|  |  |
| --- | --- |
| 3GPP TS 38.101-1 V18.2.0 (2023-06) | |
| Technical Specification | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  NR;  User Equipment (UE) radio transmission and reception;  Part 1: Range 1 Standalone  (Release 18) | |
|  | |
|  |  |
|  | |
| The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP. The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented. This Specification is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification. Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices. | |

|  |
| --- |
|  |
| ***3GPP***  Postal address  3GPP support office address  650 Route des Lucioles - Sophia Antipolis  Valbonne - FRANCE  Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  Internet  http://www.3gpp.org |
| ***Copyright Notification***  No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.  © 2023, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).  All rights reserved.  UMTS™ is a Trade Mark of ETSI registered for the benefit of its members  3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  GSM® and the GSM logo are registered and owned by the GSM Association |

Contents

Foreword 16

1 Scope 18

2 References 18

3 Definitions, symbols and abbreviations 19

3.1 Definitions 19

3.2 Symbols 20

3.3 Abbreviations 22

4 General 23

4.1 Relationship between minimum requirements and test requirements 23

4.2 Applicability of minimum requirements 23

4.3 Specification suffix information 23

5 Operating bands and channel arrangement 25

5.1 General 25

5.2 Operating bands 25

5.2A Operating bands for CA 27

5.2A.0 General 27

5.2A.1 Intra-band CA 27

5.2A.2 Inter-band CA 28

5.2A.2.1 Inter-band CA (two bands) 29

5.2A.2.2 Inter-band CA (three bands) 36

5.2A.2.3 Inter-band CA (four bands) 42

5.2A.2.4 Inter-band CA (five bands) 45

5.2A.2.5 Inter-band CA (six bands) 45

5.2B Operating bands for DC 45

5.2C Operating band combination for SUL 45

5.2D Operating bands for UL MIMO 48

5.2E Operating band for V2X 49

5.2E.1 V2X operating bands 49

5.2E.2 V2X operating bands for con-current operation 50

5.3 UE channel bandwidth 50

5.3.1 General 50

5.3.2 Maximum transmission bandwidth configuration 52

5.3.3 Minimum guardband and transmission bandwidth configuration 52

5.3.4 RB alignment 54

5.3.5 UE channel bandwidth per operating band 54

5.3.6 Asymmetric channel bandwidths 59

5.3A UE channel bandwidth for CA 60

5.3A.1 General 60

5.3A.2 Maximum transmission bandwidth configuration for CA 61

5.3A.3 Minimum guardband and transmission bandwidth configuration for CA 61

5.3A.4 Void 63

5.3A.5 UE channel bandwidth per operating band for CA 63

5.3E Channel bandwidth for V2X 64

5.3E.1 General 64

5.3E.2 Channel bandwidth for V2X concurrent operation 65

5.3I Channel bandwidth for RedCap 67

5.4 Channel arrangement 67

5.4.1 Channel spacing 67

5.4.1.1 Channel spacing for adjacent NR carriers 67

5.4.2 Channel raster 67

5.4.2.1 NR-ARFCN and channel raster 67

5.4.2.2 Channel raster to resource element mapping 68

5.4.2.3 Channel raster entries for each operating band 68

5.4.3 Synchronization raster 72

5.4.3.1 Synchronization raster and numbering 72

5.4.3.3 Synchronization raster entries for each operating band 73

5.4.4 TX–RX frequency separation 76

5.4A Channel arrangement for CA 77

5.4A.1 Channel spacing for CA 77

5.4A.2 Channel raster for CA 78

5.4A.3 Synchronization raster for CA 78

5.4A.4 Tx-Rx frequency separation for CA 78

5.4B Reserved 78

5.4C Reserved 78

5.4D Reserved 78

5.4E Channel arrangement for V2X 78

5.4E.1 Channel spacing 78

5.4E.2 Channel raster 79

5.4E.2.1 NR-ARFCN and channel raster 79

5.4E.2.2 Channel raster to resource element mapping 79

5.4E.2.3 Channel raster entries for each operating band 79

5.4E.3 Synchronization raster for V2X 79

5.5 Void 79

5.5A Configurations for CA 79

5.5A.0 General 79

5.5A.1 Configurations for intra-band contiguous CA 80

5.5A.2 Configurations for intra-band non-contiguous CA 85

5.5A.3 Configurations for inter-band CA 90

5.5A.3.1 Configurations for inter-band CA (two bands) 90

5.5A.3.2 Configurations for inter-band CA (three bands) 138

5.5A.3.3 Configurations for inter-band CA (four bands) 230

5.5A.3.4 Configurations for inter-band CA (five bands) 287

5.5A.3.5 Configurations for inter-band CA (six bands) 298

5.5B Configurations for DC 299

5.5C Configurations for SUL 316

6 Transmitter characteristics 231

6.1 General 231

6.1A General 231

6.1F General 231

6.2 Transmitter power 231

6.2.1 UE maximum output power 231

6.2.1I Void 234

6.2.2 UE maximum output power reduction 234

6.2.3 UE additional maximum output power reduction 237

6.2.3.1 General 237

6.2.3.2 A-MPR for NS\_04 243

6.2.3.3 A-MPR for NS\_10 244

6.2.3.4 A-MPR for NS\_05 and NS\_05U 244

6.2.3.5 A-MPR for NS\_40 248

6.2.3.6 A-MPR for NS\_43 and NS\_43U 249

6.2.3.7 A-MPR for NS\_03 and NS\_03U 250

6.2.3.8 A-MPR for NS\_37 250

6.2.3.9 A-MPR for NS\_38 251

6.2.3.10 A-MPR for NS\_39 251

6.2.3.11 A-MPR for NS\_41 252

6.2.3.12 A-MPR for NS\_42 252

6.2.3.13 A-MPR for NS\_18 253

6.2.3.14 A-MPR for NS\_21 254

6.2.3.15 A-MPR for NS\_24 255

6.2.3.16 A-MPR for NS\_27 256

6.2.3.17 A-MPR for NS\_46 257

6.2.3.18 A-MPR for NS\_47 258

6.2.3.19 A-MPR for NS\_50 259

6.2.3.20 A-MPR for NS\_44 261

6.2.3.21 A-MPR for NS\_12 262

6.2.3.22 A-MPR for NS\_13 262

6.2.3.23 A-MPR for NS\_14 262

6.2.3.24 A-MPR for NS\_15 263

6.2.3.25 A-MPR for NS\_45 264

6.2.3.26 A-MPR for NS\_48 264

6.2.3.27 A-MPR for NS\_49 266

6.2.3.28 A-MPR for NS\_51 268

6.2.3.29 A-MPR for NS\_07 269

6.2.3.30 A-MPR for NS\_56 269

6.2.3.31 A-MPR for NS\_35 270

6.2.3.32 A-MPR for NS\_06 270

6.2.4 Configured transmitted power 270

6.2A Transmitter power for CA 273

6.2A.1 UE maximum output power for CA 273

6.2A.1.1 UE maximum output power for Intra-band contiguous CA 273

6.2A.1.2 UE maximum output power for Intra-band non-contiguous CA 273

6.2A.1.3 UE maximum output power for Inter-band CA 274

6.2A.1.4 Void 279

6.2A.1.5 Void 279

6.2A.2 UE maximum output power reduction for CA 279

6.2A.2.1 UE maximum output power reduction for Intra-band contiguous CA 279

6.2A.2.2 UE maximum output power reduction for Intra-band non-contiguous CA 283

6.2A.2.2.0 General 283

6.2A.2.2.1 MPR to meet -30dBm/MHz 284

6.2A.2.2.1.1 PC3 with indicating dualPA-Architecture supported 284

6.2A.2.2.1.2 PC2 with indicating dualPA-Architecture supported 284

6.2A.2.2.1.3 PC3 without indicating dualPA-Architecture supported 284

6.2A.2.2.1.4 PC2 without indicating dualPA-Architecture supported 285

6.2A.2.2.2 MPR to meet -13dBm/MHz 285

6.2A.2.2.2.1 PC3 with indicating dualPA-Architecture supported 285

6.2A.2.2.2.2 PC2 with indicating dualPA-Architecture supported 285

6.2A.2.2.2.3 PC3 without indicating dualPA-Architecture supported 286

6.2A.2.2.2.4 PC2 without indicating dualPA-Architecture supported 286

6.2A.2.3 UE maximum output power reduction for Inter-band CA 287

6.2A.2.4 Void 287

6.2A.3 UE additional maximum output power reduction for CA 287

6.2A.3.1 UE additional maximum output power reduction for Intra-band CA 287

6.2A.3.1.1 UE additional maximum output power reduction for Intra-band contiguous CA 287

6.2A.3.1.1.1 A-MPR for CA\_NS\_04 288

6.2A.3.1.1.1.1 Contiguous allocations 288

6.2A.3.1.1.1.2 Non-contiguous allocations 288

6.2A.3.1.2 UE additional maximum output power reduction for Intra-band non-contiguous CA 294

6.2A.3.1.3 UE additional maximum output power reduction for Inter-band CA 297

6.2A.4 Configured output power for CA 300

6.2A.4.1 Configured transmitted power level 300

6.2A.4.1.1 Configured transmitted power for Intra-band contiguous CA 300

6.2A.4.1.2 Configured transmitted power for Intra-band non-contiguous CA 302

6.2A.4.1.3 Configured transmitted power for Inter-band CA 305

6.2A.4.1.4 Void 308

6.2A.4.2 ΔTIB,c for CA 308

6.2A.4.2.1 Void 308

6.2A.4.2.2 Void 308

6.2A.4.2.3 ΔTIB,c for Inter-band CA (two bands) 308

6.2A.4.2.4 ΔTIB,c for Inter-band CA (three bands) 314

6.2A.4.2.5 ΔTIB,c for Inter-band CA (four bands) 320

6.2A.4.2.6 ΔTIB,c for Inter-band CA (five bands) 323

6.2A.4.2.7 ΔTIB,c for Inter-band CA (six bands) 323

6.2B Transmitter power for NR-DC 323

6.2B.0 General 323

6.2B.1 UE maximum output power for NR-DC 323

6.2B.2 UE maximum output power reduction for NR-DC 325

6.2B.3 UE additional maximum output power reduction for NR-DC 325

6.2B.4.1 Configured transmitted power level for NR-DC 325

6.2B.4.2 ΔTIB,c for NR-DC 329

6.2C Transmitter power for SUL 329

6.2C.1 Configured transmitted power for SUL 329

6.2C.2 ΔTIB,c 330

6.2D Transmitter power for UL MIMO 331

6.2D.1 UE maximum output power for UL MIMO 331

6.2D.2 UE maximum output power reduction for UL MIMO 333

6.2D.3 UE additional maximum output power reduction for UL MIMO 334

6.2D.4 Configured transmitted power for UL MIMO 335

6.2E Transmitter power for V2X 336

6.2E.1 UE maximum output power for V2X 336

6.2E.1.1 General 336

6.2E.1.2 UE maximum output power for V2X con-current operation 336

6.2E.2 UE maximum output power reduction for V2X 337

6.2E.2.1 General 337

6.2E.2.2 MPR for Power class 2 and Power class 3 V2X UE 337

6.2E.2.3 MPR for Power class 2 and Power class 3 V2X con-current operation 339

6.2E.2.4 MPR for Power class 1 UE in Band n14 342

6.2E.3 UE additional maximum output power reduction for V2X 342

6.2E.3.1 General 342

6.2E.3.2 A-MPR for V2X UE by NS\_33 343

6.2E.3.3 A-MPR for Power class 3 V2X UE by NS\_52 346

6.2E.3.4 A-MPR for V2X con-current operation 347

6.2E.4 Configured transmitted power for V2X 348

6.2E.4.1 General 348

6.2E.4.2 Configured transmitted power for inter-band V2X con-current operation 349

6.2E.4.3 Configured transmitted power for intra-band V2X con-current operation 349

6.2F Transmitter power for shared spectrum channel access 352

6.2F.1 UE maximum output power 352

6.2F.1A UE maximum output power for CA 353

6.2F.1A.1 UE maximum output power for inter-band CA 353

6.2F.1A.2 UE maximum output power for intra-band contiguous CA 354

6.2F.1B UE maximum output power for NR-DC 354

6.2F.1D UE maximum output power for UL MIMO 354

6.2F.2 UE maximum output power reduction 355

6.2F.2A UE maximum output power reduction for CA 357

6.2F.2A.1 UE maximum output power reduction for inter-band CA 357

6.2F.2A.2 UE maximum output power reduction for intra-band contiguous CA 357

6.2F.2D UE maximum output power reduction for UL MIMO 358

6.2F.3 UE additional maximum output power reduction 359

6.2F.3.1 General 359

6.2F.3.2 A-MPR for NS\_28 360

6.2F.3.3 A-MPR for NS\_29 361

6.2F.3.4 A-MPR for NS\_30 361

6.2F.3.5 A-MPR for NS\_31 363

6.2F.3.6 A-MPR for NS\_53 363

6.2F.3.7 A-MPR for NS\_54 364

6.2F.3.8 A-MPR for NS\_58 365

6.2F.3.9 A-MPR for NS\_59 367

6.2F.3.10 A-MPR for NS\_60 368

6.2F.3.11 A-MPR for NS\_61 369

6.2F.3.12 A-MPR for NS\_63 369

6.2F.3.13 A-MPR for NS\_64 370

6.2F.3.14 A-MPR for NS\_65 371

6.2F.3.15 A-MPR for NS\_66 371

6.2F.3.16 A-MPR for NS\_67 371

6.2F.3.17 A-MPR for NS\_68 372

6.2F.3.18 A-MPR for NS\_69 372

6.2F.3A UE additional maximum output power reduction for CA 373

6.2F.3A.1 UE additional maximum output power reduction for inter-band CA 373

6.2F.3D UE additional maximum output power reduction for UL MIMO 373

6.2F.4 Configured transmitted power 373

6.2F.4D Configured transmitted power UL MIMO 374

6.2G Transmitter power for Tx Diversity 374

6.2G.1 UE maximum output power for Tx Diversity 374

6.2G.2 UE maximum output power reduction for Tx Diversity 374

6.2G.3 UE additional maximum output power reduction for Tx Diversity 375

6.2G.4 Configured transmitted power for Tx Diversity 375

6.2H Transmitter power for CA with UL MIMO 375

6.2H.1 Transmitter power for intra-band UL contiguous CA with UL MIMO 375

6.2H.1.1 UE maximum output power for intra-band UL contiguous CA with UL MIMO 375

6.2H.1.2 UE maximum output power reduction for intra-band UL contiguous CA with UL MIMO 376

6.2H.1.3 UE additional maximum output power reduction for intra-band UL contiguous CA with UL MIMO 376

6.2H.1.4 Configured transmitted power for intra-band UL contiguous CA with UL MIMO 376

6.2I Transmitter power for RedCap 377

6.2I.1 Maximum output power for RedCap 377

6.3 Output power dynamics 377

6.3.1 Minimum output power 377

6.3.2 Transmit OFF power 377

6.3.3 Transmit ON/OFF time mask 378

6.3.3.1 General 378

6.3.3.2 General ON/OFF time mask 378

6.3.3.3 Transmit power time mask for slot and short or long subslot boundaries 379

6.3.3.4 PRACH time mask 379

6.3.3.5 Void 381

6.3.3.6 SRS time mask 381

6.3.3.7 PUSCH-PUCCH and PUSCH-SRS time masks 382

6.3.3.8 Transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries 383

6.3.3.9 Transmit power time mask for consecutive short subslot transmissions boundaries 384

6.3.4 Power control 385

6.3.4.1 General 385

6.3.4.2 Absolute power tolerance 385

6.3.4.3 Relative power tolerance 385

6.3.4.4 Aggregate power tolerance 386

6.3A Output power dynamics for CA 386

6.3A.1 Minimum output power for CA 386

6.3A.1.1 Minimum output power for intra-band contiguous CA 386

6.3A.1.2 Minimum output power for intra-band non-contiguous CA 386

6.3A.1.3 Minimum output power for inter-band CA 386

6.3A.1.4 Void 387

6.3A.2 Transmit OFF power for CA 387

6.3A.2.1 Transmit OFF power for intra-band contiguous CA 387

6.3A.2.2 Transmit OFF power for intra-band non-contiguous CA 387

6.3A.2.3 Transmit OFF power for inter-band CA 387

6.3A.2.4 Void 387

6.3A.3 Transmit ON/OFF time mask for CA 387

6.3A.3.1 Transmit ON/OFF time mask for intra-band contiguous CA 387

6.3A.3.2 Transmit ON/OFF time mask for intra-band non-contiguous CA 388

6.3A.3.3 Transmit ON/OFF time mask for inter-band CA 388

6.3A.3.3.1 General 388

6.3A.3.3.2 Time mask for switching between two uplink carriers 388

6.3A.3.3.3 Time mask for switching between two uplink carriers with two transmit antenna connectors 389

6.3A.3.3.4 Time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors 390

6.3A.3.3.5 Time mask for switching between two uplink bands with two transmit antenna connectors 392

6.3A.3.4 Void 393

6.3A.4 Power control for CA 393

6.3A.4.1 Power control for intra-band contiguous CA 393

6.3A.4.1.1 Absolute power tolerance 393

6.3A.4.1.2 Relative power tolerance 393

6.3A.4.1.3 Aggregate power control tolerance 393

6.3A.4.2 Power control for intra-band non-contiguous CA 394

6.3A.4.2.1 Absolute power tolerance 394

6.3A.4.2.1.1 Minimum requirements 394

6.3A.4.2.2 Relative power tolerance 394

6.3A.4.2.2.1 Minimum requirements 394

6.3A.4.2.3 Aggregate power control tolerance 394

6.3A.4.3 Power control for inter-band CA 394

6.3A.4.4 Void 394

6.3B Output power dynamics for NR-DC 394

6.3C Output power dynamics for SUL 395

6.3C.1 Void 395

6.3C.2 Void 395

6.3C.3 Transmit ON/OFF time mask for SUL 395

6.3C.3.1 Time mask for switching between two uplink carriers 395

6.3C.3.2 Time mask for switching between two uplink carriers with two transmit antenna connectors 396

6.3C.3.3 Time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors 397

6.3C.3.4 Time mask for switching between two uplink bands with two transmit antenna connectors 398

6.3D Output power dynamics for UL MIMO 400

6.3D.1 Minimum output power for UL MIMO 400

6.3D.2 Transmit OFF power for UL MIMO 400

6.3D.3 Transmit ON/OFF time mask for UL MIMO 400

6.3D.4 Power control for UL MIMO 400

6.3E Output power dynamics for V2X 400

6.3E.1 Minimum output power for V2X 400

6.3E.1.1 General 400

6.3E.1.2 Minimum output power for V2X con-current operation 401

6.3E.2 Transmit OFF power for V2X 401

6.3E.2.1 General 401

6.3E.2.2 Transmit OFF power for V2X con-current operation 401

6.3E.3 Transmit ON/OFF time mask for V2X 402

6.3E.3.1 General 402

6.3E.3.2 General time mask 402

6.3E.3.3 S-SSB time mask 402

6.3E.3.4 Transmit ON/OFF time mask for V2X con-current operation 403

6.3E.4 Power control for V2X 404

6.3E.4.1 General 404

6.3E.4.2 Absolute power tolerance 404

6.3E.4.3 Power control for V2X con-current operation 404

6.3F Output power dynamics for shared spectrum channel access 404

6.3F.1 Minimum output power 404

6.3F.2 Transmit OFF power 405

6.3F.3 Transmit ON/OFF time mask 405

6.3F.3.1 General 405

6.3F.3.2 General ON/OFF time mask 405

6.3F.3A General ON/OFF mask for CA 405

6.3F.3A.1 General ON/OFF mask for inter-band CA 405

6.3F.4 Power control 405

6.3F.4.1 General 405

6.3F.4.2 Absolute power tolerance 406

6.3F.4.3 Relative power tolerance 406

6.3F.4.4 Aggregate power tolerance 406

6.3F.4A Power control for inter-band CA 406

6.3G Output power dynamics for Tx Diversity 406

6.3G.1 Minimum output power for Tx Diversity 406

6.3G.2 Transmit OFF power for Tx Diversity 406

6.3G.3 Transmit ON/OFF time mask for Tx Diversity 406

6.3G.4 Power control for Tx Diversity 406

6.3H Output power dynamics for CA with UL MIMO 407

6.3H.1 Output power dynamics for intra-band UL contiguous CA with UL MIMO 407

6.3H.1.1 Minimum output power for intra-band UL contiguous CA with UL MIMO 407

6.3H.1.2 Transmit OFF power for intra-band UL contiguous CA with UL MIMO 407

6.3H.1.3 Transmit ON/OFF time mask for intra-band UL contiguous CA with UL MIMO 407

6.3H.1.4 Power control for intra-band UL contiguous CA with UL MIMO 407

6.4 Transmit signal quality 407

6.4.1 Frequency error 407

6.4.2 Transmit modulation quality 407

6.4.2.0 General 407

6.4.2.1 Error Vector Magnitude 408

6.4.2.1a Error Vector Magnitude including symbols with transient period 408

6.4.2.2 Carrier leakage 409

6.4.2.3 In-band emissions 410

6.4.2.4 EVM equalizer spectrum flatness 411

6.4.2.4.1 Requirements for Pi/2 BPSK modulation 412

6.4.2.5 Phase continuity requirements for DMRS bundling 413

6.4A Transmit signal quality for CA 414

6.4A.1 Frequency error for CA 414

6.4A.1.1 Frequency error for intra-band contiguous CA 414

6.4A.1.2 Frequency error for intra-band non-contiguous CA 415

6.4A.1.3 Frequency error for inter-band CA 415

6.4A.1.4 Void 415

6.4A.2 Transmit modulation quality for CA 415

6.4A.2.1 Transmit modulation quality for intra-band contiguous CA 415

6.4A.2.1.0 General 415

6.4A.2.1.1 Error Vector Magnitude 415

6.4A.2.1.2 In-band emissions 416

6.4A.2.1.3 Carrier leakage 420

6.4A.2.2 Transmit modulation quality for intra-band non-contiguous CA 420

6.4A.2.2.0 General 420

6.4A.2.2.1 Error Vector Magnitude 420

6.4A.2.2.2 In-band emissions 421

6.4A.2.2.3 Carrier leakage 421

6.4A.2.3 Transmit modulation quality for inter-band CA 421

6.4A.2.4 Void 422

6.4B Transmit signal quality for NR-DC 422

6.4C Transmit signal quality for SUL 422

6.4D Transmit signal quality for UL MIMO 422

6.4D.0 General 422

6.4D.1 Frequency error for UL MIMO 423

6.4D.2 Transmit modulation quality for UL MIMO 423

6.4D.2.0 General 423

6.4D.2.1 Error Vector Magnitude 423

6.4D.2.2 Carrier leakage 423

6.4D.2.3 In-band emissions 423

6.4D.2.4 EVM equalizer spectrum flatness for UL MIMO 423

6.4D.3 Time alignment error for UL MIMO 424

6.4D.4 Requirements for coherent UL MIMO 424

6.4E Transmit signal quality for V2X 424

6.4E.1 Frequency error for V2X 424

6.4E.1.1 General 424

6.4E.1.2 Frequency error for V2X con-current operation 425

6.4E.2 Transmit modulation quality for V2X 425

6.4E.2.1 General 425

6.4E.2.2 Error Vector Magnitude for V2X 425

6.4E.2.3 Carrier leakage for V2X 425

6.4E.2.4 In-band emissions for V2X 425

6.4E.2.5 EVM equalizer spectrum flatness for V2X 425

6.4E.2.6 Transmit modulation quality for V2X con-current operation 425

6.4F Transmit signal quality for shared spectrum channel access 426

6.4F.1 Frequency error 426

6.4F.2 Transmit modulation quality 426

6.4F.2.0 General 426

6.4F.2.1 Error Vector Magnitude 426

6.4F.2.2 Carrier leakage 426

6.4F.2.3 In-band emissions 426

6.4F.2.4 EVM equalizer spectrum flatness 427

6.4F.2A Transmit modulation quality for CA 427

6.4F.2A.1 Transmit modulation quality for inter-band CA 427

6.4G Transmit signal quality for Tx Diversity 428

6.4G.1 Frequency error for Tx Diversity 428

6.4G.2 Transmit modulation quality for Tx Diversity 428

6.4G.2.0 General 428

6.4H Transmit signal quality for CA with UL MIMO 429

6.4H.1 Transmit signal quality for intra-band UL contiguous CA with UL MIMO 429

6.4H.1.1 Frequency error for intra-band UL contiguous CA with UL MIMO 429

6.4H.1.2 Transmit modulation quality for intra-band UL contiguous CA with UL MIMO 429

6.4H.1.2.0 General 429

6.4H.1.2.1 Error Vector Magnitude 429

6.4H.1.2.2 Carrier leakage 429

6.4H.1.2.3 In-band emissions 430

6.4H.1.3 Time alignment error for intra-band UL contiguous CA with UL MIMO 430

6.4H.1.4 Coherent UL MIMO requirement for intra-band UL contiguous CA with UL MIMO 430

6.5 Output RF spectrum emissions 430

6.5.1 Occupied bandwidth 430

6.5.2 Out of band emission 430

6.5.2.1 General 430

6.5.2.2 Spectrum emission mask 430

6.5.2.3 Additional spectrum emission mask 431

6.5.2.3.1 Requirements for network signalling value "NS\_35" 431

6.5.2.3.2 Requirements for network signalling value "NS\_04" 431

6.5.2.3.3 Requirements for network signalling values "NS\_03" and “NS\_03U” 432

6.5.2.3.4 Requirements for network signalling value "NS\_06" or “NS\_07” 433

6.5.2.3.5 Void 433

6.5.2.3.6 Void 433

6.5.2.3.7 Void 433

6.5.2.3.8 Requirements for network signalling value "NS\_27" 433

6.5.2.3.9 Requirements for network signalling value "NS\_21" 434

6.5.2.4 Adjacent channel leakage ratio 434

6.5.2.4.1 NR ACLR 434

6.5.2.4.2 UTRA ACLR 435

6.5.3 Spurious emissions 435

6.5.3.0 General 435

6.5.3.1 General spurious emissions 436

6.5.3.2 Spurious emissions for UE co-existence 436

6.5.3.3 Additional spurious emissions 445

6.5.3.3.1 Requirement for network signalling value "NS\_04" 445

6.5.3.3.2 Requirement for network signalling value "NS\_17" 446

6.5.3.3.3 Requirement for network signalling value "NS\_18" 446

6.5.3.3.4 Requirement for network signalling values "NS\_05" and “NS\_05U” 446

6.5.3.3.5 Requirement for network signalling values "NS\_43" and “NS\_43U” 446

6.5.3.3.6 Requirement for network signalling value "NS\_37" 447

6.5.3.3.7 Requirement for network signalling value "NS\_38" 447

6.5.3.3.8 Requirement for network signalling value "NS\_39" 447

6.5.3.3.9 Requirement for network signalling value "NS\_40" 447

6.5.3.3.10 Requirement for network signalling value "NS\_41" 448

6.5.3.3.11 Requirement for network signalling value "NS\_42" 448

6.5.3.3.12 Requirement for network signalling value "NS\_21" 448

6.5.3.3.13 Requirement for network signalling value "NS\_24" 449

6.5.3.3.14 Requirement for network signalling value "NS\_27" 449

6.5.3.3.15 Requirement for network signalling value "NS\_47" 449

6.5.3.3.16 Requirement for network signalling value "NS\_50" 450

6.5.3.3.17 Requirement for network signalling value "NS\_12" 450

6.5.3.3.18 Requirement for network signalling value "NS\_13" 450

6.5.3.3.19 Requirement for network signalling value "NS\_14" 451

6.5.3.3.20 Requirement for network signalling value "NS\_15" 451

6.5.3.3.21 Requirement for network signalling value "NS\_45" 451

6.5.3.3.22 Requirement for network signalling values "NS\_48" and "NS\_51" 452

6.5.3.3.23 Requirement for network signalling value "NS\_49" 452

6.5.3.3.24 Requirement for network signalling value "NS\_44" 452

6.5.3.3.25 Requirement for network signalling value "NS\_46" 453

6.5.3.3.26 Requirement for network signalling value "NS\_07" 453

6.5.3.3.27 Requirement for network signalling value “NS\_56” 453

6.5.3.3.28 Requirement for network signalling value “NS\_62” 454

6.5.4 Transmit intermodulation 454

6.5A Output RF spectrum emissions for CA 455

6.5A.0 General 455

6.5A.1 Occupied bandwidth for CA 455

6.5A.1.1 Void 455

6.5A.1.1a Occupied bandwidth for Intra-band contiguous CA 455

6.5A.1.2 Occupied bandwidth for Intra-band non-contiguous CA 455

6.5A.1.3 Occupied bandwidth for Inter-band CA 455

6.5A.2 Out of band emission for CA 455

6.5A.2.1 General 455

6.5A.2.2 Spectrum emission mask 456

6.5A.2.2.1 Spectrum emission mask for intra-band contiguous CA 456

6.5A.2.2.2 Spectrum emission mask for intra-band non-contiguous CA 456

6.5A.2.2.3 Spectrum emission mask for Inter-band CA 456

6.5.A.2.2.4 Void 457

6.5A.2.3 Additional spectrum emission mask for CA 457

6.5A.2.3.1 Additional spectrum emission mask for intra-band contiguous CA 457

6.5A.2.3.2 Additional spectrum emission mask for Intra-band non-contiguous CA 457

6.5A.2.3.3 Additional spectrum emission mask for Inter-band CA 458

6.5A.2.4 Adjacent channel leakage ratio 458

6.5A.2.4.1 NR ACLR 458

6.5A.2.4.2 UTRA ACLR 459

6.5A.3 Spurious emission for CA 459

6.5A.3.1 General spurious emissions 459

6.5A.3.2 Spurious emissions for UE co-existence 460

6.5A.3.2.0 General 460

6.5A.3.2.1 Spurious emissions for UE co-existence for intra-band contiguous CA 460

6.5A.3.2.2 Spurious emissions for UE co-existence for intra-band non-contiguous CA 464

6.5A.3.2.3 Spurious emissions for UE co-existence for Inter-band CA 465

6.5A.3.2.4 Void 472

6.5A.3.2.5 Void 472

6.5A.3.2.6 Void 472

6.5A.3.3 Additional spurious emissions for CA 472

6.5A.3.3.1 Additional spurious emissions for intra-band contiguous CA 472

6.5A.3.3.2 Additional spurious emissions for intra-band non-contiguous CA 473

6.5A.4 Transmit intermodulation for CA 473

6.5A.4.2.1 Transmit intermodulation for intra-band contiguous CA 473

6.5A.4.2.2 Void 473

6.5B Output RF spectrum emissions for NR-DC 474

6.5D Output RF spectrum emissions for UL MIMO 474

6.5D.1 Occupied bandwidth for UL MIMO 474

6.5D.2 Out of band emission for UL MIMO 474

6.5D.3 Spurious emission for UL MIMO 474

6.5D.4 Transmit intermodulation for UL MIMO 475

6.5E Output RF spectrum emissions for V2X 475

6.5E.1 Occupied bandwidth for V2X 475

6.5E.1.1 General 475

6.5E.1.2 Occupied bandwidth for V2X con-current operation 475

6.5E.2 Out of band emission for V2X 475

6.5E.2.1 General 475

6.5E.2.2 Spectrum emission mask 476

6.5E.2.2.1 General 476

6.5E.2.2.2 Spectrum emission mask for V2X con-current operation 476

6.5E.2.3 Additional Spectrum emission mask 476

6.5E.2.3.1 Requirements for network signalling value "NS\_33" 476

6.5E.2.3.2 Requirements for network signalling value "NS\_52" 476

6.5E.2.3.3 Requirements for network signalling value "NS\_06" 477

6.5E.2.4 Adjacent channel leakage ratio 477

6.5E.2.4.1 General 477

6.5E.2.4.2 ACLR for V2X con-current operation 477

6.5E.3 Spurious emissions for V2X 478

6.5E.3.1 General spurious emissions 478

6.5E.3.2 Spurious emissions for UE co-existence 478

6.5E.3.3 Spurious emissions for UE co-existence for V2X con-current operation 478

6.5E.3.4 Additional spurious emissions requirements for V2X 481

6.5E.3.4.1 General 481

6.5E.3.4.2 Requirements for network signalling value "NS\_33" 481

6.5E.3.4.3 Void 482

6.5E.4 Transmit intermodulation 482

6.5E.4.1 General 482

6.5E.4.2 Transmit intermodulation for V2X con-current operation 482

6.5F Output RF spectrum emissions for shared spectrum channel access 482

6.5F.1 Occupied bandwidth 482

6.5F.2 Out of band emission 482

6.5F.2.1 General 482

6.5F.2.2 Spectrum emission mask for operation with shared spectrum channel access 482

6.5F.2.2.0 General 482

6.5F.2.2.1 Spectrum emission mask for non-transmitted channels 483

6.5F.2.3 Additional spectrum emission mask 483

6.5F.2.4 Adjacent channel leakage ratio 483

6.5F.2.4.0 General 483

6.5F.2.4.1 Shared spectrum channel access ACLR 483

6.5F.2.4.2 Additional requirement for network signalled value "NS\_29" 484

6.5F.2A Out of band emission for CA 484

6.5F.2A.1 Spectrum emission mask for CA 484

6.5F.2A.1.1 Spectrum emission mask for Inter-band CA 484

6.5F.2A.1.2 Spectrum emission mask for Intra-band contiguous CA 484

6.5F.2A.1.2.1 General 484

6.5F.2A.1.2.2 Intra-band contiguous CA spectrum emission mask for non-transmitted channels 485

6.5F.2A.2 Adjacent channel leakage ratio for CA 485

6.5F.2A.2.1 Adjacent channel leakage ratio for inter-band CA 485

6.5F.2A.2.2 Adjacent channel leakage ratio for intra-band contiguous CA 485

6.5F.3 Spurious emissions 486

6.5F.3.0 General 486

6.5F.3.1 General spurious emissions 486

6.5F.3.2 Spurious emissions for UE co-existence 486

6.5F.3.3 Additional spurious emissions 486

6.5F.3.3.0 General 486

6.5F.3.3.1 Requirement for network signalling value "NS\_28" 486

6.5F.3.3.2 Requirement for network signalling value "NS\_29" 487

6.5F.3.3.3 Requirement for network signalling value "NS\_30" 488

6.5F.3.3.4 Requirement for network signalling value "NS\_31" 489

6.5F.3.3.5 Requirements for network signalling value "NS\_53" or "NS\_54" or "NS\_60" or “NS\_66” or “NS\_67” 490

6.5F.3.3.6 Requirements for network signalling value "NS\_58" 490

6.5F.3.3.7 Requirements for network signalling value "NS\_61" 491

6.5F.3.3.8 Requirements for network signalling value “NS\_63” or “NS\_69” 491

6.5F.3.3.9 Requirements for network signalling value “NS\_64” 491

6.5F.4 Transmit intermodulation 492

6.5G Output RF spectrum emissions for Tx Diversity 492

6.5G.1 Occupied bandwidth for Tx Diversity 492

6.5G.2 Out of band emission for Tx Diversity 492

6.5G.3 Spurious emission for Tx Diversity 492

6.5G.4 Transmit intermodulation for Tx Diversity 492

6.5H Output RF spectrum emissions for CA with UL MIMO 493

6.5H.1 Output RF spectrum emissions for intra-band UL contiguous CA with UL MIMO 493

6.5H.1.1 Occupied bandwidth for intra-band UL contiguous CA with UL MIMO 493

6.5H.1.2 Out of band emission for intra-band UL contiguous CA with UL MIMO 493

6.5H.1.3 Spurious emission for intra-band UL contiguous CA with UL MIMO 493

6.5H.1.4 Transmit intermodulation for intra-band UL contiguous CA with UL MIMO 493

6.6 Void 494

6.6E Time alignment error 494

7 Receiver characteristics 491

7.1 General 491

7.1A General 491

7.1F General 492

7.1I General 492

7.2 Diversity characteristics 492

7.3 Reference sensitivity 492

7.3.1 General 492

7.3.2 Reference sensitivity power level 492

7.3.3 ΔRIB,c 504

7.3A Reference sensitivity for CA 504

7.3A.1 General 504

7.3A.2 Reference sensitivity power level for CA 504

7.3A.2.1 Reference sensitivity power level for Intra-band contiguous CA 504

7.3A.2.2 Reference sensitivity power level for Intra-band non-contiguous CA 505

7.3A.2.3 Reference sensitivity power level for Inter-band CA 506

7.3A.2.4 Void 507

7.3A.3 ΔRIB,c for CA 507

7.3A.3.1 General 507

7.3A.3.2 ΔRIB,c for Inter-band CA 507

7.3A.3.2.1 ΔRIB,c for two bands 508

7.3A.3.2.2 Void 512

7.3A.3.2.3 ΔRIB,c for three bands 512

7.3A.3.2.4 ΔRIB,c for four bands 517

7.3A.3.2.5 ΔRIB,c for five bands 520

7.3A.3.2.6 ΔRIB,c for six bands 520

7.3A.3.3 ΔRIB,c for Intra-band CA 520

7.3A.4 Reference sensitivity exceptions due to UL harmonic interference for CA 520

7.3A.5 Reference sensitivity exceptions due to intermodulation interference due to 2UL CA 535

7.3A.6 Reference sensitivity exceptions due to cross band isolation for CA 571

7.3B Reference sensitivity for NR-DC 576

7.3C Reference sensitivity for SUL 576

7.3C.1 General 576

7.3C.2 Reference sensitivity power level for SUL 576

7.3C.3 ΔRIB,c for SUL 580

7.3C.3.1 General 580

7.3C.3.2 SUL band combination 580

7.3C.3.2.1 ΔRIB,c for two bands 580

7.3C.3.2.2 ΔRIB,c for three bands 581

7.3C.3.2.3 ΔRIB,c for four bands 581

7.3D Reference sensitivity for UL MIMO 581

7.3E Reference sensitivity for V2X 582

7.3E.1 General 582

7.3E.2 Minimum requirements 582

7.3E.3 Reference sensitivity power level for V2X con-current operation 583

7.3F Reference sensitivity for shared spectrum channel access 584

7.3F.1 General 584

7.3F.2 Reference sensitivity power level 585

7.3F.3 Void 585

7.3F.4 Void 586

7.3F.4A Shared spectrum channel access CA 586

7.3F.4A.1 Intra-band contiguous shared spectrum channel access CA 586

7.3F.5 Void 586

7.3F.5.1 Void 586

7.3F.5.2 Void 586

7.3F.5.3 Void 586

7.3G Reference sensitivity for Tx Diversity 586

7.3G.5 Void 586

7.3G.5.0 Void 586

7.3I Reference sensitivity for RedCap 586

7.3I.1 General 586

7.3I.2 Reference sensitivity power level 586

7.4 Maximum input level 594

7.4A Maximum input level for CA 594

7.4A.1 Maximum input level for Intra-band contiguous CA 594

7.4A.2 Maximum input level for Intra-band non-contiguous CA 595

7.4A.3 Maximum input level for Inter-band CA 595

7.4B Maximum input level for NR-DC 595

7.4D Maximum input level for UL MIMO 595

7.4E Maximum input level for V2X 595

7.4E.1 General 595

7.4E.2 Maximum input level for V2X con-current operation 596

7.5 Adjacent channel selectivity 596

7.5A Adjacent channel selectivity for CA 598

7.5A.1 Adjacent channel selectivity for Intra-band contiguous CA 598

7.5A.2 Adjacent channel selectivity Intra-band non-contiguous CA 600

7.5A.3 Adjacent channel selectivity Inter-band CA 601

7.5B Adjacent channel selectivity for NR-DC 601

7.5D Adjacent channel selectivity for UL MIMO 601

7.5E Adjacent channel selectivity for V2X 601

7.5E.1 General 601

7.5E.2 Adjacent channel selectivity for V2X con-current operation 603

7.5F Adjacent channel selectivity for shared spectrum channel access 603

7.5F.1 General 603

7.5F.1A Adjacent channel selectivity for shared spectrum channel access CA 604

7.5F.1A.1 Intra-band contiguous shared spectrum channel access CA 604

7.5F.2 Void 605

7.6 Blocking characteristics 605

7.6.1 General 605

7.6.2 In-band blocking 605

7.6.3 Out-of-band blocking 607

7.6.4 Narrow band blocking 611

7.6A Blocking characteristics for CA 611

7.6A.1 General 611

7.6A.2 In-band blocking for CA 611

7.6A.2.1 In-band blocking for Intra-band contiguous CA 611

7.6A.2.2 In-band blocking for Intra-band non-contiguous CA 613

7.6A.2.3 In-band blocking for Inter-band CA 613

7.6A.3 Out-of-band blocking for CA 614

7.6A.3.1 Out-of-band blocking for Intra-band contiguous CA 614

7.6A.3.2 Out-of-band blocking for Intra-band non-contiguous CA 615

7.6A.3.3 Out-of-band blocking for Inter-band CA 615

7.6A.4 Narrow band blocking for CA 617

7.6A.4.1 Narrow band blocking for Intra-band contiguous CA 617

7.6A.4.2 Narrow band blocking for Intra-band non-contiguous CA 617

7.6A.4.3 Narrow band blocking for Inter-band CA 617

7.6B Blocking characteristics for NR-DC 618

7.6C Blocking characteristics for SUL 618

7.6C.1 General 618

7.6C.2 In-band blocking for SUL 618

7.6C.3 Out-of-band blocking for SUL 618

7.6C.4 Narrow band blocking for SUL 619

7.6D Blocking characteristics for UL MIMO 619

7.6E Blocking characteristics for V2X 619

7.6E.1 General 619

7.6E.2 In-band blocking 619

7.6E.2.1 General 619

7.6E.2.2 In-band blocking for V2X con-current operation 620

7.6E.3 Out-of-band blocking 620

7.6E.3.1 General 620

7.6E.3.2 Out-of-band blocking for V2X con-current operation 621

7.6F Blocking characteristics for shared spectrum channel access 621

7.6F.1 General 621

7.6F.2 In-band blocking 621

7.6F.2.1 General 621

7.6F.2.2 Void 622

7.6F.2A In-band blocking for shared spectrum CA 622

7.6F.2A.1 Intra-band contiguous shared spectrum channel access CA 622

7.6F.3 Out-of-band blocking 623

7.6F.3.1 General 623

7.6F.3.2 Void 624

7.6F.3A Out-of-band blocking for shared spectrum CA 624

7.6F.3A.1 Intra-band contiguous shared spectrum channel access CA 624

7.7 Spurious response 625

7.7A Spurious response for CA 626

7.7A.1 Spurious response for Intra-band contiguous CA 626

7.7A.2 Spurious response for Intra-band non-contiguous CA 626

7.7A.3 Spurious response for Inter-band CA 626

7.7B Spurious response for NR-DC 627

7.7D Spurious response for UL MIMO 627

7.7E Spurious response for V2X 627

7.7E.1 General 627

7.7E.2 Spurious response for V2X con-current operation 627

7.7F Spurious response for shared spectrum channel access 627

7.7F.1 General 627

7.7F.1A Spurious response for shared spectrum channel access CA 628

7.7F.1A.1 Intra-band contiguous shared spectrum channel access CA 628

7.7F.2 Void 628

7.8 Intermodulation characteristics 629

7.8.1 General 629

7.8.2 Wide band Intermodulation 629

7.8A Intermodulation characteristics for CA 631

7.8A.1 General 631

7.8A.2 Wide band intermodulation for CA 631

7.8A.2.1 Wide band intermodulation for Intra-band contiguous CA 631

7.8A.2.2 Wide band intermodulation for Intra-band non-contiguous CA 632

7.8A.2.3 Wide band intermodulation for Inter-band CA 632

7.8B Intermodulation characteristics for NR-DC 632

7.8D Intermodulation characteristics for UL MIMO 633

7.8E Intermodulation characteristics for V2X 633

7.8E.1 General 633

7.8E.2 Wide band Intermodulation 633

7.8E.2.1 General 633

7.8E.2.2 Wide band Intermodulation for V2X con-current operation 634

7.8F Intermodulation characteristics for shared spectrum channel access 634

7.8F.1 General 634

7.8F.2 Wide band Intermodulation 634

7.9 Spurious emissions 635

7.9A Spurious emissions for CA 635

7.9A.1 Void 635

7.9A.2 Void 635

7.9A.3 Spurious emissions for Inter-band CA 635

7.9B Spurious emissions for NR-DC 636

7.10 Power imbalance 636

7.10A Power imbalance for CA 636

7.10A.1 General 636

7.10A.2 Minimum requirement 636

Annex A (normative): Measurement channels 626

A.1 General 626

A.2 UL reference measurement channels 626

A.2.1 General 626

A.2.2 Reference measurement channels 628

A.2.2.1 DFT-s-OFDM Pi/2-BPSK 628

A.2.2.2 DFT-s-OFDM QPSK 629

A.2.2.3 DFT-s-OFDM 16QAM 629

A.2.2.4 DFT-s-OFDM 64QAM 631

A.2.2.5 DFT-s-OFDM 256QAM 633

A.2.2.6 CP-OFDM QPSK 635

A.2.2.7 CP-OFDM 16QAM 637

A.2.2.8 CP-OFDM 64QAM 639

A.2.2.9 CP-OFDM 256QAM 641

A.2.3 Reference measurement channels for TDD 643

A.2.3.1 DFT-s-OFDM Pi/2-BPSK 643

A.2.3.2 DFT-s-OFDM QPSK 643

A.2.3.3 DFT-s-OFDM 16QAM 643

A.2.3.4 DFT-s-OFDM 64QAM 643

A.2.3.5 DFT-s-OFDM 256QAM 644

A.2.3.6 CP-OFDM QPSK 644

A.2.3.7 CP-OFDM 16QAM 644

A.2.3.8 CP-OFDM 64QAM 644

A.2.3.9 CP-OFDM 256QAM 645

A.3 DL reference measurement channels 646

A.3.1 General 646

A.3.2 DL reference measurement channels for FDD 648

A.3.2.1 General 648

A.3.2.2 FRC for receiver requirements for QPSK 649

A.3.2.3 FRC for maximum input level for 64QAM 652

A.3.2.4 FRC for maximum input level for 256 QAM 655

A.3.2.5 FRC for maximum input level for 1024 QAM 658

A.3.3 DL reference measurement channels for TDD 661

A.3.3.1 General 661

A.3.3.2 FRC for receiver requirements for QPSK 662

A.3.3.3 FRC for maximum input level for 64QAM 665

A.3.3.4 FRC for maximum input level for 256 QAM 668

A.3.3.5 FRC for maximum input level for 1024 QAM 671

A.4 CSI reference measurement channels 674

A.5 OFDMA Channel Noise Generator (OCNG) 674

A.5.1 OCNG Patterns for FDD 674

A.5.1.1 OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused REs 674

A.5.2 OCNG Patterns for TDD 674

A.5.2.1 OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused REs 674

A.6 Void 675

A.7 V2X reference measurement channels 675

A.7.1 General 675

A.7.2 FRC for V2X receiver requirements for QPSK 675

A.7.3 FRC for maximum input level for 64QAM 677

A.7.4 FRC for maximum input level for 256QAM 678

Annex B (informative): Void 680

Annex C (informative): Downlink physical channels 681

C.1 General 681

C.2 Setup 681

C.3 Connection 681

C.3.1 Measurement of Receiver Characteristics 681

Annex D (normative): Characteristics of the interfering signal 683

D.1 General 683

D.2 Interference signals 683

Annex E (normative): Environmental conditions 684

E.1 General 684

E.2 Environmental 684

E.2.1 Temperature 684

E.2.2 Voltage 685

E.2.3 Vibration 685

Annex F (normative): Transmit modulation 686

F.0 General 686

F.1 Measurement Point 686

F.2 Basic Error Vector Magnitude measurement 686

F.3 Basic in-band emissions measurement 687

F.4 Modified signal under test 687

F.5 Window length 690

F.5.1 Timing offset 690

F.5.2 Window length 690

F.5.3 Window length for normal CP 690

F.5.4 Window length for Extended CP 691

F.5.5 Window length for PRACH 692

F.6 Averaged EVM 693

F.7 Spectrum Flatness 694

F.8 EVM measurement for dual Tx 694

F.9 Phase offset measurement for DMRS bundling 694

F.9.1 Measurement point 694

F.9.2 Symbols used 694

F.9.3 Modified test signal 694

F.9.4 Phase offset measurement 695

F.10 EVM for UL MIMO 695

F10.1 General 695

F10.2 MIMO Equalization 696

F10.3 Layer processing 696

Annex G (normative): Difference of relative phase and power errors 698

G.0 General 698

G.1 Measurement Point 698

G.2 Relative Phase Error Measurement 698

G.2.1 Symbols and subcarriers used 698

G.2.2 CFO (carrier frequency offset) correction 699

G.2.3 Steps of the measurement method 699

Annex H (informative): Void 700

Annex I (informative): Void 700

Annex J (informative): Void 700

Annex K (informative): Void 700

Annex L (normative): ModifiedMPR-Behavior 700

L.1 Indication of modified MPR behavior 700

Annex M (informative): Change history 704