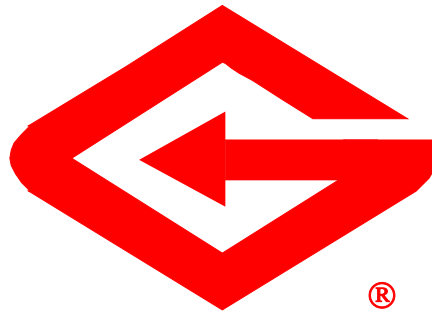




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FCC TEST REPORT
for
HUBSUNG
2 Channel FM Transmitter, 27MHz
Model: Husky FM

GARWOOD LABORATORIES, INC.
TESTING AND ENGINEERING SERVICES



FCC TEST REPORT
Certification for FCC Part 95
Subpart C – Radio Control (R/C) Radio Service

Report for:
HUBSUNG
2 CHANNEL FM TRANSMITTER, 27MHz
Model: Husky FM

Prepared For: Hubsung Plastics, Ltd.
182-3 Dodang-dong Wonmi-ku Bucheon-city
Kyonggi-do, South Korea, 420-130

Prepared By: Garwood Laboratories, Inc
7829 Industry Avenue
Pico Rivera, CA 90660

Issued: August 13, 2003



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FCC TEST REPORT FOR HUBSUNG

RESPONSIBLE SIGNATURES

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EMC Manager

DOCUMENT HISTORY

Revision	Issue Date	Affected Page(s)	Description Of Modifications	Revised By	Approved By
N/C			Initial release		



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CLIENT INFORMATION

<i>Purchase Order</i>	1351
<i>Company Name</i>	Hubsung Plastics Ltd.
<i>Address</i>	182-3 Dodang-dong Wonmi-ku
<i>City, State, Country Zip</i>	Bucheon-city, Kyounggi-do, South Korea, 420-130
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<i>Title</i>	EMC Manager

<i>Test Personnel</i>	<i>Test Dates</i>
Arnulfo Tapia – EMC Sr. Technician	1/17/03, 2/21/03



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ACCREDITATIONS:

The Open Area Test Site (OATS) and measurement facilities used to collect the test data are located at Garwood Laboratories, Incorporated test facility in Pico Rivera, California. This facility has been fully described in a report submitted to the FCC and accepted in a letter dated 22 April 2002, Registration Number 534174.

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



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. Registration Number: 534174. Date of listing: April 22, 2002. **Garwood Laboratories** is an authorized test laboratory for the DoC process.



Garwood Laboratories, Inc. has been assessed in accordance with ISO 17025 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 Number: 01-051, effective through August 5, 2002, or until the next agreed assessment date (October 11, 2002).



Industry
Canada

Garwood Laboratories, Inc. is registered by Industry Canada for performance of measurements and complies with RSS 212, Issue 1 (Provisional). Reference IC 3298, Dated: January 8, 2003.



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.

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 R&TTE Directive and Maritime Directive as well as a Competent Body for the EMC Directive.



FCC TEST REPORT FOR HUBSUNG

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FCC TEST REPORT FOR HUBSUNG

Measurement / Technical Report Summary

Type of Authorization	Certification for 27MHz Radio Control (R/C) Transmitter
Applicable FCC Rules and Tests	<p>This test report has been prepared in accordance with the requirements of FCC Rules and Regulations as listed in title 47 CFR. The following subparts are applicable:</p> <p>PART 95 – PERSONAL RADIO SERVICES Subpart C – Radio Control (R/C) Radio Service Subpart E – Technical Regulations</p> <p>PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS Subpart J – Equipment Authorization Procedures</p> <p>Tests: RF Power Output Modulation Characteristics Occupied Bandwidth Field Strength of Spurious Radiation Frequency Stability</p> <p>In performing the tests listed above, the guidelines listed under FCC Part 2 §2.1046, §2.1047, §2.1049, §2.1053, §2.1055 and §2.1057 were followed.</p>
Summary of Test Results	<p>The EUT, Husky 2 Channel FM Transmitter, complied with all the applicable tests.</p> <p>The EUT is a battery-operated unit; therefore, the conducted emissions test was not performed.</p>



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FCC TEST REPORT FOR HUBSUNG

1.0 GENERAL INFORMATION

1.1 Product Description

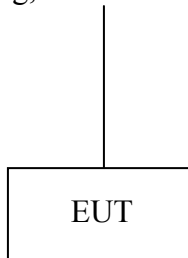
Equipment Under Test	2 Channel FM Transmitter, 27MHz
Model Number	Husky FM
Description	The EUT is a 2 Channel FM Transmitter that is used for remote control of surface R/C models. The transmitter can only be tuned to any one of the six allowed operating frequencies in the 27MHz band (26.995, 27.045, 27.095, 27.145, 27.195, or 27.255MHz). The preferred frequency is selectable by pressing the trim buttons. The transmitter can operate from either 8 'AA' size Alkaline batteries or 8 'AA' size NiCd rechargeable batteries.
Operating Frequencies	4MHz crystal, The unit was tuned to 27.145MHz during testing.

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					
<i>Item</i>	<i>Manufacturer</i>	<i>Description</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>FCC ID</i>
EUT	Hubsung	2 Channel FM Transmitter, 27MHz	Husky FM	Not Available	----

The EUT was tested as a stand-alone unit. The EUT contains an integral antenna, which was extended to its maximum length for each test. Before testing, new batteries were installed in the EUT.





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FCC TEST REPORT FOR HUBSUNG

2. TECHNICAL INFORMATION

2.1 Specifications

Type of Emission	8K00F1D
Frequency Range	26.995 – 27.255 MHz
Range of Operating Power	Fixed Output Power
Measured Output Power	845 μ W
FCC Limit Power Output	4W
Type of Modulation	Frequency Modulation
Power Requirement	Eight 'AA' alkaline batteries

2.2 Circuit Schematics

Please refer to the Attachment section of this report for circuit schematics of the 2 Channel FM Transmitter, 27MHz.

2.3 Additional Circuit Information

Please refer to the Attachment section of this report for the parts list of the FM 27MHz Radio Control transmitter.



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3.0 PRODUCT LABELING

3.1 FCC ID Label

The FCC ID consists of two elements, a grantee code and an equipment product code (EPC), in the exact order as shown in the example below (Ref: §2.925(a)).

Example FCC ID:

FCC ID XXX123

XXX = The three-character grantee code is assigned permanently by the FCC to a specific grantee (applicant) and is valid only for the party listed and at the address listed in the Notification of Code Assignment.

123 = The equipment product code (EPC) is assigned by the grantee (applicant) and should consist of a series of Arabic numerals, capital letters or a combination thereof and may include the dash or hyphen (-). The series of characters of the EPC should not exceed 14.

Please refer to the attachment section for a drawing of the FCC ID label for the Husky 2 Channel FM Transmitter.

3.2 Location of the Label on the EUT

In order to validate the grant of equipment authorization, the FCC ID label should be permanently affixed to the equipment and should be readily visible to the purchaser at the time of purchase (Ref: §2.925(d)).

Please refer to the attachment section for a picture of the location of the FCC ID label on the Husky 2 Channel FM Transmitter.

3.3 Instructions and Warnings

A user's instruction manual must be supplied with each transmitter marketed. The instruction manual must contain all information necessary for the proper installation and operation of the transmitter including (Ref, §95.653):

- a) Instructions concerning all controls, adjustments and switches that may be operated or adjusted without resulting in violation of the rules.
- b) Warnings concerning any adjustment that could result in a violation of the rules.
- c) Warnings concerning the replacement of any transmitter component that could result in a violation of the rules.

Please refer to the attachment section for the instruction manual of the Husky 2 Channel FM Transmitter.



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4. TEST RESULTS

4.1 Power Output

Test Requirement: Power Output (Reference: FCC PT.95, Subpart E, §95.639(b1))

<i>Frequency (MHz)</i>	<i>Antenna Polarity (V or H)</i>	<i>Corrected Field Strength Measurement (dBμV/m)</i>	<i>Power Output (μW)</i>	<i>FCC Limit Power Output (W)</i>	<i>Judgment</i>
27.145	V	94.5	845	4.0	Complied
27.145	H	89.0	238	4.0	Complied

Test Details:

The field strength of the fundamental frequency of the EUT was measured in the Open Air Test Site, OATS. The power output (in Watts) was derived from the measured field strength using the equation shown below, which approximates the relationship between power and field strength:

$$(PG / 4\pi D^2) = (E^2 / 120\pi)$$

where,

P is transmitter power in Watts

G is the numerical gain of the transmitting antenna relative to an isotropic source

D is the distance of the measuring point from the electrical center of the antenna in meters

E is the electric field strength in volts/meter.

Using the above equation, and with the gain of the transmit antenna equal to one (G=1) and a measurement distance of 3 meters (D=3), a formula for determining power given field strength can be developed:

$$P = 0.3 E^2$$

Sample calculation:

$$E \text{ (V/m)} = (1E-6) * (10^{(94.5/20)}) = 0.05308 \text{ V/m}$$

$$P \text{ (W)} = 0.3 * (0.05308)^2 = 845 \mu\text{W}$$

**FCC TEST REPORT FOR HUBSUNG****4.2 Spurious Radiated Emissions**

Test Requirement: Unwanted Radiation (Reference FCC PT.95, Subpart E, §95.635)

Test Procedure: Antenna Substitution Method (Reference ANSI/TIA/EIA-603-1992)

The field strengths of the spurious emissions of the EUT were measured in the Open Air Test Site, OATS. The unit was then removed from the table and the antenna substitution method was used to find the power of the radiated spurious emissions. The table below summarizes the test results.

<i>Frequency (MHz)</i>	<i>Antenna Polarity (V or H)</i>	<i>Measured Field Strength Radiated Spurious (dBμV/m)</i>	<i>Power Radiated Spurious (dBm)</i>	<i>Radiated Spurious Attenuation from Carrier (dB)</i>	<i>Limit Attenuation from Carrier (dB)</i>	<i>Judgment</i>
54.29	V	71.0	-36.46	35.7	12.3	Complied
54.29	H	62.5	-43.15	42.4	12.3	Complied
81.435	V	61.0	-40.02	39.3	12.3	Complied
81.435	H	56.1	-48.41	47.7	12.3	Complied
108.58	V	79.0	-20.92	20.2	12.3	Complied
108.58	H	78.5	-23.09	22.4	12.3	Complied
135.725	V	74.5	-26.71	26.0	12.3	Complied
135.725	H	77.6	-25.78	25.0	12.3	Complied

Test Details:

Sample Calculations:

A) Power Radiated Spurious

$$P_d \text{ (dBm)} = P_g \text{ (dBm)} - \text{Cable Loss (dB)} + \text{antenna gain (dBd)}$$

where,

 P_g is the generator output power into the substitution antenna

Antenna gain is gain of the substitution antenna relative to an ideal half-wave dipole

Example: (54.29MHz, vertical)

$$P_d \text{ (dBm)} = (-29.30\text{dBm}) - (-0.1\text{dB}) + (-7.26\text{dBd}) = -36.46\text{dBm}$$

B) Radiated Spurious Attenuation from Carrier

$$\text{Attenuation spurious emission (dB)} = 10 \log (\text{TX power in watts} / 0.001) - P_d$$

Example: (54.29MHz, vertical)

$$\text{Attenuation spurious emission (dB)} = 10 \log (845\text{E-6} / 0.001) - (-36.46\text{dBm}) = 35.7\text{dB}$$

C) Limit

The spurious emissions should be attenuated by at least $[43 + 10 \log (\text{TX power in watts})]$

Example:

$$43 + 10 \log (845\text{E-6}) = 12.3\text{dB}$$

The radiated spurious emissions should be attenuated by at least 12.3dB. For this example, the spurious emission at 54MHz was attenuated by 35.7dB.



FCC TEST REPORT FOR HUBSUNG

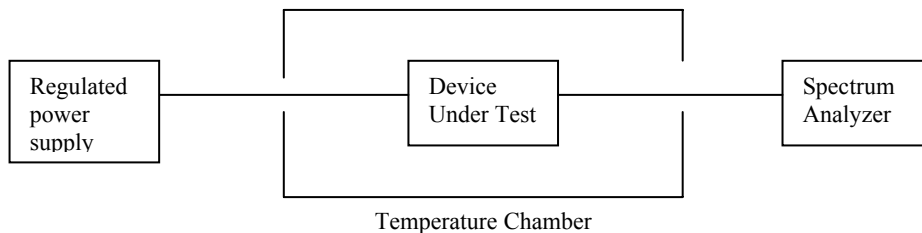
4.3 Frequency Stability

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at 20°C and the rated supply voltage.

Note, for handheld equipment that is only capable of operating from internal batteries, the frequency stability tests should be performed using a new battery without any further requirement to vary the supply voltage.

Frequency vs Temperature Test:

Reference (FCC Pt.95 Subpart E §95.623 and FCC Pt.2 Subpart J §2.1055)

Test Setup DiagramTest Results

Reference Frequency (MHz)	Temperature (°C)	Frequency Drift (%)	Limit (%)
27.145	-30	+0.001	±0.01%
	-20	+0.002	
	-10	+0.002	
	0	+0.002	
	+10	+0.002	
	+20	+0.002	
	+30	+0.002	
	+40	+0.002	
	+50	+0.002	

Judgment: The EUT complied with the specification requirements.



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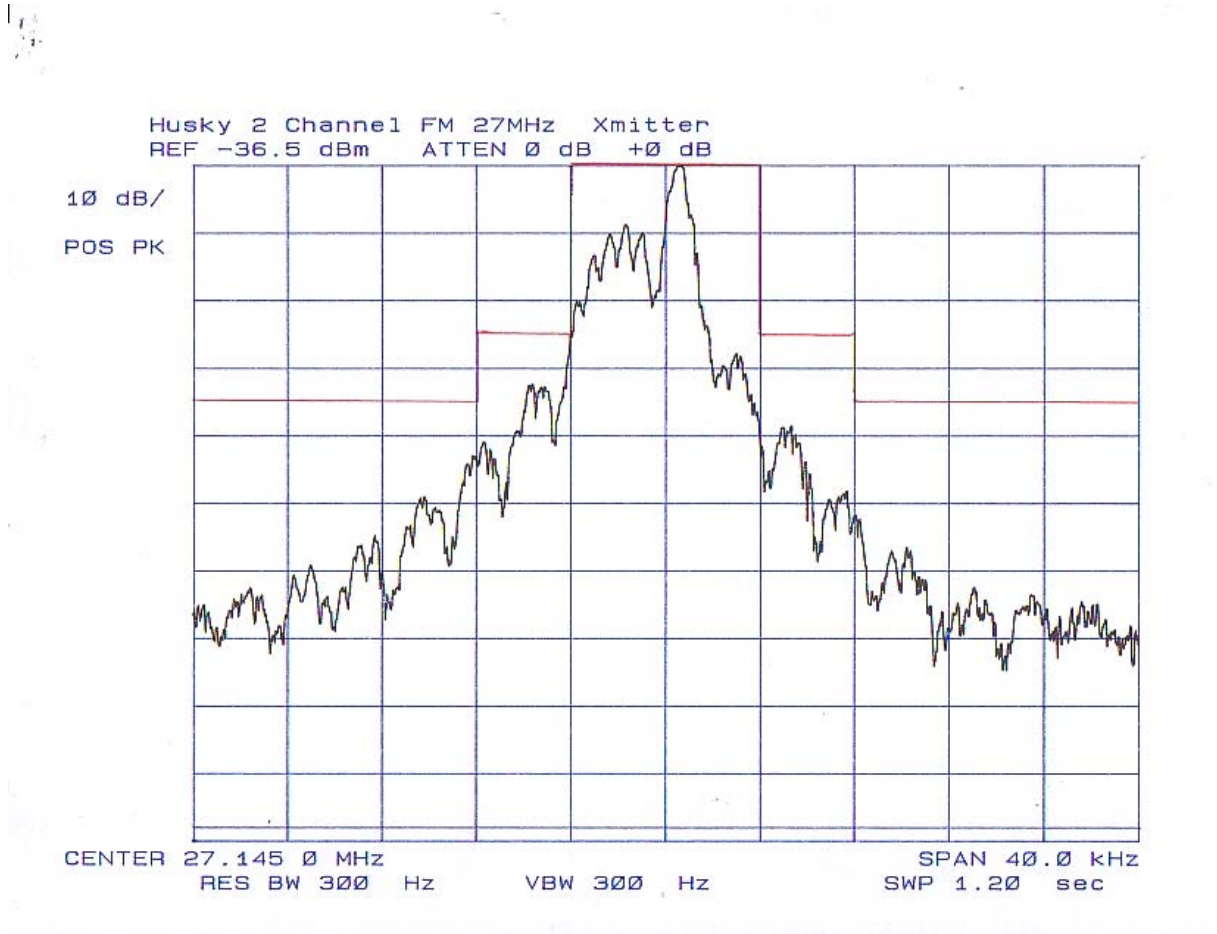
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4.4 Occupied Bandwidth

During testing, all control knobs and buttons were investigated for the worst-case modulated signal. The occupied bandwidth plot shown below is the worst-case condition. The EUT complied with the occupied bandwidth requirement.

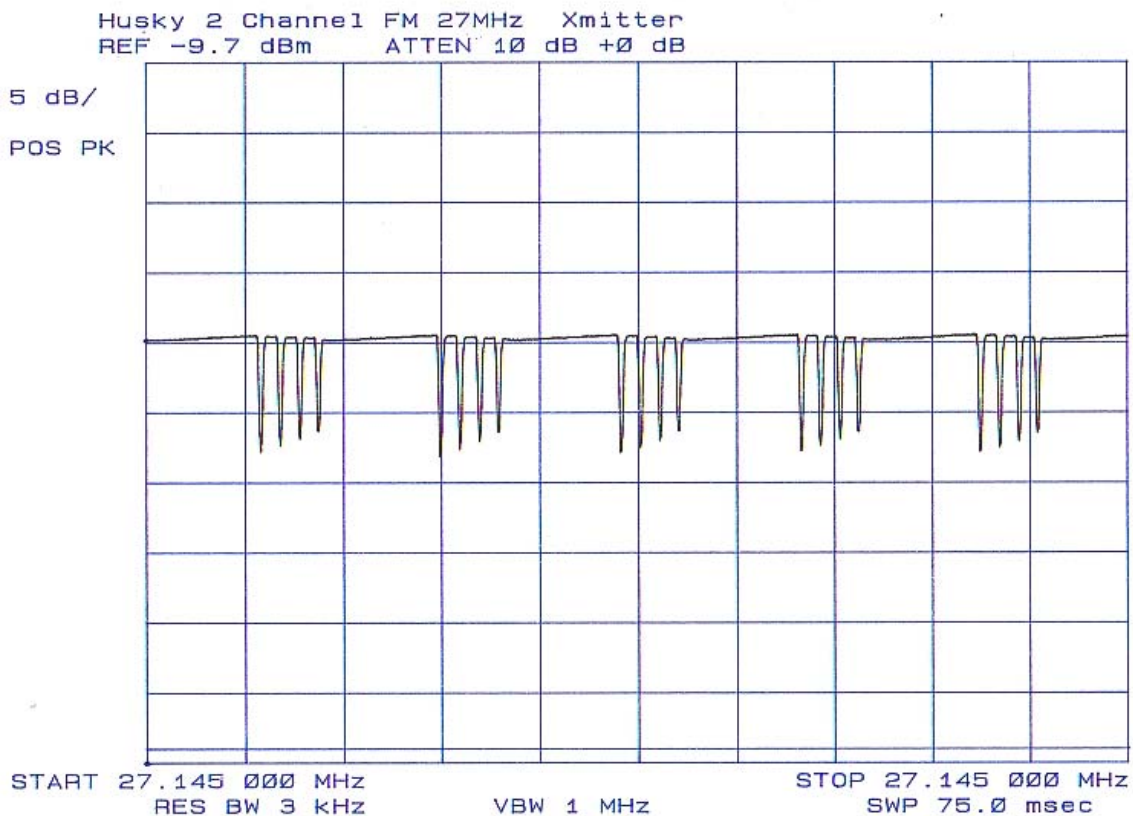




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4.5 Modulation Characteristics

A plot showing the modulation characteristics of the 2 Channel 27MHz FM Transmitter is shown below.

**4.6 Crystal Access Restrictions**

The EUT has no control, switch, or other type of adjustment either on the operating front panel or on the exterior of the transmitter enclosure which when manipulated can result in violation of the rules.



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5.0 TEST MEASUREMENT PHOTOS

Refer to exhibits

Photo: Radiated Emissions (Front View)

Refer to exhibits

Photo: Radiated Emissions (Rear View)



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APPENDIX A - TEST EQUIPMENT USED

The absolute performance calibration of equipment requiring calibration is performed on an as needed basis in accordance with ANSI/NCSL Z540-1-1994. 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. Pico Rivera, California. All equipment is checked and verified for proper operation before and after each series of tests.

A.1 Specific Equipment Used

<i>Instrument</i>	<i>MFG / Model No.</i>	<i>Asset No.</i>	<i>CAL. Due Date</i>
Biconical Antenna	AH Systems / SAS-200/540	20052	7/22/03
Biconical Antenna	AH Systems / SAS-200/540	20051	5/28/04
Log Periodic	AH Systems / SAS-200/512	20053	4/14/04
Log Periodic	AH Systems / SAS-200/512	20054	5/8/04
Quasi-Peak	Hewlett Packard / 85650A	20011	7/24/04
Spectrum Analyzer Display	Hewlett Packard / 85662A	9466B	3/13/04
Spectrum Analyzer	Hewlett Packard / 8568B	9466A	3/13/04
RF Pre-selector	Hewlett Packard / 85685A	20022	7/24/04
Pre-Amplifier	ISCI / RFPA/Z FL-2000	20007	7/11/03
Signal Generator	Marconni / 2022D	20037	7/12/03
Directional Coupler	Amplifier Research / DC3010	20157	UWCE
Spectrum Analyzer	Hewlett Packard / 8585E	20024	4/17/04



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ATTACHMENTS

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FCC ID Label and Location	A3
Instruction Manual	A4