Transmitter Certification

Test Report

FCC ID: SDBTGB001LP

FCC Rule Part: CFR 47 Part 24 Subpart D, Part 90 Subpart I, Part 101 Subpart C

ACS Report Number: 05-0169-LP

Manufacturer: Advanced Metering Data Systems, LLC
Equipment Type: Base Station Transceiver
Model: TGB001LP

Test Dates: May 9, 2005 – May 13, 2005

Report Issue Date: May 17, 2005

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612

Prepared by:
J. Kirby Munroe
Manager Wireless Certifications
ACS, Inc.

Reviewed by:
R. Sam Wismer
Engineering Manager
ACS, Inc.

This report contains **24** pages

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1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J, Part 24 Subpart D, Part 90 Subpart I, and Part 101 Subpart C of the FCC's Code of Federal Regulations.

1.2 Product Description

The AMDS TGB Transceiver is the base station component of the AMDS Automated Meter Reading (AMR) and Telemetry System.

The device receives telemetry transmissions from multiple system end point units. These units are mostly utilized for utility metering, but in some cases may send other types of information such as that used for inventory and industrial control applications.

The end points may initiate transmissions to the TGB upon their own initiative (using an ALOHA protocol for transmission) or may be commanded by the TGB transmission to the end points to transmit upon demand. The TGB may also transmit command information to the end point units that may or may not result in a subsequent end point transmission (i.e. system synchronization information).

The Transmitter section of the TGB transceiver utilizes GFSK modulation to communicate with the end point devices at one or two output power levels (different model numbers identify the transmit output power levels) of 45 dBm or 31 dBm. The transmitter emission designator is 5K90F1D.

The TGB transceiver is housed in a 19 inch, rack mountable, enclosure that contains an RF PCB that provides the RF Transmit and Receive functionality, an Analog To Digital Converter Card (A2D) that digitizes the IF output of the RF PCB, two Channel Processor Cards (CPC) that utilize DSP techniques to demodulate the base band, sampled, IF signal, a Fusion Processor section containing a Linux based computer that collects received messages from the CPC cards and commands the RF card setup and data transfer tasks for the transmitter section.

Detailed photographs of the EUT are filed separately with this filing.

1.3 Emission Designator

The emissions designator for the TGB Transceiver is as follows:
GFSK Modulation: 5K90F1D

1.4 Product Modifications

In order for the TGB transceiver base station to comply to radiated emission limits for CFR 47 Part 15 Subpart B for unintentional radiators the following modifications were made:

- Ferrite bead added to I/O board ribbon near back.
- Ferrite bead added to I/O board CAT5 cable wrapped toward the front near the I/O board.
- 8 strips of gasketing were used on all the seams. 2 on each side.

Gasketing Material:
Chomerics, M/N: Softshield 5000, P/N: 82-122-74037-02400 or
Instrument Specialties, P/N: 8422-0151-26

Ferrite Beads:
On Ethernet is Steward 28B1000-000
On ribbon cable is Steward 28S2023-0M0

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

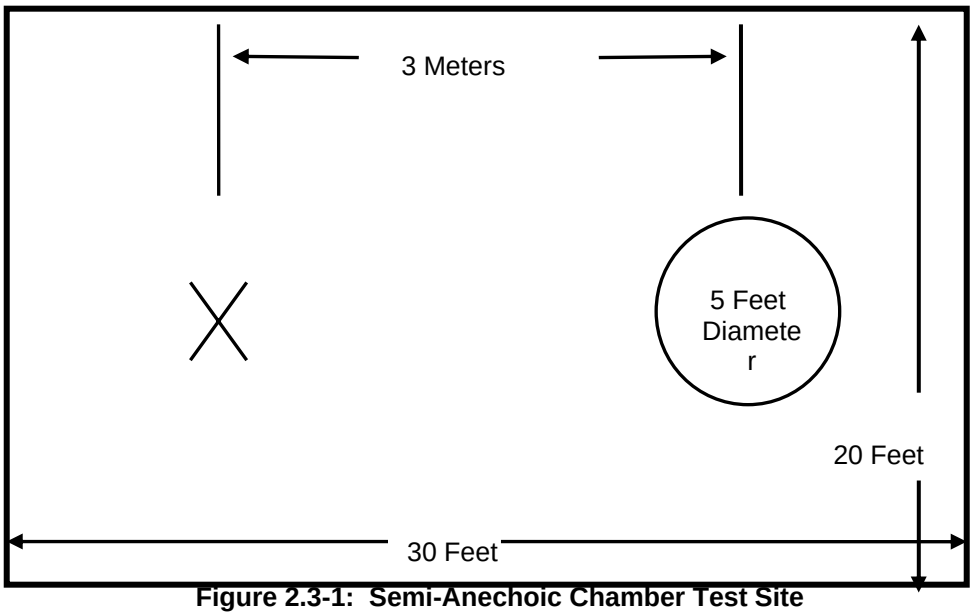


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

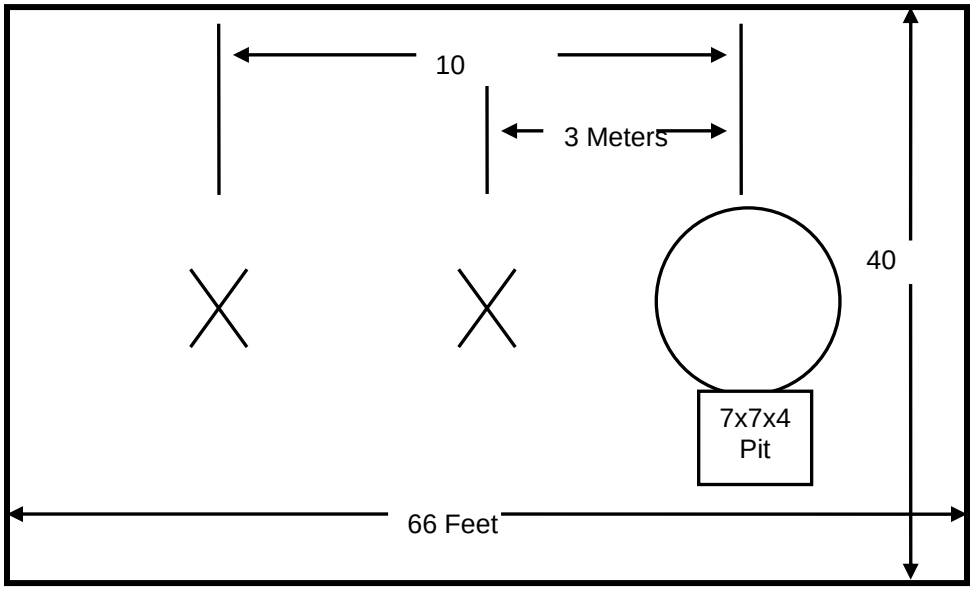


Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 2.4-1:

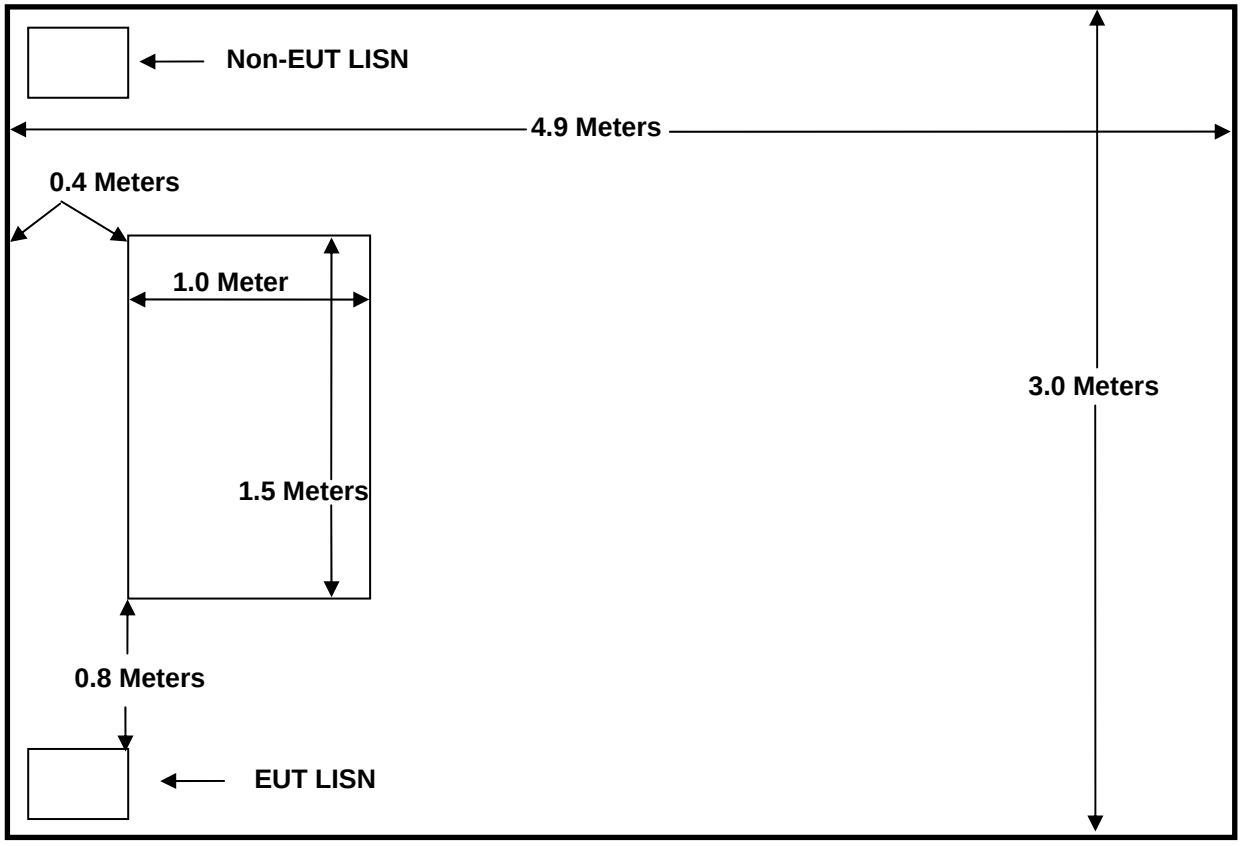


Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

1 - ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz

2 - US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures (October 2004)

3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communication Service (October 2004)

4 - US Code of Federal Regulations (CFR): Title 47, Part 90, Subpart I: Private Land Mobile Radio Services (October 2004)

5 - US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services (October 2004)

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
☒ 26	Chase	Bi-Log Antenna	CBL6111	1044	10/05/05
☐ 152	EMCO	LISN	3825/2	9111-1905	01/18/06
☐ 153	EMCO	LISN	3825/2	9411-2268	12/20/05
☐ 193	ACS	OATS Cable Set	RG8	193	01/07/06
☐ 225	Andrew	OATS RF cable	Heliax	225	01/06/06
☐ 165	ACS	Conducted EMI Cable Set	RG8	165	01/06/06
☒ 22	Agilent	Pre-Amplifier	8449B	3008A00526	05/06/06
☒ 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	05/09/06
☒ ---	EMCO	Horn Antenna	3115	9512-4636	01/21/06
☒ 105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	06/09/05
☐ 209	Microwave Circuits	High Pass Filters	H3G020G2	4382-01 DC0421	06/09/05
☒ 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	03/07/06
☒ 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	03/07/06
☒ 3	Rohde & Schwarz	Receiver Display	804.8932.52	839379/011	12/15/05
☒ 4	Rohde & Schwarz	ESMI Receiver	1032.5640.53	833827/003	12/15/05
☒ ---	Agilent	Spectrum Analyzer	E7402A	US41110277	11/10/05
☐ 213	Test Equipment Corp.	Pre-Amplifier	PA-102	44927	06/28/05
☐ 211	Eagle	Band Reject Filter	C7RFM3NFNM	n/a	06/28/05
☐ 93	Chase	EM Clamp	CIC 8101	65	01/06/06
☒ 204	ACS	Cable	RG8	204	12/29/05
☒ 6	Harbour Industries	HF RF Cable	LL-335	00006	03/16/06
☒ 7	Harbour Industries	HF RF Cable	LL-335	00007	03/16/06
☒ 208	n/a	HF RF Cable	n/a	00208	06/14/05
☐ 5	ChaseRF Current Probe	Current Probe	CSP-8441	19	01/06/06
☒ 167	ACS	Chamber EMI Cable Set	RG6	167	12/29/05
☒ 204	ACS	Chamber EMI RF cable	RG8	204	01/07/06
☒ ---	Bird Electronics	50 Ohm 100W Terminator	8164	7655	NA
☒ ---	Hewlett Packard	Pre-amplifier	8447F OPT H64	3113A06535	4/28/06

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Diagram #	Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
1	AMDS	EUT	TGB001HP	None	SDBTGB001HP
2	Sorenson	DC Power Supply	DSC 60-50	0024B1130	NA
3	Dell	Laptop PC	Think Pad	78-TFN16 96/12	ANOGCF2704AT
4	Bird Electronics	100W 50 Ohm Termination	8164	7655	NA
5	NA	50 Ohm Termination	NA	NA	NA

6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM

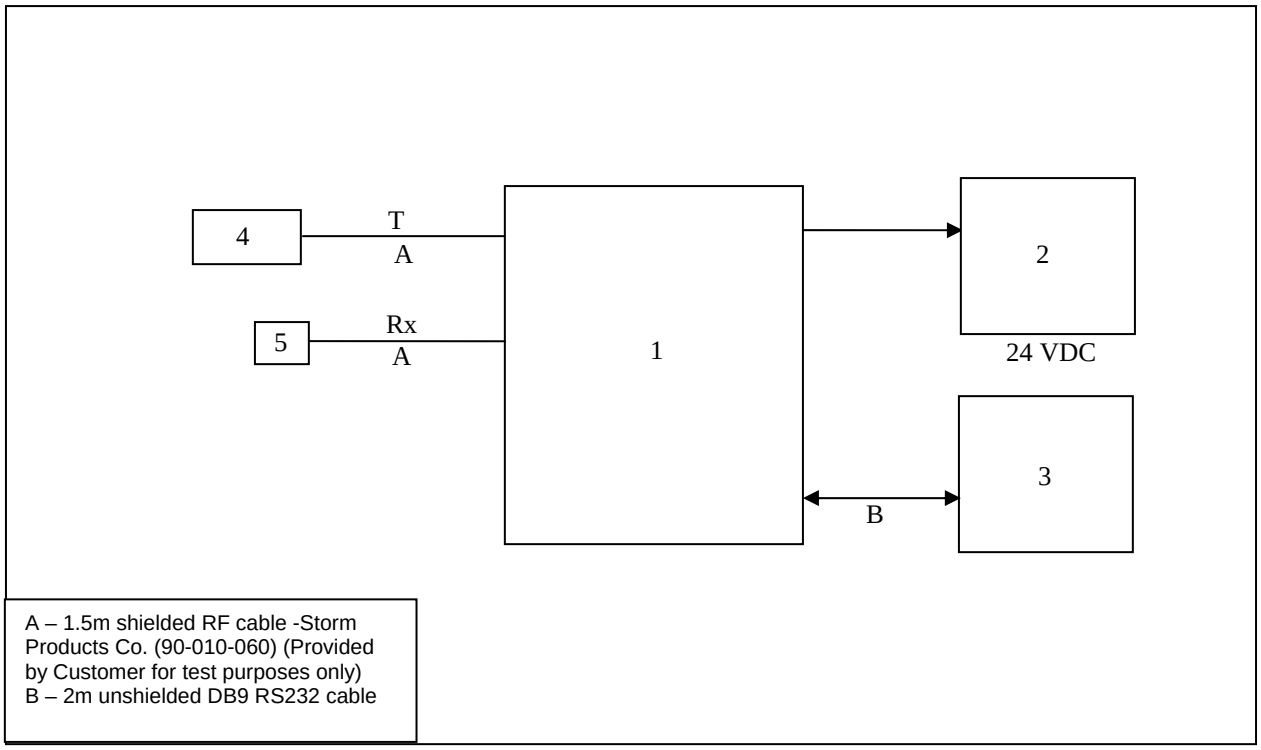


Figure 6-1: EUT Test Setup

The EUT was power by an external DC power supply as shown above. The DB9 connector was used to connect to a PC for programming the EUT test modes. The PC was removed prior to testing for unintentional emissions only.

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 RF Power Output - FCC Section 2.1046

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 30 dB passive attenuator. The resolution and video bandwidths of the spectrum analyzer were set at sufficient levels, >> signal bandwidth, to produce accurate results. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results are shown below in Table 7.1.1-2 and Figure 7.1.1-1 through 7.1.1-9.

7.1.2 Measurement Results

Table 7.1.1-1: Peak Output Power

Frequency (MHz)	FCC Rule Part	Output Power (dBm)
930.00625	24	30.76
940.99375	24	30.76
935.00625	90	30.94
939.99375	90	30.86
941.00625	101	30.76
959.99375	101	30.20

Part 24

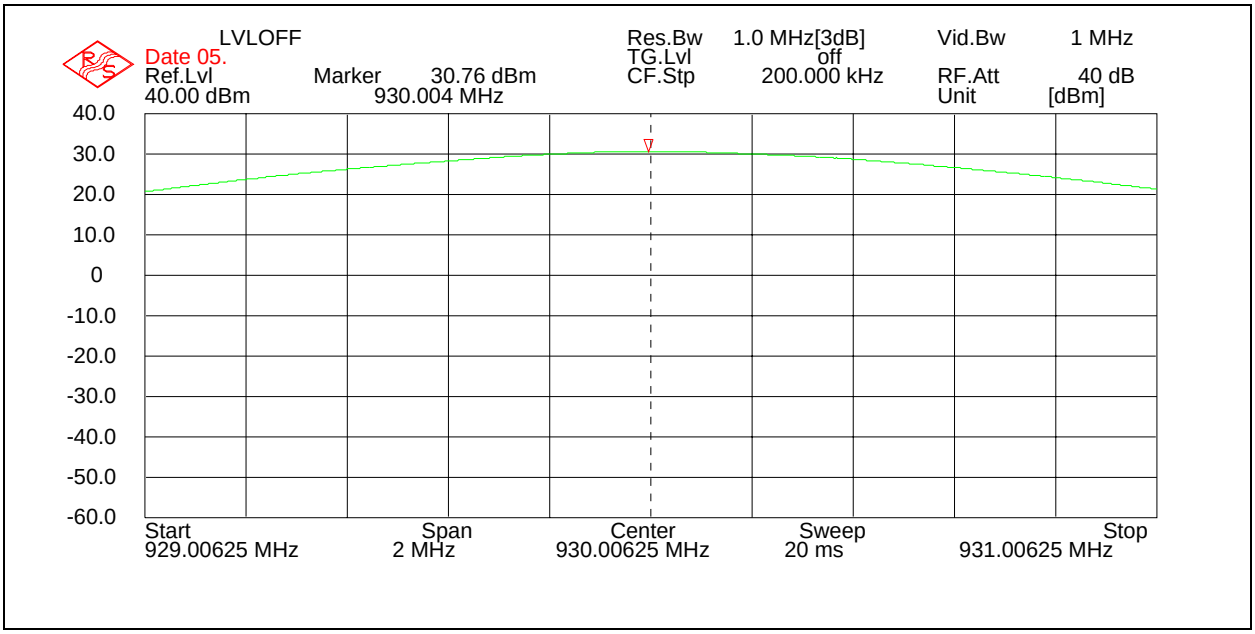


Figure 7.1.2-1: Peak Output Power 930.00625 MHz

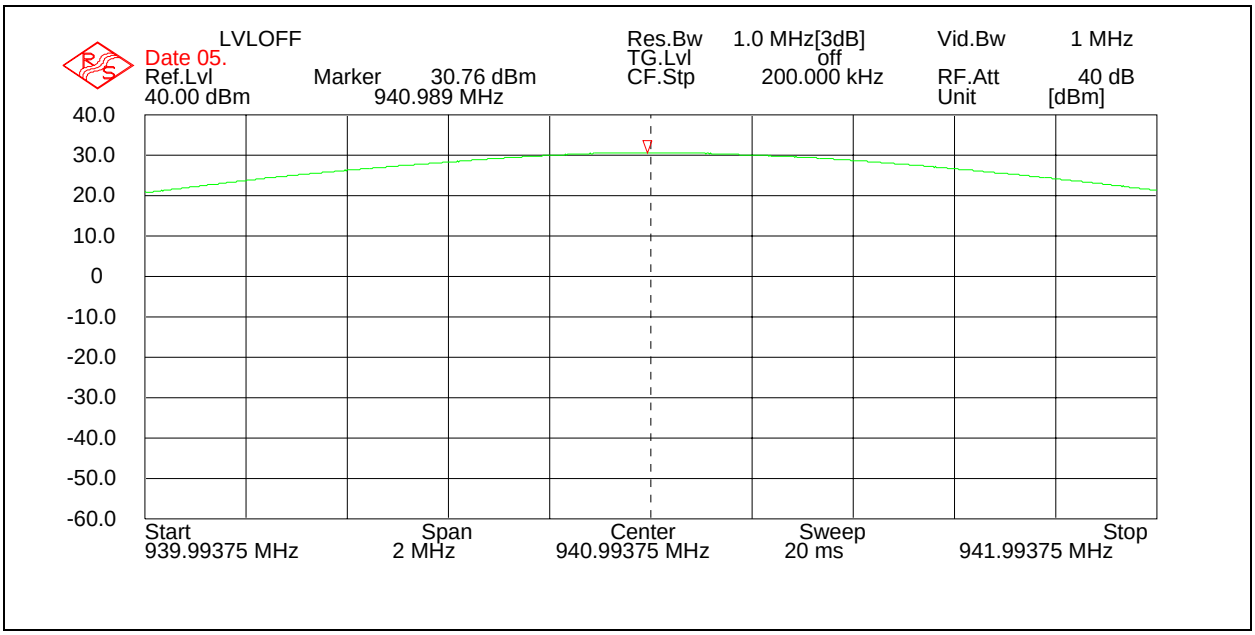


Figure 7.1.2-2: Peak Output Power 940.99375 MHz

Part 90

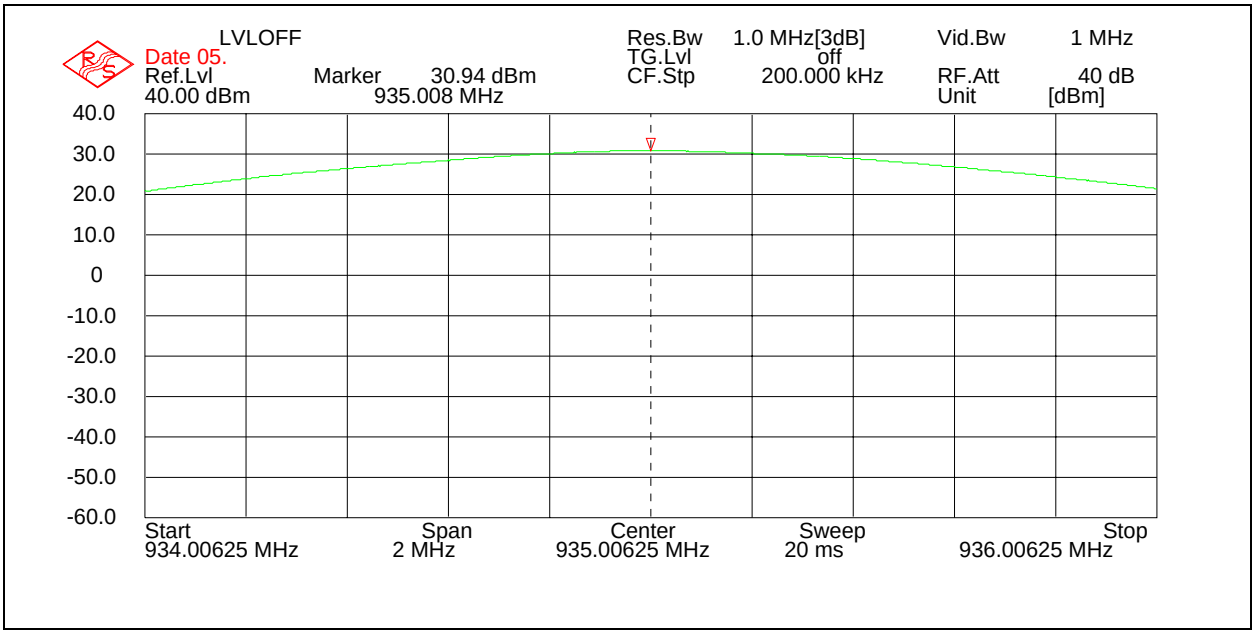


Figure 7.1.2-3: Peak Output Power 935.00625 MHz

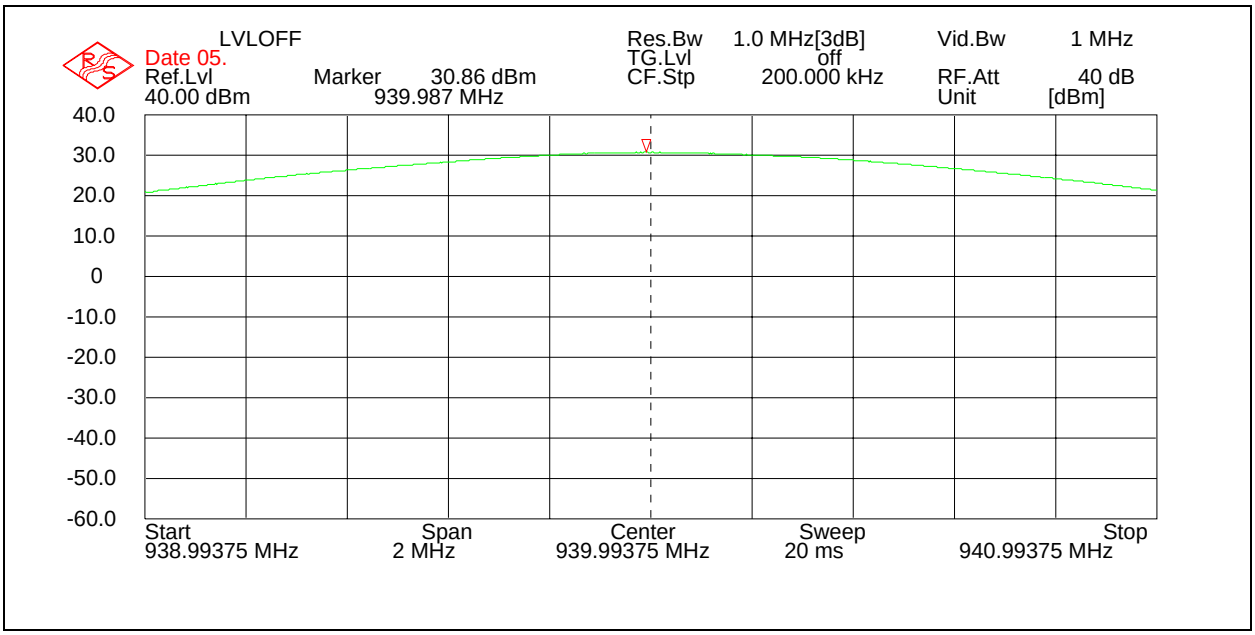


Figure 7.1.2-4: Peak Output Power 939.99375 MHz

Part 101

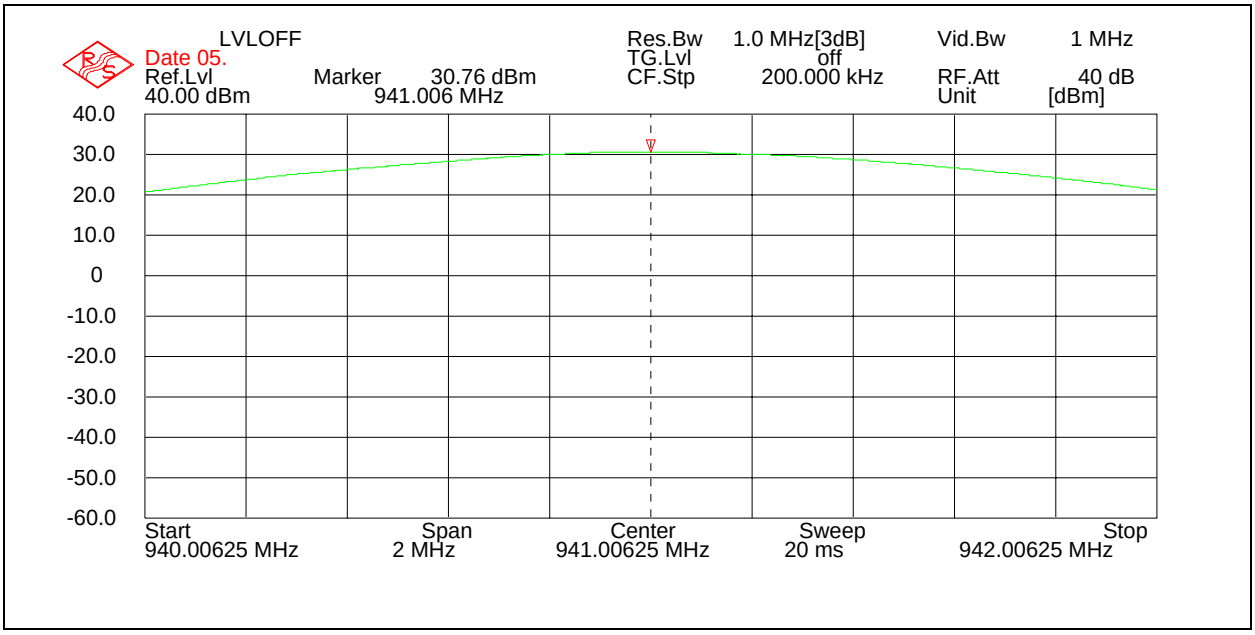


Figure 7.1.2-5: Peak Output Power 941.00625 MHz

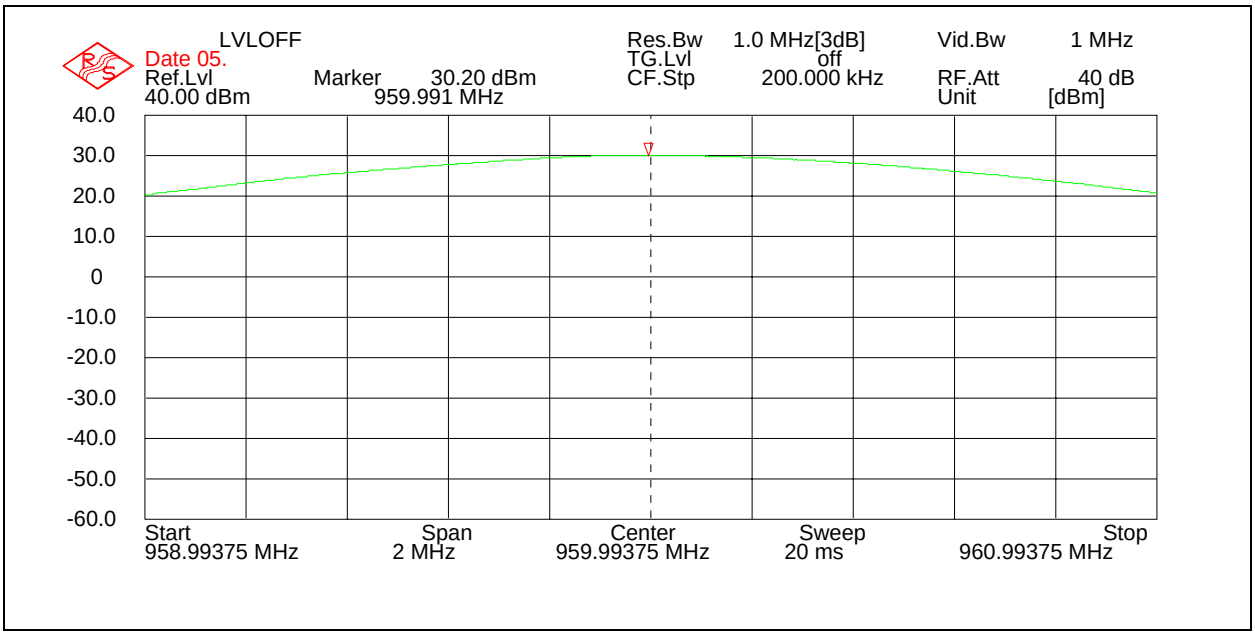


Figure 7.1.2-9: Peak Output Power 959.99375 MHz

7.2 Occupied Bandwidth (Emission Limits) - FCC Section 2.1049

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 30 dB passive attenuator. The spectrum analyzer resolution and video bandwidths were set to 300 Hz. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results of the test are shown below in for all modes of operation.

7.2.2 Measurement Results – Part 24.133 a(1), a(2)

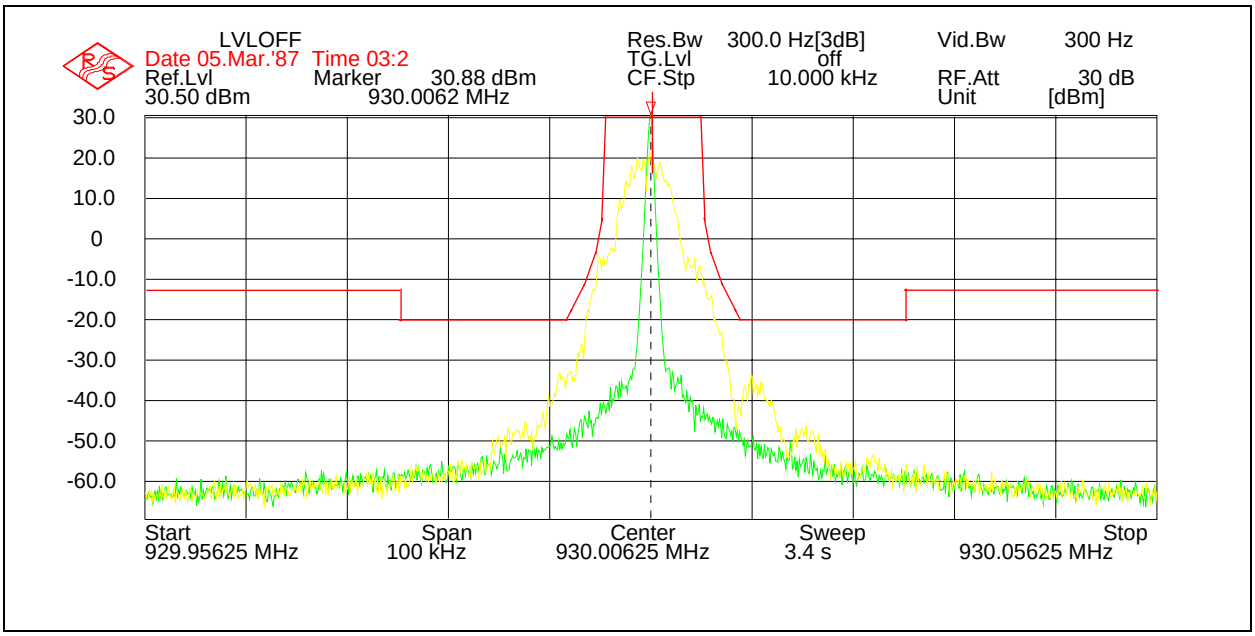


Figure 7.2.2-1: – 930.00625 MHz – 12.5 kHz Channel Spacing

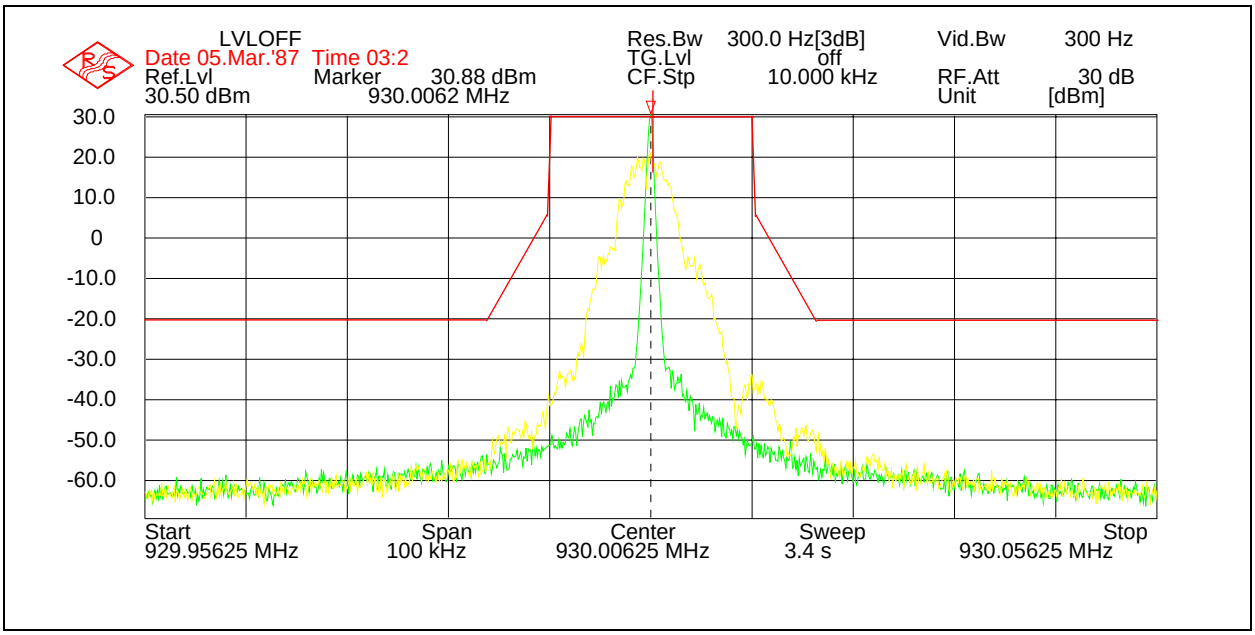


Figure 7.2.2-2: – 930.00625 MHz - 25 kHz Channel Spacing

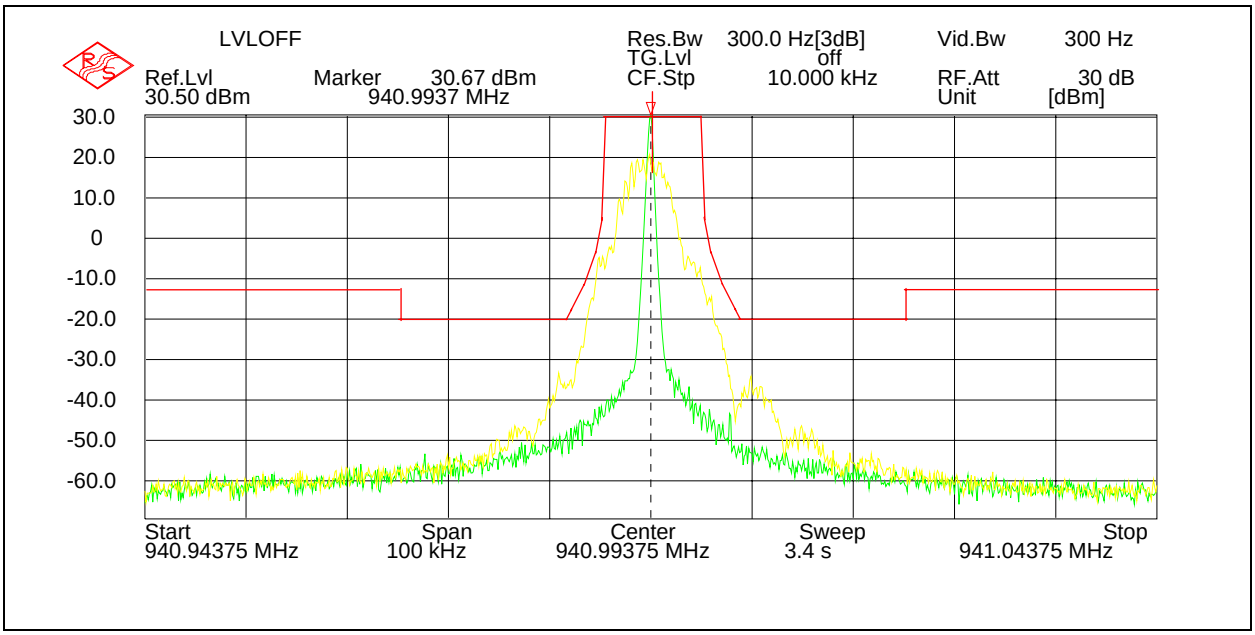


Figure 7.2.2-3: – 940.99375 MHz – 12.5 kHz Channel Spacing

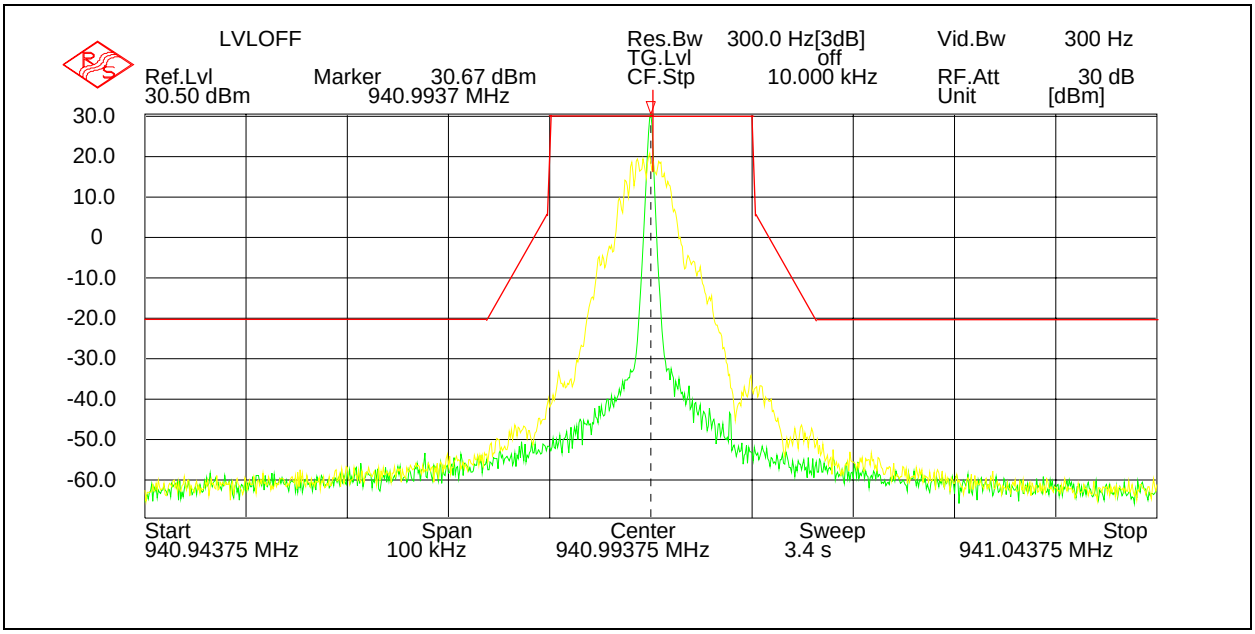


Figure 7.2.2-4: – 940.99375 MHz - 25 kHz Channel Spacing

7.2.3 Measurement Results – Part 90.210 (j)

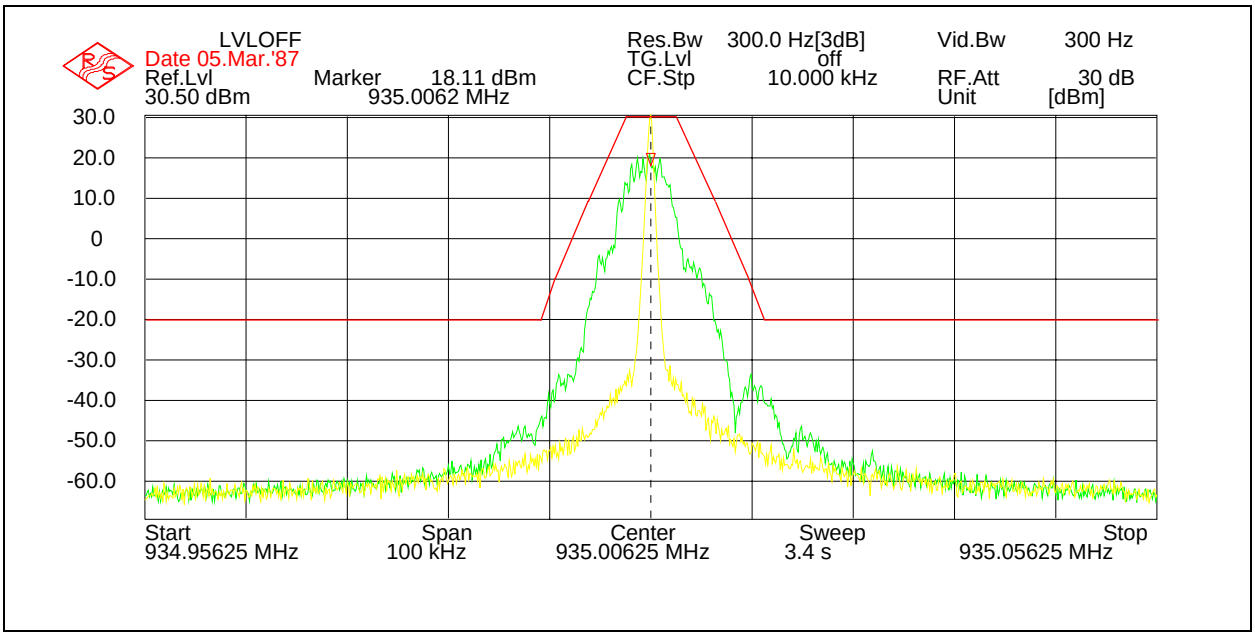


Figure 7.2.3-1: – 935.00625 MHz

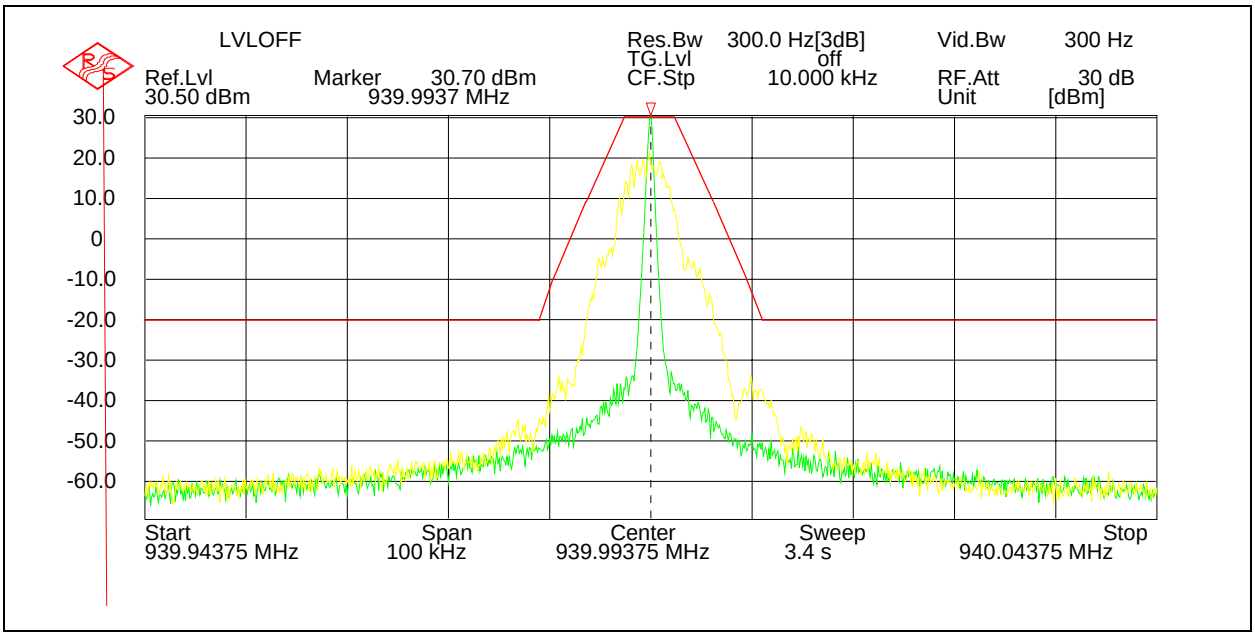


Figure 7.2.3-2: – 939.99375 MHz

7.2.4 Measurement Results – Part 101.111 a(6)

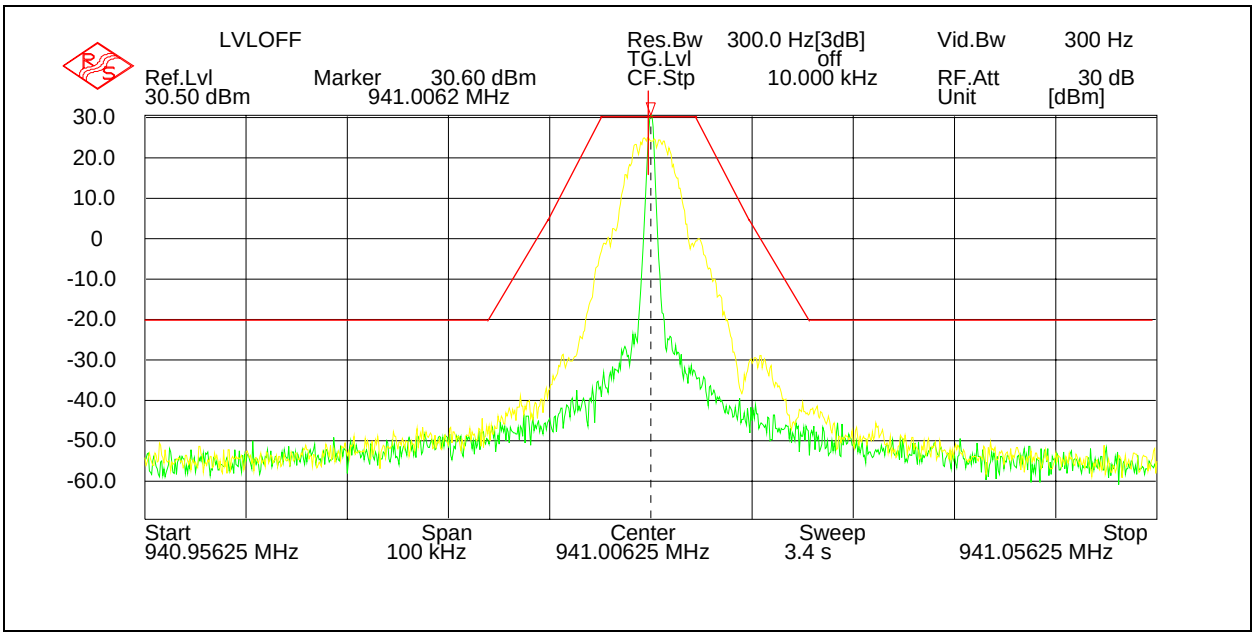


Figure 7.2.4-1: – 941.00625 MHz

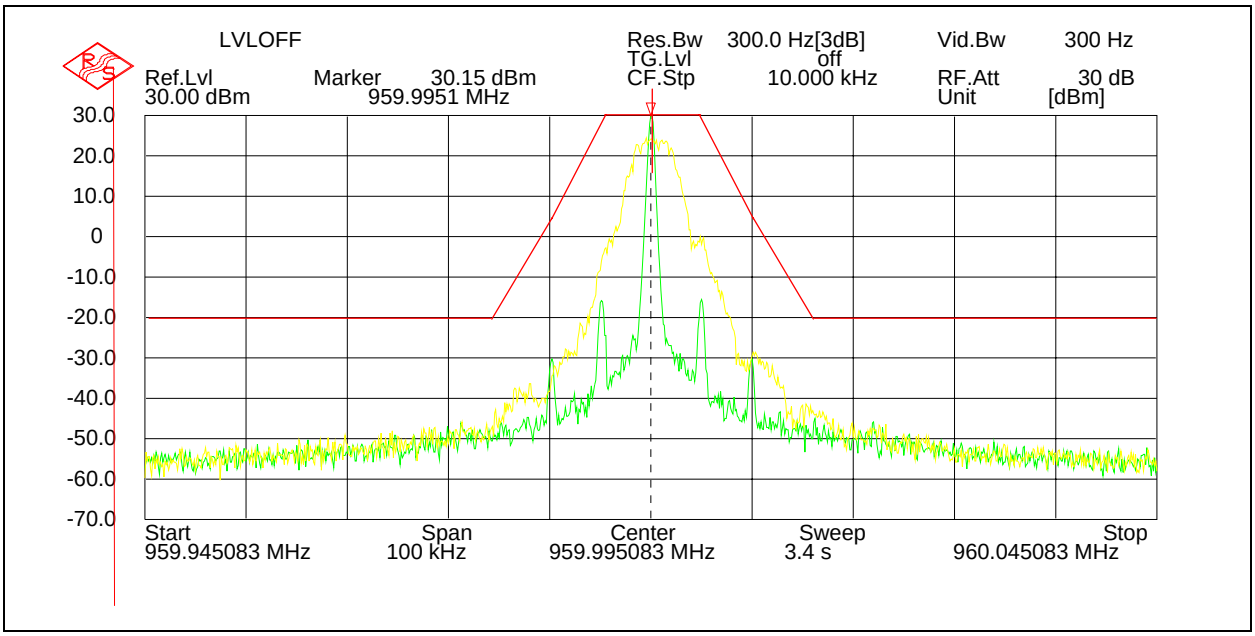


Figure 7.2.4-2: – 959.99375 MHz

7.3 Spurious Emissions at Antenna Terminals - FCC Section 2.1051, 101.111 a (6)

7.3.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 30 dB passive attenuator. The spectrum analyzer resolution bandwidth was set to 30 kHz below 1000 MHz and 1 MHz above 1000 MHz. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. The spectrum was investigated in accordance to CFR 47 Part 2.1057.

7.3.2 Measurement Results

Data was collected at the low, middle, and high end of the operating range of the device. Plots are supplied in Figure 7.3.2-1 through 7.3.2.6.

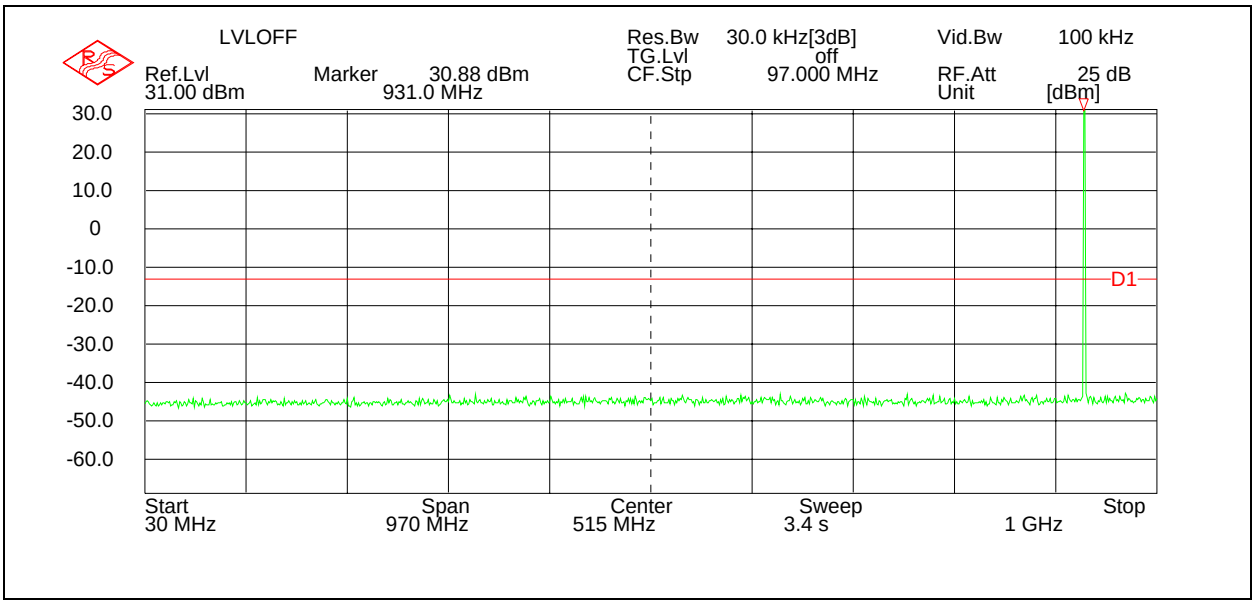


Figure 7.3.2-1: – 930.00625 MHz

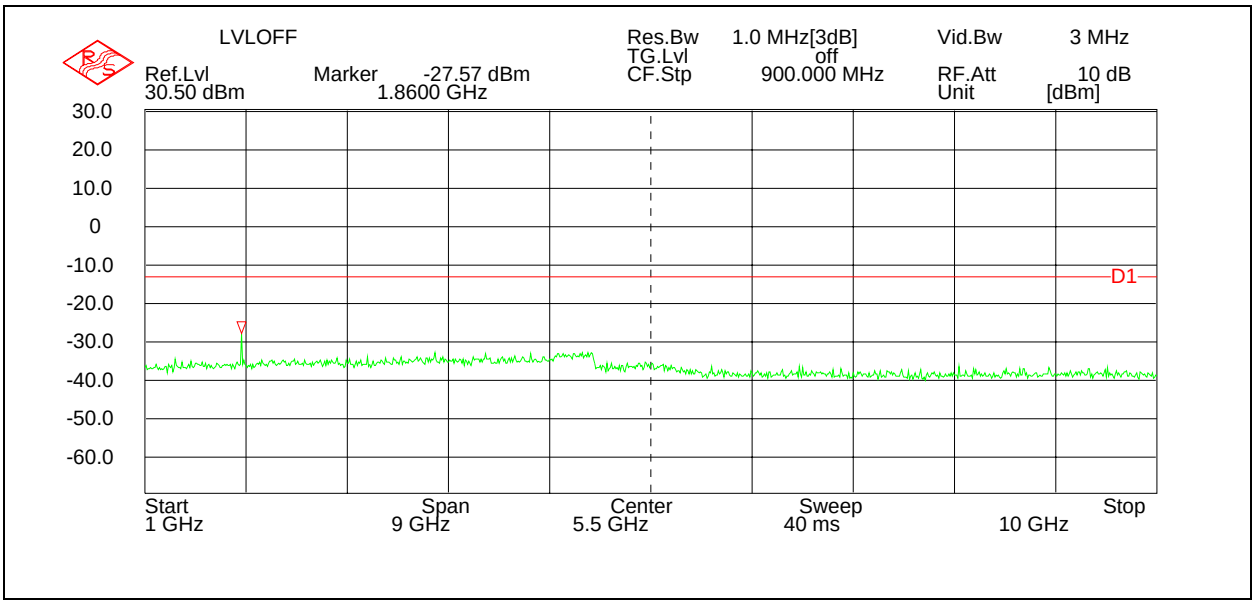


Figure 7.3.2-2: – 930.00625 MHz

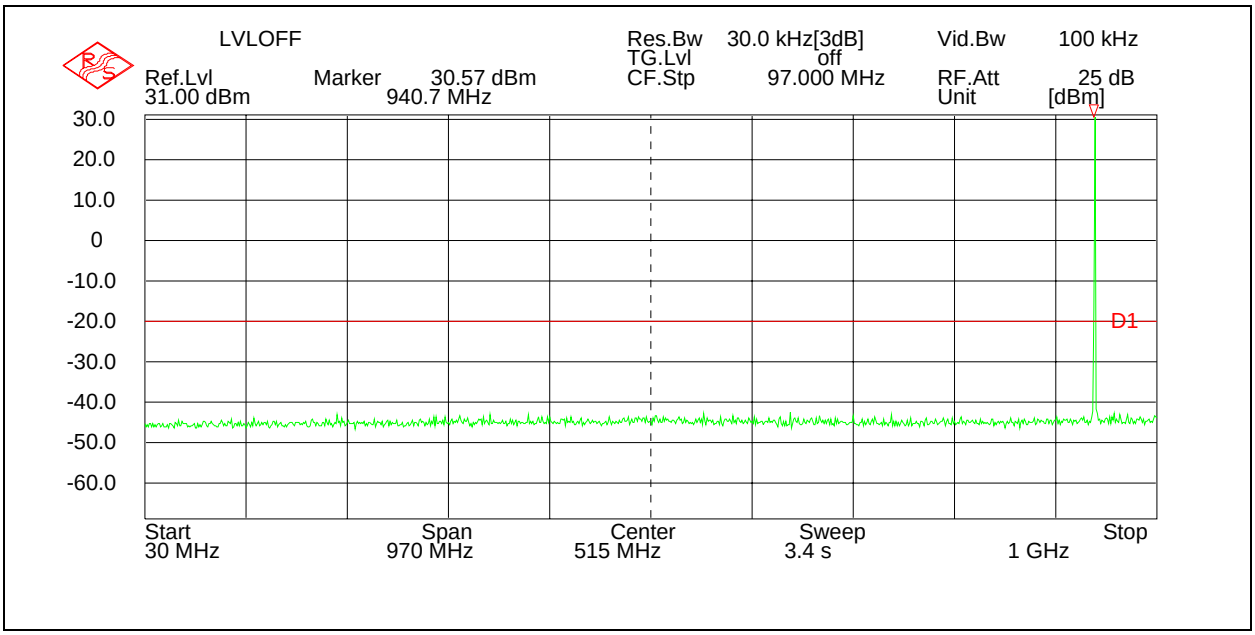


Figure 7.3.2-3: – 939.99375 MHz

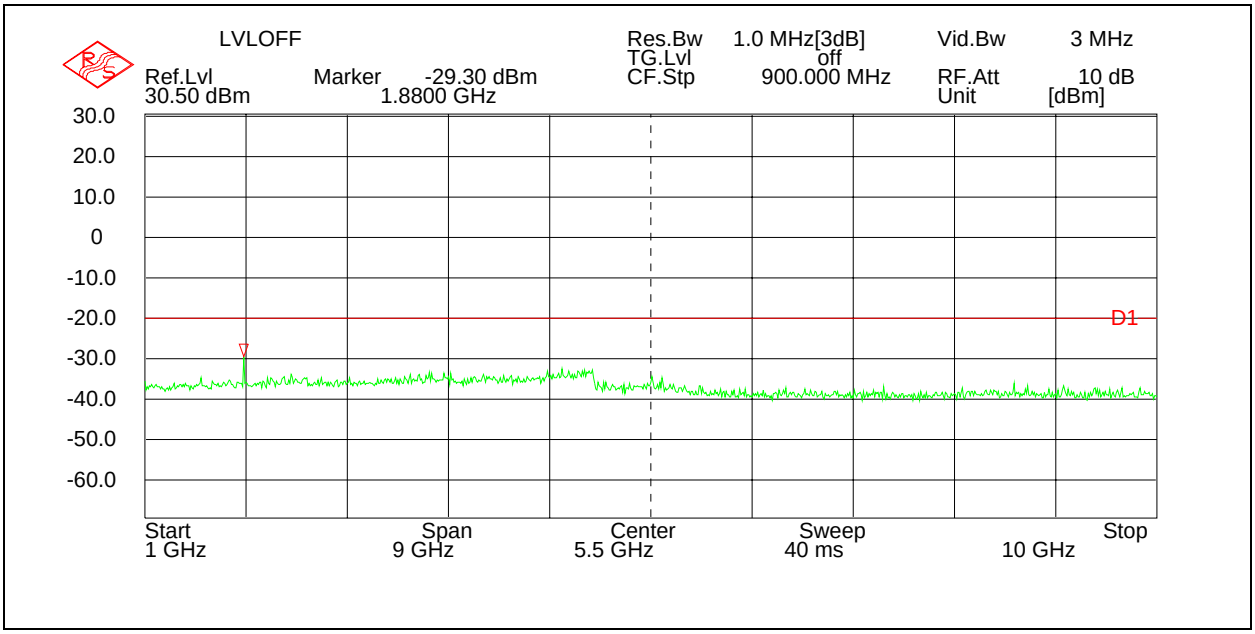


Figure 7.3.2-4: – 939.99375 MHz

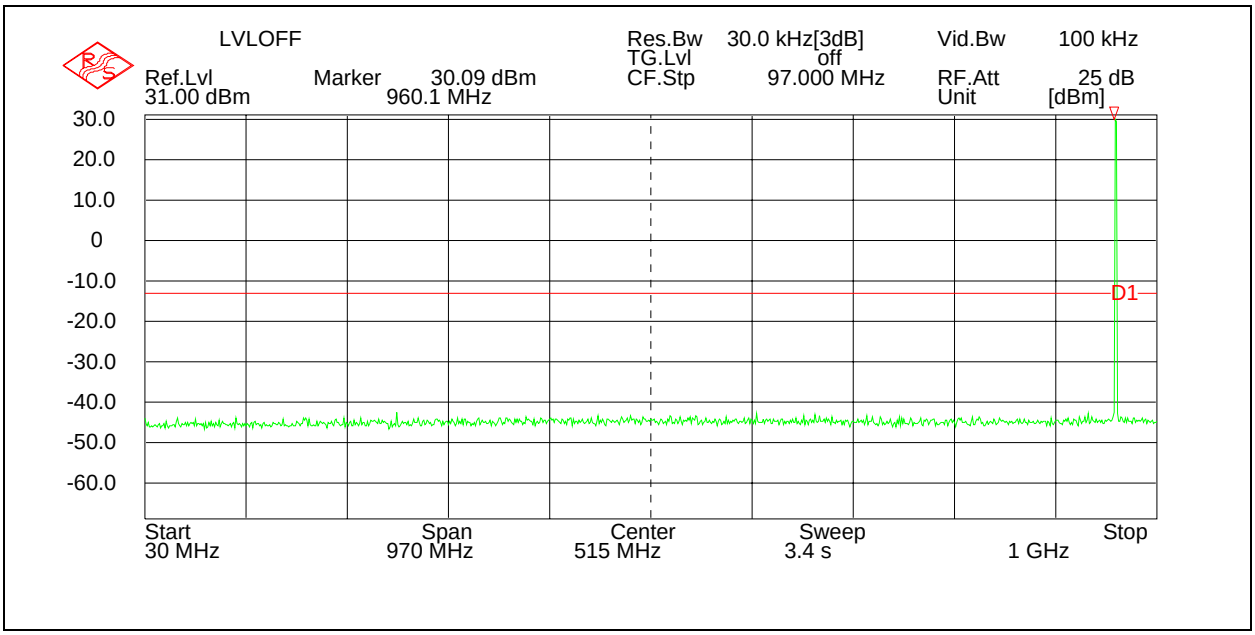


Figure 7.3.2-5: – 959.99375 MHz

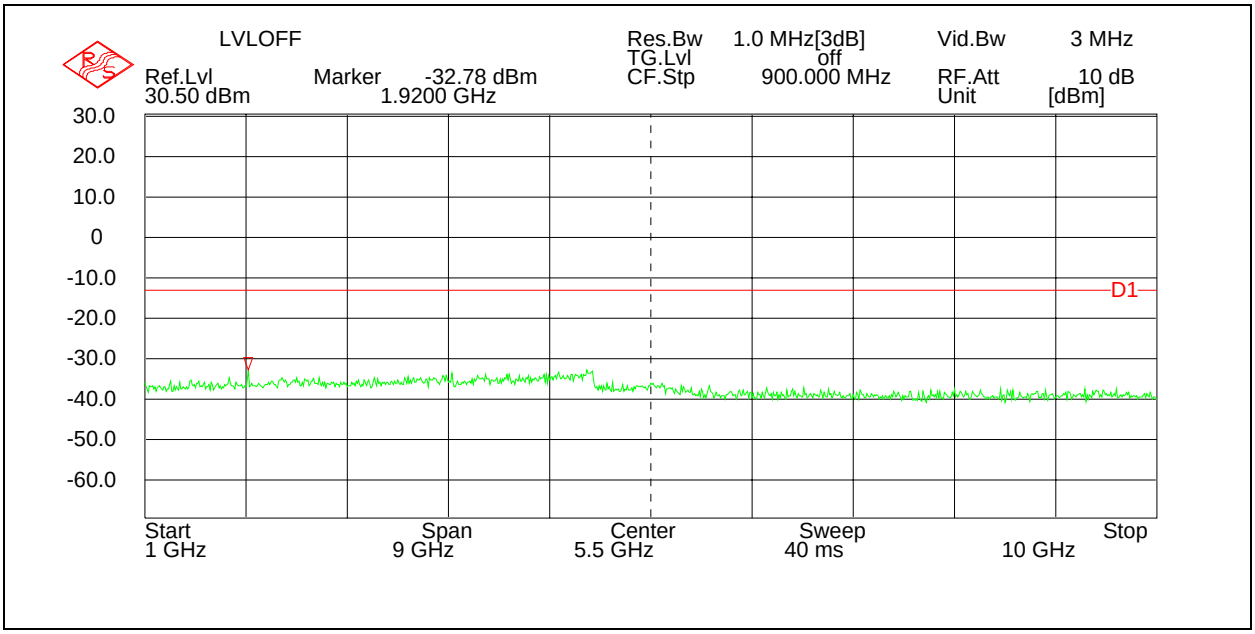


Figure 7.3.2-6: – 959.99375 MHz

7.4 Field Strength of Spurious Emissions - FCC Section 2.1053, 24.133, 90.210, and 101.111

7.4.1 Measurement Procedure

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.1) on a wooden table at the turntable center. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º and the maximum reading on the spectrum analyzer is recorded. This repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded. The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057.

Data was collected at the low, middle, and high frequencies contained in the operating range of the device. Results of the test are shown below in Table 7.4.2-1. The magnitude of all spurious emissions not reported were attenuated below the noise floor of the measurement system and therefore not specified in this report.

The most stringent limit from Part 24, 90, and 101 of 50+10Log(P) or -20 dBm is specified for low , middle, and high channels of operation.

7.4.2 Measurement Results

Table 7.4.2-1: Field Strength of Spurious Emissions

Frequency (GHz)	Uncorrected Radiated Level (dBuV)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factor (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
Low Channel – 930.00625 MHz							
1.8600	-59.96	-60	V	5.42	-54.58	-20.00	34.58
3.7200	-61.79	-56	H	5.82	-50.18	-20.00	30.18
3.7200	-62.04	-54	V	5.82	-48.18	-20.00	28.18
5.5800	-59.07	-47	V	6.06	-40.94	-20.00	20.94
Mid Channel – 941.00625 MHz							
1.8820	-59.76	-60	H	5.42	-54.58	-20.00	34.58
1.8820	-58.97	-58	V	5.42	-52.58	-20.00	32.58
5.6460	-59.96	-48	V	6.10	-41.90	-20.00	21.90
High Channel – 959.99375 MHz							
2.8800	-62.8	-62	H	5.82	-56.18	-20.00	36.18
3.8400	-62.91	-54	V	5.71	-48.29	-20.00	28.29

7.5 Frequency Stability - FCC Section 2.1055, 24.135, 90.213, 101.107

7.5.1 Measurement Procedure

The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment and a power supply is attached to the primary supply voltage.

Frequency measurements were made at the extremes of the of temperature range -30º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. At a temperature 20º C the supply voltage was varied from 85% to 115% from the normal. The maximum variation of frequency was recorded.

Data was collected on the middle channel of the operating range for the device. Results of the test are shown below in Table 7.5.2-1.

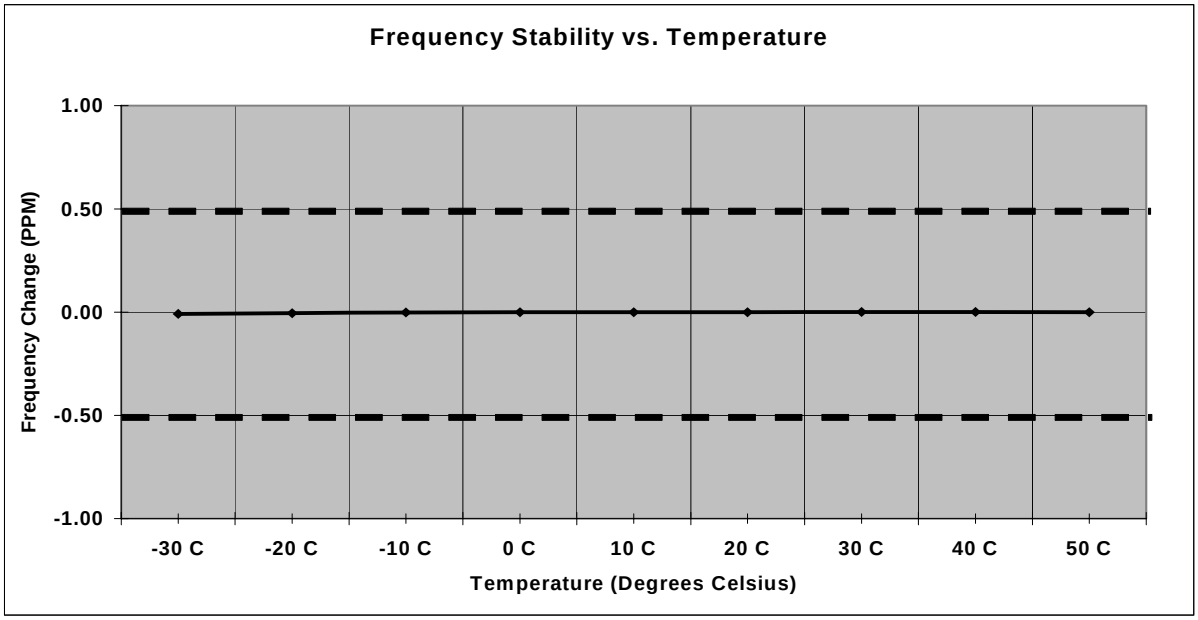
7.5.2 Measurement Results

Table 7.5.2-1: Frequency Stability

Frequency Stability

Frequency (MHz): 939.993728
Deviation Limit (PPM): 0.1 ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	939.99372	**-0.009**	100%	24.00
-20 C	939.993723	**-0.005**	100%	24.00
-10 C	939.993726	**-0.002**	100%	24.00
0 C	939.993727	**-0.001**	100%	24.00
10 C	939.993728	**0.000**	100%	24.00
20 C	939.993728	**0.000**	100%	24.00
30 C	939.993729	**0.001**	100%	24.00
40 C	939.993729	**0.001**	100%	24.00
50 C	939.993728	**0.000**	100%	24.00
20 C	939.993730	**0.002**	85%	20.40
20 C	939.993726	**-0.002**	115%	27.60



7.6 Radiated Emissions (Unintentional Radiators) - FCC Section 15.109

7.6.1 Measurement Procedure

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.1) on a wooden table at the turntable center. For each radiated emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º to obtain a maximum peak reading on the spectrum analyzer. This repeated for both horizontal and vertical polarizations of the receive antenna.

The field strength of each radiated emission is calculated by correcting the EMI receiver level for cable loss, amplifier gain, and antenna correction factors.

Field Strength (dBuV/m) = EMI Receiver Level (dBuV) + Cable Loss (dB) – Amplifier Gain (dB) + Antenna Correction Factor (1/m)

The peak data met both quasi-peak and average limits therefore only peak data is presented in this report. The frequency range from 30 MHz to 5 GHz was evaluated and the peak results are shown below in Table 7.6.2-1 and Figure 7.6.2-1.

7.6.2 Measurement Results

Table 7.6.2-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (°)	Corrected Reading (dBµV)	Limit (dBµV)	Margin (dB)
30.00	V	359	60	28.93	40	11.07
39.70	H	101	305	31.1	40	8.9
72.03	H	259	182	33.68	40	6.32
488.06	V	133	12	35.93	46	10.07
619.54	H	101	272	39.19	46	6.81
630.32	H	112	272	34.62	46	11.38
714.39	H	400	285	35.3	46	10.7
934.26	V	101	183	34.04	46	11.96
946.11	H	124	347	34.16	46	11.84
979.52	V	375	71	44.88	53.9	9.02

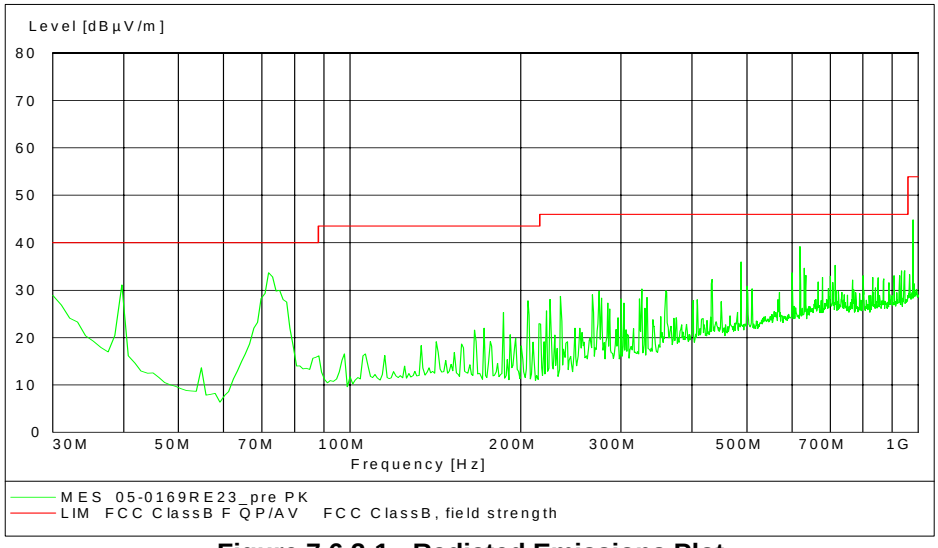


Figure 7.6.2-1: Radiated Emissions Plot

7.7 Power Line Conducted Emissions - FCC Section 15.107

The EUT is power by a DC source therefore Power Line Conducted Emissions testing is not applicable.

End Report