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Date	26 <sup>th</sup> Aug 2021
EUT Description	Asset Tracker
FCC ID	2AT4VSKALLI1RM
IC ID	26629-SKALLIR2
Authorised by	Paul Reilly
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## **TEST SUMMARY**

The equipment complies with the requirements according to the following standards.

FCC 15.247 Section	RSS-247 Section	TEST PARAMETERS	Test Result
15.247 (a)2	RSS-247 5.2a	6dB bandwidth	Pass
15.247 (e)	RSS-247 5.2b	Power Spectral Density	Pass
15.247 (b)3	RSS-247 5.4d	Output power Conducted	Pass
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Pass
15.205 15.209	RSS Gen 8.9 RSS Gen 8.10	Radiated Spurious Emissions	Pass
	RSS Gen 6.7	99% bandwidth	Pass

RSS 247-2 (Feb 2017) RSS Gen Issue5 Amd 2 (Feb 2021)

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF COMPLIANCE ENGINEERING IRELAND LTD

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## 1.0 EUT Description

FCC ID	2AT4VSKALLI1RM
IC ID	26629-SKALLI1RM
Model:	2EE-2707AB
HVIN:	2EE-2707AB
PMN:	Skalli1RM
Туре:	Asset Tracker
Type of radio:	Stand-alone

Sigfox			
Transmitter Type:	D-BPSK		
Classification:	DSS		
Operating Frequency Range(s):	902.138MHz -904.663 MHz		
Number of Channels:	Hopping on 54 channels (902.138 – 904.663 MHz)		
Antenna:	Integral		
Transmitter power configuration:	3.6 VDC Internal Battery (non-rechargeable)		
Sigfox Antenna Type :	Folded metal antenna		
Sigfox Antenna Gain Max:	3.86dBi		
Sigfox Antenna Impedance:	50 ohms		
Test Standards:	15.247 RSS-247		
Test Methodology:	Measurements performed according to the procedures in		
	ANSI C63.10-2013		
	KDB 558074 V5 R02		

BLE	
Type of radio:	Stand-alone
Transmitter Type:	BLE
Operating Frequency Range(s):	2.402 GHz - 2.480GHz
Number of Channels:	40
Power configuration:	3.7v Battery.
Ports:	None
Classification:	DTS
BLE Antenna Type :	Pcb printed antenna
BLE Antenna Gain Max:	0.9 dBi
Antenna Impedance:	50 ohms
Test Standards:	15.247 RSS-247
Test Methodology:	Measurements performed according to the procedures in
	ANSI C63.10-2013
	KDB 558074 V5 R02

The EUT was an asset tracker reporting on the 915 MHz band over the Sigfox network

The EUT also contained a custom BLE radio.

This report details test carried out on the BLE transmitter.

## 1.1 EUT Operation Operating Conditions during Test:

Conducted measurements were carried out on a sample (Sample #Y) where the antenna was replaced by cable and SMA.

The EUT was operated in test mode where the channel and modulation was set via USB connection from the EUT to a laptop.

The EUT was powered from a bench PSU set to 3.6Vdc. for all conducted tests

Radiated measurements were performed on a sample (Sample #Z) with standard internal antenna with the EUT powered from its (new) internal battery.

## **Environmental conditions**

	Temperature	<b>Relative Humidity</b>
Test	°C	%
Conducted Emissions	21.2	49
Radiated Emissions <1GHz	18	42
Radiated Emissions >1GHz	19	47

## 1.2 Modifications

No modifications were required in order to pass the test specifications.

## 1.3 Date of Test

The tests were carried out on 7<sup>th</sup> 8<sup>th</sup> 27<sup>th</sup> Jul and 13<sup>th</sup> Aug 2021.

## 1.4 Description of Test modes

Channel List

Channel	Channel	Freq MHz
Low	1	2402
	2	2404
Mid	19	2440
High	39	2480

All tests were performed with the EUT on the low mid and high channels.

## 2 Emissions Measurements

## 2.1 Conducted Emissions Measurements

Radio Conducted measurements were carried out on the EUT as per section 1.1 above.

All results were measured as conducted on the antenna except radiated spurious emissions.

## 2.2 Radiated Emissions Measurements

Radiated Power measurements were made at the Compliance Engineering Ireland Ltd anechoic chamber located in Dunshaughlin, Co. Meath, Ireland to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

The EUT was centred on a motorized turntable, which allows 360 degree rotation.

Emissions below 1GHz were measured using a test antenna positioned at a distance of 3 metres from the EUT (as measured from the closest point of the EUT). The radiated emissions were maximised by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 metres. In this case the resolution bandwidth was 100kHz. Emissions in the 1GHz-3.6GHz range were measured using a horn antenna located at 3 metres distance from the EUT in a fully anechoic chamber.

The radiated emissions were maximised by configuring the EUT and by rotating the EUT, and by raising and lowering the test antenna from 1 to 4 metres.

Emissions above 3.6GHz were measured using a horn antenna located at 1 metre distance from the EUT in a fully anechoic chamber. The radiated emissions were maximised by configuring the EUT and by rotating the EUT and raising the test and antenna from 1 to 4 metres.

In this case the resolution bandwidth was 1MHz and video bandwidth was 3 MHz. for peak measurements. The Video bandwidth was changed to 10Hz for Average measurements (as per ANSI 63.10 2013 Section 4.1.4.2.3)

A pre-scan was performed to determine the worst case EUT orientation for the radiated measurements.

All radiated tests were performed with the EUT in orientation O3 for Horizontal polarization measurements and with the EUT in orientation O2 for Vertical polarisation measurements.

Ref Appendix D for orientations.

## 3.0 Results for Conducted emissions on the mains

Test not performed as the host for the EUT is battery powered only

#### **Conducted Measurements**

## 4.1 Bandwidth

#### 4.1.1 6dB bandwidth

Test Method As per Ansi 63.10 Section 11.8.2

#### Ansi63.10 Section 11.8.2 Option 2

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described in 11.8.1 (i.e., RBW = 100 kHz, VBW  $\ge$  3 × RBW, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be  $\ge$ 6 dB. Limit for 6dB Bandwidth = 500KHz min

10 dBm       M1       Bw       672.900000000 kHz         0 dBm       T1       Q factor       3569.5         0 dBm       T1       Q       10         -10 dBm       -20 dBm       -20 dBm       -20 dBm       -20 dBm         -20 dBm       -30 dBm       -30 dBm       -40 dBm       -40 dBm       -40 dBm         -50 dBm       -50 dBm       -50 dBm       -50 dBm       -50 dBm       -50 dBm         -70 dBm       -691 pts       Span 5.0 MHz       -50 MHz	Receiver	Spe	ctrum 🗷				
PS  10 km  10 dm  10 dm  10 dm  10 dm  10 dm  11  1  1  1  1  1  1  1  1  1  1  1						T Innet 140	
1Pk Max       ndB       6.00 dB         10 dBm       10       0 factor       3569.5         0 dBm       10       0 factor       3569.5         -10 dBm       10       10       10       10         -20 dBm       10       10       10       10       10         -20 dBm       10       10       1       1       1       1         2.0 dBm       10       1       <		30 aB	<b>SMI</b> 18.9 µs	SUU KHZ	MOGE AUTO FF	I Input I AC	
10 dBm     M1     Bw     672.900000000 kHz       0 dBm     71     Q factor     3569.5       0 dBm     1     2.000000000000000000000000000000000000	01Pk Max						
0 dBm     10 dBm <td>10 dBm</td> <td></td> <td></td> <td>5.41</td> <td>Bw</td> <td></td> <td></td>	10 dBm			5.41	Bw		
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-20 dBm -30 dBm -40 dBm -40 dBm -50 dBm -50 dBm -60 dBm -70	0 dBm			7	<u> </u>		
-20 dBm -30 dBm -40 dBm -40 dBm -50 dBm -50 dBm -60 dBm -70	-10 dBm				- V		
-30 dBm -40 dBm -40 dBm -50 dBm -50 dBm -60 dBm -70				1	$\sum$		
-40 dBm	-20 dBm			/			
-50 dBm       -50 dBm       -60 dBm       -60 dBm       -60 dBm       -70 dBm	-30 dBm					-	
-50 dBm       -50 dBm       -60 dBm       -60 dBm       -60 dBm       -70 dBm							
-60 dBm     -60 dBm     Image: Constraint of the second se	-40 dBm						
-70 dBm     -70 dBm     Image: Span 5.0 MHz       GF 2.4020217 GHz       691 pts       Span 5.0 MHz       Marker       Type     Ref     Trc     X-value     Y-value     Function     Function Result       M1     1     2.4020217 GHz     5.33 dBm     ndB down     672.9 kHz	-50 dBm						
-70 dBm     -70 dBm     Image: Span 5.0 MHz       GF 2.4020217 GHz       691 pts       Span 5.0 MHz       Marker       Type     Ref     Trc     X-value     Y-value     Function     Function Result       M1     1     2.4020217 GHz     5.33 dBm     ndB down     672.9 kHz							
CF 2.4020217 GHz         691 pts         Span 5.0 MHz           Marker         Yarker         Yarker           Type         Ref         Trc         X-value         Y-value         Function         Function Result           M1         1         2.4020217 GHz         5.33 dBm         ndB down         672.9 kHz	-60 dBm						
Marker           Type         Ref         Trc         X-value         Y-value         Function         Function Result           M1         1         2.4020217 GHz         5.33 dBm         ndB down         672.9 kHz	-70 dBm						
Marker         Year         Year         Function         Function Result							
Type         Ref         Trc         X-value         Y-value         Function         Function Result           M1         1         2.4020217 GHz         5.33 dBm         ndB down         672.9 kHz	CF 2.40202	17 GHz	· ·	691 pt	s		Span 5.0 MHz
M1 1 2.4020217 GHz 5.33 dBm ndB down 672.9 kHz	Marker						
				ALL TO CONTRACTO		Func	
11 I 2.40166/1 GHz -0.69 dBm ndB 6.00 dB			(3) Math. Ecological and Colling States (1) 101-101				
Fig 1 6dB Bandwidth		1	2.4016671 GHz				6.00 dB

Frequency	6dB Bandwidth	Limit Min	Margin
GHz	KHz	KHz	KHz
2.402	672.9	500	172.9
2.44	665.7	500	165.7
2.48	672.9	500	172.9

**Result :- Pass** 

4.

#### 4.1.2 99% bandwidth

Test Method

As per Ansi 63.10 Section 6.9.3

Ansi63.10 Section 6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Receiver	S⊧	oectrum 🗴 S	pectrum 2 🛛 🗷				
Ref Level	20.00 dBr	m Offset 10.00 dB	🔵 RBW 🛛 30 kHz				
Att	25 d	В <b>SWT</b> 63.2 µs	🔵 <b>VBW</b> 100 kHz	Mode Auto FF	T Input 1 AC	l D	
⊖1Rm Max							
				Occ Bw		1.0202604	92 MHz
10 dBm							
10 dbm			M1				
0 dBm			- m	~ ^ _			
		Τ1	N I		T2		
-10 dBm		<u> </u>	÷.	- h	X		
-20 dBm							
-30 dBm					5	~	
-30 UBIII	$\sim$					N V	
-40 dBm						- Nu	
~~~							m
-50 dBm							
-60 dBm							
-00 ubiii							
-70 dBm							
, o abiii							
CF 2.44001	2 0 4 2		691 pts			Span 3.	
Marker			091 pt:	3			
Type   Ref	Trc	X-value	Y-value	Function	Eusy	ction Result	
M1	1	2.440013 GHz	1.99 dBm	runction	Fun	Scion Result	
T1	1	2.43952241 GHz	-12.24 dBm	Occ Bw		1.02026049	2 MHz
T2	1	2.44054267 GHz	-12.47 dBm				
			Fig 2 99% Ba	andwidth			

Frequency	99% Bandwidth
GHz	MHz
2.402	1.016
2.44	1.020
2.48	1.020

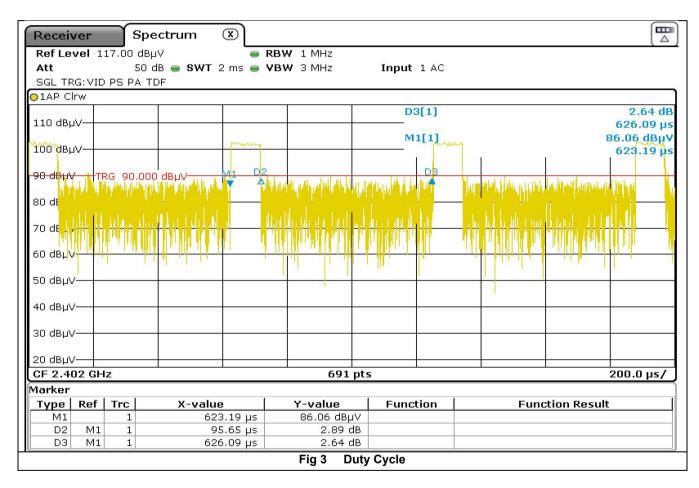
#### 4.2 Duty Cycle

Test Method

As per Ansi 63.10 Section 11.6 KDB 558074 zero span measurement method

# Ansi63.10 Section **11.6 Duty cycle (***D***), transmission duration (***T***), and maximum power control level**

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).



KDB 558074 D01 FAQ section

## Duty Cycle =

Note the duty cycle results above shows how the sample operated during testing.

One Period uS	Pulse Width uS	Duty Cycle	10 log duty cycle for Power Averaging (dB)
626.09	95.65	0.153	-8.16

#### 4.3 **Power Spectral Density**

Test Method As per Ansi 63.10 Section 11.10.2

#### Ansi63.10 Section Section 11.10.2 Method PKPSD (peak PSD)

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz  $\leq$  RBW  $\leq$  100 kHz.

- d) Set the VBW  $\geq$  [3 × RBW].
- e) Detector = peak.

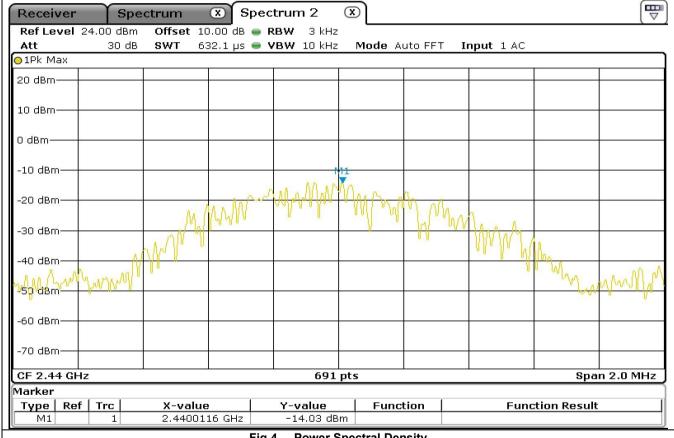
f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.



#### Fig 4 Power Spectral Density

Frequency	Measurement	Conducted Peak	Limit	Margin
GHz	dBm	dBm	dBm	dB
2.402	-14.22	-14.22	8	22.22
2.44	-14.03	4.67	8	3.33
2.48	-13.03	4.49	8	3.51

**Result :- Pass** 

#### 4.4 Output power Conducted

4.4.1 Test Method

As per Ansi 63.10 Section 11.9..1.1

#### Ansi63.10 Section 11.9.1.1 RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.

b) Set VBW ≥ [3 × RBW].

c) Set span  $\geq$  [3 × RBW].

d) Sweep time = auto couple.

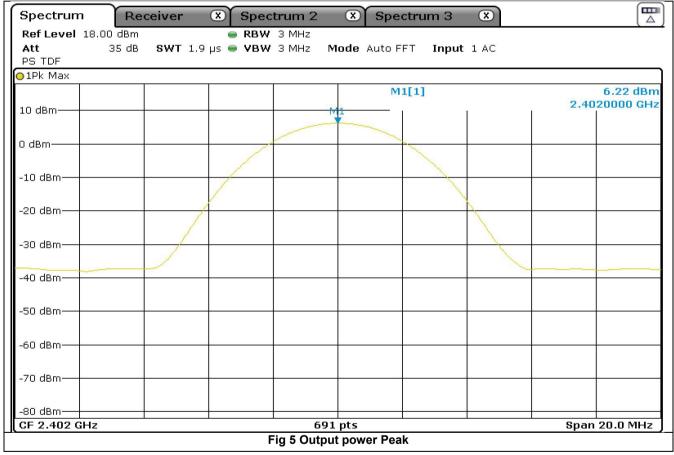
e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use peak marker function to determine the peak amplitude level.

#### 4.4.2 Results



	Conducted		
Frequency	Measurement Peak	Limit	Margin
GHz	dBm	dBm	dB
2.402	6.22	30	23.78
2.44	6.19	30	23.81
2.48	6.38	30	23.62

**Test Result :- Pass** 

#### 5. Spurious Emissions Measurements

#### 5.1 Conducted Emissions

5.1.1 Test Method As per Ansi63.10 Section 11.11.1 and 6.10.4

#### Ansi63.10 Section 11.11.1 General

Typical regulatory requirements specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions<sup>89</sup>: a) If the maximum peak conducted output power procedure was used to determine compliance as described in 11.9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

#### Ansi63.10 Section 6.10.4 Authorized-band band-edge measurements (relative method)

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

Frequency	Peak 100KHz RBW	Measured	Limit Min	Margin
GHz	dBm	dBc	dBc	dB
2.402	6.15	0	20	-
4.804	-60.3	66.45	20	46.45
7.206	-54.12	60.27	20	40.27
9.608	-66.49	72.64	20	52.64
12.01	-54.85	61	20	41

#### 5.1.2 Results

	Peak 100KHz			
Frequency	RBW	Limit Min	Limit Min	Margin
GHz	dBm	dBc	dBc	dB
2.44	6.05	0	20	-
4.88	-59.85	65.9	20	45.9
7.32	-56.19	62.24	20	42.24
9.76	-65.29	71.34	20	51.34
12.2	-57.18	63.23	20	43.23

Frequency	Peak 100KHz RBW	Limit Min	Limit Min	Margin
GHz	dBm	dBc	dBc	dB
2.48	6.24	0	20	-
4.96	-56	62.24	20	42.24
7.44	-57.53	63.77	20	43.77
9.92	-62.55	68.79	20	48.79
12.4	-57.93	64.17	20	44.17
14.878	-53.86	60.1	20	40.1

Ref Appendix A for Scans

Test Result: - Pass

## 5.2 Radiated Spurious Emissions in Restricted bands

#### 5.2.1 Test Method

As per Ansi63.10 Section 11.12.1 and 6.10.5

#### Ansi63.10 Section 11.12.1 Radiated emission measurements

Because the typical emission requirements are specified in terms of radiated field strength levels, measurements performed to determine compliance have traditionally relied on a radiated test configuration.<sup>92</sup> Radiated measurements remain the principal method for determining compliance to the specified requirements; however antenna-port conducted measurements are also now acceptable to determine compliance (see 11.12.2 for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in 6.3, 6.5, and 6.6 shall be followed

#### 6.10.5 Restricted-band band-edge measurements

These procedures are applicable for determining compliance at band edges of restricted bands.

### 6.10.5.1 Test setup

Restricted-band band-edge tests shall be performed as radiated measurements, on a test site meeting the specifications in 5.2 at the measurement distances specified in 5.3.57

The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors specified in 4.1.4.2. Considering the requirements of 5.8, the antenna(s) shall be connected to the antenna ports. When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3, and the relevant procedure in 6.4, 6.5, or 6.6

#### As per Ansi 63.10 Section 11.12.2.5.2

## 11.12.2.5.2 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT ( $D \ge 98\%$ ) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%), then the following procedure shall be used:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle D of the transmitter output signal as described in 11.6.

c) RBW = 1 MHz (unless otherwise specified).

d) VBW ≥ [3 \*RBŴ].

e) Detector = RMS (power averaging), if span / (# of points in sweep)  $\leq$  (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak. f) Averaging type = power (i.e., rms):

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows: 1) If power averaging (rms) mode was used in step f), then the applicable correction factor is  $[10 \log (1 / D)]$ , where D is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is [20 log (1 / D)], where D is the duty cycle.

3) If a specific emission is demonstrated to be continuous ( $D \ge 98\%$ ) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Reduction of the measured emission amplitude levels to account for operational duty cycle is not permitted. Determining compliance is based on emission levels occurring during transmission; it is not based on an average across ON and OFF times of the transmitter

One Period uS	Pulse Width uS	Duty Cycle	10 log duty cycle for Power Averaging (dB)
626.09	95.65	0.153	-8.16

#### Duty cycle correction factor =8.16dB for average measurements

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Frequency	Measured Peak Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Peak Level	Average Limit +20dB	Margin
4.804	47.7	32.4	37.1	5.2	Vertical	0.00	48.2	74	25.8
12.010	40.8	40.3	36.5	7.8	Vertical	0.00	52.4	74	21.6
4.804	47.4	32.4	37.1	5.2	Horizontal	0.00	47.9	74	26.2
12.010	39.8	40.3	36.5	7.8	Horizontal	0.00	51.4	74	22.7

Frequency	Measured Peak Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Peak Level	Average Limit +20dB	Margin
4.880	47.2	32.4	37.3	5.2	Vertical	0.00	47.5	74	26.5
7.320	50.1	37.7	38	6.7	Vertical	0.00	56.5	74	17.5
12.200	39.5	40.3	37.7	8.9	Vertical	0.00	51.0	74	23.0
4.880	47.4	32.4	37.3	5.2	Horizontal	0.00	47.7	74	26.3
7.320	49.2	37.7	38	6.7	Horizontal	0.00	55.6	74	18.4
12.200	39.5	40.3	37.7	8.9	Horizontal	0.00	51.0	74	23.0

Frequency	Measured Average Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Average Level	Average Limit	Margin
7.320	33.6	37.7	38	6.7	Vertical	8.16	48.2	54	5.8
7.320	26.9	37.7	38	6.7	Horizontal	8.16	41.5	54	12.5

Frequency	Measured Peak Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Peak Level	Average Limit +20dB	Margin
4.960	47.7	33.5	37.4	5.4	Vertical	0.00	49.2	74	24.8
7.440	50.6	37.7	37.5	6.3	Vertical	0.00	57.1	74	17.0
12.400	39.6	40.3	36.4	8.0	Vertical	0.00	51.5	74	22.5
4.960	48.3	33.5	37.4	5.4	Horizontal	0.00	49.8	74	24.2
7.440	48.6	37.7	37.5	6.3	Horizontal	0.00	55.1	74	18.9
12.400	39.2	40.3	36.4	8.0	Horizontal	0.00	51.1	74	23.0

Frequency	Measured Average Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Average Level	Average Limit	Margin
7.440	34.0	37.7	37.5	6.3	Vertical	8.16	48.6	54	5.4
7.440	27.6	37.7	37.5	6.3	Horizontal	8.16	42.2	54	11.8

Note the final average measurements include the duty cycle correction factor (which has been added to the measured result)

Test Result: - Pass

## 5.3 Radiated Band Edge / Restricted band Measurements

#### 11.13.3.2 Peak detection

When using a peak detector to measure unwanted emissions at or near the band edge (within 2 MHz of the authorized band), the following integration procedure can be used:

a) Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).

b) Set span to 2 MHz.

c) RBW = 100 kHz.

d) VBW  $\geq$  [3 × RBW].

e) Detector = peak.

f) Sweep time = auto.

g) Trace mode = max hold.

h) Allow sweep to continue until the trace stabilizes (required measurement time may increase for low-duty-cycle applications).

i) Compute the power by integrating the spectrum over 1 MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency ( $f_{emission}$ ) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by  $f_{emission} \pm 0.5$  MHz.

## 11.13.3.4 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT ( $D \ge 98\%$ ) cannot be achieved and the duty cycle is constant (duty cycle variations are less ±2%), then the following procedure may be used to measure the average power of unwanted emssions within 2 MHz of the authorized band edge:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle D of the transmitter output signal as described in 11.6.

c) Set instrument center frequency to the frequency of the emission to be measured.

d) Set span to 2 MHz.

e) RBW = 100 kHz.

f) VBW  $\geq$  3 × RBW.

g) Detector = RMS (power averaging), if [span / (# of points in sweep)]  $\leq$  (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

h) Averaging type = power (i.e., rms):

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.

i) Sweep time = auto.

j) Perform a trace average of at least 100 traces.

 $\dot{k}$ ) Compute the power by integrating the spectrum over 1 MHz using the instrument's band power measurement function with band limits set equal to the emission frequency ( $f_{emission}$ ) ± 0.5 MHz. If the spectrum analyzer does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by  $f_{emission}$  ± 0.5 MHz.

I) A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

1) If power averaging (rms) mode was used in step f), then the applicable correction factor is  $[10 \log (1 / D)]$ , where D is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is  $[20 \log (1 / D)]$ , where D is the duty cycle.

3) If a specific emission is demonstrated to be continuous ( $D \ge 98\%$ ) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Reduction of the measured emission amplitude levels to account for operational duty cycle is not permitted. Determining compliance is based on emission levels occurring during transmission—it is not based on an average across ON and OFF times of the transmitter.

Frequency	Measured Peak Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Peak Level	Average Limit +20dB	Margin
GHz	dBuV/m	dB	dB	dB	V/H	dB	dBuV/m	dBuV/m	dB
2.310	53.3	27.4	39.2	3.4	Vertical	0.00	44.9	74	29.1
2.390	62.4	27.4	38.5	3.5	Vertical	0.00	54.8	74	19.2
2.400	79.3	27.4	38.5	3.5	Vertical	0.00	71.7	74	2.3
2.310	49.3	27.4	39.2	3.4	Horizontal	0.00	40.9	74	33.1
2.390	62.3	27.4	38.5	3.5	Horizontal	0.00	54.7	74	19.3
2.400	79.1	27.4	38.5	3.5	Horizontal	0.00	71.5	74	2.5

## 5.3.1 Result Radiated Restricted Band and band edge near 2.4 GHz band

Frequency	Measured Average Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Average Level	Average Limit	Margin
GHz	dBuV/m	dB	dB	dB	V/H	dB	dBuV/m	dBuV/m	dB
2.310	39.0	27.4	39.2	3.4	Vertical	8.16	38.8	54	15.3
2.338	39.9	27.4	39.2	3.4	Vertical	8.16	39.6	54	14.4
2.369	39.5	27.4	38.5	3.5	Vertical	8.16	40.1	54	13.9
2.390	39.0	27.4	38.5	3.5	Vertical	8.16	39.6	54	14.4
2.400	51.2	27.4	38.5	3.5	Vertical	8.16	51.8	54	2.2
2.310	39.0	27.4	39.2	3.4	Horizontal	8.16	38.8	54	15.2
2.338	42.6	27.4	39.2	3.4	Horizontal	8.16	42.3	54	11.7
2.369	42.2	27.4	38.5	3.5	Horizontal	8.16	42.7	54	11.3
2.390	39.4	27.4	38.5	3.5	Horizontal	8.16	39.9	54	14.1
2.400	52.3	27.4	38.5	3.5	Horizontal	8.16	52.8	54	1.2

Frequency	Measured Peak Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Peak Level	Average Limit +20dB	Margin
GHz	dBuV/m	dB	dB	dB	V/H	dB	dBuV/m	dBuV/m	dB
2.4835	67.2	28.7	38.3	3.4	Vertical	0.00	61.0	74	13.0
2.500	54.0	28.7	38.3	3.4	Vertical	0.00	47.8	74	26.2
2.4835	66.8	28.7	38.3	3.4	Horizontal	0.00	60.6	74	13.4
2.500	53.8	28.7	38.3	3.4	Horizontal	0.00	47.6	74	26.4

Frequency	Measured Average Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Duty Cycle Correction	Final Average Level	Average Limit	Margin
GHz	dBuV/m	dB	dB	dB	V/H	dB	dBuV/m	dBuV/m	dB
2.4835	49.3	28.7	38.3	3.4	Vertical	8.16	51.3	54	2.7
2.500	39.3	28.7	38.3	3.4	Vertical	8.16	41.2	54	12.8
2.4835	48.6	28.7	38.3	3.4	Horizontal	8.16	50.5	54	3.5
2.500	40.1	28.7	38.3	3.4	Horizontal	8.16	42.1	54	11.9

Note the final average measurements include the duty cycle correction factor (which has been added to the measured result)

Test Result: - Pass

Frequency	Measured Peak Level	Antenna Polarity	Antenna Factor	Preamp Gain	Cable Loss	Final Peak Level	Power	Limit	Margin
GHz	dBuV/m	V/H	dB	dB	dB	dBuV/m	dBm	dB	dB
2.402	14.3	Vertical	27.4	38.5	3.5	101.9	6.7	36	29.3
2.402	14.5	Horizontal	27.4	38.5	3.5	102.1	6.9	36	29.1
2.440	14.4	Vertical	27.4	38.5	3.5	102	6.8	36	29.2
2.440	14.7	Horizontal	27.4	38.5	3.5	102.3	7.1	36	28.9
2.480	13.0	Vertical	28.7	38.3	3.4	102	6.8	36	29.2
2.480	13.4	Horizontal	28.7	38.3	3.4	102.4	7.2	36	28.8

## 5.4 Radiated Power at fundamental

Note the Radiated field strength was measured at 3 metres and the conversion formula below was used to determine the EIRP in dBm  $EIRP (dBm) = E_{3m} (dBuV/m) - 95.2$ 

## 6 List of Test Equipment

Instrument	Manufacturer	Model	Serial Num	CEI Ref	Cal Due Date	Cal Interval Months
Spectrum Analyser 30Hz-40GHz	Rohde & Schwarz	FSP40	100053	850	11-Dec-21	36
Test Receiver 3.6GHz	Rohde & Schwarz	ESR	1316.3003k03- 101625-s	869	28-May-23	36
Antenna Biconical	Schwarzbeck	VHBB 9124	9124 667	871	30-Sep-21	36
Antenna Horn	EMCO	3115	9905-5809	655	13-Dec-21	24
Anechoic Chamber	CEI	SAR 10M	845	845	16-May-22	36
Antenna Log Periodic	Chase	UPA6108	1072	609	03-Sep-21	36
Fully Anechoic Chamber	CEI	FAR 3M	906	906	23-Jul-22	36
Microwave Preamplifier	Hewlett Packard	83017A	3123A00175	805	30-Sep-21	12
Antenna Horn Standard Gain 18- 26.5GHz	A-Info	LB-42-25-C-KF	J2021091103028	877	16-May-22	12

#### 7 Measurement Uncertainties

Measurement	Uncertainty
Radio Frequency	+/- 5x10 <sup>-7</sup>
Maximum Frequency Deviation	+/- 1.7 %
Conducted Emissions	+/- 1 dB
Radiated Emission 30MHz-100MHz	+/- 5.3 dB
Radiated Emission 100MHz-300MHz	+/- 4.7 dB
Radiated Emission 300MHz-1GHz	+/- 3.9 dB
Radiated Emission 1GHz-40GHz	+/- 3.8 dB
Modulation bandwidth	+/- 5x10 <sup>-7</sup>
Duty Cycle	+/- 5 %
Power supply	±0.1 VDC
Temperature	±0.2 °C
Frequency	±0.01 ppm

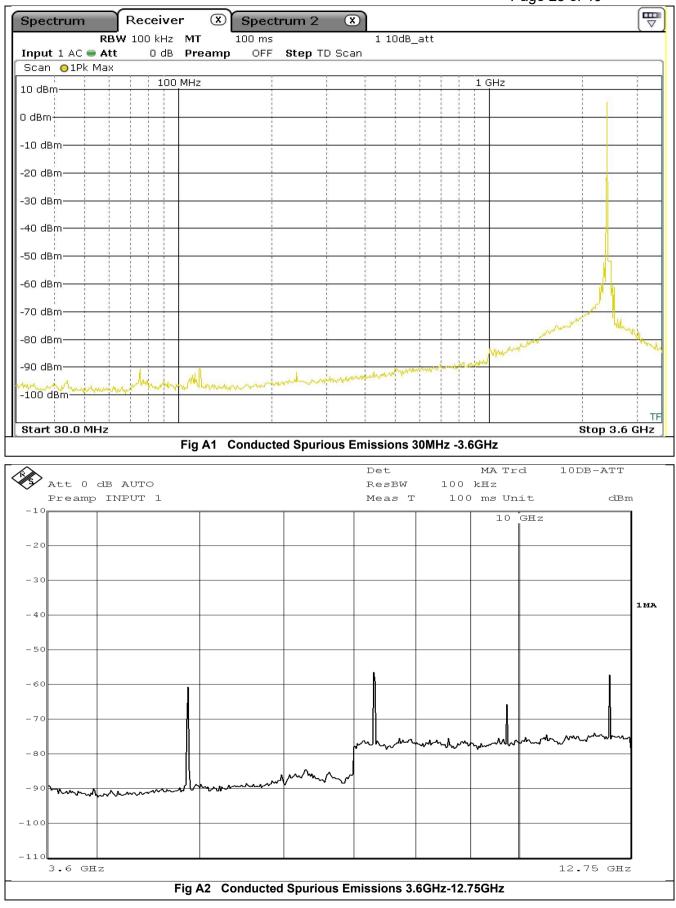
The measurement uncertainties stated were calculated with a k=2 for a confidence level of over 95% as per ETS TR100 028.

The test data can be compared directly to the specification limit to determine compliance, as the calculated measurement uncertainty meets the requirements of the applicable specification.

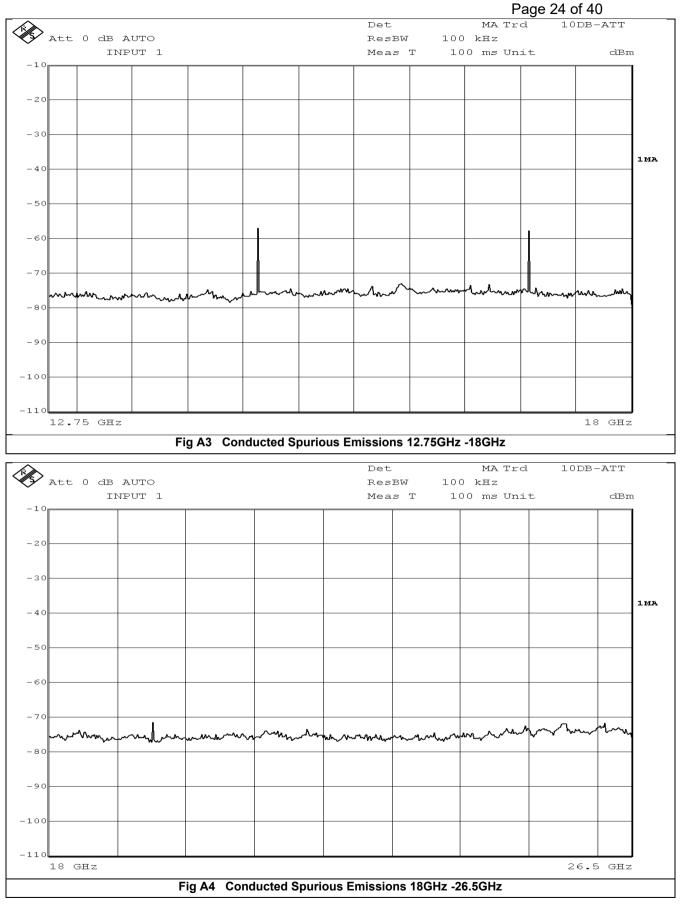
## Appendix A

## Conducted Measurements on the Antenna Port

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	ceiver	X Spec	trum 2	🗴 Spec	trum 3	×		
Ref Level 18.00 dBm Att 35 dB TDF	<b>SWT</b> 18.	e RBV 9 μs e VBV	✔ 100 kHz ✔ 300 kHz	Mode Auto	FFT Inp	out 1 AC		
⊖1Pk Max								
10 dBm				M1	[1]	I	2.440	6.05 dBm 00780 GHz
0 dBm								
-10 dBm			<u></u>		<u> </u>			
-20 dBm								
-30 dBm								
-40 dBm								
-50 dBm								
-60 dBm								
-70 dBm								
-80 dBm				a				
CF 2.4400078 GHz			691				Spa	n 1.0 MHz
		Fig A5	Carrier po	ower 100KHz	z RBW			

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Spectrum F	Receiver	× Spec	trum 2	🗴 Spe	ctrum 3	X		
Ref Level 15.00 dB			₩ 100 kHz					
TDF	3B <b>SWT</b> 18.9	a ha 👝 AR	N 3UU KHZ	Mode Aut		nput 1 AC		
⊖1Pk Max		I	1		2 F 2 F			5.04.15
10 dBm				M	1[1]		2.40	5.31 dBm 20140 GHz
0 dBm				M	2[1]			35.09 dBm
					1	Ĩ	2.40	00000 GHz
-10 dBm								
-20 dBm								
-30 dBm						M2	1	×
-40 dBm	_			~ ~	~~~~		Υ	
-50 dBm	m	han	m		$\sim$			
-60 dBm								
-70 dBm								×
-80 dBm			601	nte			Eton	2.403 GHz
Marker			691	pts			stup.	2.403 GHZ
Type   Ref   Trc	X-value		Y-value	Func	tion	Fun	ction Result	
M1 1 M2 1	2.40203	14 GHz .4 GHz	5.31 dB -35.09 dB					
D3 M1 1		L4 MHz	-52.49 c					
	Fig	JA4 Lowe	r Band Edge	Low Chan	nel Condi	ucted		
			-					
Receiver S	pectrum	ത						Ē
Receiver S		×	RBW 100 kH					
RefLevel 12.00 dB Att 20 d	m Offset 10	).00 dB 🔵 I		z			:	
RefLevel 12.00 dB Att 20 d PS	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z			:	
Ref Level 12.00 dB Att 20 c PS 1Pk Max	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z			:	
Ref Level         12.00 dB           Att         20 d           PS	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level 12.00 dB Att 20 c PS 1Pk Max M1 0 dbm	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         20 d           1Pk Max         20 d           M1         20 dBm	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         20 d           1Pk Max         20 d           M1         20 dBm           -10 dBm         -10 dBm	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         1Pk Max           IPk Max         0 dBm           -10 dBm         -20 dBm           -30 dBm         -30 dBm	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         1Pk Max           IPk Max         0 dBm           -10 dBm         -20 dBm           -30 dBm         -40 dBm	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         1Pk Max           IPk Max         0 dBm           -10 dBm         -20 dBm           -30 dBm         -30 dBm	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         1Pk Max           IPk Max         0 dBm           -10 dBm         -20 dBm           -30 dBm         -40 dBm	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         1Pk Max           IPk Max         0 dBm           -10 dBm         -           -20 dBm         -           -30 dBm         -           -40 dBm         -	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level         12.00 dB           Att         20 d           PS         1Pk Max           IPk Max         1           0 dBm         -           -10 dBm         -           -20 dBm         -           -30 dBm         -           -40 dBm         -           -50 dBm         -	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z				
Ref Level       12.00 dB         Att       20 dF         PS       1Pk Max         IPk Max       0 dBm         -10 dBm       -         -20 dBm       -         -30 dBm       -         -40 dBm       -         -50 dBm       -         -60 dBm       -         -70 dBm       -         -80 dBm       -	m Offset 10	).00 dB 🔵 I	RBW 100 kH	z Mode				M3
Ref Level       12.00 dB         Att       20 dF         PS       1Pk Max         IPk Max       0 dBm         -10 dBm       -         -20 dBm       -         -30 dBm       -         -40 dBm       -         -50 dBm       -         -60 dBm       -         -80 dBm       -         Start 2.4795 GHz       -	m Offset 10	).00 dB 🔵 I	<b>RBW</b> 100 kH	z Mode				
Ref Level       12.00 dB         Att       20 dF         PS       1Pk Max         IPk Max       0 dBm         -10 dBm       -         -20 dBm       -         -30 dBm       -         -40 dBm       -         -50 dBm       -         -60 dBm       -         -70 dBm       -         -80 dBm       -	m Offset 10 dB SWT 3	0.00 dB • I 37.9 μs • '	RBW 100 kH YBW 300 kH	z Mode	Auto FFT			M3
Ref Level       12.00 dB         Att       20 d         PS       20 d         1Pk Max       20 d         1Pk Max       20 d         1Pk Max       20 d         -10 dBm       -10 dBm         -20 dBm       -20 dBm         -30 dBm       -30 dBm         -40 dBm       -40 dBm         -50 dBm       -50 dBm         -60 dBm       -50 dBm         -80 dBm       -70 dBm         Start 2.4795 GHz       Marker         Type       Ref       Trc         M1       1	m Offset 10 dB SWT 3	0.00 dB • I 37.9 μs • '	RBW 100 kH VBW 300 kH 691 Y-value 5.85 dB	z Mode	Auto FFT		Stop :	M3
Ref Level 12.00 dB         Att       20 d         PS         1Pk Max         0 dBm         -10 dBm         -20 dBm         -30 dBm         -40 dBm         -50 dBm         -60 dBm         -80 dBm         Start 2.4795 GHz         Marker         Type       Ref   Trc	m Offset 10 #B SWT 3	0.00 dB • I 37.9 μs • '	RBW 100 kH YBW 300 kH	z Mode	Auto FFT		Stop :	M3

Appendix B

Radiated tests for Band Edges /Restricted band

Receive	er Spe	ectrum	×					
	RBW (0	CISPR) 1 M			5	655Rx		
Input 1	AC 🔵 Att	0	dB Prea	mp ON	I Step TD Scan			
Leve	Peak	dBµV			Frequenc	У	2.4020000 GH	1z
Max	Peak	92.99	-10		10	30	50	70
Scan O	1Pk Max	Γ					I	
90 dBµV-								
80 dBµV-								Ma
70 dBµV-								1
60 dBµV-							M2	~
50 dBµV-	M3 <b>X</b>			Ann	·····			-
40 dBµV-	~~~~~	~~~~		CA A P A				
30 dBµV-								-
20 dBµV-								
10 dBµV-								
Start 2.3	3 GHz						 Stop 2.402 (	GHz
Marker	- 12 An - An 12 (201							
Diagr	Type Ref	Trc	Stimu	lus	Response	Function	Function Result	
Scan	N1	1		2.4 GHz	71.73 dBµV			
Scan	N2	1		2.39 GHz	54.83 dBµV			
Scan	N3	1		2.31 GHz	44.94 dBµV			
	Fig B	1 Low C	Channel	Restricted	d Band /Band Edg	ge Vertical pe	ak at 3 metres	
Receive		s ater uss	×					
Receive	spe	ectrum	$\odot$					

Receive	Spe	ectrum				
		CISPR) 1 MHz		าร	655Rx	
Input 1	AC 🔵 Att	0 de	<b>Preamp</b> O	N Step TD Scan		
				Frequency	/(	2.4000000 GHz
Max	Peak	71.62	-10	10	30	50 70
Scan 🔾	1Pk Max	ī.				
90 dBµV-						
80 dBµV-						Mi
70 dBµV-						1
60 dBµV-						M2
50 dBµV-	M3				mm	
40 d8µ∨-	<u> </u>	h	man			
30 dBµV-						
20 dBµV-						
10 dBµV-						TF
Start 2.	3 GHz					Stop 2.402 GHz
Marker						-
Diagr	Type   Ref	Trc	Stimulus	Response	Function	Function Result
Scan	N1	1	2.4 GHz	71.52 dBμV		
Scan	N2	1	2.39 GHz			
Scan	N3	1	2.31 GHz	40.80 dBµV		
	Fig B2	Low Cha	nnel Restricted	I Band /Band Edge	Horizontal pe	eak at 3 metres

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Receiver	Spe	ectrum	®						
Ref Level				RBW 1 MHz					
Att SGL Count 1		IB 🔲 SWI 3 PS PA 1		VBW 3 MHz M	<b>100e</b> Auto	FFT Inpu	IT I AC		
⊖1Rm AvgPw	/r								
					M4	4[1]			1.92 dBµV
60 dBµV					MI	L[1]			69750 GHz 3.64 dBµV
50 dBµV						.[.+]			00000 GHz
									M
40 dBµV- MB	1		М	5		M4		M2	
30 dBµV									
20 dBµV									
10 dBµV									
Ο dBµV		-							
-10 dBµV——									
-20 dBµV—									
Start 2.3 GH	Hz			691	ots			Stop 2	.402 GHz
Marker								· · ·	
Type Ref		X-value		Y-value	Funct	ion	Fund	tion Result	
M1 M2	1		.4 GHz 39 GHz	43.64 dΒμ' 31.42 dΒμ'					
M3	1		39 GHZ	30.59 dBµ'					
M4	1	2.3697	75 GHz	31.92 dBµ'	7				
M5	1	2.33815		31.47 dBµʻ					
	Fig B3	Low Chan	nel Re	etrictod Rand /I			verage at :	3 motroe	
	U			Stricted Band /	sand Edge	Veilicaia	totago ut	5 metres	
Receiver			®		Sand Edge	Ventical a		Jinetres	
Receiver Ref Level	Spe	ectrum	×	RBW 1 MHz		Vertical a			
Ref Level • Att	<b>Spe</b> 72.00 dBµ 0 d	ectrum IV IB <b>e SWT</b> 3	(Я)	RBW 1 MHz	Mode Auto		nt 1 AC		
Ref Level Att SGL Count 1	<b>Spe</b> 72.00 dBµ 0 d 100/100	ectrum	(Я)	RBW 1 MHz					
Ref Level • Att	<b>Spe</b> 72.00 dBµ 0 d 100/100	ectrum IV IB <b>e SWT</b> 3	(Я)	RBW 1 MHz	Mode Auto	FFT Inpu			(
Ref Level Att SGL Count 1 1Rm AvgPw	<b>Spe</b> 72.00 dBµ 0 d 100/100	ectrum IV IB <b>e SWT</b> 3	(Я)	RBW 1 MHz	Mode Auto			3	(Δ 4.57 dΒμγ
Ref Level Att SGL Count 1	<b>Spe</b> 72.00 dBµ 0 d 100/100	ectrum IV IB <b>e SWT</b> 3	(Я)	RBW 1 MHz	Mode Auto	FFT Inpu		3 2.3 4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level Att SGL Count 1 1Rm AvgPw	<b>Spe</b> 72.00 dBµ 0 d 100/100	ectrum IV IB <b>e SWT</b> 3	(Я)	RBW 1 MHz	Mode Auto	FFT Inpu +[1]		3 2.3 4	(
Ref Level Att SGL Count 1 1Rm AvgPw 60 dBµV 50 dBµV	<b>Spe</b> 72.00 dBµ 0 d 100/100	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1]		3 2.3 4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level Att SGL Count 1 1Rm AvgPw 60 dBµV	5ре 72.00 dBµ 0 d 100/100 /r	ectrum IV IB <b>e SWT</b> 3	(Я)	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1]		3 2.3 4 2.4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level ● Att SGL Count 1 ● 1Rm AvgPw 60 dBµV 50 dBµV 40 dBµV	5ре 72.00 dBµ 0 d 100/100 /r	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level Att SGL Count 1 1Rm AvgPw 60 dBµV 50 dBµV 40 dBµV	5ре 72.00 dBµ 0 d 100/100 /r	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level SGL Count 1 P1Rm AvgPw 60 dBµV 50 dBµV 40 dBµV MB 30 dBµV	5ре 72.00 dBµ 0 d 100/100 /r	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level ● Att SGL Count 1 ● 1Rm AvgPw 60 dBµV 50 dBµV 40 dBµV 40 dBµV 20 dBµV 20 dBµV	5ре 72.00 dBµ 0 d 100/100 /r	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level ● Att SGL Count 1 ● 1Rm AvgPw 60 dBµV 50 dBµV 40 dBµV 40 dBµV 20 dBµV 10 dBµV	5ре 72.00 dBµ 0 d 100/100 /r	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level         ● Att       SGL Count 1         SGL Count 1       ●         ● 1Rm AvgPw       ●         60 dBµV       ●         50 dBµV       ●         40 dBµV       ●         30 dBµV       ●         20 dBµV       ●         10 dBµV       ●         -10 dBµV       ●	5ре 72.00 dBµ 0 d 100/100 /r	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level         ● Att       SGL Count 1         ● 1Rm AvgPw         60 dBµV         50 dBµV         40 dBµV         40 dBµV         20 dBµV         10 dBµV         -10 dBµV         -20 dBµV	Spe 72.00 dBµ 0 d 100/100	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4 M2	4.57 dBµV 59750 GHz 4.65 dBµV 00000 GHz
Ref Level         ● Att       SGL Count 1         SGL Count 1       ●         ● 1Rm AvgPw       ●         60 dBµV       ●         50 dBµV       ●         40 dBµV       ●         30 dBµV       ●         20 dBµV       ●         10 dBµV       ●         -10 dBµV       ●         -20 dBµV       ●         Start 2.3 GH       ●	Spe 72.00 dBµ 0 d 100/100	ectrum IV IB <b>e SWT</b> 3	8 μs • ' TDF	RBW 1 MHz VBW 3 MHz M	Mode Auto	FFT Inpu +[1] L[1] M4		3 2.3 4 2.4 M2	4.57 dBµV 59750 GHz 4.65 dBµV
Ref Level         ● Att       SGL Count 1         SGL Count 1       ●         ● 1Rm AvgPw       ●         60 dBµV       ●         50 dBµV       ●         40 dBµV       ●         30 dBµV       ●         20 dBµV       ●         10 dBµV       ●         -10 dBµV       ●         -20 dBµV       ●         Start 2.3 GH       ●	Spe 72.00 dBµ 0 d 100/100 /r	ectrum	× μs • Υ	RBW 1 MHz VBW 3 MHz 1	Mode Auto	FFT Inpu	t 1 AC	3 2.3 4 2.4 M2 V	4.57 dBµV 59750 GHz 4.65 dBµV 00000 GHz
Ref Level         ● Att       SGL Count 1         SGL Count 1       ●         ● 1Rm AvgPw       ●         60 dBµV       ●         50 dBµV       ●         40 dBµV       ●         30 dBµV       ●         20 dBµV       ●         10 dBµV       ●         -10 dBµV       ●         -20 dBµV       ●         Start 2.3 GH       ●         Marker          Type       Ref	72.00 dBµ 0 d 100/100 лг	ectrum	8 μs • 9 TDF	RBW 1 MHz VBW 3 MHz 1	Mode Auto	FFT Inpu	t 1 AC	3 2.3 4 2.4 M2	4.57 dBµV 59750 GHz 4.65 dBµV 00000 GHz
Ref Level         ● Att       SGL Count 1         SGL Count 1       ●         ● 1Rm AvgPw       ●         60 dBµV       ●         50 dBµV       ●         40 dBµV       ●         30 dBµV       ●         20 dBµV       ●         10 dBµV       ●         -10 dBµV       ●         -20 dBµV       ●         Start 2.3 GH       ●	Spe 72.00 dBµ 0 d 100/100 /r	ectrum	× μs • Υ TDF	RBW 1 MHz VBW 3 MHz M 5 5 691 j 691 j 44.65 dBµ	Mode Auto	FFT Inpu	t 1 AC	3 2.3 4 2.4 M2 V	4.57 dBµV 59750 GHz 4.65 dBµV 00000 GHz
Ref Level         ● Att       SGL Count 1         SGL Count 1       ●         ● 1Rm AvgPw       ●         60 dBµV       ●         50 dBµV       ●         40 dBµV       ●         30 dBµV       ●         20 dBµV       ●         10 dBµV       ●         -10 dBµV       ●         -20 dBµV       ●         Start 2.3 GH       ●         Marker       ■         Type       Ref	72.00 dBµ 0 d 100/100 /r Hz Нz	Ectrum	Х 18 µs 10 F 10 F	RBW 1 MHz VBW 3 MHz M 5 5 5 6 7 6 9 7 6 9 1 6 9 1 6 9 1 7 8 8 9 1 7 8 8 9 1 7 8 8 9 1 7 8 9 1 7 8 9 1 7 8 8 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1	Mode Auto	FFT Inpu	t 1 AC	3 2.3 4 2.4 M2 V	4.57 dBµV 59750 GHz 4.65 dBµV 00000 GHz
Ref Level         Att         SGL Count 1         1Rm AvgPw         60 dBµV         50 dBµV         40 dBµV         40 dBµV         20 dBµV         10 dBµV         -10 dBµV         -20 dBµV         Start 2.3 GH         Marker         Type       Ref         M1         M2         M3	Spe           72.00 dBµ           0 d           100/100           /r	Ectrum	Х 18 µs 10 F 10 F	RBW 1 MHz VBW 3 MHz M 5 5 5 5 6 7 691 p 691 p 7-value 44.65 dBµ' 31.78 dBµ' 30.60 dBµ' 34.57 dBµ'	Mode Auto Mode Auto M2 M2 M3 M3 M3 M3 M3 M3	FFT Inpu	t 1 AC	3 2.3 4 2.4 M2 V	4.57 dBµV 59750 GHz 4.65 dBµV 00000 GHz
Ref Level         ● Att       SGL Count 1         ● 1Rm AvgPw         ● 0 dBµV         60 dBµV         40 dBµV         40 dBµV         20 dBµV         10 dBµV         -10 dBµV         -20 dBµV         Start 2.3 GF         Marker         Type       Ref         M1         M2         M3	72.00 dBµ 0 d 100/100 /r Hz Нz	Ectrum W IB SWT 3 PS PA - PS PA -	Х 18 µs 10 F 10 F	RBW 1 MHz VBW 3 MHz M 5 5 5 6 7 6 9 7 6 9 1 6 9 1 6 9 1 7 8 8 9 1 7 8 8 9 1 7 8 8 9 1 7 8 9 1 7 8 9 1 7 8 8 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1	Mode Auto Mode Auto M2 M2 M2 M2 M2 M2 M2 M	FFT Inpu [1] [1] 		Stop 2	4.57 dBµV 59750 GHz 4.65 dBµV 00000 GHz

	Spectrum	X	-			
RBV Input 1 AC = Att	<b>V</b> (CISPR) 1 M 0	1Hz <b>MT</b> 10 dB <b>Preamp</b>	0 ms ON <b>Step</b> TD Sca	655Rx n		
Level	dBµV		Frequen	су	2.483	5000 GHz
Max Peak	68.03		10	30	50	• •
Scan 👴 1 Pk Max	T	-	T	Ī	-	
3 '90 dBµV						
80 двµv						
60 dBµV						
50 dвµV				M2		
40 dBµV					$\sim$	$\sim$
30 dвµV						
20 dBµV						
10 dBµV						
TF Start 2.48 GHz						Stop 2.51 GHz
Marker						
Diagr Type F Scan N1	Ref Trc 1	<b>Stimulus</b> 2.4835 G	Hz 61.02 dBµ	Function	Fun	ction Result
Scan N2	1	2.5 G 2.48 G	Hz 47.82 dBµ	V		
			Hz 91.57 dBµ		beak at 3 metr	] 'es
		<b>8</b>	0 ms	ACCDV		
	V (CISPR) 1 M		0 ms ON <b>Step</b> TD Sca	655Rx n		
RBV	V (CISPR) 1 M	1Hz <b>MT</b> 10 dB <b>Preamp</b>		n	2.5100	
RBV Input 1 AC - Att	V (CISPR) 1 M 0	1Hz MT 10 dB Preamp	ON Step TD Sca	n	2.510(	( <u>A</u>
RBV Input 1 AC • Att Level	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n CY	<u> </u>	0000 GHz
RBV Input 1 AC • Att Level Max Peak Scan • 1Pk Max 3	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n CY	<u> </u>	0000 GHz
RBV Input 1 AC • Att Level Max Peak Scan • 1Pk Max 3 '90 dBµV	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n CY	<u> </u>	0000 GHz
RBV Input 1 AC ● Att Level Max Peak Scan ●1Pk Max <sup>3</sup> 90 dBµV 80 dBµV	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n CY	<u> </u>	0000 GHz
RBV Input 1 AC ● Att Level Max Peak Scan ● 1Pk Max 3 90 dBµV- 80 dBµV- 70 dBµV- M1	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n CY	<u> </u>	0000 GHz
RBV         Input 1 AC ● Att         Level       Max Peak         Scan       ● 1Pk Max         3       *90 dBµV         80 dBµV       70 dBµV         70 dBµV       M1         60 dBµV       M1	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n CY	<u> </u>	0000 GHz
RBV Input 1 AC ● Att Level Max Peak Scan ● 1Pk Max 3 90 dBµV- 80 dBµV- 70 dBµV- 70 dBµV- 50 dBµV- 50 dBµV-	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n Cy 30	<u> </u>	0000 GHz
RBV         Input 1 AC ● Att         Level       Max Peak         Scan       ● 1Pk Max         3       90 dBµV         90 dBµV	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n Cy 30	<u> </u>	0000 GHz
RBV Input 1 AC ● Att Level Max Peak Scan ● 1Pk Max 3 90 dBµV- 80 dBµV- 70 dBµV- 70 dBµV- 50 dBµV- 50 dBµV-	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n Cy 30	<u> </u>	0000 GHz
RBV         Input 1 AC ● Att         Level         Max Peak         Scan ● 1Pk Max         3         90 dBµV         80 dBµV         80 dBµV         70 dBµV         60 dBµV         50 dBµV         40 dBµV         30 dBµV	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n Cy 30	<u> </u>	0000 GHz
RBV         Input 1 AC ● Att         Level         Max Peak         Scan ● 1Pk Max         3         90 dBµV         80 dBµV         80 dBµV         70 dBµV         60 dBµV         50 dBµV         30 dBµV         40 dBµV         20 dBµV         10 dBµV	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n Cy 30	<u> </u>	20000 GHZ 70
RBV         Input 1 AC ● Att         Level         Max Peak         Scan ● 1Pk Max         3         90 dBµV         80 dBµV         80 dBµV         70 dBµV         70 dBµV         50 dBµV         30 dBµV         30 dBµV         20 dBµV	(CISPR) 1 M 0 dBµV	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n Cy 30	<u> </u>	20000 GHz 70
RBV         Input 1 AC ● Att         Level       Max Peak         Scan       1Pk Max         3       90 dBµV         80 dBµV       80 dBµV         80 dBµV       90 dBµV         70 dBµV       10 dBµV         30 dBµV       10 dBµV         10 dBµV       10 dBµV         Start 2.48 GHz         Marker       Diagr         Diagr       Type	v (CISPR) 1 M 0 dBµV 44.89	1Hz MT 10 dB Preamp	ON Step TD Sca	n Cy 30 M2 M2 Function		20000 GHZ 70
RBV         Input 1 AC ● Att         Level       Max Peak         Scan       1Pk Max         3       90 dBµV         80 dBµV       80 dBµV         80 dBµV       90 dBµV         70 dBµV       10 dBµV         30 dBµV       10 dBµV         10 dBµV       10 dBµV         Start 2.48 GHz	v (CISPR) 1 M 0 dBµV 44.89	1Hz MT 10 dB Preamp	ON Step TD Sca Frequen	n Cy 30 		D0000 GHz 70

Fig B6 High Channel Restricted Band /Band Edge Horizontal peak at 3 metres

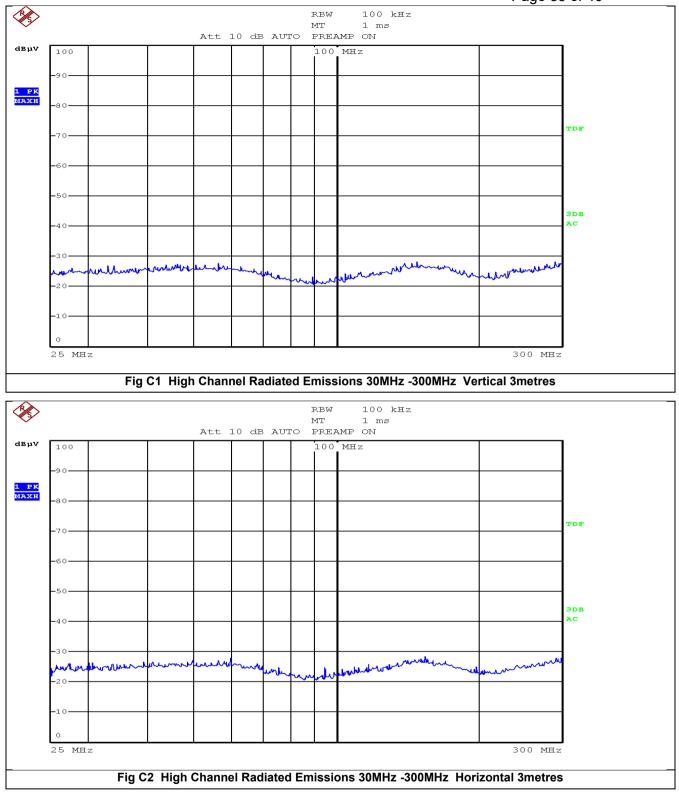
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Receiver	Spe	ectrum	®						
	72.00 dBµ			RBW 1 MHz		4 - 10 - 10 10 P			
Att SGL Count	0 c 100/100	18 👄 SWT 3 PS PA 1		VBW 3 MHz	Mode Auto F	FFT Inp	ut 1 AC		
⊖1Rm AvgPv									
1									
60 dBµV									
50 dBµV	M1								
40 dBµV—						M2			
30 dBµV—									
30 app v									
20 dBµV—									
10 dBµV—									
0 dBµV									
-10 dBµV—									
00 d0.42									
-20 dBµV—									
Start 2.48	GHz			691	pts			Stop	2.51 GHz
Marker	1	Particular Statement			1	Constant I			]
Type Ref	Trc 1	X-value 2.483	B5 GHz	<u>Y-value</u> 43.12 dBµ	Functi	on	Fun	ction Result	<u> </u>
M2	1	2	.5 GHz	33.05 dBµ	IV .				
								A	
	Fig B7	High Char	inel Re	estricted Band	Band Edge	Vertical a	average at	3 metres	
Receiver			_	estricted Band	/Band Edge	Vertical a	average at	3 metres	Ē
Receiver Ref Level	Spe	ectrum	×	RBW 1 MHz	/Band Edge	Vertical a	average at	3 metres	
Ref Level • Att	72.00 dBµ 0 c	ectrum	I8 µs					3 metres	
Ref Level Att SGL Count	72.00 dBµ 0 c 100/100	ectrum	I8 µs	RBW 1 MHz				3 metres	
Ref Level • Att	72.00 dBµ 0 c 100/100	ectrum	I8 µs	RBW 1 MHz					
Ref Level Att SGL Count 1Rm AvgPv	72.00 dBµ 0 c 100/100	ectrum	I8 µs	RBW 1 MHz					
Ref Level Att SGL Count	72.00 dBµ 0 c 100/100	ectrum	I8 µs	RBW 1 MHz					
Ref Level Att SGL Count 1Rm AvgPv	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz					
Ref Level Att SGL Count IRm AvgPv 60 dBµV 50 dBµV	72.00 dBµ 0 c 100/100	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level Att SGL Count O 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz	Mode Auto P				
Ref Level Att SGL Count IRm AvgPv 60 dBµV 50 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level Att SGL Count O 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level Att SGL Count 0 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level Att SGL Count 0 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level Att SGL Count 0 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level ● Att SGL Count ● 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV 10 dBµV 0 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level ● Att SGL Count ● 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV 10 dBµV -10 dBµV -10 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level ● Att SGL Count ● 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV 10 dBµV 0 dBµV	72.00 dB <sub>L</sub> 0 c 100/100 wr	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto P				
Ref Level ● Att SGL Count ● 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV 10 dBµV -10 dBµV -10 dBµV -20 dBµV	Spe 72.00 dBµ 0 c 100/100 ₩r	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto A				
Ref Level ● Att SGL Count ● 1Rm AvgPv 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV 10 dBµV -10 dBµV -10 dBµV	Spe 72.00 dBµ 0 c 100/100 ₩r	ectrum	I8 µs	RBW 1 MHz VBW 3 MHz	Mode Auto A				
Ref Level         ● Att         SGL Count         ● 1Rm AvgPv         60 dBµV         50 dBµV         40 dBµV         30 dBµV         20 dBµV         10 dBµV         -10 dBµV         -20 dBµV         Start 2.48         Marker         Type         Ref	5pe 72.00 dBµ 0 c 100/100 wr M1 GHz GHz	Actrum	× 18 μs TDF	RBW 1 MHz VBW 3 MHz	Mode Auto A	FFT Inp	ut 1 AC		( △ )
Ref Level         ● Att         SGL Count         ● 1Rm AvgPv         60 dBµV         50 dBµV         40 dBµV         30 dBµV         20 dBµV         10 dBµV         -10 dBµV         -20 dBµV         -20 dBµV         Start 2.48	5pe 72.00 dBµ 0 c 100/100 wr	Ectrum	×	RBW       1 MHz         VBW       3 MHz	Mode Auto A	FFT Inp	ut 1 AC	Stop	( △ )

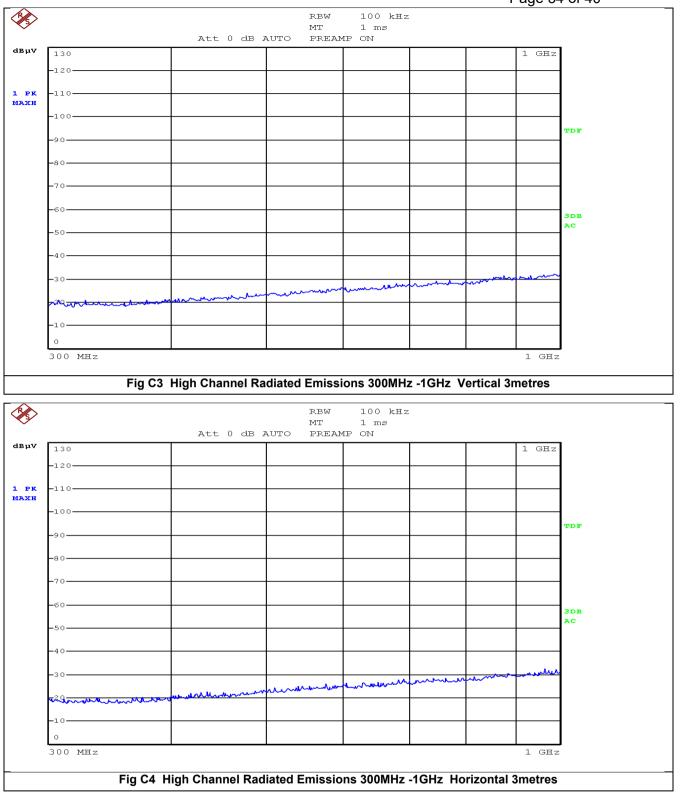
Appendix C

**Radiated Spurious Emissions** 

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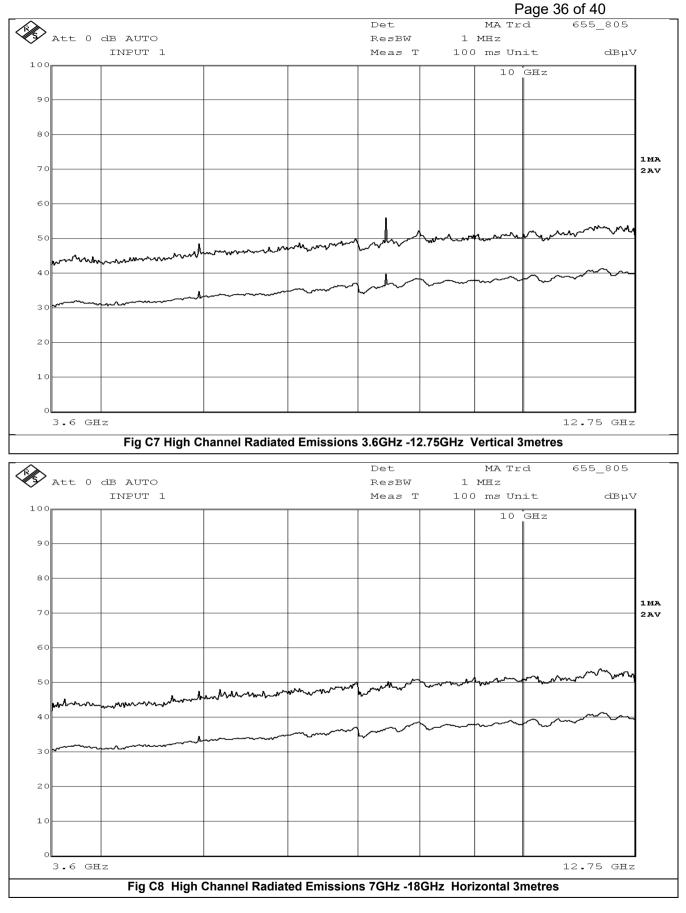


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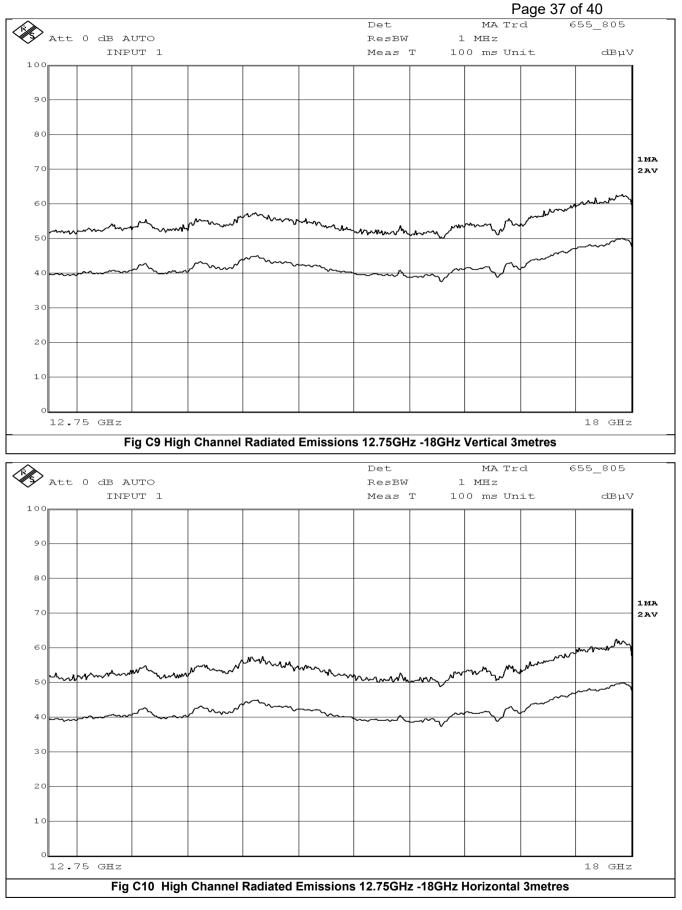
Spectrum Receiver 🛞	
<b>RBW</b> 1 MHz <b>MT</b> 100 ms 655Rx	
Input 1 AC  Att 0 dB Preamp ON Step TD Scan	
Scan O1Pk Max	
100 dBµV	
90 dBµV	
80 dBµV	
70 dBµV	
60 dBµV	
50 dBµV	
40 dBµV	
30 dBµV	
20 dBµV	
10 dBµV	
0 dBµV	TF
Start 1.0 GHz	Stop 3.6 GHz
Fig C5 High Channel Radiated Emissions 1GHz -3.6GHz Vertical 3metres	

Spectrum Receiver 🗵	
<b>RBW</b> 1 MHz <b>MT</b> 100 ms 655Rx	· · ·
Input 1 AC 🖷 Att 0 dB Preamp ON Step TD Scan	
Scan O1Pk Max	
100 dBµV	
90 dBµV	
80 dBµV	
70 dBµV	
60 dBµV	
Д	
40 dBµV	men and and and and and and and and and an
A GBPA	
30 dBµV	
20 dBµV	
10 dBµV	
0 dBµV	TF
Start 1.0 GHz	Stop 3.6 GHz
Fig C6 High Channel Radiated Emissions 1GHz -3.6GHz Horizontal 3	3metres

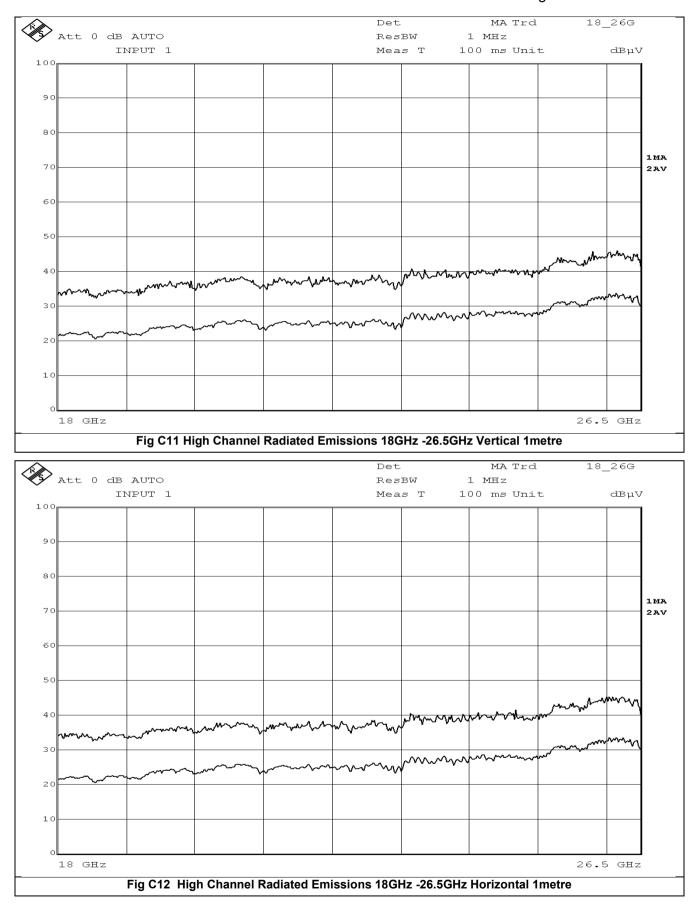
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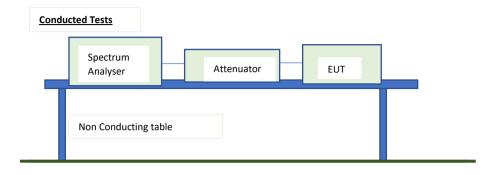


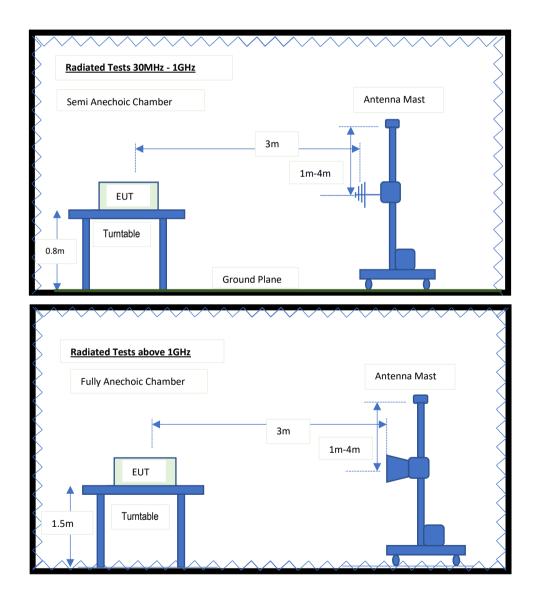
## Appendix D

Fig D1 EUT orientation O1"	Fig D2 EUT orientation "O2"	Fig D3 EUT orientation "O3"

Orientations for Radiated Emissions

## Appendix E Block Diagrams of test set up





**End of Report**