

Report on the Radio Testing

For

GKD Technik Ltd

on

Base Station

Report no. TRA-051350-47-0A

10 October 2021

RF915 8.0



Report Number: TRA-051350-47-0A
Issue: A

REPORT ON THE RADIO TESTING OF A
GKD Technik Ltd
Base Station
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 30th June to 30th July 2021

Tested by: Steve Garwell/ Michael Else

Written by:

Steven Hodgkinson
Radio Test Engineer

Approved by:

John Charters
Laboratory Manager

Date: 10 October 2021

Disclaimers:

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

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	10 October 2021	Original

2 Summary

TEST REPORT NUMBER: TRA-051350-47-0A

WORKS ORDER NUMBER: TRA-051350-04

PURPOSE OF TEST: Certification

TEST SPECIFICATION: 47CFR15.247

EQUIPMENT UNDER TEST (EUT): Base Station

FCC IDENTIFIER: 2A2IY – P2100005

EUT SERIAL NUMBER: W11352

MANUFACTURER/AGENT: GKD Technik Ltd

ADDRESS:
17 Cobham Road
Ferndowne Industrial Estate
Wimborne
Dorset
BH21 7PE
United Kingdom

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ORDER NUMBER: 602220

TEST DATE: 30th June to 30th July 2021

TESTED BY: Steve Garwell/ Michael Else
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)	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions		15.207	<input type="checkbox"/>	Note 1
Occupied bandwidth		15.247 (a) (2)	<input checked="" type="checkbox"/>	Pass
Conducted carrier power	Peak	15.247 (b) (3)	<input checked="" type="checkbox"/>	Pass
	Max.		<input type="checkbox"/>	
Out of band emissions		15.247 (d)	<input checked="" type="checkbox"/>	Pass
Power spectral density		15.247 (e)	<input checked="" type="checkbox"/>	Pass
Calculation of duty correction		-	<input type="checkbox"/>	Note 2

Specific Note:

1. The EUT is a 12 Vdc-24 Vdc powered device via the vehicle battery
2. The equipment under test was transmitting 100% during the tests.

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).

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4 Introduction

This report TRA-051350-47-0A presents the results of the Radio testing on a GKD Technik Ltd, Base Station to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for GKD Technik Ltd by Element, at the address detailed below.

<input type="checkbox"/> Element Hull	<input checked="" type="checkbox"/> Element Skelmersdale
Unit E	Unit 1
South Orbital Trading Park	Pendle Place
Hedon Road	Skelmersdale
Hull	West Lancashire
HU9 1NJ	WN8 9PN
UK	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-UK MRA, Designation number 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: Base Station
- Serial Number: W11352
- Model Number: P2100005
- Software Revision: . GKD-1103-SW-001 v5.4.0 / GKD-1103-SW-003 v5.1.0 / GKD-1103-SW-002 v4.0.0 / GKD-1103-SW-002 v4.0.0.
- Build Level / Revision Number: v2.1

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.

Not Applicable – No support/monitoring equipment required whilst the equipment was under test.

7.3 EUT Mode of Operation

The transmitter was transmitting with modulation applied, the test modes were selected via client provided test scripts

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	916.00 MHz
Modulation type(s):	GFSK
Occupied channel bandwidth(s):	≥ 500kHz
Declared output power(s):	9.6 dBm
Nominal Supply Voltage:	12 Vdc to 24 Vdc via the vehicle battery

7.4.2 Antennas

Type:	W3118A/553-2746-1-ND/5436009
Frequency range:	869 MHz-894 MHz
Impedance:	50Ω
Gain:	-1dBi
Polarisation:	Vertical
Antenna position:	Integral, PCB mounted

7.5 EUT Description

The EUT is a proximity warning sensor, to be used with off-road vehicles, to alert drivers to the presence of personnel on the ground. The Base station makes use of 125 kHz and 916 MHz and a pre-approved 2.4 GHz Wi-Fi module FCC ID: 2AC7Z-ESPWROOM02. This test report only covers the 916 MHz radio.

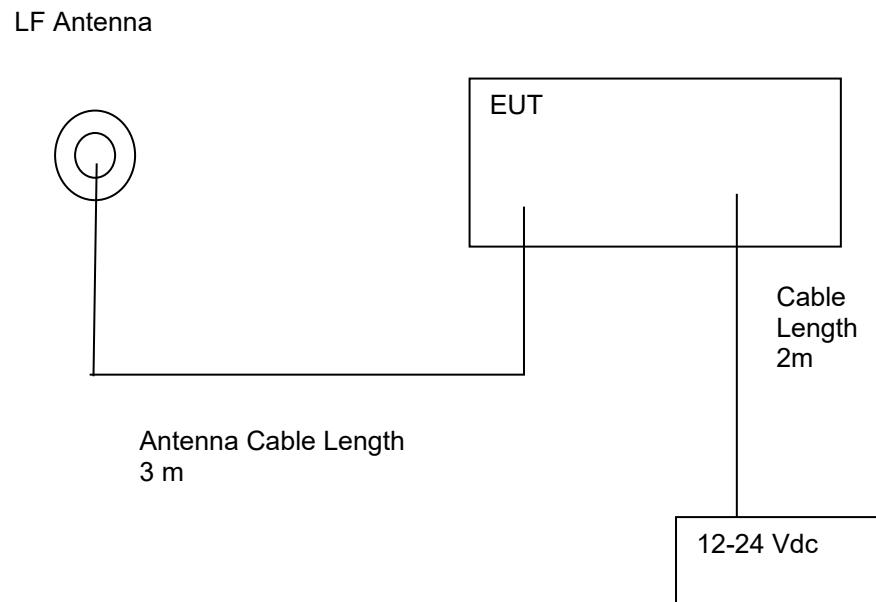
8 Modifications

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 EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 12 Vdc-24 Vdc

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:

	<i>Category</i>	<i>Nominal</i>	<i>Variation</i>
☒	Battery	12 Vdc to 24 Vdc via vehicle battery	-

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:	Chamber 01
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	916 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: 20 °C	+15 °C to +35 °C (as declared)
Humidity: 50 % RH	20 % RH to 75 % RH (as declared)
Supply: 12-24 Vdc	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 dB μ V/m at the regulatory distance, using:

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

Where,

PR is the power recorded on the receiver / spectrum analyzer in dB μ V;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

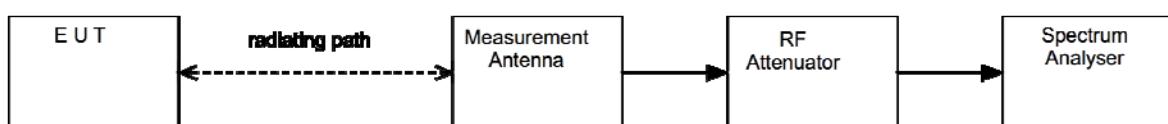
PA is the pre-amplifier gain in dB (where used);

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

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

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

Figure i Test Setup

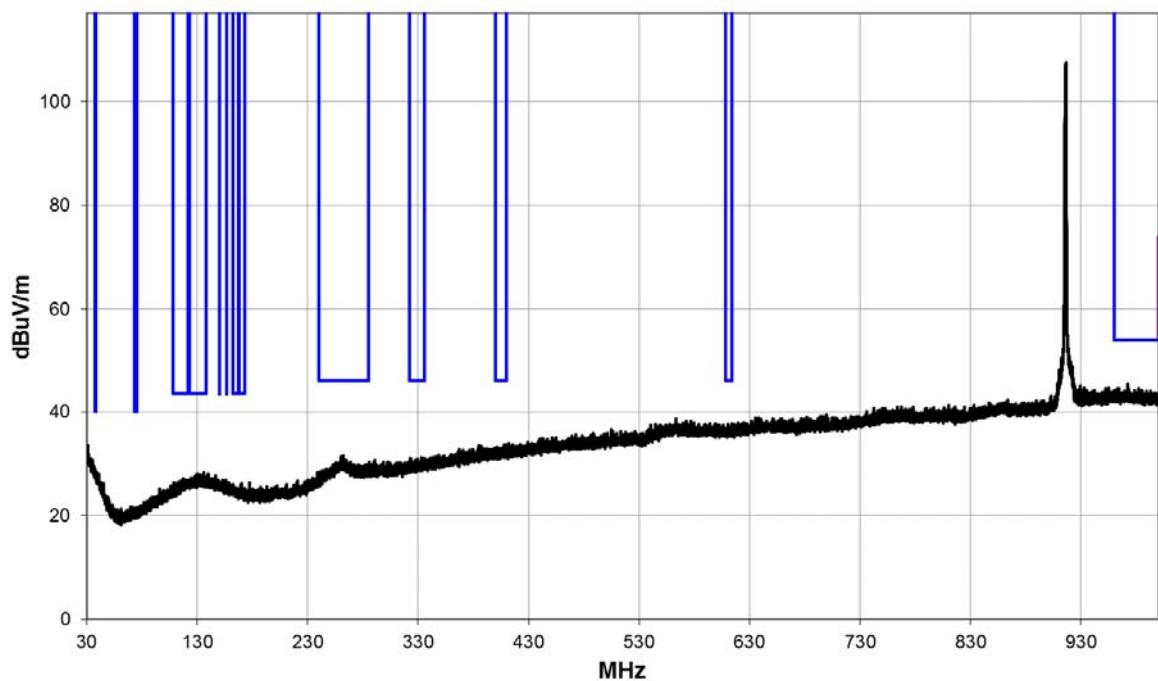


11.5 Test Equipment

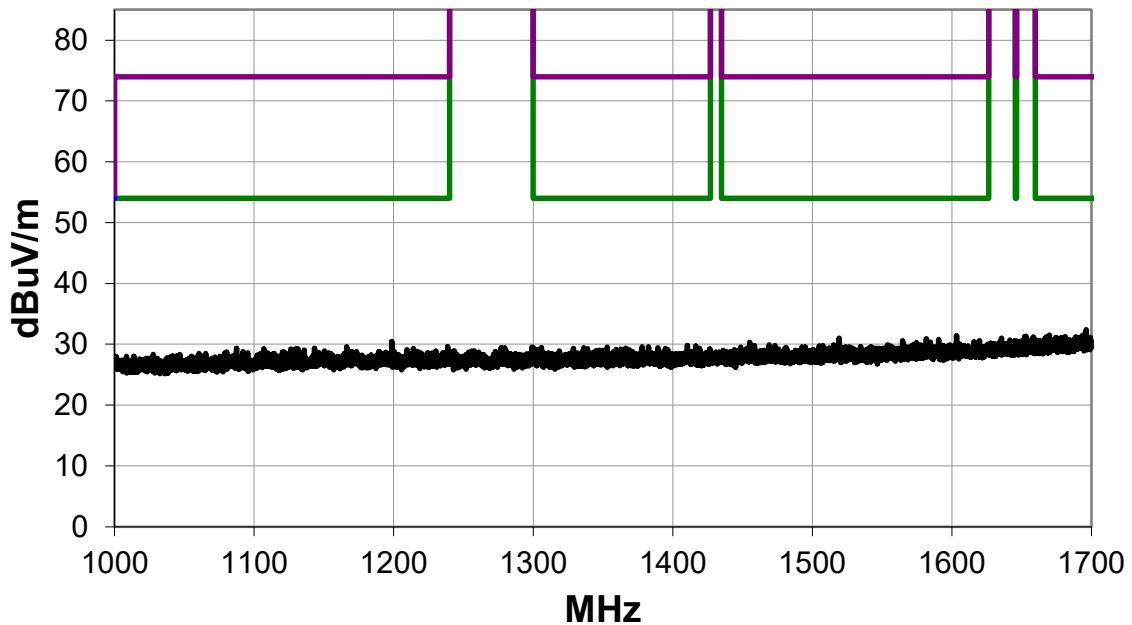
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Emissions R5	Element	Radiated Test Software	REF9000	Cal not required
ATS	Rainford EMC	Chamber 1	U387	2021-09-09
6201-69	Watkins Johnson	PreAmp	U372	2022-03-01
8449B	Agilent	Pre Amp	L572	2021-10-19
CBL611/B	Chase	Bilog	U573	2023-01-28
3115	EMCO	1-18GHz Horn	U223	2021-11-05
AFH-07000	Atlantic Microwave	High Pass Filter	U558	2022-01-30
VHF-1500+	MiniCircuits	High Pass Filter	U519	2022-01-30
VLF-575+	Mini-Circuits	Low Pass Filter	U685	2022-01-30
6502	EMCO	Active Loop Antenna	R0079	2023-06-16
EMI TEST RECIEVER	R&S	ESR 26	UH489	2022-03-08

11.6 Test Results

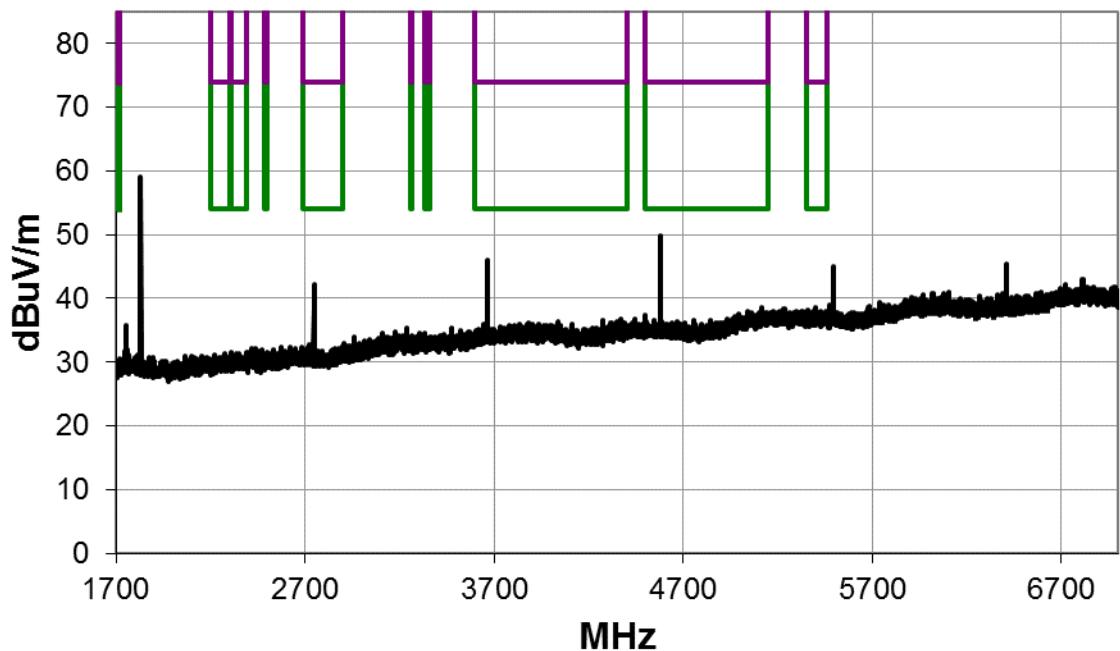
916 MHz 30 MHz-1 GHz



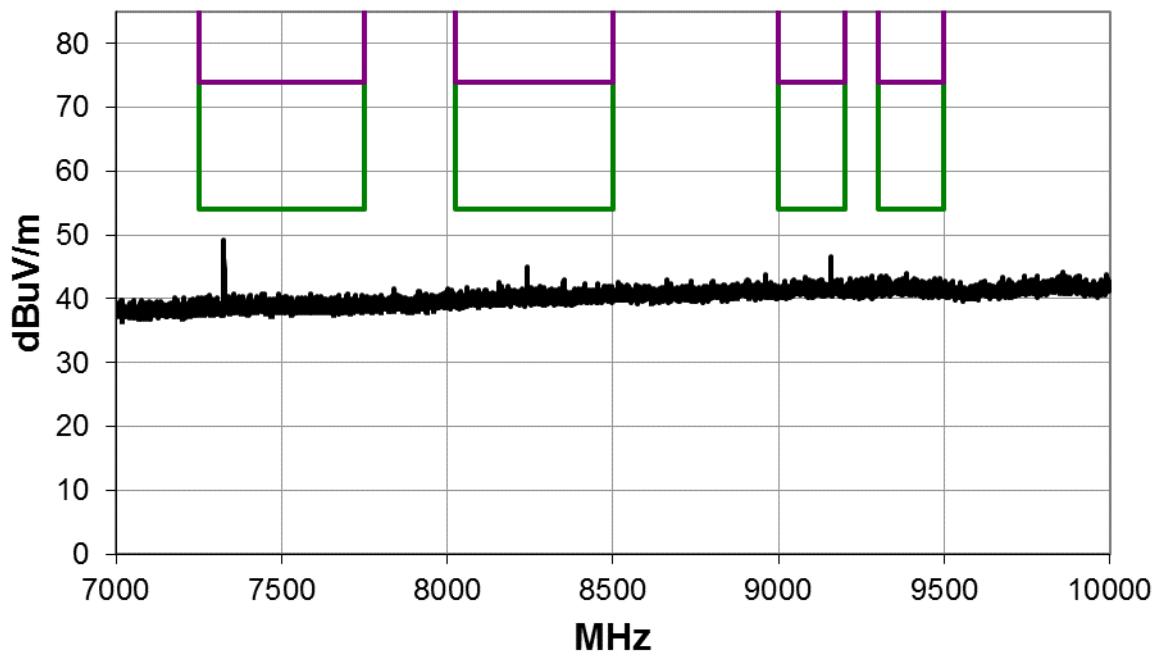
916 MHz 1 GHz-1.7 GHz



916 MHz 1.7 GHz-7 GHz



916 MHz 7 GHz-10 GHz



Maximised radiated spurious emissions

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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)
4578.757	48.4	1.4	1.62	248.1	3.0	0.0	Vert	AV	0.0	49.8	54.0	-4.2
4578.749	48.3	1.4	2.02	133.9	3.0	0.0	Horz	AV	0.0	49.7	54.0	-4.3
3662.992	48.6	0.1	1.62	89.8	3.0	0.0	Vert	AV	0.0	48.7	54.0	-5.3
3662.992	44.9	0.1	1.5	238.1	3.0	0.0	Horz	AV	0.0	45.0	54.0	-9.0
2747.250	47.1	-3.6	1.29	136.9	3.0	0.0	Vert	AV	0.0	43.5	54.0	-10.5
2747.250	43.9	-3.6	1.49	124.1	3.0	0.0	Horz	AV	0.0	40.3	54.0	-13.7
4579.007	52.9	1.4	2.02	133.9	3.0	0.0	Horz	PK	0.0	54.3	74.0	-19.7
4578.765	52.6	1.4	1.62	248.1	3.0	0.0	Vert	PK	0.0	54.0	74.0	-20.0
3663.208	53.0	0.2	1.62	89.8	3.0	0.0	Vert	PK	0.0	53.2	74.0	-20.8
3663.141	50.8	0.2	1.5	238.1	3.0	0.0	Horz	PK	0.0	51.0	74.0	-23.0
2747.283	52.3	-3.6	1.29	136.9	3.0	0.0	Vert	PK	0.0	48.7	74.0	-25.3
2747.308	50.4	-3.6	1.49	124.1	3.0	0.0	Horz	PK	0.0	46.8	74.0	-27.2

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	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)
7325.476	39.6	5.8	2.39	29.2	3.0	0.0	Horz	AV	0.0	45.4	54.0	-8.6
7325.484	39.2	5.8	2.72	206.2	3.0	0.0	Vert	AV	0.0	45.0	54.0	-9.0
7325.326	56.5	5.8	2.39	29.2	3.0	0.0	Horz	PK	0.0	62.3	74.0	-11.7
9157.218	34.9	7.2	1.88	254.0	3.0	0.0	Horz	AV	0.0	42.1	54.0	-11.9
7325.892	55.9	5.8	2.72	206.2	3.0	0.0	Vert	PK	0.0	61.7	74.0	-12.3
9157.135	34.3	7.2	2.61	192.1	3.0	0.0	Vert	AV	0.0	41.5	54.0	-12.5
8241.416	33.9	6.6	2.0	261.8	3.0	0.0	Vert	AV	0.0	40.5	54.0	-13.5
8241.408	33.6	6.6	2.17	148.1	3.0	0.0	Horz	AV	0.0	40.2	54.0	-13.8
9157.301	50.9	7.2	1.88	254.0	3.0	0.0	Horz	PK	0.0	58.1	74.0	-15.9
9157.318	50.1	7.2	2.61	192.1	3.0	0.0	Vert	PK	0.0	57.3	74.0	-16.7
8241.441	49.4	6.6	2.0	261.8	3.0	0.0	Vert	PK	0.0	56.0	74.0	-18.0
8241.275	48.9	6.6	2.17	148.1	3.0	0.0	Horz	PK	0.0	55.5	74.0	-18.5

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:	FCC: ANSI C63.10-2013, Clause 11.8
Frequencies Measured:	916.0 MHz
20 dB Occupied bandwidth	777.88 kHz
Deviations From Standard:	None
Measurement BW:	100 kHz
(IC requirement: 1% to 5% OBW; FCC requirement: 100 kHz)	30 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Span: (requirement 2 to 5 times OBW)	3 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 53 % RH	20 % RH to 75 % RH (as declared)
Supply: 12-24 Vdc	

12.3 Test Limit

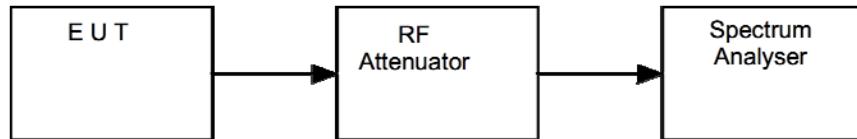
The minimum -6 dB bandwidth shall be at least 500 kHz.

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

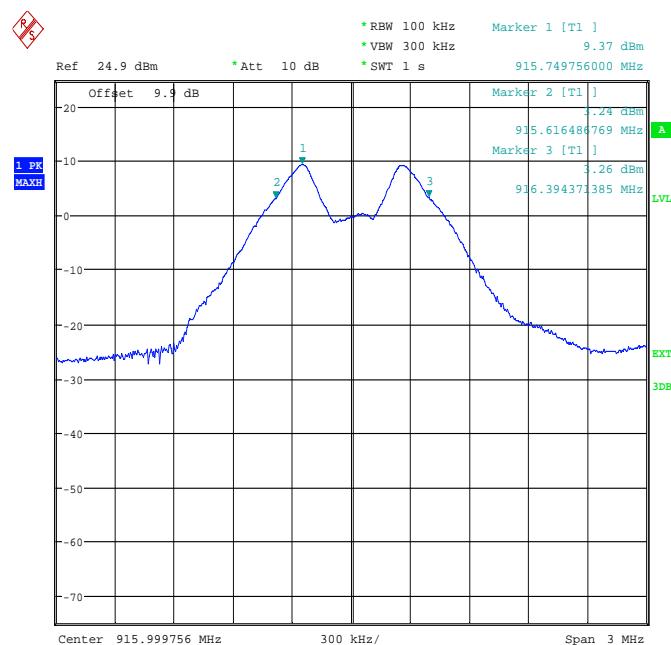


12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	REF910	2021-11-18
Attenuator	AtlanTecRF Microwave	10dB SMA Attenuator	U633	Cal In use

12.6 Test Results

FCC 15.247. Modulation: GFSK; Power level setting 11				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6dB Bandwidth (kHz)	Result
916.0	915.616486	916.394371	777.88	PASS



Date: 30.JUN.2021 21:45:22

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
Frequencies Measured:	916 MHz
Deviations From Standard:	None
20 dB Occupied bandwidth	777.88 kHz
Measurement BW:	2 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 53 % RH	20 % RH to 75 % RH (as declared)

13.3 Test Limit

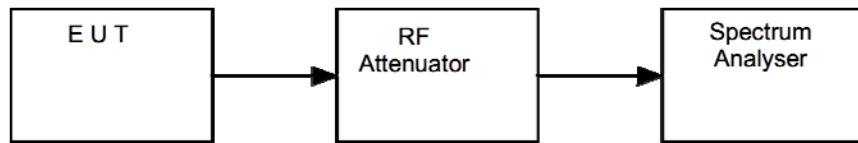
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

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

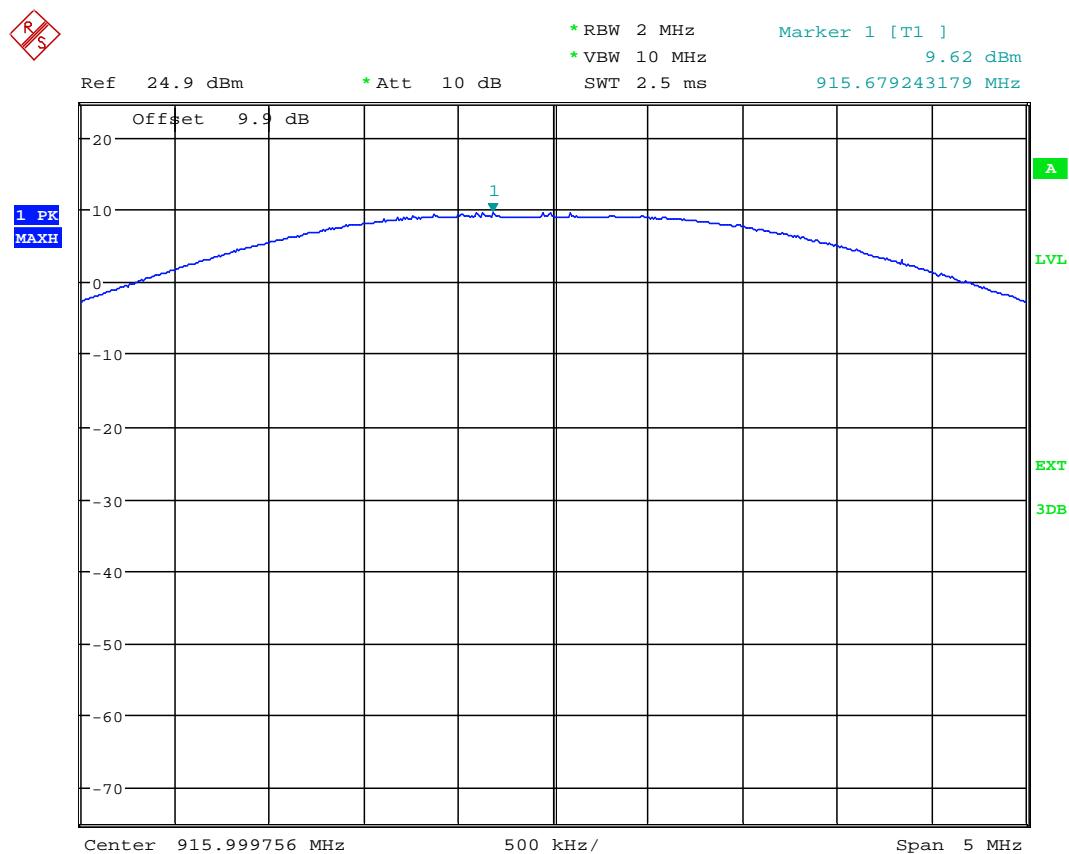


13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	REF910	2021-11-18
Attenuator	AtlanTecRF Microwave	10dB SMA Attenuator	U633	Cal In use

13.6 Test Results

Power setting: 11					
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Power (W)	Result
916.00	-0.28	9.9	9.62	0.0092	PASS



Date: 1.JUL.2021 15:14:06

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
Frequencies Measured:	916 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:	30 MHz to 26.5 GHz

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 53 % RH	20 % RH to 75 % RH (as declared)
Supply: 12-24 Vdc	

14.3 Test Limit

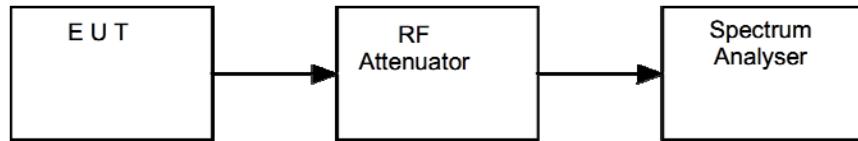
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either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

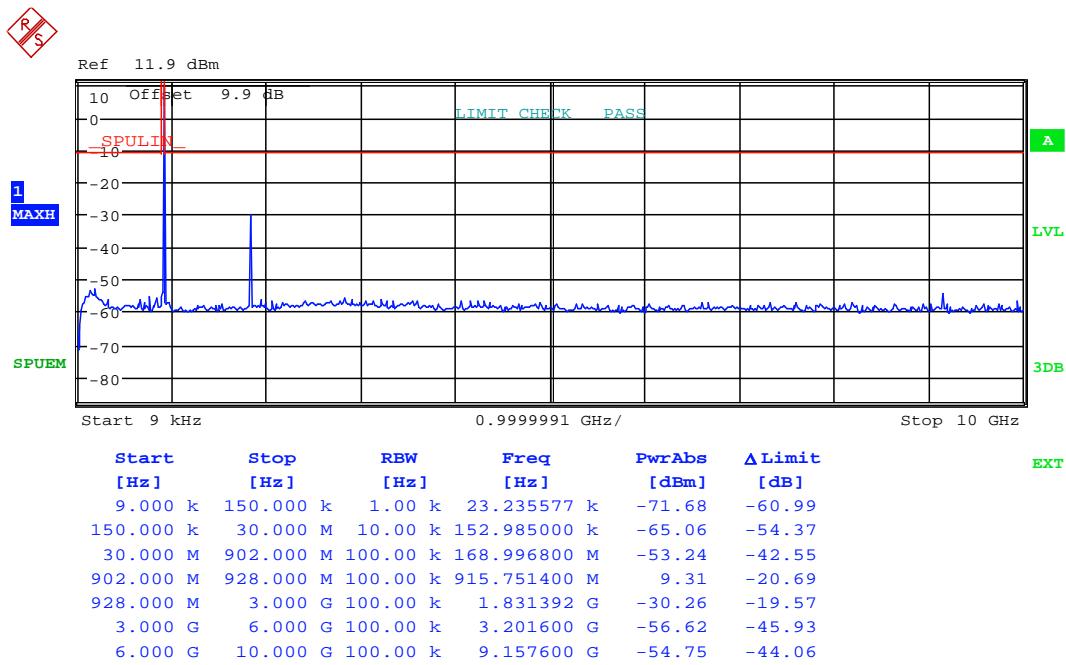


14.5 Test Equipment

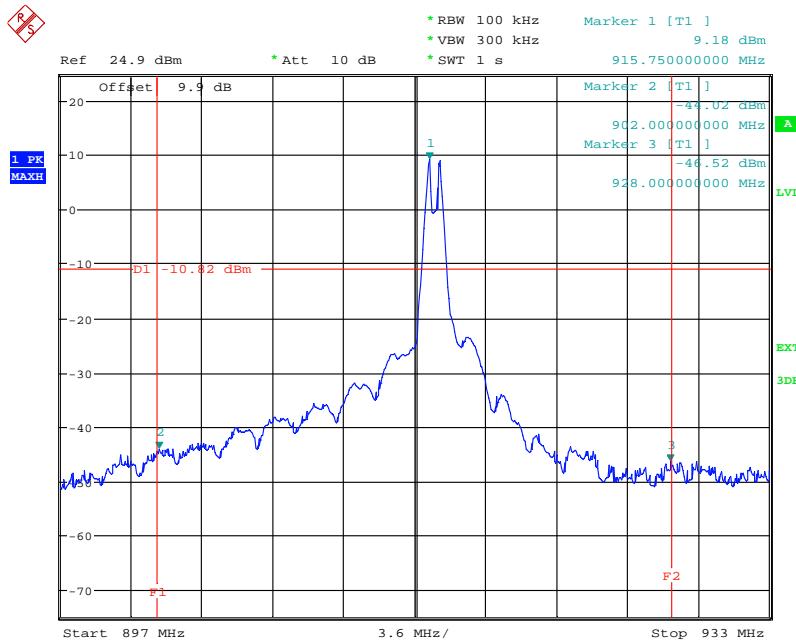
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	REF910	2021-11-18
Attenuator	AtlanTecRF Microwave	10dB SMA Attenuator	U633	Cal In use

14.6 Test Results

916 MHz power level setting 11
9 kHz-10 GHz



Conducted Band-Edge



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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
Frequencies Measured:	916 MHz
Deviations from Standard:	None
Measurement BW:	3 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 KHz
Measurement Span: (requirement 1.5 times Channel BW)	1.2 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 53 % RH	20 % RH to 75 % RH (as declared)
Supply: 12-24 Vdc	

15.3 Test Limit

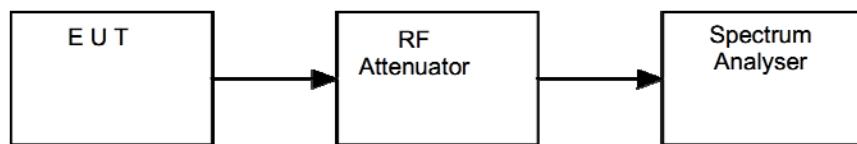
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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

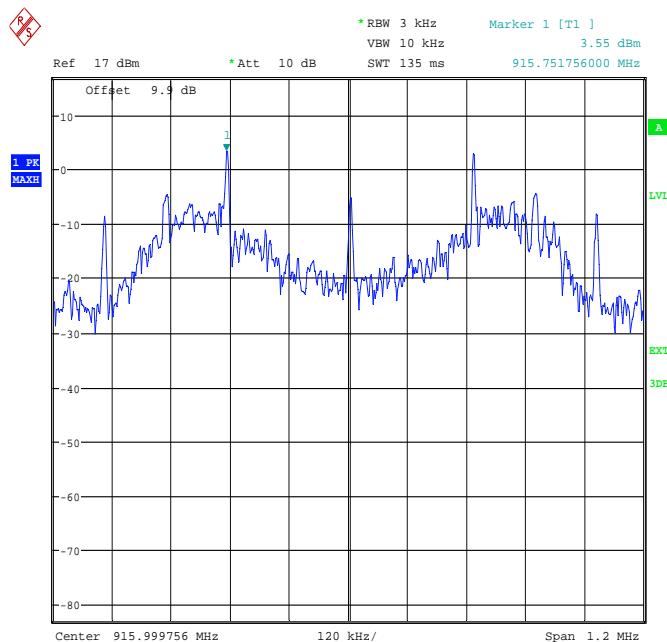


15.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	REF910	2021-11-18
Attenuator	AtlanTecRF Microwave	10dB SMA Attenuator	U633	Cal In use

15.6 Test Results

Modulation: GFSK; Power Level setting 11				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Result
916.0	-6.35	9.9	3.55	PASS



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16 RF Exposure

MPE Calculation

Prediction of MPE limit at a given distance

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20 cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than the power density limit, as required under FCC rules.

Equation from IEEE C95.1

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

Where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Result

Channel Frequency (MHz)	EIRP (mW)	Power density limit (S) (mW/cm ²)	Distance (R) cm required to be less than the power density limit
916	9.2	0.61	1.1

FCC SAR Exemption (KDB 447498 Section 4.3.1 for <= 50 mm)			
Distance (mm)	5		
Frequency (MHz)	Maximum Conducted Output Power (mW)	SAR Exclusion Threshold at a distance of 5 mm (mW)	SAR Evaluation
916	9.2	15.7	Not Required

17 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

Reference Number	Parameter	Description	Value	Unit
1	Adjacent Channel Power	Uncertainty in test result	1.9	dB
2	Carrier Power	Uncertainty in test result (power meter) upto 40 GHz	0.9	dB
		Uncertainty in test result (Spectrum Analyser) upto 40 GHz	1.7	
		40 to 50 GHz	2.4	
		50 to 75 GHz	2.5	
3	Effective Radiated Power	75 GHz to 110 GHz	2.4	
		Uncertainty in test result	4.71	dB
4	Radiated Spurious Emissions	Uncertainty in test result 30 MHz – 1 GHz	4.75	dB
		Uncertainty in test result 1 MHz – 18 GHz	4.46	dB
5	Maximum Frequency Error	Uncertainty in test result (CMTA)	113.441	Hz
		Uncertainty in test result (Spectrum Analyser) Using GPS locked frequency Source	0.0413	ppm
6	Radiated spurious emissions Field Strength, OAT'S 9 kHz -110 GHz	Uncertainty in test result (9 kHz-30 MHz)	2.3	dB
		Uncertainty in test result (30 MHz-1GHz)	4.75	dB
		Uncertainty in test result (1 GHz-18 GHz)	4.46	dB
		Uncertainty in test result (18 GHz-26 GHz)	3.2	dB
		Uncertainty in test result (26 GHz-40 GHz)	3.3	dB
		Uncertainty in test result (40 GHz-50 GHz)	3.5	dB
		Uncertainty in test result (50 GHz-75 GHz)	3.6	dB
		Uncertainty in test result (75 GHz-110 GHz)	3.6	dB
7	Frequency Deviation	Uncertainty in test result	3.7	%
	Magnetic Field Emissions	Uncertainty in test result	2.3	dB
9	Conducted Spurious Emissions	Uncertainty in test result Upto 40 GHz	0.921	dB
		Uncertainty in test result 40 GHz-50 GHz	2.4	dB
		Uncertainty in test result 50 GHz-75 GHz	2.5	dB
		Uncertainty in test result 75 GHz-110 GHz	2.4	dB
10	Channel Bandwidth	Uncertainty in test result	7.75	%
11	Spectrum Mask Measurements	Uncertainty in test result (Frequency)	2.59	%
		Uncertainty in test result (Amplitude)	1.32	dB
12	Adjacent Sub Band Selectivity	Uncertainty in test result	1.24	dB
13	Receiver Blocking-Listen Mode, Radiated	Uncertainty in test result	3.23	dB
14	Receiver Blocking-Talk Mode, Radiated	Uncertainty in test result	3.36	dB