Report on the Radio Testing

For

Tunstall Healthcare (UK) Ltd

on

Universal Sensor (312)

Report no. TRA-031108-45-00

31st August 2016

Report Number: TRA-031108-45-00
Issue: B

# REPORT ON THE RADIO TESTING OF A
# Tunstall Healthcare (UK) Ltd
# Universal Sensor (312)
# WITH RESPECT TO SPECIFICATION
# FCC 47CFR 15.231 & IC RSS-210 Issue 8 Annex 1

TEST DATE: 28th – 29th April 2016

Written by: A Tosif — Atif Tosif, Radio Test Engineer

Approved by: John Charters — Digitally signed by John Charters DN: cn=John Charters, o=Element Materials Technology, ou, email=john.charters@element.com, c=GB Date: 2016.08.31 11:33:41 +01'00' — J. Charters, Department Manager - Radio

Date: 31st August 2016





Element Materials Technology Warwick Ltd.
Registered in England and Wales. Registered Office: 5 Fleet Place, London, EC4M 7RD
Company Reg No. 02536659

# 1 Revision Record

| *Issue Number* | *Issue Date* | *Revision History* |
|---|---|---|
| A | 3rd June 2016 | Original |
| B | 31st August 2016 | Update calibration details |

## 2 Summary

| | |
|---|---|
| TEST REPORT NUMBER: | TRA-031108-45-00 |
| WORKS ORDER NUMBER | TRA-031108-00 |
| PURPOSE OF TEST: | USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J.<br><br>Canada: Testing of radio apparatus for TAC (technical acceptance certificate) per subsections 4(2) of the Radio communication Act and 21(1) of the Radio communication Regulations. |
| TEST SPECIFICATION(S): | FCC 47CFR 15.231 &<br>IC RSS-210 Issue 8 Annex 1 |
| EQUIPMENT UNDER TEST (EUT): | Universal Sensor (312) |
| FCC IDENTIFIER:<br>IC IDENTIFIER: | G2X-4100430<br>1231A-4100430 |
| EUT SERIAL NUMBER: | 962328290585 and 962293290585 |
| MANUFACTURER/AGENT: | Tunstall Healthcare (UK) Ltd |
| ADDRESS: | Whitley Lodge<br>Whitley Bridge<br>Yorkshire<br>DN14 0HR<br>United Kingdom |
| CLIENT CONTACT: | Mark Jennings<br>☎ +44 (0)1977 660338<br>✉ mark.jennings@tunstall.com |
| ORDER NUMBER: | 481514 |
| TEST DATE: | 28th – 29th April 2016 |
| TESTED BY: | A Tosif<br>Element |

## *2.1 Test Summary*

| *Test Method and Description* | *Requirement Clause* | | *Applicable to this equipment* | *Result / Note* |
|---|---|---|---|---|
| | *RSS* | *47CFR15* | | |
| Transmitter Radiated spurious emissions | Gen, 8.9 & 8.10 | 15.231(b)(3) | ☒ | *Pass* |
| AC power line conducted emissions | Gen, 8.8 | 15.207 | ☐ | *Note 1* |
| Occupied bandwidth | Gen, 6.6<br>210, A1.1.3 | 15.231(c) | ☒ | *Pass* |
| Field strength of fundamental | 210, A1.1 | 15.231(b) | ☒ | *Pass* |
| Manually Operated Transmitter | 210, A1.1.1(a) | 15.231(a)(1) | ☒ | *Pass* |
| Radiated emissions – unintentional radiation (Transmitter Idle) / receiver emissions | Gen, 7.1 | 15.109/15.209 | ☒ | *Pass* |
| Calculation of duty correction1 | - | 15.35(c) | ☐ | *Note 2* |

Note 1: EUT is battery powered only
Note 2: EUT transmitting duty cycle >98 % during assessment.

**Notes:**

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

# 3 Contents

# 4 Introduction

This report TRA-031108-45-00 presents the results of the Radio testing on a Tunstall Healthcare (UK) Ltd, Universal Sensor (312) to specification 47CFR15 Radio Frequency Devices and RSS-210 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Tunstall Healthcare (UK) Ltd by Element, at the address(es) detailed below.

☒ Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☐ Element North West
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

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 quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. 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 & 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 Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:
Element is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):
Element North West 3930B

The test site requirements of ANSI C63.4-2014 are met up to 1 GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

# 5 Test Specifications

## *5.1 Normative References*

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- 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.
- Industry Canada RSS-210, Issue 8, December 2010 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus.

## *5.2 Deviations from Test Standards*

There were no deviations from the test standard.

# 6 Glossary of Terms

| | |
|---|---|
| **§** | denotes a section reference from the standard, not this document |
| **AC** | Alternating Current |
| **ANSI** | American National Standards Institute |
| **BW** | bandwidth |
| **C** | Celsius |
| **CFR** | Code of Federal Regulations |
| **CW** | Continuous Wave |
| **dB** | decibel |
| **dBm** | dB relative to 1 milliwatt |
| **DC** | Direct Current |
| **DSSS** | Direct Sequence Spread Spectrum |
| **EIRP** | Equivalent Isotropically Radiated Power |
| **ERP** | Effective Radiated Power |
| **EUT** | Equipment Under Test |
| **FCC** | Federal Communications Commission |
| **FHSS** | Frequency Hopping Spread Spectrum |
| **Hz** | hertz |
| **IC** | Industry Canada |
| **ITU** | International Telecommunication Union |
| **LBT** | Listen Before Talk |
| **m** | metre |
| **max** | maximum |
| **MIMO** | Multiple Input and Multiple Output |
| **min** | minimum |
| **MRA** | Mutual Recognition Agreement |
| **N/A** | Not Applicable |
| **PCB** | Printed Circuit Board |
| **PDF** | Portable Document Format |
| **Pt-mpt** | Point-to-multipoint |
| **Pt-pt** | Point-to-point |
| **RF** | Radio Frequency |
| **RH** | Relative Humidity |
| **RMS** | Root Mean Square |
| **Rx** | receiver |
| **s** | second |
| **SVSWR** | Site Voltage Standing Wave Ratio |
| **Tx** | transmitter |
| **UKAS** | United Kingdom Accreditation Service |
| **V** | volt |
| **W** | watt |
| **Ω** | ohm |

# 7 Equipment Under Test

## *7.1 EUT Identification*

- Name: Universal Sensor (312)
- Serial Number: 41004/30
- Model Number: 41004/30
- Software Revision: 221V2R1.07
- Build Level / Revision Number: Issue Z1 (This will be up-issued to Issue A1 upon approvals)
- Element Sample No. S03 With perm Mod S02 normal operation

## *7.2 System 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 required.*

## *7.3 EUT Mode of Operation*

### *7.3.1 Transmission*

The EUT was set in a mode transmitting a permanently modulated carrier on the required operating frequency

### *7.3.2 Transmitter Standby (Idle)*

The EUT was powered and ready to transmit upon indication from NC/NO connections.

## *7.4 EUT Radio Parameters*

### *7.4.1 General*

| | |
|---|---|
| ***Frequency of operation:*** | 312 MHz |
| ***Modulation type(s):*** | 2FSK modulation scheme with data rate of 3 kbps over-the-air transmission |
| ***Occupied channel bandwidth(s):*** | 12.4 kHz |
| ***Channel spacing:*** | 3 kHz |
| ***Nominal Supply Voltage:*** | 3.6Vdc |

### *7.4.2 Antennas*

| | |
|---|---|
| ***Type:*** | Integral |
| ***Frequency range:*** | 312MHz |
| ***Connector type:*** | N/A |
| ***Mounting:*** | Wall |

## *7.5 EUT Description*

The Universal sensor (312) is a battery powered single channel transmitter which operates at a frequency of 312 MHz with a channel bandwidth of 12.4 kHz (Intentional radiator in the ISM band for the US and Canadian territories). There is no LBT. The transmitter employs 2FSK modulation scheme with data rate of 3 kbps over-the-air transmission. The Universal sensor accepts external inputs which are in the form of NO/NC contacts from hard-wired peripherals such as carbon dioxide sensor, carbon monoxide sensor etc. The radio protocol is a Tunstall propriety protocol and will only be decoded by a compatible Tunstall receiver.

# 8 Modifications

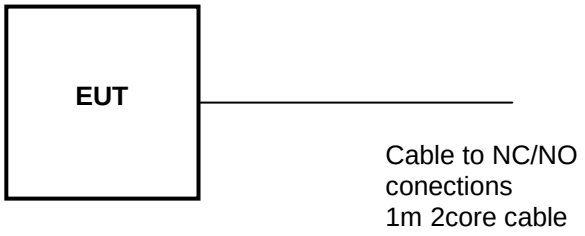
No modifications were performed during this assessment.

# 9 EUT Test Setup

## *9.1 Block Diagram*

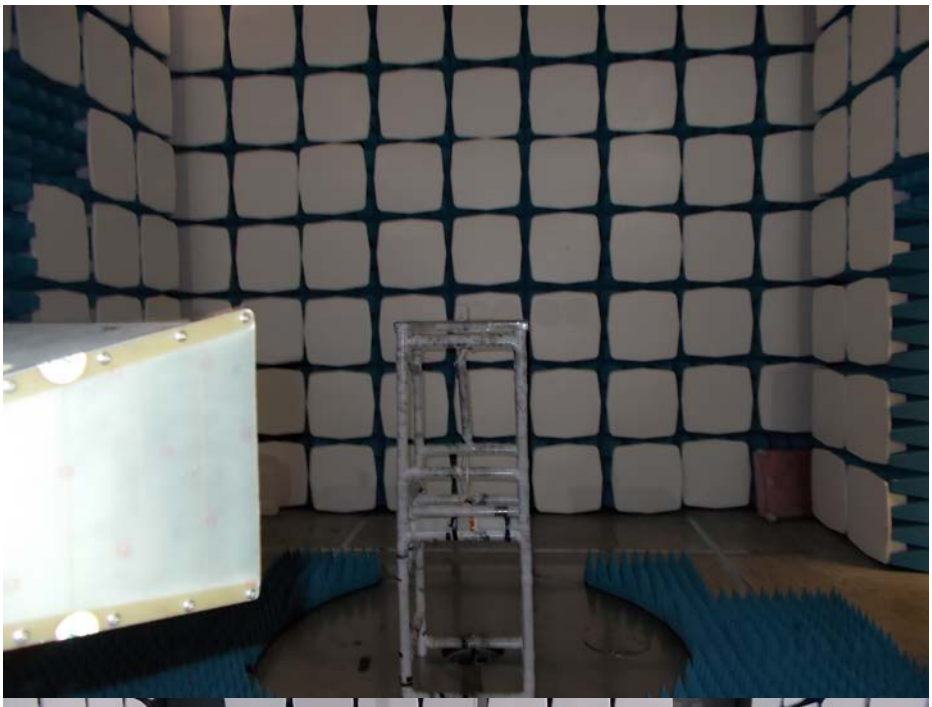
The following diagram shows basic EUT interconnections with cable type and cable lengths identified:

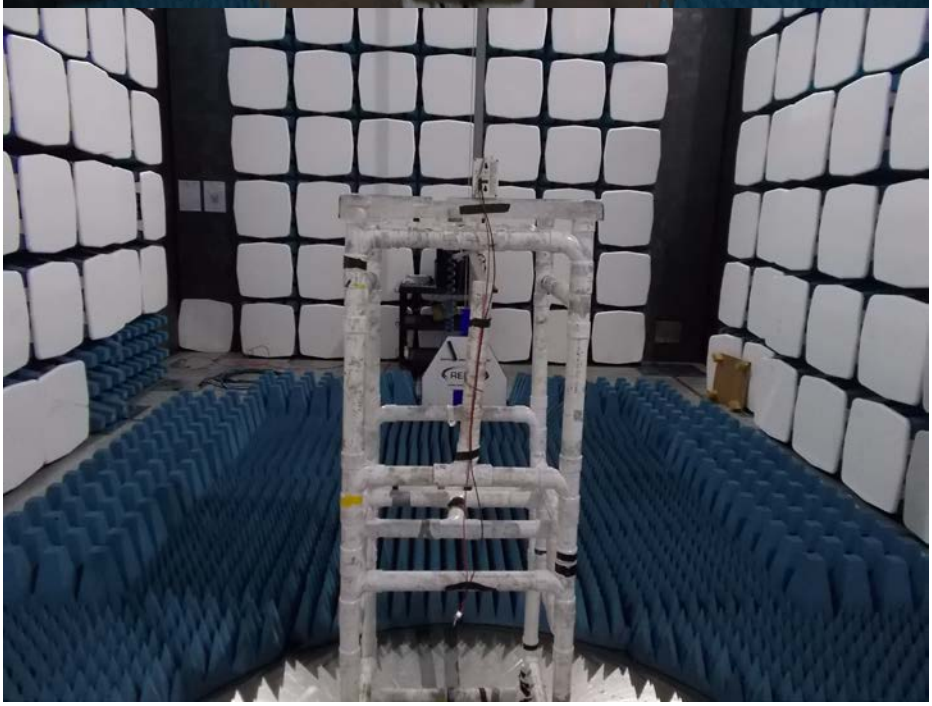
EUT is a battery powered device with no external connections.



### *9.2 General Set-up Photograph*

The following photograph shows basic EUT set-up:





# 10 General Technical Parameters

## *10.1 Normal Conditions*

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was approx. 3.6 V dc from lithium batteries.

## *10.2 Varying Test Conditions*

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

Variation of supply voltage is required to ensure stability of the declared output power. During carrier power testing the following variations were made:

| | ***Category*** | ***Nominal*** | ***Variation*** |
|---|---|---|---|
| ☐ | Mains | 110 V ac +/-2 % | 85 % and 115 % |
| ☒ | Battery | New battery | N/A |

# 11 Transmitter Radiated emissions

## *11.1 Definitions*

*Spurious emissions*
Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

*Restricted bands*
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

## *11.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Hull |
| Test Chamber: | Lab 16 |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.5 and 6.6 |
| EUT Channels / Frequencies Measured: | 312 MHz single channel |
| EUT Channel Bandwidths: | 3 kHz |
| Deviations From Standard: | None |
| Measurement BW: | 30 MHz to 1 GHz: 120 kHz<br>Above 1 GHz: 1 MHz |
| Measurement Detector: | Up to 1 GHz: quasi-peak<br>Above 1 GHz: RMS average and Peak |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 20 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 36 % RH | 20 % RH to 75 % RH (as declared) |
| Supply: 3.6 Vdc | New Batteries (as declared) |

## *11.3 Test Limit*

Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

**General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz**

| ***Frequency (MHz)*** | ***Field Strength (µV/m at 3 m)*** |
|---|---|
| 30 to 88 | 100 |
| 88 to 216 | 150 |
| 216 to 960 | 200 |
| Above 960 | 500 |

### *11.4 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

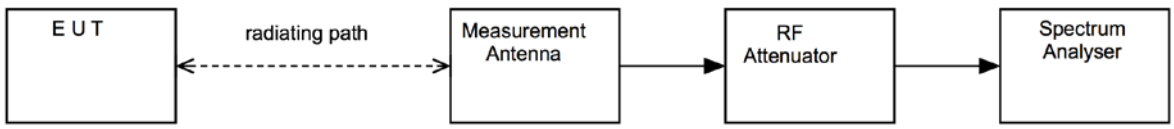
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

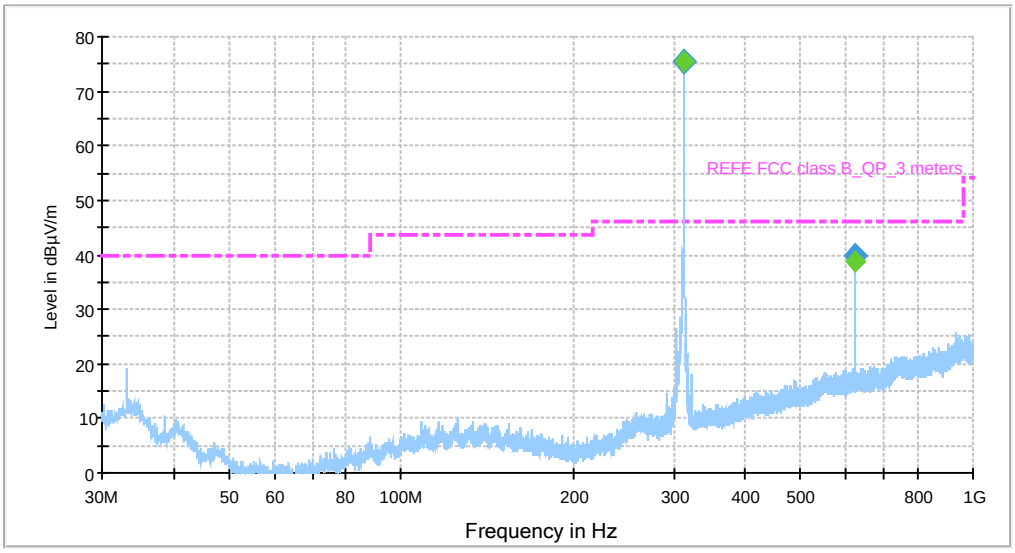
**Figure i Test Setup**

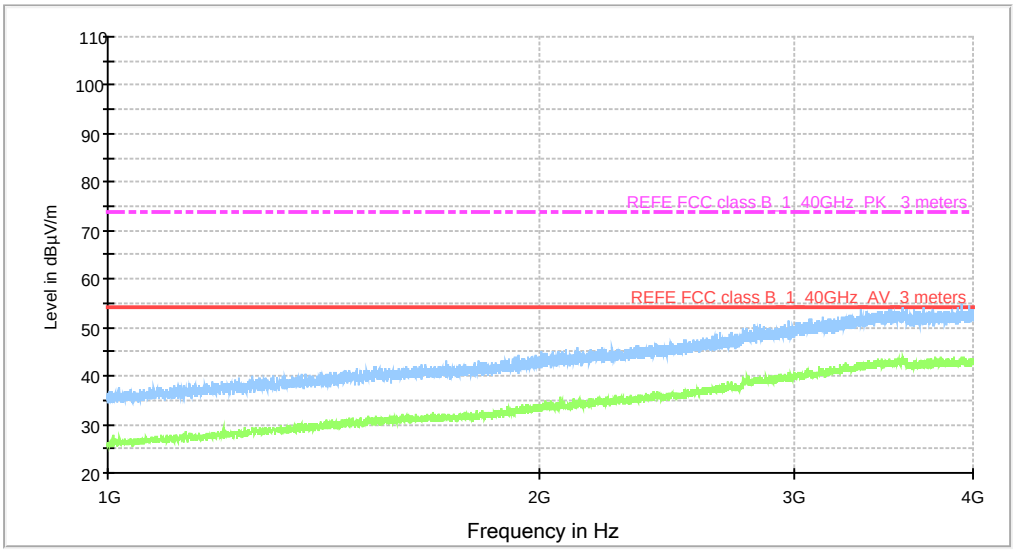


### *11.5 Test Equipment*

| *Type of Equipment* | *Maker/Supplier* | *Model Number* | *Element Number* | *Calibration Due Date* |
|---|---|---|---|---|
| Spectrum Analyser | Rohde & Schwarz | FSU | REF910 | 28/05/16 |
| EMI Test Receiver | Rohde & Schwarz | ESVS20 | RFG126 | 17/04/16 |
| 1GHz to 26 GHz Microwave Amplifier | Agilent | 8449B | REF913 | 02/02/17 |
| 9 kHz – 1GHz Amplifier | Sonoma Instrument | 310 | REF927 | 01/07/16 |
| Biconical Antenna 20 MHz – 300 MHz | Eaton | 96002 | RFG095 | 09/05/16 |
| Log Periodic Antenna 200 MHz -1 GHz | EMCO | 3146 | RFG191 | 09/05/16 |
| Horn Antenna | EMCO | 3115 | RFG129 | 09/02/17 |

## *11.6 Test Results*



| *Detector* | *Freq. (MHz)* | *Meas'd Emission (dBµV)* | *Cable Loss (dB)* | *Antenna Factor (dB/m)* | *Pre-amp Gain (dB)* | *Duty Cycle Corr'n (dB)* | *Distance Extrap'n Factor (dB)* | *Field Strength (dBµV/m)* | *Field Strength (µV/m)* | *Limit (µV/m)* |
|---|---|---|---|---|---|---|---|---|---|---|
| All other Emissions >20dB below the limit in the range of 30 MHz to 200 MHz | | | | | | | | | | |
| QP | **624.0008** | 52.6 | 3.28 | 19.4 | -31.78 | 0 | 0 | 43.5 | 149.62 | 200 |
| All other Emissions >20dB below the limit in the range of 1GHz to 4 GHz | | | | | | | | | | |

# 12 Occupied Bandwidth

## *12.1 Definitions*

*Occupied bandwidth*
The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.25 % of the emitted power. This is also known as the *99 % emission bandwidth*. For transmitters in which there are multiple carriers, contiguous or non-contiguous in frequency, the occupied bandwidth is to be the sum of the occupied bandwidths of the individual carriers.

*20 dB bandwidth*
The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

## *12.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Hull |
| Test Chamber: | Radio Lab |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.9 |
| EUT Channels / Frequencies Measured: | 312 MHz single channel |
| EUT Channel Bandwidths: | 3kHz |
| EUT Test Modulations: | 3kHz with +- 1.5KHz FM deviation |
| Deviations From Standard: | None |
| Measurement BW:<br>(requirement: 1 % to 5 % OBW) | 64.74 Hz to 323.717 Hz<br>RBW = 100 Hz |
| Spectrum Analyzer Video BW:<br>(requirement at least 3x RBW) | 300 Hz |
| Measurement Span:<br>(requirement 2 to 5 times OBW) | 20 kHz |
| Measurement Detector: | Peak |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 20 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 37 % RH | 20 % RH to 75 % RH (as declared) |
| Supply: 3.6 Vdc | New batteries (as declared) |

### *12.3 Test Limit*

Industry Canada:
If the frequency stability of the license-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the license-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54 to 72 MHz, 76 to 88 MHz, 174 to 216 MHz, 470 to 608 MHz and 614 to 806 MHz.

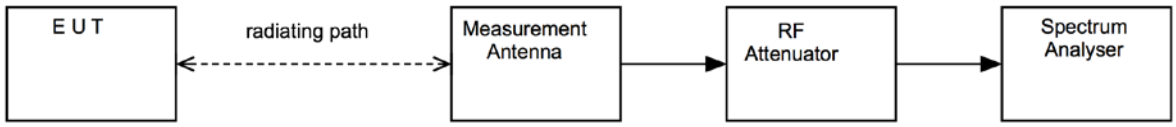
Federal Communications Commission:
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### *12.4 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure iii, the bandwidth of the EUT was measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

**Figure iii Test Setup**



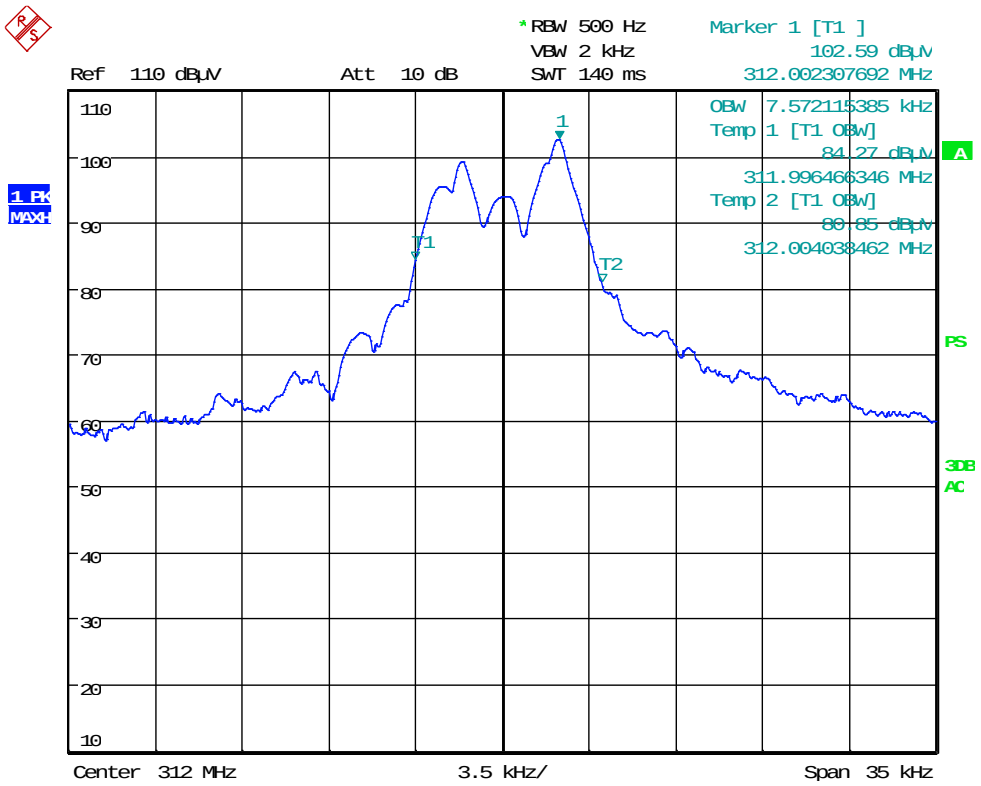

### *12.5 Test Equipment*

| Equipment Type | Manufacturer | Equipment Description | Element No | Due For Calibration |
|---|---|---|---|---|
| Spectrum Analyser | Rohde & Schwarz | FSU | UH405 | 11/05/16 |

## 12.6 Test Results

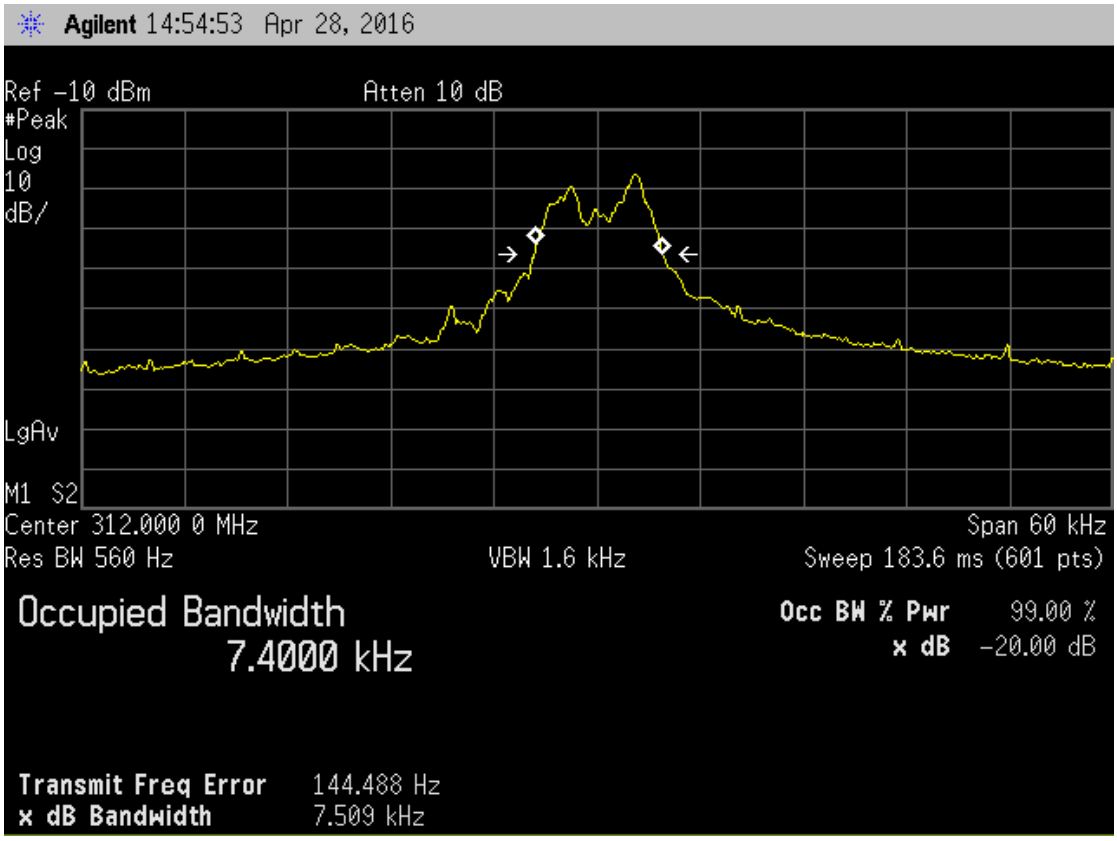
## 12.7 Test Results

| FCC 15.231 & RSS-210. | | | | |
|---|---|---|---|---|
| **Channel Frequency (MHz)** | **$F_L$ (MHz)** | **$F_H$ (MHz)** | **99% Bandwidth (kHz)** | **Result** |
| 312.000 | 311.9964 | 312.004038 | 7.572115 | PASS |




Date: 16.MAY.2003 06:16:27

| FCC 15.231 | | | | |
|---|---|---|---|---|
| ***Channel Frequency (MHz)*** | ***$F_L$ (MHz)*** | ***$F_H$ (MHz)*** | ***20dB Bandwidth (kHz)*** | ***Result*** |
| 312.000 | 311.996 | 312.0034 | 7.4 | PASS |



# 13 Transmitter output power (fundamental radiated emission)

## *13.1 Definition*

The RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval.

## *13.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Hull |
| Test Chamber: | Radio Lab |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.5 / 6.6 |
| EUT Channels / Frequencies Measured: | 312 MHz single channel |
| EUT Channel Bandwidths: | 3 kHz |
| Deviations From Standard: | None |
| Measurement BW: | 120 kHz <1 GHz |
| Spectrum Analyzer Video BW: (requirement at least 3x RBW) | 500 kHz |
| Measurement Detector: | Up to 1 GHz: Quasi-peak<br>Above 1 GHz: Average RMS and Peak |
| Voltage Extreme Environment Test Range: | Mains Power = 85 % and 115 % of Nominal (FCC only requirement);<br>Battery Power = new battery. |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 20 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 36 % RH | 20 % RH to 75 % RH (as declared) |

### *13.3 Test Limit*

The field strength measured at 3 meters shall not exceed the limits in the following table:

Radiated emission limits (47 CFR 15:2015 Clause 15.231 (b) for the maximum permitted fundamental field strength and the maximum permitted unwanted emission levels:

| ***Fundamental Frequency (MHz)*** | ***Field strength of Fundamental (µV/m)*** | ***Field strength of Spurious Emissions (µV/m)*** |
|---|---|---|
| 40.66-40.70 | 2250 | 225 |
| 70-130 | 1250 | 125 |
| 130-174 | 1250 to 3750** | 125 to 375** |
| 174-260 | 3750 | 375 |
| 260-470 | 3750 to 12500** | 375 to 1250 |
| Above 470 | 12500 | 1250 |

** Linear interpolations

In accordance with ANSI C63.10 clause 7.6.2

$$\text{Limit } \mu V/m = Lim_{Lower} + \Delta F\ [Lim_{Upper} - Lim_{Lower} / f\text{upper} - f\text{lower}\ ]$$

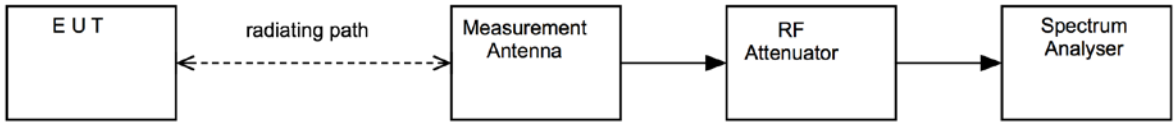
Where $\Delta F = fc - f\text{lower}$

### *13.4 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

**Figure iv Test Setup**




### *13.5 Test Equipment*

| *Type of Equipment* | *Maker/Supplier* | *Model Number* | *Element Number* | *Calibration Due Date* |
|---|---|---|---|---|
| Spectrum Analyser | Rohde & Schwarz | FSU | REF910 | 28/05/16 |
| EMI Test Receiver | Rohde & Schwarz | ESVS20 | RFG126 | 17/04/16 |
| 9 kHz – 1GHz Amplifier | Sonoma Instrument | 310 | REF927 | 01/07/16 |
| Log Periodic Antenna 200 MHz -1 GHz | EMCO | 3146 | RFG191 | 09/05/16 |

### *13.6 Test Results*

| *Detector* | *Freq. (MHz)* | *Meas'd Emission (dBµV)* | *Cable Loss (dB)* | *Antenna Factor (dB/m)* | *Pre-amp Gain (dB)* | *Duty Cycle Corr'n (dB)* | *Distance Extrap'n Factor (dB)* | *Field Strength (dBµV/m)* | *Field Strength (µV/m)* | *Limit (µV/m)* |
|---|---|---|---|---|---|---|---|---|---|---|
| QP | **311.9976** | 91.46 | 2.29 | 13.16 | -31.61 | 0 | 0 | 75.3 | 5821.03 | 5916.677 |

# 14 Automatically Operated Transmitter

## *14.1 Definition*

Measurements of the transmission duration, determining compliance with regulatory requirements of certain unlicensed wireless devices that are subject to a limit on the transmission period during a manually operated transmitter.

## *14.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Hull |
| Test Chamber: | Radio Lab |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 7.4 |
| EUT Channels / Frequencies Measured: | 312 MHz single channel |
| EUT Channel Bandwidths: | 3 kHz |
| Deviations From Standard: | None |
| Measurement BW: | 1 MHz |
| Spectrum Analyzer Video BW: (requirement at least 3x RBW) | 3 MHz |
| Spectrum Analyser Span | Zero span |
| Measurement Detector: | Peak |
| Voltage Extreme Environment Test Range: | Mains Power = 85 % and 115 % of Nominal (FCC only requirement);<br>Battery Power = new battery. |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 20 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 36 % RH | 20 % RH to 75 % RH (as declared) |

## *14.3 Test Limit*

An automatically operated transmitter; deactivate the transmitter within 5 seconds of being activated.

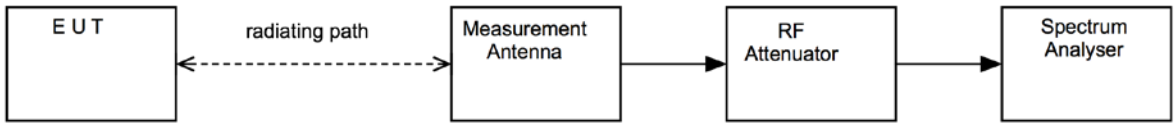
### *14.4 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set within its normal operating condition, with a switch to simlaute the trigger form a sensor.

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1 MHz and a VB of 3MHz. The sweep time was set accordingly to capture the transmission duration times and the total transmission time duration over a 10 second period 60. The formal measurements are detailed below

**Figure iv Test Setup**

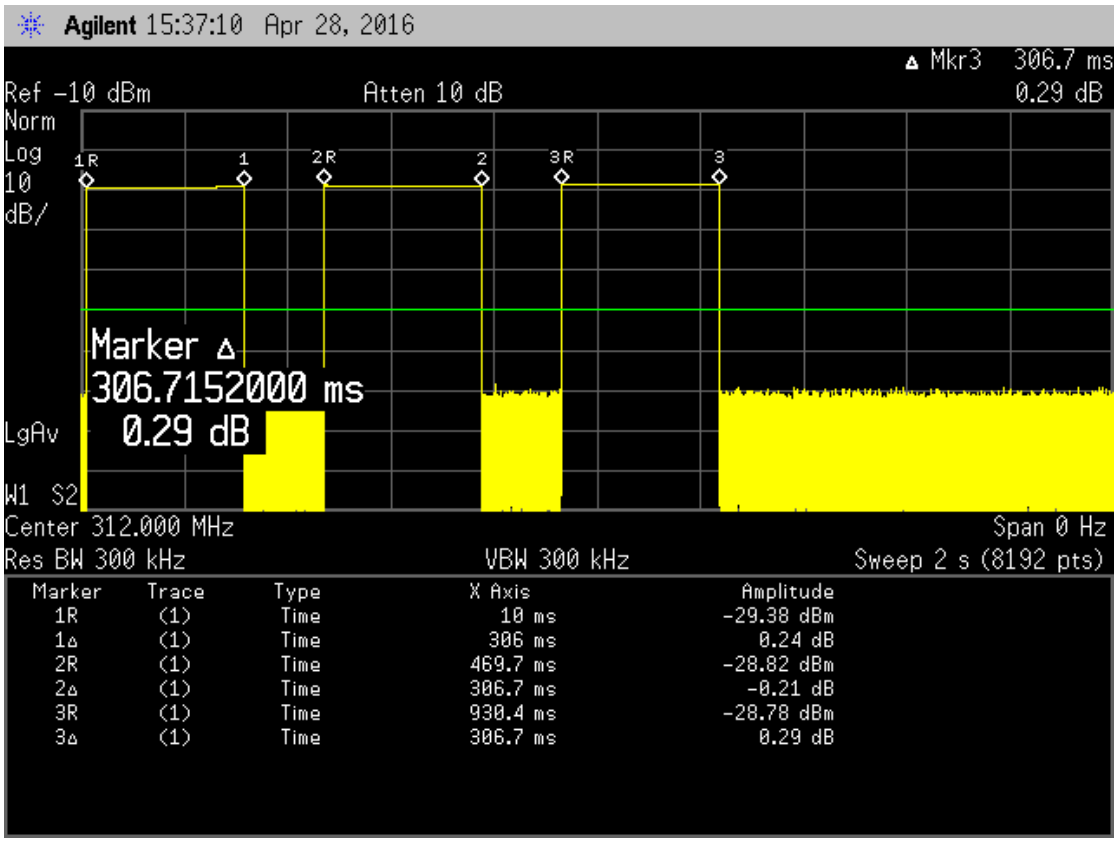



### *14.5 Test Equipment*

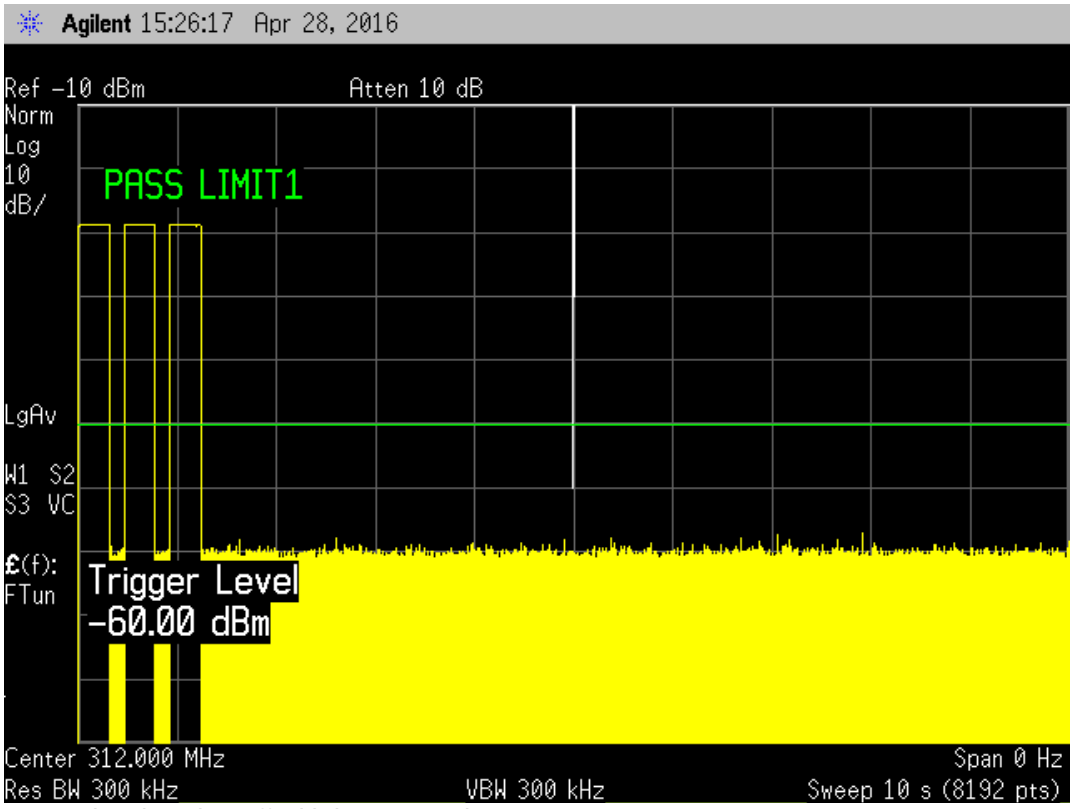
| Equipment Type | Manufacturer | Equipment Description | Element No | Due For Calibration |
|---|---|---|---|---|
| Spectrum Analyser | Rohde & Schwarz | FSU | UH405 | 11/05/16 |

### *14.6 Test Results*

| ***FCC 15.231* Modulation: 3kHz with +- 1.5KHz FM deviation** | | | |
|---|---|---|---|
| **Manually Activated Transmitter Duration (Seconds)** | **Limit (Seconds)** | **Margin (Seconds)** | **Result** |
| 1.67 | 5 | 3.3 | Pass |




Close up of TX on total




TX on showing shut off with in 5 seconds

# 15 Radiated emissions – unintentional radiation (Transmitter Idle) / receiver emissions

## *15.1 Definitions*

*Receiver spurious emissions*
The radio frequency signals generated within the receiver, which may cause interference to other equipment. This includes the period during which the equipment is scanning or switching channels.

*Unintentional radiator*
A device that generates RF energy which is not intended to be radiated for reception by a radio receiver.

## *15.2 Test Parameters*

| | |
|---|---|
| Test Location: | Element Hull |
| Test Chamber: | Lab 16 |
| Test Standard and Clause: | ANSI C63.10-2013, Clause 6.5 and 6.6 |
| EUT Channels / Frequencies Measured: | 312 MHz single channel |
| EUT Channel Bandwidths: | 3 kHz |
| Deviations From Standard: | None |
| Measurement BW: | 30 MHz to 1 GHz: 120 kHz<br>Above 1 GHz: 1 MHz |
| Measurement Detector: | Up to 1 GHz: quasi-peak<br>Above 1 GHz: Peak |

**Environmental Conditions (Normal Environment)**

| | |
|---|---|
| Temperature: 20 °C | +15 ºC to +35 ºC (as declared) |
| Humidity: 36 % RH | 20 % RH to 75 % RH (as declared) |
| Supply: 3.6 Vdc | New Batteries (as declared) |

Only radio communication receivers operating in stand-alone mode within the band 30 to 960 MHz, as well as scanner receivers, are subject to requirements, as described above. All other receivers are exempted from any certification, testing, labelling and reporting requirements.

However, all receivers in all frequency bands shall comply with the limits set forth in FCC 47CFR15B / IC RSS-Gen even in cases where testing, reporting and/or certification are not required.

**Receiver Radiated Limits**

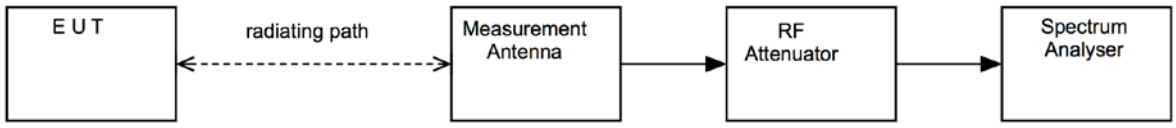
| ***Frequency (MHz)*** | ***Field Strength (µV/m at 3 m)*** |
|---|---|
| 30 to 88 | 100 |
| 88 to 216 | 150 |
| 216 to 960 | 200 |
| Above 960 | 500 |

### *15.3 Test Method*

With the EUT setup as per section 9 of this report and connected as per Figure viii, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver. The EUT was rotated in three orthogonal planes and the measurement antenna height scanned (below 1 GHz, from 1 to 4 m; above 1 GHz as necessary) in order to maximise emissions.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration at each frequency.
Pre-scan plots are shown with a peak detector and 100 kHz RBW.

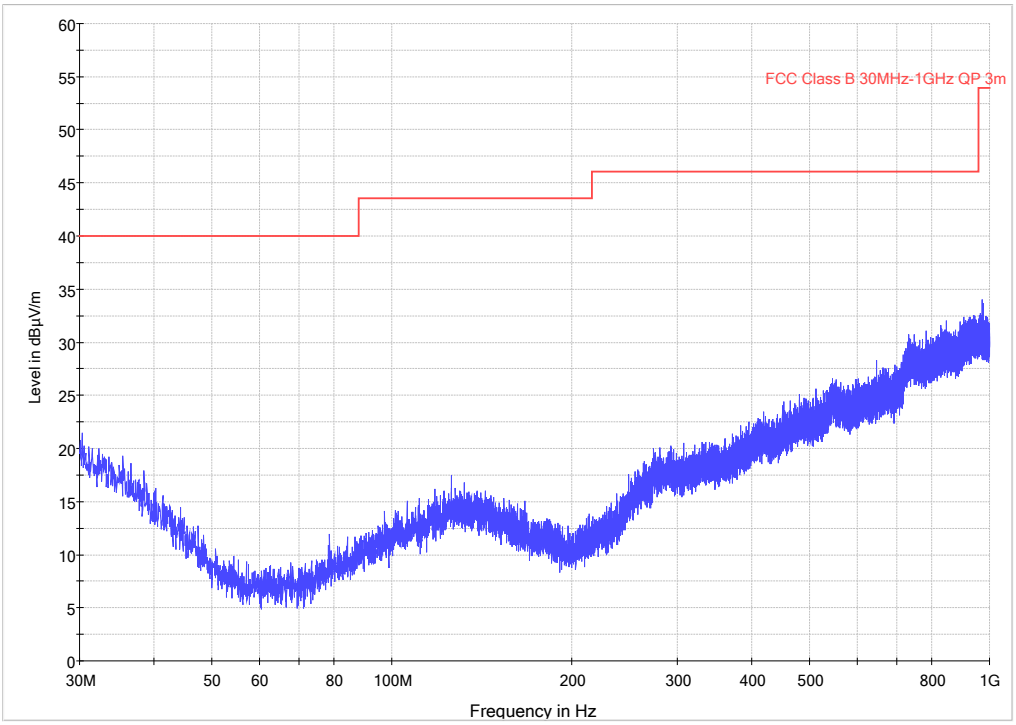
**Figure viii Test Setup**

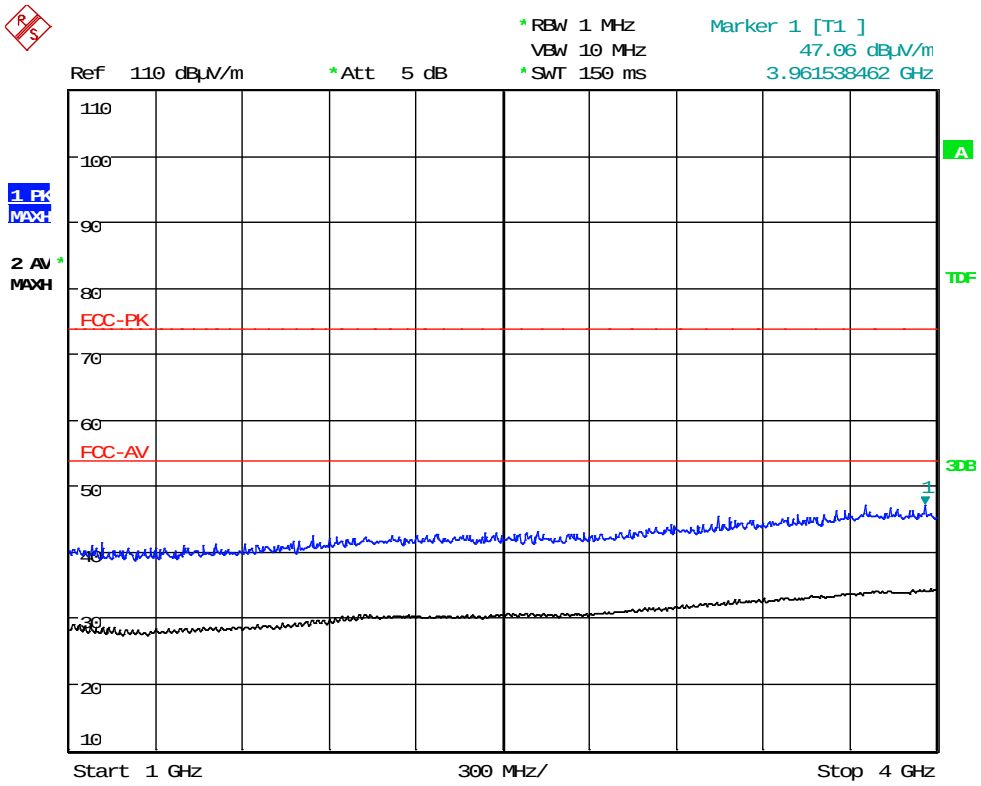


### *15.4 Test Equipment*

| *Type of Equipment* | *Maker/Supplier* | *Model Number* | *Element Number* | *Calibration Due Date* |
|---|---|---|---|---|
| Spectrum Analyser | Rohde & Schwarz | FSU | REF910 | 28/05/16 |
| EMI Test Receiver | Rohde & Schwarz | ESVS20 | RFG126 | 17/04/16 |
| 1GHz to 26 GHz Microwave Amplifier | Agilent | 8449B | REF913 | 02/02/17 |
| 9 kHz – 1GHz Amplifier | Sonoma Instrument | 310 | REF927 | 01/07/16 |
| Biconical Antenna 20 MHz – 300 MHz | Eaton | 96002 | RFG095 | 09/05/16 |
| Log Periodic Antenna 200 MHz -1 GHz | EMCO | 3146 | RFG191 | 09/05/16 |
| Horn Antenna | EMCO | 3115 | RFG129 | 09/02/17 |

### *15.5 Test Results*






Date: 26.MAY.2016 15:21:07

| *Detector* | *Freq. (MHz)* | *Measured Emission (dBµV/m)* | *Cable Loss (dB)* | *Antenna Factor (dB/m)* | *Pre-amp Gain (dB)* | *Field Strength (dBµV/m)* | *Extrap'n Factor (dB)* | *Field Strength (µV/m)* | *Limit (µV/m)* |
|---|---|---|---|---|---|---|---|---|---|
| 30 MHz to 200 MHz: No Significant Emissions Within 20 dB of Limit | | | | | | | | | |
| 200 MHz to 1 GHz: No Significant Emissions Within 17 dB of Limit | | | | | | | | | |
| 1 GHz to 4 GHz: No Significant Emissions Within 10 dB of Limit | | | | | | | | | |

# 16 Measurement Uncertainty

## Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence:

**[1] Radiated spurious emissions**

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

**[2] AC power line conducted emissions**

Uncertainty in test result = **3.4 dB**

**[3] Occupied bandwidth**

Uncertainty in test result = **15.5 %**

**[4] Conducted carrier power**

Uncertainty in test result (Power Meter) = **1.08 dB**

**[5] Conducted / radiated RF power out-of-band**

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**
Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**
Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

**[6] Power spectral density**

Uncertainty in test result (Spectrum Analyser) = **2.48 dB**