GENERAL DYNAMICS
C4 Systems

Exhibit 6 – Test Report

General Dynamics C4 Systems

PathMaker Network Radio

FCC ID: MIJPNR-1000

Model No. PNR-1000

Equipment Applicant: **General Dynamics C4 Systems**
8220 E. Roosevelt St.
Scottsdale, Arizona 85257

Tests Conducted By: **General Dynamics C4 Systems**
EMC Test Facility
8201 E. McDowell Rd.
Scottsdale, Arizona 85257

Test Summary: **Complies with FCC Part 15, Subpart C, Unlicensed Transmitter**

The General Dynamics EMC Laboratory is accredited through the

NVLAP®

NVLAP Lab Code 100405-0

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TEST SUMMARY SHEET

Specification Requirement	Test Performed	Test Results (Pass/Fail)
6dB Emission Bandwidth	47 CFR 15.247(a)(2)	Pass
Maximum Conducted Output Power	47 CFR 15.247(b)(3)	Pass
Power Spectral Density	47 CFR 15.247(e)	Pass
Conducted Spurious Emissions	47 CFR 15.247(d)	Pass
Radiated Spurious Emissions including Restricted Bands of Operation	47 CFR 15.247(d) and 15.209(a)	Pass

The laboratory is accredited by NIST NVLAP for the standard FCC Radiated Emissions test methods. The other tests are non-standard, RF Characteristic, tests required only for this specific type of intentional radiator. The test results shown in this report are only valid for the specific item tested. Other units may have different results.

It is the policy of the General Dynamics EMC Laboratory to provide uncertainty data sheets for all compliance related measurements. Table 1 of CISPR 16-4-2 defines an upper limit on expanded uncertainty (U_{CISPR}) of 5.2dB for radiated emissions from 30MHz to 1GHz. The General Dynamics EMC Lab has an expanded uncertainty (U_{LAB}) of 3.91dB for radiated emissions. According to CISPR 16-4-2, if U_{LAB} is less than U_{CISPR}, then demonstration of compliance to the limits does not require an additional safety margin to account for measurement uncertainty. For all tests other tests, the test limits as defined by the appropriate standards organizations are assumed to already include a reasonable amount of uncertainty built into the limits to account for measurement uncertainty and therefore, demonstration of compliance to the limits does not require an additional safety margin to account for measurement uncertainty.

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

1.1 INTRODUCTION

This document describes the applicable Federal Communications Commission (FCC) certification tests conducted on the PathMaker Network Radio. This product complies with the requirements and associated test limits of 47 CFR Part 15.247 (Subpart C) for an Intentional Radiator. The majority of the testing was performed from October 12th to November 8th, 2011. Some additional testing was performed on March 2nd, 2012 to verify a few measurements related upper channel frequency restrictions. The list of equipment tested is shown in Table 2.2-1.

1.2 APPLICABLE RULES

The PathMaker Network Radio has been categorized as an intentional radiator operating in the unlicensed Industrial, Scientific, and Medical (ISM) frequency band. This ISM band is authorized for use by specific low power, short range, devices. Thus, the PathMaker Network Radio must meet the following FCC Rules and Regulations.

47 CFR Part 15, Subpart C	Title 47, Telecommunications; Code of Federal Regulations (CFR), Part 15--Radio Frequency Devices; Subpart C -- Intentional Radiators
ANSI C63.4 - 2003	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
ANSI C63.10 - 2009	American National Standard for Testing Unlicensed Wireless Devices

1.3 TEST METHODOLOGY

The specifications listed in the previous section were used to perform the required radiated and conducted emissions testing. Radiated emissions' testing was performed at a test distance of 3 meters.

1.4 TEST FACILITY

The testing was performed at General Dynamics C4 Systems (GDC4S), EMC/TEMPEST Test Laboratory which is located in the southeast wing of the Hayden building at 8201 E. McDowell Road, Scottsdale, AZ.

The GDC4S EMC test facility includes a certified three-meter and ten-meter Open Area Test Site (OATS) and several shielded enclosures. The facility has been found to be in compliance with the requirements of Section 2.948 of the FCC rules, per Registration Number 90811, dated July 27, 2010. The facility has also been issued a Certificate of Accreditation through the National Voluntary Laboratory Accreditation Program (NVLAP) by NIST. This is under NVLAP Code: 100405-0 and is effective through September 30, 2012. The facility is in compliance with all CISPR 16 requirements.

Listed below is the GDC4S EMC Test Facility address:

General Dynamics C4 Systems
Hayden EMC Facility, M/S H2550
8201 E. McDowell Rd.
Scottsdale, AZ 85257

1.5 QUALITY SYSTEM

The GDC4S EMI/TEMPEST Test Laboratory maintains a Quality Manual that describes the quality assurance program of the EMC/TEMPEST Facility to set forth procedures covering all quality assurance functions. This manual has been constructed to reflect a quality program in compliance with the requirements of the following:

- National Institute of Standards & Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP)
- NIST Handbook 150-11 (2007 Edition)
- ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

2.0 TEST SAMPLE DESCRIPTION

2.1 THEORY OF OPERATION

PathMaker Network Radios provide dynamic wireless, mobile, ad-hoc networking communications without reliance on network infrastructure. PathMaker Radio users become their own network, which makes the radios ideal for use in remote locations where no infrastructure exists or where the infrastructure has been destroyed or overloaded.

Where legacy network infrastructure exists, the PathMaker Network Radio System can take advantage of those networks by providing gateways, thereby increasing the network's footprint and reach. With a maximum of 32 radio users per network, users can form traditional squad communications groups, or extend range and coverage by connecting to multiple networks. Users can communicate privately (one to one), as a group (one to many), and have multiple private and group sessions.

The following diagram shows the basic system connectivity environment.

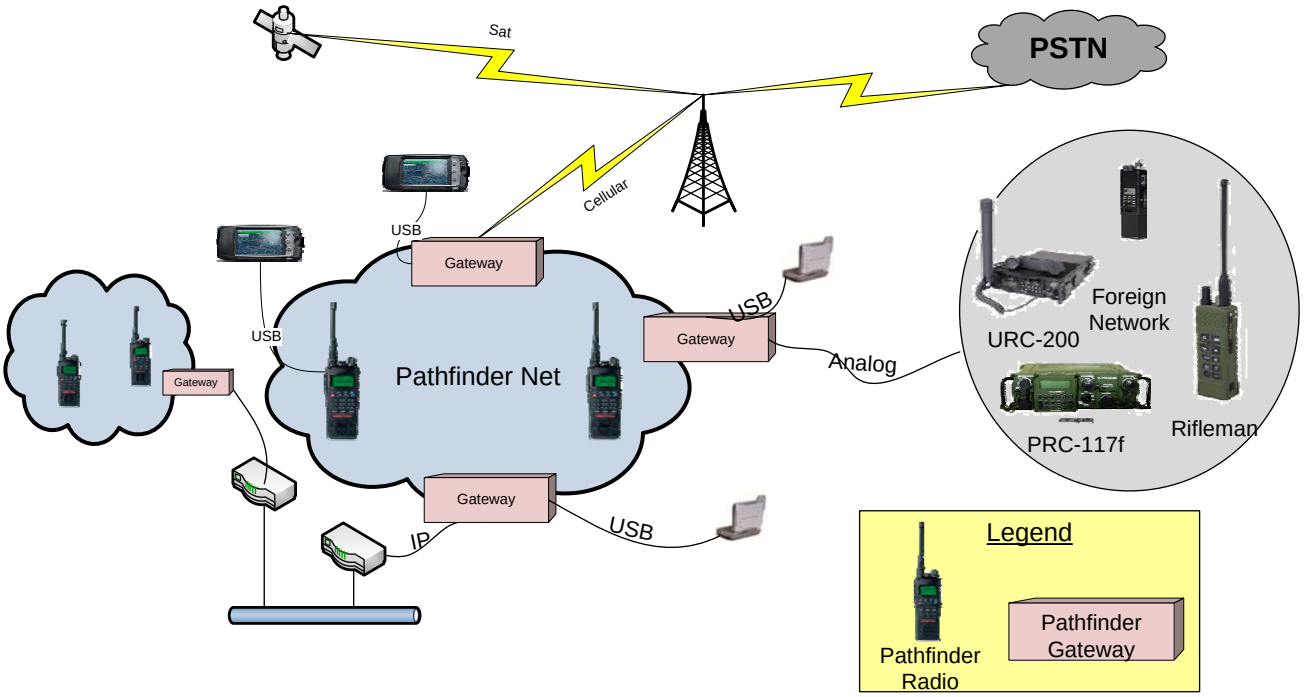


Figure 2.1-1 PathMaker Network Radio System Context Diagram

2.2 LIST OF EQUIPMENT TESTED

The PathMaker Network Radio was tested as a stand-alone unlicensed wireless device.

Table 2.2-1 PathMaker Network Radio Equipment Tested

Nomenclature	Hardware Version	Serial Number
PathMaker Network Radio	2.10	S/N ES0102
PathMaker Network Radio	2.28	S/N ES0215

3.0 TEST SETUP AND METHODOLOGY

3.1 SYSTEM TEST MODES AND CONFIGURATIONS

For all testing, the PathMaker was powered up and transmitting in either Channel 1, 20, or 38. For some of the testing, the radio was set to a continuous transmit mode with typical FSK digital modulation using the Maxtech Savion Suite Test software.

For a data mode configuration, the radio was also connected to a Dell Laptop Computer via the Universal Serial Bus (USB) interface and sending data packets to another PathMaker radio with maximum duty cycle. The radio was set using the Savion+ Wireless Network Interface Configuration Utility software.

3.2 PERIPHERALS AND INTERFACE CABLES

A Dell Laptop Computer was used to exercise the radio in data mode but is not part of the test article. A standard USB cable as supplied with the radio was used to connect to the laptop.

Table 3.2-1 Interface Cables

Cable	Length	Type
USB Cable	1.5 meter	Standard as Supplied

3.3 EQUIPMENT MODIFICATIONS

The PathMaker Network Radio was required to change the antenna connector from a standard SMA to a reverse thread SMA connector in order to meet the requirements of 47 CFR Part 15.203.

Additionally, a factory set channel restriction on the use of Channels 39 and 40 has been implemented into the radios. This restriction will be set prior to shipment in order to meet the band edge emissions requirements.

3.4 POWER REQUIREMENTS

The PathMaker Network Radios operate from a 7.4V rechargeable battery pack. The Entel CNB750E is an 1800mAh Lithium-ion lightweight battery pack for the HT series of hand portable radios.

3.5 DUTY CYCLE CORRECTION FACTOR FOR RADIATED EMISSIONS

The FCC regulations provide an allowance for correcting pulsed transmissions when the limits are expressed in terms of an average, and the average measurement may be derived from the peak pulse amplitude corrected for the duty cycle.

As detailed in 47 CFR Part 15.35(c), the correction factor of a transmission is a 100 ms capture of a characteristic pulse train of "on time". In the event that the pulse train is greater than 100 ms, the 100 ms pulse train captured must include a representation of worst-case "on time" pulses.

Since the pulse train for the PathMaker Radio is actually greater than 100 ms, the worst-case "on time" used for the duty cycle factor was taken from the pulse train characteristics illustrated in the following figures. The worst-case duty cycle occurs in data mode where the frames alternate between having three-pulse frames and having eight-pulse frames as shown in Figure 3.5-1.

The eight-pulse frame over 100 ms was used as the worst-case approximation of the duty cycle. The eight-pulse frame consists of one (1) pulse that is 0.8 ms wide and seven (7) pulses that are 1.1 ms wide. Figure 3.5-2 shows a close up plot of the 1.1 ms pulse. The detailed plot on the bottom right of Figure 3.5-1 illustrates the worst-case "on time" as a total of eight (8) pulses.

Therefore, the duty cycle correction factor, when expressed in dB, is calculated using the following formula:

$$\textit{Duty Cycle Correction Factor } \delta = \frac{(1\text{pulse} * 0.8\text{ms} + (7\text{pulses} * 1.1\text{ ms/pulse}))}{100\text{ ms}} = 8.5\%$$

$$\delta\,(\text{dB}) = 20 \log 0.085 = -21.4\text{ dB}$$

This procedure for calculating the average value of pulsed emissions is specified in the American National Standard (ANSI) for Testing Unlicensed Wireless Devices IEEE ANSI C63.10-2009, section 7.5, which is a recognized and accepted methodology by the FCC.

Pulse Train Characteristics

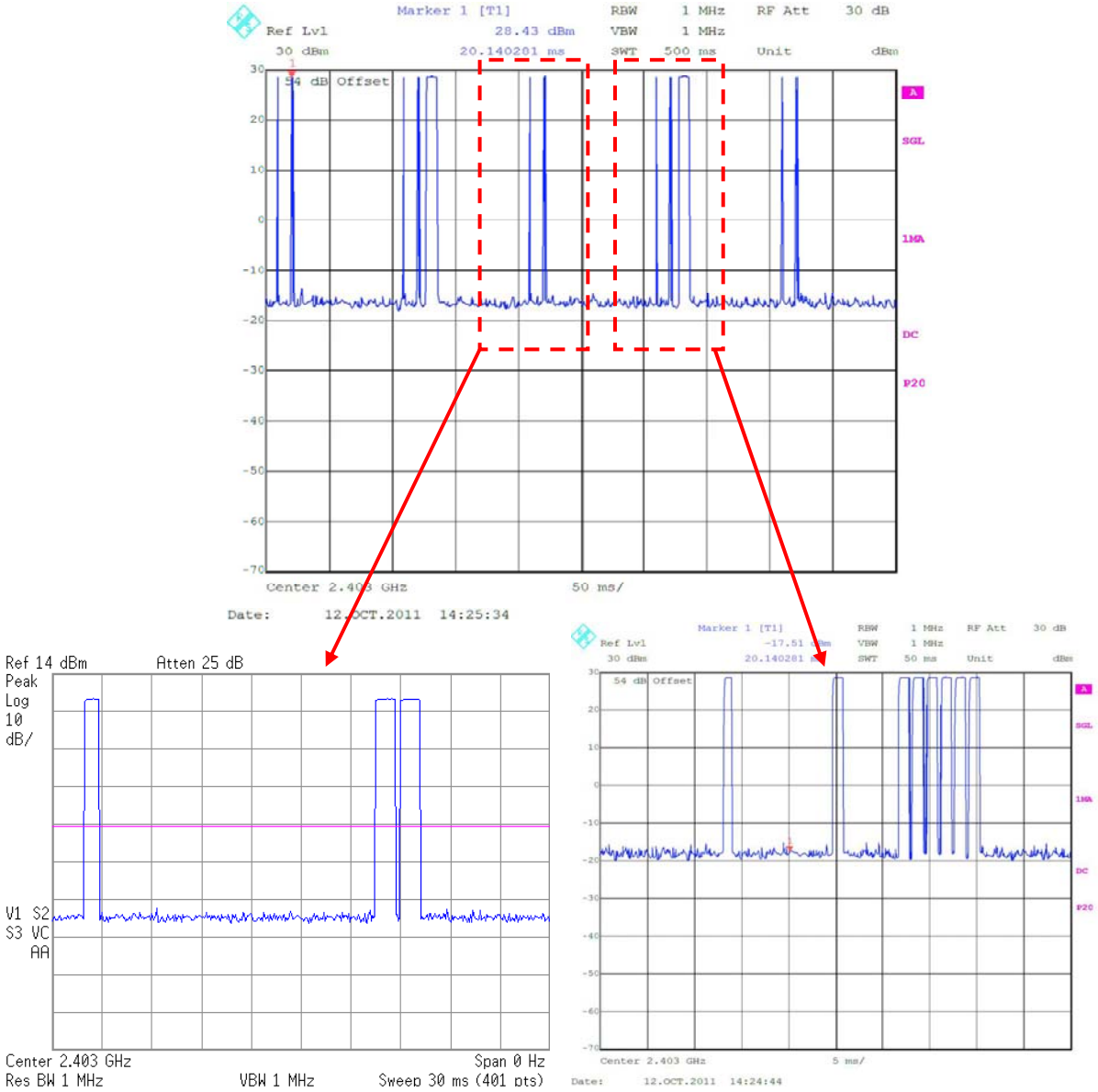


Figure 3.5-1 PathMaker Pulse Train Characteristics

Wide Pulse Close Up
(Pulse width = 1.1 ms)

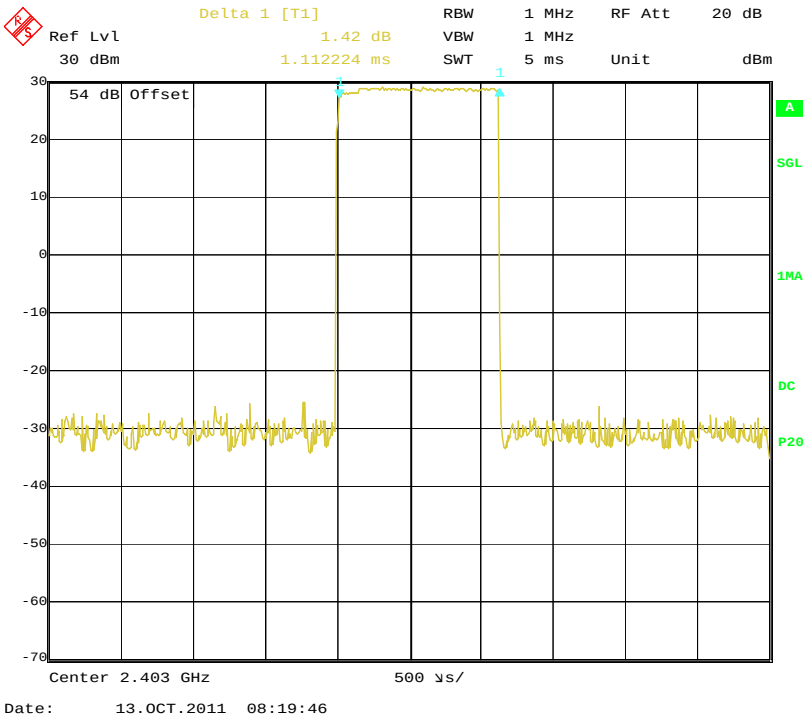


Figure 3.5-2 Close Up of the 1.1 ms Pulse

3.6 ANTENNA REQUIREMENTS

The PathMaker Network Radio is designed to utilize a half-wave dipole type antenna (rubber duck) having a gain of approximately +2 dBi. The connector interface is a reverse thread (RT) SMA type connector. This specific connector type provides compliance with the antenna requirements of 47 CFR Part 15.203.

3.7 ATMOSPHERIC CONDITIONS

The lab temperature and relative humidity were monitored during the testing. The average temperature was approximately 22°C with a relative humidity of 34%. The OATS temperature and relative humidity at the time of measurements were 14°C and 47%, respectively, and are also noted on the radiated emissions data sheet.

4.0 TEST RESULTS

The PathMaker Network Radio test results are summarized in the test summary sheet located on Page 2, herein. Complete test data including a detailed discussion of each test method and results are located in the following paragraphs.

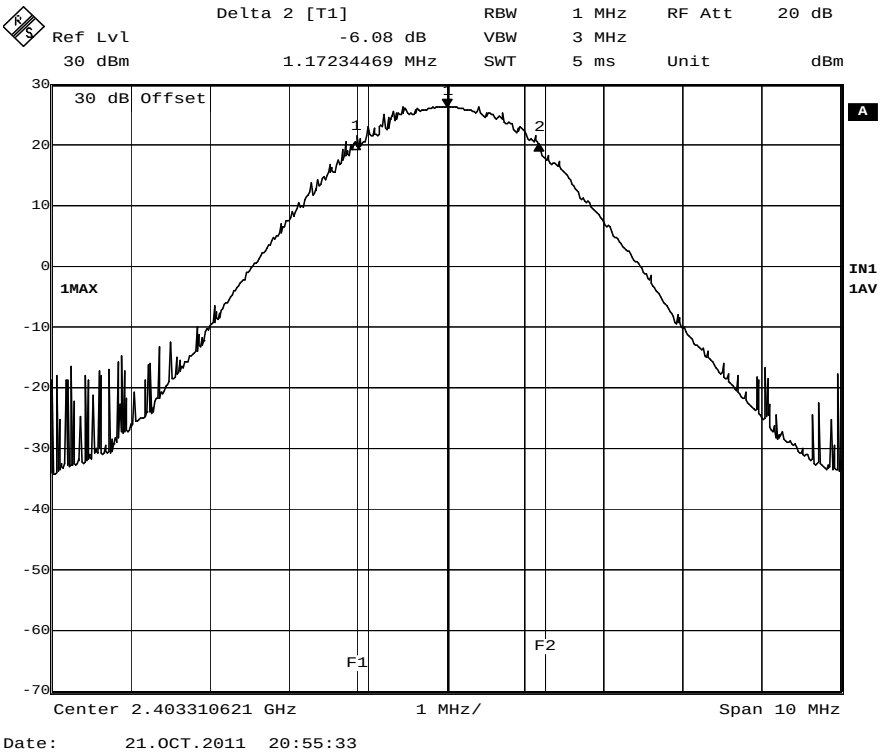
4.1 6 dB Emission Bandwidth

As defined in 47 CFR 15.247(a)(2), systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz. The carrier was measured while transmitting on Channels 1, 20, and 38 and all found to be greater than 500 kHz.

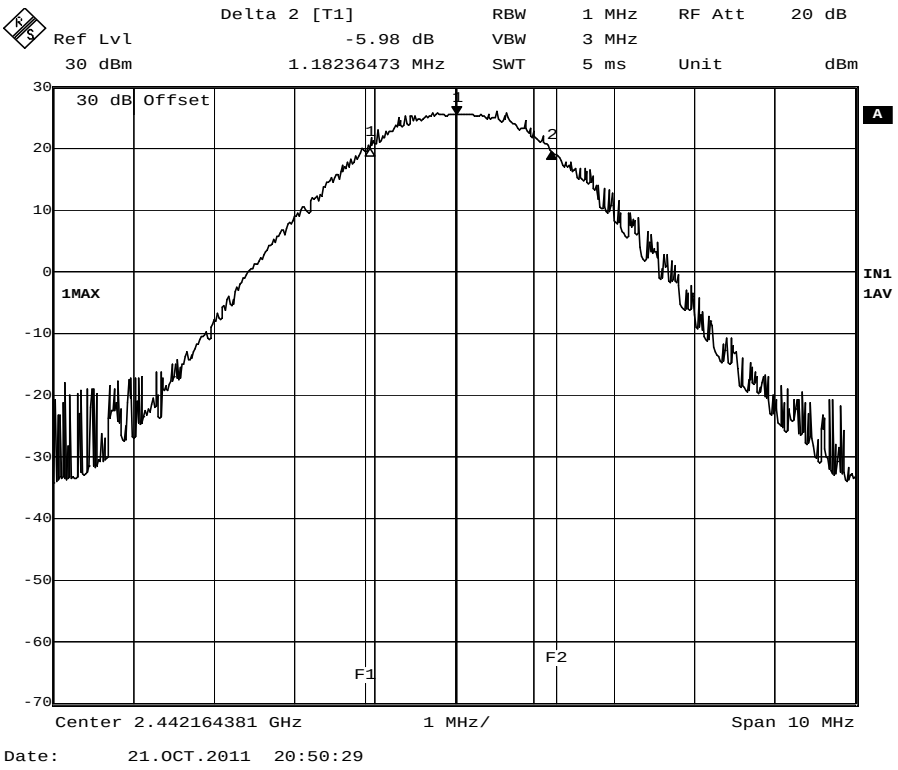
The following test instruments were used for this measurement:

MODEL	DESCRIPTION	MFG.	ASSET #	UN-CERT.	LAST CAL.	DUE CAL.
Attenuators						
8491A	Attenuator, 30dB, 2W, DC-18GHz	Hewlett Packard	T47381	± 1.0 dB	31-May-11	31-May-12
Receivers						
ESI-40	Receiver, 20Hz-40GHz	Rohde & Schwarz	G68094	± 2.0 dB	14-Jul-11	31-Jul-12

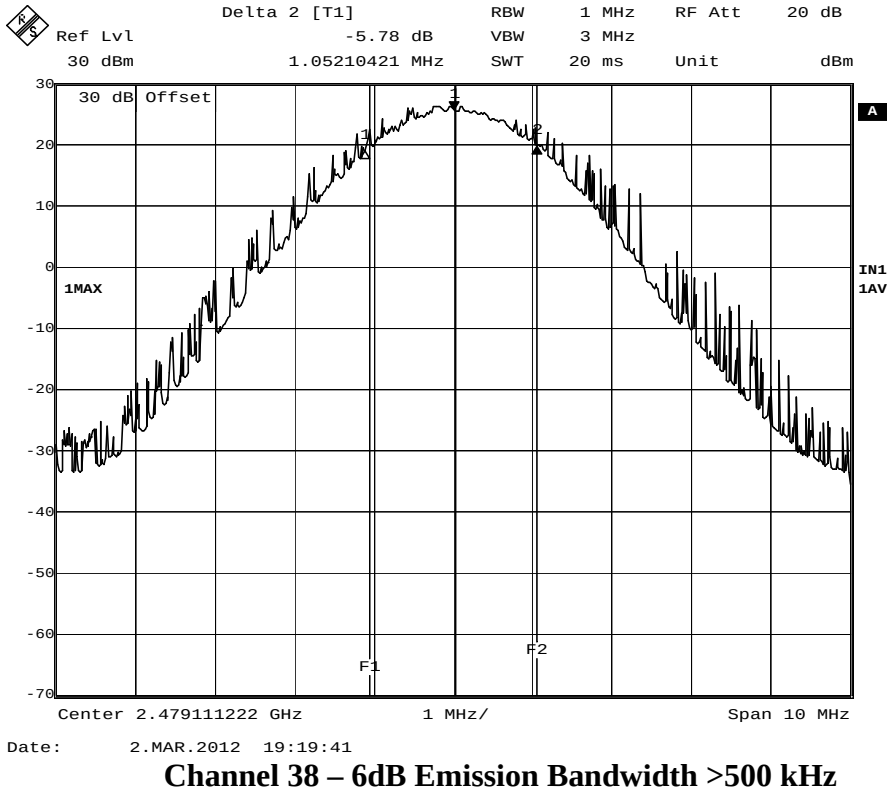
Equipment calibration is traceable to NIST



Channel 1 – 6dB Emission Bandwidth >500 kHz



Channel 20 – 6dB Emission Bandwidth >500 kHz



Channel 38 – 6dB Emission Bandwidth >500 kHz

4.2 Maximum Conducted Output Power

As defined in 47 CFR 15.247(b)(3) for systems using digital modulation in the 2400–2483.5 MHz band the maximum conducted output power is limited to 1 Watt (+30 dBm). The maximum conducted output power was measured with the radio transmitting on Channels 1, 20, and 38. This test was performed with the radio operating at a typical duty cycle and using the "Max hold" function on the spectrum analyzer. All measurements were below 1 Watt (+30 dBm) requirement as measured by both an R&S Spectrum Analyzer and an Agilent Power Meter with peak detector head (Table 4.2-1).

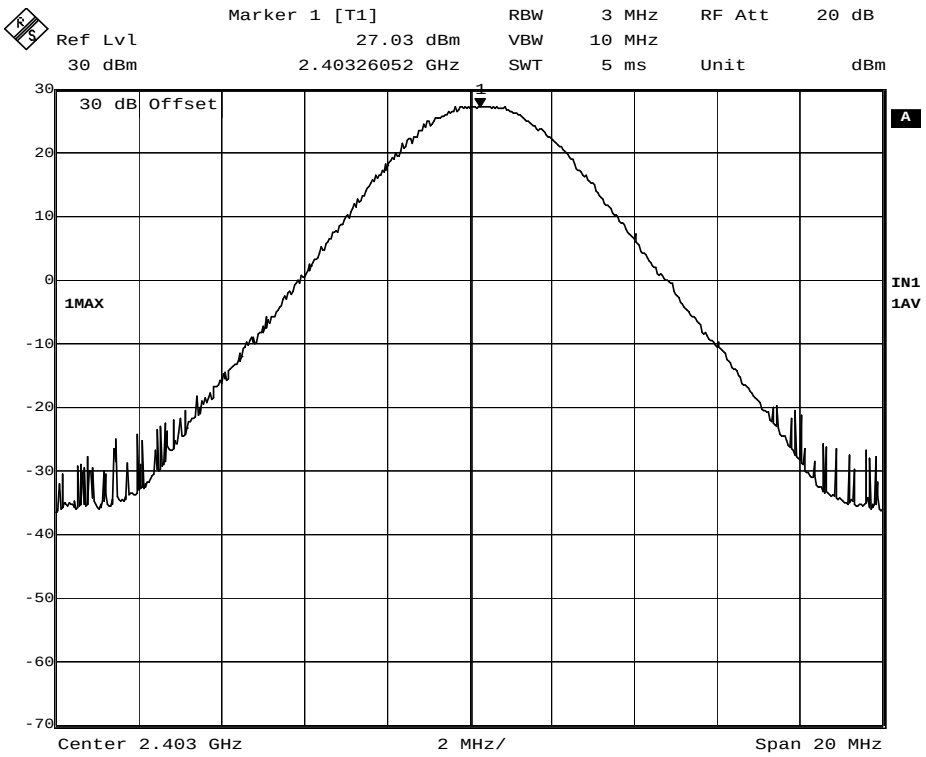
The following test instruments were used for this measurement:

MODEL	DESCRIPTION	MFG.	ASSET #	UN-CERT.	LAST CAL.	DUE CAL.
Attenuators						
8491A	Attenuator, 30dB, 2W, DC-18GHz	Hewlett Packard	T47381	± 1.0 dB	31-May-11	31-May-12
Receivers						
ESI-40	Receiver, 20Hz-40GHz	Rohde & Schwarz	G68094	± 2.0 dB	14-Jul-11	31-Jul-12
Power Meter						
N1911A	Meter, Power P-Series	Agilent	G77311	± 0.03 dB	26-Apr-11	30-Apr-12
N1922A	Meter,Power Sensor; 50MHz-40GHz; Peak; +23dBm	Agilent	TA0404	± 0.3 dB	22-Jul-11	31-Jul-12

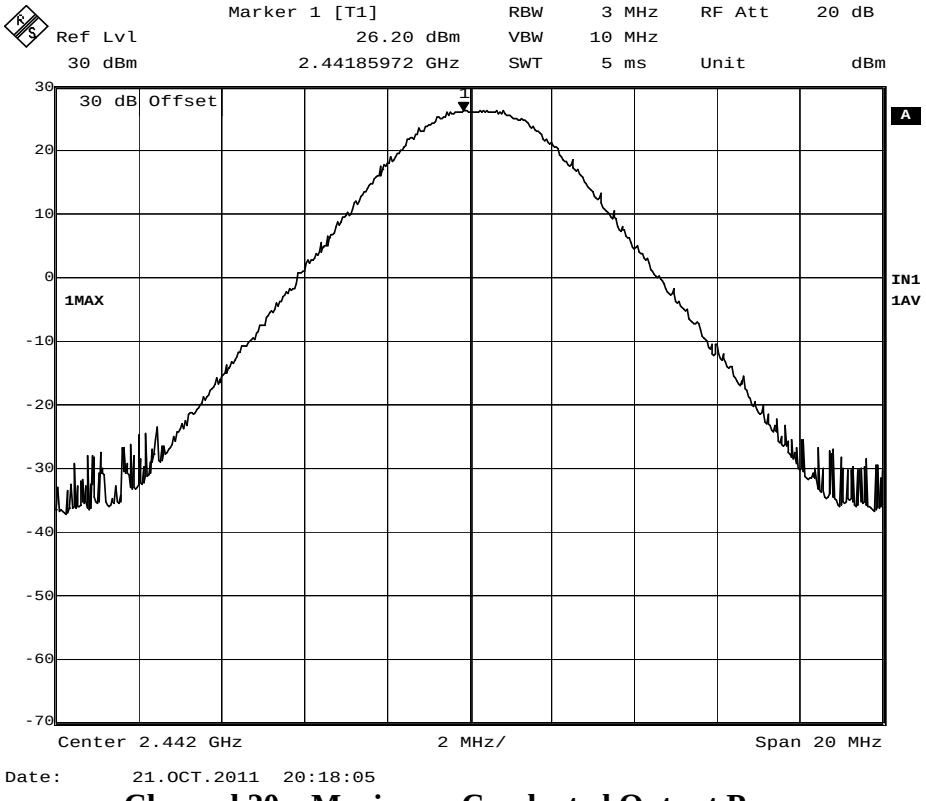
Equipment calibration is traceable to NIST

Table 4.2-1 Power Meter Measurements

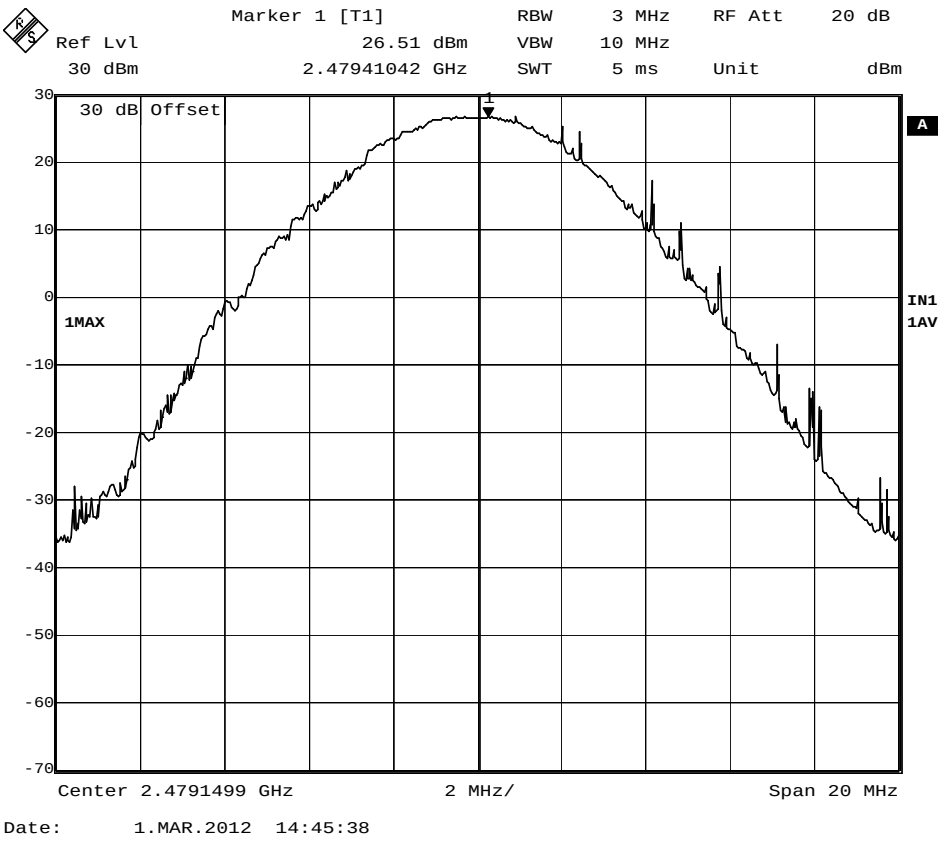
Channel 1	Channel 20	Channel 38
+28.2 dBm	+27.6 dBm	+27.5 dBm



Channel 1 – Maximum Conducted Output Power



Channel 20 – Maximum Conducted Output Power



Channel 38 – Maximum Conducted Output Power

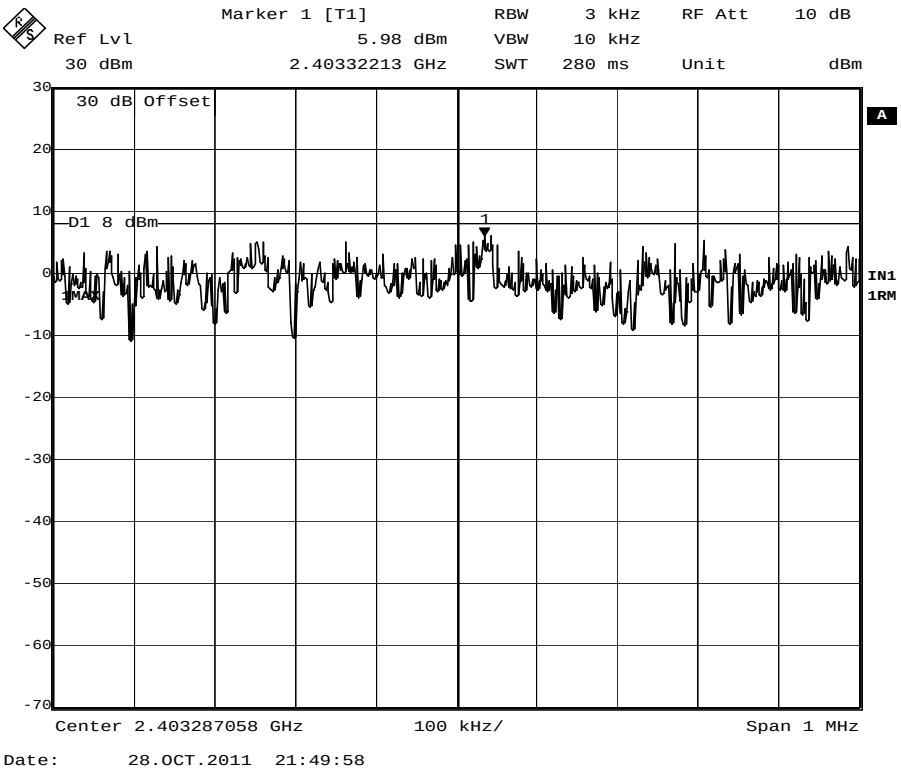
4.3 Power Spectral Density

As defined in 47 CFR 15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission. The power spectral density was measured with the radio transmitting on Channels 1, 20, and 38. This test was performed with the radio operating at a typical duty cycle and using the "Max hold" function on the spectrum analyzer. All measurements were below the +8dBm/3kHz requirement as measured by an R&S Spectrum Analyzer.

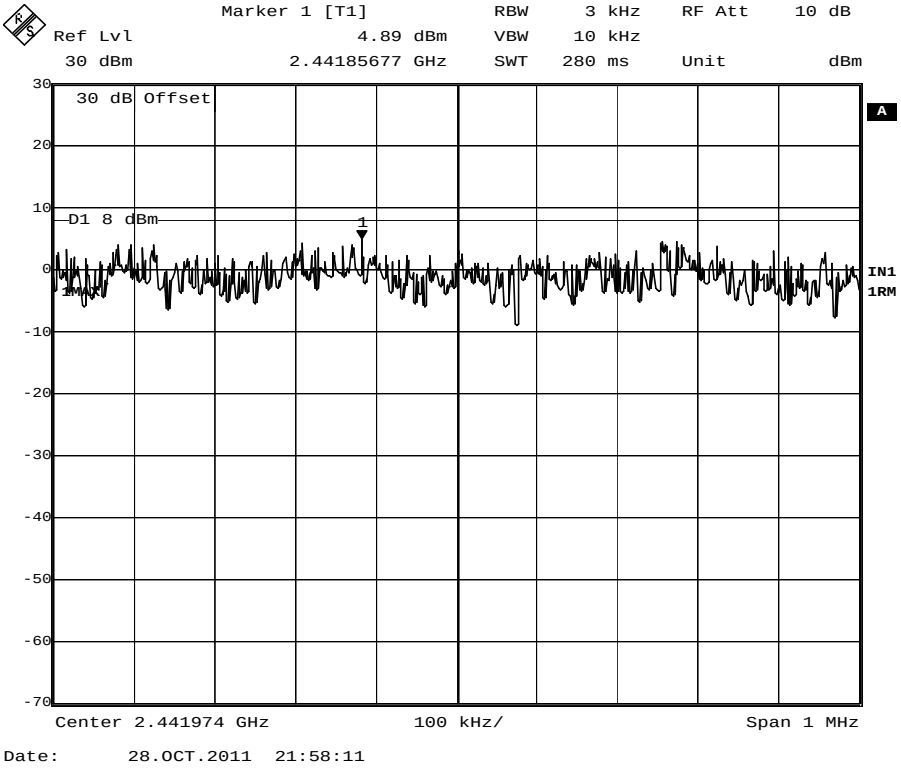
The following test instruments were used for this measurement:

MODEL	DESCRIPTION	MFG.	ASSET #	UN-CERT.	LAST CAL.	DUE CAL.
Attenuators						
8491A	Attenuator, 30dB, 2W, DC-18GHz	Hewlett Packard	T47381	± 1.0 dB	31-May-11	31-May-12
Receivers						
ESI-40	Receiver, 20Hz-40GHz	Rohde & Schwarz	G68094	± 2.0 dB	14-Jul-11	31-Jul-12

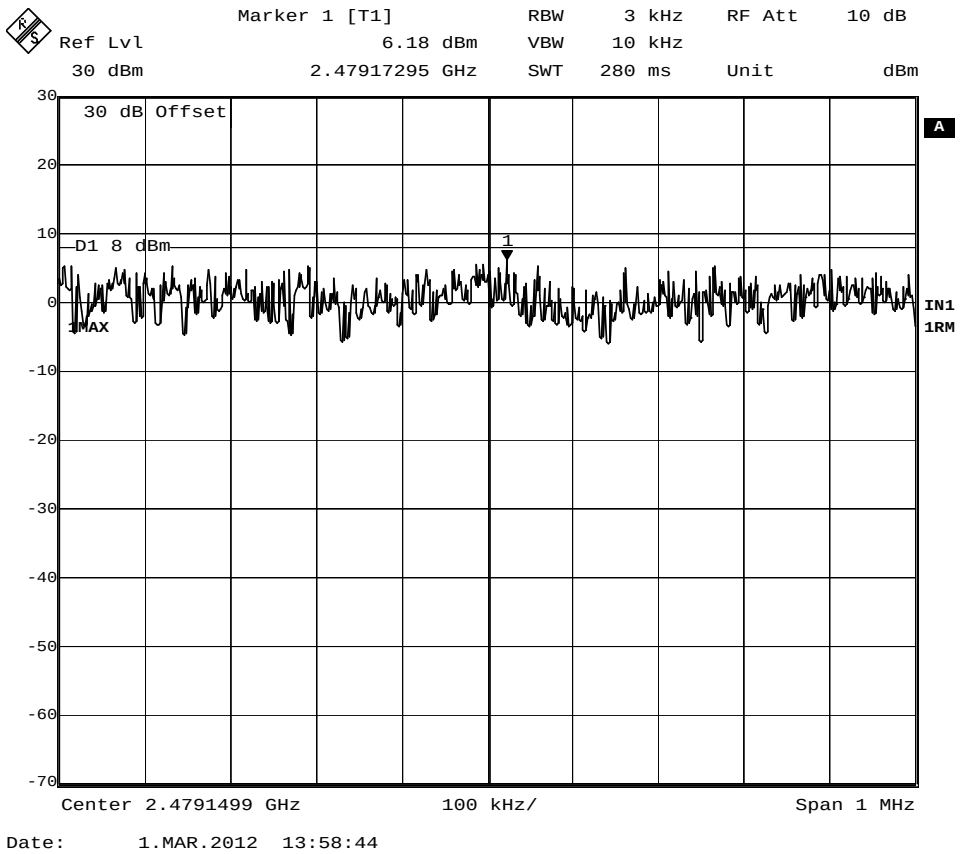
Equipment calibration is traceable to NIST



Channel 1 – Power Spectral Density (+6 dBm/3kHz)



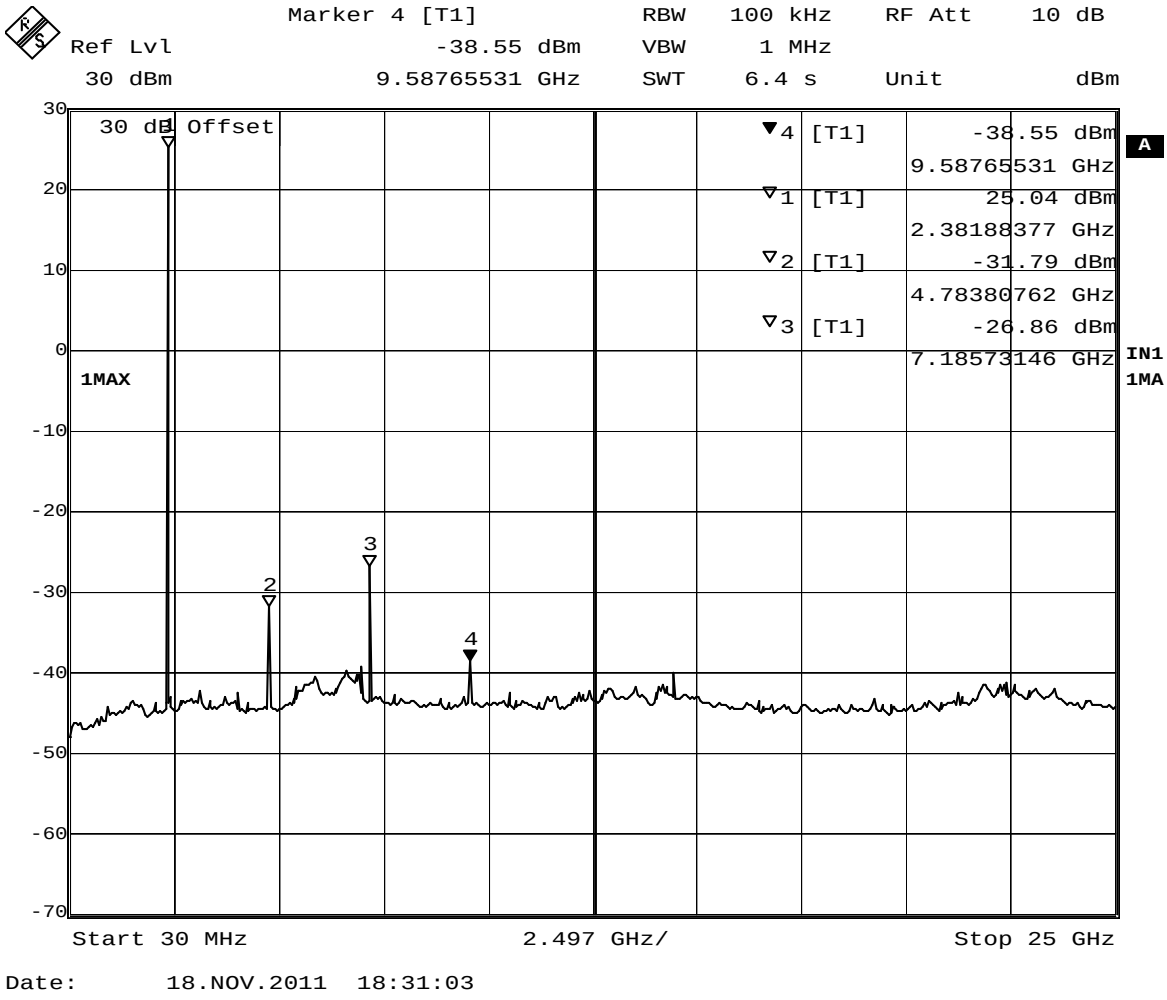
Channel 20 – Power Spectral Density (+4.9 dBm/3kHz)



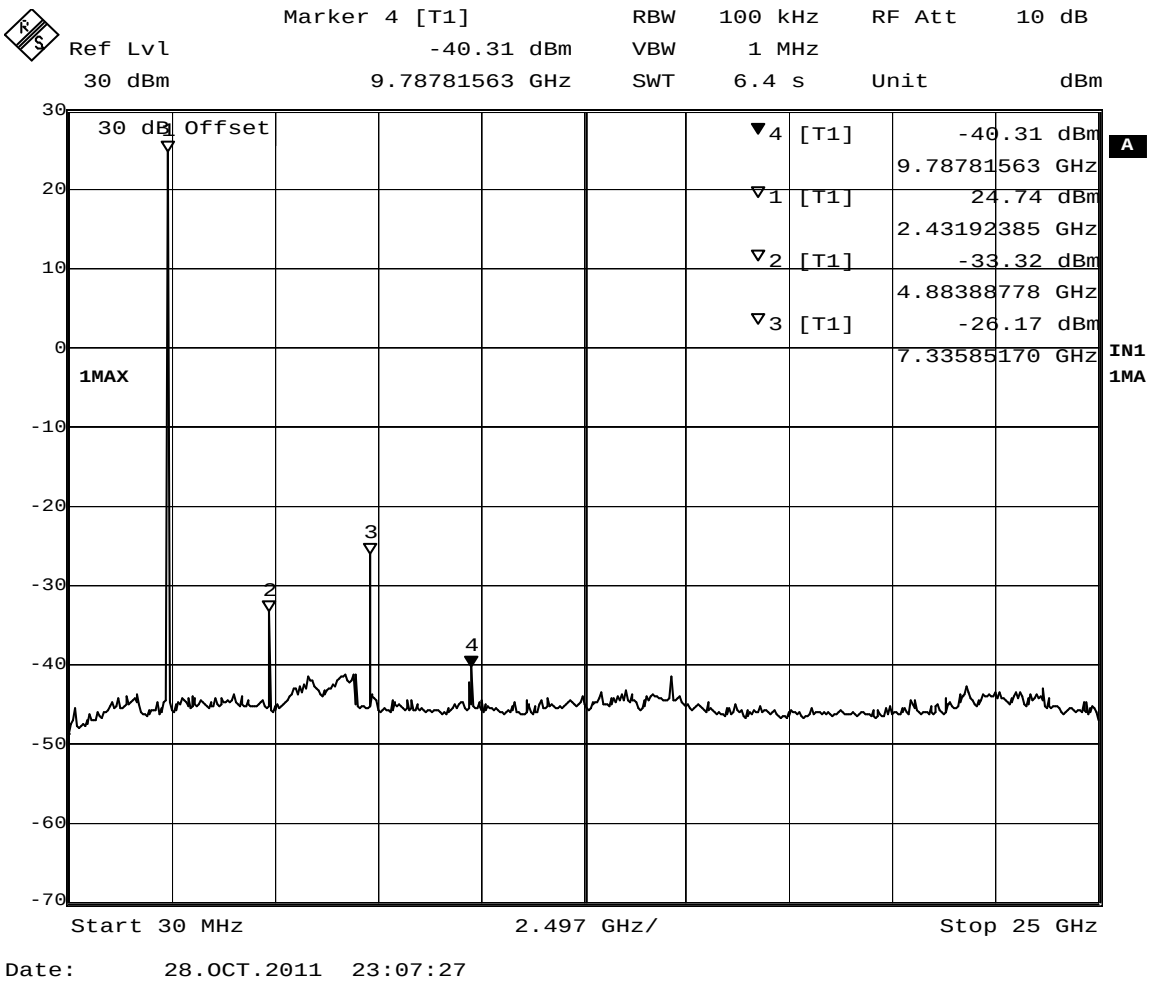
Channel 38 – Power Spectral Density (+6.2 dBm/3kHz)

4.4 Conducted Spurious Emissions including Band Edges

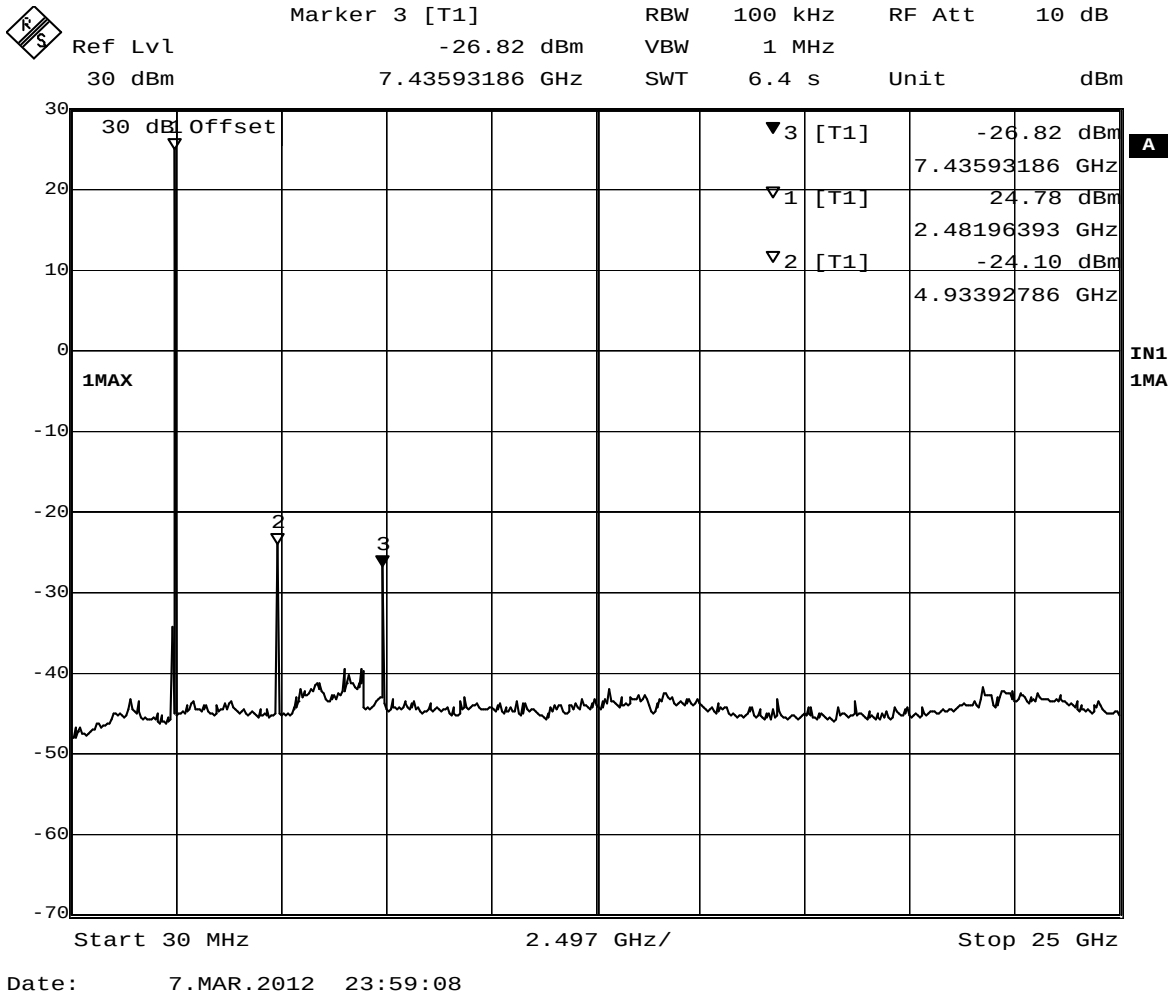
As defined in 47 CFR 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.



Channel 1 – Conducted Spurious Emissions (all harmonics < -20dBc)



Channel 20 – Conducted Spurious Emissions (all harmonics < -20dBc)



Channel 38 – Conducted Spurious Emissions (all harmonics < -20dBc)

The "Marker-Delta Method" established by the FCC was used for the Lower and Upper Band Edge measurements. In accordance with this test method, the maximum peak radiated field strength of the carrier was measured and is displayed in Section 4.5. The carrier field strength levels for Channels 1 and 38 were measured at 125.6 dBuV/m and 123 dBuV/m, respectively.

The "Marker-Delta" measurements of emissions for Channels 1 and 38 are shown in subsequent plots. For Channel 1, this level was measured to be -63.3 dBc for the emissions below 2390 MHz. The equivalent radiated field is 125.6 dBuV/m – 63.3 dB = 62.3 dBuV/m. The FCC requirement for emissions in the restricted band is 74 dBuV/m (Peak) and 54 dBuV/m (Avg). Therefore, Channel 1 satisfies the band edge peak emission requirement.

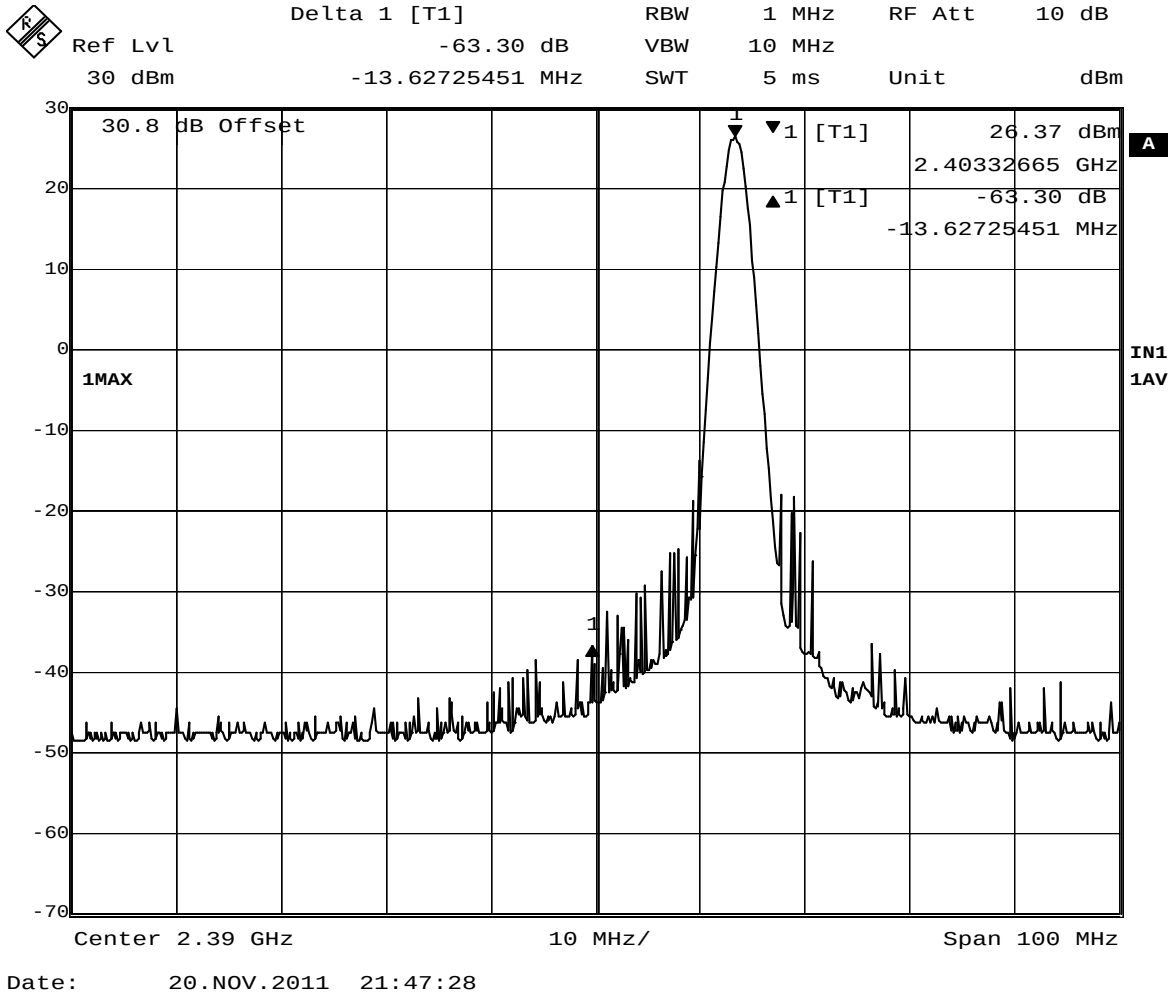
The emission levels from 2390 MHz to the 2400 MHz band edge are only required to be -20 dBc since this frequency range is not part of a restricted band. The measured band edge at 2400 MHz was -40 dBc.

For Channel 38, the “Marker-Delta” measurement was approximately -51.9 dBc. Therefore, the upper band edge emission level is estimated to be 71.1 dBuV/m which is also compliant with the peak measurement level of 74 dBuV/m. The restricted band on the upper band edge covers 2483.5 MHz to 2500 MHz.

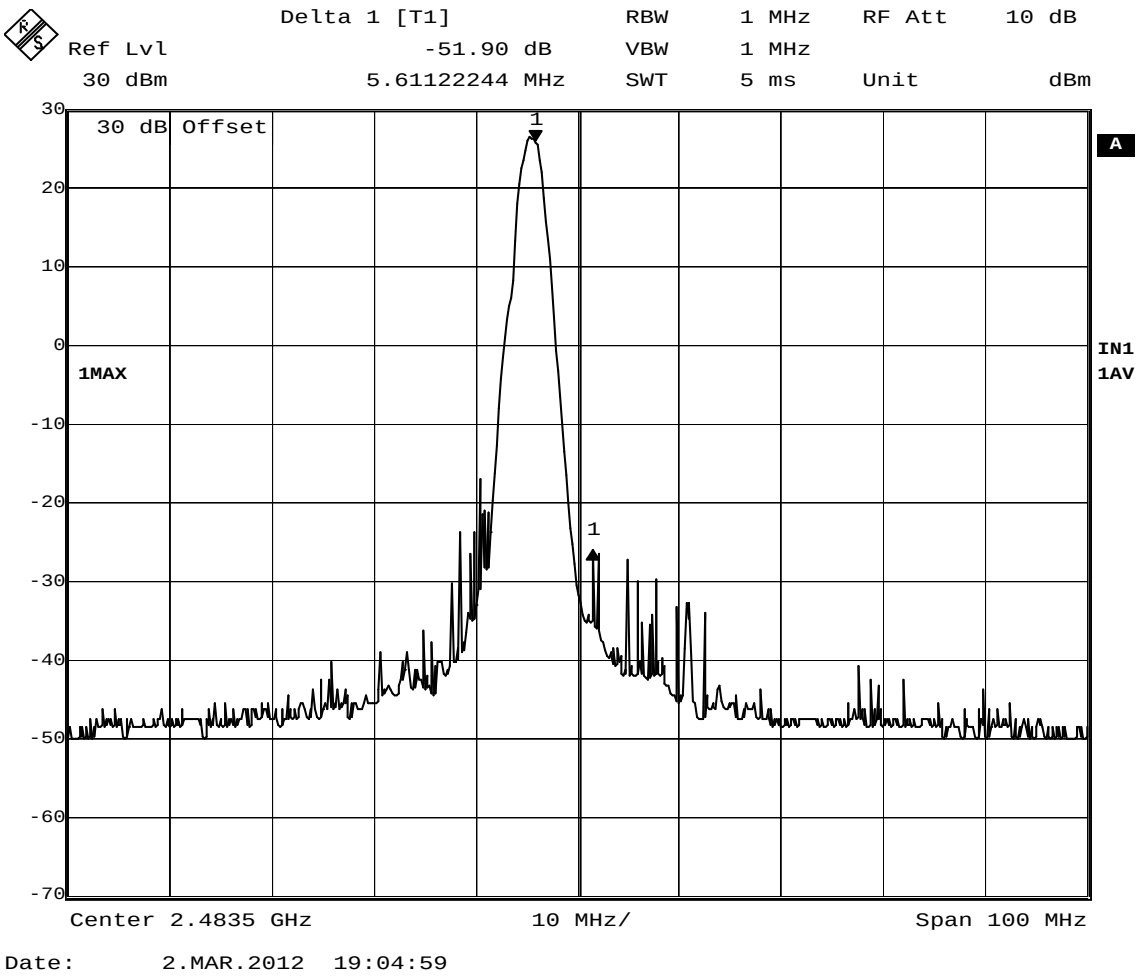
The average levels were calculated based on the worst-case duty cycle of 8.5%. Therefore, the estimated Average Band Edge Emissions were calculated to be:

Channel 1 Average Band Edge Emission Level: 104.2 dBuV/m - 63.3 = 40.9 dBuV/m
Channel 38 Average Band Edge Emission Level: 101.6 dBuV/m - 51.9 = 49.7 dBuV/m

These calculated levels are both below the Average emission limit of 54 dBuV/m.



Channel 1 – Lower Band Edge Measurement



Channel 38 – Upper Band Edge Measurement

4.5 Radiated Emissions, Electric Field, FCC, 30MHz - 25GHz

Radiated Spurious and Harmonic emissions were measured for comparison to the requirements of 47 CFR 15.247(d) for emissions in Non-Restricted Frequency Bands and 47 CFR 15.209(a) for Restricted Frequency Bands as defined in 15.205(a).

The radiated electric field emissions were measured over the frequency range of 30 MHz – 25 GHz per the procedures of ANSI 63.4. Pre-scan measurements were performed on the PathMaker Radio in a shielded enclosure prior to being tested at the Open Area Test Site (OATS) in order to isolate emissions in an ambient free environment. The peak mode was used to define the frequency and approximate amplitude. The pre-scans included all four sides of the EUT and in both polarities.

The final measurements for the 30 MHz – 1 GHz range were performed at the OATS. The EUT was placed on a turntable in normal operation using the intended power source. A receiving antenna located 3 meters from the turntable picks up any signal radiated from the transmitter and its operating accessories. The antenna is adjustable in height from 1 to 4 meters and can be horizontally and vertically polarized. A Rohde & Schwarz EMI Receiver/Spectrum Analyzer system was used to scan the applicable frequency range to detect and measure any radiation picked up by the antenna. The FCC Class B limits are shown in Figure 4.5-1 below and a general test setup diagram is shown as Figure 4.5-2.

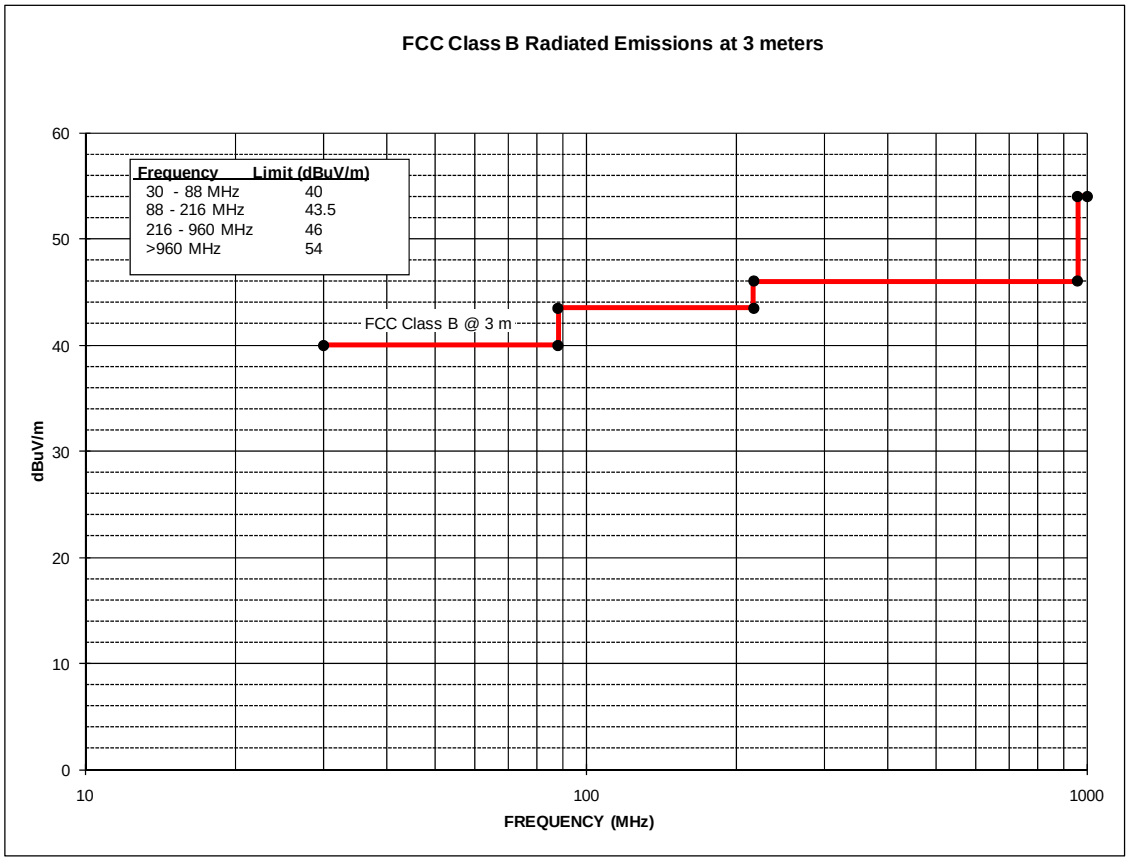


Figure 4.5-1 FCC Class B Radiated Emissions Limit

All tests above 1GHz were free space measurements performed in a fully anechoic chamber at a distance of 3 meters. A pre-amp along with a band-pass filter and several high-pass filters were used for these measurements. The limit for frequencies above 1 GHz is 54 dBuV/m for average measurements and 20 dB above for maximum peak measurements or 74 dBuV/m.

The EUT was adjusted to obtain peak readings of received signals by rotating the transmitter under test and adjusting the antenna height and polarization. The radiated signal strengths are derived from the received power levels and measured antenna factors. Also included in the field strength derivation are the cable losses and any other corrections for external attenuation and/or pre-amplification. All readings below 1 GHz are Quasi-Peak and above 1 GHz are performed with maximum peak and/or average measurements as necessary.

The data sheets are included in the following pages. The worst-case radiated emissions above 1 GHz were measured with the antenna in the vertical polarization. Representative radiated emission plots for the vertical polarization are also shown, however, final measurements were performed in both antenna polarizations. There were no emissions present in the 18 GHz to 25 GHz range on any of the measurements. For this reason the sample measurement plots stop at 18 GHz.

The measurement scans shown are with the PathMaker Radio in test mode while transmitting continuously. The average measurements above 1 GHz were corrected based on the typical duty cycle of 8.5% as detailed in Section 3.5.

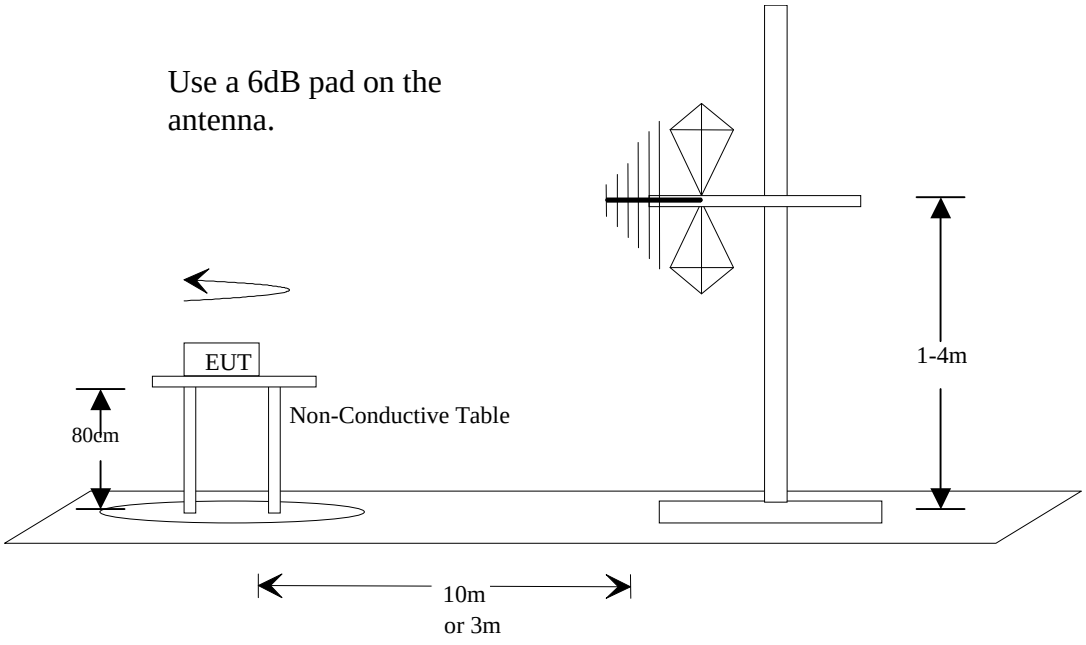


Figure 4.5-2 General Radiated Test Setup for Portable Equipment

The following test instruments were used for these measurements:

MODEL	DESCRIPTION	MFG.	ASSET #	UN-CERT.	LAST CAL.	DUE CAL.
Antennas						
2070-2	Antenna Mast, 6 meter	EMCO	G72315	N/A	NCR	NCR
3115	Antenna, Horn 1.0-18GHz	EMCO	G43252	± 2.0 dB	27-May-11	31-May-12
3142B	Antenna, BiConiLog	EMCO	T47085	± 2.0 dB	01-Feb-11	28-Feb-12
3142B	Antenna, BiConiLog	EMCO	T47086	± 2.0 dB	01-Feb-11	28-Feb-12
3121C	Antenna, Dipole	EMCO	G40498	± 2.0 dB	26-May-11	31-May-12
3121C	Antenna, Dipole	EMCO	G40499	± 2.0 dB	26-May-11	31-May-12
Controllers						
2090	Controller, Multi-Device	EMCO	G72315.1	N/A	NCR	NCR
Receivers						
ESI-7	Receiver, 20Hz-7GHz	Rohde & Schwarz	G71791	± 2.0 dB	02-Apr-11	30-Apr-12
ESI-7	Receiver BIOS Firmware 3.3	Rohde & Schwarz	G71791.1	N/A	NCR	NCR
ESI-7	Receiver Analyzer Firmware 4.01	Rohde & Schwarz	G71791.2	N/A	NCR	NCR
ES-K1.60	Receiver Software, EMI Controller(1999), Service Pack 2	Rohde & Schwarz	G71791.3	N/A	NCR	NCR
ESI-40	Receiver, 20Hz-40GHz	Rohde & Schwarz	G68094	± 2.0 dB	14-Jul-11	31-Jul-12
ESI-40	Receiver Analyzer Firmware 4.01	Rohde & Schwarz	G68094.2	N/A	NCR	NCR
ESI-40	Receiver BIOS Firmware 3.3	Rohde & Schwarz	G68094.1	N/A	NCR	NCR
ES-K1.60	Receiver Software, EMI Controller(1999), Service Pack 2	Rohde & Schwarz	G68094.3	N/A	NCR	NCR
Filters						
3TNF-00051	Filter, Tunable Band reject, 1.5-3.0GHz	K&L	EMC00731	N/A	CAT	CAT
HD-60N	Filter, High Pass, 6 GHz	Micro Lab	T37199	N/A	NCR	NCR
HA-30N	Filter, High Pass, 3 GHz	Micro Lab	T03645	N/A	NCR	NCR
Preamps						
AMF-4D-00501800-24-1QP	Preamplifier, 0.5-18GHz	Miteq	TA4690	± 2.0 dB	13-Jan-11	31-Jan-12

Equipment calibration is traceable to NIST

GENERAL DYNAMICS
C4 Systems

FCC Radiated Test Results

Equip.	Path Finder	Test Date:	11/8/2011
Mode:	Tx Data	Test Technician:	R. Johnston
Model#:		Measurement Distance (m)	3
Serial #:	ES0102	Equipment Class	B

Bold Reading are Quasi Peak — 14.44°C 47%R.H. 97.8 BP kpa

Ant	Frequency MHz	SA Reading (dBuV)	Az	Ht cm	Pol	Antenna Factor	Cable/Attn. Loss	Pre Amp dB	Emission (dBuV/m)	Spec Limit (dBuV/m)	Pass/ Fail	Comments:
Dipole	**33.420**	**23.4**	F	236	V	13.1	3.2	0.0	39.7	40.0	PASS	
Dipole	**39.060**	**22.4**	R	212	V	11.7	3.3	0.0	37.4	40.0	PASS	
Dipole	**48.080**	**23.9**	BR	174	H	10.5	3.5	0.0	37.9	40.0	PASS	
Dipole	**63.540**	**20.4**	F	154	V	8.9	3.8	0.0	33.1	40.0	PASS	
Dipole	**150.300**	**16.7**	LF	100	V	14.9	4.9	0.0	36.5	43.5	PASS	
Dipole	**186.480**	**17.1**	B	166	V	16.5	5.2	0.0	38.8	43.5	PASS	

Radiated Emissions, 30 MHz – 1 GHz, OATS

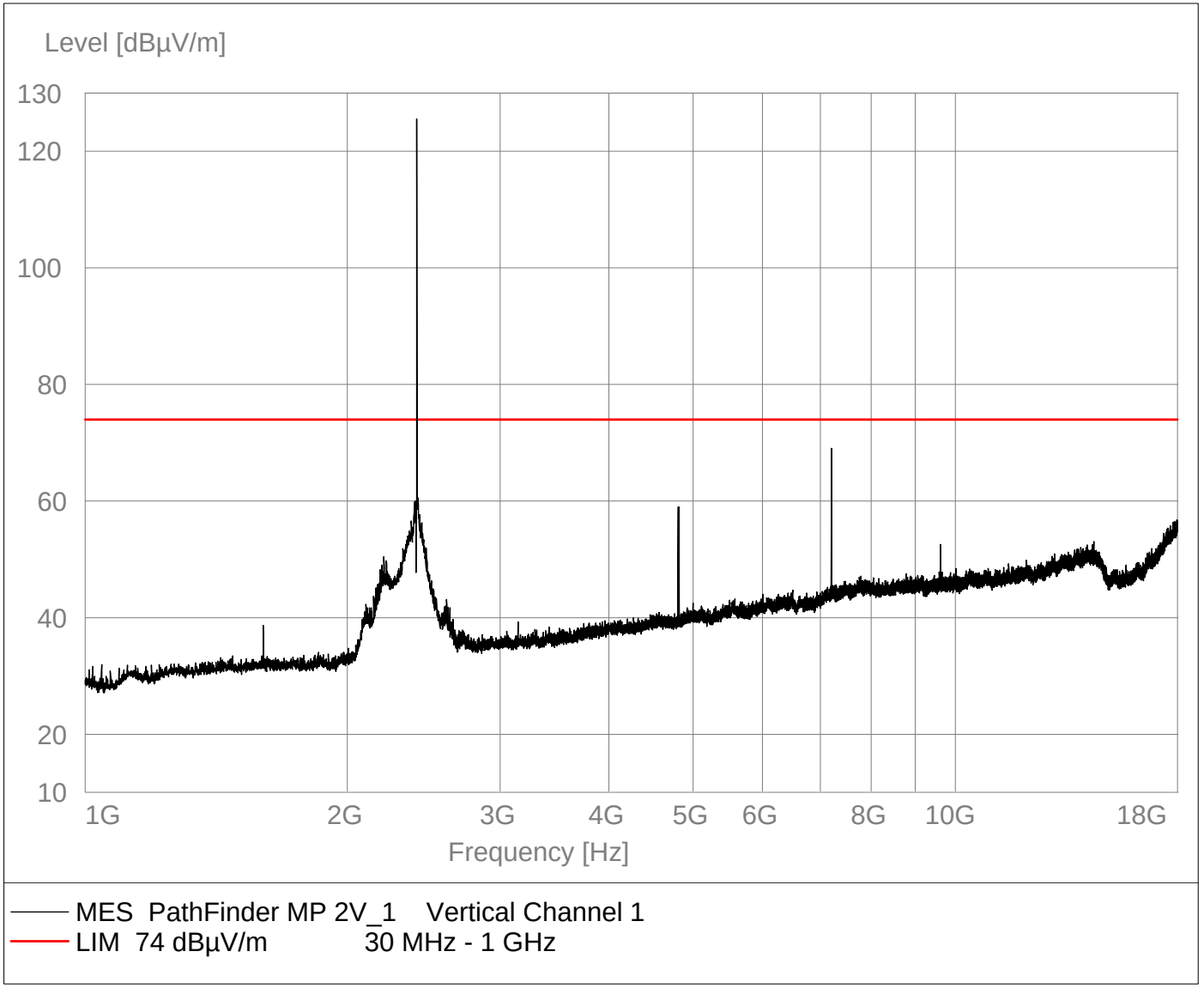
GENERAL DYNAMICS
C4 Systems

Equipment Measured: Pathfinder Radio
Mode of Operation: Transmit
Line or Condition:
Performed by: Gooding/Johnston
Type of Measurement: Radiated Emisison, Spurious 1 GHz to 25 GHz

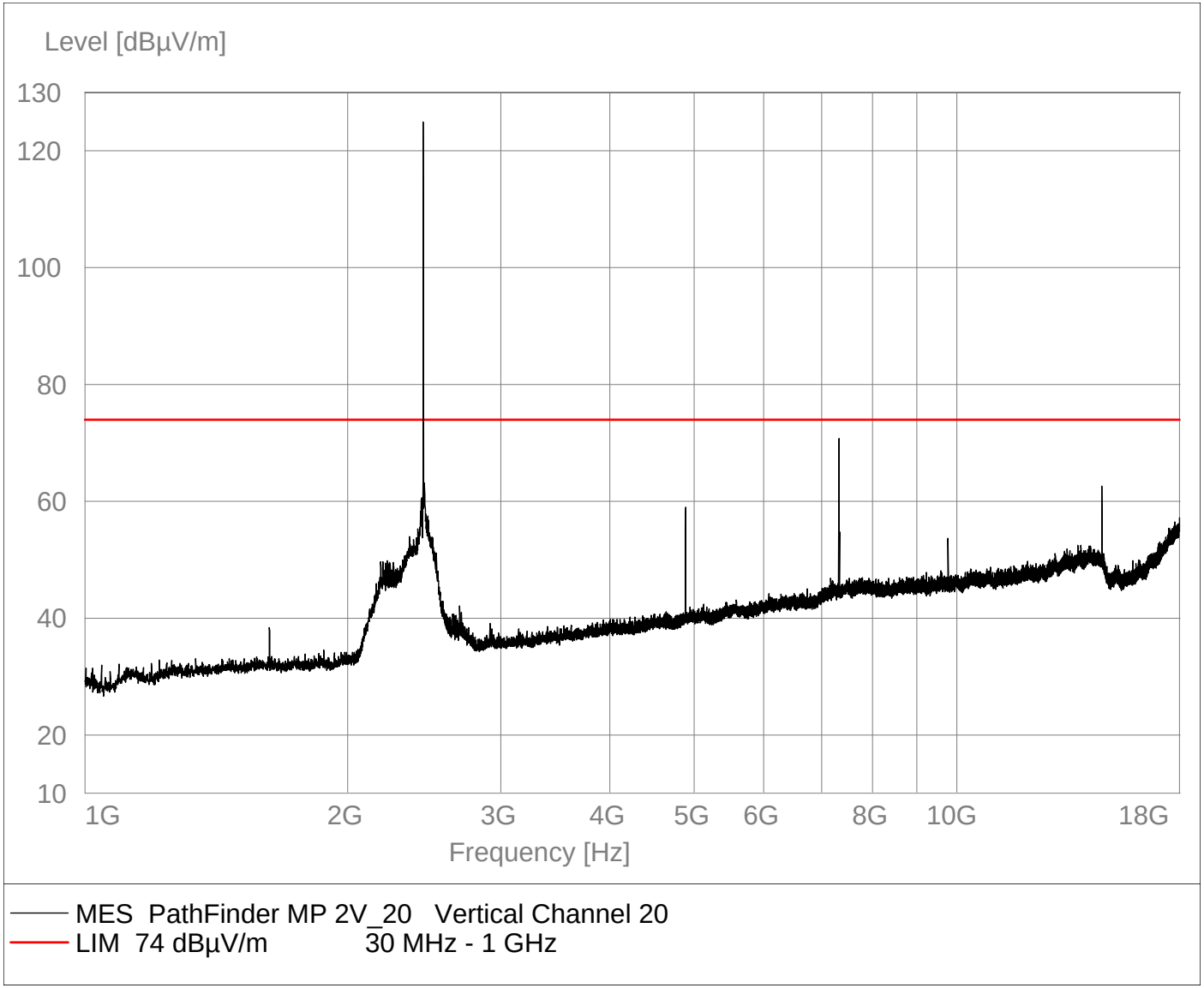
Project No.: 32497-1200
Serial No.: 2
Date of Measurement:
Spec. No.: 47 CFR Part 15.247(d)/209(a)
Test Proc.: ANSI 63.4

Frequency (GHz)	Max Peak Scan Level (dBuV/m)	Calculated Avg Level (Note 1)	15.247(d) Spurious Emissions (>20 dBc)	15.209(a) Restricted Band Peak Limit (74dBuV/m)	15.209(a) Restricted Band Average Limit (54dBuV/m)	REMARKS
2.403	125.6	N/A	N/A	N/A	N/A	***Channel 1 Fo***
4.806	58.30	36.90	Pass	Pass	Pass	2nd Harmonic
7.209	69.07	47.67	Pass	N/A	N/A	3rd Harmonic
9.612	51.99	30.59	Pass	N/A	N/A	4th Harmonic
12.0	49.80	28.40	Pass	Pass	Pass	5th Harmonic
2.441	125.0	N/A	N/A	N/A	N/A	***Channel 20 Fo***
4.882	58.45	37.05	Pass	Pass	Pass	2nd Harmonic
7.323	70.73	49.33	Pass	Pass	Pass	3rd Harmonic
9.764	53.70	32.30	Pass	N/A	N/A	4th Harmonic
12.2	62.60	41.20	Pass	Pass	Pass	5th Harmonic
2.479	123.0	N/A	N/A	N/A	N/A	***Channel 38 Fo***
4.958	61.20	39.80	Pass	Pass	Pass	2nd Harmonic
7.437	71.67	50.27	Pass	Pass	Pass	3rd Harmonic
9.916	51.90	30.50	Pass	N/A	N/A	4th Harmonic
12.4	50.51	29.11	Pass	Pass	Pass	5th Harmonic
14.9	57.75	36.35	Pass	N/A	N/A	6th Harmonic
Note 1: Average level calculated using worst-case duty cycle of 8.5% (-21.4 dB)						
Note 2: Vertical and Horizontal Polarization measurements were performed; worst-case levels recorded						
Note 3: Measurements were performed from 1 GHz to 25 GHz						

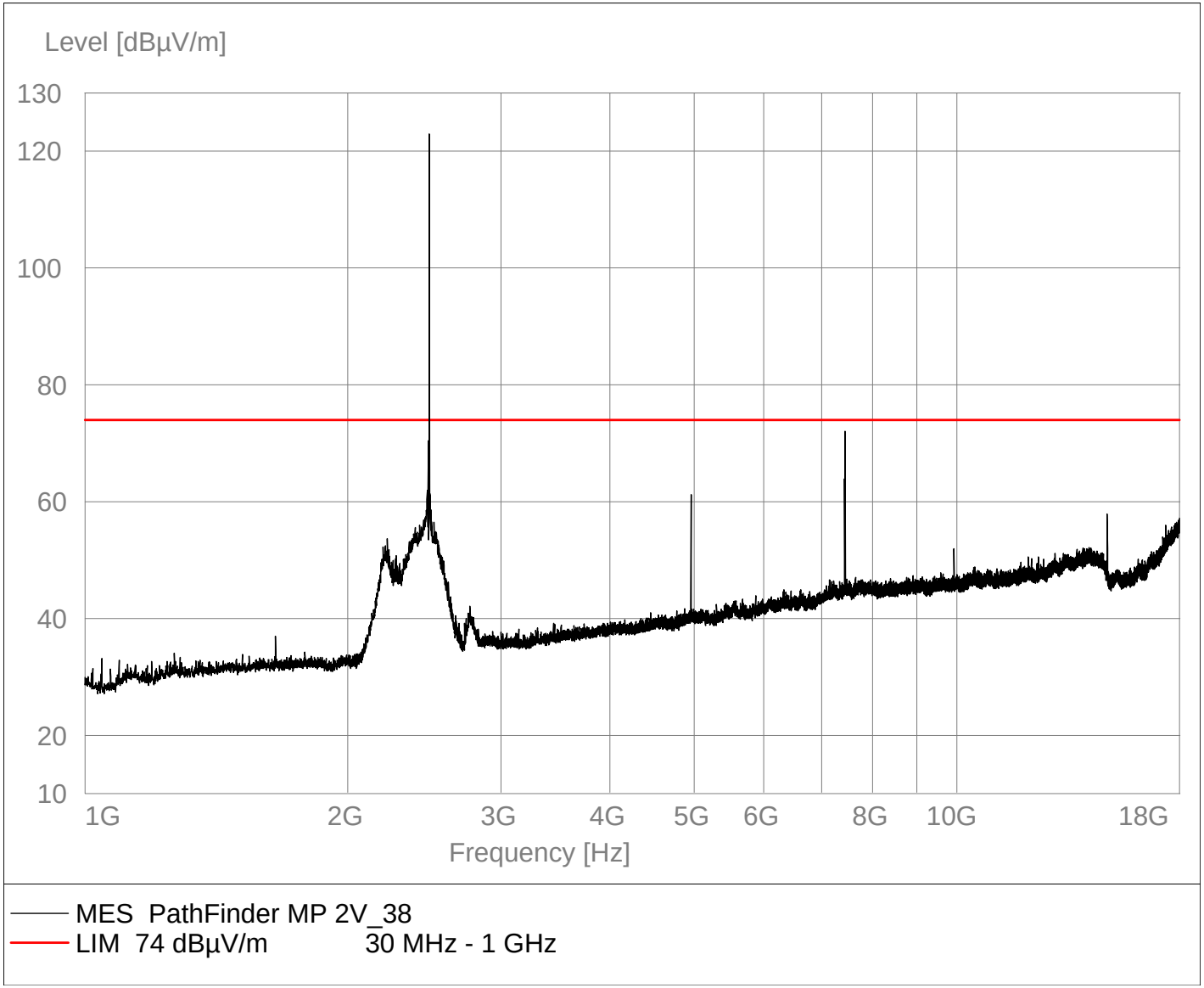
Radiated Emissions, 1 GHz - 25 GHz, Anechoic Chamber



Channel 1 - Radiated Emission, Spurious, Max Peak 1 GHz to 18 GHz



Channel 20 - Radiated Emission, Spurious, Max Peak 1 GHz to 18 GHz



Channel 38 - Radiated Emission, Spurious, Max Peak 1 GHz to 18 GHz

5.0 CONCLUSIONS

The PathMaker Network Radio complies with the FCC certification requirements per 47 CFR Part 15 Subpart C for unlicensed intentional radiators. The test results in this report apply to the specific units tested. Results from other units may differ.

ATTACHMENT 1: ESTIMATE OF UNCERTAINTY

ELECTROMAGNETIC INTERFERENCE
UNCERTAINTY DATA SHEET

Type of Measurement: Radiated Emissions, FCC

*Notes: Enter equipment or process uncertainty as dB in Column D or percent (±) in Column B.
If % is used, then column C is 10 if based on power (or resistance) or 20 if based on voltage (or current)
In column E, enter R if the uncertainty is a rectangular distribution (e.g., ± 2dB)
In column E, enter U if the uncertainty is a u-shaped distribution (e.g., ± 2dB)
In column E, enter T if the uncertainty is a triangular shaped distribution (e.g., ± 2dB)
In column E, enter S if the uncertainty is one standard deviation (e.g., 2dB)
In column E, enter E if the uncertainty is expanded uncertainty at 95% confidence (e.g., 2dB)

Device or Source of Error	(Column B) Measurement Tolerance (%)	(Column C) 10 or 20 Log basis	(Column D) Measurement Tolerance (dB)	(Column E) Type of Distribution	Standard Uncertainty (dB)	Remarks
Setup Repeatability			0.36	S	0.36	Stnd Dev of Test Setup
EMI Receiver			2.00	R	1.15	R&S ESI7
Cable Loss			1.00	T	0.41	Cable Pre-cal
Antenna Factor			2.00	R	1.15	Robert's Dipoles
Site anomalies			1.00	R	0.58	ANSI C63.4 para. 5.4.6.2
Antenna Distance	5.00	20	0.42	T	0.17	Distance variation
VSWR Mismatch			1.00	U	0.71	VSWR=2:1 source & load
Combined Standard Uncertainty, u_c , expressed in dB =					1.96	
Expanded Uncertainty, U, using coverage factor, k=2, expressed in dB =					3.91	

The expanded uncertainty, U, represents 95% confidence that the measured value will be within ± U dB of the true value.

Rectangular distributions are Type B evaluations (see NIST Technical Note 1297) where the range of accuracy is expressed as ± X dB or ± x % without any statistical information. For the user, the true value could lie anywhere within the range from -x to +x with equal probability. Triangular distributions have a probability that increases uniformly from zero at the extremities to a maximum at the center. U-shaped distributions have higher probability near the extremities than at the center with VSWR being a classic example.

For Type A evaluations, the standard uncertainty of a measured value is calculated from the descriptive statistics of a series of repeated observations. The measurement uncertainty is equal to one standard deviation of the mean. This value is related to the standard deviation about the mean by the inverse of the square root of n. The expanded uncertainty is typically twice the standard deviation (i.e., coverage factor of 2) and represents 95% confidence that the measured value lies within +/- U dB of the true value.

It is the policy of the General Dynamics EMC Laboratory to provide uncertainty data sheets for all compliance related measurements. Table 1 of CISPR 16-4-2 defines an upper limit on expanded uncertainty (UCISPR) of 3.6dB for conducted emissions from 150kHz to 30MHz and 5.2dB for radiated emissions from 30MHz to 1GHz. The General Dynamics EMC Lab has an expanded uncertainty (ULAB) of 3.41dB for conducted emissions and 3.91dB for radiated emissions. According to CISPR 16-4-2, if ULAB is less than UCISPR, then demonstration of compliance to the limits does not require an additional safety margin to account for measurement uncertainty.

ELECTROMAGNETIC INTERFERENCE
UNCERTAINTY DATA SHEET

Type of Measurement: Conducted Emissions, Transmitter, CE06

*Notes: Enter equipment or process uncertainty as dB in Column D or percent (±) in Column B.
If % is used, then column C is 10 if based on power (or resistance) or 20 if based on voltage (or current)
In column E, enter R if the uncertainty is a rectangular distribution (e.g., ± 2dB)
In column E, enter U if the uncertainty is a u-shaped distribution (e.g., ± 2dB)
In column E, enter T if the uncertainty is a triangular shaped distribution (e.g., ± 2dB)
In column E, enter S if the uncertainty is one standard deviation (e.g., 2dB)
In column E, enter E if the uncertainty is expanded uncertainty at 95% confidence (e.g., 2dB)

Device or Source of Error	(Column B) Measurement Tolerance (%)	(Column C) 10 or 20 Log basis	(Column D) Measurement Tolerance (dB)	(Column E) Type of Distribution	Standard Uncertainty (dB)	Remarks
Setup Repeatability			0.27	S	0.27	Stnd Dev of Test Setup
EMI Receiver			2.00	R	1.15	R&S EMI Receiver
Cable Loss			1.00	T	0.41	Cable Pre-cal
Attenuator			1.00	R	0.58	Weinschel 48-20-34
VSWR Mismatch			0.29	U	0.21	VSWR=1.5:1 & 1.4:1
Combined Standard Uncertainty, u_c , expressed in dB =					1.40	
Expanded Uncertainty, U, using coverage factor, k=2, expressed in dB =					2.79	

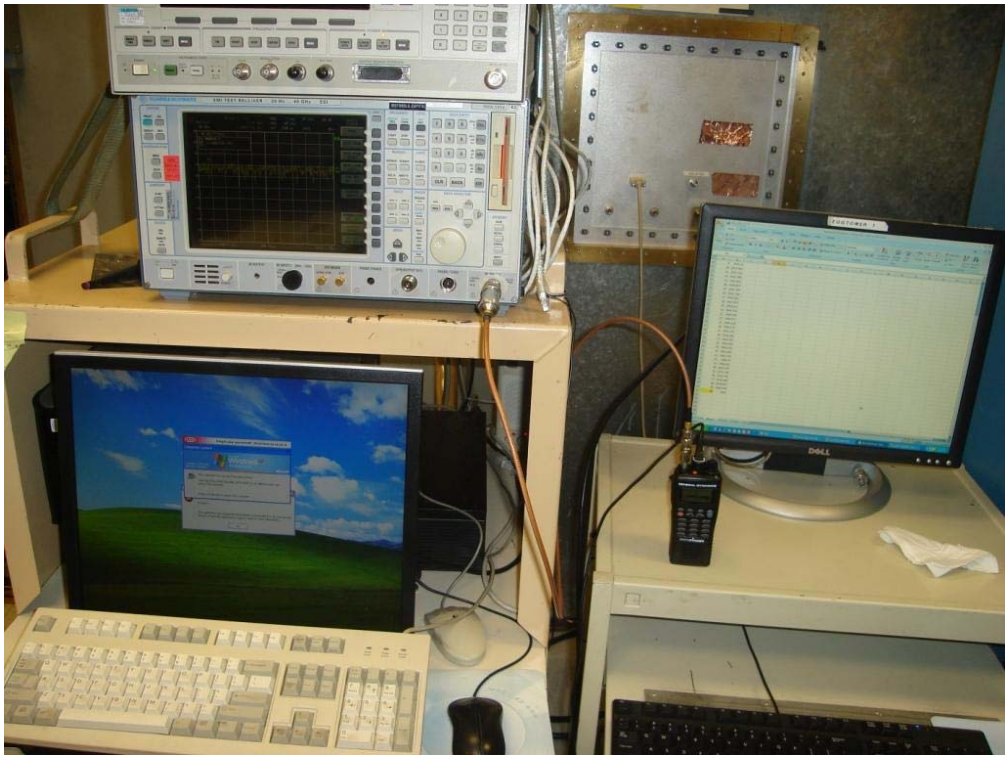
The expanded uncertainty, U, represents 95% confidence that the measured value will be within ± U dB of the true value.

Rectangular distributions are Type B evaluations (see NIST Technical Note 1297) where the range of accuracy is expressed as ± X dB or ± x % without any statistical information. For the user, the true value could lie anywhere within the range from -x to +

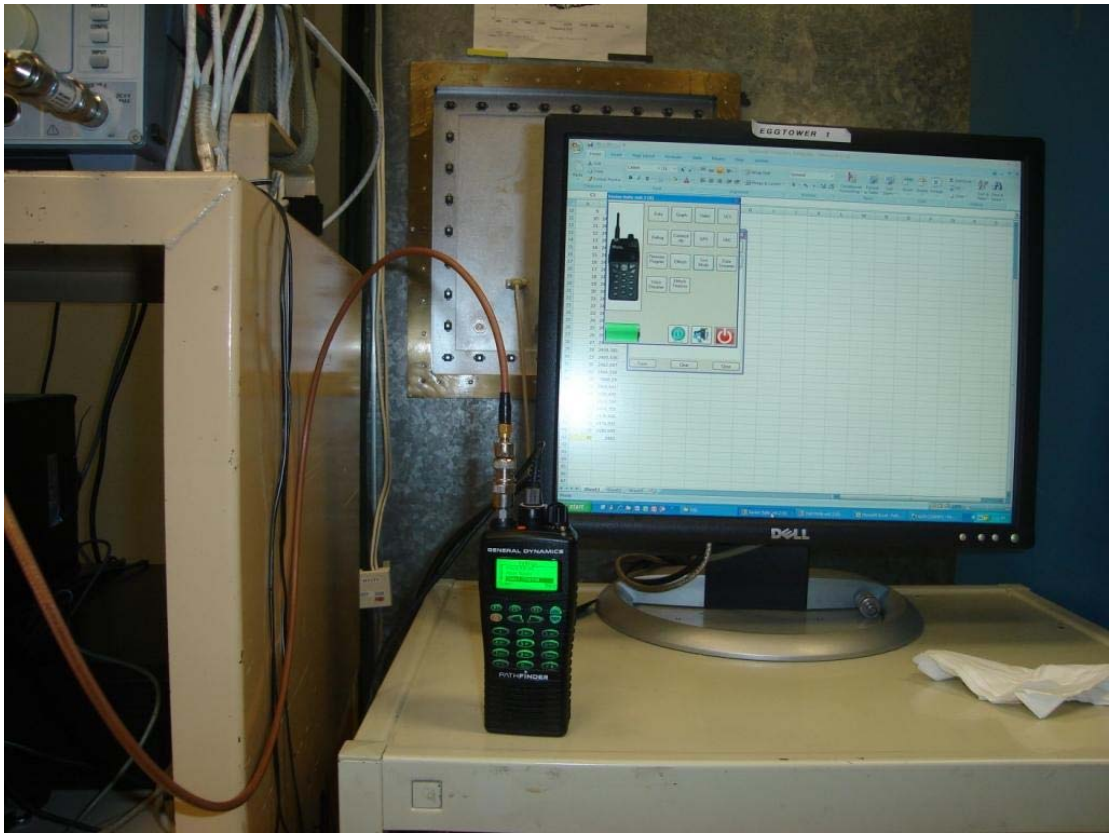
For Type A evaluations, the standard uncertainty of a measured value is calculated from the descriptive statistics of a series of repeated observations. The measurement uncertainty is equal to one standard deviation of the mean. This value is related to

It is the policy of the General Dynamics EMC/TEMPEST Laboratory to provide uncertainty data sheets for all compliance related measurements. The test limits as defined by the appropriate standards organizations are assumed to already include a reasonable

ATTACHMENT 2: TEST SETUP PHOTOS



Conducted Emissions Test Configuration



Conducted Emissions Test Configuration

Radiated Emissions Test Configuration, Anechoic Chamber

Radiated Emissions Test Configuration, OATS

Radiated Emissions Test Configuration, OATS