ENGINEERING TEST REPORT

UHF Bi-Directional Amplifier
Model: UBDA4551
FCC ID: WDM-UBDA4551

Applicant:

Comprod Communications Ltd
3405 North Benzing Road
Orchard Park, NY 14127
USA

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Parts 2 & 90

UltraTech's File No.: CMPR-008F90

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: August 16, 2012

Report Prepared by: Dan Huynh	Tested by: Mr. Wei Wu
Issued Date: August 16, 2012	Test Dates: June 14 ~ August 24, 2011

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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FCC	VCCI	Industry Canada / Industrie Canada Approved Test Facility	NVLAP	BSMI	Korea KCC-RRL
91038	1309	46390-2049	NvLap Lab Code 200093-0	SL2-IN-E-1119R	CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 2 & 90
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Part 2 & 90
Purpose of Test:	To gain FCC Certification Authorization for Radio Amplifier operating in the Frequency Range 450 - 512 MHz
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2011	Code of Federal Regulations – Title 47, Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
TIA/EIA 603, Edition C	2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

EXHIBIT 2. PERFROMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Comprod Communications Ltd
Address:	3405 North Benzing Road Orchard Park, NY 14127 USA
Contact Person:	Mr. Fernando Apolinario Phone #: 450-641-1454 Fax #: 450-641-4616 Email Address: fapolinario@comprodcom.com

MANUFACTURER	
Name:	Comprod Communications Ltd
Address:	138 De La Barre Boucherville, Quebec Canada 4127
Contact Person:	Mr. Fernando Apolinario Phone #: 450-641-1454 Fax #: 450-641-4616 Email Address: fapolinario@comprodcom.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Comprod Communications Ltd
Product Name:	UHF Bi-Directional Amplifier
Model Name or Number:	UBDA4551
Serial Number:	Test Sample
Type of Equipment:	Booster
Power Supply Requirement:	100-260 VAC 50 / 60 Hz
Transmitting/Receiving Antenna Type:	Non-Integral
Primary User Functions of EUT:	Extends RF coverage area of radio communications indoor/outdoor environments.

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Base station (fixed use)
Intended Operating Environment:	Commercial, Light Industry & Heavy Industry
RF Output Power Rating (Conducted):	Single output: 32.5 dBm or 1.778 Watts
Operating Frequency Range:	Uplink band: 450 - 512 MHz Downlink band: 450 - 512 MHz
RF Input/Output Impedance:	50 Ohm
Nominal Gain (at -40dBm input power):	76 dB maximum
Occupied Bandwidth (99%):	Booster
Emission Designation:	F3E, F1D
Antenna Connector Type:	SMA
Antenna Description:	Antenna gain: 3.5 dBd maximum

Receiver	
Equipment Type:	Base station (fixed use)
Intended Operating Environment:	Commercial, Light Industry & Heavy Industry
Power Supply Requirement:	100-260 VAC 50 / 60 Hz
RF Input Power Rating:	Single input: -40 dBm nominal
Operating Frequency Range:	Uplink band: 450 - 512 MHz Downlink band: 450 - 512 MHz

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	AC power input	1	RCPT waterproof 3 positions, male	Non-shielded
2	D/L VGA IN	1	SMA female	Shielded
3	D/L VGA OUT	1	SMA female	Shielded
4	D/L PA IN	1	SMA female	Shielded
5	D/L PA OUT	1	SMA female	Shielded
6	U/L VGA IN	1	SMA female	Shielded
7	U/L VGA OUT	1	SMA female	Shielded
8	U/L PA IN	1	SMA female	Shielded
9	U/L PA OUT	1	SMA female	Shielded

2.5. ASSOCIATED EQUIPMENT

None.

2.6. ANCILLARY EQUIPMENT

N/A

2.7. DRAWING OF TEST SETUP

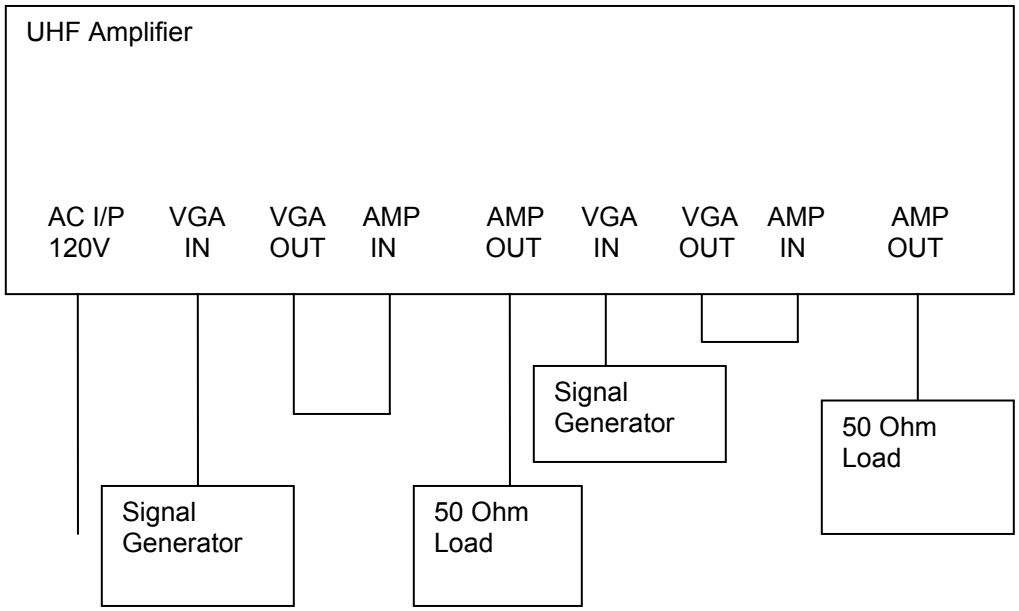


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	22°C
Humidity:	54%
Pressure:	100 kPa
Power input source:	120 VAC, 60 Hz

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The amplifier was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the amplifier antenna ports terminated to a 50 Ohm RF Load.

Transmitter Test Signals	
Frequency Band(s):	450 - 512 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	451, 469.9 and 511.9 MHz
Transmitter Wanted Output Test Signals:	
Transmitter Power (measured maximum output power):	32.40 dBm
Normal Test Modulation:	F3E, F1D
Modulating signal source:	External

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2014-04-04.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.107(b)	AC Power Line Conducted Emissions	Yes
2.1046 & 90.219	RF Power Output & Inter-modulation	Yes
1.1307, 1.1310, 2.1091	RF Exposure Limit	Yes
2.1055 & 90.213	Frequency Stability	N/A for Amplifier
2.1047(a)	Audio Frequency Response	N/A for Amplifier
2.1047(b) & 90.210	Modulation Limiting	N/A for Amplifier
2.1049	Occupied Bandwidth	Yes
2.1051, 2.1057 & 90.210	Spurious Emissions at Antenna Terminals	Yes
2.1051, 2.1057 & 90.210	Field Strength of Spurious Radiation	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 5. TEST DATA

Remark:

The amplication chain for Downlink band and Uplink band are identical, each chain consists of an identical VGA unit and an identical Power Amplifier unit. The the following test results will represents worst-case test configuration for both Downlink and Uplink bands.

5.1. POWER LINE CONDUCTED EMISSIONS [[§ 15.107(b)]

5.1.1. Limits

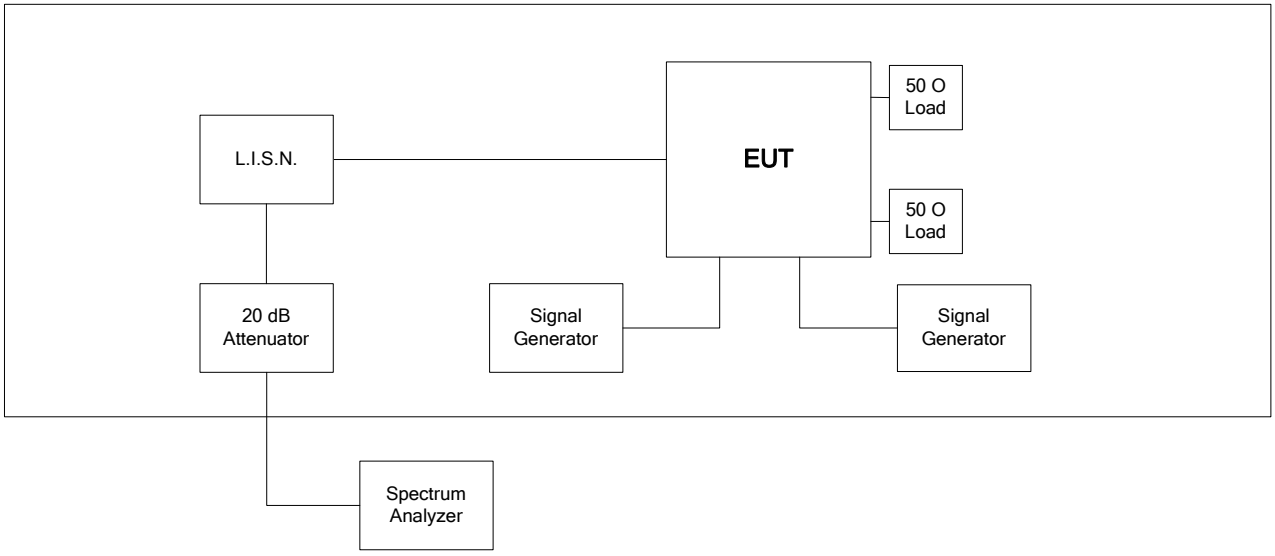
The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15 - 0.5	79	66
0.5 - 30	73	60

5.1.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

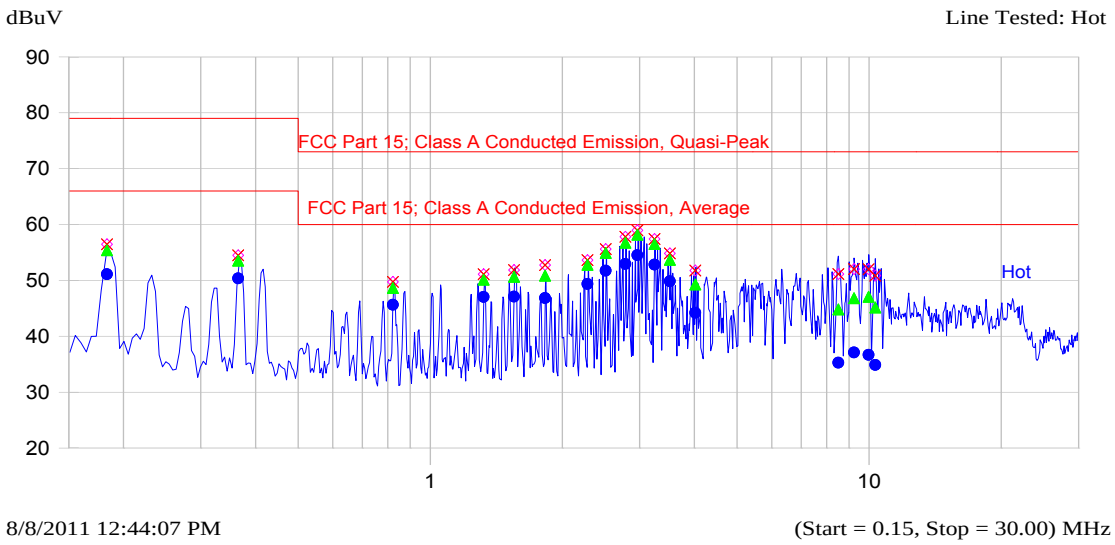
5.1.3. Test Arrangement



5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions
Line Voltage: 120 VAC 60 Hz, Line Tested: Hot

Current Graph

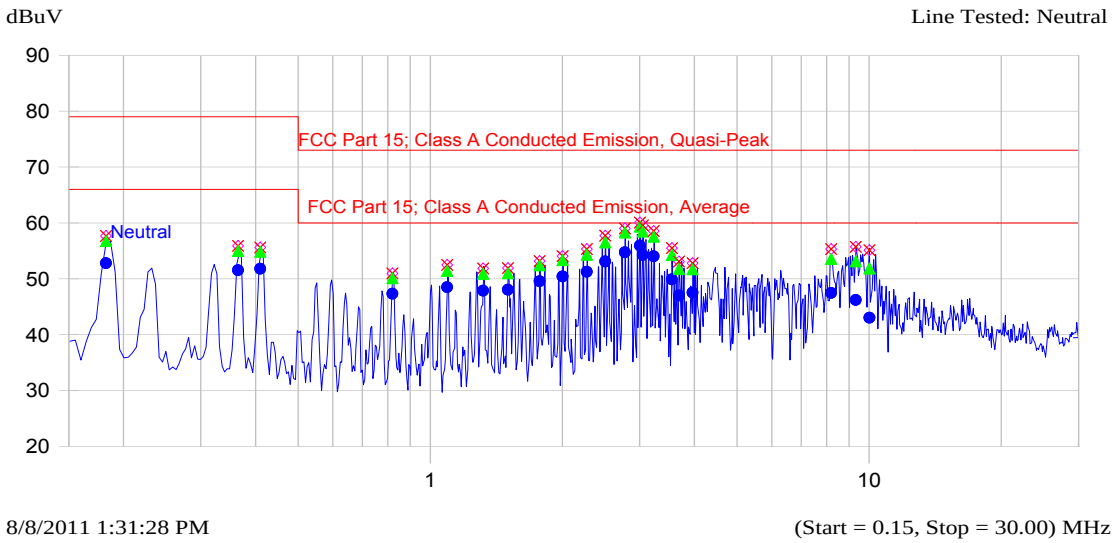


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.183	56.5	55.4	-23.6	51.1	-14.9	Hot
0.365	54.5	53.5	-25.5	50.4	-15.6	Hot
0.822	49.7	48.6	-24.4	45.6	-14.4	Hot
1.324	51.1	50.1	-22.9	47.0	-13.0	Hot
1.553	51.9	50.6	-22.4	47.1	-12.9	Hot
1.826	52.8	50.8	-22.2	46.8	-13.2	Hot
2.283	53.6	52.8	-20.2	49.4	-10.6	Hot
2.511	55.6	54.9	-18.1	51.8	-8.2	Hot
2.785	57.8	56.8	-16.2	52.9	-7.1	Hot
2.966	59.0	58.2	-14.8	54.5	-5.5	Hot
3.241	57.4	56.5	-16.5	52.8	-7.2	Hot
3.515	54.8	53.7	-19.3	49.9	-10.1	Hot
4.019	51.8	49.3	-23.7	44.2	-15.8	Hot
8.513	51.1	44.8	-28.2	35.3	-24.7	Hot
9.238	52.0	46.8	-26.2	37.1	-22.9	Hot
9.971	52.0	47.1	-25.9	36.7	-23.3	Hot
10.335	50.9	45.2	-27.8	34.9	-25.1	Hot

Plot 5.1.4.2. Power Line Conducted Emissions
Line Voltage: 120 VAC 60 Hz, Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.182	57.7	56.8	-22.2	52.8	-13.2	Neutral
0.410	55.6	54.9	-24.1	51.8	-14.2	Neutral
0.365	55.9	55.0	-24.0	51.5	-14.5	Neutral
0.820	51.0	50.1	-22.9	47.3	-12.7	Neutral
1.093	52.5	51.4	-21.6	48.5	-11.5	Neutral
1.321	51.9	50.9	-22.1	47.9	-12.1	Neutral
1.502	51.9	51.0	-22.0	48.0	-12.0	Neutral
1.775	53.2	52.4	-20.6	49.6	-10.4	Neutral
2.004	54.1	53.3	-19.7	50.4	-9.6	Neutral
2.275	55.3	54.3	-18.7	51.3	-8.7	Neutral
2.504	57.7	56.5	-16.5	53.1	-6.9	Neutral
2.778	59.0	58.3	-14.7	54.7	-5.3	Neutral
3.006	60.1	59.4	-13.6	55.9	-4.1	Neutral
3.052	59.6	58.5	-14.5	54.3	-5.7	Neutral
3.232	58.6	57.6	-15.4	54.0	-6.0	Neutral
3.552	55.5	54.3	-18.7	49.9	-10.1	Neutral
3.687	53.1	51.8	-21.2	47.0	-13.0	Neutral
3.959	52.8	51.7	-21.3	47.5	-12.5	Neutral
8.193	55.3	53.6	-19.4	47.5	-12.5	Neutral
9.332	55.7	53.2	-19.8	46.2	-13.8	Neutral
10.016	55.1	51.9	-21.1	43.0	-17.0	Neutral

5.2. RF POWER OUTPUT [§§ 2.1046 and 90.205]

5.2.1. Limits

Refer to FCC 47 CFR § 90.205 for specification details and § 90.219.

Licensees authorized to operate radio systems in the frequency bands above 150 MHz may employ signal boosters at fixed locations in accordance with the following criteria:

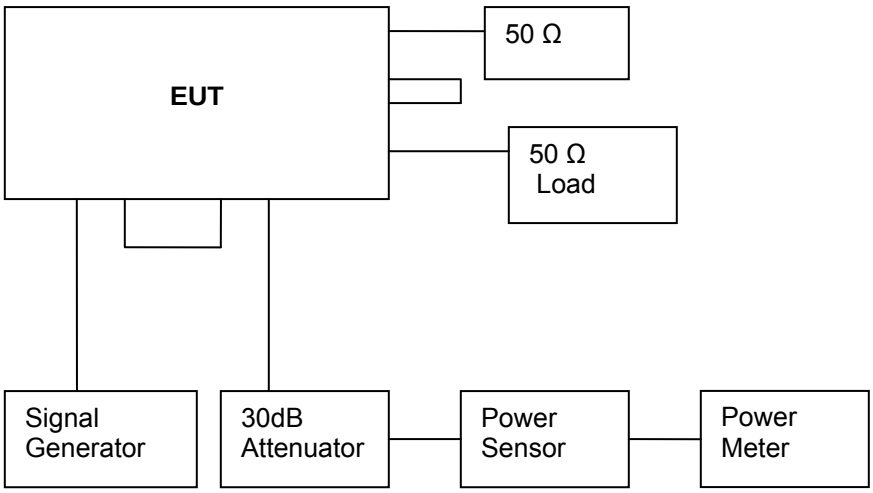
(a) The amplified signal is retransmitted only on the exact frequency(ies) of the originating base, fixed, mobile, or portable station(s). The booster will fill in only weak signal areas and cannot extend the system's normal signal coverage area.

(b) Class A narrowband signal boosters must be equipped with automatic gain control circuitry which will limit the total effective radiated power (ERP) of the unit to a maximum of 5 watts under all conditions. Class B broadband signal boosters are limited to 5 watts ERP for each authorized frequency that the booster is designed to amplify.

5.2.2. Method of Measurements

ANSI/TIA-603-C-2004

5.2.3. Test Arrangement



5.2.4. Test Data

Remark: The maximum antenna gain to be used with this device is 3.5 dBd.

Test Frequency (MHz)	Channel Spacing (kHz)	Input Power (dBm)	VGA Input Level Adjustment Setting	VGA Output Power Setting	Total RF Output Power at Antenna Port	
					(dBm)	(Watt)
451	6.25	-39.63	0	9	28.27	0.671
	12.5	-39.90	0	7	30.01	1.002
	25	-39.90	0	6	31.06	1.276
469.9	6.25	-40.22	0	B	28.02	0.634
	12.5	-40.22	0	8	30.61	1.151
	25	-40.22	0	6	32.40	1.738
511.9	6.25	-40.40	0	B	27.11	0.514
	12.5	-39.46	0	9	29.26	0.843
	25	-39.46	0	8	30.28	1.067

5.3. OCCUPIED BANDWIDTH [§ 2.1049]

5.3.1. Limits

The spectral shape of the output should look similar to input for all modulations.

5.3.2. Method of Measurements

The measurement procedure shall be as follows:

Step 1:

- Connect the EUT to the spectrum analyzer and use the following settings:

Span:	the minimum span to fully display the emission
Resolution BW:	300 Hz or 1% of the approximate emission width
Video BW:	3 times the Resolution BW or greater
Video Averaging:	none
Sweep time:	coupled or set to a slower rate

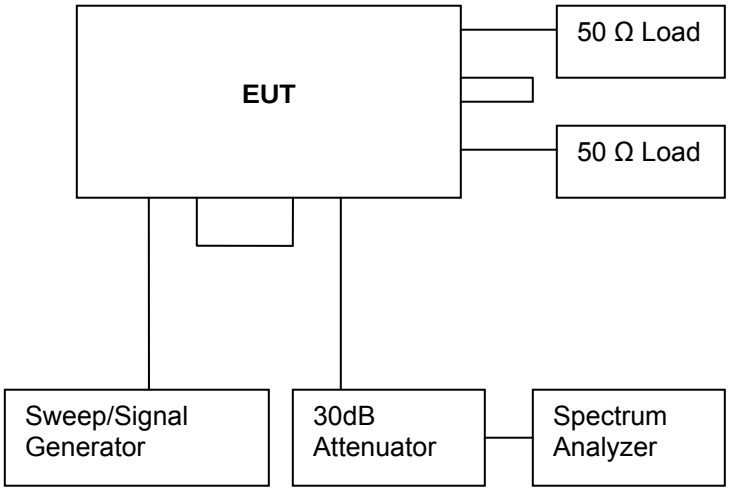
Step 2:

- When the trace is complete, capture the trace.
- Find the peak value of the trace and place the analyzer marker on this peak.

Step 3:

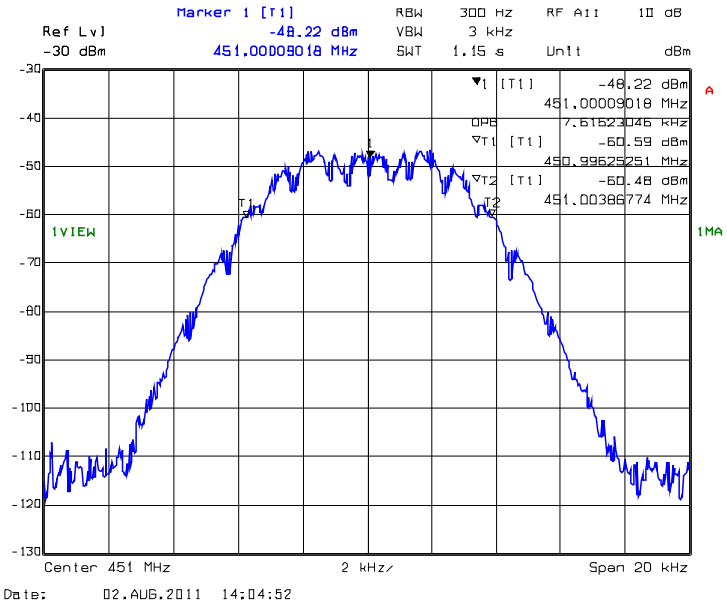
- Use the 99 % bandwidth function of the spectrum analyzer to measure the occupied bandwidth of the EUT. This value shall be recorded.

5.3.3. Test Arrangement

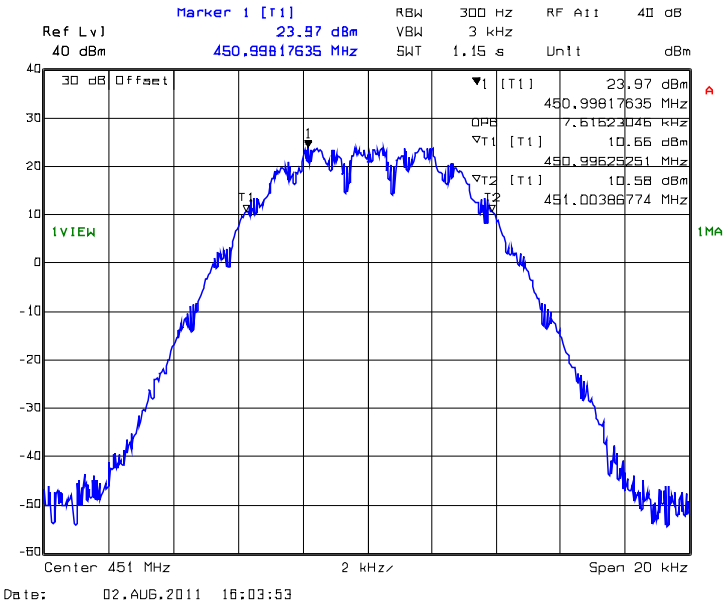


5.3.4. Test Data

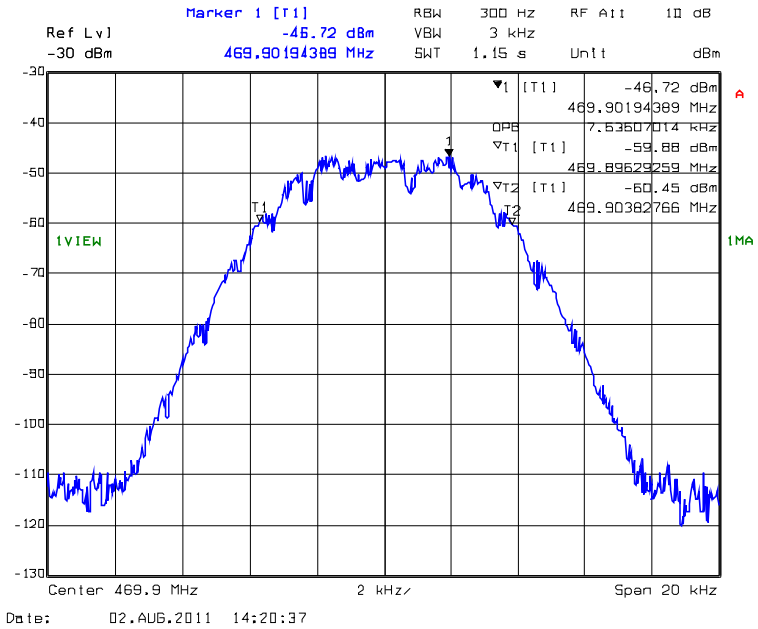
Plot 5.3.4.1. 99% Occupied Bandwidth – Input Signal, F1D
Transmitter Frequency: 451 MHz



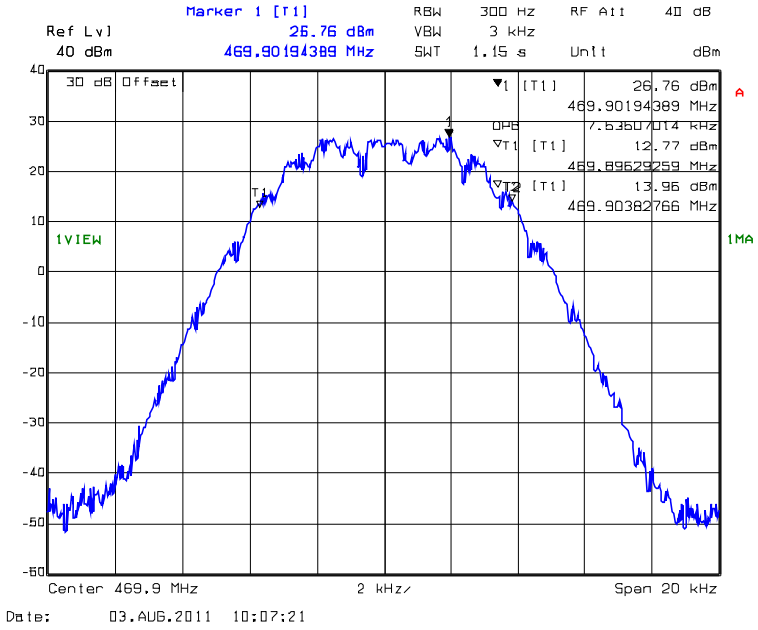
Plot 5.3.4.2. 99% Occupied Bandwidth – Output Signal, F1D
Transmitter Frequency: 451 MHz



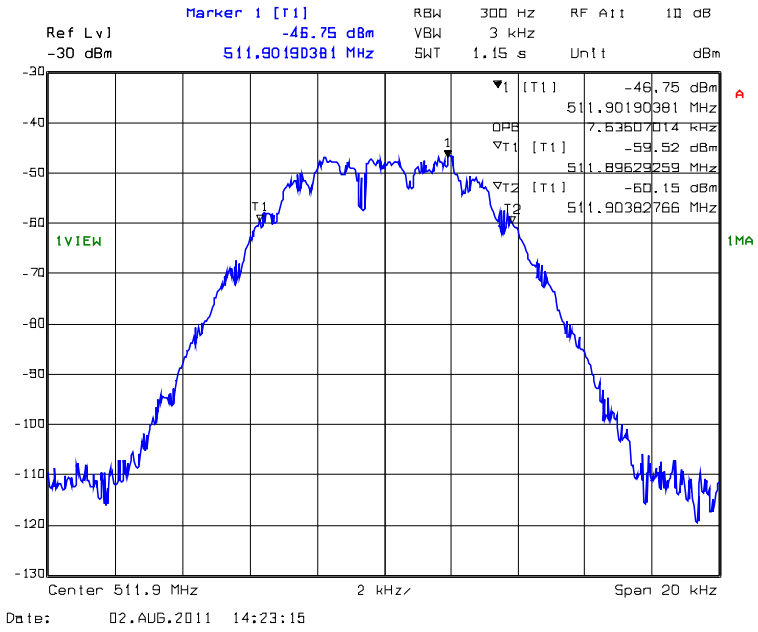
Plot 5.3.4.3. 99% Occupied Bandwidth – Input Signal, F1D
Transmitter Frequency: 469.9 MHz



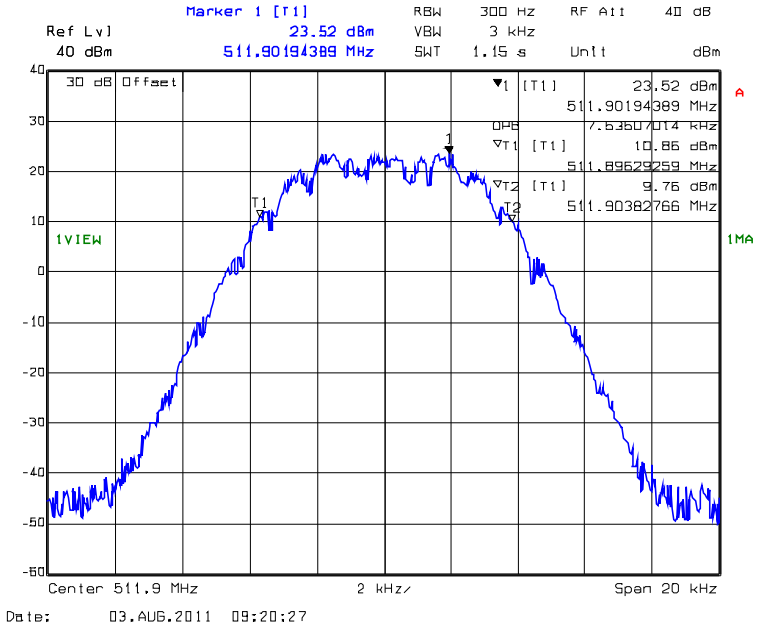
Plot 5.3.4.4. 99% Occupied Bandwidth – Output Signal, F1D
Transmitter Frequency: 469.9 MHz



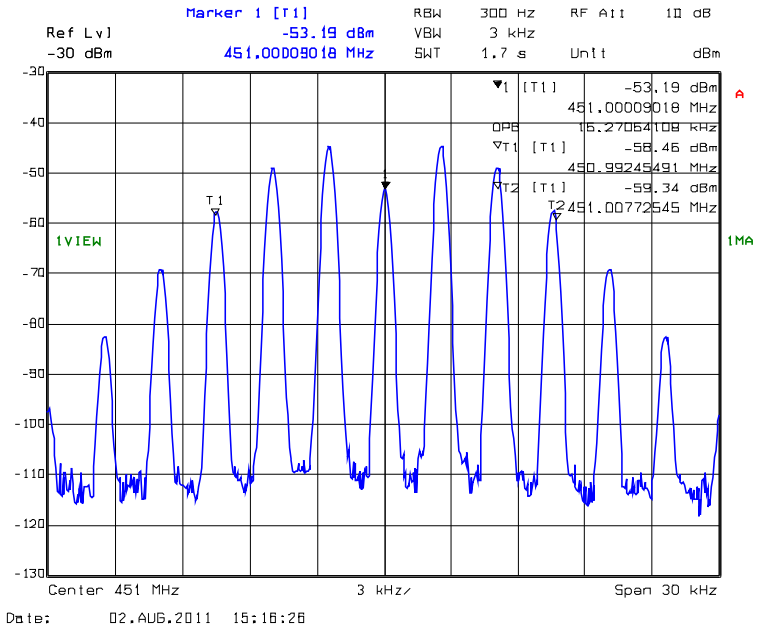
Plot 5.3.4.5. 99% Occupied Bandwidth – Input Signal, F1D
Transmitter Frequency: 511.9 MHz



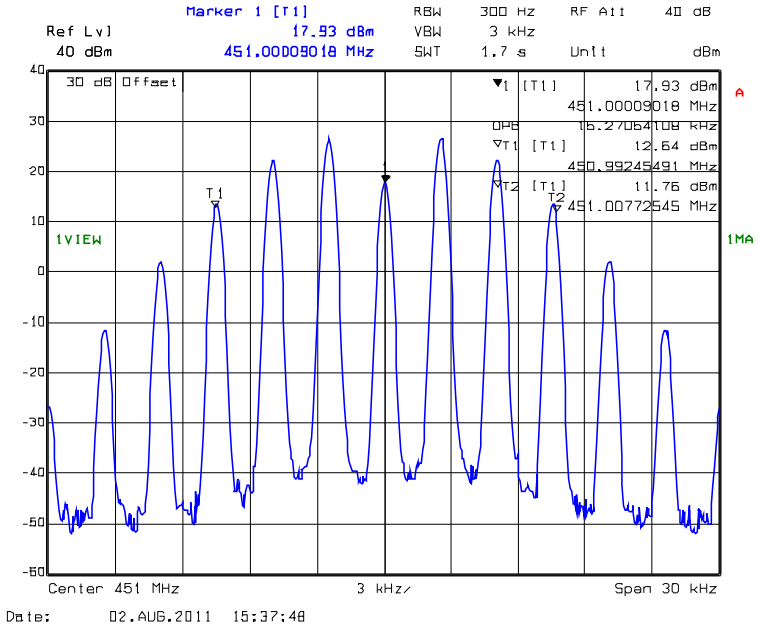
Plot 5.3.4.6. 99% Occupied Bandwidth – Output Signal, F1D
Transmitter Frequency: 511.9 MHz



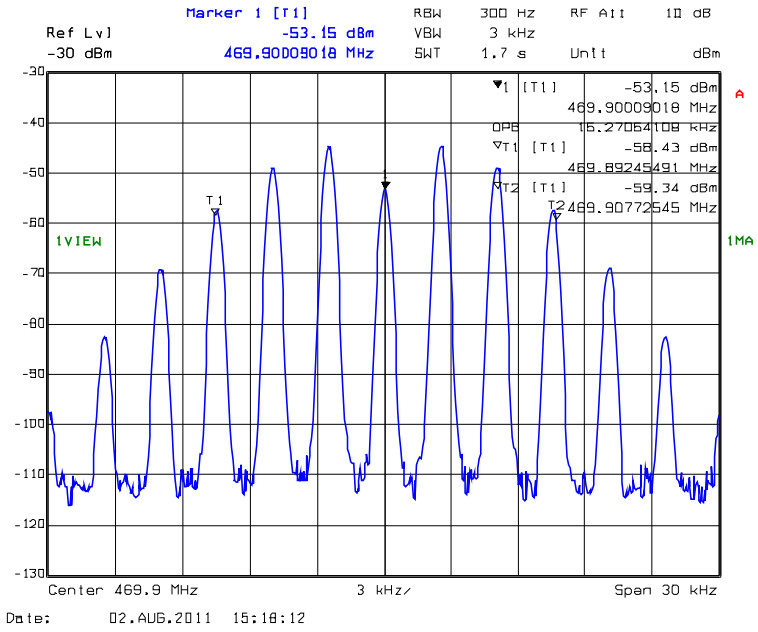
Plot 5.3.4.7. 99% Occupied Bandwidth – Input Signal, F3E
Transmitter Frequency: 451 MHz



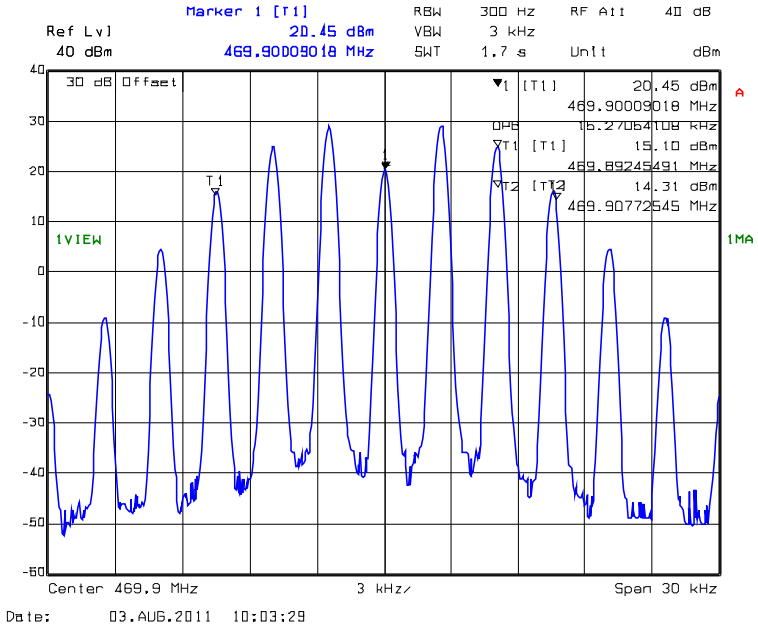
Plot 5.3.4.8. 99% Occupied Bandwidth – Output Signal, F3E
Transmitter Frequency: 451 MHz



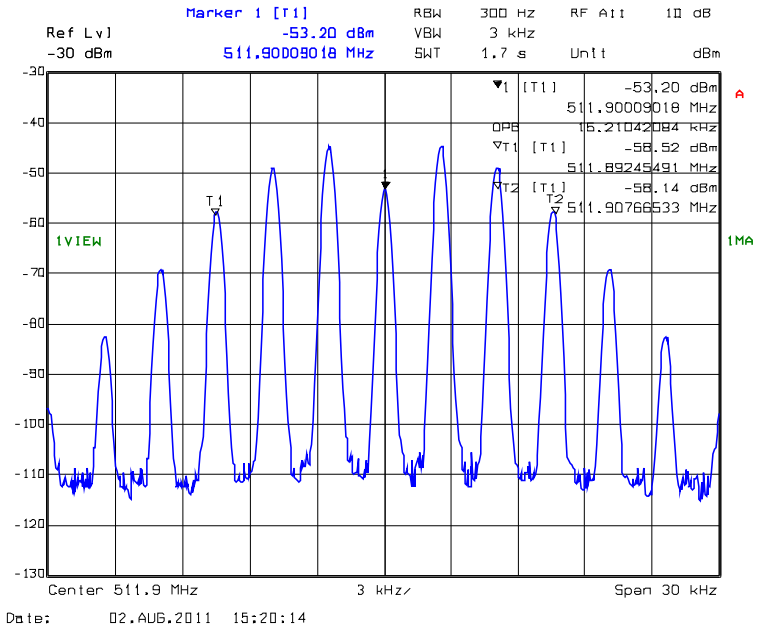
Plot 5.3.4.9. 99% Occupied Bandwidth – Input Signal, F3E
Transmitter Frequency: 469.9 MHz



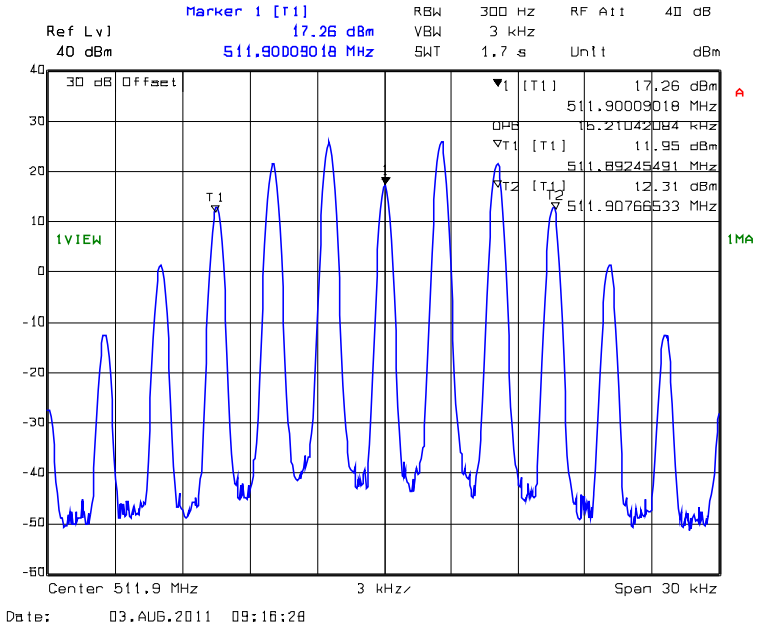
Plot 5.3.4.10. 99% Occupied Bandwidth – Output Signal, F3E
Transmitter Frequency: 469.9 MHz



Plot 5.3.4.11. 99% Occupied Bandwidth – Input Signal, F3E
Transmitter Frequency: 511.9 MHz



Plot 5.3.4.12. 99% Occupied Bandwidth – Output Signal, F3E
Transmitter Frequency: 511.9 MHz



5.4. SPURIOUS EMISSIONS AT ANTENNA TERMINAL AND INTERMODULATION [§§ 2.1051, 2.1057 & 90.210]

5.4.1. Limits

§ 90.219 (c) Class A narrowband boosters must meet the out-of-band emission limits of § 90.210 for each narrowband channel that the booster is designed to amplify. Class B broadband signal boosters must meet the emission limits of § 90.210 for frequencies outside of the booster's designed passband.

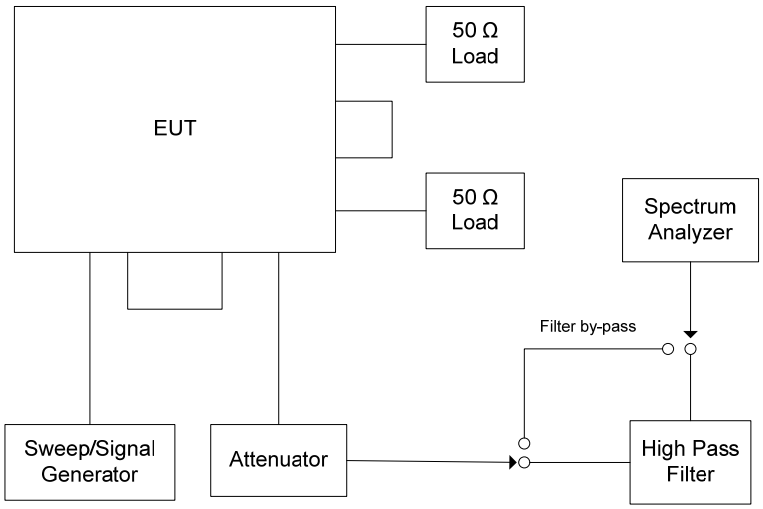
KDB 935210 - FCC guidelines for testing amplifiers, boosters and repeater:
Intermodulation limit: -13dBm conducted.

5.4.2. Method of Measurements

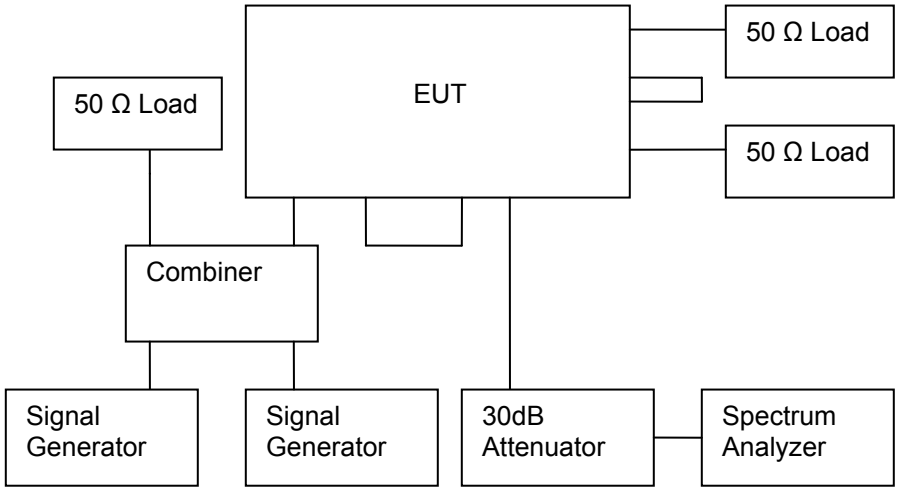
TIA-603-C.

5.4.3. Test Arrangement

Single Channel Input:



Multiple Channel Inputs:

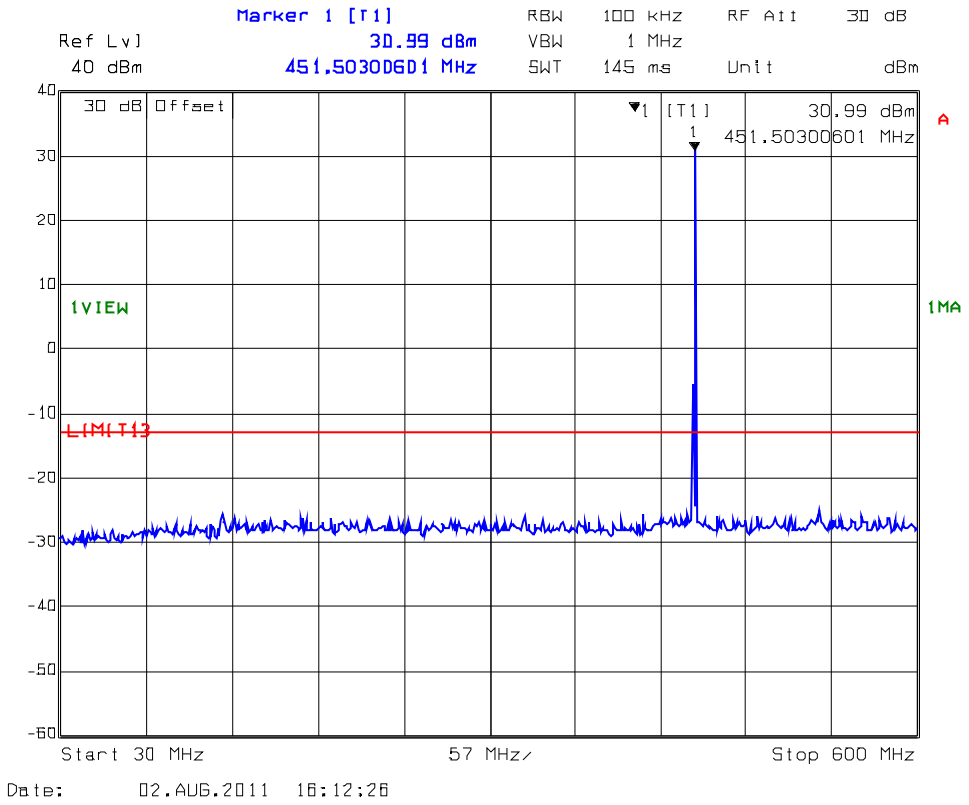


5.4.4. Test Data

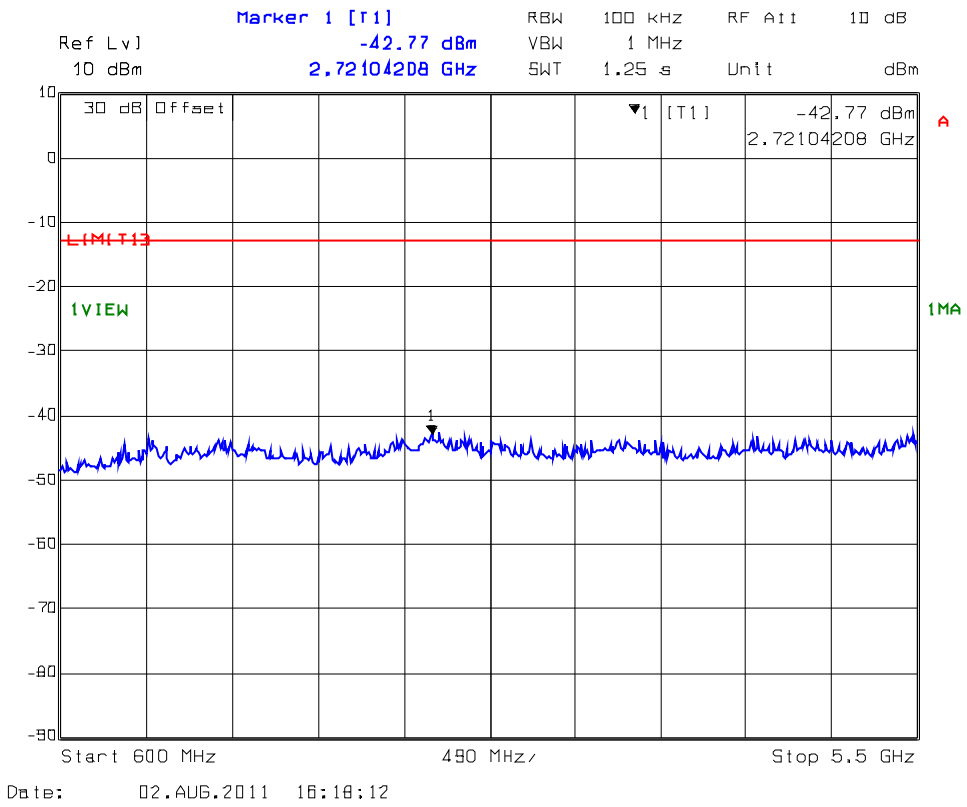
Remarks:

- The RF emissions were scanned with all different modulations and there was no discernable difference in the spurious emissions between the different modulation types. Therefore, the final tests were only performed without modulation and it shall represent for all different modulations required.
- Single RF input will be tested to represent the worst case with highest input/output powers

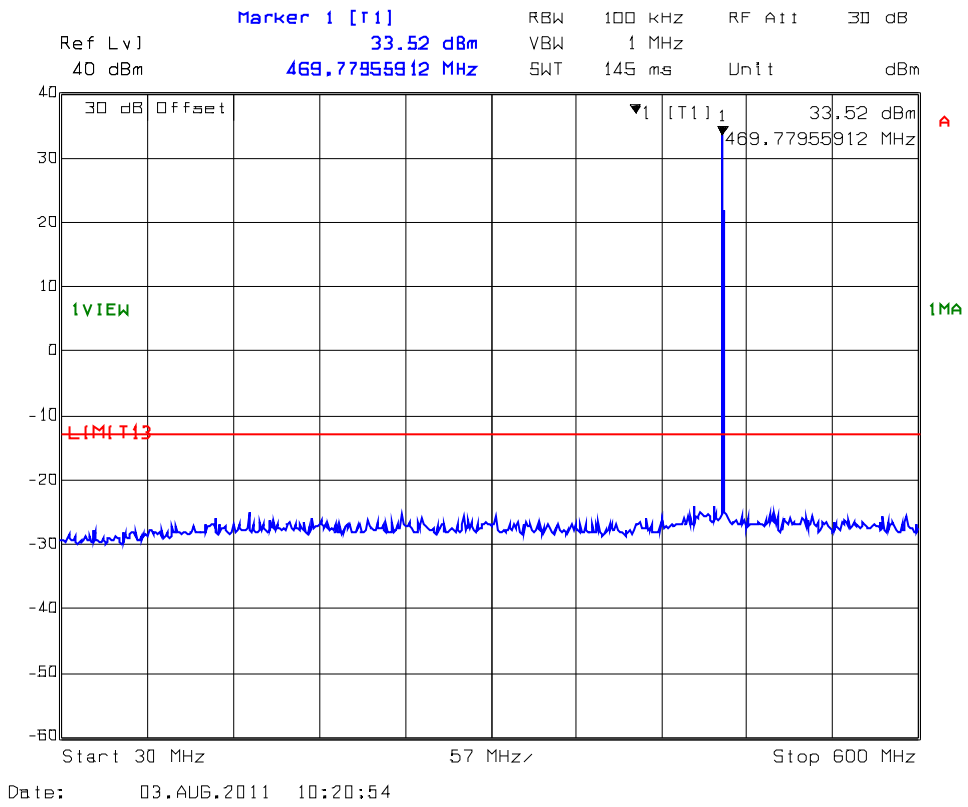
Plot 5.4.4.1. Conducted Transmitter Spurious Emissions for 451 MHz, 25 kHz Channel Spacing, 30 - 600 MHz



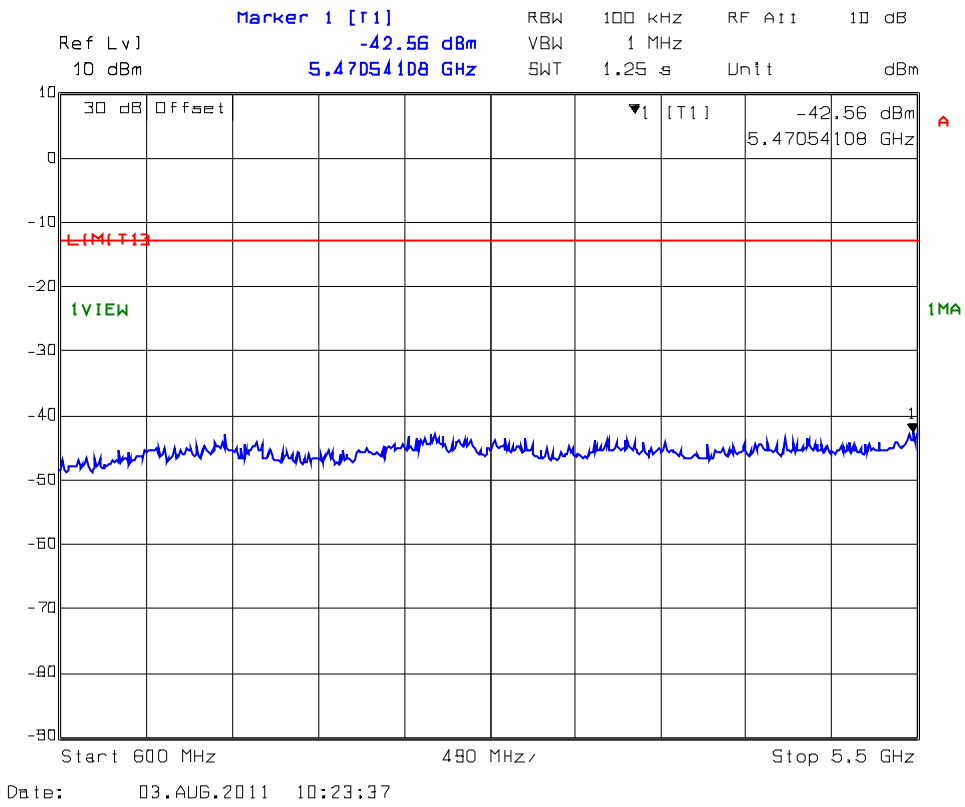
Plot 5.4.4.2. Conducted Transmitter Spurious Emissions for 451 MHz, 25 kHz Channel Spacing, 600 MHz - 5.5 GHz



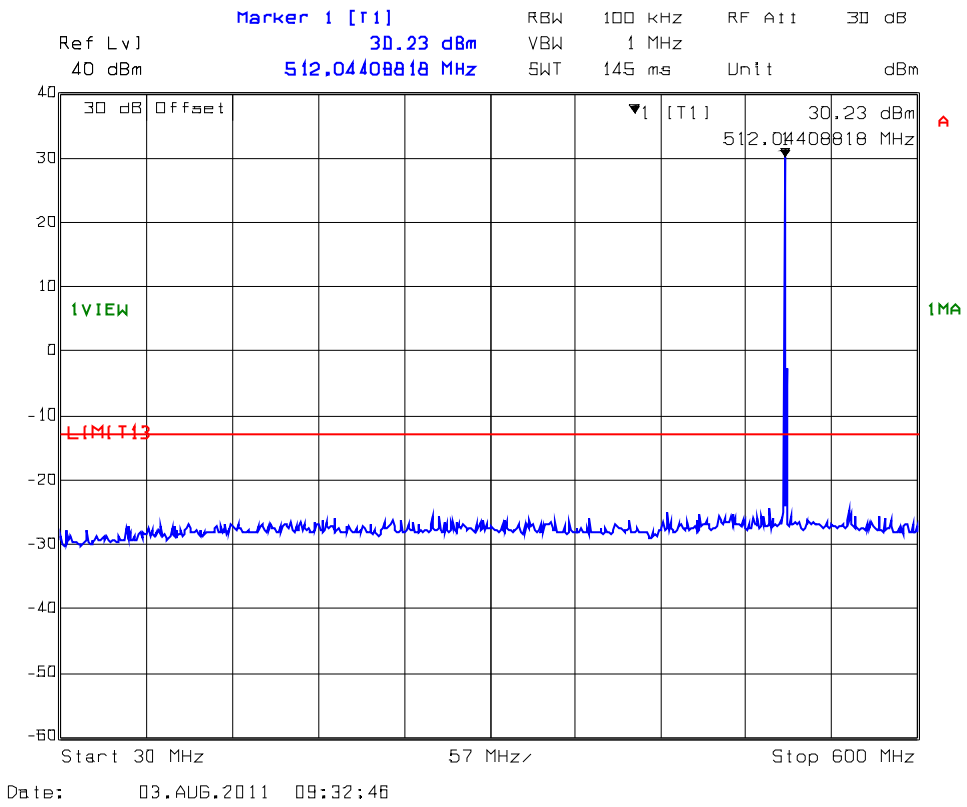
Plot 5.4.4.3. Conducted Transmitter Spurious Emissions for 469.9 MHz, 25 kHz Channel Spacing, 30 - 600 MHz



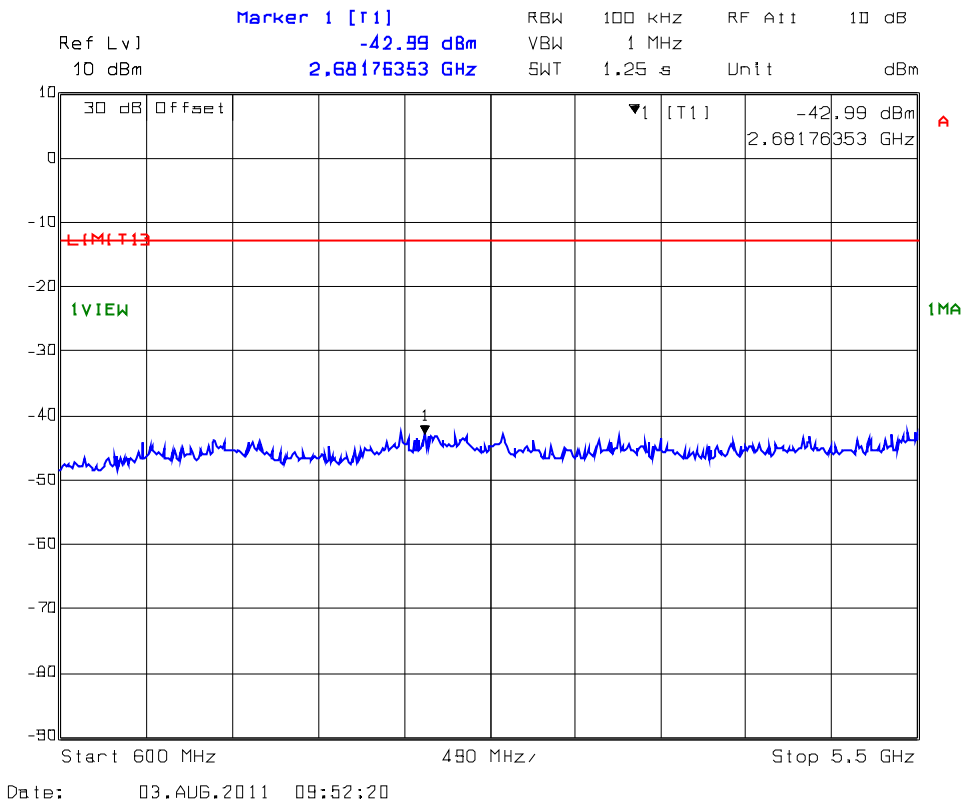
Plot 5.4.4.4. Conducted Transmitter Spurious Emissions for 469.9 MHz, 25 kHz Channel Spacing, 600 MHz - 5.5 GHz



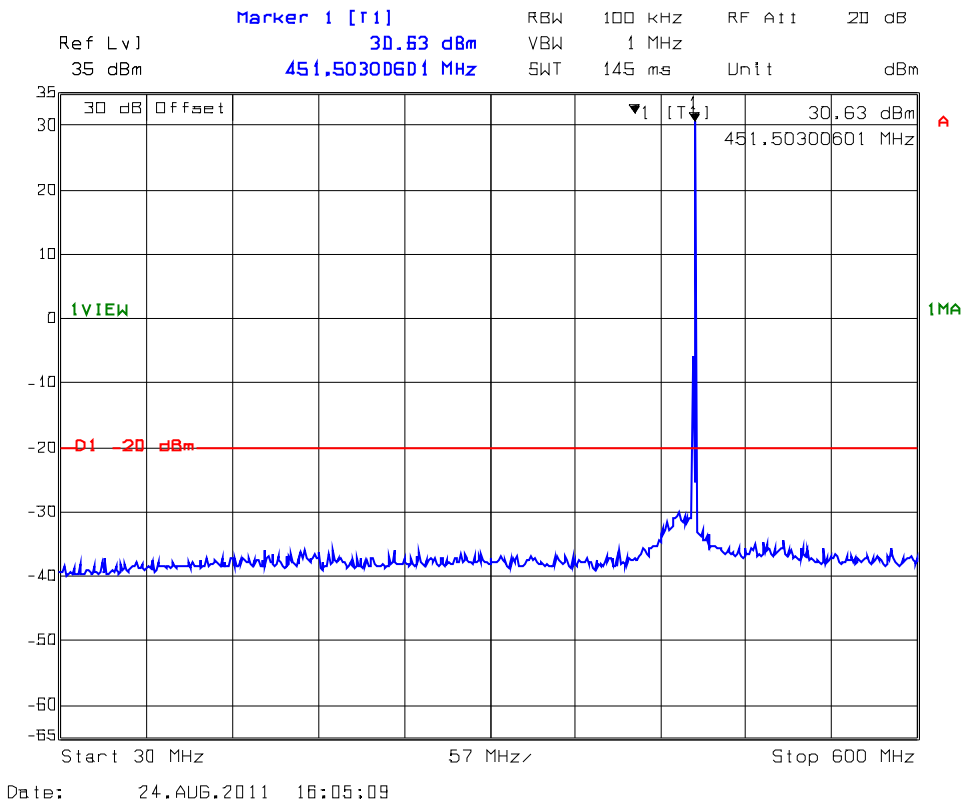
Plot 5.4.4.5. Conducted Transmitter Spurious Emissions for 511.9 MHz, 25 kHz Channel Spacing, 30 - 600 MHz



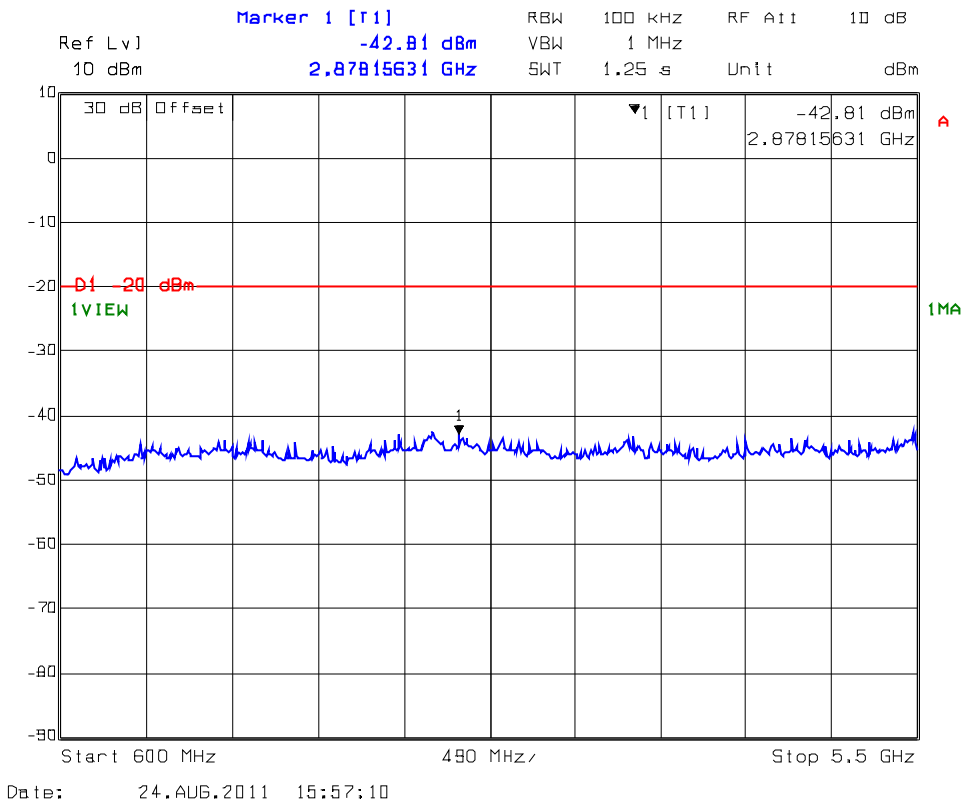
Plot 5.4.4.6. Conducted Transmitter Spurious Emissions for 511.9 MHz, 25 kHz Channel Spacing, 600 MHz - 5.5 GHz



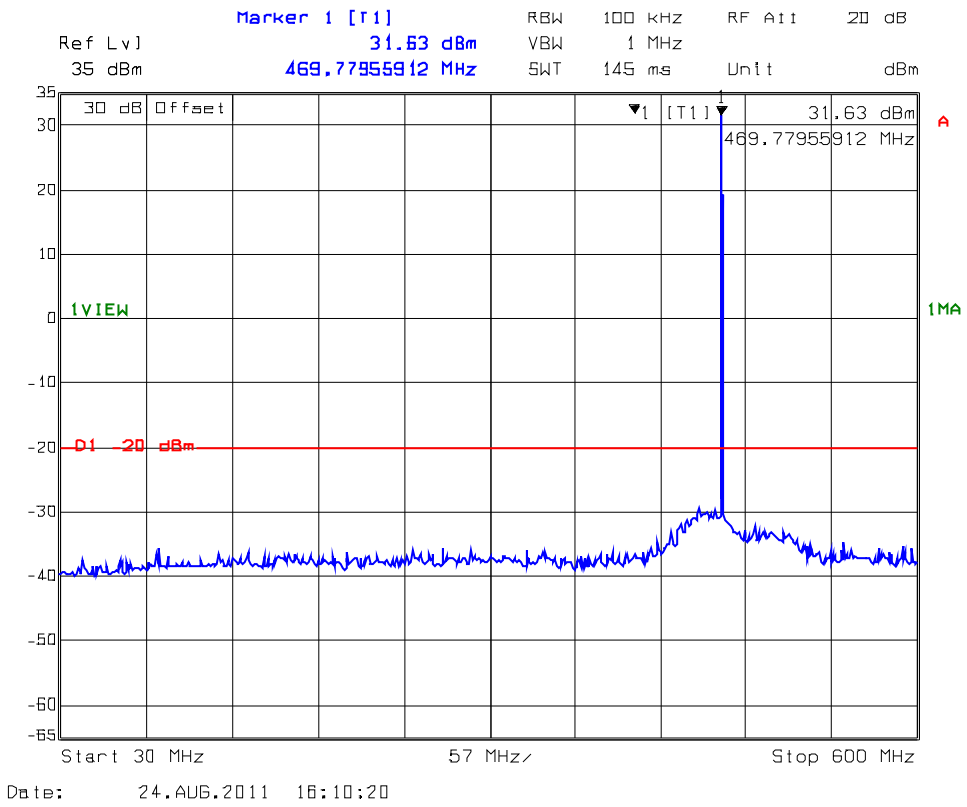
Plot 5.4.4.7. Conducted Transmitter Spurious Emissions for 451 MHz, 12.5 kHz Channel Spacing, 30 - 600 MHz



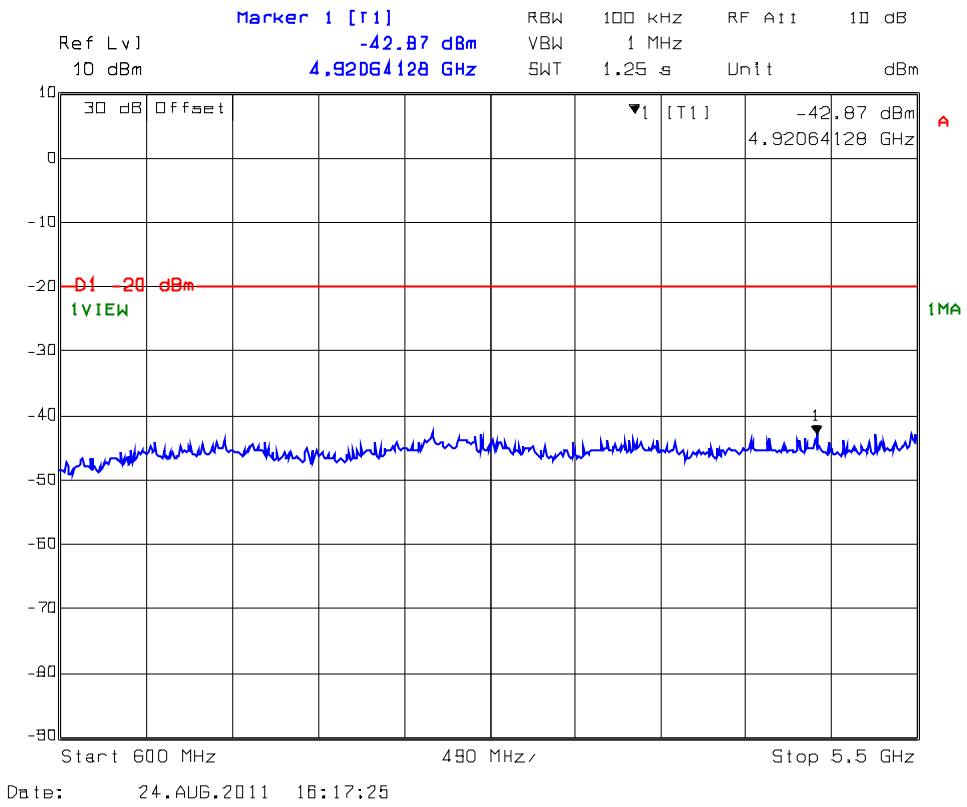
Plot 5.4.4.8. Conducted Transmitter Spurious Emissions for 451 MHz, 12.5 kHz Channel Spacing, 600 MHz - 5.5 GHz



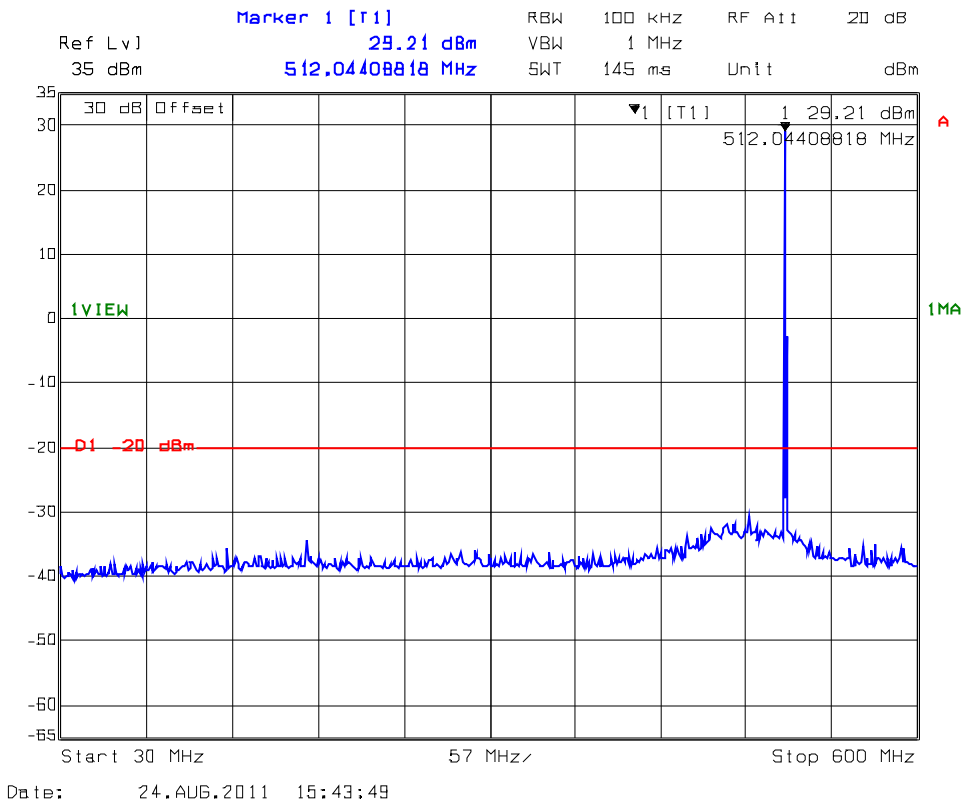
Plot 5.4.4.9. Conducted Transmitter Spurious Emissions for 469.9 MHz, 12.5 kHz Channel Spacing, 30 - 600 MHz



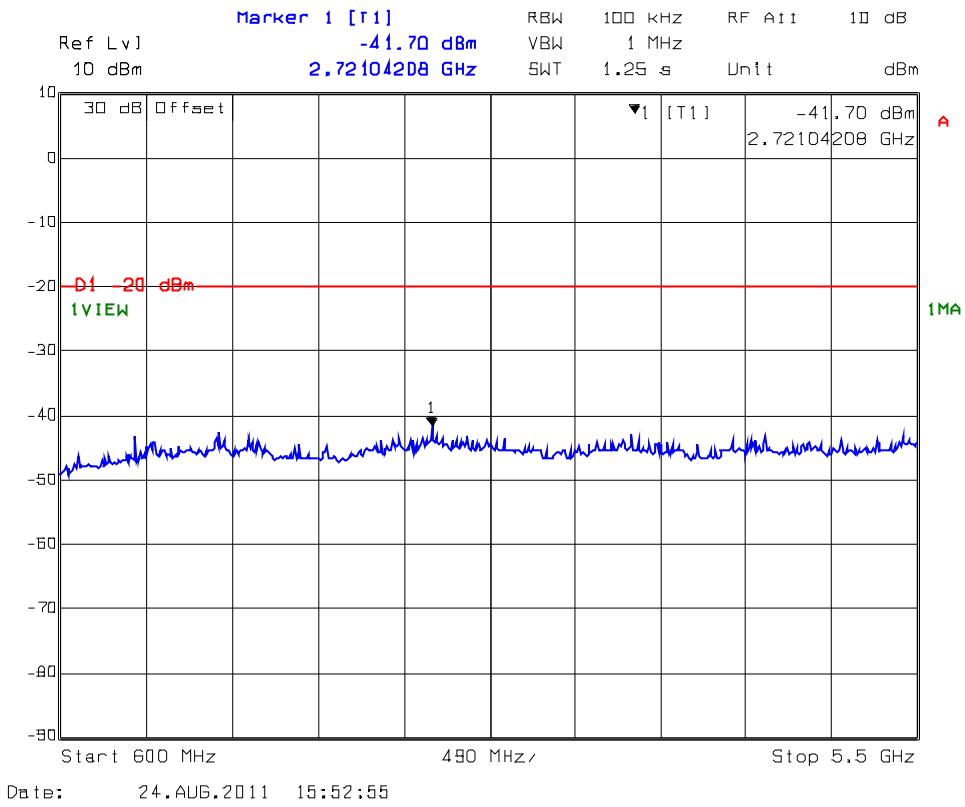
Plot 5.4.4.10. Conducted Transmitter Spurious Emissions for 469.9 MHz, 12.5 kHz Channel Spacing, 600 MHz - 5.5 GHz



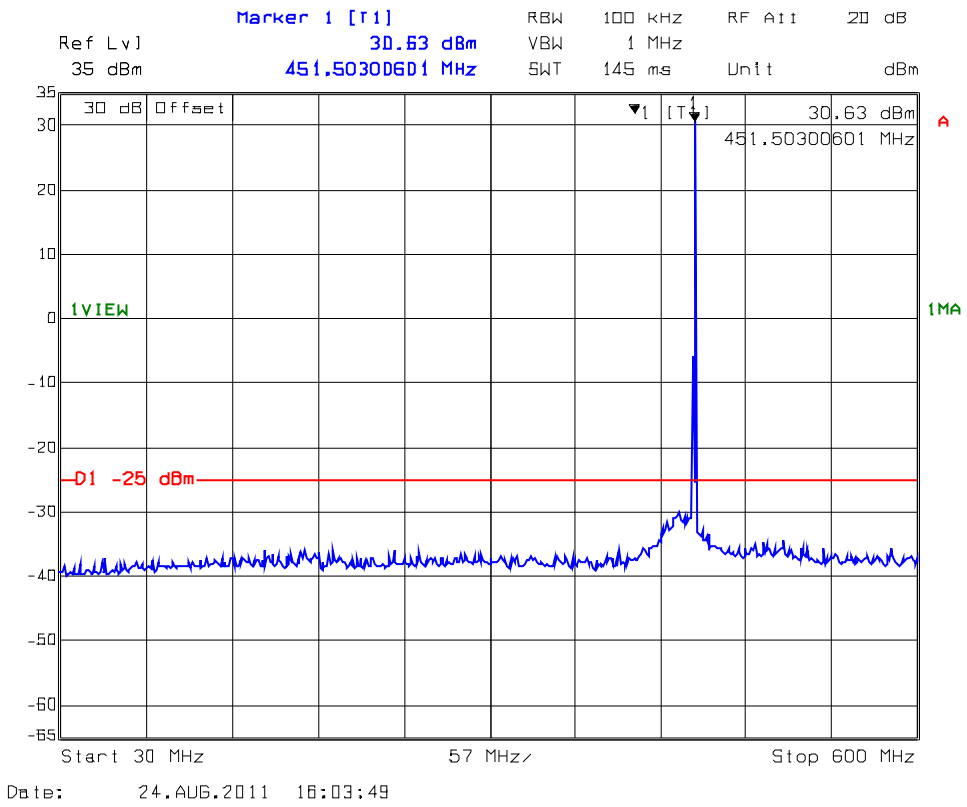
Plot 5.4.4.11. Conducted Transmitter Spurious Emissions for 511.9 MHz, 12.5 kHz Channel Spacing, 30 - 600 MHz



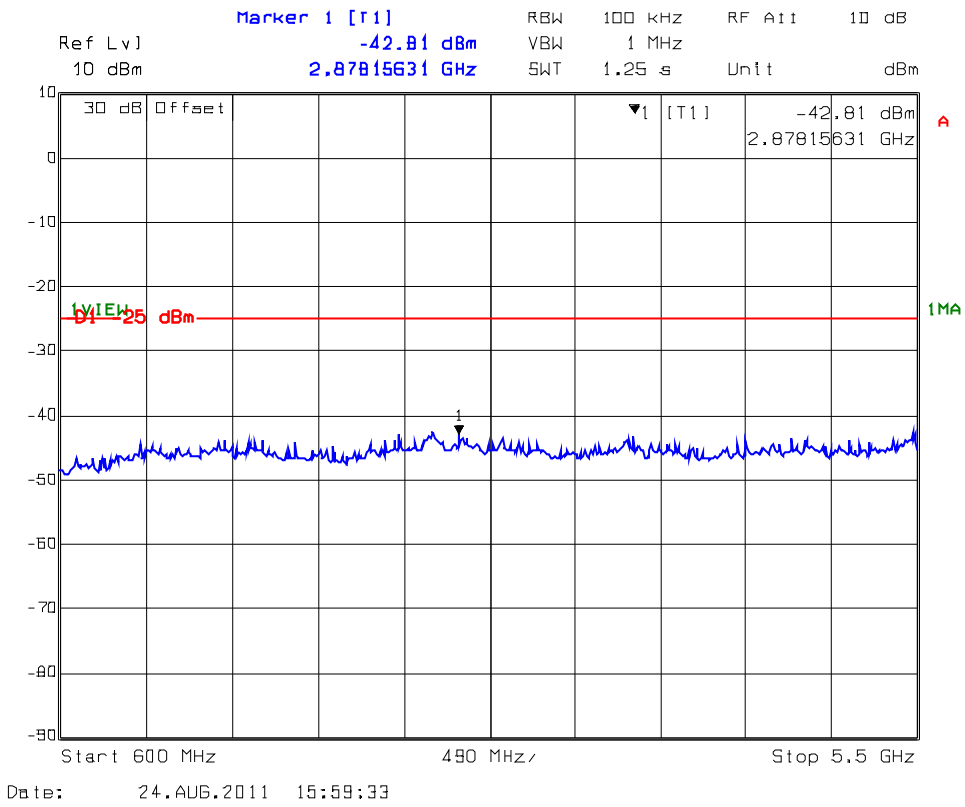
Plot 5.4.4.12. Conducted Transmitter Spurious Emissions for 511.9 MHz, 12.5 kHz Channel Spacing, 600 MHz - 5.5 GHz



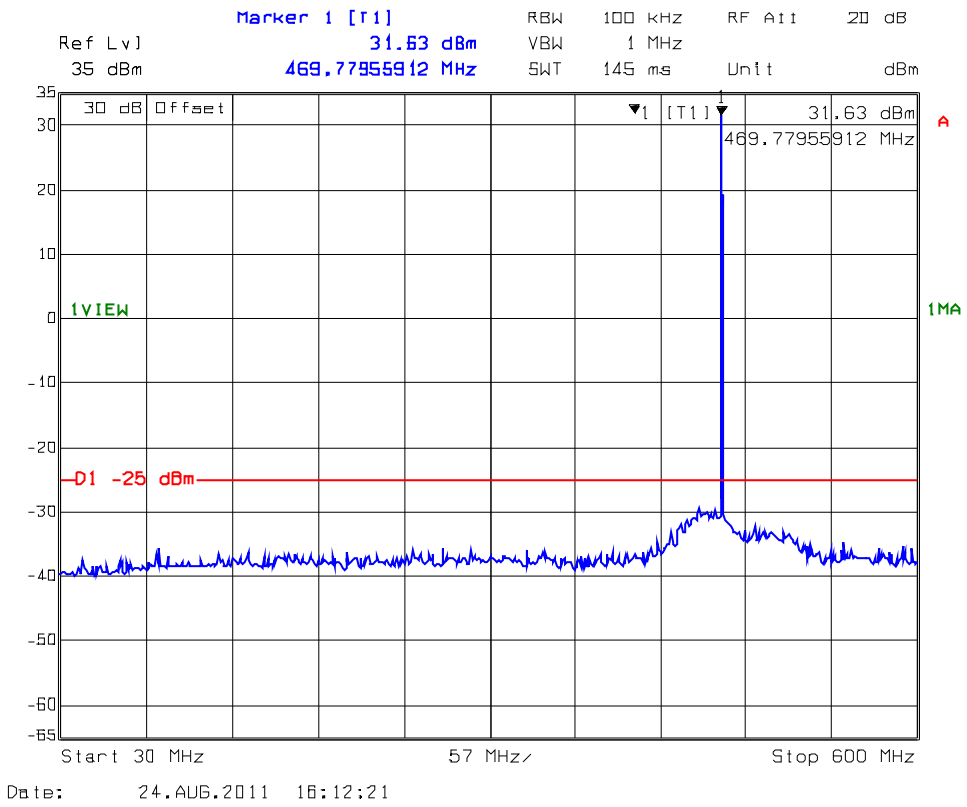
Plot 5.4.4.13. Conducted Transmitter Spurious Emissions for 451 MHz, 6.25 kHz Channel Spacing, 30 - 600 MHz



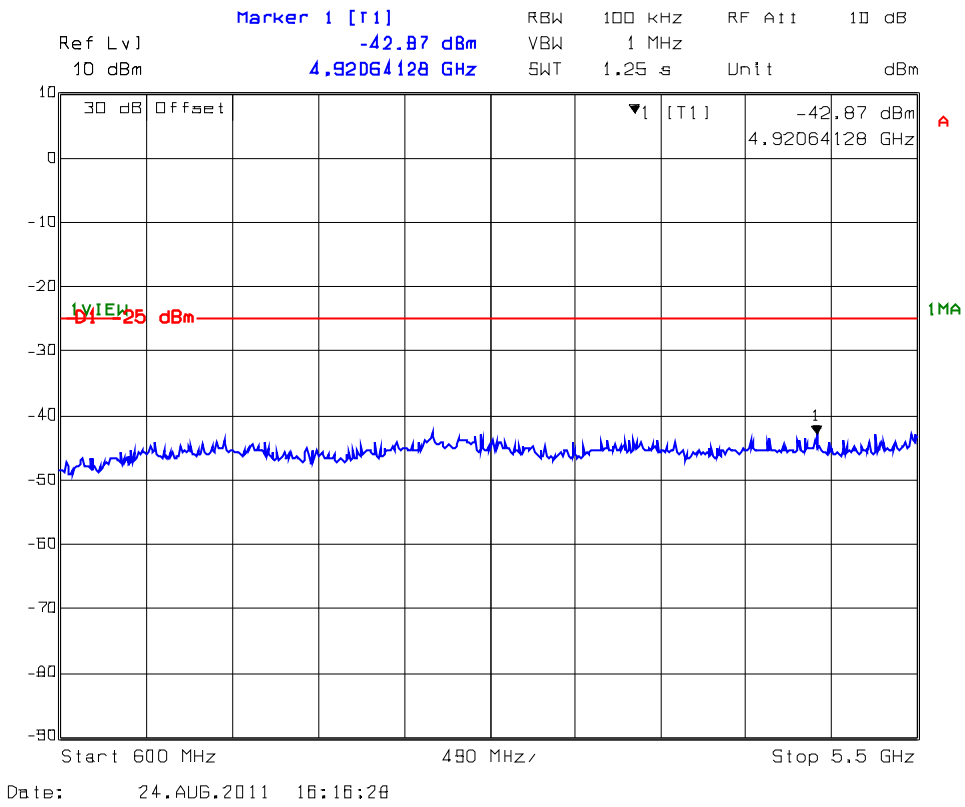
Plot 5.4.4.14. Conducted Transmitter Spurious Emissions for 451 MHz, 6.25 kHz Channel Spacing, 600 MHz - 5.5 GHz



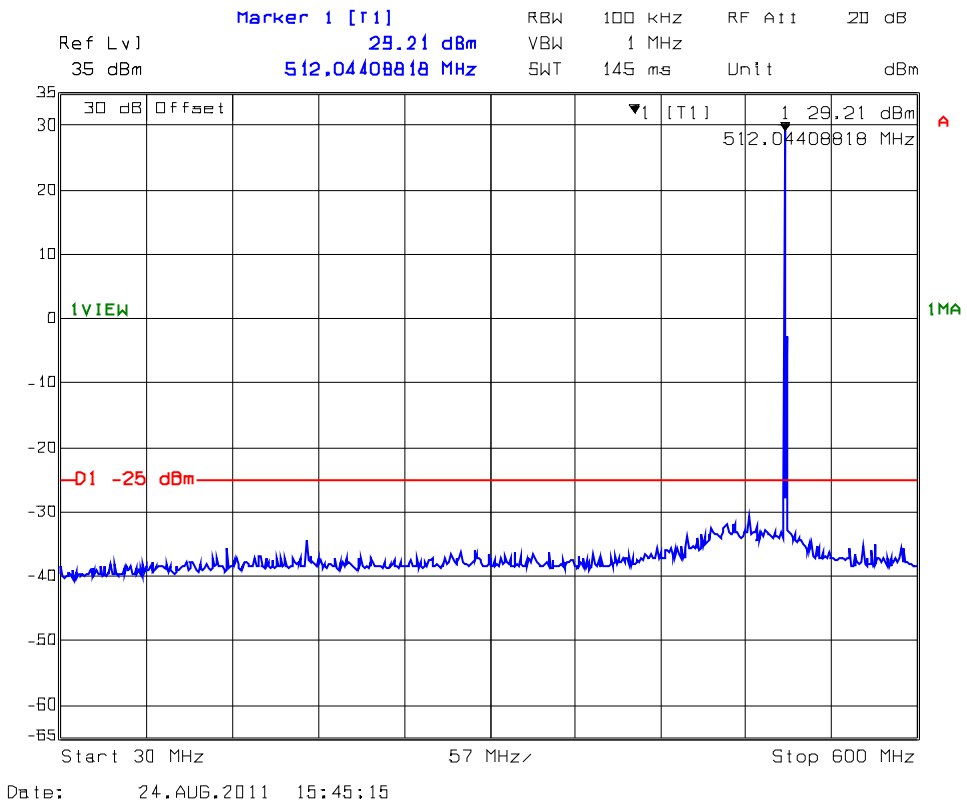
Plot 5.4.4.15. Conducted Transmitter Spurious Emissions for 469.9 MHz, 6.25 kHz Channel Spacing, 30 - 600 MHz



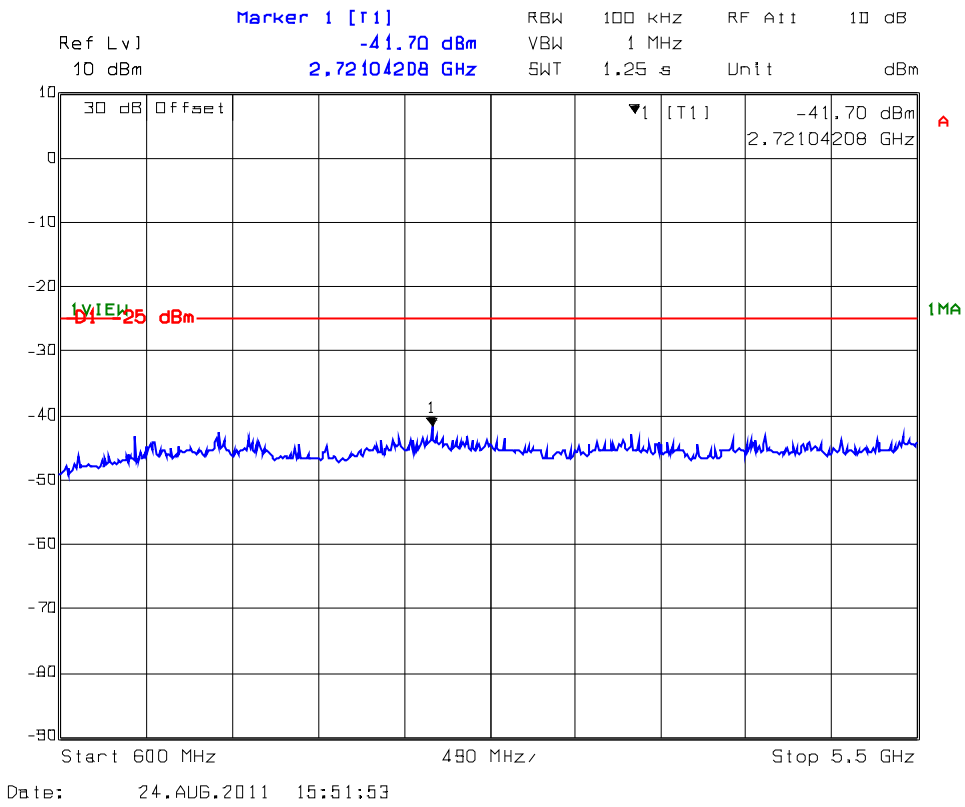
Plot 5.4.4.16. Conducted Transmitter Spurious Emissions for 469.9 MHz, 6.25 kHz Channel Spacing, 600 MHz - 5.5 GHz



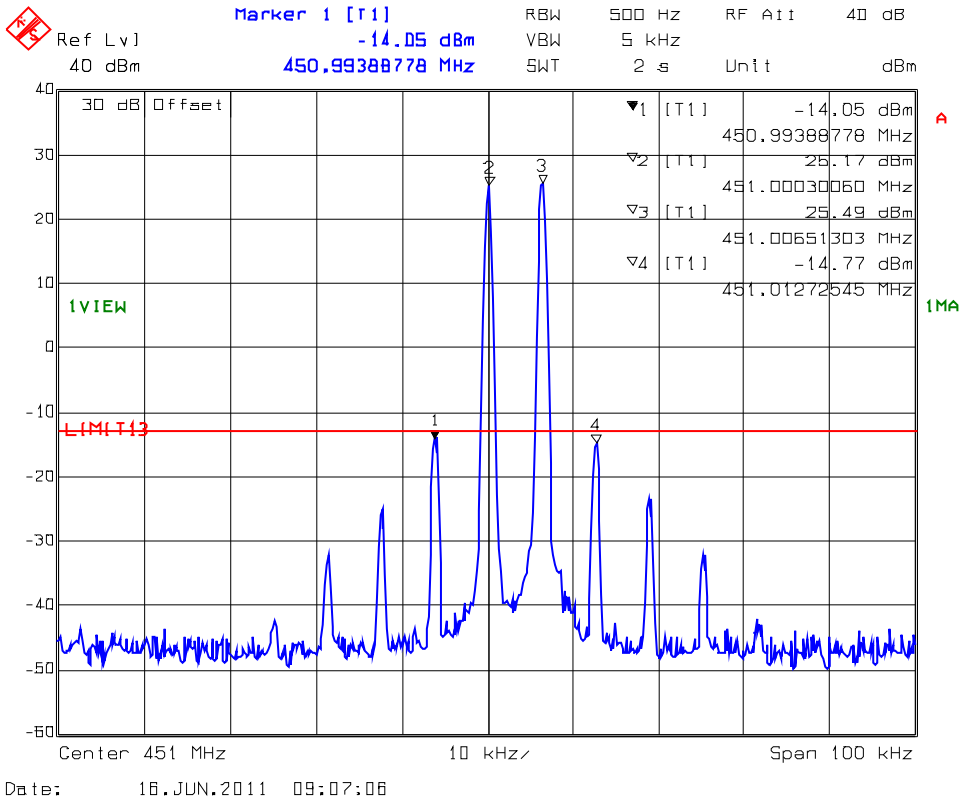
Plot 5.4.4.17. Conducted Transmitter Spurious Emissions for 511.9 MHz, 6.25 kHz Channel Spacing, 30 - 600 MHz



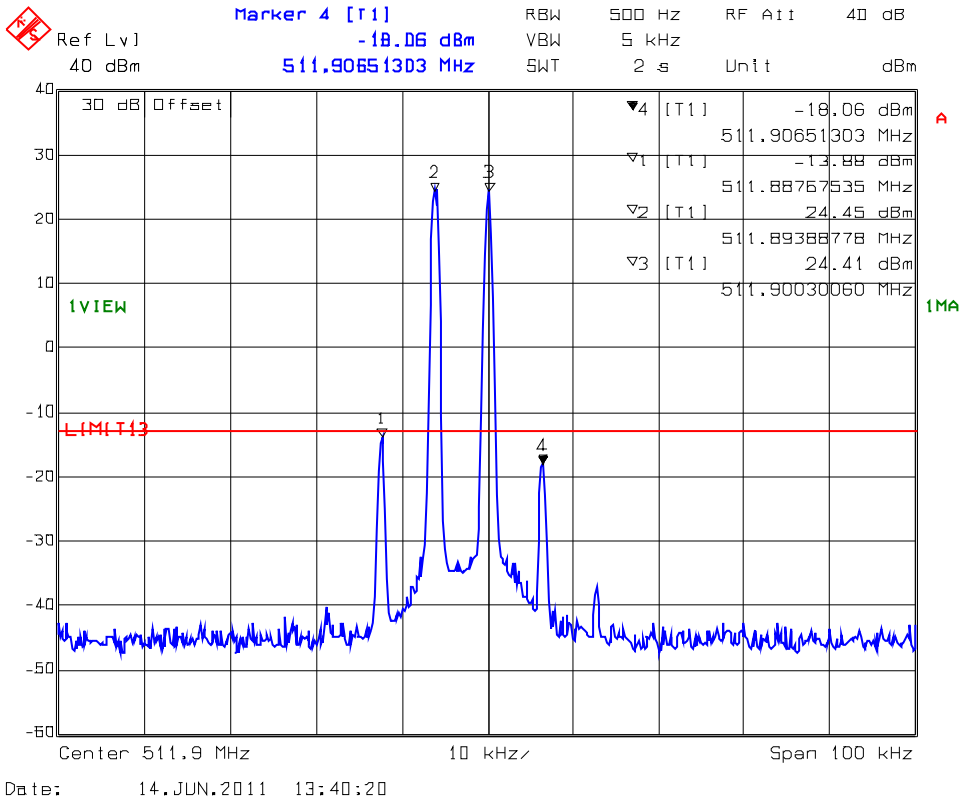
Plot 5.4.4.18. Conducted Transmitter Spurious Emissions for 511.9 MHz, 6.25 kHz Channel Spacing, 600 MHz - 5.5 GHz



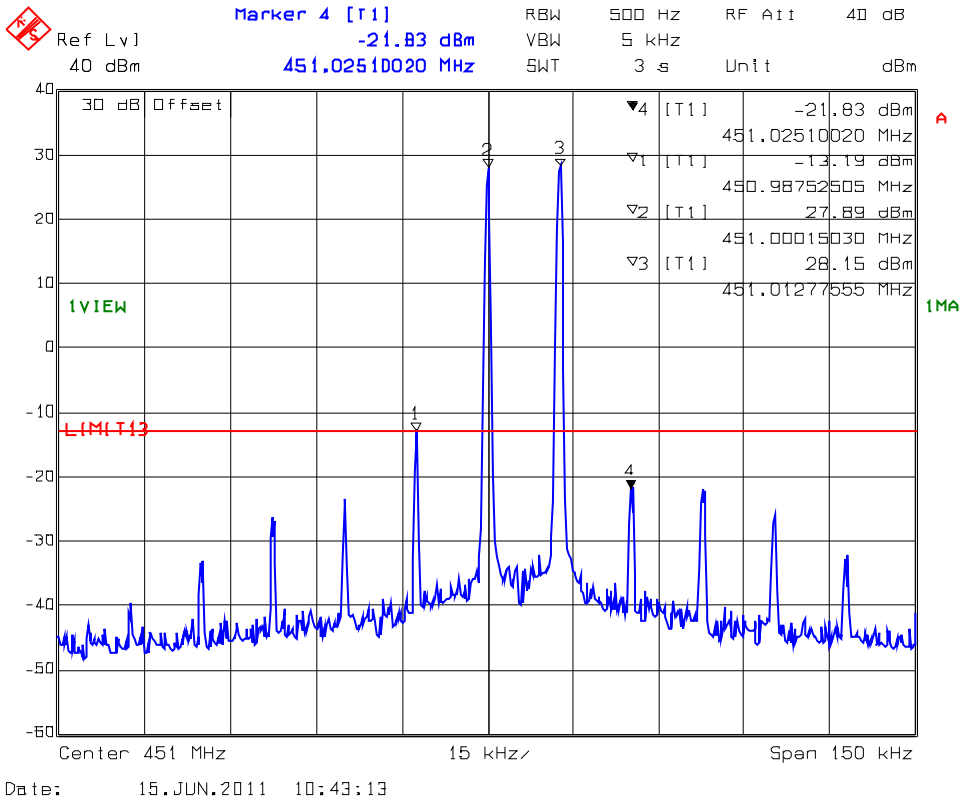
Plot 5.4.4.19. Intermodulation, Two Signals at Lower Edge of Passband for 6.25 kHz Channel Spacing
Input Signals: 451 MHz at -39.88 dBm and 451.00625 MHz at -39.63 dBm



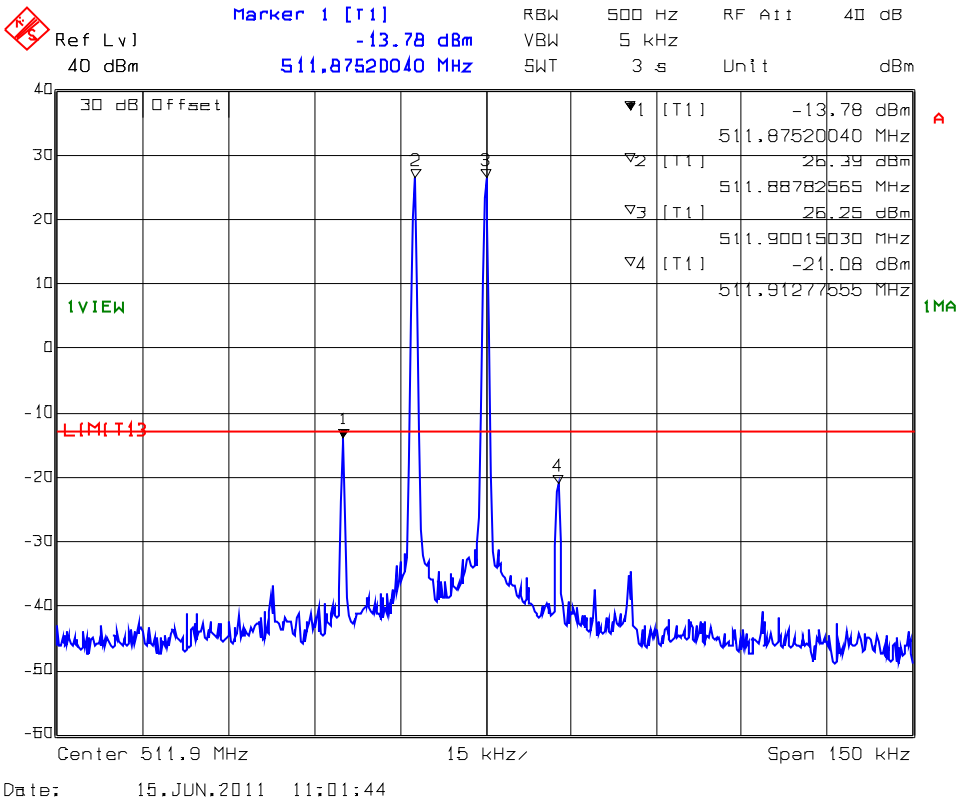
Plot 5.4.4.20. Intermodulation, Two Signals at Upper Edge of Passband for 6.25 kHz Channel Spacing
Input Signals: 511.9 MHz at -39.77 dBm and 511.89375 MHz at -40.01 dBm



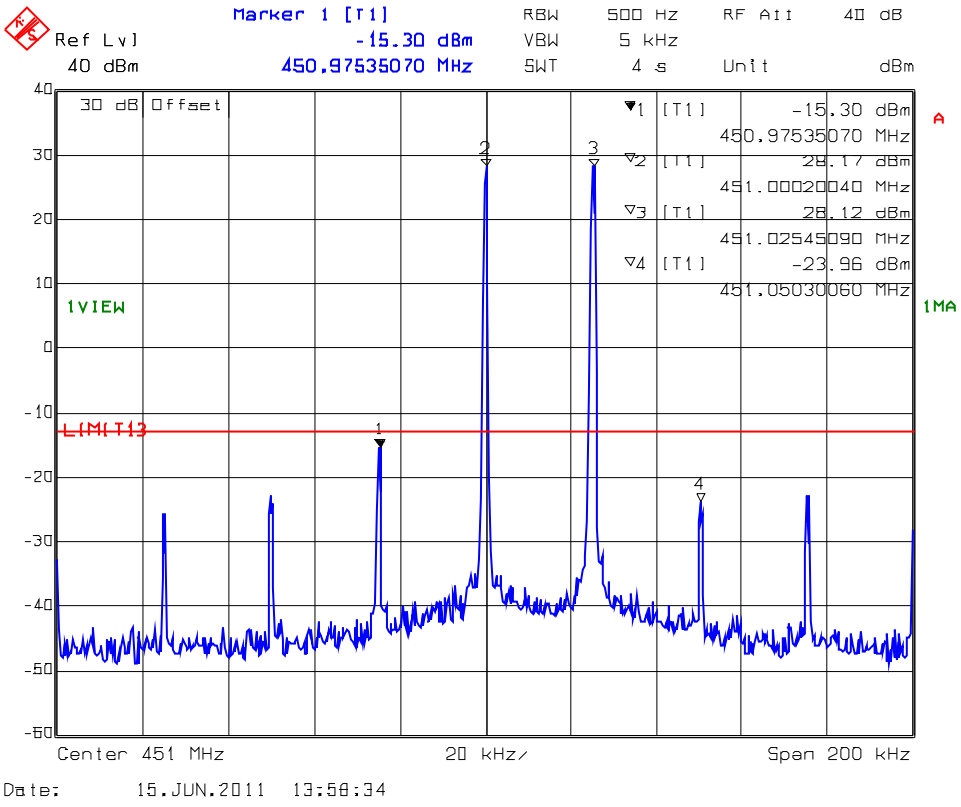
Plot 5.4.4.21. Intermodulation, Two Signals at Lower Edge of Passband for 12.5 kHz Channel Spacing
Input Signals: 451 MHz at -39.90 dBm and 451.0125 MHz at -39.91dBm



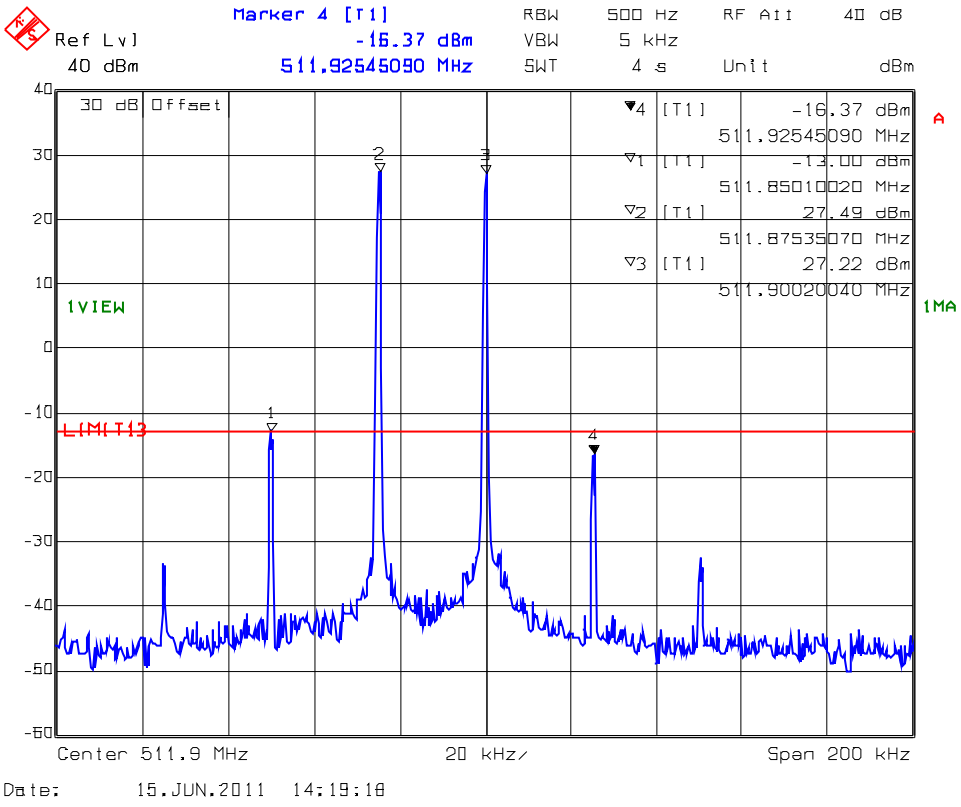
Plot 5.4.4.22. Intermodulation, Two Signals at Upper Edge of Passband for 12.5 kHz Channel Spacing
Input Signals: 511.9 MHz at -39.46 dBm and 511.8875 MHz at -39.96 dBm



Plot 5.4.4.23. Intermodulation, Two Signals at Lower Edge of Passband for 25 kHz Channel Spacing
Input Signals: 451.0 MHz at -39.90 dBm and 451.025MHz at -39.91dBm



Plot 5.4.4.24. Intermodulation, Two Signals at Upper Edge of Passband for 25 kHz Channel Spacing
Input Signals: 511.9 MHz at -39.46 dBm and 511.875 MHz at -39.96 dBm



5.5. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 90.210, 2.1057 & 2.1051]

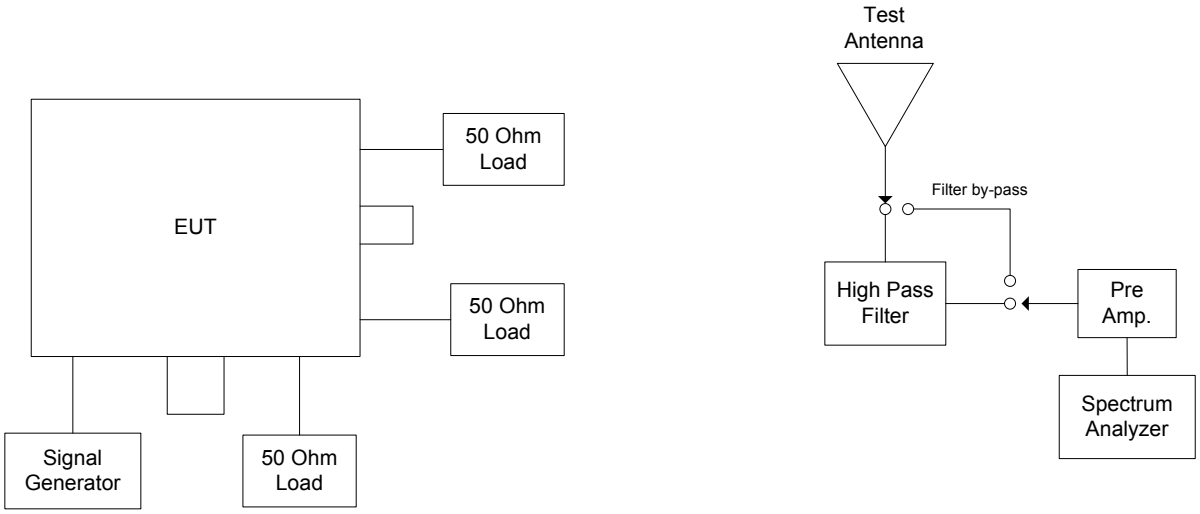
5.5.1. Limits

§ 90.219 (c) Class A narrowband boosters must meet the out-of-band emission limits of § 90.210 for each narrowband channel that the booster is designed to amplify. Class B broadband signal boosters must meet the emission limits of § 90.210 for frequencies outside of the booster's designed passband.

5.5.2. Method of Measurements

The test shall be performed using substitution method specified in TIA-603-C.

5.5.3. Test Arrangement



5.5.4. Test Data

Remarks:

- The RF spurious/harmonic emission characteristics for different channel spacing are similar. Therefore, the following radiated emissions were performed at 25 kHz channel spacing and the results were compared with the more stringent limit for the worst-case.
- The radiated emissions were performed at high power setting with single RF input signal at 3 m distance to represents the worst-case test configuration.
- The emissions were scanned from at least 30 MHz to 10th harmonics; all spurious emissions that are in excess of 20dB below the specified limit shall be recorded.

5.5.4.1. Near Lowest Frequency (451 MHz)

Test Frequency (MHz): 451
Limit (dBm): -25

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	V/H	*	-25	*

* Spurious emissions are more than 20dB below the specified limit.

5.5.4.2. Near Middle Frequency (469.9 MHz)

Test Frequency (MHz): 469.9
Limit (dBm): -25

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	V/H	*	-25	*

* Spurious emissions are more than 20dB below the specified limit.

5.5.4.3. Near Highest Frequency (511.9 MHz)

Test Frequency (MHz): 511.9
Limit (dBm): -25

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured (dBm)	Limit (dBm)	Margin (dB)
30-6000	*	Peak	V/H	*	-25	*

* Spurious emissions are more than 20dB below the specified limit.

5.6. RF EXPOSURE REQUIRMENTS @ 1.1310 & 2.1091

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.6.1. Method of Measurements

Refer to Sections 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot r^2} = \frac{EIRP}{4 \cdot \pi \cdot r^2}$$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.6.2. RF Evaluation

EVALUATION OF RF EXPOSURE COMPLIANCE REQUIREMENTS	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: ***46.7 cm**	Manufacturer' instruction for separation distance between antenna and persons required: **66 cm.**
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

S = 450/1500 mW/cm^2
EIRP = $P_{(Max.\ ERP\ permitted)}$ + 2.15 dB = 37 dBm + 2.15 dB = 39.15 dBm = 8222 mW (Worst Case)

(Minimum Safe Distance, r) = $\sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{8222}{4 \cdot \pi \cdot (450/1500)}} \approx 46.7cm$

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK	834157/005	9 KHz – 40 GHz	18 Jul 2012
Attenuator (20dB)	Aeroflex/Weinschel	46-30-34	BR9127	DC-18 GHz	Cal on use
High Pass Filter	Mini Circuit	SHP 250	--	Cut off 230 MHz	Cal on use
Power Meter	Hewlett Packard	437B	3125U06665	100K--50G sensor dependent	24 Aug 2012
Power Sensor	Hewlett Packard	8481A	US37295684	0.1 - 18 GHz	27 Aug 2011
Modulation Analyzer	Hewlett Packard	8901B	3226A04606	150KHz-1300MHz	17 Dec 2011
Frequency Counter	EIP	545A	2683	10Hz - 18 GHz	31 Jan 2012
Combiner	Mini Circuit	ZFSC-3-4	15542	1MHz - 1GHz	Cal on use
RF Detector	Pasternack	PE8000-50	--	10M--1G Hz	Cal on use
Infinium Digital Oscilloscope	Hewlett-Packard	54801A	US38380192	DC--500M Hz 1G sampling	27 May 2012
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177 degree C	11 Aug 2012
RF Synthesized signal Generator	HP	8648C	3343U00391	100K-3200M Hz AM/ FM/ PM	16 Dec 2011
Power supply	Tenma	72-7295	490300297	1-40V DC 5A	Cal on use
FFT Digital Spectrum Analyzer	Advantest	R9211E	8202336	10mHz--100KHz	12 Nov 2011
RF Communication Test Set	Hewlett Packard	8920B	US39064699	30MHz-1GHz	27 Oct 2012
Horn antenna	ETS-LINDGREN	3117	119425	1-18GHz	15 Feb 2012
Preamplifier	Hewlett Packard	8449B	3008A00769	1-26.5GHz	17 Feb 2012
High Pass Filter	Mini Circuit	SHP 600	--	Cut off 560 MHz	Cal on use
Power supply	XANTREX	XKW 60-50	26509	0-60V 0-50A DC	Cal on use
Attenuator (20dB)	narda	26298	A577	DC-1GHz 150W	Cal on use
Attenuator (10dB)	Aeroflex/Weinschel	46-10-34	BS4336	DC-18 GHz	Cal on use
Attenuator (3dB)	Weinschel	2	A86-4204	DC-12GHz	Cal on use
Synthesized Sweeper	Hewlett Packard	83752B	3610A00457	0.01-20GHz	19 Oct 2011
Signal Generator	IFR	2025	202304/141	9 kHz – 2.51 GHz	16 Nov 2011
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3710A00223	9 kHz - 22 GHz	25 Apr 2012
Attenuator	Pasternack	PE7010-20	--	DC – 2 GHz	08 Jan 2012
L.I.S.N.	EMCO	3825/2	8907-1531	10 kHz – 100 MHz	30 Mar 2012
Log Periodic Antenna	ETS	93148	1101	200 MHz – 2 GHz	04 Jan 2012
Horn Antenna	EMCO	3115	9701-5955	1 GHz – 18 GHz	09 Jan 2012

- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (150 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.57**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.14**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.15**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.30**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	Under consideration
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	Under consideration