TEST REPORT

Test Report No. : UL-RPT-RP15215065-416A

Customer	:	Chiaro Technology Ltd
Model No. / HVIN	:	ER01
PMN	:	Elvie Rise
FCC ID	:	2AEHI-ER01
ISED Certification No.	:	IC: 20167-ER01
Technology	:	*Bluetooth* – Low Energy
Test Standard(s)	:	FCC Parts 15.207, 15.209(a) & 15.247 Innovation, Science and Economic Development Canada RSS-247 Issue 3 August 2023 RSS-Gen Issue 5 February 2021
Test Laboratory	:	UL International (UK) Ltd, Basingstoke, Hampshire, RG24 8AH, United Kingdom

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 1.0.

Date of Issue: 05 November 2024

Checked by:

Ben Mercer
Lead Project Engineer, Radio Laboratory

Company Signatory:

Sarah Williams
Staff Engineer, Radio Laboratory

5772

Customer Information

Company Name:	Chiaro Technology Ltd
Address:	63-66 Hatton Garden, London, EC1N 8LE, United Kingdom

Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	05/11/2024	Initial Version	Ben Mercer

Table of Contents

1 Attestation of Test Results

1.1 Description of EUT

The equipment under test (EUT) was a 2 in 1 bouncer bassinet containing a *Bluetooth* LE transceiver.

1.2 General Information

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.247
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Sections 15.207 and 15.209
Specification Reference:	RSS-Gen Issue 5 February 2021
Specification Title:	General Requirements for Compliance of Radio Apparatus
Specification Reference:	RSS-247 Issue 3 August 2023
Specification Title:	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Site Registration:	FCC: 685609, ISEDC: 20903
FCC Lab. Designation No.:	UK2011
ISEDC CABID:	UK0001
Location of Testing:	Units 3 & 4 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	29 July 2024 to 24 October 2024

1.3 Summary of Test Results

FCC Reference (47CFR)	ISED Canada Reference	Measurement	Result
N/A	RSS-Gen 6.7	Transmitter 99% Occupied Bandwidth	✓
Part 15.247(a)(2)	RSS-Gen 6.7 / RSS-247 5.2(a)	Transmitter Minimum 6 dB Bandwidth	✓
Part 15.247(b)(3)	RSS-Gen 6.12 / RSS-247 5.4(d)	Transmitter Maximum Peak Output Power	✓
Part 15.247(e)	RSS-247 5.2(b)	Transmitter Power Spectral Density	Note 1
Part 15.247(d) & 15.209(a)	RSS-Gen 6.13 / RSS-247 5.5	Transmitter Radiated Emissions	✓
Part 15.247(d) & 15.209(a)	RSS-Gen 6.13 / RSS-247 5.5	Transmitter Band Edge Radiated Emissions	✓
Part 15.207	RSS-Gen 8.8	Transmitter AC Conducted Emissions	✓
Key to Results ✓ = Complied ✗ = Did not comply			

Note(s):

1. In accordance with ANSI C63.10 Section 11.10.1, PSD measurements are not required if the maximum conducted output power is less than the PSD limit of 8 dBm / 3 kHz. The PSD level is therefore deemed be equal to the measured output power.

1.4 Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

2 Summary of Testing

2.1 Facilities and Accreditation

The test site and measurement facilities used to collect data are located at Units 3 & 4 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom. The following table identifies which facilities were utilised for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

Site 1	X
Site 2	-
Site 17	-
Site 32	-
Site 33	X

UL International (UK) Ltd is accredited by the United Kingdom Accreditation Service (UKAS). UKAS is one of the signatories to the International Laboratory Accreditation Co-operation (ILAC) Arrangement for the mutual recognition of test reports. The tests reported herein have been performed in accordance with its terms of accreditation.

2.2 Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
Title:	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
Reference:	KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

2.3 Calibration and Uncertainty

Measuring Instrument Calibration

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

Measurement Uncertainty & Decision Rule

Overview

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

Decision Rule

Measurement system instrumentation shall be used with an accuracy specification meeting the accuracy specification limits according to IEC/IECEE OD-5014.

As applicable, unless specified otherwise in this quotation, the compliance “Decision Rule” is based on Simple Acceptance. If the measured value is on the limit, the result is defined as a pass. In this case the risk of a false positive is 50%. For further information regarding risk assessment refer to ILAC G8:09/2019.

Measurement Uncertainty

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Duty Cycle	2.4 GHz to 2.4835 GHz	95%	±1.14 %
99% Occupied Bandwidth	2.4 GHz to 2.4835 GHz	95%	±2.41 %
Minimum 6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±3.27 %
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±1.25 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	±5.44 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±2.98 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±3.64 dB
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±1.88 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

2.4 Test and Measurement Equipment

Test Equipment Used for Transmitter Conducted Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2001	Thermohygrometer	Testo	608-H1	45041824	27 Dec 2024	12
M2018	Signal Analyser	Rohde & Schwarz	FSV7	102699	02 Oct 2024	12
A3119	Attenuator	AtlanTecRF	AN18-10	237378#3	Calibrated before use	-
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	27 Apr 2026	36

Test Equipment Used for Transmitter Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M226556	Thermohygrometer	Testo	608-H1	83800306	28 Dec 2024	12
K226203	3m RSE Chamber	Albatross Projects	N/A	N/A	10 May 2025	12
A3142	Pre Amplifier	Schwarzbeck	BBV 9718 B	00020	25 Apr 2025	12
M2077	Test Receiver	Rohde & Schwarz	ESW44	102026	28 Mar 2025	12
A230567	Pre-Amplifier	Atlantic Microwave	A-HPAKX-380143-K5K5	VJ3601001	04 Apr 2025	12
A231050	Antenna	Schwarzbeck	BBHA 9170	01280	05 Apr 2025	12
A3140	Antenna	Schwarzbeck	HWRD 750	00028	29 Apr 2025	12
A227129	High Pass Filter	Micro-Tronics	HPS20722	003	05 Jun 2025	12
M2040	Thermohygrometer	Testo	608-H1	45124934	27 Dec 2024	12
K0001	3m RSE Chamber	MVG Industries UK Ltd.	N/A	N/A	11 Sep 2025	12
M236226	Test Receiver	Rohde & Schwarz	ESW26	103134	06 May 2025	12
A3179	Pre Amplifier	Hewlett Packard	8449B	3008A00934	30 Aug 2025	12
A3093	High Pass Filter	AtlanTecRF	AFH-03000	18051800077	16 Sep 2025	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	06 Sep 2025	12
A3139	Antenna	Schwarzbeck	HWRD750	00027	06 Sep 2025	12
A222867	Pre Amplifier	Atlantic Microwave	A-LNAKX-380116-S5S5	220705003	30 Aug 2025	12
A3165	Mag Loop Antenna	ETS-Lindgren	6502	00224383	26 Mar 2025	12
A3010	Attenuator	AtlanTecRF	AN18-06	208801#5	07 May 2025	12
A3154	Pre Amplifier	Com Power Corp	PAM-103	18020012	28 Aug 2025	12
A553	Antenna	Chase EMC Ltd	CBL6111A	1593	27 Aug 2025	12
A3112	Attenuator	AtlanTecRF	AN18-06	219706#2	27 Aug 2025	12

Test and Measurement Equipment (continued)

Test Equipment Used for Transmitter Band Edge Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M226556	Thermohygrometer	Testo	608-H1	83800306	28 Dec 2024	12
K226203	3m RSE Chamber	Albatross Projects	N/A	N/A	10 May 2025	12
A3142	Pre Amplifier	Schwarzbeck	BBV 9718 B	00020	25 Apr 2025	12
M2077	Test Receiver	Rohde & Schwarz	ESW44	102026	28 Mar 2025	12
A231044	Antenna	Schwarzbeck	BBHA 9120 B	00835	20 Apr 2025	12
A230461	Attenuator	Atlantic Microwave	ATT06KXP-483034-N4N5	#5	10 Jun 2025	12

Test Equipment Used for Transmitter AC Conducted Spurious Emissions:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2037	Thermohygrometer	Testo	608-H1	45124925	27 Dec 2024	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Oct 2025	12
A649	Single Phase LISN	Rohde & Schwarz	ESH3-Z5	825562/008	07 Aug 2025	12
A1830	Pulse Limiter	Rohde & Schwarz	100668	ESH3-Z2 Pulse Limiter	15 July 2025	12

Test Measurement Software/Firmware Used:

Name	Version	Release Date
Rohde & Schwarz EMC32	6.30.0	2018

3 Equipment Under Test (EUT)

3.1 Identification of Equipment Under Test (EUT)

Brand Name:	Elvie Rise
Model Name or Number / HVIN:	ER01
PMN:	Elvie Rise
Test Sample Serial Number:	JM242640073 *(Conducted sample #1)*
Hardware Version:	BOM-004092 Rev A
Software Version:	SFW-004439 Rev C
FCC ID:	2AEHI-ER01
ISED Canada Certification Number:	IC: 20167-ER01
Date of Receipt:	29 July 2024

Brand Name:	Elvie Rise
Model Name or Number / HVIN:	ER01
PMN:	Elvie Rise
Test Sample Serial Number:	#8 *(Radiated sample #1)*
Hardware Version:	BOM-004092 Rev A
Software Version:	SFW-004439 Rev C
FCC ID:	2AEHI-ER01
ISED Canada Certification Number:	IC: 20167-ER01
Date of Receipt:	29 July 2024

3.2 Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.3 Additional Information Related to Testing

Technology Tested:	*Bluetooth* Low Energy (Digital Transmission System)		
Type of Unit:	Transceiver		
Channel Spacing:	2 MHz		
Modulation:	GFSK		
Data Rate: LE	1 Mbps		
Power Supply Requirement(s):	12 VDC		
Maximum Conducted Output Power:	4.3 dBm		
Transmit Frequency Range:	2402 MHz to 2480 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	37	2402
	Middle	38	2426
	Top	39	2480

3.4 Description of Available Antennas

The radio utilizes an integrated antenna, with the following maximum gain:

Frequency Range (MHz)	Antenna Gain (dBi)
2400-2480	3.3

3.5 Description of Test Setup

Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Test Laptop
Brand Name:	Lenovo
Model Name or Number:	L480
Serial Number:	PF1EHZPL

Description:	Power Supply
Brand Name:	Huizhou Fujia Appliance Tech.Co.LTD
Model Name or Number:	FJ-SW124S1202000N
Serial Number:	Not Specified

Description:	USB Diagnostic Cable
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Operating Modes

The EUT was tested in the following operating mode(s):

- Transmitting at maximum power in *Bluetooth* LE mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.

Configuration and Peripherals

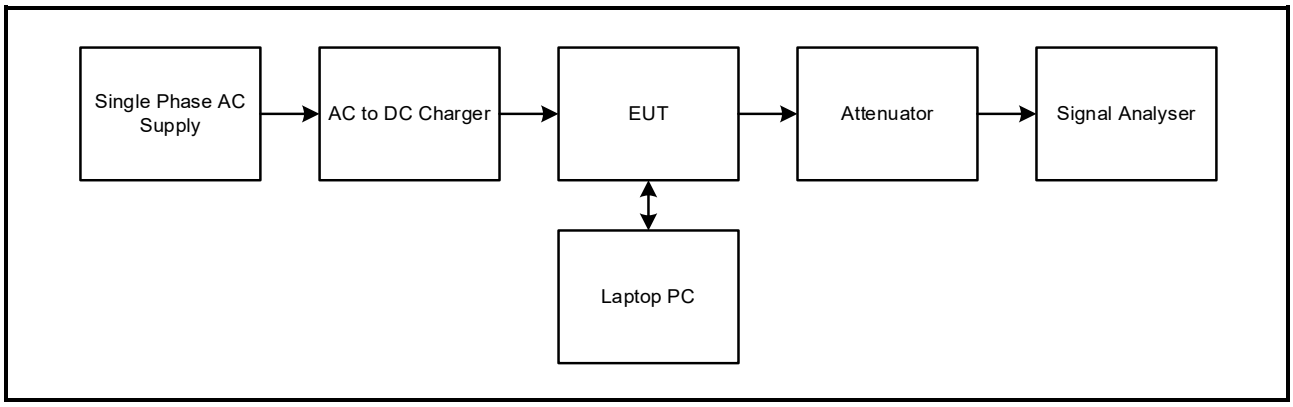
The EUT was tested in the following configuration(s):

- A test laptop with a third-party test application was provided by the customer and was used to place the EUT into *Bluetooth* LE test mode. The application was used to enable continuous transmission, set transmit power and change channels as required.
- The EUT was powered from an AC to DC charger. The input was connected to a 120 VAC 60 Hz single phase mains supply.
- Transmitter radiated spurious emissions tests were performed with the EUT in its normal orientation and the AC to DC charger connected. There were no active ports to terminate.

Test Setup Diagrams

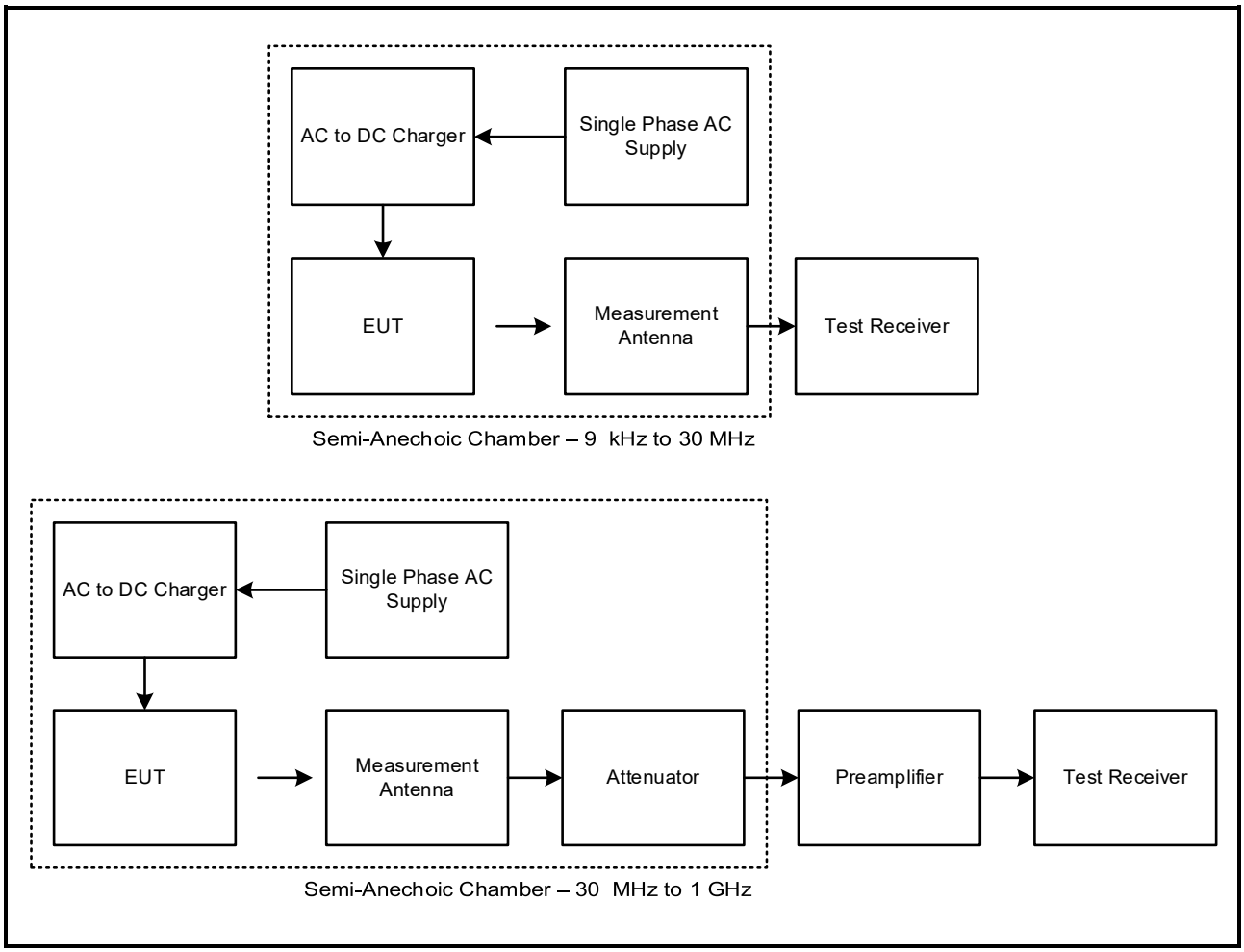
Conducted Tests:

Test Setup for Transmitter 99% occupied Bandwidth, Minimum 6 dB Bandwidth & Maximum Peak Output Power



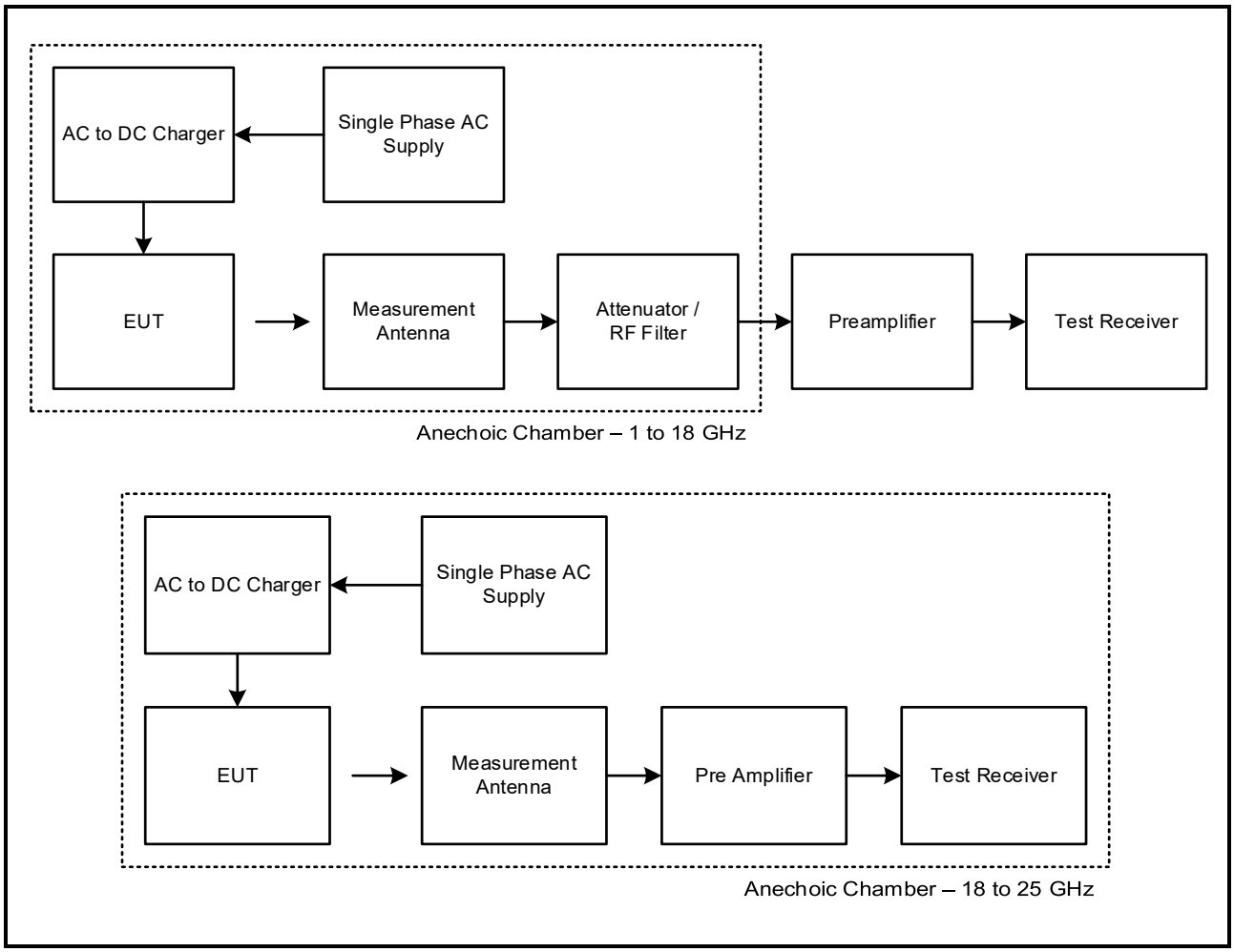
Radiated Tests:

Test Setup for Transmitter Radiated Emissions

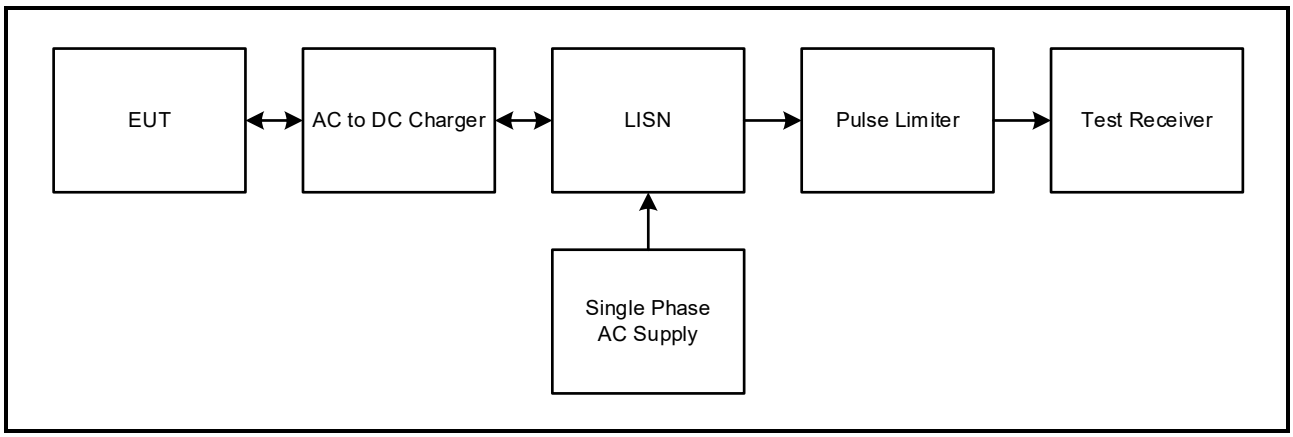


Test Setup Diagrams (continued)

Test Setup for Transmitter Radiated Emissions (continued)



Test Setup for Transmitter AC Conducted Spurious Emissions



4 Antenna Port Test Results

4.1 Transmitter 99% Occupied Bandwidth

Test Summary:

Test Engineer:	Raghavendra Katti	**Test Date:**	29 July 2024
Test Sample Serial Number:	JM242640073		

FCC Reference:	N/A
ISED Canada Reference:	RSS-Gen 6.7
Test Method Used:	RSS-Gen 6.7 and Notes below

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	58

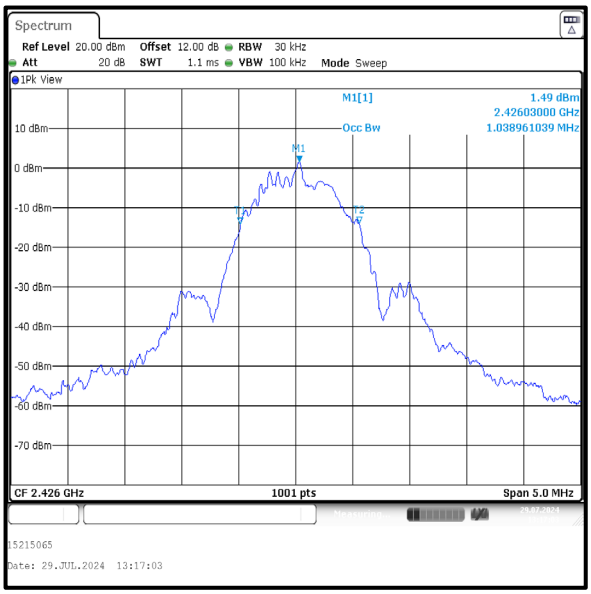
Note(s):

1. The 99% emission bandwidth was measured using the signal analyser occupied bandwidth function. The resolution bandwidth was set in the range of 1% to 5% of the occupied bandwidth and the video bandwidth set to 3 times the resolution bandwidth. The span was set to capture all products of the modulation process including emission skirts.
2. Example plots on middle channel can be seen below to show setting parameters comply with testing method/procedure. All other plots are archived on the UL IT server and available for inspection if required.

Transmitter 99% Occupied Bandwidth (continued)

Results: LE

Channel	99% Occupied Bandwidth (kHz)
Bottom	1038.961
Middle	1038.961
Top	1048.951



Middle Channel

4.2 Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	Raghavendra Katti	**Test Date:**	29 July 2024
Test Sample Serial Number:	JM242640073		

FCC Reference:	Part 15.247(a)(2)
ISED Canada Reference:	RSS-Gen 6.7 / RSS-247 5.2(a)
Test Method Used:	FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8.1

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	58

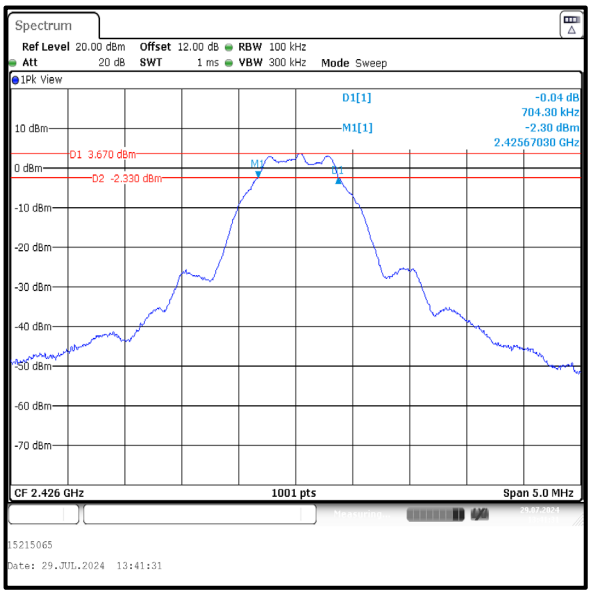
Note(s):

1. 6 dB DTS bandwidth tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.8.1 Option 1 measurement procedure. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
2. Example plots on middle channel can be seen below to show setting parameters comply with testing method/procedure. All other plots are archived on the UL IT server and available for inspection if required.

Transmitter Minimum 6 dB Bandwidth (continued)

Results: LE

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	719.300	≥500	219.300	Complied
Middle	704.300	≥500	204.300	Complied
Top	720.900	≥500	220.900	Complied



Middle Channel

4.3 Transmitter Maximum Peak Output Power

Test Summary:

Test Engineer:	Raghavendra Katti	**Test Date:**	29 July 2024
Test Sample Serial Number:	JM242640073		

FCC Reference:	Part 15.247(b)(3)
ISED Canada Reference:	RSS-Gen 6.12 / RSS-247 5.4(d)
Test Method Used:	FCC KDB 558074 Section 8.3.1.1 referencing ANSI C63.10 Section 11.9.1.1 and Notes below

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	58

Note(s):

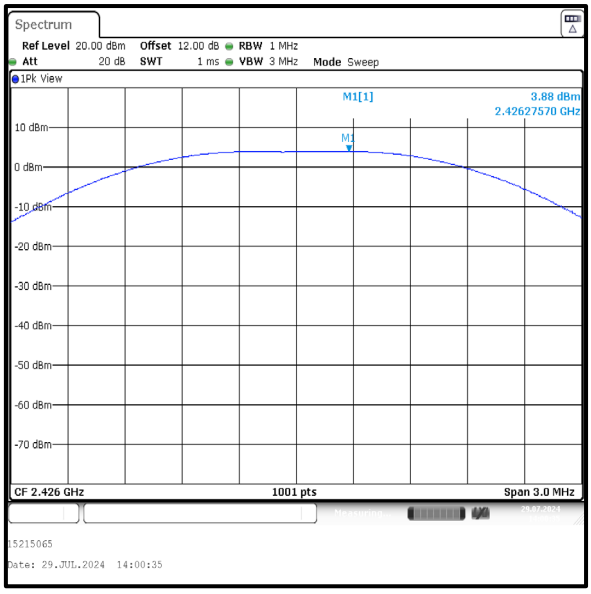
1. Conducted power tests were performed using a signal analyser in accordance with ANSI C63.10 Section 11.9.1.1 with the RBW ≥ DTS bandwidth procedure.
2. The signal analyser resolution bandwidth was set to 1 MHz and video bandwidth of 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 3 MHz. A marker was placed at the peak of the signal and the results recorded in the tables below.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
4. The conducted power was added to the declared antenna gain to obtain the EIRP.
5. Example plots of each modulation on middle channel, for one antenna configuration, can be seen below to show setting parameters comply with testing method/procedure. All other plots are archived on the UL IT server and available for inspection if required.

Transmitter Maximum Peak Output Power (continued)

Results: LE

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	3.8	30.0	26.2	Complied
Middle	3.9	30.0	26.1	Complied
Top	4.3	30.0	25.7	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	3.8	3.3	7.1	36.0	28.9	Complied
Middle	3.9	3.3	7.2	36.0	28.8	Complied
Top	4.3	3.3	7.6	36.0	28.4	Complied



Middle Channel

5 Radiated Test Results

5.1 Transmitter Radiated Emissions <1 GHz

Test Summary:

Test Engineer:	Nick Steele	**Test Dates:**	06 August 2024 & 24 September 2024
Test Sample Serial Number:	#8		

FCC Reference:	Parts 15.247(d) & 15.209(a)
ISED Canada Reference:	RSS-Gen 6.13 & 8.9 / RSS-247 5.5
Test Method Used:	ANSI C63.10 Sections 6.3, 6.4 and 6.5
Frequency Range	9 kHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	47 to 53

Transmitter Radiated Emissions (continued)

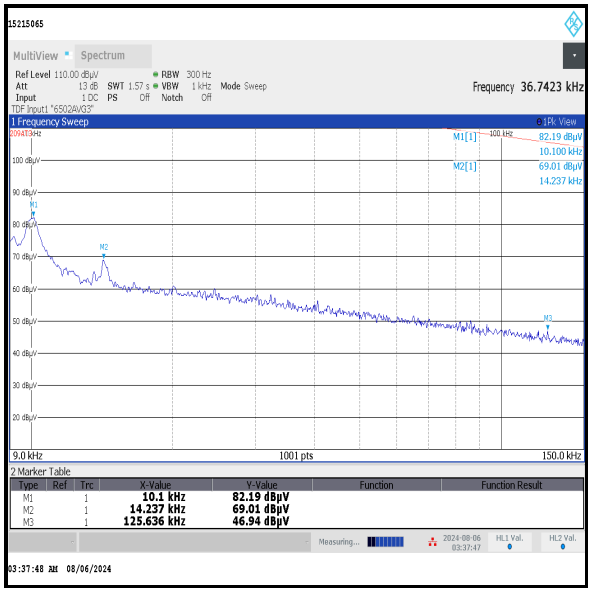
Note(s):

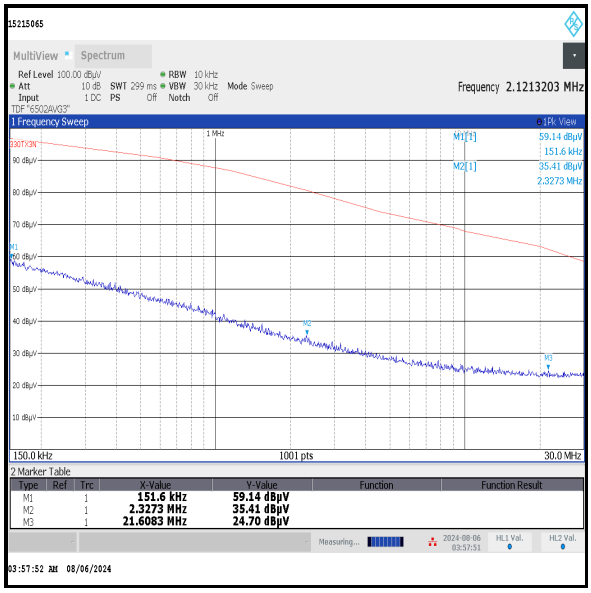
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the middle channel only.
3. All other emissions shown on the pre-scans were investigated and found to be ambient, > 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. Measurements below 30 MHz were performed in a semi-anechoic chamber (Asset Number K0001) at 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. ANSI C63.10 clause 5.2 states an alternative test site that can demonstrate equivalence to an open area test site may be used for measurements below 30 MHz. Therefore, measurements were performed in a semi-anechoic chamber. The correlation data between semi-anechoic chamber and an open field test site is available upon request.
5. The measured values at 3 metres were extrapolated to the required measurement distances of 300 metres and 30 metres and compared to the specified limits at those distances:
    - 9 kHz to 490 kHz: measured value extrapolated from 3 metres to 300 metres by subtracting 80 dB at 40 dB / decade
    - 490 kHz to 30 MHz: measured value extrapolated from 3 metres to 30 metres by subtracting 40 dB at 40 dB / decade
6. Measurements from 30 MHz to 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Pre-scans were performed and markers placed on the highest measured levels. The test receiver was configured as follows: For 9 kHz to 150 kHz, the resolution bandwidth was set to 300 Hz and video bandwidth 1 kHz. A peak detector was used and trace mode was Max Hold. For 150 kHz to 30 MHz, the resolution bandwidth was set to 10 kHz and video bandwidth 30 kHz, trace mode was Max Hold. For 30 MHz to 1 GHz, the resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
8. Final measurements were performed on the marker frequencies and the results entered into the table below. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span wide enough to see the whole emission.

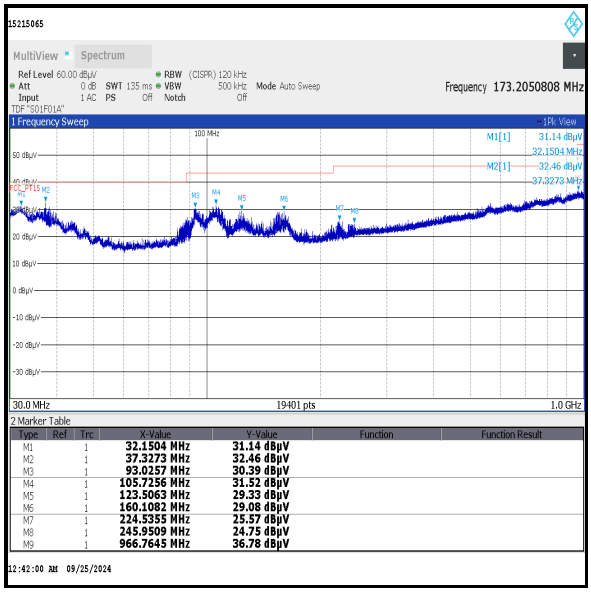
Transmitter Radiated Emissions (continued)

Results: Quasi-Peak / Middle Channel / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
35.943	Vertical	25.4	40.0	14.6	Complied
105.002	Vertical	23.2	43.5	20.3	Complied
122.312	Vertical	23.0	43.5	20.5	Complied
161.392	Vertical	24.0	43.5	19.5	Complied







Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

5.2 Transmitter Radiated Emissions >1 GHz

Test Summary:

Test Engineer:	Nick Steele & Lenny Hantz	**Test Dates:**	05 August 2024 & 06 August 2024
Test Sample Serial Number:	#8		

FCC Reference:	Parts 15.247(d) & 15.209(a)
ISED Canada Reference:	RSS-Gen 6.13 & 8.9 / RSS-247 5.5
Test Method Used:	FCC KDB 558074 Sections 8.1 c)3), 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.6, 11.11 & 11.12
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	50

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All other emissions shown on the pre-scans were investigated and found to be ambient, > 20 dB below the appropriate limit or below the noise floor of the measurement system.
3. The emission shown on the 1 GHz to 3 GHz plot is the EUT fundamental.
4. *In accordance with ANSI C63.10 Section 6.6.4.3, Note 1, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
5. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001/K226203) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
6. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001/K226203) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto. Peak and average measurements were performed with their respective detectors.
8. *The reference level for the emission in the non-restricted band was established by following ANSI C63.10 Section 11.11.2 procedure.
9. **-20 dBc limit applies in non-restricted band as the conducted output power measurements were performed using a peak detector.

Transmitter Radiated Emissions (continued)

Results: Bottom Channel / Peak / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2226.940	Vertical	49.1	54.0*	4.9	Complied
2258.440	Vertical	49.6	54.0*	4.4	Complied
2274.430	Vertical	50.1	54.0*	3.9	Complied
2290.430	Vertical	53.5	54.0*	0.5	Complied
2322.040	Vertical	48.7	54.0*	5.3	Complied
2370.410	Vertical	49.7	54.0*	4.3	Complied
2498.000	Vertical	53.5	54.0*	0.5	Complied

Results: Middle Channel / Peak / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2263.930	Vertical	49.9	54.0*	4.1	Complied
2295.930	Vertical	50.1	54.0*	3.9	Complied
2312.420	Vertical	50.9	54.0*	3.1	Complied
2328.420	Vertical	53.7	54.0*	0.3	Complied
2342.910	Vertical	52.9	54.0*	1.1	Complied
2376.530	Vertical	51.5	54.0*	2.5	Complied
7319.257	Vertical	60.1	74.0	13.9	Complied

Results: Middle Channel / Average / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7319.257	Vertical	51.3	54.0	2.7	Complied

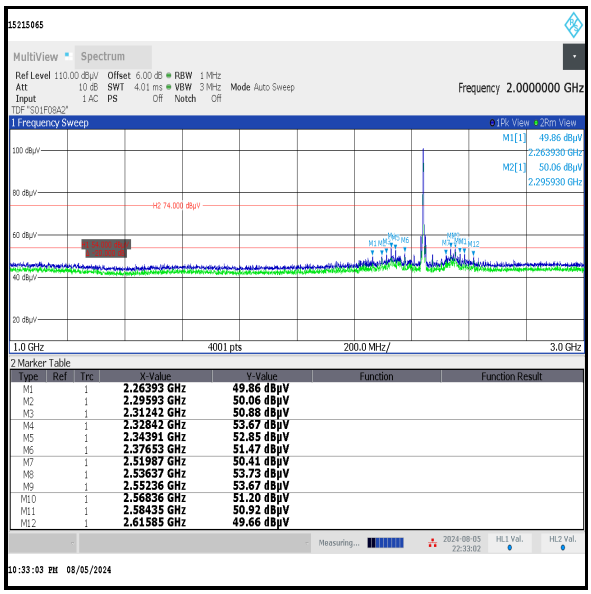
Results: Top Channel / Peak / LE

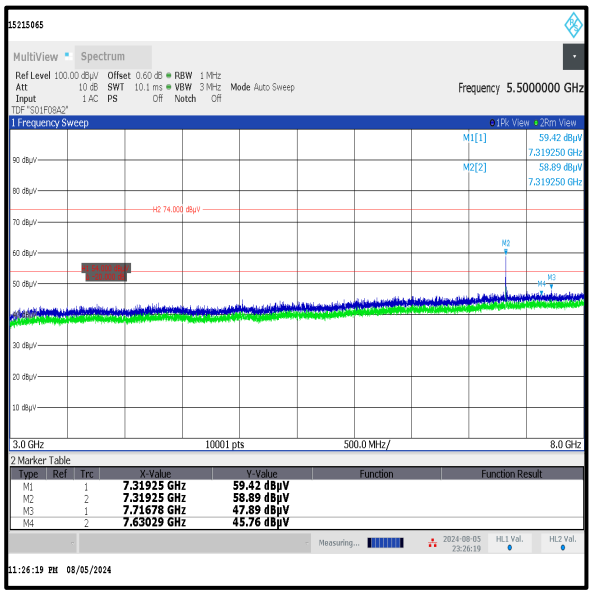
Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2336.420	Vertical	49.6	54.0*	4.4	Complied
2351.910	Vertical	52.1	54.0*	1.9	Complied
2367.910	Vertical	53.4	54.0*	0.6	Complied
2384.400	Vertical	55.3	74.0	18.7	Complied
7440.755	Vertical	60.8	74.0	13.2	Complied

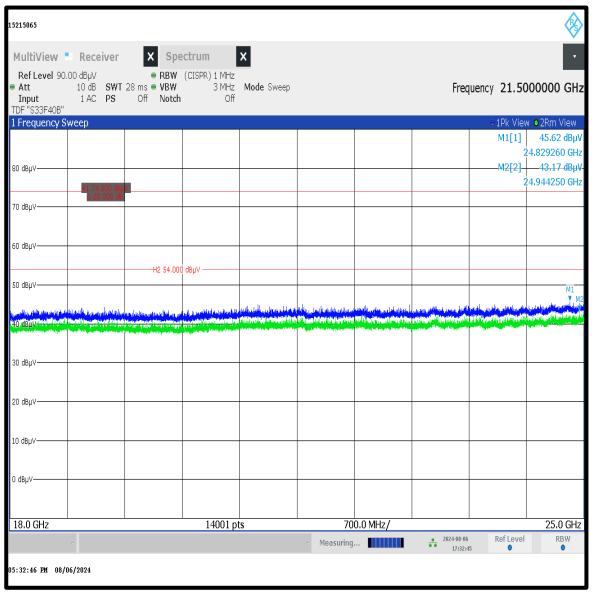
Results: Top Channel / Average / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2384.400	Vertical	38.3	54.0	15.7	Complied
7440.755	Vertical	51.8	54.0	2.2	Complied

Transmitter Radiated Emissions (continued)







Note: The plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.3 Transmitter Band Edge Radiated Emissions

Test Summary:

Test Engineers:	Lenny Hantz & Andrew Edwards	**Test Date:**	06 August 2024
Test Sample Serial Number:	#8		

FCC Reference:	Parts 15.247(d) & 15.209(a)
ISED Canada Reference:	RSS-Gen 6.13 / RSS-247 5.5
Test Method Used:	KDB 558074 Section 8.7 referencing ANSI C63.10 Sections 7.5, 11.11, 11.12 & 11.13

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	52

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. As the lower band edge is adjacent to a non-restricted band, only peak measurements are required. In accordance with ANSI C63.10 Section 11.11.1, the test method in Section 11.11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum peak conducted output power was measured using an peak detector in accordance with ANSI C63.10 Section 11.9.1.1 an out-of-band limit line was placed 20 dB (ANSI C63.10 Section 11.11.1(a)) below the peak level. A marker was placed on the band edge spot frequencies. Marker frequency and levels were recorded.
3. As the upper band edge is adjacent to a restricted band, both peak and average measurements were recorded by placing a marker at the edge of the band. For peak measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. An RMS detector was used, sweep time was set to auto and trace mode was Max Hold. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
4. There is a restricted band 10 MHz below the lower band edge. The test receiver was set up as follows: the RBW set to 1 MHz, the VBW set to 3 MHz, with the sweep time set to auto couple. Peak and average measurements were performed with peak and RMS detectors respectively. Markers were placed on the highest point on each trace.
5. * -20 dBc limit.
6. ** The average value was determined by subtracting a duty cycle correction factor from the peak value in accordance with ANSI C63.10 Section 7.5. See Annex A for further information.

$$\delta(dB) = 20\log(\Delta)$$

Maximum Duty Cycle: 45.4%

$$20\log(0.454) = -6.9\ dB$$

Transmitter Band Edge Radiated Emissions (continued)

Results: Peak / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2394.000	Vertical	57.3	80.9*	23.6	Complied
2400.000	Vertical	51.7	80.9*	29.2	Complied
2483.500	Vertical	54.9	74.0	19.1	Complied
2487.660	Vertical	58.2	74.0	15.8	Complied

Results: Average / LE

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2483.500	Vertical	50.8	54.0	3.2	Complied
2487.660	Vertical	51.3**	54.0	2.7	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Peak / LE

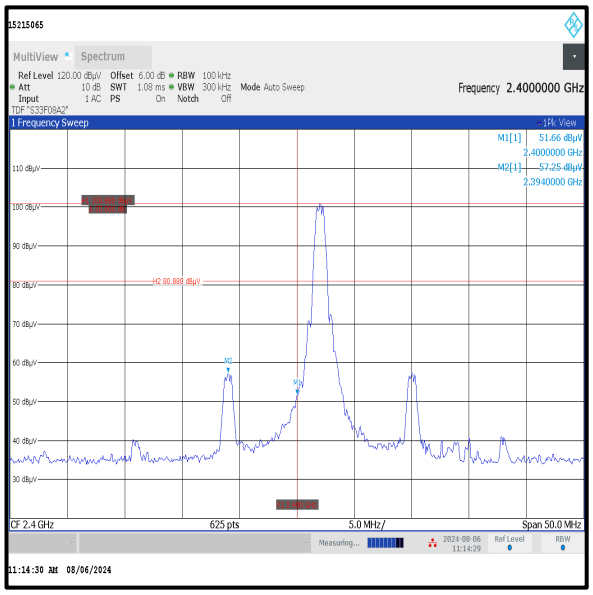
Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2321.970	Vertical	50.2	74.0	23.8	Complied
2337.710	Vertical	49.9	74.0	24.1	Complied
2353.970	Vertical	48.3	74.0	25.7	Complied
2369.840	Vertical	51.4	74.0	22.6	Complied
2386.220	Vertical	49.3	74.0	24.7	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Average / LE

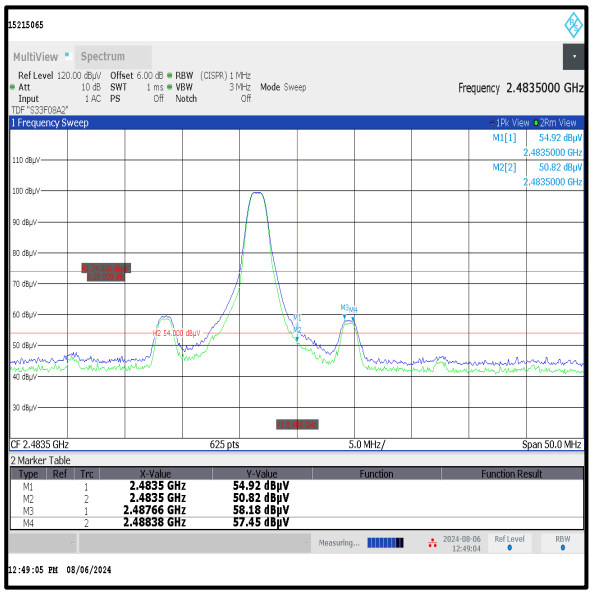
Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
2321.970	Vertical	48.9	54.0	5.1	Complied
2337.710	Vertical	48.8	54.0	5.2	Complied
2354.100	Vertical	47.1	54.0	6.9	Complied
2369.970	Vertical	50.3	54.0	3.7	Complied
2386.220	Vertical	47.1	54.0	6.9	Complied

Transmitter Band Edge Radiated Emissions (continued)

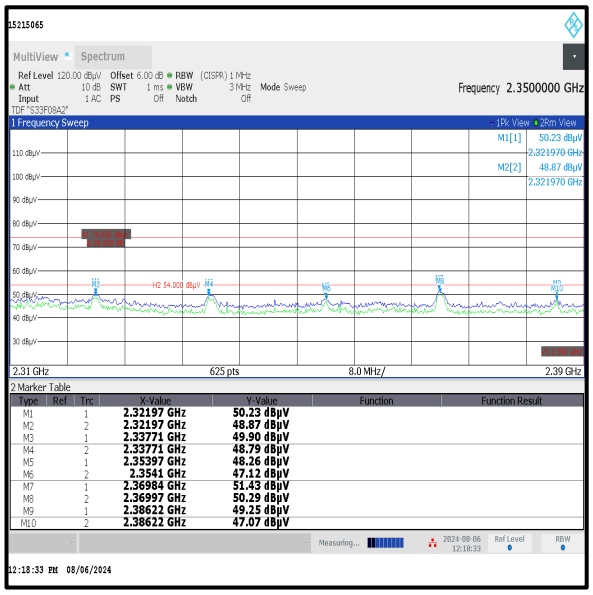
Results: LE



Lower Band Edge



Upper Band Edge



2310 MHz to 2390 MHz Restricted Band

6 AC Power Line Conducted Emissions Test Results

6.1 Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Alison Johnston	**Test Date:**	24 October 2024
Test Sample Serial Number:	#8		

FCC Reference:	Part 15.207
ISED Canada Reference:	RSS-Gen 8.8
Test Method Used:	ANSI C63.10 Section 6.2, FCC KDB 174176 and notes below

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	49

Note(s):

1. The EUT was plugged into an AC to DC charger. The AC to DC charger was connected to a 120 VAC 60 Hz single phase supply via a LISN.
2. In accordance with FCC KDB 174176 Q4, tests were performed with a 240 VAC 60 Hz single phase supply as this was within the voltage range marked on the AC to DC charger.
3. A pulse limiter was fitted between the LISN and the test receiver.
4. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.

Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.190500	Live	36.4	64.0	27.6	Complied
0.460500	Live	39.3	56.7	17.4	Complied
0.829500	Live	29.1	56.0	26.9	Complied
1.198500	Live	26.3	56.0	29.7	Complied
1.482000	Live	26.8	56.0	29.2	Complied
15.184500	Live	32.0	60.0	28.0	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.208500	Live	16.0	53.3	37.3	Complied
0.460500	Live	16.6	46.7	30.1	Complied
0.816000	Live	13.0	46.0	33.0	Complied
1.216500	Live	7.9	46.0	38.1	Complied
1.459500	Live	7.9	46.0	38.1	Complied
15.157500	Live	12.0	50.0	38.0	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

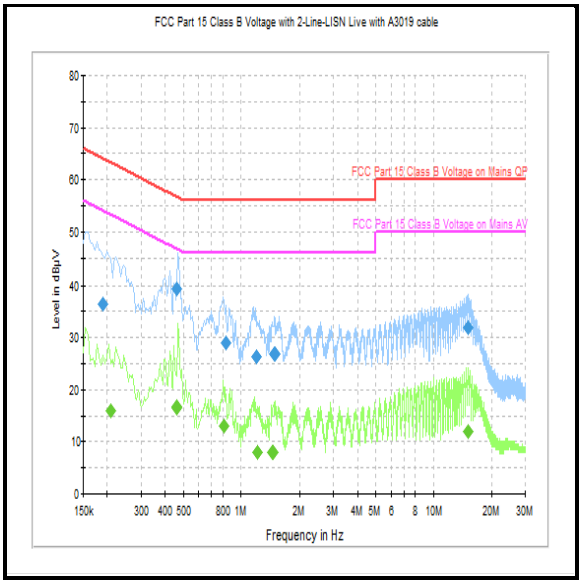
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.172500	Neutral	32.8	64.8	32.0	Complied
0.240000	Neutral	27.5	62.1	34.6	Complied
0.483000	Neutral	29.6	56.3	26.7	Complied
0.829500	Neutral	19.8	56.0	36.2	Complied
1.234500	Neutral	17.6	56.0	38.4	Complied
1.482000	Neutral	18.2	56.0	37.8	Complied

Results: Neutral / Average / 120 VAC 60 Hz

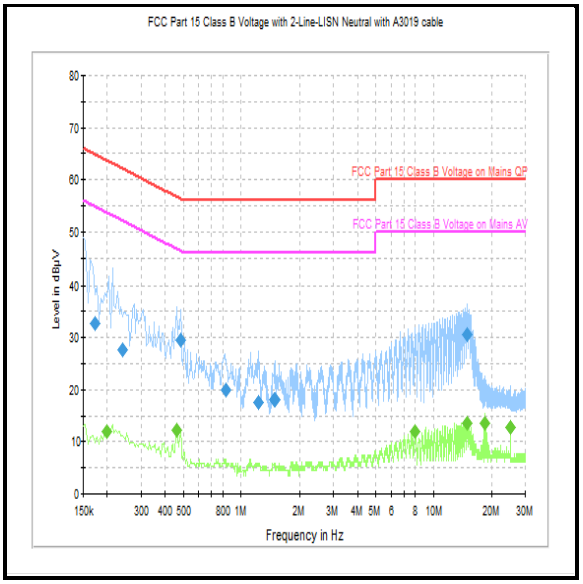
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.199500	Neutral	12.0	53.6	41.6	Complied
0.460500	Neutral	12.3	46.7	34.4	Complied
8.002500	Neutral	11.9	50.0	38.1	Complied
14.887500	Neutral	13.6	50.0	36.4	Complied
18.406500	Neutral	13.5	50.0	36.5	Complied
25.057500	Neutral	12.7	50.0	37.3	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: 120 VAC 60 Hz



Live



Neutral

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.163500	Live	36.3	65.3	29.0	Complied
0.321000	Live	35.1	59.7	24.6	Complied
0.483000	Live	37.4	56.3	18.9	Complied
0.883500	Live	32.4	56.0	23.6	Complied
0.892500	Live	33.6	56.0	22.4	Complied
1.446000	Live	31.2	56.0	24.8	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.195000	Live	17.4	53.8	36.4	Complied
0.316500	Live	14.5	49.8	35.3	Complied
0.501000	Live	15.0	46.0	31.0	Complied
0.888000	Live	12.4	46.0	33.6	Complied
1.446000	Live	10.4	46.0	35.6	Complied
2.044500	Live	10.5	46.0	35.5	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

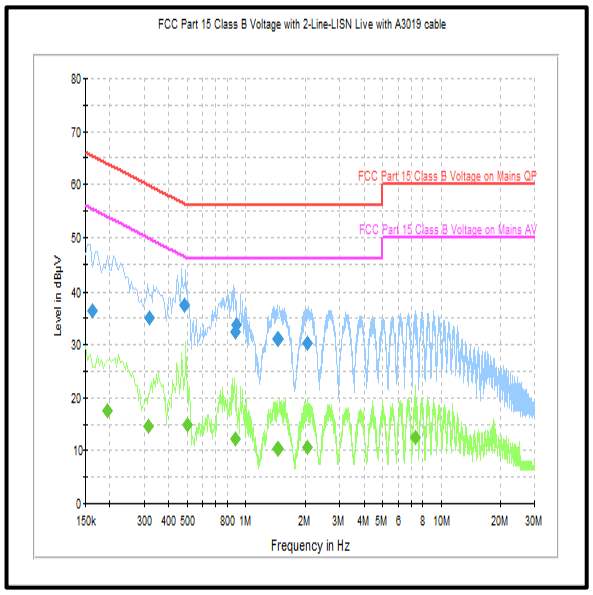
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.163500	Neutral	29.3	65.3	36.0	Complied
0.303000	Neutral	25.0	60.2	35.2	Complied
0.478500	Neutral	28.6	56.4	27.8	Complied
0.784500	Neutral	21.7	56.0	34.3	Complied
0.865500	Neutral	22.9	56.0	33.1	Complied
1.423500	Neutral	22.6	56.0	33.4	Complied

Results: Neutral / Average / 240 VAC 60 Hz

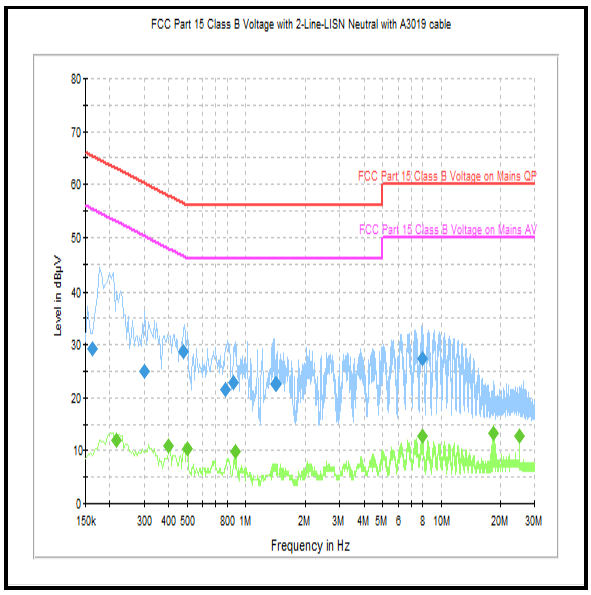
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.217500	Neutral	12.0	52.9	40.9	Complied
0.402000	Neutral	10.8	47.8	37.0	Complied
0.501000	Neutral	10.4	46.0	35.6	Complied
0.888000	Neutral	10.0	46.0	36.0	Complied
7.998000	Neutral	12.7	50.0	37.3	Complied
18.406500	Neutral	13.2	50.0	36.8	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: 240 VAC 60 Hz



Live



Neutral

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Annex A – Duty Cycle Correction

Customer Declaration

With a duty cycle of 60% we calculate:
20 * LOG (0.6) = -4.4dB
This would achieve the 4.2 dB reduction we would need.

To give a margin for error we will apply a limit of 50% to our emissions which gives a reduction of 6.0dB.

The firmware currently only has one scenario where transmission of continuous data is required, this is the download of data logs via SMP over *Bluetooth*.

The remaining *Bluetooth* transmissions are in response to BLE characteristics which have a low update rate and very low bandwidth requirements calculations for this are given later.

For the characteristics we are giving a generous 5% of our 50% duty allowance meaning that for SMP transfers we must limit the duty to 45%.

The BLE stack in our implementation has the following features:
Minimum connection intervals (allowing us to control the minimum off period)
Maximum buffer size (allowing us to control the on time)

Using these 2 features we can limit the maxim SMP transfer duty to less than 45% over a minimum period of ~16.3ms

We can also apply a minimum connection interval to BLE characteristics which represent the remaining majority of transfers but have much smaller transfer sizes.

Calculations:

SMP TX duty

Minimum connection interval = 6 (minimum configurable value) * 1.5ms = 9ms

Which gives:
Maximum transmit time = (9ms / 55%) * 45% = 7.363636ms

And therefore:
Maximum packet size = 7.363ms * 1000 bits/ms (1Mb/s) = 7363 bits = 920 bytes (inc. framing and SMP overhead)

BLE characteristics duty

Maximum update rate = 2 Hz (most are much slower)
Maximum characteristic size = 20 bytes (most are 1 byte)
Total number of characteristics = 26
Total bandwidth = 26 x 20 x 2 = 1040 bytes/s = 8320bits/s

Max BLE bandwidth = 1Mbit
Worst case used bandwidth = 8320 / 1000000 = 0.8%

On top of the low bandwidth required for characteristic updates we will also apply a minimum interval between characteristic transmission.

Minimum interval =9ms
Maximum characteristic packet size = 20 bytes + 14 bytes overhead
Maximum packet time = 34 us
TX Duty = 34 / 9034 = 0.4%

Combining these would give a maximum duty of 45.4%, however realistically, only one of these transfers would be occurring at any one time.

--- END OF REPORT ---