

EMC Test Report

Report Number: 4262158EMC01 **Revision Level:** 1

Project Number: 4262158

Client: Applied Micro Design Inc.

Equipment Under Test: Fiber to Antenna Transmission System

Model Number: 121317-DL

FCC Rule Parts: FCC Part 90.219

935210 D05 Indus Booster Basic Meas v01r02

Report issued on: 18 July 2018

Test Result: Compliant

Tested by:


Shawn McGuinness, EMC Engineering Leader

Reviewed by:


David Schramm, Operations Manager

Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 General Information

1.1 Client Information

Name: Applied Micro Design Inc.
Address: 19516 Amaranth Drive
City, State, Zip, Country: Germantown, MD, 20874

1.2 Test Laboratory

Name: SGS Consumer Retail Services
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA

Environmental Conditions over duration of testing

	Min	Max
Temperature:	20.2 °C	23.9 °C
Relative Humidity:	45.2 %	53.6 %

1.3 General Information of EUT

Type of Product: Fiber to Antenna Transmission System
Model Number: 121317-UL/DL
Serial Number: Not labeled
Band 1 of Operation: 151.115 – 171.175 MHz 0 dBm
Band 2 of Operation: 453.2125 – 484.7625 MHz 0 dBm
Band 3 of Operation: 763.000 – 775.0000 MHz 0 dBm
Band 4 of Operation: 851.2125 – 853.9125 MHz 0 dBm

Rated Voltage: 48 Vdc
Tested Voltage: 48 Vdc
Sample Received Date: 24 Jan 2018
Dates of testing: 26 Jan to 30 May 2018

1.4 Operating Modes and Conditions

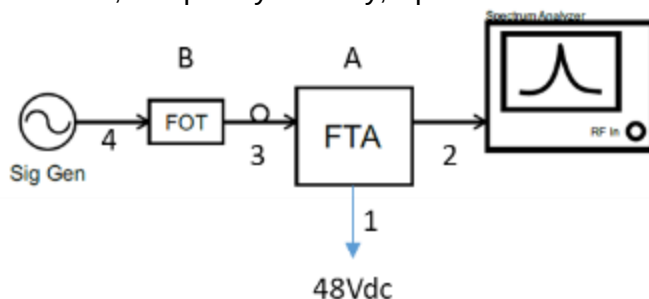
A signal generator was connected to the RF In of the RF to Fiber Optic converter (support equipment). This RF signal was converted internally to a fiber optic interface and the fiber optic cable was connected to the FO IN port of the EUT. The RF output port of the EUT was connected to the spectrum analyzer.

1.5 Modifications Required for Compliance

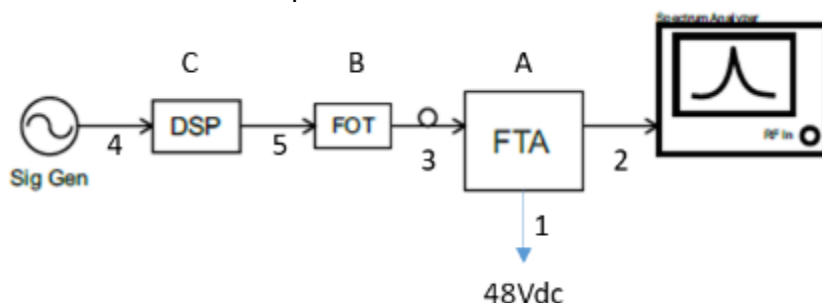
None

1.6 EUT Connection Block Diagram

For measurements: AGC, Out of Band Rejection, Input vs Output, Bandwidth, Noise Figure, Out of Band / Out of Block, Frequency Stability, Spurious Radiated Emissions.



Output Power Measurement



1.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A (EUT)	Applied Micro Design	Fiber to Antenna Transmission System	121317-DL	Not labeled
B	Applied Micro Design	Fiber Optic Transmitter (FOT)	Not labeled	Not labeled
C	Applied Micro Design	DSP	Not labeled	Not labeled
Sig Gen	Rohde & Schwarz	Signal Generator (provided by test lab)	SMB100A	B097846

1.8 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
1	DC Input	EUT	48 V DC supply	1.75	No	No
2	Coaxial Cable	EUT	Spec An (test equipment)	Depends on test	No	Coax
3	Fiber optic cable	EUT	Fiber Optic Transmitter (FOT)	10	No	No
4	Coaxial Cable	Sig Gen (test equipment)	DSP or FOT	Depends on test	No	Coax
5	Coaxial Cable	DSP	FOT	Depends on test	No	Coax

2 AGC Threshold

2.1 Test Result

Test Description	Basic Standards	Test Result
AGC Threshold	KDB 935210 D05	Reported

2.2 Test Method

Testing was performed per KDB 935210 D05 Indus Booster Basic Meas v01r02, Section 4.2

The AGC threshold was determined as follows

- Connect a signal generator to the input of the EUT (i.e. the RF input of support equipment).
- Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
- The signal generator was configured to produce a CW signal.
- Set the signal generator frequency to the center frequency of the EUT operating band.
- While monitoring the output power of the EUT, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
- Record this level as the AGC threshold level.
- Repeat the procedure with the remaining test signal.

2.3 Test Equipment

Test End Date: 1-May-2018

Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-May-2018
ANTENNA, BILOG	JB6	SUNOL	B079690	29-Nov-2018
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079716	24-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079661	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	25-Jul-2018
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	28-Jul-2018
SIGNAL GENERATOR, 40 GHZ	HMC-T2240	HITTITE	16005	CNR
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17016	25-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018

Note: The calibration period equipment is 1 year.

2.4 Test Data

Frequency, MHz	Gain	AGC Threshold Level
160.7	10.3 dB	-10.3 dBm
468.7	25.7 dB	-25.7 dBm
768.9	21.3 dB	-21.3 dBm
852.5	20.0 dB	-20.0 dBm

3 Out-Of Band Rejection

3.1 Test Result

Test Description	Basic Standards	Test Result
Out-Of Band Rejection	935210 D05 Indus Booster Basic Meas v01r02	Reported

3.2 Test Method

Testing was performed per KDB 935210 D05 Indus Booster Basic Meas v01r02, Section 4.3

Adjust the internal gain control of the EUT to the maximum gain for which equipment certification is sought.

- Connect a signal generator (network analyzer output) to the input of the EUT.
- Configure a swept CW signal with the following parameters:
 - Frequency range = ± 250 % of the manufacturer's specified pass band.
 - The CW amplitude shall be 3 dB below the AGC threshold (see 4.2), and shall not activate the AGC threshold throughout the test.
 - Dwell time = approximately 10 ms.
 - Frequency step = 50 kHz.
- Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
- Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 $\times$ RBW.
- Set the detector to Peak and the trace to Max-Hold.
- 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).
- Capture the frequency response plot for inclusion in the test report.

3.3 Test Equipment

Test End Date: 1-May-2018

Tester: ASF

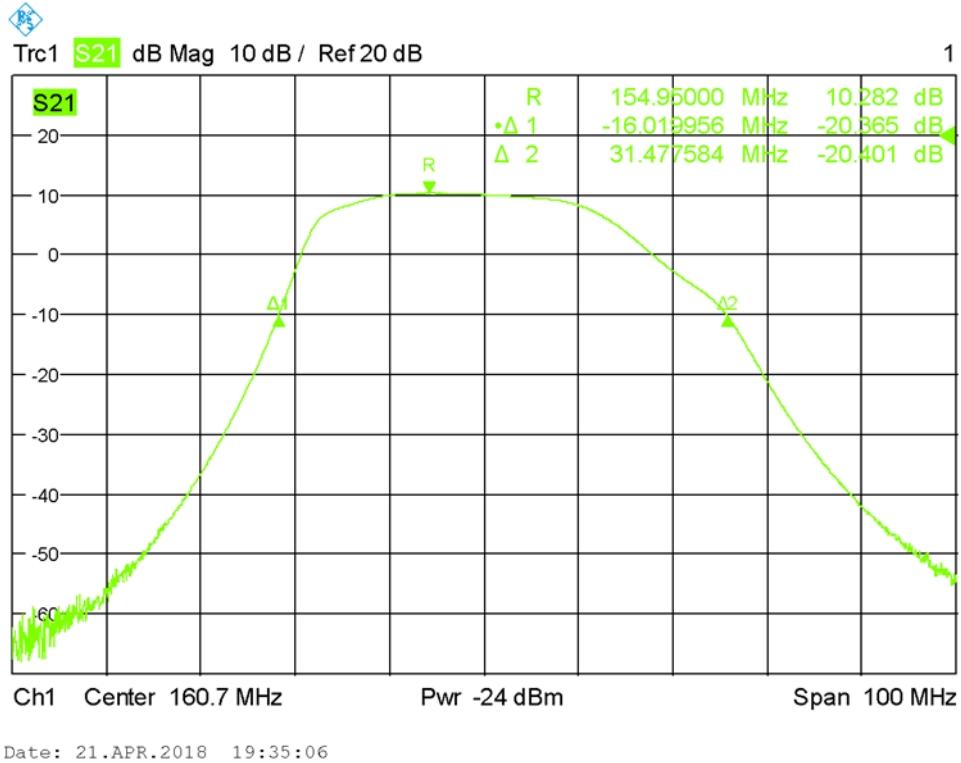
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-May-2018
ANTENNA, BILOG	JB6	SUNOL	B079690	29-Nov-2018
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079716	24-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079661	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	25-Jul-2018
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	28-Jul-2018
SIGNAL GENERATOR, 40 GHZ	HMC-T2240	HITTITE	16005	CNR
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17016	25-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018

Note: The calibration period equipment is 1 year.

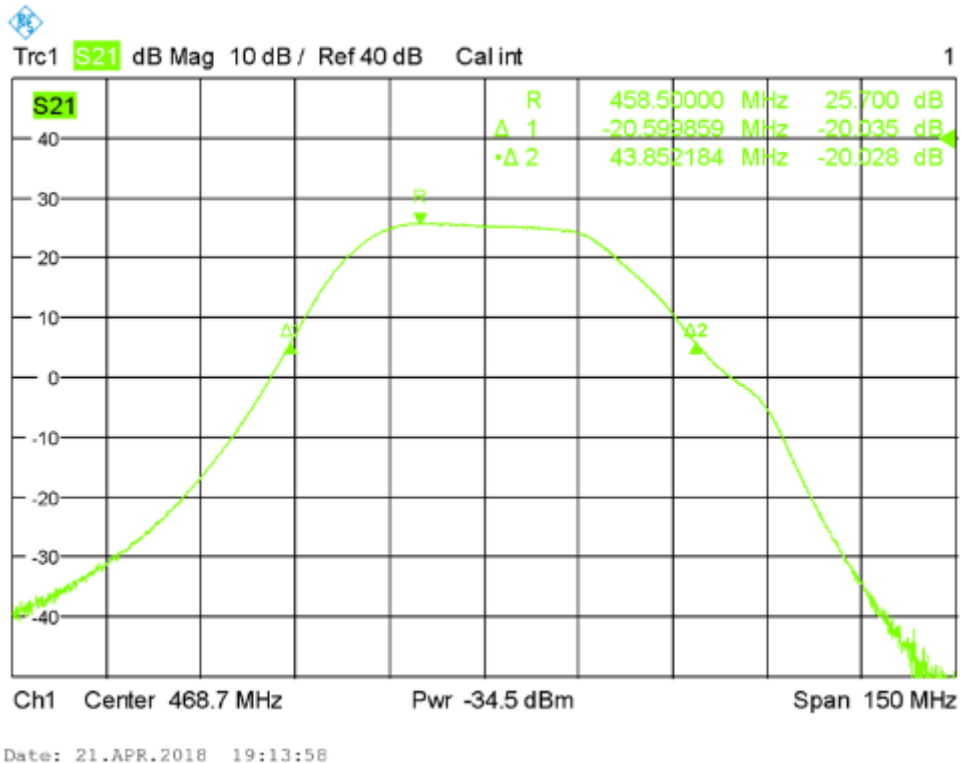
3.4 Test Data

Frequency, MHz	Bandwidth
160.7	47.5 MHz
468.7	64.5 MHz
768.9	34.8 MHz
852.5	34.9 MHz

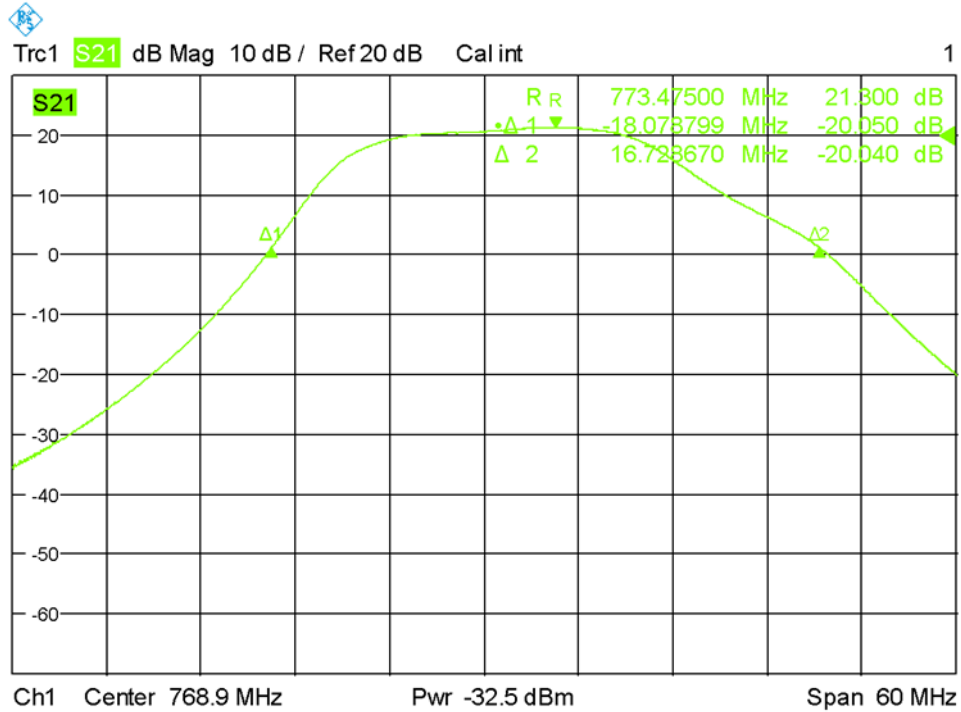
3.5 Plot - VHF



3.6 Plot - 450 MHz band

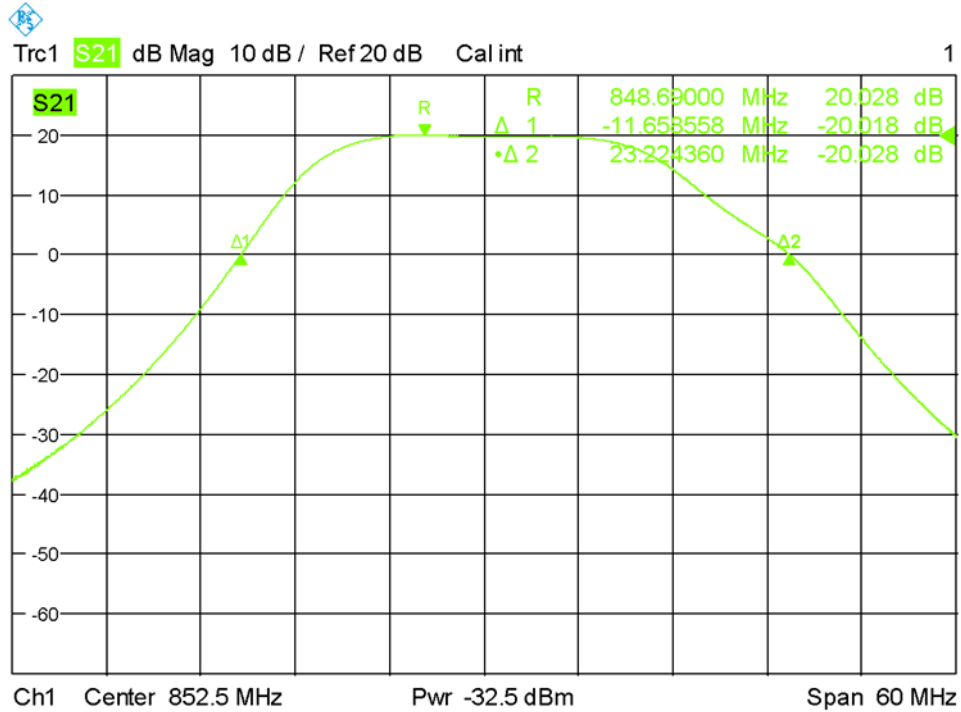


3.7 Plot – 700 MHz band



Date: 21.APR.2018 19:52:01

3.8 Plot – 800 MHz band



Date: 21.APR.2018 19:53:20

4 Input-versus-output signal comparison

4.1 Test Result

Test Description	Basic Standards	Test Result
Input-versus-output signal comparison	935210 D05 Indus Booster Basic Meas v01r02	Compliant

4.2 Test Method

Testing was performed according to KDB 935210 D05 Indus Booster Basic Meas v01r02, Section 4.4

The signals were adjusted according to Table 1.

Table 1—Test signals for PLMRS devices

Emission Designator	Modulation	Occupied Bandwidth	Channel Bandwidth	Audio Frequency
16K0F3E	FM	16 kHz	25 kHz	1 kHz
11K3F3E	FM	11.3 kHz	12.5 kHz	1 kHz
4K00F1E	FM	4 kHz	6.25 kHz	1 kHz
N/A	CW	N/A	N/A	N/A

4.3 Test Equipment

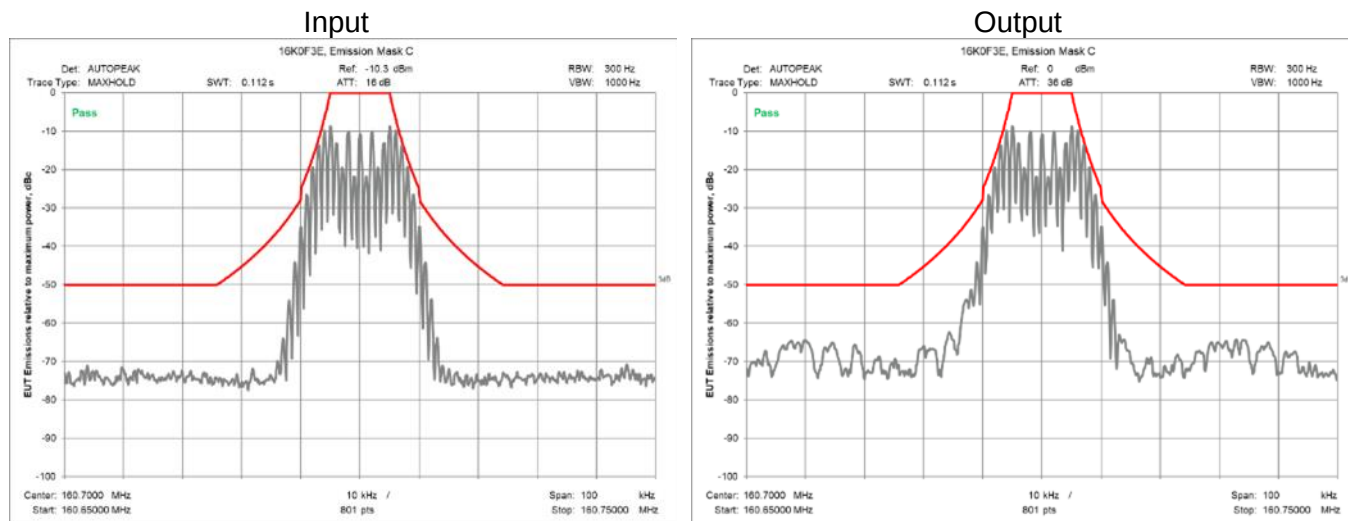
Test End Date: 1-May-2018

Tester: ASF

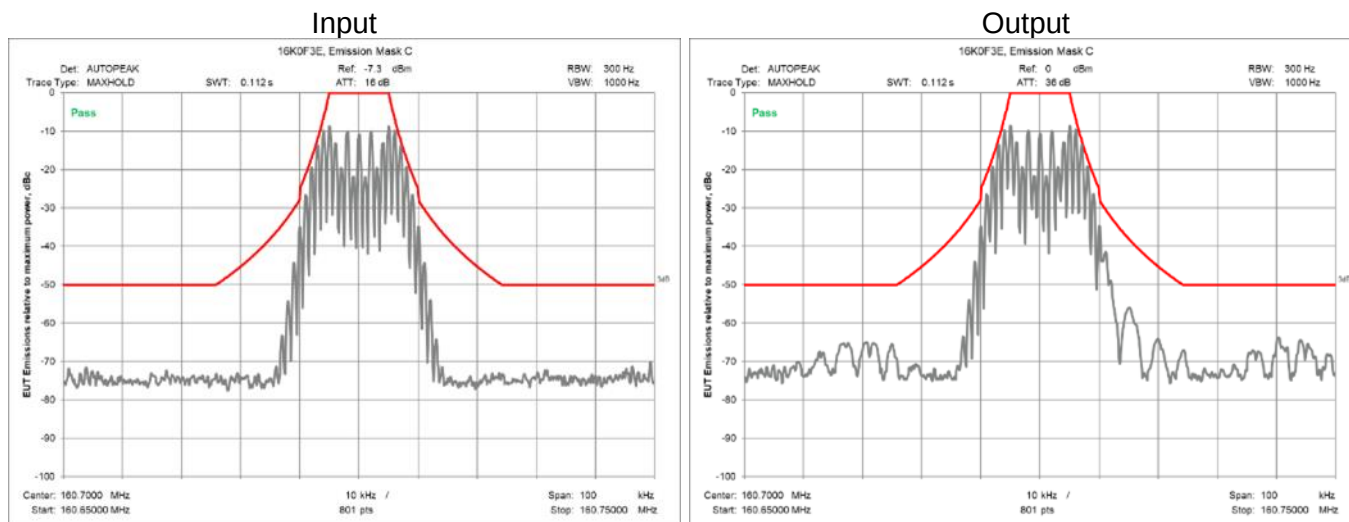
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-May-2018
ANTENNA, BILOG	JB6	SUNOL	B079690	29-Nov-2018
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079716	24-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079661	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	25-Jul-2018
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	28-Jul-2018
SIGNAL GENERATOR, 40 GHZ	HMC-T2240	HITTITE	16005	CNR
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17016	25-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018

Note: The calibration period equipment is 1 year.

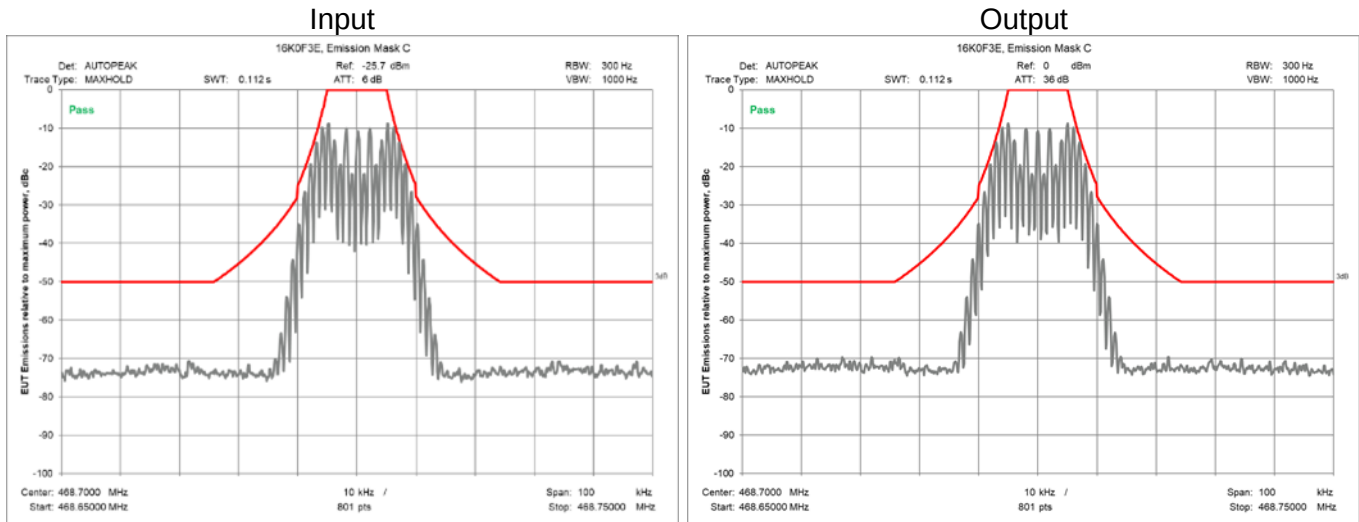
4.4 Test Data - 16K0F3E at ACG – 160.7 MHz



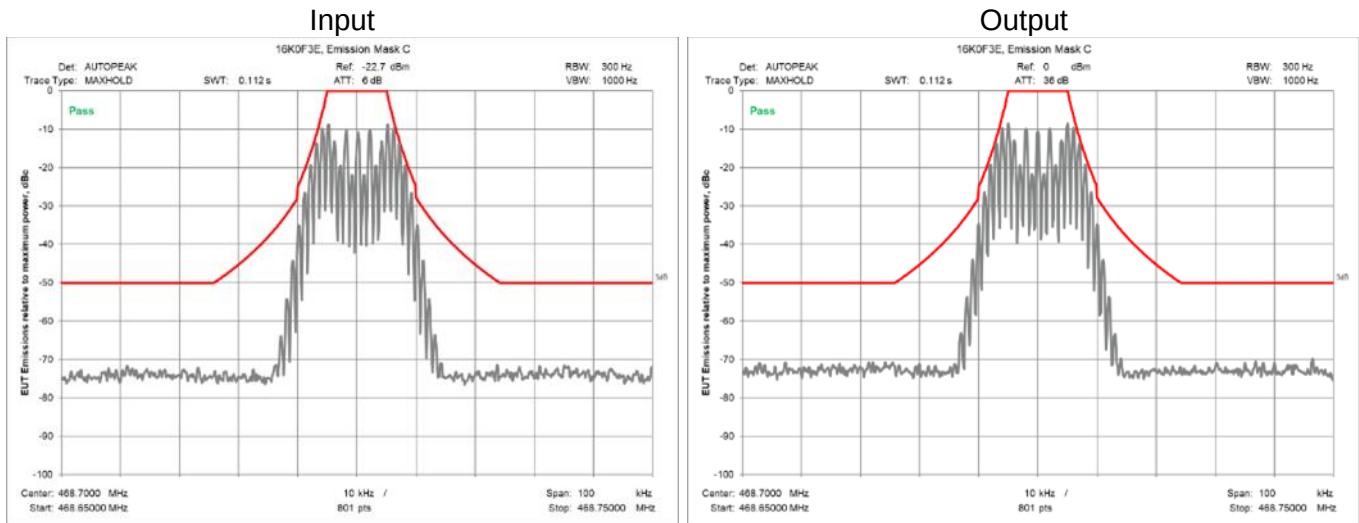
4.5 Test Data - 16K0F3E at ACG +3 dB – 160.7 MHz



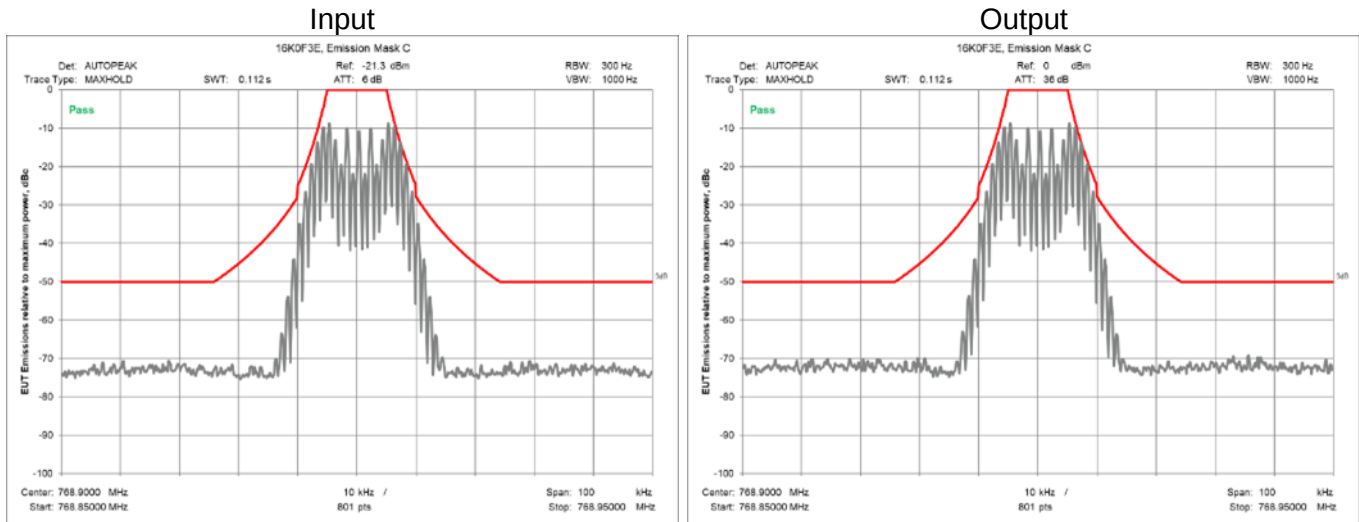
4.6 Test Data - 16K0F3E at ACG – 468.7 MHz



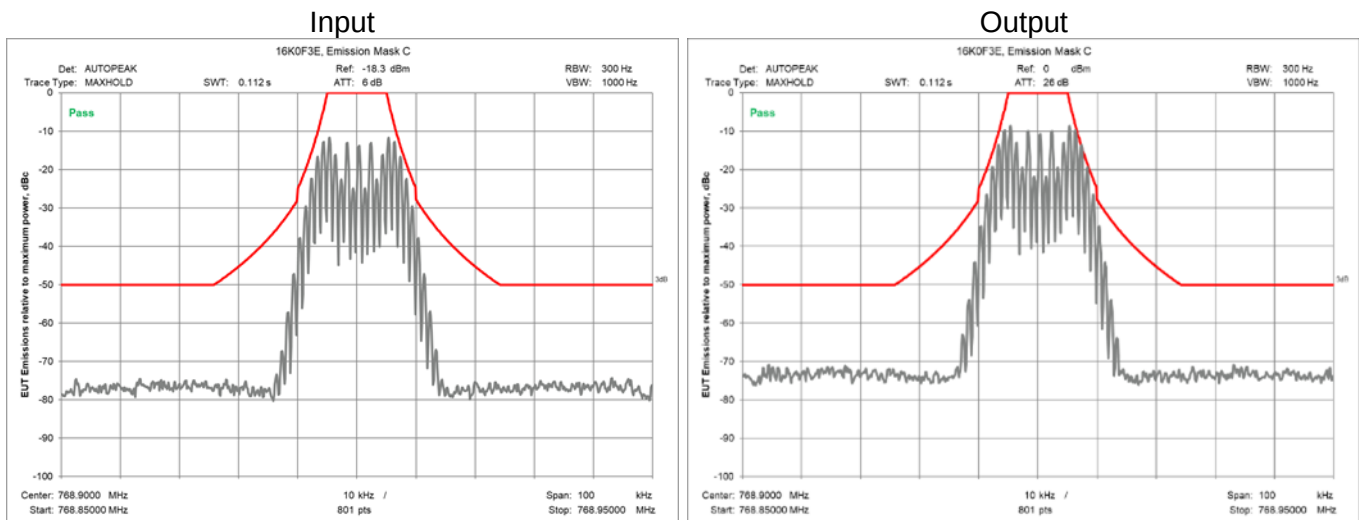
4.7 Test Data - 16K0F3E at ACG +3 dB – 468.7 MHz



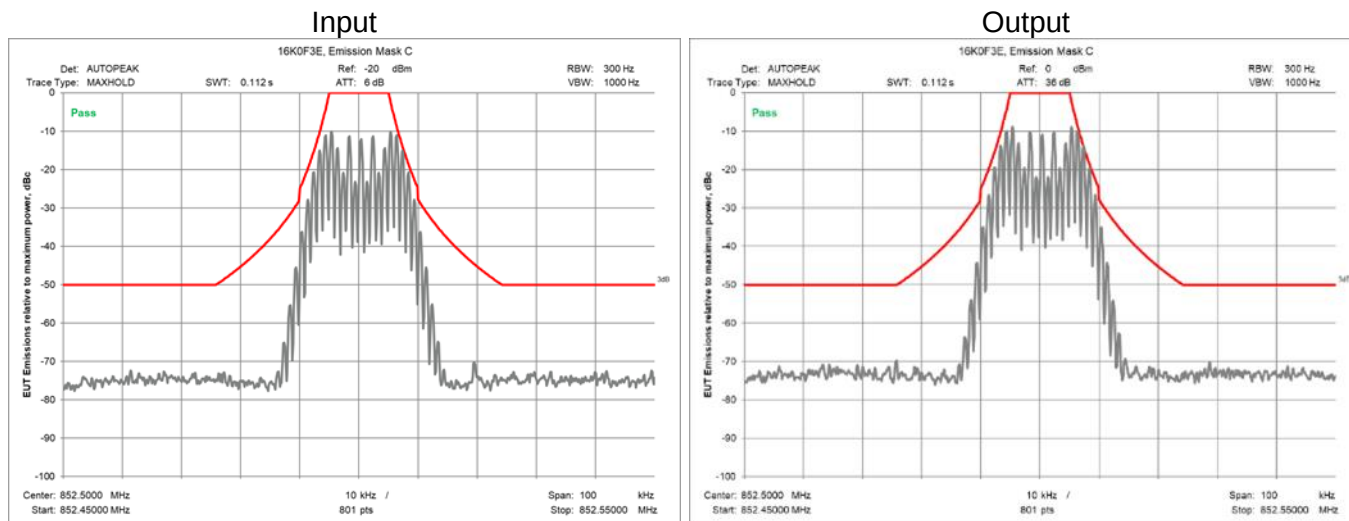
4.8 Test Data - 16K0F3E at ACG – 768.9 MHz



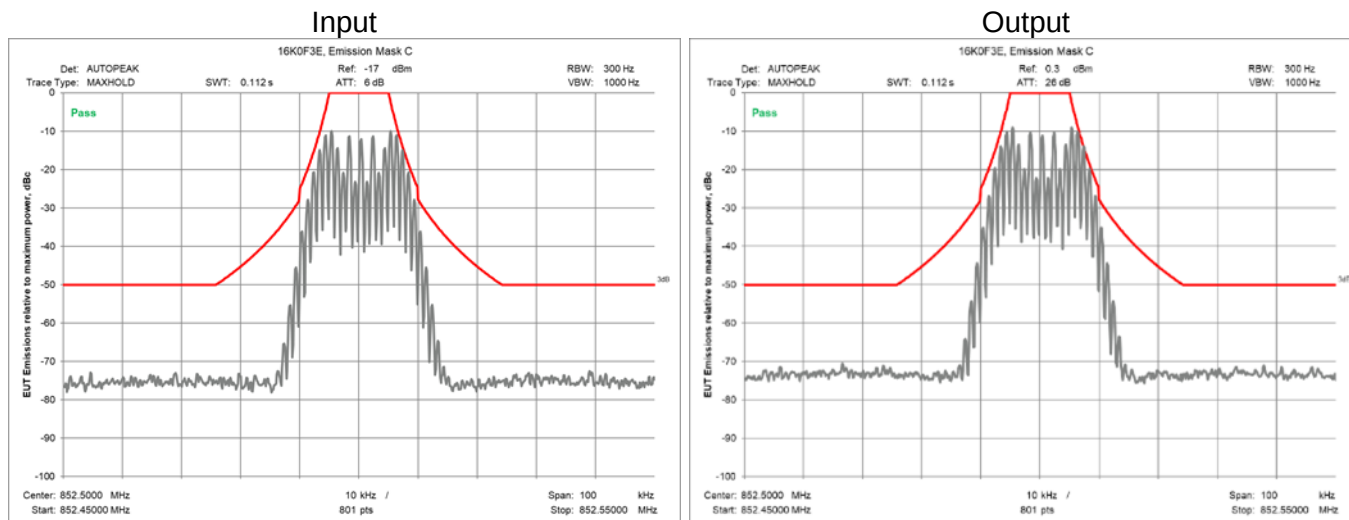
4.9 Test Data - 16K0F3E at ACG – +3 dB – 768.9 MHz



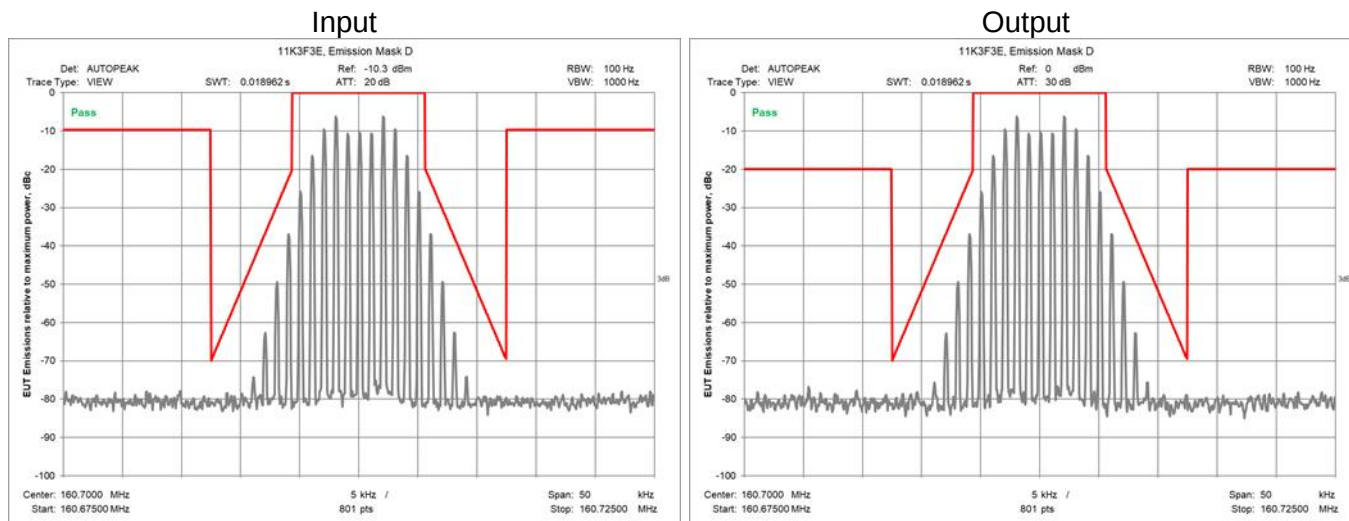
4.10 Test Data - 16K0F3E at ACG – 852.5 MHz



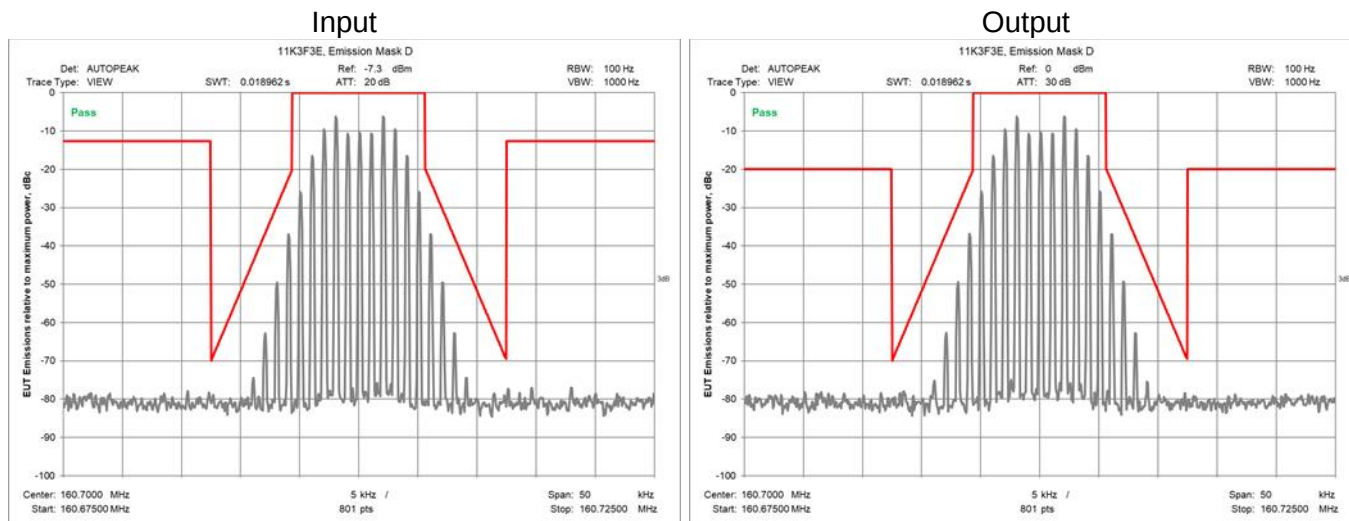
4.11 Test Data - 16K0F3E at ACG – +3 dB – 852.5 MHz



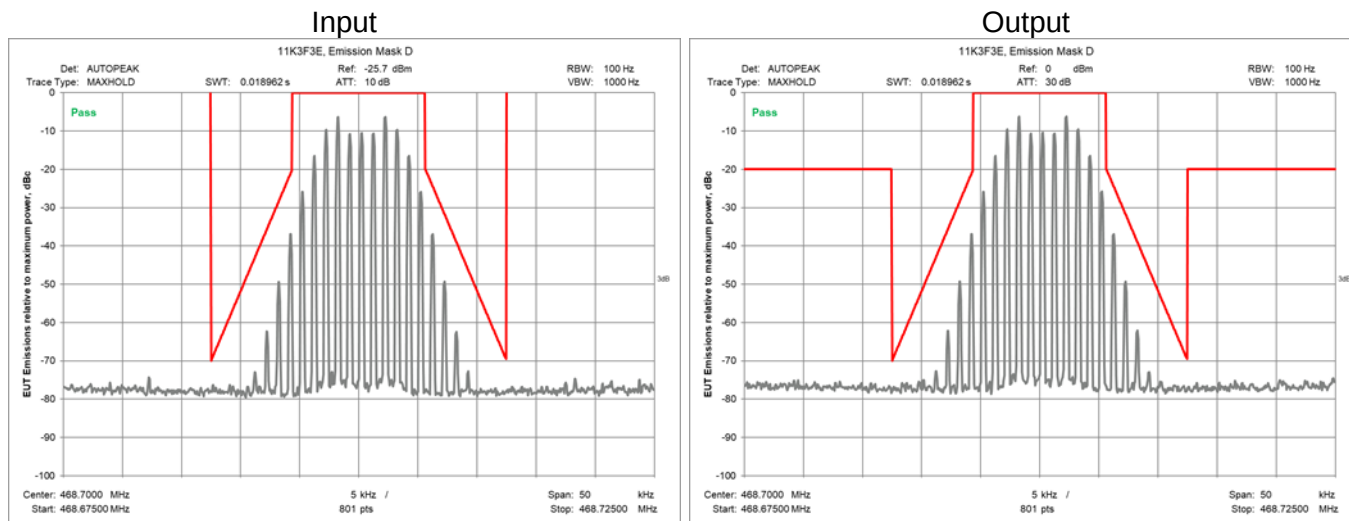
4.12 Test Data - 11K3F3E at ACG – 160.7 MHz



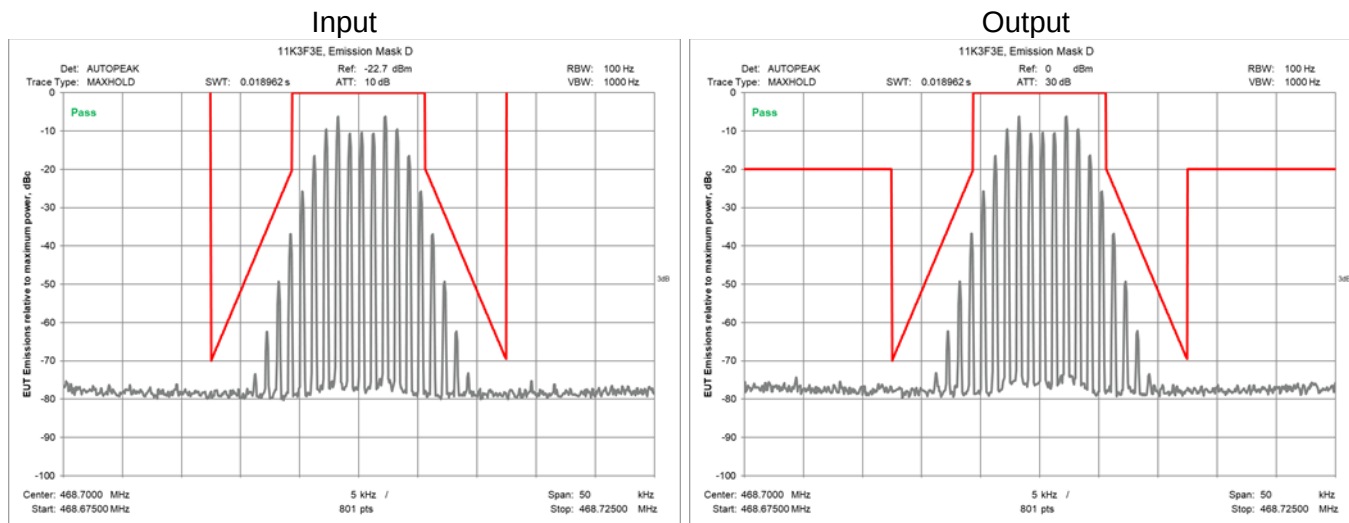
4.13 Test Data - 11K3F3E at ACG +3 dB – 160.7 MHz



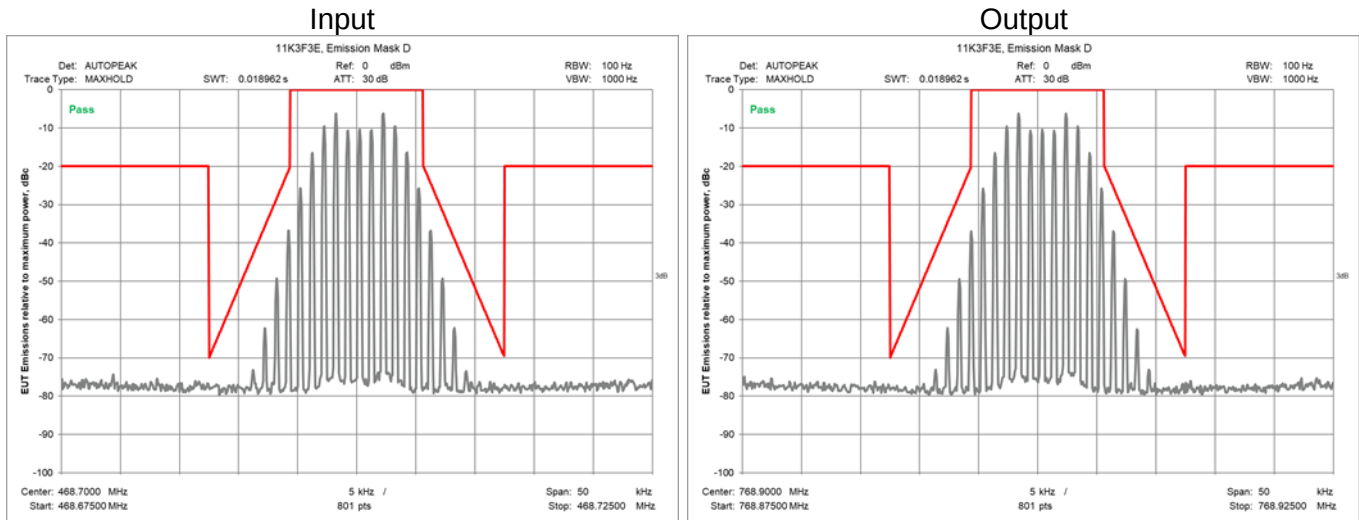
4.14 Test Data - 11K3F3E at ACG – 468.7 MHz



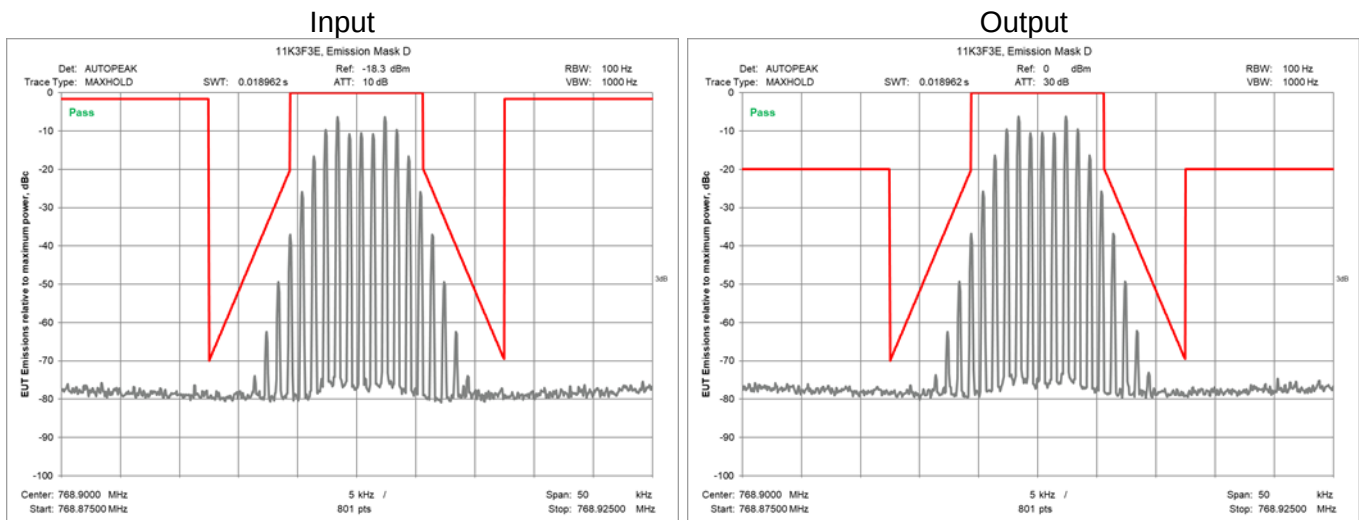
4.15 Test Data - 11K3F3E at ACG +3 dB – 468.7 MHz



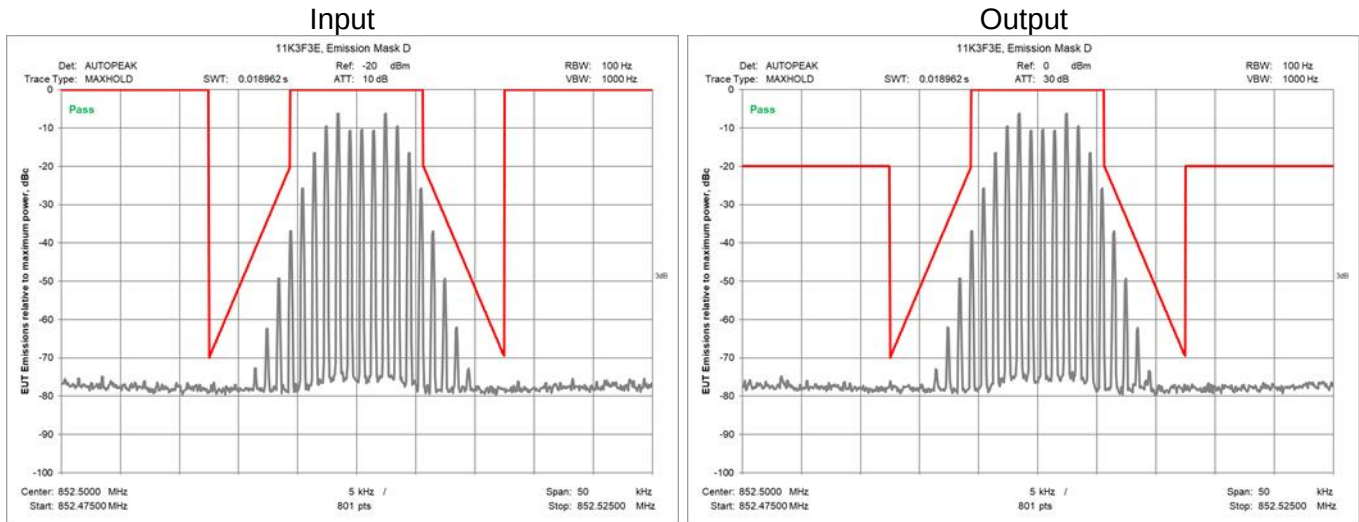
4.16 Test Data - 11K3F3E at ACG – 768.9 MHz



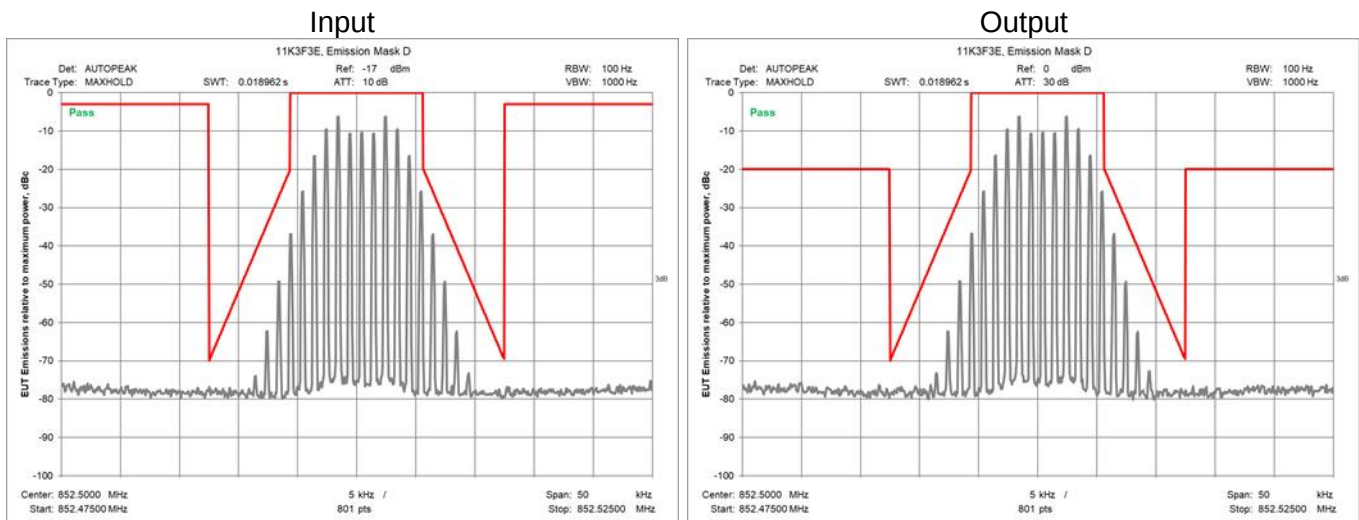
4.17 Test Data - 11K3F3E at ACG – +3 dB – 768.9 MHz



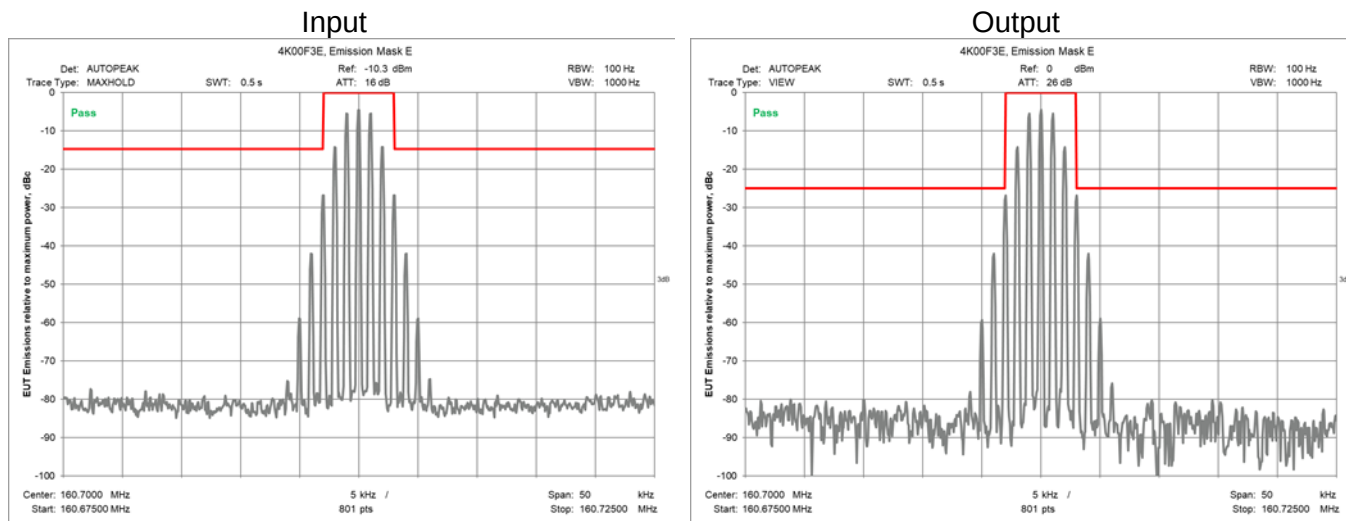
4.18 Test Data - 11K3F3E at ACG – 852.5 MHz



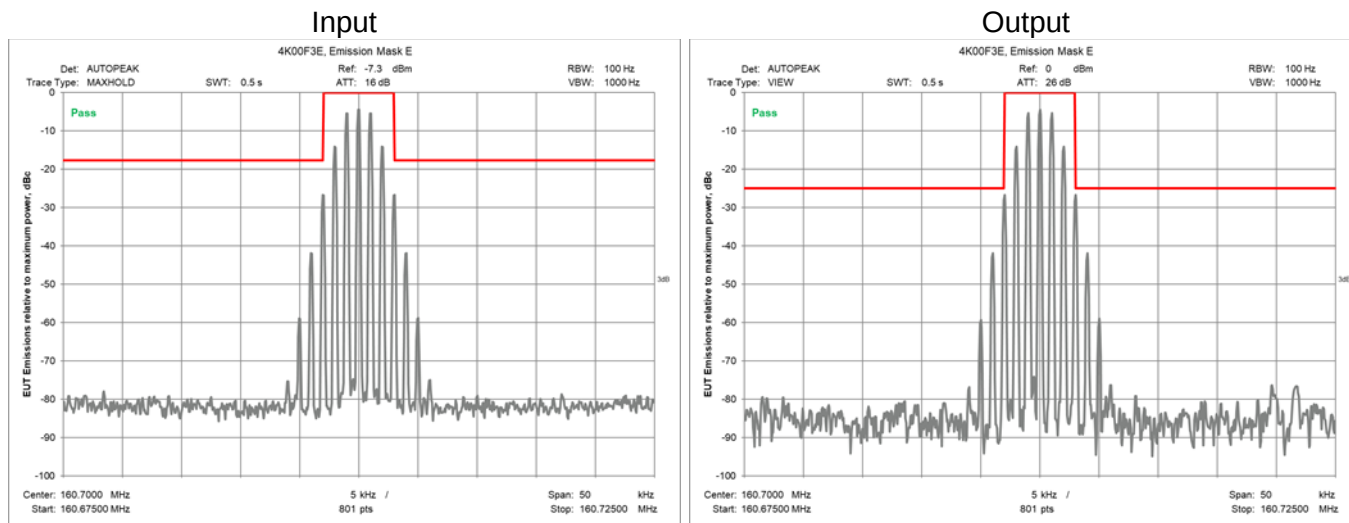
4.19 Test Data - 11K3F3E at ACG – +3 dB – 852.5 MHz



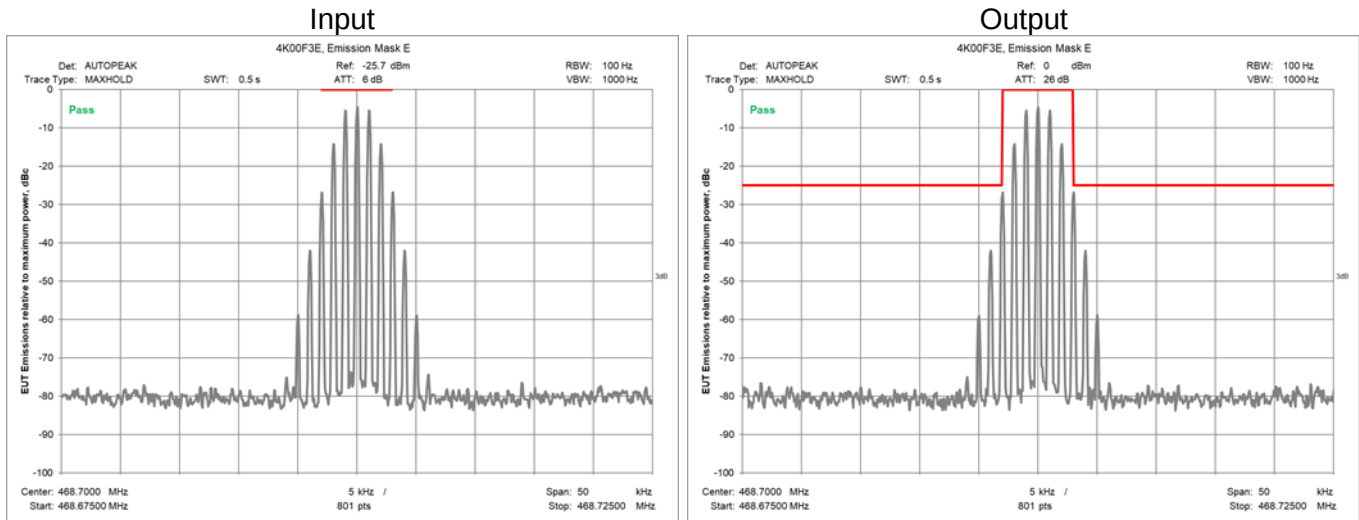
4.20 Test Data - 4K00F1E at ACG – 160.7 MHz



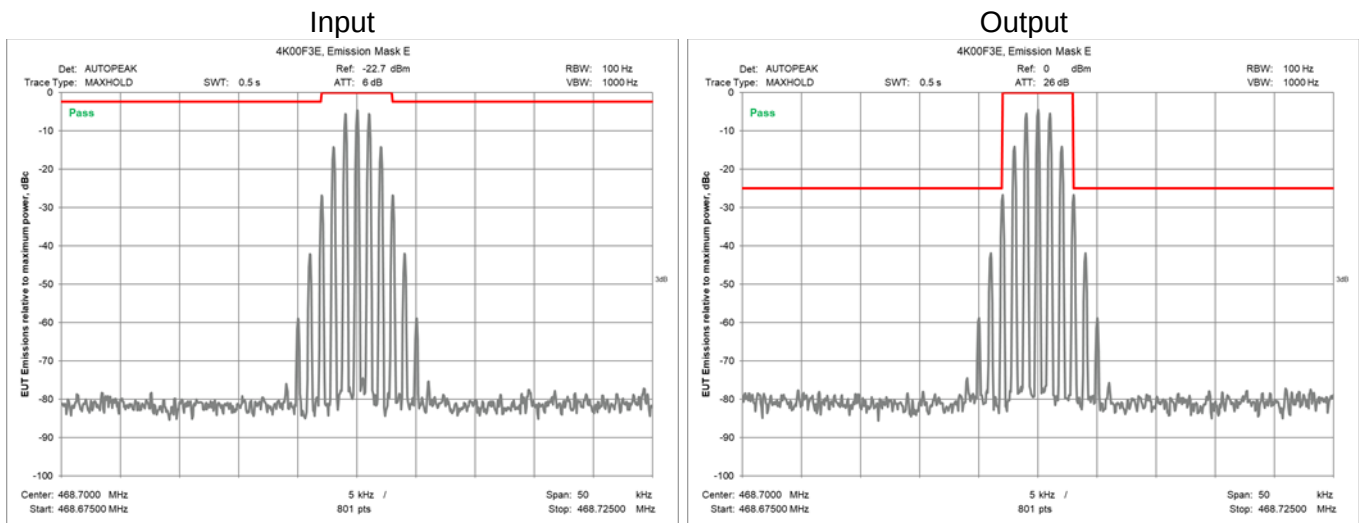
4.21 Test Data - 4K00F1E at ACG +3 dB – 160.7 MHz



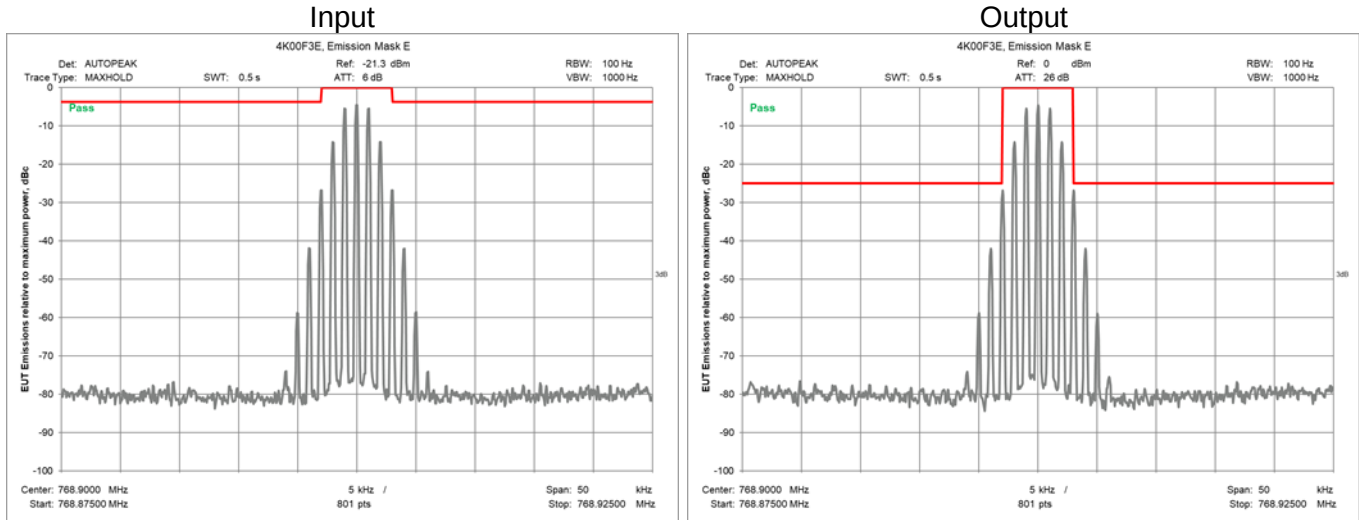
4.22 Test Data - 4K00F1E at ACG – 468.7 MHz



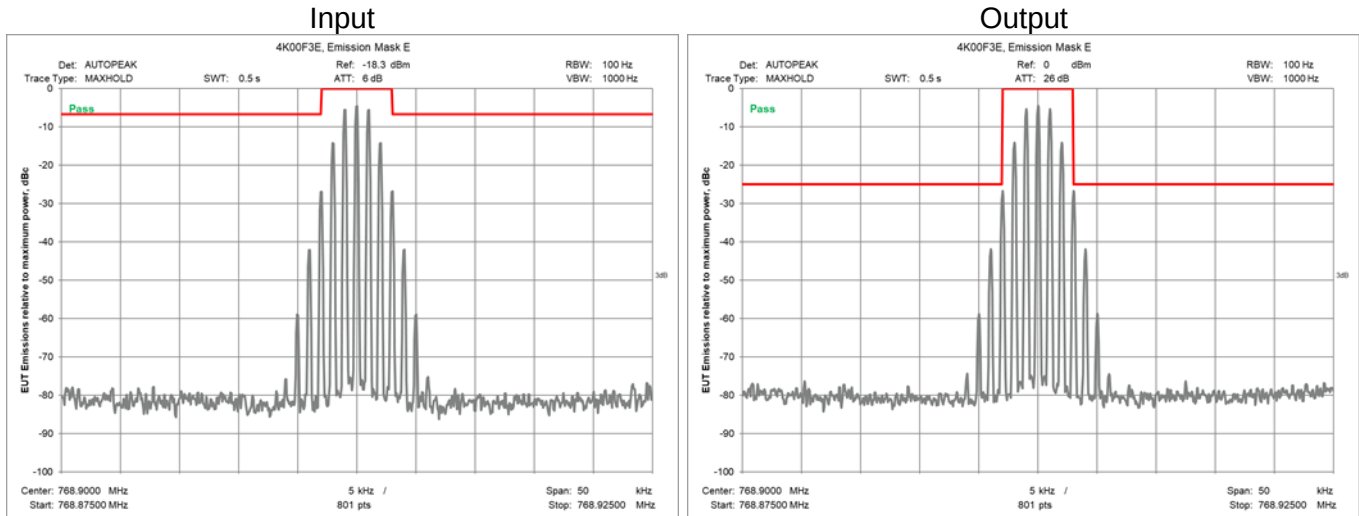
4.23 Test Data - 4K00F1E at ACG +3 dB – 468.7 MHz



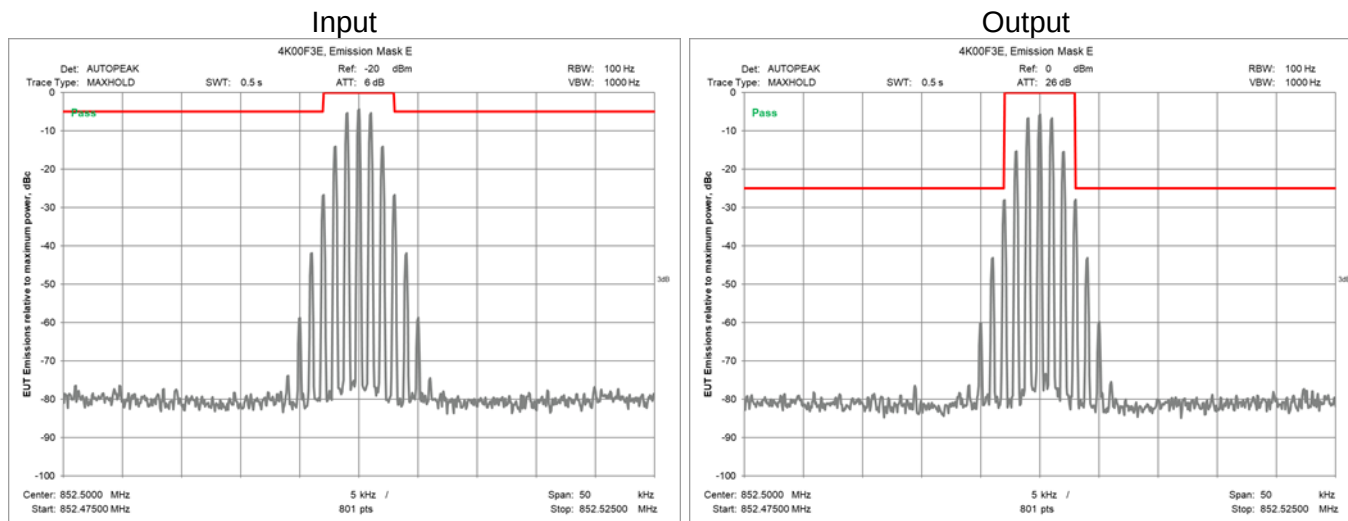
4.24 Test Data - 4K00F1E at ACG – 768.9 MHz



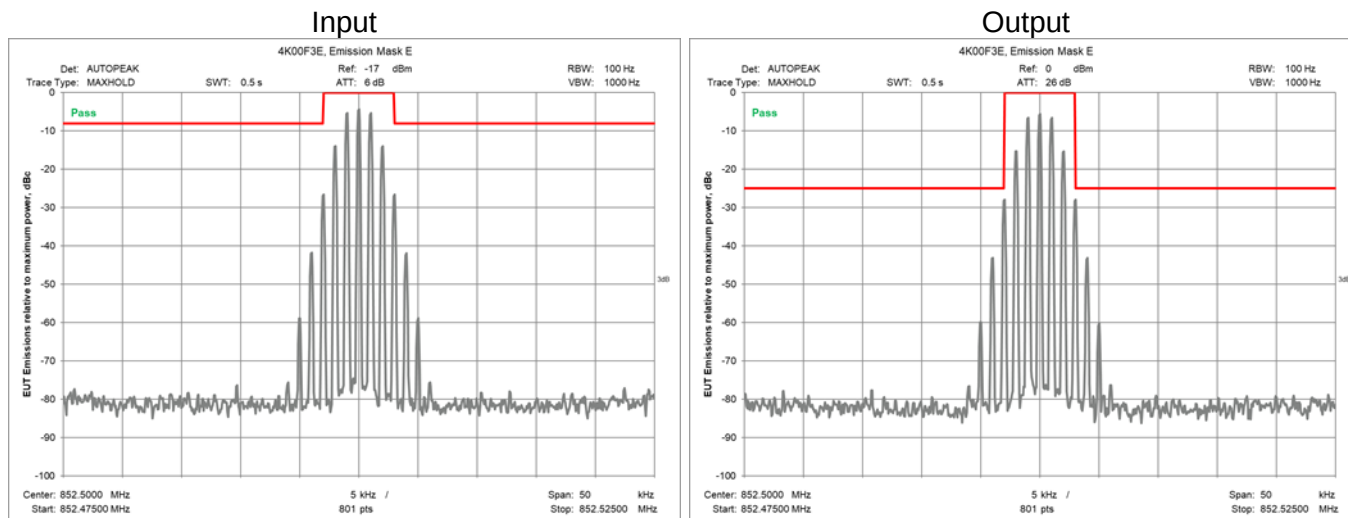
4.25 Test Data - 4K00F1E at ACG – +3 dB – 768.9 MHz



4.26 Test Data - 4K00F1E at ACG – 852.5 MHz



4.27 Test Data - 4K00F1E at ACG – +3 dB – 852.5 MHz



5 Input/output power and amplifier/booster gain

5.1 Test Result

Test Description	Basic Standards	Test Result
Input/output power and amplifier/booster gain	935210 D05 Indus Booster Basic Meas v01r02	Reported

5.2 Test Method

Testing was performed according to KDB 935210 D05 Indus Booster Basic Meas v01r02, Section 4.5

5.3 Test Equipment

Test End Date: 1-May-2018

Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-May-2018
ANTENNA, BILOG	JB6	SUNOL	B079690	29-Nov-2018
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	27-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079716	24-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079661	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	25-Jul-2018
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	28-Jul-2018
SIGNAL GENERATOR, 40 GHZ	HMC-T2240	HITTITE	16005	CNR
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17016	25-Jul-2018
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2018

Note: The calibration period equipment is 1 year.

5.4 Test Data

Frequency, MHz	Input Level	Output Level	Gain
160.7	-10.3 dBm	0 dBm	10.3 dB
468.7	-25.7 dBm	0 dBm	25.7 dB
768.9	-21.3 dBm	0 dBm	21.3 dB
852.5	-20 dBm	0 dBm	20.0 dB

6 Band Noise

6.1 Test Result

Test Description	Basic Standards	Test Result
Noise figure measurements	935210 D05 Indus Booster Basic Meas v01r02	Compliant

6.2 Test Method

In accordance with 935210 D02 Signal Boosters Certification v04, Section V, paragraph (j)(5): For the remote unit of a conventional fiber-connected host/remote DAS booster system, it is acceptable to submit compliance information and test data consistent with Section 90.219(d)(6)(ii) (i.e., ERP of noise ≤ -43 dBm in 10 kHz RBW) for the downlink path only, in place of Section 90.219(e)(2) noise figure test data (i.e., NF ≤ 9 dB for both UL and DL). Test reports must provide explicit details about the instrumentation and test procedure used for Section 90.219(d)(6)(ii) testing.

6.3 Test Equipment

Test End Date: 18-May-2018

Tester: SKM

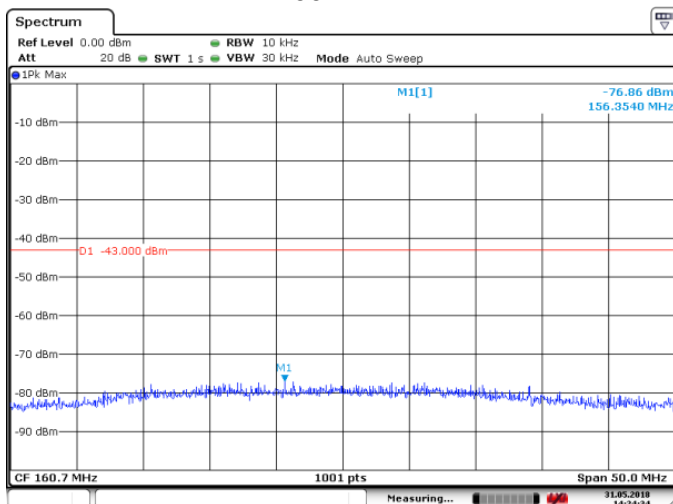
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SPECTRUM ANALYZER	FSV 30	ROHDE & SCHWARZ	16085221	24-Jul-2018
SIGNAL GENERATOR	SMB 100A	ROHDE & SCHWARZ	B085760	29-Jun-2019
SIGNAL GENERATOR	SMBV100A	ROHDE & SCHWARZ	15002	2-Oct-2018
RF CABLE	SF102	HUBER & SUHNER	B079823	26-Jul-2018
RF CABLE	SF102	HUBER & SUHNER	B079824	26-Jul-2018
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	B101741	27-Jul-2018

6.4 Test Data

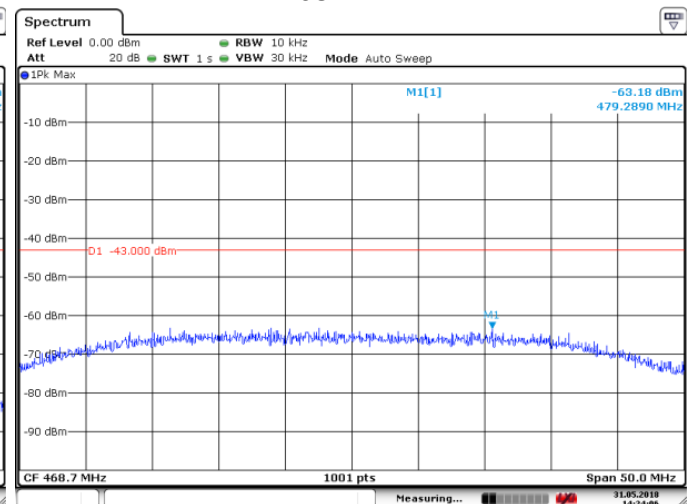
Frequency MHz	Noise dBm	Limit dBm	Result	Note
160.7	-76.9	-43	Complies	Valid for any antenna gain below 33.9 dBd
468.7	-63.2	-43	Complies	Valid for any antenna gain below 20.2 dBd
768.9	-67.8	-43	Complies	Valid for any antenna gain below 24.8 dBd
852.5	-68.8	-43	Complies	Valid for any antenna gain below 25.8 dBd

6.5 Plots

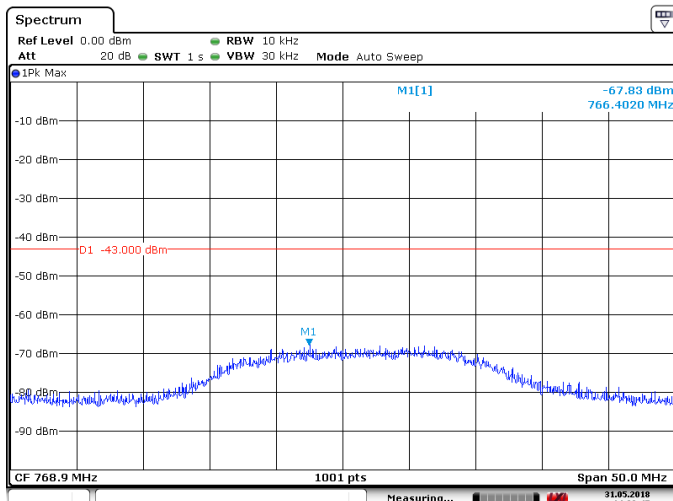
160.7MHz



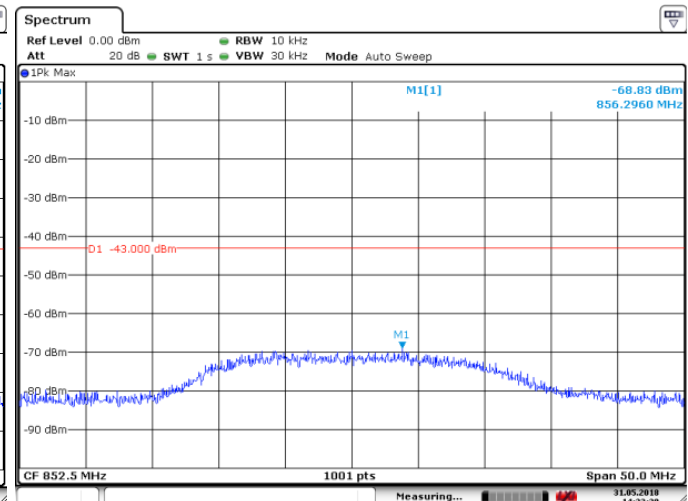
468.7 MHz



768.9 MHz



852.5 MHz



7 Measuring out-of-band/out-of-block (including intermodulation)

7.1 Test Result

Test Description		Test Result
Measuring out-of-band/out-of-block (including intermodulation) and spurious emissions	935210 D05 Indus Booster Basic Meas v01r02	Pass

7.2 Test Method

Testing was performed according to KDB 935210 D05 Indus Booster Basic Meas v01r02, Section 4.7.

7.3 Test Equipment

Test End Date: 1-May-2018

Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-May-2018
RF CABLE	141	HUBER & SUHNER	B095590	26-Jul-2018

Note: The calibration period equipment is 1 year.

7.4 Test Data – Intermodulation products

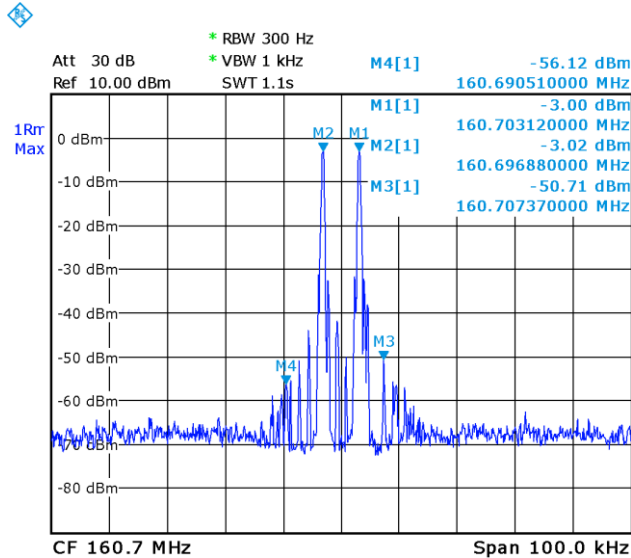
Test data starts on the next page.

7.4.1 Intermodulation products with rated input

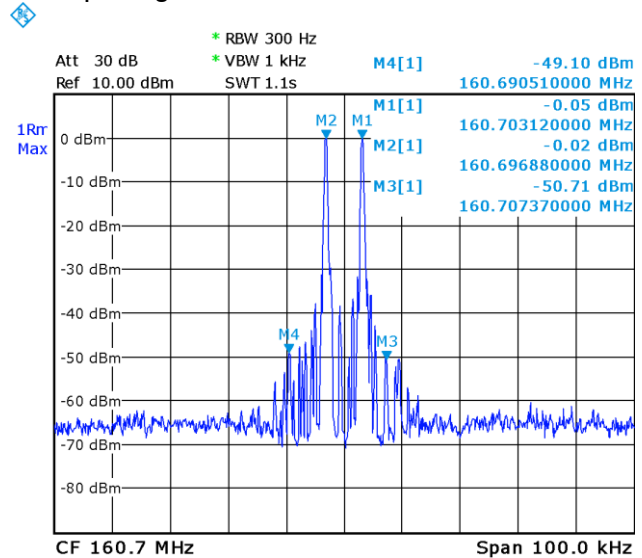
7.4.1.1

160.7 MHz Fundamental

6.25 kHz Channel Spacing

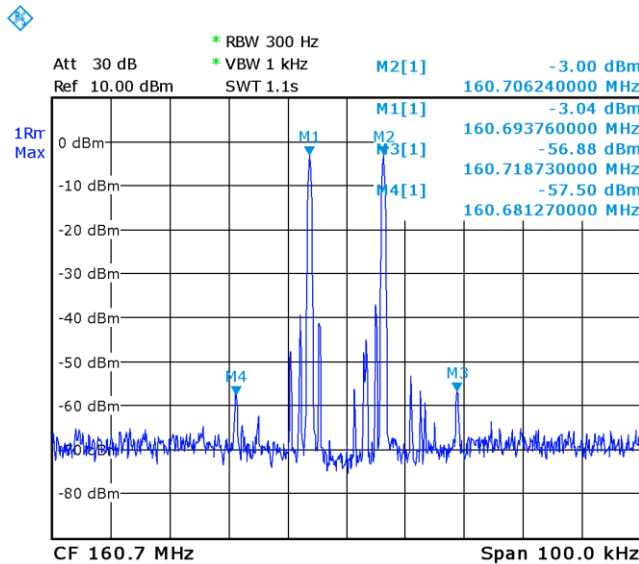


Date: 28.APR.2018 03:08:05

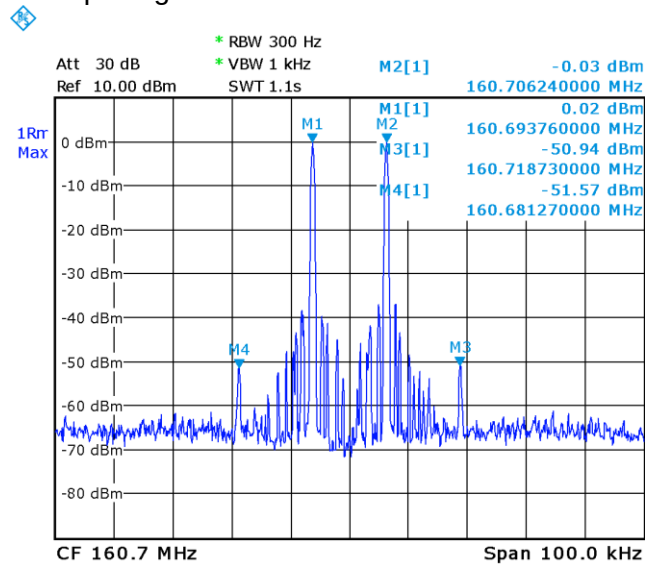


Date: 28.APR.2018 03:08:46

12.5 kHz Channel Spacing

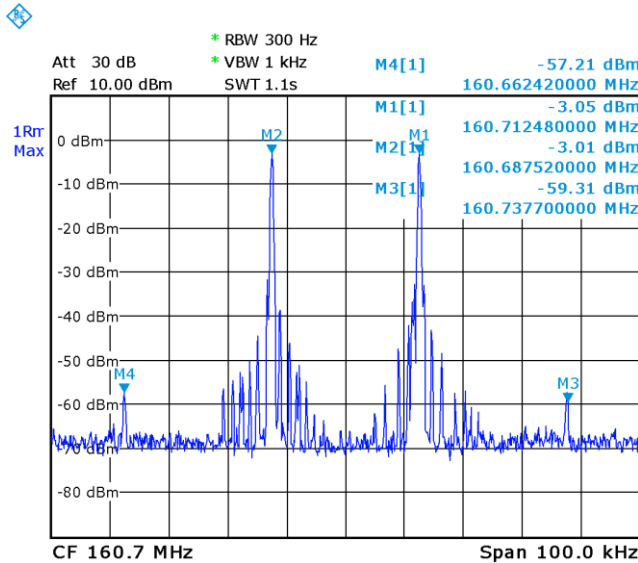


Date: 28.APR.2018 03:13:05

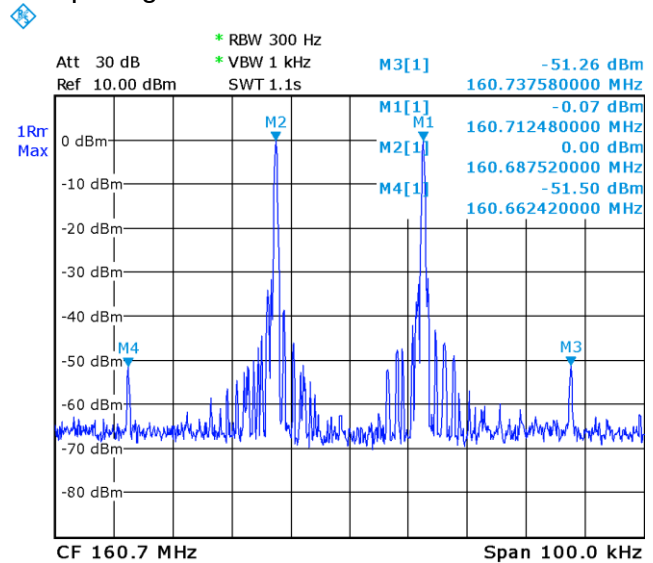


Date: 28.APR.2018 03:13:49

25 kHz Channel Spacing



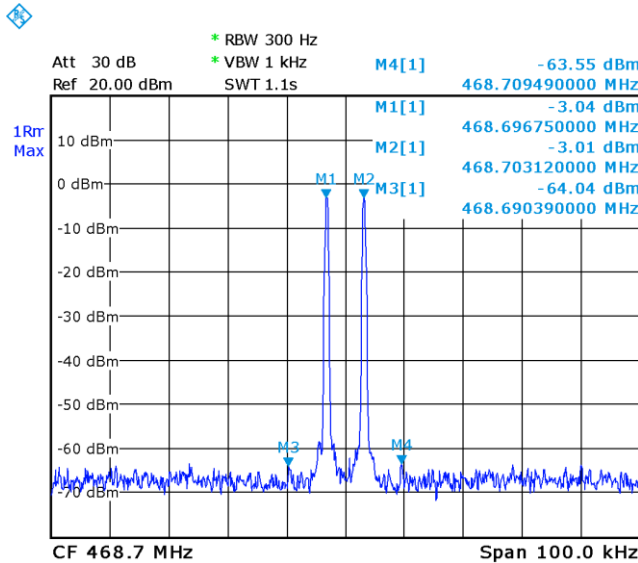
Date: 28.APR.2018 03:16:57



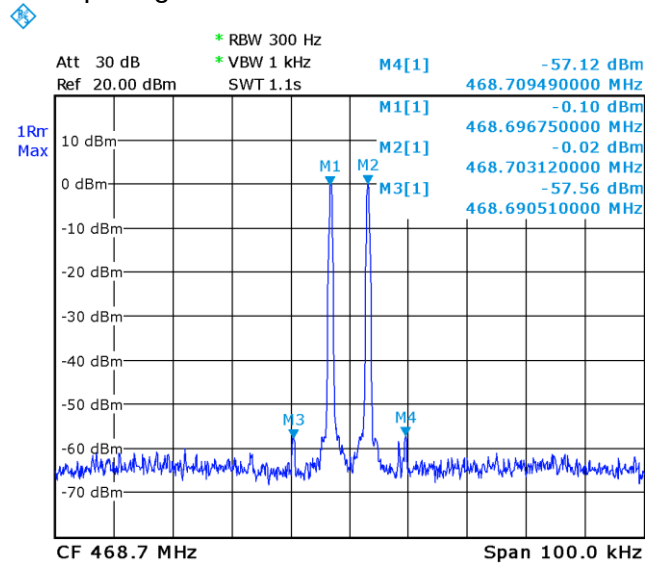
Date: 28.APR.2018 03:17:29

7.4.1.2 468.7 MHz Fundamental

6.25 kHz Channel Spacing

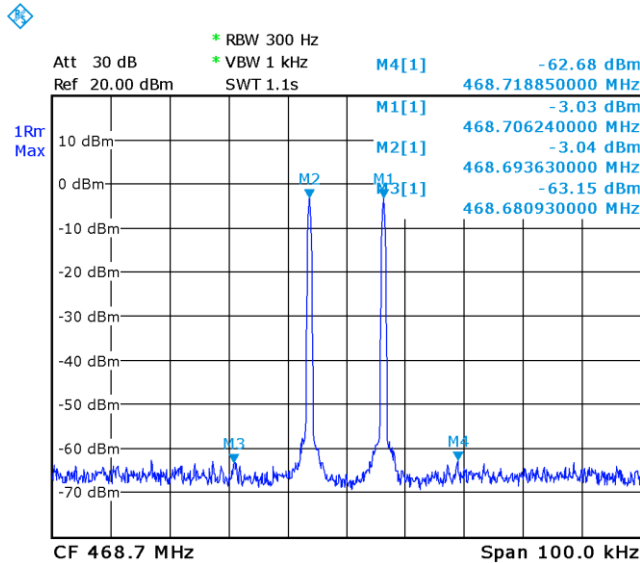


Date: 28.APR.2018 03:21:35

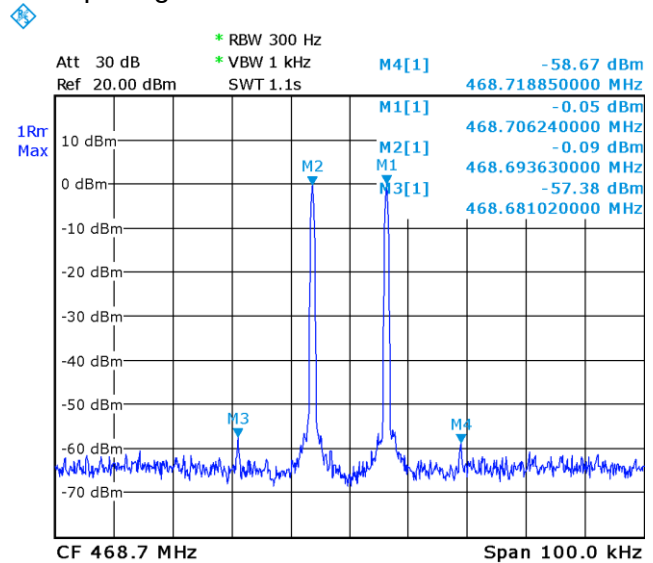


Date: 28.APR.2018 03:22:25

12.5 kHz Channel Spacing

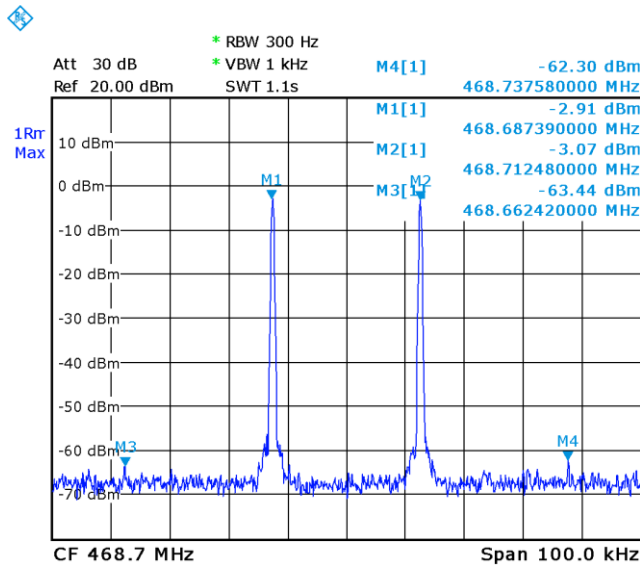


Date: 28.APR.2018 03:25:58

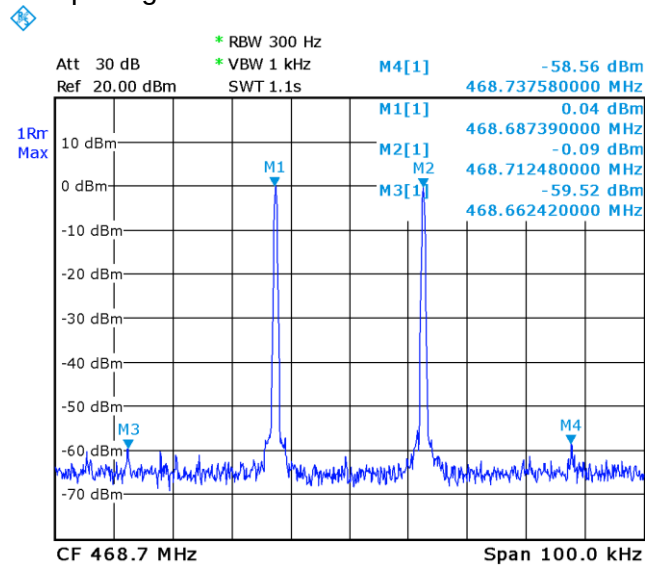


Date: 28.APR.2018 03:26:39

25 kHz Channel Spacing



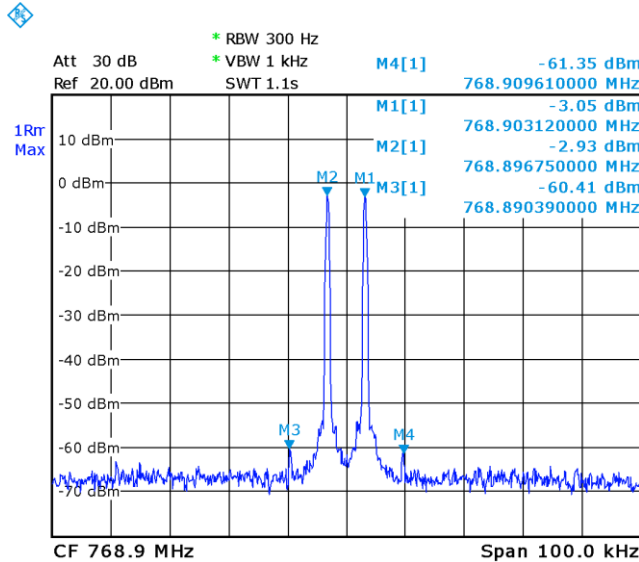
Date: 28.APR.2018 03:29:10



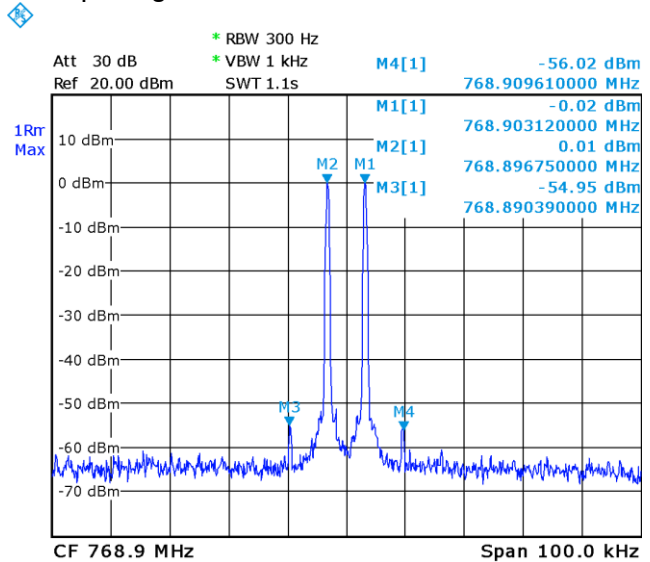
Date: 28.APR.2018 03:29:40

7.4.1.3 768.9 MHz Fundamental

6.25 kHz Channel Spacing

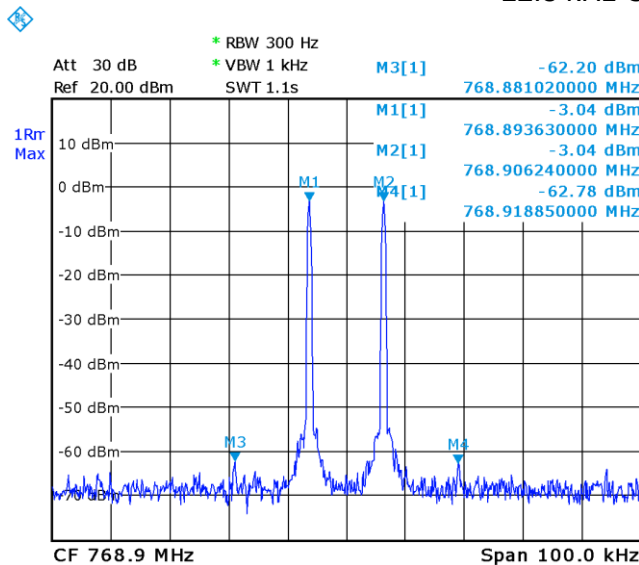


Date: 28.APR.2018 03:33:51

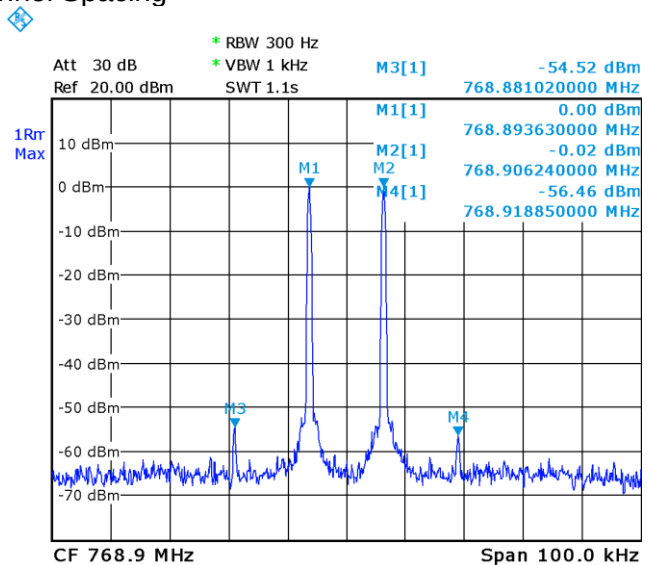


Date: 28.APR.2018 03:34:38

12.5 kHz Channel Spacing

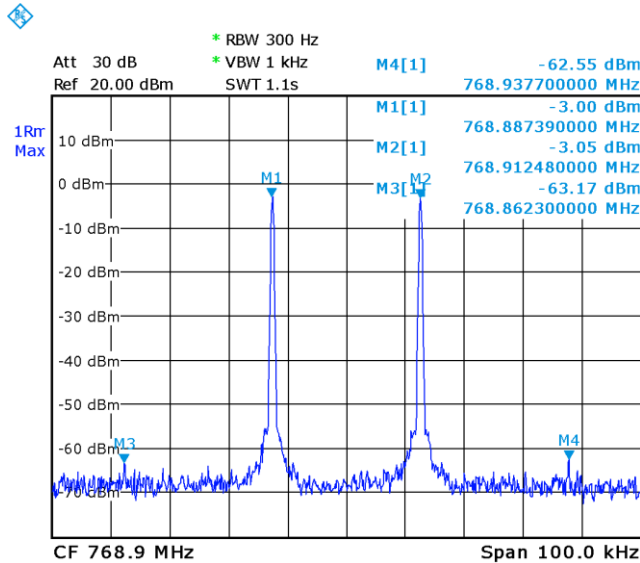


Date: 28.APR.2018 03:36:48

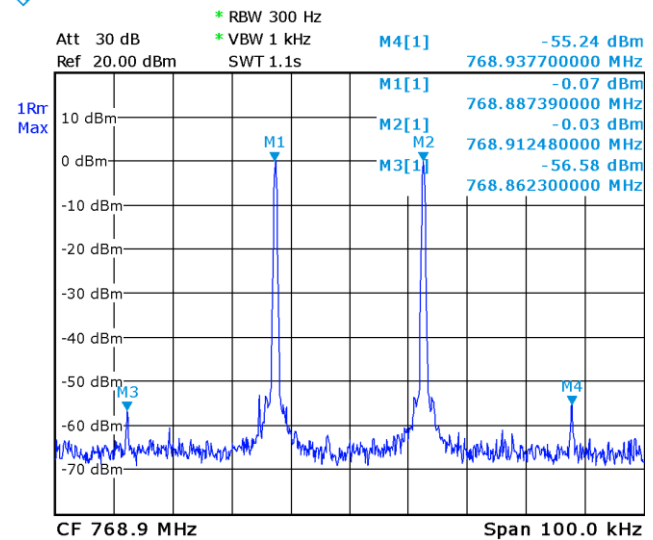


Date: 28.APR.2018 03:37:28

25 kHz Channel Spacing



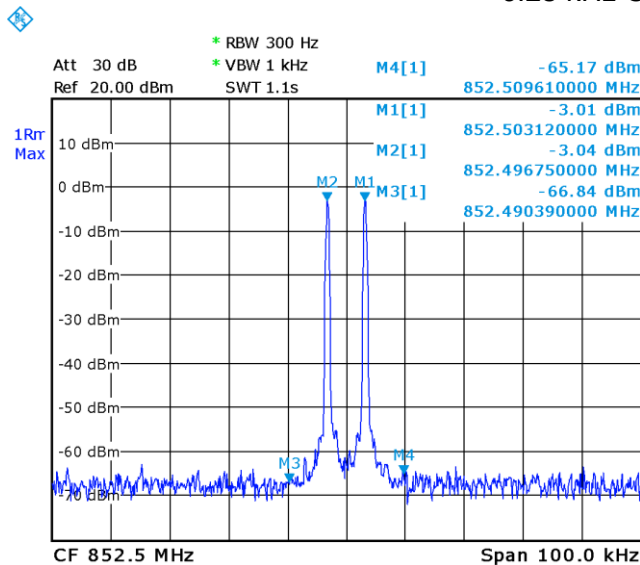
Date: 28.APR.2018 03:39:29



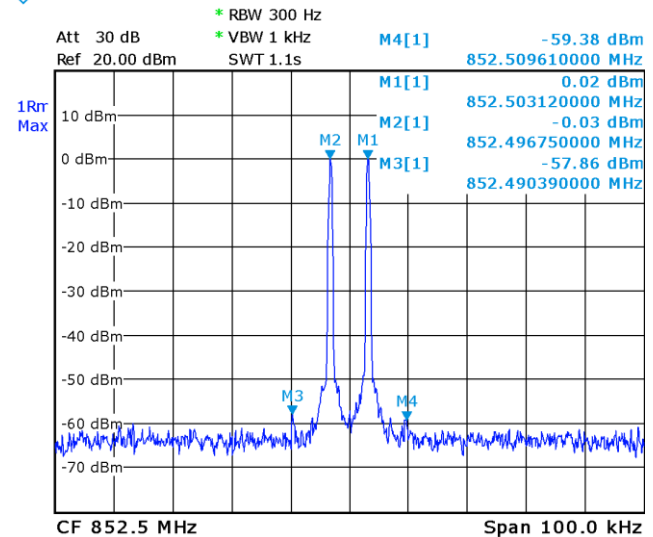
Date: 28.APR.2018 03:40:00

7.4.1.4 852.5 MHz Fundamental

6.25 kHz Channel Spacing

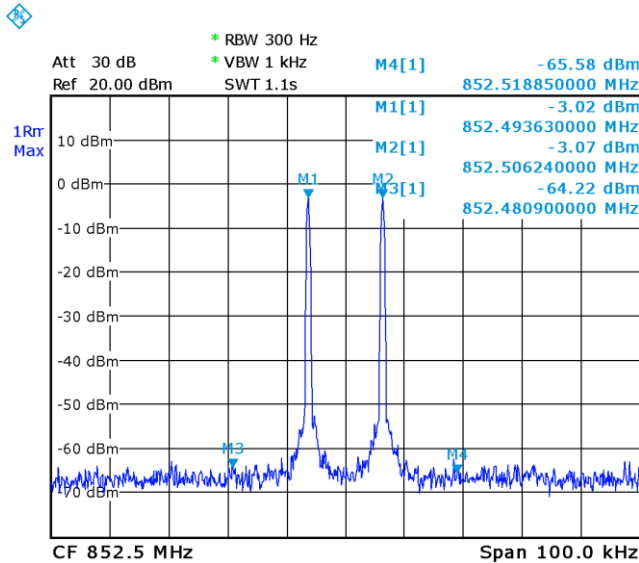


Date: 28.APR.2018 03:42:53

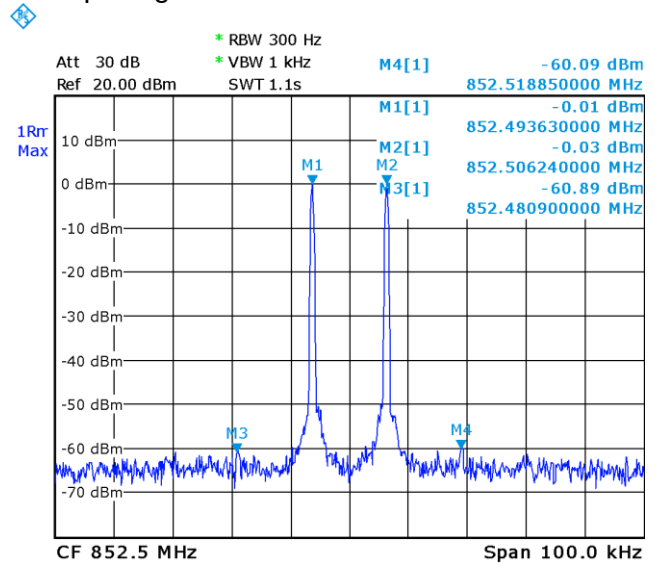


Date: 28.APR.2018 03:43:48

12.5 kHz Channel Spacing

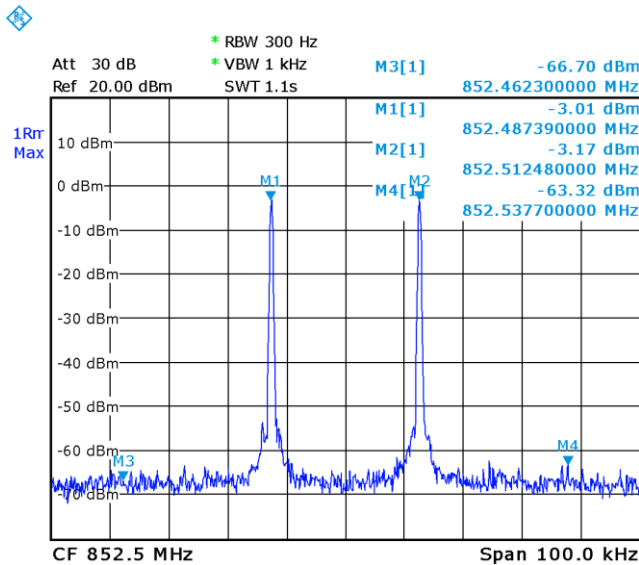


Date: 28.APR.2018 03:45:36

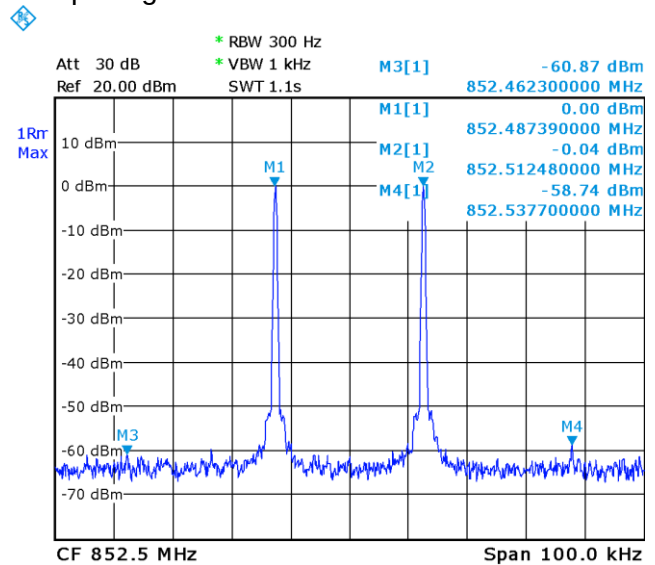


Date: 28.APR.2018 03:46:15

25 kHz Channel Spacing



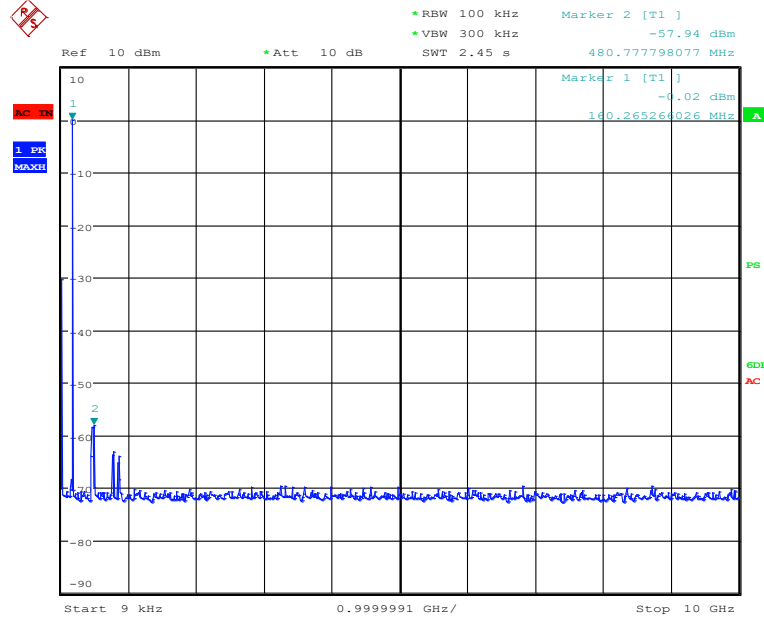
Date: 28.APR.2018 03:49:35



Date: 28.APR.2018 03:50:32

7.4.1 Conducted Spurious Emissions

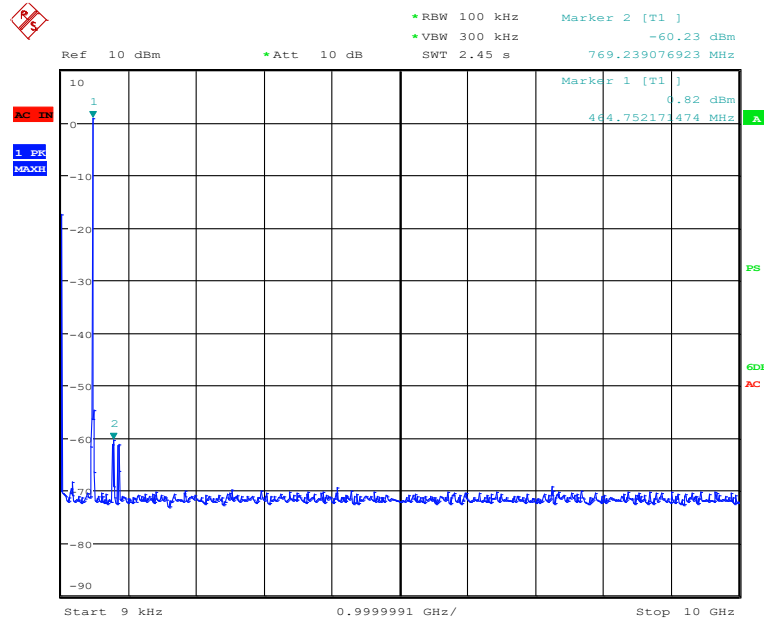
7.4.1.1 VHF Plot



Date: 1.MAY.2018 21:55:03

Cable Loss = 0.496 dB

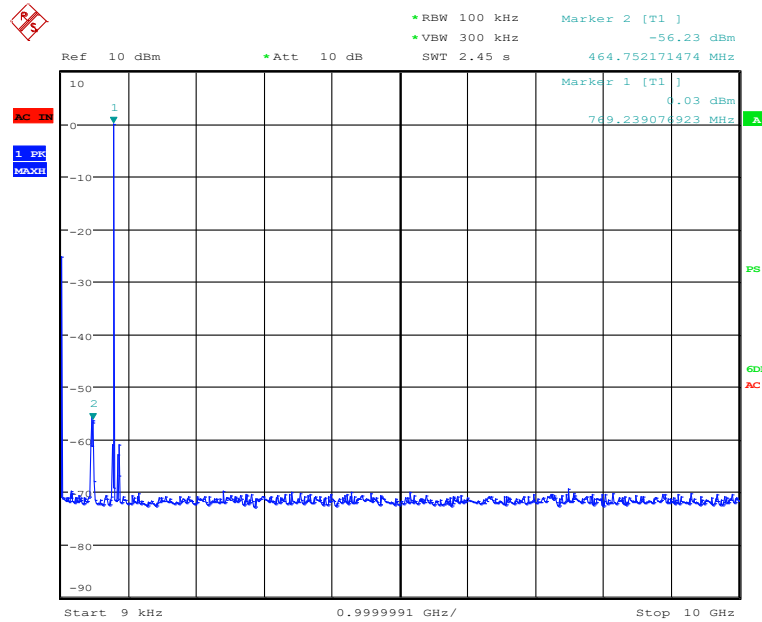
7.4.1.2 450 MHz Band



Date: 1.MAY.2018 21:53:50

Cable Loss = 0.668 dB

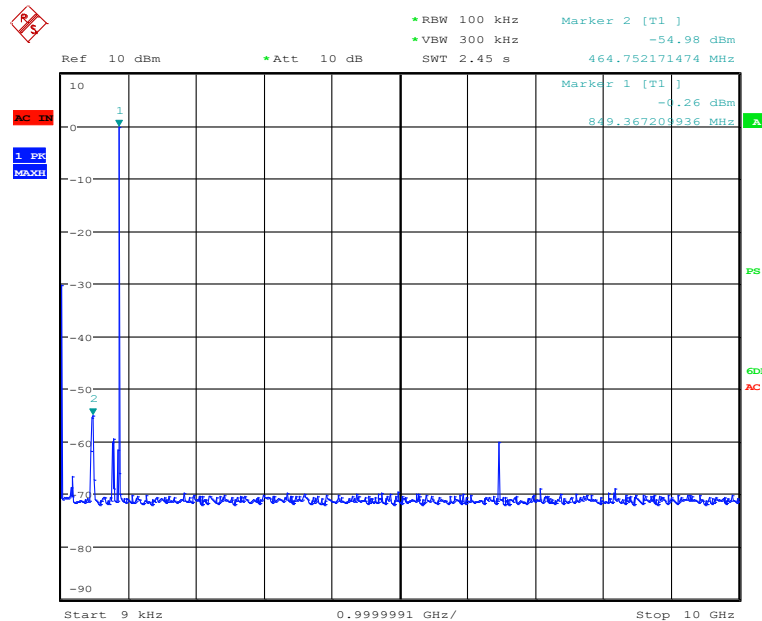
7.4.1.3 700 MHz Band



Date: 1.MAY.2018 21:52:30

Cable Loss = 0.496 dB

7.4.1.4 800 MHz Band



Date: 1.MAY.2018 21:50:25

Cable Loss = 0.496 dB

8 Frequency stability measurements

8.1 Test Result

Test Description		Test Result
Frequency stability measurements	935210 D05 Indus Booster Basic Meas v01r02	Pass

8.2 Test Method

Testing was performed according to KDB 935210 D05 Indus Booster Basic Meas v01r02, Section 4.8

8.3 Test Equipment

Test End Date:03/13/2018

Tester: SKM

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ENVIRONMENTAL TEST CHAMBER	T2RC	TENNEY ENVIRONMENTAL	B094877	CNR
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079659	25-Jul-2018
SIGNAL GENERATOR	SMBV100A	ROHDE & SCHWARZ	15002	2-Oct-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17016	25-Jul-2018