ENGINEERING TEST REPORT

EL806 OEM TransNet
Model No.: EL806

Applicant:

Microwave Data Systems Inc.
175 Science Parkway
Rochester, NY
USA, 14620

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Part 15, Subpart B
Class A Unintentional Radiators &
Radio Receivers Operating in the Frequency Band 902 - 928 MHz

UltraTech's File No.: MIC-068FRX

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: March 24, 2003	
Report Prepared by: Dan Huynh Issued Date: March 24, 2003	Tested by: Hung Trinh, RFI/EMI Technician Test Dates: Feb. 21 & Mar. 4, 2003

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart B, Sections 15.107, 15.109 & 15.111
Title:	Telecommunication – 47 Code of Federal Regulations (CFR), Part 15
Purpose of Test:	To gain FCC Verification Authorization for Radio Receivers Operating in 902.2 – 927.6 MHz and FCC Verification Authorization for Class A Unintentional Radiators.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	• Light-industry, Commercial • Industry

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2002	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 22 & EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1	1999	Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Microwave Data Systems Inc.
Address:	175 Science Parkway Rochester, NY USA, 14620
Contact Person:	Mr. Dennis McCarthy Agency Compliance Engineer Phone #: 585 242-8440 Fax #: 585 241-5590 Email Address: dmccarthy@microwavedata.com

MANUFACTURER	
Name:	Microwave Data Systems Inc.
Address:	175 Science Parkway Rochester, NY USA, 14620
Contact Person:	Mr. Dennis McCarthy Agency Compliance Engineer Phone #: 585 242-8440 Fax #: 585 241-5590 Email Address: dmccarthy@microwavedata.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Microwave Data Systems Inc.
Product Name:	EL806 OEM Transnet
Model Name or Number:	EL806
Serial Number:	Test Sample
Type of Equipment:	Radio Receivers and Class A Digital Devices
External Power Supply:	N/A
Power Input Source:	13.8 Vdc nominal

2.3. EUT'S TECHNICAL SPECIFICATIONS

RECEIVER	
Equipment Type:	Mobile and Base Station (fixed use)
Power Supply Requirement:	13.8 Vdc nominal
Operating Frequency Range:	902.2 – 927.6 MHz
RF Input Impedance:	50 Ohms

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF output	1	MMCX	Shielded
2	16 pin In line	1	SAMTEC, IDC	NA

2.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Laptop
Brand:	Toshiba
Model Name or Number:	1605CDS/4.3
Serial Number:	1027387CU
Connected to EUT's Port:	COM1

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	13.8 Vdc nominal

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	Each of lowest, middle and highest channel frequencies receives continuously for emissions measurements.
Special Test Software & Hardware:	Special firmware and hardware provided by the Applicant are installed to allow the EUT to operate in hopping mode or at each channel frequency continuously. For example, the receiver will be operated at each of lowest, middle and highest frequencies individually, continuously during testing.
Receiver Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as non-integral antenna equipment.

Receiver Test Signals	
Frequency Band(s): ▪ 902.2 – 927.6 MHz	The following frequencies were selected for receiver tests: Lowest: 902.2 MHz Middle: 915.0 MHz Highest: 927.6 MHz

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 16'(L) by 12'(W) by 12'(H).
- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: August 10, 2002.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Part 15, Subpart B	Test Requirements	Margin Below (-) / Above (+) The Limits	Compliance (Yes / No)
15.109(b) Class A	AC Power Line Conducted Emissions	-18.1 dB @ 0.37 MHz	Yes
15.109(a)	Radiated Emissions from Radio Receivers	-9.7 dB @ 804.30 MHz	Yes
15.109(b) Class A	Radiated Emissions from Unintentional Radiators (Digital Devices)	-2.3 dB @ 57.13 MHz	Yes
15.111(a)	Receiver Antenna Power Conducted Emissions for Non-Integral Antenna Port	-5.6 dB @ 811 MHz	Yes

4.3. MODIFICATIONS REQUIRED FOR COMPLIANCE

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 7 of this report

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 6 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:1992, CISPR 22 and CISPR 16-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The Radio Receiver was operated as its normal intended mode during testing.

5.5. AC POWERLINE CONDUCTED EMISSIONS [47 CFR §15.107(b)]

5.5.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Class A Limits		Measuring Bandwidth
	Quasi-Peak (dBμV)	Average (dBμV)	
0.15 to 0.5	79	66	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	73	60	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average

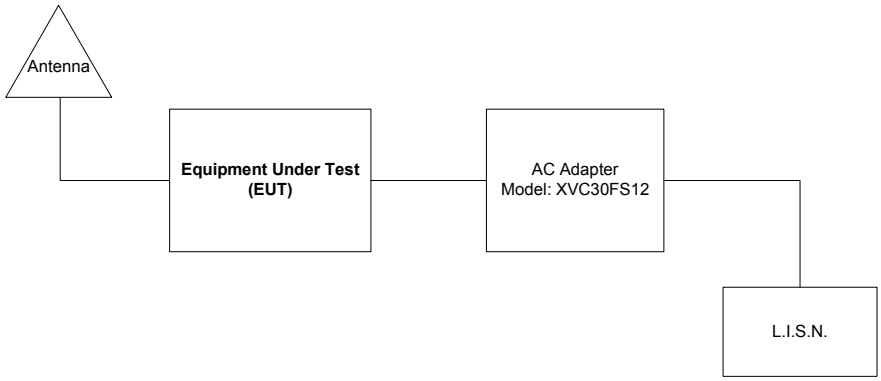
5.5.2. Method of Measurements

Refer to Exhibit 7 of this test report & ANSI C63-4:1992

5.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 μH
12'x16'x12' RF Shielded Chamber	RF Shielding	…	..	…

5.5.4. Test Arrangement

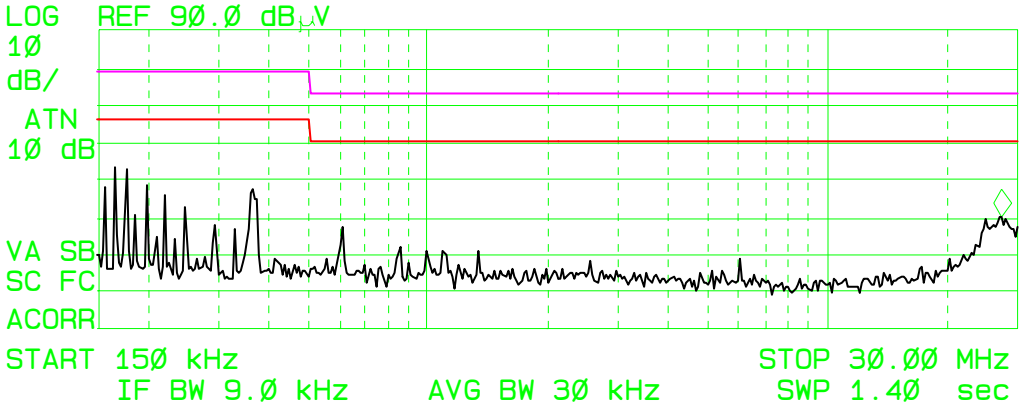


5.5.5. Test data

Plot 1:
AC Power Line Conducted Emissions
Line Tested: 1
Line Voltage: 120 Vac 60 Hz

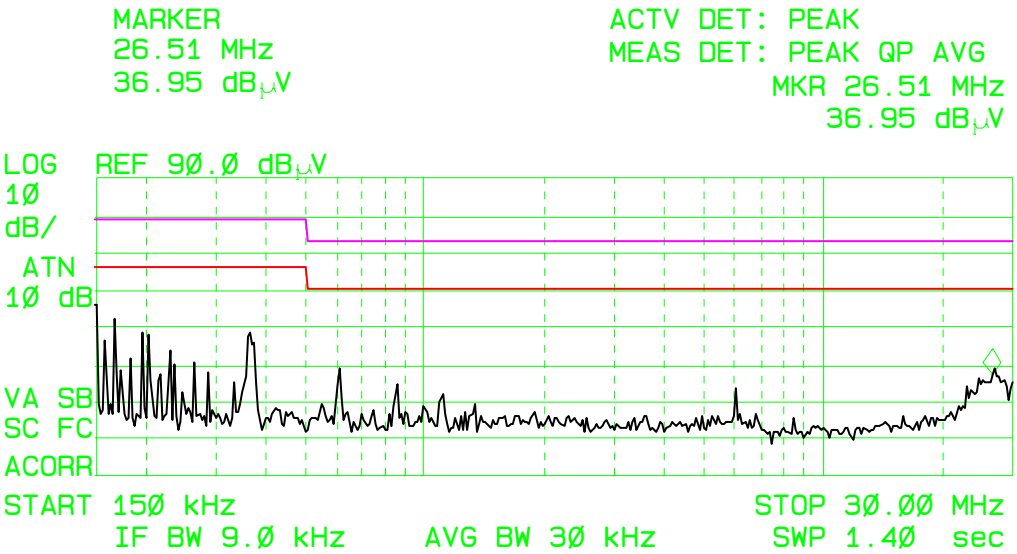
Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	AV△L2
1	0.151004	58.3	50.4	15.7	-50.3
2	0.368710	49.1	46.9	46.7	-19.3
3	0.614779	37.2	35.3	34.2	-25.8
4	6.061995	34.1	31.6	29.8	-30.2
5	27.369170	42.6	39.0	28.9	-31.1

START 150 kHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 27.28 MHz
39.97 dBμV



Plot 2:
AC Power Line Conducted Emissions
Line Tested: 2
Line Voltage: 120 Vac 60 Hz

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	AV△L2
1	0.150213	56.9	48.8	16.5	-49.5
2	0.369425	49.0	48.0	47.9	-18.1
3	26.658285	40.9	37.4	29.5	-30.5



5.6. RECEIVER SPURIOUS/HARMONIC RADIATED EMISSIONS [47 CFR §15.109(b)]

5.6.1. Limits

The equipment shall meet the limits of the following table:

Frequency of Emission (MHz)	Class B Limits @ 3 Meters (dBμV/m)	EMI Detector Used	Measuring Bandwidth (kHz)
30 – 88	40.0	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
88 – 216	43.5	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
216 – 960	46.0	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
Above 960	54.0	Average	RBW = 1 MHz, VBW ≥ 1 Hz

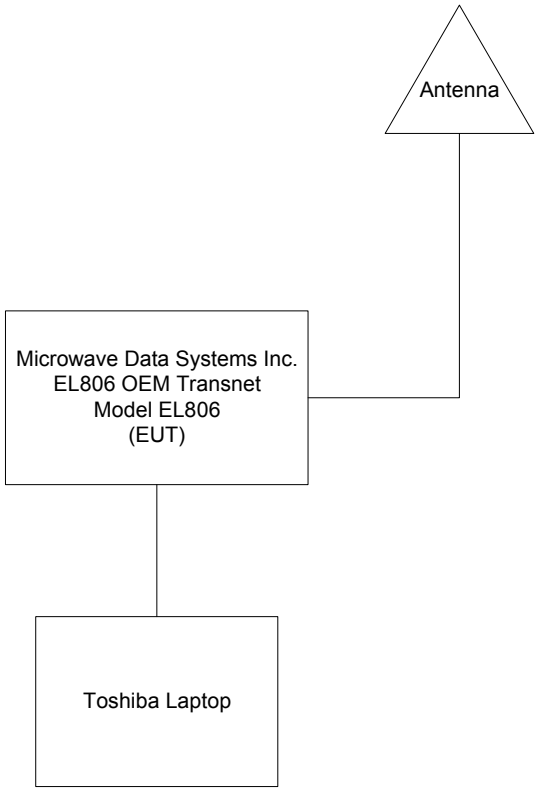
5.6.2. Method of Measurements

The EUT shall be scanned from 30 MHz to the 5th harmonic of the highest oscillator frequency in the radio receivers or 1 GHz whichever is higher. Please refer to Exhibit 7 of this test report and ANSI C63-4:1992 for radiated emissions test method.

5.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Microwave Amplifier	Hewlett Packard	HP 83017A	3116A00661	1 GHz to 26.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna with Mixer	EMCO	3160-09	1007	18 GHz – 26.5 GHz
Horn Antenna with Mixer	EMCO	3160-10	1001	26.5 GHz – 40 GHz

5.6.4. Test Arrangement



5.6.5. Test Data

5.6.5.1. *Near Lowest Frequency (902.2 MHz)*

Frequency (MHz)	Frequency (MHz)	Detector Used (QP/Avg)	Antenna Plane (H/V)	Limit @3m (dBµV/m)	Margin (dB)	Pass/ Fail
791.50	31.26	QP	V	46.0	-14.7	Pass
791.50	32.16	QP	H	46.0	-13.8	Pass
The emissions were scanned from 30 MHz to 5 GHz at 3 metres distance and all emissions within 20 dB below the permissible limits were recorded.						

5.6.5.2. *Near Middle Frequency (915 MHz)*

Frequency (MHz)	Frequency (MHz)	Detector Used (QP/Avg)	Antenna Plane (H/V)	Limit @3m (dBµV/m)	Margin (dB)	Pass/ Fail
804.30	34.43	QP	V	46.0	-11.6	Pass
804.30	36.27	QP	H	46.0	-9.7	Pass
The emissions were scanned from 30 MHz to 5 GHz at 3 metres distance and all emissions within 20 dB below the permissible limits were recorded.						

5.6.5.3. *Near Highest Frequency (927.6 MHz)*

Frequency (MHz)	Frequency (MHz)	Detector Used (QP/Avg)	Antenna Plane (H/V)	Limit @3m (dBµV/m)	Margin (dB)	Pass/ Fail
816.90	34.92	QP	V	46.0	-11.1	Pass
816.90	35.60	QP	H	46.0	-10.4	Pass
The emissions were scanned from 30 MHz to 5 GHz at 3 metres distance and all emissions within 20 dB below the permissible limits were recorded.						

5.7. RADIATED EMISSIONS FROM CLASS A UNINTENTIONAL RADIATORS (DIGITAL DEVICES) [47 CFR §15.109(b)]

5.7.1. Limits

The equipment shall meet the limits of the following table:

Frequency of Emission (MHz)	Class A Limits @10m (dBµV/m)	EMI Detector Used	Measuring Bandwidth (kHz)
30 – 88	39.1	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
88 – 216	43.5	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
216 – 960	46.4	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
Above 960	49.5	Average	RBW = 1 MHz, VBW ≥ 1 Hz

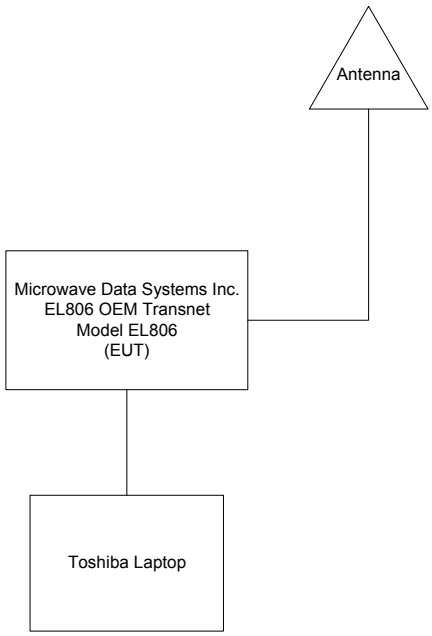
5.7.2. Method of Measurements

The EUT shall be scanned from 30 MHz to the 5th harmonic of the highest oscillator frequency in the digital devices or 1 GHz whichever is higher. Please refer to the Exhibit 7 of this test report and ANSI C63-4:1992 for radiated emissions test method.

5.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Microwave Amplifier	Hewlett Packard	HP 83017A	3116A00661	1 GHz to 26.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna with Mixer	EMCO	3160-09	1007	18 GHz – 26.5 GHz
Horn Antenna with Mixer	EMCO	3160-10	1001	26.5 GHz – 40 GHz

5.7.4. Test Arrangement



5.7.5. Test Data

Frequency (MHz)	RF Level (dBµV/m)	Detector Used (Peak/QP)	Antenna Plane (H/V)	Limit (dBµV/m)	Margin (dB)	Pass/ Fail
34.29	34.72	QP	V	39.1	-4.4	Pass
34.29	27.35	Peak	H	39.1	-11.8	Pass
35.30	26.07	Peak	V	39.1	-13.0	Pass
36.50	23.28	Peak	V	39.1	-15.8	Pass
45.85	25.17	Peak	V	39.1	-13.9	Pass
57.13	36.85	QP	V	39.1	-2.3	Pass
57.13	25.14	Peak	H	39.1	-14.0	Pass
62.95	23.10	Peak	V	39.1	-16.0	Pass
68.69	21.36	Peak	V	39.1	-17.7	Pass
137.38	27.08	Peak	V	43.5	-16.4	Pass
137.38	23.58	Peak	H	43.5	-19.9	Pass
220.13	26.36	Peak	V	46.4	-20.0	Pass
400.20	29.63	Peak	V	46.4	-16.8	Pass
480.50	31.19	Peak	V	46.4	-15.2	Pass
480.50	28.51	Peak	H	46.4	-17.9	Pass
The emissions were scanned from 30 MHz to 5 GHz and all emissions within 20 dB below the limits were recorded.						

5.8. RECEIVER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [47 CFR §15.111(a)]

5.8.1. Limits

Receivers that operate (tune) in the frequency range 30 to 960 Mhz and CB receivers that provides terminals for the connection of an external antenna may be tested to demonstrate compliance with the provisions of §15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: ***With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at frequency within the range from 30 Mhz to 5th harmonic of the highest frequency shall not exceed 2.0 nanowatts (or -57 dBm @ 50 Ohm).***

5.8.2. Method of Measurements

Refer to ANSI C63-4:1992

5.8.3. Test Equipment List

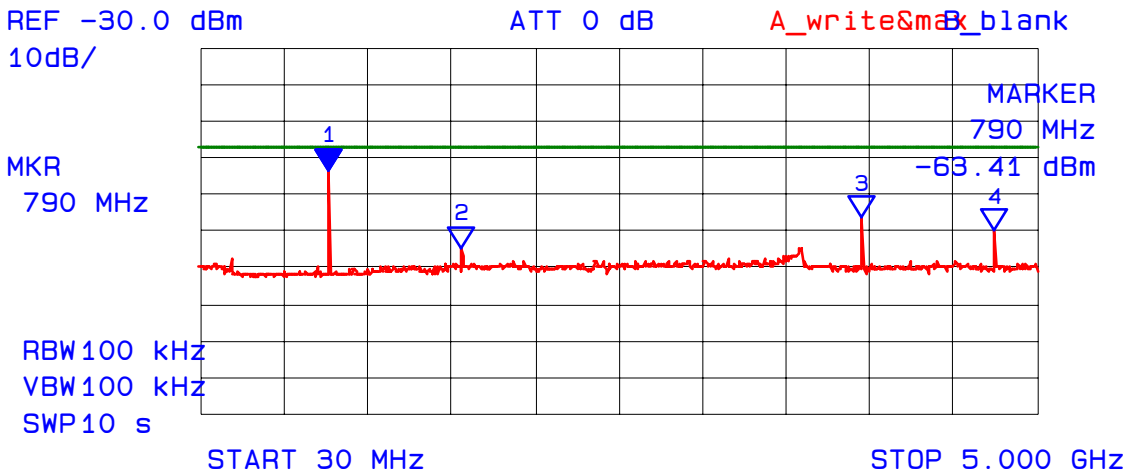
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz – 26.5 GHz

5.8.4. Test Arrangement

5.8.5. Test Data

The emissions were scanned from 10 MHz to 5 GHz with receive mode set at 902.2 MHz, 915 MHz and 927.6 MHz; refer to the following test data plots #1 – 3 for measurement results:

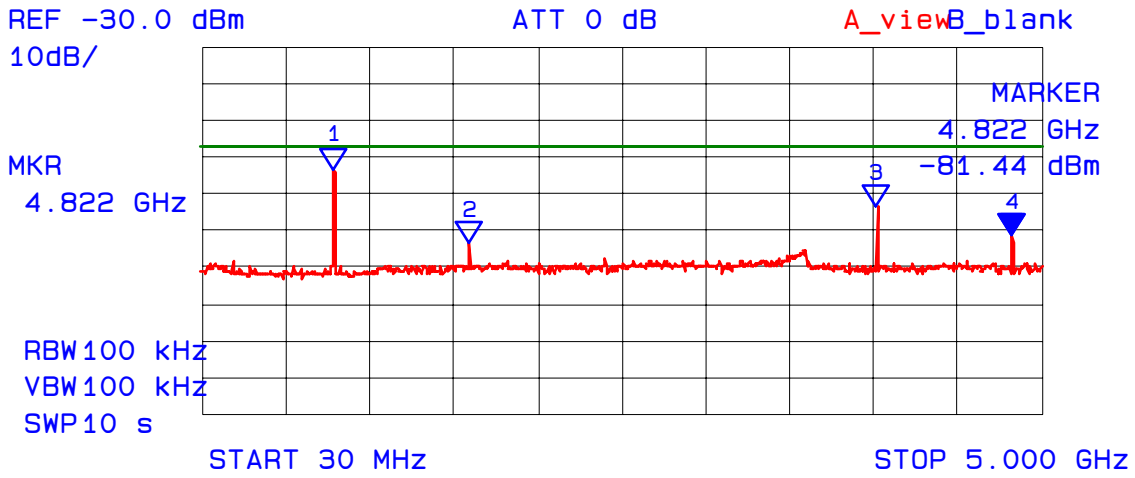
Plot #3:
Receiver Spurious Emissions (Conducted)
Receive Frequency: 902.2 MHz



*** Multi Marker List ***

No.1:	790 MHz	-63.41 dBm	A
No.2:	1.578 GHz	-84.06 dBm	A
No.3:	3.956 GHz	-76.25 dBm	A
No.4:	4.744 GHz	-79.78 dBm	A
No.5:			
No.6:			
No.7:			
No.8:			

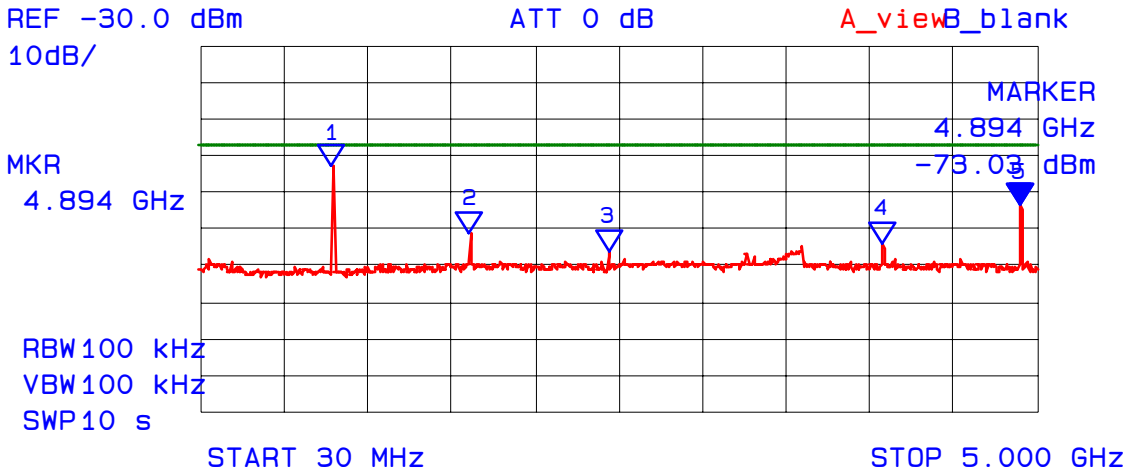
Plot #4:
Receiver Spurious Emissions (Conducted)
Receive Frequency: 915 MHz



*** Multi Marker List ***

No.1:	804 MHz	-63.50 dBm	A
No.2:	1.606 GHz	-83.44 dBm	A
No.3:	4.020 GHz	-73.31 dBm	A
No.4:	4.822 GHz	-81.44 dBm	A
No.5:			
No.6:			
No.7:			
No.8:			

Plot #5:
Receiver Spurious Emissions (Conducted)
Receive Frequency: 927.6 MHz



*** Multi Marker List ***

No.1:	811 MHz	-62.59 dBm	A
No.2:	1.627 GHz	-80.84 dBm	A
No.3:	2.451 GHz	-85.75 dBm	A
No.4:	4.077 GHz	-83.94 dBm	A
No.5:	4.894 GHz	-73.03 dBm	A
No.6:			
No.7:			
No.8:			
:			

EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

6.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC Γ_1 = 0.03 LISN VRC Γ_R = 0.8(9 kHz) 0.2 (30 MHz) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 150 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 7. MEASUREMENT METHODS

7.1. GENERAL TEST CONDITIONS

7.1.1. Test Conditions

- The measurement shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications.
- An attempt shall be made to maximize the detected radiated emissions, for example moving cables of the equipment, rotating the equipment by 360° and moving the measuring receiving antenna up and down within 1 to 4 meters high.
- Where appropriate, a single tone or a bit stream shall be used to modulate the receiver. The manufacturer shall define the modulation with the highest emission in transmit mode.

7.1.2. Method of Measurements - AC Mains Conducted Emissions

- AC Mains conducted emissions measurements were performed in accordance with the standard against appropriate limits for each detector function.
- The test was performed in the shielded room, 16'(L) by 16'(W) by 12'(H).
- The test was performed were made over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio noise voltage which was conducted from the EUT power-input terminals that were directly connected to a public power network.
- The EUT normally received power from another device that connects to the public utility ac power lines, measurements would be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.
- If the EUT operates only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines, AC Mains conducted measurements are not required.
- Table-top devices were placed on a platform of nominal size 1 m by 1.5m raised 80 cm above the conducting ground plane.
- The EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the power source. All unused 50-Ohm connectors of the LISN was terminated in 50-ohm when not connected to the measuring instruments.
- The line cord of the EUT connected to one LISN which was connected to the measuring instrument. Those power cords for the units of devices not under measurement were connected to a separate multiple ac outlFCC. Drawings and photographs of typically conducted emission test setups were shown in the Test Report. Each current-carrying conductor of the EUT shall be individually tested.
- The EUT was normally operated with a ground (safety) connection, the EUT was connected to the ground at the LISN through a conductor provided in the lead from the ac power mains to the LISN.
- The excess length of the power cord was folded back and forth in an 8-shape on a wooden strip with a vertical prong located on the top of the LISN case.
- The EUT was set-up in its typical configuration and operated in its various modes as described in this test report.
- A preliminary scan was made by using spectrum analyzer system with the detector function set to PEAK mode (9 KHz RBW, VBW > RBW), frequency span 450KHz - 30MHz.

- The maximum conducted emission for a given mode of operation was found by using the following step-by-step procedure:

  Step1. Monitor the frequency range of interest at a fixed EUT azimuth.

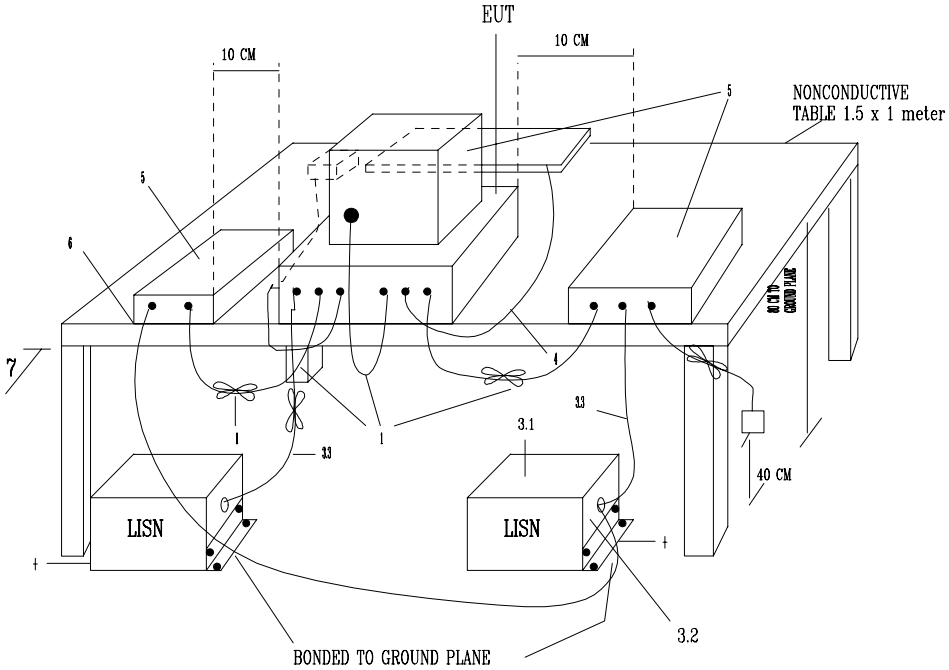
  Step2. Manipulate the system cables and peripheral devices to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

  Step3. The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed.

  Step4. After completing step 1 through 3, record EUT and peripheral device configuration, mode of operation, cable configuration, signal levels and frequencies for final test.

- Each highest signal level at the maximized test configuration was zoomed in a small frequency span on the spectrum analyzer's display (the manipulation of cables and peripheral devices and EUT operation modes might have to be repeated to obtain the highest signal level with the spectrum analyzer set to PEAK detector mode 9 KHz RBW and VBW > RBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (10 KHz RBW, 1 MHz VBW) and AVERAGE detector mode (9 kHz RBW, 1 Hz VBW). The final highest RF signal levels and frequencies were record.

- ***Broad-band ac Powerline conducted emissions***:- If the EUT exhibits ac Powerline conducted emissions that exceed the limit with the instrument set to the quasi-peak mode, then measurements should be made in the average mode. If the amplitude measured in the quasi-peak mode is at least 6 dB higher than the amplitude measured in the average mode, the level measured in quasi peak mode may be reduced by 13 dB before comparing it to the limit.



+LISNs may have to be moved to the side to meet 3.3 below

LEGEND:

1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back at forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.

2. I/O cables that are connected to a peripheral shall be bundled in center. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1m.

3. EUT connected to one LISN. Unused LISN connectors shall be terminated in 50 Ohm. LISN can be placed on top of, or immediately beneath, ground plane.
3.1 All other equipment powered from second LISN.
3.2 Multiple outlet strip can be used for multiple power cords of non-EUTequipment.
3.3 LISN at least 80 cm from nearest part of EUT chassis.

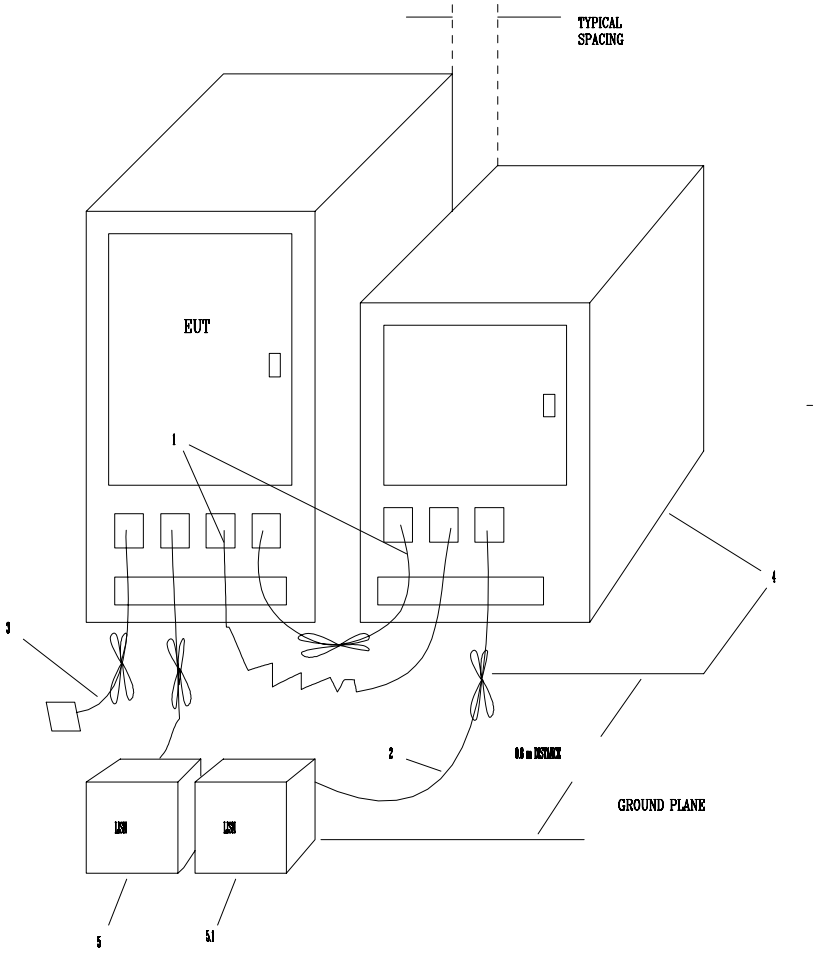
4. Cables of hand-operated devices, such as keyboards, mouses, etc., have to be placed as close as possible to the host.

5. Non-EUT components being tested.

6. Rear of EUT, including peripherals, shall be all aligned and flush with rear of tabletop.

7. Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the floor ground plane (see 5.2)

Tabletop Equipment Conducted Emissions



LEGENEND:

1. Excess I/O cables shall be bundled in center. If bundling is not possible, the cables shall be arranged in serpentine fashion. Bunding shall not exceed 40 cm in length.

2. Excess power cords shall be bundled in the center or shortened to appropriated length.

3. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using correct terminating impedance. If bundling is not possible, the cable shall be arranged in serpentine fashion.

4. EUT and all cables shall be insulated from ground plane by 3 to 12 mm of insulating material.

5. EUT connected to one LISN. LISN can be placed on top of, or immediately beneath, ground plane.
5.1 All other equipment powered from second LISN.

Floor-Standing Equipment Conducted Emissions

7.1.3. Method of Measurements - Electric Field Radiated Disturbance

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:

  1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
  2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
  3. Calibrated Advantest spectrum analyzer and pre-selector. In general, the spectrum analyzer would be used as follows:

     – The rf electric field levels were measured with the spectrum analyzer set to PEAK detector (120 KHz VBW and VBW $\geq$ RBW).

     – If any rf emission was observed to be a broadband noise, the spectrum analyzer's CISPR QUASI-PEAK detector (120 KHz RBW and VBW $\geq$ RBW) was then set to measure the signal level.

     – If the signal being measured was narrowband and the ambient field was broadband, the bandwidth of the spectrum analyzer was reduced.

- The EUT was set-up in its typical configuration and operated in its various modes as described in this test report.
- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

  The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

  Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

  Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

  Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

  Step4: Move the antenna over its full allowed range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

  Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

Calculation of Field Strength:

The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

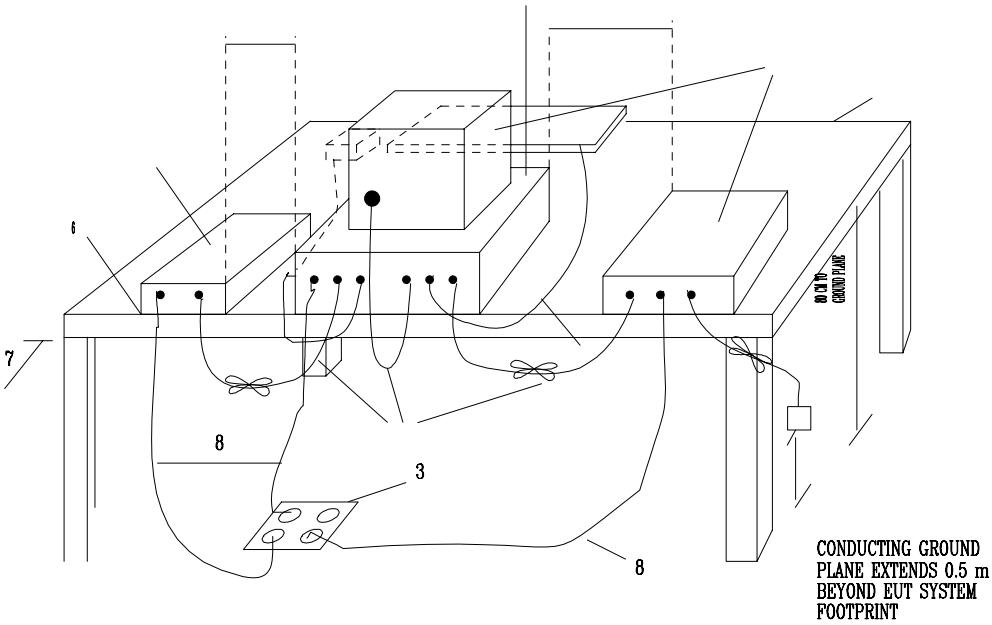
$$FS = RA + AF + CF - AG$$

Where	FS	=	Field Strength
	RA	=	Receiver/Analyzer Reading
	AF	=	Antenna Factor
	CF	=	Cable Attenuation Factor
	AG	=	Amplifier Gain

Example: If a receiver reading of 60.0 dBµV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:

Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBµV/m.

Field Level = $10^{(38/20)}$ = 79.43 µV/m.



LEGEND:

1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.

2. I/O cables that are connected to a peripheral shall be bundled in center. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1m.

3. If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground plane with the receptable flush with the ground plane.

4. Cables of hand-operated devices, such as keyboards, mouses, etc., have to be placed as close as possible to the controller.

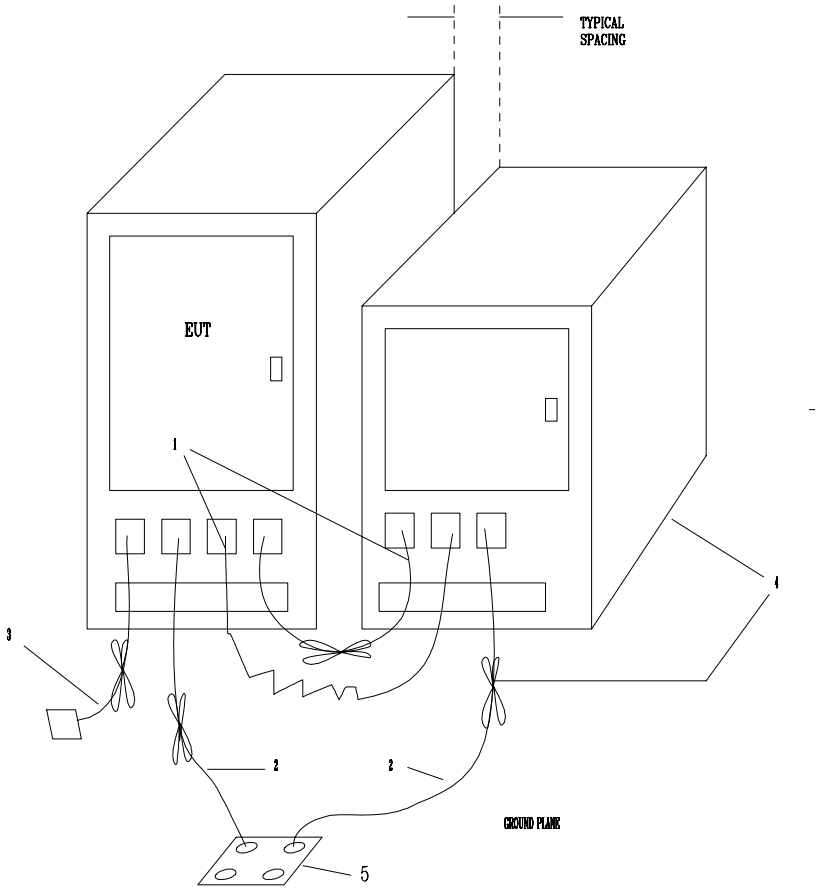
5. Non-EUT components of EUT system being tested.

6. The rear of all components of the system under test shall be located flush with the rear of the table.

7. No vertical conducting wall used.

8. Power cords drape to the floor and are routed over to receptacle.

Tabletop Equipment Radiated Emissions



LEGEND:

1. Excess I/O cables shall be bundled in center. If bundling is not possible, the cables shall be arranged in serpentine fashion.

2. Excess power cords shall be bundled in the center or shortened to appropriated length.

3. I/O cables that are not connected to aperipheral shall be bundled in the center. The end of the cable may be terminated if required using correct terminating impedance. If bundling is not possible, the cable shall be arranged in serpentine fashion.

4. EUT and all cables shall be inslulated from ground plane by 3 to 12 mm of insulating material.

5. If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground plane with the receptacle flush with the ground plane.

Floor-Standing Equipment Radiated Emissions

EXHIBIT 8. LABELLING & VERIFICATION REQUIREMENTS

8.1. LABELLING REQUIREMENTS [47 CFR §15.19]

(a) The device subject to **Verification** must be labeled as follows:

> ***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 received, including interference that may cause undesired operation.***

(b) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified in this Section is required to be affixed only to the main control unit.

(c) When the device is so small or for such use that it is not practicable to place the statement specified in this Section on it, the information required by these paragraphs shall be placed in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

8.2. INFORMATION TO USER [47 CFR §§15.21 & 15.105]

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.

<u>Warning</u>: Changes or modifications not expressly approved by <manufacturer> could void the user's authority to operate the equipment.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

<u>NOTE</u>: ***This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provided reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.***

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

NOTE: ***This equipment has been tested and found to comply with the limits for a Class B digital devices, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of more of the following measures:***

- ***Reorient or relocate the receiving antenna***
- ***Increase the separation between the equipment and receiver***
- ***Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.***
- ***Consult the dealer or an experienced radio/TV technician for help.***

8.3. RESPONSIBLE PARTY [47 CFR §2.909]

The following parties are responsible for the compliance of radio frequency equipment with the applicable standards:

(c) In the case of the equipment subject to authorization under the Verification procedure:

(1) The manufacturer or, if the equipment is assembled from individual component parts and the resulting system is subject to authorization under Verification, the assembler.

(2) If the equipment, by itself, is subject to Verification and the equipment is imported, the importer.

8.4. SAMPLING TEST OF EQUIPMENT COMPLIANCE [47 CFR §2.945]

The Commission will, from time to time, request the responsible party to submit equipment subject to this chapter to determine the extent to which subsequent production of such equipment continues to comply with the data filed by the applicant (or on file with the responsible party for equipment subject to notification or a Verification). Shipping costs to the Commission's laboratory and return shall be borne by the responsible party.

8.5. PENALTY FOR FAILURE TO PROVIDE TEST SAMPLES AND DATA [47 CFR §2.946]

(a) Any responsible party, as defined in Section 2.909 of this chapter, or nay party who markets equipment subject to the provisions of this chapter, shall provide test sample(s) or data upon request by the Commission. Failure to comply with such a request with the time frames shown below may be cause for forfeiture, pursuant to Section 1.80 of Part 1 of this chapter, or other administrative sanctions such as suspending action on any applications for equipment authorization submitted by such party while the matter is being resolved.

(1) When the equipment is subject to authorization under Verification, data shall be provided within 14 days of delivery of the request and test sample(s) shall be provided within 60 days of delivery of the request.

(2) For all other devices, test sample(s) or data shall be provided within 60 days of the request.

(b) In the case of the equipment involving harmful interference or safety of life or property, the Commission may specify that test samples subject to the provisions of this section be submitted within less than 60 days, but not less than 14 days. Failure to comply within the specified time period will be subject to the sanctions specified in paragraph (a) of this section.

8.6. LIMITATION ON VERIFICATION [47 CFR §2.952]

(a) Verification signifies that the manufacturer or importer has determined that the equipment has been shown to be capable of compliance with the applicable technical standards if no unauthorized change is made in the equipment and if the equipment is properly maintained and operated. Compliance with these standards shall not be construed to be a finding by the manufacturer or importer with respect to matters not encompassed by the Commission's rules.

(b) Verification of the equipment by the manufacturer or importer is effective until a termination date is otherwise established by the Commission.

(c) No person shall, in any advertising matter, brochure, etc., use or make reference to a verification in a deceptive or misleading manner or convey the impression that such verification reflects more than a determination by the manufacturer or importer that the device or product has been shown to be capable of compliance with the applicable technical standards of the Commission's Rules.

8.7. RESPONSIBILITY OF MANUFACTURER OR IMPORTER [47 CFR §2.953]

(a) In verifying compliance, the manufacturer or importer (in the case of imported equipment) warrants that each unit of the equipment marketed under the verification procedure will conform to the unit tested and found acceptable by the manufacturer or importer and that data on file with the manufacturer or importer continues to be representative of the equipment being produced under such verification within the variation that can be expected due to quantity production and testing on a statistical basis.

(b) The importer of equipment subject to verification may upon receiving a written statement from the manufacturer that the equipment complies with the appropriate technical standards rely on the manufacturer or independent testing agency to verify compliance. The test records required by §2.955 however should be in English language and made available to the Commission upon a reasonable request.

(c) In the case of transfer of control of equipment, as in the case of sale or merger of the grantee, the new manufacturer or importer shall bear the responsibility of continued compliance of the equipment.

(d) Equipment verified by the manufacturer or importer shall be re-verified if the modification or change adversely affects the emanation characteristics of the modified equipment. The manufacturer or importer continues to bear the responsibility for continued compliance of subsequently produced equipment.

8.8. IDENTIFICATION [47 CFR §2.954]

The identification of equipment subject to verification shall be consistent with current manufacturer or marketing practices: *Provided*, The manufacturer or importer maintains adequate identification records for each unit verified to facilitate positive identification of each equipment marketed.

8.9. RETENTION OF RECORDS [47 CFR §2.955]

(a) For each equipment subject to verification, the manufacturer (or importer) shall maintain the records listed below:

(1) A record of the original design drawings and specifications and all changes that have been made that may affect compliance with the requirements of §2.953.

(2) A record of the procedures used for production inspection and testing (if tests were performed) to insure the conformance required by §2.953. (Statistical production line emission testing is not required).

(b) The records listed in paragraphs (a) of this section shall be retained for two years after the manufacture of said equipment item has been permanently discontinued, or until the conclusion of an investigation or a proceeding if the manufacturer or importer is officially notified that an investigation or any other administrative proceeding involving his equipment has been instituted.

8.10. FCC INSPECTION & SUBMISSION OF EQUIPMENT FOR TESTING [47 CFR §2.956]

(a) Each manufacturer or importer of equipment subject to verification shall upon receipt of reasonable request submit to the Commission the records required by §2.955.

(b) The Commission may require the manufacturer or importer of equipment subject to verification to submit one or more of sample units for measurements at the Commission's Laboratory.

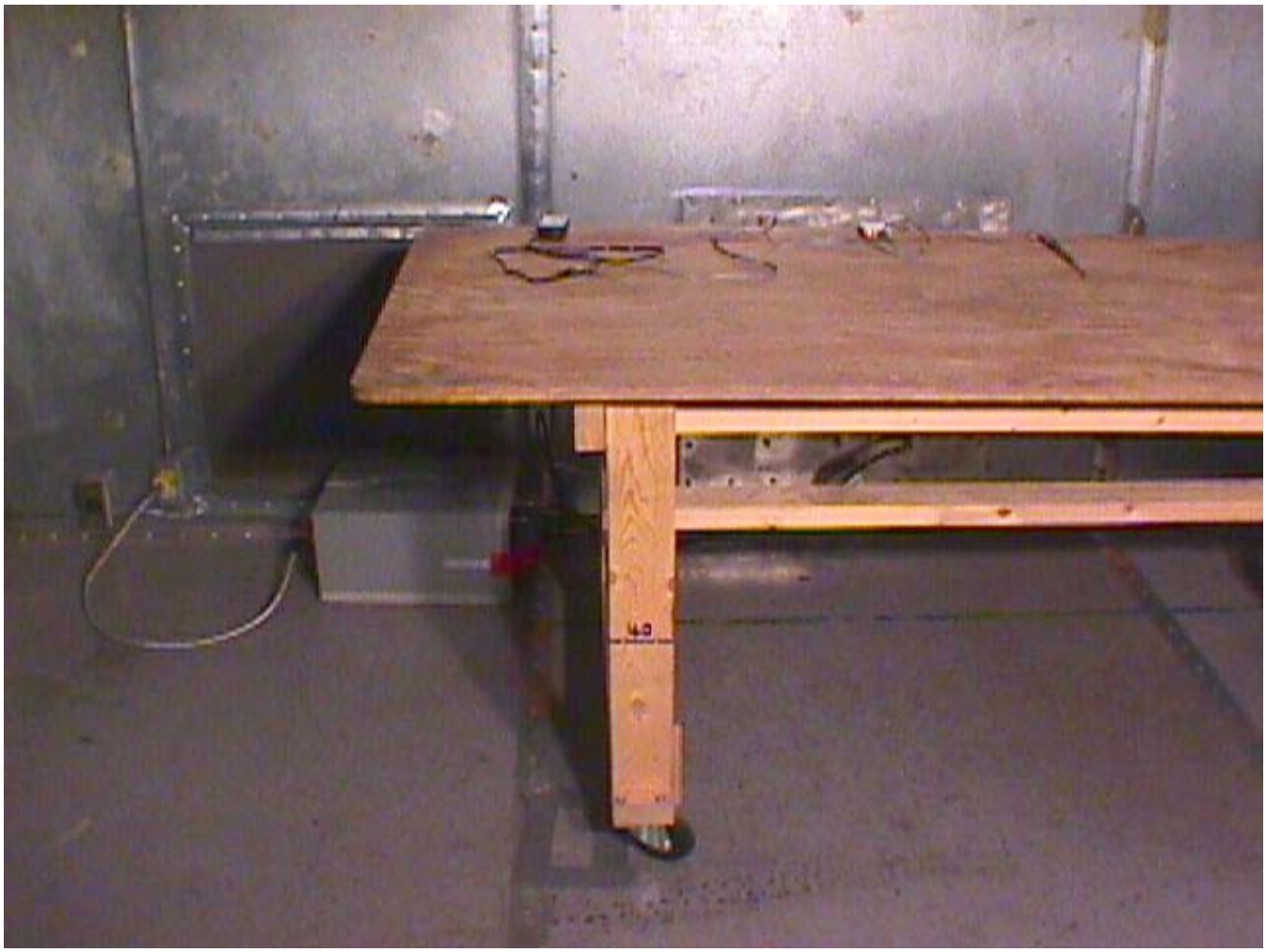
(c) In the event the manufacturer believes that shipment of the sample to the Commission's Laboratory is impractical because of the size or weight of the equipment, or the power requirement or for any other reason, the applicant may submit a written explanation why such shipment is impractical and should not be required.

8.11. SAMPLING TESTS OF EQUIPMENT COMPLIANCE [47 CFR §2.957]

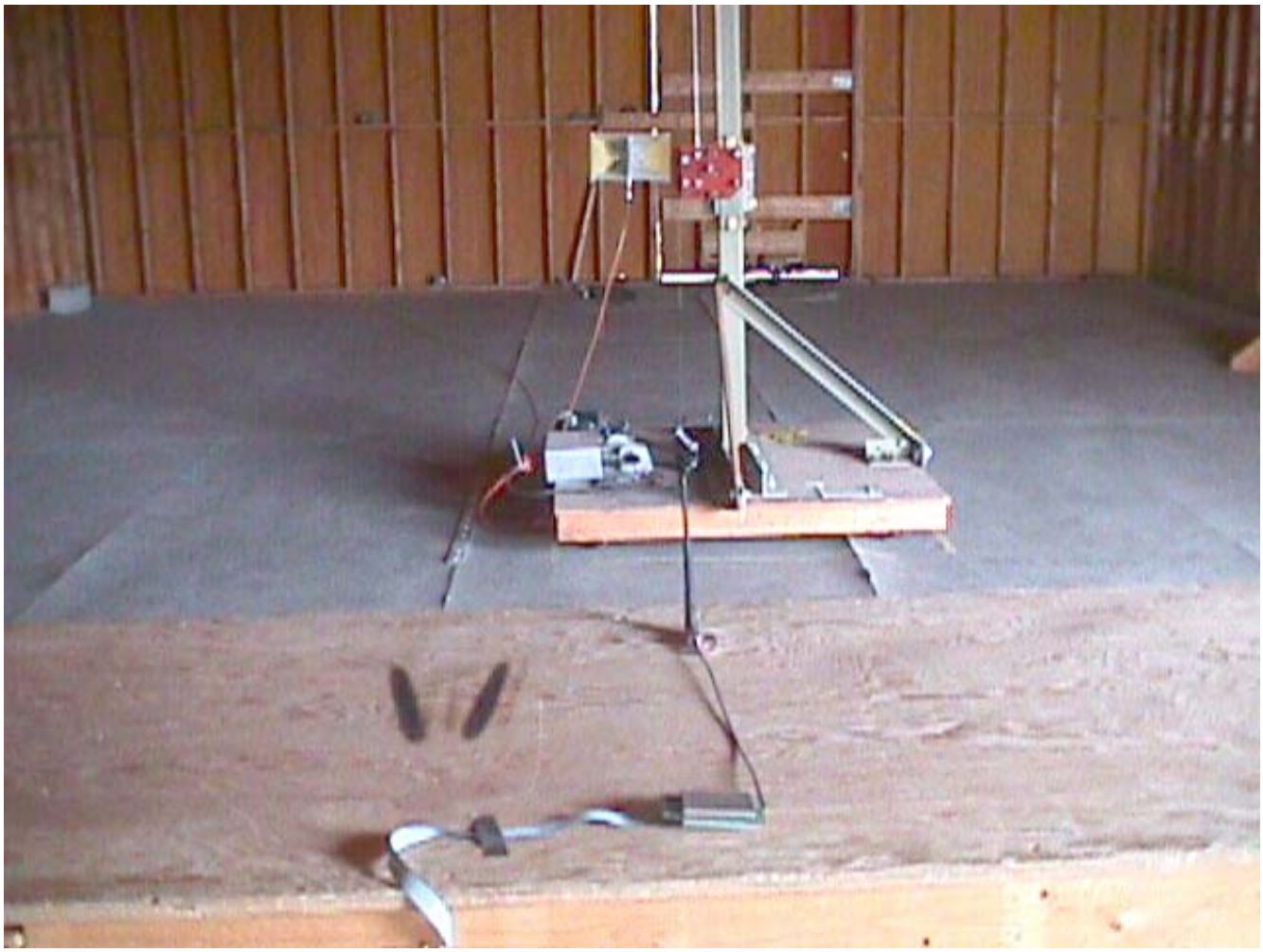
The Commission will from time to time, request the manufacturer or importer to submit to the FCC Laboratory in Columbia, Maryland, various equipment(s) for which verification has been made, to determine the extent to which subsequently produced units continue to comply with the applicable standards.

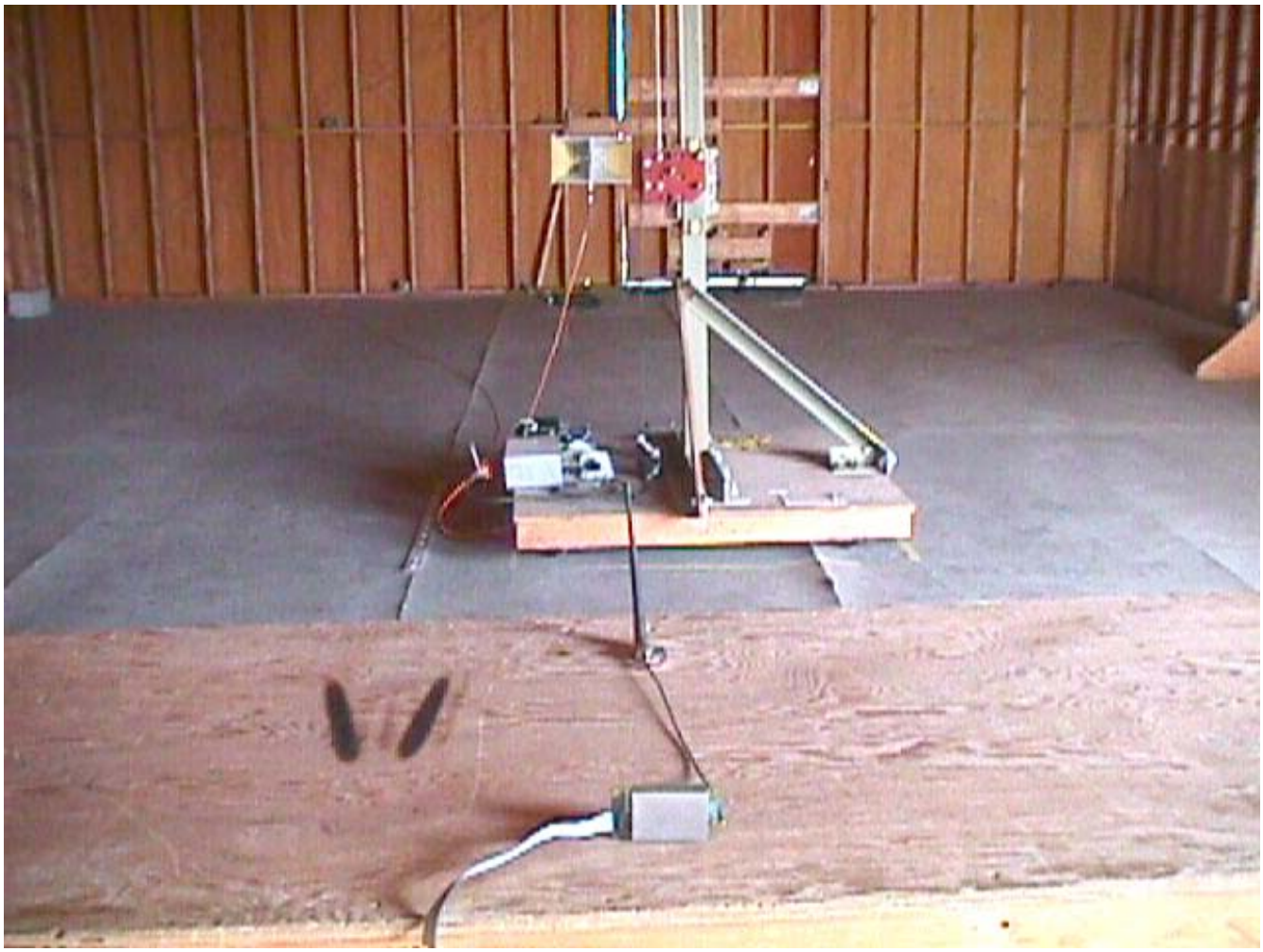
EXHIBIT 9. PHOTOGRAPHS OF TEST SETUP

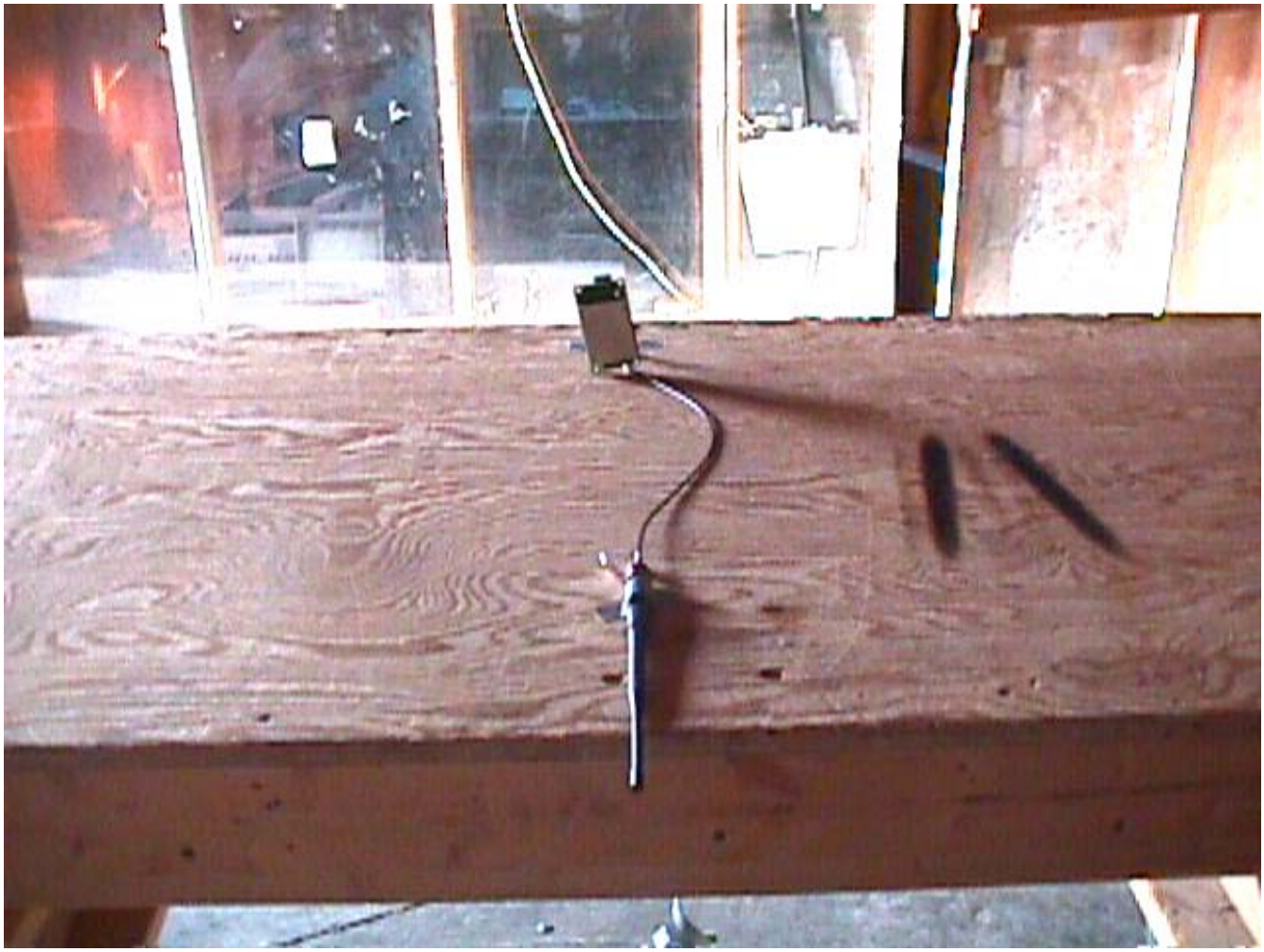
9.1. AC POWER LINE CONDUCTED EMISSIONS

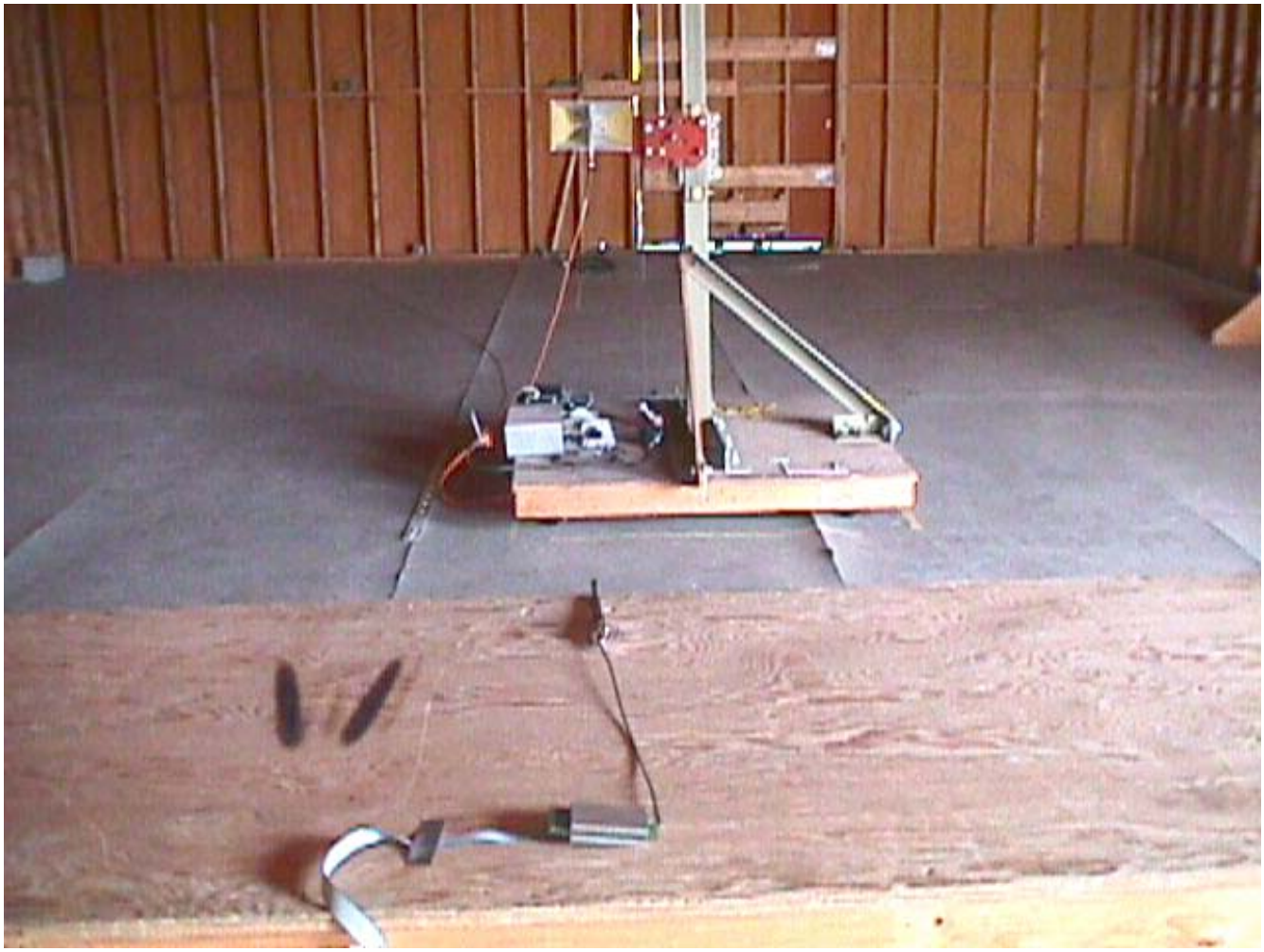


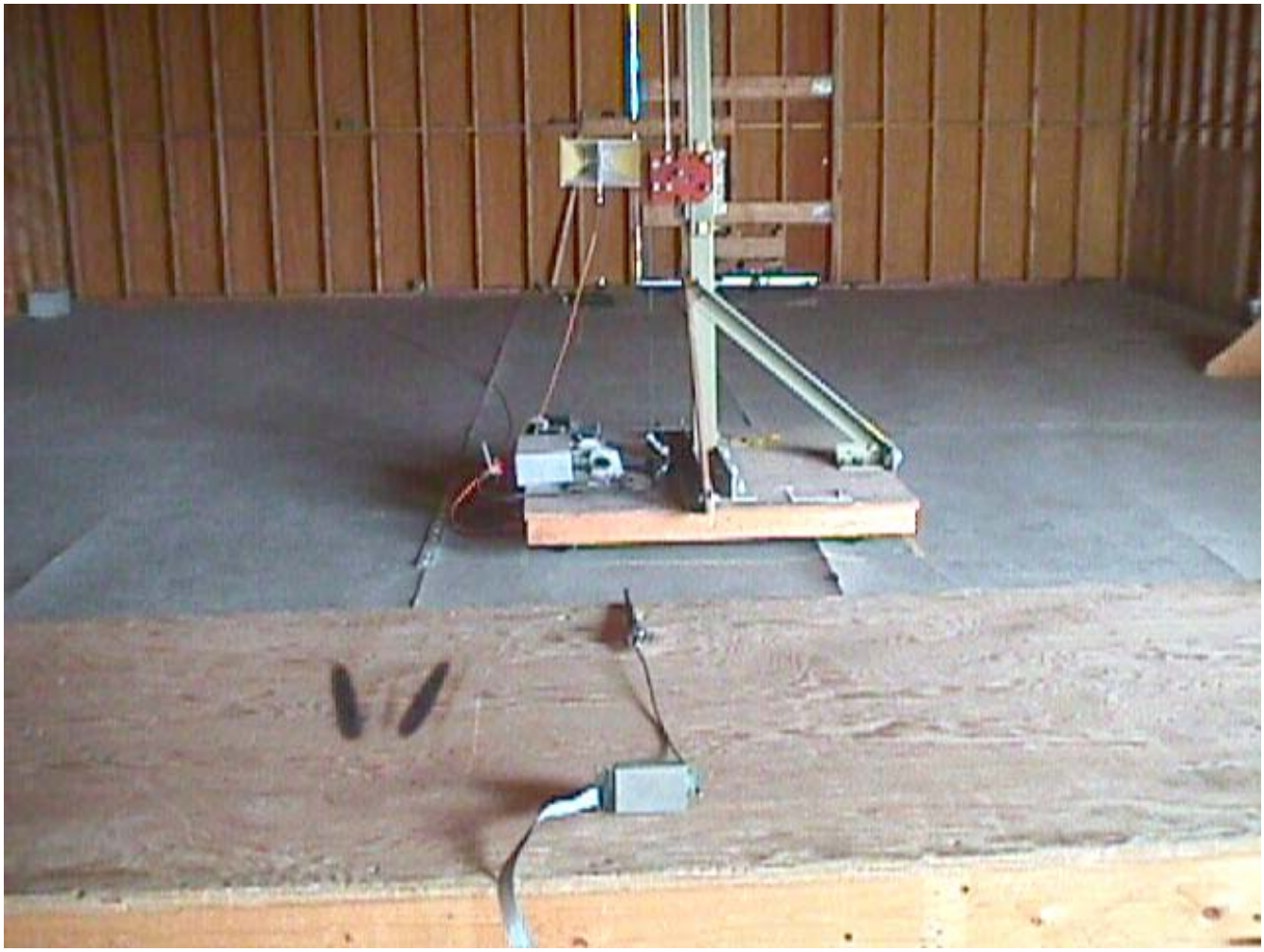
9.2. RECEIVER SPURIOUS/HARMONIC RADIATED EMISSIONS AT 3 METERS



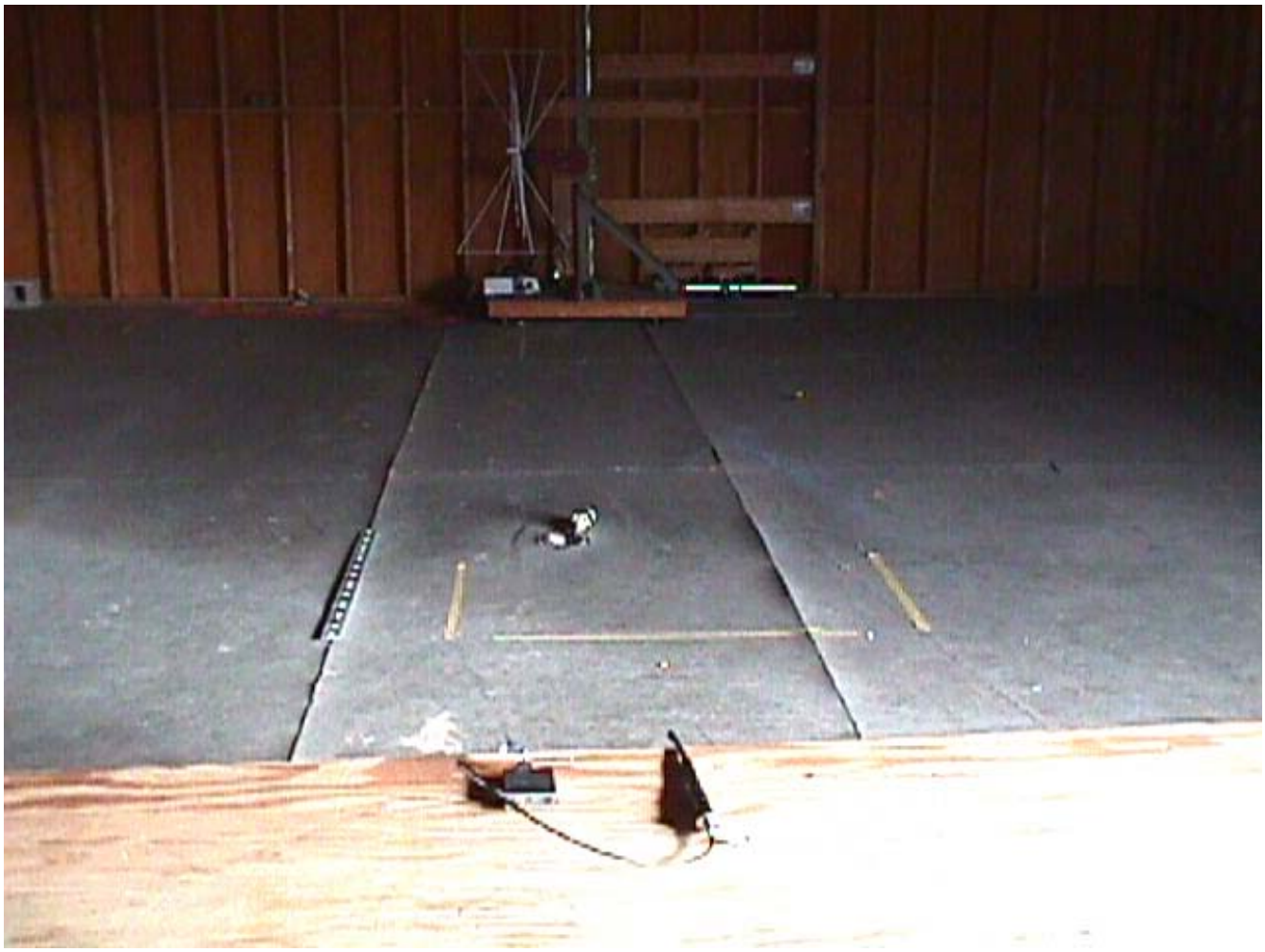








9.3. UNINTENTIONAL RADIATED EMISSIONS AT 10 METERS



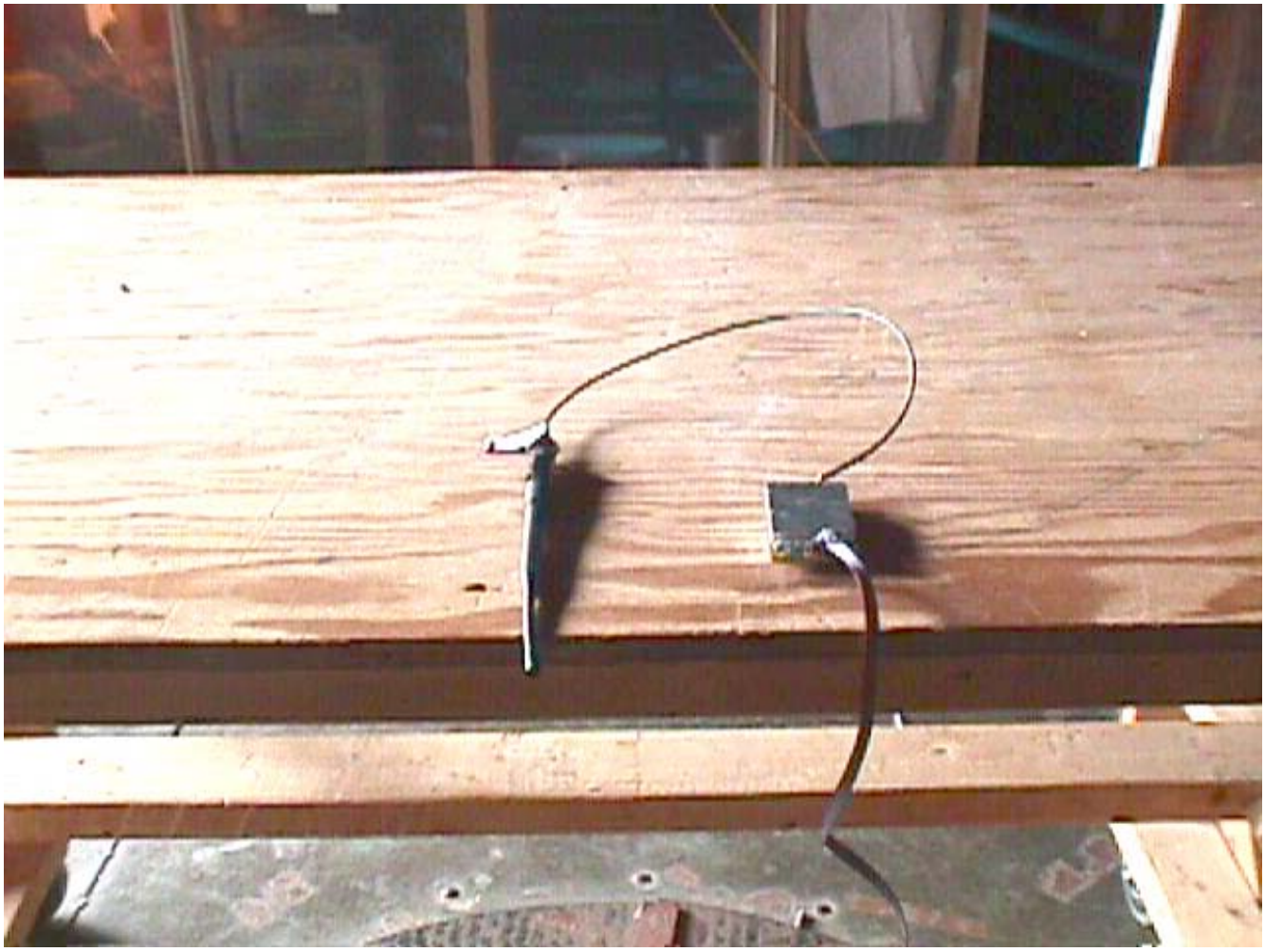
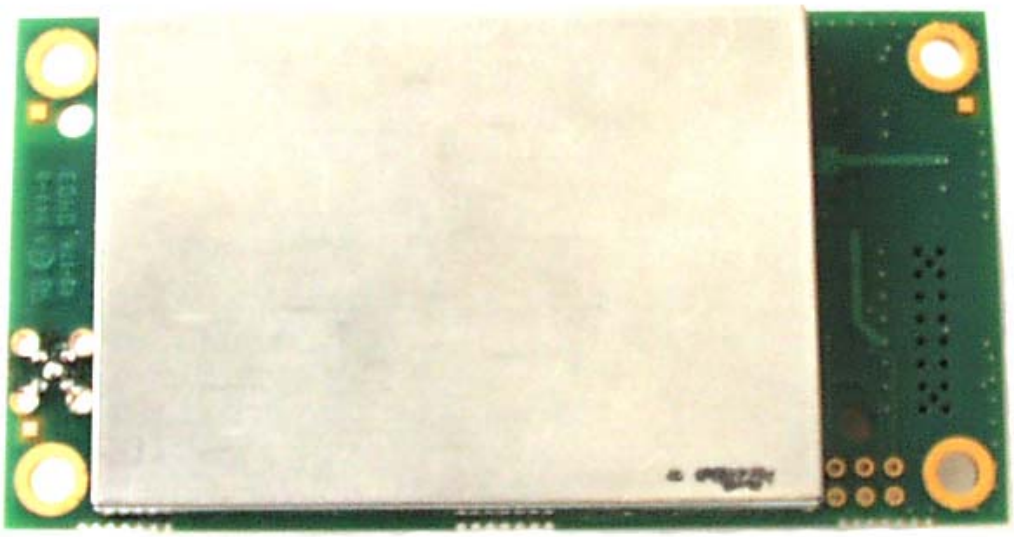
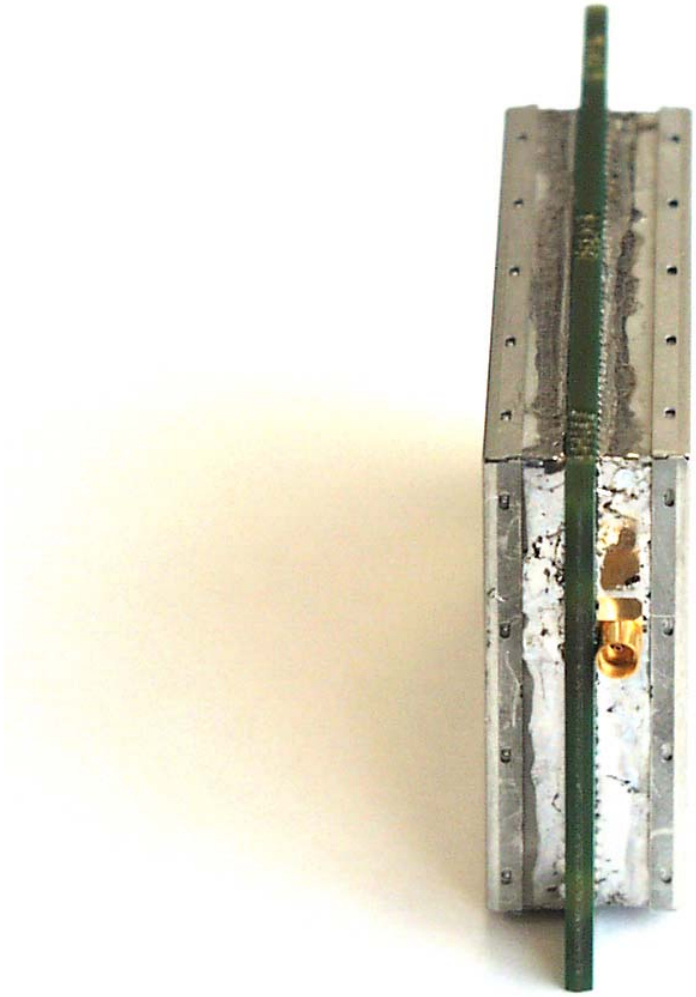
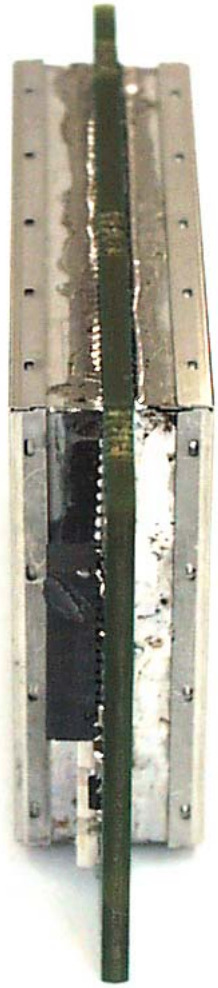



EXHIBIT 10. PHOTOGRAPHS OF EQUIPMENT UNDER TEST