

Test Report No.	BC300175-1	Issue Date: 2/Dec/2003
Model / Serial No.	TX-002 / SN: EMC1	
Product Type	Button Push Transmitter & AC Switch Reciever	
Client	Silverton	
Manufacturer	Silverton	
License holder	Python	
Address	224 E. Douglas, Suite 500	
	Wichita, KS 67202	
Test Criteria Applied	FCC CFR47 Part 15 Class B	
Test Result	PASS	
Test Project Number	BC300175-1	
References		Title 47 CFR 15: RADIO FREQUENCY DEVICES
Total Pages	18	
Including Appendices:		



Reviewed By : Todd Seeley



Approved By : Robert Cresswell

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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: 25-Sept-2003

Testing Start Date: 25-Sept-2003

Testing End Date: 25-Sept-2003

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 - Not Applicable, only tested Radio

Test Result

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

Remarks: _____

Radiated Emissions (15.209) -

Test Result

Minimum limit margin _____ -15.9 dB at 79.35 MHz
 Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions (15.205) -

Test Result

Minimum limit margin _____ -7.92 dB at 1301.84 MHz
 Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions (15.231) -

Test Result

Minimum limit margin _____ -13.6 dB at 434.02 MHz
 Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

GENERAL REMARKS: None

Modifications required to pass: None

Test Specification Deviations: Additions to or Exclusions from: None

Test-setup photo(s):
Radiated Emissions



Test-setup photo(s):
Radiated Emissions



Appendix A

Test Data Sheets

and

Test Equipment Used

Radiated Electromagnetic Emissions

Test Report #:	BC300175 Run 02	Test Area:	Pinewood Site 1 (3m)	Temperature:	25.5	°C
Test Method:	FCC CFR47 Part 15.209	Test Date:	25-Sep-2003	Relative Humidity:	31	%
EUT Model #:	TX-002	EUT Power:	120 VAC / 60 Hz	Air Pressure:	80	kPa
EUT Serial #:	EMC1					Page: 1 of 3
Manufacturer:	Silverton					Level Key
EUT Description:	Button Push Transmitter & AC Switch Receiver				Pk – Peak	Nb – Narrow Band
Notes:	Both the transmitter and receiver were in the field for this testing.				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)	DELTA2 (dB)
No emissions were observed between 10MHz and 30MHz on the device.						
48.07	37.0 Qp	0.8 / 10.6 / 28.3	20.1	V / 1.0 / 0.0	-19.9	N/A
71.41	42.3 Qp	0.9 / 8.3 / 28.2	23.3	V / 1.0 / 0.0	-16.7	N/A
74.39	38.3 Qp	0.9 / 7.5 / 28.2	18.5	V / 1.0 / 0.0	-21.5	N/A
79.34	40.4 Qp	0.9 / 7.1 / 28.2	20.2	V / 1.0 / 0.0	-19.8	N/A
84.94	34.8 Qp	0.9 / 7.4 / 28.2	15.0	V / 1.0 / 0.0	-25.0	N/A
48.07	37.0 Qp	0.8 / 10.6 / 28.3	20.0	V / 1.0 / 90.0	-20.0	N/A
75.39	43.1 Qp	0.9 / 7.3 / 28.2	23.1	V / 1.0 / 90.0	-16.9	N/A
75.39	43.9 Qp	0.9 / 7.3 / 28.2	23.9	V / 1.0 / 180.0	-16.1	N/A
48.07	37.5 Qp	0.8 / 10.6 / 28.3	20.5	V / 1.0 / 270.0	-19.5	N/A
71.41	42.6 Qp	0.9 / 8.3 / 28.2	23.5	V / 1.0 / 270.0	-16.5	N/A
The following were maximized between 30 and 200 MHz.						
75.39	44.1 Qp	0.9 / 7.3 / 28.2	24.1	V / 1.0 / 355.0	-15.9	N/A
71.43	42.7 Qp	0.9 / 8.3 / 28.2	23.7	V / 1.0 / 355.0	-16.3	N/A
No higher emissions found: 0Deg, Horizontal.						
No higher emissions found: 90Deg, Horizontal.						
No higher emissions found: 180Deg, Horizontal.						
No higher emissions found: 270Deg, Horizontal.						
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

Radiated Electromagnetic Emissions

Test Report #:	BC300175 Run 02		Test Area:	Pinewood Site 1 (3m)		Temperature:	25.5	°C
Test Method:	FCC CFR47 Part 15.209		Test Date:	25-Sep-2003		Relative Humidity:	31	%
EUT Model #:	TX-002		EUT Power:	120 VAC / 60 Hz		Air Pressure:	80	kPa
EUT Serial #:	EMC1					Page:	2 of 3	
Manufacturer:	Silverton					Level Key		
EUT Description:	Button Push Transmitter & AC Switch Receiver					Pk – Peak	Nb – Narrow Band	
Notes:	Both the transmitter and receiver were in the field for this testing.					Qp – QuasiPeak	Bb – Broad Band	
						Av - Average		

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dbuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB)	DELTA2 (dB)
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 2 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
No emissions found: 1 to 2 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

Radiated Electromagnetic Emissions

Test Report #:	BC300175 Run 02	Test Area:	Pinewood Site 1 (3m)	Temperature:	25.5	°C
Test Method:	FCC CFR47 Part 15.209	Test Date:	25-Sep-2003	Relative Humidity:	31	%
EUT Model #:	TX-002	EUT Power:	120 VAC / 60 Hz	Air Pressure:	80	kPa
EUT Serial #:	EMC1					Page: 3 of 3
Manufacturer:	Silverton					Level Key
EUT Description:	Button Push Transmitter & AC Switch Receiver				Pk – Peak	Nb – Narrow Band
Notes:	Both the transmitter and receiver were in the field for this testing.				Qp – QuasiPeak	Bb – Broad Band
					Av - Average	

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dbuV)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) 15.209 <1GHz	DELTA2 (dB) 15.209 >1GHz
***** Measurement Summary *****						
75.39	44.1 Qp	0.9 / 7.3 / 28.2	24.1	V / 1.0 / 355.0	-15.9	N/A
71.43	42.7 Qp	0.9 / 8.3 / 28.2	23.7	V / 1.0 / 355.0	-16.3	N/A
48.07	37.5 Qp	0.8 / 10.6 / 28.3	20.5	V / 1.0 / 270.0	-19.5	N/A
79.34	40.4 Qp	0.9 / 7.1 / 28.2	20.2	V / 1.0 / 0.0	-19.8	N/A
74.39	38.3 Qp	0.9 / 7.5 / 28.2	18.5	V / 1.0 / 0.0	-21.5	N/A
84.94	34.8 Qp	0.9 / 7.4 / 28.2	15.0	V / 1.0 / 0.0	-25.0	N/A
195.00	30.1 Qp	1.4 / 13.5 / 27.6	17.5	H / 1.4 / 270.0	-26.0	N/A
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
205.00	29.4 Qp	1.5 / 11.1 / 27.5	14.5	H / 1.0 / 0.0	-29.0	N/A
80.00	30.9 Qp	0.9 / 7.1 / 28.2	10.8	H / 1.4 / 270.0	-29.2	N/A
30.00	23.8 Qp	0.6 / 13.1 / 28.3	9.2	H / 1.4 / 270.0	-30.8	N/A
505.00	22.7 Qp	2.4 / 18.1 / 28.4	14.8	H / 1.0 / 0.0	-31.2	N/A
995.00	21.1 Qp	3.2 / 24.2 / 27.5	21.0	V / 1.0 / 270.0	-33.0	N/A
990.00	21.2 Qp	3.2 / 23.9 / 27.6	20.8	H / 1.0 / 0.0	-33.2	N/A
2000.00	35.0 Av	3.6 / 29.1 / 37.6	30.0	V / 1.0 / 270.0	N/A	-24
1990.00	34.8 Av	3.5 / 29.1 / 37.6	29.7	H / 1.0 / 270.0	N/A	-24.3
1450.00	34.6 Av	3.0 / 26.7 / 36.8	27.5	H / 1.0 / 270.0	N/A	-26.5
1500.00	34.8 Av	3.0 / 26.9 / 37.2	27.4	V / 1.0 / 270.0	N/A	-26.6
1000.00	34.9 Av	3.2 / 25.0 / 37.1	26.0	V / 1.0 / 270.0	N/A	-28
1050.00	35.4 Av	3.2 / 25.2 / 37.8	26.0	H / 1.0 / 270.0	N/A	-28

Radiated Electromagnetic Emissions

Test Report #:	BC300175 Run 01		Test Area:	Pinewood Site 1 (3m)		Temperature:	22	°C
Test Method:	FCC CFR47 Part 15.231/205/209		Test Date:	25-Sep-2003		Relative Humidity:	48	%
EUT Model #:	TX-002		EUT Power:	3 VDC		Air Pressure:	80	kPa
EUT Serial #:	EMC1						Page: 1 of 1	
Manufacturer:	Silverton						Level Key	
EUT Description:	Push Button Transmitter						Pk – Peak	Nb – Narrow Band
Notes:	Sample labeled #2 Only the transmitter was in the field for this testing.						Qp – QuasiPeak	Bb – Broad Band
The worst case Duty Cycle for this device within a 100mS window is 42%.								
Changed from differential driven to single ended driven to the transmitting antenna.								

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

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 15.205 and 15.231

434.02	84.8 Pk	2.2 / 16.3 / 28.1	75.2	V / 1.2 / 89.0	-7.54	67.66	80.83	-13.16
867.87	51.9 Pk	2.2 / 22.4 / 28.2	48.3	V / 1.2 / 278.0	-7.54	40.76	53.98	-13.22
434.02	80.3 Pk	2.2 / 16.3 / 28.1	70.7	H / 3.1 / 353.0	-7.54	63.16	80.83	-17.66
867.87	45.6 Pk	2.2 / 22.4 / 28.2	42.1	H / 2.0 / 0.0	-7.54	34.56	53.98	-19.42
1301.84	62.4 Pk	2.6 / 25.9 / 37.4	53.6	V / 1.2 / 314.0	-7.54	46.06	53.98	-7.92
1735.82	64.5 Pk	3.0 / 27.4 / 37.1	57.8	V / 1.5 / 98.0	-7.54	50.26	60.83	-10.56
2169.75	50.3 Pk	3.5 / 28.6 / 37.1	45.3	V / 1.2 / 3.0	-7.54	37.76	60.83	-23.06
2603.60	39.1 Pk	4.1 / 29.4 / 36.7	35.9	V / 1.2 / 34.0	-7.54	28.36	53.98	-25.62
1301.82	57.4 Pk	3.1 / 25.8 / 37.4	48.9	H / 1.4 / 351.0	-7.54	41.36	53.98	-12.62
1301.83	53.8 Pk	2.6 / 25.9 / 37.4	45.0	H / 1.1 / 116.0	-7.54	37.46	53.98	-16.52
1735.77	56.0 Pk	3.0 / 27.4 / 37.1	49.3	H / 1.9 / 116.0	-7.54	41.76	60.83	-19.06
2169.74	46.7 Pk	3.5 / 28.6 / 37.1	41.7	H / 1.1 / 3.0	-7.54	34.16	60.83	-26.66
2603.60	37.6 Pk	4.1 / 29.4 / 36.7	34.4	H / 1.9 / 18.0	-7.54	26.86	53.98	-27.12

No other harmonics detected, Horizontal or Vertical

Part 15.209 Checked

Checking from 9 kHz to 30 MHz

Loop Antenna

No emissions detected 9 kHz to 30 MHz

Checking the 30 MHz to 1,000 MHz range.

No emissions detected: FCC CFR47 Part 15.209 checked. No emissions detected.

End of run.

Radiated Electromagnetic Emissions

Test Report #:	BC300175 Run 01	Test Area:	Pinewood Site 1 (3m)	Temperature:	25.5	°C
Test Method:	FCC CFR47 Part 15.231(c)	Test Date:	25-Sep-2003	Relative Humidity:	31	%
EUT Model #:	TX-002	EUT Power:	120 VAC / 60 Hz	Air Pressure:	80	kPa
EUT Serial #:	EMC1	Page: 1 of 1				
Manufacturer:	Silverton					
EUT Description:	Button Push Transmitter & AC Switch Receiver					
Notes:	Measurements were taken in accordance to FCC CFR47 Part 15.231(c).					
Unit Labeled #2						

Level Key					
Pk – Peak	Nb – Narrow Band				
Qp – QuasiPeak	Bb – Broad Band				
Av - Average					

FREQ of Fundamental	LEVEL Low Edge	LEVEL High Edge	Bandwidth Measured	Bandwidth Limit 0.25% Fc	DELTA2 (dB)
(MHz)	(-20dBuV)	(-20dBuV)	(MHz)	(MHz)	(MHz)
433.98	433.92825	434.03175	0.104	1.084	0.98

Project Report

Technician Todd Seeley

Project: BC300175

Capital Asset ID	Manufacturer	Model #	Serial #	Description	Test Performed	Cal Date	Cal Due
106	Tensor	4105	2020	Ridge Guided Antenna 1 - 18 GHz	R Radiated Emissions	7/11/2003	7/11/2004
189	EMCO	3109	9801-3142	Bicon Antenna 30 - 300 MHz	R Radiated Emissions	9/30/2002	9/30/2003
202	Avantek	AWT-18037	1002	RF Pre-Amplifier 8-18GHz	R Radiated Emissions	4/23/2003	4/23/2004
203	Avantek	AFT97-8434-10F	1007	RF Pre-Amplifier 4-8GHz	R Radiated Emissions	4/23/2003	4/23/2004
209	Hewlett-Packard	85662A	2403A08749	Display Section	R Radiated Emissions	10/21/2002	10/21/2003
210	Hewlett-Packard	8566B	2410A00154	Spectrum Analyzer (dc-22 GHz)	R Radiated Emissions	10/21/2002	10/21/2003
211	Hewlett-Packard	85650A	2043A00256	Quasi Peak Adapter (set 1)	R Radiated Emissions	9/17/2003	9/17/2004
217	EMCO	3146	9203-3376	Log Periodic Antenna	R Radiated Emissions	9/11/2002	9/11/2003
248	Hewlett-Packard	8447F	3113A05545	9 kHz- 1.3GHz Pre Amp	R Radiated Emissions	6/5/2003	6/5/2004
195	EMCO	6502	9205-2738	Magnetic loop	R Radiated Emissions	9/29/2002	9/29/2003

Appendix B

Test Plan
and
Constructional Data Form

To be supplied by Customer

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

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."

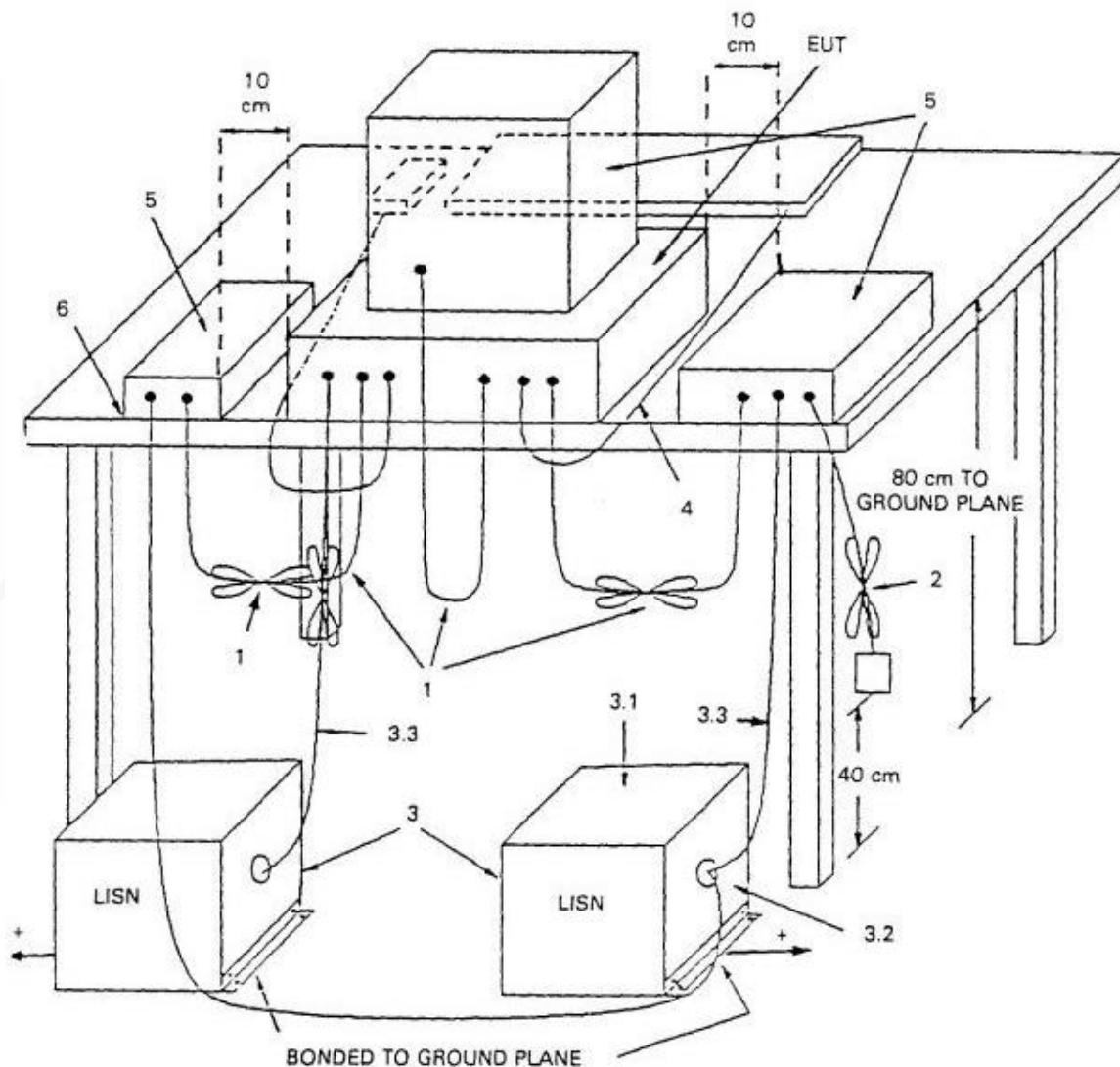
Conducted Emissions

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:
