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# Test report

## 320936-1TRFWL

Date of issue: April 28, 2017

Applicant:

fiplex

Product:

BI-DIRECTIONAL AMPLIFIER

Model:

DH7

FCC ID:

P3TDH7

Specification:

FCC 47 CFR Part 90

PRIVATE LAND MOBILE RADIO 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 | Russell Grant, Senior Technical Assessor |
| Date | April 28, 2017 |
| 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 | Fiplex Communications, Inc. |
| Address | 7331 N.W. 54th Street |
| City | Miami |
| Province/State | FL |
| Postal/Zip code | 33166 |
| Country | USA |

## 1.2 Test specifications

| | |
|---|---|
| FCC 47 CFR Part 90 | PRIVATE LAND MOBILE RADIO SERVICES |
| 935210 D02 Signal Boosters Certification v03r02 | SIGNAL BOOSTERS BASIC CERTIFICATION REQUIREMENTS |
| 935210 D05 Indus Booster Basic Meas v01r01 | MEASUREMENTS GUIDANCE FOR INDUSTRIAL AND NON-CONSUMER SIGNAL BOOSTER, REPEATER, AND AMPLIFIER DEVICES |

## 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 90 test results

| Part | Test description | Verdict |
|---|---|---|
| §90.219(e)(1), §90.205(j) | RF Output Power | Pass |
| §90.219(e)(3), §90.543(c), 90.543(e) | Conducted Spurious | Pass |
| §90.219(e)(3), §90.543 (c) | Radiated Spurious | Pass |
| §90.219(e)(4), §90.543(c) | Input Output | Pass |
| 935210 D05 v01r01 4.2 | AGC threshold | Reported |
| 935210 D05 v01r01 4.3 | Out-of-band rejection | Reported |
| §90.543 (e)(f) | Radiated Spurious | Pass |
| §90.219 (e)(2) | Noise figure | Pass |

Notes: None

# **Section 3.** Equipment under test (EUT) details

## 3.1 Sample information

| | |
|---|---|
| Receipt date | February 12, 2015 |
| Nemko sample ID number | 1 |

## 3.2 EUT information

| | |
|---|---|
| Product name | BI-DIRECTIONAL AMPLIFIER |
| Model | DH7 |
| Serial number | None |

## 3.3 Technical information

| | |
|---|---|
| Operating band | DL 763-775 MHz / UL 793 - 805 MHz |
| Modulation type/ Emission designator | P25 8K10F1E C4FM voice<br>P25 8K10F1D C4FM data<br>TETRA 20K0D1E 4/TDMA voice<br>TETRA 20K0D1D 4/TDMA data<br>DMR 7K60FXE 4 Level FSK, 2/TDMA<br>DMR 7K60FXD 4 Level FSK, 2/TDMA<br>Analog 16K0F3E voice<br>Analog 11K0F3E voice |
| Power requirements | 120 Vac 60 Hz |
| Gain | 80 dB |
| Antenna information | External Antenna is not provided EUT used a 50 Ω termination. |

## 3.4 Product description and theory of operation

This signal booster is capable of handling 12 carriers in uplink and 12 carrier in downlink. The center frequency and BW of each one of the 12 filters can be tuned via a software interface. The Signal Booster BW configuration is 90 kHz, 45 kHz, 30 kHz, 20 kHz, and 15 kHz.

## 3.5 EUT exercise details

The EUT was controlled software GUI.

## 3.6 EUT setup diagram

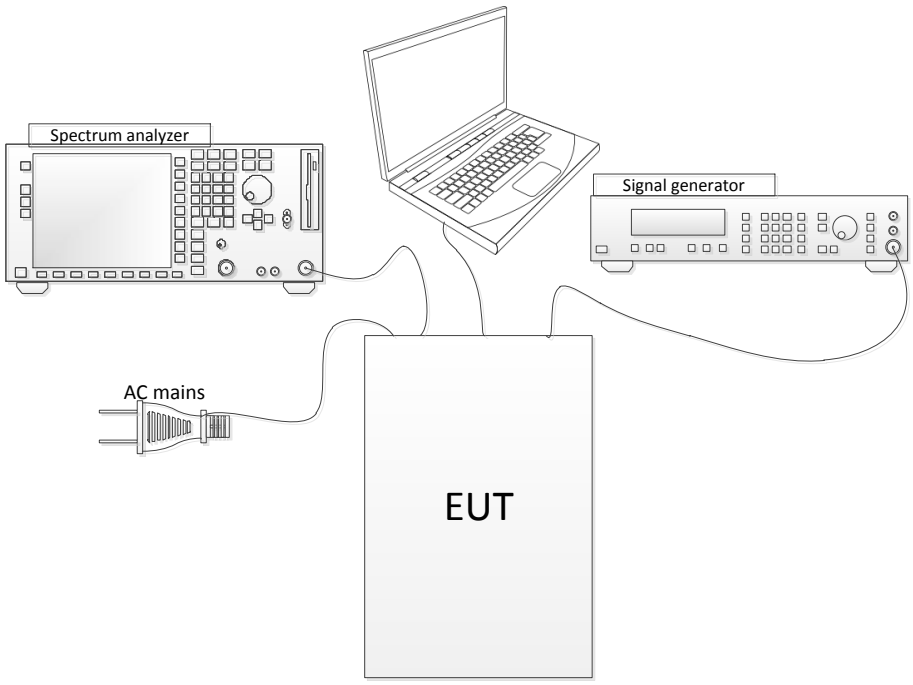


***Figure 3.6-1:*** *Setup diagram*

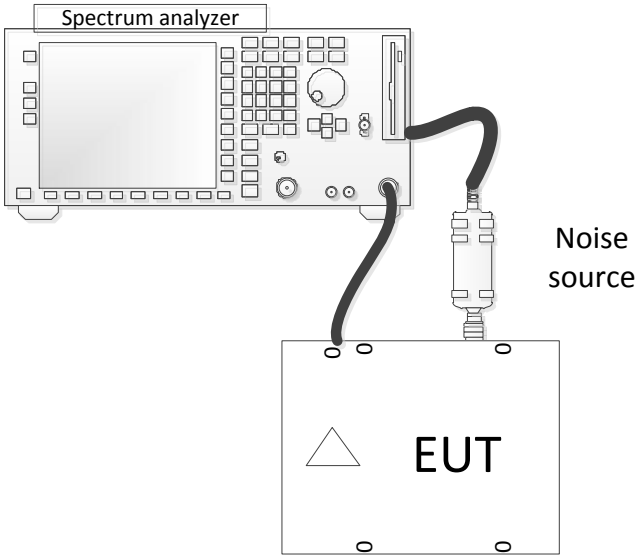


***Figure 3.6-2:*** *Noise figure setup diagram*

# **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 | Dec. 01/17 |
| Flush mount turntable | Sunol | FM2022 | FA002082 | — | NCR |
| Controller | Sunol | SC104V | FA002060 | — | NCR |
| Antenna mast | Sunol | TLT2 | FA002061 | — | NCR |
| AC Power source | California Instruments | 3001i | FA001021 | 1 year | Sept. 08/17 |
| Receiver/spectrum analyzer | Rohde & Schwarz | ESU 26 | FA002043 | 1 year | Jan. 07/17 |
| Bilog antenna (20–3000 MHz) | Sunol | JB3 | FA002108 | 1 year | Apr. 28/17 |
| Horn antenna (1–18 GHz) | EMCO | 3115 | FA000825 | 1 year | Apr. 26/17 |
| Pre-amplifier (1–18 GHz) | JCA | JCA118-503 | FA002091 | 1 year | April 26/17 |
| 50 Ω coax cable | Huber + Suhner | None | FA002074 | 1 year | April 26/17 |
| 50 Ω coax cable | Huber + Suhner | None | FA002830 | 1 year | July 29/17 |
| Spectrum analyzer | Rohde & Schwarz | FSP | FA001920 | 1 year | Aug. 20/17 |
| Signal generator | Rohde & Schwarz | SMIQ03E | FA001269 | 1 year | Apr. 08/17 |
| Signal generator | Rohde & Schwarz | SMIQ06B | FA001878 | 1 year | Apr. 07/17 |
| Noise Source | Agilent | 346C | AGIL-346C | – | NCR |

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

# **Section 8.** Testing data

## 8.1 FCC §90.219(e)(1), §90.205(j) RF Output Power

### 8.1.1 Definitions and limits

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.
90.205(j) 758-775 MHz and 788-805 MHz. Power and height limitations are specified in §§90.541 and 90.542.

### 8.1.2 Test summary

| | | | |
|---|---|---|---|
| Test date | December 8, 2016 | Temperature | 23 °C |
| Test engineer | Kevin Rose | Air pressure | 1007 mbar |
| Verdict | Pass | Relative humidity | 32 % |

### 8.1.3 Observations, settings and special notes

Worst case limit is used. Test receiver settings:

| | |
|---|---|
| Detector mode | Peak |
| Resolution bandwidth | 1 MHz |
| Intergration bandwidth | >OBW |
| Video bandwidth | >RBW |
| Trace mode | Max Hold |
| Measurement time | Auto |

### 8.1.4 Test data

***Table 8.1-1:*** *RF Output power results*

| Frequency, MHz | Input, dBm | output, dBm | Gain, dB | Rated Gain, dB |
|---|---|---|---|---|
| 799 | -57.13 | 23.35 | 80.48 | 80 |
| 769 low power | -57.2 | 22.82 | 80.02 | 80 |
| 769 | -44.11 | 36.19 | 80.30 | 80 |

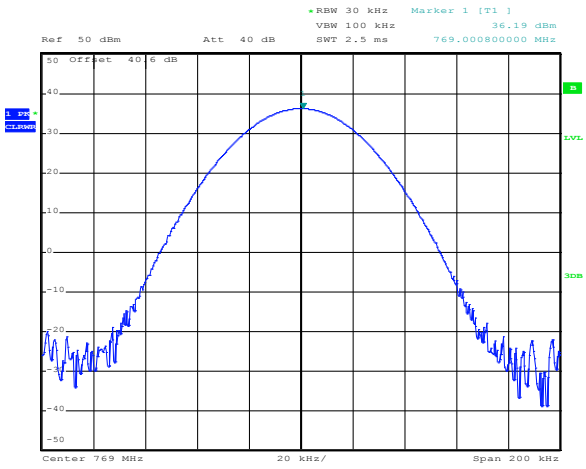


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***Figure 8.1-1:*** *768.97 MHz output power*

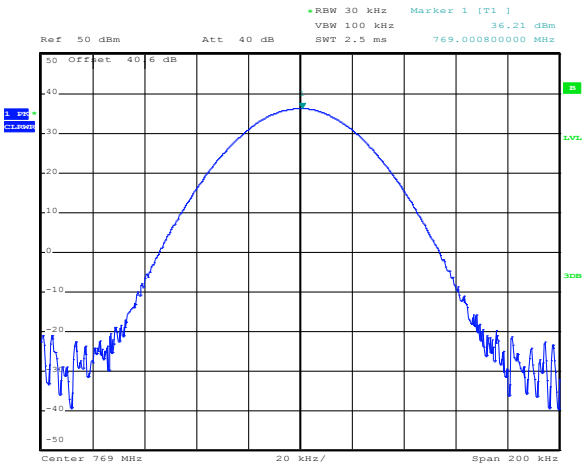


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***Figure 8.1-2:*** *768.97 MHz output power plus 3 dB above AGC threshold*

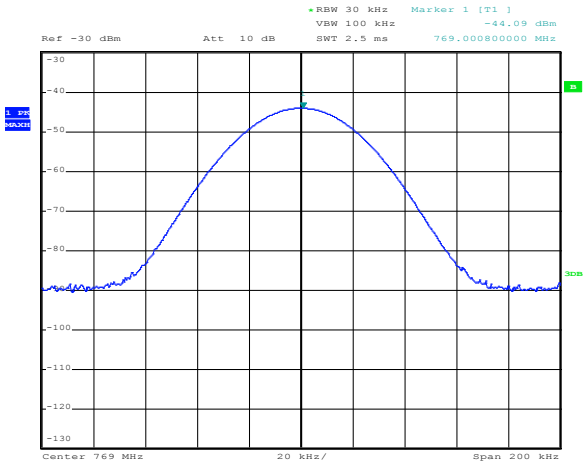


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***Figure 8.1-3:*** *768.97 MHz input power*

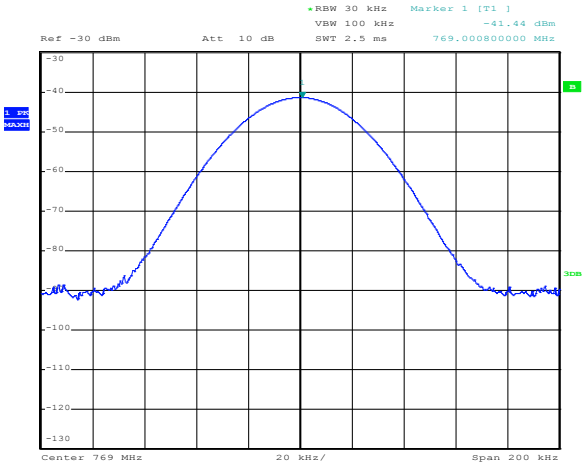


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***Figure 8.1-4:*** *768.97 MHz input power plus 3 dB above AGC threshold*

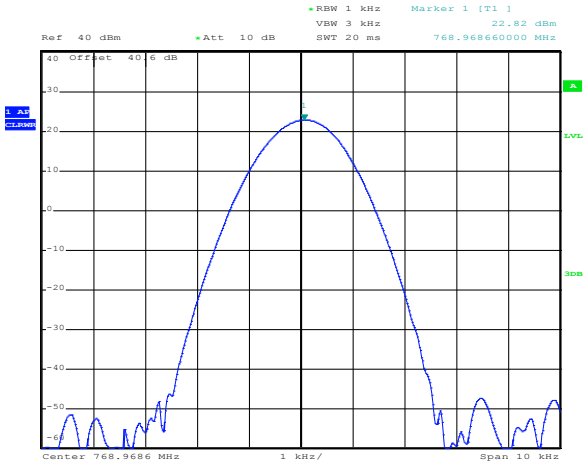


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***Figure 8.1-5:*** *768.97 MHz output power Low power*

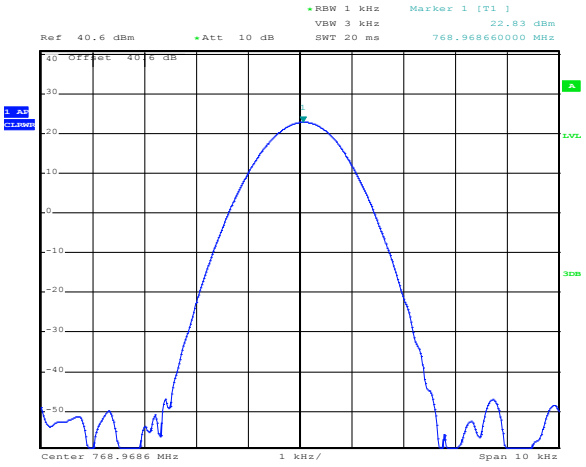


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***Figure 8.1-6:*** *768.97 MHz output power Low power plus 3 dB above AGC threshold*

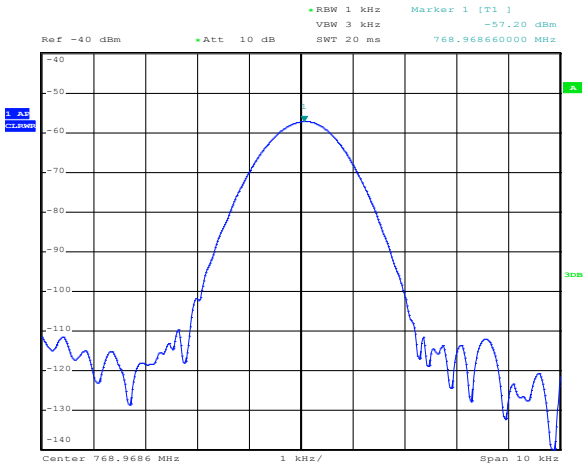


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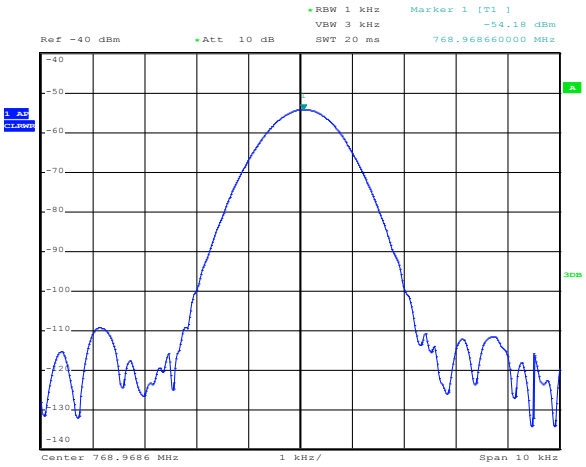
***Figure 8.1-7:*** *768.97 MHz input power Low power*




Date: 8.DEC.2016 20:44:45

***Figure 8.1-8:*** *768.97 MHz input power Low power plus 3 dB above AGC threshold*

## 8.1.4 Test data continued

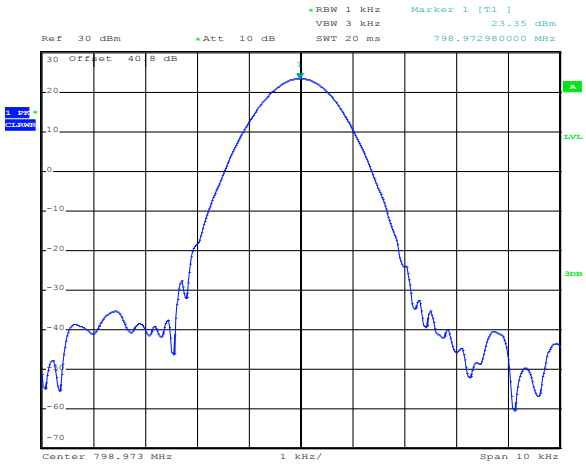



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***Figure 8.1-9:*** *798.97 MHz output power*

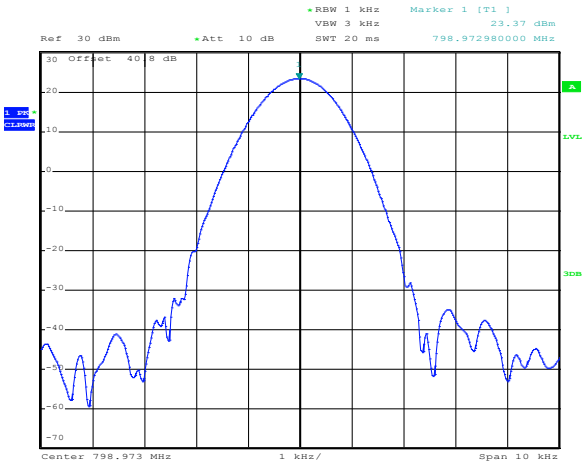


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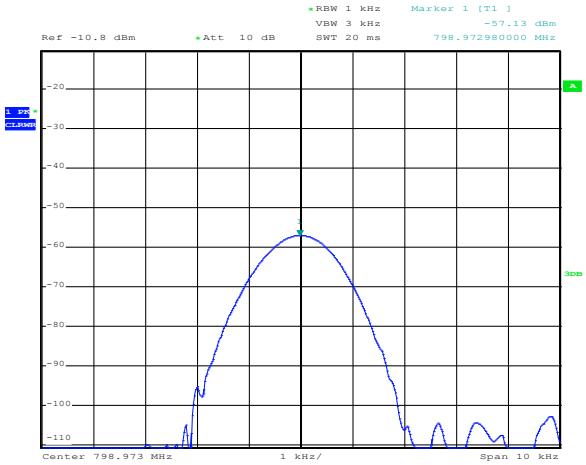
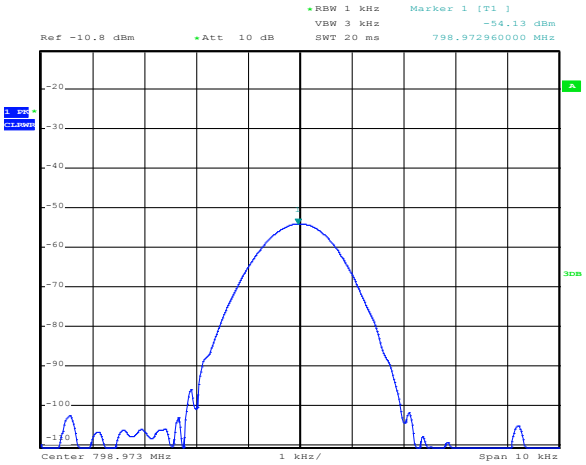
***Figure 8.1-10:****798.97 MHz output power plus 3 dB above AGC threshold*




Date: 7.DEC.2016 19:50:32

***Figure 8.1-11:*** *798.97 MHz input power*




Date: 7.DEC.2016 19:49:57

***Figure 8.1-12:*** *798.97 MHz input power plus 3 dB above AGC threshold*

## 8.2 FCC §90.219(e)(3), §90.543(c), 90.543(e) Conducted Spurious

### 8.2.1 Definitions and limits

90.219(e )(3) Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.
90.543(c) Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.
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.

### 8.2.2 Test summary

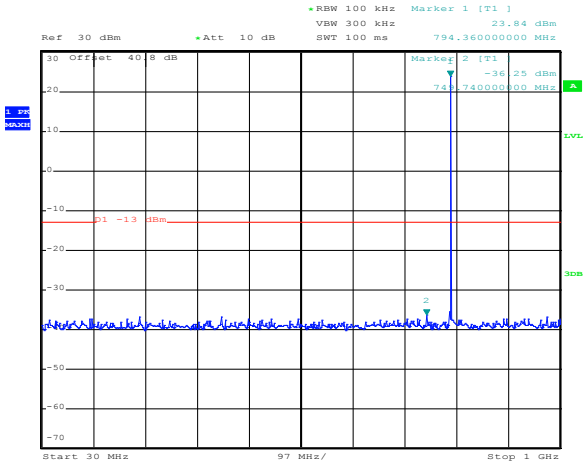
| | | | |
|---|---|---|---|
| Test date | December 8, 2016 | Temperature | 22 °C |
| Test engineer | Kevin Rose | Air pressure | 1003 mbar |
| Verdict | Pass | Relative humidity | 46 % |

### 8.2.3 Observations, settings and special notes

During the Part 90 543 (e)(3) testing the TX filter was adjusted to 763 to 768 MHz and 793 to 798 MHz

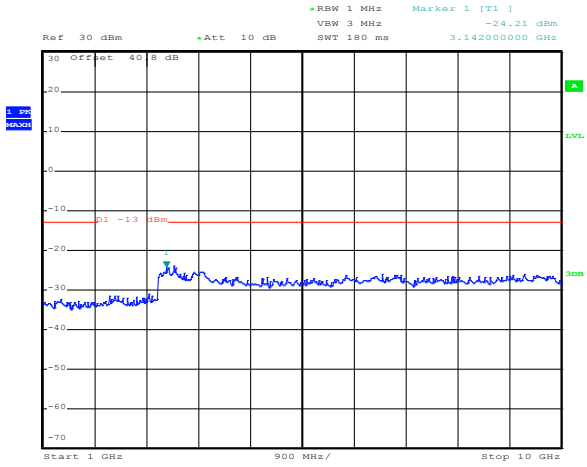
No Emission were detected within 20 dB of the -13 dBm limit

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



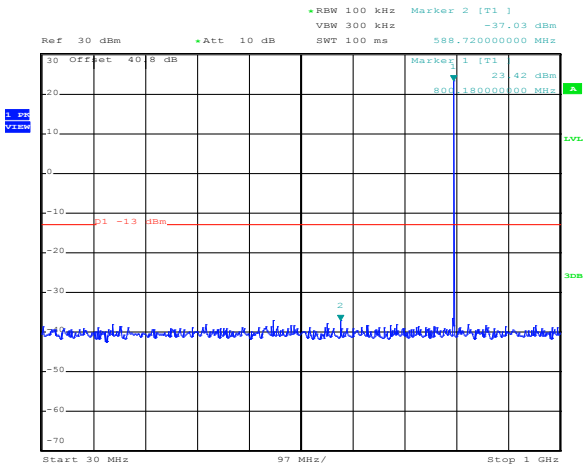

Date: 7.DEC.2016 20:04:44

***Figure 8.2-1:*** *793.0125 MHz Spurious 30-1000 MHz*



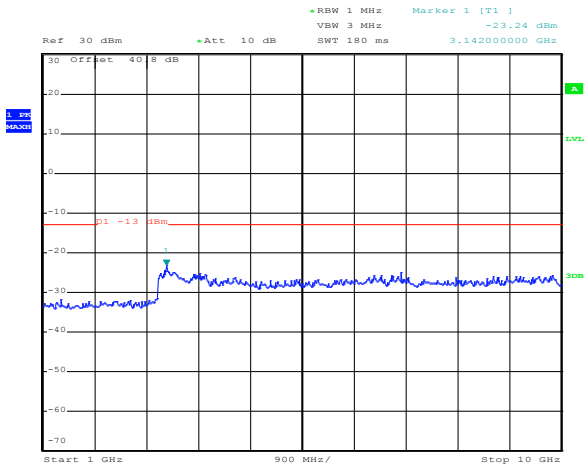

Date: 7.DEC.2016 20:03:01

*793.0125 MHz Spurious 1-10 GHz*




Date: 7.DEC.2016 19:57:30

***Figure 8.2-2:*** *799 MHz Spurious 30-1000 MHz*

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*799 MHz Spurious 1-10 GHz*

## 8.2.4 Test data continued

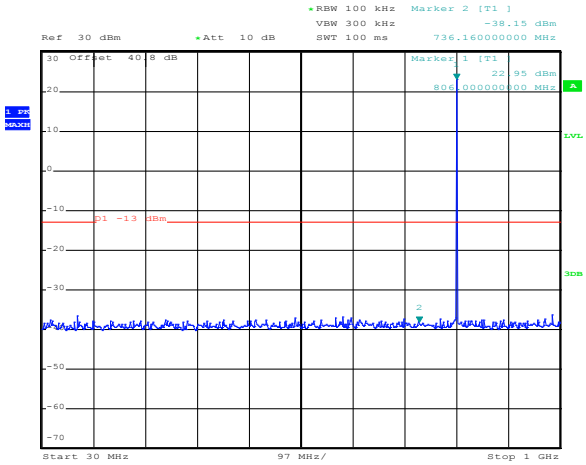
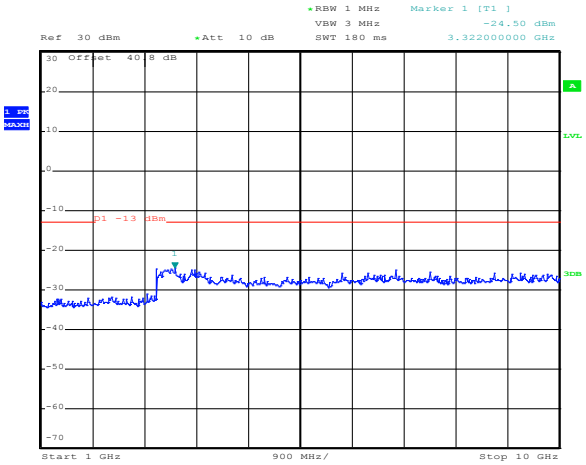



***Figure 8.2-3:*** *804.9875 MHz Spurious 30-1000 MHz*




*804.9875 MHz Spurious 1-10 GHz*

## 8.2.1 Test data continued

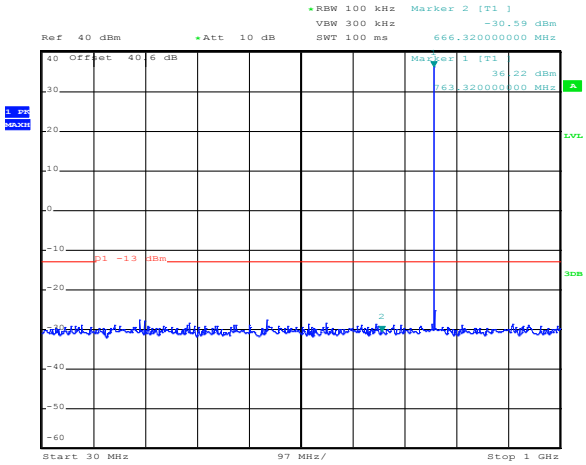



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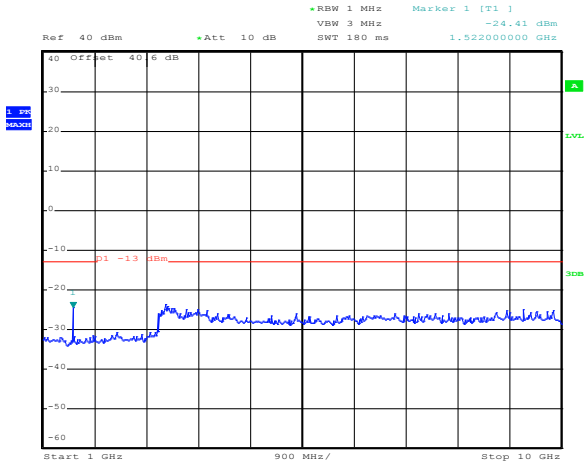
***Figure 8.2-4:*** *763.0125 MHz Spurious 30-1000 MHz*

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*763.0125 MHz Spurious 1-8 GHz*

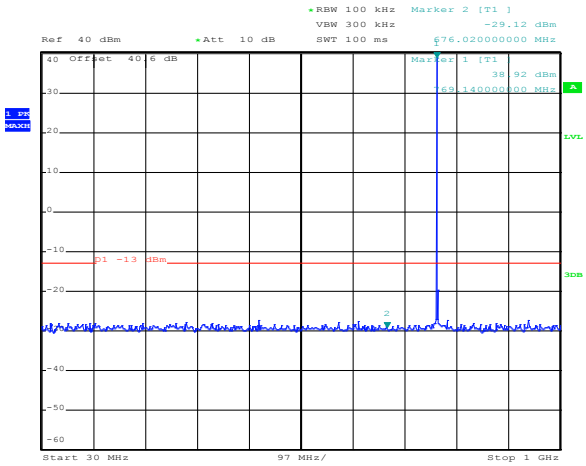


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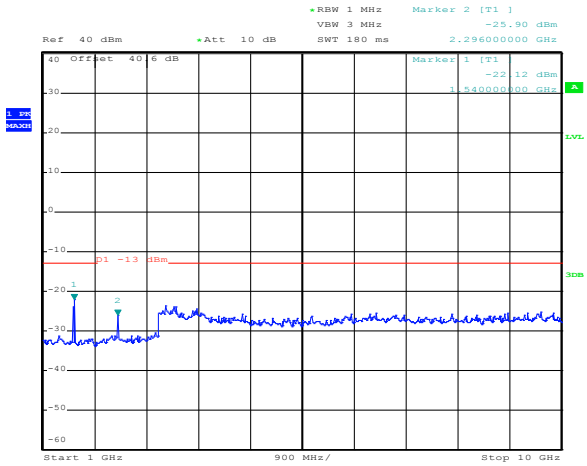
***Figure 8.2-5:*** *769 MHz Spurious 30-1000 MHz*

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*769 MHz Spurious 1-8 GHz*

## 8.2.2 Test data continued

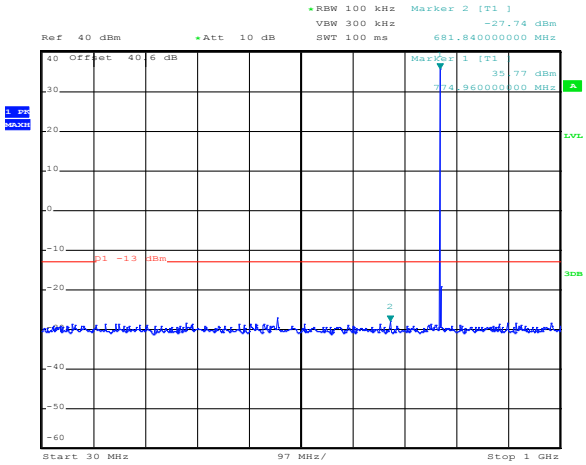


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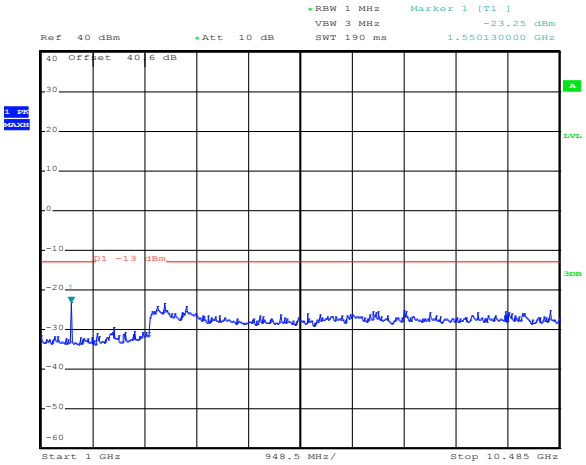
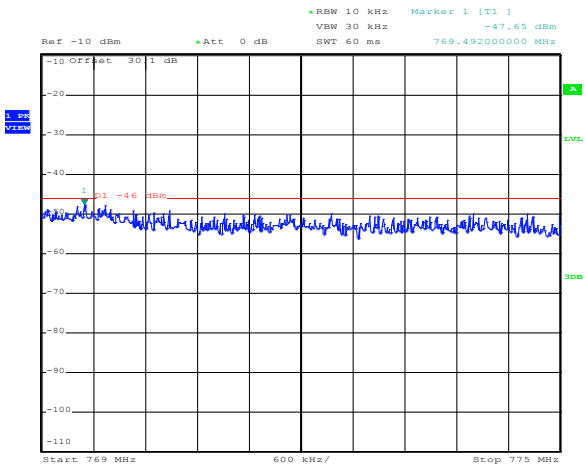
***Figure 8.2-6:*** *774.9875 MHz Spurious 30-1000 MHz*



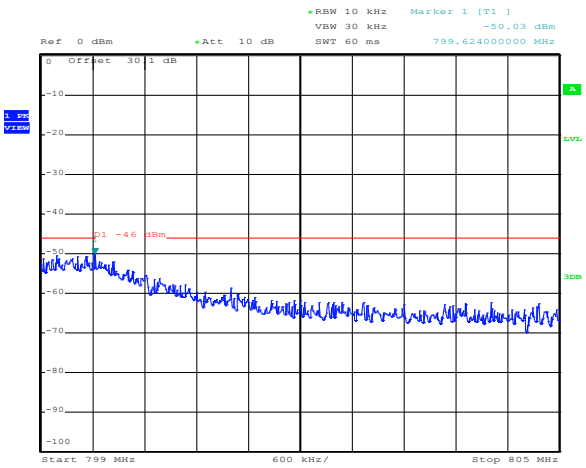

Date: 8.DEC.2016 21:09:38

***Figure 8.2-7:*** *774.9875 MHz Spurious 1-8 GHz*




Date: 27.APR.2017 09:43:35

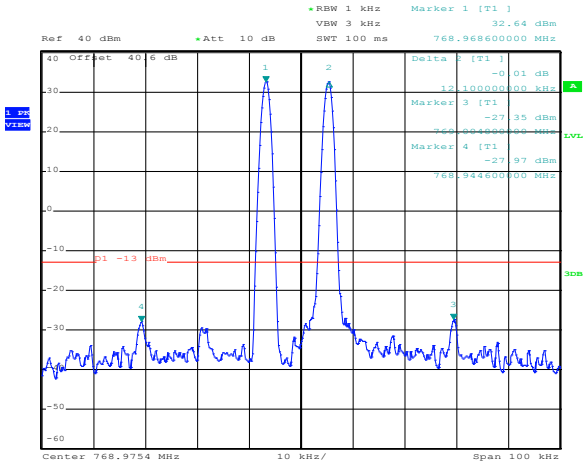
***Figure 8.2-8:*** *768 MHz Spurious 769–775 MHz*




Date: 27.APR.2017 09:48:35

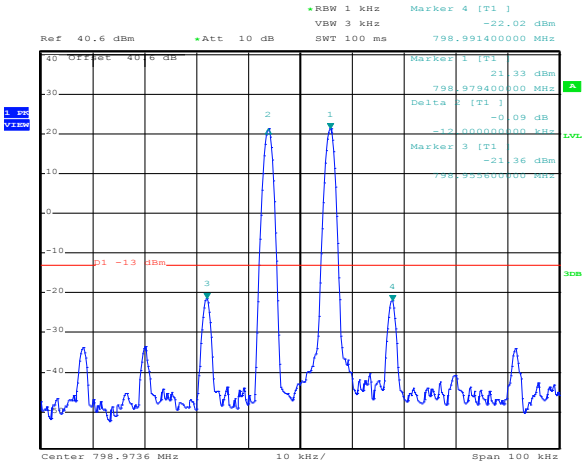
***Figure 8.2-9:*** *798 MHz Spurious 799–805 MHz*

## 8.2.1 Test data continued




Date: 8.DEC.2016 20:12:12

***Figure 8.2-10:*** *Intermodulation fo –UL 6 KHz, fo+6 kHz*




Date: 8.DEC.2016 17:02:13

***Figure 8.2-11:*** *Intermodulation fo –DL 6 KHz, fo+6 kHz*

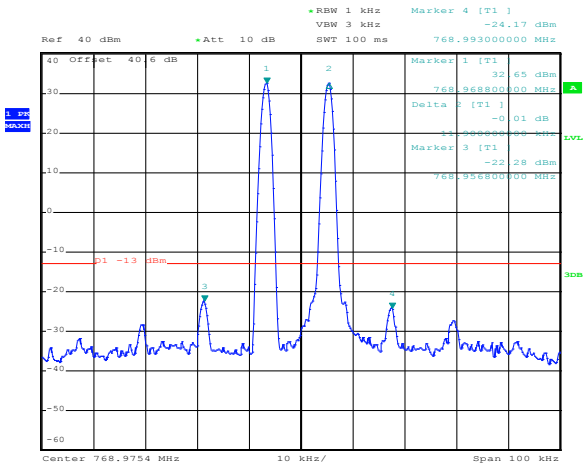



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***Figure 8.2-12:*** *Intermodulation fo –UL 6 KHz, fo+6 kHz Plus 3 dB*

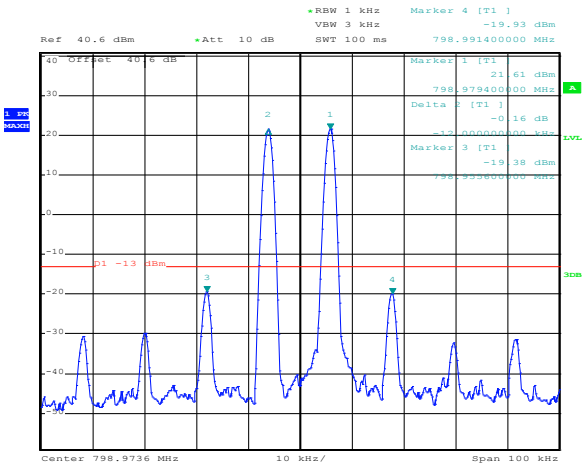


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***Figure 8.2-13:*** *Intermodulation fo –DL 6 KHz, fo+6 kHz Plus 3 dB*

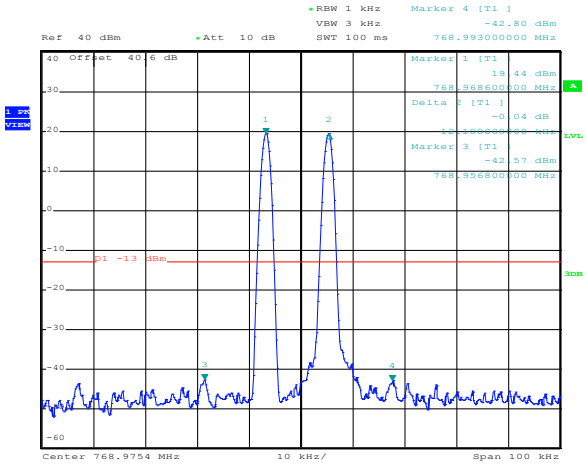


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***Figure 8.2-14:*** *Intermodulation fo –UL 6 KHz, fo+6 kHz low power*

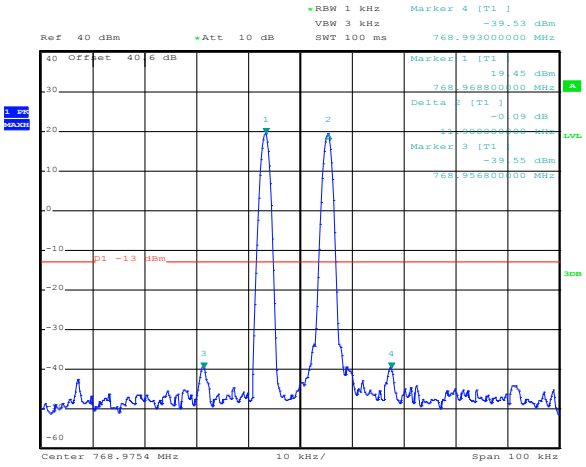


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***Figure 8.2-15:*** *Intermodulation fo –DL 6 KHz, fo+6 kHz Plus 3 dB low power*

## 8.3 FCC §90.219(e)(3), §90.543 (c) Radiated Spurious

### 8.3.1 Definitions and limits

90.219(e)(3) Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.
90.543(c) Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

### 8.3.2 Test summary

| | | | |
|---|---|---|---|
| Test date | December 8, 2016 | Temperature | 22 °C |
| Test engineer | Kevin Rose | Air pressure | 1003 mbar |
| Verdict | Pass | Relative humidity | 46 % |

### 8.3.3 Observations, settings and special notes

Low, Mid, and High channels of all modulations were investigated. Worst case examples are provided.
No emissions were detected within 20 dB of the -13 dBm limit.

Receiver settings were:

| | |
|---|---|
| Frequency range | 30 MHz to 10$^{th}$ 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

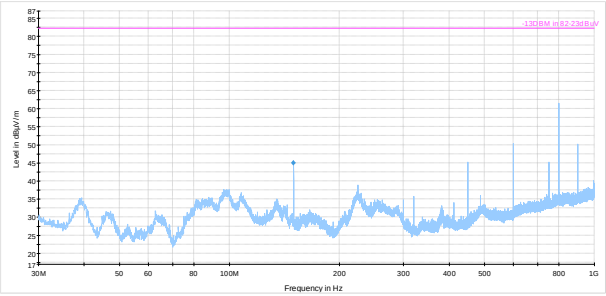


***Figure 8.3-1:*** *30-1000 MHz 769 MHz*

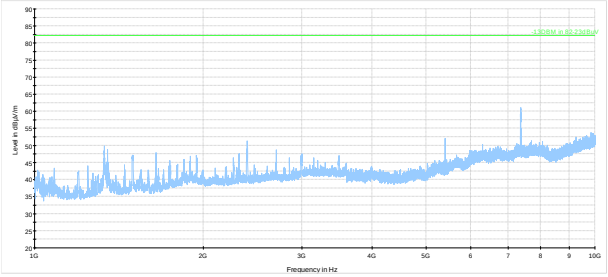


***Figure 8.3-2:*** *1-10 GHz 769 MHz*

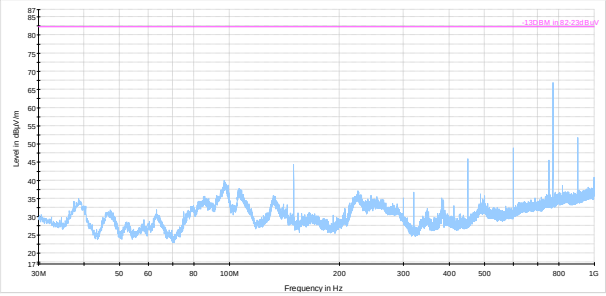


***Figure 8.3-3:*** *30-1000 MHz 799 MHz*

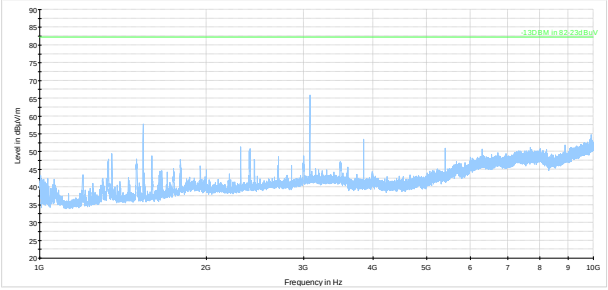


***Figure 8.3-4:*** *1-10 GHz 799 MHz*

## 8.4 FCC §90.219(e)(4), §90.543(c) Input Output

### 8.4.1 Definitions and limits

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).
90.543(c) Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

### 8.4.2 Test summary

| | | | |
|---|---|---|---|
| Test date | December 8, 2016 | Temperature | 22 °C |
| Test engineer | Kevin Rose | Air pressure | 1003 mbar |
| Verdict | Pass | Relative humidity | 46 % |

### 8.4.3 Observations, settings and special notes

Spectrum analyzer settings:

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

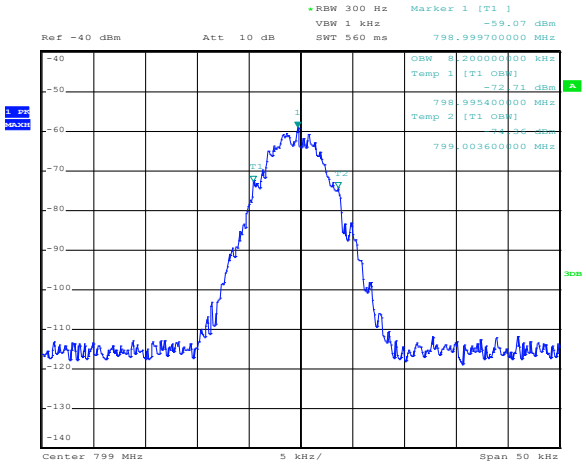


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***Figure 8.4-1:*** *799 MHz DMR input*

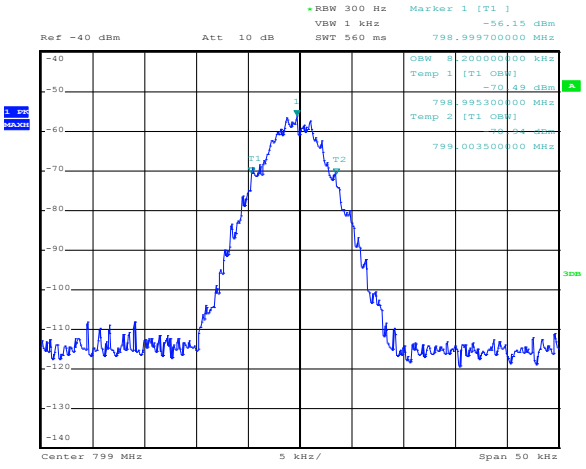


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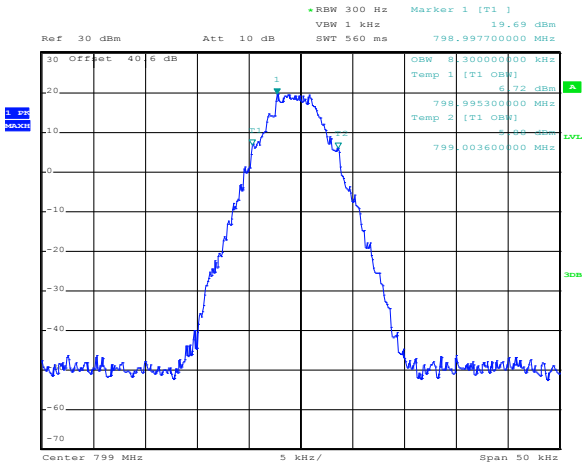
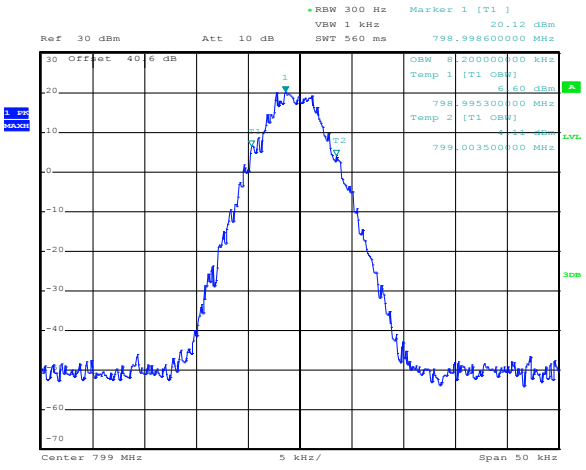
***Figure 8.4-2:*** *799 MHz DMR input Plus 3 dB* above AGC threshold




Date: 8.DEC.2016 17:58:24

***Figure 8.4-3:*** *799 MHz DMR output*




Date: 8.DEC.2016 17:59:02

***Figure 8.4-4:*** *799 MHz DMR output Plus 3 dB* above AGC threshold

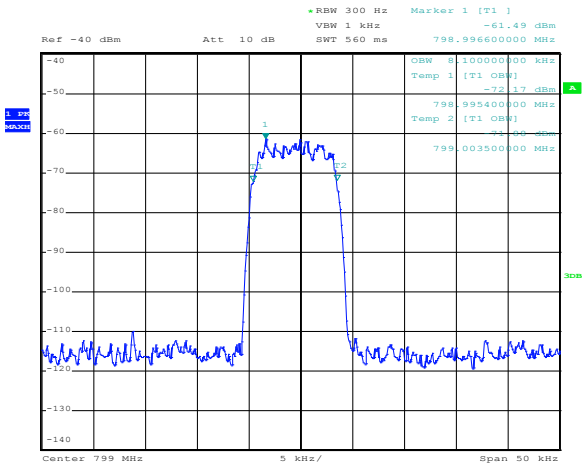



***Figure 8.4-5:*** *799 MHz P25 input*

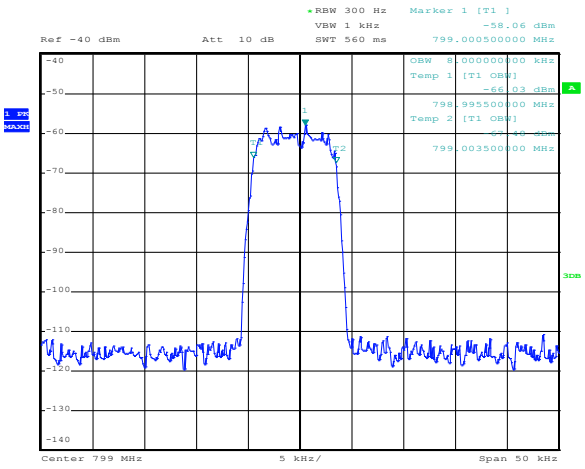



***Figure 8.4-6:*** *799 MHz P25 input Plus 3 dB* above AGC threshold

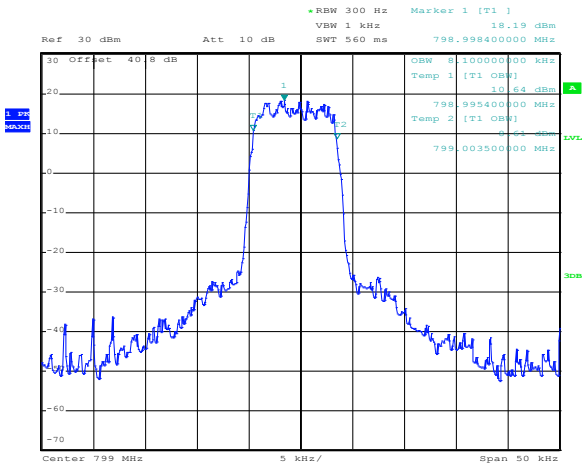



***Figure 8.4-7:*** *799 MHz P25 output*

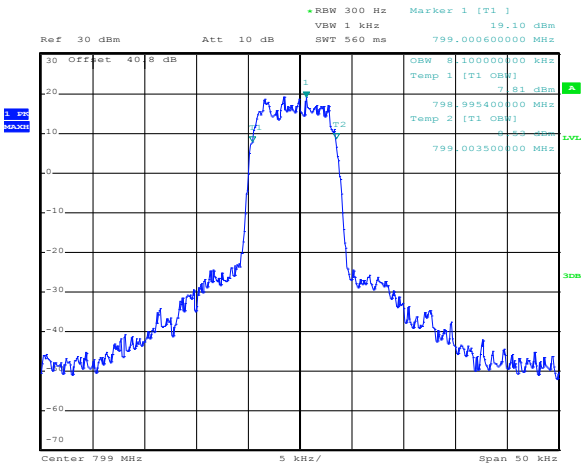



***Figure 8.4-8:*** *799 MHz P25 output Plus 3 dB* above AGC threshold

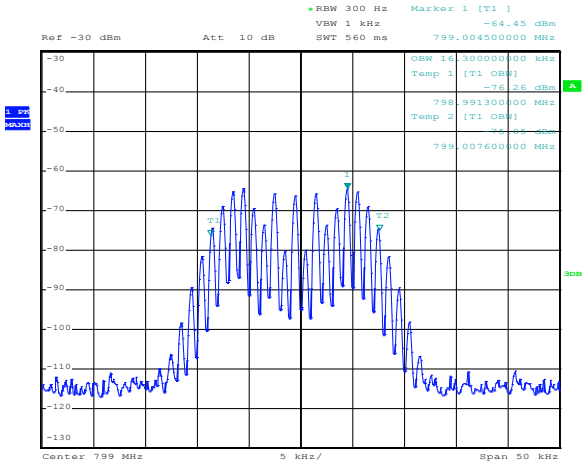



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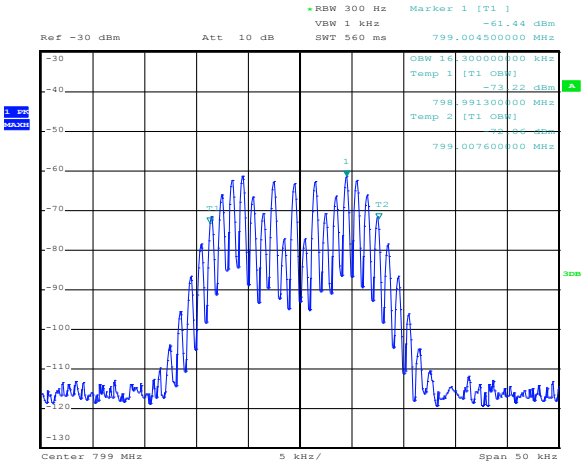
***Figure 8.4-9:*** *799 MHz analog input*




Date: 8.DEC.2016 17:50:50

***Figure 8.4-10:*** *799 MHz analog input Plus 3 dB* above AGC threshold

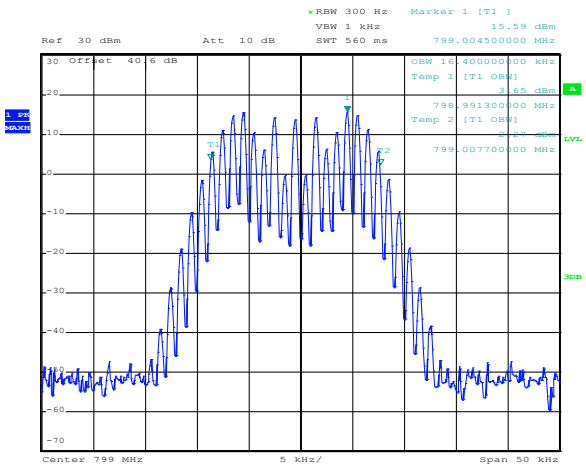



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***Figure 8.4-11:*** *799 MHz analog output*

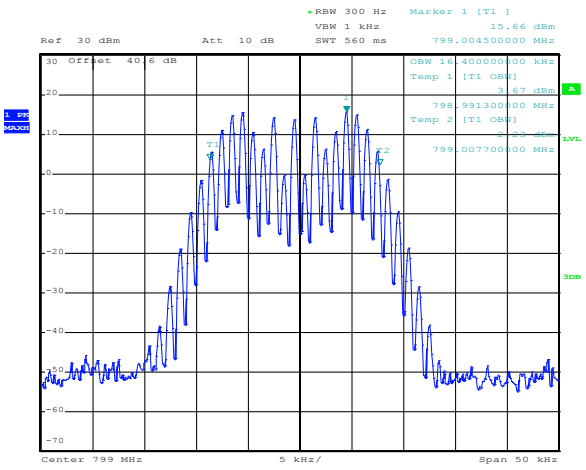


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***Figure 8.4-12:*** *799 MHz analog output Plus 3 dB* above AGC threshold

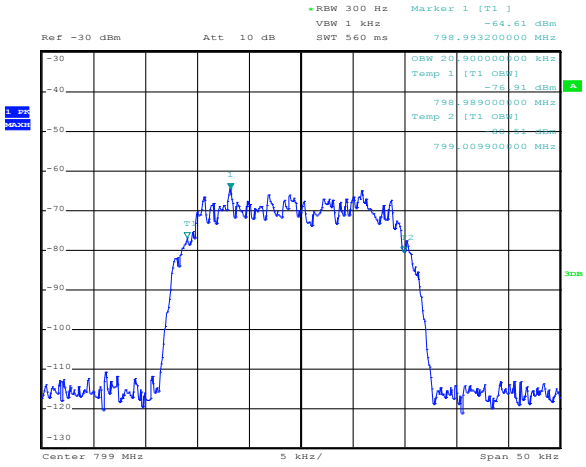



***Figure 8.4-13:*** *799 MHz TETRA input*

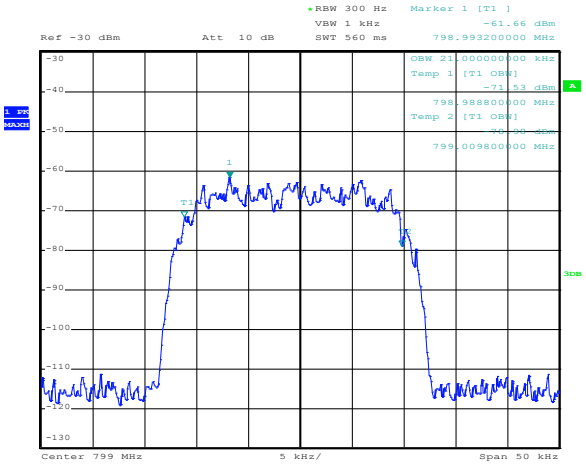



***Figure 8.4-14:*** *799 MHz TETRA input Plus 3 dB* above AGC threshold

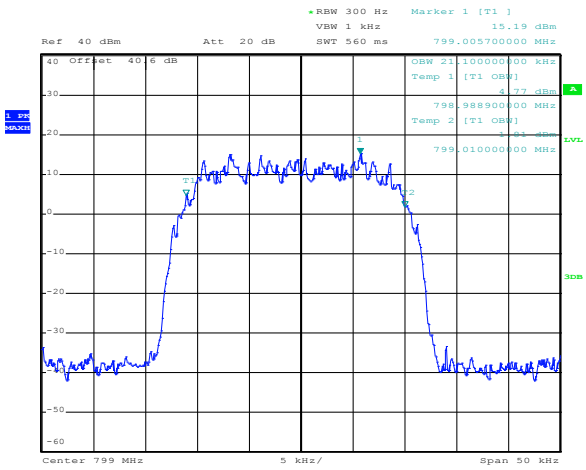



***Figure 8.4-15:*** *799 MHz TETRA output*

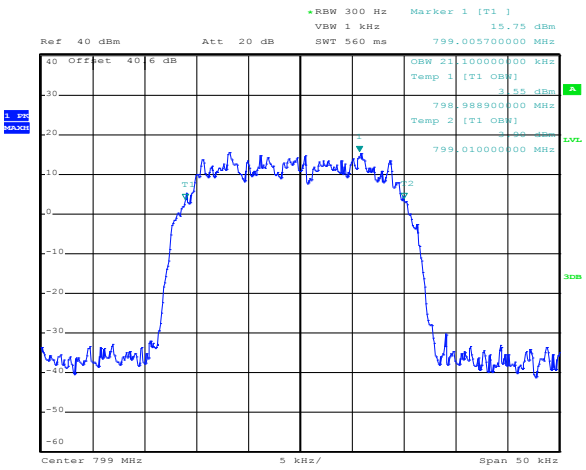



***Figure 8.4-16:*** *799 MHz TETRA output Plus 3 dB* above AGC threshold

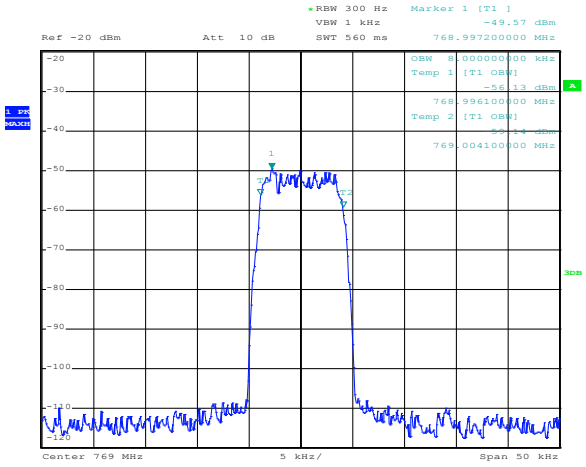



***Figure 8.4-17:*** *769 MHz P25 input*

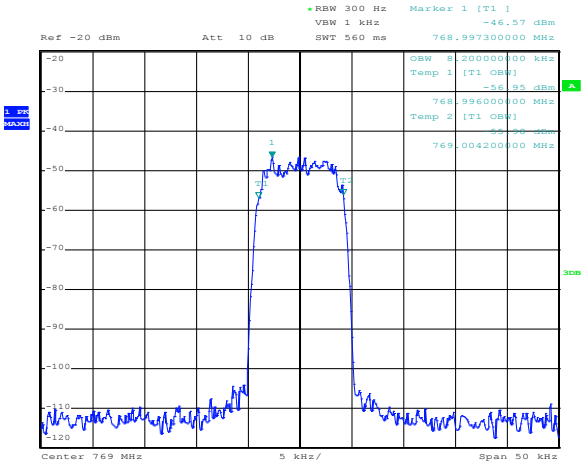



***Figure 8.4-18:*** *769 MHz P25 input Plus 3 dB* above AGC threshold

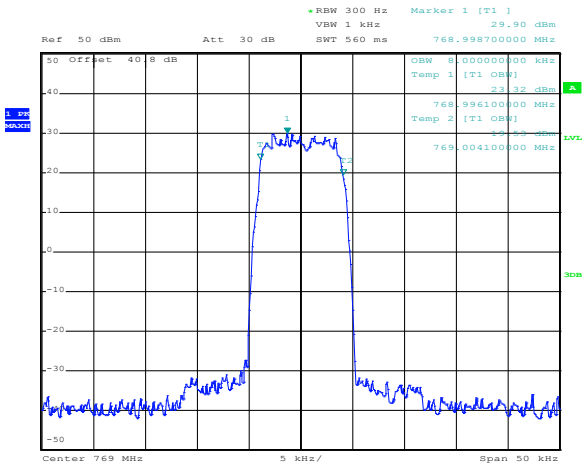



***Figure 8.4-19:*** *769 MHz P25 output*

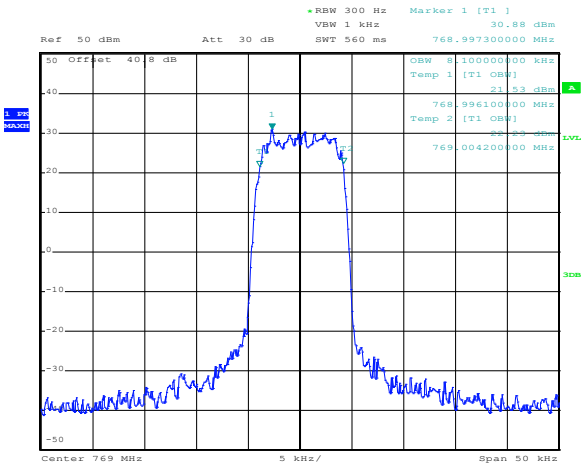



***Figure 8.4-20:*** *769 MHz P25 output Plus 3 dB* above AGC threshold

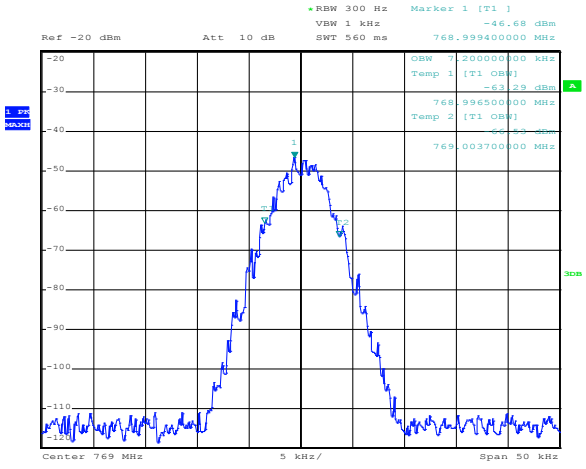



***Figure 8.4-21:*** *769 MHz DMR input*

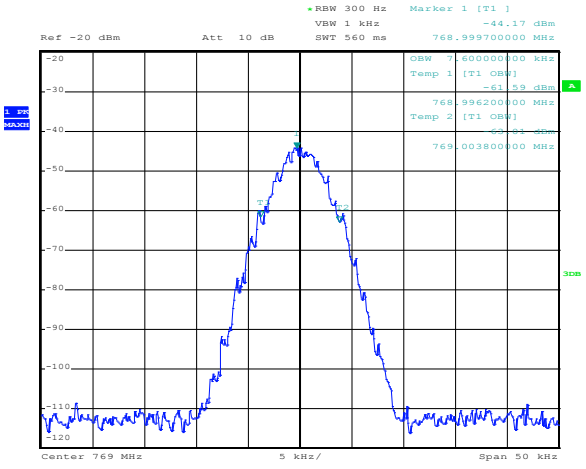



***Figure 8.4-22:*** *769 MHz DMR input Plus 3 dB* above AGC threshold

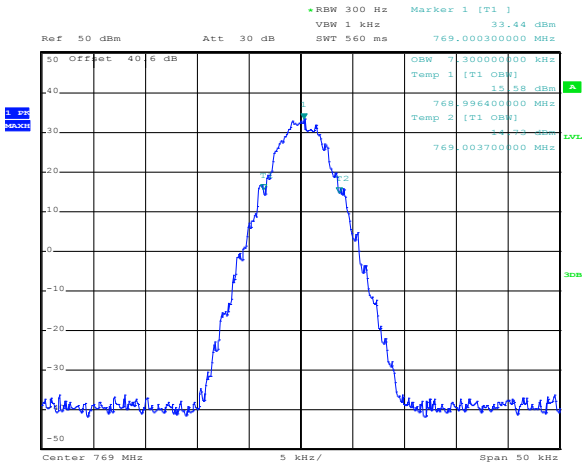



***Figure 8.4-23:*** *769 MHz DMR output*

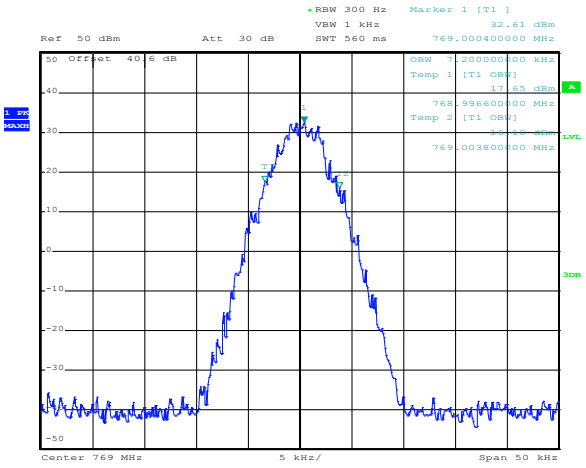



***Figure 8.4-24:*** *769 MHz DMR output Plus 3 dB* above AGC threshold

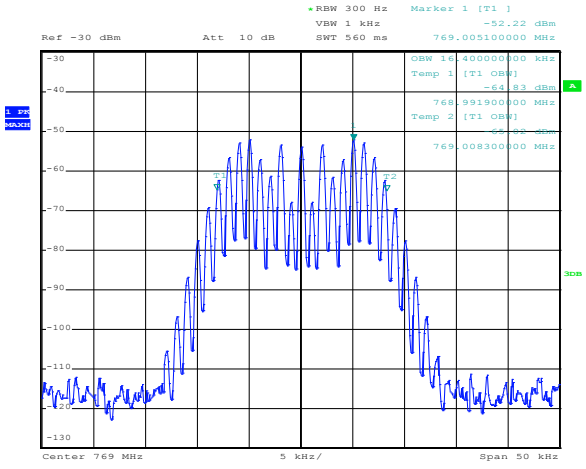



***Figure 8.4-25:*** *769 MHz analog input*

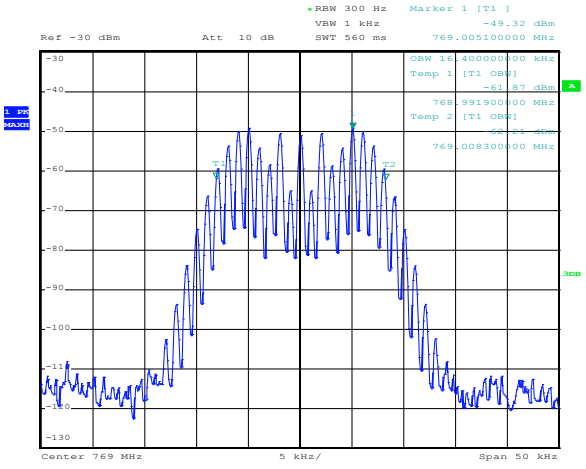



***Figure 8.4-26:*** *769 MHz analog input Plus 3 dB* above AGC threshold

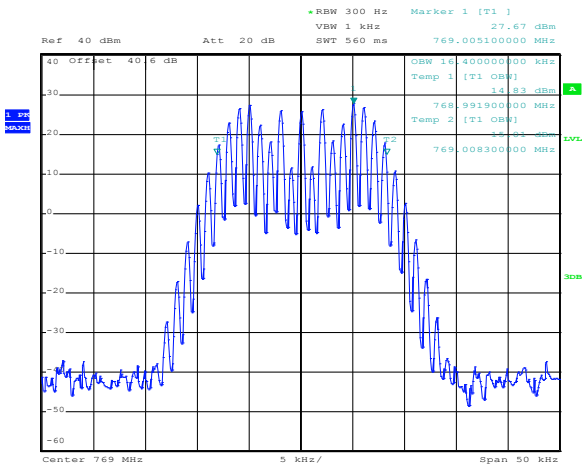



***Figure 8.4-27:*** *769 MHz analog output*

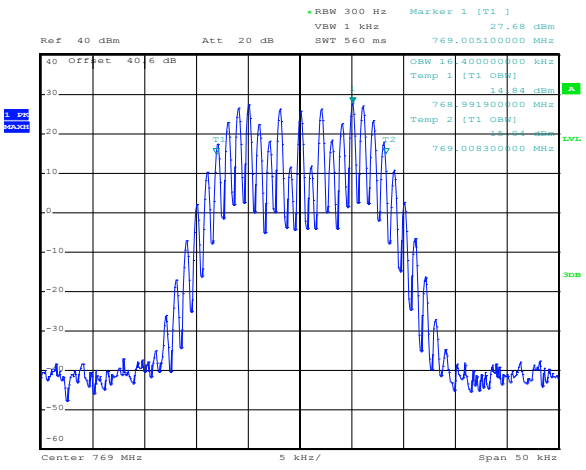
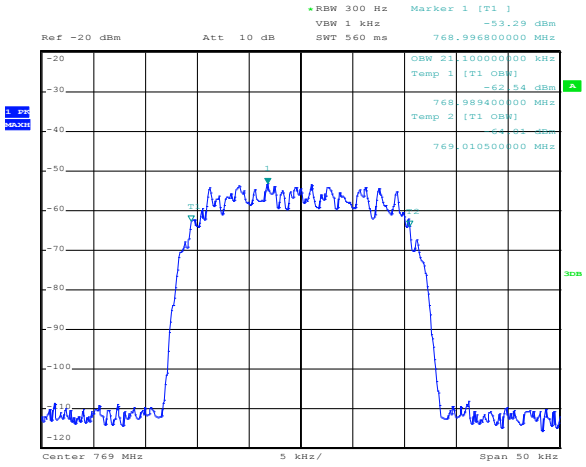
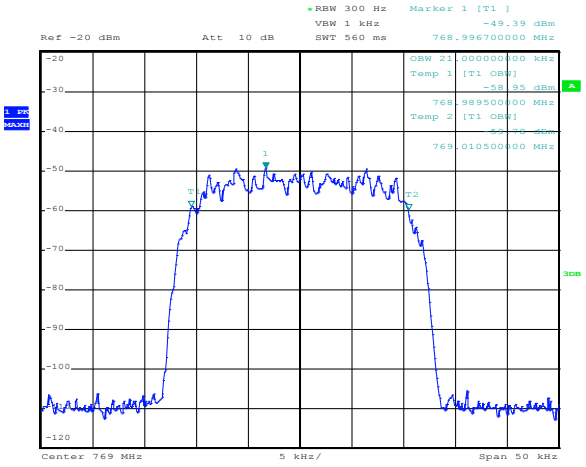



***Figure 8.4-28:*** *769 MHz analog output Plus 3 dB* above AGC threshold



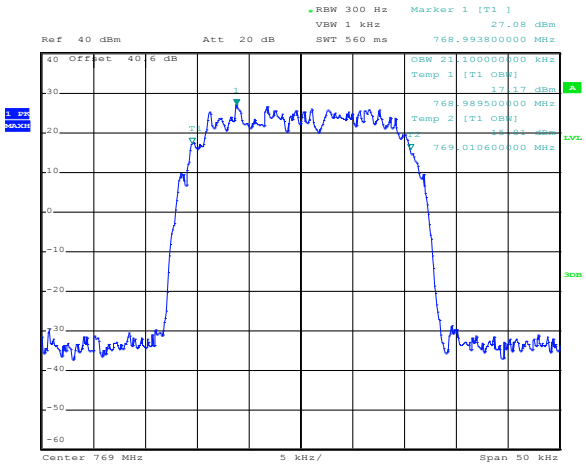

Date: 8.DEC.2016 19:21:23

***Figure 8.4-29:*** *769 MHz Tetra output*



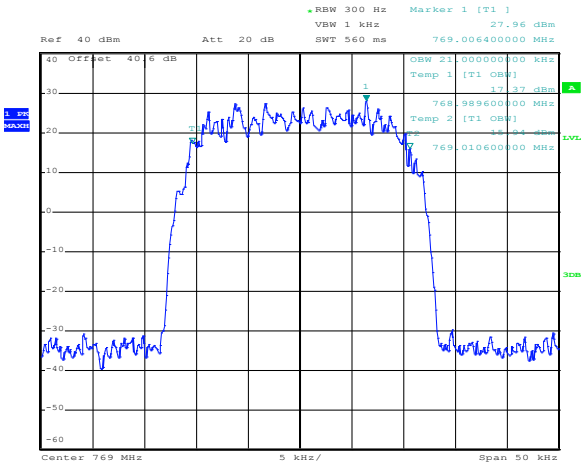

Date: 8.DEC.2016 19:22:13

***Figure 8.4-30:*** *769 MHz Tetra output plus 3 dB above AGC threshold*



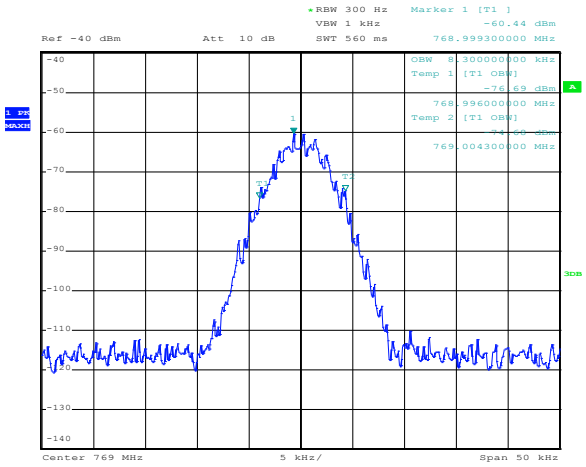

Date: 8.DEC.2016 19:23:44

***Figure 8.4-31:*** *769 MHz Tetra output*



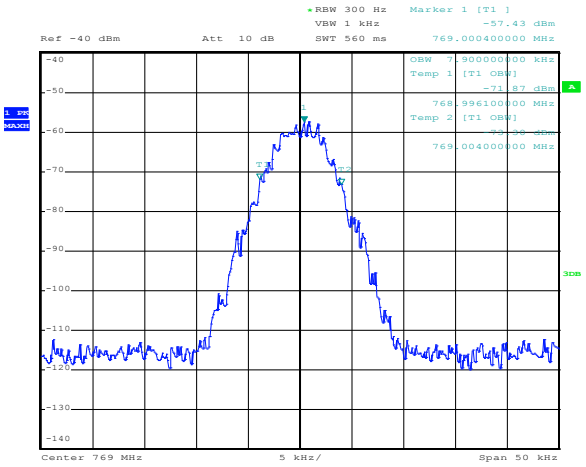

Date: 8.DEC.2016 19:23:04

***Figure 8.4-32:*** *769 MHz Tetra output plus 3 dB above AGC threshold*



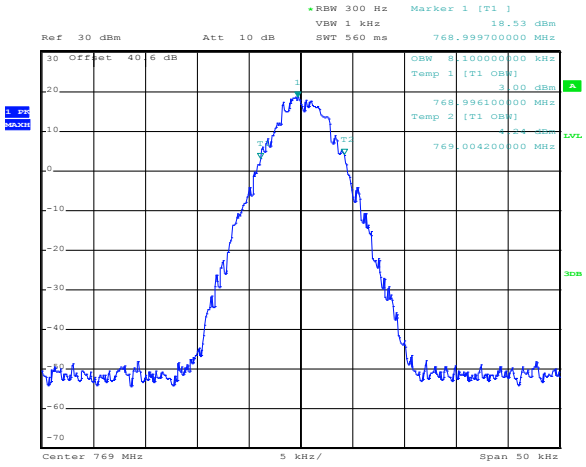

Date: 8.DEC.2016 19:47:57

***Figure 8.4-33:*** *769 MHz DMR input Low power*



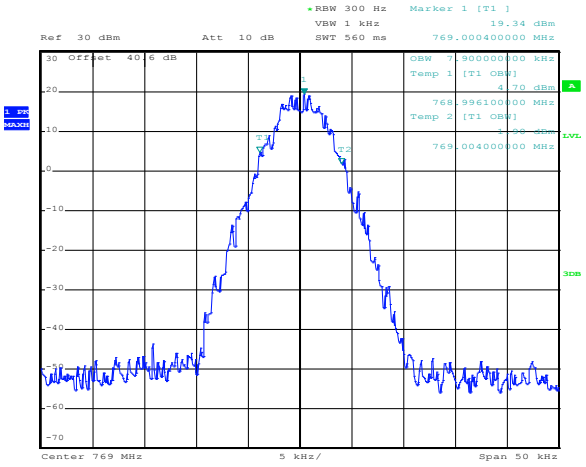

Date: 8.DEC.2016 19:47:32

***Figure 8.4-34:*** *769 MHz DMR input Low power Plus 3 dB* above AGC threshold



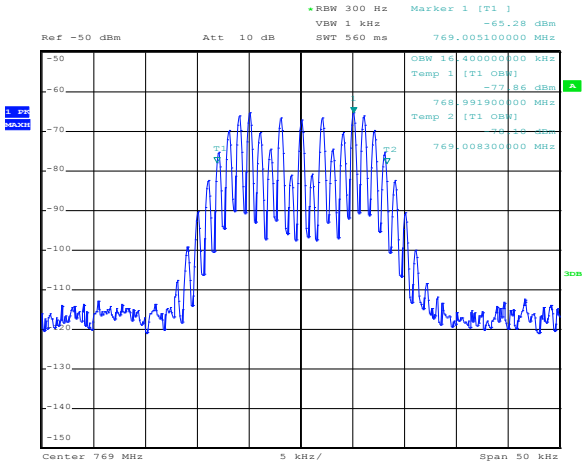

Date: 8.DEC.2016 19:46:16

***Figure 8.4-35:*** *769 MHz DMR output Low power*



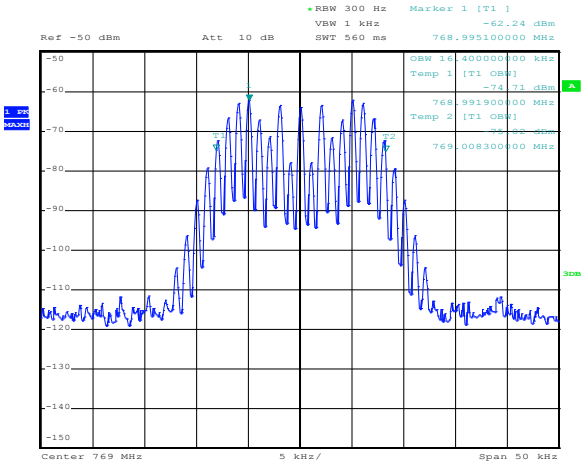

Date: 8.DEC.2016 19:46:54

***Figure 8.4-36:*** *769 MHz DMR output Low power Plus 3 dB* above AGC threshold



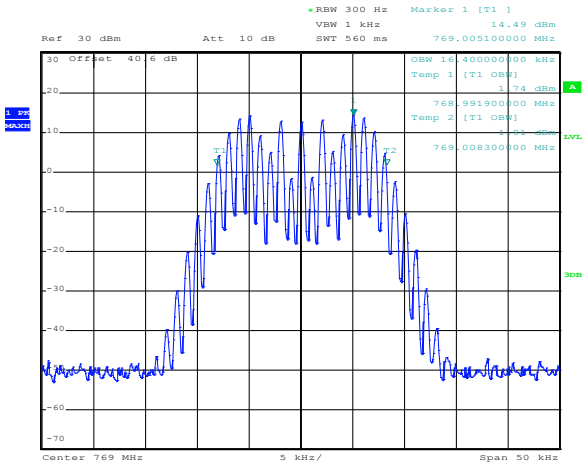

Date: 8.DEC.2016 19:42:17

***Figure 8.4-37:*** *769 MHz analog input Low power*



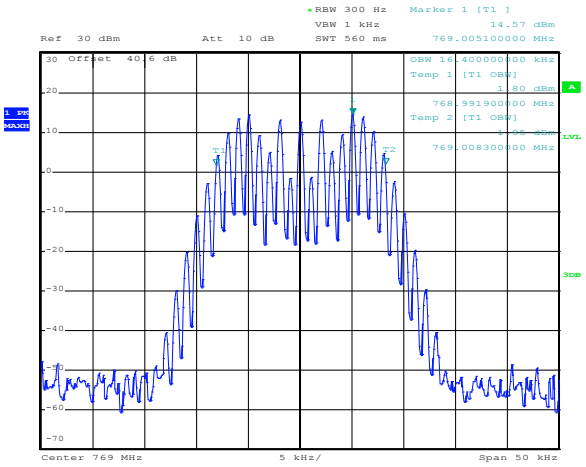

Date: 8.DEC.2016 19:41:48

***Figure 8.4-38:*** *769 MHz analog input Low power Plus 3 dB* above AGC threshold



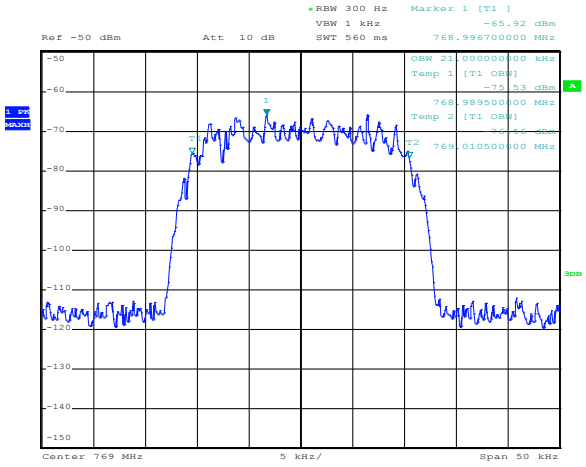

Date: 8.DEC.2016 19:40:15

***Figure 8.4-39:*** *769 MHz analog output Low power*



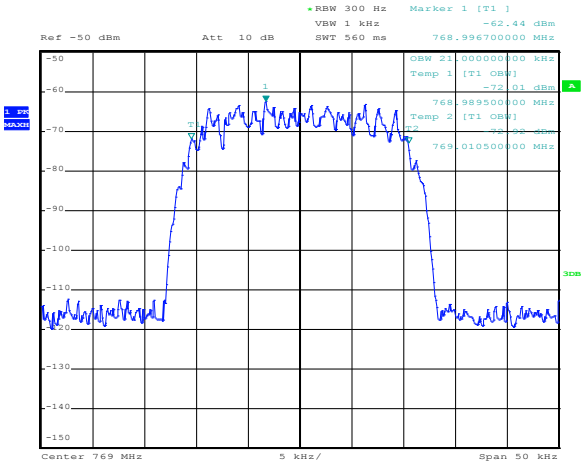

Date: 8.DEC.2016 19:40:51

***Figure 8.4-40:*** *769 MHz analog output Low power Plus 3 dB* above AGC threshold



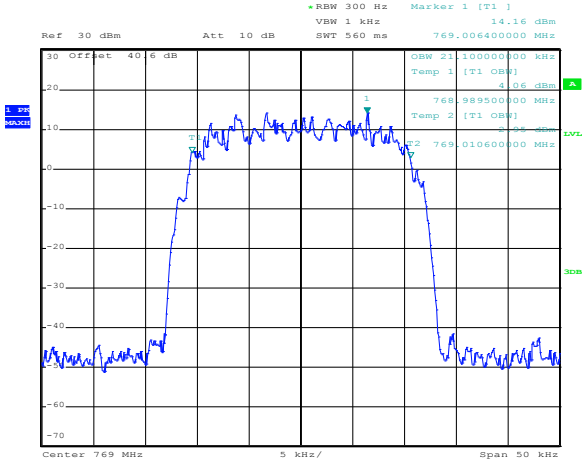

Date: 8.DEC.2016 19:43:04

***Figure 8.4-41:*** *769 MHz Tetra output Low power*



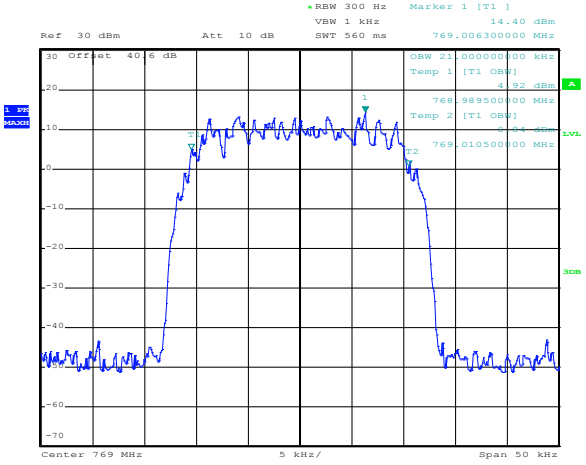

Date: 8.DEC.2016 19:43:34

***Figure 8.4-42:*** *769 MHz Tetra output Low power plus 3 dB above AGC threshold*




Date: 8.DEC.2016 19:44:53

***Figure 8.4-43:*** *769 MHz Tetra output Low power*




Date: 8.DEC.2016 19:44:24

***Figure 8.4-44:*** *769 MHz Tetra output Low power plus 3 dB above AGC threshold*

## 8.5 KDB 935210 D05 v01r01 4.2 Measuring AGC threshold

### 8.5.1 Definitions and limits

Testing at and above the AGC threshold will be required. 4 The AGC threshold shall be determined by applying the procedure of 3.2, but with the signal generator configured to produce a test signal defined in Table 1 , a CW input signal.

### 8.5.2 Test summary

| | | | |
|---|---|---|---|
| Test date | November 16, 2016 | Temperature | 22 °C |
| Test engineer | Kevin Rose | Air pressure | 1003 mbar |
| Verdict | Pass | Relative humidity | 46 % |

### 8.5.3 Observations, settings and special notes

Assessed to remain within assigned band. Spectrum analyzer settings:

| | |
|---|---|
| Detector mode | Peak |
| Resolution bandwidth | 1 MHz |
| Intergration bandwidth | >OBW |
| Video bandwidth | >RBW |
| Trace mode | Max Hold |
| Measurement time | Auto |

### 8.5.4 Test data

***Table 8.5-1:*** *AGC results*

| Frequency, MHz | Input, dBm | output, dBm | Gain, dB | Rated Gain, dB |
|---|---|---|---|---|
| 798.97 | -57.13 | 23.35 | 80.48 | 80 |
| 768.96 | -44.11 | 36.19 | 80.30 | 80 |
| 768.96 | -57.20 | 22.82 | 80.02 | 80 |

***Table 8.5-2:*** *AGC results 3 dB above AGC threshold*

| Frequency, MHz | Input, dBm | output, dBm | Gain, dB | Rated Gain, dB |
|---|---|---|---|---|
| 798.97 | -54.13 | 23.37 | 77.50 | 80 |
| 768.96 | -40.16 | 36.21 | 76.37 | 80 |
| 768.96 | -54.18 | 22.83 | 77.01 | 80 |

## 8.6 KDB 935210 D05 v01r01 4.3 Out-of-band rejection

### 8.6.1 Definitions and limits

After the trace is completely filled, place a marker at the peak amplitude, which is designated as f0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).

### 8.6.2 Test summary

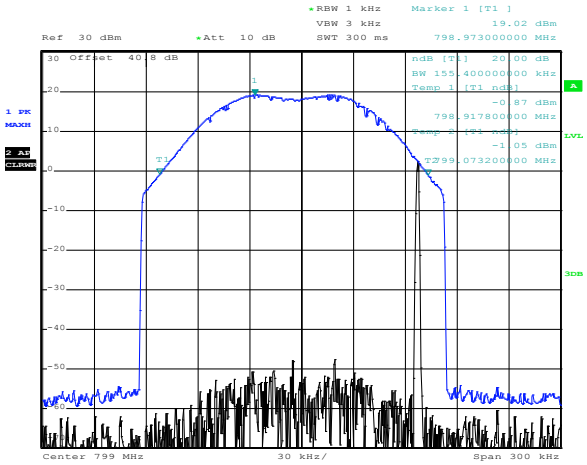
| | | | |
|---|---|---|---|
| Test date | January 11, 2017 | Temperature | 22 °C |
| Test engineer | Kevin Rose | Air pressure | 1003 mbar |
| Verdict | Pass | Relative humidity | 46 % |

### 8.6.3 Observations, settings and special notes

Assessed to remain within assigned band. Spectrum analyzer settings:

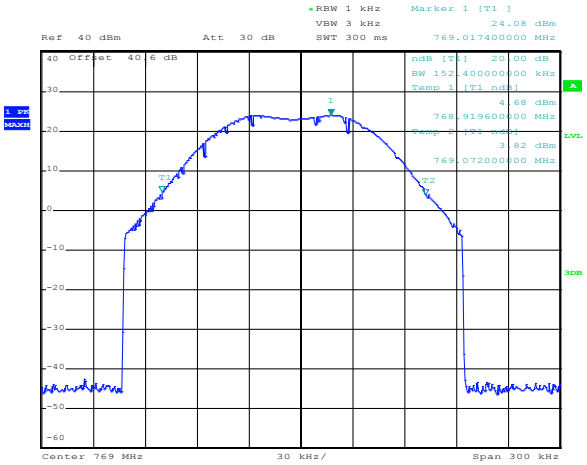
| | |
|---|---|
| Detector mode | Peak |
| Resolution bandwidth | 100 kHz |
| Video bandwidth | RBW × 3 |
| Trace mode | Max Hold |

## 8.6.4 Test data




Date: 7.DEC.2016 19:37:55

***Figure 8.6-1: UL** Out of band reject*




Date: 8.DEC.2016 20:03:22

***Figure 8.6-2: DL** Out of band reject*

## 8.7 FCC §90.543 (e)(f); Radiated Spurious

### 8.7.1 Definitions and limits

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.
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.

### 8.7.2 Test summary

| | | | |
|---|---|---|---|
| Test date | February 28, 2017 | Temperature | 23 °C |
| Test engineer | Kevin Rose | Air pressure | 1005 mbar |
| Verdict | Pass | Relative humidity | 35 % |

### 8.7.3 Observations, settings and special notes

None
Receiver settings were:

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

## 8.7.4 Test data

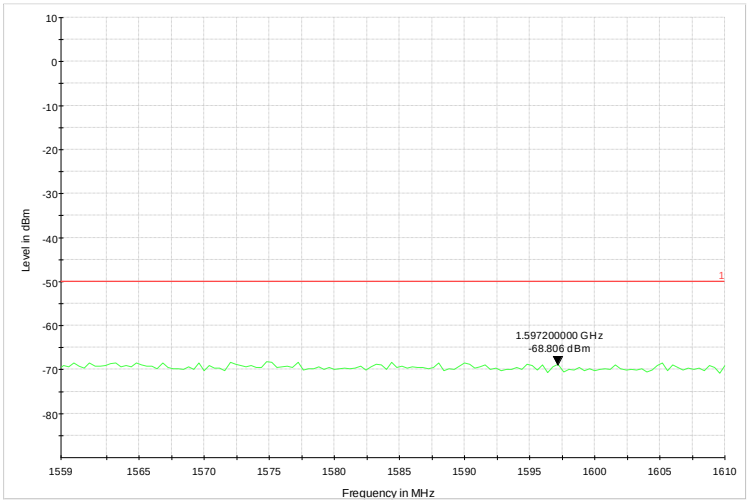



***Figure 8.7-1: DL** 1559–1610 MHz Spurious*

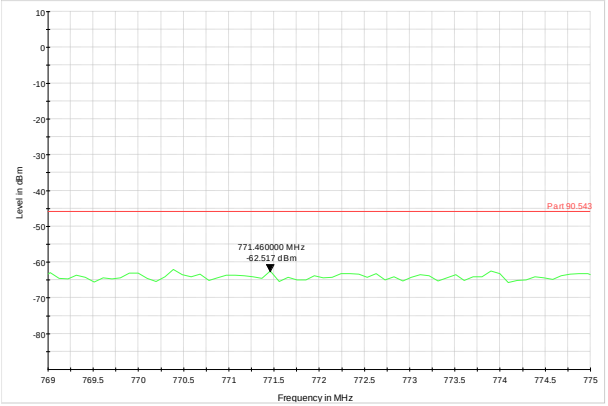



***Figure 8.7-2: DL** 769–775 MHz Spurious*

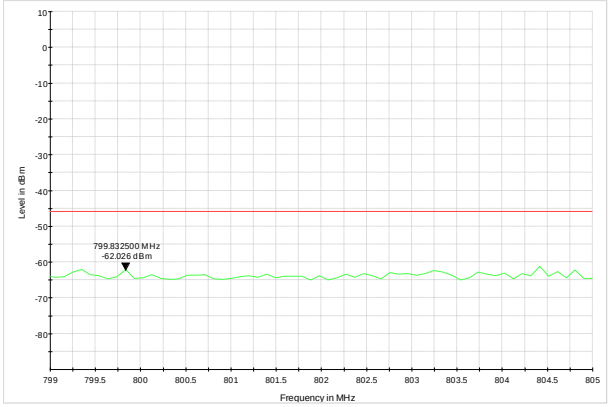



***Figure 8.7-3: UL** 779–805 MHz Spurious*

Note: dBuV/m @ 3m to EIRP dBm (A signal substitution factor was added to the dBµV/m measurement to obtain EIRP measurement.
TX frequency of 798 MHz was used

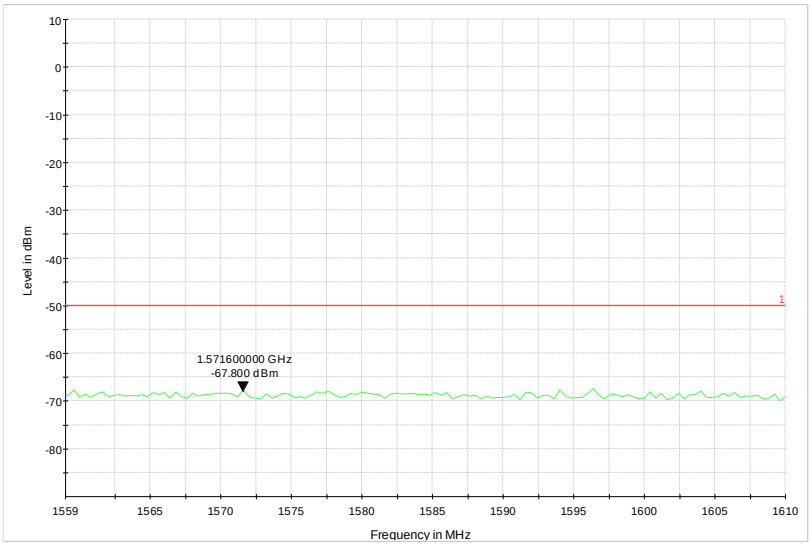



***Figure 8.7-4: UL** 1559–1610 MHz Spurious*

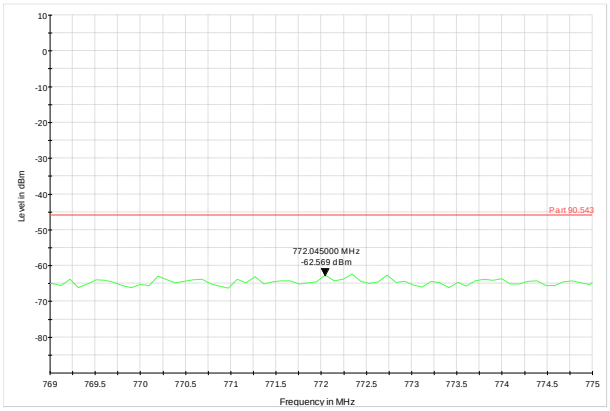



***Figure 8.7-5: DL** 769–775 MHz Spurious*

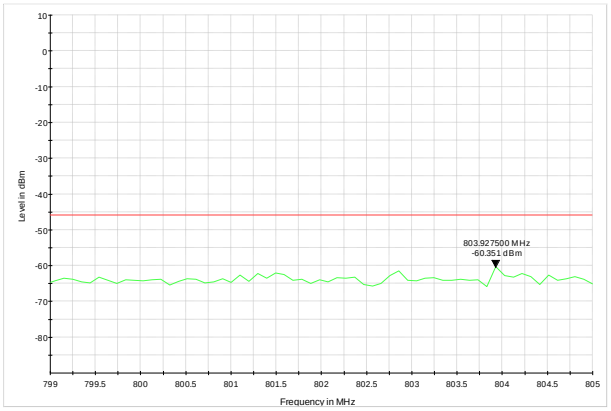



***Figure 8.7-6: UL** 779–805 MHz Spurious*

Note: dBuV/m @ 3m to EIRP dBm (A signal substitution factor was added to the dBµV/m measurement to obtain EIRP measurement.
TX frequency of 768 MHz was used

# 8.8 FCC §90.219 (e)(2) Noise figure

## 8.8.1 Definitions and limits

90.219(e)(2) The noise figure of a signal booster must not exceed 9 dB in either direction.

## 8.8.2 Test summary

| | | | |
|---|---|---|---|
| Test date | December 15, 2016 | Temperature | 22 °C |
| Test engineer | Kevin Rose | Air pressure | 1003 mbar |
| Verdict | Pass | Relative humidity | 46 % |

## 8.8.3 Observations, settings and special notes

The EUT is powered on and the Spectrum analyzer is centered on the band. Then the noise source is turned on. Then Noise floor is remeasued and the delta between two measurements is then used in the formula below.

Assessed to remain within assigned band. Spectrum analyzer settings:

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

## 8.8.4 Test data

***Table 8.8-1:*** *Noise figure result*

| DL/UL | Noise Source OFF, dBm | Noise Source ON, dBm | ENR, dB | NF Result, dB | Limit, dB | Margin, dB |
|---|---|---|---|---|---|---|
| DL | -26.49 | -20.1 | 12.83 | 7.57 | 9 | 1.43 |
| UL | -28.74 | -22.27 | 12.83 | 7.47 | 9 | 1.53 |

Noise Figure (NF) = $10 \times \log10 \{10^{(ENR/10)}/[10^{(Y/10)}-1]\}$

Y= Noise Source ON - Noise Source OFF

ENR= Noise level above Thermal noise

# **Section 9.** Setup Photos

## 9.1 Set-up

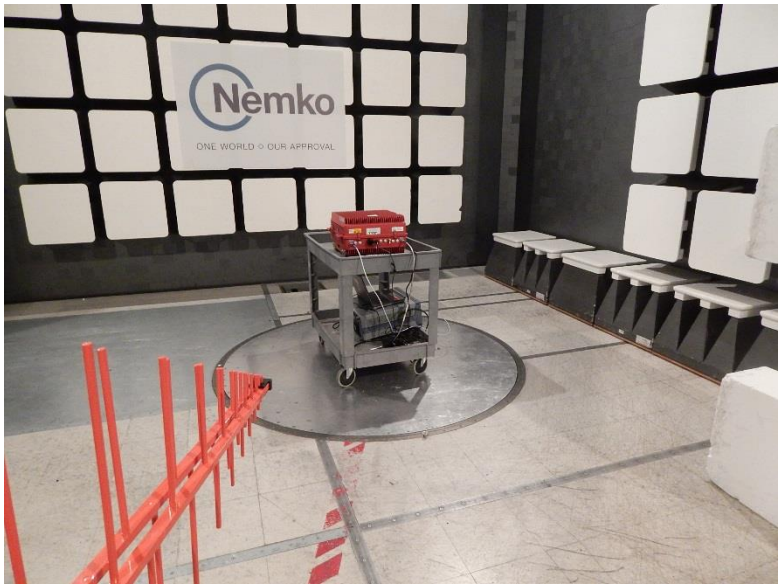
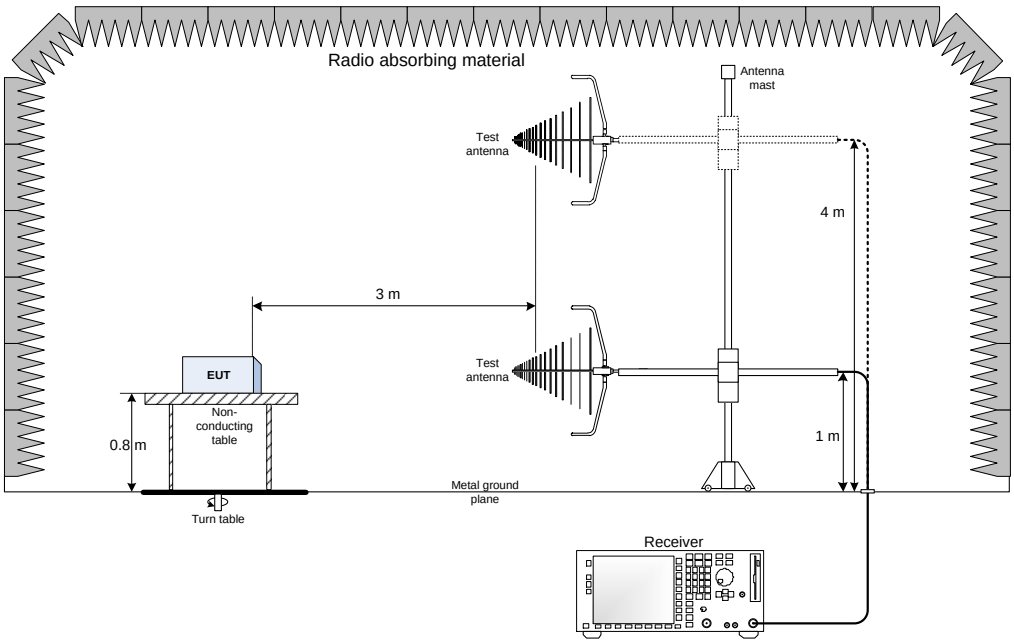



***Figure 9.1-1:*** *Radiated setup photo*

# **Section 10.** Block diagrams of test set-ups

## 10.1 Radiated emissions set-up




## 10.2 Noise figure set-up