Report on the Radio Testing

For

Elatec GmbH

on

TWN4 Palon Compact S M LEGIC

Report no. TRA-066060-47-05B

18th February 2025

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Report Number: TRA-066060-47-05B
Issue: B

REPORT ON THE RADIO TESTING OF AN
Elatec GmbH
TWN4 Palon Compact S M LEGIC
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 5th November 2024 - 12th December 2024

Tested by: D Winstanley, S Hodgkinson, S Garwell

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Date: 18th February 2025

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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

0026

1 Revision Record

Issue	*Issue Date*	*Revision History*
A	7th January 2025	Original
B	18th February 2025	Typographical Corrections

2 Summary

TEST REPORT NUMBER:	TRA-066060-47-05B
WORKS ORDER NUMBER:	TRA-066060-00
PURPOSE OF TEST:	Testing of radio frequency equipment per the relev authorisation requirements of chapter 47 of CFR (code of federal regulations) Part 2, subpart J & IS Canada RSS-Gen
TEST SPECIFICATION:	47CFR15.247
EQUIPMENT UNDER TEST (EUT):	TWN4 Palon Compact S M LEGIC
FCC IDENTIFIER:	WP5TWN4F24
EUT SERIAL NUMBER:	R2024289057
MANUFACTURER:	Elatec GmbH
ADDRESS:	Zeppelinstraße 1 82178 Puchheim Germany
CLIENT CONTACT:	Birgit Bachl +49 89 552 9961 0 b.bachl@elatec.com
AGENT:	Element Materials Technology Straubing GmbH
AGENT ADDRESS:	Gustav-Hertz-Str. 35 Straubing 94315 Germany
AGENT CONTACT:	Katja Frankl +49 9421 56868-0 katja.frankl@element.com
ORDER NUMBER:	DE05100186PO
TEST DATE:	5th November 2024 - 12th December 2024
TESTED BY:	D Winstanley, S Hodgkinson, S Garwell
	Element

2.1 Test Summary

Test Method and Description		*Requirement Clause FCC 47 CFR*	*Applicable to this equipment*	*Result / Note*
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		15.205	☒	*Pass*
AC power line conducted emissions		15.207	☒	*Pass*
6 dB bandwidth		15.247 (a) (2)	☒	*Pass*
Occupied bandwidth (99% bandwidth)		N/A	☒	*Pass*
Conducted output power	Peak	15.247 (b) (3)	☒	*Pass*
	Maximum		☐	
Undesirable / unwanted emissions		15.247 (d)	☒	*Pass*
Power spectral density		15.247 (e)	☒	*Pass*
Pulsed operation correction		15.35 (c)	☒	*Pass*

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-066060-47-05B presents the results of the Radio testing on a, Elatec GmbH TWN4 Palon Compact S M LEGIC to specification FCC Title 47 CFR 15 Radio Frequency Devices.

The testing was carried out for Elatec GmbH 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 ISO/IEC 17025:2017 accredited 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 US-UK MRA,

Designation number(s):

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: TWN4 Palon Compact S M LEGIC
- Serial Number: R2024289057
- Model Number: EL20232
- Software Revision: B1.08/NKD4.81/CONT2.02/PIB (Beta 1)
- Build Level / Revision Number: A

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.

Equipment Description	***Manufacturer***	***Serial / Asset No(s)***
Support Laptop	Dell	UKSDLTS169

7.3 EUT Mode of Operation

The EUT was programmed via a test laptop using client supplied software (ApprovalCommander200). The EUT was tested transmitting 1 Mbps modulated carrier on the required frequencies.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	2402 MHz – 2480 MHz
Modulation type(s):	GFSK
Channel bandwidth(s):	1 MHz
Channel spacing:	2 MHz
ITU emission designator(s):	F1D
Nominal Supply Voltage:	5 Vdc via USB

7.4.2 Antennas

Type:	Chip Antenna
Frequency range:	2402 MHz – 2480 MHz
Impedance:	50 Ohms
Gain:	+0.5 dBi
Mounting:	Solder

7.4.3 Product specific declarations

Multiple antenna configuration(s), e.g. MIMO:	No
Fixed pt-pt operations (yes/no):	No
Installation manual advice on pt-pt operational restrictions (yes/no):	No
Fixed pt-mpt operations (yes/no):	No
Simultaneous tx (yes/no):	No

7.5 EUT Description

The EUT is a RFID reader/writer module with Bluetooth low energy.

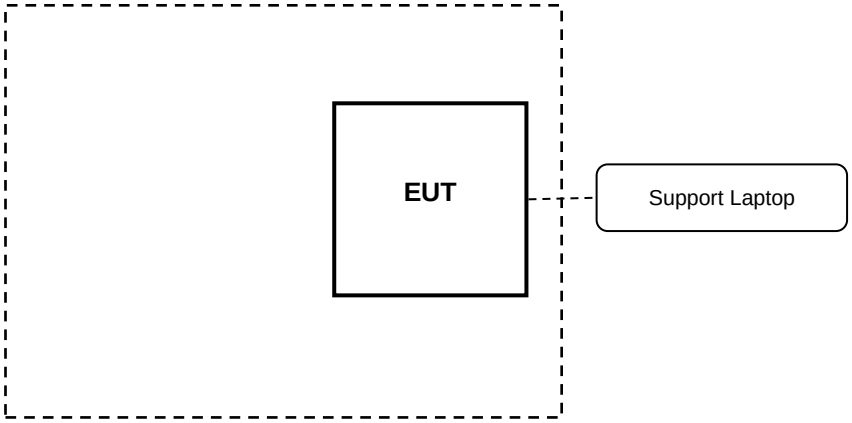
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

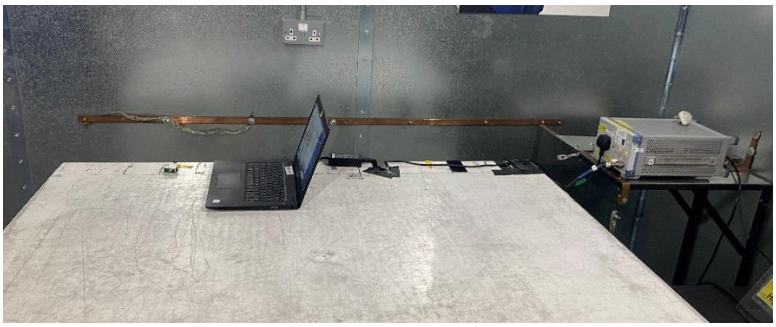
9.1 Block Diagram

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

10 General Technical Parameters

10.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 5 Vdc via USB.

11 Radiated emissions

11.1 Definitions

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

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

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber (SK03)
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	2402 MHz / 2440 MHz / 2480 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: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 48 % RH	20 % RH to 75 % RH (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:

$$FS = PR + CL + AF – PA + DC – CF$$

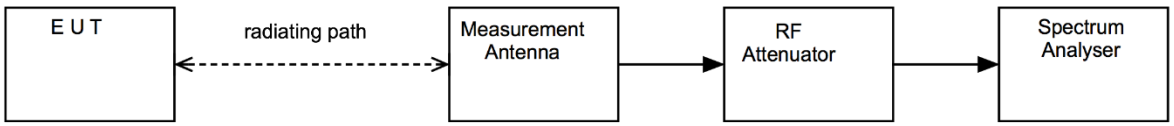
$$Factor = CL + AF – PA$$

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

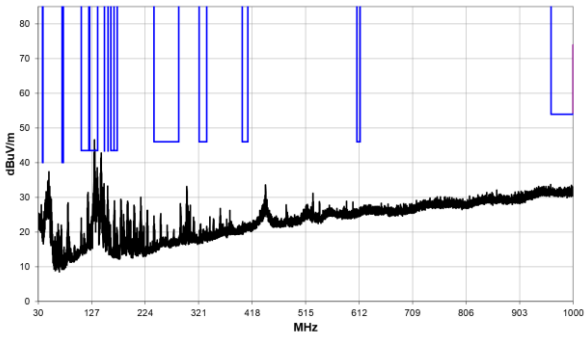


11.5 Test Equipment

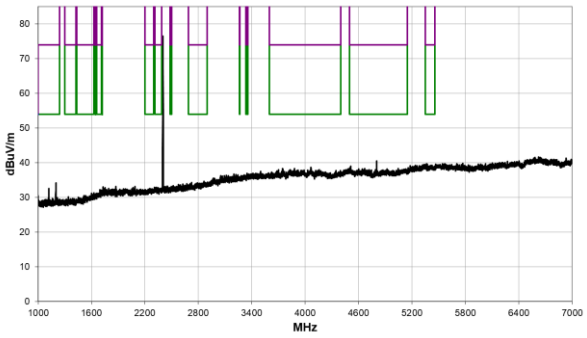
Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
ESR7	R&S	EMI Receiver	U456	2025-03-08
FSU26	R&S	Spectrum Analyser	REF909	2025-09-24
6201-69	Watkins Johnson	PreAmp	U372	2025-03-15
CBL611/A	Chase	Bilog	U191	2025-08-11
8449B	Agilent	Pre Amp	U457	2025-01-26
3115	EMCO	1-18GHz Horn	U223	2026-01-17
20240-20	Flann	Horn 18-26GHz (&U330)	L263A	2026-07-23
ATS	Rainford EMC	Radio Chamber - PP	REF940	2026-01-29
Emissions R5	Element	Radiated Test Software	REF9000	Cal Not Required

11.6 Test Results

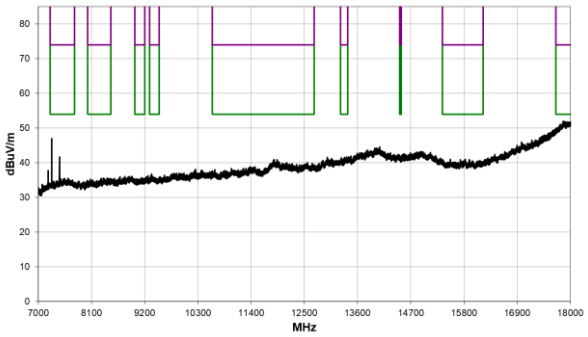
Frequency: 2402 MHz; Modulation: GFSK; Data Rate: 1 Mbps								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Factor (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Limit (dBµV/m)***	***Margin (dB)***
QP	132.060	49.2	-9.4	0.0	0.0	39.8	43.5	-3.7
QP	134.583	40.0	-9.5	0.0	0.0	30.5	43.5	-13.0
QP	137.010	39.6	-9.6	0.0	0.0	30.0	43.5	-13.5
AV	4804.542	32.4	2.7	0.0	0.0	35.1	54.0	-18.9
PK	4804.283	45.5	2.7	0.0	0.0	48.2	74.0	-25.8



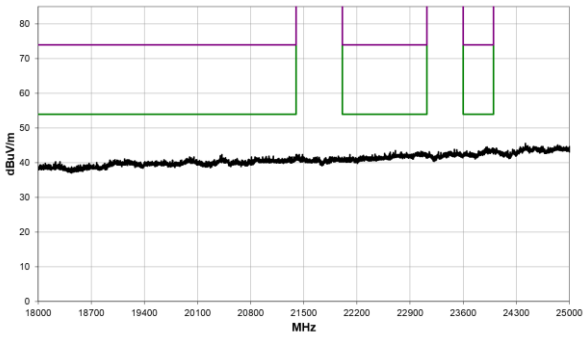
30 MHz – 1 GHz



1 GHz – 7 GHz

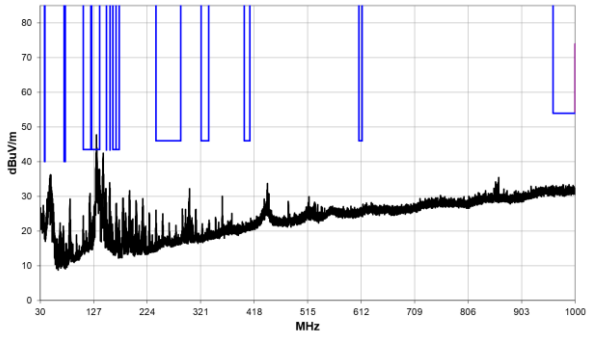


7 GHz – 18 GHz

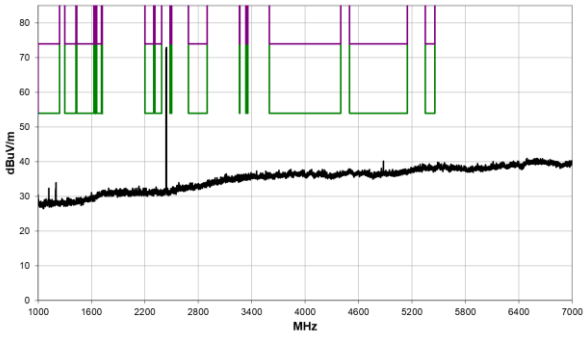


18 GHz – 25 GHz

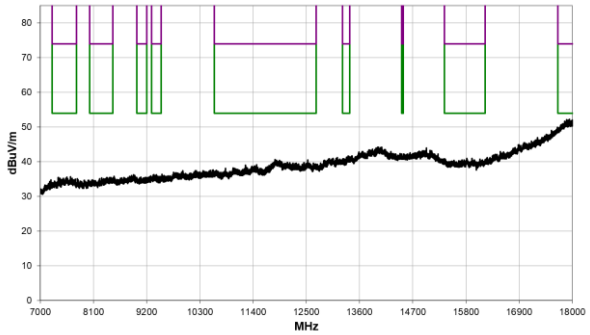
Frequency: 2440 MHz; Modulation: GFSK; Data Rate: 1 Mbps								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Factor (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Limit (dBµV/m)***	***Margin (dB)***
QP	132.060	49.2	-9.4	0.0	0.0	39.8	43.5	-3.7
QP	134.583	40.0	-9.5	0.0	0.0	30.5	43.5	-13.0
QP	137.010	39.6	-9.6	0.0	0.0	30.0	43.5	-13.5
AV	4879.433	34.6	3.0	0.0	0.0	37.6	54.0	-16.4
PK	4879.875	47.2	3.0	0.0	0.0	50.2	74.0	-23.8



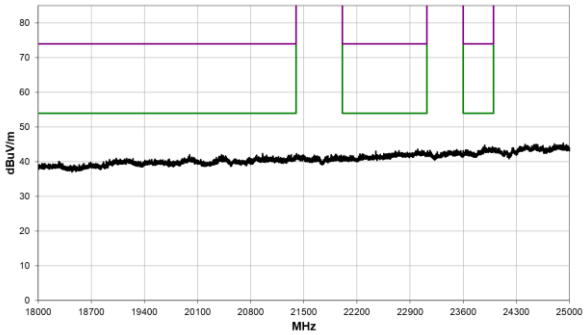
30 MHz – 1 GHz



1 GHz – 7 GHz

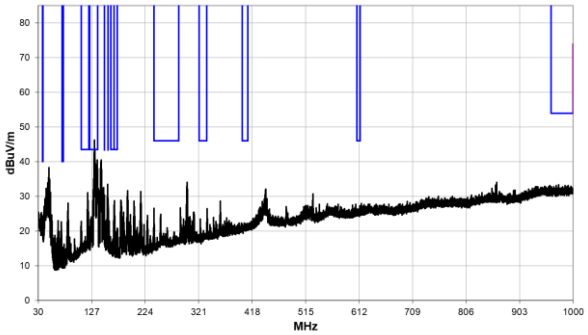


7 GHz – 18 GHz

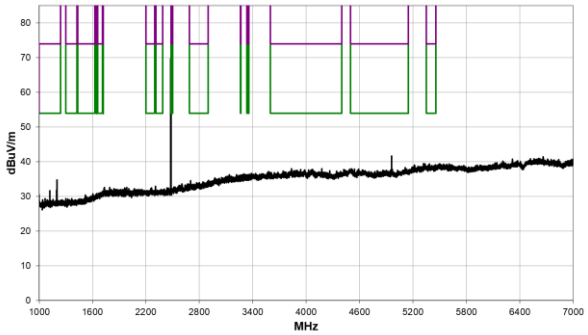


18 GHz – 25 GHz

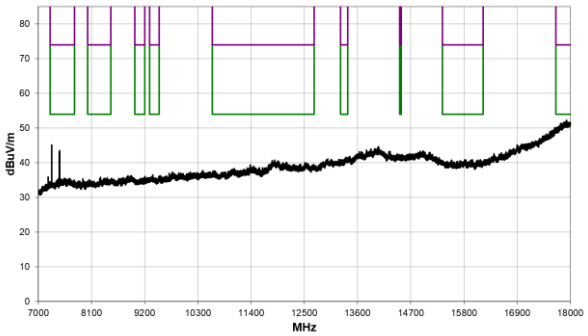
Frequency: 2480 MHz; Modulation: GFSK; Data Rate: 1 Mbps								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Factor (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Limit (dBµV/m)***	***Margin (dB)***
QP	132.060	49.2	-9.4	0.0	0.0	39.8	43.5	-3.7
QP	134.583	40.0	-9.5	0.0	0.0	30.5	43.5	-13.0
QP	137.010	39.6	-9.6	0.0	0.0	30.0	43.5	-13.5
AV	4960.425	35.5	3.4	0.0	0.0	38.9	54.0	-15.1
PK	4960.058	47.9	3.4	0.0	0.0	51.3	74.0	-22.7
AV	20866.680	30.9	13.3	0.0	0.0	34.7	54.0	-19.3
PK	20869.620	46.7	13.3	0.0	0.0	50.5	74.0	-23.5



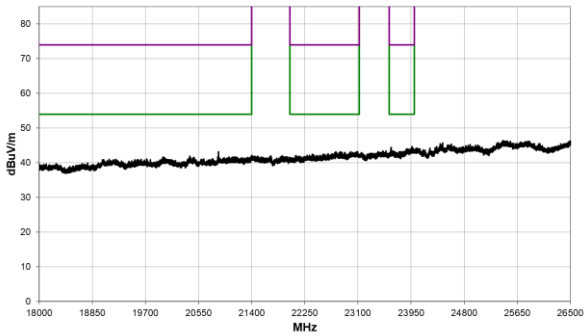
30 MHz – 1 GHz



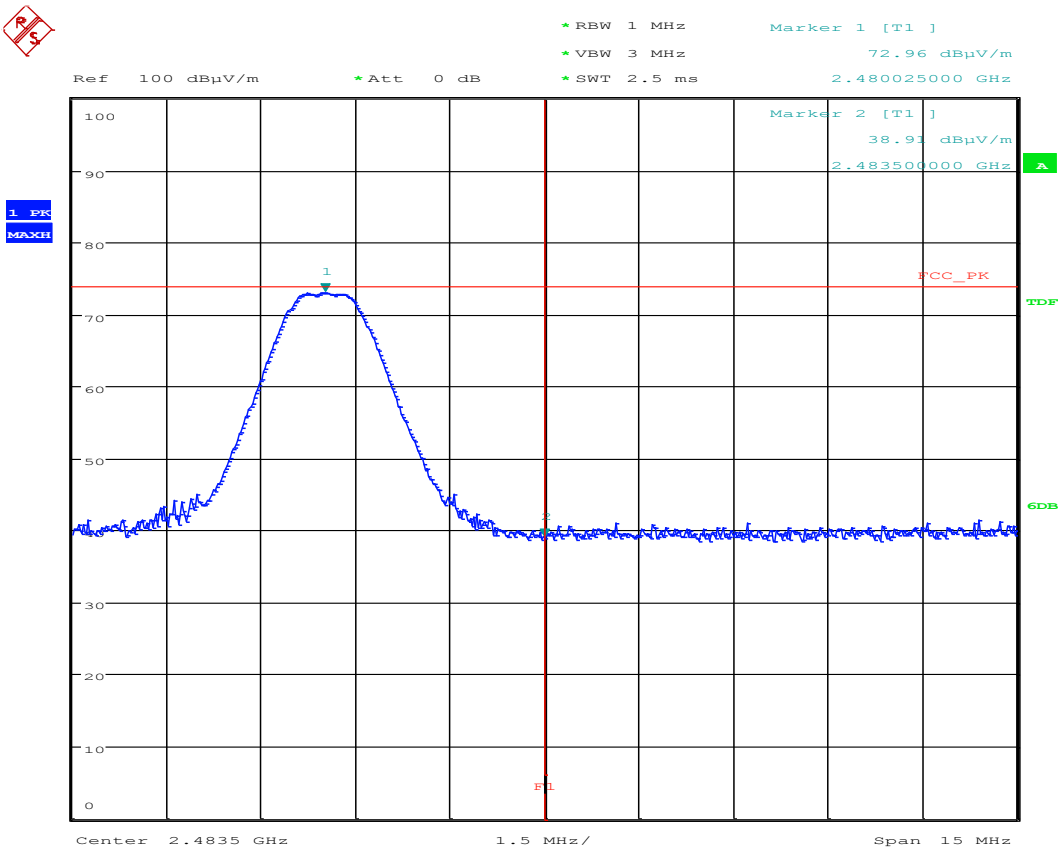
1 GHz – 7 GHz



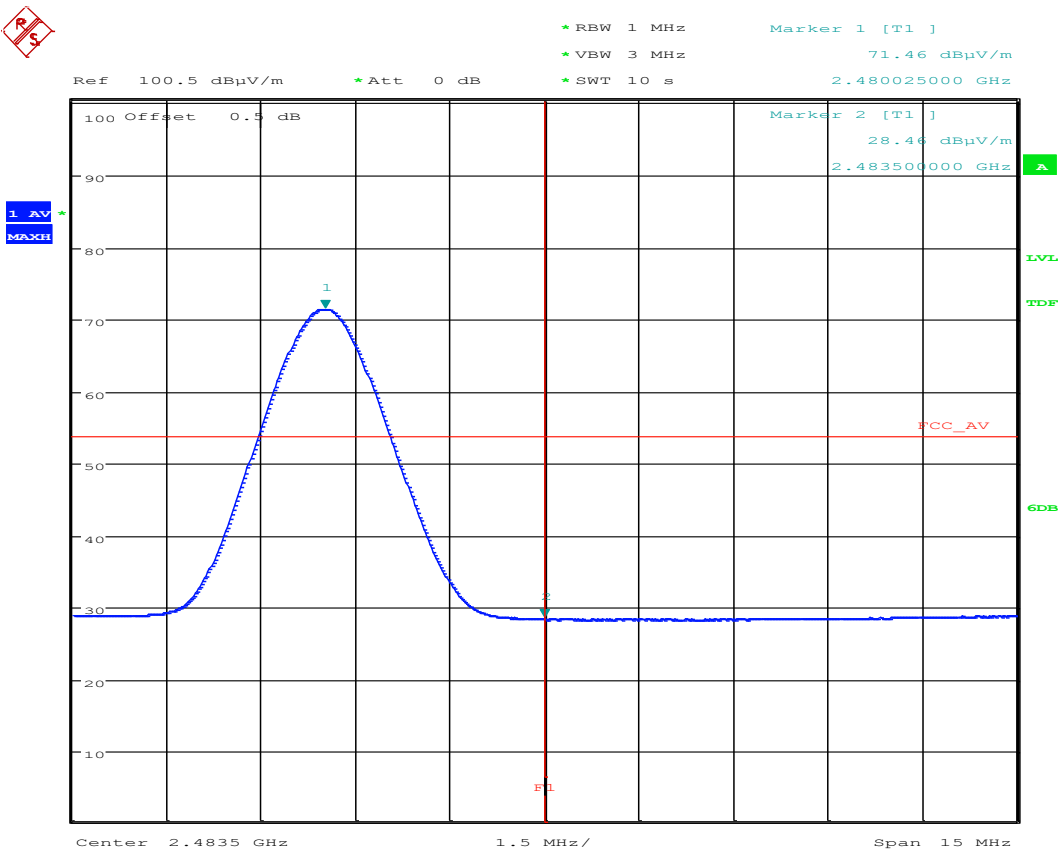
7 GHz – 18 GHz



18 GHz – 25 GHz



Upper bandedge Radiated - Peak



Upper bandedge Radiated - Average

12 AC power-line conducted emissions

12.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Transient Lab (U390)
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Channels / Frequencies Measured:	Mid
EUT Channel Bandwidths:	2 MHz
EUT Modulation:	GFSK
Deviations From Standard:	None
Measurement BW:	9 kHz
Measurement Detectors:	Quasi-Peak and Average, RMS

Environmental Conditions (Normal Environment)

Temperature: 16 °C	+15 ºC to +35 ºC (as declared)
Humidity: 39 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emission Limits

Frequency (MHz)	***Conducted limit (dBµV)***	
	Quasi-Peak	***Average****
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*The level decreases linearly with the logarithm of the frequency.
**A linear average detector is required.

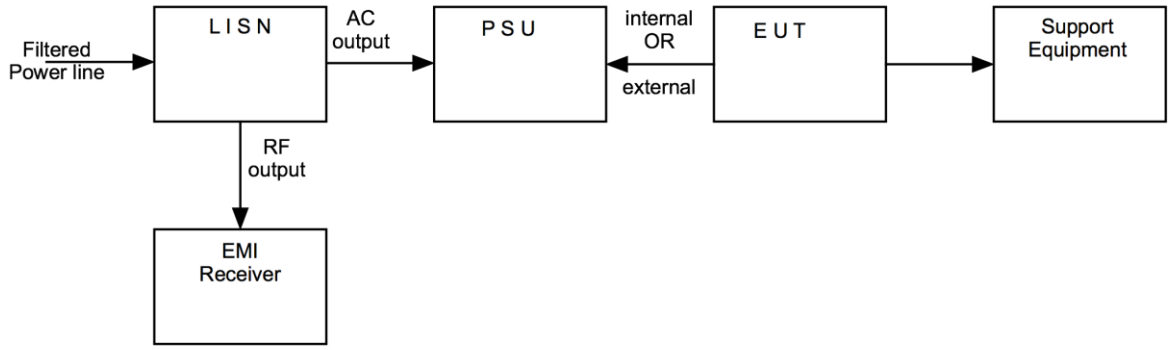
12.4 Test Method

With the EUT setup in a screened room, as per section 9 of this report and connected as per Figure ii, the power line emissions were measured on a spectrum analyzer / EMI receiver.

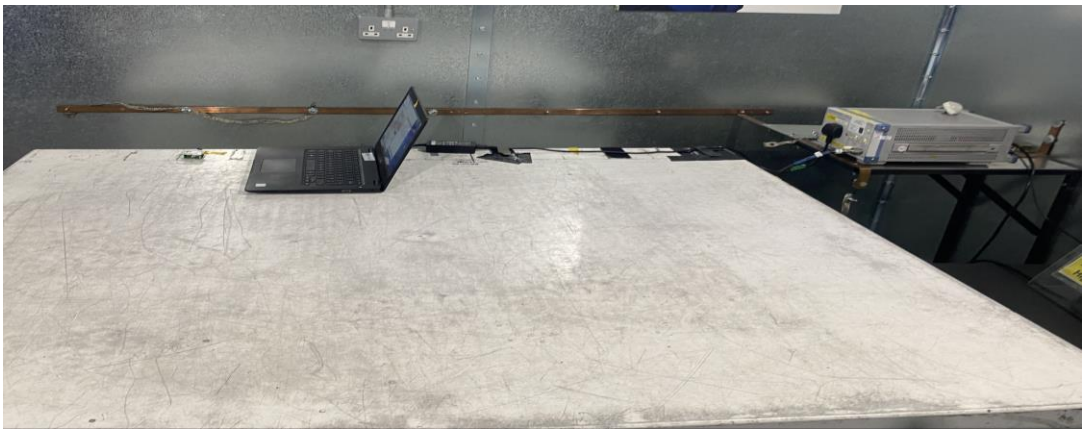
AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure ii Test Setup



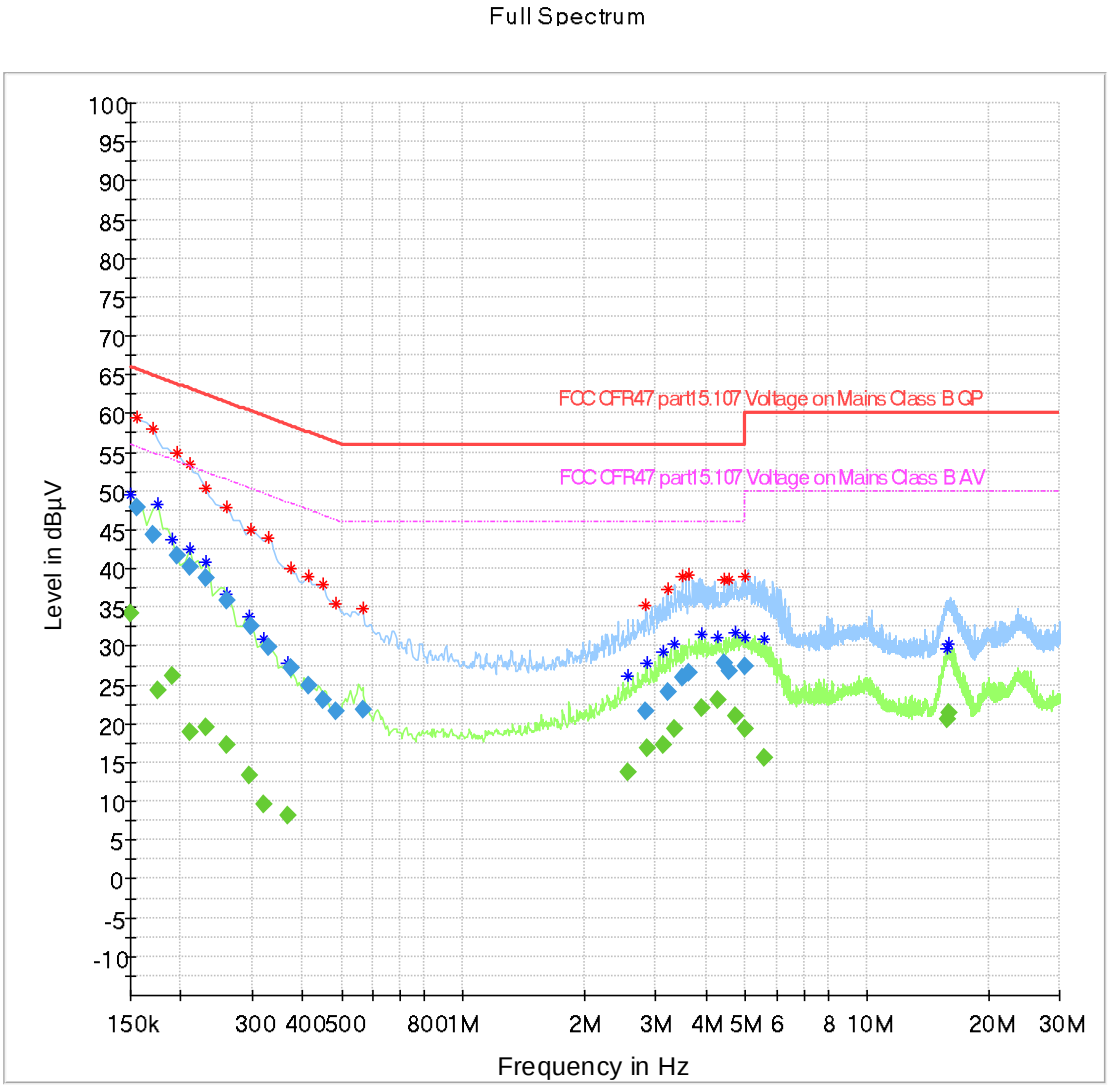
12.5 Test Set-up Photograph



12.6 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
ENV216	R&S	Lisn	U396	2025-05-16
ESR7	R&S	EMI Receiver	U456	2025-03-08
ESH3-Z2	R&S	Pulse Limiter	U559	2025-02-12

12.7 Test Results



Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	---	34.31	56.00	21.69	2000.0	9.000	N	OFF	19.5
0.154975	47.82	---	65.73	17.91	2000.0	9.000	L1	OFF	19.5
0.169900	44.40	---	64.97	20.56	2000.0	9.000	L1	OFF	19.5
0.174875	---	24.30	54.73	30.43	2000.0	9.000	L1	OFF	19.5
0.189800	---	26.14	54.05	27.90	2000.0	9.000	N	OFF	19.5
0.194775	41.65	---	63.83	22.18	2000.0	9.000	L1	OFF	19.5
0.209700	40.31	---	63.22	22.91	2000.0	9.000	L1	OFF	19.5
0.209700	---	19.00	53.22	34.22	2000.0	9.000	L1	OFF	19.5
0.229600	38.85	---	62.46	23.61	2000.0	9.000	L1	OFF	19.5
0.229600	---	19.50	52.46	32.96	2000.0	9.000	L1	OFF	19.5
0.259450	---	17.22	51.45	34.23	2000.0	9.000	L1	OFF	19.5
0.259450	35.86	---	61.45	25.59	2000.0	9.000	L1	OFF	19.5
0.294275	---	13.43	50.40	36.97	2000.0	9.000	L1	OFF	19.5
0.299250	32.64	---	60.26	27.62	2000.0	9.000	L1	OFF	19.5
0.319150	---	9.64	49.73	40.09	2000.0	9.000	L1	OFF	19.5
0.329100	29.93	---	59.47	29.55	2000.0	9.000	L1	OFF	19.5
0.368900	---	8.16	48.53	40.36	2000.0	9.000	L1	OFF	19.5
0.373875	27.21	---	58.41	31.20	2000.0	9.000	L1	OFF	19.5
0.413675	24.95	---	57.57	32.62	2000.0	9.000	L1	OFF	19.5
0.448500	23.13	---	56.90	33.77	2000.0	9.000	L1	OFF	19.5
0.483325	21.60	---	56.28	34.69	2000.0	9.000	L1	OFF	19.5
0.562925	21.88	---	56.00	34.12	2000.0	9.000	L1	OFF	19.5
2.562875	---	13.67	46.00	32.33	2000.0	9.000	L1	OFF	19.6
2.836500	21.62	---	56.00	34.38	2000.0	9.000	L1	OFF	19.6
2.846450	---	16.83	46.00	29.17	2000.0	9.000	L1	OFF	19.6
3.125050	---	17.29	46.00	28.71	2000.0	9.000	L1	OFF	19.6
3.204650	24.13	---	56.00	31.87	2000.0	9.000	L1	OFF	19.6
3.338975	---	19.30	46.00	26.70	2000.0	9.000	L1	OFF	19.6
3.488225	25.98	---	56.00	30.02	2000.0	9.000	L1	OFF	19.6
3.632500	26.66	---	56.00	29.34	2000.0	9.000	L1	OFF	19.6
3.911100	---	21.95	46.00	24.05	2000.0	9.000	L1	OFF	19.6
4.289200	---	23.11	46.00	22.89	2000.0	9.000	L1	OFF	19.6
4.428500	27.76	---	56.00	28.24	2000.0	9.000	L1	OFF	19.6
4.567800	26.83	---	56.00	29.17	2000.0	9.000	L1	OFF	19.6
4.707100	---	20.96	46.00	25.04	2000.0	9.000	L1	OFF	19.6
4.970775	---	19.33	46.00	26.67	2000.0	9.000	L1	OFF	19.6
4.995650	27.39	---	56.00	28.61	2000.0	9.000	L1	OFF	19.6
5.572750	---	15.67	50.00	34.33	2000.0	9.000	L1	OFF	19.7
15.791400	---	20.61	50.00	29.39	2000.0	9.000	N	OFF	19.9
15.910800	---	21.37	50.00	28.63	2000.0	9.000	N	OFF	19.9

13 Occupied Bandwidth

13.1 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.

The 99% emission bandwidth is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	6 dB Bandwidth: ANSI C63.10-2013, Clause 11.8
Frequencies Measured:	2402 MHz / 2440 MHz / 2480 MHz
EUT Channel Bandwidths:	2 MHz
EUT Test Modulations:	GFSK
Deviations From Standard:	None
Measurement BW:	100 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 ºC to +35 ºC (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)
Supply: 5.0 VDC	

13.3 Test Limit

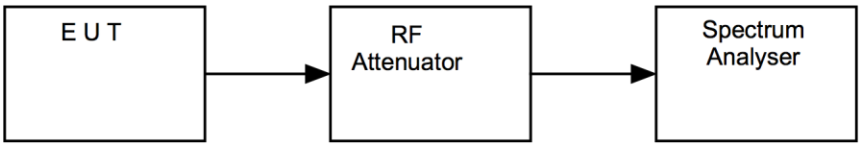
The minimum -6 dB bandwidth shall be at least 500 kHz.

13.4 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

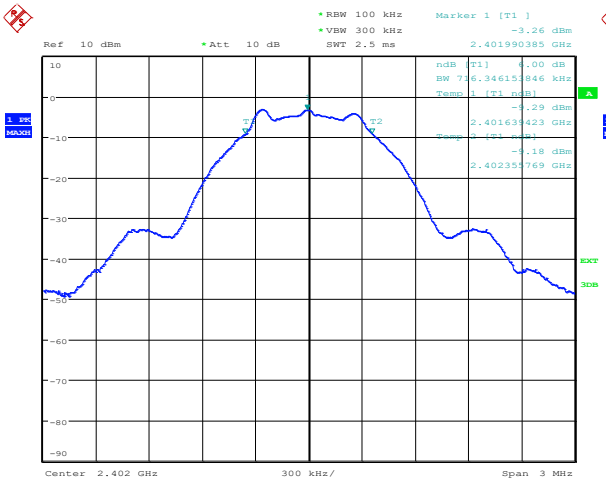


13.5 Test Equipment

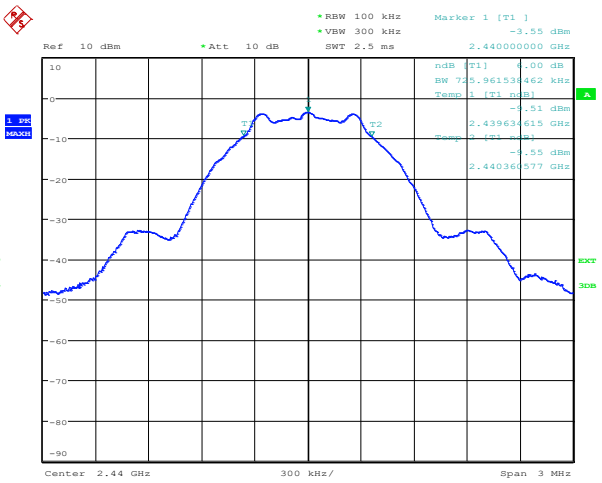
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	2025-09-24

13.6 Test Results

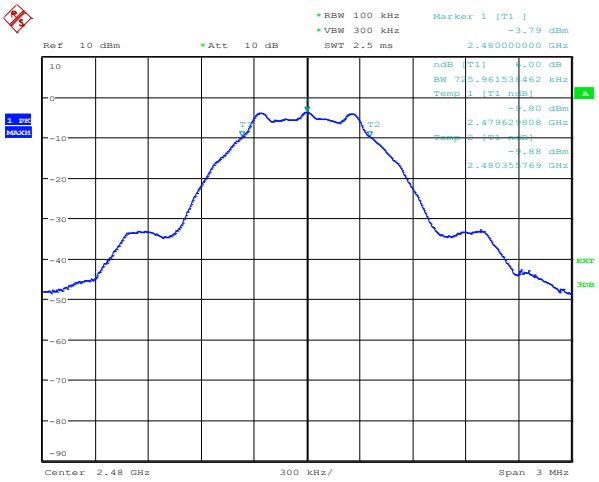
Bandwidth Type: 6 dB; Modulation: GFSK; Data rate: 1 Mbps				
Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***Bandwidth (kHz)***	***Result***
2402	2401.639423	2402.355769	716.346	PASS
2440	2439.634615	2440.360577	725.962	PASS
2480	2479.629808	2480.355769	725.961	PASS



2402 MHz



2440 MHz



2480 MHz

14 Maximum peak conducted output power

14.1 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.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Frequencies Measured:	2402 MHz / 2440 MHz / 2480 MHz
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	2 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	5 MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Mains Power = 85 % and 115 % of Nominal (FCC only requirement); Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)

14.3 Test Limit

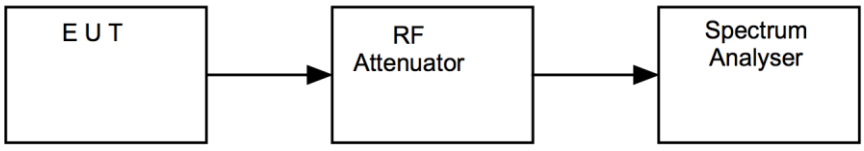
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

14.4 Test Method

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

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

Figure iv Test Setup

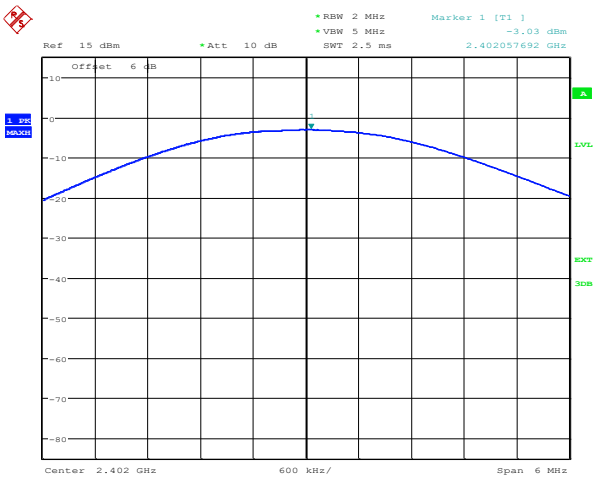


14.5 Test Equipment

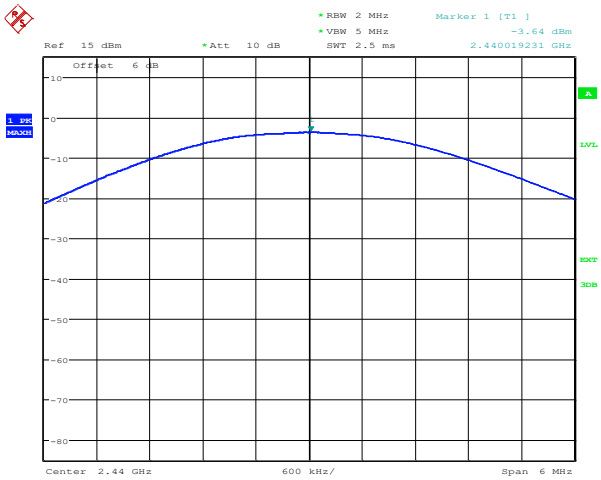
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	2025-09-24
40 GHz BW-K6 2W44+	Mini Circuits	6dB Attenuator	U762	2025-07-17

14.6 Test Results

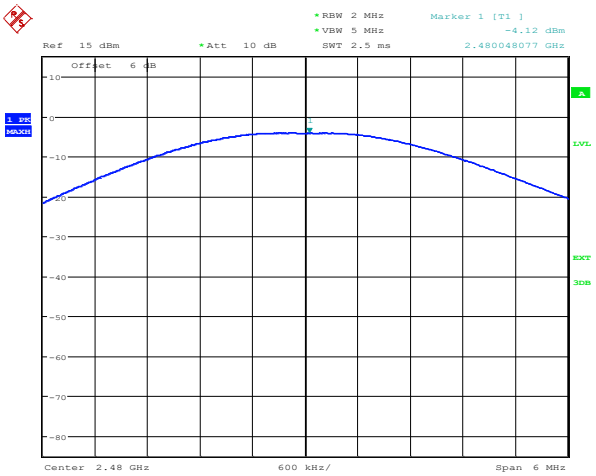
Modulation: GFSK; Data rate: 1 Mbps			
Frequency (MHz)	***Maximum peak conducted output power***		***Result***
	(dBm)	***(mW)***	
2402	-3.03	0.50	Pass
2440	-3.64	0.43	Pass
2480	-4.12	0.39	Pass



2402 MHz



2440 MHz



2480 MHz

15 Out-of-band and conducted spurious emissions

15.1 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.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Frequencies Measured:	2402 MHz / 2440 MHz / 2480 MHz
EUT Channel Bandwidths:	2 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 25 GHz

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)

15.3 Test Limit

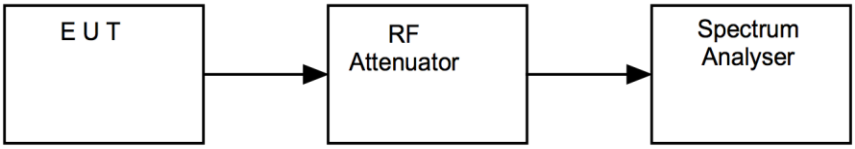
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either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

15.4 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

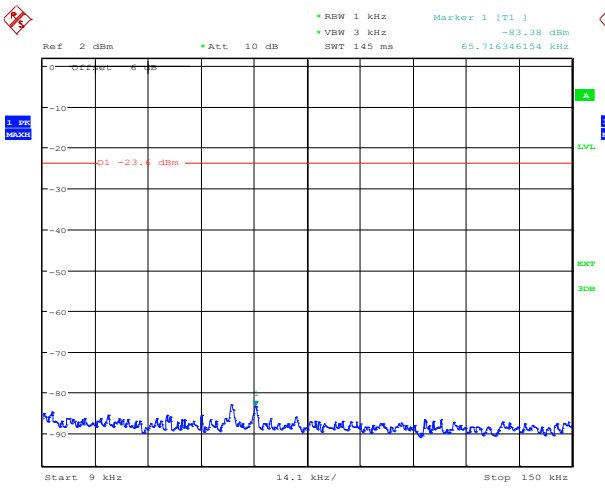


15.5 Test Equipment

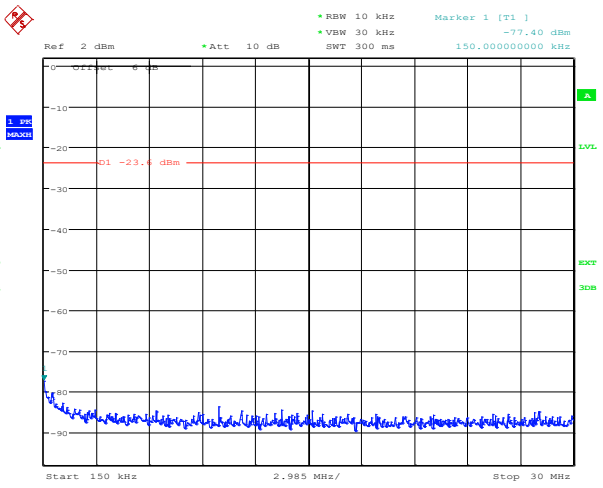
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	2025-09-24
40 GHz BW-K6 2W44+	Mini Circuits	6dB Attenuator	U762	2025-07-17

15.6 Test Results

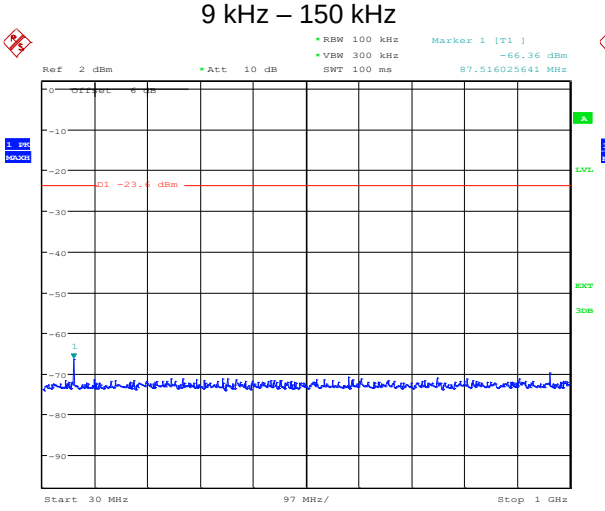
Modulation: GFSK; Data rate: 1 Mbps						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
Low	2402	-3.51	-3.51	N/A	N/A	PASS
No Significant Spurious Emissions within 20 dB of limit						PASS



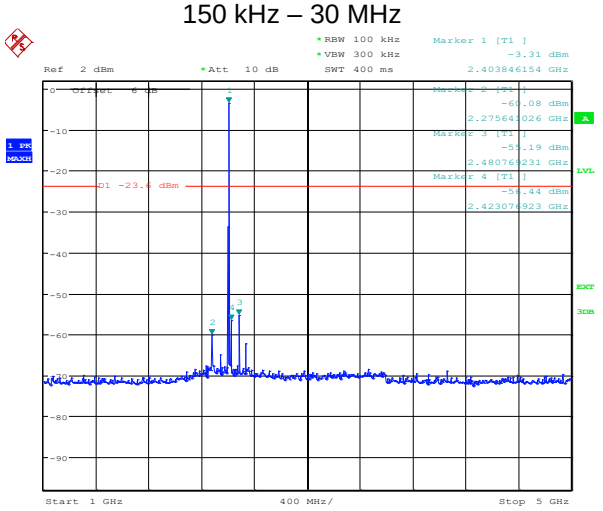
9 kHz – 150 kHz



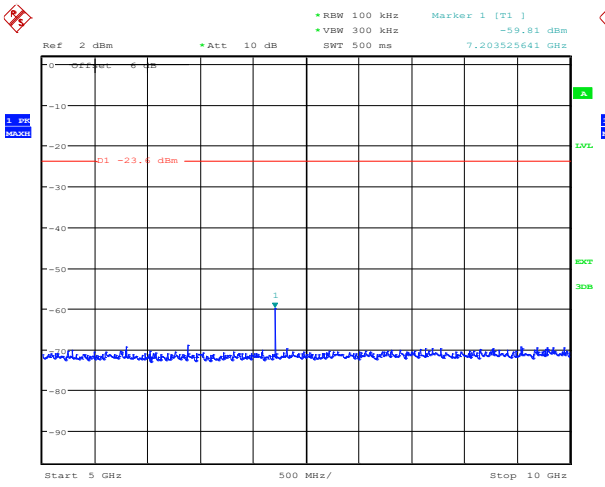
150 kHz – 30 MHz



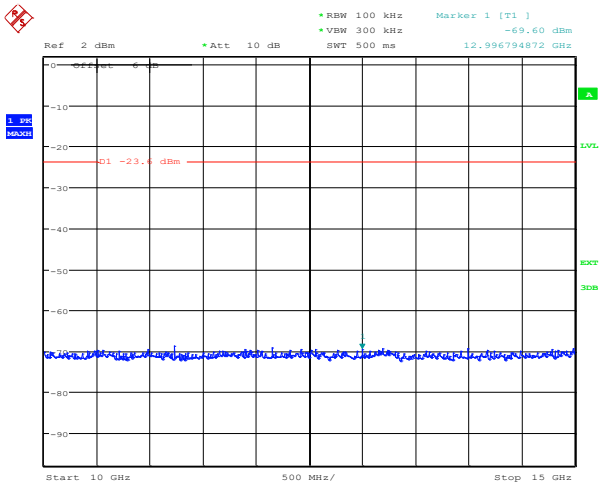
30 MHz – 1 GHz



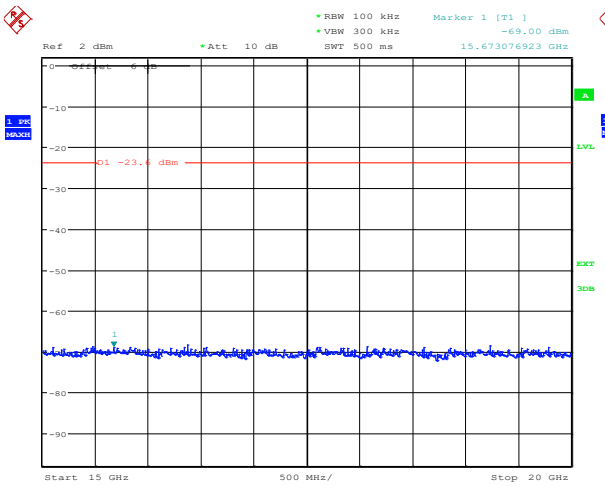
1 GHz – 5 GHz



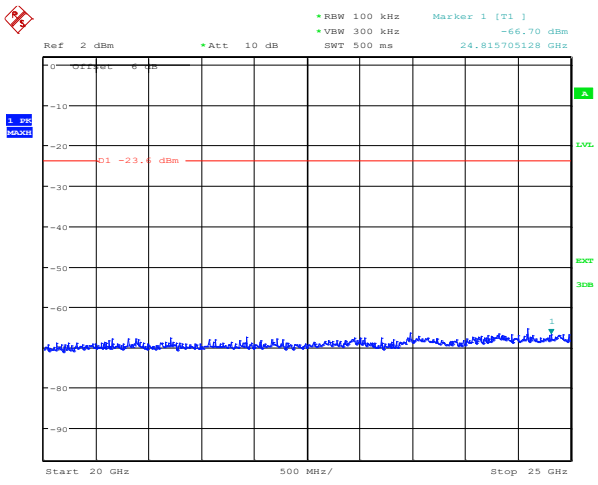
5 GHz – 10 GHz



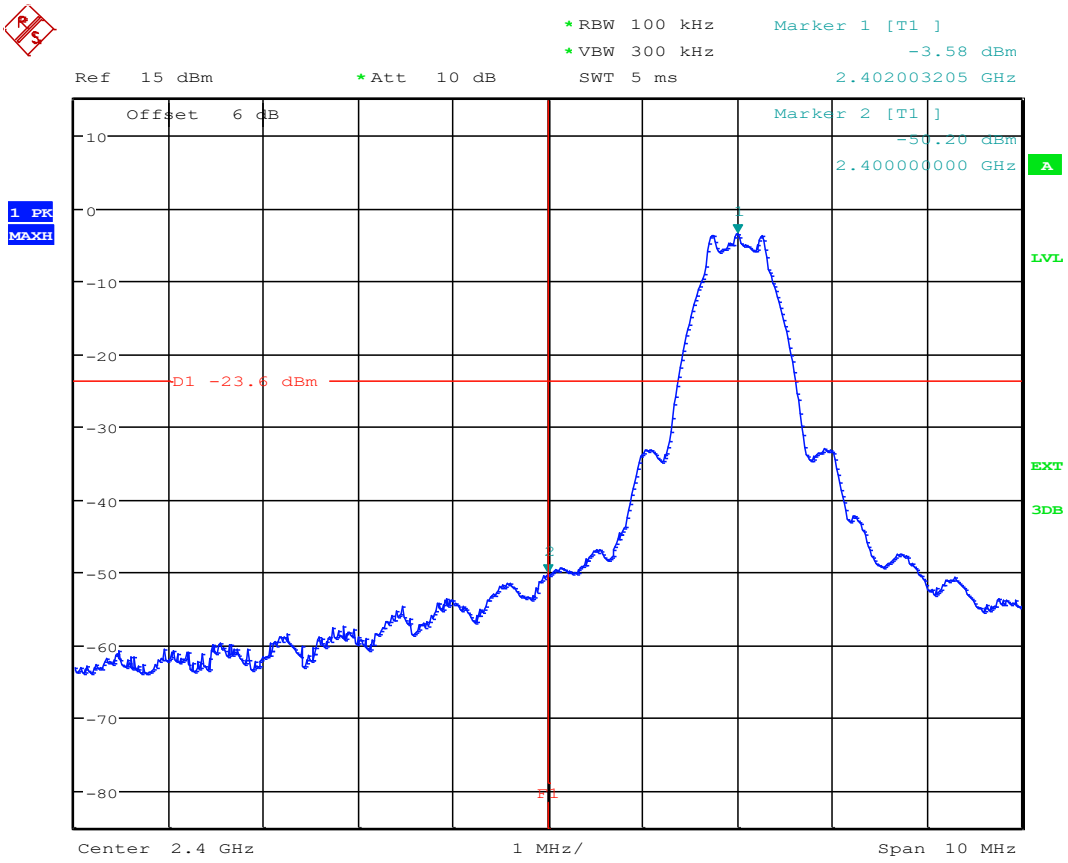
10 GHz – 15 GHz



15 GHz – 20 GHz

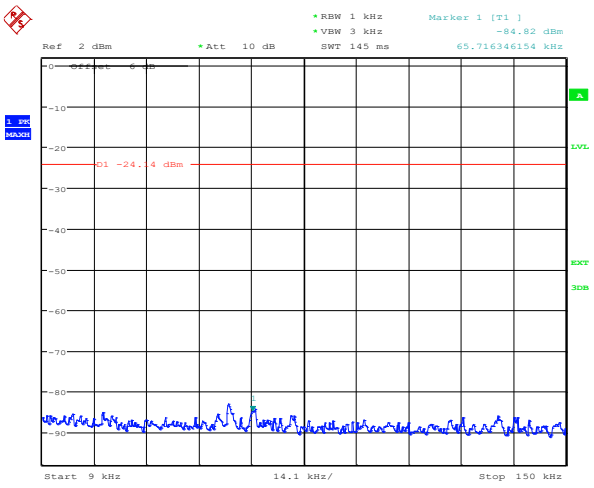


20 GHz – 25 GHz

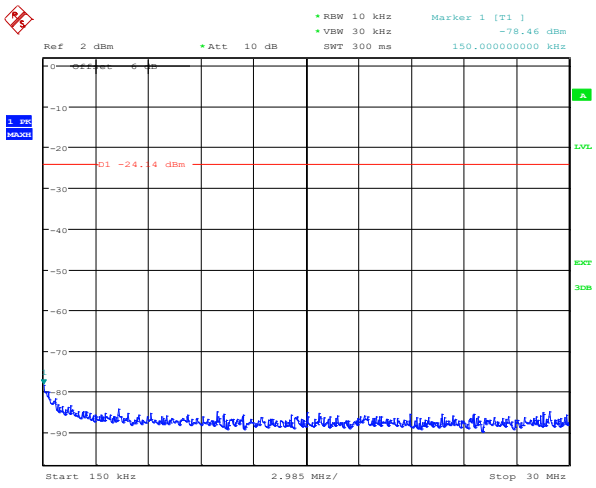


Lower Bandedge

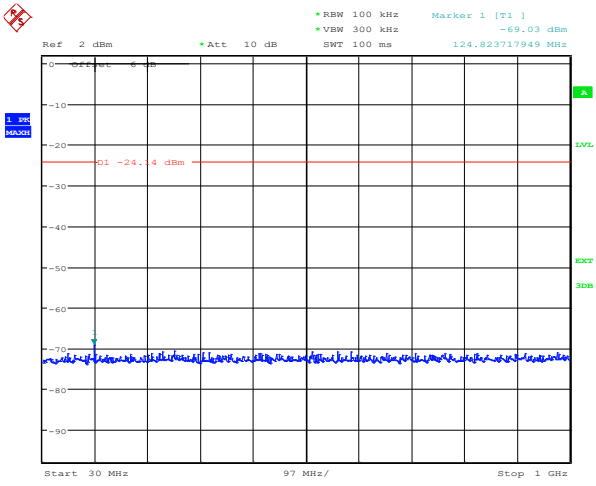
Modulation: GFSK; Data rate: 1 Mbps						
Channel Frequency (MHz)	**Emission Frequency (MHz)**	**Analyzer Level (dBm)**	**Emission Level (dBm)**	**Limit (dBm)**	**Margin (dB)**	**Result**
Mid	2440	-4.11	-4.11	N/A	N/A	PASS
No Significant Spurious Emissions within 20 dB of limit						PASS



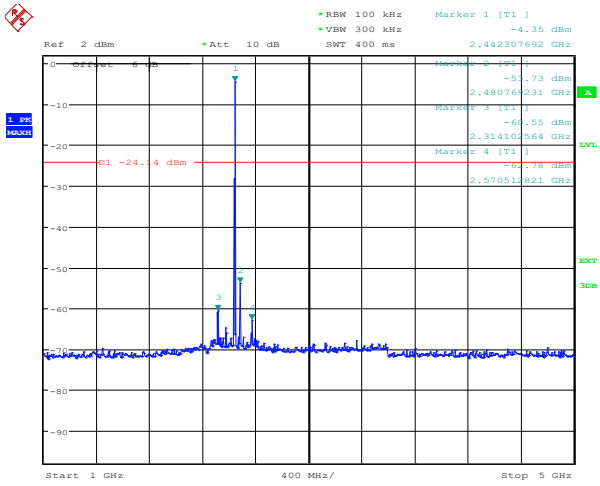
9 kHz – 150 kHz



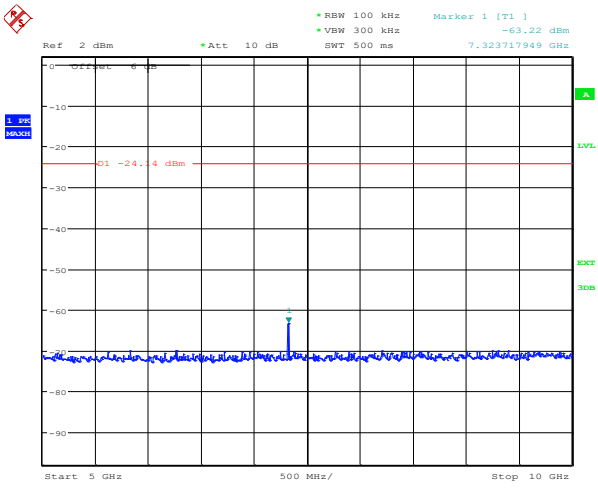
150 kHz – 30 MHz



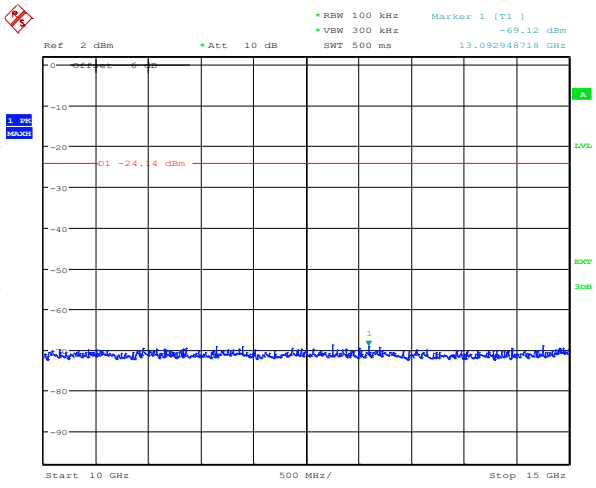
30 MHz – 1 GHz



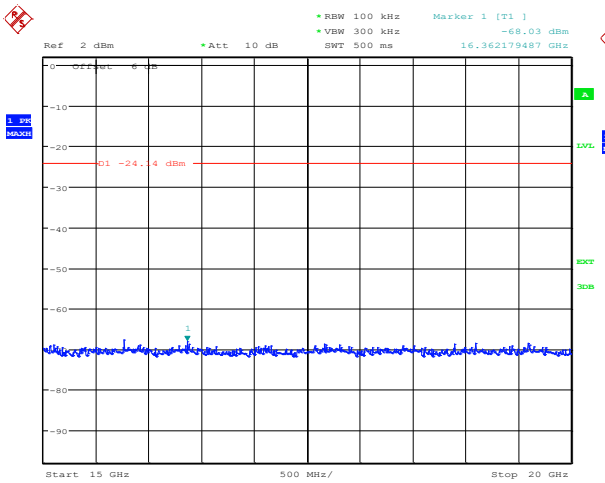
1 GHz – 5 GHz



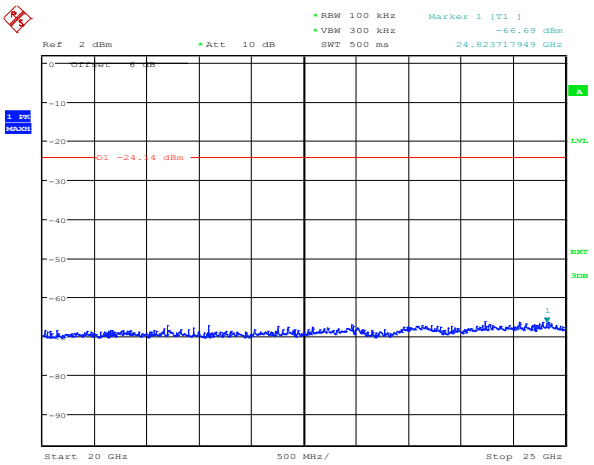
5 GHz – 10 GHz



10 GHz – 15 GHz

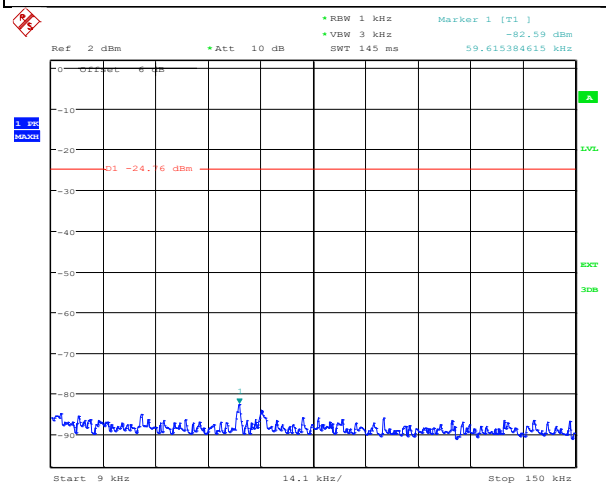


15 GHz – 20 GHz

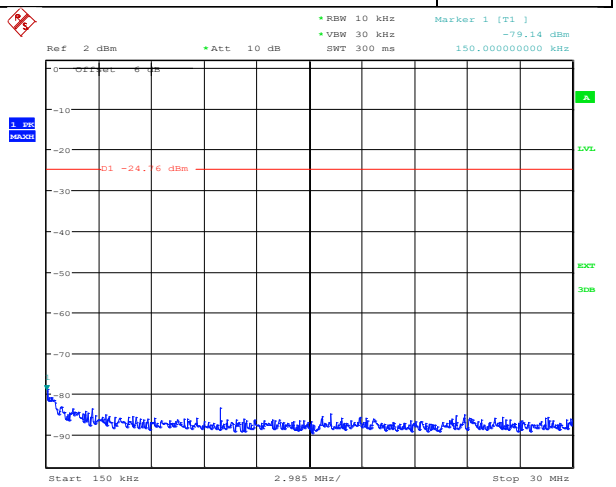


20 GHz – 25 GHz

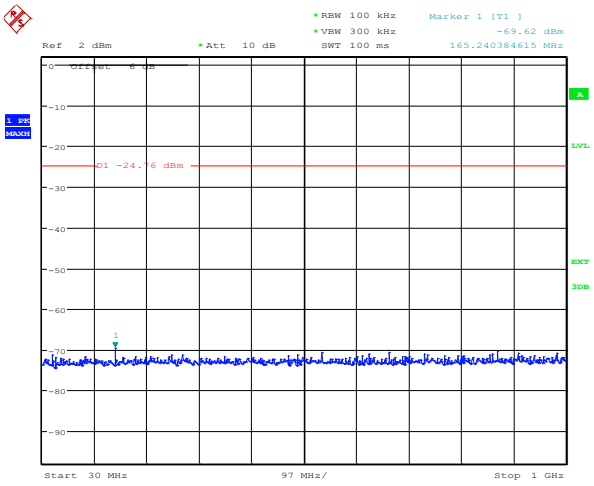
Modulation: GFSK; Data rate: 1 Mbps						
Channel Frequency (MHz)	**Emission Frequency (MHz)**	**Analyzer Level (dBm)**	**Emission Level (dBm)**	**Limit (dBm)**	**Margin (dB)**	**Result**
High	2480	-4.69	-4.69	N/A	N/A	PASS
No Significant Spurious Emissions within 20 dB of limit						PASS



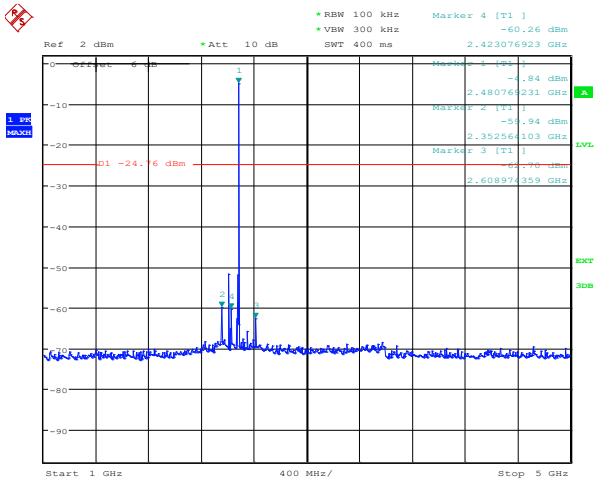
9 kHz – 150 kHz



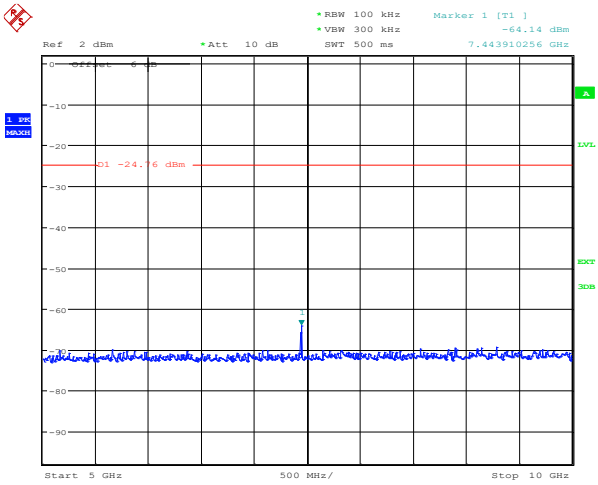
150 kHz – 30 MHz



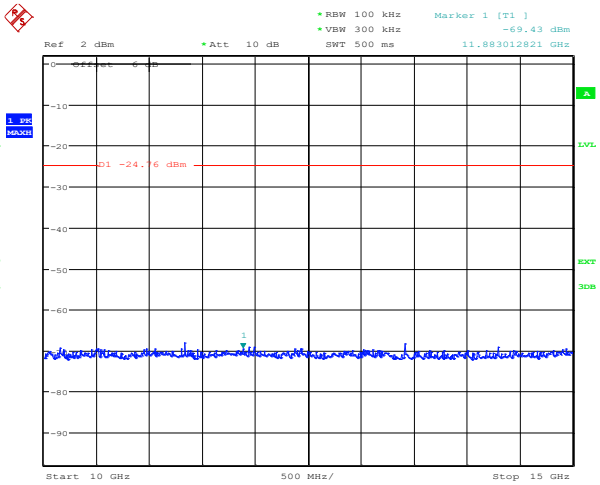
30 MHz – 1 GHz



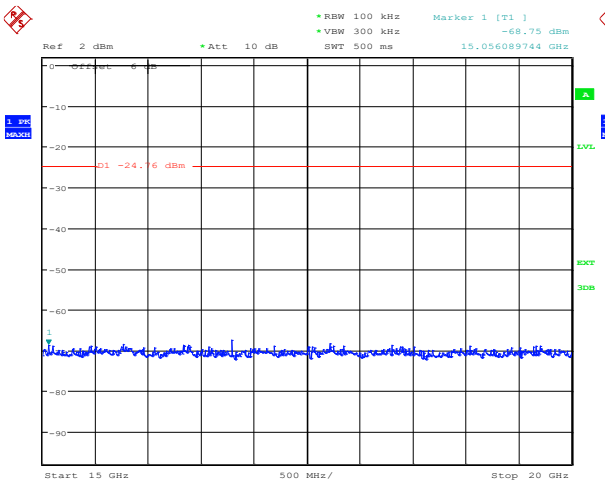
1 GHz – 5 GHz



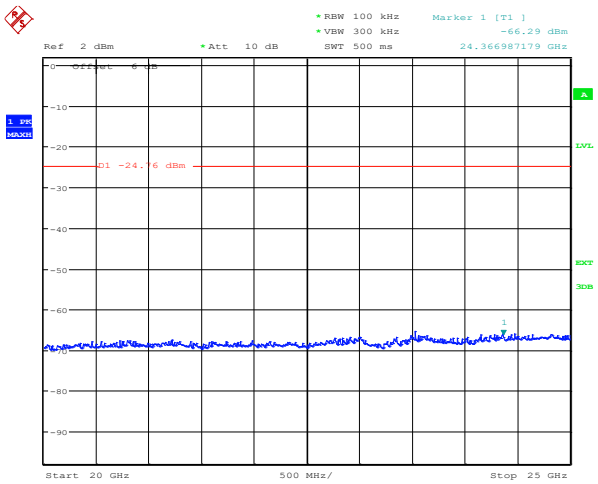
5 GHz – 10 GHz



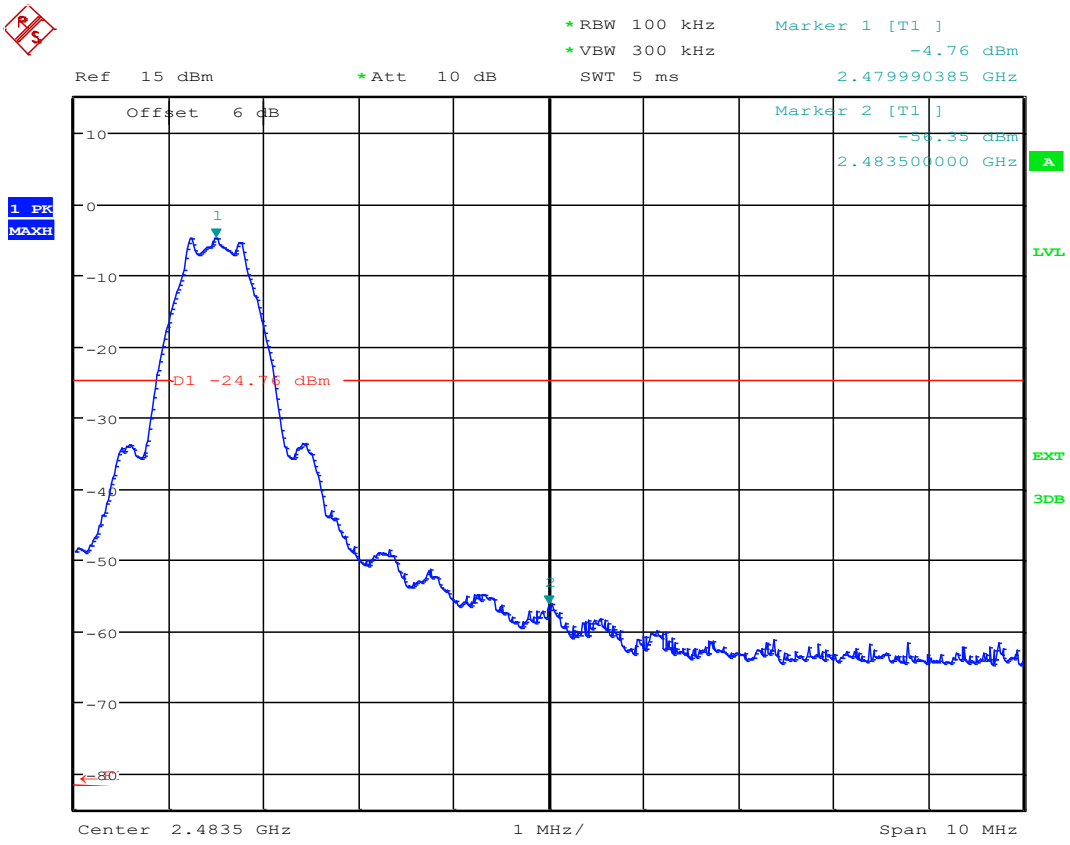
10 GHz – 15 GHz



15 GHz – 20 GHz



20 GHz – 25 GHz



Upper Bandedge

16 Power spectral density

16.1 Definition

The power per unit bandwidth.

16.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Frequencies Measured:	2402 MHz / 2440 MHz / 2480 MHz
EUT Channel Bandwidths:	1 MHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Span: (requirement 1.5 times Channel BW)	1.5 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)

16.3 Test Limit

For equipment operating in the bands 902 - 928 MHz and 2400 - 2483.5 MHz 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.

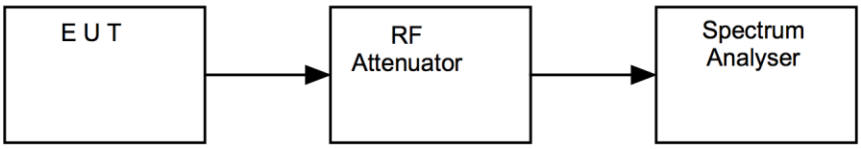
For equipment operating in the band 5725 - 5850 MHz the output power spectral density shall not exceed 30 dBm in any 500 kHz band

16.4 Test Method

With the EUT setup as per section 9 of this report and connected as per the test set-up diagram below, 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.

Test Set-up Diagram

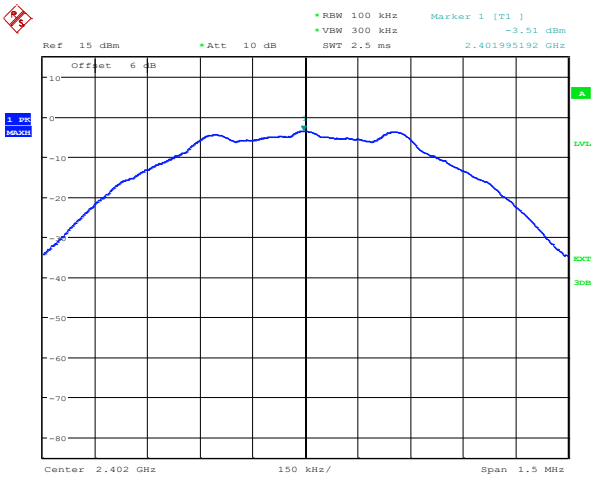


16.5 Test Equipment

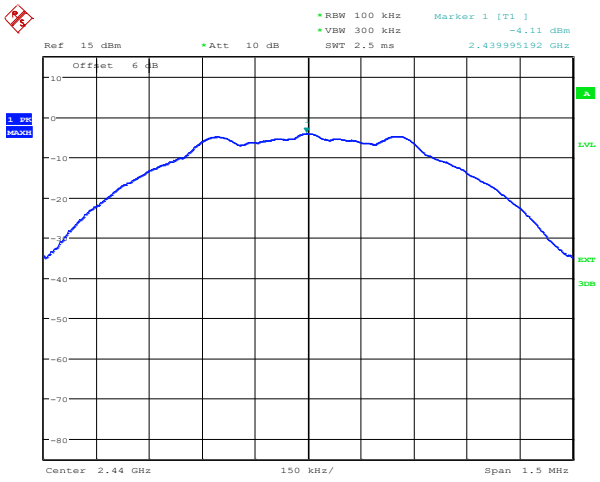
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	2025-09-24
40 GHz BW-K6 2W44+	Mini Circuits	6dB Attenuator	U762	2025-07-17

16.6 Test Results

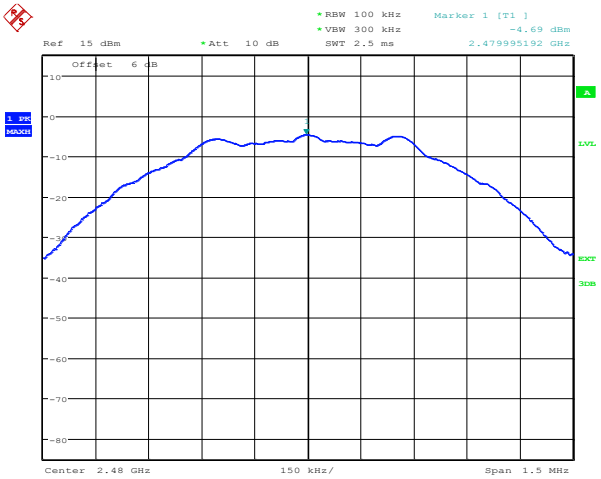
Modulation: GFSK; Data rate: 1 Mbps				
Channel Frequency (MHz)	***Analyser Level (dBm)***	***Cable loss (dB)***	***Power (dBm)***	***Result***
2402	-3.51	0.00	-3.51	Pass
2440	-4.11	0.00	-4.11	Pass
2480	-4.69	0.00	-4.69	Pass



2402 MHz



2440 MHz



2480 MHz

17 Duty Cycle

17.1 Definition

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

17.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.5
EUT Frequency Measured:	2440 MHz
EUT Channel loading:	Maximum
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	N/A
Voltage Extreme Environment Test Range:	N/A

Environmental Conditions (Normal Environment)

Temperature: 16 °C	+15 ºC to +35 ºC (as declared)
Humidity: 39 % RH	20 % RH to 75 % RH (as declared)

17.3 Test Limit

N/A.

17.4 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 used to observe the worst-case configuration.

[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.

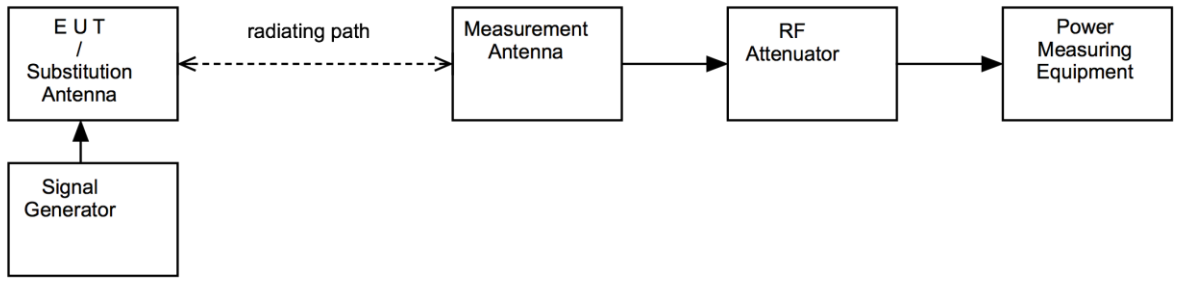
ANSI C63.10-2013 clause 11.6
The duty cycle correction factor, DC, shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as:

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

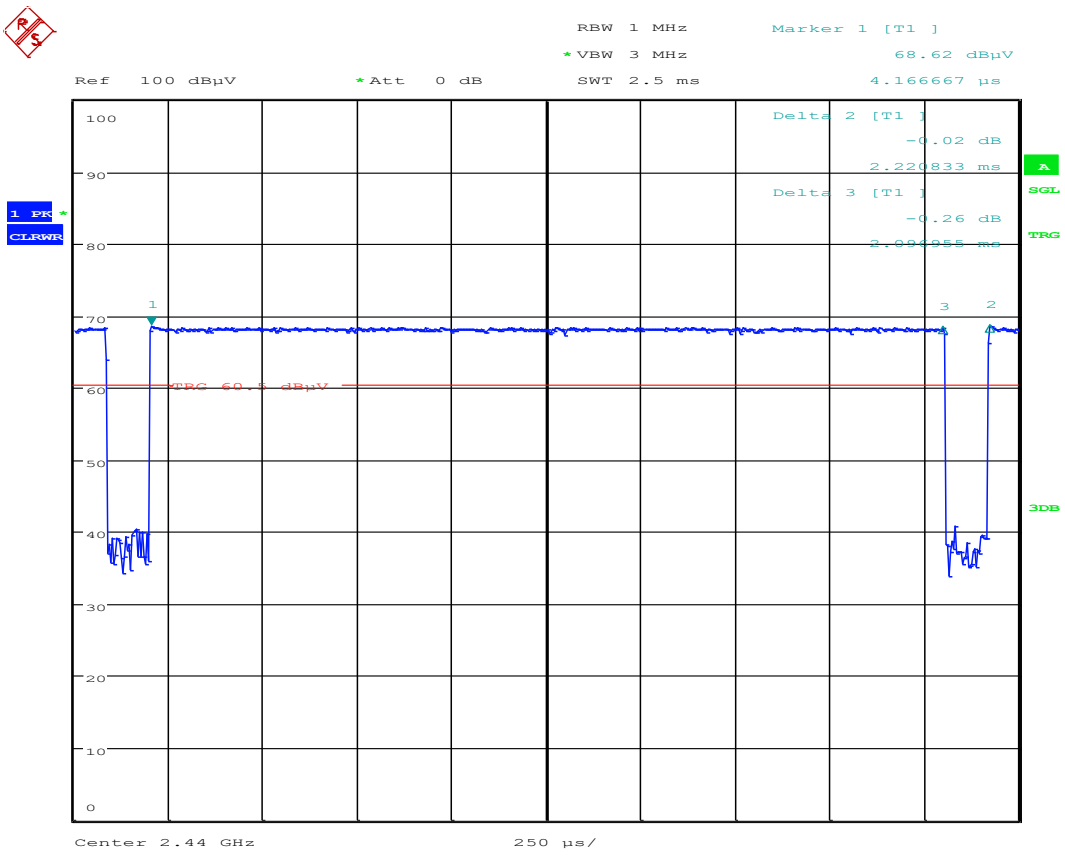


17.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	2025-09-24

17.6 Test Results

Frequency: 2440 MHz; Modulation: GFSK; Data rate: 1 Mbps						
Test Environment		*Single Channel TxOn time (ms)*	*Total TxOn time (ms)*	*Observation period (ms)*	*Duty (%)*	*Calculated Factor*
$V_{nominal}$	$T_{nominal}$	2.096955	2.220833	2.5	94.4	0.5



18 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) Sampling Power Meter to 8 GHz	MU4001	**0.9 dB**
Carrier Power and PSD - Spectrum Analysers	MU4004	**1.7 dB**
Adjacent Channel Power	MU4002	**1.9 dB**
Transmitter conducted spurious emissions (Including emissions due to intermodulation)	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**
Input and output intermodulation	MU4053	**1.6 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**
In-band (3450-3980 MHz) TRP using CATR_ASH_B2	MU4051	**4.1 dB**
Cellular Effective radiated RF power in a SAC between 30 MHz to 180 MHz	MU4052	**6.3 dB**
Cellular Effective radiated RF power in a SAC between 180 MHz to 1 GHz	MU4052	**3.5 dB**
Cellular Effective radiated RF power in a SAC between 1 GHz and 18 GHz	MU4052	**2.8 dB**
Cellular Effective radiated RF power in a SAC between 18 GHz to 26 GHz	MU4052	**2.8 dB**
Cellular Effective radiated RF power in a FAR between 30 MHz to 180 MHz	MU4052	**5.4 dB**
Cellular Effective radiated RF power in a FAR between 180 MHz to 1 GHz	MU4052	**2.9 dB**
Cellular Effective radiated RF power in a FAR between 1 GHz and 18 GHz	MU4052	**2.6 dB**
Cellular Effective radiated RF power in a FAR between 18 GHz to 26 GHz	MU4052	**2.7 dB**
Spurious Emissions Electric and Magnetic Field		
Radiated Spurious Emissions 30 MHz to 1 GHz (Including emissions due to intermodulation)	MU4037	**4.7 dB**
Radiated Spurious Emissions 1-18 GHz (Including emissions due to intermodulation)	MU4032	**4.5 dB**
E Field Emissions 18 GHz to 26 GHz	MU4024	**3.2 dB**
E Field Emissions 26 GHz to 40 GHz	MU4025	**3.3 dB**
E Field Emissions 40 GHz to 50 GHz	MU4026	**3.5 dB**

Test/Measurement	*Budget Number*	*MU*
E Field Emissions 50 GHz to 75 GHz	MU4027	**3.6 dB**
E Field Emissions 75 GHz to 110 GHz	MU4028	**3.6 dB**
Radiated Magnetic Field Emissions	MU4031	**2.3 dB**
Frequency Measurements		
Frequency Deviation	MU4022	**3.7 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	**678.984 µs**
DFS Generator - Frequency Error	MU4007	**91.650 Hz**
DFS Threshold Conducted	MU4008	**1.3 dB**
DFS Threshold Radiated	MU4009	**3.2 dB**
Receiver Parameters		
EN 300 328 Receiver Blocking	MU4010	**1.1 dB**
EN 301 893 Receiver Blocking	MU4011	**1.1 dB**
EN 303 340 Adjacent Channel Selectivity	MU4012	**1.1 dB**
EN 303 340 Overloading	MU4013	**1.1 dB**
EN 303 340 Receiver Blocking	MU4014	**1.1 dB**
EN 303 340 Receiver Sensitivity	MU4015	**0.9 dB**
EN 303 372-1 Image Rejection	MU4016	**1.4 dB**
EN 303 372-1 Receiver Blocking	MU4017	**1.1 dB**
EN 303 372-2 Adjacent Channel Selectivity	MU4018	**1.1 dB**
EN 303 372-2 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**

Test/Measurement	***Budget Number***	***MU***
Rohde & Schwarz TS8997		
Carrier frequency	MU4050	**5.2 ppm**
RF Output Power	MU4050	**1.0 dB**
Peak Power	MU4050	**0.8 dB**
Power Spectral Density	MU4050	**1.0 dB**
Occupied Channel Bandwidth	MU4050	**2.08 %**
Transmitter unwanted emissions in-band	MU4050	**0.9 dB**
Transmitter unwanted emissions in the spurious domain 30 MHz to 1 GHz	MU4050	**0.6 dB**
Transmitter unwanted emissions in the spurious domain 1 GHz to 12.75 GHz	MU4050	**1.8 dB**
Receiver Spurious emission 30 MHz to 1 GHz	MU4050	**0.6 dB**
Receiver Spurious emission 1 GHz to 12.75 GHz	MU4050	**1.8 dB**
Duty Cycle	MU4050	**0.02 %**
Tx Sequence	MU4050	**0.02 %**
Tx Gap	MU4050	**0.02 %**
Medium Utilisation	MU4050	**0.1 %**
Accumulated Transmit Time	MU4050	**0.01 %**
Minimum Frequency Occupation Time	MU4050	**0.01 %**
Hopping Frequency Separation	MU4050	**0.6 %**
Receiver blocking (for bit streams)	MU4050	**3.0 dB**
Channel Access Mechanism / Adaptivity / DFS / Contention Based Protocol	MU4050	**1.8 dB**

19 RF Exposure

OVERVIEW

Human exposure to RF emissions from mobile devices (47 CFR §2.1091) may be evaluated based on the MPE limits adopted by the FCC for electric and magnetic field strength and/or power density, as appropriate, since exposures are assumed to occur at distances of 20 cm or more from persons. ANSI C95.1:2005 + Amd 1:2010 specifies a minimum separation distance of 20 cm for performing reliable field measurements to determine adherence to MPE limits. If the minimum separation distance between a transmitter and nearby persons is more than 20 cm under normal operating conditions, compliance with MPE limits may be determined at such distance from the transmitter. When applicable, operation instructions and prominent warning labels may be used to alert the exposed persons to maintain a specified distance from the transmitter or to limit their exposure durations and usage conditions to ensure compliance. If the use of warning labels on a transmitter is not effective or desirable, the alternative of performing SAR evaluation with the device at its closest range to persons under normal operating conditions may be used. The field strength and power density limits adopted by the FCC are based on whole-body averaged exposure and the assumption of RF field levels relate most accurately to estimating whole-body averaged SAR. This means some local values of exposures exceeding the stated field strength and power density limits may not necessarily imply non-compliance if the spatial average of spatially averaged RF fields over the exposed portions of a person's body does not exceed the limits.

COMPLIANCE WITH FCC 2.1091

47 CFR §1.1307
"(b)(1) Requirements. (i) With respect to the limits on human exposure to RF provided in §1.1310 of this chapter, applicants to the Commission for the grant or modification of construction permits, licenses or renewals thereof, temporary authorities, equipment authorizations, or any other authorizations for radiofrequency sources must either:

(A) Determine that they qualify for an exemption pursuant to §1.1307(b)(3);

(B) Prepare an evaluation of the human exposure to RF radiation pursuant to §1.1310 and include in the application a statement confirming compliance with the limits in §1.1310; or

(C) Prepare an Environmental Assessment if those RF sources would cause human exposure to levels of RF radiation in excess of the limits in §1.1310.

47 CFR §2.1091
"A mobile device is defined as a transmitting device 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 the RF source's radiating structure(s) and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location while transmitting. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal desktop computer, are considered to be mobile devices if they meet the 20-centimeter separation requirement."

The device will only be used with a separation distance between the antenna and the body of the user or nearby persons as shown in the table below and can therefore be considered a mobile transmitter per 47 CFR 2.1091(b).

COMPLIANCE WITH FCC KDB 447498 D01 General RF Exposure Guidance v06

"KDB 447498 D01 General RF Exposure Guidance v06" provides the procedures, requirements, and authorization policies for mobile and portable devices.

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously are covered in section 7.1.

Devices containing multiple transmitters capable of simultaneous transmissions are covered in section 7.2.

LIMITS

Limits for General Population /Uncontrolled Exposure: 47 CFR 1.1310

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
0.3 - 1.34	614	1.63	*(100)	30
1.34 - 30	824/f	2.19/f	*($180/f^2$)	30
30 - 300	27.5	0.073	0.2	30
300 - 1500			f/1500	30
1500 - 100000			1	30

f = frequency in MHz

* = Plane-wave equivalent power density

POWER DENSITY

The exposure level for the radio is evaluated at a 20 cm distance from the radio's transmitting antenna using the general equation:

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{EIRP}{S4\pi}}$$

Where: S = power density (mW/cm2)
P = power input to the antenna (mW)
G = numeric power gain relative to an isotropic radiator
R = distance to the center of the radiation of the antenna (20 cm = limit for MPE estimates)
P*G = EIRP

Solving for S, the maximum power density 20 cm from the transmitting antenna is determined. This level is then compared to the applicable limit for the transmit frequency. If limits were not met at the 20 cm boundary the evaluation distance is increased until the limit is met as shown in the table below.

For co-located radios, the ratio of the calculated level to the limit is determined. The ratios for each co-located radio are summed. If the sum is less than or equal to one, then the device is excluded from testing and is deemed compliant.

ASSESSMENT

Frequency (MHz)	*Maximum Conducted Power (mW)*	*Antenna Gain (dBi)*	*Power density at 20cm (S) (mW/cm^2)*	*Power density limit (S) (mW/cm^2)*	*Distance (R) cm required to be less than the power density limit*
2402 - 2480	0.5	0.5	0.00011	1.0	0.2