Test of Sensus FlexNet 570x

To: FCC 47 CFR Part(s) 24, 90, 101

Test Report Serial No.: SNUS14-U1 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of Sensus FlexNet 570x

To FCC 47 CFR Part(s) 24, 90, 101
RSS-134 & RSS-119

Test Report Serial No.: SNUS14-U1 Rev A

This report supersedes: None

Manufacturer: Sensus Metering Systems
8609 Six Forks Road, 3rd Floor
Raleigh, North Carolina 27615
USA

Product Function: Remote Telemetry Module

Copy No: pdf **Issue Date:** 2nd March 2011

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
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ACCREDITED
TESTING CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	Listing #: 4143A
Japan	VCCI	-	-	No. 2959
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification
N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

**NB – Notified Body

PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf


The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence as a

Product Certification Body

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC Guide 65:1996 *General requirements for bodies operating product certification systems*. This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system for a Telecommunications Certification Body (TCB) meeting FCC (U.S.), and IC (Canada) requirements.

Presented this 24th day of June 2010.

President & CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2011

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body

TCB Identifier – US0159

Industry Canada – Certification Body

CAB Identifier – US0159

European Union - Notified Body

NB Identifier – 2280

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
A	2nd March 2011	Initial Release

1. TEST RESULT CERTIFICATE

Manufacturer:	Sensus Metering Systems 8609 Six Forks Road, 3rd Floor Raleigh, North Carolina 27615 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Sensus FlexNet Integrated Transceiver	Telephone:	+1 925 462 0304
Model:	FlexNet 570x	Fax:	+1 925 462 0306
S/N:	Engineering Sample		
Test Date(s):	29th Oct 2010 to 29th Feb 2011	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part(s) 24, 90, 101	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

ACCREDITED
TEST CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 24	2009	Code of Federal Regulations
(ii)	FCC 47 CFR Part 90	2009	Code of Federal Regulations
(iii)	FCC 47 CFR Part 101	2009	Code of Federal Regulations
(iv)	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(v)	CISPR 22/ EN 55022	2008 2006+A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(viii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(xv)	A2LA	9th June 2010	Reference to A2LA Accreditation Status – A2LA Advertising Policy
(x)	FCC (OET)	15th April 2010	Compliance Management Guidance for Wireless Broadband Services Operating in the 3650-3700 MHz Band

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the Sensus FlexNet 570x to FCC 47 CFR Part(s) 24, 90, 101 regulations.
Applicant:	Sensus Metering Systems 8609 Six Forks Road, 3rd Floor Raleigh, North Carolina 27615 USA
Manufacturer:	As Applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	SNUS14-U1 Rev A
Date EUT received:	27th October 2010
Dates of test (from - to):	29th Oct 2010 to 29th Feb 2011
Standard(s) applied:	FCC 47 CFR Part(s) 24, 90, 101
No of Units Tested:	2
Type of Equipment:	900 MHz Transceiver (Licensed Bands)
Model:	FlexNet 570x
Application:	Mobile Stations
Location for use:	Outdoor use only
Equipment Classification:	Mobile Applications
Declared Frequency Range(s):	Transmit: 896.0375 – 959.9250 MHz Receiver: 896.0375 – 959.9250 MHz
Type of Modulation:	C & I, DD Extend, mPass, Normal
Operational Bandwidth:	12.5, 25 kHz
Declared Maximum Output Power:	+30 dBm
Transmit/Receive Operation:	Time Division Duplex (TDD)
Software Revision:	1.2.1.6
Hardware Release:	3.1
Antenna Type:	Inverted F, 0 dBi
ITU Emission Designator:	9K60F2D, 4K80F2D, 5K90F1D, 14K75F1D
Rated Input Voltage and Current:	Module Voltage: 3.3 Vdc
Operating Temperature Range:	-33ºC to +55ºC
Clock/Oscillator(s):	32.768 KHz, 300 kHz Switching Frequency, 4 MHz clock, 8 MHz clock, 6.5 MHz crystal, 12.8 MHz TCXO, Receiver LO @ (RXFREQ – 320 kHz) * 2
Equipment Dimensions:	5.25” x 4.25” x 2.5”
Weight:	<0.1 lbs
Primary function of equipment:	Remote Telemetry Module

3.2. Scope of Test Program

The scope of the test program was to test the Sensus FlexNet 570x for compliance against the following standards;-

FCC 47 CFR Part 24, Subpart D requirements

FCC 47 CFR Part 90, Subpart I requirements.

FCC 47 CFR Part 101, Subpart C requirements.

Modular Approval
The test program addressed the Sensus FlexNet 570x product for limited modular approval.

Applicable Variants
This report contains data with respect to a four modulations;

- C & I
- DD Extend
- mPass
- Normal

3.3. Equipment Model(s) and Serial Number(s)

EUT/ Support	Manufacturer	Equipment Description (Including Brand Name)	Model No.	Serial No.
EUT	Sensus	FlexNet 570x, 900 MHz radio transceiver	U905458B	Engineering Sample
EUT	Sensus	900 MHz Remote Telemetry	DNP-RTMII-MA-FLX-900	--
Support	Mean Well	Universal AC/DC Switching Adapter Input:100-240Vac 50/60 Hz Output: 11-13 Vdc, 1.63-1.38A	GS18A12-P1J	R091138785
Support	Dell Laptop	Computer	--	--

3.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Integral inverted F	0.0	N/A	N/A	N/A

3.5. Cabling and I/O Ports

Number and type of I/O ports

Type of I/O Port	Description	Screened	Length
Applied Voltage	3.3 Vdc Power Input	n	3”
*Applied Voltage	26 Vdc Power Input	n	N/A

*the 26Vdc power was only used in test mode. The end product will not require this voltage it was available to provide 100% duty cycle during the test program.

3.6. Test Configurations

Test Matrix V’s Variants

Parameter	Operational Mode	Test Conditions	Bandwidths (KHz)
Output power	Modulated - C & I, DD Extend, mPass, Normal	Ambient, 12Vdc	12.5
Occupied BW			
Spectrum Mask			
Frequency Stability	Single Tone (CW)	-33°C to +50°C + voltage variation	N/A
Conducted Spurious Emissions	BPSK	Ambient, 12Vdc	12.5
Radiated Spurious Emissions	Single Tone (CW)	Ambient, 12Vdc	12.5
AC Wireline Emissions	Normal	Ambient, 12Vdc	12.5

Test Frequencies

For testing in accordance with 47 CFR 2.1046-2, 1057, FCC OET recommends the following is used to select test frequencies for licensed devices;

Frequency Range of Device	Number of Selected Frequencies	Location in Range of Operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
10 to 100 MHz	3	1 near top, 1 near middle, 1 near bottom

Test Frequency Selection

The following is the list of frequency bands associated by rule part.

Rule Part	Frequency Range (MHz)
24D	901.0-902.0
24D	930.0-931.0
24D	940.0-941.0
90	896.0 – 901.0
90	935.0-940.0
101	928.85-929.0
101	932.0-932.5
101	941.0-941.5
101	959.85-960.0

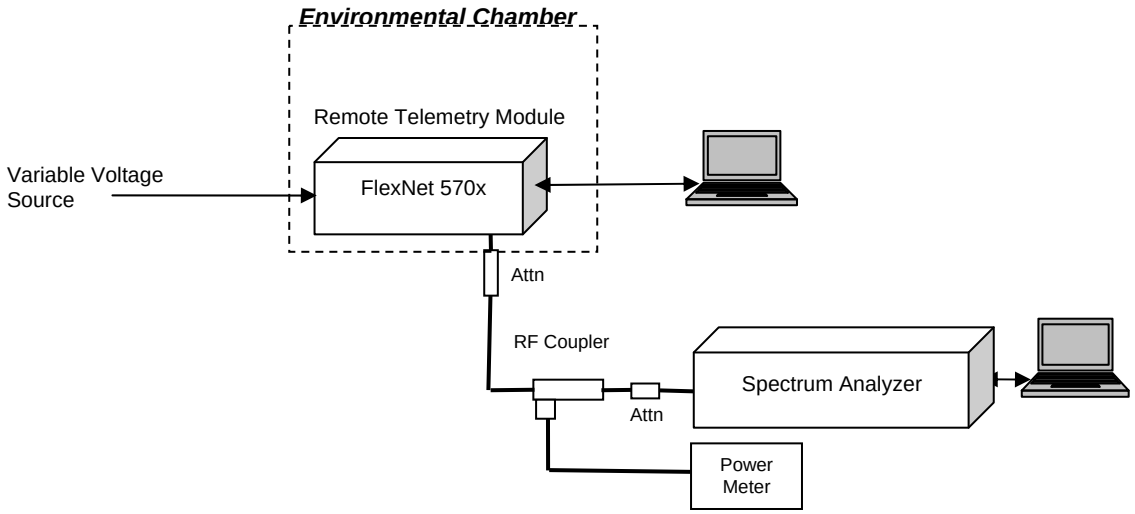
Rule Part	Frequency Range (MHz)	No. of channels tested	Selected Test Frequency (MHz)
90	896.0 – 901.0	2	896.0375 / 900.9875
24D	901.0-902.0	1	901.9875
101	928.85-929.0	1	928.9250
24D	930.0-931.0	1	930.5000
101	932.0-932.5	1	932.2500
90	935.0-940.0	2	935.0125 / 939.9875
24D	940.0-941.0	1	940.9875
101	941.0-941.5	1	941.4875
101	959.85-960.0	1	959.9250

FlexNet 570x Band-Edge Frequencies

Rule Part	Band	Band-Edge Operating Frequencies
90	896.0 - 901.0	896.03750-900.98750
24	901.0 - 902.0	901.02500-901.97500
101	928.85 - 929.0	928.87500-928.97500
24	930.0 - 931.0	930.02500-930.97500
101	932.0 - 932.5	932.02500-932.47500
90	935.0 - 940.0	935.01250-939.98750
24	940.0 - 941.0	940.02500-940.97500
101	941.0 - 941.5	941.02500-941.47500
101	959.85 - 960.0	959.87500-959.97500

Test Set-Up

Test software was available to exercise the Access Point and the equipment was tested using the following test configuration.



General Test Set-Up

3.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. Modulation Issue

   The equipment was delivered with only the CW operational mode active. Updated unit arrived 25th February 2011 to complete the test program.

3.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

3.9. Subcontracted Testing or Third Party Data

1. NONE

4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 24, 90, and 101.**

IC RSS-134, RSS-119 & RSS Gen

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1046	Output Power	Modulated Output Power	Conducted	Complies	5.1.1
24.133 a(1),a(2) **90.210 (j)** **101.111 a(6)** **RSS-134 6.3 (i), (ii)** **RSS-119 5.8.8**	Occupied Bandwidth & Spectrum Mask	Bandwidth and spectrum mask	Conducted	Complies	5.1.2
2.1055, 24.135, 90.213, 101.107 **RSS-134 (7), RSS-119 (5.3)**	Frequency Stability	Includes temperature and voltage variations	Conducted	Complies	5.1.3
24.133 a(1),a(2) **90.210 (j)** **101.111 a(6)** **RSS-134 6.3 (i), (ii)** **RSS-119 5.8.8**	Conducted Spurious Emissions	Emissions from Antenna Port	Conducted	Complies	5.1.4
FCC, Part 1 Subpart §1.1310	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Calculated	Complies	5.1.5
24.133 a(1),a(2) **90.210 (j)** **101.111 a(6)** **ANSI/TIA-603** **RSS-134 6.3 (i), (ii)** **RSS-119 5.8.8**	Radiated Spurious Emissions	Spurious emissions	Radiated	Complies	5.1.6
15.207 **7.2.2**	AC Wireline Conducted	Emissions 150 kHz–30 MHz	Conducted	Not Applicable (dc power only)	5.1.7

Note 1: *Test results reported in this document relate only to the items tested*
Note 2: *The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria*
Note 3: *Section 3.7 'Equipment Modifications' highlight the equipment modifications that were required to bring the product into compliance with the above matrix*

5. TEST RESULTS

5.1. Device Characteristics

5.1.1. Output Power

FCC 47 CFR Part 24 Subpart 24.133 a(1), a(2)
FCC 47 CFR Part 90 Subpart 90.210 (j)
FCC 47 CFR Part 101 Subpart 101.111 a(6)

Test Procedure
The transmitter output was connected to an average power meter and the Output Power was measured on a modulated carrier under all operational modes.

Output Power was measured under ambient conditions, nominal voltage for all modulations and rule parts for the applicable frequency channels.

Test Set-up is shown in Section 3.6 Test Configuration

Ambient conditions.
Temperature: **17 to 23** °C Relative humidity: **31 to 57** % Pressure: **999 to 1012** mbar

Part 24 Measurement Results

	Output Power (dBm)			
Center Frequency (MHz)	**C & I**	**DD Extend**	**mPass**	**Normal**
901.9875	+29.69	+29.69	+29.68	+29.69
930.5000	+29.98	+29.98	+29.98	+29.98

Part 90 Measurement Results

	Output Power (dBm)			
Center Frequency (MHz)	**C & I**	**DD Extend**	**mPass**	**Normal**
896.0375	+29.61	+29.66	+29.63	+29.67
900.9875	+29.68	+29.69	+29.68	+29.72
935.0125	+29.93	+29.95	+29.93	+29.94
939.9875	+29.93	+29.93	+29.93	+29.93

Part 101 Measurement Results

	Output Power (dBm)			
Center Frequency (MHz)	**C & I**	**DD Extend**	**mPass**	**Normal**
928.9250	+29.95	+29.90	+29.90	+29.90
932.2500	+29.92	+29.92	+29.95	+29.92
941.4875	+29.97	+29.98	+29.99	+29.96
959.9250	+29.99	+29.99	+29.99	+29.99

Laboratory Measurement Uncertainty for Power Measurement

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Output Power'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

5.1.2. Occupied Bandwidth and Spectrum Mask

FCC 47 CFR Part 24 Subpart 24.133 a(1), a(2)
FCC 47 CFR Part 90 Subpart 90.210 (j)
FCC 47 CFR Part 101 Subpart 101.111 a(6)

RSS-134 6.3 (i), (ii)
RSS-119 5.8.8

Test Procedure
The transmitter output was connected to a spectrum analyzer and the Occupied Bandwidth was measured with a modulated carrier.

Occupied Bandwidth was measured under ambient conditions, nominal voltage for all modulations and rule parts on low, mid and high channels. The spectrum analyzer RBW and VBW was set for 300 Hz which was based on the bandwidth of the output spectrum.

To position the mask relative to the output spectrum the EUT was initially set to transmit a CW (single) tone at the frequency of interest. The mask was then lined up with the peak of the CW tone. The EUT then was then set to modulate each modulation of interest and measurements reported.

Spectrum mask parameters were generated using the attenuation characteristics which were found in each rule part as highlighted for 25 kHz and 12.5 kHz. The spectrum analyzer pass/fail criteria was used to determine compliance which is clearly marked on each plot provided. The automatic bandwidth function within the analyzer was used to determine 99% bandwidth.

Test Set-up is shown in Section 3.6 Test Configuration

Ambient conditions.
Temperature: **17 to 23** °C Relative humidity: **31 to 57** % Pressure: **999 to 1012** mbar

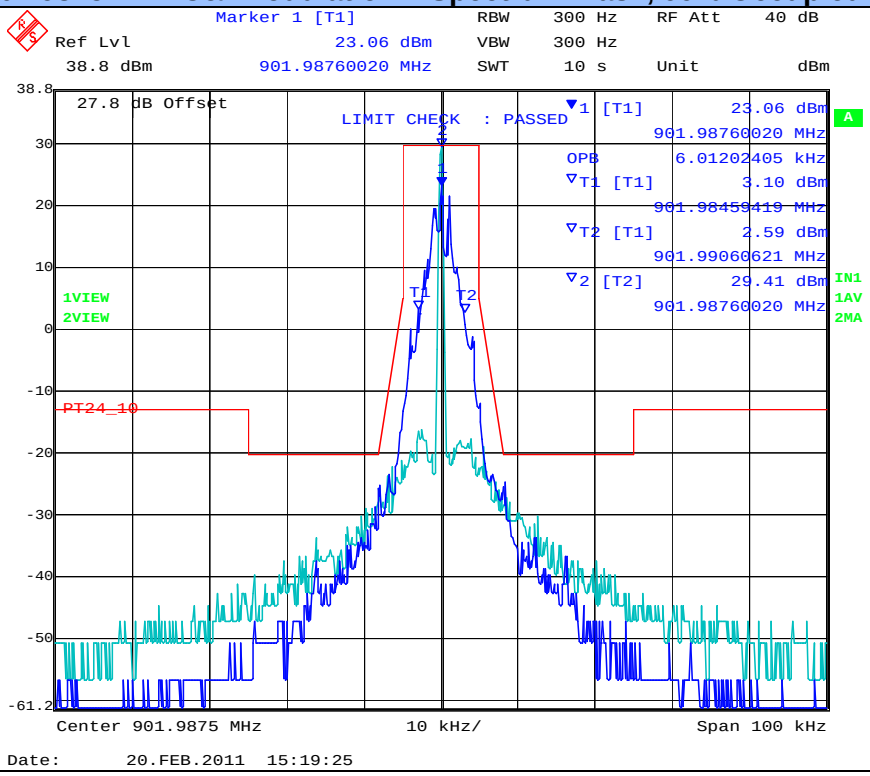
PART 24 RESULTS

Part 24.133 Measurement Results – Occupied Bandwidth + Plots

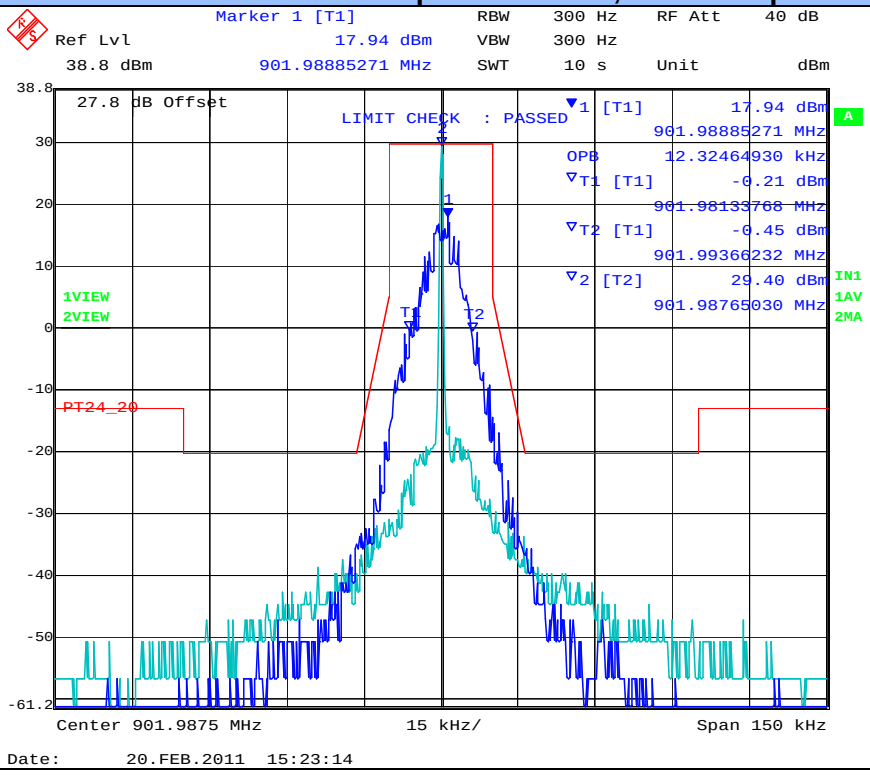
	99% Bandwidth (kHz)			
Center Frequency (MHz)	**C & I**	**DD Extend**	**mPass**	**Normal**
901.9875	6.012	12.325	6.012	11.423
930.5000	6.012	11.423	6.012	11.122

Part 24.133 Measurement Results

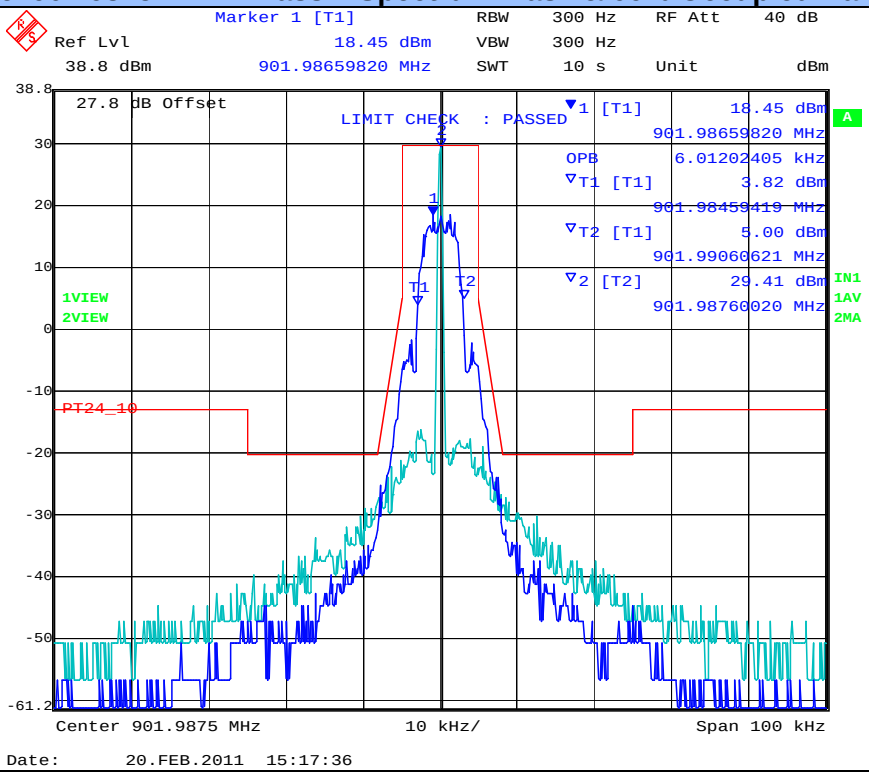
Channel 901.9875 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



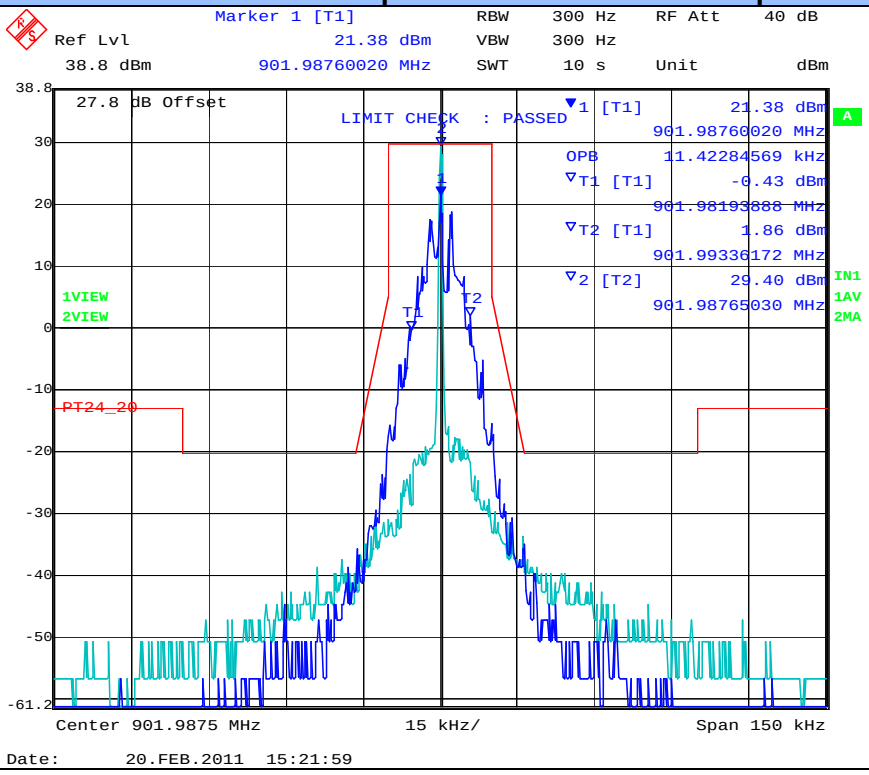
Channel 901.9875 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



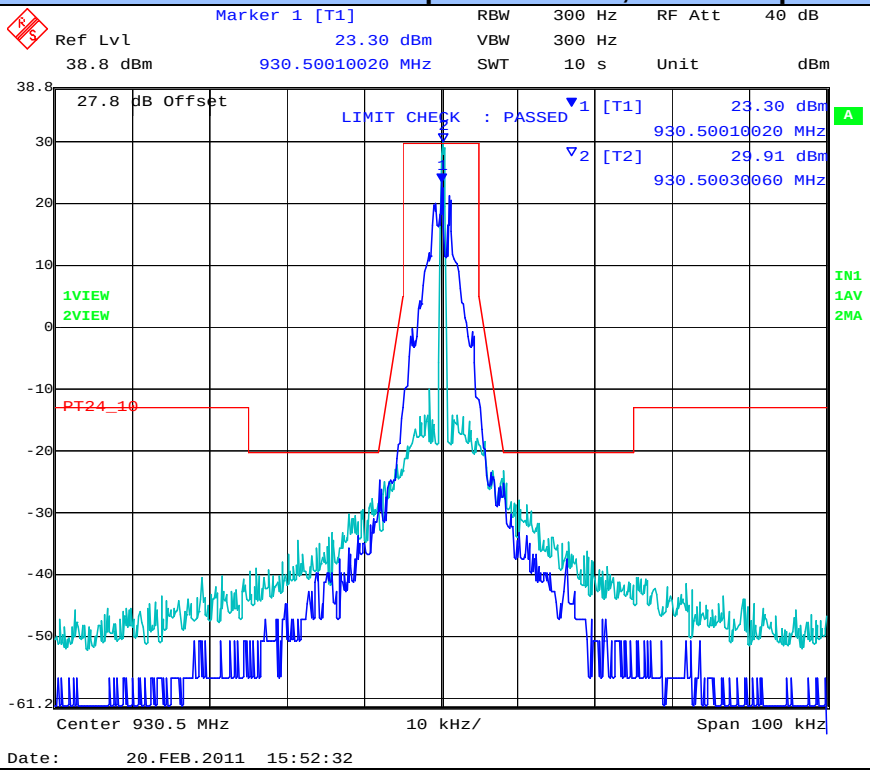
Channel 901.9875 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



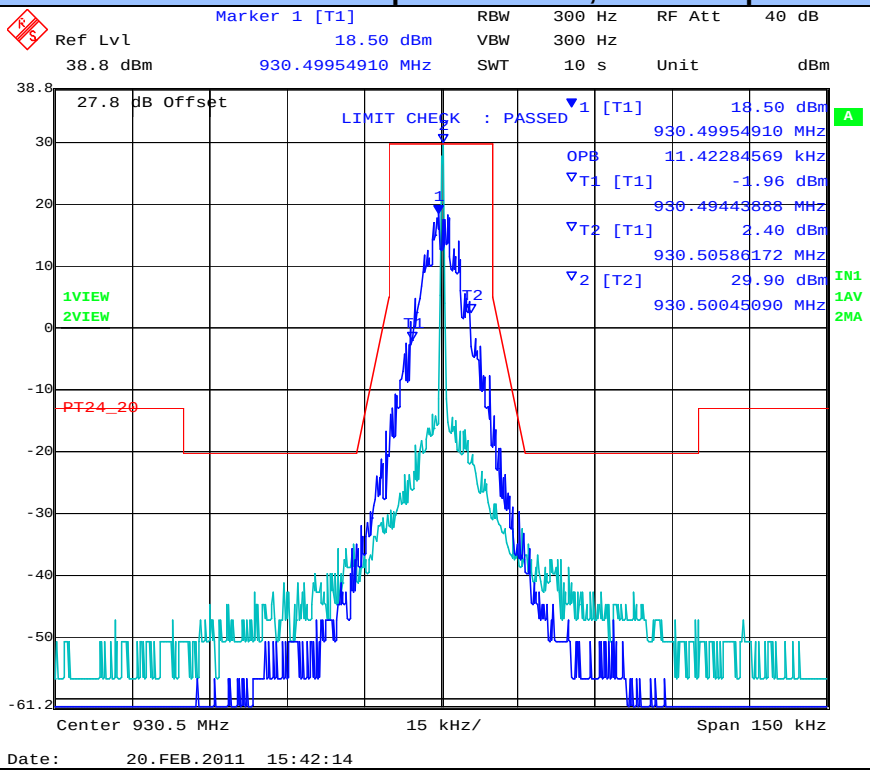
Channel 901.9875 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



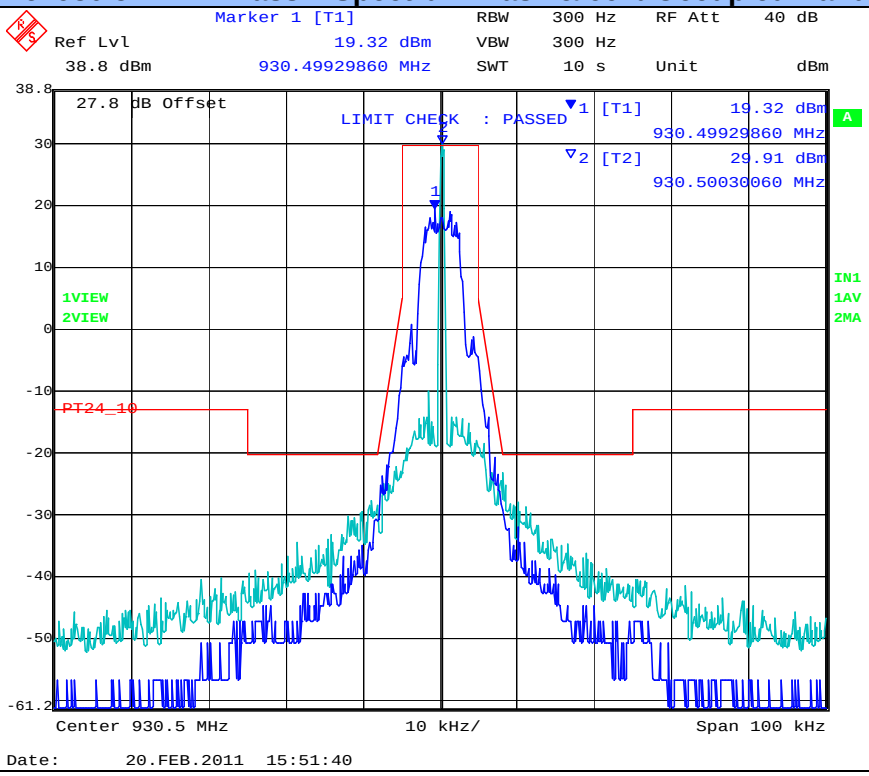
Channel 930.5 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



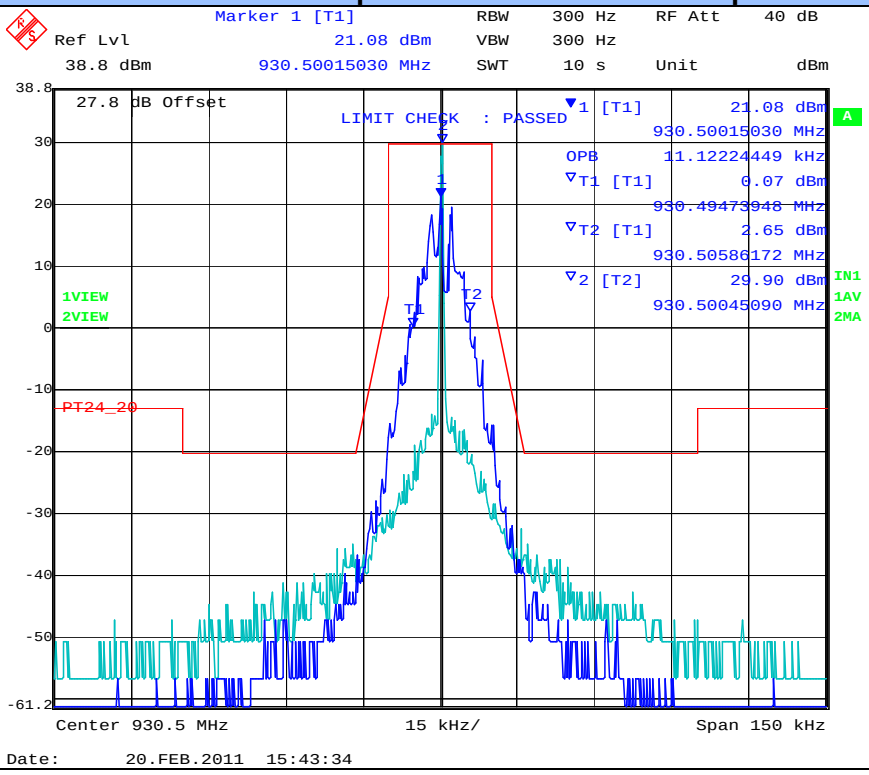
Channel 930.5 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



Channel 930.5 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



Channel 930.5 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



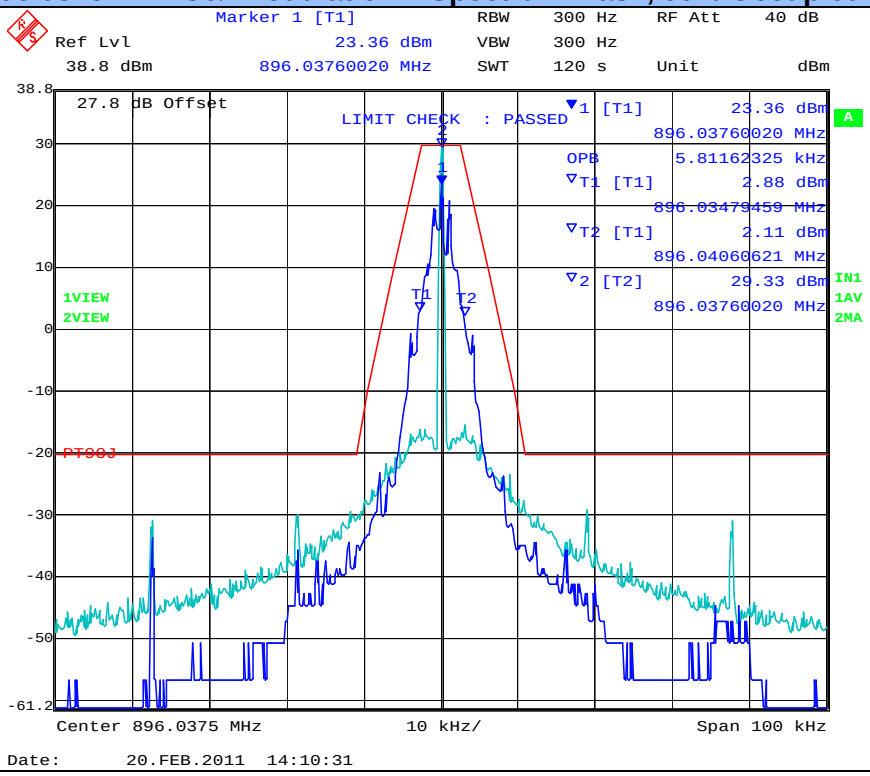
PART 90 RESULTS

Part 90.210 j Measurement Results – Occupied Bandwidth + Plots

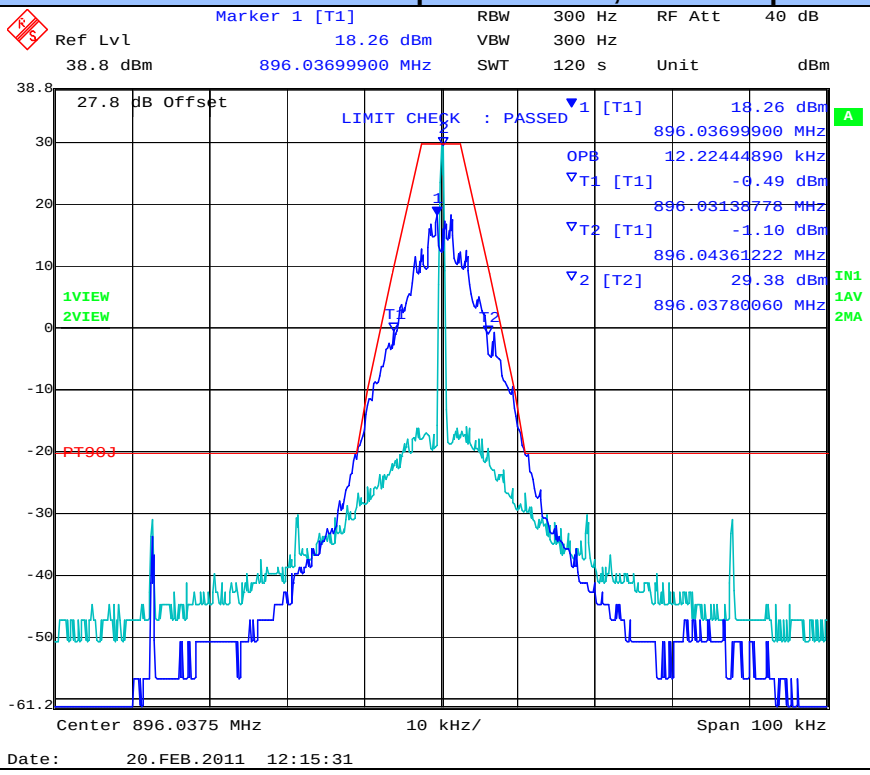
	99% Bandwidth (kHz)			
Center Frequency (MHz)	**C & I**	**DD Extend**	**mPass**	**Normal**
896.0375	5.812	12.224	5.812	11.222
900.9875	5.812	12.224	6.012	11.222
935.0125	5.611	12.224	6.012	11.222
939.9875	5.812	12.224	6.012	11.222

Part 90.210 j Measurement Results

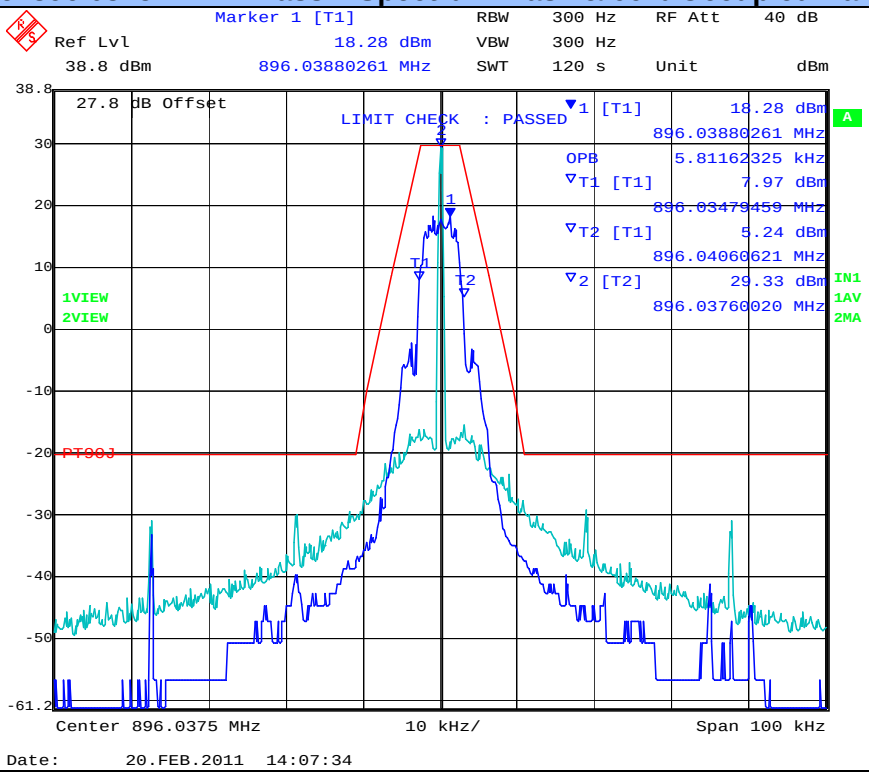
Channel 896.0375 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



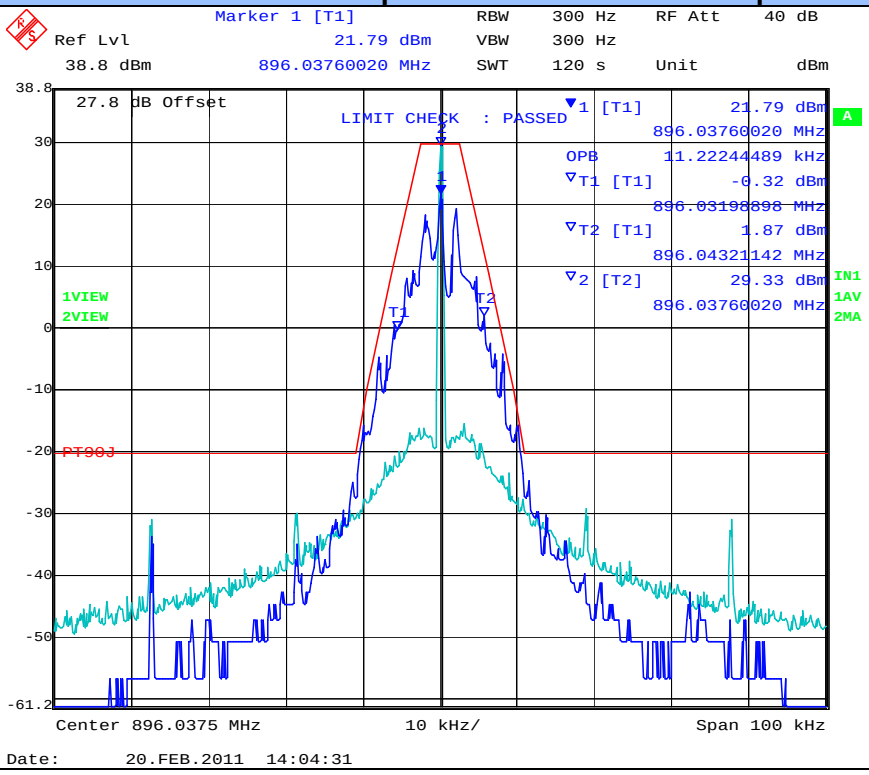
Channel 896.0375 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



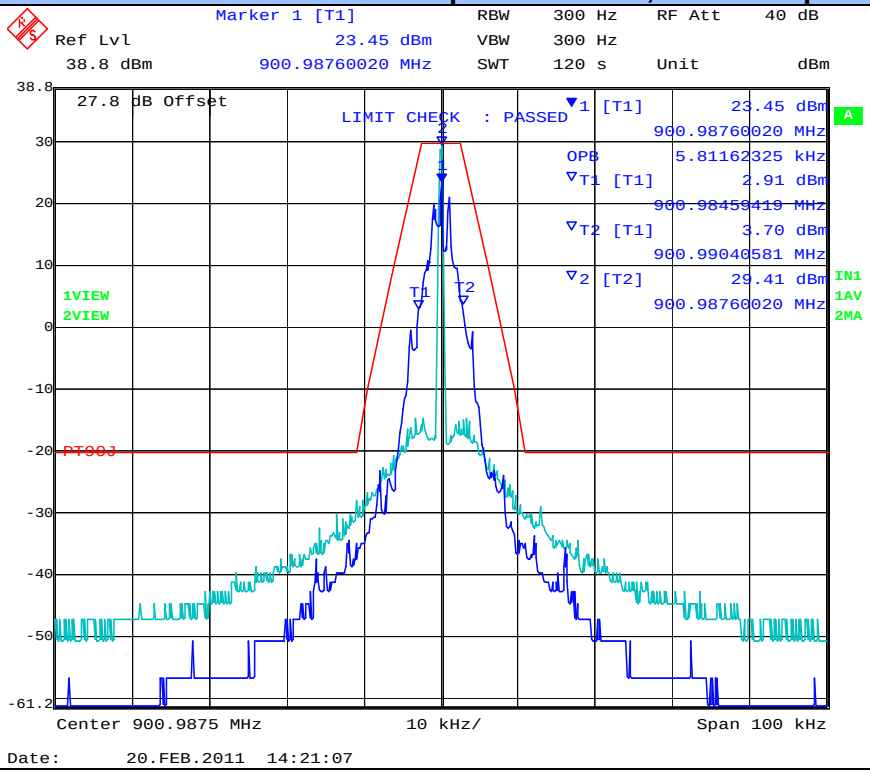
Channel 896.0375 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



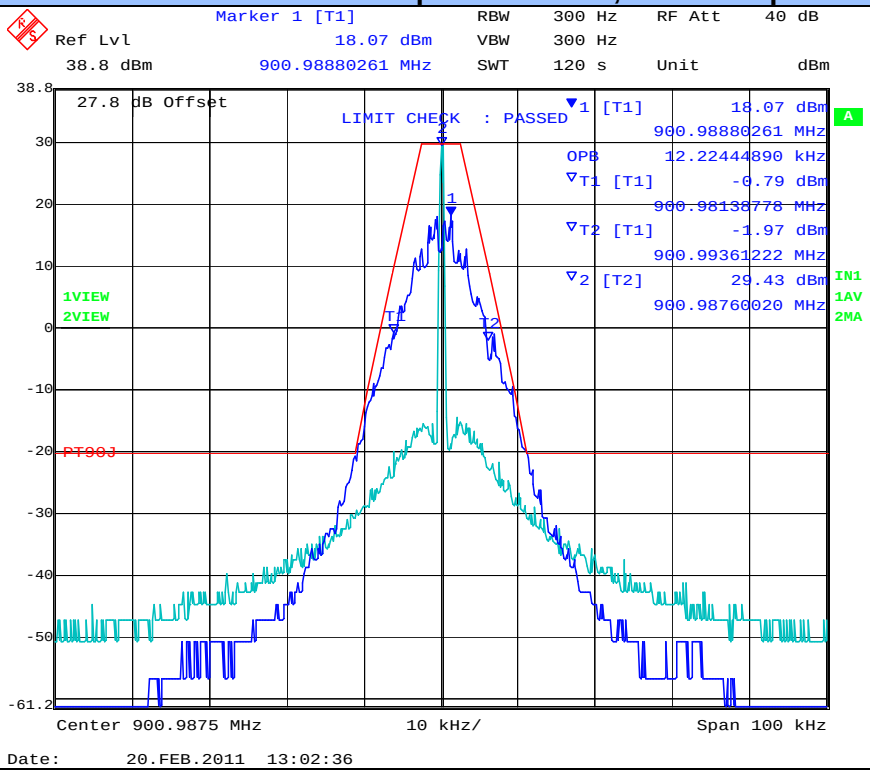
Channel 896.0375 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



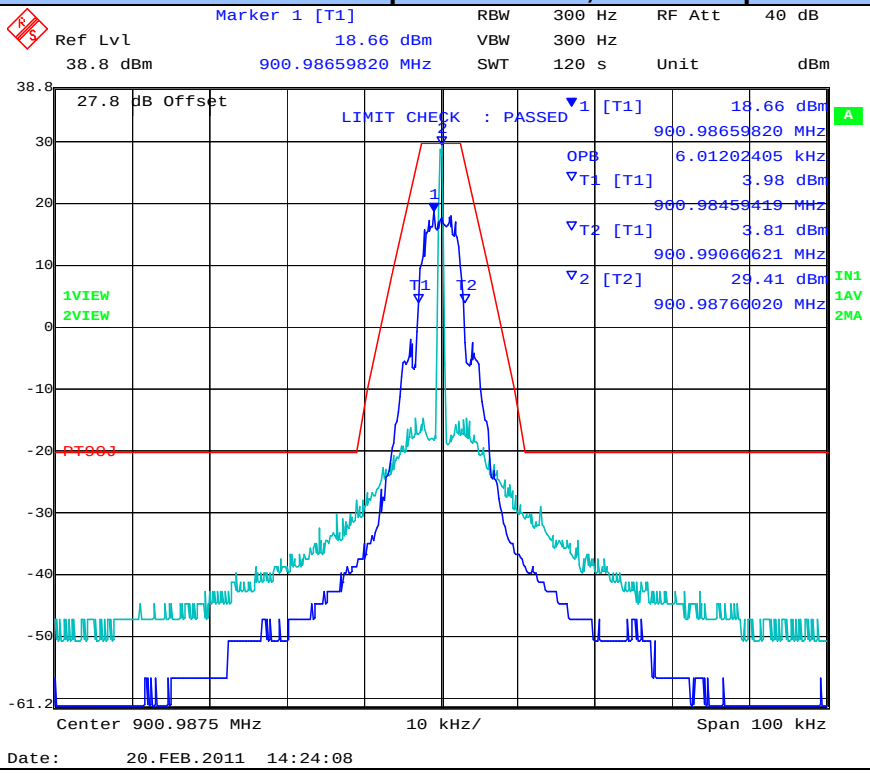
Channel 900.9875 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



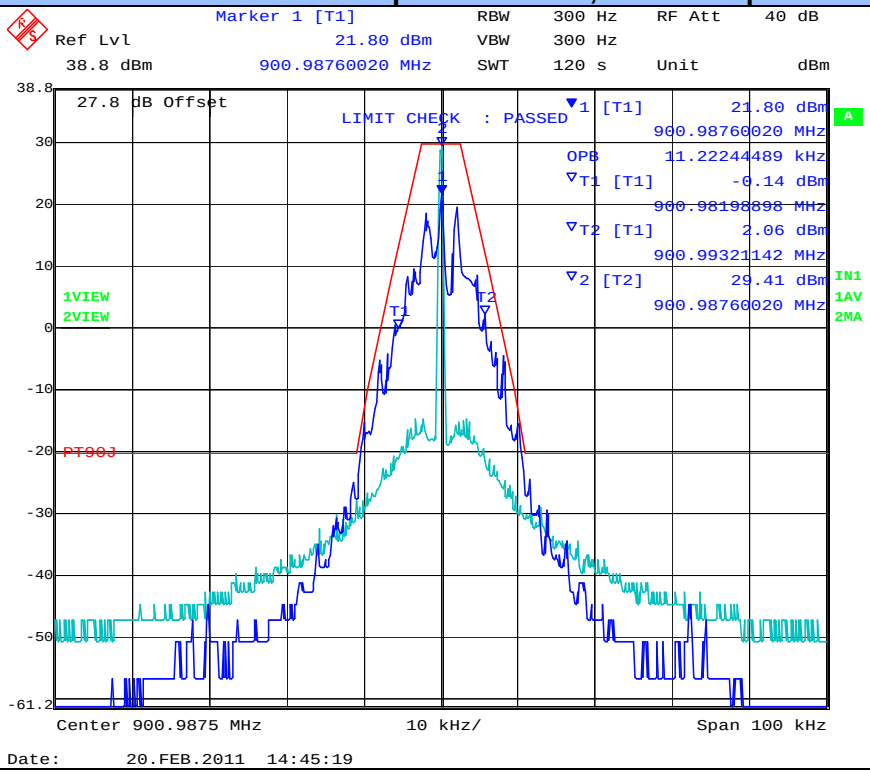
Channel 900.9875 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



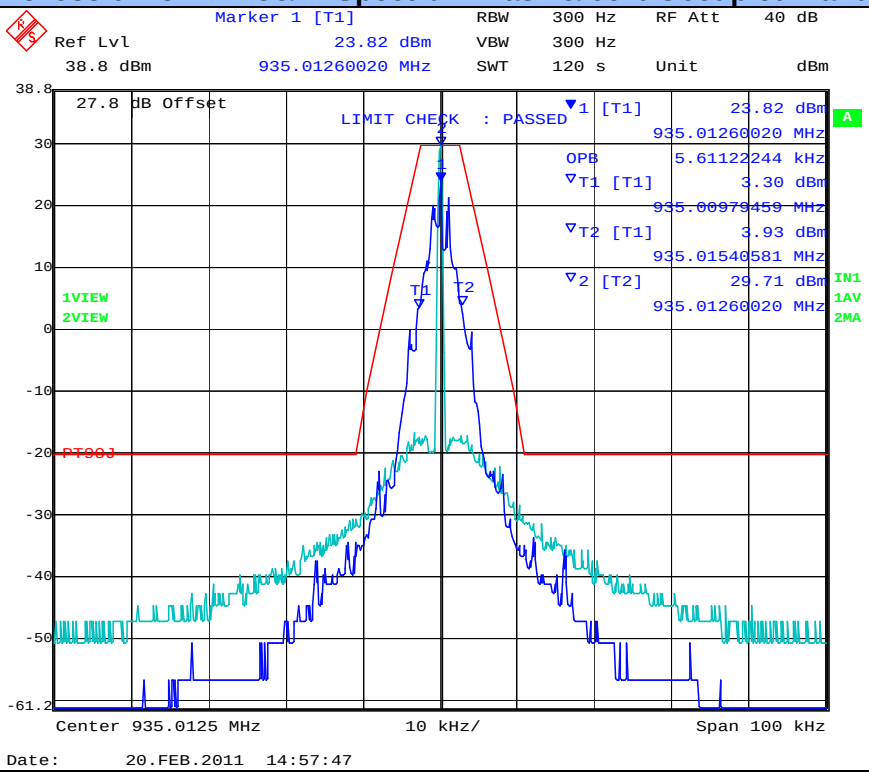
Channel 900.9875 MHz mPass – Spectrum Mask, 99% Occupied Bandwidth



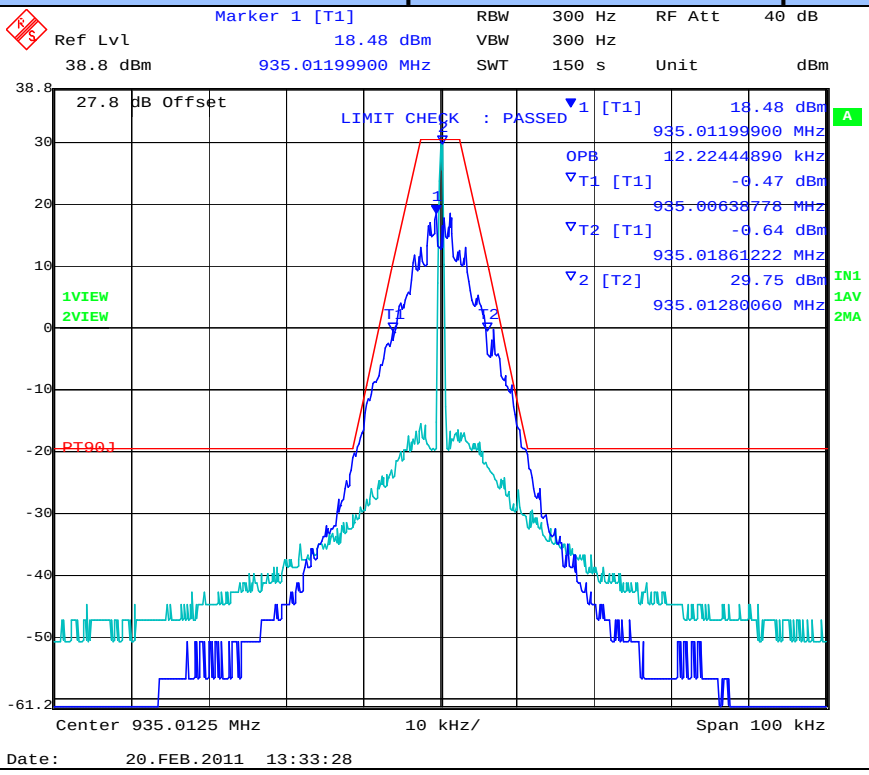
Channel 900.9875 MHz Normal – Spectrum Mask, 99% Occupied Bandwidth



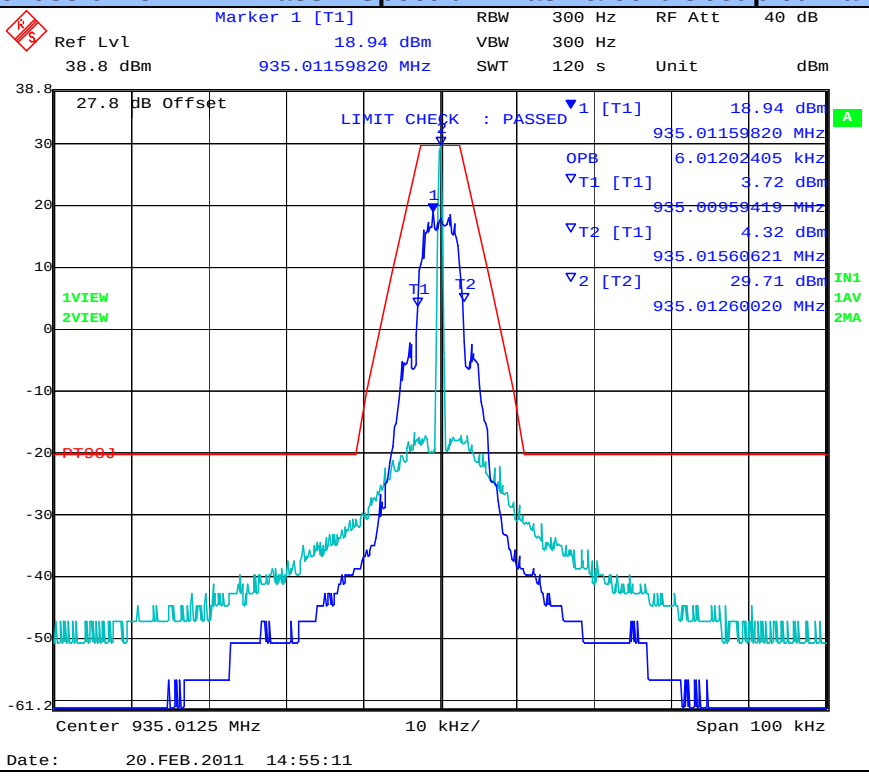
Channel 935.0125 MHz C&I – Spectrum Mask & 99% Occupied Bandwidth



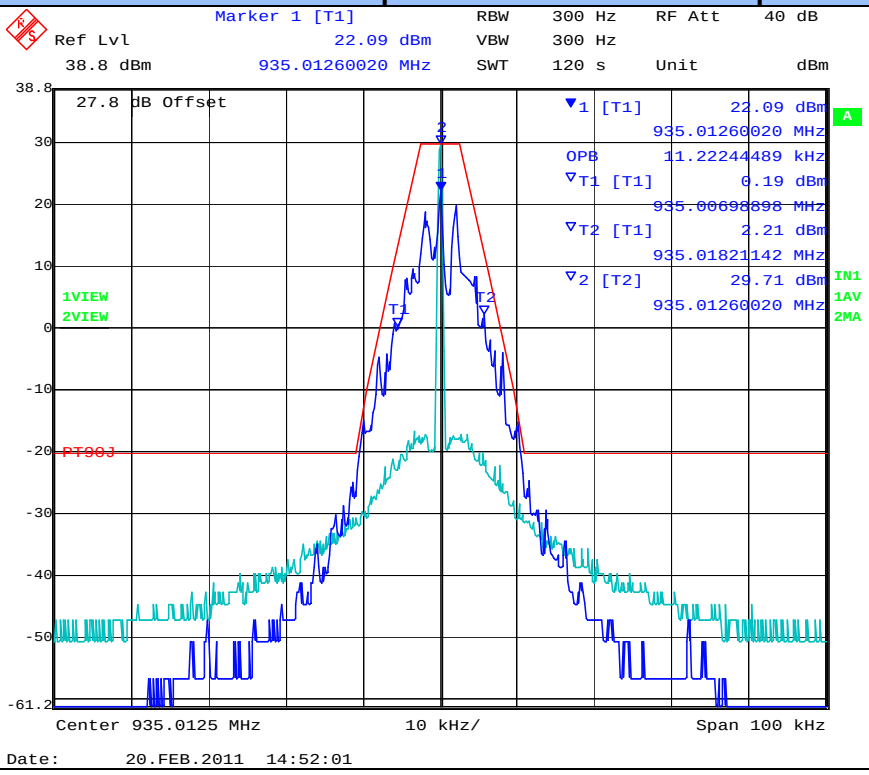
Channel 935.0125 MHz DD Extend – Spectrum Mask & 99% Occupied Bandwidth



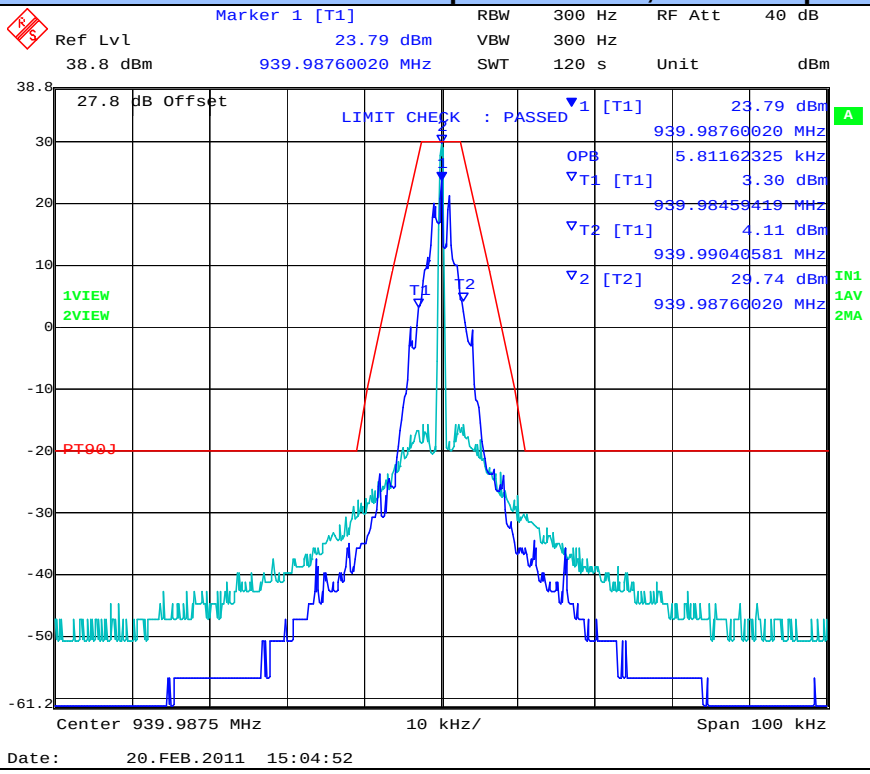
Channel 935.0125 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



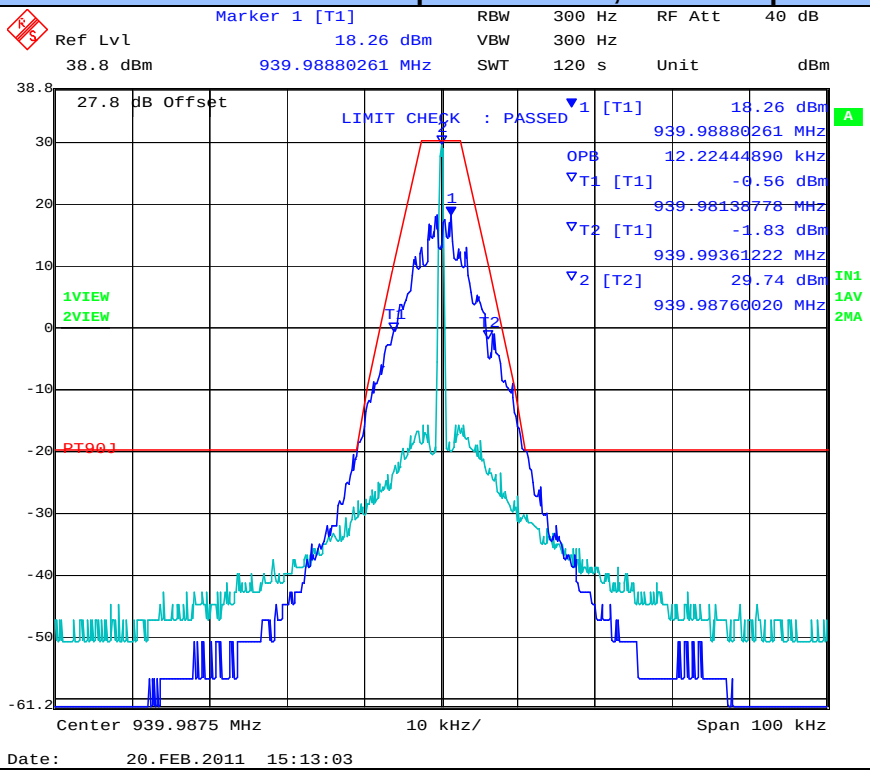
Channel 935.0125 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



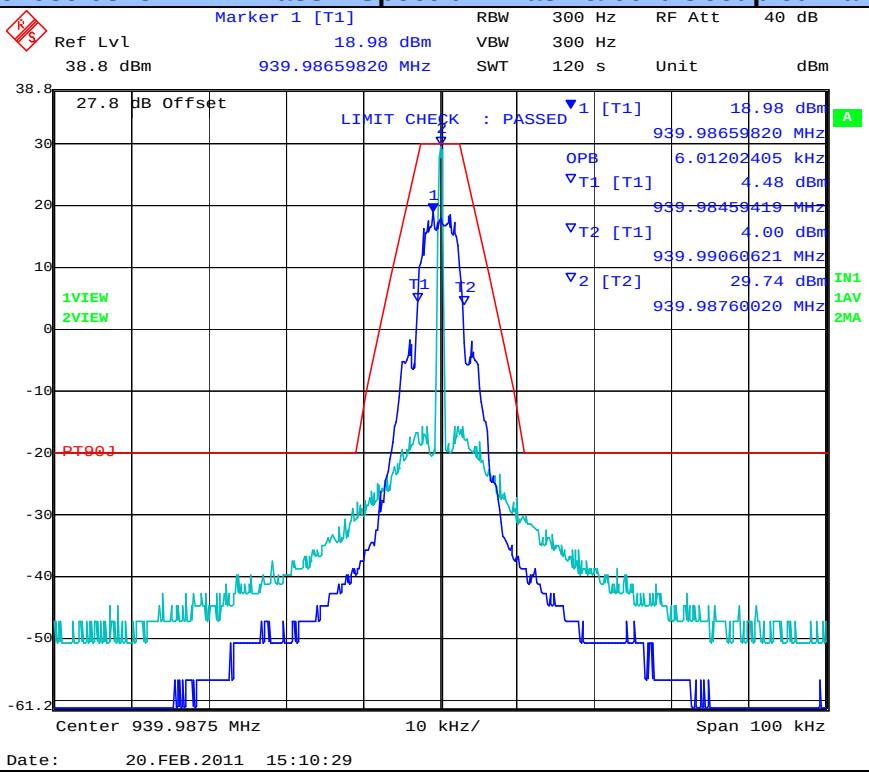
Channel 939.9875 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



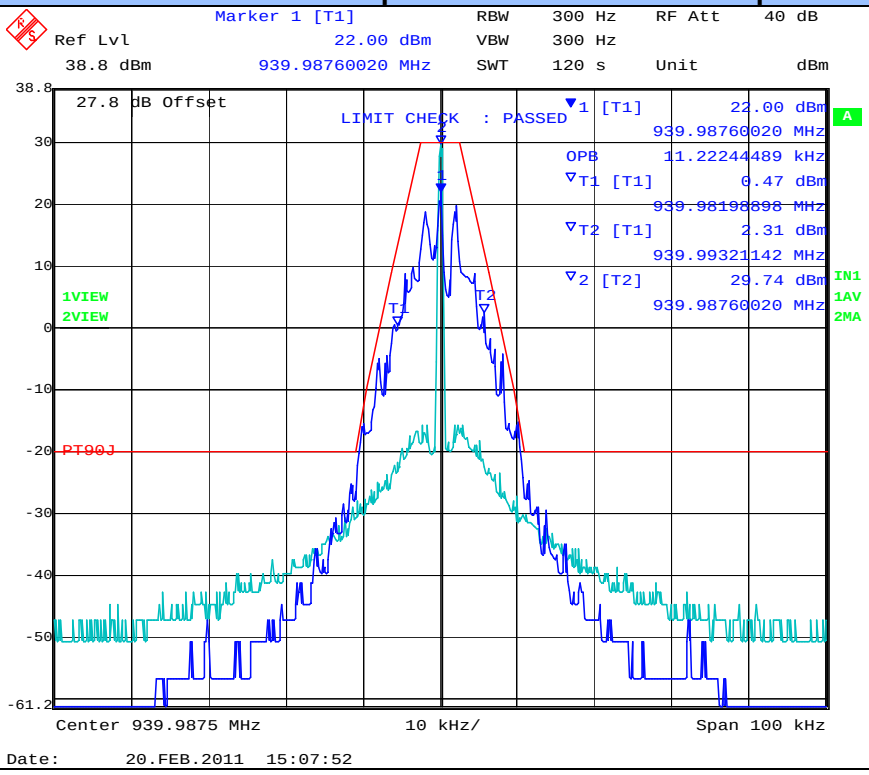
Channel 939.9875 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



Channel 939.9875 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



Channel 939.9875 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



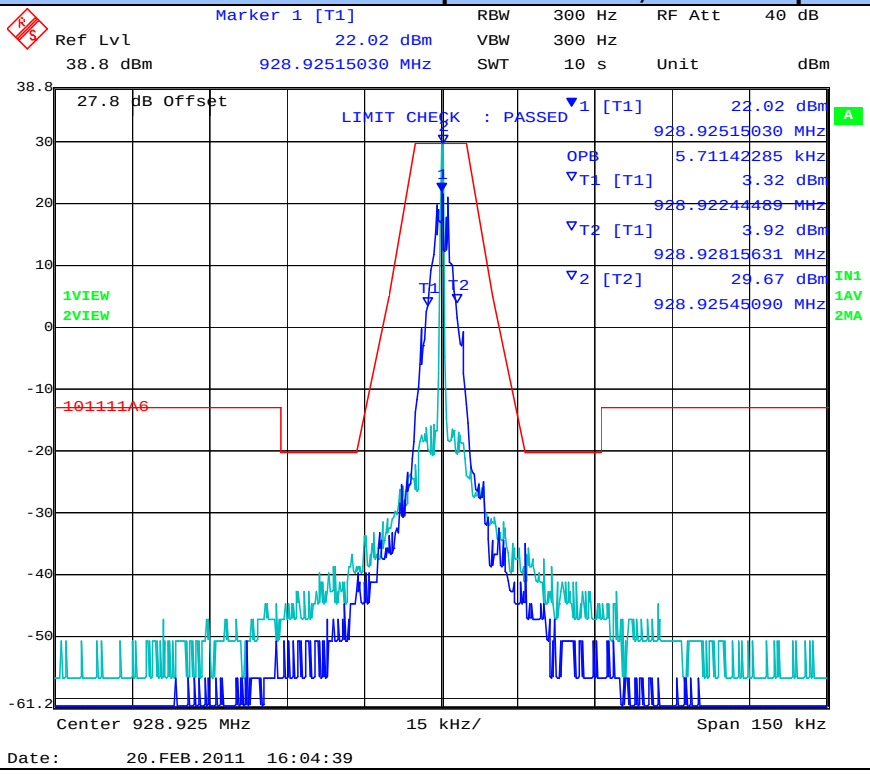
PART 101 RESULTS

Part 101.111 a(6) Measurement Results – Occupied Bandwidth + Plots

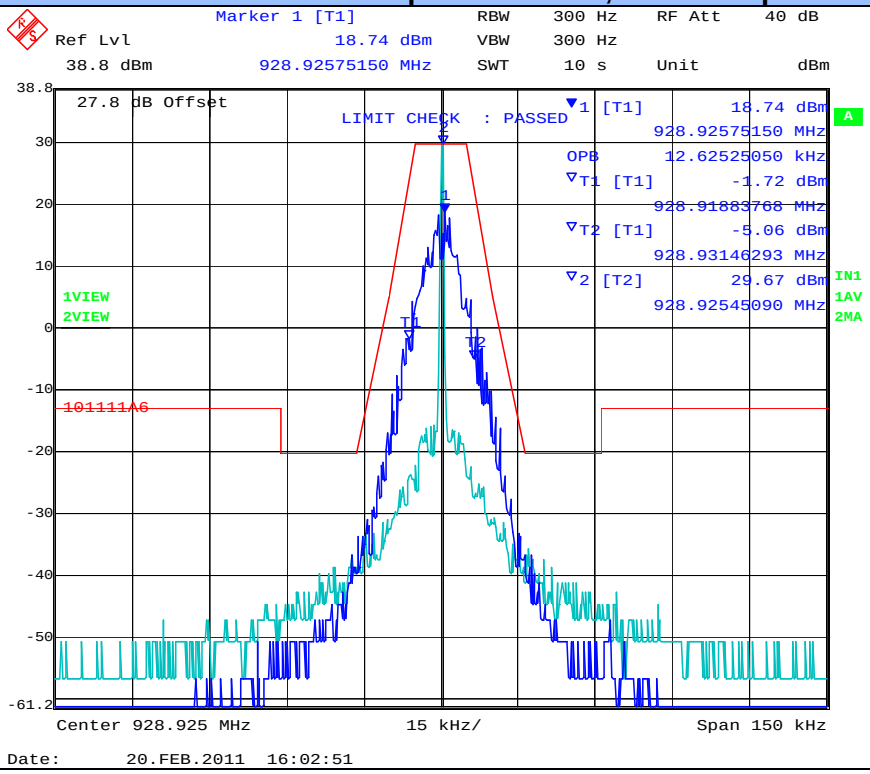
	99% Bandwidth (kHz)			
Center Frequency (MHz)	**C & I**	**DD Extend**	**mPass**	**Normal**
928.9250	5.711	12.625	6.012	11.423
932.2500	5.711	12.325	5.711	11.122
941.4875	6.012	12.024	6.012	11.122
959.9250	5.711	12.024	6.012	11.122

Part 101.111 a(6) Measurement Results

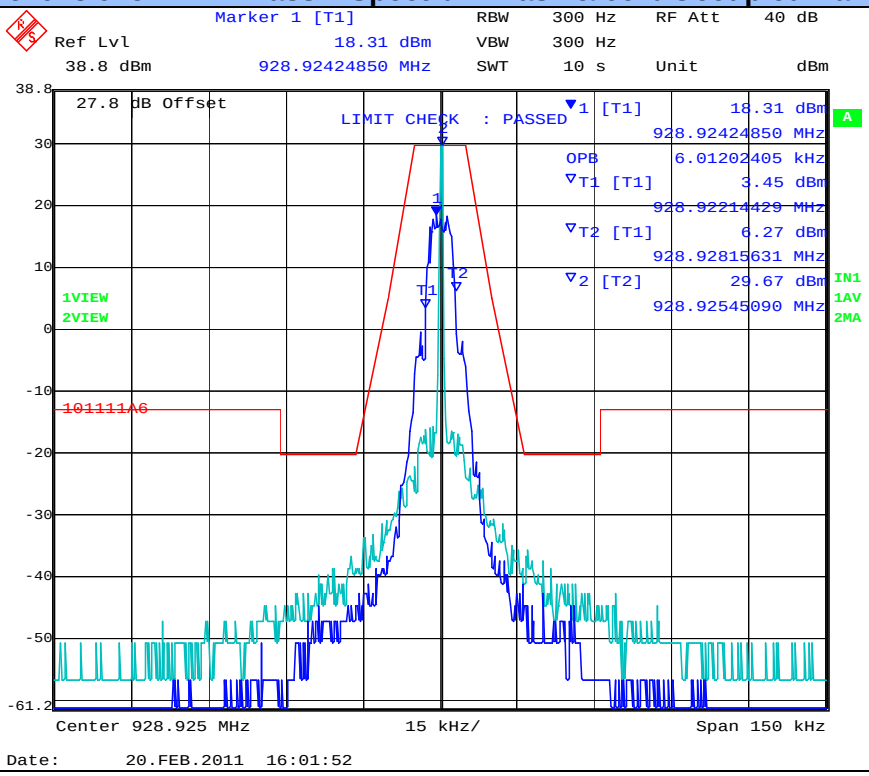
Channel 928.925 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



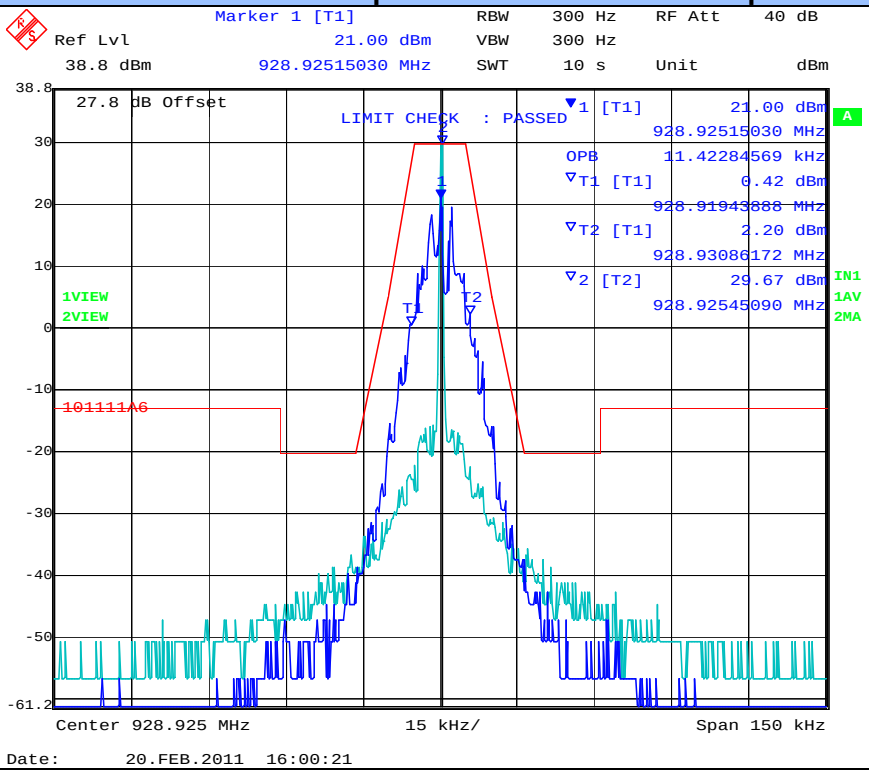
Channel 928.925 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



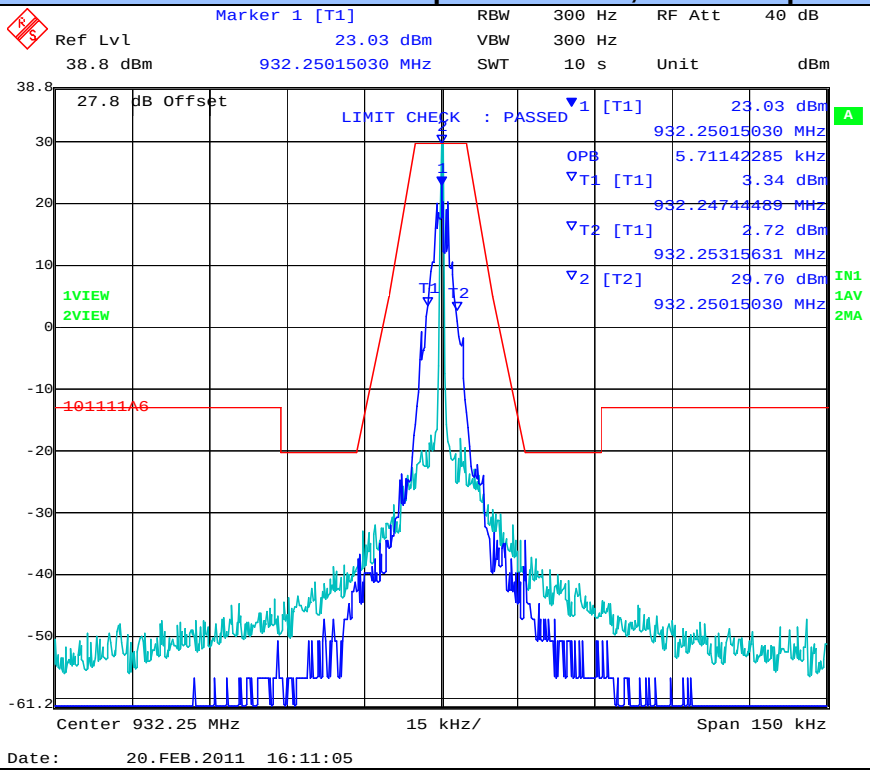
Channel 928.925 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



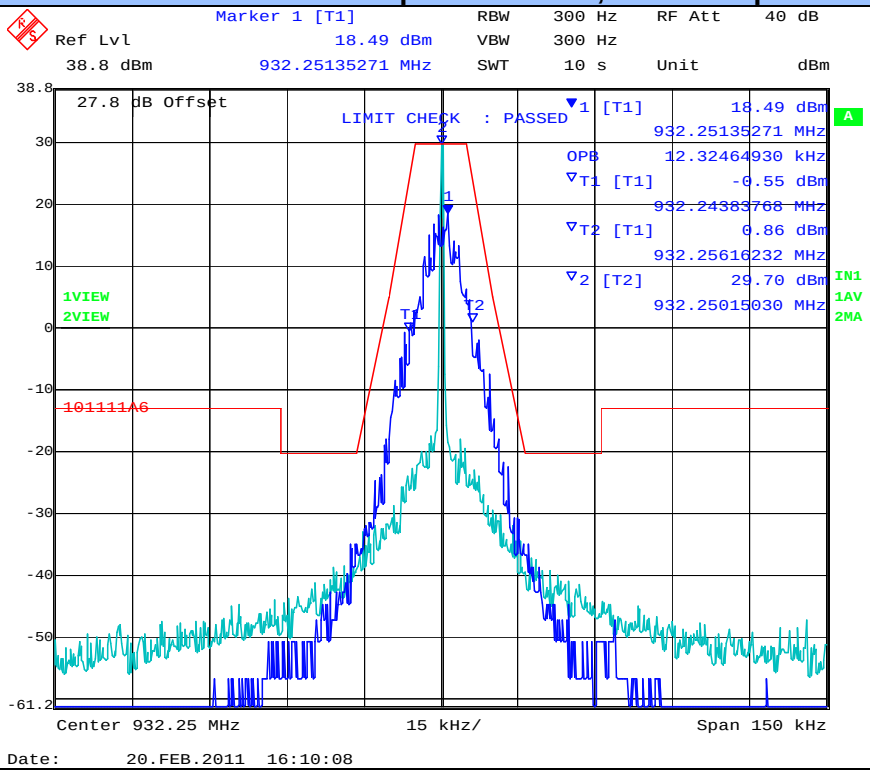
Channel 928.925 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



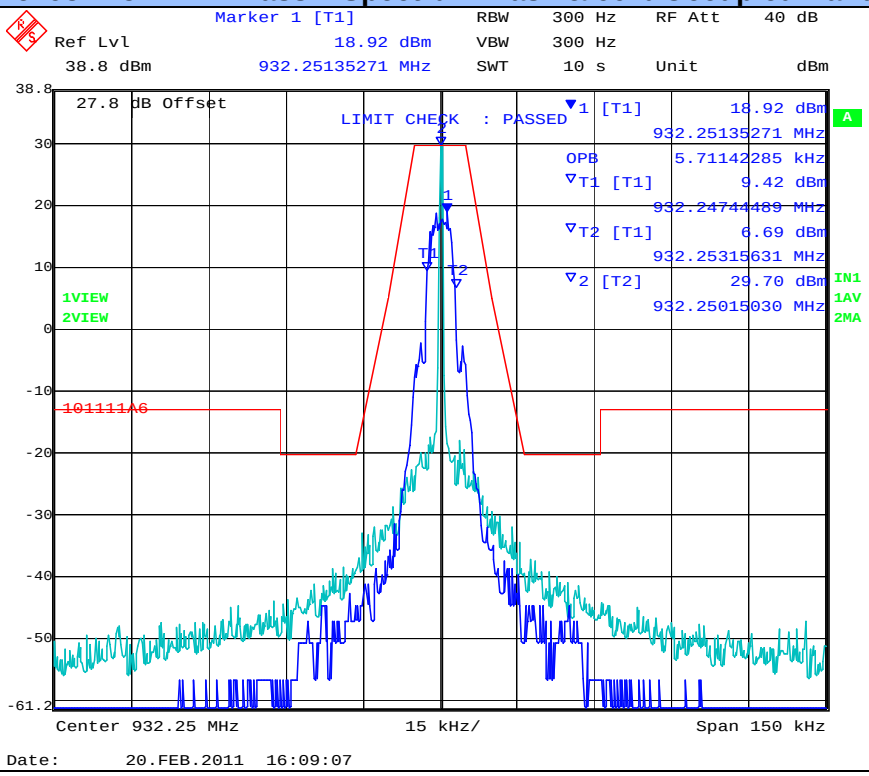
Channel 932.25 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



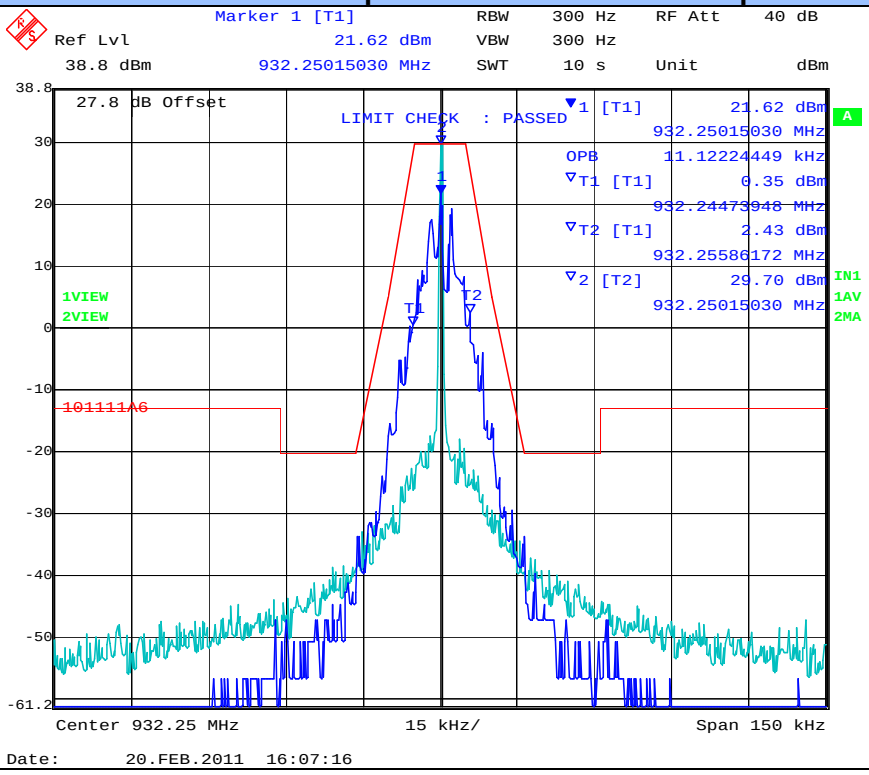
Channel 932.25 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



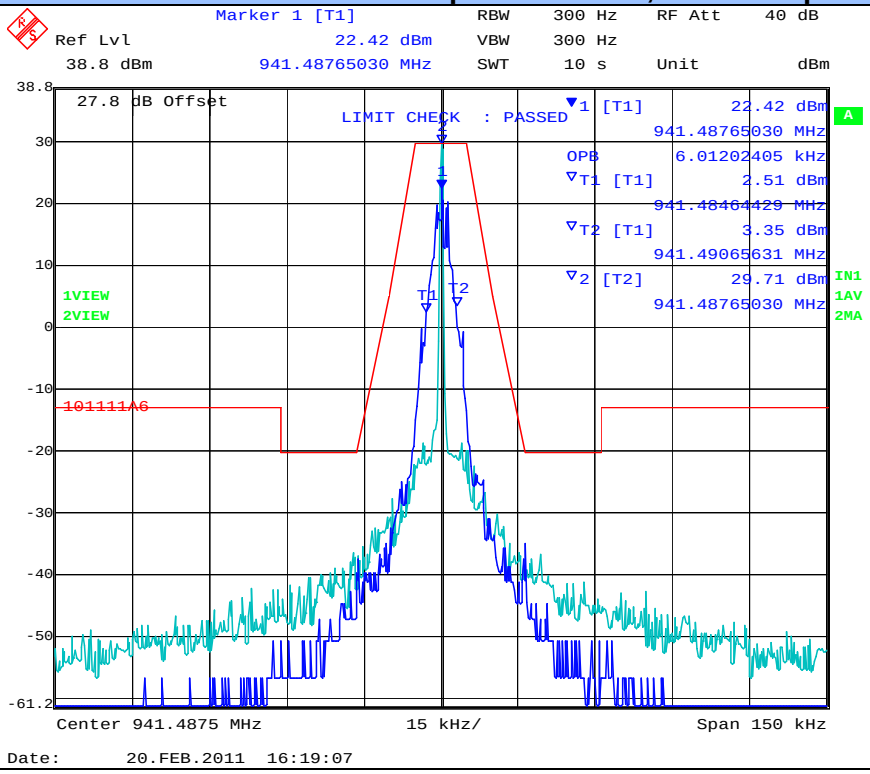
Channel 932.25 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



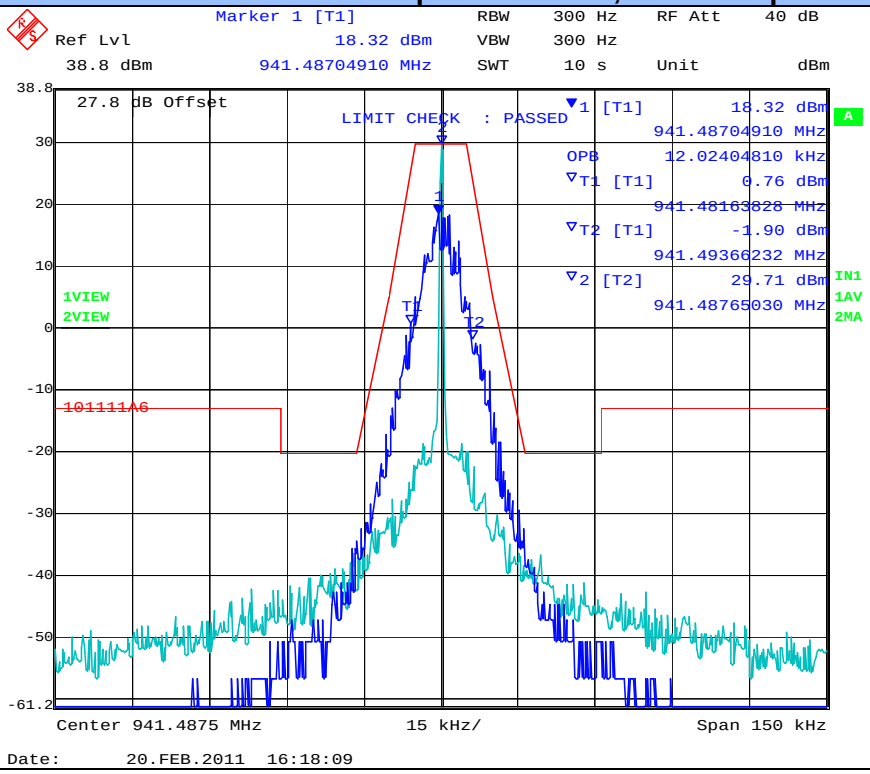
Channel 932.25 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



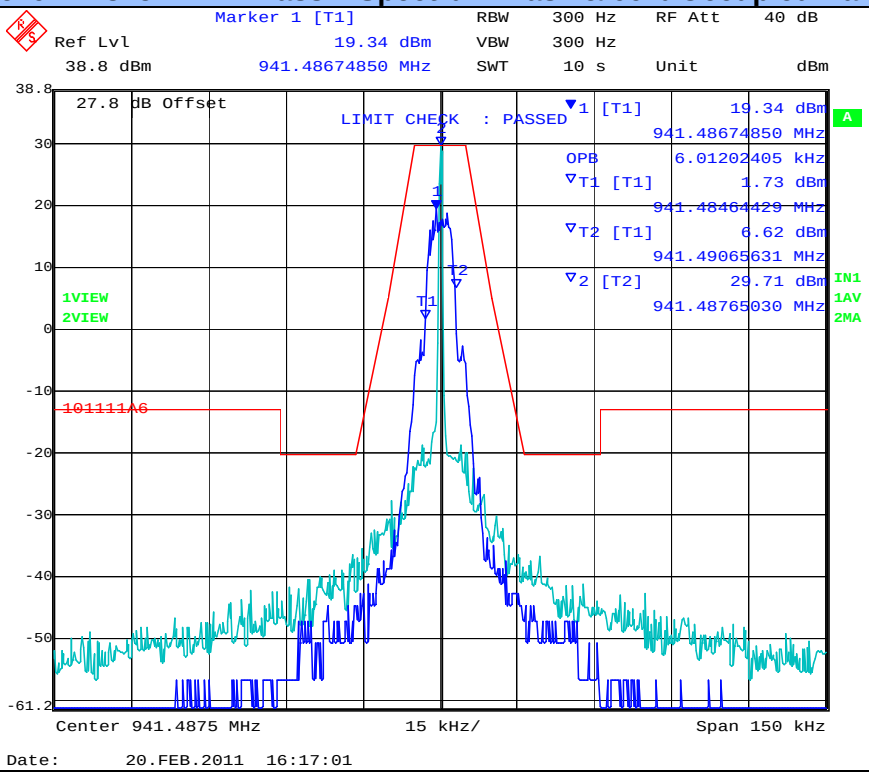
Channel 941.4875 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



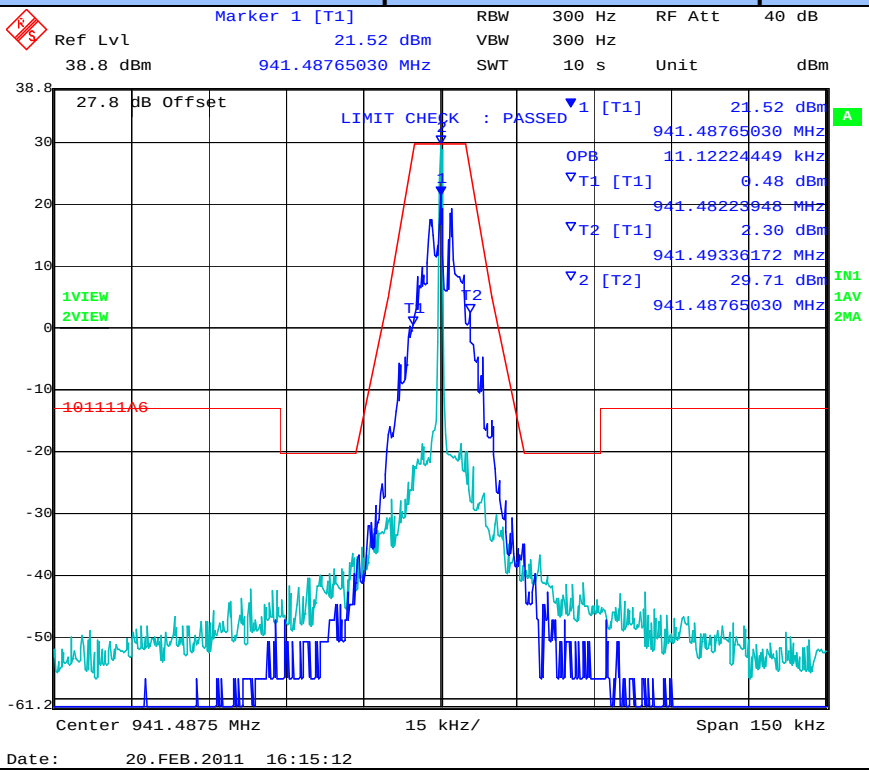
Channel 941.4875 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



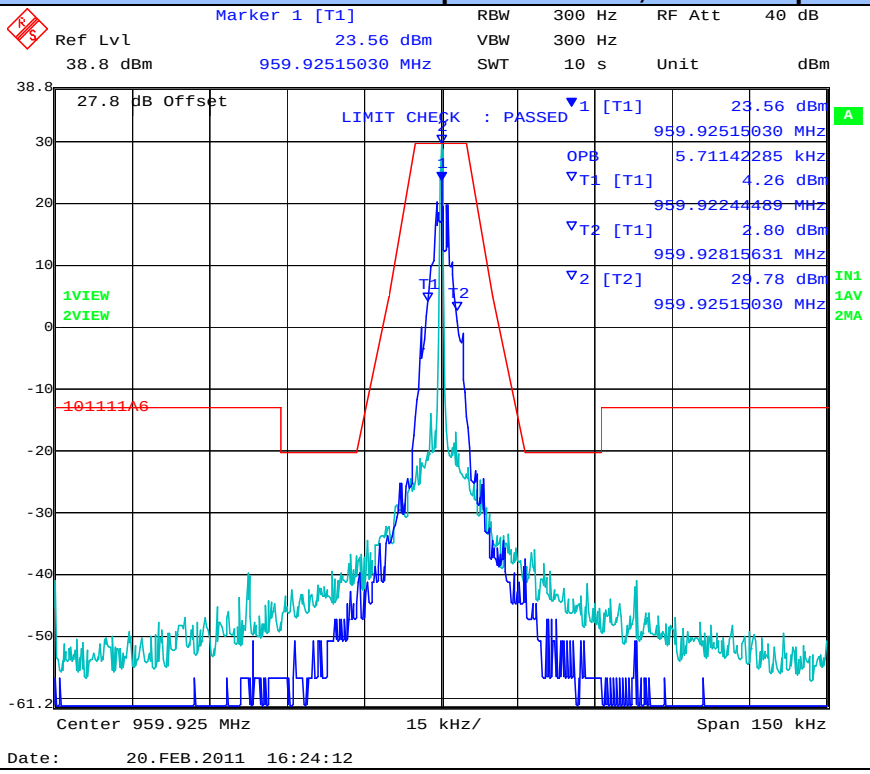
Channel 941.4875 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



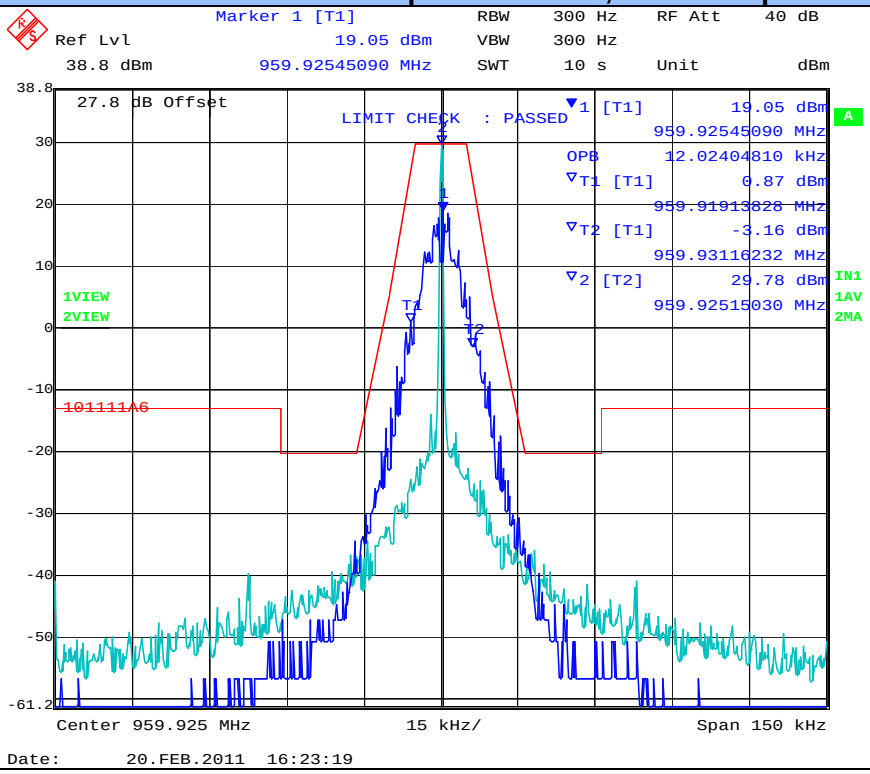
Channel 941.4875 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



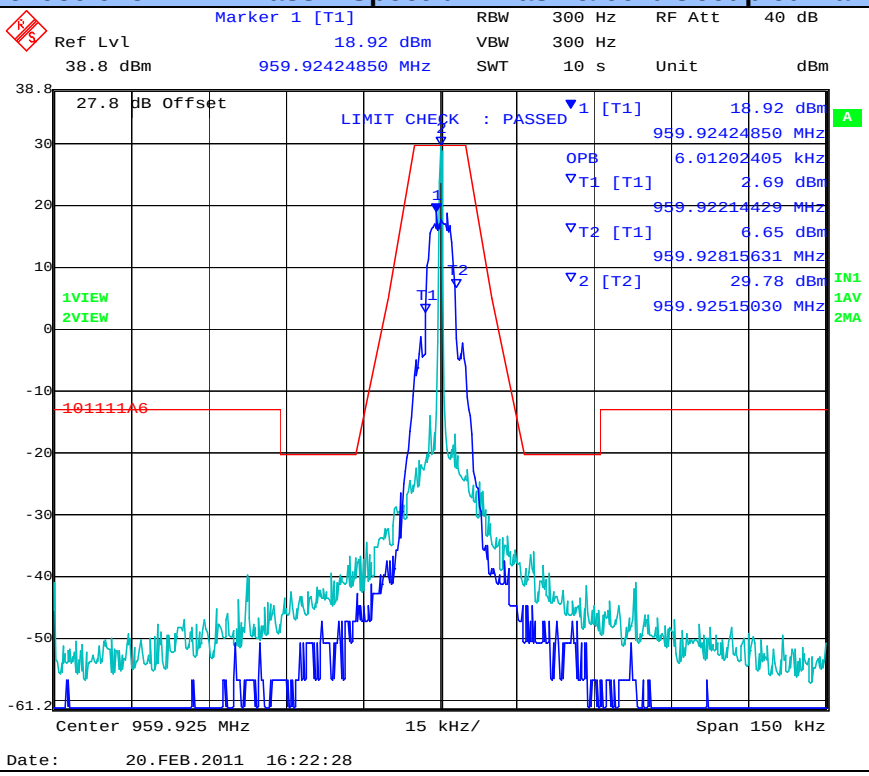
Channel 959.925 MHz C&I Modulation – Spectrum Mask, 99% Occupied Bandwidth



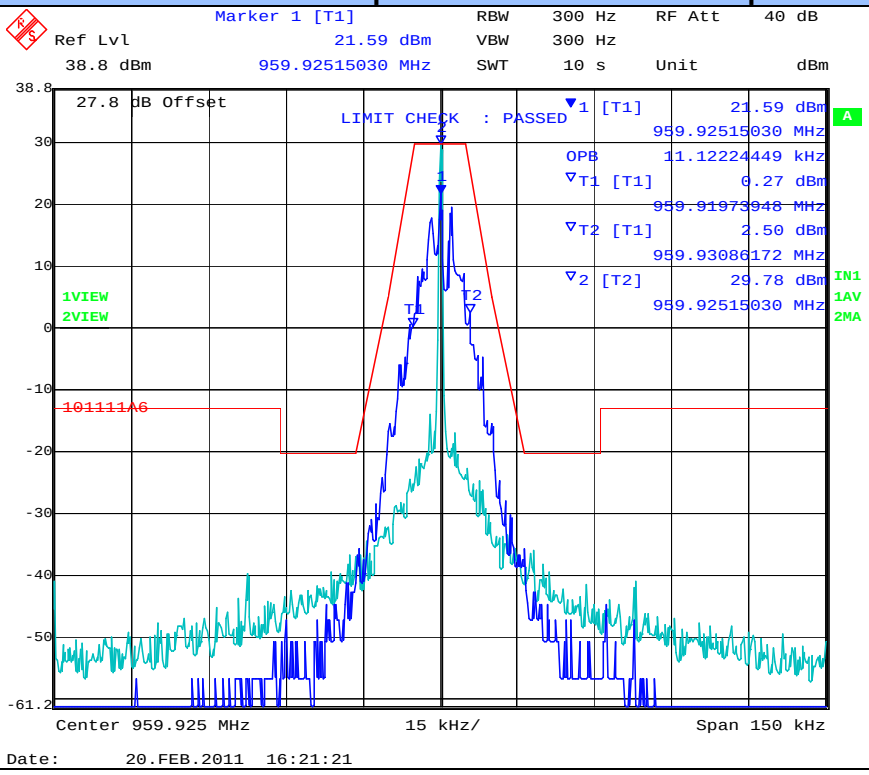
Channel 959.925 MHz DD Extend – Spectrum Mask, 99% Occupied Bandwidth



Channel 959.925 MHz mPass – Spectrum Mask & 99% Occupied Bandwidth



Channel 959.925 MHz Normal – Spectrum Mask & 99% Occupied Bandwidth



Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

5.1.3. Frequency Stability; Temperature Variations, and Voltage Variations

FCC 47 CFR Sections 2.1055, 24.135, 90.213, 101.107
IC RSS-134 (7), RSS-119 (5.3)

Test Procedure
The EUT was placed inside an environmental chamber. The transmitter output was connected to a spectrum analyzer and the frequency stability was measured using a un-modulated (CW) single tone. A thermocouple was used to monitor chamber temperature. The EUT was attached to a variable power supply providing the primary supply voltage.

Frequency stability was measured through the extremes of temperature and voltage on the mid channel of each frequency band. Before measurements were taken at each temperature the equipment waited until thermal balance was obtained.

At +20°C the primary voltage was varied ±15% and measurements were taken at each voltage level.

Test Set-up is shown in Section 3.6 Test Configuration

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS Frequency Stability – Channel Measured 896.0375 MHz

EUT Classification: Mobile Applications

Voltage	Temperature (°C)	Center Frequency (MHz)	Delta (Hz)	ppm
3.3 Vdc	-33	896.03725319	-246.810	-0.275
	-23	896.03727191	-228.090	-0.255
	-13	896.03745648	-43.520	-0.049
	-3	896.03754746	47.460	0.053
	+7	896.03744676	-53.240	-0.059
	+17	896.03753368	33.680	0.038
	+25	896.03752238	22.380	0.025
3.63 Vdc	+25	896.03751990	19.900	0.022
2.97 Vdc	+25	896.03751923	19.230	0.021
3.3 Vdc	+35	896.03745317	-46.830	-0.052
	+45	896.03735897	-141.030	-0.157
	+55	896.03728191	-218.090	-0.243
Maximum Frequency Drift with respect to the nominal frequency		-253.510 Hz / +49.100 Hz -0.275 ppm / +0.0053 ppm		

Limits
§ 90.213 (a) Frequency stability

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

MINIMUM FREQUENCY STABILITY [Parts per million (ppm)]

Frequency Range (MHz)	Fixed and Base Stations (ppm)	Mobile Stations (ppm)	
		Over 2 watts output power	2 watts or less output power
896 - 901	±0.1	±1.5	±1.5
935 - 940	±0.1	±1.5	±1.5

TABLE OF RESULTS Frequency Stability – Channel Measured 930.5 MHz

Voltage	Temperature (°C)	Center Frequency (MHz)	Delta (Hz)	ppm
3.3 Vdc	-33	930.49974649	-253.5100	-0.272
	-23	930.49976453	-235.4700	-0.253
	-13	930.49995491	-45.0900	-0.048
	-3	930.50004910	49.1000	0.053
	+7	930.49994489	-55.1100	-0.059
	+17	930.50003507	35.0700	0.038
	+25	930.50002305	23.0500	0.025
3.63 Vdc	+25	930.50002104	21.0400	0.023
2.97 Vdc	+25	930.50001904	19.0400	0.020
3.3 Vdc	+35	930.49995090	-49.1000	-0.053
	+45	930.49985271	-147.2900	-0.158
	+55	930.49977455	-225.4500	-0.242
Maximum Frequency Drift with respect to the nominal frequency		-253.51 Hz / +49.1 Hz -0.272 ppm / +0.053 ppm		

Limits
§ 24.135 Frequency stability

(a) The frequency stability of the transmitter shall be maintained within ± 0.0001 percent (±1 ppm) of the center frequency over a temperature variation of ´30° Celsius to +50° Celsius at normal supply voltage, and over a variation in the primary supply voltage of 85 percent to 115 percent of the rated supply voltage at a temperature of 20° Celsius.

(b) For battery operated equipment, the equipment tests shall be performed using a new battery without any further requirement to vary supply voltage.

(c) It is acceptable for a transmitter to meet this frequency stability requirement over a narrower temperature range provided the transmitter ceases to function before it exceeds these frequency stability limits.

TABLE OF RESULTS Frequency Stability – Channel Measured 959.925 MHz

Voltage	Temperature (°C)	Center Frequency (MHz)	Delta (Hz)	ppm	%
3.3 Vdc	-33	959.92473751	-262.491	-0.273	-0.0000273
	-23	959.92475756	-242.436	-0.253	-0.0000253
	-13	959.92495434	-45.662	-0.048	-0.0000048
	-3	959.92505084	50.845	0.053	0.0000053
	+7	959.92494306	-56.939	-0.059	-0.0000059
	+17	959.92503512	35.123	0.037	0.0000037
	+25	959.92502397	23.971	0.025	0.0000025
3.63 Vdc	+25	959.92502142	21.417	0.022	0.0000022
2.97 Vdc	+25	959.92501964	19.642	0.020	0.0000020
3.3 Vdc	+35	959.92495079	-49.213	-0.051	-0.0000051
	+45	959.92485276	-147.244	-0.153	-0.0000153
	+55	959.92477596	-224.036	-0.233	-0.0000233
Maximum Frequency Drift with respect to the nominal frequency		-262.491 Hz / +50.845 Hz -0.273 ppm / +0.053 ppm			

§ 101.107 Frequency tolerance.
(a) The carrier frequency of each transmitter authorized in these services must be maintained within the following percentage of the reference frequency except as otherwise provided in paragraph (b) of this section or in the applicable subpart of this part (unless otherwise specified in the instrument of station authorization the reference frequency will be deemed to be the assigned frequency):

Frequency Tolerance (percent)

Frequency Range (MHz)	Frequency Tolerance (%)
928 - 929 5	0.0005
932 - 932.5	0.00015
932.5 - 935	0.00025
941 - 941.5	0.00015
941.5 TO 944	0.00025

Laboratory Uncertainty for Frequency Measurements

Measurement uncertainty (dB)	±0.86ppm

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-02 'Frequency Measurement"	0075, 0156, 0193, 0252, 0313, 0314

5.1.4. Spurious Emissions from Antenna Terminals

FCC 47 CFR Part 24 Subpart 24.133 a(1), a(2)
FCC 47 CFR Part 90 Subpart 90.210 (j)
FCC 47 CFR Part 101 Subpart 101.111 a(6)
IC RSS-134 6.3 (i), (ii)
IC RSS-119 5.8.6

Test Procedure
The transmitter output was connected to a spectrum analyzer and the Spurious Emissions were measured using an un-modulated carrier.

Spurious Emissions were measured under ambient conditions, nominal voltage for all rule parts on low and high channels for the particular frequency band.

The limit line was calculated from the attenuation characteristics found within each rule part.

Test Set-up is shown in Section 3.6 Test Configuration

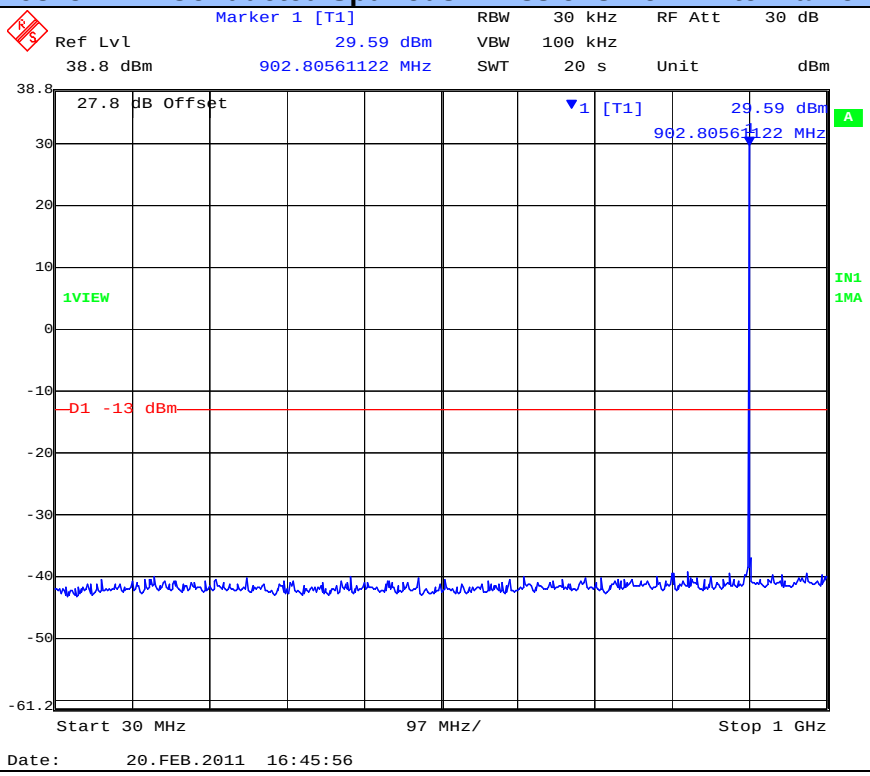
Ambient conditions.
Temperature: **17 to 23** °C Relative humidity: **31 to 57** % Pressure: **999 to 1012** mbar

PART 24 RESULTS

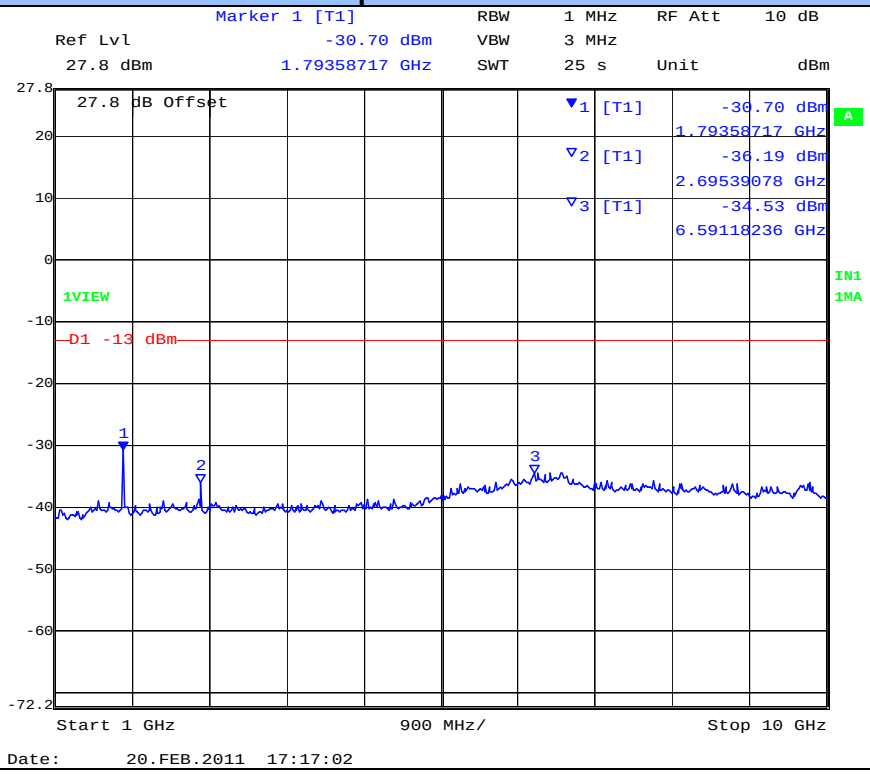
Part 24.133 Measurement Results

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
901.9875	30	1,000	-39.05	-13.0	-26.05
	1,000	10,000	-30.70		-17.70
930.5000	30	1,000	-39.10		-26.10
	1,000	10,000	-33.29		-20.29

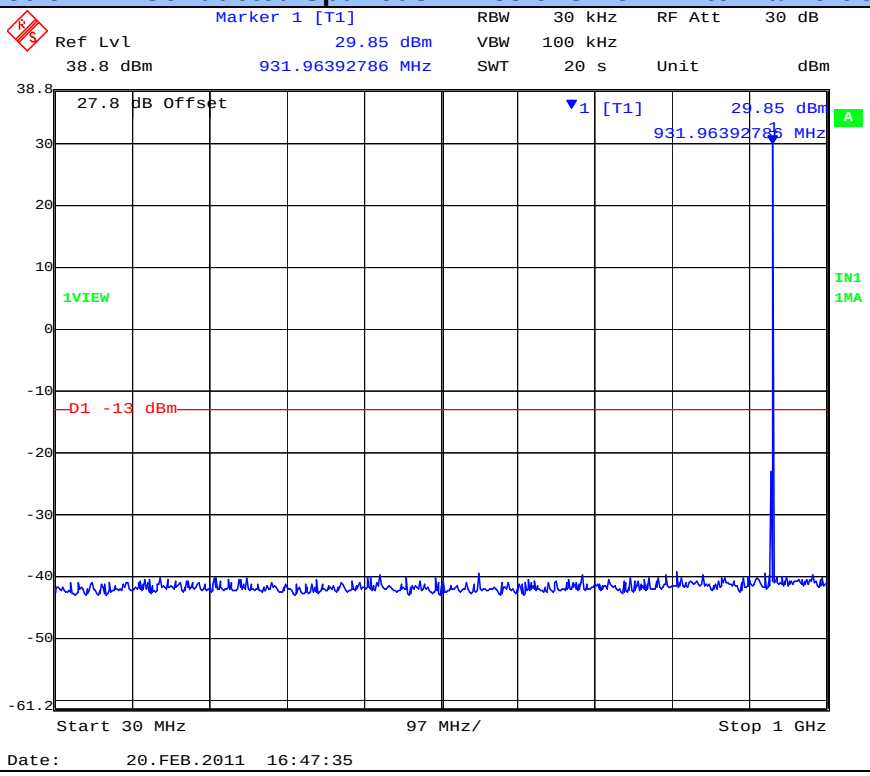
Channel 901.9875 MHz–Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



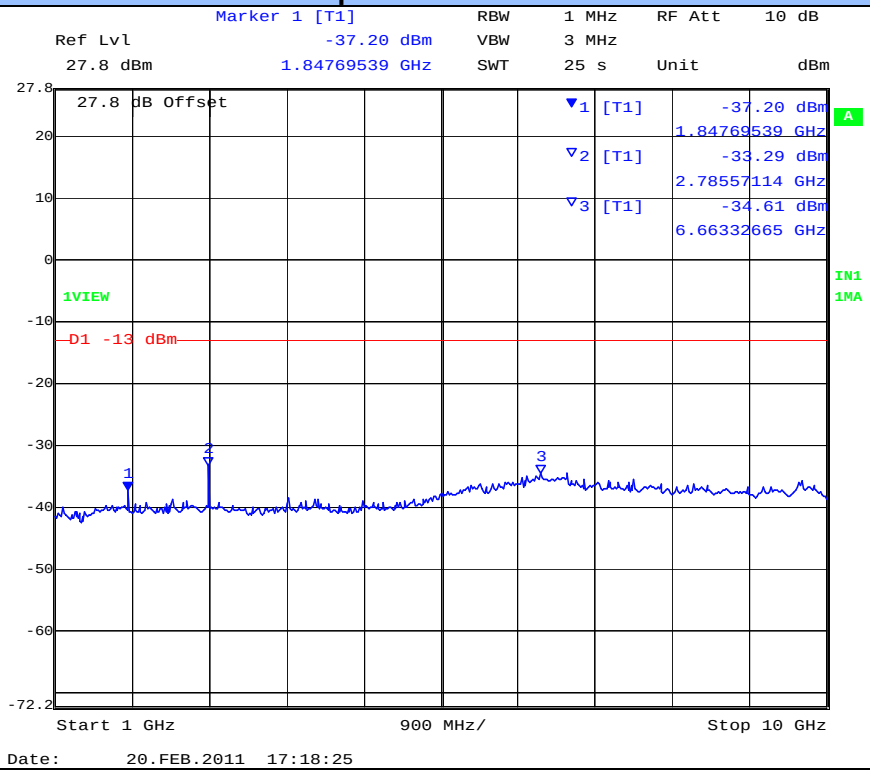
Channel 901.9875 MHz–Conducted Spurious Emissions from Antenna Port 1– 10 GHz



Channel 930.5 MHz-Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



Channel 930.5 MHz-Conducted Spurious Emissions from Antenna Port 1-10 GHz

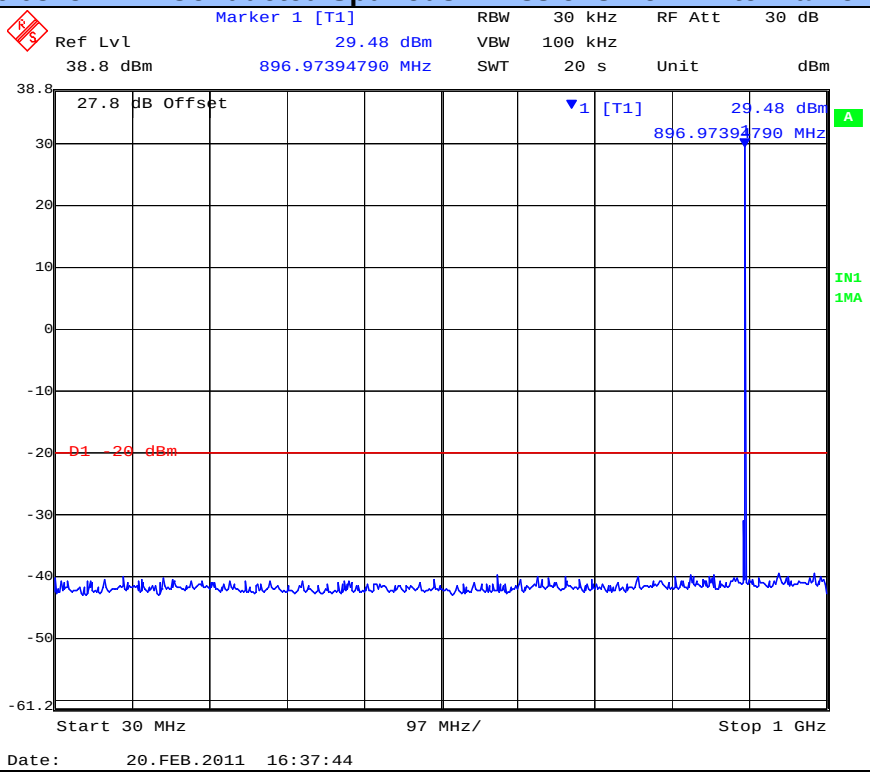


PART 90 RESULTS

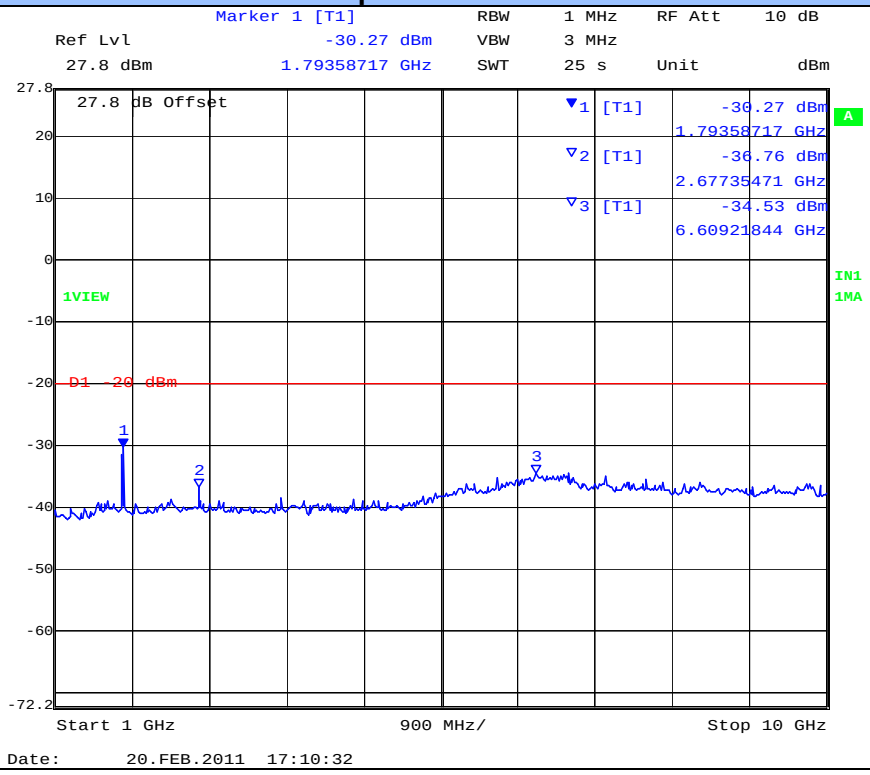
Part 90.210 j Measurement Results – Conducted Spurious Emissions

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
896.0375	30	1,000	-39.33	-20	-19.33
	1,000	10,000	-30.27		-10.27
900.9875	30	1,000	-38.91		-18.91
	1,000	10,000	-30.64		-10.64
935.0125	30	1,000	-39.62		-19.62
	1,000	10,000	-33.52		-13.52
939.9875	30	1,000	-39.86		-19.86
	1,000	10,000	-33.06		-13.06

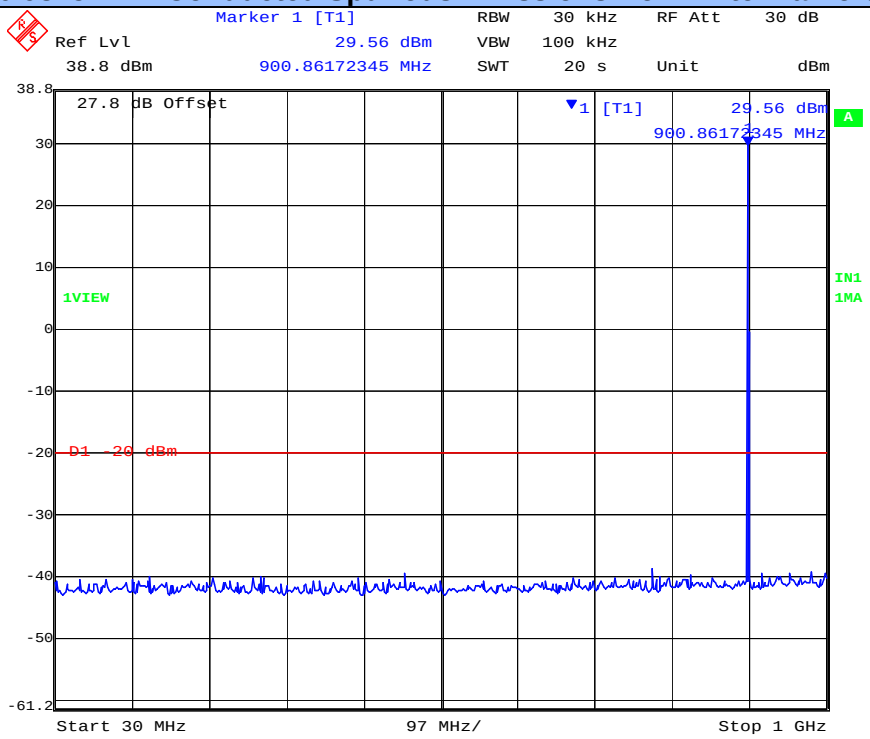
Channel 896.0375 MHz–Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



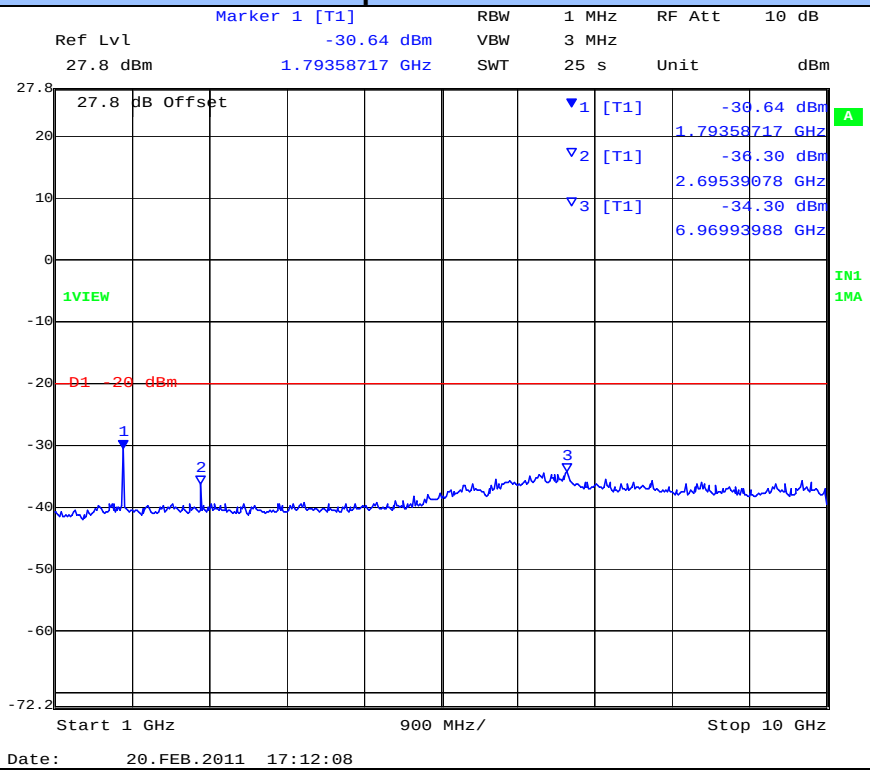
Channel 896.0375 MHz–Conducted Spurious Emissions from Antenna Port 1– 10 GHz



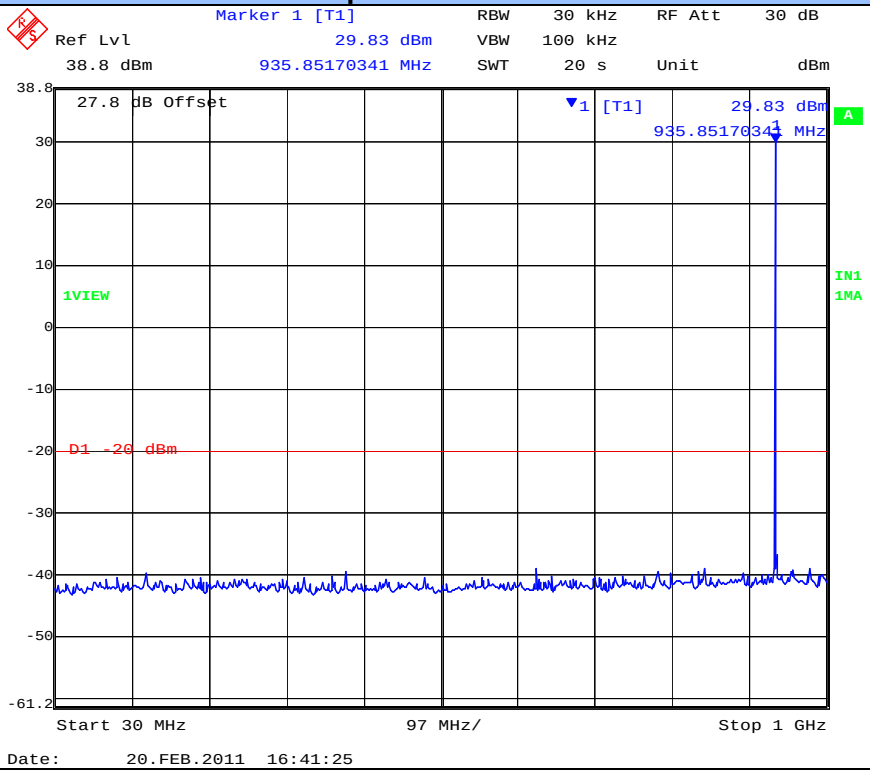
Channel 900.9875 MHz-Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



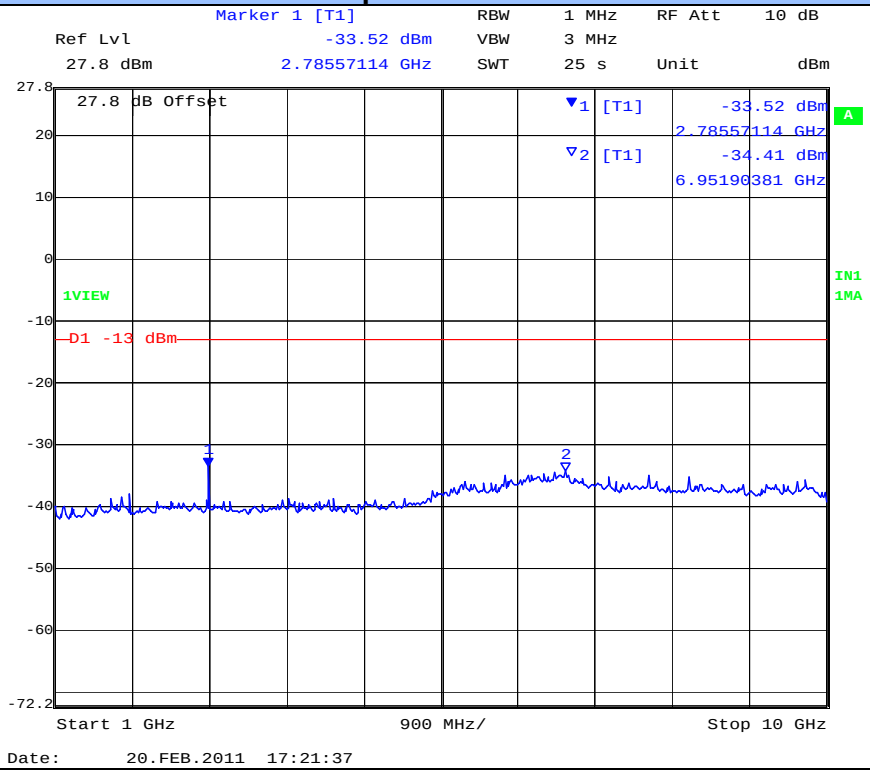
Channel 900.9875 MHz-Conducted Spurious Emissions from Antenna Port 1-10 GHz



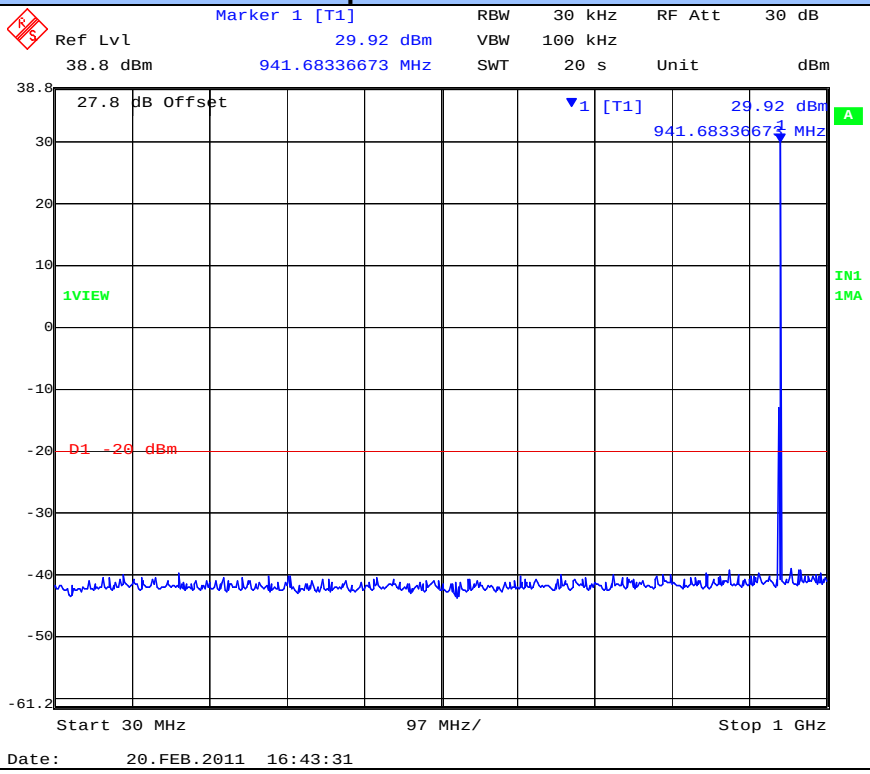
Channel 935.0125 MHz-Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



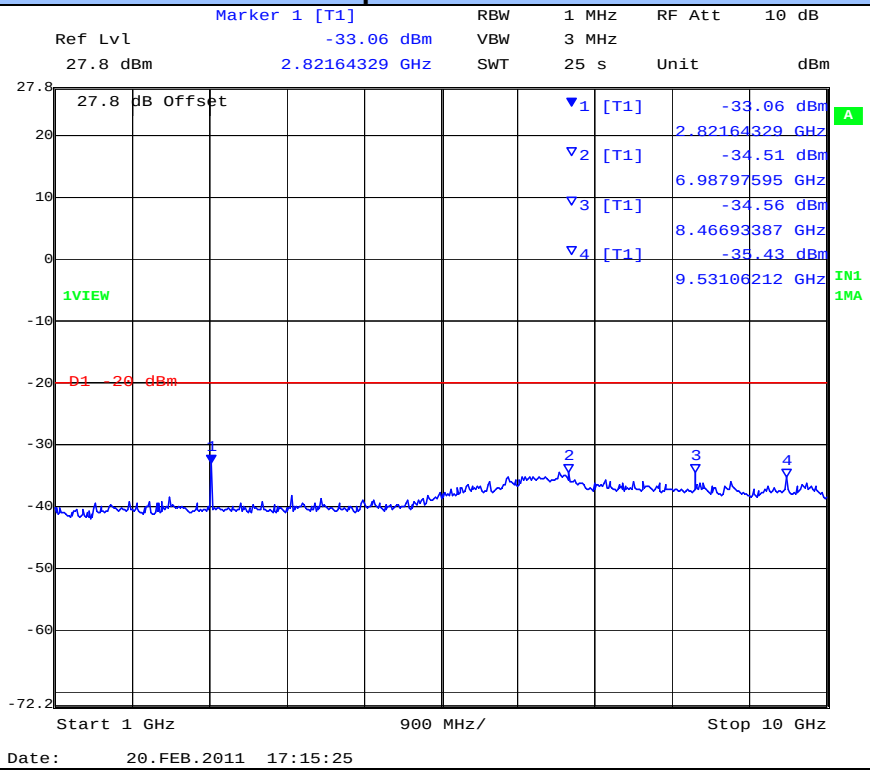
Channel 935.0125 MHz-Conducted Spurious Emissions from Antenna Port 1-10 GHz



Channel 939.9875 MHz-Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



Channel 939.9875 MHz-Conducted Spurious Emissions from Antenna Port 1-10 GHz

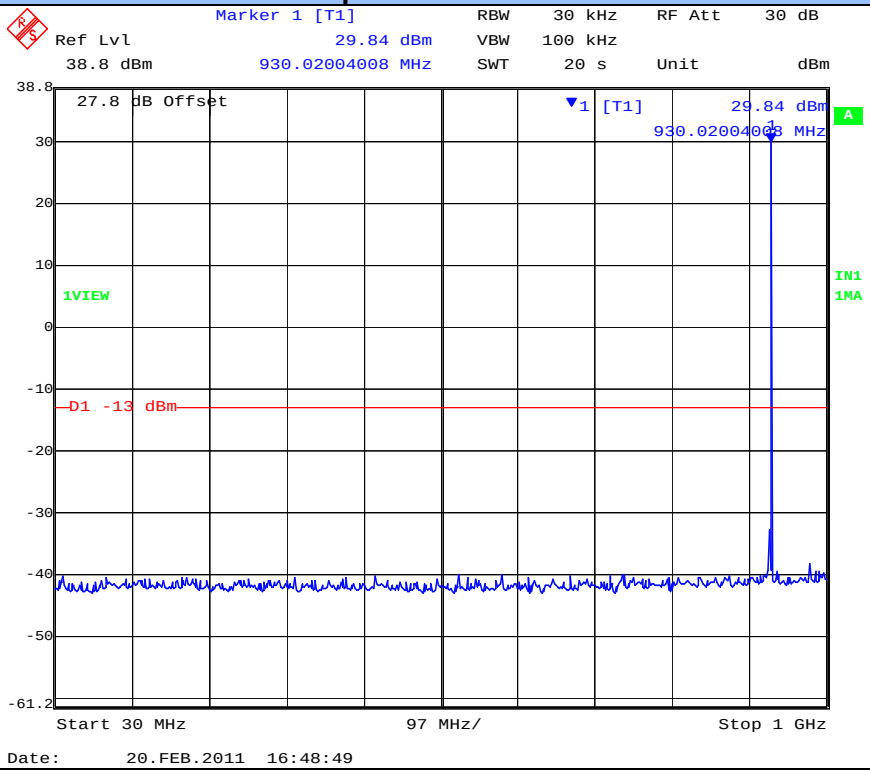


PART 101 RESULTS

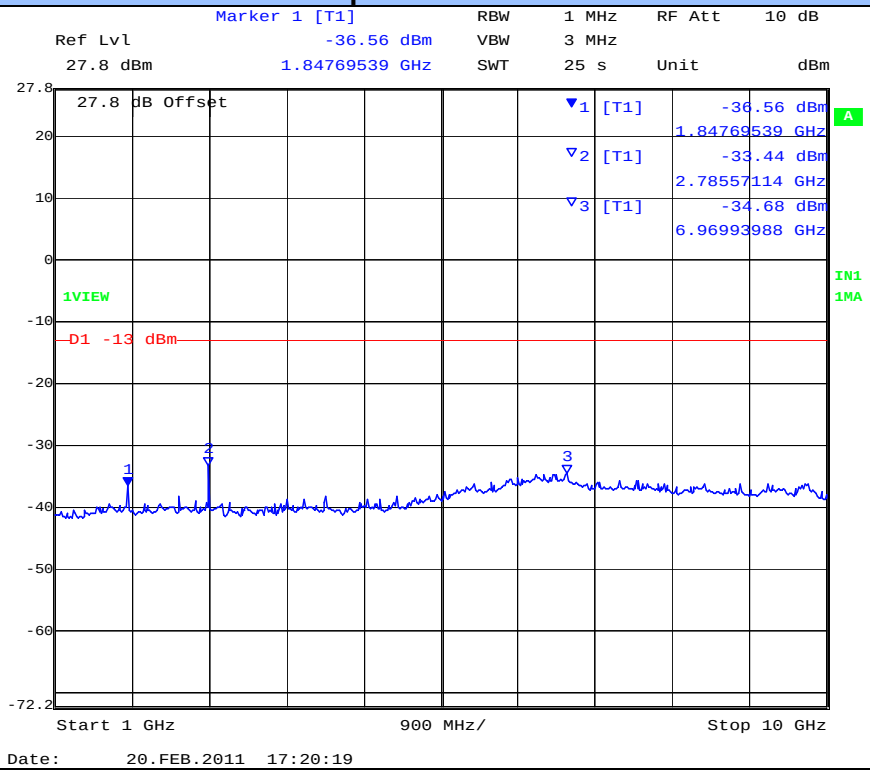
Part 101.111 a(6) Measurement Results – Conducted Spurious Emissions

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
928.9250	30	1,000	-38.55	-13.0	-25.55
	1,000	10,000	-33.44		-20.44
932.2500	30	1,000	-38.11		-25.11
	1,000	10,000	-33.52		-20.52
941.4875	30	1,000	-38.75		-25.75
	1,000	10,000	-32.98		-19.98
959.9250	30	1,000	-38.97		-25.97
	1,000	10,000	-34.54		-21.54

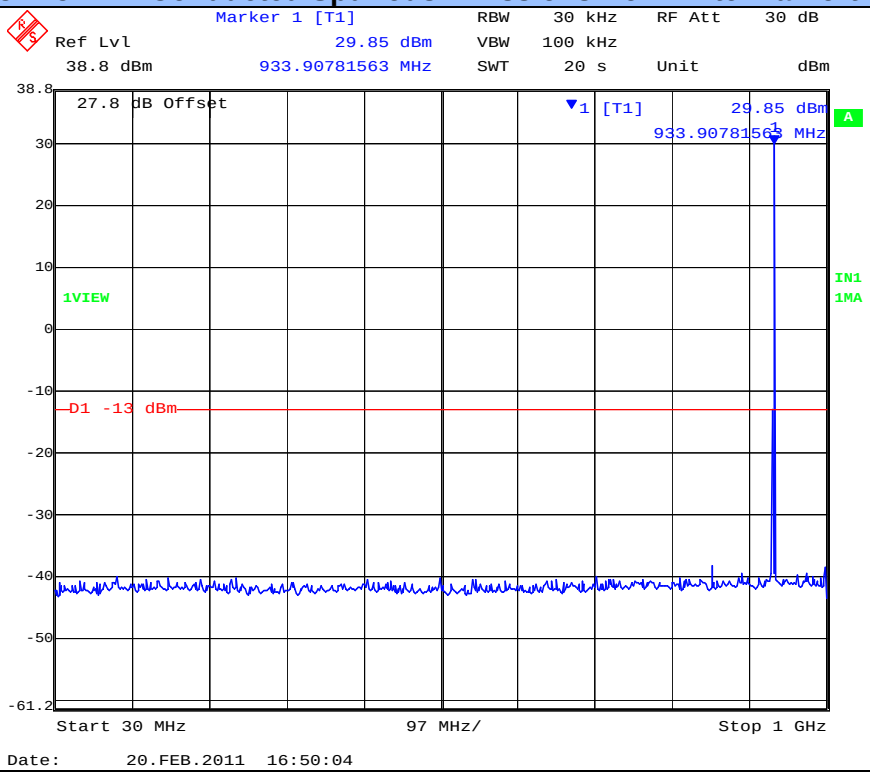
Channel 928.925 MHz–Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



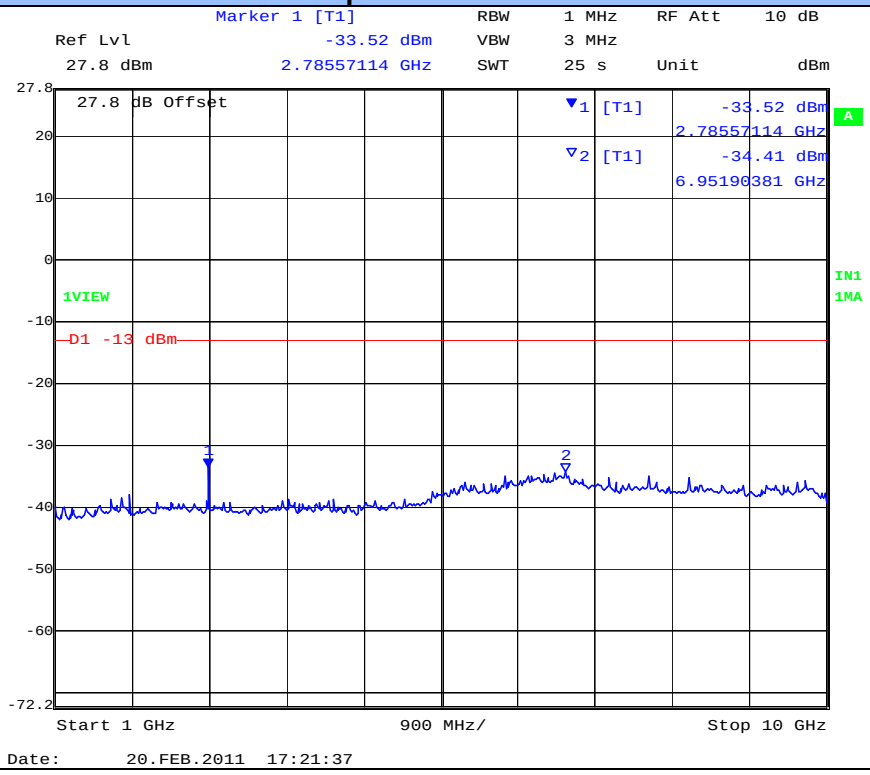
Channel 928.925 MHz–Conducted Spurious Emissions from Antenna Port 1– 10 GHz



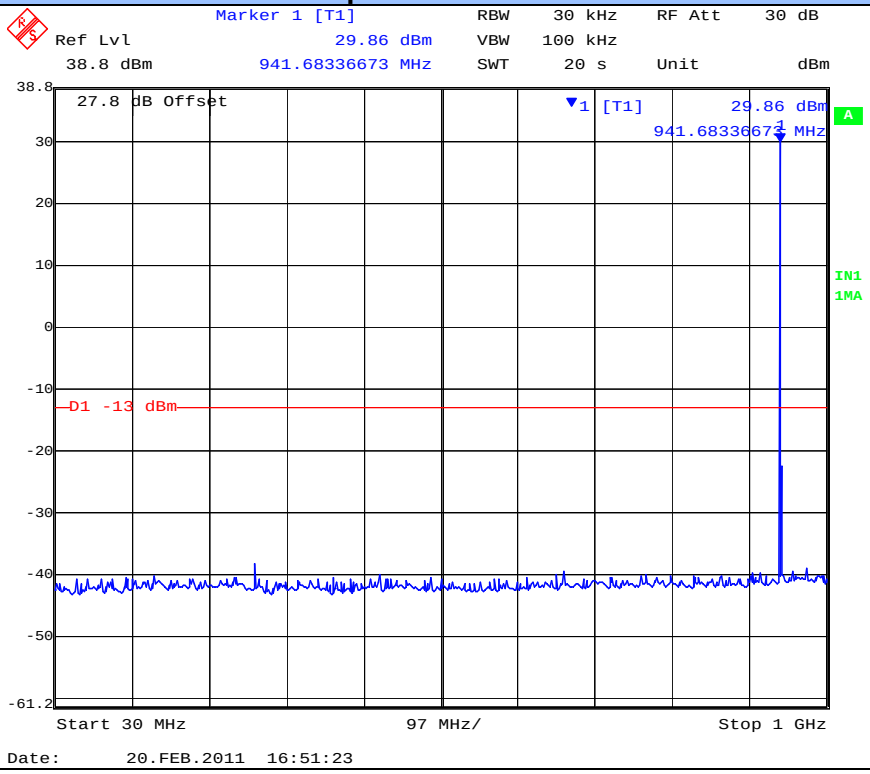
Channel 932.25 MHz-Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



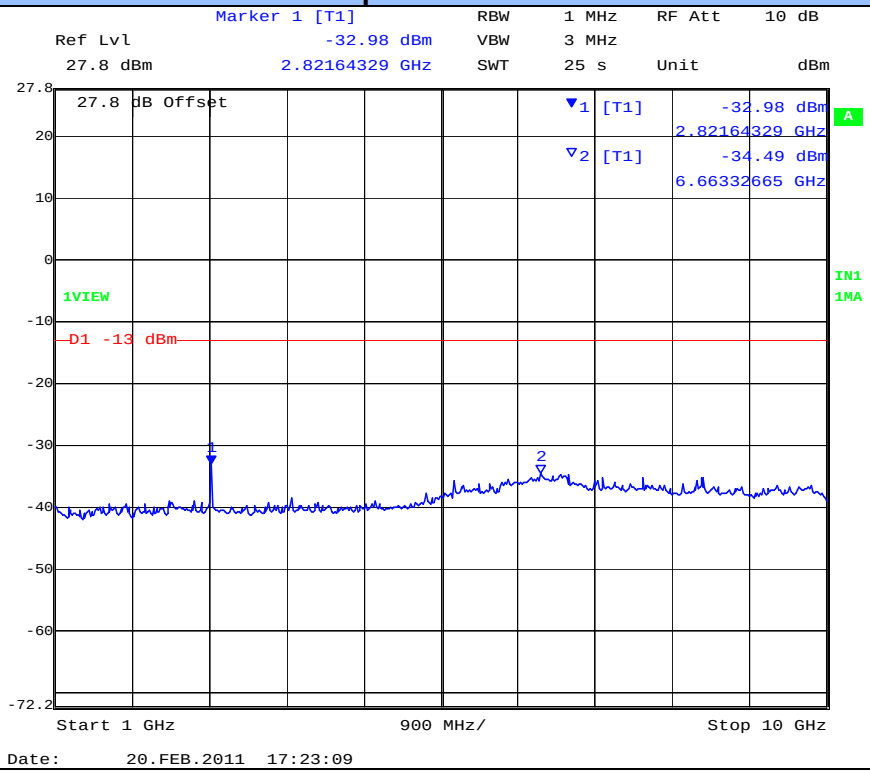
Channel 932.25 MHz-Conducted Spurious Emissions from Antenna Port 1-10 GHz



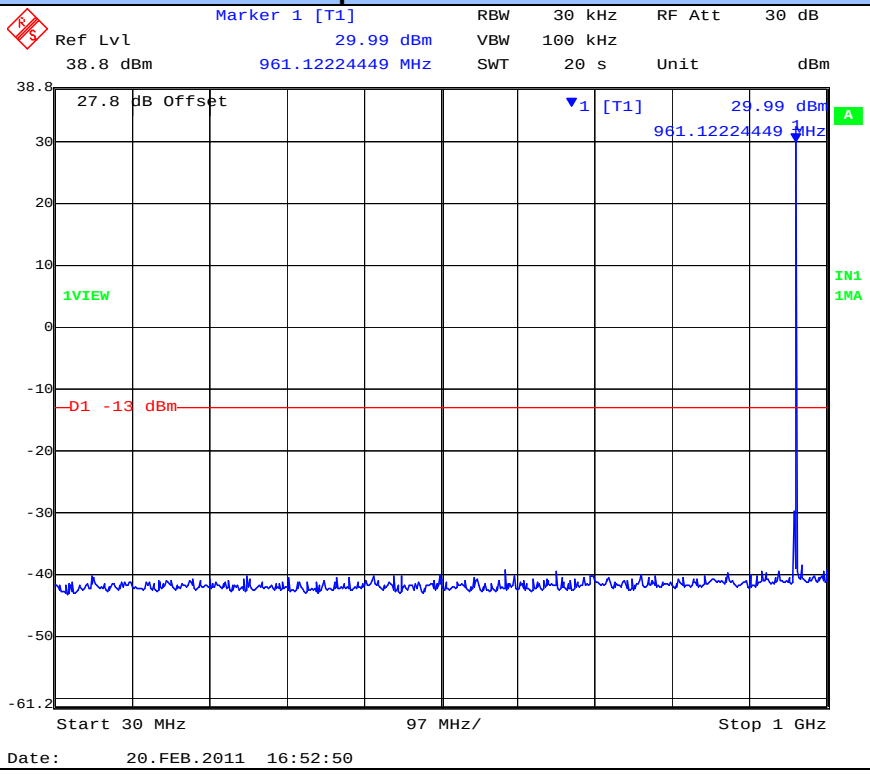
Channel 941.4875 MHz-Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



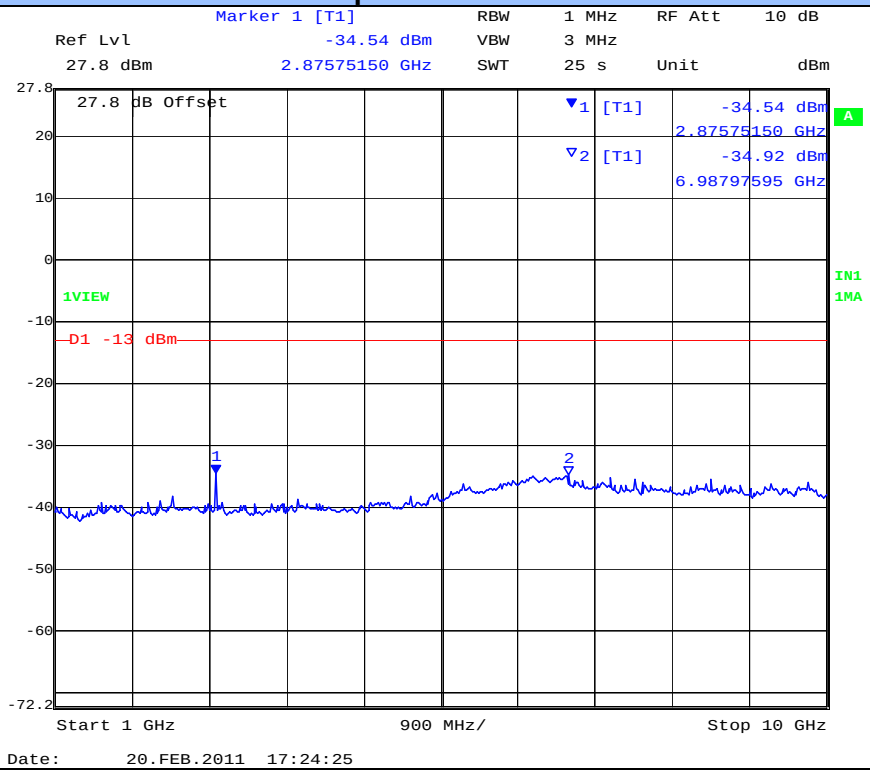
Channel 941.4875 MHz-Conducted Spurious Emissions from Antenna Port 1-10 GHz



Channel 959.925 MHz-Conducted Spurious Emissions from Antenna Port 0.03–1 GHz



Channel 959.925 MHz-Conducted Spurious Emissions from Antenna Port 1-10 GHz



Laboratory Measurement Uncertainty for Power Measurement

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Output Power'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

5.1.5. Maximum Permissible Exposure

FCC, Part 1 Subpart §1.1310

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm^2) = EIRP/(4πd^2)

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

The calculated separation distance is for worst case i.e. highest power level.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is f/1500 (where f = 896 MHz) = 0.6 mW/cm^2

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Max Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 0.6 mW/cm^2 Limit(cm)	Minimum Separation Distance (cm)
900	0.0	1.00	+29.99	997.7	8.91	20

*Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if the calculations indicate the MPE distance to be lower.

Specification
Maximum Permissible Exposure Limits

§1.1310 Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines. See §1.1307 (b)(1) of this chapter.

Limit = 0.6 mW / cm^2 from 1.310 Table 1

Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33dB

5.1.6. Radiated Spurious Emissions

5.1.6.1. Transmitter Radiated Emissions above 1 GHz

FCC 47 CFR Part 24 Subpart 24.133 a(1), a(2)
FCC 47 CFR Part 90 Subpart 90.210 (j)
FCC 47 CFR Part 101 Subpart 101.111 a(6)
ANSI/TIA-603
IC RSS-134 6.3 (i), (ii)
IC RSS-119 5.8.6

Test Procedure
Test was performed on a CW (continuous) carrier at the maximum allowed output power at the appropriate center frequency. Substitution was performed on any emissions observed within 6 dB of the limit.

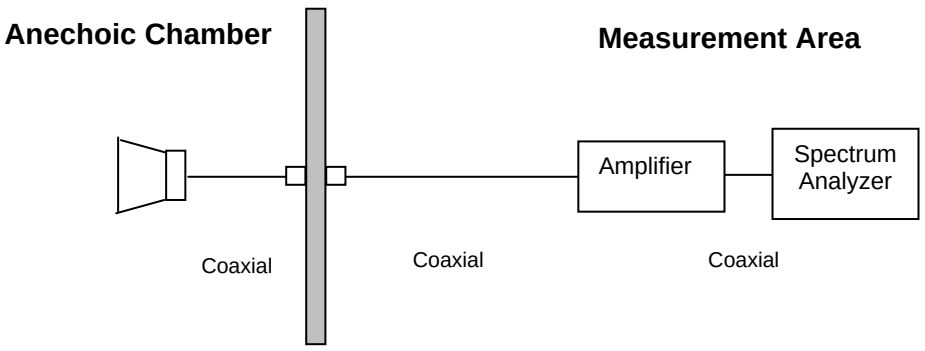
Testing was completed in accordance with EIA/TIA 603 requirements

The measurement equipment was set to measure in peak hold mode. The emissions were measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode.

The highest emissions relative to the limit are listed for each frequency band measured.

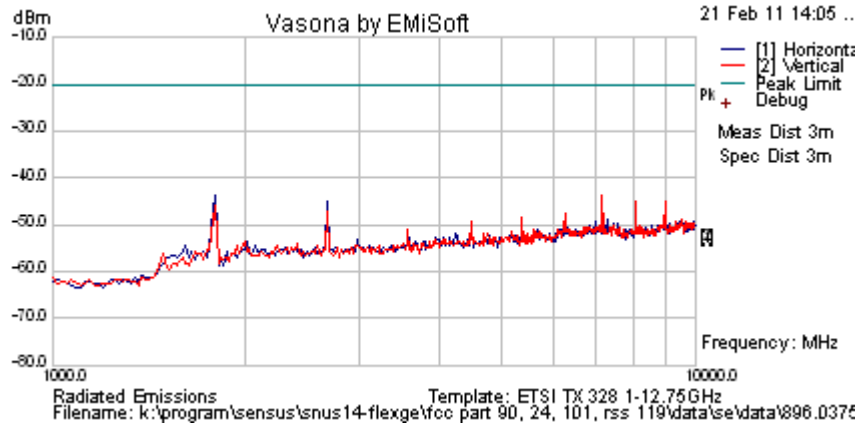
Limit
The worst case limit for all applicable CFR Parts were applied during radiated testing.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Test Freq.	896.0375 MHz	**Engineer**	GMH
Variant	Pt. 90 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	896-901 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



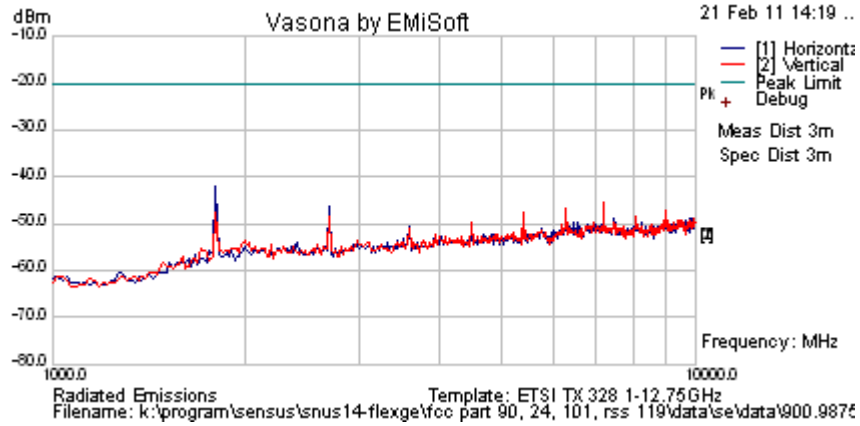
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	900.9875 MHz	**Engineer**	GMH
Variant	Pt. 90 CW Mode (single tone)	**Temp (°C)**	17.5
Freq. Range	896-901 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



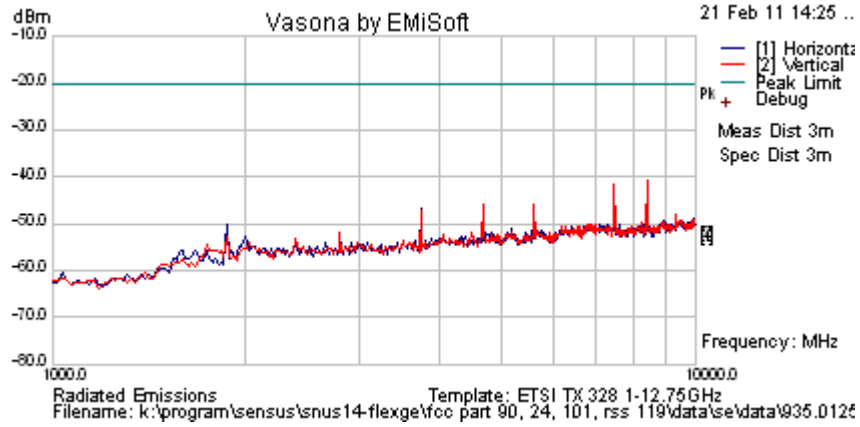
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	935.125 MHz	**Engineer**	GMH
Variant	Pt. 90 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	935-940MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



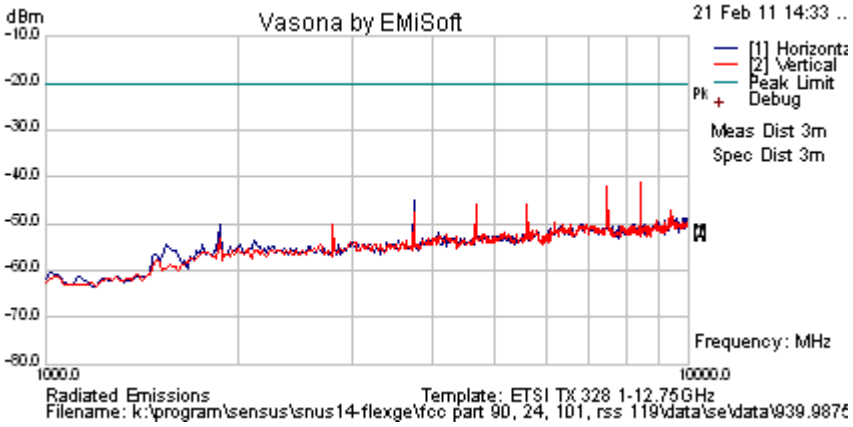
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	939.9875 MHz	**Engineer**	GMH
Variant	Pt. 90 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	896-901 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



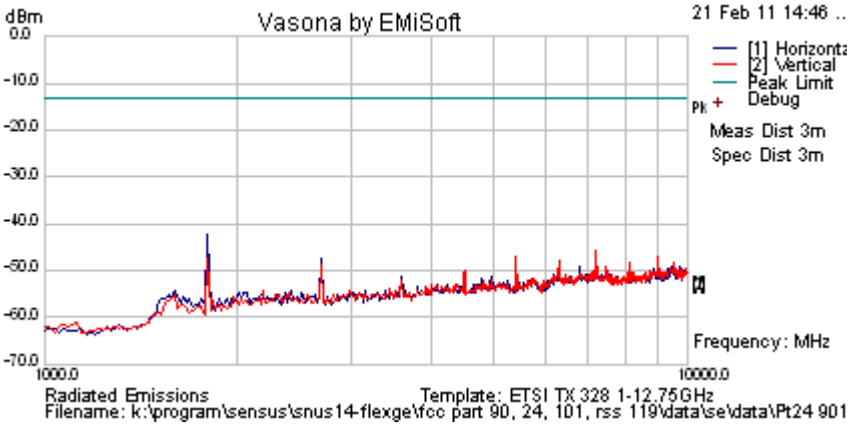
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	901.9875 MHz	**Engineer**	GMH
Variant	Pt. 24 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	901-902 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



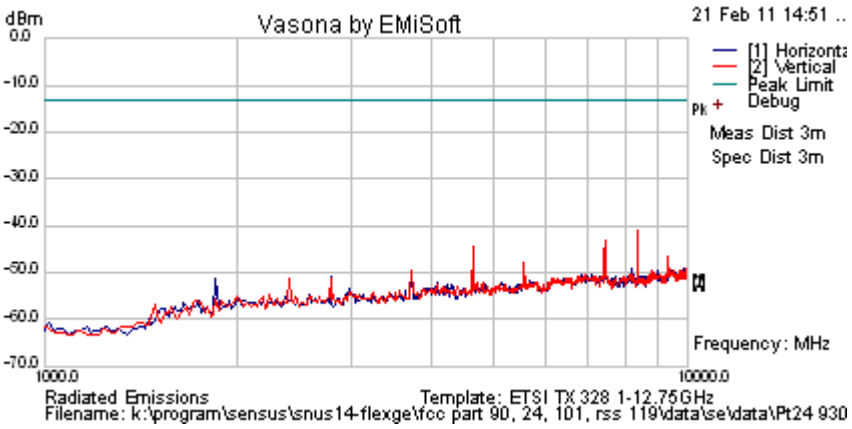
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	930.5 MHz	**Engineer**	GMH
Variant	Pt. 24 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	901-902 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



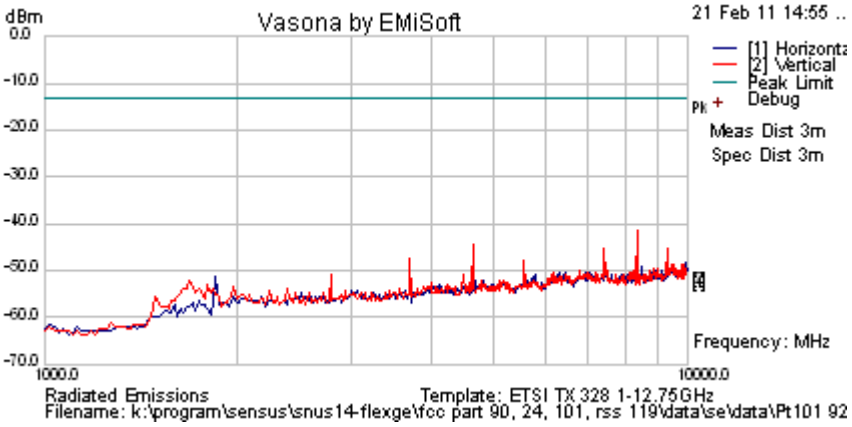
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	928.925 MHz	**Engineer**	GMH
Variant	Pt. 101 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	928.85 - 929.0	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



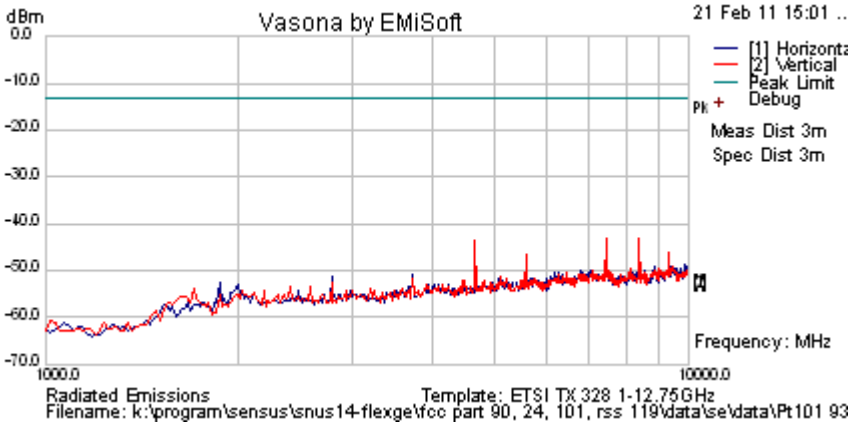
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	932.25 MHz	**Engineer**	GMH
Variant	Pt. 90 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	932-932.5 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



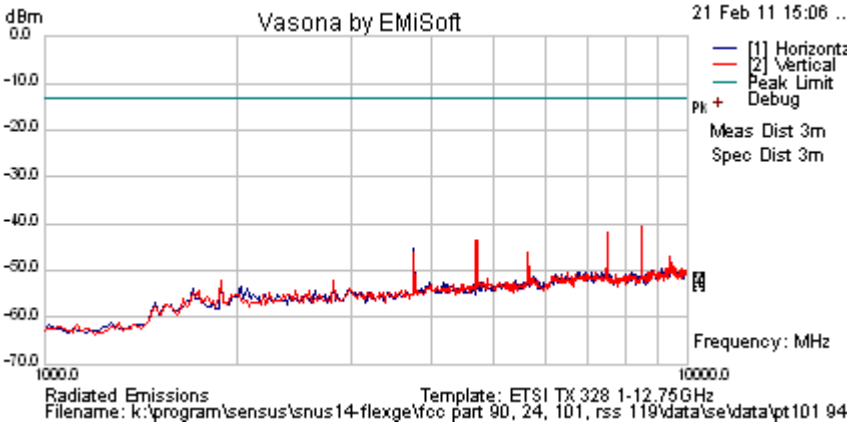
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	941.4875 MHz	**Engineer**	GMH
Variant	Pt. 90 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	941-941.5 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



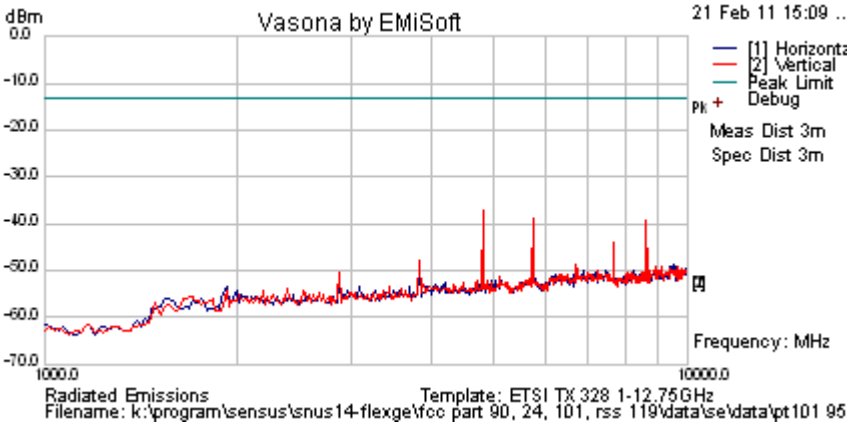
Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Test Freq.	959.925 MHz	**Engineer**	GMH
Variant	Pt. 90 CW Mode (single tone)	**Temp (ºC)**	17.5
Freq. Range	959.85-960.0 MHz	**Rel. Hum.(%)**	36
Power Setting	Maximum	**Press. (mBars)**	1002
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	CW Operational Mode		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. RB = Restricted Band.

No emissions were found to be within 6 dB of the limit

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0104, 0158, 0134, 0310, 0312, Dipole.

5.1.6.2. Transmitter Radiated Spurious Emissions (30M-1 GHz)

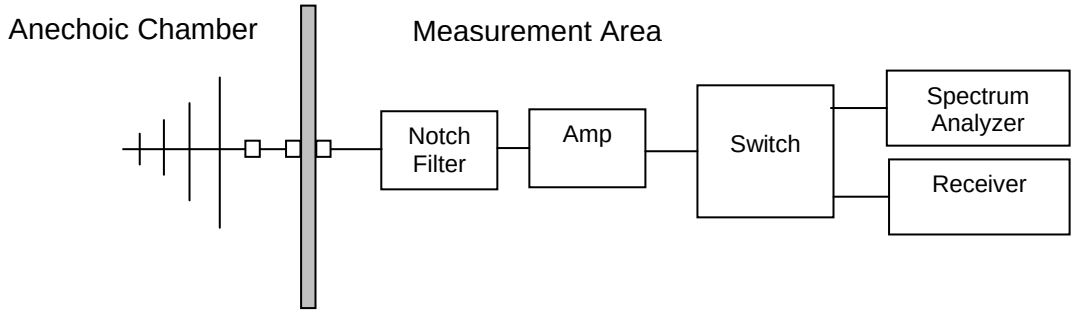
FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-111 §4.4

RSS Gen 6

Test Procedure

Preliminary radiated emissions were measured in the anechoic chamber at a 10-meter distance on every azimuth in both horizontal and vertical polarity. The emissions are recorded with a spectrum analyzer in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

Test Measurement Set up



Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

For example:
Given a Receiver input reading of 51.5dBμV; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

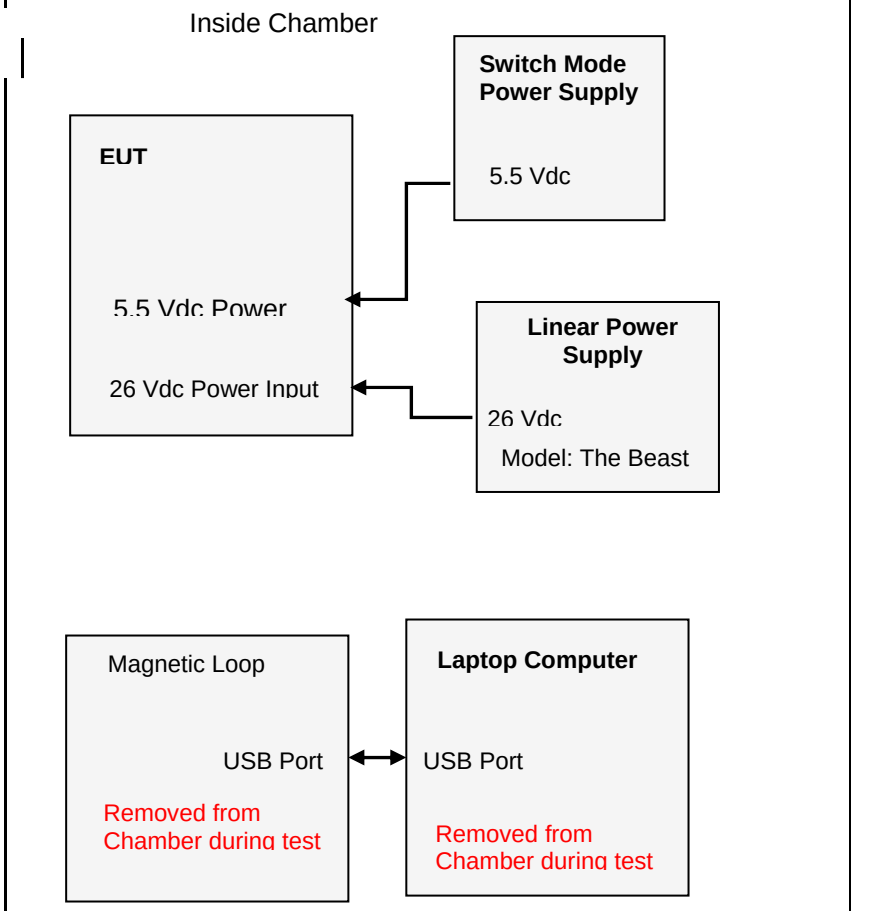
FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

EUT Setup Diagram



Test Setup Description

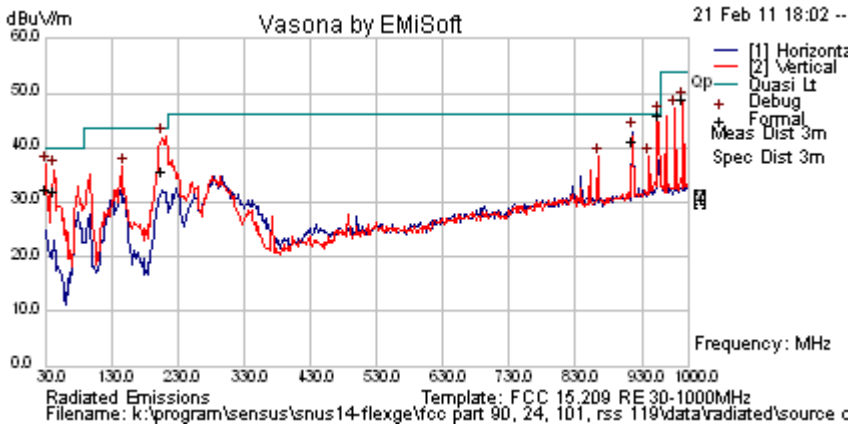
Both Vertical (Wall Mount) and Horizontal (Table Top Mount) positions were investigated during preliminary testing. EUT was setup in the Vertical Position during compliance test.

Note: Module testing required two voltages to be applied (+5.5 and 26 Vdc) in test mode. In final product(s) the 26 Vdc is not present. The 26 Vdc was only required to provide 100% duty cycle during testing.

It was found that all cables acted like an antenna for unwanted noise. Client declared maximum cable length in the final product would be no greater than 3". For this reason ferrites were added to all the voltage carrying cables.

Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Test Freq.	2437 MHz	**Engineer**	EVF
Variant	Digital Emissions	**Temp (ºC)**	19.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	35
Power Setting	maximum	**Press. (mBars)**	1000
Antenna	Port Terminated with 50 Ohm		
Test Notes 1	5Vdc AC-DC power supply + Linear Power Supply (+26 Vdc)		
Test Notes 2	three A3 ferrites were placed on the power cables (see photo)		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
953.346	45.0	7.5	-6.7	45.8	Quasi Max	V	106	198	46	-0.2	Pass	
206.549	50.2	4.8	-19.5	35.6	Quasi Max	V	123	264	43.5	-7.9	Pass	
914.946	41.0	7.4	-7.4	41.0	Quasi Max	H	204	273	46	-5.0	Pass	
30.174	38.3	3.4	-9.3	32.4	Quasi Max	V	98	229	40	-7.6	Pass	
43.251	47.9	3.6	-19.3	32.1	Quasi Max	V	98	319	40	-7.9	Pass	
991.758	47.4	7.7	-6.2	48.9	Quasi Max	V	98	207	54	-5.1	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

§15.209 (a) Limit Matrix

Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

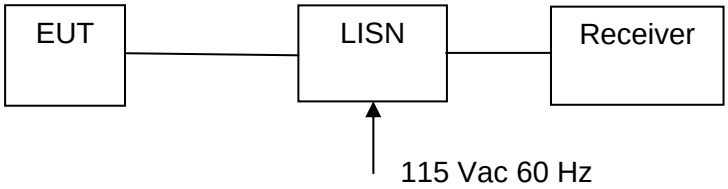
5.1.7. AC Wireline Conducted Emissions (0.15 – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

Test Procedure

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

NOTE: This test is not applicable as the unit is dc powered.

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

NOTE: This test is not applicable as the unit is dc powered.

Specification

Limit

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

§15.207 (a) Limit Matrix

The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

Laboratory Measurement Uncertainty for Conducted Emissions

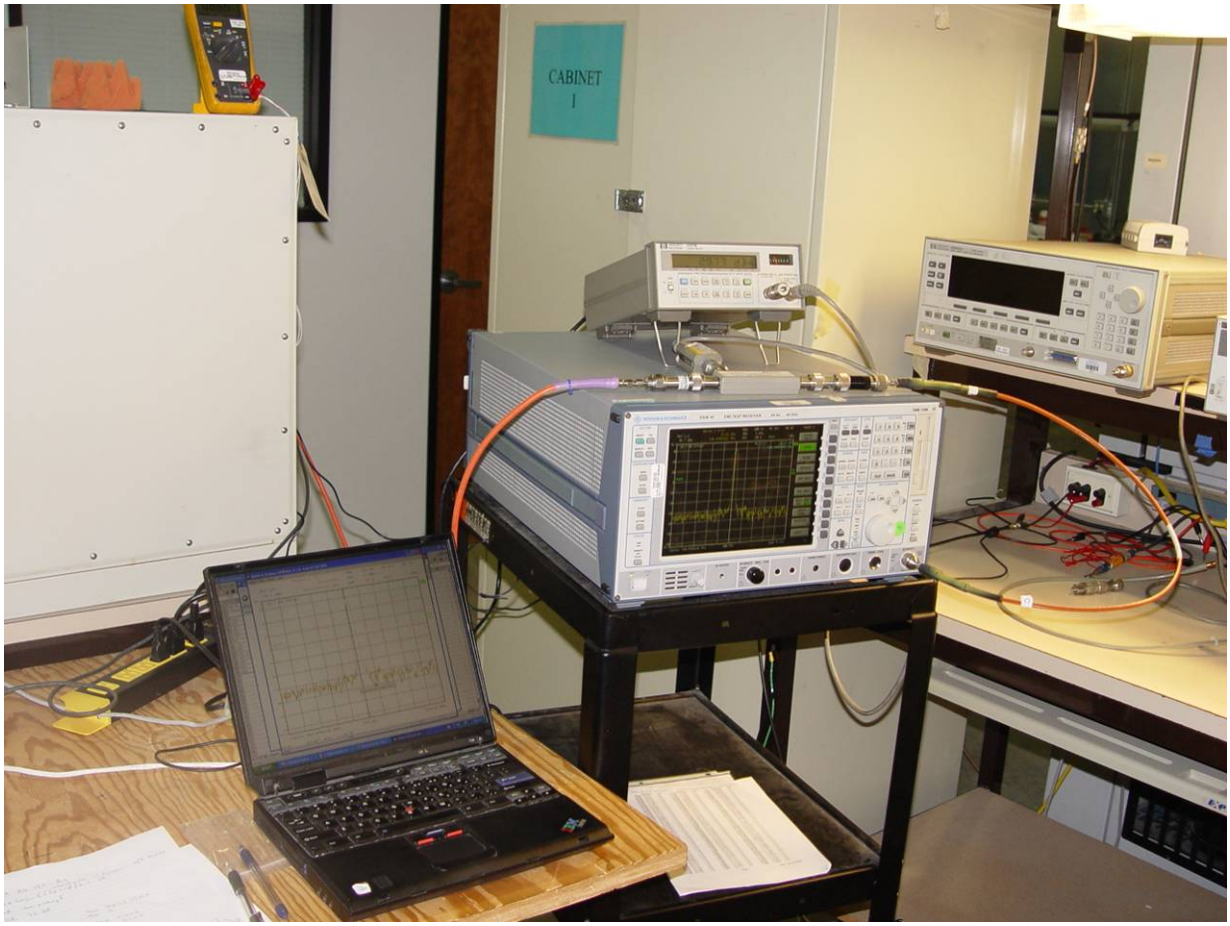
Measurement uncertainty	±2.64 dB

Traceability

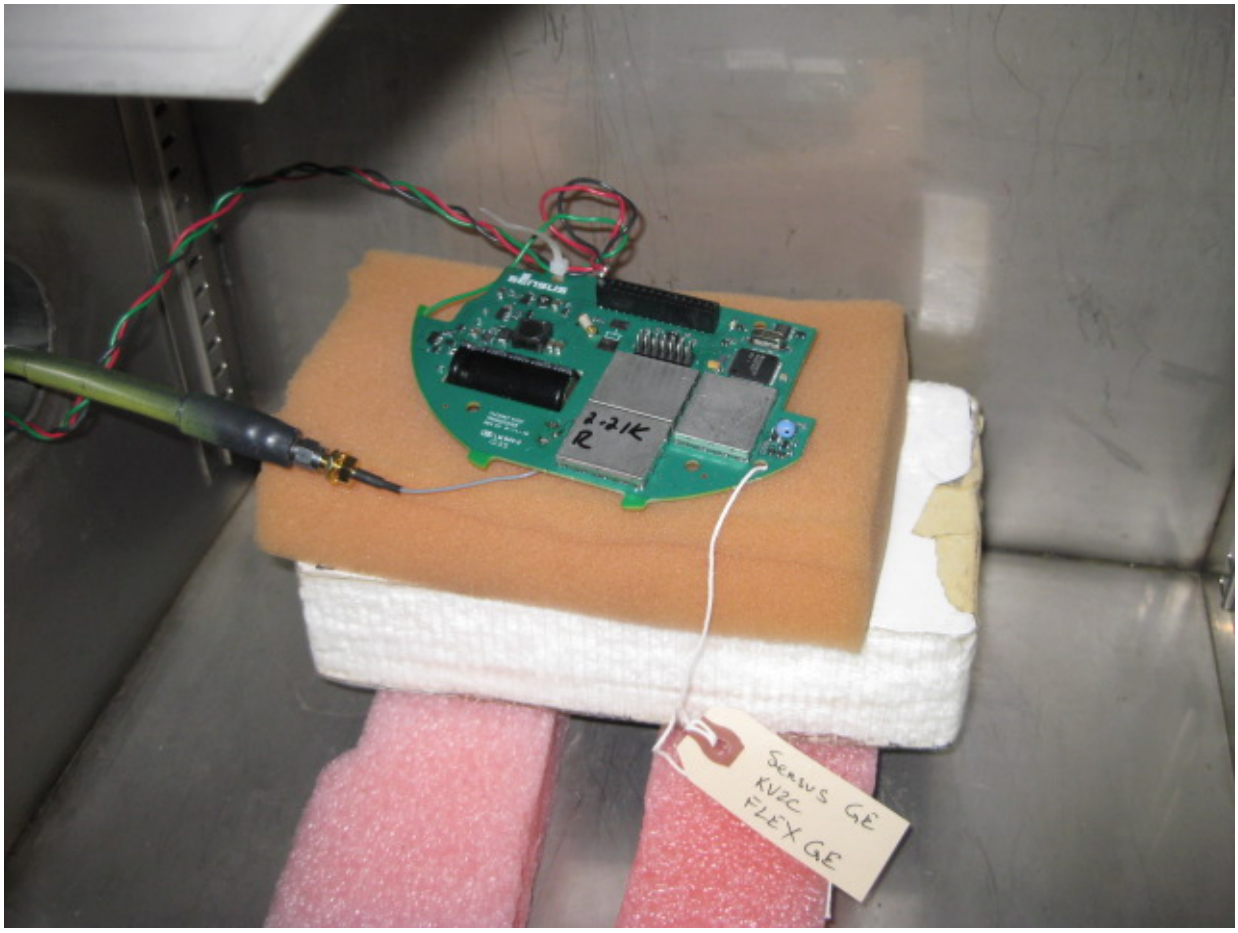
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

6. TEST SET-UP PHOTOGRAPHS

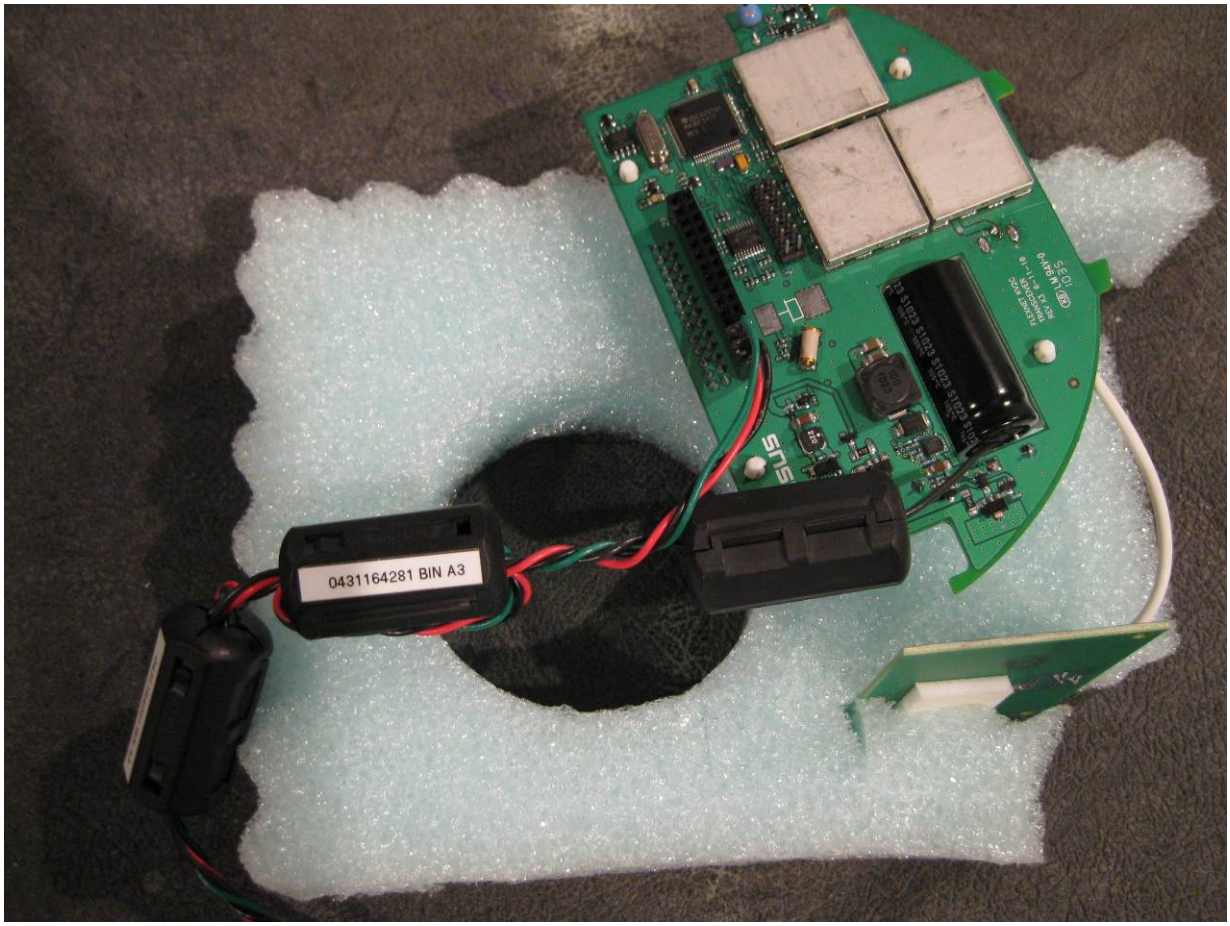
6.1. General Measurement Test Set-Up



6.2. General Measurement – Environmental Chamber



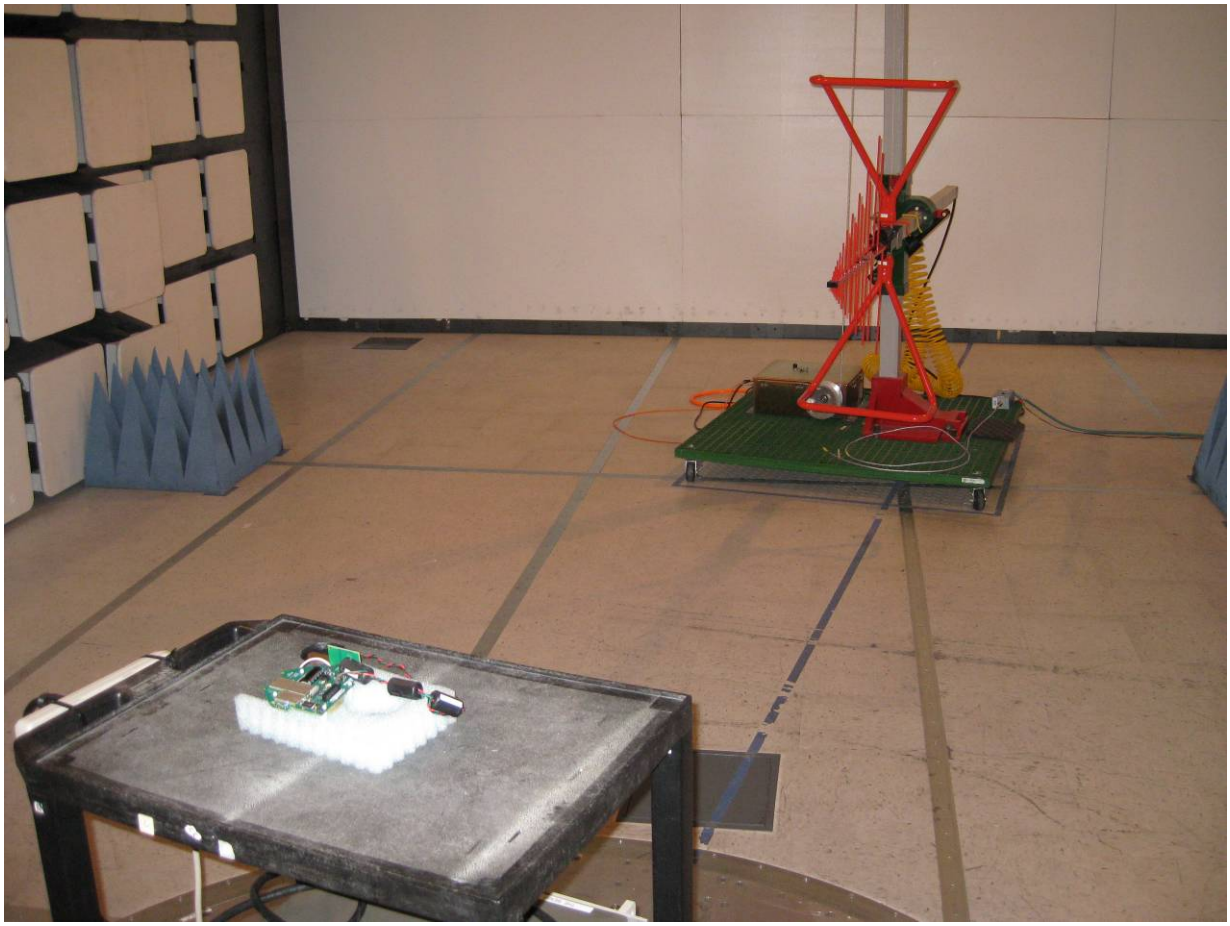
6.3. Radiated Emissions Module Test Configuration



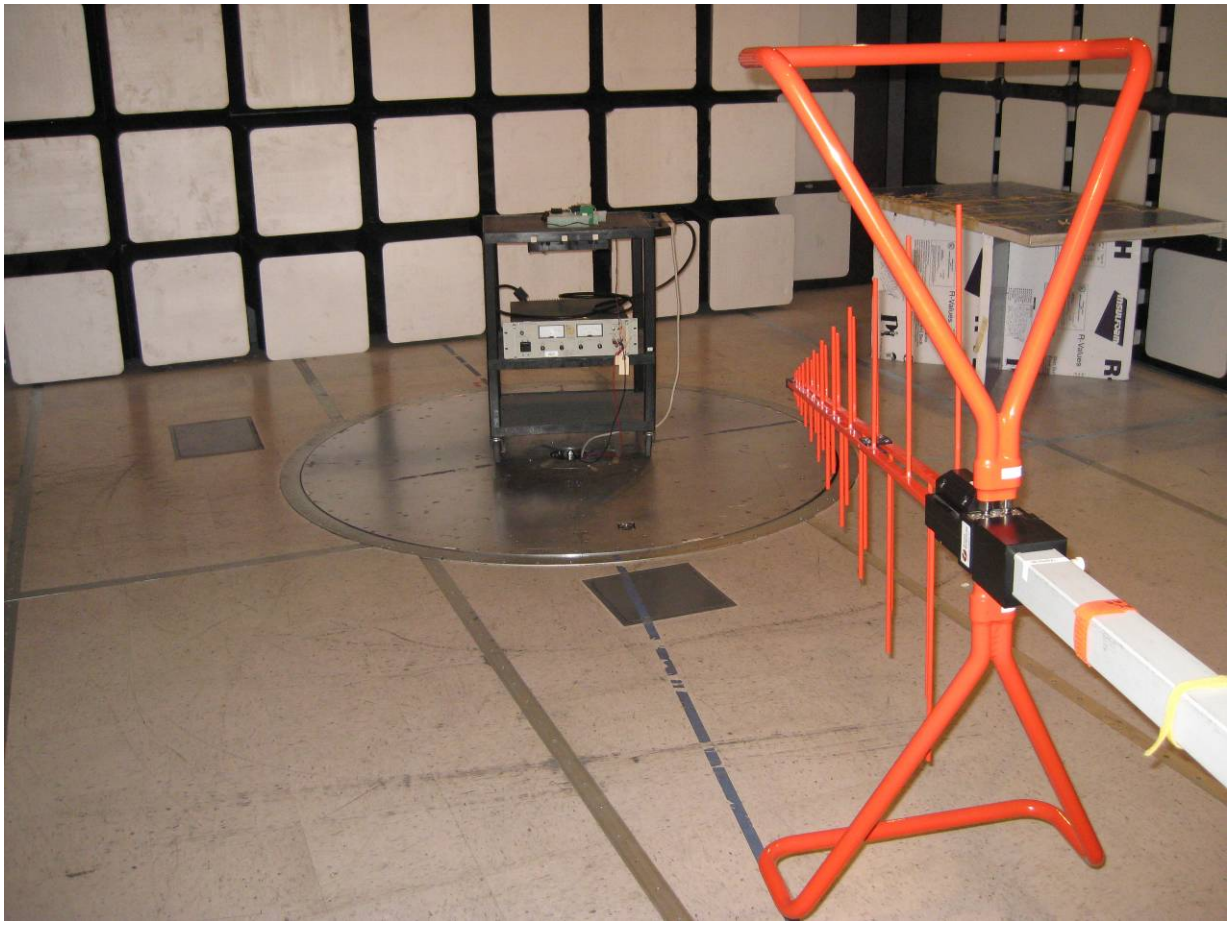
Note: Module testing required two voltages to be applied (+5.5 and 26 Vdc) in test mode. In final product(s) the 26 Vdc is not present. The 26 Vdc was only required to provide 100% duty cycle during testing. The 26 Vdc cable is the single black cable going through the ferrite.

It was found that all cables acted like an antenna for unwanted noise. Client declared maximum cable length in the final product would be no greater than 3". For this reason ferrites were added to all the voltage carrying cables.

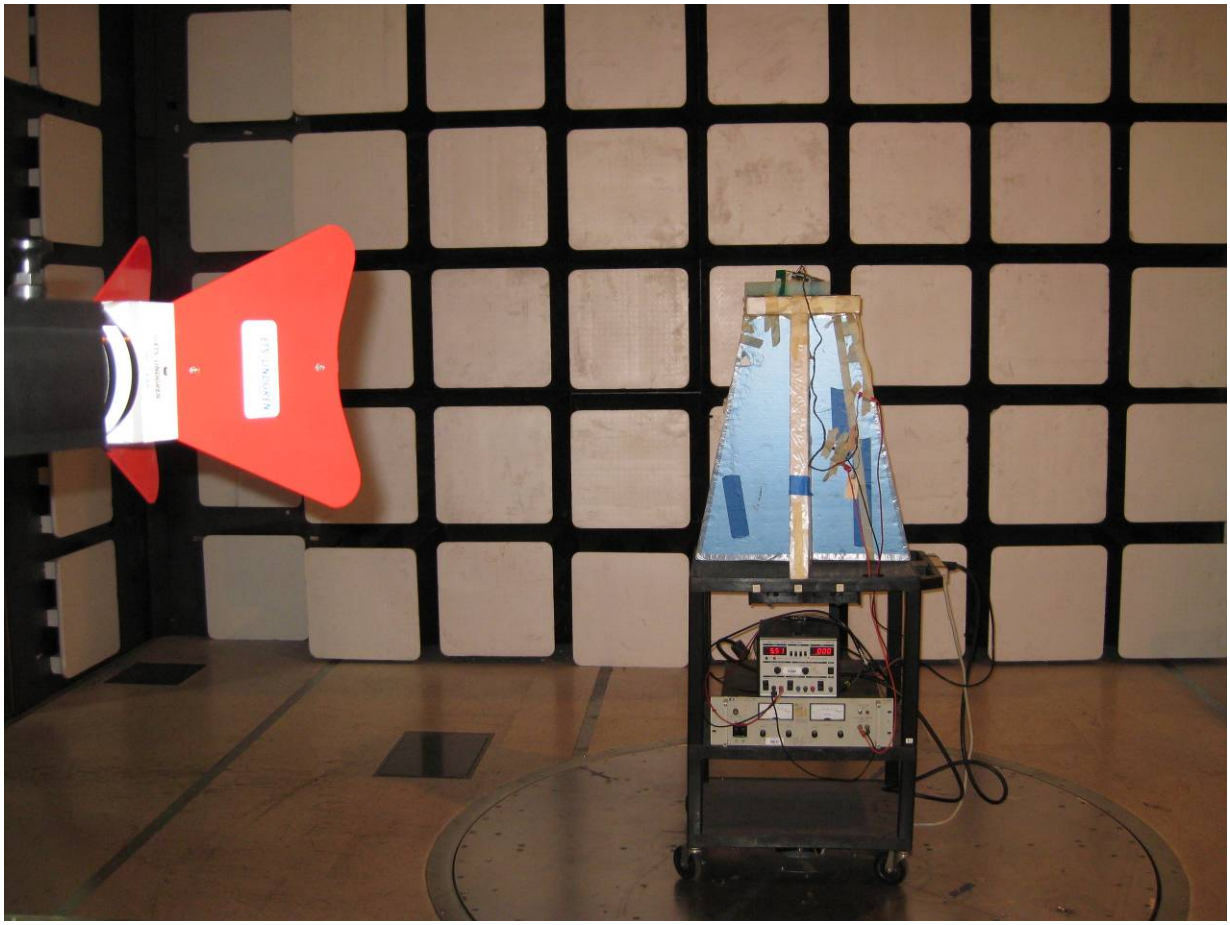
6.4. Radiated Emissions below 1 GHz



6.5. Radiated Emissions below 1 GHz (2)



6.6. Radiated Digital Emissions above 1 GHz



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0104	1-18GHz Horn Antenna	EMCO	3115	9205-3882
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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