UltraTech
Group of Labs

31040/SIT

C-1376

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SL2-IN-E-1119R

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Nov. 20, 2003

TIMCO ENGINEERING INC.
P.O. Box 370
849 N.W. State Road 45
Newberry, Florida
USA 32669

Subject: **Type Acceptance Application under FCC CFR 47, Parts 2 and 90 (Subparts I, T & K) - Non-Broadcast Radio Transceivers Operating in the frequency bands 217-220 MHz and 220-222 MHz (12.5KkHz and 15 KHz Channel Spacings).**

Applicant: **Cattron-Theimeg Inc.**
Product: **OCU**
Model: **M840220**
FCC ID: **CN2M840220**

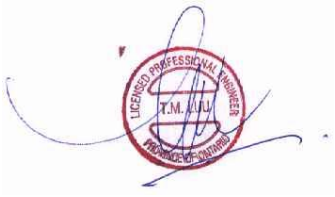
Dear Sir/Madam,

As appointed agent for **Cattron-Theimeg Inc.**, we would like to submit the application for FCC certification of the above product. Please review all necessary files uploaded to TIMCO Upload site.

If you have any queries, please do not hesitate to contact us by our TOLL FREE number:

OUR TELEPHONE NO.: 1-877-765-4173

Yours truly,



Tri Minh Luu, P. Eng.,
V.P., Engineering

TML/DH

Encl.

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Website: www.ultratech-labs.com
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Nov. 20, 2003

Cattron-Theimeg Inc.
58 West Shenago St.
Sharpsville, PA
USA, 16150

Attn.: **Mr. Curt Bellotti**

Subject: **Certification Testing in accordance with FCC CFR 47, Parts 2 and 90 (Subparts I, T & K) - Non-Broadcast Radio Transceivers Operating in the frequency bands 217-220 MHz and 220-222 MHz (12.5KkHz and 15 KHz Channel Spacings).**

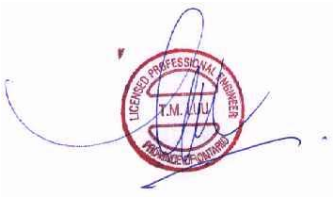
Product: **OCU**
Model: **M840220**
FCC ID: **CN2M840220**

Dear Mr. Bellotti,

The product sample has been tested in accordance with **FCC CFR 47, Parts 2 and 90 (Subparts I, T & K) - Non-Broadcast Radio Transceivers Operating in the frequency bands 217-220 MHz and 220-222 MHz (12.5KkHz and 15 KHz Channel Spacings, aggregated by 2 adjacent 5 kHz OBW Channels),** and the results and observation were recorded in the engineering report, Our File No.:

Enclosed you will find copy of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,



Tri Minh Luu, P.Eng
Vice President - Engineering

Encl.

ENGINEERING TEST REPORT

OCU
Model No.: M840220
FCC ID: CN2M840220

Applicant: **Cattron-Theimeg Inc.**
58 West Shenago St.
Sharpsville, PA
USA, 16150

Tested in Accordance With

Federal Communications Commission (FCC)
CFR 47, Parts 2 and 90 (Subparts I, T & K)

UltraTech's File No.: MIC-101B-FCC90

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: Nov. 20, 2003	
Report Prepared by: Tri Luu, P.Eng. Issued Date: Nov. 20, 2003	Tested by: Mr. Wayne Wu Test Dates: Sep. 10-Nov. 20, 2003

- *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

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report		OK
1	Test Setup Photos	Photos # 1 and 2	OK
2	External Photos of EUT	Photos # 1 to 2	OK
3	Internal Photos of EUT	Photos of 1 to 6	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	OK OK OK
5	Attestation Statements	• Manufacturer's Declaration for compliance with FCC Clause 90.203(e)	OK
6	ID Label/Location Info	ID Label Location of ID Label	OK
7	Block Diagrams		OK
8	Schematic Diagrams		OK
9	Parts List/Tune Up Info		OK
10	Operational Description		OK
11	RF Exposure Info		OK
12	Users Manual		OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 90 (Subparts I, T & K)
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Parts 2 and 90 (Subparts I, T & K)
Purpose of Test:	To obtain FCC Certification Authorization for Radio operating in the frequency bands 217-220 MHz and 220-222 MHz (12.5KkHz and 15 KHz Channel Spacings, aggregate by 2 5 kHz OBW Adjacent Channels).
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 SUBMITAL(S)/GRANT(S)

None

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2002	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	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	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Cattron-Theimeg Inc.
Address:	58 West Shenago St. Sharpsville, PA USA, 16150
Contact Person:	Mr. Curt Bellotti Phone #: 724-962-3571 Fax #: 724-962-4310 Email Address: cbellotti@cattron.com

MANUFACTURER	
Name:	Microwave Data Systems Inc.
Address:	175 Science Parkway Rochester, NY USA, 14620-4261
Contact Person:	Mr. Dennis McCarthy Phone #: 585-242-8440 Fax #: 585-241-5590 Email Address: dmccarthy@microwavedata.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:	Cattron-Theimeg Inc.
Product Name:	OCU
Model Name or Number:	M840220
Serial Number:	63577021
Type of Equipment:	Non-broadcast Private Land Mobile Radio Services
External Power Supply:	DC 62 Vdc battery
Transmitting/Receiving Antenna Type:	TNC

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Portable (body worn) with antenna located more than 2.5 cm from the user's body
Intended Operating Environment:	[x] Commercial [x] Light Industry & Heavy Industry
Power Supply Requirement:	DC 62 Volts battery
RF Output Power Rating:	2.5 Watts peak or 0.064 Watts Average
Duty Cycle:	2.5875% maximum
Operating Frequency Range:	217-220 MHz and 220-222 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	• 12.5 kHz aggregated by two 5 kHz BW adjacent channels • 15 kHz aggregated by two 5 kHz BW adjacent channels
Occupied Bandwidth (99%):	• 7.13 KHz for 12.5 kHz Channelisation with maximum 1.85 kHz frequency deviation. • 8.33 kHz for 15 kHz Channelisation with maximum 2.66 kHz frequency deviation.
Emission Designation*:	• 8K5F1D • 10K1F1D
Antenna Connector Type:	BNC
Antenna Description:	Manufacturer: Centurion Type: ¼ Wave Dipole Antenna Model: EXB-220 Frequency Range: 220-225 MHz In/Out Impedance: 50 Ohms Gain: 0 dBi

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

(1) 12.5 kHz Channel Spacing FM Digital Modulation:
- FM Level 2, M = 4 kb/s
- B_n = 2M + 2DK = 2(4/2) + 2*1.85*1 = .**7.7 KHz**
- Emission designation: 7K70F1D

(2) 15 kHz Channel Spacing FM Digital Modulation:
- FM Level 2, M = 4 kb/s
- B_n = 2M + 2DK = 2(4/2) + 2*2.66*1 = **9.3 KHz**
- Emission designation: 9K30F1D

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	DC Input Port	1	Terminal Block	Wire harness
2	Parallel I/O Port	1	DB25	Shielded Cables
3	RS232 Serial I/O Ports (COM1 & COM3)	2	DB9	Shielded Cable
4	RF In/Out Port	1	BNC	Coaxial
5	RS 485 Serial Port (COM2) – J5	1	PCB Edge Connector	Direct plug onto a host system
6	J1A – J4A Port	4	PCB Edge Connectors	Direct plug onto a host system

3.5. ANCILLARY EQUIPMENT

No peripheral devices are used

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:	DC 62 Volts

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated at its maximum duty cycle of 2.59% and repeated continuously. The carrier was FM modulated internal data source at 9.6 kb/s. The test frequencies were pre-set by the manufacturer at its maximum peak level and maximum frequency deviation (2.5 kHz peak)
Special Test Software:	N/A
Special Hardware Used:	N/A
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): ▪ 217-220 MHz band: ▪ 220-222 MHz band:	Near lowest, near middle & near highest frequencies in each frequency bands that the transmitter covers: ▪ 217.01250 & 219.9875 MHz ▪ 220.00625 & 221.99375 MHz
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating signal source:	 ▪ 2.5 Watts peak at 2.59% duty cycle maximum. ▪ FSK ▪ 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.: IC2049). Last Date of Site Calibration: Nov. 04, 2003.

5.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

CC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
90.205 (e)&(f) and 90.259(a)(4) & 2.1046	RF Power Output	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
90.213 & 2.1055	Frequency Stability	Yes
2.1047(a)	Audio Frequency Response	Not applicable to new standard. However, tests are conducted under FCC's recommendation.
90.210 & 2.1047(b)	Modulation Limiting	Yes
90.210 & 2.1049	Emission Limitation & Emission Mask	Yes
90.210, 2.1057 & 2.1051	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
90.210, 2.1057 & 2.1053	Emission Limits - Field Strength of Spurious Emissions	Yes
OCU, **Model No.: M840220**, by **Cattron-Theimeg Inc.** 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 C63.4:1992 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. RF POWER OUTPUT @ FCC 2.1046 & 90.205 (E)&(F) AND 90.259(A)(4)

6.5.1. Limits

FCC 90.205:- (e) 217-220 MHz. Limitations on power and antenna heights are specified in Sec. 90.259.
(f) 220-222 MHz. Limitations on power and antenna heights are specified in Sec. 90.729

FCC 90.259(a)(4) - In the 217-220 MHz band, the maximum transmitter output power is 2 watts. The maximum antenna height above average terrain (HAAT) is 152m (500 feet).

6.5.2. Method of Measurements

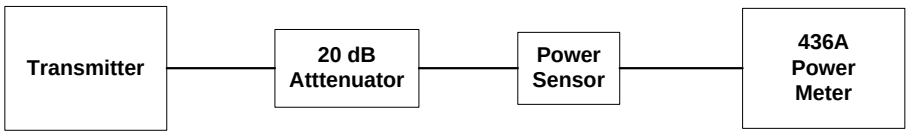
Refer to Exhibit 8, § 8.1 (Conducted) and 8.2 (Radiated) of this report for measurement details

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Attenuator(s)	Bird	…	…	DC – 22 GHz
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz – 50 GHz, sensor dependent
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz

6.5.4. Test Arrangement

- Power at RF Power Output Terminals



6.5.5. Test Data

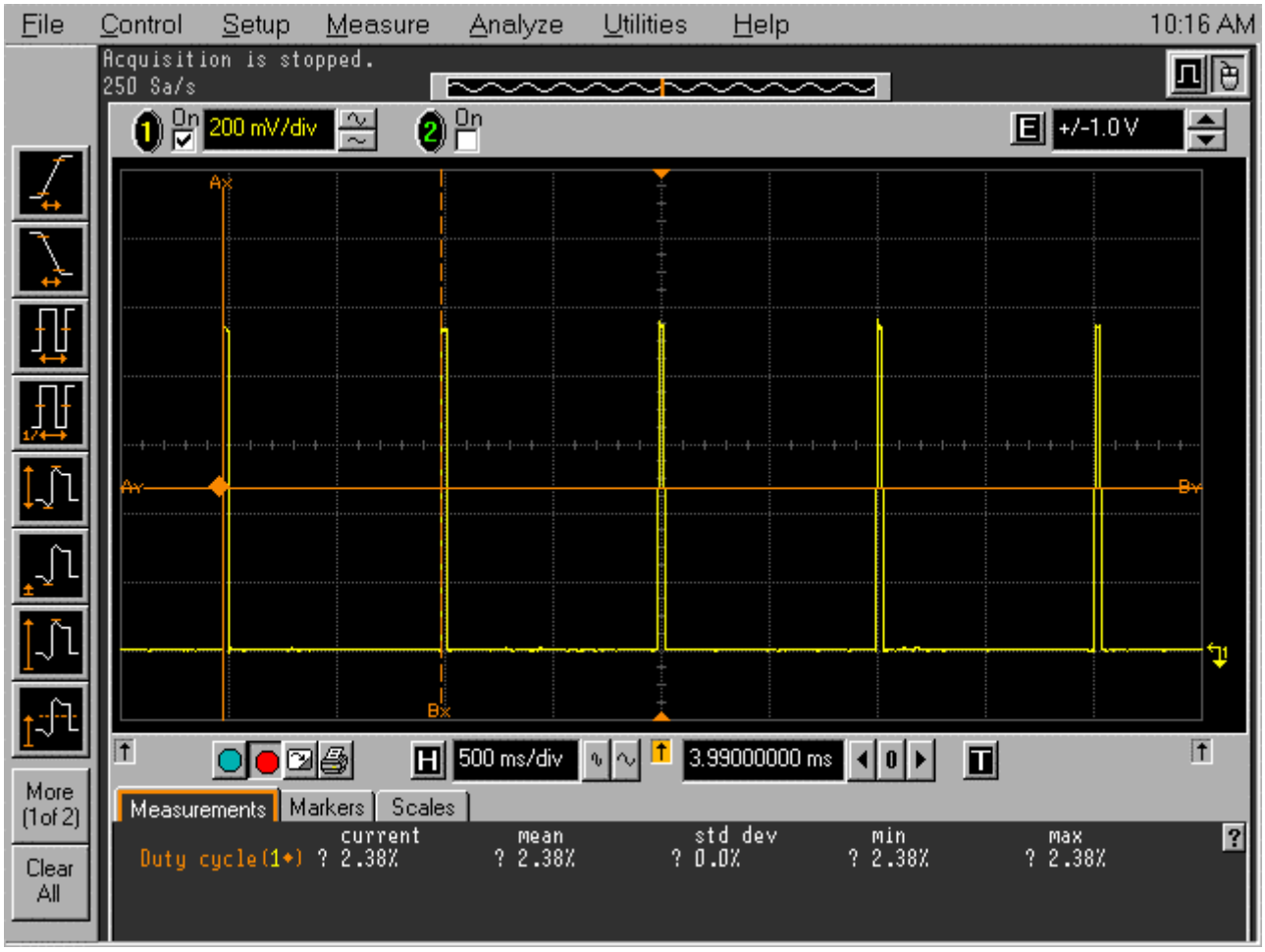
Duty Cycle: The maximum duty Cycle was measure to be 2.59%.

Since the duty cycle is very low (2.59% maximum), it is not able to be measured in a 100 MS interval. The actual duty cycle over its period of 1000 mS interval was measured as shown in Plots # 1 and 2.

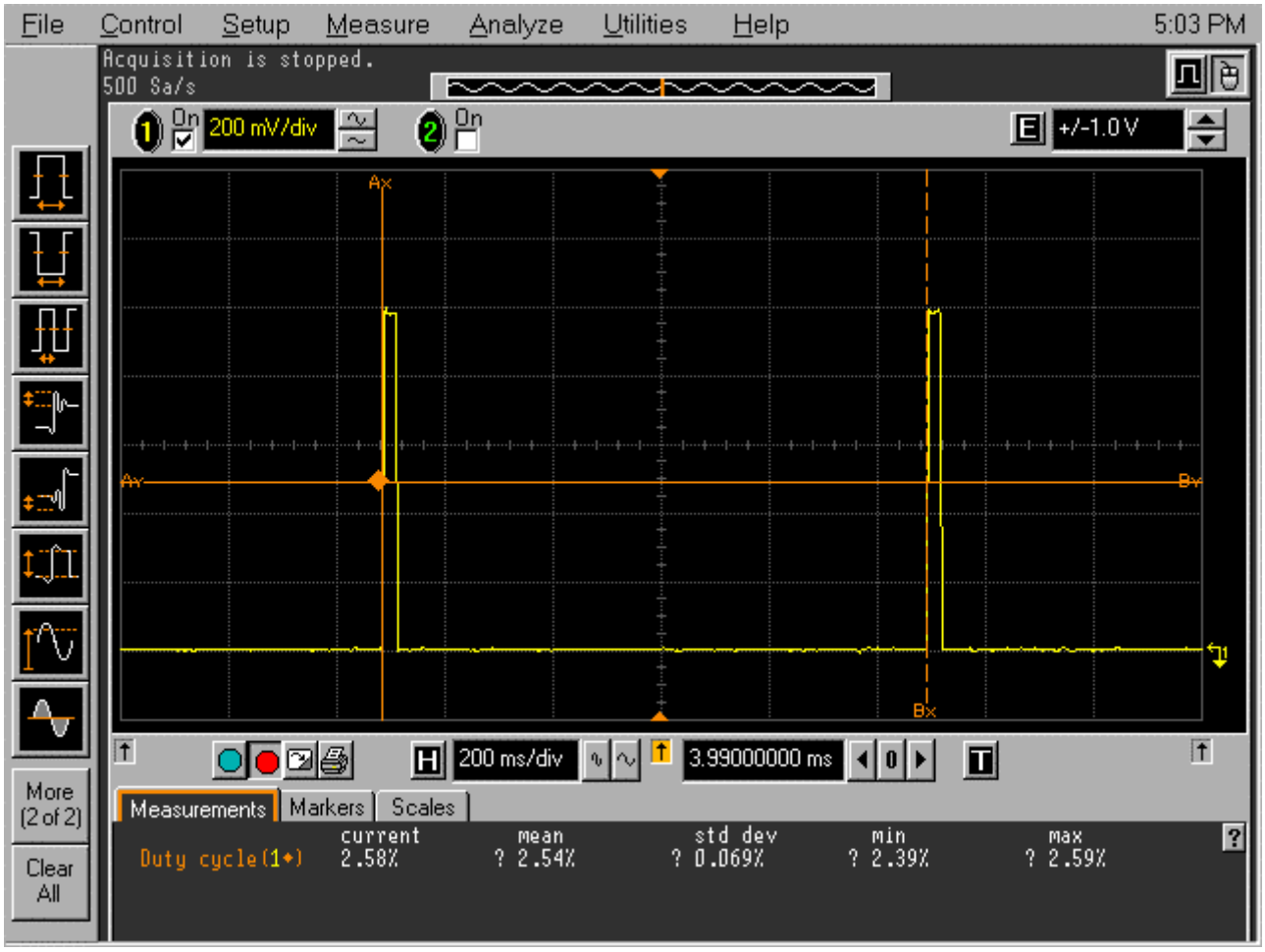
Average-Peak Correction factor = 10*log(0.0259) = -15.9 dB

Operating Band (MHz)	Fundamental Frequency (MHz)	Measured Peak Power (Watts)	Measured (Average) Power (Watts)	Peak Power Rating (Watts)	Average Power Limit (Watts)
217-220	217.01250	2.47	0.064	2.5	2.0
	219.98750	2.47	0.063	2.5	2.0
220-222	220.00625	2.48	0.064	2.5	2.0
	221.993750	2.46	0.064	2.5	2.0

Plot #1: Duty Cycle Measurements



Plot #2: Duty Cycle Measurements



6.6. RF EXPOSURE REQUIRMENTS @ 1.1310 & 2.1091

6.6.1. Limits

- **FCC 1.1310:-** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

IMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
30-300	61.4	0.163	1.0	6
(B) Limits for General Population/Uncontrolled Exposure				
30-300	27.5	0.073	0.2	30

F = Frequency in MHz

6.6.2. Method of Measurements

Refer to FCC @ 1.1310, 2.1091 and Public Notice DA 00-705 (March 30, 2000)

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

$r = \sqrt{PG/4\Pi S}$

FCC radio frequency exposure limits may not be exceeded at distances closer than r cm from the antenna of this device

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones., an SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d)

6.6.3. Test Data

Antenna Gain Limit specified by Manufactuer: 0 dBi

Frequency (MHz)	Measured Average RF Conducted (Watts)	Calculated Average EIRP (Watts)	Laboratory's Recommended Minimum RF Safety Distance r (cm)
217 –222	0.064	0.064	1.6 cm

Note 1: **RF EXPOSURE DISTANCE LIMITS:** $r = (PG/4\Pi S)^{1/2} = (EIRP/4\Pi S)^{1/2}$
$S = 0.2$ mW/cm^2

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum Calculated separation distance between antenna and persons required: 1.6 cm	Manufacturer' instruction for separation distance between antenna and persons required: 2.5 cm.

6.7. FREQUENCY STABILITY @ FCC 2.1055 & 90.213

6.7.1. Limits @ FCC 90.213

Please refer to FCC CFR 47, Part 90, Subparts I, T & K, Para. 90.213 for specification details.

FREQUENCY RANGE (MHz)	FIXED & BASE STATIONS (ppm)			MOBILE STATIONS (ppm)					
				> 2 W			≤ 2 W		
	6.25 kHz	12.5 kHz	25 kHz	6.25 kHz	12.5 kHz	25 kHz	6.25 kHz	12.5 kHz	25 kHz
216-220	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
220-220	0.1	0.1	0.1	1.5	1.5	1.5	1.5	1.5	1.5

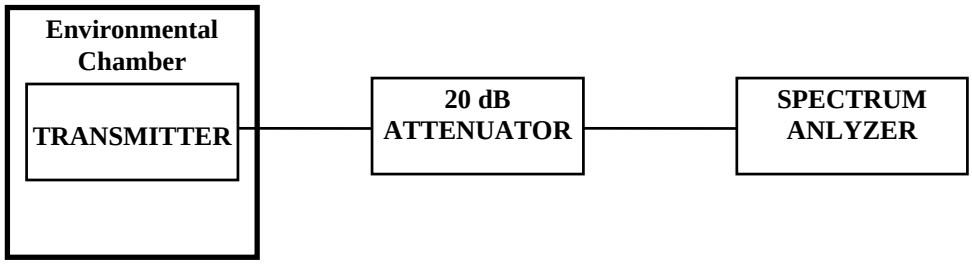
6.7.2. Method of Measurements

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

6.7.3. 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

6.7.4. Test Arrangement



6.7.5. Test Data

Product Name: **Model No.:**	**OCU** **M840220**
Center Frequency:	217 MHz
Full Power Level:	2.5 Watts peak
Frequency Tolerance Limit:	1.0 ppm is applied as worst case
Max. Frequency Tolerance Measured:	+120 Hz or +0.55 ppm
Input Voltage Rating:	62 Vdc

CENTER FREQUENCY & RF POWER OUTPUT VARIATION			
Ambient Temperature	**Supply Voltage (Nominal) 62 Vdc**	**Supply Voltage Transmitter ceases its operation at 35.0 Vdc**	**Supply Voltage (115% of Nominal) 71.3 Vdc**
(°C)	**Hz**	**Hz**	**Hz**
-30	-69	N/A	N/A
-20	0	N/A	N/A
-10	-120	N/A	N/A
0	-111	N/A	N/A
+10	-103	N/A	N/A
+20	0	+5	+9
+30	-17	N/A	N/A
+40	+17	N/A	N/A
+50	-9	N/A	N/A

6.8. MODULATION LIMITING @ FCC 2.1047(B) & 90.210

6.8.1. Limits

Recommended frequency deviation characteristics are given below:

- 2.5 kHz for 12.5 KHz Channel Spacing
- 3.0 kHz for 15 KHz Channel Spacing.

6.8.2. Method of Measurements

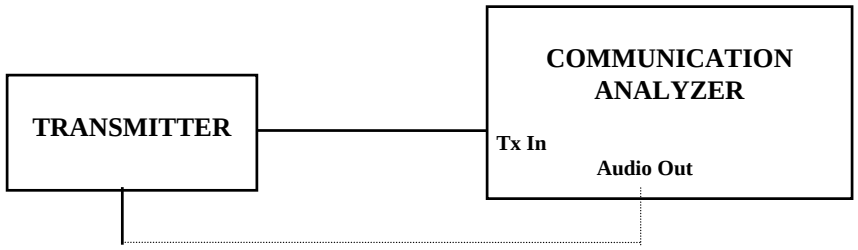
For Audio Transmitter:- The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition.

For Data Transmitter with Maximum Frequency Deviation set by Factory:- The EUT was set at maximum frequency deviation, and its peak frequency deviation was then measured using EUT's internal random data source.

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Communication Analyzer	Rohde & Schawrz	SMF02	879988/057	400 kHz - 1000 MHz including AF & RF Signal Generators, SINAD, DISTORTION, DEVIATION meters and etc

6.8.4. Test Arrangement



6.8.5. Test Data

6.8.5.1. Data Modulation Limiting: FM modulation with random data and Modulation Limiter set at a Maximum Frequency Deviation (Factory Setting).

Channel Spacing Operations	Data Baud Rate	Peak Deviation (kHz)	Maximum Limit (kHz)
12.5	9600	1.85	2.5
15.0	9600	2.66	3.0

6.9. EMISSION MASK @ FCC 2.1049, 90.208 & 90.210

6.9.1. Limits @ FCC 90.209 & 90.210

Emissions shall be attenuated below the mean output power of the transmitter as follows:

Frequency Range (MHz)	Maximum Authorized BW (KHz)	Channel Spacing (KHz)	FCC Applicable Mask
216-220	6.25	--	• Emission mask F
220-222	5	4	• Emission Mask F

90.210(f) - Emission Mask F. For transmitters operating in the 220-222 MHz frequency band, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f<INF>o</INF> to the edge of the authorized bandwidth f<INF>e:</INF> Zero dB.
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f<INF>d</INF> in kHz) of more than 2 kHz up to and including 3.75 kHz: 30 + 20(f<INF>d</INF> -2) dB or 55 + 10 log (P), or 65 dB, whichever is the lesser attenuation.
(3) On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth f<INF>d:</INF> At least 55 + 10 log (P) dB.

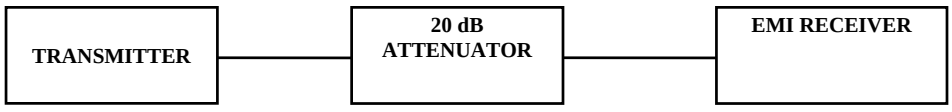
6.9.2. Method of Measurements

Refer to Exhibit 8, § 8.4 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

6.9.4. Test Arrangement



6.9.5. Test Data

6.9.5.1. 99% Occupied Bandwidth for 12.5 kHz Channelisation

FCC Permitted Band (MHz)	Frequency (MHz)	Channel Spacing (kHz)	Measured 99% OBW (kHz)
217	217.01250	12.5	6.98
220	219.97500	12.5	7.05
220	220.00625	12.5	7.09
222	221.00375	12.5	7.13

Please refer to Plots #3 to 6 for detailed measurements.

6.9.5.2. 99% Occupied Bandwidth for 15 kHz Channelisation

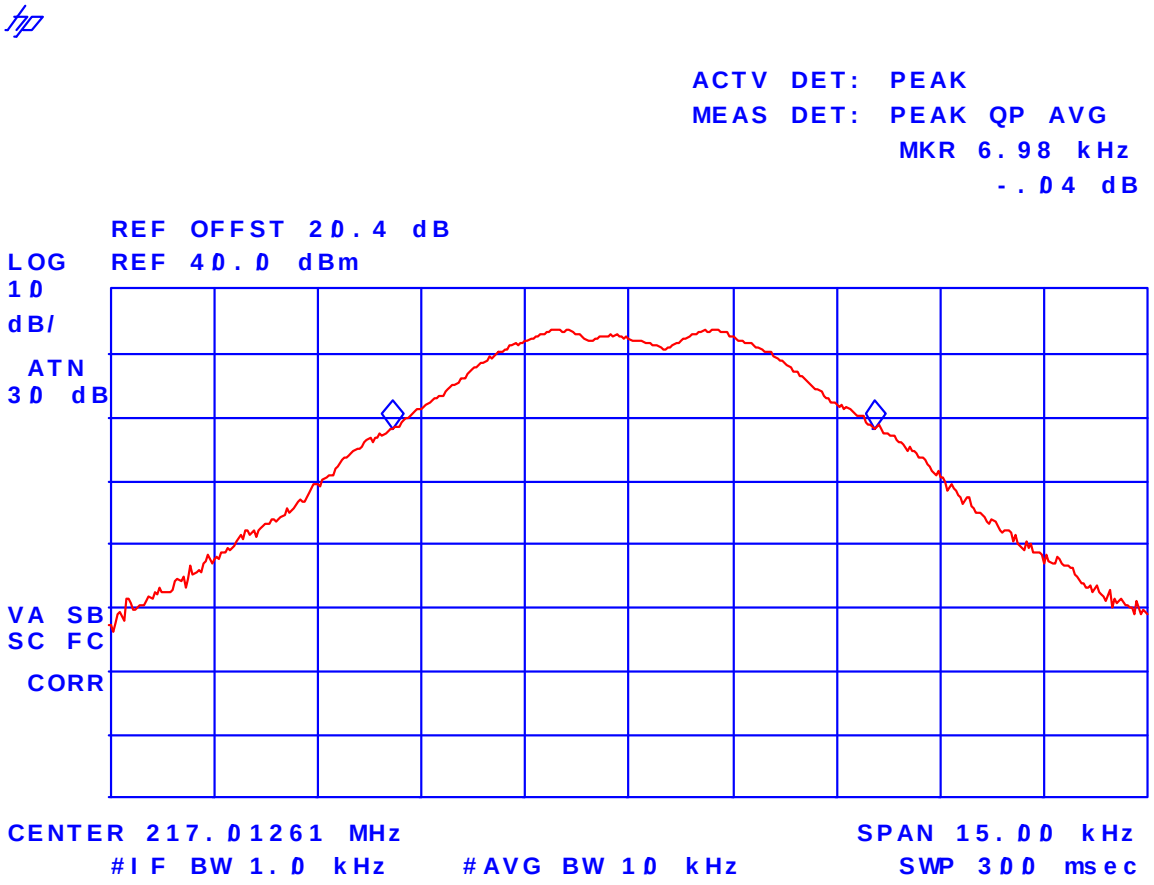
FCC Permitted Band (MHz)	Frequency (MHz)	Channel Spacing (kHz)	Measured 99% OBW (kHz)
217	217.01250	15	8.18
220	219.97500	15	8.29
220	220.00625	15	8.25
222	221.00375	15	8.33

Please refer to Plots #7 to 10 for detailed measurements.

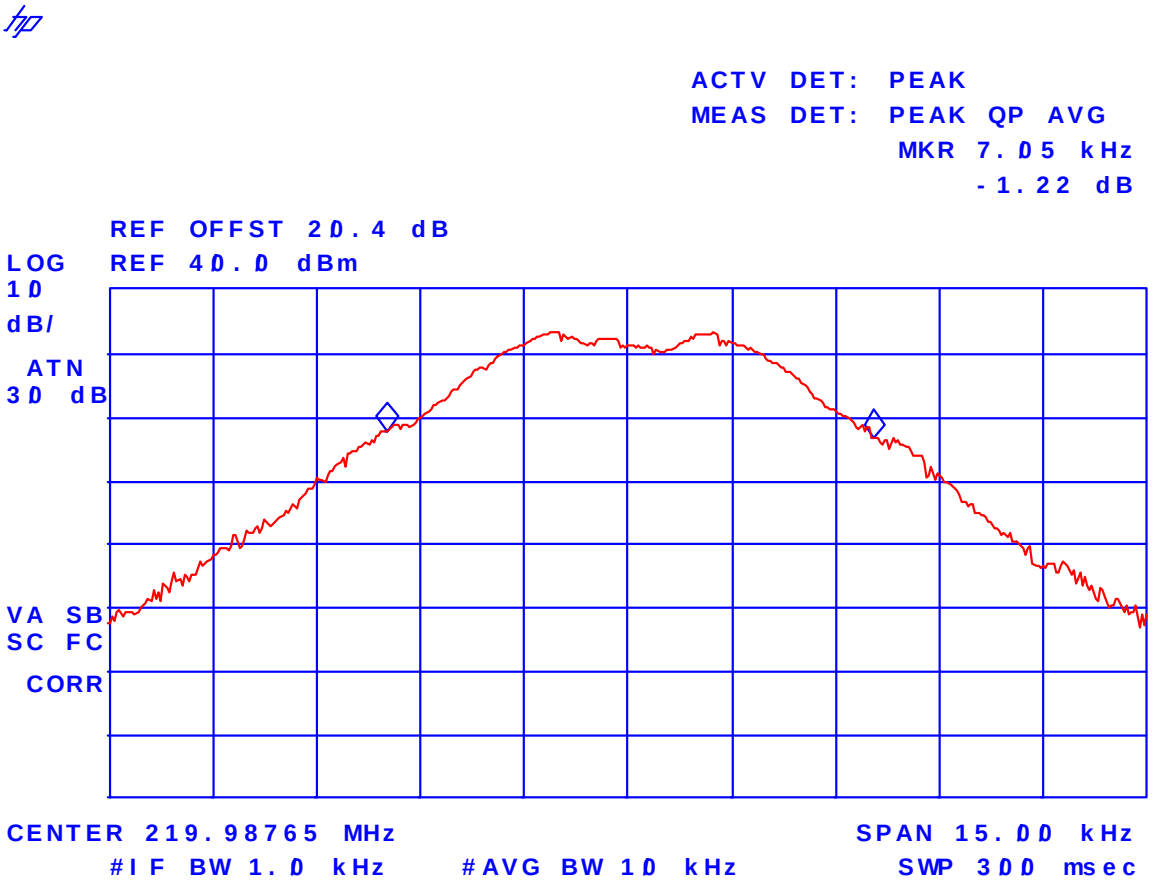
6.9.5.3. Emission Masks

Conform. Please refer to Plot # 11 through # 18 for Details of measurements

Plot # 3: 99% Occupied Bandwidth @ 217.0125 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz max.

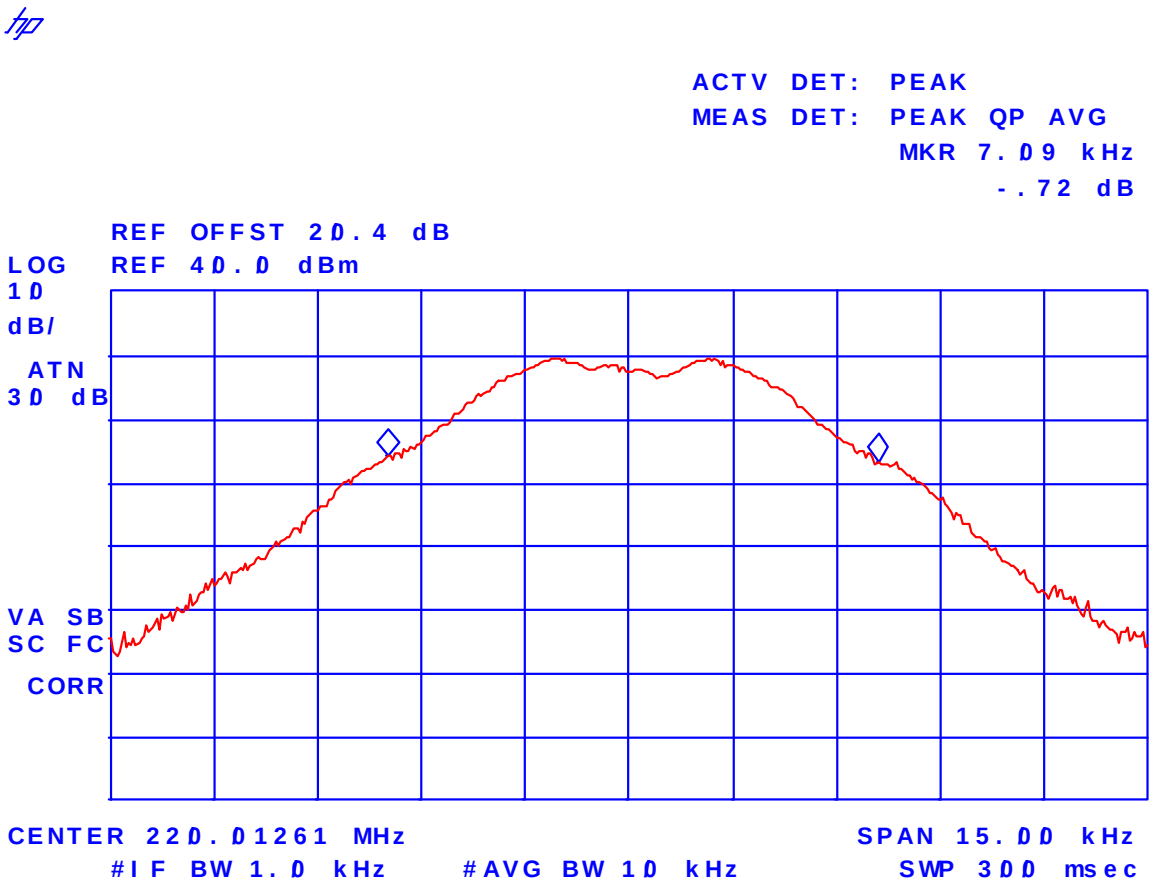


Plot # 4: 99% Occupied Bandwidth @ 219.9875 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz max.



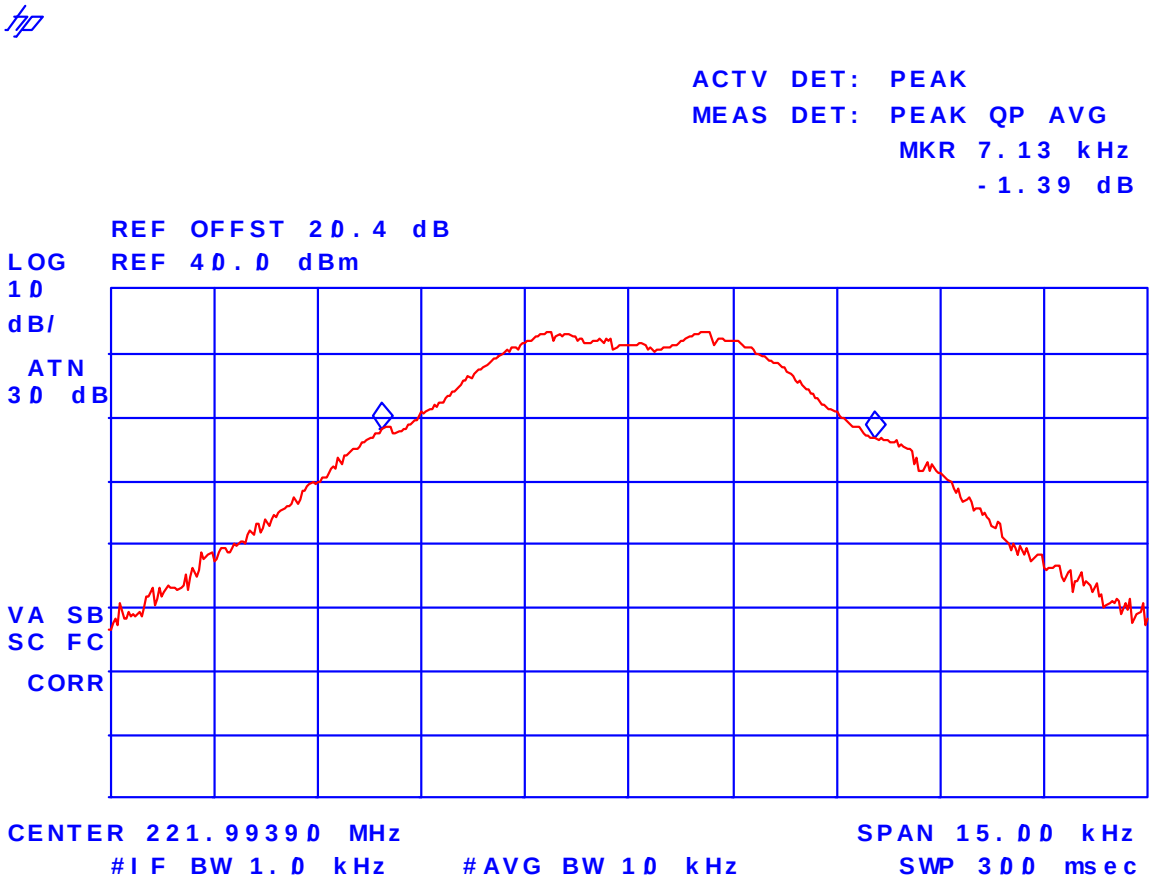
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 5: 99% Occupied Bandwidth @ 220.0125 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz max.



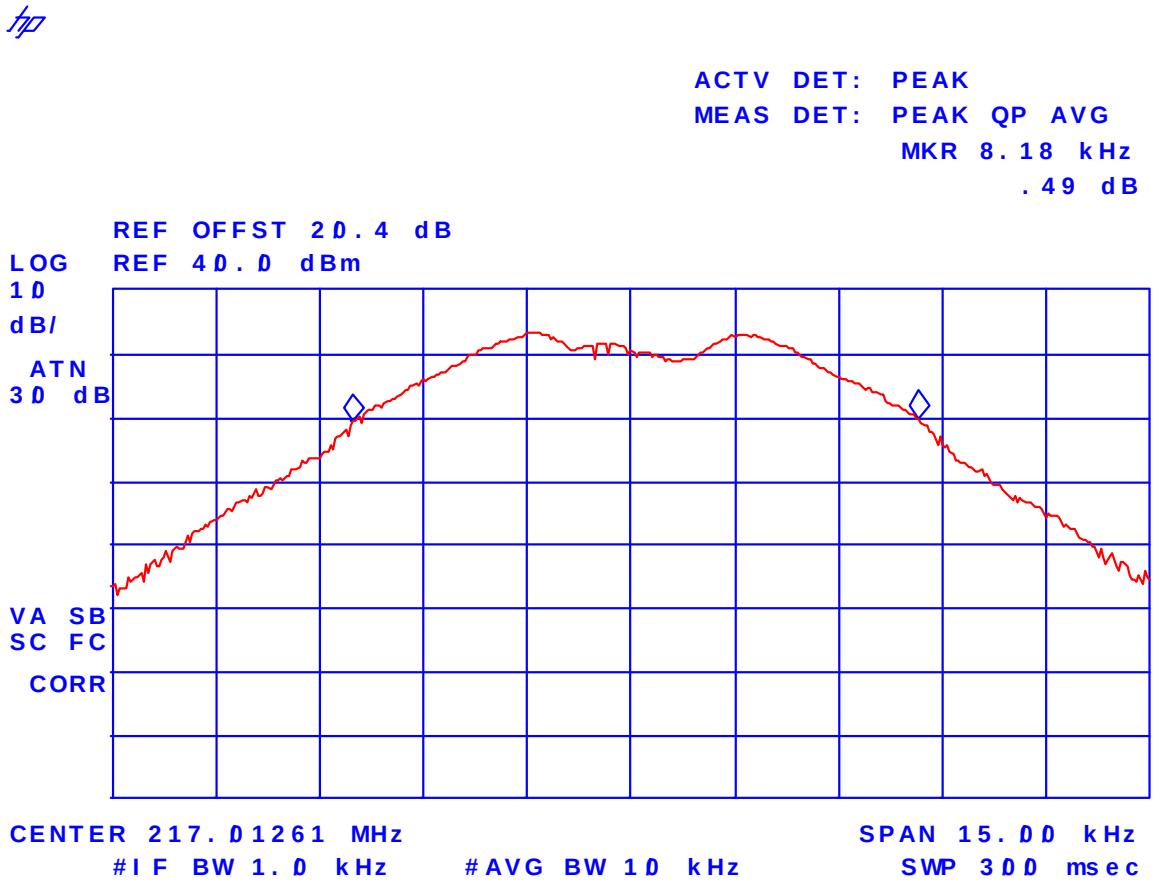
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 6: 99% Occupied Bandwidth @ 221.993 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz max.



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

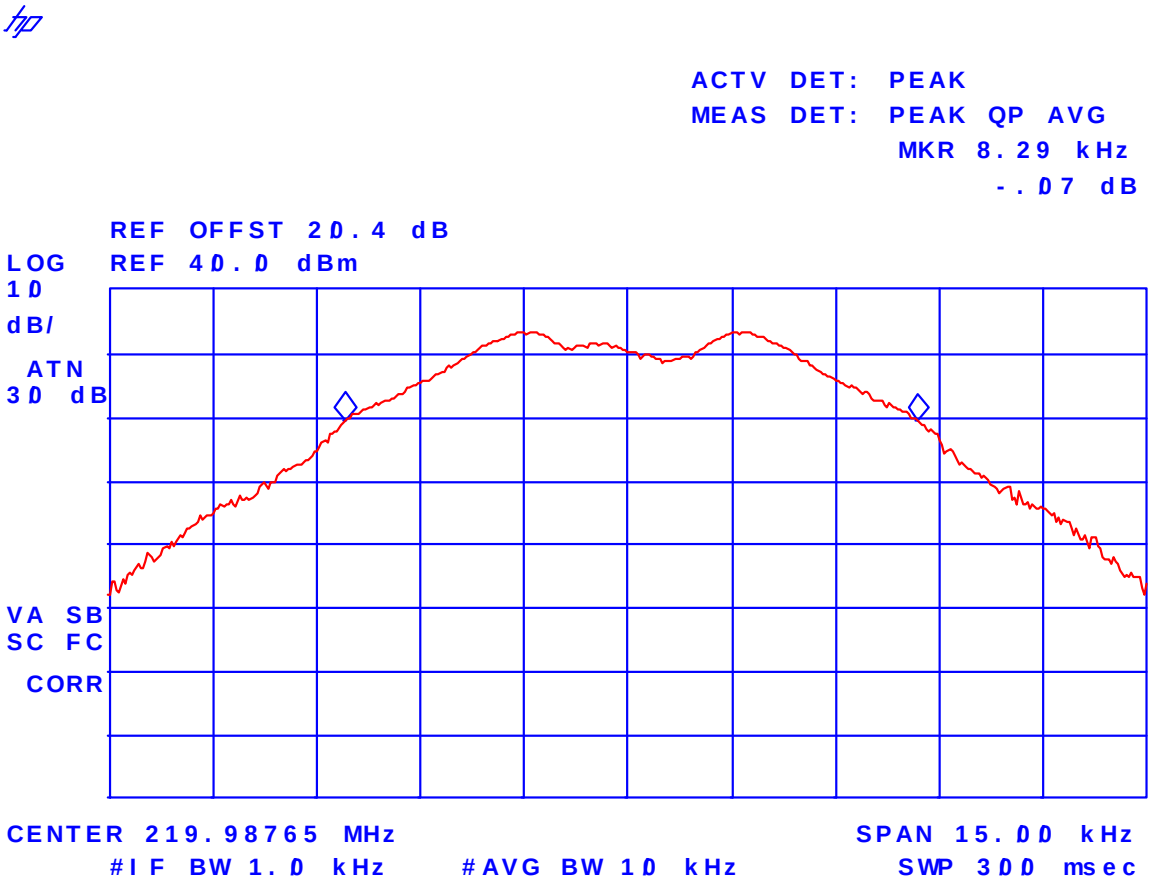
Plot # 7: 99% Occupied Bandwidth @ 217.0125 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz max.



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

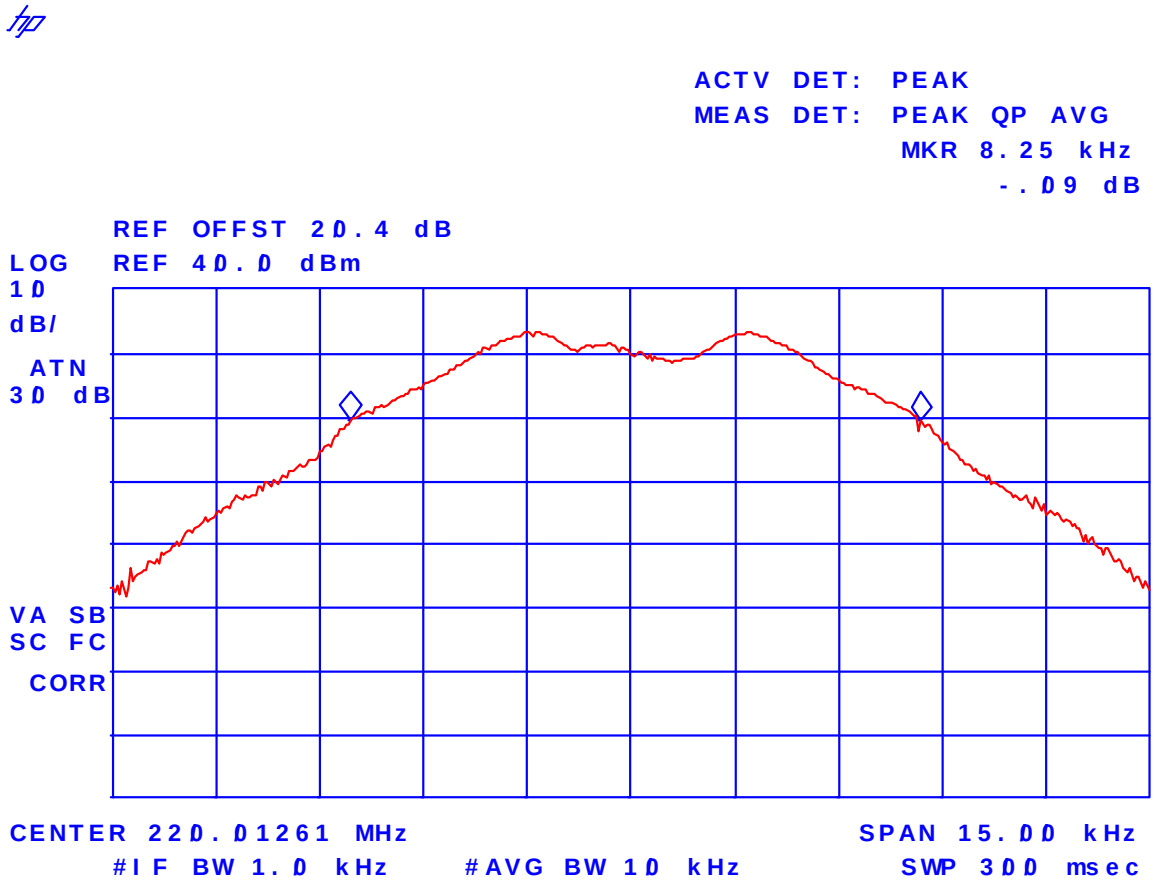
Plot # 8: 99% Occupied Bandwidth @ 219.9875 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz max.

Date: Nov 18 2003
Tested By: Wayne

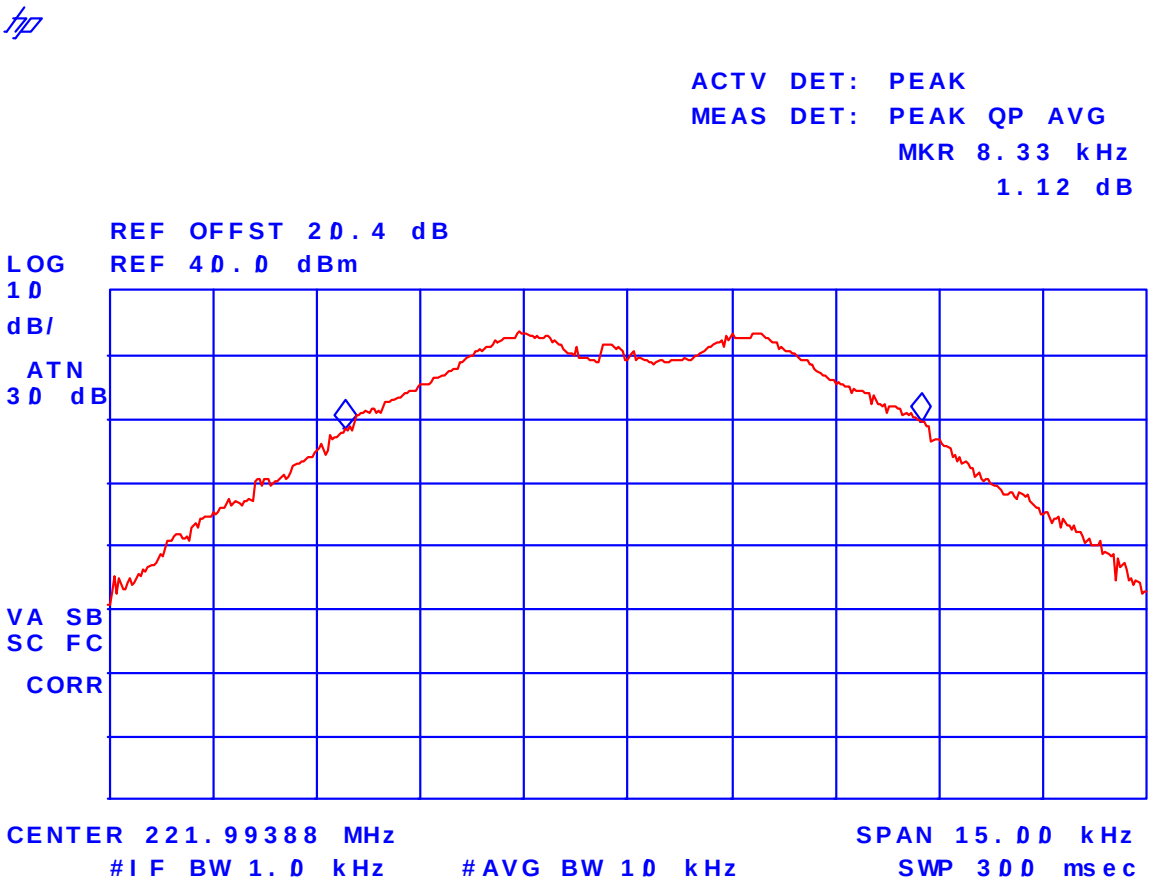


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 9: 99% Occupied Bandwidth @ 220.0125 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz max.

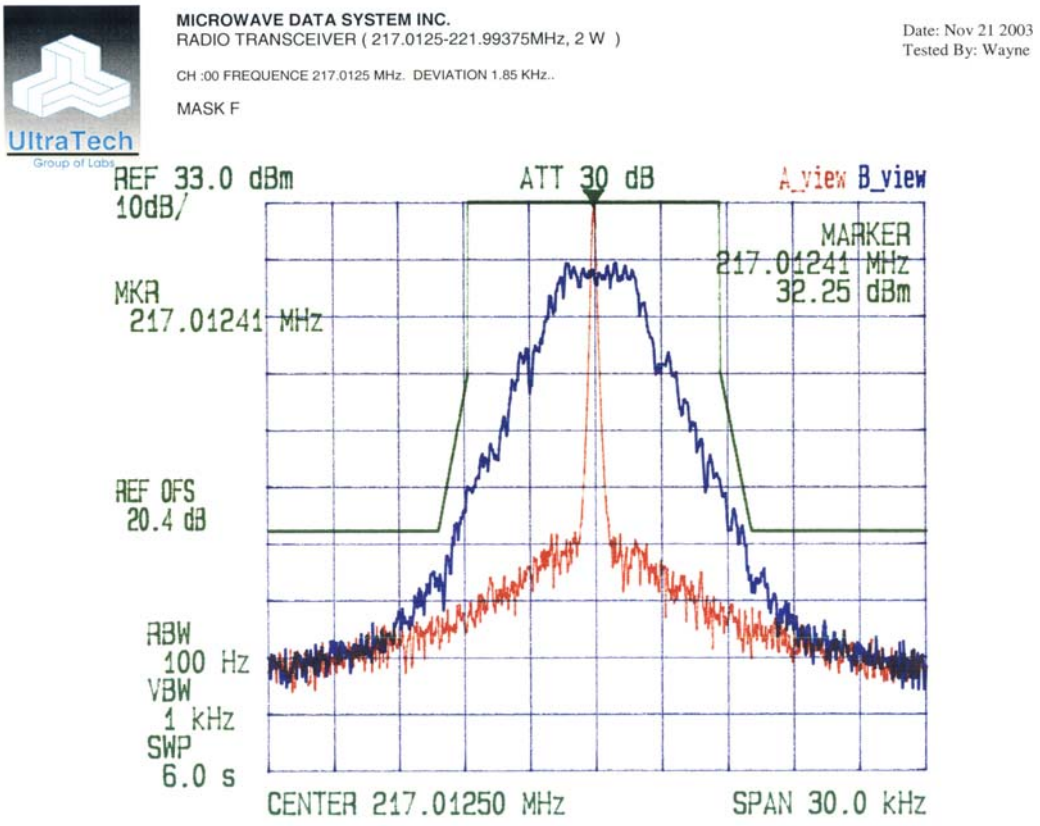


Plot # 10: 99% Occupied Bandwidth @ 221.99388 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz max.



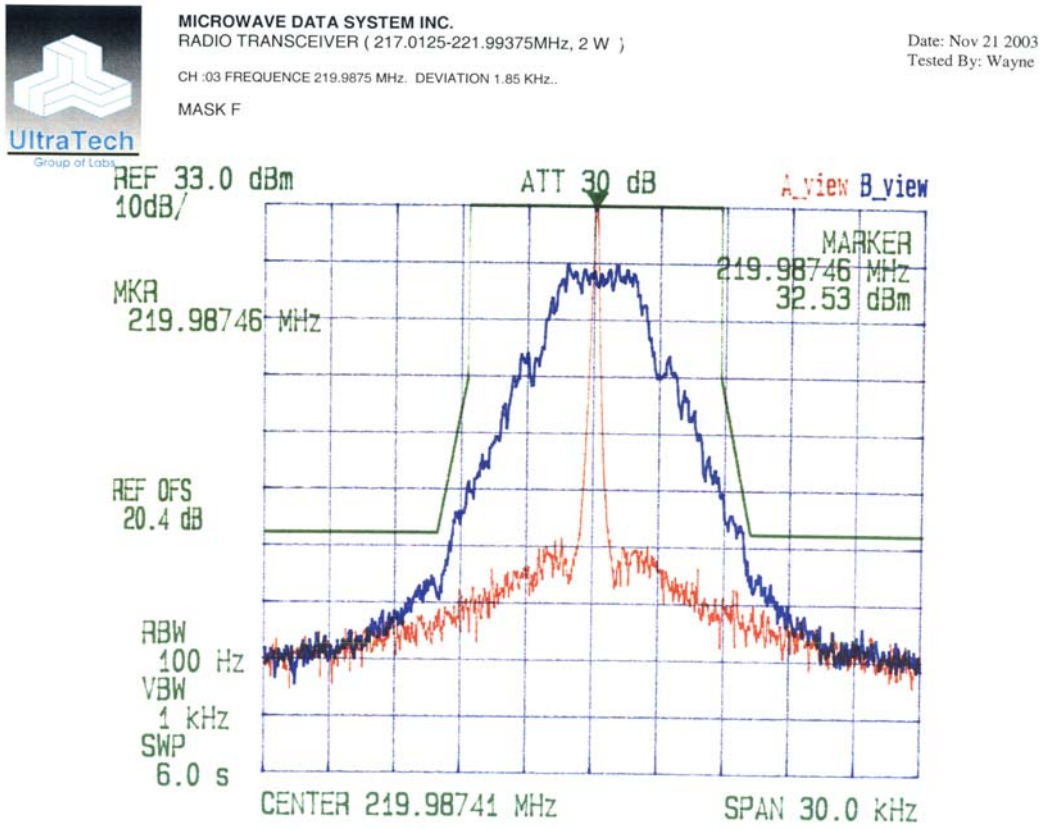
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 11: Emission Mask F @ 217.0125 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz



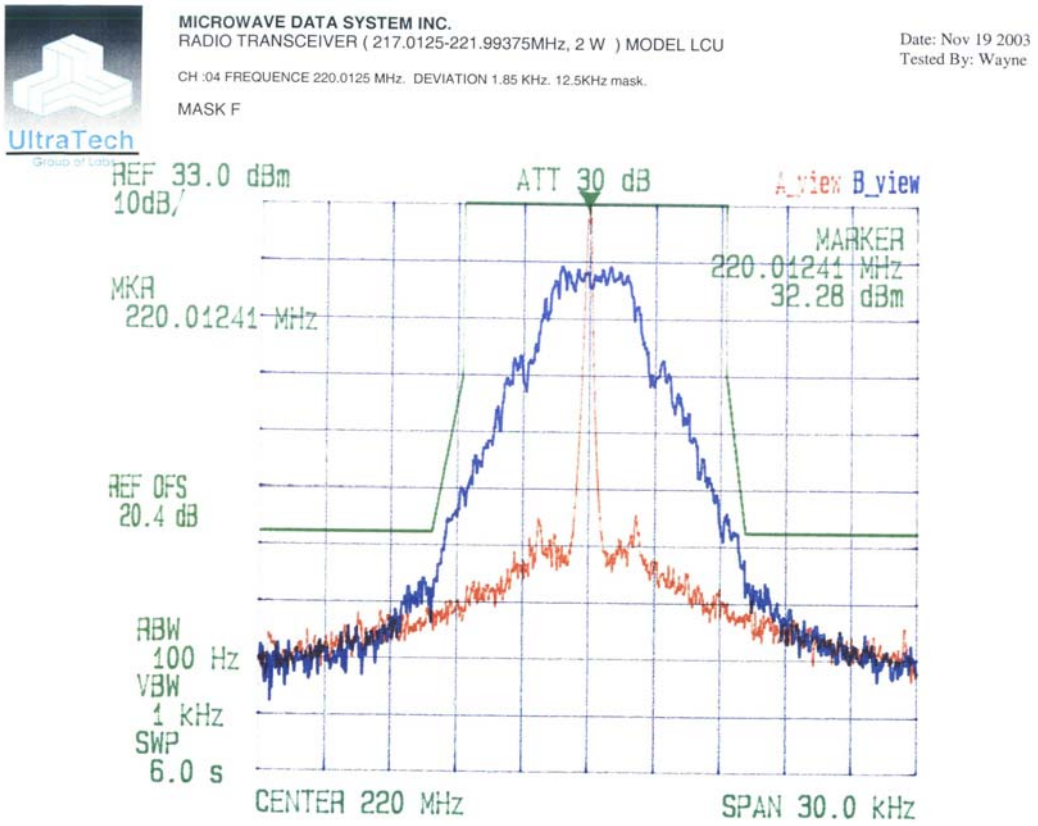
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 12: Emission Mask F @ 219.9875 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz



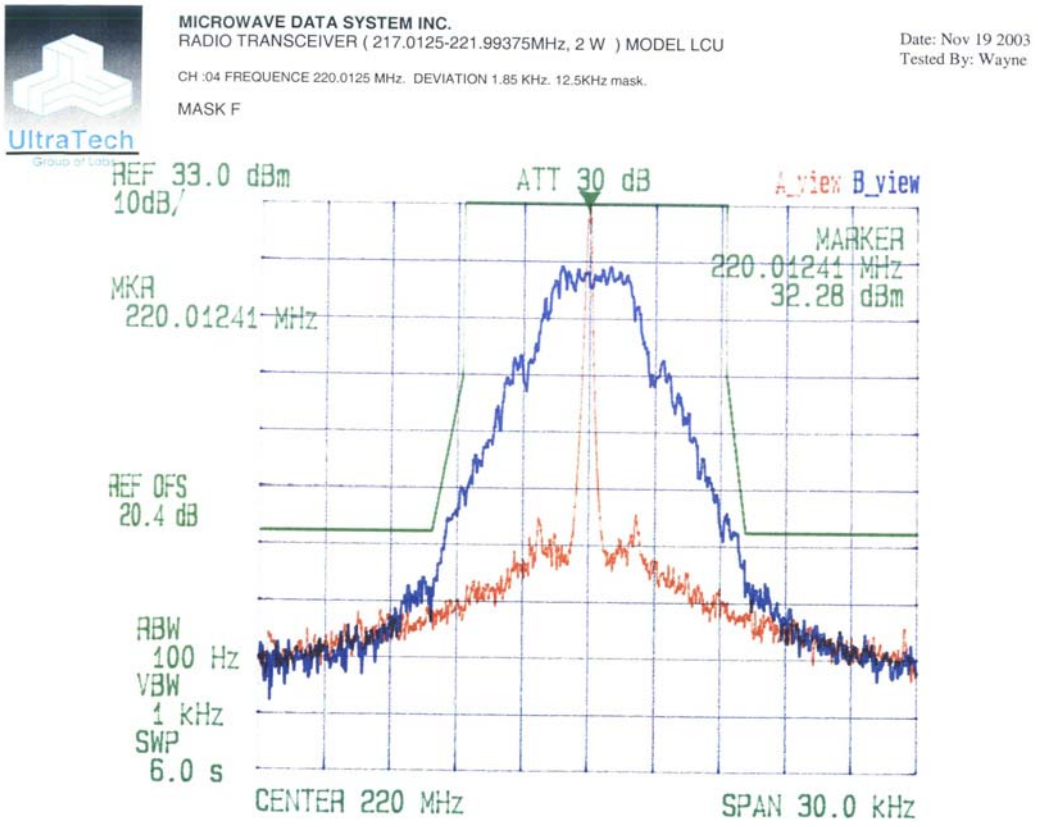
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 13: Emission Mask F @ 220.00625 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz

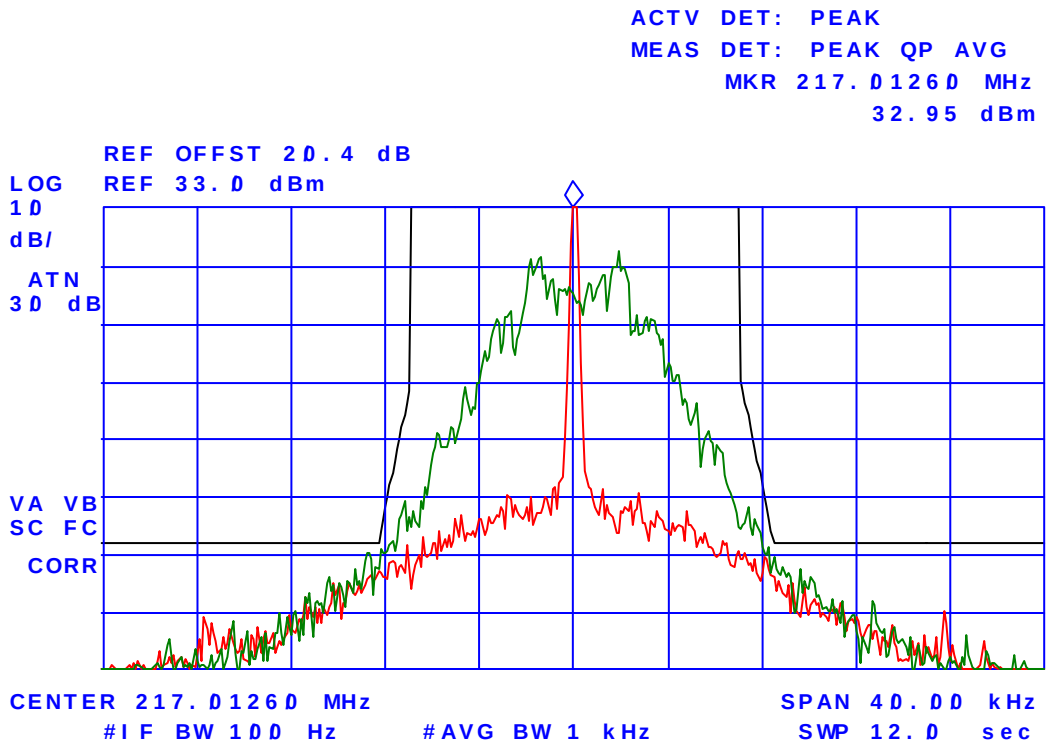


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 14: Emission Mask F @ 221.99375 MHz
12.5 kHz Channel Spacing, Freq. Dev. = 1.85 kHz

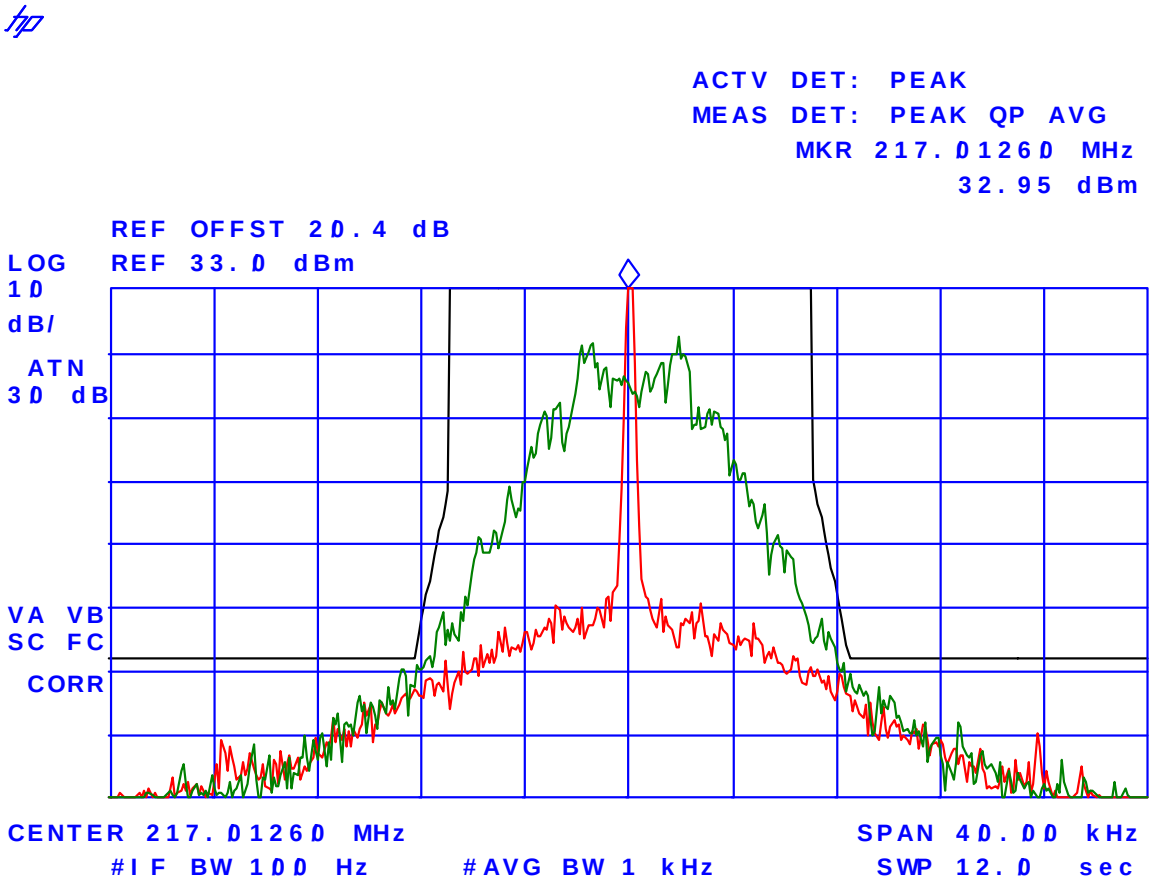


Plot # 15: Emission Mask F @ 217.0125 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz



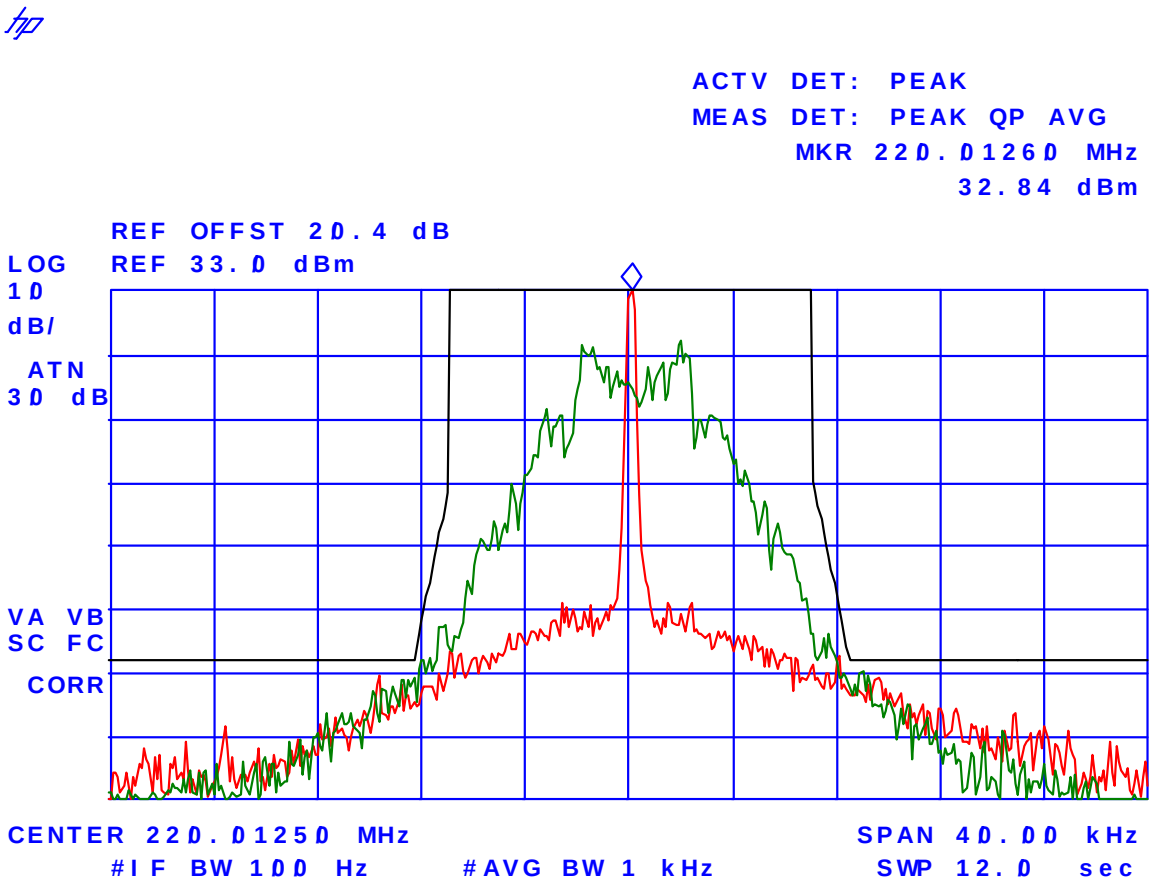
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 16: Emission Mask F @ 219.9875 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz



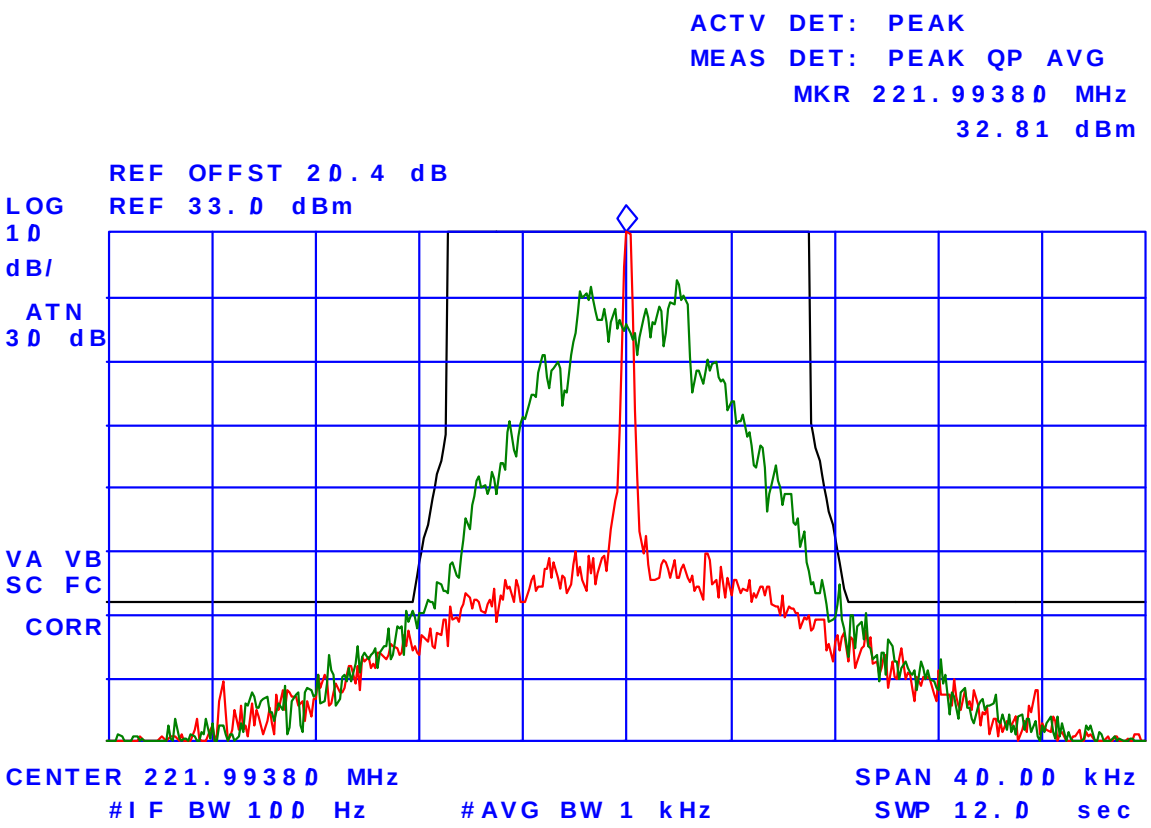
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 17: Emission Mask F @ 220.00625 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz



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

Plot # 18: Emission Mask F @ 221.99375 MHz
15 kHz Channel Spacing, Freq. Dev. = 2.66 kHz



6.10. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS @ FCC 90.210

6.10.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Frequency Range	Attenuation Limit (dBc)
90.210(f) – Voice & data	10 MHz to Lowest frequency of the radio to 10th harmonic of the highest frequency of the radio	55+10*log(P) or -25 dBm or 65 dBc whichever is less

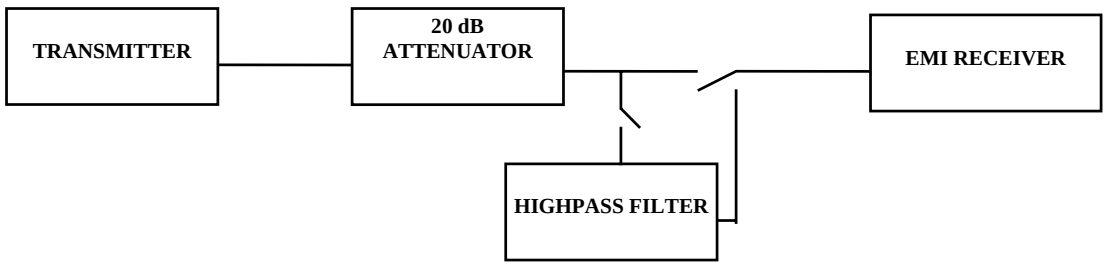
6.10.2. Method of Measurements

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

6.10.3. 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

6.10.4. Test Arrangement



6.10.5. Test Data

Note: Since there are no differences for spurious emissions when the transmitter operates in 12.5 or 15 kHz Channel Spacings due to our prescans, final tests were conducted on 12.5 kHz operation only.

6.10.5.1. Near Lowest Frequency in 217-220 MHz Band (217.0125 MHz)

Fundamental Frequency: 217.0125 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

FREQUENCY (MHz)	TRANSMITTER CONDUCTED ANTENNA EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<-52.0	< -86.0	-59 dBc	< -27.0	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and all emissions within 20 dB below the limits were recorded.
- Please refer to Plots # 9 and 10 for detailed measurements.

6.10.5.2. Near Lowest Frequency in 217-220 MHz Band (219.9875 MHz)

Fundamental Frequency: 219.9875 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

FREQUENCY (MHz)	TRANSMITTER CONDUCTED ANTENNA EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<-54.0	< -88.0	-59 dBc	< -29.0	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and all emissions within 20 dB below the limits were recorded.
- Please refer to Plots # 11 and 12 for detailed measurements.

6.10.5.3. Near Lowest Frequency in 220-222 MHz Band (220.00625 MHz)

Fundamental Frequency: 220.00625 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

FREQUENCY (MHz)	TRANSMITTER CONDUCTED ANTENNA EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<-53	< -87.0	-59 dBc	< -28.0	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and all emissions within 20 dB below the limits were recorded.
- Please refer to Plots # 13 and 14 for detailed measurements.

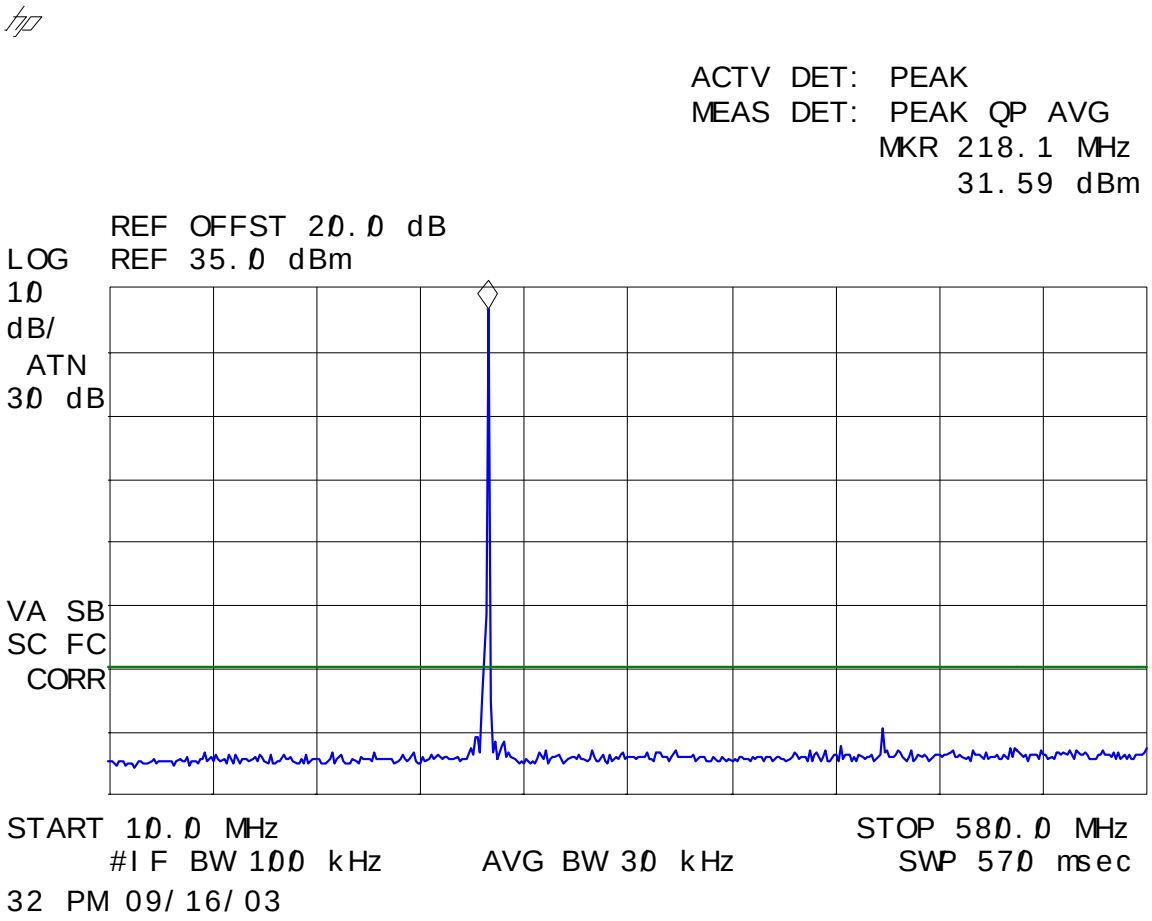
6.10.5.4. Near Lowest Frequency in 220-222 MHz Band (221.99375 MHz)

Fundamental Frequency: 221.99375 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

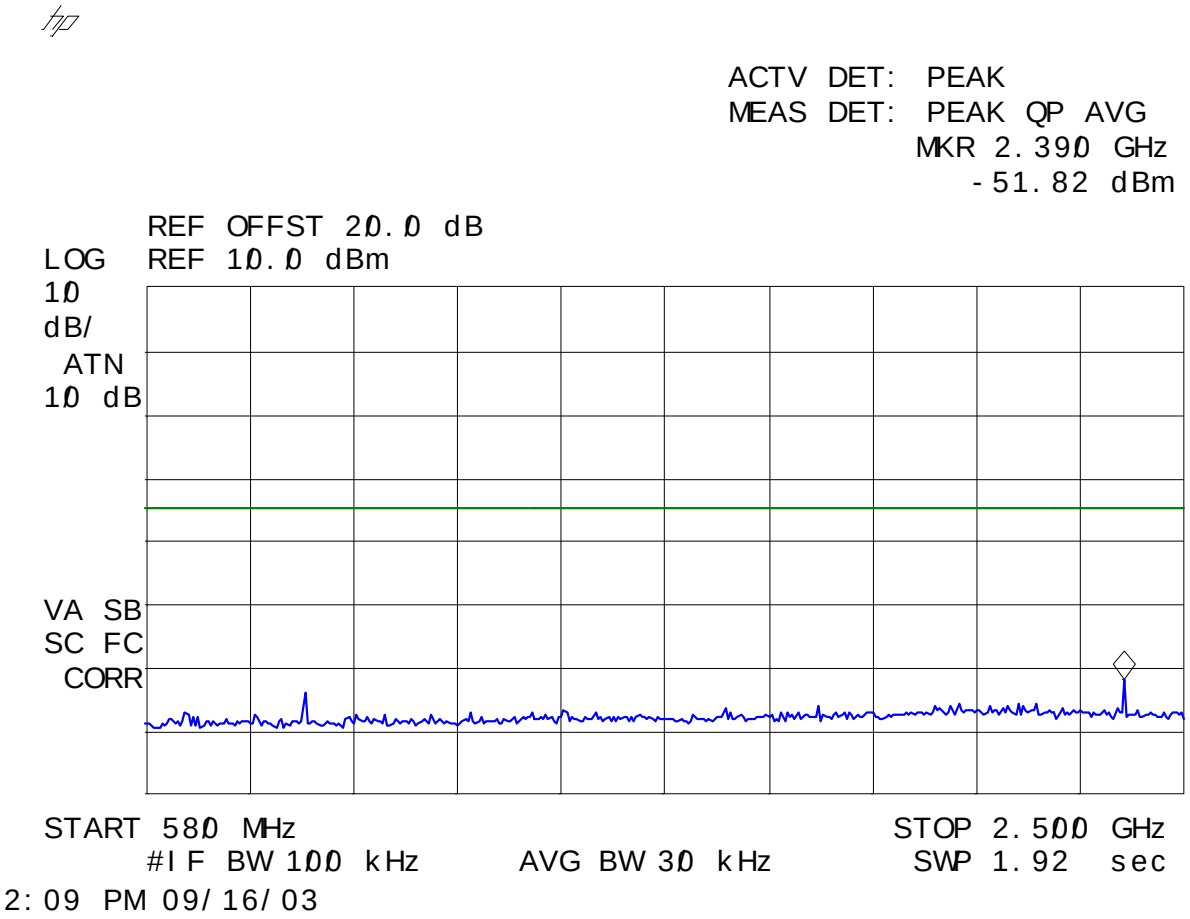
FREQUENCY (MHz)	TRANSMITTER CONDUCTED ANTENNA EMISSIONS (dBm)	(dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<-54	< -88.0	-59 dBc	< -29.0	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and all emissions within 20 dB below the limits were recorded.
- Please refer to Plots # 15 and 16 for detailed measurements.

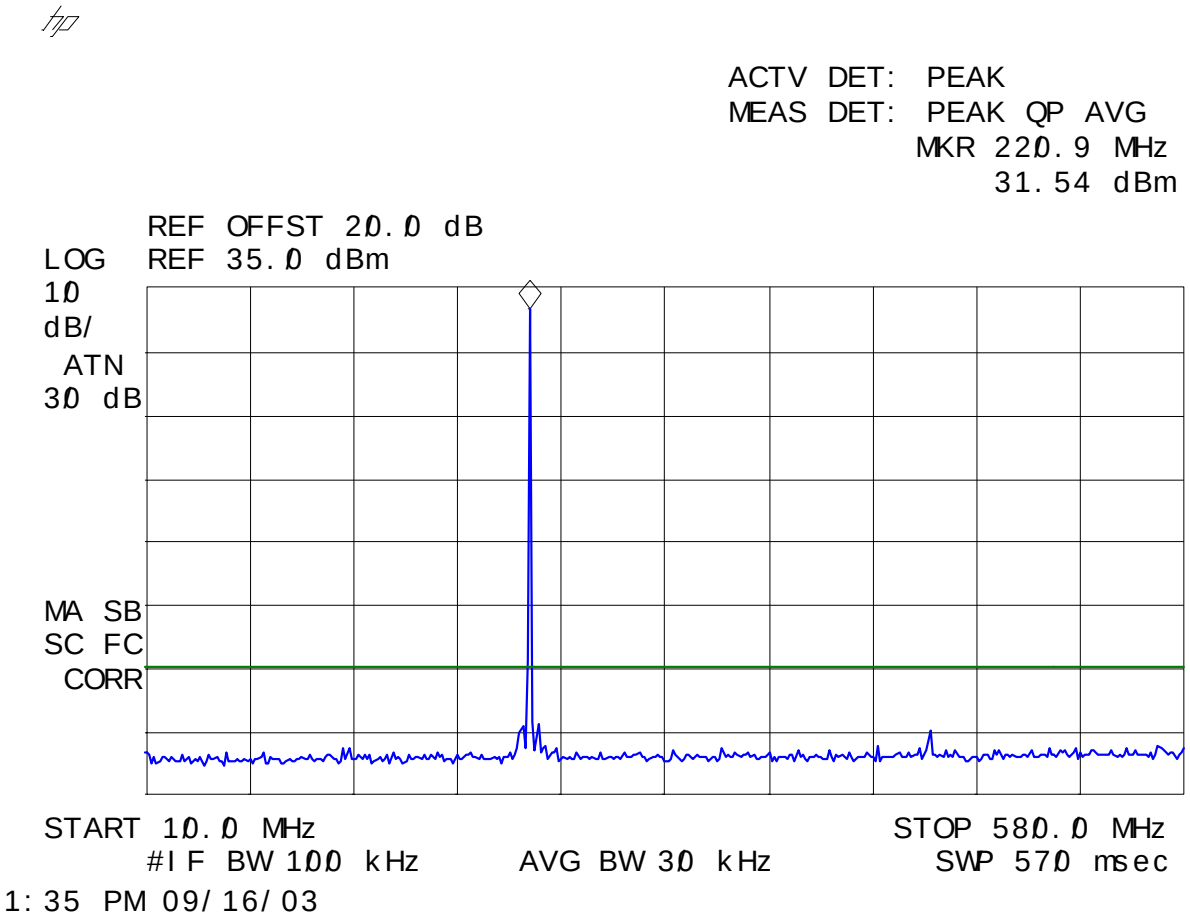
Plot # 9: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 217.0125 MHz, RF Output Power: 2.5 Watts peak



Plot # 10: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 217.0125 MHz, RF Output Power: 2.5 Watts peak

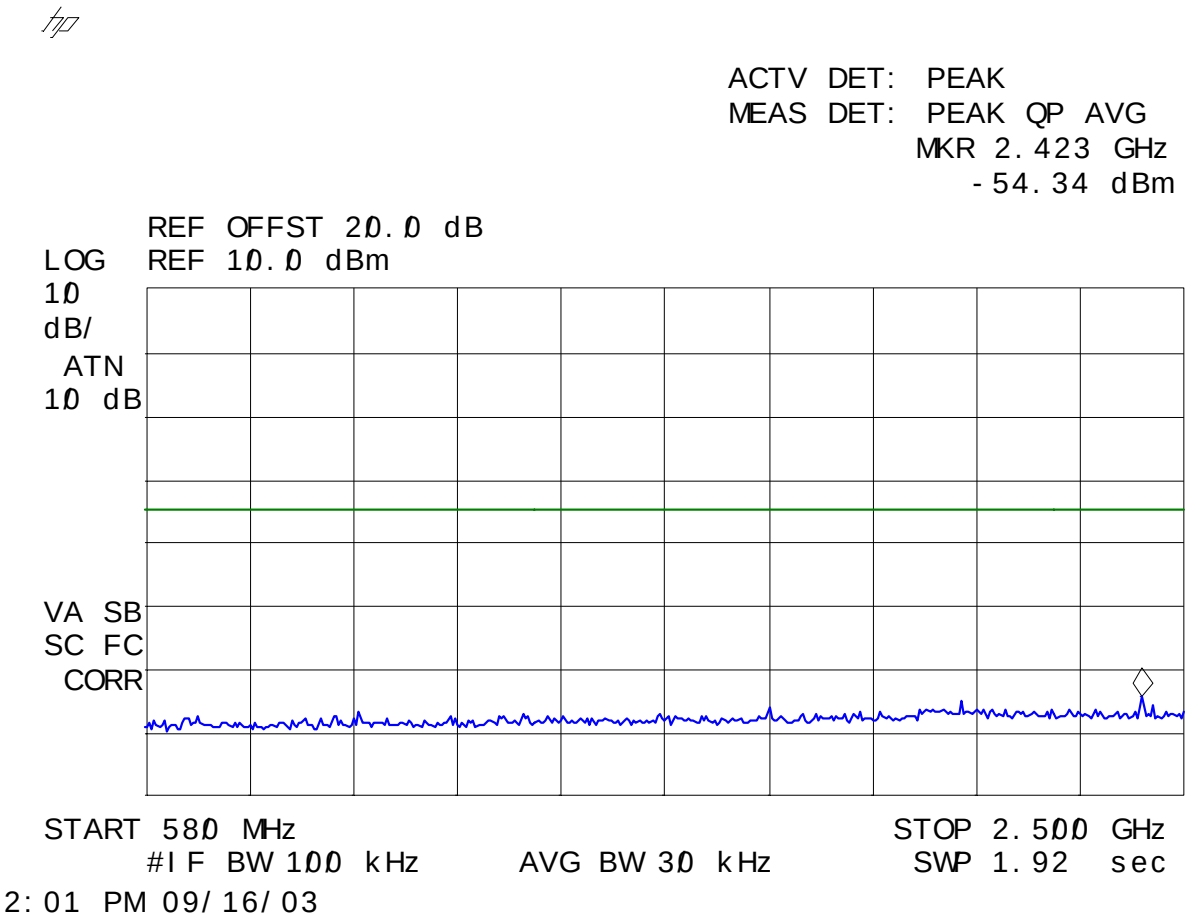


Plot # 11: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 219.9875 MHz, RF Output Power: 2.5 Watts peak

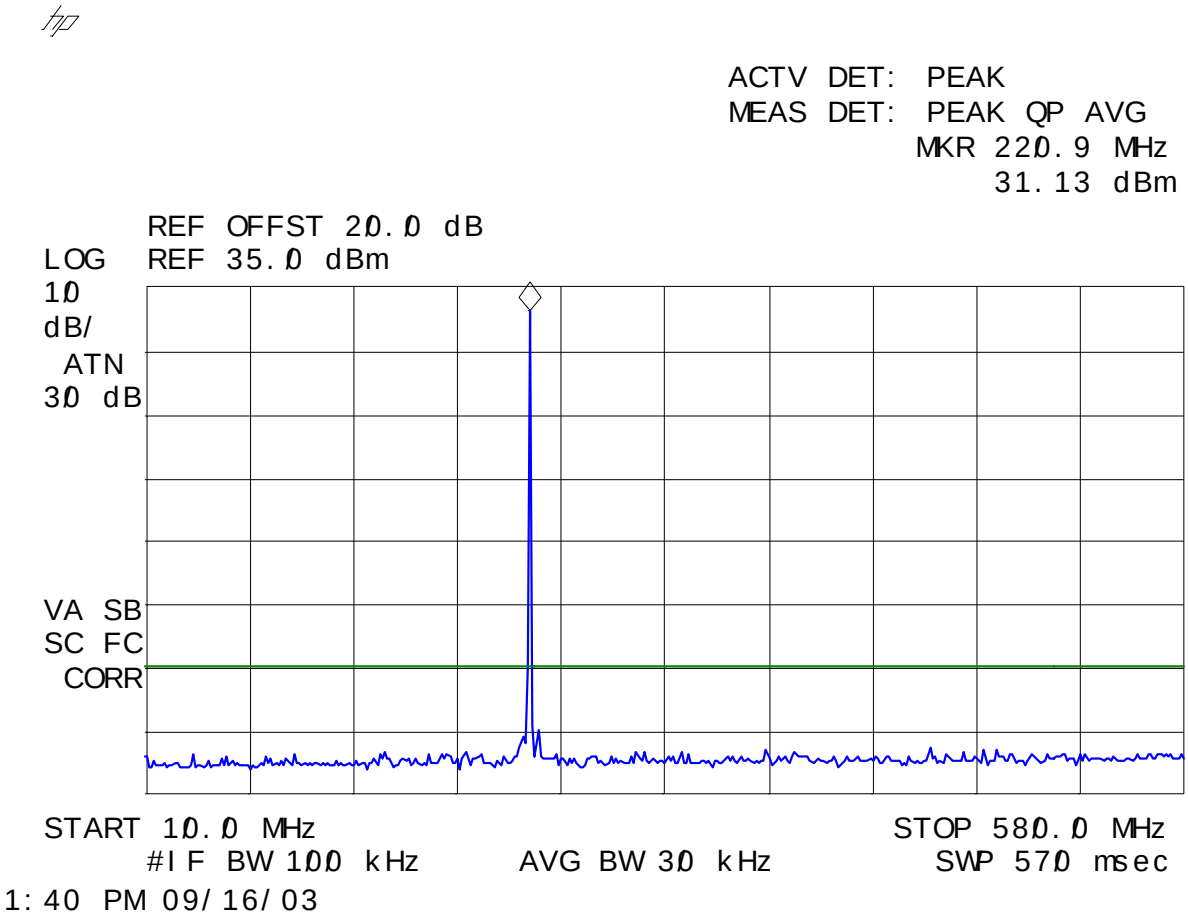


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

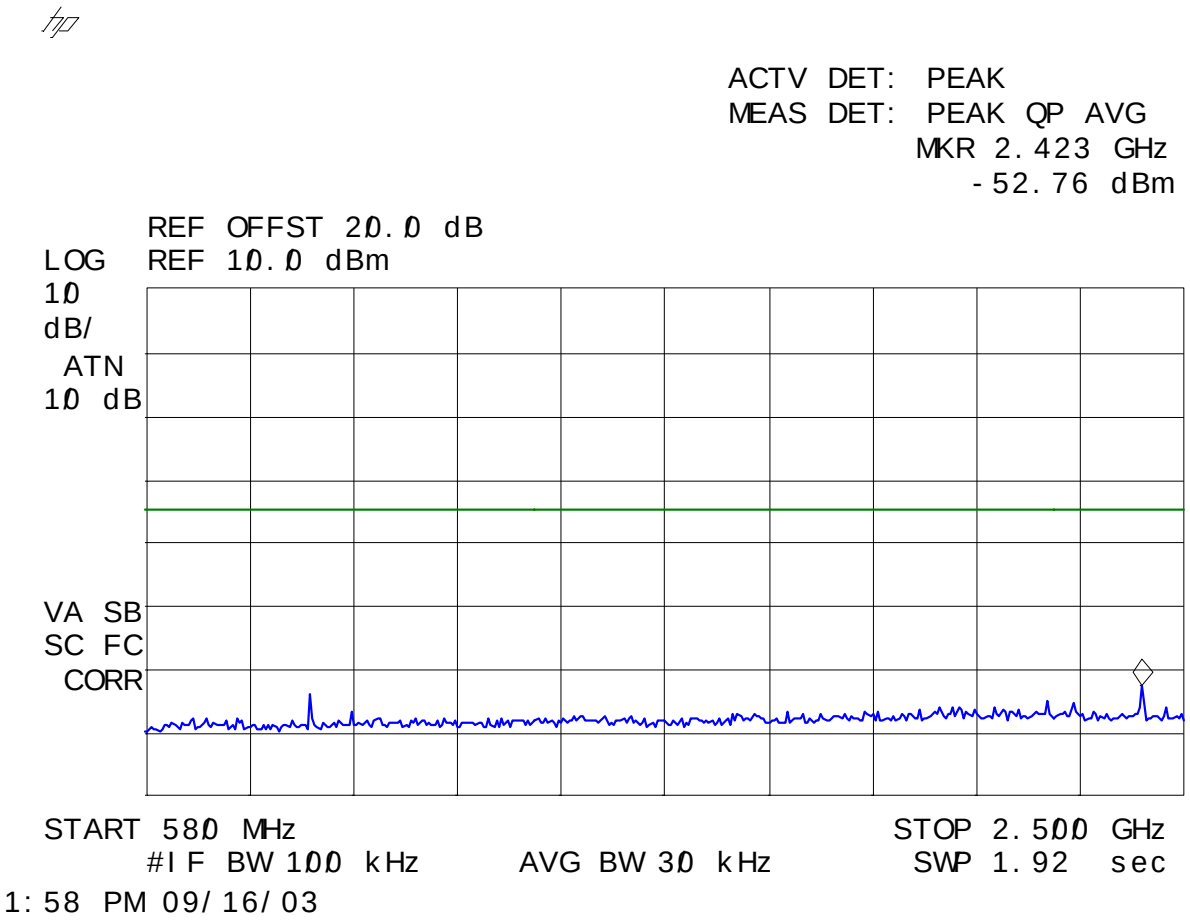
Plot # 12: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 219.9875 MHz, RF Output Power: 2.5 Watts peak



Plot # 13: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 220.00625 MHz, RF Output Power: 2.5 Watts peak

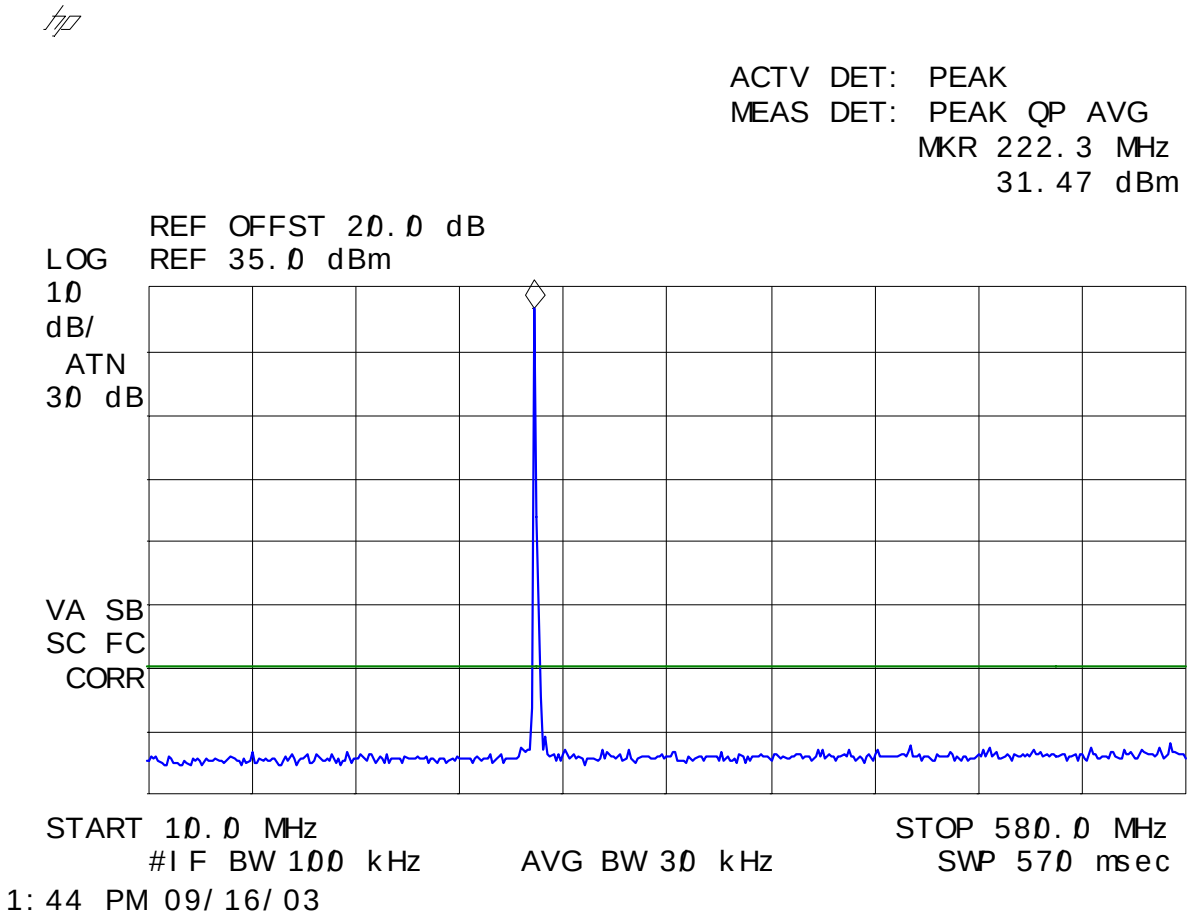


Plot # 14: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 220.00625 MHz, RF Output Power: 2.5 Watts peak

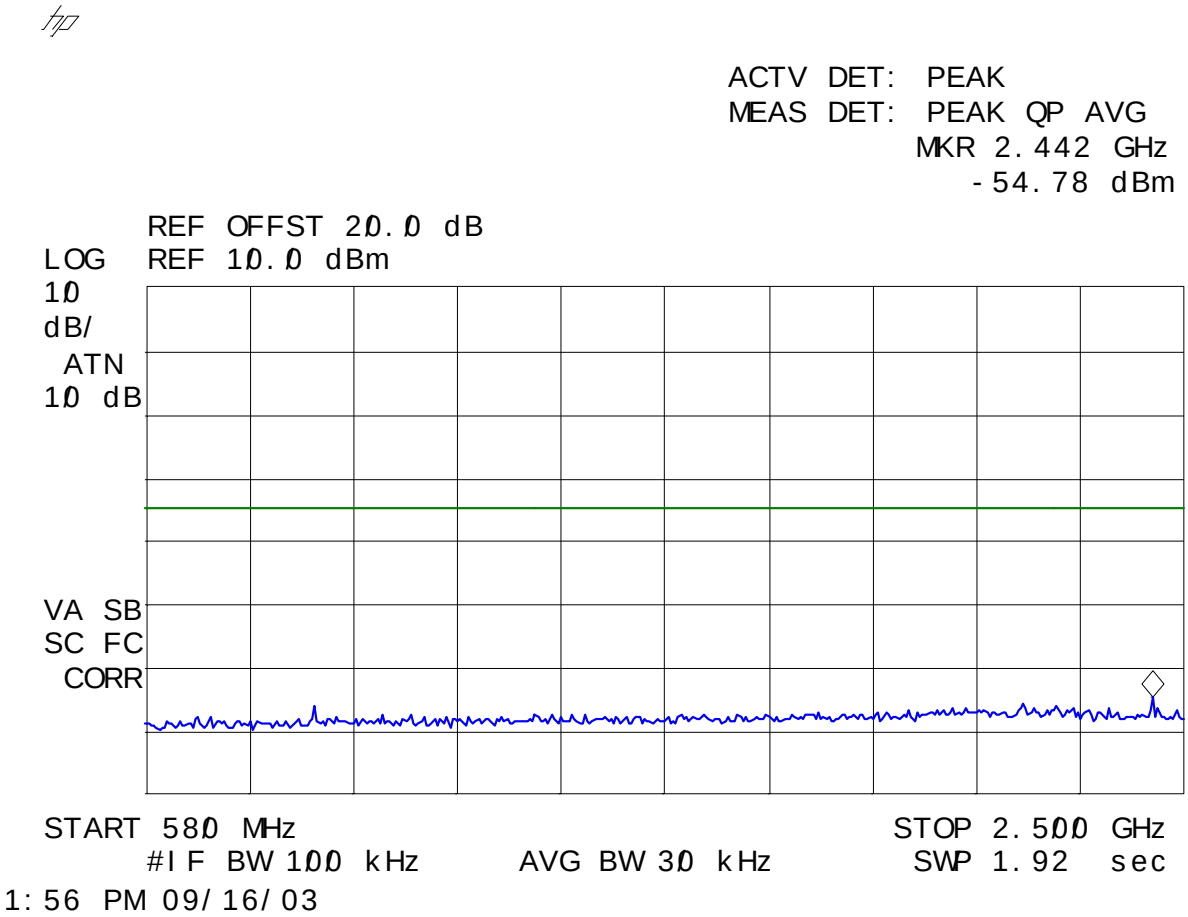


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 15: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 221.99375 MHz, RF Output Power: 2.5 Watts peak



Plot # 16: Transmitter RF Conducted Emissions at the Antenna Port
Tx Frequency: 221.99375 MHz, RF Output Power: 2.5 Watts peak



6.11. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 90.210

6.11.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Frequency Range	Attenuation Limit (dBc)
90.210(f) – Voice & data	10 MHz to Lowest frequency of the radio to 10th harmonic of the highest frequency of the radio	55+10*log(P) or -25 dBm or 65 dBc whichever is less

6.11.2. 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)

6.11.3. 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

6.11.4. Test Setup

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

6.11.5. Test Data

Notes: Since there are no differences for spurious emissions when the transmitter operates in 12.5 or 15 kHz Channel Spacings due to our prescans, final tests were conducted on 12.5 kHz operation only.

The Radiated emissions were performed at 3 meters distance.

6.11.5.1. Near Lowest Frequency in 217-220 MHz Band (217.0125 MHz)

Fundamental Frequency: 217.0125 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

FREQUENCY (MHz)	E-Field @3m (dBuV/m)	ERP (dBm)	ERP (dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<	<<	< <	-59 dBc	<<	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and no significant RF emissions were found at 3 meters distance.

6.11.5.2. Near Lowest Frequency in 217-220 MHz Band (219.9875 MHz)

Fundamental Frequency: 219.9875 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

FREQUENCY (MHz)	E-Field @3m (dBuV/m)	ERP (dBm)	ERP (dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<	<<	< <	-59 dBc	<<	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and no significant RF emissions were found at 3 meters distance.

6.11.5.3. Near Lowest Frequency in 220-222 MHz Band (220.00625 MHz)

Fundamental Frequency: 220.00625 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

FREQUENCY (MHz)	E-Field @3m (dBuV/m)	ERP (dBm)	ERP (dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<	<<	< <	-59 dBc	<<	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and no significant RF emissions were found at 3 meter distance.

6.11.5.4. Near Lowest Frequency in 220-222 MHz Band (221.99375 MHz)

Fundamental Frequency: 221.99375 MHz
RF Output Power: 2.5 Watts peak or 34 dBm peak (conducted)
Modulation: FM modulation with 4 kb/s internal ramdom data soruce
FCC Limit: 55+10*log(P) = 59 dBc

FREQUENCY (MHz)	E-Field @3m (dBuV/m)	ERP (dBm)	ERP (dBc)	LIMIT (dBc)	MARGIN (dB)	PASS/ FAIL
10 – 2500	<<	<<	< <	-59 dBc	<<	PASS

- The emissions were scanned from 10 MHz to 2.5 GHz and no significant RF emissions were found at 3 meter distance.

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 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.

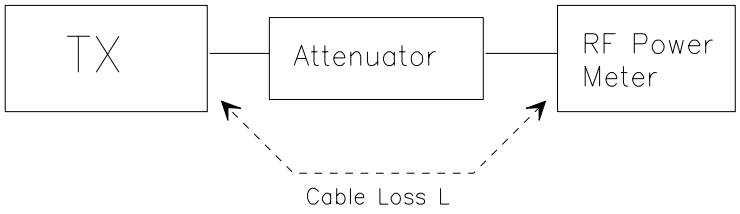
Step 2: Calculation of Average EIRP. See Figure 1

- 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.



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

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 caOCUlate 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

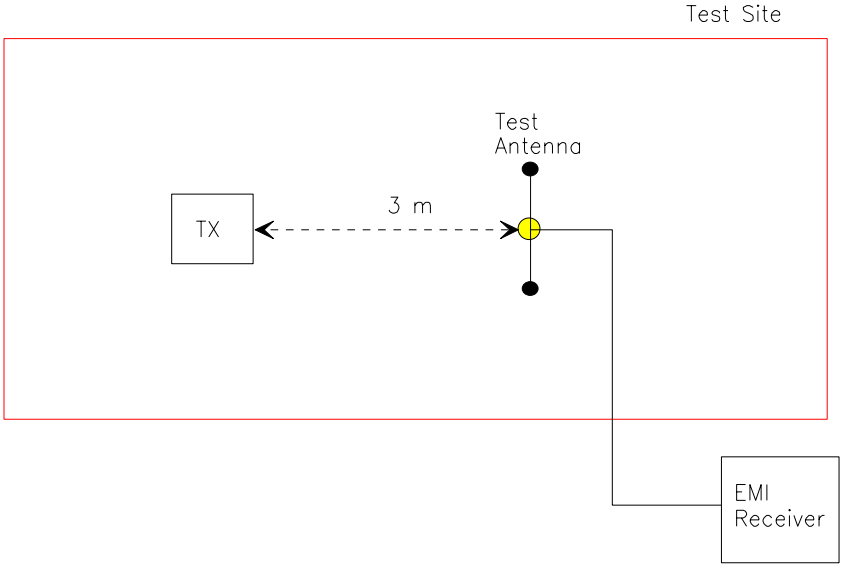
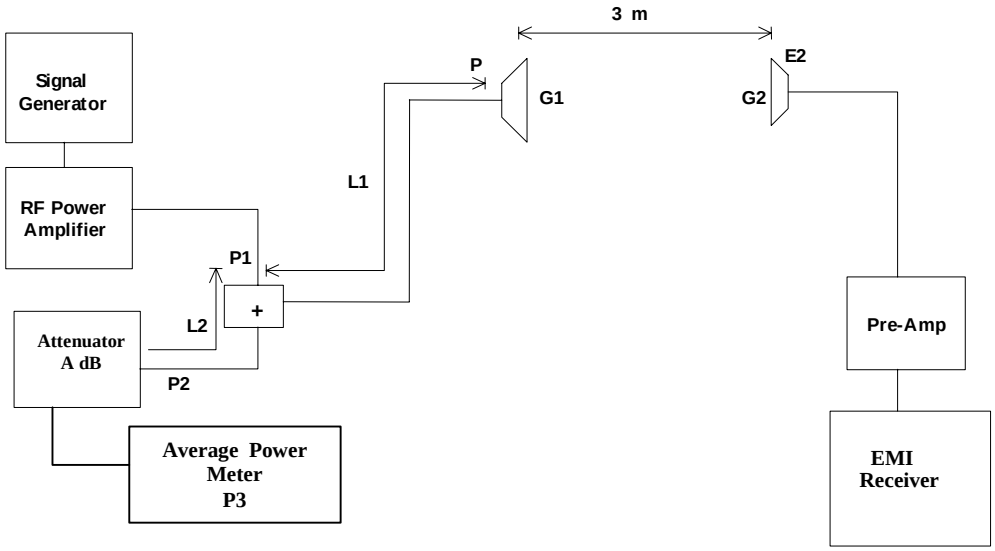


Figure 3



- *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 -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 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 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..