



IMQ S.p.A. - Società con Socio Unico  
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# TEST REPORT


## No. AR16-0002224-01-1

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47  
Part 15 Subpart C Section 15.247

<b>PRODUCT</b>	RF Module
<b>MODEL(s) TESTED</b>	SPSGRFC-915
<b>FCC ID</b>	S9NSPSGRFC
<b>TRADE MARK(s)</b>	STMicroelectronics

<b>APPLICANT</b>	STMicroelectronics S.r.l. ~ Centro Direzionale Colleoni - Palazzo Andromeda 3 I-20864 Agrate Brianza (MB)
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Tested by	Robertino Torri [Laboratory technician]	
Approved by	Giovanni Di Turi [Laboratory manager]	

### Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2016-09-19	First edition <small>Digital signed - AR16-0002224-01-1 _TR_FCC 15.247_STMICROELECTRONICS_Modulo SPSGRFC-915</small>
Rev. 1	2016-11-02	Adjustment page 4 Maximum RF radiated power, page 7 Operating condition EUT and support equipment, page 10 Antenna requirement, § 7.2 test on "Conducted disturbance on AC Notebook power port" and page 52 instrumentation list <small>Digital signed - AR16-0002224-01-1 rev.1_TR_FCC 15.247_STMICROELECTRONICS_Modulo SPSGRFC-915</small>

The results of tests and checks reported in this Test Report refer exclusively to the samples tested and described in the Report itself.

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## 1. GENERAL DATA

SAMPLE		
Samples received on	2016-07-20	(Item(s) sampled and sent by applicant)
IMQ reference samples	BEM	82715
Samples tested No.	1	
Object under analysis recognition	<b>Not carried out</b> Except where stated, characteristics of products were taken from client description and were not verified by the laboratory	
Date of acceptance of test item	2016-07-20	
TEST LOCATION		
Testing dates	2016-07-20 ÷ 2016-11-02	
Testing laboratory.	IMQ S.p.A. - Via Quintiliano, 43 – I-20138 Milano	
Testing site	Viale Lombardia, 20 – I-20021 Bollate (MI) Via Quintiliano, 43 – I-20138 Milano	
ENVIRONMENTAL CONDITIONING		
<i>Parameter</i>	<i>Measured</i>	
Ambient Temperature	25 ÷ 35 °C	
Relative Humidity	50 ÷ 60 %	
Atmospheric Pressure	900 ÷ 1000 mbar	
REMARKS		
Throughout this report a point is used as the decimal separator. The ability or reliability of this product to perform its intended function in a particular application has not been investigated. IMQ declines any responsibility derived from missing or wrong information provided aside by the applicant.		

## 2. REFERENCE DOCUMENT

	DOCUMENT	DATE	TITLE
<input checked="" type="checkbox"/>	47 CFR Part 15	2015	Radio Frequency Device
<input checked="" type="checkbox"/>	ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
<input checked="" type="checkbox"/>	ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

### 3. UNIT UNDER TEST (EUT) DETAILS

#### GENERAL DATA

MODEL (basic)	Description
SPSGRFC-915	RF Module
VARIANTS (derived)	Description
/	/

<b>FCC ID</b>	S9NSPSGRFC
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<b>Manufacturer</b>	STMicroelectronics S.r.l. ~ Centro Direzionale Colleoni - Palazzo Andromeda 3 I-20864 Agrate Brianza (MB)
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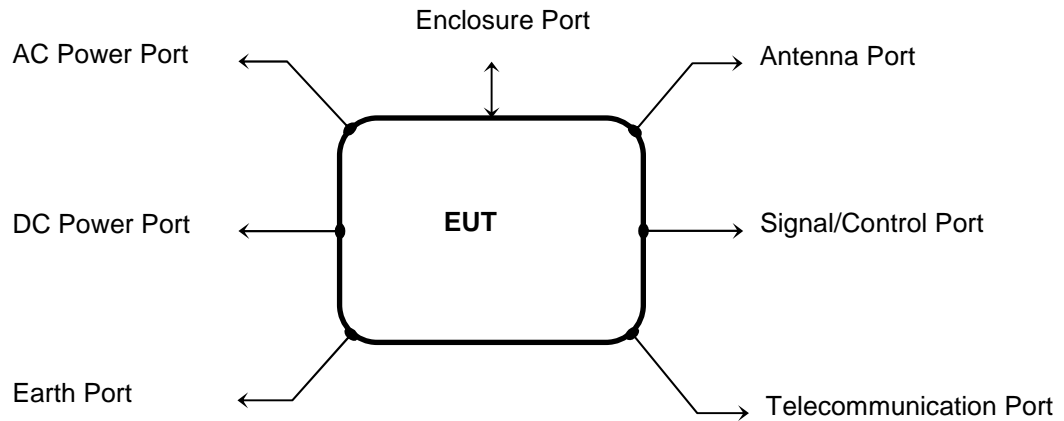
<b>Type of equipment</b>	Radio module
<b>Operating frequency:</b>	903.5 ÷ 926.3 MHz
<b>Maximum RF radiated power:</b>	11.6 dBm (rated declared) 11.05 dBm (effective measured)
<b>Modulation:</b>	2FSK, GFSK and MSK
<b>Channel Spacing:</b>	/
<b>Antenna:</b>	External antenna with RP-SMA connector and adapter for U.FL connector (TAOGLASS mod.TI.19.2113 gain +2.5 dBi)
<b>RX sensitivity:</b>	/
<b>Main SW identification</b>	/
<b>Main HW Board identification</b>	/
<b>Peripherals included (for system application)</b>	/
<b>Interfaces :</b>	/
<b>Integrated interfaces :</b>	/
<b>AC adapter:</b>	/
<b>Remarks</b>	The antenna have been furnished by applicant for tests

Parameters set on the RF module that will be used on transceiver module during test for limits compliance in FCC certification.

Operation band MHz	Modulation	Data rate Min/Max [kbps]	Frequency deviaton Min/Max [kHz]	Output power maximum [dBm]
903.5 ÷ 926.3	2FSK / GFSK	1/500	160/732	+11.6
	MSK	310/500	20/732	

## 4. TEST CONFIGURATION OF UNIT UNDER TEST

### EUT PORTS



Port	Description	Max length
Enclosure	Not present (open frame)	/
AC power	Not present	/
DC power	DC power supply 3.3 V DC	/
Earth	/	/
Telecommunication	/	/
Signal	I/O pin (see also schematics data sheet)	/
Control	I/O pin (see also schematics data sheet)	/
Antenna	Dedicated	/

## STATE OF THE EUT DURING TESTS

Ref.	Mode	Description
#1	Operating	<p>Continuous transmission (single channel transmission) supply by dedicated dongle. The EUT is installed on module device board (dongle). The dongle is powered from the USB cable port. The USB cable is connected to Notebook.</p> <p>The EUT is in continuously transmitting at the highest power with 100% approximately duty cycle.</p>

## SUPPORT EQUIPMENT

Defined as equipment needed for correct operation or loading of the EUT, but not considered as tested:

Equipment	Manufacturer	Model
Dongle furnished by manufacturer for supply and management of radio module	ST Microelectronics	PC92A V01
Notebook for dongle management and supply	IBM	1830

## ELECTROMAGNETICALLY RELEVANT COMPONENTS

Component	No.	Manufacturer	Model
Radio module	1	STMicroelectronics	PC74A V01
Antenna	1	TAOGLASS	TI.19.2113

## RFI SUPPRESSION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

## EMI PROTECTION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

## EUT TECHNICAL DOCUMENTATION

Document	Reference
/	/

## 5. METHODS OF MEASUREMENT

All compliance measurements have been carried out using the procedures described in the standard ANSI C63.4-2014, ANSI C63.10-2013 and Section 15.31 of CFR47 Part 15 – Subpart A (General).

Additional test requirements have been adopted according to the reference Section indicated in the § 6 of this test report.

### FREQUENCY RANGE INVESTIGATED

Radiated emission tests: from 9 kHz to tenth harmonic of fundamental.

## 6. SUMMARY OF TEST RESULTS

### POSSIBLE TEST CASE VERDICTS:

Test object meets the requirement	PASS
Test object does not meet the requirement	FAIL
Test case does not apply to the test object	N.A.
Test not performed	N.P.

CFR47 Part 15	TITLE	RESULT
§ 15.203 § 15.247 (b)(4)(i)	Antenna Requirements	PASS
§ 15.207 (a)	Conducted Emission	PASS <sup>1</sup>
§ 15.209 (a) (f)	Radiated Emission	PASS
§ 15.247 (a)	Frequency Hopping Spread Spectrum Specifications	
§ 15.247(a)	20 dB Bandwidth	N.A. <sup>2</sup>
§ 15.247(a)(1)	Carrier frequency (Hopping Channel) Separation	N.A. <sup>2</sup>
§ 15.247(a)(1)(iii)	Number of Hopping Channels Used	N.A. <sup>2</sup>
§ 15.247(a)(1)(iii)	Time occupancy (Dwell Time) of Each Ch. within a 0,4 x Nch (sec) Period	N.A. <sup>2</sup>
§ 15.247(a)(2)	6dB Minimum Bandwidth	PASS
§ 15.247(b)	Maximum Peak Output Power	
§ 15.247(b) (1)	Peak Output Power	N.A.
§ 15.247(b) (3)	RF power output, radiated (EIRP)	PASS
§ 15.247(b) (4)	Antenna gain	N.A.
§ 15.247(c)	Operation with directional antenna gains greater than 6 dBi	N.A.
§ 15.247 (d)	100 kHz Bandwidth of Frequency Band Edges	PASS
§ 15.247 (d)	Conducted Emission	PASS
§ 15.247 (e)	Power Spectral Density	PASS
§ 15.247 (f)	Hybrid systems	N.A. <sup>2</sup>
§ 15.247 (g)	FHSS Transmission characteristics	N.A. <sup>2</sup>
§ 15.247 (h)	Recognition of occupied channel and multiple transmission system	N.A. <sup>2</sup>
§ 15.247(i) (§ 47CFR 1.1307(b)(1))	RF humane exposure	PASS

**Note 1** The test has been carried out on DC power port of dongle.

**Note 2** Not applicable for DTS equipment



## 7. TEST RESULTS

### 7.1 ANTENNA REQUIREMENTS

#### TEST REQUIREMENT

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

Testing dates	2016-07-20
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#### Antenna specifications

N° of authorized antenna types	1
Antenna type	External RP-SMA connector (From antenna to RF module by cable adapter U.FL/SMA RP)
Maximum total gain	+2.5 dBi (rated)
External power amplifiers	Not present

#### TEST RESULT

The EUT meets the requirements of section 15.203 and 15.204

## 7.2 CONDUCTED EMISSION

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Shielded chamber
Frequency range	150 kHz – 30 MHz
IF bandwidth	9 kHz
EMC class	B
EUT operating condition	#1
Testing dates	2016-11-02

LIMITS		
Band of operations	Quasi-Peak (dB $\mu$ V)	Average Limit (dB $\mu$ V)
0.15 ÷ 0.5	66 ÷ 56	56 ÷ 46
0.5 ÷ 5	56	46
5 ÷ 30	60	50

TEST RESULT
The EUT meets the requirements of sections 15.207 (a).

TEST PROCEDURE
<ol style="list-style-type: none"> <li>1) The EUT was placed on a wooden table of size, 80 cm by 80 cm, raised 80 cm in which is located 40 cm away from the vertical wall the shielded room.</li> <li>2) Each EUT power cord input cord was individually connected through a 50<math>\Omega</math>/50<math>\mu</math>H LISN to the input power source.</li> <li>3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.</li> <li>4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.</li> <li>5) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 9 kHz during the measurements.</li> <li>6) The measurements with Quasi-Peak detector are performed only for frequencies for which the Peak values are <math>\geq</math> (Q.P. limit - 6 dB).</li> </ol>

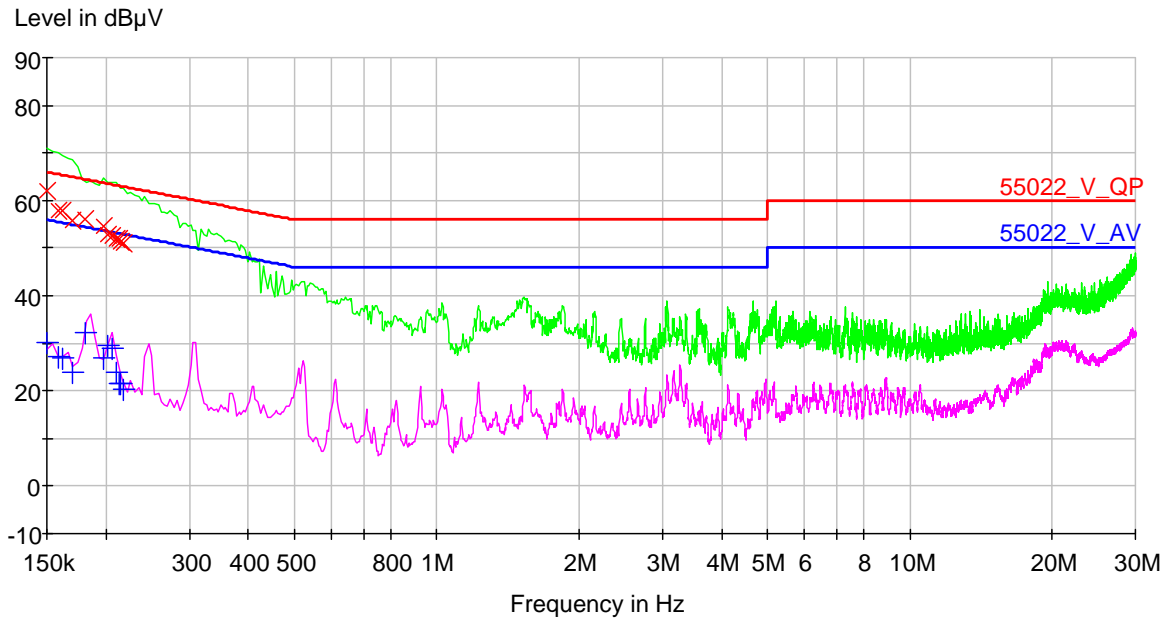
## MEASUREMENTS RESULTS

### Conducted disturbance on AC Notebook power port

150 kHz+30 MHz

Modulation: 2FSK

- Peak detector (Quasi-Peak detector: X marked points)
- Average detector (Average detector 1 sec: + marked points)



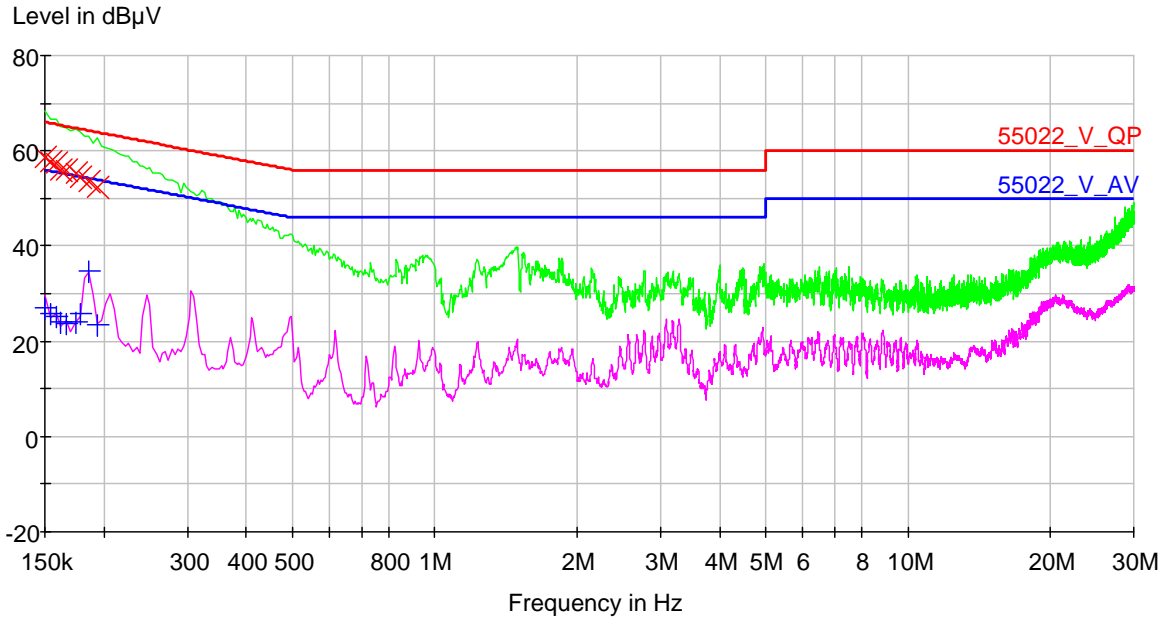
## MEASUREMENTS RESULTS

Conducted disturbance on AC Notebook power port

150 kHz+30 MHz

Modulation: GFSK

- Peak detector (Quasi-Peak detector: X marked points)
- Average detector (Average detector 1 sec: + marked points)



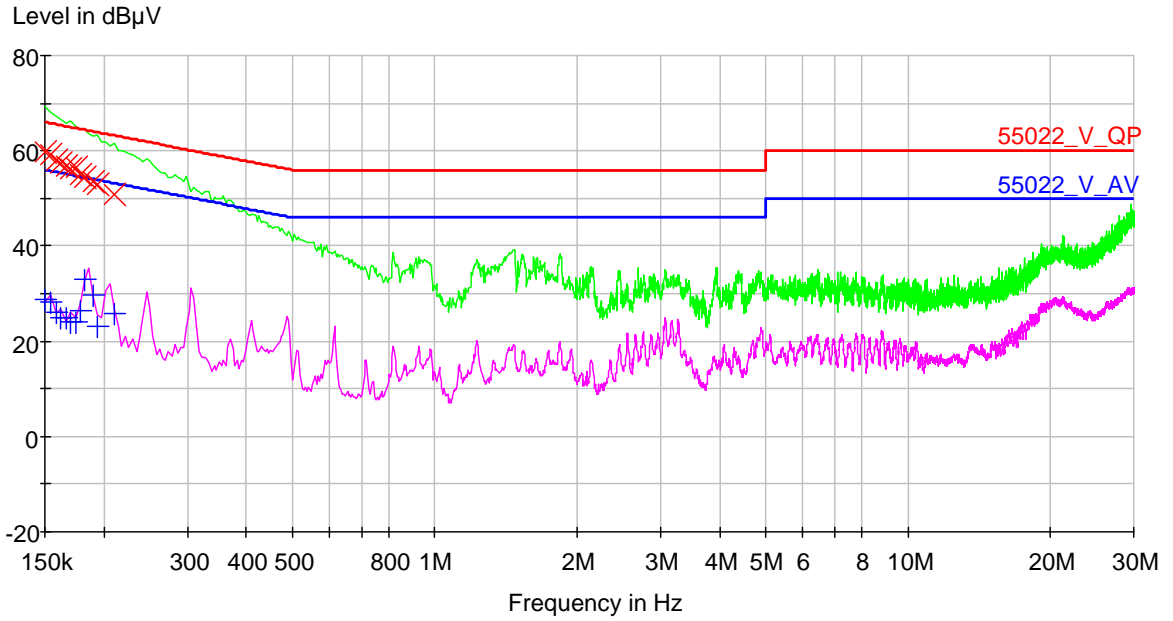
## MEASUREMENTS RESULTS

Conducted disturbance on AC Notebook power port

150 kHz+30 MHz

Modulation: MSK

- Peak detector (Quasi-Peak detector: X marked points)
- Average detector (Average detector 1 sec: + marked points)



### 7.3 RADIATED DISTURBANCES

TEST REQUIREMENT	
Test setup	ANSI C63.4
Test facility	Semi-anechoic chamber
Test distance	3 meters
Frequency range	9 kHz to tenth harmonic of fundamental
IF bandwidth (below 30 MHz)	9 kHz
IF bandwidth (below 1,000 MHz)	120 kHz
IF bandwidth (above 1,000 MHz)	1 MHz
EMC class	B
EUT operating condition	#1
Remark	In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = $40\log(300\text{meter} / 3\text{meter}) = +80\text{db}$ Extrapolation (dB) = $40\log(30\text{meter} / 3\text{meter}) = +40\text{db}$
Testing dates	2016-07-25 ÷ 2016-09-07

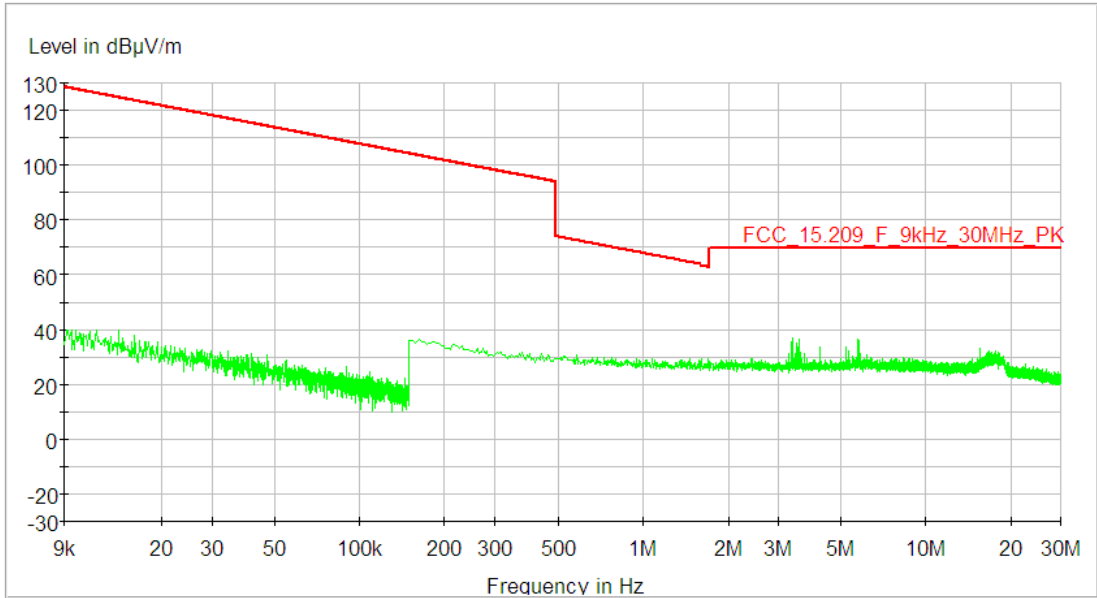
LIMITS		
Band of operations	Peak (dB $\mu$ V/m)	Average Limit (dB $\mu$ V/m)
Restricted bands (par. 15.205)	74	54
Other bands	According to 15.209 or fundamental -20dB (which is greater)	According to 15.209 or fundamental -20dB (which is greater)

TEST PROCEDURE
<ol style="list-style-type: none"> <li>1) The EUT was placed on turntable which is 0.8 m above the ground plane</li> <li>2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level.</li> <li>3) The EUT is positioned 3 m away from the receiving antenna which varied from 1 to 4 m to find the highest emission.</li> <li>4) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 100 kHz below 1000 MHz and 1 MHz above 1000 MHz.</li> <li>5) The receiving antenna was positioned in both horizontal and vertical polarization.</li> <li>6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are <math>\geq</math> (Q.P. limit - 6 dB).</li> </ol>

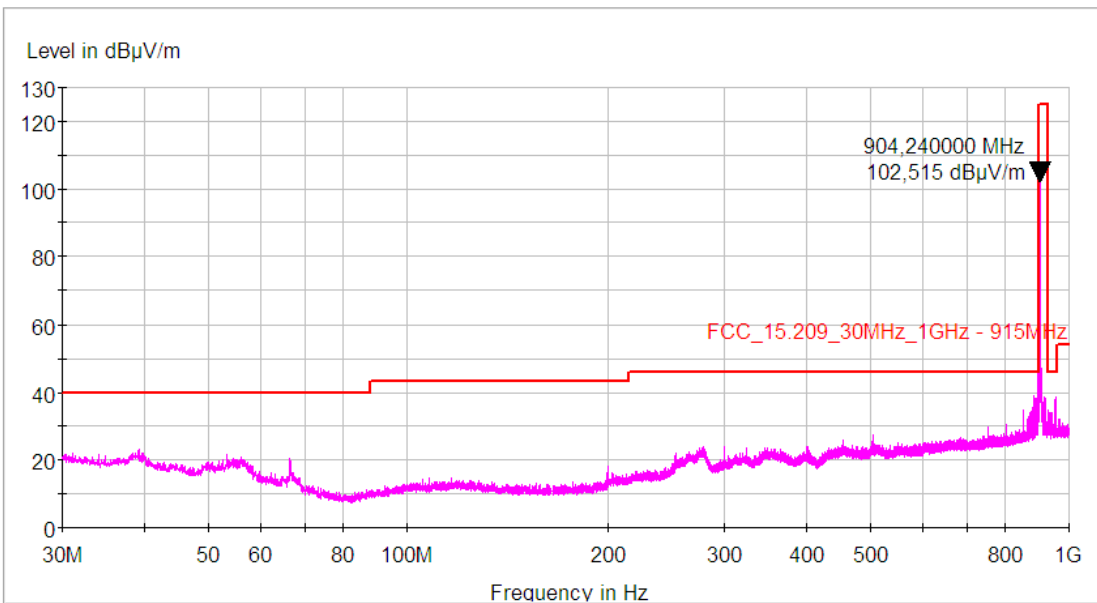
## MEASUREMENTS RESULTS

Modulation: 2FSK

9 kHz+30 MHz

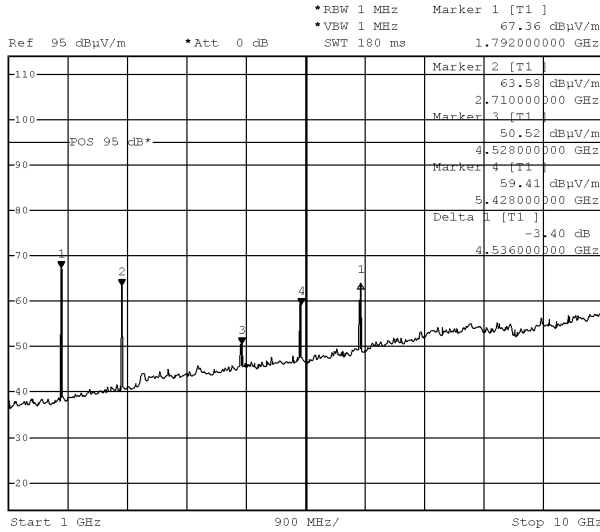


30÷1,000 MHz

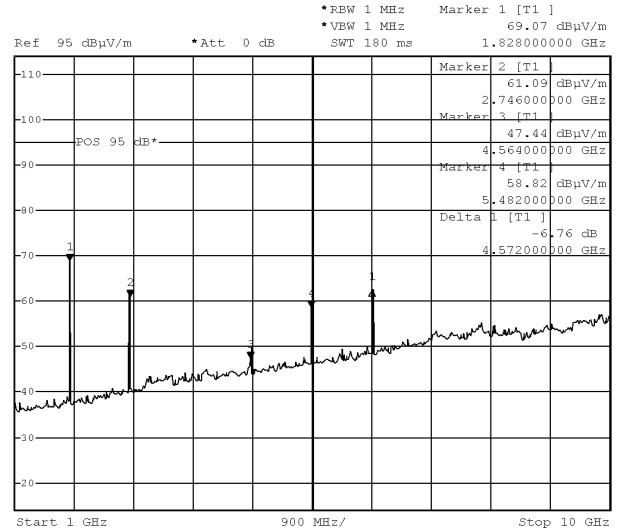


## 1000 MHz ÷ 10000 MHz

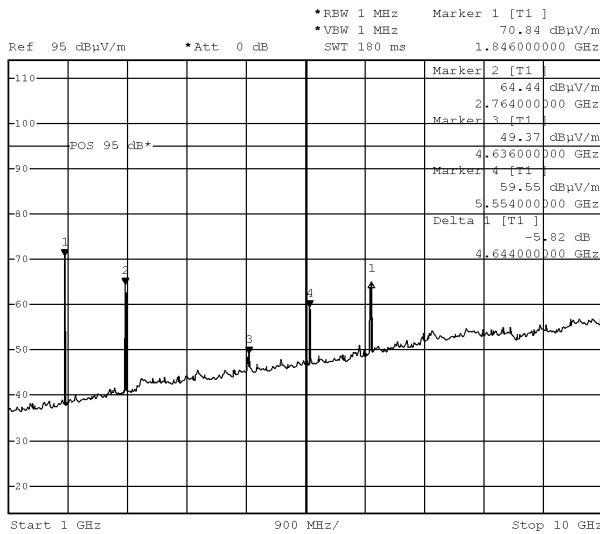
### Lowest frequency



### Middle frequency



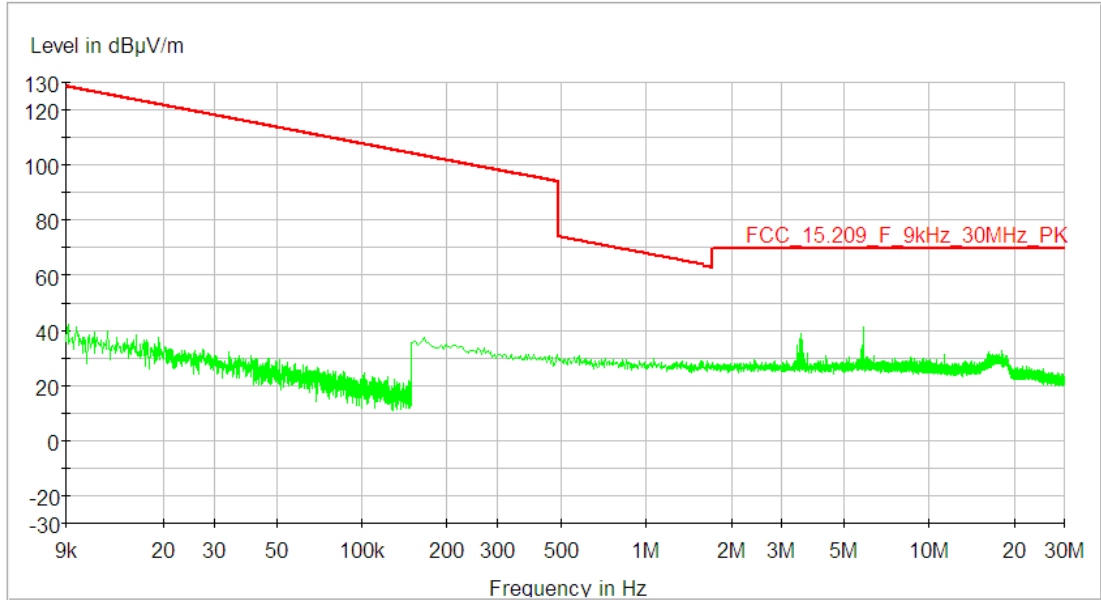
### Highest frequency



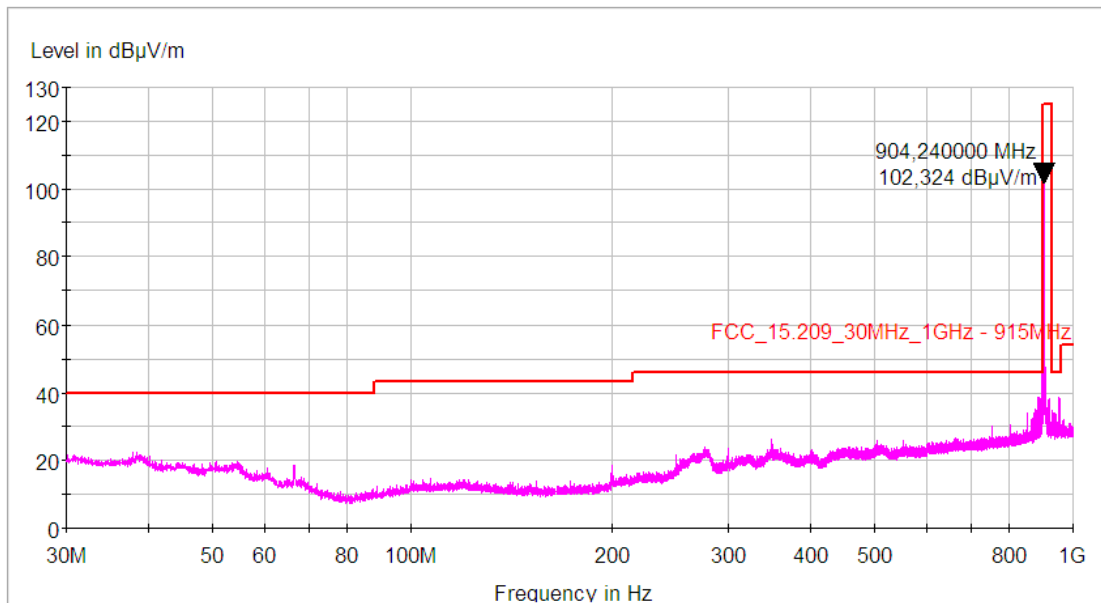


**Modulation: GFSK**

**9 kHz÷30 MHz**

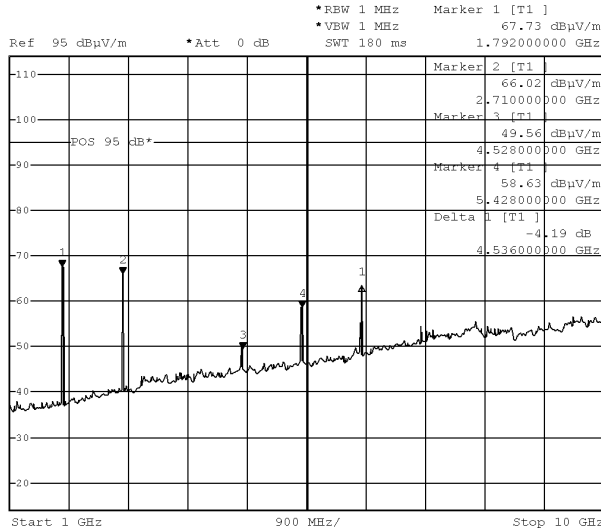


**30÷1,000 MHz**

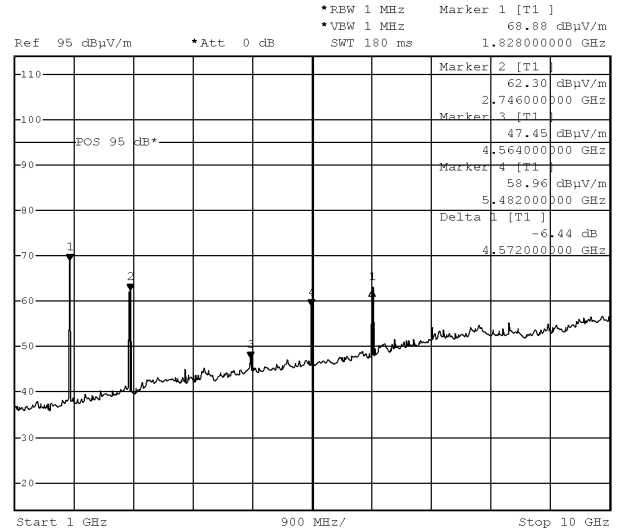


## 1000 MHz ÷ 10000 MHz

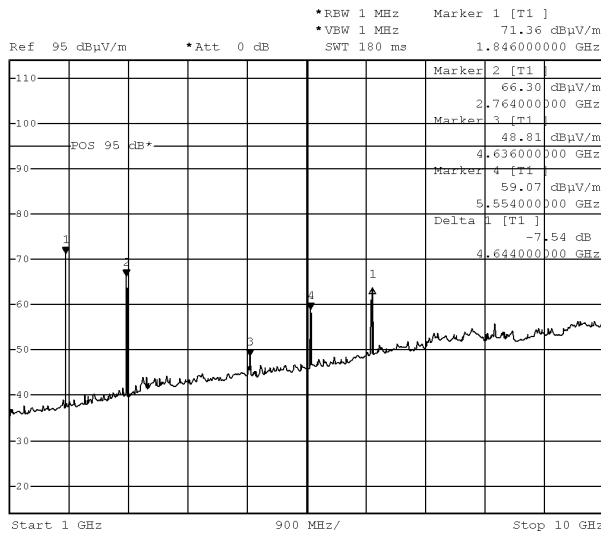
### Lowest frequency



### Middle frequency

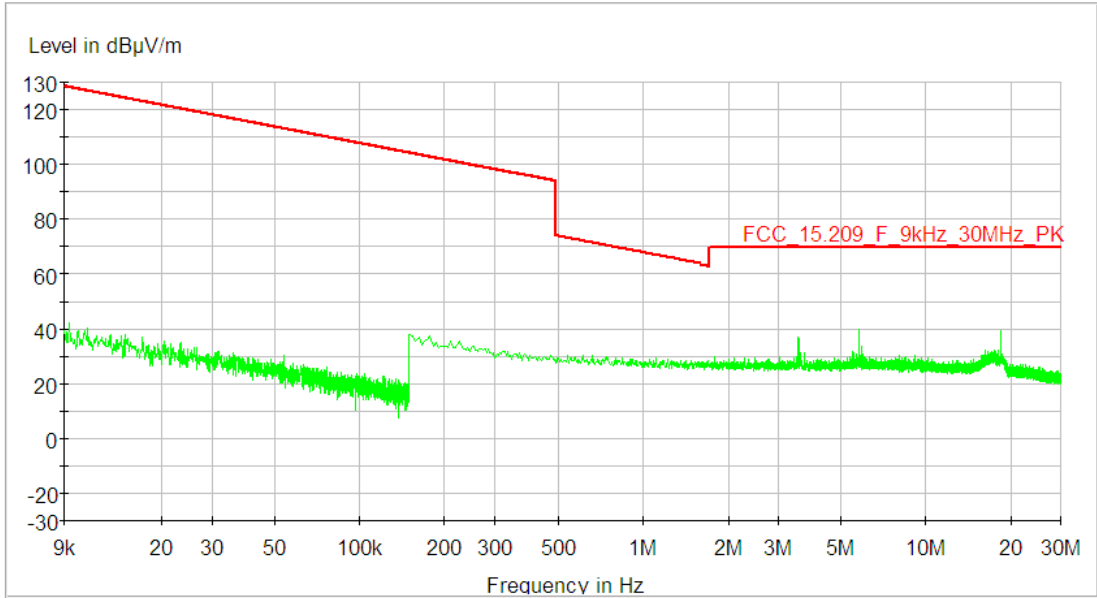


### Highest frequency

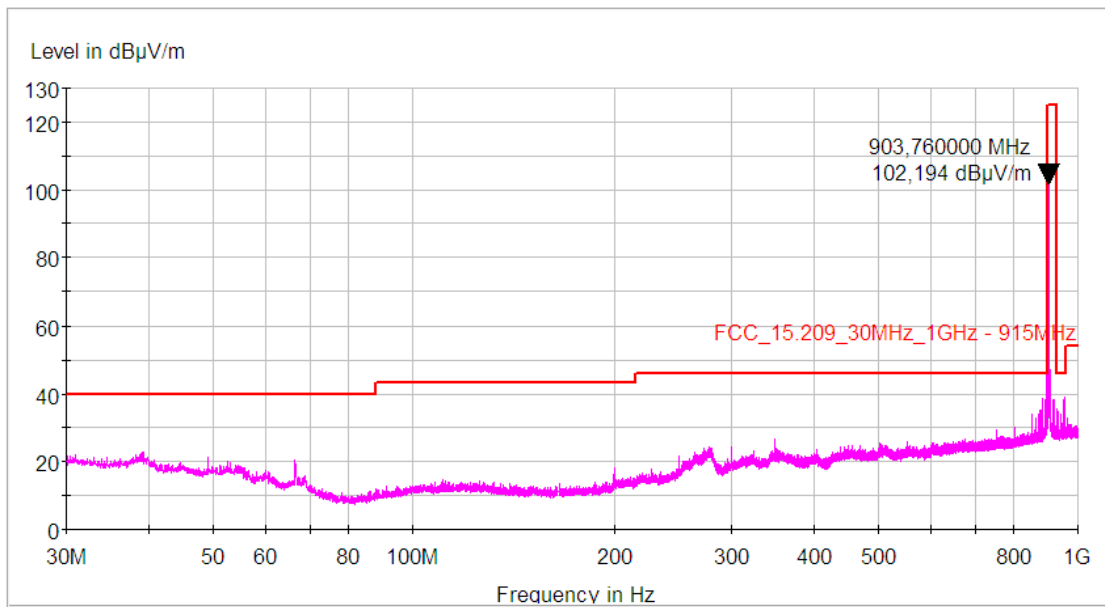


**Modulation: MSK**

**9 kHz÷30 MHz**

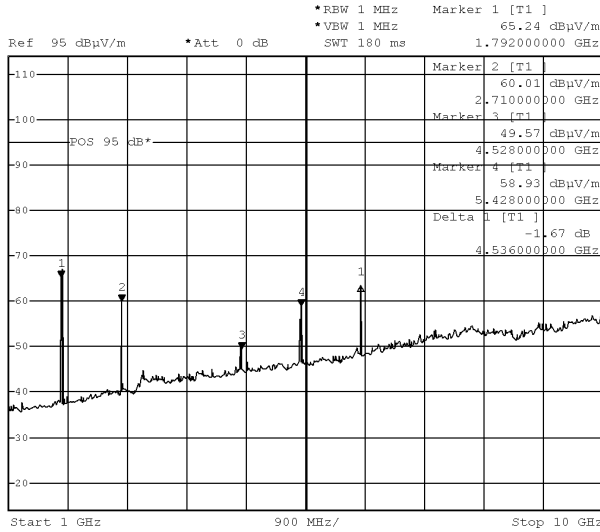


**30+1,000 MHz**

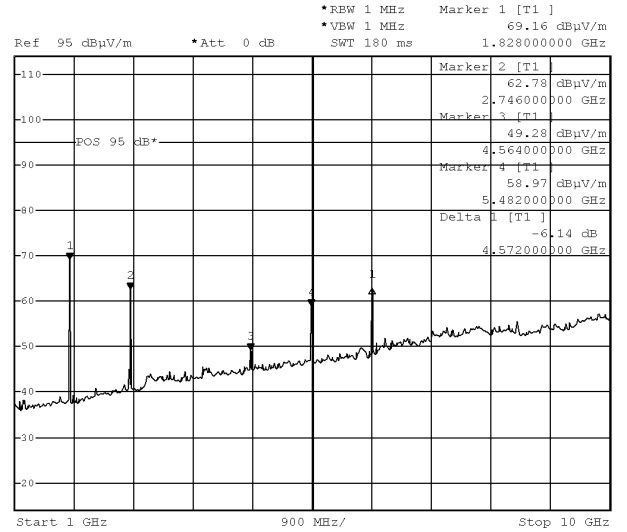


## 1000 MHz ÷ 10000 MHz

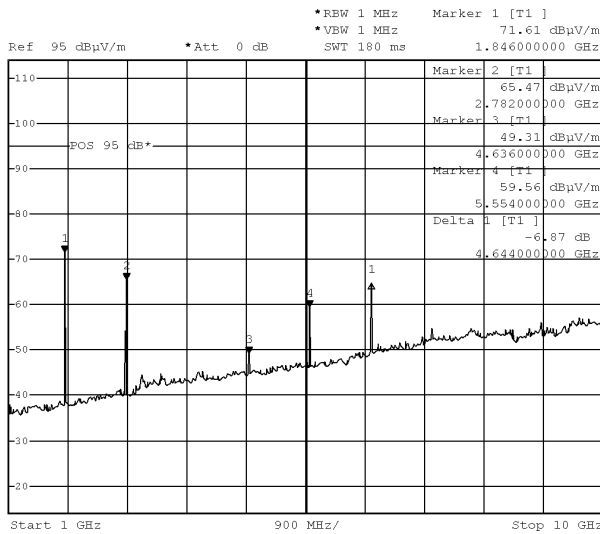
### Lowest frequency



### Middle frequency



### Highest frequency



**HARMONICS – Worst case reported**

**Modulation 2FSK**

**PEAK RESULT (RBW=1MHz; VBW=1MHz)**

Frequency (MHz)	Measured Level (dB $\mu$ V/m)	Limit ( $\mu$ V/meter)	Limit (dB $\mu$ V/m)	Margin (dB)
1,846	70.84	5000	74.00	-3.16
2,746	64.44	5000	74.00	-9.56
4,528	50.52	5000	74.00	-23.48
5,554	59.55	5000	74.00	-14.45
6,490	65.12	5000	74.00	-8.88
f>6,50	No spurious detected	5000	74.00	---

**AVERAGE FACTOR**

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
/	/	100 %	/

**AVERAGE RESULT (RBW=1MHz; VBW=10Hz)**

Frequency (MHz)	Measured Level (dB $\mu$ V/m)	Limit ( $\mu$ Volt/meter)	Limit (dB $\mu$ V/m)	Margin (dB)
2,746	53.58	500	54	-0.42
4,528	47.58	500	54	-6.42

### Modulation GFSK

#### PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dB $\mu$ V/m)	Limit ( $\mu$ V/meter)	Limit (dB $\mu$ V/m)	Margin (dB)
1,846	71.36	5000	74.00	-2.64
2,764	66.33	5000	74.00	-7.7
4,636	49.56	5000	74.00	-24.44
5,554	59.07	5000	74.00	-14.93
6,490	63.82	5000	74.00	-10.18
f > 6,50	No spurious detected	5000	74.00	---

#### AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
/	/	100 %	/

#### AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB $\mu$ V/m)	Limit ( $\mu$ Volt/meter)	Limit (dB $\mu$ V/m)	Margin (dB)
2,764	53.88	500	54	-0.20
4,636	37.62	500	54	-16.38

### Modulation MSK

#### PEAK RESULT (RBW=1MHz; VBW=1MHz)

Frequency (MHz)	Measured Level (dB $\mu$ V/m)	Limit ( $\mu$ V/meter)	Limit (dB $\mu$ V/m)	Margin (dB)
1,846	71.61	5000	74.00	-2.39
2,782	65.47	5000	74.00	-8.53
4,636	49.31	5000	74.00	-24.69
5,554	59.56	5000	74.00	-14.44
6,490	64.74	5000	74.00	-9.26
f > 6,50	No spurious detected	5000	74.00	---

#### AVERAGE FACTOR

T. Pulse (ms)	TX on + TX off (ms)	Duty cycle	Average Factor (dB)
/	/	100 %	/

#### AVERAGE RESULT (RBW=1MHz; VBW=10Hz)

Frequency (MHz)	Measured Level (dB $\mu$ V/m)	Limit ( $\mu$ Volt/meter)	Limit (dB $\mu$ V/m)	Margin (dB)
2,782	52.93	500	54	-1.07
4,636	38.71	500	54	-15.29

#### TEST RESULT

The EUT has been tested in 3 orthogonal axes at the frequencies lowest, middle and highest for each modulation.

The results reported are worst case.

The measurement of spurious emission of EUT in receiver mode is deemed to be fulfilled as no limits are exceeded in transmitter mode (condition considered more burdensome).

The EUT meets the requirements of sections 15.205 (b), 15.209 and 15.247.

## 7.4 6 dB BANDWIDTH

TEST REQUIREMENT	
<b>Spectrum analyzer settings</b>	
Span	2 MHz
Resolution bandwidth (RBW)	100 kHz
Video bandwidth (VBW)	300 kHz
Sweep time (SWT)	2,5 ms
Detector function	Peak
Trace	max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None
Testing dates	2016-07-21

TEST RESULT
The EUT meets the requirements of sections 15.247 (a) (2)

TEST PROCEDURE
The EUT is set to transmit has its maximum data rate. The Channel bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB.

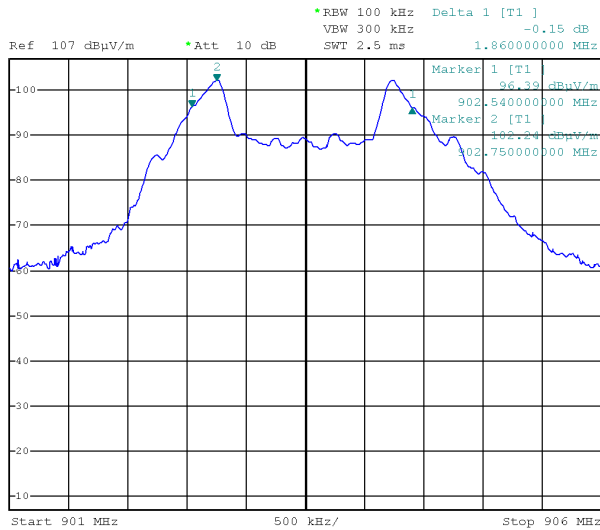


## MEASUREMENTS RESULTS

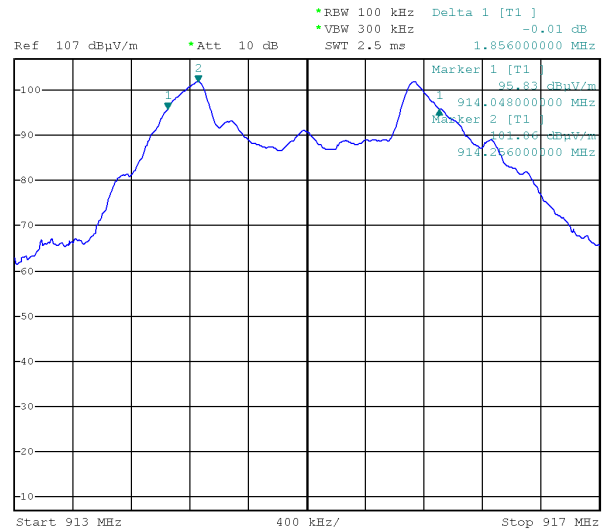
### Modulation 2FSK

Channel (No.)	Frequency (MHz)	Channel Bandwidth (MHz)	Plot (No.)
Low	903.5	1.860	1
Middle	915.0	1.856	2
High	926.3	1.810	3

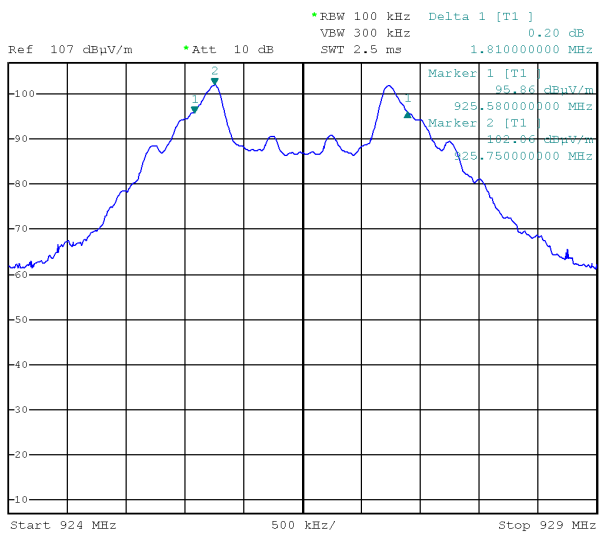
Plot 1



Plot 2



Plot 3

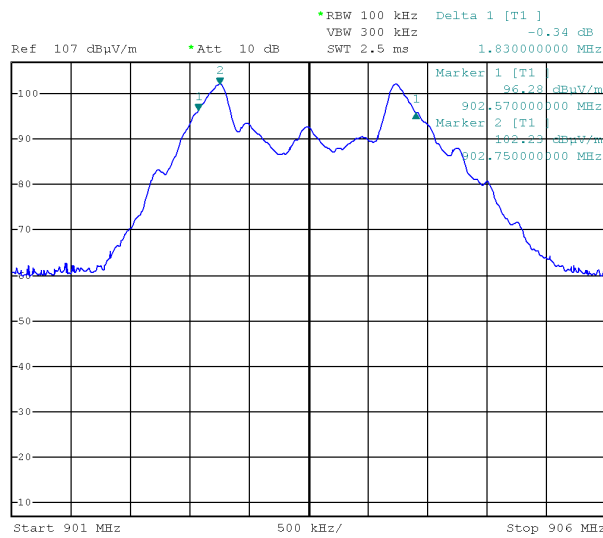


## MEASUREMENTS RESULTS

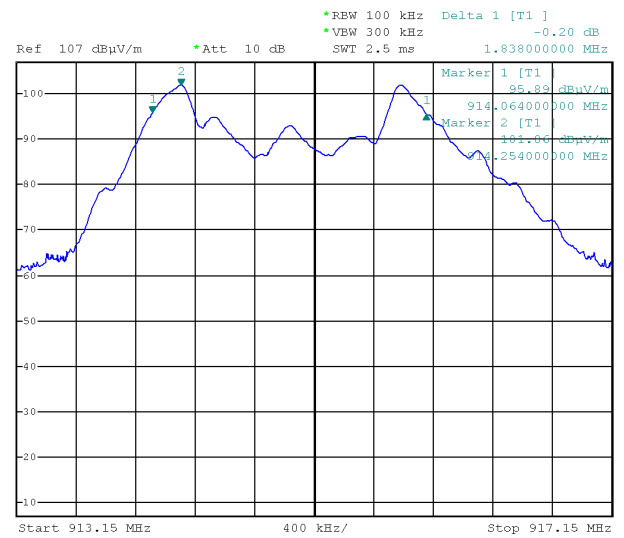
### Modulation GFSK

Channel (No.)	Frequency (MHz)	Channel Bandwidth (MHz)	Plot (No.)
Low	903.5	1.830	1
Middle	915	1.838	2
High	926.3	1.800	3

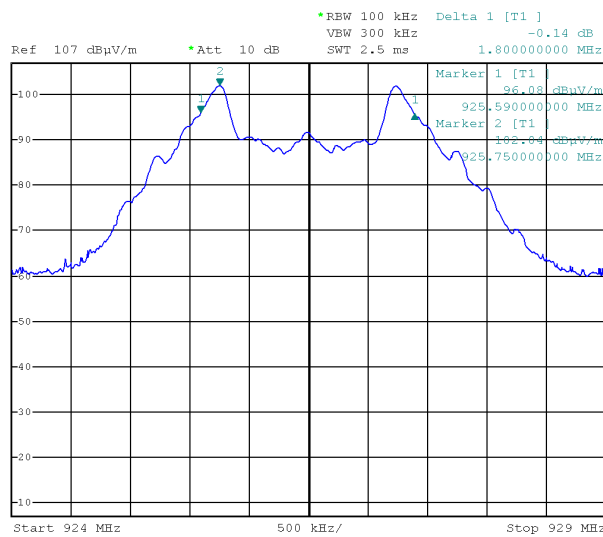
Plot 1



Plot 2



Plot 3

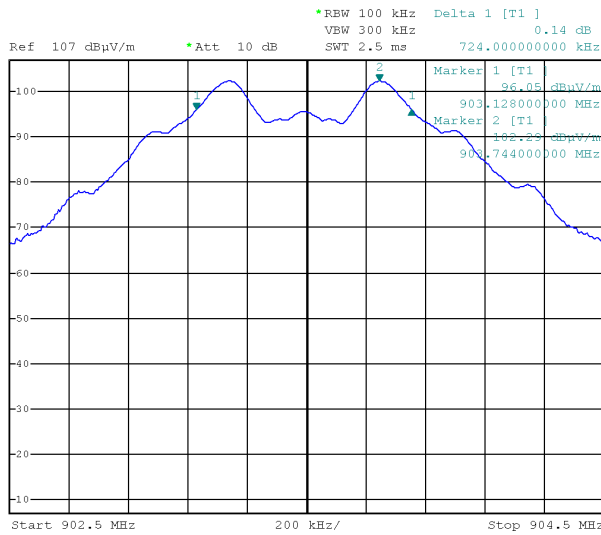


## MEASUREMENTS RESULTS

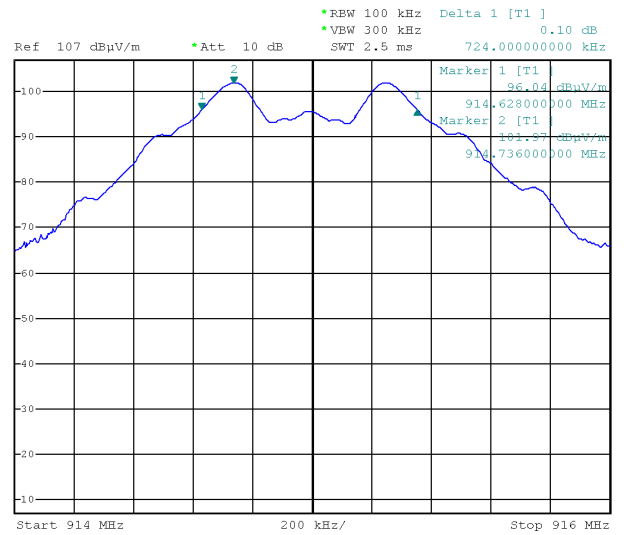
### Modulation MSK

Channel (No.)	Frequency (MHz)	Channel Bandwidth (MHz)	Plot (No.)
Low	903.5	0.724	1
Middle	915	0.724	2
High	926.3	0.716	3

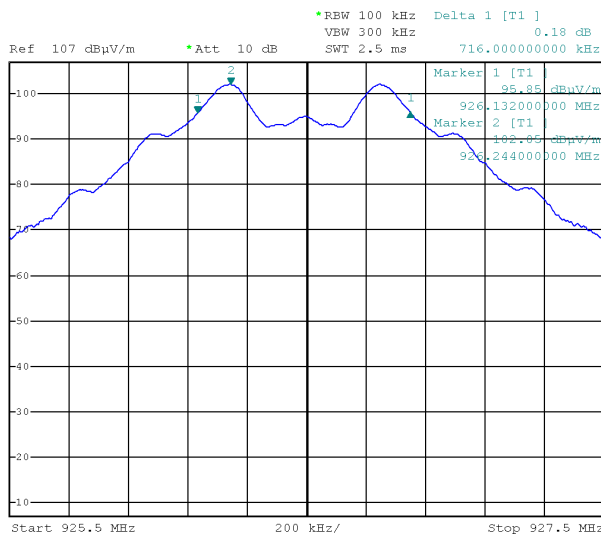
Plot 1



Plot 2



Plot 3



## 7.5 MAXIMUM PEAK OUTPUT POWER WITH EXTERNAL ANTENNA (DE FACTO EIRP)

TEST REQUIREMENT	
<b>Spectrum analyzer settings</b>	
Resolution bandwidth (RBW)	10 MHz
Video bandwidth (VBW)	10 MHz
Sweep time (SWT)	2,5 ms
Detector function	Peak
Trace	max hold
Test distance	3 meters (for radiated measurement)
EUT operating condition	#1
Remark	$\text{eirp} = p_t \times g_t = (E \times d)^2 / 30$ where: $p_t$ = transmitter output power in watts, $g_t$ = numeric gain of the transmitting antenna (unitless) -0.2 dBi, $E$ = electric field strength in V/m, $d$ = measurement distance in meters (m).
Testing dates	2016-07-21 ÷ 2016-09-07

TEST RESULT
The EUT meets the requirements of sections 15.247 (b) (3)

LIMITS
1 Watt (30dBm)

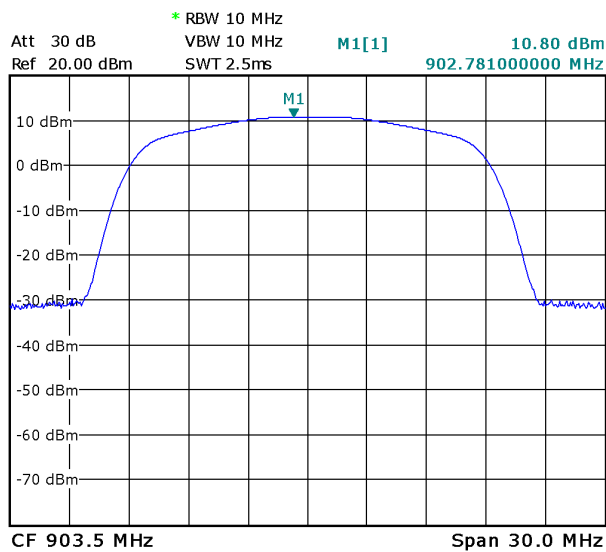
TEST PROCEDURE
<b>Radiated and conducted measurements:</b>
The EUT is tested with and without a dedicated antenna. The effective radiated power is measured in a 3 m anechoic chamber.



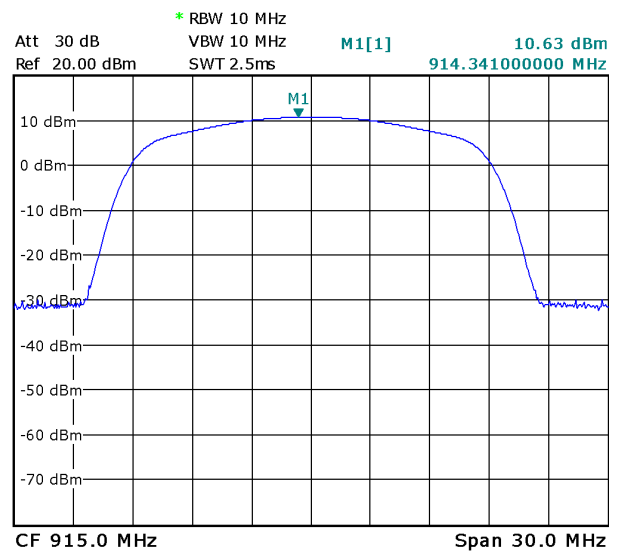
## Modulation GFSK

Channel (No.)	Frequency (MHz)	Measured Output Power (dBm)	Output Power (mW)
Low	903.5	10.80	12.02
Middle	915	10.63	11.56
High	926.3	10.55	11.35

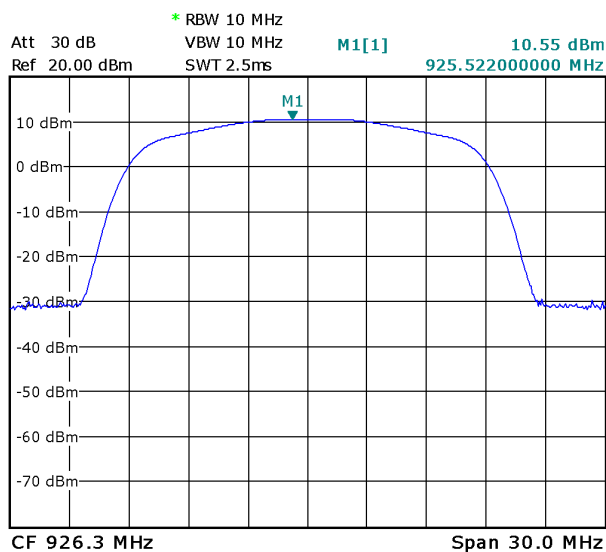
Plot 1



Plot 2



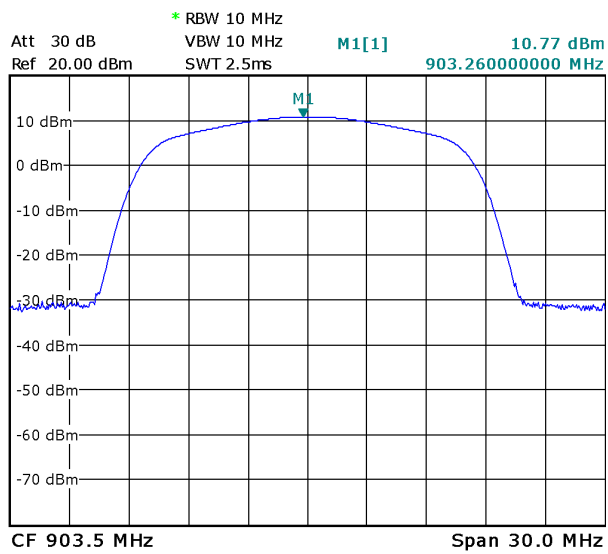
Plot 3



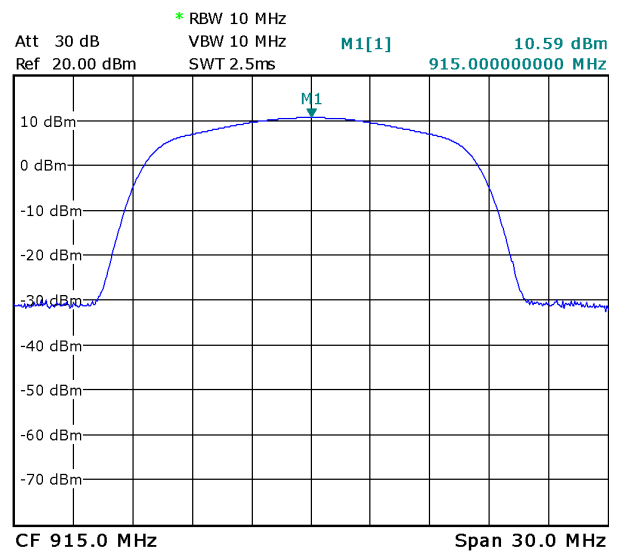
## Modulation MSK

Channel (No.)	Frequency (MHz)	Measured Output Power (dBm)	Output Power (mW)
Low	903.5	10.77	11.94
Middle	915	10.59	11.46
High	926.3	10.48	11.17

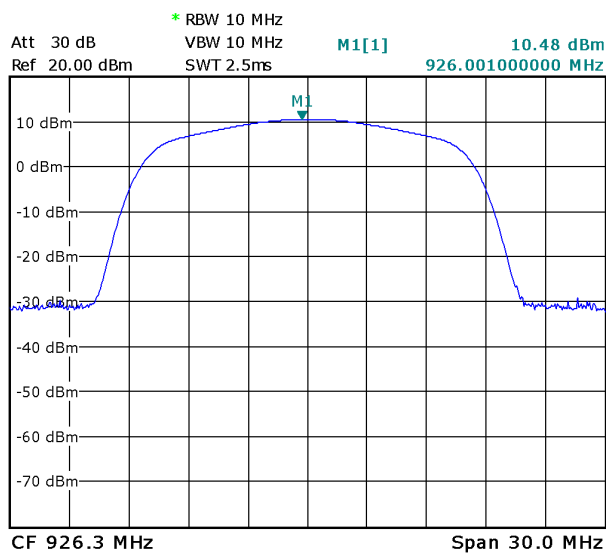
Plot 1



Plot 2



Plot 3

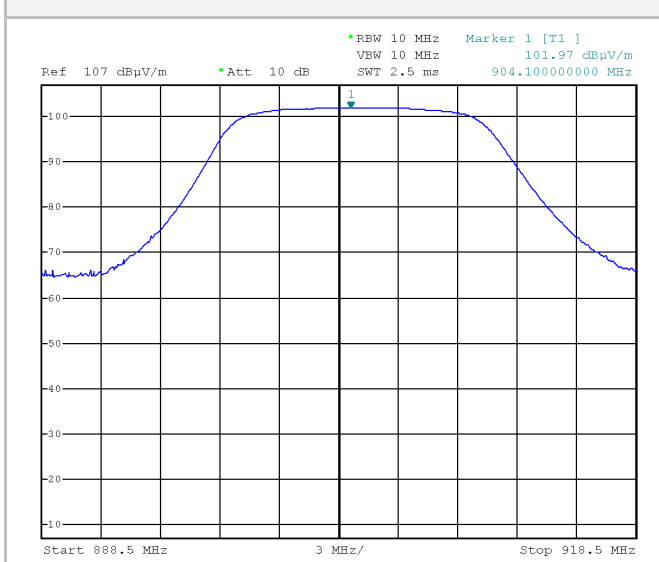


## MEASUREMENTS RESULTS (RADIATED)

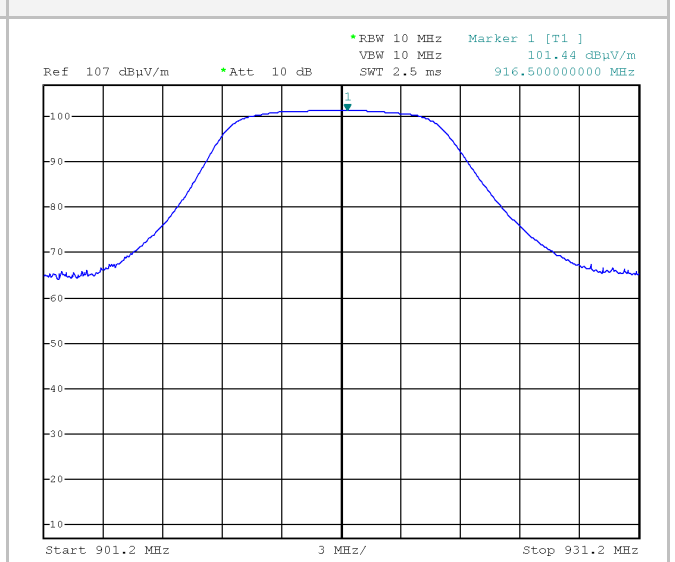
### Modulation 2FSK

Channel (No.)	Frequency (MHz)	Measured Output Power (dB $\mu$ V/m)	Output Power (dBm)	Output Power (mW)
Low	903.5	101.97	6.74	4.72
Middle	915	101.44	6.21	4.18
High	926.3	101.72	6.49	4.46

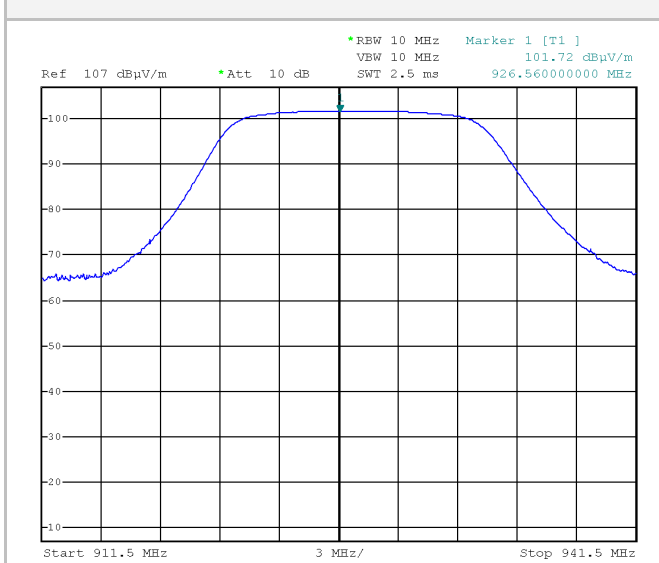
Plot 1



Plot 2



Plot 3

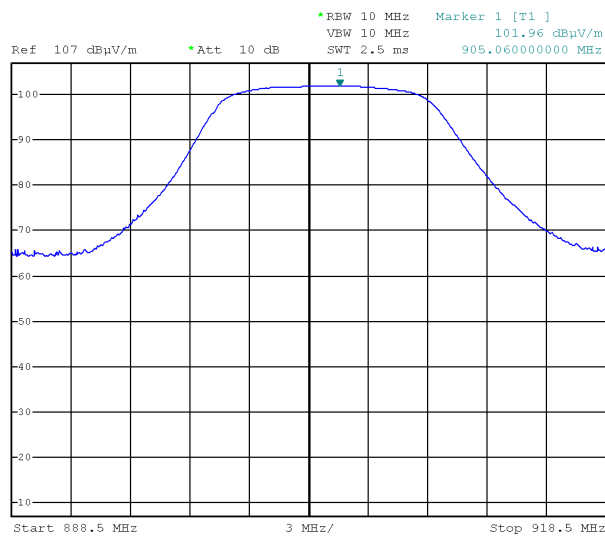




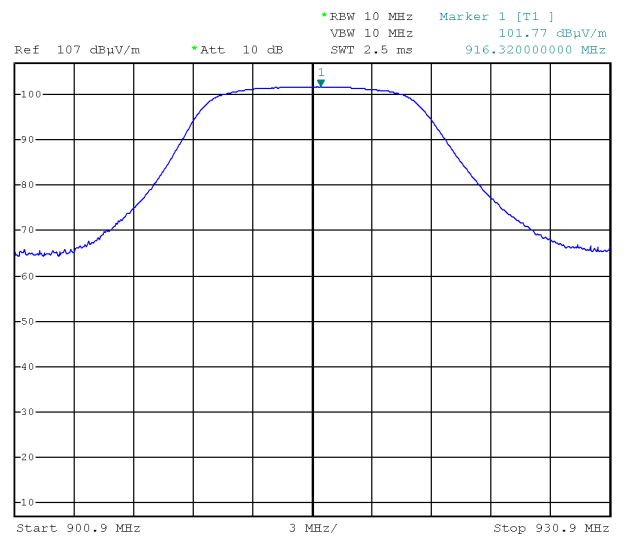
## Modulation GFSK

Channel (No.)	Frequency (MHz)	Measured Output Power (dBµV/m)	Output Power (dBm)	Output Power (mW)
Low	903.5	101.96	6.73	4.71
Middle	915	101.77	6.54	4.51
High	926.3	101.69	6.46	4.43

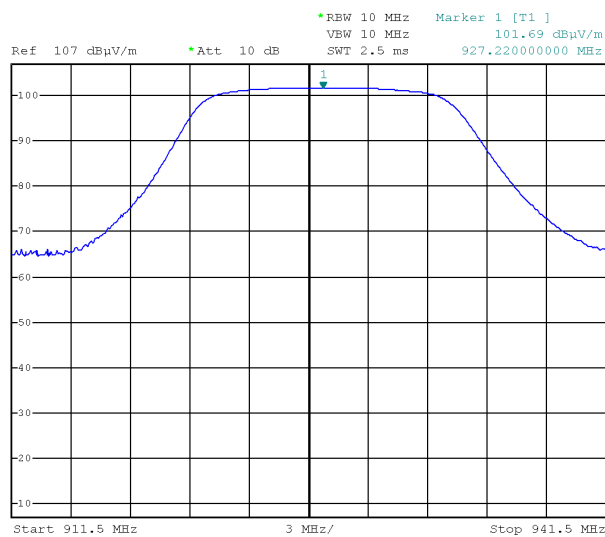
Plot 1



Plot 2



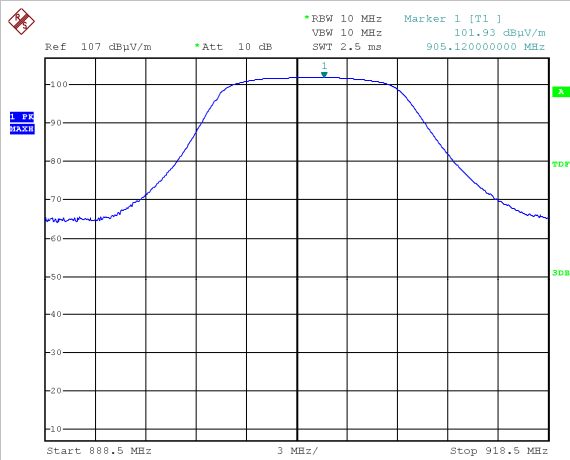
Plot 3



## Modulation MSK

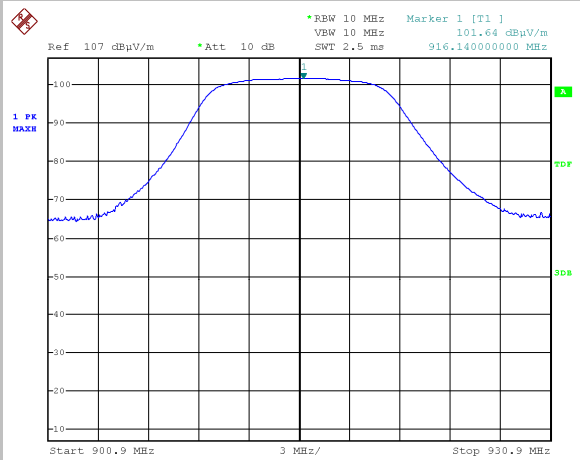
Channel (No.)	Frequency (MHz)	Measured Output Power (dB $\mu$ V/m)	Output Power (dBm)	Output Power (mW)
Low	903.5	101.93	6.70	4.68
Middle	915	101.64	6.41	4.38
High	926.3	101.70	6.47	4.44

Plot 1



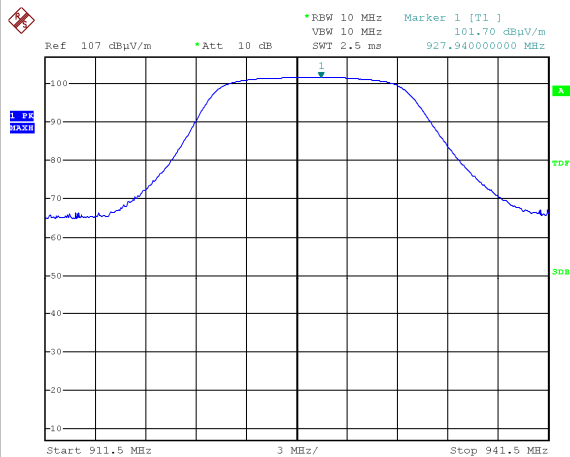
Date: 21.JUL.2016 15:55:48

Plot 2



Date: 21.JUL.2016 14:35:59

Plot 3



Date: 21.JUL.2016 16:13:01

## 7.6 BAND-EDGE COMPLIANCE OF RF RADIATED EMISSIONS

TEST REQUIREMENT	
<b>Spectrum analyzer settings</b>	
Span	Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
Resolution bandwidth (RBW)	1 MHz (100 kHz band-edge)
Video bandwidth (VBW)	1 MHz (100 kHz band-edge)
Sweep time (SWT)	Auto
Detector function	Peak
Trace	Max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None
Testing dates	2016-07-21

### TEST RESULT

The EUT meets the requirements of sections 15.247 (d)  
All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

### LIMITS

-20 dB below peak output power

### TEST PROCEDURE

Only for measuring emissions up to 2 MHz removed from the band-edge the "delta" technique for Radiated emissions was used.

Delta technique: The transmitter output was connected to the spectrum analyser through a test fixture (radio frequency coupling device associated with the dedicated antenna of the equipment under test)

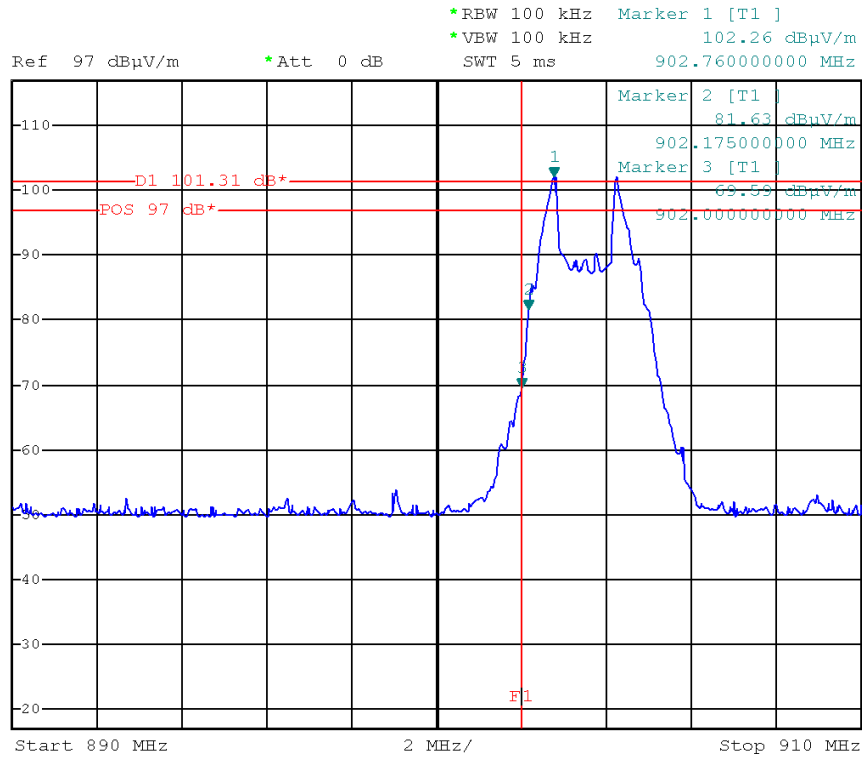
Once the trace is stabilized, by the marker the emission at the band edge (or on the highest modulation product outside of the band, if this level is greater than that at the band edge) was set.

The "n" by the marker-delta function and the marker-to-peak function the peak of the in-band emission was selected. The marker-delta value displayed was compared with the limit specified in this Section

## MEASUREMENTS RESULTS

### Modulation 2FSK

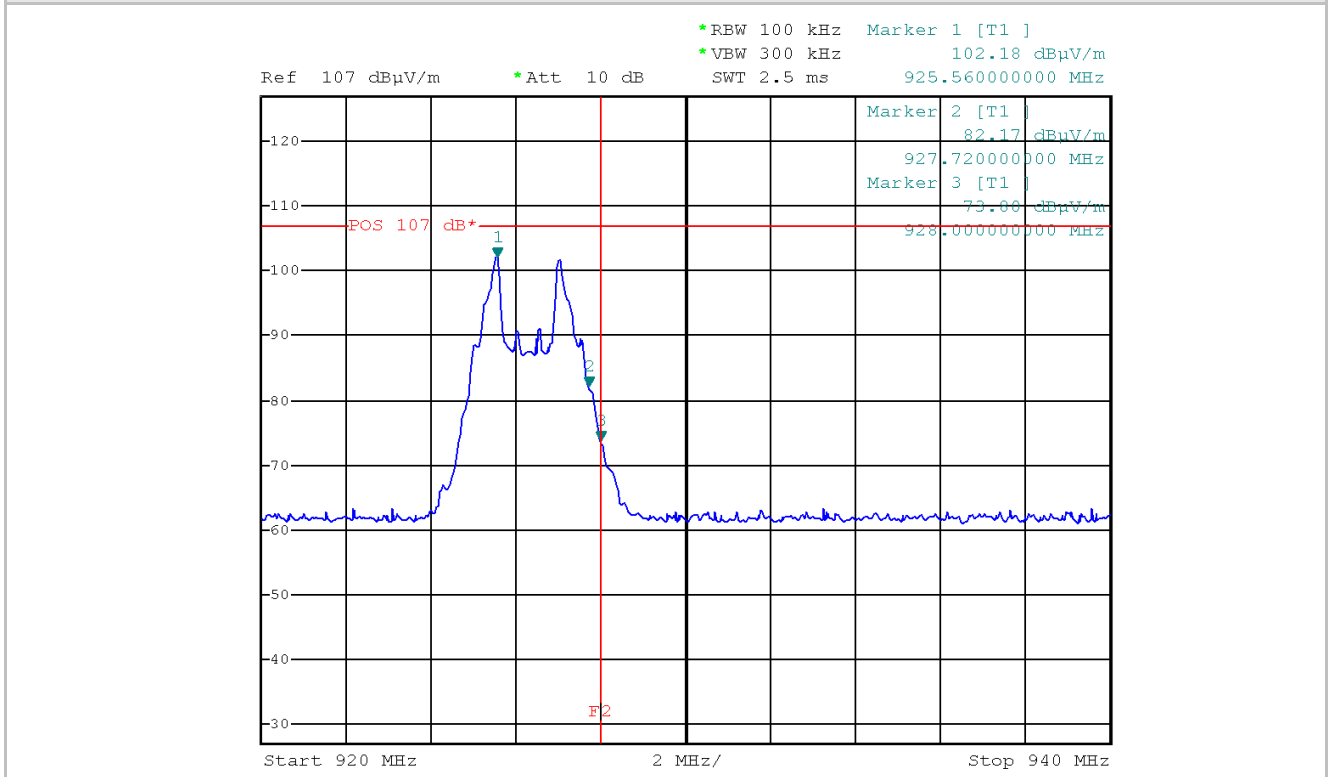
#### Band-edge compliance, lower band edge, (Peak)



Measured power (dBm)	Measured power at the band edge (dBm)	Difference Peak / band edge (dBm)	Peak Limit at PK power -20 dB (dBm)	Margin (dB)
7.03	-26.64	-32.67	-12.97	-19.70

Measured Level (dBμV/m)	Limit (μVolt/meter)	Limit (dBμV/m)	Margin (dB)
69.59	5000	74.00	-4.41

## Band-edge compliance, upper band edge, (Peak)

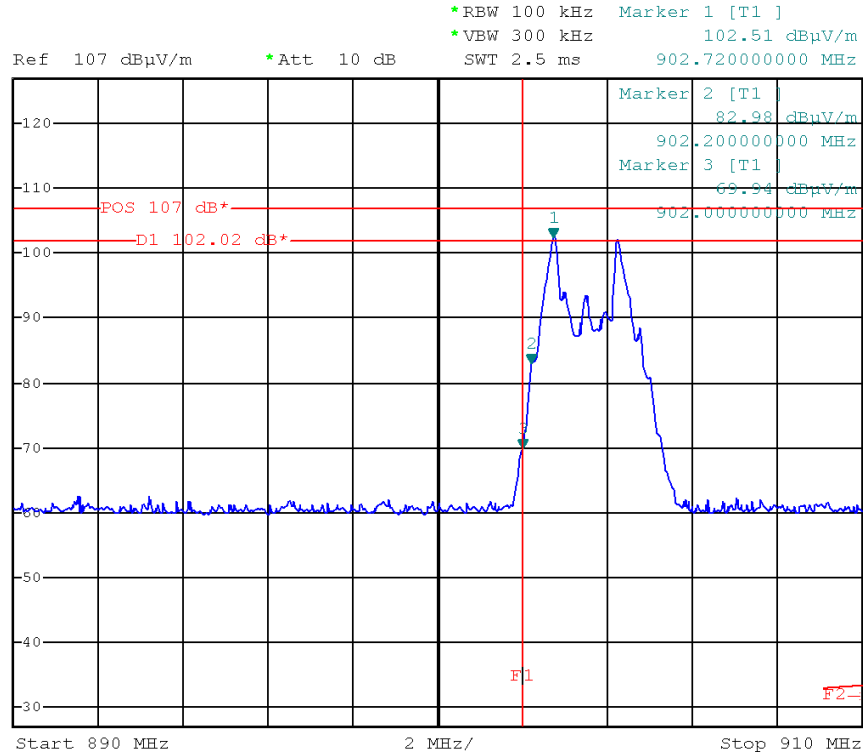


Measured power (dBm)	Measured power at the band edge (dBm)	Difference Peak - band edge (dBm)	Peak Limit at PK power -20 dB (dBm)	Margin (dB)
6.95	-21.43	-28.38	-13.05	-13.33

Measured Level (dBμV/m)	Limit (μVolt/meter)	Limit (dBμV/m)	Margin (dB)
73.80	5000	74.00	-0.2

## Modulation GFSK

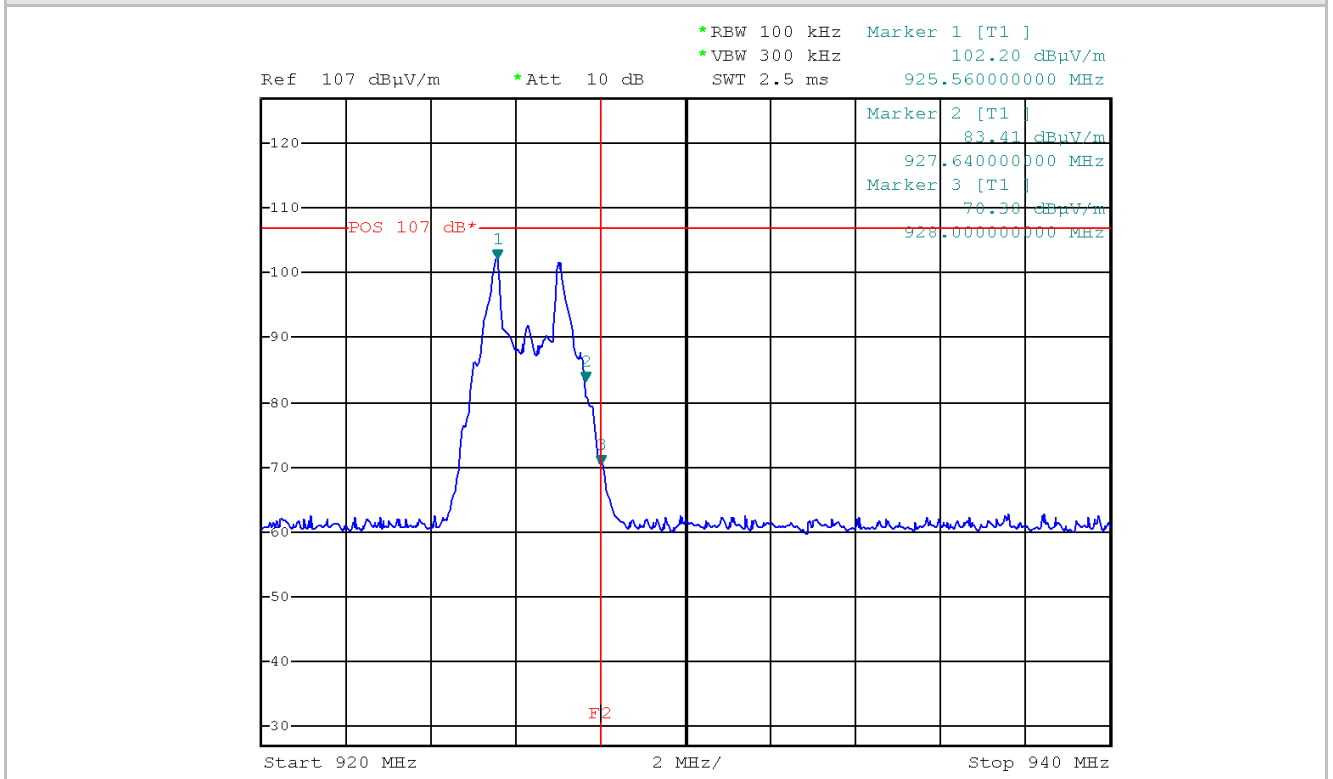
### Band-edge compliance, lower band edge, (Peak)



Measured power (dBm)	Measured power at the band edge (dBm)	Difference Peak – band edge (dBm)	Peak Limit at PK power –20 dB (dBm)	Margin (dB)
7.28	-25.29	-32.57	-12.72	-19.85

Measured Level (dBµV/m)	Limit (µVolt/meter)	Limit (dBµV/m)	Margin (dB)
69.94	5000	74.00	-4.06

## Band-edge compliance, upper band edge, (Peak)

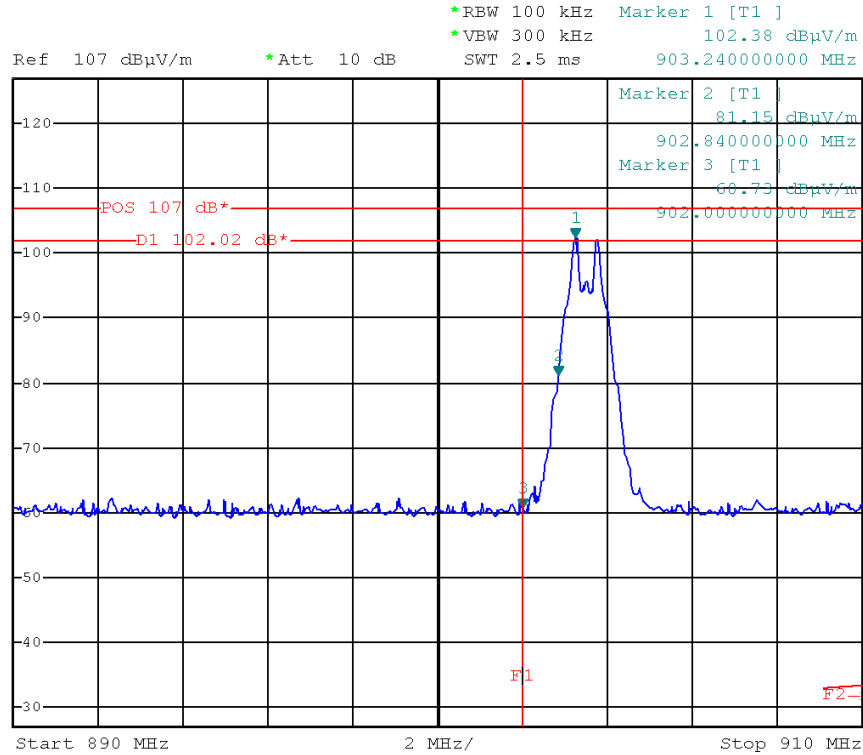


Measured power (dBm)	Measured power at the band edge (dBm)	Difference Peak – band edge (dBm)	Peak Limit at PK power –20 dB (dBm)	Margin (dB)
6.97	-24.85	-31.82	-13.03	-18.79

Measured Level (dBμV/m)	Limit (μVolt/meter)	Limit (dBμV/m)	Margin (dB)
70.38	5000	74.00	-3.62

## Modulation MSK

### Band-edge compliance, lower band edge, (Peak)

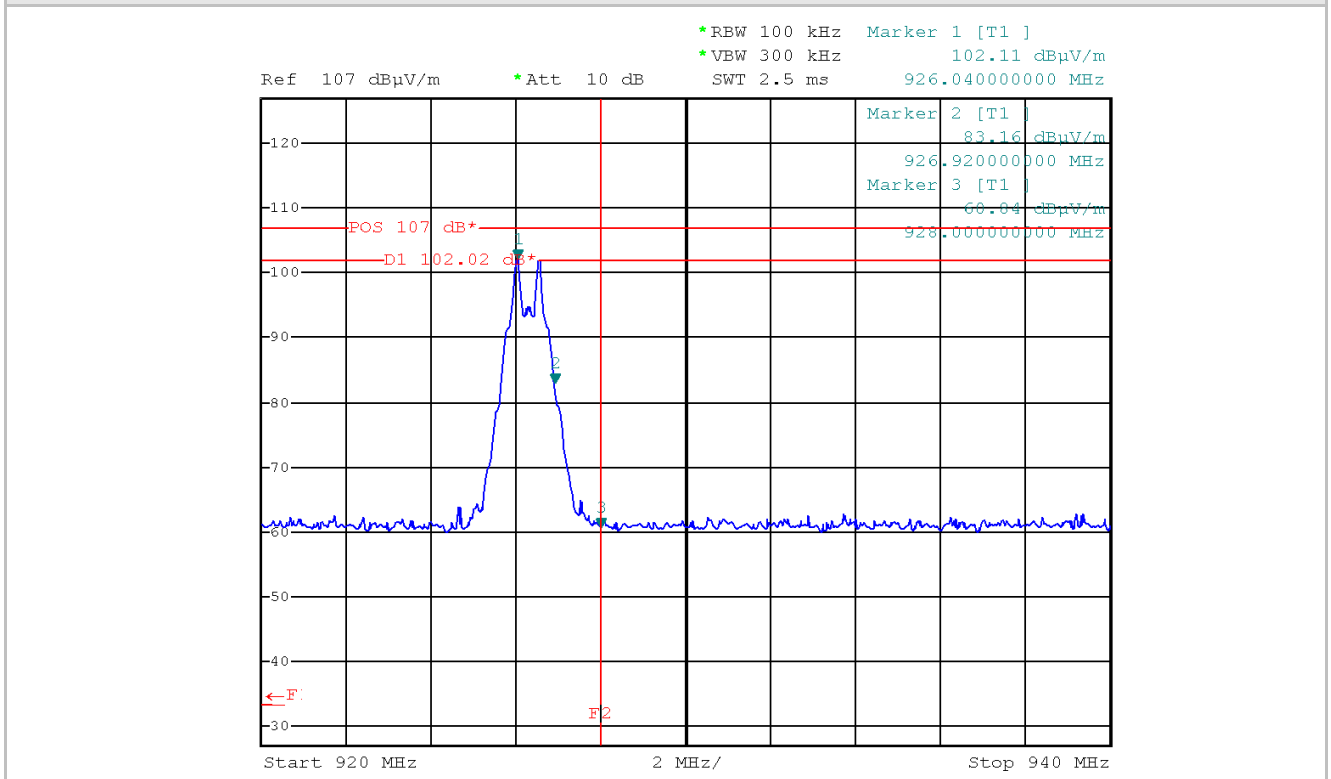


Measured power (dBm)	Measured power at the band edge (dBm)	Difference Peak – band edge (dBm)	Peak Limit at PK power –20 dB (dBm)	Margin (dB)
7.15	-34.50	-41.65	-12.85	-28.80

Measured Level (dBμV/m)	Limit (μVolt/meter)	Limit (dBμV/m)	Margin (dB)
60.73	5000	74.00	-13.27



## Band-edge compliance, upper band edge, (Peak)



Measured power (dBm)	Measured power at the band edge (dBm)	Difference Peak - band edge (dBm)	Peak Limit at PK power -20 dB (dBm)	Margin (dB)
6.88	-34.39	-41.27	-13.12	-28.15

Measured Level (dBμV/m)	Limit (μVolt/meter)	Limit (dBμV/m)	Margin (dB)
60.84	5000	74.00	-13.16

## 7.7 CONDUCTED EMISSIONS OUTSIDE THE BAND

TEST REQUIREMENT	
<b>Spectrum analyzer settings</b>	
Span	/
Resolution bandwidth (RBW)	100 kHz
Video bandwidth (VBW)	300 kHz
Sweep time (SWT)	as necessary to capture the entire dwell time
Detector function	Peak
Trace	Max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None
Testing dates	2016-07-25 ÷ 2016-07-26

TEST RESULT
The EUT meets the requirements of sections 15.247 (d) All out of band spurious emissions are more 20 dB below the in band power of the fundamental.

LIMITS
-20 dB below peak output power

TEST PROCEDURE
The measure has been executed with the lowest transmit channel, the highest transmit channel and one located somewhere in the middle of the band.

## MEASUREMENTS RESULTS

### PEAK RESULT - Worst case reported

Modulation 2FSK				
Frequency (MHz)	Measured Level (dBm)	Limit (dBm) Fundamental value - 20dB	Limit (dBm) Restricted band -33dBm	Margin (dB)
926.3 (fundamental)	10.79	---	---	---
1,853	-36.39	-9.21	---	-27.18
2,779	-34.11	---	-33	-1.11
3,705	-56.53	---	-33	-23.53
4,632	-49.01	---	-33	-16.01
5,558	-56.78	-9.21	---	-47.57
6,484	-45.80	-9.21	---	-36.59
7,410	-62.82	---	-33	-29.82
8,337	-58.86	---	-33	-25.86
9,263	-63.44	-9.21	---	-54.23

Modulation GFSK -				
Frequency (MHz)	Measured Level (dBm)	Limit (dBm) Fundamental value - 20dB	Limit (dBm) Restricted band -33dBm	Margin (dB)
903.5 (fundamental)	10.81	---	---	---
1,807	-36.65	-9.19	---	-27.46
2,711	-34.47	---	-33	-1.47
3,614	-56.56	---	-33	-47.37
4,518	-49.66	---	-33	-16.66
5,421	-56.86	---	-33	-23.86
6,325	-45.59	-9.19	---	-36.40
7,228	-62.65	-9.19	---	-53.46
8,132	-59.01	---	-33	-26.01
9,035	-63.30	---	-33	-30.30

Modulation MSK				
Frequency (MHz)	Measured Level (dBm)	Limit (dBm) Fundamental value - 20dB	Limit (dBm) Restricted band -33dBm	Margin (dB)
926.3 (fundamental)	10.97	---	---	---
1,853	-36.41	-9.03	---	-27.38
2,779	-34.53	---	-33	-1.53
3,705	-61.12	---	-33	-28.12
4,632	-48.78	---	-33	-15.78
5,558	-63.31	-9.03	---	-54.28
6,484	-62.03	-9.03	---	-53.00
7,410	-65.53	---	-33	-32.53
8,337	-57.58	---	-33	-25.58
9,263	-63.39	-9.03	---	-54.36

## 7.8 TRANSMITTER POWER SPECTRAL DENSITY

TEST REQUIREMENT	
<b>Spectrum analyzer settings</b>	
Span	1.5 MHz
Resolution bandwidth (RBW)	3 kHz
Video bandwidth (VBW)	10 kHz
Sweep time (SWT)	500 s
Detector function	Peak
Trace	Max hold
Attenuator	/
Deviation to test procedure	None
EUT operating condition	#1
Remark	None
Testing dates	2016-07-21

TEST RESULT
The EUT meets the requirements of sections 15.247 (e)

LIMITS
8 dBm in 3 kHz bandwidth.

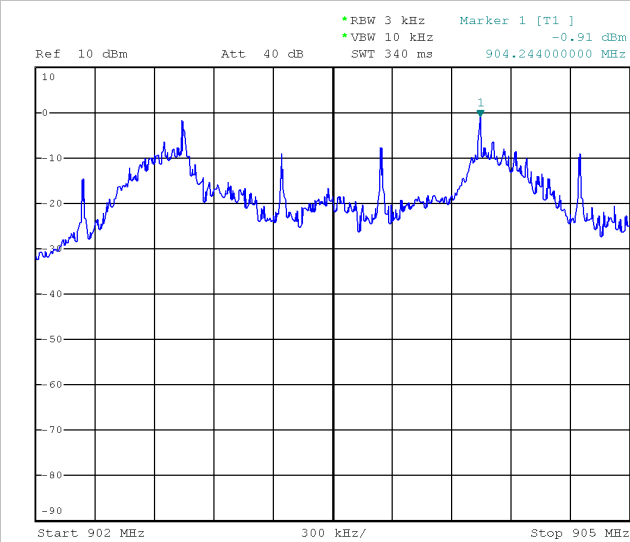
TEST PROCEDURE
After trace stabilisation the marker shall be set on the signal peak. The indicated level is the power spectral density.

## MEASUREMENTS RESULTS

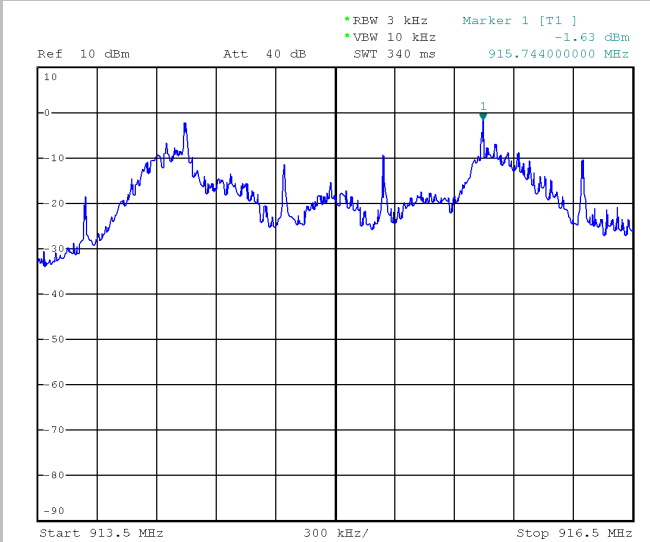
### Modulation 2FSK

Channel (No.)	Frequency (MHz)	Transmitter power on 3 kHz band (dBm)	Plot (No.)
Low	903.5	-0.91	1
Middle	915	-1.63	2
High	926.5	-0.16	3

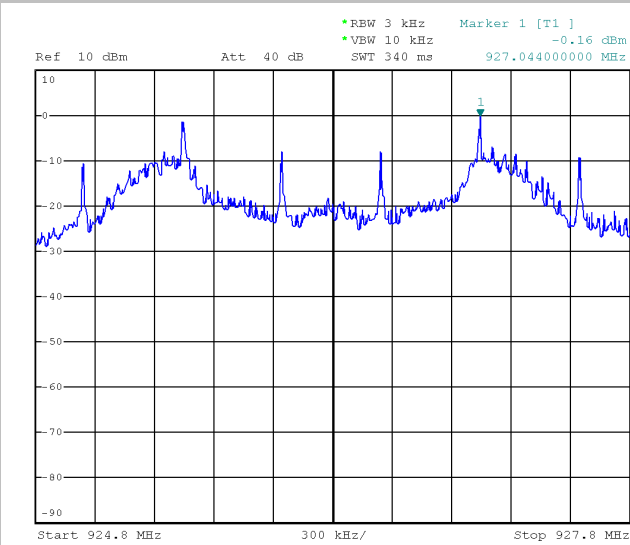
Plot 1



Plot 2



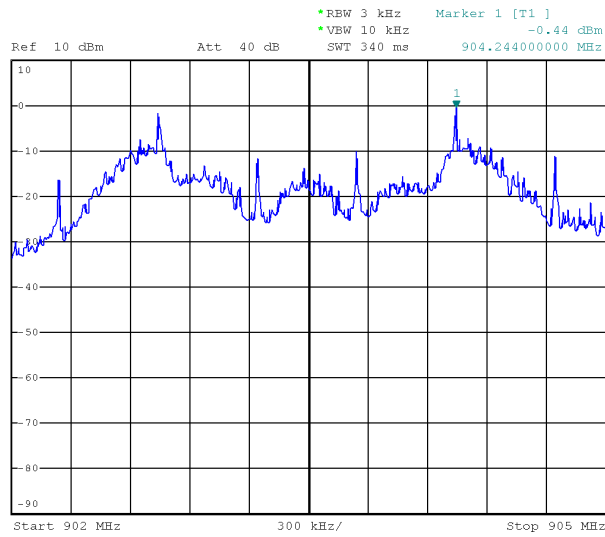
Plot 3



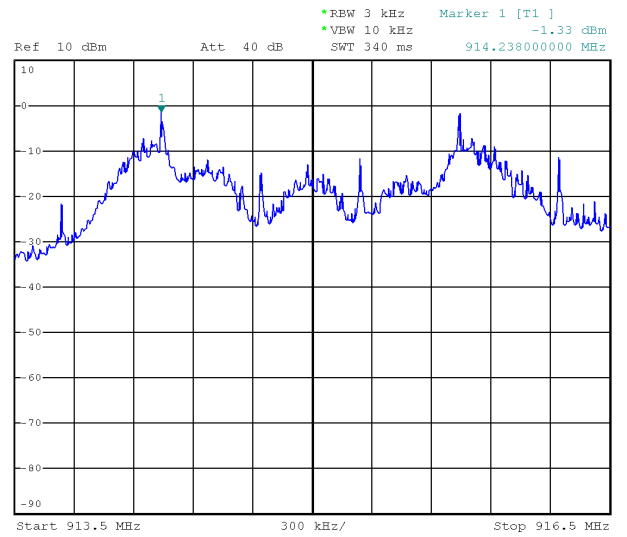
## Modulation GFSK

Channel (No.)	Frequency (MHz)	Transmitter power on 3 kHz band (dBm)	Plot (No.)
Low	903.5	-0.44	1
Middle	915	-1.33	2
High	926.5	0.35	3

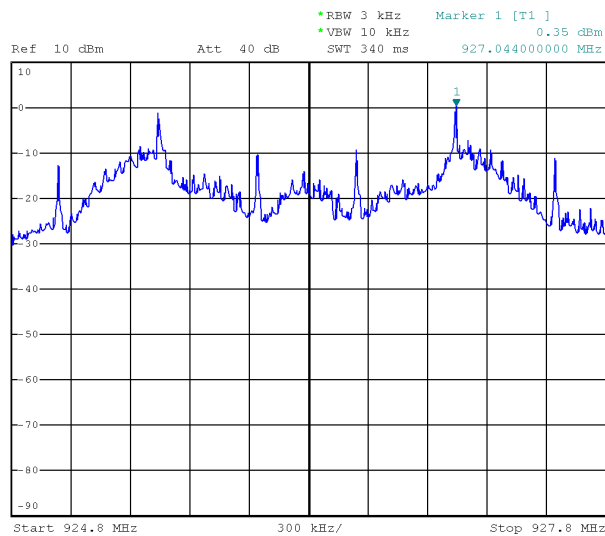
Plot 1



Plot 2



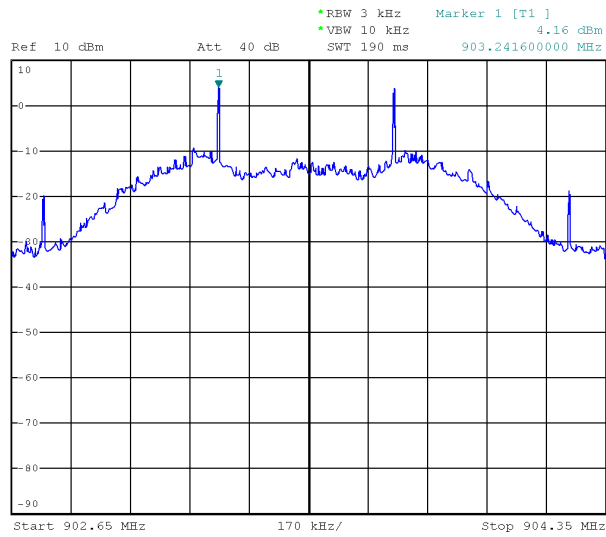
Plot 3



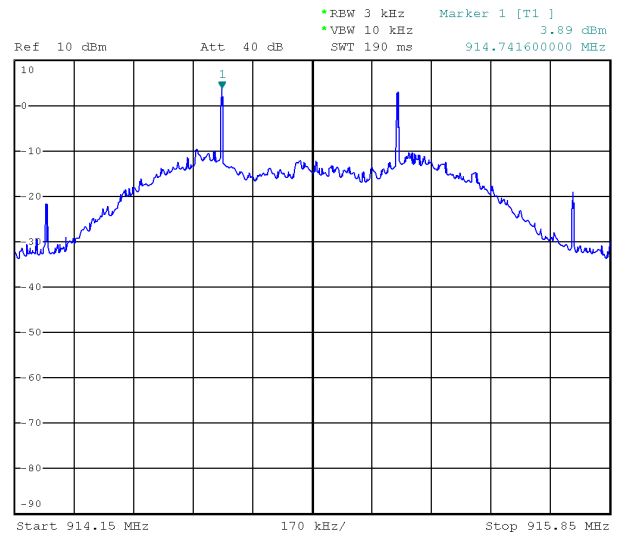
## Modulation MSK

Channel (No.)	Frequency (MHz)	Transmitter power on 3 kHz band (dBm)	Plot (No.)
Low	903.5	4.16	1
Middle	915	3.89	2
High	926.5	4.25	3

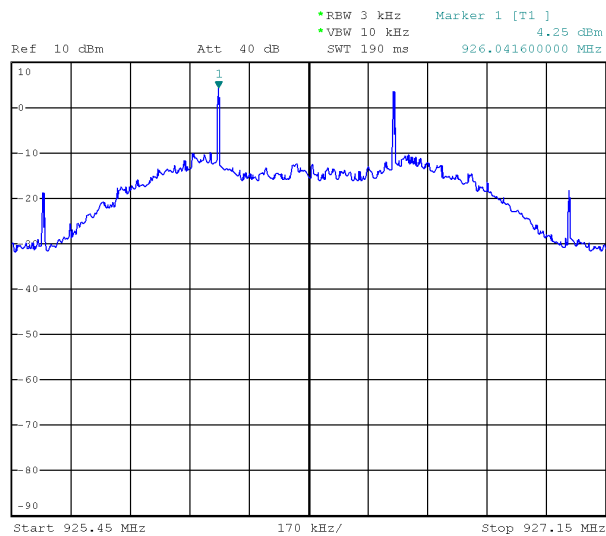
Plot 1



Plot 2



Plot 3





## 7.9 RF EXPOSURE EVALUATION

TEST REQUIREMENT	
Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines § 1.1307(b)(1).	
EUT classification (fixed, mobile or portable devices)	Portable according to § 2.1093(b) of this Chapter
LIMITS	According to § 2.1093 of this Chapter, by means of the following guidelines: OET Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies (447498 D01 General RF Exposure Guidance v06)

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm						
447498 D01 General RF Exposure Guidance v06 – Appendix A						
MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
<b>900</b>	<b>16</b>	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

The test separation distances  $\geq 5$  mm is applied to determine SAR test exclusion.

### SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

447498 D01 General RF Exposure Guidance v06 § 4.3

#### Modulation 2FSK

Channel No.	Frequency (MHz)	Conducted power (dBm)	Conducted power (mW)	Distance (mm)	$\frac{\text{max. power (mW)}}{\text{min. distance (mm)}} \times \sqrt{f(\text{GHz})}$	Limits
Lowest	903.5	11.05	12.74	5	2.421	≤ 3.0 for 1-g head SAR or ≤ 7.5 for 10-g extremity SAR
Middle	915	10.82	12.08	5	2.311	
Highest	926.3	10.64	11.59	5	2.231	

#### Modulation GFSK

Channel No.	Frequency (MHz)	Conducted power (dBm)	Conducted power (mW)	Distance (mm)	$\frac{\text{max. power (mW)}}{\text{min. distance (mm)}} \times \sqrt{f(\text{GHz})}$	Limits
Lowest	903.5	10.80	12.02	5	2.286	≤ 3.0 for 1-g head SAR or ≤ 7.5 for 10-g extremity SAR
Middle	915	10.63	11.56	5	2.212	
Highest	926.3	10.55	11.35	5	2.185	

#### Modulation MSK

Channel No.	Frequency (MHz)	Conducted power (dBm)	Conducted power (mW)	Distance (mm)	$\frac{\text{max. power (mW)}}{\text{min. distance (mm)}} \times \sqrt{f(\text{GHz})}$	Limits
Lowest	903.5	10.77	11.94	5	2.270	≤ 3.0 for 1-g head SAR or ≤ 7.5 for 10-g extremity SAR
Middle	915	10.59	11.46	5	2.191	
Highest	926.3	10.48	11.17	5	2.150	

#### TEST RESULT

This value is less than the low threshold limit. No SAR test is required..

## 8. MEASUREMENTS AND TESTS UNCERTAINTY

Unless otherwise stated the uncertainties for the tests and measurements are evaluated in according to IMQ Operational Instruction IO-LAB-001 and IO-LAB-004. and requirement of NIST Technical Note 1297 and NIS 81: 1994 "The Treatment of Uncertainty in EMC Measurements"

The expanded uncertainty was calculated for all measurements and tests listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainty in EMC Measurements", with UKAS document LAB 34 and is documented in the quality system accordance to ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device

Internal Procedure PI-037 ensures that the requirements for traceability of calibrations, of all test equipment requiring calibration, and calibration intervals are met.

Methods/Standard	Parameter	Expanded Uncertainty	Unit	Confidence level	Coverage Factor	Degree of freedom
Continuous disturbance	QP detector 9 – 150 kHz	2,47	dB	95%	2,00	25
	QP detector 150 k – 30 MHz	2,61	dB	95%	2,00	26
	QP detector using Voltage Probe	2,45	dB	95%	2,00	26
	QP detector using ISN	3,15	dB	95%	2,00	> 60
	QP detector using Current Probe	2,15	dB	95%	2,00	35
Radiated disturbance	QP detector (30 MHz - 100 MHz) H polarization	4,33	dB	95%	2,00	> 60
	QP detector (30 MHz - 100 MHz) V polarization	4,22	dB	95%	2,00	> 60
	QP detector (100 MHz - 200 MHz) H polarization	3,40	dB	95%	2,00	> 60
	QP detector (100 MHz - 200 MHz) V polarization	4,76	dB	95%	2,00	> 60
	QP detector (200 MHz - 1000 MHz) H polarization	3,91	dB	95%	2,00	> 60
	QP detector (200 MHz - 1000 MHz) V polarization	3,82	dB	95%	2,00	> 60
	P detector 1-6 GHz	4,77	dB	95%	2,00	> 60
	P detector 6 – 18 GHz	5,14	dB	95%	2,00	> 60

## 9. LIST OF MEASURING EQUIPMENT AND CALIBRATION INFORMATION

IMQ Serial Number	Instrument	Manufacturer	Type	Last Cal.	Cal. Period.	Calibration Company
P01709	Shielded semi-anechoic chamber	SIDT	/	03-15	24	IMQ
P02486	Turntable controller unit	FRANKONIA	FCTAM01	/	/	/
P02488	Mast antenna	FRANKONIA	FAM4	/	/	/
S03511	Log antenna	ARA	LPB-2520/1	05-15	36	NPL
S03463	Horn Antenna	SCHWARZBECK	BBHA 9120D	12-14	36	NPL
S02508	Loop Antenna	ROHDE & SCHWARZ	HFH2-Z2	01-15	24	SEIBERSDORF
S03629	Spectrum Analyzer	ROHDE & SCHWARZ	FSP40	04-16	12	ROHDE & SCHWARZ
S05562	EMI receiver	ROHDE & SCHWARZ	ESU8	05-15	18	ROHDE & SCHWARZ
S03542	Preamplifier	Hewlett Packard	HP 8449B	04-16	12	IMQ
S04193	Preamplifier	Bonn Elektronik	BLNA 0110-15C35	05-16	24	IMQ
S03631	LISN	ROHDE & SCHWARZ	ENV216	03-16	12	I.N.R.I.M
W-00199/E	Software	ROHDE & SCHWARZ	EMC32 Ver. 6.30	/	/	/
H-00165	PC	/	/	/	/	/

**END OF TEST REPORT**