

Report on the Radio Testing

For

Pektron Group Ltd

on

Chassis Control Unit

Report no. TRA-034795-47-03B

29th November 2017

Report Number: TRA-034795-47-03B
Issue: B

REPORT ON THE RADIO TESTING OF A
Pektron Group Ltd
Chassis Control Unit
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.209 & IC RSS-210 Annex 2.5.1

TEST DATE: 24th - 26th October 2017

Written by: D Winstanley

D Winstanley
Radio Senior Test Engineer

Approved by:

J Charters
Department Manager - Radio

Date: 29th November 2017

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
- [2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

RF922 3.0

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	13 th November 2017	Original
B	29 th November 2017	Amendments

2 Summary

TEST REPORT NUMBER: TRA-034795-47-03B

WORKS ORDER NUMBER: TRA-034795-01

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.

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): 47CFR15.209 & RSS-210 Annex 2.5.1

EQUIPMENT UNDER TEST (EUT): Chassis Control Unit

FCC IDENTIFIER: AQO006

CERTIFICATION NUMBER: 10176A-006

EUT SERIAL NUMBER: 10009399

MANUFACTURER/AGENT: Pektron Group Ltd

ADDRESS: Alfreton Road
Derby
Derbyshire
DE21 4AP
United Kingdom

CLIENT CONTACT: Ian Marriott
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ORDER NUMBER: PROJ-00000319

TEST DATE: 24th - 26th October 2017

TESTED BY: D Winstanley
Element

2.1 Test Summary

Test Method and Description	Requirement Clause		Applicable to this equipment	Result / Note
	RSS	47CFR15		
Radiated spurious emissions	Gen; 8.9 / 7.1	15.209 / 15.109	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions	Gen; 8.8	15.207 / 15.107	<input type="checkbox"/>	N/A Battery Only
Occupied bandwidth	Gen; 6.6	15.215c	<input type="checkbox"/>	Pass
Field strength of fundamental	210; 2.5.1	15.209	<input checked="" type="checkbox"/>	Pass

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

1	Revision Record	3
2	Summary	4
2.1	Test Summary	5
3	Contents	6
4	Introduction	7
5	Test Specifications	8
5.1	Normative References	8
5.2	Deviations from Test Standards	8
6	Glossary of Terms	9
7	Equipment Under Test	10
7.1	EUT Identification	10
7.2	System Equipment	10
7.3	EUT Mode of Operation	10
7.4	EUT Radio Parameters	11
7.4.1	General	11
7.5	EUT Description	11
8	Modifications	12
9	EUT Test Setup	13
9.1	Block Diagram	13
9.2	General Set-up Photograph	14
10	General Technical Parameters	15
10.1	Normal Conditions	15
10.2	Varying Test Conditions	15
11	Radiated emissions below 30 MHz	16
11.1	Definitions	16
11.2	Test Parameters	16
11.3	Test Limit	17
11.4	Test Method	17
11.5	Test Set-up Photograph	18
11.6	Test Equipment	18
11.7	Test Results	19
12	Radiated emissions	20
12.1	Definitions	20
12.2	Test Parameters	20
12.3	Test Limit	20
12.4	Test Method	21
12.5	Test Set-up Photograph	22
12.6	Test Equipment	22
12.7	Test Results	23
13	Occupied Bandwidth	24
13.1	Definitions	24
13.2	Test Parameters	24
13.3	Environmental Conditions (Normal Environment)	24
13.4	Test Limit	24
13.5	Test Method	25
13.6	Test Equipment	25
13.7	Test Results	26
14	Transmitter output power (fundamental radiated emission)	28
14.1	Definition	28
14.2	Test Parameters	28
14.3	Test Limit	28
14.4	Test Method	29
14.5	Test Equipment	29
14.6	Test Results	29
15	Measurement Uncertainty	30
16	RF Exposure	31

4 Introduction

This report TRA-034795-47-03B presents the results of the Radio testing on a Pektron Group Ltd, Chassis Control Unit 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 Pektron Group Ltd by Element, at the address detailed below.

- | | |
|--|--|
| <input type="checkbox"/> Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK | <input type="checkbox"/> 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 9, August 2016 – 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: Chassis Control Unit
- Serial Number: 10009399
- Model Number: 0771G09
- Software Revision: P0771A23A_T11 (Test)
P0771A23A (Production)
- Build Level / Revision Number: A-0771G09B

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.

Description: Manual test set including Loads and Harness
Make: Pektron

Description: 433 MHz RF Transmitter
Make: Pektron

Description: Note Book PC running CANalyzer
Make: Dell

Description: CAN Case Number 27 CANalyzer Package
Make: Vector
Model No: VN1611
Serial No: 27

Description: AC/DC Power Adapter
Make: Dell

Description: 1x Smart Keyfobs
Make: Triumph / Pektron
Serial No: 1

7.3 EUT Mode of Operation

CANalyzer panel was used to put the CCU into a normal motorcycle running mode of operation. Ignition on bike at 30kmph lights on fuel pump active. LF and UHF transmitting and receiving.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	134.2 kHz
Modulation type(s):	ASK
Occupied channel bandwidth(s):	Wideband
Channel spacing:	Wideband
Nominal Supply Voltage:	13.5 Vdc
Duty cycle:	100 %
Antenna Type:	Ferrite Core Magnetic Coil
Antenna Mounting:	Bike Mounted

7.5 EUT Description

The EUT is a motorcycle chassis controller unit. Controls chassis systems & multiple loads on the motorcycle. The device contains a wireless receiver and keyless start. This report covers the 134.2kHz.

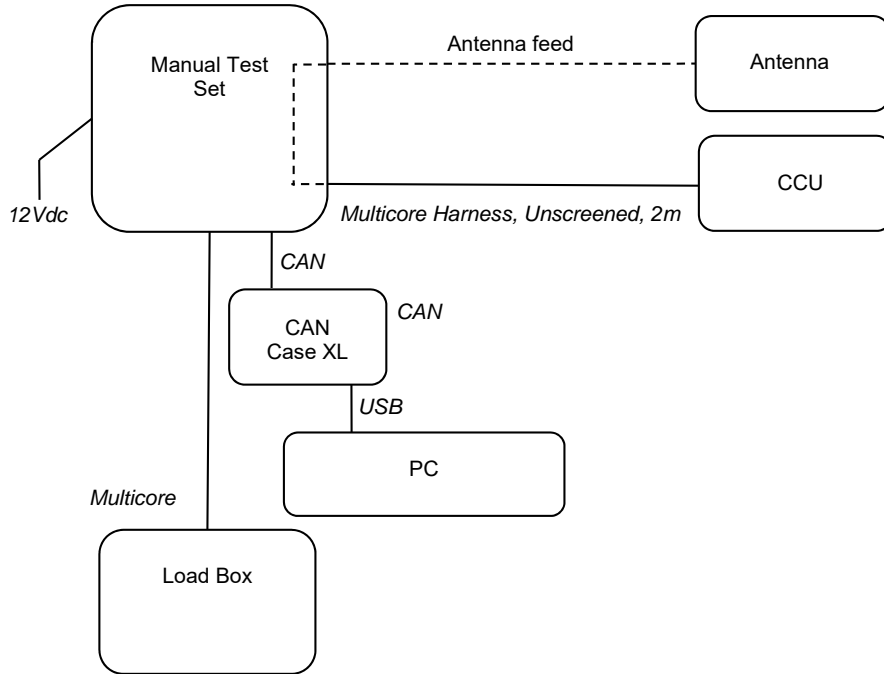
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

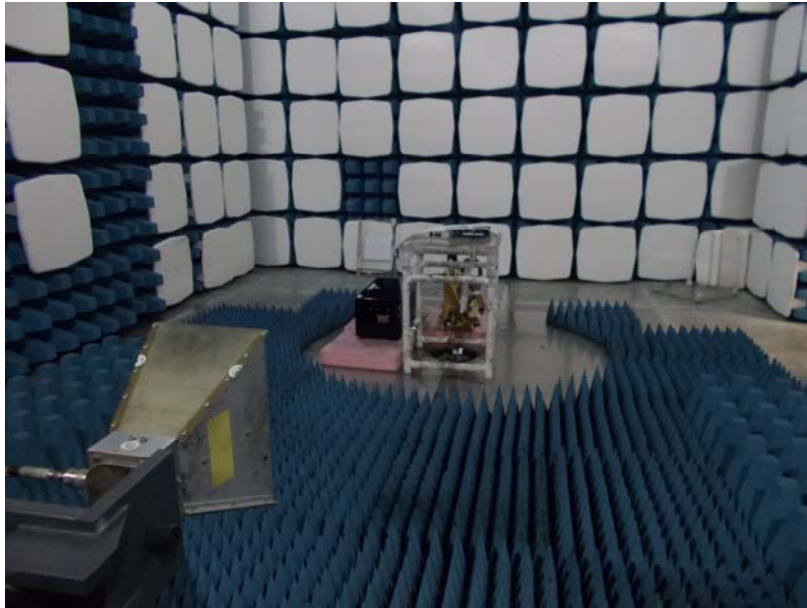
9.1 Block Diagram

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



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. +13.5 V dc from a supply

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
<input type="checkbox"/>	Mains	110 V ac +/-2 %	85 % and 115 %
<input type="checkbox"/>	Battery	New battery	N/A

11 Radiated emissions below 30 MHz

11.1 Definitions

Out-of-band emissions

Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

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 Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.4
EUT Channels / Frequencies Measured:	134.2 kHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement Distance and Site	10 m, OATS without ground plane. (3m ATS for Previews)
EUT Height:	1 m
Measurement Antenna and Height:	60 cm shielded loop; 1 m
Measurement BW:	9 kHz to 150 kHz: 200 Hz; 150 kHz to 30 MHz: 9 kHz
Measurement Detector:	9 kHz to 90 kHz and 110 kHz to 490 kHz: Average, RMS Other frequencies below 30 MHz: Quasi-peak.

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 46 % RH	20 % RH to 75 % RH (as declared)
Supply: 13.5 V dc	

11.3 Test Limit

Emissions from license-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

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

<i>Frequency, f (kHz)</i>	<i>Field Strength</i>	<i>Measurement Distance (m)</i>
9 to 490	2,400 / 377.f (μA/m) 2,400 / f (μV/m)	300
490 to 1,750	24,000 / 377.f (μA/m) 24,000 / f (μV/m)	30
1,750 to 30,000	30 (μV/m)	30

n.b. Devices operated pursuant to §15.225 / RSS-210 A2.6 are exempt from complying with the restricted band requirements for the 13.36–13.41 MHz band only.

11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the EUT fundamental frequency was maximised by rotating the EUT through 360°, in three orthogonal planes, and adjusting the measurement antenna azimuth.

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 9 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 9 kHz and 30 MHz are measured using a calibrated 60cm active loop antenna. 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.

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

$$FS = 10^{(PR - CF) / 20}$$

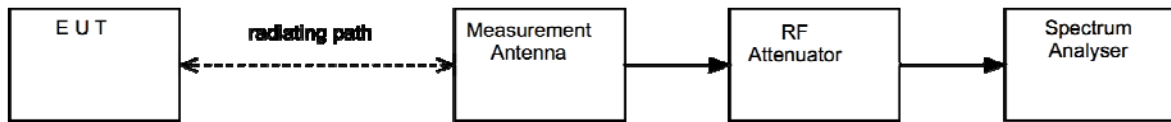
Where,

PR is the power recorded on the receiver / spectrum analyzer in dBμV and includes any cable loss, antenna factor and pre-amplifier gain;
CF is the distance extrapolation factor in dB (where measurement distance different to limit distance);

Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.

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

Figure i Test Setup



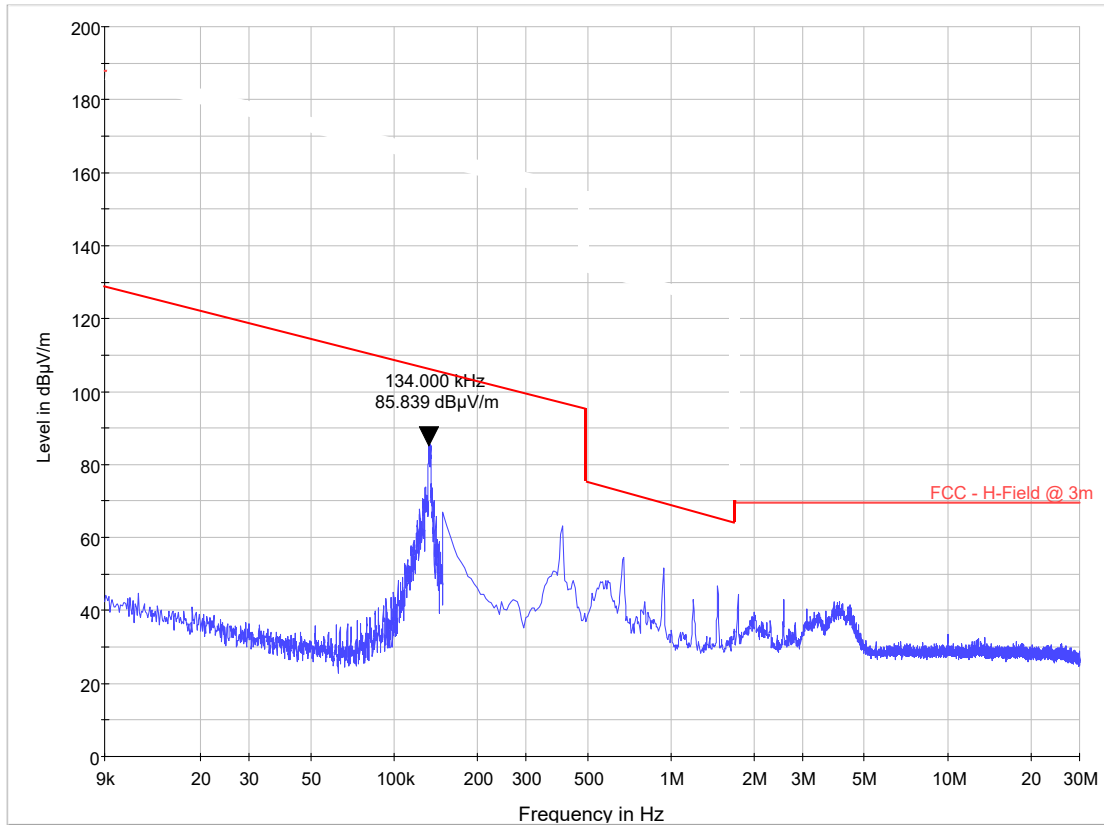
11.5 Test Set-up Photograph



11.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
hfh2	R&S	Loop Antenna	L007	12/04/2019
ESHS10	R&S	Receiver	U003	29/08/2018

11.7 Test Results



<i>Emission Frequency (MHz)</i>	<i>Receiver Level (dBµV/m)</i>	<i>Measurement Distance (m)</i>	<i>Limit Distance (m)</i>	<i>Extrapolation Factor (dB)</i>	<i>Field Strength (µV/m)</i>	<i>Result</i>
No Significant Emissions Within 20dB of Limit						PASS

12 Radiated emissions

12.1 Definitions

Out-of-band emissions

Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

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.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	134.2 kHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 46 % RH	20 % RH to 75 % RH (as declared)
Supply: 13.5 V dc	

12.3 Test Limit

Except for harmonics, out-of-band emissions shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in FCC 47CFR15.209 / RSS-Gen {see table below}, whichever is less stringent.

Harmonics shall be limited to a maximum level of 0.5 mV/m measured at 3 metres.

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

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

n.b. per FCC 47CFR15.35(b) / RSS-Gen 8.1, peak limit is 20 dB above average.

12.4 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 dB μ V/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 dB μ V;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

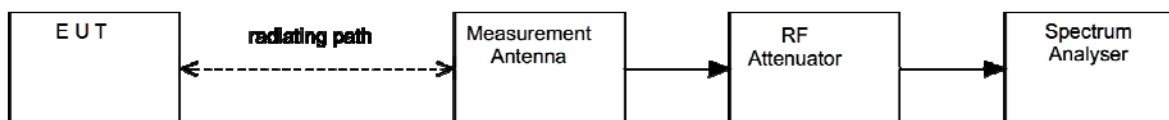
PA is the pre-amplifier gain in dB (where used);

DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);

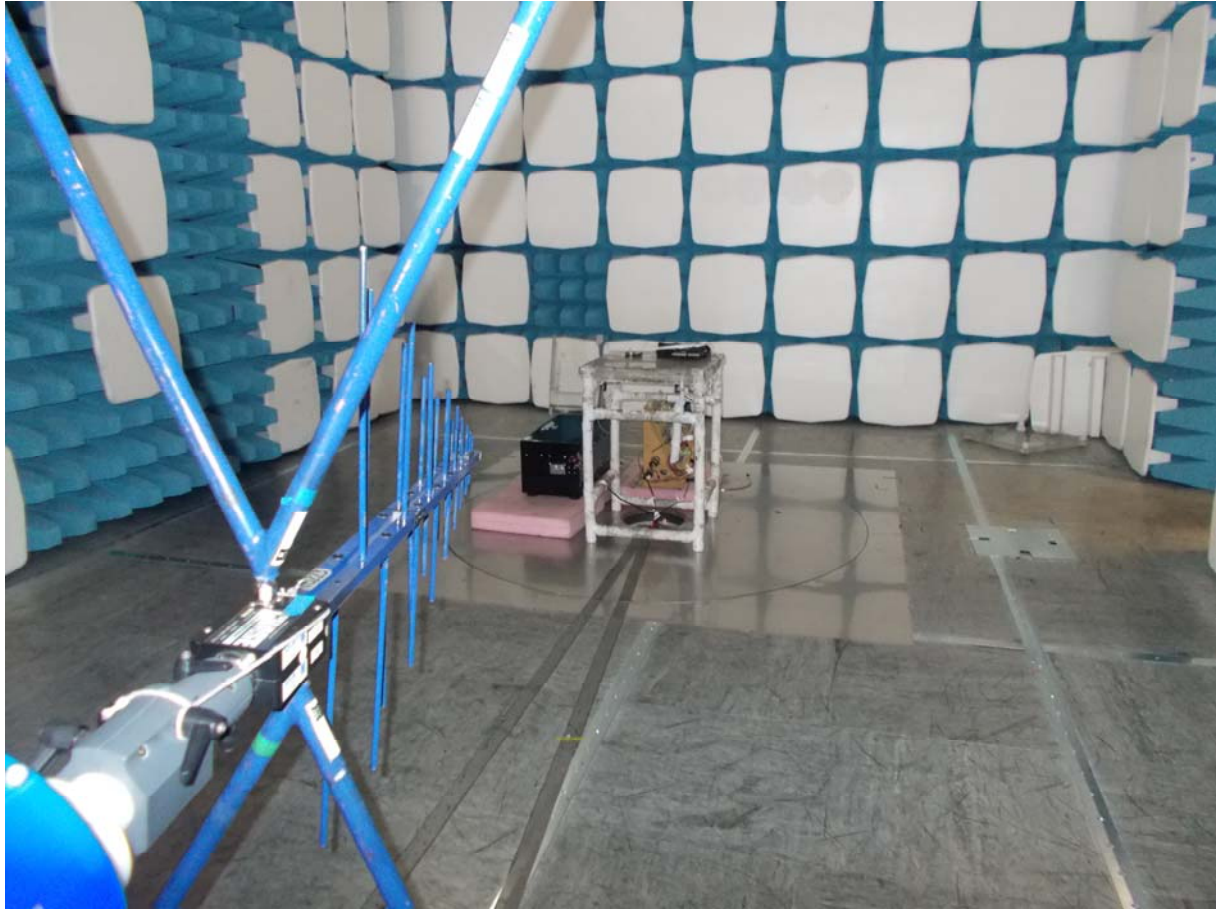
CF is the distance factor in dB (where measurement distance different to limit distance);

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

Figure i Test Setup



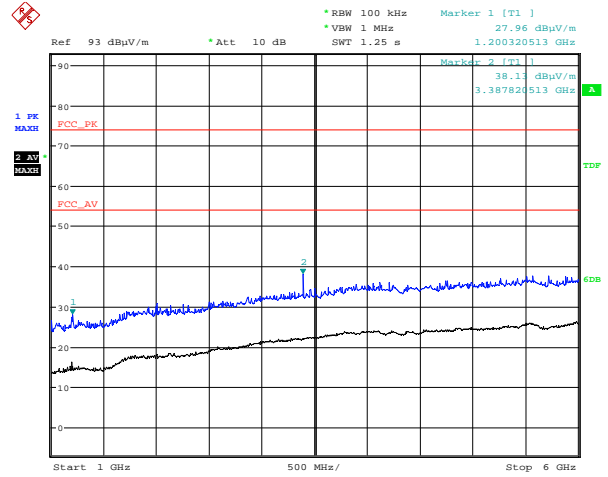
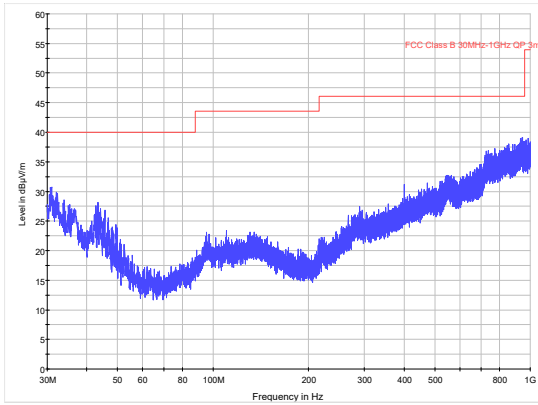
12.5 Test Set-up Photograph



12.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
CBL611/A	Chase	Bilog	U191	08/12/2018
ESVS10	R&S	Receiver	L317	22/03/2018
8449B	Agilent	Pre Amp	L572	07/02/2018
3115	EMCO	1-18GHz Horn	L139	25/09/2019
FSU46	R&S	Spectrum Analyser	U281	19/06/2018

12.7 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	35.80	-1.20	0.80	22.34	N/A	0.00	0.00	21.94	12.50	100
QP	42.75	0.60	0.90	18.70	N/A	0.00	0.00	20.20	10.23	100
QP	45.60	0.70	1.00	17.16	N/A	0.00	0.00	18.86	8.77	100
QP	43.50	2.90	0.93	18.30	N/A	0.00	0.00	22.13	12.78	100
QP	44.10	2.00	0.96	17.94	N/A	0.00	0.00	20.90	11.09	100
Av	3387.00	40.76	3.60	31.10	36.31	0.00	0.00	39.15	90.68	500
Pk	3387.00	48.80	3.60	31.10	36.31	0.00	0.00	47.19	228.82	5000

13 Occupied Bandwidth

13.1 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 0.5 % 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.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Channels / Frequencies Measured:	134.2 kHz
EUT Channel Bandwidths:	Wideband
EUT Test Modulations:	ASK
Deviations From Standard:	None
Measurement BW: (requirement: 1 % to 5 % OBW)	500 Hz
Measurement Detector:	Peak

13.3 Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 43 % RH	20 % RH to 75 % RH (as declared)
Supply: 13.5 V dc	

13.4 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:

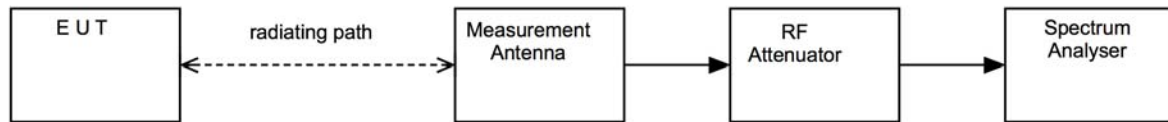
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific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

13.5 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

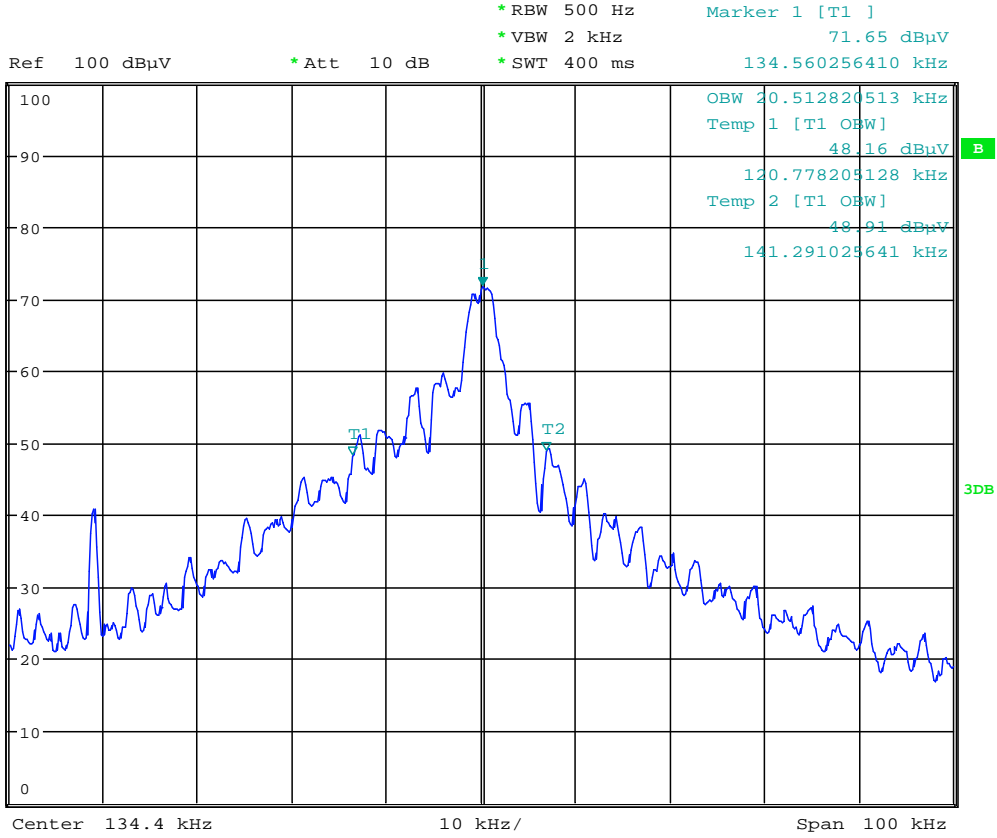


13.6 Test Equipment

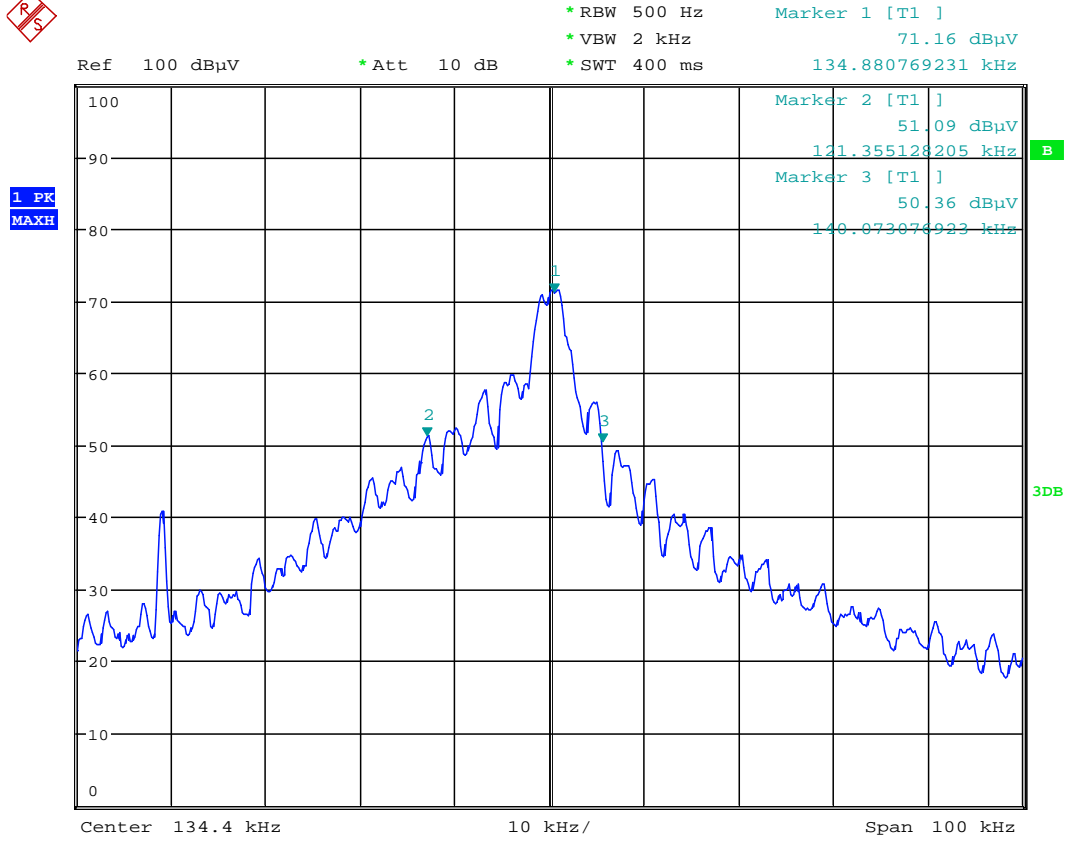
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
hfh2	R&S	Loop Antenna	L007	12/04/2019
ESHS10	R&S	Receiver	U003	29/08/2018
FSU46	R&S	Spectrum Analyser	U281	19/06/2018

13.7 Test Results

99%				
Channel Frequency (kHz)	F_L (kHz)	F_H (kHz)	99% Bandwidth (kHz)	Result
134.4	120.778205128	141.291025641	20.512820513	PASS



20 dB				
Channel Frequency (kHz)	F_L (kHz)	F_H (kHz)	20dB Bandwidth (kHz)	Result
134.2	121.355128205	140.073076923	18.717948718	PASS



Date: 24.OCT.2017 17:07:52

14 Transmitter output power (fundamental radiated emission)

14.1 Definition

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

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber / OATS
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 / 6.6
EUT Channels / Frequencies Measured:	134.2 kHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement BW:	10 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	N/A
Measurement Detector:	Average
Voltage Extreme Environment Test Range:	85 % and 115 % of Nominal (FCC only requirement);

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 46 % RH	20 % RH to 75 % RH (as declared)

14.3 Test Limit

The field strength shall not exceed the limits in the following table:

Strength Limits for License-Exempt Transmitters at Frequencies Below 30 MHz

Frequency, <i>f</i> (kHz)	Field Strength	Measurement Distance (m)
9 to 490	2,400 / 377. <i>f</i> (μA/m) 2,400 / <i>f</i> (μV/m)	300
490 to 1,750	24,000 / 377. <i>f</i> (μA/m) 24,000 / <i>f</i> (μV/m)	30
1,750 to 30,000	30 (μV/m)	30

Strength Limits for License-Exempt Transmitters at Frequencies Above 30 MHz

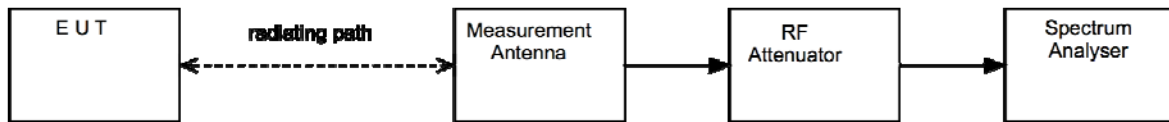
Frequency (MHz)	Field Strength (μV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

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 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



14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
hfh2	R&S	Loop Antenna	L007	12/04/2019
ESHS10	R&S	Receiver	U003	29/08/2018

14.6 Test Results

Channel Frequency (kHz)	Receiver Level (dB μ V/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (μ V/m)	Result
135.66	80.7	3	300	88.4	0.412	PASS
135.66	51.4	10	300	59.1	0.412	PASS

Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.

Per FCC 47CFR15.31(f)(2) / RSS-Gen 6.4, an extrapolation factor of 27.4 dB per was determined from measurements between 3 and 10 metres.

15 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] Carrier power

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

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

[2] 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**

[3] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[4] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113 ppm**

Uncertainty in test result (Spectrum Analyser) = **0.265 ppm**

[6] Duty cycle

Uncertainty in test result = **7.98 %**

16 RF Exposure

General SAR test reduction and exclusion guidance

KDB 447498

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when the considering SAR exclusion Threshold requirement in KDB 447498 is satisfied standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

In the frequency range below 100 MHz and test separation distance ≤ 50 mm, the SAR Test Exclusion Threshold will be determined as follows

SAR Exclusion Threshold (SARET)

$$\text{SAR Exclusion Threshold} = ([\text{Step 1} + \text{Step 2}] * \text{Step 3a}) * \text{Step 3b}$$

Step 1

$$\text{NT} = [(MP/TSD^A) * \sqrt{f_{\text{GHz}}}]$$

NT	=	Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP	=	Max Power of channel (mW) (inc tune up)
TSD ^A	=	Min Test separation Distance or 50mm (whichever is lower) = 5
f _{GHz}	=	Transmit frequency (or 100MHz if lower)

We can transpose this formula to allow us to find the maximum power of a channel allowed and compare this to the measured maximum power.

$$\text{MP} = [(\text{NT} \times \text{TSD}^A) / \sqrt{f_{\text{GHz}}}]$$

For Distances Greater than 50 mm Step 2 applies

Step 2

$$(\text{TSD}^B - 50\text{mm}) * f_{(\text{MHz})}/150$$

Where:

f _{MHz}	=	Transmit frequency
TSD ^B	=	Min Test separation Distance (mm) = 5

Step 3

3a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by $[1 + \log(100/f(\text{MHz}))]$ for *test separation distances* > 50 mm and < 200 mm

3b) The power threshold determined by the equation in steps 1 and 2 for 50 mm and 100 MHz is multiplied by $1/2$ for *test separation distances* ≤ 50 mm

$$\begin{aligned} \text{SARET} &= (\{ [(NT \times \text{TSD}^A) / \sqrt{f_{\text{GHz}}}] + (\text{TSD}^B - 50) * [0.13566/150] \} * (1 + \text{Log} [100 / F_{\text{MHz}}])) * 1/2 \\ \text{SARET} &= (\{ [(3.0 \times 5) / \sqrt{0.1}] + (5 - 50) * [0.13566/150] \} * (1 + \text{Log} [100 / F_{\text{MHz}}])) * 1/2 \\ \text{SARET} &= ([47.43 + -0.04] * (1 + \text{Log} [100 / 0.13566])) * 1/2 \\ \text{SARET} &= 91.64 \text{ mW} \end{aligned}$$

The calculated output power is 0.51 nW (eirp) is less than the SAR Exclusion Threshold of 91.64 mW, at 5mm test separation distance, for general population and uncontrolled exposure.

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

RADIO FREQUENCY RADIATION EXPOSURE

RSS-102 issue 5

Exemption Limits for Routine Evaluation

All transmitters are exempt from routine SAR and RF exposure evaluations provided that they comply with the requirements of sections RSS-102 Issue 5 sections 2.5.1 or 2.5.2

If the EUT does not meet the appropriate exemption limit, a complete SAR or RF exposure evaluation shall be performed. However, the power exemption limits in RSS-102 Issue 5 Table 1 can be applied to reduce the number of test configurations (e.g. testing of a tablet edge).

RSS-102 Issue 5 sections 2.5.1

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤ 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥ 50 mm
≤ 300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Exemption Limits for Routine Evaluation – RF Exposure Evaluation

$$S = \frac{EIRP}{4 \pi R^2} \text{ re - arranged} \quad R = \sqrt{\frac{EIRP}{S 4 \pi}}$$

where:

S = power density

R = distance to the centre of radiation of the antenna

ERP = EUT Maximum power

RSS-102 Issue 5		
Evaluation Frequency	0.13566	MHz
Section 2.5 Exemption limits		
Exemption Frequency	<300	MHz
Exemption Distance	<5	mm
Exemption Limit	71	mW
Radiated Carrier Power	-7.7	dBµV/m
Measurement Distance	300	meters
EIRP	0.51	nW
Exempt		