

Component / Subsystem EMC Test Plan Title Page

Product Name: Wireless FES Remote Control	
Product Supplier Name:	Ford Recognized EMC Test Facility(s) used: Dayton T. Brown, Inc., Attn: Mr. Tom Arcati 1195 Church St. Bohemia, NY 11716
Product Design Engineer:	
Product Manager:	Vehicles & Model Year using this product: 07MY U222/228, 07MY U287/288, 07MY P356, 07MY U387/388, 07MY U354
Product Part Number(s): FS-6L2T-18C919-AA	
Product Manufacturing Location(s)	EMC Specification Used: ES-XW7T-1A278-AC

I certify that the information contained in this test plan is factual including description of the product operation, correct functional classifications, and acceptance criteria. I understand and agree that any subsequent changes to this test plan prior to design verification testing shall be communicated to the FMC EMC department. Any changes or revisions to this test plan after test completion shall require written technical justification and approval by the same EMC department. I understand that failure to follow this process may result in non-acceptance of the product's EMC test data by the FMC EMC department. I also understand and acknowledge that requirements validated via this test plan are relevant only to the specific vehicles that the product is to be fitted to. Use of the product on other vehicle platforms may require additional EMC performance requirements, which will necessitate additional verification testing of the product. I certify that the product samples submitted for EMC testing are of a production representative design. I agree to submit a summary report directly to the FMC EMC department no later than five (5) business days following completion of testing. I also agree to forward a copy of the test laboratory's detailed test report directly to the FMC EMC department within thirty (30) business days following completion of testing.

Supplier Product Design Engineer:

Sign and Date

Supplier Product Manager Concurrence:

Sign and Date

Ford Design & Release Engineer Concurrence:

Approved, CTP 0583

Sign and Date

For Internal EMC Department Use (Do not Mark)

Received by FMC EMC Department

Aston Martin FOA FOE Jaguar Land Rover Mazda Volvo

Date Received/ FMC EMC Engineer

Test Plan Tracking Number

Test Plan Revision History

Date	Description
	Initial Test Plan Release

1.0 Introduction

This test covers the Infra-red wireless remote controls that are part of the Ford Family Entertainment System (FES).

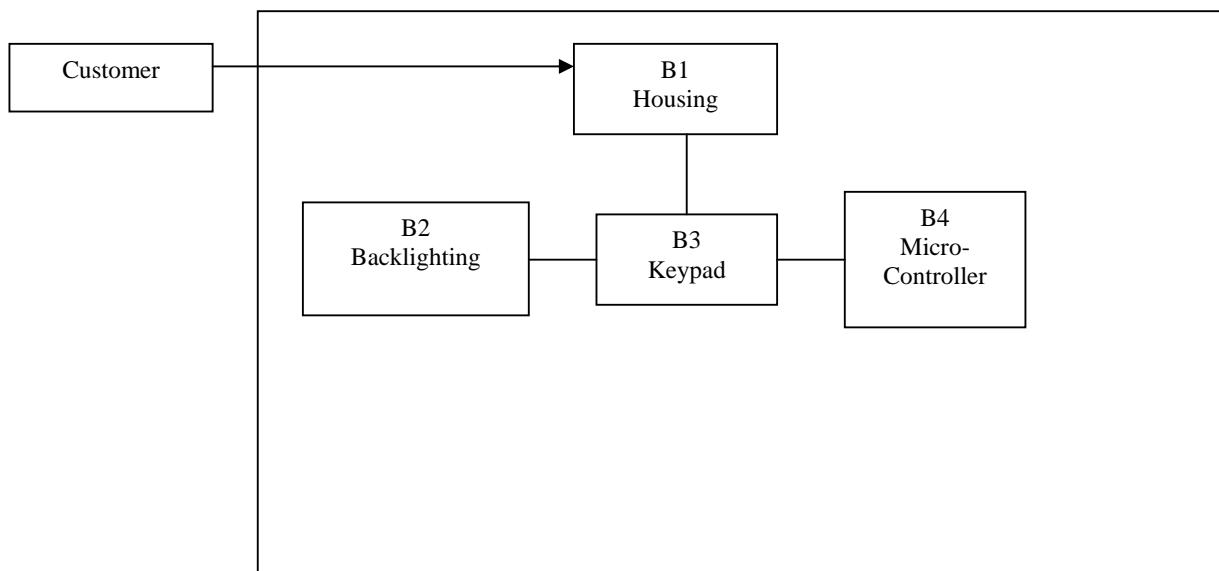
1.1 Product Family Description

The 38-key Infra-red (IR) remote control is used to transmit commands of operation to the (FES).

1.2 Theory of Operation

The FES RC shall communicate using light at 940 nm wavelength in the infra-red spectrum to allow the user full functionality control of the FES without using any of the bezel buttons. The user shall be able to perform all desired functions and access all levels of the menu tree of the system or disc via the remote control. The FES is powered by two AAA batteries and has a 4 bit micro-controller. The FES remote control transmitter uses CMOS technology which enables transmission code outputs of different configurations, multiple custom code output and double push key output. Wake-up is initiated by pressing the power button or function keys.

Remote Control Block Diagram



B1 - Housing

- Top part
- Bottom part
- Battery compartment

B2 – Backlighting

- Lighting Guides
- LED's

B3 – Keypad

- Silicone Pad
- Graphics

B4 – Micro-Controller

- 4 bit micro-controller

1.3 Physical Construction

Remote control housing is made of ABS/PC plastic and the keypad is made of silicone rubber. The physical dimensions are 22 x 198 x 54 mm. The PCB is a single layer FR-1 type and includes an IR-LED and 4-bit micro-controller.



1.4 EMC Specification Release Date

ES-XW7T-1A278-AC (October 10, 2003)
ES-XW7T-1A278-AB (April 30, 1999) used for RI-110 only

1.5 Approved Test Facility

Dayton T. Brown, Inc.
1195 Church Street
Bohemia, NY 11716

1.6 DUT Part Number(s)

FS-6L2T-18C919-AA

1.7 DUT Manufacturer(s)

1.8 DUT Usage

Model Year Vehicle Application(s)

2007MY	U222/228
2007MY	U287/288
2007MY	P356
2007MY	U387/388
2007MY	U354

2.0 EMC Requirements Analysis

2.1 Critical Interface Signals

Signal Description	Voltage/Current Level	Frequency	% Duty Cycle (range)	Other
IR Signal	N/A	38K	30-33%	940 nm

2.2 Potential Sources of Emissions

Signal Source Description	Voltage/Current Level	Frequency	% Duty Cycle (range)	Other
IR Carried Signal	1.9V – 3.6V 5uA – 170mA	38K	30 – 33%	
Microprocessor		4 Mhz (Clock)	33.33%	

2.3 Test Sample / Surrogate Selection

Three samples per the FES Remote Control DV/PV test matrix stated in FS-6L2T-18C919-AA will be utilized for all EMC tests.

3.0 Test Design and Requirements

DUT is a wireless self-powered (2 internal AAA batteries) remote control with no connecting or external wires. Applicable tests are radiated emission, radiated immunity and ESD.

*Special Note – As this DUT is a self-powered device with no external wiring harness that connects to the vehicle, RI 110 is being recommended in place of RI112 to cover the lower frequency ranges between 10Khz – 400Mhz.

3.1 DUT Operating Modes/Functional Classifications

DUT Mode	DUT Functions			Vehicle Operating Modes			
	Class A	Class B	Class C	Off	Accessory	Start	Run
OFF	X			X	X	X	X
ON	X				X		X

Mode Description(s):

OFF mode: Keypad backlight is off. No IR signal is being transmitted to IR receiver.

ON mode: Keypad backlight is on and unit is transmitting an IR signal to receiver.

Function Description(s):

Button	Function	RC6 Code
Power	Power the System On/Off	12
Audio(Language)	Changes the language	75
Subtitles(on/off)	Switches the subtitles On/Off	227
Angle	Select the Angle to view the scene	133
Enter	Selects the high-lighted function that is currently active on the screen	92
Cursor up	Advances cursor up while any menu is active	88
Cursor down	Advances cursor down while any menu is active	89
Cursor left	Advances cursor left while any menu is active	90
Cursor right	Advances cursor right while any menu is active	91
Display	Accesses the on-screen display of FES functions and adjustments	15
Menu	Accesses the DVD disc menu for selection	84
Return	Return to the previous menu screen	131
FF (seek up)	Initial enable shall launch the 4x normal playback speed, subsequent button presses shall toggle to 8X then 32X then back to 4X speed.	40
Rew (seek down)	Initial enable shall launch the 4x normal playback speed, subsequent button presses shall toggle to 8X then 32X then back to 4X speed.	41
Play/Pause	FES shall play current stopped or paused disc, FES shall pause the current disc from play mode	44
Eject	In non-operational mode with disc stored, the disc will be ejected	29
Stop	FES shall stop the disc if in play mode	49
Shuffle	This function causes the tracks of the current disc to be played in an random order	28
Video	Toggle the display input source between FES DVD and FES AUX	67
Media	ACM in Single Play Mode: the FES shall control the media source changes at the ACM ACM in Dual Play Mode: FES shall control rear-seat accessed media source changes at the FES/RSCM as heard through the headphones.	78
Headphone H/P	This key shall toggle between Single and Dual Play	68 (Dual-Play)
Numeric Key 1	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	1
Numeric Key 2	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	2
Numeric Key 3	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	3

Numeric Key 4	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	4
Numeric Key 5	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically (0)	5
Numeric Key 6	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	6
Numeric Key 7	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	7
Numeric Key 8	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	8
Numeric Key 9	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	9
Numeric Key 0	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	0
Numeric Key 10+	The Numeric keypad (0-9 & +10) shall enable Track/Chapter selection numerically	120
Cancel/Clear	This key shall cancel/clear the marked memory points	58
Volume up	Single Play: This key shall linearly increase the cabin audio volume. Dual Play: This key shall linearly increase the headphone volume.	16
Volume down	Single Play: This key shall linearly increase the cabin audio volume. Dual Play: This key shall linearly increase the headphone volume.	17
Channel A	This key shall enable an alternate input source via the FES that is output via the Wireless headphones	56
Channel B	This key shall enable an alternate input source via the FES that is output via the Wireless headphones	57

3.2 Test Requirements

Test Description	Test applies (Y/N)	Interface to be tested (S/C ¹)	Operating Mode(s) to be used for indicated test
RI 110	Y	C	ON (functional status I for Level 1 functional status II for Level 2 functional status III for Level 3 functional status II for Level 4) [RI 110 is being performed as an alternate to RI 112 to cover frequency ranges below 400MHz.]
RI 112	N		(Device has no external wires, internal AAA battery powered.)
RI 114	Y	C	ON (functional status I for Level 1 functional status II for Level 2)
RI 130	N		
RI 140	N		
RI 150	N		
CI 210	N		
CI 220	N		
Pulse A1	N		
Pulse A2	N		
Pulse B1	N		
Pulse B2	N		
Pulse C	N		
Pulse D	N		
Pulse E	N		
Pulse F	N		
Pulse G	N		
CI 230	N		
Waveform A	N		
Waveform B	N		
Waveform C	N		
Waveform D	N		
CI 250	N		
CI 260	N		
Waveform A	N		
Waveform B	N		
Waveform C	N		
Waveform D	N		
Waveform E	N		
Waveform F	N		

Test Description	Test applies (Y/N)	Interface to be tested (S/C ¹)	Operating Mode(s) to be used for indicated test
CI 270	N		
- 14 Volt	N		
+19 Volt	N		
+ 24 volt	N		
CI 280			
Handling (DUT not powered)	Y	C	OFF (functional status: IV)
Powered (all except 25 KV)	Y	C	ON (functional status: I for sequence 1-3 II for sequence 4-7)
Powered (25 KV)	N		
RE 310	Y	C	ON (refer to page 15,16 of ES-XW7T-1A278-AC)
CE 410	N		
CE 420	N		

¹ Indicate specific DUT circuits that test applies to.

C (Combined): Circuits are to be tested simultaneously.

S (Separate): Circuits to be tested separately.

3.3 Input Requirements

Electrical Input Signals/Characteristics To Operate DUT in the specified test Mode

DUT Mode	Signal Name	Test	Pin #	Waveform	Amplitude	Freq/PW/DC%	Other
ON	Battery power			DC	3V	0	2xAAA

Non-electrical input signals/characteristics to make DUT functional:

Continuous mechanical actuation of remote control, volume or channel button.

3.4 Output Requirements

Electrical output(s) to monitor and acceptance criteria:

None: 2 internal AAA batteries power DUT, no connection to vehicle.

Non-electrical output(s) to monitor and acceptance criteria

Mode	Function Description	Test	Note 2	Acceptance criterion for function
ON	Backlit Keypad	RI110 RI114 CI280(powered)	N	On
			A	On, for functional status I. For functional status 2-4 light may turn off but unit must return to functional state after disturbance is removed, with minimal user intervention.
ON	IR Signal Beam being Emitted by Remote	RI110 RI114 CI280(powered)	N	On
			A	*Fully Functional, for functional status I. For functional status 2-4, signal may be distorted or interrupted but unit must return to functional state after disturbance is removed, with minimal user intervention.
			N	
			A	

Note 2:

N = Nominal Value

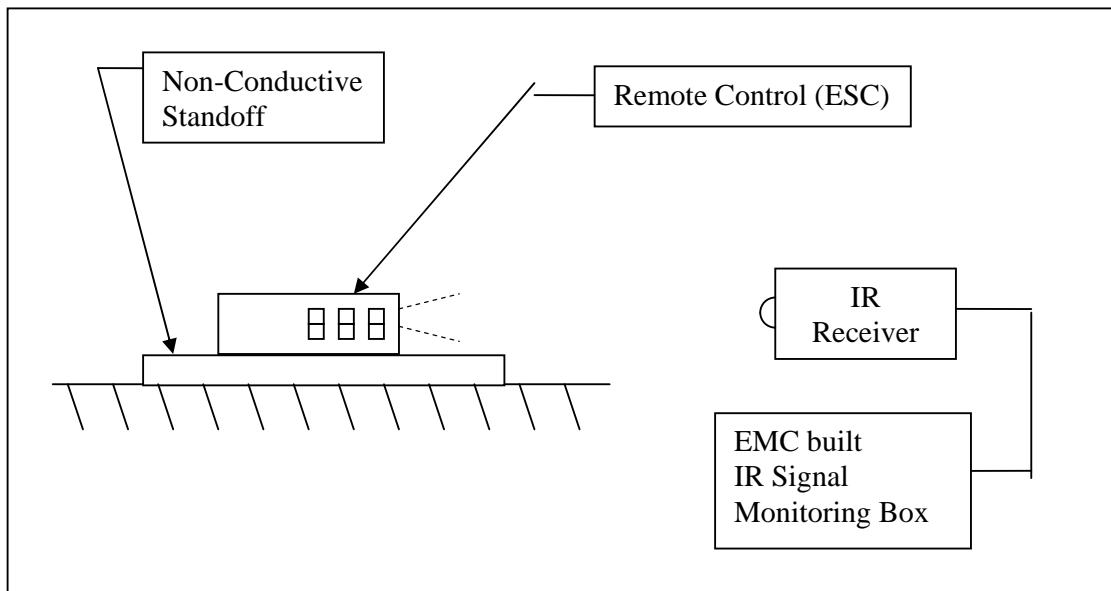
A = Acceptable Value

*Fully Functional is defined as transmitting the proper Phillips RC6 codes corresponding to the button actuation per table 1.6 of FES Remote Control Assemble document number FS-6L2T-18C919-AA.

3.5 Load Box/Test Support Requirements:

For purposes of EMC testing, the remote control programming allows continuous transmission of the RC6 code for PLAY upon simultaneous pressing of the Language, Shuffle and C (Cancel) keys. Pressing of any key subsequently on the remote keypad shall terminate the transmission.

Test Fixture and DUT Setup Block Diagram

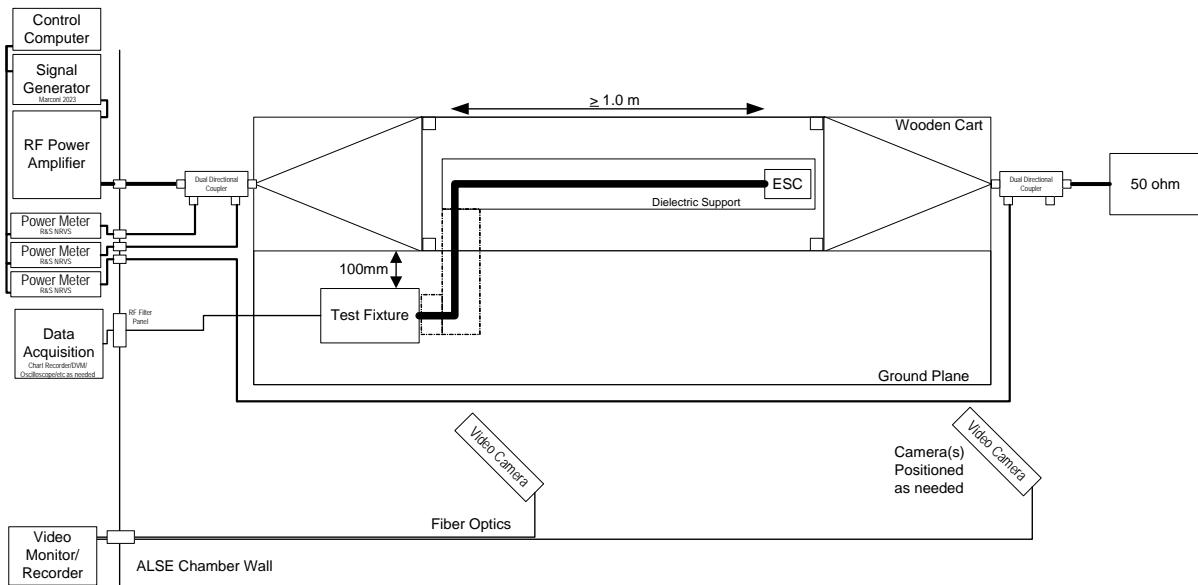


Test Equipment List

Type	Make	Model Number
Signal Generator	Marconi	2023
Signal Generator	HP	83640B
Power Meters	Rhode & Schwartz	NRVS
Triplate	Dayton T.Brown, Inc	N/A
Audio Analyzer	HP	8903
Condenser Microphone	Radio Shack	270-092C
Oscilloscope	Tektronics	TDS3054
Antenna	Amplifier Research	AT1000, AT4002A
Antenna	Electro-Metrics	LPA-25
Antenna	EMCO	3301B,3104,3115
ESD Simulator	Keytek	2000
Amplifiers	M/A-COM	EWAL 1050-13
Amplifiers	Applied Systems	200L
Amplifiers	Logimetrics	A600S
IR Signal Monitor	Electro-Mechanical Co.	N/A
EMI Receiver	Rhode & Schwartz	ESIB40

4.1 RF Immunity (RI 110)

RI 110 Test Set-up

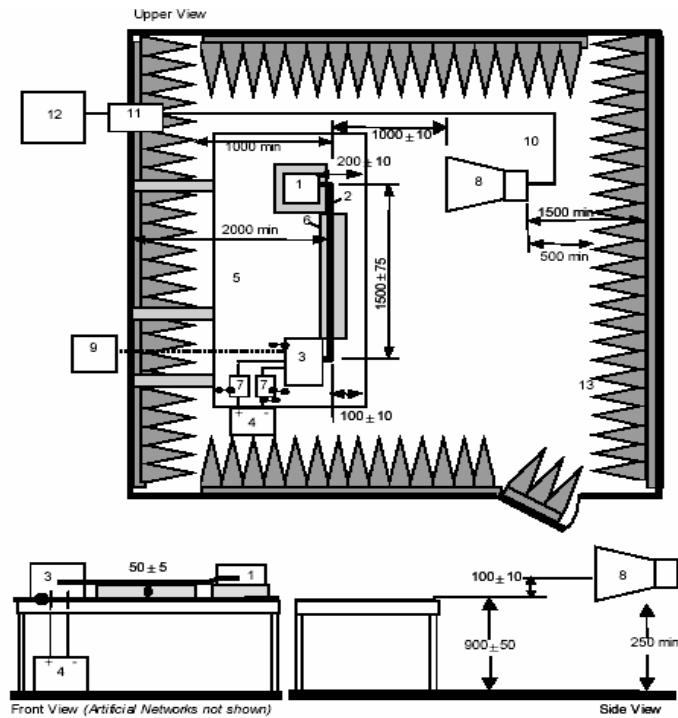


Test Details	Comments
Specified Test Method	The device shall operate as required when exposed to RF electromagnetic field through transmission antenna
Deviations from Specified Test Method	Test is to run from 10KHz through 400MHz.
Harness Configuration	None, unit has internal battery power
DUT Orientation	Remote Controls will be laid flat on non-conductive foam, centered between the bottom and middle plates of the Triplate.
DUT Grounding (case or harness)	DUT placed on insulated support 50 mm above the ground plane
Additional Test Specific Information	None
DUT Monitoring Information	IR signal for PLAY from remote will be monitored via EMC signal box to determine if corresponding RC6 code is being received.

Monitoring/Support Equipment	Make/Model
Monitoring equipment	IR receiver and signal monitoring box, both EMC built.
Recording equipment	N/A (test results manually recorded on data sheets)

4.2 RF Immunity (RI 114)

RI 114 Test Set-up



The figure is adapted from ISO/CD 11452-2. Note: Horn antenna has been moved to sight on the DUT.

Key:

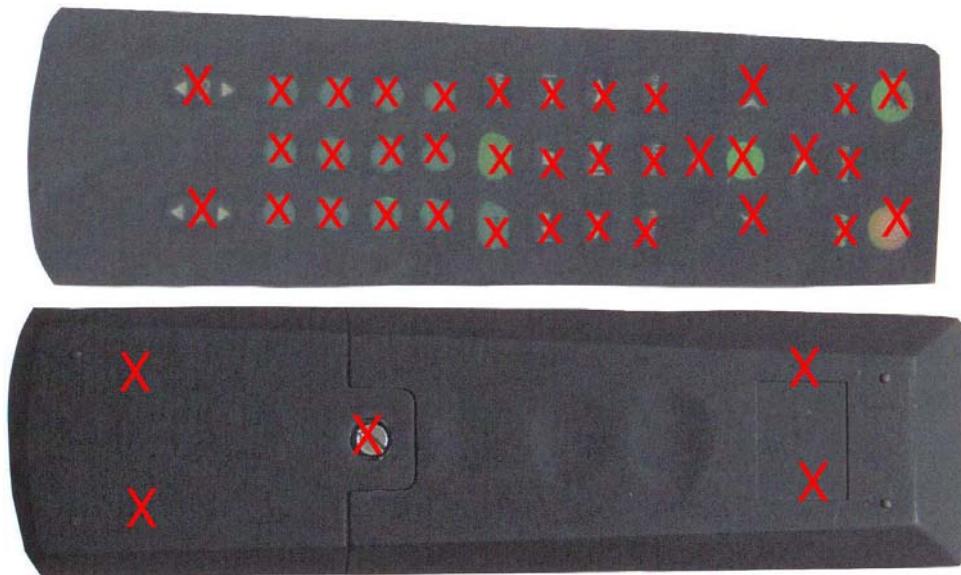
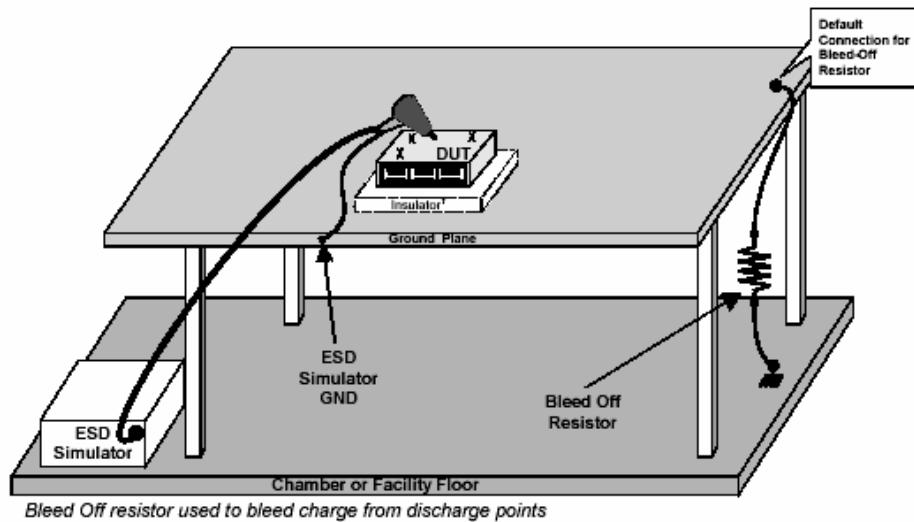
1 DUT	8 Transmitting Antenna
2 Test harness	9 Support /Monitoring Equipment
3 Test Fixture	10 High quality double-shielded coaxial cable (50Ω)
4 Automotive Battery	11 Bulkhead connector
5 Ground plane (bonded to shielded enclosure)	12 RF Generation Equipment
6 Insulated support ($\epsilon_r \leq 1.4$)	13 RF absorber material
7 Artificial Network	

Test Details	Comments
Specified Test Method	The device shall operate as required when exposed to RF electromagnetic field through transmission antenna
Deviations from Specified Test Method	None
Harness Configuration	None, DUT has internal battery power.
DUT Orientation	As shown in diagram for section 3.5
DUT Grounding (case or harness)	DUT placed on insulated support 50 mm above the ground plane
Additional Test Specific Information	None
DUT Monitoring Information	IR signal for PLAY from remote will be monitored via EMC signal box to determine if corresponding RC6 code is being received.

Monitoring/Support Equipment	Make/Model
Monitoring equipment	IR receiver and signal monitoring box, both EMC built.
Recording equipment	N/A (test results manually recorded on data sheets)

4.12 Electrostatic Discharge (CI 280: unpowered)

CI 280 Set-up Unpowered

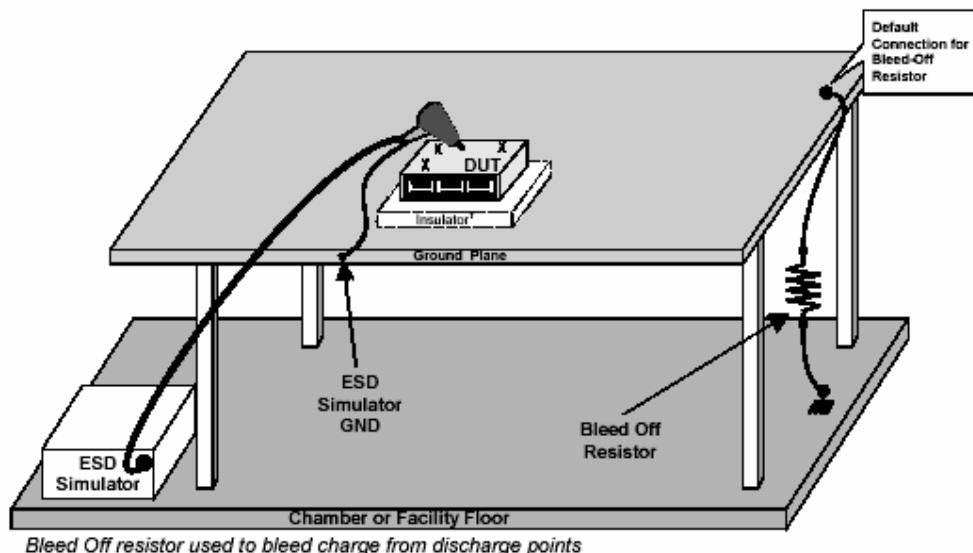


**X – Above denotes ESD Discharge points
(Also battery terminals underneath case, not shown)**

Test Details	Comments
Specified Test Method	The DUT shall be immune to overstress due to Electrostatic Discharge (not powered).
Deviations from Specified Test Method	None
Harness Configuration	None
DUT Orientation	As shown above
DUT Grounding (case or harness)	DUT placed on insulated support 50 mm above the ground plane
Additional Test Specific Information	Remove battery; discharge to battery connector points, all control buttons and case as shown above.
DUT Monitoring Information	None
Monitoring/Support Equipment	Make/Model
Monitoring equipment	N/A
Recording equipment	N/A (test results manually recorded on data sheets)

4.13 Electrostatic Discharge (CI 280: powered)

CI 280 Set-up – Powered



X – Above denotes ESD Discharge points

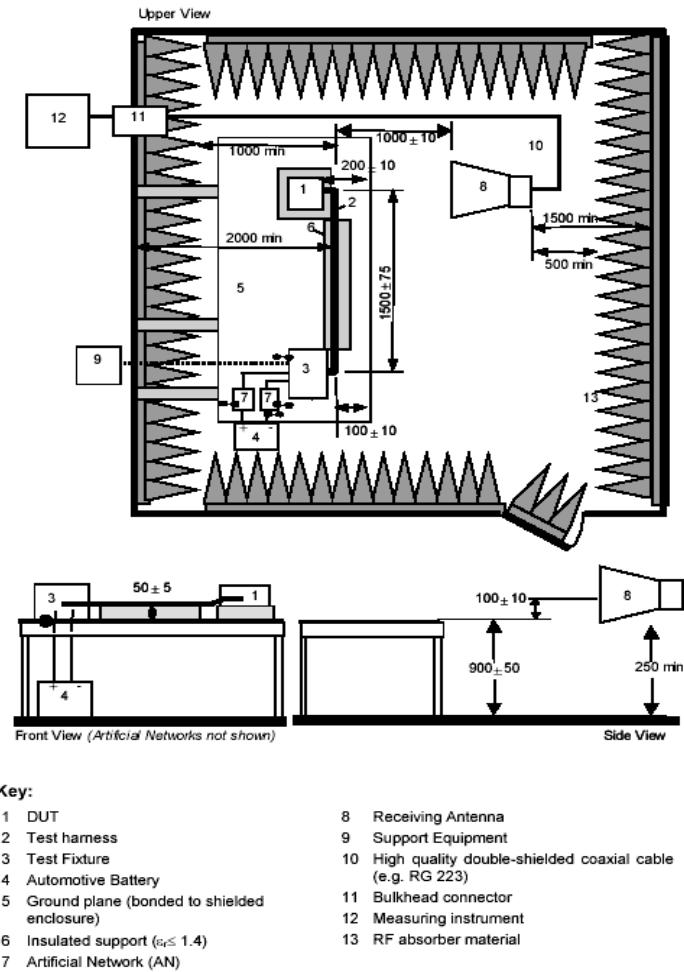
Test Details	Comments
Specified Test Method	DUT shall be immune to overstress due to Electrostatic Discharge (while powered – AAA battery).
Deviations from Specified Test Method	None
Harness Configuration	None unit has internal battery power.
DUT Orientation	As shown above
DUT Grounding (case or harness)	DUT placed on insulated support 50 mm above the ground plane

Additional Test Specific Information	Discharge to case and all controls buttons as shown above.
DUT Monitoring Information	IR signal for PLAY from remote will be monitored via EMC signal box to determine if corresponding RC6 code is being received.

Monitoring/Support Equipment	Make/Model
Monitoring equipment	IR receiver and signal monitoring box, both EMC built.
Recording equipment	N/A (test results manually recorded on data sheets)

4.14 Radiated Emissions (RE310)

RE 310 Test Set-up



Test Details	Comments
Specified Test Method	DUT shall not generate RF noise beyond given limits, measured through antenna
Deviations from Specified Test Method	None
Harness Configuration	None unit has internal battery power.
DUT Orientation	As shown in diagram for section 3.5
DUT Grounding (case or harness)	DUT placed on insulated support 50 mm above the ground plane
Additional Test Specific Information	None
DUT Monitoring Information	IR signal for PLAY from remote will be monitored via EMC signal box to determine if corresponding RC6 code is being received.

Monitoring/Support Equipment	Make/Model
Monitoring equipment	IR receiver and signal monitoring box, both EMC built.
Recording equipment	Output from EMI receiver recorded on computer and on printed graphs.

射频和天线设计培训课程推荐

易迪拓培训(www.edatop.com)由数名来自于研发第一线的资深工程师发起成立，致力并专注于微波、射频、天线设计研发人才的培养；我们于 2006 年整合合并微波 EDA 网(www.mweda.com)，现已发展成为国内最大的微波射频和天线设计人才培养基地，成功推出多套微波射频以及天线设计经典培训课程和 ADS、HFSS 等专业软件使用培训课程，广受客户好评；并先后与人民邮电出版社、电子工业出版社合作出版了多本专业图书，帮助数万名工程师提升了专业技术能力。客户遍布中兴通讯、研通高频、埃威航电、国人通信等多家国内知名公司，以及台湾工业技术研究院、永业科技、全一电子等多家台湾地区企业。

易迪拓培训推荐课程列表：<http://www.edatop.com/peixun/tuijian/>



射频工程师养成培训课程套装

该套装精选了射频专业基础培训课程、射频仿真设计培训课程和射频电路测量培训课程三个类别共 30 门视频培训课程和 3 本图书教材；旨在引领学员全面学习一个射频工程师需要熟悉、理解和掌握的专业知识和研发设计能力。通过套装的学习，能够让学员完全达到和胜任一个合格的射频工程师的要求…

课程网址：<http://www.edatop.com/peixun/rfe/110.html>

手机天线设计培训视频课程

该套课程全面讲授了当前手机天线相关设计技术，内容涵盖了早期的外置螺旋手机天线设计，最常用的几种手机内置天线类型——如 monopole 天线、PIFA 天线、Loop 天线和 FICA 天线的设计，以及当前高端智能手机中较常用的金属边框和全金属外壳手机天线的设计，通过该套课程的学习，可以帮助您快速、全面、系统地学习、了解和掌握各种类型的手机天线设计，以及天线及其匹配电路的设计和调试…

课程网址：<http://www.edatop.com/peixun/antenna/133.html>



WiFi 和蓝牙天线设计培训课程

该套课程是李明洋老师应邀给惠普 (HP) 公司工程师讲授的 3 天员工内训课程录像，课程内容是李明洋老师十多年工作经验积累和总结，主要讲解了 WiFi 天线设计、HFSS 天线设计软件的使用，匹配电路设计调试、矢量网络分析仪的使用操作、WiFi 射频电路和 PCB Layout 知识，以及 EMC 问题的分析解决思路等内容。对于正在从事射频设计和天线设计领域工作的您，绝对值得拥有和学习！…

课程网址：<http://www.edatop.com/peixun/antenna/134.html>



CST 学习培训课程套装

该培训套装由易迪拓培训联合微波 EDA 网共同推出, 是最全面、系统、专业的 CST 微波工作室培训课程套装, 所有课程都由经验丰富的专家授课, 视频教学, 可以帮助您从零开始, 全面系统地学习 CST 微波工作的各项功能及其在微波射频、天线设计等领域的设计应用。且购买该套装, 还可超值赠送 3 个月免费学习答疑…

课程网址: <http://www.edatop.com/peixun/cst/24.html>



HFSS 学习培训课程套装

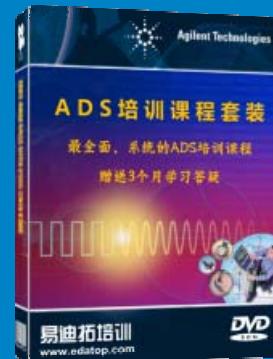
该套课程套装包含了本站全部 HFSS 培训课程, 是迄今国内最全面、最专业的 HFSS 培训教程套装, 可以帮助您从零开始, 全面深入学习 HFSS 的各项功能和在多个方面的工程应用。购买套装, 更可超值赠送 3 个月免费学习答疑, 随时解答您学习过程中遇到的棘手问题, 让您的 HFSS 学习更加轻松顺畅…

课程网址: <http://www.edatop.com/peixun/hfss/11.html>

ADS 学习培训课程套装

该套装是迄今国内最全面、最权威的 ADS 培训教程, 共包含 10 门 ADS 学习培训课程。课程是由具有多年 ADS 使用经验的微波射频与通信系统设计领域资深专家讲解, 并多结合设计实例, 由浅入深、详细而又全面地讲解了 ADS 在微波射频电路设计、通信系统设计和电磁仿真设计方面的内容。能让您在最短的时间内学会使用 ADS, 迅速提升个人技术能力, 把 ADS 真正应用到实际研发工作中去, 成为 ADS 设计专家…

课程网址: <http://www.edatop.com/peixun/ads/13.html>



我们的课程优势:

- ※ 成立于 2004 年, 10 多年丰富的行业经验,
- ※ 一直致力并专注于微波射频和天线设计工程师的培养, 更了解该行业对人才的要求
- ※ 经验丰富的一线资深工程师讲授, 结合实际工程案例, 直观、实用、易学

联系我们:

- ※ 易迪拓培训官网: <http://www.edatop.com>
- ※ 微波 EDA 网: <http://www.mweda.com>
- ※ 官方淘宝店: <http://shop36920890.taobao.com>