

Itron, Inc.
Mobile Collector
FCC Part 101 Report
FCC ID: EO9-MC

1. TEST AND MEASUREMENT EQUIPMENT DETAIL:	3
2. RF POWER OUTPUT	4
2.1 Test Requirement	4
2.2 Test Technical Standard	4
TEST SETUP BLOCK DIAGRAM	4
3. OCCUPIED BANDWIDTH	5
3.1 Test Requirement	5
3.2 Test Technical Standard	5
TEST SETUP BLOCK DIAGRAM	5
4. MEASUREMENT OF NECESSARY BANDWIDTH	7
4.1 Test Requirement	7
4.2 Test Technical Standards	7
TEST SETUP BLOCK DIAGRAM	8
5. SPURIOUS EMISSION AT ANTENNA TERMINALS	9
5.1 Test Requirement	9
5.2 Test Technical Standard	9
TEST SETUP BLOCK DIAGRAM	9
6. FIELD STRENGTH OF SPURIOUS RADIATION	13
6.1 Test Requirement	13
6.2 Test Technical Standard	13
6.3 Test Procedure	13
TEST SETUP BLOCK DIAGRAM	14
7. FREQUENCY STABILITY	19
7.1 Test Requirement	19
7.2 Test Technical Standard	19
7.3 Test Procedure	20
TEST SETUP	20
8.1 RF Exposure	23
8.2 Classification	23
8.3 Calculations	23
8.4 Conclusion	23

1. Test And Measurement Equipment Detail:

Test Equipment	Model	Manufacturer	Serial Number	Asset Number	Cal Due
Spectrum Analyzer Display Section	141T	Hewlett-Packard	1337A07596	3063	N/A
RF Section	8555A	Hewlett-Packard	172A08466	3750	N/A
IF Section	8552A	Hewlett-Packard	1736A13353	8932	N/A
Spectrum Analyzer	8593E	Hewlett-Packard	3543A02032	6965	08/03
Spectrum Analyzer	8594E	Hewlett-Packard	3710A04999	10202	02/03
Power Meter	437B	Hewlett-Packard	3125U11553	1872024	10/03
Power Meter Sensor	8481D	Hewlett-Packard	3318A08626	1872025	10/03
Antenna - Double Ridged Guide	3115	EMCO	9205-3878	16256	04/03
Antenna - Double Ridged Guide	3115	EMCO	9205-4550	6412	04/03
Antenna - Log periodic	3146	EMCO	9203-3358	16248	01/03
Antenna - Bi-conical	3108	EMCO	9807-3129	11730	01/03
High Pass Filter	HD14690		-----	-----	N/A
Notch Filter		EFJ	-----	-----	N/A
Attenuator: 10 dB Power	8340-100	Tenuline	1390	-----	N/A
Attenuator: 10 dB	PE7004-10	Pasternack	-----	-----	N/A
Attenuator: 40 dB	PE7004-40	Pasternack	-----	-----	N/A
Sweep Generator	3350B	Hewlett-Packard	2722A08843	XXXX	N/A
RF Plug-in	83592A	Hewlett-Packard	2252A00787	XXXX	N/A
Amplifier < 5 GHz	ZHL - 1042J	Mini-Circuits	H110894-009	-----	N/A
Amplifier > 5 GHz	JCA010- 415	JCA	103	-----	N/A
Power Supply	6201B	Hewlett-Packard	1145A03611	4070	12/02
Power Supply	6264B	Hewlett-Packard		3093	N/A

2. RF Power Output

Date of Test: October 10, 2002

Temperature: 60° F

Relative Humidity: 65

2.1 Test Requirement

Section 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

2.2 Test Technical Standard

Section 101.113 Transmitter power limitations.

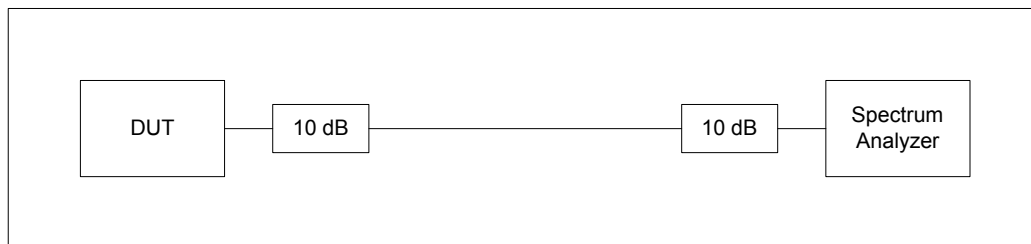
(a) On any authorized frequency, the average power delivered to an antenna in this service must be the minimum amount of power necessary to carry out the communications desired. Application of this principle includes, but is not to be limited to, requiring a licensee who replaces one or more of its antennas with larger antennas to reduce its antenna input power by an amount appropriate to compensate for the increased primary lobe gain of the replacement antenna(s). In no event shall the average equivalent isotropically radiated power (EIRP), as referenced to an isotropic radiator, exceed the values specified below. In cases of harmful interference, the Commission may, after notice and opportunity for hearing, order a change in the effective radiated power of this station. Further, the output power of a transmitter on any authorized frequency in this service may not exceed the following:

Frequency Band (MHz)	Maximum Allowable EIRP ^{1,2}	
	Fixed (dBW)	Mobile (dBW)
952.0 - 960.0 ⁽²⁾	+40	+14

1) Per polarization

2) For multiple address operations, see § 101.147 Remote alarm units that are part of a multiple address central station projection system are authorized a maximum of 2 watts.

Test Setup Block Diagram



Test Results

Transmitter Output Power = Raw Data + Attenuators and Cable Losses

Transmitter Output Power = +13.68 dBm + 22.23 dB = +35.91 dBm = +5.91 dBW.

EIRP = +5.91 dBW + 5.0 dBi (antenna Gain) = +10.91 dBW.

3. Occupied Bandwidth

Date of Test: October 10, 2002

Temperature: 60

Relative Humidity: 65

3.1 Test Requirement

Section 2.1049 Measurements required: Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

3.2 Test Technical Standard

Section 101.111 Emission limitations

(a) The mean power of emissions must be attenuated below the mean power output of the transmitter in accordance with the following schedule:

(5) When using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a 12.5 kHz bandwidth, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule:

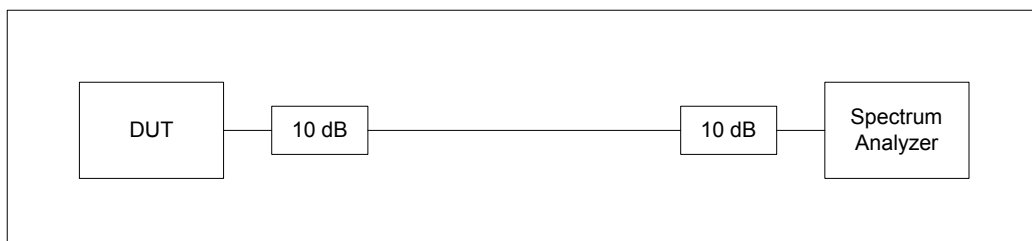
(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 2.5 kHz up to and including 6.25 kHz: At least $53 \log (f_d/2.5)$ decibels;

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 6.25 kHz up to and including 9.5 kHz: At least $103 \log (f_d/3.9)$ decibels;

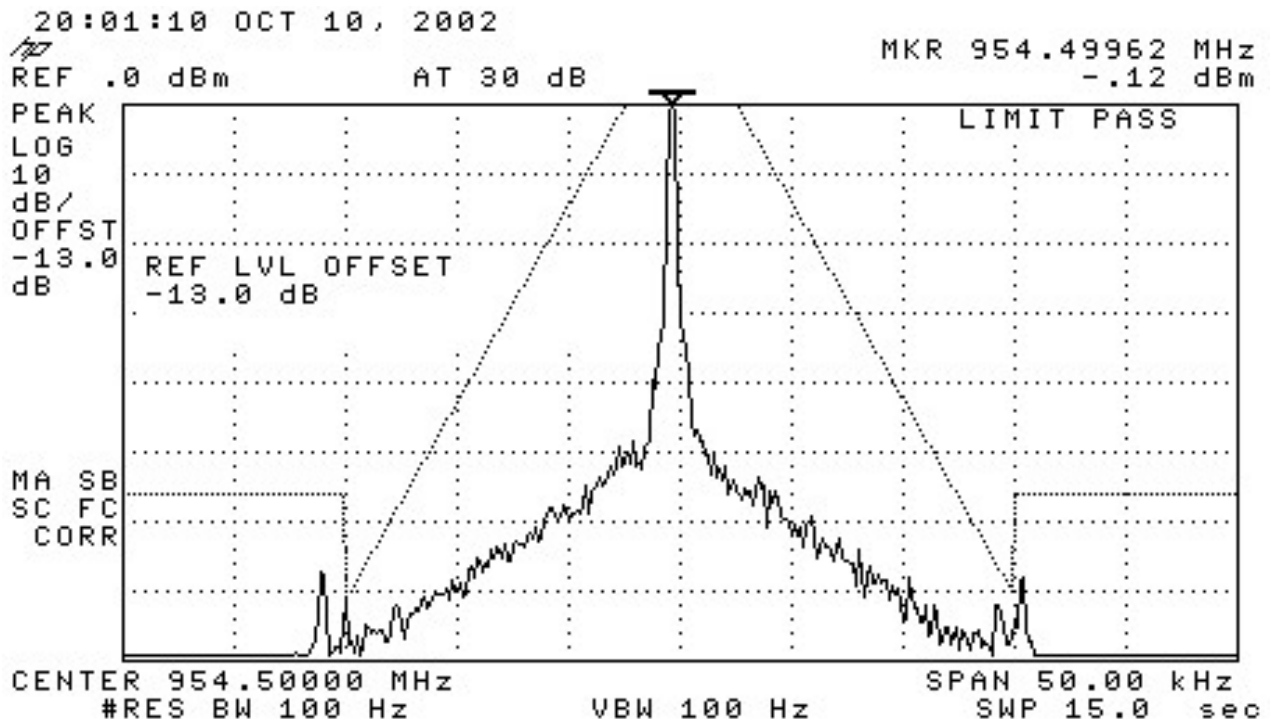
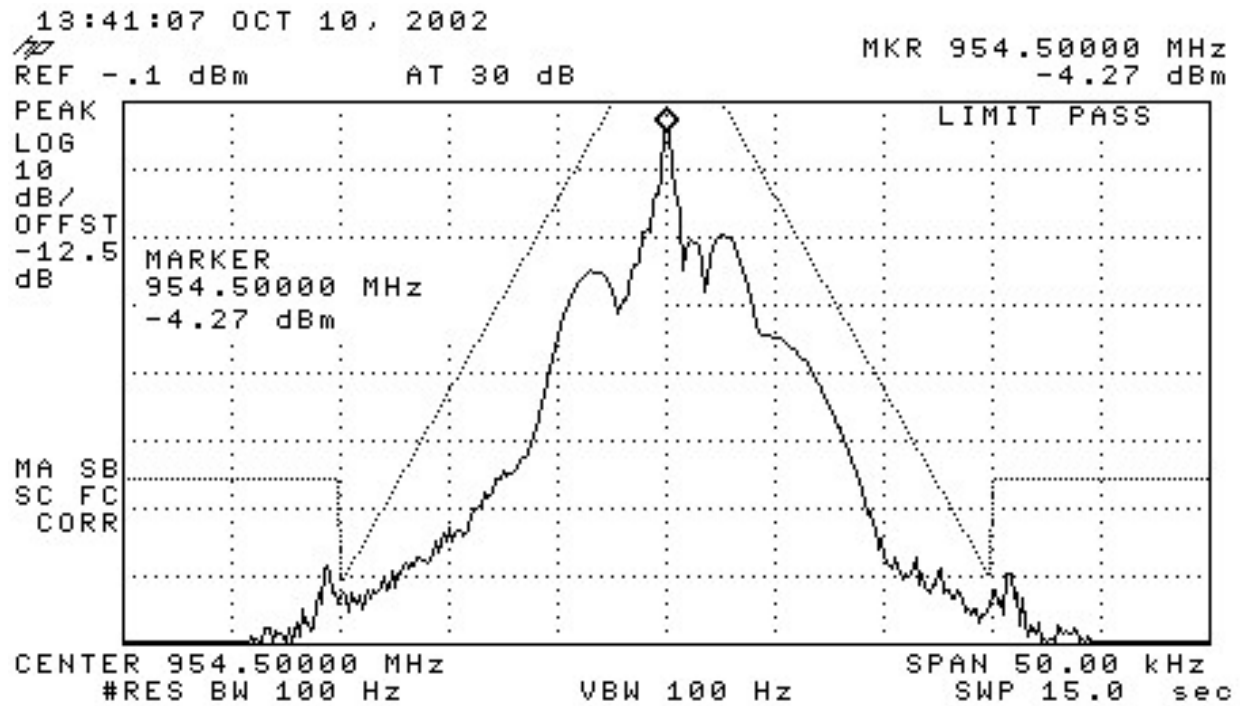
(iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 9.5 kHz up to and including 15 kHz: At least $157 \log (f_d/5.3)$ decibels; and

(iv) On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 kHz: At least 50 plus $10 \log (P)$ or 70 decibels, whichever is the lesser attenuation.

Test Setup Block Diagram



Test Results



4. Measurement of Necessary Bandwidth

Date of Test: October 10, 2002

Temperature: 60

Relative Humidity: 65

4.1 Test Requirement

Section 2.202

(C) The necessary bandwidth may be determined by one of the following methods:

(4) Measurement in cases not covered by paragraph (C) (1), (2), or (3) of this section.

It is not possible to calculate necessary bandwidth in accordance with 47CFR Part 2 Section 2.202 (c) (1), (2), or (3). Therefore, per Section 2.202 (c) (4) the actual 99 percent bandwidth was required to be measured.

4.2 Test Technical Standards

Section 101.109 Bandwidth

(a) Each authorization issued pursuant to these rules will show, as the emission designator, a symbol representing the class of emission which must be prefixed by a number specifying the necessary bandwidth. This figure does not necessarily indicate the bandwidth actually occupied by the emission at any instant. In those cases where part 2 of this chapter does not provide a formula for the computation of the necessary bandwidth, the occupied bandwidth may be used in the emission designator.

(b) Stations in this service will be authorized any type of emission, method of modulation, and transmission characteristic, consistent with efficient use of the spectrum and good engineering practice, except that Type B, damped-wave emission will not be authorized.

(c) The maximum bandwidth which will be authorized per frequency assigned is set out in the table that follows. Regardless of the maximum authorized bandwidth specified for each frequency band, the Commission reserves the right to issue a license for less than the maximum bandwidth if it appears that a lesser bandwidth would be sufficient to support an applicant's intended communications.

Frequency Band (MHz)	Maximum authorized bandwidth
952 to 960	200 kHz ^{1, 5, 6}

1) The maximum bandwidth that will be authorized for each particular frequency in this band is detailed in the appropriate frequency table in § 101.147. If contiguous channels are aggregated in the 928-928.85/952-952.85/956.25-956.45 MHz, the 928.85-929/959.85-960 MHz, or the 932-932.5/941-941.5 MHz bands, then the bandwidth may exceed that which is listed in the table.

5) A 12.5 kHz bandwidth applies only to frequencies listed in § 101.147 (b) (1) through (4).

6) For frequencies listed in Section 101.147 (b) (1) through (4), consideration will be given on a case-by-case basis to authorizing bandwidths up to 50 kHz.

Test Setup Block Diagram



Test Results

12:45:06 OCT 10, 2002

~~HP~~

REF 12.0 dBm AT 30 dB

SMPL

LOG

10

dB/

OCCUPIED BW (99.00%)

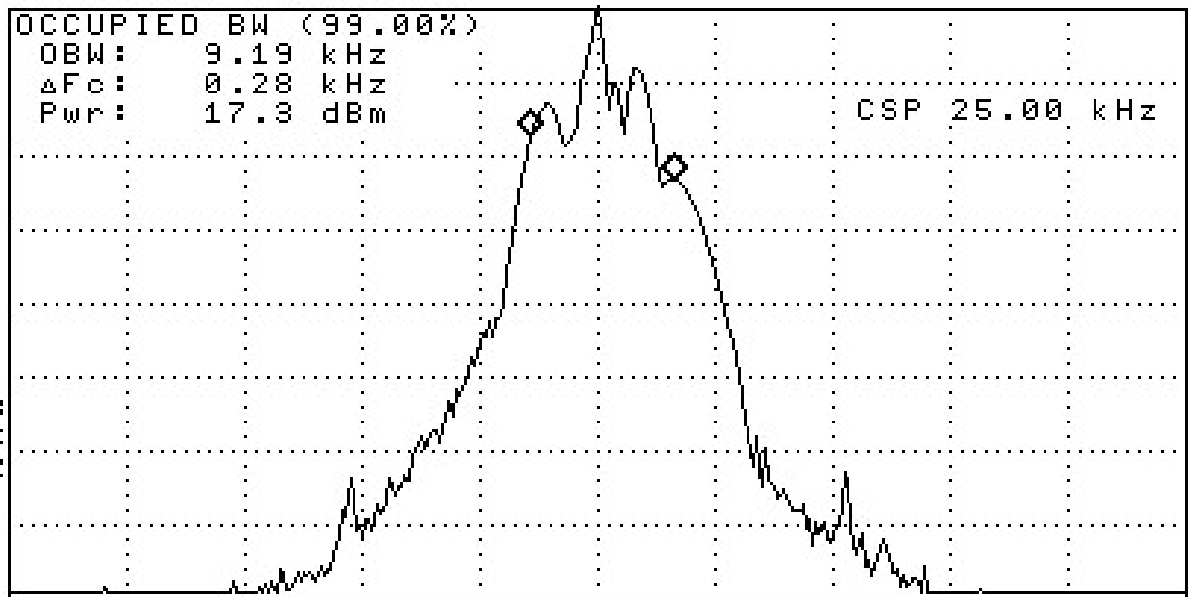
OBW: 9.19 kHz

ΔF_c : 0.28 kHz

Pwr: 17.3 dBm

CSP 25.00 kHz

MA SB
SC FC
CORR



CENTER 954.50000 MHz

#RES BW 300 Hz

#VBW 3 kHz

SPAN 75.00 kHz

SWP 2.50 sec

5. Spurious Emission at Antenna Terminals

Date of Test: October 10, 2002

Temperature: 60

Relative Humidity: 65

5.1 Test Requirement

Section 2.1051 Measurements required: Spurious emissions at antenna terminals

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

5.2 Test Technical Standard

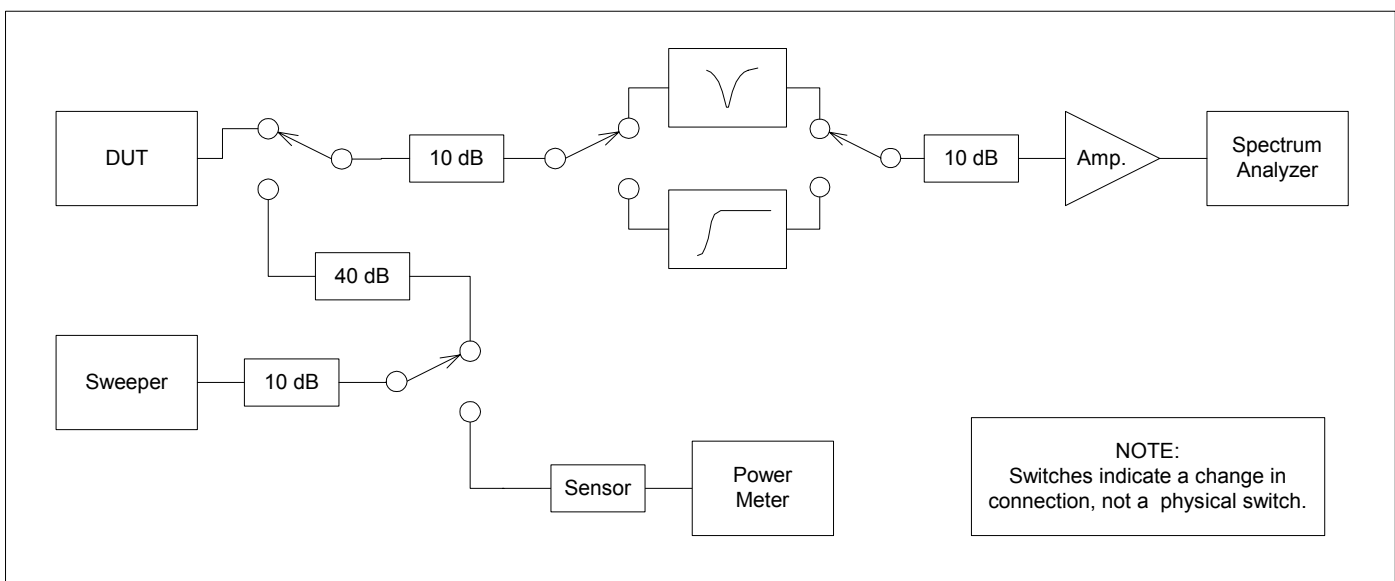
Section 101.111 Emission limitations

(a) The mean power of emissions must be attenuated below the mean power output of the transmitter in accordance with the following schedule:

(5) When using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a 12.5 kHz bandwidth, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule:

(iv) On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 kHz: At least 50 plus 10 log (P) or 70 decibels, whichever is the lesser attenuation.

Test Setup Block Diagram



Conducted Spurious at Antenna Port

EUT: Mobile Reader

Part 101.111 (a) (5) (iv)

Model : DCU4

Serial No.:

Test Dates: Oct. 10, 2002

Transmitter Harmonic	Freq. (MHz)	Level (dBm)	[1]	Pads, Filter, Coax and Amplifier (dB)	Final Level (dBm)	Limit (dBm)	Delta to Limit (dB)
2	1909.0	-62.1	P	6.9	-69.1	-20.0	-49.1
3	2863.5	-63.3	P	11.6	-74.9	-20.0	-54.9
4	3818.0	-63.8	P	19.2	-83.0	-20.0	-63.0
5	4772.5	-65.4	P	13.7	-79.1	-20.0	-59.1
6	5727.0	-48.9	P	22.1	-71.0	-20.0	-51.0
7	6681.5	-50.8	P	23.1	-73.9	-20.0	-53.9
8	7636.0	-53.6	<i>NF</i>	18.9	-72.6	-20.0	
9	8590.5	-53.2	<i>NF</i>	16.3	-69.5	-20.0	
10	9545.0	-54.4	<i>NF</i>	12.7	-67.1	-20.0	

Notes:

[1] QP = Quasi-peak, P = Peak, NF = Noise Floor of the Spectrum Analyzer

[2] The Spectrum Analyzer settings are as follows:

Resolution Bandwidth = 1 MHz; Video Bandwidth = 1 MHz;

Span = 10 MHz; Sweep = 20 msec.

[3] "Final Level" numbers in bold are RF signal levels.

"Final Level" numbers in italics are noise floor and as such indicate that there is no RF signal at that level. The attenuators, filters, coax loss, and amplifier gain have been factored in with the noise floor levels in order to demonstrate what the "Final Level" of an RF signal at the noise floor level would have been equal to.





6. Field Strength of Spurious Radiation

Date of Test: October 11, 12, & 14, 2002

Temperature: 57

Relative Humidity: 71

6.1 Test Requirement

Section 2.1053 Measurements required: Field strength of spurious radiation

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz.
- (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
- (4) Other types of equipment as required, when deemed necessary by the Commission.

6.2 Test Technical Standard

Section 101.111 Emission limitations

(a) The mean power of emissions must be attenuated below the mean power output of the transmitter in accordance with the following schedule:

(5) When using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a 12.5 kHz bandwidth, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule:

(iv) On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 kHz: At least 50 plus $10 \log (P)$ or 70 decibels, whichever is the lesser attenuation.

6.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.12

RADIATED POWER LIMIT

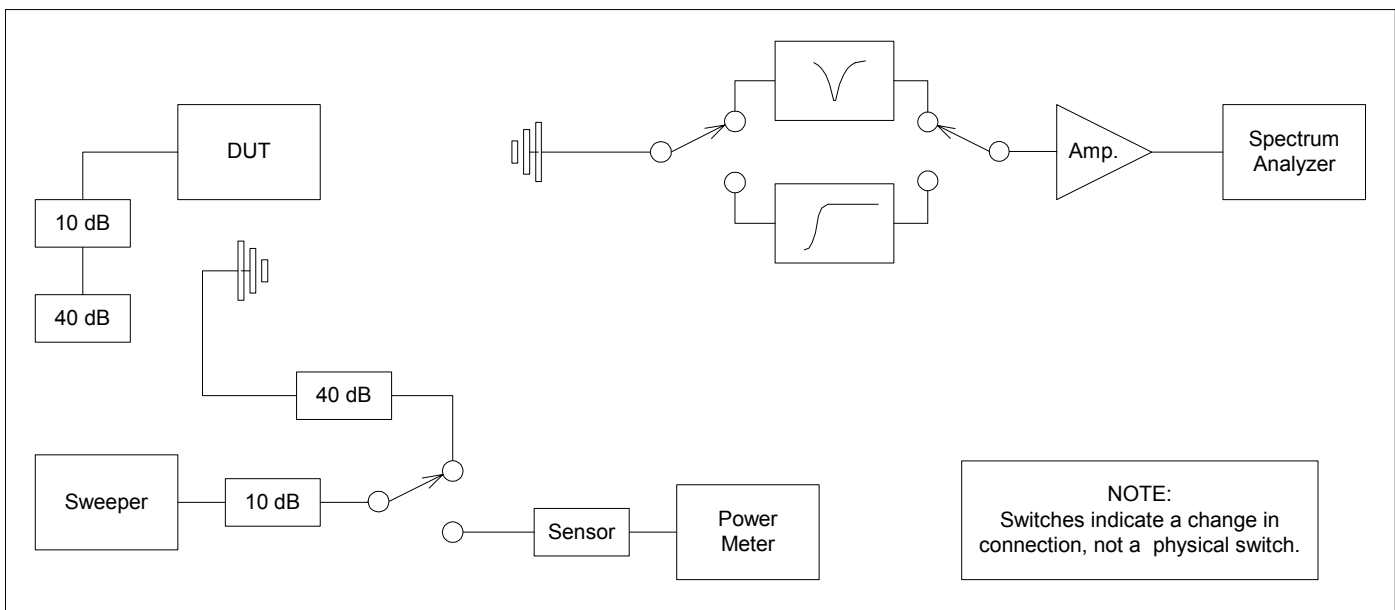
All emissions are expressed in terms of the equivalent power that would be radiated by a substitution antenna, positioned where the center of the device under test was located, in order to produce the same electric field strength as radiated by the device under test. This level is equivalent to the power applied to the input of the substitute antenna plus the gain (dBi) of the antenna

The output power of the transmitter is +38.91 dBm (+8.91 dBW) or 7.78 Watts.

Therefore the minimum attenuation allowed is $50 + 10 \log 7.78 = 58.91$ dBW.

Therefore the maximum absolute power of the spurious emission is $+8.91$ dBW $- 58.91$ dBW or -50 dBW or -20 dBm.

Test Setup Block Diagram



EUT: Mobile Reader
Model : DCU4
Serial No.:

Part 101.111
Emission Limitations
Test Dates: Oct. 11, 12, & 14, 2002

Transmitter Harmonic	Freq. (MHz)	Ant. Pos.	Level to Sub. Antenna (dBm)	Antenna Gain (dBi)	EIRP Level (dBm)	Limit EIRP Level (dBm)	Delta to Limit (dB)
2	1909.0	V	-52.5	6.8	-45.7	-20.0	-25.7
		H	-56.5	6.8	-49.7	-20.0	-29.7
3	2863.5	V	-49.8	7.7	-42.1	-20.0	-22.1
		H	-51.4	7.7	-43.7	-20.0	-23.7
4	3818.0	V	-44.0	8.0	-36.0	-20.0	-16.0
		H	-42.4	8.0	-34.4	-20.0	-14.4
5	4772.5	V	-46.5	8.6	-37.9	-20.0	-17.9
		H	-44.8	8.6	-36.2	-20.0	-16.2
6	5727.0	V	-48.0	8.4	-39.6	-20.0	-19.6
		H	-48.6	8.4	-40.2	-20.0	-20.2
7	6681.5	V	-51.4	9.0	-42.4	-20.0	-22.4
		H	-53.9	9.0	-44.8	-20.0	-24.8
8	7636.0	V	-54.5	8.6	-45.9	-20.0	-25.9
		H	-53.0	8.6	-44.4	-20.0	-24.4
9	8590.5	V	-43.2	9.6	-33.6	-20.0	-13.6
		H	-38.4	9.6	-28.9	-20.0	-8.9
10	9545.0	V	-50.4	9.0	-41.4	-20.0	-21.4
		H	-50.4	9.0	-41.4	-20.0	-21.4

Notes:

[1] QP = Quasi-peak, P = Peak, NF = Noise Floor of the Spectrum Analyzer

[2] The Spectrum Analyzer settings are as follows:

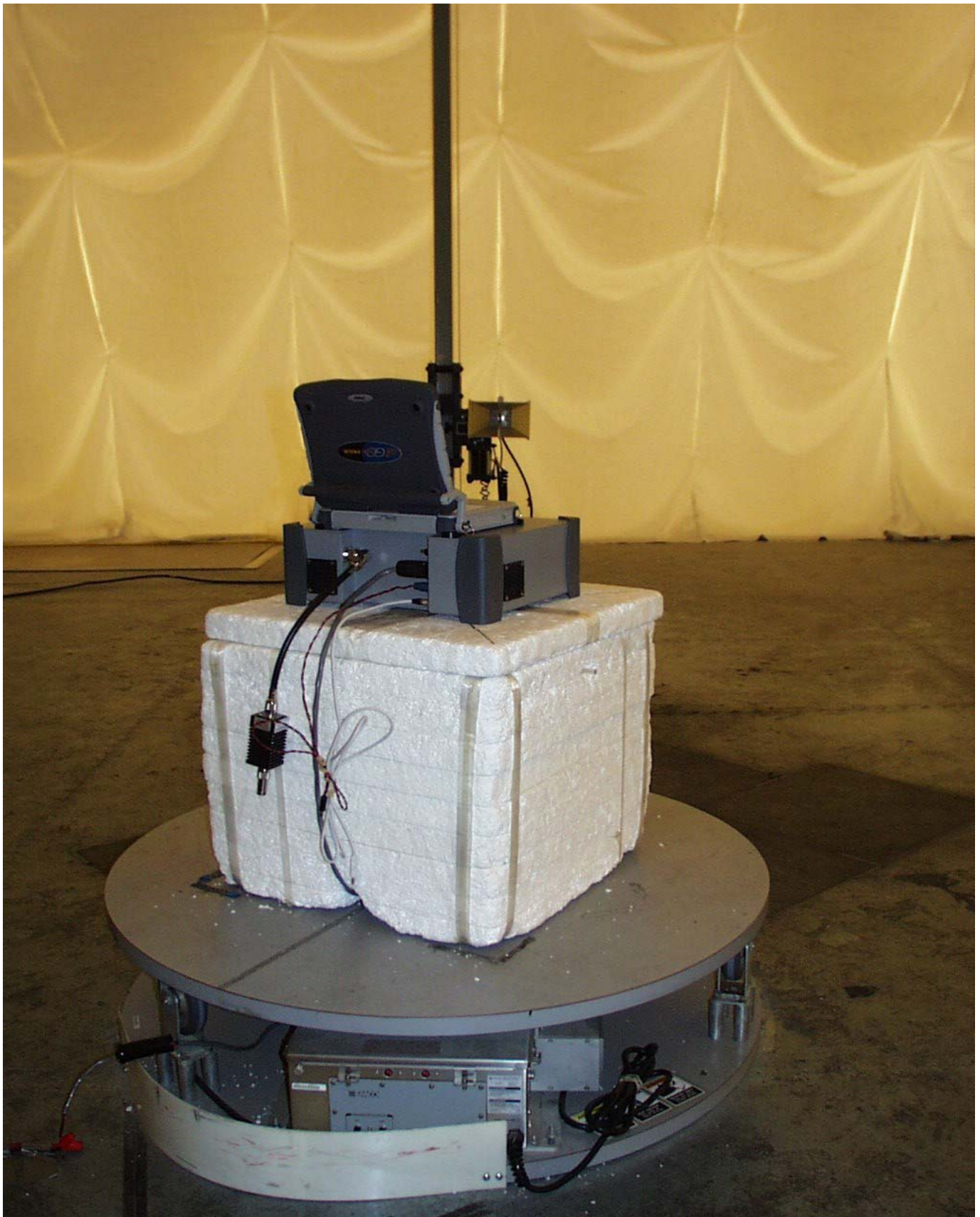
Search - Resolution Bandwidth = 30 kHz; Video Bandwidth = 100 kHz;

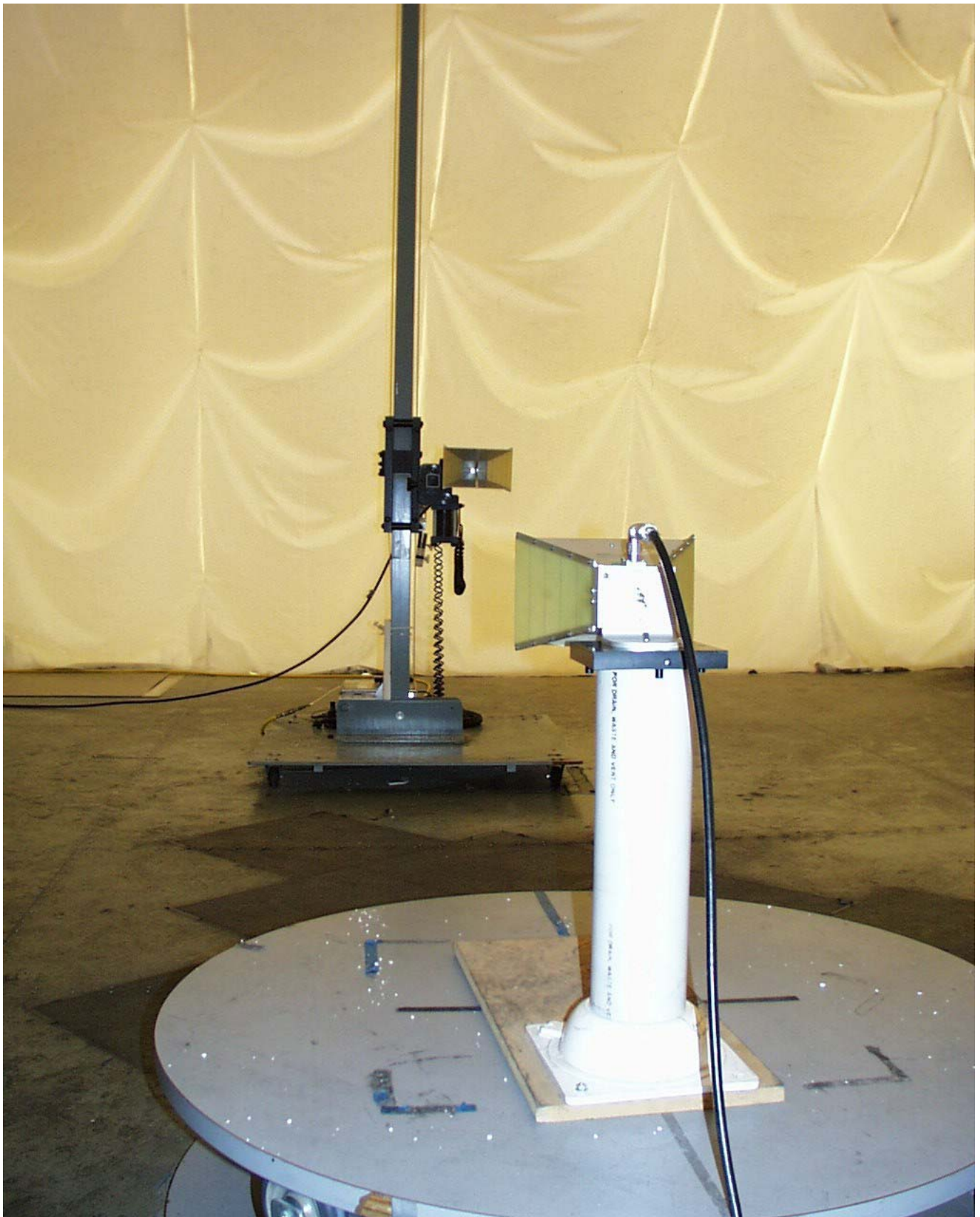
Span = 1 MHz; Sweep = 20 msec.

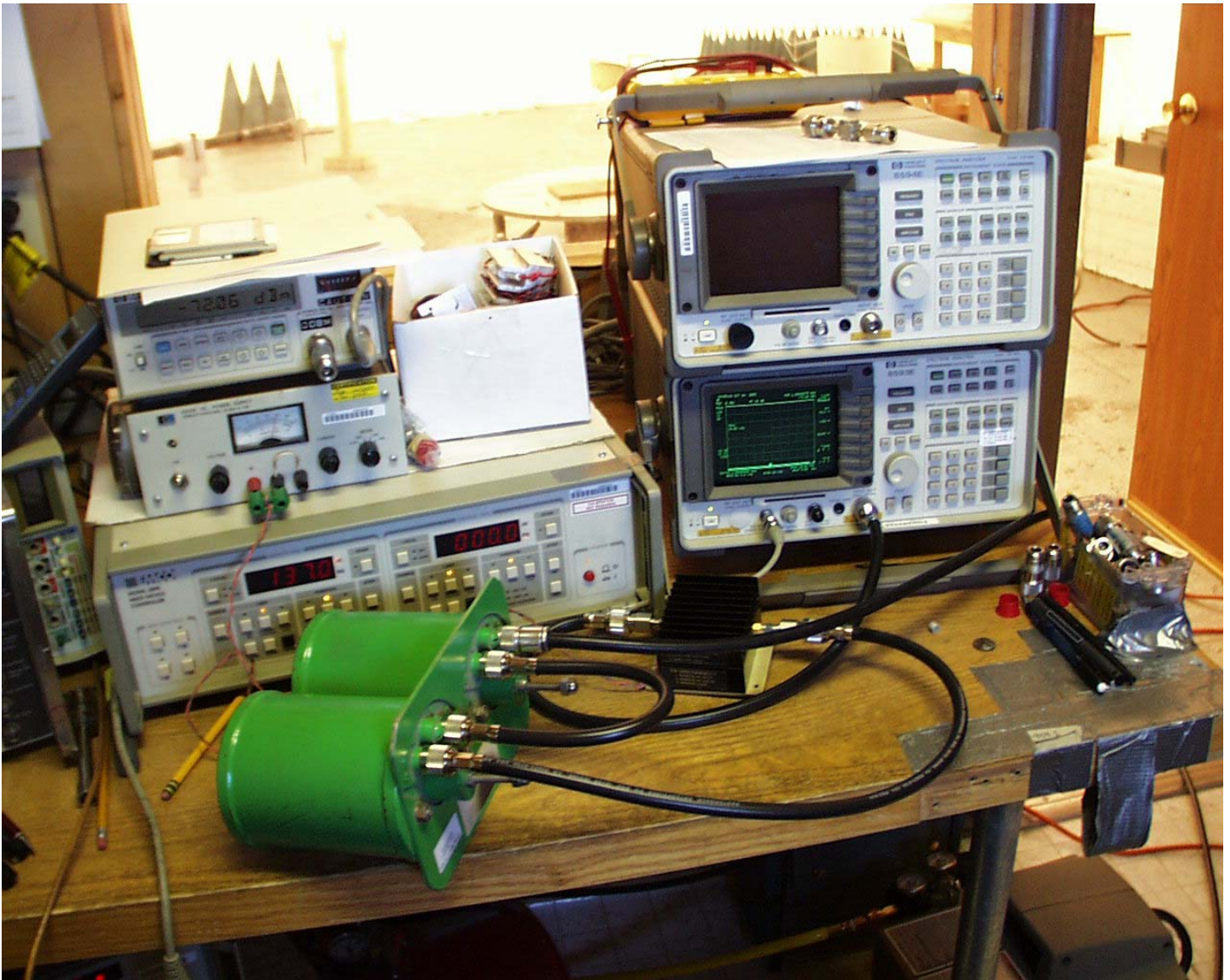
Read - Resolution Bandwidth = 3 kHz; Video Bandwidth = 10 kHz;

Span = 10 kHz; Sweep = 5 sec.

[3] "Level to Sub. Antenna" numbers are input levels to the Sub. Antenna which produce the same level as the spurious radiation.







7. Frequency Stability

Date of Test: October 10, 2002

Temperature:

Relative Humidity:

7.1 Test Requirement

Section 2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30 degrees to +50 degrees centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

7.2 Test Technical Standard

Section 101.107 Frequency tolerance.

(a) The carrier frequency of each transmitter authorized in these services must be maintained within the percentage of the reference frequency except as otherwise provided in paragraph (b) of this section or in the applicable subpart of this part (unless otherwise specified in the instrument of station authorization the reference frequency will be deemed to be the assigned frequency):

...
952 to 960 (7)
...

(7) For private operational fixed point-to-point microwave systems, with a channel greater than or equal to 50 KHz bandwidth, $\pm 0.0005\%$; for multiple address master stations, regardless of bandwidth, $\pm 0.00015\%$; for multiple address remote stations with 12.5 KHz bandwidths or less, $\pm 0.00015\%$; for multiple address remote stations with channels greater than 12.5 KHz bandwidth, $\pm 0.0005\%$.

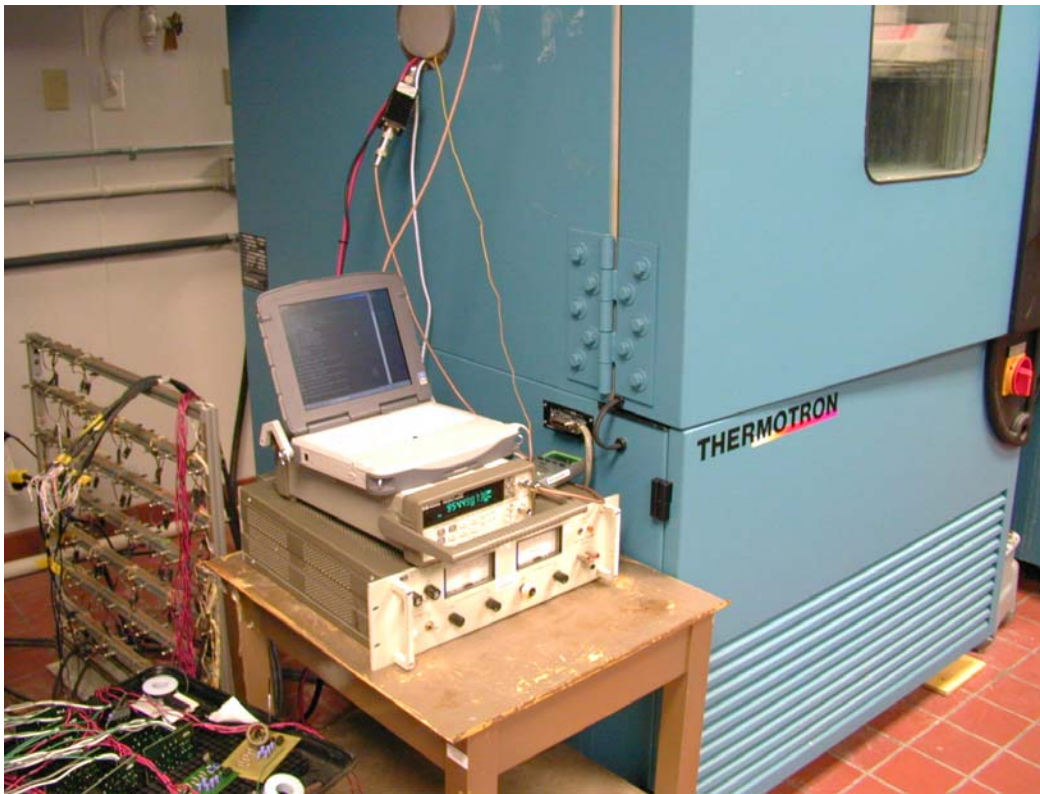
Limit = $\pm 0.00015\% \times 954,499,989 \text{ Hz} = \pm 1431.7 \text{ Hz}$.

7.3 Test Procedure

TIA/EIA-603:1993 Section 2.2.1

Test Setup







Test Results

Test date: 10/14/02

Temperature soak time: 1 hour

Temperature (degrees C)	Fundamental (MHz)	Delta to reference (Hz)
<i>Reference</i>	954.500000	0
-30	954.499059	-941
-20	954.499012	-988
-10	954.499230	-770
0	954.499230	-770
10	954.499381	-619
20	954.499263	-737
30	954.499143	-857
40	954.499012	-988
50	954.498754	-1246

8. Radio-Frequency Exposure

Date of Test: October 10, 2002

Temperature:

Relative Humidity:

8.1 RF Exposure

Section 1.1310 Radiofrequency radiation exposure limits.

Table 1 (B). See also § 1.1307(b)(1) of the FCC Rules.

8.2 Classification

According to Section 1.1307b(1), the EUT does not require an environmental evaluation.

1. This equipment classification is not listed within Table 1 of Section 1.1307 and is not listed in Section 1.1307b(2).
2. The EUT is a fixed transmitter and is thus categorically exempt from routine environmental evaluation per Section 2.1093.

Included in the following section of this Test Report are calculations that determine that minimum distance from the transmitter antenna that will ensure an exposure limit at or below the guidelines given in Table I of Section 1.1310 for the general population. The formula for these calculations are taken from OET Bulletin' 65, edition 97-01, August 1997; "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields".

8.3 Calculations

The EUT is intended to be used in a mobile environment.

Per Table 1 of Section 1.1310, the Maximum Permissible Exposure (MPE) limit for General Population/Uncontrolled Exposure in the band of 300-1500 MHz is equal to $f/1500 = 956/1500$ or 0.638 mW/cm^2 .

Supplement C, Edition 01-01, of OET Bulletin 65, Edition 97 - 01,

The formula for calculating power density is:

$$P_d = P_t * G / 4 \pi * r^2$$

Power = +35.91 dBm = 3.90 W

Gain of the mobile antenna = 5 dBi or a numeric gain of 3.16.

Therefore solving for r gives a minimum safe distance of 39.2 cm.

The FCC specified maximum safe distance for mobile installations is 2 meters.

8.4 Conclusion

The EUT complies with the requirements of Table (B) limits for Maximum Permissible Exposure (MPE) for the general population uncontrolled exposure of Section 1.1310 of the FCC Regulations. The manufacturer has specified 40 cm as the minimum safe distance in the User Manual.