INTERNATIONAL APPROVALS LABORATORIES

EMC EMISSIONS - TEST REPORT (Full)

Test Report No.	**BC400101-1**	Issue Date:	**Fri 30/Jan/2004**
Model / Serial No.	**Championship Start / SN: EMC1**		
Product Type	**Electronic Start System**		
Client	**InterTest Systems, Inc.**		
Manufacturer	**Colorado Time Systems**		
License holder	**Colorado Time Systems**		
Address	**1551 E. 11th Street**		
	Loveland, CO 80537		
Test Criteria Applied	**FCC CFR47 Part 15.249**		
Test Result	**PASS**		
Test Project Number	**BC400101**		
References		Title 47 CFR 15: RADIO FREQUENCY DEVICES	
Total Pages Including Appendices:	27		

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.

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NVLAP
Lab Code: 200624-0

Accredited

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 ±2.30dB and for Radiated Emissions is calculated to be ±3.60dB in the frequency range of 30MHz – 200MHz and ±3.38dB in the frequency range of 200MHz – 1000MHz.

EUT Received Date: 19-Jan-2004

Testing Start Date: 19-Jan-2004

Testing End Date: 19-Jan-2004

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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 15.249

Emission Test Results:

Conducted Emissions, Powerline - 15.207 - (Not Applicable)

Test Result

Minimum limit margin	00.00 dB	at	0000.00 MHz
Maximum limit exceeding	_____ dB	at	_____ MHz

Remarks: _____

Conducted Emissions, Data I/O (Ethernet, RJ11, etc.) - (Not Applicable)

Test Result

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

Remarks: _____

Radiated Emissions (Electric Field) - 15.209 - PASS

Test Result

Minimum limit margin	-16.10 dB	at	30.00 MHz
Maximum limit exceeding	_____ dB	at	_____ MHz

Remarks: _____

Fundamental Field Strength Measurement
Radiated Emissions (Electric Field) - 15.249(a) - PASS

Test Result

Minimum limit margin	-2.70 dB	at	903.42 MHz
Maximum limit exceeding	_____ dB	at	_____ MHz

Remarks: _____

Radiated Emissions outside Frequency Band
Radiated Emissions (Electric Field) - 15.249(c)/15.205 - PASS

Test Result

Minimum limit margin	-3.0 dB	at	2764.16 MHz
Maximum limit exceeding	_____ dB	at	_____ MHz

Remarks: _____

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Average Measurements for Emissions >1GHz

Radiated Emissions (Electric Field) - 15.249(d) - PASS

Test Result

Minimum limit margin	-20.90 dB	at	1842.79 MHz	
Maximum limit exceeding	_____ dB	at	_____ MHz	

Remarks: CW mode was selected for the fact that it gives the worst case measurement.

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GENERAL REMARKS:

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

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

Modifications required to pass: **NONE**

Test Specification Deviations: **NONE**

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

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**

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Test-setup photo(s):
Radiated Emissions

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Test-setup photo(s):
Radiated Emissions

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Appendix A

Test Data Sheets

and

Test Equipment Used

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Part 15.249 (a)
Fundamental Field Strength

Part 15.249 (c)
Emissions outside Frequency Band

Part 15.249 (d)
Emissions > 1GHz

Part 15.205
Restricted Bands of Operation

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Radiated Electromagnetic Emissions

Test Report #:	**BC400101-1**	Test Area:	Pinewood Site 1 (3m)	Temperature:	19.5	°C
Test Method:	FCC CFR47 Part 15.249/205	Test Date:	19-Jan-2004	Relative Humidity:	26	%
EUT Model #:	Championship Start	EUT Power:	120VAC & 5VDC	Air Pressure:	80	kPa
EUT Serial #:	none			Page:	1 of 2	
Manufacturer:	Colorado Time Systems					
EUT Description:	Electronic Start System					
Notes:	All I/O cables connected including two microphones					

Level Key	
Pk – Peak	Nb – Narrow Band
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) (dB\m) (dB)	(dBuV)	(m) (DEG)	(dB)	(dBuV/m)	(dBuV/m) 15.249 (a)(c)(d) 15.205	(dB)
The following duty cycle was declared by the manufacturer. Duty Cycle = active / 100ms. = 100% Product is FM Modulated								
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 15.249 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 15.249 and the emission/limit delta was calculated. the DCCF is calculated as follows $20*\log_{10}$(duty cycle in 100mS) "not to exceed 20dB"								
DCCF Methods were not utilized in any case of 15.249(d) for the fact that it is a maximum peak specification. All emissions that fall under the 15.205 restricted band limits will always meet the 15.249(d) limit, even with utilizing the 20dBmaximum DCCF.								
Part 15.249(a) "Limit = 94dBuV/m", Part 15.249(c) "Limit = 54dBuV/m", Part 15.249(d) "Limit = 74dBuV/m" and 15.205 "Limit = 54dBuV/m" Respectively								
Worst Case Emissions of all 3 Axis								
919.92	65.7 Pk	2.2 / 23.0 / 0.0	90.9	H / 1.0 / 10.0	0	90.9	94	-3.1
919.92	62.1 Pk	2.2 / 23.0 / 0.0	87.4	V / 1.5 / 247.0	0	87.4	94	-6.6
High Channel								
921.42	62.2 Pk	2.2 / 22.9 / 0.0	87.3	V / 1.7 / 259.0	0	87.3	94	-6.7
921.42	65.9 Pk	2.2 / 22.9 / 0.0	91.0	H / 1.0 / 10.0	0	91.0	94	-3
Mid Channel								
909.42	65.5 Pk	2.2 / 23.1 / 0.0	90.8	H / 1.0 / 10.0	0	90.8	94	-3.2
909.42	59.6 Pk	2.2 / 23.1 / 0.0	85.0	V / 1.6 / 270.0	0	85.0	94	-9
Low Channel								
903.42	60.7 Pk	2.2 / 23.2 / 0.0	86.1	V / 1.7 / 67.0	0	86.1	94	-7.9
903.42	66.0 Pk	2.2 / 23.2 / 0.0	91.3	H / 1.0 / 0.0	0	91.3	94	-2.7
All Channels Harmonics								
1806.80	50.9 Pk	3.1 / 27.7 / 38.2	43.5	V / 1.0 / 89.0	0	43.5	74	-30.5
1806.80	59.2 Pk	3.1 / 27.7 / 38.2	51.8	H / 1.0 / 358.0	0	51.8	74	-22.2
1818.79	58.6 Pk	3.1 / 27.7 / 38.3	51.1	H / 1.0 / 0.0	0	51.1	74	-22.9
1818.79	50.6 Pk	3.1 / 27.7 / 38.3	43.2	V / 1.0 / 0.0	0	43.2	74	-30.8
1842.79	51.6 Pk	3.1 / 27.8 / 37.7	44.9	V / 1.0 / 70.0	0	44.9	74	-29.1
1842.79	59.9 Pk	3.1 / 27.8 / 37.7	53.1	H / 1.0 / 15.0	0	53.1	74	-20.9
2764.16	54.0 Pk	4.3 / 29.8 / 37.1	51.0	H / 1.9 / 165.0	0	51.0	54	-3
2764.16	53.8 Pk	4.3 / 29.8 / 37.1	50.8	V / 1.9 / 224.0	0	50.8	54	-3.2
2728.16	53.4 Pk	4.3 / 29.7 / 37.1	50.2	V / 1.9 / 76.0	0	50.2	54	-3.8

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Radiated Electromagnetic Emissions

Test Report #:	**BC400101-1**	Test Area:	Pinewood Site 1 (3m)	Temperature:	19.5	°C
Test Method:	FCC CFR47 Part 15.249/205	Test Date:	19-Jan-2004	Relative Humidity:	26	%
EUT Model #:	Championship Start	EUT Power:	120VAC & 5VDC	Air Pressure:	80	kPa
EUT Serial #:	none			Page:	2 of 2	
Manufacturer:	Colorado Time Systems					
EUT Description:	Electronic Start System					
Notes:	All I/O cables connected including two microphones					

Level Key	
Pk – Peak	Nb – Narrow Band
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)	Duty Cycle Correction (dB)	Final Corrected (dBuV/m)	Limit (dBuV/m) 15.249 (a)(c)(d) 15.205	DELTA (dB)
2728.16	54.1 Pk	4.3 / 29.7 / 37.1	50.9	H / 2.6 / 160.0	0	50.9	54	-3.1
2710.15	47.5 Pk	4.3 / 29.6 / 36.4	45.0	H / 1.0 / 201.0	0	45.0	54	-9
2710.15	54.1 Pk	4.3 / 29.6 / 36.4	51.6	V / 1.0 / 91.0	0	51.6	54	-2.4
3613.53	49.6 Pk	5.0 / 32.0 / 36.7	50.0	V / 1.5 / 120.0	0	50.0	54	-4
3613.53	50.6 Pk	5.0 / 32.0 / 36.7	51.0	H / 2.0 / 238.0	0	51.0	54	-3
3637.54	51.4 Pk	5.0 / 32.1 / 38.2	50.3	H / 2.0 / 260.0	0	50.3	54	-3.7
3637.54	50.8 Pk	5.0 / 32.1 / 38.2	49.7	V / 1.3 / 143.0	0	49.7	54	-4.3
3685.54	50.8 Pk	5.1 / 32.2 / 37.5	50.6	V / 1.4 / 147.0	0	50.6	54	-3.4
3685.54	52.0 Pk	5.1 / 32.2 / 37.5	51.8	H / 2.0 / 235.0	0	51.8	54	-2.2
4606.91	45.1 Pk	6.8 / 33.3 / 38.9	46.2	H / 2.0 / 0.0	0	46.2	54	-7.8
4606.91	48.1 Pk	6.8 / 33.3 / 38.9	49.2	V / 1.6 / 292.0	0	49.2	54	-4.8
4546.90	48.0 Pk	6.7 / 33.1 / 39.0	48.8	V / 1.6 / 270.0	0	48.8	54	-5.2
4546.90	44.5 Pk	6.7 / 33.1 / 39.0	45.3	H / 1.7 / 180.0	0	45.3	54	-8.7
4516.90	45.2 Pk	6.6 / 33.0 / 39.0	45.9	H / 1.9 / 250.0	0	45.9	54	-7.1
4516.90	48.3 Pk	6.6 / 33.0 / 39.0	48.9	V / 1.9 / 268.0	0	48.9	54	-5.1
No other emissions observed through the 10th Harmonic of the Fundamental.								

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Part 15.209 (a)
Spurious Emissions Field Strength

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Radiated Electromagnetic Emissions

Test Report #:	**BC400101 Run 3**	Test Area:	Pinewood Site 1 (10m)	Temperature:	23.5	°C
Test Method:	EN55022/15.209	Test Date:	27-Jan-2004	Relative Humidity:	26	%
EUT Model #:	Championship Start	EUT Power:	120 VAC 60 Hz & 5VDC	Air Pressure:	80	kPa
EUT Serial #:	EMC1			Page	1 of 4	
Manufacturer:	Colorado Time Systems					
EUT Description:	Electronic Start System					

Notes: Cables connected to all I/O ports, including 2 microphones.

The radio and receiver were tested together.

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

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV/m)	(m) (DEG)	EN55022 B	FCC Part 15.209
Emissions testing was completed from 10.7 MHz with no emissions observed from 10.7 to 30MHz .						
Bicon Antenna, Vertical, 0 degrees turntable azimuth						
30.00	26.5 Qp	0.9 / 13.2 / 28.3	12.3	V / 1.0 / 0.0	-17.7	-17.2
31.36	26.3 Qp	0.9 / 13.0 / 28.3	11.9	V / 1.0 / 0.0	-18.1	-17.6
33.39	26.1 Qp	0.9 / 12.9 / 28.3	11.5	V / 1.0 / 0.0	-18.5	-18.0
35.56	25.8 Qp	1.0 / 12.5 / 28.3	10.9	V / 1.0 / 0.0	-19.1	-18.6
37.59	24.9 Qp	1.0 / 12.3 / 28.3	9.8	V / 1.0 / 0.0	-20.2	-19.7
40.28	26.1 Qp	1.0 / 12.1 / 28.3	10.9	V / 1.0 / 0.0	-19.1	-18.6
42.62	24.4 Qp	1.0 / 11.8 / 28.3	9.0	V / 1.0 / 0.0	-21.0	-20.5
44.74	26.2 Qp	1.0 / 11.4 / 28.3	10.4	V / 1.0 / 0.0	-19.6	-19.1
45.97	19.9 Pk	1.1 / 11.2 / 28.3	3.9	V / 1.0 / 0.0	-26.1	-25.6
47.23	25.0 Qp	1.1 / 11.0 / 28.3	8.8	V / 1.0 / 0.0	-21.2	-20.7
48.31	25.1 Qp	1.1 / 10.9 / 28.3	8.8	V / 1.0 / 0.0	-21.2	-20.7
50.47	24.7 Qp	1.1 / 10.5 / 28.3	8.0	V / 1.0 / 0.0	-22.0	-21.5
53.17	24.3 Qp	1.1 / 10.1 / 28.3	7.2	V / 1.0 / 0.0	-22.8	-22.3
62.16	26.6 Qp	1.2 / 8.9 / 28.2	8.4	V / 1.0 / 0.0	-21.6	-21.1
79.51	26.8 Qp	1.4 / 7.6 / 28.2	7.6	V / 1.0 / 0.0	-22.4	-21.9
90 degrees						
45.97	27.0 Qp	1.1 / 11.2 / 28.3	11.0	V / 1.0 / 90.0	-19.0	-18.5
45.32	27.2 Qp	1.1 / 11.4 / 28.3	11.4	V / 1.0 / 90.0	-18.6	-18.1
180 degrees						
42.62	25.4 Qp	1.0 / 11.8 / 28.3	10.0	V / 1.0 / 180.0	-20.0	-19.5
44.74	27.1 Qp	1.0 / 11.4 / 28.3	11.2	V / 1.0 / 180.0	-18.8	-18.3
45.32	28.0 Qp	1.1 / 11.4 / 28.3	12.2	V / 1.0 / 180.0	-17.8	-17.3
47.23	26.1 Qp	1.1 / 11.0 / 28.3	9.8	V / 1.0 / 180.0	-20.2	-19.7
50.47	25.7 Qp	1.1 / 10.5 / 28.3	9.0	V / 1.0 / 180.0	-21.0	-20.5
270 degrees						
48.31	26.4 Qp	1.1 / 10.9 / 28.3	10.1	V / 1.0 / 270.0	-19.9	-19.4
53.17	25.8 Qp	1.1 / 10.1 / 28.3	8.7	V / 1.0 / 270.0	-21.3	-20.8
Maximized emissions, vertical, from 30-200 MHz						

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Radiated Electromagnetic Emissions

Test Report #:	**BC400101 Run 3**	Test Area:	Pinewood Site 1 (10m)	Temperature:	23.5	°C
Test Method:	EN55022/15.209	Test Date:	27-Jan-2004	Relative Humidity:	26	%
EUT Model #:	Championship Start	EUT Power:	120 VAC 60 Hz & 5VDC	Air Pressure:	80	kPa
EUT Serial #:	EMC1			Page:	2 of 4	
Manufacturer:	Colorado Time Systems					
EUT Description:	Electronic Start System					

Notes: Cables connected to all I/O ports, including 2 microphones.

The radio and receiver were tested together.

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

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV/m)	(m) (DEG)	EN55022 B	FCC Part 15.209
30.00	27.7 Qp	0.9 / 13.2 / 28.3	13.4	V / 1.0 / 10.0	-16.6	-16.1
checking the site source						
nothing higher						
90 degrees						
nothing higher						
180 degrees						
nothing higher						
270 degrees						
nothing higher						
Changing to the Log Antenna, Horizontal, 0 degrees turntable azimuth						
no emissions detected						
90 degrees						
no emissions detected						
180 degrees						
no emissions detected						
270 degrees						
no emissions detected						
Changing to Vertical polarization						
0 degrees						
no emissions detected						
90 degrees						
no emissions detected						
180 degrees						
no emissions detected						

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Radiated Electromagnetic Emissions

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EUT Model #:	Championship Start	EUT Power:	120 VAC 60 Hz & 5VDC	Air Pressure:	80	kPa
EUT Serial #:	EMC1			Page:	3 of 4	
Manufacturer:	Colorado Time Systems					
EUT Description:	Electronic Start System					
Notes:	Cables connected to all I/O ports, including 2 microphones.					
	The radio and receiver were tested together.					

Level Key	
Pk – Peak	Nb – Narrow Band
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Av - Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV/m)	(m) (DEG)	EN55022 B	FCC Part 15.209
270 degrees						
no emissions detected						
end of run.						

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Radiated Electromagnetic Emissions

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Test Method:	EN55022/15.209	Test Date:	27-Jan-2004	Relative Humidity:	26	%
EUT Model #:	Championship Start	EUT Power:	120 VAC 60 Hz & 5VDC	Air Pressure:	80	kPa
EUT Serial #:	EMC1			Page	4 of 4	
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EUT Description:	Electronic Start System					

Notes: Cables connected to all I/O ports, including 2 microphones.

The radio and receiver were tested together.

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

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB\m) (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) EN55022 B	DELTA2 (dB) FCC Part 15.109 B
********** **Measurement Summary** **********						
30.00	27.7 Qp	0.9 / 13.2 / 28.3	13.4	V / 1.0 / 10.0	-16.6	-16.1
45.32	28.0 Qp	1.1 / 11.4 / 28.3	12.2	V / 1.0 / 180.0	-17.8	-17.3
31.36	26.3 Qp	0.9 / 13.0 / 28.3	11.9	V / 1.0 / 0.0	-18.1	-17.6
33.39	26.1 Qp	0.9 / 12.9 / 28.3	11.5	V / 1.0 / 0.0	-18.5	-18.0
44.74	27.1 Qp	1.0 / 11.4 / 28.3	11.2	V / 1.0 / 180.0	-18.8	-18.3
45.97	27.0 Qp	1.1 / 11.2 / 28.3	11.0	V / 1.0 / 90.0	-19.0	-18.5
35.56	25.8 Qp	1.0 / 12.5 / 28.3	10.9	V / 1.0 / 0.0	-19.1	-18.6
40.28	26.1 Qp	1.0 / 12.1 / 28.3	10.9	V / 1.0 / 0.0	-19.1	-18.6
48.31	26.4 Qp	1.1 / 10.9 / 28.3	10.1	V / 1.0 / 270.0	-19.9	-19.4
42.62	25.4 Qp	1.0 / 11.8 / 28.3	10.0	V / 1.0 / 180.0	-20.0	-19.5
37.59	24.9 Qp	1.0 / 12.3 / 28.3	9.8	V / 1.0 / 0.0	-20.2	-19.7
47.23	26.1 Qp	1.1 / 11.0 / 28.3	9.8	V / 1.0 / 180.0	-20.2	-19.7
50.47	25.7 Qp	1.1 / 10.5 / 28.3	9.0	V / 1.0 / 180.0	-21.0	-20.5
53.17	25.8 Qp	1.1 / 10.1 / 28.3	8.7	V / 1.0 / 270.0	-21.3	-20.8
62.16	26.6 Qp	1.2 / 8.9 / 28.2	8.4	V / 1.0 / 0.0	-21.6	-21.1
79.51	26.8 Qp	1.4 / 7.6 / 28.2	7.6	V / 1.0 / 0.0	-22.4	-21.9

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Radiated Electromagnetic Emissions

Test Report #:	**BC400101 Run 2**	Test Area:	Pinewood Site 1 (3m)	Temperature:	19.5 °C
Test Method:	FCC CFR47 Part15.209	Test Date:	19-Jan-2004	Relative Humidity:	26 %
EUT Model #:	Championship Start	EUT Power:	5VDC	Air Pressure:	80 kPa
EUT Serial #:	EMC1			Page:	1 of 3
Manufacturer:	Colorado Time Systems				
EUT Description:	Electronic Start System				
Notes:	The radio device was tested above 1 GHz.				

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

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV/m)	(m) (DEG)	FCC Part 15.209	N/A
No emissions found: 8 to 10 GHz Horizontal.						
Noise floor.						
9500.00	44.6 Av	9.4 / 39.1 / 48.4	44.7	H / 1.0 / 0.0	-9.3	N/A
No emissions found: 8 to 10 GHz Vertical.						
Noise floor.						
10000.0	45.3 Av	9.5 / 39.3 / 48.2	45.9	V / 1.0 / 0.0	-8.1	N/A
No emissions found: 4 to 8 GHz Vertical						
Noise floor.						
8000.00	34.3 Av	8.3 / 38.6 / 39.4	41.8	V / 1.0 / 0.0	-12.2	N/A
No unintentional emissions found: 4 to 8 GHz Horizontal.						
Noise floor.						
6000.00	33.2 Av	7.7 / 34.9 / 39.1	36.7	H / 1.0 / 0.0	-17.3	N/A
1773.40	38.6 Av	3.1 / 27.6 / 37.6	31.6	H / 1.0 / 0.0	-22.4	N/A
2660.07	38.6 Av	4.2 / 29.5 / 36.3	35.9	H / 1.0 / 0.0	-18.1	N/A
1773.40	44.7 Av	3.1 / 27.6 / 37.6	37.8	H / 1.0 / 90.0	-16.2	N/A
No higher emissions found: 180Deg, Horizontal.						
No higher emissions found: 270Deg, Horizontal.						
The following were maxmized between 1 and 4 GHz.						
1773.40	51.6 Av	3.1 / 27.6 / 37.6	44.7	H / 1.7 / 82.0	-9.3	N/A
2660.07	41.4 Av	4.2 / 29.5 / 36.3	38.7	H / 1.2 / 82.0	-15.3	N/A
1773.40	44.4 Av	3.1 / 27.6 / 37.6	37.5	V / 1.0 / 0.0	-16.5	N/A
2660.07	36.9 Av	4.2 / 29.5 / 36.3	34.3	V / 1.0 / 0.0	-19.7	N/A
1101.54	39.3 Av	2.3 / 25.2 / 37.5	29.4	V / 1.0 / 0.0	-24.6	N/A
1137.53	37.1 Av	2.4 / 25.4 / 37.6	27.3	V / 1.0 / 0.0	-26.7	N/A
1626.67	40.1 Av	3.0 / 27.1 / 37.4	32.8	V / 1.0 / 0.0	-21.2	N/A

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Radiated Electromagnetic Emissions

Test Report #:	**BC400101 Run 2**	Test Area:	Pinewood Site 1 (3m)	Temperature:	19.5	°C
Test Method:	FCC CFR47 Part15.209	Test Date:	19-Jan-2004	Relative Humidity:	26	%
EUT Model #:	Championship Start	EUT Power:	5VDC	Air Pressure:	80	kPa
EUT Serial #:	EMC1			Page:	2 of 3	
Manufacturer:	Colorado Time Systems					
EUT Description:	Electronic Start System					
Notes:	The radio device was tested above 1 GHz.					

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

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB\m) (dB)	(dBuV/m)	(m) (DEG)	FCC Part 15.209	N/A
1662.67	41.4 Av	3.0 / 27.2 / 37.1	34.4	V / 1.0 / 0.0	-19.6	N/A
3546.76	38.2 Av	4.9 / 31.8 / 38.3	36.6	V / 1.0 / 90.0	-17.4	N/A
1773.40	44.0 Av	3.1 / 27.6 / 37.6	37.1	V / 1.0 / 180.0	-16.9	N/A
3546.76	38.4 Av	4.9 / 31.8 / 38.3	36.8	V / 1.0 / 270.0	-17.2	N/A
The following were maximized between 1 and 4 GHz.						
3546.76	46.5 Av	4.9 / 31.8 / 38.3	44.9	V / 3.8 / 273.0	-9.1	N/A
1662.67	42.8 Av	3.0 / 27.2 / 37.1	35.8	V / 1.0 / 12.1	-18.2	N/A
1773.40	53.4 Av	3.1 / 27.6 / 37.6	46.5	V / 3.4 / 290.0	-7.5	N/A

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Radiated Electromagnetic Emissions

Test Report #:	**BC400101 Run 2**	Test Area:	Pinewood Site 1 (3m)	Temperature:	19.5	°C
Test Method:	FCC CFR47 Part15.209	Test Date:	19-Jan-2004	Relative Humidity:	26	%
EUT Model #:	Championship Start	EUT Power:	5VDC	Air Pressure:	80	kPa
EUT Serial #:	EMC1			Page:	3 of 3	
Manufacturer:	Colorado Time Systems					
EUT Description:	Electronic Start System					
Notes:	The radio device was tested above 1 GHz.					

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

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB\m) (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) FCC Part 15.109 B	DELTA2 (dB) > 1 GHzN/A
********** Measurement Summary **********						
1773.40	53.4 Av	3.1 / 27.6 / 37.6	46.5	V / 3.4 / 290.0	-7.5	N/A
10000.0	45.3 Av	9.5 / 39.3 / 48.2	45.9	V / 1.0 / 0.0	-8.1	N/A
3546.76	46.5 Av	4.9 / 31.8 / 38.3	44.9	V / 3.8 / 273.0	-9.1	N/A
9500.00	44.6 Av	9.4 / 39.1 / 48.4	44.7	H / 1.0 / 0.0	-9.3	N/A
8000.00	34.3 Av	8.3 / 38.6 / 39.4	41.8	V / 1.0 / 0.0	-12.2	N/A
2660.07	41.4 Av	4.2 / 29.5 / 36.3	38.7	H / 1.2 / 82.0	-15.3	N/A
6000.00	33.2 Av	7.7 / 34.9 / 39.1	36.7	H / 1.0 / 0.0	-17.3	N/A
1662.67	42.8 Av	3.0 / 27.2 / 37.1	35.8	V / 1.0 / 12.1	-18.2	N/A
1626.67	40.1 Av	3.0 / 27.1 / 37.4	32.8	V / 1.0 / 0.0	-21.2	N/A
1101.54	39.3 Av	2.3 / 25.2 / 37.5	29.4	V / 1.0 / 0.0	-24.6	N/A
1137.53	37.1 Av	2.4 / 25.4 / 37.6	27.3	V / 1.0 / 0.0	-26.7	N/A

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Project Report

Begin Date: **End Date:** 1/19/2004 1/19/2004

Technician Todd Seeley **Project:** BC400101

Capital Asset ID	Manufacturer	Model #	Serial #	Description	Test Performed	Service Type	Service Date	Service Due
192	RHODE & SCHWARZ	ESH2-Z5	830364/002	LISN 50 ohm/50uH 3 line (1kHz - 30 MHz)	C Conducted Emissions	For Ver	3/8/2004	3/8/2005
198	Hewlett-Packard	11947A	3107A01984	Transient Limiter	C Conducted Emissions	For Ver	9/30/2003	9/30/2004
238	RHODE & SCHWARZ	ESHS 30	842806/001	EMI Test Receiver	C Conducted Emissions	For Cal	6/24/2003	6/24/2004
3	Hewlett-Packard	85650A	2811A01300	Q.P Adapter	R Radiated Emissions	For Cal	9/3/2003	9/3/2004
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
208	Hewlett-Packard	83640A	3009A00216	Synthetic Sweeper	R Radiated Emissions	For Cal	2/5/2004	2/5/2006
210	Hewlett-Packard	8566B	2410A00154	Spectrum Analyzer (dc-22 GHz)	R Radiated Emissions	For Cal	11/4/2003	11/4/2004
238	RHODE & SCHWARZ	ESHS 30	842806/001	EMI Test Receiver	R Radiated Emissions	For Cal	6/24/2003	6/24/2004
248	Hewlett-Packard	8447F	3113A05545	9 kHz- 1.3GHz Pre Amp	R Radiated Emissions	For Ver	6/5/2003	6/5/2004
106	TENSOR	4105	2020	Ridged Guide Antenna 1-18GHz	R Radiated Emissions	For Cal	7/11/2003	7/11/2004
202	Avantek	AWT-18037	1002	RF Pre-Amplifier (8-18 GHz)	R Radiated Emissions	For Ver	4/23/2003	4/23/2004
203	Avantek	AFT97-8434-10F	1007	RF Pre-Amplifier (4-8 GHz)	R Radiated Emissions	For Ver	4/23/2003	4/23/2004

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Appendix B

Test Plan

and

Constructional Data Form

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Appendix C

Measurement Protocol

And

Test Procedures

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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 it's 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 dBµV, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the applicable limit.

To convert between dBµV and µV, the following conversions apply:

- dBµV = 20(log µV)
- µV = Inverse log(dBµV/20)

RADIATED EMISSIONS

The final level, expressed in dBµV/m, is arrived at by taking the reading from the spectrum analyzer (Level dBµV) 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
(dBµV)		(dB)		(dBµV/m)	(dBµV/m)		(dBµV/m)		
14.0		**14.9**		**28.9**	**40.0**		**28.9**		**-11.1**

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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 Ω/50 µH (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.

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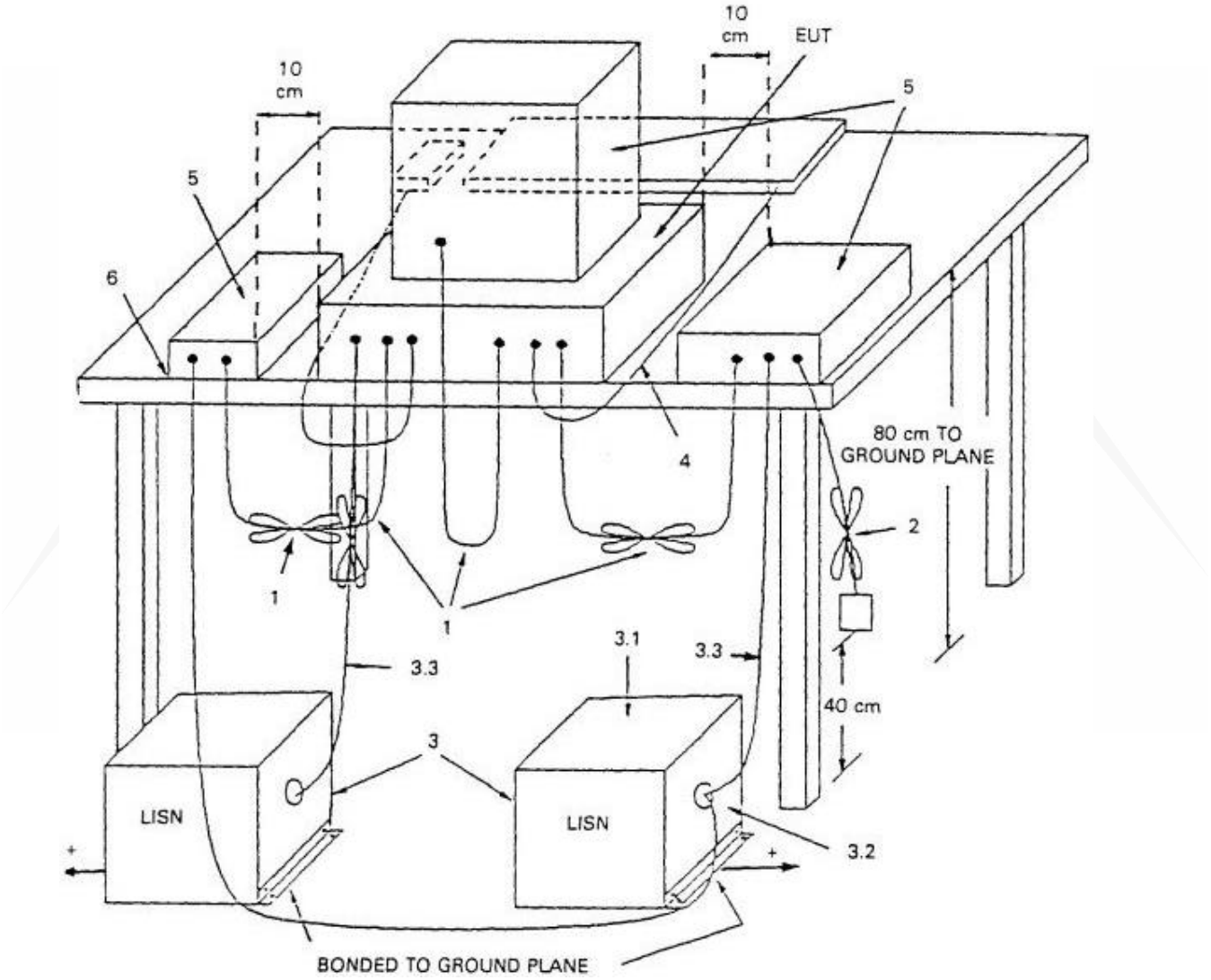
Conducted Emissions Diagram:



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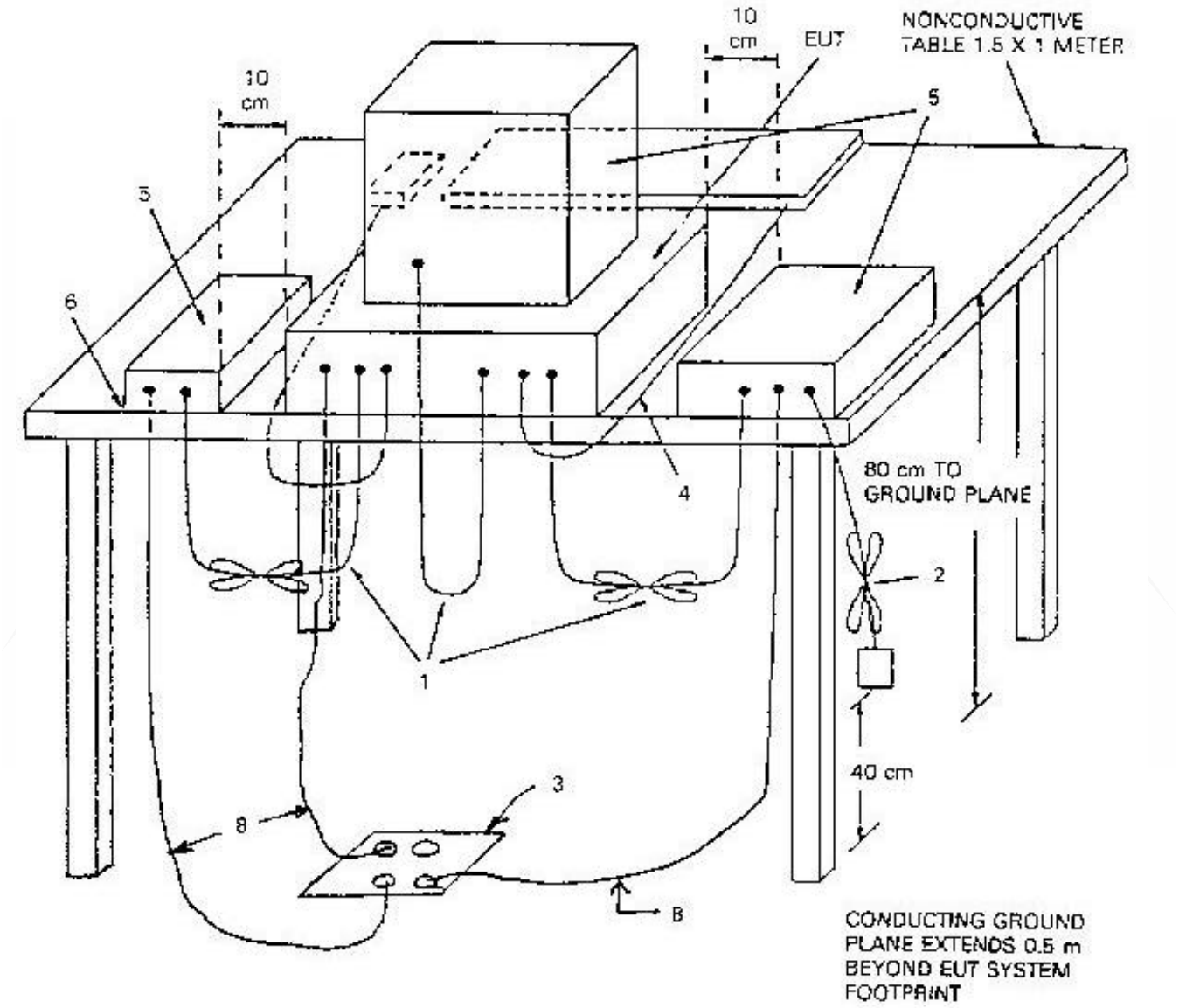
Radiated Emissions Diagram:



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