

Test Report No.	BC400127-3	Issue Date: Friday, February 6, 2004
Model / Serial No.	T24A / SN: EMC1	
Product Type	IR and RF Transmitter	
Client	Electronic Solutions, Inc.	
Manufacturer	Electronic Solutions, Inc.	
License holder	Electronic Solutions, Inc.	
Address	11811 Upham Street	
	Broomfield, CO 80020	
Test Criteria Applied	FCC CFR47 Part 15.231	
Test Result	PASS	
Test Project Number	BC400127-1	
References		
Total Pages	26	
Including		
Appendices:		
<i>Todd Gealey</i>		<i>Robert Crosswell</i>
Reviewed By :		Approved By :

INTERNATIONAL APPROVALS LABORATORIES (IAL) reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. IAL have no liability for any deductions, inferences or generalizations drawn by the client or others from IAL issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval of IAL. This report shall not be used by the client to claim product endorsement by NVLAP (No. 200624-0) or any agency of the US government.

International Approval Laboratories and its professional staff hold government
 and professional organization certifications and are members of
 IEEE, NVLAP, and VCCI.

D I R E C T O R Y



Documentation	Page(s)
Test report	<u>1 - 9</u>
Directory	<u>2</u>
Test Regulations	<u>3-4</u>
General Remarks	<u>5-6</u>
Test-setup Photographs	<u>6-9</u>
Appendix A	
Test Data Sheets and Test Equipment Used	<u>10 - 20</u>
Appendix B	
Test Plan/Constructional Data Form	<u>21 - 21</u>
Appendix C	
Measurement Protocol/Test Procedures	<u>22 - 26</u>

STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty for Conducted Emissions in the frequency range of 150kHz – 30MHz is calculated to be ± 2.30 dB and for Radiated Emissions is calculated to be ± 3.60 dB in the frequency range of 30MHz – 200MHz and ± 3.38 dB in the frequency range of 200MHz – 1000MHz.

EUT Received Date: 26-Jan-2004

Testing Start Date: 26-Jan-2004

Testing End Date: 26-Jan-2004

The tests were performed according to following regulations :

1. FCC CFR47 Part 15.205
2. FCC CFR47 Part 15.207
3. FCC CFR47 Part 15.209
4. FCC CFR47 Part 15.231
5. ICES-003

Emission Test Results:

Conducted Emissions, Powerline (15.207) - Not Applicable

Test Result

Minimum limit margin _____ dB at _____ MHz
 Maximum limit exceeding _____ dB at _____ MHz

Remarks: Battery Powered Device

Radiated Emissions (15.209) / 15.231(b)(3) - PASS

Test Result

Minimum limit margin _____ -26.0 dB at _____ 195.0 MHz
 Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions (15.205) / 15.231(b)(2) - PASS

Test Result

Minimum limit margin _____ -16.31 dB at _____ 1301.85 MHz
 Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions 15.231(a)(1)&(2) - PASS

Test Result

Remarks: Required measurement for manually and automatic operated transmitter equipment. <5 Sec. after activation

Radiated Emissions 15.231(b)(1) - PASS

Test Result

Minimum limit margin _____ -1.96 dB at _____ 433.99 MHz
 Maximum limit exceeding _____ dB at _____ MHz

Remarks: Measurements were taken utilizing the methods dictated by Part 15.35 for averaging pulsed emissions and for limiting peak emissions

Radiated Emissions 15.231(c) - PASS**Test Result 0.98MHz**

Remarks: Devices operated within the frequency band of 70 – 900MHz: **-20dBc Bandwidth** maximum of 0.25% of the center frequency

Devices operated within the frequency band of >900MHz: **-20dBc Bandwidth** maximum of 0.50% of the center frequency

Radiated Emissions 15.231(d) - Not Applicable**Test Result**

Remarks: Devices operated within the frequency band of 40.66 – 40.70MHz: **-20dBc Bandwidth** maximum of 0.01% of the center frequency as measured through the temp range of -20 to +50 deg. C, and at 85 - 115% of the nominal supply voltage at 20 deg. C “a new battery would be used in cases where the device is powered from a battery”

Radiated Emissions 15.231(e) - Not Applicable**Test Result**

Minimum limit margin 00.00 dB at 0000.00 MHz

Maximum limit exceeding dB at MHz

Remarks: Measurements were taken utilizing the methods dictated by Part 15.35 for averaging pulsed emissions and for limiting peak emissions

GENERAL REMARKS:

Testing was performed in 3 different orthogonal axis to determine the worst case emissions from the device. The worst case emissions measurements are shown in this report.

In any case where the device is powered off a battery, a fresh battery was used during test. In cases where the device is powered off an AC supply, voltage was varied per Part 15.31 to find worst case emissions.

Modifications required to pass: **NONE**

Test Specification Deviations: **NONE**

Required Information In Accordance to FCC CFR 47 Part 2.1033:

Rule Part 11, 15 & 18 Devices	Other Rule Part Devices	Description	Comments
2.1033(b)(1)	2.1033(c)(1)	Manu. Contact	See Page 1 of this report
2.1033(b)(2)	2.1033(c)(2)	FCC Identifier	
2.1033(b)(3)	2.1033(c)(3)	Users Manual to include Operating, installation	Attached as Exhibit
	2.1033(c)(4)	Emissions Designator per 2.	
	2.1033(c)(5)	Frequency Range	Not Applicable to Part 15 Devcies
	2.1033(c)(6)	Power range and controls	Not Applicable to Part 15 Devcies
	2.1033(c)(7)	Maximum power ouput rating	Not Applicable to Part 15 Devcies
	2.1033(c)(8)	DC Voltage and Current suplying final RF stages	Not Applicable to Part 15 Devcies
2.1033(b)(3)	2.1033(c)(9)	Tune -up procedure	Please refer to the users manual for applicability
2.1033(b)(4&5)	2.1033(c)(10)	Complete Circuit Diagrams and circuit operation description	Attached as Exhibit
2.1033(b)(7)	2.1033(c)(11)	Photographs/drawings of the identification label & its location on the device	Attached as Exhibit
2.1033(b)(7)	2.1033(c)(12)	Photographs of the external and internal surfaces, and construction	Attached as Exhibit
	2.1033(c)(13)	Digital Modulation	Not Applicable
2.1033(b)(6)	2.1033(c)(14)	Report of Measurement Data Required by 2.1046 –2.1057	See Data Below (This report consists of the testing required under Part 15.231)
2.1033(b)(8)		Description of publicly available support equipment used during test	Refer to Exhibit B of this report (Client Test Plan)
2.1033(b)(9)		Statement of Autorization to Part 15.37 of CFR47	The equipment herein is being authorized in accordance to 15.37 of the CFR47 Rules.
2.1033(b)(10)		Direct Sequence Spread Spectrum Devices (DSSS)	Exhibit of compliance to 15.247(e)
2.1033(b)(10)		Frequency Hopping Devices	Exhibit of compliance to 15.247(a)(1)
2.1033(b)(11)		Scanning receiver construction	Exhibit stating compliance to construction in accordance to 15.121.
15.31	15.31	Transmitter Supply Voltage	Testing herein was completed in accordance to FCC CFR47 Part 15.31

Exhibits Including (where applicable):

1. Users Manual	7. Parts List
2. Operation Description	8. Tuning Procedure (if applicable)
3. Block Diagram	9. Test Setup Photograph
4. Report of Measurement	10. Label Drawings and or Photograpghs
5. External & Internal Photographs	11. Description of Support Equipment (where Applicable)
6. Schematic	

Required Information in Accordance to Industry Canada Regulations (In addition to the above):

Information Required	Description	Comments
Modulation Type	(i.e. ASK, NON, FSK, DSSS, FHSS, etc.)	N/A
Emissions Designator	Per TRC-49	N/A
In Country Representative	Contact Information	N/A
99% Bandwidth Measurement	Per RSS-210	N/A

Test-setup photo(s):
Radiated Emissions



Test-setup photo(s):
Radiated Emissions



Appendix A

Test Data Sheets

and

Test Equipment Used

Part 15.231 (a) (1&2)

Device must cease to function after manual or automatic activation.

Verification of 5 second Deactivation

It was verified that the transmitter inactivated itself within 5 seconds of a manual button push. The transmitter is operated manually.

Part 15.231 (b)(1) or (e)
Field Strength Emissions from Intentional Radiators

&

Part 15.231 (b)(2) / 15.205
Restricted Bands of Operation

Field Strength Measurements

Fundamental and Spurious of the Transmitter

Test Report #:	BC400127 Run 1	Test Area:	Pinewood Site 1 (3m)	Temperature:	22 °C
Test Method:	FCC CFR47 Part 15.231/205	Test Date:	Jan 26, 2004	Relative Humidity:	48 %
EUT Model #:	T24A	EUT Power:	3VDC	Air Pressure:	80 kPa
EUT Serial #:	EMC1			Page:	1 of 26
Manufacturer:	Electronic Solutions Inc.				Level Key
EUT Description:	IR & RF Transmitter			Pk – Peak	Nb – Narrow Band
Notes:				Qp – QuasiPeak	Bb – Broad Band
				Av - Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	Duty Cycle Correction	Final Corrected	Limit	DELTA
(MHz)	(dBuV)	(dB) (dBm) (dB)	(dBuV)	(m) (DEG)	(dB)	(dBuV/m)	(dBuV/m) 15.231(b)- 15.205	(dB)

The following duty cycle was declared by the manufacturer.

Duty Cycle = active / 100ms. = 45%

Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.231 emissions and delta limits were calculated as follows:

Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission

The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.209 and 15.231 and the emission/limit delta was calculated.
the DTCF is calculated as follows $20 \times \log_{10}(\text{duty cycle in 100ms})$ "not to exceed 20dB"

Part 15.231 (b) and 15.205 Respectively

433.99	97.9 Pk	2.2 / 16.3 / 30.0	86.4	V / 1.2 / 260.0	-6.94	79.46	80.83	-1.37
433.99	93.8 Pk	2.2 / 16.3 / 30.0	82.3	V / 1.2 / 223.0	-6.94	76.66	80.83	-4.17
867.86	58.8 Pk	202 / 22.4 / 29.7	53.8	H / 1.1 / 51.0	-6.94	45.86	60.83	-14.97
867.86	59.6 Pk	202 / 22.4 / 29.7	54.6	V / 1.2 / 224.0	-6.94	53.59	60.83	-7.24
1301.85	55.2 Pk	2.6 / 26.1 / 38.7	45.2	V / 1.1 / 306.0	-6.94	38.26	53.98	-15.72
1301.85	50.7 Pk	2.6 / 26.1 / 38.7	43.8	V / 1.4 / 13.0	-6.94	36.86	53.98	-17.12
1735.75	56.0 Pk	3.0 / 27.9 / 38.1	48.9	V / 1.1 / 351.0	-6.94	44.49	60.83	-16.34
1735.75	57.3 Pk	3.0 / 27.9 / 38.1	50.2	H / 1.5 / 50.0	-6.94	44.79	60.83	-16.04

Part 15.231 (b)(3) / 15.209
Spurious and Unintentional Emissions

Field Strength Measurements

Unintentional Spurious Emissions

Test Report #:	BC400127 Run 1	Test Area:	Pinewood Site 1 (3m)		Temperature:	22	°C
Test Method:	FCC CFR47 Part 15.231/209	Test Date:	Jan 26, 2004		Relative Humidity:	48	%
EUT Model #:	T24A	EUT Power:	3VDC		Air Pressure:	80	kPa
EUT Serial #:	EMC1					Page:	1 of 2
Manufacturer:	Electronic Solutions Inc.						Level Key
EUT Description:	IR & RF Transmitter						Pk – Peak Nb – Narrow Band
Notes:							Qp – QuasiPeak Bb – Broad Band
						Av - Average	

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB\m) (dB)	FINAL (dbuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) 15.209 <1GHz	DELTA2 (dB) 15.209 >1GHz
No emissions found: 0Deg, Horizontal.						
No emissions found: 90Deg, Horizontal.						
No emissions found: 180Deg, Horizontal.						
No emissions found: 270Deg, Horizontal.						
Noise floor.						
30.00	23.8 Qp	0.6 / 13.1 / 28.3	9.2	H / 1.4 / 270.0	-30.8	N/A
80.00	30.9 Qp	0.9 / 7.1 / 28.2	10.8	H / 1.4 / 270.0	-29.2	N/A
195.00	30.1 Qp	1.4 / 13.5 / 27.6	17.5	H / 1.4 / 270.0	-26.0	N/A
No emissions found: 200 to 1000 MHz Vertical.						
Noise floor.						
200.00	30.1 Qp	1.4 / 11.3 / 27.6	15.2	V / 1.0 / 270.0	-28.3	N/A
500.00	25.4 Qp	2.4 / 18.2 / 28.4	17.5	V / 1.0 / 270.0	-28.5	N/A
995.00	21.1 Qp	3.2 / 24.2 / 27.5	21.0	V / 1.0 / 270.0	-33.0	N/A
No emissions found: 200 to 1000 MHz Horizontal.						
205.00	29.4 Qp	1.5 / 11.1 / 27.5	14.5	H / 1.0 / 0.0	-29.0	N/A
505.00	22.7 Qp	2.4 / 18.1 / 28.4	14.8	H / 1.0 / 0.0	-31.2	N/A
990.00	21.2 Qp	3.2 / 23.9 / 27.6	20.8	H / 1.0 / 0.0	-33.2	N/A
No emissions found: 1 to 5 GHz Vertical.						
Noise floor.						
1000.00	34.9 Av	3.2 / 25.0 / 37.1	26.0	V / 1.0 / 270.0	N/A	-28
1500.00	34.8 Av	3.0 / 26.9 / 37.2	27.4	V / 1.0 / 270.0	N/A	-26.6
2000.00	35.0 Av	3.6 / 29.1 / 37.6	30.0	V / 1.0 / 270.0	N/A	-24

Field Strength Measurements

Unintentional Spurious Emissions

Test Report #:	BC400127 Run 1	Test Area:	Pinewood Site 1 (3m)	Temperature:	22 °C
Test Method:	FCC CFR47 Part 15.231/209	Test Date:	Jan 26, 2004	Relative Humidity:	48 %
EUT Model #:	T24A	EUT Power:	3VDC	Air Pressure:	80 kPa
EUT Serial #:	EMC1	Page: 2 of 2			
Manufacturer:	Electronic Solutions Inc.	Level Key			
EUT Description:	IR & RF Transmitter	Pk – Peak Nb – Narrow Band Qp – QuasiPeak Bb – Broad Band Av - Average			
Notes:					

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB/m) (dB)	(dbuV)	(m) (DEG)	15.209 <1GHz	15.209 >1GHz
3000.00	34.3 Av	4.6 / 30.4 / 36.6	32.7	V / 1.0 / 270.0	N/A	-27.3
4000.00	33.6 Av	5.7 / 33.0 / 37.6	34.7	V / 1.0 / 270.0	N/A	-25.1
5000.00	34.6 Av	7.6 / 34.7 / 38.2	38.6	V / 1.0 / 270.0	N/A	-21.4

No emissions found: 1 to 5 GHz Horizontal.

Noise floor.

1050.00	35.4 Av	3.2 / 25.2 / 37.8	26.0	H / 1.0 / 270.0	N/A	-28
1450.00	34.6 Av	3.0 / 26.7 / 36.8	27.5	H / 1.0 / 270.0	N/A	-26.5
1990.00	34.8 Av	3.5 / 29.1 / 37.6	29.7	H / 1.0 / 270.0	N/A	-24.3
3000.00	34.4 Av	4.6 / 30.4 / 36.6	32.8	H / 1.0 / 270.0	N/A	-27.2
4000.00	33.5 Av	5.7 / 33.0 / 37.6	34.6	H / 1.0 / 270.0	N/A	-25.4
5000.00	34.4 Av	7.6 / 34.7 / 38.2	38.4	H / 1.0 / 270.0	N/A	-21.6

Part 15.231 (c) or (d)
-20dBc Bandwidth

-20dB Bandwidth Measurement

Test Report #:	BC400127 Run 1		Test Area:	Pinewood Site 1 (3m)		Temperature:	25.5	°C
Test Method:	15.231 (c)		Test Date:	Jan 26, 2004		Relative Humidity:	31	%
EUT Model #:	T24A		EUT Power:	3VDC		Air Pressure:	80	kPa
EUT Serial #:	EMC1					Page:	1 of 1	
Manufacturer:	Electronic Solutions Inc.							
EUT Description:	IR & RF Transmitter							
Notes: Measurements were taken in accordance to FCC CFR47 Part 15.231(c).								

FREQ of Fundamental (MHz)	LEVEL Low Edge (-20dBuV)	LEVEL High Edge (-20dBuV)	Bandwidth Measured (MHz)	Bandwidth Limit 0.25% or 0.50% Fc (MHz)	DELTA2 (dB) (MHz)
433.99	433.92	434.03	0.104	1.08	0.98

Equipment Utilized During Test

Project Report

Begin Date: 1/26/2004 **End Date:** 1/26/2004

Technician Dennis King

Project: BC400127

Capital Asset ID	Manufacturer	Model #	Serial #	Description	Test Performed	Service Type	Service Date	Service Due
3	Hewlett-Packard	85650A	2811A01300	Q.P Adapter	R Radiated Emissions	For Cal	9/3/2003	9/3/2004
106	TENSOR	4105	2020	Ridged Guide Antenna 1-18GHz	R Radiated Emissions	For Cal	7/11/2003	7/11/2004
135	EMCO	3146	9402-3775	Log Periodic Antenna (200-1000MHz)	R Radiated Emissions	For Cal	9/10/2003	9/10/2004
189	EMCO	3109	9801-3142	Bicon Antenna 30 - 300 MHz	R Radiated Emissions	For Cal	9/9/2003	9/9/2004
203	Avantek	AFT97-8434-10F	1007	RF Pre-Amplifier (4-8 GHz)	R Radiated Emissions	For Ver	4/23/2003	4/23/2004
209	Hewlett-Packard	85662A	2403A08749	Display Section	R Radiated Emissions	For Cal	11/4/2003	11/4/2004
210	Hewlett-Packard	8566B	2410A00154	Spectrum Analyzer (dc-22 GHz)	R Radiated Emissions	For Cal	11/4/2003	11/4/2004
213	Mini-Circuits Lab	ZHL-42	N052792-2	Amplifier	R Radiated Emissions	For Ver	6/20/2003	6/20/2004
248	Hewlett-Packard	8447F	3113A05545	9 kHz- 1.3GHz Pre Amp	R Radiated Emissions	For Ver	6/5/2003	6/5/2004

Appendix B

Test Plan

and

Constructional Data Form

Appendix C

Measurement Protocol And Test Procedures

MEASUREMENT PROTOCOL

GENERAL INFORMATION

Test Methodology

Conducted and radiated emission testing is performed according to the procedures in ANSI C63.4 & CNS13438.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the applicable limit.

To convert between dB μ V and μ V, the following conversions apply:

- dB μ V = 20(log μ V)
- μ V = Inverse log(dB μ V/20)

RADIATED EMISSIONS

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB μ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the applicable limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example: At a Test Frequency of 30 MHz, with a peak reading on the spectrum analyzer or measuring receiver of 14 dBmV:

Measured Level	+	Transducer & Cable Loss factor	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dB μ V)		(dB)		(dB μ V/m)	(dB μ V/m)		(dB μ V/m)		
14.0		14.9		28.9	40.0		28.9		-11.1

DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

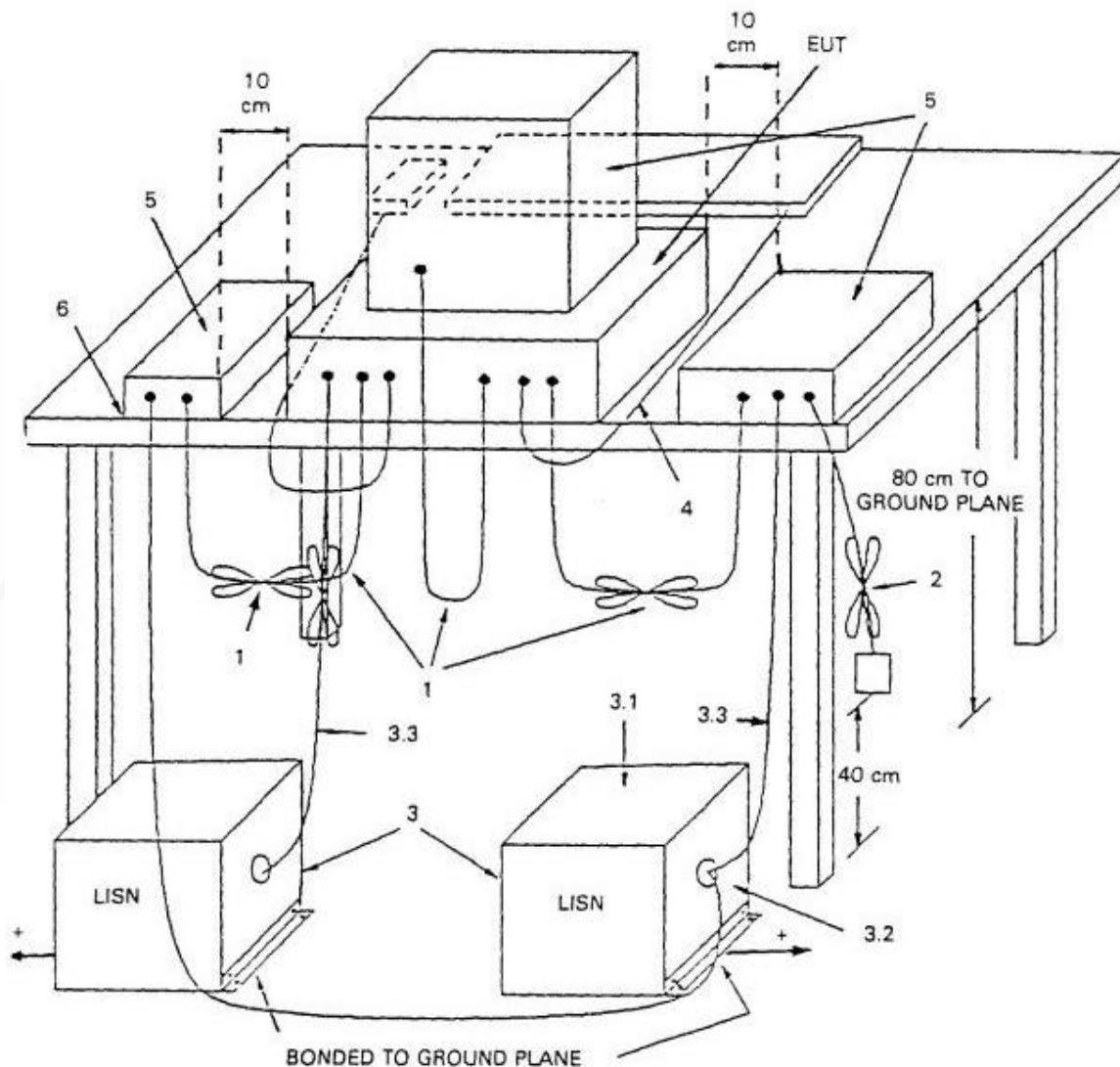
Conducted Emissions

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with $50\ \Omega/50\ \mu\text{H}$ (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 22GHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3, 10 or 30 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees.

Conducted Emissions Diagram:



Radiated Emissions Diagram:

