



<b>Report Reference ID:</b>	400107-8TRFWL
-----------------------------	---------------

<b>Test specification:</b>	<b>Title 47 – Telecommunication</b> Chapter I – Federal Communications Commission Subchapter D – Safety and special radio services Part 90 – Private land mobile services Subpart I – General technical standards
----------------------------	---

<b>Applicant:</b>	TEKO Telecom Srl. Via Meucci, 24/a I-40024 Castel S. Pietro Terme (BO) (Italy)
<b>Apparatus:</b>	Very Very High Power Module Amplifier
<b>Model:</b>	MWHPA20017E-D3
<b>FCC ID:</b>	XM2-WHPA7EN

<b>Testing laboratory:</b>	<b>Nemko Italy Spa</b> Via del Carroccio, 4 20853 Biassono (MB) – Italy Telephone: +39 039 2201201 Facsimile: +39 039 2201221
----------------------------	---

	Name and title	Date
<b>Tested by:</b> (name, function and signature)	 <hr/> P. Barbieri (project handler)	2020-07-14
<b>Reviewed by:</b> (name, function and signature)	 <hr/> R. Giampaglia (verifier)	2020-07-14

*This test report may not be partially reproduced, except with the prior written permission of Nemko Spa*  
*The test report merely corresponds to the tested sample.*  
*The phase of sampling / collection of equipment under test is carried out by the customer.*

**Nemko Spa, 20853 Biassono (MB) - Italy. All rights reserved.**

This publication may be reproduced in whole for non-commercial purposes as long as Nemko Spa is acknowledged as copyright owner and source of the material. Nemko Spa takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context. Nemko Spa accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This test report may not be partially reproduced, except with the prior written permission of Nemko Spa. The test report merely corresponds to the test sample. The phase of sampling / collection of equipment under test is carried out by the customer.

This Test Report, when bearing the Nemko name and logo is only valid when issued by a Nemko laboratory, or by a laboratory having special agreement with Nemko.

## Table of contents

<b>Section 1: Report summary</b>	<b>3</b>
1.1 Test specification	3
1.2 Statement of compliance	3
1.3 Exclusions	3
1.4 Registration number	3
1.5 Test report revision history	3
1.6 Limits of responsibility	3
<b>Section 2: Summary of test results</b>	<b>4</b>
2.1 FCC Part 90, test results	4
<b>Section 3: Equipment under test (EUT) and application details</b>	<b>5</b>
3.1 Applicant details	5
3.2 Modular equipment	5
3.3 Product details	5
3.4 Application purpose	5
3.5 Composite/related equipment	6
3.6 Sample information	6
3.7 EUT technical specifications	6
3.8 Accessories and support equipment	7
3.9 Operation of the EUT during testing	8
3.10 EUT setup diagram	8
<b>Section 4: Engineering considerations</b>	<b>10</b>
4.1 Modifications incorporated in the EUT	10
4.2 Deviations from laboratory tests procedures	10
4.3 Technical judgment	10
<b>Section 5: Test conditions</b>	<b>11</b>
5.1 Deviations from laboratory tests procedures	11
5.2 Test conditions, power source and ambient temperatures	11
5.3 Measurement uncertainty	11
5.4 Test equipment	13
<b>Appendix A: Test results</b>	<b>14</b>
Clause 935210 D05v01 (4.2) AGC threshold	14
Clause 935210 D05v01 (4.3) Out of band rejection	15
Clause 90.209, 90.219(e)(4) Occupied bandwidth	16
Clause 90.205, 90.542(a)(3), 90.219(e)(1) Output power at RF antenna connector	18
Clause 935210 D05v01 (4.6) Noise figure	21
Clause 90.543(e), 90.219(e)(3) Spurious emissions at the antenna terminal	22
Clause 90.543(e), 90.219(e)(3) Spurious emissions radiated	28
Clause 90.543(f) Radiated spurious emissions within 1559–1610 MHz band	38
<b>Appendix B: Block diagrams of test set-ups</b>	<b>41</b>
<b>Appendix C: EUT Photos</b>	<b>42</b>

## Section 1: Report summary

### 1.1 Test specification

<b>Specifications</b>	<b>Part 90 – Private land mobile services</b>
-----------------------	---

### 1.2 Statement of compliance

<b>Compliance</b>	<p>In the configuration tested the EUT was found compliant</p> <p>Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Test method: ANSI C63.26-2015, 662911 D01 Multiple Transmitter Output v02r01, 662911 D02 MIMO with Cross-Polarized Antennas v01</p>
-------------------	--

### 1.3 Exclusions

<b>Exclusions</b>	None
-------------------	------

### 1.4 Registration number

<b>Test site FCC ID number</b>	682159
--------------------------------	--------

### 1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

### 1.6 Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. Nemko Spa authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Nemko Spa accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

## Section 2: Summary of test results

### 2.1 FCC Part 90, test results

Part	Methods	Test description	Verdict
	§ 935210 D05v01r04 (4.2)	AGC threshold	Pass
	§ 935210 D05v01r04 (4.3)	Out of band rejection	Pass
§90.209 §90.219(e)(4)	§ 935210 D05v01r04 (4.4)	Occupied bandwidth	Pass
§90.205 §90.542(a)(3) §90.219(e)(1)	§ 935210 D05v01r04 (4.5)	Output power at RF antenna connector	Pass
§90.219(e)(2)	§ 935210 D05v01r04 (4.6)	Noise Figure	Pass
§90.543(e) §90.219(e)(3)	§ 935210 D05v01r04 (4.7)	Spurious emissions at RF antenna connector	Pass
§90.543(e) §90.219(e)(3)	§ 935210 D05v01r04 (4.9)	Radiated spurious emissions	Pass
§90.543(f) §90.219(e)(3)	§ 935210 D05v01r04 (4.9)	Radiated spurious emissions within 1559-1610 MHz band	Pass
§90.213	§ 935210 D05v01r04 (4.8)	Frequency stability	N/A a)
Notes: a) NOT APPLICABLE: Modulation/frequency conversion circuitry not in use. No frequency change in EUT (input and output have same frequency)			

## Section 3: Equipment under test (EUT) and application details

### 3.1 Applicant details

<b>Applicant complete business name</b>	Name:	Teko Telecom Srl
	Federal Registration Number (FRN):	0018963462
	Grantee code	XM2
<b>Mailing address</b>	Address:	Via Meucci, 24/a
	City:	Castel S. Pietro Terme
	Province/State:	Bologna
	Post code:	40024
	Country:	Italy

### 3.2 Modular equipment

<b>a) Single modular approval</b>	Single modular approval Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<b>b) Limited single modular approval</b>	Limited single modular approval Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>

### 3.3 Product details

<b>FCC ID</b>	Grantee code:	XM2
	Product code:	-WHPA7EN
<b>Equipment class</b>	B9B	
<b>Description of product as it is marketed</b>	Booster	
	Model name/number:	MWHPA20017E-D3
	Serial number:	1021299001

### 3.4 Application purpose

<b>Type of application</b>	<input checked="" type="checkbox"/>	Original certification
	<input type="checkbox"/>	Change in identification of presently authorized equipment
		Original FCC ID: Grant date:
	<input type="checkbox"/>	Class II permissive change or modification of presently authorized equipment

## Section 3: Equipment under test

### 3.5 Composite/related equipment

<b>a) Composite equipment</b>	The EUT is a composite device subject to an additional equipment authorization Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
<b>b) Related equipment</b>	The EUT is part of a system that operates with, or is marketed with, another device that requires an equipment authorization Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<b>c) Related FCC ID</b>	If either of the above is "yes": <input type="checkbox"/> has been granted under the FCC ID(s) listed below: <input checked="" type="checkbox"/> is in the process of being filled under the FCC ID(s) listed below: <input type="checkbox"/> is pending with the FCC ID(s) listed below: <input type="checkbox"/> has a mix of pending and granted statuses under the FCC ID(s) listed below: i FCC ID: XM2-WHPA7EN ii FCC ID:

### 3.6 Sample information

<b>Receipt date:</b>	2020-05-18
<b>Nemko sample ID number:</b>	400107

### 3.7 EUT technical specifications

<b>Operating band:</b>	Down Link: 758–768 MHz, Up Link: 788-798 MHz
<b>Operating frequency:</b>	Wideband
<b>Modulation type:</b>	LTE (QAM and QPSK)
<b>Occupied bandwidth:</b>	LTE: 5 MHz, 10 MHz
<b>Channel spacing:</b>	standard
<b>Emission designator:</b>	LTE: D7W
<b>RF Output</b>	Down Link: 46dBm (40W) Up Link: N.A. (The EUT does not transmit over the air in the up-link direction)
<b>Gain</b>	Down Link: 51dB Up Link: N.A. (The EUT does not transmit over the air in the up-link direction)
<b>Antenna type:</b>	External Antenna is not provided, equipment that has an external 50 $\Omega$ RF connector
<b>Power source:</b>	28-30 Vdc

## Section 3: Equipment under test

### 3.8 Accessories and support equipment

The following information identifies accessories used to exercise the EUT during testing:

No other FCC-ID equipment are used to exercise the EUT during testing

#### Item # 1

Type of equipment:	Power Supply
Brand name:	EA-PS
Model name or number:	8080-60
Serial number:	1421120002
Nemko sample number:	-----
Connection port:	To supply amplifier
Cable length and type:	-----

#### Item # 2

Type of equipment:	Power supply
Brand name:	GWINSTEK
Model name or number:	GPS4303
Serial number:	GER846883
Nemko sample number:	-----
Connection port:	To supply cooling fan of heatsink
Cable length and type:	-----

#### Item # 3

Type of equipment:	Management Module
Brand name:	Teko Telecom
Model name or number:	MSPVRUV0001
Serial number:	100739447
Nemko sample number:	-----
Connection port:	LAN Port, To manage amplifier module
Cable length and type:	-----

#### Item # 4

Type of equipment:	
Brand name:	
Model name or number:	
Serial number:	
Nemko sample number:	
Connection port:	
Cable length and type:	

### 3.9 Operation of the EUT during testing

<b>Details:</b>	In down-link direction, normal working at max gain with max RF power output.
-----------------	--

### 3.10 EUT setup diagram

In this system, Very Very High Power Amplifier is the EUT and it is intended for mounting in Remote Unit and Digital Service Front-End (optical system with Master Unit that includes only management module and optical module, to convert RF signal in optical signal in down link direction and viceversa optical signal in RF signal in up link direction). As described in "Operational description", master unit is connected directly to base station, so the system doesn't use another equipment (under another FCC ID) to exercise the EUT. Signal generator is linked directly to the RF input connector.

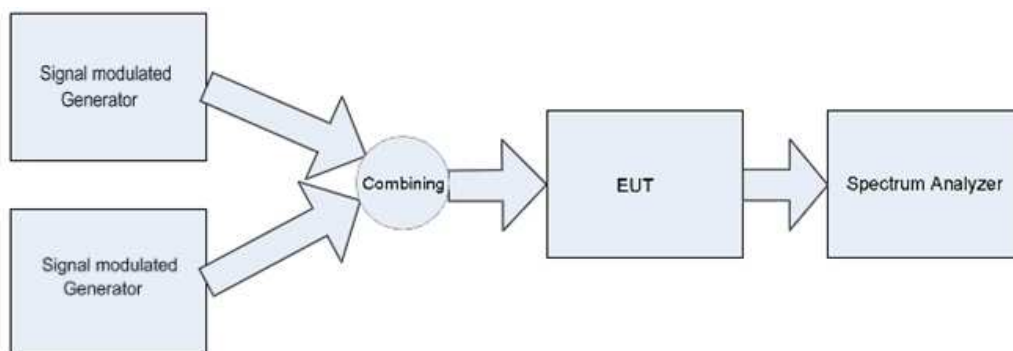
#### Test setup for output power, occupied bandwidth, spurious emissions:



#### Procedure

Connect the signal modulated generator to the input of the EUT, so that the EUT works at the max gain. Raise the input level to the EUT until reach the maximum output power. Connect the spectrum analyzer to the RF output connector of the EUT.

#### Test setup for intermodulation:

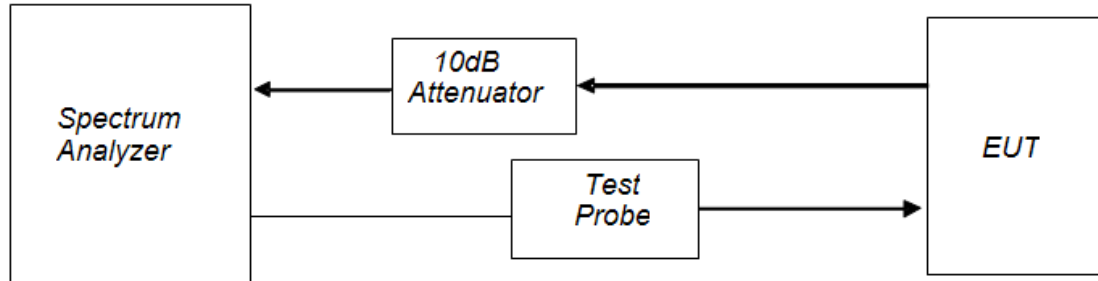


#### Procedure

Connect two signal modulated generators to the input of the EUT, so that the two input signals are same level. The EUT works at the max gain. Raise the input level to the EUT until reach the maximum output power. Connect the spectrum analyzer to the RF output connector of the EUT. At maximum drive level, for each modulation applies two tones for fulfill two tests (high-band edge and low-band-edge)



### Test setup for Noise figure:



### Procedure

Connect the EUT with the spectrum analyzer as described in the picture below.

Connect the "Output Noise Source" spectrum analyzer with the RF input connector of the Power Amplifier by a "Noise Source" (Test probe), so the noise of reference is generated. Connect the output RF connector with the spectrum analyzer. Set the EUT at max gain.

## Section 4: Engineering considerations

### 4.1 Modifications incorporated in the EUT

**Modifications**

Modifications performed to the EUT during this assessment  
None ☒ Yes ☐, performed by Client ☐ or Nemko ☐  
Details:

### 4.2 Deviations from laboratory tests procedures

**Deviations**

Deviations from laboratory test procedures  
None ☒ Yes ☐ - details are listed below:

### 4.3 Technical judgment

**Judgment**

None

## Section 5: Test conditions

### 5.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

### 5.2 Test conditions, power source and ambient temperatures

Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa  When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$ , for which the equipment was designed.

### 5.3 Measurement uncertainty

The measurement uncertainty was calculated for each test and quantity listed in this test report, according to CISPR 16-4-2 and other specific test standard and is documented in Nemko Spa working manual WML1002.

The assessment of conformity for each test performed on the equipment is performed not taking into account the measurement uncertainty. The two following possible verdicts are stated in the report:

P (Pass) - The measured values of the equipment respect the specification limit at the points tested. The specific risk of false accept is up to 50% when the measured result is close to the limit.

F (Fail) - One or more measured values of the equipment do not respect the specification limit at the points tested. The specific risk of false reject is up to 50% when the measured result is close to the limit.

Hereafter Nemko's measurement uncertainties are reported:

## Section 5: Test conditions, continued

EUT	Type	Test	Range	Measurement Uncertainty	Notes
Transmitter	Conducted	Frequency error	0.001 MHz ÷ 40 GHz	0.08 ppm	(1)
		Carrier power RF Output Power	0.009 MHz ÷ 30 MHz	1.1 dB	(1)
			30 MHz ÷ 18 GHz	1.5 dB	(1)
			18 MHz ÷ 40 GHz	3.0 dB	(1)
			40 MHz ÷ 140 GHz	5.0 dB	(1)
		Adjacent channel power	1 MHz ÷ 18 GHz	1.4 dB	(1)
		Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)
		Intermodulation attenuation	1 MHz ÷ 18 GHz	2.2 dB	(1)
		Attack time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Attack time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Release time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Release time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Transient behaviour of the transmitter– Transient frequency behaviour	1 MHz ÷ 18 GHz	0.2 kHz	(1)
		Transient behaviour of the transmitter – Power level slope	1 MHz ÷ 18 GHz	9%	(1)
		Frequency deviation - Maximum permissible frequency deviation	0.001 MHz ÷ 18 GHz	1.3%	(1)
		Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz	0.001 MHz ÷ 18 GHz	0.5 dB	(1)
		Dwell time	-	3%	(1)
		Hopping Frequency Separation	0.01 MHz ÷ 18 GHz	1%	(1)
		Occupied Channel Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
		Modulation Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
Receiver	Radiated	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Effective radiated power transmitter	10 kHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
	Radiated	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Sensitivity measurement	1 MHz ÷ 18 GHz	6.0 dB	(1)
Receiver	Conducted	Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)

## NOTES:

(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2$ , which for a normal distribution corresponds to a coverage probability of approximately 95 %

## Section 5: Test conditions, continued

## 5.4 Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Keysight	N5172B EXG	MY53051238	2021-05
Vector Signal Generator	Keysight	N5172B EXG	MY56200267	2022-12
Spectrum Analyzer	Agilent	N9030A PXA	MY53120882	2020-12
Trilog Antenna (25 ÷ 8000 MHz)	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2021-07
Antenna (1 ÷ 18 GHz)	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2021-09
Double ridge horn antenna (4 ÷ 40 GHz)	RFSpin	DRH40	061106A40	2023-04
Broadband preamplifier (18 ÷ 40 GHz)	Miteq	JS44-18004000-35-8P-R	1.627	2021-07
Broadband preamplifier (1 ÷ 18 GHz)	Schwarzbeck	BBV 9718	9718-137	2021-07
EMI receiver (2 Hz ÷ 44 GHz)	R&S	ESW44	101620	2020-08
Controller	Maturo	FCU3.0	10041	NCR
Tilt antenna mast	Maturo	TAM4.0-E	10042	NCR
Turntable	Maturo	TT4.0-5T	2.527	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	2021-09
Shielded room	Siemens	10m control room	1947	NCR

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use

## Appendix A: Test results

### Clause 935210 D05v01 (4.2) AGC threshold

Measure of EUT AGC Threshold.

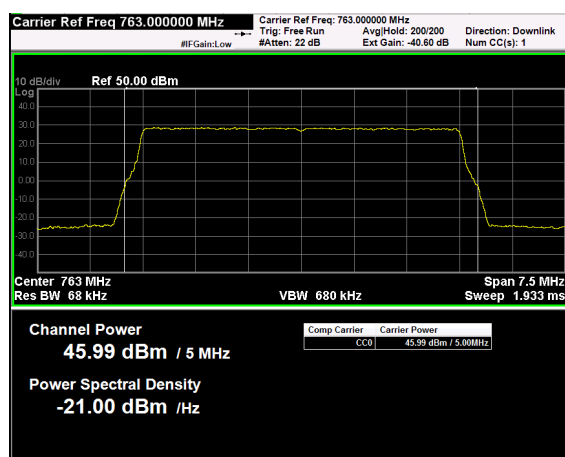
Test date: 2020-05-18 to 2020-06-05

Test results: Pass

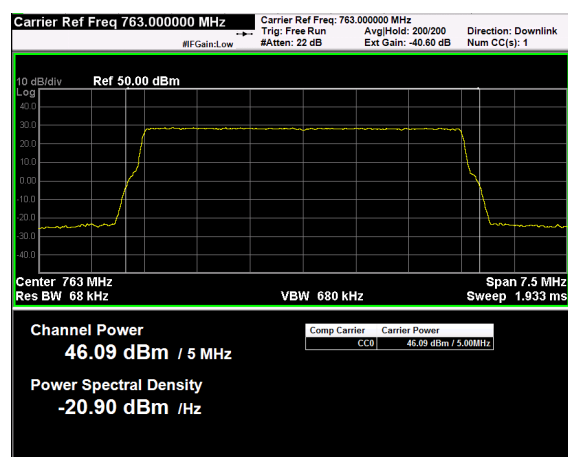
### Special notes

- AWGN test signal used (5 MHz LTE channel)

### Test data



AWGN signal, nominal input signal



AWGN signal, nominal input signal + 1dB

## Clause 935210 D05v01 (4.3) Out of band rejection

Out of Band Rejection – Test for rejection of out of band signals.

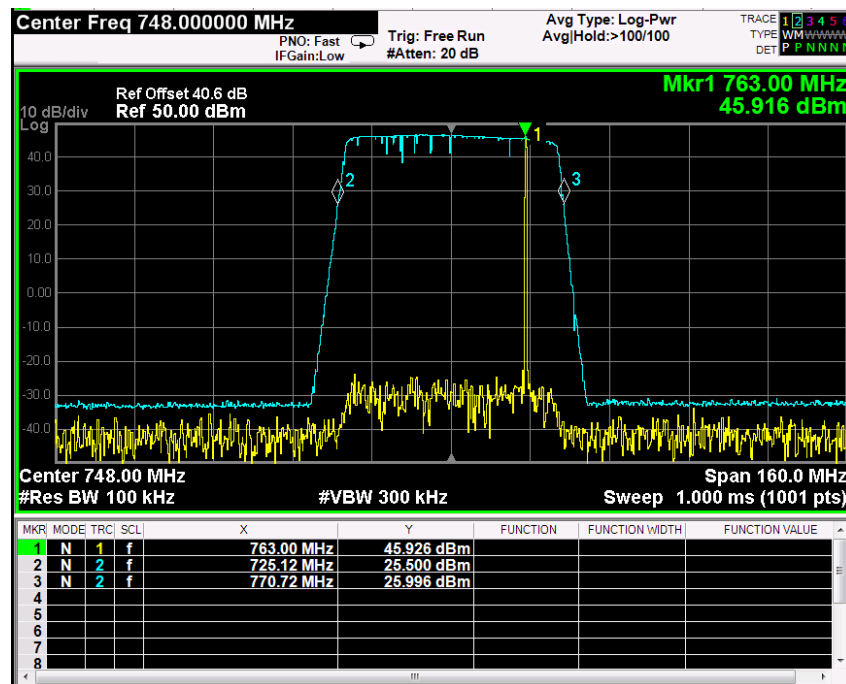
Test date: 2020-05-18 to 2020-06-05

Test results: Pass

### Special notes

–

### Test data



**Clause 90.209, 90.219(e)(4) Occupied bandwidth****§ 90.219(e)(4)**

A signal booster must be designed such that all signals that it retransmits meet the following requirements:

(i) The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed, *provided that* the retransmitted signals meet the requirements of § 90.213.

(ii) There is no change in the occupied bandwidth of the retransmitted signals.

(iii) The retransmitted signals continue to meet the unwanted emissions limits of § 90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).

Test date: 2020-05-18 to 2020-06-05

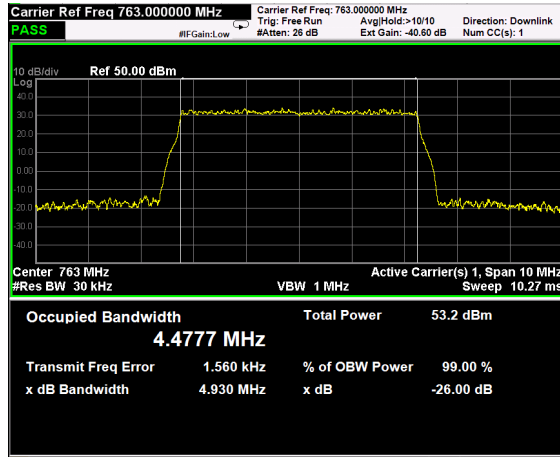
**Test results: Pass**

**Special notes**

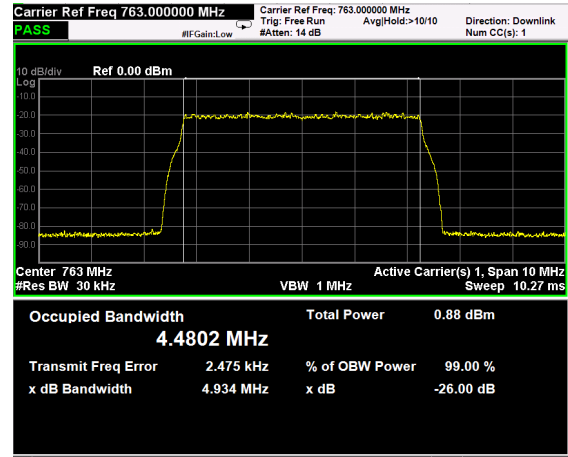
- AWGN test signal used (5 MHz LTE channel)



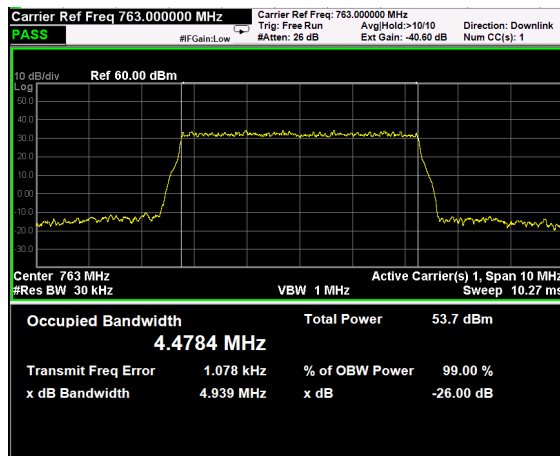
## Test data



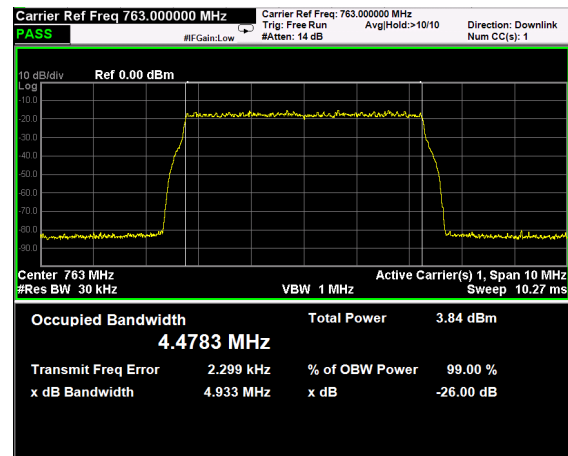
AWGN Signal, Nominal Input Signal, Output



AWGN Signal, Nominal Input Signal, Input



AWGN Signal, Nominal Input Signal +3dB, Output



AWGN Signal, Nominal Input Signal +3dB, Input

## Clause 90.205, 90.542(a)(3), 90.219(e)(1) Output power at RF antenna connector

### § 90.205

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized to applicants whose license applications for new stations are filed after August 18, 1995 is as follows in FCC Part 90.205 (a) through (r).

### § 90.542(a)(3)

(a) The following power limits apply to the 758-768/788-798 MHz band:

(3) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

### § 90.219(e)(1)

The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

Test date: 2020-05-18 to 2020-06-05

Test results: Pass

### Special notes

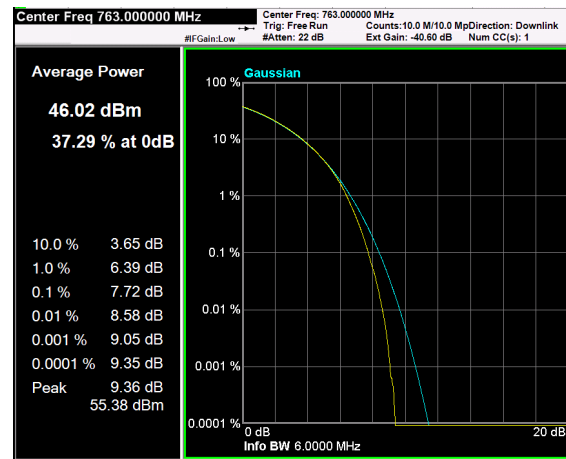
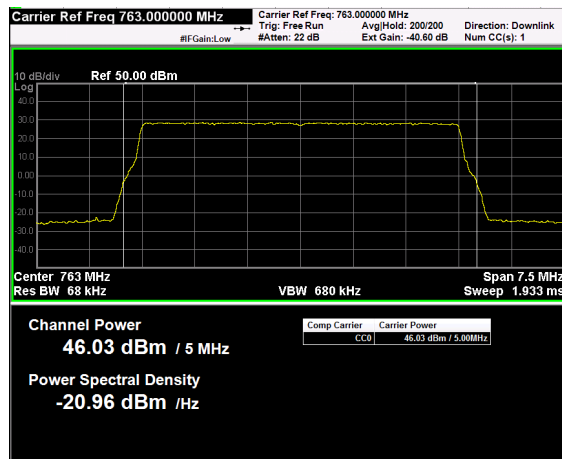
- AWGN test signal used (5 MHz LTE channel)

## Test data

### AWGN signal, nominal input signal

## Test data

Direction	Modulation	Frequency (MHz)	RF output Power (dBm)	RF output channel Power (W)	RF output Power (W/MHz)	PAR (dB)
Down-link	AWGN (LTE, 5MHz)	763.0	46.0	40.00	8.00	9.4



PAR measure is performed by the “CCDF” function installed on Spectrum analyzer that provides average power (the same measured with “Channel power” function), peak power and PAR.

## Test result

In a DAS system, we suppose a loss due to cable insertion, splitter, etc... about of 15dB.

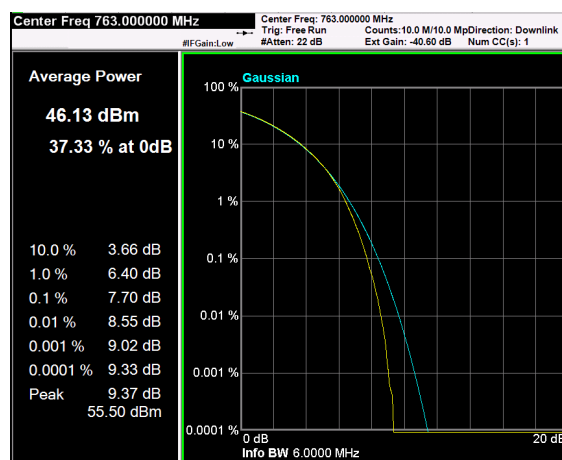
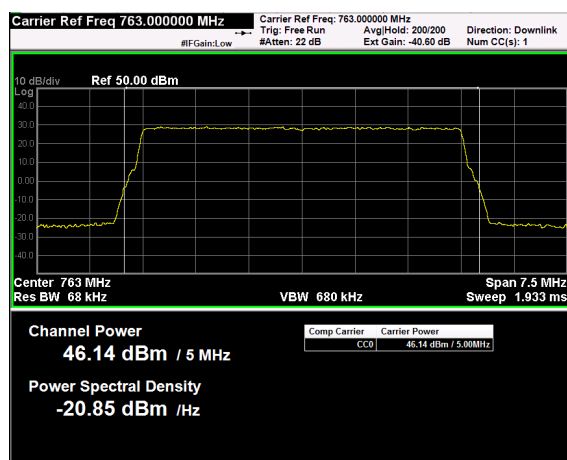
Gmax antenna gain (dBi) = 39 – 46 + 15 = 8 dBi

EIRP = Pout – insertion loss + Gmax antenna gain (dBi) = 46 – 15 + 8 = 39dbm

ERP = 39 – 2.14 = 36.86dBm = 4.85W < 5 W ERP

## AWGN signal, nominal input signal + 3dB

Test data						
Direction	Modulation	Frequency (MHz)	RF output Power (dBm)	RF output channel Power (W)	RF output Power (W/MHz)	PAR (dB)
Down-link	AWGN (LTE, 5MHz)	763.0	46.1	41.1	8.23	9.4



PAR measure is performed by the “CCDF” function installed on Spectrum analyzer that provides average power (the same measured with “Channel power” function), peak power and PAR.

## Clause 935210 D05v01 (4.6) Noise figure

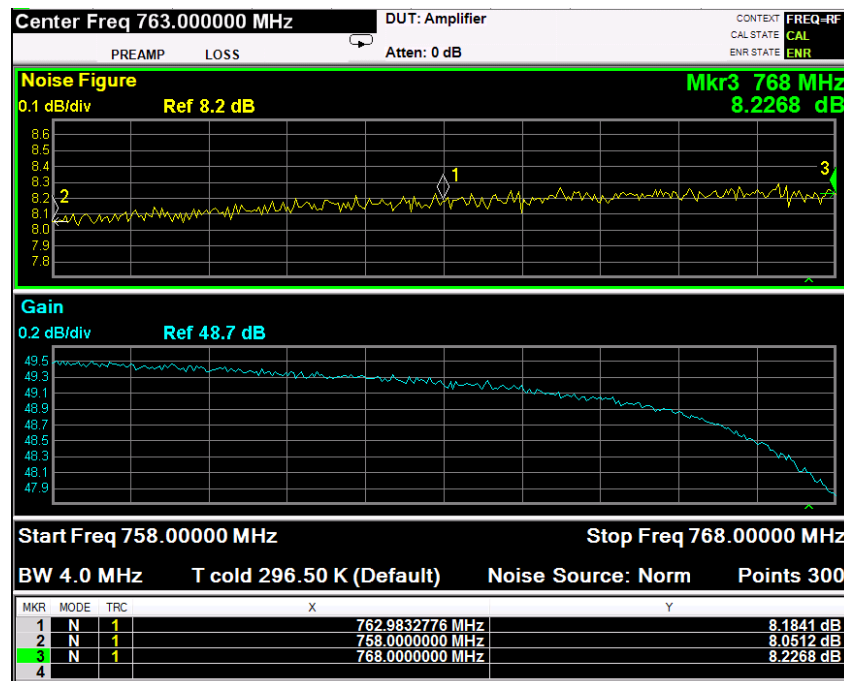
### § 90.219(e)(2)

The noise figure of a signal booster must not exceed 9 dB in either direction.

Test date: 2020-05-18 to 2020-06-05

Test results: Pass

### Special notes



## Clause 90.543(e), 90.219(e)(3) Spurious emissions at the antenna terminal

### § 90.543(e)

For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than  $76 + 10 \log (P)$  dB in a 6.25 kHz band segment, for base and fixed stations.
- (2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than  $65 + 10 \log (P)$  dB in a 6.25 kHz band segment, for mobile and portable stations.
- (3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least  $43 + 10 \log (P)$  dB.
- (4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.
- (5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

### § 90.219(e)(3)

Spurious emissions from a signal booster must not exceed  $-13\text{dBm}$  within any 100 kHz measurement bandwidth.

Test date: 2020-05-18 to 2020-06-05

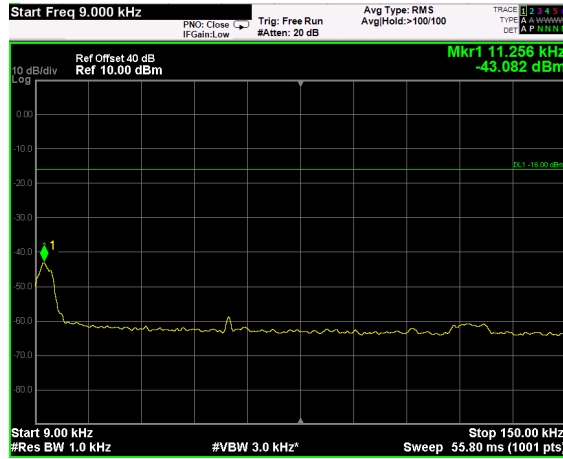
Test results: Pass

### Special notes

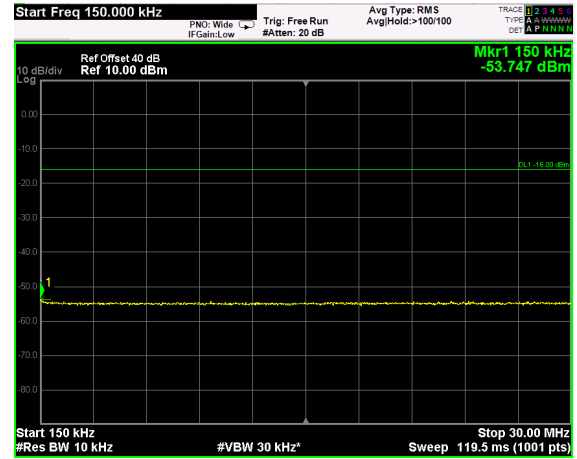
- AWGN test signal used (5 MHz LTE channel)

Test data			
See Plots below			
Spurious emissions measurement results:			
Frequency (MHz)	Spurious emission (dBm)	Limit (dBm)	Margin (dB)
First channel	Negligible	-13	
Mid channel	Negligible	-13	
Last channel	Negligible	-13	
MIMO consideration			
<p>In the final Remote Unit, the EUT could be used in MIMO configuration according to KDB 662911-D01 v02r01 and 662911-D02 v01 with signals completely uncorrelated. So, the maximum emission is calculated as follows:</p> <ul style="list-style-type: none"> <li>MIMO Maximum Emission = Emission at each path + <math>10\log(N_{ant})</math> dB = = Emission at each path + <math>10\log(2)</math> = Emission at each path + 3dB</li> <li>Spurious emission limit is -16dBm.</li> </ul>			

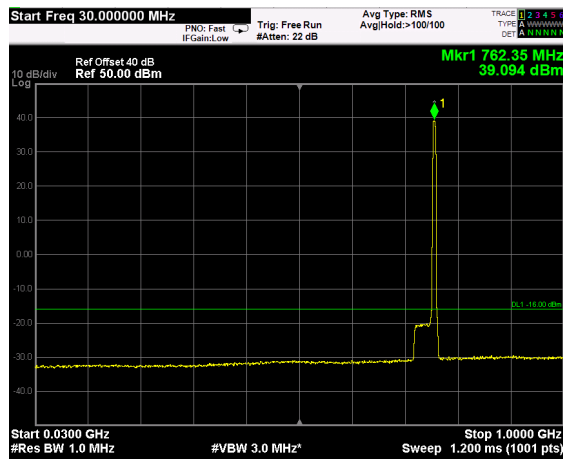
## Test data, continued: spurious emissions at antenna terminal



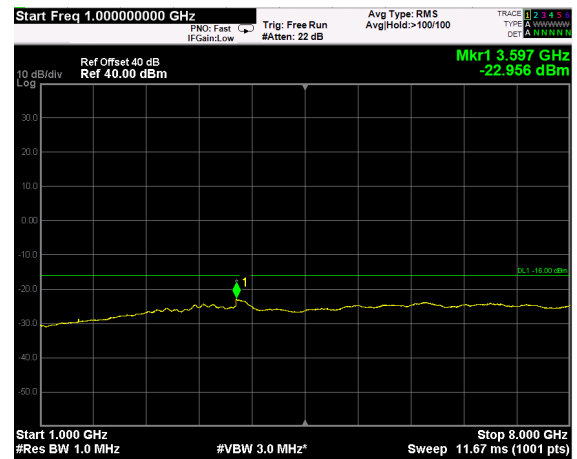
AWGN SIGNAL, 9kHz-150kHz



AWGN SIGNAL, 150kHz-30MHz



AWGN SIGNAL, 30MHz-1GHz



AWGN SIGNAL, 1GHz-8GHz



Test data, continued: Spurious emissions at antenna terminal, band 769-775MHz and 799-805MHz

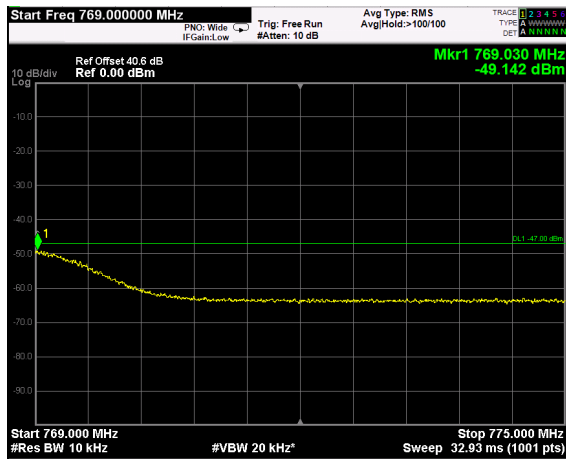
### Special notes

On all frequencies between 769–775 MHz and 799–805 MHz, by a factor not less than  $76 + 10 \log (P)$  dB in a 6.25 kHz band segment, for base and fixed stations

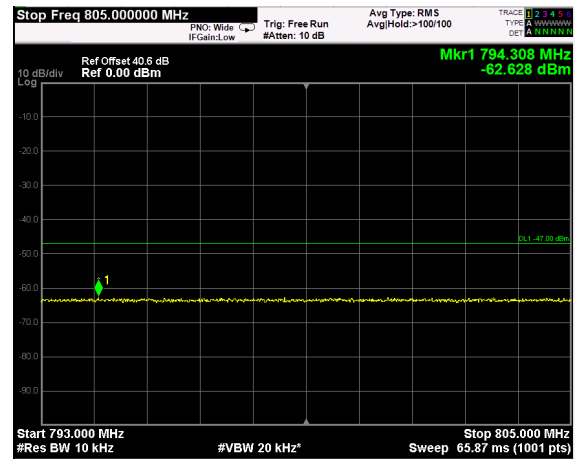
$$76 + 10 \log P (W) = 76 + 10 \log 2W = 79$$

$$P (W) = 2W = 33 \text{ dBm}$$

$$\rightarrow \text{limit: } 33 - 79 = -46 \text{ dBm/6,25kHz} = -44\text{dBm/10kHz}$$

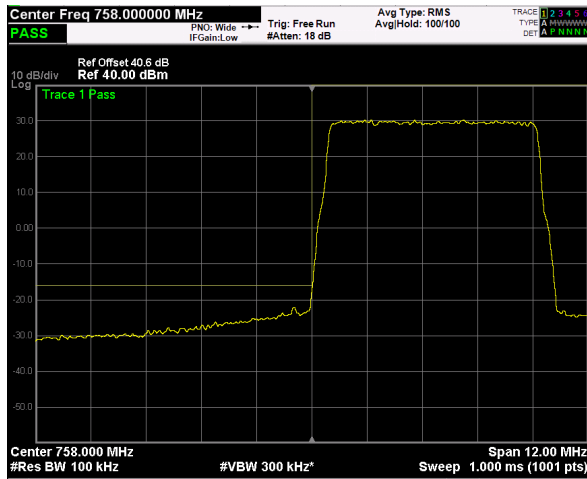


769MHz-775MHz

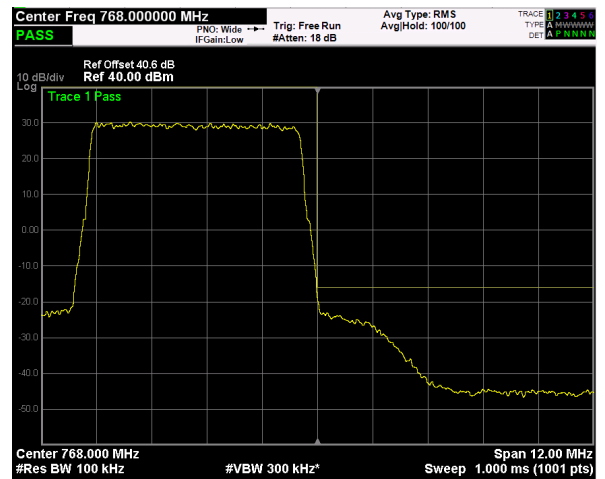


793MHz-805MHz

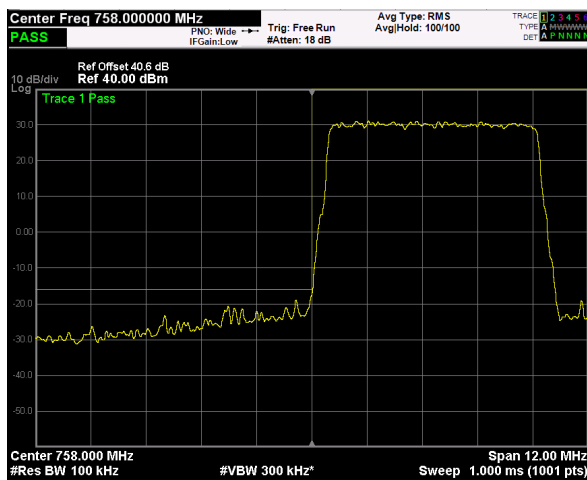
## Test data, continued: band edges intermodulation



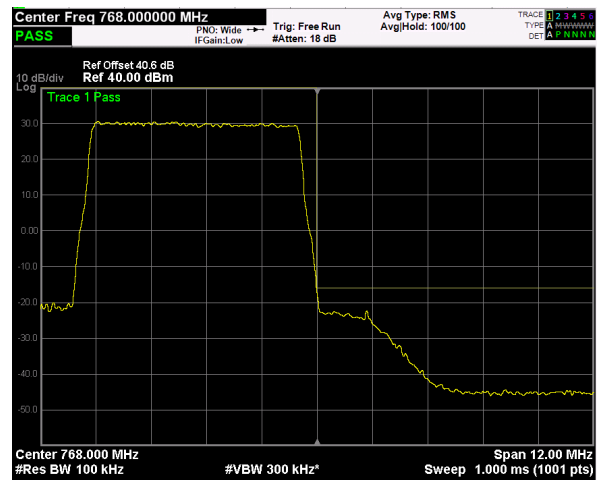
AWGN Signal, Nominal Input Signal,  
Low Band Edge, 1 Carrier



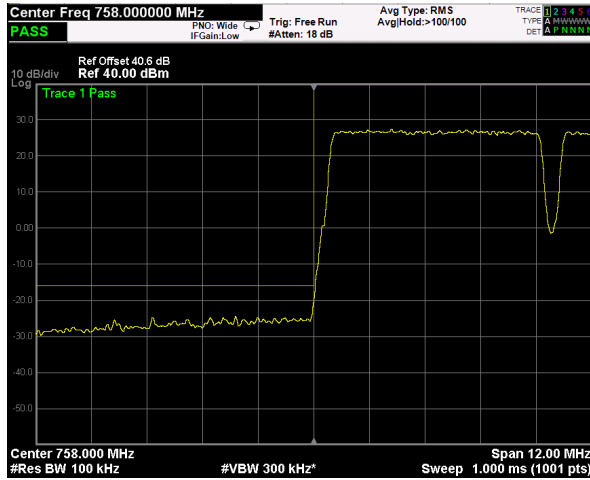
AWGN Signal, Nominal Input Signal,  
High Band Edge, 1 Carrier



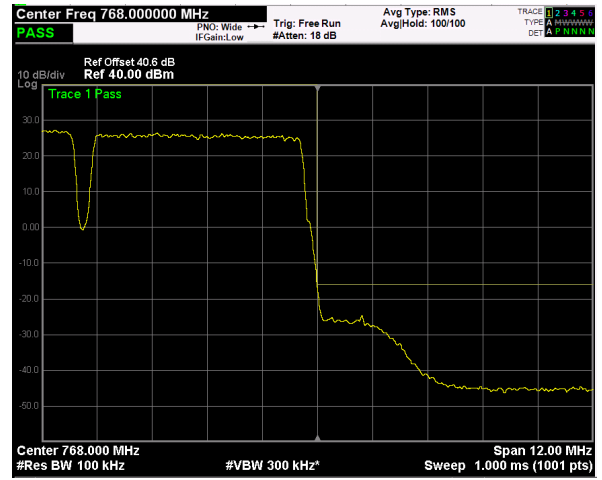
AWGN Signal, Nominal Input Signal +3dB,  
Low Band Edge, 1 Carrier



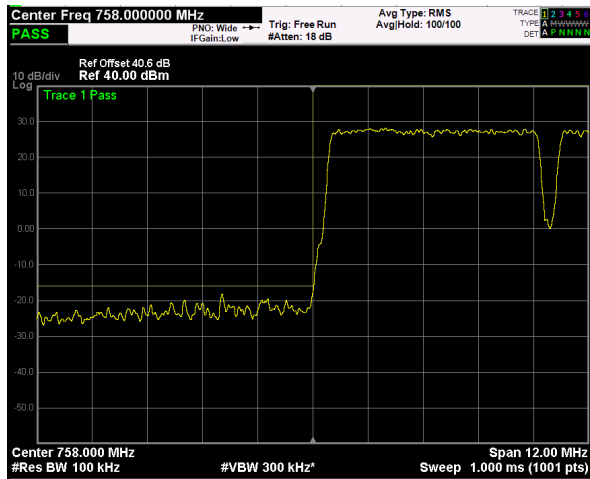
AWGN Signal, Nominal Input Signal +3dB,  
High Band Edge, 1 Carrier



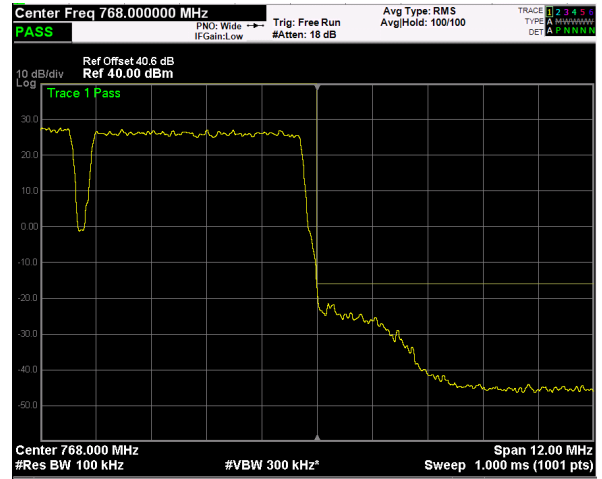
AWGN Signal, Nominal Input Signal,  
Low Band Edge, 2 Carrier



AWGN Signal, Nominal Input Signal,  
High Band Edge, 2 Carrier



AWGN Signal, Nominal Input Signal +3dB,  
Low Band Edge, 2 Carrier



AWGN Signal, Nominal Input Signal +3dB,  
High Band Edge, 2 Carrier

## Clause 90.543(e), 90.219(e)(3) Spurious emissions radiated

### § 90.543(e)

For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than  $76 + 10 \log (P)$  dB in a 6.25 kHz band segment, for base and fixed stations.
- (2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than  $65 + 10 \log (P)$  dB in a 6.25 kHz band segment, for mobile and portable stations.
- (3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least  $43 + 10 \log (P)$  dB.
- (4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.
- (5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

### § 90.219(e)(3)

Spurious emissions from a signal booster must not exceed  $-13\text{dBm}$  within any 100 kHz measurement bandwidth.

Test date: 2020-07-14

Test results: Pass

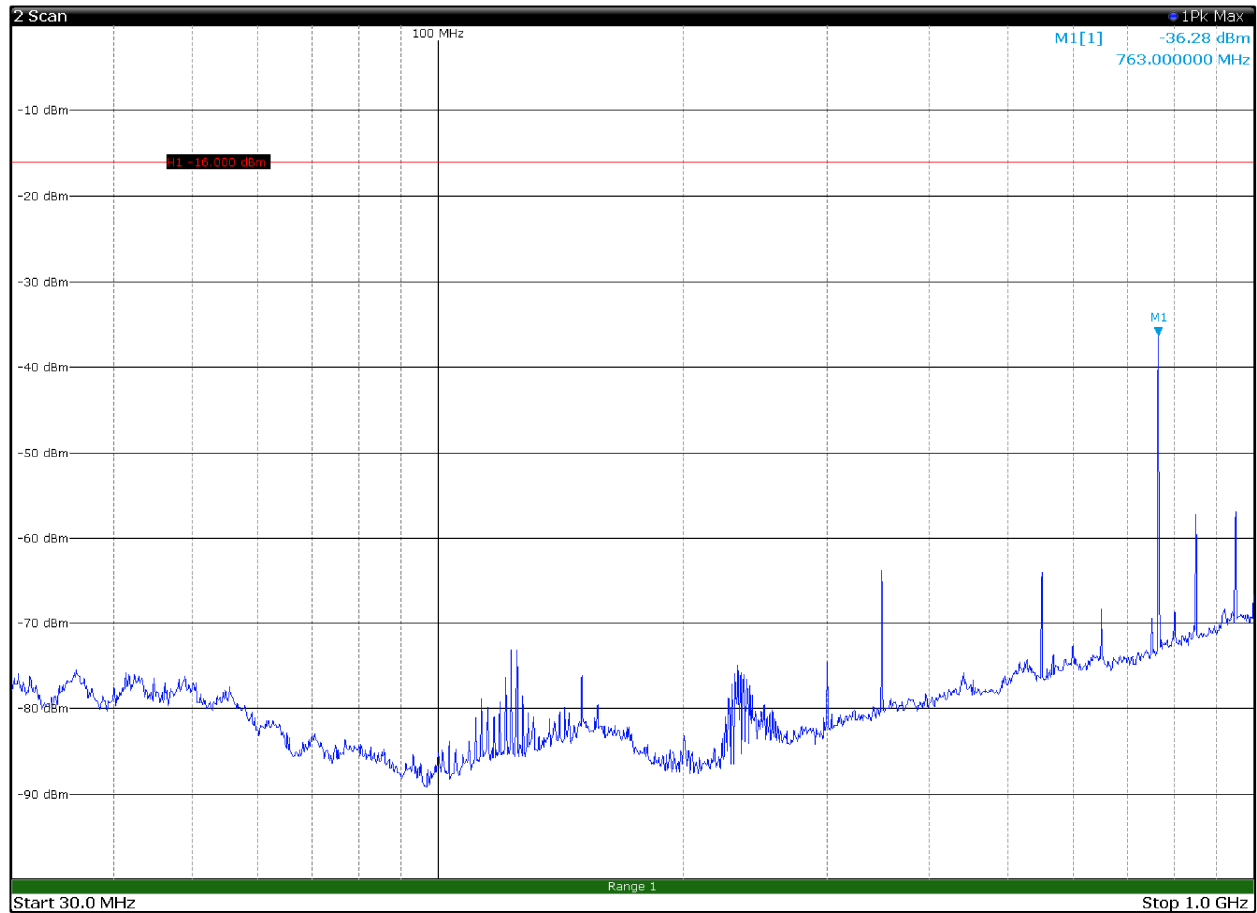
### Special notes

-

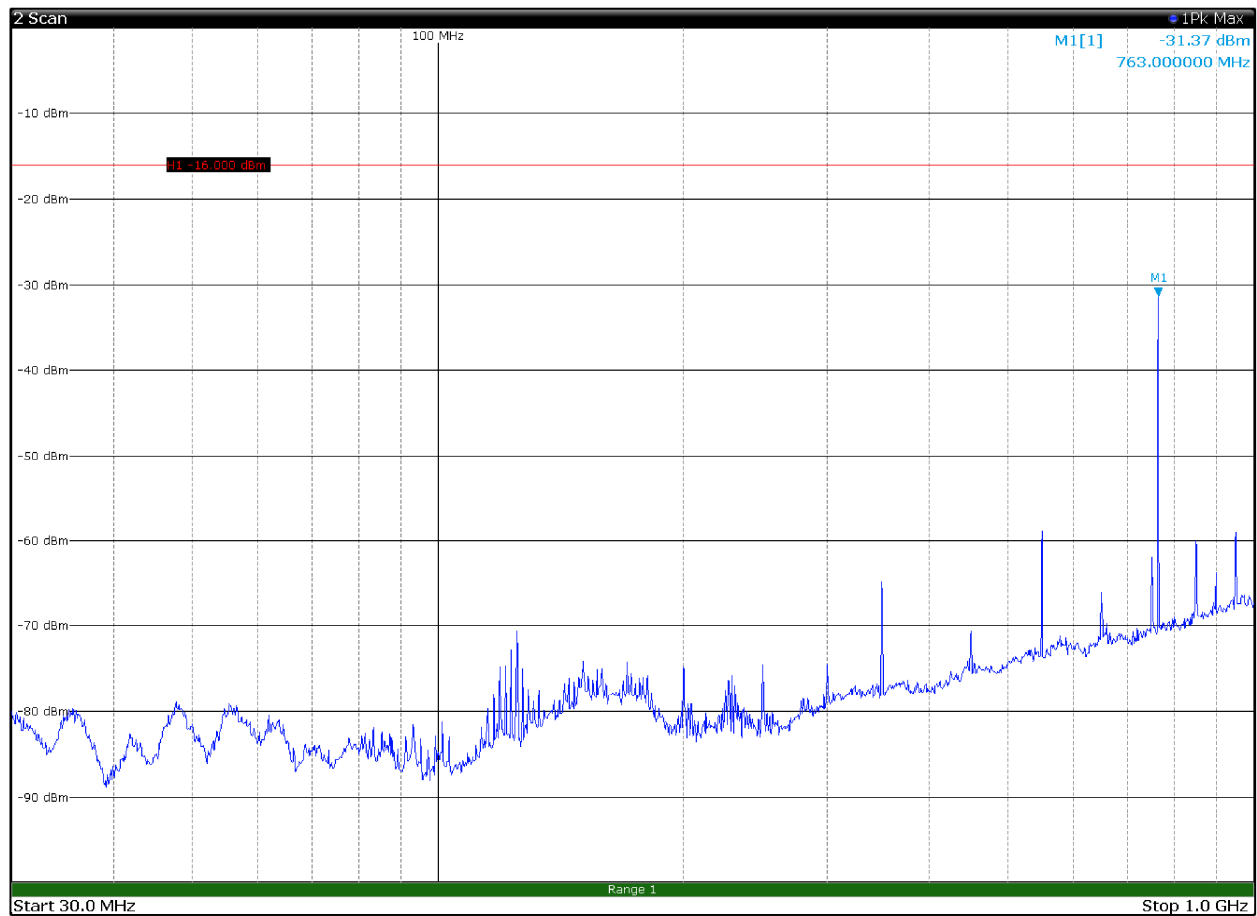
Test data				
The D.U.T. was positioned according to the radiated emissions set-up				
The D.U.T. antenna connector was terminated by a 50 $\Omega$ shielded dummy load.				
The spectrum was searched from 30 MHz to 1 GHz (RBW 100 kHz) & 1 GHz (RBW 1 MHz) to the tenth harmonic of the carrier.				
There were no emissions detected above the noise floor which was at least 20 dB below the specification limit.				
Spurious emissions measurement results:				
Frequency (MHz)	Polarization. V/H	Field strength (dBm)	Limit (dBm)	Margin (dB)
First Channel	V/H	Negligible	-13	
Mid channel	V/H	Negligible	-13	
Last Channel	V/H	Negligible	-13	
Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.				

MIMO consideration
<p>In the final Remote Unit, the EUT could be used in MIMO configuration according to KDB 662911-D01 v02r01 and 662911-D02 v01 with signals completely uncorrelated. So, the maximum emission is calculated as follows:</p> <ul style="list-style-type: none"> <li>MIMO Maximum Emission = Emission at each path + <math>10\log(N_{ant})</math> dB = Emission at each path + <math>10\log(2)</math> = Emission at each path + 3dB</li> <li>Spurious emission limit is -16dBm.</li> </ul>

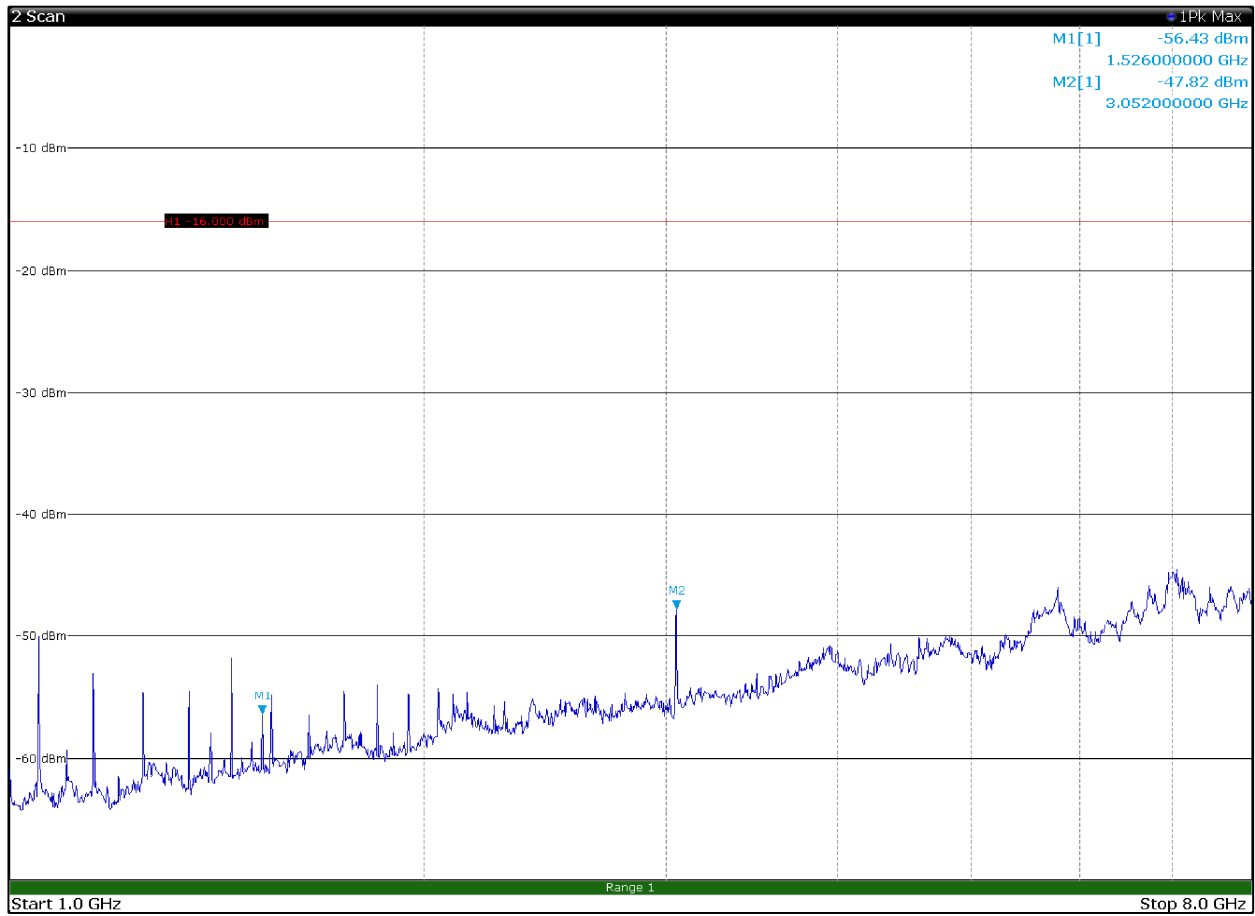
## Test data



30 MHz – 1 GHz – H Pol

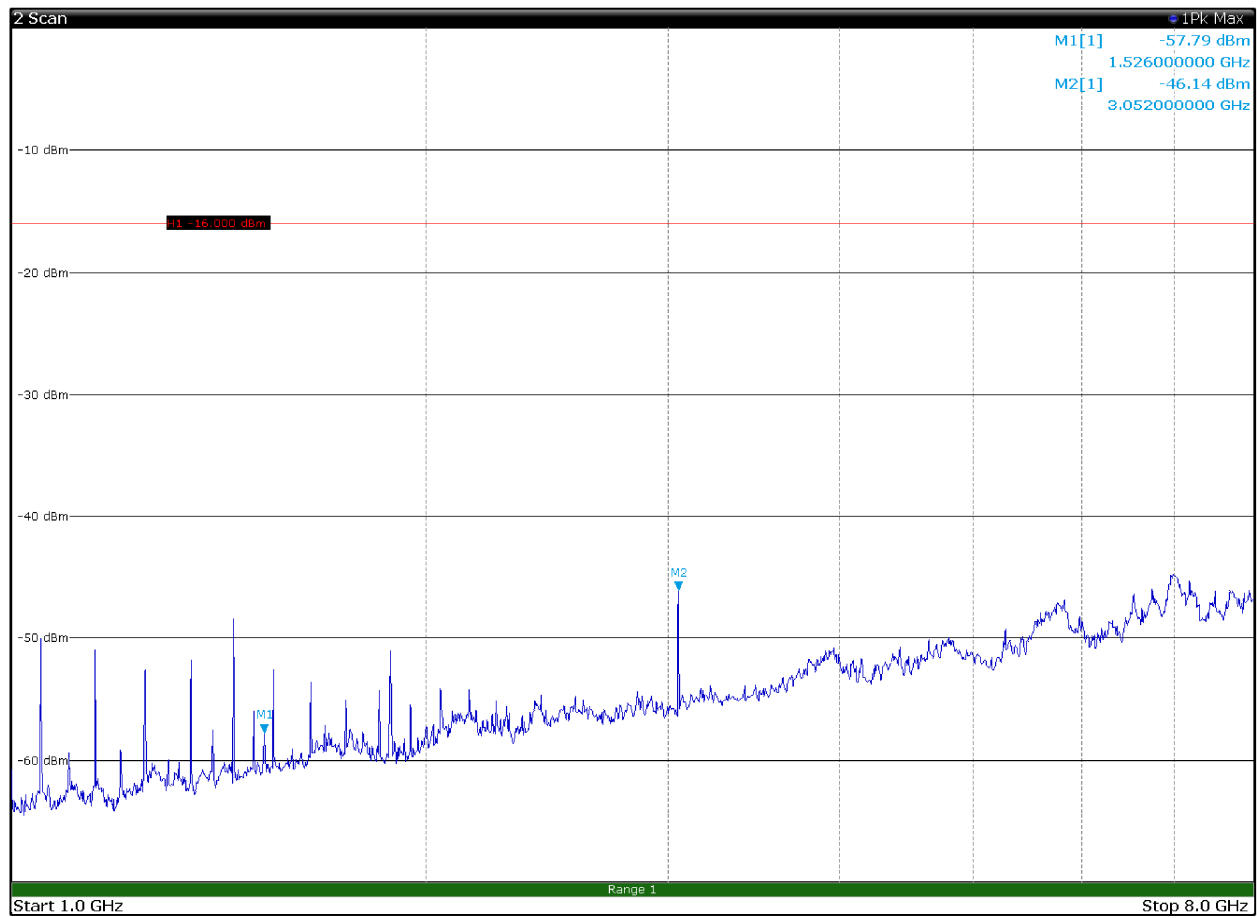


30 MHz – 1 GHz – V Pol

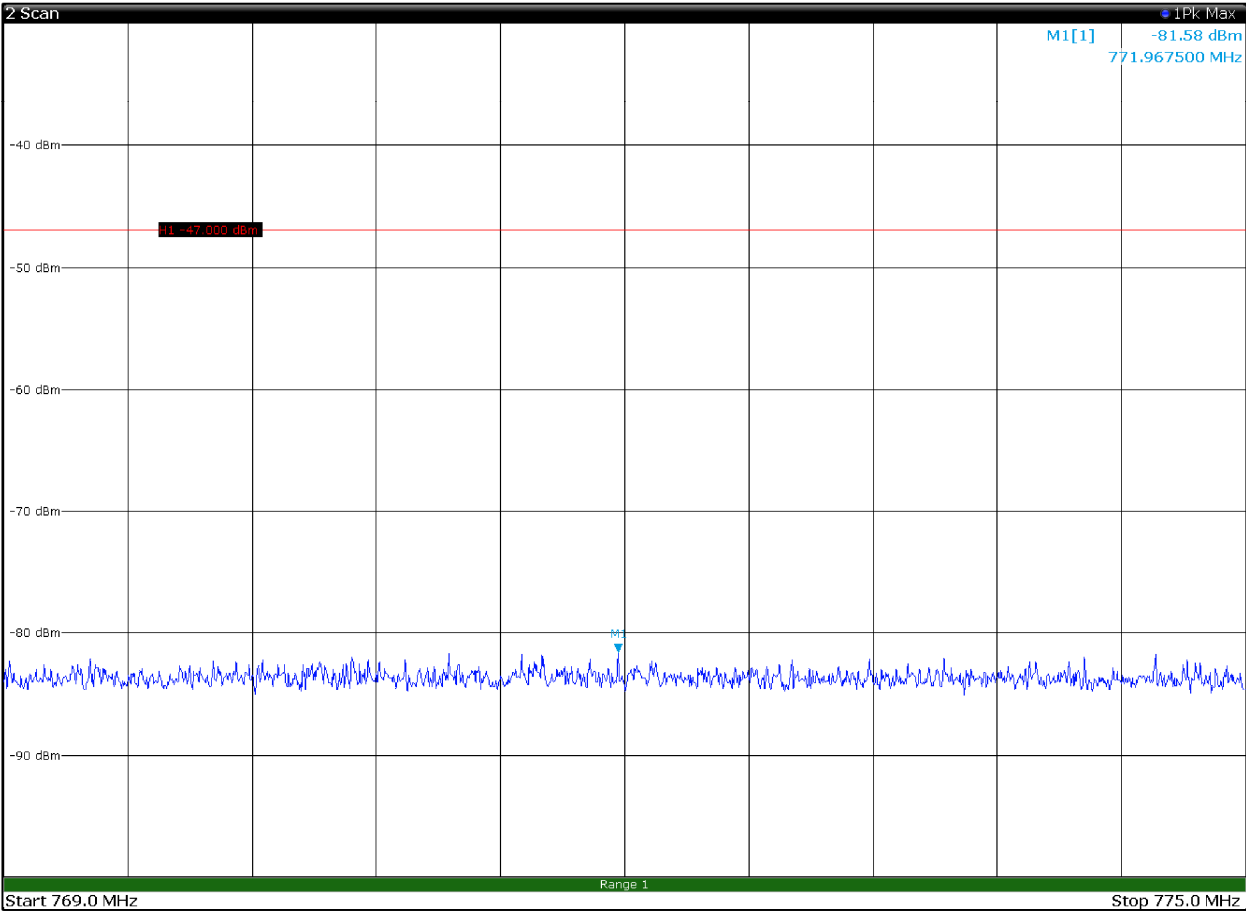


1 GHz – 8 GHz – H Pol

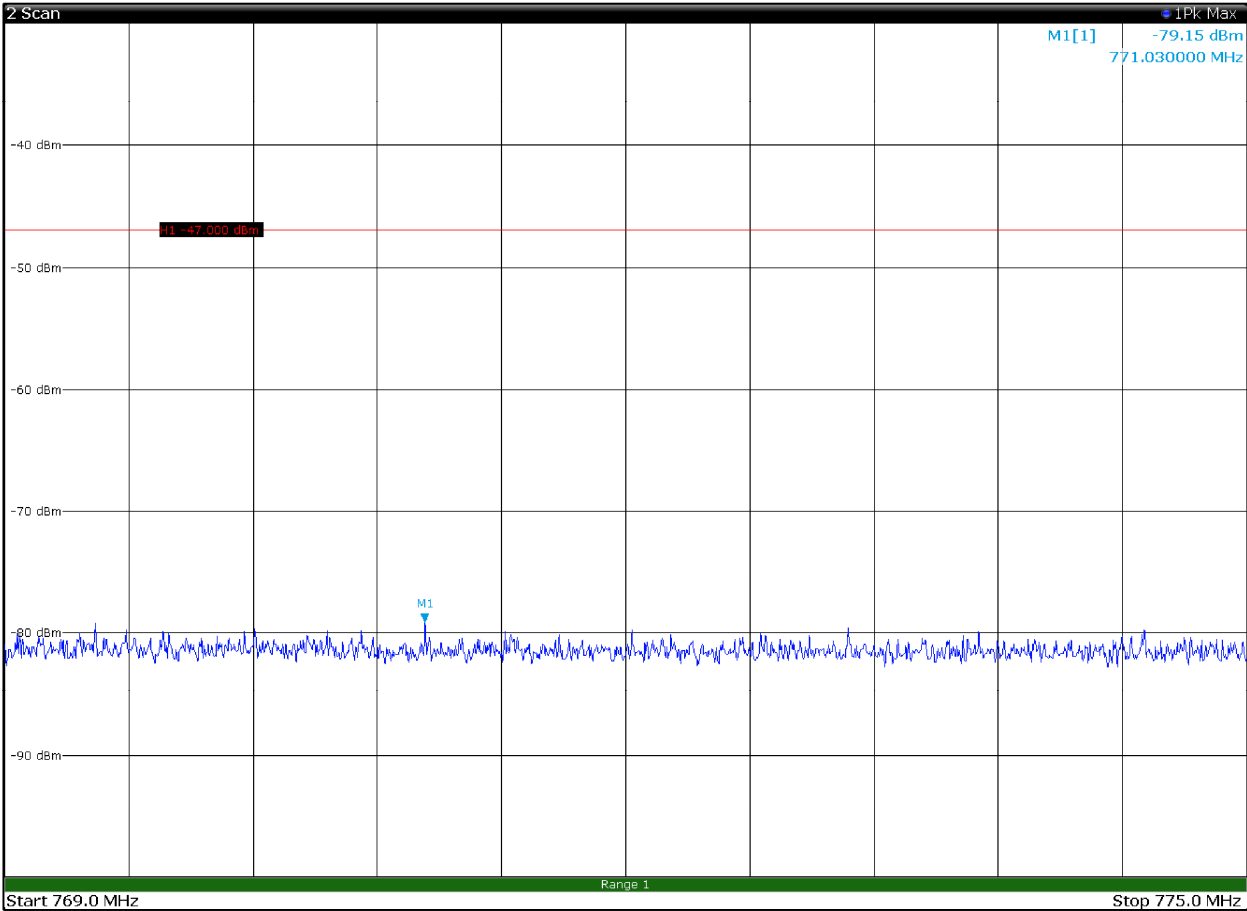




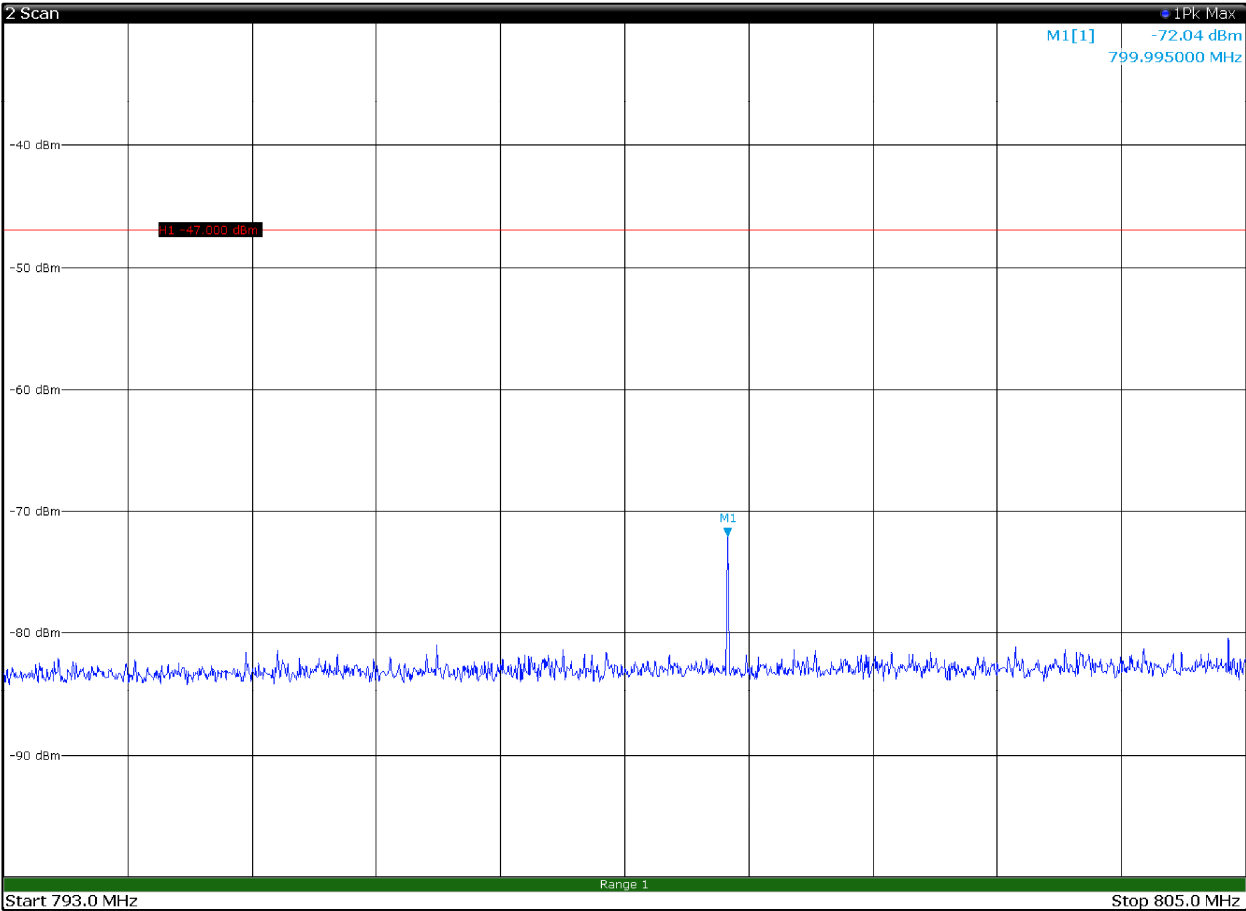
1 GHz – 8 GHz – V Pol



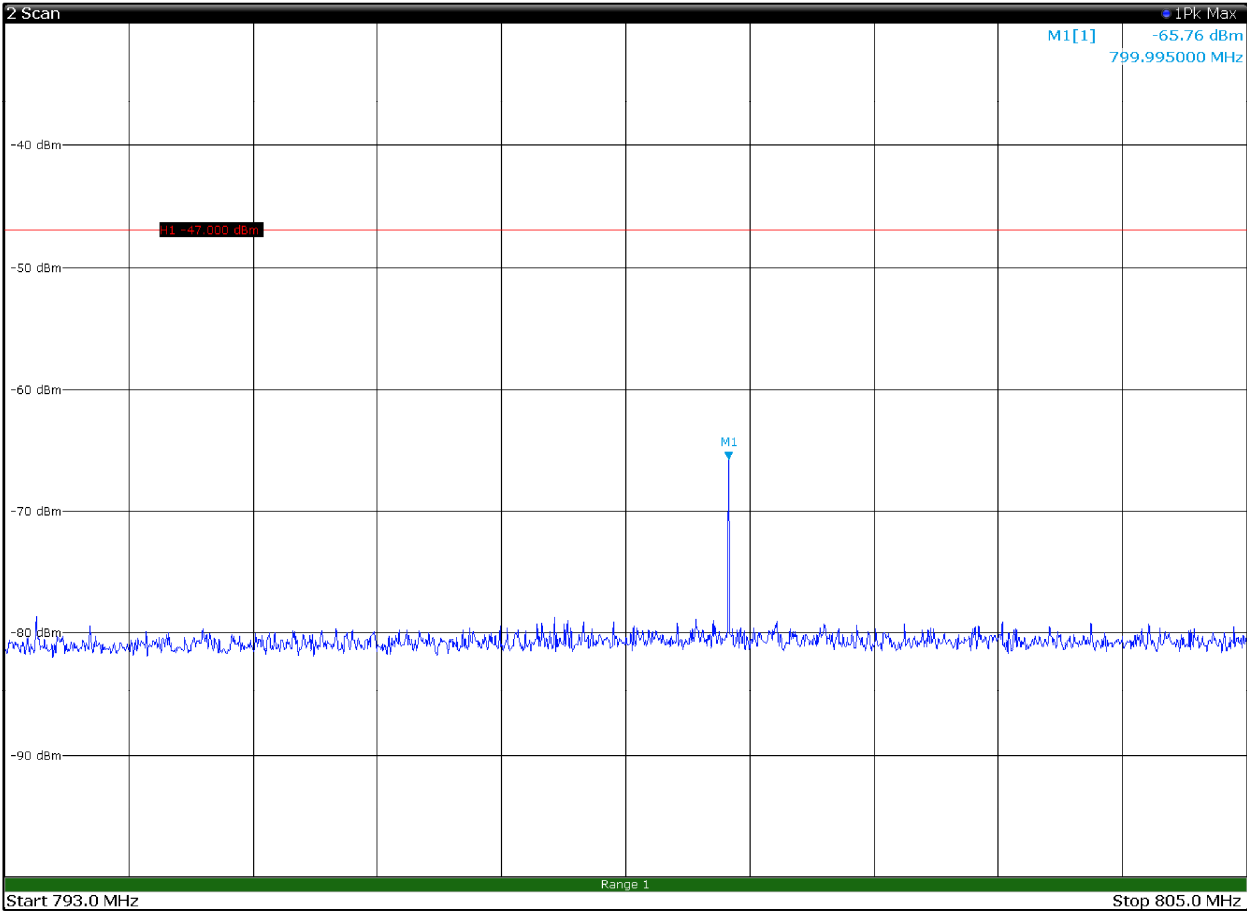
769 MHz – 775 MHz – H Pol



769 MHz – 775 MHz – V Pol



793 MHz – 805 MHz – H Pol



793 MHz – 805 MHz – V Pol

## Clause 90.543(f) Radiated spurious emissions within 1559–1610 MHz band

### § 90.543(f)

For operations in the 758-775 MHz and, 788-805 MHz bands, all emissions including harmonics in the band 1559–1610 MHz shall be limited to –70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and –80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation

Test date: 2020-07-14

Test results: Pass

### Test data

#### Spurious emissions measurement results:

Frequency (MHz)	Polarization. V/H	Field strength (dBm)	Limit (dBm)	Margin (dB)
First Channel	V/H	Negligible	-13	
Mid channel	V/H	Negligible	-13	
Last Channel	V/H	Negligible	-13	

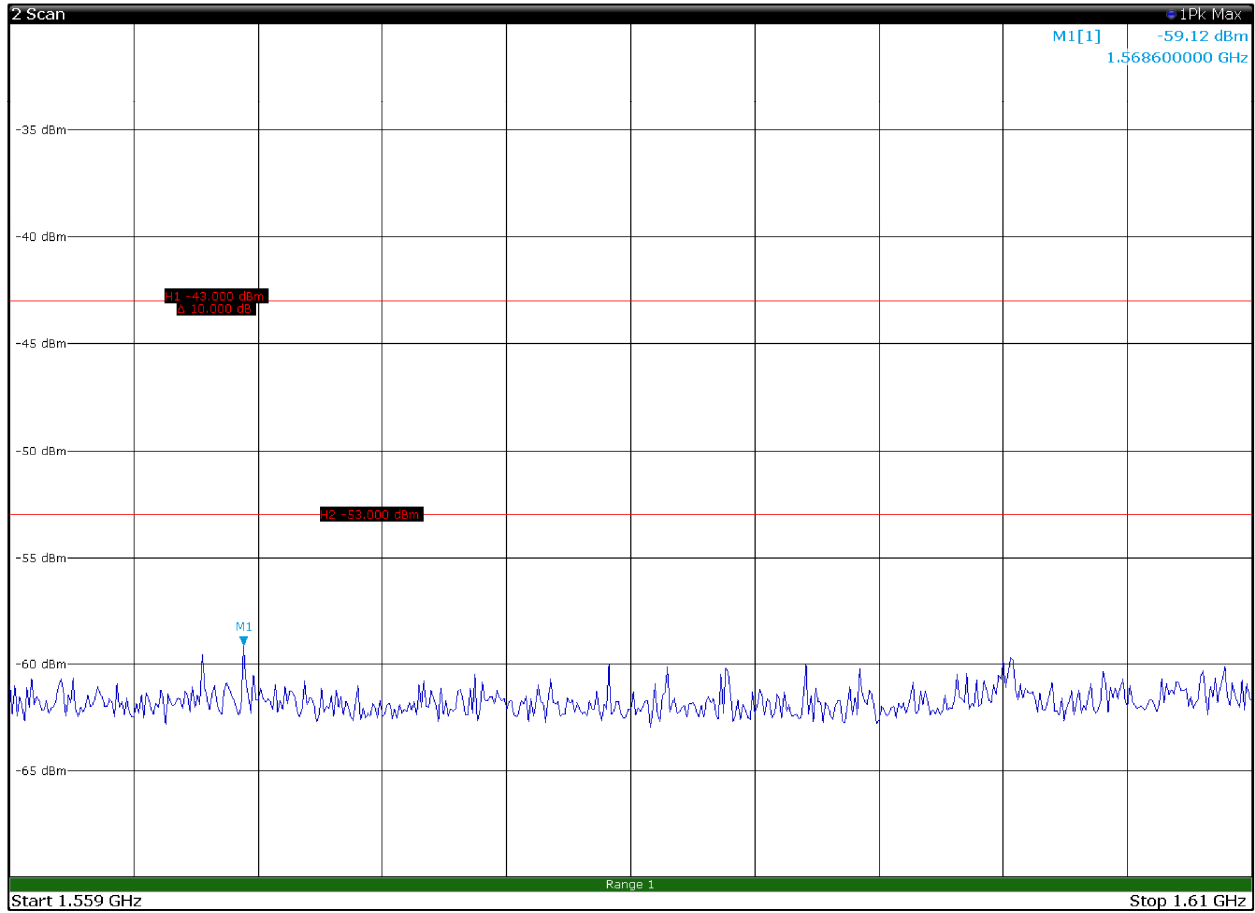
#### Note:

Method of measurement according to TIA-603-C (EIRP in GNSS band: 1.556 to 1.610 GHz) .

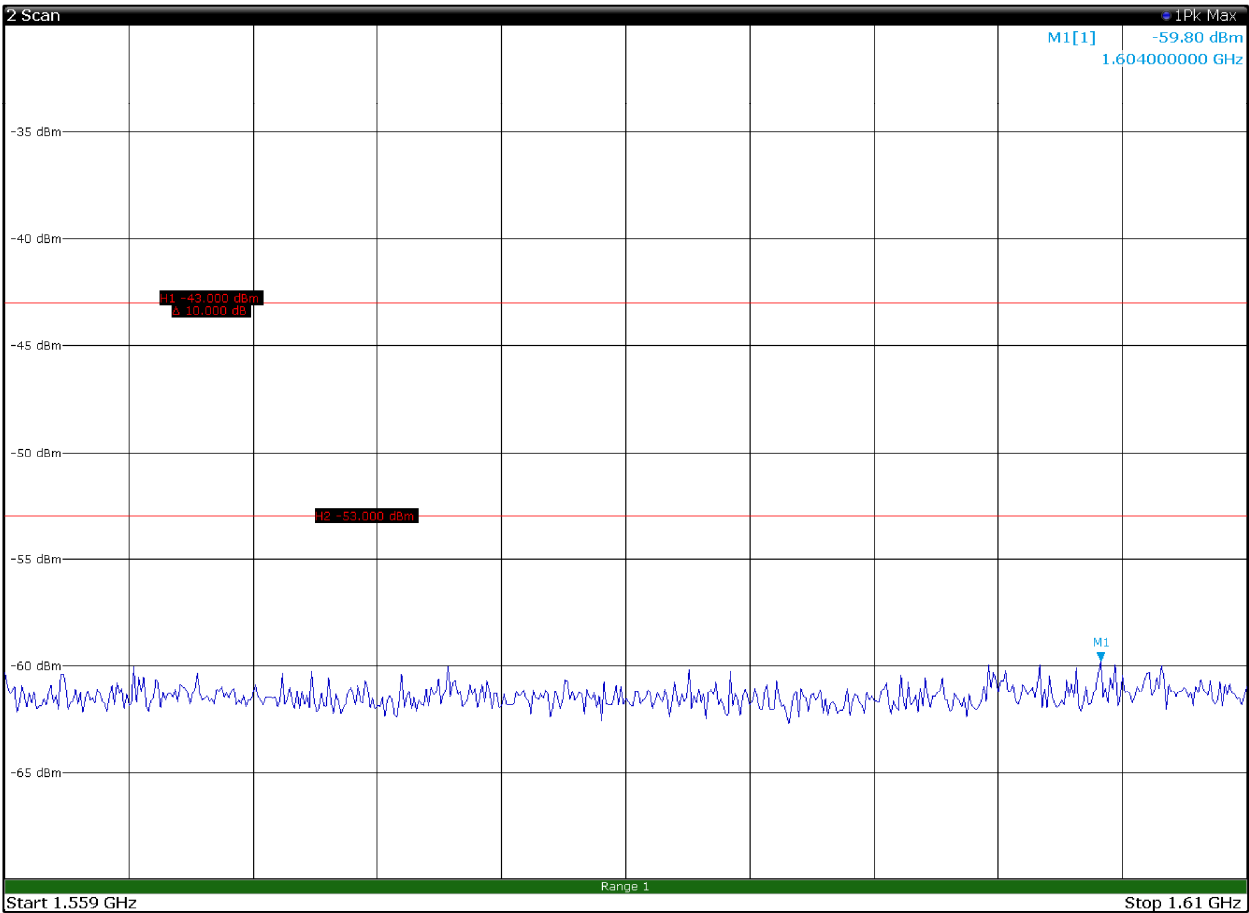
$\Delta$  Band = 51 MHz, Correction Factor calculated at central band 1604.5 MHz. in Fraunhofer Region.

Limit used for discrete emissions: -80 dBw = -50 dBm (added 3 dB for MIMO configuration)

## Test data



1559 MHz – 1610 MHz – H Pol

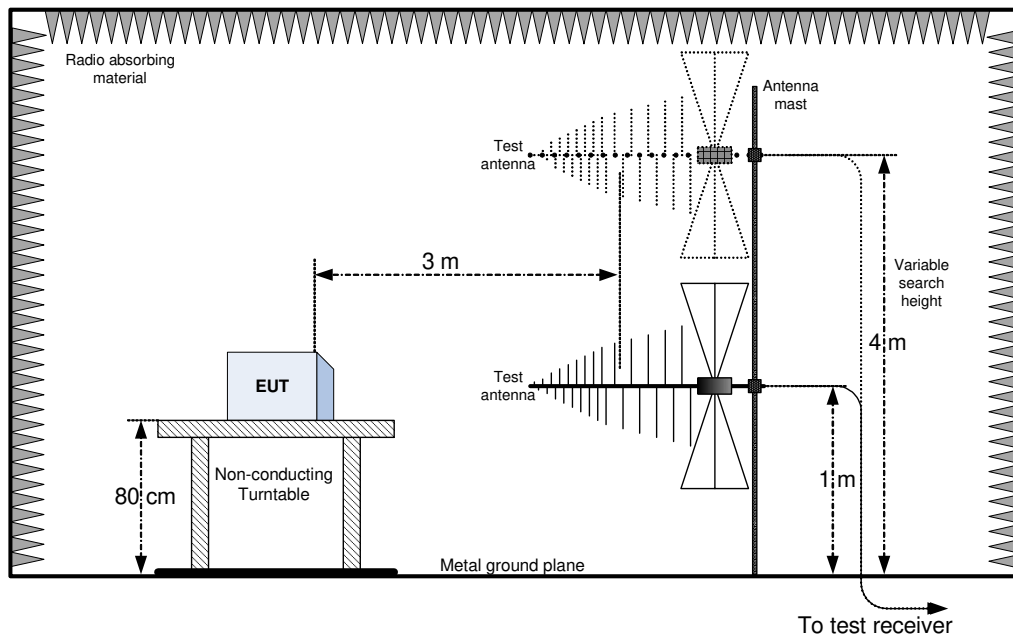


1559 MHz – 1610 MHz – V Pol

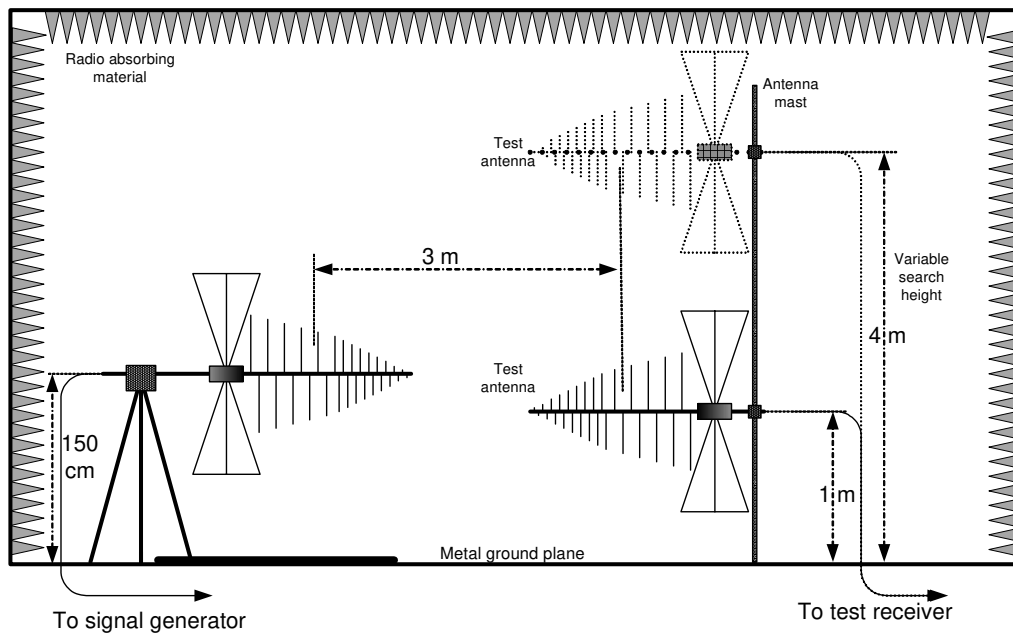


## Appendix B: Block diagrams of test set-ups

### Radiated emissions set-up

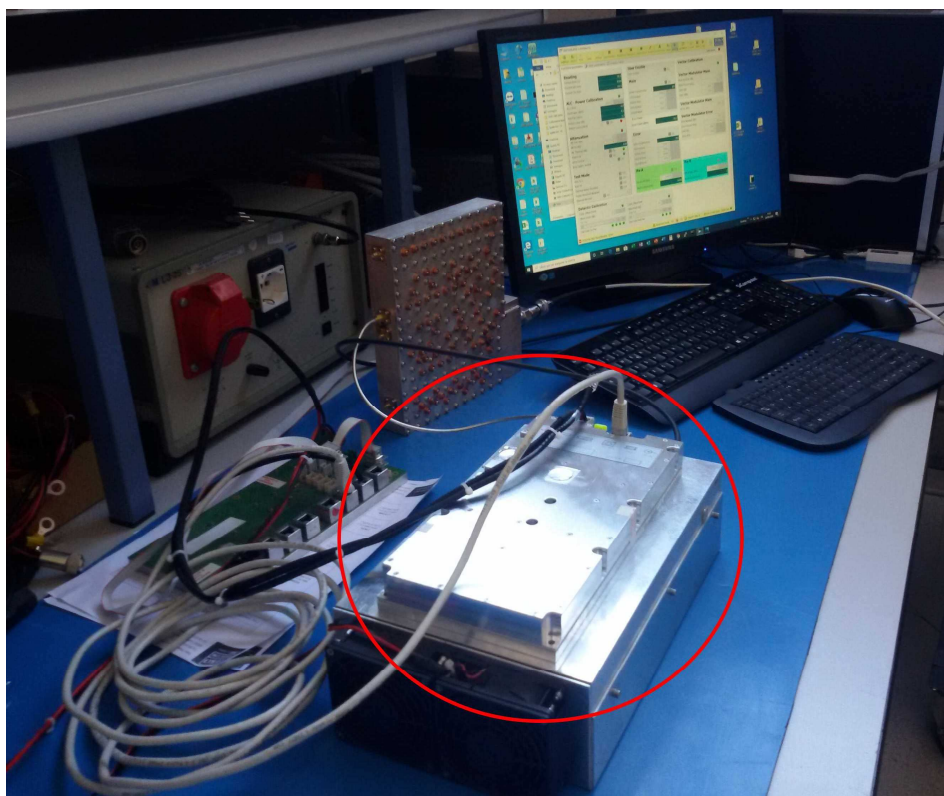


### Substitution method set-up



## Appendix C: EUT Photos

### Photo Set up







## Photo EUT



END OF REPORT