Engineering and Testing for EMC and Safety Compliance

TYPE CERTIFICATION REPORT

Dell Star Technologies, Inc
6334 East 13th Street
Tulsa, Oklahoma 74112

MODEL: DSX-2437-701
FCC ID: IOS2437

September 30, 2001

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15: 1999	§15.109: RADIATED EMISSIONS LIMITS
PART 22: 1998	PUBLIC MOBILES SERVICES
PART 90: 1998	PRIVATE LAND MOBILE RADIO SERVICES
PART 95 (A): 1998	GENERAL MOBILE RADIO SERVICES
ANSI C63.4-1992	STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS
ANSI/TIA/EIA603- 1992	LAND MOBILE FM OR PM COMMUNICATIONS EQUIPMENT MEASUREMENT AND PERFORMANCE STANDARDS
ANSI/TIA/EIA 603-1-1998	ADDENDUM TO ANSI/TIA/EIA 603-1992

Frequency Range	Output Power (W)	Freq. Tolerance	Emission Designator
2465.062 MHz	5.0	2.5	17M9F8W

REPORT PREPARED BY:

EMC Engineer: **Rachid SEHB**
Administrative Writer: **Melissa Fleming**

Document Number: 2001234 / QRTL01-379F

360 Herndon Parkway, Suite 1400
Herndon, VA 20170
Phone: 703-689-0368; Fax: 703-689-2056; Metro: 703-471-6441

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF PLOTS

TABLE OF FIGURES

TABLE OF APPENDIXES

TABLE OF PHOTOGRAPHS

1 GENERAL INFORMATION

The following Report of a Type Certification, is prepared on behalf of **Dell-Star Technologies, Inc.** in accordance with the Federal Communications Commissions and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the **Model: DSX-2437-701; FCC ID: IOS2437.** The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47, Industry Canada RSS-119, and ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

1.1 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1994, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

1.2 RELATED SUBMITTAL(S)/GRANT(S)

This is an original application report.

1.3 CONFORMANCE STATEMENT

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15: 1999	§15.109: RADIATED EMISSIONS LIMITS
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ANSI/TIA/EIA 603-1-1998	ADDENDUM TO ANSI/TIA/EIA 603-1992
RSS-119; Issue 6; 2000	LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS 27.41 TO 960.0 MHZ

Frequency Range	Output Power (W)	Freq. Tolerance	Emission Designator
2465.062 MHz	5.0	2.5	17M9F8W

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. No modifications were made to the equipment during testing in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the above standards for Certification methodology.

Signature: 

Date: September 26, 2001

Typed/Printed Name: Bruno Clavier

Position: Vice President of Operations
(NVLAP Signatory)

Signature: 

Date: September 26, 2001

Typed/Printed Name: Daniel W. Baltzell

Position: Test Engineer

NVLAP *Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 200061-0.*

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

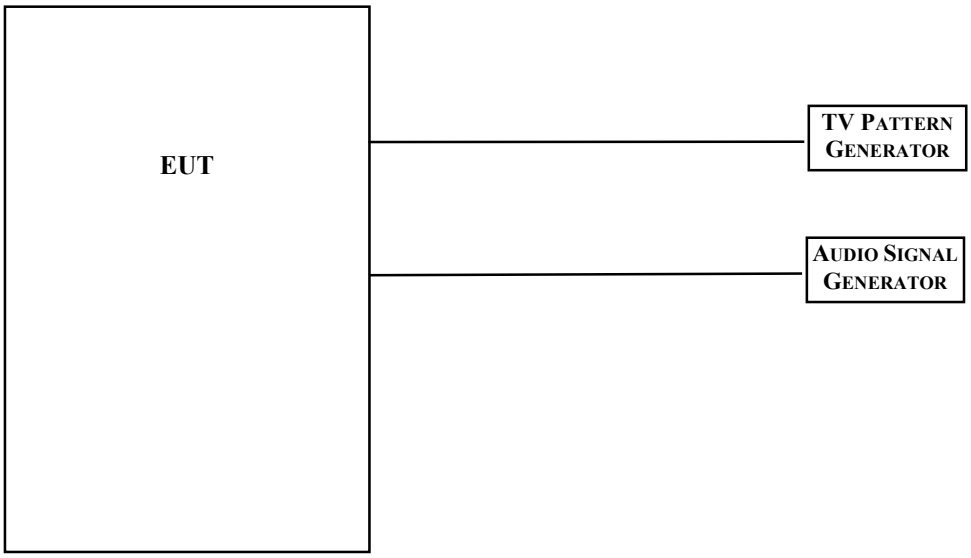
1.4 TESTED SYSTEM DETAILS

Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

TABLE 1-1: EQUIPMENT UNDER TEST (EUT)

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CABLE DESCRIPTION	RTL BAR CODE
MOBILE RADIO	DELLSTAR TECHNOLOGIES	DSX-2437-701	N/A	IOS2437	N/A	

FIGURE 1-1: CONFIGURATION OF TESTED SYSTEM



2 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)
FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

SCF(dB/m) = - PG(dB) + AF(dB/m) + CL(dB)

SCF = Site Correction Factor
PG = Pre-amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(uV/m) = 10^{FI(dBuV/m)/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

49.3 dBuV - 11.5 dB/m = 37.8 dBuV/m

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

3 FCC RULES AND REGULATIONS PART 2 §2.1046 (A): RF POWER OUTPUT: CONDUCTED

3.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.1

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

3.2 TEST DATA

The following channel (in MHz) was tested:
The worst-case Output Power (highest) levels are shown.

CARRIER OUTPUT POWER (UNMODULATED)

TABLE 3-1: RF POWER OUTPUT (HIGH POWER)

Frequency (MHz)	RF Power measured (Watt)*
2465.062	5.0

* Measurement accuracy: +/- 3%

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER — SIGNATURE — SEPTEMBER 25, 2001 — DATE OF TEST

TABLE 3-2: TEST EQUIPMENT USED FOR TESTING (RF POWER OUTPUT - CONDUCTED)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number
900770	Hewlett Packard	437B	Power Meter	2949A02966
900769	Hewlett Packard	8481B	Power Sensor	2702A05059

4 FCC RULES AND REGULATIONS PART 2 §2.1051: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

4.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, Section 2.2.13

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer.
The transmitter is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.
Device with video modulation: Transmitter is modulated with a 1 Vpp video signal

4.2 TEST DATA

Frequency range of measurement per Part 2.1057: 9kHz to 10 x Fc

Limits:

The following channel (in MHz) were investigated: 2465.062
The worst case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

TABLE 4-1: SPURIOUS EMISSIONS

Frequency (MHz)	Level (-dBc)	Limit (-dBc)	Margin(dB)
4930.1222	112.54	49.9	63.3
7395.1892	110.34	49.9	61.1
9860.248	96.54	49.9	47.3
12325.314	90.44	49.9	41.2
14790.376	108.54	49.9	59.3
17255.439	112.74	49.9	63.5
19720.5001	100.34	49.9	51.1
22185.523	NF	49.9	
24650.584	NF	49.9	

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER — SIGNATURE — SEPTEMBER 29, 2001 — DATE OF TEST

TABLE 4-2: TEST EQUIPMENT USED FOR TESTING (RADIATED – ERP RF POWER OUTPUT)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 KHz – 6.5 GHz)	3325A00159

5 FCC RULES AND REGULATIONS PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION

5.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.12

The transmitter is terminated with a 50 Ω load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.
Device with video modulation: Transmitter is modulated with a 1 Vpp video signal

Refer to section "Radiated Measurement" in this report for further information.

5.2 TEST DATA

5.2.1 CFR 47 PART 90.210 REQUIREMENTS

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

TABLE 5-1: FIELD STRENGTH OF SPURIOUS RADIATION {(CHANNEL AT 2465.00 MHZ, 5.0 W) SUBSTITUTION METHOD}

Frequency	S/G level (dBm)	Antenna gain - Cable Loss (dB)*	Emission level (-dBc)	Limit (-dBc)	Margin (dB)
4930.1222	-19.3	4.5	51.04	49.9	1.8
7395.1892	-22.2	5.4	53.04	49.9	3.8
9860.248	-39.7	6.4	69.54	49.9	20.3
12325.314	NF				
14790.376	NF				
17255.439	NF				
19720.5001	NF				
22185.523	NF				
24650.584	NF				

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER
SIGNATURE
SEPTEMBER 29, 2001 — DATE OF TEST

TABLE 5-2: TEST EQUIPMENT USED FOR TESTING (FIELD STRENGTH OF SPURIOUS RADIATION)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number
900791	Schaffner@Chase	CBL6112	Antenna (25MHz – 2GHz)	2099
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5 GHz)	3008A00505
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 KHz to 3200 MHz)	3537A01741
900928	Hewlett Packard	83752A	Synthesized Sweeper, 0.01 to 20 GHz	3610A00866

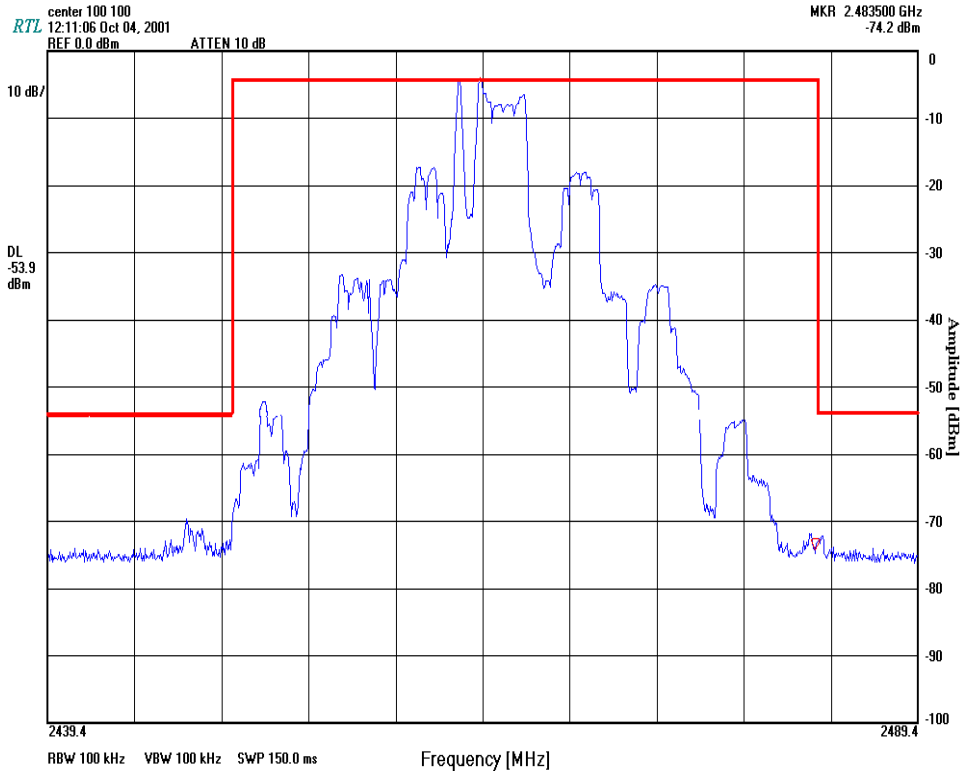
6 FCC RULES AND REGULATIONS PART 2 §2.1049 (I): OCCUPIED BANDWIDTH

OCCUPIED BANDWIDTH - COMPLIANCE WITH THE EMISSION MASKS

6.1 TEST PROCEDURE

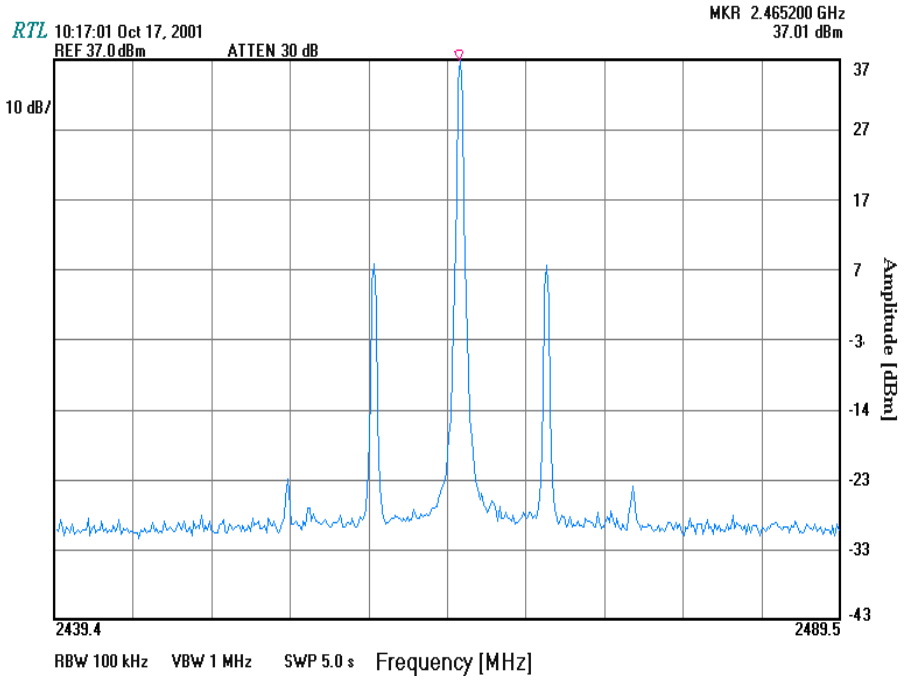
ANSI/TIA/EIA-603-1992, section 2.2.11

Device with audio modulation: Transmitter is modulated with a 1K Hz tone.
Device with video modulation: Transmitter is modulated with a 1 Vpp bar signal
Device with digital modulation: N/A

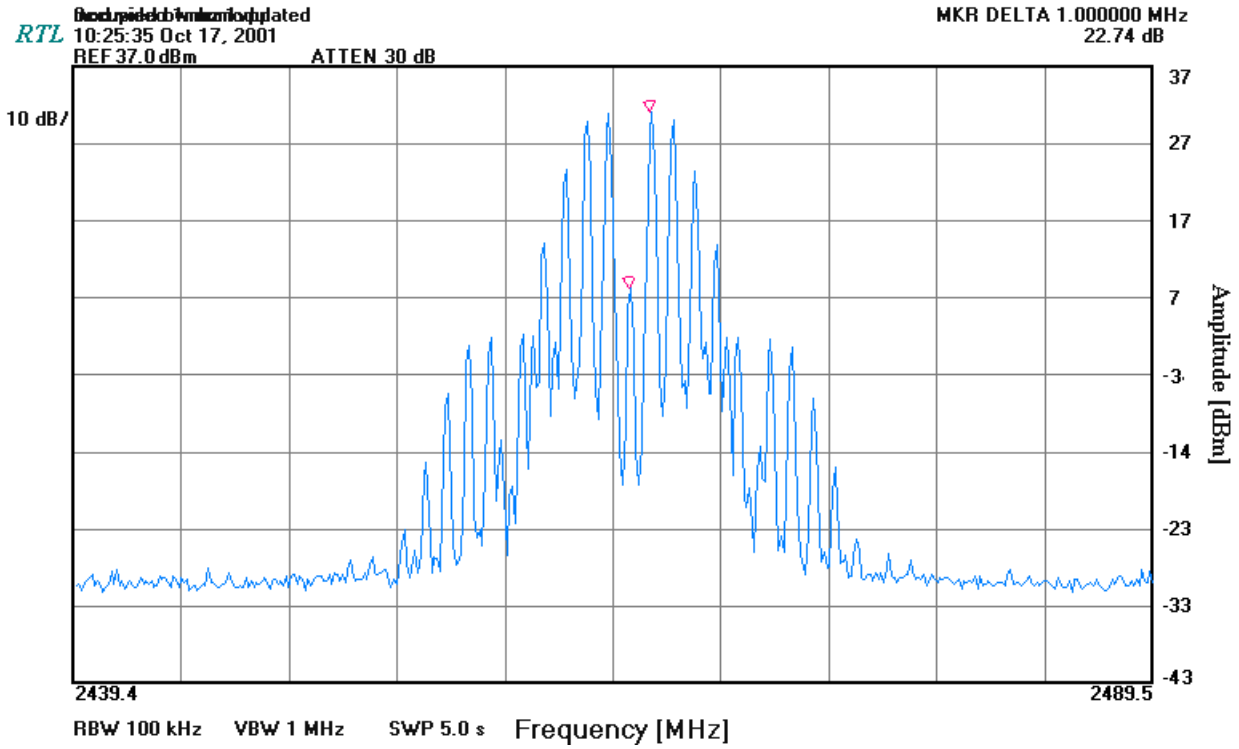


PLOT 6-1: OCCUPIED BANDWIDTH MODULATED SIGNAL

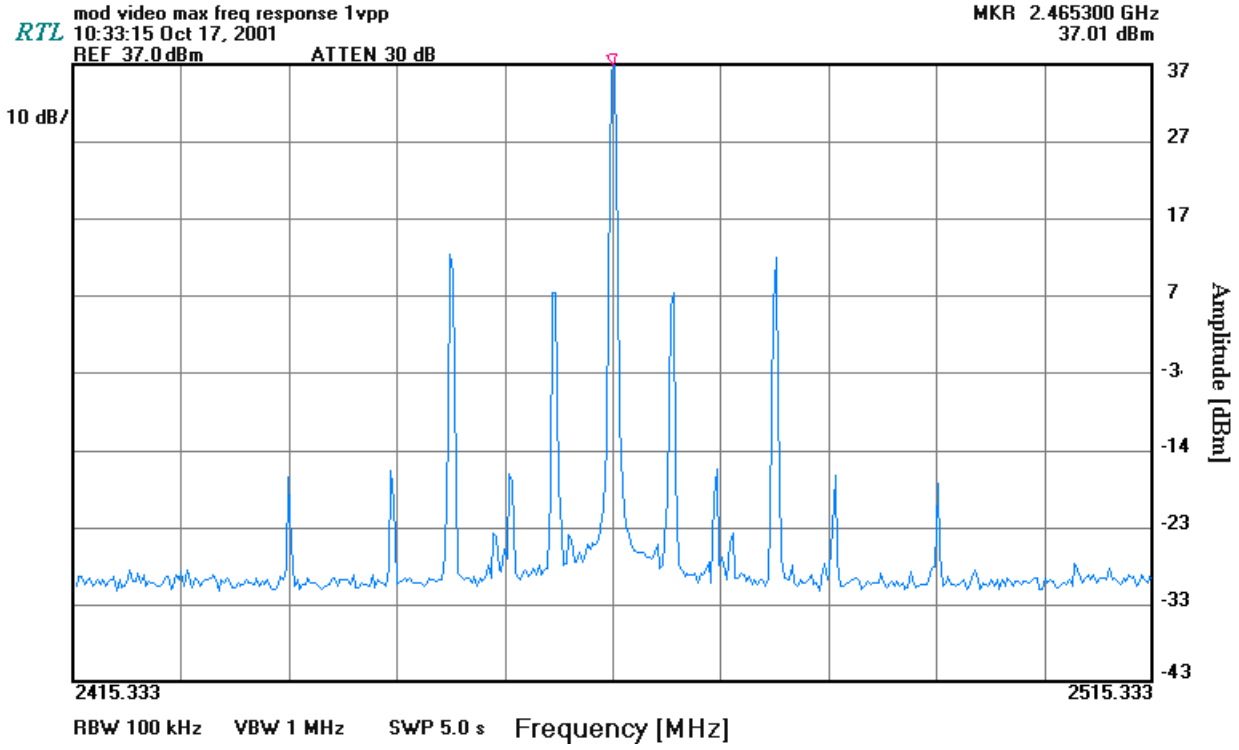
Device with audio modulation: none
Device with video modulation: Transmitter is modulated with a 1 Vpp
Device with digital modulation: N/A



PLOT 6-2: OCCUPIED BANDWIDTH UNMODULATED SIGNAL



PLOT 6-3: OCCUPIED BANDWIDTH 1 MHZ MODULATED SIGNAL



PLOT 6-4: OCCUPIED BANDWIDTH MAXIMUN FREQUENCY RESPONSE 15MHZ MODULATED SIGNAL

TEST PERSONNEL:

TEST PERSONNEL: **Typed/Printed Name**: Rachid SEHB **Date:** October 11.2001

Signature: _____

Barcode	Date Purchased	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01
900927	5/11/98	TEKTRONIX	ASG 100	AUDIO SIGNAL GENERATOR	B03274 V2.3	
900915	8/19/99	Hewlett Packard, also 900821	33120A	15 MHz Function/Arbitrary Waveform Generator	US36029992	
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01

7 FCC RULES AND REGULATION PART 2 §2.1055: FREQUENCY STABILITY

7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

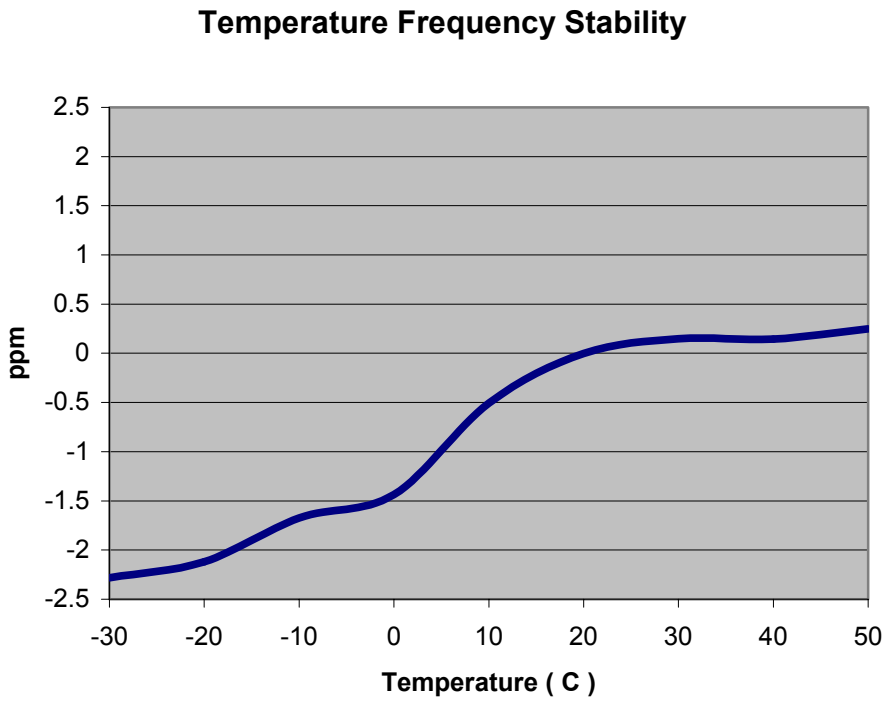
The EUT was evaluated over the temperature range -30°C to +50°C.

The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT.
The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½ an hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter.
Additionally, the power supply voltage of the EUT was varied from 85% to 115% of the nominal voltage.

The worst-case test data are shown.

7.2 TEST DATA

7.2.1 FREQUENCY STABILITY/TEMPERATUARE VARIATION



Plot 7-1: Temperature Frequency Stability

TEST PERSONNEL:

DANIEL BALTZELL		SEPTEMBER 31, 2001
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

TABLE 7-1: TEMPERATURE FREQUENCY STABILITY

Temperature (C)	Frequency Measured (MHz)	ppm
-30	2465.05850	-2.3
-20	2465.05890	-2.1
-10	2465.06000	-1.7
0	2465.060586	-1.4
10	2465.062874	-0.5
20	2465.064124	0.0
30	2465.064489	0.1
40	2465.064477	0.1
50	2465.064739	0.2

TEST PERSONNEL:

DANIEL BALTZELL — TEST TECHNICIAN/ENGINEER

SIGNATURE

SEPTEMBER 31, 2001 — DATE OF TEST

TABLE 7-2: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/TEMPERATURE)

Barcode	Date Purchased	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900946	9/22/99	Tenney Engineering, Inc	TH65	Temperature Chamber with Humidity	11380	11/7/01
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01

PLOT 7-2: FREQUENCY STABILITY/VOLTAGE VARIATION

Endpoint = 8.0 VDC

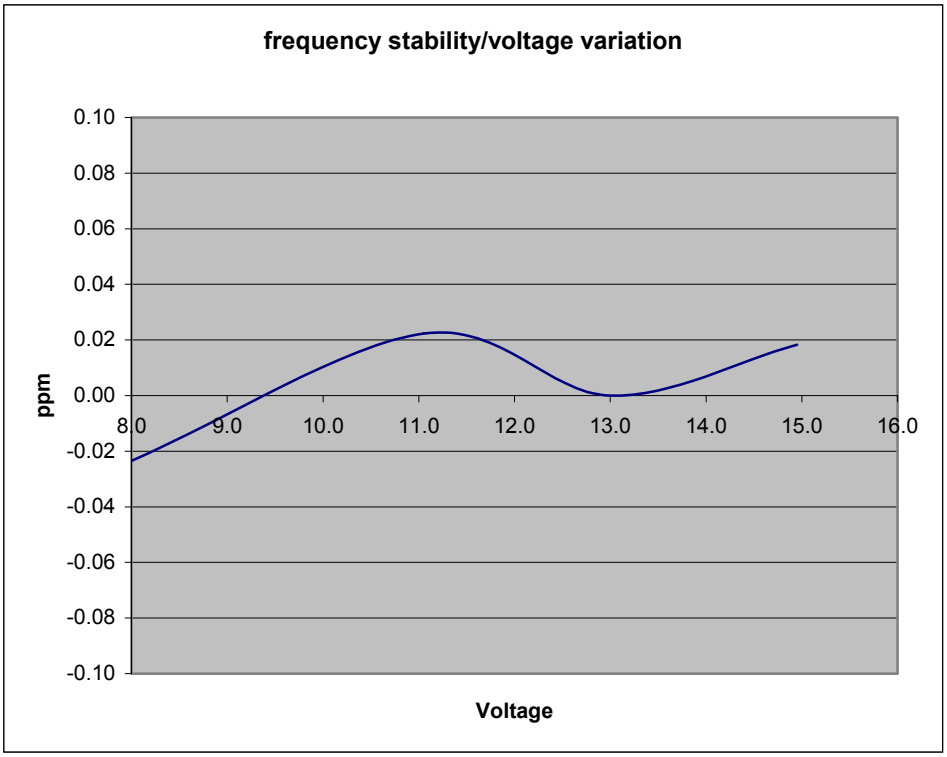


TABLE 7-3: FREQUENCY STABILITY/VOLTAGE VARIATION

Voltage (VDC)	Frequency Measured (MHz)	ppm
8.0	2465.062805	-0.02
11.1	2465.062918	0.02
15.0	2465.062908	0.02

DANIEL BALTZELL
TEST TECHNICIAN/ENGINEER

SIGNATURE

September 28, 2001
DATE OF TEST

TABLE 7-4: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/VOLTAGE)

Barcode	Date Purchased	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01

8 FCC PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE

8.1 TEST PROCEDURE

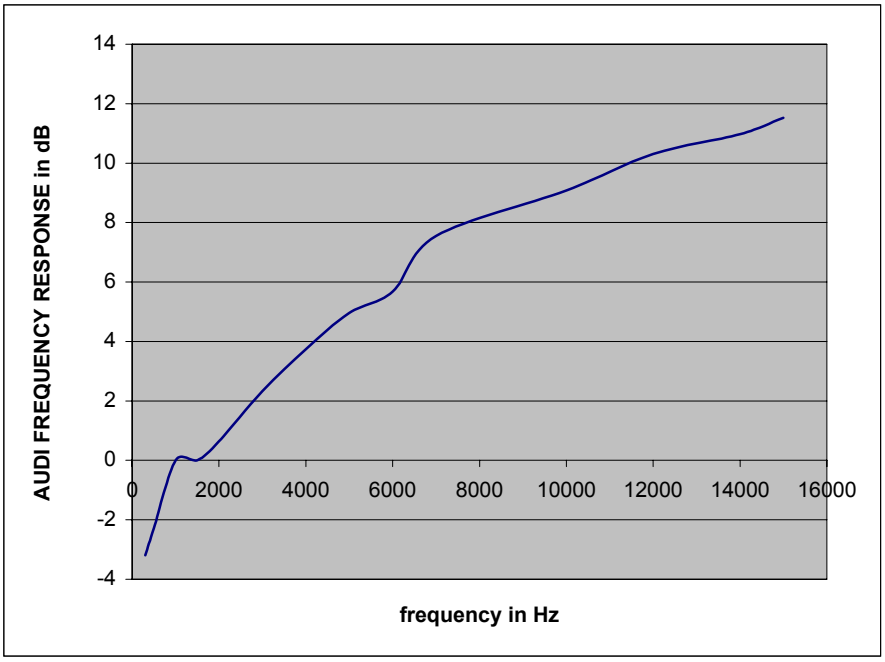
ANSI/TIA/EIA-603-1992, section 2.2.6

The audio and the video frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

The input audio level at 1000 Hz is set to produce 20% of the rated system deviation. This point is shown as the 0 dB reference level, noted DEVref.
The audio signal generator was varied from 100Hz to 5kHz with the input level held constant.
The deviation in kHz was recorded using a modulation analyzer as DEVfreq.
The response in dB relative to 1 kHz was calculated as follows:

Audio Frequency Response = 20 LOG (DEVfreq/DEVref)

8.2 TEST DATA



PLOT 8-1: MODULATION CHARACTERISTICS - Audio Frequency Response

TEST PERSONNEL:

Typed/Printed Name: Rachid SEHB **Date:** September 28, 2001

Signature: _____

The input audio level is set to produce 20% of the rated system deviation. This point is shown as the 0 dB reference level, noted DEVref.
The audio signal generator was varied from 500KHz to 10MHz with the input level held constant.
The deviation in KHz was recorded using a modulation analyzer as DEVfreq.
The response relative was calculated as follows:

Audio Frequency Response = (DEVfreq/DEVref)

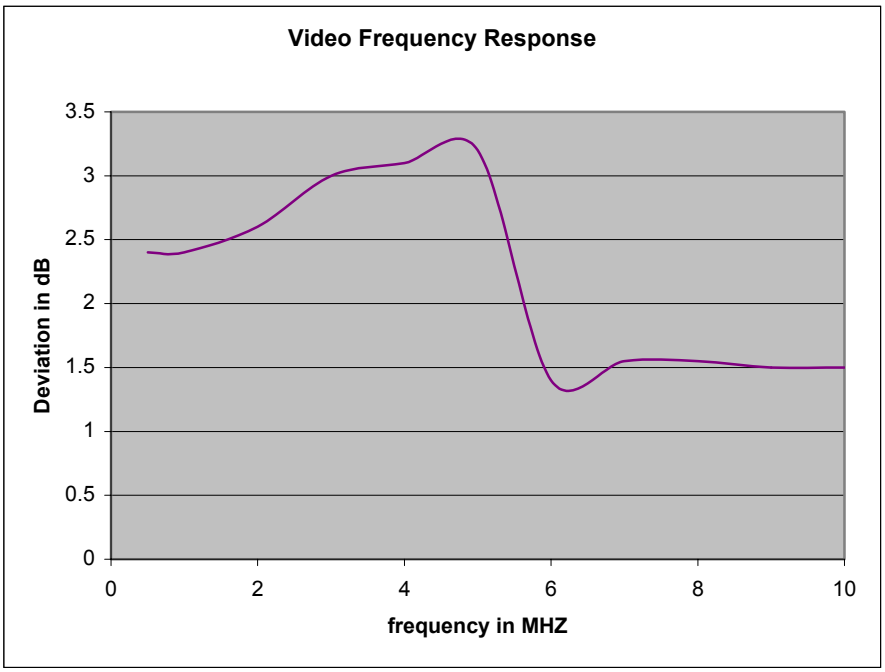


TABLE 8-1: TEST EQUIPMENT USED FOR TESTING (AUDIO FREQUENCY RESPONSE)

Barcode	Date Purchased	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900946	9/22/99	Tenney Engineering, Inc	TH65	Temperature Chamber with Humidity	11380	11/7/01
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01

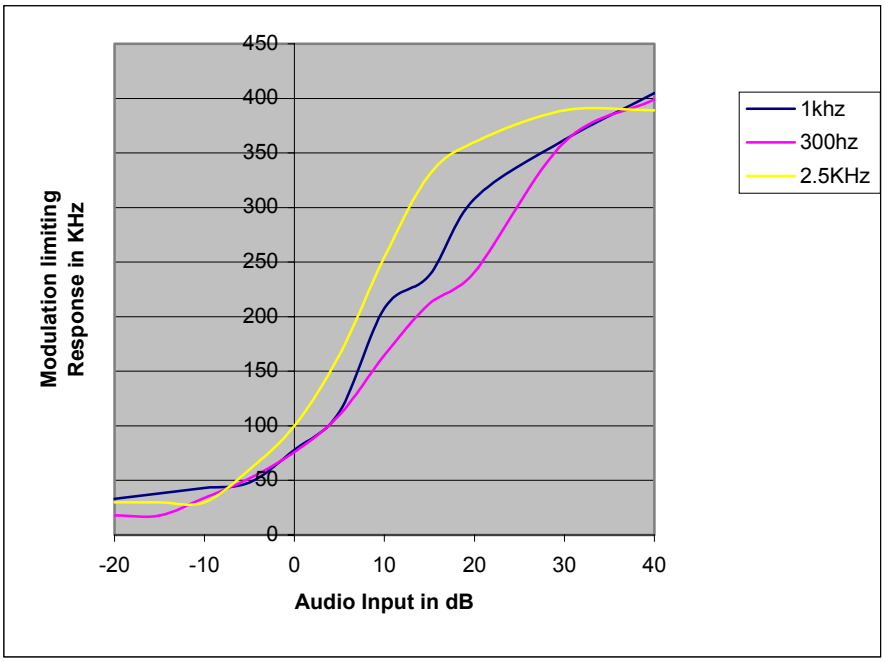
9 FCC RULES AND REGULATIONS PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - MODULATION LIMITING

9.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.3

The transmitter is adjusted for full rated system deviation. The audio input level is adjusted for 60% of rated system deviation at 1000Hz. Using this level as a reference (0dB) the audio input level is varied from the reference to a level +20 dB above it and –20 dB under it, for modulation frequencies of 300Hz, 1,000Hz, and 2,500Hz. The system deviation obtained as a function of the input level is recorded.
Both Positive and Negative Peak deviations were recorded. Test Data

PLOT 9-1: MODULATION CHARACTERISTICS – MODULATION LIMITING:



TEST PERSONNEL:
Typed/Printed Name: Rachid SEHB **Date:** October 10, 2001

Signature: _____

TABLE 9-1: TEST EQUIPMENT USED FOR TESTING (MODULATION LIMITING)

Barcode	Date Purchased	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01
900914	8/25/95	HEWLETT PACKARD	8546OA	RF Filter Section, 100 KHz to 6.5 GHz	3330A00107	11/7/01
900927	5/11/98	TEKTRONIX	ASG 100	AUDIO SIGNAL GENERATOR	B03274 V2.3	

10 FCC RULES AND REGULATIONS PART 2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F8W

	Video	Audio
M	4.75 MHz	15 kHz
D	10.4 MHz	400 kHz

Bn = 2M+2D = 2 x 4.75 + 2 x (0.4+10.4) =17.9 MHz

Emission Designator: 17M9F8W