



Engineering and Testing for EMC and Safety Compliance

TYPE CERTIFICATION REPORT

M/A-COM, Inc.
 221 Jefferson Ridge Parkway
 Lynchburg, VA 24501
 Bryan McWatters
 Phone: (434) 455-9377

MODEL: P7100^(IP) UHF-L Portable Radio

FCC ID: OWDTR-0016-E

April 10, 2003

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 2001	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15: 2001	RADIO FREQUENCY DEVICES - §15.109: RADIATED EMISSIONS LIMITS
PART 90: 2001	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	Maximum Measured Output Power (W) Conducted	Frequency Tolerance (ppm)	Emission Designator
378-430 MHz	4.40	1.5	16K0F3E (Voice)
378-430 MHz	4.40	1.5	11K0F3E (Voice)
378-430 MHz	4.40	1.5	15K6F1D (2 level WB)
378-430 MHz	4.40	1.5	15K6F1E (2 level WB)
378-430 MHz	4.40	1.5	11K0F1D (2 level NB 9600) measured
378-430 MHz	4.40	1.5	11K0F1E (2 level NB 9600) measured
378-430 MHz	4.40	1.5	7K8F1D (2 level NB 4800)
378-430 MHz	4.40	1.5	7K8F1E (2 level NB 4800)
378-430 MHz	4.40	1.5	9K38F1D (C4FM) measured
378-430 MHz	4.40	1.5	9K38F1E (C4FM) measured

REPORT PREPARED BY TEST ENGINEER: DAN BIGGS

Document Number: 2003046 / QRTL03-776

No part of this report may be reproduced without the full written approval of Rhein Tech Laboratories, Inc.

TABLE OF CONTENTS

1	GENERAL INFORMATION.....	5
1.1	TEST FACILITY.....	5
1.2	RELATED SUBMITTAL(S)/GRANT(S).....	5
2	CONFORMANCE STATEMENT.....	6
3	TESTED SYSTEM DETAILS.....	7
4	FCC RULES AND REGULATIONS PART 2 §2.1033(C)(8) VOLTAGES AND CURRENTS THROUGH THE FINAL AMPLIFYING STAGE.....	8
5	RADIATED EMISSIONS.....	9
5.1	RADIATED MEASUREMENT.....	9
6	FCC RULES AND REGULATIONS PART 2 §2.1046 (A): RF POWER OUTPUT: CONDUCTED.....	10
6.1	TEST PROCEDURE.....	10
6.2	TEST DATA.....	10
7	FCC RULES AND REGULATIONS PART 2 §2.1051: SPURIOUS EMISSIONS AT ANTENNA TERMINALS.....	11
7.1	TEST PROCEDURE.....	11
7.2	TEST DATA.....	11
8	FCC RULES AND REGULATIONS PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION.....	13
8.1	TEST PROCEDURE.....	13
8.2	TEST DATA.....	13
8.2.1	CFR 47 PART 90.210 REQUIREMENTS.....	13
9	FCC RULES AND REGULATIONS PART 2 §2.1049 (C) (1): OCCUPIED BANDWIDTH.....	15
9.1	TEST PROCEDURE.....	15
9.2	TEST DATA.....	15
10	FCC RULES AND REGULATION PART 2 §2.1055: FREQUENCY STABILITY.....	20
10.1	TEST PROCEDURE.....	20
10.2	TEST DATA.....	21
10.2.1	FREQUENCY STABILITY/TEMPERATURE VARIATION.....	21
10.2.2	FREQUENCY STABILITY/VOLTAGE VARIATION.....	23
11	FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE.....	25
11.1	TEST PROCEDURE.....	25
11.2	TEST DATA.....	25
12	FCC PART 2 §2.1047 (A): MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER.....	27
12.1	TEST PROCEDURE.....	27
12.2	TEST DATA.....	27
13	FCC RULES AND REGULATIONS PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - MODULATION LIMITING.....	29
13.1	TEST PROCEDURE.....	29
13.2	TEST DATA.....	29
14	FCC RULES AND REGULATIONS PART 90 §90.214: TRANSIENT FREQUENCY BEHAVIOR.....	33
14.1	TEST PROCEDURE.....	33
14.2	TEST DATA.....	33
15	FCC RULES AND REGULATIONS PART 2 §2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH.....	37
16	CONCLUSION.....	41

TABLE OF TABLES

TABLE 3-1:	EQUIPMENT UNDER TEST (EUT)	7
TABLE 6-1:	RF POWER OUTPUT (HIGH POWER): CARRIER OUTPUT POWER (UNMODULATED).....	10
TABLE 6-2:	RF POWER OUTPUT (RATED POWER)	10
TABLE 6-3:	TEST EQUIPMENT USED FOR TESTING (RF POWER OUTPUT - CONDUCTED).....	10
TABLE 7-1:	CONDUCTED SPURIOUS EMISSIONS CHANNEL 1 – 378.0 MHz.....	11
TABLE 7-2:	CONDUCTED SPURIOUS EMISSIONS CHANNEL 2 – 404.0 MHz.....	12
TABLE 7-3:	CONDUCTED SPURIOUS EMISSIONS CHANNEL 3 – 430.0 MHz.....	12
TABLE 7-4:	TEST EQUIPMENT USED FOR TESTING (CONDUCTED SPURIOUS EMISSIONS)	12
TABLE 8-1:	FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 2 – 481.0 MHz; NARROW BAND	13
TABLE 8-2:	TEST EQUIPMENT USED FOR TESTING (FIELD STRENGTH OF SPURIOUS RADIATION).....	14
TABLE 9-1:	TEST EQUIPMENT USED FOR TESTING (OCCUPIED BANDWIDTH).....	19
TABLE 10-1:	TEMPERATURE FREQUENCY STABILITY CHANNEL 2, 404.0 MHz	21
TABLE 10-2:	TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/TEMPERATURE)	22
TABLE 10-3:	FREQUENCY STABILITY/VOLTAGE VARIATION CHANNEL 2, 404.0 MHz	23
TABLE 10-4:	TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/VOLTAGE)	24
TABLE 11-1:	TEST EQUIPMENT USED FOR TESTING (AUDIO FREQUENCY RESPONSE)	26
TABLE 12-1:	TEST EQUIPMENT USED FOR TESTING (AUDIO LOW PASS FILTER RESPONSE).....	28
TABLE 13-1:	TEST EQUIPMENT USED FOR TESTING (MODULATION LIMITING).....	32
TABLE 14-1:	TEST EQUIPMENT USED FOR TESTING (TRANSIENT FREQUENCY BEHAVIOR)	36
TABLE 15-1:	TEST EQUIPMENT USED FOR NECESSARY AND EMISSION BANDWIDTH MEASUREMENTS	40

TABLE OF PLOTS

PLOT 9-1:	OCCUPIED BANDWIDTH; WIDE BAND; AUDIO MODULATION: 2,500 Hz.....	15
PLOT 9-2:	OCCUPIED BANDWIDTH; NARROW BAND; AUDIO MODULATION: 2,500 Hz.....	16
PLOT 9-3:	OCCUPIED BANDWIDTH; 20 dB BW; 9600 BAUD WIDE BAND; 2 LEVEL DIGITAL MODULATION	17
PLOT 9-4:	OCCUPIED BANDWIDTH; 20 dB BW; 9600 BAUD NARROW BAND; 2 LEVEL DIGITAL MODULATION	18
PLOT 10-1:	TEMPERATURE FREQUENCY STABILITY.....	21
PLOT 10-2:	VOLTAGE FREQUENCY STABILITY.....	23
PLOT 11-1:	MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE {12.5 kHz CHANNEL BANDWIDTH}	25
PLOT 12-1:	MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER	27
PLOT 13-1:	MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND; POSITIVE PEAK	29
PLOT 13-2:	MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND; NEGATIVE PEAK	30
PLOT 13-3:	MODULATION CHARACTERISTICS – MODULATION LIMITING: NARROW BAND; POSITIVE PEAK	31
PLOT 13-4:	MODULATION CHARACTERISTICS – MODULATION LIMITING: NARROW BAND; NEGATIVE PEAK	32
PLOT 14-1:	TRANSIENT FREQUENCY BEHAVIOR – 404 MHz; HIGH POWER; WIDE BAND; CARRIER ON TIME	33
PLOT 14-2:	TRANSIENT FREQUENCY BEHAVIOR – 404 MHz; HIGH POWER; WIDE BAND; CARRIER OFF TIME	34
PLOT 14-3:	TRANSIENT FREQUENCY BEHAVIOR – 404 MHz; HIGH POWER; NARROW BAND; CARRIER ON TIME	35
PLOT 14-4:	TRANSIENT FREQUENCY BEHAVIOR – 404 MHz; HIGH POWER; NARROW BAND; CARRIER OFF TIME	36
PLOT 15-1:	26 dB BANDWIDTH; WIDEBAND; 2 LEVEL DIGITAL MODULATION.....	38
PLOT 15-2:	26 dB BANDWIDTH; NARROW BAND; 2 LEVEL DIGITAL MODULATION	39
PLOT 15-3:	26 dB BANDWIDTH; NARROW BAND; C4FM DIGITAL MODULATION	40

TABLE OF FIGURES

FIGURE 3-1:	CONFIGURATION OF TESTED SYSTEM.....	8
-------------	-------------------------------------	---

TABLE OF APPENDICES

APPENDIX A:	FCC PART 1.1307, 1.1310, 2.1091, 2.1093: RF EXPOSURES.....	42
APPENDIX B:	OPERATIONAL DESCRIPTION.....	43
APPENDIX C:	LABEL INFORMATION.....	44
APPENDIX D:	PARTS LIST.....	46
APPENDIX E:	SCHEMATICS.....	47
APPENDIX F:	BLOCK DIAGRAM.....	48
APPENDIX G:	MANUAL.....	49
APPENDIX H:	TEST CONFIGURATION PHOTOGRAPHS.....	50
APPENDIX I:	EXTERNAL PHOTOGRAPHS.....	51
APPENDIX J:	INTERNAL PHOTOGRAPHS.....	55

TABLE OF PHOTOGRAPHS

PHOTOGRAPH 1:	LABEL LOCATION ON BACK OF EUT WITH BATTERY REMOVED.....	45
PHOTOGRAPH 2:	RADIATED EMISSIONS FRONT VIEW.....	50
PHOTOGRAPH 3:	RADIATED EMISSIONS REAR VIEW.....	50
PHOTOGRAPH 4:	UHF-L P7100 ^(IP) FRONT VIEW.....	51
PHOTOGRAPH 5:	UHF-L P7100 ^(IP) SIDE VIEW.....	52
PHOTOGRAPH 6:	UHF-L P7100 ^(IP) SIDE VIEW.....	53
PHOTOGRAPH 7:	UHF-L P7100 ^(IP) VIEW OF REAR CASTING.....	54
PHOTOGRAPH 8:	UHF-L P7100 ^(IP) VIEW OF INSIDE OF FRONT COVER.....	55
PHOTOGRAPH 9:	UHF-L P7100 ^(IP) VIEW OF TOP OF INTERFACE BOARD AND RF SHIELD.....	56
PHOTOGRAPH 10:	UHF-L P7100 ^(IP) VIEW OF TOP OF INTERFACE BOARD.....	57
PHOTOGRAPH 11:	UHF-L P7100 ^(IP) VIEW OF BOTTOM OF INTERFACE BOARD.....	58
PHOTOGRAPH 12:	UHF-L P7100 ^(IP) VIEW OF TOP OF RF SHIELD WITH INTERFACE BOARD REMOVED.....	59
PHOTOGRAPH 13:	UHF-L P7100 ^(IP) VIEW OF TOP OF MAIN BOARD WITH RF SHIELD REMOVED.....	60
PHOTOGRAPH 14:	UHF-L P7100 ^(IP) VIEW OF BOTTOM OF MAIN BOARD.....	61
PHOTOGRAPH 15:	UHF-L P7100 ^(IP) VIEW OF INSIDE WALL OF REAR CASTING WITH MAIN BOARD REMOVED.....	62

1 GENERAL INFORMATION

The following Type Certification Report is prepared on behalf of **M/A-COM, Inc.** in accordance with the Federal Communications Commission and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the **P7100^(IP) UHF Radio**; **FCC ID: OWDTR-0016-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.

2 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
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
378-430 MHz	4.40	1.5	16K0F3E (Voice)
378-430 MHz	4.40	1.5	11K0F3E (Voice)
378-430 MHz	4.40	1.5	15K6F1D (2 level WB)
378-430 MHz	4.40	1.5	15K6F1E (2 level WB)
378-430 MHz	4.40	1.5	11K0F1D (2 level NB 9600) measured
378-430 MHz	4.40	1.5	11K0F1E (2 level NB 9600) measured
378-430 MHz	4.40	1.5	7K8F1D (2 level NB 4800)
378-430 MHz	4.40	1.5	7K8F1E (2 level NB 4800)
378-430 MHz	4.40	1.5	9K38F1D (C4FM) measured
378-430 MHz	4.40	1.5	9K38F1E (C4FM) measured

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: *Richard B. Mc Murray*

Date: April 10, 2003

Typed/Printed Name: Rick McMurray


Position: Vice President of Operations

Signature: *Daniel Biggs*

Date: April 10, 2003

Typed/Printed Name: Daniel W. Biggs

Position: Test Engineer

 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.

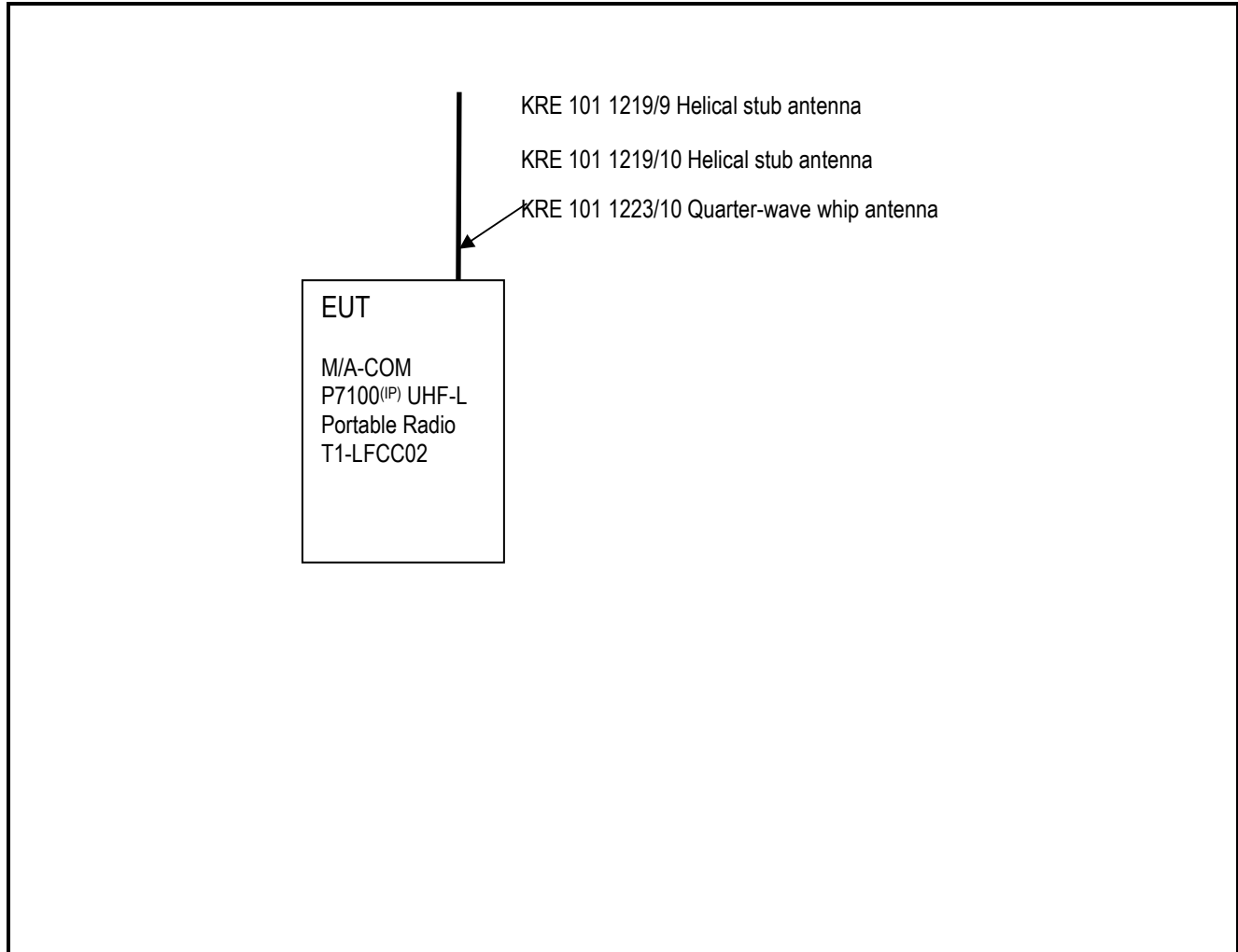
3 TESTED SYSTEM DETAILS

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

TABLE 3-1: EQUIPMENT UNDER TEST (EUT)

Part	Manufacturer	Model	Serial Number	FCC ID	RTL Bar Code
UHF Portable Radio	M/A-COM, Inc.	P7100 ^(IP)	T1-LFCC02	OWDTR-0016-E	14893
High Capacity NICAD Battery	M/A-COM, Inc.	BKB191210/3	N/A	N/A	14836
Helical stub antenna	M/A-COM, Inc.	KRE 101 1219/9	N/A	N/A	15098
Helical stub antenna	M/A-COM, Inc.	KRE 101 1219/10	N/A	N/A	15099
Quarter-wave whip antenna	M/A-COM, Inc.	KRE 101 1223/10	N/A	N/A	15100

FIGURE 3-1: CONFIGURATION OF TESTED SYSTEM



4 FCC RULES AND REGULATIONS PART 2 §2.1033(C)(8) VOLTAGES AND CURRENTS THROUGH THE FINAL AMPLIFYING STAGE

Nominal DC Voltage: 7.5 VDC
Current: 2 AMPS

5 RADIATED EMISSIONS

5.1 RADIATED MEASUREMENT

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

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

6.1 TEST PROCEDURE

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

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

6.2 TEST DATA

The following channels (in MHz) were tested: 378, 404, and 430

TABLE 6-1: RF POWER OUTPUT (HIGH POWER): CARRIER OUTPUT POWER (UNMODULATED)

Channel	Frequency (MHz)	RF Power Measured (Watt)*
1	378	4.35
2	404	4.37
3	430	4.40

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

TABLE 6-2: RF POWER OUTPUT (RATED POWER)

Rated Power (W)
4.26

TABLE 6-3: TEST EQUIPMENT USED FOR TESTING (RF POWER OUTPUT - CONDUCTED)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901184/901186	Agilent	E4416A/E9323A	Power Meter / Sensor	GB41050573/US40410380	07/19/03

TEST PERSONNEL:

DANIEL BIGGS		MARCH 27, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

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

7.1 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 – 9600-bps

7.2 TEST DATA

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

Limits: Mask D (dBm): $P(\text{dBm}) - (50 + 10 \times \text{LOG } P(\text{W}))$

The following channels (in MHz) were investigated: 378.0, 404.0, and 430.0. 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 7-1: CONDUCTED SPURIOUS EMISSIONS CHANNEL 1 – 378.0 MHZ

(378.0 MHz); 12.5 kHz channel spacing; Mask D; Conducted power = 4.35 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
756	83.1	56.38	-26.7
1134	80.4	56.38	-24.1
1512	106.1	56.38	-49.7
1890	97.4	56.38	-41.1
2268	102.2	56.38	-45.9
2646	111.2	56.38	-54.9
3024	106.7	56.38	-50.4
3402	107.4	56.38	-51.1
3780	103.0	56.38	-46.7
4158	101.7	56.38	-45.4

TABLE 7-2: CONDUCTED SPURIOUS EMISSIONS CHANNEL 2 – 404.0 MHZ

(404.0 MHz); 12.5 kHz channel spacing; Mask D; Conducted power = 4.37 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
808	80.2	56.40	-24.0
1212	82.7	56.40	-26.4
1616	107.7	56.40	-51.4
2020	105.1	56.40	-48.8
2424	105.7	56.40	-49.5
2828	108.1	56.40	-51.8
3232	106.9	56.40	-50.6
3636	100.6	56.40	-44.3
4040	105.2	56.40	-48.9

TABLE 7-3: CONDUCTED SPURIOUS EMISSIONS CHANNEL 3 – 430.0 MHZ


(430.0 MHz); 12.5 kHz channel spacing; Mask D; Conducted power = 4.40 W

Frequency (MHz)	Level (dBc)	Limit (dBc)	Margin(dB)
860	80.4	56.43	-24.0
1290	91.1	56.43	-34.7
1720	108.6	56.43	-52.2
2150	97.1	56.43	-40.7
2580	108.9	56.43	-52.5
3010	106.6	56.43	-50.2
3440	104.1	56.43	-47.7
3870	93.1	56.43	-36.7
4300	109.3	56.43	-52.9

TABLE 7-4: TEST EQUIPMENT USED FOR TESTING (CONDUCTED SPURIOUS EMISSIONS)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
901215	Hewlett Packard	8596EM (9kHz-12.8GHz)	EMC Analyzer	3826A00144	08/23/03
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	12/05/03

TEST PERSONNEL:

DANIEL BIGGS		APRIL 1, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

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

8.1 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 – 9600-bps

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.

8.2 TEST DATA

8.2.1 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 8-1: FIELD STRENGTH OF SPURIOUS RADIATION CHANNEL 2 – 481.0 MHZ; NARROW BAND

Radiated Spurious Emissions
 Mid Band Channel 2 (404 MHz, Narrowband)
 Limit = 50 + 10 Log P = 56.40 dBc
 Conducted Power = 36.40 dBm = 4.37 W


Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Corrected Signal Generator Level (dBc)	Margin (dB)
808	52.0	-59.8	0.4	-1.3	97.9	-41.5
1212	46.0	-57.1	0.4	4.0	89.9	-33.5
1616	43.8	-53.7	0.5	4.7	85.9	-29.5
2020	36.9	-45.2	0.6	4.9	77.3	-20.9
2424	26.2	-55.8	0.6	5.1	87.7	-31.3
2828	26.6	-54.8	0.7	5.9	86.0	-29.6
3232	26.8	-51.4	0.8	6.1	82.5	-26.1
3636	23.1	-48.5	0.8	5.9	79.8	-23.4
4040	24.6	-47.5	1.8	6.0	79.7	-23.3
4444	24.0	-48.3	0.9	6.9	78.7	-22.3

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

TABLE 8-2: TEST EQUIPMENT USED FOR TESTING (FIELD STRENGTH OF SPURIOUS RADIATION)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
901053	Schaffner-Chase	CBL6112	Antenna (25 MHz – 2 GHz)	2648	06/11/03
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		APRIL 2, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

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

OCCUPIED BANDWIDTH - COMPLIANCE WITH THE EMISSION MASKS

9.1 TEST PROCEDURE

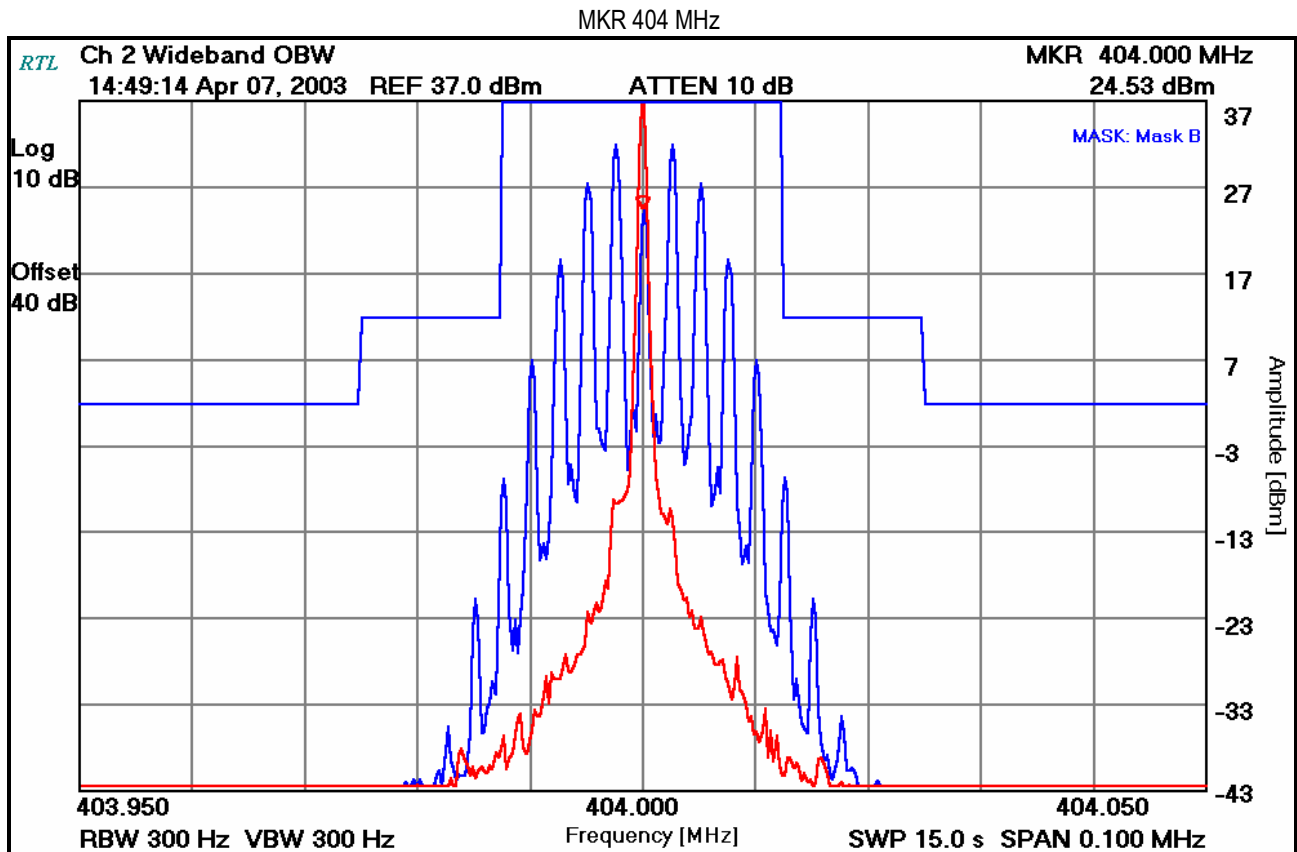
ANSI/TIA/EIA-603-1992, section 2.2.11 and TIA/EIA-102.CAAA-1999 section 2.2.5

Device with audio modulation: Transmitter was 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 – 9600-bps

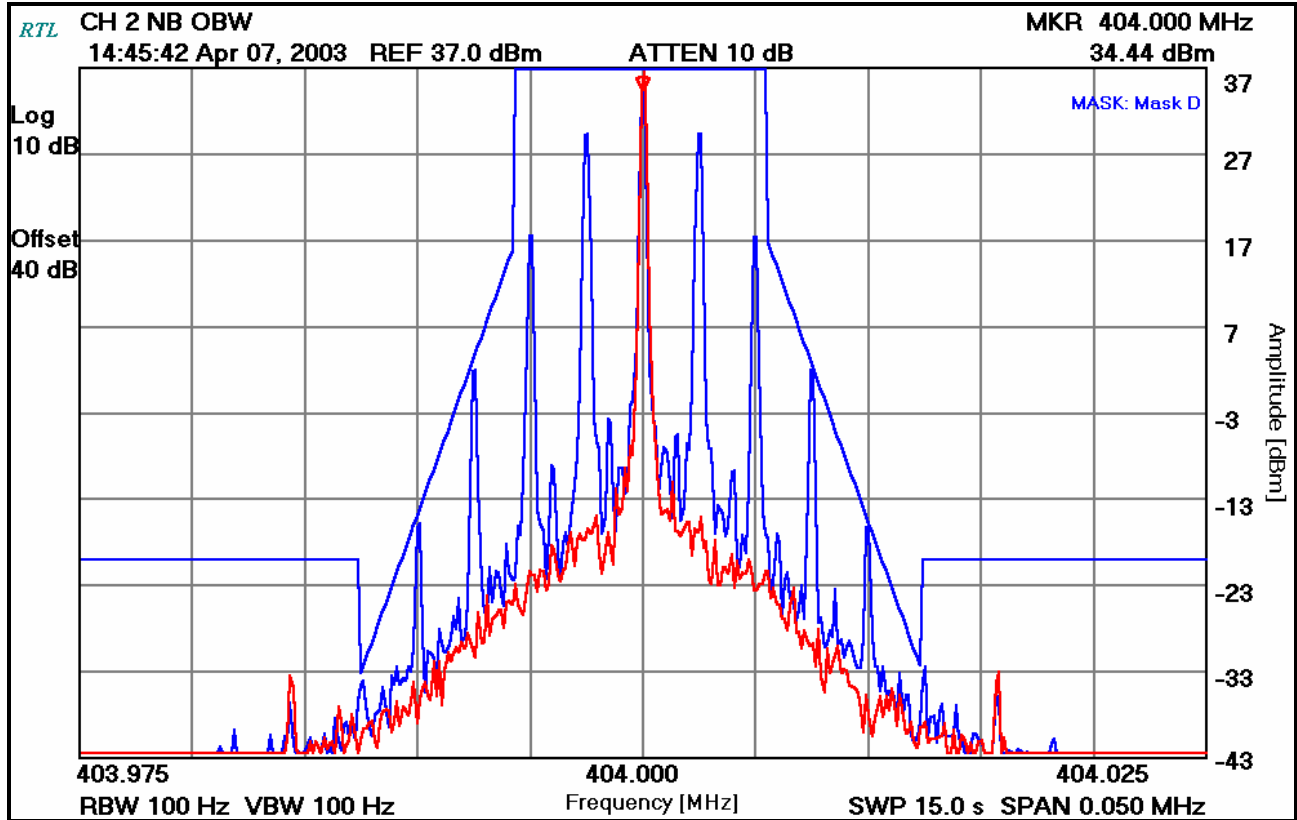
9.2 TEST DATA

PLOT 9-1: OCCUPIED BANDWIDTH; WIDE BAND; AUDIO MODULATION: 2,500 HZ

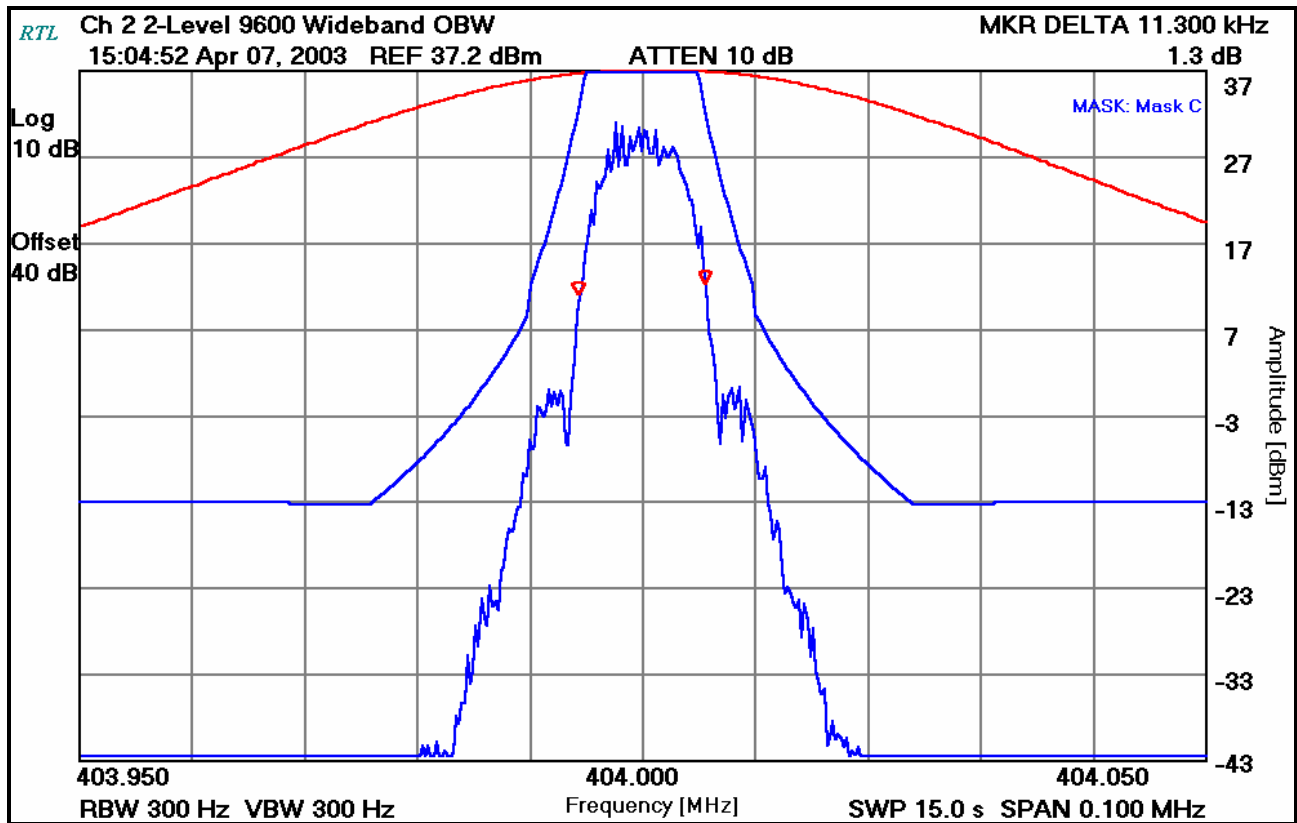


PLOT 9-2: OCCUPIED BANDWIDTH; NARROW BAND; AUDIO MODULATION: 2,500 HZ

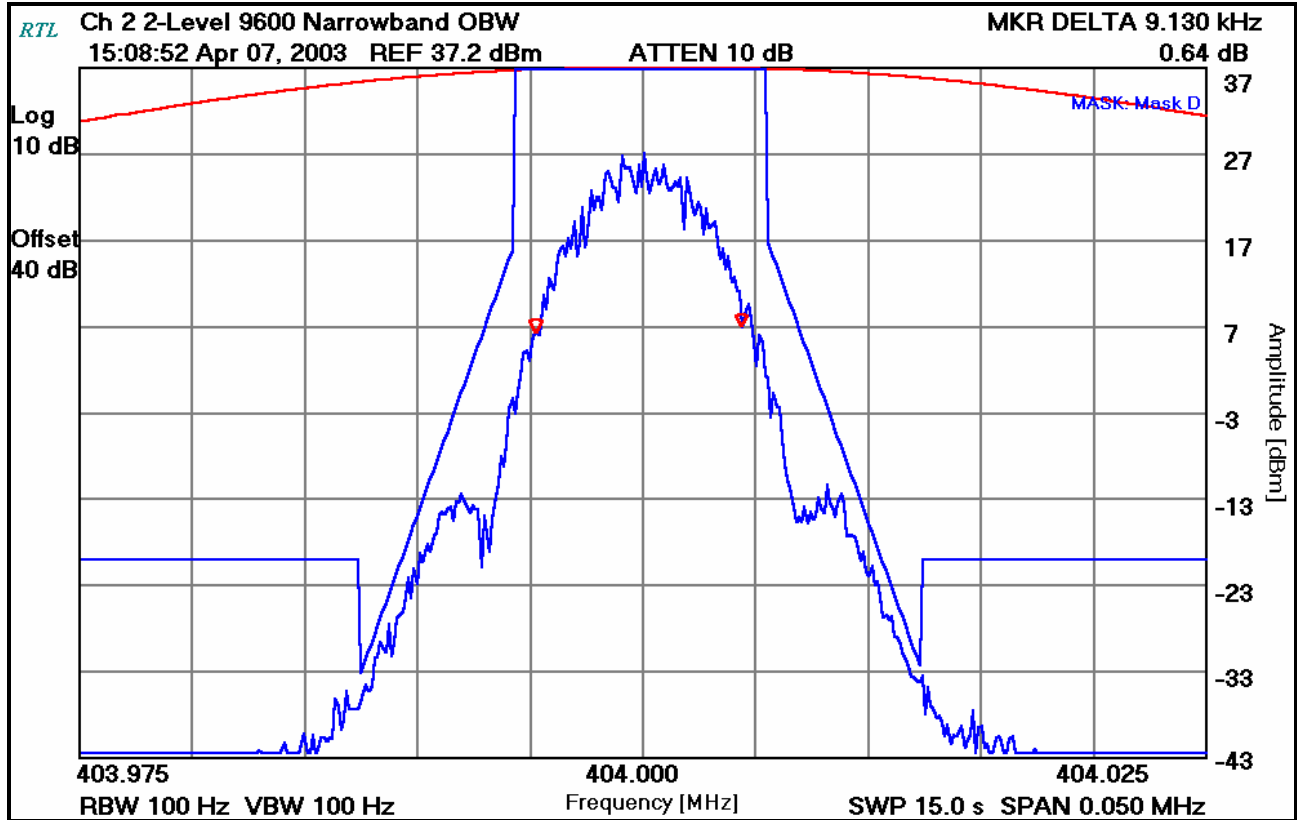
MKR 404 MHz



PLOT 9-3: OCCUPIED BANDWIDTH; 20 DB BW; 9600 BAUD WIDE BAND; 2 LEVEL DIGITAL MODULATION



PLOT 9-4: OCCUPIED BANDWIDTH; 20 DB BW; 9600 BAUD NARROW BAND; 2 LEVEL DIGITAL MODULATION



PLOT 9-5: OCCUPIED BANDWIDTH; NARROW BAND; 20 DB BANDWIDTH; C4FM DIGITAL MODULATION

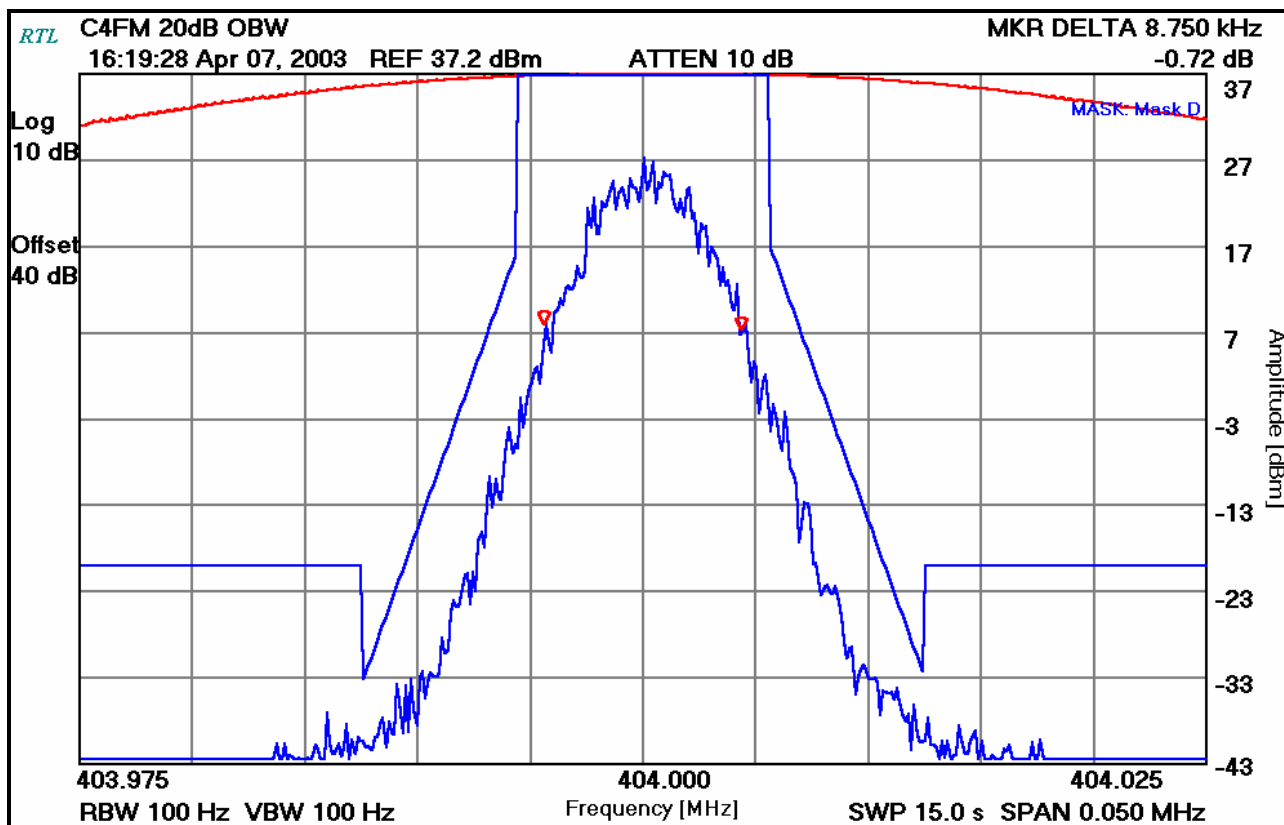


TABLE 9-1: TEST EQUIPMENT USED FOR TESTING (OCCUPIED BANDWIDTH)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
901215	Hewlett Packard	8596EM (9kHz-12.8GHz)	EMC Analyzer	3826A00144	08/23/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03

TEST PERSONNEL:

DANIEL BIGGS	<i>Daniel Biggs</i>	APRIL 7, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

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

10.1 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 below in Table 11-1.

10.2 TEST DATA

10.2.1 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 0.72 ppm at -30°C.

PLOT 10-1: TEMPERATURE FREQUENCY STABILITY

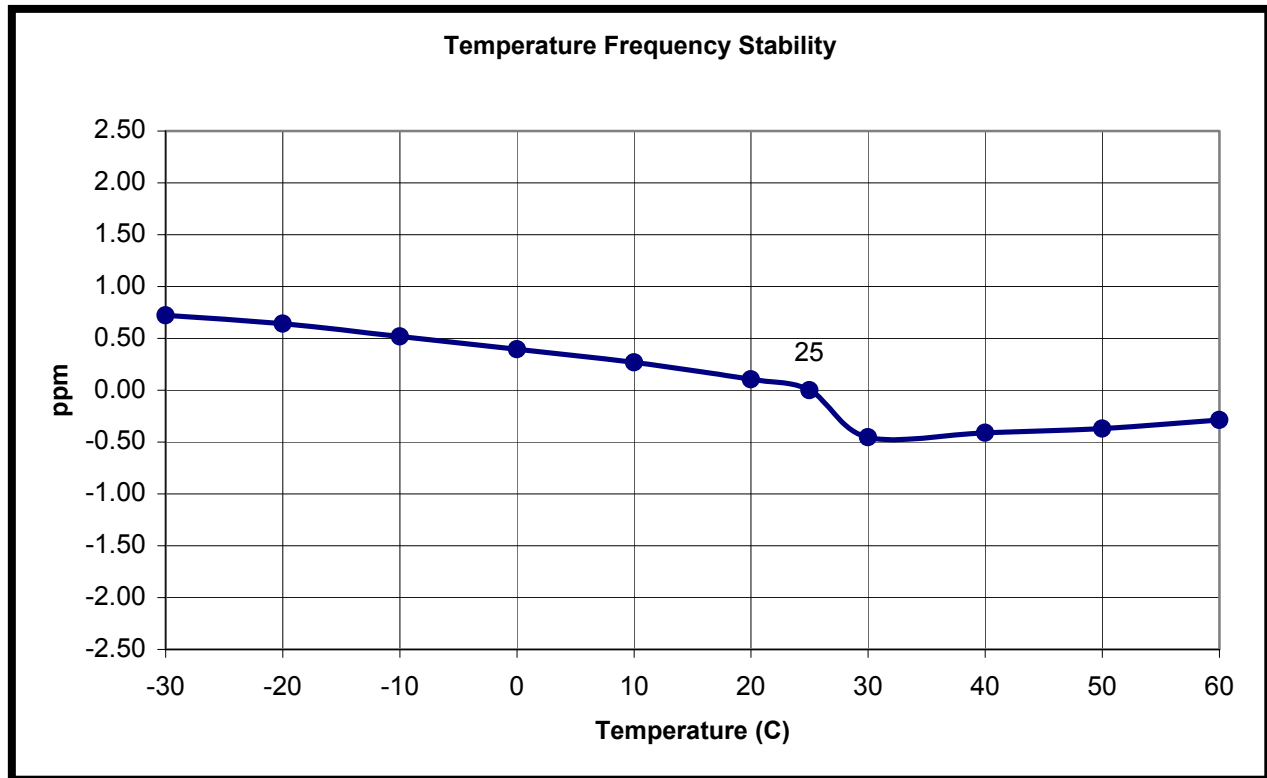



TABLE 10-1: TEMPERATURE FREQUENCY STABILITY CHANNEL 2, 404.0 MHZ

Temperature C	Measured Frequency (MHz)	ppm
-30	404.000367	0.72
-20	404.000334	0.64
-10	404.000284	0.52
0	404.000234	0.39
10	404.000184	0.27
20	404.000117	0.10
25 reference	404.000075	0.00
30	403.999892	-0.45
40	403.999909	-0.41
50	403.999925	-0.37
60	403.999959	-0.29

TABLE 10-2: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/TEMPERATURE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	12/16/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03

TEST PERSONNEL:

DANIEL BIGGS		APRIL 4, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

10.2.2 FREQUENCY STABILITY/VOLTAGE VARIATION

The battery endpoint was measured at 6.30 VDC. Worst-case variation is -0.06 ppm at the 8.625 VDC.

PLOT 10-2: VOLTAGE FREQUENCY STABILITY

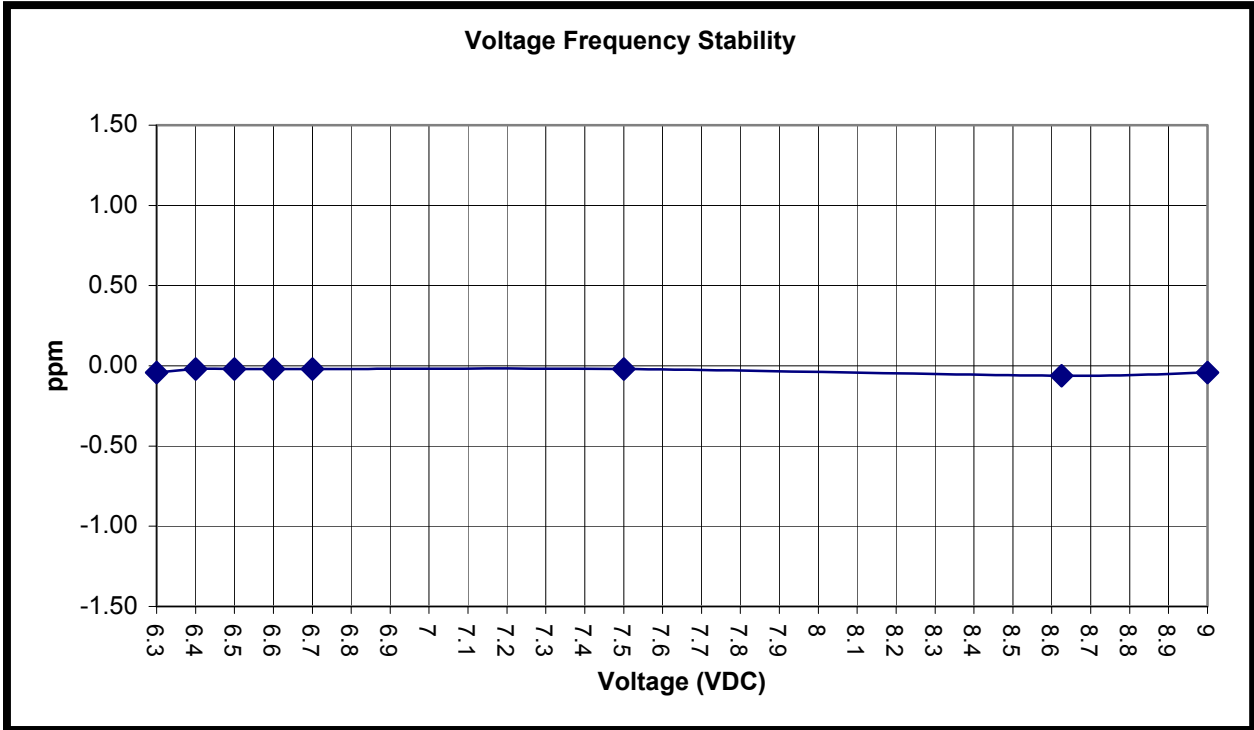



TABLE 10-3: FREQUENCY STABILITY/VOLTAGE VARIATION CHANNEL 2, 404.0 MHZ

Voltage (Vdc)	Measured Frequency (MHz)	ppm
6.3	404.000040	-0.04
6.4	404.000049	-0.02
6.5	404.000049	-0.02
6.6	404.000049	-0.02
6.7	404.000049	-0.02
7.5	404.000049	-0.02
8.625	404.000032	-0.06
9	404.000040	-0.04

TABLE 10-4: TEST EQUIPMENT USED FOR TESTING (FREQUENCY STABILITY/VOLTAGE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
901215	Hewlett Packard	8596EM (9kHz-12.8GHz)	EMC Analyzer	3826A00144	08/23/03
901118	Hewlett Packard	8901A Opt. 002-003	Modulation Analyzer	2406A00178	06/14/03

TEST PERSONNEL:

DANIEL BIGGS		APRIL 7, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

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

11.1 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 was 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:

$$\text{Audio Frequency Response} = 20 \text{ LOG} (\text{DEVfreq}/\text{DEVref})$$

11.2 TEST DATA

PLOT 11-1: MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE {12.5 KHZ CHANNEL BANDWIDTH}

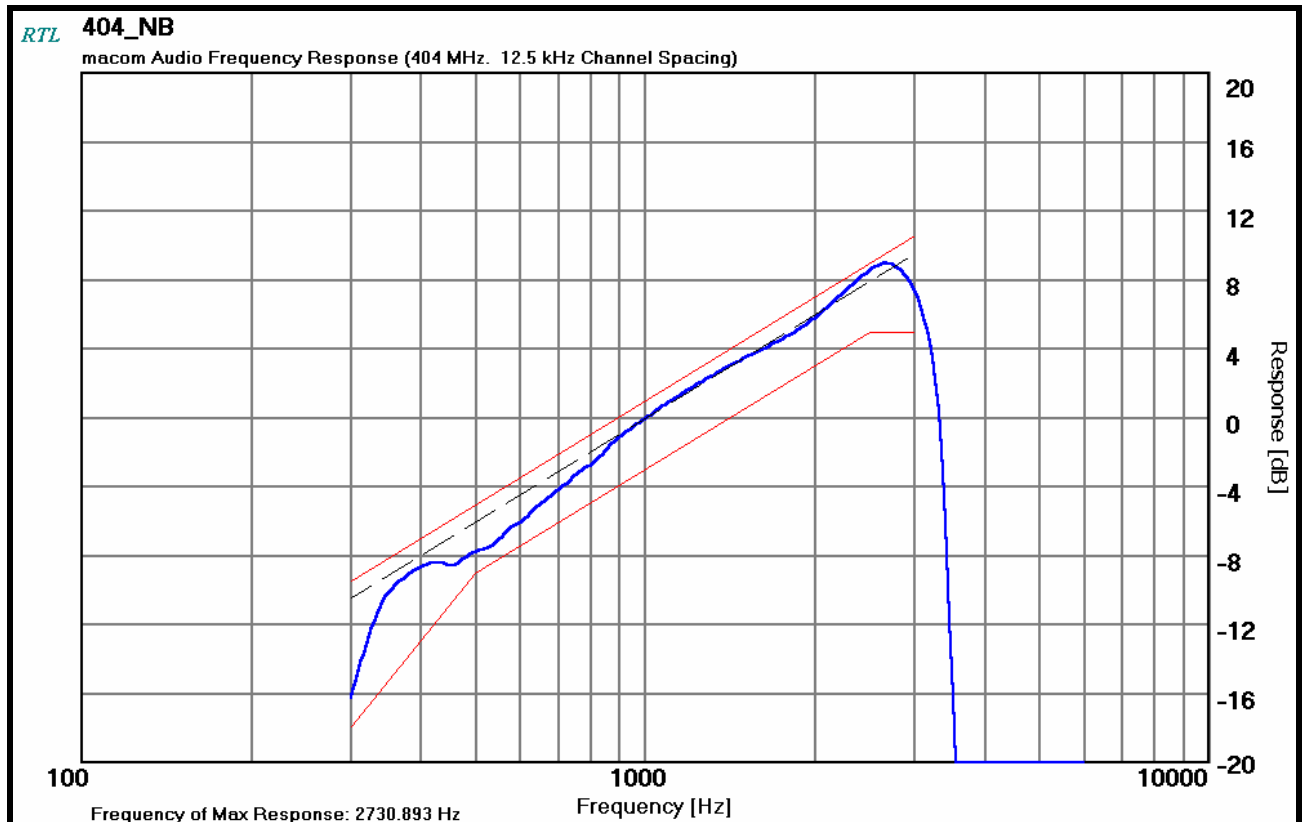



TABLE 11-1: TEST EQUIPMENT USED FOR TESTING (AUDIO FREQUENCY RESPONSE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration 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		MARCH 27, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

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

12.1 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.

12.2 TEST DATA

PLOT 12-1: MODULATION CHARACTERISTICS – AUDIO LOW PASS FILTER

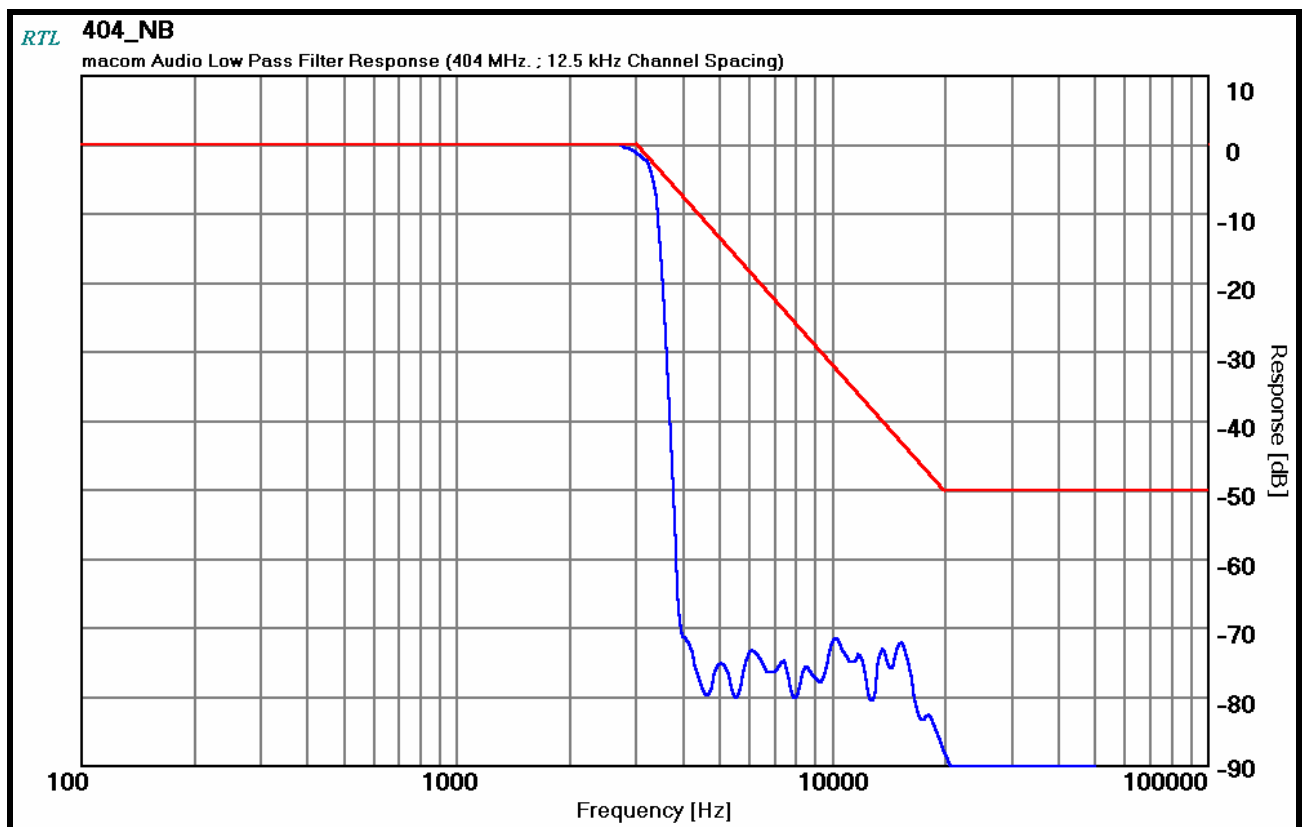



TABLE 12-1: TEST EQUIPMENT USED FOR TESTING (AUDIO LOW PASS FILTER RESPONSE)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration 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		MARCH 27, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

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

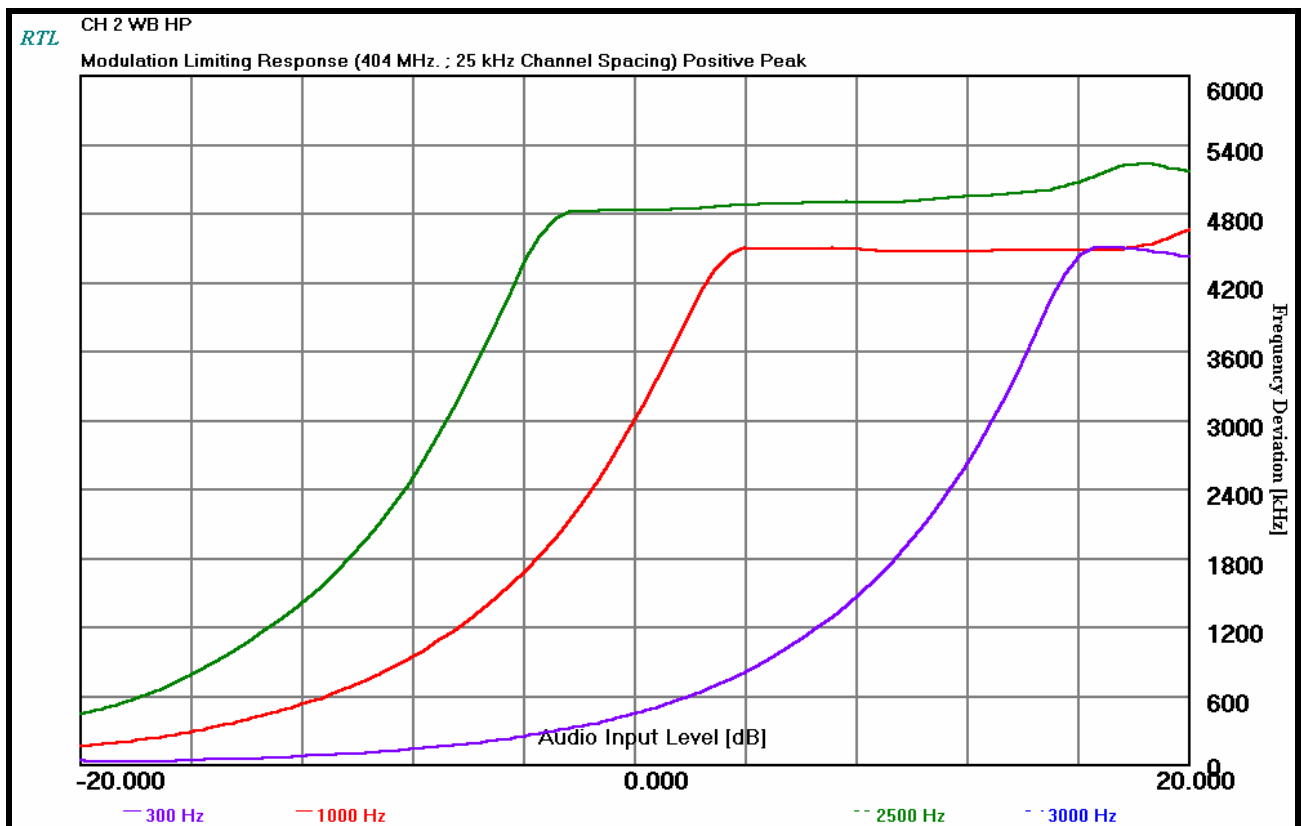
13.1 TEST PROCEDURE

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

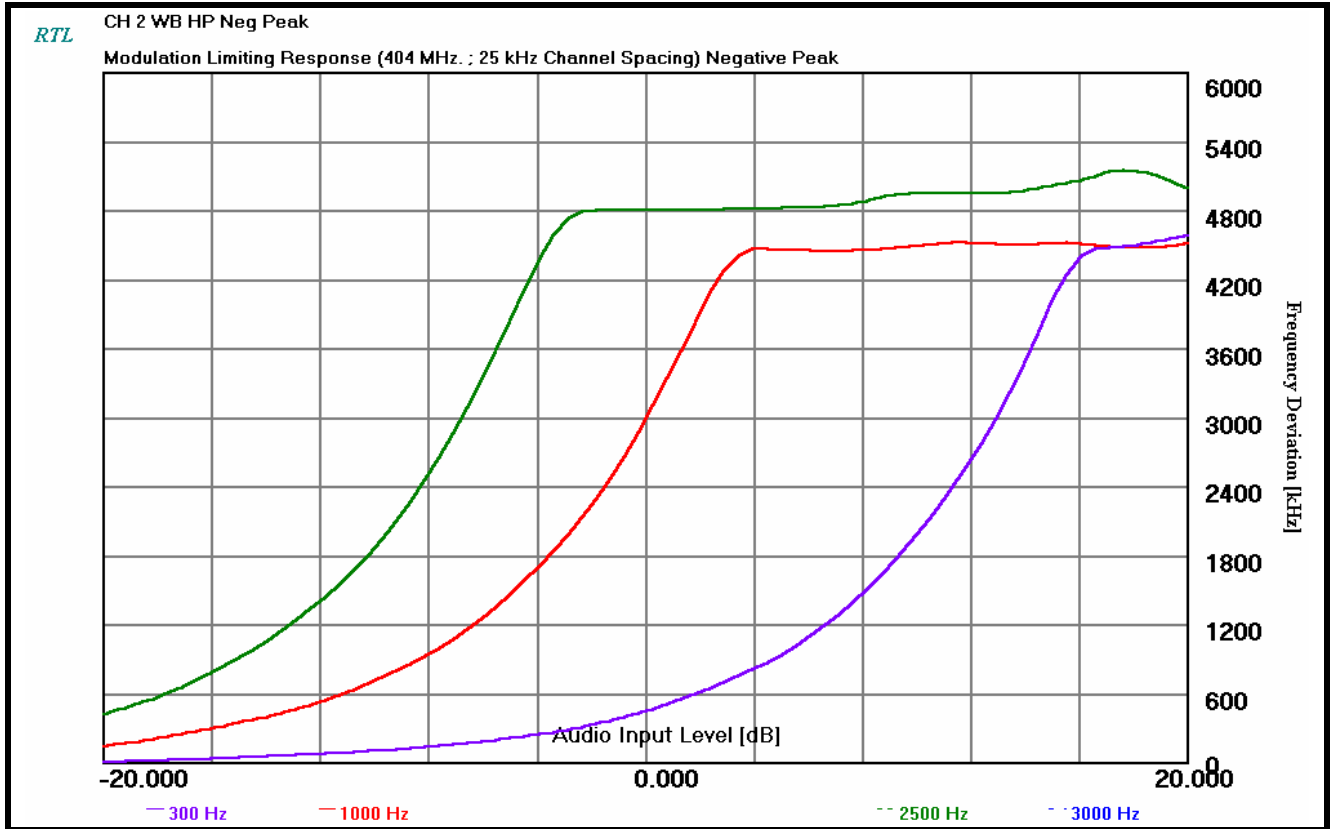
The transmitter was adjusted for full rated system deviation. The audio input level was adjusted for 60% of rated system deviation at 1000 Hz. Using this level as a reference (0dB) the audio input level was varied from the reference +/-20 dB for modulation frequencies of 300 Hz, 1,000 Hz, and 2,500 Hz. The system deviation obtained as a function of the input level was recorded. Both positive and negative peak deviations were recorded.

13.2 TEST DATA

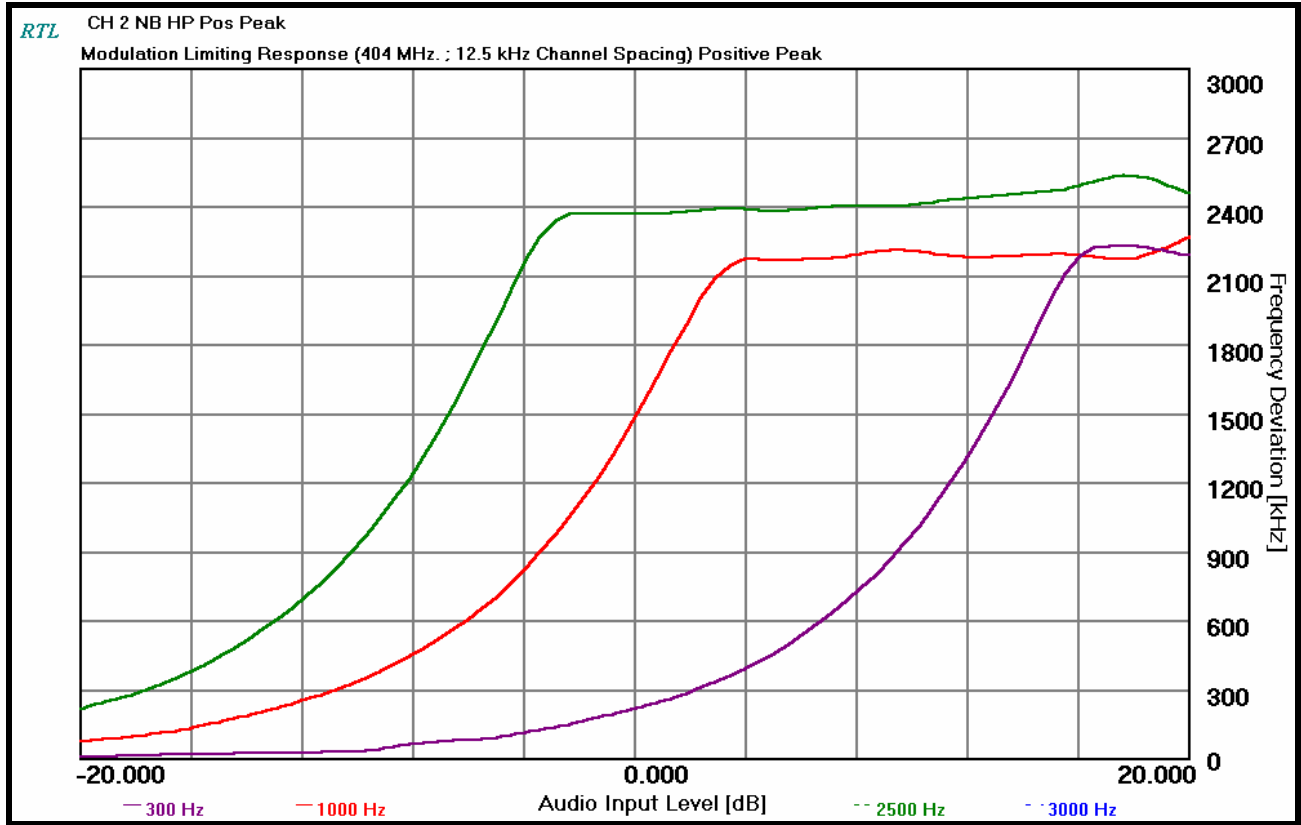
PLOT 13-1: MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND; POSITIVE PEAK



PLOT 13-2: MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND; NEGATIVE PEAK



PLOT 13-3: MODULATION CHARACTERISTICS – MODULATION LIMITING: NARROW BAND; POSITIVE PEAK



PLOT 13-4: MODULATION CHARACTERISTICS – MODULATION LIMITING: NARROW BAND; NEGATIVE PEAK

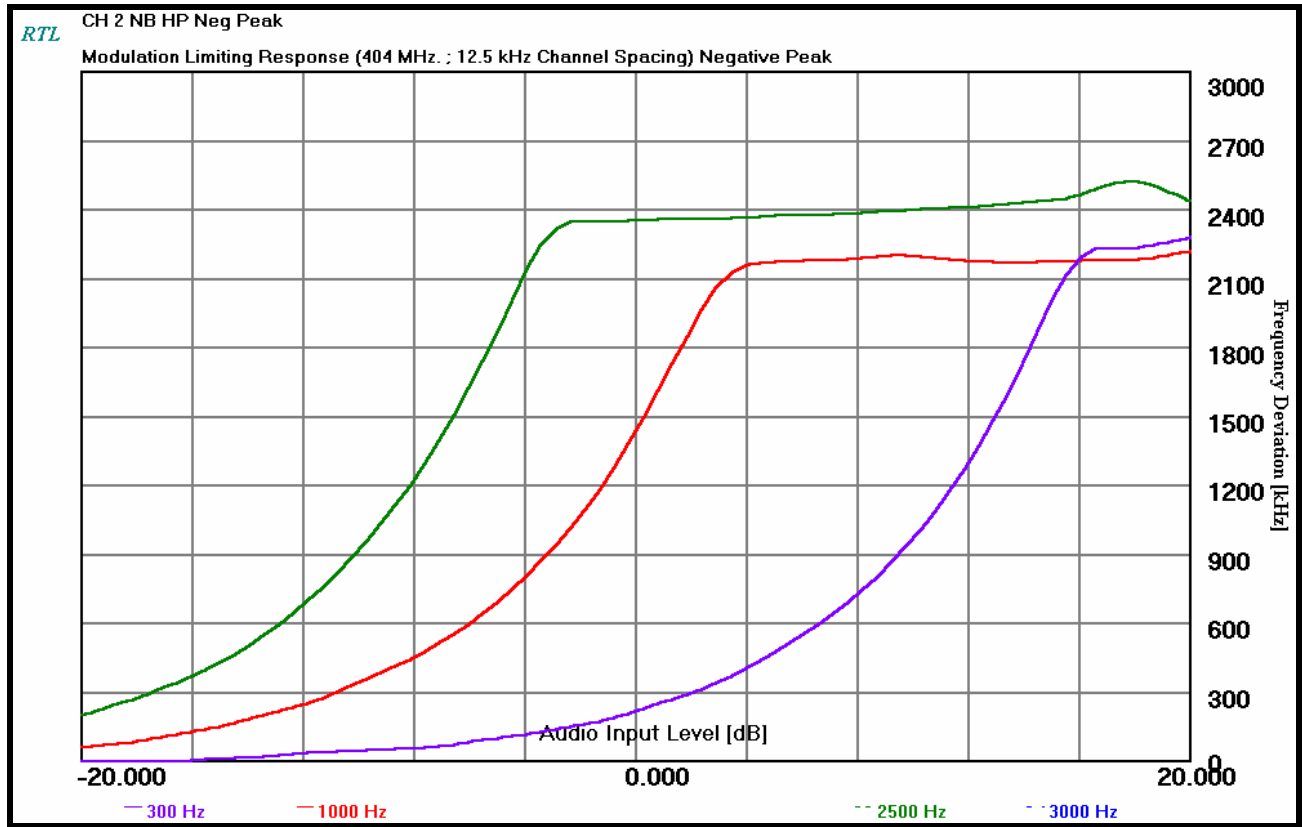


TABLE 13-1: TEST EQUIPMENT USED FOR TESTING (MODULATION LIMITING)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration 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	<i>Daniel Biggs</i>	MARCH 28, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

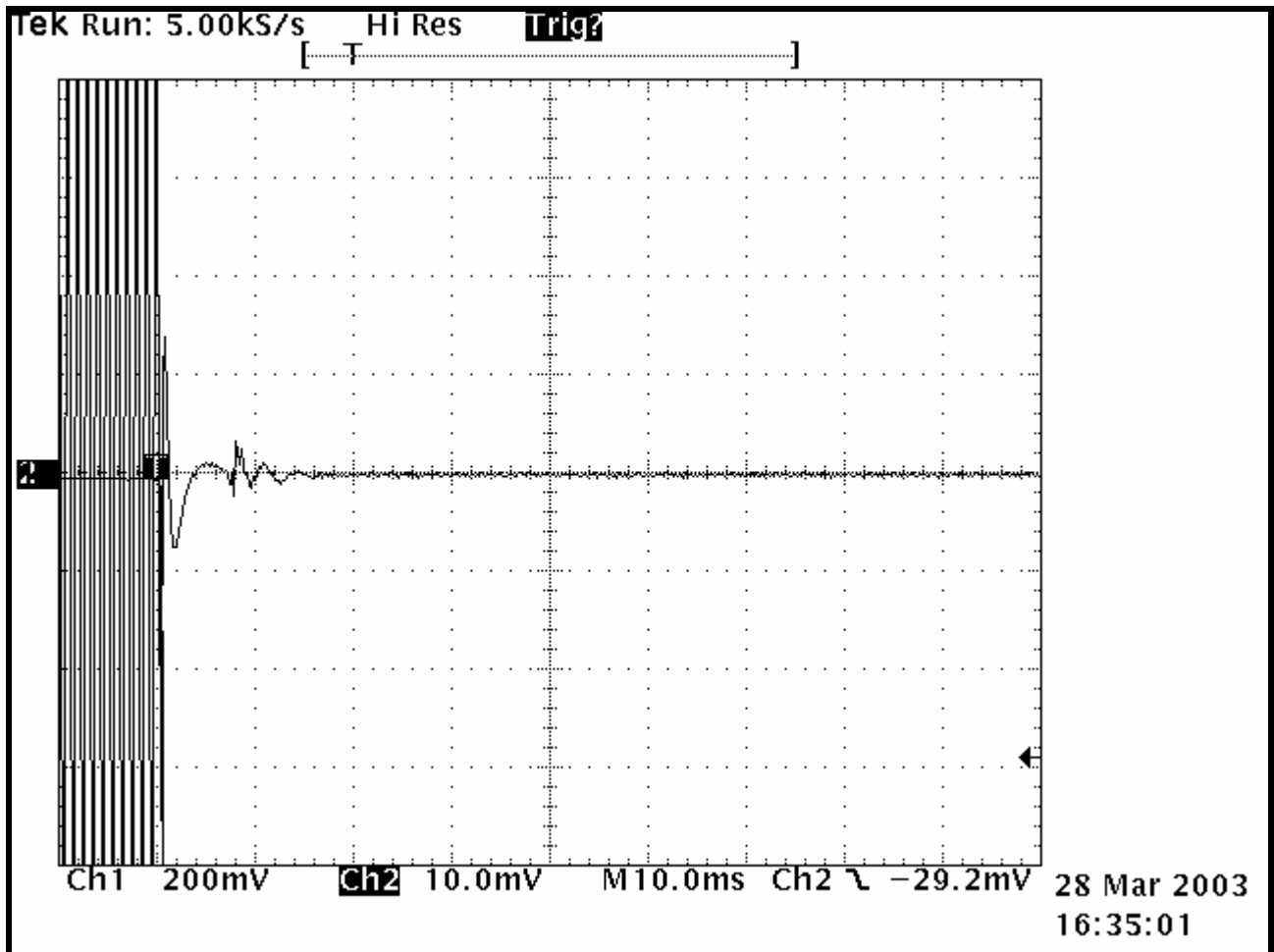
14 FCC RULES AND REGULATIONS PART 90 §90.214: TRANSIENT FREQUENCY BEHAVIOR

14.1 TEST PROCEDURE

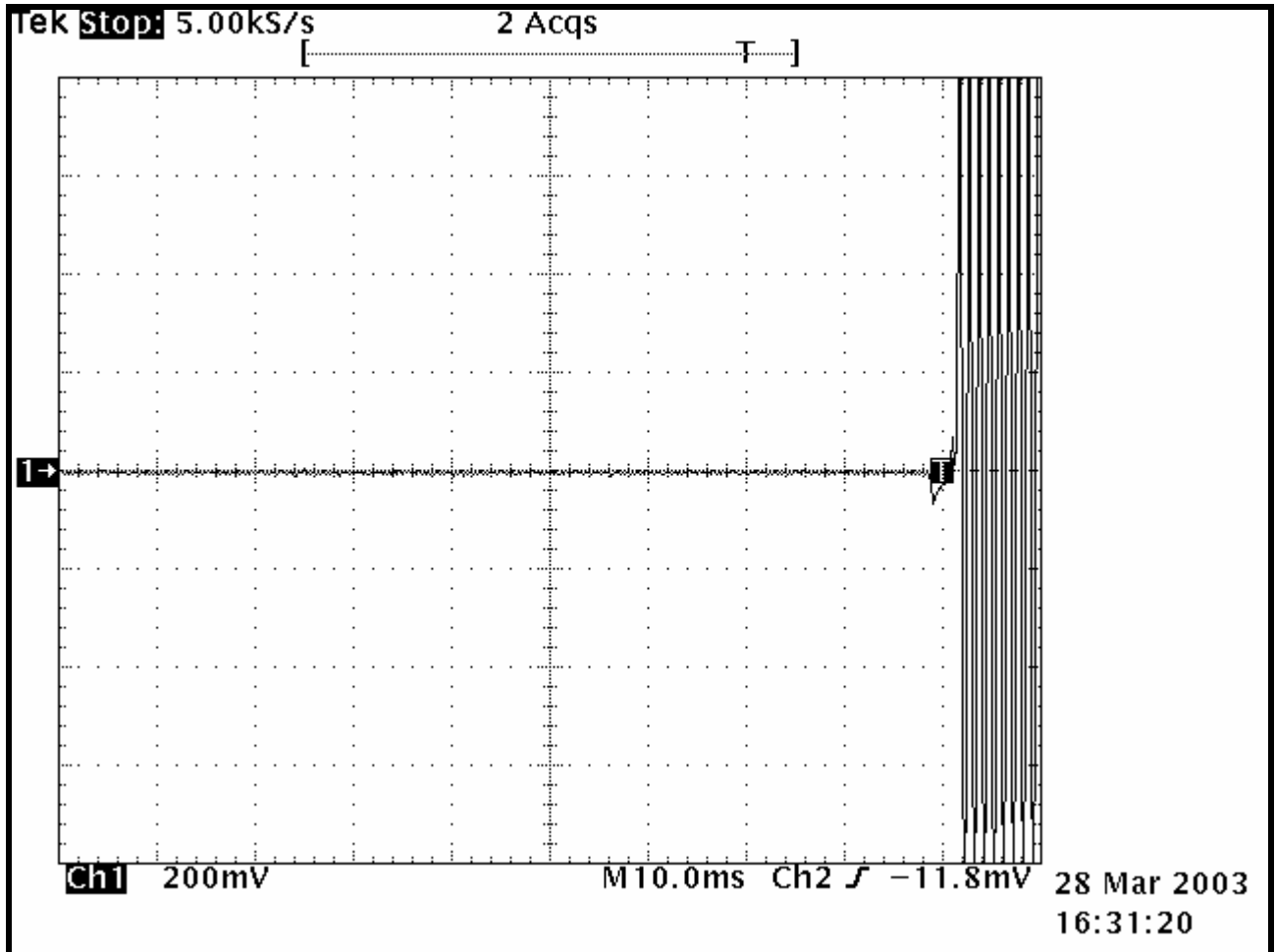
ANSI/TIA/EIA-603-1992, section 2.2.3

14.2 TEST DATA

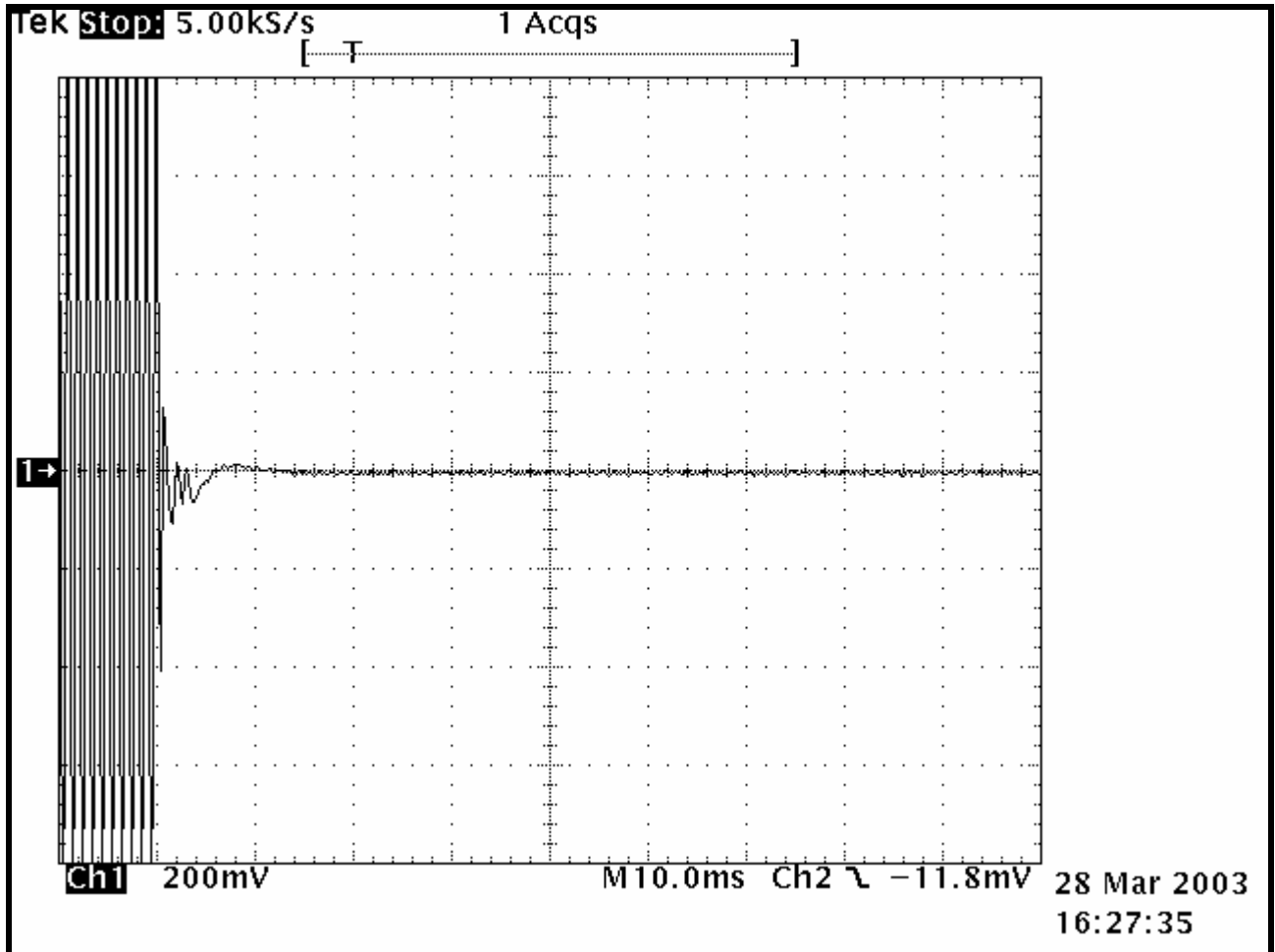
PLOT 14-1: TRANSIENT FREQUENCY BEHAVIOR – 404 MHZ; HIGH POWER; WIDE BAND; CARRIER ON TIME



PLOT 14-2: TRANSIENT FREQUENCY BEHAVIOR – 404 MHZ; HIGH POWER; WIDE BAND; CARRIER OFF TIME



PLOT 14-3: TRANSIENT FREQUENCY BEHAVIOR – 404 MHZ; HIGH POWER; NARROW BAND; CARRIER ON TIME



PLOT 14-4: TRANSIENT FREQUENCY BEHAVIOR – 404 MHZ; HIGH POWER; NARROW BAND; CARRIER OFF TIME

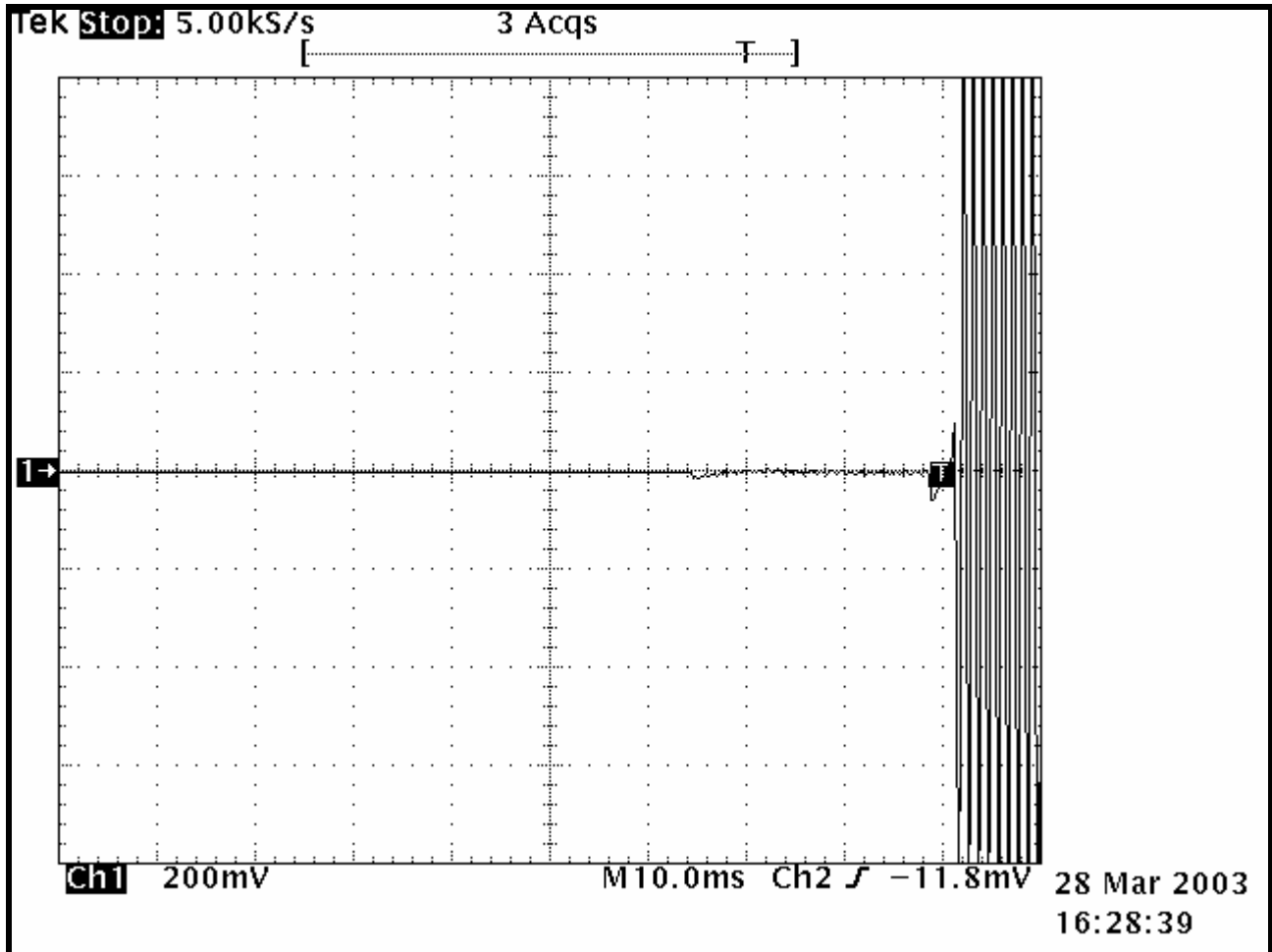


TABLE 14-1: TEST EQUIPMENT USED FOR TESTING (TRANSIENT FREQUENCY BEHAVIOR)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration 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	<i>Daniel Biggs</i>	MARCH 28, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

15 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)

$B_n = 2xM + 2xDK = 16.0$ 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)

$B_n = 2xM + 2xDK = 11.0$ 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)

$B_n = B + 2xDK = 15.6$ kHz

Emission designator: 15K6F1D, 15K6F1E

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)

$B_n = B + 2xDK = 7.8$ kHz

Emission designator: 7K8F1D, 7K8F1E

Measurement: 99.75% Occupied Bandwidth

$B_n = 12.3$ kHz

Emission designator: 12K3F1D, 12K3F1E

Measurement: 99.75% Occupied Bandwidth

$B_n = 11.0$ kHz

Emission designator: 11K0F1D, 11K0F1E

C4FM – 9600 bps:

Calculation:

Max modulation (B) in kHz: 4.8

Max deviation (D) in kHz: 1.8

Constant factor (K): 1 (assumed)

$B_n = B + 2xDK = 8.4$ kHz

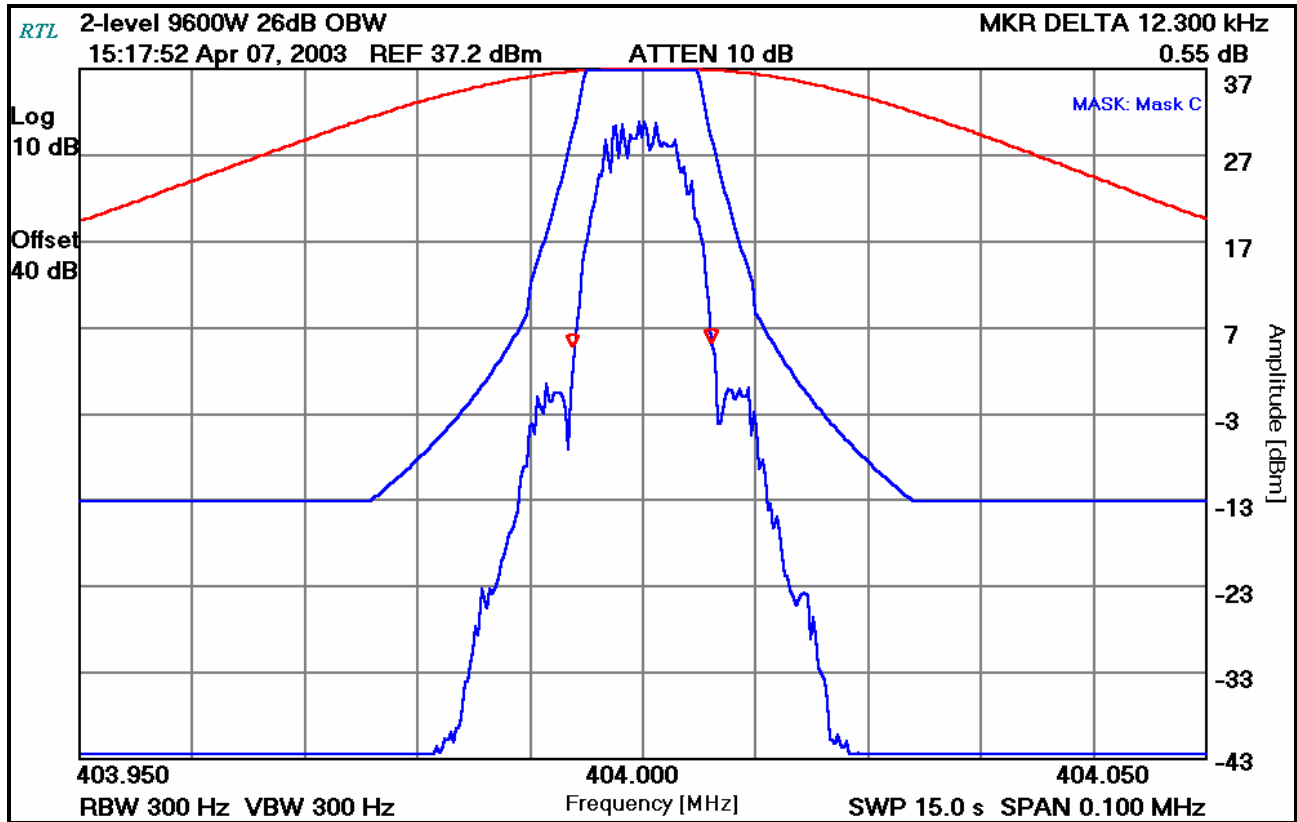
Emission designator: 8K4F1D, 8K4F1E

Measurement: 99.75% Occupied Bandwidth

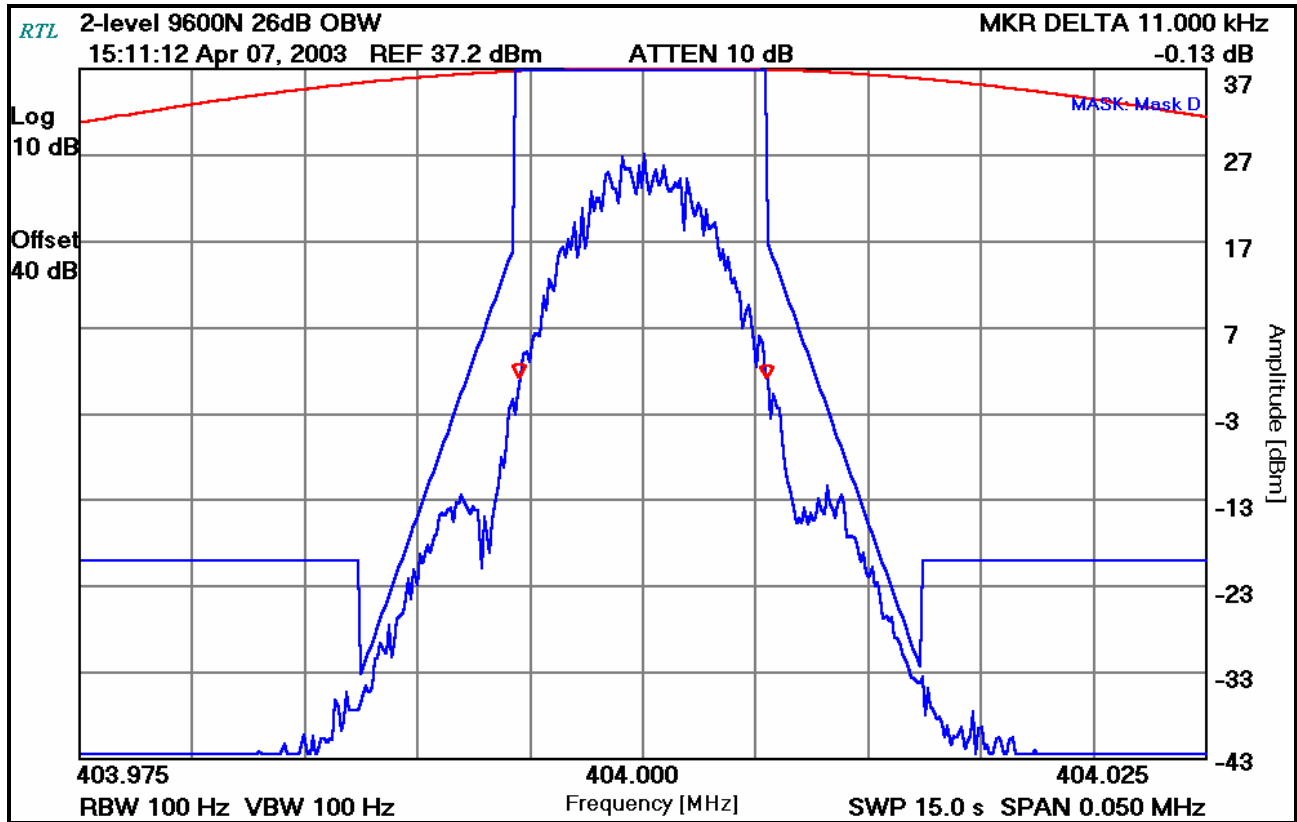
$B_n = 9.38$ kHz

Emission designator: 9K38F1D, 9K38F1E

PLOT 15-1: 26 DB BANDWIDTH; WIDEBAND; 2 LEVEL DIGITAL MODULATION



PLOT 15-2: 26 DB BANDWIDTH; NARROW BAND; 2 LEVEL DIGITAL MODULATION



PLOT 15-3: 26 DB BANDWIDTH; NARROW BAND; C4FM DIGITAL MODULATION

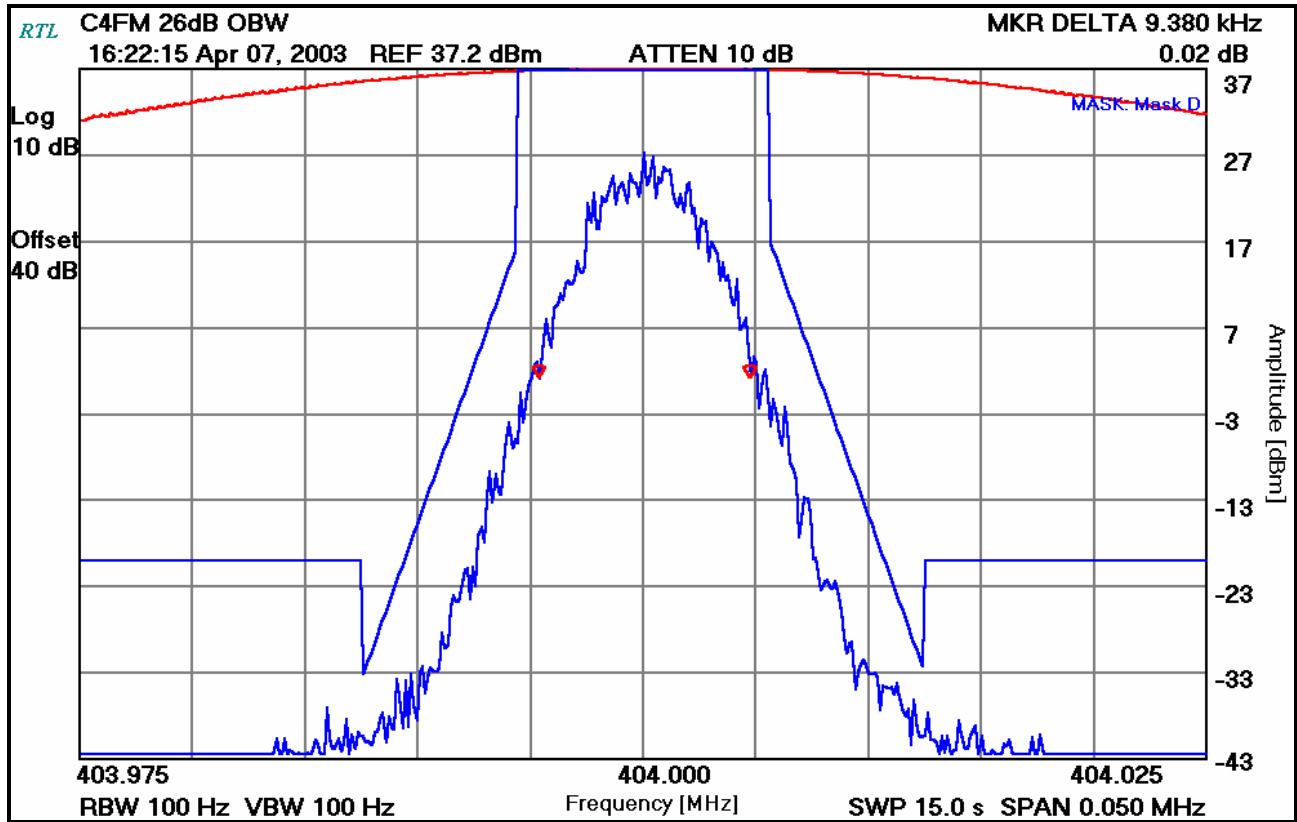


TABLE 15-1: TEST EQUIPMENT USED FOR NECESSARY AND EMISSION BANDWIDTH MEASUREMENTS

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Date
900913	Hewlett Packard	8546	EMI Receiver	3325A00159	12/05/03
900914	Hewlett Packard	85460	RF Filter Section	3330A00107	12/05/03

TEST PERSONNEL:

DANIEL BIGGS	<i>Daniel Biggs</i>	APRIL 7, 2003
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

16 CONCLUSION

The data in this measurement report shows that the **M/A-COM, Inc. Model P7100^(IP) UHF-L Portable Radio, FCC ID: OWDTR-0016-E** complies with all the requirements of Parts 90, 15 and 2 of the FCC Rules, and Industry Canada RSS-119, Issue 6, 2000.