



August 9, 1999

Federal Communications Commission
Authorization and Evaluation Division
7435 Oakland Mills Road Columbia, MD 21046

Attention: Applications Examiner

Applicant: LMW Electronics, Ltd.
Marry Lees Industrial Estate.

Equipment: Video Transmitter, Model: VT2400SC2D
FCC ID: NWRVT2400SC2D

Specification: 47 CFR Parts 74 & 90 Licensed Certification

Dear Examiner:

The following application for Grant of Equipment Authorization is presented on behalf of LMW Electronics, Ltd., for the Licensed Certification of their Model:VT2400SC2D, Video Transmitter module.

Enclosed, please find a complete data and documentation package demonstrating that this device complies with the technical requirements of 47 CFR, Part 74 and 90, for a Video Transmitter.

If you have any questions, please contact the undersigned, who is authorized to act as Agent.

Sincerely,

Kenneth Bass
Sr. EMC Engineer, EMC Laboratory



MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE ! BALTIMORE, MARYLAND 21230-3432 ! PHONE (410) 354-3300 ! FAX (410) 354-3313

ENGINEERING TEST REPORT

in support of the Application for Grant of Equipment Authorization

EQUIPMENT: Video Transmitter, Model: VT2400SC2D

FCC ID: NWRVT2400SC2D

Specification: 47CFR Parts 74 and 90

**On Behalf of the Applicant/
Manufacturer:** LMW Electronics, Inc.
LMW House, Leaside
Merry Lees Industrial Estate
Desford, LEICESTER
LE9 9FS, EngLand

**Manufacturer's
Representative** Mr. Harry Price

Test Date(s): May 14 thru June 16, 1999

ENGINEERING STATEMENT

I ATTEST: the measurements shown in this report were made in accordance with the procedures indicated, and that the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements. On the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 74 and 90 of the FCC Rules under normal use and maintenance.

Kenneth Bass
Sr. EMC Engineer, MET Laboratories, Inc.



1.0 INTRODUCTION

The following data is presented on behalf of the Applicant, LMW Electronics, Inc., as verification of the compliance of the LMW Video Transmitter, Model VT2400SC2D, to the requirements of 47CFR Parts 74 and 90.

2.0 TEST SITE

All testing was conducted at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, Maryland 21230-3493. Radiated emissions measurements were performed on a three-meter open area test site (OATS). A complete site description is on file with the FCC Laboratory Division as 31040/SIT/MET.

3.0 TEST EQUIPMENT USED

Manufacturer	Equipment	Calibration Due	Cal. Interval
Hewlett Packard	8563A Spectrum Analyzer	05/26/00	annual
EMCO	Biconical Antenna 3104	02/10/00	annual
EMCO	EMCO Log Periodic Antenna	01/04/00	annual
EMCO	Double Ridge Guided Horn	05/22/00	annual
Hewlett Packard	8594EM Analyzer	11/18/99	annual

4.0 EQUIPMENT UNDER TEST CONFIGURATION

The Video Transmitter was configured with a DC power supply, an NTSC signal generator, and an audio signal generator to produce modulation conditions of the type the EUT was designed to transmit. The EUT was configured for maximum signal gain and bandwidth. In addition, the EUT was operated in a manner representative of the typical usage of the equipment. During all testing, system components were manipulated within the confines of typical usage to maximize each emission.

5.0 TEST TYPE(S)

- 5.1 Radiated Emissions: **47CFR2.993, 74.637 (a)(1), (a)(2), and (a)(3); 90.210(b)(1),(b)(2), and (b)(3)**
- 5.2 Occupied Bandwidth: **47CFR2.989, 90.209 (bandwidth approved case by case), 74.602(a) (see table Band A for 2450-2467, and 2467-2483.5 MHz)**
- 5.3 Modulation Characteristics : **47CFR 2.987, 74.663 (n/a since FM), and 90.211(a)**
- 5.4 RF Power Output: **47CFR 2.985, 90.205(I), and 74.636**
- 5.5 Spurious Emission at Antenna Terminals: **47CFR2.991, 90.210 (b)(1),(b)(2), and (b)(3) 74.637(a)(1), (a)(2), and (a)(3).**
- 5.6 Frequency Stability over Temperature Variations: **47CFR2.995(a)(1), 74.661, 90.213(a)**
- 5.7 Frequency Stability over Voltage Variations: **47CFR2.995(d)(1), 74.661, 90.213(a)**



6.0 TEST RESULTS

6.1 TEST TYPE: Radiated Emissions

6.1.1 TECHNICAL SPECIFICATION: 2.993(a); 90.210(b)(1), (b)(2), and (b)(3);
74.637(a)(1), (a)(2), and (a)(3)

6.1.2 TEST DATE(S): June 16, 1999

6.1.3 MEASUREMENT PROCEDURES:

As required by §2.993, *field strength of spurious radiation measurements* were made in accordance with the general procedures of ANSI C63.4-1992 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz". Preliminary radiated emission measurements were performed inside a shielded chamber with a digital signal generator on and terminated. The frequency list from the preliminary measurements were used as a guide for making final measurements on an 10 meter open area test site. The unit was scanned over the frequency range of 9 kHz to 24 GHz. The Radiated Spurious Emissions *Limit* is obtained by the following:

Based on an input power (as measured at the output of the Amplifier) of 1.56 watts:

$$P_o = 1.56 \text{ W}$$

As per 2.993 (a), it is assumed this power is to be fed to a half-wave tuned dipole. Using a conversion formula for distance, the field strength at one meter can be derived:

$$E(V/m)_{1m} = \frac{\sqrt{49.2 \times 1.56}}{1}$$
$$E(V/m)_{1m} = 8.76 \text{ V/m or } 138.85 \text{ dB}\mu\text{V}$$

As per 90.210(b)(3) and 74.637(a)(3), spurious emissions must be attenuated by $43 + \log(P)$, which is:

$$43 + 10\text{Log}(1.56) = 44.93 \text{ dB}$$

Therefore, the limit for spurious emissions is:

$$138.85 \text{ dB}\mu\text{V} - 44.93 \text{ dB} = 93.92 \text{ dB}\mu\text{V} @ 1m$$

At 3 meters measurement distance, the limit is;

$$E(V/m)_{3m} = \frac{\sqrt{49.2 \times 1.56}}{3}$$
$$E(V/m)_{3m} = 2.92 \text{ V/m or } 129.31 \text{ dB}\mu\text{V}$$

Again, according to the above applicable rule parts, all signals must be attenuated by 44.93dB; Therefore, the limit for spurious emissions for a test distance of 3 meters is:

$$129.31 - 44.93 = 84.38 \text{ dB}\mu\text{V} @ 3m$$



6.1.4 RESULTS:

Carrier Emission: 1.56 Watts

FREQUENCY (MHZ)	EUT AZIMUTH (Degrees)	ANTENNA		EUT RADIATION (dBμV) (Quasi-Peak)	ANTENNA FACTOR (dB/m)	TEST DISTANCE (m)	CABLE LOSS (dB)	Distance Correction (dB)	FIELD STRENGTH (dBuV/m)	LIMITS @ 3m (dBuV/m)
		POL (H/V)	HGT (m)							
80.000	90	H	2	11.8	7.2	3	1.7	n/a	20.7	84.37
80.000	90	V	2	11.8	8.8	3	1.7	n/a	22.3	84.37
150.000	0	H	1.5	11.2	13.3	3	2.3	n/a	26.8	84.37
150.000	0	V	1.5	11.2	13.4	3	2.3	n/a	26.9	84.37
273.000	45	H	1	11.1	19.5	3	3.2	n/a	33.8	84.37
273.000	180	V	1	11.1	19.4	3	3.2	n/a	33.7	84.37
450.000	0	H	1	13.3	17.6	3	4.2	n/a	35.1	84.37
450.000	90	V	1	13.3	17.1	3	4.2	n/a	34.6	84.37
750.000	45	H	1	15.1	22.2	3	5.9	n/a	43.2	84.37
750.000	0	V	1	15.1	21.7	3	5.9	n/a	42.7	84.37
980.000	90	H	1	15.05	25.1	3	6.7	n/a	46.1	84.37
980.000	90	V	1	15.05	24.3	3	6.7	n/a	46.1	84.37
3000.000	0	H	1	17.10	31.5	1	0.5	-9.54	39.56	84.37
3000.000	0	V	1	16.30	31.9	1	0.5	-9.54	39.16	84.37

Equipment meets the specifications of 90, 74 ; and 2.993;

Photograph of Radiated Emissions Test Configuration



**6.2 TEST TYPE:** Occupied Bandwidth

6.2.1 TECHNICAL SPECIFICATION: 47CFR2.989; 90.209 (approved on a case-by-case basis)
74.602(a) (see table Band A for 2450-2467, and 2467-2483.5MHz)

6.2.2 TEST DATE(S): 17 May 1999

6.2.3 MEASUREMENT PROCEDURES:

As required by §2.989 of CFR 47, *occupied bandwidth measurements* were made on the EUT. A NTSC signal generator was configured to transmit color bars onto the carrier signal. Using a resolution bandwidth of 30Hz, we determined the occupied bandwidth of the emission at the middle of the selectable channel range.

The unit was exercised using signal types required by §2.989.

6.2.4 RESULTS:

Equipment complies with Section 2.989. Plots of the occupied bandwidth were measured at the antenna RF output port.

The attached plots illustrate that the Transmitter, as implemented, meets the specifications of 90.209 and 74.602(a) for signal bandwidth.

Special Note:

Calculation of bandwidth is given by the following :

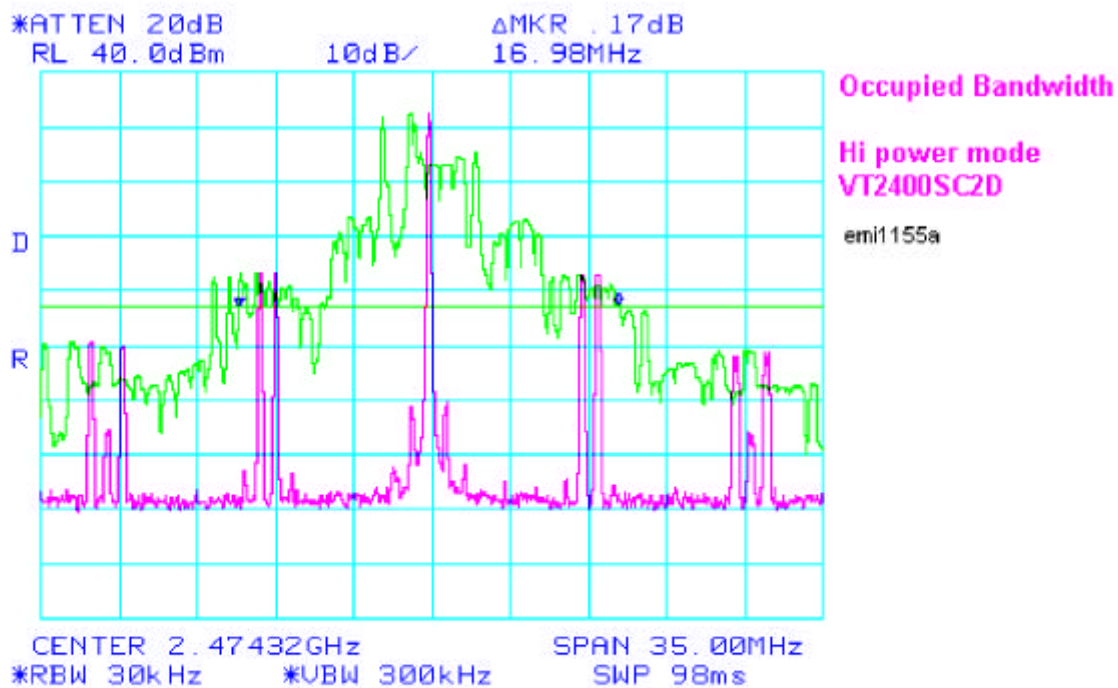
- a) Maximum modulating frequency = ± 5.5 MHz (M)
- b) Maximum frequency deviation = ± 4.0 MHz (D)
- c) Audio subcarriers (2 stereo pair) = 10 kHz deviation maximum
= 10 kHz deviation maximum

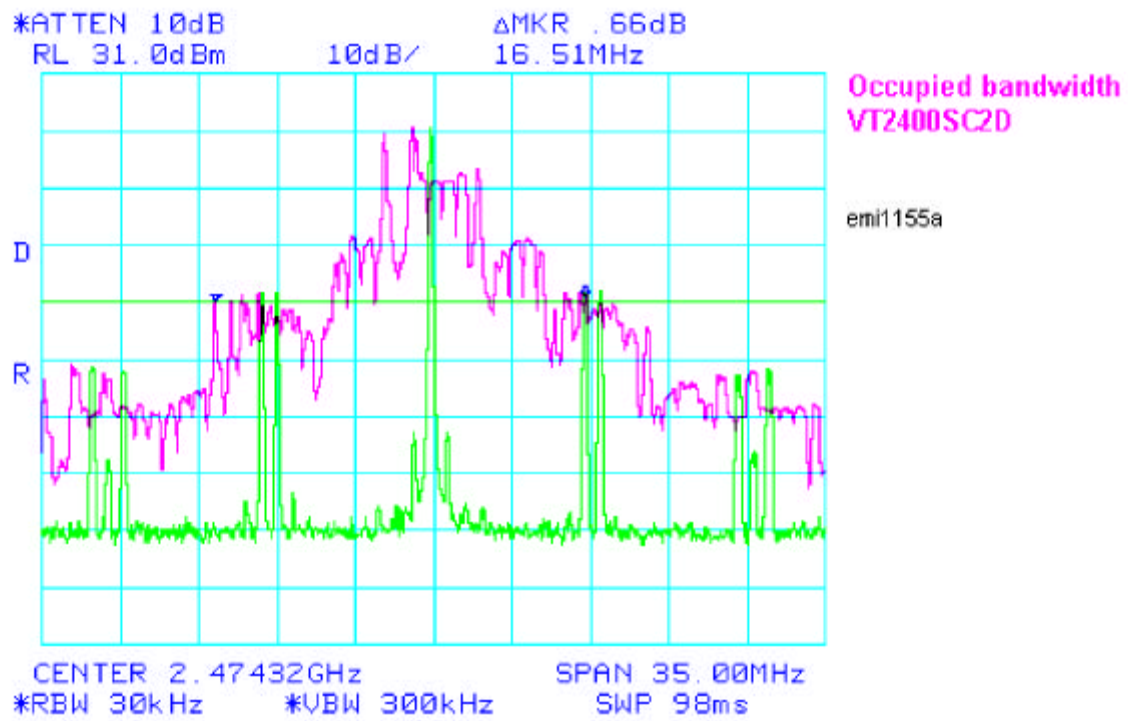
Therefore;

$$BW_{\text{channel}} = 2M + 2D + 4(0.01) = 11 \text{ MHz} + 8.0 \text{ MHz} + 0.16 \text{ MHz} = 19.16 \text{ MHz}_{\text{max}}$$

Since the maximum allowable Bandwidth under Part 74 is 17MHz, and the measurement of Occupied Bandwidth with the EUT modulated with signal types typical of normal use, The bandwidth of the EUT to be authorized is 17MHz. Thus, the emission designator for the unit is:

17M0F8W







6.3 TEST TYPE: Modulation Characteristics

6.3.1 TECHNICAL SPECIFICATION: 47CFR2.987; 74.633(n/a since EUT is FM) ; 90.211(a)

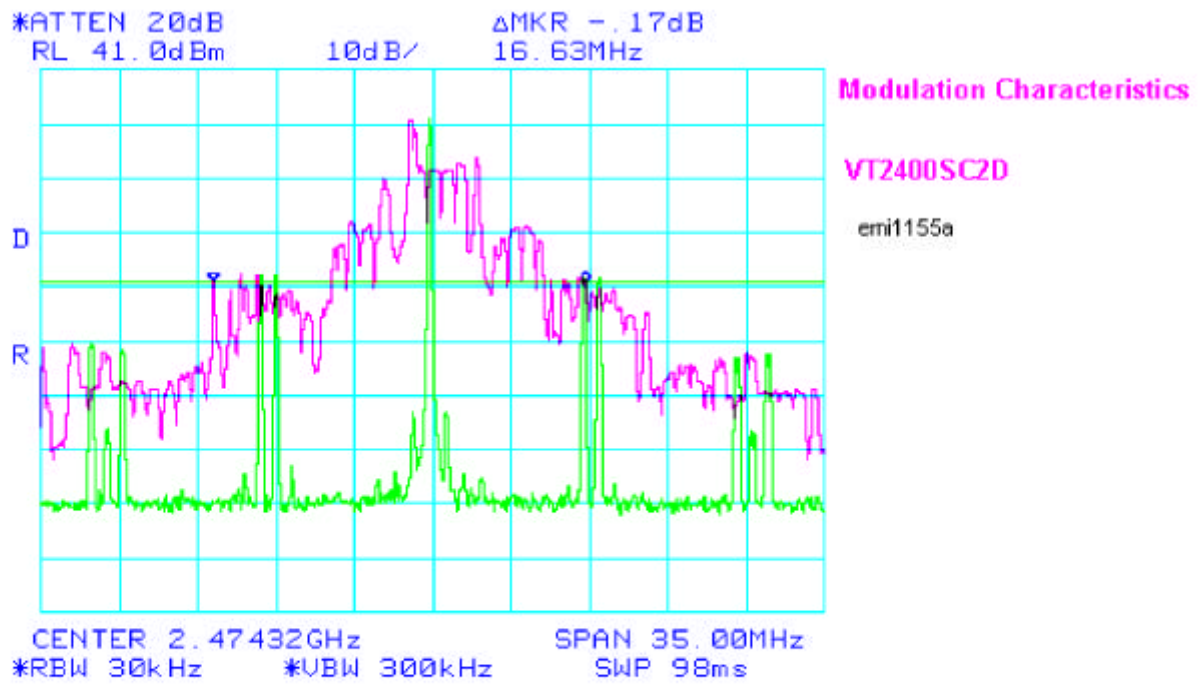
6.4.2 TEST DATE(S): 17 May 1999

6.4.3 MEASUREMENT PROCEDURES:

TECHNICAL SPECIFICATION: 2.987

Comment: A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licenced.

Refer to the following plots for modulation characteristics. The input signals used for this (and other appropriate tests) was an NTSC standard input from a Tektronix NTSC signal generator set to provide standard color bars video signal. The audio subcarriers were modulated with 15 kHz tones from an audio signal generator.



**6.4 TEST TYPE:** RF Power Output**6.4.1 TECHNICAL SPECIFICATION:** 47CFR2.985 and 90.205(I); 74.636**6.4.2 TEST DATE(S):** 14 May 1999**6.4.3 MEASUREMENT PROCEDURES:**

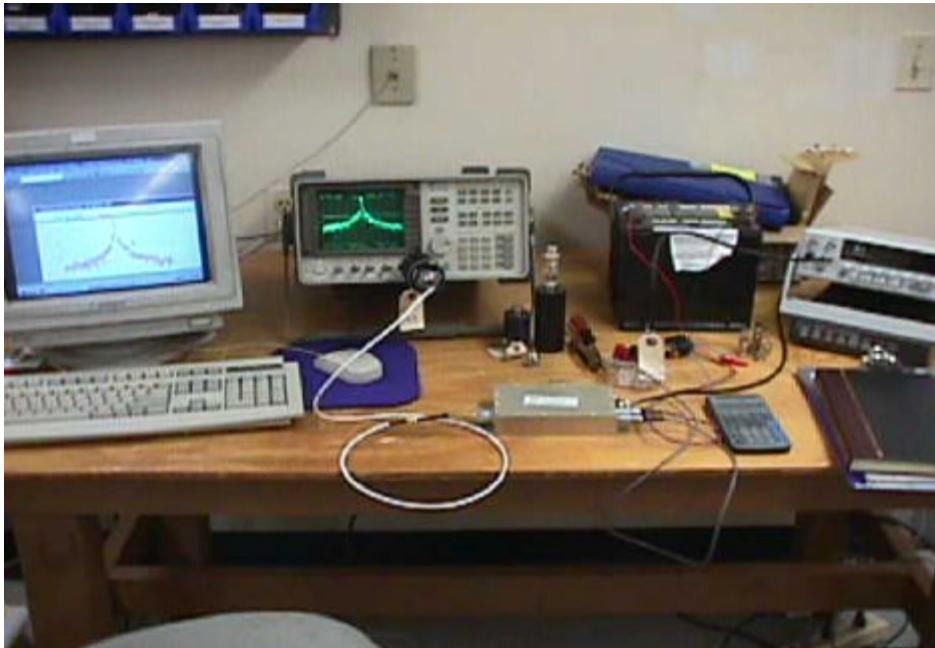
As required by §2.985 of CFR 47, *RF power output measurements* were made at the RF output terminals using an attenuator and spectrum analyzer. This test was performed with carrier unmodulated.

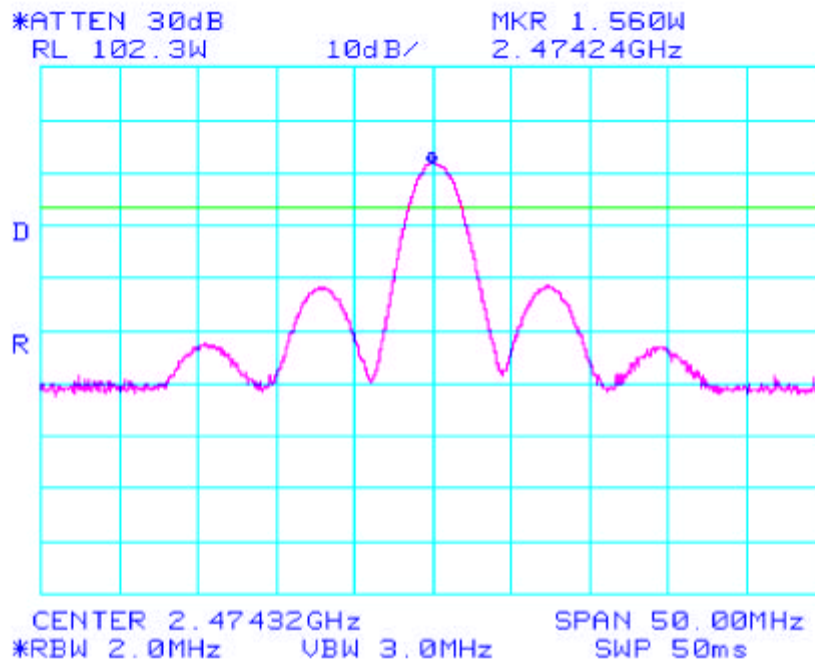
The power output was measured for a Channels at the center of the Video Transmitter authorized range and plots of the RF output Power level, as measured at the RF output terminals of the EUT are included:

6.4.4 RESULTS:

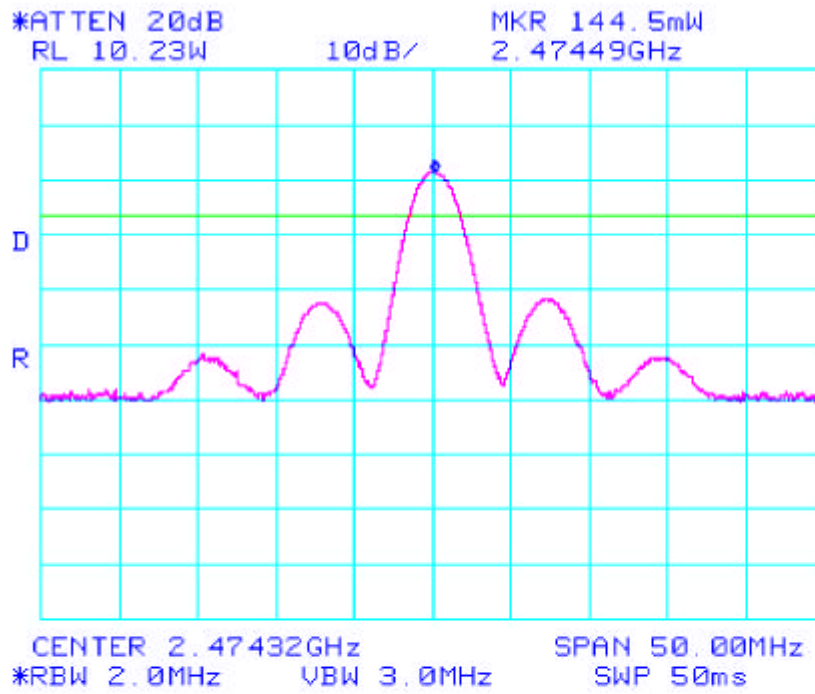
Equipment complies with 47CFR 2.985 and 90.205(I) and 74.636. The Video Transmitter does not exceed the limits of 12 Watts (under Part 74) or 5 Watts (under Part 90), at the carrier frequency.

**Photograph of Antenna Conducted Spurious Emissions and
RF Power Output Test Configuration**





Power Output Test
Hi Power Mode
FCC PT 74/90
emi1155



Power Output Test
Lo Power Mode
FCC Pt 74/90
emi1155

**6.5 TEST TYPE:** Spurious Emissions at Antenna Terminals**6.5.1 TECHNICAL SPECIFICATION:** 2.991; 90.210(b)(1), (b)(2), and (b)(3) ;
74.637(a)(1), (a)(2), and (a)(3)**6.5.2 TEST DATE(S):** 17 May 1999**6.5.3 MEASUREMENT PROCEDURES:**

As required by §2.991 of CFR 47, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a 50 Ω attenuator and spectrum analyzer set for a 100 kHz bandwidth. The frequency spectrum was investigated from 9.0 KHz to 24.0 GHz. For measuring emissions above 2 GHz, a high-pass filter was used to eliminate the fundamental transmit frequency to prevent possible saturation effects on the front end of the spectrum analyzer.

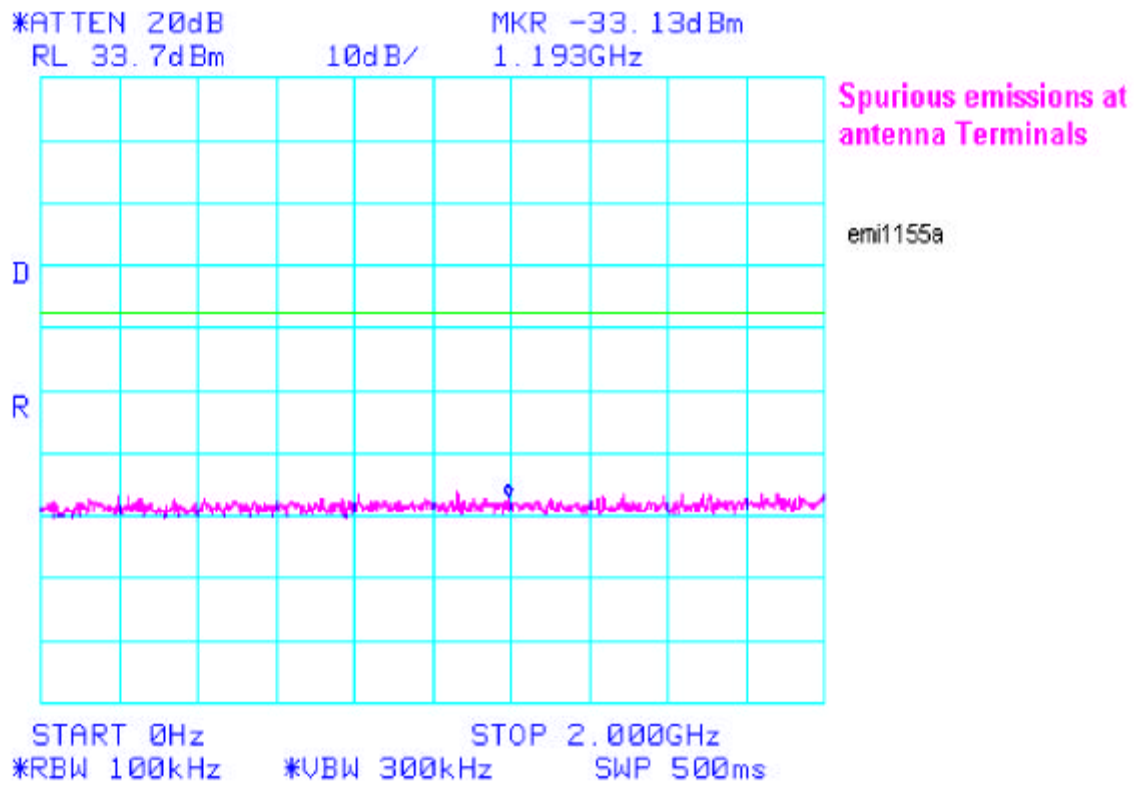
6.5.4 RESULTS:

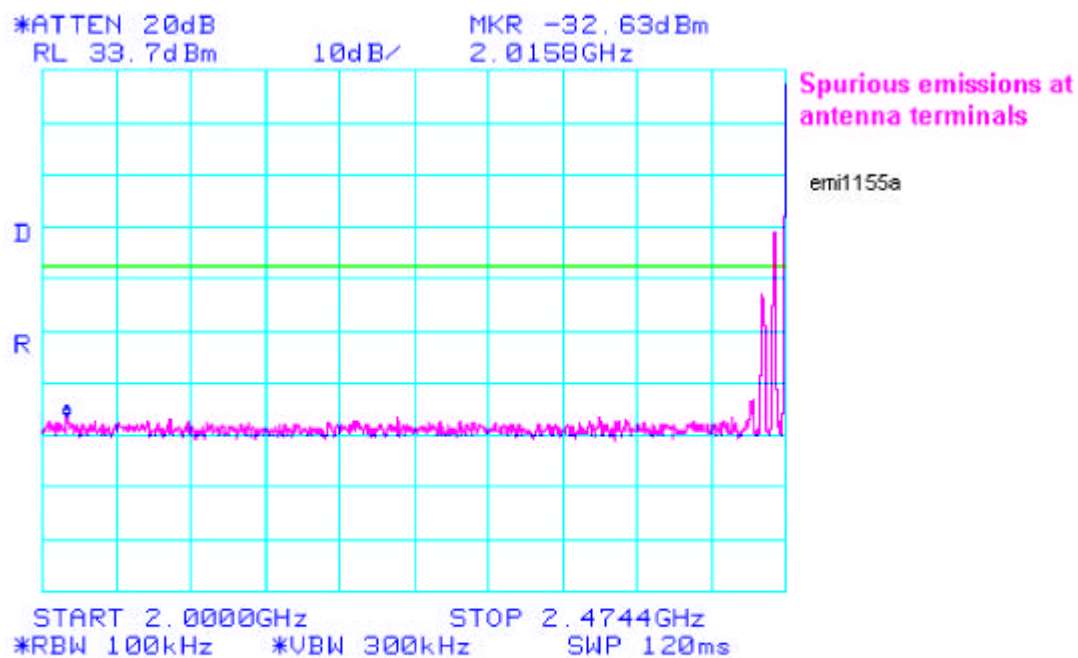
Equipment complies with Section 2.991; 90.210(b)(1), (b)(2), and (b)(3) ; and 74637(a)(1), (a)(2), and (a)(3):

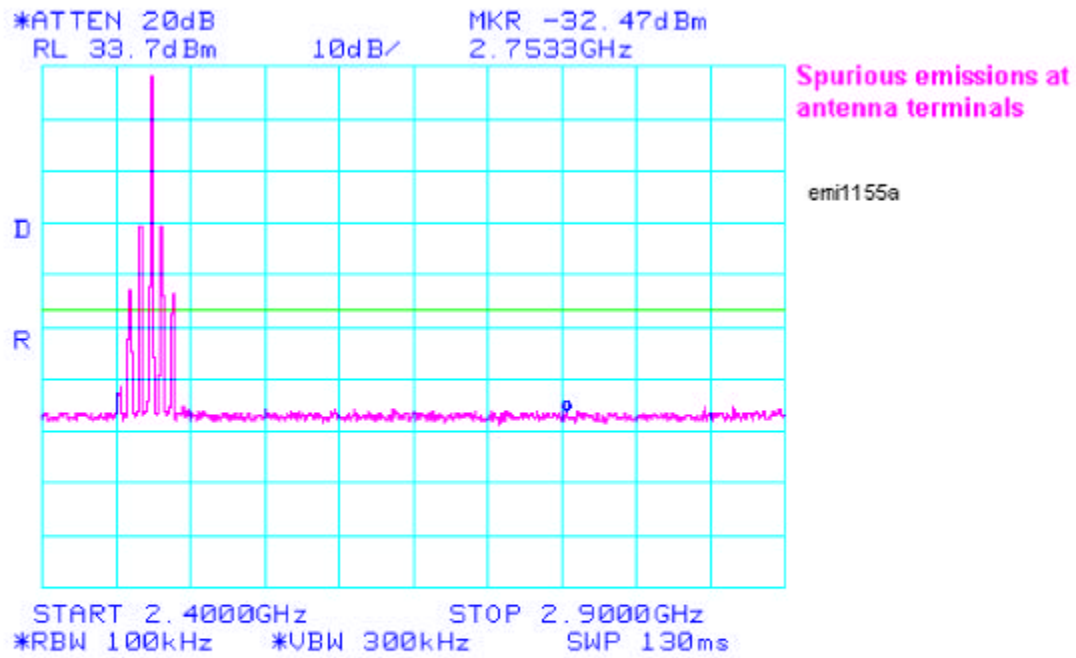
SUMMARY OF SPURIOUS EMISSIONS AT ANTENNA TERMINALS

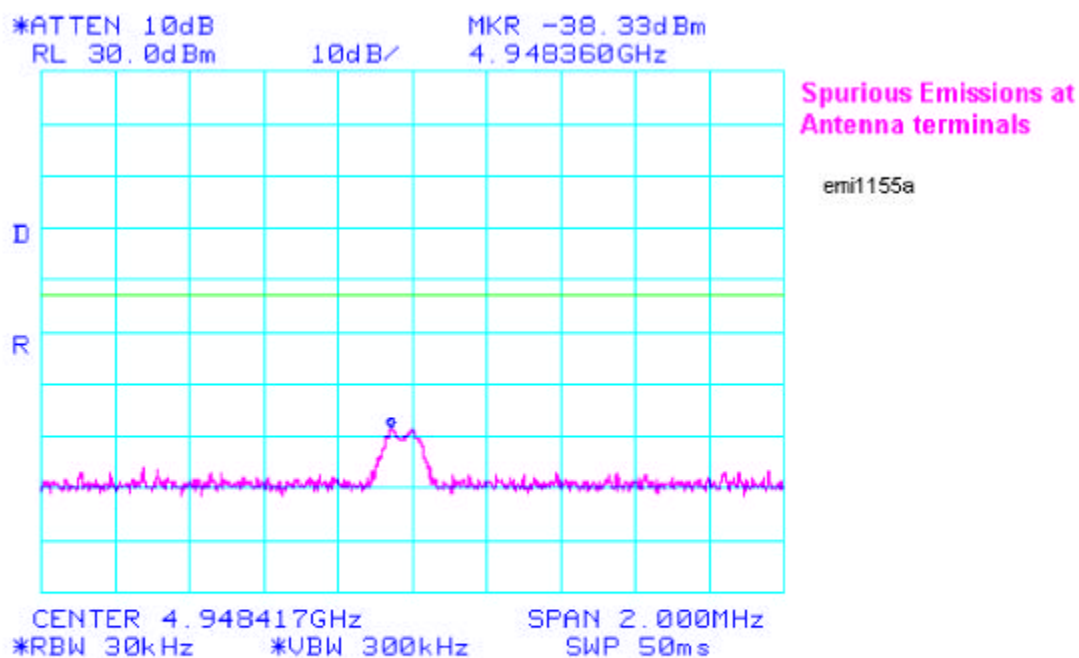
Frequency Range (GHz)	Emission Frequency	Emission Level (dBm)	Limit (dBm)
0Hz-2GHz	1.193 GHz	-33.13	-13.1
2-2.47GHz	2.015GHz	-32.63	-13.1
2.4-2.9GHz	2.75GHz	-32.47	-13.1
2.9-4.6GHz	NONE	N/A	-13.1
4.6-10GHz	4.948GHz	-38.33	-13.1
4.6-10GHz	8.578GHz	-29.67	-13.1
10-20GHz	20GHz	-18.83	-13.1
20-24GHz	22GHz	-18.90	-13.1

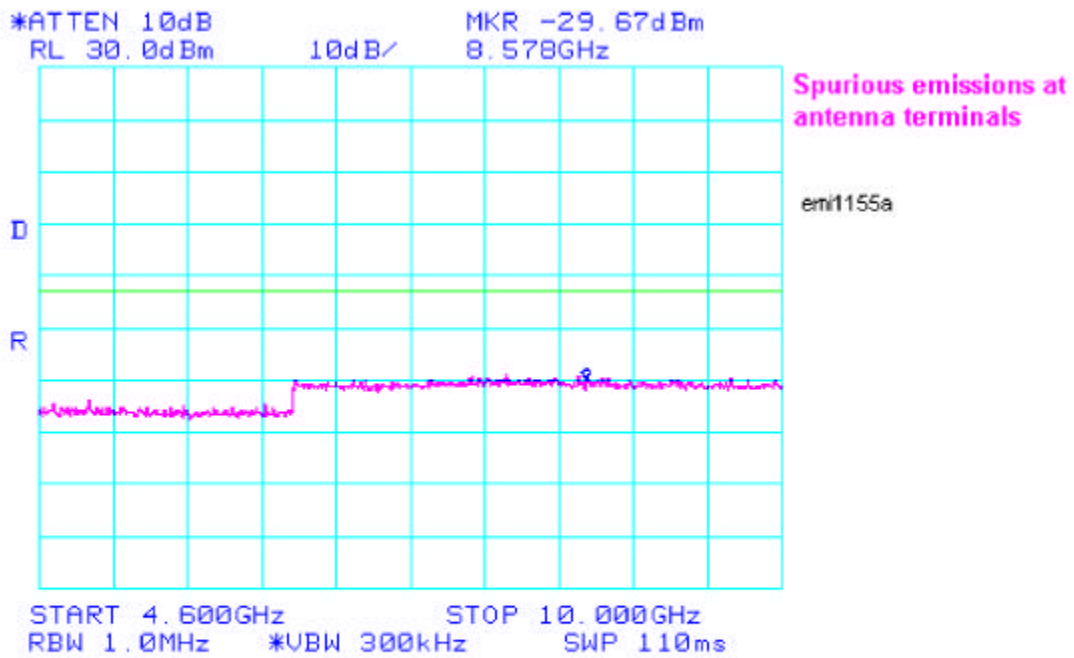
The plots included on the following pages, illustrate compliance to 47CFR 90.210(b)(3) and 74.637(a)(3) at > 150 % of the Authorized bandwidth:

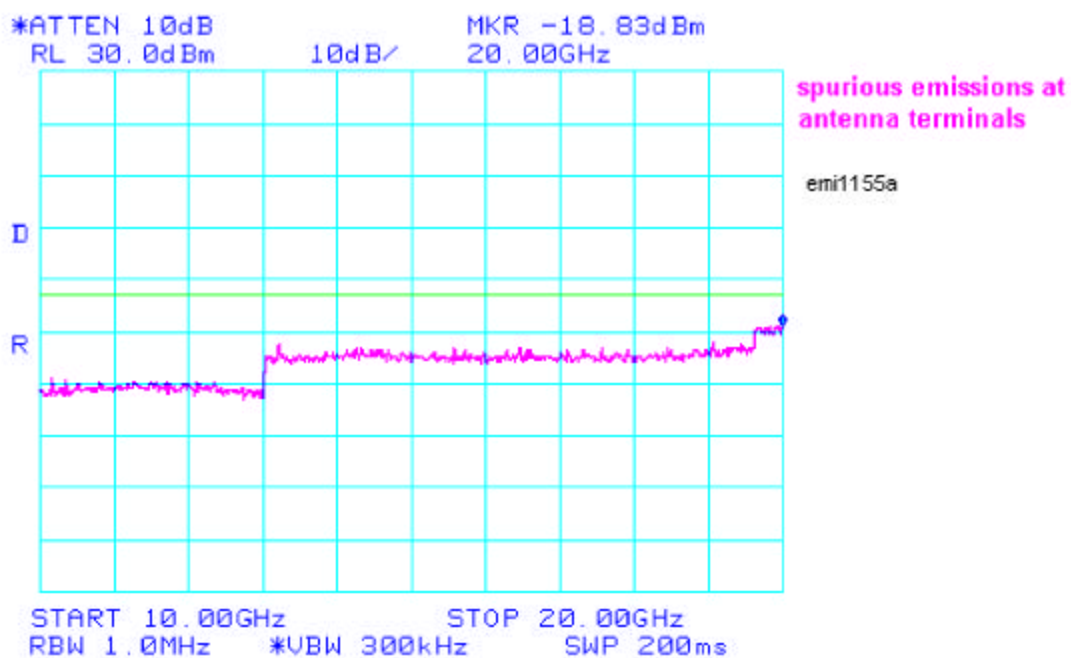






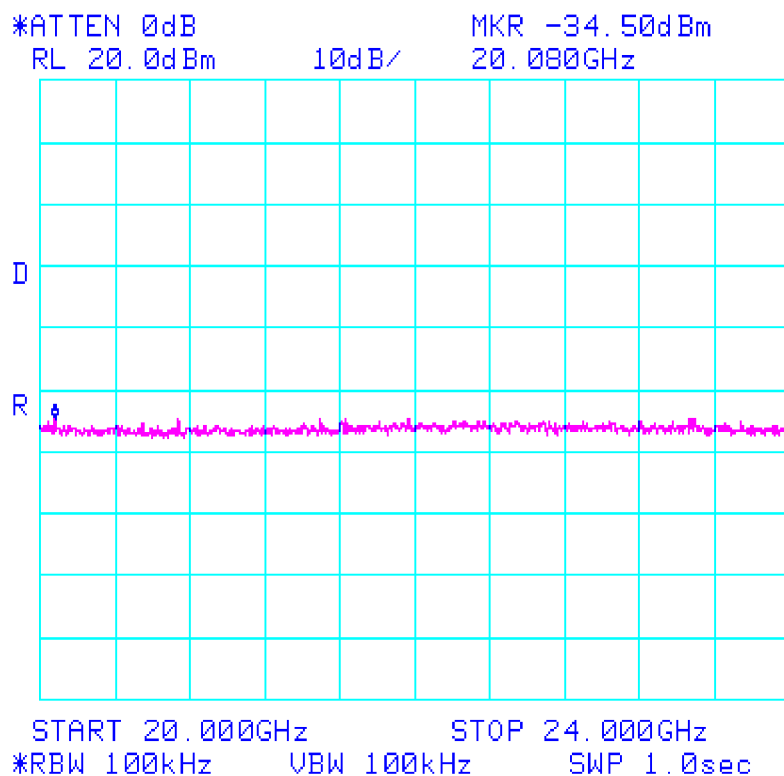


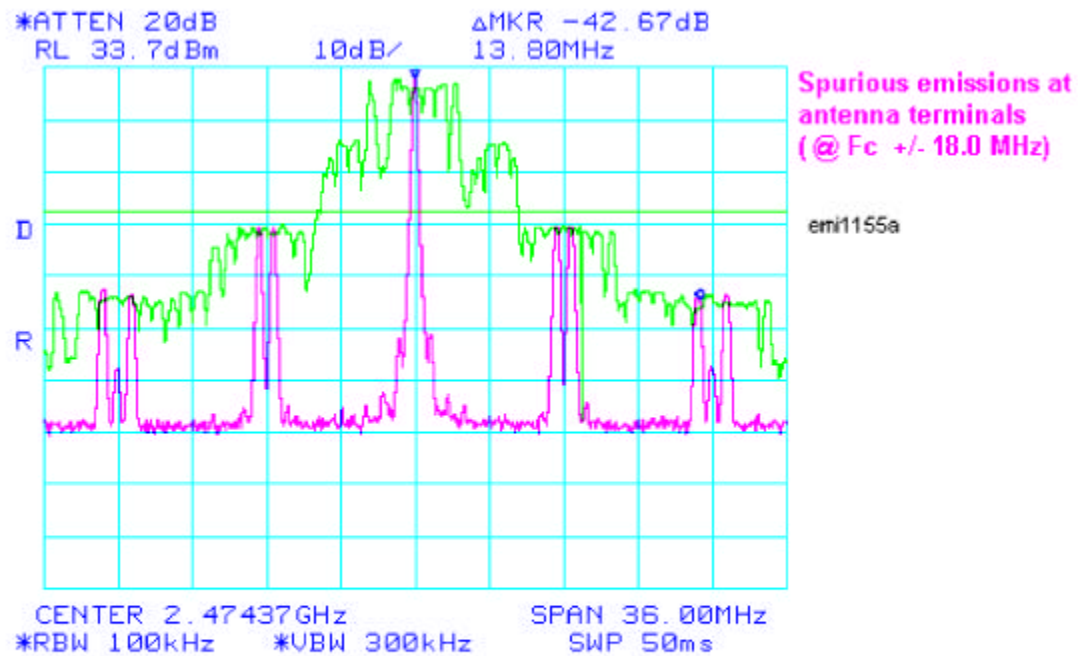




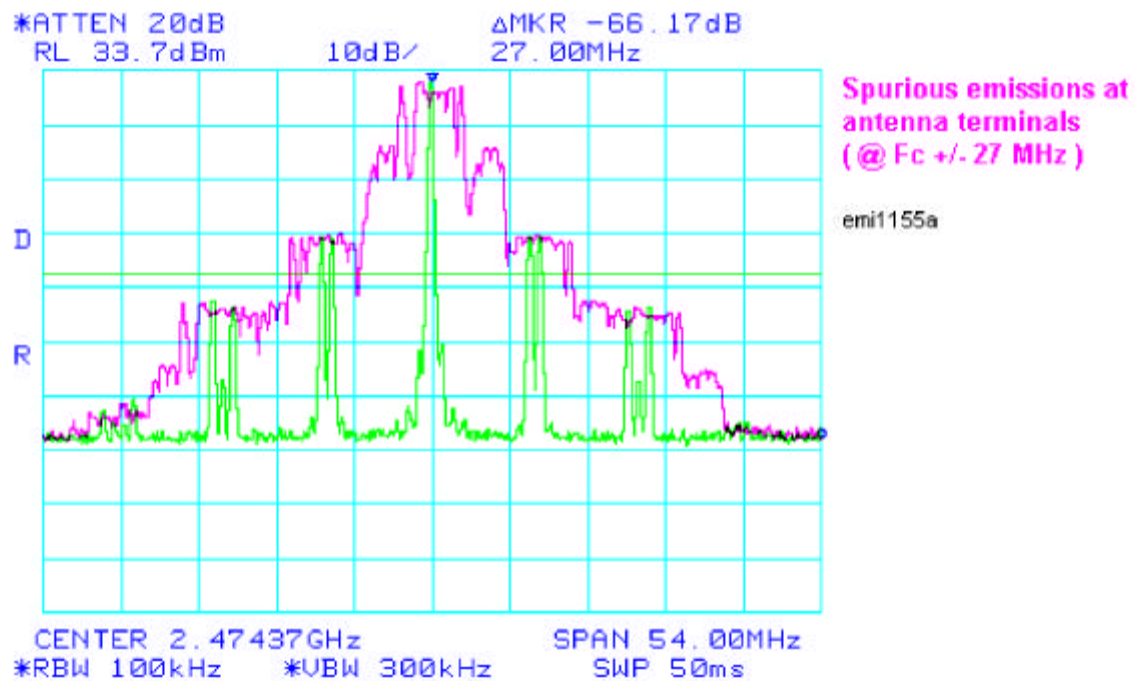


Conducted Spurious emissions
emi1155a





Plot illustrating compliance to 47CFR 90.210(b)(1) and 74.637(a)(1) at 50 to 100 % of the Authorized bandwidth:



Plot illustrating compliance to 47CFR 90.210(b)(2) and 74.637(a)(2) at 100 to 150 % of the Authorized bandwidth:

**6.6 TEST TYPE:** Frequency Stability over Temperature Variations**6.6.1 TECHNICAL SPECIFICATION:** 2.995(a)(1); 90.213(a) ; 74.661**6.6.2 TEST DATE(S):** 20 May 1999**6.6.3 MEASUREMENT PROCEDURES:**

As required by §2.995 of CFR 47, *frequency tolerance measurements* were made over the temperature range of -30°C to +50°C. The frequency measurements were made using direct input to a spectrum analyzer. Climatic control was accomplished using an environmental simulation chamber. The temperature was first lowered to -30°C and then raised in 10° increments. The unit remained in the chamber during temperature transitions and during the measurement process.

6.5.4 Results:

Frequency tolerance of carrier signal: +/- 0.005% for a temperature variation from -30°C to +50°C at normal supply voltage at the rated supply voltage at +20°C.

CARRIER FREQUENCY DEVIATIONS DUE TO TEMPERATURE INSTABILITY

Temperature (°C)	Carrier Frequency (GHz)	frequency deviation (kHz)
-30	2.474198401	13.571
-20	2.474193303	8.473
-10	2.474190278	5.448
0	2.474185373	0.543
+10	2.474185448	0.618
+20	2.474183375	1.08
+30	2.474186330	1.50
+40	2.474185731	0.901
+50	2.474147170	37.66

$$\text{Deviation limit} = F_c \times 0.005\% = 2.474184830 \times 10^9 \times 0.00005 = \pm 123,709.24 \text{ Hz}$$

The unit meets the requirements of 2.995(a)(1) ; 90.213(a) ; 74.661

**6.7 TEST TYPE:** Frequency Stability over Voltage Variations**6.7.1 TECHNICAL SPECIFICATION:** 2.995(d)(1) ; 90.213(a) ; 74.661**6.7.2 TEST DATE(S):** 20 May 1999**6.7.3 MEASUREMENT PROCEDURES:**

As required by §2.995 of CFR 47, *frequency tolerance measurements* were made over changes in the supply voltage to the EUT from the lowest operating voltage to 115% of the nominal supply voltage using a variable DC power supply. The frequency drift measurements were made using direct input to a spectrum analyzer.

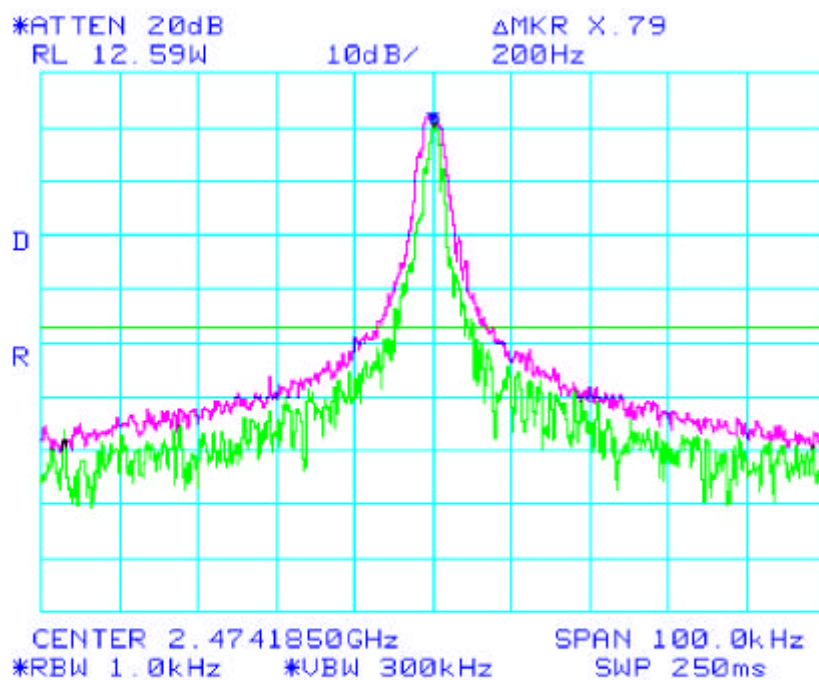
6.7.4 Results:

CARRIER FREQUENCY DEVIATIONS

Channel 661	Deviation (Hz)
2.474188	1300
2.474185	80
2.474185	500
2.474185	200

$$\text{Deviation limit} = F_c \times 0.005\% \\ 2.474184830 \times 10^9 \times 0.00005 = \pm 123,709.24 \text{ Hz}$$

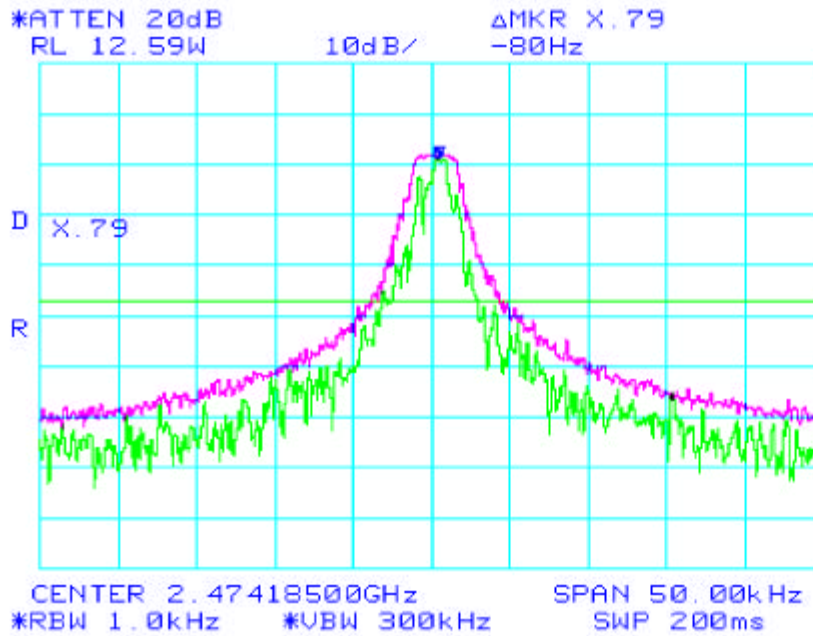
The unit meets the requirements of 2.995(d)(1) ; 90.213(a) ; 74.661



Frequency stability over
voltage variations

VT2400SC2D
Hi power mode
10.7 VDC vs. 12.6 VDC

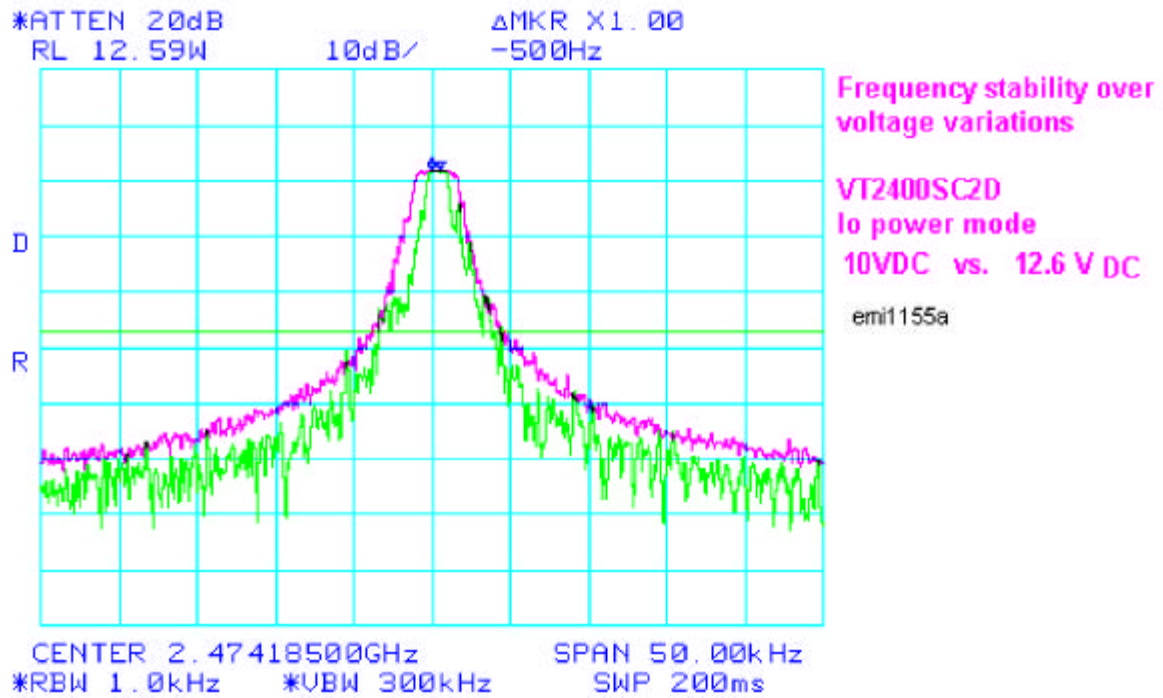
emi1155a

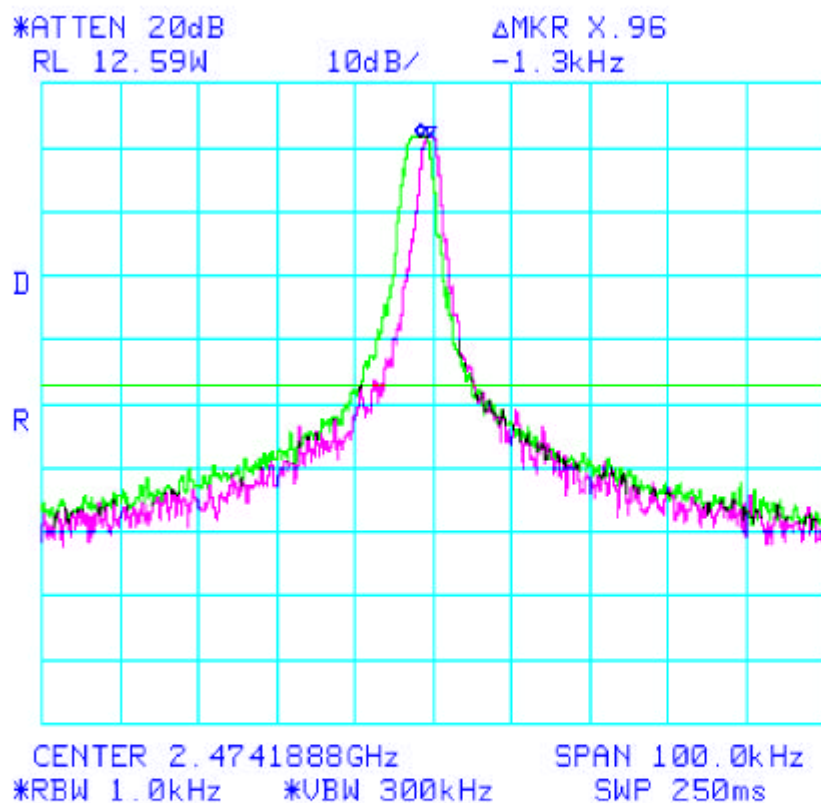


Frequency Stability over
voltage variations

VT2400SC2D
Io power mode
14.6 VDC vs. 12.6 VDC

emi1155a





Frequency Stability over
Voltage variations

VT2400SC2D

Hi power mode
12.6 VDC vs. 14.6 VDC

emi1155a