



Garwood Laboratories, Inc. - World Compliance Division
Electromagnetic Compatibility

EMC Measurement / Technical Report

FCC Test Specification : FCC Part 95, Subpart C
Radio Control (R/C) Radio Service

Equipment Authorization : Certification

Manufacturer : A.H.C. Megatech

Equipment Under Test : 27MHz Radio Control Transmitter
Part Number MTC993011

Test Report No. : FR1780-E

Purchase Order No. : 1251

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EMC Measurement / Technical Report

Document No. FR1780-E

From

**Garwood Laboratories, Inc.
World Compliance Division**

Test for

A.H.C. Megatech

27 MHz Radio Control Transmitter

Part Number MTC993011

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Electromagnetic Compatibility

MEASUREMENT / TECHNICAL REPORT SUMMARY

<i>Manufacturer Company</i> <i>Address</i> <i>City, State, Zip</i> <i>Country</i> <i>Contact Name</i> <i>Phone</i> <i>Fax</i>	A.H.C./Megatech 8300 Tonelle Avenue North Bergen, NJ 07047 USA Peter Winston 201-662-8500 201-662-1450
<i>Type of Authorization</i>	Certification for 27 MHz R/C Transmitter
<i>Applicable FCC Rules</i>	<p>This technical report is to certify that Equipment Under Test (EUT) complied with the requirements of:</p> <p style="text-align: center;">FCC Pt.95 Subpart C – Radio Control Radio Service Technical Regulations found in FCC Pt. 95 Subpart E</p> <p>All the tests necessary to show compliance to the requirements were performed and are listed below. The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2 Subpart J-Equipment Authorization Procedures.</p> <p style="text-align: center;">RF Power Output (§2.1046) Modulation Characteristics (§2.1047) Occupied Bandwidth (§2.1049) Field Strength of Spurious Radiation (§2.1053) Frequency Stability (§2.1055)</p>
<i>Test Results</i>	<p>The EUT complied with the applicable FCC requirements. The test results presented in this document are valid only for the equipment identified herein under the test conditions described. Repeatability of these test results will only be achieved with identical measurement conditions.</p> <p>The EUT is a battery-operated device; therefore, the conducted emissions test is not applicable and was not performed.</p>
<i>Equipment Under Test</i>	27 MHz Radio Control Transmitter
<i>Identification of EUT</i>	Part Number MTC993011 FCC ID: P4SMTC993011
<i>Production Quantity</i>	Multiple Units

<i>EMC Test Laboratory</i> <i>Facility</i> <i>Address</i> <i>City, State, Zip Code</i> <i>Country</i> <i>Contact Name</i> <i>Title</i> <i>Phone</i> <i>Fax</i>	Garwood Laboratories, Inc. -OC World Compliance Division 565 Porter Way Placentia, CA 92870 USA Greg Lewis General Manager (714) 572-2027 (714) 572-2025
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1. General Information

1.1 Product Description

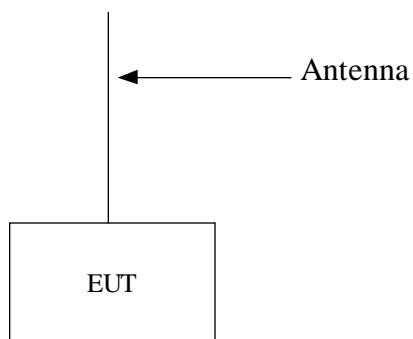
Equipment Under Test	27 MHz Radio Control (R/C) Transmitter
Part Number	MTC993011
Description	The Equipment Under Test (EUT) is an FM 27 MHz 2-Channel Radio Control Transmitter Part Number MTC993011 that is used for aircraft remote control. The working voltage of the EUT is 8.0-12.0VDC and it operates from 8 'AA' size batteries.
Clock Frequencies	Crystal frequency – 13.5MHz Transmitter frequency tuned to during test 27.045MHz

1.2 Configuration of Tested System

The following table lists all of the components of the tested system. FCC ID numbers are included if available for a tested system component.

Tested System Details					
Item	Manufacturer	Description	Part No.	Serial No.	FCC ID
EUT	A.H.C. Megatech	R/C Transmitter	MTC993011	Not Available	P4SMTC993011

The Equipment Under Test (EUT) was tested as a stand-alone unit. The EUT contains an integral antenna, which was extended to its maximum length during the test. The EUT derives its operating voltage from 8 'AA' size batteries. Before the field strength measurements, new batteries were installed in the EUT.





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1.3 Test Facility

The Open Area Test Site (OATS) and measurement facilities used to collect the test data are located at Garwood Laboratories, Inc. World Compliance Division test facility in Placentia, CA. This facility has been fully described in a report submitted to the FCC and accepted in a letter dated 28 January 2000 (31040/SIT 1300F2) registration #90681.

The test facility is also recognized, certified, or accredited by the following organizations:

NVLAP Lab Code: 200119-0

Garwood Laboratories, Inc. is recognized under the National Voluntary Laboratory Accreditation Program (NVLAP/NIST) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002:1994 (ANSI/ASQC Q9002-1994) for suppliers of calibration or test results. NVLAP Code: 200119-0, Effective through December 31, 2001.

FCC

This site has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Reference: 31040/SIT 1300F2, Registration #90681, January 28, 2000. With the above and NVLAP, Garwood Laboratories is an authorized test laboratory for the DoC process.

Technology International (IT)

Garwood Laboratories, Inc. has been assessed in accordance with ISO Guide 25 and with ITI's assessment criteria. Based upon this assessment, Technology International (Europe), Ltd. has granted approval for specifications implementing the EU Directive on EMC (89/336/EEC). The scope of the approval was provided on a Schedule of Assessment supplied with a certificate and is available upon request. Certificate #01-051, Dated: August 5, 2001.

ACA

Garwood Laboratories, Inc. can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation and the MRA (Mutual Recognition Agreement) between the US and Australia.

VCCI

Garwood Laboratories, Inc. has been accepted as a member to the VCCI. Our conducted and radiated measurement facilities have been registered in accordance with Regulations for Voluntary Control Measures. January 27, 2003. Registration: C1226, C1184, R1127.

Industry Canada

Garwood Laboratories, Inc. is registered by Industry Canada for performance of measurements and complies with RSP 100. Reference IC 3298, Dated: March 11, 1999.

KETI

Garwood Laboratories, Inc. is authorized, by joint agreement with Korea Electric Testing Institute (KETI), to perform required and necessary South Korean Product Safety and EMC testing (including reports) according to the IEC and CISPR standards.

BSMI (Formerly known as BCIQ)

Garwood Laboratories, Inc. can perform testing for Taiwan to the CNS requirements. This is as a result of our NVLAP accreditation and the MRA (Mutual Recognition Agreement) between the US and Taiwan.

Nmi (Nederlands Meetinstituut)

Garwood Laboratories, Inc. has entered into a cooperative agreement with Nmi Certin B.V. of the Netherlands. This is a Notified Body for the RATTE Directive and Maritime Directive as well as a Competent Body for the EMC Directive.



2. Technical Information

<i>Type of Emission</i>	8K0F1D
<i>Operating Frequency Range</i>	Channel 1: 26.995MHz Channel 2: 27.045MHz Channel 3: 27.095MHz Channel 4: 27.145MHz Channel 5: 27.195MHz Channel 6: 27.255MHz
<i>Range of Operating Power</i>	Fixed Output Power
<i>Measured Output Power</i>	3.27mW
<i>FCC Requirement Transmitter Power</i>	4W
<i>Modulation</i>	Frequency Modulation
<i>Power Requirement</i>	8 "AA" alkaline dry cells (12VDC)

2.1 EUT Circuit Schematics

The circuit schematics of the unit under test can be found in the Attachment section of this report.

2.2 EUT Parts List

The parts list of the unit under test can be found in the Attachment section of this report.



3. Product Labeling

3.1 FCC ID Label

All devices authorized under the certification procedures are required to display an identification label showing the FCC Identifier (FCC ID) under which they are authorized.

Example:

FCC ID: XXX123

XXX = Indicates manufacturer's Grantee Code

123 = Indicates manufacturer's Equipment Product Code

In addition, the manufacturer (or importer) is responsible for having the compliance label produced, and for having it affixed to each unit that is marketed or imported.

FCC Compliance Label:

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference including interference that may cause undesired operation.

3.2 Location of Label on the EUT

As stated in §15.19, the label shall be located in a conspicuous location on the device. When the device is so small or for such use that it is not practicable to place the compliance label on it, the information required should be placed in a prominent location in the instruction manual or pamphlet supplied to the user. Alternatively, the compliance label can be placed on the container in which the device is marketed. However, the FCC identifier must be displayed on the device.

3.3 Information to the User

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



4. Block Diagram of the EUT

A circuit block diagram of the EUT was not available.



5. Test Results

5.1 Transmitter Power

Test Requirement:

The maximum transmitter power for an R/C transmitter, under any condition of modulation, should not exceed a carrier power or peak envelop TP (single-sideband only) of:

- 4 Watts in the 26-27MHz frequency band, except of channel frequency 27.255MHz.
- 25 Watts on channel frequency 27.255 MHz

Test Method:

The technique used to find the output power of the transmitter was the antenna substitution method. The following test procedure was followed:

1. The EUT was powered ON and placed on a table in the OATS. The antenna of the transmitter was extended to its maximum length.
2. The fundamental frequency (27.045MHz) of the transmitter was maximized on the Spectrum Analyzer display by raising and lowering the receive antenna and by rotating the turntable. After the fundamental emission was maximized, a field strength measurement was made.
3. Steps 1 and 2 were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
4. The transmitter was then removed and replaced with a half-wave tuned dipole antenna. The center of the antenna was approximately at the same location as the center of the transmitter. When vertically polarized, the lower end of the substitution antenna was 0.3m above the ground since the antenna was very long.
5. A signal at the fundamental frequency (27.045MHz) was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the Spectrum Analyzer. The level of the signal generator was adjusted until the measured field strength level in step 2 is obtained for this set of conditions.
6. The output power into the substitution antenna was then measured.
7. Steps 5 and 6 were repeated with both antennas polarized vertically.

Test Result:

The highest field strength measured at the fundamental frequency (27.045MHz) was 85.5dB μ V/m at a distance of 3 meters. The transmitter output power found using the antenna substitution method was 3.27mW.



5.2 Emission Bandwidth

Test Requirement:

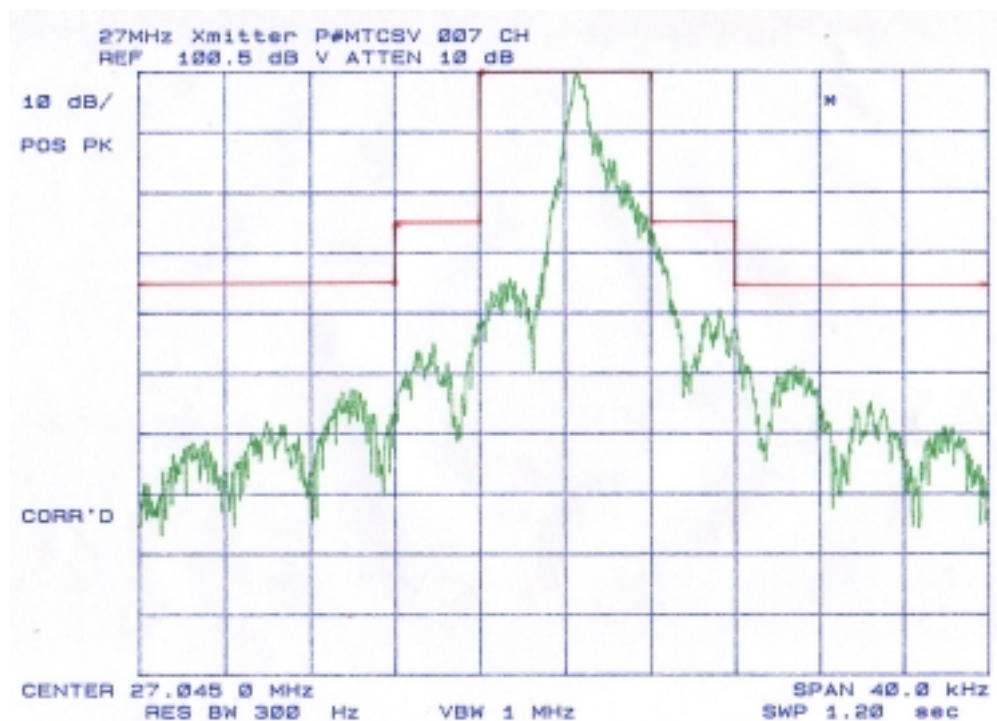
An R/C transmitter is allowed to transmit any appropriate non-voice emission, which meets the emission limitations for an R/C transmitter. The authorized bandwidth for any emission type transmitted by an R/C transmitter is 8kHz.

The power of each unwanted emission shall be less than the transmitter power (TP) by:

- (1) At least 25 dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.
- (2) At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth

Test Results:

The EUT complied with the emission bandwidth requirement. During testing, all control switches and buttons were investigated for the worst-case modulated signal. The following plot shows the test results.





5.3 Field Strength of Spurious Radiation

Test Requirement:

The power of each unwanted emission should be less than the transmitter power (TP) by at least $43 + 10\log(\text{TP})$ on any frequency removed from the center of the authorized bandwidth by more than 250%.

Test Method:

Radiated spurious emissions measurements were made in the OATS. The EUT was placed 80 centimeters above the ground plane on a non-conductive tabletop 1.0-meter width by 1.5-meter length. The frequency span of 30MHz-1000MHz was scanned to detect spurious emissions. Rotating the turntable and varying the antenna height from 1 to 4 meters maximized the emissions found. Furthermore, the configuration of the EUT and its cables were varied to maximize the amplitude level of the emissions if applicable. Field strength measurements were made at a EUT to receive antenna distance of 3 meters in vertical and horizontal antenna polarizations.

Test Results:

The transmitter complied with the radiated spurious requirement and the following table contains the 10 highest spurious emissions.

Tuned Frequency: 27.045 MHz

Measurement Distance: 3m

Calculation of FCC Limit: $\text{FS} - [43 + 10\log(\text{TP})]$

Where, TP = measured transmitter power

FS = Fundamental field strength

$$85.5\text{dB}\mu\text{V/m} - [43 + 10\log(3.27\text{mW})] = 67.35\text{dB}\mu\text{V/m}$$

The field strength of the spurious emissions should not exceed 67.35dB μ V/m

Frequency (MHz)	Antenna Polarization (V or H)	S.A. Reading (dB μ V)	Correction Factor (dB)	Corrected Reading (dB μ V/m)	FCC Limit (dB μ V/m)	Delta to FCC Limit (dB)
Fundamental						
27.045	V	69.20	16.3	85.5	--	--
Spurious Emissions						
405.681	H	44.1	19.1	63.2	67.35	-4.15
392.158	H	42.8	18.8	61.6	67.35	-5.75
378.621	H	42.0	18.7	60.7	67.35	-6.65
419.212	H	40.9	19.6	60.5	67.35	-6.85
459.758	H	39.9	20.1	60.0	67.35	-7.35
473.291	H	38.8	20.3	59.1	67.35	-8.25
581.464	H	35.7	22.6	58.3	67.35	-9.05
689.656	H	33.6	24.5	58.1	67.35	-9.25
432.715	H	37.9	19.8	57.7	67.35	-9.65
446.237	H	37.5	19.9	57.4	67.35	-9.95



- The Correction Factor consist of Antenna Factor + Cable Loss.



5.4 Frequency Stability

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the assigned carrier frequency.

Test Requirement: (Reference CFR 47 Subpart E §95.623(b))

Each R/C transmitter that transmits in the 26-27 MHz frequency band with a mean TP of 2.5Watts or less and that is used solely by the operator to turn on and/or off a device at a remote location, other than a device used solely to attract attention, must be maintained within a frequency tolerance of 0.01% (100ppm). All other R/C transmitters that transmit in the 26-27 MHz frequency band must be maintained within a frequency tolerance of 0.005% (50ppm).

Test Method:

Frequency measurements were made as follows:

- (a) at 10 degree intervals of temperatures between -30°C and +50°C at the manufacturer's rated supply voltage, and
- (b) at +20°C temperature and ±15% supply voltage variations.

Note, for handheld equipment that is only capable of operating from internal batteries, reduce the primary supply voltage to the battery operating end point. The manufacturer should specify the battery operating endpoint voltage of the equipment.

Test Results:

The transmitter complied with the frequency stability requirements. The tables below show the test results.

Frequency Stability vs. Temperature

Assigned Frequency (MHz)	Temperature (°C)	Measured Frequency (MHz)	Frequency Deviation (ppm)	Limit
27.045	-30	27.046102	+40.74	±50ppm
	-20	27.046092	+40.37	
	-10	27.046073	+39.67	
	0	27.045998	+36.90	
	+10	27.045820	+30.31	
	+20	27.045656	+24.25	
	+30	27.045489	+18.08	
	+40	27.045341	+12.60	
	+50	27.045249	+9.2	

Frequency Stability vs. Supply Voltage

Nominal Voltage: 12.0VDC

Temperature: 17°C

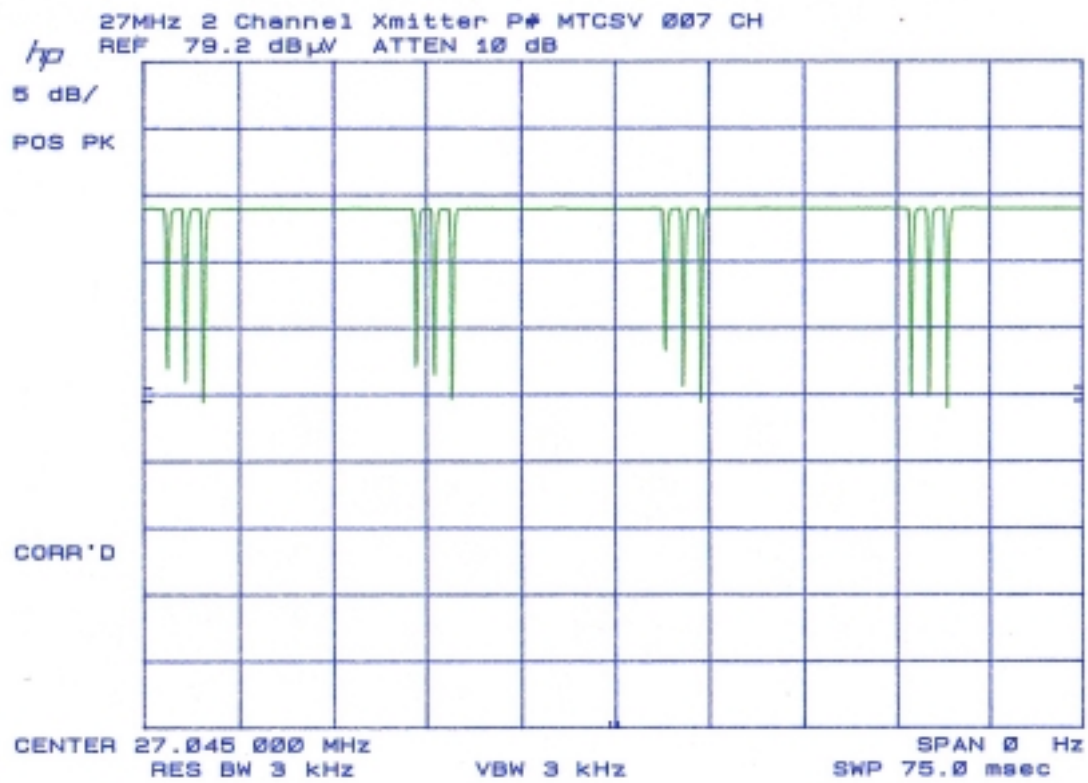
Assigned Frequency (MHz)	Voltage (V)	Measured Frequency (MHz)	Frequency Deviation (ppm)	Limit
27.045	12	27.045469	+17.34	±50ppm
	11	27.045542	+20.04	
	10	27.045609	+22.51	
	9	27.045757	+27.99	
	8	27.045906	+33.49	

The battery operating voltage endpoint of the transmitter per the manufacturer is 8.0VDC.



5.5 Modulation Characteristics

A plot showing the modulation characteristics of the transmitter is shown below.





5.6 Crystal Access Restrictions

The EUT has no control knobs, switches, or other type of adjustments either on the operating front panel or on the exterior of the transmitter enclosure, which when manipulated can result in violation of the rules. The plug in crystal is not accessible to the user.



5.7 Radio Frequency Radiation Exposure

As stated in CFR 47 Part 2 Subpart J §2.1093, an evaluation for radio frequency radiation exposure is not required for portable devices authorized under CFR 47 Part 95 Subpart C (Radio Control R/C Radio Service).



6. Photographs of Test Arrangement and EUT Construction

REFER TO EXHIBITS
Test Setup Picture (Front View)

REFER TO EXHIBITS
Test Setup Picture (Rear View)



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REFER TO EXHIBITS
EUT Construction Front View



Garwood Laboratories, Inc. - *World Compliance Division*
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REFER TO EXHIBITS
EUT Construction Back View



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REFER TO EXHIBITS
EUT with Front Cover Removed



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REFER TO EXHIBITS
EUT PCB Components Side



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REFER TO EXHIBITS
EUT Solder Side



APPENDIX A - TEST EQUIPMENT USED

The absolute performance calibration of equipment requiring calibration is performed on an as needed basis in accordance with MIL-STD 45662A. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least +/- 2dB amplitude and +/- 2% frequency deviation. Equipment certifications showing traceability to NIST (National Institute of Standards and Technology) are maintained on file at Garwood Laboratories, Inc. Placentia, CA. All equipment is checked and verified for proper operation before and after each series of tests.

A.1 Specific Equipment Used

<i>Test</i>	<i>Instrument</i>	<i>MFG / Model No.</i>	<i>Asset No.</i>	<i>Cal. Due Date</i>
Field Strength of Spurious emissions				
	Quasi-Peak Adapter	Hewlett Packard / 85650A	20011	07/27/02
	Spectrum Analyzer Display	Hewlett Packard	20010	07/27/02
	Spectrum Analyzer	Hewlett Packard / 8568B	20009	07/27/02
	RF Preselector	Hewlett Packard / 85685A	20008	07/27/02
	RF Coax Cable	Times Microwave / LMR 600	20180	02/25/02
	BiLog Antenna	Chase / CBL6111A	20062	04/26/02
Power Output				
	Quasi-Peak Adapter	Hewlett Packard / 85650A	20011	07/27/02
	Spectrum Analyzer Display	Hewlett Packard	20010	07/27/02
	Spectrum Analyzer	Hewlett Packard / 8568B	20009	07/27/02
	RF Preselector	Hewlett Packard / 85685A	20008	07/27/02
	RF Coax Cable	Times Microwave / LMR 600	20180	02/25/02
	Biconical Antenna	A.H. Systems / SAS-200/540	20052	2/21/02
	Signal Generator	Marconni / 2022D	20037	06/01/02
	RF Amplifier	EIN / 411LA	20028	Verify Before Use
	Directional Coupler	Werlatone / C1460	20389	Verify Before Use
	Dipole Antenna	Roberts Dipoles/Roberts Antenna 1	20063	06/30/02
	Spectrum Analyzer	Hewlett Packard / 8595E	20024	01/11/02
Occupied Bandwidth/Modulation Characteristics				
	Quasi-Peak Adapter	Hewlett Packard / 85650A	20016	06/01/02
	Spectrum Analyzer Display	Hewlett Packard	20015	06/01/02
	Spectrum Analyzer	Hewlett Packard / 8566B	20014	06/01/02
	RF Preselector	Hewlett Packard / 85685A	20017	06/01/02



APPENDIX B – SUPPLEMENTAL TEST DATA

<i>Basic Standard</i>	<i>Test Type</i>	<i>Data Format</i>	<i>Page No.</i>
FCC Pt. 95 Subpart C	No Supplemental data attached	---	---



ATTACHMENTS

INDEX OF ATTACHMENTS

<i>Description of Contents</i>	<i>Page No.</i>
EUT Circuit Schematic	Exhibit A
EUT Parts List	Exhibit B
User Instruction Manual	Exhibit C