MIRA Test Report

Carried out for: Schrader Electronics Ltd
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On the Authority of: Order N°: 07833

Company Liaison Engineer: Mr D Lynn

Test Report No: 1008842#01

Radio Frequency Emissions of a Schrader Ltd G3 Tyre Sensor Transmitter to FCC Regulation Part 15

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SUMMARY

A Schrader Electronics Ltd G3 Tyre 315 MHz Sensor Transmitter Model MRXNIS315G3 was tested in accordance with FCC Part 15, Subpart C and with RSS-210 of Industry Canada.

The Schrader Ltd Nissan G3 Tyre 315 MHz Sensor met the limits for radiated emissions by 3.7 dB and by 19.01 dB at the harmonics. Beside the harmonics there were no other significant spurious emissions located.

The test results contained within relate only to the sample(s) identified in this report.

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1 Introduction

A Schrader Electronics Ltd G3 Tyre 315 MHz Sensor Transmitter Model MRXNIS315G3 was tested for compliance in accordance with FCC Regulations, part 15, adopted under Docket 87-389, April 18, 1989 and with Industry Canada RSS-210, Issue 5, dated November 1, 2001.

The tests were performed at MIRA Ltd Open Area Test Site following the procedures described in ANSI C63.4-1992 “Methods of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz’.

The Schrader Electronics Ltd G3 Tyre 315 MHz Sensor Transmitter Models MRXNIS315G3 were received at MIRA on 24/03/05 and 15/09/05. Tests were performed on 16/03/05 (correction for pulse operation), 25/03/05 (emissions), 22/04/05 (emissions) and 30/09/05 (bandwidth and supply voltage variation). All equipment was returned to Schrader Electronics Ltd on 12/10/05.

No representative was present to witness the testing, on behalf of Schrader Electronics Ltd.

The site description and attenuation characteristics of MIRA Ltd Open Area Test Site are on file with FCC Laboratory, Columbia, Maryland, USA (registration number 877566).

2 Configuration and Equipment Under Test (EUT) Details

The EUT is a 3.5 x 7.0 x 1.5 cm size (including value stem) potted tyre pressure sensor/transmitter that mounts on a rim inside the tyre. When the vehicle is in motion, the EUT transmits tyre pressure information to the receiver in the vehicle. The transmission consists of eight ASK and FSK encoded words of total duration of 0.928 seconds which repeat typically every 33 seconds. The 315 MHz carrier is generated by a SAW stabilised oscillator. The coding is performed by an ASCI timed by a 32.768 kHz crystal oscillator

- Manufacturer Schrader Electronics Ltd
- EUT ID: Schrader Remote Tyre Pressure Monitoring Transmitter
- Model: MRXNIS315G3
- Serial Number: FCCGen3
- FCC ID: MRXNIS315G3
- MIRA IDs: E205-0225 (emissions), E205-0684 (bandwidth), E205-0225 (relative emissions)

Three samples were provided. These were a continuous sample used to maximise the emissions; a standard sample for the emission and bandwidth measurements and a sample without a battery for the relative emissions verse battery voltage at 315 MHz.

3 Radiated Emissions

The radiated emissions tests were carried out on the Open Area Test Site (OATS) at MIRA in accordance with FCC Regulation 47, Subpart C, Section 15.231 and ANSI Standard C63.4-1992 standard.

3.1 Test Method

The EUT was tested as a standalone unit (i.e. not mounted on a tyre rim)

The tests were performed on the EUT over the frequency range 30 MHz to the tenth harmonic of the EUT 315 MHz fundamental. This involved measuring the emissions from the EUT using an antenna, turntable and a receiver system. The EUT was placed on a 1 m by 1.5 m, 0.8 m table. Photographs showing the test configuration are shown in Appendix B.

Tests were conducted using both the vertical and horizontal polarisations of the antenna. Peak readings were taken in three orthogonal EUT planes (see figure 3.1). The highest readings were converted to average readings based on the duration of the EUT 'on' time. When an emission was located, the table was rotated to maximise the signal strength. When this signal strength was determined, the test antenna was raised and lowered from 1 m to 4 m to locate the maximum signal strength.

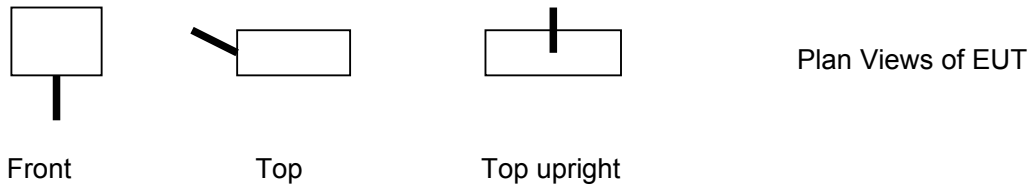

Figure 3.1 Plan View of EUT (not to scale)

3.2 Test Conditions

The EUT was tested in active roll mode where the EUT sends a transmission every 33 seconds.

3.3 Test Limits and Computations

The EUT is classified under the category of an Intentional Radiators and Digital Devices.

For FCC the EUT is subject to Subpart C, Sections 15.209 and 15.231; Subpart A, Section 15.33.

For Industry Canada the EUT is subject to RSS-210, Sections 6.1 and 6.3.

The applicable test frequencies with corresponding emission limits are given in Tables 3.3.1 and 3.3.2 below.

Table 3.3.1 - Radiated Emission Limits (FCC:15.231(e); IC:RSS-210; 6.1,6.3 Table 4)
Data Transmission

Frequency	Fundamental	Ave. E_{lim} (3 m)	Spurious	Ave. E_{lim} (3 m)
MHz	µV/m	dB (µV/m)	µV/m	dB (µV/m)
260-470 315	1500-5000* 2418	67.7	150-500 241.8	47.7

* Linear interpolation formula: E = -2833.2 + 16.67 x F (MHz)

Table 3.3.2 - Radiated Emission Limits (FCC:15.33, 15.35, 15.109; IC:RSS-210; 6.2.2(r))
Digital Class B

Frequency MHz	E_{lim} (3 m) µV/m	E_{lim} dB µV/m
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-2000	500	54.0

3.4 Test Results

Table 3.4 - Highest Radiated Emission Measured

Emission Freq MHz	Antenna Polarity	Peak Field Strength dBµV/m	Average Field Strength* dBµV/m	Field Strength Limit dBµV/m	EUT Position
315.08	V	82.80	64.00	67.7	Top Upright
630.20	V	63.21	44.41	47.7	Top Upright
945.28	V	54.29	35.49	47.7	Top Upright
1260.40	V	46.01	27.21	54.0	Top Upright
1575.20	H	53.79	34.99	54.0	Top
1890.80	V	50.86	32.06	54.0	Top
2520.40	V	49.69	30.89	54.0	Top

* The average field strength reading includes the antenna factor (dB/m), cable loss (dB) and the –18.8 pulse operation correction factor (see section 4.1).

The measured emissions from the EUT were shown to be below the limits at the fundamental by 3.7 dB and by 19.01 dB at the harmonics.

4 Conducted Emissions

The conducted emission tests are not required because the EUT is powered by a 3 V internal lithium battery.

5 Other Measurements and Computations

These measurements were performed to determine the measured value for pulse EUT operation as per FCC Part 15 Section 15.35 (c) and the bandwidth of the EUT fundamental emission as per FCC Part 15 Section 15.231 (c).

5.1 Correction for Pulse Operation

The EUT pulse sequence is shown in figure 1 of appendix C. The EUT pulse duration was measured at 11.42 ms over a 100 ms time period.
The transmission consists of eight 11.42 ms FSK pulses (words) with a 100 ms period.
The averaging factor was calculated as:

K_E = (20 Log_{10} (11.42ms/100ms) = -18.8 dB

5.2 Bandwidth

The measured bandwidth of the EUT is shown in figure 2 of appendix C. The allowed (-20 dB) bandwidth is 0.25 % of 315 MHz or 768 kHz. The EUT 20 dB bandwidth measured was 114.06 kHz.

5.3 Effects of Supply Voltage Variation

For this test, the EUT without an internal was powered by an external power supply unit. Relative power measurements were made at the EUT fundamental frequency as the voltage was varied over the EUT voltage range of 2.6 to 3.3 V. These measurements were carried out using a RF test fixture. The RF test fixture is a radio frequency device for coupling the integral antenna to a 50 ohm RF terminal at the EUT fundamental frequency.
The measurements are shown below.

Table 5.3 – Relative Emissions at 315 MHz vs. Supply Voltage

Voltage V	Power dBm
2.6	-7.4
2.8	-6.4
3.0	-7.0
3.2	-6.1
3.3	-6.1

6 Conclusions

The Schrader Electronics Ltd G3 Tyre 315 MHz Sensor Transmitter Model MRXNIS315G3 met the FCC Requirements for unlicensed transmitters in the following aspects:

Section 15.231 (e), radiated emissions for periodic operated equipment.

Section 15.231 (c) Bandwidth less than 0.25 % of the centre frequency.

Appendix A

Test Equipment

The Quality Assurance scheme at MIRA has been established to ensure that all equipment has a clearly identified calibration classification, calibration expiry date, and that all calibrations are traceable to national standards. All equipment within the scheme is given a Quality Assurance number of the form Qnnnnnn A DD/MM/YYYY where:

nnnnnn	is a unique number assigned to the instrument
A	is the calibration category of the instrument e.g. A, A1 etc
DD/MM/YYYY	is the date on which the calibration expires

Test Equipment	**N°**	**Classification**	**Calibration Due**
R&S ESMI Test Receiver	Q025182	A	20/10/2005
Chase CBL6112 BiLog Antenna	Q013853	A	20/10/2005
Schwarzbeck BBHA 9120A Horn Antenna (0.8-5GHz)	Q024341	A	21/01/2006
Cables	Q019181	A	24/05/2005
	Q019190	A	24/05/2005
	Q025072	A	24/05/2005
Tape Measure Fisco FT30/79	Q022588	A1	10/09/2008
RH Turntable Controller	Q006878	A	04/01/2006
R&S 1008.8107.04/06 Mast	Q015174	A	04/01/2006
R&S 1008.8207.02 Mast Controller	Q015178	A	04/01/2006
Open Area Test Site	Q007015	A	29/09/2006
RF Test Fixture	Q016118	A	26/04/2006
Digital Multimeter	Q011945	A	28/10/2005

Classification A	Item conforms to a MIRA QAM Performance Specification, which does not differ from the Manufacturer's Specification.
Classification A1	Item conforms to a MIRA QAM Performance Specification, which differs from the Manufacturer's Specification.

Appendix B

EUT Photographs

Photograph	Title	Negative N°
Plate 1	Test Configuration	IMG_8757
Plate 2	Close up of EUT	IMG-7094

Plate 1 General Set-up (IMG_8757)

Plate 2 Close up of EUT During Test (IMG-7094)

Appendix C

Test Results

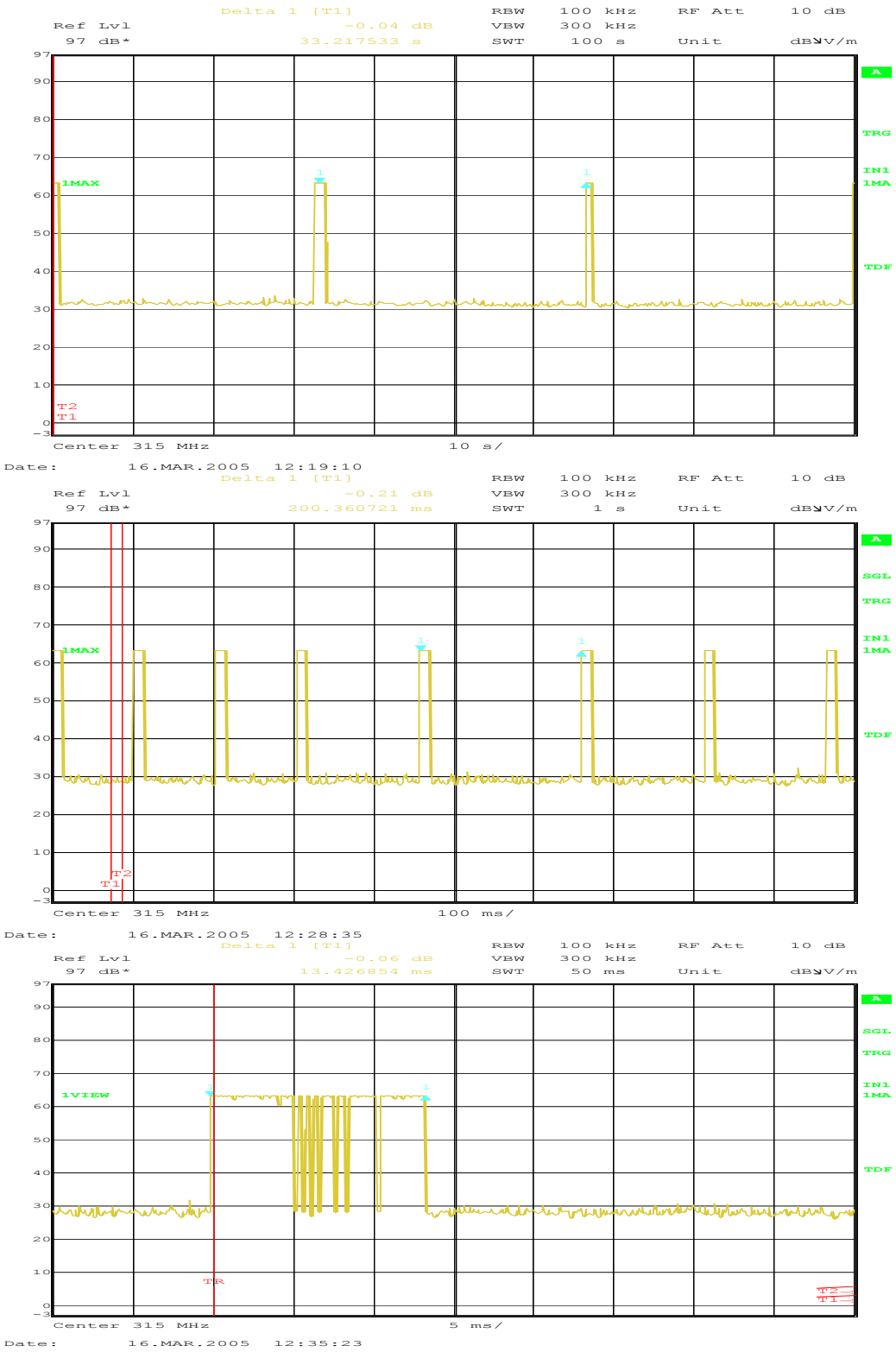

Figure1 Transmission Modulation Characteristics: (top) transmission repetition, (centre) transmission pulses, (bottom) pulse width (5 ms per division)

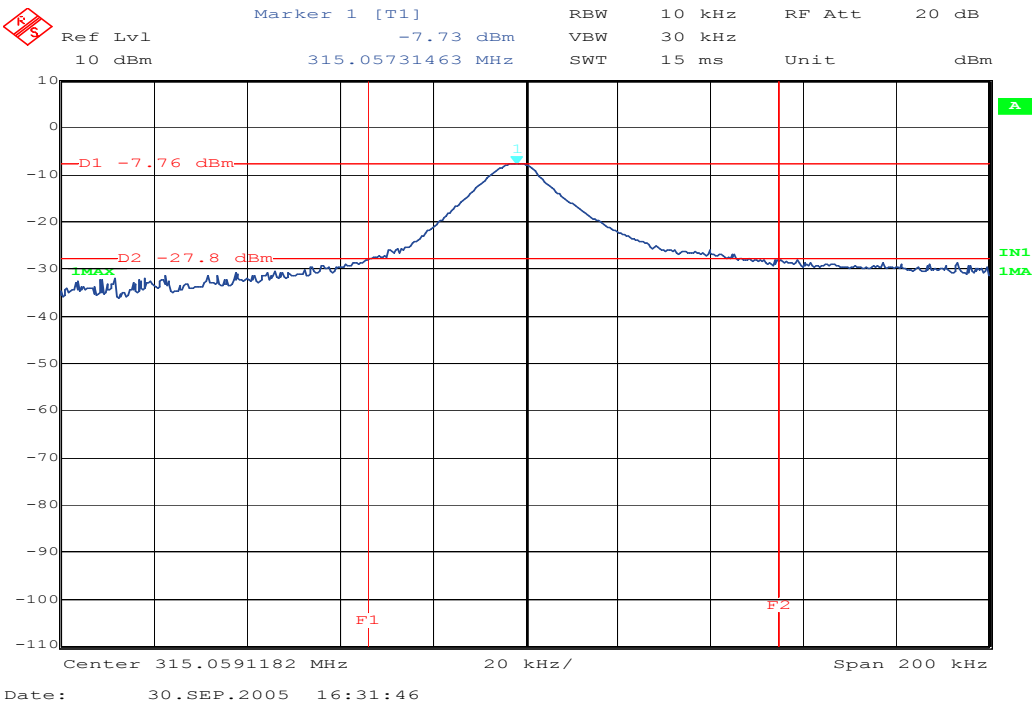

Figure 2 – Bandwidth Measurement

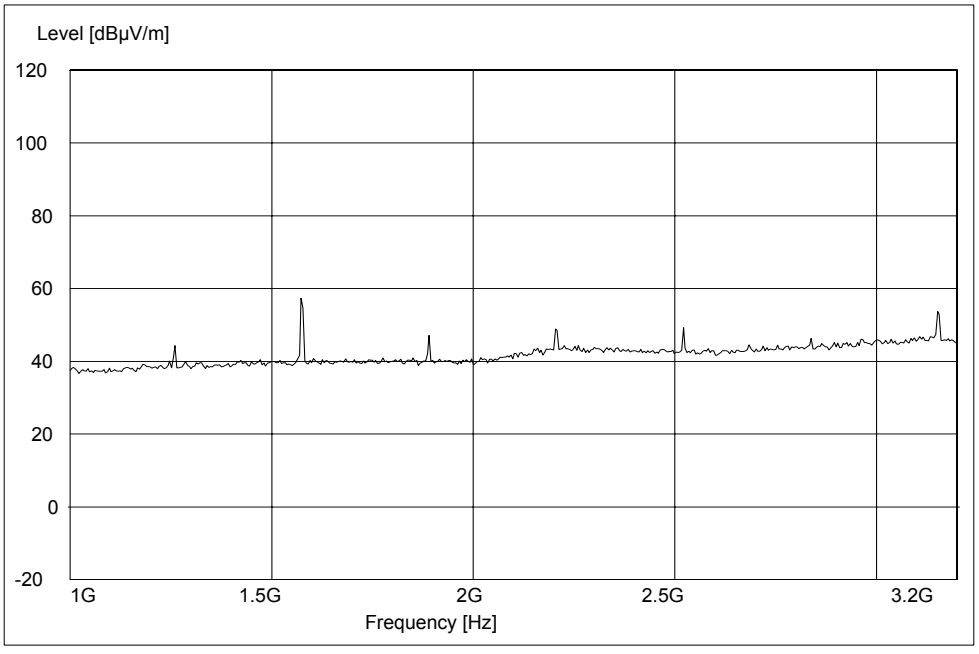

Figure 3 – Identification of Frequencies above 1 GHz