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Testing of

Electromagnetic Emissions

per

USA: CFR Title 47, Part 15.109 (Emissions)
Canada: ISED RSS-GEN (Emissions)

are herein reported for

Schrader Electronics FMCT

Test Report No.: 20160617-RPTSCHR10002Ar0

Applicant/Provider:
Schrader Electronics
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Measured by:	Dr. Joseph Brunett, EMC-002790-NE	Report Approved by:	Dr. Joseph Brunett, EMC-002790-NE
Report by:	Dr. Joseph Brunett, EMC-002790-NE	Report Date of Issue:	June 17, 2016

Results of testing completed on (or before) April 5, 2016 are as follows.

Emissions: Radiated spurious emissions associated with the receive chain of this device **COMPLY** the regulatory limit(s) by no less than 8.2 dB.

Revision History

Rev. No.	Date	Details	Revised By
r0	June 17, 2016	Initial Release.	J. Brunett

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1 Test Specifications, Procedures, Location, and Equipment List

1.1 Test Specification and General Procedures

The ultimate goal of Schrader Electronics is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Schrader Electronics FMCT for compliance to:

Country/Region	Rules or Directive	Referenced Section(s)
United States	Code of Federal Regulations	CFR Title 47, Part 15.109
Canada	ISED Canada	ISED RSS-GEN

Schrader Electronics has determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

ANSI C63.4:2014	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
ANSI C63.10:2013 (USA)	"American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"

1.2 Test Location

The EUT was fully tested by **Willow Run Test Labs, LLC**, 8501 Beck Road, Building 2227, Belleville, Michigan 48111 USA. Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: 688478) and with ISED Canada, Ottawa, ON (File Ref. No: IC 8719A-1). Table 1 lists all site(s) employed herein. Specific test sites utilized are also listed in the test results sections of this report.

Table 1: Test Site List.

Description	Location	Quality Num.
OATS (3 meter)	8501 Beck Rd. Bldg 2227, Belleville MI 48111	OATSA

1.3 Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 2. The quality system employed at Willow Run Test Labs, LLC has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 2: Equipment List.

Description	Manufacturer/Model	SN	Quality Num.	Last Cal By / Date Due
Spectrum Analyzer	Rhode-Schwarz / FSV30	101660	RSFSV30001	RS / May-2018
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Lib. Labs / April-2016
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Lib. Labs/ April-2017
Quad Ridge Horn	ETS Lind. / 3164-04	00066988	HRNQR316401	Lib. Labs / April-2017

2 Configuration and Identification of the Equipment Under Test

2.1 Description and Declarations

The equipment under test is an automotive superheterodyne receiver. The EUT is approximately 8 x 4 x 2 cm (approx.) in dimension, and is depicted in Figure 1. It is powered by a 12 VDC vehicular power system. In use, this device is installed in a motor vehicle. Table 3 outlines provider declared EUT specifications.

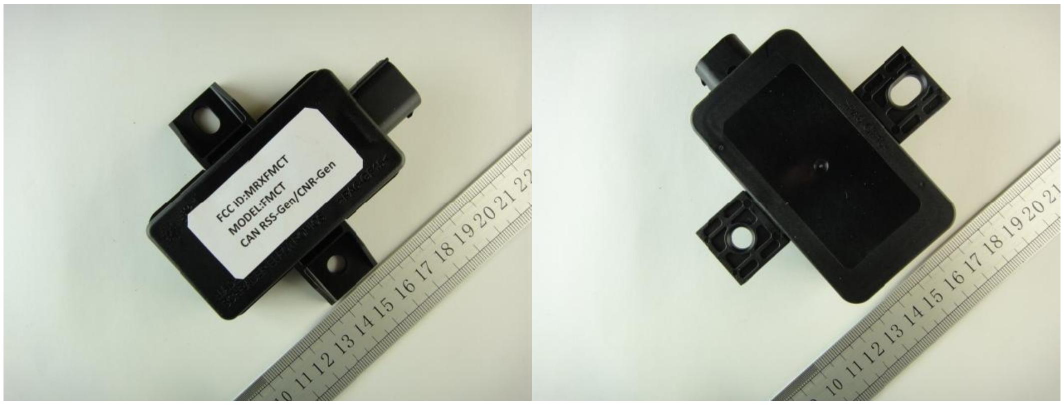

Figure 1: Photos of EUT.

Table 3: EUT Declarations.

General Declarations			
Equipment Type:	Receiver	**Country of Origin:**	Not Declared
Nominal Supply:	12 VDC	**Oper. Temp Range:**	Not Declared
Frequency Range:	433.92 MHz	**Antenna Dimension:**	6 cm
Antenna Type:	wire loop	**Antenna Gain:**	Integral (not declared)
United States			
FCC ID Number:	MRXFMCT	**Classification:**	CYY
Canada			
IC Number:	CAN RSS-Gen/CNR-Gen	**Classification:**	Receiver, Vehicular Device

2.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

2.1.2 Modes of Operation

There is only a single mode of operation, as a receiver.

2.1.3 Variants

There is only a single variant of the EUT.

2.1.4 Test Samples

Two samples in total were provided, including one normal operating sample and one sample software modified to keep the receiver awake.

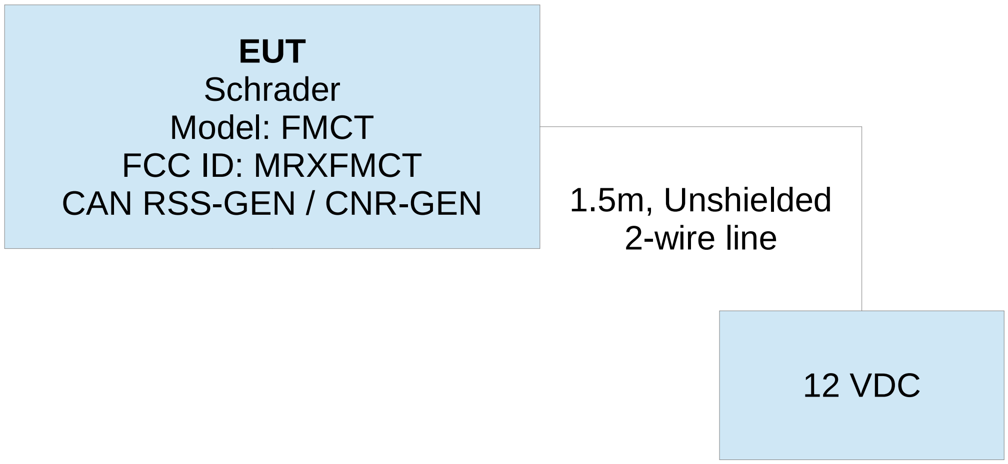

Figure 2: EUT Test Configuration Diagram.

2.1.5 Functional Exerciser

Awake functionality was verified by observation of DC current draw.

2.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

2.1.7 Production Intent

The EUT appears to be a production ready sample.

2.1.8 Declared Exemptions and Additional Product Notes

The EUT is permanently installed in a transportation vehicle. As such, digital emissions are exempt from US and Canadian digital emissions regulations (per FCC 15.103(a) and IC correspondence on ICES-003).

3 Emissions

3.1 General Test Procedures

3.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our shielded anechoic chamber or GTEM test cell. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.2 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded.

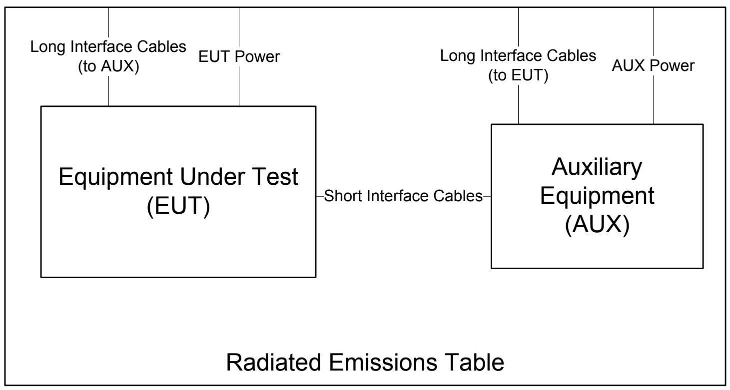

Figure 3: Radiated Emissions Diagram of the EUT.

If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied. For devices with intentional emissions below 30 MHz, a shielded loop antenna is used. It is placed at a 1 meter receive height. Emissions between 30 MHz and 1 GHz are measured using tuned dipoles and/or calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360^o in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain horn or broadband ridge-horn antennas on our OATS with a 4×5 m rectangle of H-4 absorber placed over the ground screen covering the OATS ground screen. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

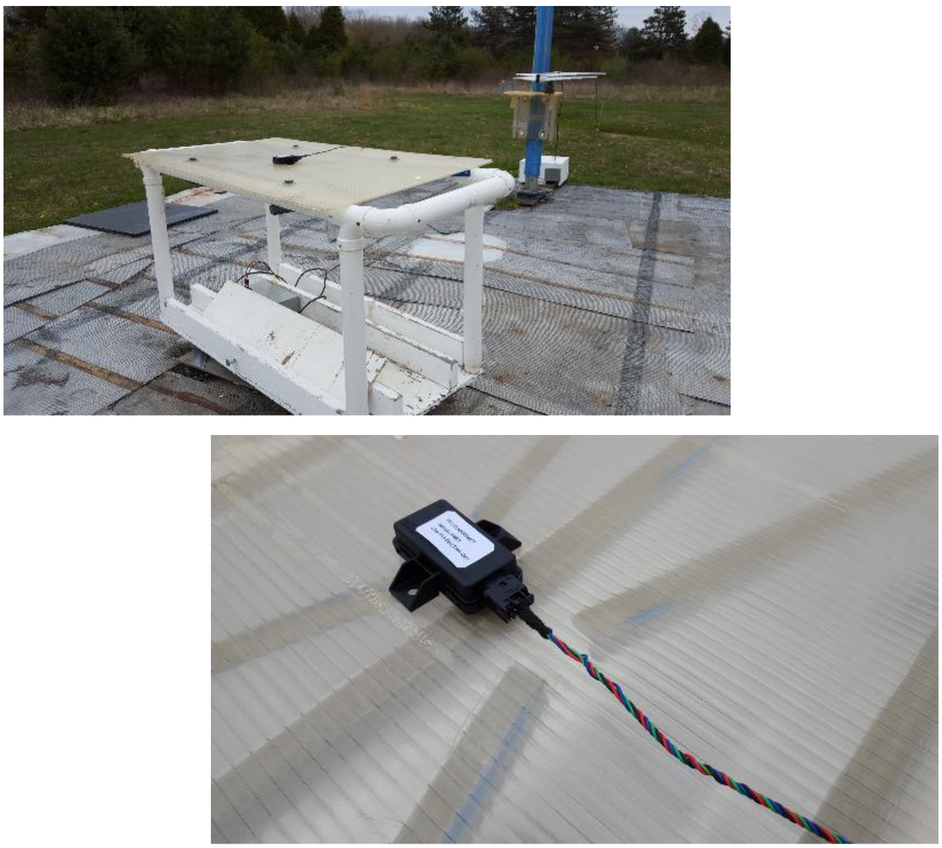

Figure 4: Radiated Emissions Test Setup Photograph(s).

3.1.2 Conducted Emissions Test Setup and Procedures

Vehicle Power Conducted Spurious The EUT is not subject to power line conducted emissions regulations as it is powered solely by the vehicle power system for use in said motor vehicle.

3.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the the procedures specified in the test standard, and results of this testing are detailed in this report.

3.1.4 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report. The provider has declared that the EUT is designed for operation over the temperature range Not Declared. Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber, temperature and humidity are recorded, and thermal balance is verified via a thermocouple–based probe.

3.2 Unintentional Emissions

3.2.1 Radiated Receiver Spurious

The results for the measurement of radiated receiver spurious emissions (emissions arrising from the receiver chain, e.g. LO or VCO) at the nominal voltage and temperature are reported in Table 4. Receive chain emissions are measured to 5 times the highest receive chain frequency employed or 4 GHz, whichever is higher. If no emissions are detected, only those noise floor emissions at the LO/VCO frequency are reported.

Table 4: Receiver Chain Spurious Emissions $\geq$ 30 MHz.

Frequency Range	**Det**	**IF Bandwidth**	**Video Bandwidth**
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz

Test Date:	16-Apr-16
Test Engineer:	Joseph Brunett
EUT:	Schrader FMCT
Mode:	Awake
Meas. Distance:	3m

Receiver Spurious

	Frequency Band		Test Antenna + Cable				Rx. Power*		Distance			E-Field**		EIRP		E-Field Limit		
	Start	Stop	Type/Asset	Pol.	Ka	Kg	Peak	Qpk/Avg	Meas.	Des.	CF	Pk	Avg/QPk	Pk	Avg	FCC	Pass By	
#	MHz	MHz		H/V	dB/m	dB	dBm	dBm	m	m	dB	dBuV/m	dBuV/m	dBm	dBm	dBuV/m	dB	Comments
1	423.2	423.2	LOGEMCO01	H	16.1	31.6	-69.2		3.0	3.0	.0	37.8				46.0	**8.2**	noise
2	423.2	423.2	LOGEMCO01	V	16.1	31.6	-68.1		3.0	3.0	.0	23.4				46.0	22.6	noise
3	846.4	846.4	LOGEMCO01	H	22.0	27.5	-70.2		3.0	3.0	.0	31.2				46.0	14.8	background
4	846.4	846.4	LOGEMCO01	V	22.0	27.5	-65.1		3.0	3.0	.0	36.3				46.0	9.7	background
5	1000.0	4500.0	HRNQR316401	H/V	33.0	-0.5	-101.0		4.0	4.0	.0	39.5				54.0	14.5	noise
6	3600.0	3600.0	HRNQR316401	H/V	35.4	-0.4	-105.0		5.0	5.0	.0	37.8				54.0	16.2	noise
7	4500.0	18000.0	HQR2TO18S01	H/V	34.3	-1.6	-107.0		6.0	6.0	.0	35.9				54.0	18.1	noise
8																		
9																		
10																		
11																		
12																		
13																		

*QPk detection below 1 GHz, Avg detection at or above 1 GHz with receiver bandwidth as specified at top of table.

** When E-field is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings.

4 Measurement Uncertainty

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 5: Measurement Uncertainty.

Measured Parameter	**Measurement Uncertainty**†
Radio Frequency	$\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS-1))/2 + 1\,\mathrm{Hz})$
Conducted Emm. Amplitude	$\pm1.8\,\mathrm{dB}$
Radiated Emm. Amplitude ($30 - 200\,\mathrm{MHz}$)	$\pm2.7\,\mathrm{dB}$
Radiated Emm. Amplitude ($200 - 1000\,\mathrm{MHz}$)	$\pm2.5\,\mathrm{dB}$
Radiated Emm. Amplitude ($f > 1000\,\mathrm{MHz}$)	$\pm3.7\,\mathrm{dB}$
DC and Low Frequency Voltages	±2%
Temperature	±0.5°C
Humidity	±5%

†Ref: CISPR 16-4-2:2011+A1:2014