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Technical Report

3rd Generation Partnership Project;

Technical Specification Group Radio Access Network;

NR inter-band Carrier Aggregation/Dual connectivity for 2 bands DL with x bands UL (x=1, 2)

(Release 16)



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Contents

Foreword 16

1 Scope 17

2 References 21

3 Definitions, symbols and abbreviations 21

3.1 Definitions 21

3.2 Symbols 22

3.3 Abbreviations 22

4 Background 22

4.1 TR Maintenance 22

5 NR Inter-Band Combination: General Part 22

6 Both bands within FR1 Carrier Aggregation: Specific Band Combination Part 23

6.1 CA\_n1-n78 23

6.1.1 Common for 1 band UL and 2 bands UL 23

6.1.1.1 Operating bands for CA 23

6.1.1.2 Channel bandwidths per operating band for CA 23

6.1.1.3 UE co-existence studies 23

6.1.1.4 ∆TIB and ∆RIB values 24

6.1.1.5 REFSENS requirements 24

6.1.2 Specific for 2 bands UL CA 24

6.1.2.1 UE co-existence studies 24

6.1.2.2 REFSENS requirements 26

6.2 CA\_n3-n79 26

6.2.1 Common for 1 band UL and 2 bands UL CA 26

6.2.1.1 Operating bands for CA 26

6.2.1.2 Channel bandwidths per operating band for CA 26

6.2.1.3 Co-existence studies 27

6.2.1.4 ∆TIB and ∆RIB values 27

6.2.1.5 REFSENS requirements 27

6.2.2 Specific for 2 bands UL CA 27

6.2.2.1 UE co-existence studies 27

6.2.2.2 REFSENS requirements 29

6.3 CA\_n66-n70 29

6.3.1 Common for 1 band UL and 2 bands UL CA 29

6.3.1.1 Operating bands for CA 29

6.3.1.2 Channel bandwidths per operating band for CA 29

6.3.1.3 UE co-existence studies 29

6.3.1.4 ∆TIB and ∆RIB values 30

6.3.1.5 REFSENS requirements 30

6.4 CA\_n66-n71 30

6.4.1 Common for 1 band UL and 2 bands UL CA 30

6.4.1.1 Operating bands for CA 30

6.4.1.2 Channel bandwidths per operating band for CA 31

6.4.1.3 UE co-existence studies 31

6.4.1.4 ∆TIB and ∆RIB values 32

6.4.1.5 REFSENS requirements 32

6.4.2 Specific for 2 bands UL CA 32

6.4.2.1 UE co-existence studies 32

6.4.2.2 REFSENS requirements 34

6.5 CA\_n1-n77 34

6.5.1 Common for 1 band UL and 2 bands UL CA 34

6.5.1.1 Operating bands for CA 34

6.5.1.2 Channel bandwidths per operating band for CA 34

6.5.1.3 UE co-existence studies 35

6.5.1.4 ∆TIB and ∆RIB values 35

6.5.1.5 REFSENS requirements 35

6.6 CA\_n1-n79 36

6.6.1 Common for 1 band UL and 2 bands UL CA 36

6.6.1.1 Operating bands for CA 36

6.6.1.2 Channel bandwidths per operating band for CA 36

6.6.1.3 Co-existence studies 37

6.6.1.4 ∆TIB and ∆RIB values 37

6.6.1.5 REFSENS requirements 37

6.6.2 Specific for 2 bands UL CA 37

6.6.2.1 UE co-existence studies 37

6.6.2.2 REFSENS requirements 39

6.7 CA\_n3-n41 39

6.7.1 Common for 1 band UL and 2 bands UL 39

6.7.1.1 Operating bands for CA 39

6.7.1.2 Channel bandwidths per operating band for CA 39

6.7.1.3 UE co-existence studies 39

6.7.1.4 ∆TIB and ∆RIB values 40

6.7.1.5 REFSENS requirements 40

6.7.2 Specific for 2 bands UL CA 41

6.7.2.1 UE co-existence studies 41

6.7.2.2 REFSENS requirements 43

6.8 CA\_n39-n41 43

6.8.1 Common for 1 band UL and 2 bands UL 43

6.8.1.1 Operating bands for CA 43

6.8.1.2 Channel bandwidths per operating band for CA 44

6.8.1.3 UE co-existence studies 44

6.8.1.4 ∆TIB and ∆RIB values 44

6.8.1.5 REFSENS requirements 45

6.8.2 Specific for 2 bands UL CA 45

6.8.2.1 UE co-existence studies 45

6.8.2.2 REFSENS requirements 47

6.9 CA\_n8-n41 47

6.9.1 Common for 1 band UL and 2 bands UL 47

6.9.1.1 Operating bands for CA 47

6.9.1.2 Channel bandwidths per operating band for CA 47

6.9.1.3 UE co-existence studies 48

6.9.1.4 ∆TIB and ∆RIB values 48

6.9.1.5 REFSENS requirements 49

6.9.2 Specific for 2 bands UL CA 49

6.9.2.1 UE co-existence studies 49

6.9.2.2 REFSENS requirements 50

6.10 CA\_n41-n79 51

6.10.1 Common for 1 band UL and 2 bands UL 51

6.10.1.1 Operating bands for CA 51

6.10.1.2 Channel bandwidths per operating band for CA 51

6.10.1.3 UE co-existence studies 51

6.10.1.4 ∆TIB and ∆RIB values 52

6.10.1.5 REFSENS requirements 52

6.10.2 Specific for 2 bands UL CA 52

6.10.2.1 UE co-existence studies 52

6.10.2.2 REFSENS requirements 53

6.11 CA\_n5-n78 54

6.11.1 Common for 1 band UL and 2 bands UL CA 54

6.11.1.1 Operating bands for CA 54

6.11.1.2 Channel bandwidths per operating band for CA 54

6.11.1.3 Co-existence studies 54

6.11.1.4 ∆TIB and ∆RIB values 54

6.11.1.5 REFSENS requirements 55

6.11.2 Specific for 2 bands UL CA 55

6.11.2.1 UE co-existence studies 55

6.11.2.2 REFSENS requirements 56

6.12 CA\_n5-n79 57

6.12.1 Common for 1 band UL and 2 bands UL CA 57

6.12.1.1 Operating bands for CA 57

6.12.1.2 Channel bandwidths per operating band for CA 57

6.12.1.3 Co-existence studies 57

6.12.1.4 ∆TIB and ∆RIB values 58

6.12.1.5 REFSENS requirements 58

6.12.2 Specific for 2 bands UL CA 58

6.12.2.1 UE co-existence studies 58

6.12.2.2 REFSENS requirements 60

6.13 CA\_n40-n41 60

6.13.1 Common for 1 band UL and 2 bands UL 60

6.13.1.1 Operating bands for CA 60

6.13.1.2 Channel bandwidths per operating band for CA 60

6.13.1.3 UE co-existence studies 60

6.13.1.4 ∆TIB and ∆RIB values 61

6.13.1.5 REFSENS requirements 61

6.13.2 Specific for 2 bands UL CA 61

6.13.2.1 UE co-existence studies 61

6.13.2.2 REFSENS requirements 63

6.14 CA\_n70-n71 63

6.14.1 Common for 1 band UL and 2 bands UL CA 63

6.14.1.1 Operating bands for CA 63

6.14.1.2 Channel bandwidths per operating band for CA 63

6.14.1.3 UE co-existence studies 64

6.14.1.4 ∆TIB and ∆RIB values 64

6.14.1.5 REFSENS requirements 65

6.14.2 Specific for 2 bands UL CA 65

6.14.2.1 UE co-existence studies 65

6.14.2.2 REFSENS requirements 67

6.15 CA\_n50-n78 67

6.15.1 Common for 1 band UL and 2 bands UL CA 67

6.15.1.1 Operating bands for CA 67

6.15.1.2 Channel bandwidths per operating band for CA 68

6.15.1.3 Co-existence studies 68

6.15.1.4 ∆TIB and ∆RIB values 68

6.15.1.5 REFSENS requirements 69

6.15.2 Specific for 2 bands UL CA 69

6.15.2.1 UE co-existence studies 69

6.16 CA\_n28-n50 71

6.16.1 Common for 1 band UL and 2 bands UL CA 71

6.16.1.1 Operating bands for CA 71

6.16.1.2 Channel bandwidths per operating band for CA 71

6.16.1.3 Co-existence studies 71

6.16.1.4 ∆TIB and ∆RIB values 72

6.16.1.5 Self-interference analysis 72

6.16.2 Specific for 2 bands UL CA 73

6.16.2.1 UE co-existence studies 73

6.16.2.2 REFSENS requirements 75

6.17 CA\_n41-n50 76

6.17.1 Common for 1 band UL and 2 bands UL CA 76

6.17.1.1 Operating bands for CA 76

6.17.1.2 Channel bandwidths per operating band for CA 76

6.17.1.3 Co-existence studies 76

6.17.1.4 ∆TIB and ∆RIB values 76

6.17.1.5 REFSENS requirements 77

6.17.2 Specific for 2 bands UL CA 77

6.17.2.1 UE co-existence studies 77

6.17.2.2 REFSENS requirements 79

6.18 CA\_ n41-n71 79

6.18.1 Common for 1 band UL and 2 bands UL CA 79

6.18.1.1 Operating bands for CA 79

6.18.1.2 Channel bandwidths per operating band for CA 80

6.18.1.3 UE co-existence studies 80

6.18.1.4 ∆TIB and ∆RIB values 81

6.18.1.5 REFSENS requirements 81

6.18.2 Specific for 2 bands UL CA 81

6.18.2.1 UE co-existence studies 81

6.18.2.2 REFSENS requirements 83

6.19 CA\_n3-n8 83

6.19.1 Common for 1 band UL and 2 bands UL CA 83

6.19.1.1 Operating bands for CA 83

6.19.1.2 Channel bandwidths per operating band for CA 83

6.19.1.3 Co-existence studies 84

6.19.1.4 ∆TIB and ∆RIB values 84

6.19.1.5 REFSENS requirements 85

6.19.2 Specific for 2 bands UL CA 85

6.19.2.1 UE co-existence studies 85

6.19.2.2 REFSENS requirements 87

6.20 CA\_n8-n79 87

6.20.1 Common for 1 band UL and 2 bands UL CA 87

6.20.1.1 Operating bands for CA 87

6.20.1.2 Channel bandwidths per operating band for CA 88

6.20.1.3 Co-existence studies 88

6.20.1.4 ∆TIB and ∆RIB values 88

6.20.1.5 REFSENS requirements 88

6.20.2 Specific for 2 bands UL CA 88

6.20.2.1 UE co-existence studies 88

6.20.2.2 REFSENS requirements 90

6.21 CA\_n25-n41 90

6.21.1 Common for 1 band UL and 2 bands UL CA 90

6.21.1.1 Operating bands for CA 90

6.21.1.2 Channel bandwidths per operating band for CA 91

6.21.1.3 UE co-existence studies 91

6.21.1.4 ∆TIB and ∆RIB values 91

6.21.1.5 REFSENS requirements 92

6.21.2 Specific for 2 bands UL CA 92

6.21.2.1 UE co-existence studies 92

6.21.2.2 REFSENS requirements 94

6.22 CA\_n25-n71 94

6.22.1 Common for 1 band UL and 2 bands UL CA 94

6.22.1.1 Operating bands for CA 94

6.22.1.2 Channel bandwidths per operating band for CA 94

6.22.1.3 UE co-existence studies 94

6.22.1.4 ∆TIB and ∆RIB values 95

6.22.1.5 REFSENS requirements 95

6.22.2 Specific for 2 bands UL CA 96

6.22.2.1 UE co-existence studies 96

6.22.2.2 REFSENS requirements 98

6.23 CA\_n39-n79 98

6.23.1 Common for 1 band UL and 2 bands UL 98

6.23.1.1 Operating bands for CA 98

6.23.1.2 Channel bandwidths per operating band for CA 99

6.23.1.3 UE co-existence studies 99

6.23.1.4 ∆TIB and ∆RIB values 99

6.23.1.5 REFSENS requirements 100

6.23.2 Specific for 2 bands UL CA 100

6.23.2.1 UE co-existence studies 100

6.23.2.2 REFSENS requirements 101

6.24 CA\_n40-n78 101

6.24.1 Common for 1 band UL and 2 bands UL CA 101

6.24.1.1 Operating bands for CA 101

6.24.1.2 Channel bandwidths per operating band for CA 101

6.24.1.3 UE co-existence studies 102

6.24.1.4 ∆TIB and ∆RIB values 102

6.24.1.5 REFSENS requirements 103

6.24.2 Specific for 2 bands UL CA 104

6.24.2.1 UE co-existence studies 104

6.24.2.2 REFSENS requirements 105

6.25 CA\_n40-n79 105

6.25.1 Common for 1 band UL and 2 bands UL 105

6.25.1.1 Operating bands for CA 105

6.25.1.2 Channel bandwidths per operating band for CA 106

6.25.1.3 UE co-existence studies 106

6.25.1.4 ∆TIB and ∆RIB values 107

6.25.1.5 REFSENS requirements 107

6.25.2 Specific for 2 bands UL CA 107

6.25.2.1 UE co-existence studies 107

6.25.2.2 REFSENS requirements 109

6.26 CA\_n8-n39 109

6.26.1 Common for 1 band UL and 2 bands UL 109

6.26.1.1 Operating bands for CA 109

6.26.1.2 Channel bandwidths per operating band for CA 109

6.26.1.3 UE co-existence studies 109

6.26.1.4 ∆TIB and ∆RIB values 110

6.26.1.5 REFSENS requirements 110

6.26.2 Specific for 2 bands UL CA 110

6.26.2.1 UE co-existence studies 110

6.26.2.2 REFSENS requirements 112

6.27 CA\_n28-n77 112

6.27.1 Common for 1 band UL and 2 bands UL CA 112

6.27.1.1 Operating bands for CA 112

6.27.1.2 Channel bandwidths per operating band for CA 112

6.27.1.4 ∆TIB and ∆RIB values 113

6.27.1.5 REFSENS requirements 114

6.27.2 Specific for 2 bands UL CA 114

6.27.2.1 UE co-existence studies 114

6.27.2.2 REFSENS requirements 116

6.28 CA\_n1-n28 116

6.28.1 Common for 1 band UL and 2 bands UL CA 116

6.28.1.1 Operating bands for CA 116

6.28.1.2 Channel bandwidths per operating band for CA 116

6.28.1.3 UE co-existence studies 116

6.28.1.4 ∆TIB and ∆RIB values 117

6.28.1.5 REFSENS requirements 117

6.28.2 Specific for 2 bands UL CA 118

6.28.2.1 UE co-existence studies 118

6.28.2.2 REFSENS requirements 119

6.29 CA\_n3-n28 120

6.29.1 Common for 1 band UL and 2 bands UL CA 120

6.29.1.1 Operating bands for CA 120

6.29.1.2 Channel bandwidths per operating band for CA 120

6.29.1.3 UE co-existence studies 120

6.29.1.4 ∆TIB and ∆RIB values 120

6.29.1.5 REFSENS requirements 121

6.29.2 Specific for 2 bands UL CA 121

6.29.2.1 UE co-existence studies 121

6.29.2.2 REFSENS requirements 123

6.30 CA\_n7-n28 124

6.30.1 Common for 1 band UL and 2 bands UL CA 124

6.30.1.1 Operating bands for CA 124

6.30.1.2 Channel bandwidths per operating band for CA 124

6.30.1.3 UE co-existence studies 124

6.30.1.4 ∆TIB and ∆RIB values 124

6.30.1.5 REFSENS requirements 125

6.30.2 Specific for 2 bands UL CA 125

6.30.2.1 UE co-existence studies 125

6.30.2.2 REFSENS requirements 126

6.31 CA\_n20-n28 127

6.31.1 Common for 1 band UL and 2 bands UL CA 127

6.31.1.1 Operating bands for CA 127

6.31.1.2 Channel bandwidths per operating band for CA 127

6.31.1.3 UE co-existence studies 127

6.31.1.4 ∆TIB and ∆RIB values 127

6.31.1.5 REFSENS requirements 128

6.31.2 Specific for 2 bands UL CA 128

6.31.2.1 UE co-existence studies 128

6.31.2.2 REFSENS requirements 129

6.32.1 Common for 1 band UL and 2 bands UL CA 129

6.32.2 Specific for 2 bands UL CA 131

6.32.2.1 UE co-existence studies 131

6.32.2.2 REFSENS requirements 132

6.33 CA\_n7-n78 133

6.33.1 Common for 1 band UL and 2 bands UL CA 133

6.33.1.1 Operating bands for CA 133

6.33.1.2 Channel bandwidths per operating band for CA 133

6.33.1.3 Co-existence studies 133

6.33.1.4 ∆TIB and ∆RIB values 134

6.33.1.5 REFSENs requirements 134

6.33.2 Specific for 2 bands UL CA 135

6.33.2.1 UE co-existence studies 135

6.33.2.2 REFSENS requirements 137

6.34 CA\_n7-n66 137

6.34.1 Common for 1 band UL and 2 bands UL CA 137

6.34.1.1 Operating bands for CA 137

6.34.1.2 Channel bandwidths per operating band for CA 137

6.34.1.3 Co-existence studies 138

6.34.1.4 ∆TIB and ∆RIB values 138

6.34.1.5 REFSENs requirements 138

6.34.2 Specific for 2 bands UL CA 138

6.34.2.1 UE co-existence studies 138

6.34.2.2 REFSENS requirements 140

6.35 CA\_n41-n66 140

6.35.1 Common for 1 band UL and 2 bands UL CA 140

6.35.1.1 Operating bands for CA 140

6.35.1.2 Channel bandwidths per operating band for CA 141

6.35.1.3 UE co-existence studies 141

6.35.1.4 ∆TIB and ∆RIB values 141

6.35.1.5 REFSENS requirements 142

6.35.2 Specific for 2 bands UL CA 142

6.35.2.1 UE co-existence studies 142

6.35.2.2 REFSENS requirements 144

6.36.1 Common for 1 band UL and 2 bands UL CA 144

6.36.2 Specific for 2 bands UL CA 146

6.36.2.1 UE co-existence studies 146

6.36.2.2 REFSENS requirements 147

6.37 CA\_n28-n78 148

6.37.2 Specific for 2 bands UL CA 148

6.37.2.1 Channel bandwidths per operating band for CA 148

6.37.2.2 UE co-existence studies 148

6.37.2.3 REFSENS requirements 149

6.38.1 Common for 1 band UL and 2 bands UL 150

6.38.1.1 Operating bands for CA 150

6.38.1.2 Channel bandwidths per operating band for CA 150

6.38.1.3 UE co-existence studies 150

6.38.1.4 ∆TIB and ∆RIB values 151

6.38.1.5 REFSENS requirements 151

6.38.2 Specific for 2 bands UL CA 151

6.38.2.1 UE co-existence studies 151

6.38.2.2 REFSENS requirements 153

6.39 CA\_n66-n78 154

6.39.1 Common for 1 band UL and 2 bands UL CA 154

6.39.1.1 Operating bands for CA 154

6.39.1.2 Channel bandwidths per operating band for CA 154

6.39.1.3 Co-existence studies 154

6.39.1.4 ∆TIB and ∆RIB values 155

6.39.1.5 REFSENs requirements 155

6.39.2 Specific for 2 bands UL CA 156

6.39.2.1 UE co-existence studies 156

6.39.2.2 REFSENS requirements 157

6.40.1 Common for 1 band UL and 2 bands UL CA 157

6.40.2 Specific for 2 bands UL CA 159

6.40.2.1 UE co-existence studies 159

6.41.1 Common for 1 band UL and 2 bands UL CA 160

6.41.2 Specific for 2 bands UL CA 162

6.41.2.1 UE co-existence studies 162

6.42.1 Common for 1 band UL and 2 bands UL CA 163

6.42.2 Specific for 2 bands UL CA 165

6.42.2.1 UE co-existence studies 165

6.43 CA\_n1-n3 166

6.43.1 Common for 1 band UL and 2 bands UL CA 166

6.43.1.1 Operating bands for CA 166

6.43.1.2 Channel bandwidths per operating band for CA 167

6.43.1.3 Co-existence studies 167

6.43.1.4 ∆TIB and ∆RIB values 167

6.43.1.5 REFSENs requirements 168

6.43.2 Specific for 2 bands UL CA 168

6.43.2.1 UE co-existence studies 168

6.43.2.2 REFSENS requirements 172

6.44 CA\_n1-n41 172

6.44.1 Common for 1 band UL and 2 bands UL CA 172

6.44.1.1 Operating bands for CA 172

6.44.1.2 Channel bandwidths per operating band for CA 172

6.44.1.3 Co-existence studies 172

6.44.1.4 ∆TIB and ∆RIB values 173

6.44.1.5 REFSENs requirements 173

6.44.2 Specific for 2 bands UL CA 174

6.44.2.1 UE co-existence studies 174

6.44.2.2 REFSENS requirements 176

6.45 CA\_n28-n41 177

6.45.1 Common for 1 band UL and 2 bands UL CA 177

6.45.1.1 Operating bands for CA 177

6.45.1.2 Channel bandwidths per operating band for CA 177

6.45.1.3 Co-existence studies 177

6.45.1.4 ∆TIB and ∆RIB values 178

6.45.1.5 REFSENs requirements 178

6.45.2 Specific for 2 bands UL CA 178

6.45.2.1 UE co-existence studies 178

6.45.2.2 REFSENS requirements 180

6.46 CA\_n2\_n5 181

6.46.1 Common for 1 band UL and 2 bands UL CA 181

6.46.2 Specific for 2 bands UL CA 182

6.46.2.1 UE co-existence studies 182

6.51 CA\_n29-n70 195

6.51.1 Common for 1 band UL and 2 bands UL CA 195

6.51.1.1 Operating bands for CA 195

6.51.1.2 Channel bandwidths per operating band for CA 195

6.51.1.3 UE co-existence studies 195

6.51.1.4 ∆TIB and ∆RIB values 196

6.51.1.5 REFSENS requirements 196

6.52 CA\_n29-n66 197

6.52.1 Common for 1 band UL and 2 bands UL CA 197

6.52.1.1 Operating bands for CA 197

6.52.1.2 Channel bandwidths per operating band for CA 197

6.52.1.3 UE co-existence studies 197

6.52.1.4 ∆TIB and ∆RIB values 198

6.52.1.5 REFSENS requirements 198

6.53.1 Common for 1 band UL and 2 bands UL CA 198

6.53.1.5 REFSEN requirements 200

6.53.2 Specific for 2 bands UL CA 200

6.53.2.1 UE co-existence studies 200

6.53.2.2 REFSENS requirements 202

6.54 CA\_n2-n66 202

6.54.1 Common for 1 band UL and 2 bands UL CA 202

6.54.1.1 Operating bands for CA 202

6.54.1.2 Channel bandwidths per operating band for CA 202

6.54.1.3 UE co-existence studies 203

6.54.1.4 ∆TIB and ∆RIB values 203

6.54.1.5 REFSENS requirements 204

6.55 CA\_n5-n66 204

6.55.1 Common for 1 band UL and 2 bands UL CA 204

6.55.1.1 Operating bands for CA 204

6.55.1.2 Channel bandwidths per operating band for CA 204

6.55.1.3 UE co-existence studies 204

6.55.1.4 ∆TIB and ∆RIB values 205

6.55.1.5 REFSENS requirements 205

6.55.2 Specific for 2 bands UL CA 205

6.55.2.1 UE co-existence studies 205

6.55.2.2 REFSENS requirements 207

6.56 CA\_n2-n78 207

6.56.1 Common for 1 band UL and 2 bands UL CA 207

6.56.1.1 Operating bands for CA 207

6.56.1.2 Channel bandwidths per operating band for CA 207

6.56.1.3 Co-existence studies 207

6.56.1.4 ∆TIB and ∆RIB values 208

6.56.1.5 REFSENs requirements 208

6.56.2 Specific for 2 bands UL CA 209

6.56.2.1 UE co-existence studies 209

6.56.2.2 REFSENS requirements 210

6.57 CA\_n7-n25 211

6.57.1 Common for 1 band UL and 2 bands UL CA 211

6.57.1.1 Operating bands for CA 211

6.57.1.2 Channel bandwidths per operating band for CA 211

6.57.1.3 Co-existence studies 211

6.57.1.4 ∆TIB and ∆RIB values 212

6.57.1.5 REFSENs requirements 212

6.57.2 Specific for 2 bands UL CA 212

6.57.2.1 UE co-existence studies 212

6.57.2.2 REFSENS requirements 214

6.58 CA\_n25-n66 214

6.58.1 Common for 1 band UL and 2 bands UL CA 214

6.58.1.1 Operating bands for CA 214

6.58.1.2 Channel bandwidths per operating band for CA 214

6.58.1.3 Co-existence studies 214

6.58.1.4 ∆TIB and ∆RIB values 215

6.58.1.5 REFSENs requirements 215

6.58.2 Specific for 2 bands UL CA 215

6.58.2.1 UE co-existence studies 215

6.58.2.2 REFSENS requirements 217

6.59 CA\_n25-n78 217

6.59.1 Common for 1 band UL and 2 bands UL CA 217

6.59.1.1 Operating bands for CA 217

6.59.1.2 Channel bandwidths per operating band for CA 217

6.59.1.3 Co-existence studies 218

6.59.1.4 ∆TIB and ∆RIB values 218

6.59.1.5 REFSENs requirements 219

6.59.2 Specific for 2 bands UL CA 219

6.59.2.1 UE co-existence studies 219

6.59.2.2 REFSENS requirements 220

6.60 CA\_n20-n75 221

6.60.1 Common for 1 band UL and 2 bands UL CA 221

6.60.1.1 Operating bands for CA 221

6.60.1.2 Channel bandwidths per operating band for CA 221

6.60.1.3 Co-existence studies 221

6.60.1.4 ∆TIB and ∆RIB values 222

6.60.1.5 REFSENs requirements 222

6.61 CA\_n78-n92 223

6.61.1 Common for 1 band UL and 2 bands UL 223

6.61.1.1 Operating bands for CA 223

6.61.1.2 Channel bandwidths per operating band for CA 223

6.61.1.3 UE co-existence studies 223

6.61.1.4 ∆TIB and ∆RIB values 224

6.61.1.5 REFSENS requirements 224

6.61.1.6 Out-of-band blocking requirements 225

6.61.2 Specific for 2 bands UL CA 225

6.61.2.1 UE co-existence studies 225

6.61.2.2 REFSENS requirements 225

6.62 CA\_n41-n78 226

6.62.1 Common for 1 band UL and 2 bands UL CA 226

6.62.1.1 Operating bands for CA 226

6.62.1.2 Channel bandwidths per operating band for CA 226

6.62.1.3 Co-existence studies 226

6.62.1.4 ∆TIB and ∆RIB values 227

6.62.1.5 REFSENs requirements 227

6.62.2 Specific for 2 bands UL CA 229

6.62.2.1 UE co-existence studies 229

6.62.2.2 REFSENS requirements 230

6.63 n1-n40 231

6.63.1 Common for 1 band UL and 2 bands UL CA 231

6.63.1.1 Operating bands for CA 231

6.63.1.2 Channel bandwidths per operating band for CA 231

6.63.1.3 UE co-existence studies 231

6.63.1.4 ∆TIB and ∆RIB values 232

6.63.1.5 REFSENS requirements 232

6.63.2 Specific for 2 bands UL CA 232

6.63.2.1 UE co-existence studies 232

6.63.2.2 REFSENS requirements 234

6.64 n28-n40 235

6.64.1 Common for 1 band UL and 2 bands UL CA 235

6.64.1.1 Operating bands for CA 235

6.64.1.2 Channel bandwidths per operating band for CA 235

6.64.1.3 UE co-existence studies 235

6.64.1.4 ∆TIB and ∆RIB values 236

6.64.1.5 REFSENS requirements 236

6.64.2 Specific for 2 bands UL CA 236

6.64.2.1 UE co-existence studies 236

6.64.2.2 REFSENS requirements 238

6.65 n46-n48 238

6.65.1 Common for 1 band UL and 2 bands UL CA 238

6.65.1.1 Operating bands for CA 238

6.65.1.2 Channel bandwidths per operating band for CA 238

6.65.1.3 UE co-existence studies 239

6.65.1.4 ∆TIB and ∆RIB values 239

6.65.1.5 REFSENS requirements 239

6.65.2 Specific for 2 bands UL CA 240

6.65.2.1 UE co-existence studies 240

6.65.2.2 Reference sensitivity exceptions due to Cross band isolation for NR-CA in NR FR1 241

6.66 n25-n46 242

6.66.1 Common for 1 band UL and 2 bands UL CA 242

6.66.1.1 Operating bands for CA 242

6.66.1.2 Channel bandwidths per operating band for CA 242

6.66.1.3 UE co-existence studies 242

6.66.1.4 ∆TIB and ∆RIB values 243

6.66.1.5 REFSENS requirements 243

6.67 n46-n66 244

6.67.1 Common for 1 band UL and 2 bands UL CA 244

6.67.1.1 Operating bands for CA 244

6.67.1.2 Channel bandwidths per operating band for CA 244

6.67.1.3 UE co-existence studies 244

6.67.1.4 ∆TIB and ∆RIB values 244

6.67.1.5 REFSENS requirements 245

6.68 CA\_n2-n77 245

6.68.1 Common for 1 band UL and 2 bands UL CA 245

6.68.1.1 Operating bands for CA 245

6.68.1.2 Channel bandwidths per operating band for CA 245

6.68.1.3 UE co-existence studies 246

6.68.1.4 ∆TIB and ∆RIB values 246

6.68.1.5 REFSENS requirements 247

6.68.2 Specific for 2 bands UL CA 248

6.68.2.1 UE co-existence studies 248

6.68.2.2 REFSENs requirements 249

6.69 CA\_n5-n77 249

6.69.1 Common for 1 band UL and 2 bands UL CA 249

6.69.1.1 Operating bands for CA 249

6.69.1.2 Channel bandwidths per operating band for CA 249

6.69.1.3 UE co-existence studies 250

6.69.1.4 ∆TIB and ∆RIB values 250

6.69.1.5 REFSENS requirements 251

6.69.2 Specific for 2 bands UL CA 252

6.69.2.1 UE co-existence studies 252

6.69.2.2 REFSENs requirements 253

6.70 CA\_n66-n77 253

6.70.1 Common for 1 band UL and 2 bands UL CA 253

6.70.1.1 Operating bands for CA 253

6.70.1.2 Channel bandwidths per operating band for CA 253

6.70.1.3 UE co-existence studies 254

6.70.1.4 ∆TIB and ∆RIB values 254

6.70.1.5 REFSENS requirements 254

6.70.2 Specific for 2 bands UL CA 255

6.70.2.1 UE co-existence studies 255

6.70.2.2 REFSENs requirements 256

6.71.1 Common for 1 band UL and 2 bands UL CA 256

6.71.1.5 REFSEN requirements 258

6.71.2 Specific for 2 bands UL CA 258

6.71.2.1 UE co-existence studies 258

6.71.2.2 REFSENS requirements 259

6.72 n5-n7 260

6.72.1 Common for 1 band UL and 2 bands UL CA 260

6.72.1.1 Operating bands for CA 260

6.72.1.2 Channel bandwidths per operating band for CA 261

6.72.1.3 UE co-existence studies 261

6.72.1.4 ∆TIB and ∆RIB values 261

6.72.1.5 REFSENS requirements 262

6.73 n3-n7 262

6.73.1 Common for 1 band UL and 2 bands UL CA 262

6.73.1.1 Operating bands for CA 262

6.73.1.2 Channel bandwidths per operating band for CA 262

6.73.1.3 UE co-existence studies 262

6.73.1.4 ∆TIB and ∆RIB values 263

6.73.1.5 REFSENS requirements 263

6.73.2 Specific for 2 bands UL CA 263

6.73.2.1 UE co-existence studies 263

6.73.2.2 REFSENS requirements 265

7 Both bands within FR2 Carrier Aggregation: Specific Band Combination Part 266

7.x CA\_nX-nY 266

7.x.1 Common for 1 band UL and 2 bands UL CA 266

7.x.1.1 Operating bands for CA 266

7.x.1.2 Channel bandwidths per operating band for CA 266

7.x.1.3 UE co-existence studies 266

7.x.1.4 ∆TIB and ∆RIB values 267

7.x.1.5 REFSENS requirements 267

7.x.2 Specific for 2 bands UL CA 267

7.x.2.1 UE co-existence studies 267

7.x.2.2 REFSENS requirements 267

8 FR1+FR2 Carrier Aggregation: Specific Band Combination Part 268

8.1 CA\_n71\_n261 268

8.1.1 Common for 1 band UL and 2 bands UL 268

8.1.1.1 Channel bandwidths per operating band for CA 268

8.1.1.2 UE co-existence studies 268

8.1.1.3 ∆TIB and ∆RIB values 269

8.1.1.4 REFSENS requirements 269

8.2 CA\_n71-n260 269

8.2.1 Common for 1 band UL and 2 bands UL CA 269

8.2.1.1 Operating bands for CA 269

8.2.1.2 Channel bandwidths per operating band for CA 269

8.2.1.3 UE co-existence studies 270

8.2.1.4 ∆TIB and ∆RIB values 270

8.2.1.5 REFSENS requirements 270

8.3 CA\_n41-n261 270

8.3.1 Common for 1 band UL and 2 bands UL CA 270

8.3.1.1 Operating bands for CA 270

8.3.1.2 Channel bandwidths per operating band for CA 271

8.3.1.3 UE co-existence studies 271

8.3.1.4 ∆TIB and ∆RIB values 271

8.3.1.5 REFSENS requirements 271

8.4 CA\_n25-n261 272

8.4.1 Common for 1 band UL and 2 bands UL CA 272

8.4.1.1 Operating bands for CA 272

8.4.1.2 Channel bandwidths per operating band for CA 272

8.4.1.3 UE co-existence studies 272

8.4.1.4 ∆TIB and ∆RIB values 272

8.4.1.5 REFSENS requirements 273

8.5 CA\_n77-n258 273

8.5.1 Common for 1 band UL and 2 bands UL CA 273

8.5.1.1 Operating bands for CA 273

8.5.1.2 Channel bandwidths per operating band for CA 273

8.5.1.3 Co-existence studies 273

8.5.1.4 ∆TIB and ∆RIB values 274

8.5.1.5 REFSENS requirements 274

8.6 CA\_n78-n258 275

8.6.1 Common for 1 band UL and 2 bands UL CA 275

8.6.1.1 Operating bands for CA 275

8.6.1.2 Channel bandwidths per operating band for CA 275

8.6.1.3 Co-existence studies 276

8.6.1.4 ∆TIB and ∆RIB values 277

8.6.1.5 REFSENS requirements 277

8.6.2 Specific for 2 bands UL CA 277

8.6.2.1 UE co-existence studies 277

8.6.2.2 REFSENS requirements 278

8.7 CA\_n79-n258 278

8.7.1 Common for 1 band UL and 2 bands UL CA 278

8.7.1.1 Operating bands for CA 278

8.7.1.2 Channel bandwidths per operating band for CA 278

8.7.1.3 Co-existence studies 278

8.7.1.4 ∆TIB and ∆RIB values 279

8.7.1.5 REFSENS requirements 279

8.9 CA\_n78-n257 283

8.9.1 Common for 1 band UL and 2 bands UL CA 283

8.9.1.1 Operating bands for CA 283

8.9.1.2 Channel bandwidths per operating band for CA 283

8.9.1.3 UE co-existence studies 284

8.9.1.4 ∆TIB and ∆RIB values 284

8.9.1.5 REFSENS requirements 284

8.9.2 Specific for 2 bands UL CA 284

8.9.2.1 UE co-existence studies 284

8.9.2.2 REFSENS requirements 284

8.10 CA\_n41-n260 284

8.10.1 Common for 1 band UL and 2 bands UL CA 284

8.10.1.1 Operating bands for CA 284

8.10.1.2 Channel bandwidths per operating band for CA 285

8.10.1.3 UE co-existence studies 285

8.10.1.4 ∆TIB and ∆RIB values 285

8.10.1.5 REFSENS requirements 285

8.11 CA\_n25-n260 286

8.11.1 Common for 1 band UL and 2 bands UL CA 286

8.11.1.1 Operating bands for CA 286

8.11.1.2 Channel bandwidths per operating band for CA 286

8.11.1.3 UE co-existence studies 286

8.11.1.4 ∆TIB and ∆RIB values 286

8.11.1.5 REFSENS requirements 287

8.12 CA\_n77-n257 287

8.12.1 Common for 1 band UL and 2 bands UL CA 287

8.12.1.1 Operating bands for CA 287

8.12.1.2 Channel bandwidths per operating band for CA 287

8.12.1.3 Co-existence studies 289

8.12.1.4 ∆TIB and ∆RIB values 289

8.12.1.5 REFSENS requirements 289

8.12.2 Specific for 2 bands UL CA 290

8.12.2.1 UE co-existence studies 290

8.12.2.2 REFSENS requirements 292

8.13 CA\_n3-n257 292

8.13.1 Common for 1 band UL and 2 bands UL CA 292

8.13.1.2 Channel bandwidths per operating band for CA 292

8.13.2 Specific for 2 bands UL CA 294

8.13.2.1 UE co-existence studies 294

8.13.2.2 REFSENS requirements 296

8.14 CA\_n28-n257 296

8.14.1 Common for 1 band UL and 2 bands UL CA 296

8.14.1.2 Channel bandwidths per operating band for CA 296

8.14.2 Specific for 2 bands UL CA 298

8.14.2.1 UE co-existence studies 298

8.14.2.2 REFSENS requirements 300

8.15 CA\_n5-n260 300

8.15.1 Common for 1 band UL and 2 bands UL CA 300

8.15.1.1 Operating bands for CA 300

8.15.1.2 Channel bandwidths per operating band for CA 301

8.15.1.3 UE co-existence studies 301

8.15.1.4 ∆TIB and ∆RIB values 302

8.15.1.5 REFSENS requirements 302

8.15.2 Specific for 2 bands UL CA 302

8.15.2.1 UE co-existence studies 302

8.15.2.2 REFSENS requirements 304

8.16 CA\_n5-n261 304

8.16.1 Common for 1 band UL and 2 bands UL CA 304

8.16.1.1 Operating bands for CA 304

8.16.1.2 Channel bandwidths per operating band for CA 305

8.16.1.3 UE co-existence studies 306

8.16.1.4 ∆TIB and ∆RIB values 306

8.16.1.5 REFSENS requirements 307

8.16.2 Specific for 2 bands UL CA 307

8.16.2.1 UE co-existence studies 307

8.16.2.2 REFSENS requirements 308

8.17 CA\_n77-n261 309

8.17.1 Common for 1 band UL and 2 bands UL CA 309

8.17.1.1 Operating bands for CA 309

8.17.1.2 Channel bandwidths per operating band for CA 309

8.17.1.3 Co-existence studies 312

8.17.1.4 ∆TIB and ∆RIB values 313

8.17.1.5 REFSENS requirements 313

8.17.2 Specific for 2 bands UL CA 314

8.17.2.1 UE co-existence studies 314

8.17.2.2 REFSENS requirements 315

9 2 bands Dual Connectivity: Specific Band Combination Part 319

9.1 DC\_n2-n77 319

9.1.1 Operating bands for DC\_n2-n77 319

9.1.2 Configurations for DC\_n2-n77 319

9.2 DC\_n5-n77 319

9.2.1 Operating bands for DC\_n5-n77 319

9.2.2 Configurations for DC\_n5-n77 319

9.3 DC\_n66-n77 319

9.3.1 Operating bands for DC\_n66-n77 319

9.3.2 Configurations for DC\_n66-n77 319

9.4 DC\_n77-n261 320

9.4.1 Operating bands for DC\_n77-n261 320

9.4.2 Configurations for DC\_n77-n261 320

Annex A: Change history 322

# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document is a technical report for NR inter-band CA and DC for 2 bands DL with up to 2 bands UL under Rel-16 time frame. The purpose is to gather the relevant background information and studies in order to address NR inter-band CA and DC for 2 bands DL with up to 2 bands UL for the Rel-16 band combinations in Table 1-1 to Table 1-3

Table 1-1: Release 16 Inter-band NR CA for 2 bands DL with 1 band UL

|  |  |
| --- | --- |
| CA combination | REL independent from |
| n1-n3 | Rel-15 |
| n1-n7 | Rel-15 |
| n1-n8 | Rel-15 |
| n1-n28 | Rel-15 |
| n1-n40 | Rel-15 |
| n1-n41 | Rel-15 |
| n1-n77 | Rel-15 |
| n1-n78 | Rel-15 |
| n1-n79 | Rel-15 |
| n1-n257 | Rel-15 |
| n2-n5 | Rel-15 |
| n2-n48 | Rel-15 |
| n2-n66 | Rel-15 |
| n2-n77 | Rel-15 |
| n2-n78 | Rel-15 |
| n3-n7 | n3-n8 |
| n3-n8 | Rel-15 |
| n3-n28 | Rel-15 |
| n3-n38 | Rel-15 |
| n3-n40 | Rel-15 |
| n3-n41 | Rel-15 |
| n3-n77 | Rel-15 |
| n3-n79 | Rel-15 |
| n3-n257 | Rel-15 |
| n5-n7 | Rel-15 |
| n5-n66 | Rel-15 |
| n5-n77 | Rel-15 |
| n5-n78 | Rel-15 |
| n5-n79 | Rel-15 |
| n5-n260 | Rel-15 |
| n5-n261 | Rel-15 |
| n7-n25 | Rel-15 |
| n7-n28 | Rel-15 |
| n7-n66 | Rel-15 |
| n7-n78 | Rel-15 |
| n8-n39 | Rel-15 |
| n8-n40 | Rel-15 |
| n8-n41 | Rel-15 |
| n8-n79 | Rel-15 |
| n20-n7 | Rel-15 |
| n20-n28 | Rel-15 |
| n20-n78 | Rel-15 |
| n25-n41 | Rel-15 |
| n25-n66 | Rel-15 |
| n25-n71 | Rel-15 |
| n25-n78 | Rel-15 |
| n25-n260 | Rel-15 |
| n25-n261 | Rel-15 |
| n28-n40 | Rel-15 |
| n28-n41 | Rel-15 |
| n28-n50 | Rel-15 |
| n28-n77 | Rel-15 |
| n28-n78 | Rel-15 |
| n29-n66 | Rel-15 |
| n29-n70 | Rel-15 |
| n28-n257 | Rel-15 |
| n38-n78 | Rel-15 |
| n39-n40 | Rel-15 |
| n39-n41 | Rel-15 |
| n39-n79 | Rel-15 |
| n40-n41 | Rel-15 |
| n40-n78 | Rel-15 |
| n40-n79 | Rel-15 |
| n41-n50 | Rel-15 |
| n41-n66 | Rel-15 |
| n41-n71 | Rel-15 |
| n41-n79 | Rel-15 |
| n41-n260 | Rel-15 |
| n41-n261 | Rel-15 |
| n48-n66 | Rel-15 |
| n50-n78 | Rel-15 |
| n66-n78 | Rel-15 |
| n66-n70 | Rel-15 |
| n66-n71 | Rel-15 |
| n66-n77 | Rel-15 |
| n66-n78 | Rel-15 |
| n66-n260 | Rel-15 |
| n66-n261 | Rel-15 |
| n70-n71 | Rel-15 |
| n71-n260 | Rel-15 |
| n71-n261 | Rel-15 |
| n77-n257 | Rel-15 |
| n77-n258 | Rel-15 |
| n77-n261 | Rel-15 |
| n78-n92 | Rel-15 |
| n78-n257 | Rel-15 |
| n78-n258 | Rel-15 |
| n79-n258 | Rel-15 |
|  |  |

Table 1-2: Release 16 Inter-band NR CA for 2 bands DL with 2 bands UL

|  |  |
| --- | --- |
| CA combination | REL independent from |
| n1-n3 | Rel-15 |
| n1-n7 | Rel-15 |
| n1-n8 | Rel-15 |
| n1-n28 | Rel-15 |
| n1-n40 | Rel-15 |
| n1-n41 | Rel-15 |
| n1-n78 | Rel-15 |
| n1-n79 | Rel-15 |
| n1-n257 | Rel-15 |
| n2-n5 | Rel-15 |
| n2-n48 | Rel-15 |
| n2-n66 | Rel-15 |
| n2-n77 | Rel-15 |
| n2-n78 | Rel-15 |
| n3-n8 | Rel-15 |
| n3-n28 | Rel-15 |
| n3-n38 | Rel-15 |
| n3-n40 | Rel-15 |
| n3-n41 | Rel-15 |
| n3-n77 | Rel-15 |
| n3-n79 | Rel-15 |
| n3-n257 | Rel-15 |
| n5-n7 | Rel-15 |
| n5-n66 | Rel-15 |
| n5-n77 | Rel-15 |
| n5-n78 | Rel-15 |
| n5-n79 | Rel-15 |
| n5-n260 | Rel-15 |
| n5-n261 | Rel-15 |
| n7-n28 | Rel-15 |
| n7-n66 | Rel-15 |
| n7-n78 | Rel-15 |
| n8-n39 | Rel-15 |
| n8-n40 | Rel-15 |
| n8-n41 | Rel-15 |
| n8-n79 | Rel-15 |
| n20-n7 | Rel-15 |
| n20-n28 | Rel-15 |
| n20-n78 | Rel-15 |
| n25-n41 | Rel-15 |
| n25-n66 | Rel-15 |
| n25-n71 | Rel-15 |
| n25-n78 | Rel-15 |
| n28-n40 | Rel-15 |
| n28-n41 | Rel-15 |
| n28-n50 | Rel-15 |
| n28-n78 | Rel-15 |
| n28-n257 | Rel-15 |
| n38-n78 | Rel-15 |
| n39-n40 | Rel-15 |
| n39-n41 | Rel-15 |
| n39-n79 | Rel-15 |
| n40-n41 | Rel-15 |
| n40-n79 | Rel-15 |
| n41-n50 | Rel-15 |
| n41-n66 | Rel-15 |
| n41-n71 | Rel-15 |
| n41-n78 | Rel-15 |
| n41-n79 | Rel-15 |
| n48-n66 | Rel-15 |
| n50-n78 | Rel-15 |
| n66-n77 | Rel-15 |
| n66-n78 | Rel-15 |
| n77-n257 | Rel-15 |
| n77-n261 | Rel-15 |
| n78-n92 | Rell-15 |
| n78-n257 | Rel-15 |

Table 1-3: Release 16 Inter-band DC for 2 bands

|  |  |
| --- | --- |
| DC combination | REL independent from |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

This TR contains a general part and band specific combination part. The actual requirements are added to the corresponding technical specifications.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[3] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[4] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**Aggregated Channel Bandwidth:** The RF bandwidth in which a UE transmits and receives multiple contiguously aggregated carriers.

**Carrier aggregation:** Aggregation of two or more component carriers in order to support wider transmission bandwidths.

**Inter-band carrier aggregation:** Carrier aggregation of component carriers in different operating bands.

NOTE: Carriers aggregated in each band can be contiguous or non-contiguous.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

ΔRIB,c Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*.

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

BS Base Station

CA Carrier Aggregation

DC Dual Connectivity

DL DownLink

FDD Frequency Division Duplex

IMD Inter-modulation

MSD Maximum Sensitivity Deduction

SCS Subcarrier spacing

TDD Time Division Duplex

UE User Equipment

UL UpLink

# 4 Background

The present document is a technical report for NR inter-band CA and DC for 2 bands DL with up to 2 bands UL under Rel-16 time frame. It covers both the UE and BS side. The document is divided in two different parts:

- General part: this part covers BS and UE specific which is band combination independent.

- Specific band combination part: this part covers each band combination and its specific issues independently from each other (i.e. one subclause is defined per band combination)

The specific band combination parts are independent and therefore, the working speed also differs.

## 4.1 TR Maintenance

A single company is responsible for introducing all approved TPs in the current TR, i.e. TR editor. However, it is the responsibility of the contact person of each band combination to ensure that the TPs related to the band combination have been implemented.

# 5 NR Inter-Band Combination: General Part

# 6 Both bands within FR1 Carrier Aggregation: Specific Band Combination Part

## 6.1 CA\_n1-n78

### 6.1.1 Common for 1 band UL and 2 bands UL

#### 6.1.1.1 Operating bands for CA

**Table 6.1.1.1-1: CA band combination of band n1+n78**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

#### 6.1.1.2 Channel bandwidths per operating band for CA

**Table 6.1.1.2-1: Supported bandwidths per CA band combination of band n1+n78**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n78A | CA\_n1A-n78A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n1A-n78(2A) | CA\_n1A-n78A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |
| CA\_n1A-n78C | CA\_n1A-n78A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | See CA\_n78C Bandwidth Combination Set 0 in Table 5.5A.1-1 in 38.101-1 | | | | | | | | | | | | |

#### 6.1.1.3 UE co-existence studies

Table 6.1.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n1-n78.

**Table 6.1.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 3840 | 3960 | 5760 | 5940 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonic issue for the band combination of n1 and n78.

**Table 6.1.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 4220 | 4340 | 6330 | 6510 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n1 and n78.

#### 6.1.1.4 ∆TIB and ∆RIB values

For CA\_n1-n78 , the TIB,c and RIB,c values are given in the tables below.

**Table 6.1.1.4-1:** **ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n78 | n1 | 0.3 |
| n78 | 0.8 |

**Table 6.1.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n78 | n1 | 0 |
| n78 | 0.5 |

#### 6.1.1.5 REFSENS requirements

There are no specific REFSENS requirements

### 6.1.2 Specific for 2 bands UL CA

#### 6.1.2.1 UE co-existence studies

Table 6.1.2.1-1 lists Band n1 +Band n78 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.1.2.1-1: Band n1 and Band n78 UL harmonics and IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 1920 | 1980 | | 3300 | 3800 | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 1320 – 1880 | | | 5220 – 5780 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 40 – 660 | | | 4620 – 5680 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 7140 – 7760 | | | 8520 – 9580 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1820 – 2080 | | | 3280 – 3820 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1960 – 2640 | | | 7920 – 9480 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 2640 – 3760 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 9060 – 9740 | | | 11820 – 13380 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 10440 – 11560 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 11220 – 13280 | | | 3880 – 4620 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 5940 – 7560 | | | 660 – 1840 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 15120 – 17180 | | | 10980 – 11720 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 13740 – 15360 | | | 12360 – 13540 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

Based on above table , 4th order IMD may fall into Rx frequencies of band n1.

Table 6.1.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.1.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n1-n78 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Frequency range | 1880 | - | 1895 | -40 | 1 | RB restriction |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | RB restriction |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | RB restriction |
| NOTE 1: To simplify Table, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation. | | | | | | | |

#### 6.1.2.2 REFSENS requirements

Table 6.1.2.2-1 lists the MSD required due to 4th IMD for the dual uplink configuration.

**Table 6.1.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n1A-n78A  CA\_n1A-n78(2A) | n1 | 1950 | 5 | 25 | 2140 | 8.0 | FDD | IMD4 |
| 10.7 2 |
| n78 | 3710 | 10 | 50 | 3710 | N/A | TDD | N/A |
| NOTE 1: RBSTART = 0  NOTE 2: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured.  NOTE 3: 15 kHz SCS is assumed. | | | | | | | | |

## 6.2 CA\_n3-n79

### 6.2.1 Common for 1 band UL and 2 bands UL CA

#### 6.2.1.1 Operating bands for CA

**Table 6.2.1.1-1: CA band combination of band n3+n79**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

#### 6.2.1.2 Channel bandwidths per operating band for CA

**Table 6.2.2-1: Supported bandwidths per CA band combination of band n3+n79**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n3A-n79A | CA\_n3A-n79A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |

#### 6.2.1.3 Co-existence studies

The studies for 1 band UL for the CA band combination of band n3 + n79 have been already completed and captured into TR 37.865-01-01. There are no harmonic issues for 1 band UL according to TR 37.865-01-01.

#### 6.2.1.4 ∆TIB and ∆RIB values

For CA\_n3-n79, the TIB,c and RIB,c values are already specified in TR37.865-01-01.

#### 6.2.1.5 REFSENS requirements

The studies for 1 band UL for the CA band combination of band n3 + n79 have been already completed and captured into TR 37.865-01-01. There are no need for additional REFSENS requirements for 1 band UL according to TR 37.865-01-01.

### 6.2.2 Specific for 2 bands UL CA

#### 6.2.2.1 UE co-existence studies

Table 6.2.2.1-1 lists Band n3 +Band n79 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.2.2.1-1: Band n3 and Band n79 UL IMD products**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1785 | | 4400 | 5000 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2615 | 3290 | | 6110 | 6785 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 830 | | 1580 | 7015 | 8290 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 7820 | | 8570 | 10510 | 11785 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1610 | | 1885 | 4370 | 5030 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 130 | 955 | | 11415 | 13290 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |  |  |
| IMD frequency limits (MHz) | 5230 | | 6580 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 9530 | | 10355 | 14910 | 16785 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 12220 | | 13570 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 15815 | | 18290 | 1840 | 2740 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 9630 | | 11580 | 3445 | 4870 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 19310 | | 21785 | 11240 | 12140 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 16620 | | 18570 | 13930 | 15355 |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | |

Based on Table 6.2.2.1-1, 3rd order IMD may also fall into own Rx of band n3.

Table 6.2.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.2.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n3A-n79A | E-UTRA Band 1, 3, 5, 8, 11, 18, 19, 21, 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42 | FDL\_low | - | FDL\_high | -50 | 1 | Harmonic exception |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | PHS |
|  |  |  |  |  |  |  |
| NOTE 1: To simplify Table, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation. | | | | | | | |

#### 6.2.2.2 REFSENS requirements

According to the co-existent analysis in table 6.2.2.1-1, although 3rd order IMD frequency range from “fx\_low – max BW fy” to “fx\_low + max BW fy” may fall into own Rx of band n3, MSD caused by this IM3 should not be specified due to lower PSD of NR transmission. Thus no IMD issues are expected for this CA configuration with dual uplink carrier.

## 6.3 CA\_n66-n70

### 6.3.1 Common for 1 band UL and 2 bands UL CA

#### 6.3.1.1 Operating bands for CA

**Table 6.3.1.1-1: CA band combination of band n66+n70**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n66 | 1710 | – | 1780 | 2110 | – | 2200 | FDD |
| n70 | 1695 | – | 1710 | 1995 | – | 2020 | FDD |

#### 6.3.1.2 Channel bandwidths per operating band for CA

**Table 6.3.1.2-1: Supported bandwidths per CA band combination of band n66+n70**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n66A-n70A | - | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| n70 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |
| CA\_n66B-n70A | - | n66 | See CA\_n66B Bandwidth Combination Set 0 in Table 5.5A.1-1 in TS38.101-1 | | | | | | | | | | | | | 0 |
| n70 | 15 | Yes | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| CA\_n66(2A)-n70A | - | n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS38.101-1 | | | | | | | | | | | | | 0 |
| n70 | 15 | Yes | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| NOTE 1 This UE channel bandwidth is applicable only to downlink | | | | | | | | | | | | | | | | |

#### 6.3.1.3 UE co-existence studies

Table 6.3.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ n66-n71.

**Table 6.3.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | **DL Low Band Edge** | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |
| n70 | 1695 | 1710 | 1995 | 2020 | 3390 | 3420 | 5085 | 5130 |  |  |

Based on the table above, there is no harmonic relation.

**Table 6.3.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |
| n70 | 1695 | 1710 | 1995 | 2020 | 3990 | 4040 | 5985 | 6060 |  |  |

Based on the table above, the is no harmonic mixing relation.

#### 6.3.1.4 ∆TIB and ∆RIB values

For CA\_n66-n70, the TIB,c and RIB,c values are given in the tables below.

**Table 6.3.1.4-1:** **ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n70 | n66 | 0.5 |
| n70 | 0.5 |

**Table 6.1.x.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n70 | n66 | 0 |
| n70 | 0 |

#### 6.3.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL

## 6.4 CA\_n66-n71

### 6.4.1 Common for 1 band UL and 2 bands UL CA

#### 6.4.1.1 Operating bands for CA

**Table 6.4.1.1-1: CA band combination of band n66+n71**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n66 | 1710 | – | 1780 | 2110 | – | 2200 | FDD |
| n71 | 663 | – | 698 | 617 | – | 652 | FDD |

#### 6.4.1.2 Channel bandwidths per operating band for CA

**Table 6.4.1.2-1: Supported bandwidths per CA band combination of band n66+n71**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n66A-n71A | CA\_n66A-n71A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| CA\_n66(2A)-n71A | CA\_n66A-n71A | n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS38.101-1 | | | | | | | | | | | | | 0 |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| CA\_n66B-n71A | CA\_n66A-n71A | n66 | See CA\_n66B Bandwidth Combination Set 0 in Table 5.5A.1-1 in TS38.101-1 | | | | | | | | | | | | | 0 |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |

#### 6.4.1.3 UE co-existence studies

Table 6.4.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n66-n71.

**Table 6.4.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | **DL Low Band Edge** | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1326 | 1396 | 1989 | 2094 |  |  |

Based on the table above, there is no harmonic relation.

**Table 6.4.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1234 | 1304 | 1851 | 1956 |  |  |

Based on the table above, the is no harmonic mixing relation.

#### 6.4.1.4 ∆TIB and ∆RIB values

For CA\_n66-n71, the TIB,c and RIB,c values are given in the tables below.

**Table 6.4.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n71 | n66 | 0.3 |
| n71 | 0.3 |

**Table 6.1.x.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n71 | n66 | 0 |
| n71 | 0 |

#### 6.4.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

### 6.4.2 Specific for 2 bands UL CA

#### 6.4.2.1 UE co-existence studies

**Table 6.4.2.1-1: Impact of Intermodulations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1780 | 663 | 698 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 1117 | 1012 | 2373 | 2478 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 2722 | 2897 | 454 | 314 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 4083 | 4258 | 3036 | 3176 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4432 | 4677 | 209 | 384 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 5793 | 6038 | 3036 | 3874 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 2234 | 2024 | 4746 | 4956 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 6142 | 6457 | 872 | 1082 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 7503 | 7818 | 4362 | 4572 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 3734 | 4014 | 1571 | 1326 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 5409 | 5654 | 6456 | 6736 |

Based on the table above, there is IMD4 falling on top of n66 DL. There is pretty similar combination in EN-DC, DC\_66A\_n71A where MSD is defined for B66. Because the IMD mechanisms and frequencies are exactly the same, we propose to reuse that MSD number for n66.

Table 6.4.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.4.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA combination | Spurious emission | | | | | | |
| Protected Band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n66-n71 | E-UTRA Band 4, 5, 7, 10, 12, 13, 14, 17, 26, 27, 30, 43, 50, 51, 53, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25, 41, 42, 48 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| E-UTRA Band 71 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| NOTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.4.2.2 REFSENS requirements

MSD is defined for n66 as follows.

**Table 6.4.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA**  **Configuration** | **NR band** | **UL Fc  (MHz)** | **UL/DL BW  (MHz)** | **UL  CLRB** | **DL Fc (MHz)** | **MSD  (dB)** | **Duplex mode** | **Source of IMD** |
| CA\_n66A-n71A | n66 | 1750 | 5 | 25 | 2150 | 5 | FDD | IMD4 |
| n71 | 675 | 5 | 25 | 629 | N/A | FDD | N/A |

## 6.5 CA\_n1-n77

### 6.5.1 Common for 1 band UL and 2 bands UL CA

#### 6.5.1.1 Operating bands for CA

**Table 6.5.1.1-1: CA band combination of band n1+n77**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n77 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

#### 6.5.1.2 Channel bandwidths per operating band for CA

**Table 6.5.1.2-1: Supported NR bandwidths per CA configuration of band n1+n77**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth** | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90 MHz** | **100 MHz** | **Maximum aggregated bandwidth**  **[MHz]** |
| CA\_n1A-n77A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 120 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.5.1.3 UE co-existence studies

Table 6.5.1.3-1 gives the UL 2nd, 3rd, 4th, 5th, 6th, 7th harmonics for CA\_n1A-n77A.

**Table 6.5.1.3-1: Band n1 and Band n77 UL harmonics products**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1920 | 1980 | | 3300 | 4200 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3840 | | 3960 | 6600 | 8400 |
| 3rd harmonics frequency limits | 3\*fx\_low | | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5760 | | 5940 | 9900 | 12600 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 7680 | 7920 | | 13200 | 16800 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 9600 | | 9900 | 16500 | 21000 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | | 6\* fy\_low | 6\* fy\_high |
| 6th harmonics frequency limits (MHz) | 11520 | | 11880 | 19800 | 25200 |
| 7th harmonics frequency limits | 7\*fx\_low | | 7\*fx\_high | 7\* fy\_low | 7\* fy\_high |
| 7th harmonics frequency limits (MHz) | 13440 | | 13860 | 23100 | 29400 |

It can be seen that the 2nd harmonic interference from Band n1 UL will fall into Band n77 DL frequency range. HTF or other RF architecture should be considered to mitigate the impact of the self-interference for this combination.

#### 6.5.1.4 ∆TIB and ∆RIB values

For CA\_n1-n77, the TIB,c and RIB,c values are given in the tables below.

**Table 6.5.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n77 | n1 | 0.6 |
| n77 | 0.8 |

**Table 6.5.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n77 | n1 | 0.2 |
| n77 | 0.5 |

#### 6.5.1.5 REFSENS requirements

For single uplink operation of this combination, only harmonic issue need to be considered. MSD values for Band n77 due to 2nd harmonic of Band n1 in CA\_n1A-n77A are captured in Table 6.5.1.5-1.

**Table 6.5.1.5-1: MSD due to harmonic issue for CA\_n1-n77**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | MSD due to harmonic exception for the DL band | | | | | | | | | | | | |
| UL band | DL band | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n1 | n771,2 |  | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.8 | 16.0 | 14.8 | 14.3 | 13.8 |
| n773 |  | 1.1 | 0.8 | 0.3 |  |  | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 2: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively. | | | | | | | | | | | | | |

**Table 6.5.1.5-2 Uplink configuration for the low band**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n1 | n77 |  | 25 | 36 | 50 |  |  |  | 100 | 100 | 100 | 100 | 100 | 100 |

## 6.6 CA\_n1-n79

### 6.6.1 Common for 1 band UL and 2 bands UL CA

#### 6.6.1.1 Operating bands for CA

**Table 6.6.1.1-1: CA band combination of band n1+n79**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

#### 6.6.1.2 Channel bandwidths per operating band for CA

**Table 6.6.1.2-1: Supported bandwidths per CA band combination of band n1+n79**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS kHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n79A | CA\_n1A-n79A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |

#### 6.6.1.3 Co-existence studies

Table 6.6.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n1-n79.

**Table 6.6.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 3840 | 3960 | 5760 | 5940 |  |  |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 |  |  |

Based on above table, there is no harmonic issue for the band combination of n1 and n79.

**Table 6.6.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 4220 | 4340 | 6330 | 6510 |  |  |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n1 and n79.

#### 6.6.1.4 ∆TIB and ∆RIB values

For CA\_n1-n79, the TIB,c and RIB values are given in the tables below.

**Table 6.6.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n79 | n1 | 0 |
| n79 | 0 |

**Table 6.6.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n1-n79 | n1 | 0 |
| n79 | 0 |

#### 6.6.1.5 REFSENS requirements

According to the co-existence studies in section 6.6.1.3, there are no harmonic issues in this combination. Thus there are no change in Band n1 or Band n79 REFSENS requirements are needed

### 6.6.2 Specific for 2 bands UL CA

#### 6.6.2.1 UE co-existence studies

Table 6.6.2.1-1 lists Band n1 +Band n79 2UL CA 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency** | **1920** | **1980** | **4400** | **5000** |
| 2nd order IMD products | |fy\_low-fx\_high| | |fy\_high-fx\_low| | |fy\_low+fx\_low| | |fy\_high+fx\_high| |
| IMD frequency limits (MHz) | 2420 - 3080 | | 6320 - 6980 | |
| Two-tone 3rd order IMD products | |2\*fx\_low -fy\_high | | | 2\*fx\_high –fy\_low | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 440 - 1160 | | 6820 - 8080 | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 8240 - 8960 | | 10720 - 11980 | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1820 - 2080 | | 4380 - 5020 | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| |  |  |
| IMD frequency limits (MHz) | 4840 - 6160 | |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 760 - 1540 | | 11220 - 13080 | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 12640 - 13960 | |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 10160 - 10940 | | 15120 - 16980 | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 15620 -18080 | | 2680 - 3520 | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 19520 - 21980 | | 12080 - 12920 | |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 9240 - 11160 | | 2860 - 4240 | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 17040 - 18960 | | 14560 - 15940 | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | |

**Table 6.6.2.1-1: Band n1 and Band n79 UL harmonics and IMD products**

Based on Table 6.6.2.1-1:

* There are no IMD will fall into own Rx of band n1.
* 3rd and 4th order IMD may fall into own Rx of band n79. Since band n79 is TDD band, it is no need to consider the IMD issue for band n79 which means no self-interference for the TDD band n79

Table 6.6.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.6.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n1A-n79A | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 21, 26, 28, 34, 40, 41, 42, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  |  |  |  |  |  |  |
| Frequency range | 1880 | - | 1895 | -40 | 1 | RB restriction |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | RB restriction |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | RB restriction |
| NOTE 1: To simplify Table, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation. | | | | | | | |

#### 6.6.2.2 REFSENS requirements

According to the co-existent analysis in table 6.6.2.1-1, there are no IMD issues are expected for this CA configuration with dual uplink carrier.

## 6.7 CA\_n3-n41

### 6.7.1 Common for 1 band UL and 2 bands UL

#### 6.7.1.1 Operating bands for CA

**Table 6.7.1.1-1: CA band combination of band n3+n41**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

#### 6.7.1.2 Channel bandwidths per operating band for CA

**Table 6.7.1.2-1: Supported bandwidths per CA band combination of band n3+n41**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS kHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n3A-n41A | CA\_n3A-n41A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 1 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |

#### 6.7.1.3 UE co-existence studies

Table 6.7.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n3-n41.

**Table 6.7.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonic issue for the band combination of n3 and n41.

**Table 6.7.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n3 and n41.

#### 6.7.1.4 ∆TIB and ∆RIB values

For CA\_n3-n41, the TIB,c and RIB,c values are given in the tables below.

**Table 6.7.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n41 | n3 | 0.5 |
| n41 | 0.31 |
| 0.82 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz. | | |

**Table 6.7.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n41 | n3 | 0 |
| n41 | 01 |
| 0.52 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2515-2690 MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2515 MHz. | | |

#### 6.7.1.5 REFSENS requirements

For this combinations, sensitivity degradation is allowed for a band if it is impacted by UL of another band part of the same DC configuration due to cross band isolation issues. Reference sensitivity exceptions are specified in Table 6.7.1.5-1 with uplink configuration specified in Table 6.7.1.5-2.

**Table 6.7.1.5-1:MSD due to cross band isolation**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | NR UL band | NR DL band | Channel bandwidth | | | | | | | | | | | |
| 5 MHz (dBm) | 10 MHz (dBm) | 15 MHz (dBm) | 20 MHz (dBm) | 25 MHz (dBm) | 30 MHz (dBm) | 40 MHz (dBm) | 50 MHz (dBm) | 60 MHz (dBm) | 80 MHz (dBm) | 90 MHz (dBm) | 100 MHz (dBm) |
| CA\_n3A-n41A | n3 | n41 |  | [4.3] | [4.0] | [3.9] |  |  | [3.5] | [3.3] | [3.2] | [3.1] | [3.0] | [3.0] |
| n41 | n3 | [3.0] | [3.0] | [3.0] | [3.1] | [3.0] | [3.0] |  |  |  |  |  |  |
| NOTE 1: The Band n41 requirements are modified by -0.5dB when carrier frequency of the assigned NR channel bandwidth is within 2515-2690 MHz. | | | | | | | | | | | | | | |

**Table 6.7.1.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| NR UL band | NR DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n3 | n41 | 15 |  | 50 | 501 | 501 |  |  | 501 | 501 | 501 | 501 | 501 | 501 |
| 30 |  | 24 | 241 | 241 |  |  | 241 | 241 | 241 | 241 | 241 | 241 |
| n41 | 3 | 15 | 25 | 50 | 75 | 100 | 128 | 160 |  |  |  |  |  |  |
| 30 | 10 | 24 | 36 | 50 | 64 | 75 |  |  |  |  |  |  |
| NOTE 1: 1 refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3.2-1 in TS38.101-1). | | | | | | | | | | | | | | |

### 6.7.2 Specific for 2 bands UL CA

#### 6.7.2.1 UE co-existence studies

Table 6.7.2.1-1 lists Band n3 +Band n41 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.7.2.1-1: Band n3 and Band n41 2 UL bands IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 1710 | 1785 | | 2496 | 2690 | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 711 – 980 | | | 4206 – 4475 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 730 – 1074 | | | 3207 – 3670 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 5916 – 6260 | | | 6702 – 7165 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1610 – 1885 | | | 2466 – 2720 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2440 – 2859 | | | 5703 – 6360 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 1422 – 1960 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7626 – 8045 | | | 9198 – 9855 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 8412 – 8950 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8199 – 9050 | | | 4150 – 4644 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 3918 – 4650 | | | 0 – 363 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11694 – 12545 | | | 9336 – 9830 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 10908 – 11640 | | | 10122 – 10735 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

Based on above table, 4th order IMD may fall into Rx frequencies of band n3 and n41. But these IMDs do not affect n41 Rx since n41 is TDD band.

Table 6.7.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.7.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n3A-n41A | E-UTRA Band 1, 5, 8, 20, 26, 27, 28, 34, 39, 40, 44, 45, 50, 51, 65, 73, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 3 |
| E-UTRA Band 11, 18, 19, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 4, 5 |
| E-UTRA Band 42,  NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 5, 6 |
| NOTE 1: To simplify Table, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation.  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 and Table 6.5A.3.1-1 from the edge of the channel bandwidth.  NOTE 4: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9MHz and 1784.9MHz.  NOTE 5: This requirement applies when the NR carrier is confined within 2545-2575MHz or 2595-2645MHz and the channel bandwidth is 10 or 20 MHz  NOTE 6: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz. | | | | | | | |

#### 6.7.2.2 REFSENS requirements

Table 6.7.2.2-1 lists the MSD required due to 4th IMD for the dual uplink configuration.

**Table 6.7.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n3A-n41A | n3 | 1740 | 5 | 25 | 1835 | 8.2 | FDD | IMD4 |
| n41 | 2657.5 | 10 | 50 | 2657.5 | N/A | TDD | N/A |
| NOTE 1: RBSTART = 0  NOTE 2: 15 kHz SCS is assumed. | | | | | | | | |

## 6.8 CA\_n39-n41

### 6.8.1 Common for 1 band UL and 2 bands UL

#### 6.8.1.1 Operating bands for CA

**Table 6.8.1.1-1: CA band combination of band n39+n41**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

#### 6.8.1.2 Channel bandwidths per operating band for CA

**Table 6.8.1.2-1: Supported bandwidths per CA band combination of band n39+n41**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS kHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n39A-n41A | CA\_n39A-n41A | n39 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.8.1.3 UE co-existence studies

Table 6.8.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n39-n41.

**Table 6.8.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonic issue for the band combination of n39 and n41.

**Table 6.8.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n39 and n41.

#### 6.8.1.4 ∆TIB and ∆RIB values

For CA\_n39-n41, the TIB,c and RIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

**Table 6.8.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n39-n41 | n39 | 01 |
| 0.52 |
| n41 | 01 |
| 0.52 |
| NOTE 1: Only applicable for UE supporting inter-band carrier aggregation with uplink in one NR band and without simultaneous Rx/Tx.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx. | | |

**Table 6.8.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n39-n41 | n39 | 0.21 |
| 0.22 |
| n41 | 0.21 |
| 0.22 |
| NOTE 1: Only applicable for UE supporting inter-band carrier aggregation with uplink in one NR band and without simultaneous Rx/Tx.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx. | | |

#### 6.8.1.5 REFSENS requirements

Since the focus of this combination is not supporting simultaneous Tx/Rx, there are no specific REFSENS requirements for 1 band UL

### 6.8.2 Specific for 2 bands UL CA

#### 6.8.2.1 UE co-existence studies

Table 6.8.2.1-1 lists Band n39 +Band n41 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.8.2.1-1: Band n39 and Band n41 2UL bands IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 1880 | 1920 | | 2496 | 2690 | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 576 – 810 | | | 4376 – 4610 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 1070 – 1344 | | | 3072 – 3500 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 6256 – 6530 | | | 6872 – 7300 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1780 – 2020 | | | 2456 – 2730 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2950 – 3264 | | | 5568 – 6190 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 1152 – 1620 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8136 – 8450 | | | 9368 – 9990 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 8752 – 9220 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8064 – 8880 | | | 4830 – 5184 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 3648 – 4310 | | | 260 – 768 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11864 – 12680 | | | 10016 – 10370 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11910 – 11248 | | | 10632 – 11140 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

As IMD is not an issue for TDD bands combination, there is no MSD issue for this band combination.

Table 6.8.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.8.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n39A-n41A | E-UTRA Band 1, 8, 26, 34, 40, 42, 44, 45, 50, 51, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1805 | - | 1855 | -40 | 1 | 3 |
| Frequency range | 1855 | - | 1880 | -15.5 | 5 | 3, 4, 5 |
| NOTE 1: To simplify Table, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation.  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 and Table 6.5A.3.1-1 from the edge of the channel bandwidth.  NOTE 4: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 5: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz. | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

#### 6.8.2.2 REFSENS requirements

As IMD is not an issue for TDD bands combination, there is no MSD issue for this combination.

## 6.9 CA\_n8-n41

### 6.9.1 Common for 1 band UL and 2 bands UL

#### 6.9.1.1 Operating bands for CA

**Table 6.9.1.1-1: CA band combination of band n8+n41**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

#### 6.9.1.2 Channel bandwidths per operating band for CA

**Table 6.9.1.2-1: Supported bandwidths per CA band combination of band n8+n41**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n8A-n41A | CA\_n8A-n41A | n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 1 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |

#### 6.9.1.3 UE co-existence studies

Table 6.9.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n8-n41.

**Table 6.9.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n8 | 880 | 915 | 925 | 960 | 1760 | 1830 | 2640 | 2745 | 3520 | 3660 |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |

Based on above table, the 3rd order harmonic of Band n8 will fall into Band n41.

**Table 6.9.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n8 | 880 | 915 | 925 | 960 | 1850 | 1920 | 2775 | 2880 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n8 and n41.

#### 6.9.1.4 ∆TIB and ∆RIB values

For CA\_n8-n41 , the TIB,c and RIB,c values are given in the tables below.

**Table 6.9.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n8-n41 | n8 | 0.6 |
| n41 | 0.3 |

**Table 6.9.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n8-n41 | n8 | 0 |
| n41 | 0 |

#### 6.9.1.5 REFSENS requirements

MSD needs to be considered for Band n41 due to 3rd harmonic interference from Band n8. A diplexer is adopted to combine the two bands, i.e. diplexer + duplexer architecture is used to estimate the MSD due to 3rd harmonic.

The reference sensitivity exceptions for CA\_n8-n41 are proposed in Table 6.9.1.5-1 with the uplink configurations specified in Table 6.9.1.5-2.

Table 6.9.1.5-1: MSD due to UL harmonic for CA\_n8-n41

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz (dB) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| n8 | n418,9 | N/A | 13 | 11.3 | 10.1 |  |  | 7.0 | 6.1 | 5.5 | 4.3 | 3.9 | 3.5 |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 2 The requirements should be verified for UL EARFCN of a low band (superscript LB) such that in MHz and  with the carrier frequency of a high band in MHz and the channel bandwidth configured in the low band. | | | | | | | | | | | | | |

Table 6.9.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for CA\_n8-n41

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | NR Band / Channel bandwidth of the high band | | | | | | | | | | | | |
| UL band | DL band | 5  MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n8 | n41 |  | 16 | 25 | 25 |  |  | 25 | 25 | 25 | 25 | 25 | 25 |

### 6.9.2 Specific for 2 bands UL CA

#### 6.9.2.1 UE co-existence studies

Table 6.9.2.1-1 gives IMD interference analysis for CA\_ n8-n41 with 2 ULs.

**Table 6.9.2.1-1: Band n8 and Band n41 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency range | 880 | 915 | 2496 | 2690 |
| Two tone 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
|  | 1581 | 1810 | 3376 | 3605 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
|  | 930 | 666 | 4077 | 4500 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
|  | 4256 | 4520 | 5872 | 6295 |
| Two-tone 3rd order IMD products | |fx\_low-max BW fy| | |fx\_high+max BW fy| | |fy\_low-max BW fx| | |fy\_high+max BW fx| |
|  | 780 | 1015 | 2476 | 2710 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | |3\*fy\_low – fx\_high| | |3\*fy\_high – fx\_low| |
|  | 50 | 249 | 6573 | 7190 |
| Two-tone 4th order IMD products | |3\*fx\_low + fy\_low| | |3\*fx\_high + fy\_high| | |3\*fy\_low + fx\_low| | |3\*fy\_high + fx\_high| |
|  | 5136 | 5435 | 8368 | 8985 |
| Two-tone 4th order IMD products | |2\*fx\_low – 2\*fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low + 2\*fy\_low| | |2\*fx\_high + 2\*fy\_high| |
|  | 3620 | 3162 | 6752 | 7210 |
| Two-tone 4th order IMD products\*1 | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
|  | 1581 | 1810 | 3376 | 3605 |
| Two-tone 4th order IMD products\*1 | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
|  | 1760 | 1830 | 4992 | 5380 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
|  | 9880 | 9069 | 1164 | 830 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
|  | 10864 | 11675 | 6016 | 6350 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
|  | 6310 | 5658 | 2247 | 2740 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
|  | 9248 | 9900 | 7632 | 8125 |
| Two-tone 5th order IMD products\*2 | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
|  | 2640 | 2745 | 7488 | 8070 |
| Two-tone 5th order IMD products\*2 | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
|  | 930 | 666 | 4077 | 4500 |
| Two-tone 5th order IMD products\*2 | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
|  | 4256 | 4520 | 5872 | 6295 |
| NOTE1: The center frequency of this IMD is the same as that of 2nd harmonics and IMD. It is depending on the proponents of each band combination to include the impact of this IMD in MSD analysis.  NOTE2: The center frequency of this IMD is the same as that of 3rd harmonics and IMD. It is depending on the proponents of each band combination to include the impact of this IMD in MSD analysis. | | | | |

Based on above table, the 3rd and 5th order IMD may fall into Rx frequencies of band n8 and the 3rd order IMD may fall into Rx frequencies of Band n41. However IMD is not an issue for Band n41 since it is a TDD band. MSD need to be considered for Band n8.

Table 6.9.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.9.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected Band | Frequency range (Mhz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n8A-n41A | E-UTRA Band 1, 28, 34, 39, 40, 45, 50, 51, 65, 73,74, n77,78,79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3, 42, 52 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| NOTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz. | | | | | | | |

#### 6.9.2.2 REFSENS requirements

Table 6.9.2.2-1 lists the MSD required due to 3rd order and 5th IMD for the dual uplink configuration.

**Table 6.9.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| EUTRA CA  Configuration | EUTRA band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_8A-41A | 8 | 882.5 | 5 | 25 | 927.5 | 12.1 | FDD | IMD34 |
| 41 | 2685 | 10 | 50 | 2685 | N/A | TDD | N/A |
| NOTE 1: Both of the transmitters shall be set min(+20 dBm, PCMAX\_L,c).  NOTE 2: RBSTART = 0.  NOTE 3: 15kHz SCS is assumed.  NOTE 4: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

## 6.10 CA\_n41-n79

### 6.10.1 Common for 1 band UL and 2 bands UL

#### 6.10.1.1 Operating bands for CA

**Table 6.10.1.1-1: CA band combination of band n41+n79**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

#### 6.10.1.2 Channel bandwidths per operating band for CA

**Table 6.10.1.2-1: Supported bandwidths per CA band combination of band n41+n79**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n41A-n79A | CA\_n41A-n79A | n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 1 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |

#### 6.10.1.3 UE co-existence studies

Table 6.10.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n41-n79.

**Table 6.10.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 | 17600 | 20000 |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |

Based on above table, the 2nd order harmonic of Band n41 will fall into Band n79.

**Table 6.10.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there will be harmonic mixing issue when the assigned frequency is at the lower edge in Band n41.

However, according to the analysis in EN-DC\_41-n79 in TR 36.863-01-01, there will be no harmonic and/or harmonic mixing issue as long as the frequency in Band 41 is above 2506. According to the spectrum situation in China and Japan, the lowest frequency to be used for this combination is 2515MHz. So there will be no harmonic and/or harmonic mixing issue.

A note is proposed to clarify the frequency to be used in Band 41as “*Note: The lowest frequency is 2506 in Band 41 for this band combination.”*

#### 6.10.1.4 ∆TIB and ∆RIB values

For CA\_n41-n79, the TIB,c and RIB,c values are given in the tables below.

**Table 6.10.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n79 | n41 | 0.3 |
| n79 | 0.8 |

**Table 6.10.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n79 | n41 | 0.5 |
| n79 | 0.5 |

#### 6.10.1.5 REFSENS requirements

No specific REFSENS requirements need to be specified.

### 6.10.2 Specific for 2 bands UL CA

#### 6.10.2.1 UE co-existence studies

Table 6.10.2.1-1 gives IMD interference analysis for CA\_ n41-n79 with 2 ULs.

**Table 6.10.2.1-1: Band n41 and Band n79 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency range | 2496 | 2690 | 4400 | 5000 |
| Two tone 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
|  | 1710 | 2504 | 6896 | 7690 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
|  | 8 | 980 | 6110 | 7504 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
|  | 9392 | 10380 | 11296 | 12690 |
| Two-tone 3rd order IMD products | |fx\_low-max BW fy| | |fx\_high+max BW fy| | |fy\_low-max BW fx| | |fy\_high+max BW fx| |
|  | 2396 | 2790 | 4300 | 5100 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | |3\*fy\_low – fx\_high| | |3\*fy\_high – fx\_low| |
|  | 2488 | 3670 | 10510 | 12504 |
| Two-tone 4th order IMD products | |3\*fx\_low + fy\_low| | |3\*fx\_high + fy\_high| | |3\*fy\_low + fx\_low| | |3\*fy\_high + fx\_high| |
|  | 11888 | 13070 | 15696 | 17690 |
| Two-tone 4th order IMD products | |2\*fx\_low – 2\*fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low + 2\*fy\_low| | |2\*fx\_high + 2\*fy\_high| |
|  | 5008 | 3420 | 13792 | 15380 |
| Two-tone 4th order IMD products\*1 | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
|  | 1710 | 2504 | 6896 | 7690 |
| Two-tone 4th order IMD products\*1 | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
|  | 4992 | 5380 | 6896 | 7690 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
|  | 17504 | 14910 | 6360 | 4984 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
|  | 20096 | 22690 | 14384 | 15760 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
|  | 10008 | 7820 | 730 | 2512 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
|  | 18192 | 20380 | 16288 | 18070 |
| Two-tone 5th order IMD products\*2 | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
|  | 7488 | 8070 | 13200 | 15000 |
| Two-tone 5th order IMD products\*2 | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
|  | 8 | 980 | 6110 | 7504 |
| Two-tone 5th order IMD products\*2 | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
|  | 9392 | 10380 | 11296 | 12690 |
| NOTE1: The center frequency of this IMD is the same as that of 2nd harmonics and IMD. It is depending on the proponents of each band combination to include the impact of this IMD in MSD analysis.  NOTE2: The center frequency of this IMD is the same as that of 3rd harmonics and IMD. It is depending on the proponents of each band combination to include the impact of this IMD in MSD analysis. | | | | |

IMD is not an issue for this band combination as the involved bands are all TDD bands. The above IMD interference analysis is just for information.

Table 6.10.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.10.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected Band | Frequency range (Mhz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n41A-n79A | E-UTRA Band 1, 3, 5, 8, 9, 11, 18, 19, 21, 28, 34, 40, 42, 44, 45, 65 or NR Band n1, n3, n8, n28, n34, n40 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 1 |
|  |  |  |  |  |  |  |
| NOTE 1: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz. | | | | | | | |

#### 6.10.2.2 REFSENS requirements

No specific REFENS requirements need to be specified.

## 6.11 CA\_n5-n78

### 6.11.1 Common for 1 band UL and 2 bands UL CA

#### 6.11.1.1 Operating bands for CA

**Table 6.11.1.1-1: CA band combination**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

#### 6.11.1.2 Channel bandwidths per operating band for CA

**Table 6.11.1.2-1: Supported bandwidths per CA band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n5A-n78A | CA\_n5A-n78A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n5A-n78C | CA\_n5A-n78A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n78 | See CA\_n78C Bandwidth Combination Set 0 in Table 5.5A.1-1 in 38.101-1 | | | | | | | | | | | | |

#### 6.11.1.3 Co-existence studies

Table 6.11.1.3-1 lists the 2nd, 3rd, 4th and 5th order harmonics for CA\_n5-n78.

**Table 6.11.1.3-1: Band n5 and Band n78 UL harmonics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 824 | 849 | | 3300 | 3800 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1648 | | 1698 | 6600 | 7600 |
| 3rd harmonics frequency limits | 3\*fx\_low | | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2472 | | 2547 | 9900 | 11400 |
| 4th harmonics frequency limits | 4\*fx\_low | | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 3296 | | 3396 | 13200 | 15200 |
| 5th harmonics frequency limits | 5\*fx\_low | | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 4120 | | 4245 | 16500 | 19000 |

Based on above table, the 4th harmonic of Band n5 may fall into Rx frequencies of Band n78, which may cause Band n78 desense.

#### 6.11.1.4 ∆TIB and ∆RIB values

For CA\_n5-n78, the TIB,c and RIB,c values are given in the tables below.

**Table 6.11.1.4-1: ΔTIB,c**

| Inter-band DC Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n78 | n5 | 0.6 |
| n78 | 0.8 |

**Table 6.11.1.4-2: ΔRIB**

| Inter-band DC Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n78 | n5 | 0.2 |
| n78 | 0.5 |

#### 6.11.1.5 REFSENS requirements

Table 6.11.1.5-1 lists the MSD requirement due to the 4th harmonic of Band n5 for CA\_n5-n78 by referring the endorsed TP of R4-1810167 for DC\_5A-n78A.

**Table 6.11.1.5-1: MSD due to 4th harmonic for CA\_n5A-n78A**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MSD due to harmonic exception for the DL band** | | | | | | | | | | | |
| **UL band** | **DL band** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100**  **MHz** |
| **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** |
| n5 | n784,5 |  | 10.5 | 8.9 | 7.8 |  | 5.4 |  |  |  |  |
| NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 5: The requirements should be verified for UL NR‑ARFCN of a low band (superscript LB) such that in MHz and with the carrier frequency of a high band in MHz and the channel bandwidth configured in the low band. | | | | | | | | | | | |

**Table 6.11.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **100 MHz** |
| n5 | n78 | 8 | 16 | 25 | 253, 254 |  |  |  |  |  |  |
| NOTE 3: The configuration is used for measurement of MSD for NR channel bandwidth of 20MHz.  NOTE 4: The configuration is used for measurement of MSD for NR channel bandwidth of 40MHz. | | | | | | | | | | | |

### 6.11.2 Specific for 2 bands UL CA

#### 6.11.2.1 UE co-existence studies

Table 6.11.2.1-1 lists Band n5 +Band n78 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.11.2.1-1: Band n5 and Band n78 UL IMD products**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 824 | 849 | | 3300 | 3800 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2451 | 2976 | | 4124 | 4649 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 2152 | | 1602 | 5751 | 6776 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4948 | | 5498 | 7424 | 8449 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 724 | | 949 | 3290 | 3810 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1328 | 753 | | 9051 | 10576 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |  |  |
| IMD frequency limits (MHz) | 5952 | | 4902 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 5772 | | 6347 | 10724 | 12249 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 8248 | | 9298 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 14376 | | 12351 | 96 | 504 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 9752 | | 8202 | 4053 | 5128 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 14024 | | 16049 | 6596 | 7196 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11548 | | 13098 | 9072 | 10147 |

Based on Table 6.11.2.1-1, 4th order IMD may also fall into own Rx of band 5

Table 6.11.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.11.2.1.-2: Protected bands for 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n5A\_n78A | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 24, 25, 28, 29, 30, 31, 34, 38, 40, 42, 43, 45, 48, 65, 66, 70 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 26 | 859 | - | 869 | -27 | 1 |  |
| Frequency range | 945 | - | 960 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| Frequency range | 2545 | - | 2575 | -50 | 1 |  |
| Frequency range | 2595 | - | 2645 | -50 | 1 |  |
| E-UTRA Band 41 | FDL\_low | - | FDL\_high | -50 | 1 | 6 |
| NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  NOTE 6: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | | |

#### 6.11.2.2 REFSENS requirements

Table 6.11.2.2-1 lists the MSD required for the dual uplink configuration.

**Table 6.11.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source of IMD** |
| **DC**  **Configuration** | **EUTRA and NR band** | **UL Fc  (MHz)** | **UL/DL BW  (MHz)** | **UL  CLRB** | **DL Fc (MHz)** | **MSD  (dB)** | **Duplex mode** |
| DC\_n5A\_n78A | n5 | 844 | 5 | 25 | 889 | 8.3 | FDD | IMD4  |fB78-3\*fB5| |
| n78 | 3421 | 10 | 50 | 3421 | N/A | TDD | N/A |

## 6.12 CA\_n5-n79

### 6.12.1 Common for 1 band UL and 2 bands UL CA

#### 6.12.1.1 Operating bands for CA

**Table 6.12.1.1-1: CA band combination**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

#### 6.12.1.2 Channel bandwidths per operating band for CA

**Table 6.12.1.2-1: Supported bandwidths per CA band combination**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n5A-n79A | CA\_n5A-n79A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| CA\_n5A-n79C | CA\_n5A-n79A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n79 | See CA\_n79C Bandwidth Combination Set 0 in Table 5.5A.1-1 in 38.101-1 | | | | | | | | | | | | |

#### 6.12.1.3 Co-existence studies

Table 6.12.1.3-1 lists the 2nd, 3rd, 4th and 5th order harmonics for CA\_n5-n79.

**Table 6.12.1.3-1: Band n5 and Band n79 UL harmonics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 824 | 849 | 4400 | 5000 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1648 | 1698 | 8800 | 10000 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2472 | 2547 | 13200 | 15000 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 3296 | 3396 | 17600 | 20000 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 4120 | 4245 | 22000 | 25000 |

Based on above table, there is no harmonic issue for this band combination.

#### 6.12.1.4 ∆TIB and ∆RIB values

For CA\_n5-n79, the TIB,c and RIB,c values are given in the tables below.

**Table 6.12.1.4-1: ΔTIB,c**

| Inter-band DC Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n79 | n5 | 0 |
| n79 | 0 |

**Table 6.12.1.4-2: ΔRIB**

| Inter-band DC Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n79 | n5 | 0 |
| n79 | 0 |

#### 6.12.1.5 REFSENS requirements

Because of no harmonic falling into the own Rx Band, there is no MSD issue for this 1UL combination.

### 6.12.2 Specific for 2 bands UL CA

#### 6.12.2.1 UE co-existence studies

Table 6.12.2.1-1 lists Band n5 +Band n79 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.12.2.1-1: Band n5 and Band n79 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 824 | 849 | 4400 | 5000 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 3551 | 4176 | 5224 | 5849 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 2702 | 3352 | 7951 | 9176 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 6048 | 6698 | 9624 | 10849 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 1853 | 2528 | 12351 | 14176 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 6872 | 7547 | 14024 | 15849 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 7102 | 8352 | 10448 | 11698 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 1004 | 1704 | 16751 | 19176 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 7696 | 8396 | 18424 | 20849 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 6253 | 7528 | 11502 | 13352 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 14848 | 16698 | 11272 | 12547 |

Based on the above table, there is no IMD falling into own Rx band for this band combination.

Table 6.12.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.12.2.1.-2: Protected bands for 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n5A\_n79A | Bands 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 24, 25, 28, 29, 30, 31, 34, 38, 40, 42, 43, 45, 48, 50, 51, 65, 66, 70, 71, 73, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 26 | 859 | - | 869 | -27 | 1 |  |
| Bands 41, 52 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz | | | | | | | |

#### 6.12.2.2 REFSENS requirements

Because of no IMD falling into the own Rx Band, there is no MSD issue for this 2UL combination.

## 6.13 CA\_n40-n41

### 6.13.1 Common for 1 band UL and 2 bands UL

#### 6.13.1.1 Operating bands for CA

**Table 6.13.1.1-1: CA band combination of band n40+n41**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

#### 6.13.1.2 Channel bandwidths per operating band for CA

**Table 6.13.1.2-1: Supported bandwidths per CA band combination of band n40+n41**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n40A-n41A | CA\_n40A-n41A | n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 1 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  |  |  |

#### 6.13.1.3 UE co-existence studies

Table 6.13.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n40-n41.

**Table 6.13.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonic issue for the band combination of n40 and n41.

**Table 6.13.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n40 and n41.

#### 6.13.1.4 ∆TIB and ∆RIB values

For CA\_n40-n41, the TIB,c and RIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

**Table 6.13.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n40-n41 | n40 | 0.5 |
| n41 | 0.5 |
| NOTE 1: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx. | | |

**Table 6.13.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n40-n41 | n40 | 0 |
| n41 | 0 |
| NOTE 1: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx. | | |

#### 6.13.1.5 REFSENS requirements

Since the focus of this combination is not supporting simultaneous Tx/Rx, there are no specific REFSENS requirements for 1 band UL

### 6.13.2 Specific for 2 bands UL CA

#### 6.13.2.1 UE co-existence studies

Table 6.13.2.1-1 lists Band n40 +Band n41 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.13.2.1-1: Band n40 and Band n41 2UL bands IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 2300 | 2400 | | 2496 | 2690 | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 96 - 390 | | | 4796 - 5090 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 1910 – 2304 | | | 2592 – 3080 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 7096 – 7490 | | | 7292 – 7780 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 2200 – 2500 | | | 2416 – 2770 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 4210 – 4704 | | | 5088 – 5770 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 192 – 780 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 9396 – 9890 | | | 9788 – 10470 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 9592 – 10180 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 7584 – 8460 | | | 6510 – 7104 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 2688 – 3470 | | | 1520 – 2208 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 12284 – 13160 | | | 11696 – 12290 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 12088 – 12870 | | | 11892 – 12580 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

As IMD is not an issue for TDD bands combination, there is no MSD issue for this band combination. In addition, since only synchronized operation without supporting simultaneous Tx/Rx is considered for this combination, no MSD due to cross band isolation need to be specified.

Table 6.13.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.13.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n40-n41 | 1. UTRA Band 1, 3, 5, 8, 26, 27, 28, 34, 39, 42, 44, 45, 50, 51, 65, 73, 74,   NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, x |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.  NOTE x: This requirement applies when the NR carriers are confined within 2545-2575 MHz or 2595-2645 MHz and the channel bandwidth is 10 or 20 MHz | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

#### 6.13.2.2 REFSENS requirements

As IMD is not an issue for TDD bands combination, there is no MSD issue for this combination.

## 6.14 CA\_n70-n71

### 6.14.1 Common for 1 band UL and 2 bands UL CA

#### 6.14.1.1 Operating bands for CA

**Table 6.14.1.1-1: CA band combination of band n70+n71**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n70 | 1695 | – | 1710 | 1995 | – | 2020 | FDD |
| n71 | 663 | – | 698 | 617 | – | 652 | FDD |

#### 6.14.1.2 Channel bandwidths per operating band for CA

**Table 6.14.1.2-1: Supported bandwidths per CA band combination of band n70+n71**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n70A-n71A | CA\_n70A-n71A | n70 | 15 | Yes | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| NOTE 1: This UE channel bandwidth is applicable only to downlink. | | | | | | | | | | | | | | | | |

#### 6.14.1.3 UE co-existence studies

Table 6.14.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ n70-n71.

**Table 6.14.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | **DL Low Band Edge** | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n70 | 1695 | 1710 | 1995 | 2020 | 3390 | 3420 | 5085 | 5130 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1326 | 1396 | 1989 | 2094 |  |  |

Based on the table above, the 3rd harmonic of n71 UL lands on top of n70 DL.

**Table 6.14.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n70 | 1695 | 1710 | 1995 | 2020 | 3990 | 4040 | 5985 | 6060 |  |  |
| n71 | 663 | 698 | 617 | 652 | 1234 | 1304 | 1851 | 1956 |  |  |

Based on the table above, the is no harmonic mixing relation.

#### 6.14.1.4 ∆TIB and ∆RIB values

For CA\_n70-n71, the TIB,c and RIB,c values are given in the tables below.

**Table 6.14.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n70-n71 | n70 | 0.3 |
| n71 | 0.6 |

**Table 6.14.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n70-n71 | n70 | 0 |
| n71 | 0 |

#### 6.14.1.5 REFSENS requirements

Table 6.14.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n71 | n701,2 | 9.9 | 7.1 | 6.7 | 4.9 | 4.1 |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 3nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band. | | | | | | | | | | | | | |

Table 6.14.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n71 | n70 | 8 | 16 | 20 | 20 | 20 |  |  |  |  |  |  |  |
| NOTE: 15kHz SCS is assumed for UL band. | | | | | | | | | | | | | |

### 6.14.2 Specific for 2 bands UL CA

#### 6.14.2.1 UE co-existence studies

**Table 6.14.2.1-1: Impact of Intermodulations**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1695 | 1710 | 663 | 698 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 1047 | 997 | 2358 | 2408 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 2692 | 2757 | 384 | 299 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 4053 | 4118 | 3021 | 3106 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4387 | 4467 | 279 | 399 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 5748 | 5828 | 3021 | 3804 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 2094 | 1994 | 4716 | 4816 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 6082 | 6177 | 942 | 1097 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 7443 | 7538 | 4347 | 4502 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 3689 | 3804 | 1431 | 1296 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 5379 | 5514 | 6411 | 6526 |

Based on the table above, there is IMD4 falling on top of n70 DL. There is pretty similar combination in EN-DC, DC\_66A\_n71A with same IMD source (2\*66 UL-2\*71UL=66 DL) where MSD is defined for B66. Because the IMD mechanisms are exactly the same, we propose to reuse that MSD number for n70 recognizing MSD for n70 is not fully optimized as in CA\_n70A-n71A MSD hits only partially on top of n70 while in DC\_66A\_n71A there is full hit.

Furthermore, the 3rd harmonic relation has MSD specified for n70, but the frequency arrangement for IMD4 is such that the 3rd harmonic does not occur at n70 in IMD4 requirement.

Table 6.14.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.14.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA combination | Spurious emission | | | | | | |
| Protected Band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n70-n71 | E-UTRA Band 4, 5, 7, 10, 12, 13, 14, 17, 26, 27, 30, 48, 66, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25, 41, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| E-UTRA Band 71 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| NOTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.14.2.2 REFSENS requirements

MSD is defined for n70 as follows.

**Table 6.14.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA**  **Configuration** | **NR band** | **UL Fc  (MHz)** | **UL/DL BW  (MHz)** | **UL  CLRB** | **DL Fc (MHz)** | **MSD  (dB)** | **Duplex mode** | **Source of IMD** |
| CA\_n70A-n71A | n70 | 1697.5 | 5 | 25 | 1997.5 | 5 | FDD | IMD4 |
| n71 | 695.5 | 5 | 25 | 649.5 | N/A | FDD | N/A |

## 6.15 CA\_n50-n78

### 6.15.1 Common for 1 band UL and 2 bands UL CA

#### 6.15.1.1 Operating bands for CA

Table 6.15.1-1: DC band combination of bands n50+n78

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n50 | 1432 MHz | – | 1517 MHz | 1432 MHz | – | 1517 MHz | TDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

#### 6.15.1.2 Channel bandwidths per operating band for CA

Table 6.15.1.2-1: Supported bandwidths per CA band combination of bands n50+n78

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS kHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n50A-n78A | CA\_n50A-n78A | n50 | 15 | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes1 |  |  |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes1 |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| NOTE 1: This UE channel bandwidth is applicable only to downlink. | | | | | | | | | | | | | | | | |

#### 6.15.1.3 Co-existence studies

Table 6.15.1.3 summarizes frequency ranges where harmonics occur for CA\_n50-n78.

Table 6.15.1.3: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n50 | 1432 | 1517 | 1432 | 1517 | 2864 | 3034 | 4296 | 4551 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is a no harmonic issue for this band combination.

#### 6.15.1.4 ∆TIB and ∆RIB values

For CA\_n50\_n78, the TIB,c and RIB,c values are given in the tables below.

Table 6.15.1.4-1: ΔTIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n50\_n78 | n50 | 01 |
| n78 | 01 |
| n50 | 0.52 |
| n78 | 0.52 |
| NOTE 1: Only applicable for UE supporting inter-band carrier aggregation with uplink in one NR band and without simultaneous Rx/Tx.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx. | | |

Table 6.15.1.4-2: ΔRIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n50\_n78 | n50 | 0.21 |
| n78 | 0.21 |
| n50 | 0.22 |
| n78 | 0.22 |
| NOTE 1: Only applicable for UE supporting inter-band carrier aggregation with uplink in one NR band and without simultaneous Rx/Tx.  NOTE 2: Applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx. | | |

#### 6.15.1.5 REFSENS requirements

There are no specific REFSENS requirements

### 6.15.2 Specific for 2 bands UL CA

#### 6.15.2.1 UE co-existence studies

Table 6.15.2.1-1 lists Bands n50 +Band n78 2UL CA 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.15.2.1-1: Band n28 and Band n50 UL harmonic and IMD analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency (MHz)** | **1432** | **1517** | **3300** | **3800** |
| Two tone 2nd order IMD products | (fx\_low – fy\_high) | (fx\_high – fy\_low) | (fx\_low + fy\_low) | (fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 1783 | 2368 | 4732 | 5317 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | (2\*fx\_low – fy\_high) | (2\*fx\_high – fy\_low) |
| IMD frequency limits (MHz) | 266 | 936 | 5083 | 6168 |
| Two-tone 3rd order IMD products | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 6164 | 6834 | 8032 | 9117 |
| 3rd order IMD products | (fx\_low – fy\_high + fy\_low) | (fx\_high + fy\_high – fy\_low) | (fy\_low – fx\_high + fx\_low) | (fy\_high + fx\_high – fx\_low) |
|  | 932 | 2017 | 3215 | 3885 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1332 | 1617 | 3240 | 3860 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | (3\*fy\_low – fx\_high) | (3\*fy\_high – fx\_low) |
| IMD frequency limits (MHz) | 496 | 1251 | 8383 | 9968 |
| Two-tone 4th order IMD products | (2\*fy\_low – 2\*fx\_high) | (2\*fy\_high – 2\*fx\_low) |  |  |
| IMD frequency limits (MHz) | 3566 | 4736 |  |  |
| Two-tone 4th order IMD products | (3\*fx\_low + fy\_low) | (3\*fx\_high + fy\_high) | (3\*fy\_low + fx\_low ) | (3\*fy\_high +fx\_high) |
| IMD frequency limits (MHz) | 7596 | 8351 | 11332 | 12917 |
| Two-tone 4th order IMD products | (2\*fx\_low + 2\*fy\_low) | (2\*fx\_high + 2\*fy\_high) |  |  |
| IMD frequency limits (MHz) | 9464 | 10634 |  |  |
| Two-tone 5th order IMD products | (4\*fy\_low – fx\_high) | (4\*fy\_high – fx\_low) | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| |
| IMD frequency limits (MHz) | 11683 | 13768 | 1928 | 2768 |
| Two-tone 5th order IMD products | (3\* fy\_low-2\*fx\_high ) | (3\*fy\_high-2\*fx\_low) | |2\*fy\_low –3\* fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 6866 | 8536 | 2049 | 3304 |
| Two-tone 5th order IMD products | (4\*fy\_low + fx\_low ) | (4\*fy\_high +fx\_high) | (4\*fx\_low + fy\_low) | (4\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 14632 | 16717 | 9028 | 9868 |
| Two-tone 5th order IMD products | (3\*fy\_low + 2\*fx\_low ) | (3\*fy\_high +2\*fx\_high) | (3\*fx\_low +2\* fy\_low) | (3\*fx\_high + 2\*fy\_high) |
| IMD frequency limits (MHz) | 12764 | 14434 | 10896 | 12151 |

Based on the table 6.1.15.2.1-1:

* 3nd order harmonic products may also fall into Rx frequencies of bands n79
* 2nd IMD products may also fall into Rx frequencies of bands 1/n1, 2/n2, 3/n3, 4, 9, 10, 23, 25/n25, 30, 34/n34, 35, 36, 37, 39/n39, 40/n40, 46, 65/n65, 66/n66, 70/n70, n79
* 3rd IMD products may also fall into Rx frequencies of bands 2/n2, 5/n5, 6, 8/n8, 9, 11, 12/n12, 13, 14, 17, 18, 19, 20/n20, 21, 22, 24, 25/n25, 26, 27, 28/n28, 31, 32, 33, 34, 35, 36, 37, 39/n39, 42, 43, 45, 46, 50/n50, 51/n51, 67, 68, 70/n70, 71/n71, 74/n74, 75/n75, 76/n76, n77, n78, 85
* 4th IMD products may also fall into Rx frequencies of bands 5/n5, 6, 8/n8, 12/n12, 13, 14, 17, 18, 19, 20/n20, 22, 26, 27, 28/n28, 29, 42, 43, 44, 67, 68, 71/n71, n77, n78, n79, 85
* 5th IMD products may also fall into Rx frequencies of bands 1/n1, 2/n2, 4, 7/n7, 10, 23, 25/n25, 30, 34/n34, 36, 37, 38/n38, 40/n40, 41/n41, 65/n65, 66/n66, 69, 70/n70, n77, n78,

Tables below list the protected bands for the dual connectivity configuration due to IMD, 3, 4 and 5.

Table 6.15.2.1-2: Protected bands for the 2UL bands CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n50A\_n78A | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 17, 20, 25, 26, 27, 28, 29, 31, 33, 34, 38, 39, 40, 41, 44, 48, 65, 66, 67, 68, 69, 72, 73, 85  NR Band n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n34, n38, n39, n40, n41, n65, n66, n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | | | | | | | |

## 6.16 CA\_n28-n50

### 6.16.1 Common for 1 band UL and 2 bands UL CA

#### 6.16.1.1 Operating bands for CA

Table 6.16.1-1: CA band combination of bands n28-n50

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n50 | 1432 MHz | – | 1517 MHz | 1432 MHz | – | 1517 MHz | TDD |

#### 6.16.1.2 Channel bandwidths per operating band for CA

Table 6.16.1.2-1: Supported bandwidths per CA band combination of bands n28-n50

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS kHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n28A-n50A | CA\_n28A-n50A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n50 | 15 | Yes | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes1 |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes1 |  |  |
| NOTE 1: This UE channel bandwidth is applicable only to downlink. | | | | | | | | | | | | | | | | |

#### 6.16.1.3 Co-existence studies

Table 6.16.1.3 summarizes frequency ranges where harmonics occur for CA\_n28-n50.

Table 6.16.1.3: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n28 | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 |  |  |
| n50 | 1432 | 1517 | 1432 | 1517 | 2864 | 3034 | 4296 | 4551 |  |  |

Based on above table, there is a possible harmonic issue for the band combination of n28 and n50 in the band n50.

#### 6.16.1.4 ∆TIB and ∆RIB values

For CA\_n28-n50, the TIB,c and RIB,c values are given in the tables below.

Table 6.16.1.4-1: ΔTIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n28-n50 | n28 | 0.3 |
| n50 | 0.4 |

Table 6.16.1.4-2: ΔRIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n28-n50 | n28 | 0 |
| n50 | 0 |

#### 6.16.1.5 Self-interference analysis

There is no harmonic or IMD in the case of the UL n50 is used alone.

For this combinations, sensitivity degradation is allowed for a band if it is impacted by UL of another band part of the same DC configuration due to UL harmonic interference issues. Reference sensitivity exceptions are specified in Table 6.16.1.5-1 with uplink configuration specified in Table 6.16.1.5-2.

Table 6.16.1.5-1: Reference sensitivity exceptions due to UL harmonic

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz (dB) | 40 MHz  (dBm) | 50 MHz  (dBm) | 60 MHz  (dBm) | 80 MHz  (dBm) | 90 MHz  (dBm) | 100 MHz  (dBm) |
| n28 | n501,2 |  | 19.8 | 18.0 | 16.8 |  |  | 13.8 | 12.8 | 12.0 | 10.8 |  |  |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band. | | | | | | | | | | | | | |

Table 6.16.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n28 | n50 |  | 25 | 25 | 25 |  |  | 25 | 25 | 25 | 25 |  |  |
| NOTE 1: 15 kHz SCS is assumed for UL band.  NOTE 2: The UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies. | | | | | | | | | | | | | |

### 6.16.2 Specific for 2 bands UL CA

#### 6.16.2.1 UE co-existence studies

Table 6.16.2.1-1 lists Bands n28 and Band n50 2UL CA 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.16.2.1-1: Band n28 and Band n50 UL harmonic and IMD analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency (MHz)** | **703** | **748** | **1432** | **1517** |
| Two tone 2nd order IMD products | (fx\_low – fy\_high) | (fx\_high – fy\_low) | (fx\_low + fy\_low) | (fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 684 | 814 | 2135 | 2265 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | (2\*fx\_low – fy\_high) | (2\*fx\_high – fy\_low) |
| IMD frequency limits (MHz) | 64 | 111 | 2116 | 2331 |
| Two-tone 3rd order IMD products | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 2838 | 3013 | 3567 | 3782 |
| 3rd order IMD products | (fx\_low – fy\_high + fy\_low) | (fx\_high + fy\_high – fy\_low) | (fy\_low – fx\_high + fx\_low) | (fy\_high + fx\_high – fx\_low) |
|  | 618 | 833 | 1387 | 1562 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 643 | 808 | 1412 | 1537 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | (3\*fy\_low – fx\_high) | (3\*fy\_high – fx\_low) |
| IMD frequency limits (MHz) | 592 | 812 | 3548 | 3848 |
| Two-tone 4th order IMD products | (2\*fy\_low – 2\*fx\_high) | (2\*fy\_high – 2\*fx\_low) |  |  |
| IMD frequency limits (MHz) | 1368 | 1628 |  |  |
| Two-tone 4th order IMD products | (3\*fx\_low + fy\_low) | (3\*fx\_high + fy\_high) | (3\*fy\_low + fx\_low ) | (3\*fy\_high +fx\_high) |
| IMD frequency limits (MHz) | 3541 | 3761 | 4999 | 5299 |
| Two-tone 4th order IMD products | (2\*fx\_low + 2\*fy\_low) | (2\*fx\_high + 2\*fy\_high) |  |  |
| IMD frequency limits (MHz) | 4270 | 4530 |  |  |
| Two-tone 5th order IMD products | (4\*fy\_low – fx\_high) | (4\*fy\_high – fx\_low) | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| |
| IMD frequency limits (MHz) | 4980 | 5365 | 1295 | 1560 |
| Two-tone 5th order IMD products | (3\* fy\_low-2\*fx\_high ) | (3\*fy\_high-2\*fx\_low) | |2\*fy\_low –3\* fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 2800 | 3145 | 620 | 925 |
| Two-tone 5th order IMD products | (4\*fy\_low + fx\_low ) | (4\*fy\_high +fx\_high) | (4\*fx\_low + fy\_low) | (4\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 6431 | 6816 | 4244 | 4509 |
| Two-tone 5th order IMD products | (3\*fy\_low + 2\*fx\_low ) | (3\*fy\_high +2\*fx\_high) | (3\*fx\_low +2\* fy\_low) | (3\*fx\_high + 2\*fy\_high) |
| IMD frequency limits (MHz) | 5702 | 6047 | 4973 | 5278 |

Based on the table 6.16.2.1-1:

* 2nd order harmonic products may also fall into Rx frequencies of bands 11, 21, 32, 45, 50/n50, 51/n51, 74/n74, 75/n75, 76/n76
* 3nd order harmonic products may also fall into Rx frequencies of bands 1/n1, 4, 10, 23, 65/n65, 66/n66, n79
* 2nd IMD products may also fall into Rx frequencies of bands 1/n1, 4, 10, 12/n12, 13, 14, 17, 20/n20, 23, 28/n28, 29, 44, 65/n65, 66/n66, 67, 68, 85
* 3rd IMD products may also fall into Rx frequencies of bands 1/n1, 4, 10, 11, 12/n12, 13, 14, 17, 20/n20, 21, 22, 23, 24, , 29, 32, 40/n40, 42, 43, 44, 45,, 51/n51, 65/n65, 66/n66, 67, 68, 71/n71, 74, n74, 75/n75, 76/n76, n77, n78 85
* 4th IMD products may also fall into Rx frequencies of bands 11, 12/n12, 13, 14, 17, 19, 20/n20, 21, 22, 24, 28/n28, 29, 32, 42, 43, 44, 45, 46, 50/n50, 51/n51, 67, 68, 71/n71, 74/n74, 75/n75, 76/n76, n77, n78, n79, 85
* 5th IMD products may also fall into Rx frequencies of bands, 5/n5, 6, 11, 12/n12, 13, 14, 17, 18, 19, 20/n20, 21, 24, 26, 27, 28/n28, 29, 32, 44, 45, 46, 50/n50, 51/n51, 67, 68, 71/n71, 74/n74, 75/n75, 76/n76, n79, 85

Table 6.16.2.1-2 lists the protected bands required for the 2UL bands CA configuration

Table 6.16.2.1-2: Protected bands for the 2UL bands CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n28A\_n50A | E-UTRA Band 4, 10, 12, 13, 17, 22, 42, 43, 52, 65, 66, 73  NR Band n65, n66, n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 1  NR band n1 | FDL\_low | - | FDL\_high | -50 | 1 | 19, 25 |
| E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 25, 26, 27, 29, 31, 34, 38, 39, 40, 41, 48, 52, 67, 72, 85  NR Band n5, n40 n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 470 | - | 694 | -42 | 8 | 15, 35 |
| Frequency range | 470 | - | 710 | -26.2 | 6 | 34 |
| Frequency range | 662 | - | 694 | -26.2 | 6 | 15 |
| Frequency range | 758 | - | 773 | -32 | 1 | 15 |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 19 |
|  |  |  |  |  |  |  |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 8:Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.  NOTE 15: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 and Table 6.5.3.1-2 from the edge of the channel bandwidth.  NOTE 19:Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 25: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.1-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 34: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart<48.  NOTE 35: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies. | | | | | | | |

#### 6.16.2.2 REFSENS requirements

It may have 2nd, 4th, 5th order IMDs when the UP of the band n28 and the UP of the band n50 is used in the same time without precaution.

Table 6.16.2.2-1 lists the MSD required for the dual connectivity configuration CA\_n28A-n50A.

Table 6.16.2.2-1: MSD due to IMD issue

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR Band / Channel bandwidth / NRB / Duplex mode / MSD / Single UL** | | | | | | | | | |
| **CA**  **Configuration** | **EUTRA and NR band** | **UL Fc  (MHz)** | **UL/DL BW  (MHz)** | **UL  CLRB** | **DL Fc (MHz)** | **MSD  (dB)** | **Duplex mode** | **IMD order** | **Single UL allowed** |
| CA\_n28A-n50A | n28 | 730 | 10 | 50 | 775 | 15.3 | FDD | IMD2 |  |
| n50 | 1500 | 10 | 50 | 1500 | N/A | TDD | N/A |
| CA\_n28A-n50A | n28 | 740 | 10 | 50 | 785 | 6 | FDD | IMD4 |  |
| n50 | 1500 | 10 | 50 | 1500 | N/A | TDD | N/A |
| CA\_n28A-n50A | n28 | 740 | 10 | 50 | 785 | 0.5 | FDD | IMD5 |  |
| n50 | 1500 | 60 | 50 | 1500 | N/A | TDD | N/A |

## 6.17 CA\_n41-n50

### 6.17.1 Common for 1 band UL and 2 bands UL CA

#### 6.17.1.1 Operating bands for CA

Table 6.17.1-1: DC band combination of bands n41+n50

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n41 | 2496 MHz | – | 2690 MHz | 2596 MHz | – | 2690 MHz | TDD |
| n50 | 1432 MHz | – | 1517 MHz | 1432 MHz | – | 1517 MHz | TDD |

#### 6.17.1.2 Channel bandwidths per operating band for CA

Table 6.17.1.2-1: Supported bandwidths per CA band combination of bands n41+n50

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS kHz** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n41A-n50A | CA\_n41A-n50A | n41 | 15 |  | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| n50 | 15 | Yes | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes1 |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes1 |  |  |
| NOTE 1: This UE channel bandwidth is applicable only to downlink. | | | | | | | | | | | | | | | | |

#### 6.17.1.3 Co-existence studies

Table 6.17.1.3 summarizes frequency ranges where harmonics occur for CA\_n41-n50.

Table 6.17.1.3: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |
| n50 | 1432 | 1517 | 1432 | 1517 | 2864 | 3034 | 4296 | 4551 |  |  |

Based on above table, there is no harmonic issue for the band combination of n41 and n50 in the bands n41 and n50.

#### 6.17.1.4 ∆TIB and ∆RIB values

For CA\_n41-n50, the TIB,c and RIB,c values are given in the tables below.

Table 6.17.1.4-1: ΔTIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n50 | n41 | 0.3 |
| n50 | 0.4 |

Table 6.17.1.4-2: ΔRIB,c

| Inter-band DC Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n41-n50 | n41 | 0 |
| n50 | 0 |

#### 6.17.1.5 REFSENS requirements

There are no specific REFSENS requirements

### 6.17.2 Specific for 2 bands UL CA

#### 6.17.2.1 UE co-existence studies

Table 6.17.2.1-1 lists Bands n41 +Band n50 2UL CA 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.17.2.1-1: Band n28 and Band n50 UL harmonic and IMD analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency (MHz)** | **2496** | **2690** | **1432** | **1517** |
| Two tone 2nd order IMD products | (fx\_low – fy\_high) | (fx\_high – fy\_low) | (fx\_low + fy\_low) | (fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 1258 | 979 | 3928 | 4207 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | (2\*fx\_low – fy\_high) | (2\*fx\_high – fy\_low) |
| IMD frequency limits (MHz) | 3475 | 3948 | 174 | 538 |
| Two-tone 3rd order IMD products | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) | (2\*fx\_low + fy\_low) | (2\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 6424 | 6897 | 5360 | 5724 |
| 3rd order IMD products | (fx\_low – fy\_high + fy\_low) | (fx\_high + fy\_high – fy\_low) | (fy\_low – fx\_high + fx\_low) | (fy\_high + fx\_high – fx\_low) |
|  | 2411 | 2775 | 1238 | 1711 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 2436 | 2750 | 1332 | 1617 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | (3\*fy\_low – fx\_high) | (3\*fy\_high – fx\_low) |
| IMD frequency limits (MHz) | 5971 | 6638 | 1606 | 2055 |
| Two-tone 4th order IMD products | (2\*fy\_low – 2\*fx\_high) | (2\*fy\_high – 2\*fx\_low) |  |  |
| IMD frequency limits (MHz) | 2516 | 1958 |  |  |
| Two-tone 4th order IMD products | (3\*fx\_low + fy\_low) | (3\*fx\_high + fy\_high) | (3\*fy\_low + fx\_low ) | (3\*fy\_high +fx\_high) |
| IMD frequency limits (MHz) | 8920 | 9587 | 6792 | 7241 |
| Two-tone 4th order IMD products | (2\*fx\_low + 2\*fy\_low) | (2\*fx\_high + 2\*fy\_high) |  |  |
| IMD frequency limits (MHz) | 7856 | 8414 |  |  |
| Two-tone 5th order IMD products | (4\*fy\_low – fx\_high) | (4\*fy\_high – fx\_low) | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| |
| IMD frequency limits (MHz) | 3038 | 3572 | 8467 | 9328 |
| Two-tone 5th order IMD products | (3\* fy\_low-2\*fx\_high ) | (3\*fy\_high-2\*fx\_low) | |2\*fy\_low –3\* fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 1084 | 441 | 5206 | 4454 |
| Two-tone 5th order IMD products | (4\*fy\_low + fx\_low ) | (4\*fy\_high +fx\_high) | (4\*fx\_low + fy\_low) | (4\*fx\_high + fy\_high) |
| IMD frequency limits (MHz) | 8224 | 8758 | 11416 | 12277 |
| Two-tone 5th order IMD products | (3\*fy\_low + 2\*fx\_low ) | (3\*fy\_high +2\*fx\_high) | (3\*fx\_low +2\* fy\_low) | (3\*fx\_high + 2\*fy\_high) |
| IMD frequency limits (MHz) | 9288 | 9931 | 10352 | 11104 |

Based on the table 6.17.2.1-1:

* 2nd order harmonic products may also fall into Rx frequencies of bands 46, n79
* 3nd order harmonic products may also fall into Rx frequencies of band n79
* 2nd IMD products may also fall into Rx frequencies of band n77
* 3rd IMD products may also fall into Rx frequencies of bands 7/n7, 11, 21, 22, 24, 31, 32, 38/n38, 41/n41, 42, 43, 45, 46, 50/n50, 51/n51, 69, 72, 74/n74, 75/n75, 76/n76, n77, n78
* 4th IMD products may also fall into Rx frequencies of bands 2/n2, 3/n3, 9, 25/n25, 33, 34/n34, 35, 36, 37, 39/n39, 70/n70,
* 5th IMD products may also fall into Rx frequencies of bands 22, 42, 46, n77, n78

Table 6.17.2.1-2 lists the protected bands required for the 2UL bands CA configuration

Table 6.17.2.1-2: Protected bands for the 2UL bands CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR DC Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n41A-n50A | E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13 , 14, 17, 20, 24, 25, 26, 27, 28, 29, 30, 31, 34, 38, 39, 40, 42, 43, 44, 45, 48, 52, 65, 66, 67, 68, 70, 71, 73, 85  NR Band 1n, 2n, n3, n5, n8, n12, n20, n25, n28, n34, n38, n39, n40, n65, n66, n70, n71, n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 9, 18, 19 | FDL\_low | - | FDL\_high | -50 | 1 | 30 |
| NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 |  | 1915.7 | -41 | 0.3 | 8, 30 |
|  |  |  |  |  |  |  |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 8:Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.  NOTE 30: This requirement applies when the NR carrier is confined within 2545-2575MHz or 2595-2645MHz and the channel bandwidth is between 10 to 50 MHz | | | | | | | |

#### 6.17.2.2 REFSENS requirements

As the TDD network is synchronized between band n41 and band n50 (UL at the same time and DL at the same time), As IMD is not an issue for TDD bands combination, there is no MSD issue for this combination.

## 6.18 CA\_ n41-n71

### 6.18.1 Common for 1 band UL and 2 bands UL CA

#### 6.18.1.1 Operating bands for CA

Table 6.18.1.1-1: CA band combination of band n41+n71

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n41 | 2469 MHz | – | 2690 MHz | 2469 MHz | – | 2690 MHz | TDD |
| n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |

#### 6.18.1.2 Channel bandwidths per operating band for CA

Table 6.18.1.2-1: Supported bandwidths per CA band combination of band nX+nY

| NR CA configuration | NR Uplink CA configuration | NR  Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90  MHz | 100  MHz | ****Bandwidth combination set**** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n41A-n71A | **CA\_n41A-n71A** | n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| CA\_n41A-n71B | - | n41 | 15 |  | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| n71 | See CA\_n71B Bandwidth Combination Set 0 in 38.101-1 Table 5.5A.1-1 | | | | | | | | | | | | |
| CA\_n41C-n71A | - | n41 | See CA\_n41C BCS0 in RP-182256 “Revised WID on Rel-16 NR intra band Carrier Aggregation for xCC DL/yCC UL including contiguous and non-contiguous spectrum (x>=y)” | | | | | | | | | | | | | 0 |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| CA\_n41(2A)-n71A | - | n41 | See CA\_n41(2A) new BCS1 in revised WID “NR intra band CA for xCC DL/yCC UL including contiguous and non-contiguous spectrum” | | | | | | | | | | | | | 0 |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| CA\_n41(2A)-n71B | - | n41 | See CA\_n41(2A) Bandwidth Combination Set 1 in 38.101-1 Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n71 | See CA\_n71B Bandwidth Combination Set 0 in 38.101-1 Table 5.5A.1-1 | | | | | | | | | | | | |
| CA\_n41C-n71B | - | n41 | See CA\_n41C Bandwidth Combination Set 0 in 38.101-1 Table 5.5A.1-1 | | | | | | | | | | | | | 0 |
| n71 | See CA\_n71B Bandwidth Combination Set 0 in 38.101-1 Table 5.5A.1-1 | | | | | | | | | | | | |

#### 6.18.1.3 UE co-existence studies

Table 6.18.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ n41X-n71Y.

**Table 6.18.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| **n41** | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |
| **n71** | 663 | 698 | 617 | 652 | 1326 | 1396 | 1989 | 2094 | 2652 | 2792 |

Band n71 uplink 4th harmonic hits band n41 downlink.

**Table 6.18.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| **n41** | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |
| **n71** | 663 | 698 | 617 | 652 | 1234 | 1304 | 1851 | 1956 | 2468 | 2608 |

Band n41 is at 4th receiver harmonic of band n71 no MSD is necessary.

#### 6.18.1.4 ∆TIB and ∆RIB values

For CA\_n41-n71 , the ΔTIB,c and ΔRIB,c values for low high combination are given in the tables below.

Table 6.18.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n71 | n41 | 0.3 |
| n71 | 0.6 |

Table 6.18.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n71 | n41 | 0 |
| n71 | 0.2 |

#### 6.18.1.5 REFSENS requirements

MSD values are copied from CA\_n8-n78 as it has also 4th harmonic relation.

Table 6.18.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n71 | n414,5 |  | 10.8 | 9.1 | 8.0 |  |  | 5.1 | 4.2 | 3.5 | 2.3 | 2.1 | 1.4 |
| bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.  NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 5: The requirements should be verified for UL NR‑ARFCN of a low band (superscript LB) such that in MHz and with the carrier frequency of a high band in MHz and the channel bandwidth configured in the low band. | | | | | | | | | | | | | |

Table 6.3A.4-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n71 | n41 |  | 16 | 25 | 25 |  |  | 25 | 25 | 25 | 25 | 25 | 25 |

### 6.18.2 Specific for 2 bands UL CA

#### 6.18.2.1 UE co-existence studies

Table 6.18.2.1-1 lists Band n41 + Band n71 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.18.2.1-1: Band n41 and Band n71 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2027 | 1798 | 3159 | 3388 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1364 | 1100 | 4294 | 4717 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3822 | 4086 | 5655 | 6078 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 4054 | 3596 | 6318 | 6776 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 701 | 402 | 6790 | 7407 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4485 | 4784 | 8151 | 8768 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 10097 | 9286 | 296 | 38 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 10647 | 11458 | 5148 | 5482 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 6744 | 6092 | 2898 | 3391 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 8814 | 9466 | 6981 | 7474 |

Based on Table 6.18.2.1-1 there are IMD4 issues affecting own Rx frequencies of band n71.

Table 6.18.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1.

**Table 6.18.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n41-n71 | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 30, 48, 66, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NR Band n71 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.18.2.2 REFSENS requirements

Based on the co-existence studies for CA\_n41-n71, MSD need to be defined. MSD value reused from DC\_71A\_n38A in table below and proposed to be included in TS 38.101-1.

Table 7.3A.5-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA  Configuration | NR Band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | IMD order |
| CA\_n41A-n71A | n41 | 2614 | 5 | 25 | 2614 | N/A | N/A |
| n71 | 665 | 5 | 25 | 619 | 11 | IMD4 |

## 6.19 CA\_n3-n8

### 6.19.1 Common for 1 band UL and 2 bands UL CA

#### 6.19.1.1 Operating bands for CA

**Table 6.19.1.1-1: CA band combination of band n3+n8**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n8 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |

#### 6.19.1.2 Channel bandwidths per operating band for CA

**Table 6.19.2-1: Supported bandwidths per CA band combination of band n3+n8**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n3A-n8A | CA\_n3A-n8A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

#### 6.19.1.3 Co-existence studies

Table 6.19.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n3-n8.

**Table 6.19.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 |  |  |
| n8 | 880 | 915 | 925 | 960 | 1760 | 1830 | 2640 | 2745 |  |  |

Based on above table, 2nd harmonic produce of band n8 may fall into band n3.

**Table 6.19.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 |  |  |
| n8 | 880 | 915 | 925 | 960 | 1850 | 1920 | 2775 | 2880 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n3 and n8.

#### 6.19.1.4 ∆TIB and ∆RIB values

For CA\_n3-n8, the TIB,c and RIB values are given in the tables below.

Table 6.19.1.4-1: ΔTIB,c

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n8 | n3 | 0.3 |
| n8 | 0.3 |

Table 6.19.1.4-2: ΔRIB

| NR CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n3-n8 | n3 | 0 |
| n8 | 0 |

#### 6.19.1.5 REFSENS requirements

Based on the co-existence study in Table 6.19.1.3-1, the 2nd harmonic produce of band n8 may fall into band n3. For the MSD caused by 2nd harmonic, it is quite similar with the LTE band 3 + band 8 CA combination. According to the analysis in R4-124625, the level of desense can be 17 dB in the case of 2nd harmonic interference for LTE band 3 and band 8 combination. However, the 2nd harmonic interference is much more likely that the interference does not exist at all for the particular spectrum holdings of the operator, or is avoidable by spectrum management or by network scheduling. Otherwise, When it is present, 2nd harmonic interference (~17dB MSD) severely degrades the link budget to a point that the connection may not be able to be maintained according to the analysis in R4-124625. Consequently, it is recommended not to define the test case for MSD caused by 2nd harmonic interference in the LTE Band 3 and Band 8 combination.

Thus, for NR band n3+ NR Band n8 CA band combination, same principle is recommended, which is not to define the test case for MSD caused by 2nd harmonic interference for this NR band combination, shown in table 6.19.1.5-1 to align with the format of NR spec.

**Table 6.19.1.5-1 : MSD due to harmonic issue**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n8 | n311 | N/A | N/A | N/A | N/A | N/A | N/A |  |  |  |  |  |  |
| NOTE 11: No requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the low band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of the high band. The reference sensitivity for all active downlink component carriers is only verified when this is not the case (the requirements specified in clause 7.3.2 in TS38.101-1 apply unless otherwise specified). | | | | | | | | | | | | | |

### 6.19.2 Specific for 2 bands UL CA

#### 6.19.2.1 UE co-existence studies

Table 6.19.2.1-1 lists Band n3 +Band n8 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.19.2.1-1: Band n3 and Band n8 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency** | **880** | **915** | **1710** | **1785** |
| 2nd order IMD products | |fy\_low-fx\_high| | |fy\_high-fx\_low| | |fy\_low+fx\_low| | |fy\_high+fx\_high| |
| IMD frequency limits (MHz) | 795 | 905 | 2590 | 2700 |
| Two-tone 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 0 | 120 | 2505 | 2690 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3470 | 3615 | 4300 | 4485 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 860 | 935 | 1675 | 1820 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| |  |  |
| IMD frequency limits (MHz) | 1810 | 1590 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 855 | 1035 | 4215 | 4475 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 5180 | 5400 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4350 | 4530 | 6010 | 6235 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 6260 | 5925 | 1950 | 1735 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 7720 | 8055 | 5230 | 5445 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 3595 | 3300 | 675 | 930 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 6890 | 7185 | 6060 | 6315 |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | |

Based on Table 6.19.2.1-1:

* Considering the maximum channel bandwidth supported for each bands, the 3rd order IMD may fall into Rx frequencies of both band n8 and band n3.
* 4th order IMD may fall into Rx frequencies of band n3.
* 5th order IMD may fall into Rx frequencies of both band n8 and band n3.

Table 6.19.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.19.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n3A-n8A | E-UTRA Band 1, 20, 28, 31, 32, 33, 34, 38, 39, 40, 44, 50, 51, 65, 67, 72, 73, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3, 8 | FDL\_low | - | FDL\_high | -50 | 1 | Harmonic exception |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | RB restriction and centre frequency range restriction |
| E-UTRA band 7, 22, 41, 42, 43, 52 | FDL\_low | - | FDL\_high | -50 | 1 | Harmonic exception |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | PHS |
| Frequency range | 860 | - | 890 | -40 | 1 | RB restriction and centre frequency range restriction |
| NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | Harmonic exception |

#### 6.19.2.2 REFSENS requirements

According to the co-existent analysis in table 6.19.2.1-1, although 3rd order IMD frequency range from “fx\_low – max BW fy” to “fx\_low + max BW fy” may fall into own Rx of both band n3 and band n8, MSD caused by this IM3 should not be specified due to lower PSD of NR transmission.

Table 6.19.2.2-1 lists the IMD4 and IMD5 MSD required for this CA configuration with dual uplink carrier.

Table 6.19.2.2-1: MSD due to IMD4 and IMD5 issue

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n3A-n8A | n3 | 1755 | 10 | 50 | 1850 | N/A | FDD | N/A |
| n8 | 900 | 5 | 25 | 945 | 8 | FDD | IMD44 |
| CA\_n3A-n8A | n3 | 1747.5 | 10 | 50 | 1842.5 | 6.4 | FDD | IMD5 |
| n8 | 897.5 | 5 | 25 | 942.5 | N/A | FDD | N/A |
| NOTE 1: 15 kHz SCS is assumed.  NOTE 4: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

## 6.20 CA\_n8-n79

### 6.20.1 Common for 1 band UL and 2 bands UL CA

#### 6.20.1.1 Operating bands for CA

**Table 6.20.1.1-1: CA band combination of band n8+n79**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n8-n79 | n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

#### 6.20.1.2 Channel bandwidths per operating band for CA

**Table 6.20.2-1: Supported bandwidths per CA band combination of band n8+n79**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n8A-n79A | CA\_n8A-n79A | n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |

#### 6.20.1.3 Co-existence studies

The studies for 1 band UL for the CA band combination of band n8 + n79 have been already completed in rel-15 and captured into TR 37.865-01-01. According to the study results in TR 37.865-01-01, the 5th order harmonic of Band n8 may fall into Rx frequencies of bands n79 causing de-sensing .

#### 6.20.1.4 ∆TIB and ∆RIB values

For CA\_n8-n79, the TIB,c and RIB values are already specified in TR37.865-01-01.

#### 6.20.1.5 REFSENS requirements

For single uplink operation of this combination, only harmonic issue need to be considered. The studies for 1 band UL for the CA band combination of band n8 + n79 have been already completed and the MSD values for Band n79 due to 5th harmonic of Band n8 in CA\_n8A-n79A are captured into TR 37.865-01-01.

### 6.20.2 Specific for 2 bands UL CA

#### 6.20.2.1 UE co-existence studies

Table 6.20.2.1-1 lists Band n8 +Band n79 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.20.2.1-1: Band n8 and Band n79 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency** | **880** | **915** | **4400** | **5000** |
| 2nd order IMD products | |fy\_low-fx\_high| | |fy\_high-fx\_low| | |fy\_low+fx\_low| | |fy\_high+fx\_high| |
| IMD frequency limits (MHz) | 3485 | 4120 | 5280 | 5915 |
| Two-tone 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 3240 | 2570 | 7885 | 9120 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 6160 | 6830 | 9680 | 10915 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 780 | 1015 | 4390 | 5010 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| |  |  |
| IMD frequency limits (MHz) | 8240 | 6970 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2360 | 1655 | 12285 | 14120 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 10560 | 11830 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7040 | 7745 | 14080 | 15880 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 19120 | 16685 | 740 | 1480 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 18480 | 20915 | 7920 | 8660 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 13240 | 11370 | 6055 | 7360 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 14960 | 16830 | 11440 | 12745 |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | |

Based on Table 6.20.2.1-1:

* 3rd order IMD may fall into Rx frequencies of band n79. However, since band n79 is TDD band, i.e. transmit and receive are not supported simultaneously in a single TDD band, which mean the IMD3 has no impact on the own band of n79. In addition, considering the maximum channel bandwidth supported in band n79, the 3rd order IMD may also fall into Rx frequencies of band n8.
* 5th order IMD may fall into Rx frequencies of band n8.

Table 6.20.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.20.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n8A-n79A | E-UTRA Band 1, 8, 28, 34, 39, 40, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3,41,42 | FDL\_low | - | FDL\_high | -50 | 1 | Harmonic exception |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | RB restriction and centre frequency range restriction |
| Frequency range | 860 | - | 890 | -40 | 1 | RB restriction and centre frequency range restriction |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | PHS |

#### 6.20.2.2 REFSENS requirements

According to the co-existent analysis in table 6.20.2.1-1, although 3rd order IMD frequency range from “fx\_low – max BW fy” to “fx\_low + max BW fy” may fall into own Rx of band n8, MSD caused by this IM3 should not be specified due to lower PSD of NR transmission.

Table 6.20.2.2-1 lists the IM5 MSD required for this CA configuration with dual uplink carrier.

Table 6.20.2.2-1: MSD due to IMD5 issue

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| DC  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n8A-n79A | 8 | 897.5 | 5 | 25 | 942.5 | 4.8 | FDD | IMD5 |
| n79 | 4532.5 | 40 | 216 | 4532.5 | N/A | TDD | N/A |
| NOTE 1: RBSTART = 0  NOTE 2: 15 kHz SCS is assumed. | | | | | | | | |

## 6.21 CA\_n25-n41

### 6.21.1 Common for 1 band UL and 2 bands UL CA

#### 6.21.1.1 Operating bands for CA

Table 6.21.1.1-1: CA band combination of band nX+nY

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

#### 6.21.1.2 Channel bandwidths per operating band for CA

Table 6.21.1.2-1: Supported bandwidths per CA band combination of band n25 and n41

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| n25A-n41A | n25A-n41A | n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n41 | 15 |  | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| n25(2A)-n41A | n25A-n41A | n25 | See CA\_n25(2A) in table 5.5A.2-1 of TS 38.101-1 | | | | | | | | | | | | | 0 |
| n41 | 15 |  | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| n25A-n41C | n25A-n41A | n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n41 | See CA\_n41C in table 5.5A.1-1 of TS 38.101-1 | | | | | | | | | | | | |
| n25A-n41(2A) | n25A-n41A | n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n41 | See CA\_n41(2A) BCS1 in table 5.5A.2-1 of TS 38.101-1 | | | | | | | | | | | | |

#### 6.21.1.3 UE co-existence studies

Table 6.21.1.3-1 lists up to 7th harmonics for n25A-n41A.

**Table 6.21.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n25 | 1850 | 1915 | 3700 | 3830 | 5550 | 5745 | 7400 | 7660 | 9250 | 9575 | 11100 | 11490 | 12950 | 13405 |
| n41 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 | 12480 | 13450 | 14976 | 16140 | 17472 | 18830 |

#### 6.21.1.4 ∆TIB and ∆RIB values

For CA\_n25A-n41, the TIB,c and RIB,c values are same as DC\_25\_n41 as they are defined in [2].

Table 6.21.1.4-1: ΔTIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n41 | 25 | 0.5 |
| n41 | 0.41 |
| 0.92 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2545-2690MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2545MHz. | | |

Table 6.21.1.4-2: ΔRIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n41 | 25 | 0 |
| n41 | 0 |

#### 6.21.1.5 REFSENS requirements

For these combinations, sensitivity degradation is allowed for a band if it is impacted by the UL of another band that is part of the same CA configuration due to cross band isolation issues. RAN4 studied the impact of cross band isolation between Band 25 and n41 for DC\_25A\_n41A in [2] and decided that the MSD would be 0.6 dB the B25 DL due to n41 UL, and no MSD for the n41 DL due to the B25 UL. Reference sensitivity exceptions are specified in Table 7.3A.4-3 with uplink configuration specified in Table 7.3A.4-3a.

Table 7.3A.4-3: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | NR UL band | NR DL band | Channel bandwidth of the affected DL band | | | | | | | | | | | |
| 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n25A-n41A | n41 | n25 | 0.6 | 0.6 | 0.6 | 0.6 |  |  |  |  |  |  |  |  |
| NOTE 1: The Band n41 requirements are modified by -0.5dB when carrier frequency of the assigned NR channel bandwidth is within 2515-2690 MHz. | | | | | | | | | | | | | | |

Table 7.3A.4-3a: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n41 | n25 | 15 | 160 | 160 | 160 | 160 |  |  |  |  |  |  |  |  |

### 6.21.2 Specific for 2 bands UL CA

#### 6.21.2.1 UE co-existence studies

Table 6.21.2.1-1 lists Band n25 + Band n41 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.21.2.1-1: Band n25 and Band n41 UL IMD products

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| UE UL carriers | fx\_low | fx\_high | | fy\_low | fy\_high | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 840 – 581 | | | 2496 – 4605 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 1010 – 1334 | | | 3077 – 3530 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 6196 – 6520 | | | 6842 – 7295 | | |
| Two-tone 3rd order IMD products | |fx\_low – max BW fy| | | |fx\_high + max BW fy| | |fy\_low – max BW fx| | | |fy\_high + max BW fx| |
| IMD frequency limits (MHz) | 1750 – 2015 | | | 2476 – 2710 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2860 – 3249 | | | 5573 – 6220 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 1680 – 1162 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8046 – 8435 | | | 9338 – 9985 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 8692 – 9210 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8910 – 8069 | | | 5164 – 4710 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 4370 – 3658 | | | 753 – 170 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11834 – 12675 | | | 9896 – 10350 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11188 – 11900 | | | 10542 – 11125 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

Based on Table 6.21.2.1-1, 3rd order IMD may also fall into Rx frequencies of bands 25.

Table 6.21.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.21.2.1-2: Protected bands for the 2UL bands CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n25A-n41A | E-UTRA Band 4, 5, 10, 12, 13 , 14, 17, 24, 26, 27, 28, 29, 30, 42, 48, 66, 70, 71,85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25 |  | - |  | -50 | 1 | 2 |
| NOTE 1: To simplify Table, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation.  NOTE 2: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.21.2.2 REFSENS requirements

According to the co-existent analysis in table 6.21.2.1-1, although 3rd order IMD frequency range from “fx\_low – max BW fy” to “fx\_low + max BW fy” may fall into own Rx of band n25, MSD caused by this IM3 should not be specified due to lower PSD of NR transmission. Thus, no IMD issues are expected for this CA configuration with dual uplink carrier.

## 6.22 CA\_n25-n71

### 6.22.1 Common for 1 band UL and 2 bands UL CA

#### 6.22.1.1 Operating bands for CA

Table 6.22.1.1-1: CA band combination of band n25 and n71

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |

#### 6.22.1.2 Channel bandwidths per operating band for CA

Table 6.22.1.2-1: Supported bandwidths per CA band combination of band n25 and n71

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n25A-n71A | CA\_n25A-n71A | n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

#### 6.22.1.3 UE co-existence studies

Table 6.22.1.3-1 lists up to 7th harmonics for n25A-n71A. As can be seen, 3rd harmonic from n71 UL might fall into n25 DL.

**Table 6.22.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n25 | 1850 | 1915 | 3700 | 3830 | 5550 | 5745 | 7400 | 7660 | 9250 | 9575 | 11100 | 11490 | 12950 | 13405 |
| n71 | 663 | 698 | 1326 | 1396 | 1989 | 2094 | 2652 | 2792 | 3315 | 3490 | 3978 | 4188 | 4641 | 4886 |

Table 6.22.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. As can be seen, 3rd harmonic mixing from n71 DL might affect n25 UL.

Table 6.22.1.3-2 Harmonic mixing for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n25 | 1850 | 1915 | 1930 | 1995 | 3860 | 3990 | 5790 | 5985 | 7720 | 7980 |
| n71 | 663 | 698 | 617 | 652 | 1234 | 1304 | 1851 | 1956 | 2468 | 2608 |

#### 6.22.1.4 ∆TIB and ∆RIB values

For CA\_n25A-n71, the TIB,c and RIB,c values are derived from LTE CA\_4-17 which use a trap filter.

Table 6.22.1.4-1: ΔTIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n71 | 25 | 0.3 |
| n71 | 0.6 |

Table 6.22.1.4-2: ΔRIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n71 | 25 | 0 |
| n71 | 0.3 |

#### 6.22.1.5 REFSENS requirements

Due to identified harmonic issues MSD is derived from CA\_4-17 and need to be defined in 38.101-1 as defined below.

Table 7.3A.4-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n71 | n256 | 10 | 7.5 | 6 | 5.1 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NOTE 6: These requirements apply when the lower edge frequency of the 10 MHz, 15 MHz, or 20 MHz uplink channel in Band 71 is located at or below 668 MHz and the downlink channel in Band n25 is located with its upper edge at 1995 MHz.  NOTE 7: These requirements apply when there is at least one individual RE within the downlink transmission bandwidth of the victim (lower) band for which the 3rd harmonic is within the uplink transmission bandwidth or the uplink adjacent channel’s transmission bandwidth of an aggressor (higher) band.  NOTE 8: The requirements should be verified for UL EARFCN of the aggressor (higher) band (superscript HB) such that  in MHz and  with  the carrier frequency in the victim (lower) band and  the channel bandwidth configured in the higher band. | | | | | | | | | | | | | |

Table 7.3A.4-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n71 | n25 | 83 | 83 | 83 | 83 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NOTE 3: These requirements apply when the lower edge frequency of the uplink channel in Band n71 is located at or below 668 MHz and the downlink channel in Band n25 is located with its upper edge at 1995 MHz | | | | | | | | | | | | | |

Table 7.3A.4-4: Reference sensitivity exceptions due to harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n25 | n713,4 | 26.5 | 23.3 | 20.9 | 15.3 |  |  |  |  |  |  |  |
| NOTE 3: These requirements apply when there is at least one individual RE within the downlink transmission bandwidth of the victim (lower) band for which the 3rd harmonic is within the uplink transmission bandwidth or the uplink adjacent channel's transmission bandwidth of an aggressor (higher) band.  NOTE 4: The requirements should be verified for UL NR-ARFCN of the aggressor (higher) band (superscript HB) such that  in MHz and  with  the carrier frequency in the victim (lower) band and  the channel bandwidth configured in the higher band. | | | | | | | | | | | | |

Table 7.3A.4-4a: Uplink configuration for reference sensitivity exceptions due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | |
| UL band | DL band | SCS  (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n25 | n71 | 15 | 25 | 50 | 75 | 100 |  |  |  |  |  |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies. | | | | | | | | | | | | | |

### 6.22.2 Specific for 2 bands UL CA

#### 6.22.2.1 UE co-existence studies

Table 6.22.2.1-1 lists Band n25 + Band n71 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.22.2.1-1: Band n25 and Band n71 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1252 | 1152 | 2513 | 2613 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 589 | 454 | 3002 | 3167 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3176 | 3311 | 4363 | 4528 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2504 | 2304 | 5026 | 5226 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 74 | 244 | 4852 | 5082 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 3839 | 4009 | 6213 | 6443 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 6997 | 6702 | 942 | 737 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 8063 | 8358 | 4502 | 4707 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 4419 | 4154 | 1606 | 1841 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 6876 | 7141 | 5689 | 5924 |

Based on Table 6.22.2.1-1 there are no IMD issues affecting own Rx frequencies.

Table 6.22.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1.

**Table 6.22.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n25-n71 | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 30, 48, 53, 66, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NR Band n71 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 4 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.22.2.2 REFSENS requirements

Based on the co-existence studies for CA\_n25-n71 there are no further MSD needed to be defined.

## 6.23 CA\_n39-n79

### 6.23.1 Common for 1 band UL and 2 bands UL

#### 6.23.1.1 Operating bands for CA

Table 6.23.1.1-1: CA band combination of band n39+n79

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |

#### 6.23.1.2 Channel bandwidths per operating band for CA

Table 6.23.1.2-1: Supported bandwidths per CA band combination of band n39+n79

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n39A-n79A | CA\_n39A-n79A | n39 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |

#### 6.23.1.3 UE co-existence studies

Table 6.9.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n39-n79.

**Table 6.23.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 | 7520 | 7680 |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 | 17600 | 20000 |

Based on above table, there is no harmonic issue for the band combination of Band n39 and Band n79.

**Table 6.23.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 | 7520 | 7680 |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 | 17600 | 20000 |

Based on above table, there is no harmonic mixing issue for the band combination of n39 and n79.

#### 6.23.1.4 ∆TIB and ∆RIB values

For CA\_n39-n79 , the TIB,c and RIB,c values are given in the tables below.

Table 6.23.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n39-n79 | n39 | 0.3 |
| n79 | 0.8 |

Table 6.23.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n39-n79 | n39 | 0 |
| n79 | 0.5 |

#### 6.23.1.5 REFSENS requirements

There is no MSD issue due to harmonic interference for this band combination.

### 6.23.2 Specific for 2 bands UL CA

#### 6.23.2.1 UE co-existence studies

Table 6.23.2.1-1 gives IMD interference analysis for CA\_ n39-n79` with 2 ULs.

**Table 6.23.2.1-1: Band n39 and Band n79 IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1880 | 1920 | 4400 | 5000 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2480-3120 | | 6280-6920 | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1240-560 | | 6880-8120 | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 8160-8840 | | 10680-11920 | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1780-2020 | | 4380-5020 | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 640-1360 | | 11280-13120 | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 6240-4960 | |  | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 10040-10760 | | 15080-16920 | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 12560-13840 | |  | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 18120-15680 | | 3280-2520 | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 11240-9360 | | 3040-4360 | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 19480-21920 | | 11920-12680 | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 16960-18840 | | 14440-15760 | |

Based on Table 6.23.2.1-1, the 3rd 4th order IMD product may fall into Band 39. However it should be noted that IMD will not be an issue for TDD bands combination (no self-interference for the TDD band) even through the IMD products may fall into the concerning band.

Table 6.23.2.1-2 lists the protected bands required for this CA configuration.

Table 6.23.2.1-2: Protected bands for CA\_n39A-n79A

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA combination** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n39A-n79A | E-UTRA Band 1, 8, 34, 40, 41, 44, 45 or NR Band n1, n8, n34, n40, n41, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1805 | - | 1855 | -40 | 1 | X |
| Frequency range | 1855 | - | 1880 | -15.5 | 5 | X |
| NOTE X: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz. | | | | | | | |

#### 6.23.2.2 REFSENS requirements

There is no MSD issue due to IMD interference for this band combination.

## 6.24 CA\_n40-n78

### 6.24.1 Common for 1 band UL and 2 bands UL CA

#### 6.24.1.1 Operating bands for CA

Table 6.24.1.1-1: CA band combination of band n40 and n78

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz |

#### 6.24.1.2 Channel bandwidths per operating band for CA

Table 6.24.1.2-1: Supported bandwidths per CA band combination of band n40 and n78

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| n40A-n78A | n40A-n78A | n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n40A-n78(2A) | n40A-n78A | n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1 | | | | | | | | | | | | |

#### 6.24.1.3 UE co-existence studies

Table 6.24.1.3-1 lists up to 7th harmonics for n40A-n78A.

**Table 6.24.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n40 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 | 9200 | 9600 | 11500 | 12000 | 13800 | 14400 | 16100 | 16800 |
| n78 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 | 16500 | 19000 | 19800 | 22800 | 23100 | 26600 |

Table 6.24.1.3-2 and Table 6.24.1.3-3 list harmonic mixing issue for the 2DL bands CA with 1 UL.

able 6.24.1.3-2: Harmonic Interference for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 | 9200 | 9600 |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 |

Table 6.24.1.3-3 Harmonic mixing for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 | 9200 | 9600 |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 |

It can be seen that the frequency range of the 3rd harmonic of n40 UL/DL overlaps with that of the 2nd harmonic of n78 DL/UL. Hence there will be Rx desensing caused by receiver harmonic mixing for asynchronous operations.

#### 6.24.1.4 ∆TIB and ∆RIB values

For CA\_n40A-n78A or CA\_n40A-n78(2A), the TIB,c and RIB,c values are derived from LTE combinations CA\_40-42 and CA\_40-43 and are given in the tables below.

Table 6.24.1.4-1: ΔTIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| n40-n78 | n40 | 0 |
| n78 | 0.5 |
|  | | |

Table 6.24.1.4-2: ΔRIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| n40-n78 | n40 | 0.41 |
| n78 | 0.51 |
|  | | |

#### 6.24.1.5 REFSENS requirements

According to the co-existence study in Section 6.24.1.3, the DL performance may be affected by the receiver harmonic mixing during asynchronous operations. More explicitly, the 2nd harmonic of n78 UL may mix with the 3rd harmonic of n40 DL and cause degradation to n40 DL. Similarly, the 3rd harmonic of n40 UL may mix with the 2nd harmonic of n78 DL and cause degradation to n78 DL. The following MSD values are proposed to add to Table 7.3A.4-4 and Table 7.3A.4-5 in TS 38.101-1. The values are reused from CA\_n41-n78.

Table 7.3A.4-4: Reference sensitivity exceptions due to harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n40 | n781 |  | 8.3 | 8.0 | 6.9 |  | 3.9 | 3 | 2.3 | 1.2 |  | 0.4 |
| n78 | n402 | 10.4 | 10.4 | 10.4 | 10.4 |  | 7.2 | 6.2 | 5.5 | 4.5 |  |  |
| NOTE 1: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (high) band (superscript HB) such that in MHz and  with carrier frequency in the victim (lower) band in MHz and  the channel bandwidth configured in the higher band.  NOTE 3: These requirements apply when there is at least one individual RE within the downlink transmission bandwidth of the victim (lower) band for which the 3rd harmonic is within the uplink transmission bandwidth or the uplink adjacent channel's transmission bandwidth of an aggressor (higher) band.  NOTE 4: The requirements should be verified for UL NR-ARFCN of the aggressor (higher) band (superscript HB) such that  in MHz and  with  the carrier frequency in the victim (lower) band and  the channel bandwidth configured in the higher band. | | | | | | | | | | | | |

Table 7.3A.4-4a: Uplink configuration for reference sensitivity exceptions due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | |
| UL band | DL band | SCS  (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n40 | n78 | 30 |  | 24 | 24 | 24 |  | 24 | 24 | 24 | 24 |  | 24 |
| n78 | n40 | 30 | 50 | 50 | 50 | 50 |  | 50 | 50 | 50 | 50 |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies. | | | | | | | | | | | | | |

For asynchronous operations, the following MSD due to lack of cross band isolation is proposed to add to Table 7.3A.6-1 and Table 7.3A.6-2 in TS 38.101-1. The values are reused from CA\_n41-n78.

Table 7.3A.6-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| NR CA Configuration | UL band | DL band | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n40A-n78A  CA\_n40A-n78(2A) | n78 | n401 | 4.5 | 4.5 | 4.5 | 4.5 |  |  | 4.5 | 4.5 | 4.5 | 4.5 |  |  |
| NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.  NOTE 2: Void | | | | | | | | | | | | | | |

Table 7.3A.6-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n78 | n40 | 30 | 270 | 270 | 270 | 270 |  |  | 270 | 270 | 270 | 270 |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies.  NOTE 2: Refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1. | | | | | | | | | | | | | | |

### 6.24.2 Specific for 2 bands UL CA

#### 6.24.2.1 UE co-existence studies

Table 6.24.2.1-1 lists Band n40 +Band n78 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.24.2.1-1: Band n40 and Band n78 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 2300 | 2400 | 3300 | 3800 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 4600 | 4800 | 6600 | 7600 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 6900 | 7200 | 9900 | 11400 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 9200 | 9600 | 13200 | 15200 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 11500 | 12000 | 16500 | 19000 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 900 | 1500 | 5600 | 6200 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 800 | 1500 | 4200 | 5300 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 7900 | 8600 | 8900 | 10000 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3100 | 3900 | 7500 | 9100 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 10200 | 11000 | 12200 | 13800 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 3000 | 1800 | 11200 | 12400 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 12900 | 10800 | 6300 | 5400 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 6800 | 5100 | 600 | 700 |

Since both bands are TDD, there is no MSD issue due to IMD for this band combination.

Table 6.24.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.24.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n40-n78 | 1. UTRA Band 1, 3, 5, 7, 8, 20, 22, 26, 27, 28, 31, 32, 33, 34, 38, 39, 41, 42, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

#### 6.24.2.2 REFSENS requirements

There is no need for additional REFSENS requirements.

## 6.25 CA\_n40-n79

### 6.25.1 Common for 1 band UL and 2 bands UL

#### 6.25.1.1 Operating bands for CA

Table 6.25.1.1-1: CA band combination of band n40+n79

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |
| n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |
| Note 1: Applicable for frequency range above 4800 MHz for Band n79 in this combination. | | | | | | | |

#### 6.25.1.2 Channel bandwidths per operating band for CA

Table 6.25.1.2-1: Supported bandwidths per CA band combination of band n40+n79

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n40A-n79A | CA\_n40A-n79A | n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 1 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n79 | 15 |  |  |  |  |  |  | Yes | Yes |  |  |  |  |
| 30 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |
| 60 |  |  |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |

#### 6.25.1.3 UE co-existence studies

Table 6.25.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n40-n79.

**Table 6.25.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 |  |  |

Based on above table, there is 2nd harmonic issue for the band combination of n40 and n79.

**Table 6.25.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |
| n79 | 4400 | 5000 | 4400 | 5000 | 8800 | 10000 | 13200 | 15000 |  |  |

Based on above table, there may be 2nd harmonic mixing issue for the band combination of n40 and n79. However, there may be no MSD issue due to even order harmonic mixing according to the agreed WF R4-1709139 .

#### 6.25.1.4 ∆TIB and ∆RIB values

For CA\_n40-n79, the TIB,c and RIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

Table 6.25.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n40-n79 | n40 | 0.3 |
| n79 | 0.8 |

Table 6.25.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n40-n79 | n40 | 0 |
| n79 | 0.5 |

#### 6.25.1.5 REFSENS requirements

Regarding to the MSD due to 2nd harmonic of band 40 falling into n79, since this band combination will only be used in China where the frequency range above 4800 MHz for band n79 is allocated to IMT in China. So the 2nd harmonic issue will not be a problem for this combination.

### 6.25.2 Specific for 2 bands UL CA

#### 6.25.2.1 UE co-existence studies

Table 6.25.2.1-1 lists Band n40 +Band n79 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.25.2.1-1: Band n40 and Band n79 2UL bands IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 2300 | 2400 | | 4400 | 5000 | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 2000 - 2700 | | | 6700 - 7400 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 0 – 400 | | | 6400 – 7700 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 9000 – 9800 | | | 11100 – 12400 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 2200 – 2500 | | | 4320 – 5080 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1900 – 2800 | | | 10800 – 12700 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 4000 – 5400 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 11300 – 12200 | | | 15500 – 17400 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 13400 – 14800 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 15200 – 17700 | | | 4200 – 5200 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 8400 – 10400 | | | 1600 – 3100 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 19900 – 22400 | | | 13600 – 14600 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 17800 – 19800 | | | 15700 – 17200 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

As IMD is not an issue for TDD bands combination, there is no MSD issue for this band combination.

Table 6.25.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.25.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n40-n79 | E-UTRA Band 1, 3, 5, 8, 28, 34, 39, 41, 42, 65, | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, x |
| NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.  NOTE x: This requirement applies when the NR carriers are confined within 2545-2575 MHz or 2595-2645 MHz and the channel bandwidth is 10 or 20 MHz | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

#### 6.25.2.2 REFSENS requirements

As IMD is not an issue for TDD bands combination, there is no MSD issue due to IMD for this combination.

## 6.26 CA\_n8-n39

### 6.26.1 Common for 1 band UL and 2 bands UL

#### 6.26.1.1 Operating bands for CA

Table 6.26.1.1-1: CA band combination of band n8+n39

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| n39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
|  | | | | | | | |

#### 6.26.1.2 Channel bandwidths per operating band for CA

Table 6.26.1.2-1: Supported bandwidths per CA band combination of band n8+n39

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n8A-n39A | CA\_n8A-n39A | n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n39 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |

#### 6.26.1.3 UE co-existence studies

Table 6.26.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n8-n39.

**Table 6.26.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n8 | 880 | 915 | 925 | 960 | 1760 | 1830 | 2640 | 2745 |  |  |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 |  |  |

Based on above table, there is no harmonic issue for the band combination of n8 and n39.

**Table 6.26.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n8 | 880 | 915 | 925 | 960 | 1850 | 1920 | 2775 | 2880 |  |  |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 |  |  |

Based on above table, there may be no harmonic mixing issue for the band combination of n8 and n39.

#### 6.26.1.4 ∆TIB and ∆RIB values

For CA\_n8-n39, the TIB,c and RIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

Table 6.26.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n8-n39 | n8 | 0.3 |
| n39 | 0.3 |

Table 6.26.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n8-n39 | n8 | 0 |
| n39 | 0 |

#### 6.26.1.5 REFSENS requirements

There are no specific REFSENS requirements

### 6.26.2 Specific for 2 bands UL CA

#### 6.26.2.1 UE co-existence studies

Table 6.26.2.1-1 lists Band n8 +Band n39 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.26.2.1-1: Band n8 and Band n39 2UL bands IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 880 | 915 | | 1880 | 1920 | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 965 - 1040 | | | 2760 - 2835 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 0 – 160 | | | 2845 – 2960 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 3640 – 3750 | | | 4640 – 4755 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 720– 865 | | | 4725 – 4880 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 1930 – 2080 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4520 – 4665 | | | 6520 – 6675 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 5520 – 5670 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 6605 – 6800 | | | 1600 – 1780 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 3810 – 4000 | | | 1015 – 1200 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 8400 – 8595 | | | 5400 – 5580 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 7400 – 7590 | | | 6400 – 6585 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

Based on the above table, there is no MSD issue due to 2UL operation for this band combination.

Table 6.26.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.26.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n8-n39 | E-UTRA Band 1, 34, 40, 50, 51, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| 1. UTRA Band 22, 41, 42   NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 8 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

#### 6.26.2.2 REFSENS requirements

There is no MSD issue due to IMD for this combination.

## 6.27 CA\_n28-n77

### 6.27.1 Common for 1 band UL and 2 bands UL CA

#### 6.27.1.1 Operating bands for CA

**Table 6.27.1.1-1: CA band combination of band n28+n77**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n28-n77 | n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

#### 6.27.1.2 Channel bandwidths per operating band for CA

**Table 6.27.1.2-1: Supported bandwidths per CA band combination of band n28+n77**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n28A-n77A | CA\_n28A-n77A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n28A-n77(2A) | CA\_n28A-n77A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | See CA\_n77(2A) in Table 5.5A.2-1 in TS 38.101-1 | | | | | | | | | | | | |

6.27.1.3 Co-existence studies

Table 6.27.1.3-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n28-n77.

**Table 6.27.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n28 | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 | 2812 | 2992 | 3515 | 3740 |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 13200 | 16800 | 16500 | 21000 |

Based on the above table, there is 5th harmonic issue for the band combination of n28 and n77.

#### 6.27.1.4 ∆TIB and ∆RIB values

For CA\_n28-n77, the TIB,c and RIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

Table 6.27.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n28-n77 | n28 | 0.5 |
| n77 | 0.8 |

Table 6.27.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n28-n77 | n28 | 0.2 |
| n77 | 0.5 |

#### 6.27.1.5 REFSENS requirements

Due to identified harmonic issues, MSD for CA\_n28-n77 is derived and need to be defined in 38.101-1 as below.

Table 6.27.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n28 | n771, 2 |  | 10.4 | 8.9 | 7.8 |  |  | 4.7 | 3.7 | 3 | 1.7 | 1.2 | 0.7 |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 5th transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 2: The requirements should be verified for UL NR‑ARFCN of a low band (superscript LB) such that in MHz and with the carrier frequency of a high band in MHz and the channel bandwidth configured in the low band. | | | | | | | | | | | | | |

Table 6.27.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n28 | n77 |  | 10 | 15 | 20 |  |  | 25 | 25 | 25 | 25 | 25 | 25 |

### 6.27.2 Specific for 2 bands UL CA

#### 6.27.2.1 UE co-existence studies

Table 6.27.2.1-1 lists Band n28 + Band n77 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.28.2.1-1: Band n28 and Band n77 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 703 | 748 | 3300 | 4200 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2552 | 3497 | 4003 | 4948 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 2794 | 1804 | 5852 | 7697 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4706 | 5696 | 7303 | 9148 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2091 | 1056 | 9152 | 11897 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 5104 | 6994 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 5409 | 6444 | 10603 | 13348 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 8006 | 9896 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 16097 | 12452 | 308 | 1388 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 11194 | 8404 | 4356 | 6291 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 13903 | 17548 | 6112 | 7192 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11306 | 14096 | 8709 | 10644 |

Based on Table 6.27.2.1-1, the 5th IMD falls down own Rx frequencies of band n28.

Table 6.27.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.27.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_28\_n77 | E-UTRA Band 3, 5, 7, 8, 18, 19, 20, 26, 34, 39, 40, 41 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 1 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 758 | - | 773 | -32 | 1 |  |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 1 |
| NOTE 1: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz  NOTE 2: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz. | | | | | | | |

#### 6.27.2.2 REFSENS requirements

Table 6.27.2.2-1 lists the MSD required due to 5th IMD for the dual uplink configuration.

**Table 6.27.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_28\_n77 | n28 | 705.5 | 5 | 25 | 760.5 | 5.5 | FDD | IMD5 |
| n77 | 3582.5 | 10 | 50 | 3582.5 | N/A | TDD | N/A |
|  | | | | | | | | |

## 6.28 CA\_n1-n28

### 6.28.1 Common for 1 band UL and 2 bands UL CA

#### 6.28.1.1 Operating bands for CA

Table 6.28.1.1-1: CA band combination of band n1 and n28

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | TDD |
| n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz |

#### 6.28.1.2 Channel bandwidths per operating band for CA

Table 6.28.1.2-1: Supported bandwidths per CA band combination of band n1 and n28

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n1A-n28A | CA\_n1A-n28A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

#### 6.28.1.3 UE co-existence studies

Table 6.28.1.3-1 lists up to 7th harmonics for n1A-n28A.

**Table 6.28.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n1 | 1920 | 1980 | 3840 | 3960 | 5760 | 5940 | 7680 | 7920 | 9600 | 9900 | 11520 | 11880 | 13440 | 13860 |
| n28 | 703 | 748 | 1406 | 1496 | 2109 | 2244 | 2812 | 2992 | 3515 | 3740 | 4218 | 4488 | 4921 | 5236 |

#### 6.28.1.4 ∆TIB and ∆RIB values

For CA\_n1-n28, the TIB,c and RIB,c values are derived from LTE combination CA\_1-28 and are given in the tables below.

**Table 6.28.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| n1-n28 | n1 | 0.3 |
| n28 | 0.6 |

**Table 6.28.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| n1-n28 | n1 | 0 |
| n28 | 0.2 |

#### 6.28.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.28.1.3 the 3rd harmonics of n28 UL might affect n1 DL. MSD is defined as below.

Table 7.3A.4-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n28 | n16,7,8 | 10.2 | 7.6 | 6.2 | 5.3 |  |  |  |  |  |  |  |  |
| NOTE 6: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 3rd transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 7: The requirements should be verified for UL EARFCN of a low band (superscript LB) such that in MHz and  with the carrier frequency of a high band in MHz and the channel bandwidth configured in the low band.  NOTE 8: Applicable for the operations with 2 or 4 antenna ports supported in the band with carrier aggregation configured. | | | | | | | | | | | | | |

Table 7.3A.4-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n28 | n1 | 8 | 16 | 25 | 25 |  |  |  |  |  |  |  |  |

### 6.28.2 Specific for 2 bands UL CA

#### 6.28.2.1 UE co-existence studies

Table 6.28.2.1-1 lists Band n1 + Band n28 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.28.2.1-1: Band n1 and Band n28 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 703 | 748 | 1920 | 1980 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 1406 | 1496 | 3840 | 3960 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 2109 | 2244 | 5760 | 5940 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 2812 | 2992 | 7680 | 7920 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 3515 | 3740 | 9600 | 9900 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 4218 | 4488 | 11520 | 11880 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 4921 | 5236 | 13440 | 13860 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1277 | 1172 | 2623 | 2728 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 574 | 424 | 3092 | 3257 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3326 | 3476 | 4543 | 4708 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2554 | 2344 | 5246 | 5456 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 129 | 324 | 5012 | 5237 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4029 | 4224 | 6463 | 6688 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 7217 | 6932 | 1072 | 832 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 8383 | 8668 | 4732 | 4972 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 4534 | 4264 | 1596 | 1851 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 7166 | 7436 | 5949 | 6204 |

Based on Table 6.28.2.1-1 there are no harmonic or IMD issues affecting own Rx frequencies of either band n1 or n28.

Table 6.28.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.28.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n1-n28 | E-UTRA Band 18, 19, 27, 31, 32, 72  NR band n5, n7, n8, n20, n26, n38, n40, n41, n50, n51, n74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band42, 43  NR band n78, n75, n76 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NR band n3, n34 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 12, 14 |
| E-UTRA Band 65  NR band n1 | FDL\_low | - | FDL\_high | -50 | 1 | 12, 13 |
| Frequency range | 470 | - | 694 | -42 | 8 | 4, 18 |
| Frequency range | 470 | - | 710 | -26.2 | 6 | 14 |
| Frequency range | 758 | - | 773 | -32 | 1 | 4 |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 662 | - | 694 | -26.2 | 6 | 4 |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 4, 17 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 4, 7, 17 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 4, 7, 17 |
| Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | 4 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 12, 16 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 and Table 6.5A.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 11: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 12: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 13: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 2nd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 2nd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 14: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 15: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart<48.  NOTE 16: Applicable when NS\_05 in section 6.6.3.3.1 is signalled by the network.  NOTE 17: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 18: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies. | | | | | | | |

#### 6.28.2.2 REFSENS requirements

According to the co-existence analysis in 6.28.2.1 there is no need for additional REFSENS requirements for the 2DL/2UL configuration of CA\_n1A-n28A.

## 6.29 CA\_n3-n28

### 6.29.1 Common for 1 band UL and 2 bands UL CA

#### 6.29.1.1 Operating bands for CA

Table 6.29.1.1-1: CA band combination of band n3 and n28

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | TDD |
| n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz |

#### 6.29.1.2 Channel bandwidths per operating band for CA

Table 6.29.1.2-1: Supported bandwidths per CA band combination of band n3 and n28

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n3A-n28A | CA\_n3A-n28A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

#### 6.29.1.3 UE co-existence studies

Table 6.29.1.3-1 lists up to 7th harmonics for n3A-n28A.

**Table 6.29.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n3 | 1710 | 1785 | 3420 | 3570 | 5130 | 5355 | 6840 | 7140 | 8550 | 8925 | 10260 | 10710 | 11970 | 12495 |
| n28 | 703 | 748 | 1406 | 1496 | 2109 | 2244 | 2812 | 2992 | 3515 | 3740 | 4218 | 4488 | 4921 | 5236 |

#### 6.29.1.4 ∆TIB and ∆RIB values

For CA\_n3-n28, the TIB,c and RIB,c values are derived from LTE combination CA\_3-28 and are given in the tables below.

**Table 6.29.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| n3-n28 | n3 | 0.3 |
| n28 | 0.3 |

**Table 6.29.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| n3-n28 | n3 | 0 |
| n28 | 0 |

#### 6.29.1.5 REFSENS requirements

According to the co-existence analysis in 6.29.1.3 there is no need for additional REFSENS requirements for the 2DL/1UL configuration of CA\_n3A-n28A.

### 6.29.2 Specific for 2 bands UL CA

#### 6.29.2.1 UE co-existence studies

Table 6.29.2.1-1 lists Band n3 + Band n28 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.29.2.1-1: Band n3 and Band n28 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 703 | 748 | 1710 | 1785 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 1406 | 1496 | 3420 | 3570 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 2109 | 2244 | 5130 | 5355 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 2812 | 2992 | 6840 | 7140 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 3515 | 3740 | 8550 | 8925 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 4218 | 4488 | 10260 | 10710 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 4921 | 5236 | 11970 | 12495 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1082 | 962 | 2413 | 2533 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 379 | 214 | 2672 | 2867 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3116 | 3281 | 4123 | 4318 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2164 | 1924 | 4826 | 5066 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 324 | 534 | 4382 | 4652 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 3819 | 4029 | 5833 | 6103 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 6437 | 6092 | 1282 | 1027 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 7543 | 7888 | 4522 | 4777 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 3949 | 3634 | 1176 | 1461 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 6536 | 6851 | 5529 | 5814 |

Based on Table 6.29.2.1-1 there are no harmonic or IMD issues affecting own Rx frequencies of either band n3 or n28.

Table 6.29.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.29.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n3-n28 | E-UTRA Band 18, 19, 27, 31, 32, 72  NR band n5, n7, n8, n20, n26, n38, n40, n41, n50, n51, n74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band42, 43  NR band n78, n75, n76 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NR band n3, n34 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 12, 14 |
| E-UTRA Band 65  NR band n1 | FDL\_low | - | FDL\_high | -50 | 1 | 12, 13 |
| Frequency range | 470 | - | 694 | -42 | 8 | 4, 18 |
| Frequency range | 470 | - | 710 | -26.2 | 6 | 15 |
| Frequency range | 758 | - | 773 | -32 | 1 | 4 |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 662 | - | 694 | -26.2 | 6 | 4 |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 5,17 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 5, 7, 17 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 5, 7, 17 |
| Frequency range | 1839.9 | - | 1879.9 | -50 | 1 | 5 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 12, 16 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 and Table 6.5A.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 11: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 12: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 13: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 2nd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 2nd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 14: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 15: This requirement is applicable for 5 and 10 MHz E-UTRA channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and RBstart<48.  NOTE 16: Applicable when NS\_05 in section 6.6.3.3.1 is signalled by the network.  NOTE 17: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 18: This requirement is applicable in the case of a 10 MHz E-UTRA carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies. | | | | | | | |

#### 6.29.2.2 REFSENS requirements

According to the co-existence analysis in 6.29.2.1 there is no need for additional REFSENS requirements for the 2DL/2UL configuration of CA\_n3A-n28A.

## 6.30 CA\_n7-n28

### 6.30.1 Common for 1 band UL and 2 bands UL CA

#### 6.30.1.1 Operating bands for CA

Table 6.30.1.1-1: CA band combination of band n7 and n28

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | TDD |
| n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz |

#### 6.30.1.2 Channel bandwidths per operating band for CA

Table 6.30.1.2-1: Supported bandwidths per CA band combination of band n7 and n28

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n7A-n28A | CA\_n7A-n28A | n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

#### 6.30.1.3 UE co-existence studies

Table 6.30.1.3-1 lists up to 7th harmonics for n7A-n28A.

**Table 6.30.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n7 | 2500 | 2570 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 | 12500 | 12850 | 15000 | 15420 | 17500 | 17990 |
| n28 | 703 | 748 | 1406 | 1496 | 2109 | 2244 | 2812 | 2992 | 3515 | 3740 | 4218 | 4488 | 4921 | 5236 |

#### 6.30.1.4 ∆TIB and ∆RIB values

For CA\_n7-n28, the TIB,c and RIB,c values are derived from LTE combination CA\_7-28 and are given in the tables below.

**Table 6.30.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| n7-n28 | n7 | 0.3 |
| n28 | 0.3 |

**Table 6.30.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| n7-n28 | n7 | 0 |
| n28 | 0 |

#### 6.30.1.5 REFSENS requirements

According to the co-existence analysis in 6.30.1.3 there is no need for additional REFSENS requirements for the 2DL/1UL configuration of CA\_n7A-n28A.

### 6.30.2 Specific for 2 bands UL CA

#### 6.30.2.1 UE co-existence studies

Table 6.30.2.1-1 lists Band n7 + Band n28 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.30.2.1-1: Band n7 and Band n28 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 703 | 748 | 2500 | 2570 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 1406 | 1496 | 5000 | 5140 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 2109 | 2244 | 7500 | 7710 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 2812 | 2992 | 10000 | 10280 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 3515 | 3740 | 12500 | 12850 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 4218 | 4488 | 15000 | 15420 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 4921 | 5236 | 17500 | 17990 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1867 | 1752 | 3203 | 3318 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1164 | 1004 | 4252 | 4437 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3906 | 4066 | 5703 | 5888 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 3734 | 3504 | 6406 | 6636 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 461 | 256 | 6752 | 7007 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4609 | 4814 | 8203 | 8458 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 9577 | 9252 | 492 | 242 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 10703 | 11028 | 5312 | 5562 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 6304 | 6004 | 2756 | 3031 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 8906 | 9206 | 7109 | 7384 |

Based on Table 6.30.2.1-1 there are no harmonic or IMD issues affecting own Rx frequencies of either band n7 or n28.

Table 6.30.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.30.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n7-n28 | E-UTRA Band 27, 31, 72  NR band n2, n3, n5, n7, n8, n20, n26, n34, n40 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 4, 10, 42, 43, 65  NR band n1, n50, n51, n66, n74, n75, n76, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NR band n1 | FDL\_low | - | FDL\_high | -50 | 1 | 12, 13 |
| Frequency range | 758 | - | 773 | -32 | 1 | 4 |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 4, 11, 7 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 11, 7 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 11 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 and Table 6.5A.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 11: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 12: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 13: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 2nd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 2nd harmonic totally or partially overlaps the measurement bandwidth (MBW). | | | | | | | |

#### 6.30.2.2 REFSENS requirements

According to the co-existence analysis in 6.30.2.1 there is no need for additional REFSENS requirements for the 2DL/2UL configuration of CA\_n7A-n28A.

## 6.31 CA\_n20-n28

### 6.31.1 Common for 1 band UL and 2 bands UL CA

#### 6.31.1.1 Operating bands for CA

Table 6.31.1.1-1: CA band combination of band n20 and n28

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | TDD |
| n281 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz |
| NOTE 1: The frequency range in band n28 is restricted for this CA band combination to 703-733 MHz for the UL and 758-788 MHz for the DL | | | | | | | |

#### 6.31.1.2 Channel bandwidths per operating band for CA

Table 6.31.1.2-1: Supported bandwidths per CA band combination of band n20 and n28

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n20A-n28A1 | CA\_n20A-n28A | n20 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| NOTE 1: The frequency range in band n28 is restricted for this CA band combination to 703-733 MHz for the UL and 758-788 MHz for the DL | | | | | | | | | | | | | | | | |

#### 6.31.1.3 UE co-existence studies

Table 6.31.1.3-1 lists up to 7th harmonics for n20A-n28A.

**Table 6.31.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n20 | 832 | 862 | 1664 | 1724 | 2496 | 2586 | 3328 | 3448 | 4160 | 4310 | 4992 | 5172 | 5824 | 6034 |
| n28 | 703 | 733 | 1406 | 1466 | 2109 | 2199 | 2812 | 2932 | 3515 | 3665 | 4218 | 4398 | 4921 | 5131 |

#### 6.31.1.4 ∆TIB and ∆RIB values

For CA\_n20-n28, the TIB,c and RIB,c values are derived from LTE combination CA\_20-28 and are given in the tables below.

**Table 6.31.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| n20-n28 | n20 | 0.5 |
| n28 | 0.5 |

**Table 6.31.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| n20-n28 | n20 | 0 |
| n28 | 0 |

#### 6.31.1.5 REFSENS requirements

According to the co-existence analysis in 6.31.1.3 there is no need for additional REFSENS requirements for the 2DL/1UL configuration of CA\_n20A-n28A.

### 6.31.2 Specific for 2 bands UL CA

#### 6.31.2.1 UE co-existence studies

Table 6.31.2.1-1 lists Band n20 + Band n28 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

In below analysis the frequency range in band n28 is restricted to 703-733 MHz for the UL and 758-788 MHz for the DL

**Table 6.31.2.1-1: Band n20 and Band n28 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 703 | 733 | 832 | 862 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 1406 | 1466 | 1664 | 1724 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 2109 | 2199 | 2496 | 2586 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 2812 | 2932 | 3328 | 3448 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 3515 | 3665 | 4160 | 4310 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 4218 | 4398 | 4992 | 5172 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 4921 | 5131 | 5824 | 6034 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 159 | 99 | 1535 | 1595 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 544 | 634 | 931 | 1021 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2238 | 2328 | 2367 | 2457 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 318 | 198 | 3070 | 3190 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1247 | 1367 | 1763 | 1883 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 2941 | 3061 | 3199 | 3319 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 2745 | 2595 | 2100 | 1950 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 4031 | 4181 | 3644 | 3794 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 1180 | 1030 | 535 | 385 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 3902 | 4052 | 3773 | 3923 |

Based on Table 6.31.2.1-1 there are no harmonic or IMD issues affecting own Rx frequencies of either band n20 or n28.

Table 6.31.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.31.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n20-n28 | E-UTRA Band 1, 3, 7, 22, 28, 31, 32, 34, 38, 42, 43, 65, 75, 76, n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |

#### 6.31.2.2 REFSENS requirements

According to the co-existence analysis in 6.31.2.1 there is no need for additional REFSENS requirements for the 2DL/2UL configuration of CA\_n20A-n28A.

6.32 CA\_n48-n66, CA\_n48-n48-n66

### 6.32.1 Common for 1 band UL and 2 bands UL CA

6.32.1.1 Operating bands for CA

**Table 6.32.1.1-1: CA band combination of band n48+n66**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n48-n66  CA\_n48-n48-n66 | n48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

6.32.1.2 Channel bandwidths per operating band for CA

**Table 6.32.1.2-1: Supported bandwidths per CA band combination of band n48+n66**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **NR Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n48A-n66A | CA\_n48A-n66A | n48 | 15 | Yes | Yes | Yes | Yes |  |  | Yes | Yes1 |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes1 | Yes1 | Yes1 | Yes1 | Yes1 |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes1 | Yes1 | Yes1 | Yes1 | Yes1 |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| CA\_n48C-n66A | CA\_n48A-n66A | n48 | See CA\_n48C Bandwidth Combination in Table 5.5A.1-1 of 38.101-1 | | | | | | | | | | | | | 0 |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| CA\_n48(2A)-n66A | CA\_n48A-n66A | n48 | See CA\_n48(2A)Bandwidth Combination in Table 5.5A.2-1 of 38.101-1 | | | | | | | | | | | | | 0 |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| Note 1: This UE channel bandwidth is applicable only to DL | | | | | | | | | | | | | | | | |

6.32.1.3 Co-existence studies

Table 6.32.1.3-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n48-n66.

**Table 6.32.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n48 | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 | 17750 | 18500 |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 | 8550 | 8900 |

Based on Table 6.32.1.3-1, it can be seen that the 2nd harmonic interference for band n66 UL will impact the receive frequency of n48.

6.32.1.4 ∆TIB and ∆RIB values

For CA\_n48-n66, the TIB,c and RIB,c values for UEs are given in the tables below.

Table 6.32.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n48-n66  CA\_n48-n48-n66 | n48 | 0.8 |
| n66 | 0.6 |

Table 6.32.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n48-n66  CA\_n48-n48-n66 | n48 | 0.5 |
| n66 | 0.2 |

6.32.1.5 REFSEN requirements

Due to identified harmonic issues, MSD for CA\_n48-n66 is derived and need to be defined in 38.101-1 as below.

Table 6.32.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n66 | n481, 2 | 27.1 | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.94 | 16.14 | 14.84 | 14.34 | 13.84 |
| n483 | 1.9 | 1.1 | 0.8 | 0.3 |  |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ∆FHD above and below the edge of this downlink transmission bandwidth. The value ∆FHD depends on the band combination: ∆FHD = 10 MHz for CA\_n48-n66.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.  NOTE 4: For these bandwidths, the minimum requirements are restricted to operation when carrier is configured as a downlink carrier part of CA configuration | | | | | | | | | | | | | |

Table 6.32.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n66 | n48 | 12 | 25 | 36 | 50 |  |  | 100 | 128 | 160 | 200 | 200 | 200 |

### 6.32.2 Specific for 2 bands UL CA

#### 6.32.2.1 UE co-existence studies

Table 6.32.2.1-1 lists Band n48 + Band n66 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.32.2.1-1: Band n48 and Band n66 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE UL carriers | fx\_low | fx\_high | fy\_low | fy\_high |
| UL frequency (MHz) | 1710 | 1780 | 3550 | 3700 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1990 | 1770 | 5260 | 5480 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 280 | 10 | 5320 | 5690 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 6970 | 7260 | 8810 | 9180 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 3980 | 3540 | 10520 | 10960 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1430 | 1790 | 8870 | 9390 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8680 | 9040 | 12360 | 12880 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 13090 | 12420 | 3570 | 3140 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 15910 | 16580 | 10390 | 10820 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 7680 | 7090 | 1760 | 2270 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 14070 | 14660 | 12230 | 12740 |

Based on Table 6.32.2.1-1, the 5th order IMD may also fall into Rx frequencies of band n66 and no IMD falls into its band n48 Rx frequencies since band n48 is TDD band.

Table 6.32.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.32.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n48-n66 | E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 24, 25, 26, 27, 29, 30, 41, 50, 51, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |

#### 6.32.2.2 REFSENS requirements

Table 6.32.2.2-1 lists the MSD required due to 5th IMD for the dual uplink configuration.

Table 6.32.2.2-1: MSD due to IMD issue

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n48A-n66A  CA\_n48C-n66A  CA\_n48(2A)-n66A | n48 | 3660 | 5 | 25 | 3660 | N/A | TDD | N/A |
| n66 | 1730 | 5 | 25 | 2130 | 5.0 | FDD | IMD5 |

## 6.33 CA\_n7-n78

### 6.33.1 Common for 1 band UL and 2 bands UL CA

### 6.33.1.1 Operating bands for CA

Table 6.33.1-1: CA band combination of band n7 + n78

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n7-n78 | n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

### 6.33.1.2 Channel bandwidths per operating band for CA

Table 6.33.1: Supported bandwidths per CA band combination of band n7+n78

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n7A-n78A | CA\_n7A-n78A | n7 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n7A-n78(2A) | CA\_n7A-n78A | n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 from 38.101-1 | | | | | | | | | | | | |
| CA\_n7(2A)-n78A | CA\_n7A-n78A | n7 | See CA\_n7(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 from 38.101-1 | | | | | | | | | | | | | 0 |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n7(2A)-n78(2A) | CA\_n7A-n78A | n7 | See CA\_n7(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 from 38.101-1 | | | | | | | | | | | | | 0 |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 from 38.101-1 | | | | | | | | | | | | |

### 6.33.1.3 Co-existence studies

Table 6.33.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n7-n78.

**Table 6.33.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n7 | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 |

Based on above table, there is no harmonics issue for the band combination of n7 and n78.

**Table 6.33.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n7 and n78.

### 6.33.1.4 ∆TIB and ∆RIB values

For CA\_n7-n78, the TIB,c and RIB can follow the values of DC\_7\_n78. The values are given in the tables below.

Table 6.33.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n7-n78 | n7 | 0.5 |
| n78 | 0.8 |

Table 6.33.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n7-n78 | n7 | 0.5 |
| n78 | 0.5 |

### 6.33.1.5 REFSENs requirements

The MSD for cross band Tx-Rx interference is shown below.

Table 6.33.1.5-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| NR CA Configuration | UL band | DL band | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n7A-n78A  CA\_n7A-n78(2A) | n78 | n71 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |  |  |  |  |
| NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.  NOTE 2: Void | | | | | | | | | | | | | | |

Table 6.33.1.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n78 | n7 | 30 | 270 | 270 | 270 | 270 | 270 | 270 | 270 | 270 |  |  |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies.  NOTE 2: Refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1. | | | | | | | | | | | | | | |

### 6.33.2 Specific for 2 bands UL CA

#### 6.33.2.1 UE co-existence studies

Table 6.33.2.1-1 gives IMD interference analysis for CA\_ n7-n78 with 2 ULs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 2500 | 2570 | 3300 | 3800 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 5000 | 5140 | 6600 | 7600 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 7500 | 7710 | 9900 | 11400 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 10000 | 10280 | 13200 | 15200 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 12500 | 12850 | 16500 | 19000 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 730 | 1300 | 5800 | 6370 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1200 | 1840 | 4030 | 5100 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 8300 | 8940 | 9100 | 10170 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3700 | 4410 | 7330 | 8900 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 10800 | 11510 | 12400 | 13970 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2600 | 1460 | 11600 | 12740 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 12700 | 10630 | 6980 | 6200 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 6400 | 4760 | 1110 | 100 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 15700 | 17770 | 13300 | 14080 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 14900 | 16540 | 14100 | 15310 |

Based on above table, the 4rd order IMD may fall into Rx frequencies of Band n78. However IMD is not an issue for Band n78 since it is a TDD band. There is no IMD issue for CA\_n7-n78.

Table 6.33.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.33.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected Band | Frequency range (Mhz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n7-n78 | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 11, 18, 19, 20, 21, 26, 27, 28, 31, 32, 33, 34, 40, 50, 51, 65, 66, 67, 68, 72, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 4, 7, 18 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 7, 18 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 18 |
| NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

#### 6.33.2.2 REFSENS requirements

There is no MSD requirements for the dual uplink configuration without IMD issue.

## 6.34 CA\_n7-n66

### 6.34.1 Common for 1 band UL and 2 bands UL CA

### 6.34.1.1 Operating bands for CA

Table 6.34.1-1: CA band combination of band n7 + n66

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n7-n66 | n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

### 6.34.1.2 Channel bandwidths per operating band for CA

Table 8.x.2-1: Supported bandwidths per CA band combination of band n7+n66

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n7A-n66A | CA\_n7A-n66A | n7 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |

### 6.34.1.3 Co-existence studies

Table 6.34.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n7-n66.

**Table 6.34.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n7 | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 |  |  |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |

Based on above table, there is no harmonics issue for the band combination of n7 and n66.

**Table 6.34.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 |  |  |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n7 and n66.

### 6.34.1.4 ∆TIB and ∆RIB values

For CA\_n7A-n66A, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.34.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n7-n66 | n7 | 0.5 |
| n66 | 0.5 |

Table 6.34.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n7-n66 | n7 | 0.5 |
| n66 | 0.5 |

### 6.34.1.5 REFSENs requirements

There are no specific REFSENS requirements for 1 band UL

### 6.34.2 Specific for 2 bands UL CA

#### 6.34.2.1 UE co-existence studies

Table 6.34.2.1-1 gives IMD interference analysis for CA\_ n7-n66 with 2 ULs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1780 | 2500 | 2570 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3420 | 3560 | 5000 | 5140 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5130 | 5340 | 7500 | 7710 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 6840 | 7120 | 10000 | 10280 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 8550 | 8900 | 12500 | 12850 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 720 | 860 | 4210 | 4350 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 850 | 1060 | 3220 | 3430 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 5920 | 6130 | 6710 | 6920 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 2560 | 2840 | 5720 | 6000 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 7630 | 7910 | 9210 | 9420 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 1440 | 1720 | 8420 | 8700 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4270 | 4620 | 8220 | 8570 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 9340 | 9690 | 11710 | 12060 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 10 | 340 | 3940 | 4290 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 10920 | 11270 | 10130 | 10480 |

Based on above table, two-tone 4th order IMD products may fall into the own Rx Band of Band 7.

Table 6.34.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.34.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n7-n66 | E-UTRA Band 2, 4, 5, 7, 10, 12, 13, 14, 17, 26, 27, 28, 29, 30, 43, 66, 71, , 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 2570 | - | 2575 | 1.6 | 5 | 4, 7, 18 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 7, 18 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 18 |

#### 6.34.2.2 REFSENS requirements

The IMD issue for CA\_n7-n66 is similar as LTE CA\_4A-7A. Hence the MSD value for CA\_4A-7A can be re-used for CA\_n7-n66.

**Table 6.34.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n7A-n66A | n7 | 2535 | 10 | 50 | 2655 | 15 | FDD | IMD4 |
| n66 | 1730 | 5 | 25 | 2130 | N/A | FDD | N/A |

## 6.35 CA\_n41-n66

### 6.35.1 Common for 1 band UL and 2 bands UL CA

#### 6.35.1.1 Operating bands for CA

Table 6.35.1.1-1: CA band combination of band n41+n66

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n41 | 2469 MHz | – | 2690 MHz | 2469 MHz | – | 2690 MHz | TDD |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

#### 6.35.1.2 Channel bandwidths per operating band for CA

Table 6.35.1.2-1: Supported bandwidths per CA band combination of band n41+n66

| NR CA configuration | NR Uplink CA configuration | NR  Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90  MHz | 100  MHz | **Maximum Aggregated bandwidth**  **[MHz]** | **BCS** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n41A-n66A | **CA\_n41A-n66A** | n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 140 | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| CA\_n41(2A)-n66A | - | n41 | See CA\_n41(2A) Bandwidth Combination Set 1 in 38.101-1 Table 5.5A.2-1 | | | | | | | | | | | | | 230 | 0 |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| CA\_n41C-n66A | - | n41 | See CA\_n41C Bandwidth Combination Set 0 in 38.101-1 Table 5.5A.1-1 | | | | | | | | | | | | | 220 | 0 |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |

#### 6.35.1.3 UE co-existence studies

Table 6.35.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA \_ n41-n66.

**Table 6.35.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |

**Table 6.35.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |

Based on above tables, there is no harmonic issue.

#### 6.35.1.4 ∆TIB and ∆RIB values

For CA\_n41-n66, the ΔTIB,c and ΔRIB,c values for low high combination are reused from DC\_66\_n41 as given in the tables below.

Table 6.35.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n66 | n41 | 0.81 |
| 1.32 |
| n66 | 0.5 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2545-2690 MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2545 MHz. | | |

Table 6.35.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n66 | n41 | 0.51 |
| 12 |
| n66 | 0.5 |
| NOTE 1: The requirement is applied for UE transmitting on the frequency range of 2545-2690 MHz.  NOTE 2: The requirement is applied for UE transmitting on the frequency range of 2496-2545 MHz. | | |

#### 6.35.1.5 REFSENS requirements

A reference sensitivity exception (MSD) already exists in 38.101-3 due to cross band isolation for EN-DC of band n41 and 66 in NR FR1. The same should apply for CA\_n41-n66 as given in Table 6.35.1.5-1 with uplink configuration specified in Table 6.35.1.5-2.

**Table 6.35.1.5-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration**  CA\_n41-n66 | **NR UL band** | **NR DL band** | **Channel bandwidth** | | | | | | | | | | | |
| **5 MHz (dBm)** | **10 MHz (dBm)** | **15 MHz (dBm)** | **20 MHz (dBm)** | **25 MHz (dBm)** | **30 MHz (dBm)** | **40 MHz (dBm)** | **50 MHz (dBm)** | **60 MHz (dBm)** | **80 MHz (dBm)** | **90 MHz (dBm)** | **100 MHz (dBm)** |
| n411 | n66 | 3.5 | 3.5 | 3.5 | 3.5 |  |  | 3.5 |  |  |  |  |  |
| NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.. | | | | | | | | | | | | | | |

Table 6.35.1.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| NR UL band | NR DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n41 | n66 | 30 | 128 | 128 | 128 | 128 |  |  | 128 |  |  |  |  |  |
|  | | | | | | | | | | | | | | |

### 6.35.2 Specific for 2 bands UL CA

#### 6.35.2.1 UE co-existence studies

Table 6.35.2.1-1 lists Band n41 + Band n66 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.35.2.1-1: Band n41 and Band n66 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 980 | 716 | 4206 | 4470 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 730 | 1064 | 3212 | 3670 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 5916 | 6250 | 6702 | 7160 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1960 | 1432 | 8412 | 8940 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2440 | 2844 | 5708 | 6360 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7626 | 8030 | 9198 | 9850 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 9050 | 8204 | 4624 | 4150 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11694 | 12540 | 9336 | 9810 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 4650 | 3928 | 348 | 250 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 10908 | 11630 | 10122 | 10720 |

Based on Table 6.35.2.1-1 there are IMD4 issues affecting own Rx frequencies of band n41.

Table 6.35.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1.

**Table 6.35.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n41-n66 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 50, 51, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42, 48 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. | | | | | | | |

#### 6.35.2.2 REFSENS requirements

Based on the co-existence studies for CA\_n41-n66 MSD does not need to be defined.

6.36 CA\_n2-n48

### 6.36.1 Common for 1 band UL and 2 bands UL CA

6.36.1.1 Operating bands for CA

**Table 6.36.1.1-1: CA band combination of band n2+n48**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n2-n48 | n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz | TDD |

6.36.1.2 Channel bandwidths per operating band for CA

**Table 6.36.1.2-1: Supported bandwidths per CA band combination of band n2+n48**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **NR Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n2A-n48A | CA\_n2A-n48A | n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n48 | 15 | Yes | Yes | Yes | Yes |  |  | Yes | Yes1 |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes1 | Yes1 | Yes1 | Yes1 | Yes1 |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes1 | Yes1 | Yes1 | Yes1 | Yes1 |
| CA\_n2A-n48C | CA\_n48C  CA\_n2A-n48A | n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n48 | See CA\_n48C Bandwidth Combination in Table 5.5A.1-1 of 38.101-1 | | | | | | | | | | | | |
| Note 1: This UE channel bandwidth is applicable only to DL | | | | | | | | | | | | | | | | |

6.36.1.3 Co-existence studies

Table 6.36.1.3-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n2-n48.

**Table 6.36.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n2 | 1850 | 1910 | 1930 | 1990 | 3700 | 3820 | 5550 | 5730 | 7400 | 7640 | 9250 | 9550 |
| n48 | 3550 | 3700 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 | 17750 | 18500 |

Based on Table 6.36.1.3-1, it can be seen that the 2nd harmonic skirt interference for band n2 UL will impact the receive frequency of band n48.

6.36.1.4 ∆TIB and ∆RIB values

For CA\_n2-n48, the ΔTIB,c and ΔRIB,c values for UEs are given in the tables below.

Table 6.36.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n48 | n2 | 0.6 |
| n48 | 0.8 |

Table 6.36.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n48 | n2 | 0.2 |
| n48 | 0.5 |

6.36.1.5 REFSEN requirements

Due to identified harmonic issues, MSD for CA\_n2-n48 is derived and need to be defined in 38.101-1 as below.

Table 6.36.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| n2 | n481, 2 | 27.1 | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.94 | 16.14 | 14.84 | 14.34 | 13.84 |
| n483 | 1.9 | 1.1 | 0.8 | 0.3 |  |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ∆FHD above and below the edge of this downlink transmission bandwidth. The value ∆FHD depends on the band combination: ∆FHD = 10 MHz for CA\_n2-n48.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.  NOTE 4: For these bandwidths, the minimum requirements are restricted to operation when carrier is configured as a downlink carrier part of CA configuration | | | | | | | | | | | | | |

Table 6.36.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n2 | n48 | 25 | 50 | 50 | 50 |  |  | 50 | 50 | 50 | 50 | 50 | 50 |

### 6.36.2 Specific for 2 bands UL CA

#### 6.36.2.1 UE co-existence studies

Table 6.36.2.1-1 lists Band n2 + Band n48 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.36.2.1-1: Band n2 and Band n48 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE UL carriers | fx\_low | fx\_high | fy\_low | fy\_high |
| UL frequency (MHz) | 1850 | 1910 | 3550 | 3700 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1850 | 1640 | 5400 | 5610 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 0 | 270 | 5190 | 5550 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 7250 | 7520 | 8950 | 9310 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 3700 | 3280 | 10800 | 11220 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1850 | 2180 | 8740 | 9250 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 9100 | 9430 | 12500 | 13010 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 12950 | 12290 | 4090 | 3700 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 16050 | 16710 | 10950 | 11340 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 7400 | 6830 | 1370 | 1850 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 14350 | 14920 | 12650 | 13130 |

Based on Table 6.36.2.1-1, the 4th order IMD may also fall into Rx frequencies of band n2 and no IMD falls into its band n48 Rx frequencies since band n48 is TDD band.

Table 6.36.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.36.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n2-n48 | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 50, 51, 53, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |

#### 6.36.2.2 REFSENS requirements

Table 6.36.2.2-1 lists the MSD required due to 4th IMD for the dual uplink configuration.

Table 6.36.2.2-1: MSD due to IMD issue

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n2A-n48A  CA\_n2A-n48C | n2 | 1852.5 | 5 | 25 | 1932.5 | [12] | FDD | IMD4 |
| n48 | 3625 | 20 | 100 | 3625 | N/A | TDD | N/A |

## 6.37 CA\_n28-n78

### 6.37.2 Specific for 2 bands UL CA

#### 6.37.2.1 Channel bandwidths per operating band for CA

**Table 6.37.2.1-1: Supported bandwidths per CA band combination of band n28+n78**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth** | | | | | | | | | | | | | | |
| **NR CA Configuration** | **NR Uplink CA configuration** | **Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **Maximum aggregated bandwidth**  **[MHz]** | **Bandwidth combination set** |
| CA\_n28A-n78A | CA\_n28A-n78A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  | 120 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n28A-n78(2A) | CA\_n28A-n78A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  | 220 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | |

#### 6.37.2.2 UE co-existence studies

Table 6.37.2.2-1 lists Band n28 + Band n78 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.37.2.2-1: Band n28 and Band n78 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 703 | 748 | 3300 | 3800 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2552 | 3097 | 4003 | 4548 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 2394 | 1804 | 5852 | 6897 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4706 | 5296 | 7303 | 8348 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1691 | 1056 | 9152 | 10697 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 5104 | 6194 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 5409 | 6044 | 10603 | 12148 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 8006 | 9096 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 14497 | 12452 | 308 | 988 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 9994 | 8404 | 4356 | 5491 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 13903 | 15948 | 6112 | 6792 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11306 | 12896 | 8709 | 9844 |

Based on Table 6.37.2.2-1, the 5th IMD falls down own Rx frequencies of band n28.

Table 6.37.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.37.2.2-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n28-n78 | E-UTRA Band 3, 5, 7, 8, 18, 19, 20, 26, 34, 39, 40, 41 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 1 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 758 | - | 773 | -32 | 1 |  |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 1 |
| NOTE 1: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz  NOTE 2: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz. | | | | | | | |

#### 6.37.2.3 REFSENS requirements

Table 6.37.2.3-1 lists the MSD required due to 5th IMD for the dual uplink configuration.

**Table 6.37.2.3-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n28A-n78  CA\_n28A-n78(2A) | n28 | 705.5 | 5 | 25 | 760.5 | 5.5 | FDD | IMD5 |
| n78 | 3582.5 | 10 | 50 | 3582.5 | N/A | TDD | N/A |
|  | | | | | | | | |

6.38 CA\_n1-n8

### 6.38.1 Common for 1 band UL and 2 bands UL

#### 6.38.1.1 Operating bands for CA

Table 6.38.1.1-1: CA band combination of band n1+n8

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
|  | | | | | | | |

#### 6.38.1.2 Channel bandwidths per operating band for CA

Table 6.38.1.2-1: Supported bandwidths per CA band combination of band n1+n8

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n8A | CA\_n1A-n8A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

#### 6.38.1.3 UE co-existence studies

Table 6.38.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n1-n8.

**Table 6.38.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 3840 | 3960 | 5760 | 5940 |  |  |
| n8 | 880 | 915 | 925 | 960 | 1760 | 1830 | 2640 | 2745 |  |  |

Based on above table, there is no harmonic issue for the band combination of n1 and n8.

**Table 6.38.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 4220 | 4340 | 6330 | 6510 |  |  |
| n8 | 880 | 915 | 925 | 960 | 1850 | 1920 | 2775 | 2880 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n1 and n8.

#### 6.38.1.4 ∆TIB and ∆RIB values

For CA\_n1-n8, the ΔTIB,c and ΔRIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

Table 6.38.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n8 | n1 | 0.3 |
| n8 | 0.3 |

Table 6.38.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n8 | n1 | 0 |
| n8 | 0 |

#### 6.38.1.5 REFSENS requirements

There are no specific REFSENS requirements

### 6.38.2 Specific for 2 bands UL CA

#### 6.38.2.1 UE co-existence studies

Table 6.38.2.1-1 lists Band n1 +Band n8 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.38.2.1-1: Band n1 and Band n8 2UL bands IMD products**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 1920 | 1980 | | 880 | 915 | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 1005 - 1100 | | | 2800 - 2895 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 2925 – 3080 | | | 90 – 220 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 4720 – 4875 | | | 3680 – 3810 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 4845– 5060 | | | 660 – 825 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 2010 – 2200 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 6640– 6855 | | | 4560 – 4725 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 5600 – 5790 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 1540 – 1740 | | | 6765 – 7040 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 1095 – 1320 | | | 3930 – 4180 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 5440 – 5640 | | | 8560 – 8835 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 6480 – 6705 | | | 7520 – 7770 | | |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | | |

Based on the above table, IMD4 may fall into own Rx of band 1.

Table 6.38.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.38.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n1-n8 | E-UTRA Band 20, 28, 31, 32, 38, 40, 45, 50, 51, 65, 67, 68, 69, 72, 73, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3, 7, 22, 41, 42, 43,  NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 1, 8, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 5 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| Frequency range | 1880 |  | 1895 | -40 | 1 | 4, 6 |
| Frequency range | 1895 |  | 1915 | -15.5 | 5 | 4, 6, 7 |
| Frequency range | 1915 |  | 1920 | +1.6 | 5 | 4, 6, 7 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 5: This requirement is applicable only for the following cases: A: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB; B: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth; D: for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3.  NOTE 6: This requirement is applicable for any channel bandwidths within the range 1920 – 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 – 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

#### 6.38.2.2 REFSENS requirements

Based on the coexistence studies for CA\_n1-n8, there are 4th MSD issue need to be specified.

**Table 6.38.2.2-1: MSD due to IMD issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n1A-n8A | n1 | 1965 | 5 | 25 | 2155 | 6.0 | FDD | IMD4 |
| n8 | 887.5 | 5 | 25 | 932.5 | N/A | FDD | N/A |
| NOTE 1: RBSTART = 0  NOTE 2: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured.  NOTE 3: 15 kHz SCS is assumed. | | | | | | | | |

## 6.39 CA\_n66-n78

### 6.39.1 Common for 1 band UL and 2 bands UL CA

### 6.39.1.1 Operating bands for CA

Table 6.39.1-1: CA band combination of band n66 + n78

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n66-n78 | n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

### 6.39.1.2 Channel bandwidths per operating band for CA

Table 8.x.2-1: Supported bandwidths per CA band combination of band n7+n66

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n66A-n78A | CA\_n66A-n78A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n66A-n78(2A) | CA\_n66A-n78A | n66 | 15 | Yes | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1 | | | | | | | | | | | | |
| CA\_n66(2A)-n78A | CA\_n66A-n78A | n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n66(2A)-n78(2A) | CA\_n66A-n78A | n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1 | | | | | | | | | | | | |

### 6.39.1.3 Co-existence studies

Table 6.39.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n66-n78.

**Table** **6.39.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, the 2nd harmonic of band n66 will fall into the RX band of n78.

**Table 6.39.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n66 and n78.

### 6.39.1.4 ∆TIB and ∆RIB values

For CA\_n66A-n78A, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.39.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n78 | n66 | 0.6 |
| n78 | 0.8 |

Table 6.39.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n66-n78 | n66 | 0.2 |
| n78 | 0.5 |

### 6.39.1.5 REFSENs requirements

Based on Table 6.39.1.3-1, the 2nd harmonic of band n66 will fall into the RX band of n78. The MSD for DC\_66A\_n78A can be reused for the CA combination as shown in following tables.

Table 6.39.1.5-1: Reference sensitivity exceptions (MSD) due to UL harmonic

| E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n66 | n782 |  | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.8 | 16.0 | 14.8 | 14.3 | 13.8 |
| n783 |  | 1.1 | 0.8 | 0.3 |  |  |  |  |  |  |  |  |
| NOTE 2: The requirements should be verified for UL EARFCN or NR ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively. | | | | | | | | | | | | | |

Table 6.39.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n66 | n78 |  | 25 | 36 | 50 |  |  | 100 | 100 | 100 | 100 | 100 | 100 |

### 6.39.2 Specific for 2 bands UL CA

#### 6.39.2.1 UE co-existence studies

Table 6.39.2.1-1 gives IMD interference analysis for CA\_ n66-n78 with 2 ULs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 3300 | 3800 | 1710 | 1780 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 2090 | 1520 | 5010 | 5580 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4820 | 5890 | 380 | 260 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 8310 | 9380 | 6720 | 7360 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 8120 | 9690 | 1330 | 2040 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 11610 | 13180 | 8430 | 8640 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 4180 | 3040 | 10020 | 11160 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 11420 | 13490 | 3040 | 3820 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 14910 | 16980 | 10140 | 10920 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 6340 | 7980 | 2470 | 1260 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 11730 | 12940 | 13320 | 14960 |

Based on above table, the following cases may have IMD products fall into the own TX

* two-tone 4th order and two-tone 5th order IMD products may fall into the own Rx Band of Band n78
* two-tone 5th order IMD products may fall into the own Rx Band of Band n66

Table 6.39.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.39.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n66-n78 | E-UTRA Band 2, 4, 5, 7, 12, 13, 14, 17, 29, 26, 28, 41, 66, 71 | FDL\_low | - | FDL\_high | -50 | 1 |  |

#### 6.39.2.2 REFSENS requirements

Based on above coexistence study, two-tone 4th order and two-tone 5th order IMD products may fall into the own Rx Band of Band n78, and two-tone 5th order IMD products may fall into the own Rx Band of Band n66. n78 is a TDD band hence there is no issue for the case IMD products fall into RX of band n78. The IMD5 case is similar as CA\_n48A-n66A. The MSD

Table 6.39.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n66A-n78A  CA\_n66A-n78(2A)  CA\_n66(2A)-n78A  CA\_n66(2A)-n78(2A) | n66 | 1730 | 5 | 25 | 2130 | 5.0 | FDD | IMD5 |
| n78 | 3660 | 10 | 50 | 3660 | N/A | TDD | N/A |

6.40 CA\_n39-n40

### 6.40.1 Common for 1 band UL and 2 bands UL CA

6.40.1.1 Operating bands for CA

**Table 6.40.1.1-1: CA band combination of band n39+n40**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n39-n40 | n39 | 1880 MHz | – | 1920 MHz | 1880 MHz | – | 1920 MHz | TDD |
| n40 | 2300MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

6.40.1.2 Channel bandwidths per operating band for CA

**Table 6.40.2-1: Supported bandwidths per CA band combination of band n39+n40**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5**  **MHz** | **10MHz** | **15MHz** | **20MHz** | **25MHz** | **30MHz** | **40MHz** | **50MHz** | **60MHz** | **80MHz** | **90MHz** | **100MHz** | **Bandwidth combination set** |
| CA\_n39A-n40A | CA\_n39A-n40A | n39 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |

6.40.1.3 Co-existence studies

Table 6.40.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n39-n40.

**Table 6.40.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 |  |  |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |

Based on above table, there is no harmonic issue for the band combination of n39 and n40.

**Table 6.40.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n39 | 1880 | 1920 | 1880 | 1920 | 3760 | 3840 | 5640 | 5760 |  |  |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n39 and n40.

6.40.1.4 ∆TIB and ∆RIB values

For CA\_n39-n40, the ΔTIB,c and ΔRIB values are given in the tables below, and they are same with ENDC combination DC\_39A\_n40A.

**Table 6.40.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n39-n40 | n39 | 0 |
| n40 | 0 |
| NOTE 1: Applicable for UE supporting inter-band CA without simultaneous Rx/Tx. | | |

**Table 6.40.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n39-n40 | n39 | 0.3 |
| n40 | 0.3 |
| NOTE 1: Applicable for UE supporting inter-band CA without simultaneous Rx/Tx. | | |

6.40.1.5 REFSEN requirements

For single uplink operation of this combination, only harmonic issue need to be considered. As shown in co-existence study in section 6.40.1.3, there are no harmonic issues for CA\_n39-n40. Hence there are no specific REFSENS requirements.

### 6.40.2 Specific for 2 bands UL CA

#### 6.40.2.1 UE co-existence studies

Table 6.40.2.1-1 lists Band n39 +Band n40 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.40.2.1-1: Band n39 and Band n40 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency** | **1880** | **1920** | **2300** | **2400** |
| 2nd order IMD products | |fy\_low-fx\_high| | |fy\_high-fx\_low| | |fy\_low+fx\_low| | |fy\_high+fx\_high| |
| IMD frequency limits (MHz) | 380 | 520 | 4180 | 4320 |
| Two-tone 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1360 | 1540 | 2680 | 2920 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 6060 | 6240 | 6480 | 6720 |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | (fx\_high + max BW fy) | (fy\_low – max BW fx) | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 1860 | 1940 | 2280 | 2420 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1040 | 760 | 8360 | 8640 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3240 | 3460 | 4980 | 5320 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7940 | 8160 | 8780 | 9120 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 7720 | 7280 | 5380 | 5120 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11080 | 11520 | 9820 | 10080 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 3440 | 3060 | 1160 | 840 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 10660 | 11040 | 10240 | 10560 |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | |

Based on Table 6.40.2.1-1:

* There are no IMD will fall into own Rx of band n39 and band n40.

It shall be noted that the table 6.40.2.1-1 does not calculate the 3rd order IMD frequency range of “fx\_low – max BW fy” to “fx\_low + max BW fy” which may fall into own Rx band. However, the MSD caused by this IM3 should not be specified due to lower PSD of NR transmission. In addition, it is TDD-TDD band CA combination, which means the Tx and Rx will not be supported at the same time for a certain TDD band, thus it is no need to considered the IMD influence.

Table 6.40.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.40.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n39A-n40A | E-UTRA Band 1, 8, 22, 26, 34, 41, 42, 44, 45, 50, 51, 52, 73, 74 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1805 |  | 1855 | -40 | 1 | 8 |
| Frequency range | 1855 |  | 1880 | -15.5 | 5 | 4, 7, 8 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 8: This requirement is only applicable for E-UTRA carriers with bandwidth confined within 1885 - 1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for E-UTRA carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for E-UTRA carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz. | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

6.40.2.2 REFSENS requirements

According to the co-existence analysis in table 6.40.2.1-1, there are no IMD issues are expected for this CA configuration with dual uplink carrier.

6.41 CA\_n3-n40

### 6.41.1 Common for 1 band UL and 2 bands UL CA

6.41.1.1 Operating bands for CA

**Table 6.41.1.1-1: CA band combination of band n3+n40**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n40 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | TDD |
| n40 | 2300MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

6.41.1.2 Channel bandwidths per operating band for CA

**Table 6.41.2-1: Supported bandwidths per CA band combination of band n3+n40**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5**  **MHz** | **10MHz** | **15MHz** | **20MHz** | **25MHz** | **30MHz** | **40MHz** | **50MHz** | **60MHz** | **80MHz** | **90MHz** | **100MHz** | **Bandwidth combination set** |
| CA\_n3A-n40A | CA\_n3A-n40A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |

6.41.1.3 Co-existence studies

Table 6.41.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n3-n40.

**Table 6.41.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 4992 | 5380 |  |  |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |

Based on above table, there is no harmonic issue for the band combination of n3 and n40.

**Table 6.41.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 |  |  |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n3 and n40.

6.41.1.4 ∆TIB and ∆RIB values

For CA\_n3-n40, the ΔTIB,c and ΔRIB values are given in the tables below, and they are same with ENDC combination DC\_3A\_n40A.

**Table 6.41.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n40 | n3 | 0.5 |
| n40 | 0.5 |

**Table 6.41.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n40 | n3 | 0 |
| n40 | 0 |

6.41.1.5 REFSEN requirements

For single uplink operation of this combination, only harmonic issue need to be considered. As shown in co-existence study in section 6.41.1.3, there are no harmonic issues for CA\_n3-n40. Hence there are no specific REFSENS requirements.

### 6.41.2 Specific for 2 bands UL CA

#### 6.41.2.1 UE co-existence studies

Table 6.41.2.1-1 lists Band n3 +Band n40 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.41.2.1-1: Band n3 and Band n40 UL IMD products**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1785 | | 2300 | 2400 |
| 2nd order IMD products | |fy\_high – fx\_low| | | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 690 | | 515 | 4010 | 4185 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1020 | | 1270 | 2815 | 3090 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 5720 | | 5970 | 6310 | 6585 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1380 | | 1030 | 8020 | 8370 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2730 | | 3055 | 5115 | 5490 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7430 | | 7755 | 8610 | 8985 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 7890 | | 7415 | 4840 | 4440 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 10910 | | 11385 | 9140 | 9540 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 3780 | | 3330 | 755 | 330 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 10320 | | 10770 | 9730 | 10155 |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | | |

Based on Table 6.41.2.1-1:

* There are no IMD will fall into own Rx of band n3 and band n40.

It shall be noted that the table 6.41.2.1-1 does not calculate the 3rd order IMD frequency range of “fx\_low – max BW fy” to “fx\_low + max BW fy” which may fall into own Rx band. However, the MSD caused by this IM3 should not be specified due to lower PSD of NR transmission.

Table 6.41.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.41.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n3A-n40A | E-UTRA Band 1, 5, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 38, 39, 41, 43, 44. 45, 50, 51, 65, 67, 68, 69, 72, 73, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| 1. UTRA Band 22, 42, 52   NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 13 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the channel bandwidth.  NOTE 13: This requirement applies for 5, 10, 15 and 20 MHz E-UTRA channel bandwidth allocated within 1744.9MHz and 1784.9MHz. | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

6.41.2.2 REFSENS requirements

According to the co-existence analysis in table 6.41.2.1-1, there are no IMD issues are expected for this CA configuration with dual uplink carrier.

6.42 CA\_n8-n40

### 6.42.1 Common for 1 band UL and 2 bands UL CA

6.42.1.1 Operating bands for CA

**Table 6.42.1.1-1: CA band combination of band n8+n40**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n8-n40 | n8 | 880 MHz | – | 915 MHz | 925 MHz | – | 960 MHz | FDD |
| n40 | 2300MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

6.42.1.2 Channel bandwidths per operating band for CA

**Table 6.42.2-1: Supported bandwidths per CA band combination of band n8+n40**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5MHz** | **10MHz** | **15MHz** | **20MHz** | **25MHz** | **30MHz** | **40MHz** | **50MHz** | **60MHz** | **80MHz** | **90MHz** | **100MHz** | **Bandwidth combination set** |
| CA\_n8A-n40A | CA\_n8A-n40A | n8 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |

6.42.1.3 Co-existence studies

Table 6.42.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n8-n40.

**Table 6.42.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n8 | 880 | 915 | 925 | 960 | 1760 | 1830 | 2640 | 2745 |  |  |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |

Based on above table, there is no harmonic issue for the band combination of n8 and n40.

**Table 6.42.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n8 | 880 | 915 | 925 | 960 | 1850 | 1920 | 2775 | 2880 |  |  |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n8 and n40.

6.42.1.4 ∆TIB and ∆RIB values

For CA\_n8-n40, the ΔTIB,c and ΔRIB values are given in the tables below, and they are reused from ENDC combination DC\_8A\_n40A in TR37.863-01-01.

**Table 6.42.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n8-n40 | n8 | 0.3 |
| n40 | 0.3 |

**Table 6.42.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n8-n40 | n8 | 0 |
| n40 | 0 |

6.42.1.5 REFSEN requirements

For single uplink operation of this combination, only harmonic issue need to be considered. As shown in co-existence study in section 6.42.1.3, there are no harmonic issues for CA\_n8-n40. Hence there are no specific REFSENS requirements.

### 6.42.2 Specific for 2 bands UL CA

#### 6.42.2.1 UE co-existence studies

Table 6.42.2.1-1 lists Band n8 +Band n40 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.42.2.1-1: Band n8 and Band n40 UL IMD products**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 880 | 915 | | 2300 | 2400 |
| 2nd order IMD products | |fy\_high – fx\_low| | | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1520 | | 1385 | 3180 | 3315 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 640 | | 470 | 3685 | 3920 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4060 | | 4230 | 5480 | 5715 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 3040 | | 2770 | 6360 | 6630 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 240 | | 445 | 5985 | 6320 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4940 | | 5145 | 7780 | 8115 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8720 | | 8285 | 1360 | 1120 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 10080 | | 10515 | 5820 | 6060 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 5440 | | 5070 | 1855 | 2160 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 8660 | | 9030 | 7240 | 7545 |

Based on Table 6.42.2.1-1:

* There are no IMD will fall into own Rx of band n8 and band n40 .

It shall be noted that the table 6.42.2.1-1 does not calculate the 3rd order IMD frequency range of “fx\_low – max BW fy” to “fx\_low + max BW fy” which may fall into own Rx band. However, the MSD caused by this IM3 should not be specified due to lower PSD of NR transmission.

Table 6.42.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.42.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** | |
| CA\_n8A-n40A | E-UTRA Bands 1, 20, 28, 31, 32, 33, 34, 38, 39, 45, 50, 51, 65, 67, 68, 69, 72, 73, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  | | |
| 1. UTRA Bands 3, 7, 22, 41, 42, 43, 52   NR Bands n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 | |
| Band 8 | FDL\_low | - | FDL\_high | -50 | 1 | 4 | |
| Frequency range | 860 | - | 890 | -40 | 1 | 4, 5 | |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, 5 | |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th [or 5th] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, [5] for the 2nd, 3rd, 4th [or 5th] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3:Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.  NOTE 4:These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 5: This requirement is applicable only for the following cases: - for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB - for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth. - for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3. | | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

6.42.2.2 REFSENS requirements

According to the co-existence analysis in table 6.42.2.1-1, there are no IMD issues are expected for this CA configuration

## 6.43 CA\_n1-n3

### 6.43.1 Common for 1 band UL and 2 bands UL CA

#### 6.43.1.1 Operating bands for CA

Table 6.43.1.1-1: CA band combination of band n1 + n3

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n3 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |

#### 6.43.1.2 Channel bandwidths per operating band for CA

Table 6.43.1.2-1: Supported bandwidths per CA band combination of band n1+n3

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n3A | CA\_n1A-n3A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| CA\_n1B-n3A | CA\_n1A-n3A | n1 | See CA\_n1B Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-1 | | | | | | | | | | | | | 0 |
| n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| CA\_n1A-n3(2A) | CA\_n1A-n3A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n3 | See CA\_n3(2A) bandwidth combination set in Table 5.5A.1-2 from 38.101-1 | | | | | | | | | | | | |

#### 6.43.1.3 Co-existence studies

Table 6.43.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n1-n3.

**Table 6.43.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 3840 | 3960 | 5760 | 5940 | 7680 | 7920 |
| n3 | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 | 6840 | 7140 |

Based on above table, there is no harmonics issue for the band combination of n1 and n3.

**Table 6.43.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 4220 | 4340 | 6330 | 6510 |  |  |
| n3 | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n1 and n3.

#### 6.43.1.4 ∆TIB and ∆RIB values

For CA\_n1-n3, the ΔTIB,c and ΔRIB can follow the values of DC\_1\_n3. The values are given in the tables below.

Table 6.43.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n3 | n1 | 0.3 |
| n3 | 0.3 |

Table 6.43.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n1-n3 | n1 | 0 |
| n3 | 0 |

#### 6.43.1.5 REFSENs requirements

There is reference sensitivity exception due to cross band isolation for CA\_n1-n3 with single uplink, referring to DC\_1\_n3 or DC\_3\_n1

Table 6.43.1.5-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| NR CA Configuration | UL band | DL band | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n1A-n3A  CA\_n1B-n3A  CA\_n1A-n3(2A) | n1 | n3 | 3 | 2.2 | 1.9 | 1.7 | 1.6 | 1.5 |  |  |  |  |  |  |
| NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.  NOTE 2: Void | | | | | | | | | | | | | | |

Table 6.43.1.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n1 | n3 | 15 | 25 | 25 | 25 | 25 | 25 | 25 |  |  |  |  |  |  |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies.  NOTE 2: Refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1. | | | | | | | | | | | | | | |

### 6.43.2 Specific for 2 bands UL CA

#### 6.43.2.1 UE co-existence studies

Table 6.43.2.1-1 gives IMD interference analysis for CA\_ n1-n3 with 2 ULs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1920 | 1980 | 1710 | 1785 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3840 | 3960 | 3420 | 3570 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5760 | 5940 | 5130 | 5355 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 7680 | 7920 | 6840 | 7140 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 9600 | 9900 | 8550 | 8925 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 270 | 135 | 3630 | 3765 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 2055 | 2250 | 1440 | 1650 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 5550 | 5745 | 5340 | 5550 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3975 | 4230 | 3150 | 3435 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7470 | 7725 | 7050 | 7335 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 270 | 540 | 7260 | 7530 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 5220 | 4860 | 6210 | 5895 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 1515 | 1170 | 2520 | 2190 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 8760 | 9120 | 9390 | 9705 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 8970 | 9315 | 9180 | 9510 |

Based on above table, the 3rd order IMD may fall into Rx frequencies of Band n1.

Table 6.43.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.43.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected Band | Frequency range (Mhz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n1-n3 | E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 26, 27, 28, 31, 32, 38, 40, 41, 43, 44, 50, 51, 65, 67, 68, 69, 72, 73, 74, 75, 76  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA band 22, 42, 52  NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 17 |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 4,6 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 4, 6, 7 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 4, 6, 7 |
| N OTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 5: This requirement is applicable only for the following cases: A: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB; B: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth; D: for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3.  NOTE 6: This requirement is applicable for any channel bandwidths within the range 1920 – 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 – 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 8: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.  NOTE 9: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9 MHz and 1784.9 MHz.  NOTE 10: This requirement applies when the NR carrier is confined within 2545 - 2575 MHz or 2595 – 2645vMHz and the channel bandwidth is 10 or 20 MHz.  NOTE 11:Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 12: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.1-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and Rbstart < 48.  NOTE 14: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.  NOTE 15: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 17: Applicable when NS\_05 in section 6.6.3.3.1 is signalled by the network.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

#### 6.43.2.2 REFSENS requirements

Because of 3rd IMD issue, the MSD requirements are shown below referring to DC\_1\_n3 or DC\_3\_n1.

Table 6.43.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n1A-n3A  CA\_n1B-n3A  CA\_n1A-n3(2A) | n1 | 1950 | 5 | 25 | 2140 | [23] | FDD | IMD3 |
| n3 | 1760 | 5 | 25 | 1855 | N/A | TDD | N/A |

## 6.44 CA\_n1-n41

### 6.44.1 Common for 1 band UL and 2 bands UL CA

#### 6.44.1.1 Operating bands for CA

Table 6.44.1.1-1: CA band combination of band n1 + n41

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n1-n41 | n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

#### 6.44.1.2 Channel bandwidths per operating band for CA

Table 6.44.1.2-1: Supported bandwidths per CA band combination of band n1+n41

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n1A-n41A | CA\_n1A-n41A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n41 | 15 | Yes | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.44.1.3 Co-existence studies

Table 6.44.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n1-n41.

**Table 6.44.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 3840 | 3960 | 5760 | 5940 | 7680 | 7920 |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |

Based on above table, there is no harmonics issue for the band combination of n1 and n41.

**Table 6.44.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 4220 | 4340 | 6330 | 6510 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n1 and n41.

#### 6.44.1.4 ∆TIB and ∆RIB values

For CA\_n1-n41, the ΔTIB,c and ΔRIB can follow the values of DC\_1\_n41. The values are given in the tables below.

Table 6.44.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n41 | n1 | 0.5 |
| n41 | 0.5 |

Table 6.44.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n1-n41 | n1 | 0 |
| n41 | 0 |

#### 6.44.1.5 REFSENs requirements

MSD values for cross band isolation are shown below, referring to DC\_1\_n41 R4-1908940.

Table 6.44.1.5-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| NR CA Configuration | UL band | DL band | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n1A-n41A | n41 | n1 | 9.1 | 9.1 | 9.1 | 9.1 |  |  |  |  |  |  |  |  |
| CA\_n1A-n41A | n1 | n41 |  | 6.1 | 6.1 | 6.1 |  |  | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.  NOTE 2: Void | | | | | | | | | | | | | | |

Table 6.44.1.5-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n41 | n1 | 30 | 128 | 128 | 128 | 128 |  |  |  |  |  |  |  |  |
| n1 | n41 | 15 |  | 100 | 100 | 100 |  |  | 100 | 100 | 100 | 100 | 100 | 100 |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies.  NOTE 2: Refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1. | | | | | | | | | | | | | | |

### 6.44.2 Specific for 2 bands UL CA

#### 6.44.2.1 UE co-existence studies

Table 6.44.2.1-1 gives IMD interference analysis for CA\_n1-n41 with 2 ULs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1920 | 1980 | 2496 | 2690 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3840 | 3960 | 4992 | 5380 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5760 | 5940 | 7488 | 8070 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 7680 | 7920 | 9984 | 10760 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 9600 | 9900 | 12480 | 13450 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 516 | 770 | 4416 | 4670 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1150 | 1464 | 3012 | 3460 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 6336 | 6650 | 6912 | 7360 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3070 | 3444 | 5508 | 6150 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8256 | 8630 | 9408 | 10050 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1540 | 1032 | 8832 | 9340 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8840 | 8004 | 5424 | 4990 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 4230 | 3528 | 948 | 380 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11904 | 12740 | 10176 | 10610 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11328 | 12030 | 10752 | 11320 |

Based on above table, there is no IMD issue for CA\_n1-n41.

Table 6.44.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.44.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected Band | Frequency range (Mhz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n1-n41 | E-UTRA Band 1, 3, 5, 8, 26, 27, 28, 42, 44, 45, 50, 51, 52, 65, 73, 74  NR Band n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 34 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| NR Band n77, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 11, 18, 19, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 10 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, 10 |
| Frequency range | 1880 | - | 1895 | -40 | 1 | 4,6 |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | 4, 6, 7 |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | 4, 6, 7 |
| N OTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 5: This requirement is applicable only for the following cases: A: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB; B: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth; D: for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3.  NOTE 6: This requirement is applicable for any channel bandwidths within the range 1920 – 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 – 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 8: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.  NOTE 9: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9 MHz and 1784.9 MHz.  NOTE 10: This requirement applies when the NR carrier is confined within 2545 - 2575 MHz or 2595 – 2645vMHz and the channel bandwidth is 10 or 20 MHz.  NOTE 11:Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 12: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.1-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and Rbstart < 48.  NOTE 14: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.  NOTE 15: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 17: Applicable when NS\_05 in section 6.6.3.3.1 is signalled by the network.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

#### 6.44.2.2 REFSENS requirements

There is no MSD issue for two bands UL.

## 6.45 CA\_n28-n41

### 6.45.1 Common for 1 band UL and 2 bands UL CA

#### 6.45.1.1 Operating bands for CA

Table 6.45.1-1: CA band combination of band n28 + n41

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n28-n41 | n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |

#### 6.45.1.2 Channel bandwidths per operating band for CA

Table 8.x.2-1: Supported bandwidths per CA band combination of band n7+n78

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n28A-n41A | CA\_n28A-n41A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n41 | 15 | Yes | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.45.1.3 Co-existence studies

Table 6.45.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n28-n41.

**Table 6.45.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n28 | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 | 2812 | 2992 |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |

Based on above table, there is no harmonics issue for the band combination of n28 and n41.

**Table 6.45.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n28 | 703 | 748 | 758 | 803 | 1516 | 1606 | 2274 | 2409 |  |  |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n28 and n41.

#### 6.45.1.4 ∆TIB and ∆RIB values

For CA\_n28-n41, the ΔTIB,c and ΔRIB can follow the values of DC\_28\_n41. The values are given in the tables below.

Table 6.45.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n28-n41 | n28 | 0.3 |
| n41 | 0.3 |

Table 6.45.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n28-n41 | n28 | 0 |
| n41 | 0 |

#### 6.45.1.5 REFSENs requirements

There is no MSD issue for CA\_n28-n41 with single UL.

### 6.45.2 Specific for 2 bands UL CA

#### 6.45.2.1 UE co-existence studies

Table 6.45.2.1-1 gives IMD interference analysis for CA\_n28-n41 with 2 ULs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 703 | 748 | 2496 | 2690 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1406 | 1496 | 4992 | 5380 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2109 | 2244 | 7488 | 8070 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 2812 | 2992 | 9984 | 10760 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 3515 | 3740 | 12480 | 13450 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1748 | 1987 | 3199 | 3438 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1284 | 1000 | 4244 | 4677 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3902 | 4186 | 5695 | 6128 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 581 | 252 | 6740 | 7367 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4605 | 4934 | 8191 | 8818 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 3974 | 3496 | 6398 | 6876 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 10057 | 9236 | 496 | 122 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 6664 | 5992 | 2748 | 3271 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 10687 | 11508 | 5308 | 5682 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 8894 | 9566 | 7101 | 7624 |

Based on above table, there is no IMD issue for CA\_n28-n41.

Table 6.45.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.45.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected Band | Frequency range (Mhz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n28-n41 | E-UTRA Band 2, 3, 5, 8, 25, 26, 27, 34 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 4, 10, 42, 50, 51, 52, 65, 66, 73, 74  NR Band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 18, 19 | FDL\_low | - | FDL\_high | -50 | 1 | 10 |
| Frequency range | 470 | - | 694 | -42 | 8 | 4, 14 |
| Frequency range | 470 | - | 710 | -26.2 | 6 | 13 |
| Frequency range | 662 | - | 694 | -26.2 | 6 | 4 |
| Frequency range | 758 | - | 773 | -32 | 1 | 4 |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, 10, 11 |
| N OTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 5: This requirement is applicable only for the following cases: A: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB; B: for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth; D: for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart > 3.  NOTE 6: This requirement is applicable for any channel bandwidths within the range 1920 – 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 – 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 8: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier center frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier center frequency is within the range 1895 - 1903 MHz.  NOTE 9: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9 MHz and 1784.9 MHz.  NOTE 10: This requirement applies when the NR carrier is confined within 2545 - 2575 MHz or 2595 – 2645vMHz and the channel bandwidth is 10 or 20 MHz.  NOTE 11:Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.  NOTE 12: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.1-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 13: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718 - 728 MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with RBstart > 1 and Rbstart < 48.  NOTE 14: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies.  NOTE 15: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned E-UTRA carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.6-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).  NOTE 17: Applicable when NS\_05 in section 6.6.3.3.1 is signalled by the network.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

#### 6.45.2.2 REFSENS requirements

There is no MSD issue for two bands UL.

## 6.46 CA\_n2\_n5

### 6.46.1 Common for 1 band UL and 2 bands UL CA

6.46.1.1 Operating bands for CA

**Table 6.46.1.1-1: CA band combination of band n2+n5**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |

6.46.1.2 Channel bandwidths per operating band for CA

**Table 6.46.1.2-1: Supported bandwidths per CA band combination of band n2+n5**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **UL configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n2A-n5A | CA\_n2A-n5A | n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 | Yes |  | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 | Yes |  | Yes | Yes |  |  |  |  |  |  |  |  |
| n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

6.46.1.3 Co-existence studies

Table 6.36.1.3-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n2-n5.

**Table 6.46.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | 2nd Harmonic | | 3rd Harmonic | | 4th Harmonic | | 5th Harmonic | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n2 | 1850 | 1910 | 1930 | 1990 | 3700 | 3820 | 5550 | 5730 | 7400 | 7640 | 9250 | 9550 |
| n5 | 824 | 849 | 869 | 894 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 | 4120 | 4245 |

Based on Table 6.x.1.3-1, it can be seen that there is no harmonic skirt interference from band n5 to impact the receive frequency of band n2.

6.46.1.4 ∆TIB and ∆RIB values

For CA\_n2-n5, the ΔTIB,c and ΔRIB,c values for UEs are given in the tables below.

Table 6.46.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n5 | n2 | 0.3 |
| n5 | 0.3 |

Table 6.46.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n5 | n2 | 0 |
| n5 | 0 |

6.46.1.5 REFSEN requirements

Same REFSENS requirements will be applied from 38.101-1. There is no need for additional REFSENS requirements.

### 6.46.2 Specific for 2 bands UL CA

#### 6.46.2.1 UE co-existence studies

Table 6.46.2.1-1 lists Band n2 + Band n5 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.46.2.1-1: Band n2 and Band n5 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1850 | 1910 | 824 | 849 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3700 | 3820 | 1648 | 1698 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5550 | 5730 | 2472 | 2547 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\*fy\_low | 4\*fy\_high |
| 4th harmonics frequency limits (MHz) | 7400 | 7640 | 3296 | 3396 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 9250 | 9550 | 4120 | 4245 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 1086 | 1001 | 2674 | 2759 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 2851 | 2996 | 262 | 152 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 4524 | 4669 | 3498 | 3608 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 4524 | 4669 | 3498 | 3608 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4701 | 4906 | 562 | 697 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 6374 | 6579 | 4322 | 4457 |
| Two-tone 4th order IMD products | |2\*fx\_low – 2\*fy\_high| | |2\*fx\_high – 2\*fy\_low| | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 2002 | 2172 | 5348 | 5518 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 1546 | 1386 | 6816 | 6551 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 5146 | 5306 | 8224 | 8489 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 1153 | 1348 | 4082 | 3852 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 6172 | 6367 | 7198 | 7428 |

Based on Table 6.46.2.1-1, there is no harmonics product found to fall into Rx frequencies of band n2 and no IMD falls into its band n2 Rx frequencies.

Based on the Table 6.46.2.1-1;

* - the 2nd harmonics may fall into n43, n77 and n78 Rx frequency
* - the 3rd harmonics may fall into B46, n41 and n90 Rx frequency
* - the 4th harmonics may fall into B53 and n77 and n78 Rx frequency
* - the 5th harmonics may fall into n77 Rx frequency
* - the 2nd IMD may fall into n7, n41 and n90 Rx frequency
* - the 3rd IMD may fall into B22, B47, n49, B41, n77, n78, n79 Rx frequency
* - the 4th IMD may fall into n1, B4, B10, n34, B46, n65, n66, n70, n79 Rx frequency
* - the 5th IMD may fall into B46, n77 Rx frequency

Table 6.46.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.46.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | | NOTE |
| CA\_n2-n5 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 25, 26, 28, 29, 30, 42, 48, 50, 51, 53, 66, 70, 71, 74, 85, | FDL\_low | - | FDL\_high | -50 | | 1 |  |
| E-UTRA Band 41, 43 | FDL\_low | - | FDL\_high | -50 | | 1 | 2 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180 kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. | | | | | | | | |

6.48 CA\_n3-n77

6.48.1 Common for 1 band UL and 2 bands UL CA

6.48.1.1 Operating bands for CA

Table 6.48.1.1-1: CA band combination of band n3+n77

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

6.48.1.2 Channel bandwidths per operating band for CA

Table 6.48.1.2-1: Supported bandwidths per CA band combination of band n3+n77

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA operating / channel bandwidth [MHz] | | | | | | | | | | | | | | | | |
| NR CA Configuration | UL Configuration | NR Band | SCS [kHz] | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 80 | 90 | 100 | Bandwidth combination set |
| CA\_n3A-n77A | CA\_n3A-n77A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n3A-n77(2A) | CA\_n3A-n77A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n77 | See CA\_n77(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |

6.48.1.3 Co-existence studies

The studies for 1 band UL for the CA band combination of band n3 + n77 have been already completed and captured into TR 37.865-01-01.

6.48.1.4 ∆TIB and ∆RIB values

For CA\_n3-n77, the ΔTIB,c and ΔRIB,c values are already specified in TR37.865-01-01.

6.48.1.5 REFSENS requirements

The studies for 1 band UL for the CA band combination of band n3 + n77 have been already completed and captured into TR 37.865-01-01.

6.48.2 Specific for 2 bands UL CA

6.48.2.1 UE co-existence studies

Table 6.48.2.1-1 lists Band n3 +Band n77 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.48.2.1-1: Band n3 and Band n77 UL IMD products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| BS DL carriers | f1\_low | f1\_high | f2\_low | f2\_high |
| DL frequency (MHz) | 1710 | 1785 | 3300 | 4200 |
| 2nd order IMD products | |f2\_low – f1\_high| | |f2\_high – f1\_low| | |f2\_low + f1\_low| | |f2\_high + f1\_high| |
| IMD frequency limits (MHz) | 1515 | 2490 | 5010 | 5985 |
| Two-tone 3rd order IMD products | |2\*f1\_low – f2\_high| | |2\*f1\_high – f2\_low| | |2\*f2\_low – f1\_high| | |2\*f2\_high – f1\_low| |
| IMD frequency limits (MHz) | 780 | 270 | 4815 | 6690 |
| Two-tone 3rd order IMD products | |2\*f1\_low + f2\_low| | |2\*f1\_high + f2\_high| | |2\*f2\_low + f1\_low| | |2\*f2\_high + f1\_high| |
| IMD frequency limits (MHz) | 6720 | 7770 | 8310 | 10185 |
| Two-tone 4th order IMD products | |3\*f1\_low –1\* f2\_high| | |3\*f1\_high – 1\*f2\_low| | |3\*f2\_low – 1\*f1\_high| | |3\*f2\_high – 1\*f1\_low| |
| IMD frequency limits (MHz) | 930 | 2055 | 8115 | 10890 |
| Two-tone 4th order IMD products | |2\*f1\_low –2\* f2\_high| | |2\*f1\_high –2\* f2\_low| |  |  |
| IMD frequency limits (MHz) | 3030 | 4980 |  |  |
| Two-tone 4th order IMD products | |3\*f1\_low +1\* f2\_low| | |3\*f1\_high + 1\*f2\_high| | |3\*f2\_low + 1\*f1\_low| | |3\*f2\_high + 1\*f1\_high| |
| IMD frequency limits (MHz) | 8430 | 9555 | 11610 | 14385 |
| Two-tone 4th order IMD products | |2\*f1\_low +2\* f2\_low| | |2\*f1\_high +2\* f2\_high| |  |  |
| IMD frequency limits (MHz) | 10020 | 11970 |  |  |
| Two-tone 5th order IMD products | |f1\_low – 4\*f2\_high| | |f1\_high – 4\*f2\_low| | |f2\_low – 4\*f1\_high| | |f2\_high – 4\*f1\_low| |
| IMD frequency limits (MHz) | 15090 | 11415 | 3840 | 2640 |
| Two-tone 5th order IMD products | |2\*f1\_low - 3\*f2\_high| | |2\*f1\_high - 3\*f2\_low| | |2\*f2\_low - 3\*f1\_high| | |2\*f2\_high -3\*f1\_low| |
| IMD frequency limits (MHz) | 9180 | 6330 | 1245 | 3270 |
| Two-tone 5th order IMD products | |f1\_low + 4\*f2\_low| | |f1\_high + 4\*f2\_high| | |f2\_low + 4\*f1\_low| | |f2\_high + 4\*f1\_high| |
| IMD frequency limits (MHz) | 14910 | 18585 | 10140 | 11340 |
| Two-tone 5th order IMD products | |2\*f1\_low + 3\*f2\_low| | |2\*f1\_high + 3\*f2\_high| | |2\*f2\_low + 3\*f1\_low| | |2\*f2\_high + 3\*f1\_high| |
| IMD frequency limits (MHz) | 13320 | 16170 | 11730 | 13755 |

Based on Table 6.48.2.1-1, 2nd, 3rd and 5th order IMD may also fall into own Rx of band n3.

Table 6.48.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

Table 6.2.2.1-2: Protected bands for the 2UL bands CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n3-n77 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz | | | | | | | |

6.48.2.2 REFSENS requirements

The same MSD requirements of DC\_3\_n77 can be applied to this combination. Table 6.48.2.2-1 lists the MSD requirements for the dual uplink configuration.

Table 6.48.2.2-1: MSD due to IMD issue

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA  Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n3-n77 | n3 | 1740 | 5 | 25 | 1835 | 26 | FDD | IMD23 |
| 28.74 |
| n77 | 3575 | 10 | 50 | 3575 | N/A | TDD | N/A |
| CA\_n3-n77 | n3 | 1765 | 5 | 25 | 1860 | 8.0 | FDD | IMD43 |
| 10.74 |
| n77 | 3435 | 10 | 50 | 3435 | N/A | TDD | N/A |
| NOTE 3: This band is subject to IMD5 also which MSD is not specified.  NOTE 4: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured. | | | | | | | | |

6.49 CA\_n20-n78

6.49.1 Common for 1 band UL and 2 bands UL CA

6.49.1.1 Operating bands for CA

**Table 6.49.1.1-1: CA band combination CA\_n20A-n78A**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n20-n78 | n20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

6.49.1.2 Channel bandwidths per operating band for CA

**Table 6.49.1.2-1: Supported bandwidths per CA band combination CA\_n20A-n78A**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n20A-n78A | CA\_n20A-n78A | n20 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |

6.49.1.3 Co-existence studies

Table 6.49.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n20-n78.

**Table 6.49.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n20 | 832 | 862 | 791 | 821 | 1664 | 1724 | 2496 | 2586 | 3328 | 3448 |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 |

Based on above table, the 4th harmonics of band n20 UL will fall into the band n78 Rx.

**Table 6.49.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| n7 | 832 | 862 | 791 | 821 | 1582 | 1642 | 2373 | 2463 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n20 and n78.

6.49.1.4 ∆TIB and ∆RIB values

For CA\_n20A-n78A, the ΔTIB,c and ΔRIB can follow the values of DC\_20\_n78. The values are given in the tables below.

**Table 6.49.1.4-1: ΔTIB,c**

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n20-n78 | n20 | 0.6 |
| n78 | 0.8 |

**Table 6.49.1.4-2: ΔRIB**

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB [dB]** |
| --- | --- | --- |
| CA\_n20-n78 | n20 | 0 |
| n78 | 0.5 |

6.49.1.5 REFSENs requirements

The specific MSD requirement can follow the requirements of DC\_20\_n78 as below.

**Table 6.49.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MSD due to harmonic exception for the DL band** | | | | | | | | | | | | | |
| **UL band** | **DL band** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** |
| n20 | n782,4 |  | 10.8 | 9.1 | 8 |  |  | 6 | 4.0 | 3.2 | 2.0 | 1.5 | 1.0 |
| NOTE 2: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band. | | | | | | | | | | | | | |

**Table 6.49.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band / Channel bandwidth of the high band** | | | | | | | | | | | | | |
| **UL band** | **DL band** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| n20 | n78 |  | 16 | 25 | 25 |  |  | 25 | 25 | 25 | 25 | 25 | 25 |

6.49.2 Specific for 2 bands UL CA

6.49.2.1 UE co-existence studies

**Table 6.49.2.1-1 gives IMD interference analysis for CA\_ n20-n78 with 2 ULs.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 832 | 862 | 3300 | 3800 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1664 | 1724 | 6600 | 7600 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2496 | 2586 | 9900 | 11400 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 3328 | 3448 | 13200 | 15200 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 4160 | 4310 | 16500 | 19000 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 2438 | 2968 | 4132 | 4662 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 2136 | 1576 | 5738 | 6768 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 4964 | 5524 | 7432 | 8462 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 1304 | 714 | 9038 | 10568 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 5796 | 6386 | 10732 | 12262 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 5936 | 4876 | 8264 | 9324 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 14368 | 12338 | 148 | 472 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 9736 | 8176 | 4014 | 5104 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 14032 | 16062 | 6628 | 7248 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11564 | 13124 | 9096 | 10186 |

Based on above table, the 4rd order IMD may fall into Rx frequencies of Band n20. The IMD4 issue should be considered for CA\_n20-n78.

Table 6.49.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.49.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected Band** | **Frequency range (Mhz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n20-n78 | E-UTRA Band 1, 3, 7, 8, 34, 40, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 20 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA Band 38, 69 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

6.49.2.2 REFSENS requirements

The specific MSD requirement of IMD4 can follow the requirements of DC\_20\_n78 as below.

**Table 6.49.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source of IMD** |
| **NR CA**  **Configuration** | **NR band** | **UL Fc  (MHz)** | **UL/DL BW  (MHz)** | **UL  CLRB** | **DL Fc (MHz)** | **MSD  (dB)** | **Duplex mode** |
| CA\_n20A-n78A | n20 | 850 | 5 | 25 | 809 | 11 | FDD | IMD4 |
| n78 | 3359 | 10 | 50 | 3359 | N/A | TDD | N/A |

6.50 CA\_n1-n7

6.50.1 Common for 1 band UL and 2 bands UL CA

6.50.1.1 Operating bands for CA

Table 6.50.1.1-1: CA band combination of band n1 and n7

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz |

6.50.1.2 Channel bandwidths per operating band for CA

Table 6.50.1.2-1: Supported bandwidths per CA band combination of band n1 and n7

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration | NR Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25 MHz | 30 MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90  MHz | 100 MHz | Bandwidth combination set |
| CA\_n1A-n7A | CA\_n1A-n7A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |

6.50.1.3 UE co-existence studies

Table 6.50.1.3-1 lists up to 7th harmonics for n1A-n7A.

Table 6.50.1.3-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | 2nd Harmonic | | 3rd Harmonic | | 4th Harmonic | | 5th Harmonic | | 6th Harmonic | | 7th Harmonic | |
| Band | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n1 | 1920 | 1980 | 3840 | 3960 | 5760 | 5940 | 7680 | 7920 | 9600 | 9900 | 11520 | 11880 | 13440 | 13860 |
| n7 | 2500 | 2570 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 | 12500 | 12850 | 15000 | 15420 | 17500 | 17990 |

6.50.1.4 ∆TIB and ∆RIB values

For CA\_n1-n7, the ΔTIB,c and ΔRIB,c values are derived from LTE combination CA\_1-3 and are given in the tables below.

Table 6.50.1.4-1: ΔTIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n7 | n1 | 0.5 |
| n7 | 0.6 |

Table 6.50.1.4-2: ΔRIB,c

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n7 | n1 | 0 |
| n7 | 0 |

6.50.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.50.1.3 there are no harmonics issues.

6.50.2 Specific for 2 bands UL CA

6.50.2.1 UE co-existence studies

Table 6.50.2.1-1 lists Band n1 + Band n7 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

Table 6.50.2.1-1: Band n1 and Band n7 UL IMD products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UE UL carriers | fx\_low | fx\_high | fy\_low | fy\_high |
| UL frequency (MHz) | 1920 | 1980 | 2500 | 2570 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 3840 | 3960 | 5000 | 5140 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 5760 | 5940 | 7500 | 7710 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 7680 | 7920 | 10000 | 10280 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 9600 | 9900 | 12500 | 12850 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 11520 | 11880 | 15000 | 15420 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 13440 | 13860 | 17500 | 17990 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 650 | 520 | 4420 | 4550 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1270 | 1460 | 3020 | 3220 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 6340 | 6530 | 6920 | 7120 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1300 | 1040 | 8840 | 9100 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3190 | 3440 | 5520 | 5790 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8260 | 8510 | 9420 | 9690 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8360 | 8020 | 5420 | 5110 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11920 | 12260 | 10180 | 10490 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 3870 | 3540 | 940 | 620 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11340 | 11670 | 10760 | 11080 |

Based on Table 6.50.2.1-1 there are no IMD issues affecting own Rx frequencies of either band n1 or band n7.

Table 6.50.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1

Table 6.50.2.1-2: Protected bands for the 2UL bands CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n1-n7 | E-UTRA Band 1, 5, 7, 8, 20, 22, 26, 27, 28, 31,32, 40, 42, 43, 50, 51, 52, 65, 67, 68, 72, 74, 75, 76  NR Band n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| band 3, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| Frequency range | 1880 |  | 1895 | -40 | 1 | 4, 6 |
| Frequency range | 1895 |  | 1915 | -15.5 | 5 | 4. 7, 6 |
| Frequency range | 1915 |  | 1920 | +1.6 | 5 | 4. 7, 6 |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 4, 7, 18 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 7, 18 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 18 |
| NOTE 1: FDL\_low and FDL\_high refer to each frequency band specified in Table 5.2-1 in TS 38.101-1 or Table 5.5-1 in TS 36.101  NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 6: This requirement is applicable for any channel bandwidths within the range 1920 – 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 – 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

6.50.2.2 REFSENS requirements

Based on the co-existence studies in 6.50.1.3, there are no need to define MSD for CA\_n1-n7.

## 6.51 CA\_n29-n70

### 6.51.1 Common for 1 band UL and 2 bands UL CA

#### 6.51.1.1 Operating bands for CA

Table 6.51.1.1-1: CA band combination of band n29+n70

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n29 | N/A | | | 717 | – | 728 | SDL |
| n70 | 1695 | – | 1710 | 1995 | – | 2020 | FDD |

#### 6.51.1.2 Channel bandwidths per operating band for CA

Table 6.51.1.2-1: Supported bandwidths per CA band combination of band n29+n70

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n29A-n70A | - | n29 | 15 | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n70 | 15 | Yes | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes1 | Yes1 |  |  |  |  |  |  |  |
| NOTE 1: This UE channel bandwidth is applicable only to downlink | | | | | | | | | | | | | | | | |

#### 6.51.1.3 UE co-existence studies

Table 6.51.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n29-n70.

**Table 6.51.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | **DL Low Band Edge** | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n29 | N/A | N/A | 717 | 728 | N/A | N/A | N/A | N/A | N/A | N/A |
| n70 | 1695 | 1710 | 1995 | 2020 | 3390 | 3420 | 5085 | 5130 |  |  |

Based on the table above, there is no harmonic relation.

**Table 6.51.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n29 | N/A | N/A | 717 | 728 | 1434 | 1456 | 2151 | 2184 | N/A | N/A |
| n70 | 1695 | 1710 | 1995 | 2020 | 3990 | 4040 | 5985 | 6060 |  |  |

Based on the table above, there is no harmonic mixing relation.

#### 6.51.1.4 ∆TIB and ∆RIB values

For CA\_n29-n70, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 6.51.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n29-n70 | n70 | 0.3 |

Table 6.51.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n29-n70 | n70 | 0 |

#### 6.51.1.5 REFSENS requirements

REFSENS is defined in TS38.101-1 Table 7.3A.2.4-1, because n29A is an SDL band.

Table 6.51.1.5-1: Reference sensitivity for SDL bands

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band/Channel bandwidth | | | | | | | | | | | | | | |
| NR CA Configuration | NR band | SCS (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| CA\_n29A-n70A | n29 | 15 | -97.0 | -93.8 |  |  |  |  |  |  |  |  |  |  |
| 30 |  | -94.1 |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n70 | 15 | -100 | -96.8 | -95.0 | -93.8 | -92.7 |  |  |  |  |  |  |  |
| 30 |  | -97.1 | -95.1 | -94.0 | -92.8 |  |  |  |  |  |  |  |
| 60 |  | -97.5 | -95.4 | -94.2 | -93.0 |  |  |  |  |  |  |  |
| NOTE 1: The transmitter shall be set to PUMAX, as defined in subclause 6.2.4. | | | | | | | | | | | | | | |

## 6.52 CA\_n29-n66

### 6.52.1 Common for 1 band UL and 2 bands UL CA

#### 6.52.1.1 Operating bands for CA

Table 6.52.1.1-1: CA band combination of band n29+n66

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n29 | N/A | | | 717 | – | 728 | SDL |
| n66 | 1710 | – | 1780 | 2110 | – | 2200 | FDD |

#### 6.52.1.2 Channel bandwidths per operating band for CA

Table 6.52.1.2-1: Supported bandwidths per CA band combination of band n29+n66

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n29A-n66B | **-** | n29 | 15 | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | See CA\_n66B Bandwidth Combination Set 0 in Table 5.5A.1-1 in TS38.101-1 | | | | | | | | | | | | |
| CA\_n29A-n66(2A) | **-** | n29 | 15 | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 in TS38.101-1 | | | | | | | | | | | | |

#### 6.52.1.3 UE co-existence studies

Table 6.52.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n29-n66.

**Table 6.52.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | **DL Low Band Edge** | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n29 | N/A | N/A | 717 | 728 | N/A | N/A | N/A | N/A | N/A | N/A |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |

Based on the table above, there is no harmonic relation.

**Table 6.52.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n29 | N/A | N/A | 717 | 728 | 1434 | 1456 | 2151 | 2184 | N/A | N/A |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |

Based on the table above, there is no harmonic mixing relation.

#### 6.52.1.4 ∆TIB and ∆RIB values

For CA\_n29-n66, the ΔTIB,c and ΔRIB,c values are already defined in CA\_n29A-n66A

#### 6.52.1.5 REFSENS requirements

REFSENS is defined in TS38.101-1 Table 7.3A.2.4-1, because n29A is an SDL band.

Table 6.52.1.5-1: Reference sensitivity for SDL bands

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band/Channel bandwidth | | | | | | | | | | | | | | |
| NR CA Configuration | NR band | SCS (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| CA\_n29A-n66B | n29 | 15 | -97.0 | -93.8 |  |  |  |  |  |  |  |  |  |  |
| 30 |  | -94.1 |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | 15 | -99.5 | -96.3 | -94.5 | -93.3 |  |  | -90.1 |  |  |  |  |  |
| 30 |  | -96.6 | -94.6 | -93.5 |  |  | -90.2 |  |  |  |  |  |
| 60 |  | -97.0 | -94.9 | -93.7 |  |  | -90.4 |  |  |  |  |  |
| CA\_n29A-n66(2A) | n29 | 15 | -97.0 | -93.8 |  |  |  |  |  |  |  |  |  |  |
| 30 |  | -94.1 |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | 15 | -99.5 | -96.3 | -94.5 | -93.3 |  |  | -90.1 |  |  |  |  |  |
| 30 |  | -96.6 | -94.6 | -93.5 |  |  | -90.2 |  |  |  |  |  |
| 60 |  | -97.0 | -94.9 | -93.7 |  |  | -90.4 |  |  |  |  |  |
| NOTE 1: The transmitter shall be set to PUMAX, as defined in subclause 6.2.4. | | | | | | | | | | | | | | |

6.53 CA\_n3-n38

### 6.53.1 Common for 1 band UL and 2 bands UL CA

6.53.1.1 Operating bands for CA

**Table 6.53.1.1-1: CA band combination of band n3+n38**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n3-n38 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |

6.53.1.2 Channel bandwidths per operating band for CA

**Table 6.53.2-1: Supported bandwidths per CA band combination of band n3+n38**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n3A-n38A | CA\_n3A-n38A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n38 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |

6.53.1.3 Co-existence studies

Table 6.53.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n3-n38.

**Table 6.53.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3420 | 3570 | 5130 | 5355 |  |  |
| n38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 |  |  |

Based on above table, there is no harmonic issue for the band combination of n3 and n38.

**Table 6.53.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 |  |  |
| n38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n3 and n38.

6.53.1.4 ∆TIB and ∆RIB values

For CA\_n3-n38, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.53.1.4-1: ΔTIB,c

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n38 | n3 | 0.5 |
| n38 | 0.5 |

Table 6.53.1.4-2: ΔRIB,c

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n38 | n3 | 0 |
| n38 | 0 |

#### 6.53.1.5 REFSEN requirements

According to the analysis in subclause 6.53.1.3, there are no harmonic issues for this combination. Hence it is no need to define the MSD values caused by harmonic issues for NR CA n3+n38 band combination.

### 6.53.2 Specific for 2 bands UL CA

#### 6.53.2.1 UE co-existence studies

Table 6.53.2.1-1 lists Band n3 +Band n38 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.53.2.1-1: Band n3 and Band n38 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1785 | 2570 | 2620 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3420 | 3570 | 5140 | 5240 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5130 | 5355 | 7710 | 7860 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 6840 | 7140 | 10280 | 10480 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 8550 | 8925 | 12850 | 13100 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 785 | 910 | 4280 | 4405 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 800 | 1000 | 3355 | 3530 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 5990 | 6190 | 6850 | 7025 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2510 | 2785 | 5925 | 6150 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7700 | 7975 | 9420 | 9645 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1820 | 1570 | 8560 | 8810 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8770 | 8495 | 4570 | 4220 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 4440 | 4140 | 215 | 110 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11990 | 12265 | 9410 | 9760 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11130 | 11430 | 10270 | 10595 |

Based on Table 6.53.2.1-1, it can be seen that IMD4 may fall into band n3 DL range.

Table 6.53.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.53.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n3A-n38A | E-UTRA Band 1, 5, 8, 20, 27, 28, 31, 32, 33, 34, 40, 43, 50, 51, 65, 67, 68, 72, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 15 |
| E-UTRA band 22, 42, 52 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 13 |
| Frequency range | 2620 | - | 2645 | -15.5 | 5 | 15, 22, 26 |
| Frequency range | 2645 | - | 2690 | -40 | 1 | 15, 22 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x RBsize kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 13: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9 MHz and 1784.9 MHz.  NOTE 15: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE22:This requirement is applicable for power class 3 UE for any channel bandwidths within the range 2570 - 2615 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2597 - 2605 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. For power class 2 UE for any channel bandwidths within the range 2570 - 2615 MHz, NS\_44 shall apply. For power class 2 or 3 UE for carriers with channel bandwidth overlapping the frequency range 2615 - 2620 MHz the requirement applies with the maximum output power configured to +19 dBm in the IE *P-Max*.  NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | | |

#### 6.53.2.2 REFSENS requirements

Based on the co-existence study, it is seen that IMD4 could potentially desensitize B3 DL carrier. Therefore, MSD value and test configuration need to be defined. It is proposed to re-use the same MSD value of DC\_3A\_n38A combination for IMD4, i.e. 8.2 dB.

**Table 6.53.2.2-1: MSD due to IMD4 issue**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| CA Configuration | Operating band | UL Fc (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n3A-n38A | n3 | 1713 | 5 | 25 | 1808 | 8.2 | FDD | IMD4 |
| n38 | 2617 | 5 | 25 | 2617 | N/A | TDD | N/A |

## 6.54 CA\_n2-n66

### 6.54.1 Common for 1 band UL and 2 bands UL CA

#### 6.54.1.1 Operating bands for CA

Table 6.54.1.1-1: CA band combination of band n2+n66

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

#### 6.54.1.2 Channel bandwidths per operating band for CA

Table 6.54.1.2-1: Supported bandwidths per CA band combination of band n2+n66

| NR CA configuration | NR Uplink CA configuration | NR  Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90  MHz | 100  MHz | **Maximum Aggregated bandwidth**  **[MHz]** | **BCS** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n2A-n66A | - | n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 60 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |

#### 6.54.1.3 UE co-existence studies

Table 6.54.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n2-n66.

**Table 6.54.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n2 | 1850 | 1910 | 1930 | 1990 | 3700 | 3820 | 5550 | 5730 | 7400 | 7640 |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 |

Based on the table above, there is no harmonic relation.

**Table 6.54.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n2 | 1850 | 1910 | 1930 | 1990 | 3860 | 3980 | 5790 | 5970 | 7720 | 7960 |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | 8440 | 8800 |

Based on above tables, there is no harmonic mixing relation.

#### 6.54.1.4 ∆TIB and ∆RIB values

For CA\_n2-n66, the ΔTIB,c and ΔRIB,c values are given in tables below. For this combination, the results are mainly reused from CA\_2\_66.

Table 6.54.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n66 | n2 | 0.5 |
| n66 | 0.5 |

Table 6.54.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n66 | n2 | 0.3 |
| n66 | 0.3 |

#### 6.54.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

## 6.55 CA\_n5-n66

### 6.55.1 Common for 1 band UL and 2 bands UL CA

#### 6.55.1.1 Operating bands for CA

Table 6.55.1.1-1: CA band combination of band n5+n66

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n5 | 824 MHz | – | 849 MHz | 869MHz | – | 894 MHz | FDD |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

#### 6.55.1.2 Channel bandwidths per operating band for CA

Table 6.55.1.2-1: Supported bandwidths per CA band combination of band n5+n66

| NR CA configuration | NR Uplink CA configuration | NR  Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90  MHz | 100  MHz | **Maximum Aggregated bandwidth**  **[MHz]** | **BCS** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n5A-n66A | CA\_n5A-n66A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 60 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |  |

#### 6.55.1.3 UE co-existence studies

Table 6.55.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n5-n66.

**Table 6.55.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n5 | 824 | 849 | 869 | 894 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 |
| n5 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 |

Based on the table above, there is no harmonic relation.

**Table 6.55.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n5 | 824 | 849 | 869 | 894 | 1738 | 1788 | 2607 | 2682 | 3476 | 3576 |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | 8440 | 8800 |

Based on above tables, there is no harmonic mixing relation.

#### 6.55.1.4 ∆TIB and ∆RIB values

For CA\_n5-n66, the ΔTIB,c and ΔRIB,c values are given in tables below. For this combination, the results are mainly reused values from CA\_5-66.

Table 6.55.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n66 | n5 | 0.3 |
| n66 | 0.3 |

Table 6.55.1.4-2: ΔRIB,c

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n66 | n5 | 0 |
| n66 | 0 |

#### 6.55.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

### 6.55.2 Specific for 2 bands UL CA

#### 6.55.2.1 UE co-existence studies

Table 6.55.2.1-1 lists Band n5 +Band n66 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.55.2.1-1: Band n5 and Band n66 UL harmonics and IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 824 | 849 | 1710 | 1780 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1648 | 1698 | 3420 | 3560 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2472 | 2547 | 5130 | 5340 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 3296 | 3396 | 6840 | 7120 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 4120 | 4245 | 8550 | 8900 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 861 | 956 | 2534 | 2629 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 132 | 12 | 2571 | 2736 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3358 | 3478 | 4244 | 4409 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 692 | 837 | 4281 | 4516 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4182 | 4327 | 5954 | 6189 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1912 | 1722 | 5068 | 5258 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 6296 | 5991 | 1686 | 1516 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 3692 | 3432 | 873 | 1088 |

It can be seen that the IMD2 and IMD5 of the dual UL may fall into the DL frequency range of Band n5.

Table 6.55.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.55.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n5-n66 | E-UTRA Band 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 17, 24, 25, 28, 29, 30, 34, 38, 40, 43, 45, 50, 51, 65, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 26 | 859 | - | 869 | -27 | 1 |  |
| E-UTRA Band 41, 42, 48, 52 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 18, 19 | FDL\_low | - | FDL\_high | -40 | 1 |  |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
|  | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz | | | | | | | |

NOTE: All the tables mentioned in the note of above table are specified in TS38.101-1.

#### 6.55.2.2 REFSENS requirements

Because of 2nd and 5th IMD issue, the MSD requirements are shown below referring to DC\_5\_n66 or DC\_66\_n5.

Table 6.55.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n5A-n66A | n5 | 838 | 5 | 25 | 883 | 30 | FDD | IMD24 |
| n66 | 1721 | 5 | 25 | 2121 | N/A | FDD | N/A |
| Note 4: This band is subject to IMD5 also which MSD is not specified. | | | | | | | | |

## 6.56 CA\_n2-n78

### 6.56.1 Common for 1 band UL and 2 bands UL CA

### 6.56.1.1 Operating bands for CA

Table 6.56.1-1: CA band combination of band n38 + n66

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n2-n78 | n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

### 6.56.1.2 Channel bandwidths per operating band for CA

Table 8.x.2-1: Supported bandwidths per CA band combination of band n2+n78

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **UL configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n2A-n78A | CA\_n2A-n78A | n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n2A-n78(2A) | CA\_n2A-n78A | n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1 | | | | | | | | | | | | |

### 6.56.1.3 Co-existence studies

Table 6.56.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n2-n78.

**Table 6.56.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n2 | 1850 | 1910 | 1930 | 1990 | 3700 | 3820 | 5550 | 5730 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, the 2nd harmonic of band n2 falls into the DL of band n78.

**Table 6.56.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n2 | 1850 | 1910 | 1930 | 1990 | 3860 | 3980 | 5790 | 5970 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n2 and n78.

### 6.56.1.4 ∆TIB and ∆RIB values

For CA\_n2-n78, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.56.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n78 | n2 | 0.6 |
| n78 | 0.8 |

Table 6.56.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n2-n78 | n2 | 0.2 |
| n78 | 0.5 |

### 6.56.1.5 REFSENs requirements

Reference sensitivity exceptions due to UL harmonic for the CA combination can reuse the MSD value from DC\_2A\_n78A.

Reference sensitivity exceptions are specified in Table 6.56.1.5-1 with uplink configuration specified in Table 6.56.1.5-2.

Table 6.56.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| 2 | n781,2 |  | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.8 | 16.0 | 14.8 | 14.3 | 13.8 |
| n783 |  | 1.1 | 0.8 | 0.3 |  |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ∆FHD above and below the edge of this downlink transmission bandwidth. The value ∆FHD depends on the band combination: ∆FHD = 10 MHz for CA\_n1-n77, CA\_n2-n78, CA\_n3-n77, CA\_n3-n78, CA\_n2-n48, CA\_n48-n66.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively. | | | | | | | | | | | | | |

Table 6.56.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n2 | n78 |  | 25 | 36 | 50 |  |  | 50 | 50 | 50 | 50 | 50 | 50 |

### 6.56.2 Specific for 2 bands UL CA

#### 6.56.2.1 UE co-existence studies

Table 6.56.2.1-1 gives IMD interference analysis for CA\_ n2-n78 with 2 ULs.

**Table 6.56.2.1-1: Harmonic and IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 3300 | 3800 | 1850 | 1910 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 1950 | 1390 | 5150 | 5710 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4690 | 5750 | 100 | 520 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 8450 | 9510 | 7000 | 7620 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 7990 | 9550 | 1750 | 2430 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 11750 | 13310 | 8850 | 9030 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 3900 | 2780 | 10300 | 11420 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 11290 | 13350 | 3600 | 4340 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 15050 | 17110 | 10700 | 11440 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 6080 | 7700 | 2050 | 870 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 12150 | 13330 | 13600 | 15220 |

Based on the table 6.2.x.1-1, two-tone 4th order IMD products may fall into the own Rx Band of Band n2.

Table 6.56.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.56.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n2-n78 | E-UTRA Band 5, 7, 12, 13，26, 28, 41, 66 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.56.2.2 REFSENS requirements

Based on the table 6.2.x.1-1, two-tone 4th order IMD products may fall into the own Rx Band of Band n2. The MSD value can be reused from DC\_2A\_n78A.

Table 6.56.2.1-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n2A-n78A  CA\_n2A-n78(2A) | n2 | 1855 | 5 | 25 | 1935 | 26 | FDD | IMD24 |
| 28.75 |
| n78 | 3790 | 10 | 50 | 3790 | N/A | TDD | N/A |
| NOTE 4: This band is subject to IMD5 also which MSD is not specified.  NOTE 5: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured. | | | | | | | | |

## 6.57 CA\_n7-n25

### 6.57.1 Common for 1 band UL and 2 bands UL CA

### 6.57.1.1 Operating bands for CA

Table 6.57.1-1: CA band combination of band n7 + n25

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n7-n25 | n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |
| n25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |

### 6.57.1.2 Channel bandwidths per operating band for CA

Table 8.x.2-1: Supported bandwidths per CA band combination of band n7+n66

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **UL configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n7A-n25A | CA\_n7A-n25A | n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n25 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| CA\_n7A-n25(2A) | CA\_n7A-n25A | n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n25 | See CA\_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |
| CA\_n7(2A)-n25A | CA\_n7A-n25A | n25 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n7 | See CA\_7(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |
| CA\_n7(2A)-n25(2A) | CA\_n7A-n25A | n7 | See CA\_7(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n25 | See CA\_25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |

### 6.57.1.3 Co-existence studies

Table 6.57.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n7-n25.

**Table 6.57.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n7 | 2500 | 2570 | 2620 | 2690 | 5000 | 5140 | 7500 | 7710 |  |  |
| n25 | 1850 | 1915 | 1930 | 1995 | 3700 | 3830 | 5550 | 5745 |  |  |

Based on above table, there is no harmonic issue for the combination.

**Table 6.57.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 |  |  |
| n25 | 1850 | 1915 | 1930 | 1995 | 3860 | 3990 | 5790 | 5985 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n7 and n25.

### 6.57.1.4 ∆TIB and ∆RIB values

For CA\_n7-n25, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.57.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n7-n25 | n7 | 0.5 |
| n25 | 0.5 |

Table 6.57.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n7-n25 | n7 | 0 |
| n25 | 0 |

### 6.57.1.5 REFSENs requirements

There is neither harmonics mixing issue nor harmonics issue for the band combination of n7 and n25.

### 6.57.2 Specific for 2 bands UL CA

#### 6.57.2.1 UE co-existence studies

Table 6.57.2.1-1 gives IMD interference analysis for CA\_ n7-n25 with 2 ULs.

**Table 6.57.2-1: Harmonic and IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1850 | 1915 | 2500 | 2570 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 585 | 720 | 4350 | 4485 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 1130 | 1330 | 3085 | 3290 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 6200 | 6400 | 6850 | 7055 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 2980 | 3245 | 5585 | 5860 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 8050 | 8315 | 9350 | 9560 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 1170 | 1440 | 8700 | 8970 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4830 | 5160 | 8085 | 8430 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 9900 | 10230 | 11850 | 12195 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 410 | 745 | 3670 | 4010 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 11200 | 11540 | 10550 | 10885 |

Based on the table 6.1.x.4-1, there is no IMD issue for the combination.

Table 6.57.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.57.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n7-n25 | E-UTRA Band 4，5，7, 10，12，13，14，17，26，27，28，29，30，42，66, 85  NR Band n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 43 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 2, 25 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| Frequency range | 2570 | - | 2575 | 1.6 | 5 | 4, 7, 18 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 7, 18 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 18 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

#### 6.57.2.2 REFSENS requirements

There is no IMD issue for the band combination of n7 and n25

## 6.58 CA\_n25-n66

### 6.58.1 Common for 1 band UL and 2 bands UL CA

### 6.58.1.1 Operating bands for CA

Table 6.58.1-1: CA band combination of band n25 + n66

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n25-n66 | n25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |

### 6.58.1.2 Channel bandwidths per operating band for CA

Table 6.x.1.2-1: Supported bandwidths per CA band combination of band n25+n66

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **UL configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n25A-n66A | CA\_n25A-n66A | n25 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n66 | 15 | Yes | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| CA\_n25A-n66(2A) | CA\_n25A-n66A | n25 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |
| CA\_n25(2A)-n66A | CA\_n25A-n66A | n25 | See CA\_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n66 | 15 |  | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes |  |  |  |  |  |
| CA\_n25(2A)-n66(2A) | CA\_n25A-n66A | n25 | See CA\_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n66 | See CA\_n66(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |

### 6.58.1.3 Co-existence studies

Table 6.58.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n25-n66.

**Table 6.58.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n25 | 1850 | 1915 | 1930 | 1995 | 3700 | 3830 | 5550 | 5745 |  |  |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 |  |  |

Based on above table, there is no harmonic issue for the band combination of n25 and n66.

**Table 6.58.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n25 | 1850 | 1915 | 1930 | 1995 | 3860 | 3990 | 5790 | 5985 |  |  |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n25 and n66.

### 6.58.1.4 ∆TIB and ∆RIB values

For CA\_n25-n66, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.58.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n66 | n25 | 0.5 |
| n66 | 0.5 |

Table 6.58.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n25-n66 | n25 | 0.3 |
| n66 | 0.3 |

### 6.58.1.5 REFSENs requirements

There is neither harmonic issue nor harmonics mixing issue for the band combination of n25 and n66.

### 6.58.2 Specific for 2 bands UL CA

#### 6.58.2.1 UE co-existence studies

Table 6.58.2.1-1 gives IMD interference analysis for CA\_ n25-n66 with 2 ULs.

**Table 6.58.2.1-1: Harmonic and IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1780 | 1850 | 1915 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 70 | 205 | 3560 | 3695 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 1505 | 1710 | 1920 | 2120 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 5270 | 5475 | 5410 | 5610 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 3215 | 3490 | 3770 | 4035 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 6980 | 7255 | 7260 | 7455 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 140 | 410 | 7120 | 7390 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4925 | 5270 | 5620 | 5950 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 8690 | 9035 | 9110 | 9440 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 1300 | 1640 | 1990 | 2325 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 8970 | 9305 | 8830 | 9170 |

Based on the table 6.2.x.1-1, the MSD issue due to IMD is as below,

* Two-tone 3rd rder IMD products may fall into the own Rx Band of Band n25 and n66.
* Two-tone 5th order IMD products may fall into the own Rx Band of Band n25 and n66.

Table 6.58.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.58.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n25-n66 | E-UTRA Band 4, 5, 7, 10, 12, 13, 14, 17, 24, 26, 27, 28, 29, 30, 38, 41, 50, 51, 53, 66, 70, 71, 74, 85  NR Band n78 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42, 43, 48 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 2, 25 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.58.2.2 REFSENS requirements

Based on the co-existence study, there are IMD3 and IMD5 issues for the combination. The MSD value can be reused from DC\_25A\_n66A.

Table 6.58.2.1-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n25A-n66A  CA\_n25A-n66(2A)  CA\_n25(2A)-n66A  CA\_n25(2A)-n66(2A) | n66 | 1775 | 5 | 25 | 2175 | N/A | FDD | N/A |
| n25 | 1855 | 5 | 25 | 1935 | 20 | FDD | IMD3 |
| n66 | 1712.5 | 5 | 25 | 2112.5 | 23 | FDD | IMD3 |
| n25 | 1912.5 | 5 | 25 | 1992.5 | N/A | FDD | N/A |
| n66 | 1750 | 5 | 25 | 2150 | 4 | FDD | IMD5 |
| n25 | 1883.3 | 5 | 25 | 1963.3 | N/A | FDD | N/A |

## 6.59 CA\_n25-n78

### 6.59.1 Common for 1 band UL and 2 bands UL CA

### 6.59.1.1 Operating bands for CA

Table 6.59.1-1: CA band combination of band n25 + n78

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n25-n78 | n25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

### 6.59.1.2 Channel bandwidths per operating band for CA

Table 6.59.1.2-1: Supported bandwidths per CA band combination of band n25+n78

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **UL configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n25A-n78A | CA\_n25A-n78A | n25 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n25A-n78(2A) | CA\_n25A-n78A | n25 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | |
| CA\_n25(2A)-n78A | CA\_n25A-n78A | n25 | See CA\_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CA\_n25(2A)-n78(2A) | CA\_n25A-n78A | n25 | See CA\_n25(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n78 | See CA\_n78(2A) Bandwidth Combination Set 1 in Table 5.5A.2-1 | | | | | | | | | | | | |

### 6.59.1.3 Co-existence studies

Table 6.59.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n25-n78.

**Table 6.59.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n25 | 1850 | 1915 | 1930 | 1995 | 3700 | 3830 | 5550 | 5745 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, the 2nd harmonic of band n2 falls into the DL of band n78.

**Table 6.59.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n25 | 1850 | 1915 | 1930 | 1995 | 3860 | 3990 | 5790 | 5985 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n25 and n78.

### 6.59.1.4 ∆TIB and ∆RIB values

For CA\_n25-n78, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 6.59.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n78 | n25 | 0.6 |
| n78 | 0.8 |

Table 6.59.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n25-n78 | n25 | 0.2 |
| n78 | 0.5 |

### 6.59.1.5 REFSENs requirements

Reference sensitivity exceptions due to UL harmonic for the CA combination can reuse the MSD value from DC\_2A\_n78A.

Reference sensitivity exceptions are specified in Table 6.59.1.5-1 with uplink configuration specified in Table 6.59.1.5-2.

Table 6.59.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | |
| UL band | DL band | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| 25 | n781,2 |  | 23.9 | 22.1 | 20.9 |  |  | 17.9 | 16.8 | 16.0 | 14.8 | 14.3 | 13.8 |
| n783 |  | 1.1 | 0.8 | 0.3 |  |  |  |  |  |  |  |  |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ∆FHD above and below the edge of this downlink transmission bandwidth. The value ∆FHD depends on the band combination: ∆FHD = 10 MHz for CA\_n1-n77, CA\_n3-n77, CA\_n3-n78, CA\_n2-n48, CA\_n25-n78, CA\_n48-n66.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively. | | | | | | | | | | | | | |

Table 6.59.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the high band | | | | | | | | | | | | | |
| UL band | DL band | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n25 | n78 |  | 25 | 36 | 50 |  |  | 50 | 50 | 50 | 50 | 50 | 50 |

### 6.59.2 Specific for 2 bands UL CA

#### 6.59.2.1 UE co-existence studies

Table 6.59.2.1-1 gives IMD interference analysis for CA\_ n25-n78 with 2 ULs.

**Table 6.59.2.1-1: Harmonic and IMD analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 3300 | 3800 | 1850 | 1915 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 1950 | 1385 | 5150 | 5715 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 4685 | -5750 | -100 | 530 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 8450 | 9515 | 7000 | 7630 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 7985 | 9550 | 1750 | 2445 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 11750 | 13315 | 8850 | 9045 |
| Two-tone 4th order IMD products | 2\*fy\_low – 2\*fx\_high | 2\*fy\_high – 2\*fx\_low | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 3900 | 2770 | 10300 | 11430 |
| Two-tone 5th order IMD products | |4\*fx\_low – fy\_high| | |4\*fx\_high – fy\_low| | 4\*fy\_low – fx\_high | 4\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 11285 | 13350 | 3600 | 4360 |
| Two-tone 5th order IMD products | 4\*fx\_low + fy\_low | 4\*fx\_high + fy\_high | 4\*fy\_low + fx\_low | 4\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 15050 | 17115 | 10700 | 11460 |
| Two-tone 5th order IMD products | |3\*fx\_low – 2\*fy\_high| | |3\*fx\_high – 2\*fy\_low| | 3\*fy\_low – 2\*fx\_high | 3\*fy\_high – 2\*fx\_low |
| IMD frequency limits (MHz) | 6070 | 7700 | 2050 | 855 |
| Two-tone 5th order IMD products | 2\*fx\_low + 3\*fy\_low | 2\*fx\_high + 3\*fy\_high | 2\*fy\_low + 3\*fx\_low | 2\*fy\_high + 3\*fx\_high |
| IMD frequency limits (MHz) | 12150 | 13345 | 13600 | 15230 |

Based on the table 6.2.x.1-1, two-tone 4th order IMD products may fall into the own Rx Band of Band n25.

Table 6.59.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.59.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n25-n78 | E-UTRA Band 5, 7, 12, 13, 25, 26, 28, 41，66 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth. | | | | | | | |

#### 6.59.2.2 REFSENS requirements

Based on the table 6.2.x.1-1, two-tone 4th order IMD products may fall into the own Rx Band of Band n2. The MSD value can be reused from DC\_2A\_n78A.

Table 6.59.2.1-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n25A-n78A  CA\_n25A-n78(2A)  CA\_n25(2A)-n78A  CA\_n25(2A)-n78(2A) | n25 | 1855 | 5 | 25 | 1935 | 26 | FDD | IMD24 |
| 28.75 |
| n78 | 3790 | 10 | 50 | 3790 | N/A | TDD | N/A |
| NOTE 4: This band is subject to IMD5 also which MSD is not specified.  NOTE 5: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured. | | | | | | | | |

## 6.60 CA\_n20-n75

### 6.60.1 Common for 1 band UL and 2 bands UL CA

#### 6.60.1.1 Operating bands for CA

Table 6.60.1.1-1: CA band combination CA\_n20A-n75A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n20-n75 | n20 | 832 MHz | – | 862 MHz | 791 MHz | – | 821 MHz | FDD |
| n75 | N/A | | | 1432 MHz | – | 1517 MHz | SDL |

#### 6.60.1.2 Channel bandwidths per operating band for CA

Table 6.60.1.2-1: Supported bandwidths per CA band combination CA\_n20A-n75A

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n20A-n75A | - | n20 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n75 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |

#### 6.60.1.3 Co-existence studies

Table 6.60.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n20-n75.

**Table 6.60.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n20 | 832 | 862 | 791 | 821 | 1664 | 1724 | 2496 | 2586 | 3328 | 3448 |
| n75 | - | - | 1432 | 1571 |  |  |  |  |  |  |

Based on above table, there is no harmonics issue for the band combination of n20 and n75.

**Table 6.60.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n20 | 832 | 862 | 791 | 821 | 1582 | 1642 | 2373 | 2463 |  |  |
| n75 |  |  | 1432 | 1571 | 2864 | 3142 | 4296 | 4713 |  |  |

Based on above table, there is no harmonics mixing issue for the band combination of n20 and n75.

#### 6.60.1.4 ∆TIB and ∆RIB values

For CA\_n20A-n75A, the ΔTIB,c and ΔRIB can follow the values of DC\_20\_n75. The values are given in the tables below.

Table 6.60.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n20-n75 | n20 | 0.3 |

Table 6.60.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n20-n75 | n20 | 0 |

#### 6.60.1.5 REFSENs requirements

There is no additional MSD requirement for CA\_n20-n75. But the Reference sensitivity for CA\_n20-n75 which includes SDL band is listed below.

Table 6.60.1.5-1: Reference sensitivity for SDL bands

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band/Channel bandwidth | | | | | | | | | | | | | | |
| NR CA Configuration | NR band | SCS (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| CA\_n20A-n75A | n20 | 15 | -97.0 | -93.8 | -91.0 | -89.8 |  |  |  |  |  |  |  |  |
| 30 |  | -94.1 | -91.1 | -90.0 |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n75 | 15 | -100 | -96.8 | -95.0 | -93.8 |  |  |  |  |  |  |  |  |
| 30 |  | -97.1 | -95.1 | -94.0 |  |  |  |  |  |  |  |  |
| 60 |  | -97.5 | -95.4 | -94.2 |  |  |  |  |  |  |  |  |
| NOTE 1: The transmitter shall be set to PUMAX, as defined in subclause 6.2.4.  NOTE 2: Four Rx antenna ports shall be the baseline for this operating band, except for two Rx vehicular UE. | | | | | | | | | | | | | | |

## 6.61 CA\_n78-n92

### 6.61.1 Common for 1 band UL and 2 bands UL

#### 6.61.1.1 Operating bands for CA

**Table 6.61.1.1-1: CA band combination of band n78+n92**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |
| n92 | 832 MHz | – | 862 MHz | 1432 MHz | – | 1517 MHz | FDD |

#### 6.61.1.2 Channel bandwidths per operating band for CA

**Table 6.61.1.2-1: Supported bandwidths per CA band combination of band n78+n92**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n78A-n92A | CA\_n78A-n92A | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| n92 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| CA\_n78(2A)-n92A | CA\_n78A-n92A | n78 | See CA\_n78(2A) Bandwidth Combination Set 0 in Table 5.5A.2-1 | | | | | | | | | | | | | 0 |
| n92 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
|  |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

#### 6.61.1.3 UE co-existence studies

Table 6.61.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n78-n92.

**Table 6.61.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 |
| n92 | 832 | 862 | 1432 | 1517 | 1664 | 1724 | 2496 | 2586 | 3328 | 3448 |

Based on above table, the 4th harmonics of band n92 UL will fall into the band n78 Rx.

**Table 6.61.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |
| n92 | 832 | 862 | 1432 | 1517 | 2864 | 3034 | 4296 | 4551 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n92 and n78.

#### 6.61.1.4 ∆TIB and ∆RIB values

For CA\_n78-n92, the TIB,c and RIB,c values are given in the tables below.

**Table 6.61.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n78-n92 | n78 | 0.8 |
| n92 | 0.6 |

**Table 6.61.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n78-n92 | n78 | 0.5 |
| n92 | 0 |

#### 6.61.1.5 REFSENS requirements

The specific MSD requirement can follow the requirements of CA\_n20-n78 as defined in 6.49.1.5.

**Table 6.61.1.5-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MSD due to harmonic exception for the DL band** | | | | | | | | | | | | | |
| **UL band** | **DL band** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** |
| n92 | n784,5 |  | 10.8 | 9.1 | 8 |  |  | 6 | 4.0 | 3.2 | 2.0 | 1.5 | 1.0 |
| NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 5: The requirements should be verified for UL NR‑ARFCN of a low band (superscript LB) such that in MHz and with the carrier frequency of a high band in MHz and the channel bandwidth configured in the low band. | | | | | | | | | | | | | |

**Table 6.61.1.5-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band / Channel bandwidth of the high band** | | | | | | | | | | | | | |
| **UL band** | **DL band** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **30 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **80 MHz** | **90 MHz** | **100 MHz** |
| n92 | n78 |  | 16 | 25 | 25 |  |  | 25 | 25 | 25 | 25 | 25 | 25 |

For CA configurations of both CA\_n78A-n92A and CA\_n78(2A)-n92A, the same requirements defined in this sub-clause apply.

#### 6.61.1.6 Out-of-band blocking requirements

The combination is subject to be allowed for out-of-band blocking exceptions when the second order intermodulation product of the lower frequency band UL carrier and the CW interfering signal fully or partially overlaps with the higher frequency band DL carrier.

Table 6.61.1.6-1: CA band combination with exceptions allowed

|  |
| --- |
| CA band combination |
| CA\_n78-n92 |

Table 6.61.1.6-2: Requirement for out-of-band blocking exceptions

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| PInterferer (CW) | dBm | -441 |
| NOTE 1: The requirement applies when , where and are the carrier frequencies for lower frequency band UL and higher frequency band DL, respectively. and are the channel bandwidths configured for lower frequency band UL carrier and higher frequency band DL carrier in MHz, respectively. | | |

### 6.61.2 Specific for 2 bands UL CA

#### 6.61.2.1 UE co-existence studies

Band n78 +Band n92 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis can refer to table 6.49.2.1-1 for CA\_n20-n78.

Based on abovementioned table, no IMD issue is observed.

The protected bands required for the 2UL bands CA configuration can refer to table 6.49.2.1-2 by replacing n20 with n92 since n20 and n92 have the exact same UL frequency.

#### 6.61.2.2 REFSENS requirements

There is no specific MSD requirement.

## 6.62 CA\_n41-n78

### 6.62.1 Common for 1 band UL and 2 bands UL CA

#### 6.62.1.1 Operating bands for CA

Table 6.62.1.1-1: CA band combination CA\_n41A-n78A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n41-n78 | n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |

#### 6.62.1.2 Channel bandwidths per operating band for CA

Table 6.62.1.2-1: Supported bandwidths per CA band combination CA\_n41A-n78A

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | | |
| **NR CA Configuration** | | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n41A-n78A | | CA\_n41A-n78A | n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  | Yes |  | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  | Yes |  | Yes |
| n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| n41 | 15 |  | Yes | Yes | Yes |  | Yes | Yes | Yes |  |  |  |  |  | 1 |
| 30 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes |  | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.62.1.3 Co-existence studies

Table 6.62.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n41-n78.

**Table 6.62.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 | 13200 | 15200 |

Based on above table, there is no harmonic issue for this band combination.

**Table 6.62.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **mth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n41 | 2496 | 2690 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

The harmonics mixing exception for the band combination of n41 and n78 has been specified in the spec since Rel-15.

#### 6.62.1.4 ∆TIB and ∆RIB values

For CA\_n41A-n78A, the ΔTIB,c and ΔRIB are given in the tables below.

Table 6.62.1.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n78 | n41 | 0.3 |
| n78 | 0.8 |
|  | | |

Table 6.62.1.4-2: ΔRIB

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n41-n78 | n41 | 0 |
| n78 | 0.5 |
|  | | |

#### 6.62.1.5 REFSENs requirements

The specific MSD exception requirement has been specified in the spec since Rel-15, but it seems cross band isolation and harmonic mixing issue haven’t been completed Based on the MSD for DC\_41\_n78, the exception can be specified as below.

Table 6.62.1.5-1: Reference sensitivity exceptions due to harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 70 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n78 | n412 |  | 10.4 | 10.4 | 10.4 |  |  | 8.2 | 7.6 | 7.3 |  | 6.6 | 6.4 | 6.3 |
| NOTE 1: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (high) band (superscript HB) such that in MHz and  with carrier frequency in the victim (lower) band in MHz and  the channel bandwidth configured in the higher band.  NOTE 3: These requirements apply when there is at least one individual RE within the downlink transmission bandwidth of the victim (lower) band for which the 3rd harmonic is within the uplink transmission bandwidth or the uplink adjacent channel's transmission bandwidth of an aggressor (higher) band.  NOTE 4: The requirements should be verified for UL NR-ARFCN of the aggressor (higher) band (superscript HB) such that  in MHz and  with  the carrier frequency in the victim (lower) band and  the channel bandwidth configured in the higher band. | | | | | | | | | | | | | | |

Table 6.62.1.5-2: Uplink configuration for reference sensitivity exceptions due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | | SCS  (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| n78 | n41 | | 30 |  | 50 | 50 | 50 |  | 50 | 50 | 50 | 50 |  | 50 | 50 | 50 |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies. | | | | | | | | | | | | | | | | |

Table 6.62.1.5-3: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | | |
| NR CA Configuration | | UL band | DL band | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 70 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n41A-n78A | | n41 | n78 |  | 8.3 | 8.3 | 8.3 | 7.3 | 6.5 | 6.3 | 5.3 | 4.5 | 4.3 | 4.0 | 3.9 | 3.8 |
| n78 | n411 |  | 4.5 | 4.5 | 4.5 |  | 4.5 | 4.5 | 4.5 | 4.5 |  | 4.5 | 4.5 | 4.5 |
| NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.  NOTE 2: Void | | | | | | | | | | | | | | | | |

Table 6.62.1.5-4: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| n41 | n78 | 15 |  | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| n78 | n41 | 30 |  | 270 | 270 | 270 |  | 270 | 270 | 270 | 270 |  | 270 | 270 | 270 |
| NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies.  NOTE 2: Refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1. | | | | | | | | | | | | | | | |

### 6.62.2 Specific for 2 bands UL CA

#### 6.62.2.1 UE co-existence studies

Table 6.62.2.1-1 gives IMD interference analysis for CA\_n41-n78 with 2 ULs.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 2496 | 2690 | 3300 | 3800 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 4992 | 5380 | 6600 | 7600 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 7488 | 8070 | 9900 | 11400 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 9984 | 10760 | 13200 | 15200 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 12480 | 13450 | 16500 | 19000 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 610 | 1304 | 5796 | 6490 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1192 | 2080 | 3910 | 5104 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 8292 | 9180 | 9096 | 10290 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3688 | 4770 | 7210 | 8904 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 10788 | 11870 | 12396 | 14090 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2608 | 1220 | 11592 | 12980 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 12704 | 10510 | 7460 | 6184 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 6408 | 4520 | 1470 | 112 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 15696 | 17890 | 13284 | 14560 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 14892 | 16780 | 14088 | 15670 |

For TDD combination CA\_n41-n78, no IMD interference will fall into Rx.

Table 6.62.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.62.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Spurious emission | | | | | | |
| Protected Band | Frequency range (Mhz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n41-n78 | E-UTRA Band 1, 3, 5, 8, 26, 28, 34, 39, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 11, 18, 19, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 10 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3, 10 |
| NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  NOTE 10: This requirement applies when the NR carrier is confined within 2545 - 2575 MHz or 2595 – 2645vMHz and the channel bandwidth is 10 or 20 MHz. | | | | | | | |

#### 6.62.2.2 REFSENS requirements

There is no additional IMD exception requirements for two UL CA\_n41A-n78A

## 6.63 n1-n40

### 6.63.1 Common for 1 band UL and 2 bands UL CA

#### 6.63.1.1 Operating bands for CA

Table 6.63.1.1-1: CA band combination of band n1 and n40

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n1 | 1920 MHz | – | 1980 MHz | 2110 MHz | – | 2170 MHz | FDD |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

#### 6.63.1.2 Channel bandwidths per operating band for CA

Table 6.63.1.2-1: Supported bandwidths per CA band combination of band n1 and n40

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n1A-n40A | CA\_n1A-n40A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 100 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |

#### 6.63.1.3 UE co-existence studies

Table 6.63.1.3-1 lists up to 7th harmonics for n1A-n40A. As can be seen there are no harmonic issues.

**Table 6.63.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n1 | 1920 | 1980 | 3840 | 3960 | 5760 | 5940 | 7680 | 7920 | 9600 | 9900 | 11520 | 11880 | 13440 | 13860 |
| n40 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 | 9200 | 9600 | 11500 | 12000 | 13800 | 14400 | 16100 | 16800 |

Table 6.63.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. As can be seen there are no harmonic mixing issues.

Table 6.63.1.3-2 Harmonic mixing for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n1 | 1920 | 1980 | 2110 | 2170 | 4220 | 4340 | 6330 | 6510 | 8440 | 8680 |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 | 9200 | 9600 |

#### 6.63.1.4 ∆TIB and ∆RIB values

For CA\_n1-n40, the ΔTIB,c and ΔRIB,c values are derived from LTE combination CA\_1-40 and are given in the tables below.

**Table 6.63.1.4-1: ΔTIB,c**

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n40 | n1 | 0.5 |
| n40 | 0.5 |

**Table 6.63.1.4-2: ΔRIB,c**

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n1-n40 | n1 | 0 |
| n40 | 0 |

#### 6.63.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.63.1.3 there are no harmonics issues.

### 6.63.2 Specific for 2 bands UL CA

#### 6.63.2.1 UE co-existence studies

Table 6.63.2.1-1 lists Band n1 + Band n40 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.63.2.1-1: Band n1 and Band n40 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1920 | 1980 | 2300 | 2400 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 3840 | 3960 | 4600 | 4800 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 5760 | 5940 | 6900 | 7200 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 7680 | 7920 | 9200 | 9600 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 9600 | 9900 | 11500 | 12000 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 11520 | 11880 | 13800 | 14400 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 13440 | 13860 | 16100 | 16800 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 480 | 320 | 4220 | 4380 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1440 | 1660 | 2620 | 2880 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 6140 | 6360 | 6520 | 6780 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 960 | 640 | 8440 | 8760 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3360 | 3640 | 4920 | 5280 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 8060 | 8340 | 8820 | 9180 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 7680 | 7220 | 5620 | 5280 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11120 | 11580 | 9980 | 10320 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 3360 | 2940 | 1340 | 960 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 10740 | 11160 | 10360 | 10740 |

Based on Table 6.63.2.1-1 there are no IMD issues affecting own Rx frequencies.

Table 6.63.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1, and with same bands as for DC\_1\_n40 in TS 38.101-3.

**Table 6.63.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n1-n40 | E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 38, 41, 42, 43, 44, 45, 50, 51, 52, 65, 67, 68, 69, 72, 73, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Band 3, 34 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| Frequency range | 1880 |  | 1895 | -40 | 1 | 4, 14 |
| Frequency range | 1895 |  | 1915 | -15.5 | 5 | 4, 7, 14 |
| Frequency range | 1915 |  | 1920 | +1.6 | 5 | 4, 7, 14 |
| NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 14: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies. | | | | | | | |

#### 6.63.2.2 REFSENS requirements

There is a need to define MSD for CA\_n1-n40. Same MSD values as for DC\_1\_n40.

Table 6.63.2.2-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| NR CA Configuration | UL band | DL band | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n1-n40 | n40 | n1 | 8.3 | 8.3 | 8.3 | 8.3 |  |  |  |  |  |  |  |  |
| CA\_n1-n40 | n1 | n40 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 |  |  |

Table 6.63.2.2-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n40 | n1 | 30 | 25 | 50 | 75 | 100 |  |  |  |  |  |  |  |  |
| n1 | n40 | 15 | 25 | 50 | 75 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |  |  |

## 6.64 n28-n40

### 6.64.1 Common for 1 band UL and 2 bands UL CA

#### 6.64.1.1 Operating bands for CA

Table 6.64.1.1-1: CA band combination of band n28 and n40

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n40 | 2300 MHz | – | 2400 MHz | 2300 MHz | – | 2400 MHz | TDD |

#### 6.64.1.2 Channel bandwidths per operating band for CA

Table 6.64.1.2-1: Supported bandwidths per CA band combination of band n28 and n40

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n28A-n40A | CA\_n28A-n40A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 100 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n40 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |

#### 6.64.1.3 UE co-existence studies

Table 6.64.1.3-1lists up to 7th harmonics for n28A-n40A.

Table 6.64.1.3-1: Harmonic Interference for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n28 | 703 | 748 | 758 | 803 | 1406 | 1496 | 2109 | 2244 | 2812 | 2992 |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 | 9200 | 9600 |

Table 6.64.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. It can be seen that 3rd harmonic DL mixing from band n28 DL will affect band n40 UL.

Table 6.64.1.3-2 Harmonic mixing for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n28 | 703 | 748 | 758 | 803 | 1516 | 1606 | 2274 | 2409 | 3032 | 3212 |
| n40 | 2300 | 2400 | 2300 | 2400 | 4600 | 4800 | 6900 | 7200 | 9200 | 9600 |

#### 6.64.1.4 ∆TIB and ∆RIB values

For CA\_n28-n40, the ΔTIB,c and ΔRIB,c values are derived from CA\_28-40 and are given in the tables below.

**Table 6.64.1.4-1: ΔTIB,c**

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n28-n40 | n28 | 0.3 |
| n40 | 0.3 |

**Table 6.64.1.4-2: ΔRIB,c**

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n28-n40 | n28 | 0 |
| n40 | 0 |

#### 6.64.1.5 REFSENS requirements

Additional REFSENS requirements are needed to be defined in tables below in TS 38.101-1 due to 3rd harmonic DL mixing from band n28 UL affecting band n40 DL. Values are reused from CA\_28-40.

Table 6.64.1.5-1: Reference sensitivity exceptions due to harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n40 | n284 | 37.8 | 34.8 | 33 | 30.3 |  |  |  |  |  |  |  |
| NOTE 4: The requirements should be verified for UL NR-ARFCN of the aggressor (higher) band (superscript HB) such that  in MHz and  with  the carrier frequency in the victim (lower) band and  the channel bandwidth configured in the higher band. | | | | | | | | | | | | |

Table 6.64.1.5-2: Uplink configuration for reference sensitivity exceptions due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | |
| UL band | DL band | SCS  (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |
| n40 | n28 | 15 | 25 | 50 | 75 | 100 |  |  |  |  |  |  |  |

### 6.64.2 Specific for 2 bands UL CA

#### 6.64.2.1 UE co-existence studies

Table 6.64.2.1-1 lists Band n28 + Band n40 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.64.2.1-1: Band n28 and Band n40 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1697 | 1552 | 3003 | 3148 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 994 | 804 | 3852 | 4097 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 3706 | 3896 | 5303 | 5548 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 3394 | 3104 | 6006 | 6296 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 291 | 56 | 6152 | 6497 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 4409 | 4644 | 7603 | 7948 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8897 | 8452 | 692 | 412 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 9903 | 10348 | 5112 | 5392 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 5794 | 5404 | 2356 | 2691 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 8306 | 8696 | 6709 | 7044 |

Based on Table 6.64.2.1-1 there are no IMD issues affecting own Rx frequencies.

Table 6.64.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1, and with same bands as for DC\_8\_n40 in TS 38.101-3.

**Table 6.64.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n28-n40 | E-UTRA Band 3, 5, 7, 8, 20, 26, 27, 31, 34, 38, 41, 72 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 22, 32, 42, 43, 50, 51, 52, 65, 73, 74, 75, 76  NR band n77, n78, n79 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. | | | | | | | |

#### 6.64.2.2 REFSENS requirements

There are no additional REFSENS requirements needed for 2 bands UL.

## 6.65 n46-n48

### 6.65.1 Common for 1 band UL and 2 bands UL CA

#### 6.65.1.1 Operating bands for CA

Table 6.65.1.1-1: CA band combination of band n46 and n48

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n46 | 5150 MHz | – | 5925 MHz | 5150 MHz | – | 5925 MHz | TDD |
| n48 | 3550 MHz | – | 3700 MHz | 3550 MHz | – | 3700 MHz |

#### 6.65.1.2 Channel bandwidths per operating band for CA

Table 6.65.1.2-1: Supported bandwidths per CA band combination of band n46 and n48

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configuration | Uplink Configurations | NR Band | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Maximum  Aggregated bandwidth  (MHz) | Bandwidth combination set |
| CA\_n46A-n48A | CA\_n46A-n48A | n46 | 20 |  |  |  | 40 | 0 |
| n48 | 20 |  |  |  |
| CA\_n46B-n48A | CA\_n46A-n48A | n46 | 20,40,60 | 20,40 |  |  | 120 | 0 |
| n48 | 20 |  |  |  |
| CA\_n46C-n48A | CA\_n46A-n48A | n46 | 60,80 | 60,80 |  |  | 180 | 0 |
| n48 | 20 |  |  |  |
| CA\_n46D-n48A | CA\_n46A-n48A | n46 | 60,80 | 80 | 80 |  | 260 | 0 |
| n48 | 20 |  |  |  |
| CA\_n48A-n46E | CA\_n46A-n48A | n46 | 80 | 80 | 80 | 80 | 340 | 0 |
| n48 | 20 |  |  |  |

#### 6.65.1.3 UE co-existence studies

Table 6.65.1.3-1 lists up to 7th harmonics for n46A-n48A.

**Table 6.65.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n46 | 5150 | 5925 | 10300 | 11850 | 15450 | 17775 | 20600 | 23700 | 25750 | 29625 | 30900 | 35550 | 36050 | 41475 |
| n48 | 3550 | 3700 | 7100 | 7400 | 10650 | 11100 | 14200 | 14800 | 17750 | 18500 | 21300 | 22200 | 24850 | 25900 |

#### 6.65.1.4 ∆TIB and ∆RIB values

For CA\_n46-n48, the ΔTIB,c and ΔRIB,c values are derived from LTE combination CA\_46-48 and are given in the tables below.

**Table 6.65.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n46-n48 | n46 | 0 |
| n48 | 0.8 |

**Table 6.65.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n46-n48 | n46 | 0 |
| n48 | 0.5 |

#### 6.65.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.65.1.3 there are no harmonics issues.

### 6.65.2 Specific for 2 bands UL CA

#### 6.65.2.1 UE co-existence studies

Table 6.65.2.1-1 lists Band n46 + Band n48 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.65.2.1-1: Band n46 and Band n48 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 5150 | 5925 | 3550 | 3700 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 10300 | 11850 | 7100 | 7400 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 15450 | 17775 | 10650 | 11100 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 20600 | 23700 | 14200 | 14800 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 25750 | 29625 | 17750 | 18500 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 30900 | 35550 | 21300 | 22200 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 36050 | 41475 | 24850 | 25900 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 1450 | 2375 | 8700 | 9625 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 6600 | 8300 | 1175 | 2250 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 13850 | 15550 | 12250 | 13325 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2900 | 4750 | 17400 | 19250 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 9525 | 14225 | 4725 | 5950 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 19000 | 21475 | 15800 | 17025 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 9650 | 10500 | 20150 | 16900 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 19350 | 20725 | 24150 | 27400 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 800 | 1200 | 10675 | 8050 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 20950 | 22950 | 22550 | 25175 |

Based on Table 6.65.2.1-1 there are no IMD issues affecting own Rx frequencies of either band n46 or band n48.

Table 6.65.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1

**Table 6.65.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **E-UTRA and NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n48\_n46 | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 50, 51, 66, 70, 71, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | | | | | | | |

#### 6.65.2.2 Reference sensitivity exceptions due to Cross band isolation for NR-CA in NR FR1

Table 6.65.2.2-1: Reference sensitivity exceptions (MSD) due to cross band isolation for NR-CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n48 | n46 | - | - | - | 7 | - | - | 5.7 | - | 5.1 | 4.7 | - | - |
| n46 | n48 | 13.3 | 10.4 | 8.8 | 7.8 | - | - | 7.8 | 7 | 6.5 | 5.7 | 5.4 | 5.1 |

Table 6.65.2.2-2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for NR-CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 80 MHz | 90 MHz | 100 MHz |  |
| n48 | n46 | 15 |  |  |  | 216 |  |  | 216 |  | 216 | 216 |  |  |  |
| n46 | n48 | 30 | 216 | 216 | 216 | 216 |  |  | 216 | 216 | 216 | 216 | 216 | 216 |  |

Assumptions:

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Unit** |
| Antenna isolation | 10 | dB |
| filter minimum rejection from B48/n48 to n46 and vice versa. | 33 | dB |
| Front-end loss | 4 | dB |
| Thermal noise at B48/n48 RX ANT port | -166 | dBm/Hz |
| Thermal noise at n46 RX ANT port | -163 | dBm/Hz |
| Transceiver effective phase noise | -150 | dBc/Hz |
| PA output noise at receiver freq range | -130 | dBm/Hz |
| SNR requirement for QPSK | -1 | dB |

## 6.66 n25-n46

### 6.66.1 Common for 1 band UL and 2 bands UL CA

#### 6.66.1.1 Operating bands for CA

Table 6.66.1.1-1: CA band combination of band n25 and n46

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| n46 | 5150 MHz | – | 5925 MHz | 5150 MHz | – | 5925 MHz | TDD |

#### 6.66.1.2 Channel bandwidths per operating band for CA

Table 6.66.1.2-1: Supported bandwidths per CA band combination of band n25 and n46

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n25A-n46A | - | n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n46 | 15 |  |  |  | Yes |  |  | Yes |  |  |  |  |  |
| 30 |  |  |  | Yes |  |  | Yes |  | Yes | Yes |  |  |
| 60 |  |  |  | Yes |  |  | Yes |  | Yes | Yes |  |  |

#### 6.66.1.3 UE co-existence studies

Table 6.66.1.3-1 lists up to 7th harmonics for n25A-n46A.

**Table 6.66.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n25 | 1850 | 1915 | 3700 | 3830 | 5550 | 5745 | 7400 | 7660 | 9250 | 9575 | 11100 | 11490 | 12950 | 13405 |
| n46 | 5150 | 5925 | 10300 | 11850 | 15450 | 17775 | 20600 | 23700 | 25750 | 29625 | 30900 | 35550 | 36050 | 41475 |

#### 6.66.1.4 ∆TIB and ∆RIB values

For CA\_n25-n46, the ΔTIB,c and ΔRIB,c values are derived from LTE combination CA\_25-46 and are given in the tables below.

**Table 6.66.1.4-1: ΔTIB,c**

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n46 | n25 | 0 |
| n46 | 0 |

**Table 6.66.1.4-2: ΔRIB,c**

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n46 | n25 | 0 |
| n46 | 0 |

#### 6.66.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.66.1.3 there are 3rd harmonics issues from n25 UL into the n46 DL.

MSD for CA\_n25-n46 is proposed to be defined like in table below, where Note 1 in Table 6.66.1.5-1 is derived from Note 5 in TS36.101 Table 7.3.1A-0eA.

The Table 6.66.1.5-2 is derived from TS36.101 Table 7.3.1A-0eC.

**Table 6.66.1.5-1:** **Reference sensitivity QPSK PREFSENS (CA with n46)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | |
| UL band | DL band | 5  MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n25 | n46 |  |  |  | N/A |  | N/A |  | N/A | N/A |  |  |
| n46 | n25 | 26.5 | 26.5 | 26.5 | 26.5 |  |  |  |  |  |  |  |
| NOTE 1: These requirements do not apply when there is at least one individual RE within the downlink (victim) transmission bandwidth which falls into the reference sensitivity exclusion region as specified in Table 6.66.1.5-2. | | | | | | | | | | | | |

**Table 6.66.1.5-2:** **n46 Reference sensitivity measurement exclusion region in MHz**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Licensed Component Carriers / E-UTRA Band / Harmonic order / Channel BW in UL | | | | | | |
| Band | Harmonic order | 5MHz | 10MHz | 15MHz | 20MHz | 40MHz |
| n25 | 3 | +/- 15 | +/- 23 | +/- 35 | +/- 45 | +/- 90 |
| NOTE 1: Even though UL harmonic does not fall directly into n46 the exclusion region still applies.  NOTE 2: The center of the exclusion region is obtained by multiplying the uplink channel center frequency by the harmonic order. | | | | | | |

## 6.67 n46-n66

### 6.67.1 Common for 1 band UL and 2 bands UL CA

#### 6.67.1.1 Operating bands for CA

Table 6.67.1.1-1: CA band combination of band n46 and n66

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |
| n46 | 5150 MHz | – | 5925 MHz | 5150 MHz | – | 5925 MHz | TDD |

#### 6.67.1.2 Channel bandwidths per operating band for CA

Table 6.67.1.2-1: Supported bandwidths per CA band combination of band n46 and n66

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n46A-n66A | - | n46 | 15 |  |  |  | Yes |  |  | Yes |  |  |  |  |  | 0 |
| 30 |  |  |  | Yes |  |  | Yes |  | Yes | Yes |  |  |
| 60 |  |  |  | Yes |  |  | Yes |  | Yes | Yes |  |  |
| n66 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |

#### 6.67.1.3 UE co-existence studies

Table 6.67.1.3-1 lists up to 7th harmonics for n46A-n66A.

**Table 6.67.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n46 | 5150 | 5925 | 10300 | 11850 | 15450 | 17775 | 20600 | 23700 | 25750 | 29625 | 30900 | 35550 | 36050 | 41475 |
| n66 | 1710 | 1780 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 | 8550 | 8900 | 10260 | 10680 | 11970 | 12460 |

#### 6.67.1.4 ∆TIB and ∆RIB values

For CA\_n46-n66, the ΔTIB,c and ΔRIB,c values are derived from LTE combination CA\_46-66 and are given in the tables below.

**Table 6.67.1.4-1: ΔTIB,c**

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n46-n66 | n46 | 0 |
| n66 | 0 |

**Table 6.67.1.4-2: ΔRIB,c**

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n46-n66 | n46 | 0 |
| n66 | 0 |

#### 6.67.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.67.1.3 there are 3rd harmonics issues from n66 UL into the n46 DL

MSD for CA\_n46-n66 is proposed to be defined like in table below, where Note 1 in Table 6.67.1.5-1 is derived from Note 5 in TS36.101 Table 7.3.1A-0eA.

The Table 6.67.1.5-2 is derived from TS36.101 Table 7.3.1A-0eC.

**Table 6.67.1.5-1:** **Reference sensitivity QPSK PREFSENS (CA with n46)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA or NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | |
| UL band | DL band | 5  MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n66 | n46 |  |  |  | N/A |  | N/A |  | N/A | N/A |  |  |
| NOTE 1: These requirements do not apply when there is at least one individual RE within the downlink (victim) transmission bandwidth which falls into the reference sensitivity exclusion region as specified in Table 6.67.1.5-2. | | | | | | | | | | | | |

**Table 6.67.1.5-2:** **n46 Reference sensitivity measurement exclusion region in MHz**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Licensed Component Carriers / E-UTRA Band / Harmonic order / Channel BW in UL | | | | | | |
| Band | Harmonic order | 5MHz | 10MHz | 15MHz | 20MHz | 40MHz |
| n66 | 3 | +/- 15 | +/- 23 | +/- 35 | +/- 45 | +/- 90 |
| NOTE 1: Even though UL harmonic does not fall directly into n46 the exclusion region still applies.  NOTE 2: The center of the exclusion region is obtained by multiplying the uplink channel center frequency by the harmonic order. | | | | | | |

## 6.68 CA\_n2-n77

### 6.68.1 Common for 1 band UL and 2 bands UL CA

#### 6.68.1.1 Operating bands for CA

**Table 6.68.1.1-1: CA band combination of band n2+n77**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n2-n77 | n2 | 1850 MHz | – | 1910 MHz | 1930 MHz | – | 1990 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

#### 6.68.1.2 Channel bandwidths per operating band for CA

**Table 6.68.1.2-1: Supported NR bandwidths per CA configuration of band n2+n77**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **CA operating / channel bandwidth** | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL CA Configuration** | **Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **70**  **MHz** | **80**  **MHz** | **90 MHz** | **100 MHz** | **BCS** |
| CA\_n2A-n77A | CA\_n2A-n77A | n2 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.68.1.3 UE co-existence studies

Table 6.68.1.3-1 and Table 6.68.1.3-2 capture the UL 2nd, 3rd, 4th and 5th harmonics and harmonic mixing for CA\_n2A-n77A.

**Table 6.68.1.3-1: Band n2 and Band n77 UL harmonics products**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n2 | 1850 | 1910 | 1930 | 1990 | 3700 | 3820 | 5550 | 5730 | 7400 | 7640 | 9250 | 9550 |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 16800 | 16800 | 16500 | 21000 |

**Table 6.68.1.3-2: Band n2 and Band n77 UL harmonic mixing products**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| n2 | 1850 | 1910 | 1930 | 1990 | 3860 | 3980 | 5790 | 5970 | 7720 | 7960 | 9650 | 9550 |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 13200 | 16800 | 16500 | 21000 |

In analysis, it could be seen,

* The 2nd harmonic interference from band n2 UL may fall into band n77 DL frequency range.
* The 2nd harmonic mixing products from band n2 may fall into band n77 DL frequency range.

The MSD should be considered to mitigate the impact of the interference for this combination.

#### 6.68.1.4 ∆TIB and ∆RIB values

For CA\_n2-n77, the ΔTIB,c and ΔRIB,c values are given in the tables below.

**Table 6.68.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n77 | n2 | 0.6 |
| n77 | 0.8 |

**Table 6.68.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n2-n77 | n2 | 0.2 |
| n77 | 0.5 |

#### 6.68.1.5 REFSENS requirements

MSD values for band n77 due to 2nd harmonic of band n2 in combo CA\_n2A-n77A are captured in Table 6.68.1.5-1.

**Table 6.68.1.5-1: MSD due to harmonic issue for CA\_n2-n77**

| MSD due to harmonic exception for the DL band | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 70 MHz  (dB) | | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n2 | n771, 2 |  | 23.9 | 22.1 | 20.9 | 19.8 | 19.0 | 17.9 | 16.8 | 16.0 | 15.5 | 14.8 | | 14.3 | 13.8 |
| n773 |  | 1.1 | 0.8 | 0.3 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ∆FHD above and below the edge of this downlink transmission bandwidth. The value ∆FHD depends on the band combination: ∆FHD = 10 MHz for CA\_n1-n77, CA\_n2-n77, CA\_n2-n78, CA\_n3-n77, CA\_n3-n78, CA\_n2-n48, CA\_n25-n78, CA\_n48-n66, CA\_n66-n78  NOTE 2: The requirements should be verified for UL EARFCN or NR ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively. | | | | | | | | | | | | | | | |

The uplink configuration for reference sensitivity exceptions due to UL harmonic interference for the combo CA\_n2A-n77A are captured in Table 6.68.1.5-2.

**Table 6.68.1.5-2 Uplink configuration due to UL harmonic interference**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | NR Band / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | |
| UL band | DL band | 5  MHz  (LCRB) | 10 MHz  (LCRB) | 15 MHz  (LCRB) | 20 MHz  (LCRB) | 25 MHz  (LCRB) | 30 MHz  (LCRB) | 40 MHz  (LCRB) | 50 MHz  (LCRB) | 60 MHz  (LCRB) | 70 MHz  (LCRB) | 80 MHz  (LCRB) | 90 MHz  (LCRB) | 100 MHz  (LCRB) |
| n2 | n77 |  | 25 | 36 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

Sensitivity degradation is allowed for the impact to the received harmonic mixing to the victim band n2 DL frequency range in the configuration of CA\_n2A-n77A. Reference sensitivity exceptions are captured in Table 6.68.1.5-3.

Table 6.68.1.5-3: MSD due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | |
| UL band | DL band | 5  MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 70 MHz  (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n77 | n2 | 6.7 | 5.0 | 4.0 | 3.7 |  |  |  |  |  |  |  |  |

The uplink configuration of the aggressor band are captured in Table 6.68.1.5-4.

Table 6.68.1.5-4: Uplink configuration due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | NR Band / SCS / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | | |
| UL band | DL band | | SCS of UL band  (kHz) | 5 MHz  (LCRB) | 10 MHz  (LCRB) | 15 MHz  (LCRB) | 20 MHz  (LCRB) | 25 MHz  (LCRB) | 40 MHz  (LCRB) | 50 MHz  (LCRB) | 60 MHz  (LCRB) | 70 MHz  (LCRB) | 80 MHz  (LCRB) | 90 MHz  (LCRB) | 100 MHz  (LCRB) |
| n77 | n2 | | 15 | 25 | 50 | 75 | 100 |  |  |  |  |  |  |  |  |

### 6.68.2 Specific for 2 bands UL CA

#### 6.68.2.1 UE co-existence studies

Table 6.68.2.1-1 lists band n2+band n77 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.68.2.1-1: Band n2 and Band n77 2 UL bands IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1850 | 1910 | 3300 | 4200 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 1390 | 2350 | 5150 | 6110 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | 2\*fx\_high – fy\_low | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 500 | 520 | 4690 | 6550 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 7000 | 8020 | 8450 | 10310 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 1350 | 2430 | 7990 | 10750 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 8850 | 9930 | 11750 | 14510 |
| Two-tone 4th order IMD products | |2\*fx\_low – 2\*fy\_high| | |2\*fx\_high – 2\*fy\_low| | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 4700 | 2780 | 10300 | 12220 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 14950 | 11290 | 4340 | 3200 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 15050 | 18710 | 10700 | 11840 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 8900 | 6080 | 870 | 2850 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 13600 | 16420 | 12150 | 14130 |

* The 2nd and 4th order IMD products from band n2 UL, and 5th band n77 UL may fall into band their own DL frequency range
* The 5th order IMD of band n77 UL may fall into Rx frequency of band n2

The MSD should be considered to mitigate the impact of the interference for this combination.

Table 6.68.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.68.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA combination | Spurious emission | | | | | | |
| Protected Band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n2-n77 | E-UTRA Band 4, 5, 12, 13, 14, 17, 26, 29, 30, 41, 65, 66, 70, 71 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x RBsize kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. | | | | | | | |

#### 6.68.2.2 REFSENs requirements

Table 6.68.2.2-1 lists the MSD required for the dual connectivity configuration due to IMD2.

Based on above coexistence study, two-tone 2nd and 4th order IMD products may fall into the own Rx of Band n2, and two-tone 5th order IMD products may fall into the Rx of Band n2. The MSD for IMD2 and IMD4 are,

Table 6.68.2.2-1: MSD due to IMD issue

|  | Operating band/ Channel bandwidth / NRB / Duplex mode | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA  Configuration | Operating band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | Duplex mode | IMD order |
| CA\_n2A-n77A | n2 | 1855 | 5 | 25 | 1935 | 26 | FDD | IMD2 |
| 28.75 |
| n77 | 3790 | 10 | 50 | 3790 | N/A | TDD | N/A |
| n2 | 1885 | 5 | 25 | 1965 | 8.0 | FDD | IMD4 |
| 10.75 |
| n77 | 3690 | 10 | 50 | 3690 | N/A | TDD | N/A |
| n2 | 1885 | 5 | 25 | 1965 | [5] | FDD | IMD5 |
| n77 | 3790 | 10 | 50 | 3790 | N/A | TDD | N/A |
| NOTE 5: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured. | | | | | | | | |

## 6.69 CA\_n5-n77

### 6.69.1 Common for 1 band UL and 2 bands UL CA

#### 6.69.1.1 Operating bands for CA

**Table 6.69.1.1-1: CA band combination of band n5+n77**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n5-n77 | n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

#### 6.69.1.2 Channel bandwidths per operating band for CA

**Table 6.69.1.2-1: Supported NR bandwidths per CA configuration of band n5+n77**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **CA operating / channel bandwidth** | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL CA Configuration** | **Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **70**  **MHz** | **80**  **MHz** | **90 MHz** | **100 MHz** | **BCS** |
| CA\_n5A-n77A | CA\_n5A-n77A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.69.1.3 UE co-existence studies

Table 6.69.1.3-1 and Table 6.69.1.3-2 capture the UL 2nd, 3rd, 4th, 5th harmonics and harmonic mixing for CA\_n5A-n77A.

**Table 6.69.1.3-1: Band n5 and Band n77 UL harmonics products**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n5 | 824 | 849 | 869 | 894 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 | 4120 | 4245 |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 13200 | 16800 | 16500 | 21000 |

**Table 6.69.1.3-2: Band n5 and Band n77 Harmonic mixing products**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| n5 | 824 | 849 | 869 | 894 | 1738 | 1788 | 2607 | 2682 | 3476 | 3576 | 4345 | 4470 |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 13200 | 16800 | 16500 | 21000 |

In analysis, it could be seen,

* The 4th and 5th harmonic interferences from band n5 UL may fall into band n77 DL frequency range
* The 4nd harmonic mixing products from band n5 may fall into band n77 DL frequency range

The MSD should be considered to mitigate the impact of the interference for this combination.

For US operation, the 4th and 5th harmonic and harmonic mixing products from band n5 to band n77 DL are out of the US C-band frequency range. Therefore, there is no MSD considering the US deployment range (3700-3980MHz) inside the n77 band.

#### 6.69.1.4 ∆TIB and ∆RIB values

For the CA\_n5-n77, the ΔTIB,c and ΔRIB,c values are given in the tables below.

**Table 6.69.1.4-1: ΔTIB,c**

| Inter-band DA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n77 | n5 | 0.6 |
| n77 | 0.8 |

**Table 6.69.1.4-2: ΔRIB,c**

| Inter-band DC Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n77 | n5 | 0.2 |
| n77 | 0.5 |

#### 6.69.1.5 REFSENS requirements

For US operation, the 4th and 5th harmonic and harmonic mixing products from band n5 to band n77 DL are out of the US C-band frequency range. Therefore, there is no MSD considering the US deployment range (3700-3980MHz) inside the n77 band.

MSD values for Band n77 due to harmonic of Band n5 for CA\_n5A-n77A are captured in Table 6.69.1.5-1.

**Table 6.69.1.5-1: MSD due to UL harmonic issue for CA\_n5-n77**

|  | NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 70 MHz (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n5 | n774, 5 |  | 10.5 | 8.9 | 7.8 | 7.2 | 6.5 | 5.1 | 4.2 | 3.5 | 2.8 | 2.3 | 2.1 | 1.4 |
| n5 | n776,7 |  | 10.4 | 8.9 | 7.8 | 7.4 | 6.5 | 4.7 | 3.7 | 3 | 2.35 | 1.7 | 1.2 | 0,7 |
|  | NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.  NOTE 5: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 6: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 5th transmitter harmonic is within the downlink transmission bandwidth of a high band.  NOTE 7: The requirements should be verified for UL NR‑ARFCN of a low band (superscript LB) such that in MHz and with the carrier frequency of a high band in MHz and the channel bandwidth configured in the low band. | | | | | | | | | | | | | |

The uplink configuration for reference sensitivity exceptions due to UL harmonic interference for CA\_n5A-n77A are captured in Table 6.69.1.5-2.

**Table 6.69.1.5-2 Uplink configuration due to UL harmonic interference**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | NR Band / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | |
| UL band | DL band | 5  MHz  (LCRB) | 10 MHz  (LCRB) | 15 MHz  (LCRB) | 20 MHz  (LCRB) | 25 MHz  (LCRB) | 30 MHz  (LCRB) | 40 MHz  (LCRB) | 50 MHz  (LCRB) | 60 MHz  (LCRB) | 70 MHz  (LCRB) | 80 MHz  (LCRB) | 90 MHz  (LCRB) | 100 MHz  (LCRB) |
| n5 | n77 | - | 16 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

Sensitivity degradation is allowed for the impact to the received harmonic mixing due to n5 UL to the victim band n77 DL frequency range in the configuration of CA\_n5A-n77A. Reference sensitivity exceptions are captured in Table 6.69.1.5-3.

Table 6.69.1.5-3: MSD due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **MSD due to harmonic exception for the DL band** | | | | | | | | | | | | |
| **UL band** | | **DL band** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **70**  **MHz** | **80**  **MHz** | **100**  **MHz** |
| **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** | **dB** |
| n77 | | n5 | 5.7 | 4.0 | 3.0 | 2.7 |  |  |  |  |  |  |  |

The uplink configuration of the aggressor band n5 are captured in Table 6.69.1.5-4.

Table 6.69.1.5-4: Uplink configuration due to receiver harmonic mixing for CA in NR FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **5 MHz** | **10 MHz** | **15 MHz** | **20 MHz** | **25 MHz** | **40 MHz** | **50 MHz** | **60 MHz** | **70 MHz** | **80 MHz** | **100 MHz** |
| n77 | n5 | 25 | 25 | 20 | 20 |  |  |  |  |  |  |  |

### 6.69.2 Specific for 2 bands UL CA

#### 6.69.2.1 UE co-existence studies

Table 6.69.2.1-1 lists Band n5 +Band n77 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.69.2.1-1: Band n5 and Band n77 2 UL bands IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 2451 | 3376 | 4124 | 5049 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 2552 | 1602 | 5751 | 7576 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 4948 | 5898 | 7424 | 9249 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 1728 | 753 | 9051 | 11776 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 5772 | 6747 | 10724 | 13449 |
| Two-tone 4th order IMD products | |2\*fx\_low – 2\*fy\_high| | |2\*fx\_high – 2\*fy\_low| | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 6752 | 4902 | 8248 | 10098 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 15976 | 12351 | 96 | 904 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 14024 | 17649 | 6596 | 7596 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 10952 | 8202 | 4053 | 5928 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 11548 | 14298 | 9072 | 10947 |

There are no IMD products fell in the US C-band frequency range (3700-3980MHz). The IMD issue discussed below is for the band n77, and out of the frequency range of US C-band.

Based on the Table 6.69.2.1-1, it could be seen,

* The 4th order IMD from band n5 UL may fall into own Rx band frequency range, and 2nd order IMD from Band n77 may fall into own Rx band frequency range.
* The 4th order IMD from band n5 may fall into band n77 DL frequency range,
* The 5th order IMD from band n77 may fall into band n5 DL frequency range

The MSD should be considered to mitigate the impact of the interference for this combination.

Table 6.69.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.69.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA combination | Spurious emission | | | | | | |
| Protected Band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n5-n77 | E-UTRA Band 2, 4, 12, 13, 14, 17, 25, 26, 28, 29, 30, 65, 66, 70, 71 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x RBsize kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 3: 15 kHz SCS is assumed when RB is mentioned in the note when channel bandwidth is less than or equal to 50 MHz, lowest SCS is assumed when channel bandwidth is larger than 50 MHz. The transmission bandwidth in terms of RB position and range is not limited to 15 kHz SCS and shall scale with SCS accordingly. | | | | | | | |

#### 6.69.2.2 REFSENs requirements

Table 6.69.2.2-1 lists the MSD required for the dual connectivity configuration due to IMD4. And, the IMD produces are outside of the frequency range of US C-band.

Based on above coexistence study, two-tone 2nd order IMD products may fall into the own Rx Band of Band n77, and two-tone 4th order IMD products may fall into the own Rx Band of Band n5. The n77 is a TDD band hence there is no issue for the case IMD products fall into own RX band. The MSD requirements for both IMD4 and IMD5 from band 77 UL may fall into band n5 Rx are listed in Table 6.69.2.2-1 for the dual connectivity configuration.

Table 6.69.2.2-1: MSD due to IMD issue

| NR or E-UTRA Band / Channel bandwidth / NRB / MSD | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EN-DC  Configuration | EUTRA or NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  LCRB | DL Fc (MHz) | MSD  (dB) | IMD order |
| CA\_n5A\_n77A | 5 | 844 | 5 | 25 | 889 | 8.3 | IMD4 |
| n77 | 3421 | 10 | 50 | 3421 | N/A | N/A |
| CA\_n5A\_n77A | 5 | 829 | 5 | 25 | 875 | [5.5] | IMD5 |
| n77 | 3600 | 10 | 50 | 3600 | N/A | N/A |

## 6.70 CA\_n66-n77

### 6.70.1 Common for 1 band UL and 2 bands UL CA

#### 6.70.1.1 Operating bands for CA

**Table 6.70.1.1-1: DC band combination of band n66+n77**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n66-n77 | n66 | 1710 MHz | – | 1780 MHz | 2110 MHz | – | 2200 MHz | FDD |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |

#### 6.70.1.2 Channel bandwidths per operating band for CA

**Table 6.70.1.2-1: Supported NR bandwidths per CA configuration of band n66+n77**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **DC operating / channel bandwidth** | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL CA Configuration** | **Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25**  **MHz** | **30**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **70**  **MHz** | **80**  **MHz** | **90 MHz** | **100 MHz** | **BCS** |
| CA\_n66A-n77A | CA\_n66A-n77A | n66 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n77 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

#### 6.70.1.3 UE co-existence studies

Table 6.70.1.3-1 and Table 6.70.1.3-2 capture the UL 2nd, 3rd, 4th, 5th harmonics and harmonic mixing for CA\_n66A-n77A.

**Table 6.70.1.3-1: Band n66 and Band n77 UL harmonics products**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | |
| n66 | 1710 | 1780 | 2110 | 2200 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 | 8550 | 8900 | |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 16800 | 16800 | 16500 | 21000 | |

**Table 6.70.1.3-2: Band n2 and Band n77 Harmonic mixing products**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** | **DL Low Band Edge** | **DL High Band Edge** |
| n66 | 1710 | 1780 | 2110 | 2200 | 4220 | 4400 | 6330 | 6600 | 8440 | 8800 | 10550 | 8900 |
| n77 | 3300 | 4200 | 3300 | 4200 | 6600 | 8400 | 9900 | 12600 | 13200 | 16800 | 16500 | 21000 |

In analysis, it could be seen,

* The 2nd harmonic from band n66 UL may fall into band n77 DL frequency range
* No harmonic mixing products will fall into band n77 DL frequency range

#### 6.70.1.4 ∆TIB and ∆RIB values

For CA\_n66-n77, the ΔTIB,c and ΔRIB,c values are given in the tables below.

**Table 6.70.1.4-1: ΔTIB,c**

| Inter-band DA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n77 | n66 | 0.6 |
| n77 | 0.8 |

**Table 6.70.1.4-2: ΔRIB,c**

| Inter-band DC Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n66-n77 | n66 | 0.2 |
| n77 | 0.5 |

#### 6.70.1.5 REFSENS requirements

MSD values for Band n77 due to 2nd harmonic of Band n66 in CA\_n66A-n77A are captured in Table 6.70.1.5-1.

**Table 6.70.1.5-1: MSD due to UL harmonic issue for CA\_n66-n77**

|  | NR Band / Channel bandwidth of the affected DL band / MSD | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | 5 MHz  (dB) | 10 MHz  (dB) | 15 MHz  (dB) | 20 MHz  (dB) | 25 MHz  (dB) | 30 MHz (dB) | 40 MHz  (dB) | 50 MHz  (dB) | 60 MHz  (dB) | 70 MHz (dB) | 80 MHz  (dB) | 90 MHz  (dB) | 100 MHz  (dB) |
| n66 | n771, 2 |  | 23.9 | 22.1 | 20.9 | 19.8 | 19.0 | 17.9 | 16.8 | 16.0 | 15.3 | 14.8 | 14.3 | 13.8 |
| n773 |  | 1.1 | 0.8 | 0.3 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|  | NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band and a range ∆FHD above and below the edge of this downlink transmission bandwidth. The value ∆FHD depends on the band combination: ∆FHD = 10 MHz for CA\_n1-n77, CA\_n2-n78, CA\_n3-n77, CA\_n3-n78, CA\_n2-n48, CA\_n25-n78, CA\_n48-n66, CA\_n66-n78, CA\_n66-n77.  NOTE 2: The requirements should be verified for UL EARFCN or NR ARFCN of the aggressor (lower) band (superscript LB) such that in MHz and  with carrier frequency in the victim (higher) band in MHz and the channel bandwidth configured in the lower band.  NOTE 3: The requirements are only applicable to channel bandwidths no larger than 20 MHz and with a carrier frequency at  MHz offset from  in the victim (higher band) with , whereandare the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively. | | | | | | | | | | | | | |

The uplink configuration for reference sensitivity exceptions due to UL harmonic interference for CA\_n66A-n77A are captured in Table 6.70.1.5-2.

**Table 6.70.1.5-2 Uplink configuration due to UL harmonic interference**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | NR Band / Channel bandwidth of the affected DL band / UL RB allocation of the agressor band | | | | | | | | | | | | |
| UL band | DL band | 5  MHz  (LCRB) | 10 MHz  (LCRB) | 15 MHz  (LCRB) | 20 MHz  (LCRB) | 25 MHz  (LCRB) | 30 MHz  (LCRB) | 40 MHz  (LCRB) | 50 MHz  (LCRB) | 60 MHz  (LCRB) | 70 MHz  (LCRB) | 80 MHz  (LCRB) | 90 MHz  (LCRB) | 100 MHz  (LCRB) |
| n66 | n77 |  | 25 | 36 | 50 | 64 | 80 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

### 6.70.2 Specific for 2 bands UL CA

#### 6.70.2.1 UE co-existence studies

Table 6.70.2.1-1 lists Band n66 +Band n77 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.70.2.1-1: Band n66 and Band n77 2 UL bands IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1780 | 3300 | 4200 |
| Two tone 2nd order IMD products | fy\_low – fx\_high | fy\_high – fx\_low | fx\_low + fy\_low | fx\_high + fy\_high |
| IMD frequency limits (MHz) | 1520 | 2490 | 5010 | 5980 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | 2\*fy\_low – fx\_high | 2\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 780 | 260 | 4820 | 6690 |
| Two-tone 3rd order IMD products | 2\*fx\_low + fy\_low | 2\*fx\_high + fy\_high | 2\*fy\_low + fx\_low | 2\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 6720 | 7760 | 8310 | 10180 |
| Two-tone 4th order IMD products | |3\*fx\_low – fy\_high| | |3\*fx\_high – fy\_low| | 3\*fy\_low – fx\_high | 3\*fy\_high – fx\_low |
| IMD frequency limits (MHz) | 930 | 2040 | 8120 | 10890 |
| Two-tone 4th order IMD products | 3\*fx\_low + fy\_low | 3\*fx\_high + fy\_high | 3\*fy\_low + fx\_low | 3\*fy\_high + fx\_high |
| IMD frequency limits (MHz) | 8430 | 9540 | 11610 | 14380 |
| Two-tone 4th order IMD products | |2\*fx\_low – 2\*fy\_high| | |2\*fx\_high – 2\*fy\_low| | 2\*fx\_low + 2\*fy\_low | 2\*fx\_high + 2\*fy\_high |
| IMD frequency limits (MHz) | 4980 | 3040 | 10020 | 11960 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 15090 | 11420 | 3820 | 2640 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 14910 | 18580 | 10140 | 11320 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 9180 | 6340 | 1260 | 3270 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 13320 | 16160 | 11730 | 13740 |

In analysis, it could be seen,

* The 2nd and 5th order IMD products of Band n66 UL and Band n77 UL may fall into band n66 DL frequency range

The MSD should be considered to mitigate the impact of the interference for this combination.

Table 6.70.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.70.2.1-2: Protected bands for the 2UL bands DC configuration**

| EN-DC Configuration | Spurious emission | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n66-n77 | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 26, 29, 30, 41, 65, 66, 70, 71 | FDL\_low | - | FDL\_high | -50 | 1 |  |

#### 6.70.2.2 REFSENs requirements

Based on above coexistence study, two-tone 2nd order IMD products may fall into the own Rx Band of Band n66. And two-tone 5th order IMD products may fall into Rx Band of Band n66. The MSD for IMD2 and IMD5 are

Table 6.70.2.2-1 lists the MSD required for the dual connectivity configuration due to IMD2 and IMD5.

Table 6.70.2.2-1: MSD due to IMD issue

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating Band / Channel bandwidth / NRB / Duplex mode | | | | | | | | Source of IMD |
| NR CA  Configuration | NR band | UL Fc  (MHz) | UL/DL BW  (MHz) | UL  CLRB | DL Fc (MHz) | MSD  (dB) | Duplex mode |
| CA\_n66A-n77A | n66 | 1775 | 5 | 25 | 2175 | 31 | FDD | IMD2 |
| n77 | 3950 | 10 | 50 | 3950 | N/A | TDD | N/A |
| n66 | 1730 | 5 | 25 | 2130 | 5.0 | FDD | IMD5 |
| n77 | 3660 | 10 | 50 | 3660 | N/A | TDD | N/A |

6.71 CA\_n38-n78

### 6.71.1 Common for 1 band UL and 2 bands UL CA

6.71.1.1 Operating bands for CA

**Table 6.71.1.1-1: CA band combination of band n38+n78**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n38A-n78A | n38 | 2570 MHz | – | 2620 MHz | 2570 MHz | – | 2620 MHz | TDD |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |
| NOTE 1: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. | | | | | | | | |

6.71.1.2 Channel bandwidths per operating band for CA

**Table 6.71.2-1: Supported bandwidths per CA band combination of band n38+n78**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5** | **10** | **15** | **20** | **25** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** | **Bandwidth combination set** |
| CA\_n38A-n78A | CA\_n38A-n78A | n38 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n78 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  | Yes | Yes | Yes |
| CA\_n38A-n78(2A) | CA\_n38A-n78A | n38 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |
| n78 | See CA\_n78(2A) Bandwidth Combination in Table 5.5A.2-1 | | | | | | | | | | | | | |  |

6.71.1.3 Co-existence studies

Table 6.71.1.3-1/2 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n38-n78.

**Table 6.71.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonic issue for the band combination of n38 and n78.

**Table 6.71.1.3-2: Impact of UL/DL Harmonic mixing**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge | UL Low Band Edge | UL High Band Edge |
| n38 | 2570 | 2620 | 2570 | 2620 | 5140 | 5240 | 7710 | 7860 |  |  |
| n78 | 3300 | 3800 | 3300 | 3800 | 6600 | 7600 | 9900 | 11400 |  |  |

Based on above table, there is no harmonic mixing issue for the band combination of n38 and n78.

6.71.1.4 ∆TIB and ∆RIB values

For CA\_n38-n78, the ΔTIB,c and ΔRIB values are given in the tables below which are reused from DC\_38-n78.

Table 6.71.1.4-1: ΔTIB,c

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n38-n78 | n38 | 0.3 |
| n78 | 0.8 |

Table 6.71.1.4-2: ΔRIB,c

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n38-n78 | n38 | 0.4 |
| n78 | 0.5 |

#### 6.71.1.5 REFSEN requirements

According to the analysis in subclause 6.71.1.3, there are no harmonic issues for this combination. Hence it is no need to define the MSD values caused by harmonic issues for NR CA n38+n78 band combination.

### 6.71.2 Specific for 2 bands UL CA

#### 6.71.2.1 UE co-existence studies

Table 6.71.2.1-1 lists Band n38 +Band n78 2UL CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.71.2.1-1: Band n38 and Band n78 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| **UL frequency** | **2570** | **2620** | **3300** | **3800** |
| 2nd order IMD products | |fy\_low-fx\_high| | |fy\_high-fx\_low| | |fy\_low+fx\_low| | |fy\_high+fx\_high| |
| IMD frequency limits (MHz) | 680 | 1230 | 5870 | 6420 |
| Two-tone 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 1340 | 1940 | 3980 | 5030 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 8440 | 9040 | 9170 | 10220 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 2460 | 1360 | 11740 | 12840 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 3910 | 4560 | 7280 | 8830 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 11010 | 11660 | 12470 | 14020 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 12630 | 10580 | 7180 | 6480 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 15770 | 17820 | 13580 | 14280 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 6260 | 4660 | 1260 | 110 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 15040 | 16640 | 14310 | 15460 |
| NOTE : For each IMD item, when two bound values before taking absolute have different signs, the relevant IMD range shall be set such that (1) the lower bound is 0 and (2) the upper bound is the bigger value of the two after taking absolute. | | | | |

Since both band n38 and band n78 are belong to TDD band, therefore IMD is not an issue for TDD bands combination (no self-interference for the TDD band), there is no MSD issue for this band combination.

Table 6.71.2.2-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 6.71.2.2-1: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n38-n78 | E-UTRA Band 1, 3, 5, 8, 20, 28, 34, 40, 65, | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 3 |
| Frequency range | 2620 | - | 2645 | -15.5 | 5 | 15, 22, 26 |
| Frequency range | 2645 | - | 2690 | -40 | 1 | 15, 22 |
| NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7 MHz  NOTE 15: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE22:This requirement is applicable for power class 3 UE for any channel bandwidths within the range 2570 - 2615 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2597 - 2605 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. For power class 2 UE for any channel bandwidths within the range 2570 - 2615 MHz, NS\_44 shall apply. For power class 2 or 3 UE for carriers with channel bandwidth overlapping the frequency range 2615 - 2620 MHz the requirement applies with the maximum output power configured to +19 dBm in the IE *P-Max*.  NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. | | | | | | | |

#### 6.71.2.2 REFSENS requirements

As IMD is not an issue for TDD bands combination, there is no MSD issue caused by IMD for this combination.

In addition, since only asynchronized operation with supporting simultaneous Tx/Rx is considered for this combination, MSD due to cross band isolation need to be specified. The following MSD due to lack of cross band isolation is proposed to add to Table 6.71.2.2-1 and Table 6.71.2.2-2 in TS 38.101-1. The values are reused from DC\_41-n78.

Table 6.71.2.2-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | | |
| NR CA Configuration | UL band | DL band | 5 MHz (dB) | 10 MHz (dB) | 15 MHz (dB) | 20 MHz (dB) | 25 MHz (dB) | 30 MHz (dB) | 40 MHz (dB) | 50 MHz (dB) | 60 MHz (dB) | 70 MHz (dB) | 80 MHz (dB) | 90 MHz (dB) | 100 MHz (dB) |
| CA\_n38A-n78A  CA\_n38A-n78(2A) | n38 | n78 |  | 8.3 | 8.3 | 8.3 | 7.3 | 6.5 | 6.3 | 5.3 | 4.5 |  | 4.0 | 3.9 | 3.8 |
| n78 | n38 | 3.3 | 3.3 | 3.3 | 3.3 |  |  |  |  |  |  |  |  |  |

Table 6.71.2.2-2:Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band / SCS / Channel bandwidth of the affected DL band | | | | | | | | | | | | | | | |
| UL band | DL band | SCS of UL band (kHz) | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| n38 | n78 | 15 |  | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |  | 100 | 100 | 100 |
| n78 | n38 | 30 | 270 | 270 | 270 | 270 |  |  |  |  |  |  |  |  |  |

## 6.72 n5-n7

### 6.72.1 Common for 1 band UL and 2 bands UL CA

#### 6.72.1.1 Operating bands for CA

Table 6.72.1.1-1: CA band combination of band n5 and n7

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |

#### 6.72.1.2 Channel bandwidths per operating band for CA

Table 6.72.1.2-1: Supported bandwidths per CA band combination of band n5 and n7

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n5A-n7A | - | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| CA\_n5A-n7B | - | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |
| n7 | See CA\_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1 | | | | | | | | | | | | |

#### 6.72.1.3 UE co-existence studies

Table 6.72.1.3-1 lists up to 7th harmonics for n5-n7. As can be seen there are no harmonic issues.

**Table 6.72.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n5 | 824 | 849 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 | 4120 | 4245 | 4944 | 5094 | 5768 | 5943 |
| n7 | 2500 | 2570 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 | 12500 | 12850 | 15000 | 15420 | 17500 | 17990 |

Table 6.72.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. As can be seen there are no harmonic mixing issues.

Table 6.72.1.3-2 Harmonic mixing for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n5 | 824 | 849 | 869 | 894 | 1738 | 1788 | 2607 | 2682 | 3476 | 3576 |
| n7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 | 10480 | 10760 |

#### 6.72.1.4 ∆TIB and ∆RIB values

For CA\_n5-n7, the ΔTIB,c and ΔRIB,c values are same as for DC\_5\_n7 and are given in the tables below.

**Table 6.72.1.4-1: ΔTIB,c**

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n7 | n5 | 0.3 |
| n7 | 0.3 |

**Table 6.72.1.4-2: ΔRIB,c**

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n5-n7 | n5 | 0 |
| n7 | 0 |

#### 6.72.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.72.1.3 there are no harmonics issues.

## 6.73 n3-n7

### 6.73.1 Common for 1 band UL and 2 bands UL CA

#### 6.73.1.1 Operating bands for CA

Table 6.73.1.1-1: CA band combination of band n3 and n7

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n7 | 2500 MHz | – | 2570 MHz | 2620 MHz | – | 2690 MHz | FDD |

#### 6.73.1.2 Channel bandwidths per operating band for CA

Table 6.73.1.2-1: Supported bandwidths per CA band combination of band n3 and n7

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **Bandwidth combination set** |
| CA\_n3A-n7A | CA\_n3A-n7A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n7 | 15 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |
| CA\_n3A-n7B | - | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n7 | See CA\_n7B Bandwidth Combination Set 0 in Table 5.5A.1-1 | | | | | | | | | | | | |

#### 6.73.1.3 UE co-existence studies

Table 6.73.1.3-1 lists up to 7th harmonics for n3-n7. As can be seen there are no harmonic issues.

**Table 6.73.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n3 | 1710 | 1785 | 3420 | 3570 | 5130 | 5355 | 6840 | 7140 | 8550 | 8925 | 10260 | 10710 | 11970 | 12495 |
| n7 | 2500 | 2570 | 5000 | 5140 | 7500 | 7710 | 10000 | 10280 | 12500 | 12850 | 15000 | 15420 | 17500 | 17990 |

Table 6.73.1.3-2 list harmonic mixing issue for the 2DL bands CA with 1 UL. As can be seen there are no harmonic mixing issues.

Table 6.73.1.3-2 Harmonic mixing for 2DLs/1UL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | |
| **Band** | **UL Low Band Edge** | UL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge | DL Low Band Edge | DL High Band Edge |
| n3 | 1710 | 1785 | 1805 | 1880 | 3610 | 3760 | 5415 | 5640 | 7220 | 7520 |
| n7 | 2500 | 2570 | 2620 | 2690 | 5240 | 5380 | 7860 | 8070 | 10480 | 10760 |

#### 6.73.1.4 ∆TIB and ∆RIB values

For CA\_n3-n7, the ΔTIB,c and ΔRIB,c values are same as for DC\_3\_n7 and are given in the tables below.

**Table 6.73.1.4-1: ΔTIB,c**

| NR CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n7 | n3 | 0.5 |
| n7 | 0.5 |

**Table 6.73.1.4-2: ΔRIB,c**

| NR CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n3-n7 | n3 | 0 |
| n7 | 0 |

#### 6.73.1.5 REFSENS requirements

As can be seen in the co-existence studies in 6.73.1.3 there are no harmonics issues.

### 6.73.2 Specific for 2 bands UL CA

#### 6.73.2.1 UE co-existence studies

Table 6.73.2.1-1 lists Band n3 + Band n7 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 6.73.2.1-1: Band n3 and Band n7 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 1710 | 1785 | 2500 | 2570 |
| 2nd harmonics frequency limits | 2\* fy\_low | 2\* fy\_high | 2\*fx\_low | 2\*fx\_high |
| 2nd harmonics frequency limits (MHz) | 3420 | 3570 | 5000 | 5140 |
| 3rd harmonics frequency limits | 3\* fy\_low | 3\* fy\_high | 3\*fx\_low | 3\*fx\_high |
| 3rd harmonics frequency limits (MHz) | 5130 | 5355 | 7500 | 7710 |
| 4th harmonics frequency limits | 4\* fy\_low | 4\* fy\_high | 4\*fx\_low | 4\*fx\_high |
| 4th harmonics frequency limits (MHz) | 6840 | 7140 | 10000 | 10280 |
| 5th harmonics frequency limits | 5\* fy\_low | 5\* fy\_high | 5\*fx\_low | 5\*fx\_high |
| 5th harmonics frequency limits (MHz) | 8550 | 8925 | 12500 | 12850 |
| 6th harmonics frequency limits | 6\* fy\_low | 6\* fy\_high | 6\*fx\_low | 6\*fx\_high |
| 6th harmonics frequency limits (MHz) | 10260 | 10710 | 15000 | 15420 |
| 7th harmonics frequency limits | 7\* fy\_low | 7\* fy\_high | 7\*fx\_low | 7\*fx\_high |
| 7th harmonics frequency limits (MHz) | 11970 | 12495 | 17500 | 17990 |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 860 | 715 | 4210 | 4355 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 850 | 1070 | 3215 | 3430 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 5920 | 6140 | 6710 | 6925 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 1720 | 1430 | 8420 | 8710 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 2560 | 2855 | 5715 | 6000 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 7630 | 7925 | 9210 | 9495 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 8570 | 8215 | 4640 | 4270 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 11710 | 12065 | 9340 | 9710 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 4290 | 3930 | 355 | 10 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 10920 | 11280 | 10130 | 10495 |

Based on Table 6.73.2.1-1 there are IMD4 affecting own Rx frequencies of band n7.

Table 6.73.2.1-2 lists the protected bands required for the 2UL bands CA configuration as to be used in Table 6.5A.3.2.3-1 of TS 38.101-1, and with same bands as for DC\_3\_n7 in TS 38.101-3.

**Table 6.73.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n3-n7 | E-UTRA Band 1, 5, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 40, 43, 44, 50, 51, 65, 67, 72, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA band 3 | FDL\_low | - | FDL\_high | -50 | 1 | 4 |
| E-UTRA band 22, 42, 52  NR-band n77, n78 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| Frequency range | 2570 | - | 2575 | +1.6 | 5 | 4, 7, 18 |
| Frequency range | 2575 | - | 2595 | -15.5 | 5 | 4, 7, 18 |
| Frequency range | 2595 | - | 2620 | -40 | 1 | 4, 18 |
| NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.  NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 from the edge of the channel bandwidth.  NOTE 7: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.  NOTE 18: This requirement is applicable for any channel bandwidths within the range 2500 – 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 – 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. | | | | | | | |

#### 6.73.2.2 REFSENS requirements

There is a need to define IMD4 MSD for CA\_n3-n7. Same MSD values as for DC\_3\_n7.

**Table 6.73.2.2-1: 2DL/2UL interband Reference sensitivity QPSK PREFSENS and uplink/downlink configurations**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band / Channel bandwidth / NRB / Duplex mode** | | | | | | | | **Source of IMD** |
| **NR CA**  **Configuration** | **NR band** | **UL Fc  (MHz)** | **UL/DL BW  (MHz)** | **UL  CLRB** | **DL Fc (MHz)** | **MSD  (dB)** | **Duplex mode** |
| CA\_n3A-n7A | n3 | 1730 | 5 | 25 | 1825 | N/A | FDD | N/A |
| n7 | 2535 | 10 | 50 | 2655 | 10.2 | FDD | IMD4 |

# 7 Both bands within FR2 Carrier Aggregation: Specific Band Combination Part

## 7.x CA\_nX-nY

### 7.x.1 Common for 1 band UL and 2 bands UL CA

#### 7.x.1.1 Operating bands for CA

**Table 7.x.1.1-1: CA band combination of band nX+nY**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| nX |  | – |  |  | – |  |  |
| nY |  | – |  |  | – |  |  |

#### 7.x.1.2 Channel bandwidths per operating band for CA

**Table 7.x.1.2-1: Supported bandwidths per CA band combination of band nX+nY**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set** | | | | | | | | | |
| **NR CA configuration** | **Uplink configuration** | **NR Band** | **SCS**  **(kHz)** | **50**  **MHz** | **100**  **MHz** | **200**  **MHz** | **400**  **MHz** | **Maximum Aggregated bandwidth**  **[MHz]** | **Bandwidth combination set** |
| CA\_nXA-nYA | - | nX | 60 |  |  |  |  |  | 0 |
| 120 |  |  |  |  |
| nY | 60 |  |  |  |  |
| 120 |  |  |  |  |
| CA\_nXA-nYC | CA\_nXA-nYA | nX | 60 |  |  |  |  |  | 0 |
| 120 |  |  |  |  |
| nY | 60 | See CA\_nYC Bandwidth combination set 0 in table 5.5A.1-1 of 38.101-2 | | | |
| 120 |
| CA\_nXC-nYA | CA\_nXC | nX | 60 | See CA\_nXC Bandwidth combination set 0 in table 5.5A.1-1 of 38.101-2 | | | |  | 0 |
| 120 |
| nY | 60 |  |  |  |  |
| 120 |  |  |  |  |
| CA\_nX(2A)-nYA | - | nX | 60 | See CA\_nX(2A) Bandwidth combination set 0 in table 5.5A.2-1 of 38.101-2 | | | |  | 0 |
| 120 |
| nY | 60 |  |  |  |  |
| 120 |  |  |  |  |

#### 7.x.1.3 UE co-existence studies

< Edtor's note: Text will be added, the examples is given as follows. The harmonics issues shoule be analysed based on this table. >

Table 7.x.1.3-1 lists up to nth harmonics for CA \_ nX-nY.

**Table 7.x.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **nth Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| nX |  |  |  |  |  |  |  |  |
| nY |  |  |  |  |  |  |  |  |

#### 7.x.1.4 ∆TIB and ∆RIB values

For CA\_nX-nY , the TIB,c and RIB,c values are given in the tables below.

**Table 7.x.1.4-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_nX-nY | nX |  |
| nY |  |

**Table 7.x.1.4-2: ΔRIB,c**

| Inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_nX-nY | nX |  |
| nY |  |

#### 7.x.1.5 REFSENS requirements

*< Editor's note: Text will be added if harmonics issues are identified, and only REFSENS numbers for bands have these issues need to be provided in the table. >*

### 7.x.2 Specific for 2 bands UL CA

< Editor's note: Text will be added if 2 bands UL CA are supported, otherwise all the clauses shall be void. >

#### 7.x.2.1 UE co-existence studies

< Edtor's note: Text will be added. >

#### 7.x.2.2 REFSENS requirements

< Editor's note: Text will be added if IMD due to 2 bands UL issues are identified. >

# 8 FR1+FR2 Carrier Aggregation: Specific Band Combination Part

## 8.1 CA\_n71\_n261

### 8.1.1 Common for 1 band UL and 2 bands UL

#### 8.1.1.1 Channel bandwidths per operating band for CA

**Table 8.1.1-1: CA band combination of band n71 + n261**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_ n71-n261 | n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |
| n261 | 27500 MHz | – | 28350 MHz | 27500 MHz | – | 28350 MHz | TDD |

**Table 8.1.1-2: Supported bandwidths per CA band combination of CA\_n71A-n261A**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth** | | | | | | | | | | | | | | |
| **NR CA Configuration** | **NR Band** | **Subcarrier spacing**  **[kHz]** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Maximum aggregated bandwidth**  **[MHz]** |
| CA\_n71A-n261A | n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 420 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n261 | 60 |  |  |  |  |  | Yes |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  | Yes | Yes | Yes |
| CA\_n71A-n261(2A) | n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 820 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n261 | See CA\_n261(2A) BCS 0 in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |

#### 8.1.1.2 UE co-existence studies

Table 8.1.2-1 gives the UL 2nd, 3rd, 4th, 5th, 6th, 7th harmonic for CA\_n71A-n261A.

**Table 8.1.2-1: Band n71 and Band n261 UL harmonics products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency (MHz) | 663 | 698 | 27500 | 28350 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1326 | 1396 | 55000 | 56700 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 1989 | 2094 | 82500 | 85050 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 2652 | 2792 | 110000 | 113400 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 3315 | 3490 | 137500 | 141750 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\* fy\_low | 6\* fy\_high |
| 6th harmonics frequency limits (MHz) | 3978 | 4188 | 165000 | 170100 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\* fy\_low | 7\* fy\_high |
| 7th harmonics frequency limits (MHz) | 4641 | 4886 | 192500 | 198450 |

From table 8.1.2-1 it can be seen that UL harmonic frequencies of Band n71 and Band n261 do not locate within the UE’s own receive bands, therefore it can be concluded that there is no issue on harmonic interference.

#### 8.1.1.3 ∆TIB and ∆RIB values

For CA\_n71A-n261A, the TIB,c and RIB,c values are given in the tables below.

**Table 8.1.3-1: ΔTIB,c**

| NR inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n71A-n261A | n71 | 0 |
| n261 | 0 |

**Table 8.1.3-2: ΔRIB,c**

| NR inter-band CA Configuration | NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n71A-n261A | n71 | 0 |
| n261 | 0 |

#### 8.1.1.4 REFSENS requirements

There is no specific REFSENS requirement.

## 8.2 CA\_n71-n260

### 8.2.1 Common for 1 band UL and 2 bands UL CA

#### 8.2.1.1 Operating bands for CA

**Table 8.2.1.1-1: CA band combination of band nX+nY**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n71 | 663 MHz | – | 698 MHz | 617 MHz | – | 652 MHz | FDD |
| n260 | 37000 MHz | – | 40000 MHz | 37000 MHz | – | 40000 MHz | TDD |

#### 8.2.1.2 Channel bandwidths per operating band for CA

**Table 8.2.1.2-1: Supported bandwidths per CA band combination of band nX+nY**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n71A-n260A | - | n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | 60 |  |  |  |  |  | Yes |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  | Yes | Yes | Yes |
| CA\_n71A-n260(2A) | - | n71 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See CA\_n260(2A) in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |

#### 8.2.1.3 UE co-existence studies

Table 8.2.1.3-1 lists up to 7th harmonics for CA\_n71A-n260A.

**Table 8.2.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n71 | 663 | 698 | 1326 | 1396 | 1989 | 2094 | 2652 | 2792 | 3315 | 3490 | 3978 | 4188 | 4641 | 4886 |
| n260 | 3700 | 40000 | 74000 | 80000 | 111 k | 120 k | 148 k | 160 k | 185 k | 200 k | 222 k | 240 k | 259 k | 280 k |

#### 8.2.1.4 ∆TIB and ∆RIB values

For CA\_n71A-n260, the TIB,c and RIB,c values are given in the tables below.

**Table 8.2.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n71-n260 | n71 | 0 |
| n260 | 0 |

**Table 8.2.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n71-n260 | n71 | 0 |
| n260 | 0 |

#### 8.2.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

## 8.3 CA\_n41-n261

### 8.3.1 Common for 1 band UL and 2 bands UL CA

#### 8.3.1.1 Operating bands for CA

Table 8.3.1.1-1: CA band combination of band n41+n261

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n41 | 2496 | – | 2690 | 2496 | – | 2690 | FDD |
| n261 | 27500 | – | 28350 | 27500 | – | 28350 | TDD |

#### 8.3.1.2 Channel bandwidths per operating band for CA

Table 8.3.1.2-1: Supported bandwidths per CA band combination of band n41+n261

| NR CA configuration | NR Uplink CA configuration | NR  Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90  MHz | 100  MHz | 200  MHz | 400  MHz | ****Bandwidth combination set**** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n41A-n261A | - | n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n261 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n41A-n261(2A) | - | n41 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n261 | See CA\_ n261(2A) Bandwidth combination set in 38.101-2 | | | | | | | | | | | | | | |
| CA\_n41C-n261A | - | n41 | See Table 5.5A.1-1 CA\_ n41C BCS0 38.101-1 | | | | | | | | | | | | | | | 0 |
| n261 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n41(2A)-n261A | - | n41 | See Table 5.5A.2-1 CA\_ n41(2A) BCS1 in 38.101-1 | | | | | | | | | | | | | | | 0 |
| n261 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n41(2A)-n261(2A) | - | n41 | See Table 5.5A.2-1 CA\_ n41(2A) BCS1 in 38.101-1 | | | | | | | | | | | | | | | 0 |
| n261 | See Table 5.5A.2-1 CA\_ n261(2A) BCS0 in 38.101-2 | | | | | | | | | | | | | | |
| CA\_n41C-n261(2A) | - | n41 | See Table 5.5A.2-1 CA\_ n41(2A) BCS1 in 38.101-1 | | | | | | | | | | | | | | | 0 |
| n261 | See Table 5.5A.2-1 CA\_ n261(2A) BCS0 in 38.101-2 | | | | | | | | | | | | | | |

#### 8.3.1.3 UE co-existence studies

Harmonic relation between FR1 and FR2 band is not analyzed due to large frequency separation.

The addtional spurious emission level to coexisting bands is specified in Table 8.3.1.3-1.

Table 8.3.1.3-1: Requirements for uplink inter-band CA (two bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n41-n261 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 48, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | | | | | | | |

#### 8.3.1.4 ∆TIB and ∆RIB values

For CA\_n41-n261, the TIB,c and RIB,c values are all zero and thus do not need to be explicitly specified in TS 38.101-3.

#### 8.3.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

## 8.4 CA\_n25-n261

### 8.4.1 Common for 1 band UL and 2 bands UL CA

#### 8.4.1.1 Operating bands for CA

Table 8.4.1.1-1: CA band combination of band n25+n261

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n25 | 1850 | – | 1910 | 1930 | – | 1995 | FDD |
| n261 | 27500 | – | 28350 | 27500 | – | 28350 | TDD |

#### 8.4.1.2 Channel bandwidths per operating band for CA

Table 8.4.1.2-1: Supported bandwidths per CA band combination of band n25+n261

| **NR CA configuration** | **NR Uplink CA configuration** | **NR**  **Band** | **SCS**  **(kHz)** | **5**  **MHz** | | **10**  **MHz** | **15**  **MHz** | | **20**  **MHz** | **25**  **MHz** | | **30**  **MHz** | **40**  **MHz** | | **50**  **MHz** | **60**  **MHz** | | **80**  **MHz** | **90**  **MHz** | | **100**  **MHz** | **200**  **MHz** | **400**  **MHz** | **Bandwidth combination set** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n25A-n261A | - | n25 | 15 | Yes | | Yes | Yes | | Yes |  | |  |  | |  |  | |  |  | |  |  |  | 0 |
| 30 |  | | Yes | Yes | | Yes |  | |  |  | |  |  | |  |  | |  |  |  |
| 60 |  | | Yes | Yes | | Yes |  | |  |  | |  |  | |  |  | |  |  |  |
| n261 | 60 |  | |  |  | |  |  | |  |  | | Yes |  | |  |  | | Yes | Yes |  |
| 120 |  | |  |  | |  |  | |  |  | | Yes |  | |  |  | | Yes | Yes | Yes |
| CA\_n25A-n261(2A) | - | n25 | 15 | Yes | Yes | | Yes | Yes | |  |  | |  |  | |  |  | |  |  | |  |  | 0 |
| 30 |  | Yes | | Yes | Yes | |  |  | |  |  | |  |  | |  |  | |  |  |
| 60 |  | Yes | | Yes | Yes | |  |  | |  |  | |  |  | |  |  | |  |  |
| n261 | See CA\_ n261(2A) Bandwidth combination set in 38.101-2 | | | | | | | | | | | | | | | | | | | | |

#### 8.4.1.3 UE co-existence studies

Harmonic relation between FR1 and FR2 band is not analyzed due to large frequency separation.

The addtional spurious emission level to coexisting bands is specified in Table 8.4.1.3-1.

Table 8.4.1.3-1: Requirements for uplink inter-band CA (two bands)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n25-n261 | E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 48, 66, 70, 71, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | | | | | | | |

#### 8.4.1.4 ∆TIB and ∆RIB values

For CA\_n25-n261, the TIB,c and RIB,c values are all zero and thus do not need to be explicitly specified in TS 38.101-3.

#### 8.4.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

## 8.5 CA\_n77-n258

### 8.5.1 Common for 1 band UL and 2 bands UL CA

#### 8.5.1.1 Operating bands for CA

Table 8.5.1-1: CA band combination of band n77 + n258

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n77-n258 | n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |
| n258 | 24250 MHz | – | 27500 MHz | 24250 MHz | – | 27500 MHz | TDD |

#### 8.5.1.2 Channel bandwidths per operating band for CA

Table 8.5.2-1: Supported bandwidths per CA band combination of band n77+n258

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n77A-n258A | - | n77 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | 60 |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |

#### 8.5.1.3 Co-existence studies

Table 8.5.3-1 gives the UL 2nd, 3rd, 4th, 5th, 6th, 7th harmonic for CA\_n77A-n258A. The 6th  and 7th harmonic produced by UL band n77 may fall into Band n258 DL.

Table 8.5.1.3-1: Band n77 and Band n258 UL harmonics products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency(MHz) | 3300 | 4200 | 24250 | 27500 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\*fy\_low | 2\*fy\_high |
| 2nd harmonics frequency limits(MHz) | 6600 | 8400 | 48500 | 55000 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\*fy\_low | 3\*fy\_high |
| 3rd harmonics frequency limits(MHz) | 9900 | 12600 | 72750 | 82500 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\*fy\_low | 4\*fy\_high |
| 4th harmonics frequency limits(MHz) | 13200 | 16800 | 97000 | 110000 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\*fy\_low | 5\*fy\_high |
| 5th harmonics frequency limits(MHz) | 16500 | 21000 | 121250 | 137500 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\*fy\_low | 6\*fy\_high |
| 6th harmonics frequency limits(MHz) | 19800 | 25200 | 145500 | 165000 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\*fy\_low | 7\*fy\_high |
| 7th harmonics frequency limits(MHz) | 23100 | 29400 | 169750 | 192500 |

#### 8.5.1.4 ∆TIB and ∆RIB values

For CA\_n77A-n258A, the TIB,c and RIB values are given in the tables below.

Table 8.5.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n77-n258 | n77 | 0 |
| n258 | 0 |

Table 8.5.4-2: ΔRIB

| Inter-band CA Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n77-n258 | n77 | 0 |
| n258 | 0 |

#### 8.5.1.5 REFSENS requirements

There is no specific REFSENS requirement.

## 8.6 CA\_n78-n258

### 8.6.1 Common for 1 band UL and 2 bands UL CA

#### 8.6.1.1 Operating bands for CA

Table 8.6.1-1: CA band combination of band n78 + n258

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n78-n258 | n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |
| n258 | 24250 MHz | – | 27500 MHz | 24250 MHz | – | 27500 MHz | TDD |

#### 8.6.1.2 Channel bandwidths per operating band for CA

Table 8.6.2-1: Supported bandwidths per CA band combination of band n78+n258

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

| NR CA configuration | Uplink CA configuration | NR Band | SCS  (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 80  MHz | 90  MHz | 100 MHz | 200 MHz | 400 MHz | Bandwidth combination set |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_n78A-n258A | CA\_n78A-n258A | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n78A-n258G | CA\_n78A-n258A  CA\_n78A-n258G | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | See CA\_n258G Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-2 | | | | | | | | | | | | | | |
| CA\_n78A-n258H | CA\_n78A-n258A  CA\_n78A-n258G  CA\_n78A-n258H | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| n258 | See CA\_n258H Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-2 | | | | | | | | | | | | | | |
| CA\_n78A-n258I | CA\_n78A-n258A  CA\_n78A-n258G  CA\_n78A-n258H  CA\_n78A-n258I | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | See CA\_n258I Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-2 | | | | | | | | | | | | | | |
| CA\_n78A-n258J | CA\_n78A-n258A  CA\_n78A-n258G  CA\_n78A-n258H  CA\_n78A-n258I  CA\_n78A-n258J | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | See CA\_n258J Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-2 | | | | | | | | | | | | | | |
| CA\_n78A-n258K | CA\_n78A-n258A  CA\_n78A-n258G  CA\_n78A-n258H  CA\_n78A-n258I  CA\_n78A-n258J  CA\_n78A-n258K | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | See CA\_n258K Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-2 | | | | | | | | | | | | | | |
| CA\_n78A-n258L | CA\_n78A-n258A  CA\_n78A-n258G  CA\_n78A-n258H  CA\_n78A-n258I  CA\_n78A-n258J  CA\_n78A-n258K  CA\_n78A-n258L | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | See CA\_n258L Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-2 | | | | | | | | | | | | | | |
| CA\_n78A-n258M | CA\_n78A-n258A  CA\_n78A-n258G  CA\_n78A-n258H  CA\_n78A-n258I  CA\_n78A-n258J  CA\_n78A-n258K  CA\_n78A-n258L  CA\_n78A-n258M | n78 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n258 | See CA\_n258M Bandwidth Combination Set 0 in Table 5.5A.1-1 from 38.101-2 | | | | | | | | | | | | | | |

#### 8.6.1.3 Co-existence studies

Table 8.6.3-1 gives the UL 2nd, 3rd, 4th, 5th, 6th, 7th harmonic for CA\_n78A-n258A. The 7th harmonic produced by UL band n78 may fall into Band n258 DL.

Table 8.6.1.3-1: Band n78 and Band n258 UL harmonics products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency(MHz) | 3300 | 3800 | 24250 | 27500 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\*fy\_low | 2\*fy\_high |
| 2nd harmonics frequency limits(MHz) | 6600 | 7600 | 48500 | 55000 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\*fy\_low | 3\*fy\_high |
| 3rd harmonics frequency limits(MHz) | 9900 | 11400 | 72750 | 82500 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\*fy\_low | 4\*fy\_high |
| 4th harmonics frequency limits(MHz) | 13200 | 15200 | 97000 | 110000 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\*fy\_low | 5\*fy\_high |
| 5th harmonics frequency limits(MHz) | 16500 | 19000 | 121250 | 137500 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\*fy\_low | 6\*fy\_high |
| 6th harmonics frequency limits(MHz) | 19800 | 22800 | 145500 | 165000 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\*fy\_low | 7\*fy\_high |
| 7th harmonics frequency limits(MHz) | 23100 | 26600 | 169750 | 192500 |

#### 8.6.1.4 ∆TIB and ∆RIB values

For CA\_n78A-n258A, the TIB,c and RIB values are given in the tables below.

Table 8.6.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n78-n258 | n78 | 0 |
| n258 | 0 |

Table 8.6.4-2: ΔRIB

| Inter-band CA Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n78-n258 | n78 | 0 |
| n258 | 0 |

#### 8.6.1.5 REFSENS requirements

There is no specific REFSENS requirement.

### 8.6.2 Specific for 2 bands UL CA

#### 8.6.2.1 UE co-existence studies

Table 8.6.2.1-1 lists Band n78 + Band n258 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 8.6.2.1-1: Band n78 and Band n258 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| 2nd order IMD products | |fy\_high – fx\_low| | |fy\_low – fx\_high| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 24200 | 20450 | 27550 | 31300 |
| 3rd order IMD products | |fy\_high – 2\*fx\_low| | |fy\_low – 2\*fx\_high| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 20900 | 16650 | 44700 | 51700 |
| 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 30850 | 35100 | 51800 | 58800 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high – 2\*fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 48400 | 40900 | 55100 | 62600 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 17600 | 12850 | 68950 | 79200 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high +1\* fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 34150 | 38900 | 76050 | 86300 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 106700 | 93200 | 9050 | 14300 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 100300 | 113800 | 37450 | 42700 |
| Two-tone 5th order IMD products | |2\*fx\_low – 3\*fy\_high| | |2\*fx\_high – 3\*fy\_low| | |2\*fy\_low – 3\*fx\_high| | |2\*fy\_high – 3\*fx\_low| |
| IMD frequency limits (MHz) | 75900 | 65150 | 37100 | 45100 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 79350 | 90100 | 58400 | 66400 |

Based on Table 8.6.2.1-1 there are no IMD issues affecting own Rx frequencies.

#### 8.6.2.2 REFSENS requirements

Based on the co-existence studies in 8.6.2.1, there is no need to define MSD for CA\_n78-n258.

## 8.7 CA\_n79-n258

### 8.7.1 Common for 1 band UL and 2 bands UL CA

#### 8.7.1.1 Operating bands for CA

Table 8.7.1-1: CA band combination of band n79 + n258

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band Combination** | **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| CA\_n79-n258 | n79 | 4400 MHz | – | 5000 MHz | 4400 MHz | – | 5000 MHz | TDD |
| n258 | 24250 MHz | – | 27500 MHz | 24250 MHz | – | 27500 MHz | TDD |

#### 8.7.1.2 Channel bandwidths per operating band for CA

Table 8.7.2-1: Supported bandwidths per CA band combination of band n79+n258

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n79A-n258A | - | n79 | 15 |  |  |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| 60 |  |  |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| n258 | 60 |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |

#### 8.7.1.3 Co-existence studies

Table 8.7.3-1 gives the UL 2nd, 3rd, 4th, 5th, 6th, 7th harmonic for CA\_n79A-n258A. The 5th and 6th harmonic produced by UL band n79 may fall into Band n258 DL.

Table 8.7.1.3-1: Band n79 and Band n258 UL harmonics products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency(MHz) | 4400 | 5000 | 24250 | 27500 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\*fy\_low | 2\*fy\_high |
| 2nd harmonics frequency limits(MHz) | 8800 | 10000 | 48500 | 55000 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\*fy\_low | 3\*fy\_high |
| 3rd harmonics frequency limits(MHz) | 13200 | 15000 | 72750 | 82500 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\*fy\_low | 4\*fy\_high |
| 4th harmonics frequency limits(MHz) | 17600 | 20000 | 97000 | 110000 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\*fy\_low | 5\*fy\_high |
| 5th harmonics frequency limits(MHz) | 22000 | 25000 | 121250 | 137500 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\*fy\_low | 6\*fy\_high |
| 6th harmonics frequency limits(MHz) | 26400 | 30000 | 145500 | 165000 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\*fy\_low | 7\*fy\_high |
| 7th harmonics frequency limits(MHz) | 30800 | 35000 | 169750 | 192500 |

#### 8.7.1.4 ∆TIB and ∆RIB values

For CA\_n79A-n258A, the TIB,c and RIB values are given in the tables below.

Table 8.7.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n79-n258 | n79 | 0 |
| n258 | 0 |

Table 8.7.4-2: ΔRIB

| Inter-band CA Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n79-n258 | n79 | 0 |
| n258 | 0 |

#### 8.7.1.5 REFSENS requirements

There is no specific REFSENS requirement.

8.8 CA\_n1-n257

8.8.1 Common for 1 band UL and 2 bands UL CA

8.8.1.1 Operating bands for CA

**Table 8.8.1.1-1: CA band combination of band n1+n257**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n1 | 1920MHz | – | 1980MHz | 2110MHz | – | 2170MHz | FDD |
| n257 | 26500MHz | – | 29500MHz | 26500MHz | – | 29500MHz | TDD |

8.8.1.2 Channel bandwidths per operating band for CA

**Table 8.8.1.2-1: Supported bandwidths per CA band combination of band n1+n257**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n71A-n260A | - | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n257 | 60 |  |  |  |  |  | Yes |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  | Yes | Yes | Yes |
| CA\_n1A-n257A | CA\_n1A-n257A | n1 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| n257 | 60 |  |  |  |  |  | Yes |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  | Yes | Yes | Yes |

8.8.1.3 UE co-existence studies

Table 8.8.1.3-1 lists up to 7th harmonics for CA \_ n1-n257.

**Table 8.8.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n1 | 1920 | 1980 | 3840 | 3960 | 5760 | 5940 | 7680 | 7920 | 9600 | 9900 | 11520 | 11880 | 13440 | 13860 |
| n257 | 26500 | 29500 | 53000 | 59000 | 79500 | 88500 | 106k | 118k | 132.5k | 147.5k | 159k | 177k | 185.5k | 206.5k |

8.8.1.4 ∆TIB and ∆RIB values

For CA\_n1-n257 , the TIB,c and RIB,c values are given in the tables below.

**Table 8.8.1.4-1: ΔTIB,c**

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n257 | n1 | 0 |
| n257 | 0 |

**Table 8.8.1.4-2: ΔRIB,c**

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n1-n257 | n1 | 0 |
| n257 | 0 |

8.8.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

8.8.2 Specific for 2 bands UL CA

8.8.2.1 UE co-existence studies

Table 8.8.2.1-1 lists Band n1 +Band n257 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 8.8.2.1-1: Band n1 and Band n257 2UL bands IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 1920 | 1980 | 26500 | 29500 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 24520 | 27580 | 28420 | 31480 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 25660 | 22540 | 51020 | 57080 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 30340 | 33460 | 54920 | 60980 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | -23740 | -20560 | 77520 | 86580 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 55160 | 49040 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 32260 | 35440 | 81420 | 90480 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 56840 | 62960 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 116080 | 104020 | 18580 | 21820 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 84660 | 75540 | 47060 | 53240 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 107920 | 119980 | 34180 | 37420 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 83340 | 92460 | 58760 | 64940 |

Table 8.8.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 8.8.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n1A-n257A | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1880 | - | 1895 | -40 | 1 | RB restriction |
| Frequency range | 1895 | - | 1915 | -15.5 | 5 | RB restriction |
| Frequency range | 1915 | - | 1920 | +1.6 | 5 | RB restriction |

8.8.2.2 REFSENS requirements

There is no need for additional REFSENS requirements.

## 8.9 CA\_n78-n257

### 8.9.1 Common for 1 band UL and 2 bands UL CA

#### 8.9.1.1 Operating bands for CA

Table 8.9.1.1-1: CA band combination of band n78+n257

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n78 | 3300 MHz | – | 3800 MHz | 3300 MHz | – | 3800 MHz | TDD |
| n257 | 26500 MHz | – | 29500 MHz | 26500 MHz | – | 29500 MHz | TDD |

#### 8.9.1.2 Channel bandwidths per operating band for CA

Table 8.9.1.2-1: Supported bandwidths per CA band combination of band n78+n257

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n78A-n257G | CA\_n78A-n257A | n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257G in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n78A-n257H | CA\_n78A-n257A | n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257H in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n78A-n257I | CA\_n78A-n257A | n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257I in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n78A-n257J | CA\_n78A-n257A | n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257J in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n78A-n257K | CA\_n78A-n257A | n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257K in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n78A-n257L | CA\_n78A-n257A | n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257L in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n78A-n257M | CA\_n78A-n257A | n78 | 15 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257M in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
|  | 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n257 | See CA\_n257M in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |

#### 8.9.1.3 UE co-existence studies

The studies for 1 band UL for the CA band combination of band n78 + n257 have been already completed and captured into TR 37.865-01-01. It is expected that only 7th order harmonic of Band n78 UL may fall into Band n257 DL according to TR 37.865-01-01.

#### 8.9.1.4 ∆TIB and ∆RIB values

For CA\_n78-n257, the TIB,c and RIB,c values are already specified in TR37.865-01-01.

#### 8.9.1.5 REFSENS requirements

The studies for 1 band UL for the CA band combination of band n78 + n257 have been already completed and captured into TR 37.865-01-01. There are no need for additional REFSENS requirements for 1 band UL according to TR 37.865-01-01.

### 8.9.2 Specific for 2 bands UL CA

#### 8.9.2.1 UE co-existence studies

The studies for 2 band UL for the CA band combination of band n78 + n257 have been already completed and captured into TR 37.866-00-02.

#### 8.9.2.2 REFSENS requirements

The studies for 2 band UL for the CA band combination of band n78 + n257 have been already completed and captured into TR 37.866-00-02. There are no need for additional REFSENS requirements for 2 band UL according to TR 37.866-00-02.

## 8.10 CA\_n41-n260

### 8.10.1 Common for 1 band UL and 2 bands UL CA

#### 8.10.1.1 Operating bands for CA

Table 8.10.1.1-1: CA band combination of band nX+nY

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n41 | 2496 MHz | – | 2690 MHz | 2496 MHz | – | 2690 MHz | TDD |
| n260 | 37000 MHz | – | 40000 MHz | 37000 MHz | – | 40000 MHz |

#### 8.10.1.2 Channel bandwidths per operating band for CA

Table 8.10.1.2-1: Supported bandwidths per CA band combination of band nX+nY

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90 MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n41A-n260A | - | n41 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n260 | 60 |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n41A-n260(2A) | - | n41 | 15 |  | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |  |  |
| n260 | See CA\_n260(2A) in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | | | |

#### 8.10.1.3 UE co-existence studies

Table 8.10.1.3-1 lists up to 7th harmonics for CA\_n41A-n260A.

**Table 8.10.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n41 | 2496 | 2690 | 4992 | 5380 | 7488 | 8070 | 9984 | 10760 | 12480 | 13450 | 14976 | 16140 | 17472 | 18830 |
| n260 | 37000 | 40000 | 74000 | 80000 | 111 k | 120 k | 148 k | 160 k | 185 k | 200 k | 222 k | 240 k | 259 k | 280 k |

#### 8.10.1.4 ∆TIB and ∆RIB values

For CA\_n41A-n260, the TIB,c and RIB,c values are given in the tables below.

**Table 8.10.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n260 | n41 | 0 |
| n260 | 0 |

**Table 8.10.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n41-n260 | n41 | 0 |
| n260 | 0 |

#### 8.10.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

## 8.11 CA\_n25-n260

### 8.11.1 Common for 1 band UL and 2 bands UL CA

#### 8.11.1.1 Operating bands for CA

Table 8.11.1.1-1: CA band combination of band nX+nY

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n25 | 1850 MHz | – | 1915 MHz | 1930 MHz | – | 1995 MHz | FDD |
| n260 | 37000 MHz | – | 40000 MHz | 37000 MHz | – | 40000 MHz | TDD |

#### 8.11.1.2 Channel bandwidths per operating band for CA

Table 8.11.1.2-1: Supported bandwidths per CA band combination of band nX+nY

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n25A-n260A | - | n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |
| n260 | 60 |  |  |  |  |  | Yes |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  | Yes | Yes | Yes |
| CA\_n25A-n260(2A) | - | n25 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  |  |  |  |  |
| n260 | See CA\_n260(2A) in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | |

#### 8.11.1.3 UE co-existence studies

Table 8.11.1.3-1 lists up to 7th harmonics for CA\_n25A-n260A.

**Table 8.11.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n25 | 1850 | 1915 | 3700 | 3830 | 5550 | 5745 | 7400 | 7660 | 9250 | 9575 | 11100 | 11490 | 12950 | 13405 |
| n260 | 37000 | 40000 | 74000 | 80000 | 111 k | 120 k | 148 k | 160 k | 185 k | 200 k | 222 k | 240 k | 259 k | 280 k |

#### 8.11.1.4 ∆TIB and ∆RIB values

For CA\_n25A-n260, the TIB,c and RIB,c values are given in the tables below.

**Table 8.11.1.4-1: ΔTIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n260 | n25 | 0 |
| n260 | 0 |

**Table 8.11.1.4-2: ΔRIB,c**

| E-UTRA and NR DC Configuration | E-UTRA and NR Band | ΔRIB,c [dB] |
| --- | --- | --- |
| CA\_n25-n260 | n25 | 0 |
| n260 | 0 |

#### 8.11.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

## 8.12 CA\_n77-n257

### 8.12.1 Common for 1 band UL and 2 bands UL CA

#### 8.12.1.1 Operating bands for CA

**Table 8.12.1.1-1: CA band combination of band n77+n257**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |
| n257 | 26500 MHz | – | 29500 MHz | 26500 MHz | – | 29500 MHz | TDD |

#### 8.12.1.2 Channel bandwidths per operating band for CA

**Table 8.12.1.2-1: Supported bandwidths per CA band combination of band n77+n257**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set** | | | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **NR Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n77A-n257G | CA\_n77A-n257A  CA\_n77A-n257G | n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| n257 | See CA\_n257G in Table 5.5A1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n77A-n257H | CA\_n77A-n257A  CA\_n77A-n257G  CA\_n77A-n257H | n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| n257 | See CA\_n257H in Table 5.5A1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n77A-n257I | CA\_n77A-n257A  CA\_n77A-n257G  CA\_n77A-n257H  CA\_n77A-n257I | n77 | 15 |  | Yes | Yes | Yes |  |  | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes | Yes | Yes | Yes |  | Yes |  |  |
| n257 | See CA\_n257I in Table 5.5A1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n77(2A)-n257A | CA\_n77A-n257A | n77(2A) | See CA\_n77(2A) in Table 5.5A.2-1 in TS 38.101-1 | | | | | | | | | | | | | | | 0 |
| n257 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n77(2A)-n257D | CA\_n77A-n257A,  CA\_n77A-n257D | n77(2A) | See CA\_n77(2A) in Table 5.5A.2-1 in TS 38.101-1 | | | | | | | | | | | | | | | 0 |
| n257 | See CA\_n257D in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n77(2A)-n257G | CA\_n77A-n257A,  CA\_n77A-n257G | n77(2A) | See CA\_n77(2A) in Table 5.5A.2-1 in TS 38.101-1 | | | | | | | | | | | | | | | 0 |
| n257 | See CA\_n257G in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n77(2A)-n257H | CA\_n77A-n257A,  CA\_n77A-n257G, CA\_n77A-n257H | n77(2A) | See CA\_n77(2A) in Table 5.5A.2-1 in TS 38.101-1 | | | | | | | | | | | | | | | 0 |
| n257 | See CA\_n257H in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n77(2A)-n257I | CA\_n77A-n257A,  CA\_n77A-n257G, CA\_n77A-n257H, CA\_n77A-n257I | n77(2A) | See CA\_n77(2A) in Table 5.5A.2-1 in TS 38.101-1 | | | | | | | | | | | | | | | 0 |
| n257 | See CA\_n257I in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |

#### 8.12.1.3 Co-existence studies

Table 8.12.1.3-1 gives the UL 2nd, 3rd, 4th, 5th, 6th, 7th harmonic for CA\_n77A-n257A.

Table 8.12.1.3-1: Band n77 and Band n258 UL harmonics products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency(MHz) | 3300 | 4200 | 26500 | 29500 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\*fy\_low | 2\*fy\_high |
| 2nd harmonics frequency limits(MHz) | 6600 | 8400 | 53000 | 59000 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\*fy\_low | 3\*fy\_high |
| 3rd harmonics frequency limits(MHz) | 9900 | 12600 | 79500 | 88500 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\*fy\_low | 4\*fy\_high |
| 4th harmonics frequency limits(MHz) | 13200 | 16800 | 106000 | 118000 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\*fy\_low | 5\*fy\_high |
| 5th harmonics frequency limits(MHz) | 16500 | 21000 | 132500 | 147500 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\*fy\_low | 6\*fy\_high |
| 6th harmonics frequency limits(MHz) | 19800 | 25200 | 159000 | 177000 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\*fy\_low | 7\*fy\_high |
| 7th harmonics frequency limits(MHz) | 23100 | 29400 | 185500 | 206500 |

#### 8.12.1.4 ∆TIB and ∆RIB values

For CA\_n77-n257, the ΔTIB,c and ΔRIB,c values are given in the tables below.

Table 6.4.4-1: ΔTIB,c

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n77-n257 | n77 | 0 |
| n257 | 0 |

Table 6.4.4-2: ΔRIB

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB [dB]** |
| --- | --- | --- |
| CA\_n77-n257 | n77 | 0 |
| n257 | 0 |

#### 8.12.1.5 REFSENS requirements

There are no specific REFSENS requirements for 1 band UL.

### 8.12.2 Specific for 2 bands UL CA

#### 8.12.2.1 UE co-existence studies

Table 8.12.2-1 lists Band n77+Band n257 2UL CA 2nd and 3rd order harmonics and 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis..

Table 8.12.2.1-1: Band n77 and Band n257 UL harmonics products

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | | **fy\_low** | **fy\_high** | |
| UL frequency (MHz) | 3300 | 4200 | | 26500 | 29500 | |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | | 2\* fy\_low | 2\* fy\_high | |
| 2nd harmonics frequency limits (MHz) | 6600–8400 | | | 53000–59000 | | |
| 3rd harmonics frequency limits | 3\*fx\_low | | 3\*fx\_high | 3\* fy\_low | | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 9900–12600 | | | 79500– 88500 | | |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | | |fy\_low + fx\_low| | |fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 22300– 26200 | | | 29800– 33700 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| | |
| IMD frequency limits (MHz) | 18100–22900 | | | 48800– 54800 | | |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| | |
| IMD frequency limits (MHz) | 33100– 37900 | | | 56300– 63200 | | |
| Two-tone 3rd order IMD products | (fx\_low – max BW fy) | | (fx\_high + max BW fy) | (fy\_low – max BW fx) | | (fy\_high + max BW fx) |
| IMD frequency limits (MHz) | 2900– 4600 | | | 26400– 29600 | | |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 13900–19600 | | | 75300– 85200 | | |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | | |2\*fx\_high –2\* fy\_low| |  | |  |
| IMD frequency limits (MHz) | 44600– 81900 | | |  | | |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 36400– 41200 | | | 82800– 92700 | | |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | | |2\*fx\_high +2\* fy\_high| |  | |  |
| IMD frequency limits (MHz) | 59600– 67400 | | |  | | |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 101800– 114700 | | | 9700– 16300 | | |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 71100– 81900 | | | 40400– 49100 | | |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 109300– 122200 | | | 39700– 46300 | | |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 86100– 96900 | | | 62900– 71600 | | |

Based on Table 8.12.2.1-1, there are no harmonic or IMD issues affecting own Rx frequencies of either band n77 or n257.

Table 8.12.2.1-3 lists the protected bands required for the 2UL CA configuration.

Table 8.12.2.1-3: Protected bands for the 2UL CA configuration

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Uplink NR CA**  **configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n77A-n257A | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 21, 26, 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | PHS |

#### 8.12.2.2 REFSENS requirements

The studies for 2 band UL for the CA band combination of band n77 + n257 have been already completed and captured into TR 37.866-00-02. There are no need for additional REFSENS requirements for 2 band UL according to TR 37.866-00-02.

## 8.13 CA\_n3-n257

### 8.13.1 Common for 1 band UL and 2 bands UL CA

**8.13.1.1 Operating bands for CA**

**Table 8.13.1.1-1: CA band combination of band n3+n257**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| CA\_n3-n257 | n3 | 1710 MHz | – | 1785 MHz | 1805 MHz | – | 1880 MHz | FDD |
| n257 | 26500 MHz | – | 29500 MHz | 26500 MHz | – | 29500 MHz | TDD |

#### 8.13.1.2 Channel bandwidths per operating band for CA

**Table 8.13.1.2-1: Supported bandwidths per CA band combination of band n3+n257**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set** | | | | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **NR Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **25 MHz** | **30 MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Maximum Aggregated bandwidth**  **[MHz]** | **Bandwidth combination set** |
| CA\_n3A-n257A | CA\_n3A-n257A | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 430 | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n257 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n3A-n257D | CA\_n3A-n257A  CA\_n3A-n257D | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 430 | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257D in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n257G | CA\_n3A-n257A  CA\_n3A-n257G | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 230 | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257G in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n257H | CA\_n3A-n257A  CA\_n3A-n257G  CA\_n3A-n257H | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 330 | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257H in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n3A-n257I | CA\_n3A-n257A  CA\_n3A-n257G  CA\_n3A-n257H  CA\_n3A-n257I | n3 | 15 | Yes | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  | 430 | 0 |
| 30 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257I in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |

**8.13.1.3 Co-existence studies**

Table 8.13.1.3-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n3-n257.

**Table 8.13.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | fx\_low | fx\_high | fy\_low | fy\_high |
| UL frequency (MHz) | 1710 | 1785 | 26500 | 29500 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 3420 | 3570 | 53000 | 59000 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 5130 | 5355 | 79500 | 88500 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 6840 | 7140 | 106000 | 118000 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 8550 | 8925 | 132500 | 147500 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\* fy\_low | 6\* fy\_high |
| 6th harmonics frequency limits (MHz) | 10260 | 10710 | 159000 | 177000 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\* fy\_low | 7\* fy\_high |
| 7th harmonics frequency limits (MHz) | 11970 | 12495 | 185500 | 206500 |

**8.13.1.4 ∆TIB and ∆RIB values**

For CA\_n3-n257, the ΔTIB,c and ΔRIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

Table 8.13.1.4-1: ΔTIB,c

| Inter-band EN-DC configuration | NR Band | ΔTIB,c (dB) |
| --- | --- | --- |
| CA\_n3-n257 | n3 | 0 |
| n257 | 0 |

Table 8.13.1.4-2: ΔRIB,c

|  |  |  |
| --- | --- | --- |
| Inter-band EN-DC configuration | NR Band | ΔRIB,c (dB) |
| CA\_n3-n257 | n3 | 0 |
| n257 | 0 |

**8.13.1.5 REFSEN requirements**

As mentioned in section 8.13.1.3, REFSENSE due to harmonic is not expected.

### 8.13.2 Specific for 2 bands UL CA

#### 8.13.2.1 UE co-existence studies

Table 8.13.2.1-1 lists Band n3 + Band n257 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 8.13.2.1-1: Band n3 and Band n257 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 1710 | 1785 | 26500 | 29500 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 24715 | 27790 | 28210 | 31285 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 26080 | 22930 | 51215 | 57290 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 29920 | 33070 | 54710 | 60785 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 24370 | 21145 | 77715 | 86790 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 49430 | 55580 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 31630 | 34855 | 81210 | 90285 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 56420 | 62570 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 116290 | 104215 | 19360 | 22660 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 85080 | 75930 | 47645 | 53870 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 107710 | 119785 | 33340 | 36640 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 82920 | 92070 | 58130 | 64355 |

Based on Table 8.13.2.1-1, there are no IMD issues affecting own Rx frequencies of either band n3 or n257.

Table 8.13.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 8.13.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n3-n257 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 1 |
| NOTE 1: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz | | | | | | | |

#### 8.13.2.2 REFSENS requirements

According to the co-existence analysis in 8.13.2.1 there is no need for additional REFSENS requirements for the 2DL/2UL configuration of CA\_n3A-n257A.

## 8.14 CA\_n28-n257

### 8.14.1 Common for 1 band UL and 2 bands UL CA

**8.14.1.1 Operating bands for CA**

**Table 8.14.1.1-1: CA band combination of band n28+n257**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA Band** | NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| CA\_n28-n257 | n28 | 703 MHz | – | 748 MHz | 758 MHz | – | 803 MHz | FDD |
| n257 | 26500 MHz | – | 29500 MHz | 26500 MHz | – | 29500 MHz | TDD |

#### 8.14.1.2 Channel bandwidths per operating band for CA

**Table 8.14.1.2-1: Supported bandwidths per CA band combination of band n28+n257**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set** | | | | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **NR Uplink CA configuration** | **NR Band** | **SCS(kHz)** | **5**  **MHz** | **10MHz** | **15MHz** | **20MHz** | **25 MHz** | **30 MHz** | **40MHz** | **50MHz** | **60MHz** | **80MHz** | **90MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Maximum Aggregated bandwidth**  **[MHz]** | **Bandwidth combination set** |
| CA\_n28A-n257A | CA\_n28A-n257A | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 420 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n257 | 60 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  |  |  | Yes |  |  |  | Yes | Yes | Yes |
| CA\_n28A-n257D | CA\_n28A-n257A  CA\_n28A-n257D | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 420 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257D in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n28A-n257G | CA\_n28A-n257A  CA\_n28A-n257G | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 220 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257G in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n28A-n257H | CA\_n28A-n257A  CA\_n28A-n257G  CA\_n28A-n257H | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 320 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257H in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| CA\_n28A-n257I | CA\_n28A-n257A  CA\_n28A-n257G  CA\_n28A-n257H  CA\_n28A-n257I | n28 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  | 420 | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| n257 | See CA\_n257I in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |
| n257 | See CA\_n257I in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | |

**8.14.1.3 Co-existence studies**

Table 8.14.1.3-1 summarizes frequency ranges where harmonics and/or harmonics mixing occur for CA\_n28-n257.

**Table 8.14.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | fx\_low | fx\_high | fy\_low | fy\_high |
| UL frequency (MHz) | 703 | 748 | 26500 | 29500 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\* fy\_low | 2\* fy\_high |
| 2nd harmonics frequency limits (MHz) | 1406 | 1496 | 53000 | 59000 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\* fy\_low | 3\* fy\_high |
| 3rd harmonics frequency limits (MHz) | 2109 | 2244 | 79500 | 88500 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\* fy\_low | 4\* fy\_high |
| 4th harmonics frequency limits (MHz) | 2812 | 2992 | 106000 | 118000 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\* fy\_low | 5\* fy\_high |
| 5th harmonics frequency limits (MHz) | 3515 | 3740 | 132500 | 147500 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\* fy\_low | 6\* fy\_high |
| 6th harmonics frequency limits (MHz) | 4218 | 4488 | 159000 | 177000 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\* fy\_low | 7\* fy\_high |
| 7th harmonics frequency limits (MHz) | 4921 | 5236 | 185500 | 206500 |

**8.14.1.4 ∆TIB and ∆RIB values**

For CA\_n-n257, the ΔTIB,c and ΔRIB,c values for UEs not supporting simultaneous Rx/Tx are given in the tables below.

Table 8.14.1.4-1: ΔTIB,c

| Inter-band EN-DC configuration | NR Band | ΔTIB,c (dB) |
| --- | --- | --- |
| CA\_n28-n257 | n28 | 0 |
| n257 | 0 |

Table 8.14.1.4-2: ΔRIB,c

|  |  |  |
| --- | --- | --- |
| Inter-band EN-DC configuration | NR Band | ΔRIB,c (dB) |
| CA\_n28-n257 | n28 | 0 |
| n257 | 0 |

**8.14.1.5 REFSEN requirements**

As mentioned in section 8.14.1.3, REFSENSE due to harmonic is not expected.

### 8.14.2 Specific for 2 bands UL CA

#### 8.14.2.1 UE co-existence studies

Table 8.14.2.1-1 lists Band n28 + Band n257 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 8.14.2.1-1: Band n28 and Band n257 UL IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 703 | 748 | 26500 | 29500 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 25752 | 28797 | 27203 | 30248 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 28094 | 25004 | 52252 | 58297 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 27906 | 30996 | 53703 | 59748 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 27391 | 24256 | 78752 | 87797 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 51504 | 57594 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 28609 | 31744 | 80203 | 89248 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 54406 | 60496 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 117297 | 105252 | 23508 | 26688 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 87094 | 78004 | 50756 | 56891 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 106703 | 118748 | 29312 | 32492 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 80906 | 89996 | 55109 | 61244 |

Based on Table 8.14.2.1-1, there are no IMD issues affecting own Rx frequencies of either band n28 or n257.

Table 8.14.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 8.14.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL NR CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_n28-n257 | E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 34, 39, 40, 41, 65 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 758 | - | 773 | -32 | 1 |  |
| Frequency range | 773 | - | 803 | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 1 |
| NOTE 1: Applicable when co-existence with PHS system operating in 1884.5 - 1915.7 MHz | | | | | | | |

#### 8.14.2.2 REFSENS requirements

According to the co-existence analysis in 8.14.2.1 there is no need for additional REFSENS requirements for the 2DL/2UL configuration of CA\_n28-n257.

## 8.15 CA\_n5-n260

### 8.15.1 Common for 1 band UL and 2 bands UL CA

#### 8.15.1.1 Operating bands for CA

Table 8.15.1.1-1: CA band combination of band n5+n260

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n260 | 37000 MHz | – | 40000 MHz | 37000 MHz | – | 40000 MHz | TDD |

#### 8.15.1.2 Channel bandwidths per operating band for CA

Table 8.15.1.2-1: Supported bandwidths per CA band combination of band n5+n260

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n5A-n260A | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | 60 |  |  |  |  |  | Yes |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  | Yes | Yes | Yes |
| CA\_n5A-n260(2A) | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See NR CA\_n260(2A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n260(3A) | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See NR CA\_n260(3A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n260(4A) | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See NR CA\_n260(4A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n260(5A) | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See NR CA\_n260(5A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n260(6A) | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See NR CA\_n260(6A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n260(7A) | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See NR CA\_n260(7A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n260(8A) | CA\_n5A-n260A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n260 | See NR CA\_n260(8A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |

#### 8.15.1.3 UE co-existence studies

Table 8.15.1.3-1 lists up to 7th harmonics for CA \_ n5-n260.

**Table 8.15.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n5 | 824 | 849 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 | 4120 | 4245 | 4944 | 5094 | 5768 | 5943 |
| n260 | 37000 | 40000 | 74000 | 80000 | 111k | 120k | 148k | 160k | 185k | 200k | 222k | 240k | 259k | 280k |

#### 8.15.1.4 ∆TIB and ∆RIB values

For CA\_n5-n260, the ΔTIB,c and ΔRIB,c values are given in the tables below.

**Table 8.15.1.4-1: ΔTIB,c**

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n5-n260 | n5 | 0 |
| n260 | 0 |

**Table 8.15.1.4-2: ΔRIB,c**

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n5-n260 | n5 | 0 |
| n260 | 0 |

#### 8.15.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

### 8.15.2 Specific for 2 bands UL CA

#### 8.15.2.1 UE co-existence studies

Table 8.15.2.1-1 lists Band n5 +Band n260 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 8.15.2.1-1: Band n5 and Band n260 2UL bands IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 824 | 849 | 37000 | 40000 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 36151 | 39176 | 37824 | 40849 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 35302 | 38352 | 73151 | 79176 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 38648 | 41698 | 74824 | 80849 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 34453 | 37528 | 110151 | 119176 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 72302 | 78352 | 75648 | 81698 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 39472 | 42547 | 111824 | 120849 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 147151 | 159176 | 33604 | 36704 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 109302 | 118352 | 71453 | 77528 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 148824 | 160849 | 40296 | 43396 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 112648 | 121698 | 76472 | 82547 |

Table 8.15.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 8.15.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n5A-n260A | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 18, 19, 24, 25, 26, 28, 29, 30, 31, 34, 38, 40, 42, 43, 45, 48, 50, 51, 65, 66, 70, 71, 73, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41, 52 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | PHS |

#### 8.15.2.2 REFSENS requirements

There is no need for additional REFSENS requirements.

## 8.16 CA\_n5-n261

### 8.16.1 Common for 1 band UL and 2 bands UL CA

#### 8.16.1.1 Operating bands for CA

Table 8.16.1.1-1: CA band combination of band n5+n261

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | Uplink (UL) band | | | Downlink (DL) band | | | Duplex  mode |
| BS receive / UE transmit | | | BS transmit / UE receive | | |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| n5 | 824 MHz | – | 849 MHz | 869 MHz | – | 894 MHz | FDD |
| n261 | 27500 MHz | – | 28350 MHz | 27500 MHz | – | 28350 MHz | TDD |

#### 8.16.1.2 Channel bandwidths per operating band for CA

Table 8.16.1.2-1: Supported bandwidths per CA band combination of band n5+n261

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration** | **Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **80**  **MHz** | **100 MHz** | **200 MHz** | **400 MHz** | **Bandwidth combination set** |
| CA\_n5A-n261A | - | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | 60 |  |  |  |  |  | Yes |  |  | Yes | Yes |  |
| 120 |  |  |  |  |  | Yes |  |  | Yes | Yes | Yes |
| CA\_n5A-n261(2A) |  | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261(2A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261(3A) |  | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261(3A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261(4A) | CA\_n5A-n261A | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261(4A) Bandwidth Combination in Table 5.5A.2-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261G | CA\_n5A-n261A  CA\_n5A-n261G | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261G Bandwidth Combination in Table 5.5A.1-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261H | CA\_n5A-n261A  CA\_n5A-n261G  CA\_n5A-n261H | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261H Bandwidth Combination in Table 5.5A.1-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261I | CA\_n5A-n261A  CA\_n5A-n261G  CA\_n5A-n261H  CA\_n5A-n261I | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261I Bandwidth Combination in Table 5.5A.1-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261J | CA\_n5A-n261A  CA\_n5A\_n261G  CA\_n5A\_n261H  CA\_n5A\_n261I | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261J Bandwidth Combination in Table 5.5A.1-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261K | CA\_n5A-n261A  CA\_n5A\_n261G  CA\_n5A\_n261H  CA\_n5A\_n261I | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261K Bandwidth Combination in Table 5.5A.1-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261L | CA\_n5A-n261A  CA\_n5A\_n261G  CA\_n5A\_n261H  CA\_n5A\_n261I | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261L Bandwidth Combination in Table 5.5A.1-1 of TS 38.101-2 | | | | | | | | | | | |
| CA\_n5A-n261M | CA\_n5A-n261A  CA\_n5A-n261G  CA\_n5A-n261H  CA\_n5A-n261I | n5 | 15 | Yes | Yes | Yes | Yes |  |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |
| n261 | See NR CA\_n261M Bandwidth Combination in Table 5.5A.1-1 of TS 38.101-2 | | | | | | | | | | | |

#### 8.16.1.3 UE co-existence studies

Table 8.16.1.3-1 lists up to 7th harmonics for CA \_ n5-n261.

**Table 8.16.1.3-1: Impact of UL/DL Harmonic**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n5 | 824 | 849 | 1648 | 1698 | 2472 | 2547 | 3296 | 3396 | 4120 | 4245 | 4944 | 5094 | 5768 | 5943 |
| n261 | 27500 | 28350 | 55000 | 56700 | 82500 | 85050 | 110000 | 113400 | 137500 | 141750 | 165000 | 170100 | 192500 | 198450 |

#### 8.16.1.4 ∆TIB and ∆RIB values

For CA\_n5-n261, the ΔTIB,c and ΔRIB,c values are given in the tables below.

**Table 8.16.1.4-1: ΔTIB,c**

| **Inter-band CA Configuration** | **NR Band** | **ΔTIB,c [dB]** |
| --- | --- | --- |
| CA\_n5-n261 | n5 | 0 |
| n261 | 0 |

**Table 8.16.1.4-2: ΔRIB,c**

| **Inter-band CA Configuration** | **NR Band** | **ΔRIB,c [dB]** |
| --- | --- | --- |
| CA\_n5-n261 | n5 | 0 |
| n261 | 0 |

#### 8.16.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

### 8.16.2 Specific for 2 bands UL CA

#### 8.16.2.1 UE co-existence studies

Table 8.16.2.1-1 lists Band n5 +Band n261 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 8.16.2.1-1: Band n5 and Band n261 2UL bands IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 824 | 849 | 27500 | 28350 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 26651 | 27526 | 28324 | 29199 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 25802 | 26702 | 54151 | 55876 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 29148 | 30048 | 55824 | 57549 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 24953 | 25878 | 81651 | 84226 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |
| IMD frequency limits (MHz) | 53302 | 55052 | 56648 | 58398 |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 29972 | 30897 | 83324 | 85899 |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 109151 | 112576 | 24104 | 25054 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 80802 | 83402 | 52453 | 54228 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 110824 | 114249 | 30796 | 31746 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 84148 | 86748 | 57472 | 59247 |

Table 8.16.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 8.16.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n5A-n261A | E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 18, 19, 24, 25, 26, 28, 29, 30, 31, 34, 38, 40, 42, 43, 45, 48, 50, 51, 65, 66, 70, 71, 73, 74, 85 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 41, 52 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | PHS |

#### 8.16.2.2 REFSENS requirements

There is no need for additional REFSENS requirements.

## 8.17 CA\_n77-n261

### 8.17.1 Common for 1 band UL and 2 bands UL CA

#### 8.17.1.1 Operating bands for CA

**Table 8.17.1.1-1: CA band combination of band n77+n261**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NR Band** | **Uplink (UL) band** | | | **Downlink (DL) band** | | | **Duplex**  **mode** |
| **BS receive / UE transmit** | | | **BS transmit / UE receive** | | |
| **FUL\_low – FUL\_high** | | | **FDL\_low – FDL\_high** | | |
| n77 | 3300 MHz | – | 4200 MHz | 3300 MHz | – | 4200 MHz | TDD |
| n261 | 27500 MHz | – | 28350 MHz | 27500 MHz | – | 28350 MHz | TDD |

#### 8.17.1.2 Channel bandwidths per operating band for CA

**Table 8.17.1.2-1: Supported bandwidths per CA band combination of band n77+n261**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NR CA configuration / Bandwidth combination set** | | | | | | | | | | | | | | | | | | | | | | |
| **NR CA configuration** | **NR Uplink CA configuration** | **NR Band** | **SCS**  **(kHz)** | **5**  **MHz** | **10**  **MHz** | **15**  **MHz** | **20**  **MHz** | | **25 MHz** | **30 MHz** | | **40**  **MHz** | **50**  **MHz** | **60**  **MHz** | **70 MHz** | **80**  **MHz** | **90**  **MHz** | **100 MHz** | **200 MHz** | | **400 MHz** | **BCS** |
| CA\_n77A-n261A | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | |  |  | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| 60 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| n261 | 60 |  |  |  |  | |  |  | |  | Yes |  |  |  |  | Yes | Yes | |  |
| 120 |  |  |  |  | |  |  | |  | Yes |  |  |  |  | Yes | Yes | | Yes |
| CA\_n77A-n261D | CA\_n77A-n261A CA\_n77A-n261D | n77 | 15 |  | Yes | Yes | Yes | |  |  | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| 60 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| n261 | See CA\_n261D in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261G | CA\_n77A-n261A CA\_n77A-n261G | n77 | 15 |  | Yes | Yes | Yes | |  |  | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| 60 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| n261 | See CA\_n261G in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261H | CA\_n77A-n261A  CA\_n77A-n261G CA\_n77A-n261H | n77 | 15 |  | Yes | Yes | Yes | |  |  | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| 60 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| n261 | See CA\_n261H in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261I | CA\_n77A-n261A  CA\_n77A-n261G  CA\_n77A-n261H CA\_n77A-n261I | n77 | 15 |  | Yes | Yes | Yes | |  |  | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| 60 |  | Yes | Yes | Yes | |  |  | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes |  | |  |
| n261 | See CA\_n261I in Table 5.5A.1-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261J | CA\_n77A-n261A  CA\_n77A-n261G  CA\_n77A-n261H CA\_n77A-n261I  CA\_n77A-n261J | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 |  | See CA\_n261J in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261K | CA\_n77A-n261A  CA\_n77A-n261G  CA\_n77A-n261H CA\_n77A-n261I  CA\_n77A-n261J  CA\_n77A-n261K | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 |  | See CA\_n261K in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261L | CA\_n77A-n261A  CA\_n77A-n261G  CA\_n77A-n261H CA\_n77A-n261I  CA\_n77A-n261J  CA\_n77A-n261K  CA\_n77A-n261L | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261L in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261M | CA\_n77A-n261A  CA\_n77A-n261G  CA\_n77A-n261H CA\_n77A-n261I  CA\_n77A-n261J  CA\_n77A-n261K  CA\_n77A-n261L  CA\_n77A-n261M | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261M in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(2A) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(2A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(2G) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(2G) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(2H) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(2H) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(2I) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(2I) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(3A) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(3A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(4A) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(4A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(A-G) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(A-G) in Table 5.5A.2-2 in TS 38.101-2 | | | | | | | | | | | |  | | | | | | |
| CA\_n77A-n261(A-H) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(A-H) in Table 5.5A.2-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(A-I) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes |  |  |  |  |  |  | |  | 0 |
| 30 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| 60 |  | Yes | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | Yes | |  |
| n261 | See CA\_n261(A-I) in Table 5.5A.2-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(G-H) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes |  |  |  |  |  | |  |  | 0 |
| 30 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | | Yes |  |
| 60 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | | Yes |  |
| n261 |  | See CA\_n261(G-H) in Table 5.5A.2-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(G-I) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes |  |  |  |  |  | |  |  | 0 |
| 30 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | | Yes |  |
| 60 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | | Yes |  |
| n261 |  | See CA\_n261(G-I) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | | | | | | | |
| CA\_n77A-n261(H-I) | CA\_n77A-n261A | n77 | 15 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes |  |  |  |  |  | |  |  | 0 |
| 30 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | | Yes |  |
| 60 |  | Yes | Yes | | Yes | Yes | | Yes | Yes | Yes | Yes | Yes4 | Yes | Yes | Yes | | Yes |  |
| n261 |  | See CA\_n261(H-I) in Table 5.5A.2-2 in TS 38.101-2 | | | | | | | | | | | | | | | | | |
| NOTE 4: This UE channel bandwidth is optional in this release of the specification. (From Table 5.3.5-1 of 38.101-1) | | | | | | | | | | | | | | | | | | | | | | |

#### 8.17.1.3 Co-existence studies

Table 8.17.1.3-1 gives the UL 2nd, 3rd, 4th, 5th, 6th, 7th harmonic for CA\_n77A-n261A. The 6th  and 7th harmonic produced by UL band n77 may fall into Band n261DL.

Table 8.17.1.3-1: Band n77 and Band n258 UL harmonics products

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **fx\_low** | **fx\_high** | **fy\_low** | **fy\_high** |
| UL frequency(MHz) | 3300 | 4200 | 27500 | 28350 |
| 2nd harmonics frequency limits | 2\*fx\_low | 2\*fx\_high | 2\*fy\_low | 2\*fy\_high |
| 2nd harmonics frequency limits(MHz) | 6600 | 8400 | 55000 | 56700 |
| 3rd harmonics frequency limits | 3\*fx\_low | 3\*fx\_high | 3\*fy\_low | 3\*fy\_high |
| 3rd harmonics frequency limits(MHz) | 9900 | 12600 | 82500 | 85050 |
| 4th harmonics frequency limits | 4\*fx\_low | 4\*fx\_high | 4\*fy\_low | 4\*fy\_high |
| 4th harmonics frequency limits(MHz) | 13200 | 16800 | 110000 | 113400 |
| 5th harmonics frequency limits | 5\*fx\_low | 5\*fx\_high | 5\*fy\_low | 5\*fy\_high |
| 5th harmonics frequency limits(MHz) | 16500 | 21000 | 137500 | 141750 |
| 6th harmonics frequency limits | 6\*fx\_low | 6\*fx\_high | 6\*fy\_low | 6\*fy\_high |
| 6th harmonics frequency limits(MHz) | 19800 | 25200 | 165000 | 170100 |
| 7th harmonics frequency limits | 7\*fx\_low | 7\*fx\_high | 7\*fy\_low | 7\*fy\_high |
| 7th harmonics frequency limits(MHz) | 23100 | 29400 | 192500 | 198450 |

#### 8.17.1.4 ∆TIB and ∆RIB values

For CA\_n77A-n261A, the ΔTIB,c and ΔRIB values are given in the tables below.

Table 8.17.4-1: ΔTIB,c

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n77-n261 | n77 | 0 |
| n261 | 0 |

Table 8.17.4-2: ΔRIB

| Inter-band CA Configuration | E-UTRA and NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n77-n261 | n77 | 0 |
| n261 | 0 |

#### 8.17.1.5 REFSENS requirements

There are no specific REFSENS requirements for this configuration.

### 8.17.2 Specific for 2 bands UL CA

#### 8.17.2.1 UE co-existence studies

Table 8.17.2.1-1 lists Band n77 +Band n261 2UL bands CA 2nd, 3rd, 4th and 5th order IMD for the UE-to-UE coexistence analysis.

**Table 8.17.2.1-1: Band n77 and Band n261 2UL bands IMD products**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **UE UL carriers** | **Fx\_low** | **Fx\_high** | **Fy\_low** | **Fy\_high** |
| UL frequency (MHz) | 3300 | 4200 | 27500 | 28350 |
| 2nd order IMD products | |fy\_low – fx\_high| | |fy\_high – fx\_low| | |fy\_low + fx\_low| | |fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 23300 | 25050 | 30800 | 32550 |
| Two-tone 3rd order IMD products | |2\*fx\_low – fy\_high| | |2\*fx\_high – fy\_low| | |2\*fy\_low – fx\_high| | |2\*fy\_high – fx\_low| |
| IMD frequency limits (MHz) | 21750 | 19100 | 50800 | 53400 |
| Two-tone 3rd order IMD products | |2\*fx\_low + fy\_low| | |2\*fx\_high + fy\_high| | |2\*fy\_low + fx\_low| | |2\*fy\_high + fx\_high| |
| IMD frequency limits (MHz) | 34100 | 36750 | 58300 | 60900 |
| Two-tone 4th order IMD products | |3\*fx\_low –1\* fy\_high| | |3\*fx\_high – 1\*fy\_low| | |3\*fy\_low – 1\*fx\_high| | |3\*fy\_high – 1\*fx\_low| |
| IMD frequency limits (MHz) | 18450 | 14900 | 78300 | 81750 |
| Two-tone 4th order IMD products | |2\*fx\_low –2\* fy\_high| | |2\*fx\_high –2\* fy\_low| |  |  |
| IMD frequency limits (MHz) | 46600 | 50100 |  |  |
| Two-tone 4th order IMD products | |3\*fx\_low +1\* fy\_low| | |3\*fx\_high + 1\*fy\_high| | |3\*fy\_low + 1\*fx\_low| | |3\*fy\_high + 1\*fx\_high| |
| IMD frequency limits (MHz) | 37400 | 40950 | 85800 | 89250 |
| Two-tone 4th order IMD products | |2\*fx\_low +2\* fy\_low| | |2\*fx\_high +2\* fy\_high| |  |  |
| IMD frequency limits (MHz) | 61600 | 65100 |  |  |
| Two-tone 5th order IMD products | |fx\_low – 4\*fy\_high| | |fx\_high – 4\*fy\_low| | |fy\_low – 4\*fx\_high| | |fy\_high – 4\*fx\_low| |
| IMD frequency limits (MHz) | 110100 | 105800 | 10700 | 15150 |
| Two-tone 5th order IMD products | |2\*fx\_low - 3\*fy\_high| | |2\*fx\_high - 3\*fy\_low| | |2\*fy\_low - 3\*fx\_high| | |2\*fy\_high -3\*fx\_low| |
| IMD frequency limits (MHz) | 78450 | 74100 | 42400 | 46800 |
| Two-tone 5th order IMD products | |fx\_low + 4\*fy\_low| | |fx\_high + 4\*fy\_high| | |fy\_low + 4\*fx\_low| | |fy\_high + 4\*fx\_high| |
| IMD frequency limits (MHz) | 113300 | 117600 | 40700 | 45150 |
| Two-tone 5th order IMD products | |2\*fx\_low + 3\*fy\_low| | |2\*fx\_high + 3\*fy\_high| | |2\*fy\_low + 3\*fx\_low| | |2\*fy\_high + 3\*fx\_high| |
| IMD frequency limits (MHz) | 89100 | 93450 | 64900 | 69300 |

Based on Table 8.17.2.1-1, there are no harmonic or IMD issues affecting own Rx frequencies of either band n77 or n261.

Table 8.17.2.1-2 lists the protected bands required for the 2UL bands CA configuration.

**Table 8.17.2.1-2: Protected bands for the 2UL bands CA configuration**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **UL NR CA Configuration** | **Spurious emission** | | | | | | |
| **Protected band** | **Frequency range (MHz)** | | | **Maximum Level (dBm)** | **MBW (MHz)** | **NOTE** |
| CA\_n77A-n261A | E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 25, 26, 29, 30, 65, 66, 70, 71 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | PHS |

#### 8.17.2.2 REFSENS requirements

There are no need for additional REFSENS requirements for this configuration.

8.18 CA\_n66\_n260

8.18.1 Common for 1 band UL and 2 bands UL CA

8.18.1.1 Operating bands for CA

**Table 8.18.1.1-1: CA band combination of n66+n260**

| **NR Band** | **Uplink (UL) band** | **Downlink (DL) band** | **Duplex mode** |
| --- | --- | --- | --- |
| **BS receive / UE transmit** | **BS transmit / UE receive** |
| n66 | 1710 MHz – 1780 MHz | 2110 MHz – 2200 MHz | FDD | |
| n260 | 37000 MHz - 40000 MHz | 37000 MHz - 40000 MHz | TDD | |

8.18.1.2 Channel bandwidths per operating band for CA

**Table 8.18.1.2-1: Supported bandwidths per CA band combination of band n66+n260**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operating / channel bandwidth [MHz]** | | | | | | | | | | | | | | | |
| **NR CA Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **40** | **50** | **60** | **80** | **100** | **200** | **400** | **Bandwidth combination set** |
| CA\_n66A-n260A | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_n260A in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n260(2A) | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_n260(2A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n260(3A) | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_ n260(3A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n260(4A) | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_ n260(4A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n260(5A) | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_ n260(5A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n260(6A) | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_ n260(6A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n260(7A) | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_ n260(7A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n260(8A) | CA\_n66A-n260A | n66 | 15 | Yes | Yes | Yes | Yes |  |  | Yes |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| 60 |  | Yes | Yes | Yes |  |  | Yes |  |  |  |  |
| n260 | See CA\_ n260(8A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |

8.18.1.3 Co-existence studies

Table 8.18.1.3-1: Impact of UL/DL Harmonic

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n66 | 1710 | 1780 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 | 8550 | 8900 | 10260 | 10680 | 11970 | 12460 |
| n260 | 37000 | 40000 | 74000 | 80000 | 111000 | 120000 | 148000 | 160000 | 185000 | 200000 | 222000 | 240000 | 259000 | 280000 |

Based on Table 8.18.1.3-1, there is no harmonic skirt interference found to impact the receive frequency of each band. And, no further studies are needed for this combination.

8.18.1.4 ∆TIB and ∆RIB values

For CA\_n66A-n260A, the ΔTIB,c and ΔRIB values are given in the tables below.

**Table 8.18.5-1: ΔTIB,c**

| Inter-band CA Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n66A-n260A | n66 | 0 |
| n260 | 0 |

8.18.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

8.19 CA\_n66\_n261

8.19.1 Common for 1 band UL and 2 bands UL CA

8.19.1.1 Operating bands for CA

**Table 8.19.1.1-1: CA band combination of band n66+n261**

| **NR Band** | **Uplink (UL) band** | **Downlink (DL) band** | **Duplex mode** |
| --- | --- | --- | --- |
| **BS receive / UE transmit** | **BS transmit / UE receive** |
| n66 | 824 MHz - 849 MHz | 869 MHz - 894 MHz | FDD | |
| n261 | 27500 MHz - 28350 MHz | 27500 MHz - 28350 MHz | TDD | |

8.19.1.2 Channel bandwidths per operating band for CA

**Table 8.19.1.2-1: Supported bandwidths per CA band combination of band n66+n261**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA operation / channel bandwidth [MHz]** | | | | | | | | | | | | | | | |
| **NR DC Configuration** | **UL Configuration** | **NR Band** | **SCS [kHz]** | **5** | **10** | **15** | **20** | **40** | **50** | **60** | **80** | **100** | **200** | **400** | **Bandwidth combination set** |
| CA\_n66A-n261A | CA\_n66A-n261A | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_n261A in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261(2A) | CA\_n66A-n261A | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_n261(2A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261(3A) | CA\_n66A-n261A | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261(3A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261(4A) | CA\_n66A-n261A | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261(4A) in Table 5.5A.2-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261G | CA\_n66A-n261A  CA\_5A\_n261G | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261G in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261H | CA\_n66A-n261A  CA\_n66A\_n261G  CA\_n66A\_n261H | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261H in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261I | CA\_n66A-n261A  CA\_n66A\_n261G  CA\_n66A\_n261H  CA\_n66A\_n261I | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261I in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261J | CA\_n66A-n261A | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261J in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261K | CA\_n66A-n261A | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261K in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261L | CA\_n66A-n261A | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261L in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |
| CA\_n66A-n261M | CA\_n66A-n261A  CA\_n66A\_n261G  CA\_n66A\_n261H  CA\_n66A\_n261I | n66 | 15 | Yes | Yes | Yes | Yes | Yes |  |  |  |  |  |  | 0 |
| 30 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| 60 |  | Yes | Yes | Yes | Yes |  |  |  |  |  |  |
| n261 | See CA\_ n261M in Table 5.5A.1-1 in TS 38.101-2 | | | | | | | | | | | |

8.19.1.3 Co-existence studies

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | **2nd Harmonic** | | **3rd Harmonic** | | **4th Harmonic** | | **5th Harmonic** | | **6th Harmonic** | | **7th Harmonic** | |
| **Band** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** | **UL Low Band Edge** | **UL High Band Edge** |
| n66 | 1710 | 1780 | 3420 | 3560 | 5130 | 5340 | 6840 | 7120 | 8550 | 8900 | 10260 | 10680 | 11970 | 12460 |
| n261 | 27500 | 28350 | 55000 | 56700 | 82500 | 85050 | 110000 | 113400 | 137500 | 141750 | 165000 | 170100 | 192500 | 198450 |

Based on Table 8.19.1.3-1, there is no harmonic skirt interference found to impact the receive frequency of each band. And, no further studies are needed for this combination.

8.19.1.4 ∆TIB and ∆RIB values

For CA\_n66A-n261A, the ΔTIB,c and ΔRIB values are given in the tables below.

**Table 8.19.4-1: ΔTIB,c**

| Inter-band DC Configuration | NR Band | ΔTIB,c [dB] |
| --- | --- | --- |
| CA\_n66A-n261A | n66 | 0 |
| n261 | 0 |

**Table 8.19.4-2: ΔRIB**

| Inter-band DC Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n66A-n261A | n66 | 0 |
| n261 | 0 |

8.19.1.5 REFSENS requirements

There is no need for additional REFSENS requirements.

**Table 8.18.5-2: ΔRIB**

| Inter-band CA Configuration | NR Band | ΔRIB [dB] |
| --- | --- | --- |
| CA\_n66A-n260A | n66 | 0 |
| n260 | 0 |

# 9 2 bands Dual Connectivity: Specific Band Combination Part

## 9.1 DC\_n2-n77

### 9.1.1 Operating bands for DC\_n2-n77

**Table 9.1.1-1: Inter-band NR DC operating bands**

|  |  |
| --- | --- |
| **NR DC Band** | **NR Band** |
| DC\_n2-n77 | n2, n77 |

### 9.1.2 Configurations for DC\_n2-n77

**Table 9.1.2-1: Inter-band NR DC configurations**

| **NR DC**  **configuration** | **Uplink NR DC**  **configuration** |
| --- | --- |
| DC\_n2A-n77A | DC\_n2A-n77A |
|

## 9.2 DC\_n5-n77

### 9.2.1 Operating bands for DC\_n5-n77

**able 9.2.1-1: Inter-band NR DC operating bands**

|  |  |
| --- | --- |
| **NR DC Band** | **NR Band** |
| DC\_n5-n77 | n5, n77 |

### 9.2.2 Configurations for DC\_n5-n77

**Table 9.2.2-1: Inter-band NR DC configurations**

| **NR DC**  **configuration** | **Uplink NR DC**  **configuration** |
| --- | --- |
| DC\_n5A-n77A | DC\_n5A-n77A |
|

## 9.3 DC\_n66-n77

### 9.3.1 Operating bands for DC\_n66-n77

**Table 9.3.1-1: Inter-band NR DC operating bands**

|  |  |
| --- | --- |
| **NR DC Band** | **NR Band** |
| DC\_n66-n77 | n66, n77 |

### 9.3.2 Configurations for DC\_n66-n77

**Table 9.3.2-1: Inter-band NR DC configurations**

| **NR DC**  **configuration** | **Uplink NR DC**  **configuration** |
| --- | --- |
| DC\_n66A-n77A | DC\_n66A-n77A |
|

## 9.4 DC\_n77-n261

### 9.4.1 Operating bands for DC\_n77-n261

**Table 9.4.1-1: Inter-band NR DC operating bands**

|  |  |
| --- | --- |
| **NR DC Band** | **NR Band** |
| DC\_n77-n261 | n77, n261 |

### 9.4.2 Configurations for DC\_n77-n261

**Table 9.4.2-1: Inter-band NR DC configurations**

| **NR DC**  **configuration** | **Uplink NR DC**  **configuration** |
| --- | --- |
| DC\_n77A-n261A | DC\_n77A-n261A |
| DC\_n77A-n261D | DC\_n77A-n261A  DC\_n77A-n261D |
| DC\_n77A-n261G | DC\_n77A-n261A  DC\_n77A-n261G |
| DC\_n77A-n261H | DC\_n77A-n261A  DC\_n77A-n261G  DC\_n77A-n261H |
| DC\_n77A-n261I | DC\_n77A-n261A  DC\_n77A-n261G  DC\_n77A-n261H  DC\_n77A-n261I |
| DC\_n77A-n261J | DC\_n77A-n261A  DC\_n77A-n261G  DC\_n77A-n261H  DC\_n77A-n261I  DC\_n77A-n261J |
| DC\_n77A-n261K | DC\_n77A-n261A  DC\_n77A-n261G  DC\_n77A-n261H  DC\_n77A-n261I  DC\_n77A-n261J  DC\_n77A-n261K |
| DC\_n77A-n261L | DC\_n77A-n261A  DC\_n77A-n261G  DC\_n77A-n261H  DC\_n77A-n261I  DC\_n77A-n261J  DC\_n77A-n261K  DC\_n77A-n261L |
| DC\_n77A-n261M | DC\_n77A-n261A  DC\_n77A-n261G  DC\_n77A-n261H  DC\_n77A-n261I  DC\_n77A-n261J  DC\_n77A-n261K  DC\_n77A-n261L  DC\_n77A-n261M |
| DC\_n77A-n261(2A) | DC\_n77A-n261A |
| DC\_n77A-n261(2G) | DC\_n77A-n261A |
| DC\_n77A-n261(2H) | DC\_n77A-n261A |
| DC\_n77A-n261(2I) | DC\_n77A-n261A |
| DC\_n77A-n261(3A) | DC\_n77A-n261A |
| DC\_n77A-n261(4A) | DC\_n77A-n261A |
| DC\_n77A-n261(A-G) | DC\_n77A-n261A |
| DC\_n77A-n261(A-H) | DC\_n77A-n261A |
| DC\_n77A-n261(A-I) | DC\_n77A-n261A |
| DC\_n77A-n261(G-H) | DC\_n77A-n261A |
| DC\_n77A-n261(G-I) | DC\_n77A-n261A |
| DC\_n77A-n261(H-I) | DC\_n77A-n261A |

Annex A:  
Change history

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| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2018-08 | RAN4#88 | R4-1810913 |  |  |  | TR skeleton | 0.0.1 |
| 2018-10 | RAN4#88bis | R4-1812524 |  |  |  | Implemented TP´s from RAN4 #88:  R4-1810177, TP for TR 38.716-02-00: CA\_n3A-n79A, ZTE corporation  R4-1811447, TP for TR38.716-02-00 1UL and 2UL for CA\_n1-n78, ZTE corporation  R4-1810343, TP for TR38.716-02-00: Requirements for CA\_n66A-n71A and CA\_n66A-n70A, Dish Network  R4-1810451, 2UL UE co-ex: a problem in co-ex table, SoftBank Corp. | 0.1.0 |
| 2018-11 | RAN4#89 | R4-1814822 |  |  |  | Implemented TP´s from RAN4 #88bis:  R4-1812544, TP for TR 38.716-02-00: CA\_n1A-n79A, ZTE corporation  R4-1812606, TP for TR 38.716-02-00: CA\_n39A-n41A, ZTE corporation, CMCC  R4-1813800, TP for TR 38.716-02-00: CA\_n3A-n41A, ZTE corporation, CMCC  R4-1812627, TP for TR 38.716-02-00 UE requirements for CA\_n1-n77, CHTTL  R4-1812298, Draft CR to TS 38.101-3: to add missing requirements for inter-band CA between FR1 and FR2, Samsung | 0.2.0 |
| 2019-02 | RAN4#90 | R4-1900324 |  |  |  | Implemented TP´s from RAN4 #89:  R4-1814650, TP for TR38.716-02-00: inter-band CA\_n8-n41, CATT, CMCC  R4-1814651, TP for TR38.716-02-00: inter-band CA\_n41-n79, CATT, CMCC  R4-1814505, TP for TR38.716-02-00: MSD requirements due to cross band isolation for 1UL/2UL for CA\_n3-n41, ZTE Corporation, CMCC  R4-1816215, TP for TR 38.716-02-00: MSD for CA\_n1A-n77A due to the 2nd harmonic, MediaTek Inc., CHTTL | 0.3.0 |
| 2019-04 | RAN4#90bis | R4-1904894 |  |  |  | Implemented TP´s from RAN4 #90:  R4-1900203, TP for TR 38.716-02-00: CA\_n5A-n78A with 1UL and 2UL, China Telecom  R4-1900204, TP for TR 38.716-02-00: CA\_n5A-n79A with 1UL and 2UL, China Telecom  R4-1900455, TP for TR38.716-02-00: 1UL and 2UL for CA\_n40-n41, ZTE Corporation, CMCC  R4-1902119, TP for TR38.716-02-00: Requirements for CA\_n70A-n71A, Dish Network  R4-1902133, TP to TR 38.716-02-00: CA\_n50A\_n78A, Huawei, Hisilicon, Etisalat  R4-1902132, TP to TR 38.716-02-00: CA\_n28A\_n50A, Huawei, Hisilicon, Etisalat  R4-1902131, TP to TR 38.716-02-00: CA\_n41A\_n50A, Huawei, Hisilicon, Etisalat  R4-1900090, TP to TR 38.716-02-00 CA\_n71-n261, Nokia, TMO US  R4-1901450, TP for TR 38.716-02-00 to include CA\_n71A-n260A, CA\_n71A-n260(2A), Ericsson, T-Mobile US | 0.4.0 |
| 2019-05 | RAN4#91 | R4-1905855 |  |  |  | Implemented TP´s from RAN4 #90bis:  R4-1903085, TP for TR38.716-02-00: Requirements for CA\_n66B-n70A, Dish Network  R4-1903086, TP for TR38.716-02-00: Requirements for CA\_n66(2A)-n70A, Dish Network  R4-1903087, TP for TR38.716-02-00: Requirements for CA\_n66(2A)-n71A, Dish Network  R4-1903422, TP for TR 38.716-02-00: CA\_n1A-n78C with 1UL and 2UL, China Telecom  R4-1903423, TP for TR 38.716-02-00: CA\_n5A-n78C with 1UL and 2UL, China Telecom  R4-1903424, TP for TR 38.716-02-00: CA\_n5A-n79C with 1UL and 2UL, China Telecom  R4-1903544 TP to TR 38.716-02-00: CA\_n41x-n71x, Nokia, TMO US  R4-1904898 TP to TR 38.716-02-00: CA\_n41A\_n50A, Huawei, Hisilicon, Etisalat  R4-1903839 TP for TR 38.716-02-00: 1UL and 2UL for CA\_n3A-n8A, ZTE Corporation  R4-1904973 TP for TR 38.716-02-00: MSD for CA\_n8-n41, CATT, CMCC  R4-1904897 TP for TR 38.716-02-00: 2UL for CA\_n8A-n79A, ZTE Corporation  R4-1904435 TP for TR 38.716-02-00 to include CA\_n25A-n41A, CA\_n25(2A)-n41A, CA\_n25A-n41C, CA\_n25A-n41(2A), Ericsson, Sprint, T-Mobile US  R4-1904999 TP for TR 38.716-02-00 to include CA\_n25A-n71A, Ericsson, T-Mobile US  R4-1904893 TP for TR 38.716-02-00: Interference analysis for CA\_n39A-n79A, CATT  R4-1904902 TP to TR 38.716-02-00: CA\_n28A\_n50A, Huawei, Hisilicon, Etisalat  R4-1904430 TP for TR 38.716-02-00 to include CA\_n40-n78, Ericsson  R4-1903143 TP for TR38.716-02-00: 1UL and 2UL for CA\_n40-n79, ZTE Corporation, CMCC  R4-1904971 TP to TR 38.716-02-00: CA\_n50A\_n78A, Huawei, Hisilicon, Etisalat  R4-1903002 TP for TR 37.716-02-00 Introduction of CA\_n41-n261, Nokia, Nokia Shanghai Bell  R4-1903003 TP for TR 37.716-02-00 Introduction of CA\_n25-n261, Nokia, Nokia Shanghai Bell  R4-1903188 TP for TR 38.716-02-00 for CA\_n77A-n258A, Huawei, Hisilicon, Etisalat  R4-1903189 TP for TR 38.716-02-00 for CA\_n78A-n258A, Huawei, Hisilicon, Etisalat  R4-1903190 TP for TR 38.716-02-00 for CA\_n79A-n258A, Huawei, Hisilicon, Etisalat  R4-1903986 TP for TR 38.716-02-00: CA\_n1-n257, KDDI  R4-1904084 TP to TR 38.716-02-00 CA\_n78A-n257G,H,I,J,K,L,M with 1UL, LG Uplus  R4-1904433 TP for TR 38.716-02-00 to include CA\_n41A-n260A, CA\_n41A-n260(2A), Ericsson, T-Mobile US  R4-1904434 TP for TR 38.716-02-00 to include CA\_n25A-n260A, CA\_n25A-n260(2A), Ericsson, T-Mobile US | V0.5.0 |
| 2019-08 | RAN4#92 | R4-1909515 |  |  |  | Implemented TP´s from RAN4 #91:  R4-1905620 TP for TR38.716-02-00: 1UL and 2UL for CA\_n8-n39, ZTE Corporation  R4-1905792 TP for TR 38.716-02-00: CA\_n28-n77, SoftBank Corp  R4-1907460 TP for TR 38.716-02-00 to include CA\_n3A-n8A, ZTE Corporation  R4-1907405 TP for TR 38.716-02-00 to include CA\_n1-n28, Ericsson, BT plc  R4-1906741 TP for TR 38.716-02-00 to include CA\_n3-n28, Ericsson, BT plc  R4-1906742 TP for TR 38.716-02-00 to include CA\_n7-n28, Ericsson, BT plc  R4-1907406 TP for TR 38.716-02-00 to include CA\_n20-n28, Ericsson, BT plc  R4-1907399 TP to TR 38.716-02-00 CA\_n78-n257 with 2UL, LG Uplus | V0.6.0 |
| 2019-10 | RAN4#92bis | R4-1910833 |  |  |  | Implemented TP´s from RAN4 #92:  R4-1910299 TP for TR 38.716-02-00: CA\_n48\_n66, Samsung,Verizon  R4-1908930 [CA] TP for TR 38.716-02-00: adding BCS1 for relative inter-band CA, Huawei, HiSilicon  R4-1910263 TP for TR 38.716-02-00: CA\_n7A-n78A, Huawei, HiSilicon  R4-1910199 TP for TR 38.716-02-00: CA\_n7-n66,Huawei, HiSilicon  R4-1910200 TP for TR 38.716-02-00 CA\_n41-n66,Nokia, Nokia Shanghai Bell, T-Mobile USA  R4-1908094 TP for TR 38.716-02-00: CA\_n2\_n48, Samsung,Verizon  R4-1908264 TP for TR 38.716-02-00: CA\_n28A-n78A, KDDI  R4-1908561 TP for TR38.716-02-00: 1UL and 2UL for CA\_n1-n8, ZTE Corporation,  R4-1908706 TP for TR38.716-02-00: Requirements for CA\_n66B-n71A,Dish Network  R4-1908262 TP for TR 38.716-02-00: CA\_n77-n257, KDDI  R4-1910209 TP for TR 38.716-02-00: CA\_n3-n257, KDDI, SoftBank Corp.  R4-1910210 TP for TR 38.716-02-00: CA\_n28-n257, KDDI  R4-1908261 TP for TR 38.716-02-00: CA\_n28A-n77(2A), KDDI  R4-1908096 TP to TR 38.716-02-00 CA\_n5-n260 with 1UL and 2UL, Samsung,Verizon  R4-1908097 TP to TR 38.716-02-00 CA\_n5-n261 with 1UL and 2UL, Samsung,Verizon  R4-1908263 TP for TR 38.716-02-00: CA\_n77A-n261A, KDDI  R4-1909256 TP for TR 38.716-02-00 CA\_n41-n261 ,Nokia, Nokia Shanghai Bell, T-Mobile USA | V0.7.0 |
| 2019-11 | RAN4#93 | [R4-1913237](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1913237.zip) |  |  |  | Implemented TP´s from RAN4 #92bis:  [R4-1912578](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1912578.zip), TP for TR 38.716-02-00: CA\_n66A-n78A, Huawei, HiSilicon  [R4-1911253](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1911253.zip), TP for TR 38.716-02-00: 2UL for CA\_n39A-n40A,ZTE Corporation  [R4-1911254](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1911254.zip), TP for TR 38.716-02-00: 2UL for CA\_n3A-n40A,ZTE Corporation  [R4-1911255](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1911255.zip), TP for TR 38.716-02-00: 2UL for CA\_n8A-n40A,ZTE Corporation  [R4-1911467](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1911467.zip), updated TP for TR 38.716-02-00: CA\_n7A-n78A and CA\_n7A-n78(2A), Huawei, HiSilicon  [R4-1912579](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1912579.zip),TP for TR 38.716-02-00: CA\_n1A-n3A and CA\_n1B-n3A, Huawei, HiSilicon, Ericsson  [R4-1912580](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1912580.zip), TP for TR 38.716-02-00: CA\_n1-n41,Huawei, HiSilicon  [R4-1911470](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1911470.zip), TP for TR 38.716-02-00: CA\_n28-n41,Huawei, HiSilicon  [R4-1912429](file:///D:\RAN4\TSGRAN4_92bis\Docs\R4-1912429.zip), TP for TR 38.716-02-00: Introduction of UL CA\_n25A-n41A for DL CA\_n25A-n41C and DL CA\_n25A-n41(2A), Sprint Corporation | V0.8.0 |
| 2020-02 | RAN4#94-e | R4-2000803 |  |  |  | Implemented TP´s from RAN4 #93:  [R4-1915694](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1913835.zip), TP for TR 38.716-02-00: CA\_n2A\_n5A, Verizon, Nokia  [R4-1914013](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1914013.zip), TP for TR 38.716-02-00 CA\_n3-n77, KDDI  R4-1914295, updated TP for TR 38.716-02-00: CA\_n7-n78, Huawei, HiSilicon  [R4-1914296](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1914296.zip), updated TP for TR 38.716-02-00: CA\_n1A-n3(2A), Huawei, HiSilicon  [R4-1914297](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1914297.zip), TP for TR 38.716-02-00: CA\_n20-n78, Huawei, HiSilicon  [R4-1915633](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1915633.zip), TP for TR 38.716-02-00 to include CA\_n1-n7, Ericsson, BT plc  [R4-1913837](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1913837.zip), TP for TR 38.716-02-00: CA\_n5A\_n260A, Verizon, Nokia  [R4-1913838](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1913838.zip), TP for TR 38.716-02-00: CA\_n5A\_n261A, Verizon, Nokia  [R4-1915634](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1915634.zip), TP for TR 38.716-02-00: CA\_n66A\_n260A, Verizon, Nokia  [R4-1915635](file:///D:\RAN4\TSGRAN4_93\Docs\R4-1915635.zip), TP for TR 38.716-02-00: CA\_n66A\_n261A, Verizon, Nokia | V0.9.0 |
| 2020-04 | RAN4#94bis-e | R4-2003951 |  |  |  | Implemented TP´s from RAN4 #94-e:   1. R4-2002635, TP for TR38.716-02-00: Requirements for DL CA\_n29A-n70A, DL CA\_n29A-n66B, DL CA\_n29A-n66(2A) and for UL CA\_n66A-n71A, UL CA\_n70A-n71A, Dish Network 2. R4-2002636,TP to TR 38.716-02-00: CA\_n28-n78,Nokia, Nokia, Shanghai Bell, BT plc 3. R4-2002637, TP to TR 38.716-02-00: CA\_n41-n66, Nokia, Nokia Shanghai Bell, T-Mobile USA 4. R4-2002638, TP to TR 38.716-02-00: CA\_n41-n71, Nokia, Nokia Shanghai Bell, T-Mobile USA 5. R4-2000448, CR to TS 38.101-1: Corrections on MSD tables for CA\_n20-n78 and CA\_n66-n78, Xiaomi 6. R4-2002640, TP to TR 38.716-02-00: CA\_n3A-n38A, ZTE Corporation 7. R4-2002641, TP for TR 38.716-02-00: CA\_n2A\_n66A, Verizon, Nokia, Qualcomm 8. R4-2002642, TP for TR 38.716-02-00: CA\_n5A\_n66A, Verizon, Nokia, Qualcomm 9. R4-2002643, TP for TR 38.716-02-00: CA\_n2-n78, Huawei, HiSilicon 10. R4-2000833, TP for TR 38.716-02-00: CA\_n7-n25, Huawei, HiSilicon 11. R4-2002714, TP for TR 38.716-02-00: CA\_n25-n66, Huawei, HiSilicon 12. R4-2002645, TP to TR 38.716-02-00 for CA\_n25-n78, Huawei, HiSilicon 13. R4-2002646, TP to TR 38.716-02-00 for CA\_n66-n78, Huawei, HiSilicon 14. R4-2002647, TP to TR 38.716-02-00 for CA\_n1-n78(2A), Huawei, HiSilicon 15. R4-2002648, TP to TR 38.716-02-00 for CA\_n20A-n7A, Huawei, HiSilicon 16. R4-2001062, Draft CR for 38.101-1 to correct editoral errors, Huawei, HiSilicon 17. R4-2002639 TP to TR 38.716-02-00: Corrections to CA\_n5-n261 and CA\_n66-n261, Nokia, Nokia Shanghai Bell | V1.0.0 |
| 2020-04 | RAN4#94bis-e | R4-2005718 |  |  |  | Implemented TP´s from RAN4 #94bis-e:   1. R4-2005044, TP to TR 38.716-02-00 CA\_n78A-n92A, Huawei, HiSilicon 2. R4-2005046, Updated TP for TR 38.716-02-00: to add UL configuration for CA\_n41A-n78A, Huawei, HiSilicon 3. R4-2005047,TP for 38.716-02-00 for CA\_n40A-n78(2A), Huawei, HiSilicon 4. R4-2005048, TP to TR 38.716-02-00 for CA\_n7-n78, Huawei, HiSilicon, Bell Mobility, Telus 5. R4-2005049,TP for TR 38.716-02-00 to include CA\_n41A-n71A, Ericsson, T-Mobile 6. R4-2005050,TP for TR 38.716-02-00 to include CA\_n25A-n71A, Ericsson, T-Mobile 7. R4-2005051,TP for TR 38.716-02-00 to include CA\_n41A-n66A, Ericsson, T-Mobile 8. R4-2005052,TP for TR 38.716-02-00 to include CA\_n1A-n40A, Ericsson 9. R4-2005053,TP for TR 38.716-02-00 to include CA\_n28A-n40A, Ericsson 10. R4-2004991,TP for TR38.716-02-00: Requirements UL CA\_n66A-n71A and corrections to UL CA\_n66A-71A and UL CA\_n70-n71A UE Co-existence spurious emissions 11. R4-2005054, TP for TR 38.716-02-00 to include CA\_n78-n258,Ericsson, Telstra 12. R4-2005730 TP for TR 38.716-02-00 for CA\_n48-n46, Charter Communications, Inc 13. R4-2005721,TP for TR 38.716-02-00 to include CA\_n25A-n46A, Ericsson, T-Mobile, MediaTek 14. R4-2005722, TP for TR 38.716-02-00 to include CA\_n46A-n66A,Ericsson, T-Mobile, MediaTek | V1.1.0 |
| 2020-05 | RAN4#95-e | R4-2006872 |  |  |  | Implemented TP’s from RAN4 #95-e   1. R4-2006067 Corrections to n29-n66 CA combinations, Dish Network 2. R4-2008351 TP to TR 38.716-02-00 for CA\_n5-n66 with dual UL, Huawei, HiSilicon, Bell Mobility, Telus 3. R4-2008352 TP for TR 38.716-02-00: CA\_n2-n77, Verizon UK Ltd 4. R4-2008353 TP for TR 38.716-02-00: CA\_n5-n77,Verizon UK Ltd 5. R4-2008354 TP for TR 38.716-02-00: CA\_n5-n77,Verizon UK Ltd 6. R4-2008356 TP to TR 38.716-02-00 CA\_n78(2A)-n92A,Huawei, HiSilicon 7. R4-2008357 TP for TR 38.716-02-00:CA\_n38A-n78A, ZTE Corporation 8. R4-2007624 TP for TR 38.716-02-00 to include CA\_n5-n7,Ericsson, Telstra 9. R4-2008358 TP for TR 38.716-02-00 to include CA\_n3-n7, Ericsson, Telstra, BT plc 10. R4-2006481 TP for TR 38.716-02-00 for CA\_n48-n46,Charter Communications, Inc 11. R4-2007918 TP for TR 38.716-02-00 to correct MSD for CA\_n25-n46,Ericsson, T-Mobile US, MediaTek | v1.2.0 |
| 2020-06 | RAN #88-e | RP-200671 |  |  |  |  | v1.2.0 |

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| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2020-06 | RAN#88 |  |  |  |  | Approved by plenary – Rel-16 spec under change control | 16.0.0 |