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Test report

267266-1TRFWL

Date of issue: March 5, 2015

Applicant:

Andrew Wireless Innovations Group

Product:

ION-E

Model:

UAP

FCC ID:

BCR-IONEUAP

Specification:

FCC 47 CFR Part 27

Miscellaneous wireless communications services

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC test site registration number: 176392, IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Date	March 5, 2015
Signature	

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. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Andrew Wireless Innovations Group
Address	620 N Greenfield Parkway
City	Garner
Province/State	NC
Postal/Zip code	27529
Country	USA

1.2 Test specifications

FCC 47 CFR Part 27	Miscellaneous Wireless Communications Services
935210 D02 Signal Boosters Certification v02r01	Appendix D booster, amplifier, and repeater interim basic authorization procedures
KDB 935210 D04	Provider Specific Booster Measurements v01

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.4 Exclusions

None

1.5 Test report revision history

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

Section 2. Summary of test results

2.1 FCC Part 27 test results

Part	Test description	Verdict
§27.50(b)	Peak output power at RF antenna connector	Pass
§27.53(c)	Spurious emissions at RF antenna connector	Pass
§27.53(c)	Radiated spurious emissions	Pass
§27.53(f)	Radiated spurious emissions within 1559–1610 MHz band	Pass
§27.54	Frequency stability	Pass
§2.1049	Occupied bandwidth	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	August 18, 2014
Nemko sample ID number	1

3.2 EUT information

Product name	ION-E
Model	UAP
Serial number	18

3.3 Technical information

Operating band	746–757 MHz (LTE)
Modulation type	LTE (QPSK and QAM) 1.4, 3, 5, 10 MHz
Power requirements	110 V_{AC}, ~3 A for entire system tested
Emission designator	D7W
Gain	20 dB
Antenna information	External Antenna is not provided EUT used a 50 Ω termination.

3.4 Product description and theory of operation

The UAP amplifier is a multi-band, multi-operator remote unit configuration used in conjunction with a master unit in the ION-E optical distribution antenna system.

3.5 EUT exercise details

The UAP was controlled via a Laptop interface with control software to configure the system.

3.6 EUT setup diagram

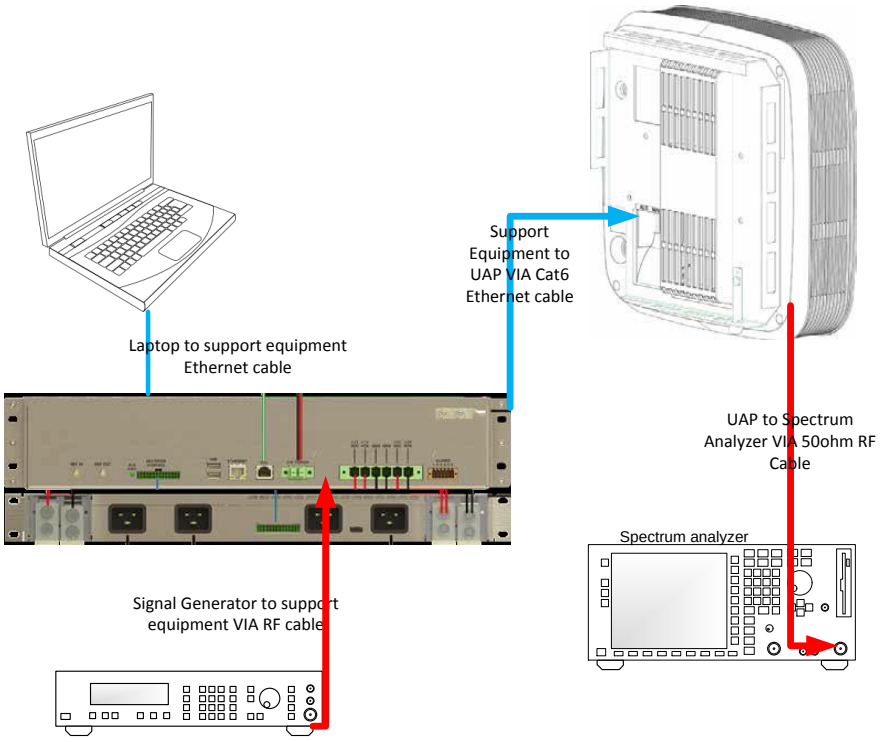

Figure 3.6-1: *Setup diagram*

Table 3.6-1: *Support equipment*

Description	Manufacturer	Model/Part number	Serial number	Rev.
Power Supply	GE	SP800XXXXXXZ0P3	14CS1227006	1
WCS rack	Commscope	WCS4	47	-

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

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.

5.2 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 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 18/15
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Jan. 7/16
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Mar. 20/15
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Mar. 12/15
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Mar. 10/15
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 23/15
Signal generator	Rohde & Schwarz	SMIQ03E	FA001269	1 year	Feb 27/15
Signal generator	Rohde & Schwarz	SMIQ06B	FA001878	1 year	Feb 24/15
50 Ω coax cable	C.C.A.	None	FA002555	1 year	June 23/15
50 Ω coax cable	Huber + Suhner	None	FA002074	1 year	June 23/15
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
Multimeter	Fluke	16	FA001831	1 year	Feb. 04/15

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 27.50(b) Peak output power at RF antenna connector

8.1.1 Definitions and limits

(4) Fixed and base stations transmitting a signal in the 746–757 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz (60 dBm/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 (60 dBm/MHz)

(12) For transmissions in the 746–757 MHz band, licensees may employ equipment operating in compliance with either the measurement techniques described in paragraph (b)(11) of §27.50 section or a Commission-approved average power technique. In both instances, equipment employed must be authorized in accordance with the provisions of §27.51.

8.1.2 Test summary

Test date	February 3, 2015	Temperature	24 °C
Test engineer	Kevin Rose	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	47 %

8.1.3 Observations, settings and special notes

Test receiver settings:

Detector mode	RMS (for average), Peak (for peak)
Resolution bandwidth	100 kHz
Integration bandwidth	>OBW
Video bandwidth	>RBW
Trace mode	Power Average (for average), Max Hold (for peak)
Measurement time	Auto

8.1.4 Test data

Table 8.1-1: *Peak to Average results*

Modulation	Frequency, MHz	RF output power AVG, dBm	RF output power Peak, dBm	Peak to Average Ratio, dB	Peak to Average Ratio Limit, dBm	Peak to Average Margin, dB
1.4 MHz LTE QAM	750	18.16	28.08	9.92	13	3.08
1.4 MHz LTE QPSK	750	18.17	27.75	9.58	13	3.42
3 MHz LTE QAM	750	18.57	28.05	9.48	13	3.52
3 MHz LTE QPSK	750	18.61	28.05	9.44	13	3.56
5 MHz LTE QAM	750	18.51	28.24	9.73	13	3.27
5 MHz LTE QPSK	750	18.59	28.11	9.52	13	3.48
10 MHz LTE QAM	750	18.57	28.13	9.56	13	3.44
10 MHz LTE QPSK	750	18.58	28.26	9.68	13	3.32

Table 8.1-2: *ERP results*

Modulation	Frequency, MHz	RF output power AVG, dBm	Antenna Gain, dBd	ERP, dBm	Limit, dBm/MHz	Margin, dBm
1.4 MHz LTE QAM	750	18.16	6.85	25.01	60	34.99
1.4 MHz LTE QPSK	750	18.17	6.85	25.02	60	34.98
3 MHz LTE QAM	750	18.57	6.85	25.42	60	34.58
3 MHz LTE QPSK	750	18.61	6.85	25.46	60	34.54
5 MHz LTE QAM	750	18.51	6.85	25.36	60	34.64
5 MHz LTE QPSK	750	18.59	6.85	25.44	60	34.56
10 MHz LTE QAM	750	18.57	6.85	25.42	60	34.58
10 MHz LTE QPSK	750	18.58	6.85	25.43	60	34.57

Note: The results were measured using a higher resolution bandwidth integrated power. 1MHz limit is the lowest limit
The actual limit may be increased by(60+10*LOG (actual bandwidth/1MHz)

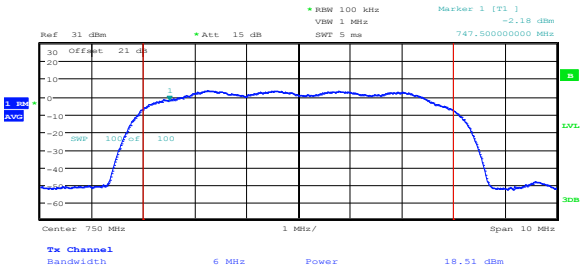

Figure 8.1-1: *Conducted Average power example*

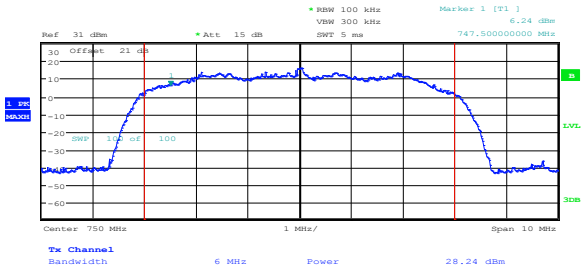

Figure 8.1-2: *Conducted Peak power example*

8.2 FCC 27.53(c) Spurious emissions at RF antenna connector

8.2.1 Definitions and limits

For operations in the 746–758 MHz band, 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 any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) 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 at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) 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.

8.2.2 Test summary

Test date	February 3, 2015	Temperature	21 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	31 %

8.2.3 Observations, settings and special notes

KDB 935210 D04 Provider Specific Booster Measurements used to perform the testing.

Frequency range	30 MHz to 10th harmonic
Detector mode	Peak
Resolution bandwidth sweep	100 kHz (below 1 GHz), 1000 kHz (above 1 GHz)
Resolution bandwidth band edge	> 1 % of OBW
Video bandwidth	>RBW
Trace mode	Max Hold
Measurement time	Auto

8.2.4 Test data

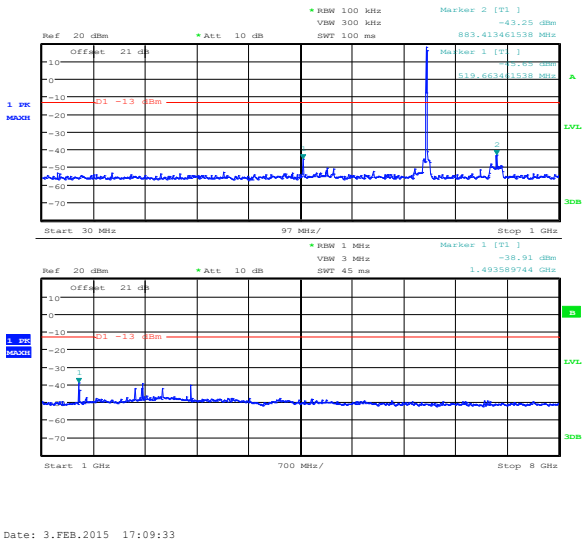

Figure 8.2-1: *1.4 MHz LTE QAM 30 MHz – 8 GHz*

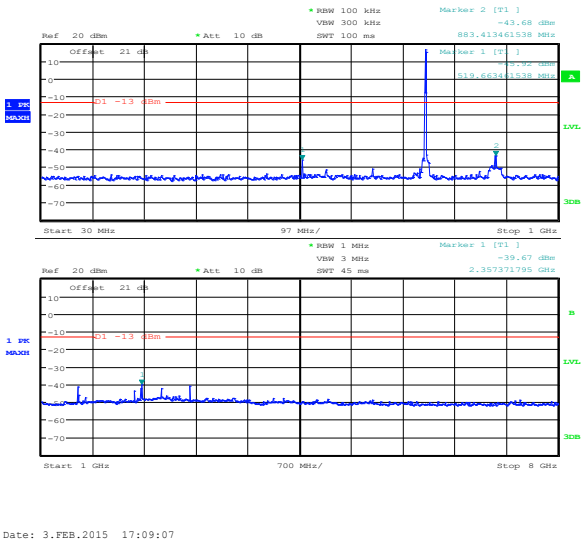

Figure 8.2-2: *1.4 MHz LTE QPSK 30 MHz – 8 GHz*

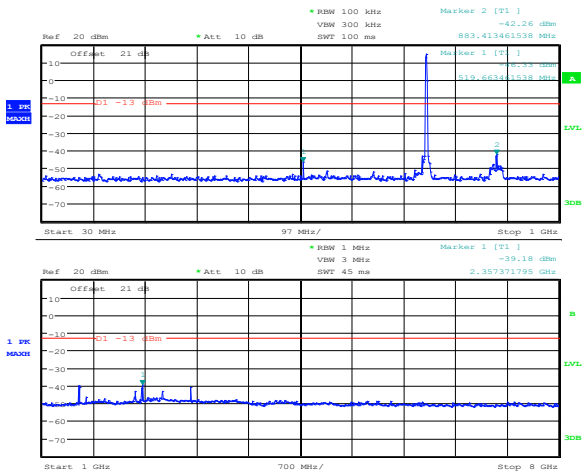

Figure 8.2-3: *3 MHz LTE QAM 30 MHz – 8 GHz*

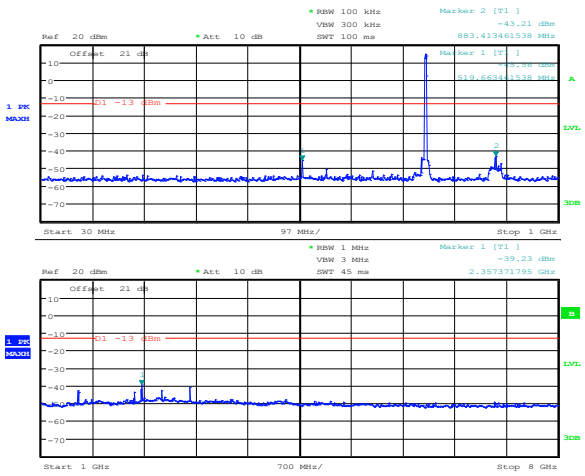

Figure 8.2-4: *3 MHz LTE QPSK 30 MHz – 8 GHz*

8.2.4 Test data continued

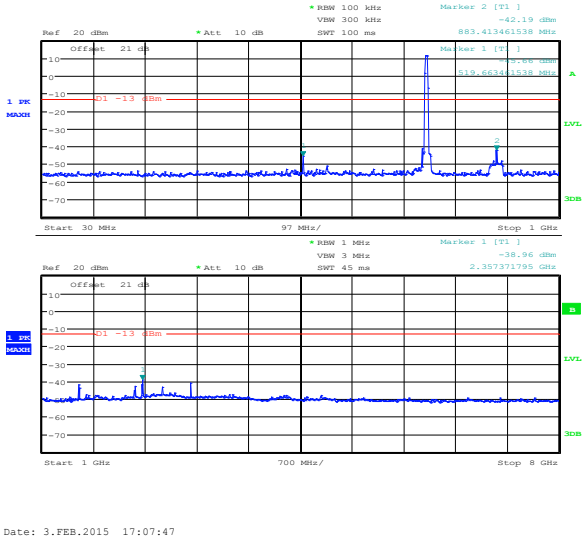

Figure 8.2-5: *5 MHz LTE QAM 30 MHz – 8 GHz*

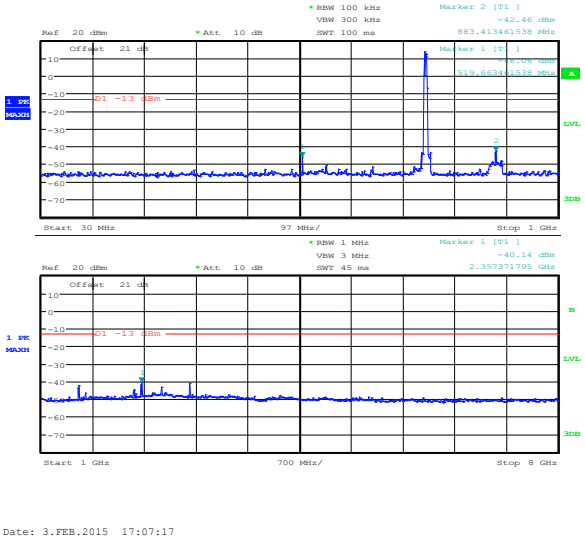

Figure 8.2-6: *5 MHz LTE QPSK 30 MHz – 8 GHz*

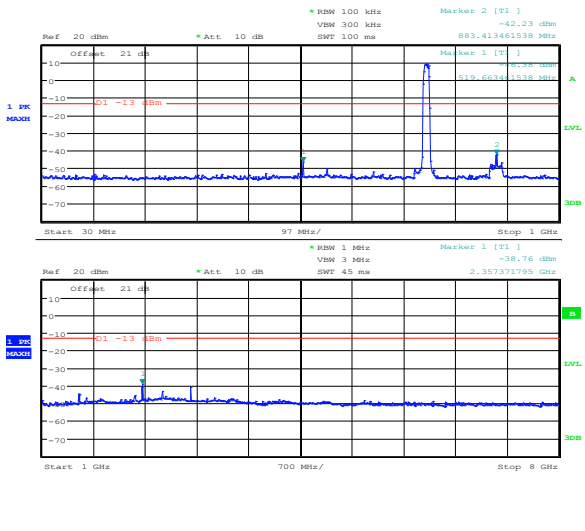

Figure 8.2-7: *10 MHz LTE QAM 30 MHz – 8 GHz*

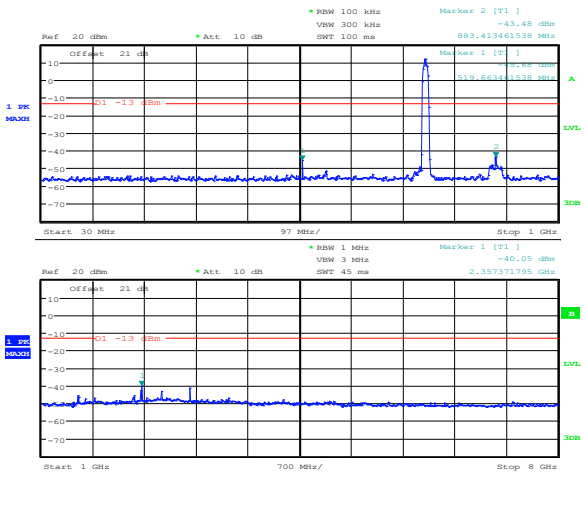

Figure 8.2-8: *10 MHz LTE QPSK 30 MHz – 8 GHz*

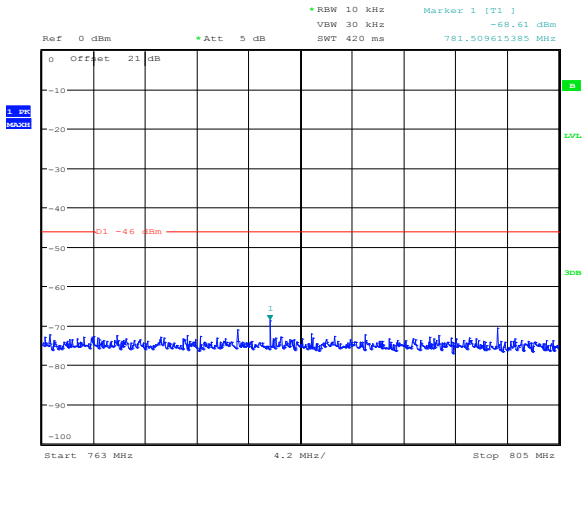

Figure 8.2-9: *1.4 MHz LTE QAM 763-775 MHz and 793-805 MHz*

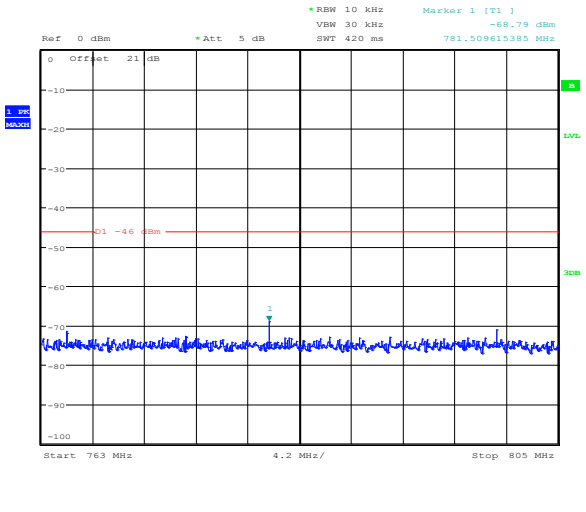

Figure 8.2-10: *1.4 MHz LTE QPSK 763-775 MHz and 793-805 MHz*

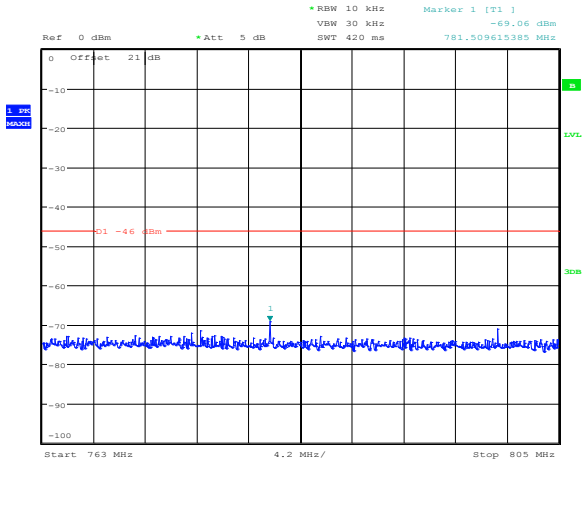

Figure 8.2-11: *3 MHz LTE QAM 763-775 MHz and 793-805 MHz*

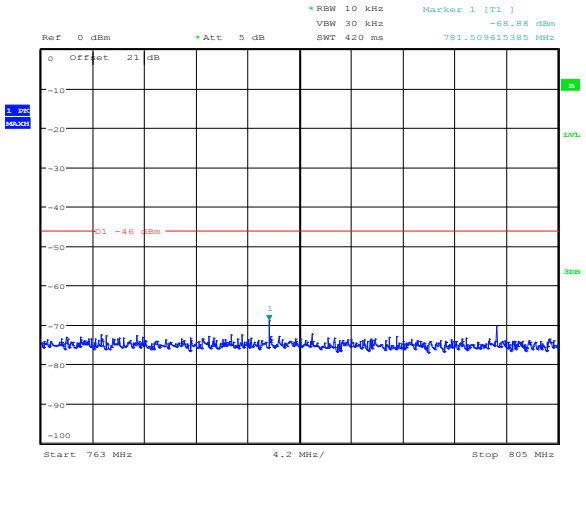

Figure 8.2-12: *3 MHz LTE QPSK 763-775 MHz and 793-805 MHz*

8.2.1 Test data continued

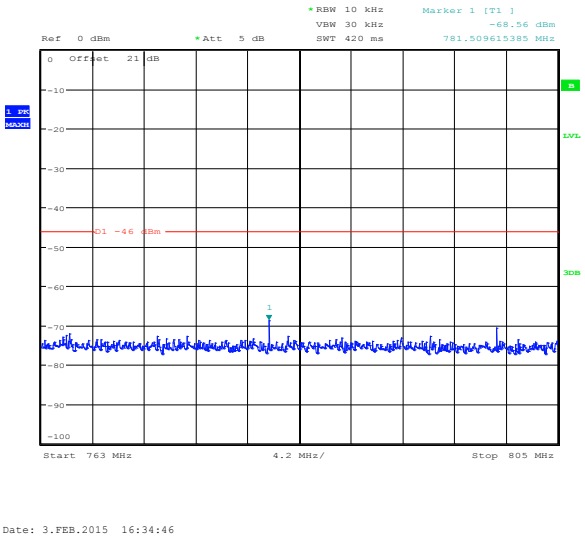

Figure 8.2-13: *5 MHz LTE QAM 763-775 MHz and 793-805 MHz*

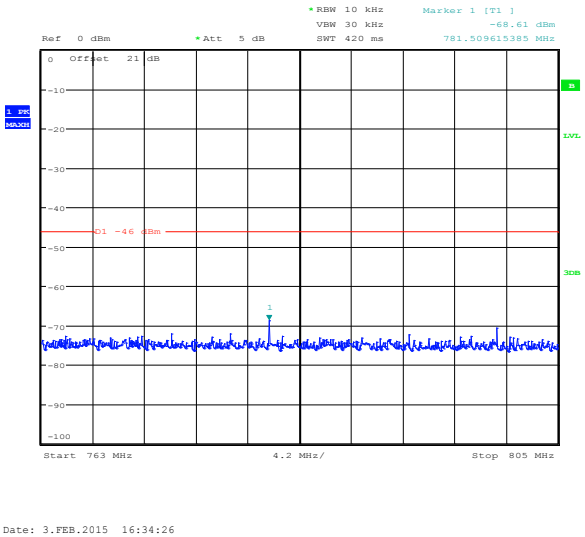

Figure 8.2-14: *5 MHz LTE QPSK 763-775 MHz and 793-805 MHz*

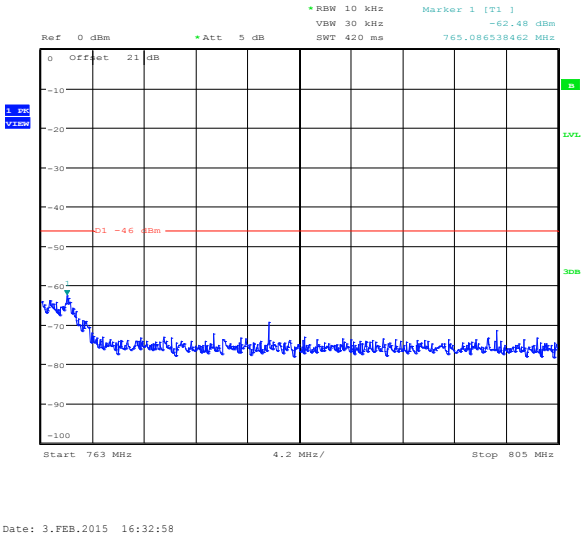

Figure 8.2-15: *10 MHz LTE QAM 763-775 MHz and 793-805 MHz*

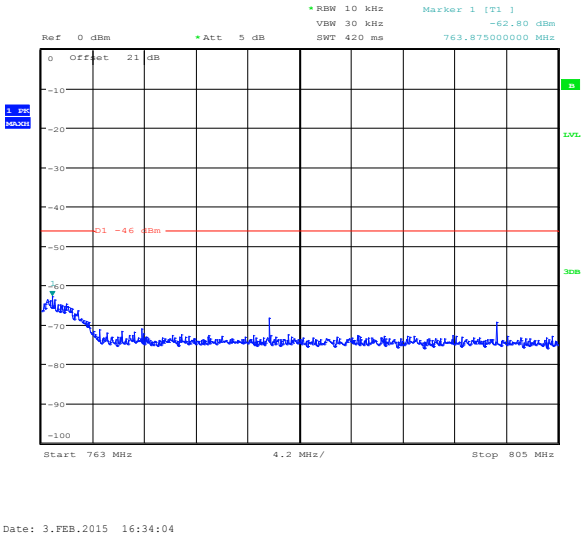

Figure 8.2-16: *10 MHz LTE QPSK 763-775 MHz and 793-805 MHz*

8.2.4 Test data continued

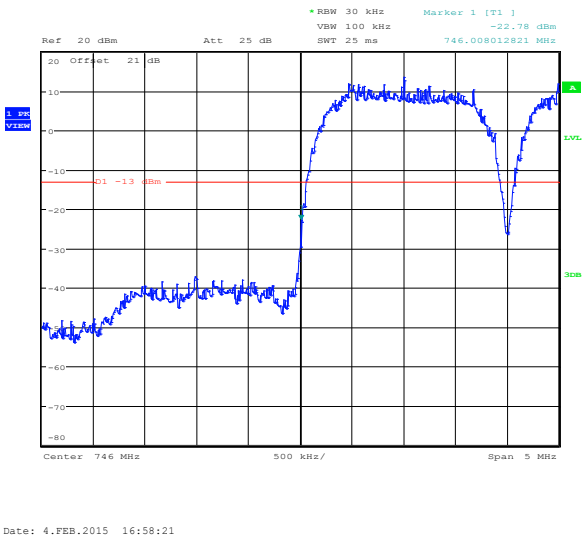

Figure 8.2-17: *1.4 MHz Lower Band edge QPSK*

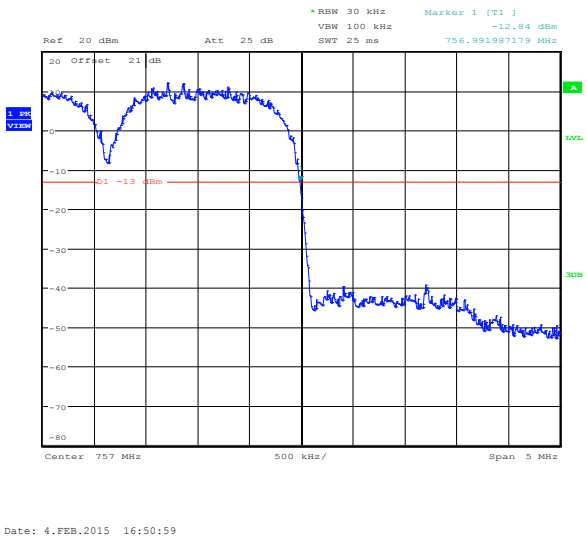

Figure 8.2-18: *1.4 MHz Upper Band edge QPSK*

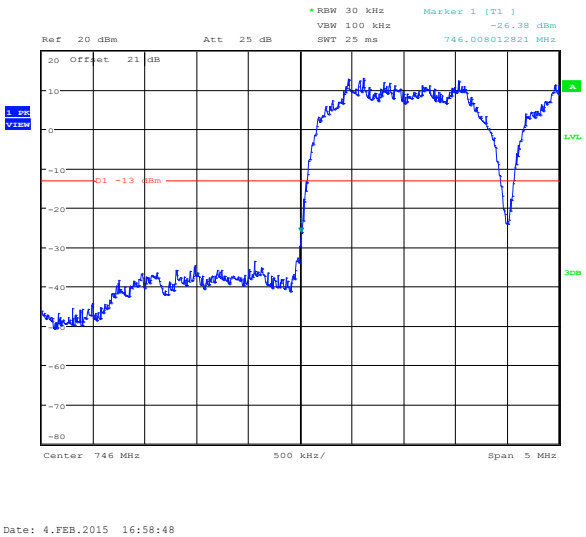

Figure 8.2-19: *1.4 MHz Lower Band edge QAM*

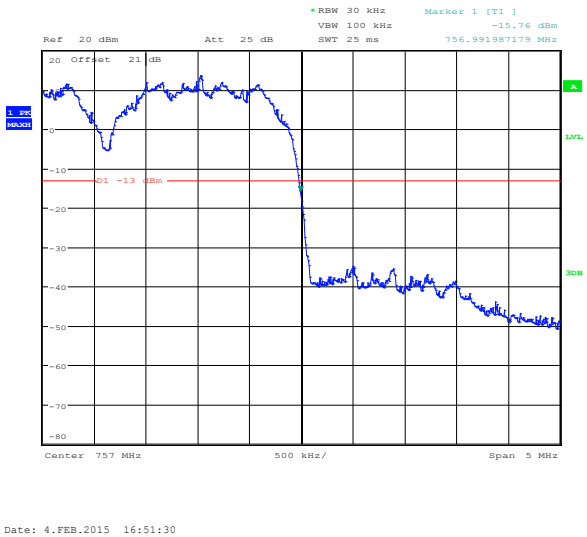

Figure 8.2-20: *1.4 MHz Upper Band edge QAM*

8.2.4 Test data continued

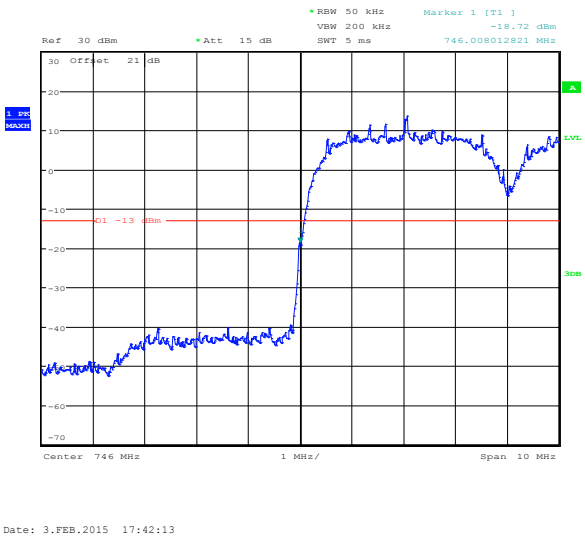

Figure 8.2-21: *3 MHz Lower Band edge QPSK*

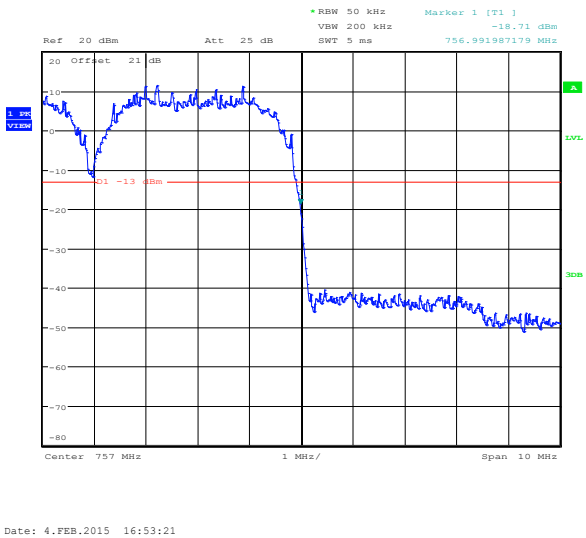

Figure 8.2-22: *3 MHz Upper Band edge QPSK*

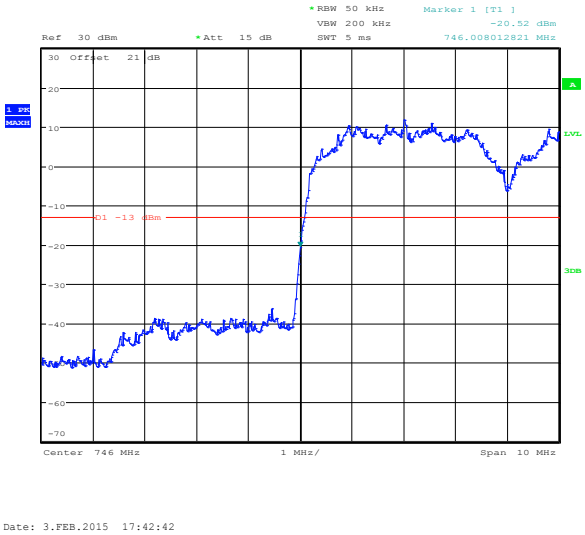

Figure 8.2-23: *3 MHz Lower Band edge QAM*

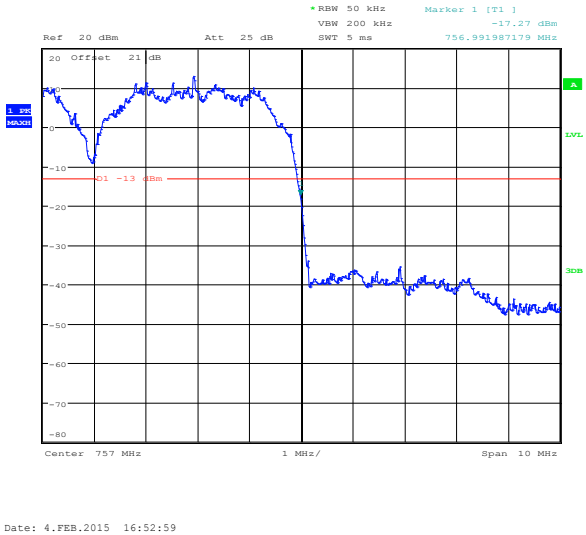

Figure 8.2-24: *3 MHz Upper Band edge QAM*

8.2.4 Test data

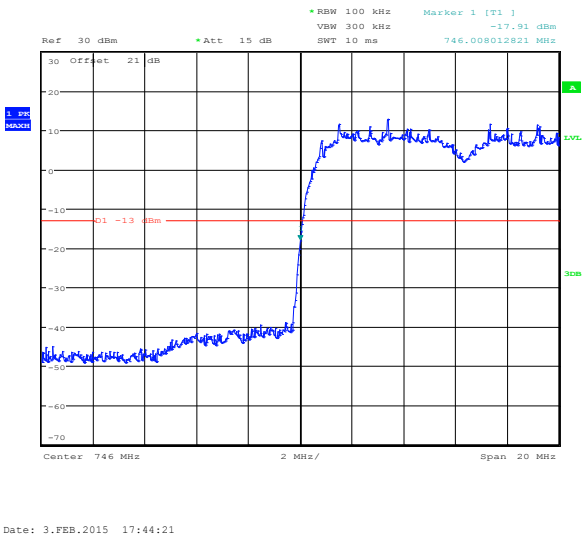

Figure 8.2-25: *5 MHz Lower Band edge QPSK*

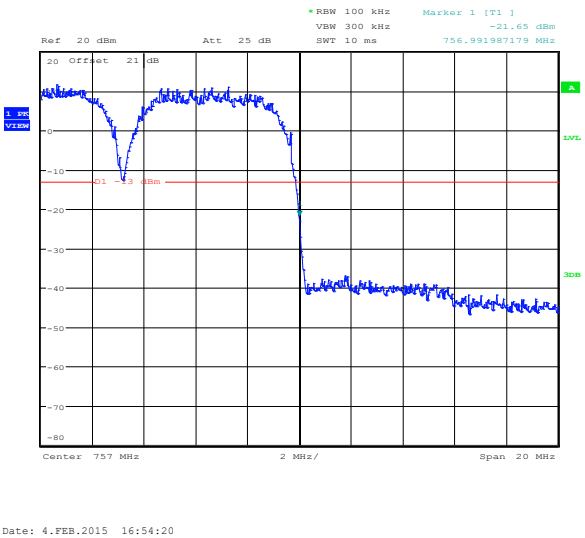

Figure 8.2-26: *5 MHz Upper Band edge QPSK*

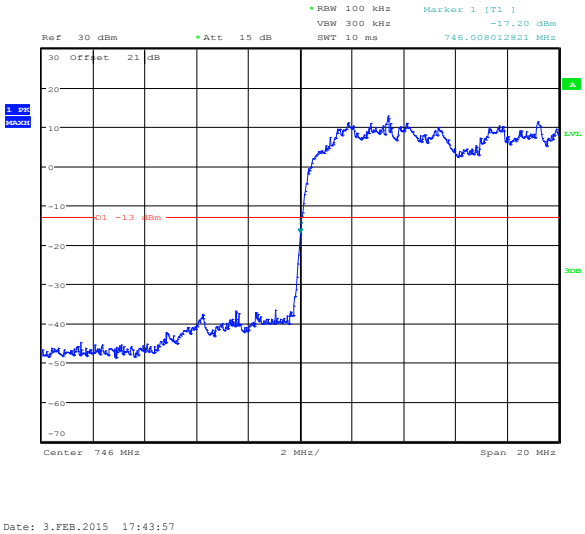

Figure 8.2-27: *5 MHz Lower Band edge QAM*

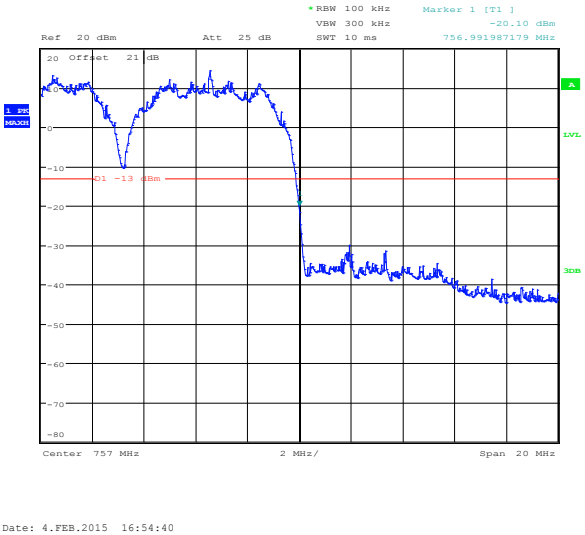

Figure 8.2-28: *5 MHz Upper Band edge QAM*

8.2.1 Test data

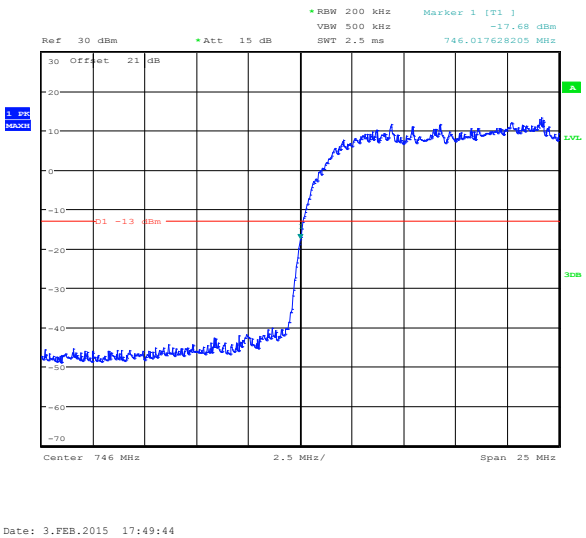

Figure 8.2-29: *10 MHz Lower Band edge QPSK*

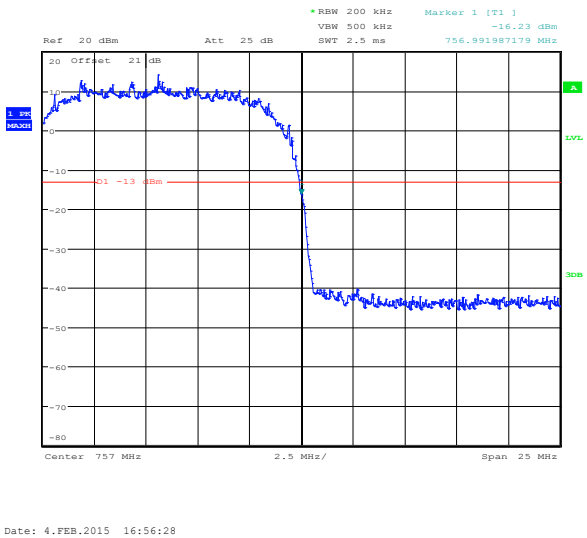

Figure 8.2-30: *10 MHz Upper Band edge QPSK*

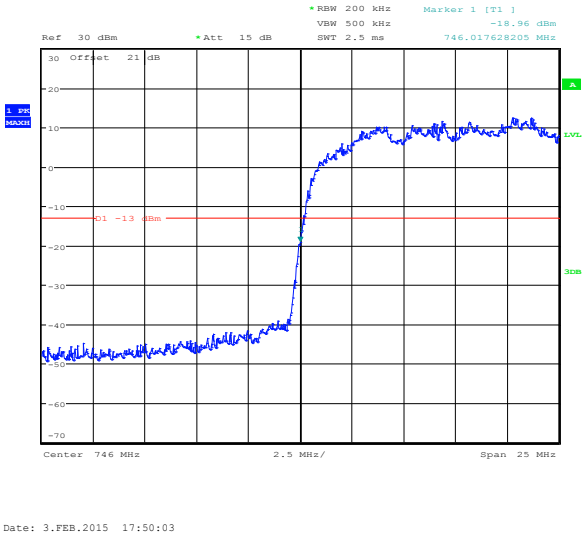

Figure 8.2-31: *10 MHz Lower Band edge QAM*

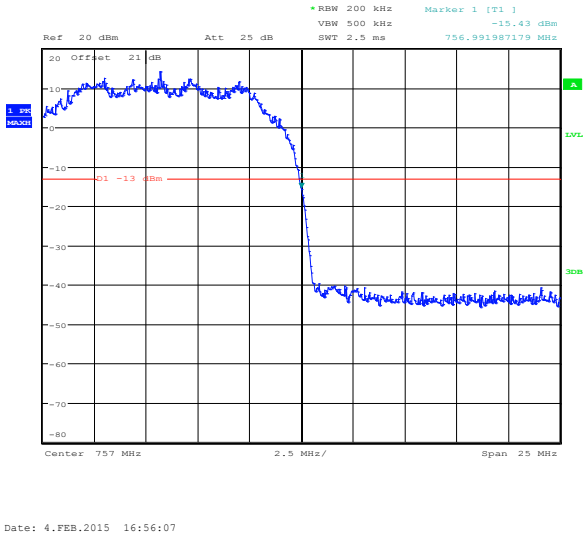

Figure 8.2-32: *10 MHz Upper Band edge QAM*

8.3 FCC 27.53(c) (f) Radiated spurious emissions

8.3.1 Definitions and limits

(c) For operations in the 746–758 MHz band, 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 any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions 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.

8.3.2 Test summary

Test date	February 11, 2015	Temperature	25 °C
Test engineer	Kevin Rose	Air pressure	1002 mbar
Verdict	Pass	Relative humidity	50 %

8.3.3 Observations, settings and special notes

Low, Mid, and High channels of all modulations were investigated. Worst case examples are provided.
935210 D02 Signal Boosters Certification v02r01 was used for Radiated Emissions

Receiver settings were:

Frequency range	30 MHz to 10th harmonic
Detector mode	Peak
Resolution bandwidth	100 kHz (below 1 GHz), 1000 kHz (above 1 GHz)
Video bandwidth	>RBW
Trace mode	Max Hold

8.3.4 Test data

Table 8.3-1: *Radiated spurious results*

Frequency, MHz	Field strength, dBµV/m	Substitution factor, dB	Calculated EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
33	26.8	-73.4	-46.6	-13	33.6
63.7	30.8	-91.2	-60.4	-13	47.4
445.1	33.3	-83.5	-50.2	-13	37.2
1500	21.7	-69.6	-47.9	-13	34.9
3200	15.5	-63.4	-47.9	-13	34.9

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

Table 8.3-2: *Radiated spurious 763 to 775 MHz results*

Frequency, MHz	Field strength, dBµV/m	Substitution factor, dB	Calculated EIRP, dBm	EIRP limit, dBm/100 kHz	EIRP margin, dB
768.55	15.63	-79.33	-63.7	-34	29.9

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

Table 8.3-3: *Radiated spurious 793 to 805 MHz results*

Frequency, MHz	Field strength, dBµV/m	Substitution factor, dB	Calculated EIRP, dBm	EIRP limit, dBm/100 kHz	EIRP margin, dB
797.4	16.59	-78.99	-62.4	-34	28.4

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

Table 8.3-4: *Radiated spurious 1559 to 1610 MHz results*

Frequency, MHz	Field strength, dBµV/m	Substitution factor, dB	Calculated EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
1600	18.3	-70.8	-52.5	-50	2.5

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
Substitution factor includes signal generator, cable loss, and antenna factor.

8.4 FCC 27.54 Frequency stability

8.4.1 Definitions and limits

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

8.4.2 Test summary

Test date	August 26, 2014	Temperature	24 °C
Test engineer	Kevin Rose	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	47 %

8.4.3 Observations, settings and special notes

Assessed to remain within assigned band. Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	20 Hz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.4.4 Test data

Table 8.4-1: *Frequency Stability result*

Test conditions	Frequency, Hz	Offset, Hz
+50 °C, Nominal	749.999495	0
+40 °C, Nominal	749.999495	0
+30 °C, Nominal	749.999495	0
+20 °C, +15 %	749.999495	0
+20 °C, Nominal	749.999495	Reference
+20 °C, −15 %	749.999495	0
+10 °C, Nominal	749.999495	0
0 °C, Nominal	749.999495	0
-10 °C, Nominal	749.999495	0
-20 °C, Nominal	749.999495	0
-30 °C, Nominal	749.999495	0

8.5 Part 2.1049 Occupied bandwidth

8.5.1 Definitions and limits

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

8.5.2 Test summary

Test date	February 3, 2015	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	32 %

8.5.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	≥1 % of OBW
Video bandwidth	≥ RBW
Trace mode	Max Hold

8.5.4 Test data

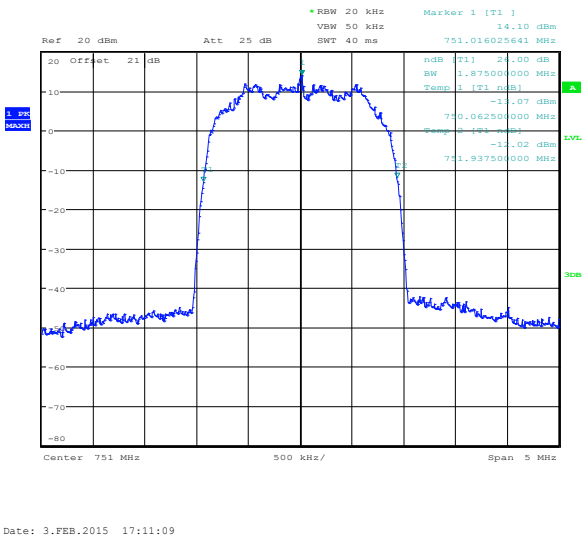

Figure 8.5-1: *1.4 MHz QAM output*

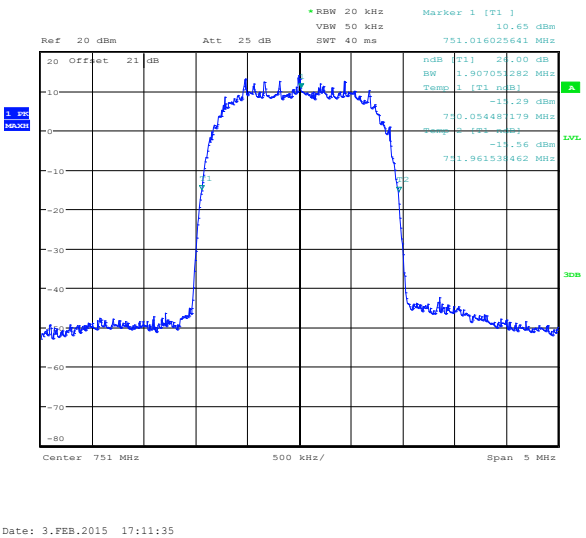

Figure 8.5-2: *1.4 MHz QPSK output*

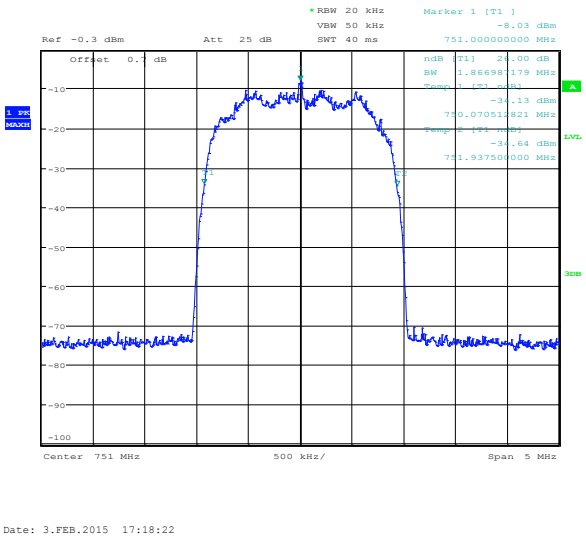

Figure 8.5-3: *1.4 MHz QAM input*

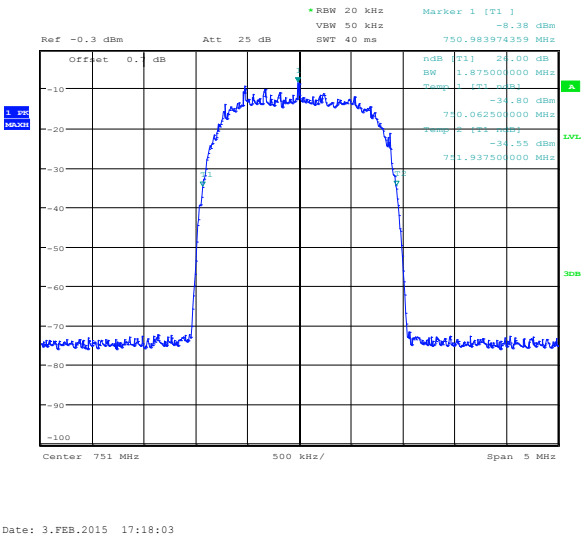

Figure 8.5-4: *1.4 MHz QPSK input*

8.5.4 Test data continued

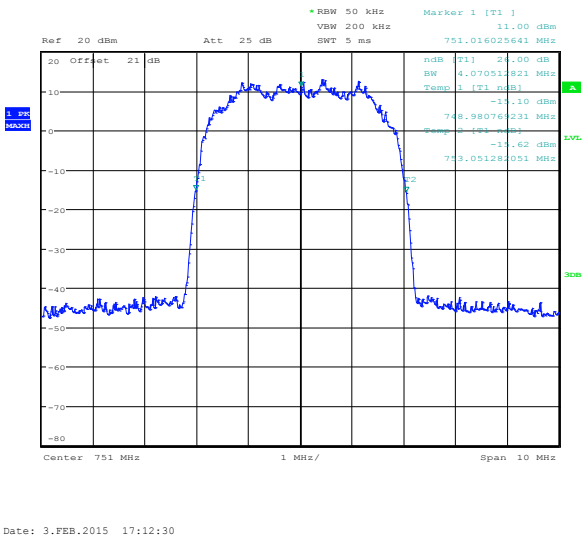

Figure 8.5-5: *3 MHz QAM output*

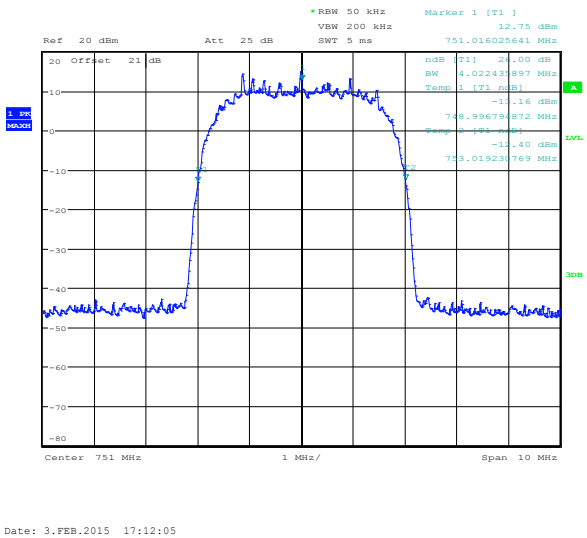

Figure 8.5-6: *3 MHz QPSK output*

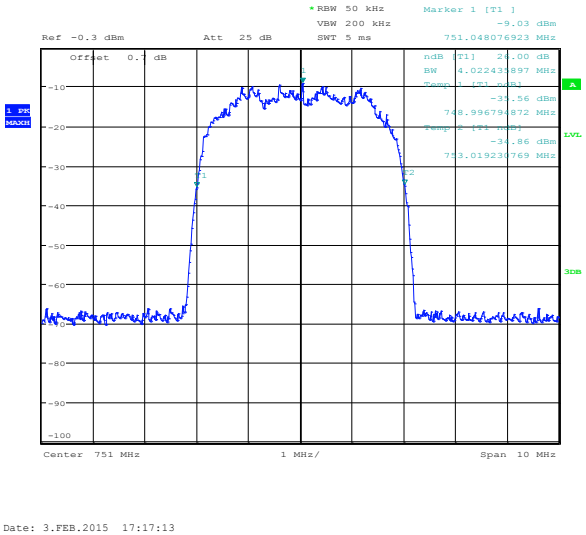

Figure 8.5-7: *3 MHz QAM input*

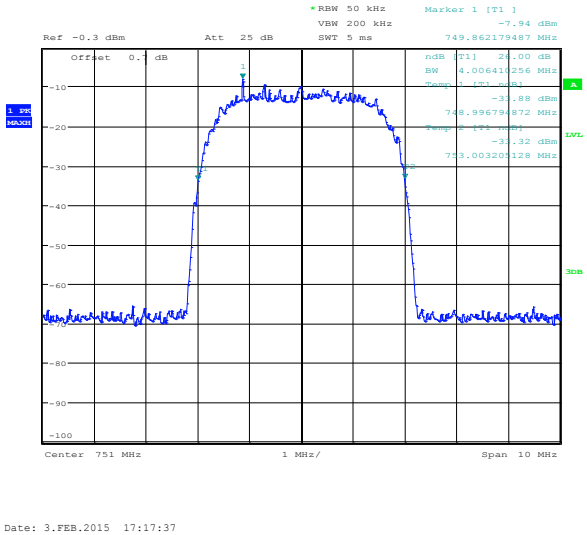

Figure 8.5-8: *3 MHz QPSK input*

8.5.4 Test data continued

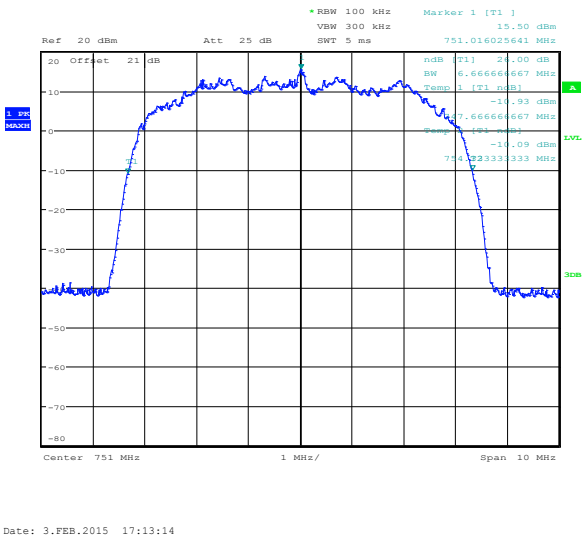

Figure 8.5-9: *5 MHz QAM output*

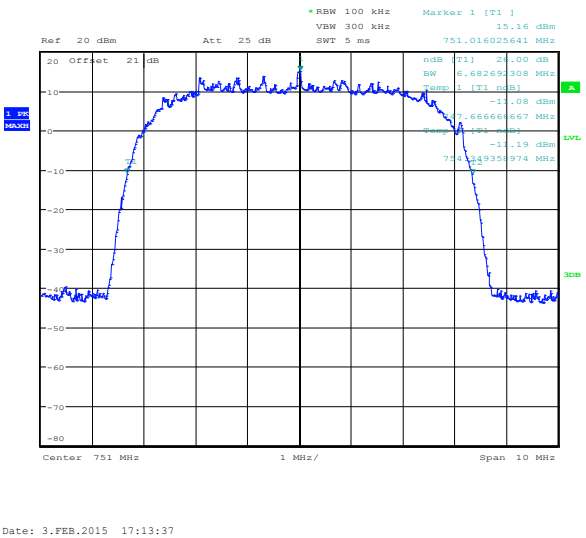

Figure 8.5-10: *5 MHz QPSK output*

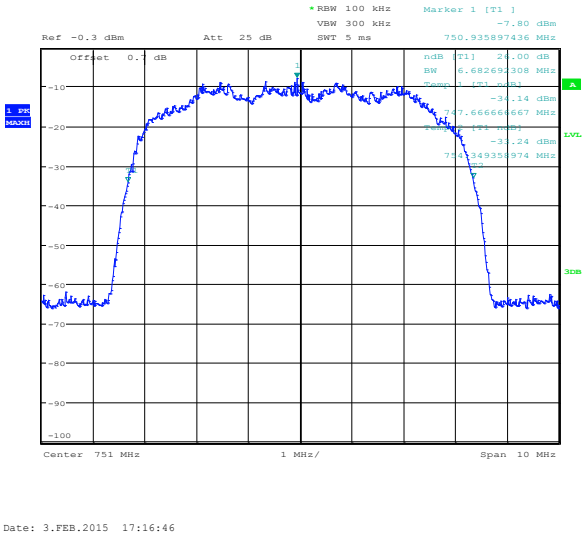

Figure 8.5-11: 5 *MHz QAM input*

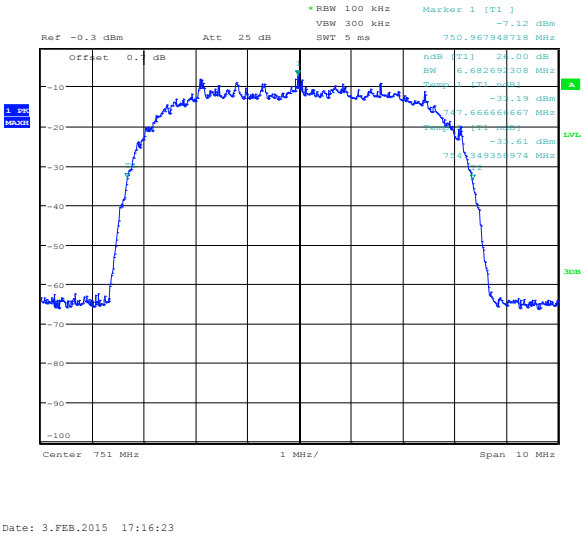

Figure 8.5-12: *5 MHz QPSK input*

8.5.4 Test data continued

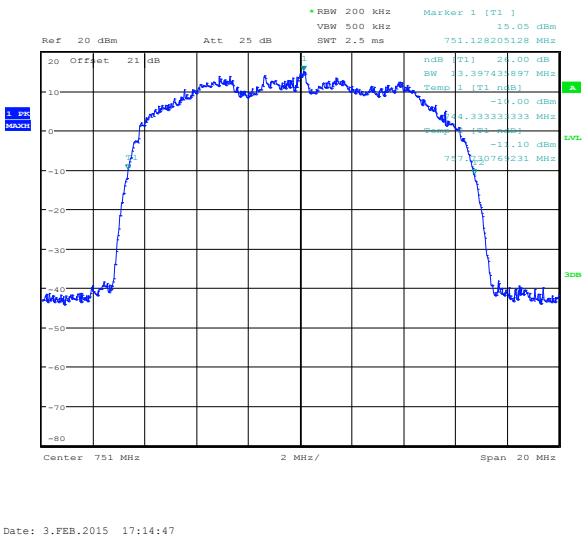

Figure 8.5-13: *10 MHz QAM output*

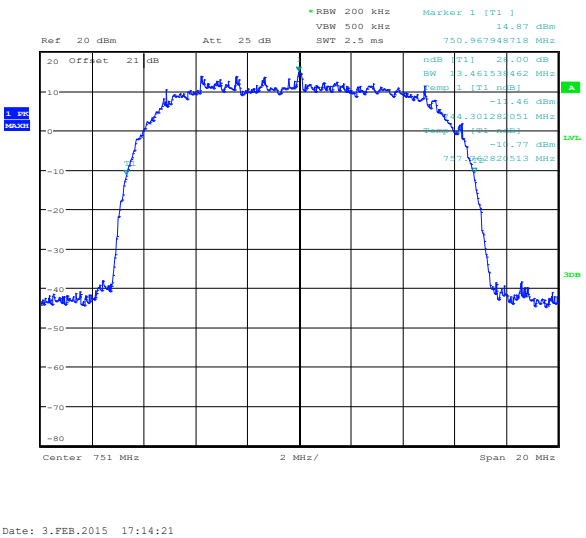

Figure 8.5-14: 10 *MHz QPSK output*

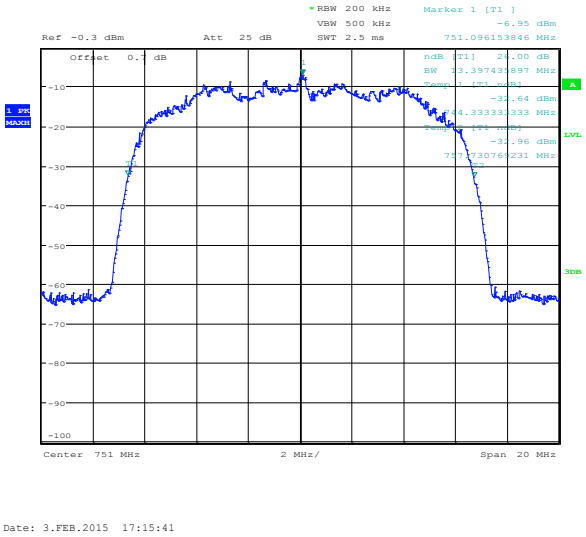

Figure 8.5-15: 10 *MHz QAM input*

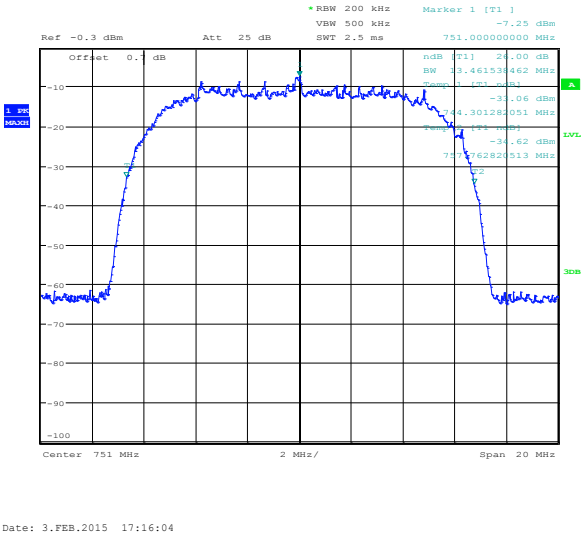

Figure 8.5-16: *10 MHz QPSK input*

8.5.4 Test data continued

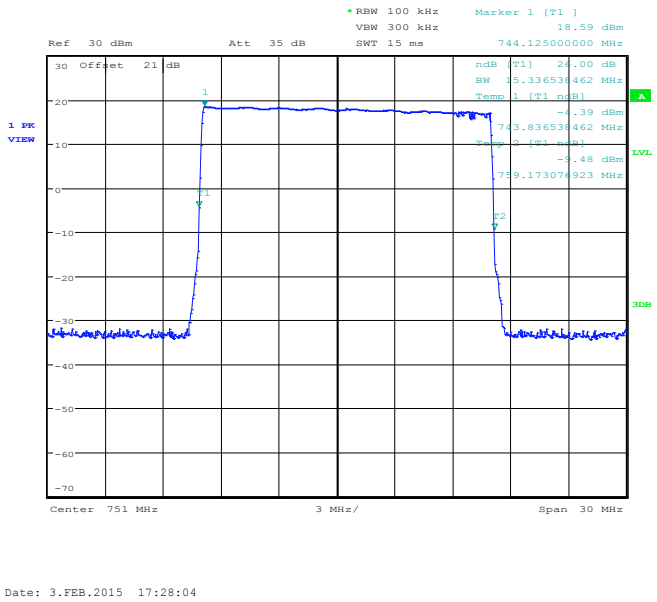

Figure 8.5-17: *Filter response*

Section 9. Setup Photos

9.1 Set-up

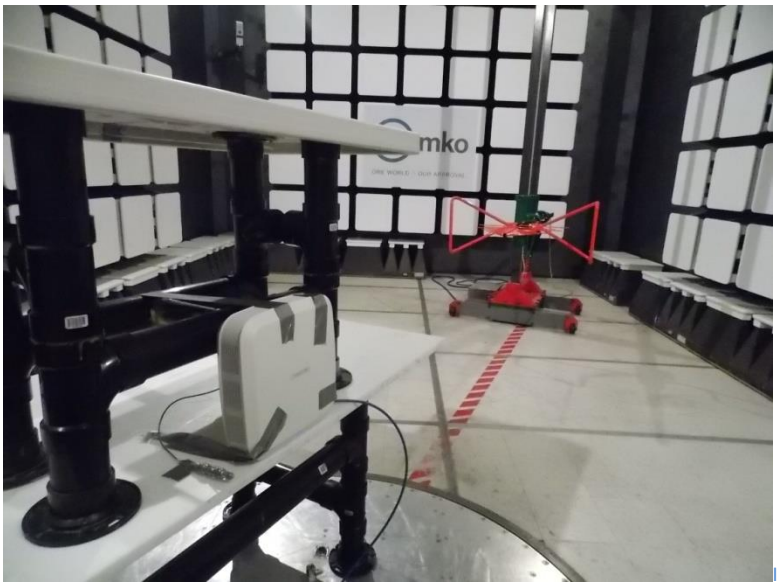

Figure 9.1-1: *Radiated setup photo*

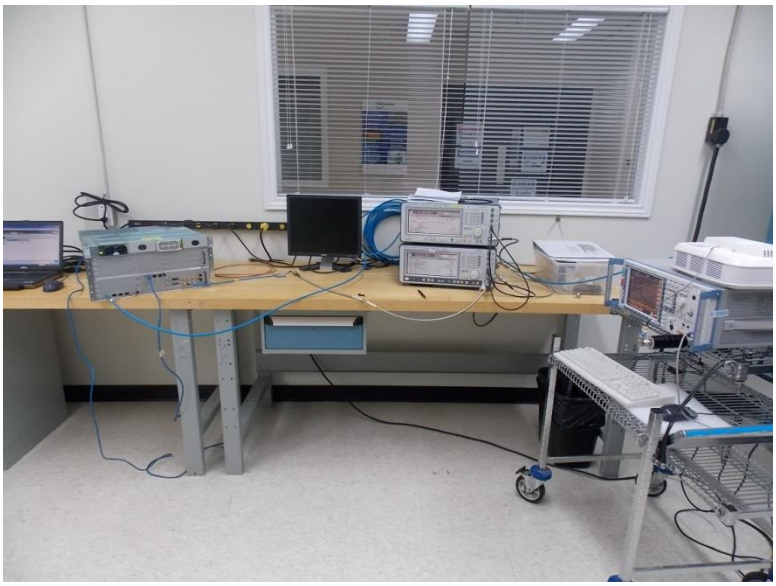

Figure 9.1-2: *Conducted setup photo*

Section 10. Block diagrams of test set-ups

10.1 Radiated emissions set-up