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Lab Number:	R11CA14739-PAS
Project Number:	11CA14739
File Number:	MC16660
Date:	March 28, 2011
Model:	PAS (FCC ID: X9INCS01010910)

Electromagnetic Compatibility Test Report

For

Elliott Tech LLC

Raleigh, NC

Test Report Details

Tests Performed By:	**Underwriters Laboratories Inc.** **12 Laboratory Dr.** **Research Triangle Park, NC 27709**
Tests Performed For:	**Elliott Tech, LLC** **346 Raleigh Street** **Holly Springs, NC 27540**
Applicant Contact: Title:	**Krista L. Larrison** **Project Administrator**
Phone: Fax: E-mail:	**+1 (919) 342-6899** **+1 (888) 631-1795** **k.larrison@elliotttech.com**
Test Report Date:	**March 28, 2010**
Product Type:	**Unlicensed Transmitter**
Product standards	**FCC Part 15, Subpart C, 15.247**
Model Number:	**PAS**
Sample Serial Number:	**Unserialized, pre-production sample**
EUT Category:	**Low Power Transmitter 902-928 MHz**
Testing Start Date:	**March 7, 2011**
Date Testing Complete:	**March 11, 2011** (Follow-up Measurement on March 31, 2011)
Overall Results:	**Compliant**

Report Directory

Report Revision History

Revision Date	Description	Revised By	Revision Reviewed By
None			

1.0 G E N E R A L - Product Description

1.1 Equipment Description

This family of devices operate as a personal alert system operating on the 902-928 MHz ISM band. The system consists of four different products.

(1) Hub – serves as the center of the system. It receives an alert and communicates to security personnel.
(2) PAS – a body-worn or hand-held transceiver that, when a button is depressed, initiates an alert.
(3) Outdoor Repeater – relays signals between the PAS and Hub. Intended to be mounted outdoors.
(4) Indoor Repeater – same as the outdoor repeater, but without a weatherproof enclosure.

All four devices contain an identical transceiver section operating with identical output power, modulation, and duty cycle.

This report documents measurements performed for the PAS.

This device contains a permanently affixed antenna of gain -1.0 dBi. No other antenna may be attached.

1.2 Device Configuration During Test

1.2.1 Equipment Used During Test:

Use	Product Type	Manufacturer	Model	Comments
EUT	Transceiver	Elliott Technologies	PAS	902-928 MHz Transceiver
Note: **EUT** - Equipment Under Test, **AE** - Auxiliary/Associated Equipment, or **SIM** - Simulator (Not Subjected to Test)				

1.2.2 Input/Output Ports:

Port #	Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
0	Enclosure	N/E	—	—	
-	Battery	DC	N	N	This unit is not AC powered.
1	Antenna	N/E	N	-	Antenna is permanently attached

Note:
AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

1.2.3 EUT Internal Operating Frequencies:

Frequency (MHz)	Description
32	Highest Digital (unintentional) operating frequency
902-928	Transmit Frequency Band

1.2.4 Power Interface:

Mode # /Rated	Voltage (V)	Frequency (DC/AC-Hz)	Phases (#)	Comments
1	Battery	DC	-	None The battery was fully charged prior to testing

1.3 Block Diagram:

A block diagram is provided as a separate exhibit for FCC Certification.

1.4 EUT Configurations

Mode #	Description
1	Device is positioned as described in each test section. Each of three orthogonal axes (Flat, Upright, and side) are examined to determine worst-case radiated spurious emissions.

1.5 EUT Operation Modes

Mode #	Description
1	The device is tested at highest output power on low, middle, or high channel as noted in each test section. Device is set to transmit continuous transmission for measurement in most tests. Normal On/Off cycle is enabled for duty cycle measurement.

1.6 Test Setup Photos

Setup Photos are provided as a separate exhibit for FCC Certification.

2.0 Summary

The tests listed in the Summary of Testing section of this report have been performed and the results recorded by Underwriters Laboratories Inc. in accordance with the procedures stated in each test requirement and specification. The applicant determined the list of tests performed were applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

2.1 Deviations from standard test methods

None

2.2 Device Modifications Necessary for Compliance

None

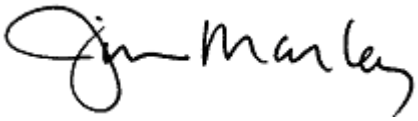
2.3 Reference Standards

Standard Number	Standard Name	Standard Date
FCC Part 15, Subpart C, 15.247	Code of Federal Regulations, Part 15, Radio Frequency Devices	2010
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	2003

2.4 Results Summary

Requirement – Test	Result (Compliant / Non-Compliant)*
Radiated Spurious Emissions	Compliant
Conducted Spurious Emissions	Compliant
Band Edge Compliance	Compliant
Frequency Hopping	Compliant
Maximum Output Power	Compliant
Occupied Bandwidth	Compliant
Duty Cycle	Pass/Fail Not Applicable
Maximum Permissible Exposure	Compliant

Test Engineer:



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3.0 Calibration of Equipment Used for Measurement

All test equipment and test accessories are calibrated on a regular basis. The maximum time between calibrations is one year or the manufacturers' recommendation, whichever is less.

All test equipment calibrations are traceable to the National Institute of Standards and Technology (NIST); therefore, all test data recorded in this report is traceable to NIST.

4.0 EMISSIONS TEST RESULTS

The emissions tests were performed according to following regulations:

---------- United States ----------

Code of Federal Regulations Title 47	Part 15, Subpart C, Section 15.247

Unless specified otherwise in the individual Methods, the tests shall be conducted under the following ambient conditions. Confirmation of these conditions shall be verified at the time the test is conducted.

Ambient Temperature, °C	22.5 ± 2.5	Relative Humidity, %	45 ± 15	Barometric Pressure, mBar	950 ± 150

Measurement Uncertainty

Test	Uncertainty
Conducted Emissions	± 2.5
Radiated Emissions	± 3.4

Sample Calculations

Radiated Emissions data contained within this report is calculated as follows:

- Field Strength (dBuV/m) = Receiver Reading (dBuV) + Antenna Factor (dB/m) – Amp Gain (dB) + Cable/Filter Losses (dB)

Conducted Emissions data contained within this report is calculated as follows:

- Conducted Voltage (dBuV) = Receiver Reading (dBuV) + Cable/Attenuator Losses (dB) + LISN Correction Factor (dB)

4.1 Test Conditions and Results – RADIATED SPURIOUS EMISSIONS

Test Description	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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section15.205(c)).

Basic Standard	47 CFR Part 15.209/15.247(d), ANSI C63.4:2003 RSS-210, A8.5 RSS-Gen 7.2.1 and 7.2.3	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 9.3 GHz	3 meter distance

Limits (Radiated – Restricted Bands Only)

Frequency (MHz)	Limit (dBµV/m)	
	Quasi-Peak	Average
	General Emissions	Spurious
30 – 88	29.54	-
88 – 216	33.06	-
216 – 960	35.56	-
960 – 1000	43.52	-
1,000 – 9280	-	54

Supplementary information:

Below 1GHz, spectrum was checked. All emissions related to the transmitter below 1GHz are not in the restricted band therefore only antenna conducted limits apply (20 dB below the peak level of the fundamental).

Radiated Spurious emissions was performed in three orthogonal axes on the middle channel. The worst-case axis was noted. The low and high channels were measured in this position.

Figure 1 RADIATED SPURIOUS EMISSIONS EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: None		

Figure 2 RADIATED SPURIOUS EMISSIONS Test Equipment

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	30-1000 MHz Range				
AT0025	Biconical Antenna, 30 to 300 MHz	Schaffner, EMC	VBA6106A	2010-8-28	2011-8-31
AT0030	Log-periodic Antenna, 200 MHz to 1000 MHz	Chase	UPA6109	2010-8-28	2011-8-31
	1-10 GHz				
AT0032	Horn Antenna 1 to 18 GHz	EMC Test Systems	3115	2010-10-28	2011-10-31
	Gain-Loss Chains				
SAC_C (Biconical 3m location)	(1) ATA084: Attenuator (2) ATA124: Amplifier (3) ATA167: Cable (4) ATA132: Cable (5) ATA229: DC Bias Tee (6) ATA199: Cable	(1) Pasternack (2) Miteq (3) Eupen (4) UL (5) Miteq (6) Micro-Coax	(1) PE7002-6 (2) AM-3A-000110-N (3) CMS/RG 214 (4) UFA210A-0-6000-50U-50U (5) BT2000-C (6) UFB293C-0-0720-5GU50U)	2010-8-16	2011-8-31
SAC_D (Log-Periodic 3m location)	(1) ATA085: Attenuator (2) ATA125: Amplifier (3) ATA225: Cable (4) ATA189: Cable (5) ATA115: DC Bias Tee (6) ATA198: Cable	(1) Pasternack (2) Miteq (3) EUPEN (4) EUPE (5) Miteq (6) Micro-Coax	(1) PE7002-6 (2) AM-3A-000110-N (3) CMS/RG 214 (4) CMS/RG 214 (5) AM-1523-7687 (6) UFB293C-0-0720-5GU50U	2010-8-16	2011-8-31
SAC_E_HORN (Horn 3m location)	(1) ATA144: Amplifier (2) ATA207: Cable (3) ATA096: Cable (4) ATA199: Cable	(1) Miteq (2) Micro-Coax (3) Micro-Coax (4) Micro-Coax	(1) AFS42-00101800-25-N-42MF (2) UFB293C-1-3360-50U50U (3) UTiFLEX (4) UFB293C-0-0720-5GU50U	2010-8-16	2011-8-31
	Receiver & Software				
SAR004	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	2010-2-25	2011-2-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
HPF003	High-Pass Filter	Mini-Circuits	HPF-1810	2011-3-3	2012-3-31

Table 3 RADIATED SPURIOUS EMISSIONS Results (Summary)

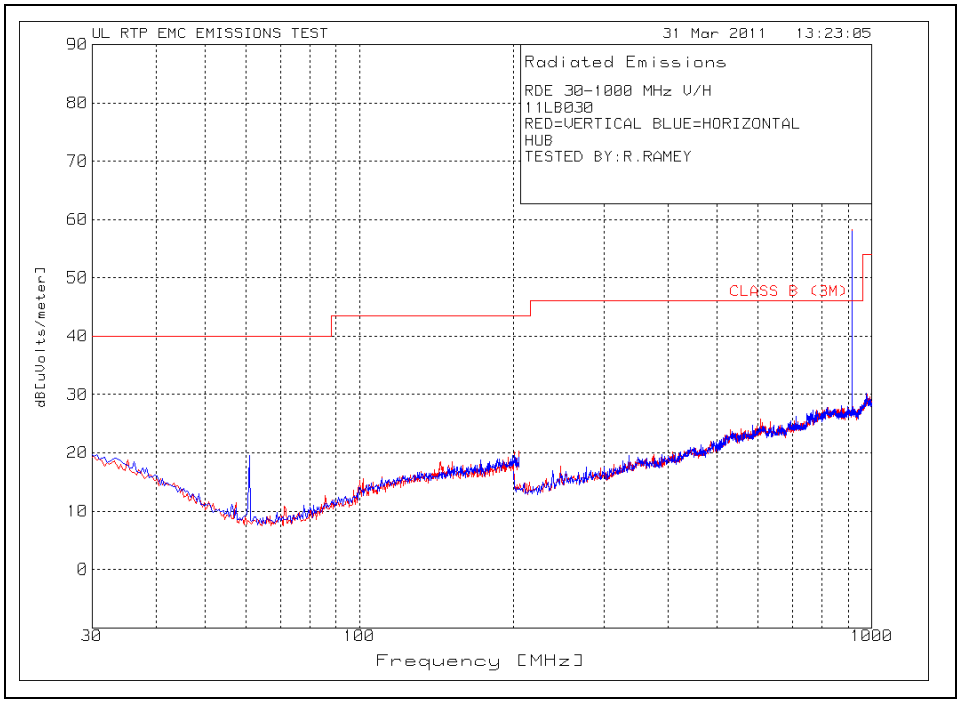
Transmit Channel (L/M/H)	EUT Orient.	Freq. (MHz)	Detect. Type (P/A/Q)	Receiver Reading (dBuV)	Cable /Amp Factor (dB)	Anten. Factor (dB/m)	Field Strength (dBuV/m)	Duty Cycle Avg (dB)	Field Strength (dBuV/m)	15.209 Limit (dBuV/m)	Margin (dB)	Anten. Polar. (V/H)	Anten. Height (cm)	Ttable Angle (deg)	Com-ments (#)
Mid	Upright	1830	P	42.7	-22.0	34.3	55.0	-	55.0	-	-	H	100	rot	
Mid	Upright	1830	A	42.7	-22.0	34.3	55.0	-8.4	46.6	-	-	H	100	rot	1
Mid	Upright	2744	P	57.1	-28.6	29.0	57.5	-	57.5	74.0	-16.5	V	100	rot	
Mid	Upright	2744	A	57.1	-28.6	29.0	57.5	-8.4	49.1	54.0	-4.9	V	100	rot	1
Mid	Upright	3660	P	59.5	-27.8	31.9	63.6	-	63.6	74.0	-10.4	V	100	rot	
Mid	Upright	3660	A	55.7	-27.8	31.9	59.8	-8.4	51.4	54.0	-2.6	V	100	rot	2
Mid	Upright	4572	P	48.9	-25.2	32.4	56.1	-	56.1	74.0	-17.9	V	100	rot	
Mid	Upright	4574.94	A	42.7	-25.2	32.4	49.9	-8.4	41.5	54.0	-12.5	V	101	250	2
Mid	Side	1830	P	61.3	-27.6	27.0	60.7	-	60.7	-	-	V	151	rot	
Mid	Side	1829.97	A	59.5	-27.6	27.0	58.9	-8.4	50.5	-	-	V	153	291	2
Mid	Side	2744	P	56.2	-28.6	29.0	56.6	-	56.6	74.0	-17.4	V	150	rot	
Mid	Side	2744	A	56.2	-28.6	29.0	56.6	-8.4	48.2	54.0	-5.8	V	150	rot	1
Mid	Side	3660	P	59.0	-27.8	31.9	63.1	-	63.1	74.0	-10.9	V	100	rot	
Mid	Side	3660	A	51.8	-27.8	31.9	55.9	-8.4	47.5	54.0	-6.5	V	100	rot	2
Mid	Side	4575	P	47.5	-25.2	32.4	54.7	-	54.7	74.0	-19.3	V	100	rot	
Mid	Side	4575	A	47.5	-25.2	32.4	54.7	-8.4	46.3	54.0	-7.7	V	100	rot	1
Mid	Side	5484	P	43.6	-22.0	34.3	55.9	-	55.9	74.0	-18.1	V	150	rot	
Mid	Side	5484	A	43.6	-22.0	34.3	55.9	-8.4	47.5	54.0	-6.5	V	150	rot	1
Mid	Flat	1830	P	63.7	-27.6	27.0	63.1	-	63.1	-	-	H	100	rot	
Mid	Flat	1829.98	A	60.4	-27.6	27.0	59.8	-8.4	51.4	-	-	H	102	328	2
Mid	Flat	2744	P	57.1	-28.6	29.0	57.5	-	57.5	74.0	-16.5	H	100	rot	
Mid	Flat	2744.95	A	54.2	-28.6	29.0	54.6	-8.4	46.2	54.0	-7.8	H	102	176	2
Mid	Flat	3660	P	59.7	-27.8	31.9	63.8	-	63.8	74.0	-10.2	H	100	rot	
Mid	Flat	3659.94	A	54.2	-27.8	31.9	58.3	-8.4	49.9	54.0	-4.1	H	102	98	2
Mid	Flat	4575	P	47.1	-25.2	32.4	54.3	-	54.3	74.0	-19.7	H	100	rot	
Mid	Flat	4575	A	47.1	-25.2	32.4	54.3	-8.4	45.9	54.0	-8.1	H	100	rot	1
Mid	Flat	5484	P	43.2	-22.0	34.3	55.5	-	55.5	74.0	-18.5	V	100	rot	
Mid	Flat	5484	A	43.2	-22.0	34.3	55.5	-8.4	47.1	54.0	-6.9	V	100	rot	1
Low	Flat (worst)	1806	P	64.5	-27.2	26.9	64.2	-	64.2	-	-	H	100	rot	
Low	Flat	1804.98	A	61.6	-27.2	26.9	61.3	-8.4	52.9	-	-	H	113	19	2
Low	Flat	2706	P	55.6	-28.7	29.0	55.9	-	55.9	74.0	-18.1	V	100	rot	
Low	Flat	2707.46	A	48.6	-28.7	29.0	48.9	-8.4	40.5	54.0	-13.5	V	113	245	2
Low	Flat	3609	P	58.9	-27.7	31.6	62.8	-	62.8	74.0	-11.2	H	100	rot	
Low	Flat	3609.95	A	56.0	-27.7	31.6	59.9	-8.4	51.5	54.0	-2.5	H	102	67	2

Transmit Channel (L/M/H)	EUT Orient.	Freq. (MHz)	Detect. Type (P/A/Q)	Receiver Reading (dBuV)	Cable /Amp Factor (dB)	Anten. Factor (dB/m)	Field Strength (dBuV/m)	Duty Cycle Avg (dB)	Field Strength (dBuV/m)	15.209 Limit (dBuV/m)	Margin (dB)	Anten. Polar. (V/H)	Anten. Height (cm)	Ttable Angle (deg)	Com-ments (#)
Low	Flat	4512	P	50.7	-26.0	32.3	57.0	-	57.0	74.0	-17.0	H	100	rot	
Low	Flat	4512.58	A	42.6	-25.9	32.3	49.0	-8.4	40.6	54.0	-13.5	H	102	196	2
Low	Flat	5412	P	45.3	-22.3	34.2	57.2	-	57.2	74.0	-16.8	V	100	rot	
Low	Flat	5414.91	A	33.5	-22.3	34.2	45.4	-8.4	37.0	54.0	-17.0	V	196	223	2
High	Flat	1856	P	62.2	-28.0	27.1	61.3	-	61.3	-	-	H	100	rot	
High	Flat	1854.94	A	53.5	-28.0	27.1	52.6	-8.4	44.2	-	-	H	112	360	2
High	Flat	2782	P	58.0	-28.5	29.0	58.5	-	58.5	74.0	-15.5	H	153	rot	
High	Flat	2782.43	A	51.7	-28.5	29.0	52.2	-8.4	43.8	54.0	-10.2	H	132	55	2
High	Flat	3710	P	61.7	-27.4	32.3	66.6	-	66.6	74.0	-7.4	H	101	rot	
High	Flat	3709.93	A	53.7	-27.4	32.3	58.6	-8.4	50.2	54.0	-3.8	H	100	98	2
High	Flat	4636	P	49.0	-25.2	32.5	56.3	-	56.3	74.0	-17.7	V	151	rot	
High	Flat	4637.57	A	49.0	-25.2	32.5	56.3	-8.4	47.9	54.0	-6.1	V	123	74	1
High	Flat	5564	P	43.0	-21.8	34.2	55.4	-	55.4	74.0	-18.6	V	100	rot	
High	Flat	5564.89	A	43.0	-21.8	34.2	55.4	-8.4	47.0	54.0	-7.0	V	172	62	1

Notes:

1 Duty cycle factor is applied to peak measurements where that is sufficient to show compliance.
2 Duty cycle factor is applied to Average Measurement. Device is tested continuously transmitting with normal modulation - on/off cycling is disabled.

Figure 4 Radiated Spurious Emissions below 1GHz - Middle Channel



Note: No significant spurious emissions are observed below 1 GHz. Low and High channels are similar. Transmit signal is reduced by notch filter.

Figure 9A Radiated Spurious Emissions, Middle Channel (Flat-Orientation)

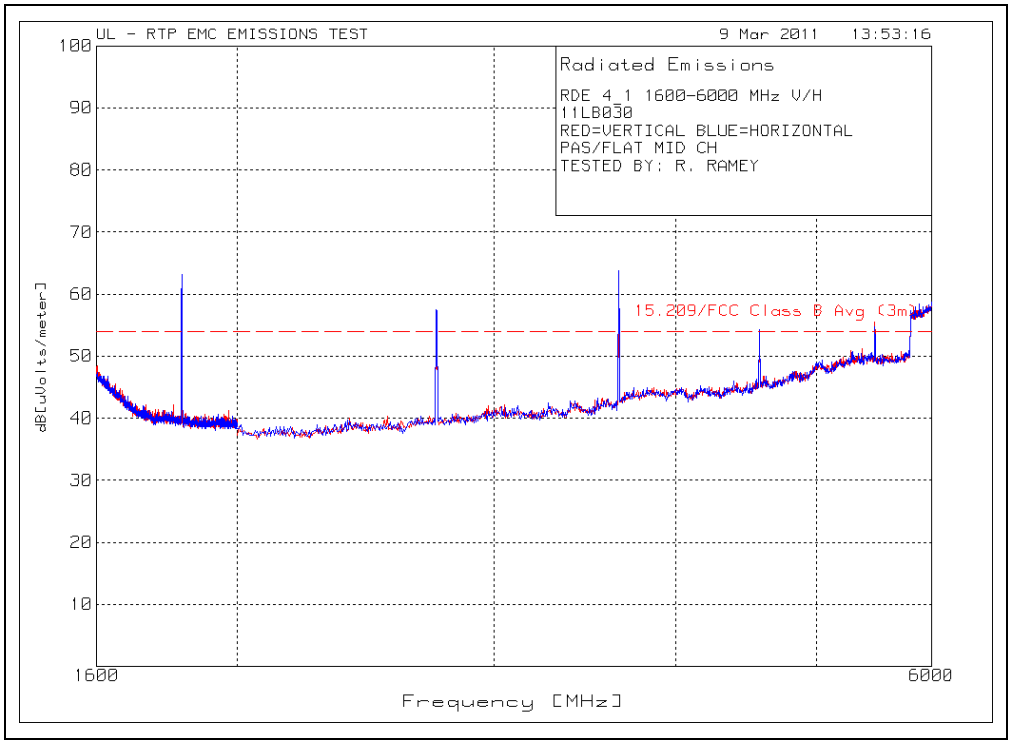


Figure 9B Radiated Spurious Emissions, Middle Channel (Side-Orientation)

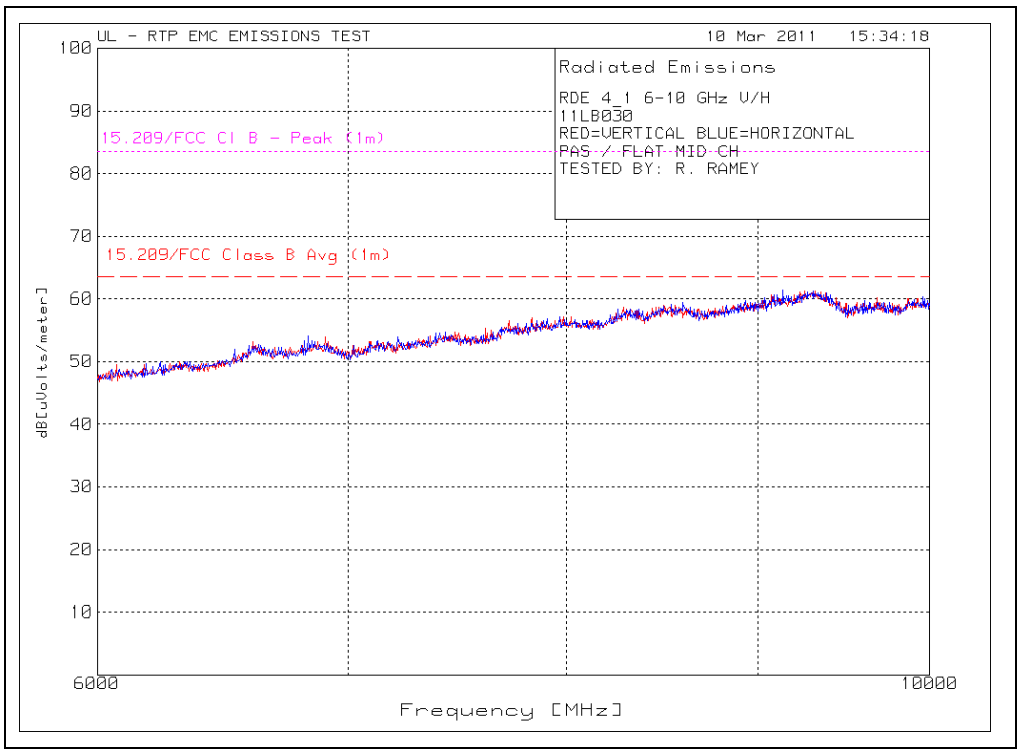


Figure 10A Radiated Spurious Emissions, Middle Channel (Side-Orientation)

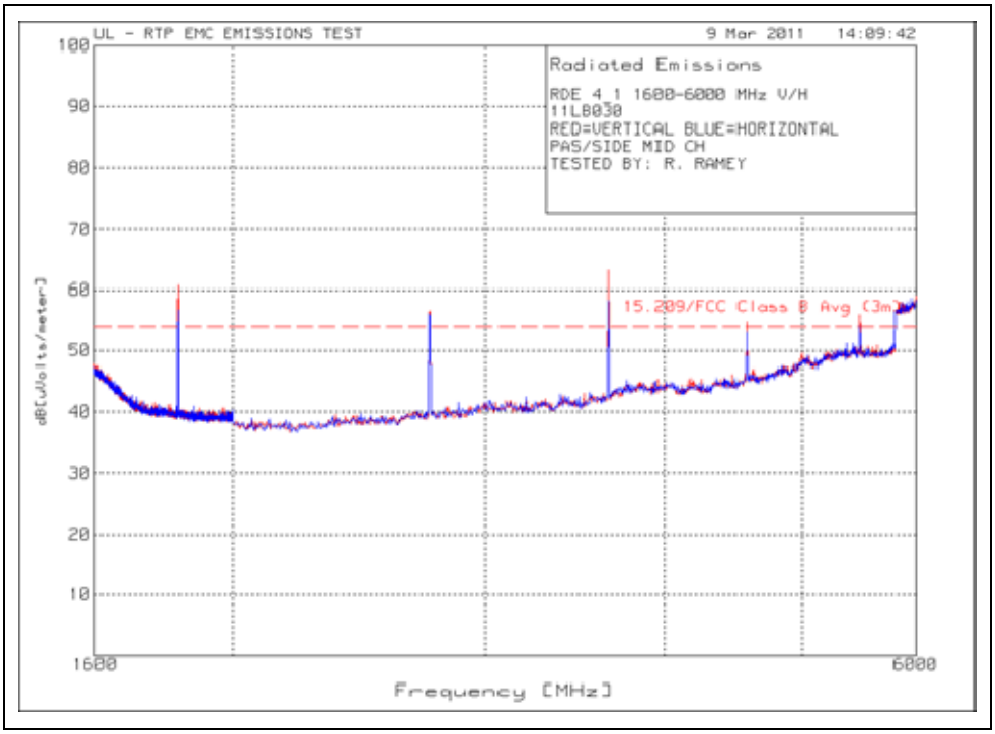


Figure 10B Radiated Spurious Emissions, Middle Channel (Side-Orientation)

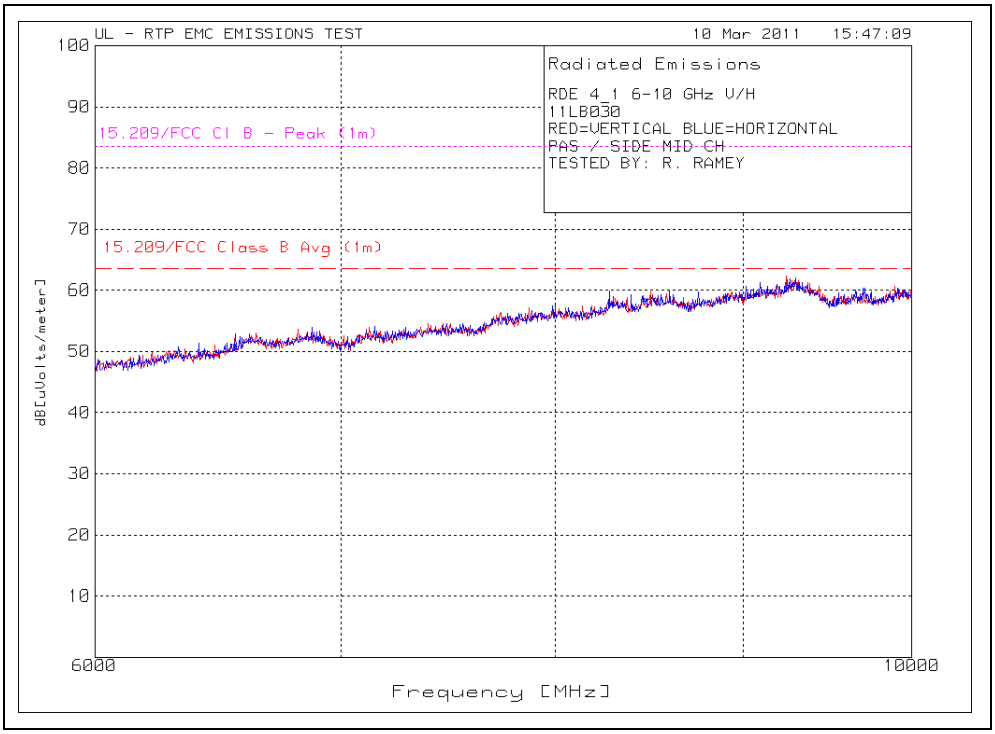


Figure 11A Radiated Spurious Emissions, Middle Channel (Upright-Orientation)

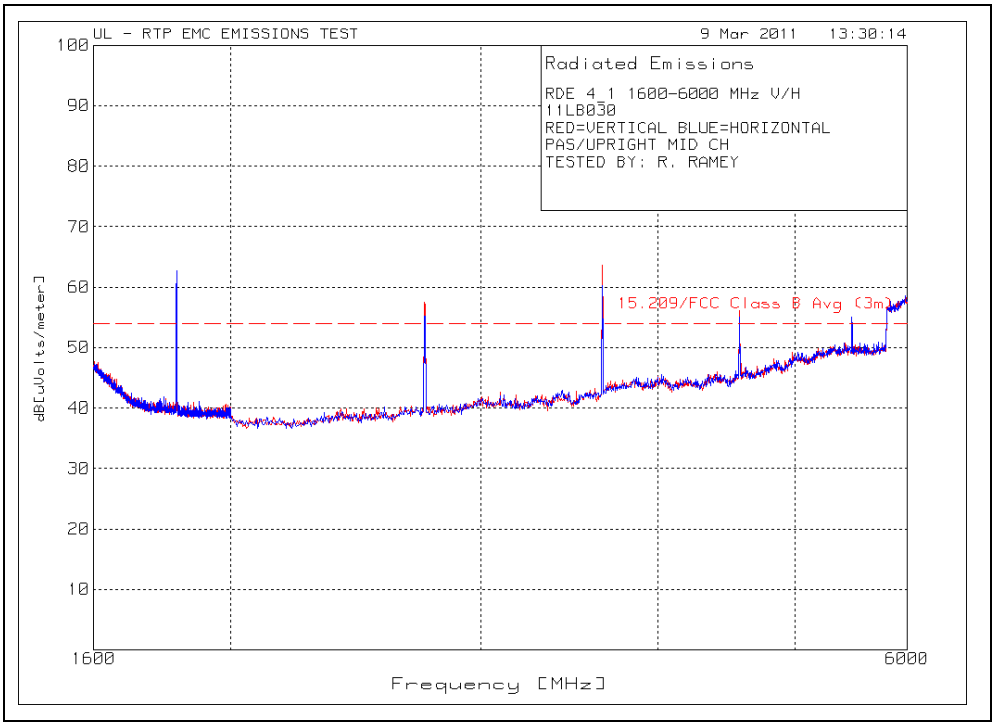


Figure 11B Radiated Spurious Emissions, Middle Channel (Z-Orientation)

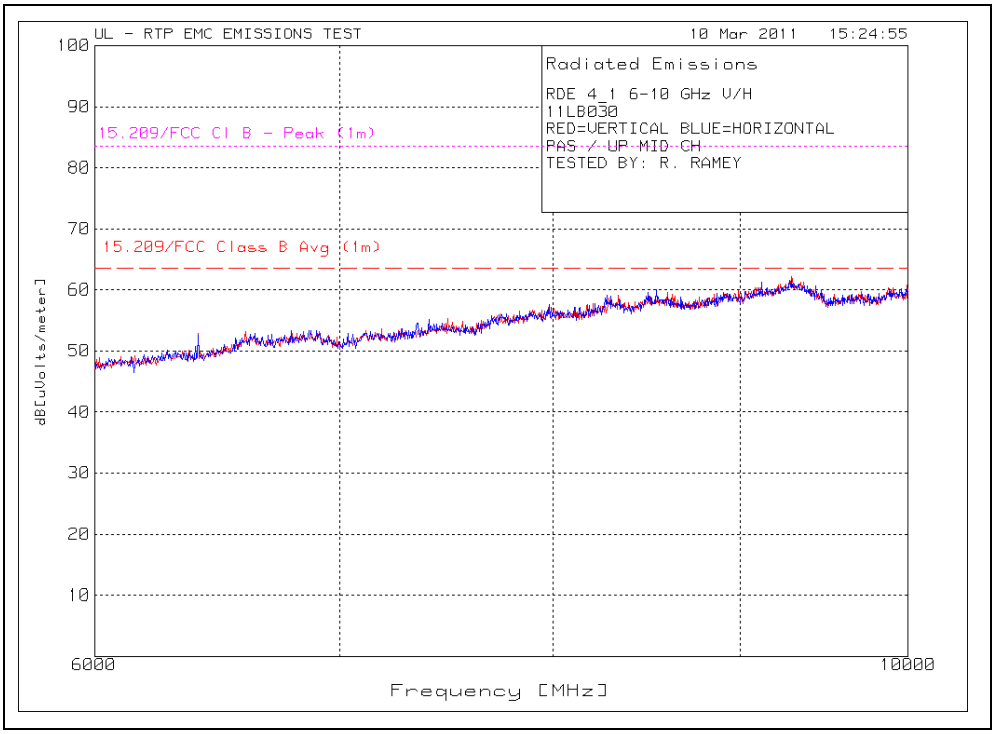


Figure 12A Radiated Spurious Emissions, Low Channel (Worst-case Orientation)

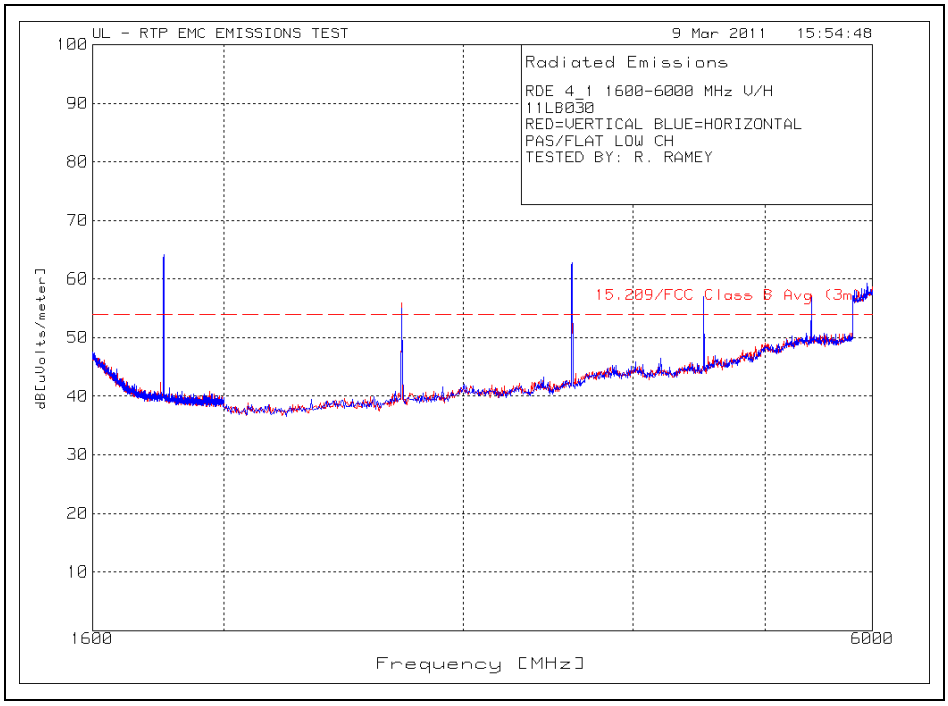


Figure 12B Radiated Spurious Emissions, Low Channel (Worst-Case Orientation)

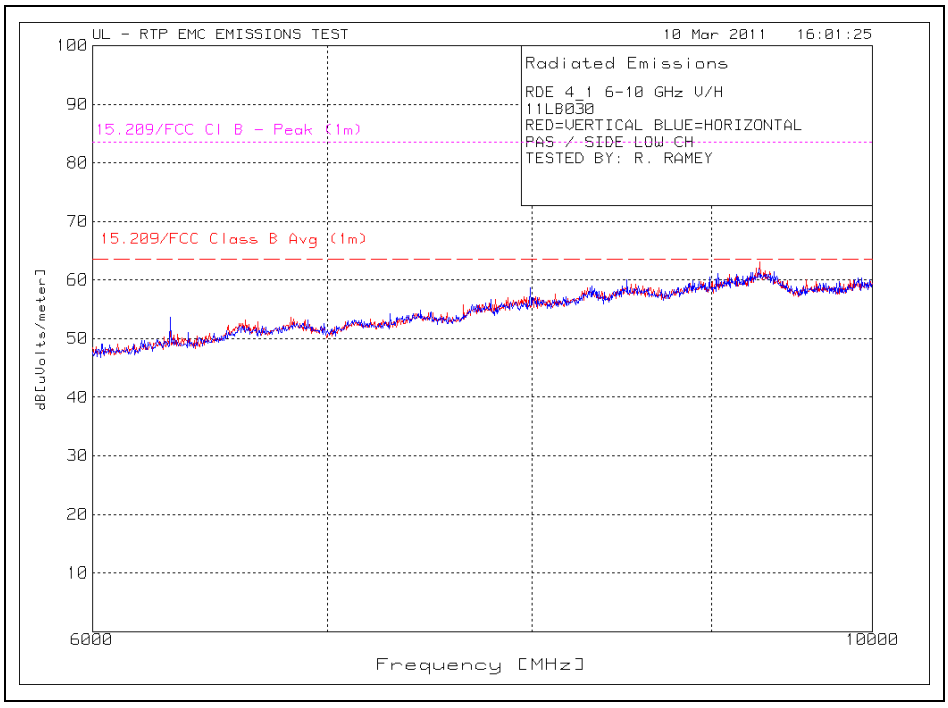


Figure 13A Radiated Spurious Emissions, High Channel (Worst-case Orientation)

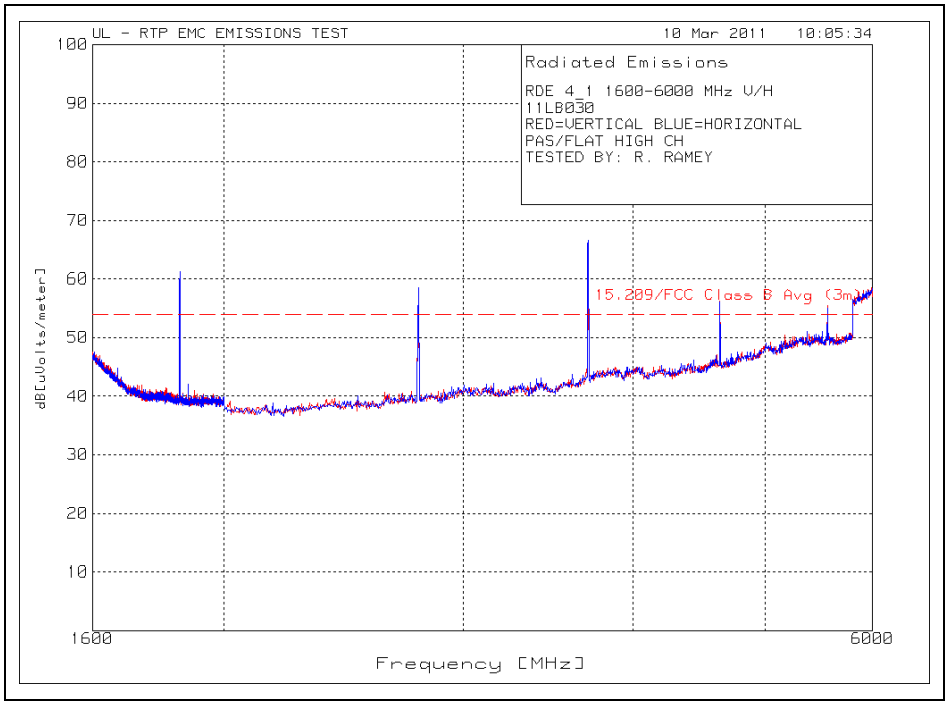
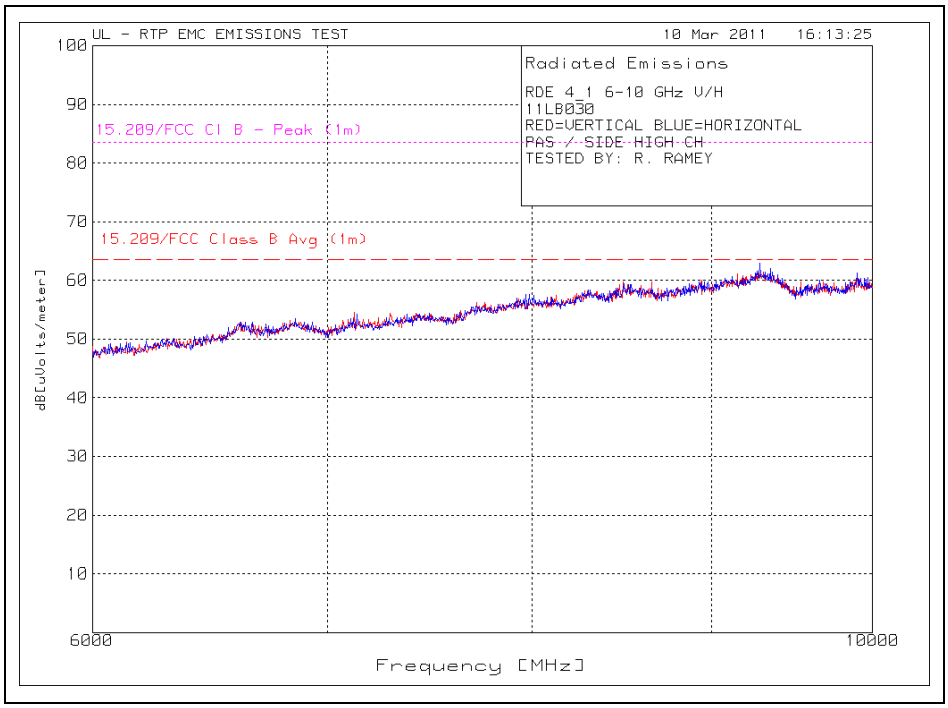


Figure 13B Radiated Spurious Emissions, High Channel (Worst-Case Orientation)



4.2 Test Conditions and Results – CONDUCTED SPURIOUS EMISSIONS

Test Description	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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section15.205(c)).	
Basic Standard	47 CFR Part 15.247(d), ANSI C63.4:2003 RSS-210, A8.5 RSS-Gen 7.2.1 and 7.2.3	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 9.3 GHz	Antenna port
Limits (Antenna Conducted)		
All emissions must be 20dB below the level of the fundamental frequency, as peak method is used.		
Supplementary information: None.		

Figure 5 CONDUCTED SPURIOUS EMISSIONS EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: None		

Figure 6 CONDUCTED SPURIOUS EMISSIONS Test Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SAR003	Spectrum Analyzer / Receiver	Hewlett-Packard	8572	2011-2-2	2012-2-29
-	Coaxial Cable	Pasternack	N-Male to SMA	N/A*	N/A
-	Attenuators (3x10dB)	-	N-Male to N-Female	N/A*	N/A

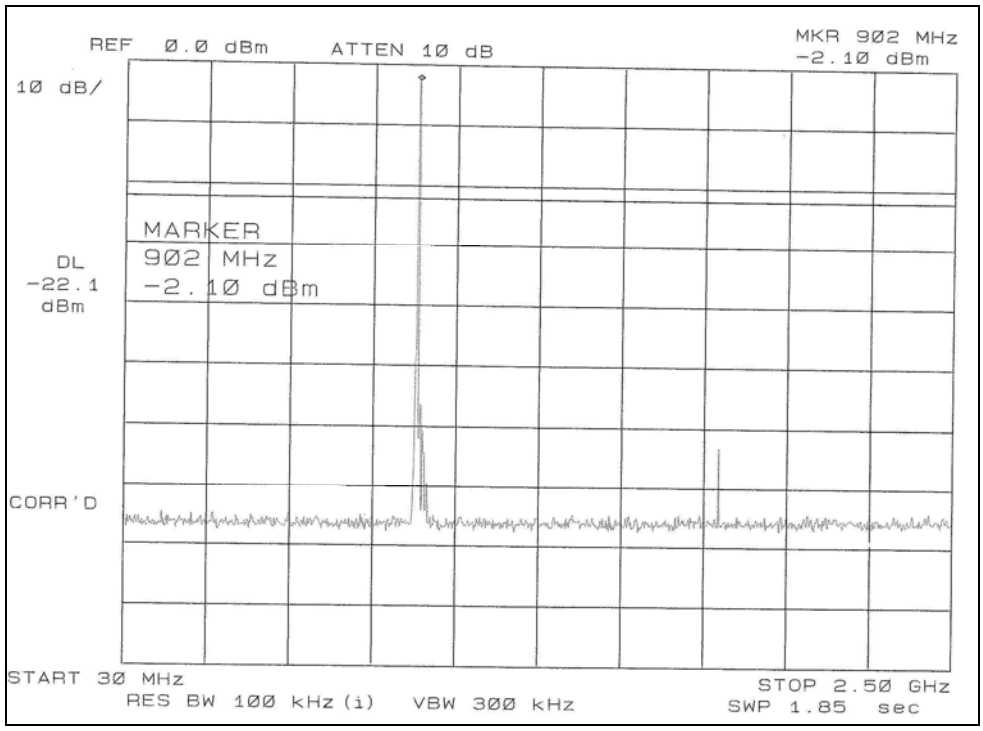
*Insertion loss verified prior to test

Figure 7 Test Results Table – Conducted Spurious Emissions (Summary)

Transmit Channel (L/M/H)	Frequency (MHz)	Detect. Type (P/A/Q)	Receiver Reading (dBuV)	Cable Factor (dB)	Attenuator Factor (dB)	Adjusted Power (dBm)	-20 dBc Limit (dBuV/m)	Margin (dB)	Comments (#)
Low	902.5	P	-2.8	0.4	30	27.6	-	-	Transmit Power
Low	1805	P	-63.0	0.4	30	-32.6	7.6	-40.2	Spurious (2nd harmonic)
Mid	914.5	P	-3.3	0.4	30	27.1	-	-	Transmit Power
Mid	1829	P	-59.1	0.4	30	-28.7	7.1	-35.8	Spurious (2nd harmonic)
High	927.5	P	-2.5	0.4	30	27.9	-	-	Transmit Power
High	1855	P	-58.5	0.4	30	-28.1	7.9	-36.0	Spurious (2nd harmonic)

*Note: Only the 2nd harmonic was visible above the measurement noise floor. All other harmonics are more than 50 dB below the transmit power.

Figure 8 Low-Channel 30 MHz – 10 GHz



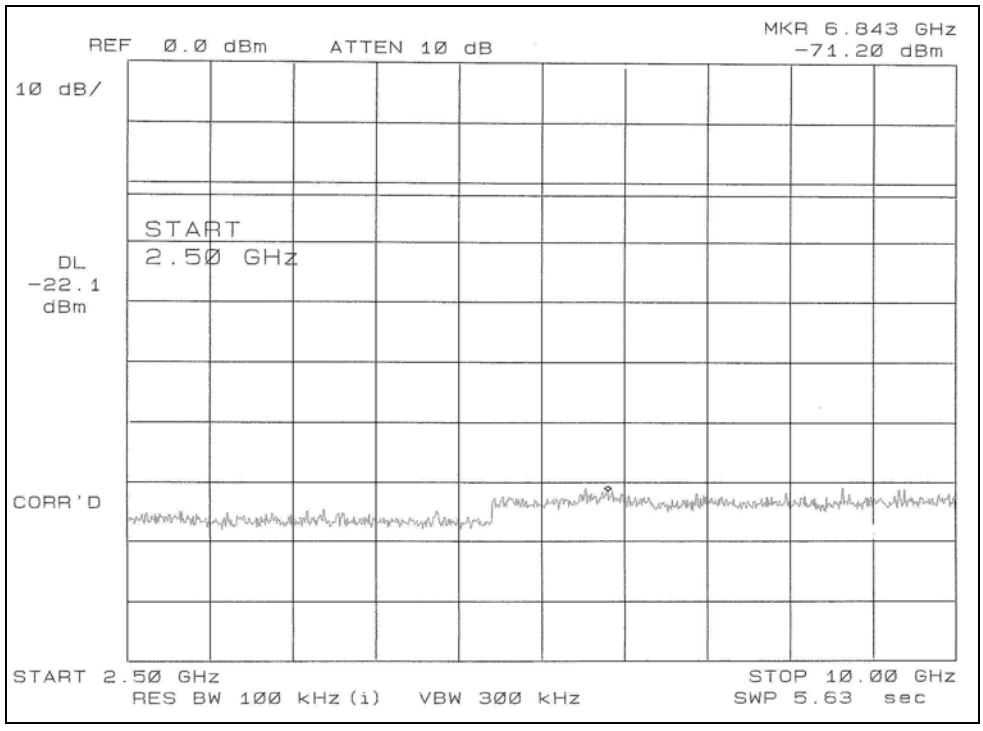
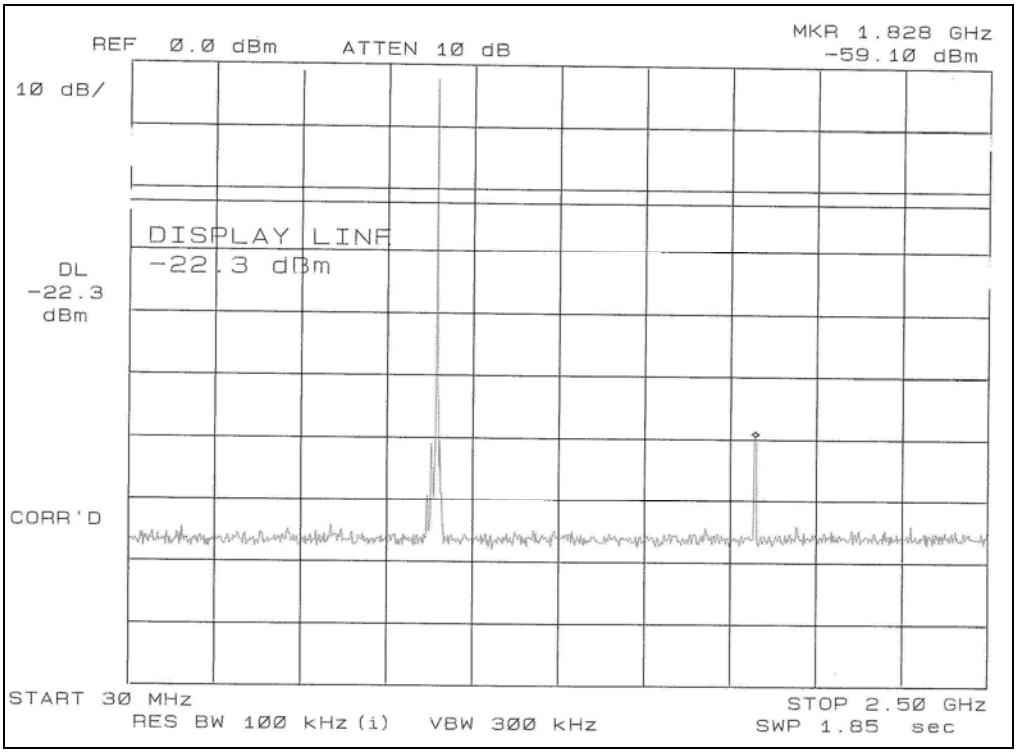


Figure 9 Mid-Channel 30 MHz – 10 GHz



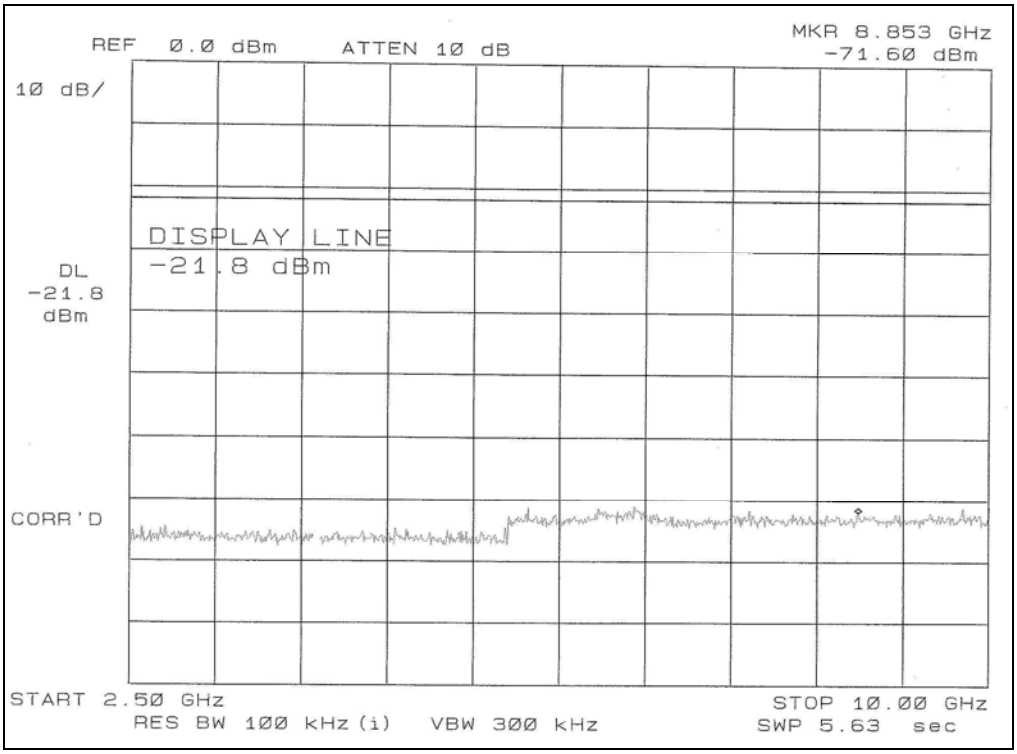
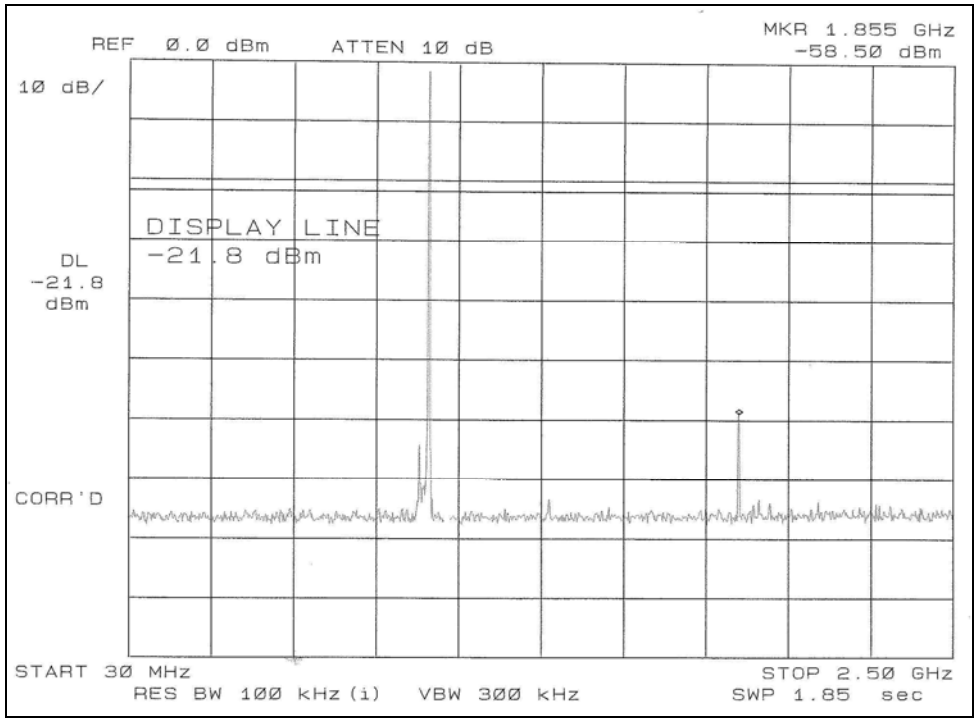
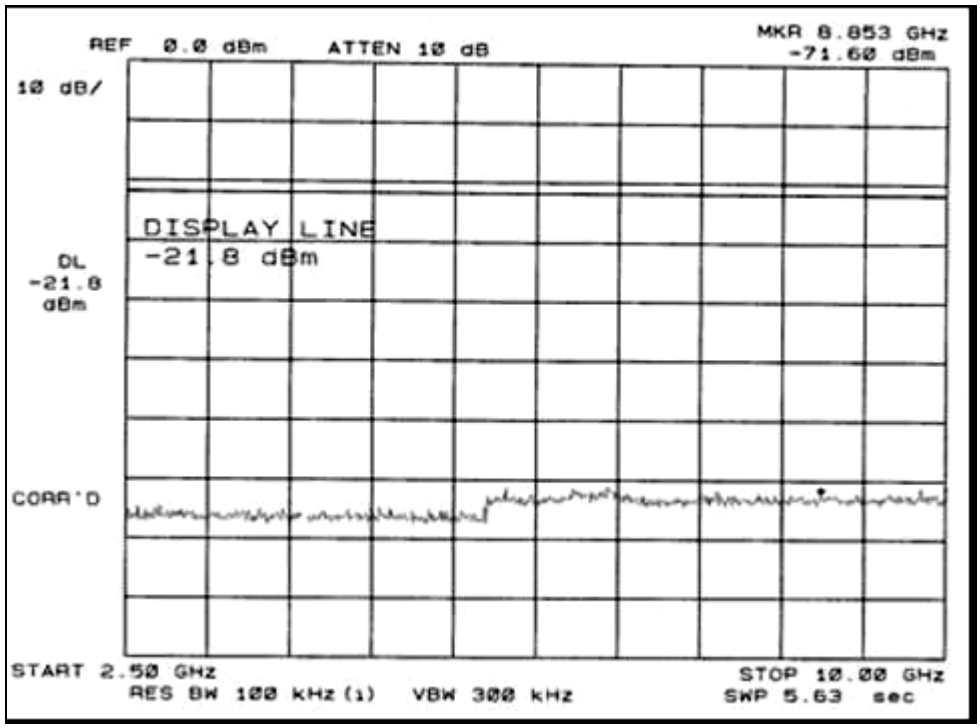


Figure 10 High-Channel 30 MHz – 10 GHz





4.3 Test Conditions and Results – BAND EDGE

Test Description	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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section15.205(c)).

Basic Standard	47 CFR Part 15.247(d). ANSI C63.4:2003 RSS-210, A8.5	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	902 MHz – 928 MHz	Antenna Conducted

Limits	
Measurement Type	
Conducted	Antenna Conducted – 20dB below the fundamental
Radiated	Radiated only required if emissions are in the restricted band
Supplementary information: Only antenna conducted is required. Peak power method is used. -20 dBc is shown to be within the 902-928 MHz band.	

Figure 11 Band Edge Compliance EUT Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: None		

Figure 12 Band Edge Compliance Test Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SAR003	Spectrum Analyzer / Receiver	Hewlett-Packard	8572	2011-2-2	2012-2-29
-	Coaxial Cable	Pasternack	N-Male to SMA	N/A*	N/A
-	Attenuators (3x10dB)	-	N-Male to N-Female	N/A*	N/A

*Insertion loss verified prior to test

Figure 13 Band Edge Compliance Data Points (Summary)

Transmit Channel (L/M/H)	Channel Frequency (MHz)	Detect. Type (P/A/Q)	-20dBC Frequency (MHz)	Band Edge (MHz)	Inside Band? (Y/N)	Comments (#)
Low	902.5	P	902.343	902.000	Y	Lower Band Edge
High	927.5	P	927.614	928.000	Y	Upper Band Edge

Figure 14 Conducted Band Edge Compliance Graph – Low Channel

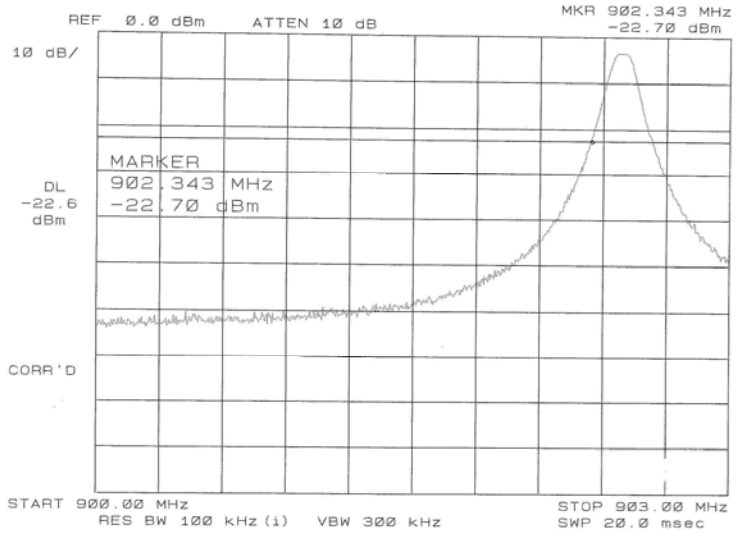
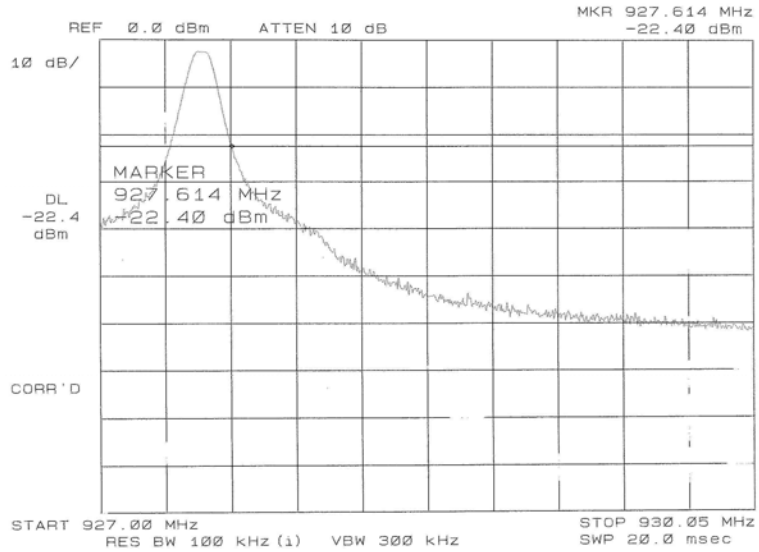


Figure 15 Conducted Band Edge Compliance Graph – High Channel



4.4 Test Conditions and Results – FREQUENCY HOPPING

Test Description	Number of Channels, Dwell on each channel, and pseudo-random hopping sequence is shown.	
Basic Standard	47 CFR Part 15.247 RSS-210, A8.1	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	902 MHz – 928 Mhz	Antenna Conducted
Limits		
Measurement Type	Requirements	
Minimum Number of Channels	50	
Channel Spacing	250 kHz	
Hopping Method	Pseudo-random sequence	
Supplementary information: None		

Figure 16 Spectral Density Compliance EUT Configuration Settings

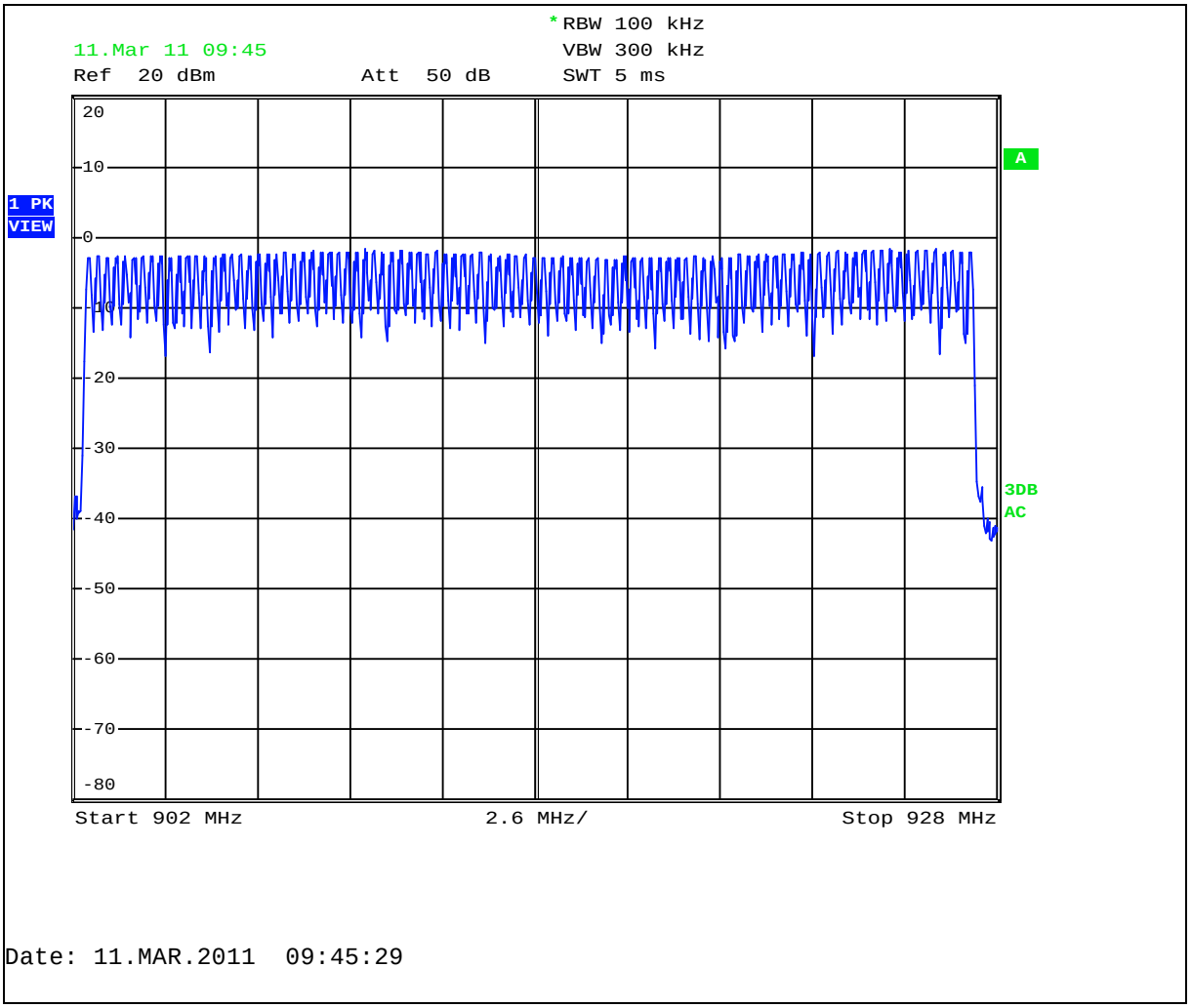
Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: None		

Figure 17 Spectral Density Compliance Test Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0015	Spectrum Analyzer / Receiver	Rohde & Schwarz	ESCI7	2011-1-25	2012-1-31
-	Coaxial Cable	Pasternack	N-Male to SMA	N/A*	N/A
-	Attenuators (3x10dB)	-	N-Male to N-Female	N/A*	N/A

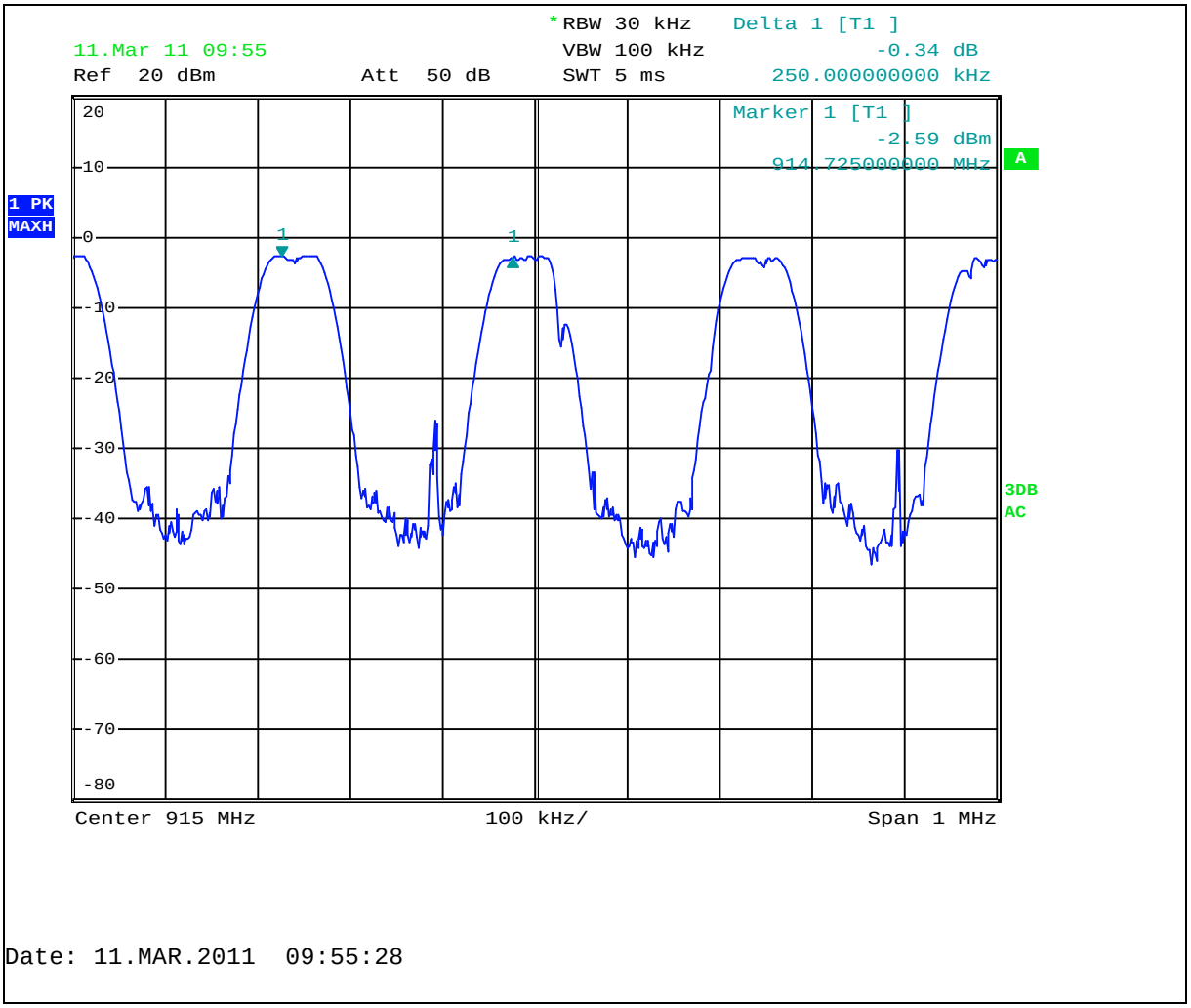
*Insertion loss verified prior to test

Figure 18 Number of Channels



A total of 101 channels are shown.

Figure 19 Channel Spacing



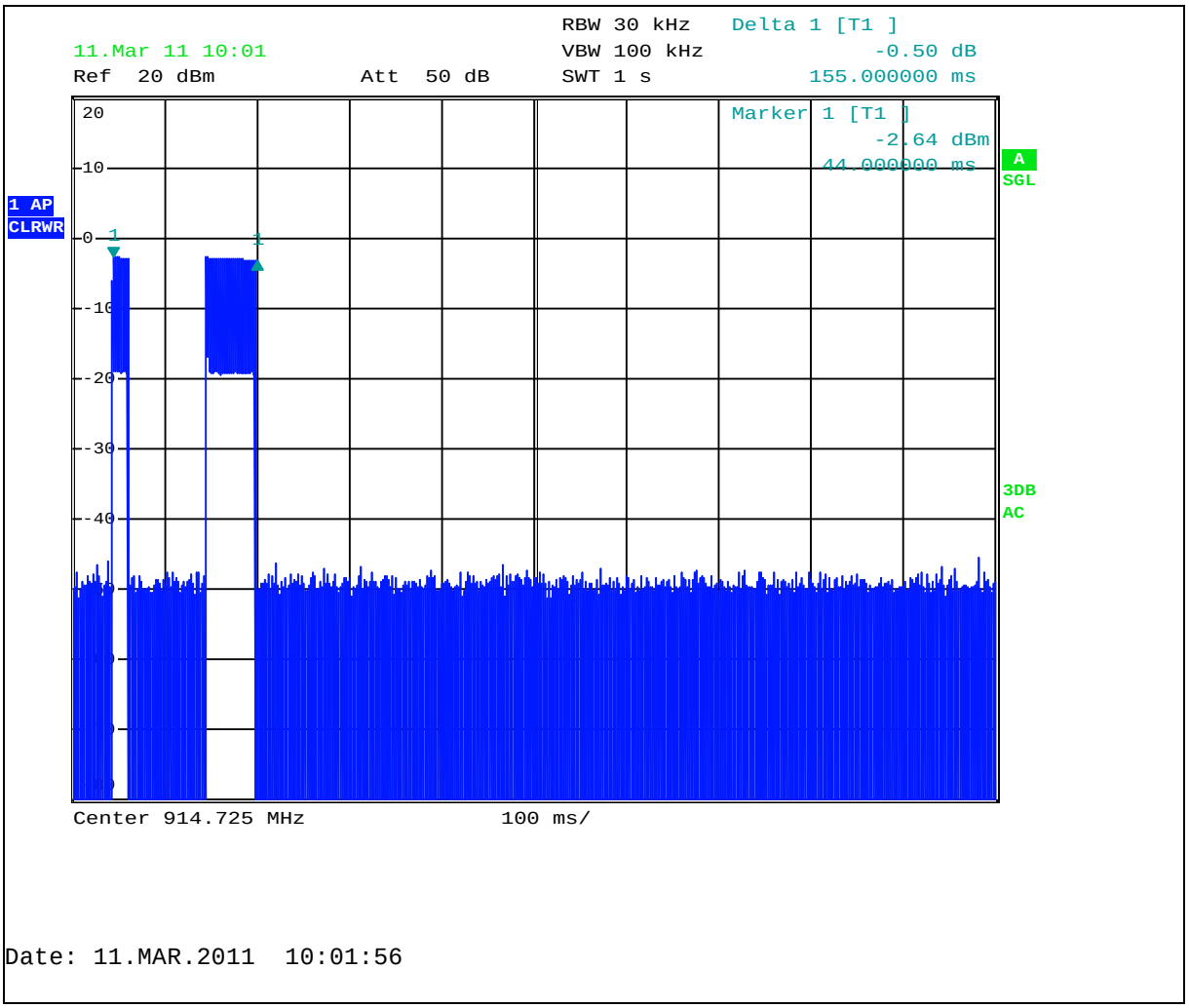
Channel Spacing is shown to be 250 kHz.

Figure 20 Pseudo-random Sequence (from Manufacturer's Literature)

Broadcast: 903, 911.25, 920.75, 925, 921.25, 922.5, 904.25, 904, 923, 910.25, 912.25, 922.25, 921.5, 904.5, 913.5, 922, 914.5, 914.75, 908.5, 903.5, 917.5, 919, 908.75, 920, 925.5, 924.5, 926.25, 905.5, 903.25, 909.75, 918.75, 926.75, 906.5, 924, 918.5, 907.25, 906.25, 902.75, 914.25, 923.5, 924.25, 908, 911.75, 915.75, 926, 927.25, 919.5, 919.25, 924.75, 917.75

Backbone: 912, 922.75, 910.5, 904.75, 912.5, 915.5, 917.25, 906, 912.75, 907.5, 923.25, 921.75, 906.75, 905, 911.5, 907, 913, 914, 905.75, 927, 926.5, 920.25, 917, 916.25, 909.25, 902.5, 925.75, 911, 903.75, 916, 905.25, 916.75, 918.25, 913.25, 921, 913.75, 915, 925.25, 918, 908.25, 916.5, 910.75, 920.5, 910, 909.5, 919.75, 915.25, 907.75, 923.75, 909

Figure 21 Dwell time per channel



Dwell time on each channel is shown to be 155 ms.

4.5 Test Conditions and Results – PEAK OUTPUT POWER

Test Description	For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.	
Basic Standard	47 CFR Part 15.247(b)(2), ANSI C63.4:2003 RSS-210, A8.4(1)	
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	902MHz – 928MHz	Antenna Conducted

Limits

Frequency (MHz)	Limit mW
	Peak
902 - 928	1000 (30dBm)

Supplementary information:

(1) Conducted Power measurement was performed on the hub device. The transmitter section of all devices within this family are identical, therefore these measurements are representative of the entire family.

(2) Resolution Bandwidth is set to 1 MHz, Video Bandwidth is set to 3 MHz. Both setting are larger than occupied BW,

(3) Transmitter is set to transmit continuously on the channel shown with normal modulation.

Figure 22 Maximum Peak Output Power Test Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SAR003	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	2011-2-2	2012-2-29
-	Coaxial Cable	Pasternack	N-Male to SMA	N/A*	N/A
-	Attenuators (3x10dB)	-	N-Male to N-Female	N/A*	N/A

*Insertion Loss verified prior to test

Figure 23 Maximum Peak Output Power Graph – Low Channel

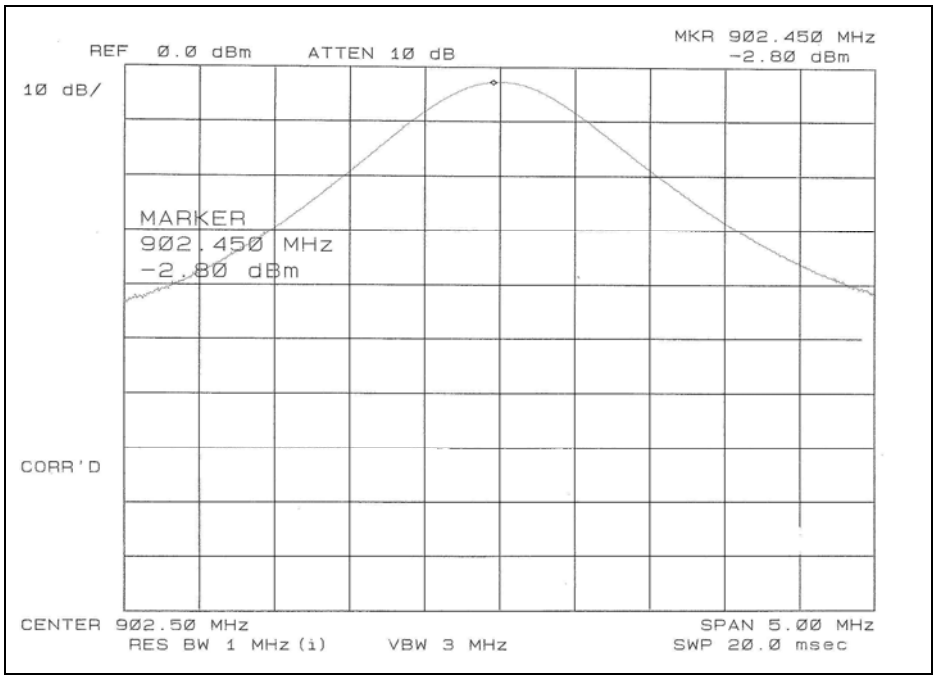


Figure 24 Maximum Peak Output Power Graph – Middle Channel

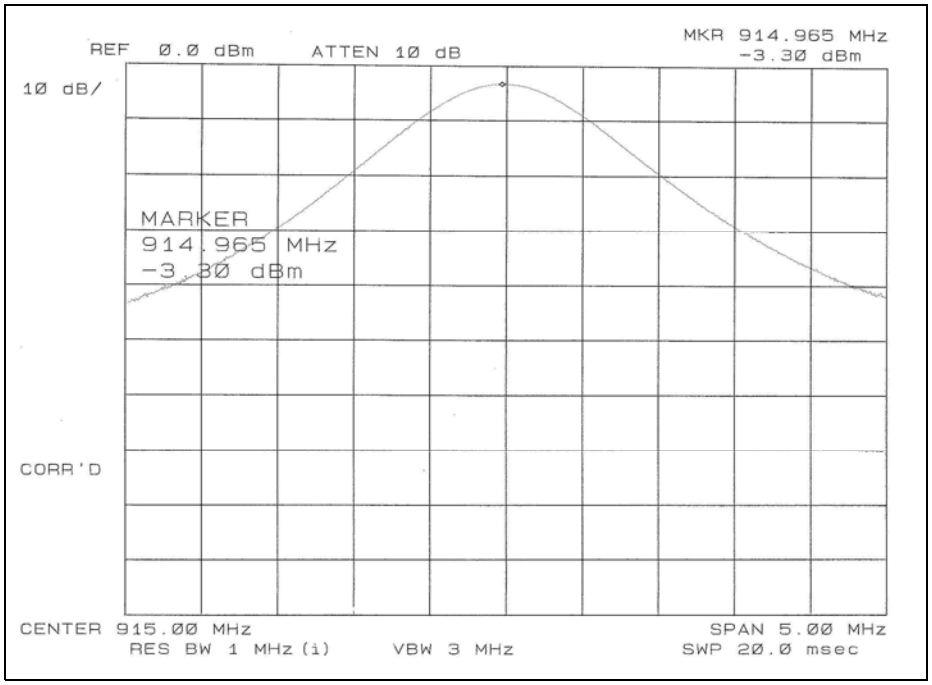


Figure 25 Maximum Peak Output Power Graph – High Channel

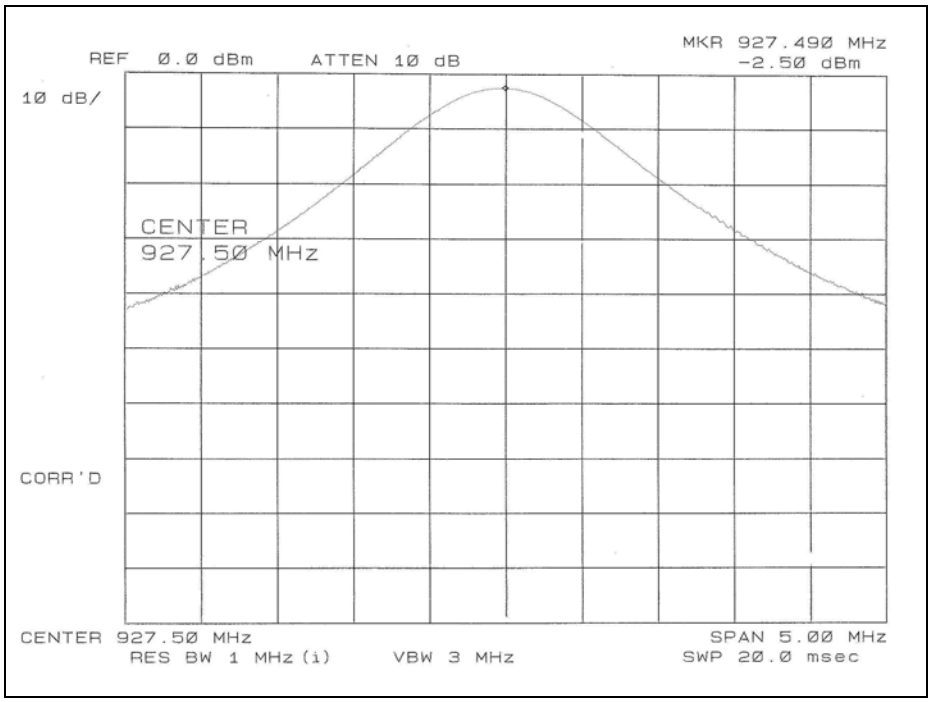


Figure 26 Maximum Peak Output Power Results

Channel	Measured (dBm)	Attenuator Loss (dB)	Cable Loss (dB)	Peak Power (dBm)	Power Limit (dBm)	Comments
Low Channel	-2.8	30.0	0.4	27.6	30.0	575 mW
Middle Channel	-3.3	30.0	0.4	27.1	30.0	513 mW
High Channel	-2.5	30.0	0.4	27.9	30.0	617 mW

4.6 Test Conditions and Results – OCCUPIED BANDWIDTH

Test Description	Measurement is performed by the following method. Frequency span is set to include entire emission. Left and Right 20dB points are marked and recorded. For 99% Power measurement the receiver 99% power function is used.
Basic Standard	47 CFR Part 15.247(a)(1)(i) RSS-210, A8.1(c)

Span (MHz)	Measurement Objective	Resolution Bandwidth (MHz)
200 kHz	-20 dBc BW	10kHz RBW, 30kHz VBW (ANSI C63.4:2003)
	99% Power	3kHz RBW, 10kHz VBW (1% to 3% of Span)
Supplementary information: None		

Figure 27 Occupied Bandwidth Configuration Settings

Power Interface Mode #	EUT Configurations Mode #	EUT Operation Mode #
1	1	1
Supplementary information: Note 99% OBW measurement is not required. Canadian certification is not requested at this time.		

Figure 28 Occupied Bandwidth Test Equipment

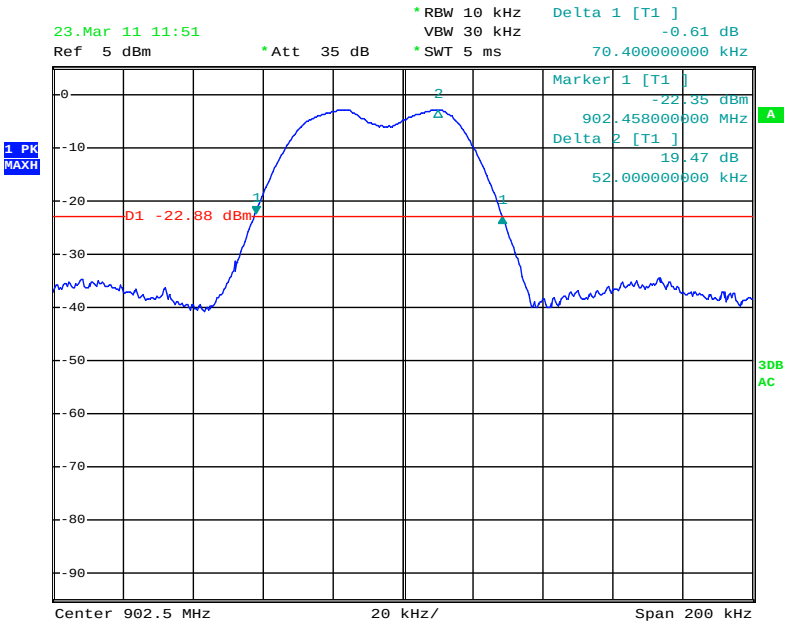
Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0015	Spectrum Analyzer / Receiver	Rohde & Schwarz	ESCI7	2011-1-25	2012-1-31
-	Coaxial Cable	Pasternack	N-Male to SMA	N/A*	N/A
-	Attenuators (3x10dB)	-	N-Male to N-Female	N/A*	N/A

*Insertion loss verified prior to test

Figure 29 Occupied Bandwidth Results

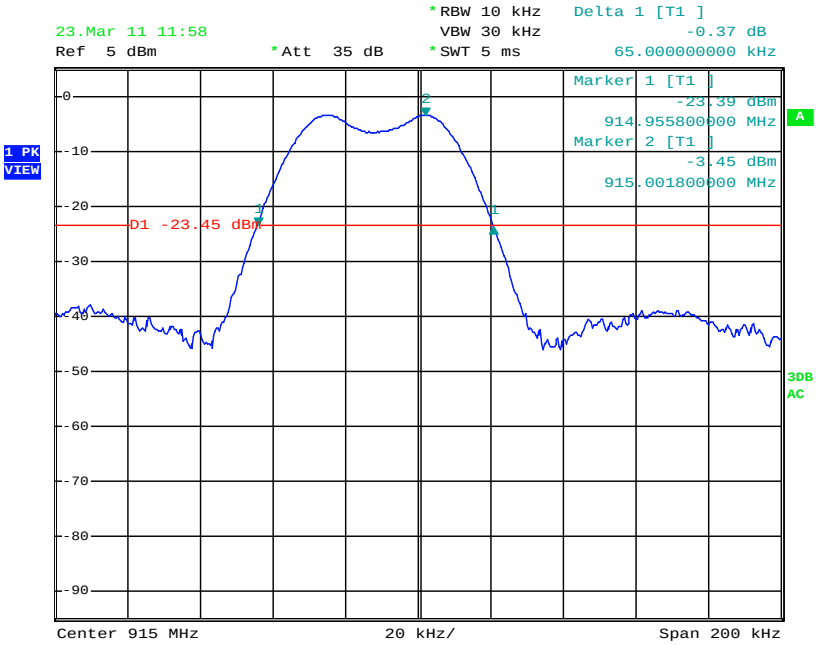
Mode	-20dBc Occupied Bandwidth Measured	-99% Occupied Bandwidth Limit	Comments
Low Channel	70.4	48.84	
Middle Channel	65.0	49.60	
High Channel	64.8	47.80	

20dB Bandwidth – Low Channel



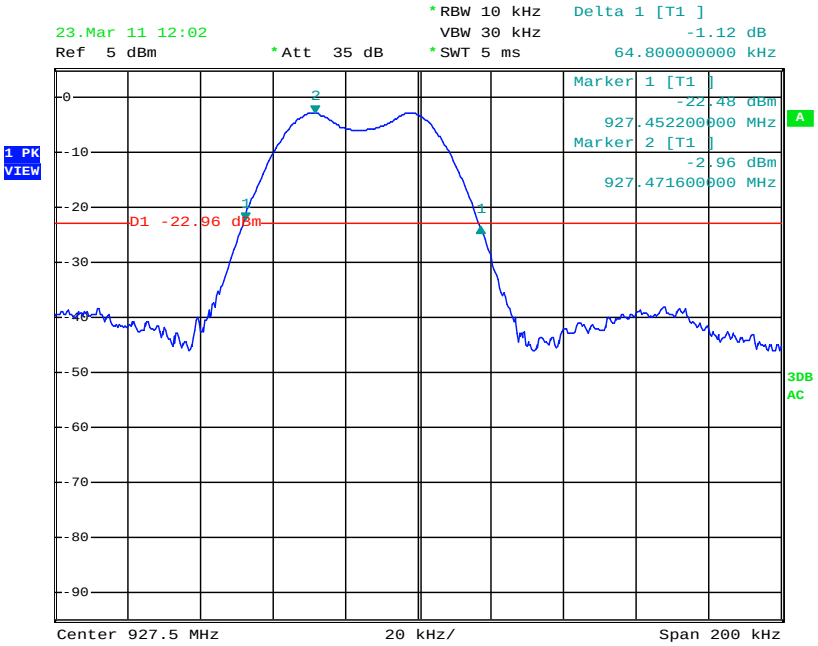
Date: 23.MAR.2011 11:51:14

20 dB Bandwidth – Mid Channel



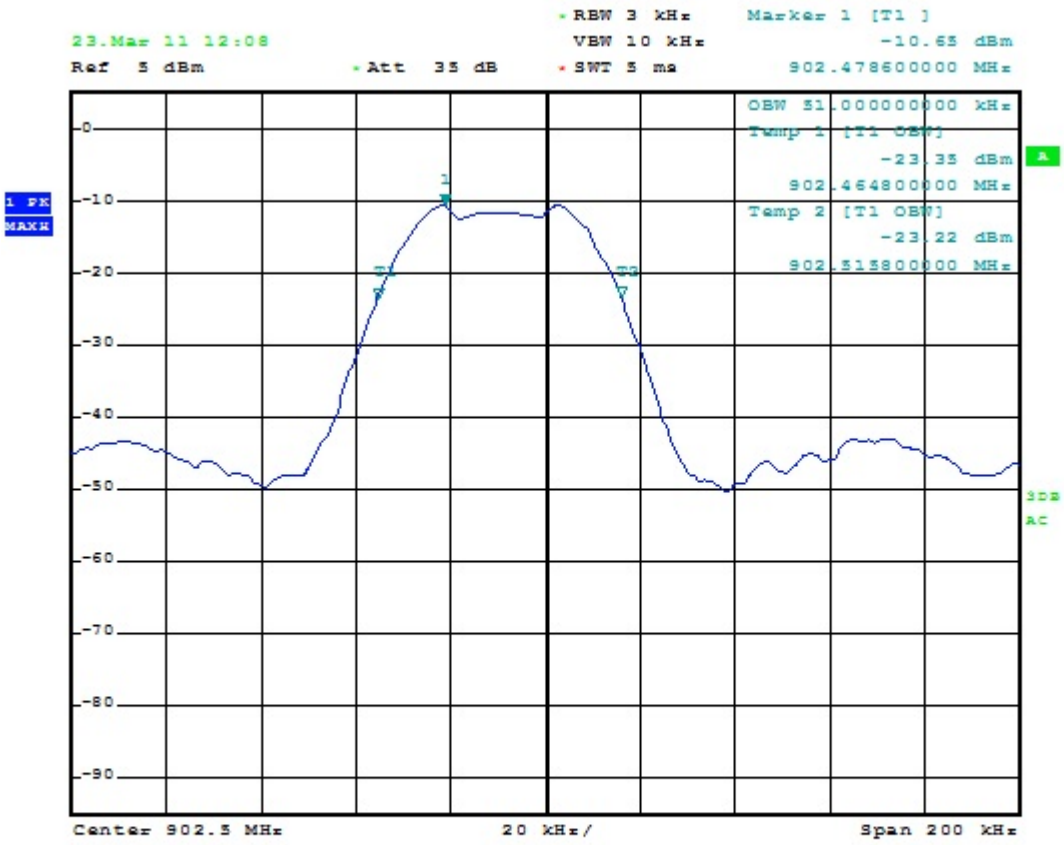
Date: 23.MAR.2011 11:58:51

20 dB Bandwidth – High Channel



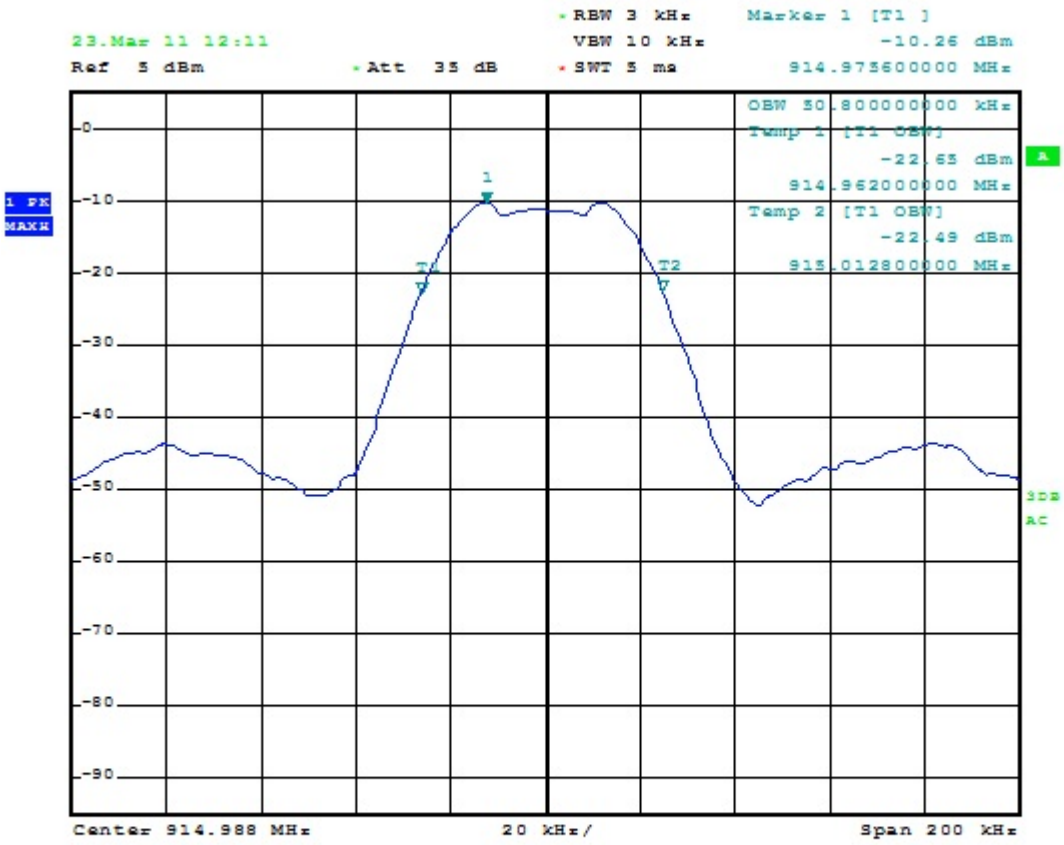
Date: 23.MAR.2011 12:02:05

99% Power Bandwidth – Low Channel



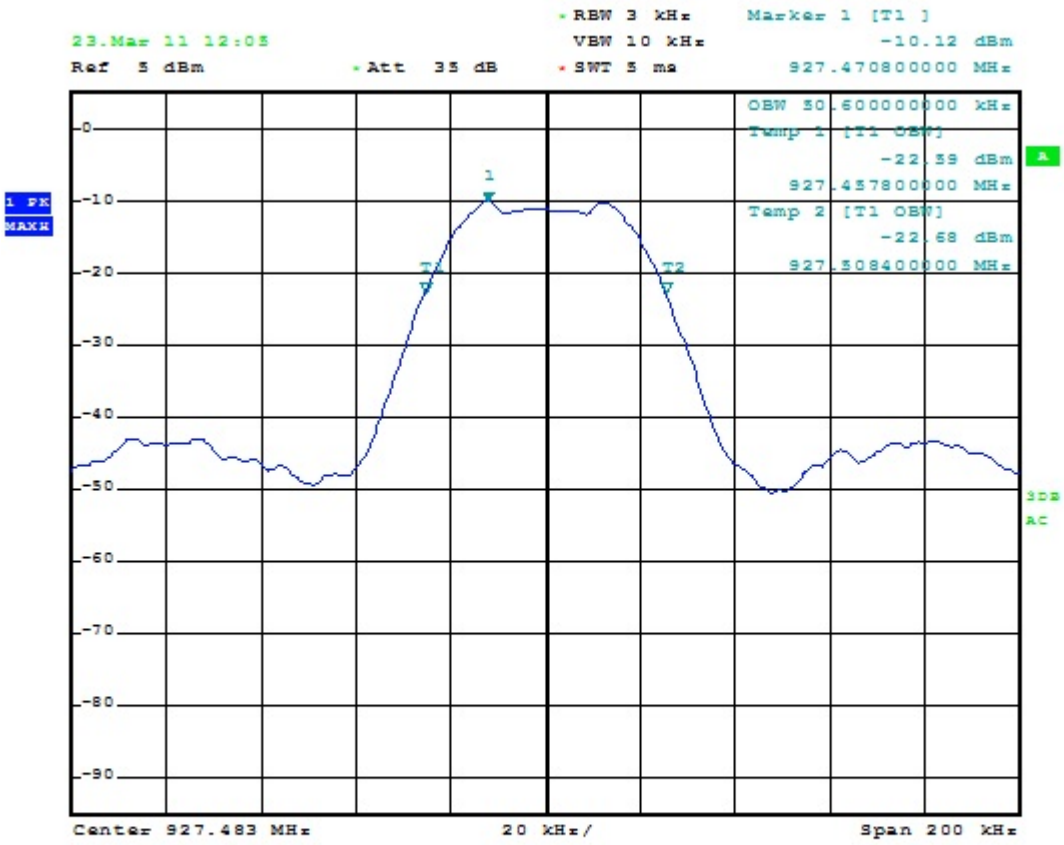
Date: 23.MAR.2011 12:08:26

99% Power Bandwidth – Mid Channel



Date: 23.MAR.2011 12:11:25

99% Power Bandwidth – High Channel



Date: 23.MAR.2011 12:05:45

4.7 Test Conditions and Results – DUTY CYCLE

Test Description	Duty Cycle is measured to determine Duty Cycle Correction Factor, if applicable, to apply to average measurements. Note that only 100 ms of cycle may be considered for this measurement.
Basic Standard	Not Applicable.

Figure 30 Duty Cycle Correction Factor (100 ms)

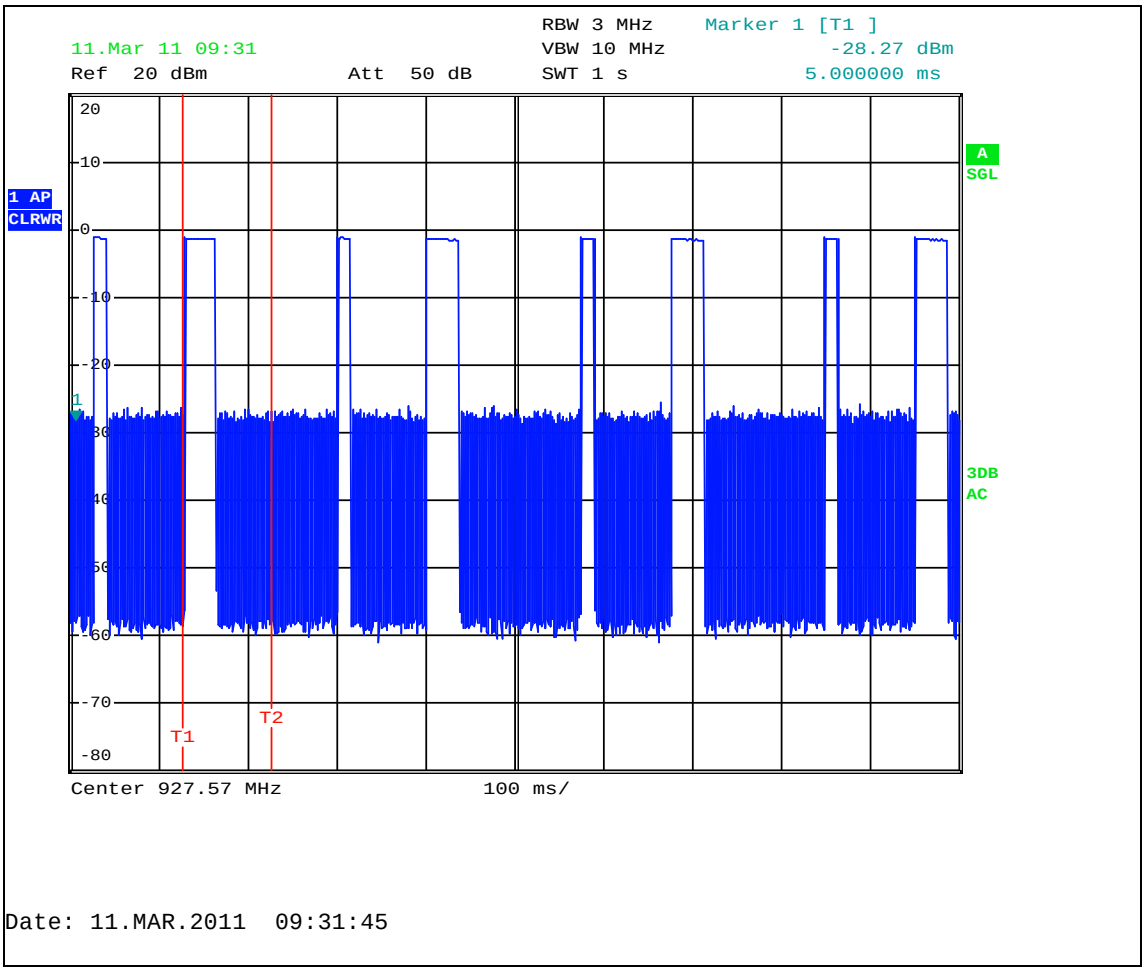
Mode	Number of TX in 100mS	TX Duration in 100mS	Duty Cycle Correction (dB) $20 \times \log(\frac{TX\,(ms)}{100\,ms})$
Hopping turned off, Normal duty cycle on	1	38 (longest transmission)	– 8.4 dB

Figure 31 Duty Cycle Test Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0015	Spectrum Analyzer / Receiver	Rohde & Schwarz	ESCI7	2011-1-25	2012-1-31
-	Coaxial Cable	Pasternack	N-Male to SMA	N/A*	N/A
-	Attenuators (3x10dB)	-	N-Male to N-Female	N/A*	N/A

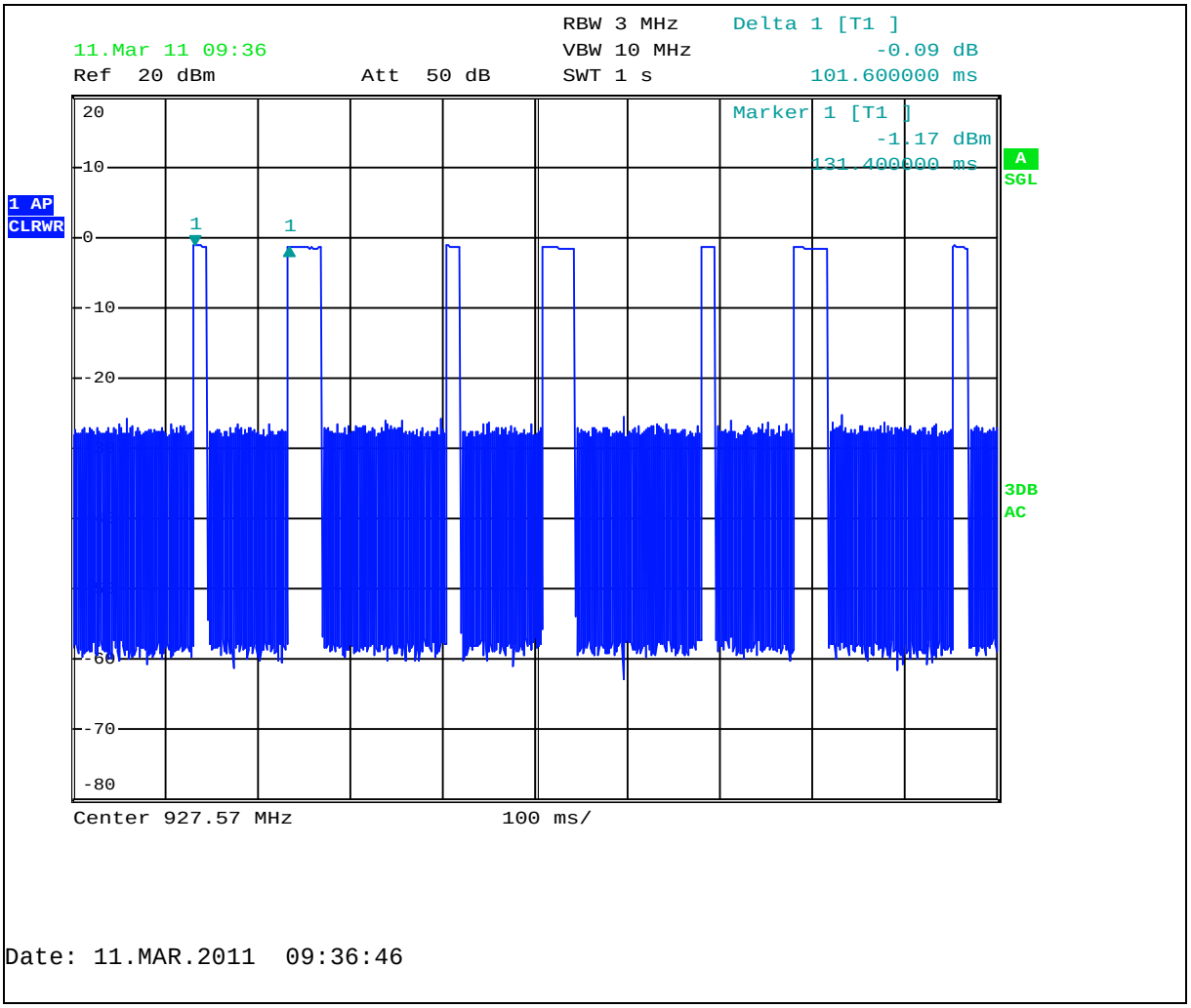
*Insertion loss verified prior to test

Figure 32 Dwell Time Graph – 1 second sweep



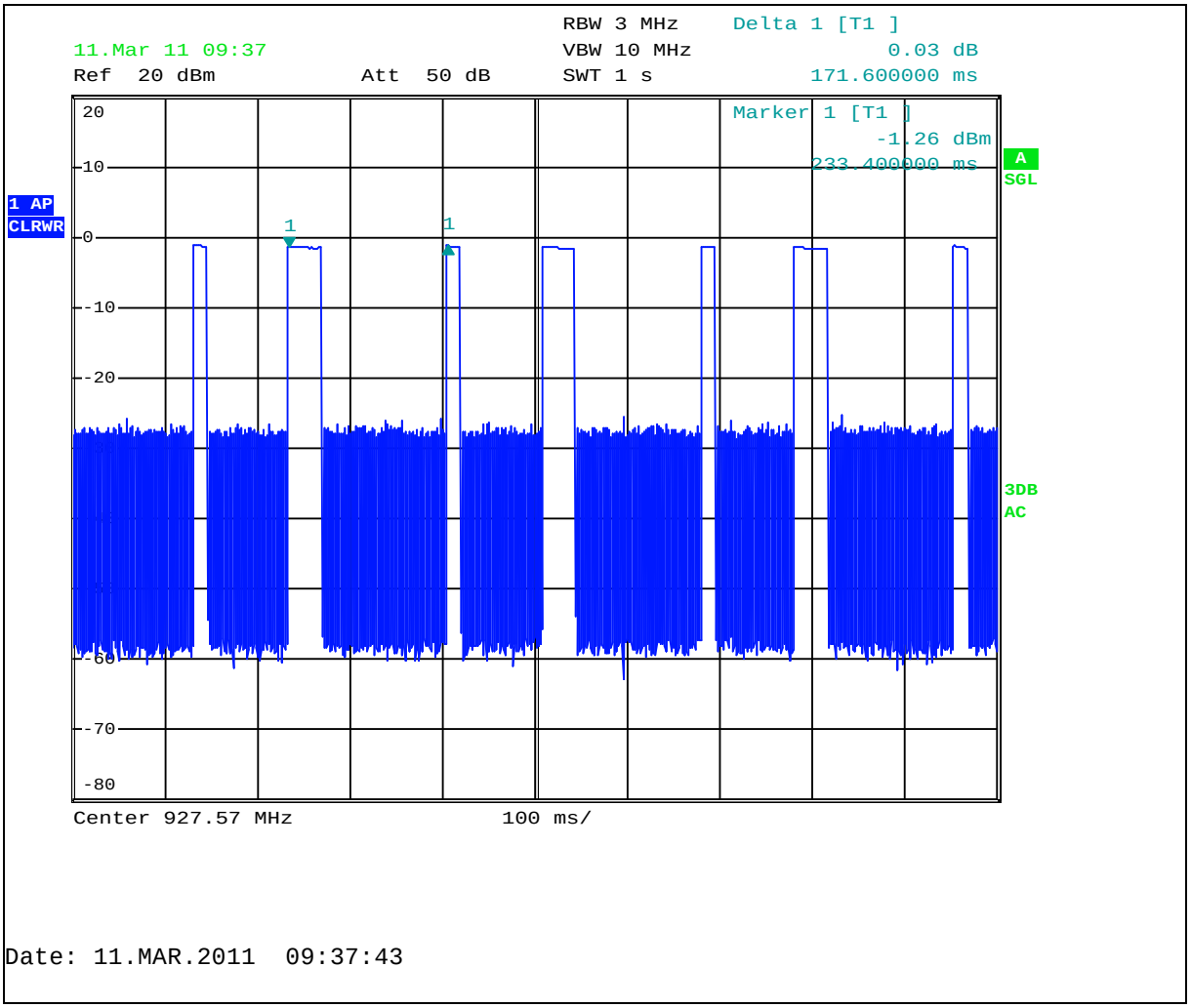
Note: A 1-second sweep shows the repeating pattern of long and short transmissions. As shown in the following measurements, there is not more than one transmission in each 100 ms window.

Figure 33 Dwell Time Graph – Short Transmission Cycle



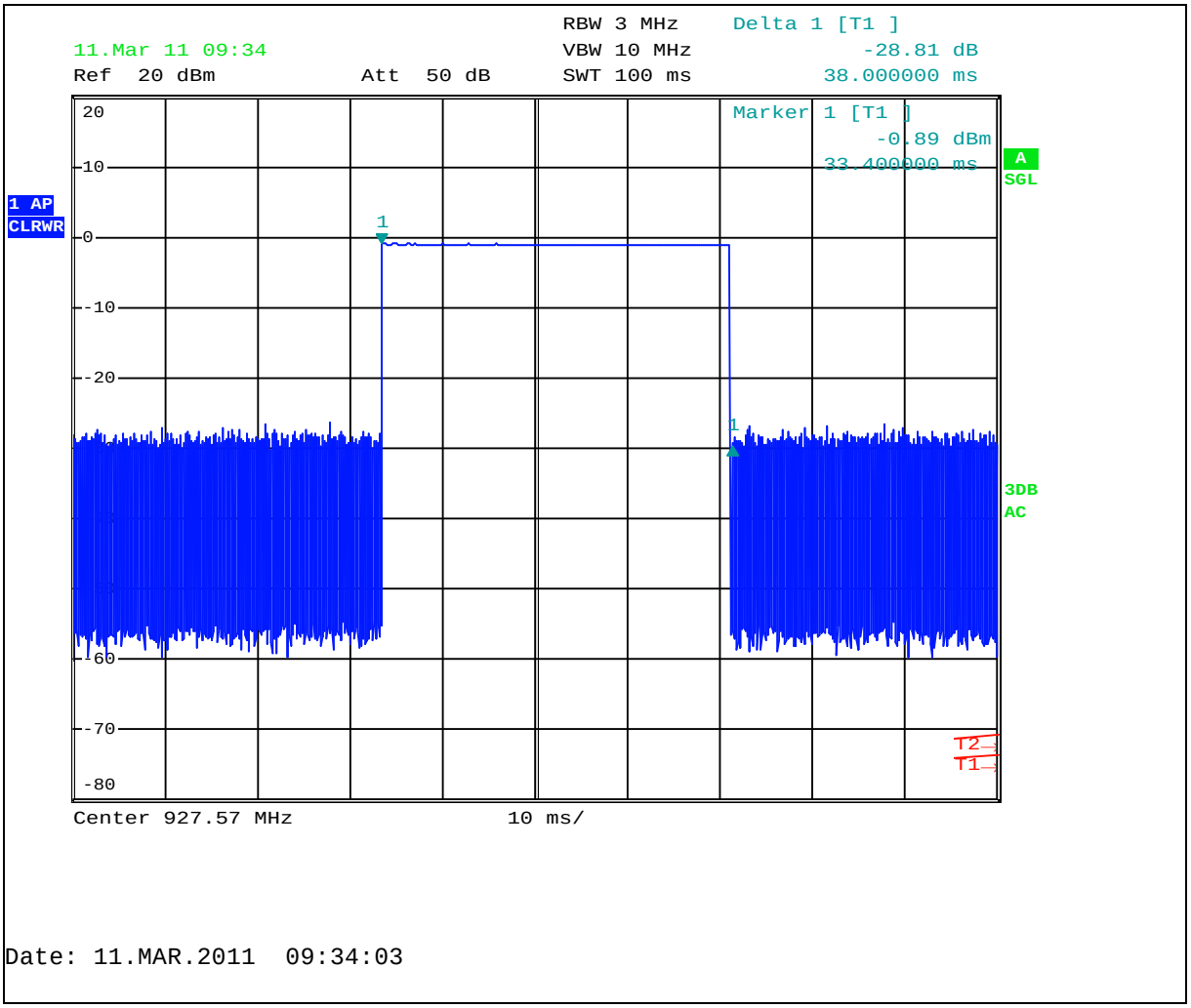
Measurement of start of short transmission plug off duration. This cycle is 101.6ms. It is shown that only one transmission exists within this 100 ms period.

Figure 34 Dwell Time Graph – Long Transmission Cycle



Measurement of start of long transmission plus off duration. This cycle is 171.6 ms. It is shown that only one transmission exists within this 100 ms period.

Figure 35 Dwell Time Graph – 100 ms sweep to measure long pulse



Duration of long pulse is 38 ms.

4.8 Test Conditions and Results – MAXIMUM PERMISSIBLE EXPOSURE

Test Description	Maximum Permissible Exposure calculation is performed to ensure that this device meets RF exposure limits for its intended environment. This device is required to meet the General Population/Uncontrolled exposure limits.
Basic Standard	47 CFR Part 1.1307 Industry Canada IC Safety Code 6

FCC Limits for Occupational/Controlled Exposure				
Frequency Range (MHZ)	Electric Field Strength (E) (V/M)	Magnetic Field Strength (H) (A/M)	Power Density (S) (MW/CM^2)	Averaging Time $\|E^2\|$, $\|H^2\|$. or S (MINUTES)
0.3 – 3.0	614	1.63	(100)*	6
3.0 - 30	1824/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	-	-	5.0	6
FCC Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mw/cm^2)	Averaging Time $\|E^2\|$, $\|H^2\|$. or S (minutes)
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

Figure 36 MPE - EUT Configuration Settings

Calculation is performed from conducted power and antenna gain measurements documented within this report.

Background: Per the following guidance from OET Bulletin 65 Supplement C required minimum spacings are provided to the professional installer.

Transmitter or Device Type[18]	Output[19]	Applicable Methods to Ensure Compliance[20]
Transmitters using indoor antennas that operate at 20 cm or more from nearby persons	>2.5 W at 915 MHz	If the MPE distance is greater than that required for normal operation of the device, operating instructions, warning instructions and/or warning labels may be used to ensure compliance by indicating the minimal separation distance to comply with MPE limits. If the antennas are professionally installed to ensure compliance, warning instructions and warning labels are not necessary.
	=< 2.5 W at 915 MHz or =< 4 W at 2450 MHz	Transmitters operating at 2.5 W EIRP (1.5 W ERP) or less at 915 MHz, or at 4 W EIRP (2.4 W ERP) or less at 2450 MHz, generally are not expected to exceed MPE limits when nearby persons are 20 cm or more from most antennas. Therefore, special instructions and warnings are normally not necessary to ensure compliance.

Figure 37 Duty Cycle Correction Factor (100 ms)

Mode	ON Duration (ms)	Total Duration (ms)	Duty Cycle Correction (dB) $20 \times \log(\frac{TX\,(ms)}{100\,ms})$	Comments
Short Pulse	14	101.4		
Long Transmission	38	171.6		
Total	52	273.0	-14.4 dB	52ms / 273ms = 19.0%

Figure 38 MPE - Calculation

MPE Calculation with highest EIRP:

The highest conducted power was observed to be 617 mW and this measurement is used for the calculation. Limit is calculated at low channel (902.5 MHz) as exposure limit increases slightly with frequency in the operating band. Duty cycle is 14.4%.

$S = EIRP / (4 * Pi * R^2)$,

Power Density = EIRP / (4 * Pi * R^2),
where EIRP = Output Power * Antenna Gain

Uncontrolled/General Exposure
0.617 Watt, 0.00 dBi antenna (Unity Gain), 20 cm spacing

Operating Frequency	902.5 MHz		
Output Power (Peak)	**0.617** Watts		
Antenna Gain	**-1.0** dB	or (linear)	0.794 (unitless)
Separation Distance	**0.2** m	-or-	7.874 inches

Peak Power Density	0.975 W/m^2	- or -	0.0975 mW/cm^2
Exposure % (over 6 min timespan for uncontrolled)	100%		
Transmit Duty Cycle (Peak-to-Average Ratio)	14.4%		
Average Power Density	**0.1404** W/m^2	- or -	**0.01404** mW/cm^2
Limit for **Uncontrolled** Exposure at Operating Frequency	**6.01667** W/m^2	- or -	**0.60167** mW/cm^2

The product was found to comply with this requirement.

Appendix A

Accreditations and Authorizations

NVLAP Lab code: 200246-0

NVLAP: The National Institute of Standards and Technology (NIST) administers the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP is comprised of laboratory accreditation programs (LAPs) which are established on the basis of requests and demonstrated need. Each LAP includes specific calibration and/or test standards and related methods and protocols assembled to satisfy the unique needs for accreditation in a field of testing or calibration. NVLAP accredits public and private laboratories based on evaluation of their technical qualifications and competence to carry out specific calibrations or tests. Accreditation criteria are established in accordance with the U.S. Code of Federal Regulations (CFR, Title 15, Part 285), NVLAP Procedures and General Requirements, and encompass the requirements of ISO/IEC 17025. For a full scope listing see http://ts.nist.gov/Standards/scopes/2002460.htm

FCC: Details of the measurement facilities used for these tests have been filed with the Federal Communications Commission's Laboratory in Columbia, Maryland (Ref. No. 91039).

Industry Canada Industrie Canada

Industry of Canada: Accredited by Industry Canada for performance of radiated measurements. Our test site complies with RSP 100, Issue 7, Section 3.3. File #: IC 2180C

VCCI: Accepted as an Associate Member to the VCCI. The measurement facilities detailed in this test report have been registered in accordance with Regulations for Voluntary Control Measures, Article 8. Registration Nos.:

- Test Station 5 (Location A) R-722, G-246
- Test Station 1 (Location D) C-742, T-1484
- Test Station 4 (Location E) C-743, T-1485

ICASA: ICASA (Independent Communications Authority of South Africa) has appointed UL as a Designated Test Laboratory to test Telecommunications equipment for type approval in compliance with CISPR 22 to assist in fulfilling its mandate under section 54(1) of the Telecommunications Act, 1996 (Act 103 of 1996).

NIST/CAB: Validated by the European Commission as a U.S. Conformity Assessment Body (CAB) of the U.S.-EU Mutual Recognition Agreement (MRA) for the Electromagnetic Compatibility - Council Directive 2004/108/EC, Annex III. Also validated for the Telecommunication Equipment-Council Directive 99/5/EC, Annex III and IV, Identification Number: 0983.
NIST/CAB: Provisioned to act as a U.S. Conformity Assessment Body (CAB) under Appendix B, Phase I Procedures, of the Asia Pacific Economic Cooperation (APEC) MRA between the American Institute in Taiwan (AIT) and the United States. Our laboratory is considered qualified to test equipment subject to the applicable EMC regulations of the Chinese Taipei Bureau of Standards, Metrology and Inspection (BSMI) which require testing to CNS 13438 (CISPR 22).
NIST/CAB: Recognized by the Infocomm Development Authority of Singapore (IDA) under the Asia Pacific Economic Cooperation Mutual Recognition Agreement (APEC MRA). Our laboratory is provisionally designated to act as a Conformity Assessment Body (CAB) under Appendix B, Phase I Procedures, of the APEC MRA. Our scope of designation includes IDA TS EMC (CISPR 22).