

FCC PART 22 and 90 TEST REPORT

For

Sepura plc

Radio House, St. Andrews Road, Cambridge CB4 1GR UK

FCC ID: XX6SEM8040

Report Type: Class II permissive change	Product Type: DMR Mobile Radio
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Report Number: <u>RDG150921003-00A1</u>	
Report Date: <u>2015-11-16</u>	
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP*, or any agency of the Federal Government.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Sepura plc*'s product, model: *SEM8040* (FCC ID: *XX6SEM8040*) (the "EUT") in this report is a *DMR Mobile Radio*, which was measured approximately: 17.2 cm (L) x 19.5 cm (H) x 5.8 cm (T), rated input voltage: 13.6 VDC or 15 VDC powered from AC/DC adapter.

** All measurement and test data in this report was gathered from production sample serial number: 7PR531532GD0139(assigned by applicant). The EUT was received on 2015-09-24.*

Objective

This test report is prepared on behalf of *Sepura plc* in accordance with Part 2, Part22, and Part 90 of the Federal Communications Commission rules.

This is the CIIPC application of the device. The difference between the original device and new device is as follows:

1. Change the low power level from 5W to 1W.
2. Updated the emission designator.
3. Updated MPE evaluation.

Please refer to the Permissive Change Declaration Letter.

According to the changes, it will impact the test results of RF power output and Occupied bandwidth&Emission mask, so in this report, we update the test data of RF power output &Occupied bandwidth&Emission mask for low power level and updated MPE evaluation.

Related Submittal(s)/Grant(s)

Original submission with FCC ID: *XX6SEM8040* which is granted on 2014-06-11.

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 22 – Public Mobile Service

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA-603-D.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode.

EUT Specification:

Operating Frequency Band	400-470MHz
Modulation Mode	FM, 4FSK
Channel Spacing	12.5 kHz
Transmitter Power	Highest power level: 25W Lowest power level: 1W

Equipment Modifications

No modifications were made to the unit tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§2.1091	Maximum Permissible Exposure	Compliance
§2.1046; § 22.727;§90.205	RF Output Power	Compliance
§2.1047;§90.207	Modulation Characteristic	Compliance*
§2.1049;§22.357;§ 22.731;§90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliance
§2.1051; §22.861;§90.210	Spurious Emission at Antenna Terminal	Compliance*
§2.1053; §22.861;§90.210	Spurious Radiated Emissions	Compliance*
§2.1055; § 22.355;§90.213	Frequency Stability	Compliance*
§90.214	Transient Frequency Behavior	Compliance*

Compliance*: Please refer to the report number R2DG131120004-00 granted on 2014-06-11, with FCC ID: XX6SEM8040.

FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for Maximum Permissible Exposure (MPE)

Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm²)	Averaging Time E , H or S (minutes)
0.3- 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

f = frequency in MHz;

* = Plane-wave equivalent power density;

MPE Calculation

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

Frequency	Max Target Output Power	Duty Cycle	Typical Antenna		Distance	Power Density	Power Density Limit
MHz	mW		dBi	numeric	cm	mW/cm ²	mW/cm ²
400.0125	28050	50%	0	1.0	65	0.26	0.27

Note1: The manufacturer does not specify an antenna to be used with this device , but a typical installation has a gain up to 0dBi.

Note2: The target power is 25W (43.98 dBm) $\pm 0.5\text{dB}$ = 28050mW (44.48dBm)

Radio Exposure Statement:

Using the parameters given in the above calculation, a minimum antenna to person distance of 65 cm is required to meet the limits for occupational/controlled exposure.

Result: Compliance

FCC §2.1046 & § 22.727 & §90.205- RF OUTPUT POWER**Applicable Standard**

FCC §2.1046, § 22.727 and §90.205.

Test Procedure

Conducted RF Output Power:

TIA-603-D section 2.2.1

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer setting:

RBW	Video B/W
100 kHz	300 kHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2015-05-09	2016-05-09
Mini-Circuits	Attenuator	UNAT-10 ⁺	15542	2015-05-06	2016-05-06
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2015-05-08	2016-05-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-05-06	2016-05-06
Pasternack	RF Coaxial Cable	RF-01(30cm)	/	2015-05-06	2016-05-06
Pasternack	RF Coaxial Cable	RF-02(30cm)	/	2015-05-06	2016-05-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	27.1 °C
Relative Humidity:	58 %
ATM Pressure:	100.3 kPa

The testing was performed by Dean Liu on 2015-09-26.

Test Mode: Transmitting

Test Result: Compliant. Please refer to following tables.

FCC Part 90:

Modulation	Channel Spacing	f _c	Conducted Output Power (W)	
		MHz	Low Power Level	High Power Level
FM	12.5 kHz	400.0125	0.998	24.89
		435	0.982	24.27
		469.9875	0.998	24.77
4FSK		400.0125	0.989	24.66
		435	0.983	24.43
		469.9875	0.998	24.60

FCC Part 22:

Modulation	Channel Spacing	f_c	Conducted Output Power (W)	
		MHz	Low Power Level	High Power Level
FM	12.5 kHz	458	1.000	24.89
4FSK		458	0.984	24.66

FCC §2.1049 & §22.357 & § 22.731 & §90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

Applicable Standard

FCC §2.1049, §22.357, § 22.731, §90.209 and §90.210

Applicable Emission Masks

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25	A or B	A or C
25-50	B	C
72-76	B	C
150-174	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854	B	H
809-824/854-869	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925		
All other bands	B	C

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2015-05-09	2016-05-09
HP	RF Communications Test Set	8920A	00 235	2015-05-09	2016-05-09
Mini-Circuits	Attenuator	UNAT-10 ⁺	15542	2015-05-06	2016-05-06
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2015-05-08	2016-05-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-05-06	2016-05-06
Pasternack	RF Coaxial Cable	RF-01(30cm)	/	2015-05-06	2016-05-06
Pasternack	RF Coaxial Cable	RF-02(30cm)	/	2015-05-06	2016-05-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	26.8~27.5 °C
Relative Humidity:	55~58 %
ATM Pressure:	99.8~100.3 kPa

The testing was performed by Dean Liu from 2015-09-24 to 2015-10-09.

Test Mode: Transmitting

Test Result: Compliant. Please refer to the following tables and plots.

FCC Part 90:

Modulation Mode	Channel Spacing	f_c	99% Occupied Bandwidth(kHz)		26 dB Bandwidth (kHz)	
	kHz	MHz	Low Power Level	High Power Level	Low Power Level	High Power Level
FM	12.5	435	9.90	10.01	10.35	10.46
4FSK			7.57	7.34	9.68	9.57

FCC Part 22:

Modulation Mode	Channel Spacing	f_c	99% Occupied Bandwidth(kHz)		26 dB Bandwidth (kHz)	
	kHz	MHz	Lowest Power Level	Highest Power Level	Lowest Power Level	Highest Power Level
FM	12.5	458	9.90	9.9	10.35	10.35
4FSK			7.34	7.59	9.12	9.90

Emission Designator

Per CFR 47 §2.201& §2.202&, $B_n = 2M + 2D$

For FM Mode (Channel Spacing: 12.5 kHz)

Emission Designator 11K0F3E

In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation.

$BW = 2(M+D) = 2*(3.0 \text{ kHz} + 2.5 \text{ kHz}) = 11 \text{ kHz} \Rightarrow 11K0$

F3E portion of the designator represents an FM voice transmission

Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.

For Digital Mode (Channel Spacing: 12.5 kHz)

Emission Designator 7K60FXD and 7K60FXW

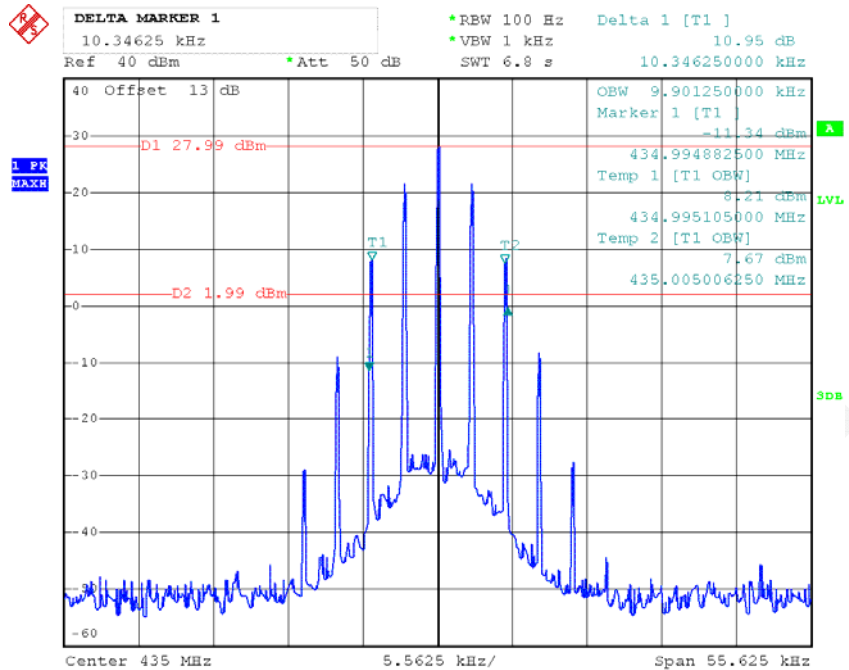
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.59 kHz. The emission mask was obtained from 47CFR 90.210(d).

FXD and FXW portion of the designator indicates digital information.

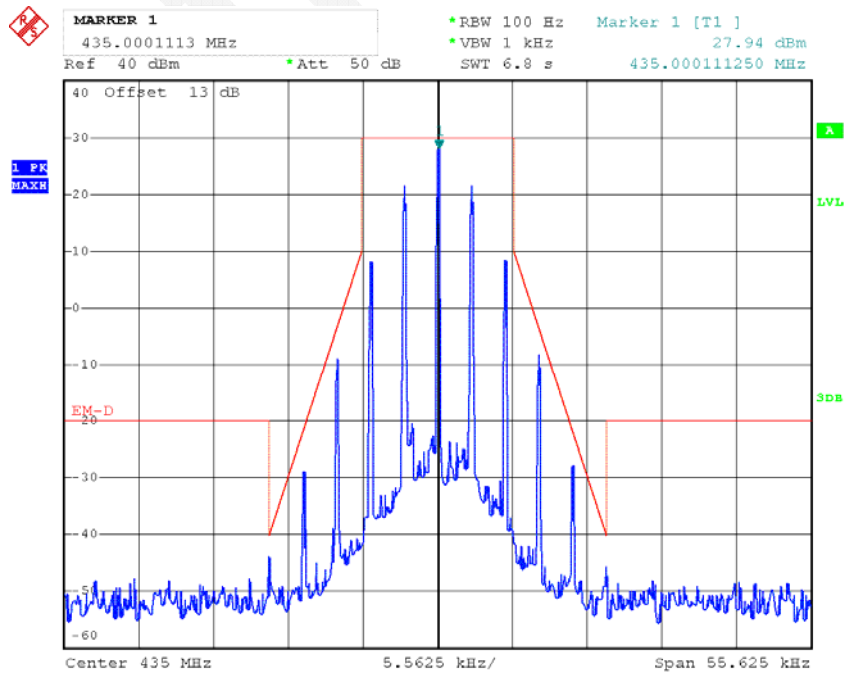
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60FXD and 7K60FXW.

Low Power Level

Part 90:

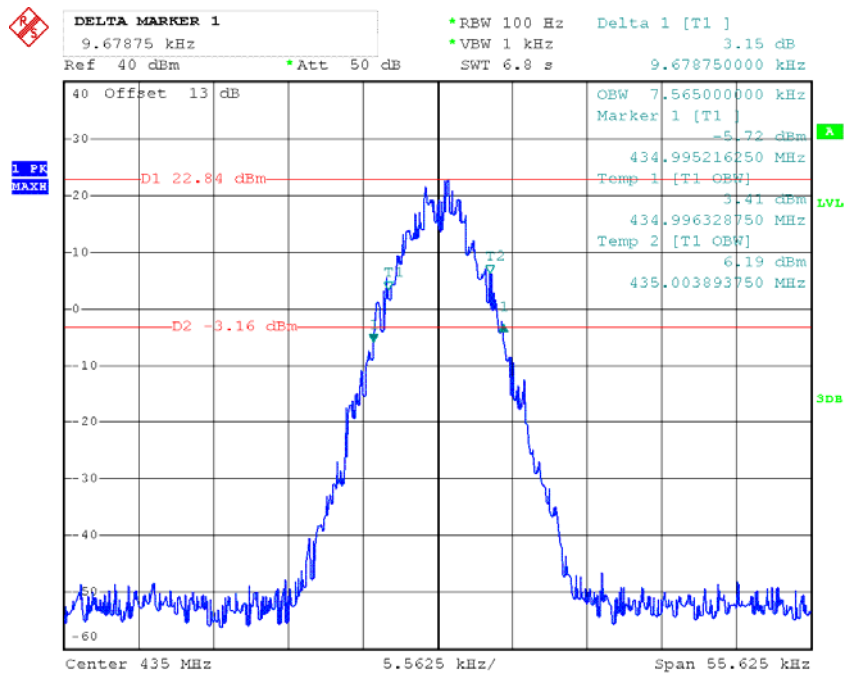
Occupied Bandwidth – FM

Date: 26.SEP.2015 17:34:29

Emission Mask - Type D

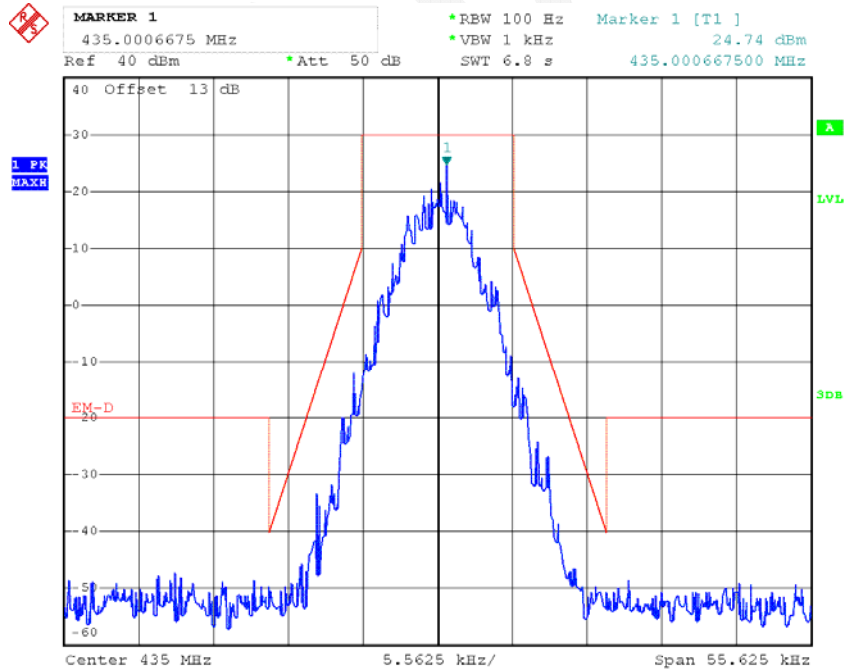
Date: 26.SEP.2015 17:31:57

Occupied Bandwidth –4FSK



Date: 26.SEP.2015 17:16:31

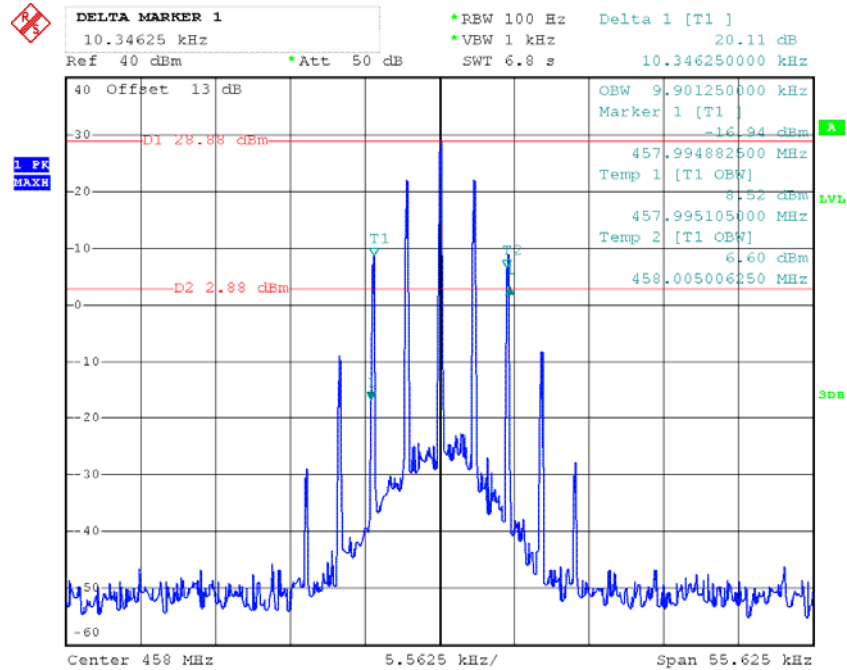
Emission Mask - Type D



Date: 26.SEP.2015 17:12:34

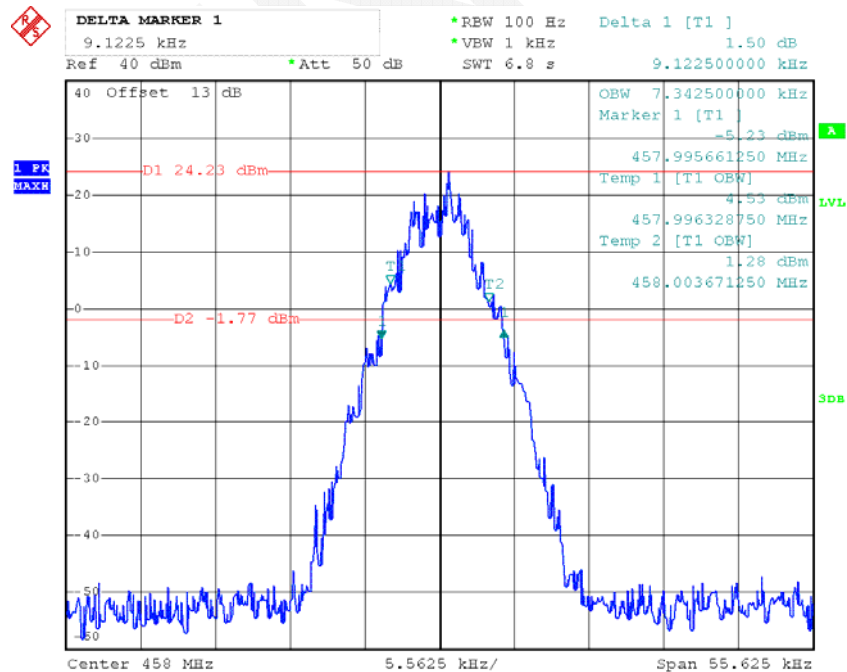
Part 22:

Occupied Bandwidth –FM



Date: 26.SEP.2015 17:36:53

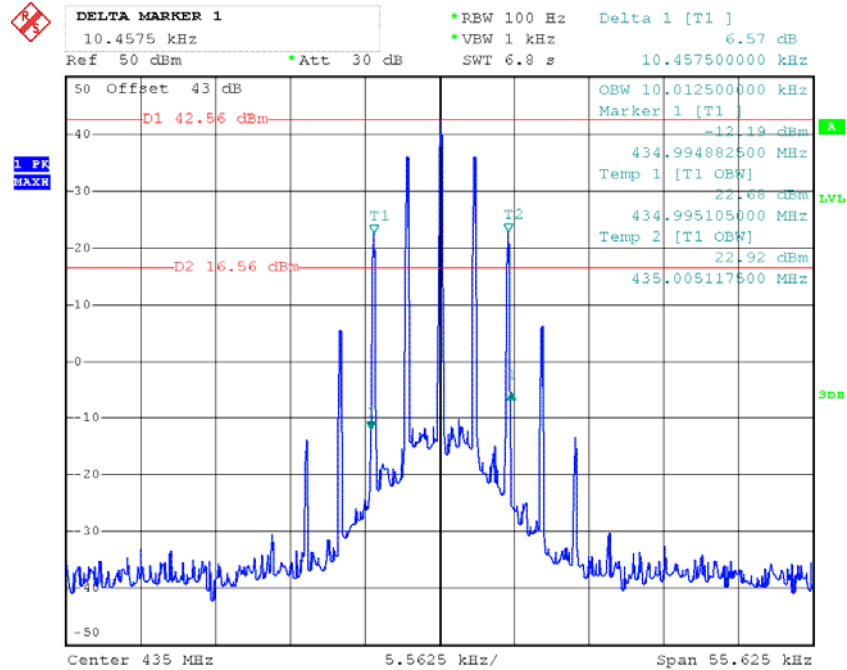
Occupied Bandwidth –4FSK



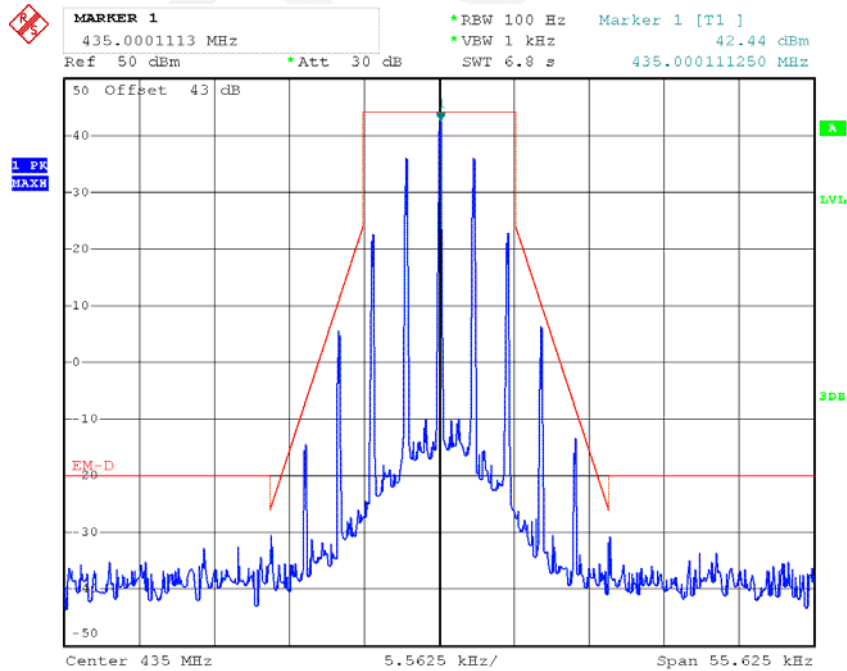
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High Power Level

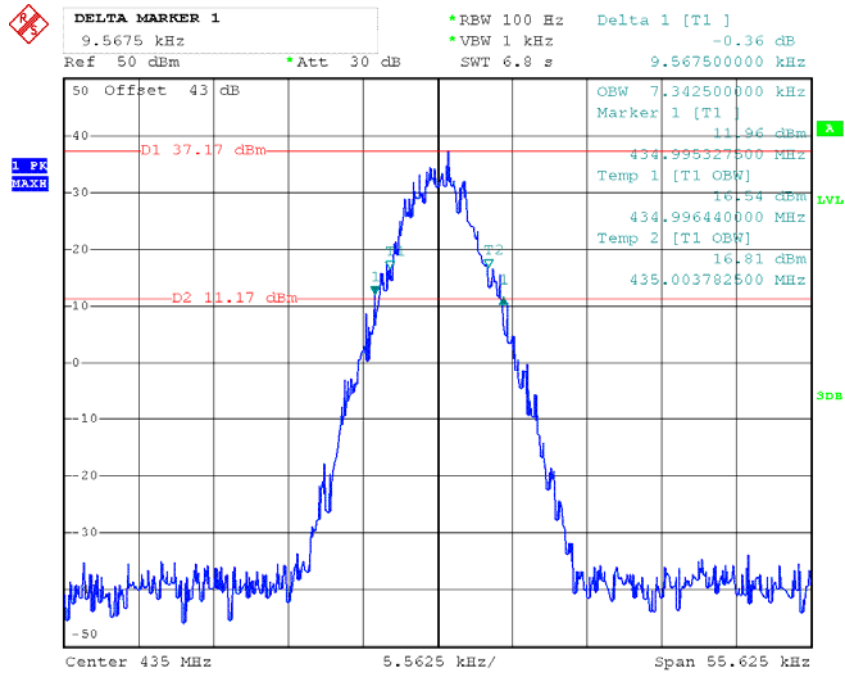
Part 90:

Occupied Bandwidth – FM

Date: 9.OCT.2015 21:54:52

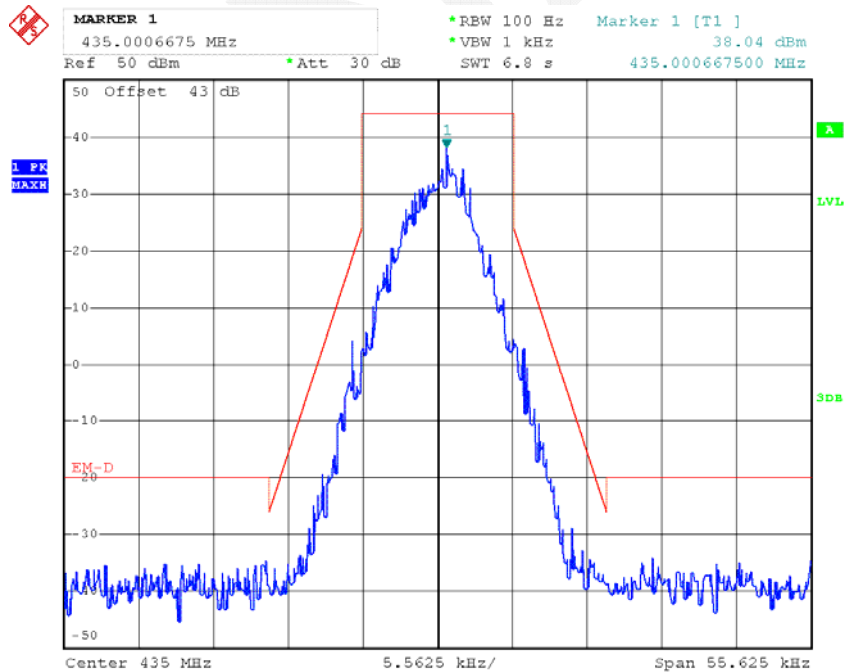
Emission Mask - Type D

Occupied Bandwidth –4FSK



Date: 9.OCT.2015 21:29:27

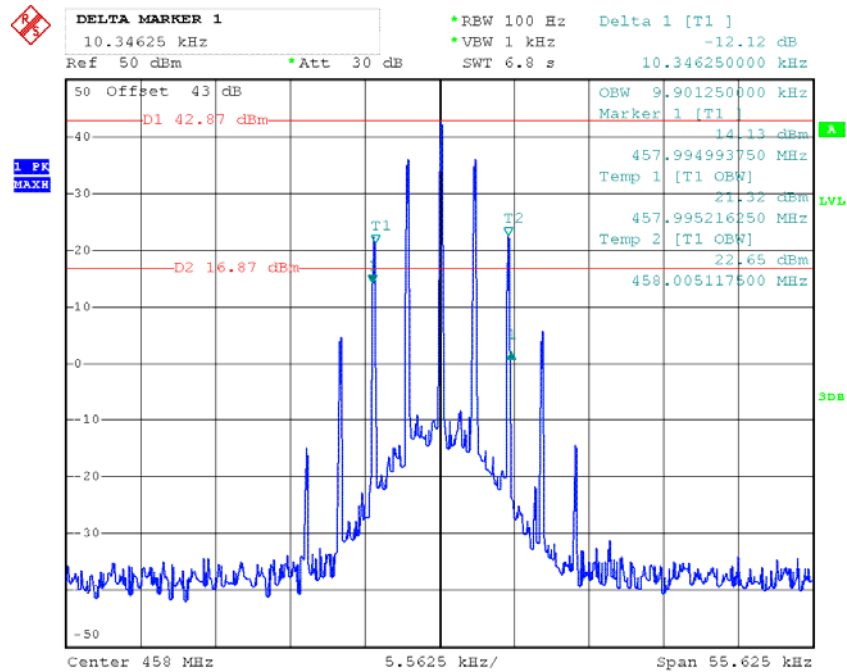
Emission Mask - Type D



Date: 9.OCT.2015 21:33:41

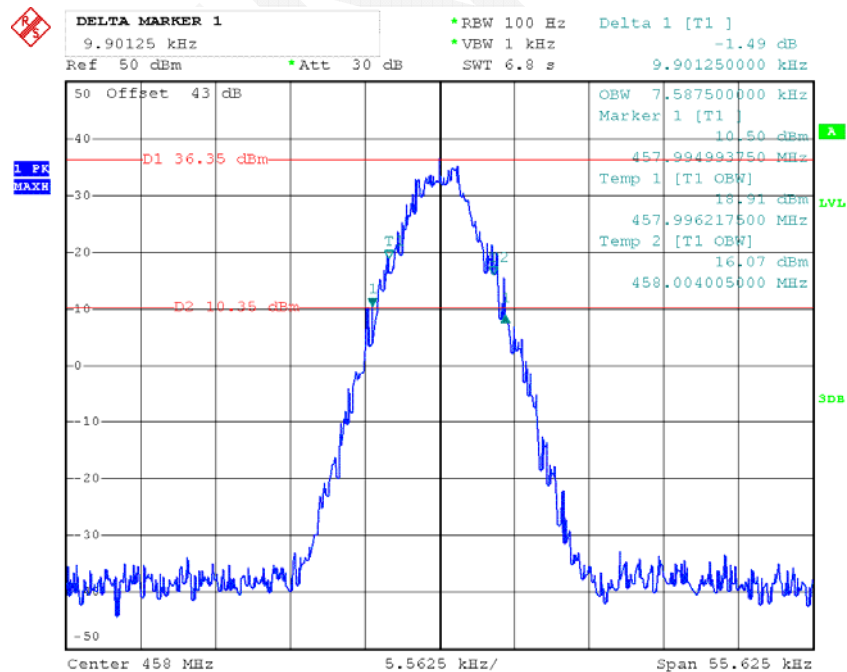
Part 22:

Occupied Bandwidth –FM



Date: 9.OCT.2015 21:58:48

Occupied Bandwidth –4FSK



Date: 9.OCT.2015 21:24:18

***** END OF REPORT *****