FCC PART 95
EMI MEASUREMENT AND TEST REPORT

For

Dakota Alert

112 W. Main Street, POBox 130, Elk Point, SD 57025 USA

FCC ID: QK8MALERT

August 15, 2002

This Report Concerns:	Equipment Type:
☒ Original Report	MURS

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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Applicant:	Dakota Alert
Model Name:	M538-SR
Product Description:	MURS Alert
Dimension:	5.5”L x 5.0”W x 6.4”H approximately
FCC ID:	QK8MALERT
Power Supply:	Fed by Dakota AC/DC Power Adapter, SID48023U
Applicable Requirements:	Part 95 Subpart E and Subpart J

** The test data was only good for test sample. There may have deviation for other product samples.*

1.2 Objective

This report is prepared on behalf of *Dakota Alert* in accordance with Part 95 Subpart A, Subpart B and Subpart E of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for effective radiated power, modulation characteristics, occupied bandwidth, radiated spurious emissions, AC line conducted emissions and frequency stability.

1.3 Test Methodology

Measurements contained in this report were also conducted with TIA/EIA Standard 603, Telecommunications Industry Association Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.4 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2000.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, IEC/CISPR 22: 1998, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

1.5 Test Equipment List

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8564E	08303	12/6/2002
HP	Spectrum Analyzer	8593B	2919A00242	12/20/2002
HP	Amplifier	8349B	2644A02662	12/20/2002
HP	Quasi-Peak Adapter	85650A	917059	12/6/2002
HP	Amplifier	8447E	1937A01046	12/6/2002
A.H. System	Horn Antenna	SAS0200/571	261	12/27/2002
Com-Power	Log Periodic Antenna	AL-100	16005	11/2/2002
Com-Power	Biconical Antenna	AB-100	14012	11/2/2002
Solar Electronics	LISN	8012-50-R-24-BNC	968447	12/28/2002
Com-Power	LISN	LI-200	12208	12/20/2002
Com-Power	LISN	LI-200	12005	12/20/2002
BACL	Data Entry Software	DES1	0001	12/20/2002
Rohde & Schwarz	Signal Generator	SMIQ03B	1125.5555.03	7/10/2002
Rohde & Schwarz	I/Q Modulation Generator	AMIQ	1110.2003.02	8/10/2002

*** Statement of Traceability:** Bay Area Compliance Laboratory Corp. certifies that all calibration has been performed using suitable standards traceable to NATIONAL INSTITUTE of STANDARDS and TECHNOLOGY. (NIST)

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was tested under typical operating modes to represent the worst-case results during the final qualification test.

2.2 EUT Exercise Software

The EUT was powered and fully operated with option speaker/microphone connected.

2.3 Special Accessories

As shown in section 2.5, interface cable used for compliance testing is shielded as normally supplied by customer and its respective support equipment manufacturers.

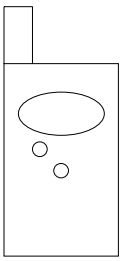
2.4 Schematics / Block Diagram

Please refer to Exhibit D.

2.5 Equipment Modifications

No modification was made by BACL Corp. to make sure the EUT to comply with the applicable limits.

2.6 Configuration of Test System



2.7 Test Setup Block Diagram

For tabletop systems, the EUT shall be centered laterally on the tabletop and its rear shall be flushed with the rear of the table. If the EUT is a stand-alone unit, it shall be placed in the center of the tabletop.

3 - REQUIREMENTS OF PROVISIONS

3.1 Definition

Multi-use Radio Service (MURS): an entity is authorized by rule to operate a MURS transmitter if it is not a foreign government or a representative of a foreign government and if it uses the transmitter in accordance with § 95.1309 and otherwise operates in accordance with the rules contained in this subpart. No license will be issued.

The MURS transmitter channel frequencies are 151.820MHz, 151.880MHz, 151.940MHz, 154.570MHz, 154.600MHz.

3.2 Requirements and Test Summary

FCC Rules	Rules Description	Requirement	Result
Transmitter Section			
2.1046 95.639 (h)	Effective Radiated Power	2W	Complied
2.1047 95.631 (j)	Modulation Characteristics F3E analogy voice Peak Frequency Deviation Audio Frequency Response	Deviation < 2.5 kHz	Complied
2.1049 95.632 (b)	Occupied Bandwidth	11.25 kHz on 151.82, 151.88 and 151.94MHz	Complied
		12.5 kHz on 154.57 and 154.60MHz	
2.1053 15.209 95.635	Spurious Radiated Emission	Worst Case < 48dB	Complied
15.207	Line Conducted Emissions	N/A	Complied
2.1055 95.632 (c)	Frequency Stability Vs. Temperature Vs. Voltage	Deviation<5ppm	Complied
Receiver Section			
15.109	Radiated Emission	Worst case < 48dB	Complied

3.2 Labeling Requirement

Each equipment for which a type acceptance applications is filed on or after May 1, 1981, shall bear an identification plate or label pursuant to §2.295 (Identification of Equipment) and §2.926 (FCC identifier)

In August 1996 the Federal Communications Commissions (FCC) adopted RF exposure guidelines with safety levels for hand-held wireless devices.

Generally users manual contains a RF exposure statement to indicate compliance with FCC requirements.

The users manual should also contain required information and instruction pursuant to 95.653.

4 - EFFECTIVE RADIATED POWER

4.1 Provision Applicable

Per FCC §2.1046 and FCC § 95.639 (h), no MURS unit, under any condition of modulation, shall exceed 2W effective radiated power (ERP).

4.2 Test Procedure

1. On a test site, the EUT shall be placed at 1.5m height on a turn table, and in the position closest to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3m from EUT to correspond to the frequency of the transmitter.
3. The output of the test antenna shall be connected to the measuring receiver and the quasi-peak detector is used for the measurement.
4. The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test.
5. The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.
6. The transmitter shall then the rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
7. The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.
8. The maximum signal level detected by the measuring receiver shall be noted.
9. The transmitter shall be replaced by a tuned dipole (substitution antenna).
10. The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.
11. The substitution antenna shall be connected to a calibrated signal generator.
12. In necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
13. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
14. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring received, which is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.
15. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.

16. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

17. The measure of the effective radiated power is the large of the two levels recorded, at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

4.3 Test equipment

- Signal Generator
  Manufacturer: Hewlett Packard
  Model: OPT001
  S/N: 3217A04699
  Calibration Due Date: 2/5/03

- Dipole Antenna
  Manufacturer: Com Power Corporation
  Model: AD-100
  S/N: 02222
  Calibration Due Date: 7/23/03

4.4 Test Results

The measured result showed as follows:

Low Channel: 30.41 dBm (1.10W) at 151.82 MHz
High Channel: 30.37 dBm (1.09W) at 154.60 MHz

5 - MODULATION CHARACTERISTICS

5.1 Provision Applicable

Per FCC § 2.1047 (a), voice modulated communication equipment, a curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Per FCC § 2.1047 (b), equipment which employs modulation limiting, a curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

5.2 Test Procedure

5.2.1 Audio Frequency Response

The RF output of the transceiver was connected to the input of a FM deviation meter through sufficient attenuation so as not to overload the meter or distort the reading. An audio signal generator was coupled into the external microphone jack of the transceiver, or alternatively, the microphone element was removed the generator output was connected to the microphone connectors.

The audio signal input level was adjusted to obtain 20% of the maximum rated system deviation at 1 kHz, and recorded as DEVREF. With the audio signal generator level unchanged, set the generator frequency between 100 Hz to 5000 Hz. The transmitter deviations (DEVFREQ) were measured and the audio frequency response was calculated as

$$20\log_{10}[DEV_{FREQ} / DEV_{REF}]$$

5.2.2 Audio Low-Pass Filter Response

An audio signal generator and an audio spectrum analyzer were connected to the input and output of the post limiter low pass filter respectively. The audio signal generator frequency was set between 1000 Hz and the upper low pass filter limit. The audio frequency response at test frequency was calculated as

$$LEV_{FREQ} - LEV_{REF}$$

5.2.3 Modulation Limiting

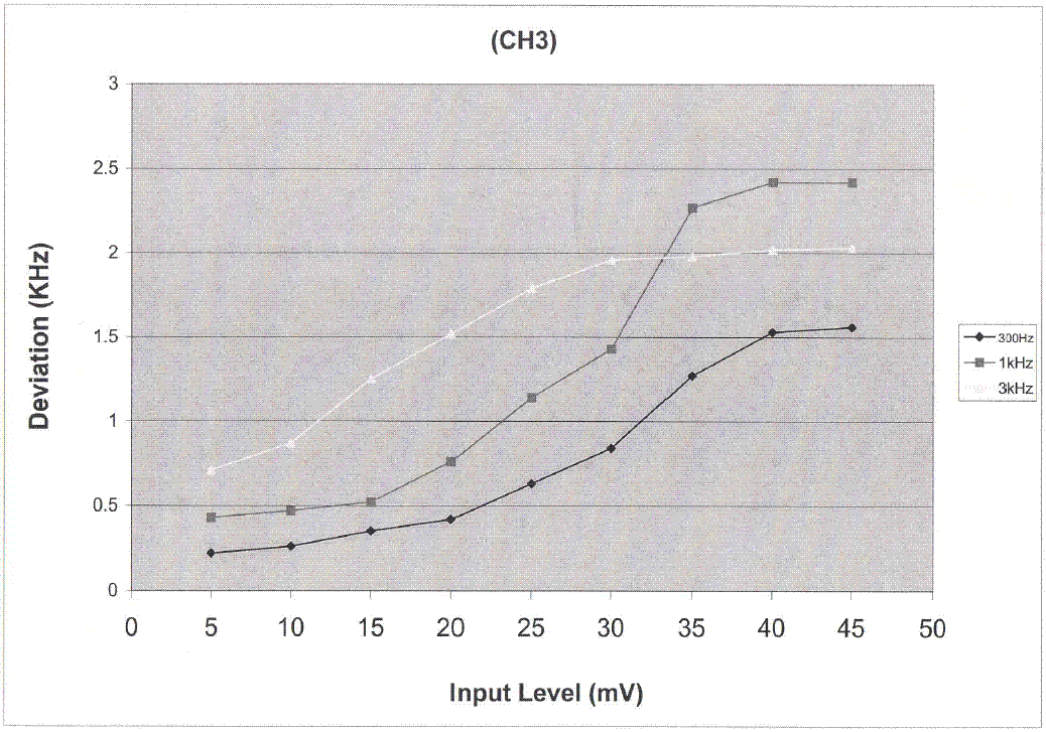
With the same setup as section 5.2.1 above, at three different modulating frequencies, the output level of the audio generator was varied and the FM deviation level was recorded.

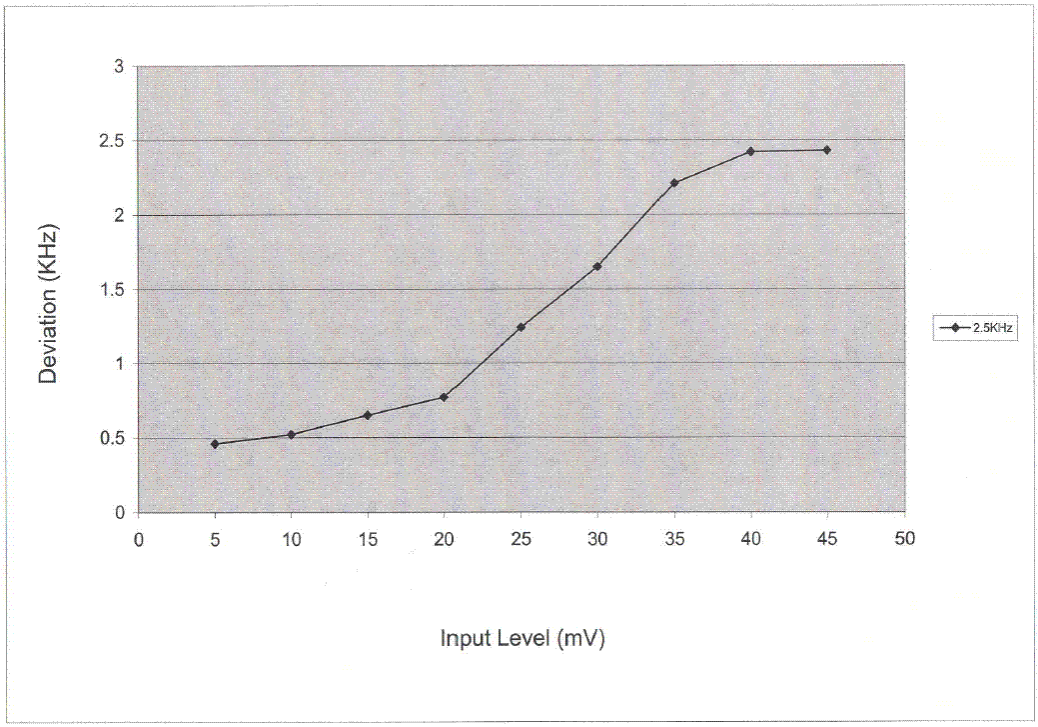
5.3 Test Equipment

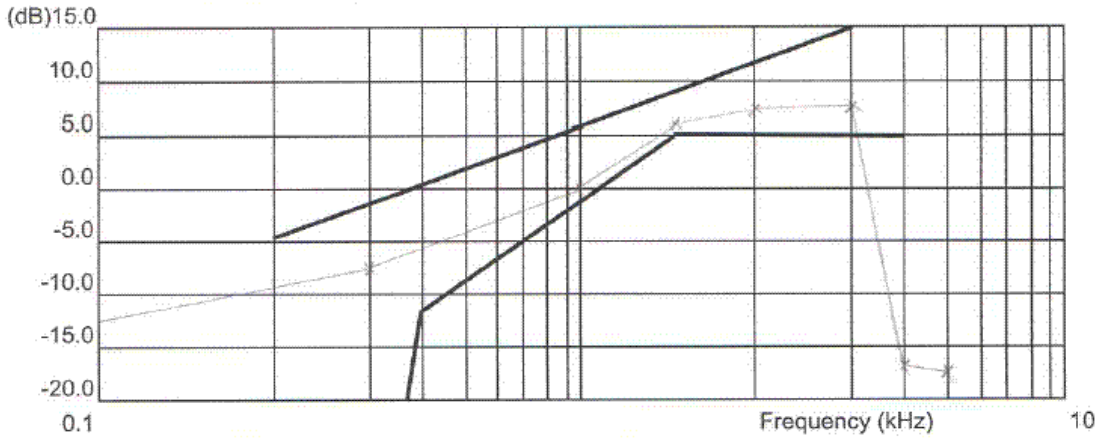
Hewlett Packard HP8566B Spectrum Analyzer
Hewlett Packard HP 7470A Plotter
Hewlett Packard HP8901A Modulation Analyzer
Lecroy 9350A Oscillscope

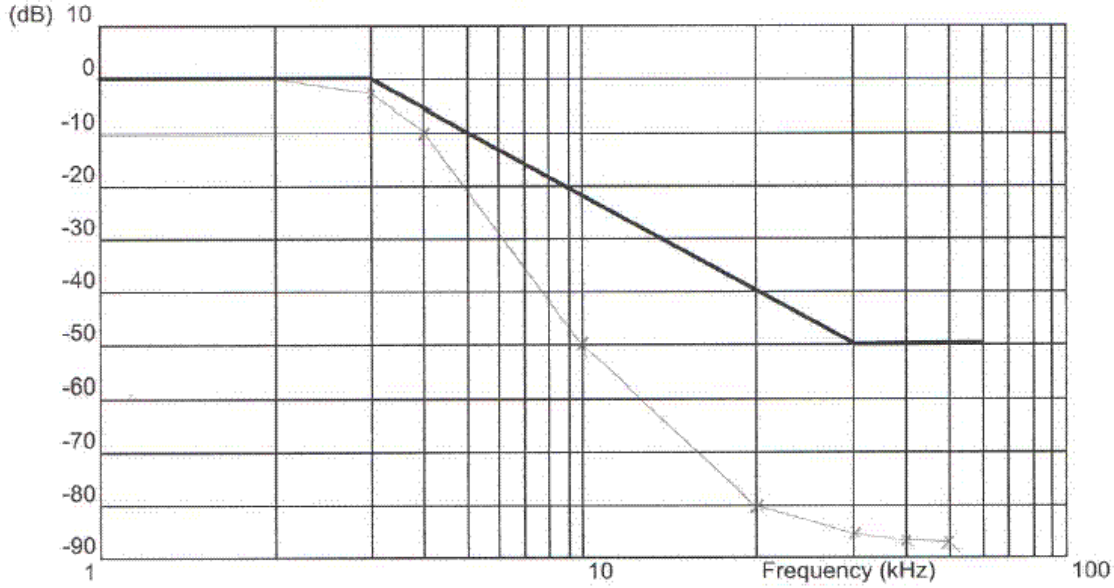
5.4 Test Results

The plot(s) of modulation characteristic is presented hereinafter as reference.


(CH3)
Deviation (KHz)
Input Level (mV)
300Hz
1kHz
3kHz
0
0.5
1
1.5
2
2.5
3
0
5
10
15
20
25
30
35
40
45
50


Deviation (KHz)
Input Level (mV)
2.5KHz
0
0.5
1
1.5
2
2.5
3
0
5
10
15
20
25
30
35
40
45
50


(dB)15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
0.1
Frequency (kHz)
10


(dB) 10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1
10
Frequency (kHz)
100

6 - OCCUPIED BANDWIDTH OF EMISSION

6.1 Provision Applicable

Per FCC §2.1049 and FCC §95.632 (b), the authorized bandwidth is 11.25 kHz on frequencies 151.820 MHz.

Per FCC §95.633 (f), the authorized bandwidth for emission type transmitted by a MURS transmitter is specified in §90.209.

6.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set up at least 10 times higher than the authorized bandwidth of the transmitter. With the transmitter keyed, the level of the unmodulated carrier was set to the full scale reference line of the spectrum analyzer. This is used as a 0dB reference for emission mask measurements.

The transmitter was then modulated with a 2500 Hz tone at an input level 20 dB greater than the necessary to produce 50% of rated system deviation. The resolution bandwidth of the spectrum analyzer was set up to 100 Hz and the spectrum of the transmitting signal was recorded. This spectrum was compared to the required emission mask.

6.3 Test Equipment

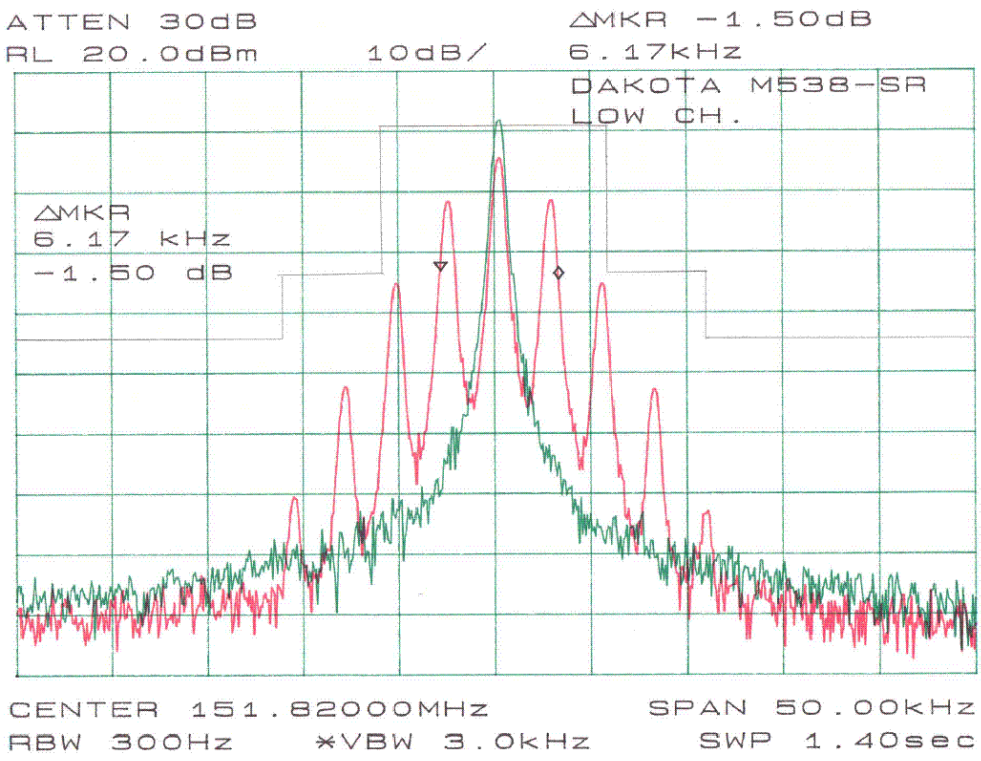
Leader LFG-1300S Function Generator
Hewlett Packard HP8566B Spectrum Analyzer
Hewlett Packard HP 7470A Plotter

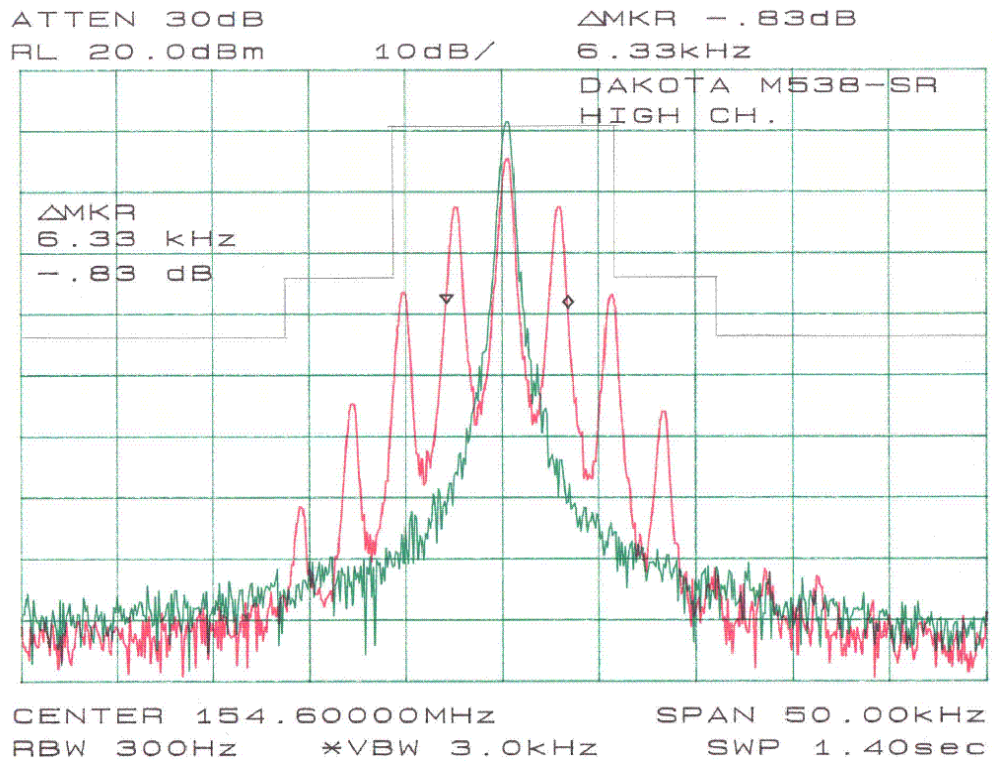
6.4 Test Results

Test Result: Pass
Please refer the following curve and plots.

6.5 Emission Designator

2M + 2D = (2 x 3 kHz) + (2 x 2.5 kHz) = 11K0F3E


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -1.50dB
6.17kHz
DAKOTA M538-SR
LOW CH.
ΔMKR
6.17 kHz
-1.50 dB
CENTER 151.82000MHz
SPAN 50.00kHz
RBW 300Hz
*VBW 3.0kHz
SWP 1.40sec


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.83dB
6.33kHz
DAKOTA M538-SR
HIGH CH.
ΔMKR
6.33 kHz
-.83 dB
CENTER 154.60000MHz
SPAN 50.00kHz
RBW 300Hz
*VBW 3.0kHz
SWP 1.40sec

7 - RADIATED SPURIOUS EMISSION

7.1 Provision Applicable

According to FCC §2.1053, measurements shall be made to detect spurious emission that may be radiated directly from the cabinet, control circuits, power leads, or intermediated circuit elements under normal condition of installation and operation. Information submitted shall include the relative radiated power of spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from a halfwave dipole antenna.

7.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 Log_{10} (power out in Watts)

7.3 Test Equipment

CDI B100/200/300 Biconical Antennas
EMCO Bi-logcon Antenna
EMCO 3115 Horn Antenna
HP 8566B Spectrum Analyzer
Preamplifiers
HP8640 Generator
Non-radiating Load

7.4 Test Result

Low Frequency: -3.5 dB at 303.64 MHz
High Frequency: -3.6 dB at 309.20 MHz

The detailed test data was presented hereinafter as reference.

30-50000MHz. CH1. (Low Frequency)

EUT					GENERATOR							FCC	
Indicated		Table	Test Antenna		Substituted		Substitution Antenna		Antenna	Cable	Absolute	Limit	Margin
Frequency MHz	Ampl. dBuV/m	Angle Degree	Height Meter	Polar H/V	Frequency MHz	Level dBm	Half-wavel. cm	Polar H/V	Gain Correction	Loss dB	Leval dBm	dBm	dB
151.82	120.9	90	1.5	v	151.82	28.6	80	v	2.1	-0.3	30.41		
151.82	120.5	60	1.8	h	151.82	28.3	80	h	2.1	-0.3	30.12		
303.64	56.2	210	1.2	v	303.64	-17.2	75	v	2.1	-0.5	-15.6	-13	-2.6
303.64	50.4	180	1.5	h	303.64	-18.5	75	h	2.1	-0.5	-16.9	-13	-3.9
455.46	51.7	320	1.5	v	455.46	-18.3	70	v	2.1	-0.5	-16.7	-13	-3.7
455.46	48.2	350	1.2	h	455.46	-19.6	70	h	2.1	-0.5	-18	-13	-5.0
607.28	45.9	0	1.5	v	607.28	-20.1	55	v	2.1	-0.7	-18.7	-13	-5.7
607.28	44.3	30	1.5	h	607.28	-22.4	55	h	2.1	-0.7	-21	-13	-8.0
759.10	42.7	270	1.8	v	759.1	-22.9	35	v	2.1	-0.7	-21.5	-13	-8.5
759.10	40.4	260	1.5	h	759.1	-23.5	35	h	2.1	-0.7	-22.1	-13	-9.1

30-50000MHz. CH.5 (High Frequency)

EUT					GENERATOR							FCC	
Indicated		Table	Test Antenna		Substituted		Substitution Antenna		Antenna	Cable	Absolute	Limit	Margin
Frequency MHz	Ampl. dBuV/m	Angle Degree	Height Meter	Polar H/V	Frequency MHz	Level dBm	Half-wavel. cm	Polar H/V	Gain Correction	Loss dB	Leval dBm	dBm	dB
154.60	120.8	110	1.8	v	154.6	28.6	80	v	2.1	-0.3	30.37		
154.60	120.6	90	1.5	h	154.6	28.5	80	h	2.1	-0.3	30.25		
309.20	55.9	270	1.5	v	309.2	-17.5	75	v	2.1	-0.5	-15.9	-13	-2.9
309.20	50.1	250	1.5	h	309.2	-18.2	75	h	2.1	-0.5	-16.6	-13	-3.6
463.80	51.4	160	1.2	v	463.8	-19.7	70	v	2.1	-0.5	-18.1	-13	-5.1
463.80	47.8	250	1.5	h	463.8	-22.1	70	h	2.1	-0.5	-20.5	-13	-7.5
618.40	45.3	310	1.5	v	618.4	-21.7	55	v	2.1	-0.7	-20.3	-13	-7.3
618.40	44.6	330	1.8	h	618.4	-22.9	55	h	2.1	-0.7	-21.5	-13	-8.5
773.00	42.5	180	1.5	v	773.0	-22.6	35	v	2.1	-0.7	-21.2	-13	-8.2
773.00	40.1	160	1.5	h	773.0	-23.8	35	h	2.1	-0.7	-22.4	-13	-10.8

8 - AC LINE CONDUCTED EMISSIONS

8.1 Applicable Requirements

According to ANSI C63.4 and FCC §15.107, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is connected back onto the AC power line on any frequency or frequencies within the band 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

8.2 Test Procedure

The EUT shall be connected to the DC power supply which shall be connected to the AC line through the first LISN. Both hot and neutral leads shall be tested.

8.3 Test Equipment

HP 8566B Spectrum Analyzer
LISN

8.4 Test Results

Not applicable because of battery operation.

9 - FREQUENCY STABILITY MEASUREMENT

9.1 Provision Applicable

According to FCC §2.1055(a)(1), the frequency stability shall be measure with variation of ambient temperature from –30ºC to +50ºC, and according to FCC 2.1055(d)(2), the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point which is specified by the manufacturer.

According to FCC §95.632 (c), MURS transmitters must maintain a frequency stability of 5.0ppm, or 2.0ppm if designed to operate with a 6.25kHz bandwidth.

9.2 Test Procedure

9.2.1 Frequency stability versus environmental temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

9.2.2 Frequency Stability versus Input Voltage

At room temperature (25±5°C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

9.3 Test Equipment

Temperature Chamber, -50°C to +100°C
Hewlett Packard HP8566B Spectrum Analyzer
Hewlett Packard HP 7470A Plotter
Hewlett Packard HP 5383A Frequency Counter
Goldstar DC Power Supply, GR303

9.4 Test Results

Reference Frequency: 151.82 MHz, Limit: 5.0ppm			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	New Batt.	151.8200	0.0
40	New Batt.	151.8201	0.7
30	New Batt.	151.8201	0.7
20	New Batt.	151.8200	0.0
10	New Batt.	151.8202	1.4
0	New Batt.	151.8199	-0.7
-10	New Batt.	151.8199	-0.7
-20	New Batt.	151.8200	0.0
-30	New Batt.	151.8199	-0.7

Frequency Stability Versus Input Voltage

Reference Frequency: 151.82 MHz, Limit: 5.0ppm						
Power Supplied (Vdc)	Frequency Measure with Time Elapsed					
	2 Minutes		5 Minutes		10 Minutes	
	MHz	%	MHz	%	MHz	%
5.6 Vdc	151.8202	1.4	151.8199	-0.7	151.8200	0.0

The manufacturer declares that the power end point is 5.6 Vdc.

Conclusion: The EUT complied with the applicable Frequency Stability Limits.