GENERAL DYNAMICS
C4 Systems

Report No. 100712-1601-01

Permissive Change Report – Class II

General Dynamics C4 Systems
VHF CM-350 Digital Transmitter (VDT)

FCC ID: MIJCM350V

Model No. CM-350

Equipment Manufacturer:	**General Dynamics C4 Systems** **8220 E. Roosevelt St.** **Scottsdale, Arizona 85257**
Tests Conducted By:	**General Dynamics C4 Systems** **EMC Test Facility** **8201 E. McDowell Rd.** **Scottsdale, Arizona 85257**
Tests Period:	**May 3rd to May 26, 2010**
Test Summary:	**Complies with** **FCC Part 87, Aviation Services**

The General Dynamics EMC Laboratory is accredited through the

NVLAP®

NVLAP Lab Code 100405-0

1.0 Introduction

This document details a repeat of the Radiated and Conducted Emissions testing conducted from the 3rd through the 26th of May 2010 on the CM-350 VDT. This testing was performed based on some minor changes to the equipment most of which would be considered Class I permissive changes with no formal submittal necessary.

However, the changes do include a slight extension in the lower operating frequency and a cavity filter option. Therefore, this report is being submitted as justification for authorization under Class II permissive change procedures.

The following is a list of the changes with those categorized as Class II highlighted:

Mechanical

- Implemented plastic guide tubes for transmitter cosite filter tuning
- Reviewing fasteners to reduce types used
- Eliminating 3-part polyurethane paint, use chemical conversion coat
- New Telerad RF heatsink
- Reduced quantity of holes in Transmitter cover

Electrical

- Removed headset jack and reference frequency output connector on front of Transmitter
- Added RCAM assembly to Transmitter
- Included cavity filter option for the Transmitter (photos of the filter shown in Appendix D)

Software

- Software change to reduce minimum operating frequency from 118MHz to 117.975MHz (still within the ATC frequency band)

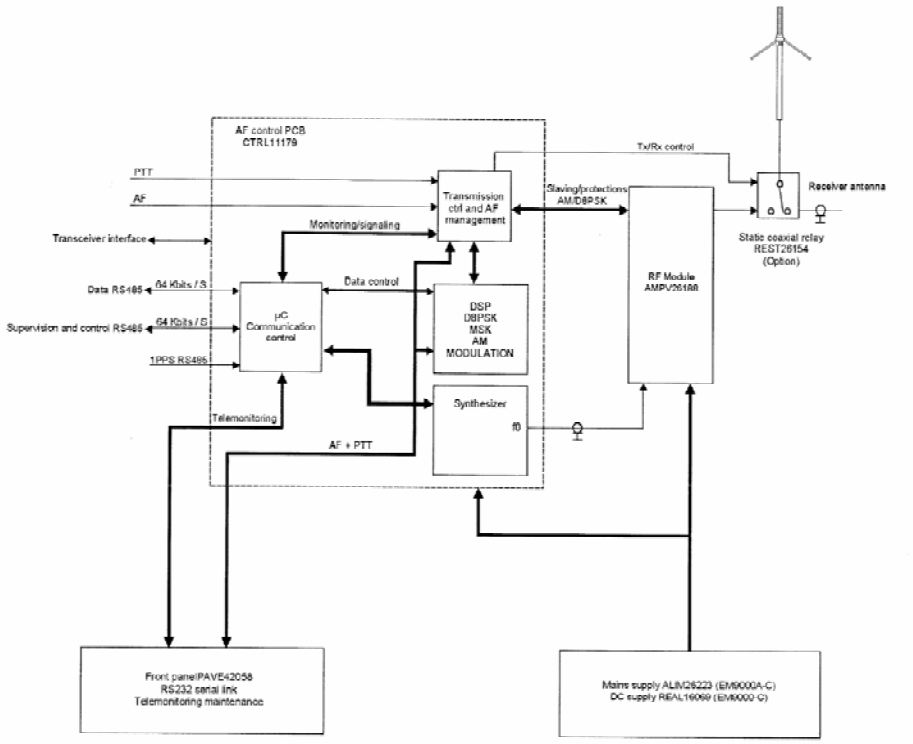
The enclosed test results indicate that there was no degradation of EMC parameters. Nevertheless, per Knowledge Database (KDB) Policy #178919 for Permissive Changes (v04r04), the operating frequency and optional filter changes defines this as a Class II permissive change requiring submittal of a new test report.

There is no increase in output power rating for the new lower operating frequency. Additionally, no frequency stability re-testing was necessary since no changes were made to the reference oscillator so the original filing data is still valid.

1.1 Product Description

The CM-350 VHF Digital Transmitter (VDT) is a VHF multimode transmitter (A3E-ACARS-MODE2) operating with an output power of 5 W to 50 W. It is used in accordance with analog modulation (AM type) and digital modulation (AM-MSK or D8PSK type). The transmitter is fully digital controlled.

The general block includes the previously described constituent elements of the transmitter. The functions of each of these elements are described here below.



1.2 Facility Description

This FCC certification testing on the CM-350 VDT was performed by General Dynamics C4 Systems (GDC4S), EMC/TEMPEST Test Laboratory which is located in the southeast wing of the Hayden building at 8201 E. McDowell Road, Scottsdale, AZ.

The GDC4S EMC test facility includes a certified three-meter and ten-meter Open Area Test Site (OATS) and several shielded enclosures. The facility has been found to be in compliance with the requirements of Section 2.948 of the FCC rules, per Registration Number 90811, dated July 18, 2007. The facility has also been issued a Certificate of Accreditation through the National Voluntary Laboratory Accreditation Program (NVLAP) by NIST. This is under NVLAP Code: 100405-0 and is effective through September 30, 2010. The facility is in compliance with all CISPR 16 requirements.

1.3 Quality System

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

- National Institute of Standards & Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP)
- NIST Handbook 150-11 (2007 Edition)
- ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories
- National Security Agency Technical and Security Requirements Document for the Endorsed TEMPEST Test Services Program NSA TSRD No. 88-9C rev. 2

1.4 Standard References

47 CFR 2	Code of Federal Regulations, Title 47, Part 2, "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
47 CFR 87	Code of Federal Regulations, Title 47, Part 87, "Aviation Services"
C63.4-2003	American National Standards Institute (ANSI), "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

2.0 Test Procedures

2.1 Requirements

The CM-350 transmitter is subject to FCC Parts 2 and 87 for FCC Certification for units deployable in the United States. The following tests were re-performed to include the lower frequency extension and the optional cavity filter.

Table 2.1-1 List of re-tests for Class II Permissive Changes

47 CFR Parts 2 & 87 Requirements	***Requirement Description***	***Compliance***
87.135 2.1049	Occupied Bandwidth	Yes
87.139 2.1051 2.1053	Emission Limitations	Yes

2.2 Operational Configuration

The unit was set up in both the 10W and 50W configurations for this testing to include both types of the optional cavity filter. The unit was tested at three frequencies for each of these configurations including the extended low frequency of 117.975 MHz.

Spurious Emissions were measured for both conducted via the antenna port, as well as inadvertent radiation from the chassis with the RF output terminated.

2.3 Measurement Equipment

MODEL	DESCRIPTION	MFG.	ASSET #	UN-CERT.	LAST CAL.	DUE CAL.
2070-2	Antenna Mast, 6 meter	EMCO	G72315	N/A	NCR	NCR
3142B	Antenna, BiConiLog	EMCO	T47085	± 2.0 dB	26-Feb-10	28-Feb-11
3142B	Antenna, BiConiLog	EMCO	T47086	± 2.0 dB	26-Feb-10	28-Feb-11
3121C	Antenna, Dipole	EMCO	G40498	± 2.0 dB	22-Apr-10	30-Apr-11
3121C	Antenna, Dipole	EMCO	G40499	± 2.0 dB	22-Apr-10	30-Apr-11
8028-50-TS-24-BNC	LISN, 50µH	Solar	T36676	± 2.0 dB	04-Feb-10	28-Feb-11
8028-50-TS-24-BNC	LISN, 50µH	Solar	T41319	± 2.0 dB	04-Feb-10	28-Feb-11
8012-50-R-24	LISN, Dual 50µH	Solar	T52419	± 2.0 dB	04-Feb-10	28-Feb-11
2090	Multi Device Controller	EMCO	G72315.1	N/A	NCR	NCR
ESI-7	Receiver, 20Hz-7GHz	Rohde & Schwarz	G71791	± 2.0 dB	02-Mar-10	31-Mar-11
ESI-7	Receiver BIOS Firmware 3.3	Rohde & Schwarz	G71791.1	N/A	NCR	NCR
ESI-7	Receiver Analyzer Firmware 4.01	Rohde & Schwarz	G71791.2	N/A	NCR	NCR
ES-K1.60	Receiver Software, EMI Controller(1999), Service Pack 2	Rohde & Schwarz	G71791.3	N/A	NCR	NCR
53-20-33	Attenuator, 20dB, 500Watt, DC-2.5GHz	Weinschel	T57060	± 0.5 dB	04-Mar-10	31-Mar-11
48-20-43	Attenuator, 20 dB, 100Watt, DC-18GHz	Weinschel	TA3610	± 0.75 dB	27-Apr-10	30-Apr-11
TB-9 MN	Termination, 30Watt, DC-12.4GHz	Micro Lab	T39256	N/A	NCR	NCR

2.4 Conducted Emissions Procedure (Spurious and Harmonics)

Spurious radiation is the radio frequency voltages or power generated within the equipment and appearing at the equipment's output terminals when properly loaded with its characteristic non-radiating artificial load. The conducted spurious emissions were measured at the antenna terminal by direct connection to a spectrum analyzer and using the necessary external attenuators and RF filters. The level of the carrier and the various conducted spurious and harmonic frequencies were measured by means of a calibrated Rohde & Schwarz ESI-7 EMI Receiver System.

The minimum standard is that the mean power of conducted spurious and harmonic emissions shall be attenuated below the mean output power of the transmitter by:

Frequency Offset	Attenuation
50 -100 %	25 dBc
100 – 250%	35 dBc
>250%	53 dBc (10W) (43+10log Pt)
>250%	60 dBc (50W)

The spectrum was scanned from 30 MHz to the 10th harmonic of the carrier, specifically 1400 MHz including the spectral mask around the carrier. All signals were measured with peak detection (worst case).

2.5 Radiated Emissions Procedure (Spurious and Harmonics)

Radiated spurious emissions were measured over the frequency range of 30 MHz to 2000 MHz in a semi-anechoic chamber (6.1m x 7.3m x 4.9m). Refer to Figure 2.5-1 for test setup. Typically, signals within approximately 10-15 dB of the limit are noted for measurements on the OATS. However, in this situation there were no signals that were even within 20 dB (reportable level) of the limit therefore no additional measurements were performed.

The same minimum standards as defined above for the conducted spurious emissions apply to the radiated spurious emissions.

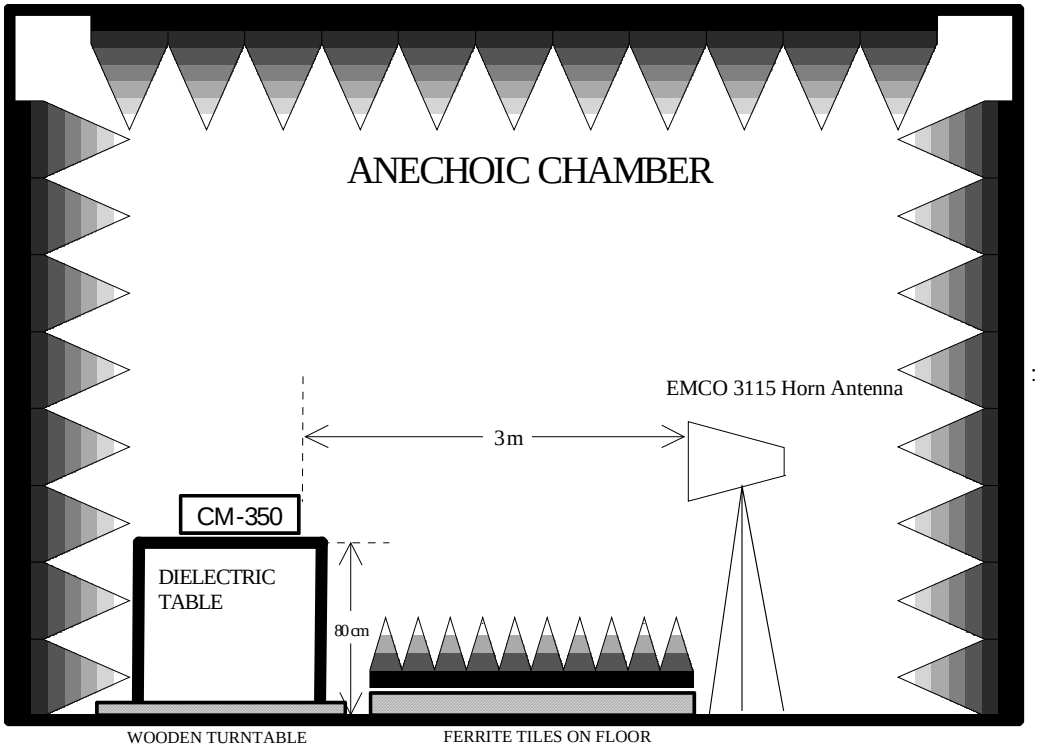


Figure 2.5-1 Radiated Spurious Emissions Test Setup - Chamber

3.0 Test Results

3.1 Occupied Bandwidth

The occupied bandwidth measurements for the CM-350 VDT were performed using a test setup similar to Figure 3.1-1. A spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in a normal mode, modulated by a frequency of 2500 Hz at a level 16 dB above 50% modulation. The power ratio in dB representing 99.0% of the total mean power was recorded from the spectrum analyzer. The test was performed at both 50 and 10W power levels including the optional cavity filters.

Requirements of 2.1049(c)(1) and applicable paragraphs of Part 87 are met. There are no deviations to the specifications.

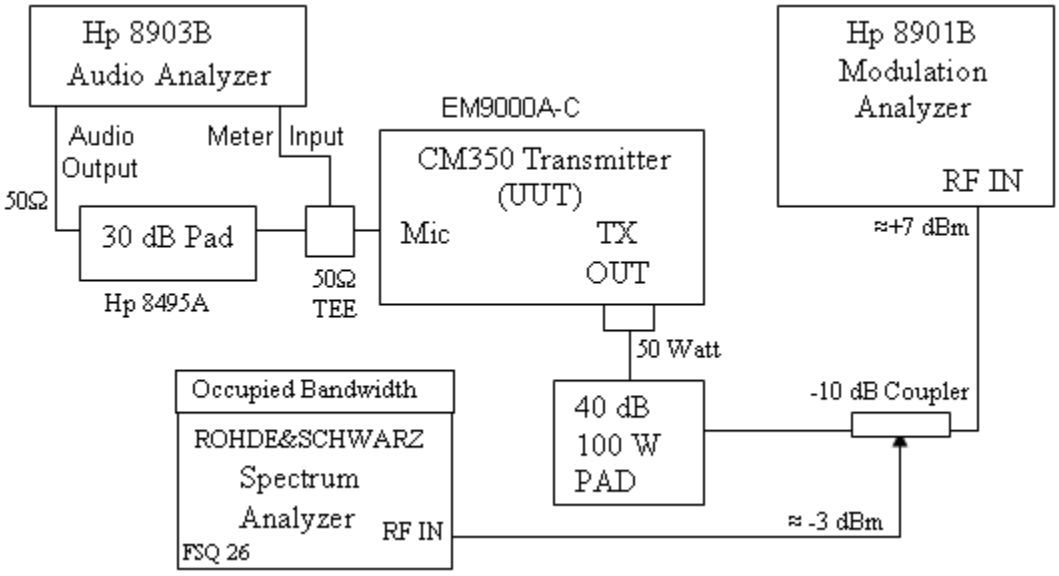


Table 3.1-1 Test Results for Occupied Bandwidth Measurements at 50W

Channel Spacing	Fc MHz	Occupied BW kHz
25 kHz	117.975	5.41
25 kHz	129.000	5.41
25 kHz	137.975	5.41
8.33 kHz	117.975	5.26
8.33 kHz	127.975	5.26
8.33 kHz	137.975	5.26

Table 3.1-2 Test Results for Occupied Bandwidth Measurements at 10W

Channel Spacing	Fc MHz	Occupied BW kHz
25 kHz	117.975	5.48
25 kHz	127.975	5.25
25 kHz	137.975	5.48
8.33 kHz	117.975	5.48
8.33 kHz	127.975	5.25
8.33 kHz	137.975	5.25

All of the occupied bandwidth measurement plots are shown in Appendix A.

3.2 Conducted Spurious Emissions Measurement Test Results

All measurements were made with the CM-350 VDT in transmit mode at both 10W and 50W output power. The conducted spurious emissions were measured at transmit frequencies of 117.975, 127.975, and 137.975 MHz. The test results indicate that the CM-350 VDT including the integrated changes is compliant with CFR Part 2.1051 and 87.139 requirements. Additionally, no significant degradation is evident due to the hardware modifications as compared to the originally filed certification data. A summary of the test results is shown in Table 3.2-1.

Appendix B contains the spectrum analyzer screen prints of the measured data for the carrier emission masks and complete frequency sweeps. All spurious and harmonic were well below the requirement limits.

Table 3.2-1 Summary of Conducted Spurious Emissions Test Results

Test Requirement	Applicable FCC Section	Pass/Fail
Carrier Emission Mask	87.139	Pass
Spurious Emissions at Antenna Terminals	87.139	Pass

3.3 Radiated Spurious Emissions Measurement Test Results

All radiated spurious emission measurements were made with the CMT-350 VDT transmitting at its maximum rated output power of 50W as well as in the 10W configuration with associated cavity filter. The RF output was terminated into 50 ohm load via a high power attenuator. All radiated spurious emission measurements were maximized to provide a worst-case level.

All emissions in the applicable frequency range were below the reportable level of 20 dB from the specified limits of 47 CFR Parts 2.1053 and 87.139. The worst-case radiated emission data is provided for reference in Appendix C as Figures C-1 through C-4. The applicable limit for these emissions is approximately 84dBuV/m.

There was also no significant degradation from the radiated spurious emissions measured for the original certification filing.

Appendix A

Occupied Bandwidth Measurements

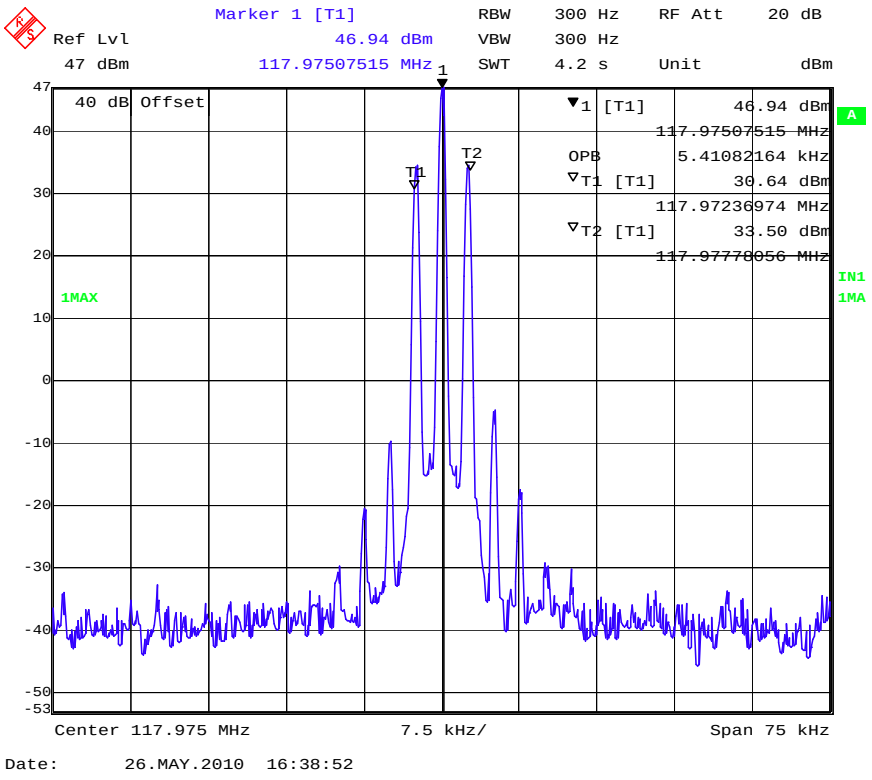


Figure A – 1 117.975 MHz, 25 kHz Channel, 50W

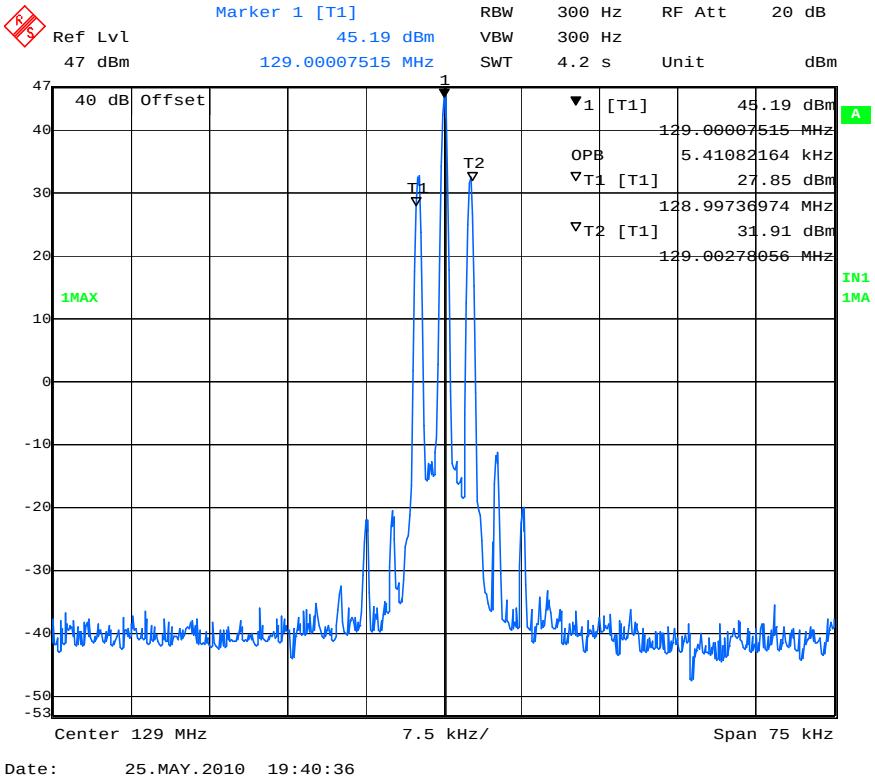


Figure A – 2 129 MHz, 25 kHz Channel, 50W

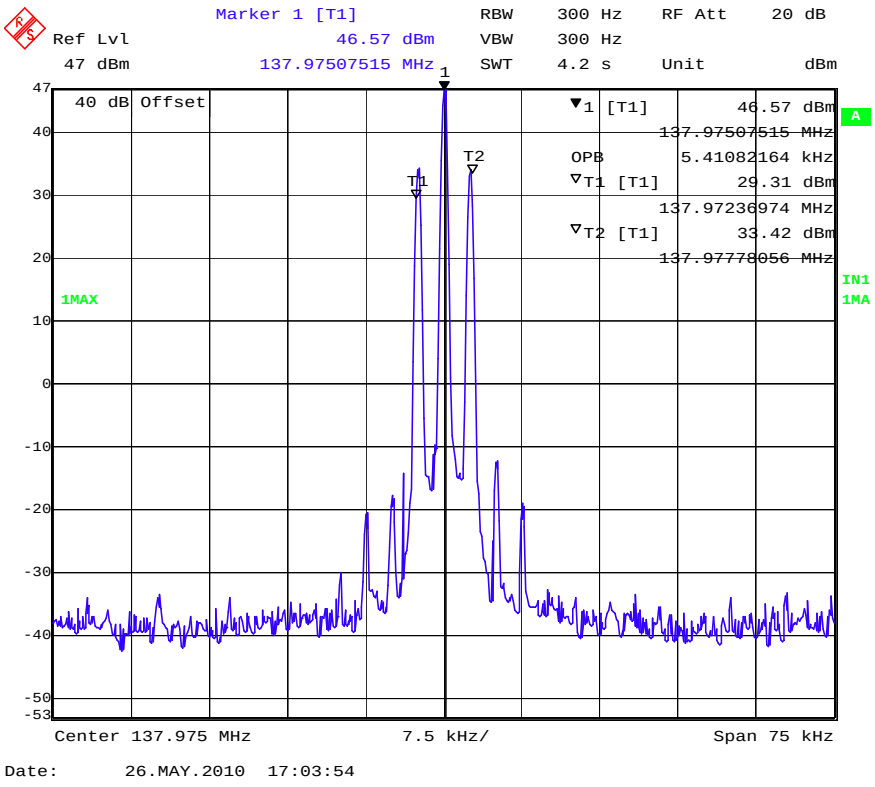


Figure A – 3 137.975 MHz, 25 kHz Channel, 50W

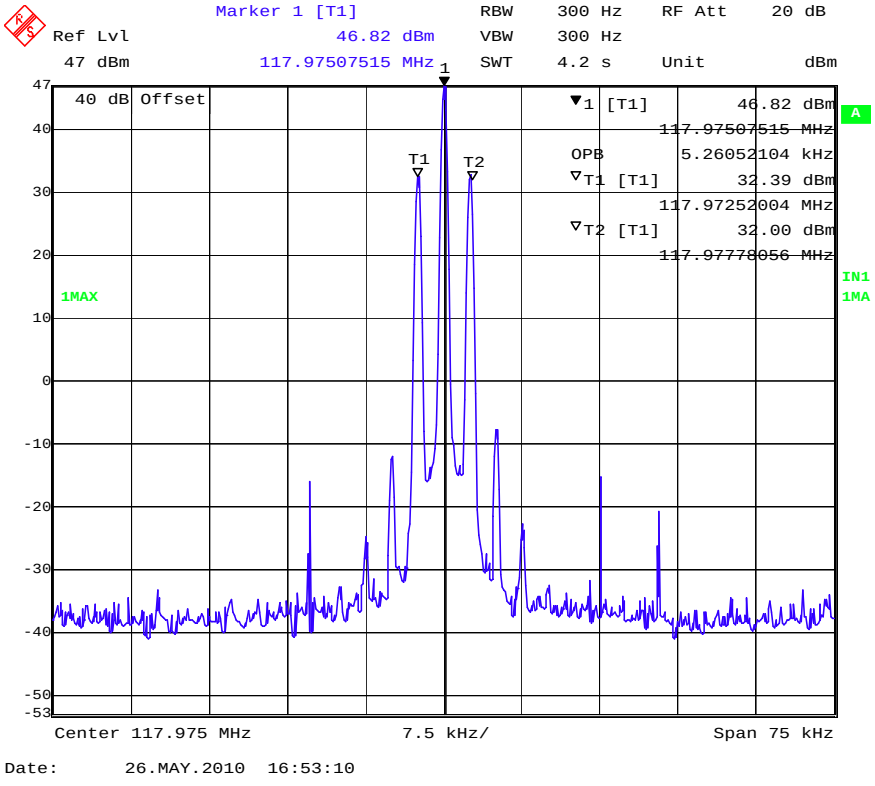


Figure A – 4 117.975 MHz, 8.33 kHz Channel, 50W

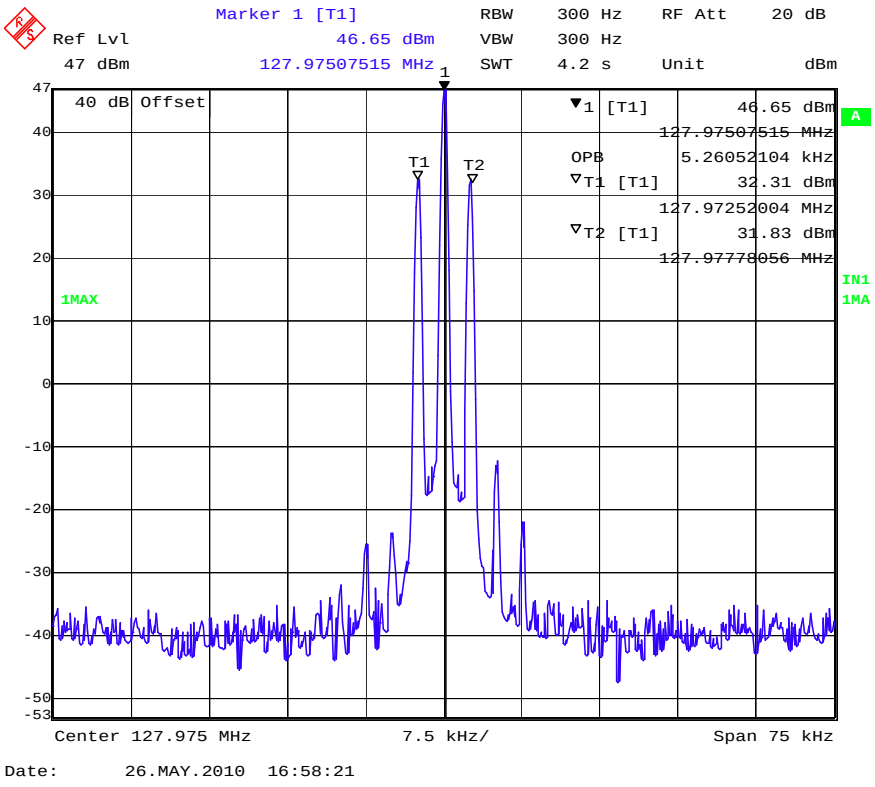


Figure A – 5 127.975 MHz, 8.33 kHz Channel, 50W

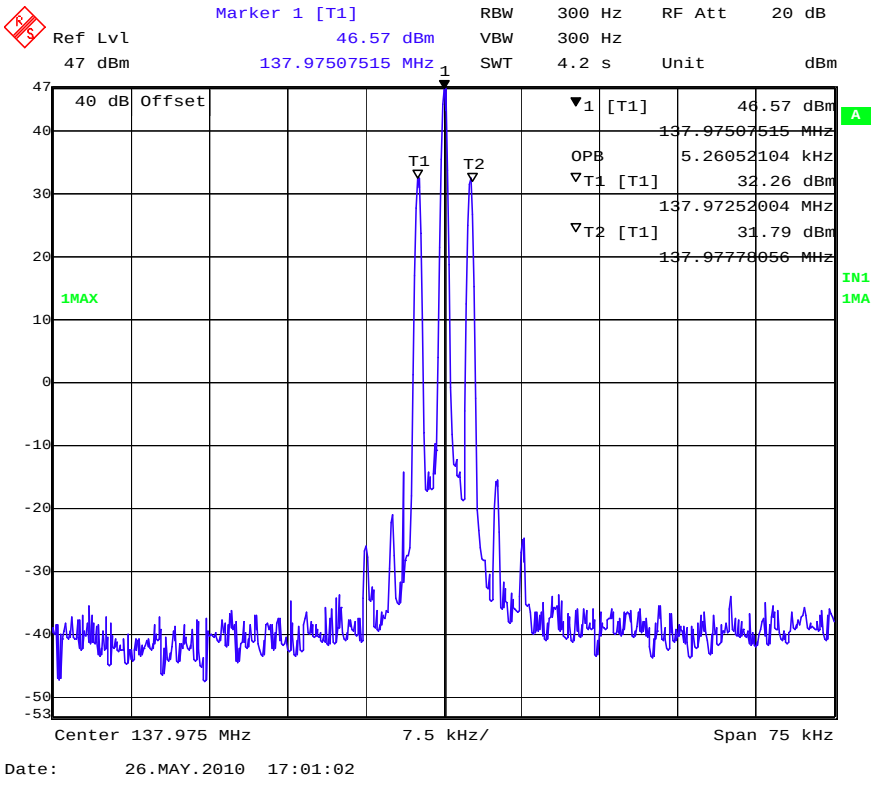


Figure A – 6 137.975 MHz, 8.33 kHz Channel, 50W

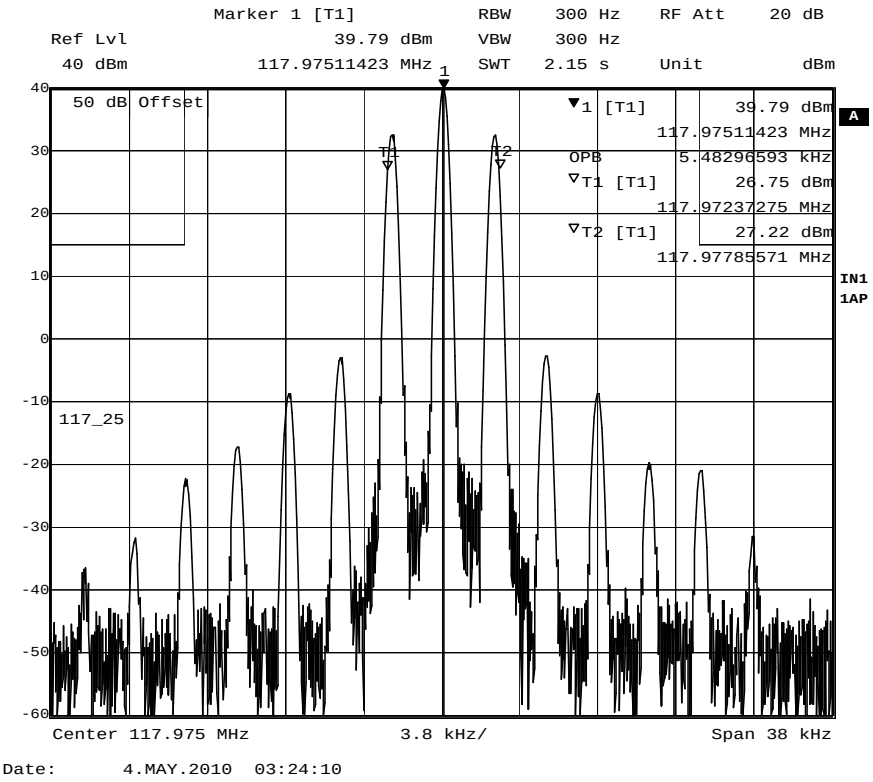


Figure A – 7 117.975 MHz, 25 kHz Channel, 10W

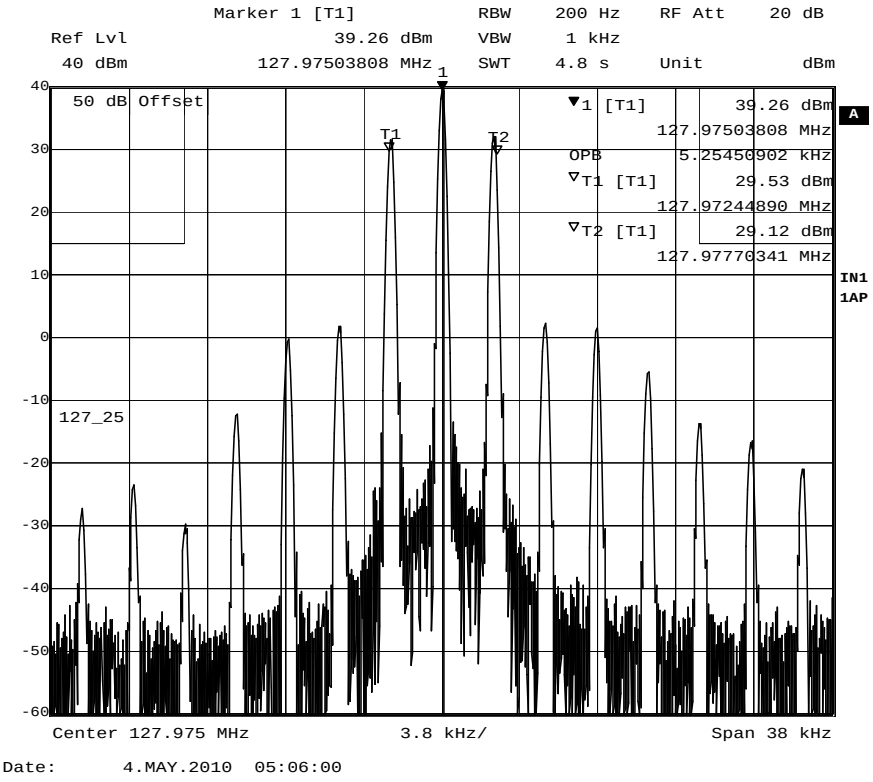


Figure A – 8 127.975 MHz, 25 kHz Channel, 10W

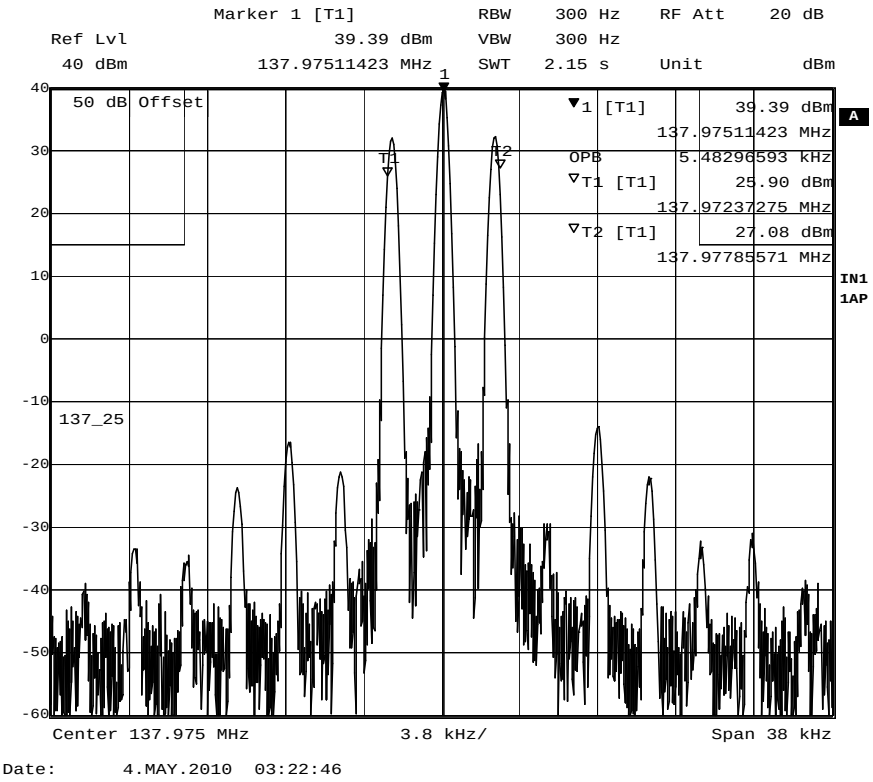


Figure A – 9 137.975 MHz, 25 kHz Channel, 10W

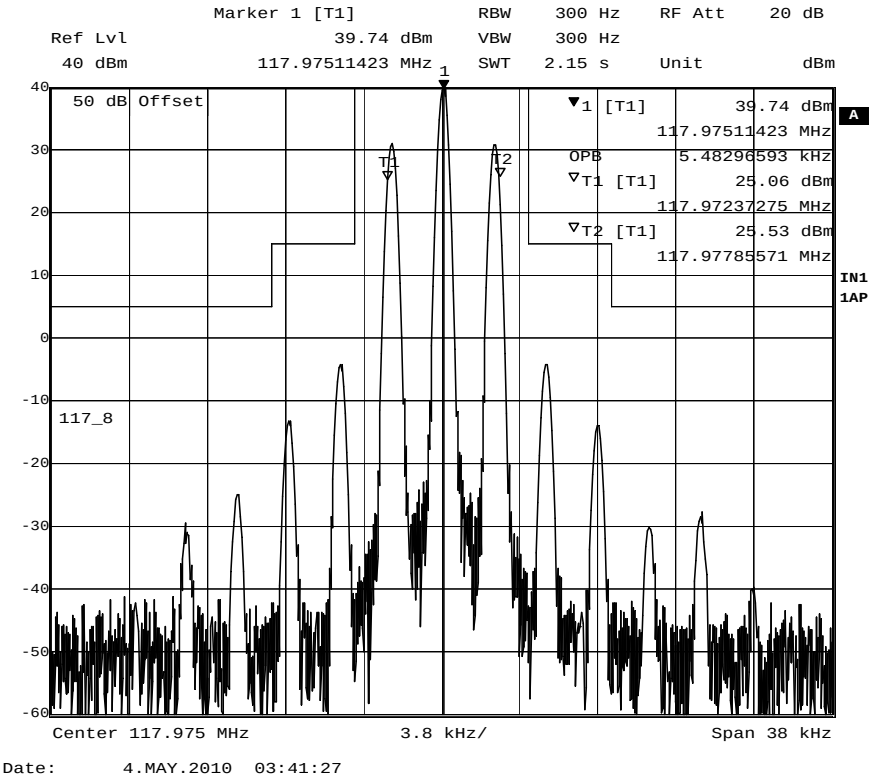


Figure A – 10 117.975 MHz, 8.33 kHz Channel, 10W

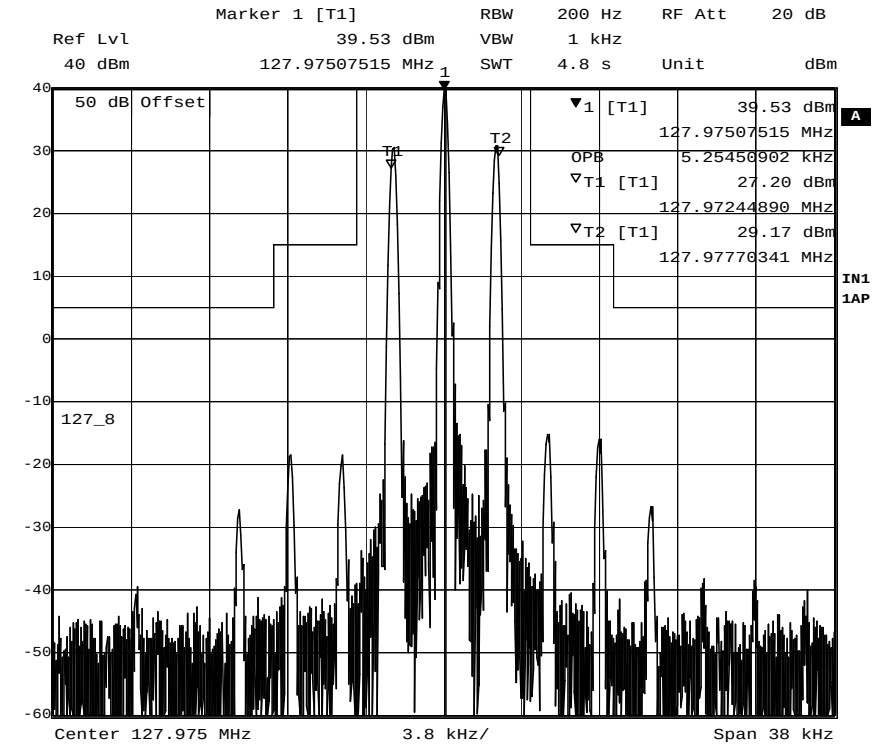


Figure A – 11 127.975 MHz, 8.33 kHz Channel, 10W

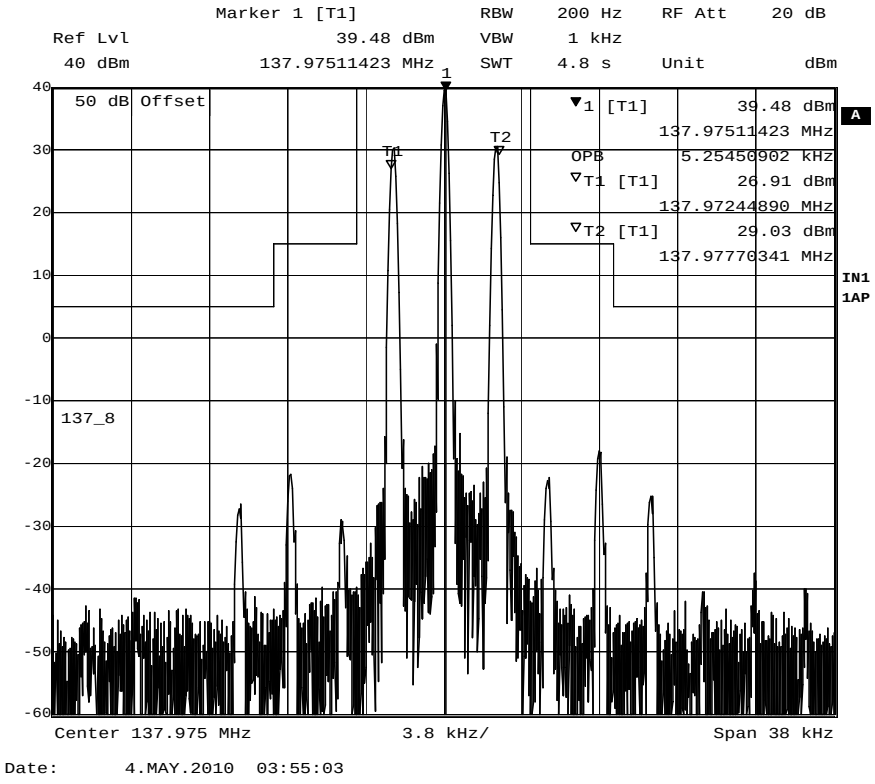


Figure A – 12 137.975 MHz, 8.33 kHz Channel, 10W

Appendix B

Conducted Spurious Emission Measurements

30 MHz to 2 GHz

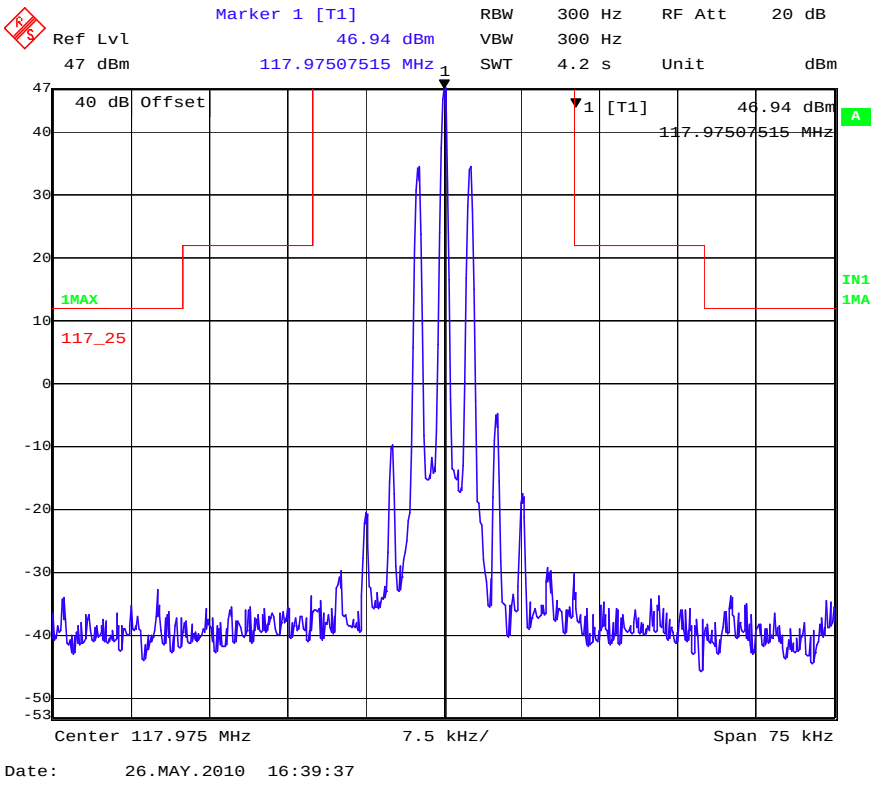


Figure B – 1 Carrier Emission Mask, 117.975 MHz (25kHz), 50W

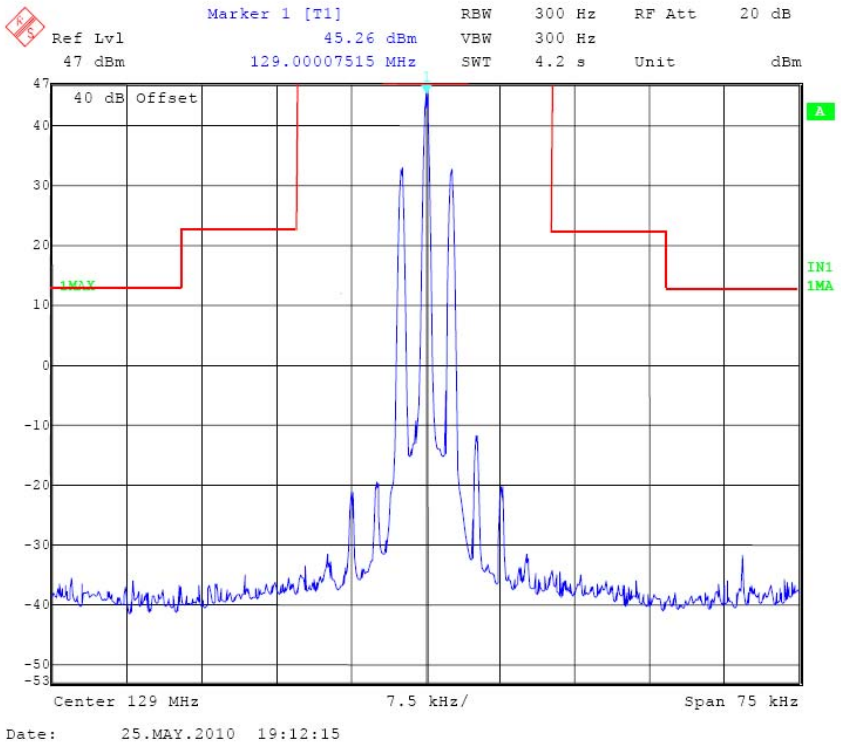


Figure B – 2 Carrier Emission Mask, 129 MHz (25kHz), 50W

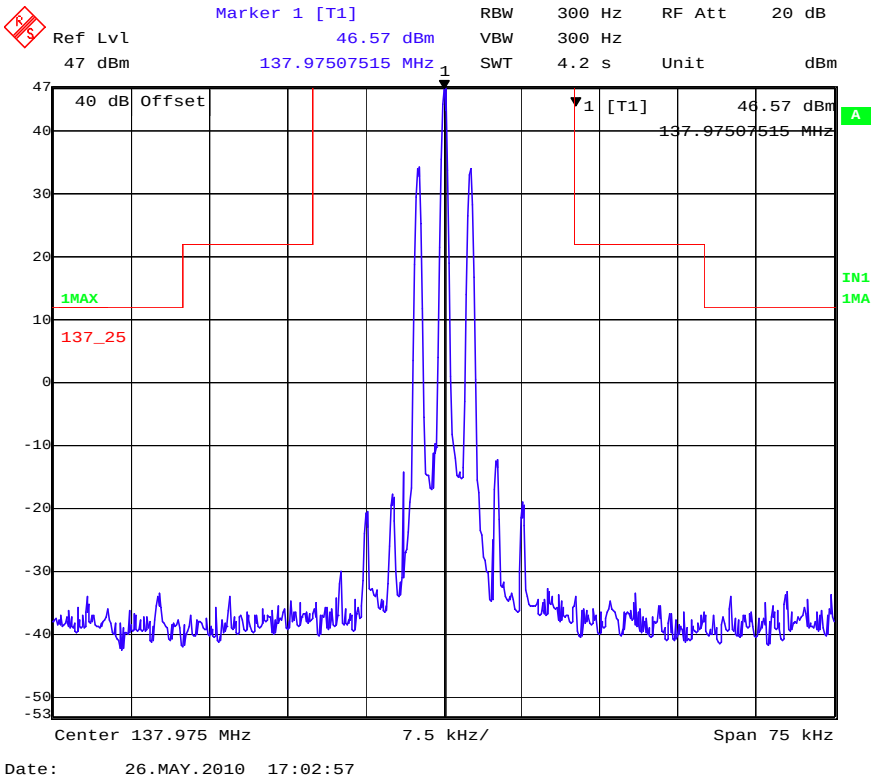


Figure B – 3 Carrier Emission Mask, 137.975 MHz (25kHz), 50W

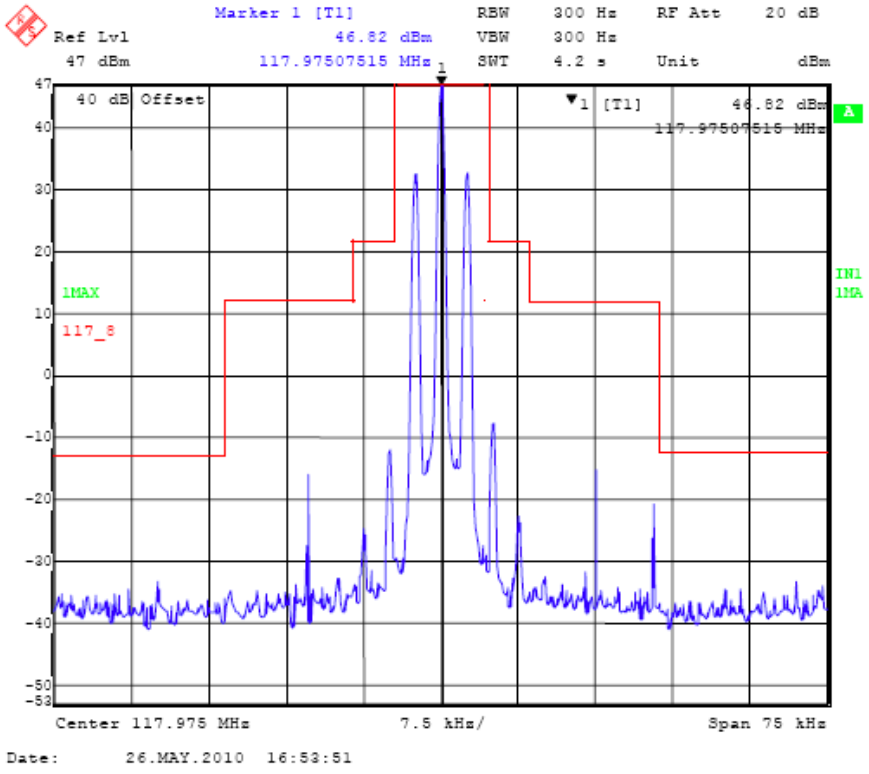


Figure B – 4 Carrier Emission Mask, 117.975 MHz (8.33kHz), 50W

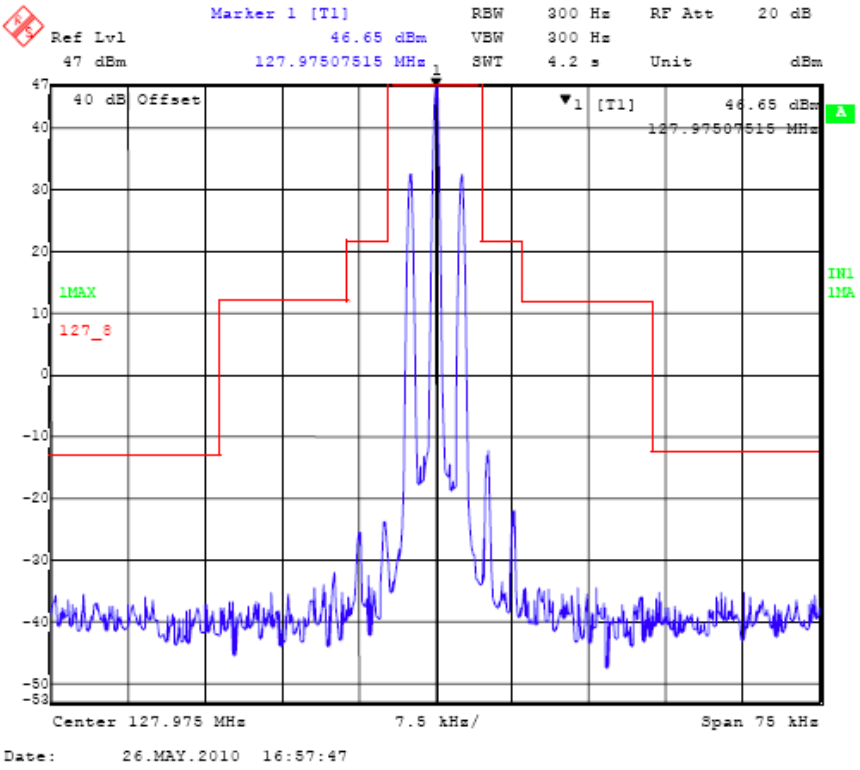


Figure B – 5 Carrier Emission Mask, 127.975 MHz (8.33kHz), 50W

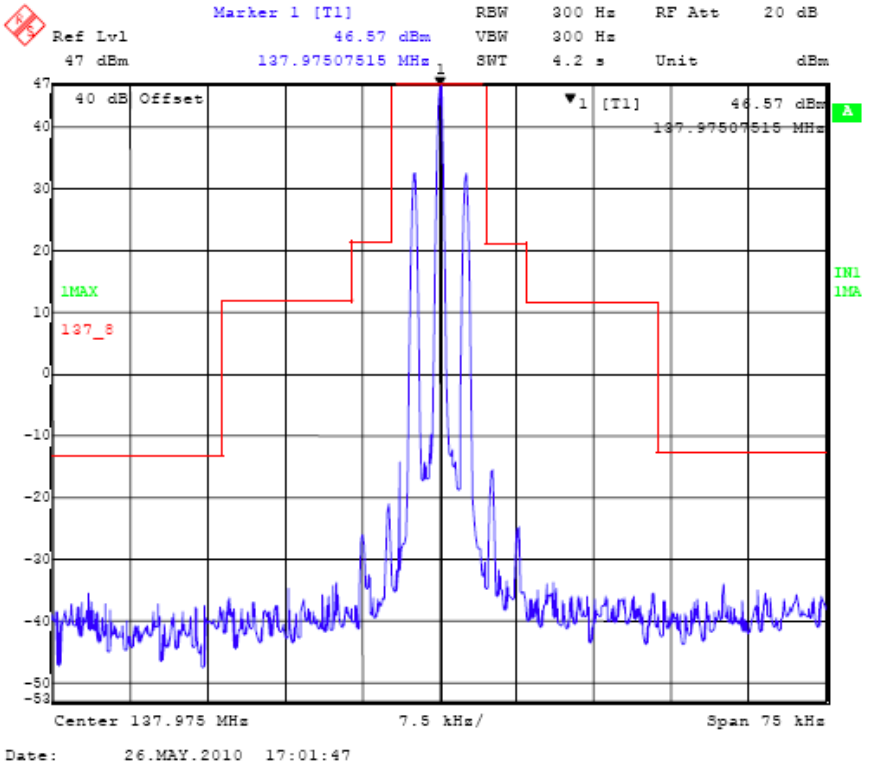


Figure B – 6 Carrier Emission Mask, 137.975 MHz (8.33kHz), 50W

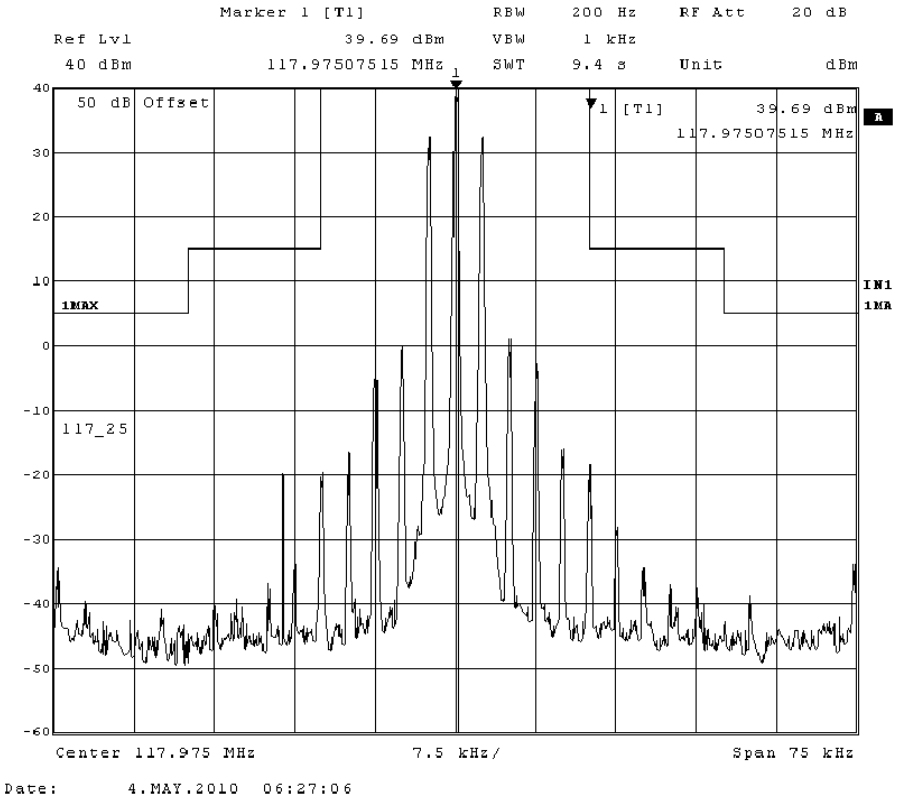


Figure B – 7 Carrier Emission Mask, 117.975 MHz (25kHz), 10W

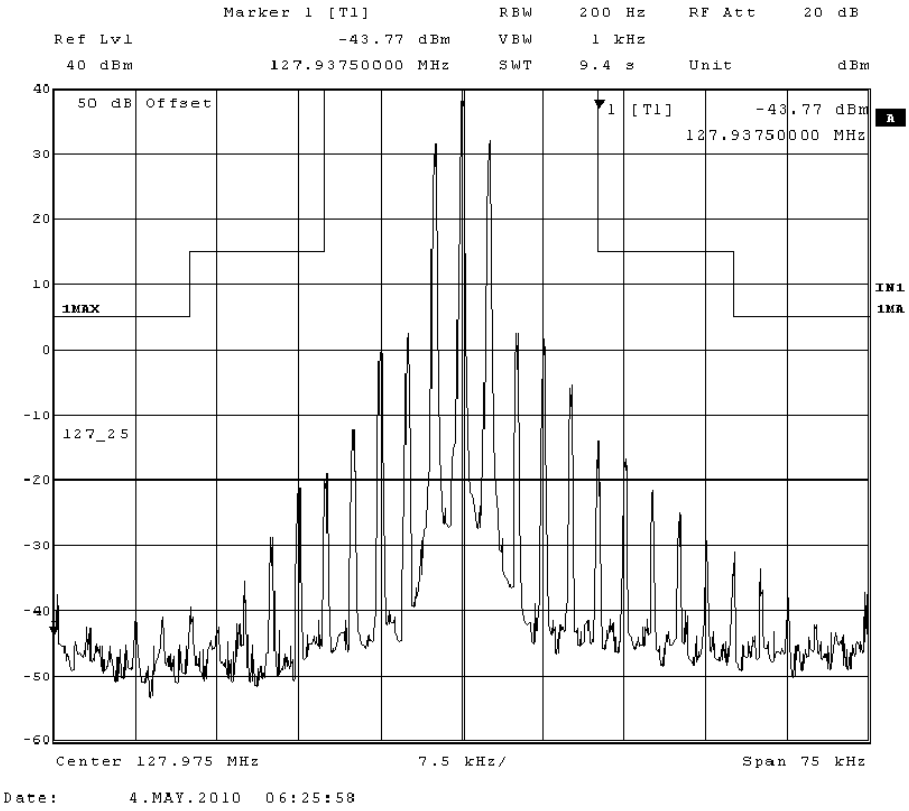


Figure B – 8 Carrier Emission Mask, 127.975 MHz (25kHz), 10W

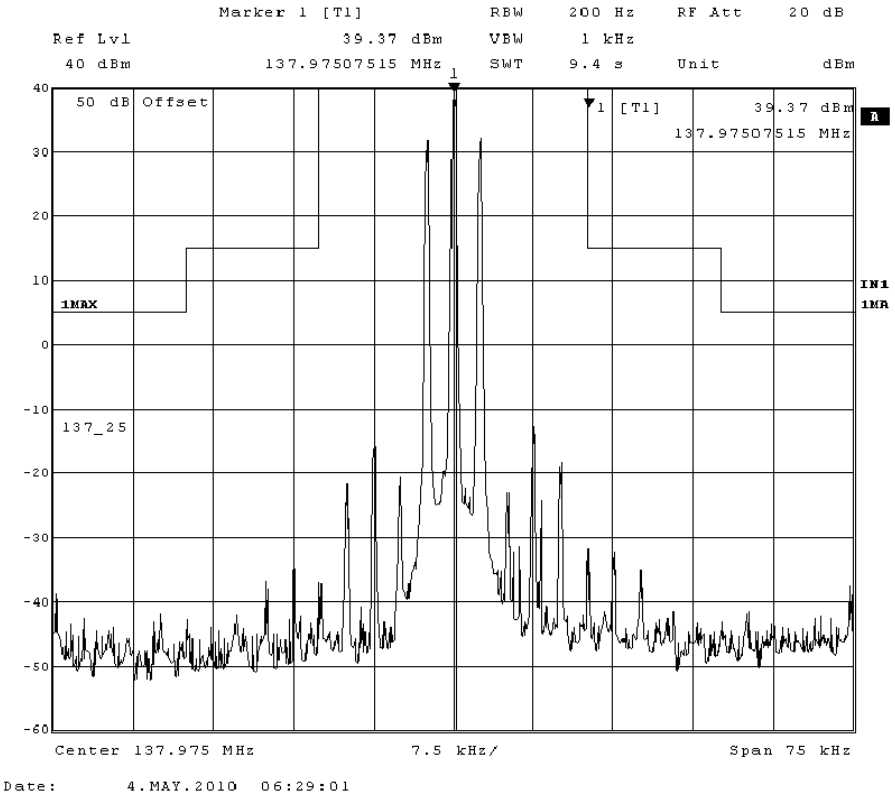


Figure B – 9 Carrier Emission Mask, 137.975 MHz (25kHz), 10W

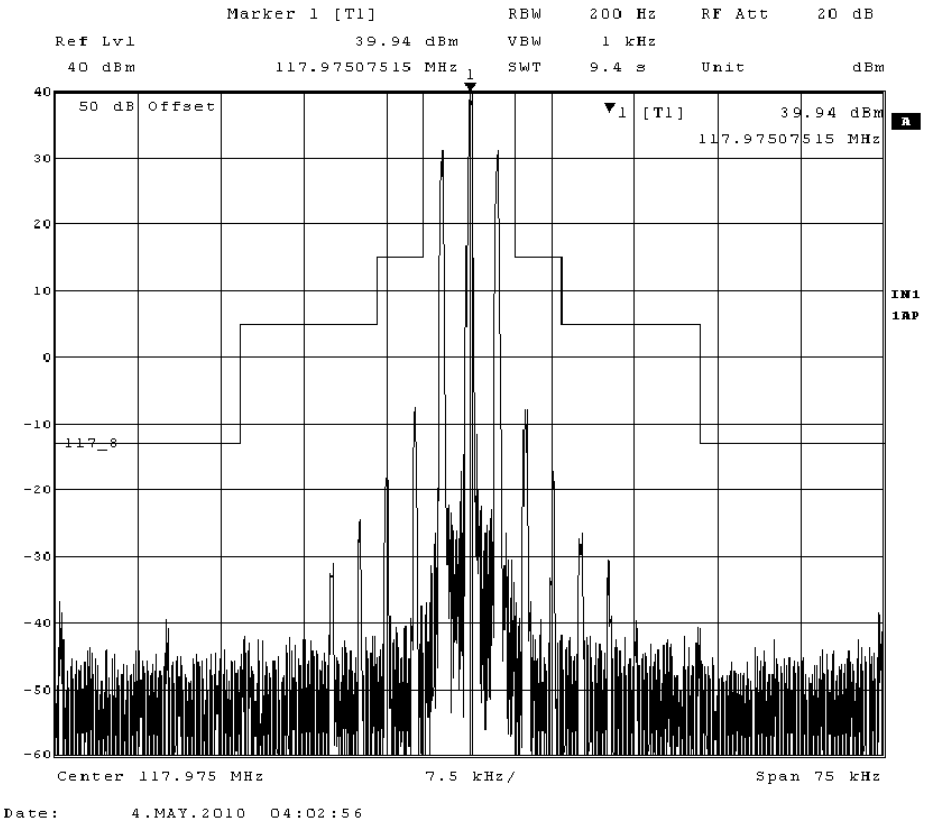


Figure B – 10 Carrier Emission Mask, 117.975 MHz (8.33kHz), 10W

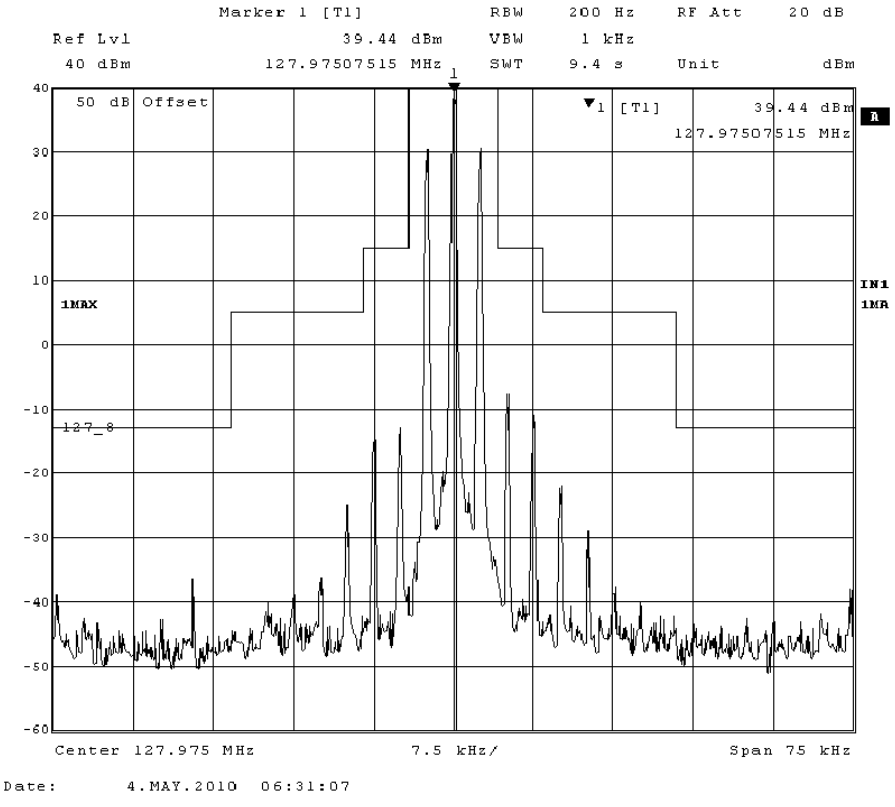


Figure B – 11 Carrier Emission Mask, 127.975 MHz (8.33kHz), 10W

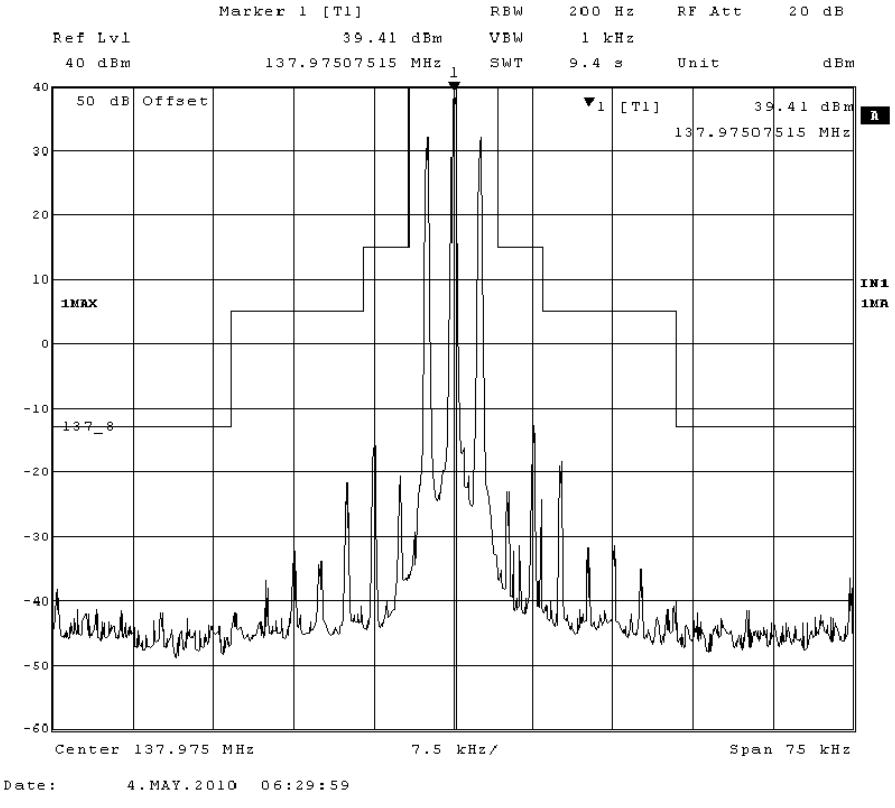


Figure B – 12 Carrier Emission Mask, 137.975 MHz (8.33kHz), 10W

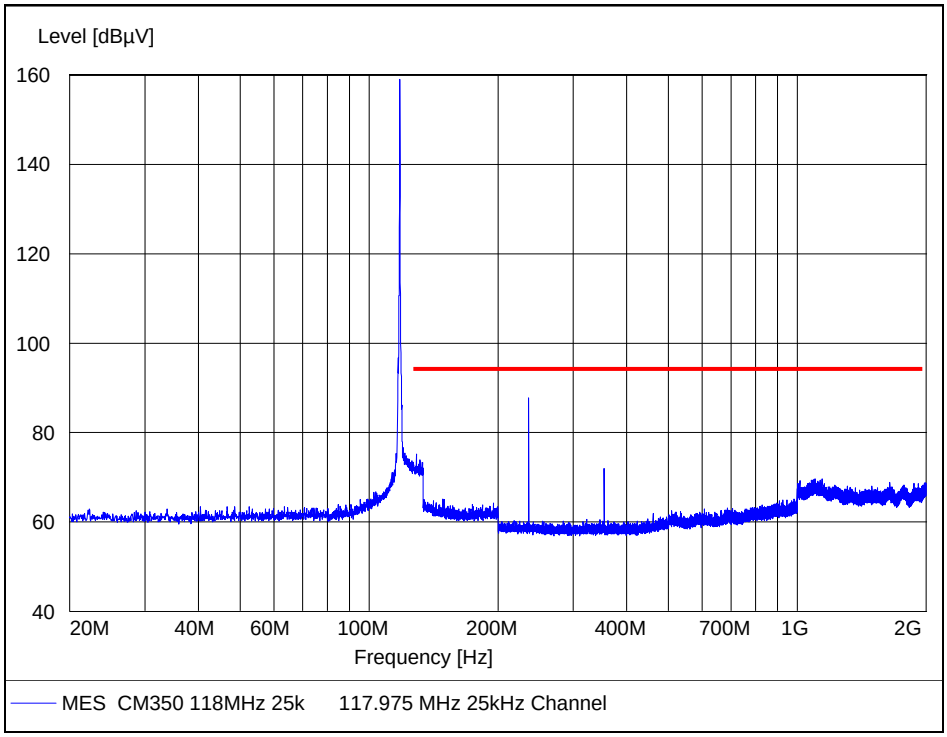


Figure B – 13 Spurious Emissions, 117.975 MHz (25kHz), 50W

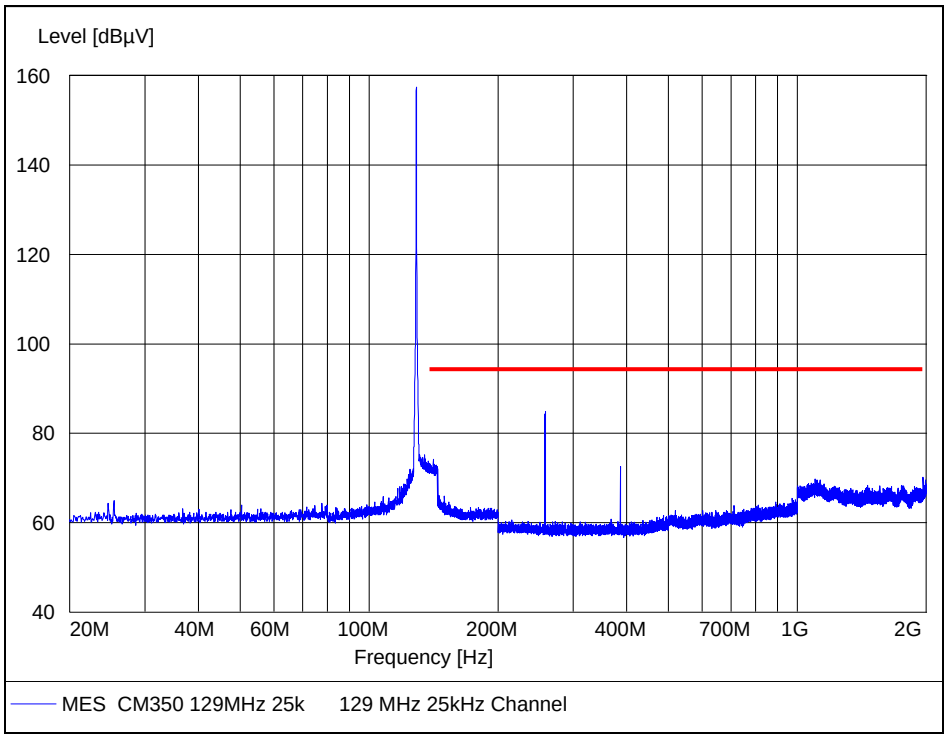


Figure B – 14 Spurious Emissions, 129 MHz (25kHz), 50W

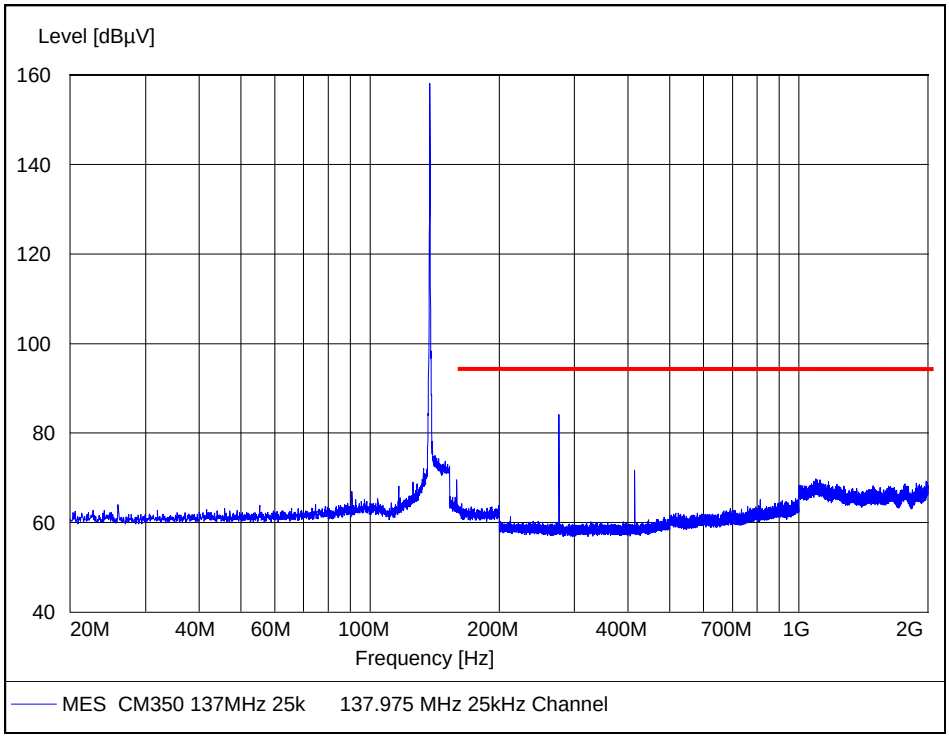


Figure B – 15 Spurious Emissions, 137.975 MHz (25kHz), 50W

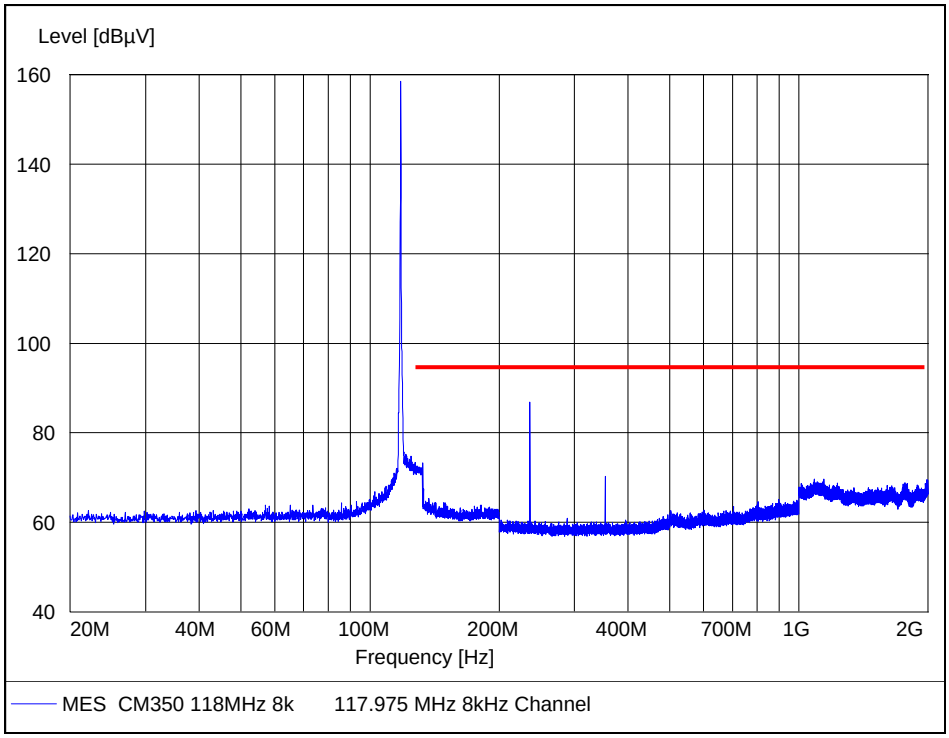


Figure B – 16 Spurious Emissions, 117.975 MHz (8.33kHz), 50W

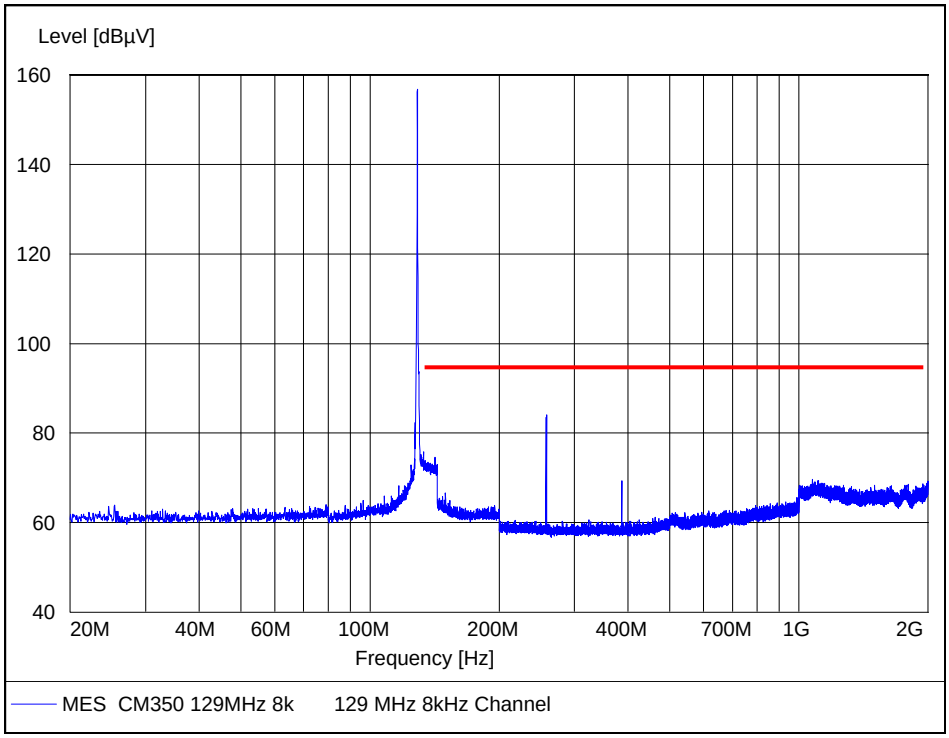


Figure B – 17 Spurious Emissions, 129 MHz (8.33kHz), 50W

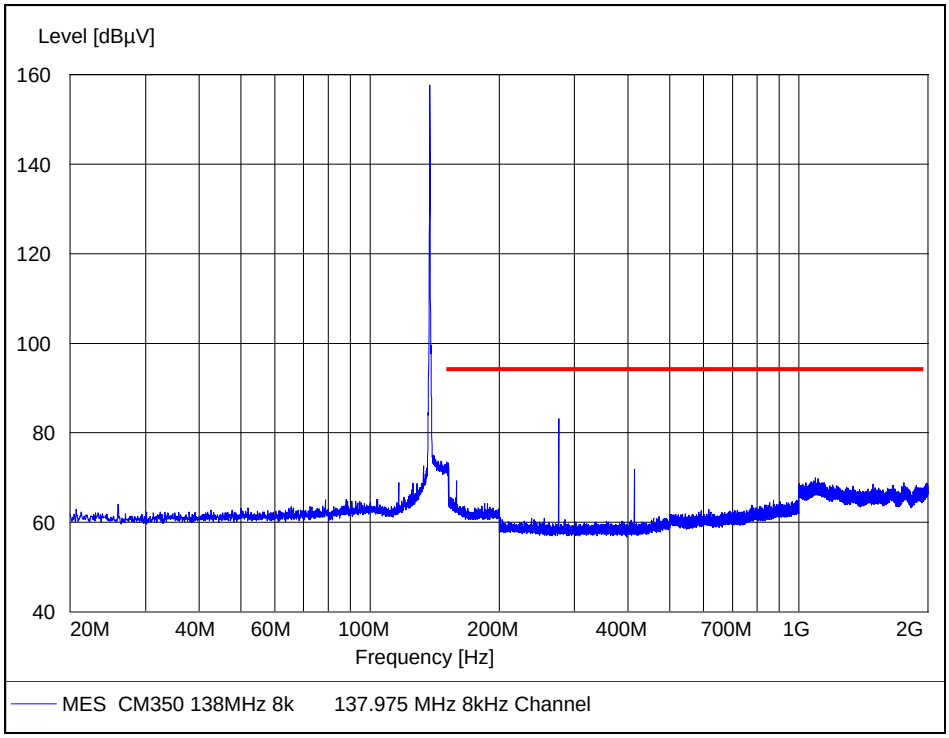


Figure B – 18 Spurious Emissions, 137.975 MHz (8.33kHz), 50W

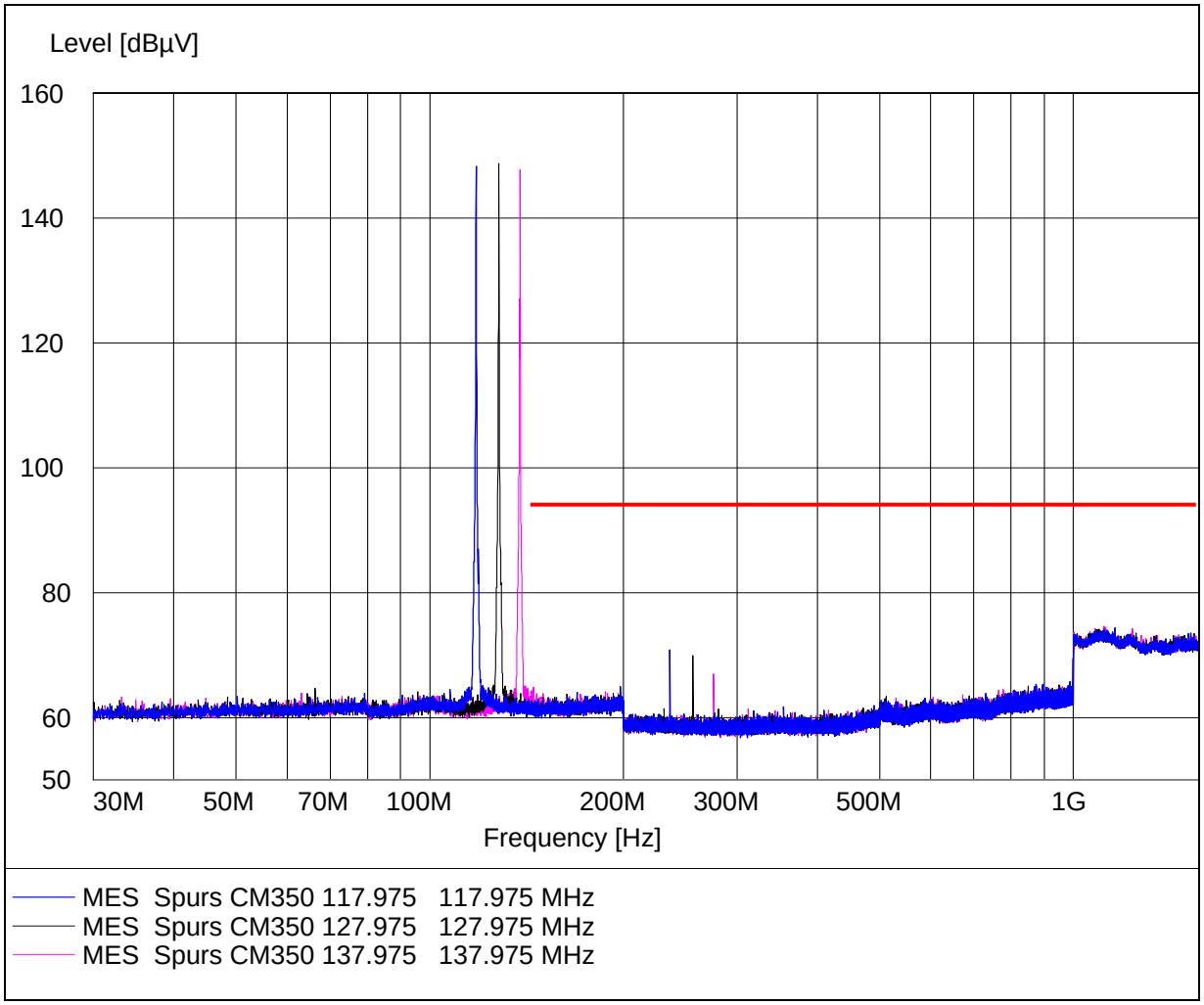


Figure B – 19 Spurious Emissions, Low/Mid/High Frequency, 10W

Appendix C

Radiated Spurious Emission Measurements

30 MHz to 2 GHz

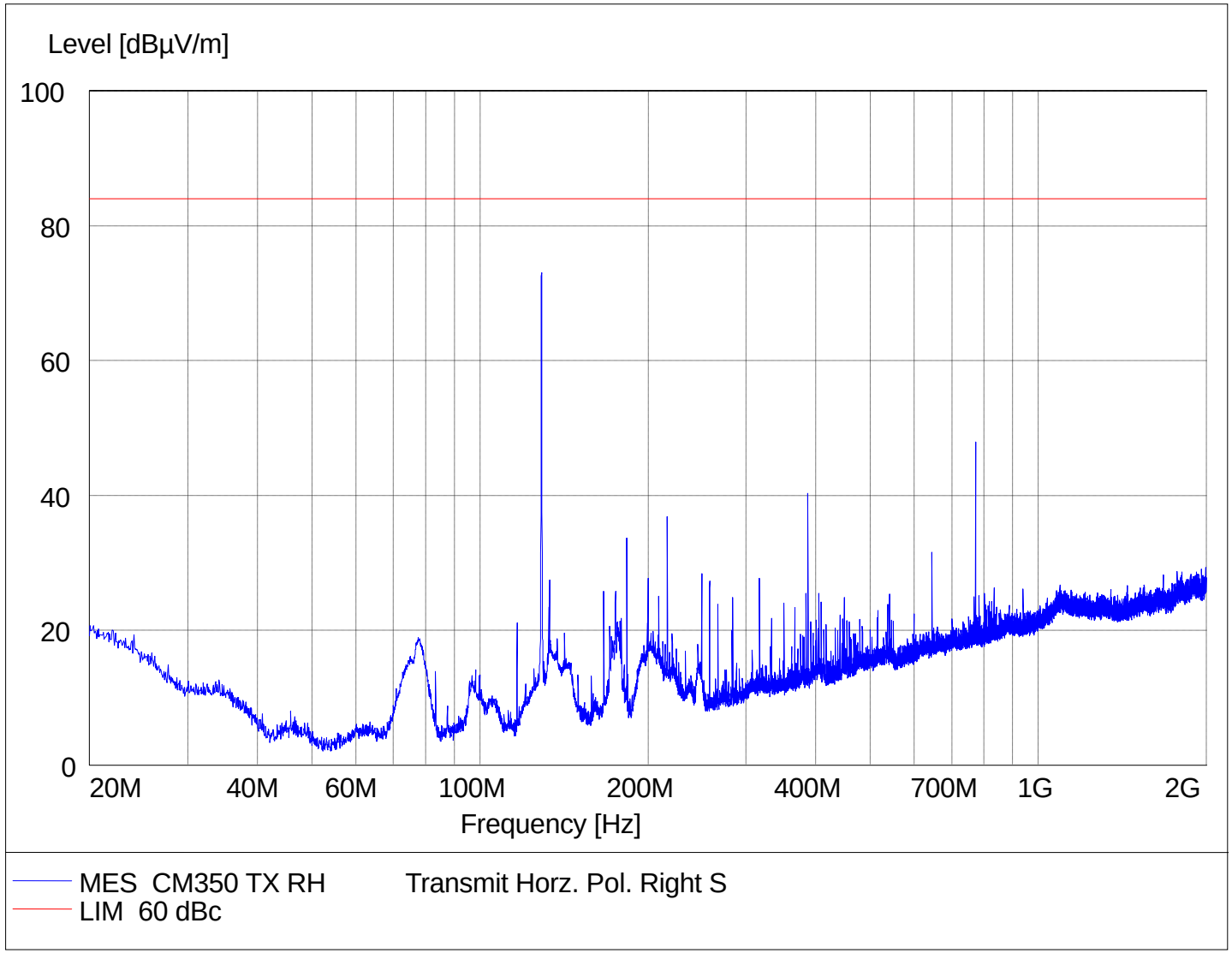


Figure C – 1 Radiated Spurious Emissions, Horizontal Polarization, 30 MHz to 2 GHz (50W)

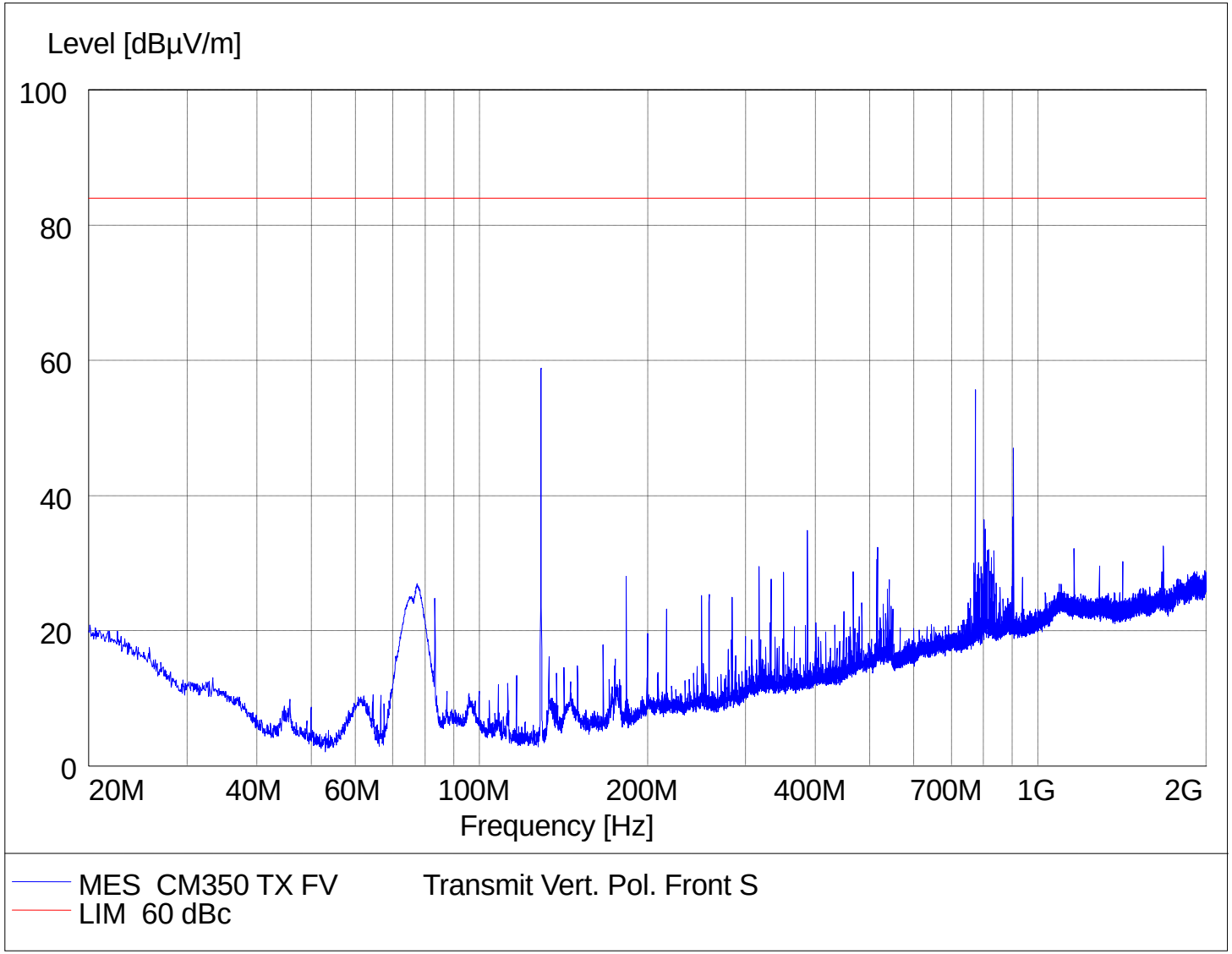


Figure C – 2 Radiated Spurious Emissions, Vertical Polarization, 30 MHz to 2 GHz (50W)

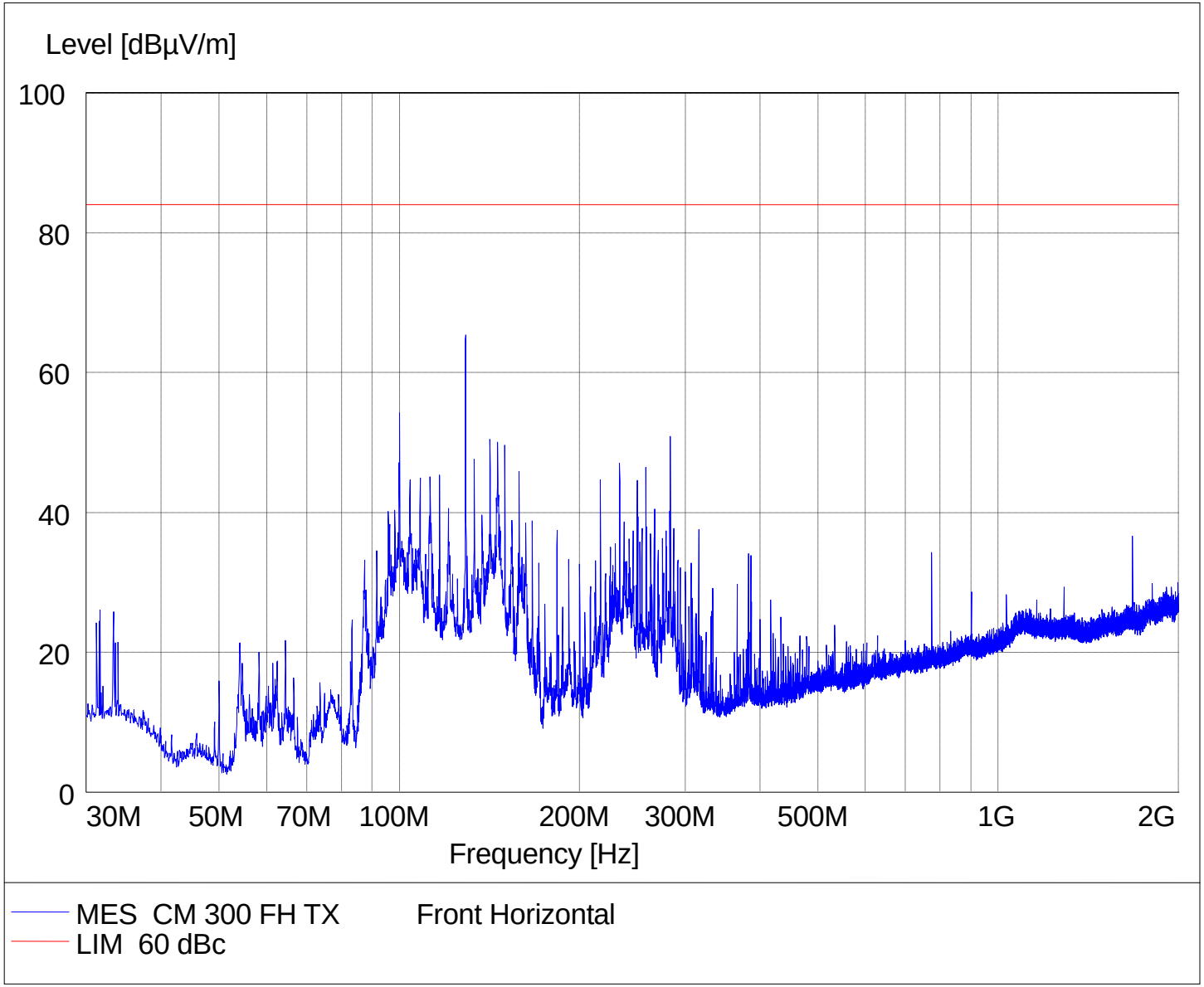


Figure C – 3 Radiated Spurious Emissions, Horizontal Polarization, 30 MHz to 2 GHz (10W)

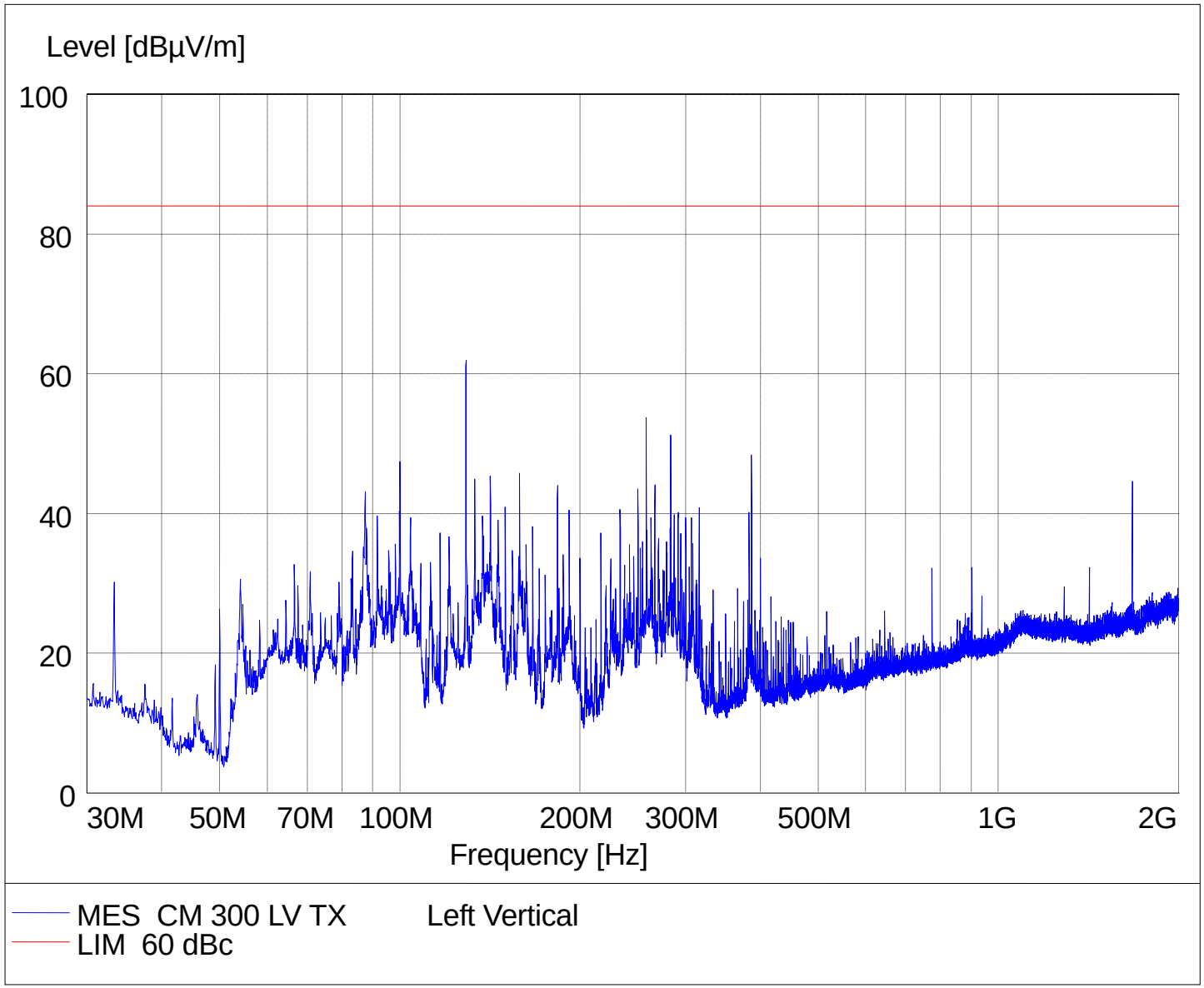


Figure C – 4 Radiated Spurious Emissions, Vertical Polarization, 30 MHz to 2 GHz (10W)

Appendix D

Optional Cavity Filter

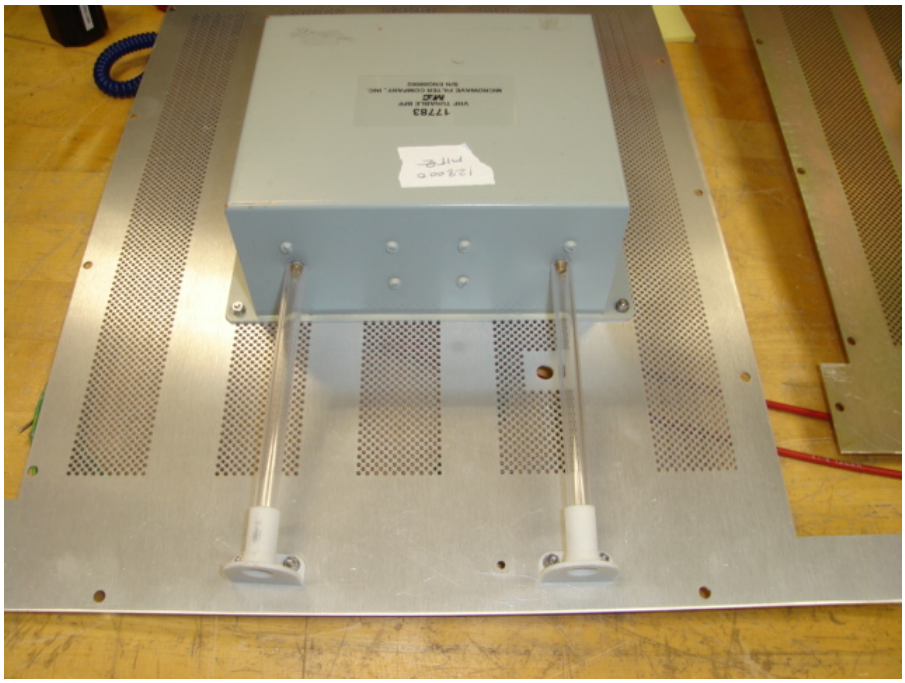


Figure D-1 Optional Cavity Filter as mounted on the top cover of the CM-350 VDT