ENGINEERING TEST REPORT

Commercial FM Stereo Transmitter
Model No.: PX50

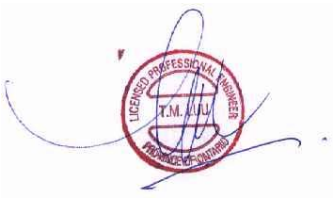
Applicant:

Ramsey Electronics, Inc.
590 Fishers Station Drive
Victor, NY 14564
USA

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, PARTS 2, 73 & 74

UltraTech's File No.: RSE-007F73

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: April 15, 2004	
Report Prepared by: Dan Huynh Issued Date: April 15, 2004	Tested by: Wayne Wu, RFI/EMI Technician Test Dates: March 11 – April 8, 2004

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	▪ Exhibit 1: Submittal check lists ▪ Exhibit 2: Introduction ▪ Exhibit 3: Performance Assessment ▪ Exhibit 4: EUT Operation and Configuration during Tests ▪ Exhibit 5: Summary of test Results ▪ Exhibit 6: Measurement Data ▪ Exhibit 7: Measurement Uncertainty ▪ Exhibit 8: Measurement Methods	OK
1	Test Setup Photos	Radiated Emissions Test Setup Photos	OK
2	External Photos of EUT	External EUT Photos	OK
3	Internal Photos of EUT	Internal EUT Photos	OK
4	Cover Letters	Cover Letter	OK
5	Attestation Statements	▪ Letter from the Applicant to appoint Ultratech to act as an agent ▪ Letter from the Applicant to request for Confidentiality Filing	OK
6	ID Label/Location Info	▪ ID Label ▪ Location of ID Label	OK
7	Block Diagrams	Block Diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	▪ Parts List ▪ Tune Up Procedure	OK
10	Operational Description	Circuit Description	OK
11	RF Exposure Info	N/A	N/A
12	Users Manual	Operating Instructions	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2, 73 & 74
Title:	Code of Federal Regulations (CFR), Title 47 - Telecommunication, Parts 2, 73 & 74
Purpose of Test:	The purpose of this test report is to verify the compliance with FCC rules for Radio operating in the frequency band 87.5 - 108.1 MHz (100 kHz Steps).
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

2.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 73 & 74	2003	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 22 & EN 55022	2002 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1	1999	Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Ramsey Electronics, Inc.
Address:	590 Fishers Station Drive Victor, NY 14564 USA
Contact Person:	Mr. Mike Leo Phone #: (585) 924-4560 Fax #: (585) 924-4886 Email Address: Mike@ramseymail.com

MANUFACTURER	
Name:	Ramsey Electronics, Inc.
Address:	590 Fishers Station Drive Victor, NY 14564 USA
Contact Person:	Mr. Mike Leo Phone #: (585) 924-4560 Fax #: (585) 924-4886 Email Address: Mike@ramseymail.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Ramsey Electronics, Inc.
Product Name:	Commercial FM Stereo Transmitter
Model Name or Number:	PX50
Serial Number:	Test Sample
Type of Equipment:	Licensed Broadcast Station Transmitter
External Power Supply:	N/A
Transmitting/Receiving Antenna Type:	Non-integral

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	[ ] Portable [ ] Mobile [x] Base station (fixed use)
Intended Operating Environment:	[ ] Residential [x] Commercial, industrial or business environment
Power Supply Requirement:	100 to 240VAC, 50/60 Hz at 2.5 Amps; or 12VDC at 10 Amps
RF Output Power Rating:	1 - 50 Watts
Operating Frequency Range:	87.5 – 108.1 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	100 kHz
Oscillator Frequency(ies):	9.728MHz, 8.0MHz, 4.0MHz, 88-108MHz
Occupied Bandwidth (99%):	166.3 kHz (maximum)
***Emission Designation:**	▪ 180KF3E ▪ 180KF8E
Antenna Connector Type:	N
Antenna Description:	None

*The Necessary Bandwidth is calculated as follows:

$B_n = 2M + 2DK$

D = 75000 Hz, K = 1, M = 15000 Hz
$B_n = 2(15000) + 2(75000)(1) = 180000$ Hz
Bandwidth: 180 kHz

3.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF output	1	N	Shielded
2	Audio in left	1	3 pin XLR	Shielded
3	Audio in right	1	3 pin XLR	Shielded
4	AC input	1	3 Prong AC	Non-shielded
5	MPX input	1	BNC	Shielded
6	Pilot Sync output	1	BNC	Shielded
7	Battery Back-up 12vDC	1	2-pin	Non-shielded

EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	AC 120V 60Hz

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ohms RF Load.

Transmitter Test Signals	
Frequency Band(s):	87.5 - 108.1 MHz
Test Frequency(ies): (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	88, 98 & 108 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	46.9 dBm, 49.0 Watts
▪ Normal Test Modulation:	F3E / F8E
▪ Modulating Signal Source:	External

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: February 17, 2004

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
73.1560, 2.1046	RF Power Output	Yes
73.1545(b) & 2.1055	Frequency Stability	Yes
73.1570, 2.1047(b)	Modulation Level	Yes
73.317 & 2.1049	Emission Limitation & Emission Mask	Yes
73.317, 2.1057 & 2.1051	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
73.317, 2.1057 & 2.1053	Emission Limits - Field Strength of Spurious Emissions	Yes

The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class A Digital Devices. The engineering test report can be provided upon requests.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

5.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 7 of this report.

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 6 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:2003 CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

6.5. RF POWER OUTPUT [§§ 2.1046 & 73.1560]

6.5.1. Limits

§73.1560 (b) *FM stations.* Except as provided in paragraph (d) of this section, the transmitter output power of an FM station, with power output as determined by the procedures specified in § 73.267, which is authorized for output power more than 10 watts must be maintained as near as practicable to the authorized transmitter output power and may not be less than 90% nor more than 105% of the authorized power. FM stations operating with authorized transmitter output power of 10 watts or less, may operate at less than the authorized power, but not more than 105% of the authorized power.

6.5.2. Method of Measurements

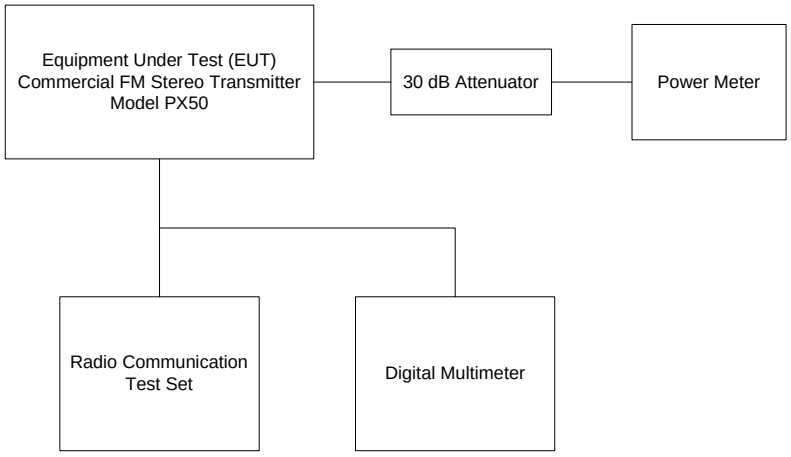
Refer to Section 8.1 of this report for measurement details.

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz – 50 GHz, sensor dependent
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz
Attenuator	Weinschel Corp	48-30-34	BM-5354	DC – 18 GHz
Radio Communication Test Set	Marconi Instruments	2955	132037/226	AF SG 20 Hz - 20 kHz
Digital Multimeter	Rohde & Schwarz	UDS-5	8729841067	DC-200 kHz

6.5.4. Test Arrangement

Power at RF Power Output Terminals



6.5.5. Test Data

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured (Average) Power (dBm)	Power Rating (dBm)
High Power (50 Watts)			
Lowest	88	46.9	47.0
Middle	98	46.8	47.0
Highest	108	46.6	47.0
Low Power (1 Watt)			
Lowest	88	28.6	30.0
Middle	98	28.2	30.0
Highest	108	27.9	30.0

6.6. FREQUENCY STABILITY [§§ 2.1055 & 73.1545(b)]

6.6.1. Limits

§73.1545(b) FM stations:

(1) The departure of the carrier or center frequency of an FM station with an authorized transmitter output power more than 10 watts may not exceed ±2000 Hz from the assigned frequency.
(2) The departure of the carrier or center frequency of an FM station with an authorized transmitter output power of 10 watts or less may not exceed ±3000 Hz from the assigned frequency.

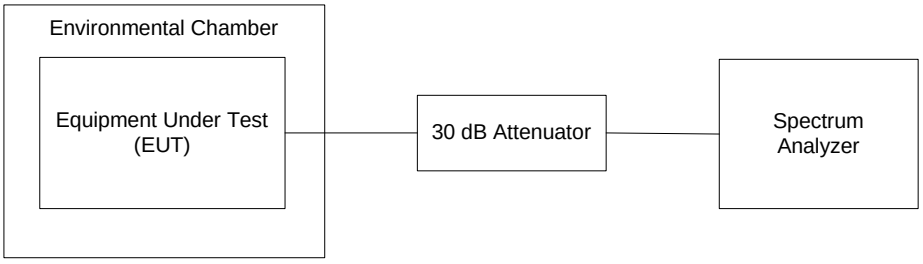
6.6.2. Method of Measurements

Refer to Section 8.3 of this report for measurement details.

6.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	8593EM	3710A00237	9KHz - 22GHz
Attenuator	Weinschel Corp	48-30-34	BM-5354	DC – 18 GHz
Temperature & Humidity Chamber	Tenney	T5	9723B	-40^{o} to +60^{o} C range

6.6.4. Test Arrangement



6.6.5. Test Data

Product Name: **Model No.:**	Commercial FM Stereo Transmitter PX50
Center Frequency:	88 MHz
Full Power Level:	50 Watts
Frequency Tolerance Limit:	± 2000 Hz
Max. Frequency Tolerance Measured:	-1386 Hz
Input Voltage Rating:	120VAC 60Hz

Ambient Temperature (°C)	**Carrier Frequency Departure Tolerances & RF Power Output Variation**		
	Supply Voltage (Nominal) 120 VAC	**Supply Voltage (85% of Nominal) 102 VAC**	**Supply Voltage (115% of Nominal) 138 VAC**
	Hz	**Hz**	**Hz**
0	+758	n/a	n/a
+10	+400	n/a	n/a
+20	-135	-243	-271
+30	-664	n/a	n/a
+40	-1086	n/a	n/a
+50	-1386	n/a	n/a

6.7. MODULATION LEVEL [§§ 2.1047(b) & 73.1570]

6.7.1. Limits

FM stations: The total modulation must not exceed 100 percent on peaks of frequent reoccurrence referenced to 75 kHz deviation. However, stations providing subsidiary communications services using subcarriers under provisions of section 73.319 concurrently with the broadcasting of stereophonic or monophonic programs may increase the peak modulation deviation as follows:

(i) The total peak modulation may be increased 0.5 percent for each 1.0 percent subcarrier injection modulation.
(ii) In no event may the modulation of the carrier exceed 110 percent (82.5 kHz peak deviation).

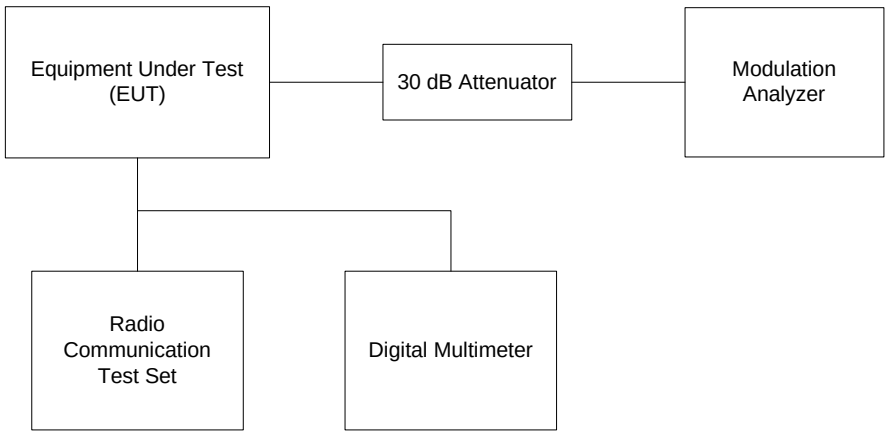
6.7.2. Method of Measurements

The EUT was pre-set by manufacturer for maximum frequency deviation. The peak frequency deviation is measured using the frequency deviation meter.

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Modulation Analyzer	Hewlett Packard	8901B	3226A04606	150 kHz – 1300 MHz
Attenuator	Weinschel Corp	48-30-34	BM-5354	DC – 18 GHz
Radio Communication Test Set	Marconi Instruments	2955	132037/226	AF SG 20 Hz - 20 kHz
Digital Multimeter	Rohde & Schwarz	UDS-5	8729841067	DC-200 kHz

6.7.4. Test Arrangement



6.7.5. Test Data

Test Frequency (MHz)	Peak Deviation (kHz)	* Maximum Limit (kHz)
88	74.8	75.0
98	74.8	75.0
108	74.8	75.0

* In no event may the modulation of the carrier exceed 110 percent (82.5 kHz peak deviation).

6.8. EMISSION MASK [§§ 2.1049, 73.317]

6.8.1. Limits

Section 73.317 FM transmission system requirements:

(a) FM broadcast stations employing transmitters authorized after January 1, 1960, must maintain the bandwidth occupied by their emissions in accordance with the specification detailed below. FM broadcast stations employing transmitters installed or type accepted before January 1, 1960, must achieve the highest degree of compliance with these specifications practicable with their existing equipment. In either case, should harmful interference to other authorized stations occur, the licensee shall correct the problem promptly or cease operation.

(b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated at least 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.

(c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB below the level of the unmodulated carrier.

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least $43 + 10 \text{ Log}_{10}$ (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

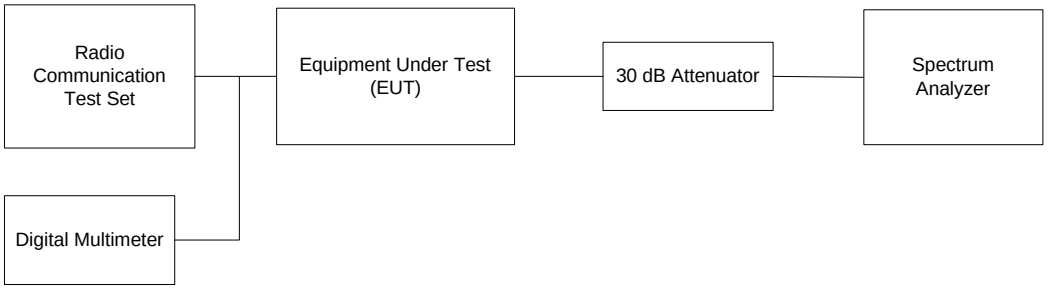
6.8.2. Method of Measurements

Refer to Section 8.4 of this report for measurement details

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100Hz--26.5GHz
Attenuator	Weinschel Corp	48-30-34	BM-5354	DC – 18 GHz
Radio Communication Test Set	Marconi Instruments	2955	132037/226	AF SG 20 Hz - 20 kHz
Digital Multimeter	Rohde & Schwarz	UDS-5	8729841067	DC-200 kHz

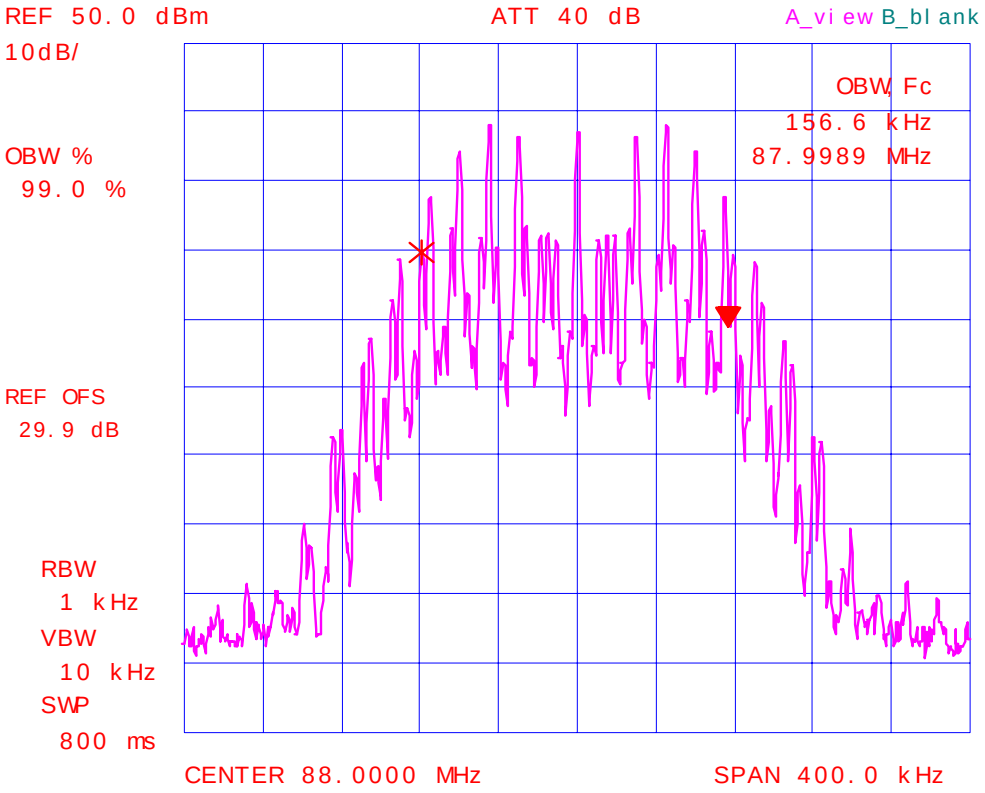
6.8.4. Test Arrangement



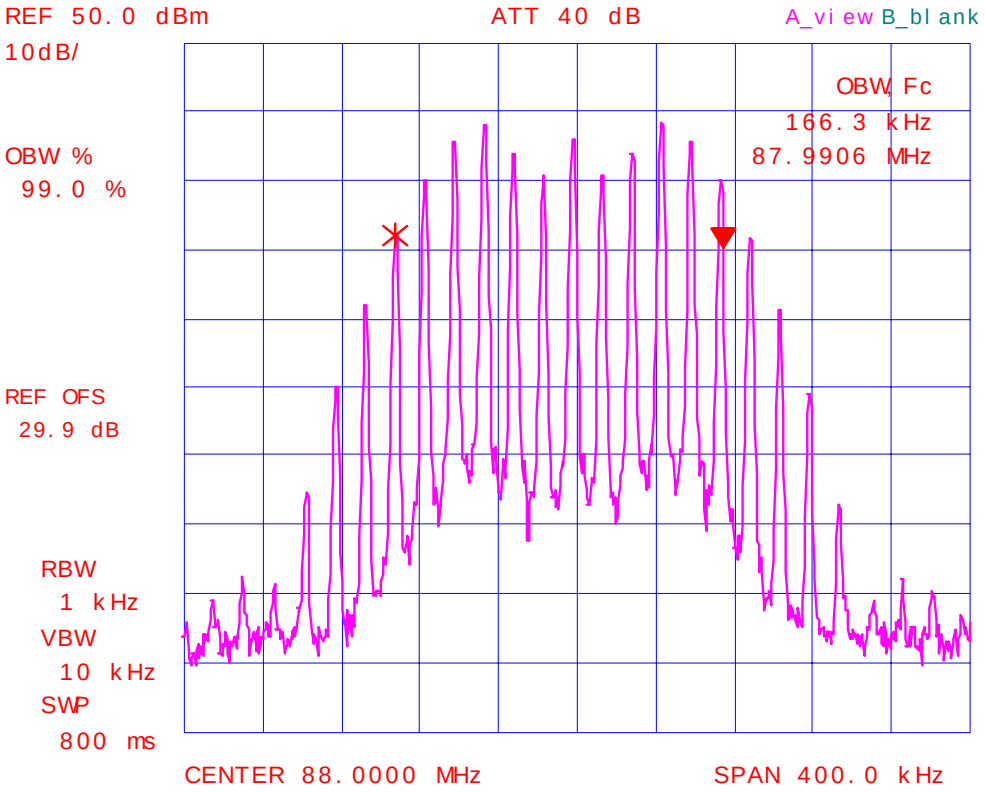
6.8.5. Test Data

Conform. See the following test data plots measurements for 99% Occupied Bandwidth and Emission Mask:

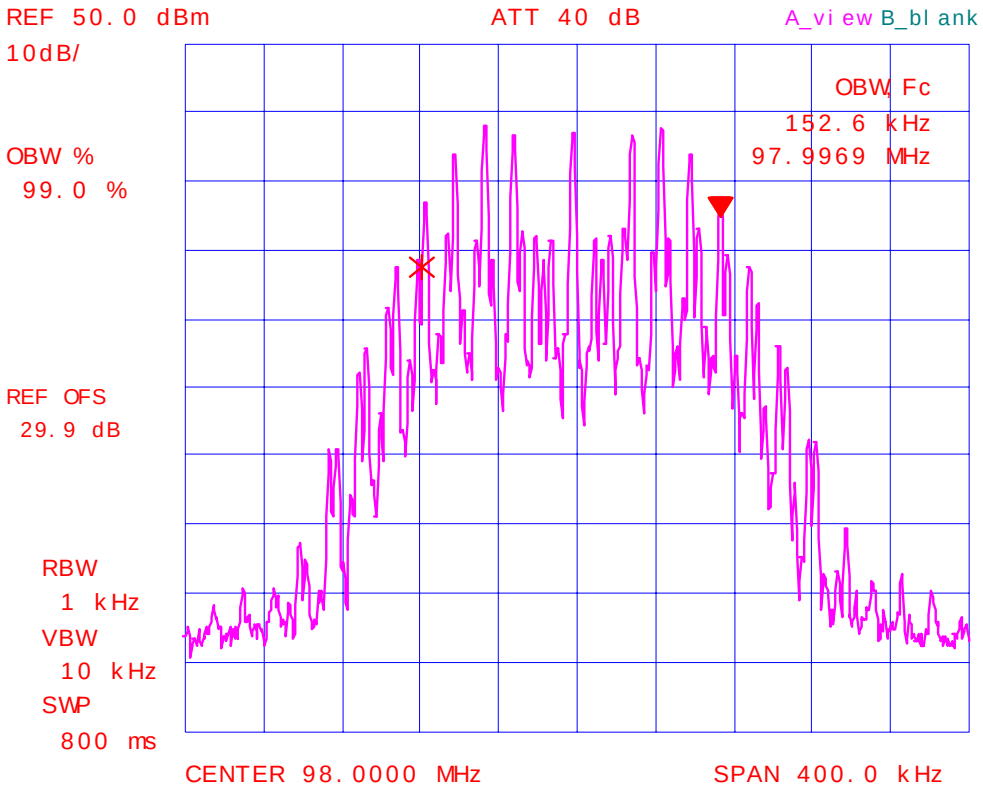
Plot 1:
99 % Occupied Bandwidth (Stereo Mode)
Carrier Frequency: 88 MHz



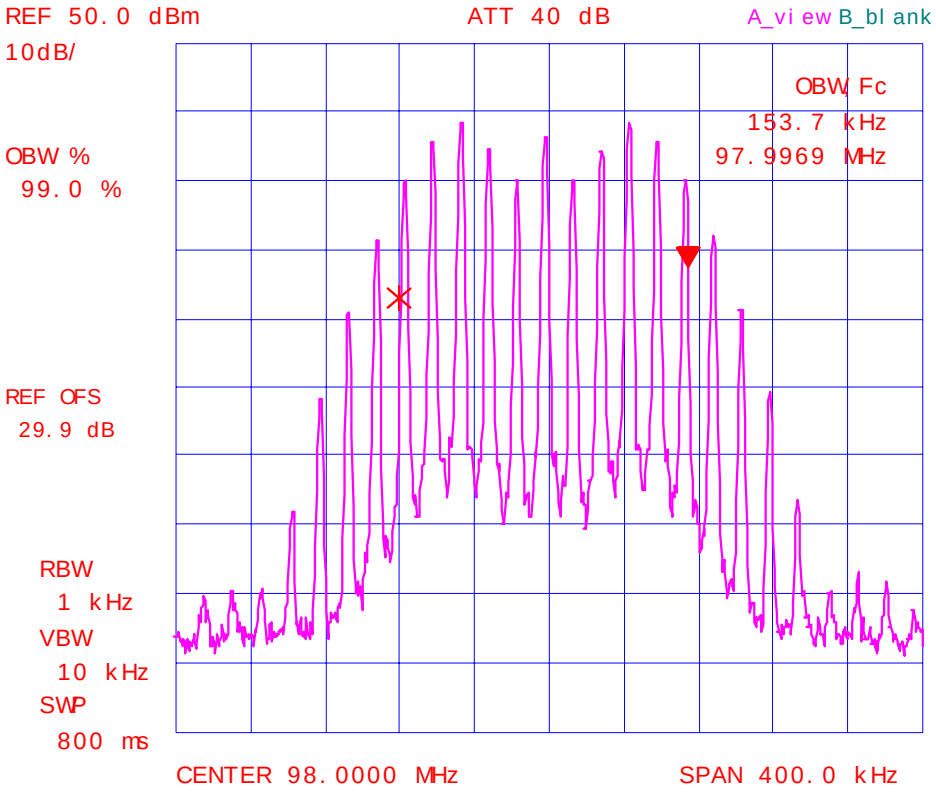
Plot 2:
99 % Occupied Bandwidth (Monaural Mode)
Carrier Frequency: 88 MHz



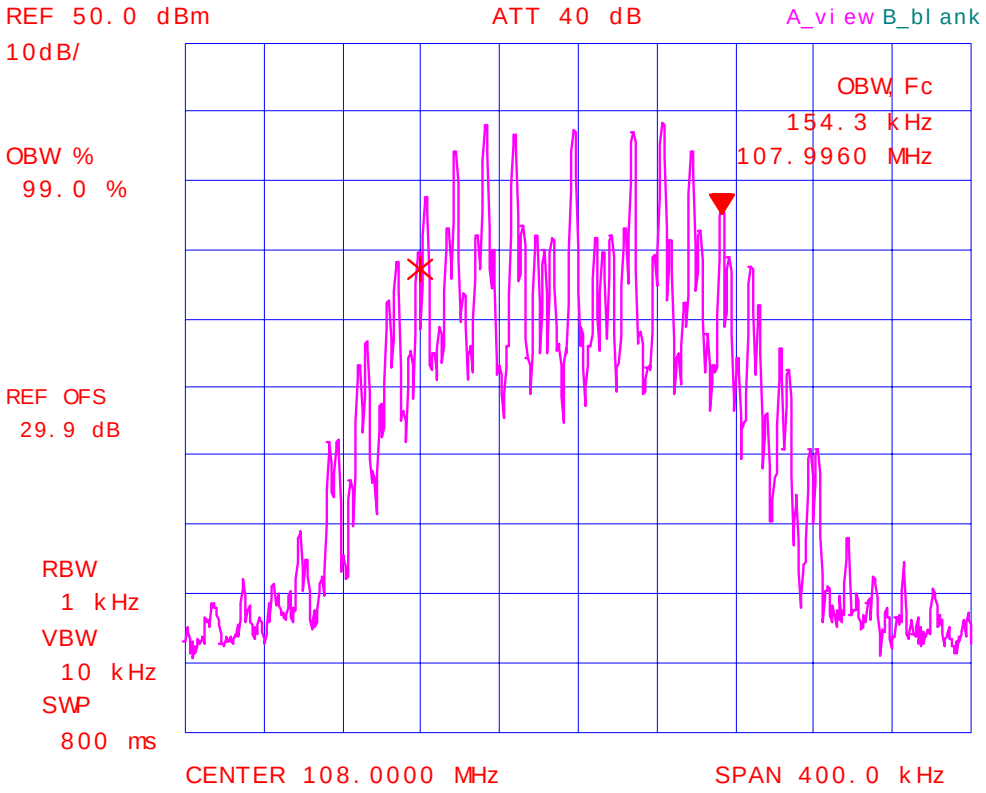
Plot 3:
99 % Occupied Bandwidth (Stereo Mode)
Carrier Frequency: 98 MHz



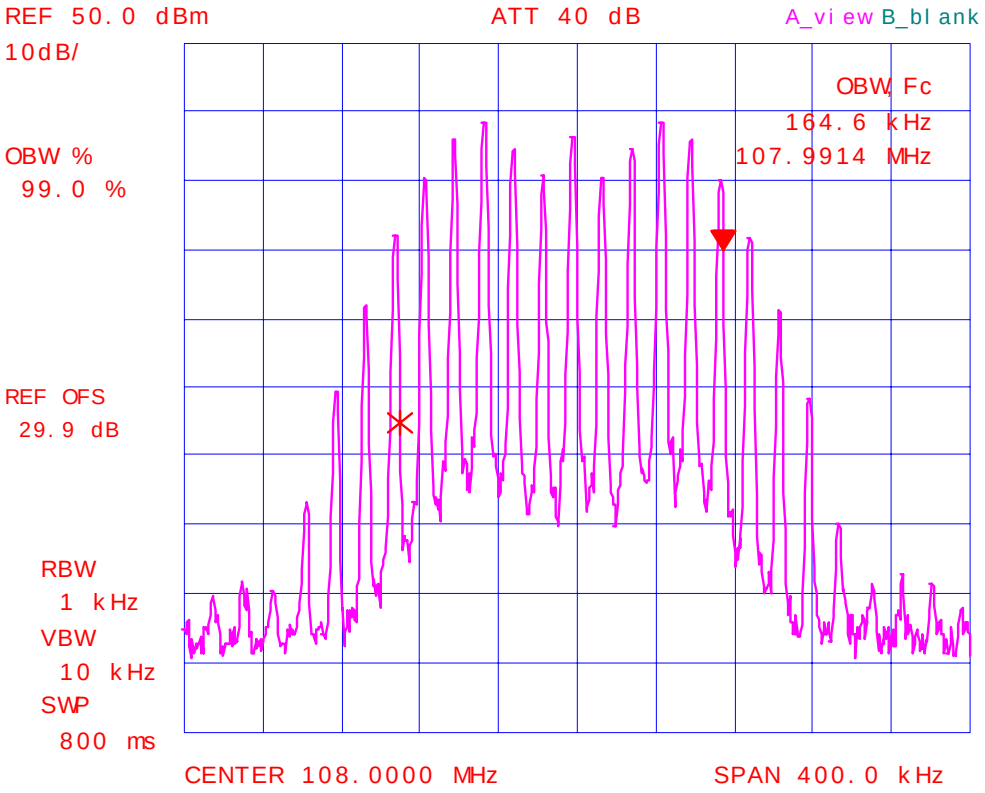
Plot 4:
99 % Occupied Bandwidth (Monaural Mode)
Carrier Frequency: 98 MHz



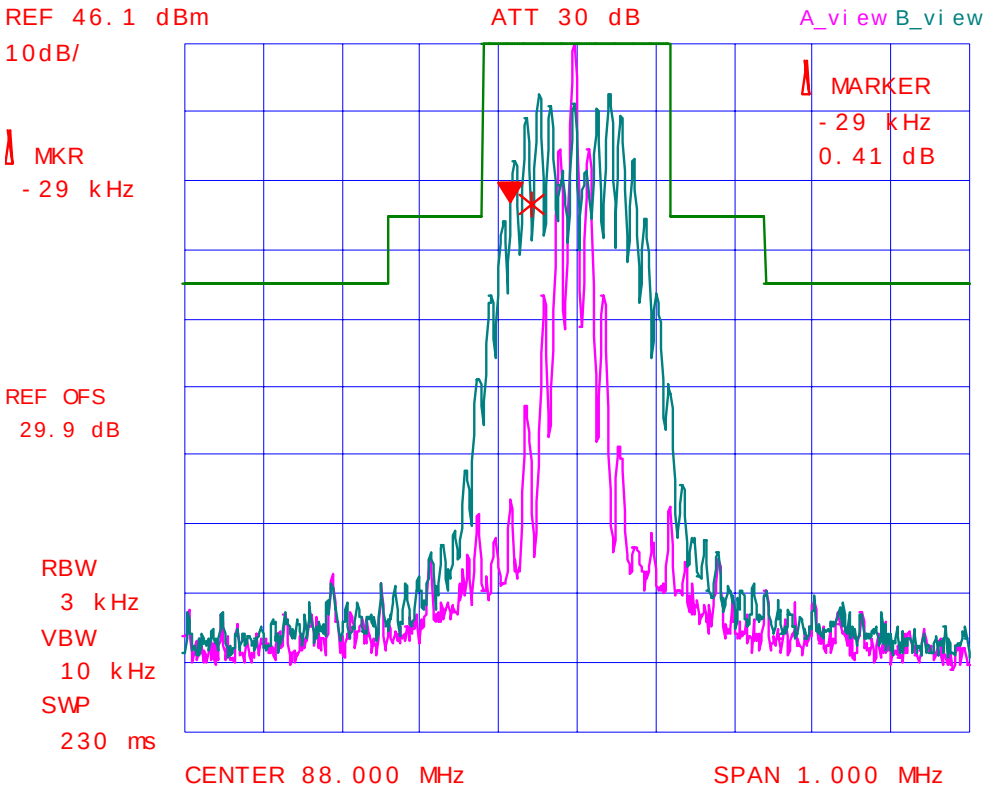
Plot 5:
99 % Occupied Bandwidth (Stereo Mode)
Carrier Frequency: 108 MHz



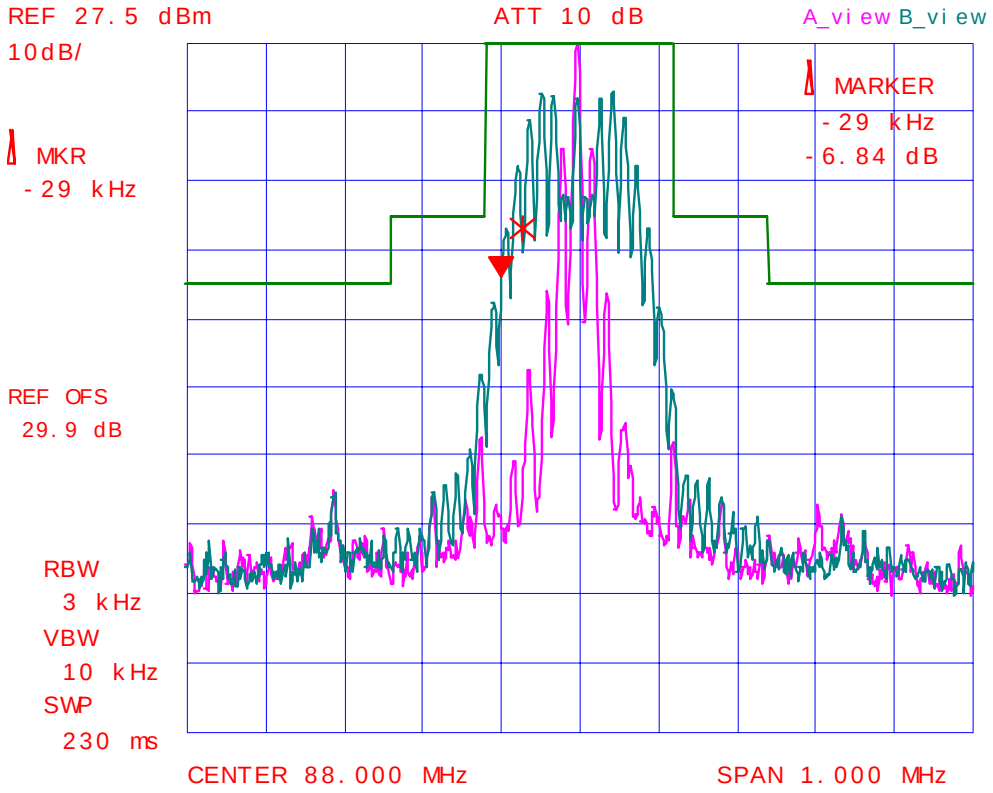
Plot 6:
99 % Occupied Bandwidth (Monaural Mode)
Carrier Frequency: 108 MHz



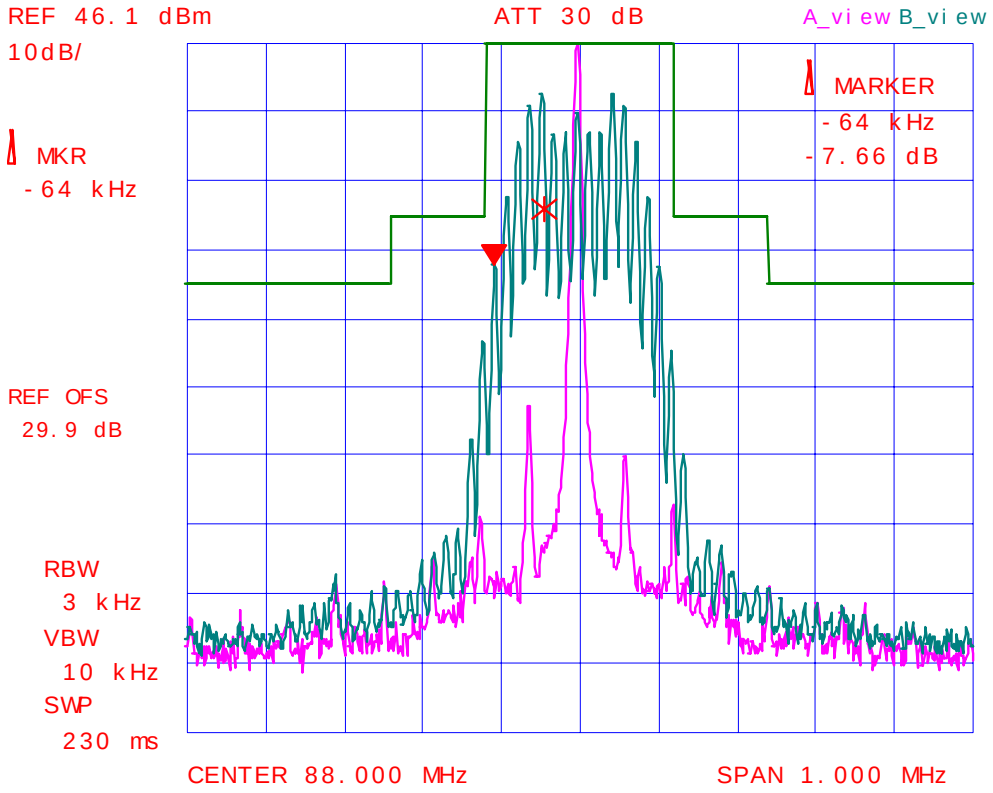
Plot 7:
Emission Mask (Stereo Mode)
Carrier Frequency: 88 MHz
Output Power: 50 Watts
Modulation: per § 2.1049(e)(5)



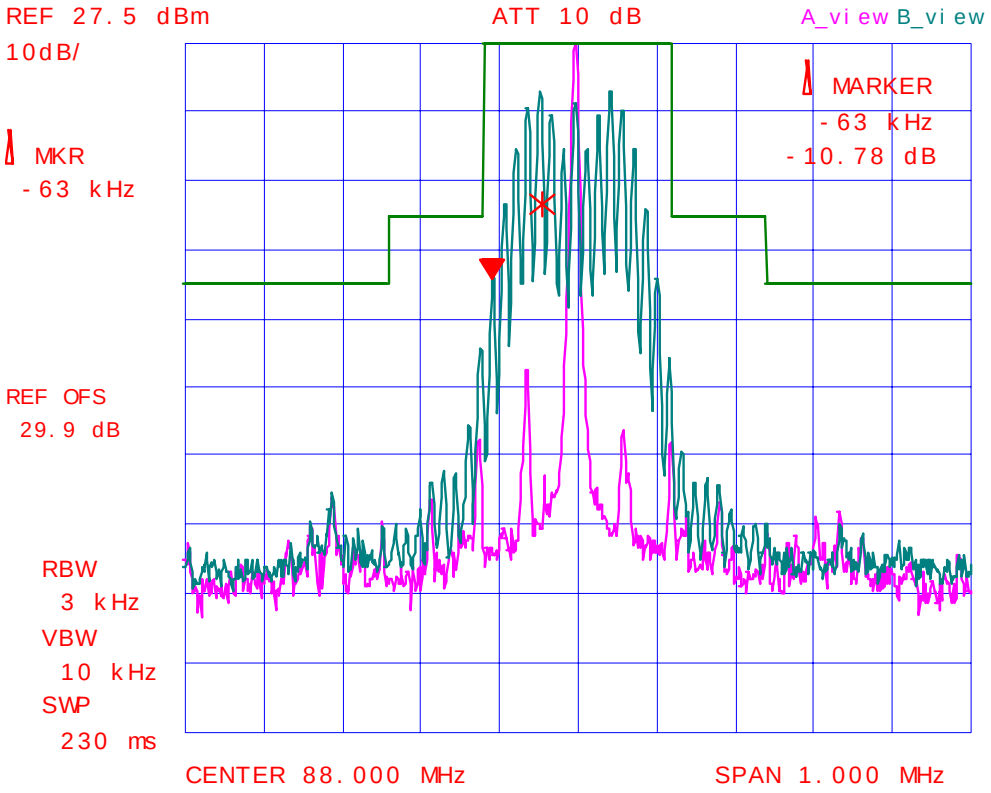
Plot 8:
Emission Mask (Stereo Mode)
Carrier Frequency: 88 MHz
Output Power: 1 Watt
Modulation: per § 2.1049(e)(5)



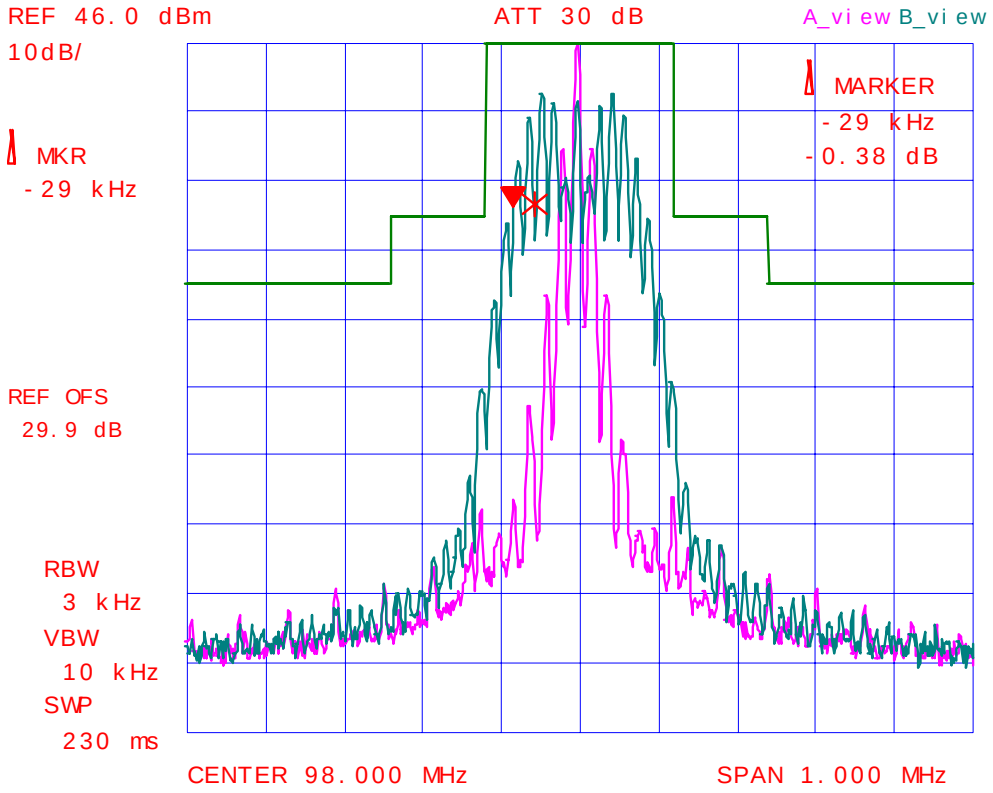
Plot 9:
Emission Mask (Monaural Mode)
Carrier Frequency: 88 MHz
Output Power: 50 Watts
Modulation: per § 2.1049(e)(3)



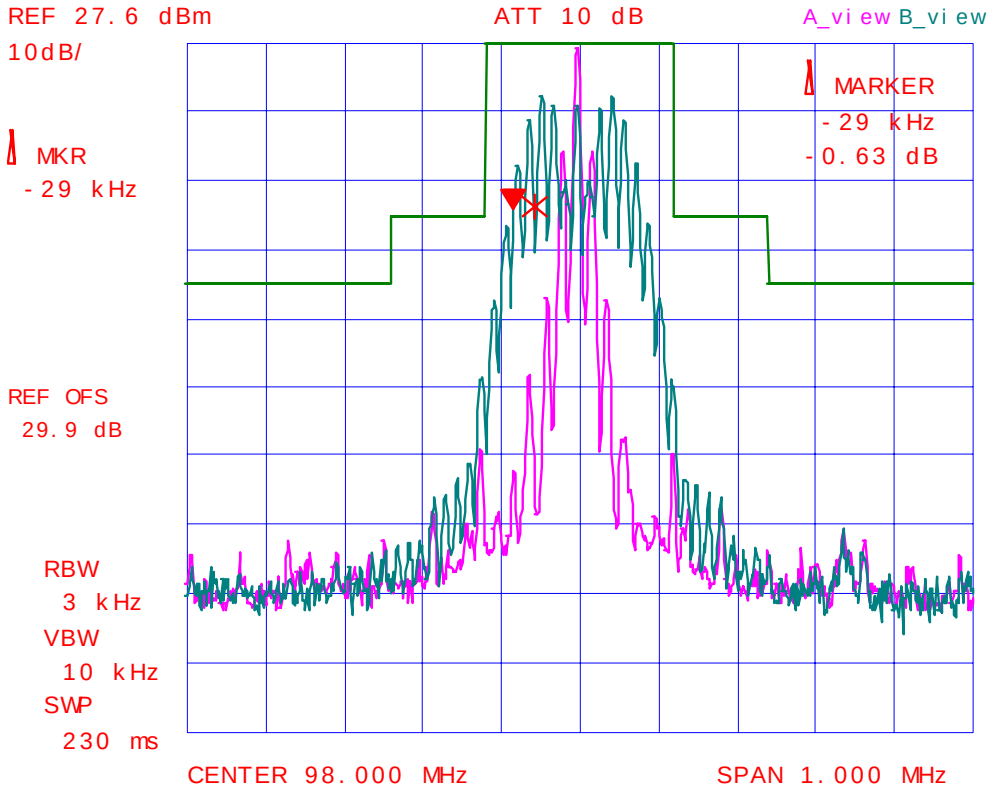
Plot 10:
Emission Mask (Monaural Mode)
Carrier Frequency: 88 MHz
Output Power: 1 Watt
Modulation: per § 2.1049(e)(3)



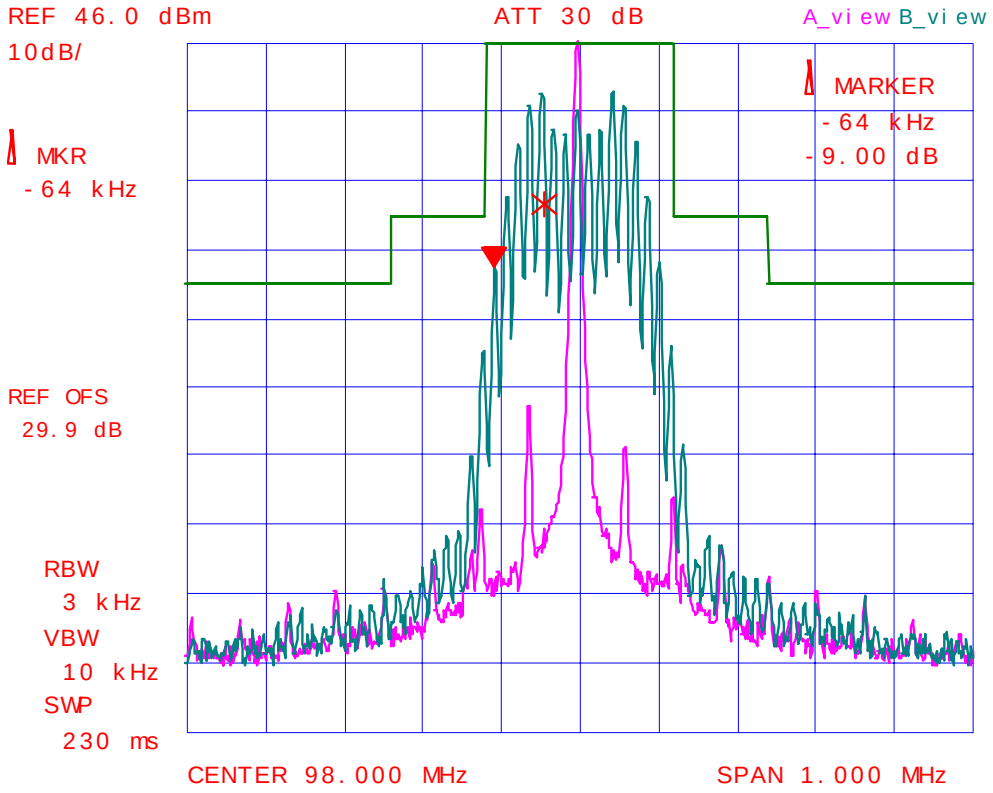
Plot 11:
Emission Mask (Stereo Mode)
Carrier Frequency: 98 MHz
Output Power: 50 Watts
Modulation: per § 2.1049(e)(5)



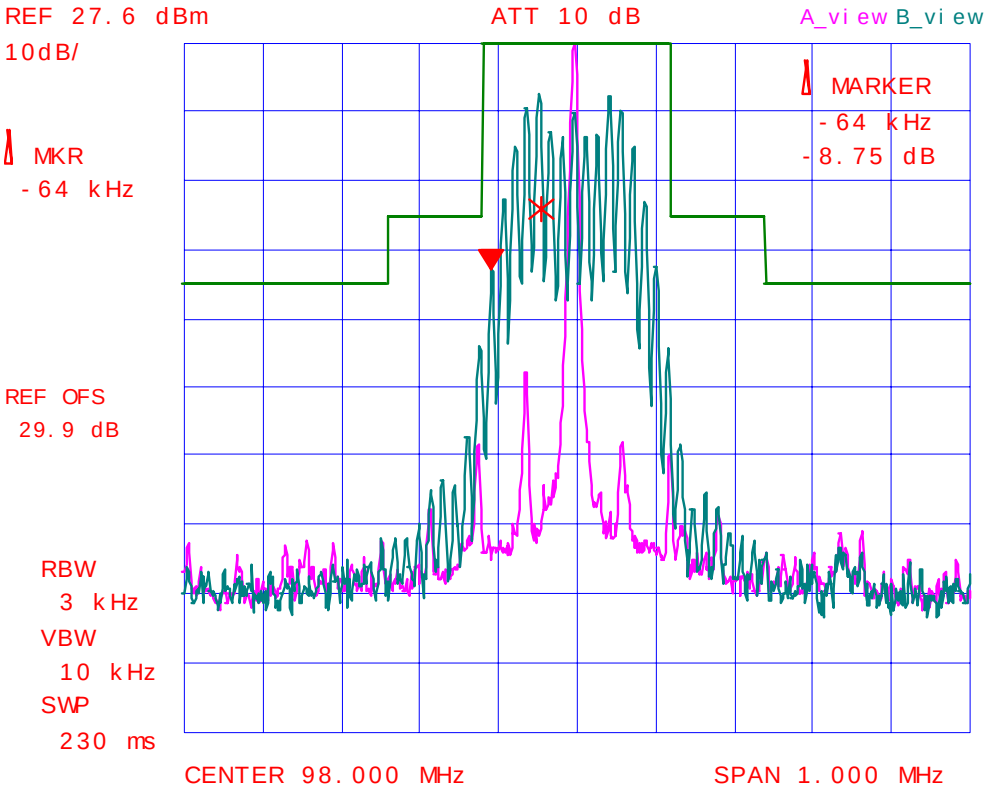
Plot 12:
Emission Mask (Stereo Mode)
Carrier Frequency: 98 MHz
Output Power: 1 Watt
Modulation: per § 2.1049(e)(5)



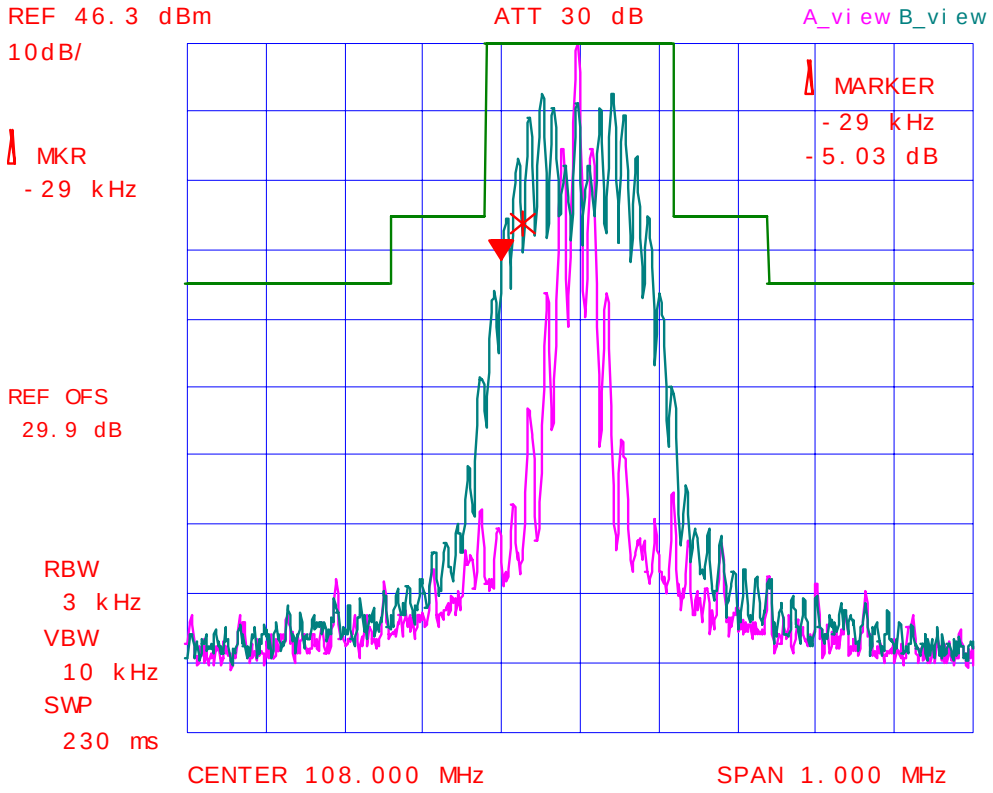
Plot 13:
Emission Mask (Monaural Mode)
Carrier Frequency: 98 MHz
Output Power: 50 Watts
Modulation: per § 2.1049(e)(3)



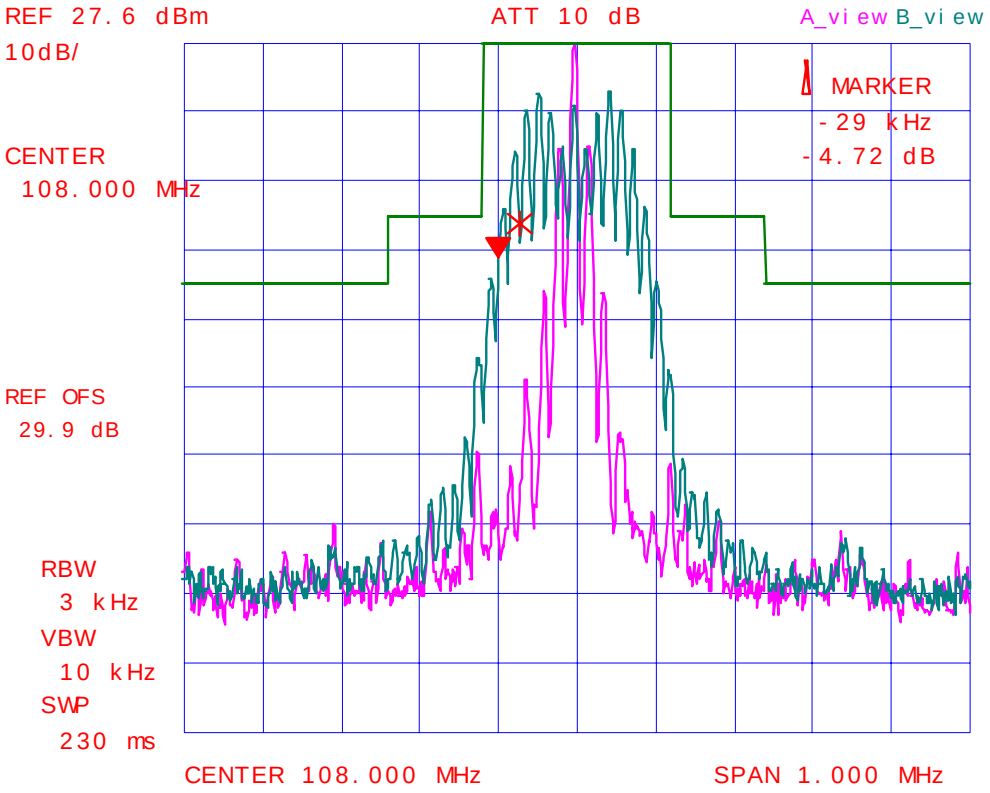
Plot 14:
Emission Mask (Monaural Mode)
Carrier Frequency: 98 MHz
Output Power: 1 Watt
Modulation: per § 2.1049(e)(3)



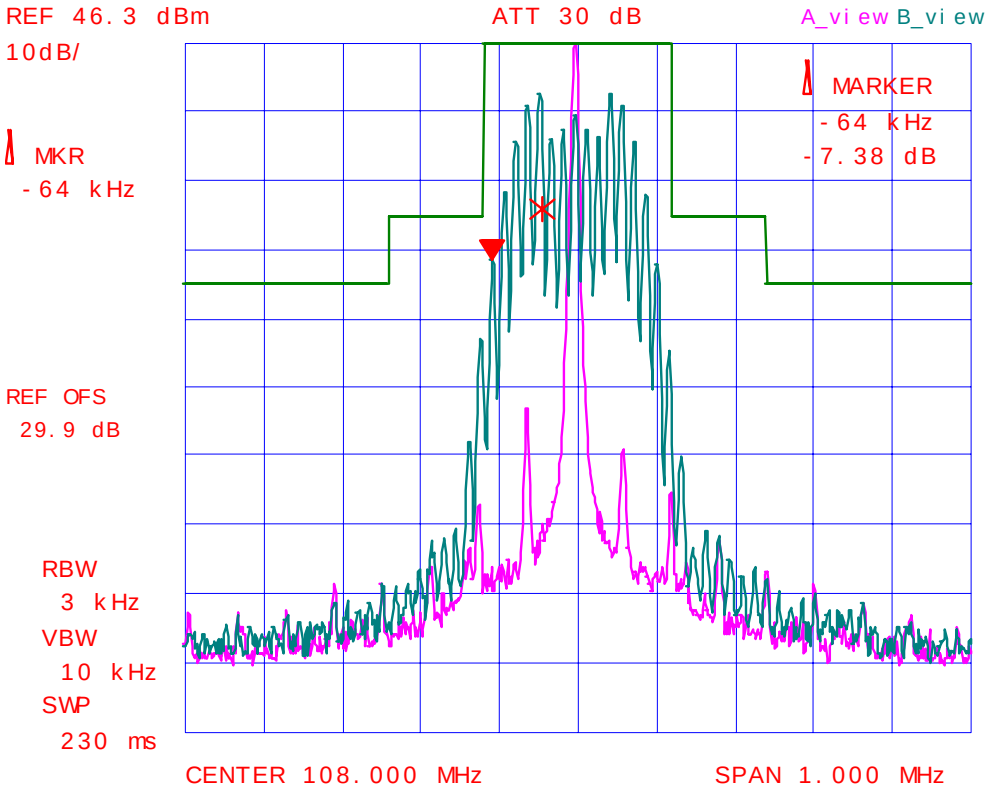
Plot 15:
Emission Mask (Stereo Mode)
Carrier Frequency: 108 MHz
Output Power: 50 Watts
Modulation: per § 2.1049(e)(5)



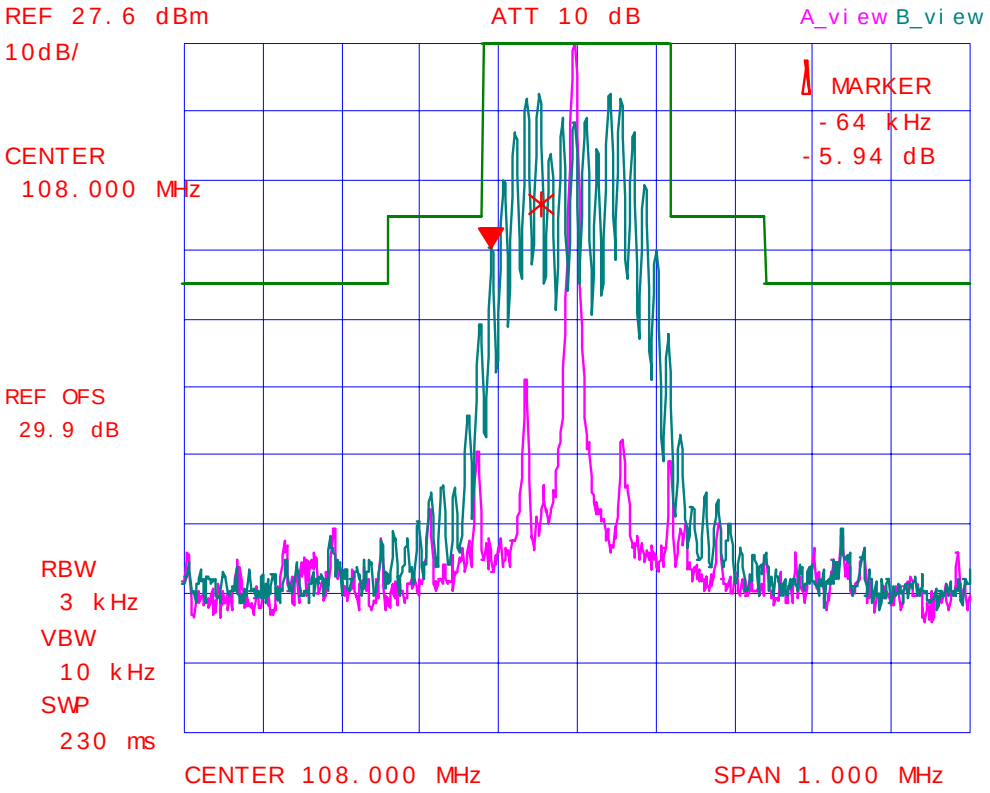
Plot 16:
Emission Mask (Stereo Mode)
Carrier Frequency: 108 MHz
Output Power: 1 Watt
Modulation: per § 2.1049(e)(5)



Plot 17:
Emission Mask (Monaural Mode)
Carrier Frequency: 108 MHz
Output Power: 50 Watts
Modulation: per § 2.1049(e)(3)



Plot 18:
Emission Mask (Monaural Mode)
Carrier Frequency: 108 MHz
Output Power: 1 Watt
Modulation: per § 2.1049(e)(3)



6.9. SPURIOUS EMISSIONS AT ANTENNA TERMINALS [§§ 2.1051 & 73.317]

6.9.1. Limits

Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least 43 + 10 Log_{10} (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

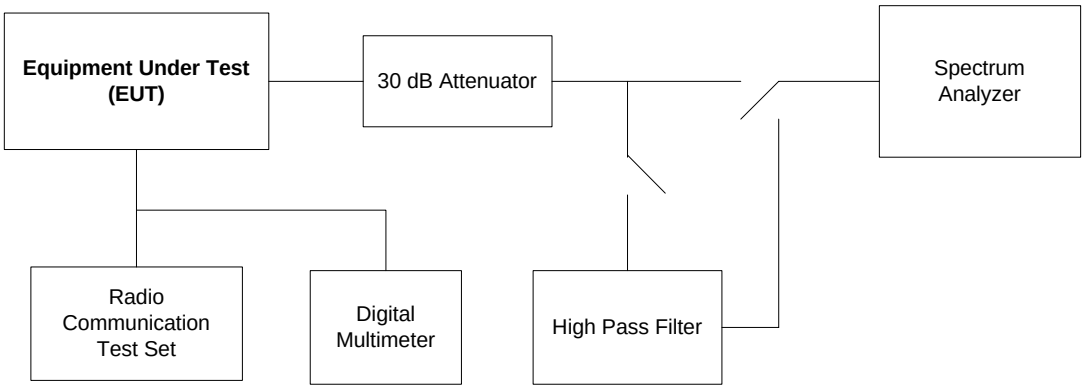
6.9.2. Method of Measurements

Refer to Section 8.5 of this report for measurement details

6.9.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett-Packard	8593EM	3710A00237	9KHz - 22GHz
Attenuator	Weinschel Corp	48-30-34	BM-5354	DC – 18 GHz
Radio Communication Test Set	Marconi Instruments	2955	132037/226	AF SG 20 Hz - 20 kHz
High Pass Filter	Mini-Circuit	SHP-230	9027 12	Cut of Frequency 230M Hz
Digital Multimeter	Rohde & Schwarz	UDS-5	8729841067	DC-200 kHz

6.9.4. Test Arrangement

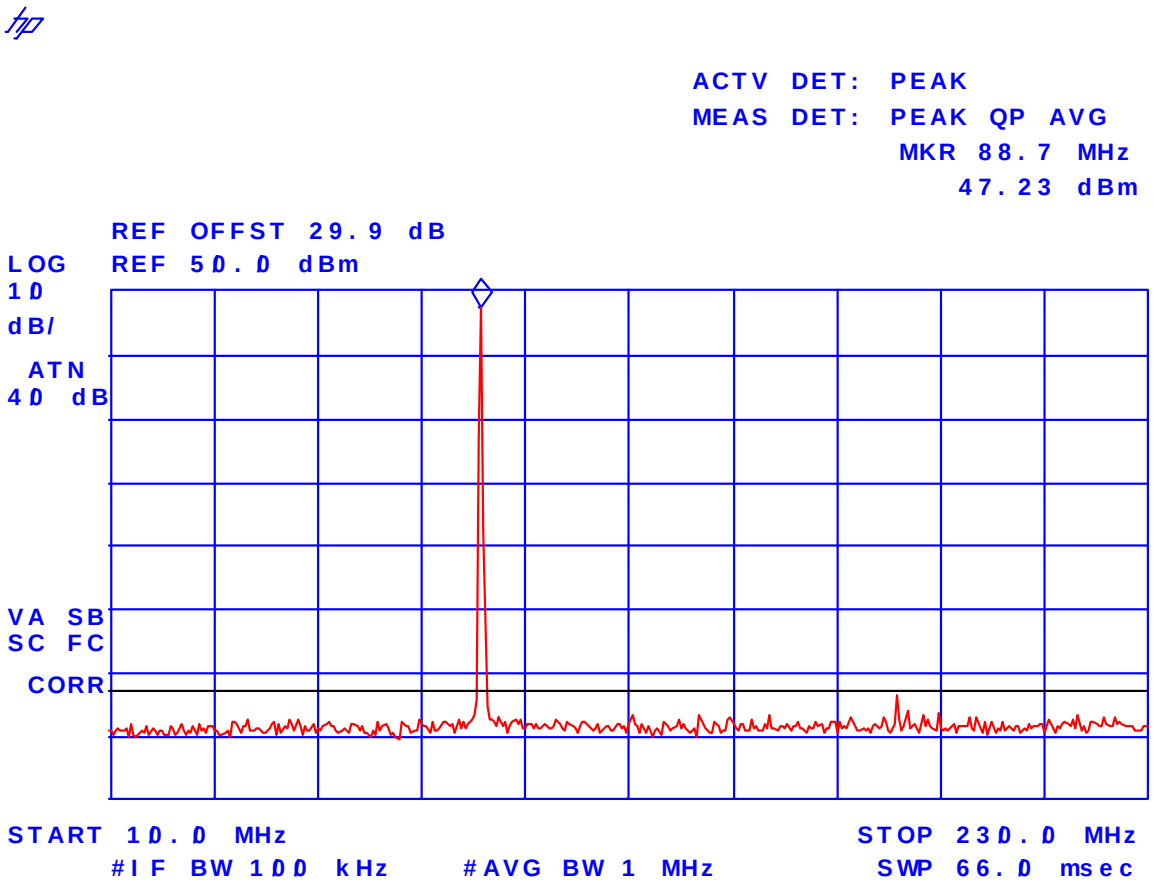


6.9.5. Test Data

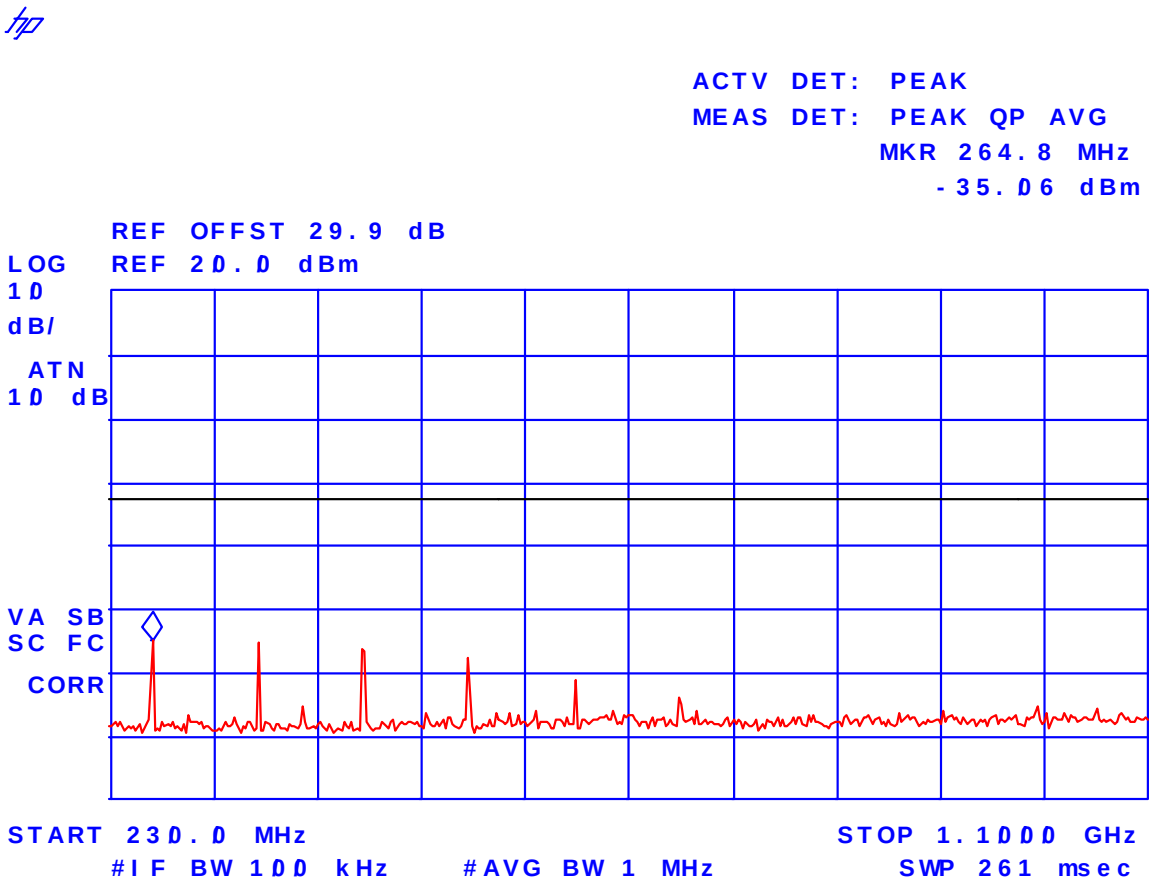
6.9.5.1. Near Lowest of Frequency Band (88 MHz)

The EUT was operating at high power level (50 Watts) and at low power level (1 Watt), emissions were scanned from 10 MHz to 1.1 GHz for both power levels. See the following test data plots (19 to 22) for details of measurements:

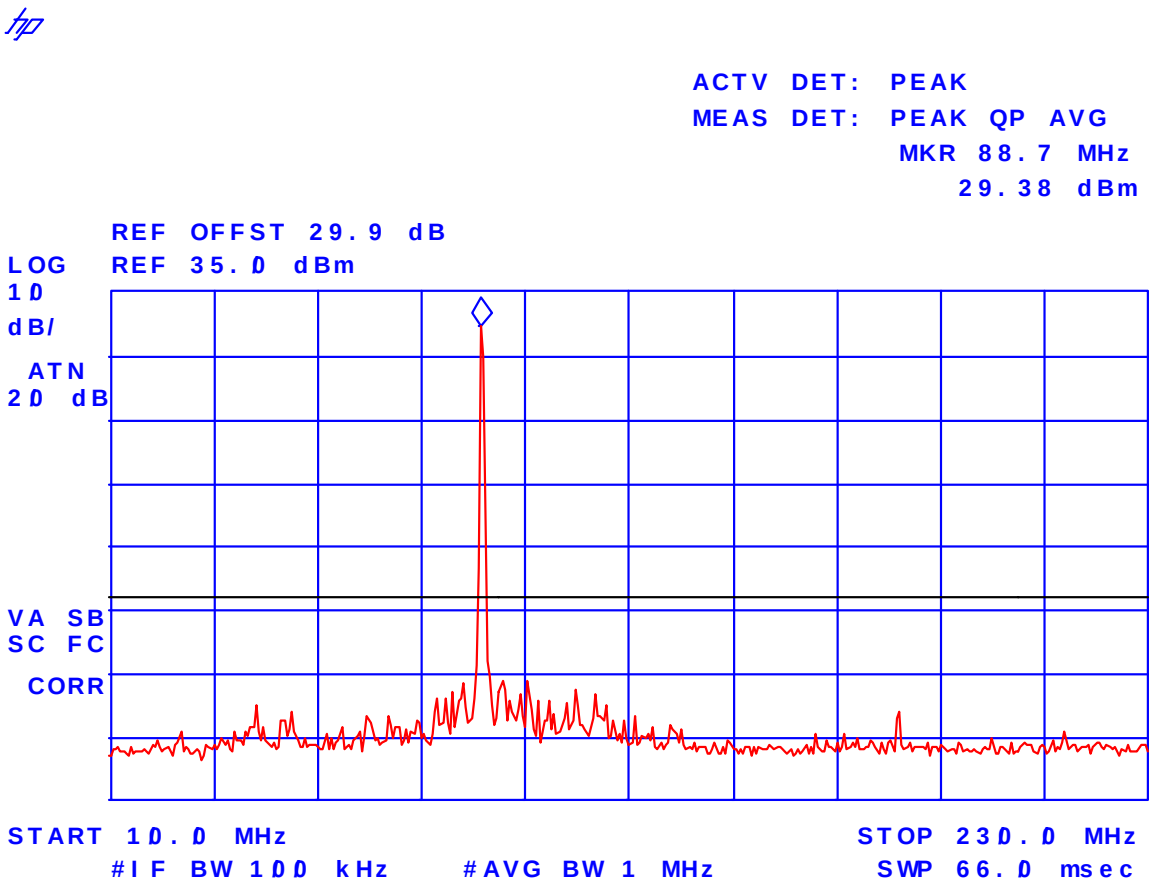
Plot 19:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 88 MHz
Output Power: 50 Watts (High Power Level)



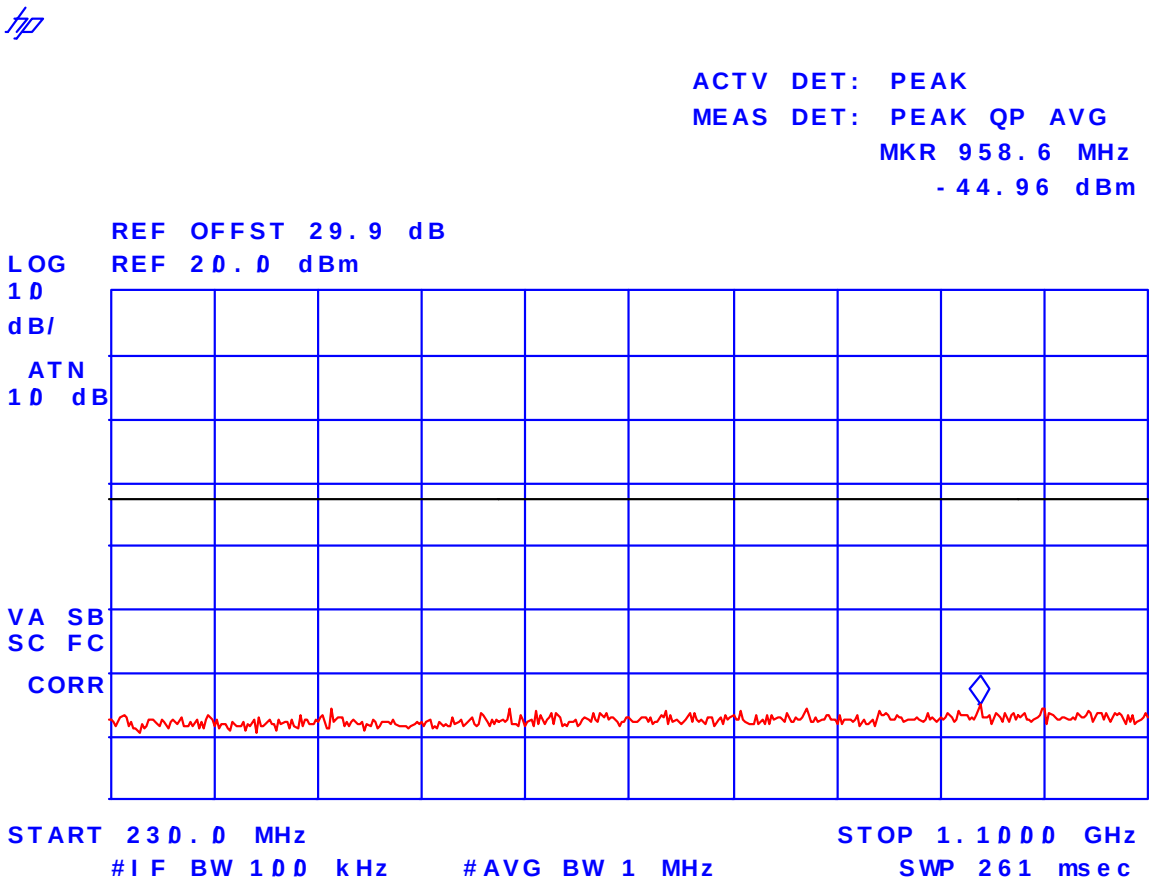
Plot 20:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 88 MHz
Output Power: 50 Watts (High Power Level)



Plot 21:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 88 MHz
Output Power: 1 Watt (Low Power Level)



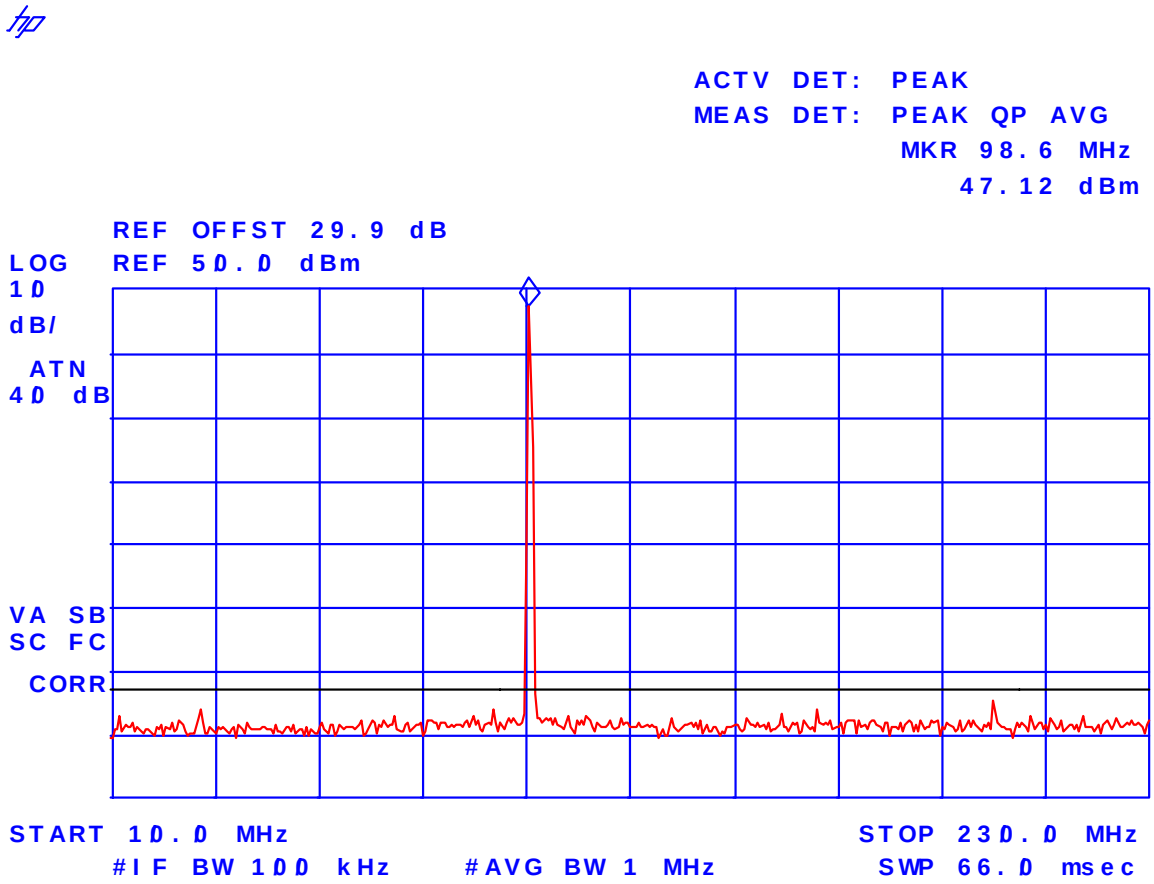
Plot 22:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 88 MHz
Output Power: 1 Watt (Low Power Level)



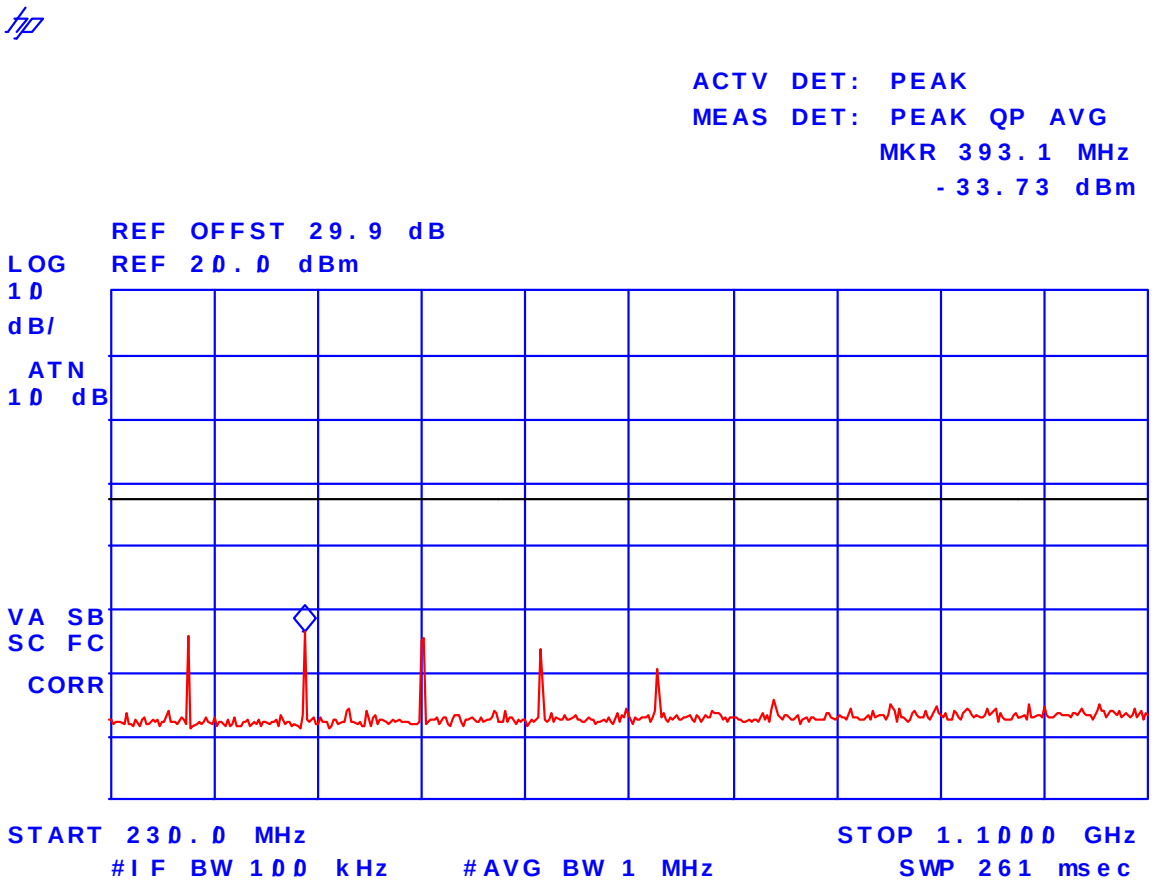
6.9.5.2. Near Middle of Frequency Band (98 MHz)

The EUT was operating at high power level (50 Watts) and at low power level (1 Watt), emissions were scanned from 10 MHz to 1.1 GHz for both power levels. See the following test data plots (23 to 26) for details of measurements:

Plot 23:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 98 MHz
Power Output: 50 Watts (High Power Level)

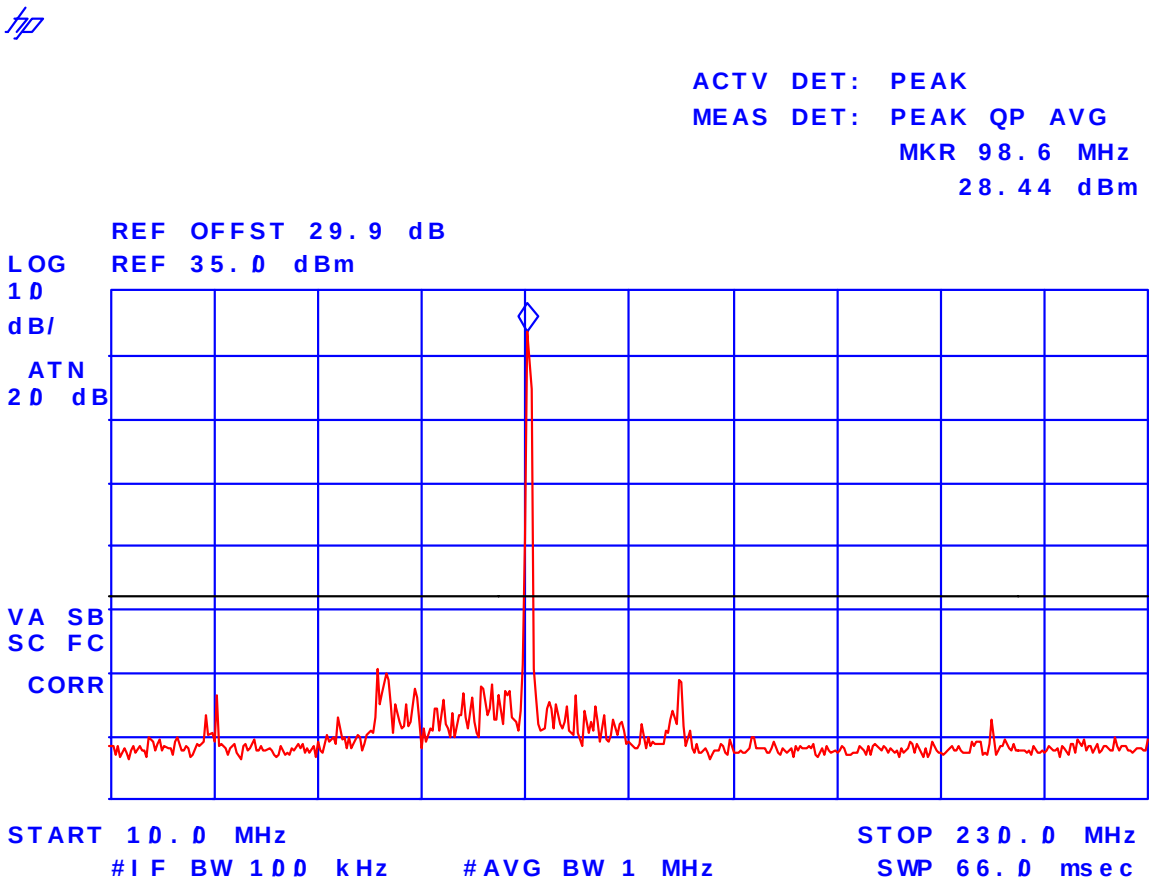


Plot 24:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 98 MHz
Power Output: 50 Watts (High Power Level)

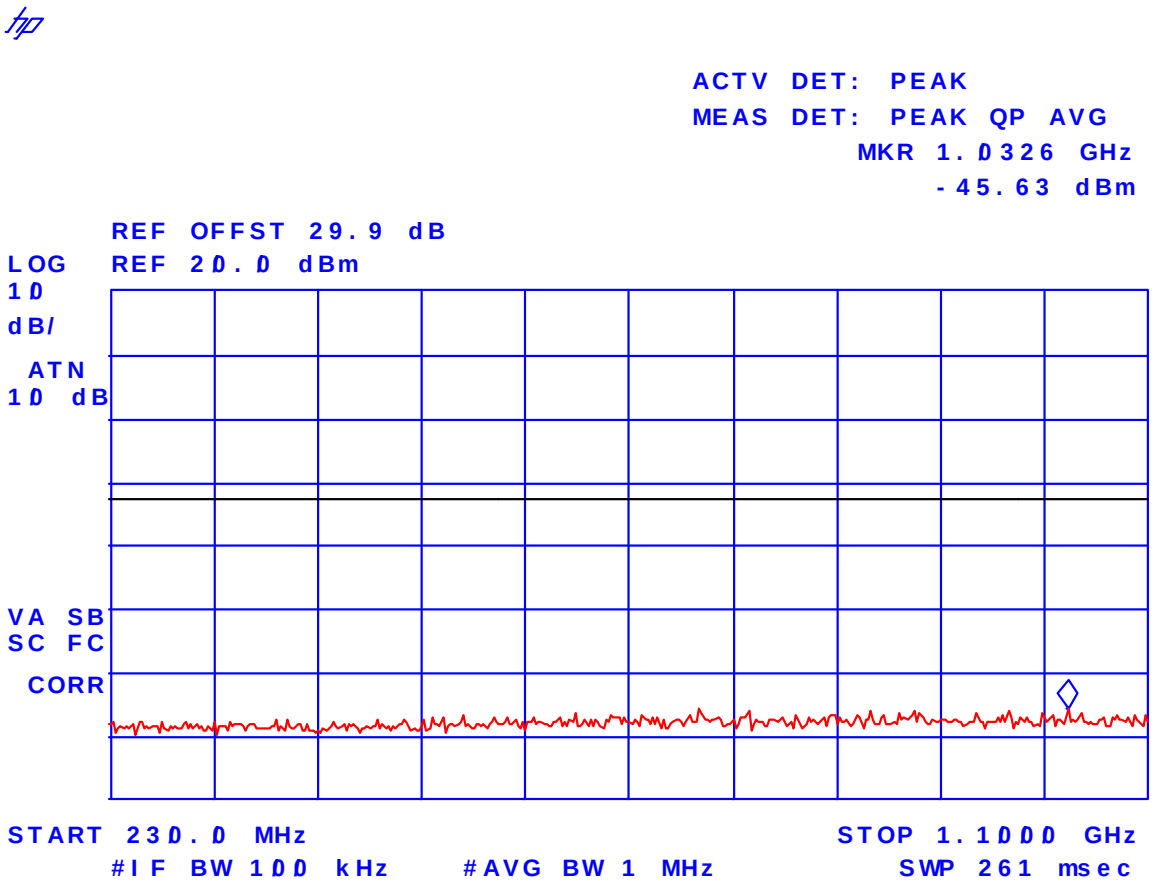


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 25:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 98 MHz
Power Output: 1 Watts (Low Power Level)



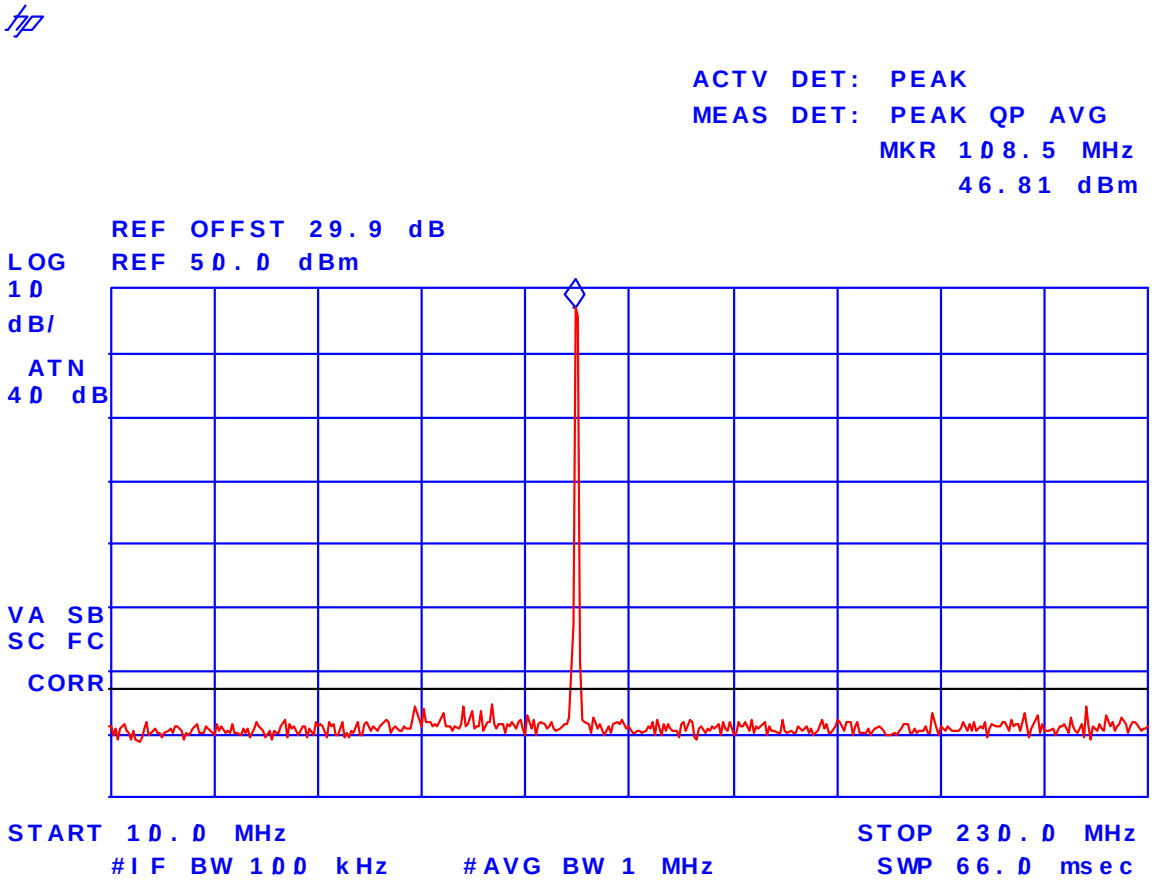
Plot 26:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 98 MHz
Power Output: 1 Watts (Low Power Level)



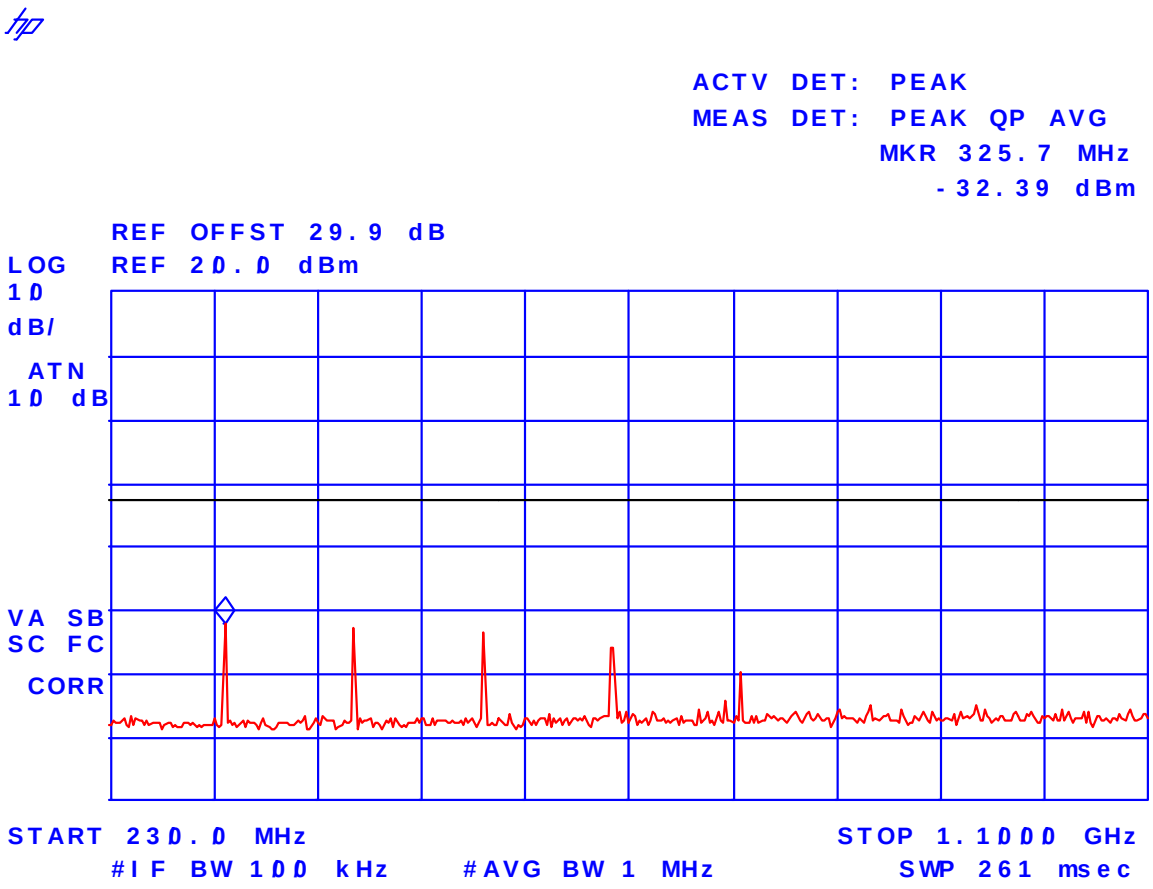
6.9.5.3. Near Highest of Frequency Band (108 MHz)

The EUT was operating at high power level (50 Watts) and at low power level (1 Watt), emissions were scanned from 10 MHz to 1.1 GHz for both power levels. See the following test data plots (27 to 30) for details of measurements:

Plot 27:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 108 MHz
Power Output: 50 Watts (High Power Level)

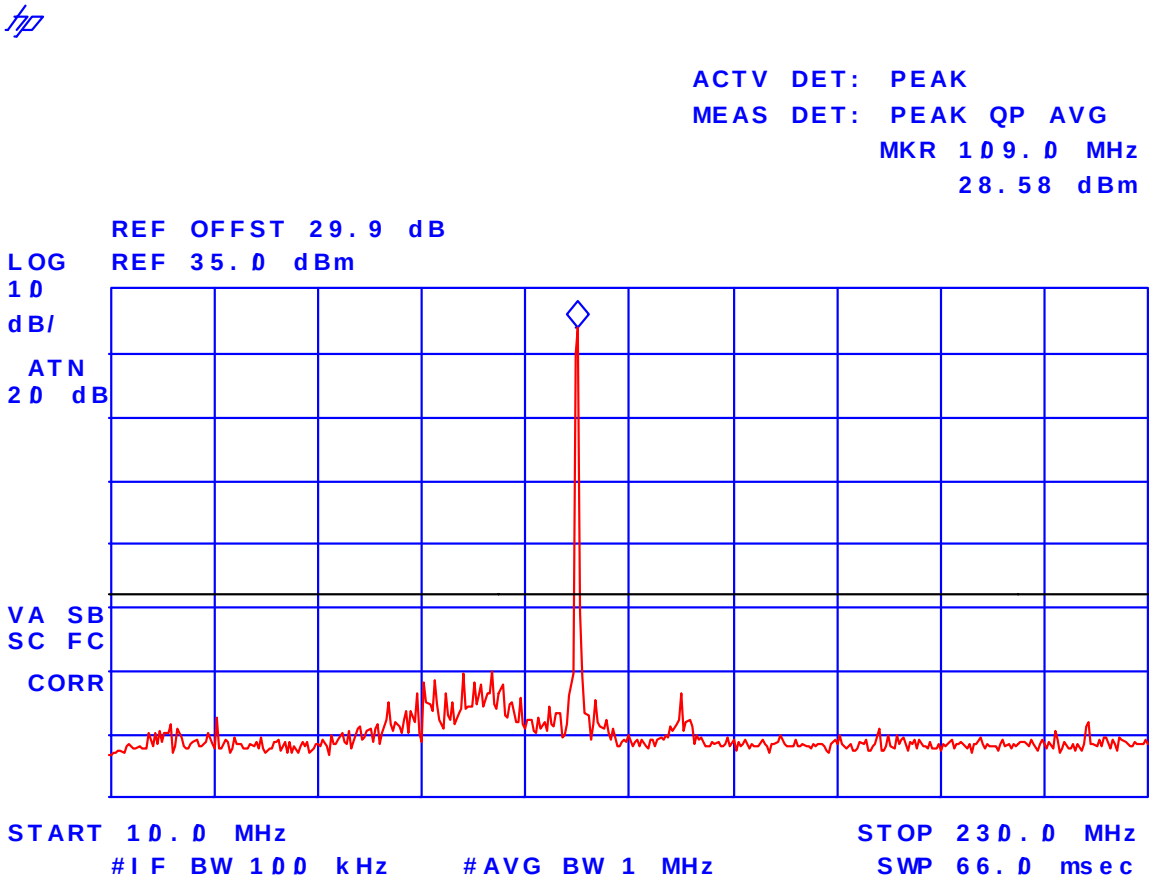


Plot 28:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 108 MHz
Power Output: 50 Watts (High Power Level)

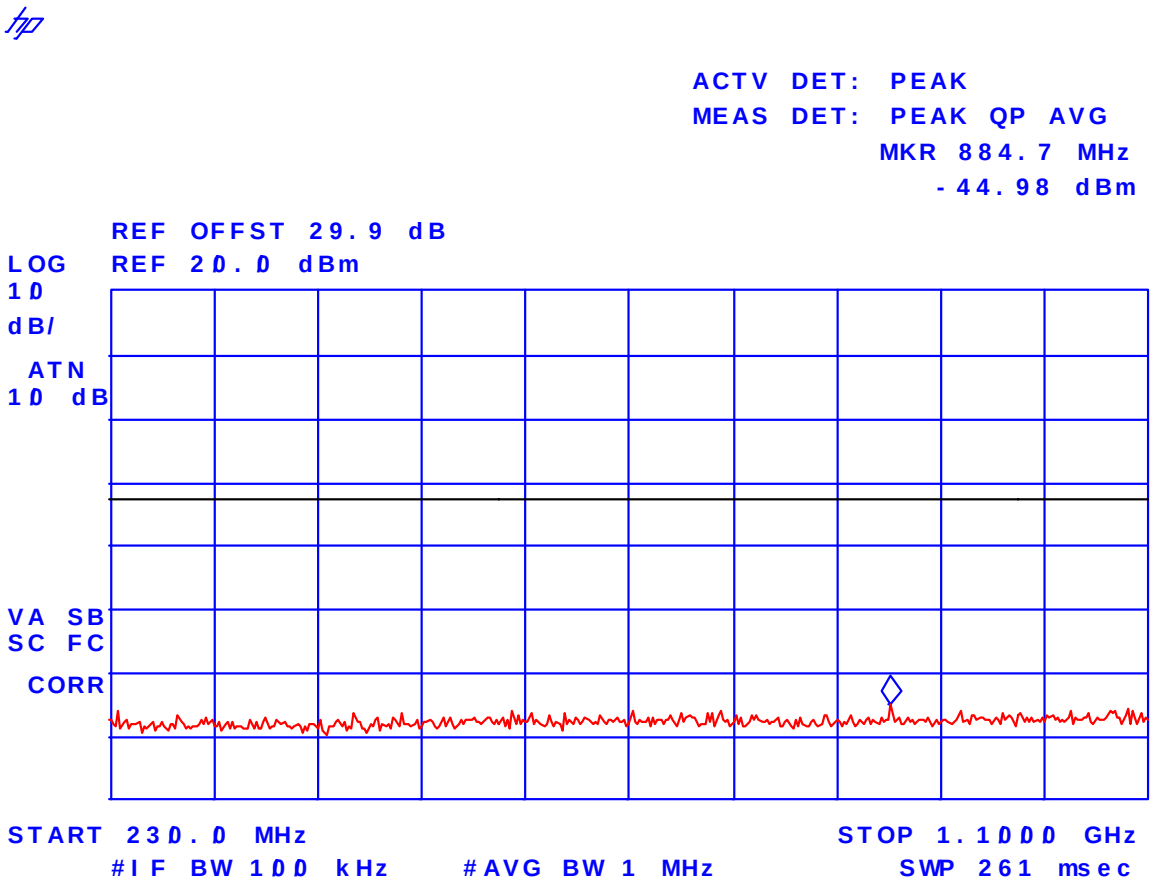


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 29:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 108 MHz
Power Output: 1 Watt (Low Power Level)



Plot 30:
Spurious Emissions at Antenna Terminal
Carrier Frequency: 108 MHz
Power Output: 1 Watt (Low Power Level)



6.10. FIELD STRENGTH OF SPURIOUS RADIATION [§§ 2.1053 & 73.317]

6.10.1. Limits

Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least 43 + 10 Log_{10} (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

6.10.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Section 8.2 of this report and its value in dBc is calculated as follows:

(1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
(2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = Pc dBm (conducted) + 0 dBi – 2.15 dB
(3) Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)

6.10.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
RF Amplifier	Com-Power	PA-102		1 MHz to 1 GHz, 30 dB gain nomimal
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz, 30 dB nominal
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 GHz – 1 GHz
Dipole Antenna	EMCO	3121C	8907-440	30 GHz – 1 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

6.10.4. Test Data

6.10.4.1. Near Bottom of Frequency Band (88 MHz)

Fundamental Frequency: 88 MHz
RF Output Power: 46.9 dBm (49.0 Watts)
Attenuation Limit: = - (43 + 10 Log_{10} (49.0)) = -59.9 dBc

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
264.0	75.26	Peak	V	-20.55	-67.5	-59.9	-7.6
264.0	73.99	Peak	H	-24.67	-71.6	-59.9	-11.7
352.0	71.09	Peak	V	-28.38	-75.3	-59.9	-15.4
352.0	69.97	Peak	H	-31.50	-78.4	-59.9	-18.5
The emissions were scanned from 10 MHz to 1.1 GHz and all emissions within 20 dB below the limit were recorded.							

6.10.4.2. Near Middle of Frequency Band (98 MHz)

Fundamental Frequency: 98 MHz
RF Output Power: 46.8 dBm (47.7 Watts)
Attenuation Limit: = -(43 + 10 Log_{10} (47.7)) = -59.8 dBc

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
294.0	75.30	Peak	V	-19.81	-66.6	-59.8	-6.8
294.0	78.33	Peak	H	-20.33	-67.1	-59.8	-7.3
392.0	66.73	Peak	V	-32.74	-79.5	-59.8	-19.7
490.0	73.91	Peak	V	-25.60	-72.4	-59.8	-12.6
490.0	71.22	Peak	H	-28.29	-75.1	-59.8	-15.3
588.0	69.50	Peak	V	-29.45	-76.3	-59.8	-16.5
686.0	65.90	Peak	V	-31.68	-78.5	-59.8	-18.7
686.0	68.72	Peak	H	-28.86	-75.7	-59.8	-15.9
The emissions were scanned from 10 MHz to 1.1 GHz and all emissions within 20 dB below the limit were recorded.							

6.10.4.3. Near Top of Frequency Band (108 MHz)

Fundamental Frequency:	108 MHz
RF Output Power:	46.6 dBm (45.7 Watts)
Attenuation Limit:	= -(43 + 10 Log_{10} (45.7)) = -59.6 dBc

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method		Limit (dBc)	Margin (dB)
				(dBm)	(dBc)		
324.0	81.68	Peak	V	-14.13	-60.7	-59.6	-1.1
324.0	81.09	Peak	H	-17.57	-64.2	-59.6	-4.6
540.0	72.88	Peak	V	-27.13	-73.7	-59.6	-14.1
540.0	72.64	Peak	H	-27.37	-74.0	-59.6	-14.4
648.0	67.29	Peak	H	-31.66	-78.3	-59.6	-18.7
The emissions were scanned from 10 MHz to 1.1 GHz and all emissions within 20 dB below the limit were recorded.							

EXHIBIT 7. MEASUREMENT METHODS

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivity	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

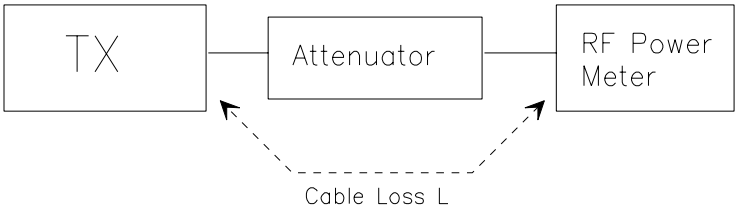
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{X = 1 for continuous transmission => 10log(1/x) = 0 dB}

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. MAXIMIZING RF EMISSION LEVEL (E-FIELD)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBμV/m) = Reading (dBμV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions Using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where:	P:	Actual RF Power fed into the substitution antenna port after corrected.
	P1:	Power output from the signal generator
	P2:	Power measured at attenuator A input
	P3:	Power reading on the Average Power Meter
	EIRP:	EIRP after correction
	ERP:	ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

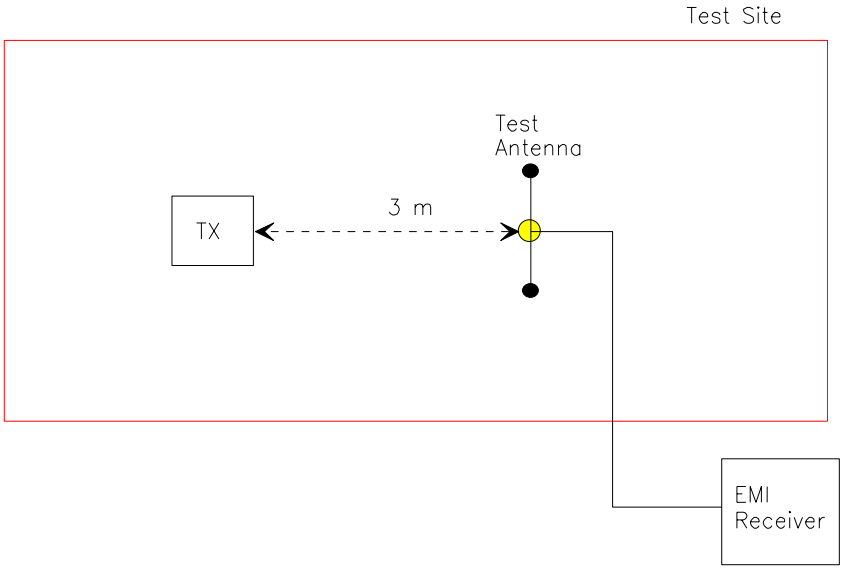
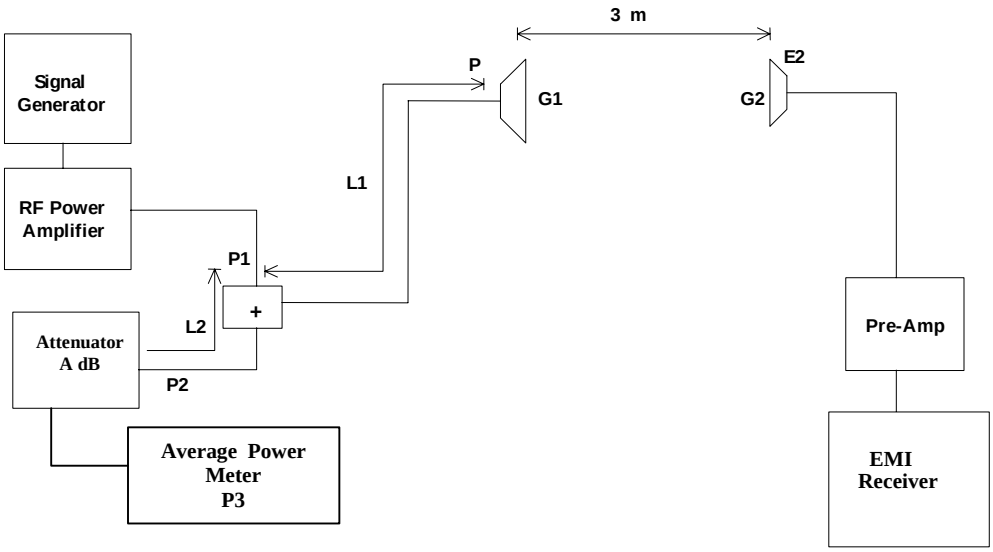


Figure 3



All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

From 0° to +50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

8.4. EMISSION MASK

Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.1049(h): Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following spectrum analyzer bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

(1) For 25 kHz Channel Spacing: RBW = 300 Hz
(2) For 12.5 kHz or 6.25 kHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum, VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC 47 CFR 2.1057 - Frequency spectrum to be investigated: The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC 47 CFR 2.1051 - Spurious Emissions at Antenna Terminal: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.