Report on the EMC Testing

For

Schrader Electronics Limited

On

Solar Powered TPMS Receiver

Report No. TRA-038947-36-00A

12th March 2018

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REPORT ON THE EMC TESTING OF A
SCHRADER ELECTRONICS LIMITED
SOLAR POWERED TPMS RECEIVER
WITH RESPECT TO SPECIFICATION
FCC RULES CFR 47: 1st October 2017 PART 15.107 AND 15.109 CLASS B

TEST DATES: 9th March 2018

Written by: Digitally signed by Darren Shephard Date: 2018.03.12 16:24:25 Z — D. Shephard, Senior EMC Engineer

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Date: 12th March 2018

Distribution:

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Copy 3: Not Applicable

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Company Reg No. 02536659

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	12th March 2018	Original

2 Summary

TEST REPORT NUMBER:	TRA-038947-36-00A
PURPOSE OF TEST:	Electromagnetic Compatibility – Emissions
TEST SPECIFICATION:	FCC Rules CFR 47: 1st October 2017 Part 15.107 and 15.109 Class B
DEVIATIONS FROM SPECIFICATION:	Not Applicable
EQUIPMENT UNDER TEST (EUT):	Solar Powered TMPS Receiver
EUT SERIAL NUMBER:	Not Applicable
EUT CATEGORY:	Unintentional Radiator
TEST RESULT:	Measured As Compliant Given any modifications stated in the relevant section of this report.
MANUFACTURER/AGENT:	Schrader Electronics Limited
ADDRESS:	Unit 11 Antrim Technology Park Antrim Co. Antrim Northern Ireland BT41 1QS
CLIENT CONTACT:	Zoe Gouley ☎ 028 94482536 ✉ zgourley@sensata.com
ORDER NUMBER:	6808900019039
TEST DATES:	9th March 2018
TESTED BY:	D. Shephard Element Materials Technology

3 Contents

1 Revision Record 3
2 Summary 4
3 Contents 5
4 Introduction 6
5 Normative References 7
6 Equipment Under Test 8
6.1 EUT Identification 8
6.2 EUT Selection, Configuration & Loading 8
6.3 System Equipment 8
6.3.1 Components of the EUT 8
6.3.2 Support Equipment 8
6.4 EUT Mode of Operation 9
6.4.1 Exploratory Testing 9
6.4.2 Final Testing 9
6.5 EUT Description 9
7 Block Diagram 10
8 Test Standard Selection 11
8.1 Product Standard 11
8.2 Basic Test Standard Selection 11
9 Radiated Emissions as per ANSI C63.4:2014 12
9.1 General 12
9.2 Radiated Emission Test Parameters 12
9.3 EUT Test Results 13
9.3.1 Radiated Emissions Test Data – 30 MHz to 1 GHz 13
9.3.2 Radiated Emissions Test Data – 1 GHz to 2 GHz 14
10 Sample Calculation 15
11 Test Equipment List – Element Malvern 16
12 EMC Modifications 18
13 Conclusion 19
13.1 Conformity in Production 19
14 Measurement Uncertainty 20
15 Appendix A – Photographs 21

4 Introduction

This report TRA-038947-36-00A presents the results of the EMC testing on a Schrader Electronics Limited, Solar Powered TMPS Receiver to specification FCC Rules CFR 47: 1st October 2017 Part 15.107 and 15.109 Class B.

The testing was carried out for Schrader Electronics Limited by Element Materials Technology, an independent accredited testing laboratory, at their EMC test facility located at:

☒ 100 Frobisher Business Park
Leigh Sinton Road
Malvern
Worcestershire
WR14 1BX
UK

FCC Site Registration Number: 452983

☐ Unit 1
Pendle Place
Skelmersdale
West Lancashire
WN8 9PN
UK

FCC Site Registration Number: 444512

☐ 74-78 Condor Close
Woolsbridge Industrial Park
Three Legged Cross
Wimborne
Dorset
BH21 6SU
UK

FCC Site Registration Number: 430273

☐ Unit E
South Orbital Trading Park
Hedon Road
Hull
East Yorkshire
HU9 1NJ
UK

FCC Site Registration Number: 378340

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The QMS meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken, being additionally UKAS accredited to EN ISO 17025. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test and measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Element Materials Technology's own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

It is Element Materials Technology policy to always use the latest version of any applicable base test standard. Where a product specification calls up a superseded dated revision or an undated basic standard, the latest state-of-the-art version will typically be used. However this would be a departure from what is urged by the Commission using dated references for measurement standards and hence a deviation. Therefore, unless specifically requested by the client, only the measurement procedures cited by the FCC rules will be relied upon & used in testing the equipment for compliance.

Throughout this report EUT denotes equipment under test.

5 Normative References

- ANSI C63.4-2014 ‘American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz’
- FCC/OET MP-2 (1986)* ‘Measurement of UHF Noise Figures of TV Receivers’
- ANSI C63.17-2013* ‘American National Standard Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communications Services (UPCS) Devices’
- ANSI C63.10-2013* ‘American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’

*Indicates a specification or standard or specific amendment that is not listed on the Element Materials Technology UKAS scope of accreditation.

6 Equipment Under Test

6.1 EUT Identification

- Name: Solar Power TPMS Receiver
- Serial Number: Not applicable
- Model Number: SCHRFK
- Software Revision: Not applicable
- Build Level / Revision Number: Helios and Solaris

Incorporating the following external interconnecting cables, ports or terminals:

Description	***Cable Type***	***Part No.***	***Manufacturer***	***Test Length***	***Max. Length***
None, system is battery powered and has no cables					

Note: *Excess length of cables interconnecting units of the EUT were bundled 0.3 m ≤ 0.4 m non-inductively in the approximate centre, forming the arranged cable lengths identified in Section 7.*

6.2 EUT Selection, Configuration & Loading

One EUT, in one configuration, fully loaded receiving tyre pressure measurements from 4 sensors.

6.3 System Equipment

6.3.1 Components of the EUT

Equipment listed below forms part of the EUT associated equipment, comprising the external modular units needed to be functionally complete or necessary to achieve a typical & representative system.

Description: Tyre Pressure Sensors x4
Manufacturer: Schrader Electronics Limited
Serial No: 5F3D86A, 5F3C813, 5F3D860, 5F601EF

Description: LF Tool V3.5
Manufacturer: Schrader Electronics Limited
Serial No: 070

6.3.2 Support Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Not Applicable – No support, monitoring equipment, interfacing units or simulators required.

6.4 EUT Mode of Operation

6.4.1 Exploratory Testing

N/a, one mode of operation only as described in 6.4.2 Final Testing below.

6.4.2 Final Testing

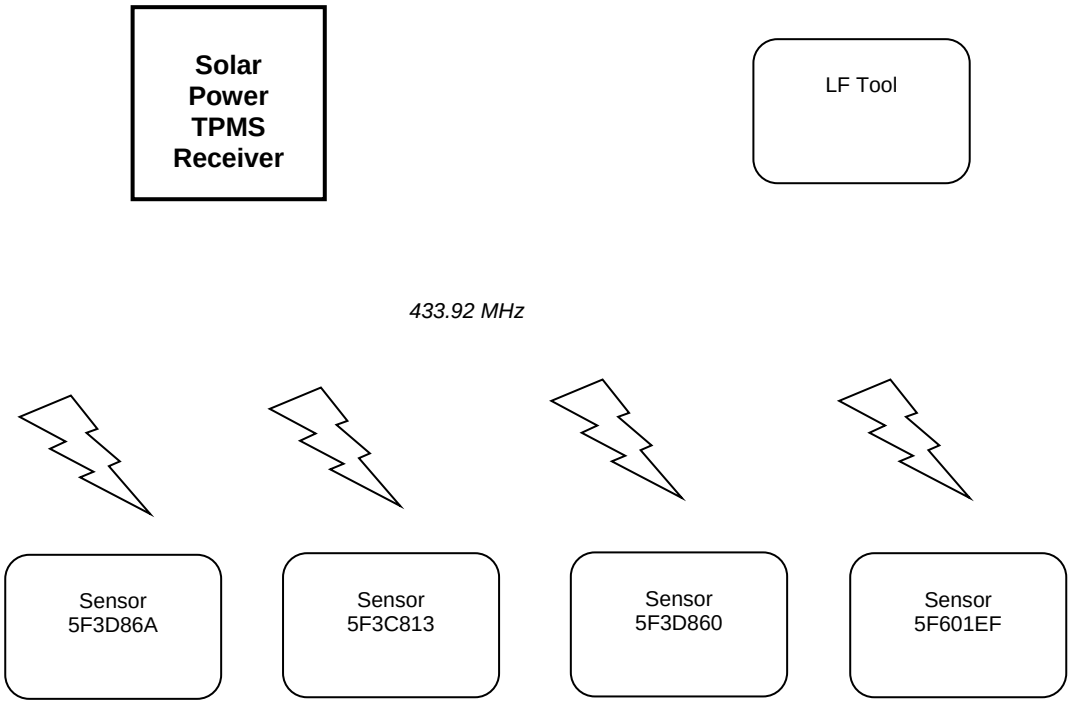
The Solar Powered TPMS Receiver was receiving and displaying tyre pressure measurements from 4 sensors.

6.5 EUT Description

Solar powered Tyre Pressure Monitoring sensor Receiver unit with an internal rechargeable battery.
Rechargeable by either Solar power or by a micro USB that can be charged from the vehicle.

7 Block Diagram

The following diagram shows basic EUT interconnections with major functional component units, cable type and cable lengths identified in Section 6.1.



Note: system is battery powered and has no external cables

8 Test Standard Selection

8.1 Product Standard

The following product standard was used as the basis of the test levels required and has been deemed the most appropriate product standard to apply to the Solar Powered TPMS Receiver, or has been requested by the manufacturer:

FCC RULES CFR 47: 1st October 2017 Federal Communications Commission Title 47 CFR Part 15: Radio Frequency Devices.

8.2 Basic Test Standard Selection

Basic Test Standard	***Applicable***		***Notes***
	Class A	***Class B***	
ANSI C63.4:2014 – Radiated Emissions	☐	☒	
ANSI C63.4:2014 – Conducted Emissions	☐	☐	1

NOTES:
[1] Not applicable, EUT contains no test ports.

9 Radiated Emissions as per ANSI C63.4:2014

9.1 General

This test measures radiated electromagnetic emissions that may emanate from EUT enclosures and cables. This test ensures the protection of broadcast and telecommunication services used in the vicinity of the EUT.

The test set-up used complies with all the dimension requirements set out in ANSI C63.4:2014. The semi-anechoic chamber used meets the site attenuation measurements required by ANSI C63.4:2014 Clause 5.4.2 & 5.5. Reference is made to company procedure RTP1029 and RTP1005.

Measurement instrumentation used meets the requirements of CISPR 16-1-1:2010, and uncertainties of CISPR 16-4-2:2011. Expanded laboratory uncertainties U_{lab} are less than or equal to CISPR 16-4-2:2011 U_{cispr} Table 1. Therefore no compensation is required to the actual measured level in determining compliance with the applied limit.

An initial scan is carried out in order to establish a frequency list that is attributable to the EUT, using automated R&S EMC32 measurement software. Receiver/analyser scan speed and bandwidth adjustments where applicable are in accordance with the reference standard, appropriate to the intercepted signal being resolved. Any emissions measurements that fall within 20 dBµV/m of the limit line are then maximised by rotating the equipment through 360 ° and raising/lowering the antenna through 1 to 4 m height for each frequency of interest.

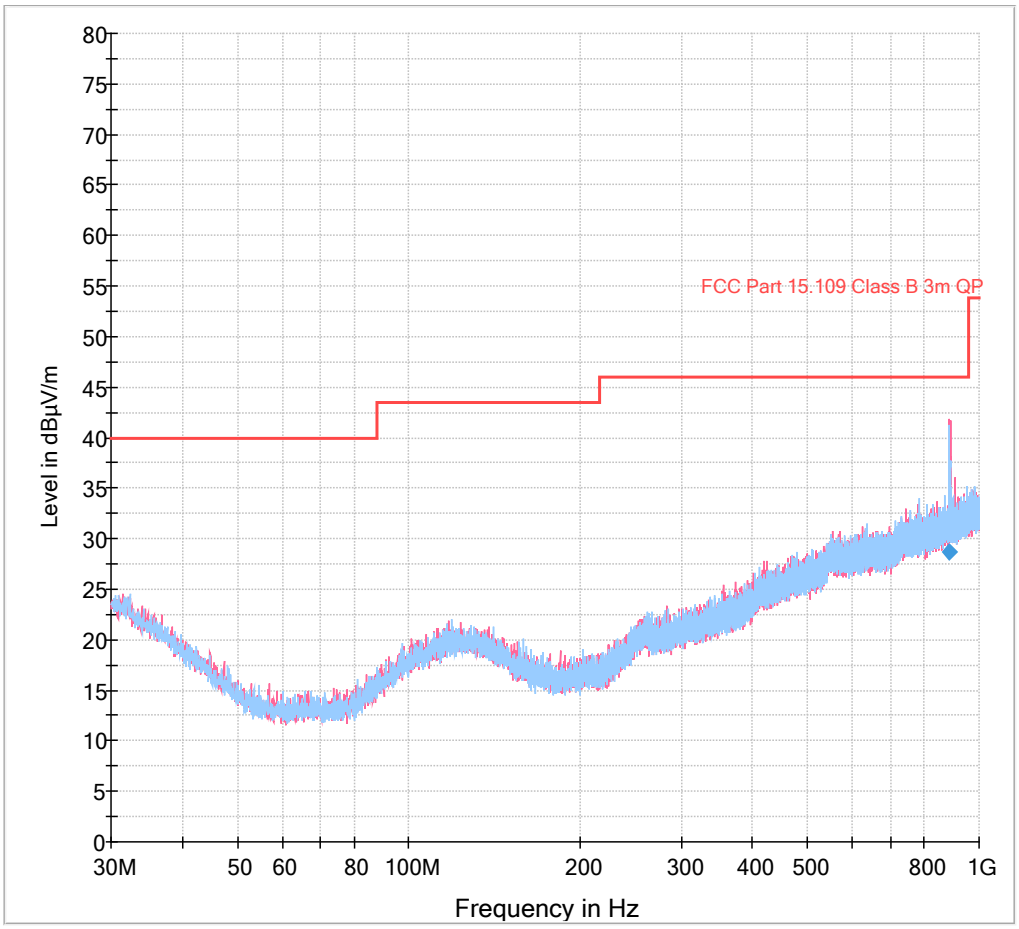
9.2 Radiated Emission Test Parameters

EUT Classification:	☐ A ☒ B
Highest EUT Frequency:	433.92 MHz (if >1 GHz upper frequency of measurement will be 5th harmonic of highest EUT frequency or 40 GHz whichever is lower)
Frequency Range:	30 MHz to 1 GHz ☒ 1 GHz to 2 GHz ☐ N/A – Max EUT Freq Used <108 MHz ☐ 2 GHz to 5G Hz ☒ N/A – Max EUT Freq Used <500 MHz ☐ 5 GHz to X GHz ☒ N/A – Max EUT Freq Used <1 GHz
Measurement Bandwidth:	120 kHz (Measurements ≤1 GHz) 1 MHz (Measurements ≥1 GHz)
Video Bandwidth:	>500 kHz (Measurements ≤1 GHz) 3 MHz (Measurements ≥1 GHz)
Detectors:	Peak (≤1 GHz scan / ≥1 GHz Final Measurements) Average (≥1 GHz Final Measurements) Quasi-peak (≤1 GHz Final Measurements)
Receiver Frequency Step Size:	50 kHz (Measurements <1 GHz) 450 kHz (Measurements >1 GHz)
Analyser Frequency Sweep Point Size:	≤50 kHz (Measurements <1 GHz) ≤450 kHz (Measurements >1 GHz)
Quasi-peak Detector Dwell:	Minimum 2 s per Frequency Point
Ambient Climatic Conditions:	Temperature 22 °C Humidity 30 % Pressure 1012 mb
Antenna Height:	1 to 4 Metres
EUT to Antenna Distance:	☐ 1 m ☒ 3 m
EUT Measurement Height:	☒ 0.8 m Insulated Table ☐ 0.1 m Insulated Support/Pallet
EUT Operation Voltage:	Internal battery
EUT Operating Frequency:	☐ 60 Hz ☒ dc

9.3 EUT Test Results

9.3.1 Radiated Emissions Test Data – 30 MHz to 1 GHz

FCC RE 30MHz-1GHz ESU26 sweep



Key:

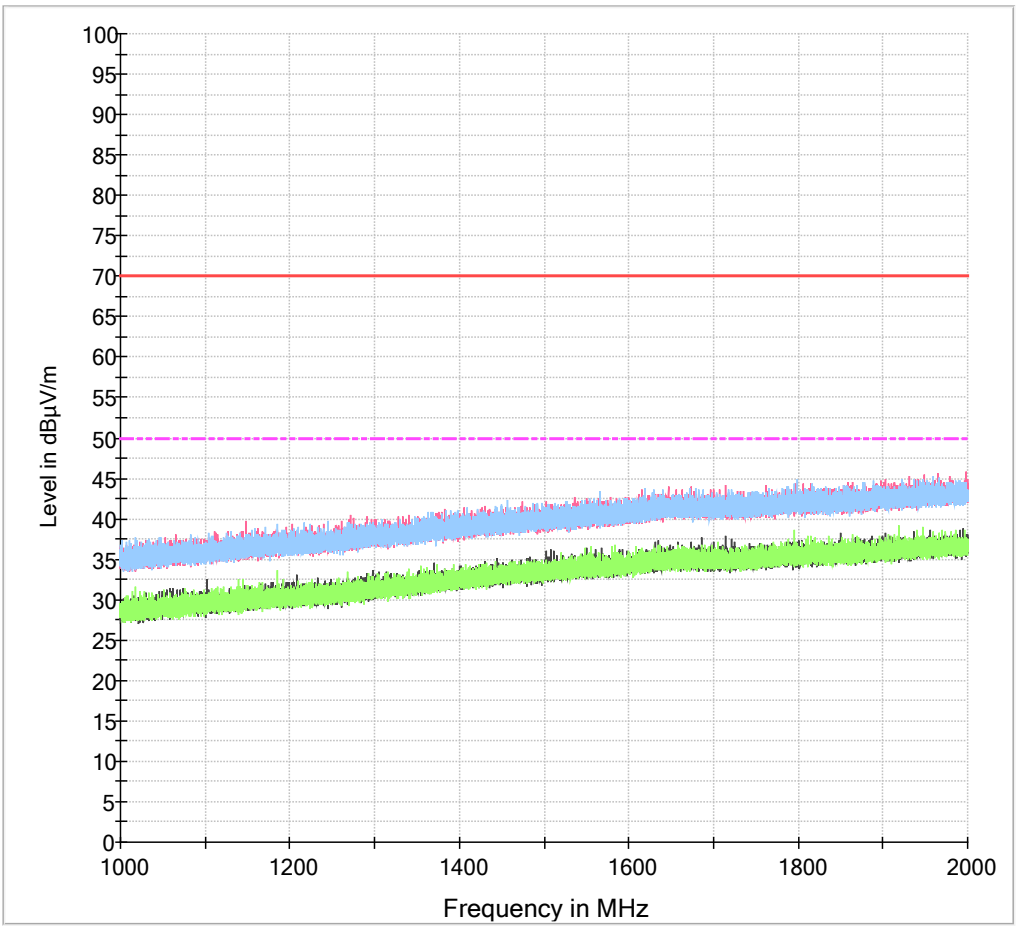
- Quasi-Peak limit
- Quasi-Peak final measurement
- Vertical Peak trace
- Horizontal Peak trace

Quasi-Peak Results Table

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
886.244500	28.6	15000.0	120.000	150.0	Vertical	112.0	30.8	17.4	46.0

9.3.2 Radiated Emissions Test Data – 1 GHz to 2 GHz

EN 550XX RE 1-6GHz ESU26 sweep



Key:

- Peak limit
- Average limit
- Horizontal Peak trace
- Horizontal Average trace
- Vertical Peak trace
- Vertical Average trace

10 Sample Calculation

The radiated emission levels used in the report are calculated thus:

Frequency (MHz)	*Measured Value (dBµV)*	*Combined Antenna & Cable Factor (dB/m)*	*Emission Level (dBµV/m)*
886.244500	-2.2	30.8	28.6

11 Test Equipment List – Element Malvern

The following test equipment was used:

Type of Equipment	*Maker/ Supplier*	*Model Number*	*Serial Number*	*Element Number*	*Actual Equipment Used*	*Calibration Date*	*Interval*
Current Probe	Eaton	91550-1	2822	L159	☐		
3 Phase LISN	Schwarzbeck	NSLK8128	8128151	L207	☐		
Test Receiver	Rohde & Schwarz	ESHS20	837960/003	L237	☐		
LISN	Rohde & Schwarz	ESHS3-Z5	839135/013	L238	☐		
Bi-Log Antenna	Chase	CBL6112	2098	L274	☒	30/11/2017	24
LISN	Rohde & Schwarz	ESHS3-Z5	837469/010	L289	☐		
Bi-Log Antenna	Chase	CBL6111	1945	L290	☐		
Voltage Probe	Element	None	None	L316	☐		
Receiver	Rohde & Schwarz	ESVS10	844594/003	L352	☐		
Receiver	Rohde & Schwarz	ESHS10	844077/019	L353	☐		
Receiver	Rohde & Schwarz	ESVS20	838804/005	L415	☐		
Bi-Log Antenna	Schaffner	CBL6112B	2761	L431	☐		
Microwave Pre-Amplifier	Agilent	8449B	3008A016	L572	☐		
Receiver/Analyser	Rohde & Schwarz	ESIB7	100182	L630	☐		
Receiver/Analyser	Rohde & Schwarz	ESIB40	100241	L691	☐		
ALSE RF Chamber ≤ 1 GHz (Radiated & Line Conducted Site)	Panashield	G72131 Comm1	A	L717	☐		
	ANSI C63.4 [D.3] Volumetric NSA						
ALSE RF Chamber ≥ 1 GHz (Radiated & Line Conducted Site)	Panashield	G72131 Comm1	A	L717	☐		
	CISPR 16-1-4 S_{vswr} (ANSI C63.4 [5.5.1 a])						
ALSE RF Chamber ≤ 1 GHz (Radiated & Line Conducted Site)	Panashield	G72231 Comm2	B	L718	☒	29/04/17	36
	ANSI C63.4 [D.3] Volumetric NSA						
ALSE RF Chamber ≥ 1 GHz (Radiated & Line Conducted Site)	Panashield	G72231 Comm2	B	L718	☒	29/04/17	36
	CISPR 16-1-4 S_{vswr} (ANSI C63.4 [5.5.1 a])						
Vertical Ground Reference Plane	Element	2.5m x 2m	None	N/A	☐		
AC Power Source	Schaffner	NSG1007	54544	L767	☐		
Log Periodic Antenna	Rohde & Schwarz	HL050	100530	L869	☒	23/01/2018	24
RF Cable	Rosenberger	FB293C1040005050	70558-01	L871	☒	29/11/2017	12
RF Cable	Rosenberger	FB293C1040005050	70558-02	L888	☐		
RF Cable	Rosenberger	FB293C1060005050	70559-02	L889	☐		
RF Cable	Rosenberger	FB293C1040005050	70558-03	L890	☐		
RF Cable	Rosenberger	FB293C1040005050	70558-04	L891	☒	29/11/2017	12
RF Cable	Rosenberger	FB293C1060005050	70559-01	L892	☒	29/11/2017	12
Bi-Log Antenna	Chase	CBL6111	None	L912	☐		
Receiver/Analyser	Rohde & Schwarz	ESR7	101056	L927	☐		
ISN ST08	Teseq	ISN ST08	32634	L933	☐		
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	101738	L938	☐		
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	101740	L939	☐		
Receiver	Rohde & Schwarz	ESU26	100447	L940	☒	18/07/2017	12
LISN	Chase	MN2050B	1203	L944	☐		
Unshielded ISN/CDN	Teseq	T800	34436	L945	☐		
T2 Balanced ISN	Fischer FCC	T2-02-09	20467	H483	☐		
T2 Balanced ISN	Fischer FCC	T2-02-09	20468	H484	☐		
T8 Balanced ISN	Fischer FCC	T8-02-09	None	H485	☐		
T4 Balanced ISN	Fischer FCC	T4-02-09	20450	H486	☐		

Type of Equipment	*Maker/ Supplier*	*Model Number*	*Serial Number*	*Element Number*	*Actual Equipment Used*	*Calibration Date*	*Interval*
T4 Balanced ISN	Fischer FCC	T4-02-09	20451	H487	☐		
Shielded ISN	Fischer FCC	ST08	26589	H655	☐		
Receiver/Analyser	Rohde & Schwarz	ESU26	100081	UH377	☐		
EMC32 EMI Measurement Software	Rohde & Schwarz	V8.54.0	None	N/A	☒	N/A	N/A

12 EMC Modifications

No modifications were performed during this assessment.

13 Conclusion

The EUT meets the performance requirements of the specification, when tested in a system configuration described in section 6 of this report.

Note should be taken of any modifications listed in the relevant section of this report.

The EUT achieved the following performance criteria during the test programme.

Test Standard	*Test Order*	*Class*		*Pass*	*Fail*
ANSI C63.4:2014 – Radiated Emissions	1	A ☐	B ☒	☒	☐
ANSI C63.4:2014 – Conducted Emissions	N/a	A ☐	B ☐	☐	☐

13.1 Conformity in Production

Element Materials Technology has based this test report on results from the equipment sample(s) provided.

The manufacturer is advised that they may have an obligation to demonstrate that production samples are in conformity with the Standards noted.

The EMC performance reported above was achieved after incorporation of any modifications as detailed in Section 12 of this report.

14 Measurement Uncertainty

SCHEDULE A – EMC MEASUREMENT UNCERTAINTY (LAB BASED)

All uncertainties listed are standard uncertainties multiplied by a coverage factor K=2.00 to give a 95 % confidence level.

Conducted Emissions including Discontinuous Emissions

[1] Conducted Emissions 150 kHz to 30 MHz = **3.4 dB**

Radiated Emissions

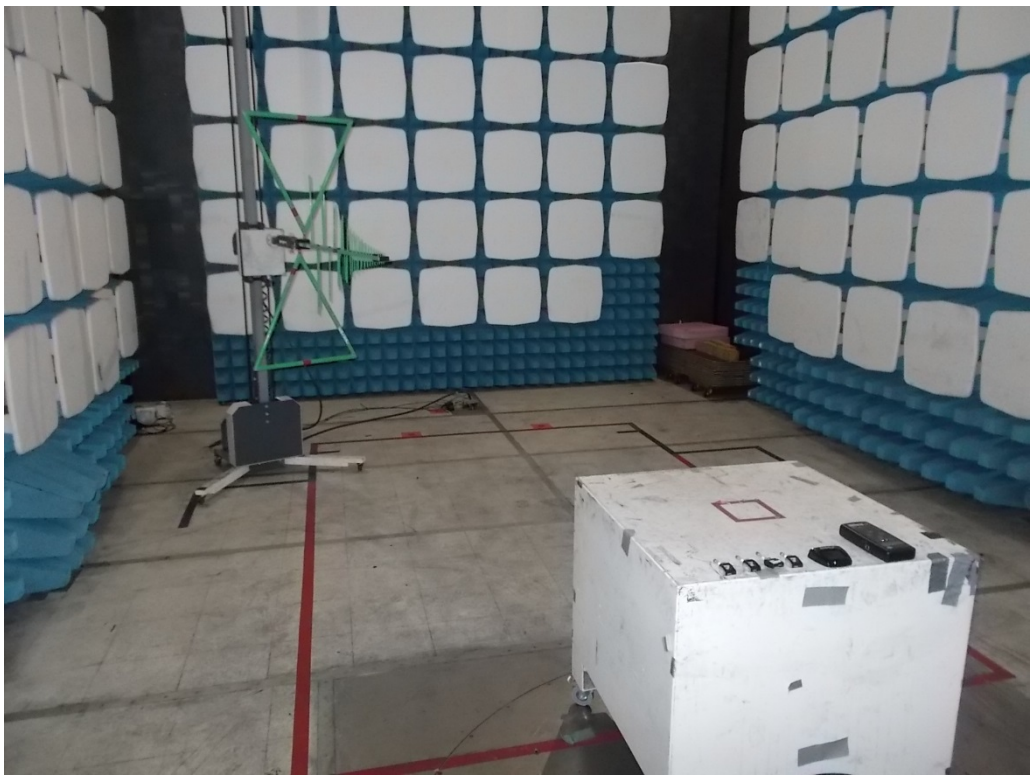
[1] Radiated Emissions 30 MHz to 1 GHz using CBL6111/2 Bilog Antenna = **4.6 dB**
[2] Radiated Emissions 1 GHz to 6 GHz using HL050 Log Periodic Antenna = **5.1 dB**
[3] Radiated Emissions 6 GHz to 18 GHz using Standard Gain Horn = **3.8 dB**
[4] Radiated Emissions 18 GHz to 26.5 GHz using Standard Gain Horn = **3.2 dB**
[5] Radiated Emissions 26.5 GHz to 40 GHz using Standard Gain Horn= **3.2 dB**

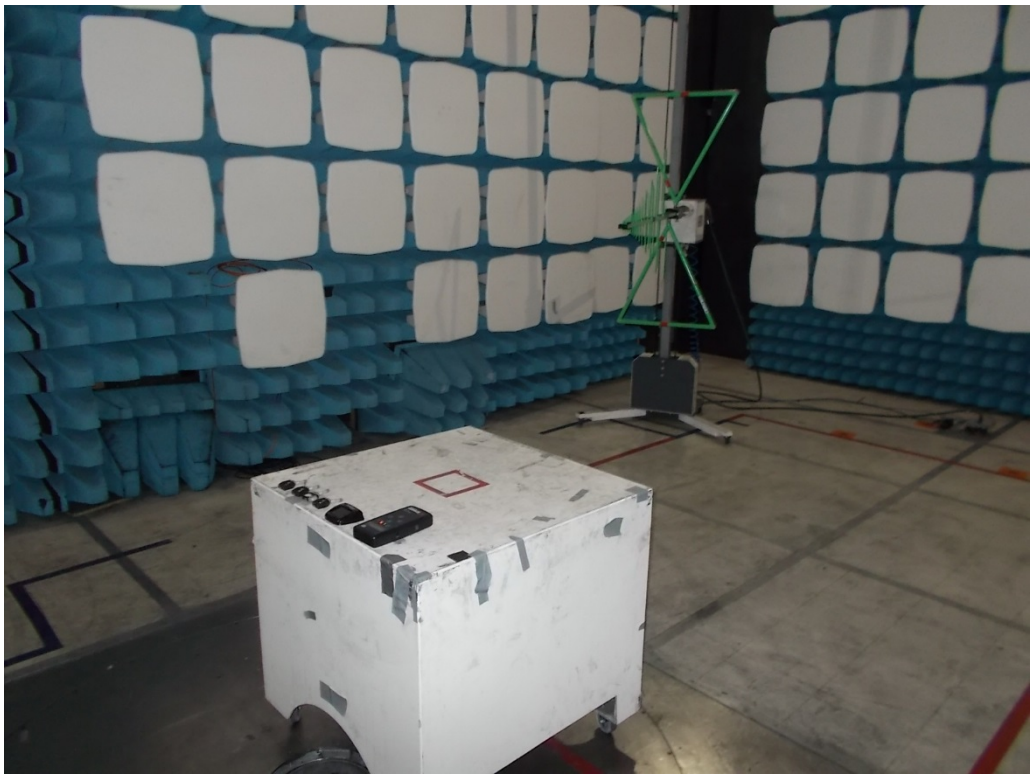
Cable Calibrations

[1] Cable calibration up to 40 GHz = **0.4 dB**

15 Appendix A – Photographs

Radiated Emissions <1 GHz





Radiated Emissions >1 GHz