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Measured Radio Frequency Emissions
From

Lear Corporation Car2U Transmitter
Model(s): UHR

Report No. 415031-283
March 29, 2006

For:
Lear Corporation
5200 Auto Club Dr.
Dearborn, MI 48126-9982

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Summary

Tests for compliance with FCC Regulations Part 15, Subpart C, and Industry Canada RSS-210/Gen, were performed on Lear Corporation model UHR. This device is subject to the Rules and Regulations as a Transmitter.

In testing completed on March 23, 2006 the device tested in the worst case met the allowed FCC specifications for radiated emissions by 1.0 dB (see p. 7-9). Besides harmonics, there were no other significant spurious emissions found; emissions from digital circuitry were negligible. Line conducted emission tests do not apply since the device is powered from a 12 V dc system.

1. Introduction

Lear Corporation model UHR was tested for compliance with FCC Regulations, Part 15, adopted under Docket 87-389, April 18, 1989 as subsequently amended, and with Industry Canada RSS-210, Issue 6, September 2005. The tests were performed at the University of Michigan Radiation Laboratory Willow Run Test Range following the procedures described in ANSI C63.4-2003 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The Site description and attenuation characteristics of the Open Site facility are on file with FCC Laboratory, Columbia, Maryland (FCC Reg. No: 91050) and with Industry Canada, Ottawa, ON (File Ref. No: IC 2057).

2. Test Procedure and Equipment Used

The pertinent test equipment commonly used in our facility for measurements is listed in Table 2.1 below. The middle column identifies the specific equipment used in these tests.

Table 2.1 Test Equipment.

Test Instrument	Eqpt. Used	Manufacturer/Model
Spectrum Analyzer (0.1-1500 MHz)		Hewlett-Packard, 182T/8558B
Spectrum Analyzer (9kHz-22GHz)	X	Hewlett-Packard 8593A SN: 3107A01358
Spectrum Analyzer (9kHz-26GHz)	X	Hewlett-Packard 8593E, SN: 3412A01131
Spectrum Analyzer (9kHz-26GHz)		Hewlett-Packard 8563E, SN: 3310A01174
Spectrum Analyzer (9kHz-40GHz)		Hewlett-Packard 8564E, SN: 3745A01031
Power Meter		Hewlett-Packard, 432A
Power Meter		Anritsu, ML4803A/MP
Harmonic Mixer (26-40 GHz)		Hewlett-Packard 11970A, SN: 3003A08327
Harmonic Mixer (40-60 GHz)		Hewlett-Packard 11970U, SN: 2332A00500
Harmonic Mixer (75-110 GHz)		Hewlett-Packard 11970W, SN: 2521A00179
Harmonic Mixer (140-220 GHz)		Pacific Millimeter Prod., GMA, SN: 26
S-Band Std. Gain Horn		S/A, Model SGH-2.6
C-Band Std. Gain Horn		University of Michigan, NRL design
XN-Band Std. Gain Horn		University of Michigan, NRL design
X-Band Std. Gain Horn		S/A, Model 12-8.2
X-band horn (8.2- 12.4 GHz)		Narda 640
X-band horn (8.2- 12.4 GHz)		Scientific Atlanta , 12-8.2, SN: 730
K-band horn (18-26.5 GHz)		FXR, Inc., K638KF
Ka-band horn (26.5-40 GHz)		FXR, Inc., U638A
U-band horn (40-60 GHz)		Custom Microwave, HO19
W-band horn(75-110 GHz)		Custom Microwave, HO10
G-band horn (140-220 GHz)		Custom Microwave, HO5R
Bicone Antenna (30-250 MHz)	X	University of Michigan, RLBC-1
Bicone Antenna (200-1000 MHz)	X	University of Michigan, RLBC-2
Dipole Antenna Set (30-1000 MHz)	X	University of Michigan, RLDP-1,-2,-3
Dipole Antenna Set (30-1000 MHz)		EMCO 2131C, SN: 992
Active Rod Antenna (30 Hz-50 MHz)		EMCO 3301B, SN: 3223
Active Loop Antenna (30 Hz-50 MHz)		EMCO 6502, SN:2855
Ridge-horn Antenna (300-5000 MHz)	X	University of Michigan
Amplifier (5-1000 MHz)	X	Avantak, A11-1, A25-1S
Amplifier (5-4500 MHz)	X	Avantak
Amplifier (4.5-13 GHz)		Avantek, AFT-12665
Amplifier (6-16 GHz)		Trek
Amplifier (16-26 GHz)		Avantek
LISN Box		University of Michigan
Signal Generator		Hewlett-Packard 8657B

3. Configuration and Identification of Device Under Test

The DUT is a multi-frequency (8 frequencies total: 288MHz, 300MHz, 303MHz, 310MHz, 315MHz, 318MHz, 372MHz, and 390MHz) transmitter, 3 x 0.5 x 3 inches in size, designed to emulate existing garage door openers. This transmitter has pre-programmed protocols selected by the user based upon garage door receiver information. There are three buttons on the device so that the user may program a separate protocol to each button. There exist 2 protocols wherein both 315 MHz and 390 MHz are used sequentially during a single button press in normal operating mode; all other protocols transmit on only a single frequency in this mode. In programming mode the device may transmit on up to 4 frequencies in a sequential manner during a single button press. The details of these modes are outlined in the included documentation. The output power of the DUT is internally adjusted according to the RF frequency and data transmitted. Duty factors are calculated in software for all fixed code transmissions. For rolling code transmissions, the duty factor is computed for the worst case maximum on time. The antenna is mounted off the PCB.

The DUT was designed and manufactured by Lear Corporation, 5200 Auto Club Dr., Dearborn, MI 48126-9982. It is identified as:

Lear Corporation Transmitter
Model: UHR
FCC ID: KOBGTE05A

Since the DUT is capable of transmitting a large number of different protocols over 8 different frequencies, the following test procedure has been followed. The lowest, middle, and highest frequencies have been tested for the worst case duty cycle (least on time in 100 ms window). This includes the worst case conditions for all protocols in both programming and normal operating modes, and follows the recommendations of the FCC. (See description of operation exhibit for more details.) In addition, we have elected to include data for all three frequencies using reduced duty cycle protocols to demonstrate correct output power adjustment by the DUT. Plots demonstrating turn off time in both programming and normal modes are provided in figure 6.4.

3.1 Modifications Made

There were no modifications made to the DUT by this laboratory. However, during product development this laboratory was used by the applicant to determine correct output power levels for the device over all operating frequencies.

4. Emission Limits

The DUT tested falls under the category of an Intentional Radiator and a Digital Device. For FCC, it is subject to Part 15, Subpart C, (Section 15.231), Subpart B, (Section 15.109), and Subpart A, (Section 15.33). For Industry Canada it is subject to RSS-210, (Section 2.6 and 2.7). The applicable testing frequencies with corresponding emission limits are given in Tables 4.1 and 4.2 below. As a digital device the DUT is exempt, as it is made solely for use in a vehicular application. However, digital emissions were measured to fully characterize the device.

4.1 Radiated Emission Limits

Table 4.1. Radiated Emission Limits (FCC: 15.33, 15.35, 15.109; IC: RSS-210, 2.7 Table 2).
(Digital Class B)

Freq. (MHz)	E_{lim} (3m) μV/m	E_{lim} dB(μV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-2000	500	54.0

Note: Average readings apply above 1000 MHz (1 MHz BW)
Quasi-Peak readings apply to 1000 MHz (120 kHz BW)

Table 4.2. Radiated Emission Limits (FCC: 15.231(b), 15.205(a); IC: RSS-210; 2.7 Table 1).
(Transmitter)

Frequency (MHz)	Fundamental Ave. E_{lim} (3m)		Spurious** Ave. E_{lim} (3m)	
	(μV/m)	dB (μV/m)	(μV/m)	dB (μV/m)
260.0-470.0	3750-12500*		375-1250	
322-335.4 399.9-410 608-614	Restricted Bands		200	46.0
960-1240/1427(IC) 1300-1427 1435-1626.5 1645.5-1646.5 (IC) 1660-1710 1718.9-1722.2 2200-2300	Restricted Bands		500	54.0

* Linear interpolation, formula: E = -7083 + 41.67*f (MHz)
** Measure up to tenth harmonic; 120 kHz BW up to 1 GHz, 1 MHz BW above 1 GHz

4.3 Line Conducted Emissions Limits
The line conducted emission limits and tests do not apply here, since the DUT is powered by a 12 VDC system.

4.4 Supply Voltage Variation (FCC 15.31(e))
For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

5. Radiated Emission Tests and Results

5.1 Semi-Anechoic Chamber Measurements

To familiarize with the radiated emission behavior of the DUT, the DUT was first studied and measured in a shielded semi-anechoic chamber. In the chamber there is a set-up similar to that of an outdoor 3-meter site, with a turntable, an antenna mast, and a ground plane. Instrumentation includes spectrum analyzers and other equipment as needed.

In testing for radiated emissions, the transmitter was activated using the each of the three buttons with a rubber band. It was placed on the test table flat, on its side, or on its end. In the chamber we studied and recorded all the emissions using a Bicone antenna up to 300 MHz and a ridged horn antenna above 200 MHz. The measurements made in the chamber below 1 GHz are used for pre-test evaluation only. The measurements made above 1 GHz are used in evaluation and in the final compliance assessment. We note that for the horn antenna, the antenna pattern is directive and hence the measurement is essentially that of free space (no ground reflection). Consequently it is not essential to measure the DUT for both antenna polarizations, as long as the DUT is measured on all three of its major axis. In the chamber we also recorded the spectrum and modulation characteristics of the carrier. This data is presented in subsequent sections. We also note that in scanning from 30 MHz to 4.5 GHz using Bicone and the ridge horn antennas, there were no other significant spurious emissions observed.

5.2 Open Area Test Site Radiated Emission Tests

After the chamber measurements, the emission were measured on the outdoor 3-meter site at the fundamental and harmonics up to 1 GHz using tuned dipoles and/or the high frequency Bicone. Photographs included show the DUT on the Open Area Test Site (OATS).

5.3 Computations and Results for Radiated Emissions

To convert the dBm's measured on the spectrum analyzer to dB(μV/m), we use expression

$$E_3(\text{dB}\mu\text{V/m}) = 107 + P_R + K_A - K_G$$

where P_R = power recorded on spectrum analyzer, dB, measured at 3m
K_A = antenna factor, dB/m
K_G = pre-amplifier gain, including cable loss, dB

When presenting the data, at each frequency the highest measured emission under all of the possible orientations is given. Computations and results are given in Table 5.1. There we see that the DUT meets the limit by 1.0 dB.

5.4 Conducted Emission Tests

These tests do not apply, since the DUT is powered from a 12 V dc system.

6. Other Measurements

6.1 Correction for Pulse Operation

For the 6 representative protocols tested, the following duty cycle calculations were performed based on the protocol data collected. (Note: The protocols tested also represent the worst case protocols in the programming mode.) See Figure 6.1.

Table 6.1. Correction for Pulse Operation

Frequency	Duty Factor	Duty Cycle Calculation	K_E (dB)
288	Largest Minimal	(18 x 0.613 ms)/100 ms = 0.1103 (15 x 4.200 ms + 3 x 0.650 ms)/100 ms = 0.650	-19.2 -3.8
318	Largest Minimal	(18 x 0.613 ms)/100 ms = 0.1103 (15 x 4.260 ms + 3 x 0.650 ms)/100 ms = 0.659	-19.2 -3.6
390	Largest Minimal	(12 x 0.200 ms + 67 x 0.395 ms)/100 ms = 0.289 26.5 µs / 50 µs = 0.53	-10.8 -5.5
315	Largest	(12 x 0.200 ms + 67 x 0.395 ms)/100 ms = 0.289	-10.8

6.2 Emission Spectrum
Using the ridge-horn antenna and DUT placed in its aperture, emission spectrum was recorded and is shown in Figure 6.2.

6.3 Bandwidth of the Emission Spectrum
The measured emission bandwidth for a sample of the worst case signals is shown in Figure 6.3. Table 6.2 below provides the emission bandwidth for all 8 frequencies. These measurements were made utilizing the shortest pulse period protocols which demonstrated the widest bandwidth measurements.

Table 6.2. Emission Spectrum Bandwidth

Frequency	Measured Bandwidth	Frequency	Measured Bandwidth
288	7.8 kHz	315	21.3 kHz
300	9.5 kHz	318	8.0 kHz
303	5.3 kHz	372	21.5 kHz
310	10.8 kHz	390	315 kHz (10 kHz RBW)
Cumulative Bandwidth			**398.9 kHz**

The allowed (-20 dB) bandwidth is 0.25% of the lowest operating frequency during a single button press. If more than one frequency is transmitted, their bandwidths should be added (per FCC correspondence). To demonstrate general compliance, the cumulative emission bandwidth including all frequencies is provided. The bandwidth is less than 0.25% x 288 MHz = 720 kHz.

6.4 Effect of Supply Voltage Variation
The DUT has been designed to be powered by 12 V dc system. For this test, the battery was replaced by a laboratory variable power supply. Relative power radiated was measured at the fundamental as the voltage was varied from 8 to 18 volts. The emission variation is shown in Figure 6.5.

6.5 Input Voltage at Battery Terminals

Voltage	V	=	12 V dc
Current	I	=	6.4 mA dc

Table 5.1 Highest Emissions Measured

Radiated Emission - RF Lear Car2U, FCC/IC

#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det. Used	Ka dB/m	Kg dB	E3* dBµV/m	E3lim dBµV/m	Pass dB	Comments
1	**Duty Cycle: 11.0ms/100ms window (18 PWM Pulses)**										
2	288.0	Dip	H	-13.7	Pk	17.6	22.7	69.1	73.8	**4.8**	flat
3	288.0	Dip	V	-16.3	Pk	17.6	22.7	66.5	73.8	7.4	side
4	576.0	SBic	H	-49.3	Pk	23.7	20.4	41.8	53.8	12.0	end
5	576.0	SBic	V	-47.0	Pk	23.7	20.4	44.1	53.8	9.7	side
6	864.0	SBic	H	-62.6	Pk	27.8	18.2	34.8	53.8	19.1	flat
7	864.0	SBic	V	-59.9	Pk	27.8	18.2	37.5	53.8	16.4	side
8	1152.0	Horn	H	-54.0	Pk	20.2	28.0	26.0	54.0	28.0	side
9	1440.0	Horn	H	-42.6	Pk	21.1	28.0	38.3	54.0	15.7	side
10	1728.0	Horn	H	-52.9	Pk	21.8	28.0	28.7	53.8	25.1	side
11	2016.0	Horn	H	-50.1	Pk	22.5	28.1	32.1	53.8	21.7	side
12	2304.0	Horn	H	-60.0	Pk	23.3	28.3	22.8	53.8	31.1	flat
13	2592.0	Horn	H	-50.6	Pk	24.1	28.2	33.1	53.8	20.8	side
14	2880.0	Horn	H	-51.5	Pk	25.0	27.9	33.4	54.0	20.6	side
15											
16	* Includes 19.2 dB duty factor										
17											
18	**Duty Cycle: 65.0ms/100ms window (18 PWM Pulses)**										
19	288.0	Dip	H	-31.3	Pk	17.6	22.7	66.8	73.8	**7.0**	side
20	288.0	Dip	V	-34.8	Pk	17.6	22.7	63.3	73.8	10.5	side
21	576.0	SBic	H	-61.1	Pk	23.7	20.4	45.4	53.8	8.4	end
22	576.0	SBic	V	-59.8	Pk	23.7	20.4	46.7	53.8	7.1	side
23	864.0	SBic	H	-69.2	Pk	27.8	18.2	43.6	53.8	10.3	side
24	864.0	SBic	V	-68.1	Pk	27.8	18.2	44.7	53.8	9.2	flat
25	1152.0	Horn	H	-62.2	Pk	20.2	28.0	33.2	54.0	20.8	max all, noise
26	1440.0	Horn	H	-62.5	Pk	21.1	28.0	33.8	54.0	20.2	max all, noise
27	1728.0	Horn	H	-61.5	Pk	21.8	28.0	35.5	53.8	18.3	max all, noise
28	2016.0	Horn	H	-62.2	Pk	22.5	28.1	35.4	53.8	18.4	max all, noise
29	2304.0	Horn	H	-61.6	Pk	23.3	28.3	36.6	53.8	17.3	max all, noise
30	2592.0	Horn	H	-62.4	Pk	24.1	28.2	36.7	53.8	17.2	max all, noise
31	2880.0	Horn	H	-59.2	Pk	25.0	27.9	41.1	54.0	12.9	max all, noise
32											
33	* Includes 3.8 dB duty factor										
34											
35	Digital emissions more than 20 dB below FCC/IC Class B Limit.										
36											
37											
38											
39											

Meas. 3/14/2006-3/23/2006; U of Mich.

Table 5.1 Highest Emissions Measured

Radiated Emission - RF											Lear Car2U, FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det. Used	Ka dB/m	Kg dB	E3* dBμV/m	E3lim dBμV/m	Pass dB	Comments
1	**Duty Cycle: 11.0ms/100ms window (18 PWM Pulses)**										
2	318.0	Dip	H	-11.3	Pk	18.7	22.3	72.9	75.8	2.9	flat
3	318.0	Dip	V	-15.1	Pk	18.7	22.3	69.1	75.8	6.7	side
4	636.0	Dip	H	-40.1	Pk	24.5	19.4	52.8	55.8	3.0	end
5	636.0	SBic	V	-39.3	Pk	24.5	19.9	53.1	55.8	**2.7**	side
6	954.0	SBic	H	-76.2	Pk	28.9	17.8	22.7	55.8	33.1	flat
7	954.0	SBic	V	-74.4	Pk	28.9	17.8	24.5	55.8	31.3	flat
8	1272.0	Horn	H	-60.0	Pk	20.7	28.0	20.5	54.0	33.5	side
9	1590.0	Horn	H	-61.3	Pk	21.5	28.0	20.0	54.0	34.0	end
10	1908.0	Horn	H	-60.2	Pk	22.3	28.0	21.9	55.8	33.9	end
11	2226.0	Horn	H	-60.0	Pk	23.1	28.1	22.8	54.0	31.2	max all, noise
12	2544.0	Horn	H	-60.2	Pk	23.9	28.3	23.2	55.8	32.6	max all, noise
13	2862.0	Horn	H	-59.9	Pk	24.9	28.2	24.6	54.0	29.4	max all, noise
14	3180.0	Horn	H	-60.3	Pk	25.9	27.9	25.5	55.8	30.3	max all, noise
15											
16	* Includes 19.2 dB duty factor										
17											
18	**Duty Cycle: 65.9ms/100ms window (18 PWM Pulses)**										
19	318.0	Dip	H	-28.5	Pk	18.7	22.3	71.3	75.8	4.5	flat
20	318.0	Dip	V	-32.2	Pk	18.7	22.3	67.6	75.8	8.2	side
21	636.0	Dip	H	-53.5	Pk	24.5	19.6	54.8	55.8	**1.0**	end
22	636.0	SBic	V	-53.9	Pk	24.5	19.9	54.1	55.8	1.7	side
23	954.0	SBic	H	-81.2	Pk	28.9	17.8	33.3	55.8	22.5	end
24	954.0	SBic	V	-81.4	Pk	28.9	17.8	33.1	55.8	22.7	end
25	1272.0	Horn	H	-62.8	Pk	20.7	28.0	33.3	54.0	20.7	max all, noise
26	1590.0	Horn	H	-62.1	Pk	21.5	28.0	34.8	54.0	19.2	max all, noise
27	1908.0	Horn	H	-62.7	Pk	22.3	28.0	35.0	55.8	20.8	max all, noise
28	2226.0	Horn	H	-61.8	Pk	23.1	28.1	36.6	54.0	17.4	max all, noise
29	2544.0	Horn	H	-62.4	Pk	23.9	28.3	36.6	55.8	19.2	max all, noise
30	2862.0	Horn	H	-61.1	Pk	24.9	28.2	39.0	54.0	15.0	max all, noise
31	3180.0	Horn	H	-60.1	Pk	25.9	27.9	41.3	55.8	14.5	max all, noise
32											
33	* Includes 3.6 dB duty factor										
34											
35	Digital emissions more than 20 dB below FCC/IC Class B Limit.										
36											
37											
38											
39											

Meas. 3/14/2006- 3/23/2006; U of Mich.

Table 5.1 Highest Emissions Measured

					Radiated Emission - RF						Lear Car2U, FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det. Used	Ka dB/m	Kg dB	E3* dBμV/m	E3lim dBμV/m	Pass dB	Comments
1	**Duty Cycle: 28.9ms/100ms (12 Manchester, 67 PWM pulses)**										
2	390.0	Dip	H	-19.4	Pk	20.6	21.5	75.9	79.2	**3.3**	flat
3	390.0	Dip	V	-23.3	Pk	20.6	21.5	72.0	79.2	7.2	end
4	780.0	SBic	H	-61.2	Pk	26.5	18.9	42.6	59.2	16.6	end
5	780.0	SBic	V	-67.8	Pk	26.5	18.9	36.0	59.2	23.2	flat
6	1170.0	Horn	H	-62.0	Pk	20.3	28.0	26.5	54.0	27.5	flat
7	1560.0	Horn	H	-61.1	Pk	21.4	28.0	28.5	54.0	25.5	flat, noise
8	1950.0	Horn	H	-57.1	Pk	22.4	28.0	33.5	59.2	25.8	side
9	2340.0	Horn	H	-57.8	Pk	23.4	28.0	33.8	54.0	20.2	side
10	2730.0	Horn	H	-53.1	Pk	24.5	28.1	39.5	54.0	14.5	side
11	3120.0	Horn	H	-57.5	Pk	25.7	28.3	36.1	59.2	23.1	flat
12	3510.0	Horn	H	-60.5	Pk	27.0	28.2	34.5	59.2	24.8	max all, noise
13	3900.0	Horn	H	-61.6	Pk	28.1	27.9	34.8	54.0	19.2	max all, noise
14											
15	* Includes 10.8 dB duty factor										
16											
17	**Duty Cycle: 28.9ms/100ms (12 Manchester, 67 PWM pulses)**										
18	315.0	SBic	H	-21.4	Pk	18.6	22.8	70.6	75.6	**5.0**	Includes 10.8 dB duty factor
19	315.0	SBic	V	-22.5	Pk	18.6	22.8	69.5	75.6	6.1	Includes 10.8 dB duty factor
20											
21	**Duty Cycle: 53ms/100ms window (Manchester > 100ms)**										
22	390.0	Dip	H	-23.5	Pk	20.6	21.5	77.1	79.2	**2.1**	flat
23	390.0	Dip	V	-25.9	Pk	20.6	21.5	74.7	79.2	4.5	side
24	780.0	SBic	H	-66.6	Pk	26.5	18.9	42.5	59.2	16.7	end
25	780.0	SBic	V	-69.5	Pk	26.5	18.9	39.6	59.2	19.6	side
26	1170.0	Horn	H	-61.0	Pk	20.3	28.0	32.8	54.0	21.2	max all
27	1560.0	Horn	H	-62.7	Pk	21.4	28.0	32.2	54.0	21.8	max all, noise
28	1950.0	Horn	H	-55.6	Pk	22.4	28.0	40.3	59.2	19.0	max all
29	2340.0	Horn	H	-62.6	Pk	23.4	28.0	34.3	54.0	19.7	max all, noise
30	2730.0	Horn	H	-62.6	Pk	24.5	28.1	35.3	54.0	18.7	max all, noise
31	3120.0	Horn	H	-62.0	Pk	25.7	28.3	36.9	59.2	22.3	max all, noise
32	3510.0	Horn	H	-62.7	Pk	27.0	28.2	37.6	59.2	21.7	max all, noise
33	3900.0	Horn	H	-62.6	Pk	28.1	27.9	39.1	54.0	14.9	max all, noise
34											
35	* Includes 5.5 dB duty factor										
36											
37	Digital emissions more than 20 dB below FCC/IC Class B Limit.										
38											

Meas. 3/14/2006-3/23/2006; U of Mich.

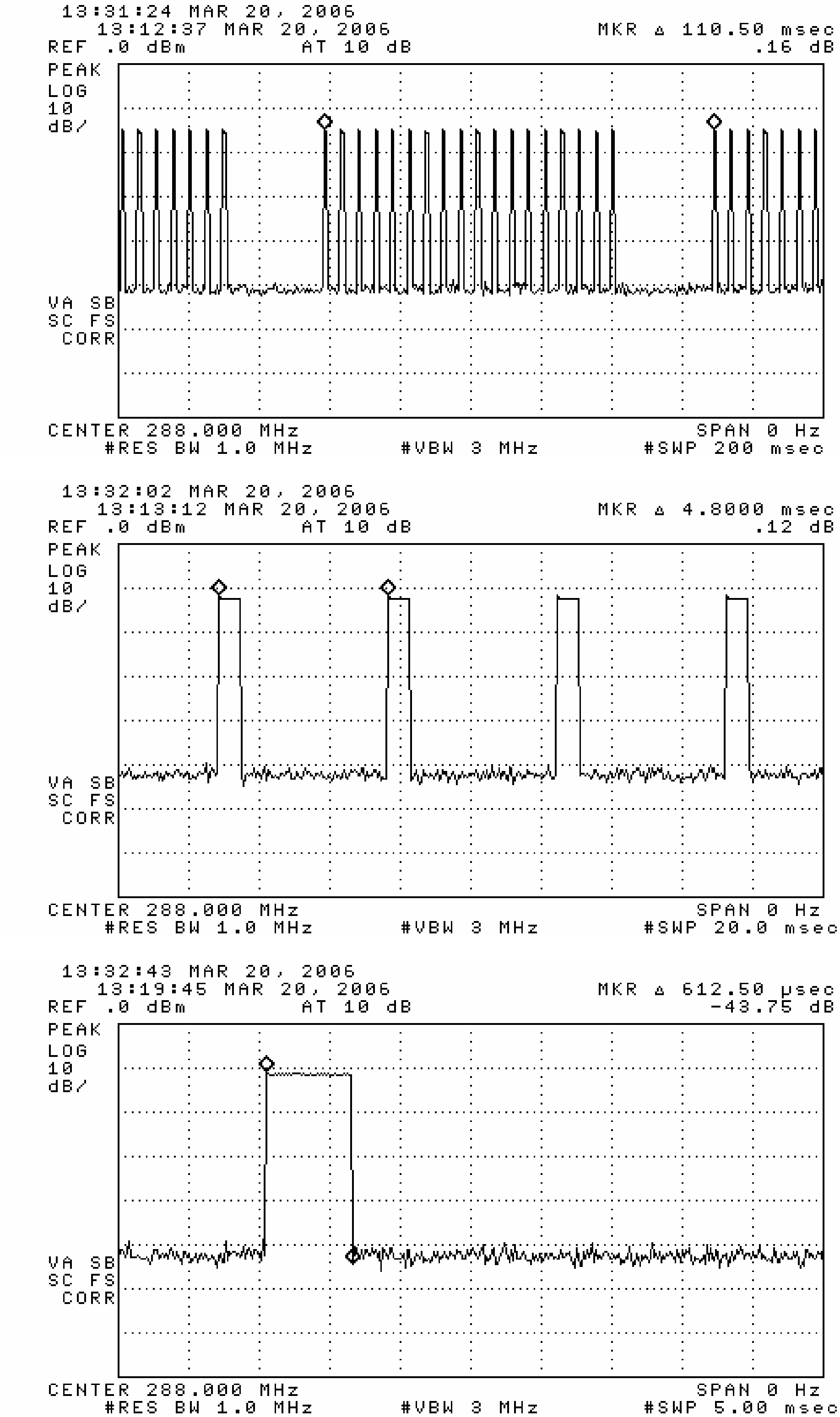


Figure 6.1(a). Transmissions modulation characteristics, 288 MHz:
(top) high duty complete transmission,
(center) expanded bit, (bottom) expanded period.

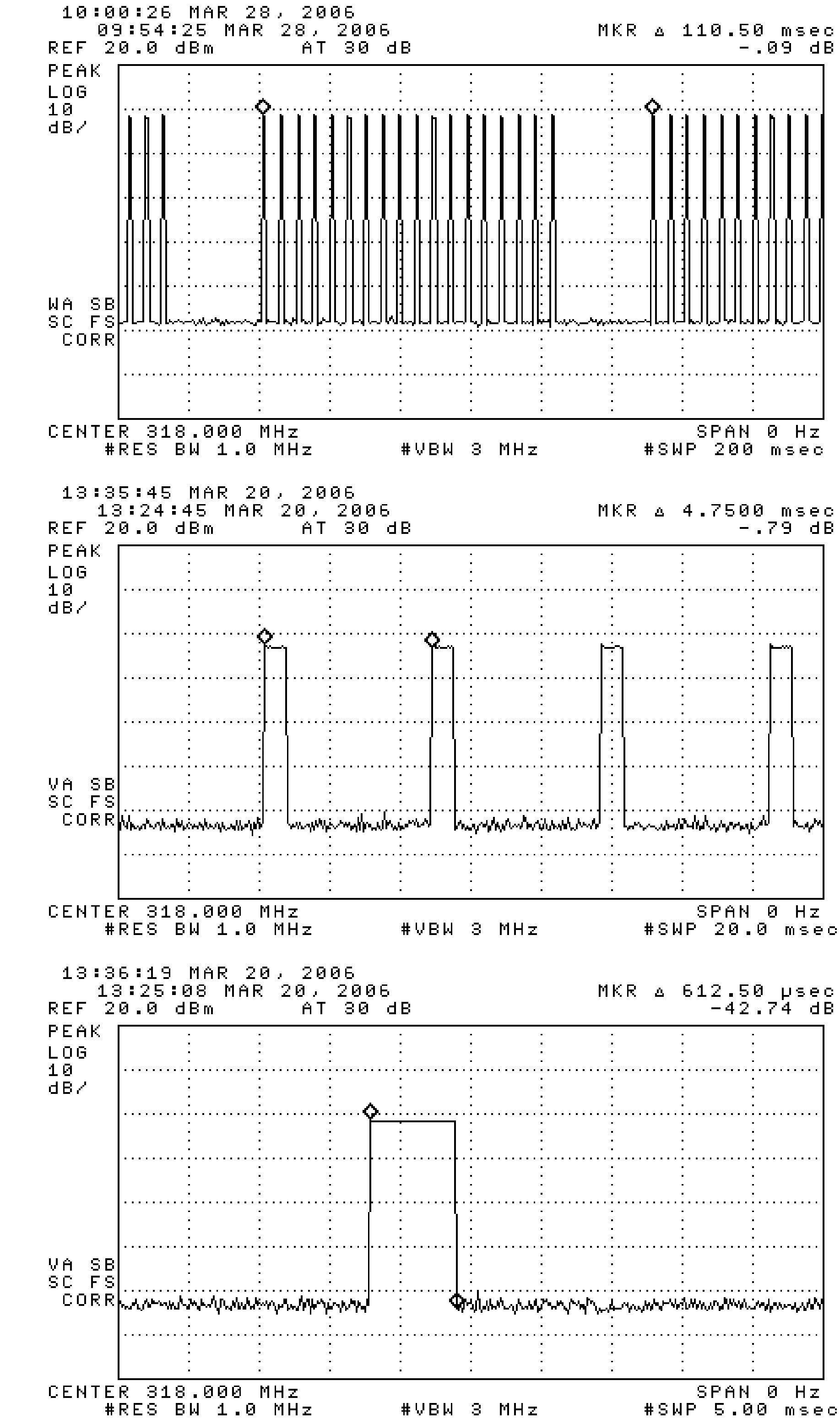


Figure 6.1(b). Transmissions modulation characteristics, 318 MHz:
(top) high duty complete transmission,
(center) expanded bit, (bottom) expanded period.

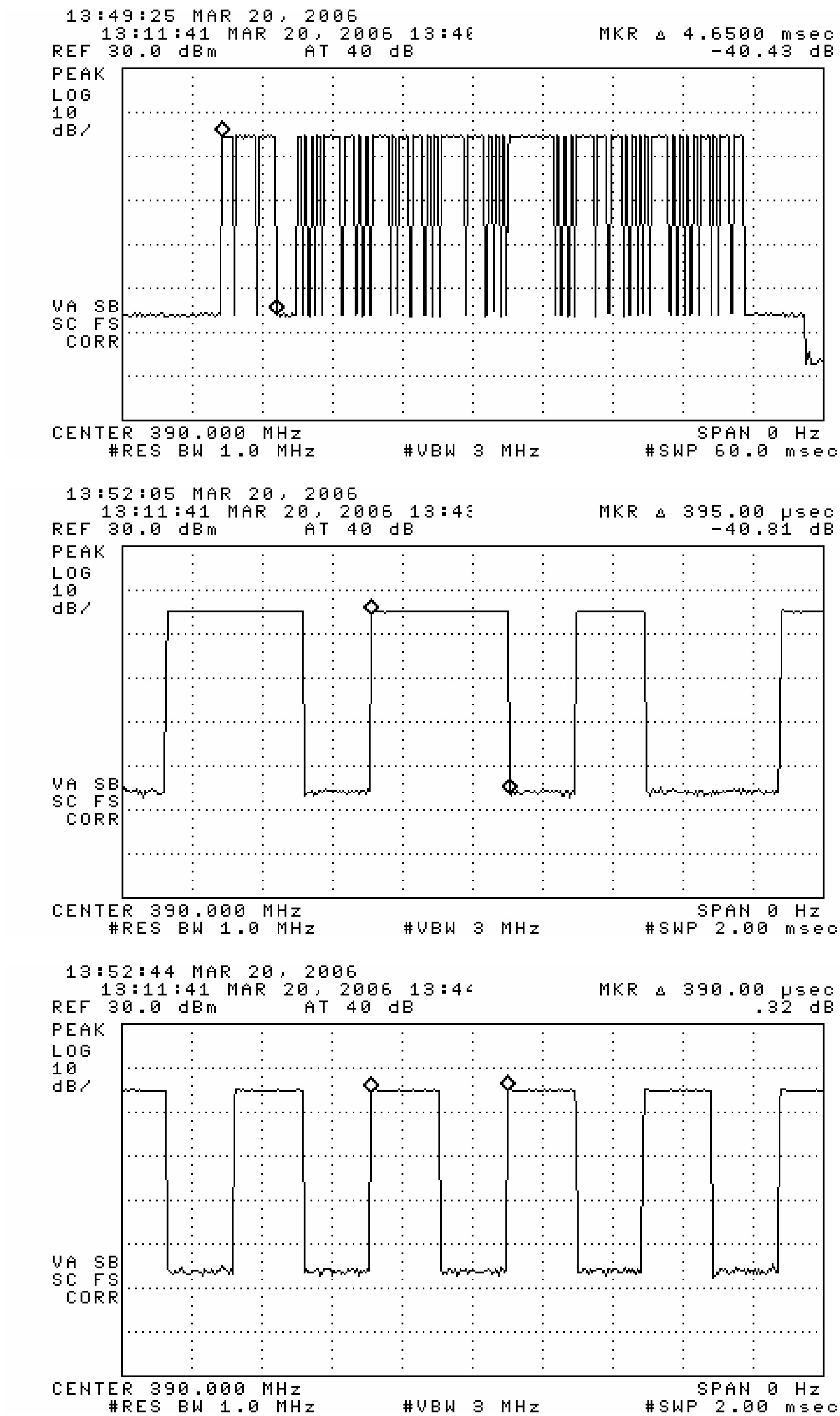


Figure 6.1(c). Transmissions modulation characteristics, 390 MHz:
(top) high duty complete transmission,
(center) expanded bit, (bottom) expanded period.

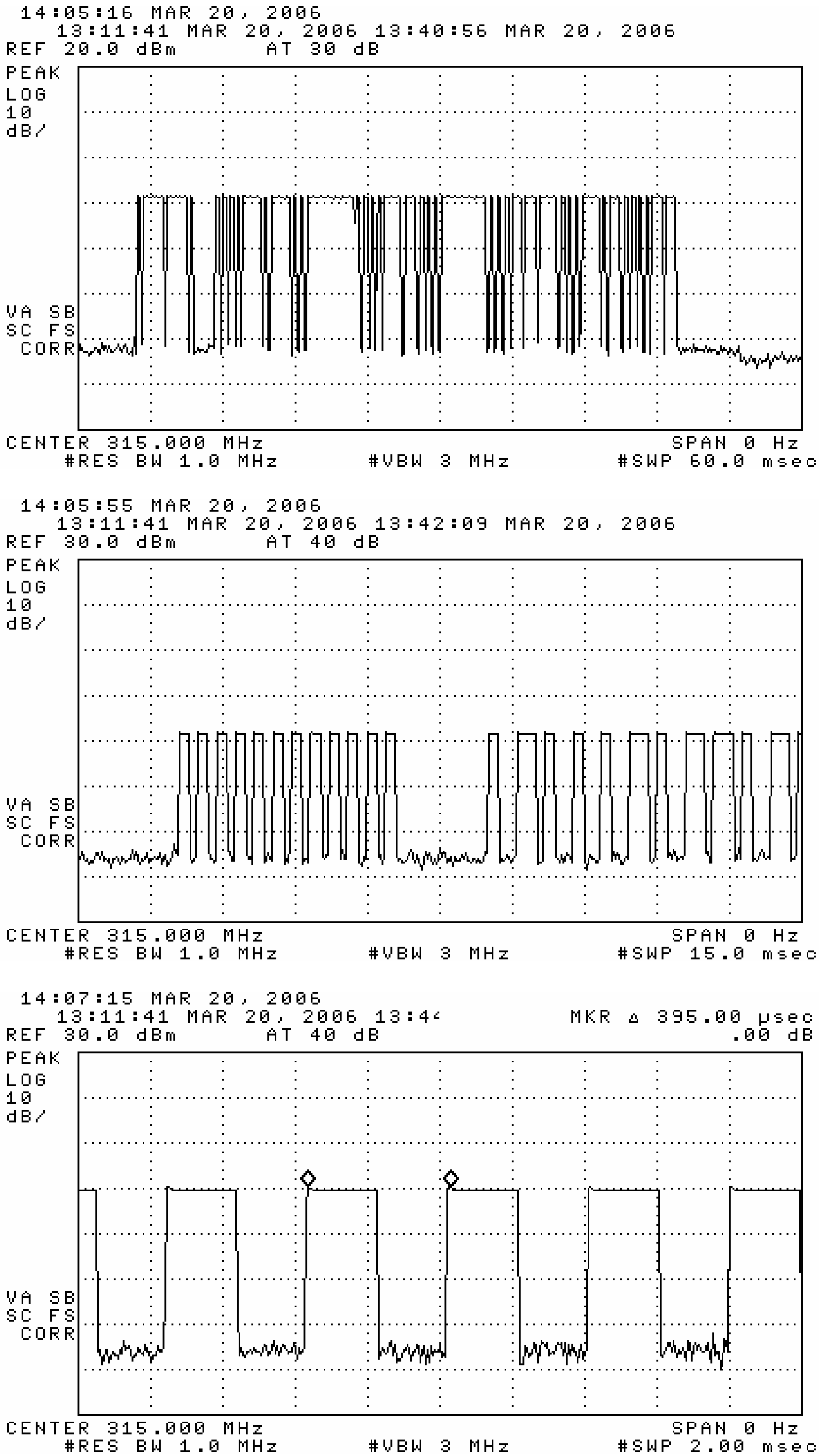


Figure 6.1(d). Transmissions modulation characteristics, 315 MHz:
(top) high duty complete transmission,
(center) expanded bit, (bottom) expanded period.

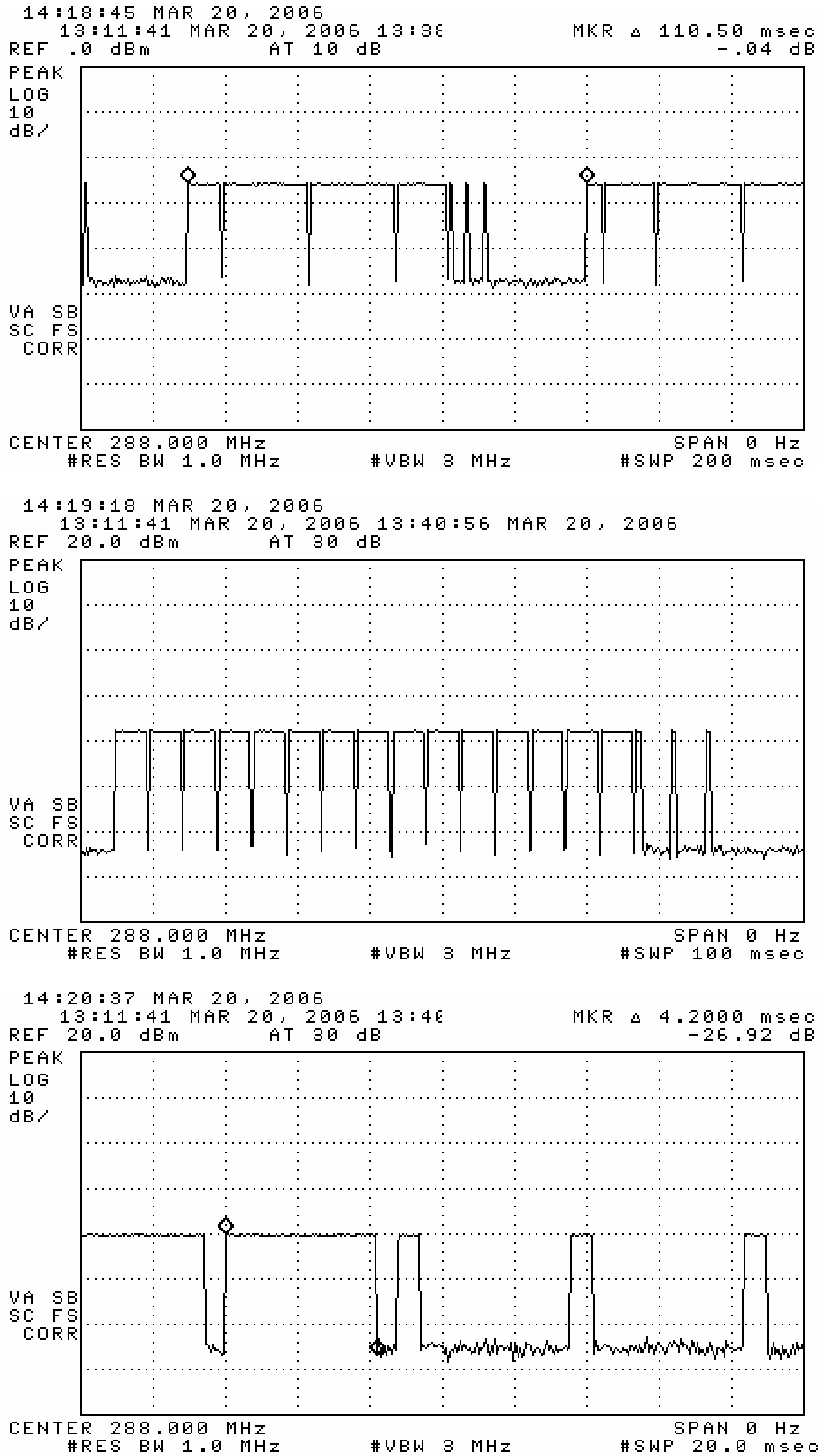


Figure 6.1(e). Transmissions modulation characteristics, 288 MHz:
(top) low duty complete transmission,
(center) expanded bit, (bottom) expanded period.

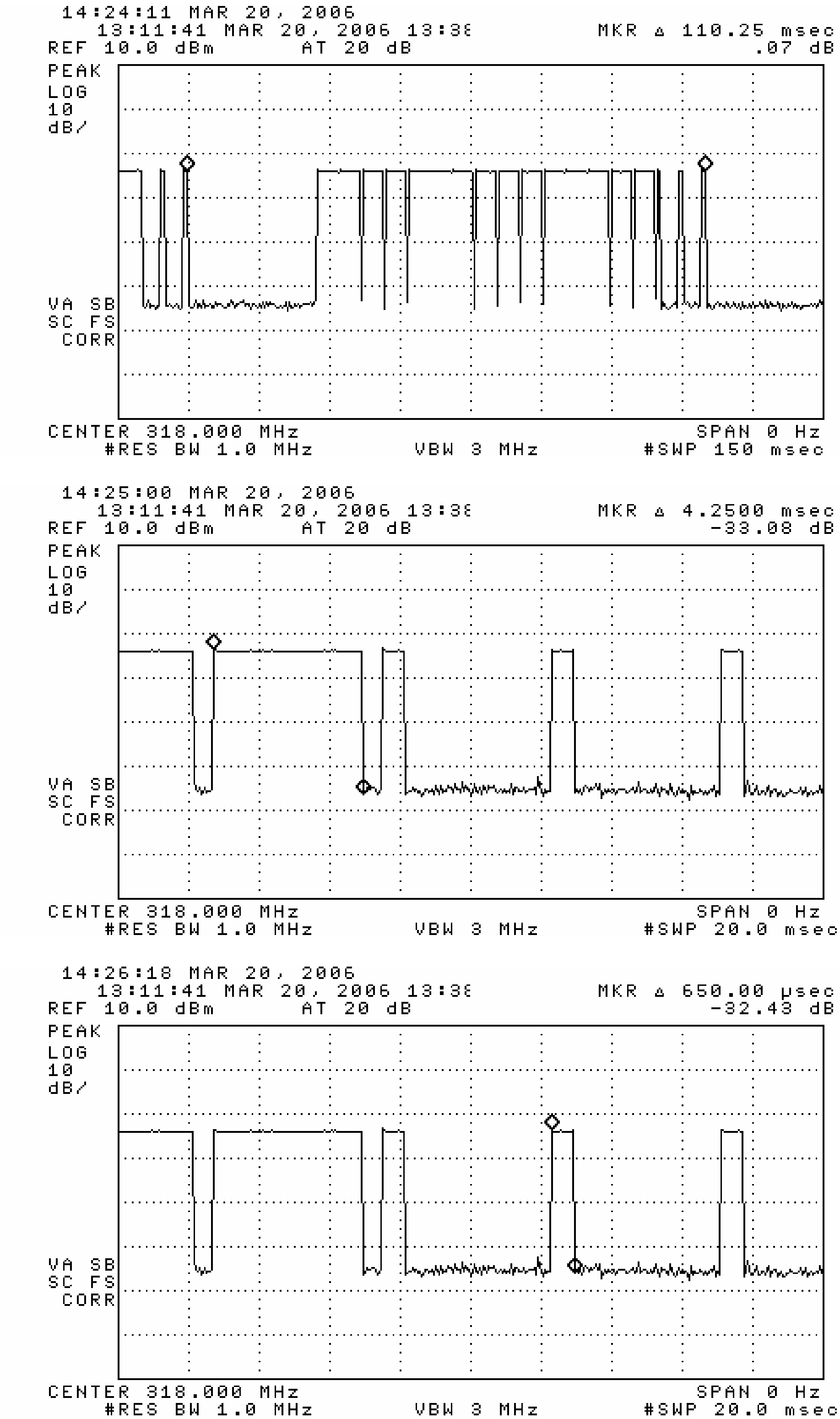


Figure 6.1(f). Transmissions modulation characteristics, 318 MHz:
(top) low duty complete transmission,
(center) expanded bit, (bottom) expanded period.

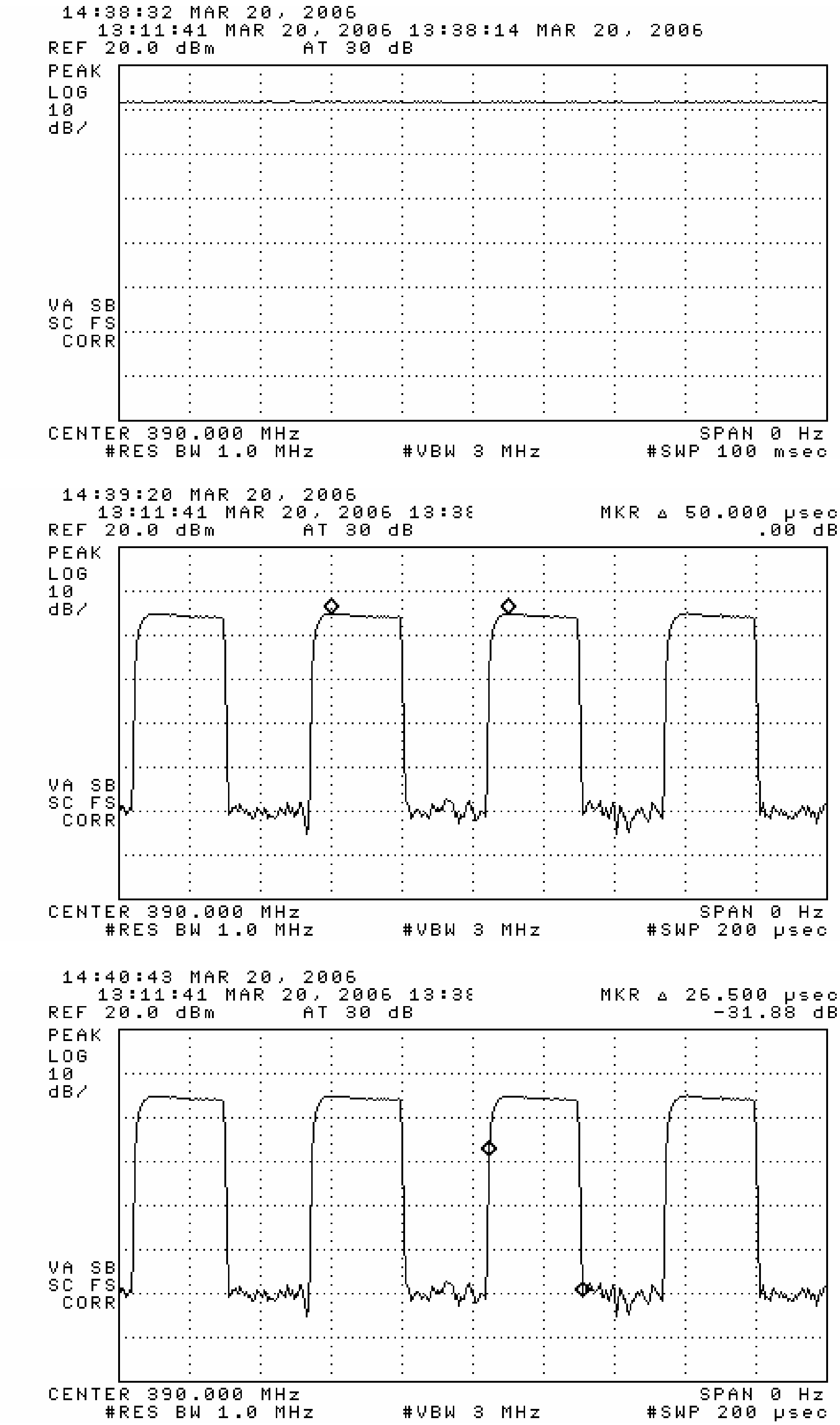


Figure 6.1(g). Transmissions modulation characteristics, 390 MHz:
(top) low duty complete transmission,
(center) expanded bit, (bottom) expanded period.

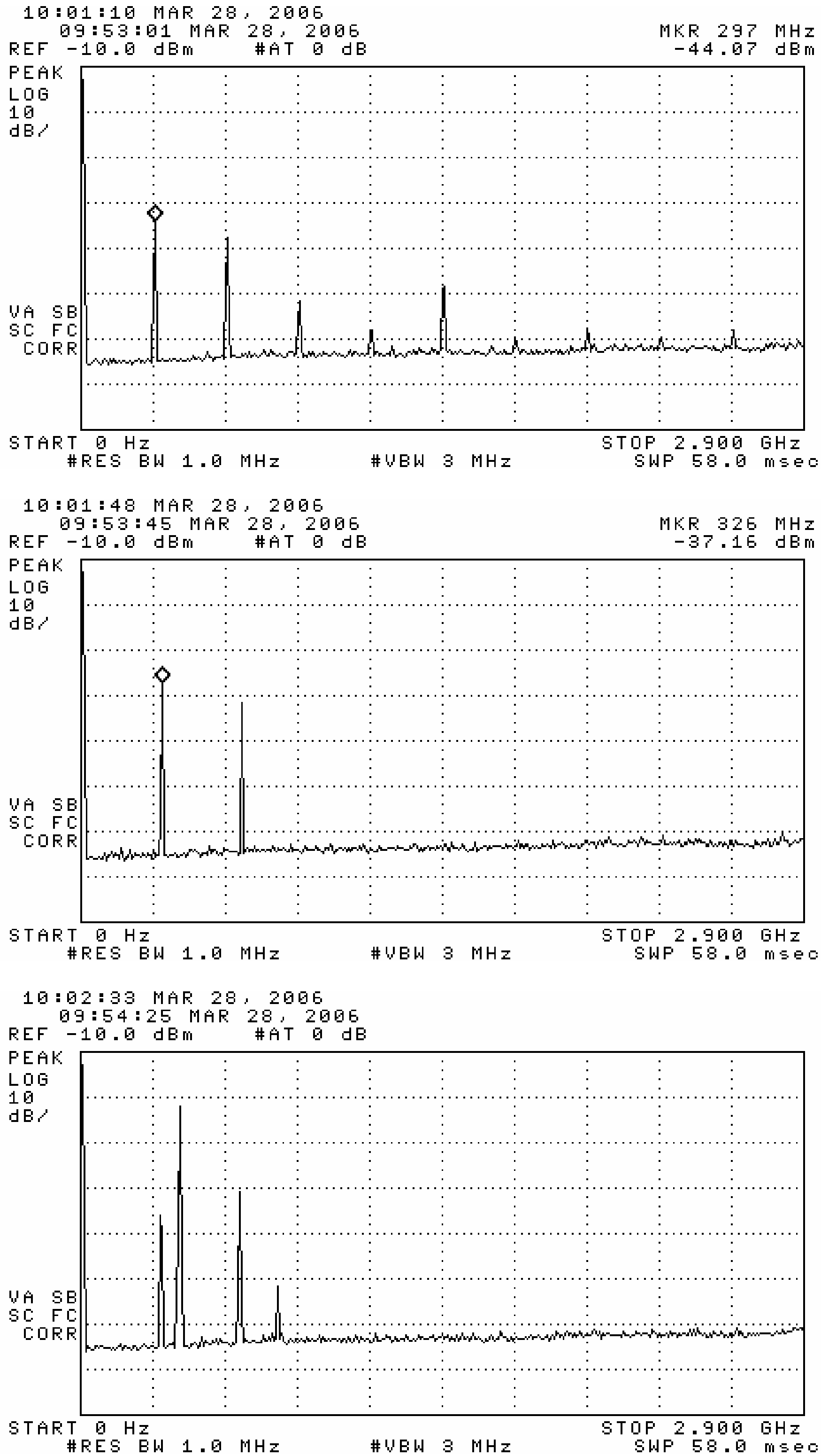
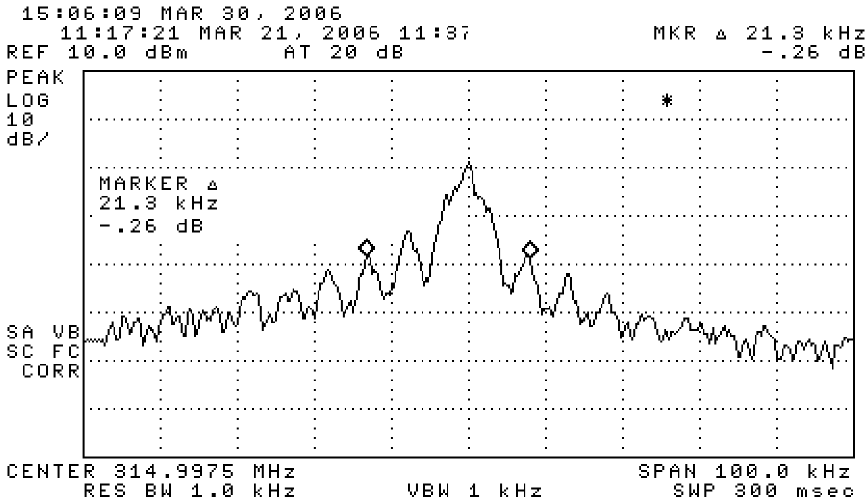
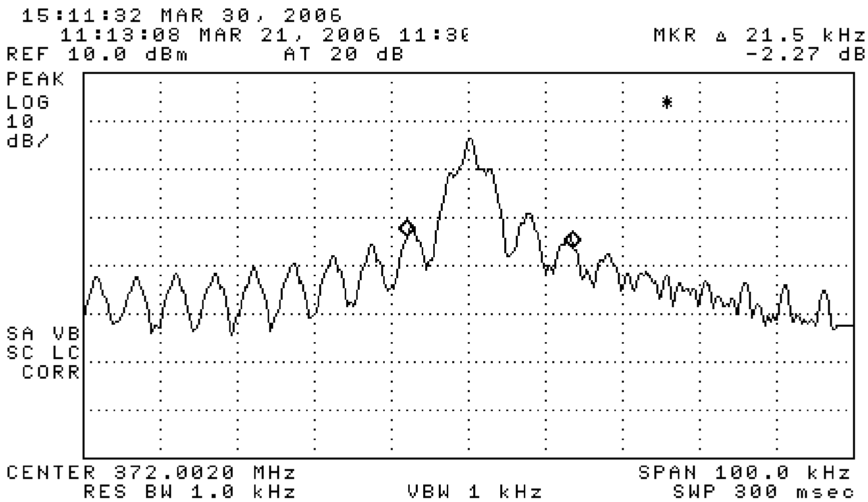


Figure 6.2. Emission spectrum of the DUT (pulsed emissions).
The amplitudes are only indicative (not calibrated).





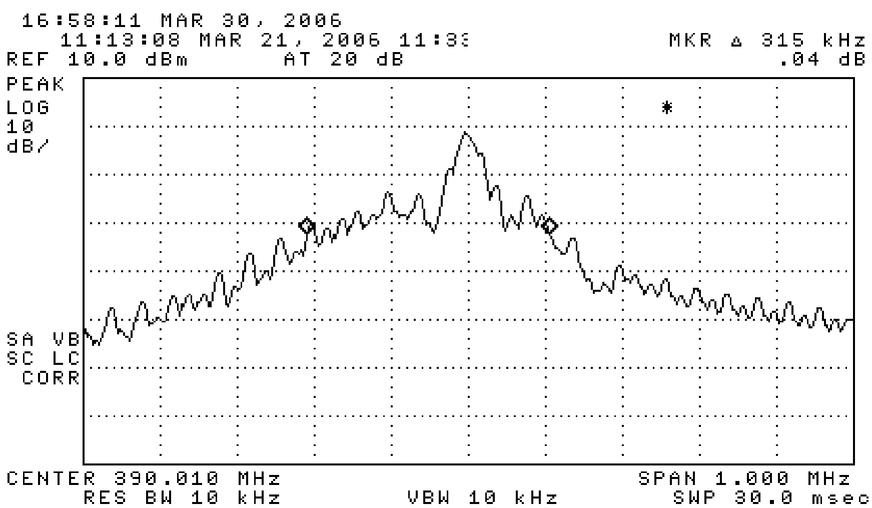
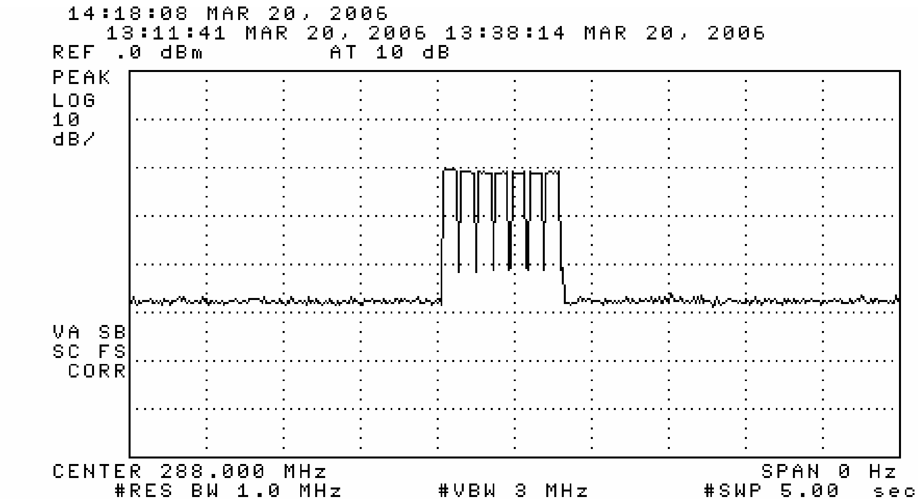
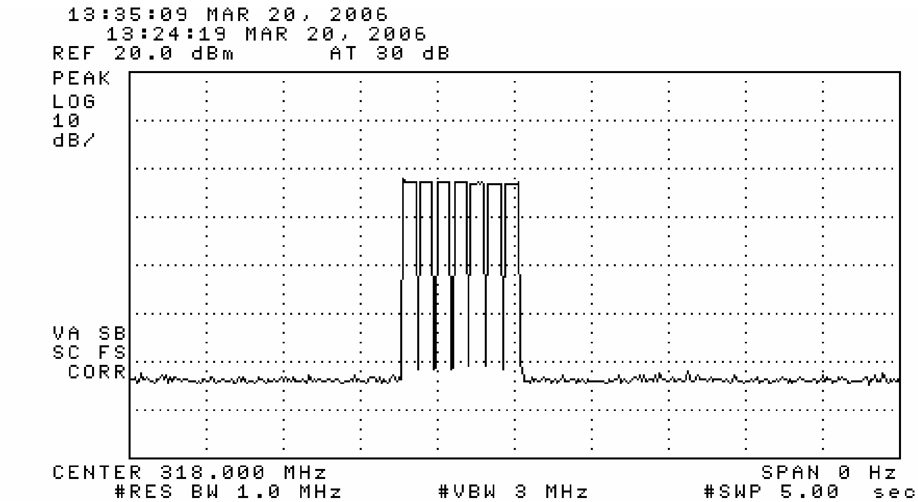


Figure 6.3. Worst Case measured bandwidths at select frequencies.
(pulsed emission, highest data rate).





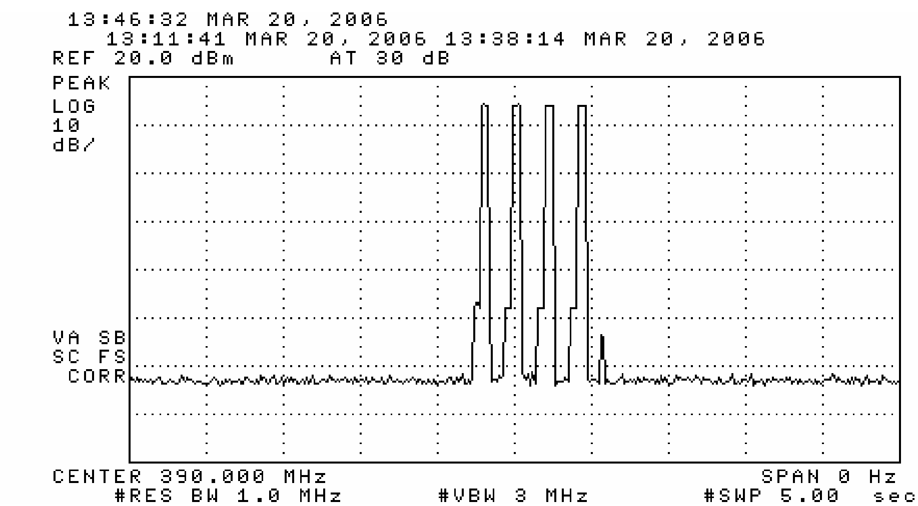
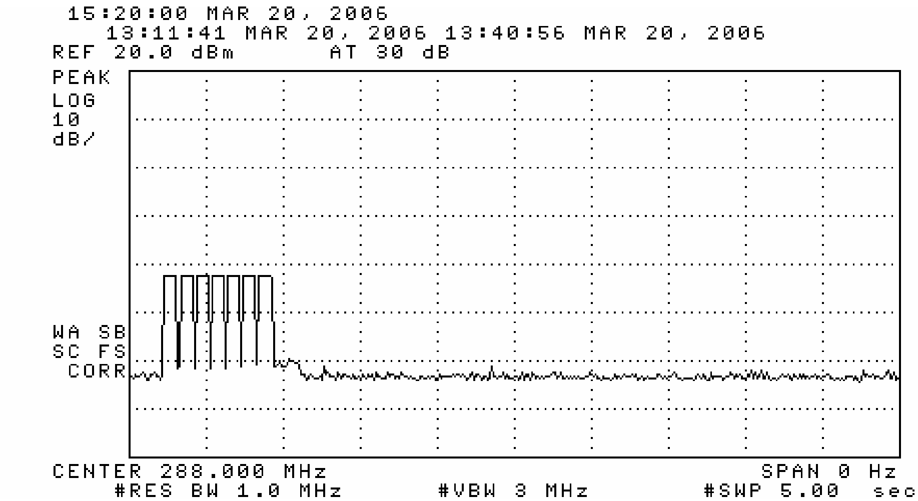
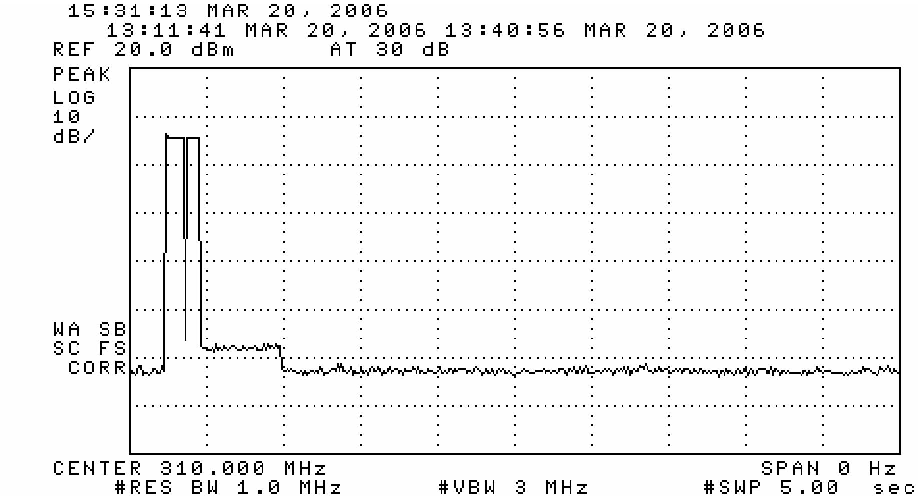


Figure 6.4(a). Transmitter 5 sec. transmission limit verification.
(normal operating mode)





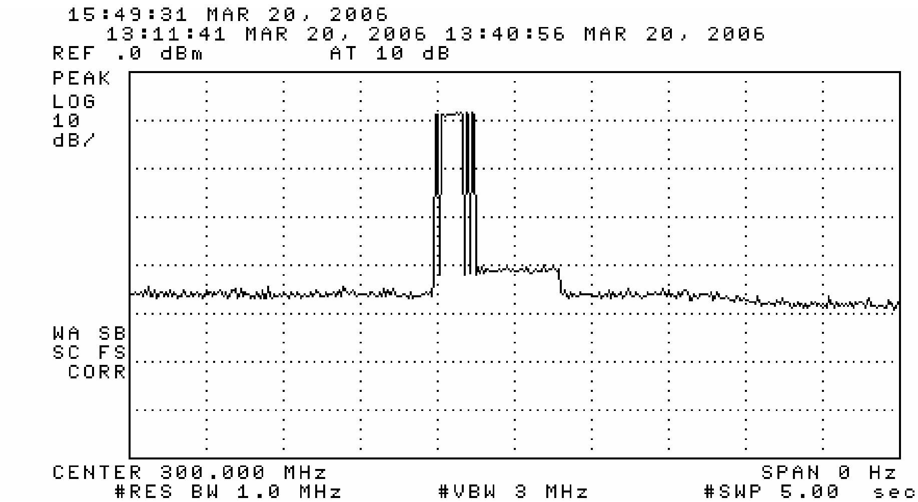
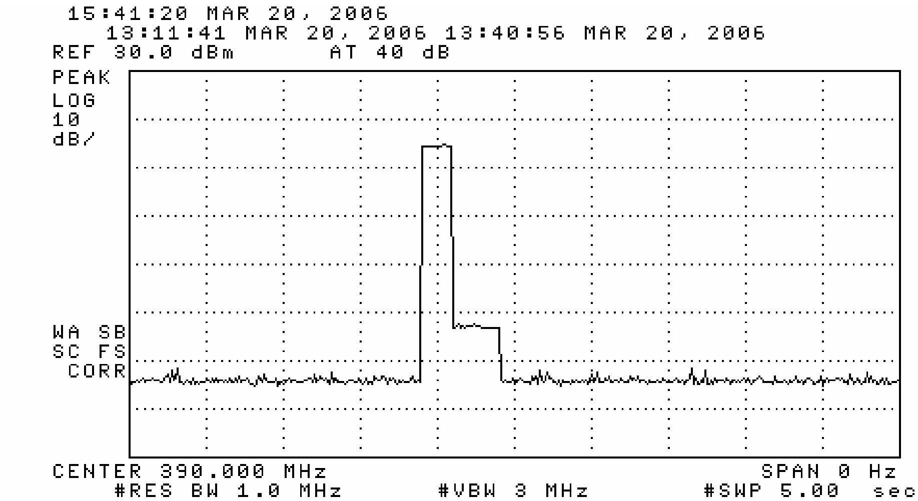


Figure 6.4(b). Transmitter 5 sec. transmission limit verification.
(top) 8 dip-switch programming mode
(middle) 9 dip-switch programming mode
(bottom) 10 dip-switch programming mode



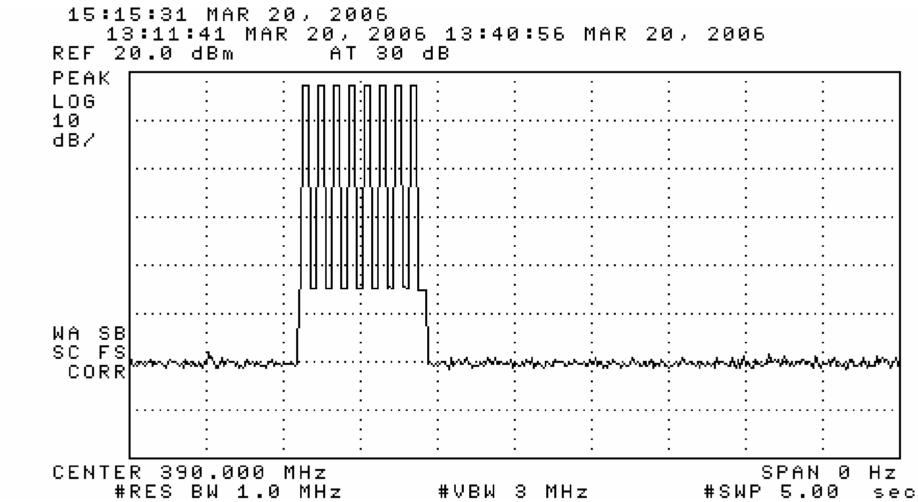


Figure 6.4(c). Transmitter 5 sec. transmission limit verification.
(top) 12 dip-switch programming mode
(bottom) rolling code programming mode

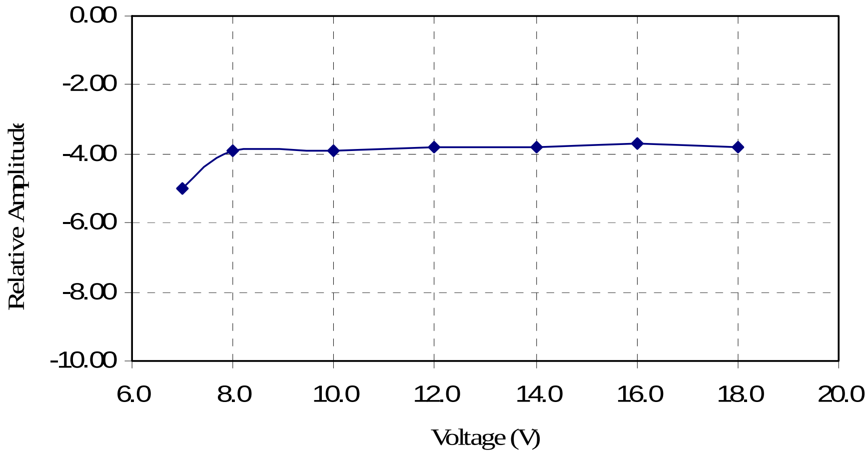


Figure 6.5. Relative emission at 318 MHz vs. supply voltage
(pulsed emission).