

Report Reference ID:	303872-1TRFWL
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Test specification:	Title 47 – Telecommunication Chapter I – Federal Communications Commission Subchapter D – Safety and special radio services Part 90 – Private land mobile services Subpart I – General technical standards
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Applicant:	TEKO Telecom Srl. Via Meucci, 24/a I-40024 Castel S. Pietro Terme (BO) (Italy)
Apparatus:	Remote unit
Model:	TRU7FL8PWE/AC-WT
FCC ID:	XM2-EP7FL8P

Testing laboratory:	Nemko Italy Spa Via del Carroccio, 4 20853 Biassono (MB) – Italy Telephone: +39 039 2201201 Facsimile: +39 039 2201221
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	Name and title	Date
Tested by:	 G. Curioni, Wireless/EMC Specialist	2016-03-17
Reviewed by:	 P. Barbieri, Wireless/EMC Specialist	2016-03-17

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Section 1: Report summary

1.1 Test specification

Specifications	Part 90 – Private land mobile services
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1.2 Statement of compliance

Compliance	In the configuration tested the EUT was found compliant Yes ☒ No ☐ This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90. Radiated tests were conducted in accordance with ANSI C63.4-2003.
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1.3 Exclusions

Exclusions	None
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1.4 Registration number

Test site FCC ID number	176392 (3 m Semi anechoic chamber)
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1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued
R1TRF	----

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.

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Section 2: Summary of test results

2.1 FCC Part 90, test results

Part	Methods	Test description	Verdict
	§ 935210 D05v01 (4.2)	AGC threshold	Pass
	§ 935210 D05v01 (4.3)	Out of band rejection	Pass
§90.209 §90.219(e)(4)	§ 935210 D05v01 (4.4)	Occupied bandwidth	Pass
§90.205 §90.542(a)(3) §90.219(e)(1)	§ 935210 D05v01 (4.5)	Output power at RF antenna connector	Pass
§90.219(e)(2)	§ 935210 D05v01 (4.6)	Noise Figure	Pass
§90.543(e) §90.219(e)(3)	§ 935210 D05v01 (4.7)	Spurious emissions at RF antenna connector	Pass
§90.543(e) §90.219(e)(3)	§ 935210 D05v01 (4.9)	Radiated spurious emissions	Pass
§90.543(f) §90.219(e)(3)	§ 935210 D05v01 (4.9)	Radiated spurious emissions within 1559-1610 MHz band	Pass
§90.213	§ 935210 D05v01 (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

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

3.2 Modular equipment

a) Single modular approval	Single modular approval Yes ☐ No ☒
b) Limited single modular approval	Limited single modular approval Yes ☐ No ☒

3.3 Product details

FCC ID	Grantee code:	XM2
	Product code:	-EP7FL8P
Equipment class	B9B	
Description of product as it is marketed	Booster	
	Model name/number:	TRU7FL8PWE/AC-WT
	Serial number:	1003295001

3.4 Application purpose

Type of application	☒ Original certification
	☐ Change in identification of presently authorized equipment
	Original FCC ID: Grant date:
	☐ Class II permissive change or modification of presently authorized equipment

Section 3: Equipment under test

3.5 Composite/related equipment

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

3.6 Sample information

Receipt date:	2016-03-14
Nemko sample ID number:	-----

3.7 EUT technical specifications

Operating band:	Down Link: 758–768 MHz, Up Link: 788-798 MHz
Operating frequency:	Wideband
Modulation type:	LTE (QAM and QPSK)
Occupied bandwidth:	LTE: 5 MHz, 10 MHz
Channel spacing:	standard
Emission designator:	LTE: D7W
RF Output	Down Link: 31dBm (1,25W) Up Link: N.A. (The EUT does not transmit over the air in the up-link direction)
Gain	Down Link: 36dB Up Link: N.A. (The EUT does not transmit over the air in the up-link direction)
Antenna type:	External Antenna is not provided, equipment that has an external 50 Ω RF connector
Power source:	100-240 Vac

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:	Master Unit - Subrack
Brand name:	Teko Telecom srl
Model name or number:	SUB-TRX-PSU
Serial number:	101083001
Nemko sample number:	-----
Connection port:	-----
Cable length and type:	-----

Item # 2

Type of equipment:	Master Unit – Management Module
Brand name:	Teko Telecom srl
Model name or number:	TSPV-R
Serial number:	081300017
Nemko sample number:	-----
Connection port:	LAN port
Cable length and type:	-----

Item # 3

Type of equipment:	Master Unit – Optical Module
Brand name:	Teko Telecom srl
Model name or number:	TTRU4W-S-M
Serial number:	110679007
Nemko sample number:	-----
Connection port:	DL/UL RF connector (to connect to the base station) Optical port (to connect to remote unit)
Cable length and type:	-----

Item # 4

Type of equipment:	Master Unit – Power Supply
Brand name:	Teko Telecom srl
Model name or number:	TPSU/AC
Serial number:	100012286
Nemko sample number:	-----
Connection port:	-----
Cable length and type:	-----

3.9 Operation of the EUT during testing

Details:	In down-link direction, normal working at max gain with max RF power output.
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3.10 EUT setup diagram

In this system, Remote Unit is the EUT. Master Unit 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 connector of optical module in the Master Unit.

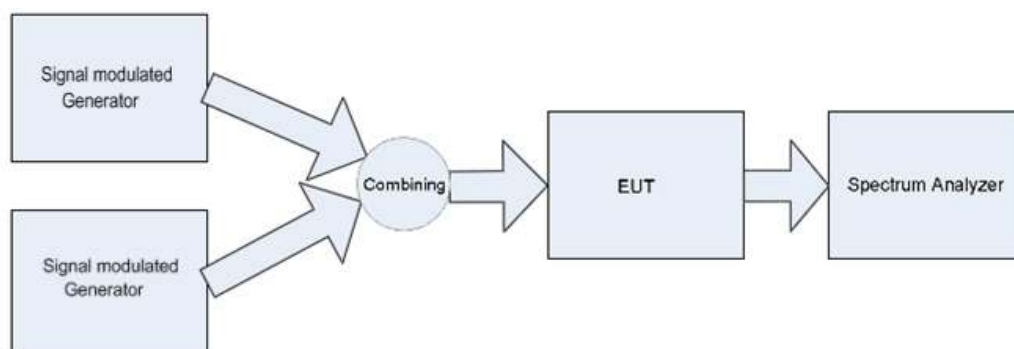
Test setup for output power, occupied bandwidth, spurious emissions:



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.

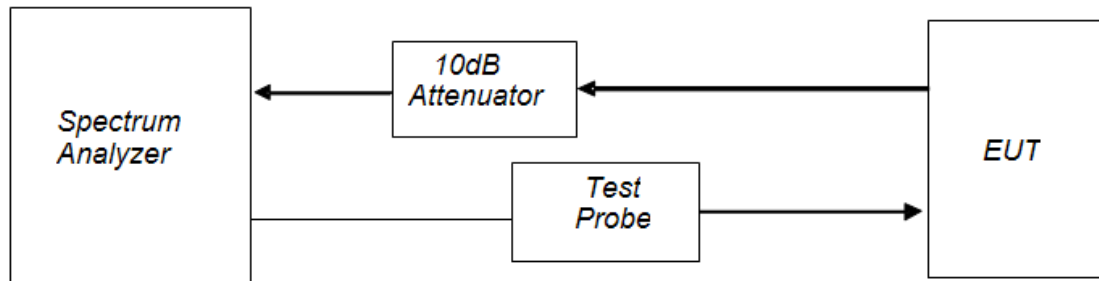
Test setup for intermodulation:



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 Remote Unit. Connect the output RF connector with the spectrum analyzer. Between spectrum analyzer and Remote Unit use a "Noise Source" (Test probe), so the noise of reference is generated. 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 ± 5 %, for which the equipment was designed.

Section 5: Test conditions, continued

5.3 Measurement uncertainty

Nemko S.p.A. measurement uncertainty has been calculated using the standard CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements". All calculations can be found in Nemko S.p.A. document WML1002.

5.4 Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Agilent	N5172B EXG	MY53051238	Jun 2018
Vector Signal Generator	Agilent	E4438C ESG	MY45094485	Ago 2016
Spectrum Analyzer	Agilent	N9030A PXA	MY53120882	Jun 2016
Network Analyzer	Agilent	E5071C ENA	MY46106183	Jun 2016
Noise Source	Agilent	346B	4124A17612	Ago 2018
V-network	R & S	ESH2-Z5	872 460/041	11/2016
Trilog Broad Band Antenna 25-2000 MHz	Schwarzbeck	VULB 9168	VULB 9168-242	06/2018
Trilog Broad Band Antenna 25-8000 MHz	Schwarzbeck	VULB 9162	VULB 9162-25	07/2018
Antenna 1-18 GHz	Schwarzbeck	STLP 9148	STPL 9148-123	06/2018
Double ridge waveguide horn	RFspin	DRH40	061106A40	08/2016
Preamplifier 18-40 GHz	Miteq	JS44	1648665	12/2016
Broadband preamplifier 1-18 GHz	Schwarzbeck	BBV 9718	9718-137	10/2016
EMI receiver 20 Hz ÷ 8 GHz	R&S	ESU8	100202	04/2016
EMI receiver 20 Hz ÷ 3 GHz	R&S	ESCI	100888	09/2016
Hydraulic revolving platform	Nemko	RTPL 01	4.233	NCR
Turning-table	R&S	HCT	835 803/03	NCR
Antenna mast	R&S	HCM	836 529/05	NCR
Controller	R&S	HCC	836 620/7	NCR
Spectrum Analyzer 9kHz ÷ 40GHz	R&S	FSEK	848255/005	11/2016
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	09/2016
Shielded room	Siemens	10m control room	1947	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	70	NCR
Shielded Room	Siemens	3m semi-anechoic chamber	3	NCR
Motor controller	Emco	1051-25	9012-1559	NCR
Motor controller	Emco	1061-1.521	9012-1508	NCR
Antenna Tower	Emco	2071-2	9601-1940	NCR
Controller pole/table	Emco	2090	9511-1099	NCR

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use
 (*) Equipment supplied by manufacturer's

Appendix A: Test results

Clause 935210 D05v01 (4.2) AGC threshold

Measure of EUT AGC Threshold

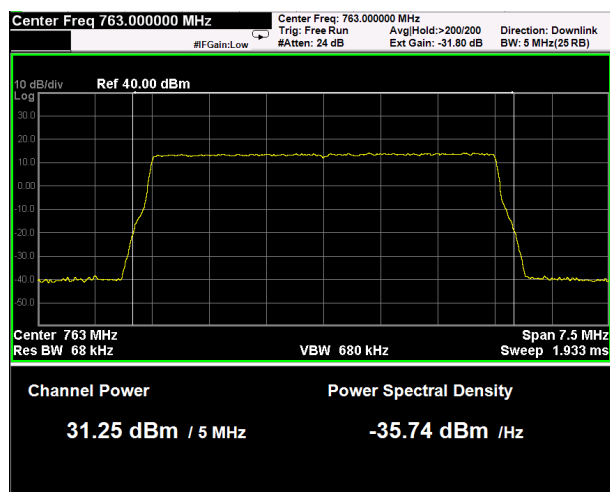
Test date: 2016-03-15

Test results: Pass

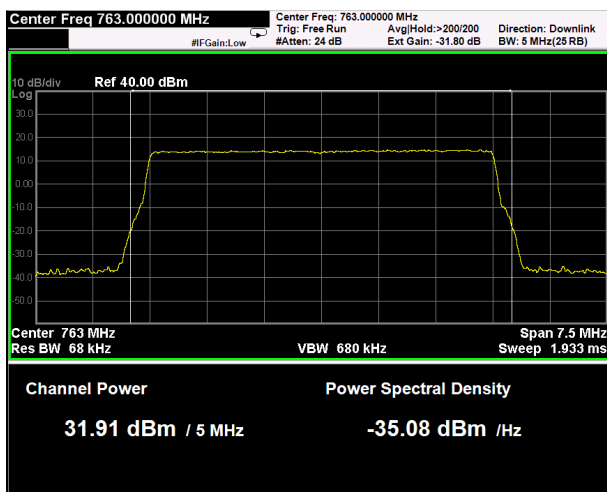
Special notes

- AWGN test signal used (5 MHz LTE channel)

Test data



AWGN signal, nominal input signal



AWGN signal, nominal input signal +1 dB

Clause 935210 D05v01 (4.3) Out of band rejection

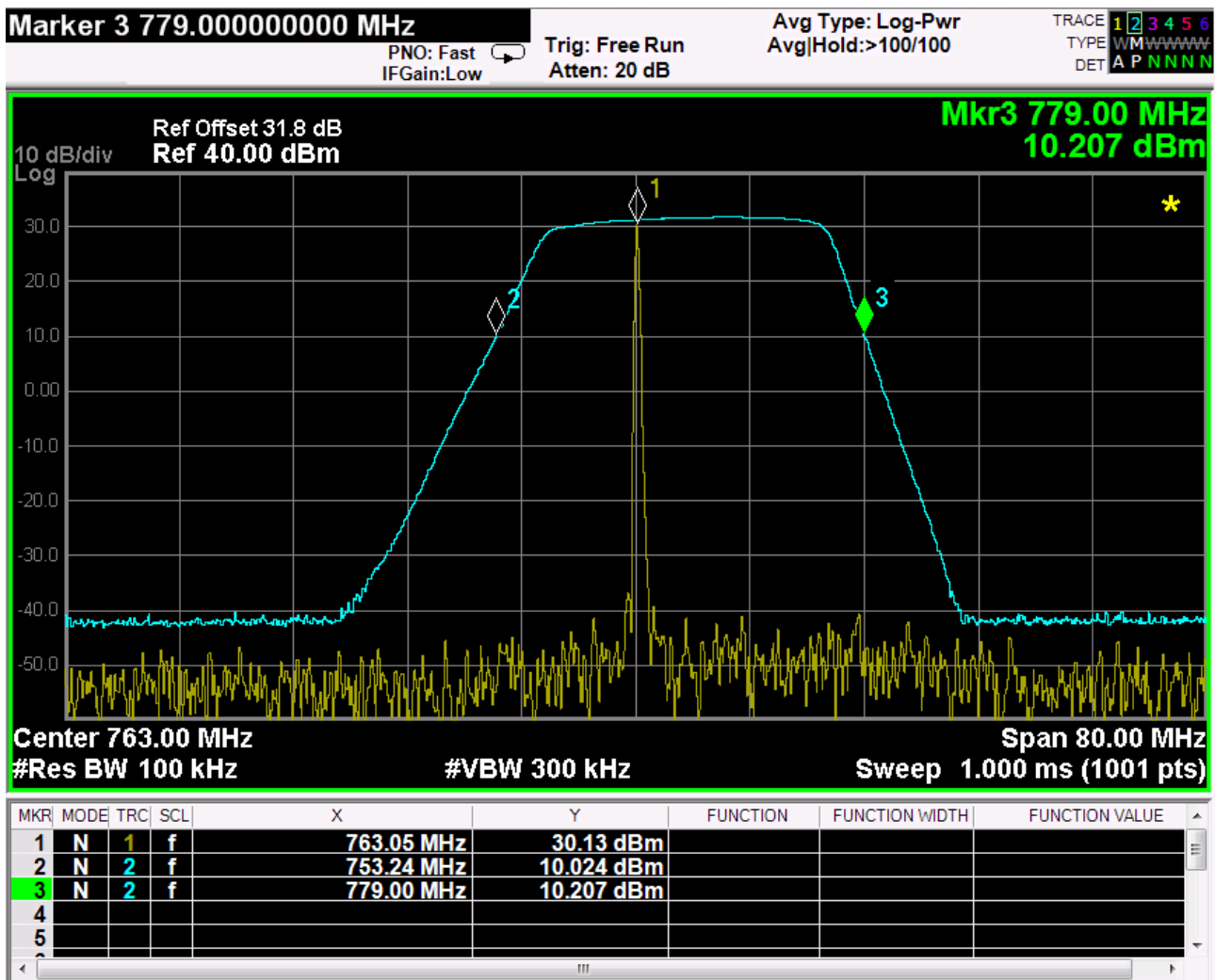
Out of Band Rejection – Test for rejection of out of band signals.

Test date: 2016-03-15

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: 2016-03-15

Test results: Pass

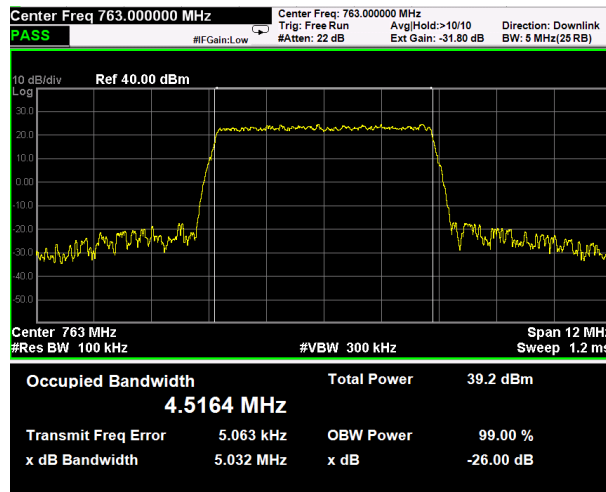
Special notes

- AWGN test signal used (5 MHz LTE channel)

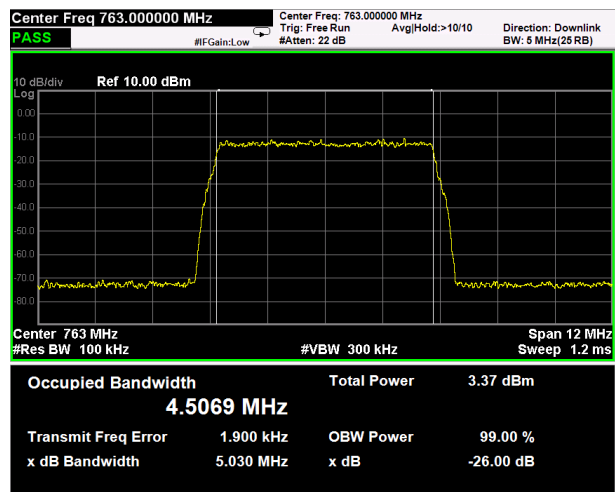
Occupied bandwidth, continued

Test data

AWGN signal, nominal input signal

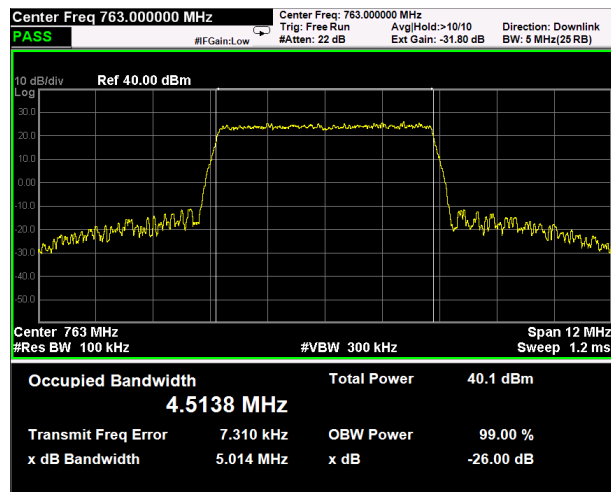


Output

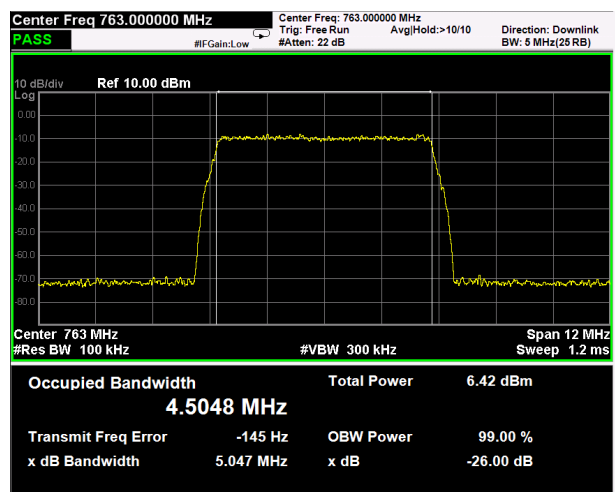


Input

AWGN signal, nominal input signal + 3dB



Output



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: 2016-03-15

Test results: Pass

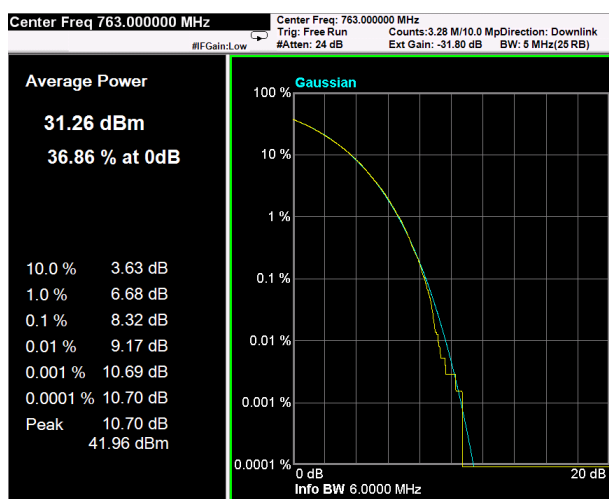
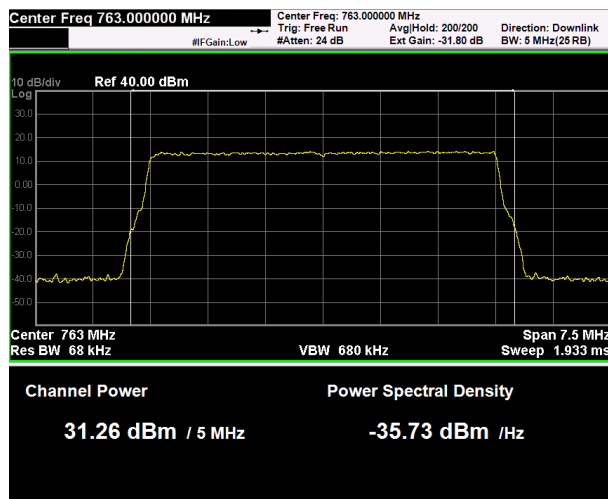
Special notes

- AWGN test signal used (5 MHz LTE channel)

Output power at RF antenna connector

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	31,26	1,34	0,27	10,70



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

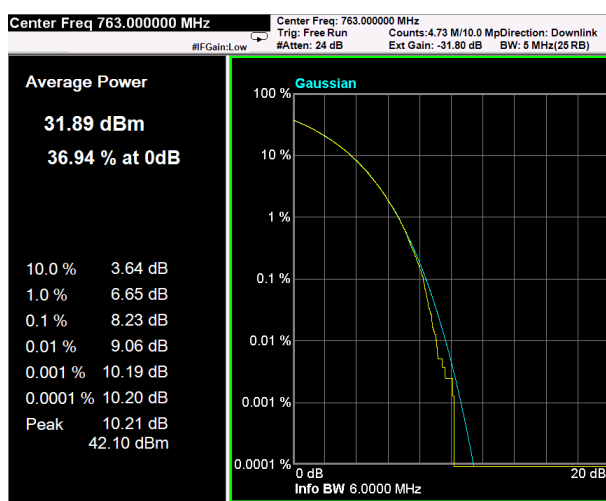
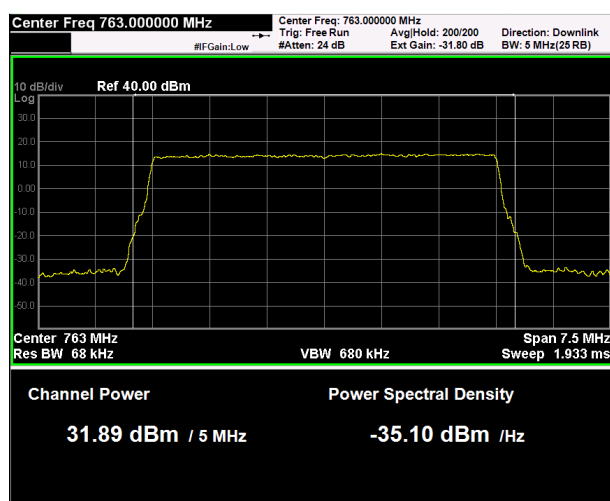
Gmax antenna gain (dBi) = 39 - 31.26 = 7.74 dBi

EIRP = 31.26 + 7.74 = 39 dBm

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	31,89	1,55	0,31	10,21



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)

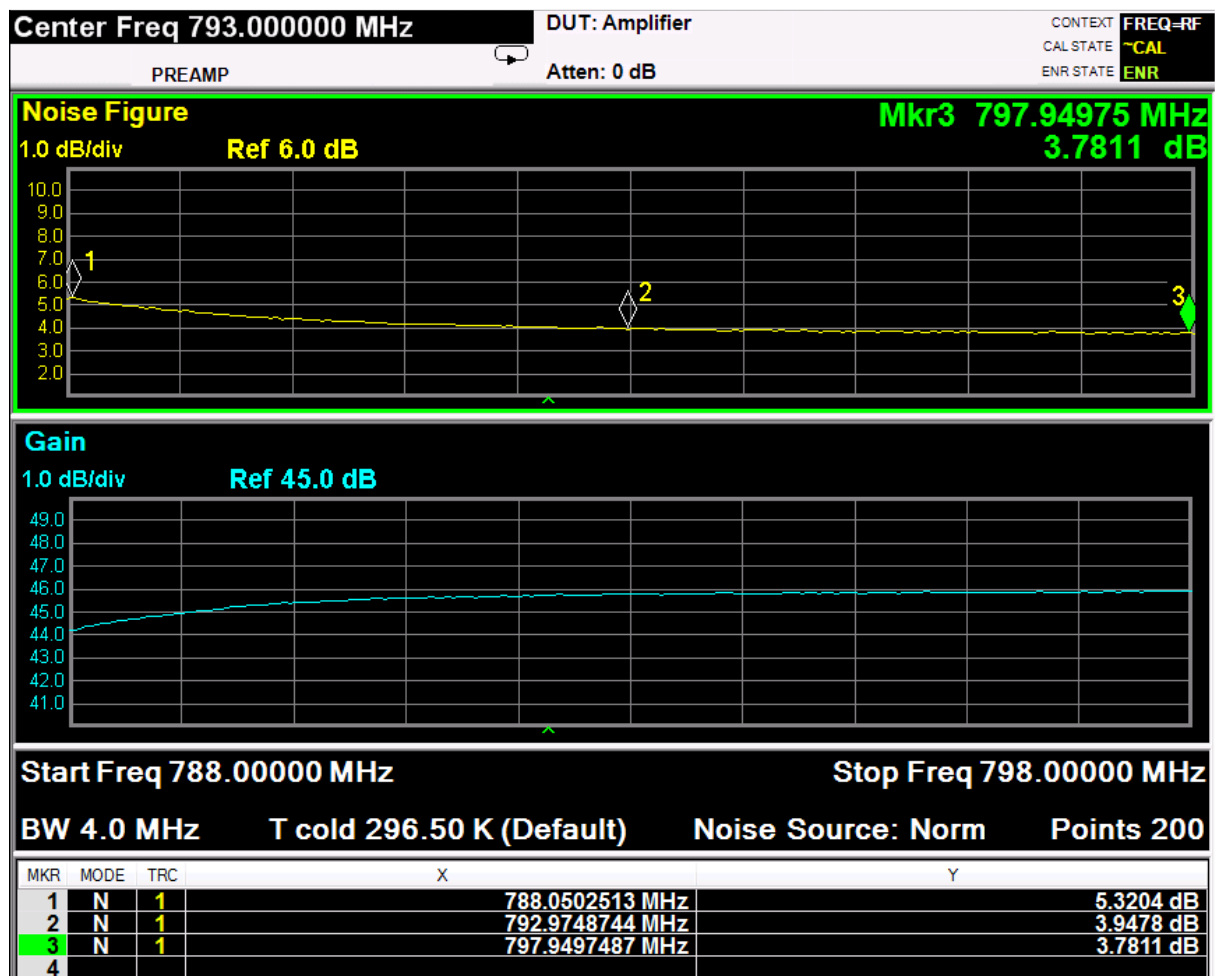
The noise figure of a signal booster must not exceed 9 dB in either direction.

Test date: 2016-03-15

Test results: Pass

Special notes

In the Remote Unit, only up-link measurement can be performed (test probe is connect to antenna port)



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 -13dBm within any 100 kHz measurement bandwidth.

Test date: 2016-03-15

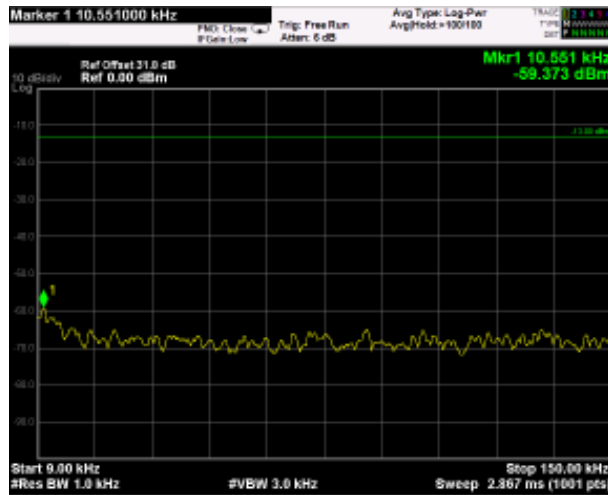
Test results: Pass

Special notes

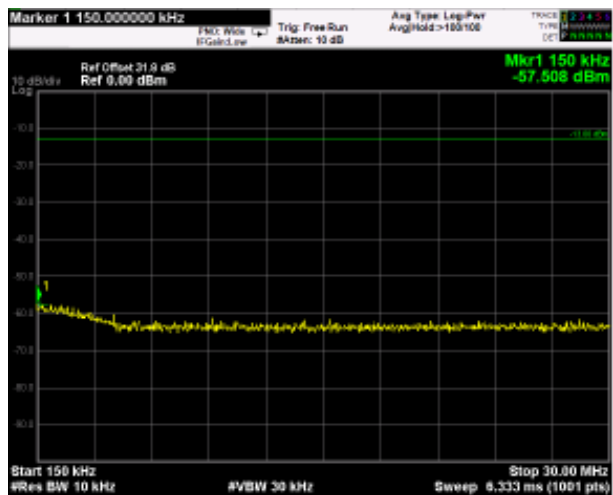
- AWGN test signal used (5 MHz LTE channel)

Test data: Spurious emissions at RF antenna connector

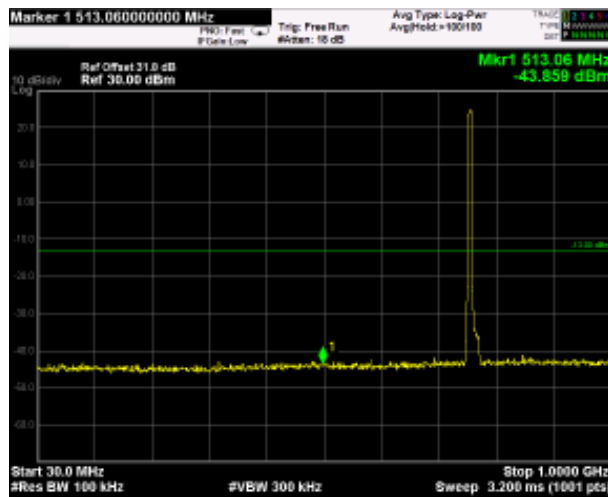
AWGN signal – First Channel (760,5MHz)



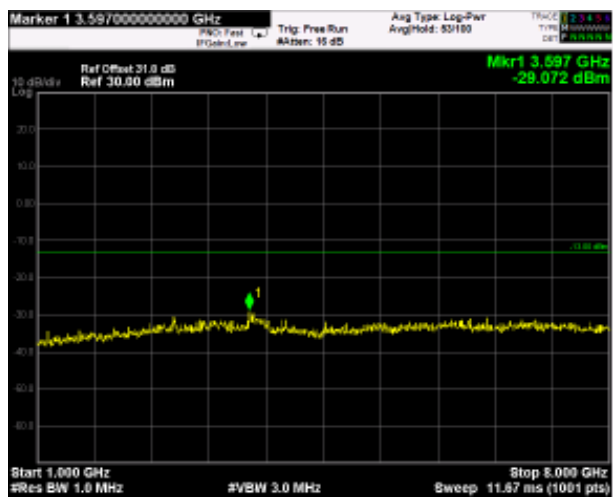
9kHz-150kHz



150kHz-30MHz

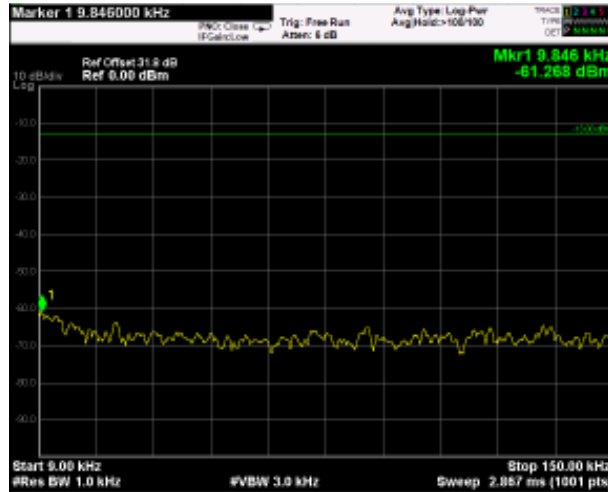


30MHz-1GHz

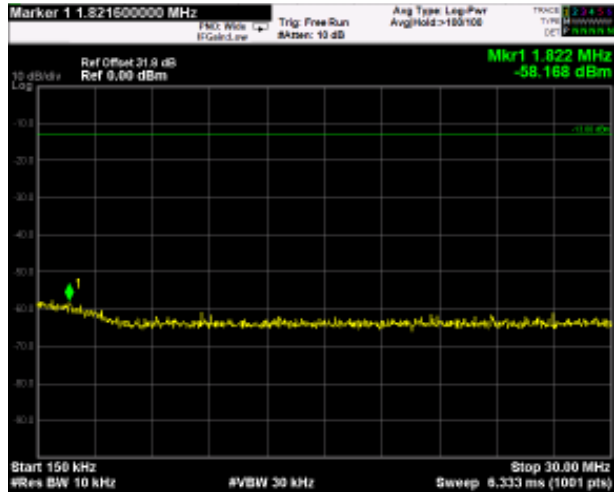


1GHz-8GHz

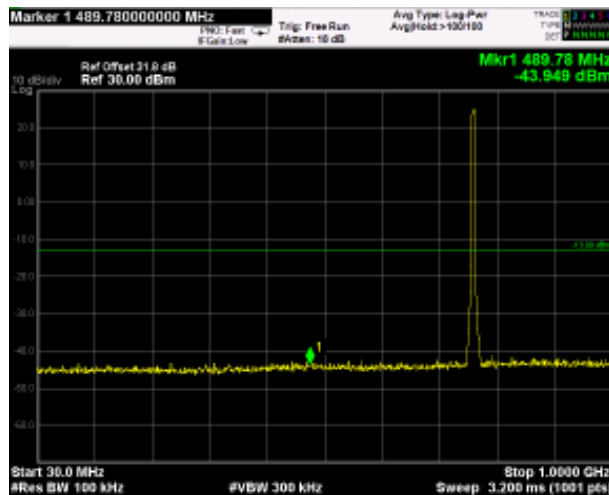
AWGN signal – Last Channel (765,5MHz)



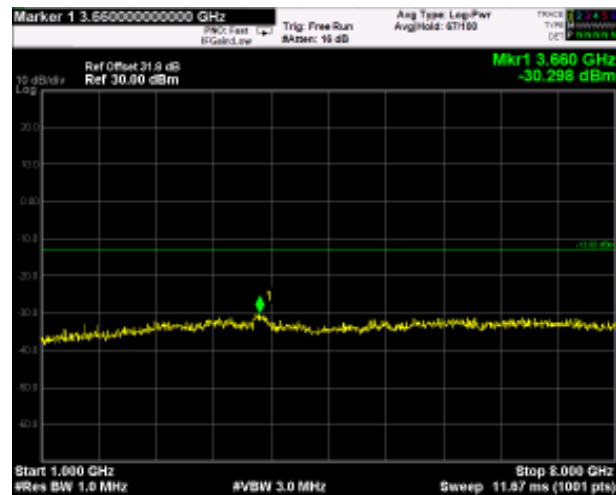
9kHz-150kHz



150kHz-30MHz



30MHz-1GHz



1GHz-8GHz

Test data: Spurious emissions at RF antenna connector: 90.543(e)(1)

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

$$76 + 10 \log P (W) = 76 + 10 \log 1,25W = 77$$

$$P (W) = 1,25W = 31 \text{ dBm}$$

$$\rightarrow \text{limit: } 31 - 77 = -46 \text{ dBm/6,25kHz}$$

AWGN signal – First Channel (760,5MHz)

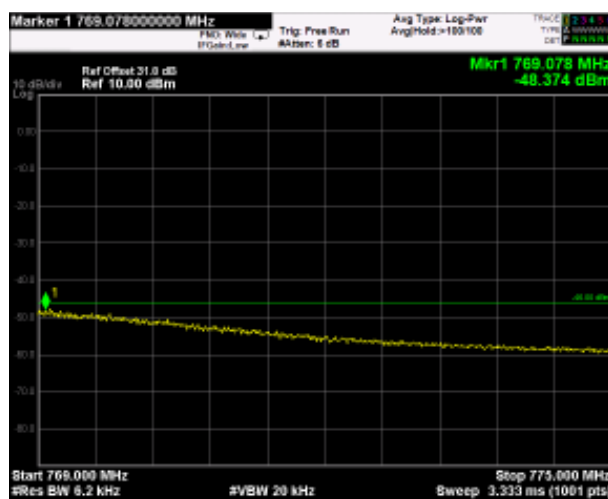


769MHz-775MHz



799MHz-805MHz

AWGN signal – Last Channel (765,5MHz)



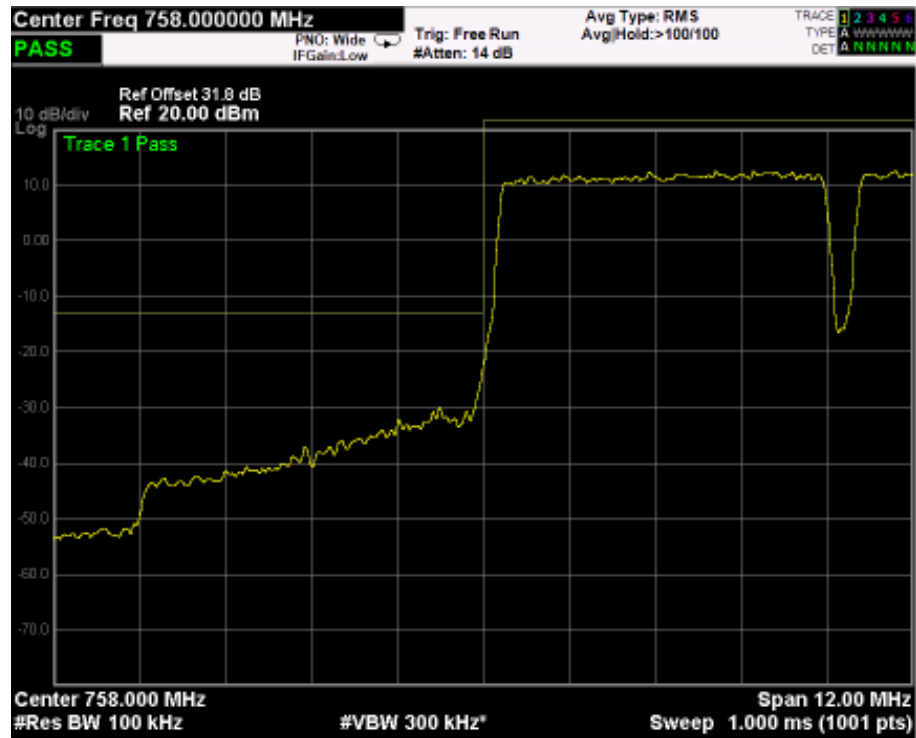
769MHz-775MHz



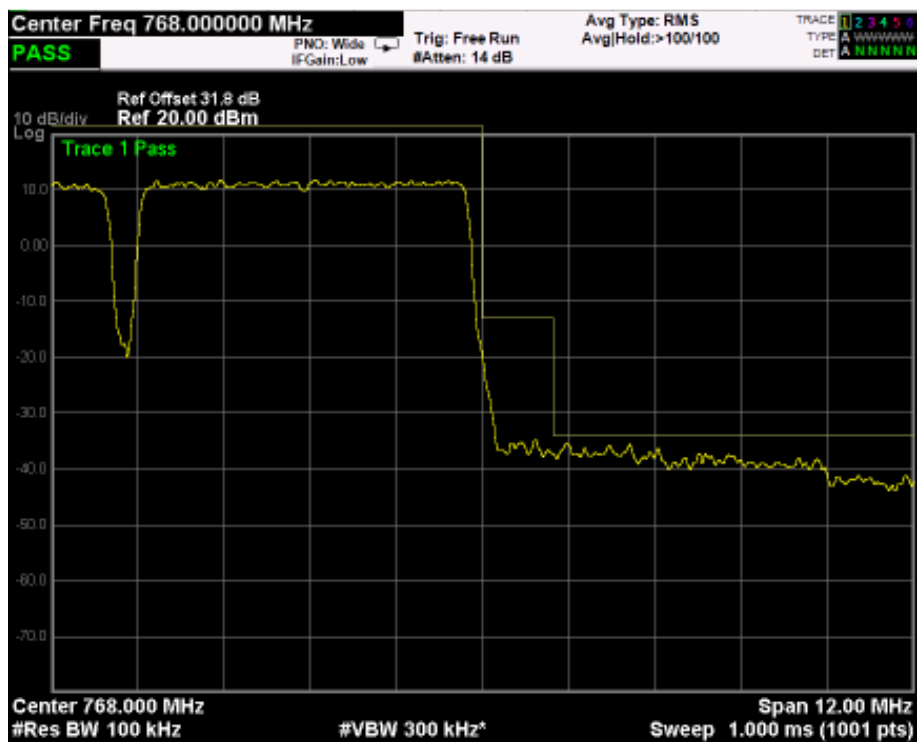
799MHz-805MHz

Test data: Spurious emissions at RF antenna connector: band edges intermodulation

AWGN signal, nominal input signal

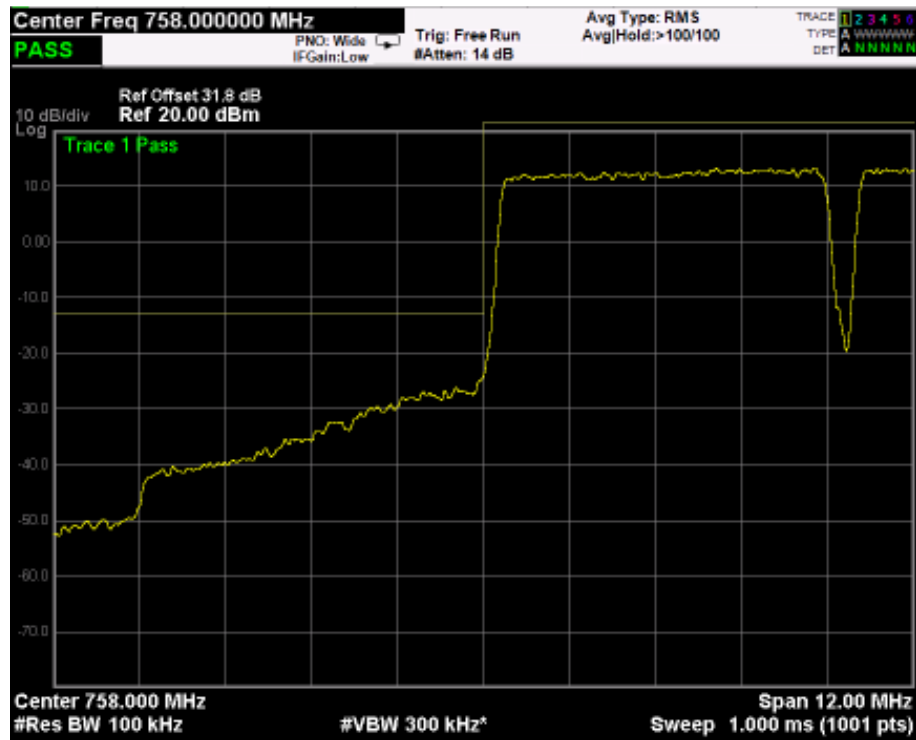


Low Band Edge

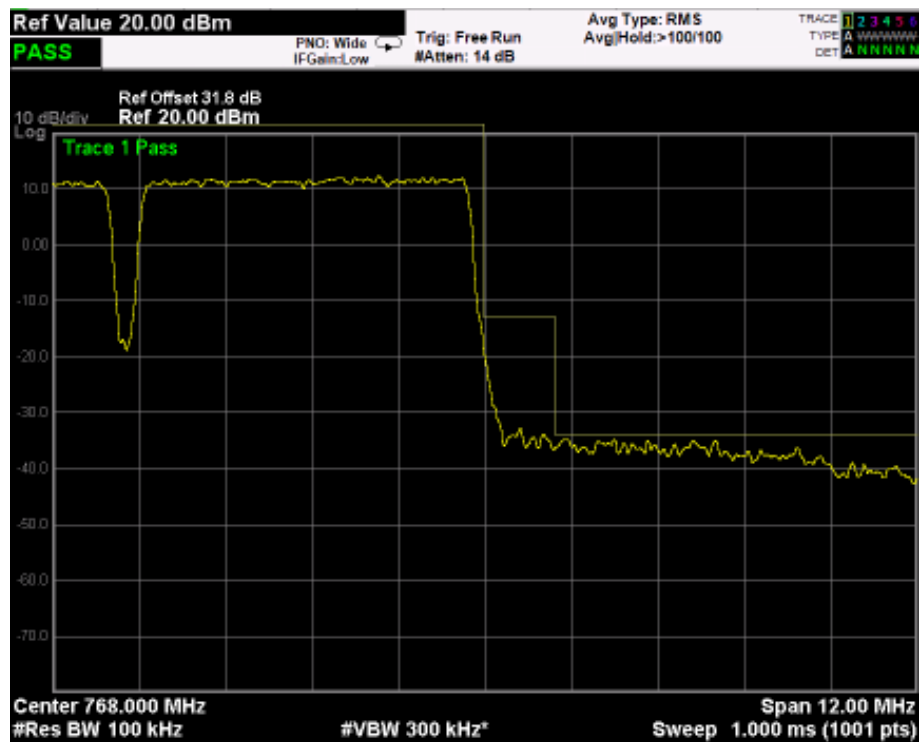


High Band Edge

AWGN signal, nominal input signal + 3dB



Low Band Edge



High Band Edge

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 -13dBm within any 100 kHz measurement bandwidth.

Test date: 2016-03-16

Test results: Pass

Special notes

Radiated spurious emissions, continued

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 Ω shielded dummy load.

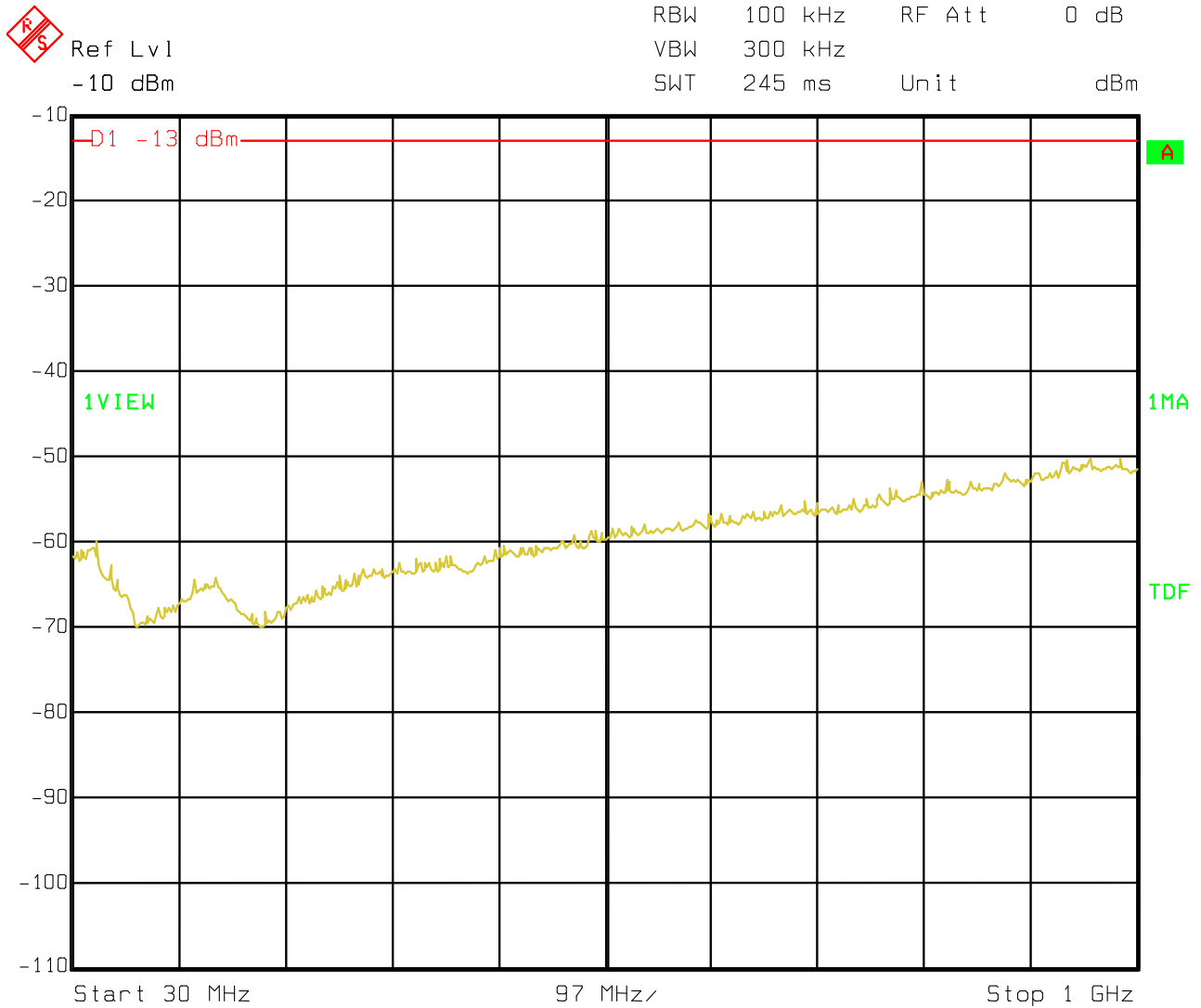
The spectrum was searched from 30 MHz to 1 GHz (RBW 100 kHz) & 1 GHz (RBW 1 MHz) to the tenth harmonic of the carrier.

There were no emissions detected above the noise floor which was at least 20 dB below the specification limit.

Spurious emissions measurement results:

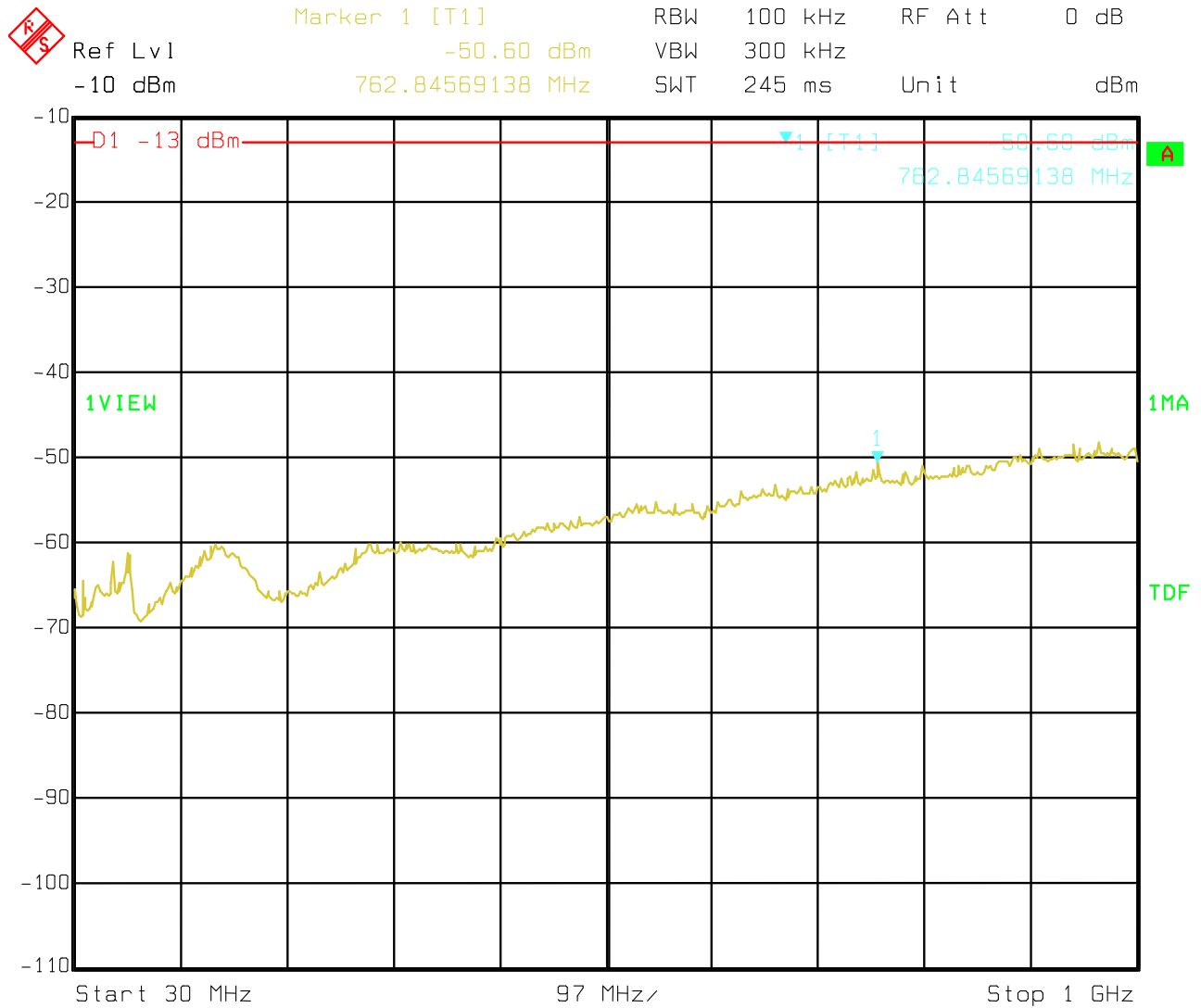
Frequency (MHz)	Polarization. V/H	Field strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Low channel				
Mid channel				
High channel				

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.



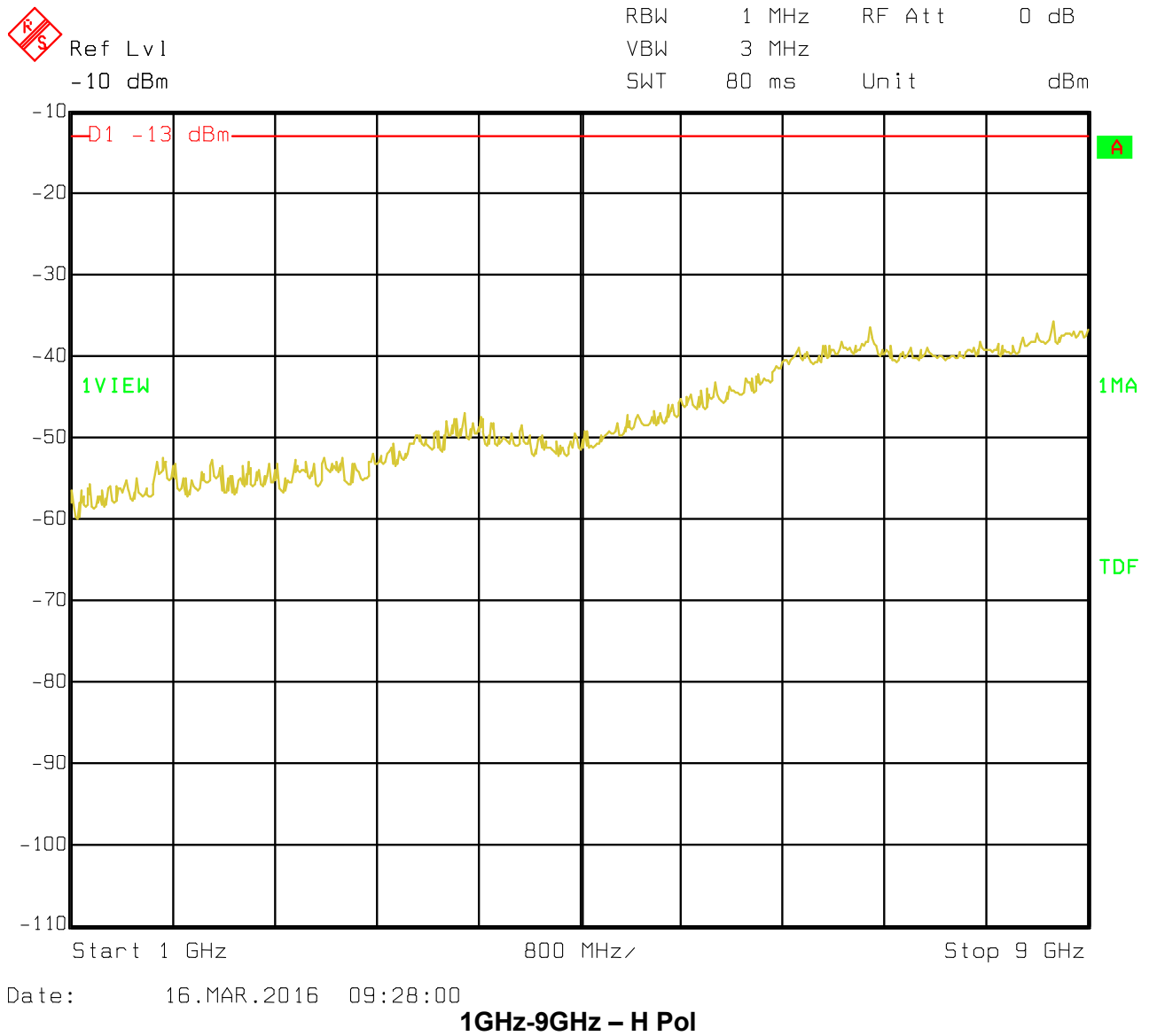
Date: 16.MAR.2016 08:18:43

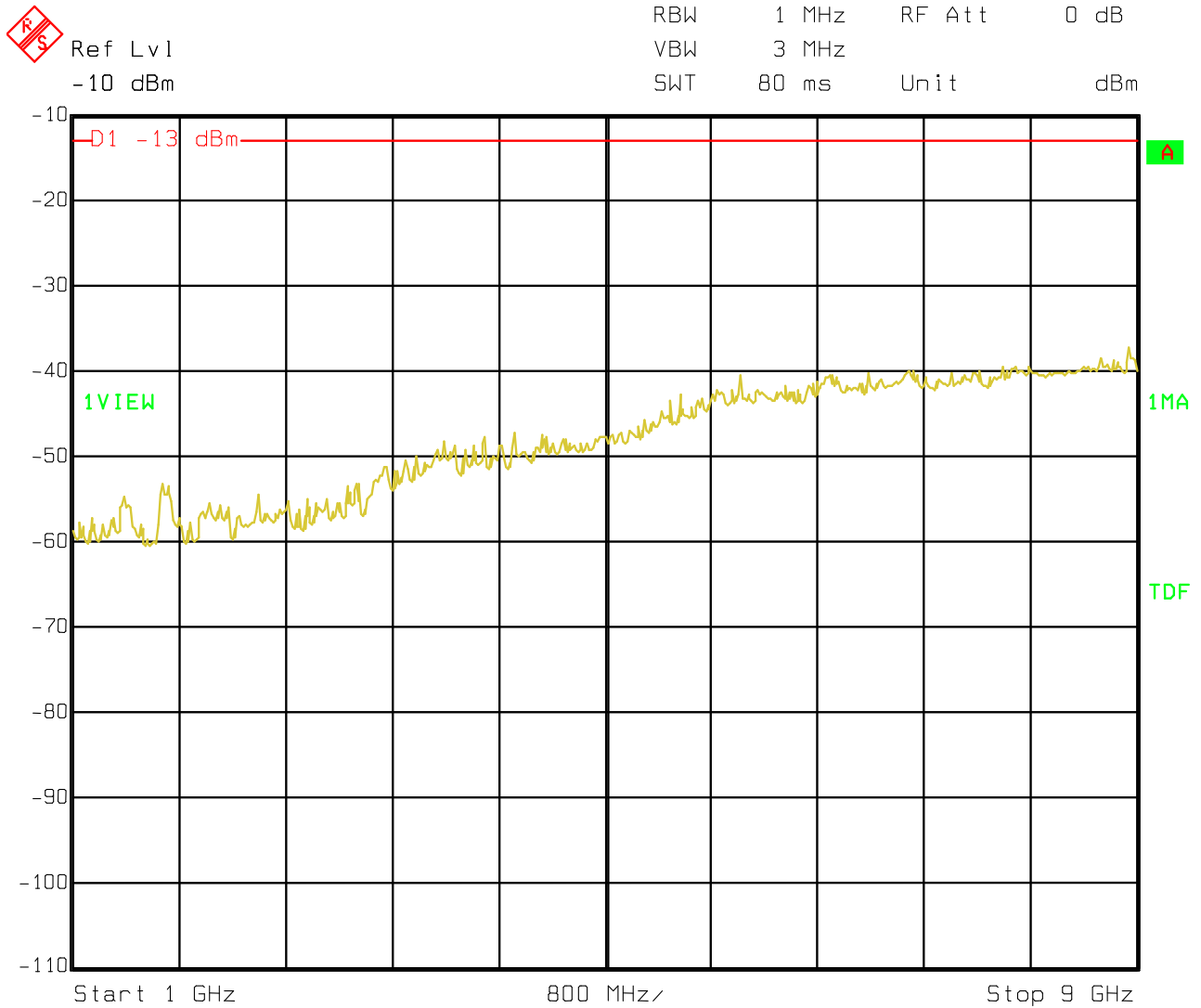
30MHz-1GHz – H Pol



Date: 16.MAR.2016 08:24:29

30MHz-1GHz – V Pol





Date: 16.MAR.2016 09:31:17

1GHz-9GHz – 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

Note:

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

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

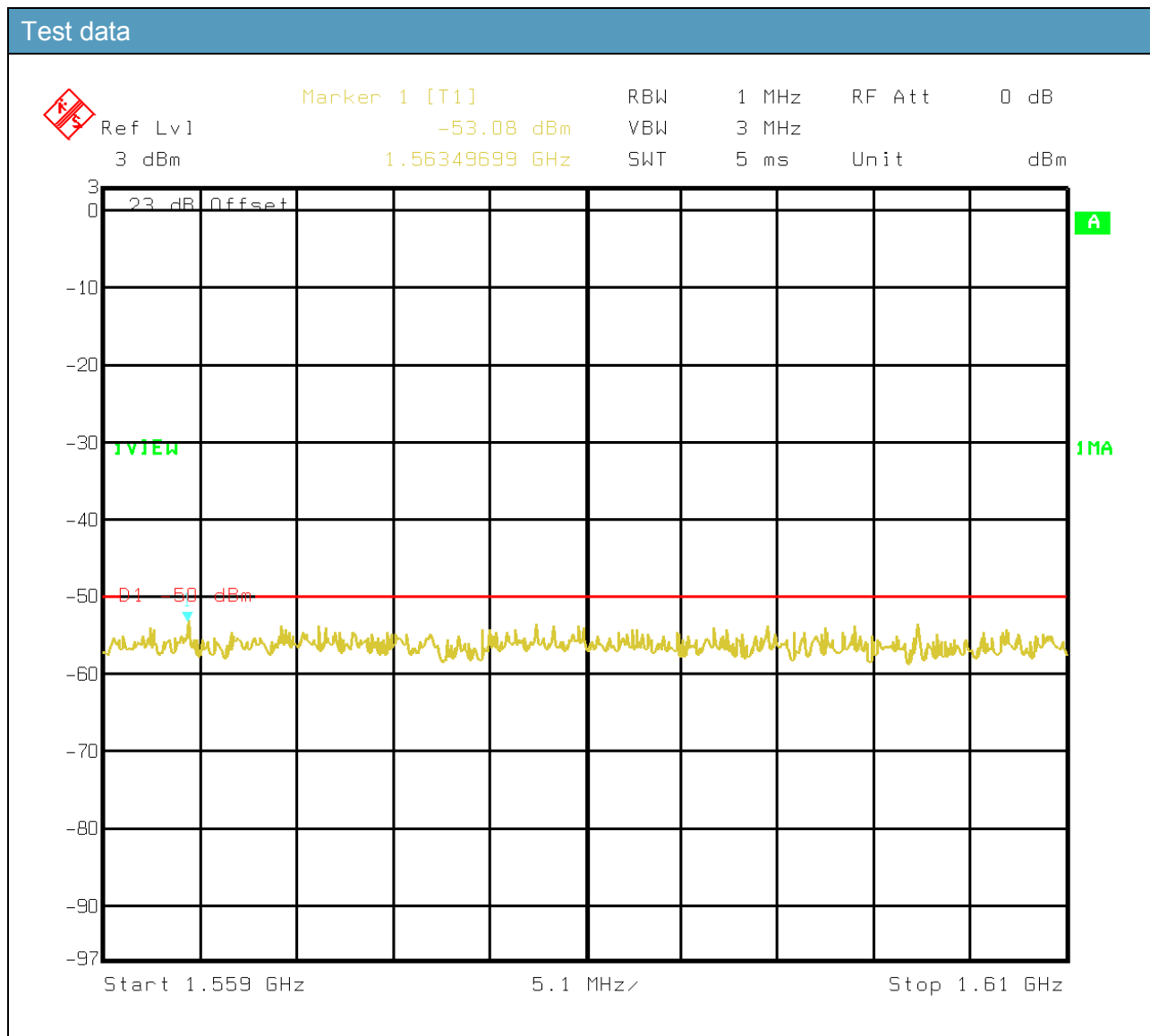
Test date: 2016-03-16

Test results: Pass

Special notes

- The spectrum was searched from 1559–1610 MHz.
- All measurements were performed using a peak detector.
- The measurements were performed at the distance of 3 m.
- RBW was set to 1 MHz and VBW was wider than RBW

Result of D.L. 31 dBm, 763.0 MHz,

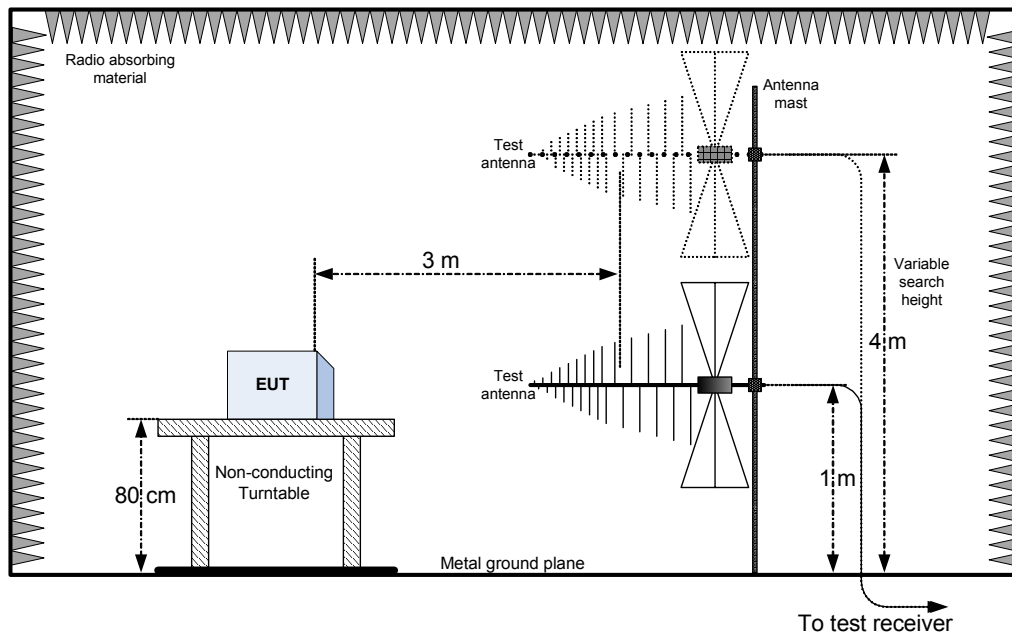


Spurious emissions measurement results:				
Frequency (MHz)	Polarization. V/H	Result Eirp (dBm)	Limit eirp (dBm)	Margin (dB)
1563.49	V(max. eirp)	-53.08	-50	-3.08

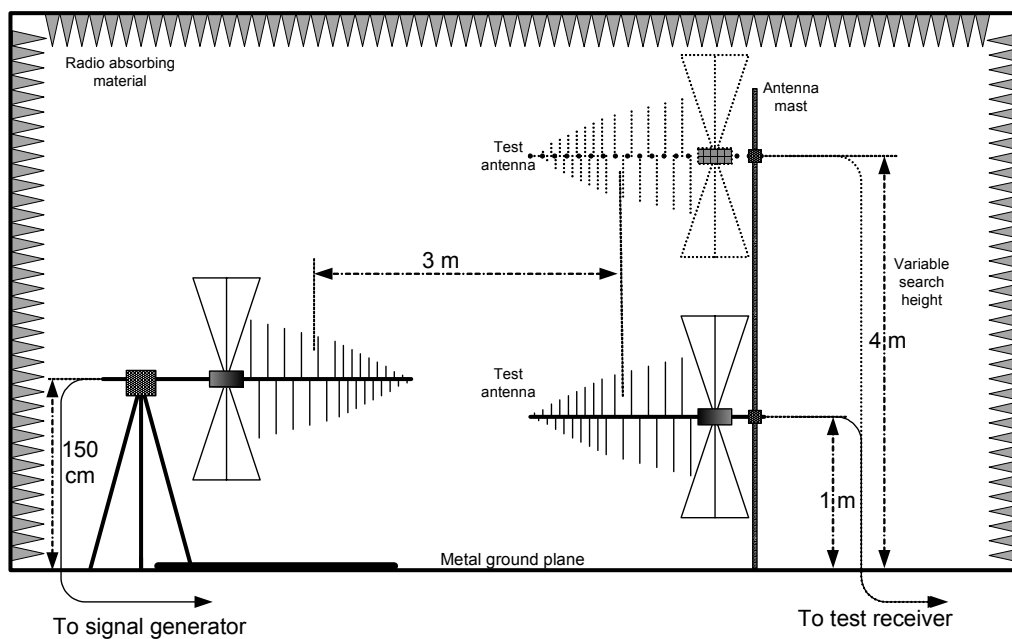
Limit used for discrete emissions: -80 dBw = -50 dBm

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up



Substitution method set-up



Appendix C: EUT Photos

Photo Set up



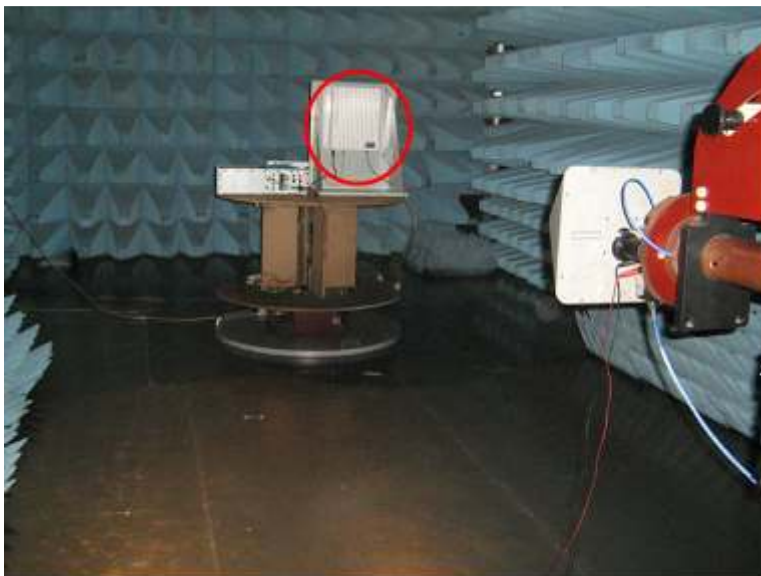
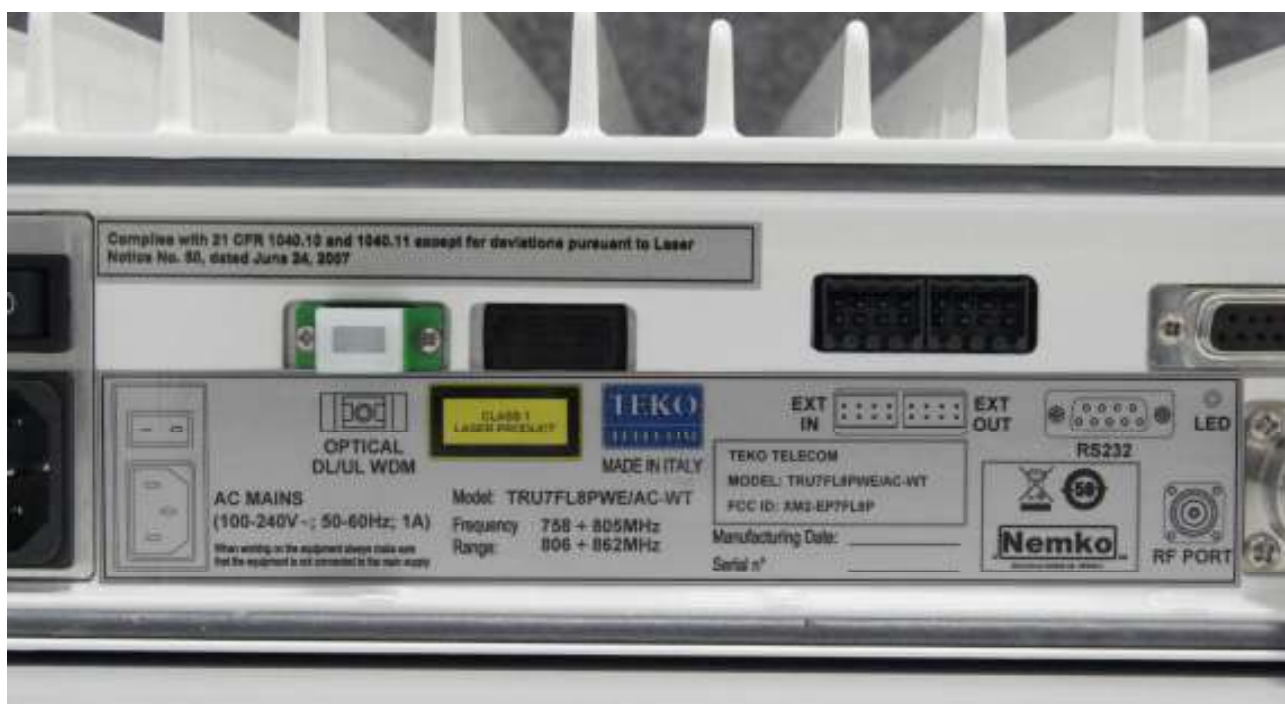


Photo EUT





Label EUT



WARNING. This is NOT a CONSUMER device. This is a 90.219 Class B signal booster. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signal-boosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.