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| Report Reference ID: | 278619-1TRFWL |
|----------------------|---------------|

| | |
|---------------------|---|
| 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 |
|---------------------|---|

| | |
|------------|---|
| Applicant: | TEKO Telecom Srl Via Meucci, 24/a I-40024 Castel S. Pietro Terme (BO) (Italy) |
| Apparatus: | Very High Power Amplifier |
| Model: | MVHPA0001S8 |
| FCC ID: | XM2-VHPA |

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

| | Name and title | Date |
|--------------|---|------------|
| Tested by: |  G. Curioni, Wireless/EMC Specialist | 2015-03-13 |
| Reviewed by: |  P. Barbieri, Wireless/EMC Specialist | 2015-03-13 |

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Section 1: Report summary

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Spa.

Test specification:

FCC Part 90 Private land mobile services

Subpart I – General technical standards

| | |
|-------------------------|---|
| Compliance status: | Complies |
| Exclusions: | None |
| Non-compliances: | None |
| Report release history: | Original release |
| Test location: | Nemko Spa Via Del Carroccio, 4 – 20853 Biassono (MB) - Italy |
| Registration number: | 481407 (10 m Semi anechoic chamber) |

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.

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Section 2: Equipment under test

2.1 Identification of equipment under test (EUT)

The following information identifies the EUT under test:

| | |
|-------------------------|---------------------------|
| Type of equipment: | Very High Power Amplifier |
| Product marketing name: | Teko Telecom Srl |
| Model number: | MVHPA0001S8 |
| Serial number: | na |
| Nemko sample number: | -- |
| FCC ID: | XM2-VHPA |
| Date of receipt: | 2015-03-09 |

2.2 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: | Teko Telecom |
| Model name or number: | MPSURU28AC1K0001 |
| Serial number: | na |
| Nemko sample number: | na |
| Description: | To supply amplifier |
| Cable length and type: | |

Item # 2

| | |
|------------------------|-----------------------------------|
| Type of equipment: | Power Supply |
| Brand name: | DF |
| Model name or number: | DF1731SB |
| Serial number: | na |
| Nemko sample number: | na |
| Description: | To supply cooling fan of heatsink |
| Cable length and type: | |

Item # 3

| | |
|------------------------|--|
| Type of equipment: | |
| Brand name: | |
| Model name or number: | |
| Serial number: | |
| Nemko sample number: | |
| Connection port: | |
| 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: | |

Section 2: Equipment under test, continued

2.3 EUT description

See confidential block diagram and operational description

2.4 Technical specifications of the EUT

| | | |
|------------------------|---|--|
| Operating band: | Down Link: 851–862 MHz, Up Link: 806-817 MHz | |
| Operating frequencies: | Wideband | |
| Modulation type: | iDEN, FM | |
| Occupied bandwidth: | Standard | |
| Channel spacing: | Standard | |
| Emission designator: | iDEN: D7W FM: F3E (Voice) | |
| RF Output | Down Link: 43dBm (20W) Up Link: N.A. (The EUT does not transmit over the air in the up-link direction) | |
| Gain | Down Link: 48dB Up Link: N.A. (The EUT does not transmit over the air in the up-link direction) | |
| Antenna data: | No antenna provided | |
| Antenna type: | No antenna provided | |
| | External Antenna (Equipment that has an external 50 Ω RF connector) | |
| Power source | 28-30 Vdc | |

Section 2: Equipment under test, continued

2.5 EUT setup diagram

In this system, 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.

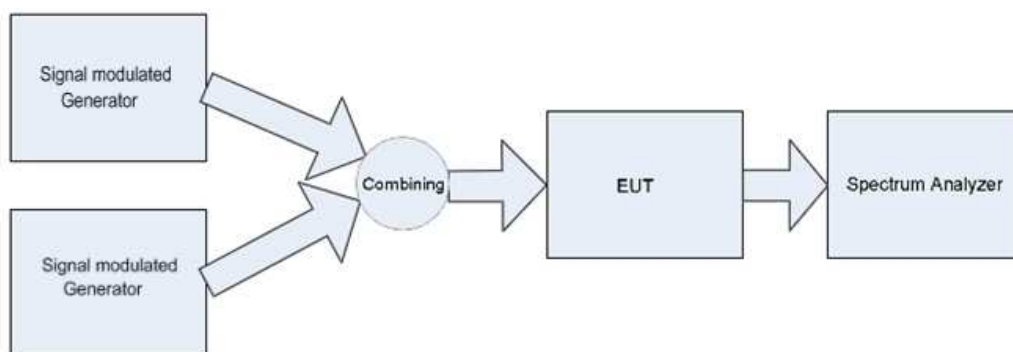
Test setup for output power, occupied bandwidth, spurious emissions:



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.

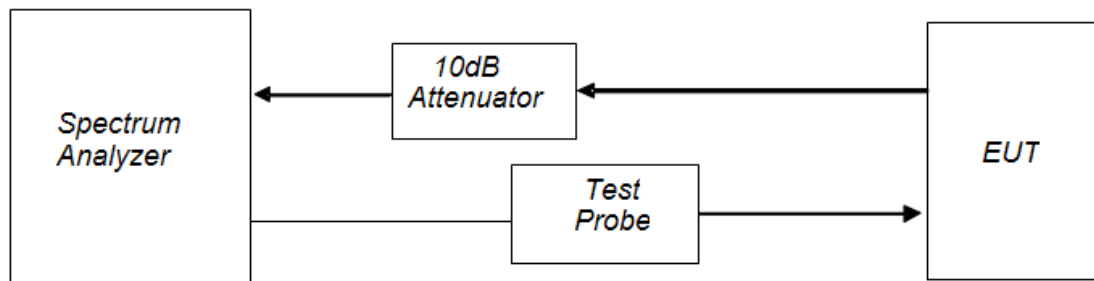
Test setup for intermodulation:



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 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.

2.6 Operation of the EUT during testing

In down-link direction, normal working at max gain with max RF power output

2.7 Modifications incorporated in the EUT

None

There were no modifications performed to the EUT during this assessment

Section 3: Test conditions

3.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

3.2 Test conditions, power source and ambient temperatures

| | |
|---|---|
| Normal temperature, humidity and air pressure test conditions | <p>Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa</p> <p>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.</p> |
| Power supply range: | <p>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.</p> |

Section 3: Test conditions, continued

3.3 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.

3.4 Test equipment

| Equipment | Manufacturer | Model No. | Asset/Serial No. | Next cal. |
|---------------------------------------|--------------|---------------------------|------------------|-----------|
| Vector Signal Generator | Agilent | N5172B EXG | MY53050534 | Feb 2017 |
| Vector Signal Generator | Agilent | E4438C ESG | MY45094485 | Ago 2016 |
| Spectrum Analyzer | Agilent | N9030A PXA | MY53120882 | Apr 2015 |
| Network Analyzer | Agilent | E5071B ENA | MY46418709 | Jan 2016 |
| -- | -- | -- | -- | -- |
| EMI Receiver | R & S | ESCI | 100888 | 08/2015 |
| V-network | R & S | ESH2-Z5 | 872 460/041 | 09/2015 |
| Trilog Broad Band Antenna 25-2000 MHz | Schwarzbeck | VULB 9168 | VULB 9168-242 | 02/2015 |
| Trilog Broad Band Antenna 25-8000 MHz | Schwarzbeck | VULB 9162 | VULB 9162-25 | 05/2015 |
| Antenna 1-18 GHz | Schwarzbeck | STLP 9148 | STPL 9148-123 | 02/2015 |
| Double ridge waveguide horn | RFspin | DRH40 | 061106A40 | 08/2016 |
| Preamplifier 18-40 GHz | Miteq | JS44 | 1648665 | 11/2015 |
| Broadband preamplifier 1-18 GHz | Schwarzbeck | BBV 9718 | 9718-137 | 10/2015 |
| EMI receiver 20 Hz ÷ 8 GHz | R&S | ESU8 | 100202 | 02/2015 |
| EMI receiver 20 Hz ÷ 3 GHz | R&S | ESCI | 100888 | 08/2015 |
| 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 | 08/2015 |
| 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 |
| V-Network | R & S | ESH2-Z5 | 872 460/041 | 09/2015 |

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

Section 4: Result summary

4.1 FCC Part 90: test results

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

| | |
|-----|--|
| N | No : not applicable / not relevant. |
| Y | Yes : Mandatory i.e. the apparatus shall conform to these tests. |
| N/T | Not Tested, mandatory but not assessed. (See report summary) |

| Part | Test method | Test description | Required | Result |
|---|-------------|--|----------|--------|
| §90.205 §90.219(e)(1) | §2.1047 | Output power | Y | Pass |
| §90.209, §90.210(g), §90.210(h), §90.691, §90.219(e)(4) | §2.1049 | Occupied bandwidth | Y | Pass |
| §90.209, §90.210(g), §90.210(h), §90.691, §90.219(e)(3) | §2.1051 | Spurious Emissions at the antenna terminal | Y | Pass |
| §90.209 §90.219(e)(3) | §2.1053 | Field strength of spurious radiation | Y | Pass |
| §90.213 | §2.1055 | Frequency stability | N | N/A a) |
| §90.214 | -- | Transient Frequency Behaviour | N | N/A b) |
| §90.219(e)(2) | -- | Noise Figure | Y | Pass |
| 935210 D02v02r01 (D.3)(i) | -- | Intermodulation | Y | Pass |
| 935210 D02v02r01 (D.3)(l) | -- | Out of Band Rejection (Filter Frequency Response) | Y | Pass |

Notes:

- a) NOT APPLICABLE: Modulation/frequency conversion circuitry not in use. No frequency change in EUT (input and output have same frequency).
- b) NOT APPLICABLE: different working band

Appendix A: Test results

Clause 90.205, 90.219(e)(1) Output power

§ 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).

§ 90.219(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: 2015-03-11

Test results: Pass

Special notes

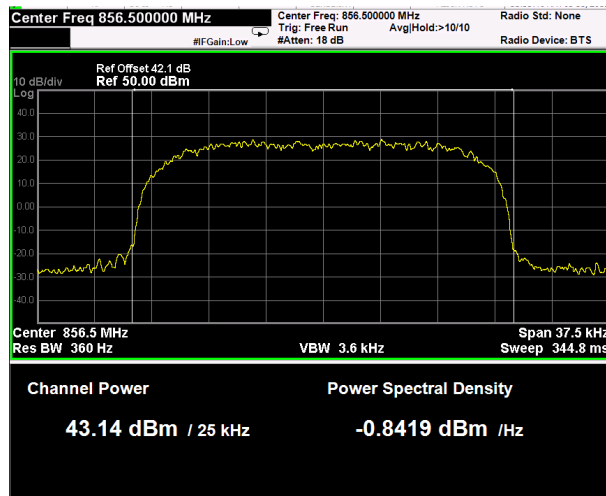
Conducted measurement were performed:

- The power was measured using spectrum analyzer with RMS detector / average power meter.

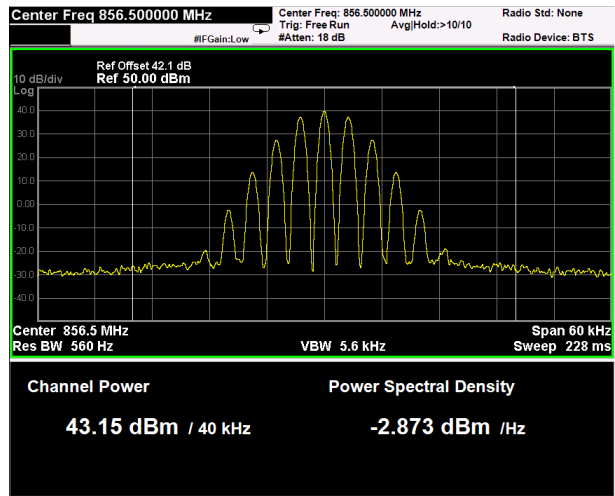
In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13dB.

Only conducted measurement at antenna connector was possible, no antenna provided by manufacturer.

| Test data | | | | | |
|-----------|---------------|-----------------|-------------------------------|-----------------------------|----------|
| Direction | Modulation | Frequency (MHz) | RF output channel Power (dBm) | RF output channel Power (W) | PAR (dB) |
| Down-link | iDEN (25 kHz) | 856.5 | 43.14 | 20,6 | 3.23 |
| Down-link | FM | 856.5 | 43.15 | 20,6 | --- |



Mod. iDEN



Mod. FM

| Test result |
|--|
| <p>In a DAS system, we suppose a loss due to cable insertion, splitter, etc, about of 12dB.</p> <p>$G_{\text{max antenna gain (dBi)}} = \text{EIRP} - P_{\text{out}} + \text{insertion loss} = 39 - 43.15 + 12.15 = 8 \text{ dBi}$</p> <p>$\text{EIRP} = P_{\text{out}} - \text{insertion loss} + G_{\text{max antenna gain (dBi)}} = 43.15 - 12.15 + 8 = 39 \text{ dBm}$</p> <p>$\text{ERP} = 39 - 2.14 = 36.86 \text{ dBm} = 4.85 \text{ W} < 5 \text{ W ERP}$</p> |

Clause 90.209, 90.210(g), 90.210(h), 90.219(e)(4), 90.691 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).

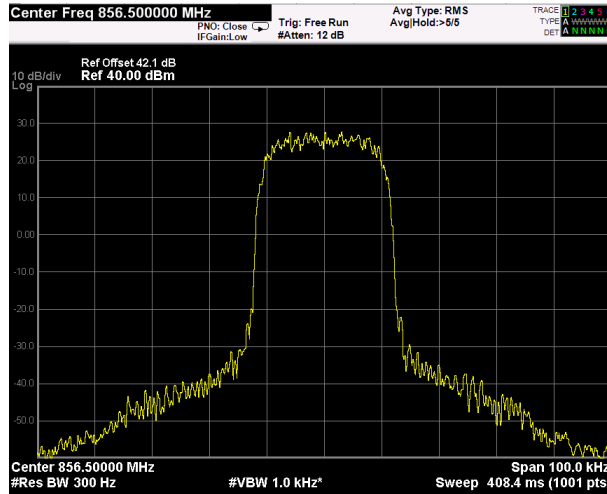
Test date: 2015-03-11

Test results: Pass

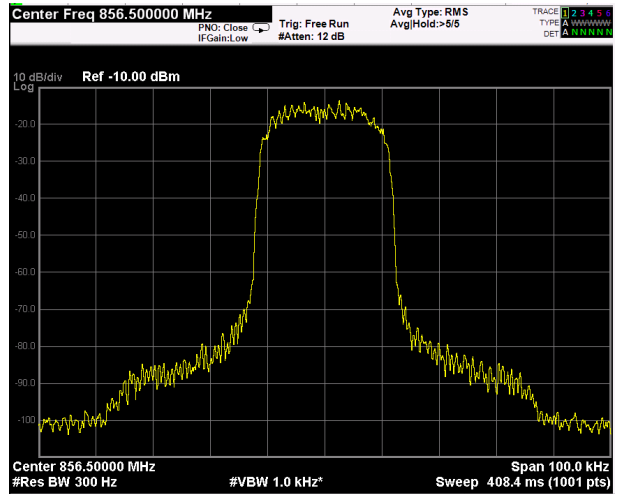
Test data

Resolution bandwidth was set wider or equal than occupied bandwidth.

Mod. iDEN (QAM)

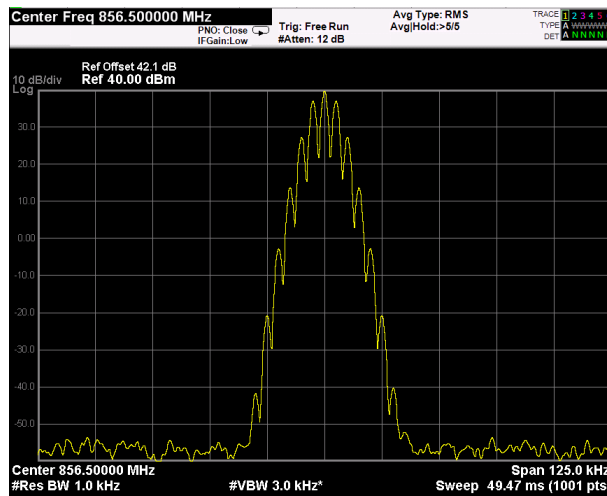


Output

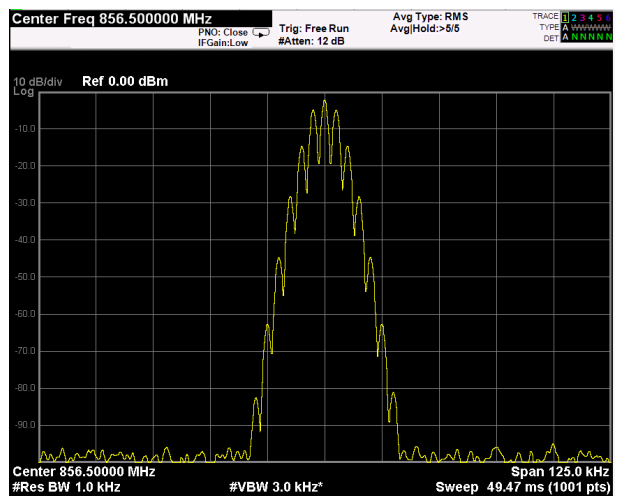


Input

Mod. FM



Output



Input

Clause 90.209, 90.210(g), 90.210(h), 90.219(e)(3), 90.691 Spurious emissions at the antenna terminal

§ 90.210(g)

Emission Mask G. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(2) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB

§ 90.210(h)

Emission Mask H. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least $43 + \log (P)$ dB.

§ 90.219(e)(3)

Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

§ 90.691

Emission mask requirements for EA-based systems.

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

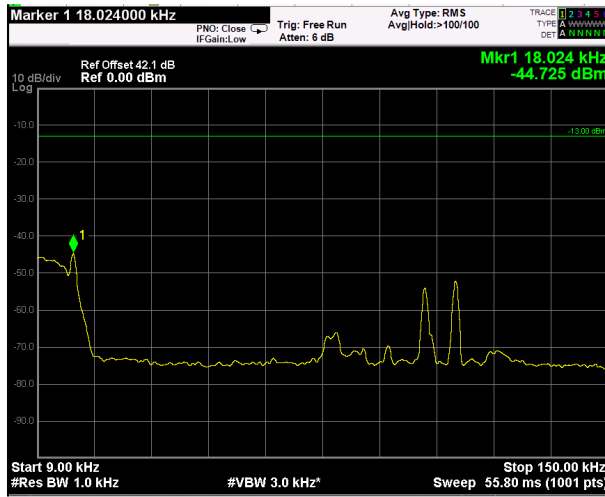
Test date: 2015-03-11

Test results: Pass

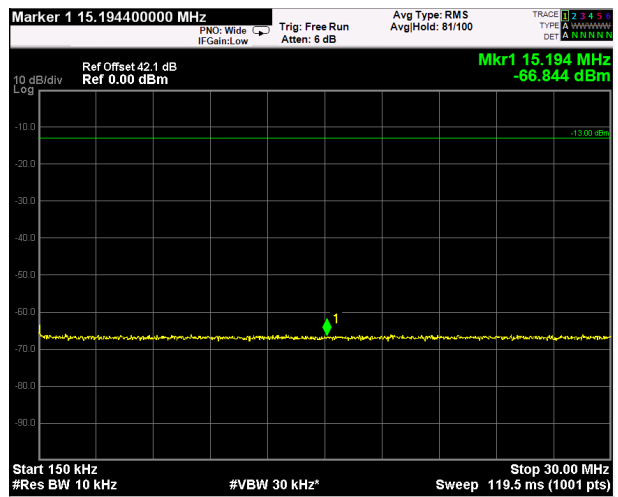
Special notes

Spurious emissions at antenna terminal:

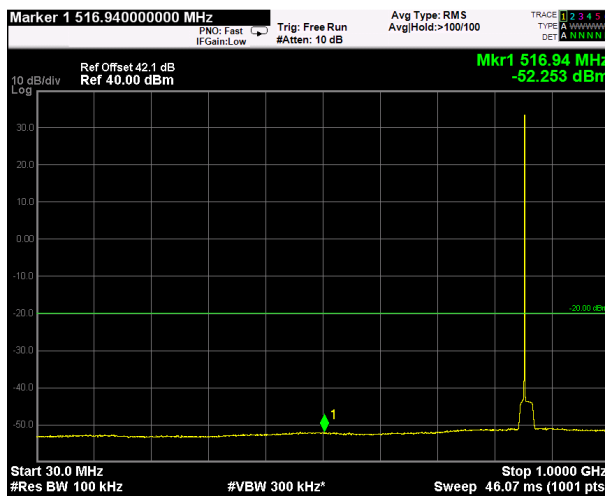
Mod. iDEN (QAM) (Down-link)



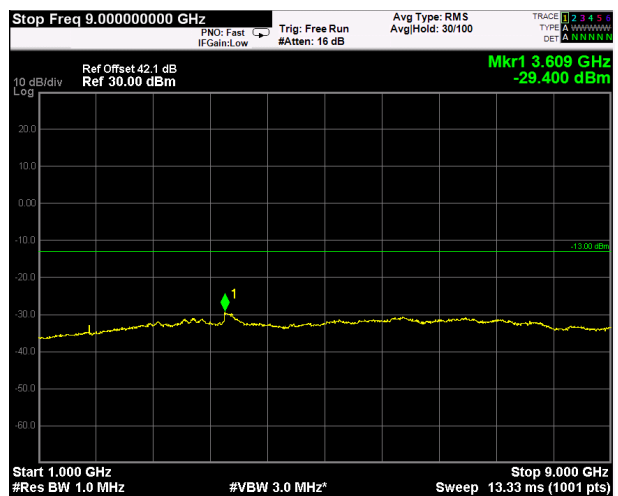
9kHz-150kHz



150kHz-30MHz

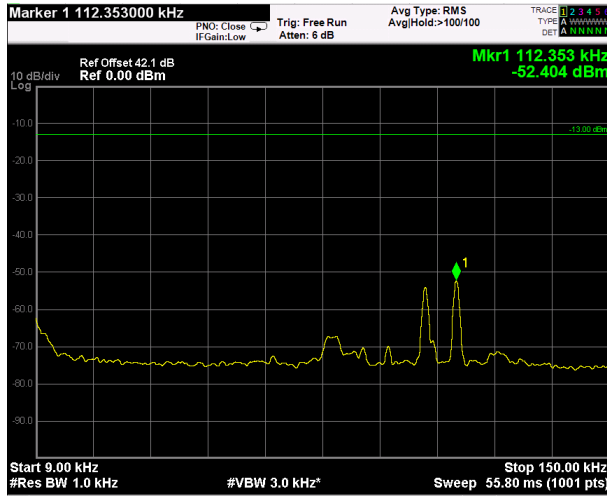


30MHz-1GHz

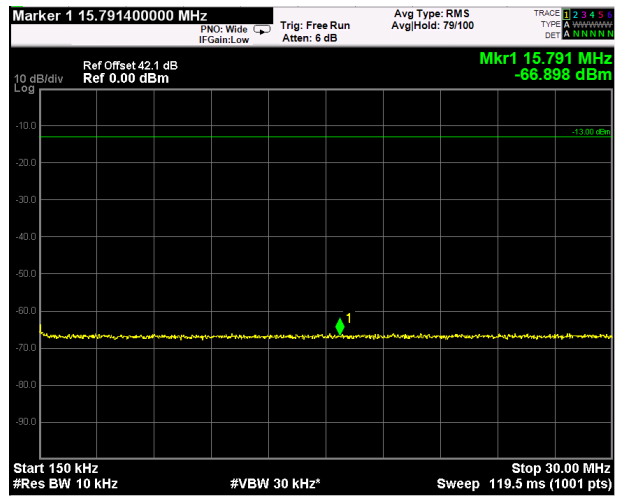


1GHz-9GHz

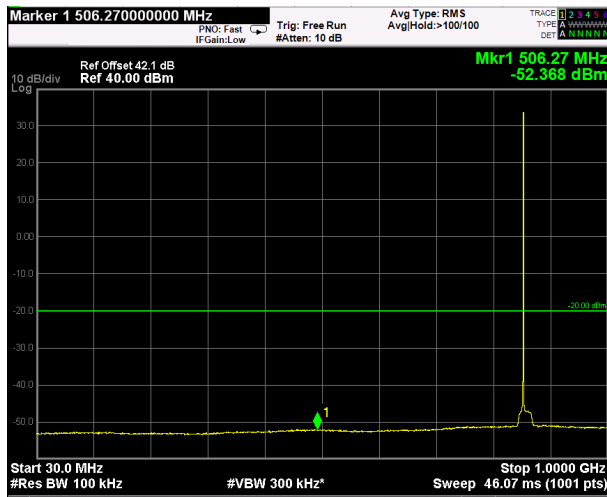
Mod. FM



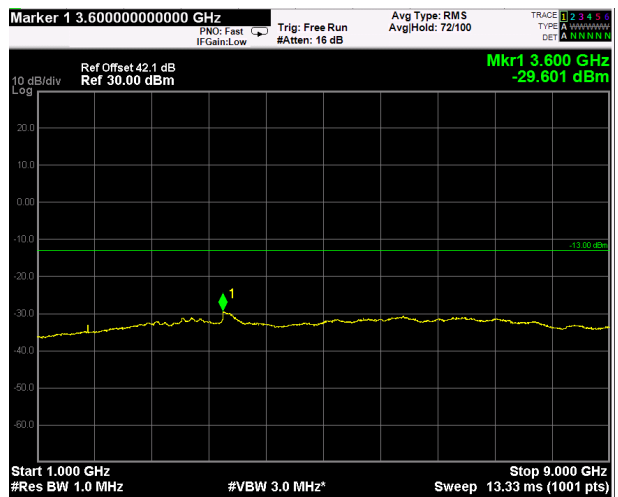
9kHz-150kHz



150kHz-30MHz



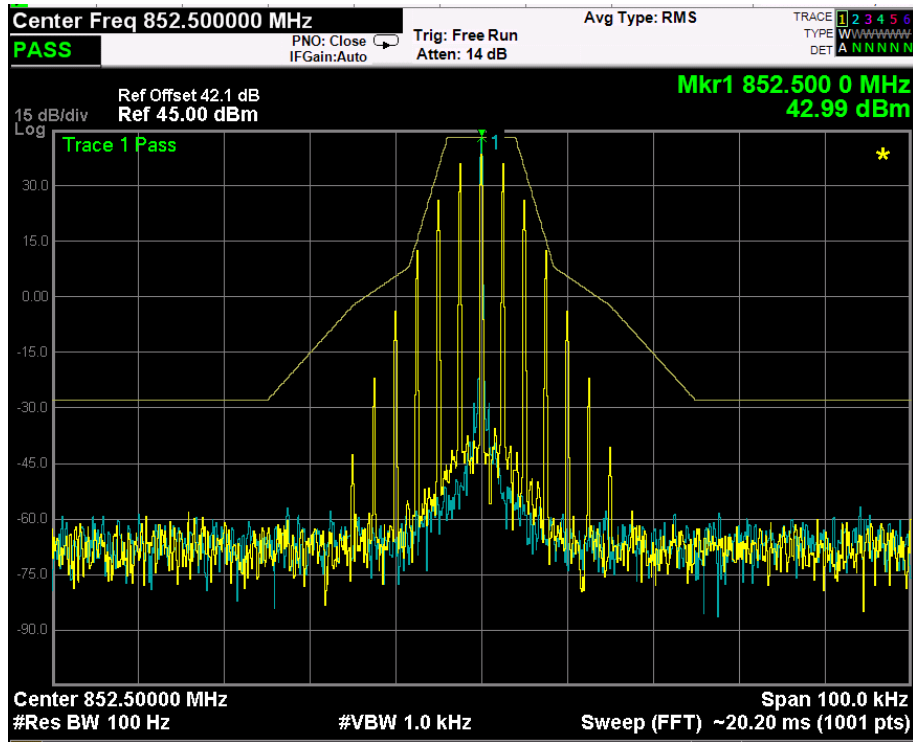
30MHz-1GHz



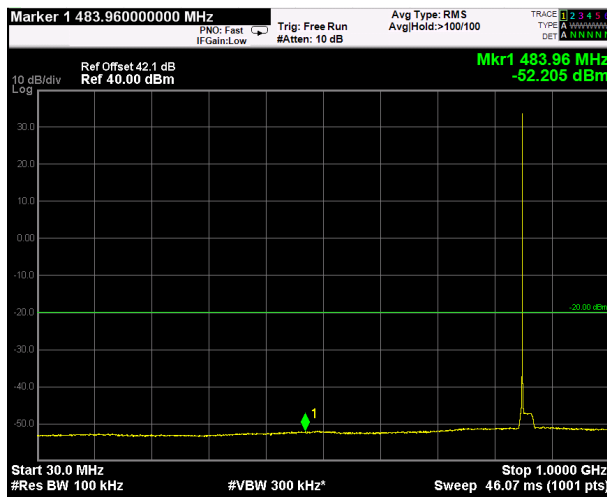
1GHz-9GHz

Spurious emissions at antenna terminal: Mask H

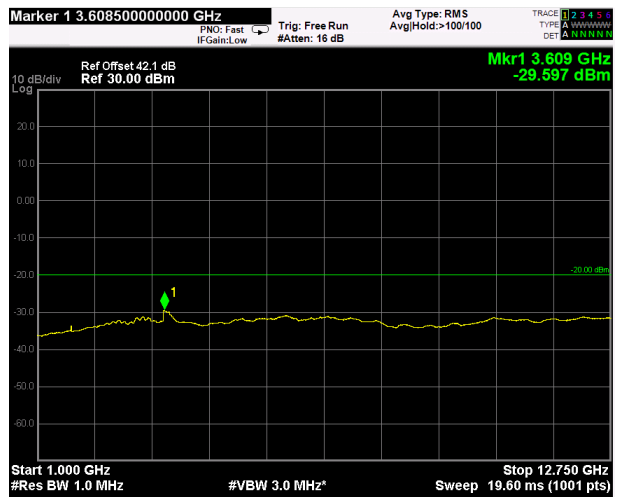
Mod. FM (Frequency band 851-854MHz)



Mask H



30MHz-1GHz



1GHz-9GHz

Clause 90.209, 90.219(e)(3) Field strength of spurious radiation

§ 90.219(e)(3)

Spurious emissions from a signal booster must not exceed –13 dBm within any 100 kHz measurement bandwidth.

§ 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

Test date: 15-03-11

Test results: Pass

Special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
- The EUT was measured on three orthogonal axis.
- All measurements were performed at a distance of 3 m.
- Only the worst data presented in the test report.

Clause 90.210 Field Strength of spurious radiation, 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.

Clause 90.219(e)(2) Noise Figure

§ 90.219(e)(2)

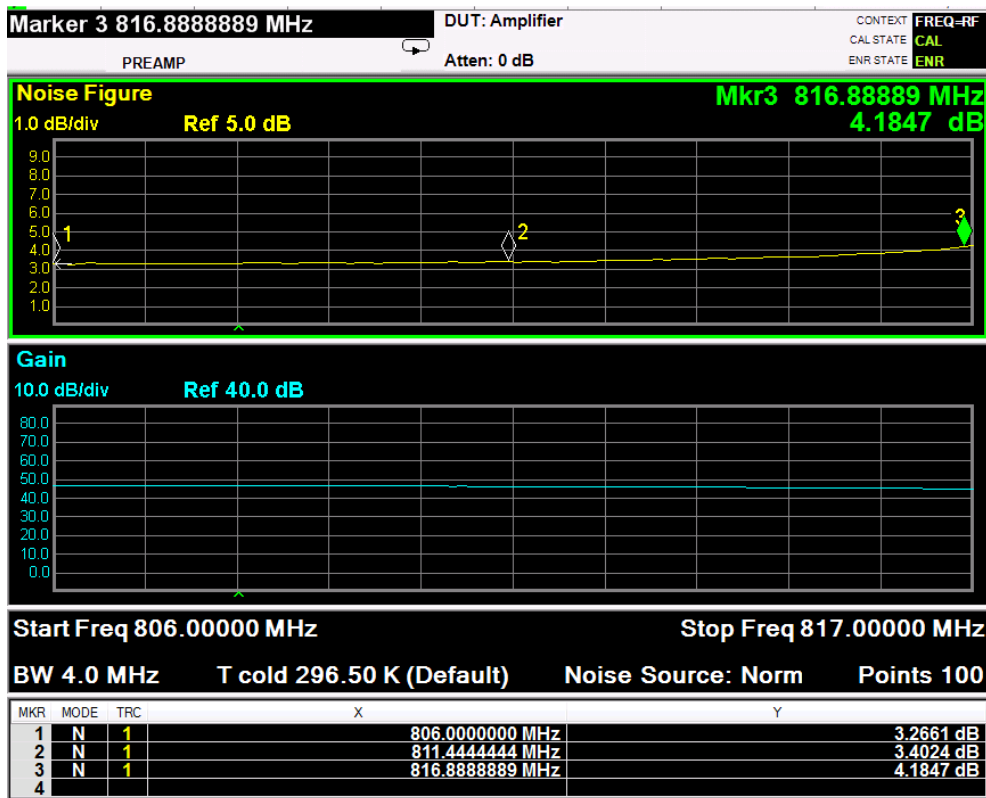
The noise figure of a signal booster must not exceed 9 dB in either direction.

Test date: 2015-03-11

Test results: Pass

Special notes

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



Clause 935210 D02v02r01 Appendix D.3 (i) Intermodulation

Intermodulation – Test all modulation types [TDMA, CDMA, and FM (covers GSM and F1D)]

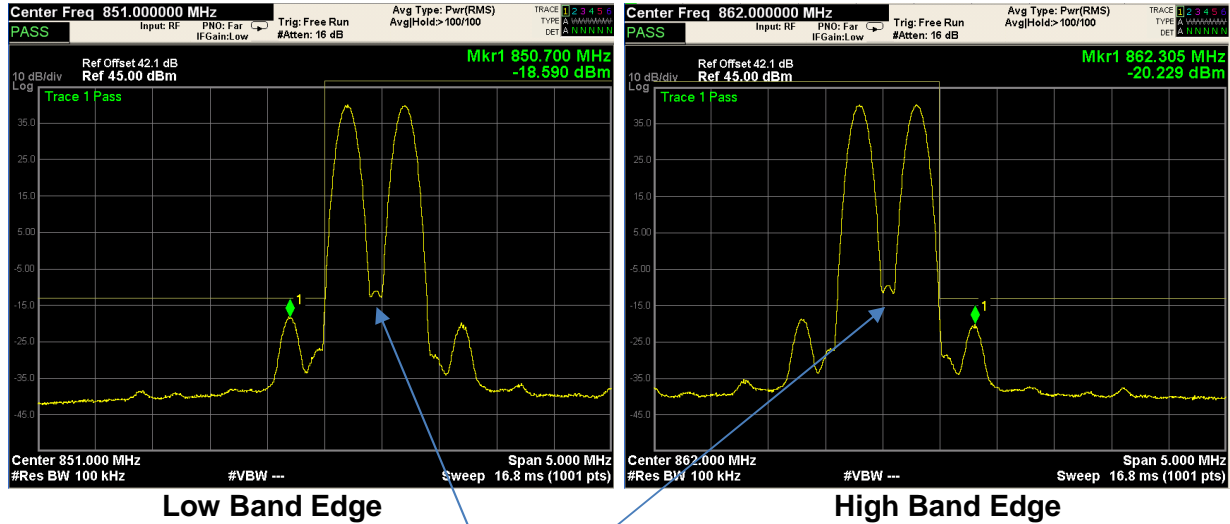
- (1) For part 90 boosters, apply the requirements of § 90.219(d) and (e).
- (2) For other boosters: (i) CW signal rather than typical signal is acceptable (for FM).
 - (ii) At maximum drive level, for each modulation: one test with three tones, or two tests (high-band edge, low- band edge) with two tones
 - (iii) Limit usually is -13 dBm conducted.
 - (iv) Not needed for Single Channel systems.
 - (v) Combination of modulation types not needed.

Test date: 2015-03-11

Test results: Pass

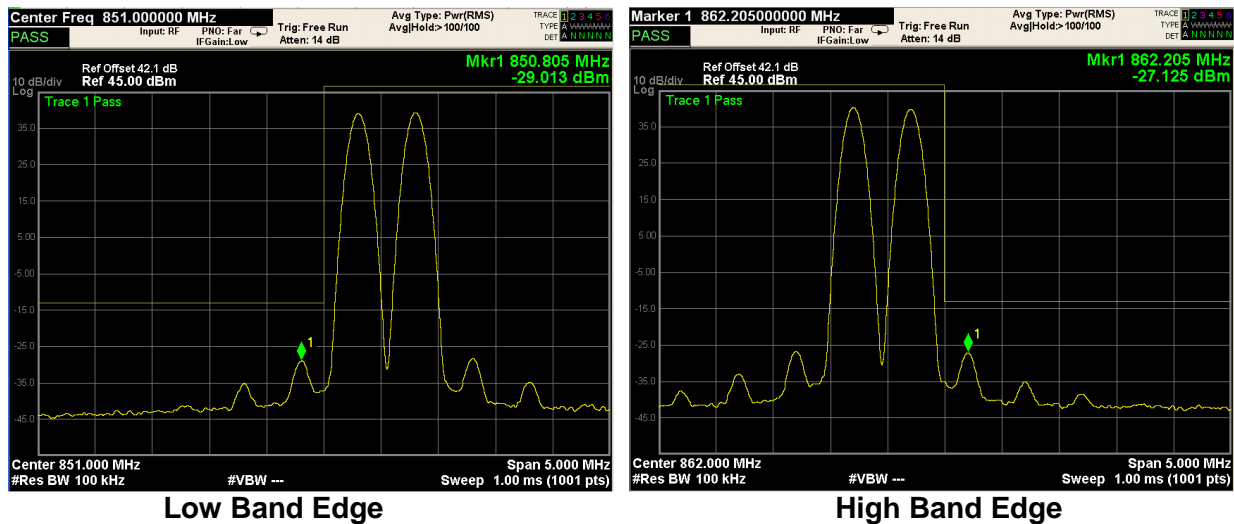
Special notes

Mod. iDEN (QAM) (Down-link)



The in-band signal between the two tones is internally generated by the "multicarrier" feature of the signal generator.

Mod. FM

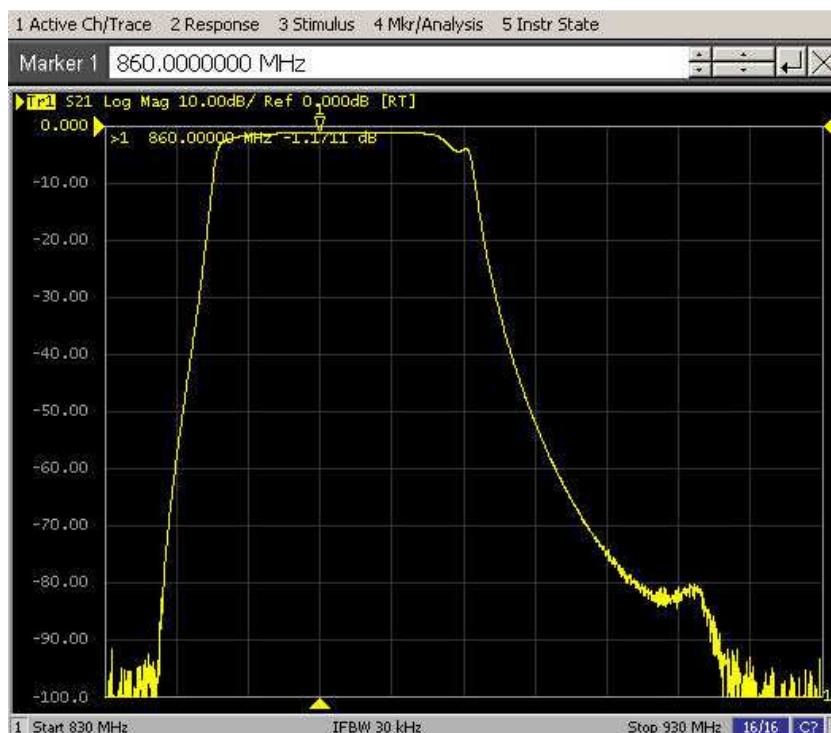


Clause 935210 D02v02r01 (D.3)(I) Out of band rejection

Out of Band Rejection – Test for rejection of out of band signals.
Filter frequency response plots are acceptable.

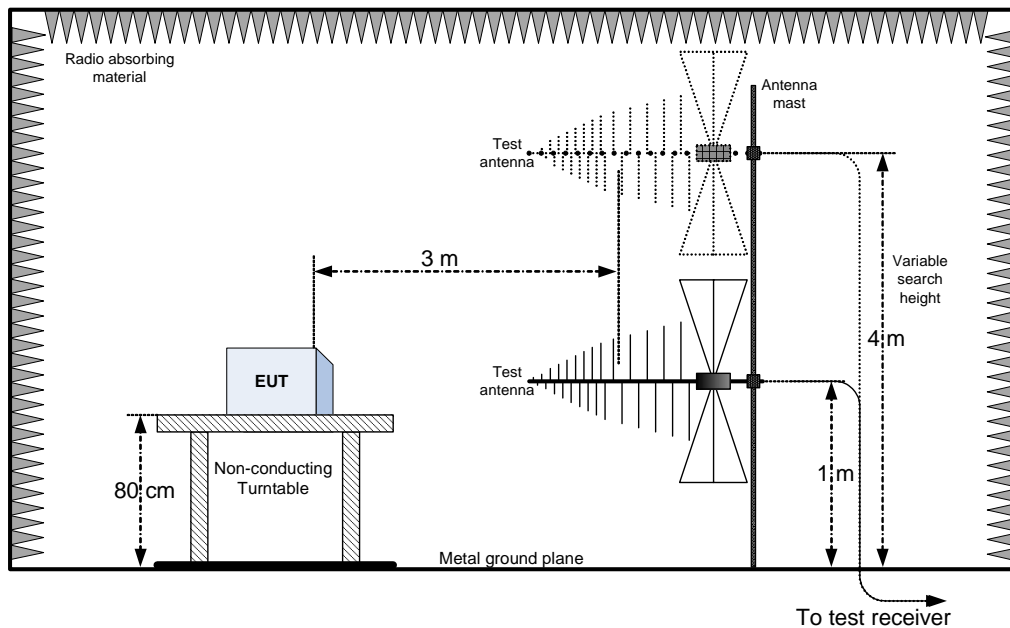
Test date: 2015-03-10

Test results: Pass

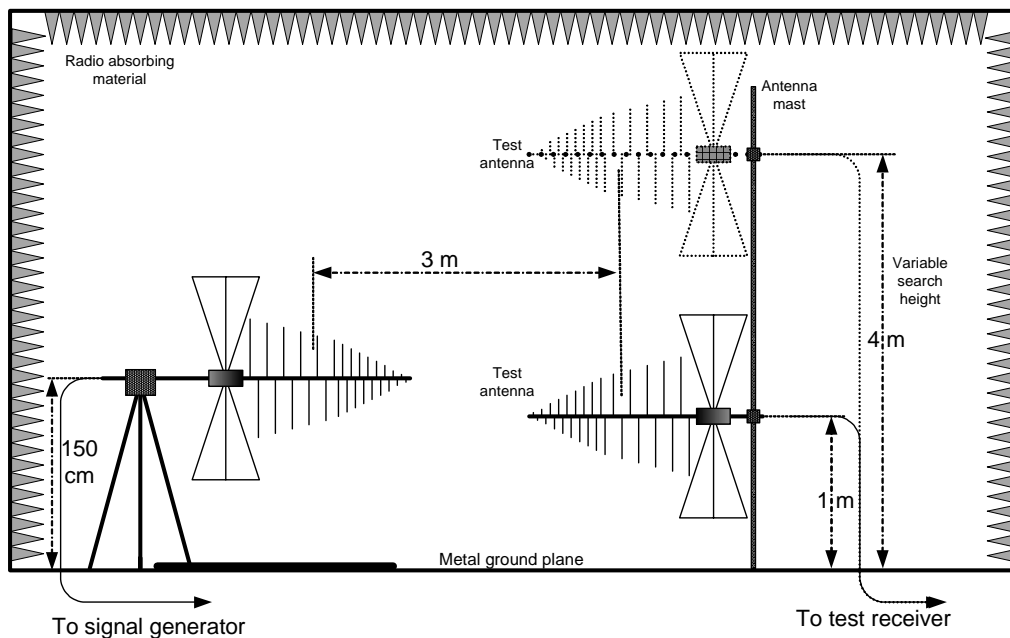


Appendix B: Block diagrams of test set-ups

Radiated emissions set-up

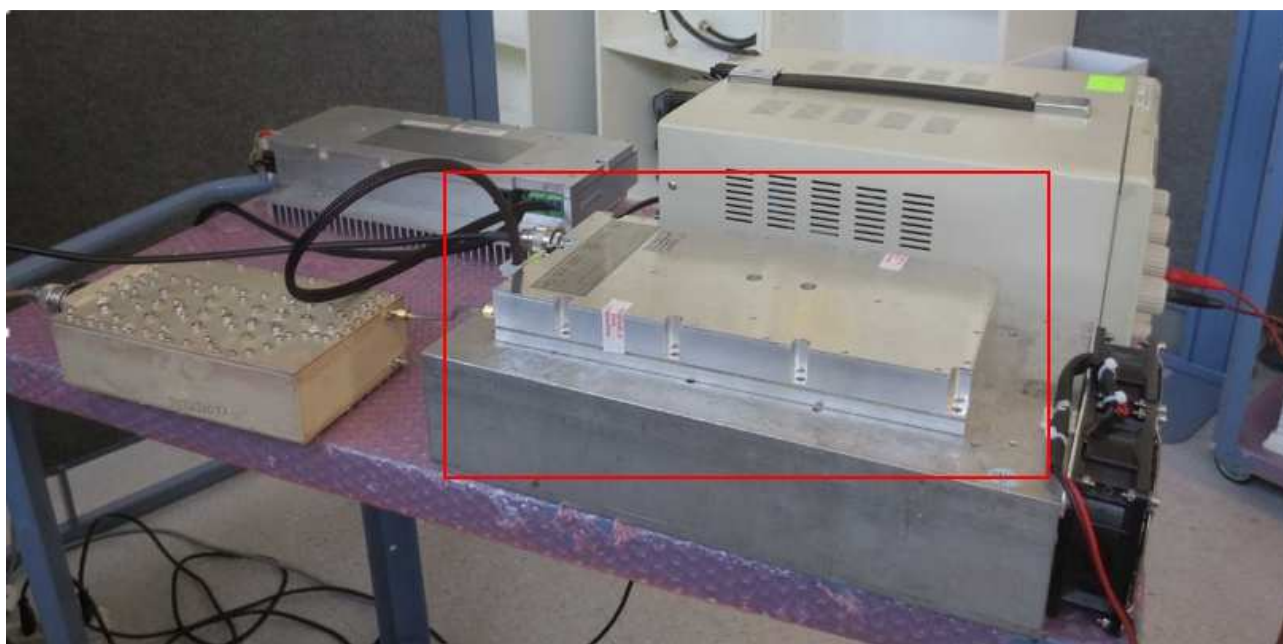


Substitution method set-up



Appendix C: EUT Photos

Photo Set up



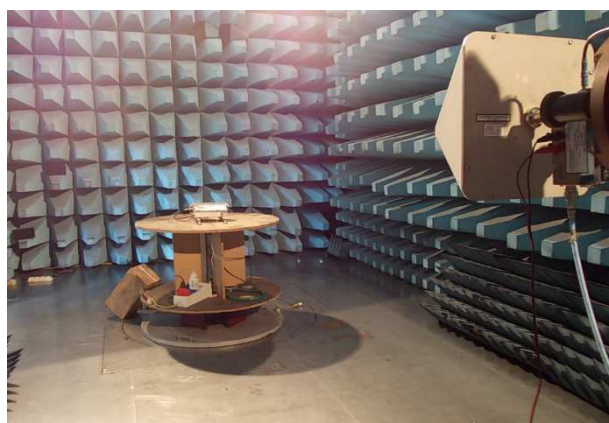
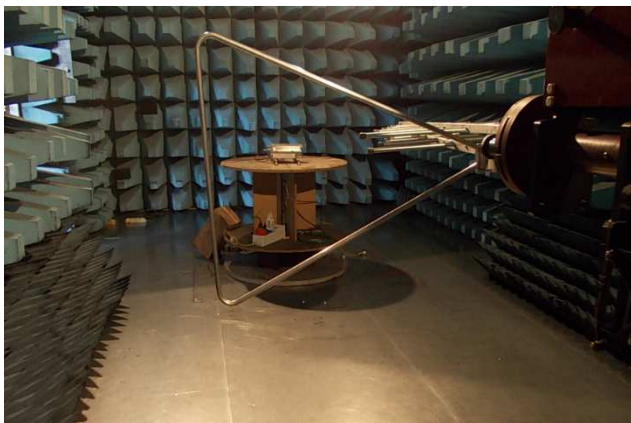


Photo EUT



Label EUT

TEKO TELECOM
MODEL: MVHPA0001S8
FCC ID: XM2-VHPA

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.