Report on the Radio Testing

For

Scope Communications UK Ltd

on

5W UHF Transmitter, 446 MHz to 460 MHz

Report no. TRA-062599-47-00B

2024-04-18

Report Number: TRA-062599-47-00B
Issue: B

REPORT ON THE RADIO TESTING OF A
Scope Communications UK Ltd
5W UHF Transmitter, 446 MHz to 460 MHz
WITH RESPECT TO SPECIFICATION
FCC 47CFR Part 90, Subpart I

TEST DATE: 2023-09-18 to 2023-09-23

Tested by:		Steven Garwell Radio Test Engineer
Written by:		Steven Garwell Radio Test Engineer
Approved by:	 Digitally signed by John Charters Date: 2024.04.18 09:28:04 +01'00'	John Charters Lab Manager
Date:	2024-04-18	

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	2023-10-19	Original
B	2024-01-17	General amendment throughout document

2 Summary

TEST REPORT NUMBER:	TRA-062599-47-00B
WORKS ORDER NUMBER:	TRA-062599.00
PURPOSE OF TEST:	Certification
TEST SPECIFICATION:	47CFR Part 90, Subpart I
EQUIPMENT UNDER TEST (EUT):	5W UHF Transmitter, 446 MHz to 460 MHz
FCC IDENTIFIER:	JRNUSAFIVETX
EUT SERIAL NUMBER:	EUT No.1
AGENT:	Scope Communications UK Ltd
AGENT ADDRESS:	Quantum House Steamer Quay Totnes Devon TQ9 5AL United Kingdom
AGENT CONTACT:	Simon Fidler ☎ 01803 860700 ✉ simon@scope-uk.com
TEST DATE:	2023-09-18 to 2023-09-23
PURCHASE ORDER NUMBER:	Not Stated
TESTED BY:	Steven Garwell Element

2.1 Test Summary

Test Method and Description	*Requirement Clause 47CFR*	*Applicable to this equipment*	*Result / Note*
Conducted Power Output	90.205	☒	-
Spurious Emissions at Antenna Terminals	90.210	☒	*PASS*
Emission Mask	90.210	☒	*PASS*
Field Strength of Spurious Emissions	90.210	☒	*PASS*
Occupied Bandwidth	90.209	☒	*PASS*
Frequency Stability	90.213	☒	*PASS*
Transient Behaviour	90.214	☒	*PASS*
Adjacent Channel Power	90.221	☐	*Note 2*
Audio Frequency Response	2.1047	☐	*Note 1*
Modulation Limiting	2.1047	☐	*Note 1*

Specific Note:

1. The EUT does not use audio or have an audio input
2. Authorised bandwidth is less than 20 kHz for 25 kHz channel spacing. For operation in the 406 MHz – 512 MHz band ACP is not required as per 90.209 table 1, note 6

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 test 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-062599-47-00B presents the results of the Radio testing on a Scope Communications UK Ltd, 5W UHF Transmitter, 446 MHz to 460 MHz to specification 47CFR90 Private Land Mobile Radio Service.

The testing was carried out for Scope Communications 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 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 following US-UK MRA, Designation numbers.

Element Skelmersdale UK2020

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

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 2 - Code of Federal Regulations, Title 47, Part 2, “Frequency allocations and Radio Telemetry Matters; General Rules and Regulations”
- FCC 47 CFR Ch. I – Part 90 - Code of Federal Regulations, Title 47, Part 90, “Land Mobile Radio Service”
- TIA EIA-603-E Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
- 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.
- ANSI C63.25-2015 - American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.
- ANSI C63.26-2015 - American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.

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
dBu	dB relative to 1 microvolt
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: 5W UHF Transmitter, 446 MHz to 460 MHz
- Serial Number: EUT No.1
- Model Number: TX5W
- Software Revision: V1.0
- Build Level / Revision Number: Pre-Production

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.

- *Hewlett Packard Probook 4540s – used for programming*

7.3 EUT Mode of Operation

The EUT accepts commands from the scope serial setup program via USB the commands allow the EUT to be set to transmit a CW or Modulated carrier as required.

7.4 EUT Radio Parameters

7.4.1 General

Frequency band of operation:	446 MHz – 460 MHz
Modulation type(s):	FSK Non return to Zero
Channel spacing:	12.5 kHz, 25 kHz selectable
ITU emission designator(s):	F1D
Declared output power(s):	5 W
Nominal Supply Voltage:	12.0 Vdc
Frequency stability:	± 1.5 ppm
Antenna Type:	No antennas were used during testing

7.5 EUT Description

The EUT is a radio module used in various end products, the module contains a 446 MHz to 460 MHz transmitter. This test report covers the testing of the 446 MHz to 460 MHz transmitter only.

8 Modifications

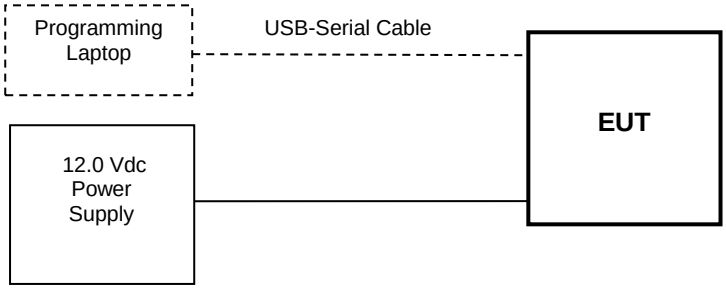
No modifications were performed during this assessment.

9 EUT Test Setup

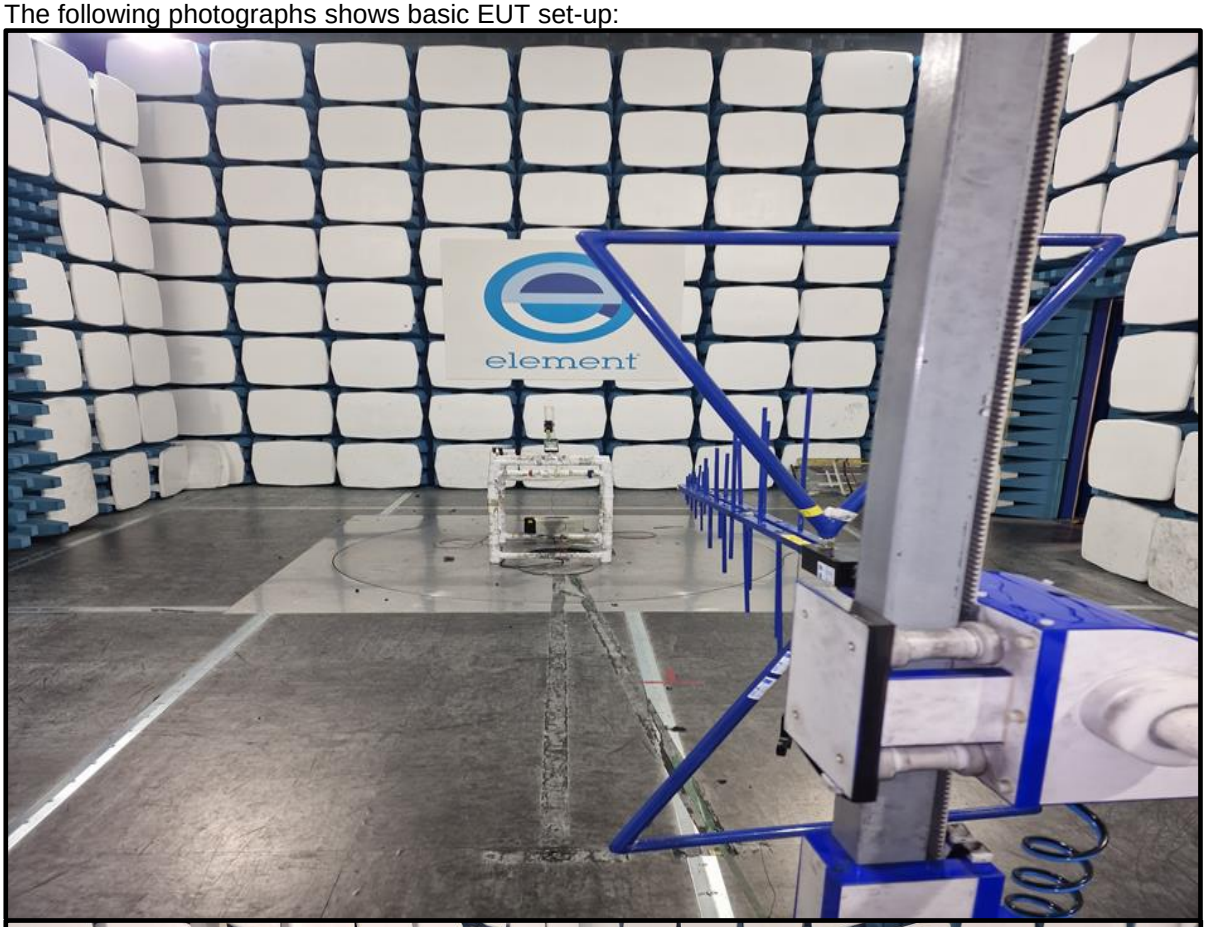
9.1 Block Diagram

The following diagram shows basic EUT interconnections with interconnections identified, the programming laptop was only present during setup and removed during test.

9.2 General Set-up Photograph



The following photographs 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: V2022.07.06.0

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 12.0 Vdc from a bench top PSU for both conducted and radiated measurements.

10.2 Extreme Test Conditions

Extreme temperatures and voltages are required to be tested, the following extremes were used:

Voltage	***Temperature***
Nominal	-30 ºC to +50 ºC in 10 ºC steps
10.5 Vdc	20 ºC
14.0 Vdc	20 ºC

Extreme voltage range as Per TIA-603-E 1.4.4.5, specified by the manufacturer.

11 Conducted Carrier Power

11.1 Definition

The conducted carrier power output rating for a transmitter is the power available at the output terminals of the transmitter when the output terminals are connected to the standard transmitter load.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	TIA-603-E, Clause 2.2.1
EUT Frequencies Measured:	446.0 MHz, 453.0 MHz & 460 MHz
EUT Channel Bandwidths:	12.5 kHz, 25 kHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW:	100 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

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

11.3 Test Limit

Part 90.205 (h) 450 MHz - 470 MHz

(1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2. Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 2 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 39 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.

(3) An applicant for a station with a service area radius greater than 32 km (20 mi) must justify the requested service area radius, which may be authorized only in accordance with table 2, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

Table 2:

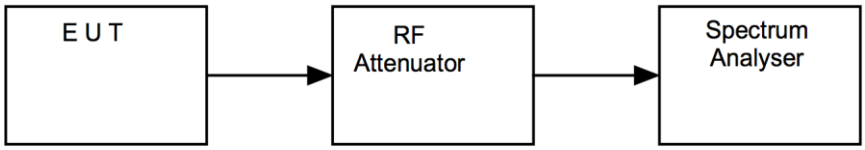
Service Area Radius (km)	**3**	**8**	**13**	**16**	**24**	**32**	**40[4]**	**48[4]**	**64[4]**	**80[4]**
Maximum ERP (W) [1]	2	100	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]
Up to reference HAAT (m) [3]	15	15	15	27	63	125	250	410	950	2700

1 Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See § 73.699, Fig. 10 b).
2 Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.
3 When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: ERPallow = ERPmax × (HAATref / HAATactual) 2.
4 Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

11.4 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.

Figure vi Test Setup



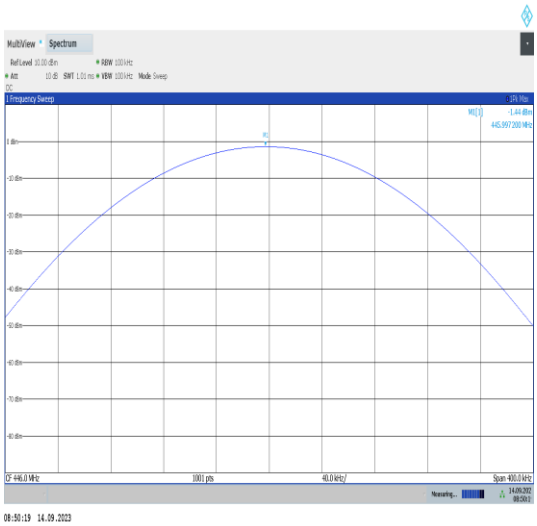
11.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSW 43	U728	2024-05-10
Signal Generator	R&S	SMB100A	U677	2024-02-03
20 dB SMA attenuator	Bird	8304-300-N	L220	Cal In Use
10 dB SMA attenuator	Bird	8304-100-N	L222	Cal In Use

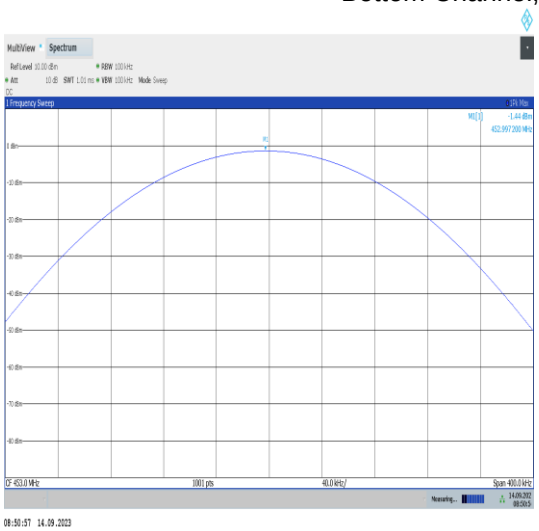
11.6 Test Results

12.5 kHz

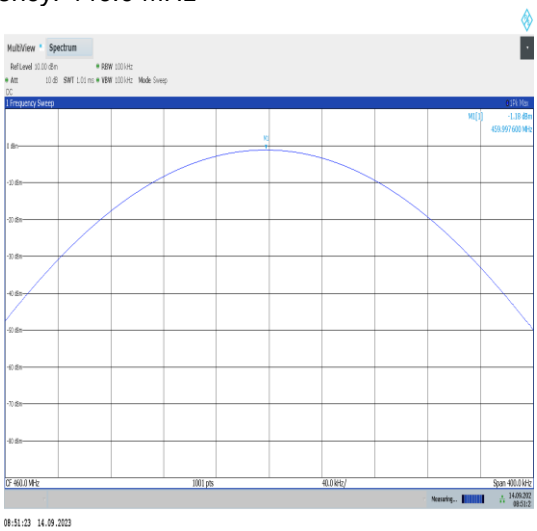
Channel Frequency (MHz)	*Analyzer Level (dBm)*	*System loss (dB)*	*Conducted Carrier Output Power (dBm)*	*Conducted Carrier Output Power (W)*	*Rated Output Power (W)*
446.0	-1.44	36.07	34.63	2.90	5
453.0	-1.44	36.08	34.64	2.91	5
460.0	-1.18	36.07	34.89	3.08	5



Bottom Channel; Frequency: 446.0 MHz



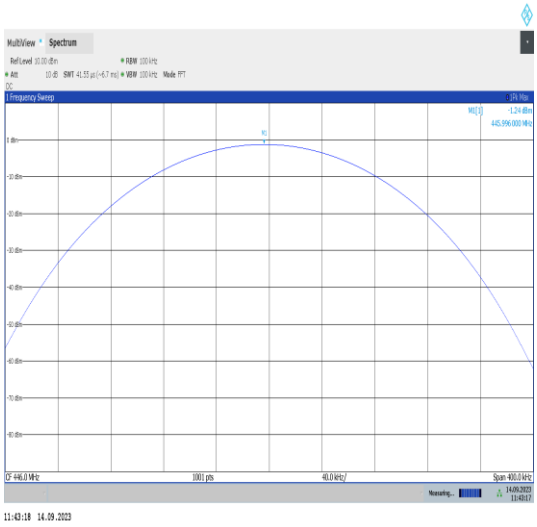
Middle Channel; Frequency: 453.0 MHz



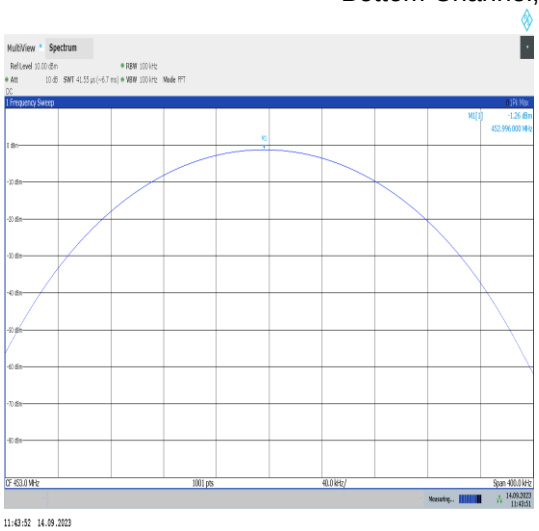
Top Channel; Frequency: 460.0 MHz

25 kHz

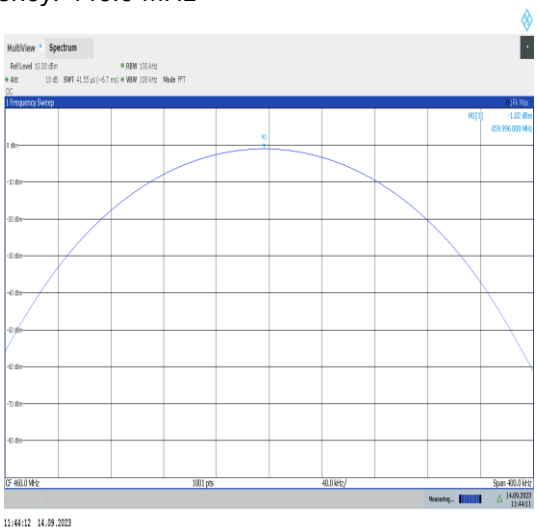
Channel Frequency (MHz)	*Analyzer Level (dBm)*	*System loss (dB)*	*Conducted Carrier Output Power (dBm)*	*Conducted Carrier Output Power (W)*	*Rated Output Power (W)*
446.0	-1.24	36.07	34.83	3.04	5
453.0	-1.26	36.08	34.82	3.03	5
460.0	-1.02	36.07	35.05	3.20	5



Bottom Channel; Frequency: 446.0 MHz



Middle Channel; Frequency: 453.0 MHz



Top Channel; Frequency: 460.0 MHz

12 Spurious Emissions at Antenna Terminals

12.1 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.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	C63.26 clause 5.7
EUT Frequencies Measured:	446.0 MHz, 453.0 MHz & 460 MHz
EUT Channel Bandwidths:	12.5 kHz, 25 kHz
Deviations From Standard:	None
Measurement BW:	100 Hz, 1 kHz, 10 kHz, 100 kHz & 1 MHz
Measurement Detector:	Peak
Measurement Range:	9 kHz to 6 GHz

Environmental Conditions (Normal Environment)

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

12.3 Test Limits

90.210 (d) Emissions Mask D – 12.5 kHz Channel Bandwidth Equipment

On any frequency removed from the centre of the authorised bandwidth (f_o) by the following frequency offsets

(1) ±0 kHz	-	5.625 kHz	0	dB
(2) ±5.625 kHz	-	12.5 kHz	7.27 (f^d -2.88 kHz)	dB
(3) > ±12.5 kHz	-		50 + 10 Log P or 70*	dB

(10 log (P_{watts} *1000)) – (50 + 10 Log (P_{watts})) = LIMIT = -20 dBm
* whichever is the lesser attenuation

90.210 (c) Emissions Mask C – 25 kHz Channel Bandwidth Equipment

On any frequency removed from the centre of the authorised bandwidth (f_o) by the following frequency offsets

(1) ±5 kHz	-	10 kHz	83 Log (f*d* / 5)	dB
(2) ±10 kHz	-	250 %	29 Log (fd^2 / 11) or 50*	dB
(3) > ±250%			43 + 10 log P	dB

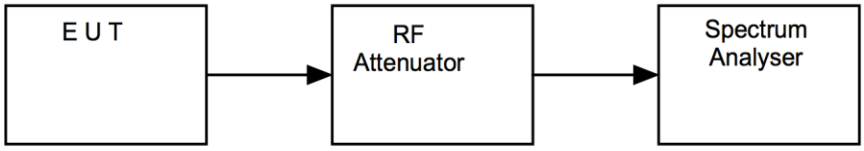
(10 log (P_{watts} *1000)) – (43 + 10 Log (P_{watts})) = LIMIT = -13 dBm
* whichever is the lesser attenuation

12.4 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



12.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSW 43	U728	2024-05-10
Signal Generator	R&S	SMB100A	U677	2024-02-03
20 dB SMA attenuator	Bird	8304-300-N	L220	Cal In Use
10 dB SMA attenuator	Bird	8304-100-N	L222	Cal In Use

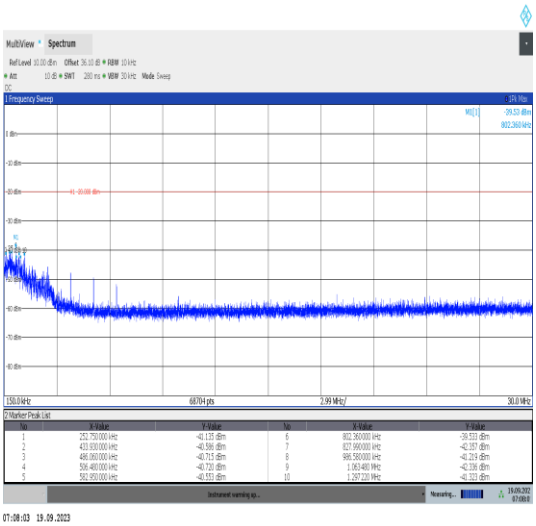
12.6 Test Results

12.5 kHz operation

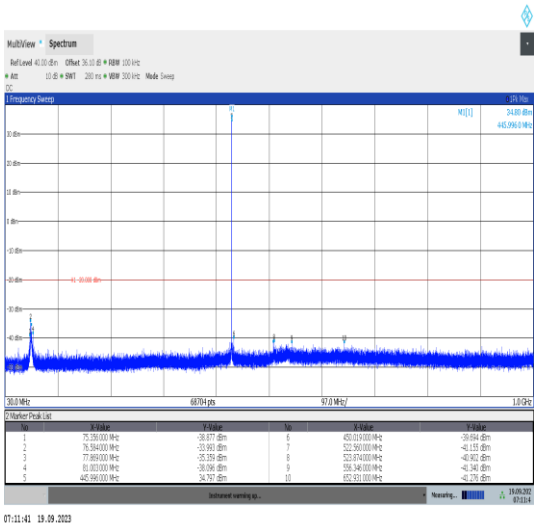
Frequency; 446.0 MHz					
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
446.0	77.8	-30.9	-20	10.9	PASS

Bottom Channel; Frequency: 446.0 MHz

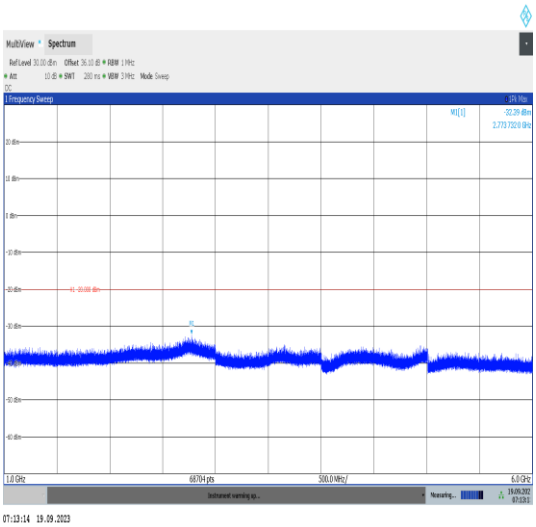
9 kHz to 150 kHz



150 kHz to 30 MHz

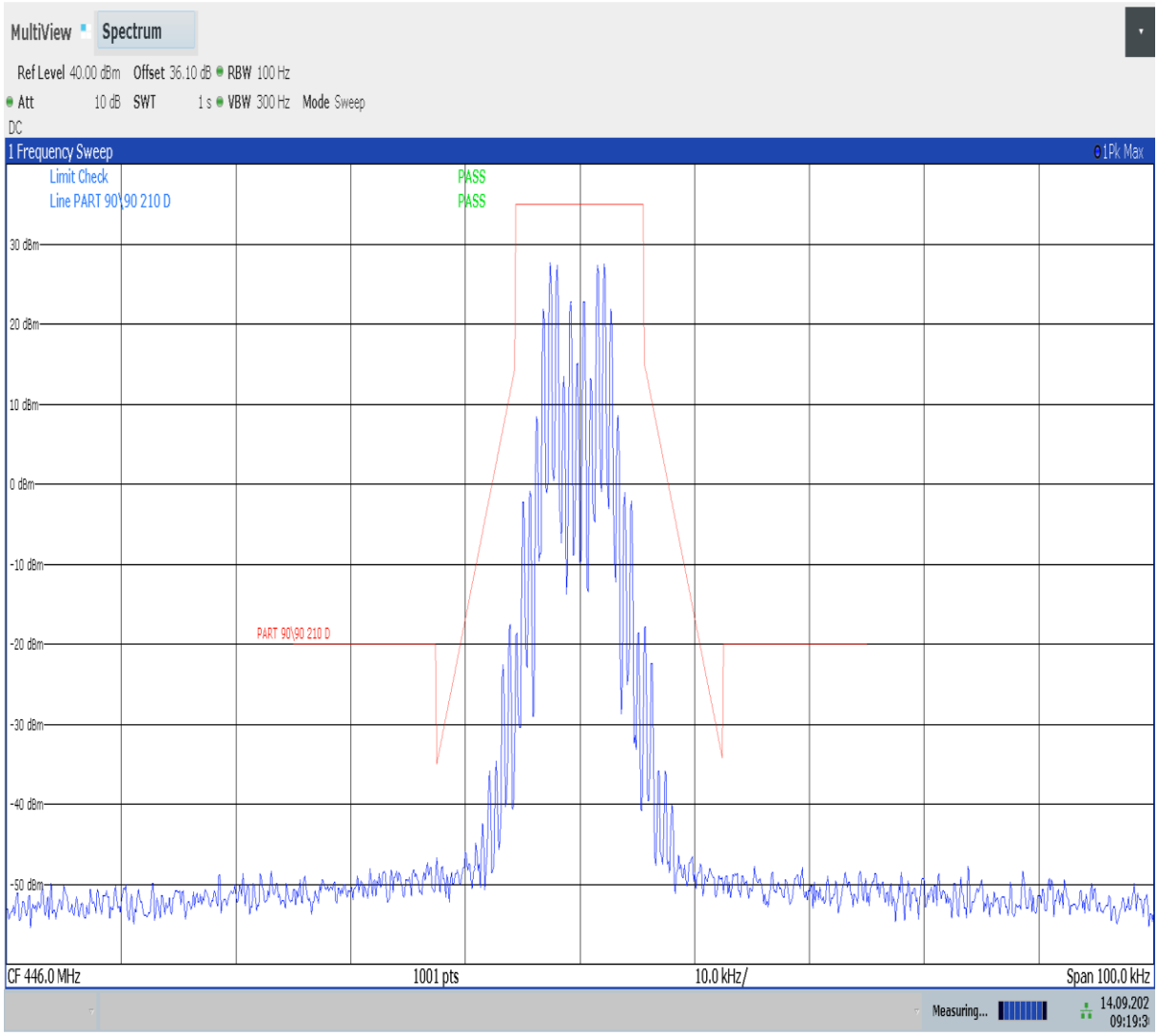


30 MHz to 1 GHz



1 GHz to 6 GHz

Bottom Channel Mask



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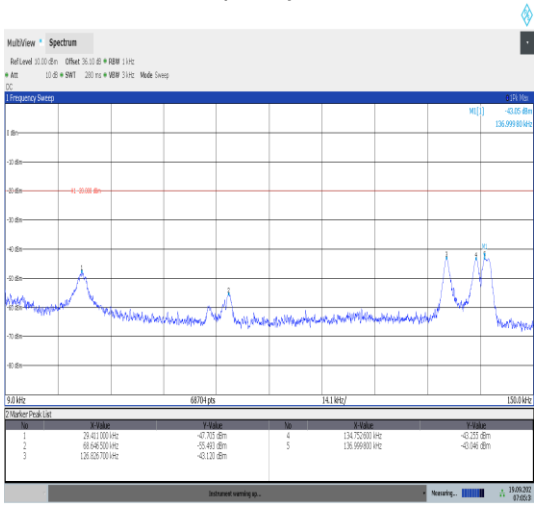
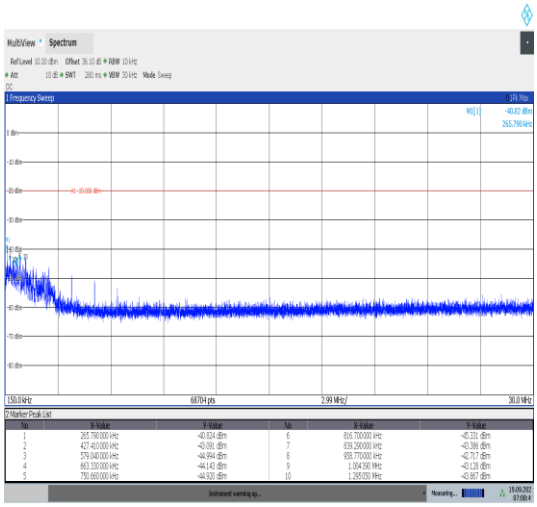
Frequency; 453.0 MHz					
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
453.0	77.9	-30.7	-20	10.7	PASS

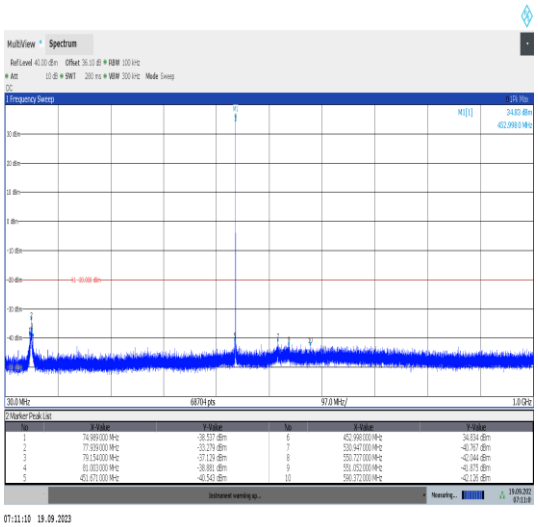
Middle Channel; Frequency: 453.0 MHz



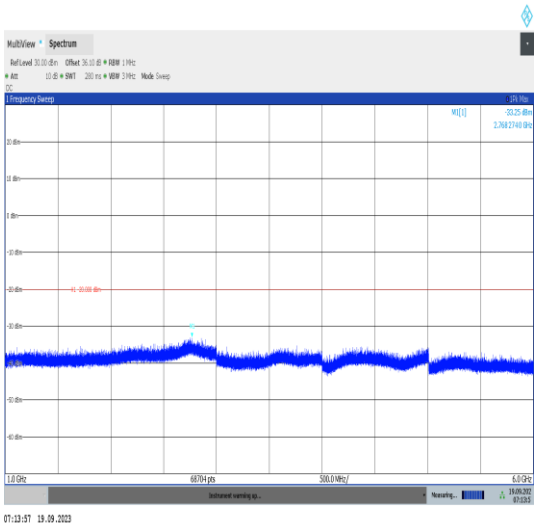
9 kHz to 150 kHz



150 kHz to 30 MHz

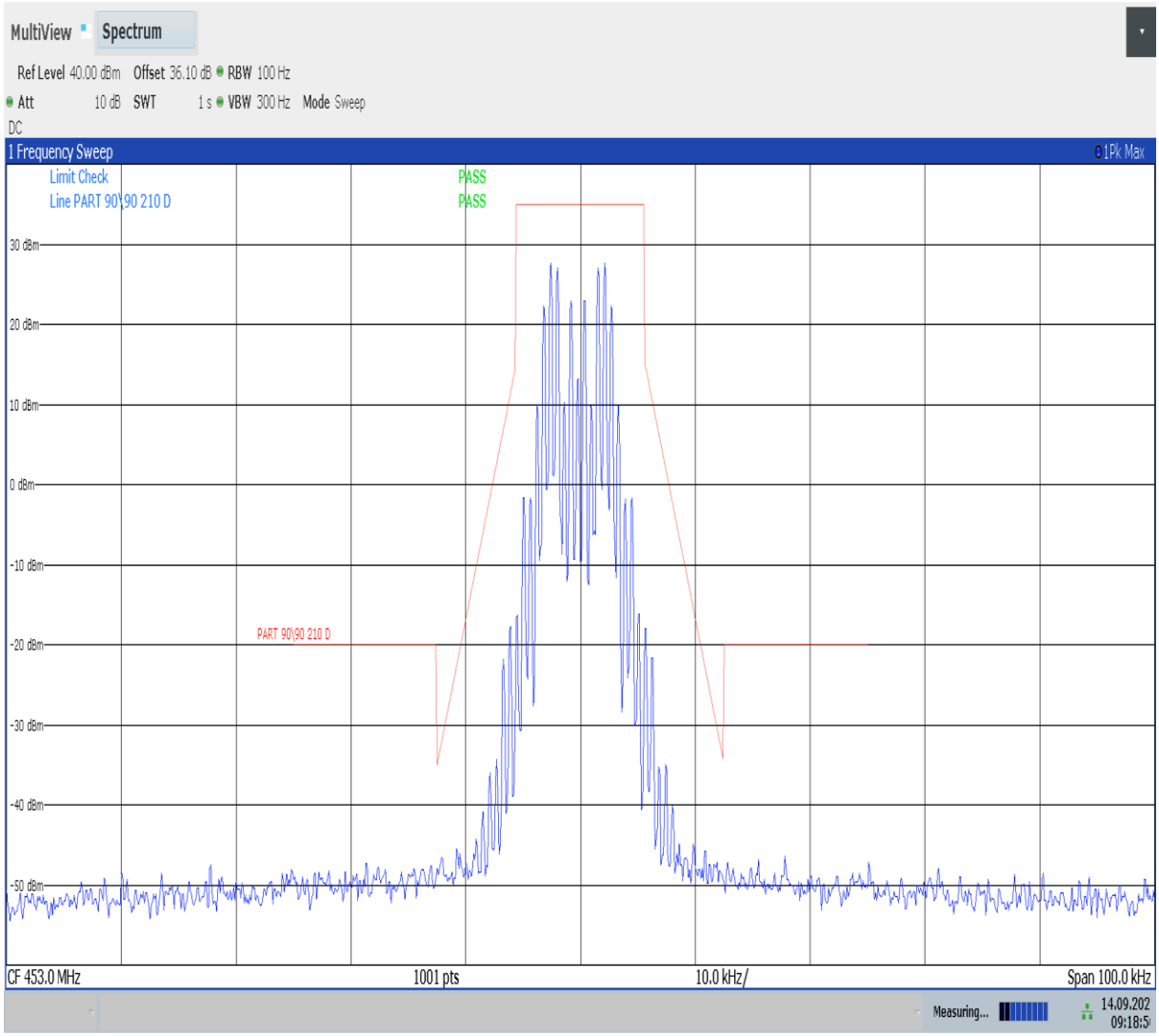


30 MHz to 1 GHz



1 GHz to 6 GHz

Middle Channel Mask



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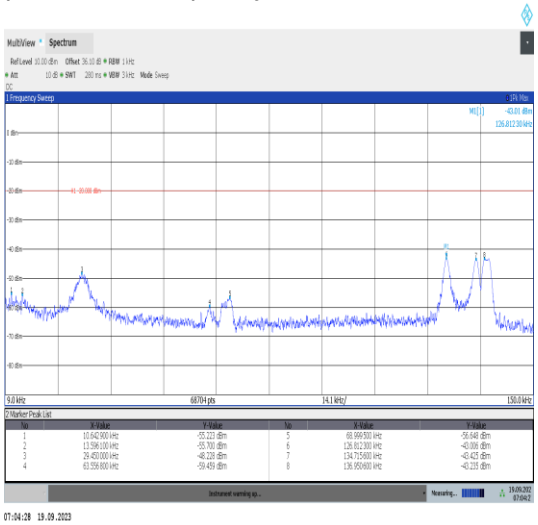
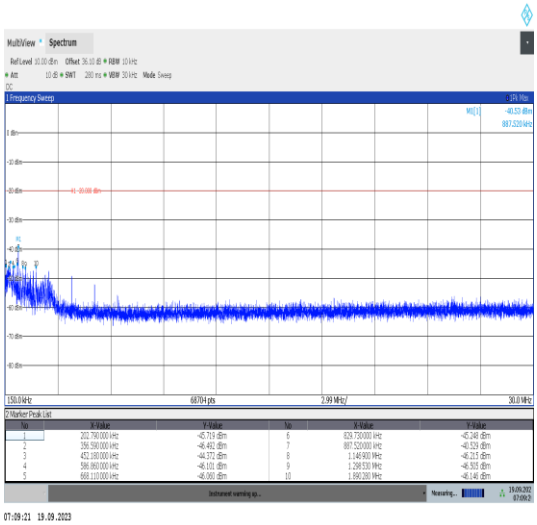
Frequency; 460.0 MHz					
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
460.0	77.7	-32.7	-20	12.7	PASS

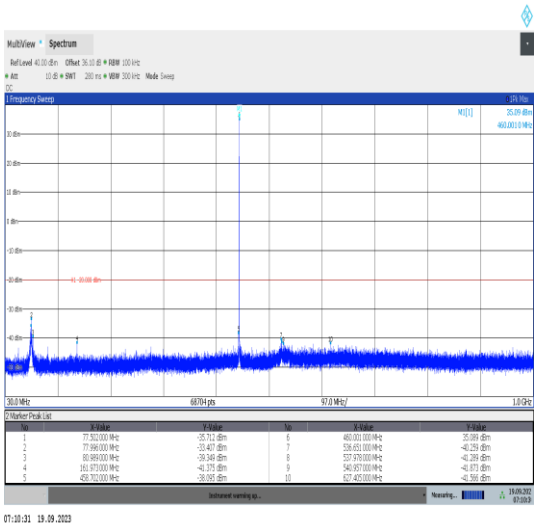
Top Channel; Frequency: 460.0



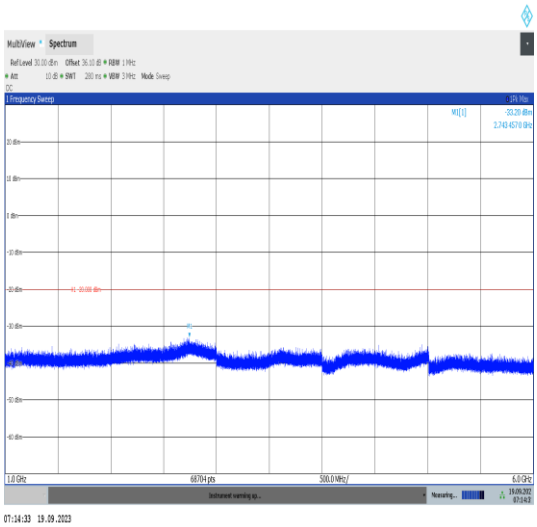
9 kHz to 150 kHz



150 kHz to 30 MHz

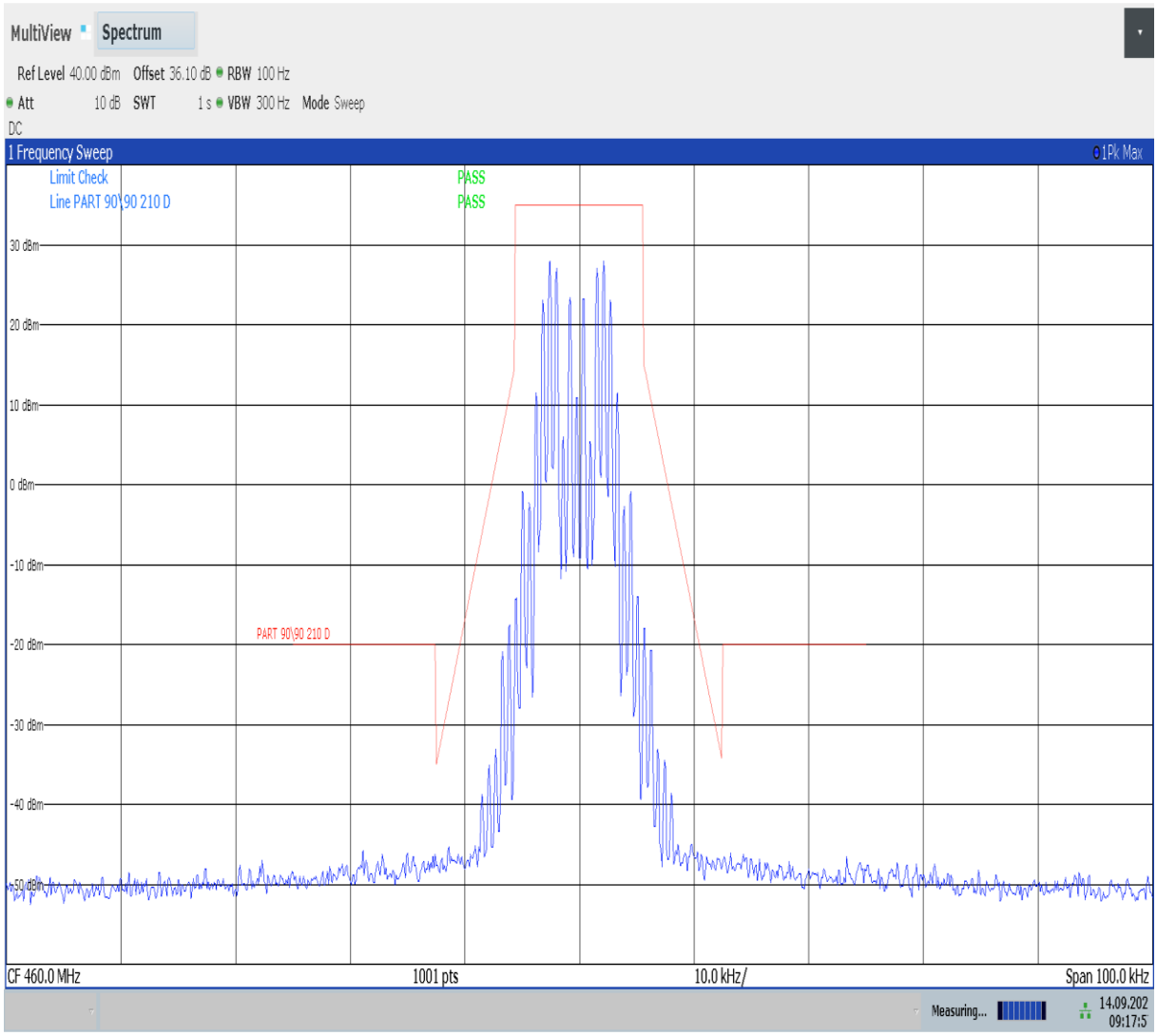


30 MHz to 1 GHz



1 GHz to 6 GHz

Top Channel Mask



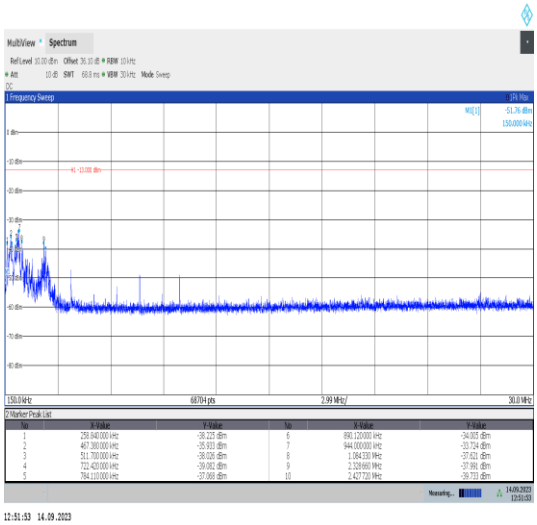
09:17:57 14.09.2023

25 kHz operation

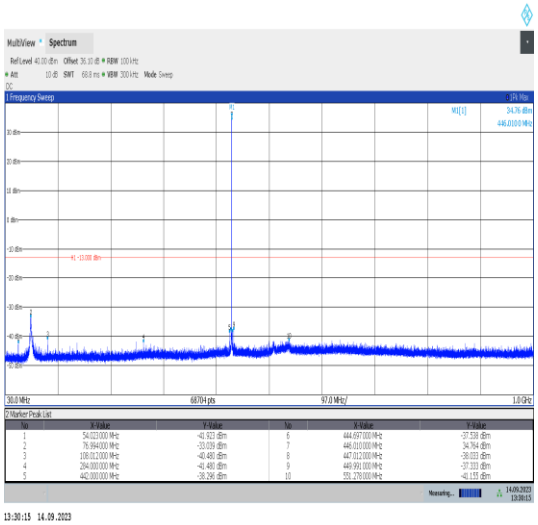
Frequency; 446.0 MHz					
Channel Frequency (MHz)	**Emission Frequency (MHz)**	**Emission Level (dBm)**	**Limit (dBm)**	**Margin (dB)**	**Result**
446.0	77.8	-30.9	-13	17.9	PASS

Bottom Channel; Frequency: 446.0 MHz

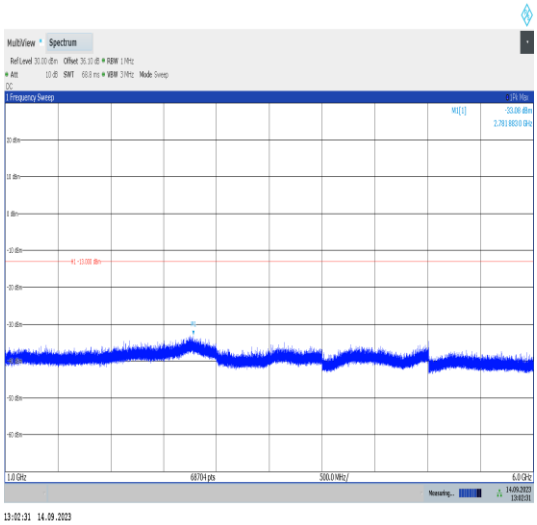
9 kHz to 150 kHz



150 kHz to 30 MHz

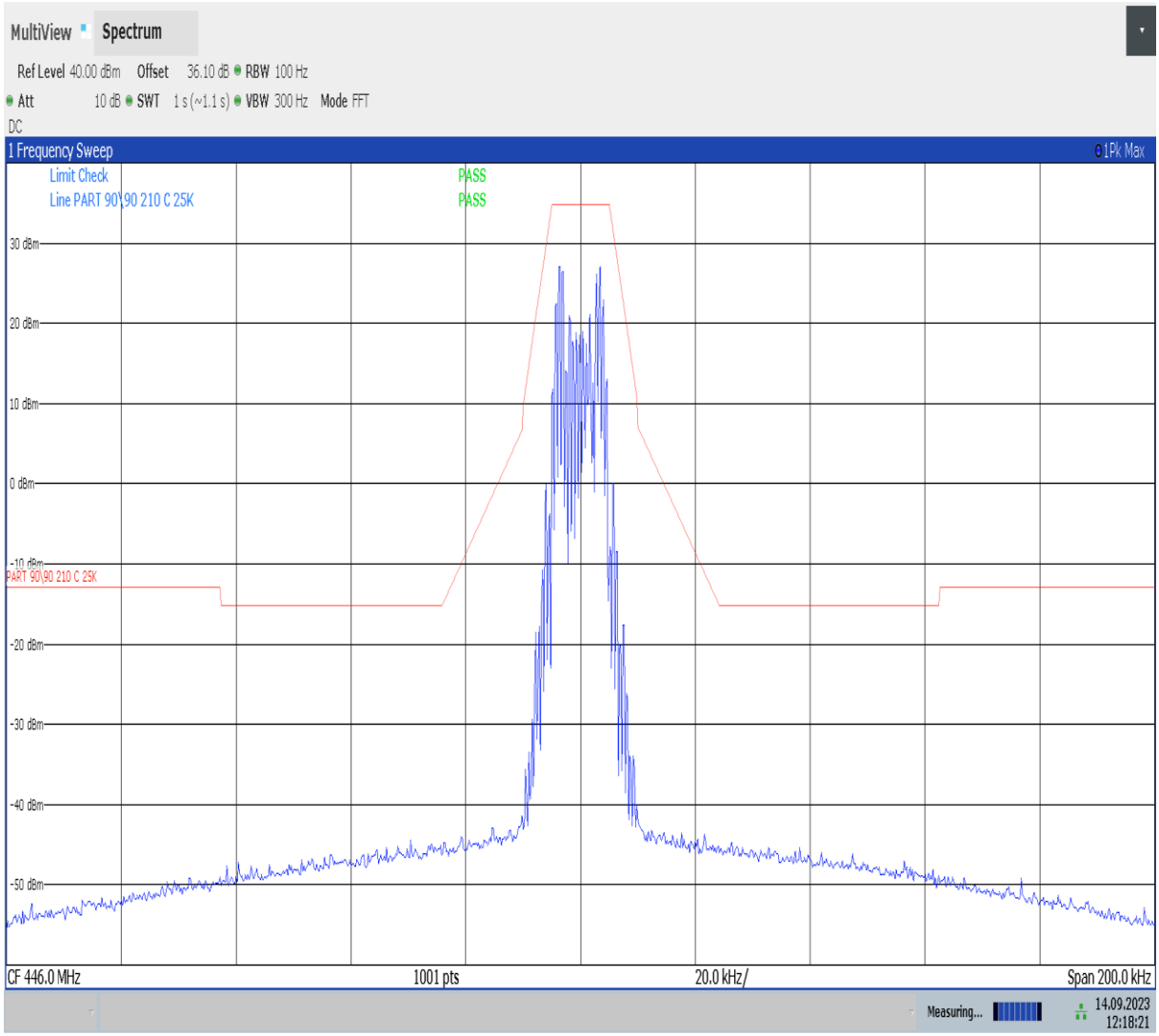


30 MHz to 1 GHz



1 GHz to 6 GHz

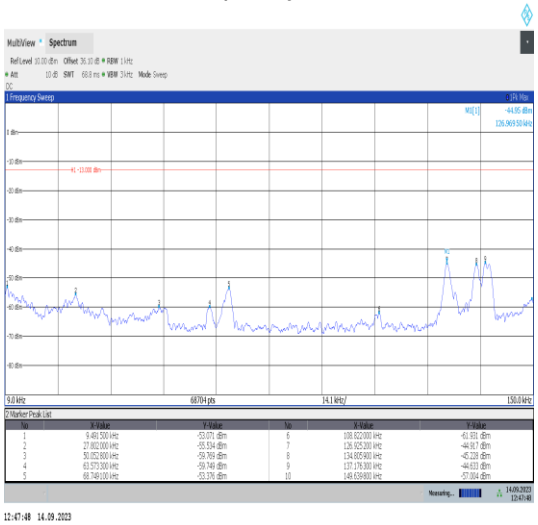
Bottom Channel Mask



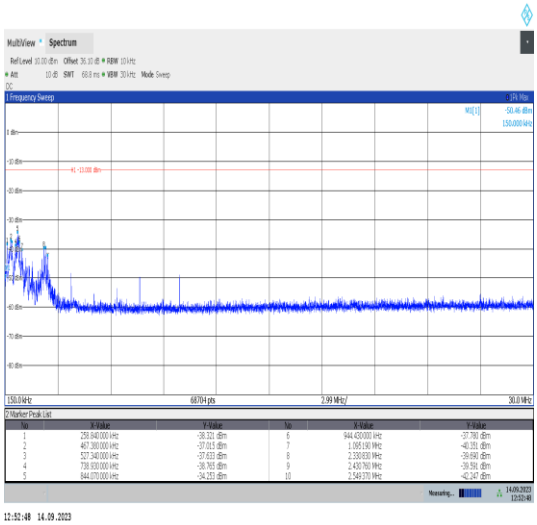
12:18:22 14.09.2023

Frequency; 453.0 MHz					
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
453.0	77.9	-30.7	-13	17.7	PASS

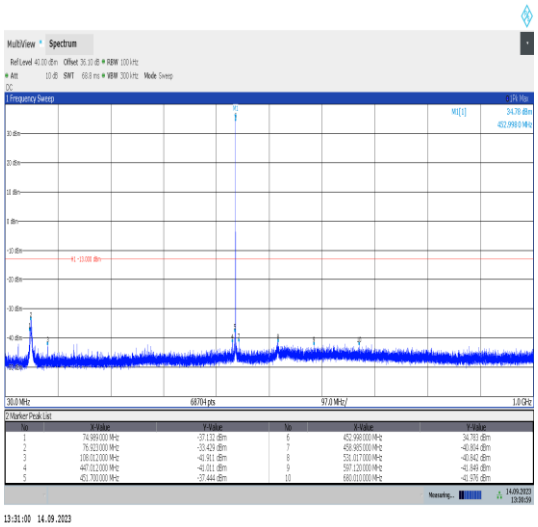
Middle Channel; Frequency: 453.0 MHz



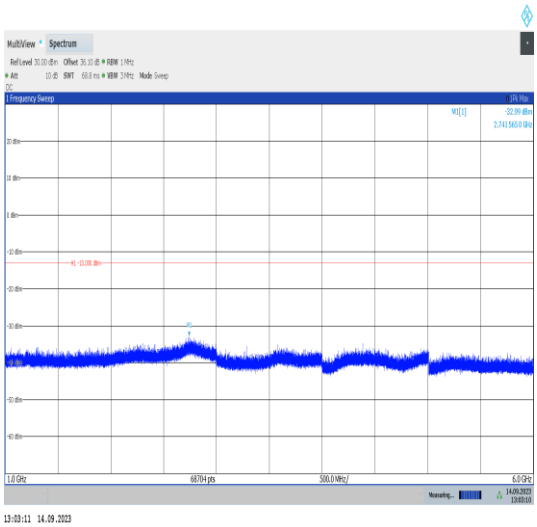
9 kHz to 150 kHz



150 kHz to 30 MHz

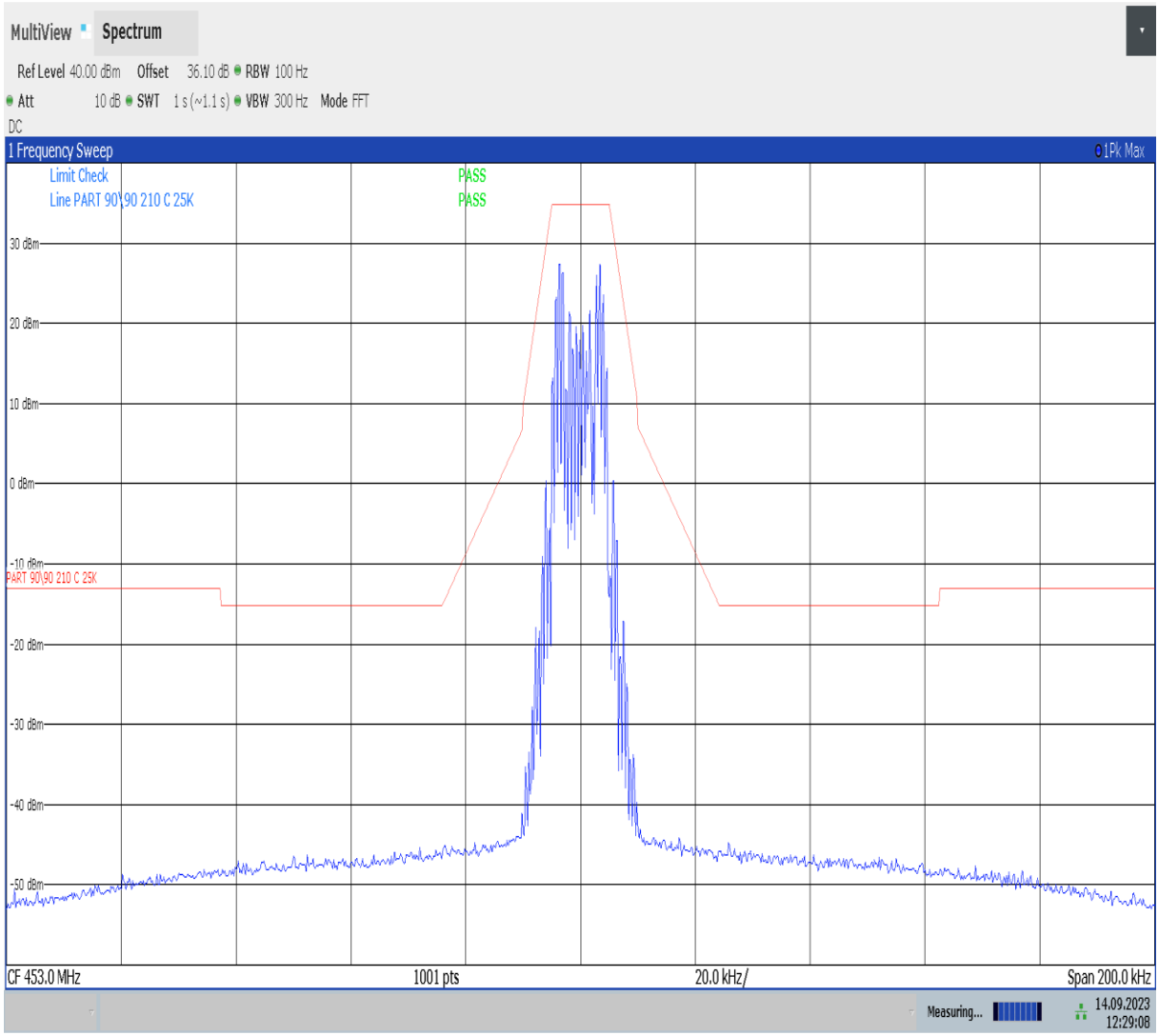


30 MHz to 1 GHz



1 GHz to 6 GHz

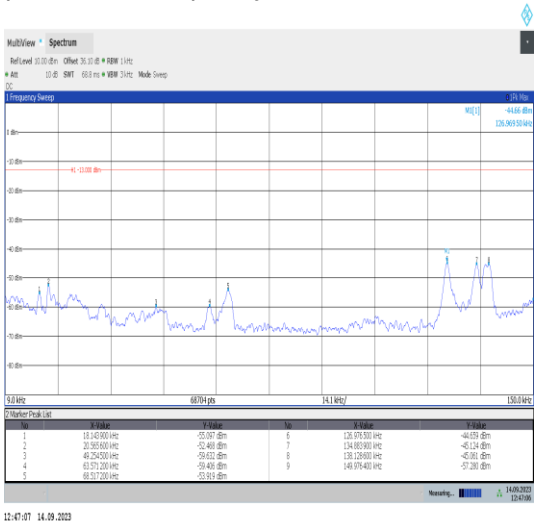
Middle Channel Mask



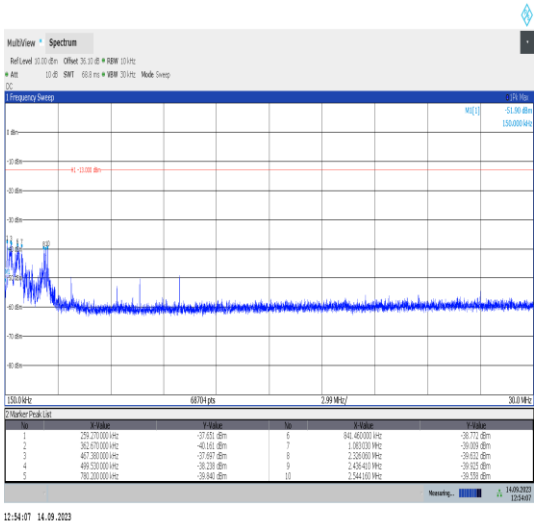
12:29:08 14.09.2023

Frequency; 460.0 MHz					
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
460.0	77.7	-32.7	-13	19.7	PASS

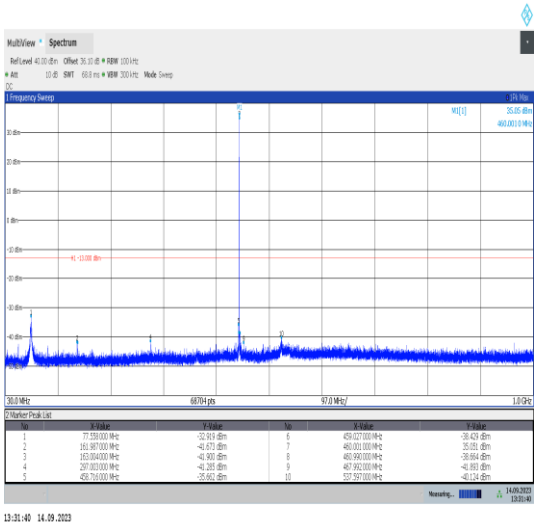
Top Channel; Frequency: 460.0



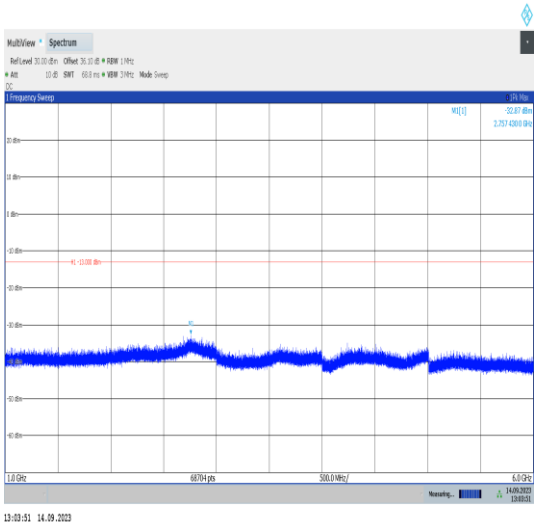
9 kHz to 150 kHz



150 kHz to 30 MHz

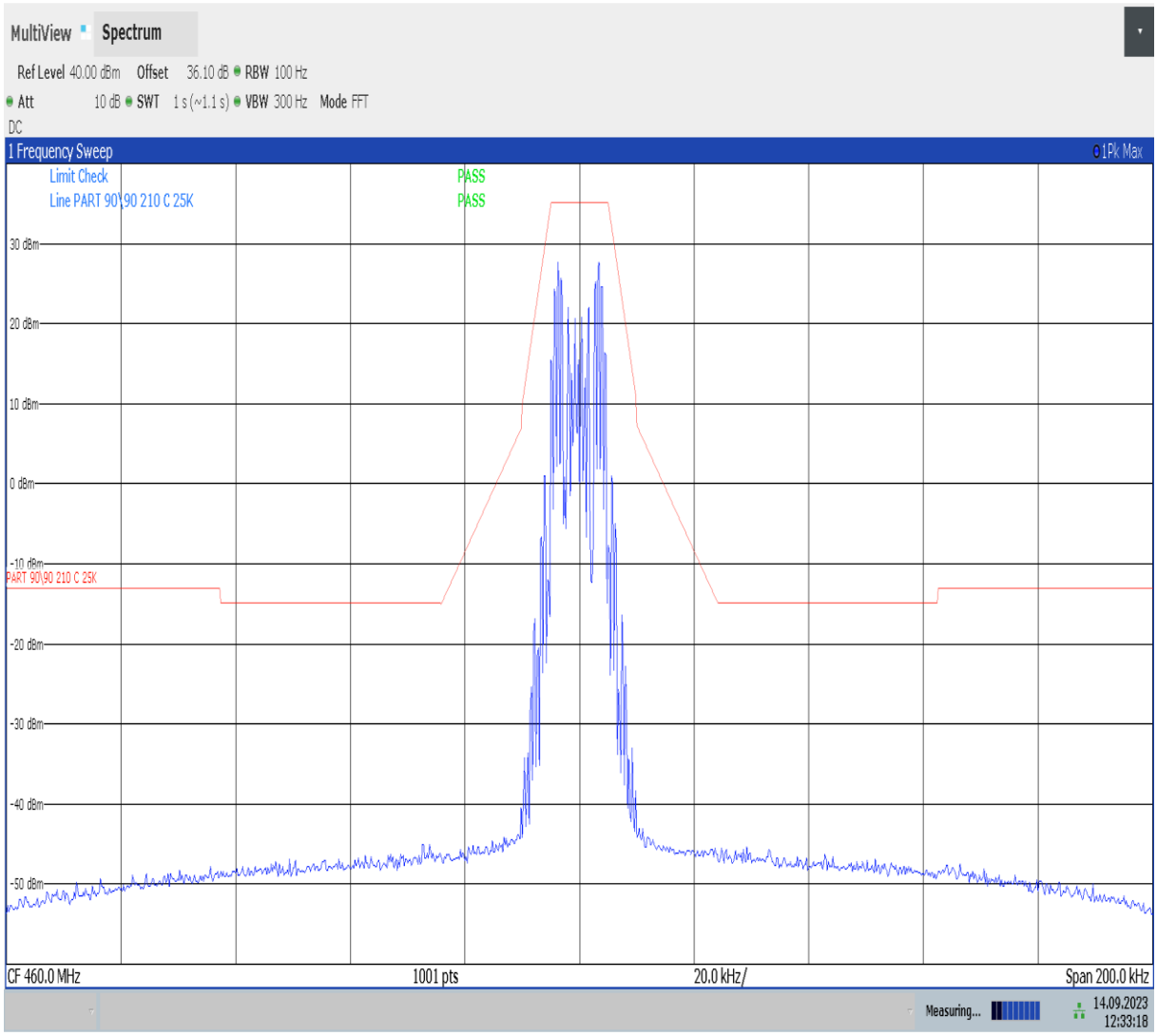


30 MHz to 1 GHz



1 GHz to 6 GHz

Top Channel Mask



12:33:19 14.09.2023

13 Field Strength of Spurious Emissions

13.1 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.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber SK03
Test Standard and Clause:	ANSI C63.26, Clause 5.5
EUT Frequencies Measured:	446.0 MHz, 453.0 MHz & 460 MHz
EUT Channel Bandwidths:	12.5 kHz, 25 kHz
Deviations from Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: Peak; Above 1 GHz: Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC (as declared)
Humidity: 58 % RH	20 % RH to 75 % RH (as declared)
Supply: 12.0 Vdc	12.0 Vdc (as declared)

13.3 Test Limit

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

90.210 (d)(3) – 12.5 kHz operation

Offsets > ±12.5 kHz - 50 + 10 Log P or 70* dB

$$(10 \log (P_{watts} * 1000)) – (50 + 10 \text{ Log } (P_{watts})) = \text{LIMIT} = -20 \text{ dBm}$$

$$E (dB\mu V/m) = EIRP (dBm) − 20\log (D) + 104.8;$$

where D is the measurement distance (in the far field region) in m.

$$E (dB\mu V/m) = -20 (dBm) − 20\log(3) + 104.8$$

$$E (dB\mu V/m) = 75.2$$

9.210 (c)(3) – 25 kHz operation

$$10 \log(P_{watts} * 1000) – (43 + 10 \log (P_{watts})) \text{ dB} = -13 \text{ dBm}$$

$$E (dB\mu V/m) = EIRP (dBm) − 20\log (D) + 104.8;$$

where D is the measurement distance (in the far field region) in m.

$$E (dB\mu V/m) = -13 (dBm) − 20\log(3) + 104.8$$

$$E (dB\mu V/m) = 82.2$$

13.4 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.

The EUT's antenna port was terminated with a 50 Ω load.

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 C63.26 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:

$$FS = PR + CL + AF – PA + DC – CF$$

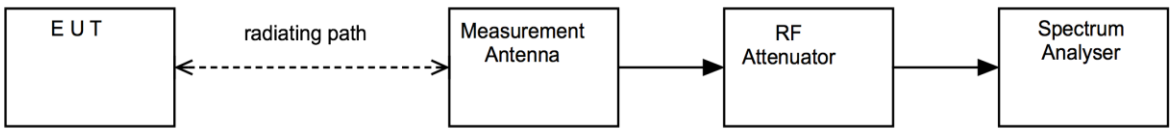
$$Factor = CL + AF – PA$$

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

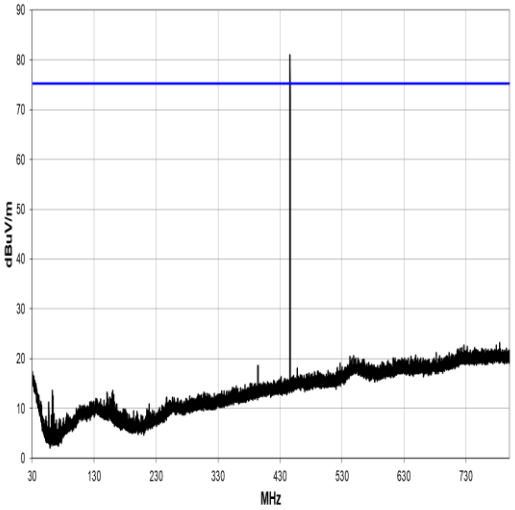


13.5 Test Equipment

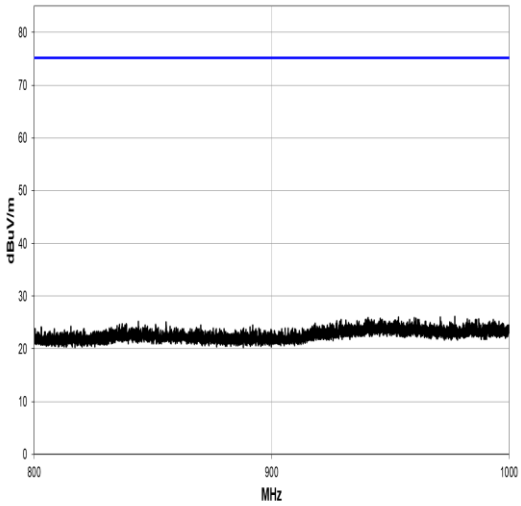
Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU50	U544	2023-11-18
1-18GHz Horn	EMCO	3115	L139	2024-07-01
Pre Amp	Agilent	8449B	L572	2023-10-24
Bilog	Chase	CBL611/B	U573	2024-10-14
PreAmp	Watkins Johnson	6201-69	U372	2024-03-07
High Pass Filter	Mini Circuits	VHF-740+	U603	2024-02-08
High Pass Filter 1.1-4 GHz	Atlantic Microwave	F-HPC5-730008-S5S5	U719	2024-02-09
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required

13.6 Test Results

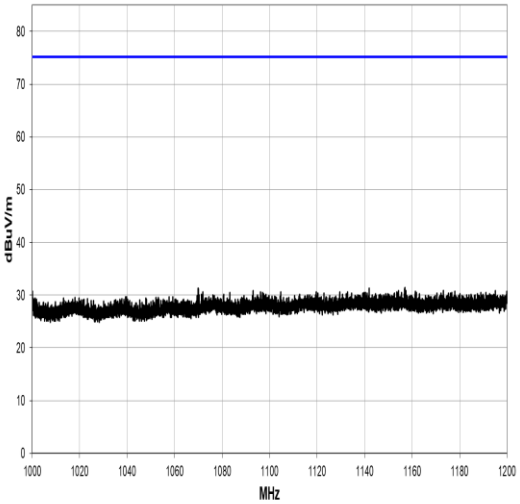
Bottom Channel: 446.0 MHz; 12.5 kHz operation



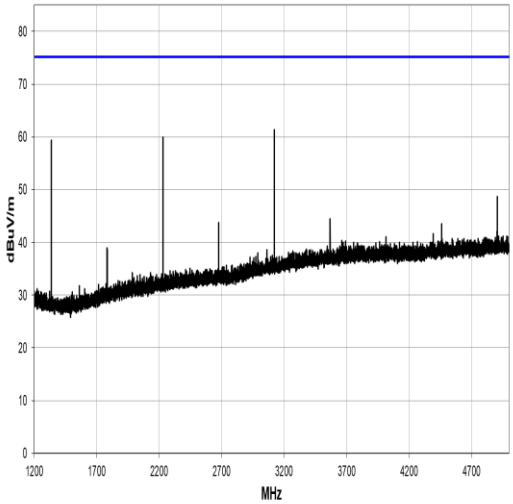
30 MHz to 800 MHz



800 MHz to 1 GHz



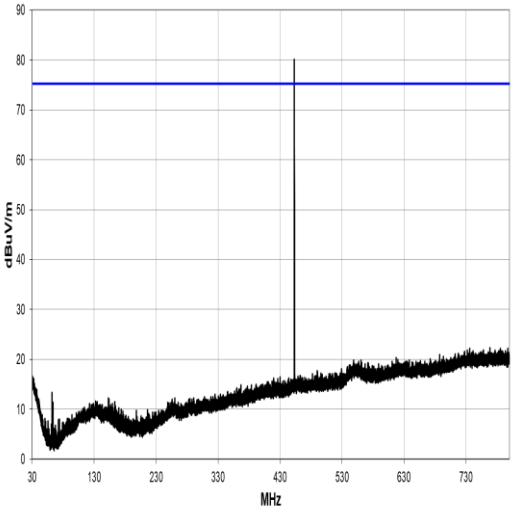
1 GHz to 1.2 GHz



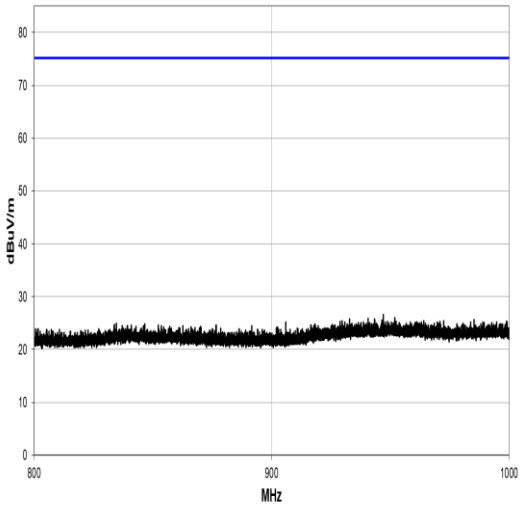
1.2 GHz to 5 GHz

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)
3121.867	64.4	-1.1	1.18	248.9	3.0	0.0	Horz	PK	0.0	63.3	75.2	-11.9
1338.025	71.6	-9.1	1.28	338.1	3.0	0.0	Horz	PK	0.0	62.5	75.2	-12.7
3121.992	58.1	-1.1	1.09	292.0	3.0	0.0	Vert	PK	0.0	57.0	75.2	-18.2
2230.025	60.6	-4.6	1.01	157.9	3.0	0.0	Vert	PK	0.0	56.0	75.2	-19.2

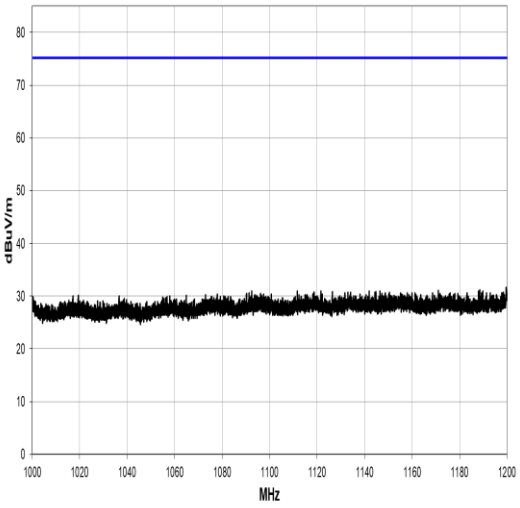
Middle Channel: 453.0 MHz; 12.5 kHz operation



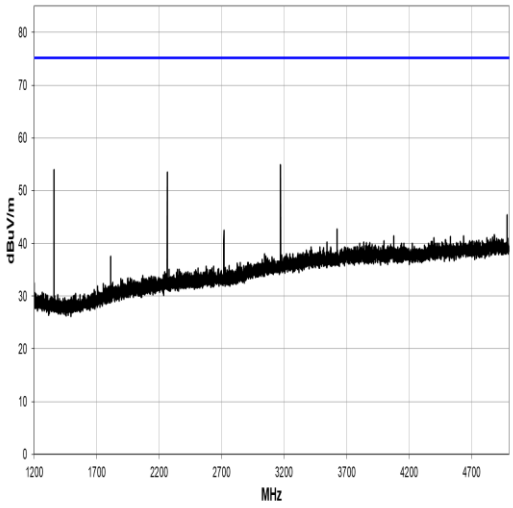
30 MHz to 800 MHz



800 MHz to 1 GHz



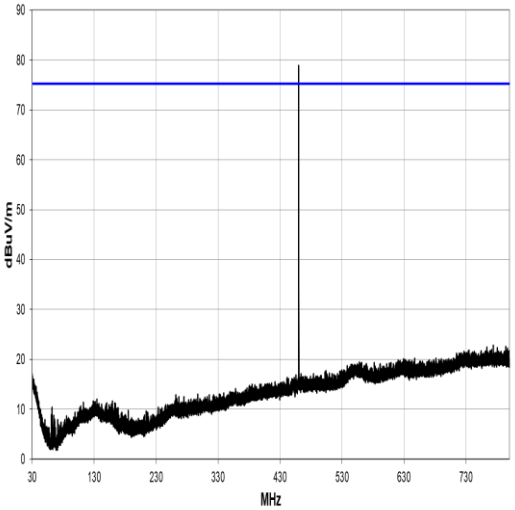
1 GHz to 1.2 GHz



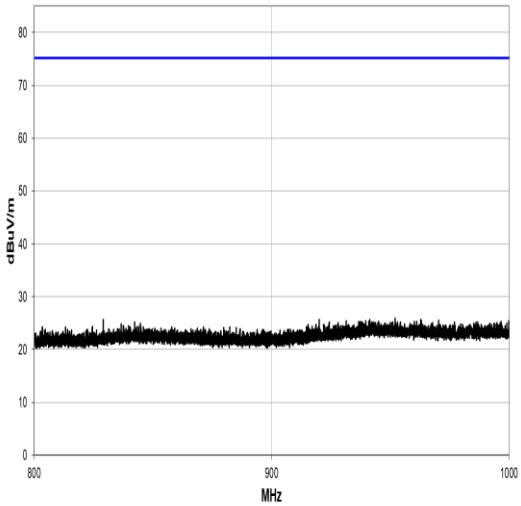
1.2 GHz to 5 GHz

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)
3170.958	58.7	-0.8	1.64	90.9	3.0	0.0	Horz	PK	0.0	57.9	75.2	-17.3
1359.017	65.3	-9.1	1.21	337.0	3.0	0.0	Horz	PK	0.0	56.2	75.2	-19.0
2265.092	60.1	-4.4	1.01	164.0	3.0	0.0	Vert	PK	0.0	55.7	75.2	-19.5

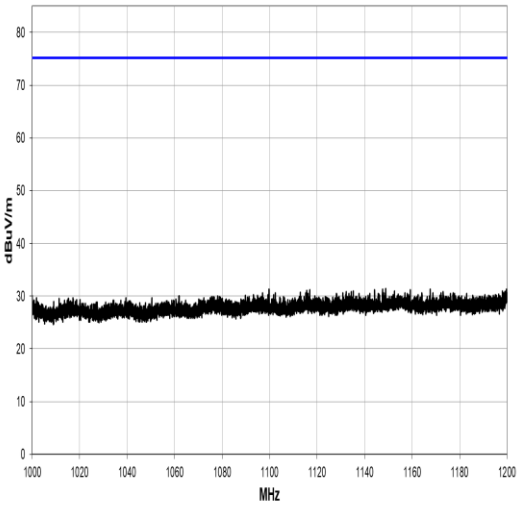
Top Channel: 460.0 MHz; 12.5 kHz operation



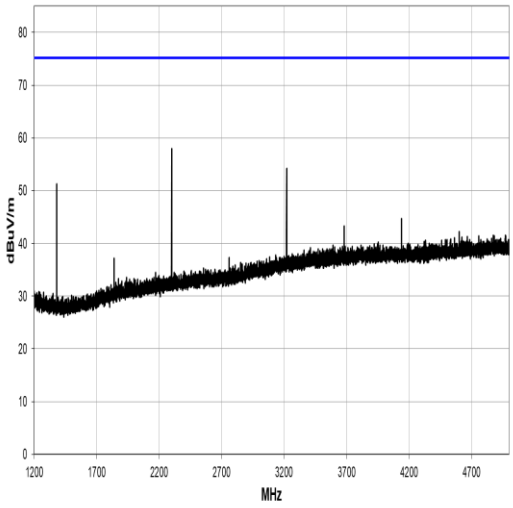
30 MHz to 800 MHz



800 MHz to 1 GHz



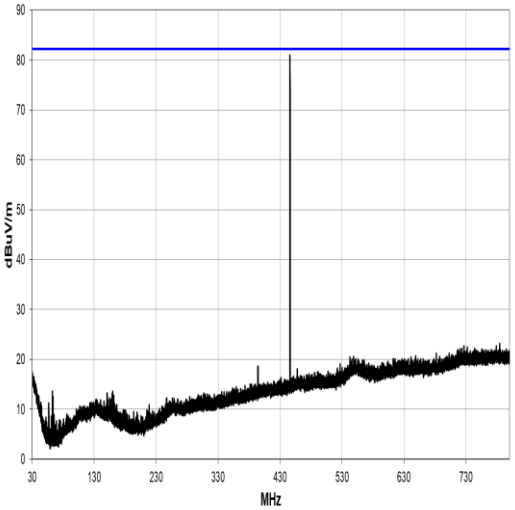
1 GHz to 1.2 GHz



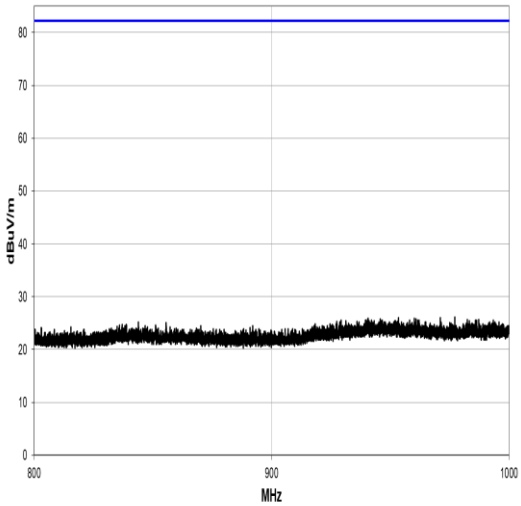
1.2 GHz to 5 GHz

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)
2299.942	63.7	-4.3	1.51	352.1	3.0	0.0	Horz	PK	0.0	59.4	75.2	-15.8
3219.933	56.8	-0.6	1.5	265.0	3.0	0.0	Horz	PK	0.0	56.2	75.2	-19.0
2299.908	60.4	-4.3	1.01	177.0	3.0	0.0	Vert	PK	0.0	56.1	75.2	-19.1

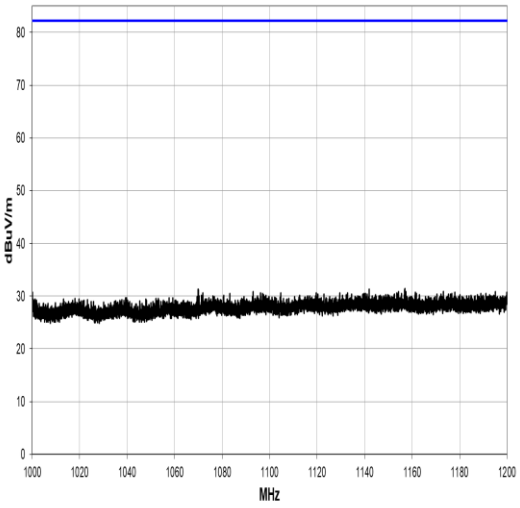
Bottom Channel: 446.0 MHz; 25 kHz operation



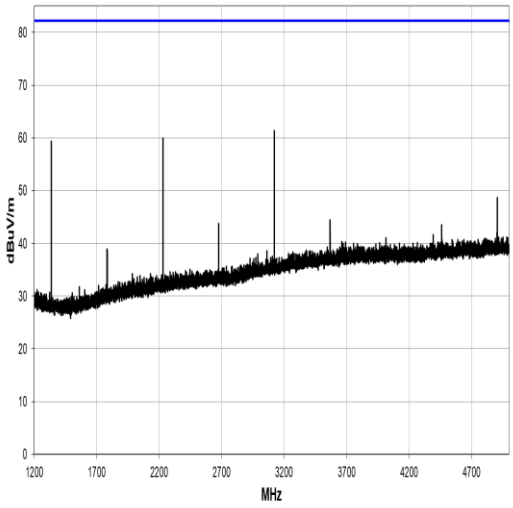
30 MHz to 800 MHz



800 MHz to 1 GHz



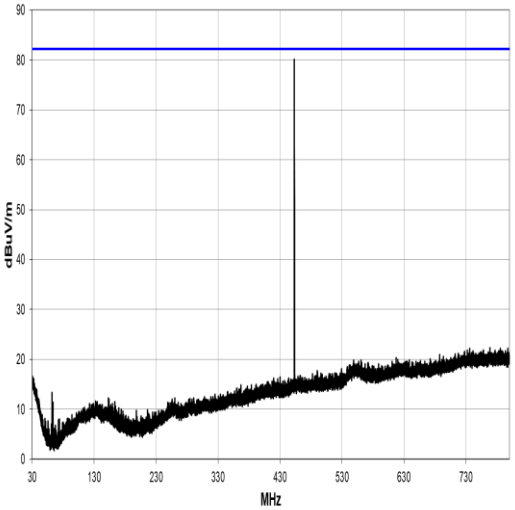
1 GHz to 1.2 GHz



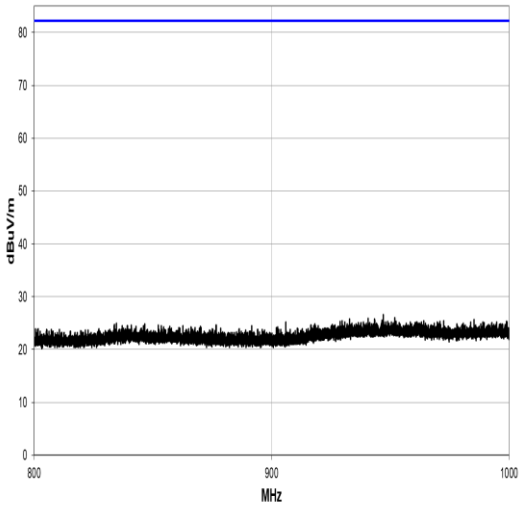
1.2 GHz to 5 GHz

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)
3121.867	64.4	-1.1	1.18	248.9	3.0	0.0	Horz	PK	0.0	63.3	82.2	-18.9
1338.025	71.6	-9.1	1.28	338.1	3.0	0.0	Horz	PK	0.0	62.5	82.2	-19.7

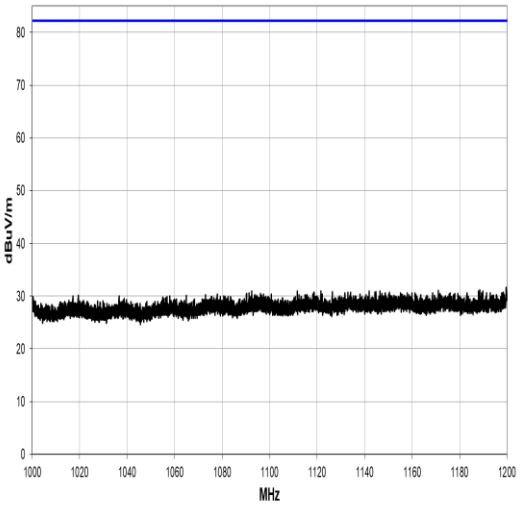
Middle Channel: 453.0 MHz; 25 kHz operation



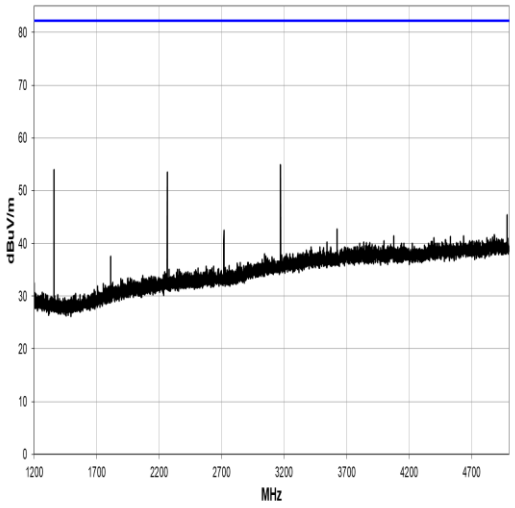
30 MHz to 800 MHz



800 MHz to 1 GHz



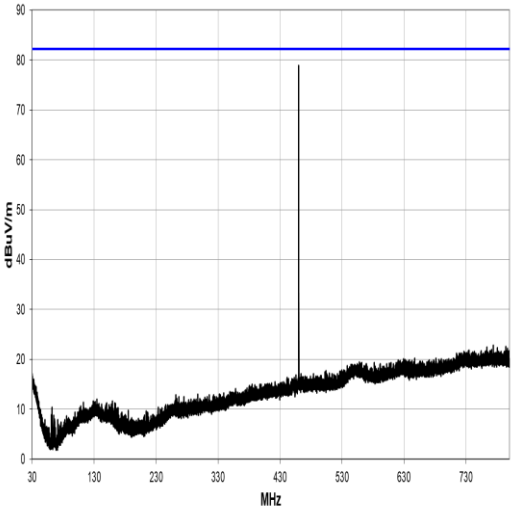
1 GHz to 1.2 GHz



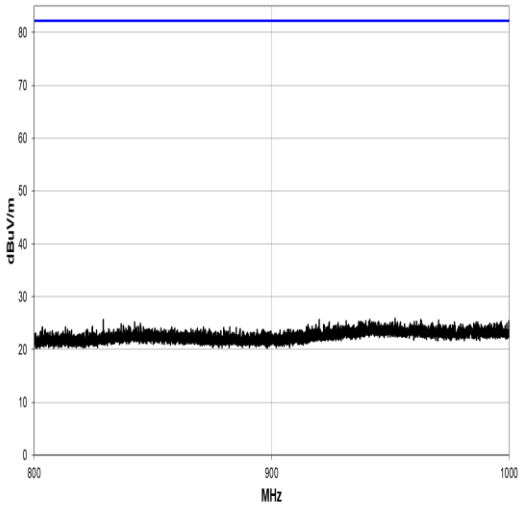
1.2 GHz to 5 GHz

Middle Channel: 453.0 MHz						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No Significant Emissions Within 20 dB of the spurious limit						PASS

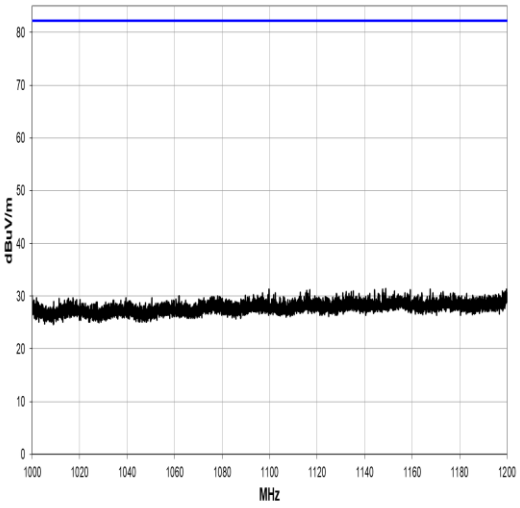
Top Channel: 460.0 MHz; 25 kHz operation



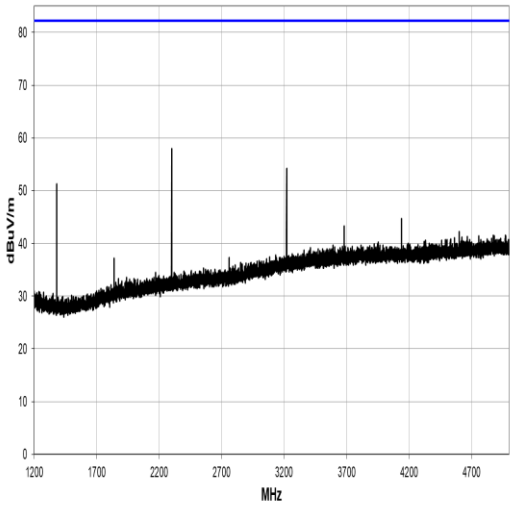
30 MHz to 800 MHz



800 MHz to 1 GHz



1 GHz to 1.2 GHz



1.2 GHz to 5 GHz

Top Channel: 460.0 MHz						
Channel Frequency (MHz)	***Emission Frequency (MHz)***	***Analyzer Level (dBm)***	***Emission Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No Significant Emissions Within 20 dB of the spurious limit						PASS

14 Bandwidth Limitations

14.1 Definition

The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Frequencies Measured:	446.0 MHz, 453.0 MHz & 460 MHz
EUT Channel Bandwidths:	12.5 kHz, 25 kHz
EUT Test Modulations:	FSK Non return to Zero
Deviations From Standard:	None
Measurement BW: (requirement: 1 % to 5 % OBW)	300 Hz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	1 kHz
Measurement Span: (requirement 2 to 5 times OBW)	50 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

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

14.3 Test Limit

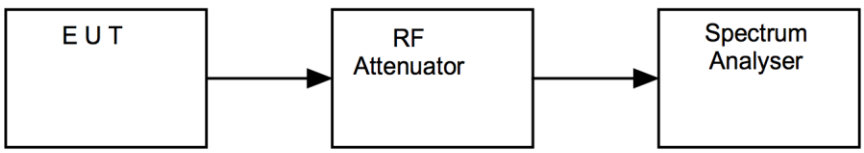
Frequency Band (MHz)	*Channel Bandwidth(s) (kHz)*	*Bandwidth Limitation (kHz)*
450 - 460	12.5, 25	11.25

14.4 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



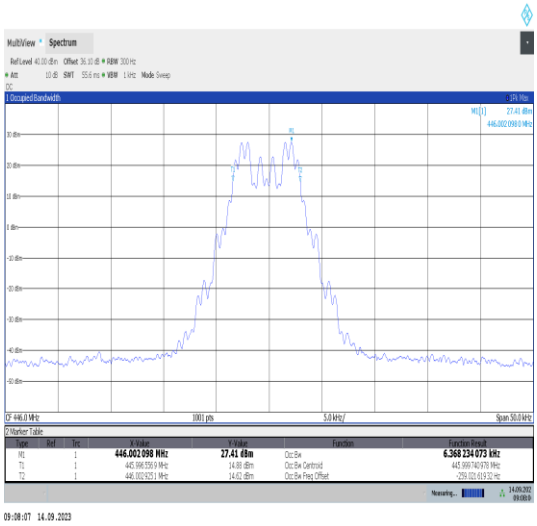
14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	FSW 43	U728	2024-05-10
Signal Generator	R&S	SMB100A	U677	2024-02-03
20 dB SMA attenuator	Bird	8304-300-N	L220	Cal In Use
10 dB SMA attenuator	Bird	8304-100-N	L222	Cal In Use

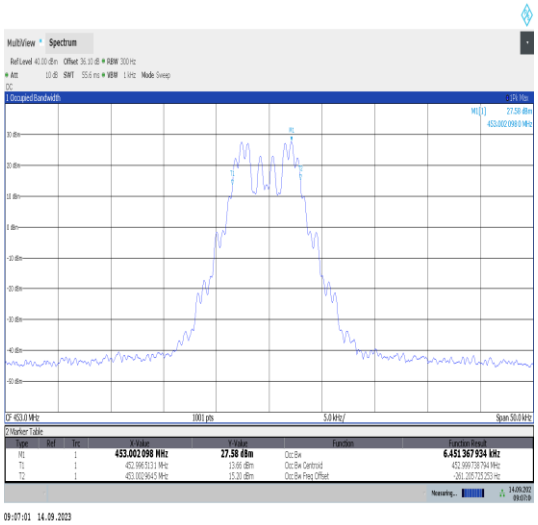
14.6 Test Results

12.5 kHz

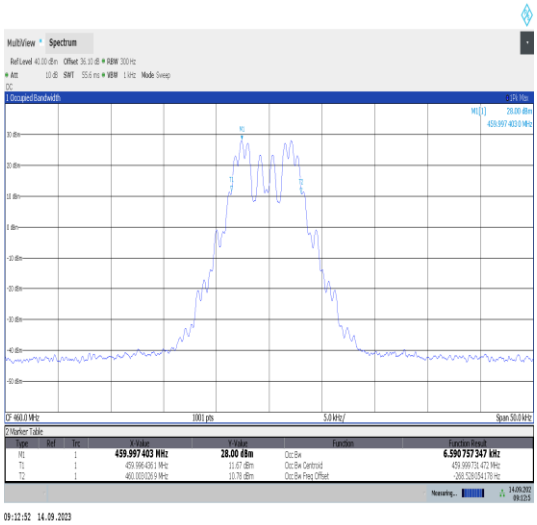
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	99% Bandwidth (kHz)	Result
446.0	445.996557	446.002925	6.3682	PASS
453.0	452.996513	453.002965	6.4514	PASS
460.0	459.996436	460.003027	6.5908	PASS



Bottom Channel 99% OCBW



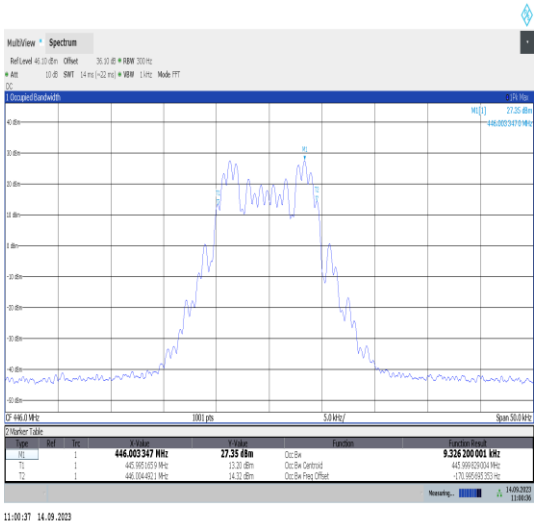
Middle Channel 99% OCBW



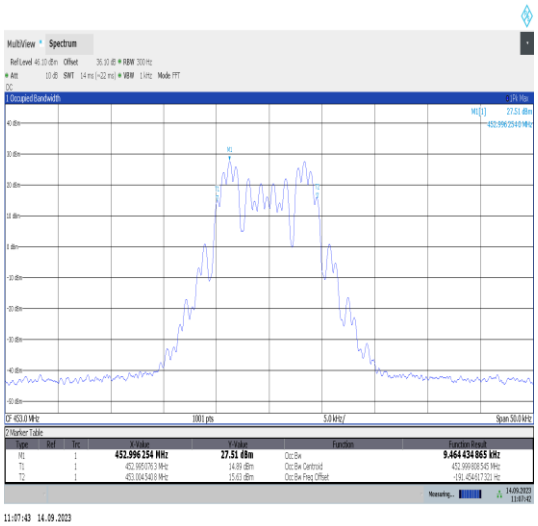
Top Channel 99% OCBW

25 kHz

Channel Frequency (MHz)	*F_L (MHz)*	*F_H (MHz)*	*99 % Bandwidth (kHz)*	*Result*
446.0	445.995166	446.004492	9.3262	PASS
453.0	452.995076	453.004541	9.4645	PASS
460.0	459.995053	460.004570	9.5174	PASS



Bottom Channel 99 % OCBW



Middle Channel 99 % OCBW

Top Channel 99 % OCBW

15 Frequency Stability

15.1 Definition

The Carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	TIA-603-E, Clause 2.2.2
EUT Frequencies Measured:	446.0 MHz, 453.0 MHz & 460 MHz
Modulation:	Off
EUT Type:	Base Station
Channel Spacing:	12.5 kHz
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	-30 to +50 C
Voltage Extreme Environment Test Range:	10.5 Vdc – 14.0 Vdc (as Per TIA-603-E 1.4.4.5 as specified by the manufacturer)

Environmental Conditions (Normal Environment)

Temperature: 23 °C	Standard Requirement: +20 ºC
Humidity: 53 %RH	20 %RH to 75 %RH (as declared)

15.3 Test Limit

Part 90.213

Frequency Range (MHz)	***Fixed and base stations (ppm)***	***Mobile Stations Output Power***	
		Over 2 watts (ppm)	***2 Watts or less (ppm)***
421 - 512	2.5[1,3,4]	5[2]	5[2]

Notes:
1 In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

2 In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

3 Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

4 Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

As per note 1 for a 12.5 kHz channel base station the applicable limit is 1.5 ppm.

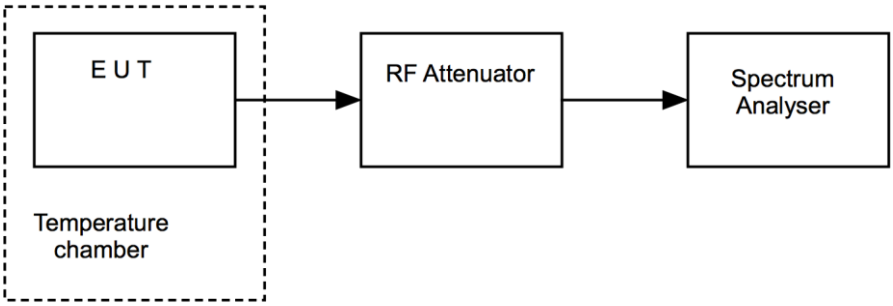
15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the frequency was measured under varying conditions of temperature and supply voltage.

The measurements were performed with EUT set in a CW mode of operation.

Measurements were made once temperature stability was achieved at each temperature.

Figure v Test Setup



15.5 Test Equipment

Equipment Type	*Manufacturer*	*Equipment Description*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSW 43	U728	2024-05-10
Temperature Chamber	Votsch	VT 4002	U521	Use L426
Temperature Indicator	Digitron	2000T	U720	2024-06-01
Power Supply	ISO-Tech	IPS 303A	U748	Use REF976
Power Supply	ISO-Tech	IPS 303A	U747	Cal in use
Multimeter	Agilent	34405a	REF976	2024-01-24
20 dB SMA attenuator	Bird	8304-300-N	L220	Cal In Use
10 dB SMA attenuator	Bird	8304-100-N	L222	Cal In Use

15.6 Test Results

EUT Frequency: 446.0 MHz					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (MHz)***	***Frequency error (ppm)***	***Result***
+50 °C	$V_{nominal}$	445.997313	-0.000080	-0.18	PASS
+40 °C	$V_{nominal}$	445.997313	-0.000080	-0.18	PASS
+30 °C	$V_{nominal}$	445.997293	-0.000100	-0.22	PASS
20 °C	$V_{minimum}$	445.997393	0.000000	0.00	PASS
	$V_{nominal}$	445.997393	0.000000	0.00	PASS
	$V_{maximum}$	445.997393	0.000000	0.00	PASS
+10 °C	$V_{nominal}$	445.997413	0.000020	0.04	PASS
+0 °C	$V_{nominal}$	445.997473	0.000080	0.18	PASS
-10 °C	$V_{nominal}$	445.997483	0.000090	0.20	PASS
-20 °C	$V_{nominal}$	445.997493	0.000100	0.22	PASS
-30 °C	$V_{nominal}$	445.997493	0.000100	0.22	PASS

EUT Frequency: 453.0 MHz					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (MHz)***	***Frequency error (ppm)***	***Result***
+50 °C	$V_{nominal}$	452.997273	-0.000060	-0.132	PASS
+40 °C	$V_{nominal}$	452.997273	-0.000060	-0.132	PASS
+30 °C	$V_{nominal}$	452.997293	-0.000040	-0.088	PASS
20 °C	$V_{minimum}$	452.997333	0.000000	0.00	PASS
	$V_{nominal}$	452.997333	0.000000	0.00	PASS
	$V_{maximum}$	452.997333	0.000000	0.00	PASS
+10 °C	$V_{nominal}$	452.997373	0.000040	0.088	PASS
+0 °C	$V_{nominal}$	452.997423	0.000090	0.199	PASS
-10 °C	$V_{nominal}$	452.997443	0.000110	0.243	PASS
-20 °C	$V_{nominal}$	452.997453	0.000120	0.265	PASS
-30 °C	$V_{nominal}$	452.997453	0.000120	0.265	PASS

EUT Frequency: 460.0 MHz					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (MHz)***	***Frequency error (ppm)***	***Result***
+50 °C	$V_{nominal}$	459.997233	-0.000060	-0.13	PASS
+40 °C	$V_{nominal}$	459.997233	-0.000060	-0.13	PASS
+30 °C	$V_{nominal}$	459.997263	-0.000030	-0.07	PASS
20 °C	$V_{minimum}$	459.997293	0.000000	0.00	PASS
	$V_{nominal}$	459.997293	0.000000	0.00	PASS
	$V_{maximum}$	459.997293	0.000000	0.00	PASS
+10 °C	$V_{nominal}$	459.997323	0.000030	0.07	PASS
+0 °C	$V_{nominal}$	459.997393	0.000100	0.22	PASS
-10 °C	$V_{nominal}$	459.997413	0.000120	0.26	PASS
-20 °C	$V_{nominal}$	459.997423	0.000130	0.28	PASS
-30 °C	$V_{nominal}$	459.997423	0.000130	0.28	PASS

16 Transient Frequency Behaviour

16.1 Definition

The transient behaviour of the transmitter is defined as the time-dependency of transmitter frequency, power and spectrum when the RF output power is switched on and off.

16.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	TIA-603-E 2.2.19
EUT Frequencies Measured:	446.0 MHz, 453.0 MHz & 460 MHz
Channel Spacing:	12.5 kHz, 25 kHz
Modulation:	FSK Non return to Zero
Deviations From Standard:	None

Environmental Conditions (Normal Environment)

Temperature: 23 °C	Standard Requirement: +15 ºC to +35 ºC
Humidity: 53 %RH	Standard Requirement: 20 %RH to 75 %RH

16.3 Test Limits

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time Interval[1][2]	Maximum Frequency Difference[3]	All Equipment	
		150 – 174 MHz	421 – 512 MHz
25 kHz channels			
t1[4]	±25 kHz	5.0 ms	10.0 ms
t2[2]	±12.5 kHz	20.0 ms	25.0 ms
t3[4]	±25 kHz	5.0 ms	10.0 ms
12.5 kHz channels			
t1[4]	±12.5 kHz	5.0 ms	10.0 ms
t2[2]	±6.25 kHz	20.0 ms	25.0 ms
t3[4]	±12.5 kHz	5.0 ms	10.0 ms
6.25 kHz channels			
t1[4]	±6.25 kHz	5.0 ms	10.0 ms
t2[2]	±3.125 kHz	20.0 ms	25.0 ms
t3[4]	±6.25kHz	5.0 ms	10.0 ms

[1]ton is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t1 is the time period immediately following ton.
t2 is the time period immediately following t1.
t3 is the time period from the instant when the transmitter is turned off until toff.
toff is the instant when the 1 kHz test signal starts to rise.
2 During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in § 90.213
3 Difference between the actual transmitter frequency and the assigned transmitter frequency.
4 If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

16.4 Test Method

With the EUT setup as per section 5 of this report and connected as per Figure 1 the transmitter attack and release time was measured.

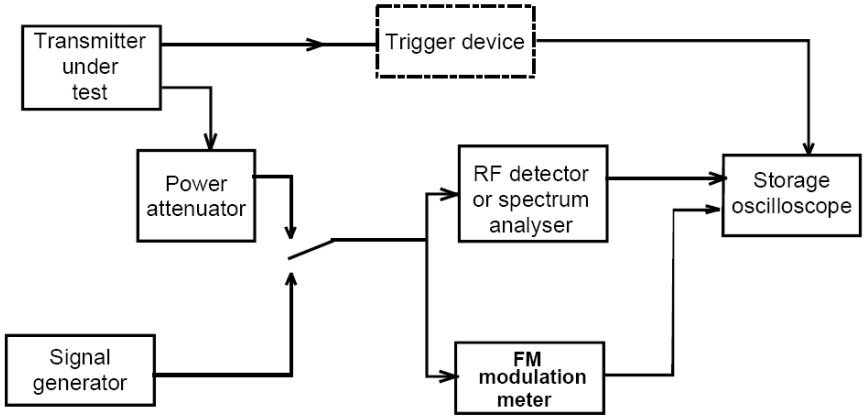
On Transient

[1] The signal generator was used to calibrate the oscilloscope traces in power and frequency (y-axis) and in time (x axis).
[2] A transmission from the EUT was initiated and the transmitter attack time was measured from the "transmitter on" point. This point is defined as -30dBc from the steady state power.

Off Transient

[1] The signal generator was used to calibrate the oscilloscope traces in power and frequency (y-axis) and in time (x axis).
[2] The EUT transmission was powered off and the release time was measured.

Figure 1 Test Setup

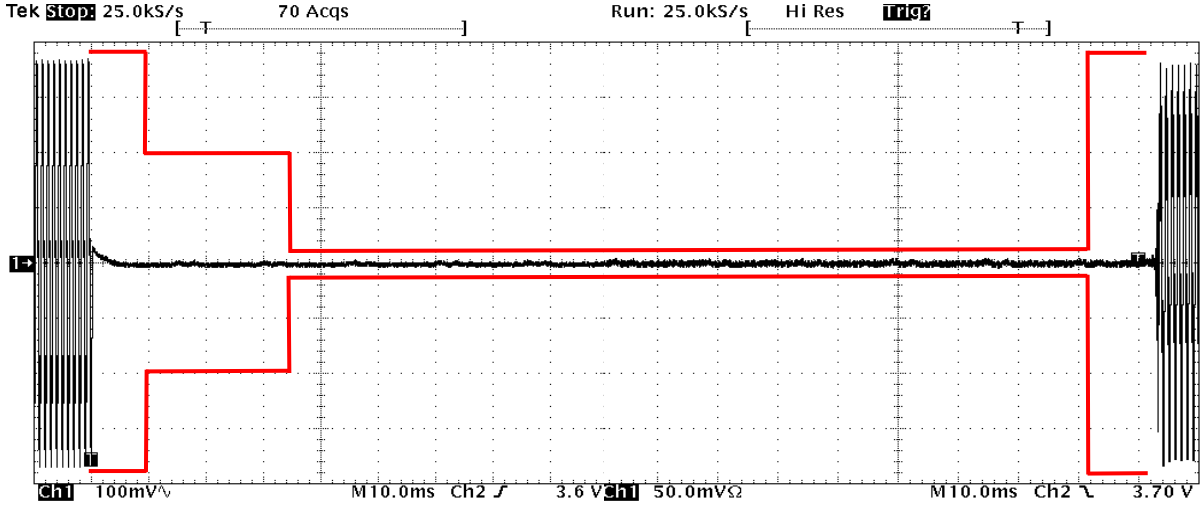


16.5 Test Equipment

Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSW 43	U728	2024-05-10
Signal Generator	R&S	SMB100A	U677	2024-02-03
Power Supply	ISO-Tech	IPS-303DD	U515	Use REF976
Multimeter	Agilent	34405a	REF976	2024-01-24
Oscilloscope	Tektronix	TDS520B	U122	2024-04-08

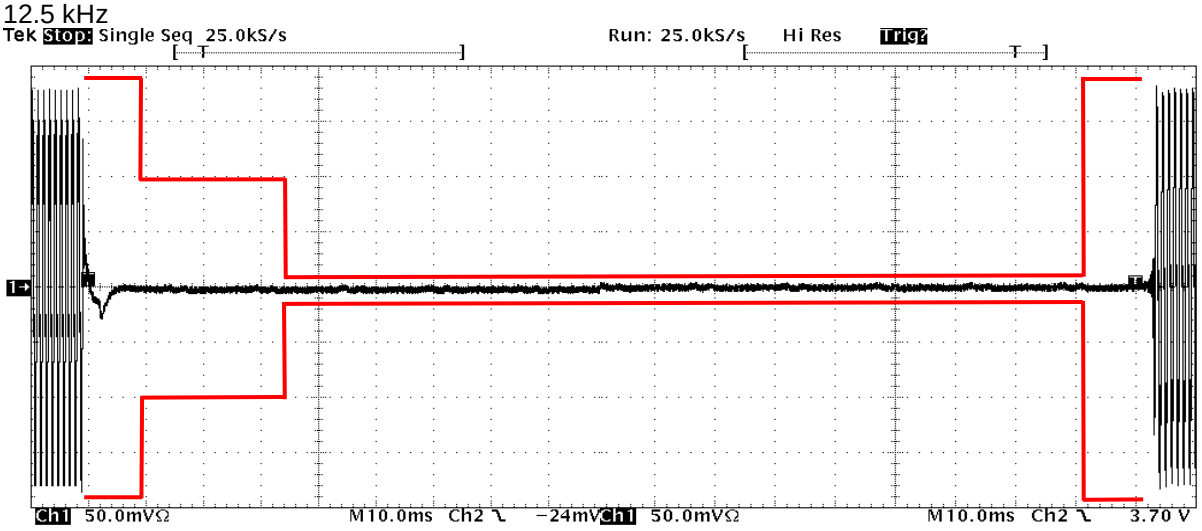
16.6 Test Results

12.5 kHz



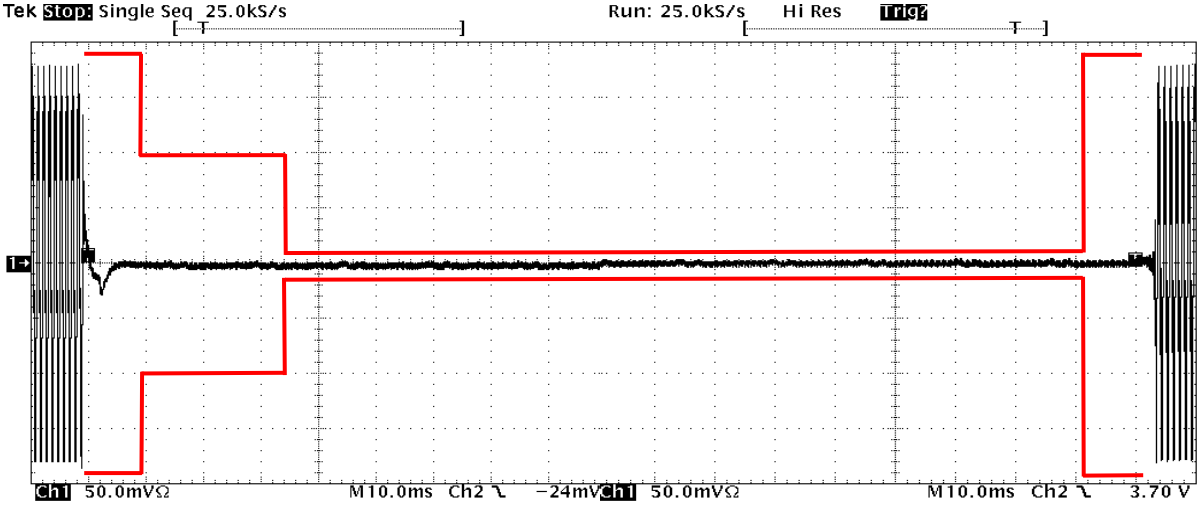
On Transient 446.0 MHz Off Transient

12.5 kHz



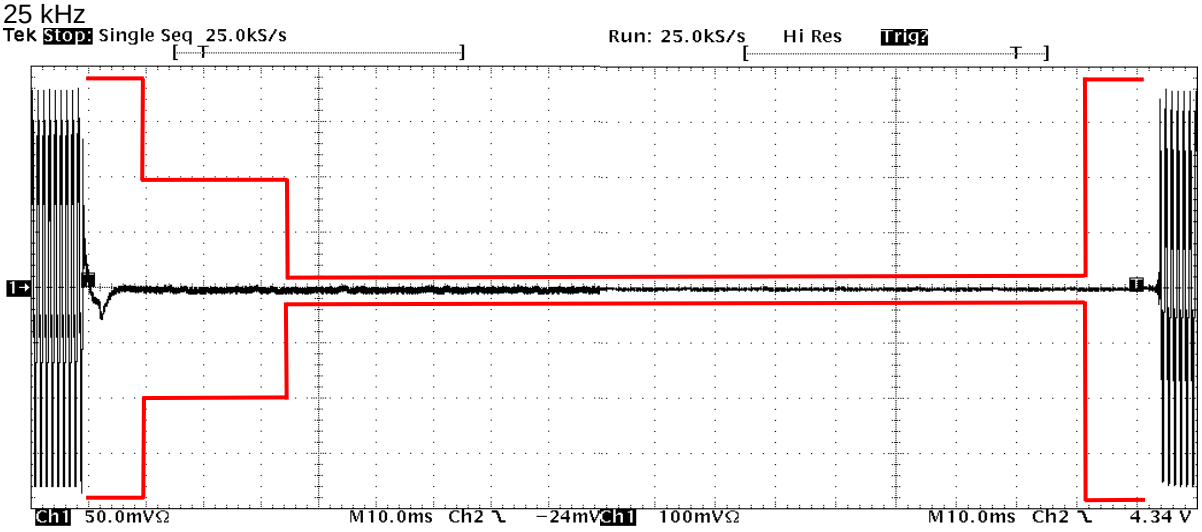
On Transient 453.0 MHz Off Transient

12.5 kHz



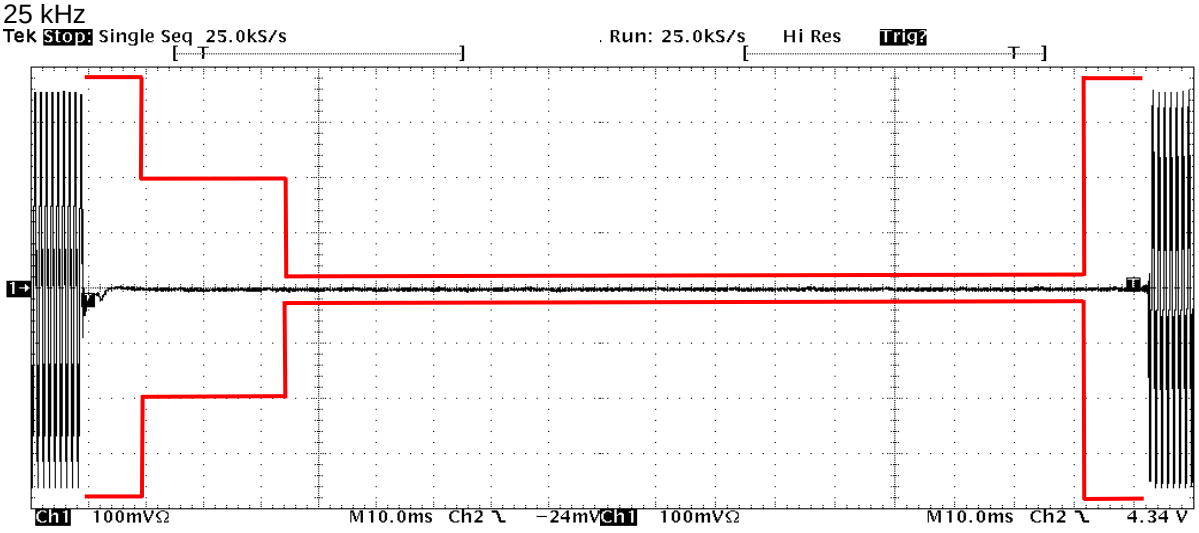
On Transient 460.0 MHz Off Transient

25 kHz



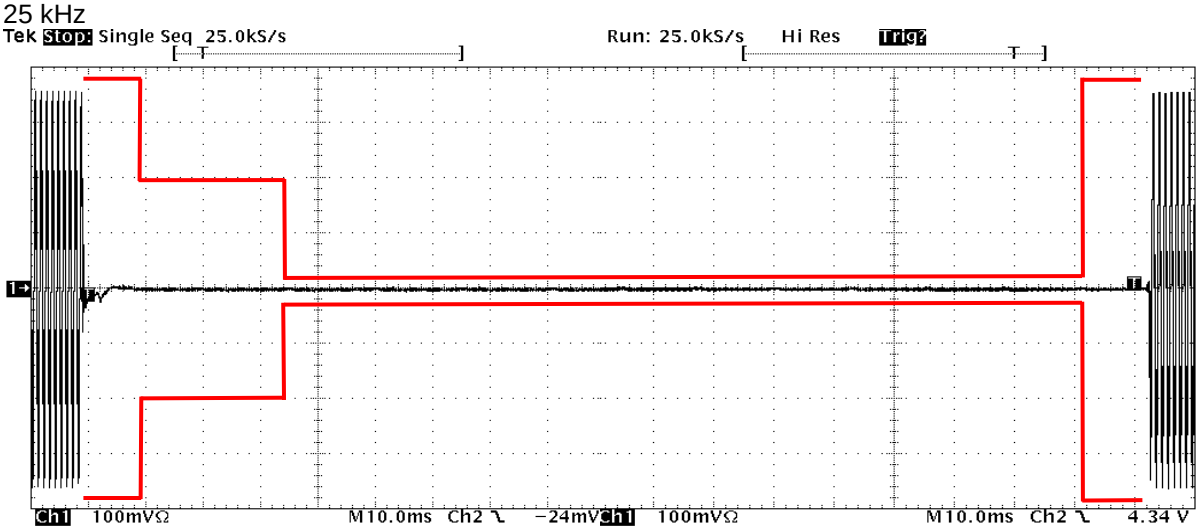
On Transient 446.0 MHz Off Transient

25 kHz



On Transient 453.0 MHz Off Transient

25 kHz



On Transient 460.0 MHz Off Transient

17 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**

18 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

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

Where:

S = power density
R = distance to the centre of radiation of the antenna
EIRP = EUT Maximum power

Result

Channel Frequency (MHz)	***EIRP (W)***	***Power density limit (S) (mW/cm^2)***	***Distance (R) cm required to be less than the power density limit***
460	3.2	0.3	28.8