Report on the Radio Testing

For

Design Reality Limited

on

FC6100 Pressure Sensor

Report no. TRA-044504-47-01B

2019/06/20 to 2019/06/21

RF915 5.0

Report Number: TRA-044504-47-01B
Issue: B

REPORT ON THE RADIO TESTING OF A DESIGN REALITY LIMITED FC6100 PRESSURE SENSOR WITH RESPECT TO SPECIFICATION

FCC 47CFR 15.247 October 2017 & ISED RSS-247 Issue 2, February 2017

TEST DATE: 2019/06/20 to 2019/06/21

Tested by:	Daniel Moncayola, Steven Garwell
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Date:	12 August 2019

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[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

RF915 5.0

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	26 July 2019	Original
B	07 August 2019	Updated

2 Summary

TEST REPORT NUMBER:	TRA-044504-47-01B
WORKS ORDER NUMBER:	TRA-044504-03
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 Radiocommunication Act and 21(1) of the Radiocommunication Regulations.
TEST SPECIFICATIONS:	FCC 47CFR 15.247 October 2017 & ISED RSS-247 Issue 2, February 2017
EQUIPMENT UNDER TEST (EUT):	FC6100 Pressure Sensor
EUT SERIAL NUMBER:	Test Sample 2
FCC ID:	2AT3JFC6100
#MANUFACTURER/AGENT:	Design Reality Limited
ADDRESS:	81 Bowen Court St Asaph Business Park St Asaph Denbighshire LL17 0JE United Kingdom
CLIENT CONTACT:	James Grimoldy ☎ 01745 584865 ✉ jgrimoldby@designreality.co.uk
ORDER NUMBER:	12330
TEST DATE:	2019/06/20 to 2019/06/21
TESTED BY:	Daniel Moncayola, Steven Garwell Element

2.1 Test Summary

Test Method and Description		*Requirement Clause*		*Applicable to this equipment*	*Result / Note*
		RSS	*47CFR15*		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		Gen, 8.10	15.205	☒	*Pass*
AC power line conducted emissions		Gen, 8.8	15.207	☐	*Note 1*
Occupied bandwidth		247, 5.2 (1)	15.247(a)(2)	☒	*Pass*
Conducted carrier power	Peak	247, 5.4 (4)	15.247(b)(3)	☒	*Pass*
	Max.			☐	
Conducted / radiated RF power out-of-band		247, 5.5	15.247(d)	☒	*Pass*
Power spectral density, conducted		247, 5.2 (2)	15.247(e)	☒	*Pass*
Calculation of duty correction		-	15.35(c)	☒	*Pass*

Notes:

Note 1: Test not applicable as product does not transmit while connected to the mains. For the idle state (part 15B) AC power line conducted emissions please refer to Test Report TRA-044504-35-00A."

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
7.3.1 Transmission 10
7.3.2 Reception 10
7.4 EUT Radio Parameters 10
7.5 EUT Description 10
8 Modifications 11
9 EUT Test Setup 12
9.1 Block Diagram 12
9.2 General Set-up Photograph 12
10 General Technical Parameters 13
10.1 Normal Conditions 13
11 Radiated emissions 14
11.1 Definitions 14
11.2 Test Parameters 14
11.3 Test Limit 14
11.4 Test Method 15
11.5 Test Set-up Photograph 16
11.6 Test Equipment 16
11.7 Test Results 17
12 Occupied Bandwidth 21
12.1 Definition 21
12.2 Test Parameters 21
12.3 Test Limit 21
12.4 Test Method 22
12.5 Test Equipment 22
12.6 Test Results 23
13 Maximum peak conducted output power 25
13.1 Definition 25
13.2 Test Parameters 25
13.3 Test Limit 25
13.4 Test Method 26
13.5 Test Equipment 26
13.6 Test Results 27
14 Out-of-band and conducted spurious emissions 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 30
15 Power spectral density 33
15.1 Definition 33
15.2 Test Parameters 33
15.3 Test Limit 33
15.4 Test Method 34
15.5 Test Equipment 34
15.6 Test Results 35
16 Measurement Uncertainty 36

4 Introduction

This report TRA-044504-47-01B presents the results of the Radio testing on a Design Reality Limited., FC6100 Pressure Sensor to specification 47CFR15 Radio Frequency Devices and RSS-247 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Design Reality Limited by Element, at the address detailed below.

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

ISED Registration Numbers:

Element Hull	3483A
Element North West	3930B

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

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 - October 2017 - 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.
- ISED RSS-247, Issue 2, February 2017 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- ISED RSS-Gen, Issue 5, April 2018 – 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
ISED	Innovation, Science and Economic Development Canada (formerly 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: FC6100 Pressure Sensor
- Serial Number: Test Sample 2

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.

1: Laptop

7.3 EUT Mode of Operation

7.3.1 Transmission

The EUT was transmitting modulated carrier on the frequencies indicated.

7.3.2 Reception

The EUT was tuned to permanent receive mode on the frequencies indicated.

7.4 EUT Radio Parameters

Frequency of operation:	2402 MHz – 2480 MHz
Modulation:	GFSK
Declared output power:	≤10.0 dBm
Antenna type:	YAGEO / ANT8010LL04R2400A
Antenna gain:	5.46 dBi
Nominal supply voltage:	5.0 V dc Via USB

7.5 EUT Description

The EUT is a mask mounted sensor designed to measure pressure / humidity with Bluetooth.

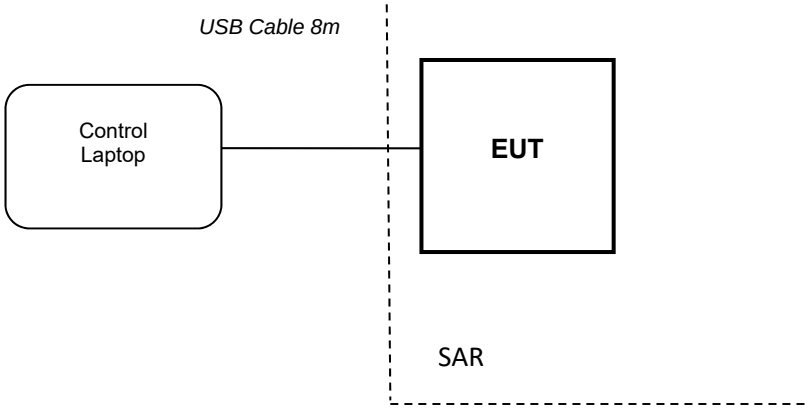
8 Modifications

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 EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 5.0 V dc from the USB port on the test laptop. The internal battery could not be used to power the EUT in the test modes required.

11 Radiated emissions

11.1 Definitions

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

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

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	2402 MHz, 2442 MHz and 2480 MHz
EUT Channel Bandwidths:	1 MHz
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: 18 °C	+15 ºC to +35 ºC (as declared)
Humidity: 32 % RH	20 % RH to 75 % RH (as declared)
Supply: 5.0 V dc	

11.3 Test Limit

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

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

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

11.4 Test Method

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

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

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

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

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

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

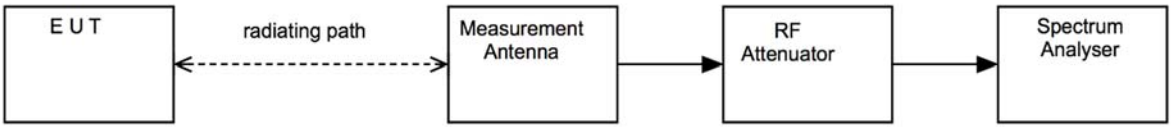
$$FS = PR + CL + AF - PA + DC - CF$$

Where,

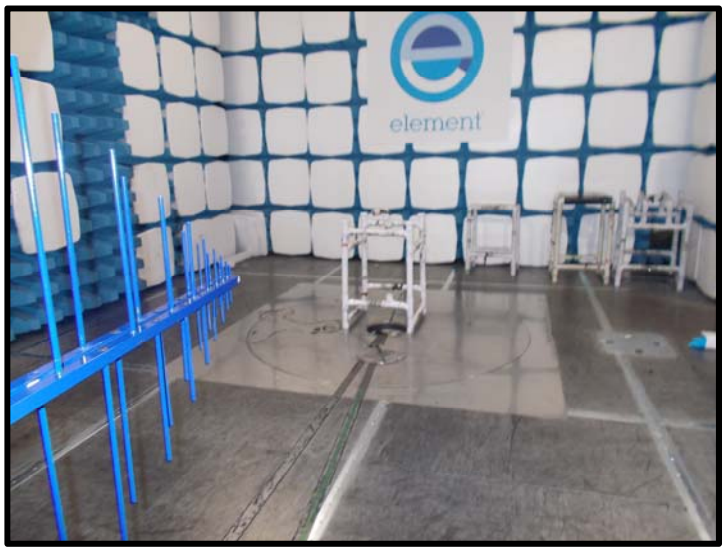
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor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

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

Figure i Test Setup



11.5 Test Set-up Photograph

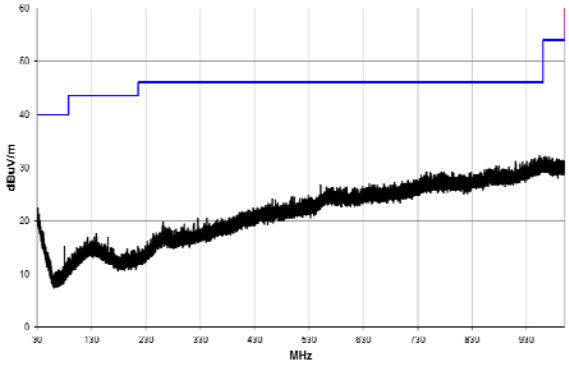


11.6 Test Equipment

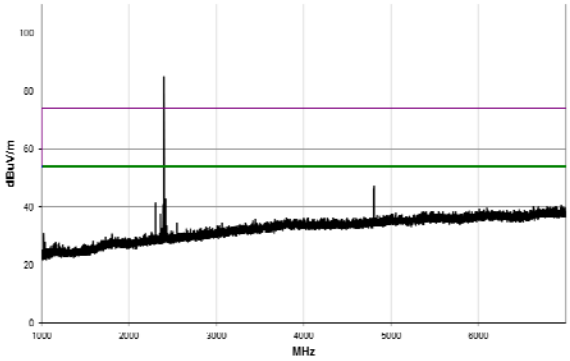
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2019-11-20
Pre Amp	Agilent	8449B	L572	2019-10-12
1-18GHz Horn	EMCO	3115	L139	2019-09-25
1-18GHz Horn	EMCO	3115	U223	2019-10-25
Receiver	R&S	ESVS10	L317	2020-04-24
Bilog	Chase	CBL611/A	U573	2019-08-02
Log Periodic Ant	Chase	UPA6108	L203	2020-06-11

11.7 Test Results

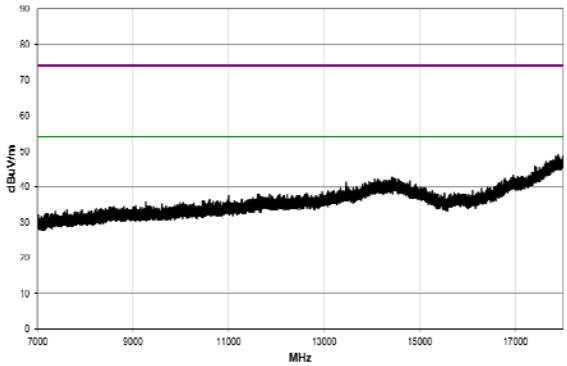
Bottom Channel: 2402 MHz



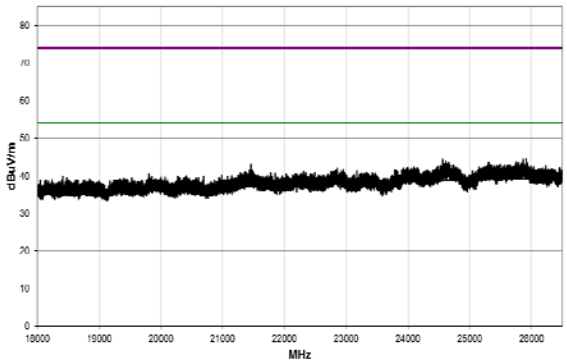
30 MHz to 1 GHz



1 GHz to 7 GHz



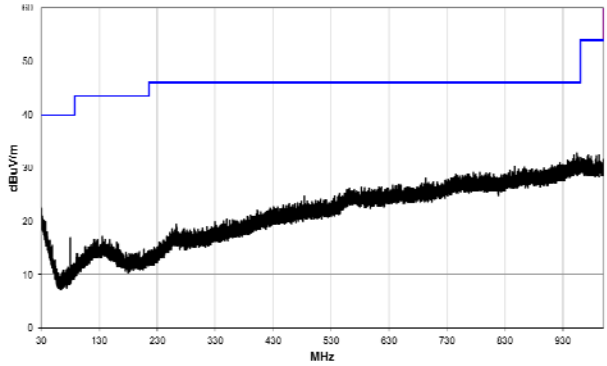
7 GHz to 18 GHz



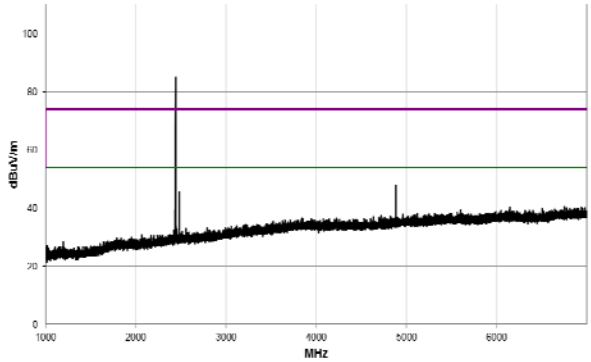
18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4804.458	53.4	2.6	1.0	177.0	3.0	0.0	Vert	PK	0.0	56.0	74.0	-18.0
4804.000	43.6	2.6	1.0	177.0	3.0	0.0	Vert	AV	0.0	46.2	54.0	-7.8

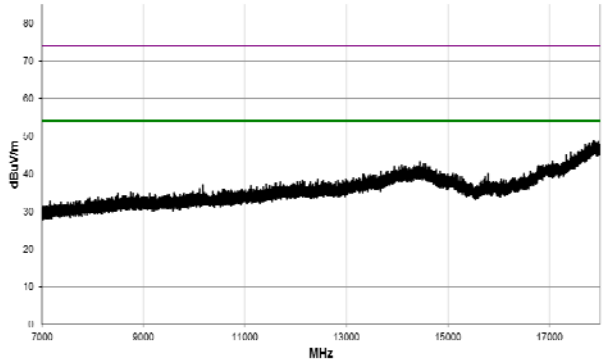
Middle Channel: 2442 MHz



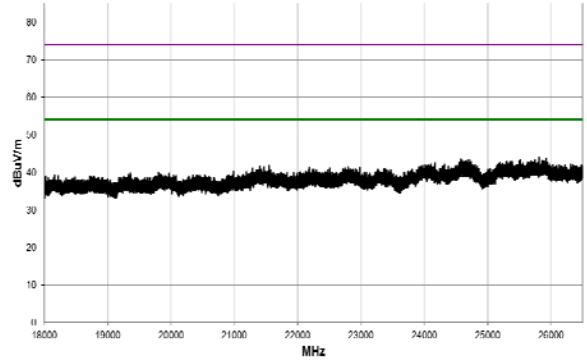
30 MHz to 1 GHz



1 GHz to 7 GHz



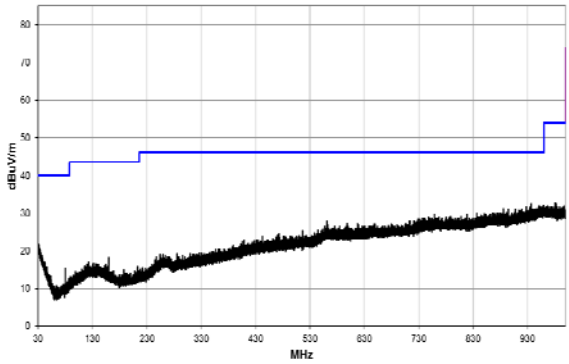
7 GHz to 18 GHz



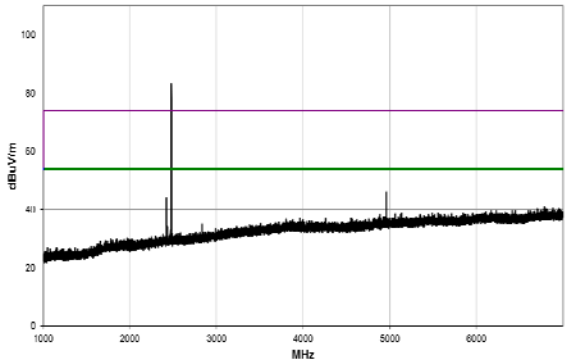
18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4884.417	52.8	2.8	1.07	173.1	3.0	0.0	Vert	PK	0.0	55.6	74.0	-18.4
4884.000	42.9	2.8	1.07	173.1	3.0	0.0	Vert	AV	0.0	45.7	54.0	-8.3

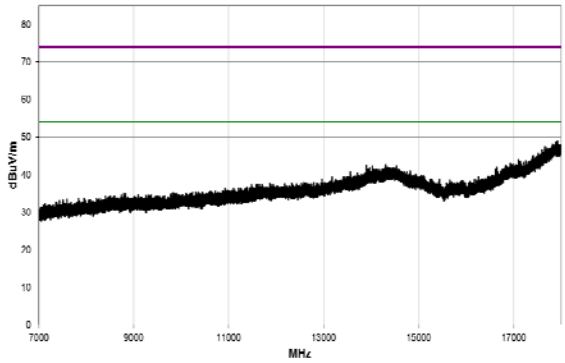
Top Channel: 2480 MHz



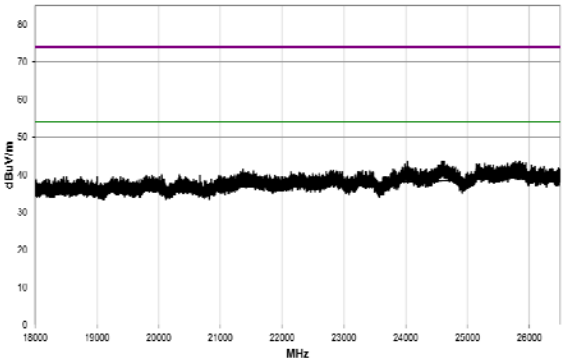
30 MHz to 1 GHz



1 GHz to 7 GHz

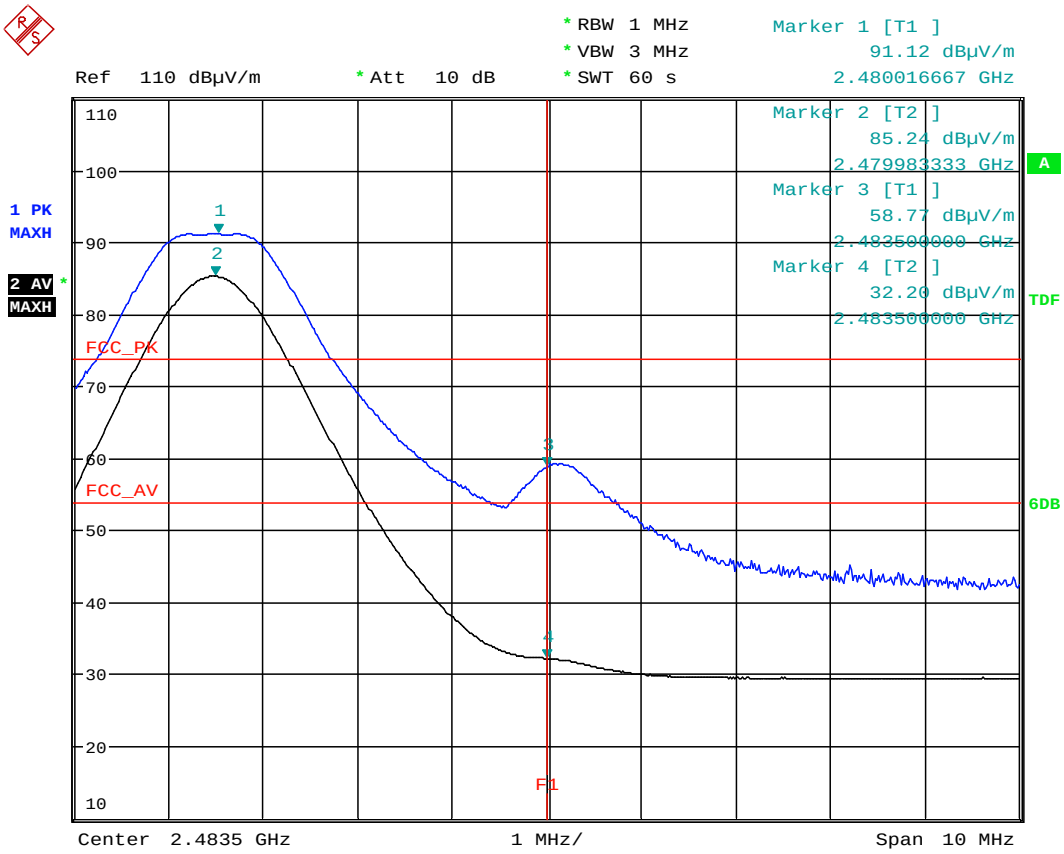


7 GHz to 18 GHz



18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
4959.333	51.3	3.1	1.36	137.9	3.0	0.0	Vert	PK	0.0	54.4	74.0	-19.6
4960.000	40.9	3.1	1.36	137.9	3.0	0.0	Vert	AV	0.0	44.0	54.0	-10.0



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Upper Band Edge 1 MHz Bandwidth

12 Occupied Bandwidth

12.1 Definition

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

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	IC: ANSI C63.10-2013, Clause 6.9 FCC: ANSI C63.10-2013, Clause 11.8
EUT Frequencies Measured:	2402 MHz, 2442 MHz and 2480 MHz
EUT Channel Bandwidths:	1 MHz
EUT Test Modulations:	GFSK
Deviations From Standard:	None
Measurement BW: (IC requirement: 1% to 5% OBW; FCC requirement: 100 kHz)	30 kHz, 100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	100 kHz, 300 kHz
Measurement Span: (requirement 2 to 5 times OBW)	3 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 37 % RH	20 % RH to 75 % RH (as declared)
Supply: 5.0 V dc	

12.3 Test Limit

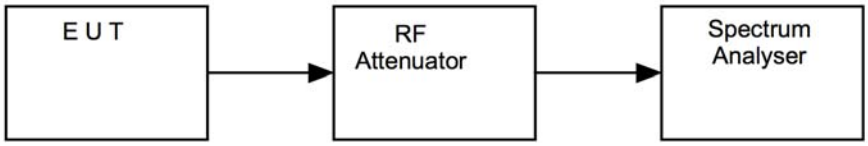
The minimum -6 dB bandwidth shall be at least 500 kHz.

12.4 Test Method

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

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

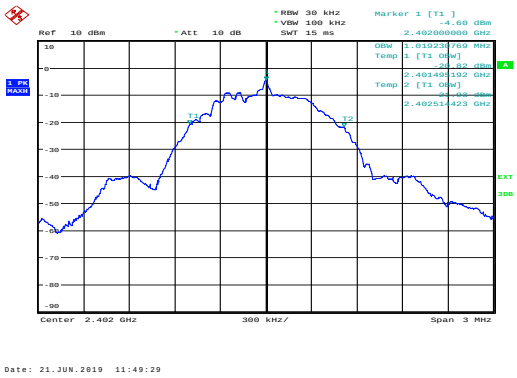
Figure iii Test Setup



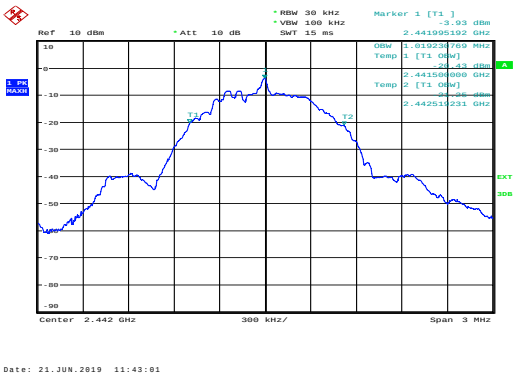
12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2019-11-20

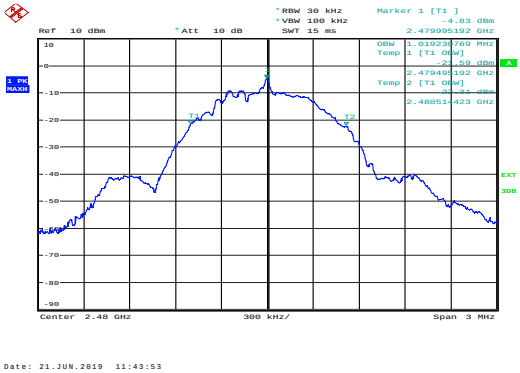
12.6 Test Results



Bottom

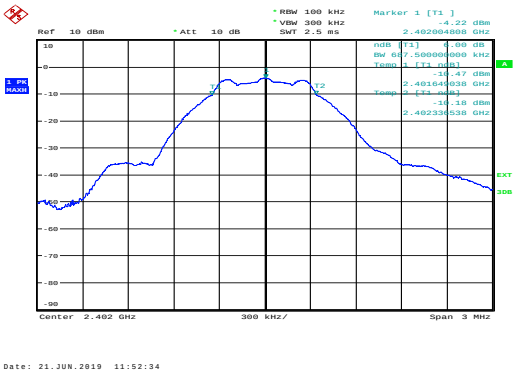


Middle



Top

RSS-Gen: 99% Bandwidth; Data rate: 1 Mbps				
Channel Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***99% Bandwidth (kHz)***	***Result***
2402	2401.495192	2402.514423	1019.231	PASS
2442	2441.500000	2442.519231	1019.231	PASS
2480	2479.495192	2480.514423	1019.231	PASS



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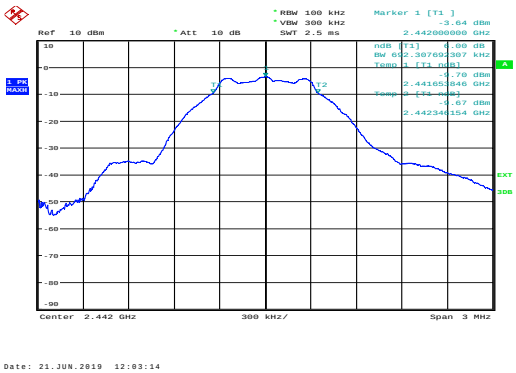

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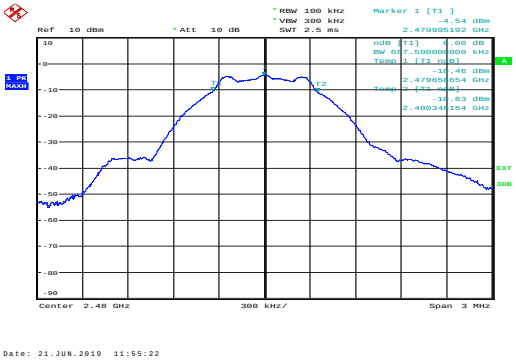


Top

FCC 15.247; Data rate: 1 Mbps				
Channel Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***6dB Bandwidth (kHz)***	***Result***
2402	2401.649038	2402.336538	687.500	PASS
2442	2441.653846	2442.346154	692.308	PASS
2480	2479.658654	2480.346154	687.500	PASS

13 Maximum peak conducted output power

13.1 Definition

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth.

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Frequencies Measured:	2402 MHz, 2442 MHz and 2480 MHz
EUT Channel Bandwidths:	2 MHz
Deviations From Standard:	None
Measurement BW:	2 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	5 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 37 % RH	20 % RH to 75 % RH (as declared)
Supply: 5.0 V dc	

13.3 Test Limit

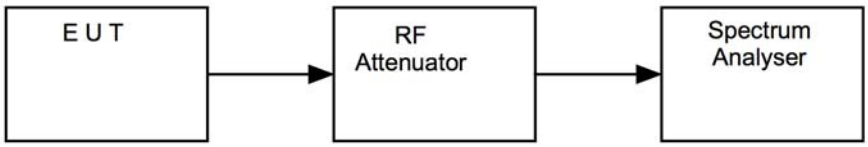
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

13.4 Test Method

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

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

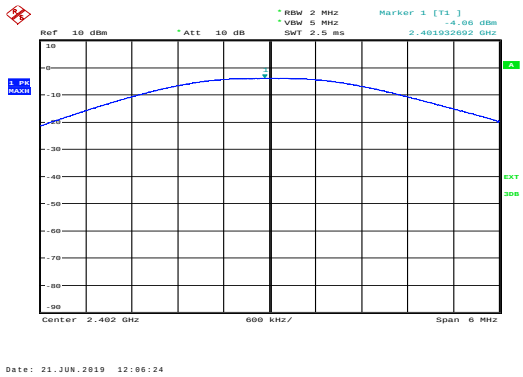
Figure iv Test Setup



13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2019-11-20

13.6 Test Results



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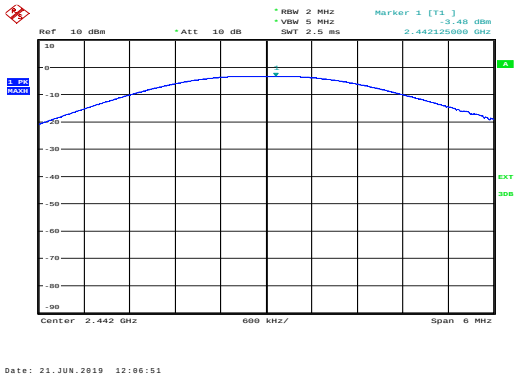

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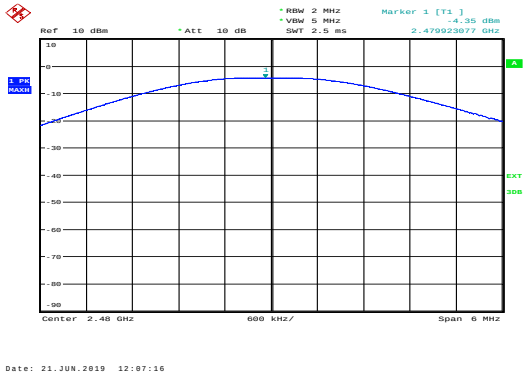


Top

Data rate: 1 Mbps; Default Power setting					
Channel Frequency (MHz)	***Analyzer Level (dBm)***	***Antenna Gain (dBi)***	***EIRP (dBm)***	***EIRP (W)***	***Result***
2402.00	-4.06	5.46	1.40	0.0014	PASS
2442.00	-3.48	5.46	1.98	0.0016	PASS
2480.00	-4.35	5.46	1.11	0.0013	PASS

14 Out-of-band and conducted spurious emissions

14.1 Definition

Out-of-band emission.
Emission on a frequency or frequencies immediately outside the necessary bandwidth that results from the modulation process but excluding spurious emissions.

Spurious emission.
Emission on a frequency or frequencies that 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.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Frequencies Measured:	2402 MHz, 2442 MHz and 2480 MHz
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW:	300 kHz
Measurement Detector:	Peak
Measurement Range:	9 kHz to 25 GHz

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 37 % RH	20 % RH to 75 % RH (as declared)
Supply: 5.0 V dc	

14.3 Test Limit

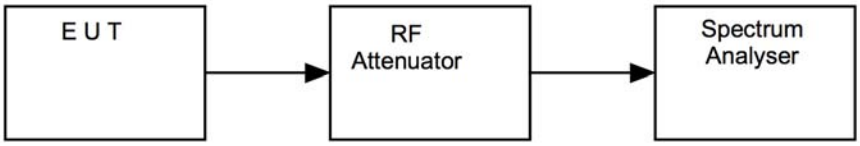
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in FCC 47CFR15.209(a) / RSS-Gen is not required.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the emissions from the EUT were 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 v Test Setup

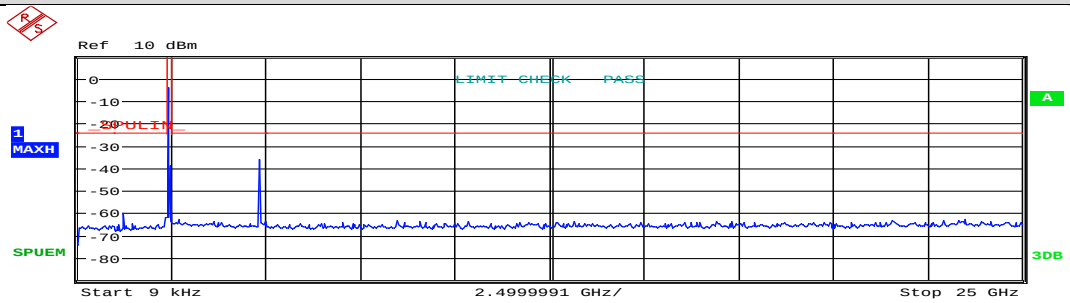


14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2019-11-20

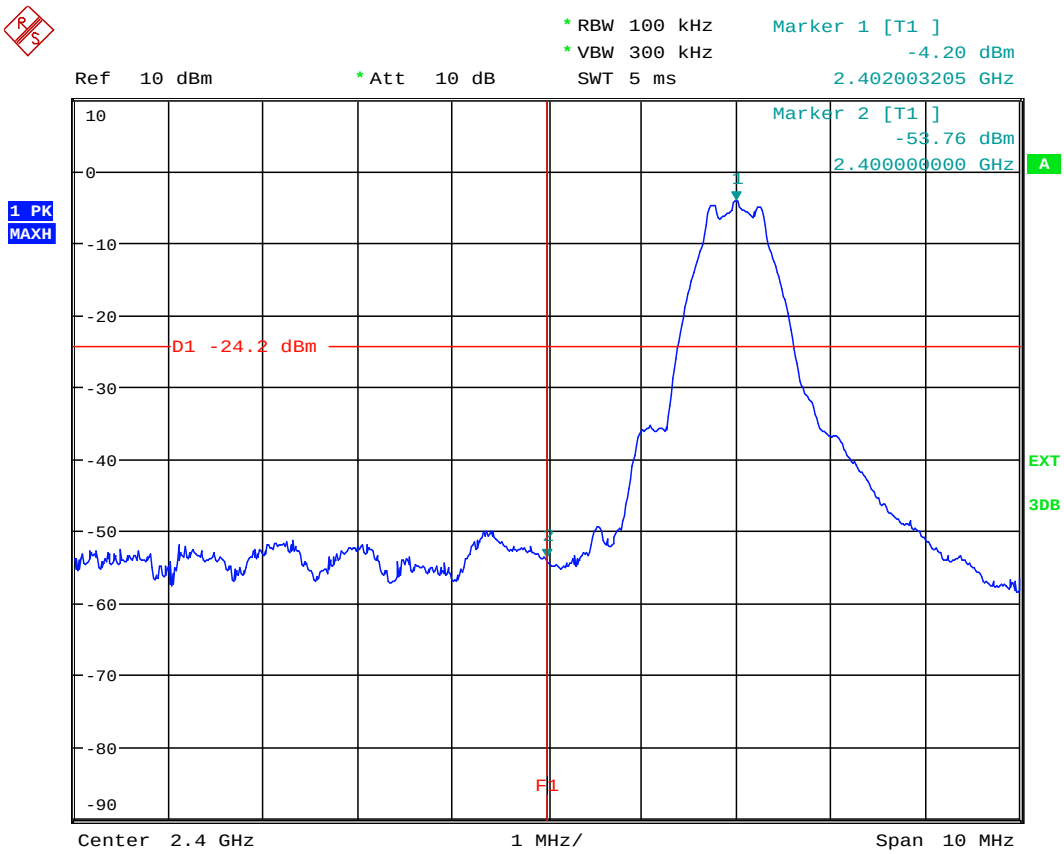
14.6 Test Results

Frequency: 2402 MHz; Bandwidth: 1 MHz; Power setting: Default



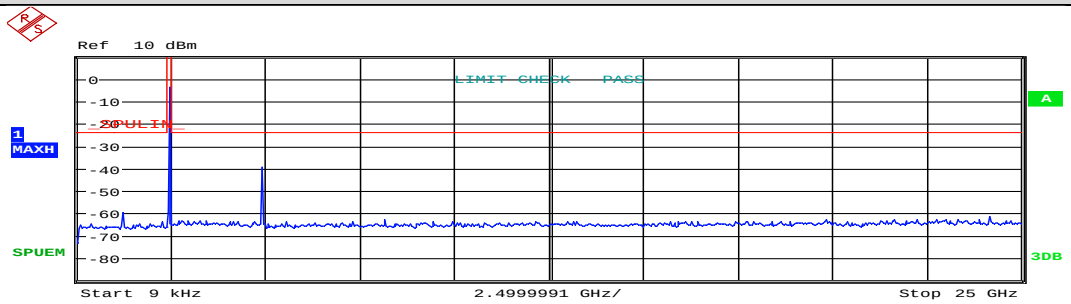
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	26.399038 k	-81.96	-57.57
150.000 k	30.000 M	10.00 k	3.937965 M	-74.17	-49.78
30.000 M	1.000 G	100.00 k	823.751000 M	-65.68	-41.29
1.000 G	2.400 G	100.00 k	1.200993 G	-60.35	-35.96
2.400 G	2.483 G	100.00 k	2.402004 G	-4.50	-34.50
2.483 G	5.000 G	100.00 k	4.803965 G	-36.02	-11.63
5.000 G	10.000 G	100.00 k	8.446500 G	-63.66	-39.27
10.000 G	15.000 G	100.00 k	10.330000 G	-63.82	-39.43
15.000 G	20.000 G	100.00 k	17.301000 G	-63.86	-39.47
20.000 G	25.000 G	100.00 k	23.481500 G	-63.19	-38.80

Date: 21.JUN.2019 13:03:17



Date: 21.JUN.2019 12:22:33

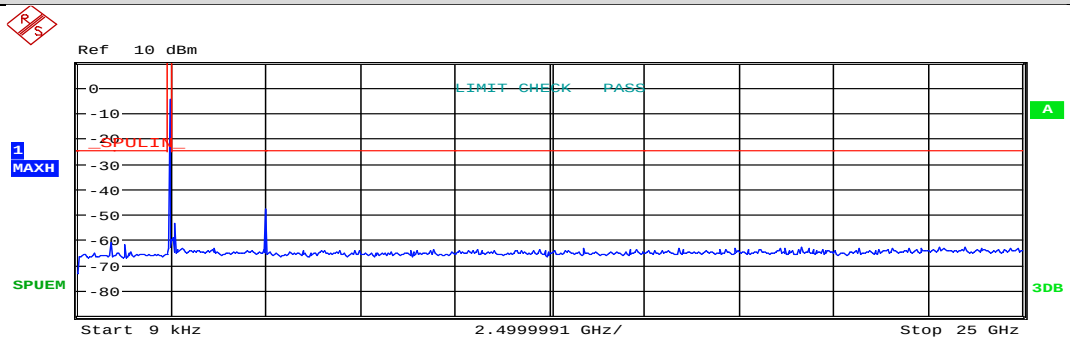
Frequency: 2442 MHz; Bandwidth: 1 MHz; Power setting: Default



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	10.581731 k	-79.01	-55.11
150.000 k	30.000 M	10.00 k	164.925000 k	-73.37	-49.47
30.000 M	1.000 G	100.00 k	370.955000 M	-65.03	-41.13
1.000 G	2.400 G	100.00 k	1.221060 G	-59.71	-35.81
2.400 G	2.483 G	100.00 k	2.442000 G	-3.77	-33.77
2.483 G	5.000 G	100.00 k	4.884241 G	-39.62	-15.72
5.000 G	10.000 G	100.00 k	8.125000 G	-63.05	-39.15
10.000 G	15.000 G	100.00 k	13.126500 G	-63.86	-39.96
15.000 G	20.000 G	100.00 k	19.848000 G	-62.99	-39.09
20.000 G	25.000 G	100.00 k	24.146500 G	-61.68	-37.78

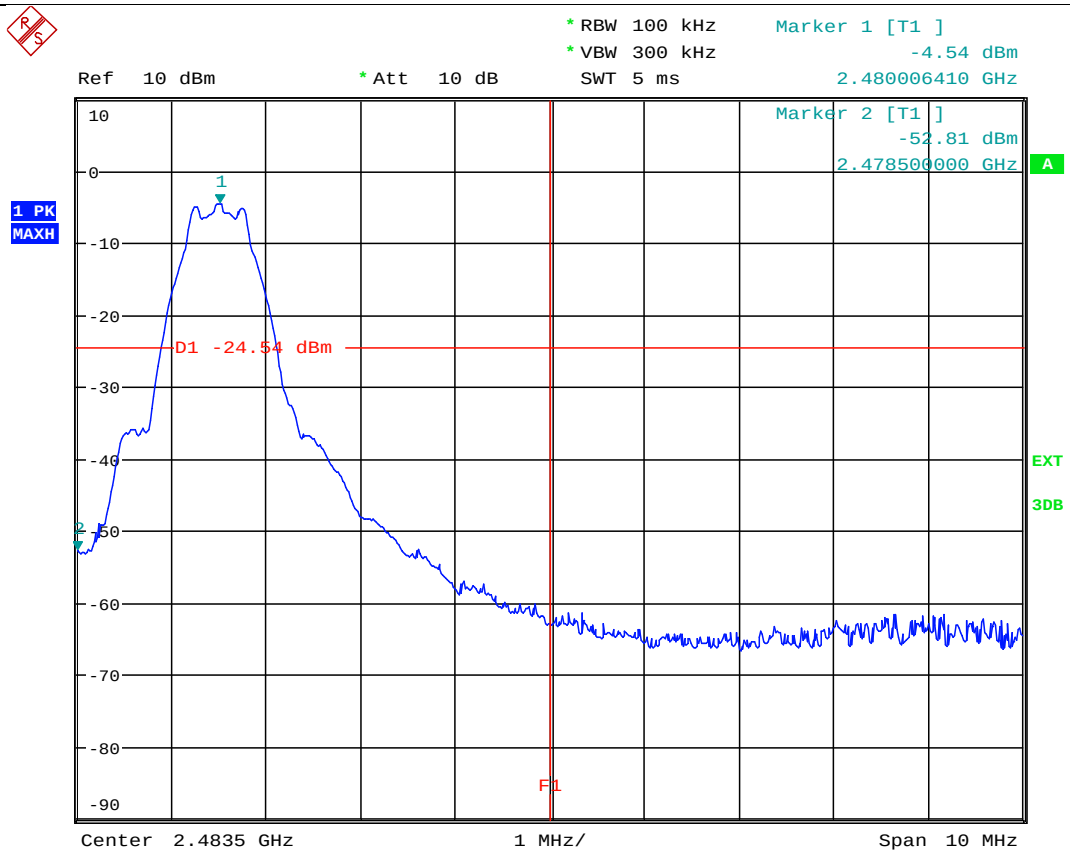
Date: 21.JUN.2019 12:57:55

Frequency: 2480 MHz; Bandwidth: 1 MHz; Power setting: Default



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	9.000000 k	-79.89	-55.36
150.000 k	30.000 M	10.00 k	152.985000 k	-73.37	-48.84
30.000 M	1.000 G	100.00 k	889.161333 M	-61.14	-36.61
1.000 G	2.400 G	100.00 k	1.240007 G	-61.85	-37.32
2.400 G	2.483 G	100.00 k	2.479993 G	-4.71	-34.71
2.483 G	5.000 G	100.00 k	4.960743 G	-47.94	-23.41
5.000 G	10.000 G	100.00 k	9.398000 G	-63.88	-39.35
10.000 G	15.000 G	100.00 k	13.373000 G	-63.62	-39.09
15.000 G	20.000 G	100.00 k	19.146000 G	-63.09	-38.56
20.000 G	25.000 G	100.00 k	23.490500 G	-63.15	-38.62

Date: 21.JUN.2019 12:55:22



Date: 21.JUN.2019 12:27:37

15 Power spectral density

15.1 Definition

The power per unit bandwidth.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Frequencies Measured:	2402 MHz / 2442 MHz / 2480 MHz
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	30 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	100 kHz
Measurement Span: (requirement 1.5 times Channel BW)	1.5 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)
Supply: 5.0 V dc	

15.3 Test Limit

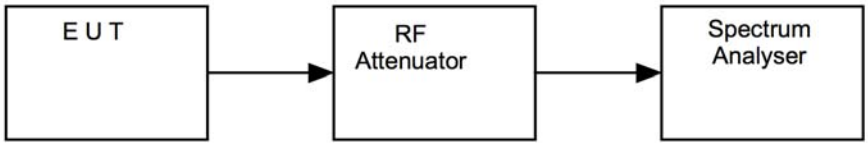
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vi, the peak emission of the EUT was measured on a spectrum analyser, with path losses taken into account.

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 vi Test Setup

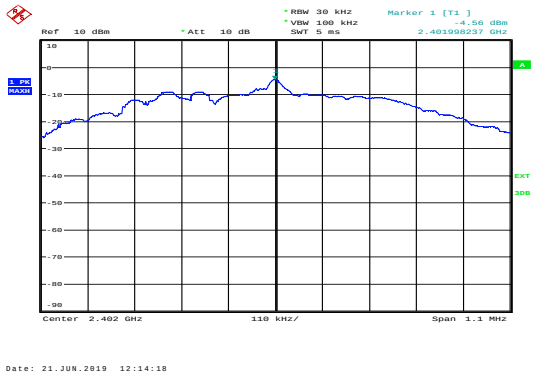


15.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2019-11-20

15.6 Test Results

Modulation: GFSK; Data rate: 1 Mbps; Default Power setting				
Channel Frequency (MHz)	**Analyzer Level (dBm)**	**Cable loss (dB)**	**Power (dBm)**	**Result**
2402	-4.56	0.0	-4.56	PASS
2442	-3.96	0.0	-3.96	PASS
2480	-4.76	0.0	-4.76	PASS



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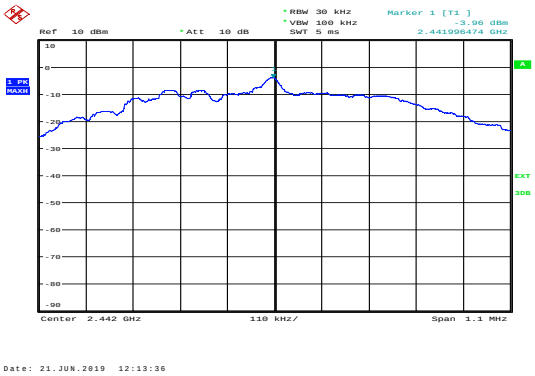

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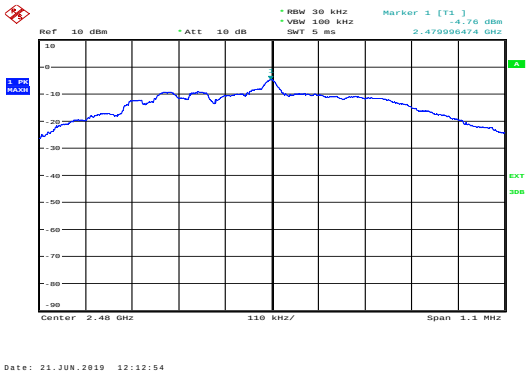

Top

16 Measurement Uncertainty

Calculated Measurement Uncertainties

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

[1] Radiated spurious emissions

Uncertainty in test result (30 MHz to 1 GHz) = **4.75 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.46 dB**

[2] AC power line conducted emissions

Uncertainty in test result = **3.2 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.58 %**

[4] Conducted carrier power

Uncertainty in test result (Power Meter) = **0.93 dB**

[5] Conducted RF power out-of-band

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**
Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**

[6] Radiated RF power out-of-band

Uncertainty in test result (30 MHz to 1 GHz) = **4.75 dB**
Uncertainty in test result (1 GHz to 18 GHz) = **4.46 dB**

[7] Power spectral density

Uncertainty in test result (Spectrum Analyser) = **3.11 dB**

[8] ERP / EIRP

Uncertainty in test result (Laboratory) = **4.71 dB**
Uncertainty in test result (Pershore OATS) = **4.26 dB**