ENGINEERING TEST REPORT

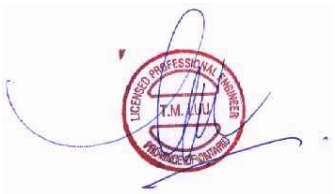
50 Watt Single Channel VHF/AM Transceiver
Model No.: TSC-4400
FCC ID: IMA-TSC-4400

Applicant: ***Technisonic Industries Ltd.***
240 Traders Blvd E,
Mississauga, Ontario
Canada, L4Z 1W7

Tested in Accordance With

Federal Communications Commission (FCC)
CFR 47, Parts 2 and 87 (Subpart D) – Aviation Services

UltraTech's File No.: TIL-041FCC87

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: November 18, 2004	
Report Prepared by: Dharmajit Solanki, RFI Engineer Issued Date: November 18, 2004	Tested by: Wayne Wu, RFI Engineer Hung Trinh, EMI/RFI Technician Test Dates: March 11 – 22, 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	Test Report	OK
1	Test Setup Photos	Photos # 1 to 2	OK
2	External Photos of EUT	Photos # 1 to 2	OK
3	Internal Photos of EUT	Photos # 1 to 28	OK
4	Cover Letters	• Letter from Ultratech for Certification Request • Letter from the Applicant to appoint Ultratech to act as an agent • Letter from the Applicant to request for Confidentiality Filing • Copy of the notification letter to the FAA	OK
5	ID Label/Location Info	ID Label Location of ID Label	OK
6	Block Diagrams	Block diagram	OK
7	Schematic Diagrams	Schematic diagrams # 1 to 12	OK
8	Parts List/Tune Up Info	Parts List & Tuning Procedure	OK
9	Operational Description	Theory of Operation	OK
10	Users Manual	Installation and Operating Instructions	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 87
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Parts 2 and 87
Purpose of Test:	To obtain FCC Certification Authorization for Radio operating in the frequency band 117.975-138 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA/EIA- 603-B (01-Nov-2002) - Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.

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

None

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	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 16-1	2003	Specification for Radio Disturbance and Immunity measuring apparatus and methods
TIA/EIA 603, Edition B	01-Nov-2002	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	TECHNISONIC INDUSTRIES LTD.
Address:	240 Traders Blvd E Mississauga, Ontario Canada, L4Z 1W7
Contact Person:	Richard Dalacker Phone #: 905-890-2113 Fax #: 905-890-5338 Email Address: rdalacker@til.ca

MANUFACTURER	
Name:	TECHNISONIC INDUSTRIES LTD.
Address:	240 Traders Blvd E Mississauga, Ontario Canada, L4Z 1W7
Contact Person:	Richard Dalacker Phone #: 905-890-2113 Fax #: 905-890-5338 Email Address: rdalacker@til.ca

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:	Technisonic
Product Name:	50 Watt Single Channel VHF/AM Transceiver
Model Name or Number:	TSC-4400
Serial Number:	ER001
Oscillators' Frequencies:	9.545 MHz, 3.58 MHz & 16 MHz
CPU's Frequencies:	3.6864 MHz & 16 MHz
External Power Supply:	110/260 V AC or 48.00 VDC or 12.0 VDC
Transmitting/Receiving Antenna Type:	Non-integral
Type of Equipment:	Non-broadcast Radio Communication Equipment

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	[ ] Portable [ ] Mobile [X] Base station (fixed use)
Intended Operating Environment:	Aviation band communications in ground based environment
Power Supply Requirement:	110/260 V AC or 48.00 VDC or 12.0 VDC
RF Output Power Rating:	50 watts (max), Adjustable downwards to 7 watts (minimum)
Operating Frequency Range:	117.975 – 138.0 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	25.0 KHz & 8.33 kHz
Modulation:	Amplitude Modulation Double Sideband (A3E)
Duty Cycle:	20% (Max. Continuous Transmit = 1 Min)
Occupied Bandwidth (99%):	7.1 kHz
Emission Designation*:	6K00A3E
Antenna Connector Type:	N Type

* For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:

Calculation of Necessary Bandwidth for AM Modulation (Double Sideband):

For Telephony (Commercial Quality):-

Bandwidth B_n = 2 M, where M= Max. Modulating Frequency in Hz = 3000
= 3 x 3000 = 6000
= 6K00A3E

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	Antenna	1	"N" Type	50 ohm coax
2	AC power	1	3 pin AC	Non-shielded
3	DC standby power	1	3 pin circular	Non-shielded
4	Microphone Jack	1	0.2" jack	Shielded
5	Headset Jack	1	0.25" jack	Shielded
6	Programming (note 2)	1	9 pin female "D"	Non-shielded
7	Remote Control	1	25 pin male "D"	Non-shielded
8	PSTN	1	RJ11	Non-shielded

3.5. BLOCK DIAGRAM OF TEST SETUP

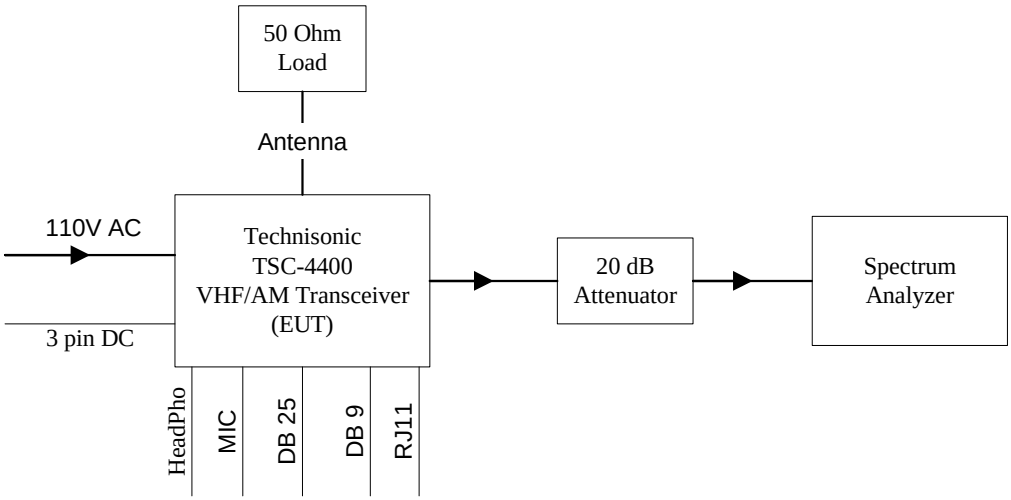


EXHIBIT 4. EUT OPERATING CONDITION AND CONFIGURATIONS DURING TESTS

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:	120 VAC

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:	Technisonic Programming Software
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): ▪ 118 - 138 MHz band:	Near lowest, near middle & near highest frequencies in each frequency bands that the transmitter covers: ▪ 118.0, 128.0 & 138.0 MHz
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating signal source:	 ▪ 50.0 Watts ▪ AM DSB ▪ Internal

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, 16'(L) by 12'(W) by 12'(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.: IC 2049). Last Date of Site Calibration: Feb. 17, 2004.

5.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
87.131 & 2.1046	Power and Emissions	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	N/A Base Station Use
87.133 & 2.1055	Frequency Stability	Yes
2.1047(b) & 87.141(a) & (b)	Modulation Requirements - Modulation Limiting	Yes
87.139 & 2.1049	99% Occupied Bandwidth and Emission Limitation	Yes
87.139, 2.1057 & 2.1051	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
87.139, 2.1057 & 2.1053	Emission Limits - Field Strength of Spurious Emissions	Yes
50 Watt Single Channel VHF/AM Transceiver, **Model No.: TSC-4400**, by **Technisonic Industries Ltd.,** has also been tested and found to comply with **FCC Part 15, Subpart B - Radio Receivers and Class A Digital Devices**. The engineering test report has been documented and kept in file and it is available anytime upon FCC request.		

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 8 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 7 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 and 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. POWER AND EMISSIONS @ FCC 2.1046 & 87.131

6.5.1. Limits

The following table lists authorized emissions and maximum power. Power must be determined by direct measurement.

Class of station	Frequency band/ frequency	Authorized emission(s) [9]	Maximum power [1]
Aeronautical advisory	VHF	A3E	10 watts.[10]
Aeronautical multicom	VHF	A3E	10 watts.
Aeronautical enroute & fixed	**VHF**	**A3E**, A9W, G1D	**200 watts**.
Aeronautical search and rescue	VHF	A3E	10 watts.
Operational fixed	VHF	G3E, F2D	30 watts.
Flight test land	VHF	A3E	200 watts.
Aviation support	**VHF**	**A3E**	**50 watts.**
Airport control tower	**VHF**	**A3E,** G1D, G7D	**50 watts.**

Notes:

(1) The power is measured at the transmitter output terminals and the type of power is determined according to the emission designator as follows:
(i) Mean power (pY) for amplitude modulated emissions and transmitting both sidebands using unmodulated full carrier.
(ii) Peak envelope power (pX) for all emission designators other than those referred to in paragraph (i) of this note.

6.5.2. Method of Measurements

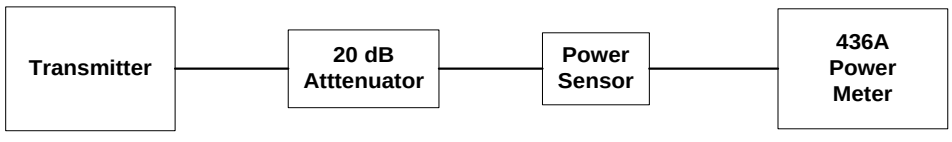
Refer to Exhibit 8, § 8.1 (Conducted) and 8.2 (Radiated) of this report for measurement details

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Attenuator(s)	Bird	…	…	DC – 22 GHz
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz – 26.5 GHz
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz – 50 GHz, sensor dependent

6.5.4. Test Arrangement

- Power at RF Power Output Terminals



6.5.5. Test Data

6.5.5.1. High Power Setting (50 Watts)

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured (Average) Power @ Antenna Port (watts)	Maximum Power Limit (watts)
Lowest	118.0	50.0	50.0
Middle	128.0	50.0	50.0
Highest	138.0	50.0	50.0

6.5.5.2. Medium Power Setting (25 Watts)

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured (Average) Power @ Antenna Port (watts)	Maximum Power Limit (watts)
Lowest	118.0	25.0	50.0
Middle	128.0	25.0	50.0
Highest	138.0	25.0	50.0

6.5.5.3. Low Power Setting (7 Watts)

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured (Average) Power @ Antenna Port (watts)	Maximum Power Limit (watts)
Lowest	118.0	7.0	50.0
Middle	128.0	7.0	50.0
Highest	138.0	7.0	50.0

6.6. FREQUENCY STABILITY @ FCC 2.1055 & 87.133

6.6.1. Limits

(a) Except as provided in paragraphs (c), (d), and (f) of this section, the carrier frequency of each station must be maintained within these tolerances:

Frequency band (lower limit exclusive, upper limit inclusive), and categories of station	Tolerance [1] (ppm)	Tolerance [2] (ppm)
108 – 137 MHz (Aeronautical stations)	50 [4]	20 [12]

(1) This tolerance is the maximum permitted until January 1990, for transmitters installed before January 2, 1985, and used at the same installation. Tolerance is indicated in parts in a million unless shown as Hertz (Hz).
(2) This tolerance is the maximum permitted after January 1, 1985 for new and replacement transmitters and to all transmitters after January 1, 1990. Tolerance is indicated in parts in a million unless shown as Hertz (Hz).
(4) The tolerance for transmitters approved between January 1, 1966, and January 1, 1974, is 30 parts in a million. The tolerance for transmitters approved after January 1, 1974, and stations using offset carrier techniques is 20 parts in a million.
(12) For emissions G1D and G7D, the tolerance is 2 parts per million.

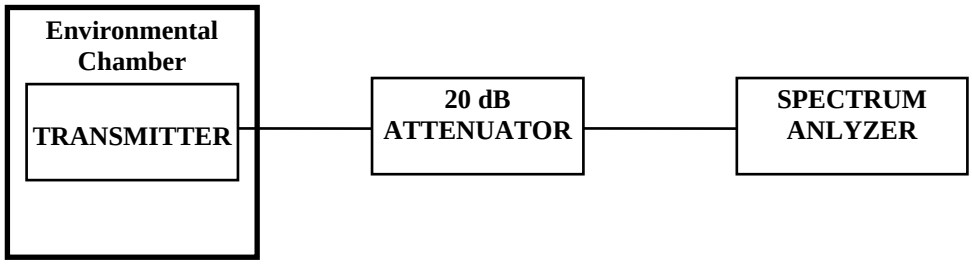
6.6.2. Method of Measurements

Refer to Exhibit 8, § 8.3 of this report for measurement details

6.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
EMI Receiver/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Temperature & Humidity Chamber	Tenney	T5	9723B	-40° to +60 ° C range

6.6.4. Test Arrangement



6.6.5. Test Data

Product Name: **Model No.:**	50 Watt Single Channel VHF/AM Transceiver TSC-4400
Center Frequency:	118.0 MHz
Full Power Level:	50.0 Watts
Frequency Tolerance Limit:	± 20 ppm or 2360 Hz
Max. Frequency Tolerance Measured:	+ 2.3 ppm or 274 Hz
Input Voltage Rating:	120.0 V AC

CENTER FREQUENCY & RF POWER OUTPUT VARIATION			
Ambient Temperature	**Supply Voltage (Nominal) Volts**	**Supply Voltage (85% of Nominal) Volts**	**Supply Voltage (115% of Nominal) Volts**
(°C)	**Hz**	**Hz**	**Hz**
-30	274	N/A	N/A
-20	206	N/A	N/A
-10	172	N/A	N/A
0	160	N/A	N/A
+10	80	N/A	N/A
+20	-20	32	23
+30	126	N/A	N/A
+40	80	N/A	N/A
+50	69	N/A	N/A

6.7. MODULATION REQUIREMENTS - MODULATION LIMITING @ FCC 2.1047(B) & 87.141(A) & (B)

6.7.1. Limits

(a) When A3E emission is used, the modulation percentage must not exceed 100 percent. This requirement does not apply to emergency locator transmitters or survival craft transmitters.

(b) A double sideband full carrier amplitude modulated radiotelephone transmitter with rated carrier power output exceeding 10 watts must be capable of automatically preventing modulation in excess of 100 percent.

(c) If any licensed radiotelephone transmitter causes harmful interference to any authorized radio service because of excessive modulation, the Commission will require the use of the transmitter to be discontinued until it is rendered capable of automatically preventing modulation in excess of 100 percent.

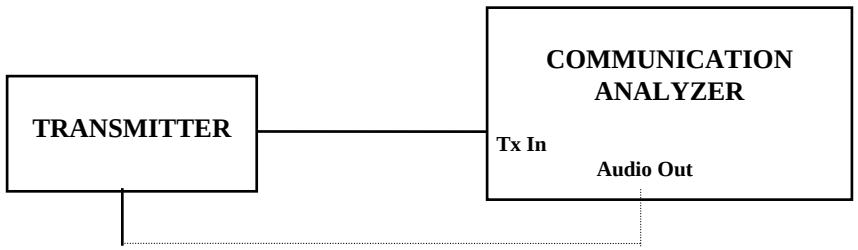
6.7.2. Method of Measurements

For Audio Transmitter:- The modulation percentage were measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum modulation percentage was recorded at each test condition.

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.
Communication Analyzer	Rohde & Schawrz	SMF02	879988/057

6.7.4. Test Arrangement



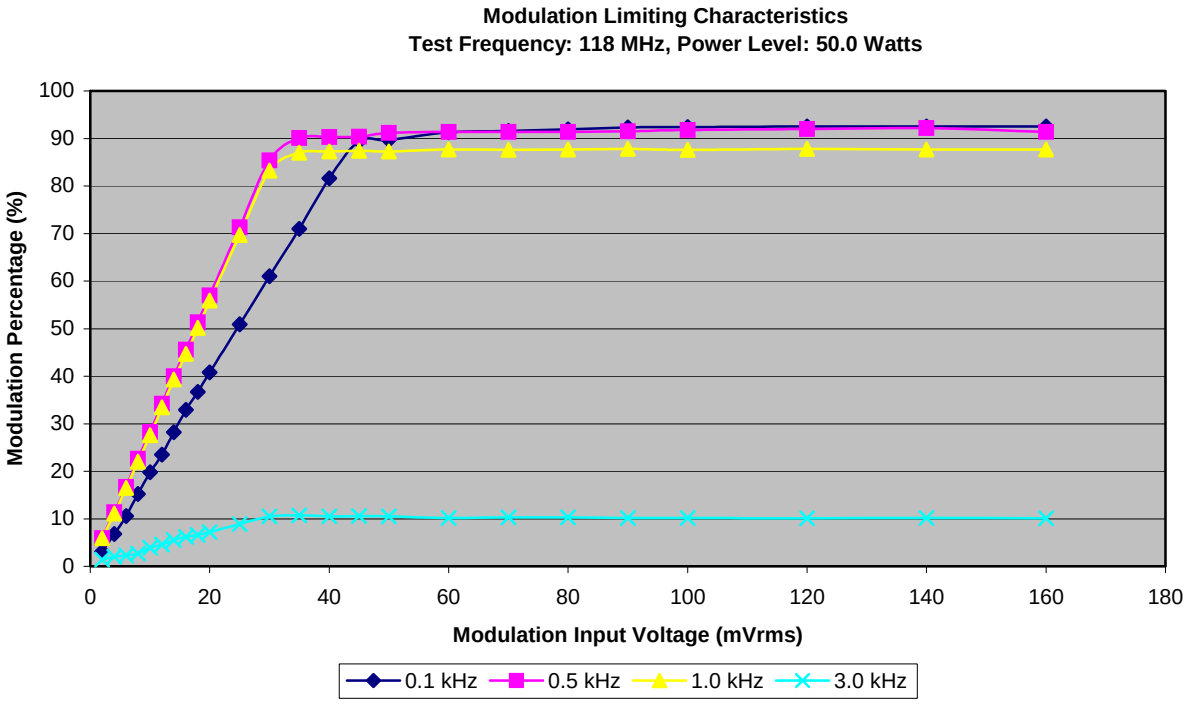
6.7.5. Test Data

6.7.5.1. Voice Modulation Limiting, Test Frequency: 118 MHz, Power Level: 50.0 Watts

MODULATING SIGNAL LEVEL	MODULATION PERCENTAGE (%) at the following modulating frequency:					LIMIT FOR MODULATION (%)
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(%)
2	3.1	5.9	5.9	1.4	0.9	100
4	6.8	11.4	11.1	2.0	0.9	100
6	10.6	16.7	16.5	2.3	0.9	100
8	15.2	22.6	22.0	2.7	0.9	100
10	19.8	28.3	27.6	3.9	0.9	100
12	23.5	34.2	33.5	4.6	0.9	100
14	28.2	40.0	39.3	5.5	0.9	100
16	32.9	45.6	44.7	6.2	0.9	100
18	36.7	51.3	50.2	6.6	0.9	100
20	40.8	57.0	55.9	7.2	0.9	100
25	50.9	71.3	69.7	8.9	0.9	100
30	61.0	85.4	83.2	10.5	0.9	100
35	71.0	90.1	87.0	10.7	0.9	100
40	81.6	90.3	87.3	10.5	0.7	100
45	89.4	90.4	87.4	10.6	0.6	100
50	89.7	91.2	87.3	10.5	0.6	100
60	91.3	91.4	87.7	10.2	0.5	100
70	91.6	91.4	87.6	10.3	0.4	100
80	91.9	91.4	87.7	10.3	0.4	100
90	92.3	91.5	87.8	10.2	0.3	100
100	92.4	91.8	87.6	10.2	0.4	100
120	92.5	92.0	87.8	10.1	0.3	100
140	92.5	92.2	87.7	10.2	0.3	100
160	92.5	91.4	87.7	10.1	0.3	100

Voice Signal Input Level = STD MOD Level + 16 dB = 25.08 + 16 = **41.08 dBmVrms** or **113.26 mV**
Standard Modulation Level measured at 50 % Modulation @ 1.0 kHz.

MODULATING FREQUENCY (KHz)	MODULATION PERCENTAGE (%)	LIMIT FOR MODULATION (%)
0.1	93.4	100
0.2	**96.5**	100
0.4	93.0	100
0.6	91.6	100
0.8	90.1	100
1.0	88.5	100
1.2	86.0	100
1.4	82.8	100
1.6	80.1	100
1.8	77.0	100
2.0	74.4	100
2.5	67.0	100
3.0	10.1	100
3.5	0.3	100
4.0	0.3	100
4.5	0.3	100
5.0	0.3	100
6.0	0.3	100
7.0	0.3	100
8.0	0.3	100
9.0	0.3	100
10.0	0.3	100


Modulation Limiting Characteristics
Test Frequency: 118 MHz, Power Level: 50.0 Watts
Modulation Percentage (%)
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
160
180
Modulation Input Voltage (mVrms)
0.1 kHz
0.5 kHz
1.0 kHz
3.0 kHz

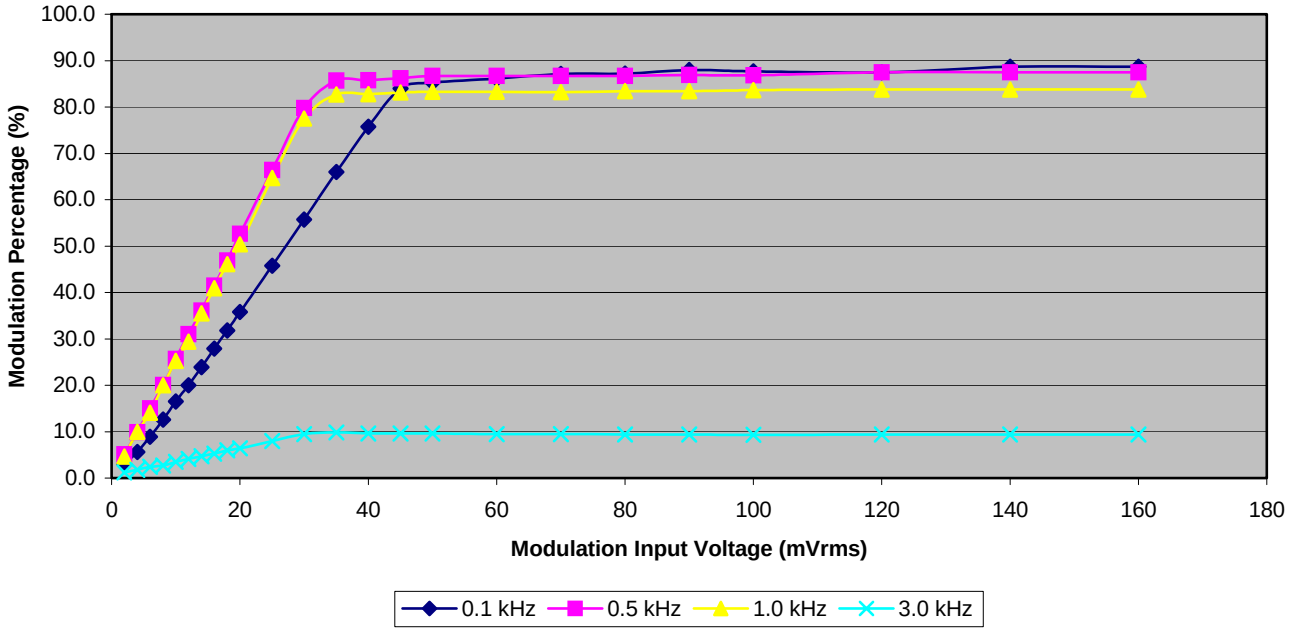
6.7.5.2. Voice Modulation Limiting, Test Frequency: 118 MHz, Power Level: 25.0 Watts

MODULATING SIGNAL LEVEL	Modulation Percentage (%) at the following modulating frequency:					LIMIT FOR MODULATION (%)
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(%)
2	3.0	5.1	4.6	1.2	0.7	100
4	5.6	9.9	10.0	1.8	0.7	100
6	8.9	15.0	14.1	2.4	0.7	100
8	12.6	20.1	20.0	2.7	0.7	100
10	16.5	25.7	25.3	3.5	0.7	100
12	20.0	31.0	29.4	4.1	0.7	100
14	23.9	36.1	35.5	4.7	0.7	100
16	27.9	41.5	40.9	5.3	0.7	100
18	31.8	46.9	46.1	6.0	0.7	100
20	35.8	52.7	50.4	6.4	0.6	100
25	45.8	66.4	64.7	8.0	0.7	100
30	55.7	79.8	77.5	9.5	0.7	100
35	66.0	85.7	82.7	9.8	0.6	100
40	75.7	85.8	82.8	9.6	0.6	100
45	84.0	86.2	83.1	9.6	0.6	100
50	85.3	86.7	83.3	9.6	0.6	100
60	86.1	86.7	83.3	9.5	0.4	100
70	87.1	86.7	83.2	9.5	0.4	100
80	87.2	86.7	83.4	9.4	0.4	100
90	88.0	86.9	83.4	9.4	0.3	100
100	87.7	86.8	83.6	9.3	0.3	100
120	87.5	87.5	83.8	9.4	0.3	100
140	88.7	87.5	83.8	9.4	0.3	100
160	88.7	87.5	83.8	9.4	0.3	100

Voice Signal Input Level = STD MOD Level + 16 dB = 25.98 + 16 = **41.98 dBVrms** or **125.56 mV**
Standard Modulation Level measured at 50 % Modulation @ 1.0 kHz.

MODULATING FREQUENCY (KHz)	MODULATION PERCENTAGE (%)	LIMIT FOR MODULATION (%)
0.1	88.6	100
0.2	**91.6**	100
0.4	88.5	100
0.6	86.9	100
0.8	85.5	100
1.0	83.8	100
1.2	81.2	100
1.4	78.2	100
1.6	75.8	100
1.8	72.8	100
2.0	70.2	100
2.5	63.0	100
3.0	9.3	100
3.5	0.2	100
4.0	0.2	100
4.5	0.2	100
5.0	0.2	100
6.0	0.2	100
7.0	0.2	100
8.0	0.2	100
9.0	0.2	100
10.0	0.2	100

Modulation Limiting Characteristics
Test Frequency: 118 MHz, Power Level: 25.0 Watts



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

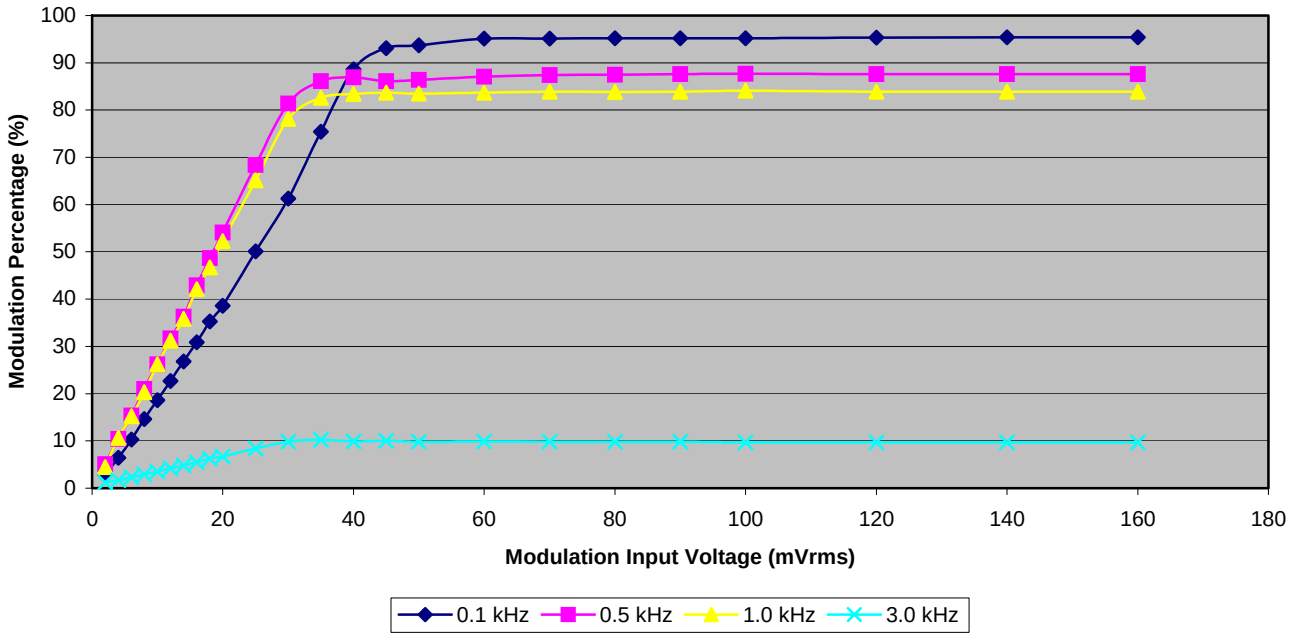
6.7.5.3. Voice Modulation Limiting, Test Frequency: 118 MHz, Power Level: 7.0 Watts

MODULATING SIGNAL LEVEL	Modulation Percentage (%) at the following modulating frequency:					LIMIT FOR MODULATION (%)
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(%)
2	2.8	5.1	4.5	1.2	0.7	100
4	6.4	10.4	10.6	1.7	0.6	100
6	10.3	15.4	15.2	2.3	0.6	100
8	14.6	21.0	20.3	2.9	0.6	100
10	18.6	26.2	26.2	3.5	0.6	100
12	22.7	31.7	31.2	4.2	0.7	100
14	26.8	36.3	35.8	4.8	0.7	100
16	30.9	42.9	42.1	5.5	0.6	100
18	35.3	48.7	46.7	6.2	0.7	100
20	38.6	54.1	52.3	6.7	0.7	100
25	50.1	68.4	65.1	8.4	0.7	100
30	61.3	81.4	78.1	9.8	0.7	100
35	75.4	86.1	82.6	10.2	0.7	100
40	88.6	86.9	83.4	9.9	0.6	100
45	93.1	86.1	83.7	10.0	0.6	100
50	93.7	86.4	83.5	9.8	0.5	100
60	95.1	87.1	83.7	9.9	0.4	100
70	95.1	87.4	83.9	9.8	0.4	100
80	95.2	87.5	83.8	9.8	0.4	100
90	95.2	87.6	83.9	9.8	0.3	100
100	95.2	87.7	84.1	9.7	0.3	100
120	95.3	87.6	83.9	9.7	0.2	100
140	95.4	87.6	83.9	9.7	0.2	100
160	95.4	87.6	83.9	9.7	0.2	100

Voice Signal Input Level = STD MOD Level + 16 dB = 25.70 + 16 = **41.70 dBVrms** or **121.59 mV**
Standard Modulation Level measured at 50 % Modulation @ 1.0 kHz.

MODULATING FREQUENCY (KHz)	MODULATION PERCENTAGE (%)	LIMIT FOR MODULATION (%)
0.1	**95.3**	100
0.2	92.4	100
0.4	89.0	100
0.6	86.8	100
0.8	85.3	100
1.0	83.9	100
1.2	81.5	100
1.4	78.6	100
1.6	76.0	100
1.8	73.0	100
2.0	70.4	100
2.5	63.4	100
3.0	9.8	100
3.5	0.3	100
4.0	0.3	100
4.5	0.2	100
5.0	0.2	100
6.0	0.2	100
7.0	0.2	100
8.0	0.2	100
9.0	0.2	100
10.0	0.2	100

Modulation Limiting Characteristics
Test Frequency: 118 MHz, Power Level: 7.0 Watts



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

6.8. 99% OCCUPIED BANDWIDTH AND EMISSION LIMITATIONS @ FCC 2.1049 & 87.139

6.8.1. Limits

FCC 90.139(a) - Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the frequency bands 1435–1535 MHz and 2310–2390 MHz or digital modulation (G7D) for differential GPS, the mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log10 pY dB.

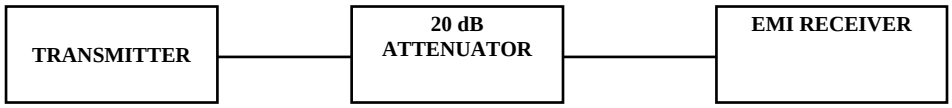
6.8.2. Method of Measurements

Refer to Exhibit 8, § 8.4 of this report for measurement details

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
EMI Receiver/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Audio Oscillator	Hewlett Packard	HP 204C	0989A08798	DC to 1.2 MHz

6.8.4. Test Arrangement



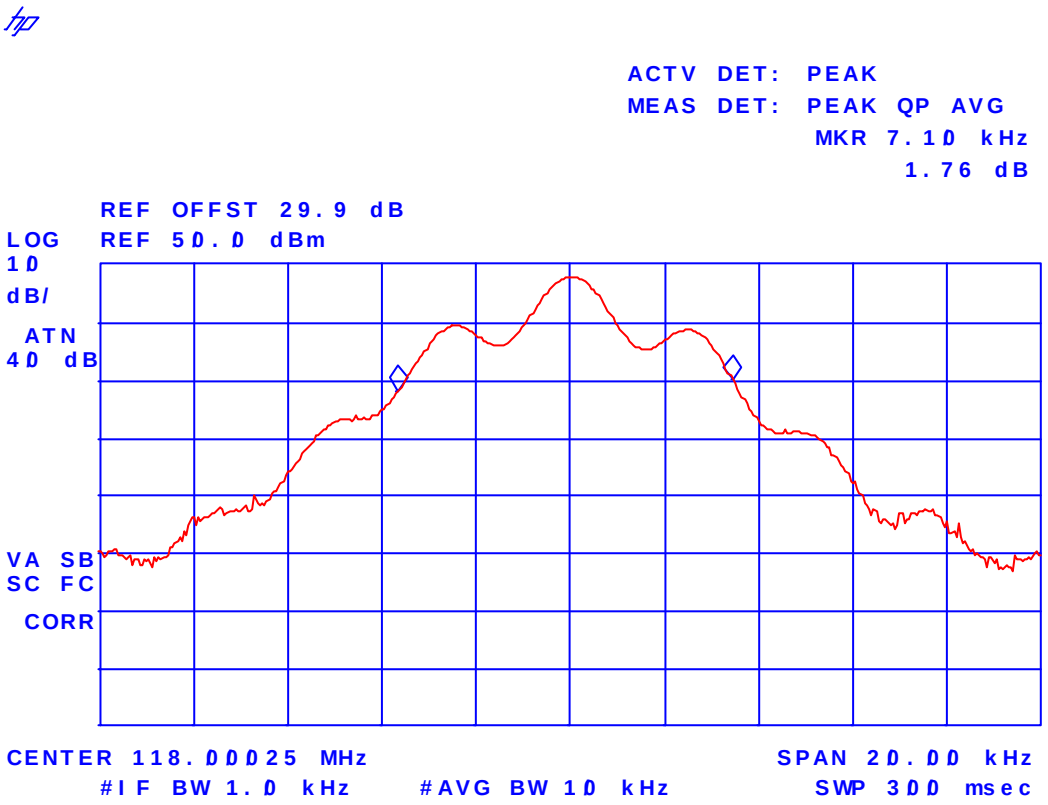
6.8.5. Test Data

6.8.5.1. 99% Occupied Bandwidth

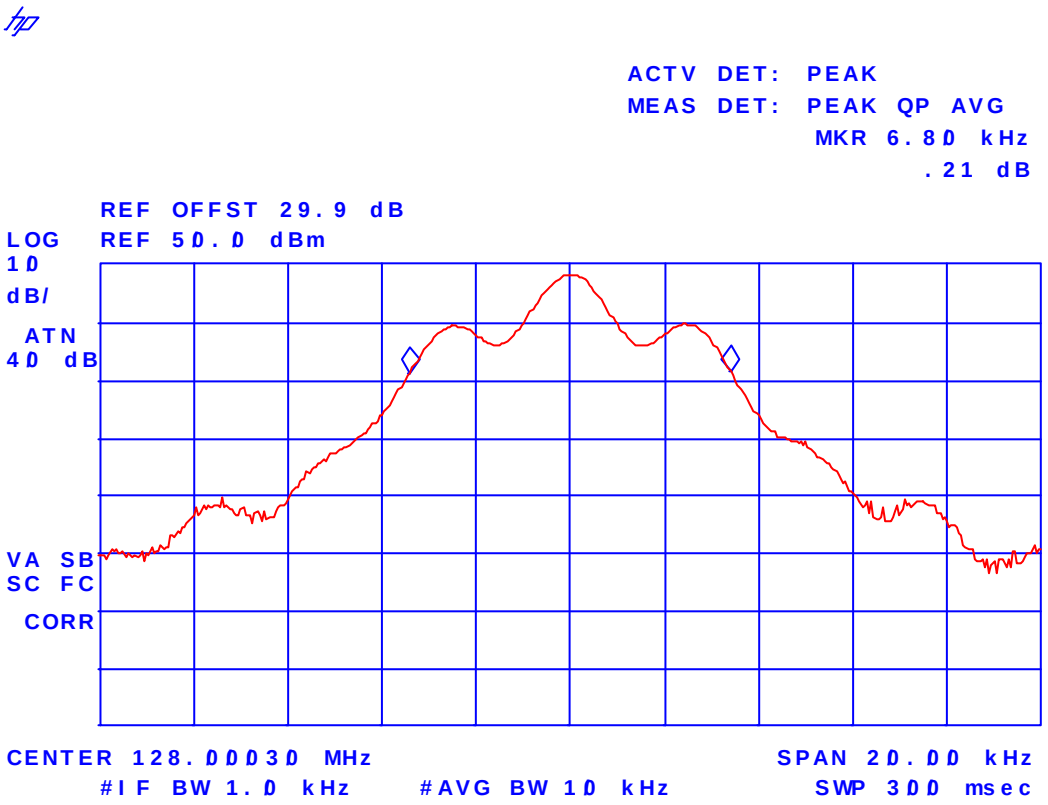
Frequency (MHz)	Power Level Setting	Modulation	Measured 99% OBW (kHz)	Authorized Bandwidth (kHz)
118.0	High (50w)	AM Double Side Band	7.10	25.0
128.0	High (50w)	AM Double Side Band	6.80	25.0
138.0	High (50w)	AM Double Side Band	6.90	25.0
118.0	Medium (25w)	AM Double Side Band	6.90	25.0
128.0	Medium (25w)	AM Double Side Band	6.90	25.0
138.0	Medium (25w)	AM Double Side Band	6.85	25.0
118.0	Low (7w)	AM Double Side Band	7.00	25.0
128.0	Low (7w)	AM Double Side Band	6.75	25.0
138.0	Low (7w)	AM Double Side Band	6.75	25.0

Conform. Please refer to Plots # 1 through # 9 for Details of measurements

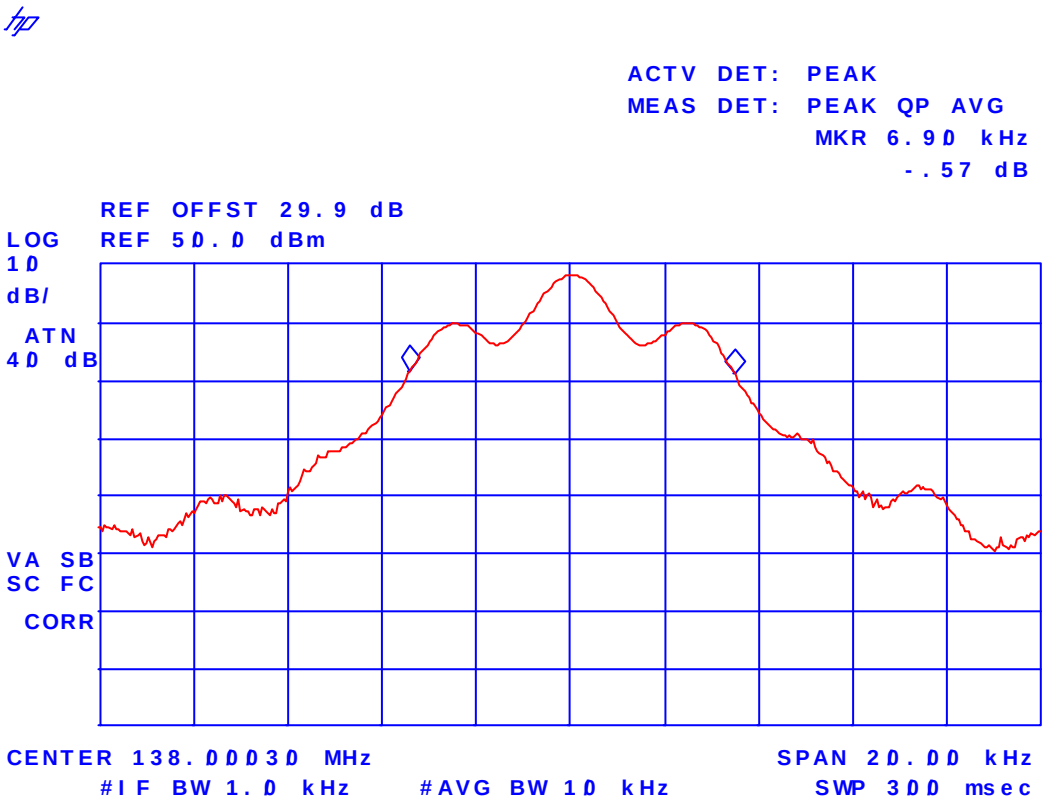
Plot # 1 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 118.0 MHz, High Power Setting



Plot # 2 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 128.0 MHz, High Power Setting

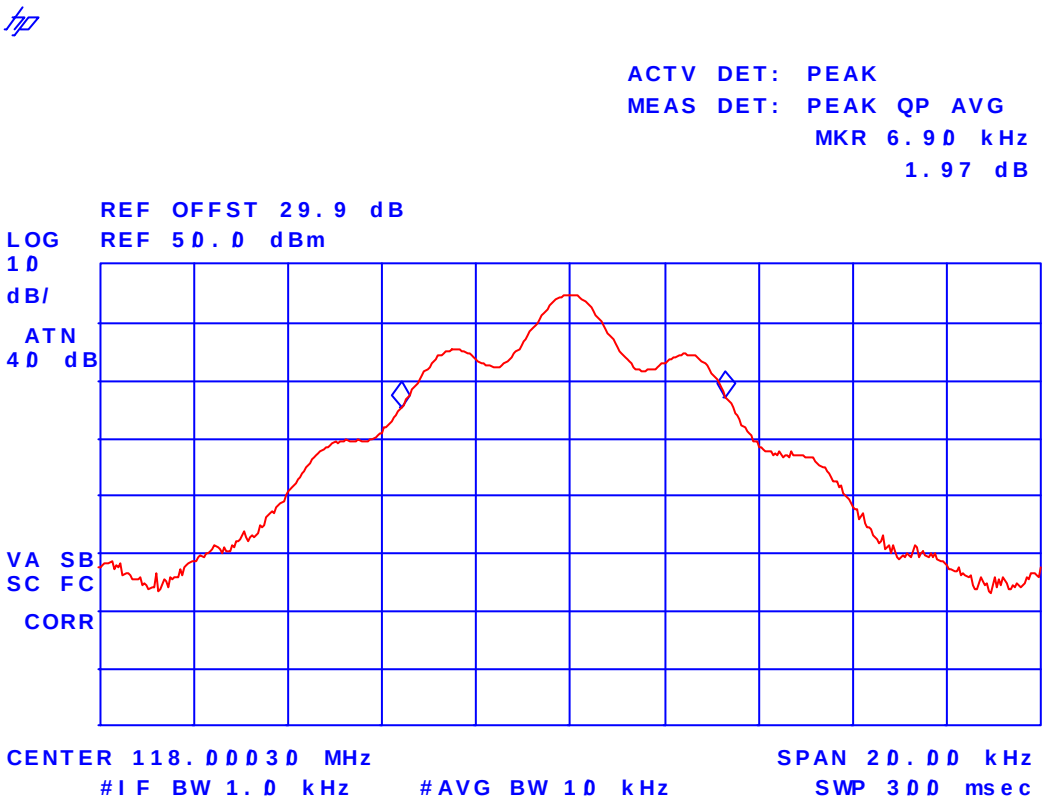


Plot # 3 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 138.0 MHz, High Power Setting

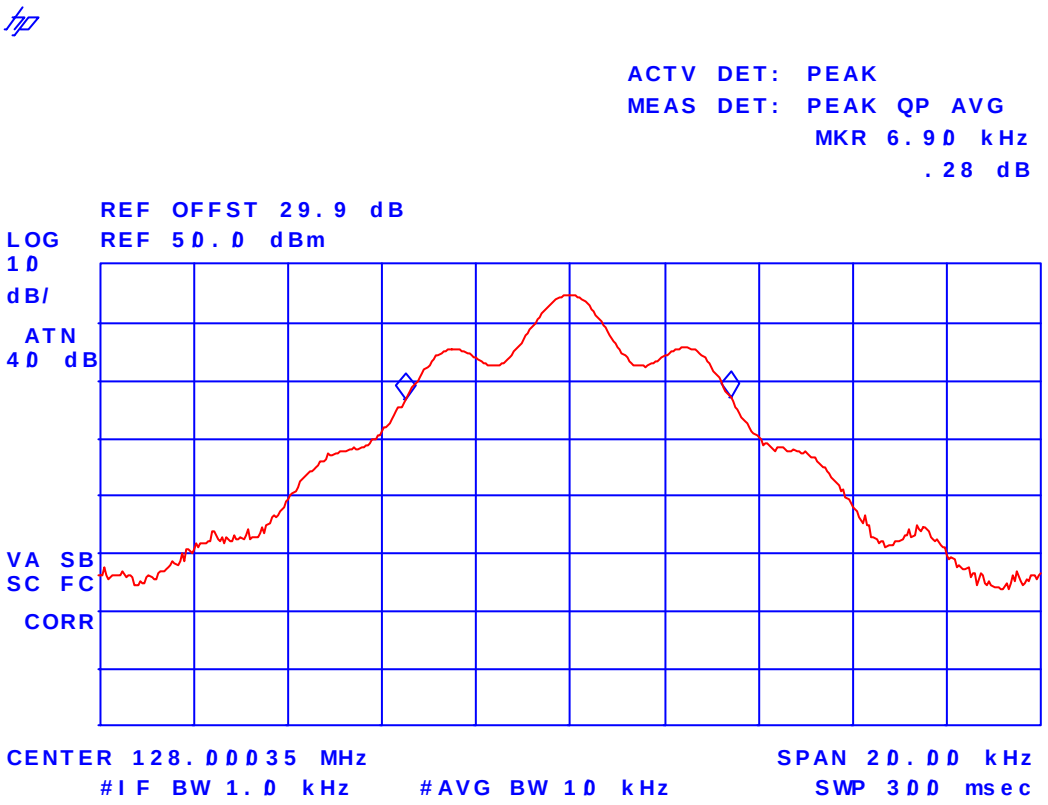


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

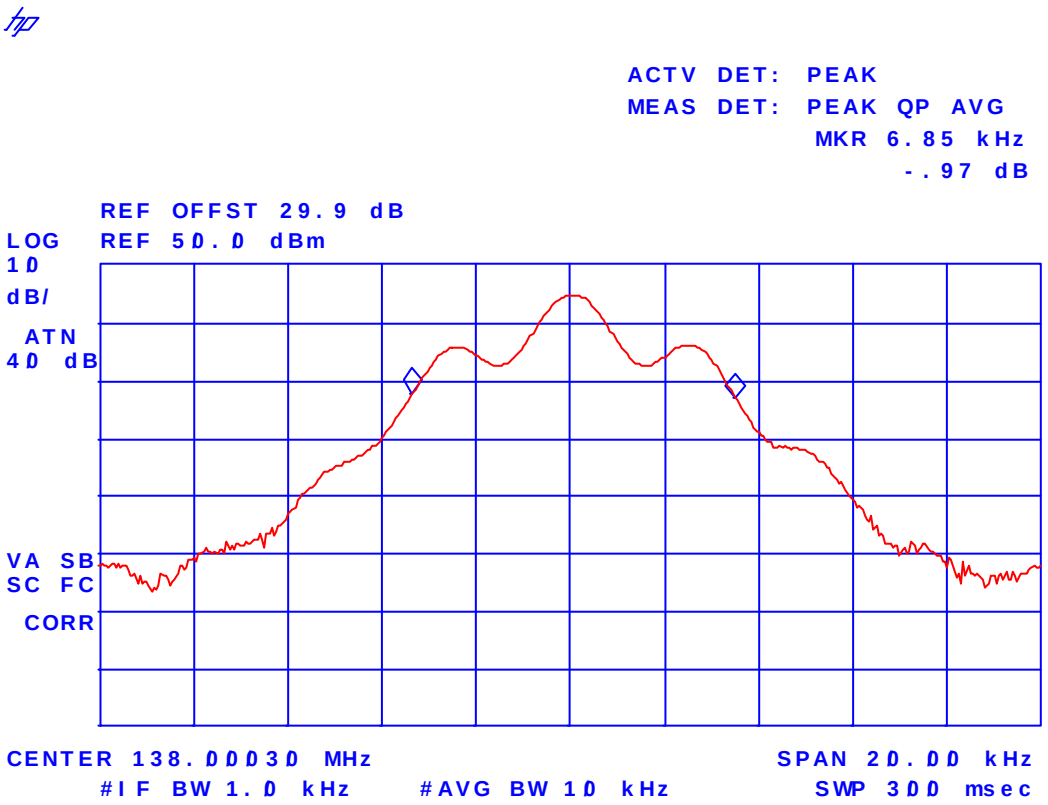
Plot # 4 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 118.0 MHz, Medium Power Setting



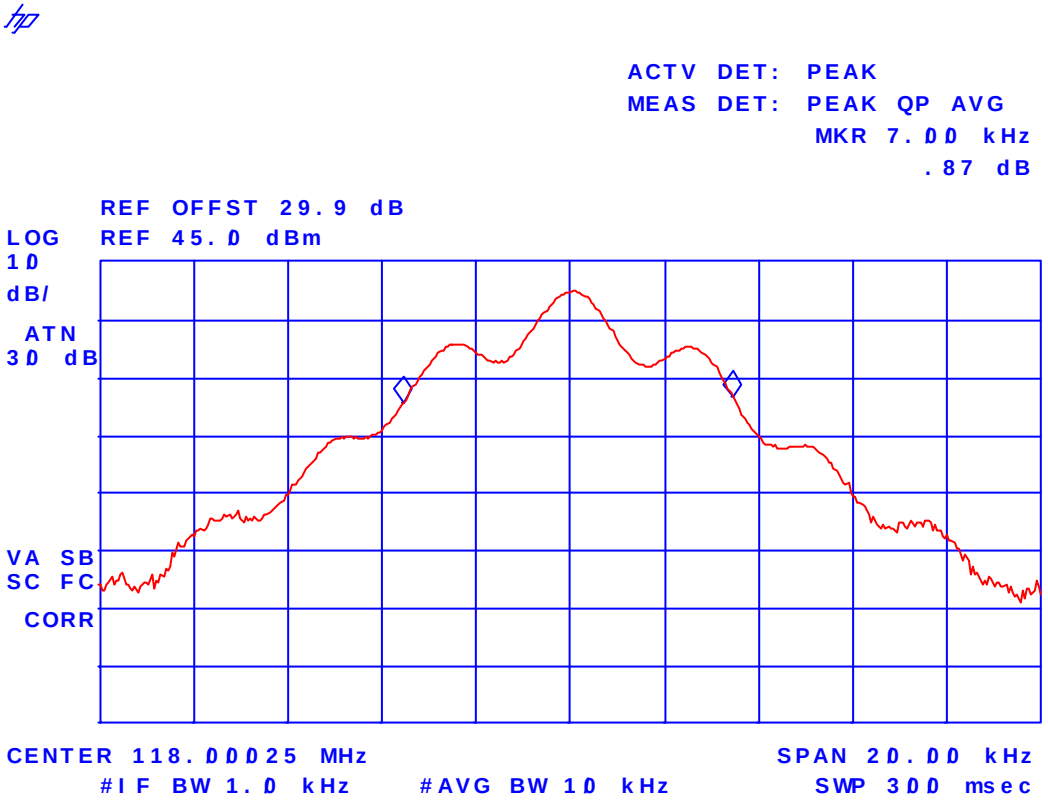
Plot # 5 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 128.0 MHz, Medium Power Setting



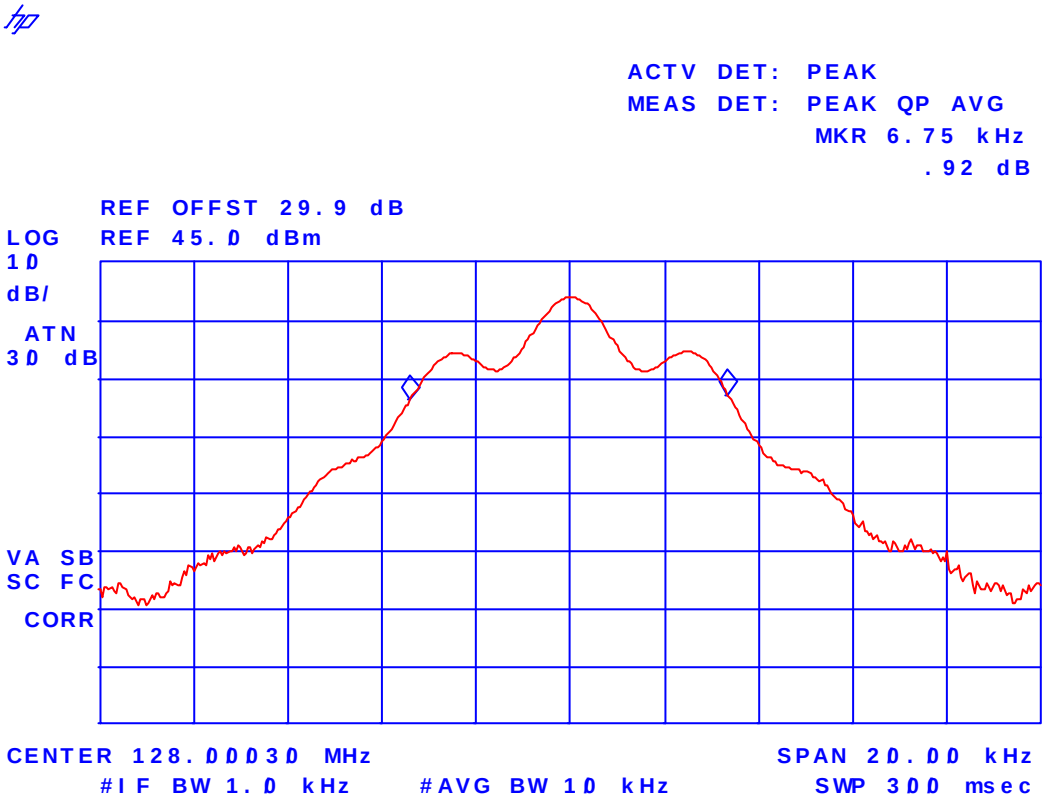
Plot # 6 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 138.0 MHz, Medium Power Setting



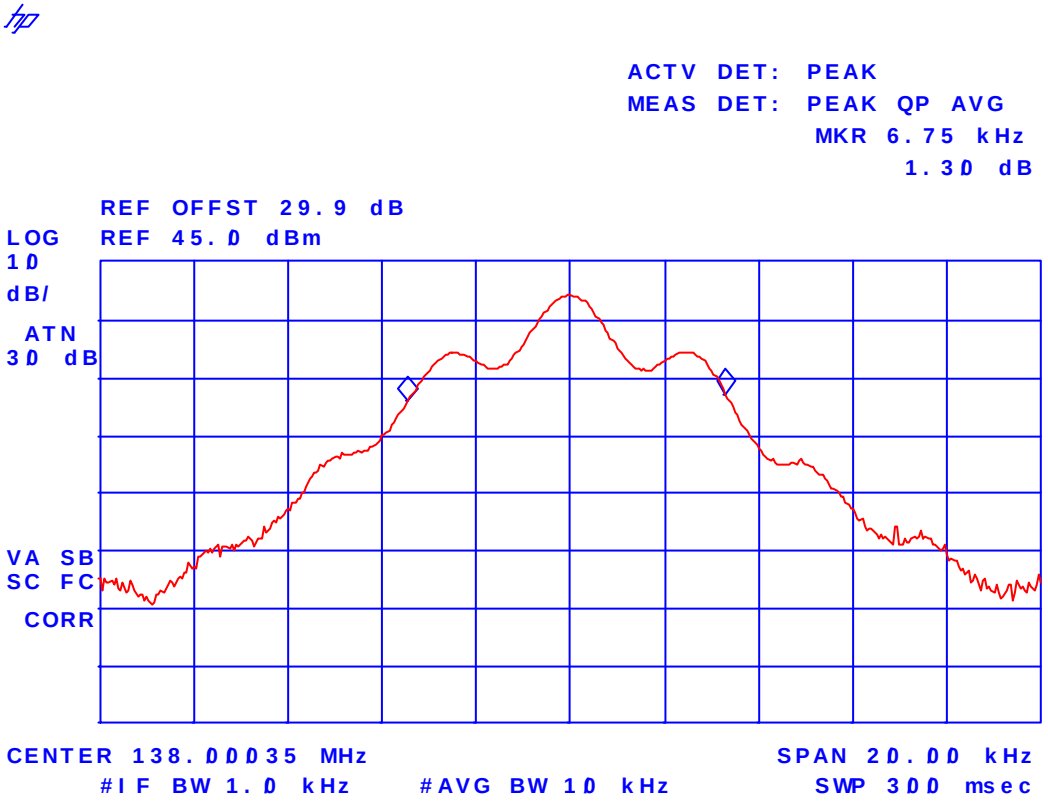
Plot # 7 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 118.0 MHz, Low Power Setting



Plot # 8 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 128.0 MHz, Low Power Setting



Plot # 9 **99% Occupied Bandwidth, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 138.0 MHz, Low Power Setting



6.8.5.2. Emission Limitations

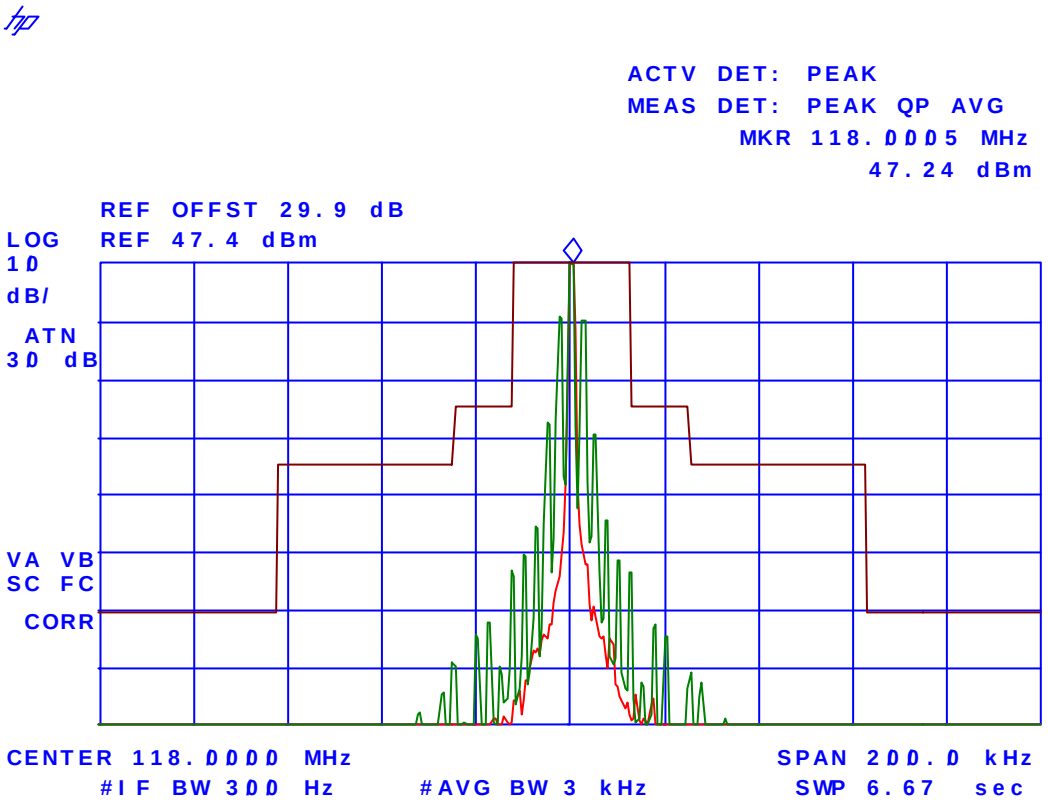
- Please refer to Plots # 10 to 12 for Measurement of Emission Limitations for AM DSB Modulation in High Power setting for 25 kHz channel spacing operation.

- Please refer to Plots # 13 to 15 for Measurement of Emission Limitations for AM DSB Modulation in Medium Power setting for 25 kHz channel spacing operation.

- Please refer to Plots # 16 to 18 for Measurement of Emission Limitations for AM DSB Modulation in Low Power setting for 25 kHz channel spacing operation.

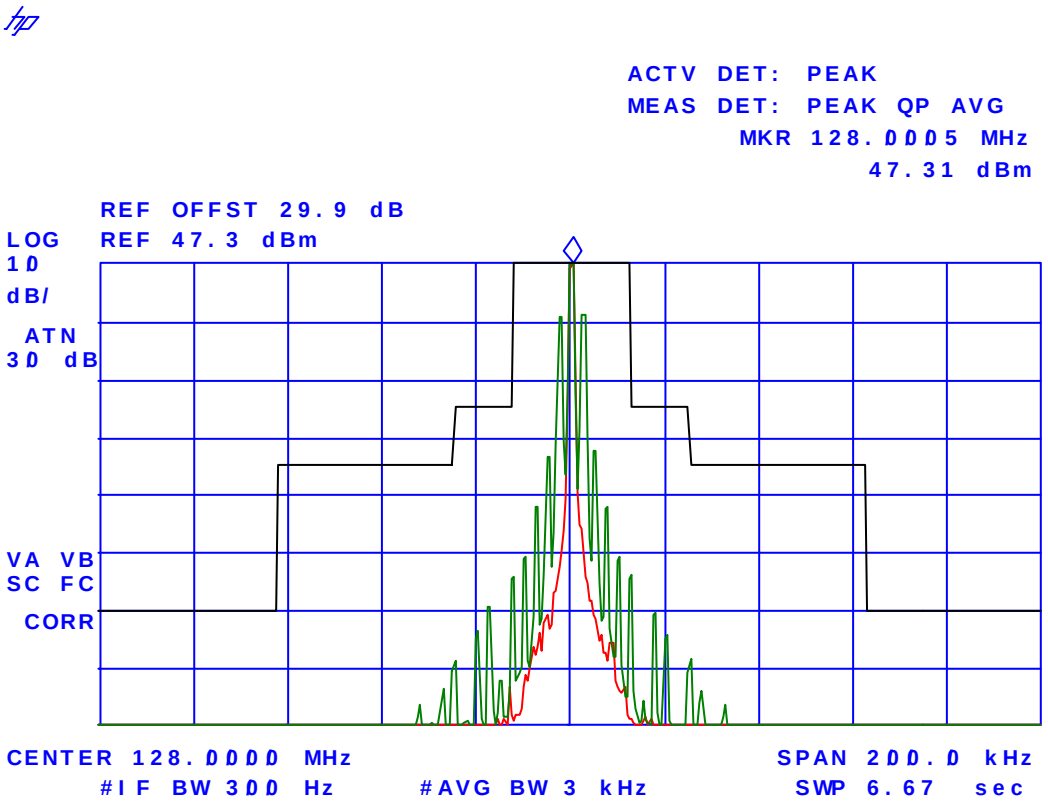
Conform. Please refer to Plots # 10 through # 18 for Details of measurements.

Plot # 10 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 118.0 MHz, High Power Setting with 25 KHz Channel Spacing

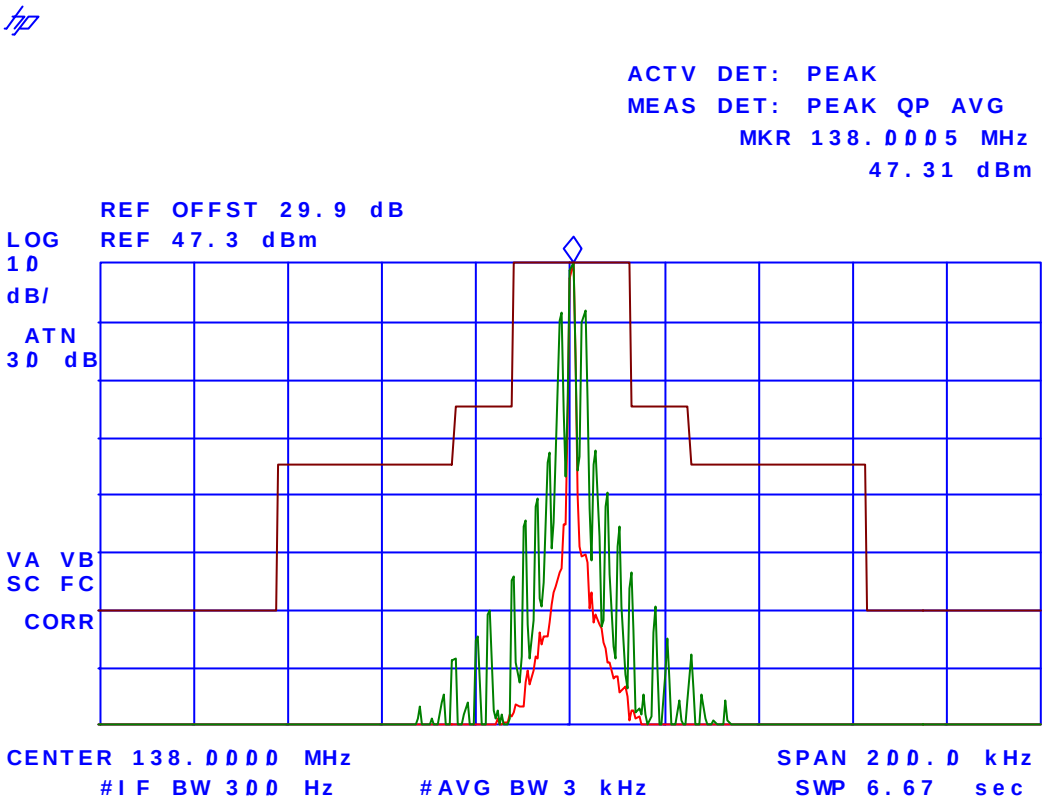


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 11 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 128.0 MHz, High Power Setting with 25 KHz Channel Spacing

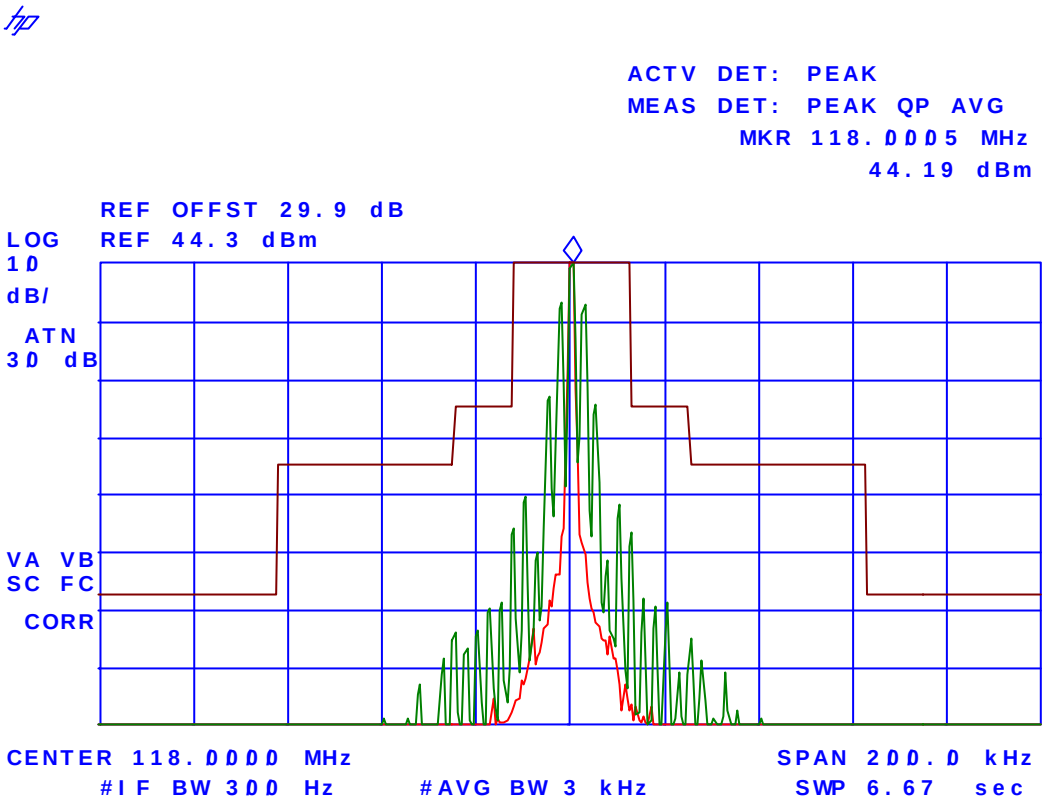


Plot # 12 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 138.0 MHz, High Power Setting with 25 KHz Channel Spacing

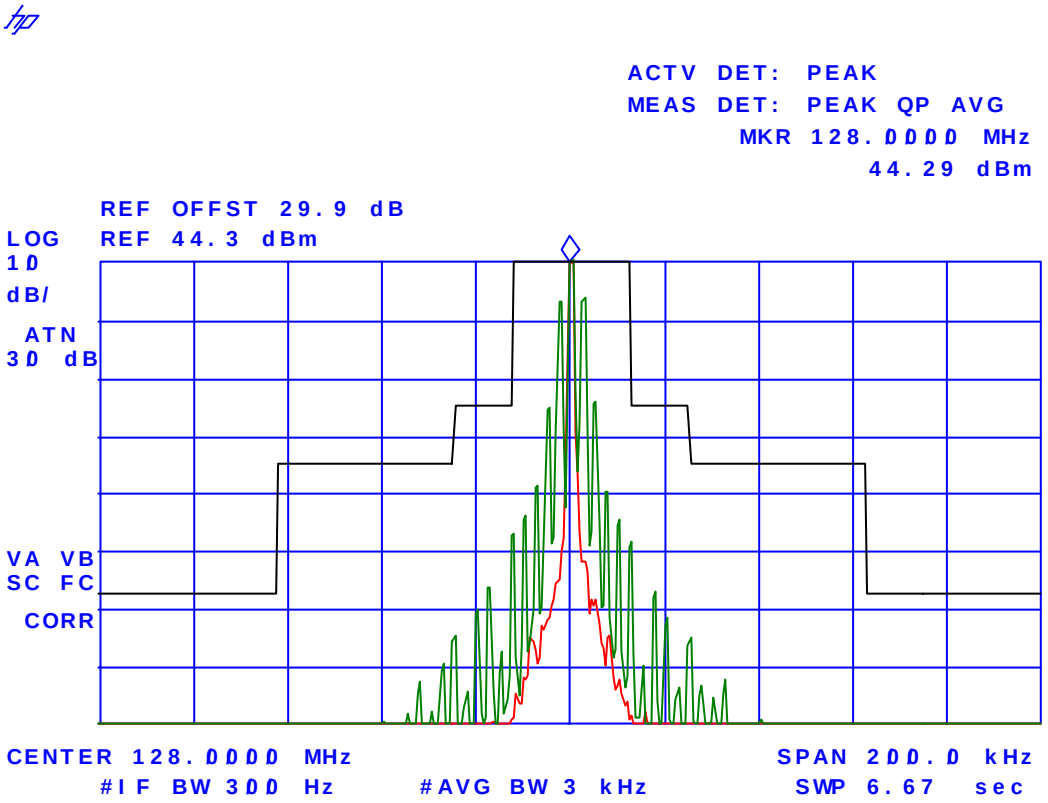


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

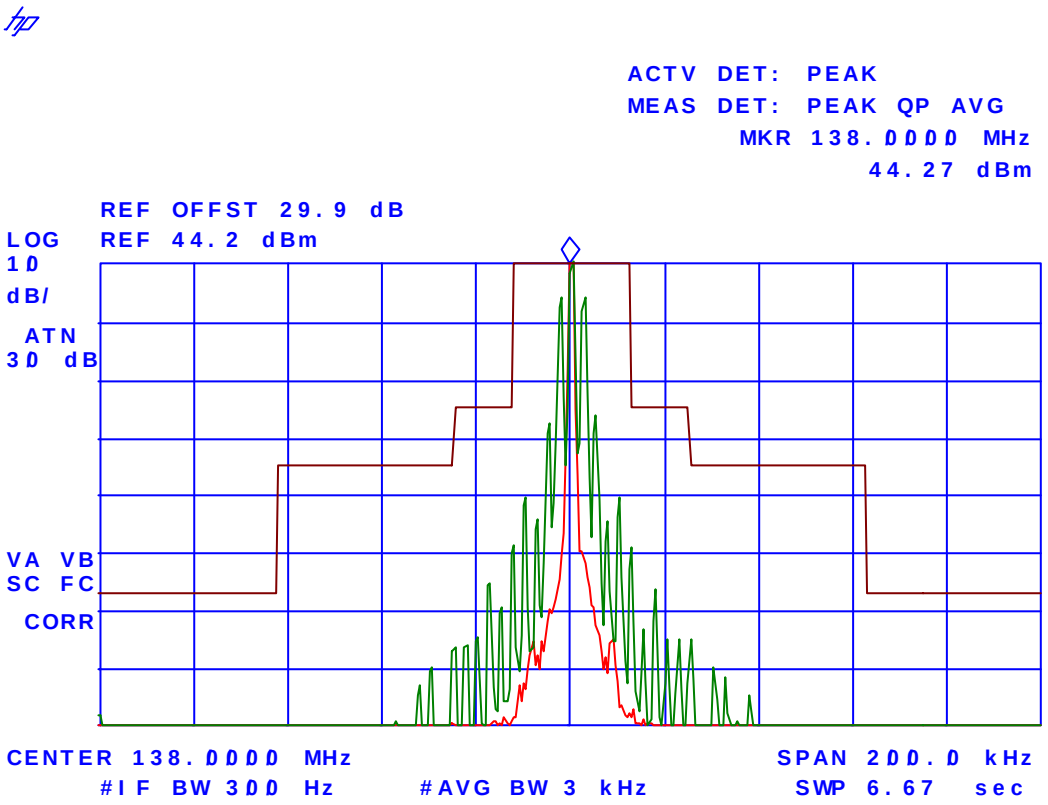
Plot # 13 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 118.0 MHz, Medium Power Setting with 25 KHz Channel Spacing



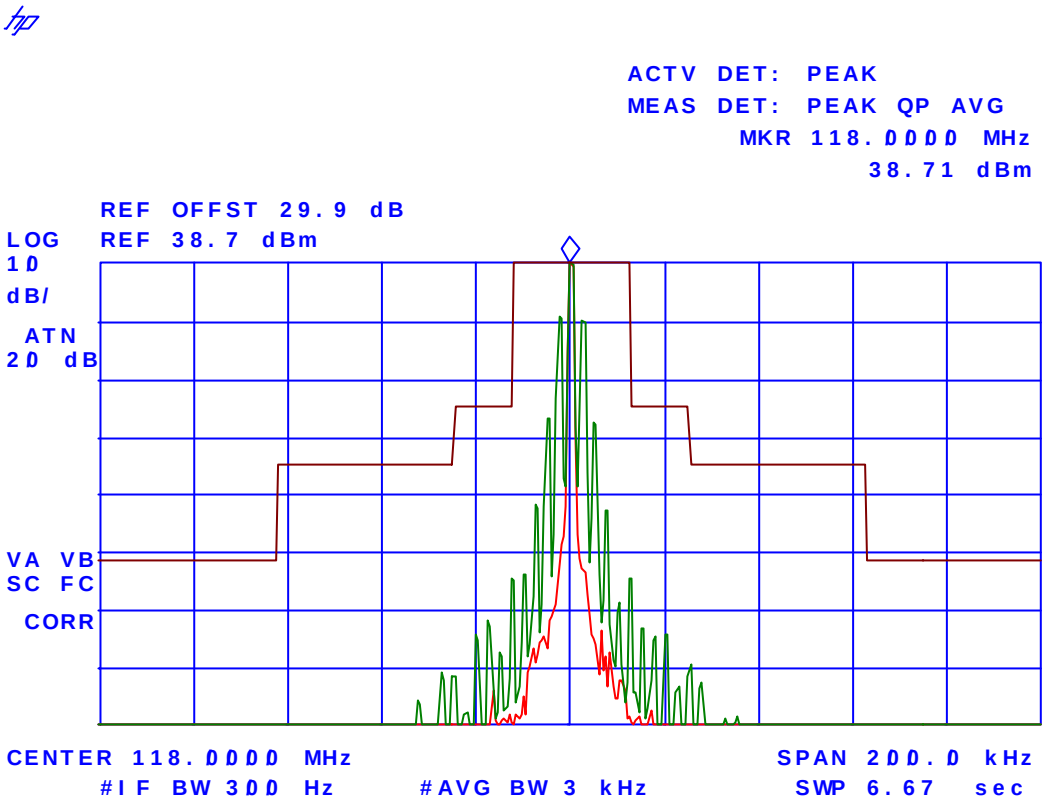
Plot # 14 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 128.0 MHz, Medium Power Setting with 25 KHz Channel Spacing



Plot # 15 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 138.0 MHz, Medium Power Setting with 25 KHz Channel Spacing

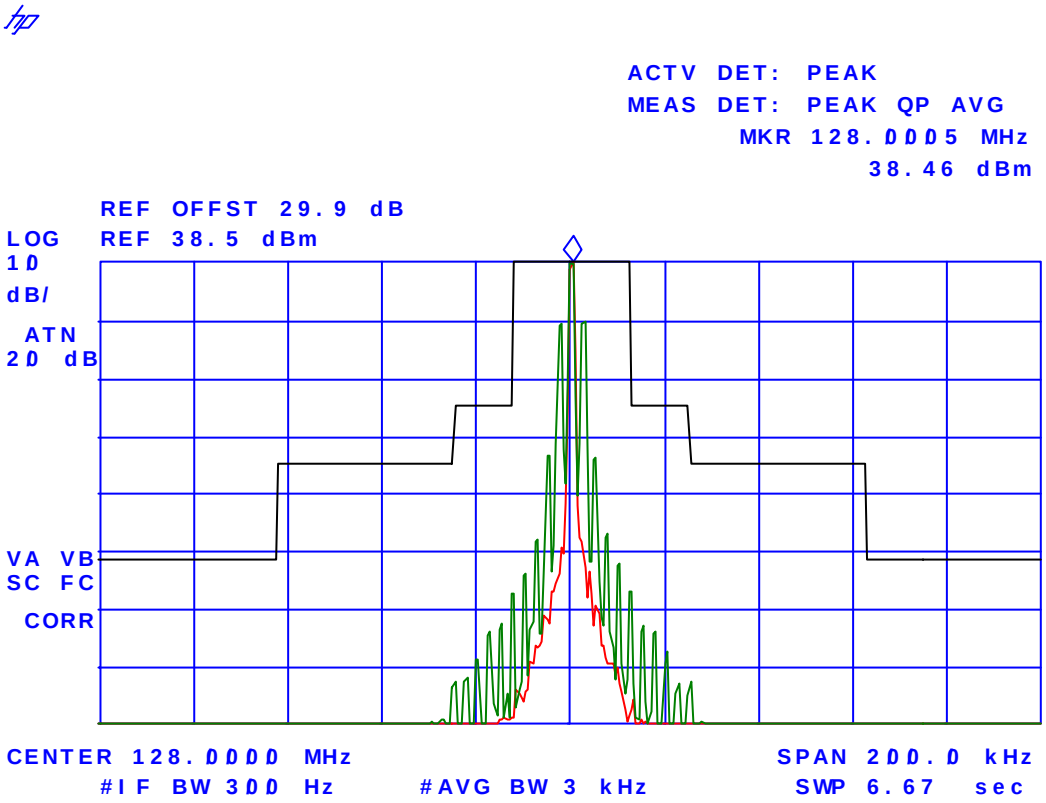


Plot # 16 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 118.0 MHz, Low Power Setting with 25 KHz Channel Spacing

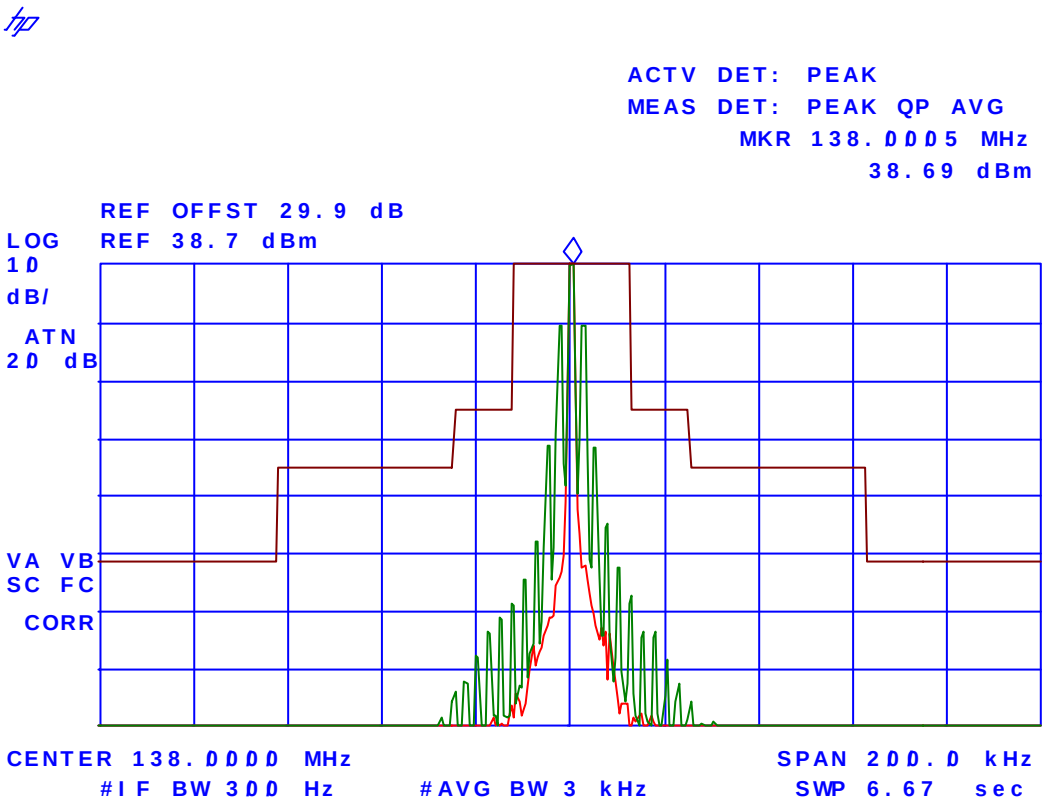


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 17 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave signal**
Freq: 128.0 MHz, Low Power Setting with 25 KHz Channel Spacing



Plot # 18 **Emission Limitations, AM Modulation with 2.5 kHz Sine Wave Signal**
Freq: 138.0 MHz, Low Power Setting with 25 KHz Channel Spacing



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

6.9. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS @ FCC 87.139

6.9.1. Limits

FCC 87.139(a)(3) - When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log10 pY dB.

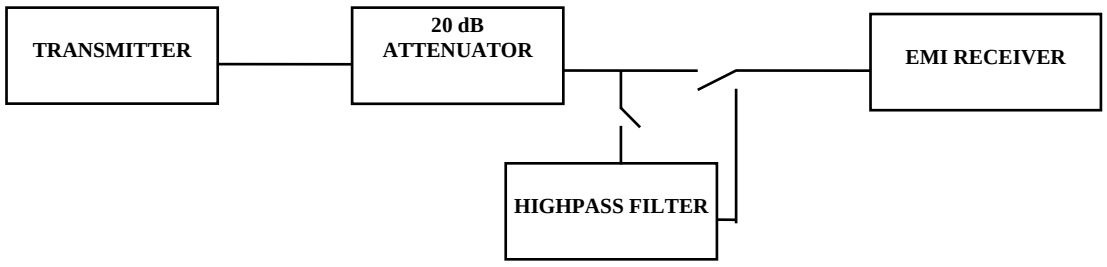
6.9.2. Method of Measurements

Refer to Exhibit 8 § 8.5 of this report for measurement details

6.9.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
EMI Receiver/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Attenuator(s)	Bird	..	…	DC – 22 GHz
Audio Oscillator	Hewlett Packard	HP 204C	0989A08798	DC to 1.2 MHz
Highpass Filter, Microphase	Microphase	CR220HID	IITI11000AC	Cut-off Frequency at 600 MHz, 1.3 GHz or 4 GHz

6.9.4. Test Arrangement



Note: There was no difference in spurious/harmonic emissions on the pre-scans for narrow band and wide band operation. Therefore the rf spurious/harmonic emissions in this section would be performed for 25 kHz Channel Spacing and the limit of 43 + 10*log(P) would be applied.

6.9.5. Test Data

6.9.5.1. High Power Setting (46.99 dBm) at Lowest Frequency (118.0 MHz)

Fundamental Frequency:	118.0 MHz
RF Output Power:	46.99 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY (MHz)	TRANSMITTER CONDUCTED ANTENNA EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
236	-30.1	-77.1	-60.0	-17.1	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded. Please refer to plots # 19 & 20 for details of measurement.

6.9.5.2. High Power Setting (46.99 dBm) at Middle Frequency (128.0 MHz)

Fundamental Frequency:	128.0 MHz
RF Output Power:	46.99 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY (MHz)	TRANSMITTER CONDUCTED ANTENNA EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
259	-18.7	-65.7	-60.0	-5.7	PASS
386	-25.2	-72.2	-60.0	-12.2	PASS
643	-29.6	-76.6	-60.0	-16.6	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded. Please refer to plots # 21 & 22 for details of measurement.

6.9.5.3. High Power Setting (46.99 dBm) at Highest Frequency (138.0 MHz)

Fundamental Frequency:	138.0 MHz
RF Output Power:	46.99 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY (MHz)	TRANSMITTER CONDUCTED ANTENNA EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
278	-13.5	-60.5	-60.0	-0.5	PASS
417	-30.8	-77.8	-60.0	-17.8	PASS
554	-30.7	-77.7	-60.0	-17.7	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded. Please refer to plots # 23 & 24 for details of measurement.

6.9.5.4. Medium Power Setting (43.98 dBm) at Lowest Frequency (118.0 MHz)

Fundamental Frequency:	118.0 MHz
RF Output Power:	43.98 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY	TRANSMITTER CONDUCTED ANTENNA EMISSIONS		LIMIT	MARGIN	PASS/
(MHz)	(dBm)	(dBc)	(dBc)	(dB)	FAIL
236	-27.5	-71.5	-57.0	-14.5	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded. Please refer to plots # 25 & 26 for details of measurement.

6.9.5.5. Medium Power Setting (43.98 dBm) at Middle Frequency (128.0 MHz)

Fundamental Frequency:	128.0 MHz
RF Output Power:	43.98 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY	TRANSMITTER CONDUCTED ANTENNA EMISSIONS		LIMIT	MARGIN	PASS/
(MHz)	(dBm)	(dBc)	(dBc)	(dB)	FAIL
259	-22.3	-66.3	-57.0	-9.3	PASS
386	-27.0	-71.0	-57.0	-14.0	PASS
643	-31.2	-75.2	-57.0	-18.2	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded. Please refer to plots # 27 & 28 for details of measurement.

6.9.5.6. Medium Power Setting (43.98 dBm) at Highest Frequency (138.0 MHz)

Fundamental Frequency:	138.0 MHz
RF Output Power:	43.98 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY	TRANSMITTER CONDUCTED ANTENNA EMISSIONS		LIMIT	MARGIN	PASS/
(MHz)	(dBm)	(dBc)	(dBc)	(dB)	FAIL
278	-16.0	-60.0	-57.0	-3.0	PASS
417	-25.1	-69.1	-57.0	-12.1	PASS
554	-32.1	-76.1	-57.0	-19.1	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded. Please refer to plots # 29 & 30 for details of measurement.

6.9.5.7. Low Power Setting (38.46 dBm) at Lowest Frequency (118.0 MHz)

Fundamental Frequency:	118.0 MHz
RF Output Power:	38.46 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY	TRANSMITTER CONDUCTED ANTENNA EMISSIONS		LIMIT	MARGIN	PASS/
(MHz)	(dBm)	(dBc)	(dBc)	(dB)	FAIL
236	-26.2	-64.7	-51.5	-13.2	PASS
357	-30.0	-68.5	-51.5	-17.0	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and no emissions within 20 dB below the limits were found. Please refer to plots # 31 & 32 for details of measurement.

6.9.5.8. Low Power Setting (38.46 dBm) at Middle Frequency (128.0 MHz)

Fundamental Frequency:	128.0 MHz
RF Output Power:	38.46 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

FREQUENCY	TRANSMITTER CONDUCTED ANTENNA EMISSIONS		LIMIT	MARGIN	PASS/
(MHz)	(dBm)	(dBc)	(dBc)	(dB)	FAIL
259	-29.1	-67.6	-51.5	-16.1	PASS
386	-30.3	-68.8	-51.5	-17.3	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and no emissions within 20 dB below the limits were found. Please refer to plots # 33 & 34 for details of measurement.

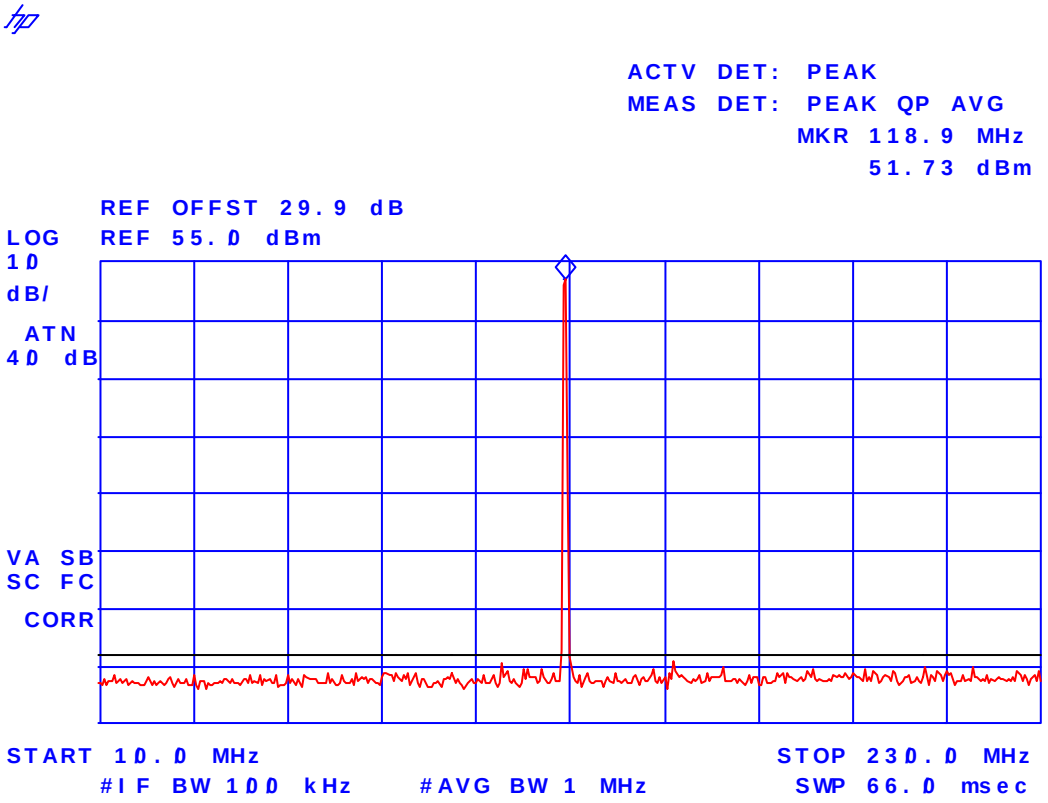
6.9.5.9. Low Power Setting (38.46 dBm) at Highest Frequency (138.0 MHz)

Fundamental Frequency:	138.0 MHz
RF Output Power:	38.46 dBm (Conducted)
Modulation:	AM modulation with 2.5 kHz Sine Wave Signal

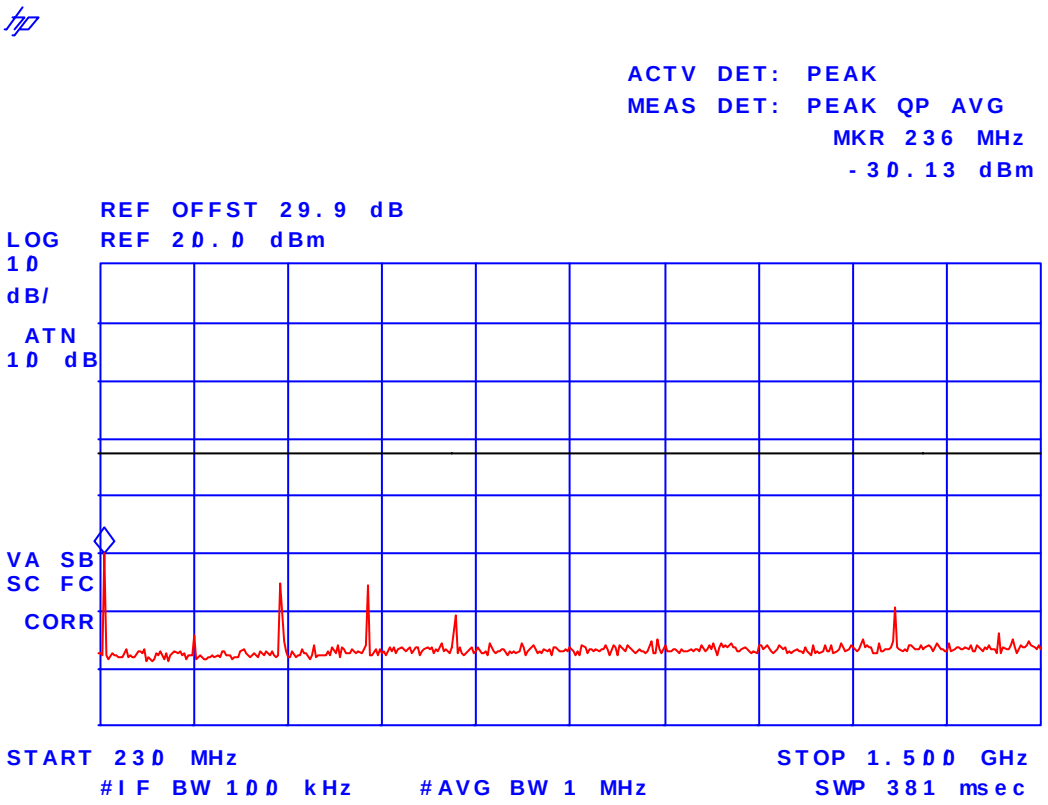
FREQUENCY	TRANSMITTER CONDUCTED ANTENNA EMISSIONS		LIMIT	MARGIN	PASS/
(MHz)	(dBm)	(dBc)	(dBc)	(dB)	FAIL
278	-28.5	-67.0	-51.5	-15.5	PASS
417	-31.6	-70.1	-51.5	-18.6	PASS

The emissions were scanned from 10 MHz to 1.5 GHz and no emissions within 20 dB below the limits were found. Please refer to plots # 35 & 36 for details of measurement.

Plot # 19 **Transmitter Antenna Power Conducted Emissions.**
Freq. 118 MHz, High Power Setting: 46.99 dBm

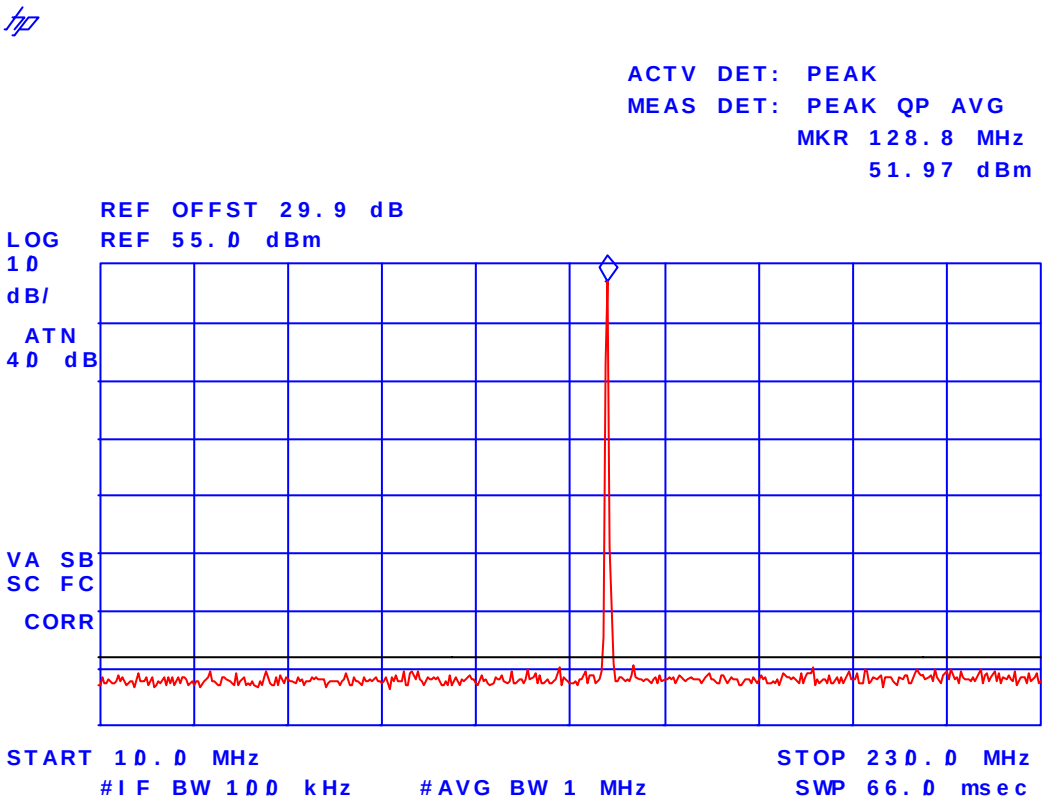


Plot # 20 **Transmitter Antenna Power Conducted Emissions.**
Freq. 118 MHz, High Power Setting: 46.99 dBm

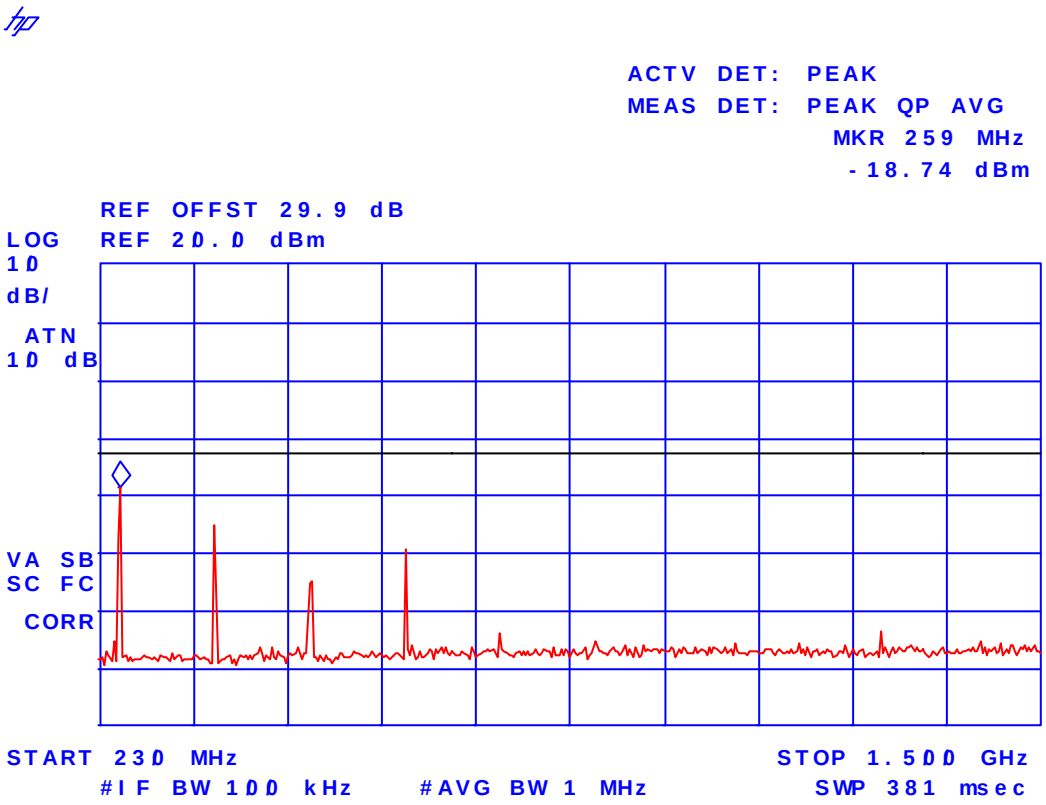


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

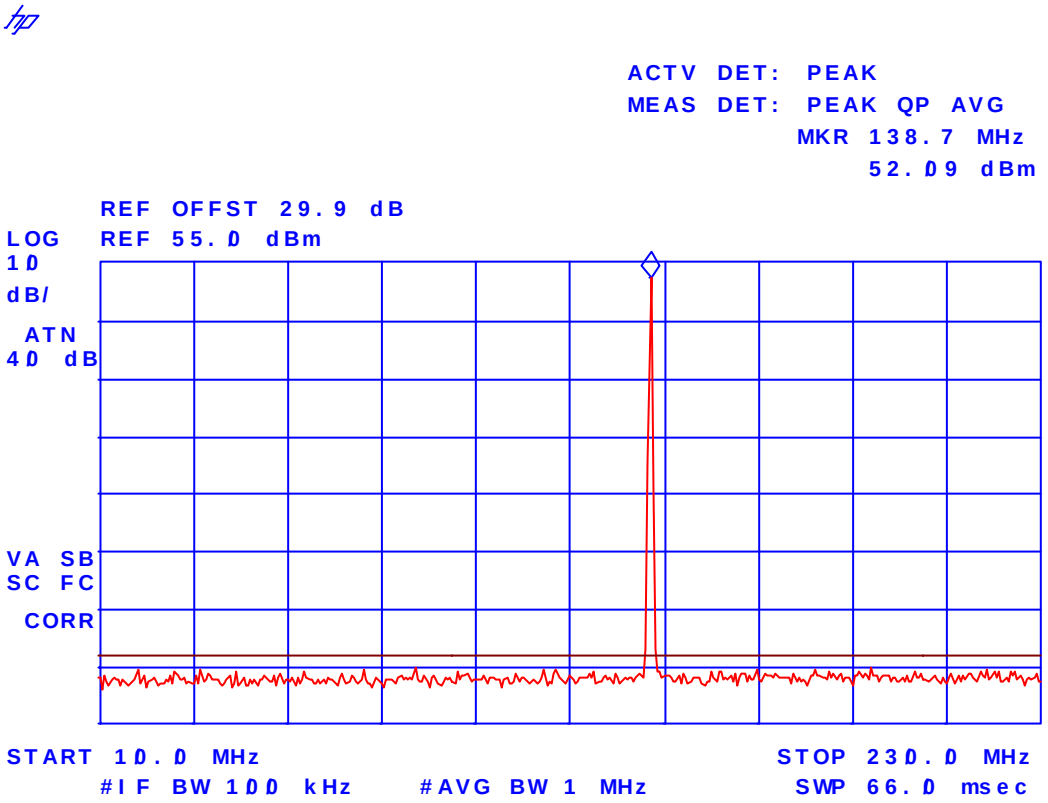
Plot # 21 **Transmitter Antenna Power Conducted Emissions.**
Freq. 128 MHz, High Power Setting: 46.99 dBm



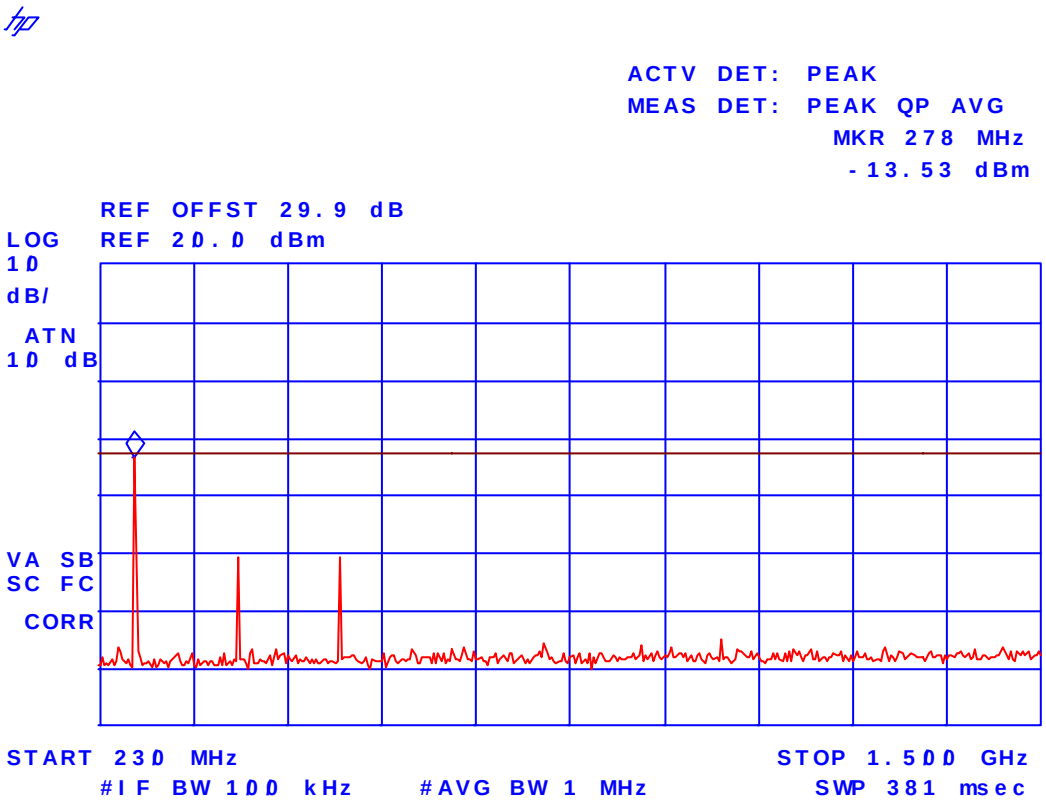
Plot # 22 **Transmitter Antenna Power Conducted Emissions.**
Freq. 128 MHz, High Power Setting: 46.99 dBm



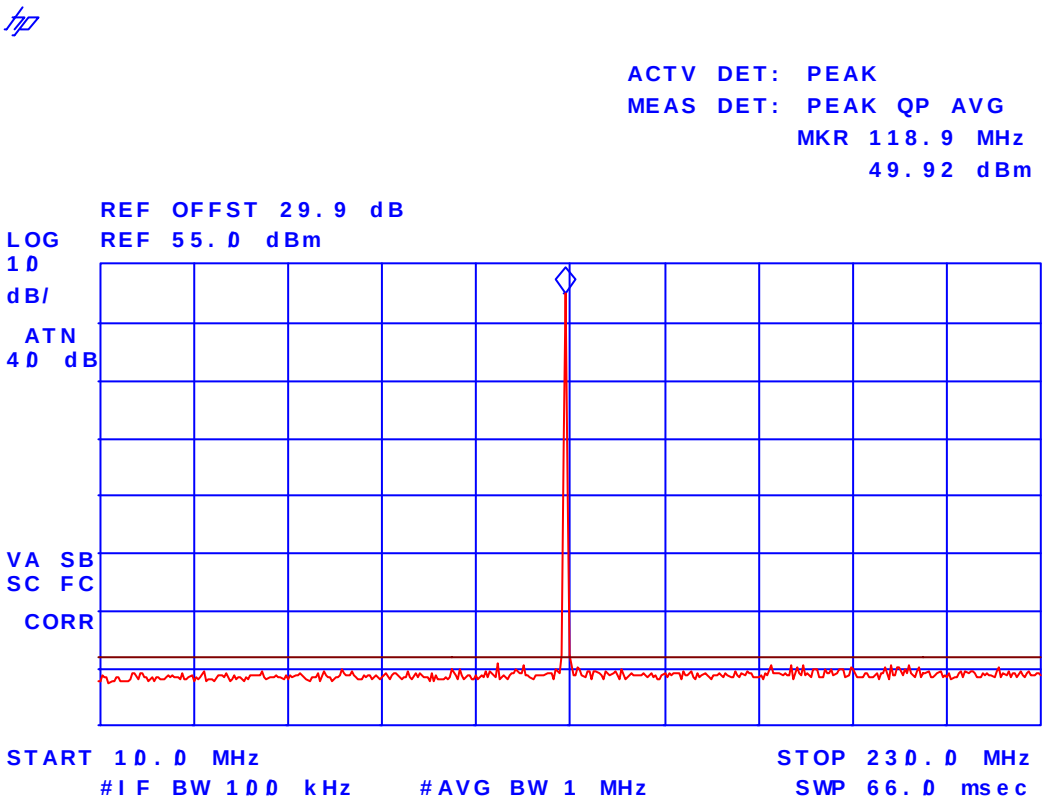
Plot # 23 **Transmitter Antenna Power Conducted Emissions.**
Freq. 138 MHz, High Power Setting: 46.99 dBm



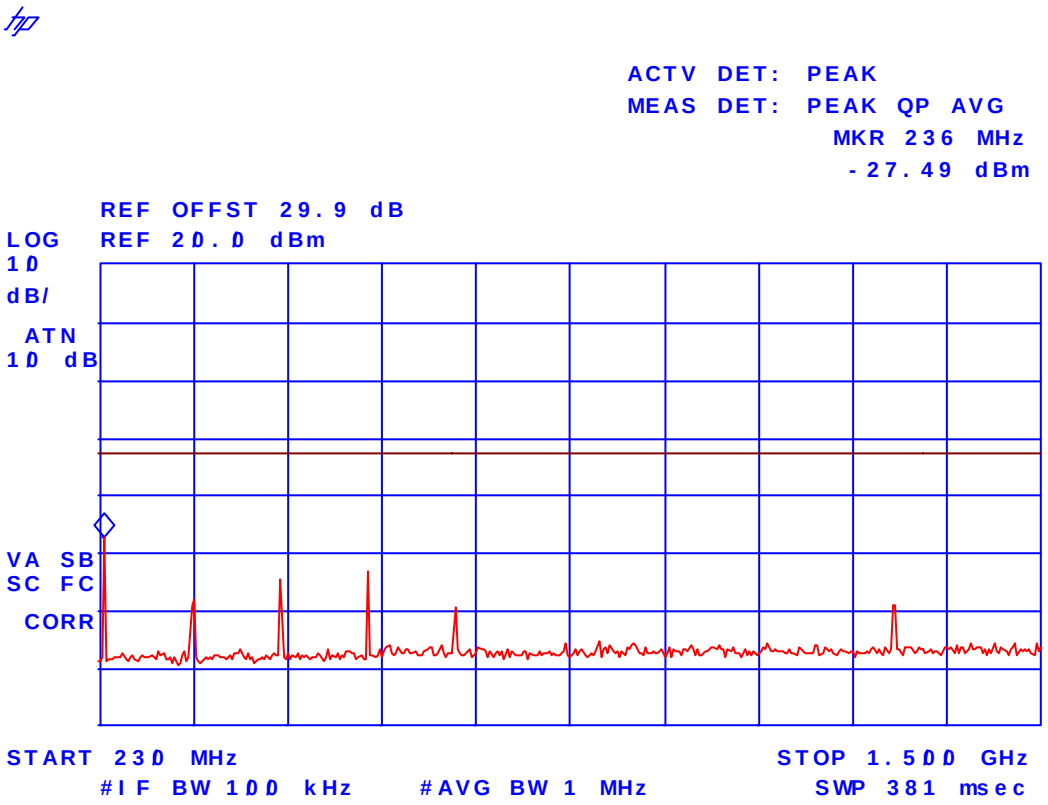
Plot # 24 **Transmitter Antenna Power Conducted Emissions.**
Freq. 138 MHz, High Power Setting: 46.99 dBm



Plot # 25 **Transmitter Antenna Power Conducted Emissions.**
Freq. 118 MHz, Medium Power Setting: 43.98 dBm

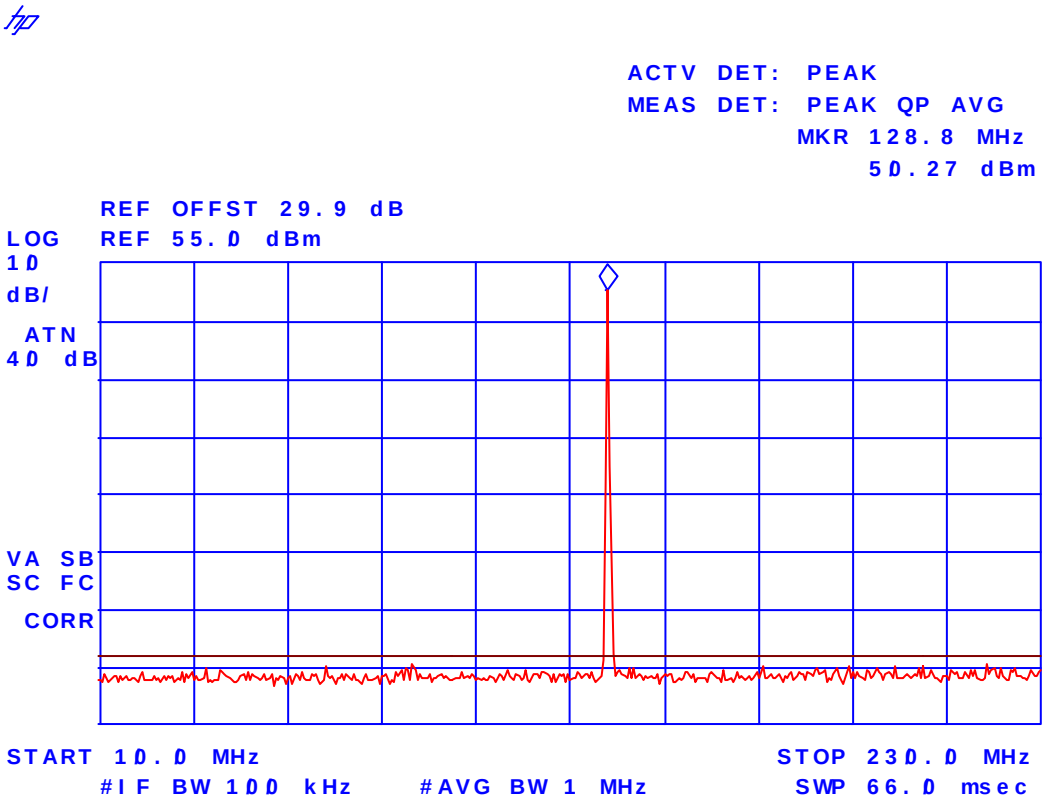


Plot # 26 **Transmitter Antenna Power Conducted Emissions.**
Freq. 118 MHz, Medium Power Setting: 43.98 dBm

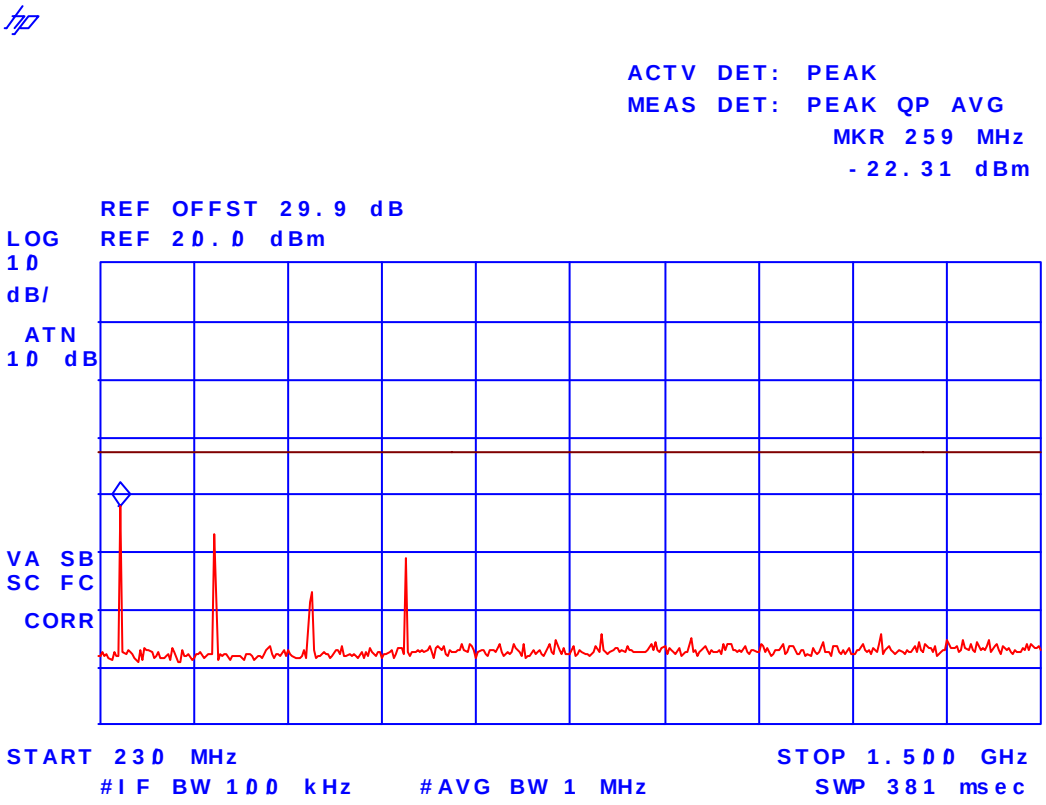


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

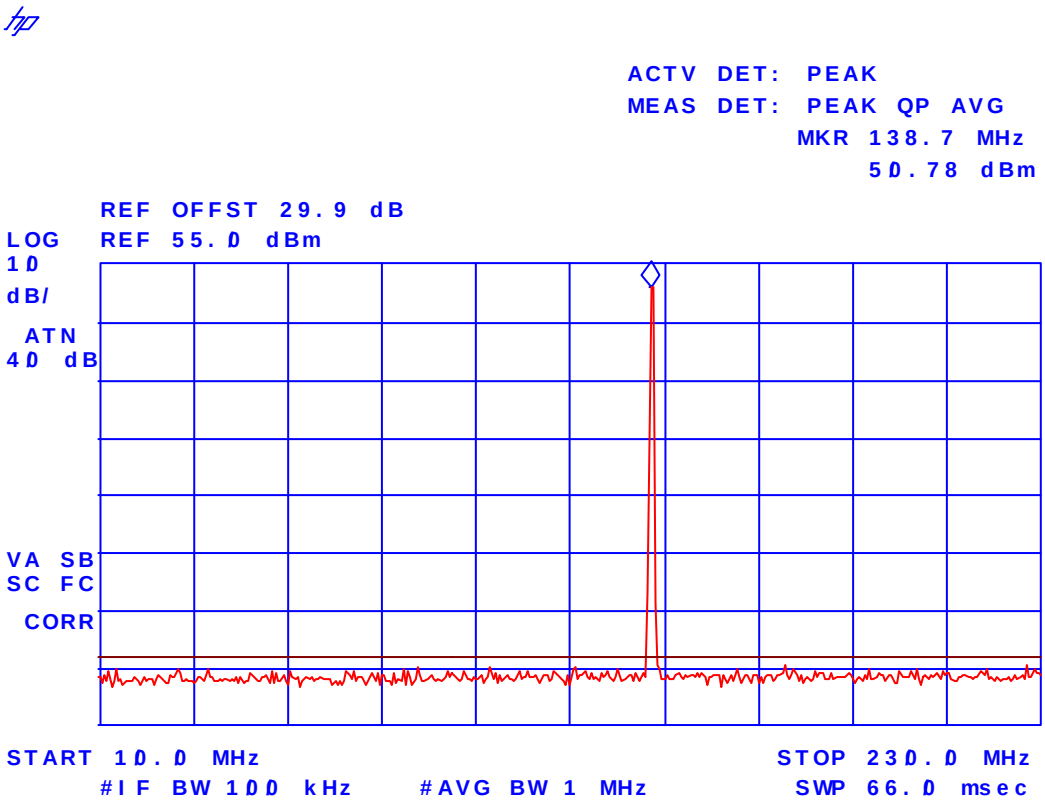
Plot # 27 **Transmitter Antenna Power Conducted Emissions.**
Freq. 128 MHz, Medium Power Setting: 43.98 dBm



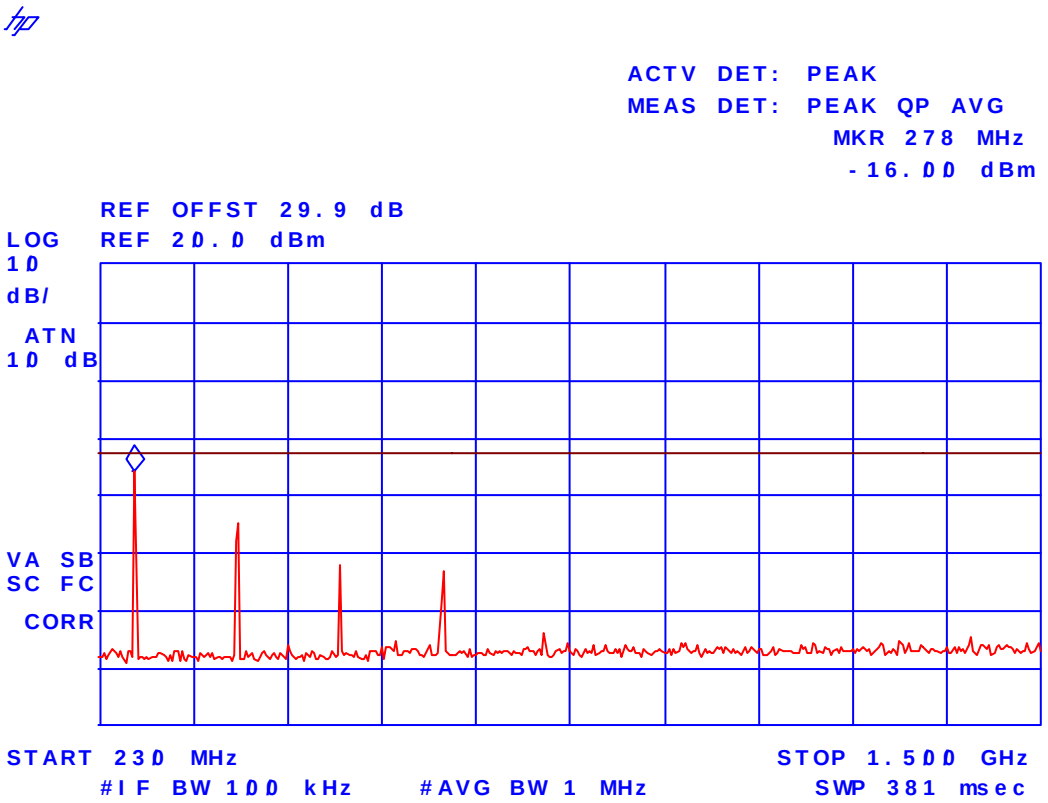
Plot # 28 **Transmitter Antenna Power Conducted Emissions.**
Freq. 128 MHz, Medium Power Setting: 43.98 dBm



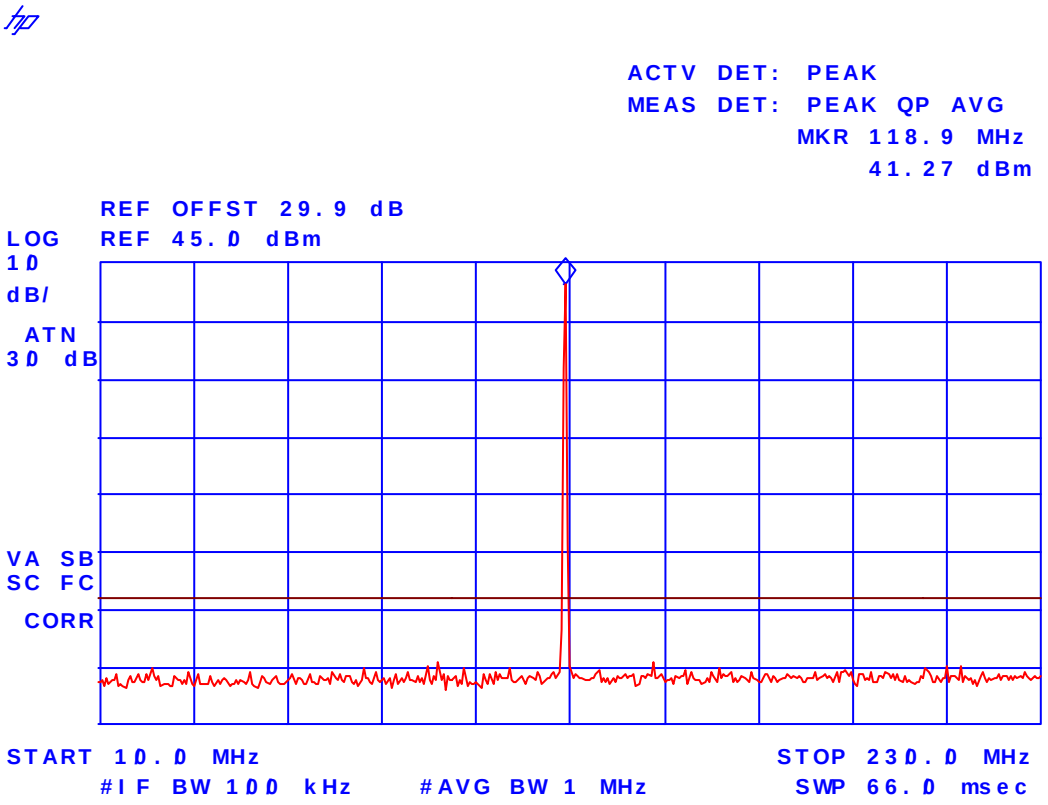
Plot # 29 **Transmitter Antenna Power Conducted Emissions.**
Freq. 138 MHz, Medium Power Setting: 43.98 dBm



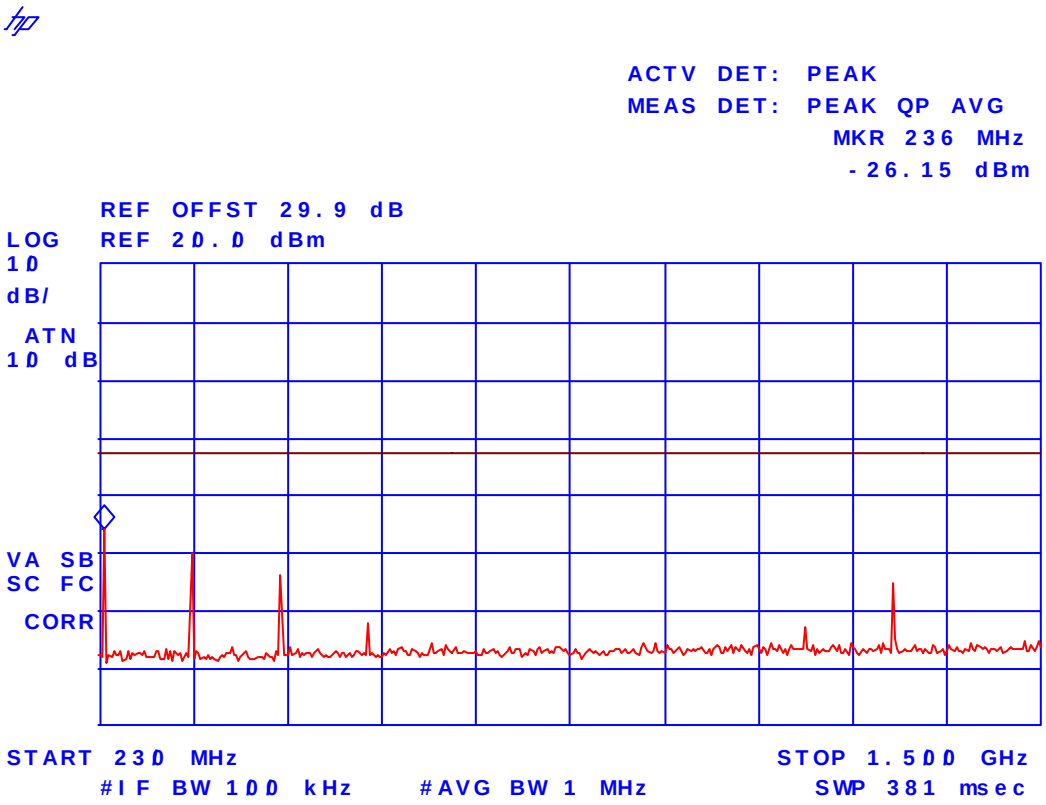
Plot # 30 **Transmitter Antenna Power Conducted Emissions.**
Freq. 138 MHz, Medium Power Setting: 43.98 dBm



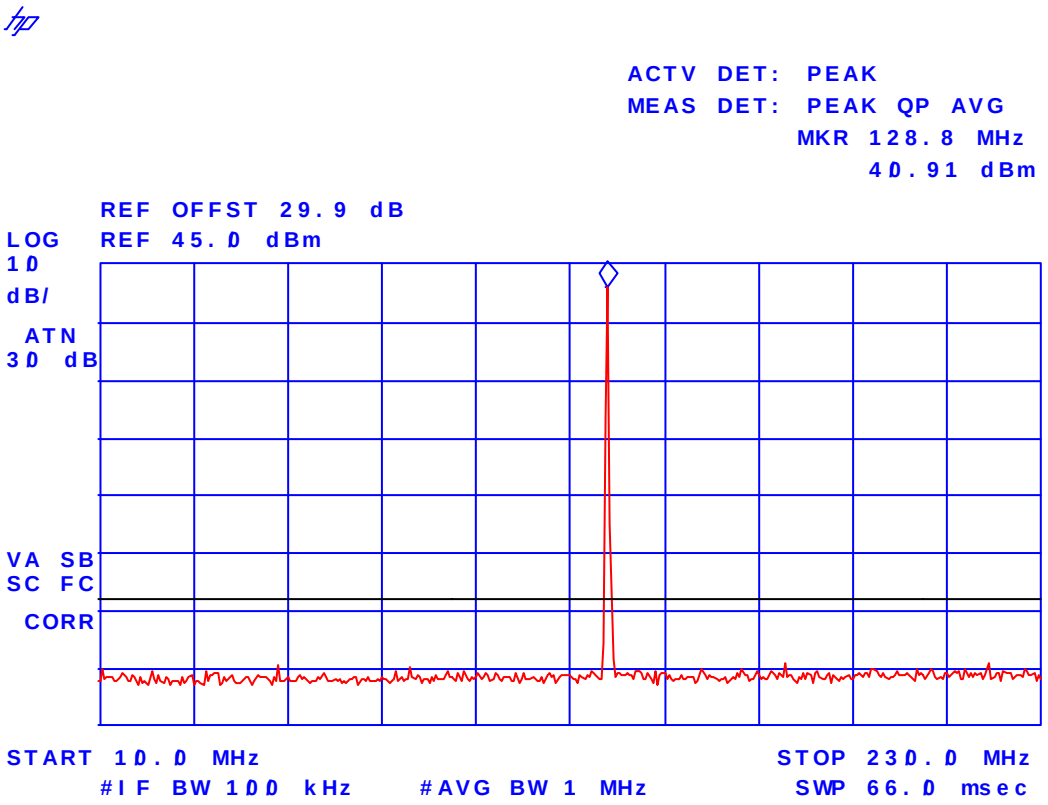
Plot # 31 **Transmitter Antenna Power Conducted Emissions.**
Freq. 118 MHz, Low Power Setting: 38.46 dBm



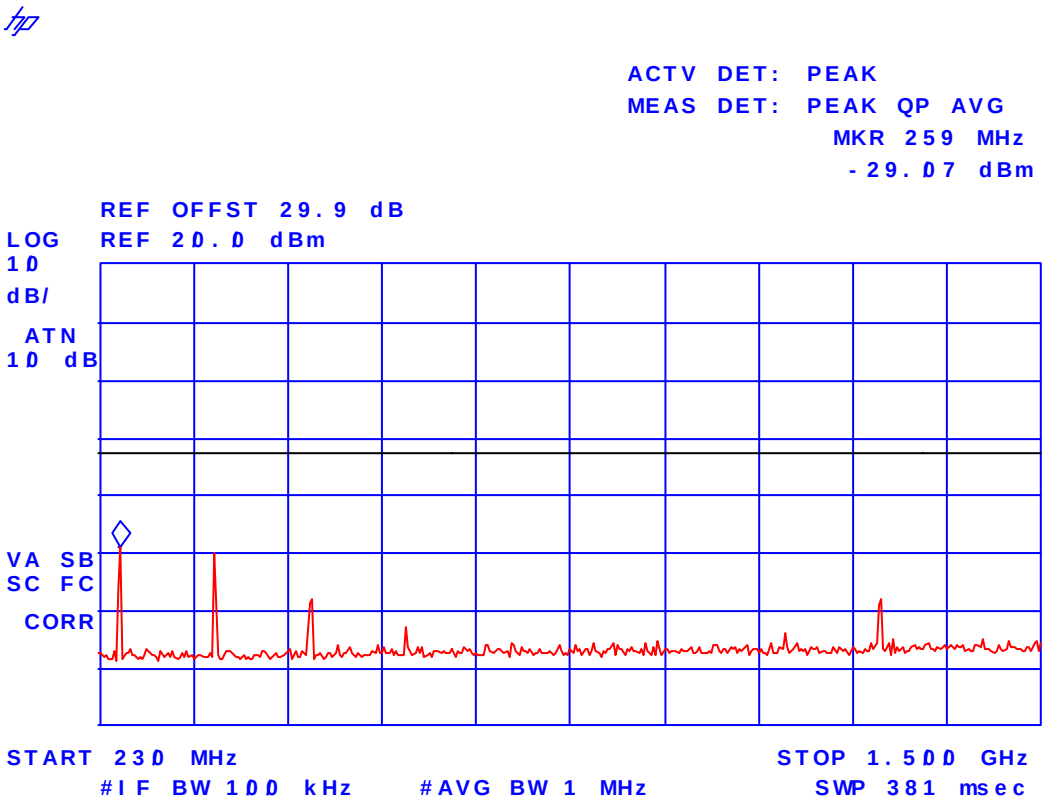
Plot # 32 **Transmitter Antenna Power Conducted Emissions.**
Freq. 118 MHz, Low Power Setting: 38.46 dBm



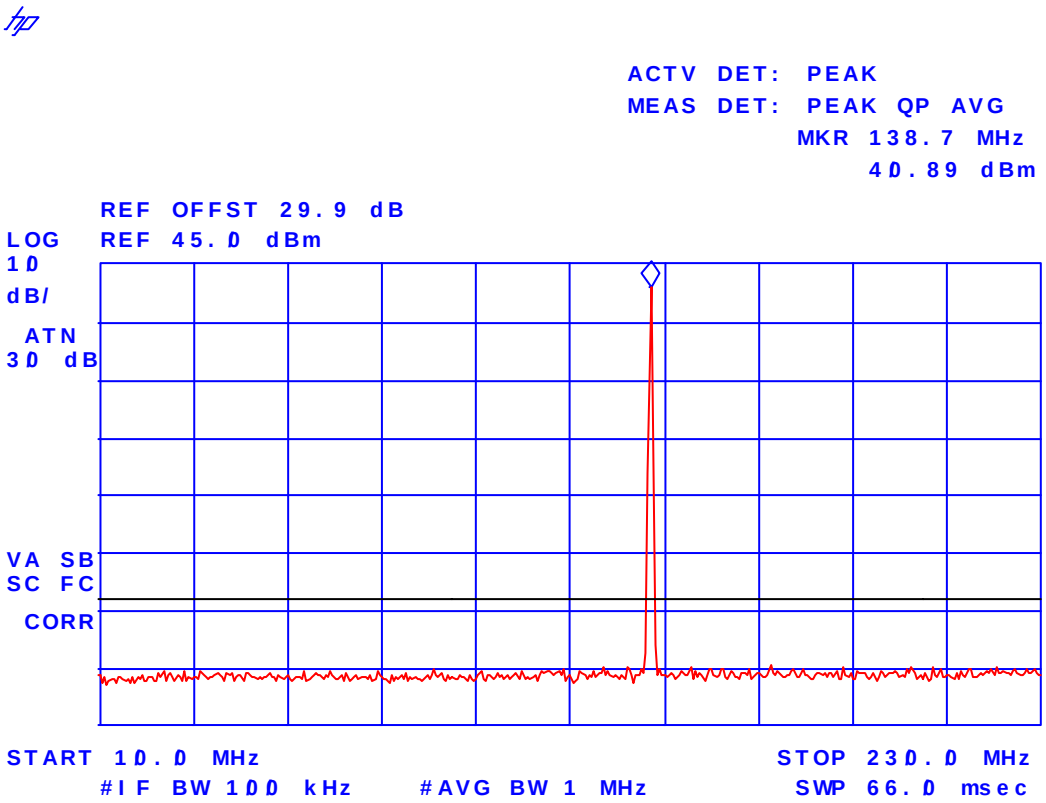
Plot # 33 **Transmitter Antenna Power Conducted Emissions.**
Freq. 128 MHz, Low Power Setting: 38.46 dBm



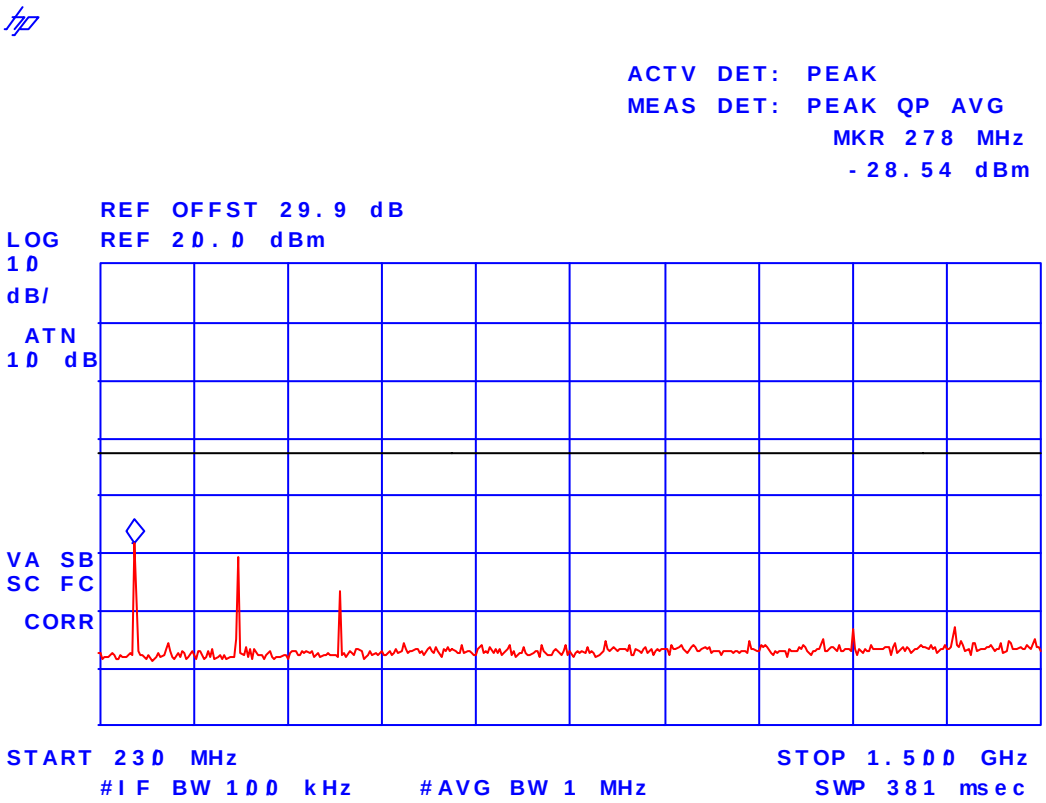
Plot # 34 **Transmitter Antenna Power Conducted Emissions.**
Freq. 128 MHz, Low Power Setting: 38.46 dBm



Plot # 35 **Transmitter Antenna Power Conducted Emissions.**
Freq. 138 MHz, Low Power Setting: 38.46 dBm



Plot # 36 **Transmitter Antenna Power Conducted Emissions.**
Freq. 138 MHz, Low Power Setting: 38.46 dBm



6.10. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 87.139

6.10.1. Limits @ FCC 87.139

FCC 87.139(a)(3) - When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log10 pY dB.

6.10.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, § 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 = xxx 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
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

6.10.4. Test Photos

Please refer to Photo # 1 & 2 in Annex 1 for detailed of test setup.

6.10.5. Test Data

Remarks:

- The RF spurious/harmonic radiated emissions were measured with transmitter set at highest output power level and the results were compared with the lowest limit of –13 dBm for the worst case
- The Radiated emissions were performed at 3 meters distance.

6.10.5.1. Near Lowest Frequency (118 MHz)

Fundamental Frequency: 118 MHz
RF Output Power: 47.0 dBm (ERP)
Modulation: AM Modulation with 2.5 kHz sine wave signal

FREQUENCY (MHz)	E-FIELD @3m (dBuV/m)	ERP measured by Substitution Method (dBm)	(dBc)	EMI DETECTOR (Peak/QP)	ANTENNA POLARIZATION (H/V)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
236	67.0	-28.2	-75.2	PEAK	V	-60.0	-15.2	PASS
236	62.7	-35.9	-82.9	PEAK	H	-60.0	-22.9	PASS

The emissions were scanned from 30 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded.

6.10.5.2. Near Middle Frequency (128 MHz)

Fundamental Frequency: 128 MHz
RF Output Power: 47.0 dBm (ERP)
Modulation: AM Modulation with 2.5 kHz sine wave signal

FREQUENCY (MHz)	E-FIELD @3m (dBuV/m)	ERP measured by Substitution Method (dBm)	(dBc)	EMI DETECTOR (Peak/QP)	ANTENNA POLARIZATION (H/V)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
256	62.4	-39.8	-86.8	PEAK	V	-60.0	-26.8	PASS
256	64.2	-38.4	-85.4	PEAK	H	-60.0	-25.4	PASS

The emissions were scanned from 30 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded.

6.10.5.3. Near Highest Frequency (138 MHz)

Fundamental Frequency: 138 MHz
RF Output Power: 47.0 dBm (ERP)
Modulation: AM Modulation with 2.5 kHz sine wave signal

FREQUENCY (MHz)	E-FIELD @3m (dBuV/m)	ERP measured by Substitution Method (dBm)	(dBc)	EMI DETECTOR (Peak/QP)	ANTENNA POLARIZATION (H/V)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
276	63.2	-39.1	-86.1	PEAK	V	-60.0	-26.1	PASS
276	64.3	-39.4	-86.4	PEAK	H	-60.0	-26.4	PASS

The emissions were scanned from 30 MHz to 1.5 GHz and all emissions within 20 dB below the limits were recorded.

EXHIBIT 7. MEASUREMENT UNCERTAINTY

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 Directivit	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 $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	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).
- If 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.

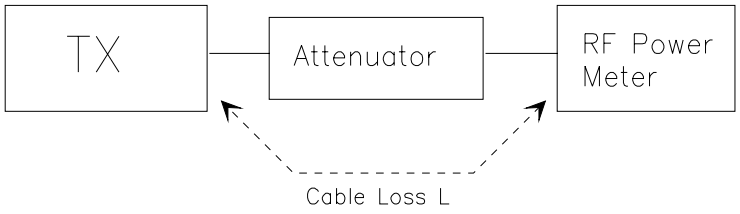
Step 2: Calculation of Average EIRP. See Figure 1

- 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 (dBuV/m) = Reading (dBuV) + 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° 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

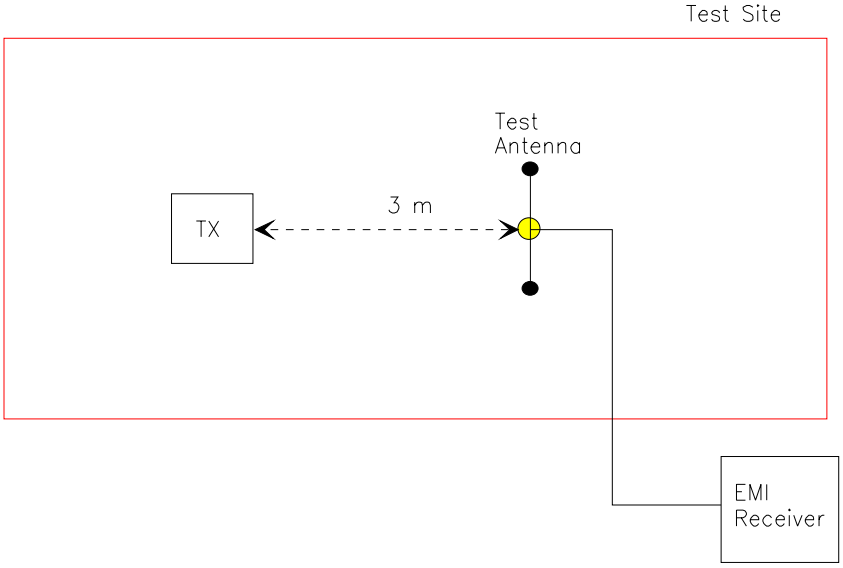
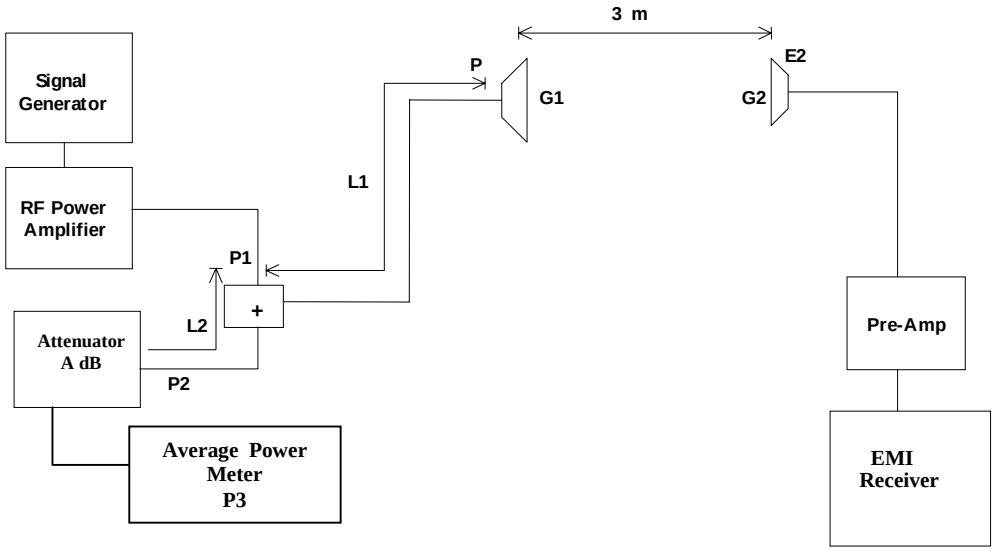


Figure 3



8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(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 LIMITATIONS

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 EMI Receiver 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 CFR 47, Para. 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 CFR 47, Para. 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.