Report on the Radio Testing

For

Draeger Safety UK Ltd

on

BG Proair

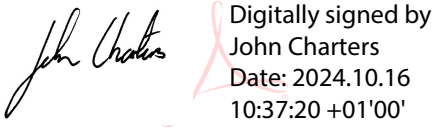
Report no. TRA-051967-47-06B

2024-10-16

Report Number: TRA-051967-47-06B
Issue: B

REPORT ON THE RADIO TESTING OF A
Draeger Safety UK Ltd
BG Proair
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 2023-04-24 to 2023-05-02 & 2024-07-12

Tested by:		Steven Garwell Radio Test Engineer
Written by:		Steven Garwell Radio Test Engineer
Approved by:	 Digitally signed by John Charters Date: 2024.10.16 10:37:20 +01'00'	John Charters Department Manager - Radio
Date:	2024-10-16	

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	Draft	Original
B	2024-10-16	Updated Average channel Occupancy and added duty cycle for hopping over all frequencies used for time averaged power.

2 Summary

TEST REPORT NUMBER:	TRA-051967-47-06B
WORKS ORDER NUMBER:	TRA-051967-19
PURPOSE OF TEST:	Certification
TEST SPECIFICATION:	47CFR15.247
EQUIPMENT UNDER TEST (EUT):	BG Proair
FCC IDENTIFIER:	X6O-BG001
EUT SERIAL NUMBER:	Test Sample S56
MANUFACTURER/AGENT:	Draeger Safety UK Ltd
ADDRESS:	Ullswater Close Blyth Riverside Business Park Blyth NE24 4RG United Kingdom
CLIENT CONTACT:	Eoghan Quigley ☎ 01670 352 891 ✉ eoghan.quigley@draeger.com
ORDER NUMBER:	4302888682
TEST DATE:	2023-04-24 to 2023-05-02 & 2024-07-12
TESTED BY:	Steven Garwell Element

2.1 Test Summary

Test Method and Description	*Requirement Clause 47CFR15*	*Applicable to this equipment*	*Result / Note*
Radiated spurious emissions (restricted bands of operation and cabinet radiation)	15.247(d)	☒	*PASS*
AC power line conducted emissions	15.207	☐	*Note 1*
Carrier frequency separation	15.247 (a) (1)	☒	*PASS*
Number of hopping channels	15.247 (a) (1) (i), (ii) and (iii)	☒	*PASS*
Average time of occupancy	15.247 (a) (1) (i), (ii) and (iii)	☒	*PASS*
Maximum peak conducted output power	15.247 (a) (1), (b)(1) and (b)(2)	☒	*PASS*
20 dB emission bandwidth	15.247 (a) (1) (i) and (ii)	☒	*PASS*
Out-of-band emissions	15.247(d)	☒	*PASS*
Calculation of duty correction	-	☒	*PASS*

Specific Note:

1. The EUT is a battery powered device

General Notes:

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

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

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

The decision rule for compliance is not inherent within this specification and compliance is based on the customer requesting a simple acceptance rule based on understanding and acceptance of Elements Measurement Uncertainty values.

3 Contents

4 Introduction

This report TRA-051967-47-06B presents the results of the Radio testing on a Draeger Safety UK Ltd, BG Proair to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Draeger Safety UK Ltd by Element, at the address detailed below.

☒ Element Skelmersdale
Unit 1
Pendle Place
Skelmersdale
West Lancashire
WN8 9PN
UK

☐ Element Surrey Hills
Unit 15 B
Henley Business Park
Pirbright Road
Normandy
Guildford
GU3 2DX
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:
The test laboratory is accredited for the above sites under the following US-UK MRA, Designation numbers.

Element Surrey Hills	UK2027
Element Skelmersdale	UK2020

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 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.

5.2 Deviations from Test Standards

There were no deviations from the test standard.

6 Glossary of Terms

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

7 Equipment under Test

7.1 EUT Identification

- Name: BG Proair
- Serial Number: Test Sample S56
- Model Number: BG Proair
- Software Revision: Not Applicable
- Build Level / Revision Number: 1st prototype

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 Computer – Dell Latitude E6410*

7.3 EUT Mode of Operation

The EUT was transmitting on the frequencies as indicated, the frequencies where programmed using Hterm 0.8.5 software which was supplied on a test laptop.

7.4 EUT Radio Parameters

7.4.1 General

Frequencies of operation:	902.25 MHz to 907.15 MHz
Modulation type:	4-GFSK
Occupied channel bandwidth:	100 kHz
Channel spacing:	100 kHz
Declared output power:	≤ 26 dBm
Nominal Supply Voltage:	7.5 V dc via 5 x AA Alkaline batteries
Duty cycle:	81.9 %

7.4.2 Antennas

Type:	PCB printed Inverted F (antenna 1)
Frequency range:	902 MHz to 914 MHz
Gain:	-1.6 dBi maximum
Type:	PCB printed Inverted F (antenna 2)
Frequency range:	902 MHz to 914 MHz
Gain:	-1.6 dBi maximum

7.5 EUT Description

The EUT is an Open circuit breathing apparatus with compressed air cylinder used for Fire Fighting.

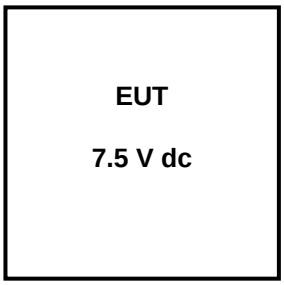
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

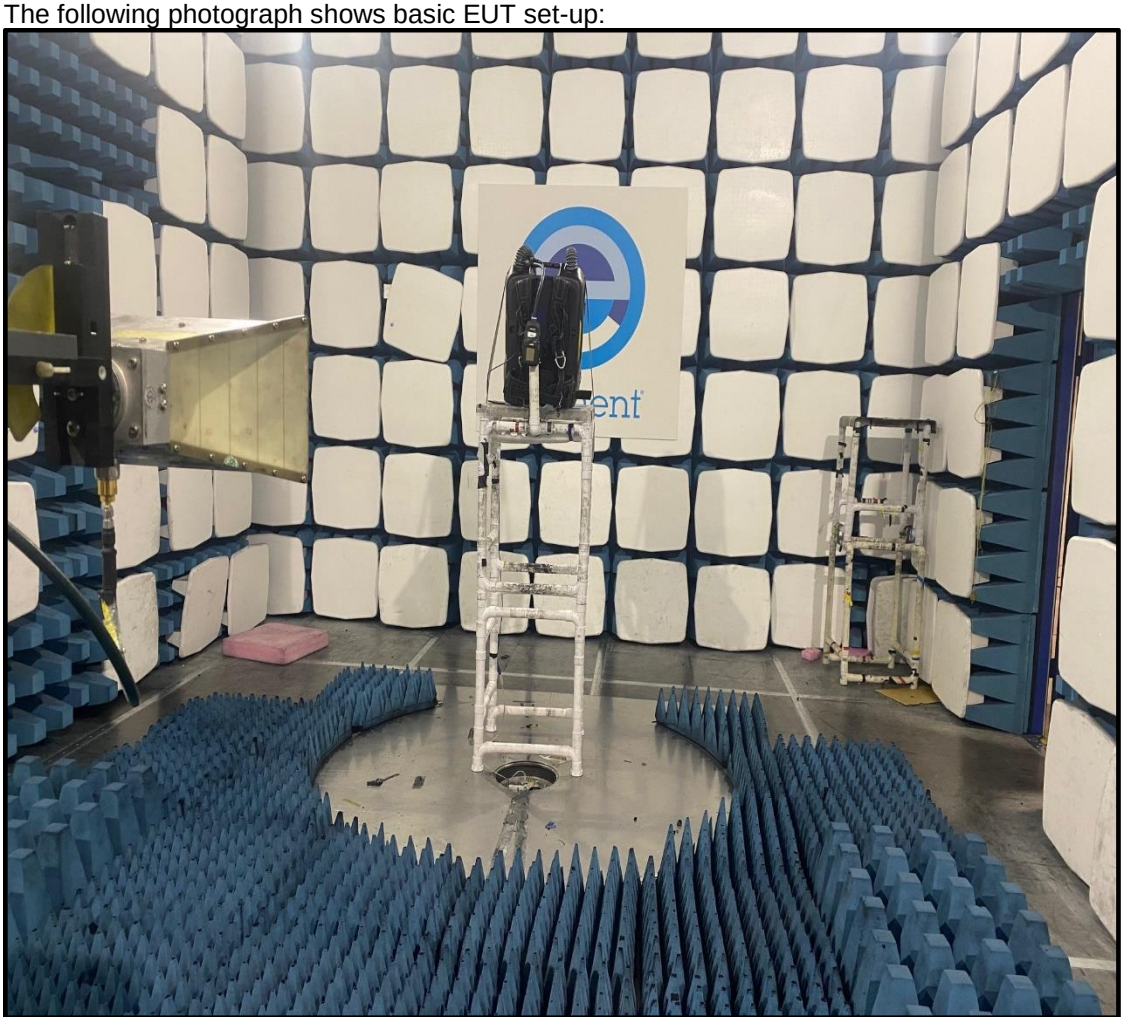
9.1 Block Diagram

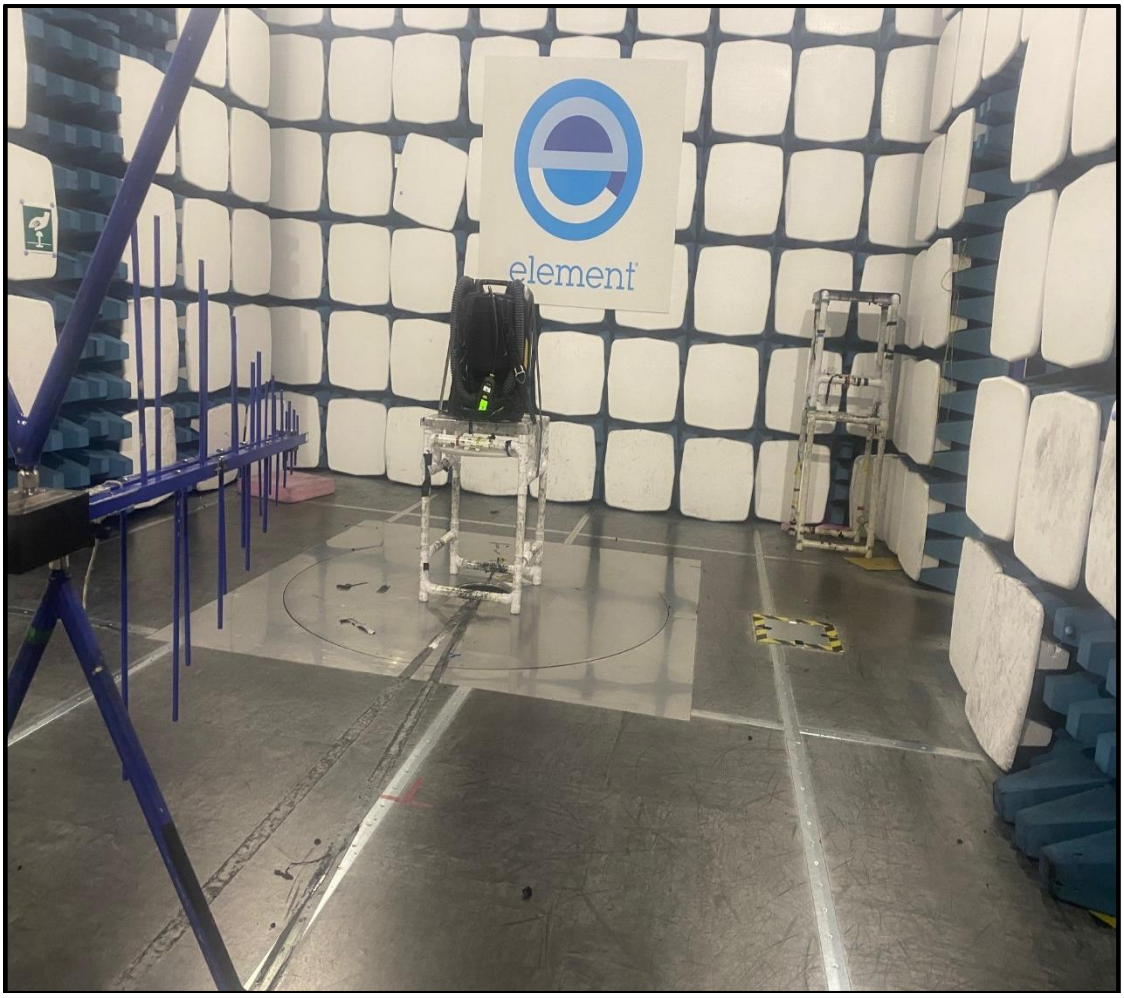
The following diagram shows basic EUT interconnections with cable type and cable lengths identified:



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:





9.3 Measurement software

Where applicable, the following software was used to perform measurements contained within this report.

Element Emissions R5
Element Transmitter Bench Test
ETS Lindgren EMPower V1.0.4.2

10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 7.5 V dc via 5 x AA Alkaline batteries.

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band.

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

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

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:	SK03 Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	902.25 MHz, 907.15 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: +21 °C	+15 ºC to +35 ºC (as declared)
Humidity: 38 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

11.3 Test Limit

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

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

Frequency (MHz)	*Field Strength (µV/m at 3 m)*	*Field Strength (dBµV/m at 3 m)*
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

On frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function. On frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit.

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:

$$FS = PR + CL + AF – PA + DC – CF$$

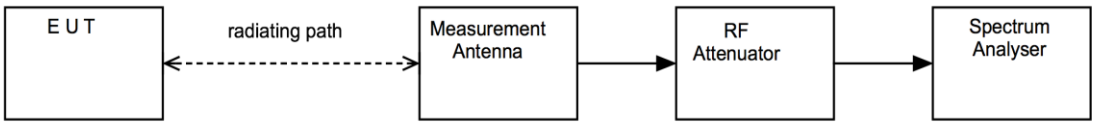
$$Factor = CL + AF - PA$$

Where,

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

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

Figure i Test Setup

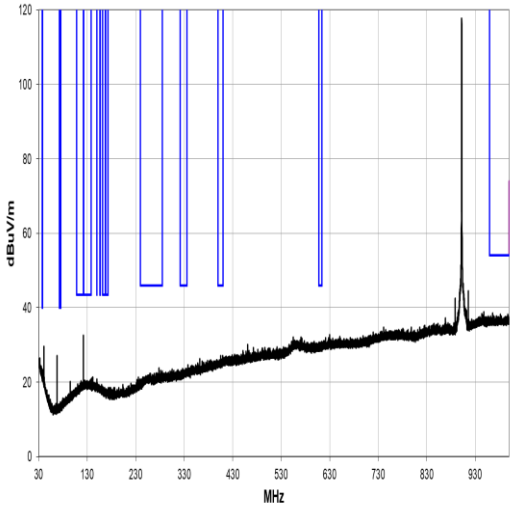


11.5 Test Equipment

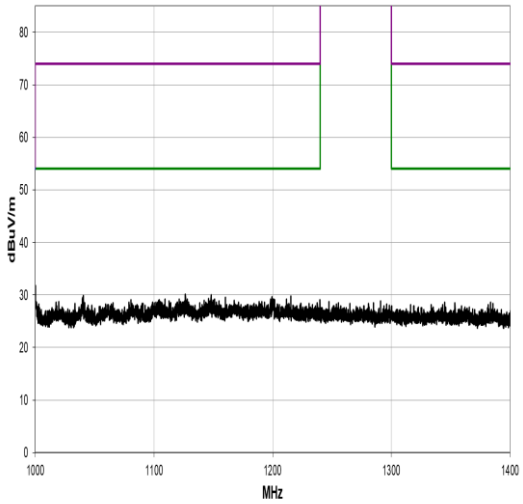
Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU50	U544	2023-11-18
EMI Receiver	R&S	ESR26	U489	2023-09-30
1-18GHz Horn	EMCO	3115	L139	2024-07-01
Pre Amp	Agilent	8449B	U457	2024-01-24
Bilog	Chase	CBL611/A	U191	2025-02-22
PreAmp	Watkins Johnson	6201-69	U372	2024-03-07
1.3GHz High Pass Filter	MiniCircuits	HPF 1300+	U716	2024-02-09
High Pass Filter	Atlantic Microwave	AFH-07000	U558	2024-02-13
Radio Chamber - PP	Rainford EMC	ATS	REF940	2023-11-06
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required

11.6 Test Results

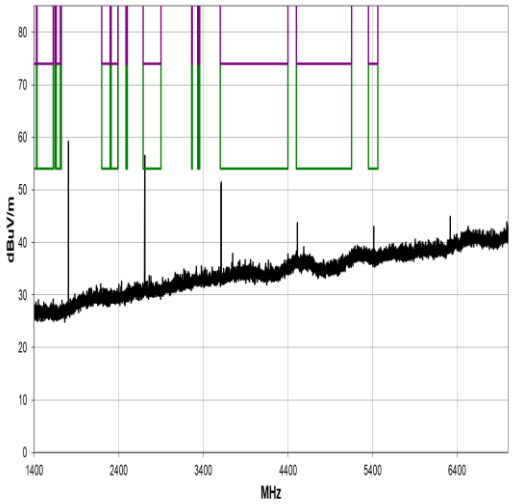
Antenna 1; Frequency: 902.25 MHz; Power Setting: 60



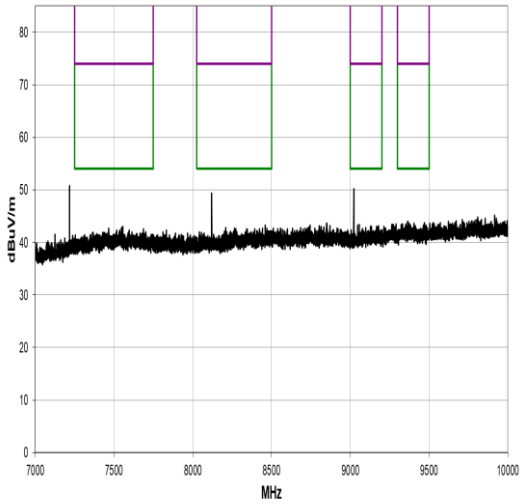
30 MHz to 1 GHz



1 GHz to 1.4 GHz



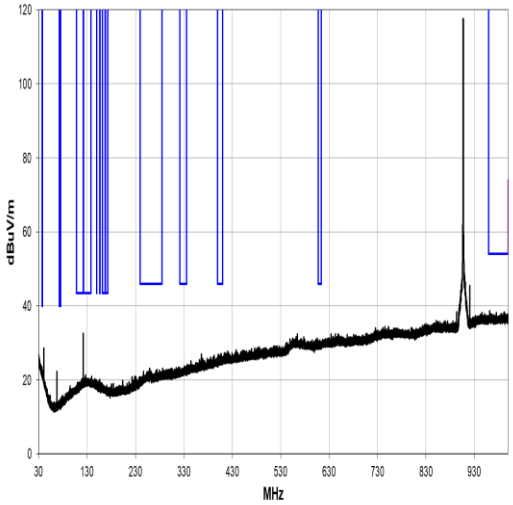
1.4 GHz to 7 GHz



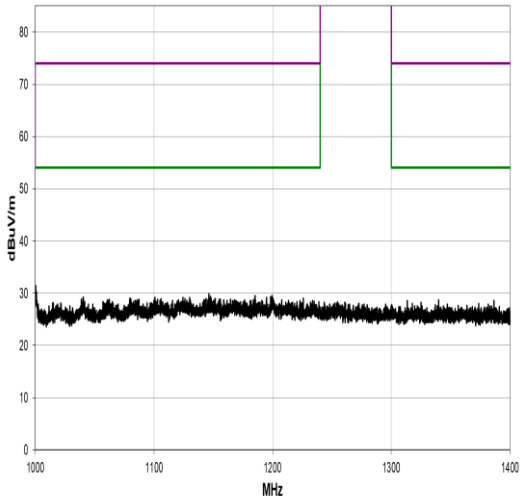
7 GHz to 10 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
2706.788	62.0	-2.2	2.0	346.1	-18.0	0.0	Horz	AV	0.0	41.8	54.0	-12.2
2706.897	59.4	-2.2	1.4	346.1	-18.0	0.0	Vert	AV	0.0	39.2	54.0	-14.8
3608.898	53.5	1.2	1.4	17.0	-18.0	0.0	Horz	AV	0.0	36.7	54.0	-17.3
3608.848	53.4	1.2	1.6	25.0	-18.0	0.0	Vert	AV	0.0	36.6	54.0	-17.4
5413.728	46.9	6.2	1.6	-0.1	-18.0	0.0	Horz	AV	0.0	35.1	54.0	-18.9
4510.943	49.1	3.8	1.4	297.9	-18.0	0.0	Horz	AV	0.0	34.9	54.0	-19.1
4511.268	48.7	3.8	1.3	222.0	-18.0	0.0	Vert	AV	0.0	34.5	54.0	-19.5
5413.495	45.1	6.2	2.9	360.0	-18.0	0.0	Vert	AV	0.0	33.3	54.0	-20.7
2706.788	62.0	-2.2	2.0	346.1		0.0	Horz	PK	0.0	59.8	74.0	-14.2
2706.897	59.4	-2.2	1.4	346.1		0.0	Vert	PK	0.0	57.2	74.0	-16.8
3608.898	53.5	1.2	1.4	17.0		0.0	Horz	PK	0.0	54.7	74.0	-19.3
3608.848	53.4	1.2	1.6	25.0		0.0	Vert	PK	0.0	54.6	74.0	-19.4
5413.728	46.9	6.2	1.6	-0.1		0.0	Horz	PK	0.0	53.1	74.0	-20.9
4510.943	49.1	3.8	1.4	297.9		0.0	Horz	PK	0.0	52.9	74.0	-21.1
4511.268	48.7	3.8	1.3	222.0		0.0	Vert	PK	0.0	52.5	74.0	-21.5
5413.495	45.1	6.2	2.9	360.0		0.0	Vert	PK	0.0	51.3	74.0	-22.7
9022.108	48.3	9.5	1.5	290.9	-18.0	0.0	Horz	AV	0.0	39.8	54.0	-14.2
9022.492	48.2	9.5	1.3	216.0	-18.0	0.0	Vert	AV	0.0	39.7	54.0	-14.3
8120.267	48.2	8.5	1.9	94.0	-18.0	0.0	Horz	AV	0.0	38.7	54.0	-15.3
8120.175	45.9	8.5	1.5	31.9	-18.0	0.0	Vert	AV	0.0	36.4	54.0	-17.6
9022.108	48.3	9.5	1.5	290.9		0.0	Horz	PK	0.0	57.8	74.0	-16.2
9022.492	48.2	9.5	1.3	216.0		0.0	Vert	PK	0.0	57.7	74.0	-16.3
8120.267	48.2	8.5	1.9	94.0		0.0	Horz	PK	0.0	56.7	74.0	-17.3
8120.175	45.9	8.5	1.5	31.9		0.0	Vert	PK	0.0	54.4	74.0	-19.6

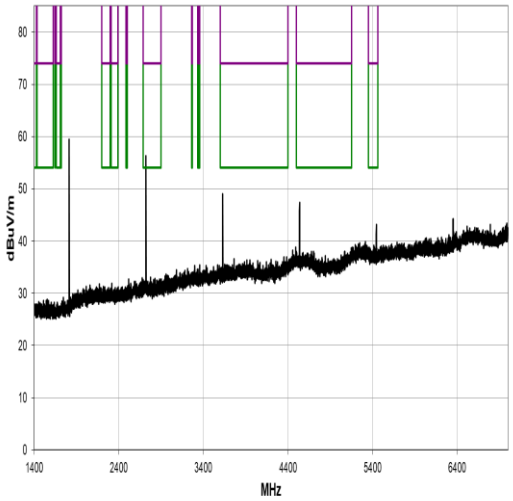
Antenna 1; Frequency: 907.15 MHz; Power Setting: 60



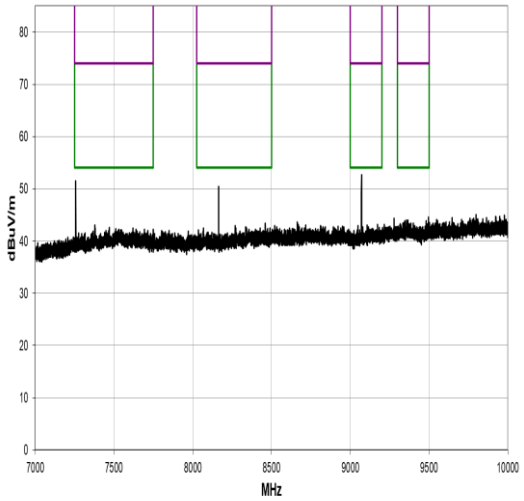
30 MHz to 1 GHz



1 GHz to 1.4 GHz



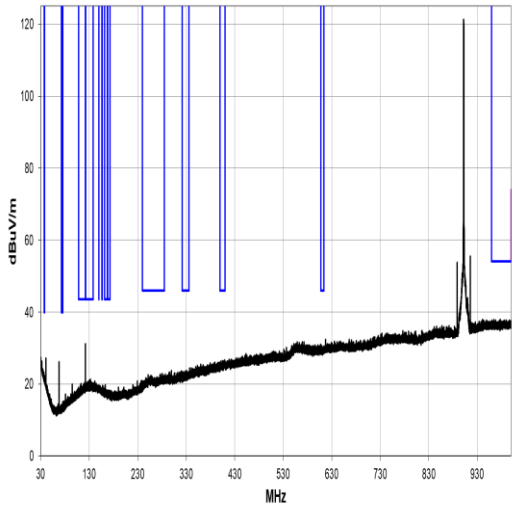
1.4 GHz to 7 GHz



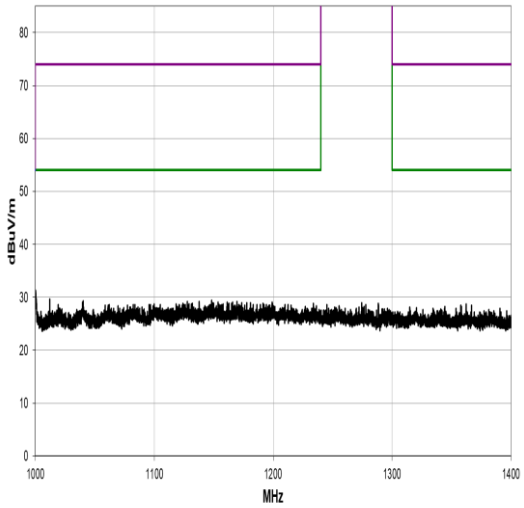
7 GHz to 10 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
2721.482	60.8	-2.2	1.9	343.0	-18.0	0.0	Horz	AV	0.0	40.6	54.0	-13.4
2721.498	59.6	-2.2	1.5	345.1	-18.0	0.0	Vert	AV	0.0	39.4	54.0	-14.6
3628.640	52.8	1.3	1.4	20.0	-18.0	0.0	Vert	AV	0.0	36.1	54.0	-17.9
4535.765	49.0	4.0	1.4	299.9	-18.0	0.0	Horz	AV	0.0	35.0	54.0	-19.0
3628.615	51.3	1.3	1.5	21.1	-18.0	0.0	Horz	AV	0.0	34.6	54.0	-19.4
4535.882	47.5	4.0	1.5	239.0	-18.0	0.0	Vert	AV	0.0	33.5	54.0	-20.5
5442.848	44.4	6.4	1.5	329.0	-18.0	0.0	Vert	AV	0.0	32.8	54.0	-21.2
5443.048	46.1	6.4	1.7	51.0	-18.0	0.0	Horz	AV	0.0	34.5	54.0	-19.5
2721.482	60.8	-2.2	1.9	343.0		0.0	Horz	PK	0.0	58.6	74.0	-15.4
2721.498	59.6	-2.2	1.5	345.1		0.0	Vert	PK	0.0	57.4	74.0	-16.6
3628.640	52.8	1.3	1.4	20.0		0.0	Vert	PK	0.0	54.1	74.0	-19.9
4535.765	49.0	4.0	1.4	299.9		0.0	Horz	PK	0.0	53.0	74.0	-21.0
3628.615	51.3	1.3	1.5	21.1		0.0	Horz	PK	0.0	52.6	74.0	-21.4
5443.048	46.1	6.4	1.7	51.0		0.0	Horz	PK	0.0	52.5	74.0	-21.5
4535.882	47.5	4.0	1.5	239.0		0.0	Vert	PK	0.0	51.5	74.0	-22.5
5442.848	44.4	6.4	1.5	329.0		0.0	Vert	PK	0.0	50.8	74.0	-23.2
9071.575	49.3	9.5	1.5	232.0	-18.0	0.0	Horz	AV	0.0	40.8	54.0	-13.2
9071.625	48.2	9.5	1.6	272.0	-18.0	0.0	Vert	AV	0.0	39.7	54.0	-14.3
8164.175	48.6	8.6	1.6	78.9	-18.0	0.0	Horz	AV	0.0	39.2	54.0	-14.8
7257.092	48.9	8.1	1.5	4.0	-18.0	0.0	Horz	AV	0.0	39.0	54.0	-15.0
7257.542	48.7	8.1	2.4	14.0	-18.0	0.0	Vert	AV	0.0	38.8	54.0	-15.2
8164.633	46.4	8.6	1.5	16.0	-18.0	0.0	Vert	AV	0.0	37.0	54.0	-17.0
9071.575	49.3	9.5	1.5	232.0		0.0	Horz	PK	0.0	58.8	74.0	-15.2
9071.625	48.2	9.5	1.6	272.0		0.0	Vert	PK	0.0	57.7	74.0	-16.3
8164.175	48.6	8.6	1.6	78.9		0.0	Horz	PK	0.0	57.2	74.0	-16.8
7257.092	48.9	8.1	1.5	4.0		0.0	Horz	PK	0.0	57.0	74.0	-17.0
7257.542	48.7	8.1	2.4	14.0		0.0	Vert	PK	0.0	56.8	74.0	-17.2
8164.633	46.4	8.6	1.5	16.0		0.0	Vert	PK	0.0	55.0	74.0	-19.0

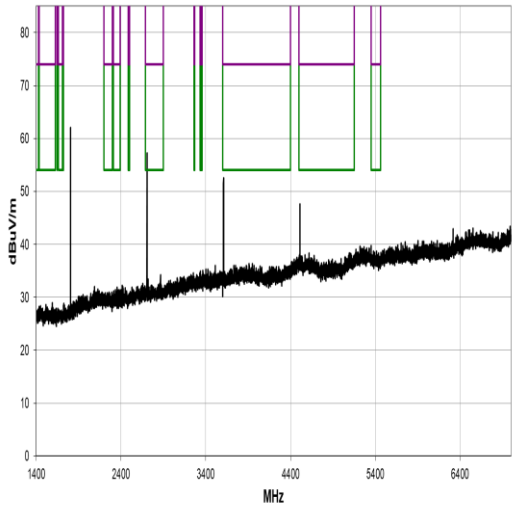
Antenna 2; Frequency: 902.25 MHz; Power Setting: 60



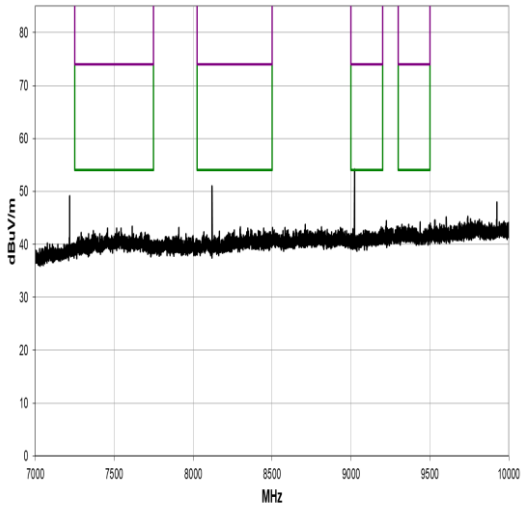
30 MHz to 1 GHz



1 GHz to 1.4 GHz



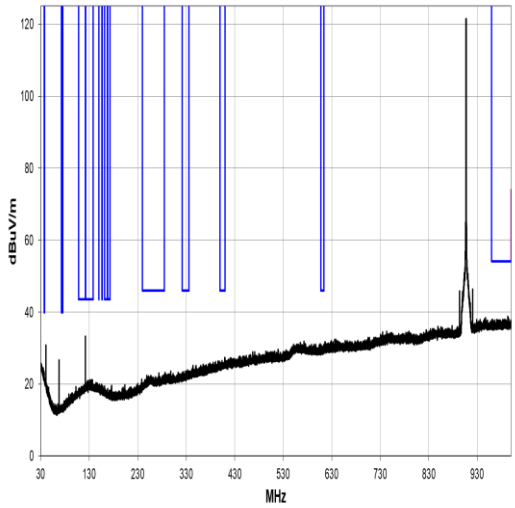
1.4 GHz to 7 GHz



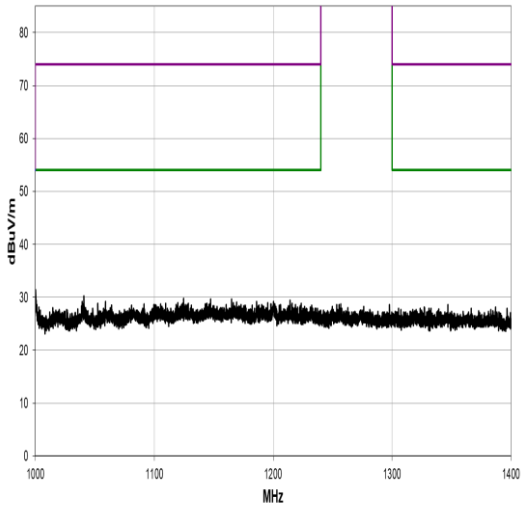
7 GHz to 10 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
2706.708	66.2	-2.2	2.8	4.0	-18.0	0.0	Horz	AV	0.0	46.0	54.0	-8.0
2706.708	61.6	-2.2	1.6	309.0	-18.0	0.0	Vert	AV	0.0	41.4	54.0	-12.6
3608.883	54.4	1.2	1.8	70.9	-18.0	0.0	Horz	AV	0.0	37.6	54.0	-16.4
3608.925	54.3	1.2	1.5	31.0	-18.0	0.0	Vert	AV	0.0	37.5	54.0	-16.5
4511.158	51.4	3.8	1.7	80.0	-18.0	0.0	Horz	AV	0.0	37.2	54.0	-16.8
4511.167	50.7	3.8	1.4	225.0	-18.0	0.0	Vert	AV	0.0	36.5	54.0	-17.5
2706.708	66.2	-2.2	2.8	4.0		0.0	Horz	PK	0.0	64.0	74.0	-10.0
2706.708	61.6	-2.2	1.6	309.0		0.0	Vert	PK	0.0	59.4	74.0	-14.6
3608.883	54.4	1.2	1.8	70.9		0.0	Horz	PK	0.0	55.6	74.0	-18.4
3608.925	54.3	1.2	1.5	31.0		0.0	Vert	PK	0.0	55.5	74.0	-18.5
4511.158	51.4	3.8	1.7	80.0		0.0	Horz	PK	0.0	55.2	74.0	-18.8
4511.167	50.7	3.8	1.4	225.0		0.0	Vert	PK	0.0	54.5	74.0	-19.5
8120.300	50.6	8.5	1.9	95.1	-18.0	0.0	Horz	AV	0.0	41.1	54.0	-12.9
9022.592	49.2	9.5	1.7	227.0	-18.0	0.0	Horz	AV	0.0	40.7	54.0	-13.3
9022.775	48.5	9.5	1.3	216.1	-18.0	0.0	Vert	AV	0.0	40.0	54.0	-14.0
8120.583	45.7	8.5	1.2	40.0	-18.0	0.0	Vert	AV	0.0	36.2	54.0	-17.8
8120.300	50.6	8.5	1.9	95.1		0.0	Horz	PK	0.0	59.1	74.0	-14.9
9022.592	49.2	9.5	1.7	227.0		0.0	Horz	PK	0.0	58.7	74.0	-15.3
9022.775	48.5	9.5	1.3	216.1		0.0	Vert	PK	0.0	58.0	74.0	-16.0
8120.583	45.7	8.5	1.2	40.0		0.0	Vert	PK	0.0	54.2	74.0	-19.8

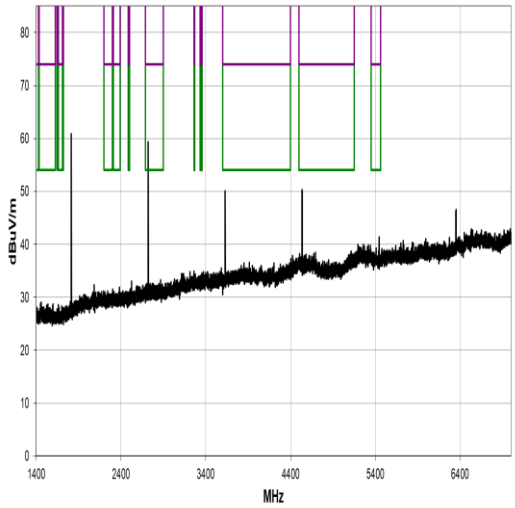
Antenna 2; Frequency: 907.15 MHz; Power Setting: 60



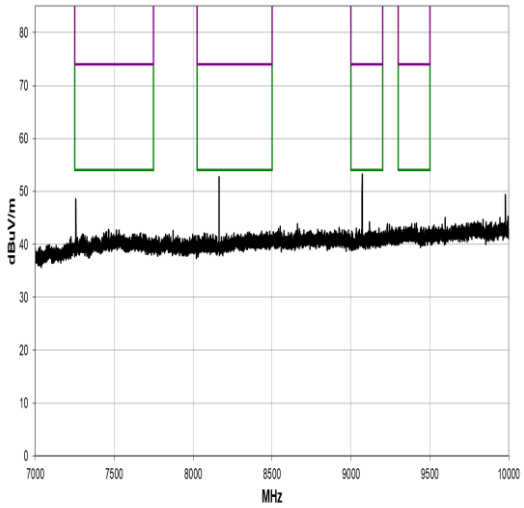
30 MHz to 1 GHz



1 GHz to 1.4 GHz



1.4 GHz to 7 GHz



7 GHz to 10 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
2721.517	64.0	-2.2	2.8	360.0	-18.0	0.0	Horz	AV	0.0	43.8	54.0	-10.2
2721.450	61.7	-2.2	1.3	359.1	-18.0	0.0	Vert	AV	0.0	41.5	54.0	-12.5
4535.658	51.5	4.0	1.7	84.1	-18.0	0.0	Horz	AV	0.0	37.5	54.0	-16.5
3628.625	53.0	1.3	1.7	29.0	-18.0	0.0	Vert	AV	0.0	36.3	54.0	-17.7
4535.875	48.6	4.0	1.2	219.9	-18.0	0.0	Vert	AV	0.0	34.6	54.0	-19.4
3628.600	51.0	1.3	1.6	25.0	-18.0	0.0	Horz	AV	0.0	34.3	54.0	-19.7
2721.517	64.0	-2.2	2.8	360.0		0.0	Horz	PK	0.0	61.8	74.0	-12.2
2721.450	61.7	-2.2	1.3	359.1		0.0	Vert	PK	0.0	59.5	74.0	-14.5
4535.658	51.5	4.0	1.7	84.1		0.0	Horz	PK	0.0	55.5	74.0	-18.5
3628.625	53.0	1.3	1.7	29.0		0.0	Vert	PK	0.0	54.3	74.0	-19.7
4535.875	48.6	4.0	1.2	219.9		0.0	Vert	PK	0.0	52.6	74.0	-21.4
3628.600	51.0	1.3	1.6	25.0		0.0	Horz	PK	0.0	52.3	74.0	-21.7
9071.517	49.7	9.5	1.7	226.0	-18.0	0.0	Horz	AV	0.0	41.2	54.0	-12.8
8164.350	50.4	8.6	2.0	85.0	-18.0	0.0	Horz	AV	0.0	41.0	54.0	-13.0
9071.542	49.1	9.5	1.5	215.0	-18.0	0.0	Vert	AV	0.0	40.6	54.0	-13.4
7257.233	48.2	8.1	1.6	97.1	-18.0	0.0	Horz	AV	0.0	38.3	54.0	-15.7
7257.650	47.8	8.1	1.6	231.0	-18.0	0.0	Vert	AV	0.0	37.9	54.0	-16.1
8164.408	47.0	8.6	1.5	32.9	-18.0	0.0	Vert	AV	0.0	37.6	54.0	-16.4
9071.517	49.7	9.5	1.7	226.0		0.0	Horz	PK	0.0	59.2	74.0	-14.8
8164.350	50.4	8.6	2.0	85.0		0.0	Horz	PK	0.0	59.0	74.0	-15.0
9071.542	49.1	9.5	1.5	215.0		0.0	Vert	PK	0.0	58.6	74.0	-15.4
7257.233	48.2	8.1	1.6	97.1		0.0	Horz	PK	0.0	56.3	74.0	-17.7
7257.650	47.8	8.1	1.6	231.0		0.0	Vert	PK	0.0	55.9	74.0	-18.1
8164.408	47.0	8.6	1.5	32.9		0.0	Vert	PK	0.0	55.6	74.0	-18.4

12 Carrier frequency separation

12.1 Definition

The carrier frequency separation is the frequency separation between two adjacent hopping frequencies.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio :Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.2
EUT Frequencies Measured:	All; 902.25 MHz – 907.15 MHz
EUT Test Modulations:	Internal pattern generation – hopping enabled
Deviations From Standard:	None
Measurement BW:	1 kHz / 10 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: +22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 34 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

12.3 Test Limit

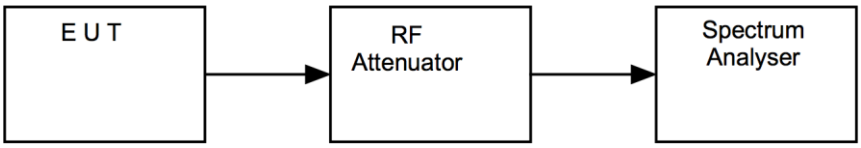
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the band 2400 to 2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iii, the emissions of 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 nominal bandwidth.

Figure iii Test Setup

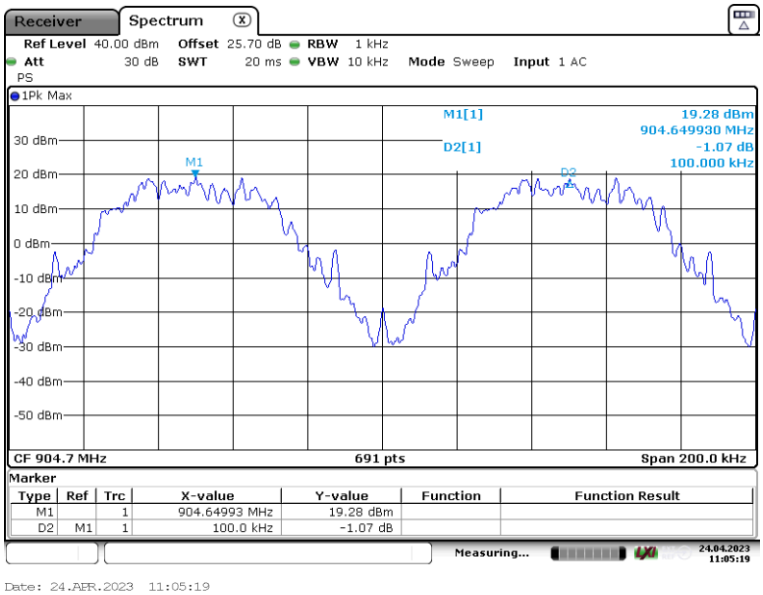


12.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
EMI Receiver	R&S	ESR26	U489	2023-09-30
Attenuator	AtlanTecRF Microwave	20dB SMA Attenuator	U632	Cal in use
Attenuator	AtlanTecRF Microwave	6dB SMA Attenuator	U635	Cal in use

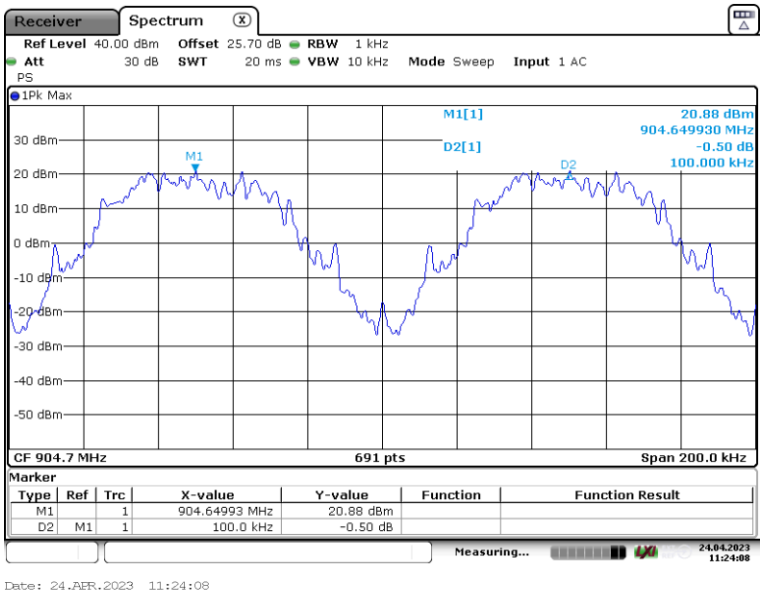
12.6 Test Results

Antenna 1; Modulation: 4-GFSK; Power Setting: 60			
$F1_c$ (MHz)	***$F2_c$ (MHz)***	***Channel Separation, $F2_c - F1_c$ (kHz)***	***Result***
904.64993	904.74993	100	PASS



902.25 MHz to 907-15 MHz – All Hopping

Antenna 2; Modulation: FM; Power Setting: 60			
$F1_c$ (MHz)	***$F2_c$ (MHz)***	***Channel Separation, $F2_c - F1_c$ (kHz)***	***Result***
904.64993	904.74993	100	PASS



902.25 MHz to 907-15 MHz – All Hopping

13 Number of hopping frequencies

13.1 Definition

The total number of hopping frequencies (the centre frequencies defined within the hopping sequence of a FHSS equipment) which are randomly sequenced in order to spread the transmission.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.3
EUT Frequencies Measured:	All; 902.25 MHz to 907.15 MHz
EUT Test Modulations:	Internal pattern generation – hopping enabled
Deviations From Standard:	None
Measurement BW:	30 kHz / 100 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: +22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 33 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

13.3 Test Limit

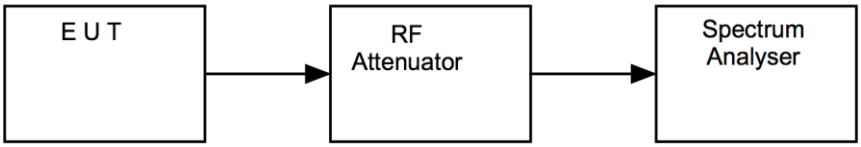
- For frequency hopping systems in the band 902 to 928 MHz: if the -20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels;
  If the -20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels;
- Frequency hopping systems operating in the band 2400 to 2483.5 MHz shall use at least 15 hopping channels;
- Frequency hopping systems operating in the band 5725 to 5850 MHz shall use at least 75 hopping channels.

13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the emissions of 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 nominal bandwidth.

Figure iv Test Setup

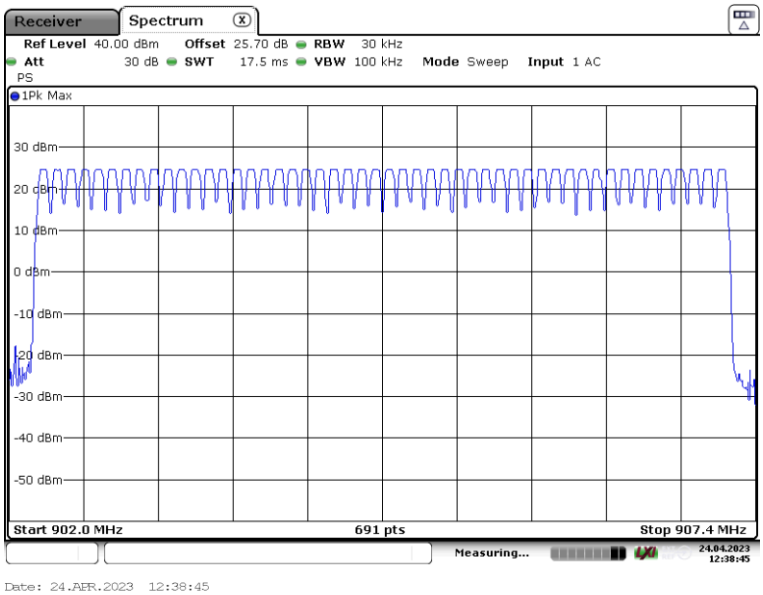


13.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
EMI Receiver	R&S	ESR26	U489	2023-09-30
Attenuator	AtlanTecRF Microwave	20dB SMA Attenuator	U632	Cal in use
Attenuator	AtlanTecRF Microwave	6dB SMA Attenuator	U635	Cal in use

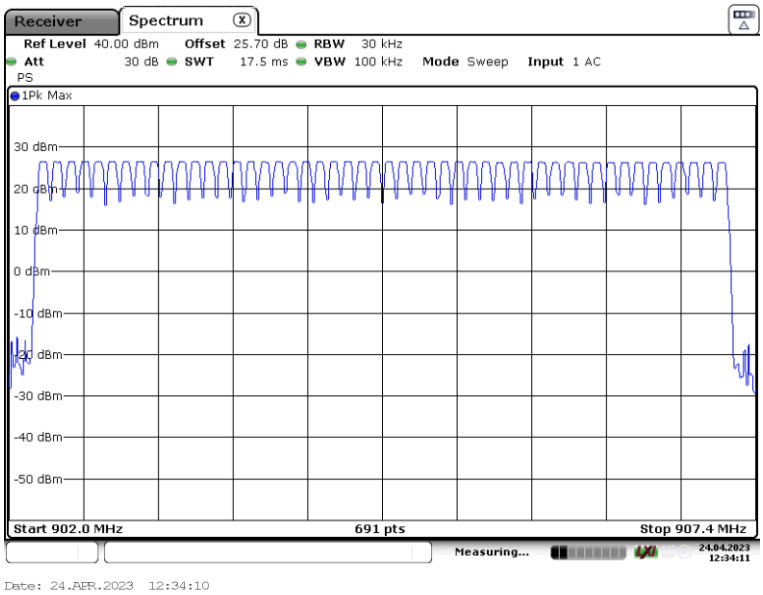
13.6 Test Results

Antenna: 1; Modulation: 4-GFSK; Power setting: 60			
Lowest channel, F_{CL} (MHz)	***Highest channel, F_{CH} (MHz)***	***Number of channels observed***	***Result***
902.25	907.15	50	PASS



902.25 MHz to 907.15 MHz – All Hopping

Antenna: 2; Modulation: 4-GFSK; Power setting: 60			
Lowest channel, F_{CL} (MHz)	***Highest channel, F_{CH} (MHz)***	***Number of channels observed***	***Result***
902.25	907.15	50	PASS



902.25 MHz to 907.15 MHz – All Hopping

14 Average channel occupancy

14.1 Definition

The channel occupancy is the total of the transmitter 'on' times, during an observation period, on a particular hopping frequency.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.4
EUT Frequencies Measured:	902.25 MHz
EUT Number of hopping channels:	50
EUT Test Modulations:	Internal pattern generation – hopping enabled
Deviations From Standard:	None
Measurement BW:	100 kHz / 300 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: +22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

14.3 Test Limit

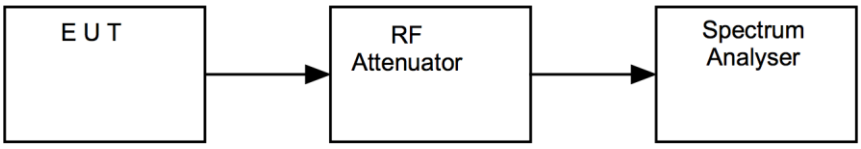
- For frequency hopping systems in the band 902 to 928 MHz: if the -20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20 second period;
  If the -20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10 second period;
- Frequency hopping systems operating in the band 2400 to 2483.5 MHz: The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed;
- Frequency hopping systems operating in the band 5725 to 5850 MHz: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the emissions of the EUT were measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. A number of hops were observed to confirm consistency of the dwell time / observe the worst case. All modulation schemes, data rates and power settings were used to observe the worst-case configuration.

Figure v Test Setup



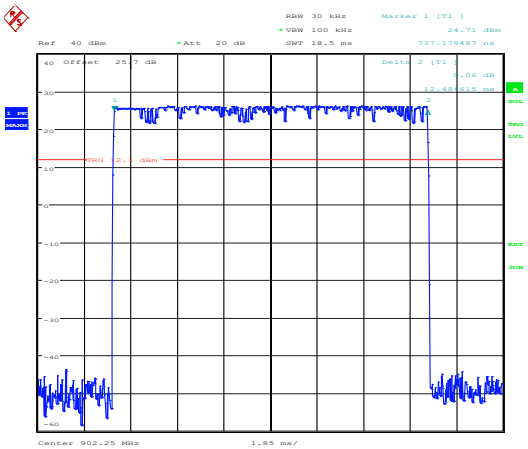
14.5 Test Equipment

2023-04-24 to 2023-05-02				
Equipment Type	***Manufacturer***	***Equipment Description***	***Element No***	***Due For Calibration***
EMI Receiver	R&S	ESR26	U489	2023-09-30
Attenuator	AtlanTecRF Microwave	20dB SMA Attenuator	U632	Cal in use
Attenuator	AtlanTecRF Microwave	6dB SMA Attenuator	U635	Cal in use

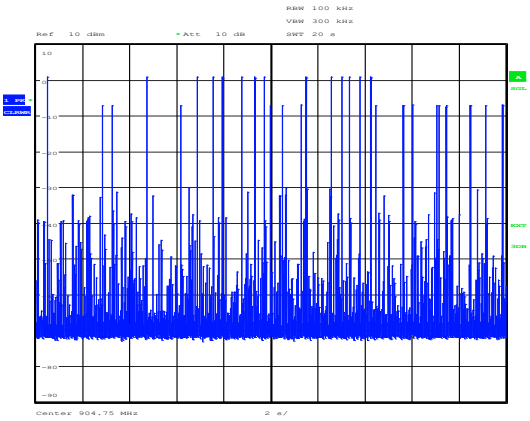
12th July 2024				
Equipment Type	***Manufacturer***	***Equipment Description***	***Element No***	***Due For Calibration***
Spectrum Analyser	R&S	FSU26	U405	2025-06-07

14.6 Test Results

Antenna 1: Modulation: 4-GFSK; Power setting: 60				
Individual occupancy time (ms)	***Observation period (s)***	***Number of hops observed***	***Average time of occupancy (s)***	***Result***
12.484615	20	14	0.17478461	PASS



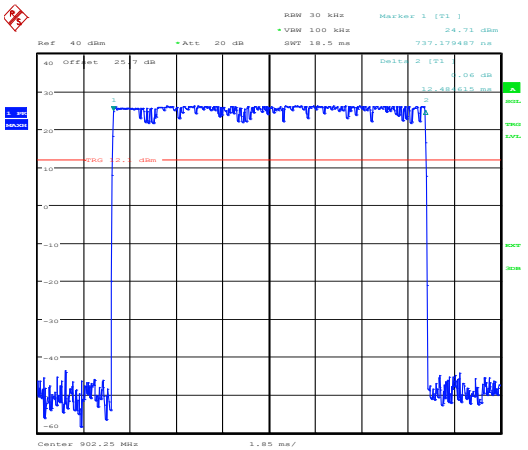
Tx on (All Hopping)



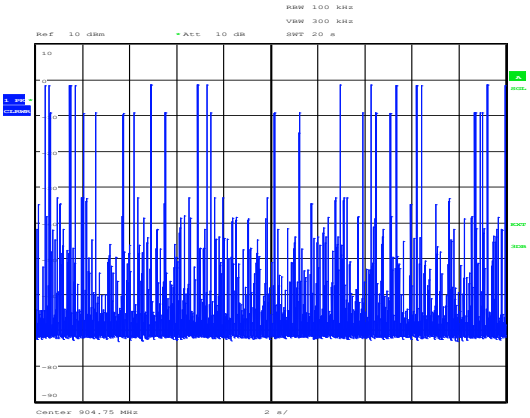
Number of transmissions during observation period

Number of transmissions during observation period measurement Made on 12th July 2024

Antenna 2: Modulation: 4-GFSK; Power setting: 60				
Individual occupancy time (ms)	***Observation period (s)***	***Number of hops observed***	***Average time of occupancy (s)***	***Result***
12.484615	20	14	0.17478461	PASS



Tx on (All Hopping)



Number of transmissions during observation period

Number of transmissions during observation period measurement Made on 12th July 2024

15 Maximum peak conducted output power

15.1 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.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.5
EUT Frequencies Measured:	902.25 MHz, 907.15 MHz – hopping disabled.
Deviations From Standard:	None
Measurement BW:	200 kHz
Spectrum Analyzer Video BW:	1 MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Battery Power = new battery.

Environmental Conditions (Normal Environment)

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

15.3 Test Limit

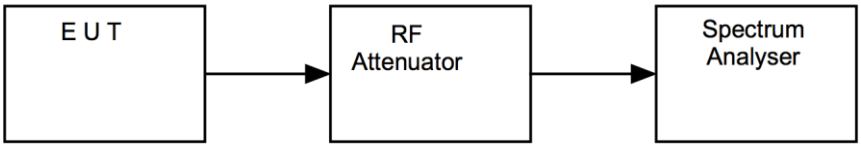
- For frequency hopping systems operating in the band 902 to 928 MHz, the maximum peak conducted output power shall not exceed 1 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels;
  the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. shall not exceed 1 W, if the hopset uses less than 50 hopping channels.
- For frequency hopping systems operating in the band 2400 to 2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W;
  for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W. The e.i.r.p. shall not exceed 4 W.
- For frequency hopping systems operating in the band 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W.
- Point-to-point systems in the bands 2400-2483.5 MHz and 5725 to 5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers.

15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vi, 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 vi Test Setup

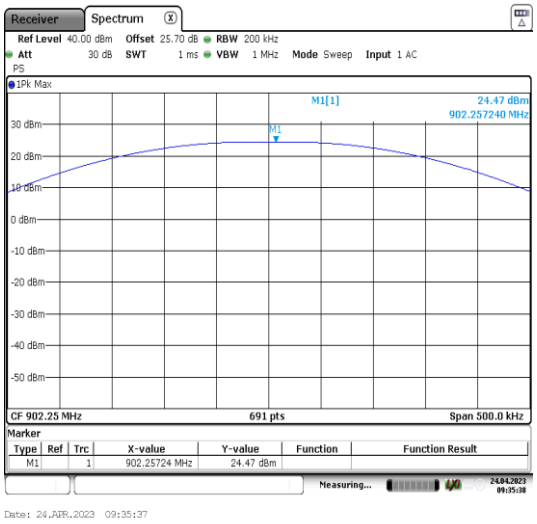


15.5 Test Equipment

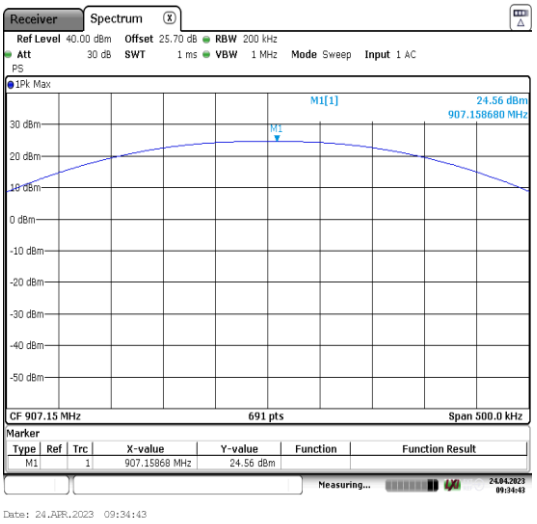
Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
EMI Receiver	R&S	ESR26	U489	2023-09-30
Attenuator	AtlanTecRF Microwave	20dB SMA Attenuator	U632	Cal in use
Attenuator	AtlanTecRF Microwave	6dB SMA Attenuator	U635	Cal in use

15.6 Test Results

Antenna: 1; Modulation: 4-GFSK; Power Setting: 60			
Frequency (MHz)	*Maximum peak conducted output power*		*Result*
	(dBm)	*(W)*	
902.25	24.47	0.2799	PASS
907.15	24.56	0.2858	PASS

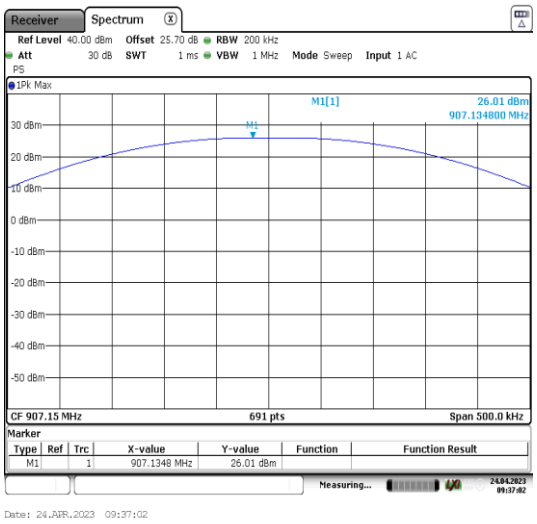


902.25 MHz

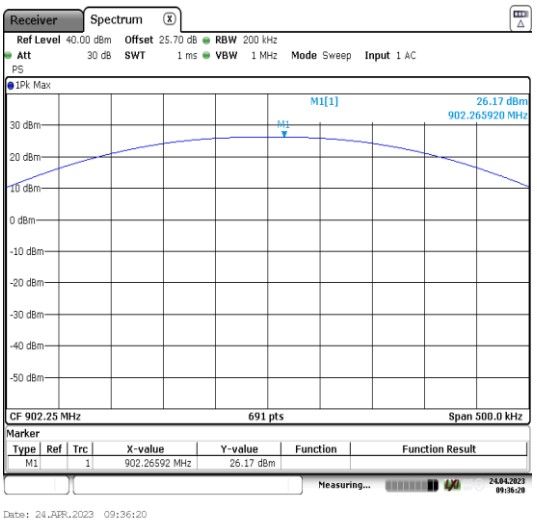


907.15 MHz

Antenna: 2; Modulation: 4-GFSK; Power Setting: 60			
Frequency (MHz)	*Maximum peak conducted output power*		*Result*
	(dBm)	*(W)*	
902.25	26.01	0.3990	PASS
907.15	26.17	0.4140	PASS



902.25 MHz



907.15 MHz

16 Occupied Bandwidth

16.1 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.

16.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Frequencies Measured:	902.25 MHz, 907.15 MHz – hopping stopped.
EUT Test Modulations:	4-GFSK
Deviations From Standard:	None
Measurement BW: (requirement: 1 % to 5 % OBW)	1 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 kHz
Measurement Span: (requirement 2 to 5 times OBW)	110 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: +22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 37.9 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

16.3 Test Limit

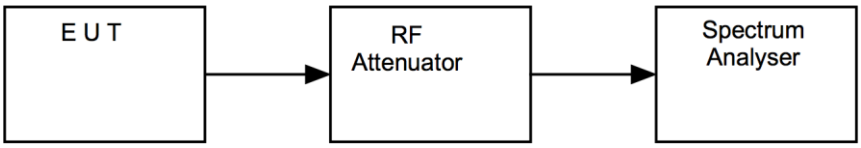
- For frequency hopping systems in the band 902 to 928 MHz: The maximum allowed -20 dB bandwidth of the hopping channel is 500 kHz.
- Frequency hopping systems operating in the band 5725 to 5850 MHz: The maximum -20 dB bandwidth of the hopping channel shall be 1 MHz

16.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vii, 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 vii Test Setup

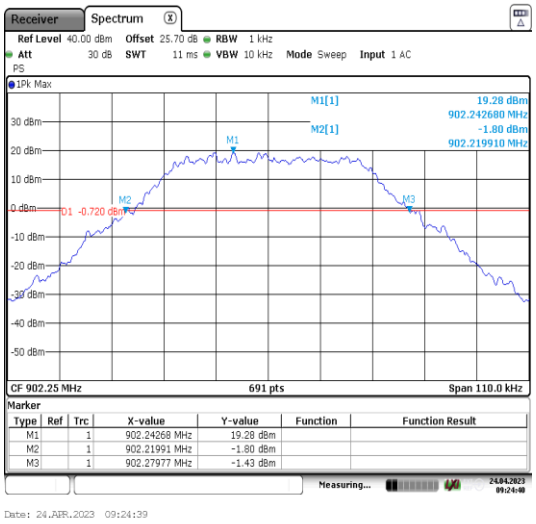


16.5 Test Equipment

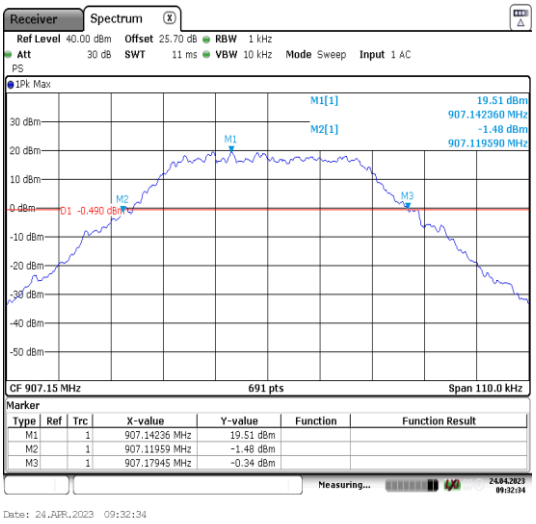
Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
EMI Receiver	R&S	ESR26	U489	2023-09-30
Attenuator	AtlanTecRF Microwave	20dB SMA Attenuator	U632	Cal in use
Attenuator	AtlanTecRF Microwave	6dB SMA Attenuator	U635	Cal in use

16.6 Test Results – 20 dB Occupied Channel Bandwidth

20 dB Occupied Channel Bandwidth; Modulation: 4-GFSK; Power setting: 60; Antenna 1				
Channel Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***20dB Bandwidth (kHz)***	***Result***
902.25	902.219910	902.279770	59.860	PASS
907.15	907.119590	907.179450	59.860	PASS

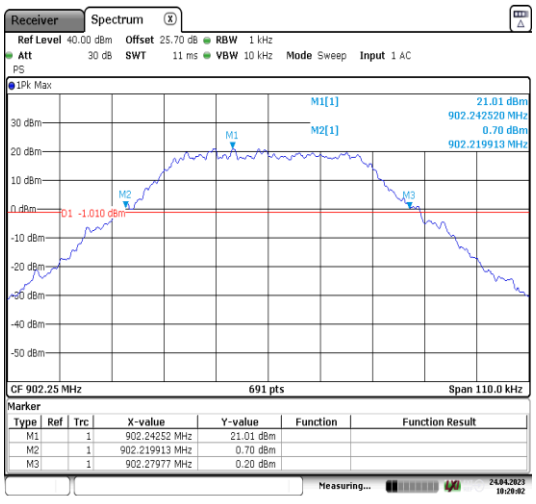


902.25 MHz

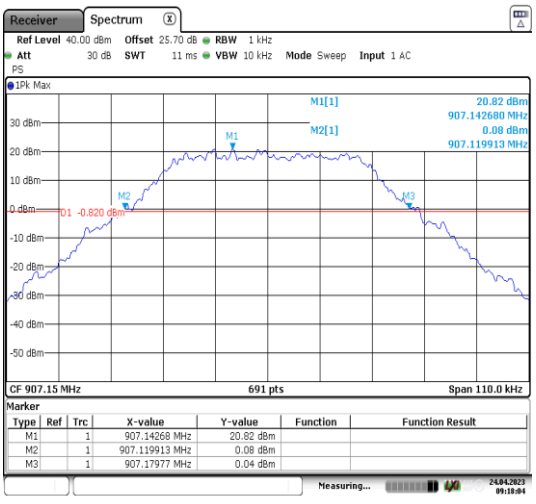


907.15 MHz

20 dB Occupied Channel Bandwidth; Modulation: 4-GFSK; Power setting: 60; Antenna 2				
Channel Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***20dB Bandwidth (kHz)***	***Result***
902.25	902.219913	902.279770	59.857	PASS
907.15	907.119913	907.179770	59.857	PASS



902.25 MHz



907.15 MHz

17 Out-of-band and conducted spurious emissions

17.1 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.

17.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.8
EUT Frequencies Measured:	902.25 MHz, 907.15 MHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Detector:	Peak
Measurement Range:	9 kHz to 10 GHz

Environmental Conditions (Normal Environment)

Temperature: +22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 33 % RH	20 % RH to 75 % RH (as declared)
Supply: 7.5 V dc	7.5 V dc (as declared)

17.3 Test Limits

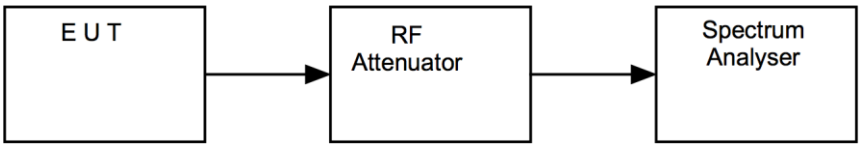
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either 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.

17.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure viii, the emissions from the EUT were measured on a spectrum 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 viii Test Setup

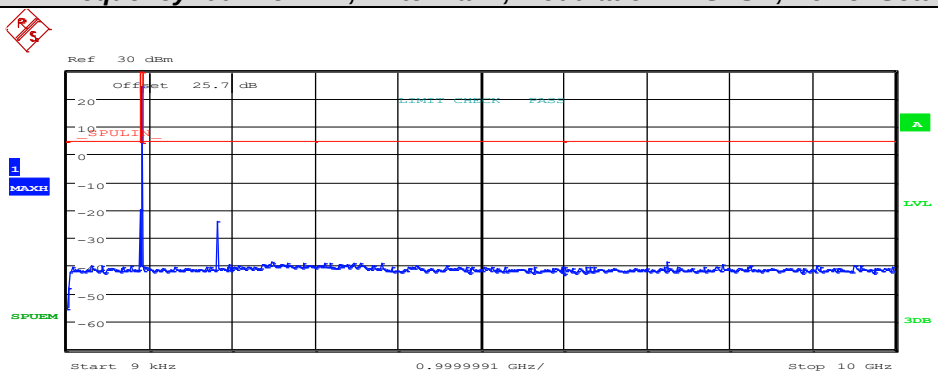


17.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
EMI Receiver	R&S	ESR26	U489	2023-09-30
Attenuator	AtlanTecRF Microwave	20dB SMA Attenuator	U632	Cal in use
Attenuator	AtlanTecRF Microwave	6dB SMA Attenuator	U635	Cal in use

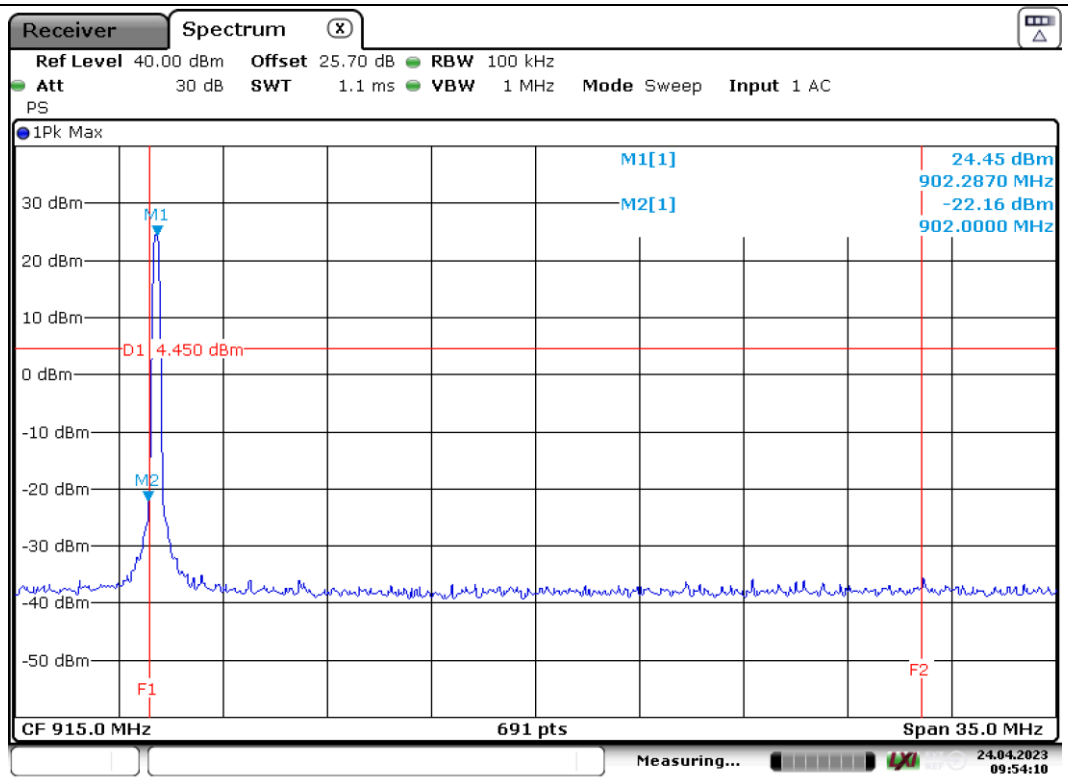
17.6 Test Results

Frequency: 902.25 MHz; Antenna: 1; Modulation: 4-GFSK; Power Setting: 60



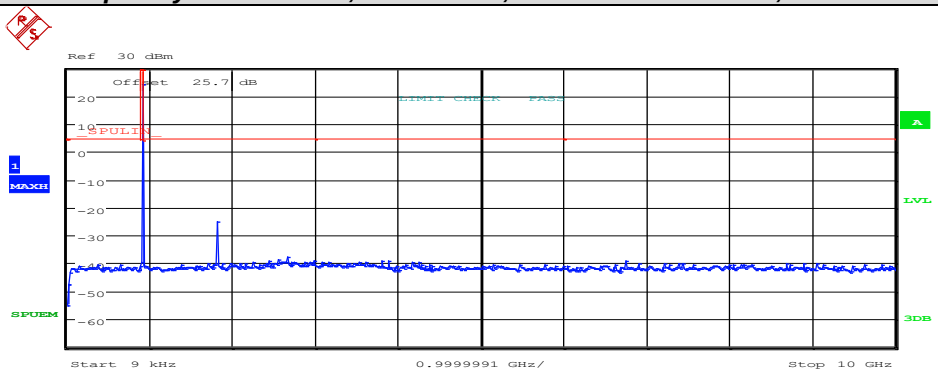
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	23.461538 k	-55.53	-59.81
150.000 k	30.000 M	10.00 k	150.000000 k	-48.13	-52.41
30.000 M	902.000 M	100.00 k	901.912800 M	-26.87	-31.15
902.000 M	928.000 M	100.00 k	902.254800 M	24.28	-5.72
928.000 M	3.000 G	100.00 k	1.804456 G	-24.13	-28.41
3.000 G	6.000 G	100.00 k	3.790800 G	-39.19	-43.47
6.000 G	10.000 G	100.00 k	7.250800 G	-38.55	-42.83

Date: 24.APR.2023 14:16:08



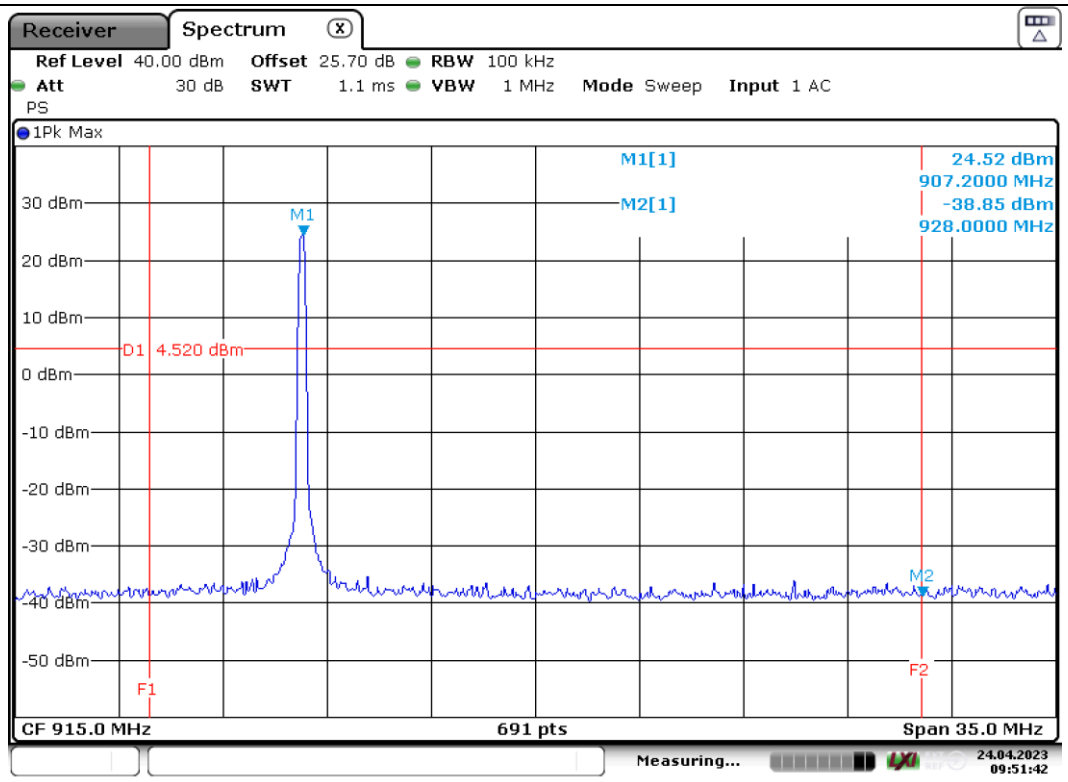
Date: 24.APR.2023 09:54:10

Frequency: 907.15 MHz; Antenna: 1; Modulation: 4-GFSK; Power Setting: 60



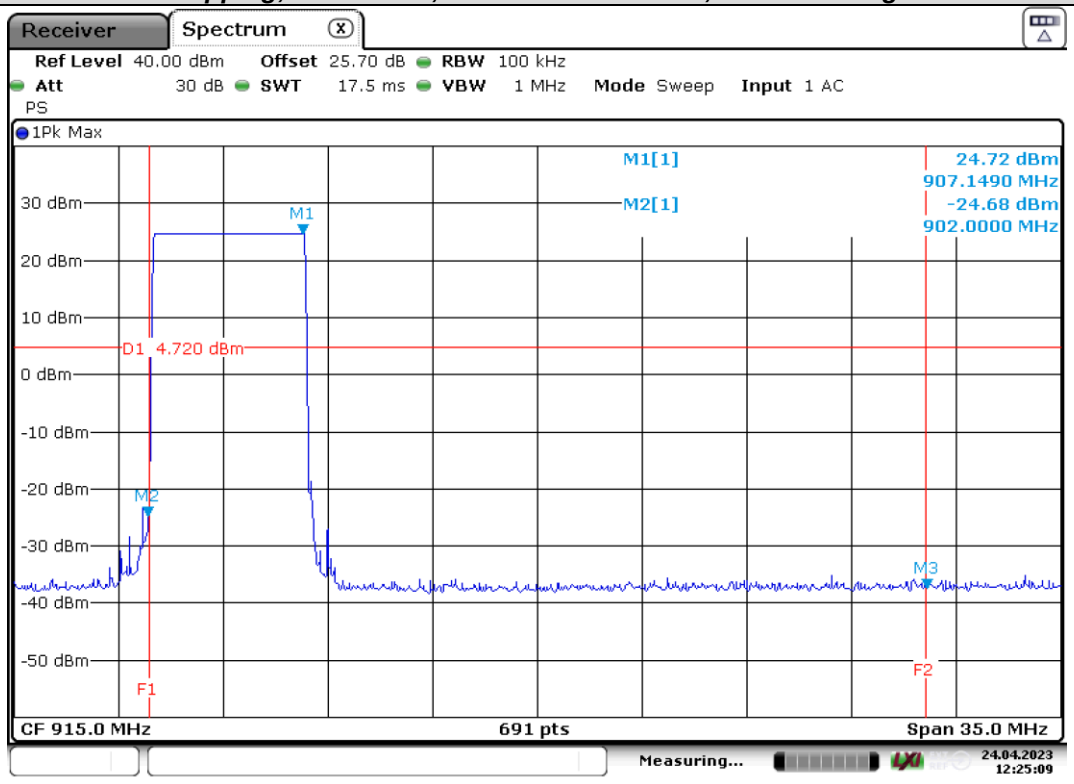
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	139.831731 k	-55.18	-59.54
150.000 k	30.000 M	10.00 k	176.865000 k	-47.64	-52.00
30.000 M	902.000 M	100.00 k	634.819200 M	-40.70	-45.06
902.000 M	928.000 M	100.00 k	907.140200 M	24.36	-5.64
928.000 M	3.000 G	100.00 k	1.814402 G	-24.94	-29.30
3.000 G	6.000 G	100.00 k	3.882300 G	-39.20	-43.56
6.000 G	10.000 G	100.00 k	6.754000 G	-39.26	-43.62

Date: 24.APR.2023 14:18:21

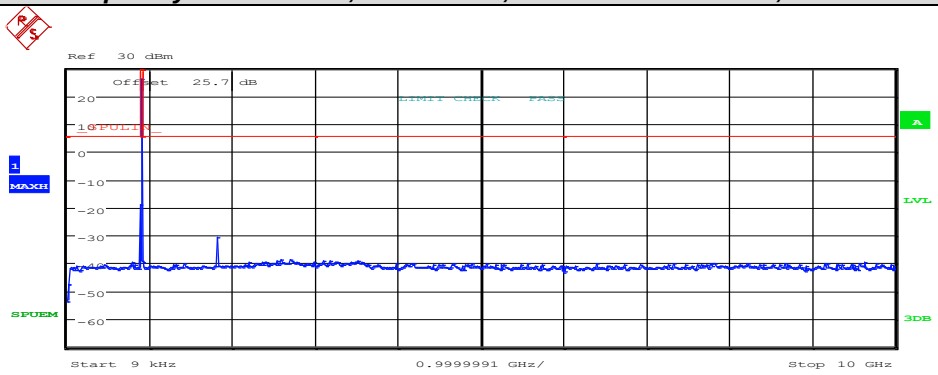


Date: 24.APR.2023 09:51:42

All Hopping; Antenna: 1; Modulation: 4-GFSK; Power Setting: 60

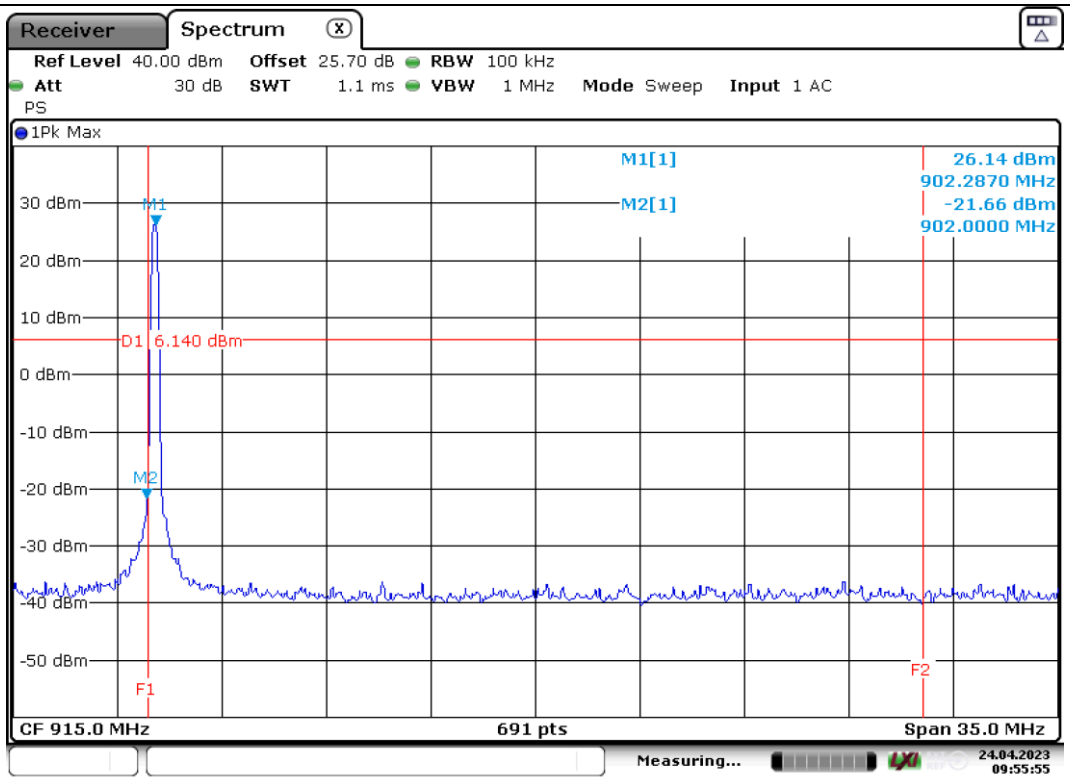


Frequency: 902.25 MHz; Antenna: 2; Modulation: 4-GFSK; Power Setting: 60



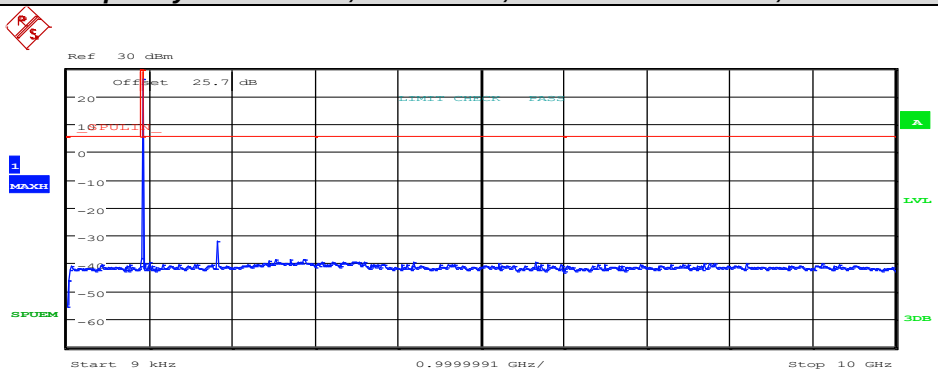
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	10.807692 k	-53.61	-59.57
150.000 k	30.000 M	10.00 k	161.940000 k	-47.64	-53.60
30.000 M	902.000 M	100.00 k	901.912800 M	-22.10	-28.06
902.000 M	928.000 M	100.00 k	902.254800 M	25.95	-4.05
928.000 M	3.000 G	100.00 k	1.804456 G	-30.92	-36.88
3.000 G	6.000 G	100.00 k	3.509700 G	-39.20	-45.16
6.000 G	10.000 G	100.00 k	9.623200 G	-39.89	-45.85

Date: 24.APR.2023 14:11:07



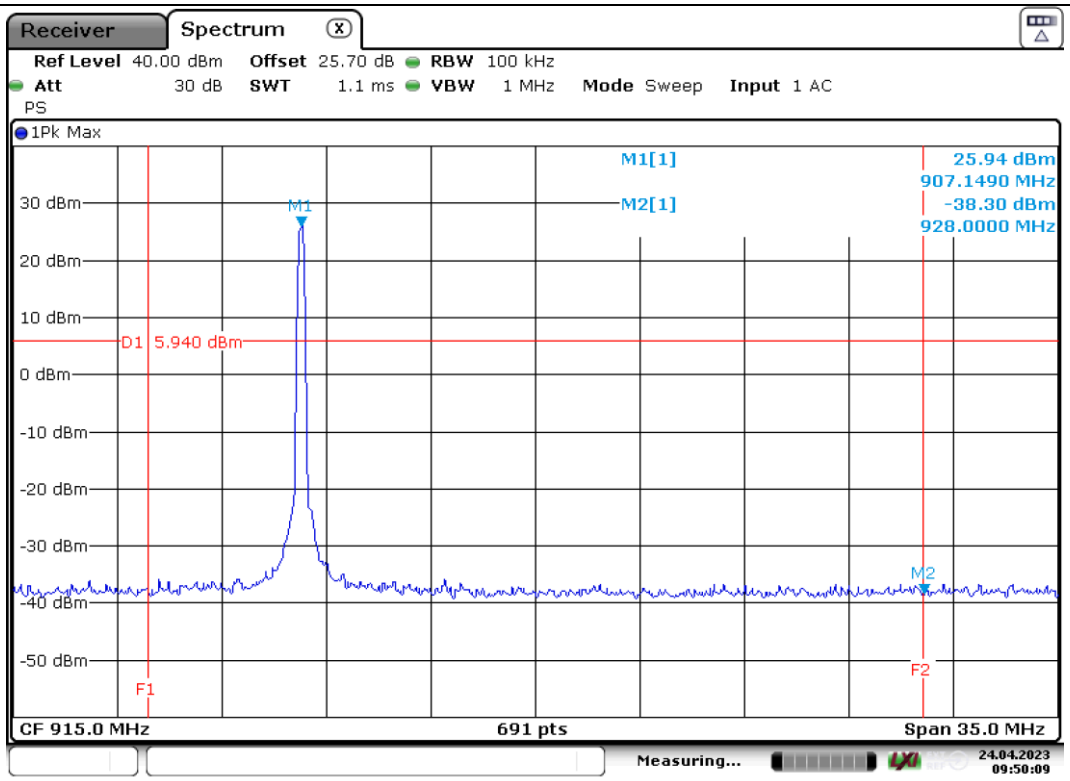
Date: 24.APR.2023 09:55:55

Frequency: 907.15 MHz; Antenna: 2; Modulation: 4-GFSK; Power Setting: 60



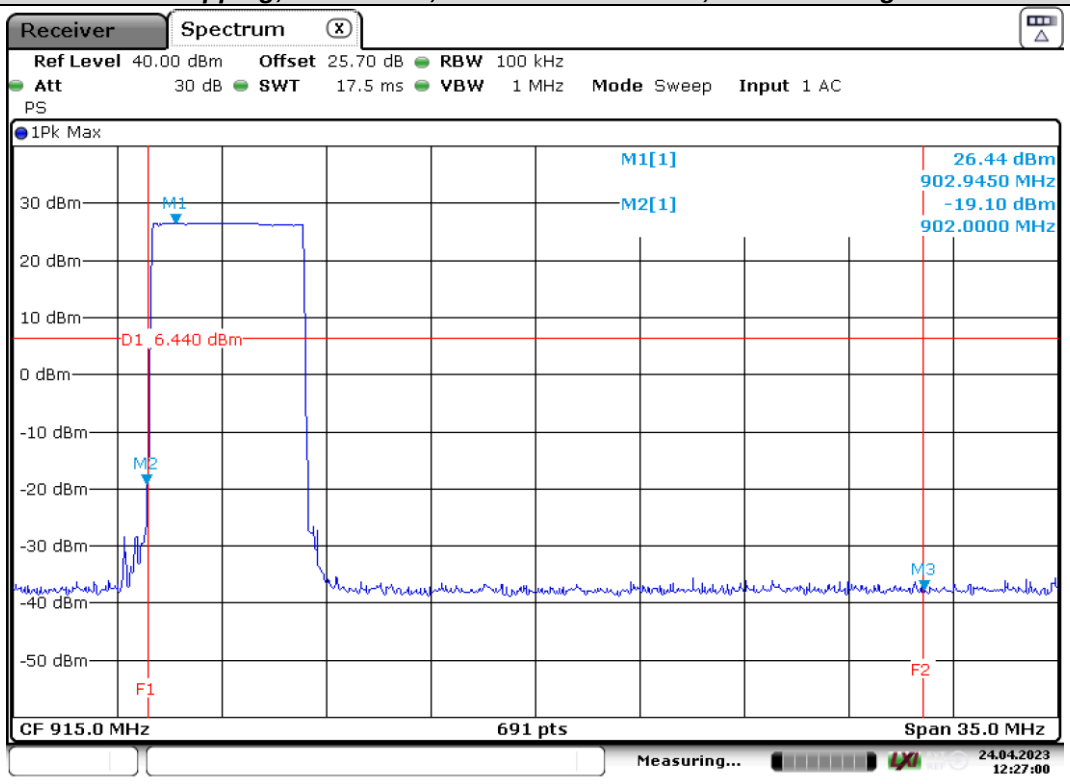
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	10.581731 k	-55.89	-61.68
150.000 k	30.000 M	10.00 k	188.805000 k	-46.47	-52.26
30.000 M	902.000 M	100.00 k	754.893600 M	-40.72	-46.51
902.000 M	928.000 M	100.00 k	907.155800 M	25.79	-4.21
928.000 M	3.000 G	100.00 k	1.814402 G	-31.97	-37.76
3.000 G	6.000 G	100.00 k	3.198900 G	-39.52	-45.31
6.000 G	10.000 G	100.00 k	7.684000 G	-40.05	-45.84

Date: 24.APR.2023 14:13:31



Date: 24.APR.2023 09:50:09

All Hopping; Antenna: 2; Modulation: 4-GFSK; Power Setting: 60



18 Duty Cycle

18.1 Definition

The ratio of the sum of all pulse durations to the total period, during a specified period of operation.

18.2 Test Parameters

Test Location:	Element Skelmersdale
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.6
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	N/A
Voltage Extreme Environment Test Range:	N/A

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 50% RH	20 % RH to 75 % RH (as declared)

18.3 Test Limit

N/A.

18.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vii, the duty of the EUT was calculated from the sum of total on and off times over the observation period.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, bandwidths, data rates and power settings were measured
[1] Single antenna output devices

Duty was measured at the antenna port / at a distance of 3 m.

[2] Multiple antenna output devices

Duty was measured as the combination of all ports simultaneously / at a distance of 3 m.

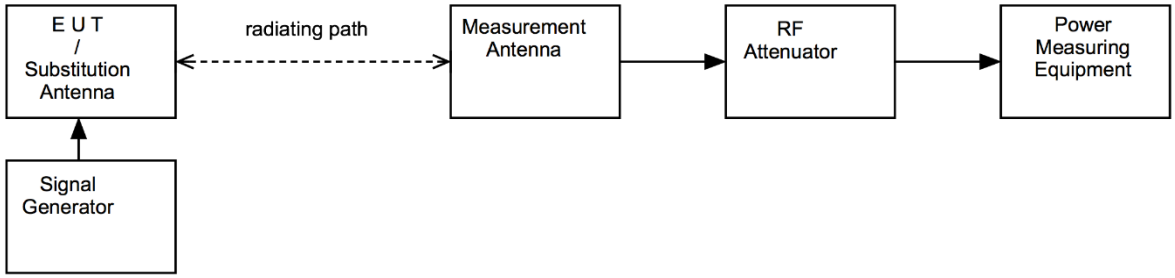
The duty cycle correction factor, DC, shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as:

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* ≥ 98%) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Figure vii Test Setup



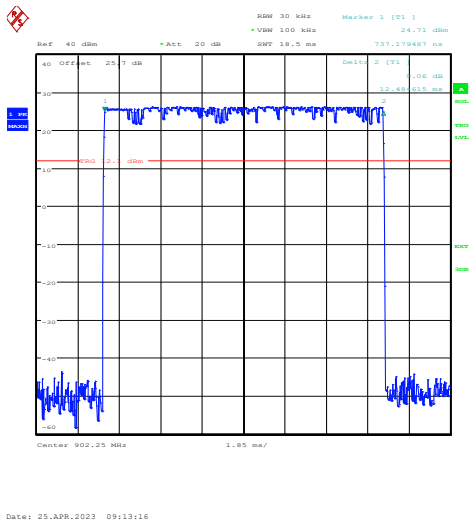
18.5 Test Equipment

Test equipment use date: 2023-04-24 to 2023-05-02				
Equipment Type	***Manufacturer***	***Equipment Description***	***Element No***	***Due For Calibration***
EMI Receiver	R&S	ESR26	U489	2023-09-30
Attenuator	AtlanTecRF Microwave	20dB SMA Attenuator	U632	Cal in use
Attenuator	AtlanTecRF Microwave	6dB SMA Attenuator	U635	Cal in use

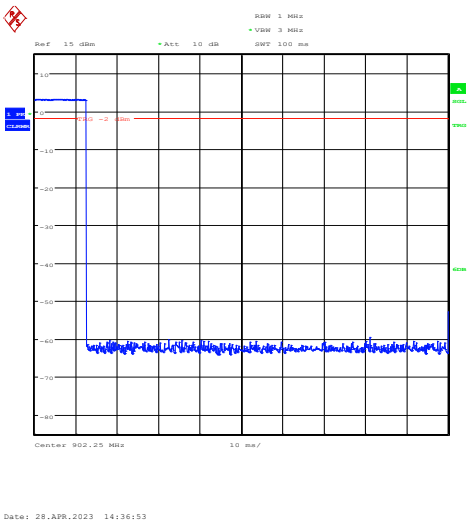
Test equipment use date: 2024-07-12				
Equipment Type	***Manufacturer***	***Equipment Description***	***Element No***	***Due For Calibration***
Power Meter	ETS Lindgren	7002-006	REF2286	2024-11-17

18.6 Test Results

On time in 100 ms Period *Test date: 2023-04-28*				
Test Environment		***Tx on time (ms)***	***No of Tx (100ms)***	***Calculated Factor (dB)***
$V_{nominal}$	$T_{nominal}$	12.484615	1	-18

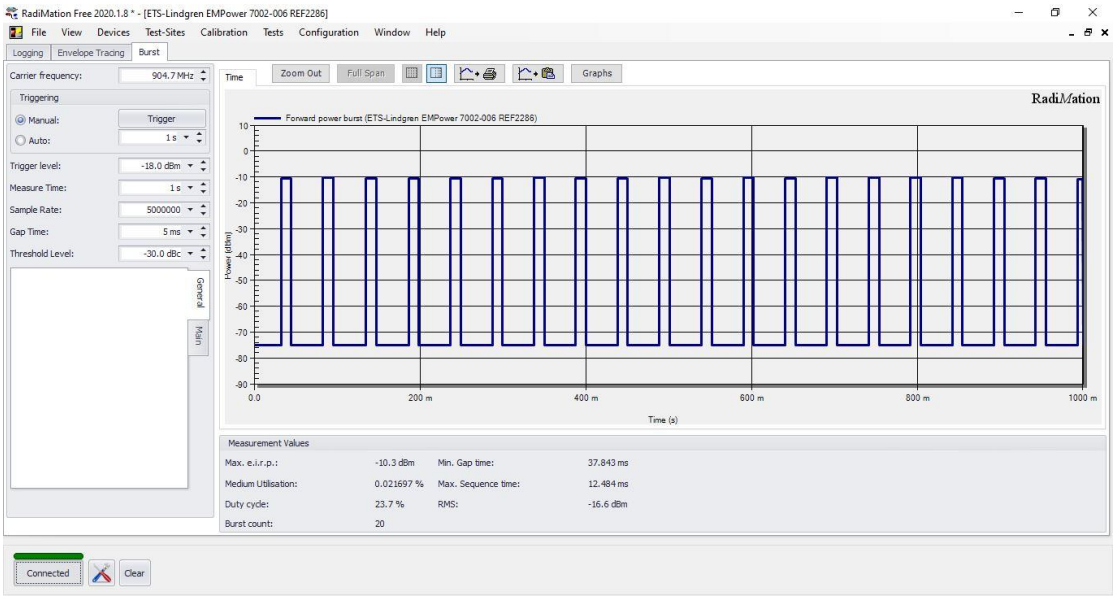


Tx on time



No of Tx in 100ms

Duty Cycle hopping over all frequencies *Test date: 2024-07-12*		
Test Environment		***Duty Cycle %***
$V_{nominal}$	$T_{nominal}$	23.7



19 Measurement Uncertainty

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence where no required test level exists.

Test/Measurement	Budget Number	MU
Conducted RF Power, Power Spectral Density, Adjacent Channel Power and Spurious emissions		
Absolute RF power (via antenna connecter) Dare RPR3006W Power Head	MU4001	**0.9 dB**
Carrier Power and PSD - Spectrum Analysers	MU4004	**0.9 dB**
Adjacent Channel Power	MU4002	**1.9 dB**
Transmitter conducted spurious emissions	MU4041	**0.9 dB**
Conducted power and spurious emissions 40 GHz to 50 GHz	MU4042	**2.4 dB**
Conducted power and spurious emissions 50 GHz to 75 GHz	MU4043	**2.5 dB**
Conducted power and spurious emissions 75 GHz to 110 GHz	MU4044	**2.4 dB**
Radiated RF Power and Spurious emissions ERP and EIRP		
Effective Radiated Power Reverb Chamber	MU4020	**3.7 dB**
Effective Radiated Power	MU4021	**4.7 dB**
TRP Emissions 30 MHz to 1 GHz using CBL6111 or CBL6112 Bilog Antenna	MU4046	**5.3 dB**
TRP Emissions 1 GHz to 18 GHz using HL050 Log Periodic Antenna	MU4047	**5.1 dB**
TRP Emissions 18 GHz to 26.5 GHz using Standard Gain Horn	MU4048	**2.7 dB**
TRP Emissions 26.5 GHz to 40 GHz using Standard Gain Horn	MU4049	**2.7 dB**
Spurious Emissions Electric and Magnetic Field		
Radiated Spurious Emissions 30 MHz to 1 GHz	MU4037	**4.7 dB**
Radiated Spurious Emissions 1-18 GHz	MU4032	**4.5 dB**
E Field Emissions 18GHz to 26 GHz	MU4024	**3.2 dB**
E Field Emissions 26GHz to 40 GHz	MU4025	**3.3 dB**
E Field Emissions 40GHz to 50 GHz	MU4026	**3.5 dB**
E Field Emissions 50GHz to 75 GHz	MU4027	**3.6 dB**
E Field Emissions 75GHz to 110 GHz	MU4028	**3.6 dB**
Radiated Magnetic Field Emissions	MU4031	**2.3 dB**
Frequency Measurements		
Frequency Deviation	MU4022	**0.316 kHz**
Frequency error using CMTA test set	MU4023	**113.441 Hz**
Frequency error using GPS locked frequency source	MU4045	**0.0413 ppm**
Bandwidth/Spectral Mask Measurements		
Channel Bandwidth	MU4005	**3.87 %**
Transmitter Mask Amplitude	MU4039	**1.3 dB**
Transmitter Mask Frequency	MU4040	**2.59 %**
Time Domain Measurements		
Transmission Time	MU4038	**4.40 %**
Dynamic Frequency Selection (DFS) Parameters)		
DFS Analyser - Measurement Time	MU4006	**679 µs**
DFS Generator - Frequency Error	MU4007	**92 Hz**
DFS Threshold Conducted	MU4008	**1.3 dB**
DFS Threshold Radiated	MU4009	**3.2 dB**

Test/Measurement	Budget Number	MU
Receiver Parameters		
EN300328 Receiver Blocking	MU4010	**1.1 dB**
EN301893 Receiver Blocking	MU4011	**1.1 dB**
EN303340 Adjacent Channel Selectivity	MU4012	**1.1 dB**
EN303340 Overloading	MU4013	**1.1 dB**
EN303340 Receiver Blocking	MU4014	**1.1 dB**
EN303340 Receiver Sensitivity	MU4015	**0.9 dB**
EN303372-1 Image Rejection	MU4016	**1.4 dB**
EN303372-1 Receiver Blocking	MU4017	**1.1 dB**
EN303372-2 Adjacent Channel Selectivity	MU4018	**1.1 dB**
EN303372-2 Dynamic Range	MU4019	**0.9 dB**
Receiver Blocking Talk Mode Conducted	MU4033	**1.2 dB**
Receiver Blocking Talk Mode- radiated	MU4034	**3.4 dB**
Rx Blocking, listen mode, blocking level	MU4035	**3.2 dB**
Rx Blocking, listen mode, radiated Threshold Measurement	MU4036	**3.4 dB**
Adjacent Sub Band Selectivity	MU4003	**4.2 dB**