Engineering and Testing for EMC and Safety Compliance

TYPE CERTIFICATION REPORT

M/A COM Private Radio Systems, Inc.
3315 Old Forest Road
Lynchburg, VA 24501
Bryan McWatters (434) 385-2146

MODEL: P7100(IP) VHF Portable Radio

FCC ID: OWDTR-0013-E

December 10, 2002

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 90: 1998	PRIVATE LAND 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
ANSI/TIA/EIA –102.CAAA; 1999	DIGITAL C4FM/CQPSK TRANSCEIVER MEASUREMENT METHODS
RSS-119; Issue 6; 2000	LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS 27.41 TO 960.0 MHZ

Frequency Range	Output Power (W) Conducted	Frequency Tolerance (ppm)	Emission Designator
136-174 MHz	5.85	1.5	16K0F3E (Voice)
136-174 MHz	5.85	1.5	11K0F3E (Voice)
136-174 MHz	5.85	1.5	15K6F1D (2 level WB)
136-174 MHz	5.85	1.5	15K6F1E (2 level WB)
136-174 MHz	5.85	1.5	10K8F1D (2 level NB 9600)
136-174 MHz	5.85	1.5	10K8F1E (2 level NB 9600)
136-174 MHz	5.85	1.5	7K8F1D (2 level NB 4800)
136-174 MHz	5.85	1.5	7K8F1E (2 level NB 4800)
136-174 MHz	5.85	1.5	8K4F1D (C4FM)
136-174 MHz	5.85	1.5	8K4F1E (C4FM)

REPORT PREPARED BY:

TEST ENGINEER: DANIEL BIGGS

Document Number: 2002158 / QRTL02-535/637

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1 GENERAL INFORMATION

The following Report of a Type Certification is prepared on behalf of **M/A COM Private Radio Systems, Inc**. in accordance with the Federal Communications Commission and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the **P7100(IP) VHF Radio; FCC ID: OWDTR-0013-E**. 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 Communications 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
PART 90: 1998	PRIVATE LAND MOBILE RADIO SERVICES
ANSI C63.4-1992	STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS
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RSS-119; Issue 6; 2000	LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS 27.41 TO 960.0 MHZ

Frequency Range	Output Power (W) Conducted	Freq. Tolerance (ppm)	Emission Designator
136-174 MHz	5.85	1.5	16K0F3E (Voice)
136-174 MHz	5.85	1.5	11K0F3E (Voice)
136-174 MHz	5.85	1.5	15K6F1D (2 level WB)
136-174 MHz	5.85	1.5	15K6F1E (2 level WB)
136-174 MHz	5.85	1.5	10K8F1D (2 level NB 9600)
136-174 MHz	5.85	1.5	10K8F1E (2 level NB 9600)
136-174 MHz	5.85	1.5	7K8F1D (2 level NB 4800)
136-174 MHz	5.85	1.5	7K8F1E (2 level NB 4800)
136-174 MHz	5.85	1.5	8K4F1D (C4FM)
136-174 MHz	5.85	1.5	8K4F1E (C4FM)

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: November 20, 2002

Typed/Printed Name: Desmond Fraser Position: President

Signature:_____ Date: November 20, 2002

Typed/Printed Name: Daniel W. Biggs 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.

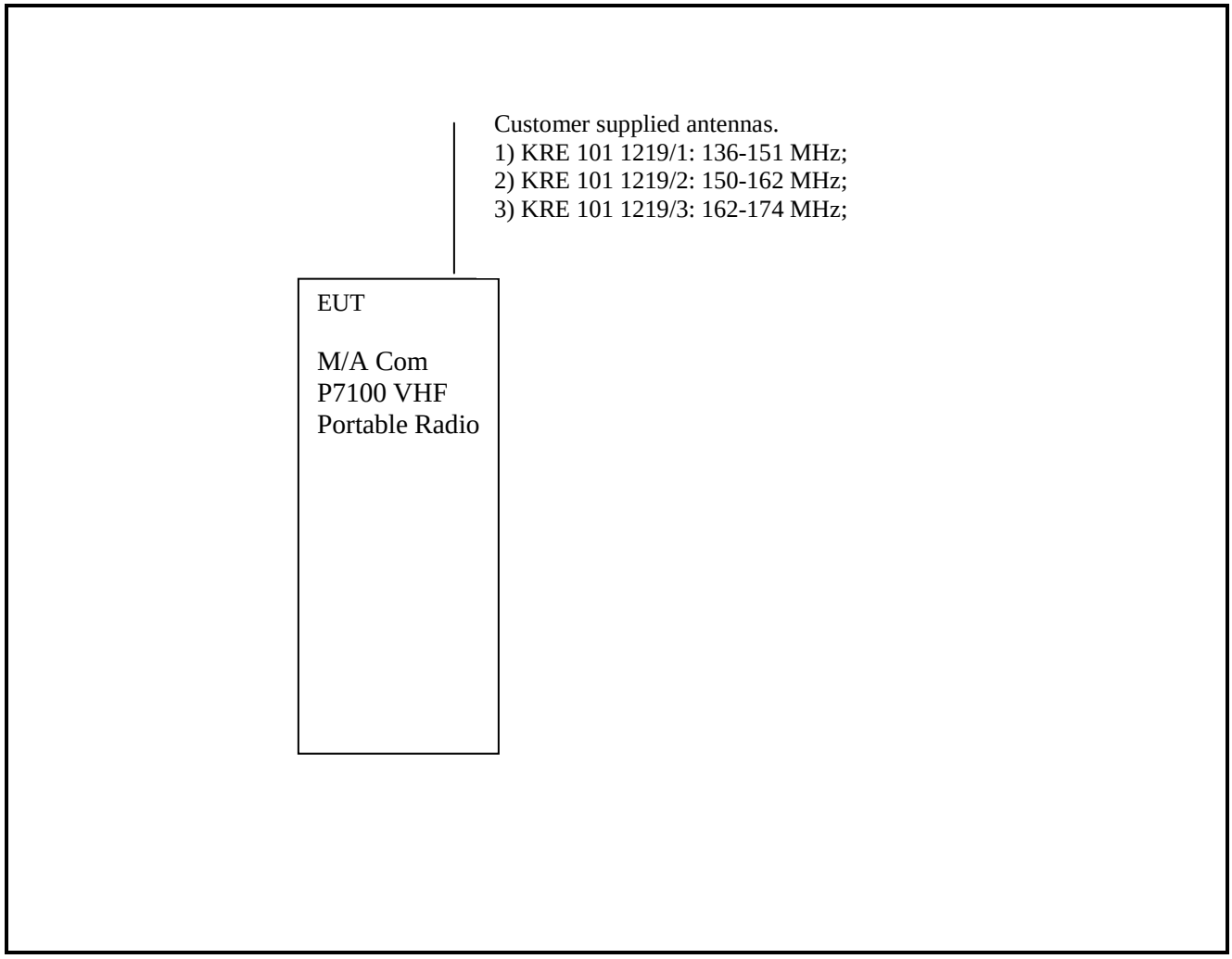
1.4 TESTED SYSTEM DETAILS

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	RTL Bar Code
VHF Portable Radio	M/A COM PRIVATE RADIO SYSTEMS, INC.	P7100	T1H-VFCC01	OWDTR-0013-E	14620
136-151 MHz Antenna	M/A COM PRIVATE RADIO SYSTEMS, INC	KRE 101 1219/1			14623
150-162 MHz Antenna	M/A COM PRIVATE RADIO SYSTEMS, INC	KRE 101 1219/2			14624
162-174 MHz Antenna	M/A COM PRIVATE RADIO SYSTEMS, INC	KRE 101 1219/3			14622
High Capacity NICAD Battery	M/A COM PRIVATE RADIO SYSTEMS, INC	BKB191210/3			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 RADIATED EMISSIONS

3.1 RADIATED MEASUREMENT

Before final measurements of radiated emissions were made on the open-field three meter range, the EUT was scanned indoors at a three meter distance in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three-meter, open-field test site. The EUT was placed on a nonconductive turntable at specified level.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

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

4.1 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.

4.2 TEST DATA

The following channels (in MHz) were tested: 136, 155, and 174

TABLE 4-1: RF POWER OUTPUT (HIGH POWER): CARRIER OUTPUT POWER (UNMODULATED)

Channel	Frequency (MHz)	RF Power measured (Watt)*
1	136	5.85
2	155	5.85
3	174	5.48

* Measurement accuracy: +/- .02 dB (logarithmic mode)

TABLE 4-2: RF POWER OUTPUT (RATED POWER)

Rated Power (W)
5.0

TABLE 4-3: TEST EQUIPMENT USED FOR TESTING (RF POWER OUTPUT - CONDUCTED)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900770	Hewlett Packard	437B	Power Meter	2949A02966	02/19/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03
900937	Hewlett Packard	8482H	Power Sensor	3318A08961	02/01/03
901184/901186	Agilent	E4416A/E9323A	Power Meter / Sensor	GB41050573/US40410380	07/19/03

TEST PERSONNEL:

DANIEL BIGGS — TEST TECHNICIAN/ENGINEER
SIGNATURE
AUGUST 13, 2002 — DATE OF TEST

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

5.1 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 1,000 Hz.

Digital Modulation: Modulated to its maximum extent using a pseudo random data sequence - 9600bps

5.2 TEST DATA

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

Limits: Mask D (dBm): P(dBm) – (50+10xLOG P(W))

The following channels (in MHz) were investigated: 136.0, 150.0, and 174.0. The worse case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

TABLE 5-1: CONDUCTED SPURIOUS EMISSIONS CHANNEL 1 – 136.0 MHZ

(136.0 MHz); 12.5 kHz channel spacing; Mask D; Conducted power = 5.8 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
272.000	91.78	57.67	-41.11
408.000	87.19	57.67	-36.52
544.000	93.70	57.67	-43.03
680.000	105.02	57.67	-54.35
816.000	120.04	57.67	-69.37
952.000	98.83	57.67	-48.16
1088.000	100.90	57.67	-50.23
1224.000	91.12	57.67	-40.45
1360.000	96.40	57.67	-45.73

TABLE 5-2: CONDUCTED SPURIOUS EMISSIONS CHANNEL 2 – 155.0 MHZ

(155.0 MHz); 12.5 kHz channel spacing; Mask D; Conducted power = 5.8 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
310.000	101.85	57.67	-51.18
465.000	98.02	57.67	-47.35
620.000	93.60	57.67	-42.93
775.000	107.73	57.67	-57.06
930.000	102.52	57.67	-51.85
1085.000	100.88	57.67	-50.21
1240.000	91.78	57.67	-41.11
1395.000	97.68	57.67	-47.01
1550.000	105.21	57.67	-54.54

TABLE 5-3: CONDUCTED SPURIOUS EMISSIONS CHANNEL 3 – 174.0 MHZ

(174.0 MHz); 12.5 kHz channel spacing; Mask D; Conducted power = 5.5 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
348.000	98.5	57.67	-47.87
522.000	89.5	57.67	-38.78
696.000	99.0	57.67	-48.35
870.000	111.8	57.67	-61.14
1044.000	94.9	57.67	-44.18
1218.000	84.2	57.67	-33.52
1392.000	93.5	57.67	-42.80
1566.000	104.5	57.67	-53.80
1740.000	105.2	57.67	-54.52

TABLE 5-4: TEST EQUIPMENT USED FOR TESTING (CONDUCTED SPURIOUS EMISSIONS)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	07/02/03
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	07/31/03
901054	Hewlett Packard	HP 3586B	Selective Level Meter	1928A01892	08/31/03
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 kHz – 6.5 GHz)	3325A00159	12/05/02

TEST PERSONNEL:

DANIEL BALTZELL — TEST ENGINEER | SIGNATURE | AUGUST 13, 2002 — DATE OF TEST

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

6.1 TEST PROCEDURE

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

Analog Modulation: 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 1,000 Hz.

Digital Modulation: Modulated to its maximum extent using a pseudo random data sequence - 9600bps.

The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator and the gain of the antenna was further corrected to a half wave dipole.

6.2 TEST DATA

6.2.1 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 6-1: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 2 – 155.0 MHZ; NARROW BAND

Radiated Spurious Emissions
Mid Band Channel 2 (155 MHz, Narrowband)
Limit = 50 + 10 Log P = 57.68 dBc
Conducted Power = 37.68 dBm = 5.86 W

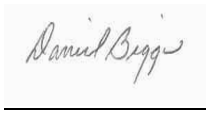
Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
310.0	61.8	-63.1	0.2	-0.6	101.5	-43.8
465.0	55.2	-63.6	0.3	-0.6	102.1	-44.5
620.0	38.8	-78.6	0.3	-1.2	117.7	-60.1
775.0	35.3	-81.9	0.4	-1.3	121.2	-63.6
930.0	31.2	-82.3	0.4	-1.2	121.6	-63.9
1085.0	27.3	-80.0	0.4	0.7	117.4	-59.7
1240.0	28.1	-75.3	0.4	2.2	111.2	-53.6
1395.0	33.4	-70.4	0.5	3.6	104.9	-47.3
1550.0	38.7	-63.3	0.5	4.7	96.8	-39.1

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

TABLE 6-2: TEST EQUIPMENT USED FOR TESTING (FIELD STRENGTH OF SPURIOUS RADIATION)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900791	Schaffner & Chase	CBL6112	Antenna (25 MHz – 2 GHz)	2099	08/23/03
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5 GHz)	3008A00505	N/A
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	07/02/03
900917	Hewlett Packard	8648C	Synthesized. Signal Generator (9 kHz to 3200 MHz)	3537A01741	04/19/03
900928	Hewlett Packard	83752A	Synthesized Sweeper, 0.01 to 20 GHz	3610A00866	06/19/03

TEST PERSONNEL:



DANIEL BIGGS
TEST ENGINEER

SIGNATURE

AUGUST 30, 2002
DATE OF TEST

7 FCC RULES AND REGULATIONS PART 2 §2.1049 (C) (1): OCCUPIED BANDWIDTH

OCCUPIED BANDWIDTH - COMPLIANCE WITH THE EMISSION MASKS

7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.11 and TIA/EIA-102.CAAA-1999 section 2.2.5

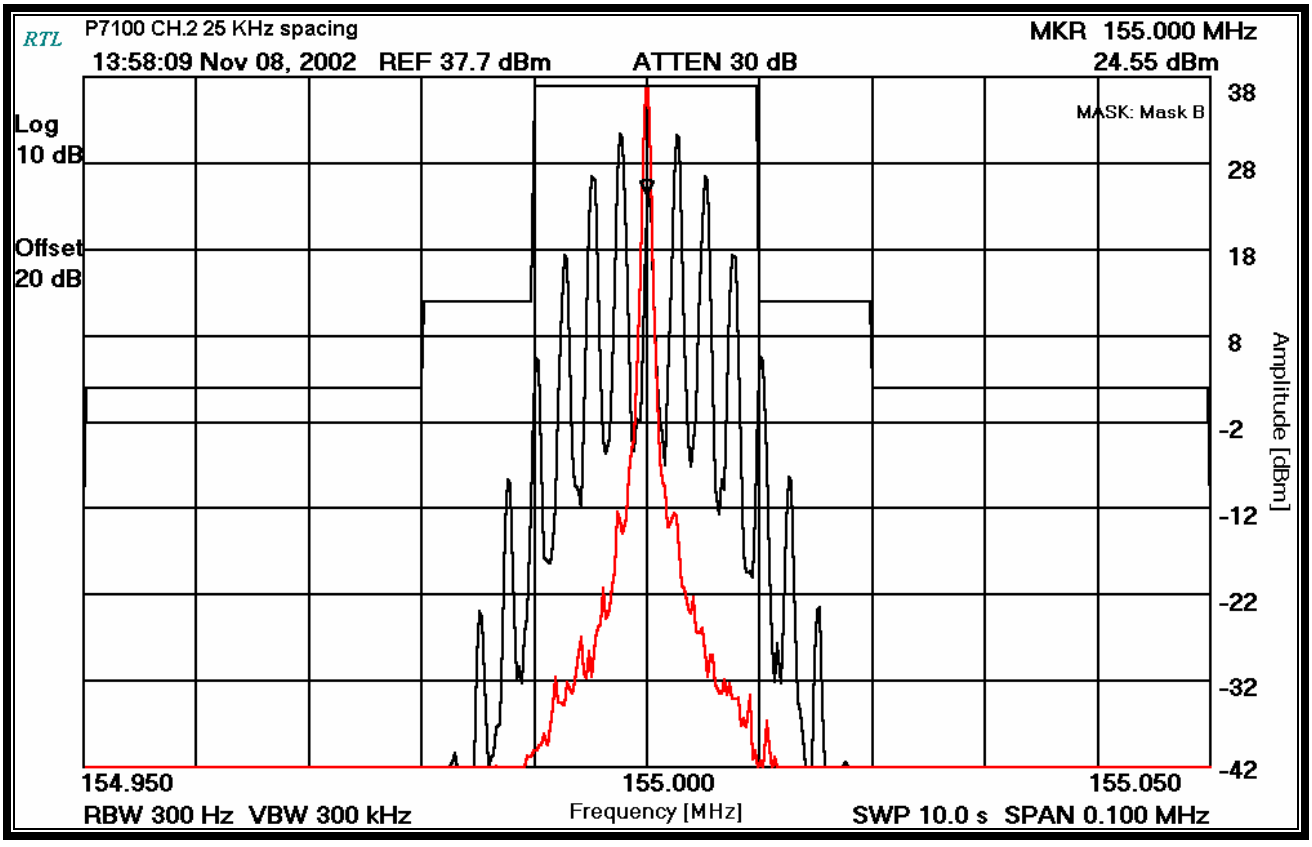
Device with audio modulation: Transmitter is modulated with a 2,500 Hz sine wave at an input level of 16 dB greater than that required to produce 50% of rated system deviation at 1,000 Hz.

Device with digital modulation: Modulated to its maximum extent using a pseudo random data sequence - 9600bps

7.2 TEST DATA

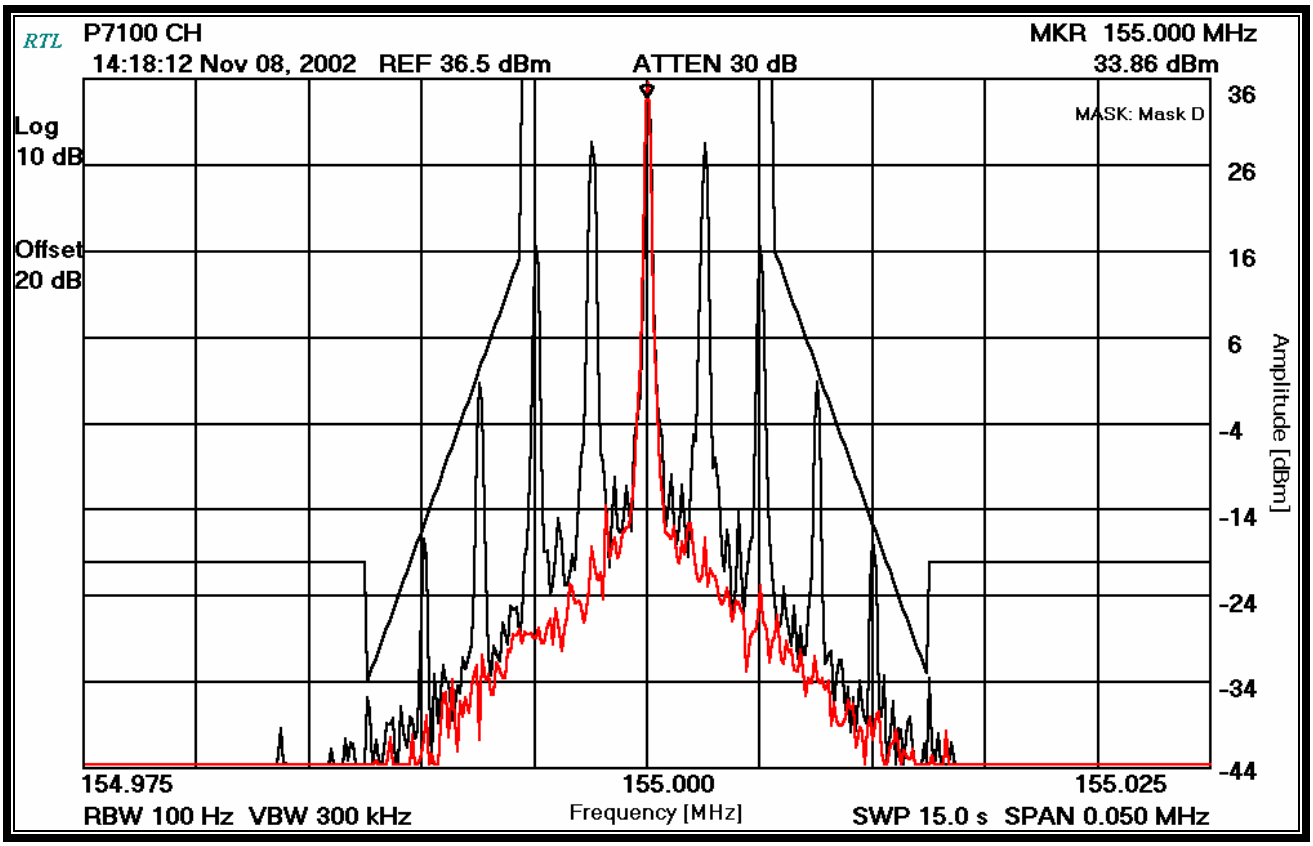
PLOT 7-1: OCCUPIED BANDWIDTH; WIDE BAND; AUDIO MODULATION: 2,500 HZ

MKR 155 MHz

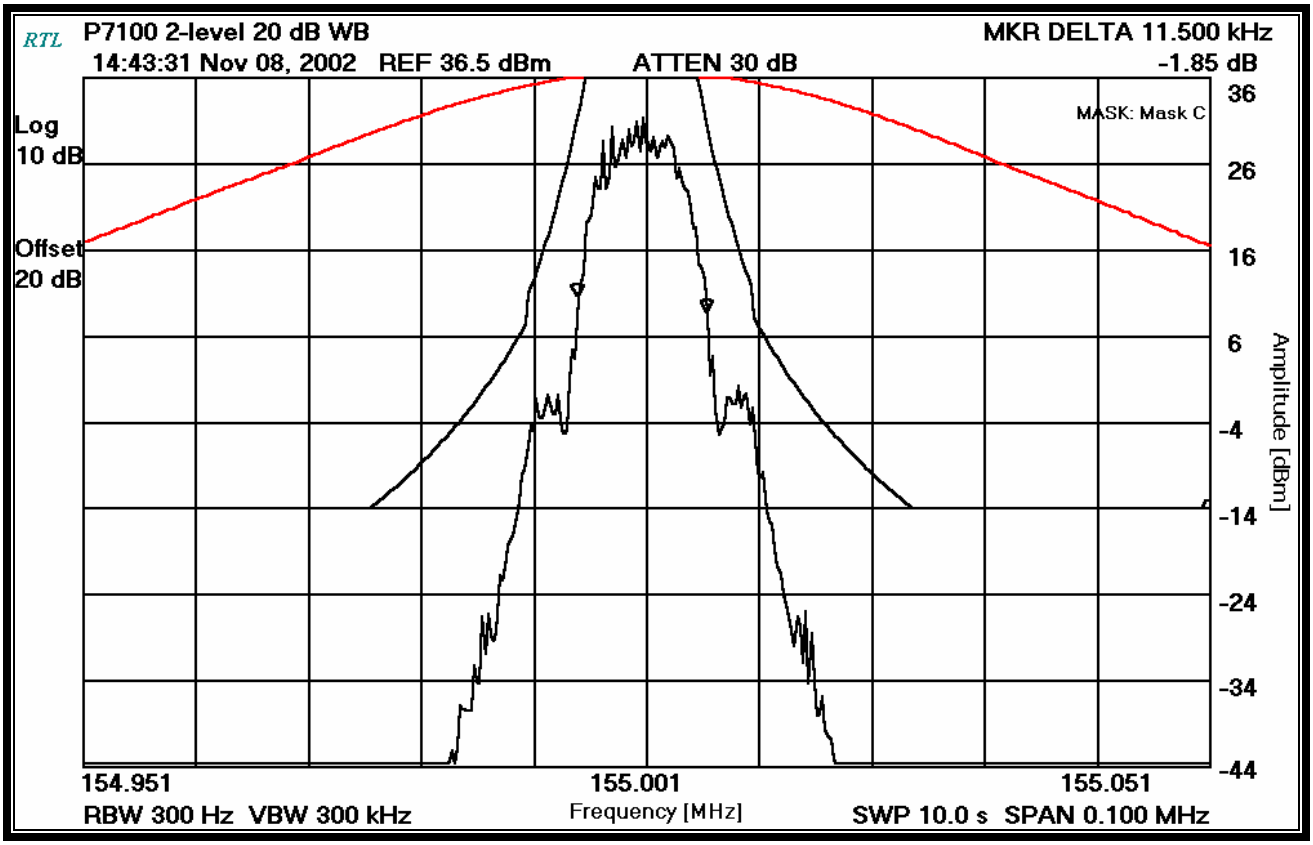


PLOT 7-2: OCCUPIED BANDWIDTH; NARROW BAND; AUDIO MODULATION: 2500 HZ

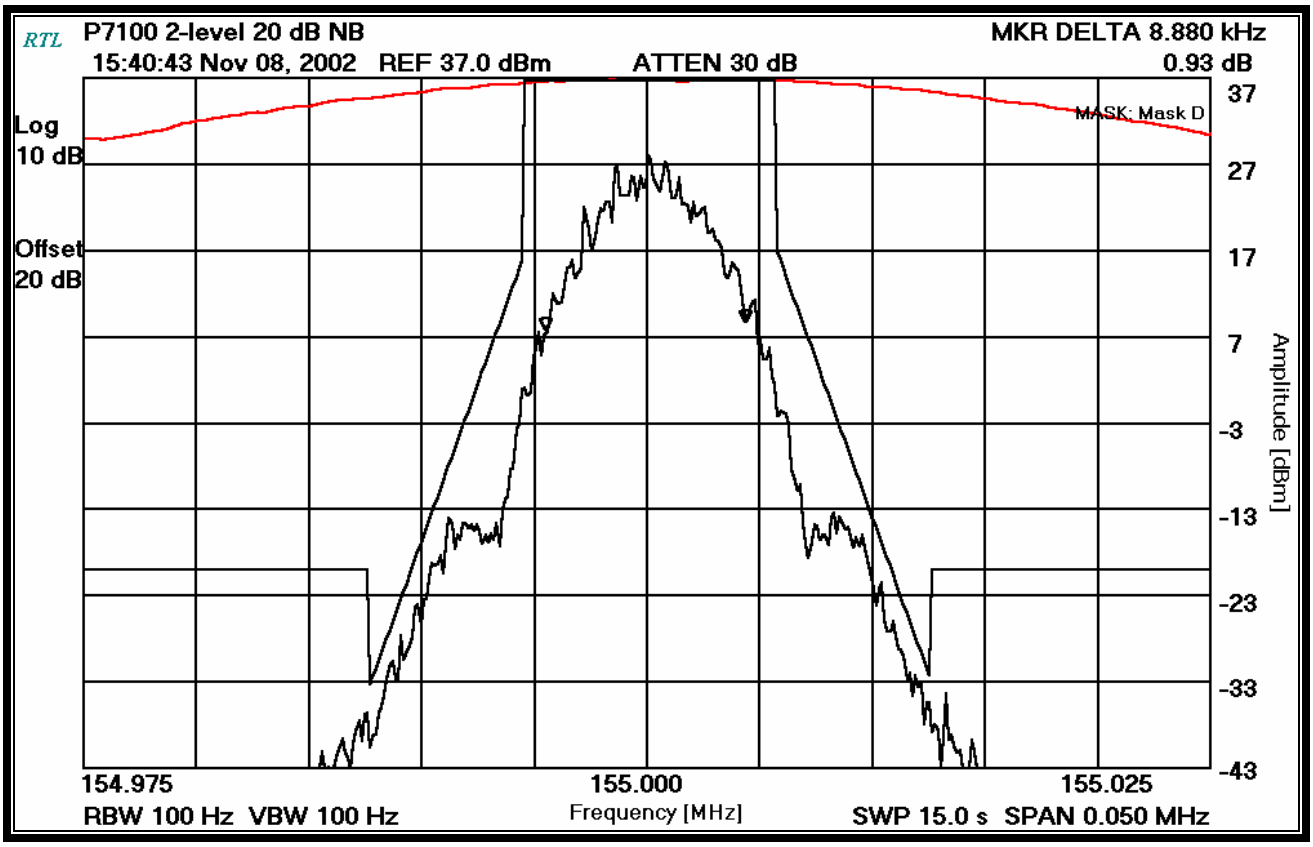
MKR 155 MHz



PLOT 7-3: OCCUPIED BANDWIDTH; 20 DB BW; WIDE BAND; 2 LEVEL DIGITAL MODULATION



PLOT 7-4: OCCUPIED BANDWIDTH; 20 DB BW; NARROW BAND; 2 LEVEL DIGITAL MODULATION



PLOT 7-5: OCCUPIED BANDWIDTH; NARROW BAND; 20 DB BANDWIDTH; C4FM DIGITAL MODULATION

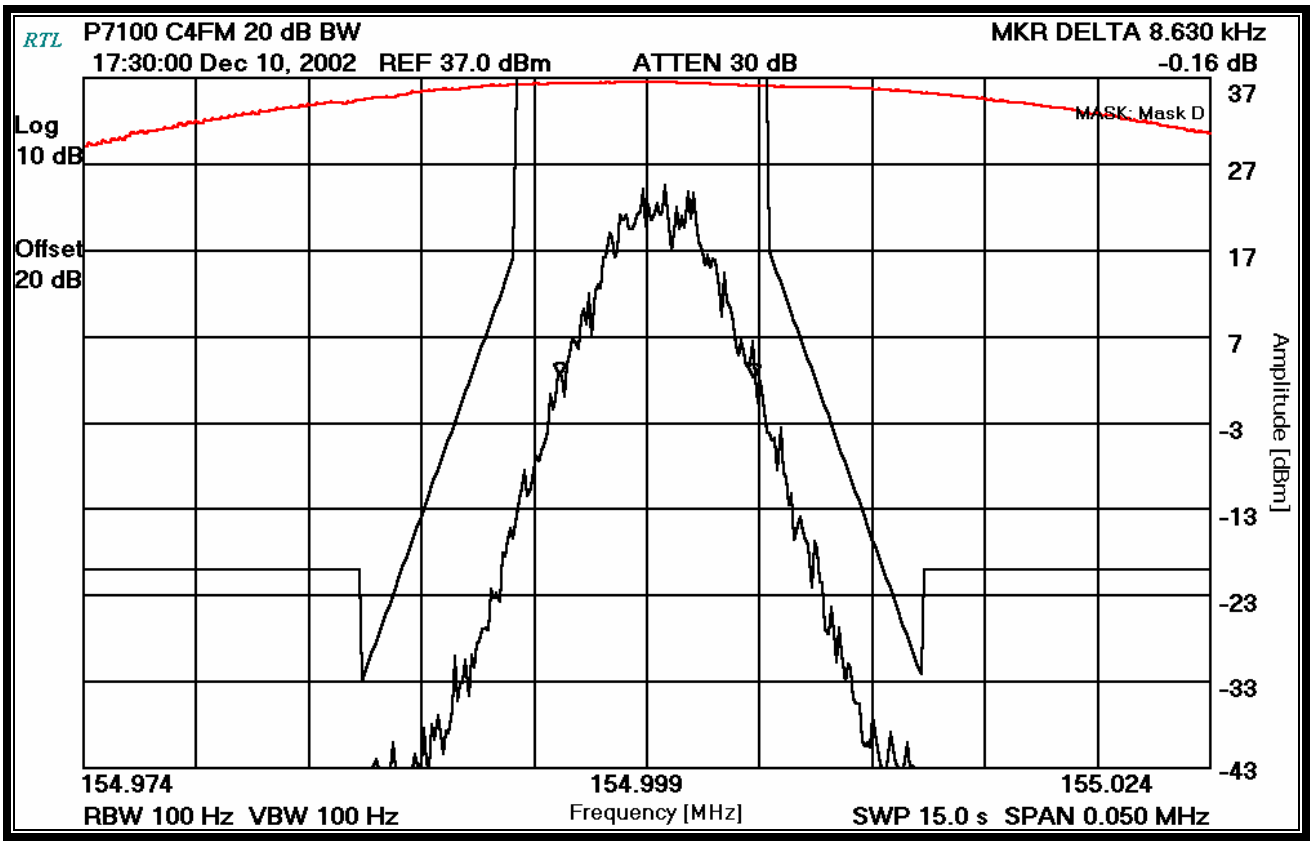


TABLE 7-1: TEST EQUIPMENT USED FOR TESTING (OCCUPIED BANDWIDTH)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900913	Hewlett Packard	8546	EMI Receiver	3325A00159	12/05/02
900914	Hewlett Packard	85460	RF Filter Section	3330A00107	12/05/02

TEST PERSONNEL:

DANIEL BIGGS
TEST TECHNICIAN/ENGINEER

SIGNATURE

NOVEMBER 8, 2002
DATE OF TEST

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

8.1 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 +60°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 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 the battery end point to maximum voltage.

The worst-case test data are shown.

8.2 TEST DATA

8.2.1 FREQUENCY STABILITY/TEMPERATURE VARIATION

Limit is 1.5 ppm for portable device with a 12.5 kHz channel bandwidth. Worst-case deviation was found to be- .39 ppm at 50°C and 60°C.

PLOT 8-1: TEMPERATURE FREQUENCY STABILITY

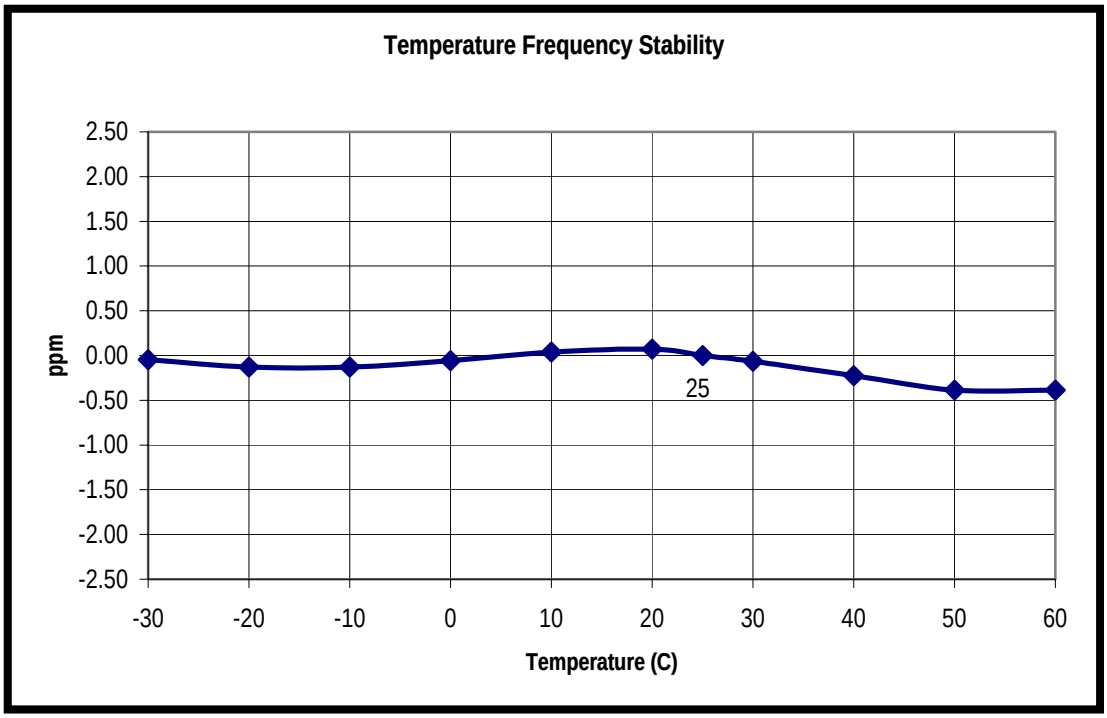


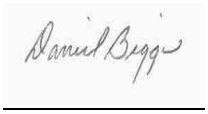
TABLE 8-1: TEMPERATURE FREQUENCY STABILITY CHANNEL 2, 155.0 MHZ

Temperature	Measured Frequency (MHz)	ppm
-30	155.000063	-0.05
-20	155.000050	-0.13
-10	155.000050	-0.13
0	155.000061	-0.06
10	155.000076	0.04
20	155.000081	0.07
25	155.000070	0.00
30	155.000060	-0.06
40	155.000035	-0.23
50	155.000010	-0.39
60	155.000010	-0.39

TABLE 8-2: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/TEMPERATURE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	11/16/02
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03

TEST PERSONNEL:



DANIEL BIGGS — TEST TECHNICIAN/ENGINEER

SIGNATURE

NOVEMBER 15, 2002 — DATE OF TEST

8.2.2 FREQUENCY STABILITY/VOLTAGE VARIATION

The battery endpoint was measured at 6.30 VDC. The worse case variation is -0.06 ppm at the 9.0 VDC.

PLOT 8-2: VOLTAGE FREQUENCY STABILITY

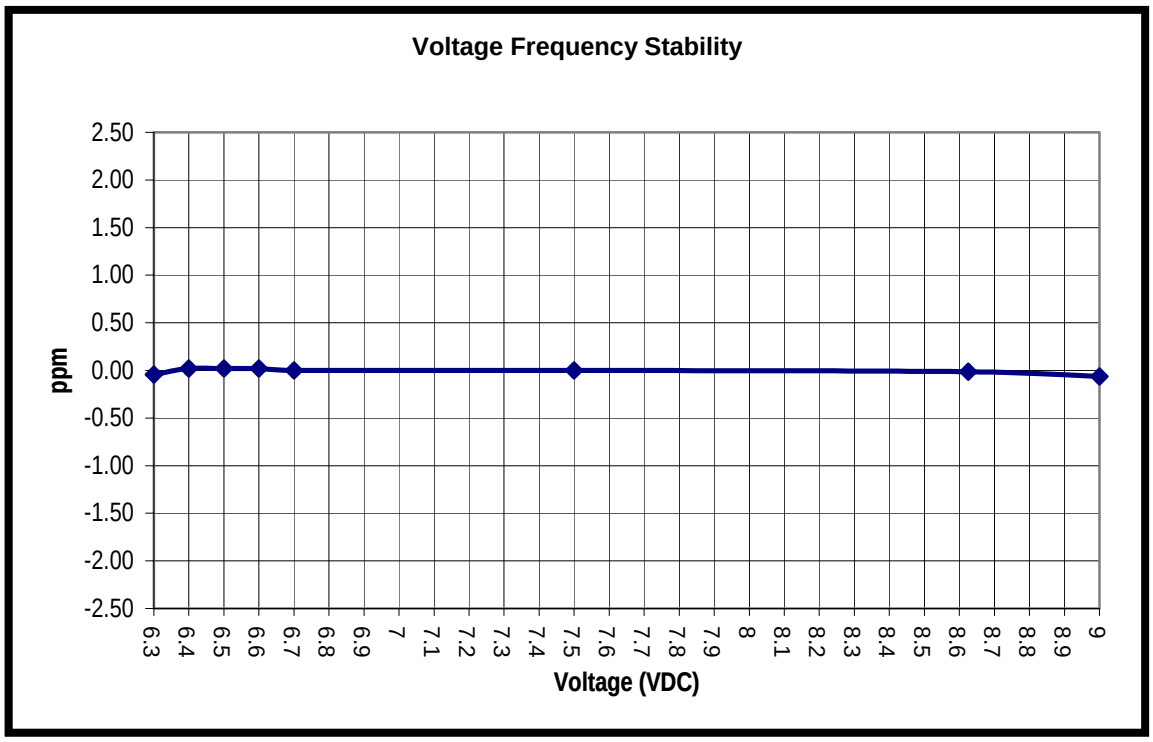


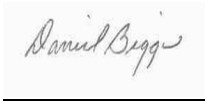
TABLE 8-3: FREQUENCY STABILITY/VOLTAGE VARIATION
Channel 2; NB; 155.0 MHz was measured and found to be as follows:

Voltage (Vdc)	Measured Frequency (MHz)	ppm
6.3	154.999973	-0.05
6.4	154.999983	0.02
6.5	154.999983	0.02
6.6	154.999983	0.02
6.7	154.999980	0.00
7.5	154.999980	0.00
8.625	154.999978	-0.01
9	154.999970	-0.06

TABLE 8-4: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/VOLTAGE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	11/16/02
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03

TEST PERSONNEL:



DANIEL BIGGS — TEST TECHNICIAN/ENGINEER

SIGNATURE

NOVEMBER 15, 2002 — DATE OF TEST

9 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE

9.1 TEST PROCEDURE

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

The audio 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 100 Hz to 5 kHz 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)

9.2 TEST DATA

PLOT 9-1: MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE {12.5 KHZ CHANNEL BANDWIDTH}

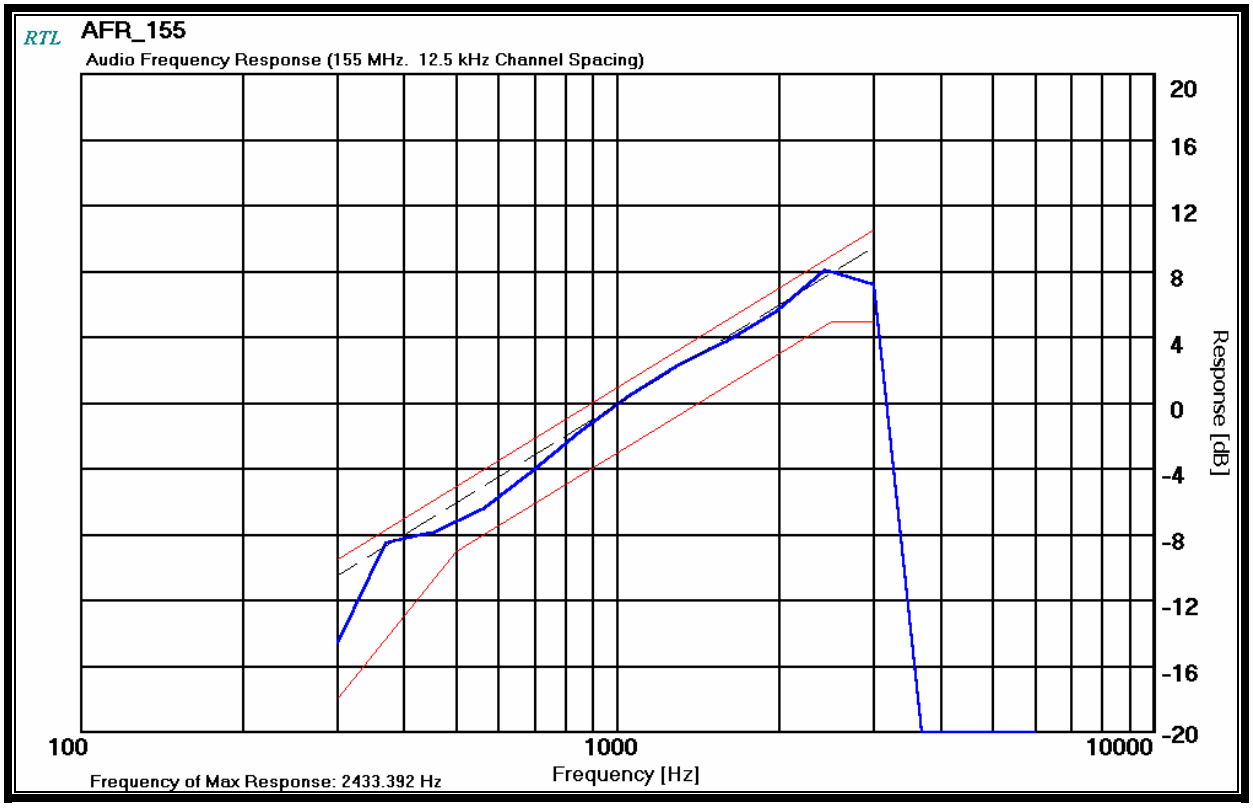
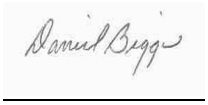


TABLE 9-1: TEST EQUIPMENT USED FOR TESTING (AUDIO FREQUENCY RESPONSE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	07/31/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03
901054	Hewlett Packard	3586B	Selective Level Meter	1928A01892	08/31/03

TEST PERSONNEL:



DANIEL BIGGS — TEST TECHNICIAN/ENGINEER
SIGNATURE
AUGUST 7, 2002 — DATE OF TEST

10 FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER

10.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, 2.2.15

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

10.2 TEST DATA

PLOT 10-1: MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER

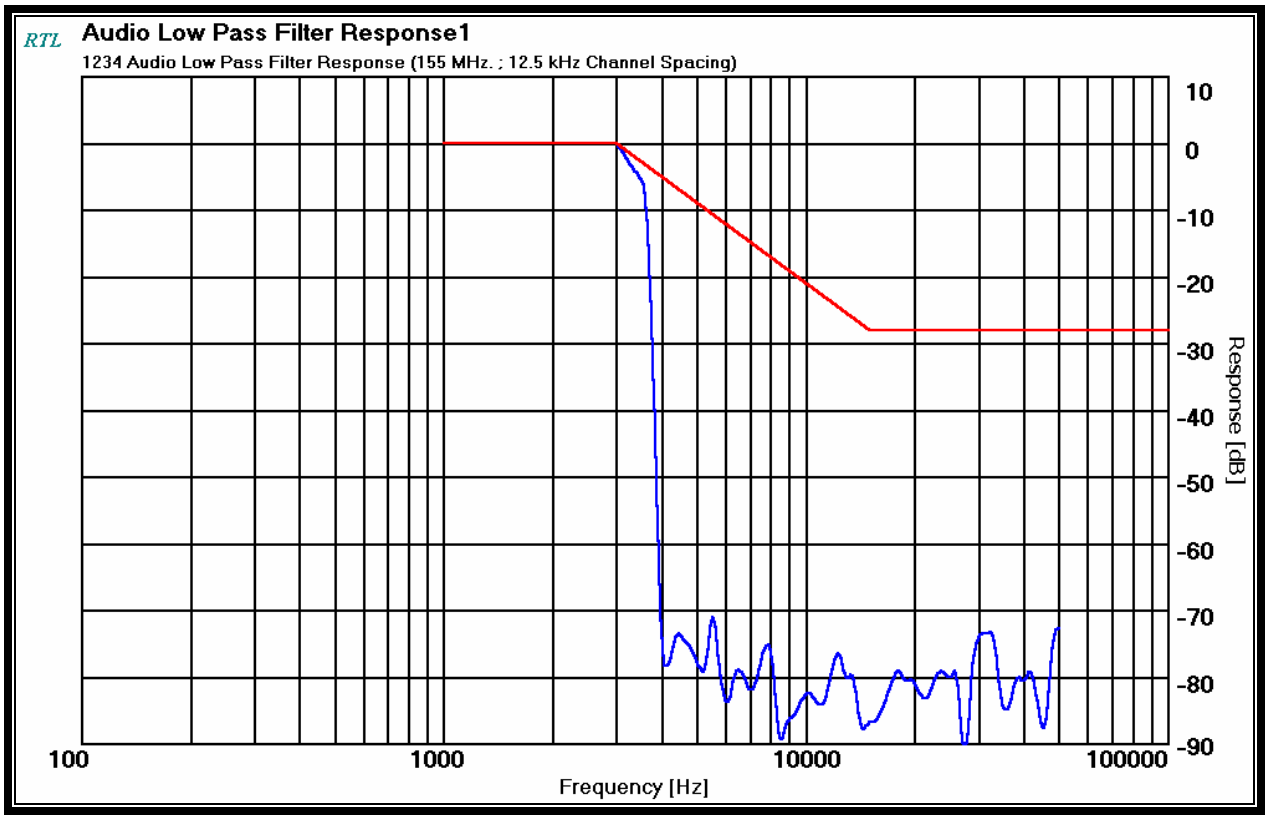
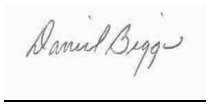


TABLE 10-1: TEST EQUIPMENT USED FOR TESTING (AUDIO LOW PASS FILTER RESPONSE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	07/31/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03
901054	Hewlett Packard	3586B	Selective Level Meter	1928A01892	08/31/03

TEST PERSONNEL:



DANIEL BIGGS — TEST TECHNICIAN/ENGINEER

SIGNATURE

AUGUST 21, 2002 — DATE OF TEST

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

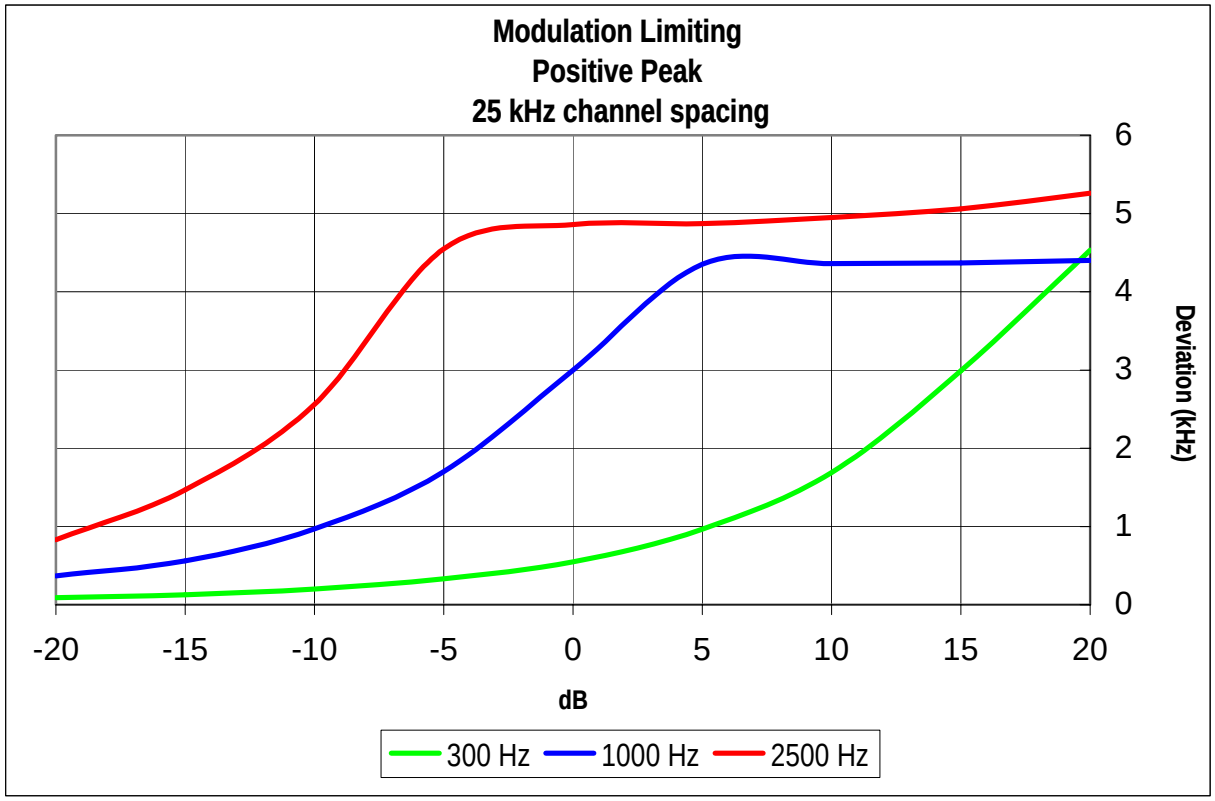
11.1 TEST PROCEDURE

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

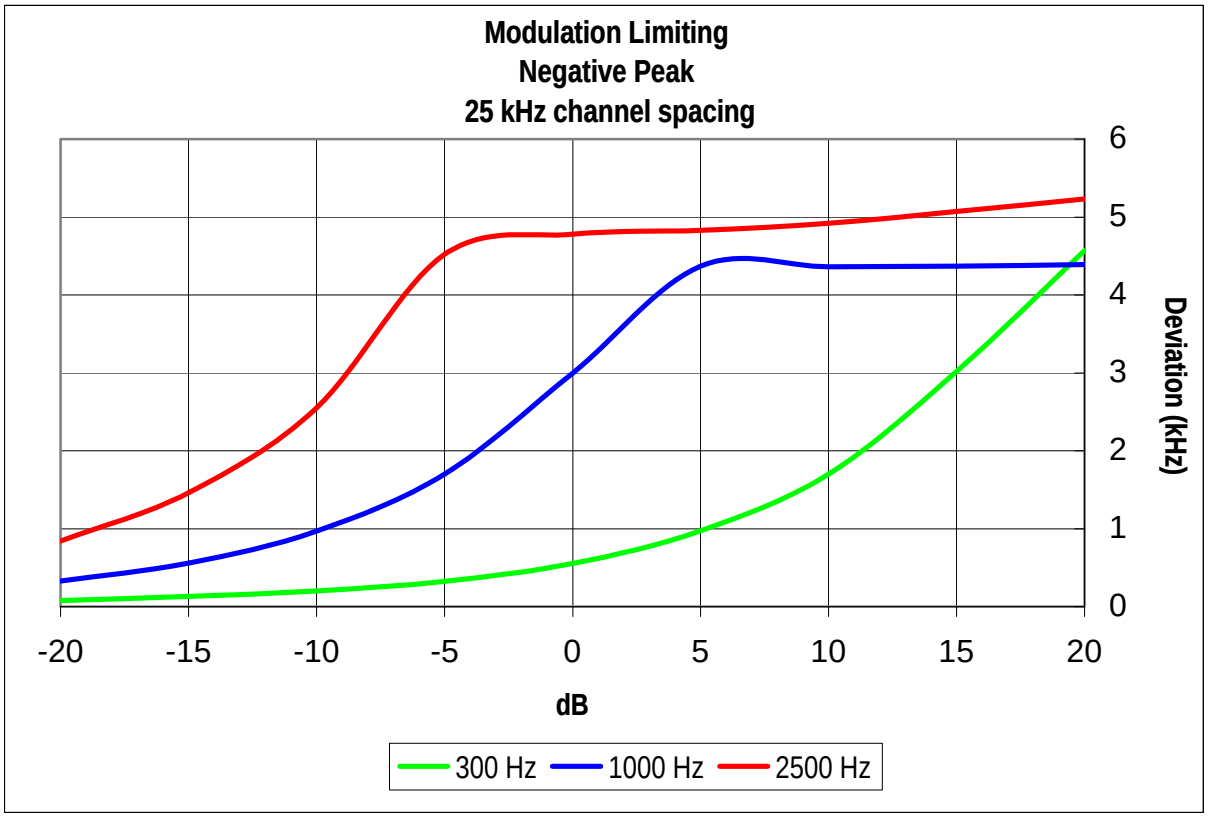
The transmitter is adjusted for full rated system deviation. The audio input level is adjusted for 60% of rated system deviation at 1000 Hz. Using this level as a reference (0dB) the audio input level is varied from the reference to a level +20 dB above it and –20 dB under it, for modulation frequencies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

11.2 TEST DATA

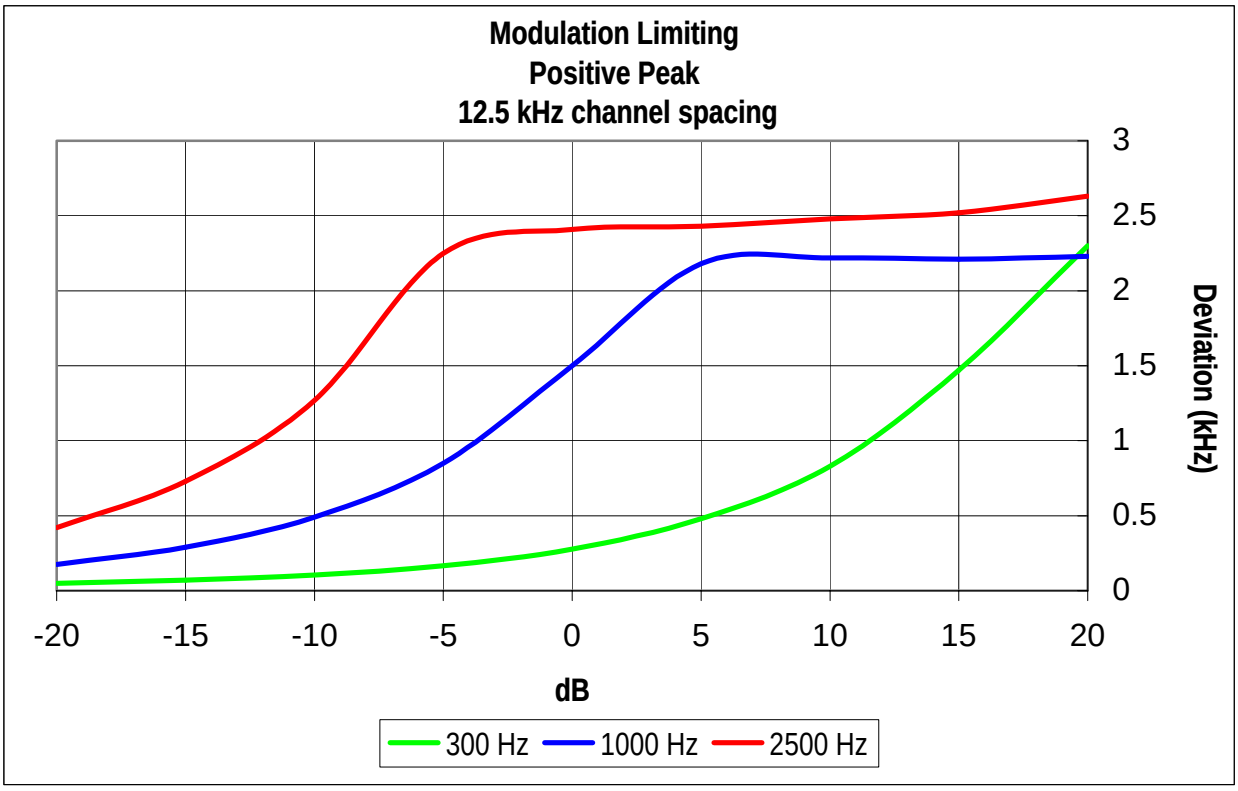
PLOT 11-1: MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND; POSITIVE PEAK



PLOT 11-2: MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND; NEGATIVE PEAK



PLOT 11-3: MODULATION CHARACTERISTICS – MODULATION LIMITING: NARROW BAND; POSITIVE PEAK



PLOT 11-4: MODULATION CHARACTERISTICS – MODULATION LIMITING: NARROW BAND; NEGATIVE PEAK

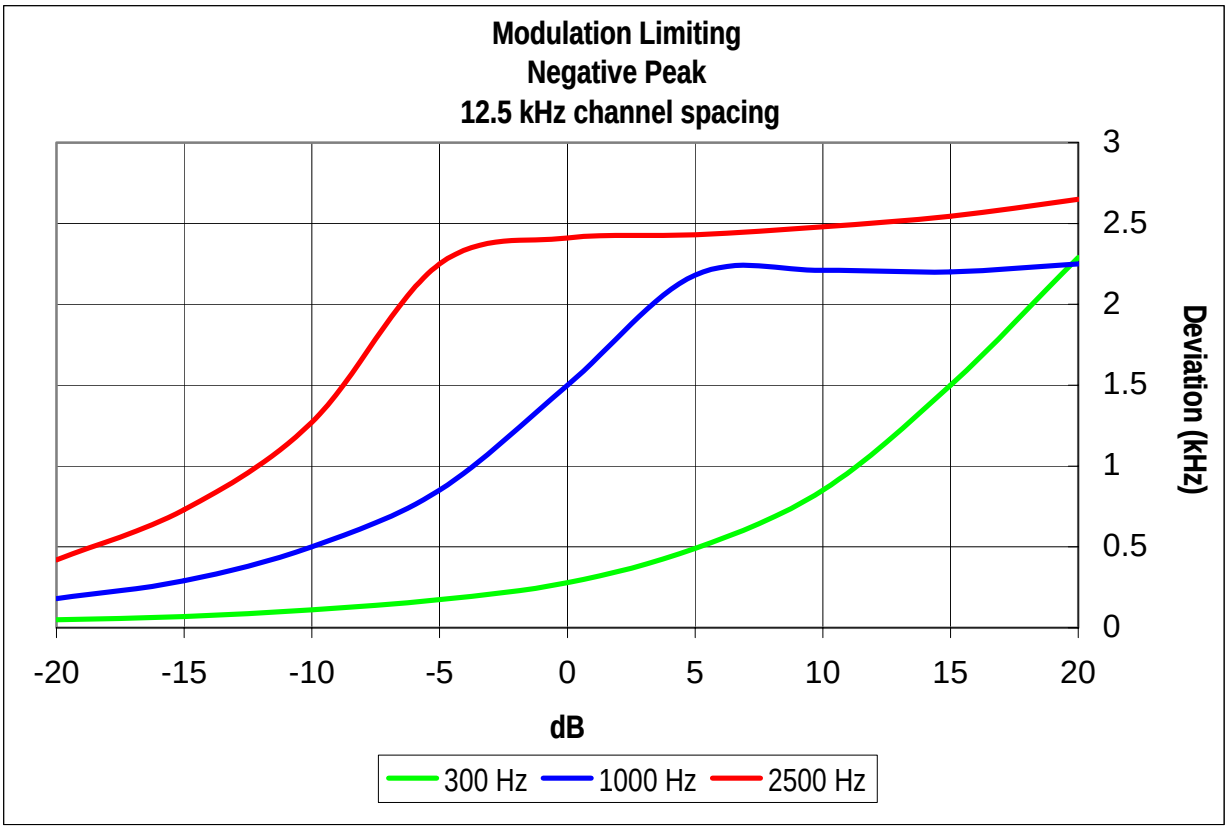


TABLE 11-1: TEST EQUIPMENT USED FOR TESTING (MODULATION LIMITING)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901057	Hewlett Packard	3336B	Synthesizer/Level Generator	2514A02585	07/31/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03
901054	Hewlett Packard	3586B	Selective Level Meter	1928A01892	08/31/03

TEST PERSONNEL:

DANIEL BIGGS — TEST TECHNICIAN/ENGINEER

SIGNATURE

NOVEMBER 15, 2002 — DATE OF TEST

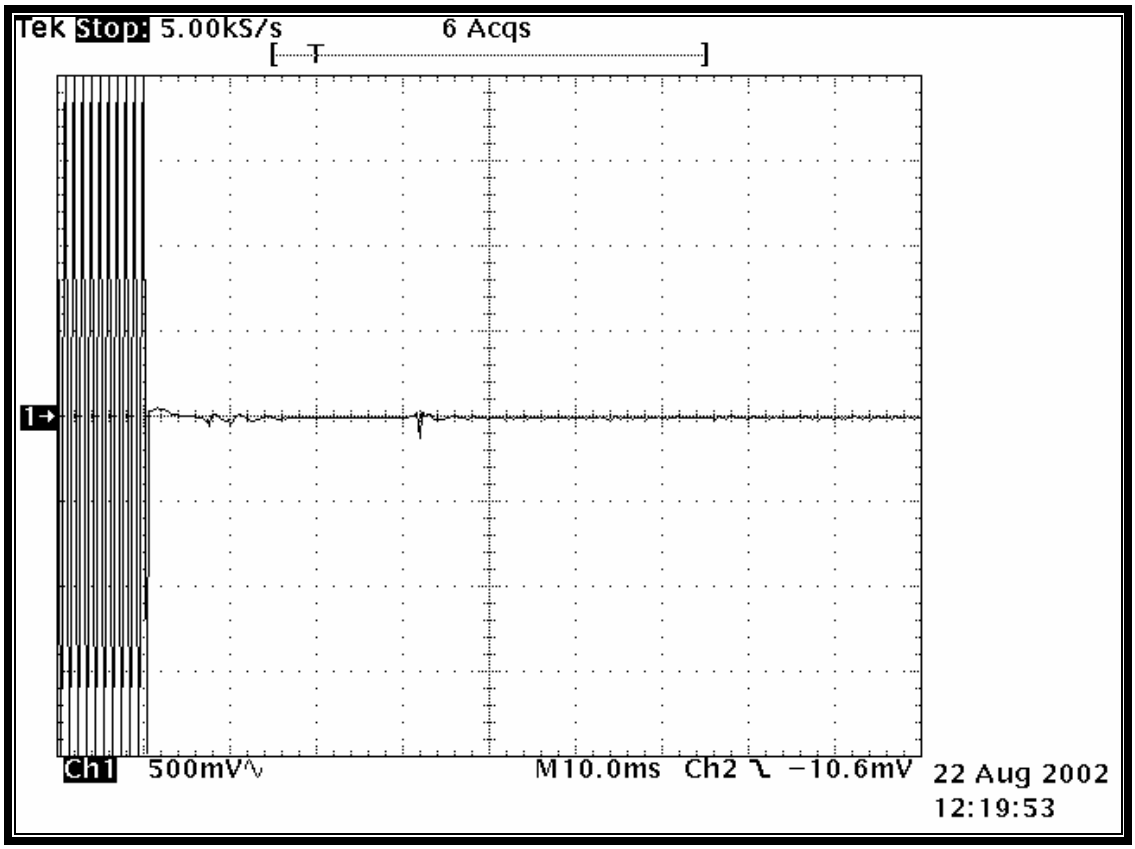
12 FCC RULES AND REGULATIONS PART 90 §90.214: TRANSIENT FREQUENCY BEHAVIOR

12.1 TEST PROCEDURE

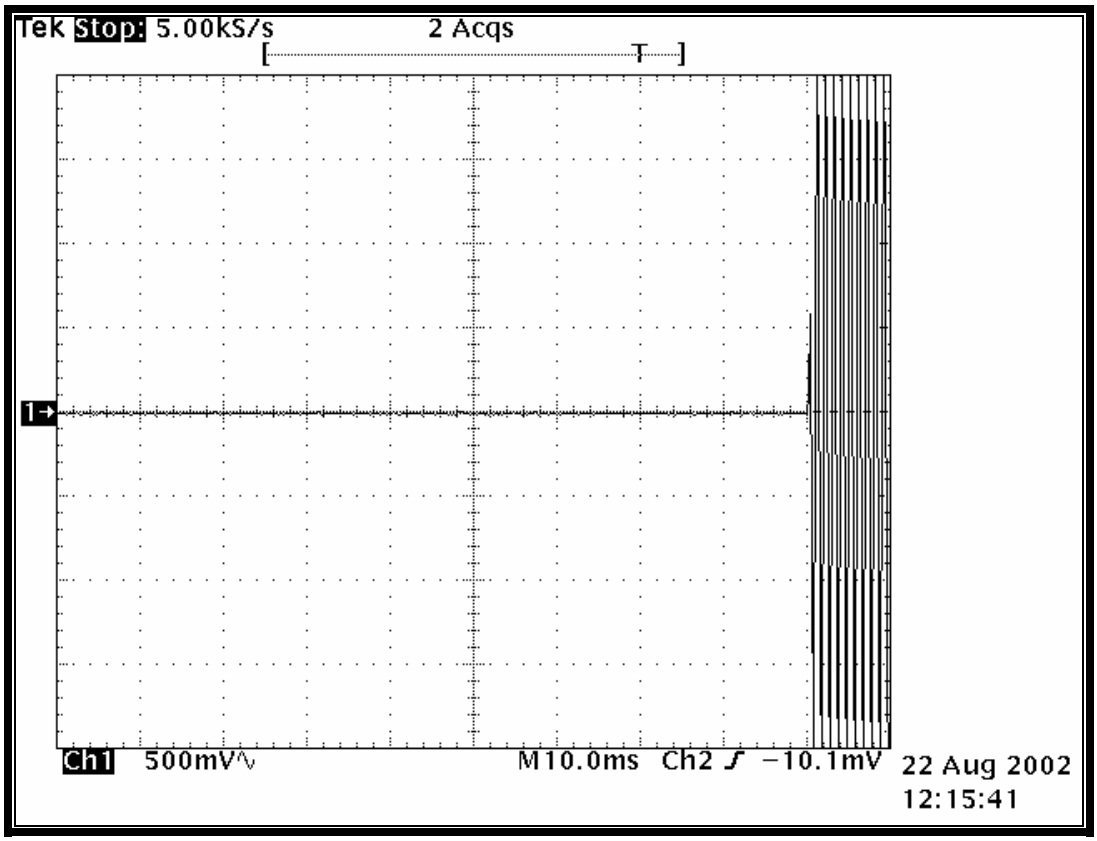
ANSI/TIA/EIA-603-1992, section 2.2.3

12.2 TEST DATA

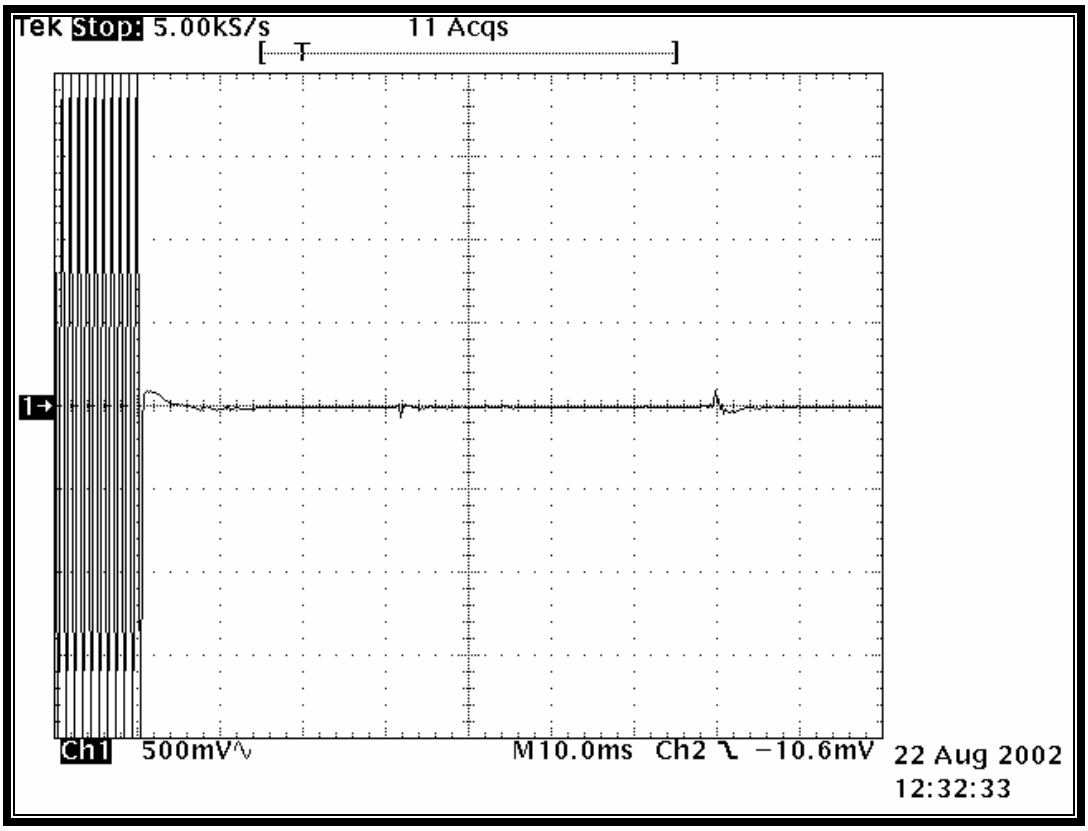
PLOT 12-1: TRANSIENT FREQUENCY BEHAVIOR – 155 MHZ; HIGH POWER; WIDE BAND; CARRIER ON TIME



PLOT 12-2: TRANSIENT FREQUENCY BEHAVIOR – 155 MHZ; HIGH POWER; WIDE BAND; CARRIER OFF TIME



PLOT 12-3: TRANSIENT FREQUENCY BEHAVIOR – 155 MHZ; HIGH POWER; NARROW BAND; CARRIER ON TIME



PLOT 12-4: TRANSIENT FREQUENCY BEHAVIOR – 155 MHZ; HIGH POWER; NARROW BAND; CARRIER OFF TIME

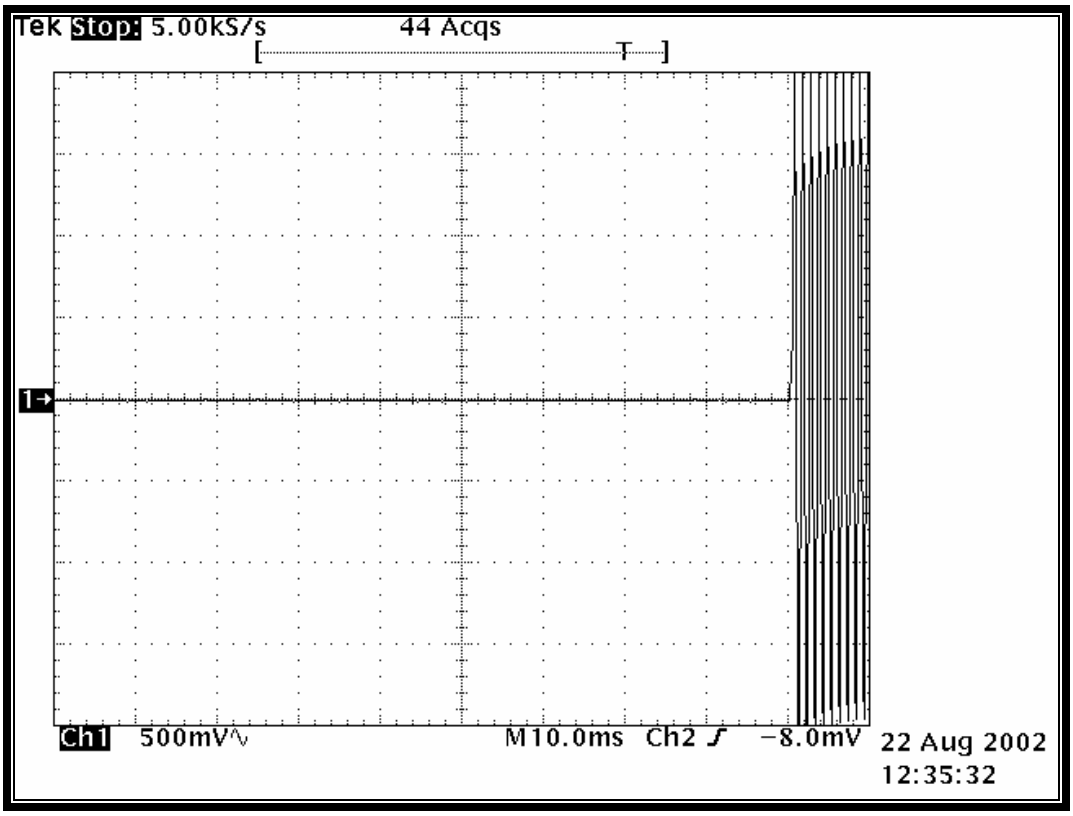


TABLE 12-1: TEST EQUIPMENT USED FOR TESTING (TRANSIENT FREQUENCY BEHAVIOR)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900917	Hewlett Packard	8648C	Signal Generator	3537A01741	04/19/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03
900561	Tektronix	TDS540B	Oscilloscope	B020129	4/19/03
900352	Werlatone	C1795	Directional Coupler	4989	N/A

TEST PERSONNEL:

DANIEL BIGGS — TEST TECHNICIAN/ENGINEER

SIGNATURE

OCTOBER 21, 2002 — DATE OF TEST

13 FCC RULES AND REGULATIONS PART 2 §2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F3E, F1D, F1E

Necessary Bandwidth and Emission Bandwidth:

Voice – 25 kHz channel separation
Calculation:
Max modulation(M) in kHz: 3.0
Max deviation (D) in kHz: 5
Constant factor (K): 1 (assumed)
Bn = 2xM+2xDK = 16.0 kHz
Emission designator: 16K0F3E

Voice – 12.5 kHz channel separation
Calculation:
Max modulation(M) in kHz: 3.0
Max deviation (D) in kHz: 2.5
Constant factor (K): 1 (assumed)
Bn = 2xM+2xDK = 11.0 kHz
Emission designator: 11K0F3E

Digital voice and data – 25 kHz separation

Calculation:
Max modulation(B) in kHz: 9.6
Max deviation (D) in kHz: 3.0
Constant factor (K): 1(assumed)
Bn = B+2xDK = 15.6 kHz
Emission designator: 15K6F1D, 15K6F1E

Measurement: 99.75% Occupied Bandwidth
Bn = 11.8 kHz
Emission designator: 11K8F1D, 11K8F1E

Digital voice and data – 12.5 kHz separation

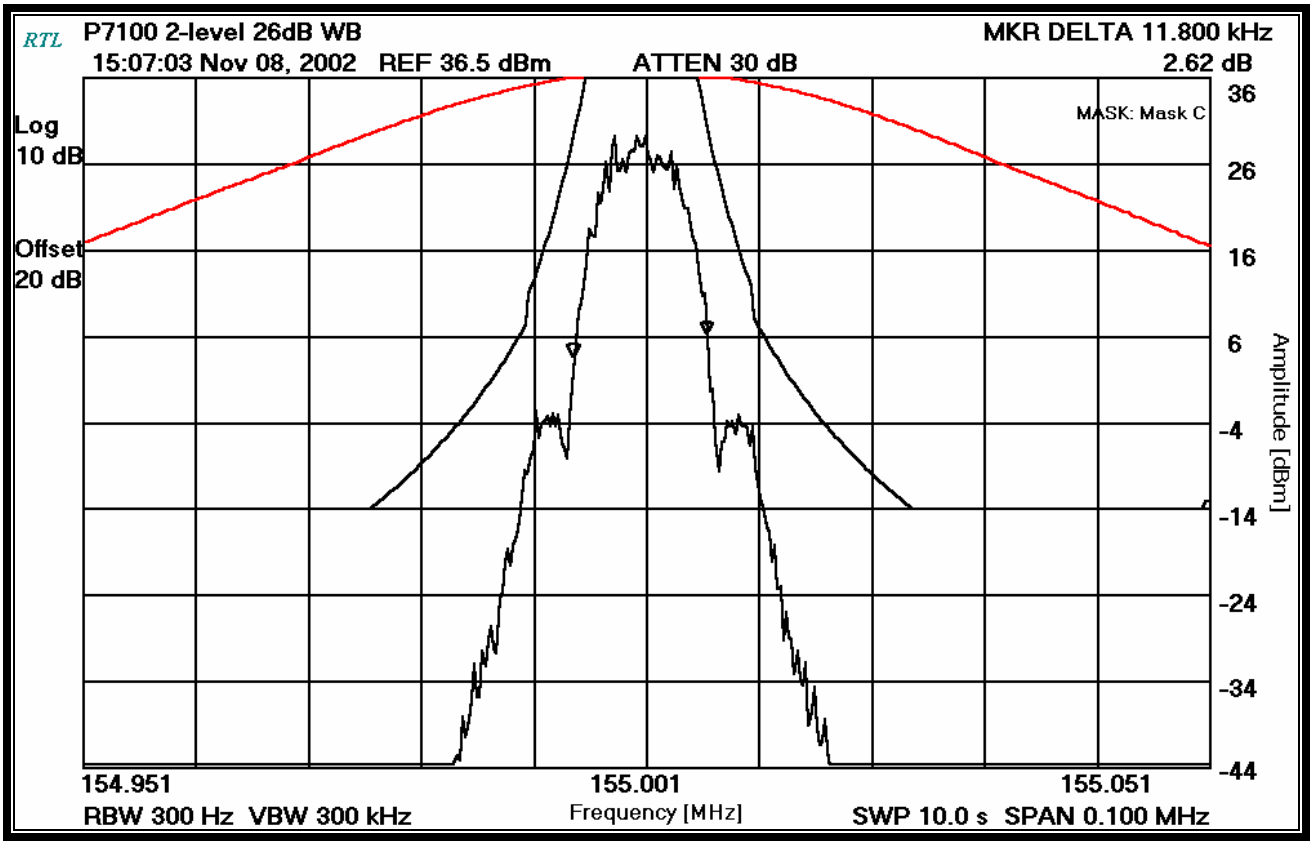
Calculation:
Max modulation(B) in kHz: 4.8
Max deviation (D) in kHz: 1.5
Constant factor (K): 1(assumed)
Bn = B+2xDK = 7.8 kHz
Emission designator: 7K8F1D, 7K8F1E

Measurement: 99.75% Occupied Bandwidth
Bn = 10.75 kHz
Emission designator: 10K8F1D, 10K8F1E

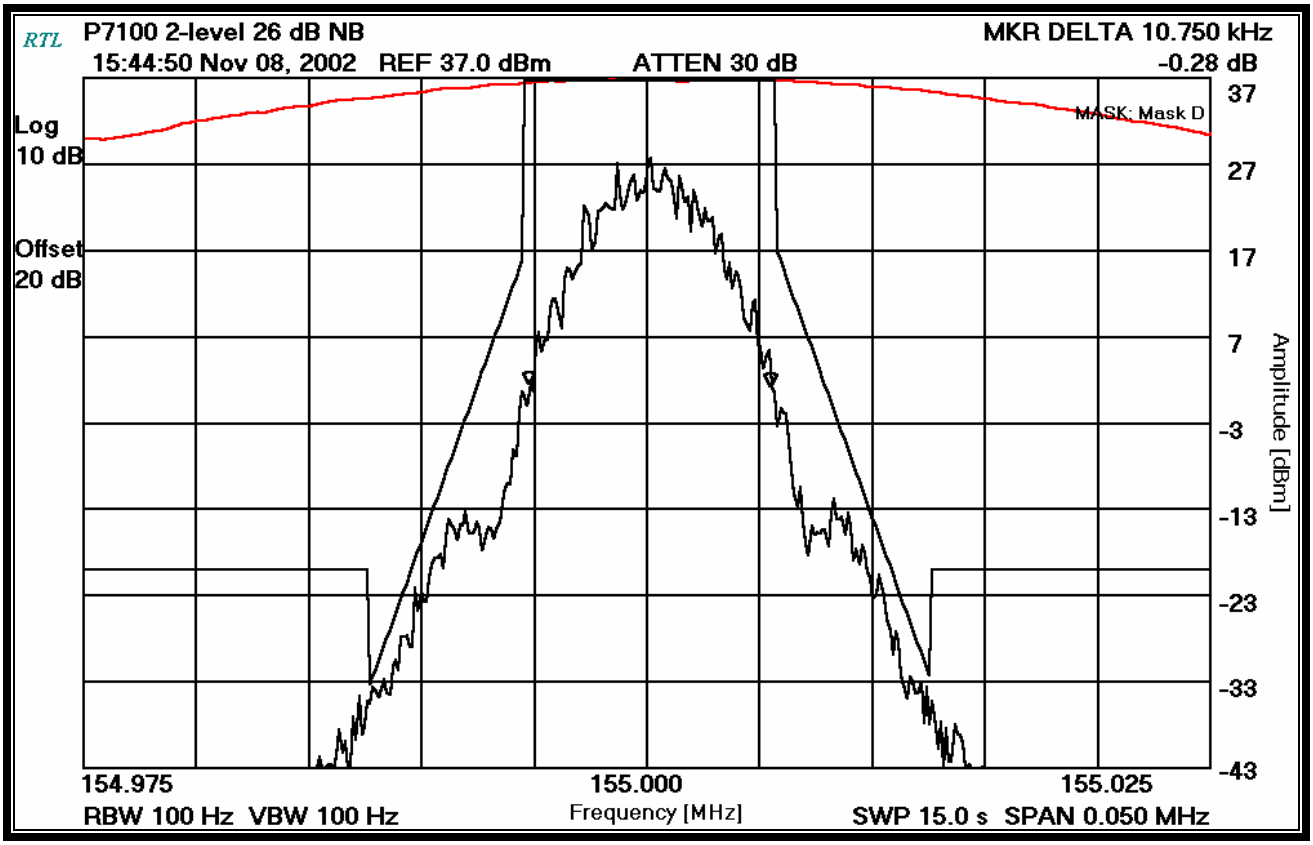
C4FM – 9600 bps:
Calculation:
Max modulation(B) in kHz: 4.8
Max deviation (D) in kHz: 1.8
Constant factor (K): 1(assumed)
Bn = B+2xDK = 8.4 kHz
Emission designator: 8K4F1D, 8K4F1E

Measurement: 99.75% Occupied Bandwidth
Bn = 10.0 kHz
Emission designator: 10K0F1D, 10K0F1E

PLOT 13-1: 26 DB BANDWIDTH; WIDEBAND; 2 LEVEL DIGITAL MODULATION



PLOT 13-2: 26 DB BANDWIDTH; NARROW BAND; 2 LEVEL DIGITAL MODULATION



PLOT 13-3: 26 DB BANDWIDTH; NARROW BAND; C4FM DIGITAL MODULATION

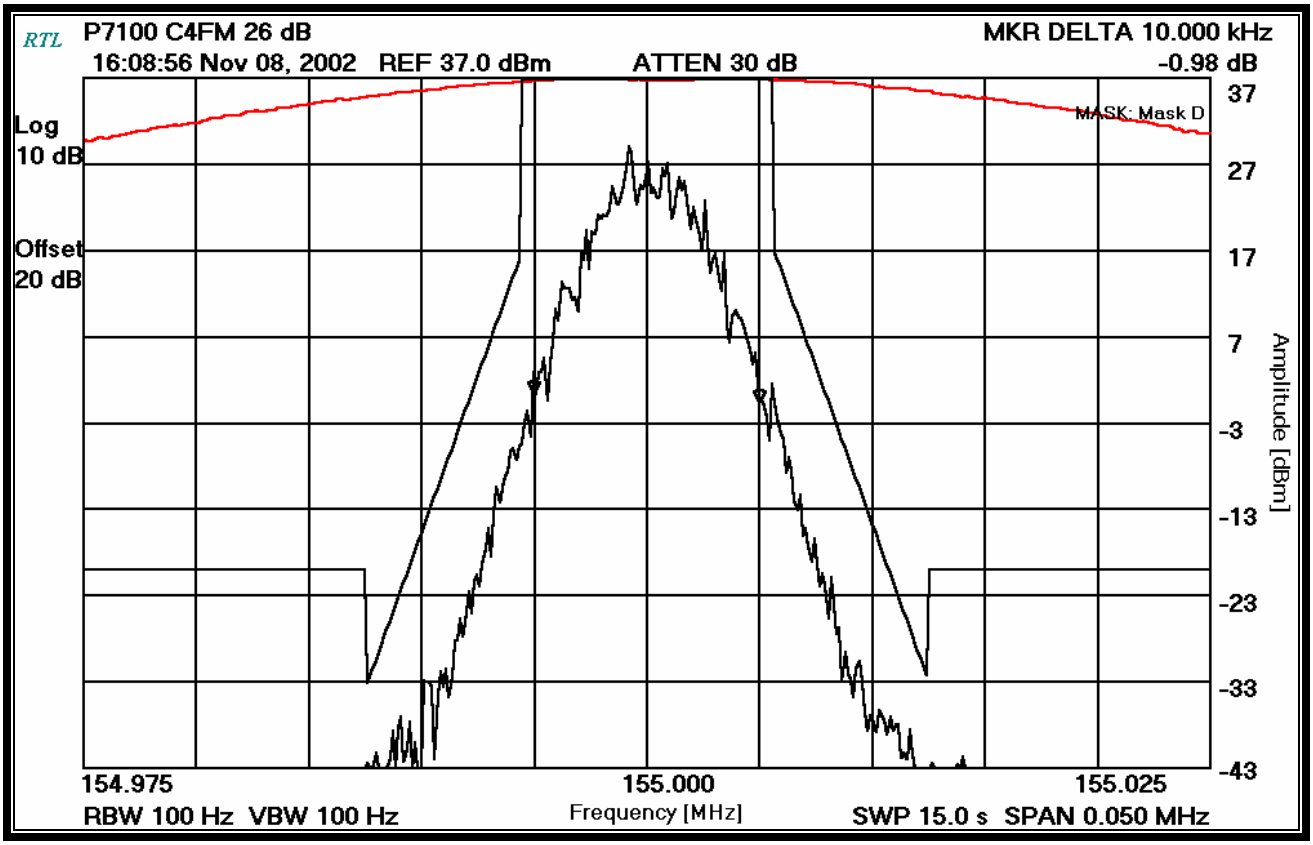


TABLE 13-1: TEST EQUIPMENT USED FOR NECESSARY AND EMISSION BANDWIDTH MEASUREMENTS

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900913	Hewlett Packard	8546	EMI Receiver	3325A00159	12/05/02
900914	Hewlett Packard	85460	RF Filter Section	3330A00107	12/05/02

TEST PERSONNEL:

DANIEL BIGGS — TEST TECHNICIAN/ENGINEER

SIGNATURE

NOVEMBER 8, 2002 — DATE OF TEST