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Test report

320935-1TRFWL

Date of issue: May 2, 2017

Applicant:

fiplex

Product:

BI-DIRECTIONAL AMPLIFIER

Model:

DH4L37-R

FCC ID:

P3TDH4L37-R

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	May 2, 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)	RF Output Power	Pass
§90.219(e)(3), §90.210(n)	Conducted Spurious	Pass
FCC §90.219(e)(3), §90.210(n)	Radiated Spurious	Pass
§90.219(e)(4)	Input Output	Pass
935210 D05 v01r01 4.2	AGC threshold	Reported
935210 D05 v01r01 4.3	Out-of-band rejection	Reported
§90.219 (e)(2)	Noise figure	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	February 9, 2015
Nemko sample ID number	2

3.2 EUT information

Product name	BI-DIRECTIONAL AMPLIFIER
Model	DH4L37-R
Serial number	FCC002

3.3 Technical information

Operating band	406.1 MHz –420 MHz
Modulation type/ Emission designator	P25 C4FM F1E / F1D, TETRA D1E / D1D, DMR FXE / FXD, Analog F3E
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 boosters extends the radio coverage into areas inside the Base Station range where propagation losses prevent reliable communication.
The system receives the UL signal though a Donor antenna to be amplified, filtered and re-radiated through the Service antennas. The DL signal is received by the Service antennas to be amplified, filtered and re-radiated through the Donor antenna back to the Base Station. This way, the system works as a Bidirectional Amplifier.
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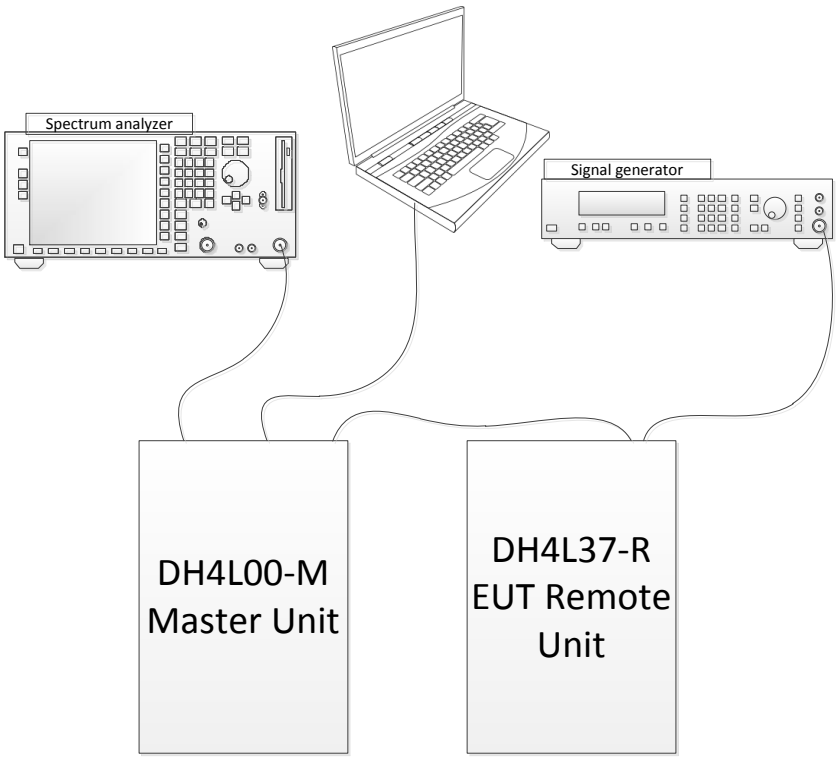
3.5 EUT exercise details

The EUT was controlled software GUI.

3.6 EUT setup diagram



b

Figure 3.6-1: *Setup diagram*

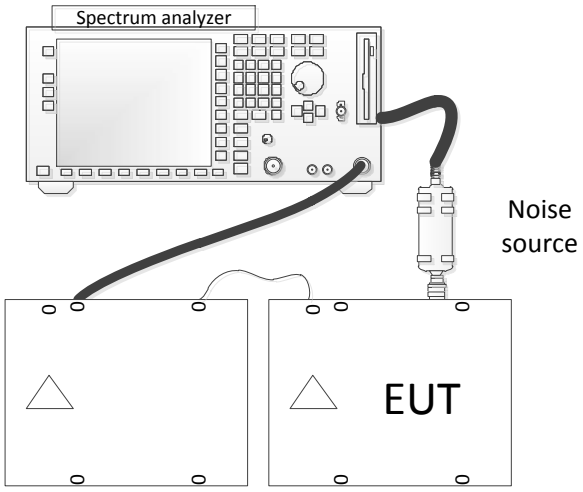


Figure 3.6-2: *Noise figure setup diagram*

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
Radiated spurious emissions	3.78

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) RF Output Power

8.1.1 Definitions and limits

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

8.1.2 Test summary

Test date	February 14, 2017	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	29 %

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*

Frequency, MHz	output, dBm	Rated output, dBm
415.175 DL	36.06	37

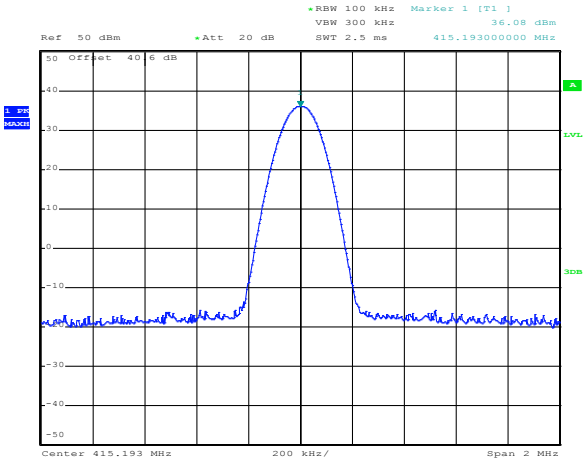


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Figure 8.1-1: *output power*

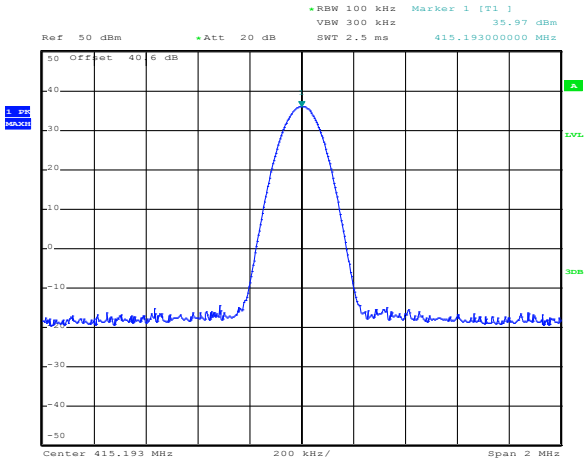

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Figure 8.1-2: *output power plus 3 dB*

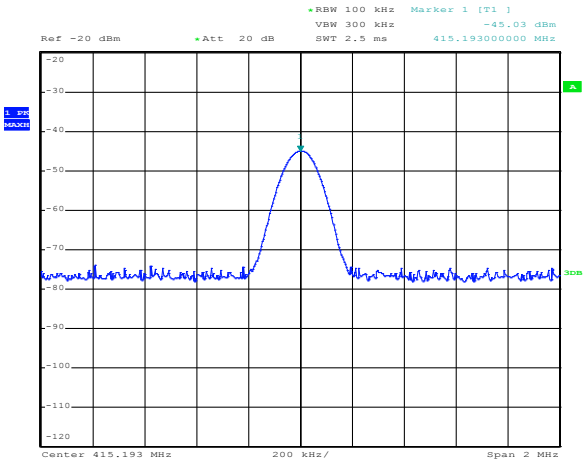

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Figure 8.1-3: *input power*

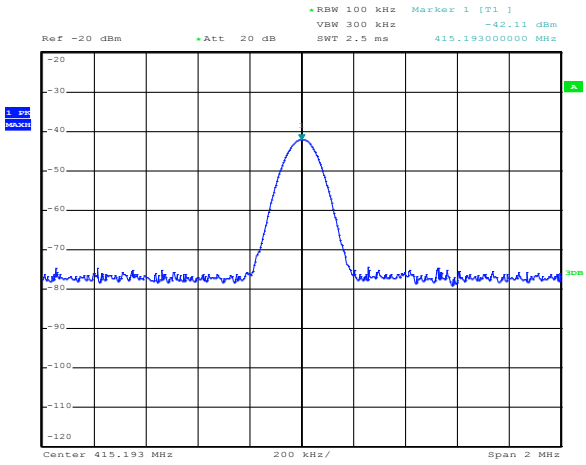

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Figure 8.1-4:*. input power plus 3 dB*

8.2 FCC §90.219(e)(3) §90.210(n) 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; 90.210(n) Other frequency bands. Transmitters designed for operation under this part on frequencies other than listed in this section must meet the emission mask requirements of Emission Mask B. Equipment operating under this part on frequencies allocated to but shared with the Federal Government, must meet the applicable Federal Government technical standards.

8.2.2 Test summary

Test date	February 14, 2017	Temperature	24 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	26 %

8.2.3 Observations, settings and special notes

None

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

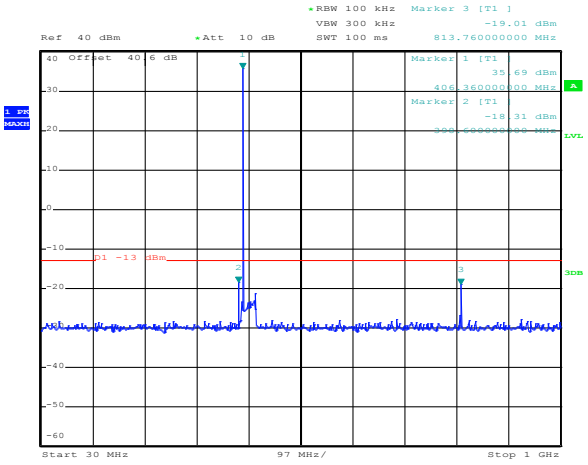

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Figure 8.2-1: *DL 406.125 MHz Spurious 30-1000 MHz*

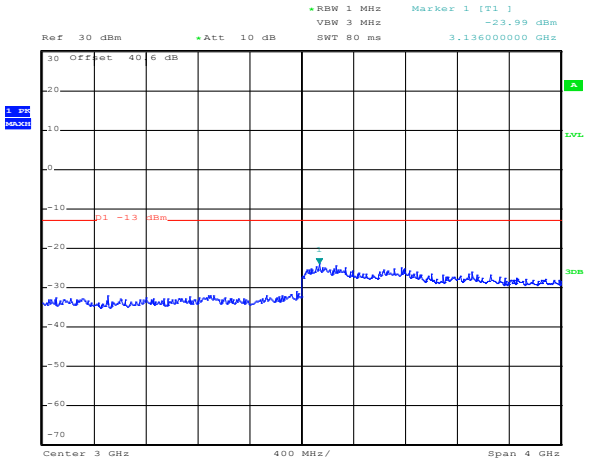

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Figure 8.2-2: *DL 406.125 MHz Spurious 1-5 GHz*

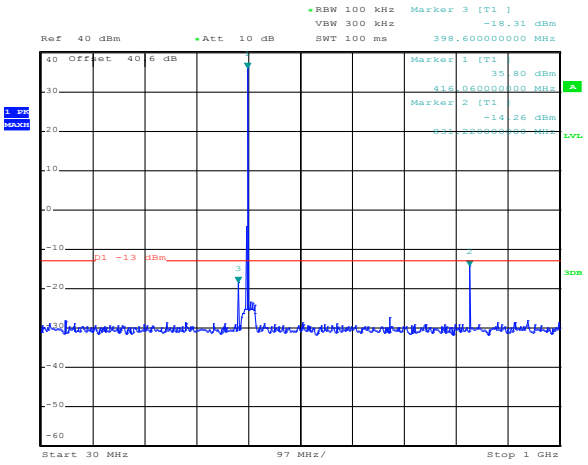

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Figure 8.2-3: *DL 415.175 MHz Spurious 30-1000 MHz*

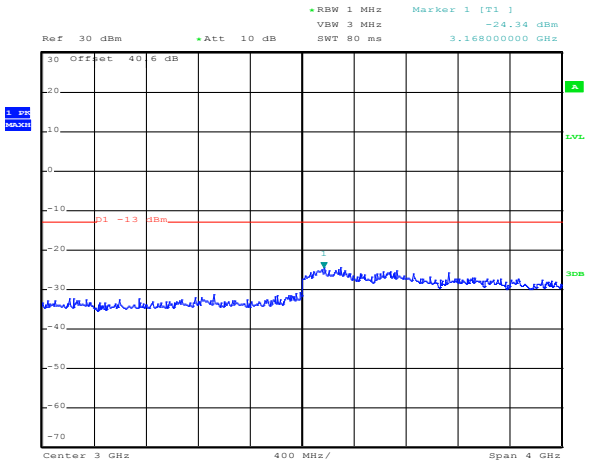

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Figure 8.2-4: *DL 415.175 MHz Spurious 1-5 GHz*

8.2.4 Test data continued

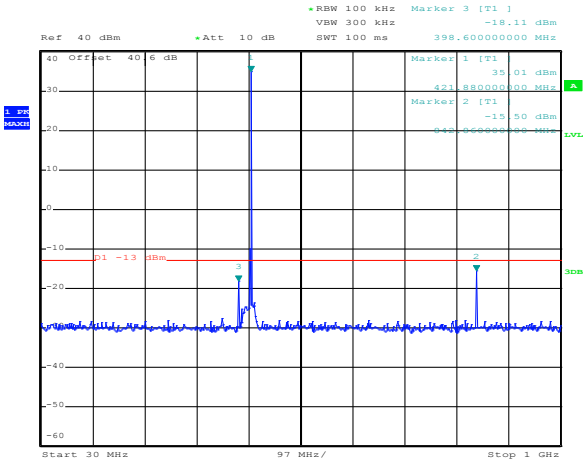

Figure 8.2-5: *DL 420.9875 MHz Spurious 30-1000 MHz*

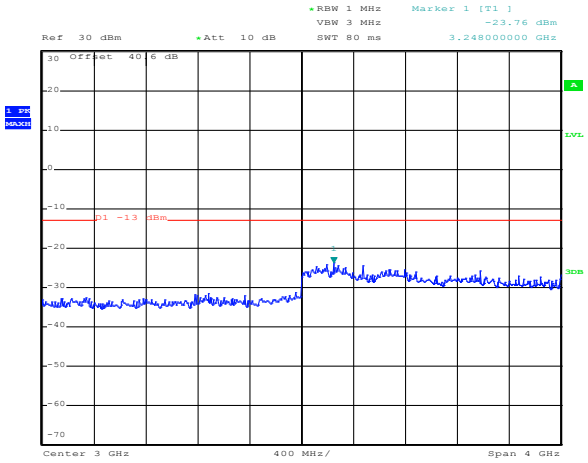

Figure 8.2-6:*DL 420.9875 MHz Spurious 1-5 GHz*

8.2.1 Test data continued

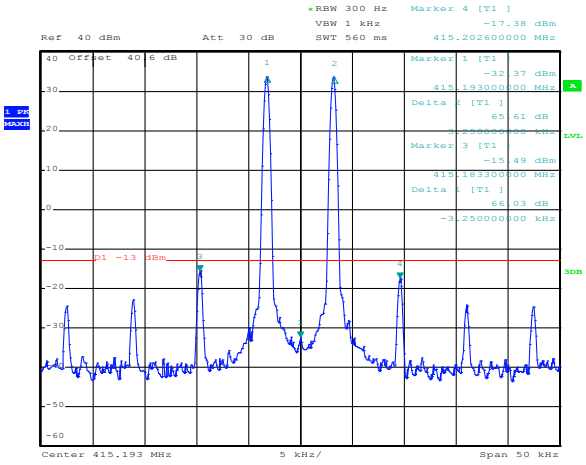

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Figure 8.2-7: *Intermodulation fo – DL 3.125 kHz, fo+3.125 kHz*

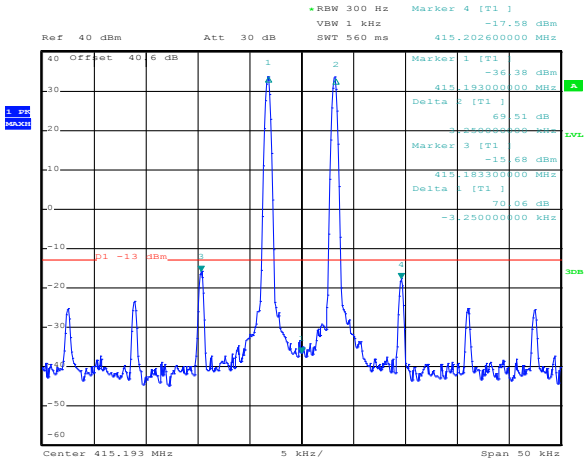

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Figure 8.2-8: *Intermodulation fo – DL 3.125 kHz, fo+3.125 kHz Plus 3 dB*

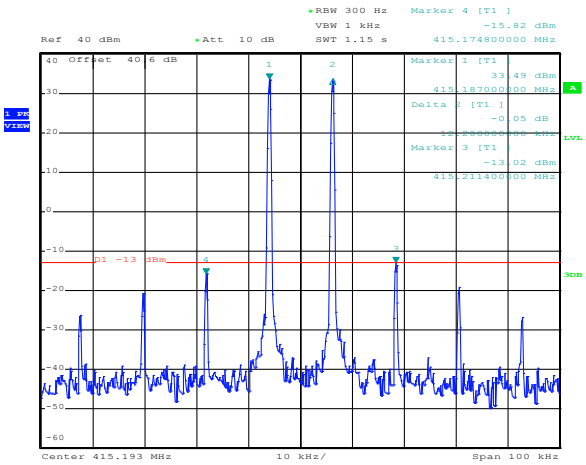

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Figure 8.2-9: *Intermodulation fo –DL 6.25 kHz, fo+6.25 kHz*

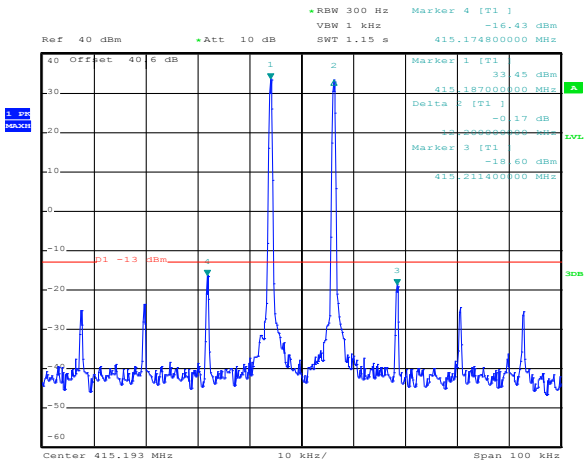

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Figure 8.2-10: *Intermodulation fo – DL 6.25 kHz, fo+6.25 kHz Plus 3 dB*

8.2.1 Test data continued

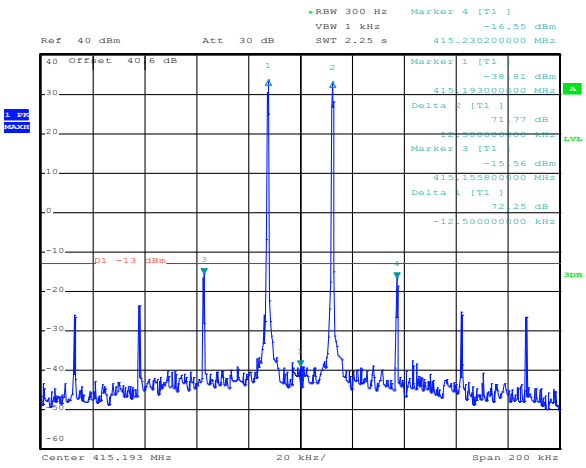

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Figure 8.2-11: *Intermodulation fo –DL 12.5 kHz, fo+12.5 kHz*

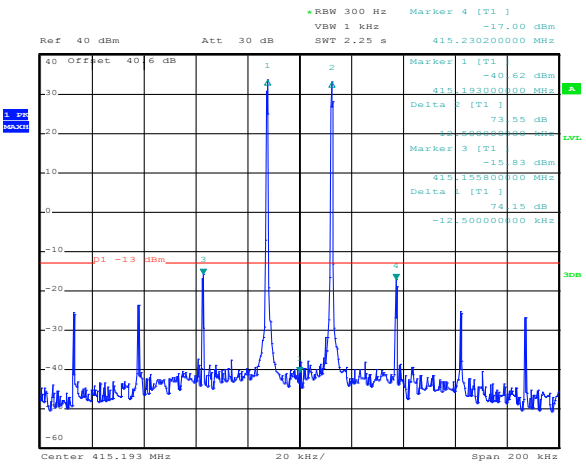

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Figure 8.2-12: *Intermodulation fo – DL 12.5 kHz, fo+12.5 kHz Plus 3 dB*

8.3 FCC §90.219(e)(3) §90.210 (n) 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; 90.210(n) Other frequency bands. Transmitters designed for operation under this part on frequencies other than listed in this section must meet the emission mask requirements of Emission Mask B. Equipment operating under this part on frequencies allocated to but shared with the Federal Government, must meet the applicable Federal Government technical standards.

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 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

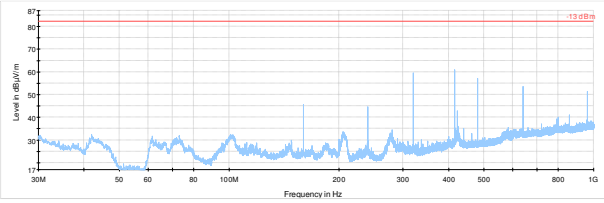

Figure 8.3-1: *30-1000 MHz*

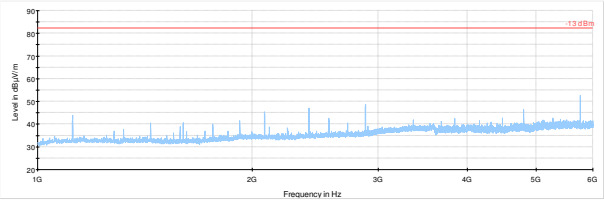

Figure 8.3-2: *1-10 GHz*

8.4 FCC §90.219(e)(4) Input Output

8.4.1 Definitions and limits

(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)

8.4.2 Test summary

Test date	February 14, 2017	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

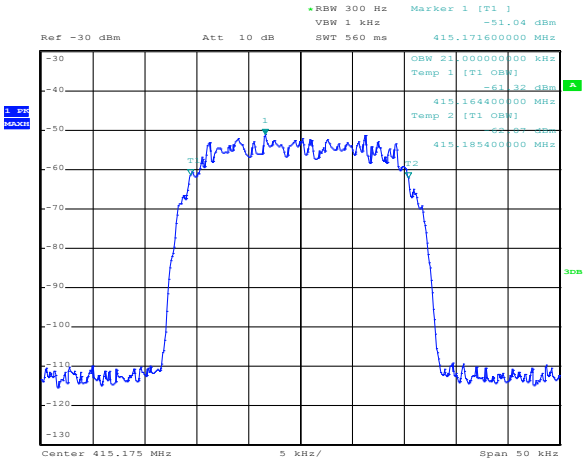

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Figure 8.4-1: *TETRA input*

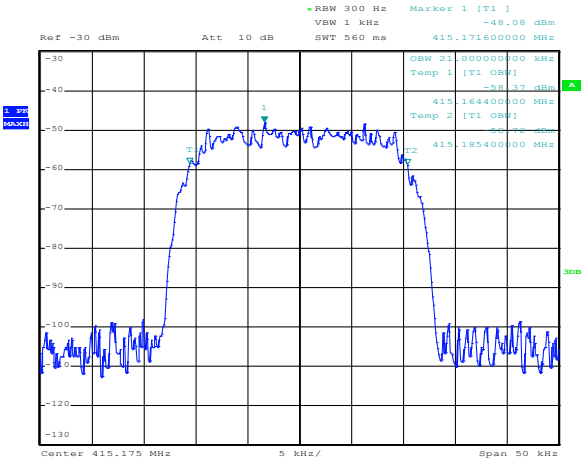

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Figure 8.4-2: *TETRA input Plus 3 dB*

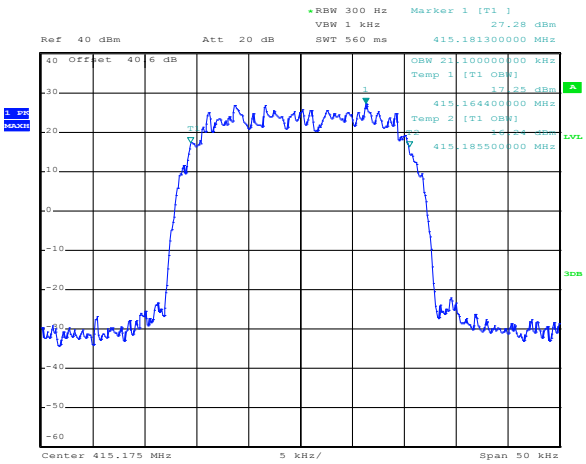

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Figure 8.4-3: *TETRA output*

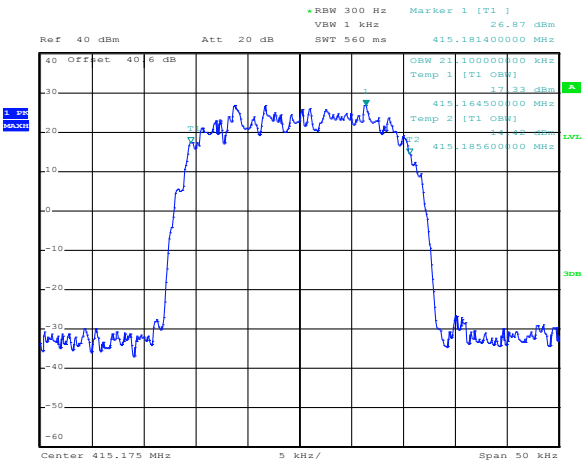

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Figure 8.4-4: *TETRA output Plus 3 dB*

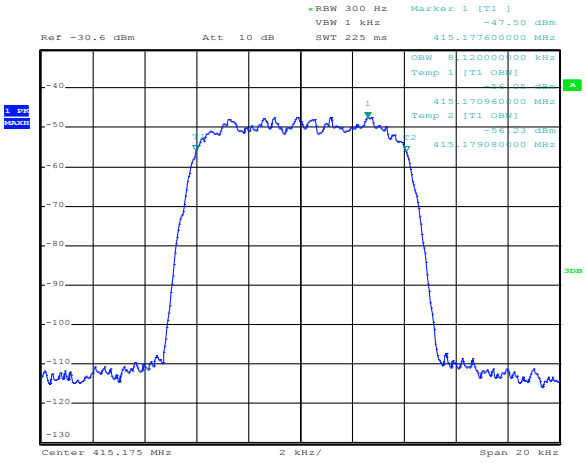

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Figure 8.4-5: *P25 input*

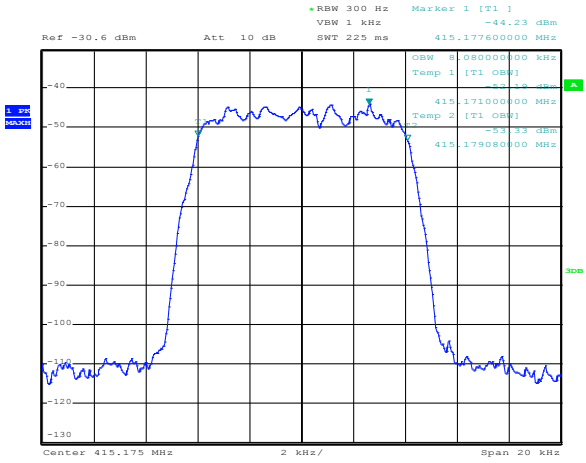

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Figure 8.4-6: *P25 input Plus 3 dB*

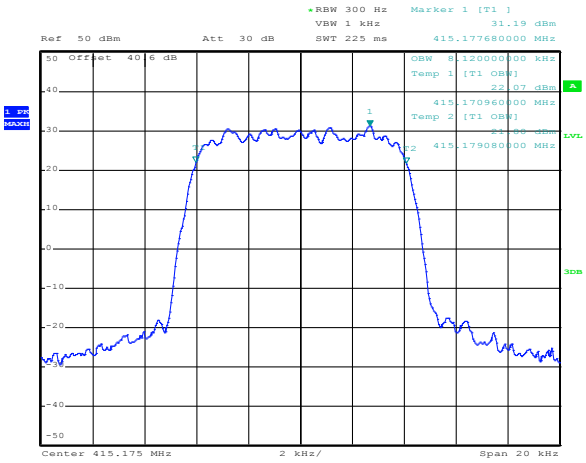

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Figure 8.4-7: *P25 output*

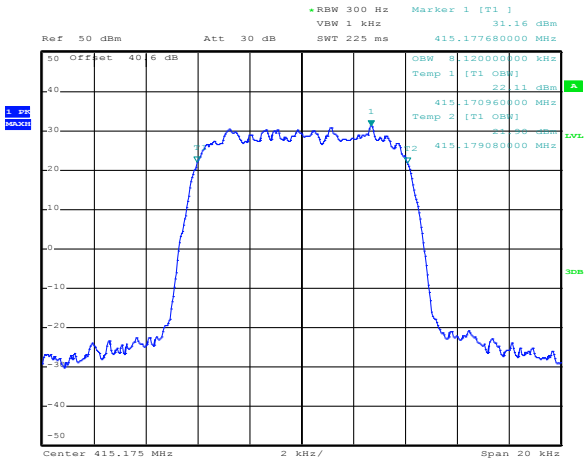

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Figure 8.4-8: *P25 output Plus 3 dB*

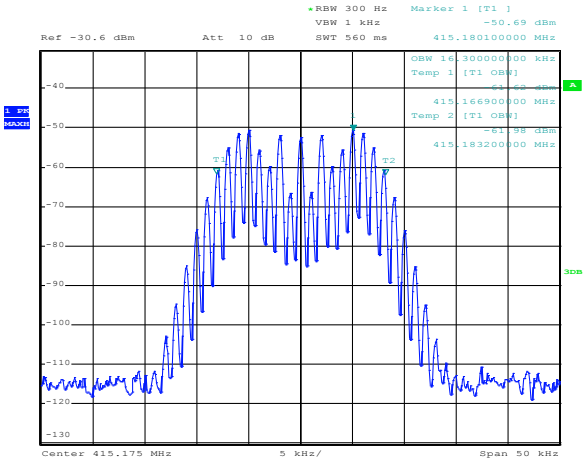

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Figure 8.4-9: *analog input*

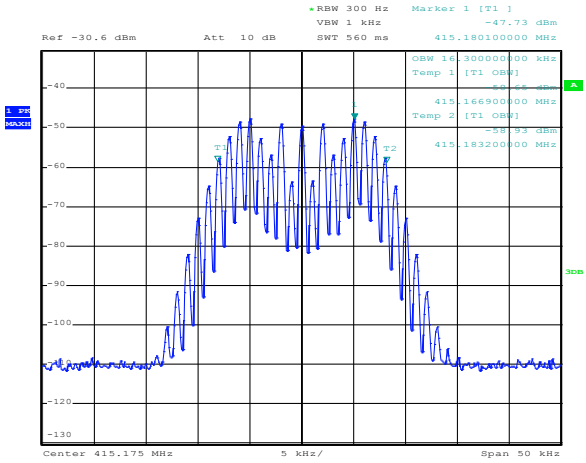

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Figure 8.4-10: *analog input Plus 3 dB*

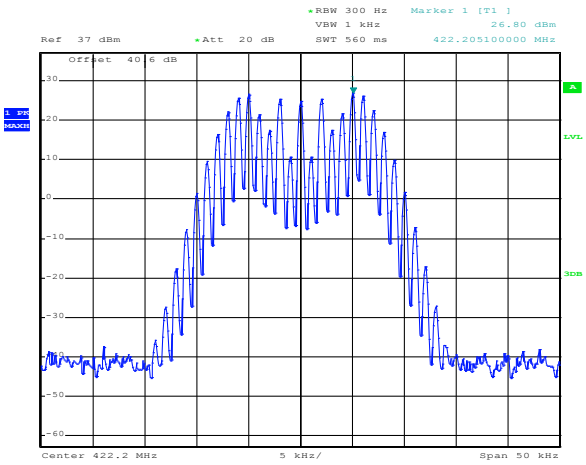

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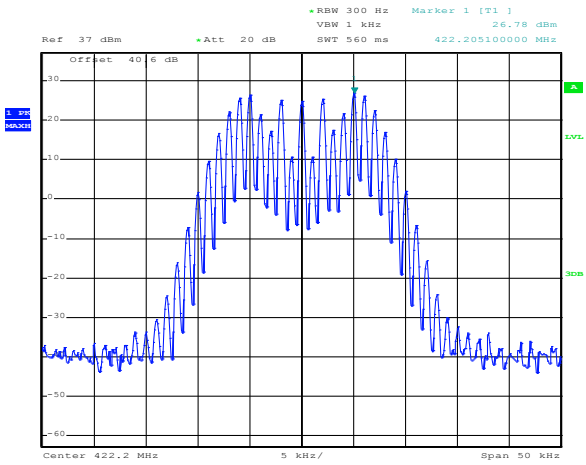
Figure 8.4-11: *analog output*



Date: 15.FEB.2017 00:17:55

Figure 8.4-12: *analog output Plus 3 dB*

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	February 14, 2017	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	29 %

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
415.193	-45.03	36.08	81.11	80

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

Frequency, MHz	Input, dBm	output, dBm	Gain, dB	Rated Gain, dB
415.193	-42.11	35.97	78.08	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	1 kHz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.6.4 Test data

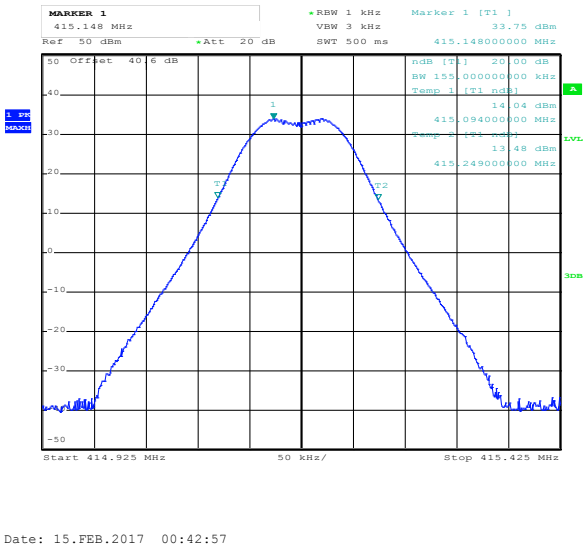


Figure 8.6-1: *Out of band reject single filter*

8.7 FCC §90.219 (e)(2) Noise figure

8.7.1 Definitions and limits

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

8.7.2 Test summary

Test date	February 14, 2017	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	46 %

8.7.3 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

8.7.4 Test data

Table 8.7-1: *Noise figure result*

DL/UL	Noise Source OFF, dBm	Noise Source ON, dBm	ENR, dB	NF Result, dB	Limit, dB	Margin, dB
DL	-63.4	-56.32	12.83	6.70	9	2.30

Noise Figure (NF) = 10 x $\log_{10}$ $\{10^{(ENR/10)}/[10^{(Y/10)}-1]\}$
Y= Noise Source ON - Noise Source OFF
ENR= Noise level above Thermal noise