Report on the Radio Testing

For

Cambium Networks Ltd

on

3GHz PMP 450m

Report no. TRA-053965-47-01A

30 July 2021

0026

Report Number: TRA-053965-47-01A
Issue: B

REPORT ON THE RADIO TESTING OF A
Cambium Networks Ltd
3GHz PMP 450m
WITH RESPECT TO SPECIFICATION
FCC Part 90 Subpart Z

TEST DATE: 1st June 2021 - 29th June 2021

Written by: D Garvey, D Winstanley, Radio Test Engineer

Digitally signed by Daniel Winstanley
DN: cn=Daniel Winstanley, o=Element, ou, email=daniel.winstanley@element.com, c=GB
Date: 2021.07.30 09:47:07 +01'00'
Adobe Acrobat version: 2021.005.20060

Approved by: J Charters, Lab Manager

Digitally signed by John Charters
DN: cn=John Charters, o, ou=Element Materials Technology Ltd., email=john.charters@element.com, c=GB
Reason: I am approving this document
Date: 2021.07.30 11:42:13 +01'00'

Date: 30 July 2021

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	30 July 2021	Original

2 Summary

TEST REPORT NUMBER:	TRA-053965-47-01A
WORKS ORDER NUMBER:	TRA-053965-00
PURPOSE OF TEST:	Class II Permissive Change
TEST SPECIFICATION(S):	Part 90 Subpart Z
EQUIPMENT UNDER TEST (EUT):	3GHz PMP 450m
FCC IDENTIFIER:	QWP-30450M
MAC ADDRESS:	0a-00-3e-60-92-1a & 0a-00-3e-60-92-24
MANUFACTURER/AGENT:	Cambium Networks Ltd
ADDRESS:	Unit B2 Linhay Business Park Eastern Road Ashburton Devon TQ13 7UP United Kingdom
CLIENT CONTACT:	Don Reid ☎ 01364 655667 ✉ Don.Reid@Cambiumnetworks.com
TEST DATE:	1st June 2021 - 29th June 2021
TESTED BY:	D Garvey D Winstanley Element

2.1 Test Summary

Test Method and Description	*Requirement Clause Part 90*	*Applicable to this equipment*	*Result / Note*
Transmitter Unwanted Emissions	90.1323	☒	*Pass*
Occupied bandwidth	90.209	☒	*Pass*
Emission Mask	90.210	☒	*Pass*
Frequency Stability	90.213	☒	*Pass*
Peak EIRP Density and Equivalent Isotropically Radiated Power (e.i.r.p)	90.1321	☒	*Pass*

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).

3 Contents

4 Introduction

This report TRA-053965-47-01A presents the results of the Radio testing on a Cambium Networks Ltd, 3GHz PMP 450m to specification RSS-197 Wireless Broadband Access Equipment Operating in the Band 3650-3700 MHz.

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

☒ 30 Meter Open Area Test Site
Pershore Airfield,
Long Lane,
Throckmorton,
Worcs,
WR10 2JH
UK

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

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:

The test laboratory is accredited for the above sites under the US-UK MRA,

Designation number(s):
Element Hull UK2007
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 90 – Private Land Mobile Radio Services
- ANSI C63.26-2015 – American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.
- 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

Maximum conducted output power

Due to the nature of the equipment it is not possible to measure the power conducted so a radiated measurement was performed. This measurement was performed at 30m to ensure the measurement was made in the antenna far field.

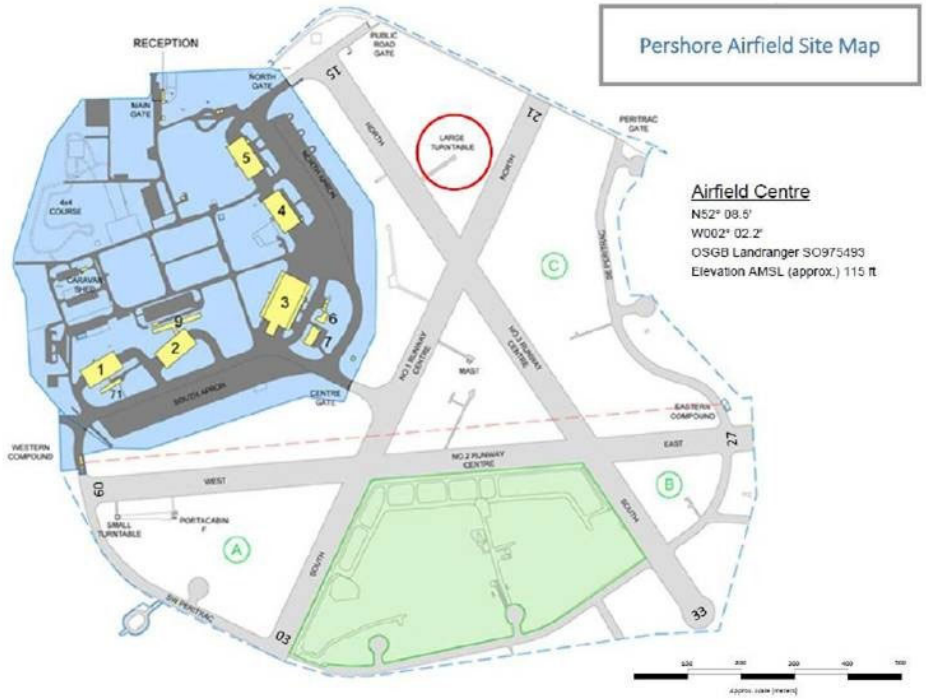
Spectral Power Density

Due to the nature of the equipment it is not possible to measure the power conducted so a radiated measurement was performed. This measurement was performed at 30m to ensure the measurement was made in the antenna far field.

5.3 Minimisation of reflections

Due to the use of a 30 meter open area test site with no RF absorbing material for the measurement of the fundamental attempts were made to minimise the influence of reflections.
To minimise the reflections the following precautions were taken.
Test performed over a grassed area to try and ensure no sub surface artefacts produce reflections.
The EUT was raised to a height of 4 meters above the ground plane to help reduce the effects of any reflected paths at 30 meters
The EUTs antennas are set with a 2 degree down tilt, and an 8 degree beam width, to negate this down tilt the EUT was rotated 180 degrees though the vertical plane (ie turned upside down to normal operation) and the EUT was angled so the bore sight was parallel to the grassed area.
Due to the increased height of the EUT the measurement antenna was varied between 1 and 6 meters to encompass the height of the EUT and its potential bandwidth

5.4 Open area test site information



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: 3GHz PMP 450m
- MAC Address: 0a-00-3e-60-92-1a & 0a-00-3e-60-92-24
- Model Number: 30383JH
- Software Revision: Not Applicable
- Build Level / Revision Number: Not Applicable

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.

- Name: Netgear 5 port 10/100/1000M switch
- Serial Number: 2N211B3D00F3C
- Model Number: GS605 v4

- Name: Dell Latitude Laptop PC
- Serial Number:
- Model Number: E6440

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Transmit tests was as follows:

The unit was transmitting modulated or unmodulated signals with 100 % duty cycle.

Operating Frequencies

Operating frequency band tested 3650-3700 MHz.

Operating modes
There are three unique operating modes. These only affect the antenna radiation pattern.

Sector Mode
This mode produces a broad antenna radiation beam.

Beamforming Mode
This produces a narrow, focused antenna beam.

MU-MIMO mode
This produces several narrow, focused antenna beams.

Modulation Modes
Supported modulation modes are QPSK, 16QAM, 64QAM and 256QAM. Each of these four modulation mode can be configured to be MIMO A or MIMO B. The differences between these MIMO modes are described below.

MIMO A
The data streams transmitted in both horizontal and vertical antenna polarisations are identical.

MIMO B
The data streams transmitted in the horizontal and vertical polarisations are independent.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	3.65 GHz – 3.70 GHz band
Modulation type(s):	QPSK; 16QAM; 64QAM and 256QAM
Occupied channel bandwidth(s):	5 MHz; 20 MHz and 40 MHz
Channel spacing:	5 MHz; 20 MHz and 40 MHz
Declared output power(s):	40W/40MHz (e.i.r.p)
Nominal Supply Voltage:	48 V dc
Location of notice for license exempt use:	Not applicable, license device
Method of prevention of use on non-US / non-Canadian frequencies:	Not stated
Duty cycle:	100 % for testing only

7.4.2 Antennas

Type:	Integral antenna
Frequency range:	3.65 GHz – 3.70 GHz
Impedance:	50 Ω
Gain:	22 dBi - Beamforming 16 dBi – Sector and MU-MIMO
Connector type:	Not applicable, integral antenna
Length:	500 × 650 × 120
Weight:	20 kg
Mounting:	Professionally installed

7.4.3 Product specific declarations

Multiple antenna configuration(s), e.g. MIMO:	Sector, Beamforming and MU-MIMO
Fixed pt-pt operations (yes/no):	Yes
Installation manual advice on pt-pt operational restrictions (yes/no):	N/A Professionally installed
Fixed pt-mpt operations (yes/no):	Yes
Simultaneous tx (yes/no):	Yes

7.5 EUT Description

The EUT is a point-to-multipoint (PMP) wireless broadband platform working in the band 3.65 GHz – 3.70 GHz.

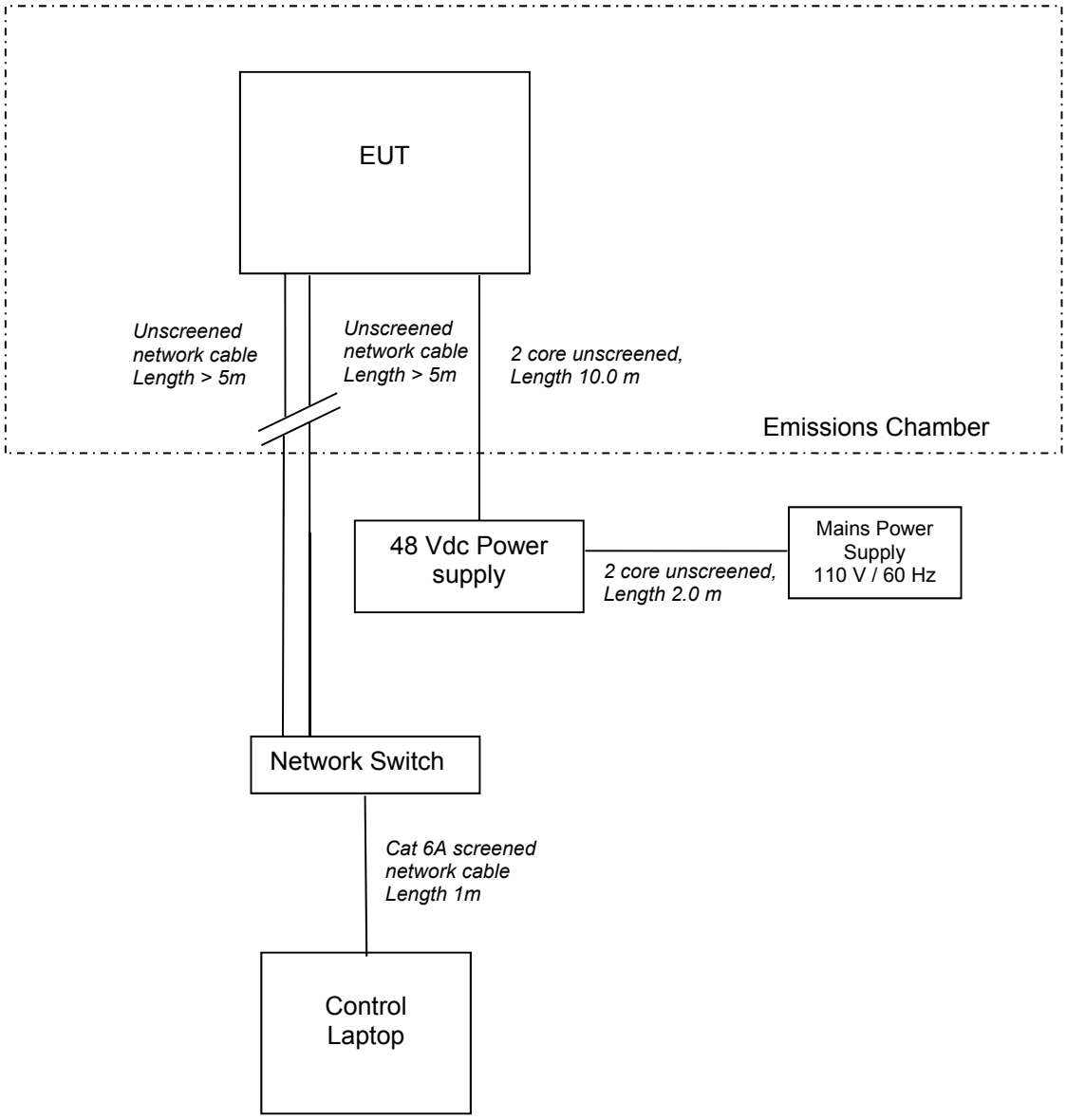
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

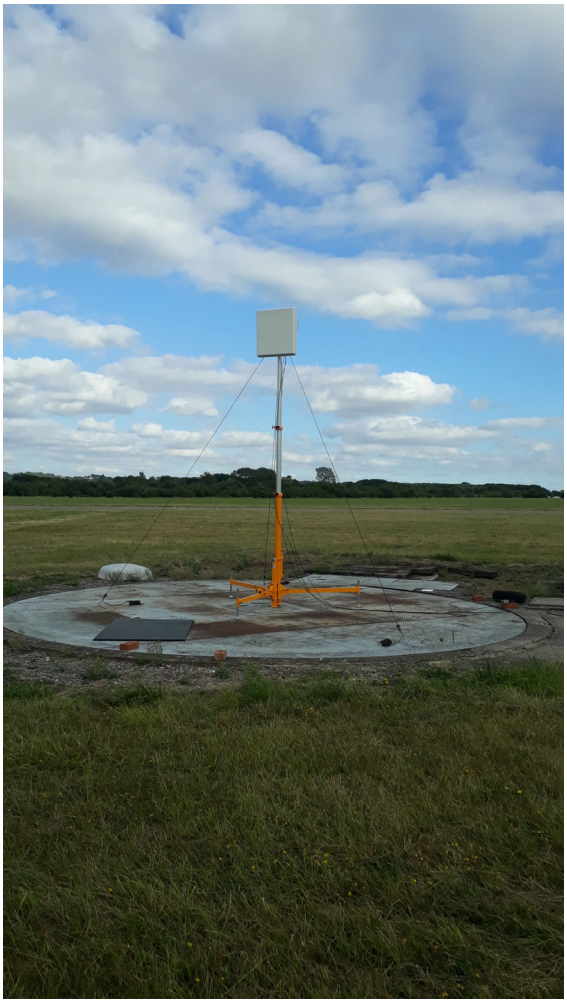
9.1 Block Diagram

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



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 48 V dc from the adaptor.

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

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

	Category	***Nominal***	***Variation***
☐	Mains	110 V ac +/-2 %	85 % and 115 %
☐	Battery	New battery	N/A
☒	Power supply	48 V dc	85 % and 115 %

11 Transmitter Unwanted 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.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	Part 90.1323
EUT Frequencies Measured:	3652.5 MHz, 3675 MHz and 3697.5 MHz
EUT Channel Bandwidths:	5 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: Peak; Above 1 GHz: Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 60 % RH	20 % RH to 75 % RH (as declared)
Supply: 48 V dc	48 V dc (as declared)

11.3 Test Limit

Frequency (MHz)	***Field Strength (µV/m at 3 m)***
30 to 40000	12968

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 C63.26 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:

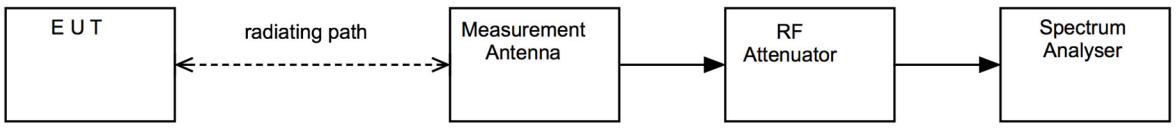
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

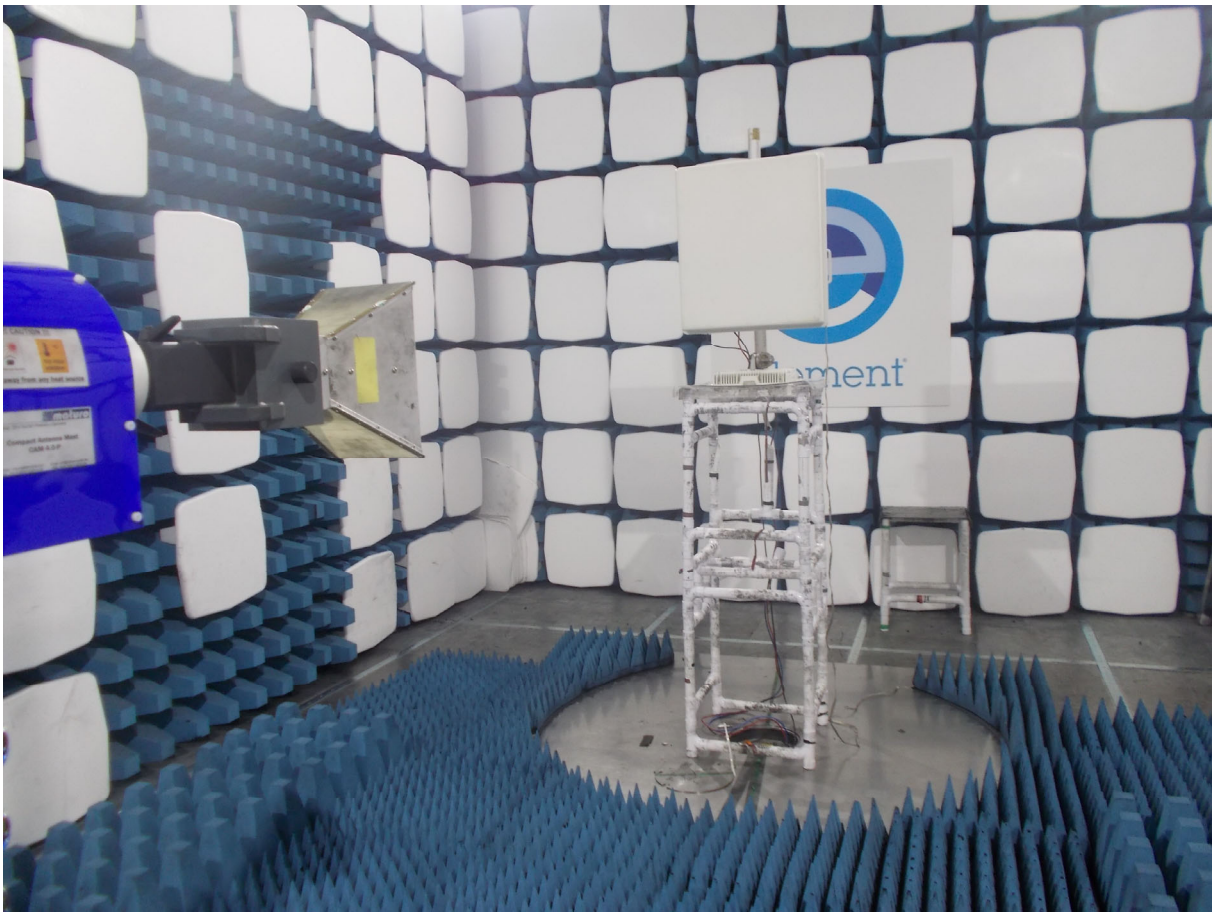
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor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

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

Figure i Test Setup



11.5 Test Set-up Photograph

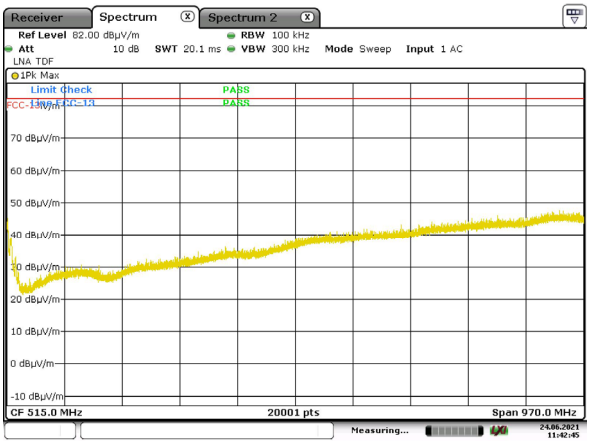


11.6 Test Equipment

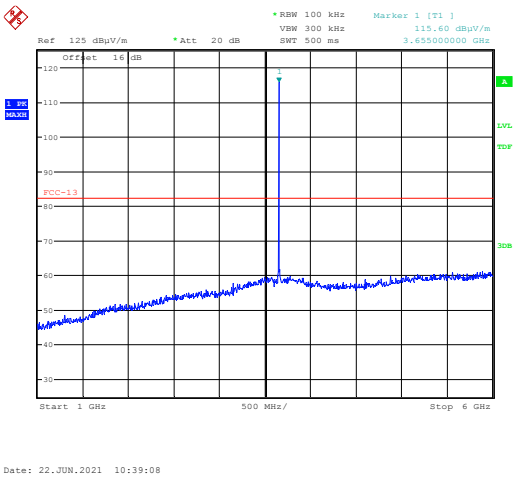
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Bilog	Chase	CBL611/A	U573	2023-01-28
EMI Receiver	R&S	ESR7	U456	2021-12-17
1-18GHz Horn	EMCO	3115	L139	2021-07-16
Spectrum Analyser	R&S	FSU46	REF910	2021-11-18
Horn 18-26GHz (&U330)	Flann	20240-20	L300	2022-04-23
Standard Gain Horn 26-40	Flann	22240-20	L301	2021-10-22
Spectrum Analyser	R&S	FSU26	U405	2021-07-17
Pre Amp	Agilent	8449B	L572	2021-10-19
HI Pass Filter 5-16 GHz	Atlantic Microwave	AFH-05000 Rev A	U663	2022-01-30
High Pass Filter	Atlantic Microwave	AFH-07000	U558	2022-01-30

11.7 Test Results

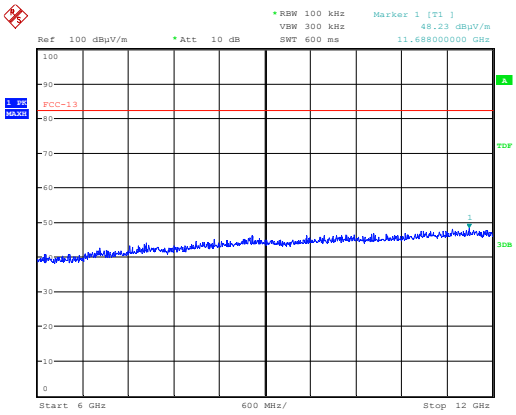
Beamforming; Power setting: 32.5; QPSK MIMOA; Channel: 3652.5 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
No emissions within 20 dB of the limit										



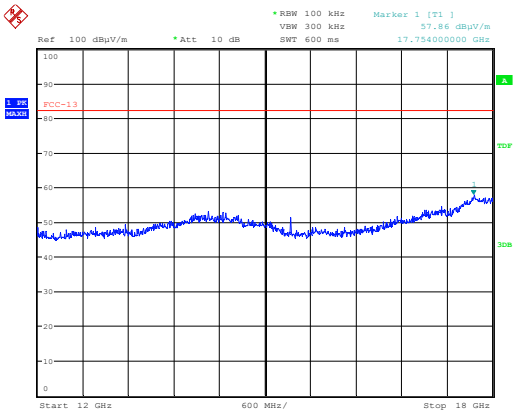
30 MHz to 1 GHz



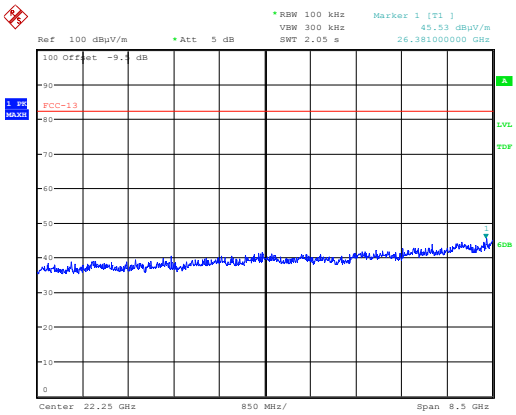
1 GHz to 6 GHz



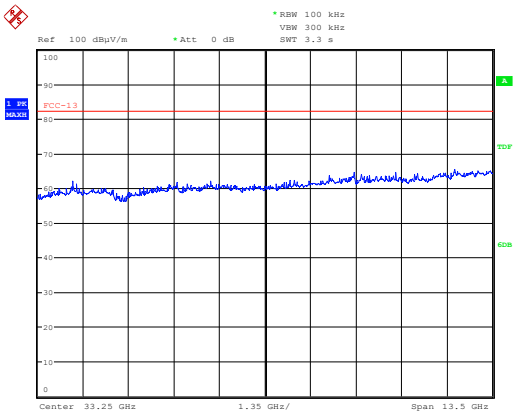
6 GHz to 12 GHz



12 GHz to 18 GHz

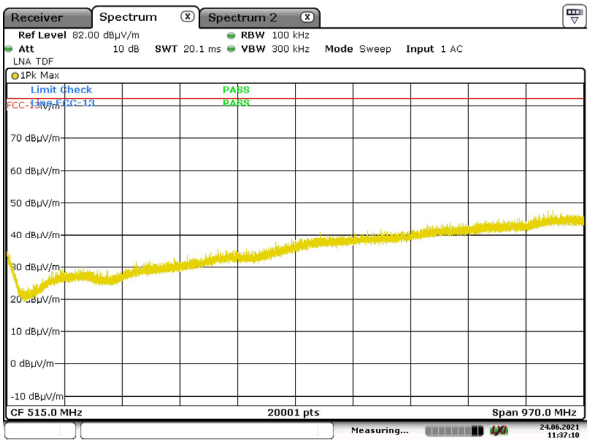


18 GHz to 26.5 GHz

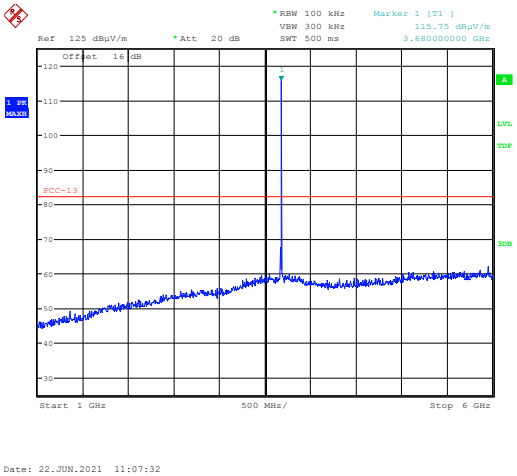


26.5 GHz to 40 GHz

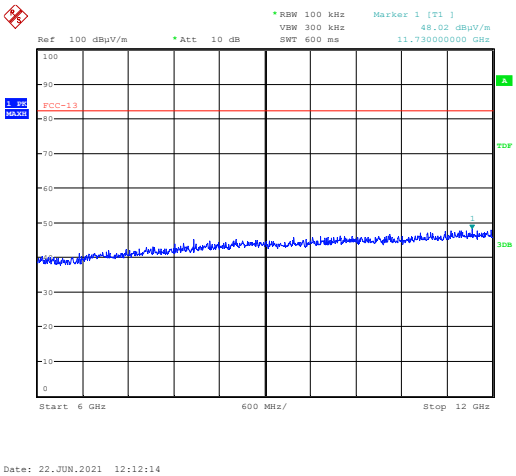
Beamforming; Power setting: 33.5; QPSK MIMOA; Channel: 3675 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
No emissions within 20 dB of the limit										



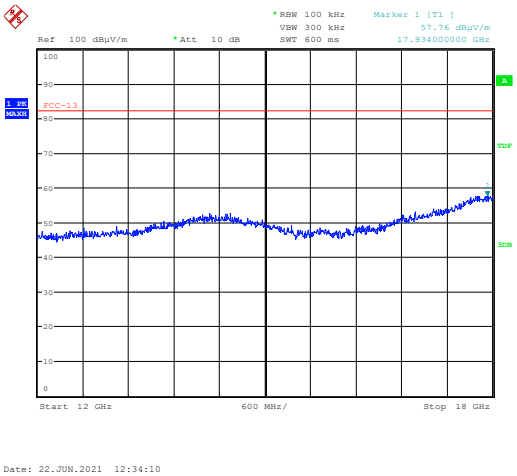
30 MHz to 1 GHz



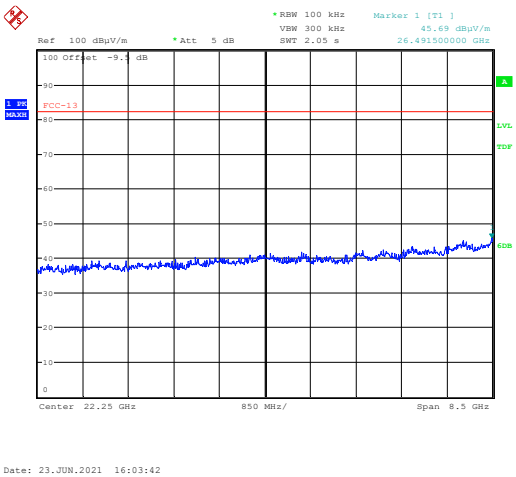
1 GHz to 6 GHz



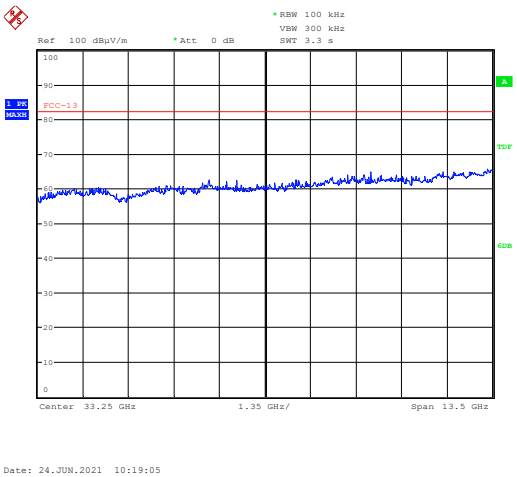
6 GHz to 12 GHz



12 GHz to 18 GHz

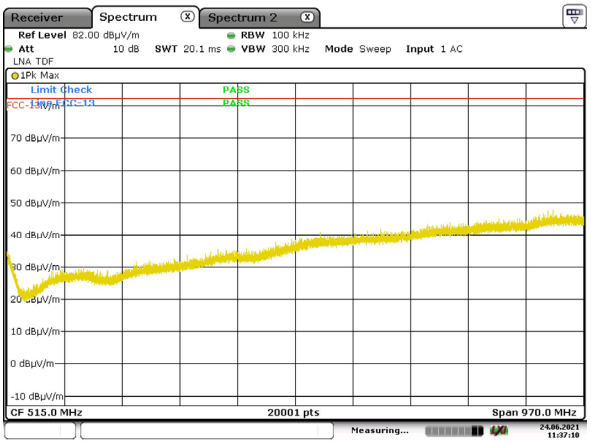


18 GHz to 26.5 GHz

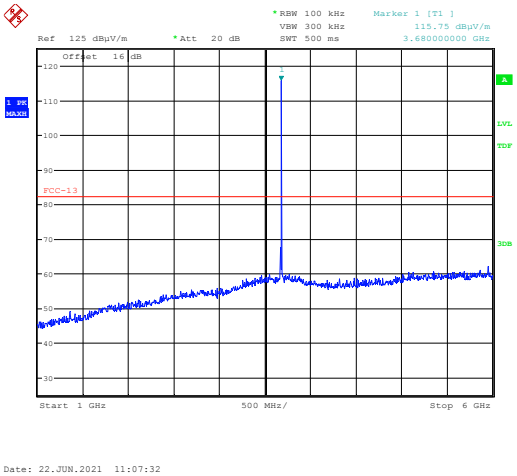


26.5 GHz to 40 GHz

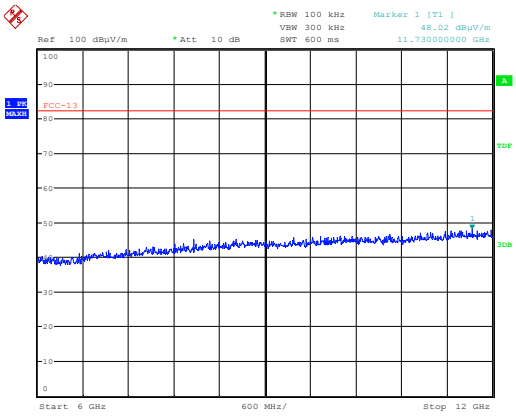
Beamforming; Power setting: 32.5; QPSK MIMOA; Channel: 3697.5 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
No emissions within 20 dB of the limit										



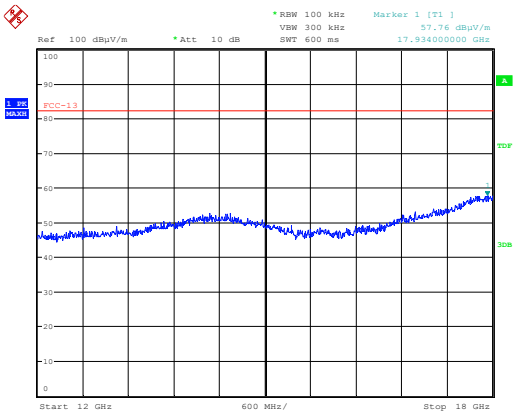
30 MHz to 1 GHz



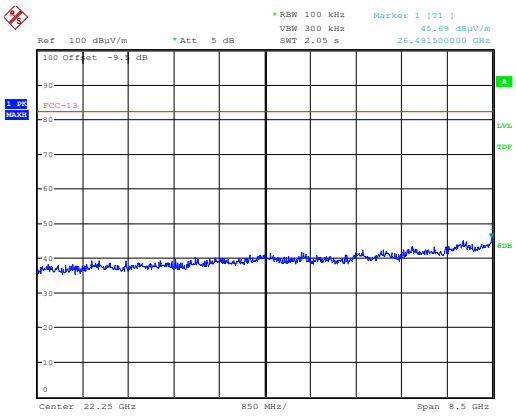
1 GHz to 6 GHz



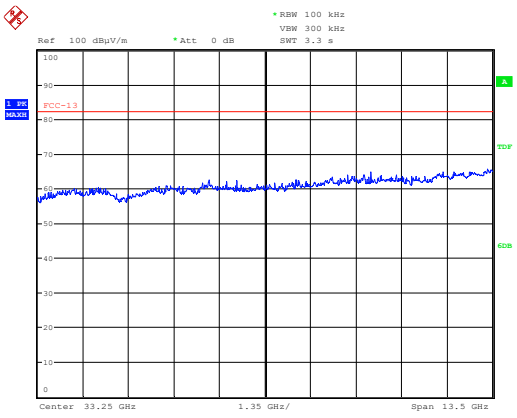
6 GHz to 12 GHz



12 GHz to 18 GHz



18 GHz to 26.5 GHz



26.5 GHz to 40 GHz

12 Occupied Bandwidth

12.1 Definition

The OBW is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	Part 90.209
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	5 MHz, 20 MHz and 40 MHz
EUT Test Modulations:	QPSK MIMO A & B, 16QAM MIMO A & B, 64QAM MIMO A & B and 256QAM MIMO A & B
Deviations From Standard:	None
Measurement BW: (Requirement: 1% to 5% OBW)	200 kHz and 500 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	500 kHz and 2 MHz
Measurement Span: (requirement 2 to 5 times OBW)	7.5 MHz, 30 MHz and 60 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 60 % RH	20 % RH to 75 % RH (as declared)
Supply: 48 V dc	48 V dc (as declared)

12.3 Test Limit

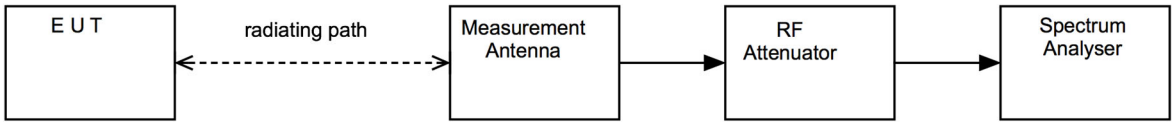
Bandwidths for radiolocation stations in the 420-450 MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by-case basis.

12.4 Test Method

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

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

Figure iii Test Setup

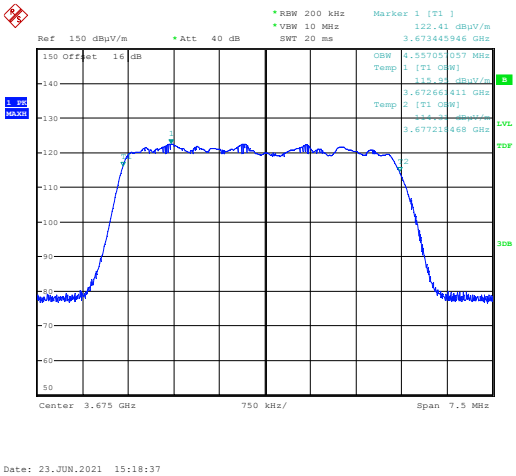


12.5 Test Equipment

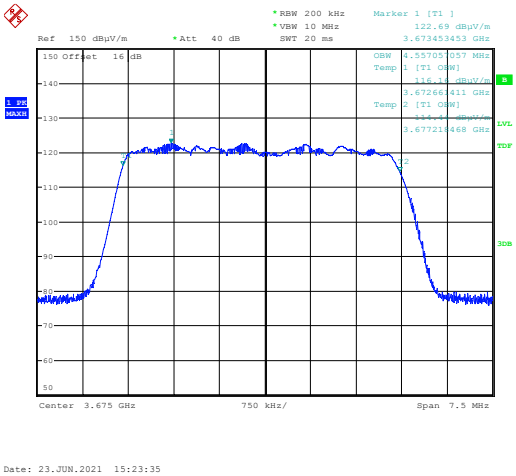
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
1-18GHz Horn	EMCO	3115	L139	2021-07-16
Spectrum Analyser	R&S	FSU26	U405	2021-07-17
Pre Amp	Agilent	8449B	L572	2021-10-19

12.6 Test Results

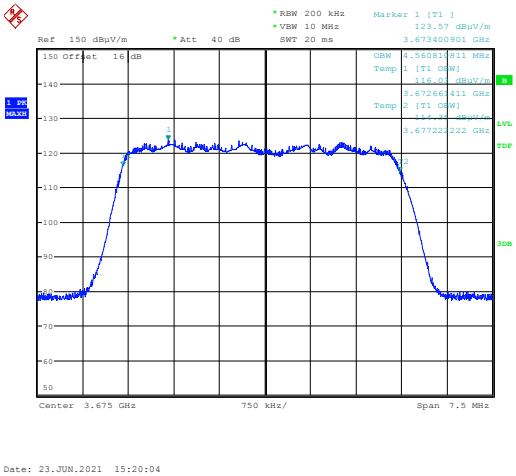
5 MHz Bandwidth Beamforming



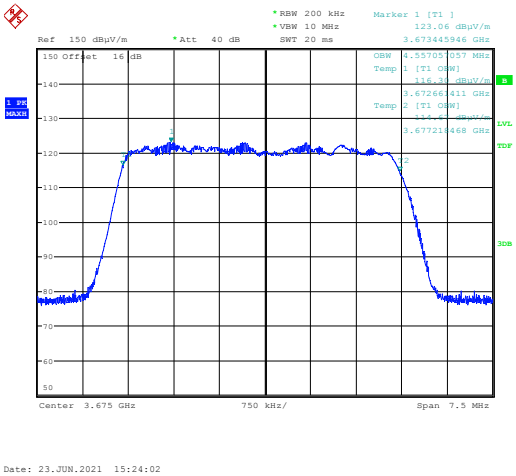
99 % Bandwidth QPSK; MIMO A



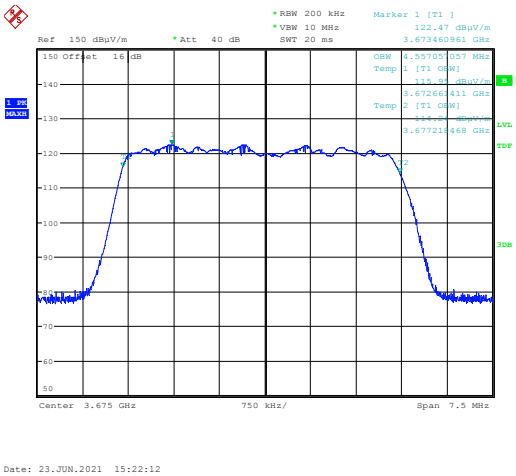
99 % Bandwidth QPSK; MIMO B



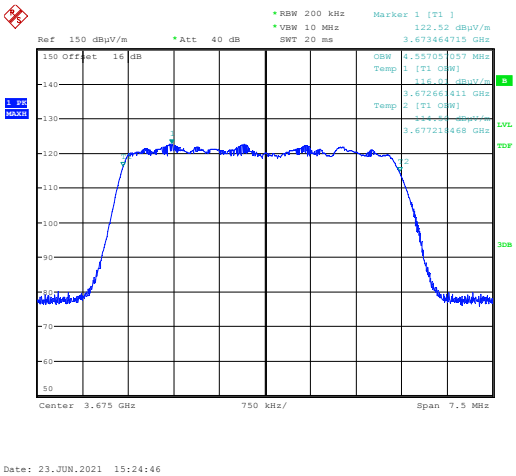
99 % Bandwidth; 16QAM; MIMO A



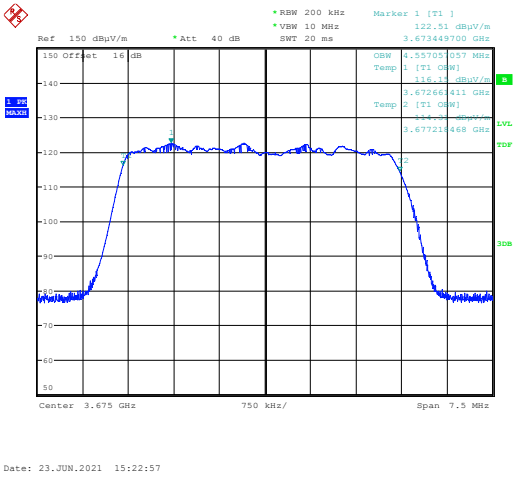
99 % Bandwidth; 16QAM;MIMO B



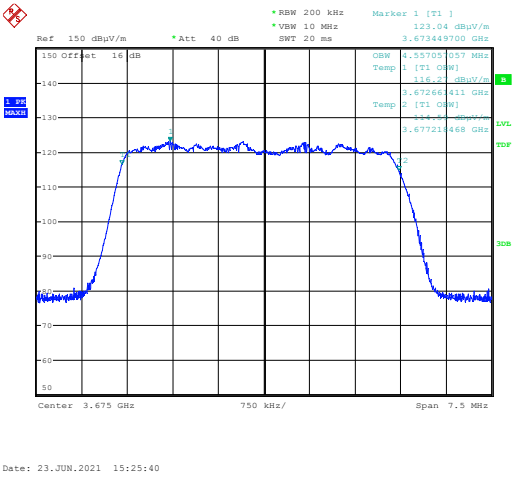
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



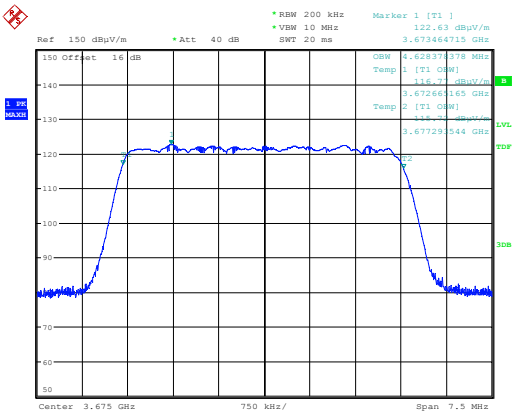
99 % Bandwidth; 256QAM; MIMO A



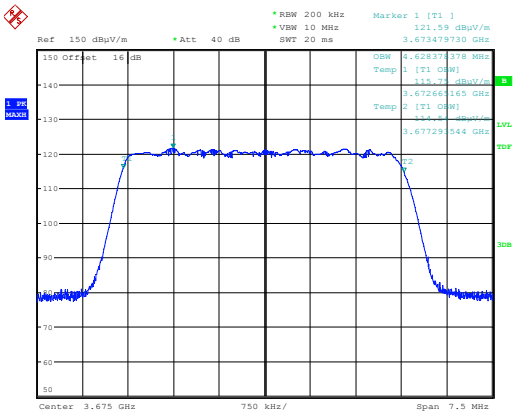
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3672.66141	3677.21847	4557.1	Pass
		16QAM	3672.66141	3677.22222	4560.8	Pass
		64QAM	3672.66141	3677.21847	4557.1	Pass
		256QAM	3672.66141	3677.21847	4557.1	Pass
	B	QPSK	3672.66141	3677.21847	4557.1	Pass
		16QAM	3672.66141	3677.21847	4557.1	Pass
		64QAM	3672.66141	3677.21847	4557.1	Pass
		256QAM	3672.66141	3677.21847	4557.1	Pass

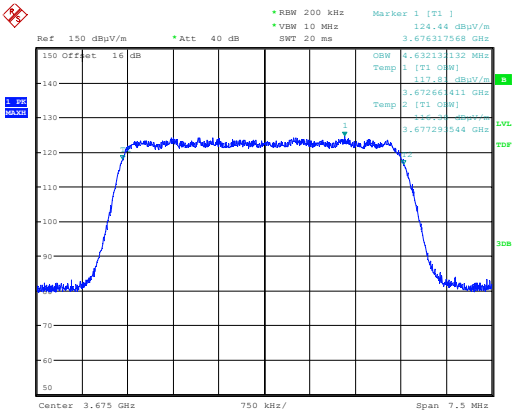
5 MHz Bandwidth Sector



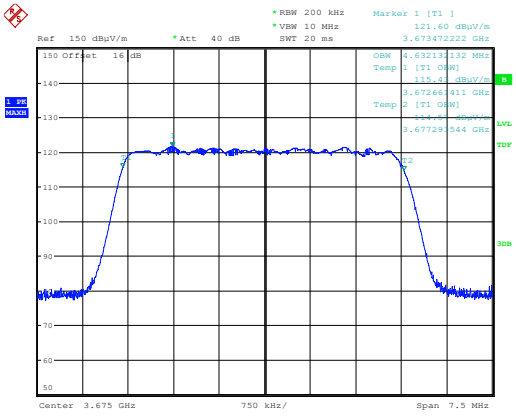
99 % Bandwidth QPSK; MIMO A



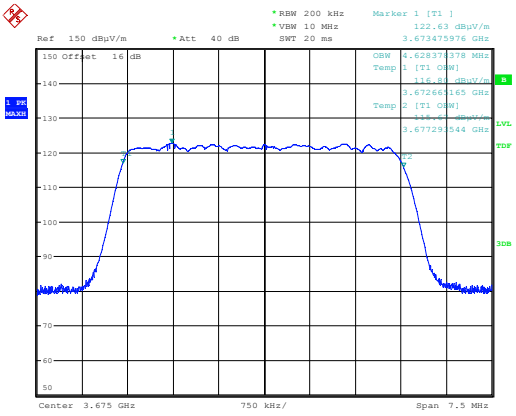
99 % Bandwidth QPSK; MIMO B



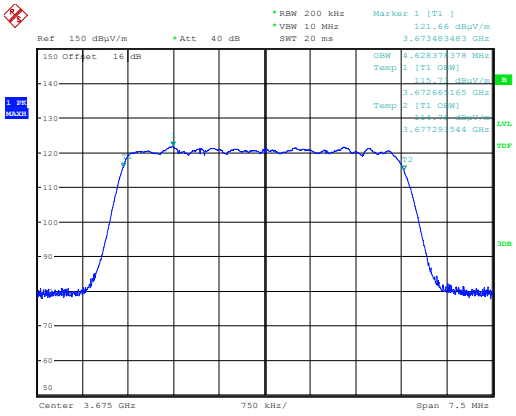
99 % Bandwidth; 16QAM; MIMO A



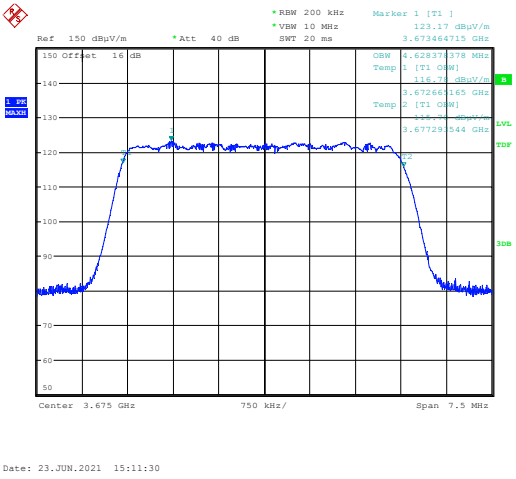
99 % Bandwidth; 16QAM;MIMO B



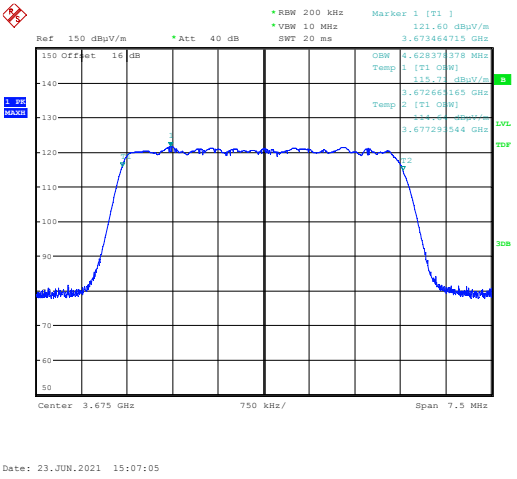
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



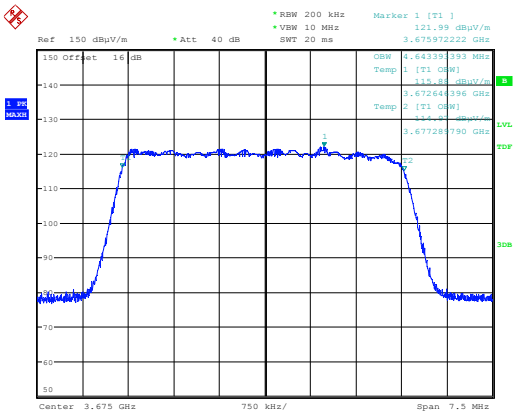
99 % Bandwidth; 256QAM; MIMO A



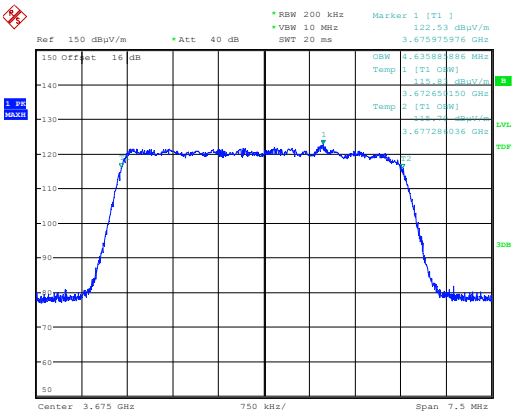
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3672.66517	3677.29354	4628.4	Pass
		16QAM	3672.61141	3677.29354	4682.1	Pass
		64QAM	3672.66517	3677.29354	4628.4	Pass
		256QAM	3672.66517	3677.29354	4628.4	Pass
	B	QPSK	3672.66517	3677.29354	4628.4	Pass
		16QAM	3672.61141	3677.29354	4682.1	Pass
		64QAM	3672.66517	3677.29354	4628.4	Pass
		256QAM	3672.66517	3677.29354	4628.4	Pass

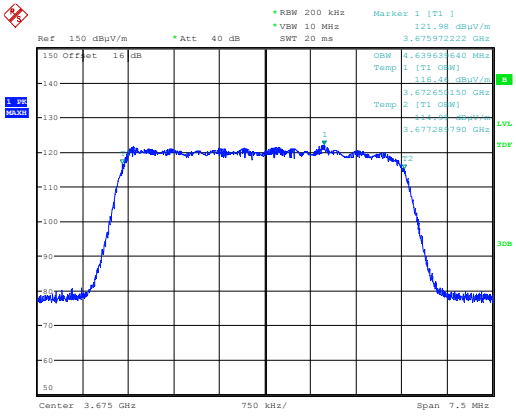
5 MHz Bandwidth MU-MIMO



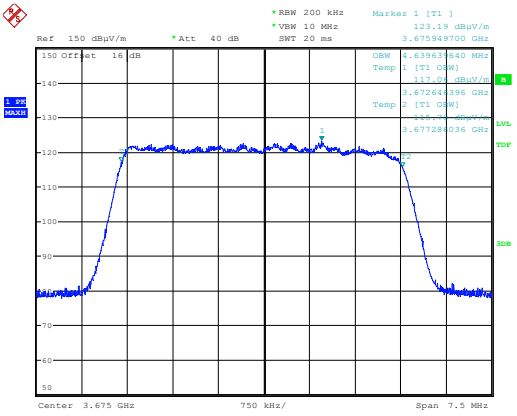
99 % Bandwidth QPSK; MIMO A



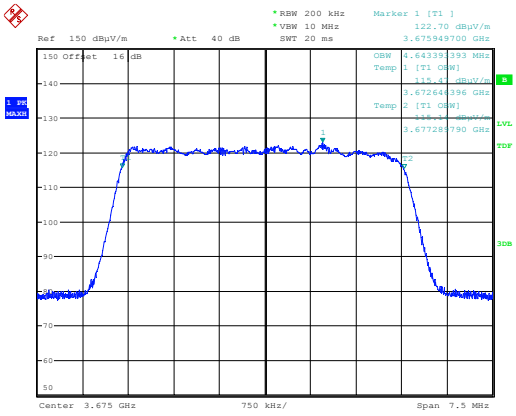
99 % Bandwidth QPSK; MIMO B



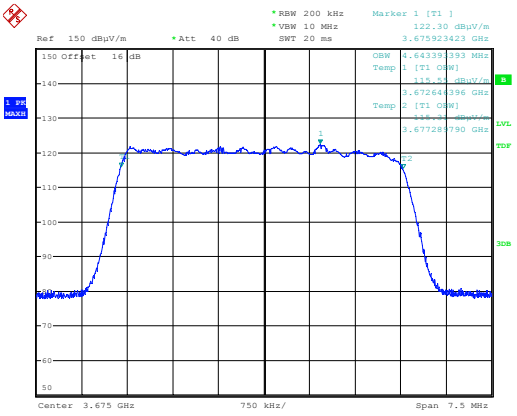
99 % Bandwidth; 16QAM; MIMO A



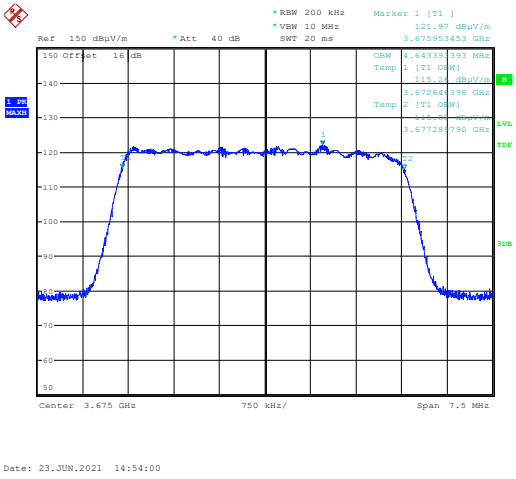
99 % Bandwidth; 16QAM;MIMO B



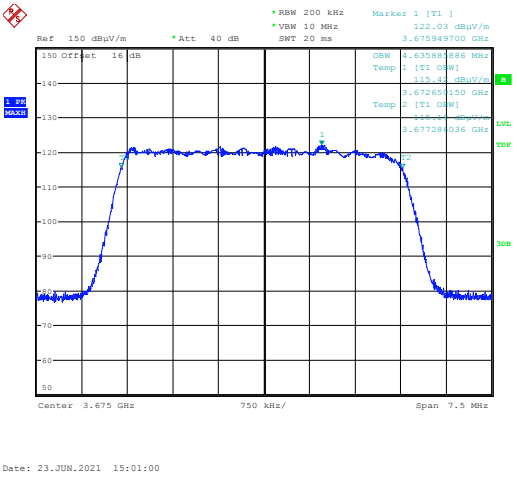
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



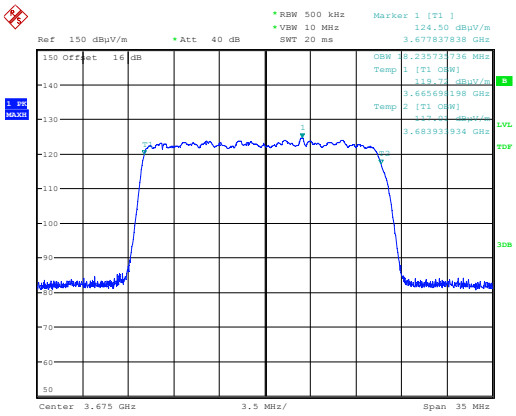
99 % Bandwidth; 256QAM; MIMO A



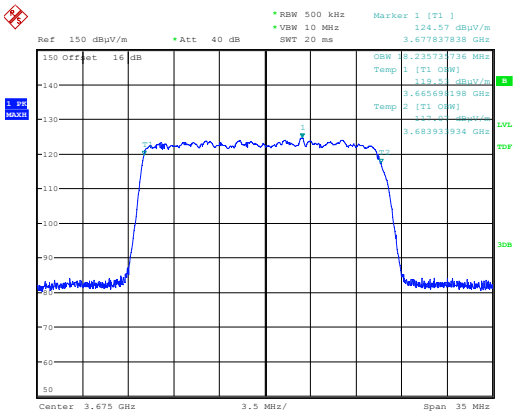
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3672.64640	3677.28979	4643.4	Pass
		16QAM	3672.65015	3677.28979	4639.6	Pass
		64QAM	3672.64640	3677.28979	4643.4	Pass
		256QAM	3672.64640	3677.28979	4643.4	Pass
	B	QPSK	3672.65015	3677.28604	4635.9	Pass
		16QAM	3672.64640	3677.28604	4639.6	Pass
		64QAM	3672.64640	3677.28979	4643.4	Pass
		256QAM	3672.65015	3677.28604	4635.9	Pass

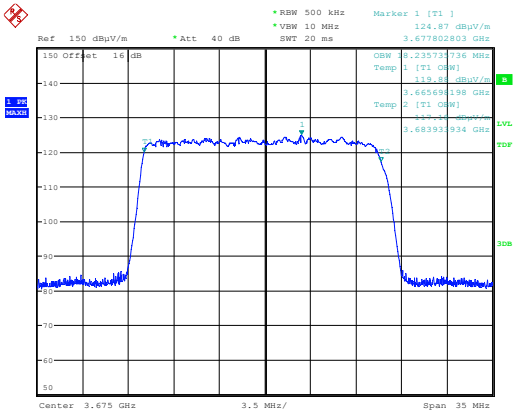
20 MHz Bandwidth Beamforming



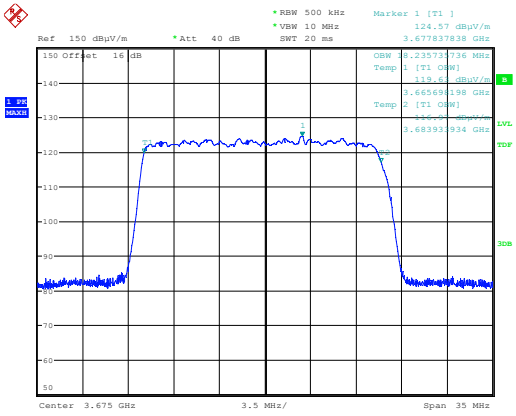
99 % Bandwidth QPSK; MIMO A



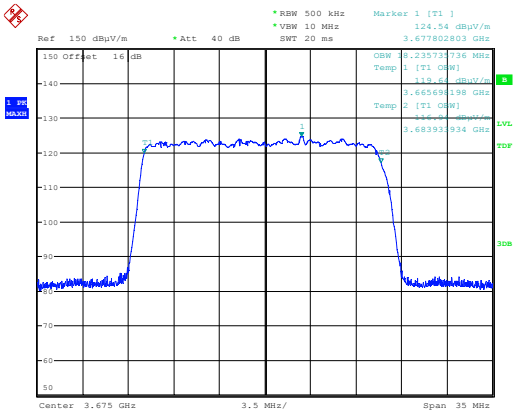
99 % Bandwidth QPSK; MIMO B



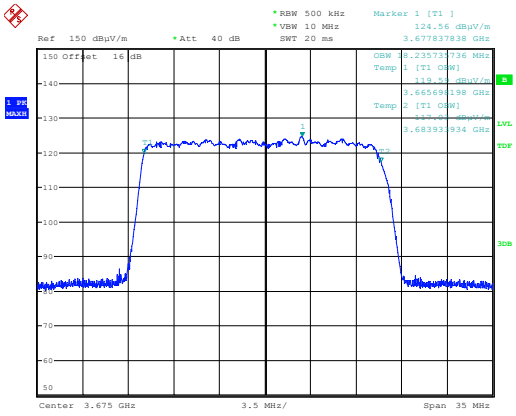
99 % Bandwidth; 16QAM; MIMO A



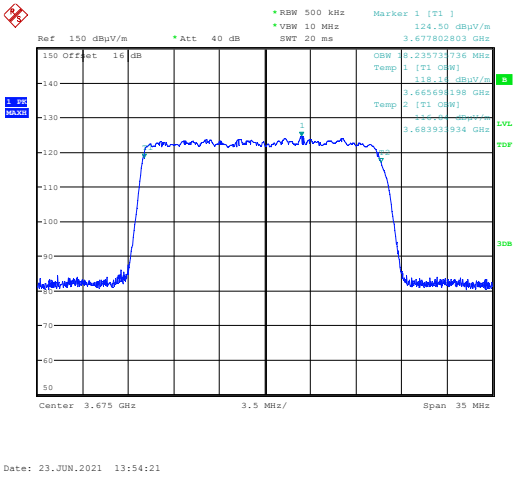
99 % Bandwidth; 16QAM;MIMO B



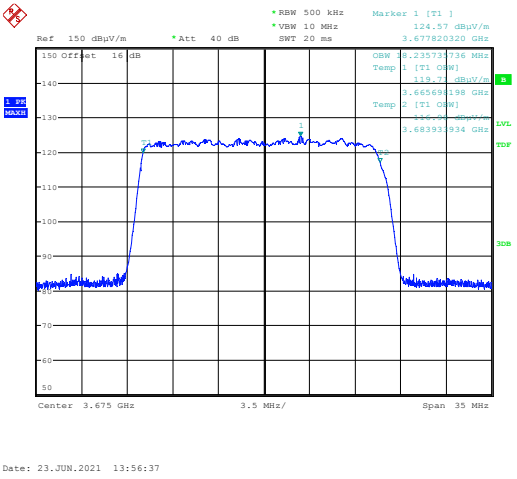
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



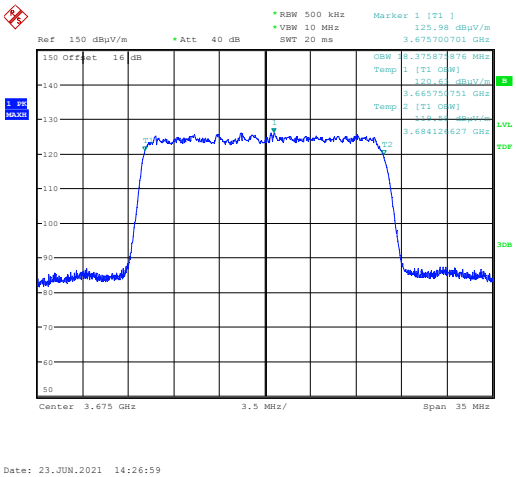
99 % Bandwidth; 256QAM; MIMO A



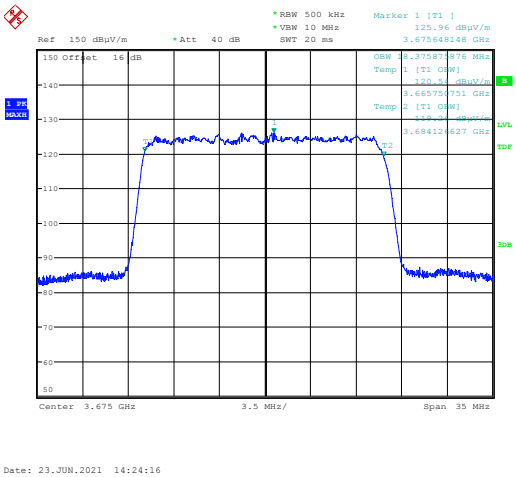
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3665.69820	3683.93393	18235.7	Pass
		16QAM	3665.69820	3683.93393	18235.7	Pass
		64QAM	3665.69820	3683.93393	18235.7	Pass
		256QAM	3665.69820	3683.93393	18235.7	Pass
	B	QPSK	3665.69820	3683.93393	18235.7	Pass
		16QAM	3665.69820	3683.93393	18235.7	Pass
		64QAM	3665.69820	3683.93393	18235.7	Pass
		256QAM	3665.69820	3683.93393	18235.7	Pass

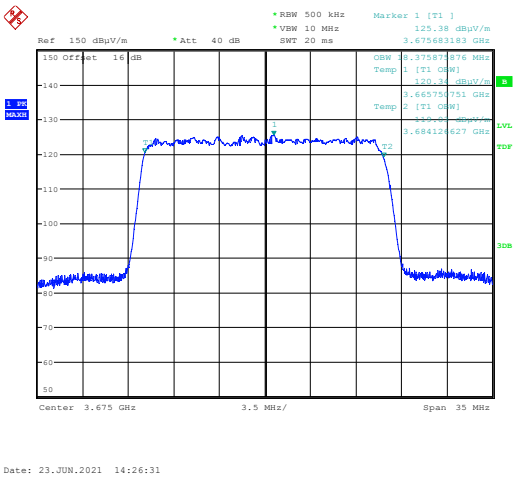
20 MHz Bandwidth Sector



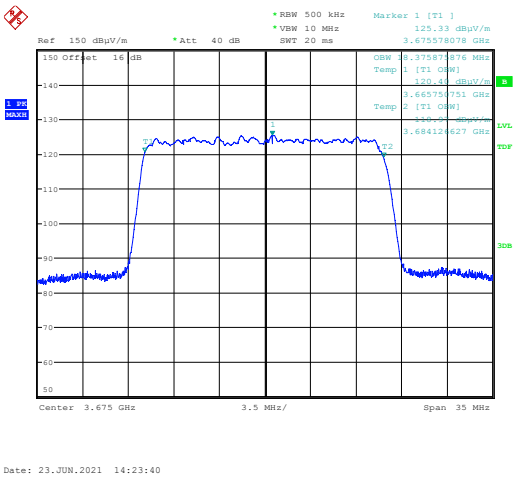
99 % Bandwidth QPSK; MIMO A



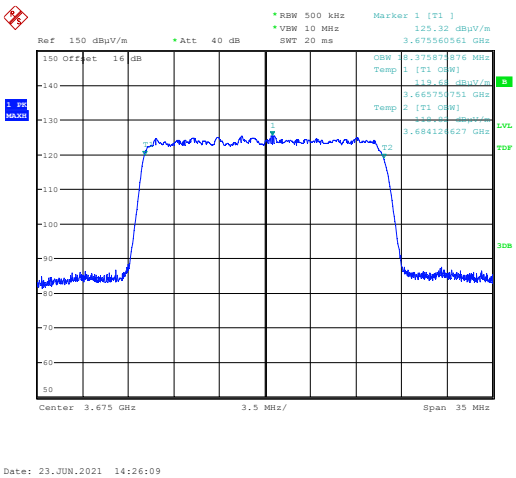
99 % Bandwidth QPSK; MIMO B



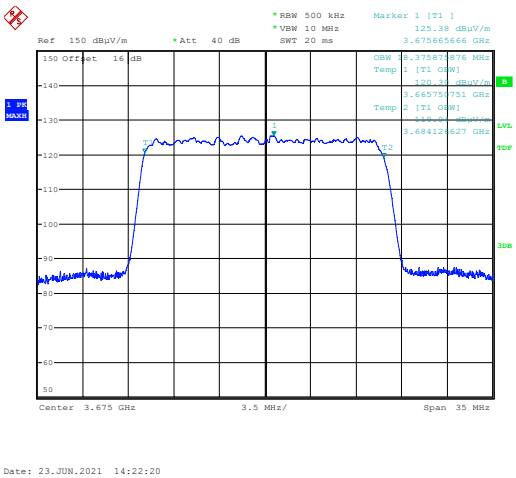
99 % Bandwidth; 16QAM; MIMO A



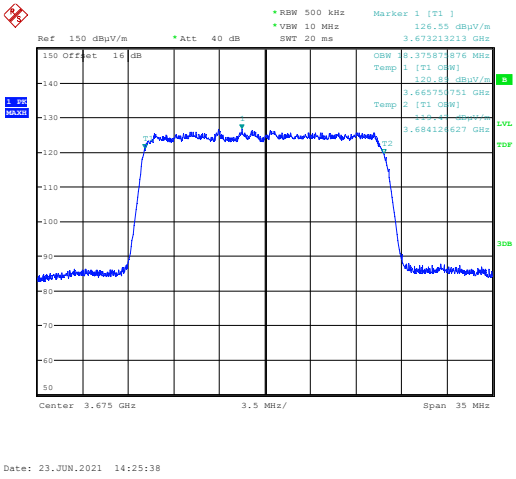
99 % Bandwidth; 16QAM;MIMO B



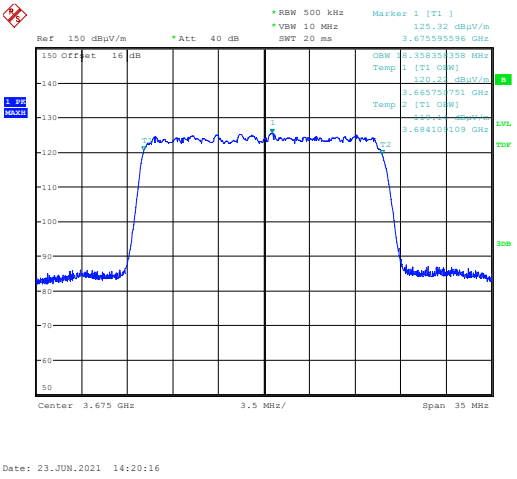
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



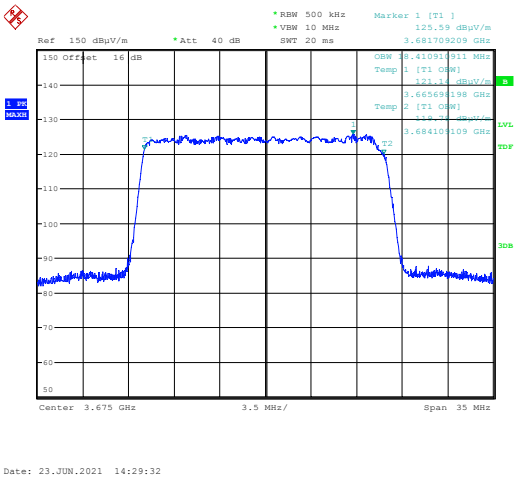
99 % Bandwidth; 256QAM; MIMO A



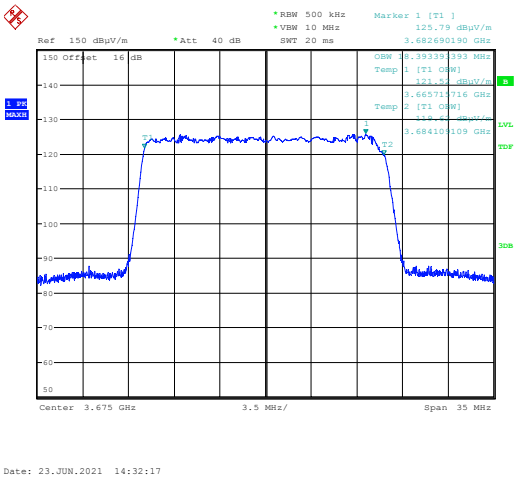
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3665.75075	3684.12663	18375.9	Pass
		16QAM	3665.75075	3684.12663	18375.9	Pass
		64QAM	3665.75075	3684.12663	18375.9	Pass
		256QAM	3665.75075	3684.12663	18375.9	Pass
	B	QPSK	3665.75075	3684.12663	18375.9	Pass
		16QAM	3665.75075	3684.12663	18375.9	Pass
		64QAM	3665.75075	3684.12663	18375.9	Pass
		256QAM	3665.75075	3684.10911	18358.4	Pass

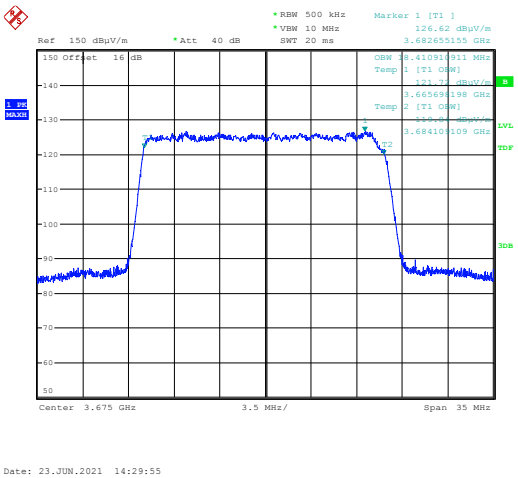
20 MHz Bandwidth MU-MIMO



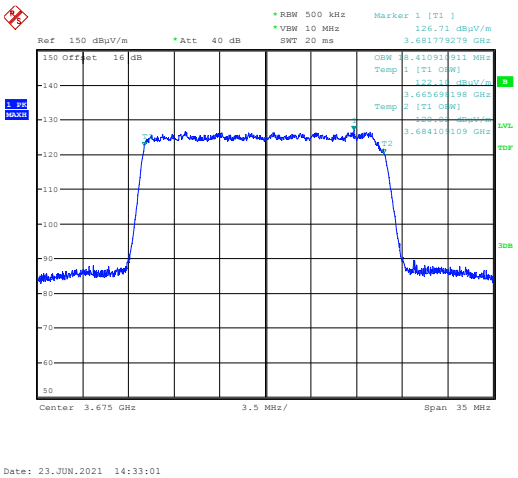
99 % Bandwidth QPSK; MIMO A



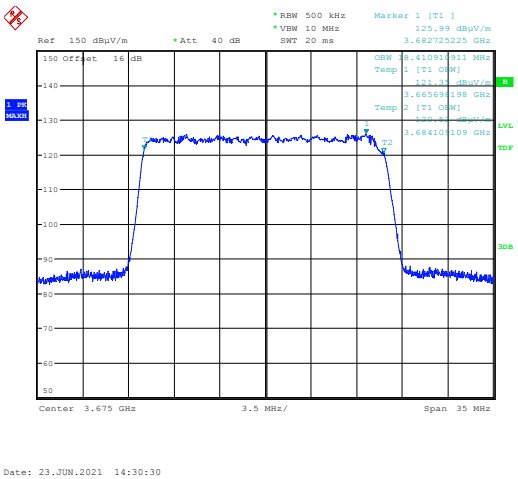
99 % Bandwidth QPSK; MIMO B



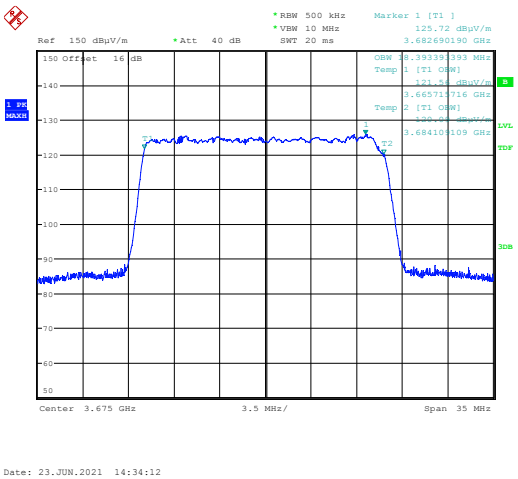
99 % Bandwidth; 16QAM; MIMO A



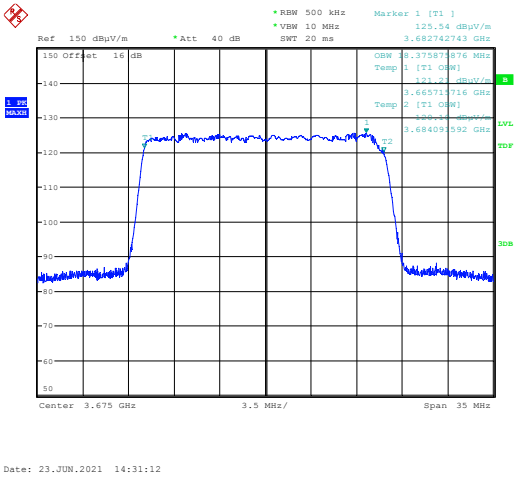
99 % Bandwidth; 16QAM;MIMO B



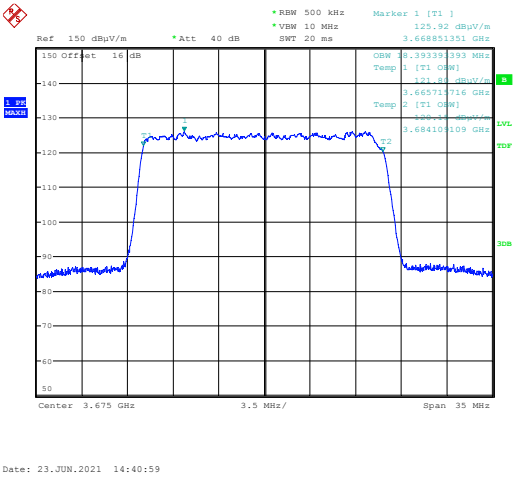
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



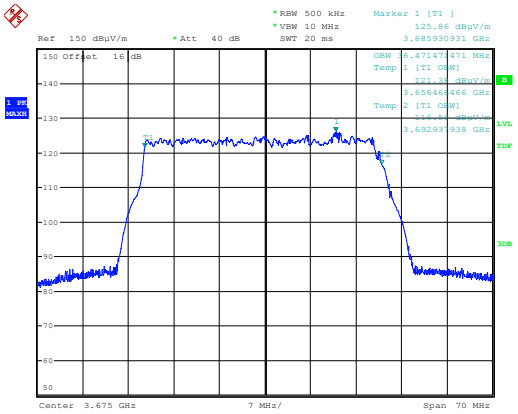
99 % Bandwidth; 256QAM; MIMO A



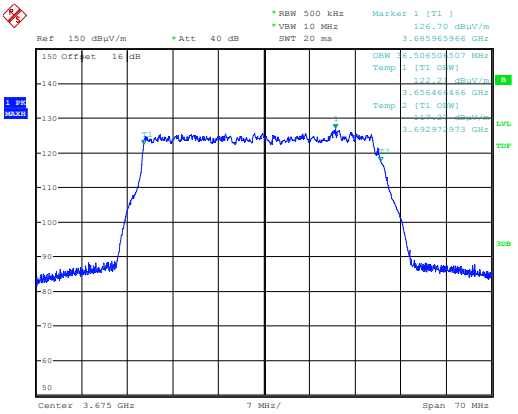
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3665.69820	3684.10911	18410.9	Pass
		16QAM	3665.69820	3684.10911	18410.9	Pass
		64QAM	3665.69820	3684.10911	18410.9	Pass
		256QAM	3665.71572	3684.09159	18375.9	Pass
	B	QPSK	3665.71572	3684.10911	18393.4	Pass
		16QAM	3665.69820	3684.10911	18410.9	Pass
		64QAM	3665.71572	3684.10911	18393.4	Pass
		256QAM	3665.71572	3684.10911	18393.4	Pass

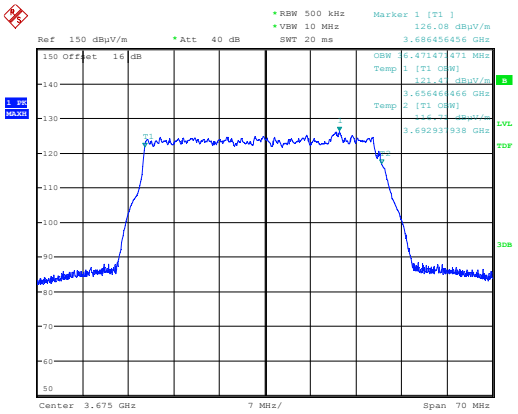
40 MHz Bandwidth Beamforming



99 % Bandwidth QPSK; MIMO A

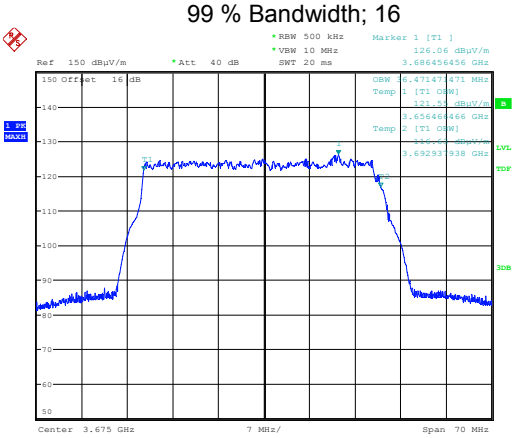


99 % Bandwidth QPSK; MIMO B

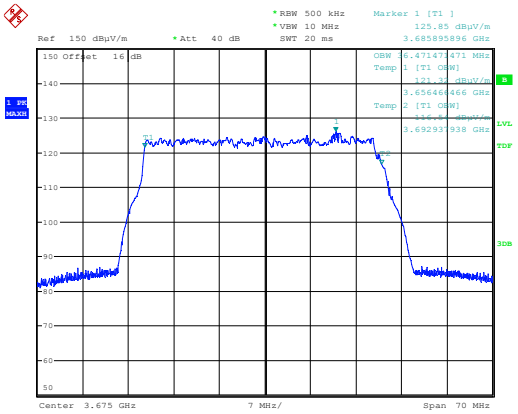


99 % Bandwidth; 16QAM; MIMO A

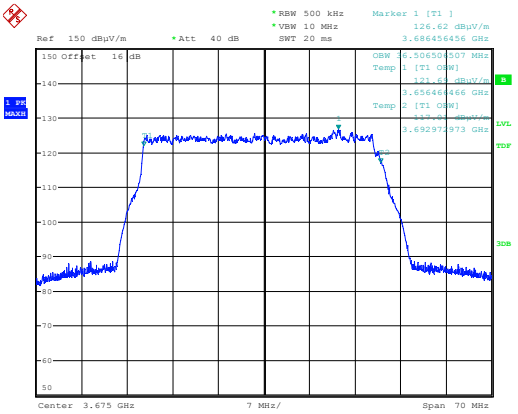
99 % Bandwidth; 16



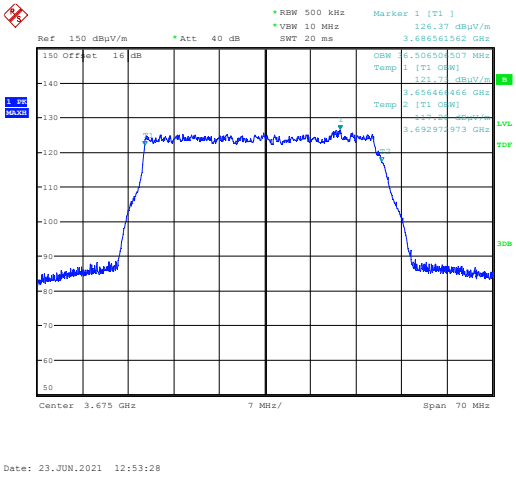
QAM;MIMO B



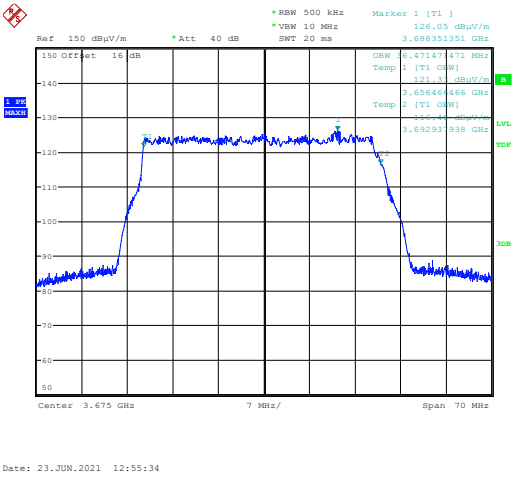
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



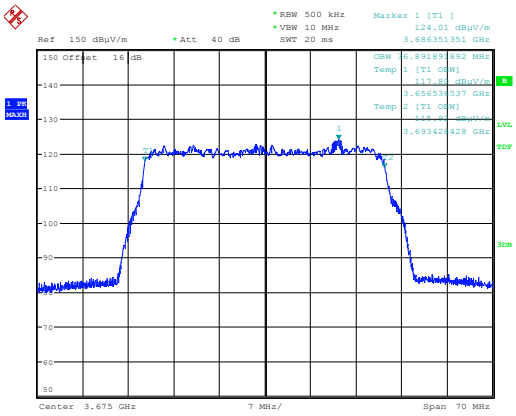
99 % Bandwidth; 256QAM; MIMO A



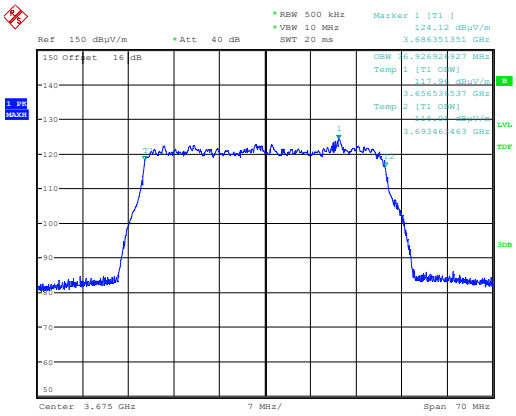
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3656.46647	3692.93794	36471.5	Pass
		16QAM	3656.46647	3692.93794	36471.5	Pass
		64QAM	3656.46647	3692.93794	36471.5	Pass
		256QAM	3656.46647	3692.97297	36506.5	Pass
	B	QPSK	3656.46647	3692.97297	36506.5	Pass
		16QAM	3656.46647	3692.93794	36471.5	Pass
		64QAM	3656.46647	3692.97297	36506.5	Pass
		256QAM	3656.46647	3692.93794	36471.5	Pass

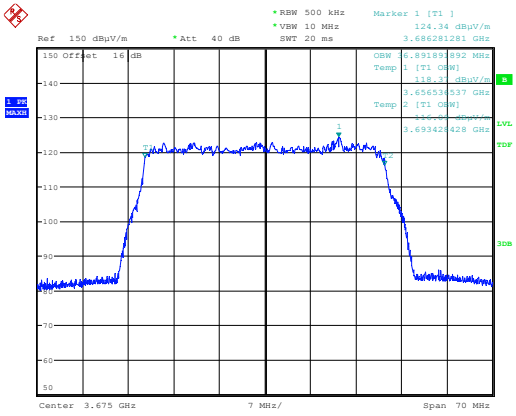
40 MHz Bandwidth Sector



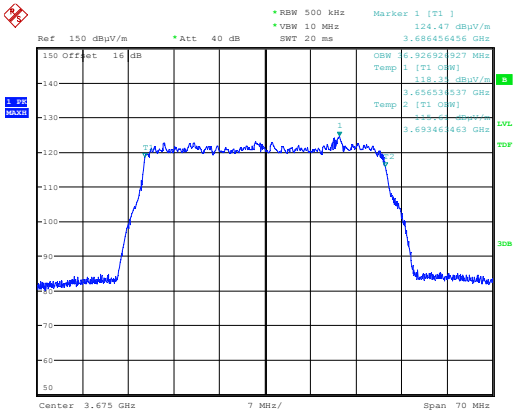
99 % Bandwidth QPSK; MIMO A



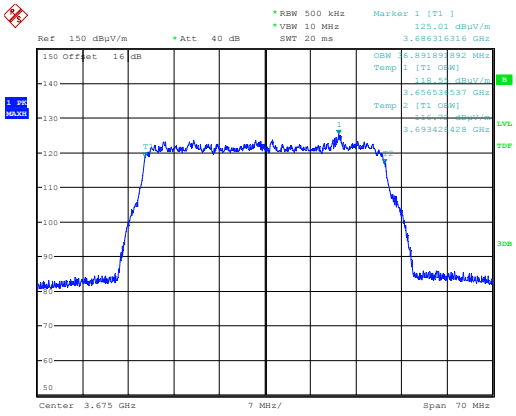
99 % Bandwidth QPSK; MIMO B



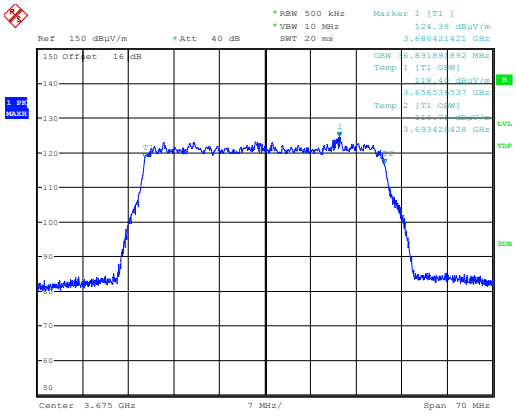
99 % Bandwidth; 16QAM; MIMO A



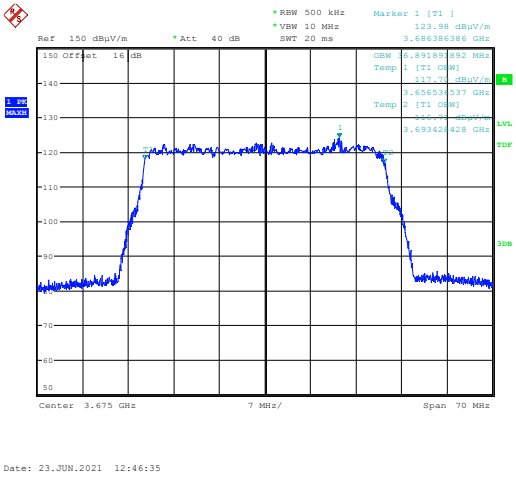
99 % Bandwidth; 16QAM;MIMO B



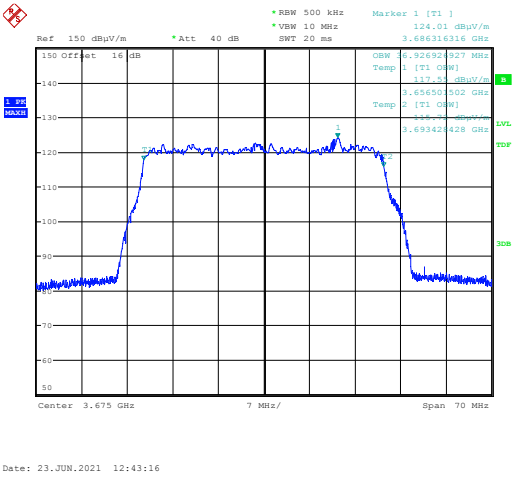
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



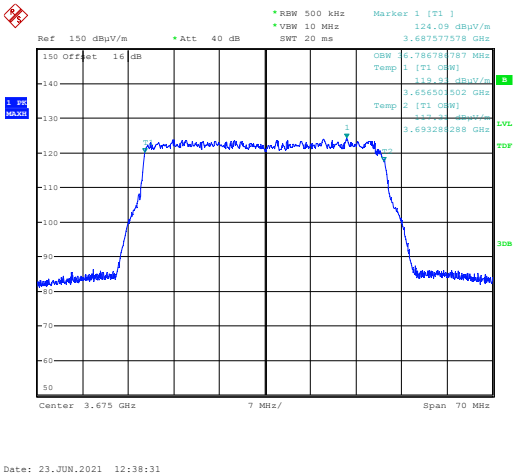
99 % Bandwidth; 256QAM; MIMO A



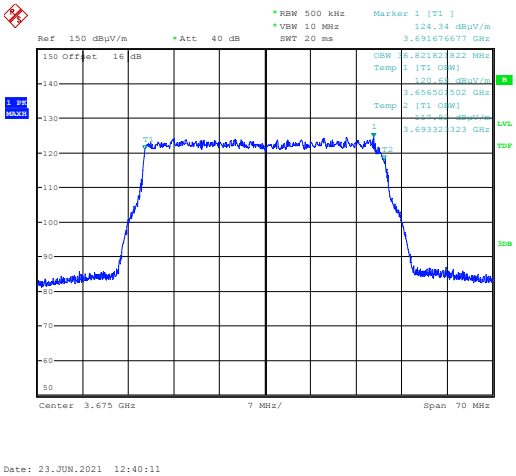
99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3656.53654	3693.42843	36891.9	Pass
		16QAM	3656.53654	3693.42843	36891.9	Pass
		64QAM	3656.53654	3693.42843	36891.9	Pass
		256QAM	3656.53654	3693.42843	36891.9	Pass
	B	QPSK	3656.53654	3693.46346	36926.9	Pass
		16QAM	3656.53654	3693.46346	36926.9	Pass
		64QAM	3656.53654	3693.42843	36891.9	Pass
		256QAM	3656.50150	3693.42843	36926.9	Pass

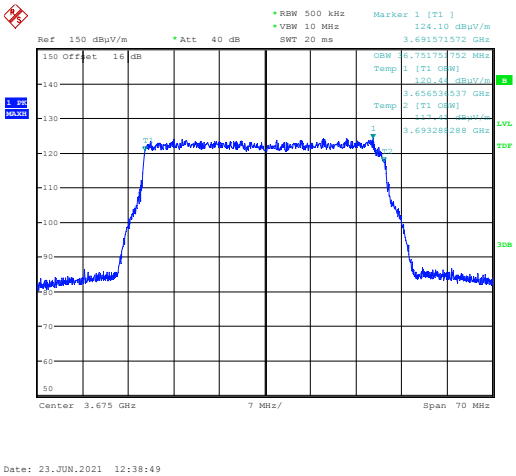
40 MHz Bandwidth MU-MIMO



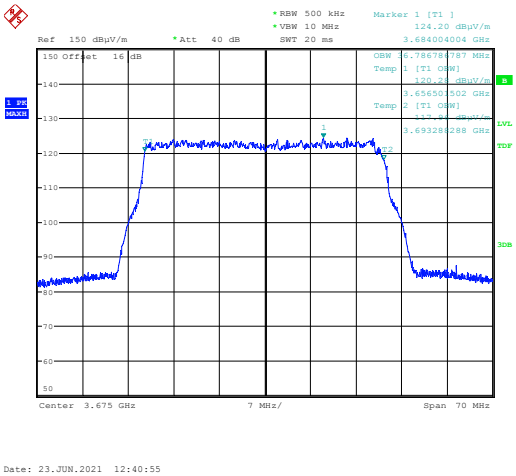
99 % Bandwidth QPSK; MIMO A



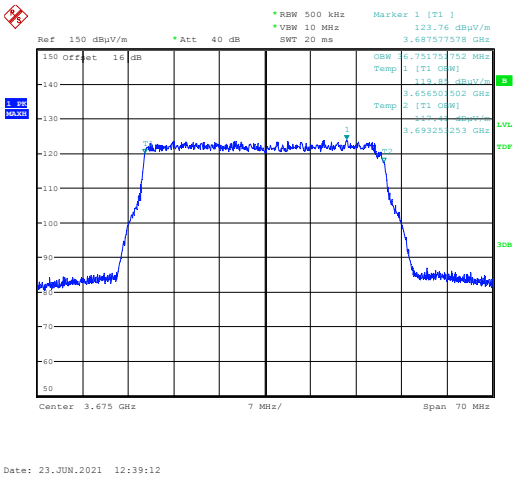
99 % Bandwidth QPSK; MIMO B



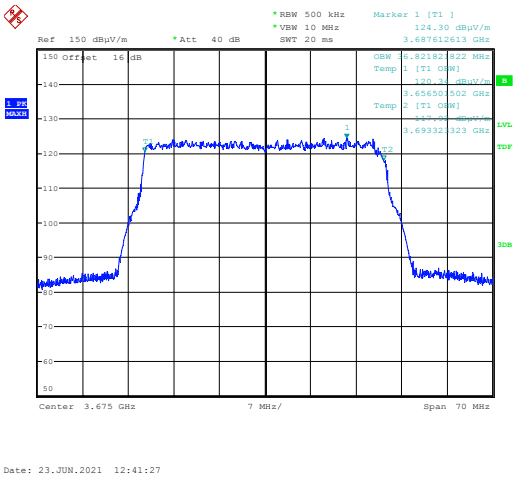
99 % Bandwidth; 16QAM; MIMO A



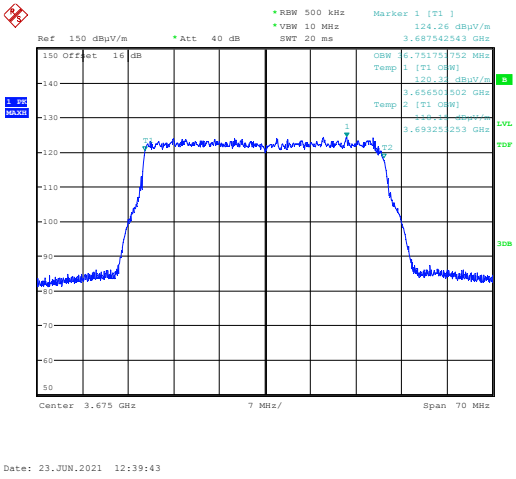
99 % Bandwidth; 16QAM;MIMO B



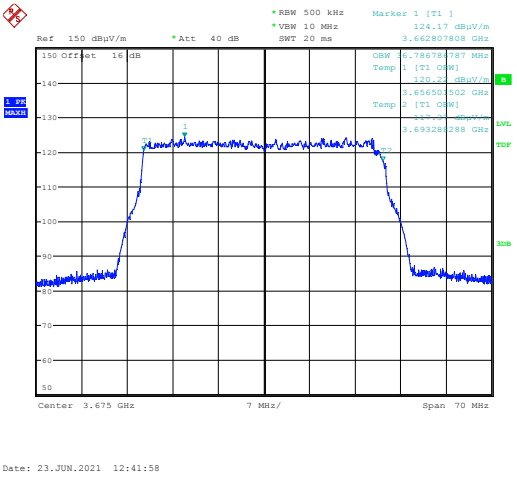
99 % Bandwidth; 64QAM; MIMO A



99 % Bandwidth; 64QAM; MIMO B



99 % Bandwidth; 256QAM; MIMO A



99 % Bandwidth; 256QAM; MIMO B

Frequency (MHz)	*MIMO*	*Modulation Mode*	*FL (MHz)*	*FH (MHz)*	*99 % Bandwidth (kHz)*	*Result*
3675	A	QPSK	3656.50150	3693.28829	36786.8	Pass
		16QAM	3656.53654	3693.28829	36751.8	Pass
		64QAM	3656.50150	3693.25325	36751.8	Pass
		256QAM	3656.50150	3693.25325	36751.8	Pass
	B	QPSK	3656.50150	3693.32332	36821.8	Pass
		16QAM	3656.50150	3693.28829	36786.8	Pass
		64QAM	3656.50150	3693.32332	36821.8	Pass
		256QAM	3656.50150	3693.28829	36786.8	Pass

13 Emission Mask

13.1 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.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber
Test Standard and Clause:	Part 90.210
EUT Channels:	Low / Mid / High
EUT Channel Bandwidths:	5 MHz, 20 MHz and 40 MHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	1 MHz
Measurement Detector:	RMS

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 60 % RH	20 % RH to 75 % RH (as declared)
Supply: 48 V dc	48 V dc (as declared)

13.3 Test Limit

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

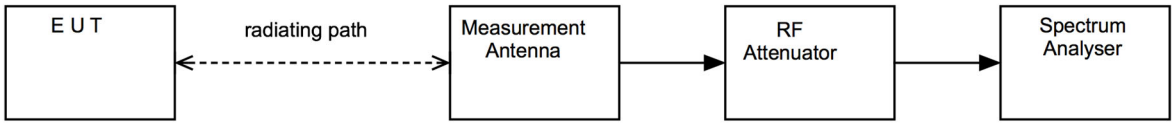
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

13.4 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



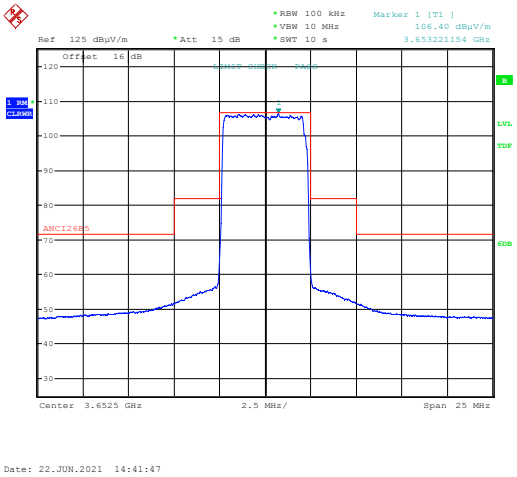
13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
1-18GHz Horn	EMCO	3115	L139	2021-07-16
Spectrum Analyser	R&S	FSU26	U405	2021-07-17
Pre Amp	Agilent	8449B	L572	2021-10-19

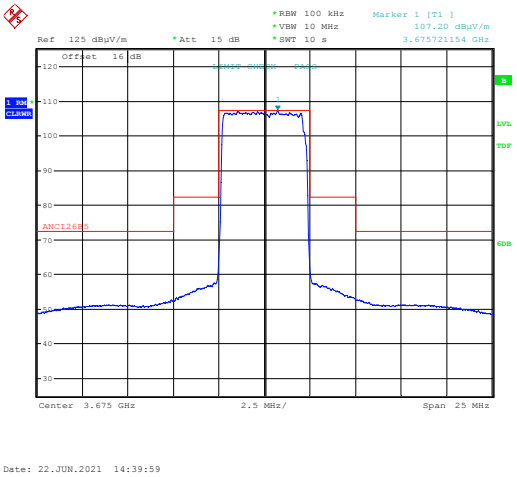
13.6 Test Results

GUI Power settings 5 MHz Bandwidth			
Transmission Mode	Bottom Channel	Middle Channel	Top Channel
Beamforming	32.5	33.5	32.0
Sector	32.5	33.5	32.5
MU-MIMO	31.5	32.0	31.5

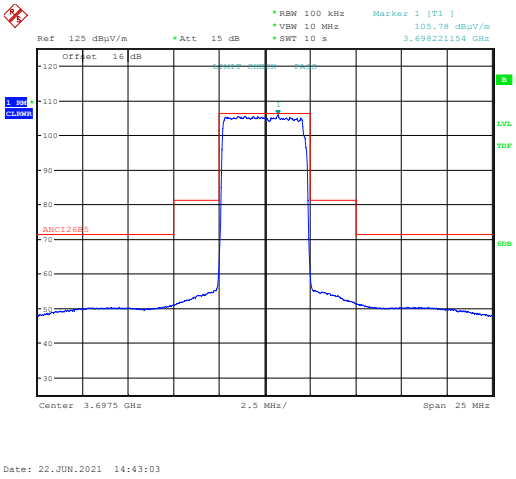
Beamforming 5 MHz Emission Mask



Emission Mask; QPSK; 3652.5 MHz; MIMO A.

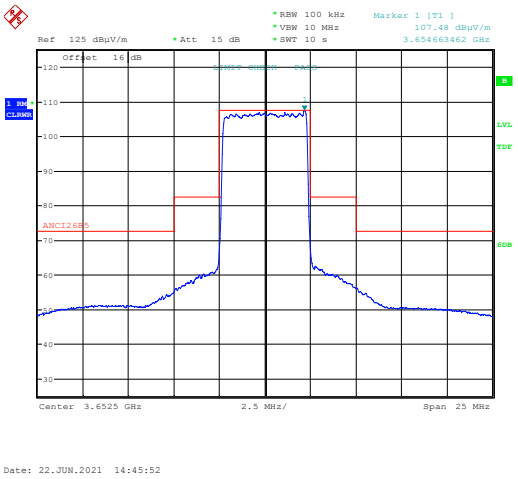


Emission Mask; QPSK; 3675 MHz; MIMO A.

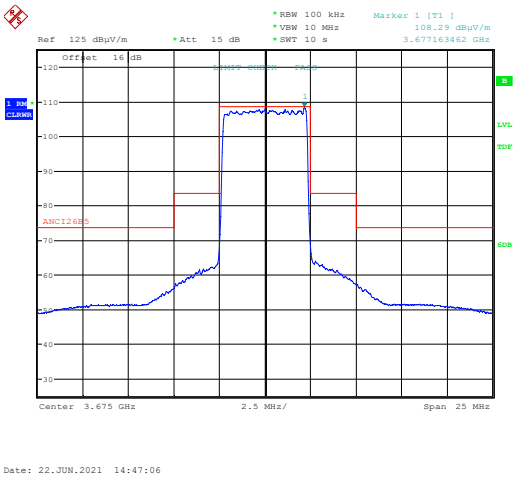


Emission Mask; QPSK; 3697.5 MHz; MIMO A.

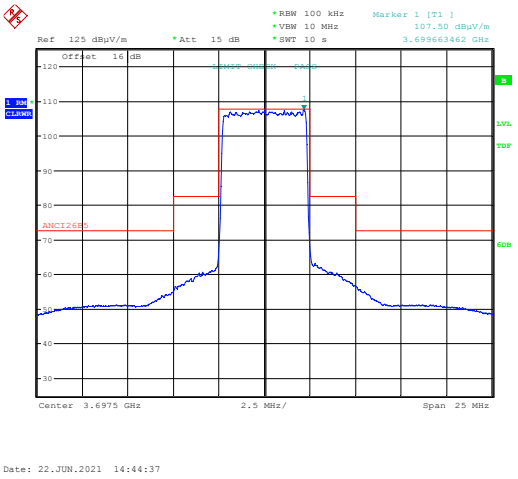
Sector 5 MHz Emission Mask



Emission Mask; QPSK; 3652.5 MHz; MIMO A.

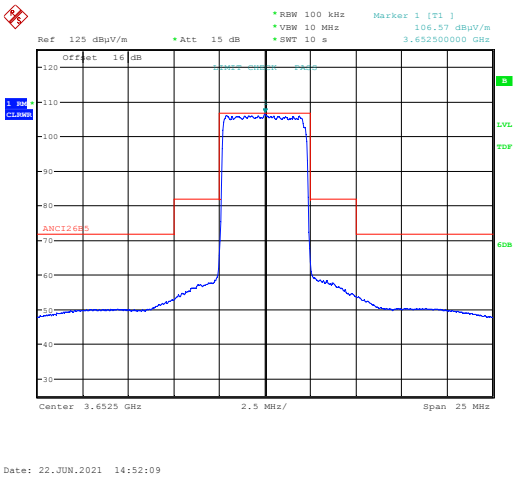


Emission Mask; QPSK; 3675 MHz; MIMO A.

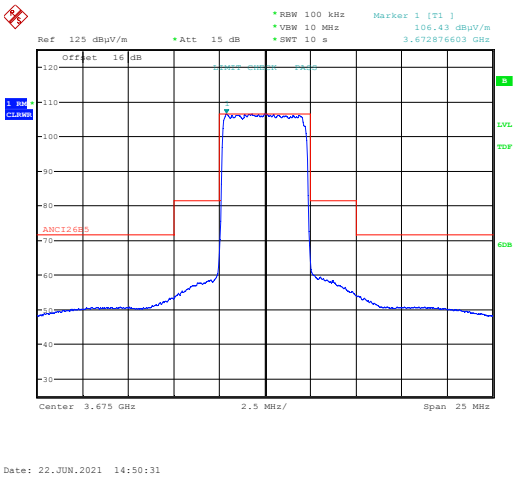


Emission Mask; QPSK; 3697.5 MHz; MIMO A.

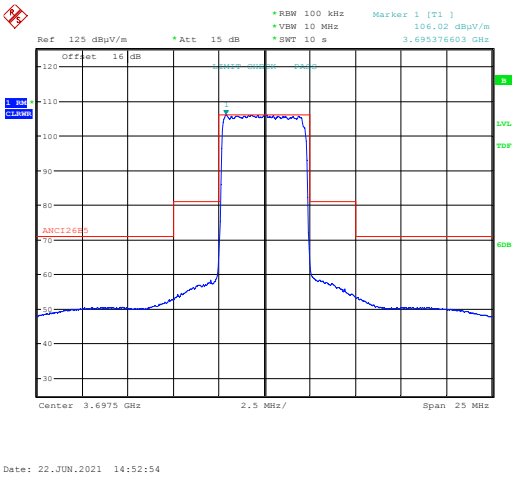
MU-MIMO 5 MHz Emission Mask



Emission Mask; QPSK; 3652.5 MHz; MIMO A.



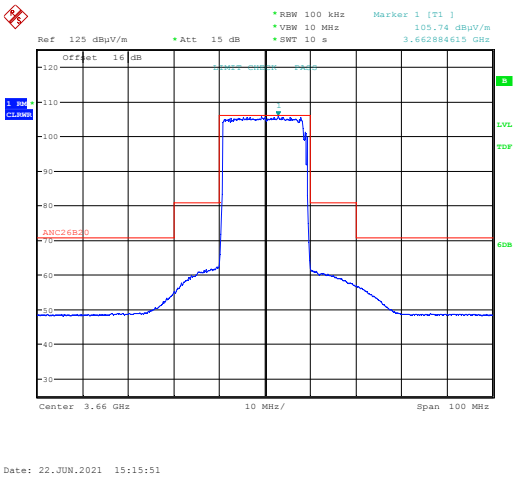
Emission Mask; QPSK; 3675 MHz; MIMO A.



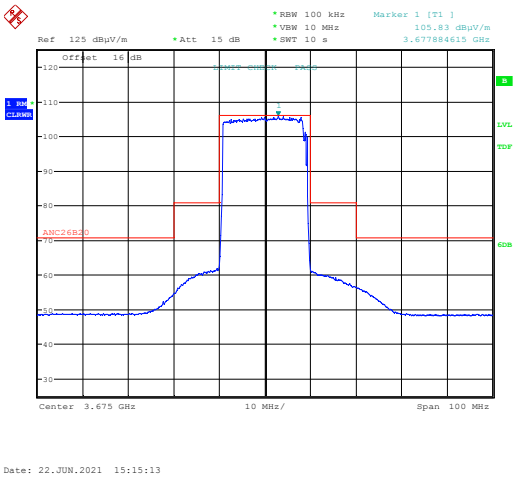
Emission Mask; QPSK; 3697.5 MHz; MIMO A.

GUI Power settings 20 MHz Bandwidth			
Transmission Mode	Bottom Channel	Middle Channel	Top Channel
Beamforming	37.5	37.5	37.5
Sector	37.5	37.5	37.5
MU-MIMO	37.5	38.0	37.5

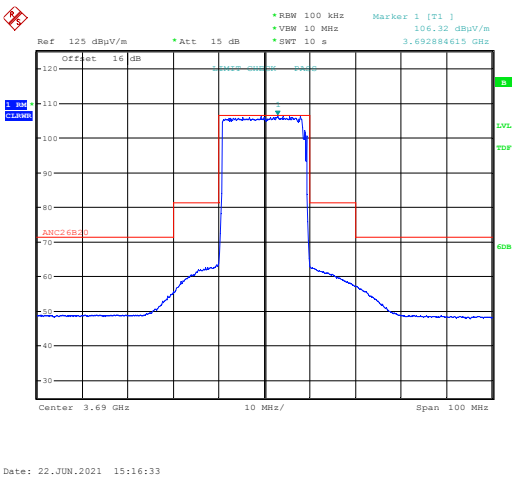
Beamforming 20 MHz Emission Mask



Emission Mask; QPSK; 3660 MHz; MIMO A.

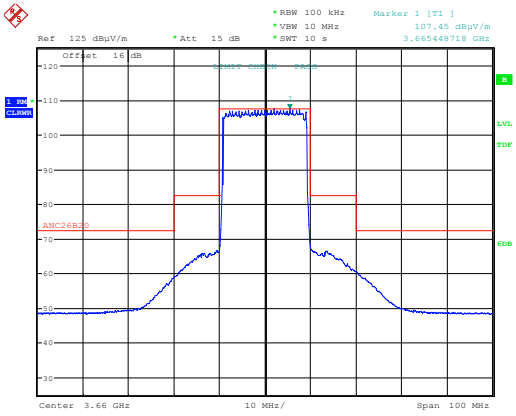


Emission Mask; QPSK; 3675 MHz; MIMO A.

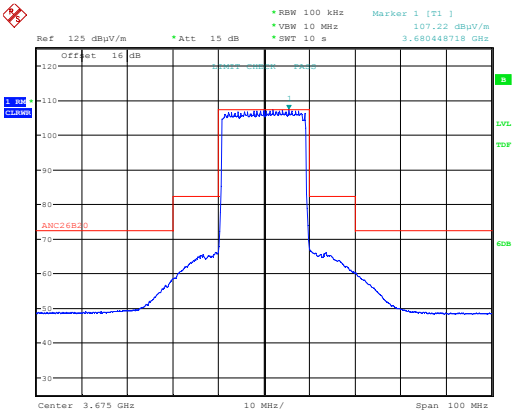


Emission Mask; QPSK; 3690 MHz; MIMO A.

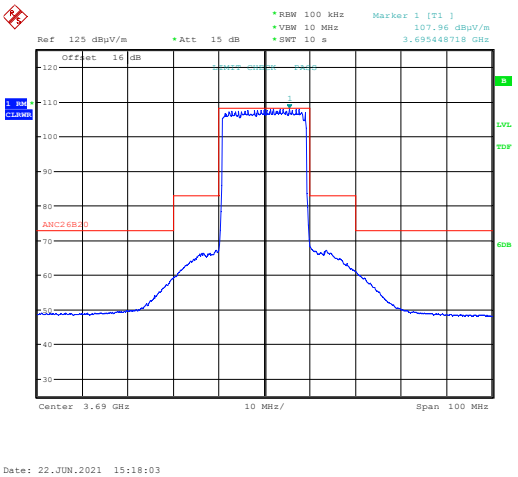
Sector 20 MHz Emission Mask



Emission Mask; QPSK; 3660 MHz; MIMO A.

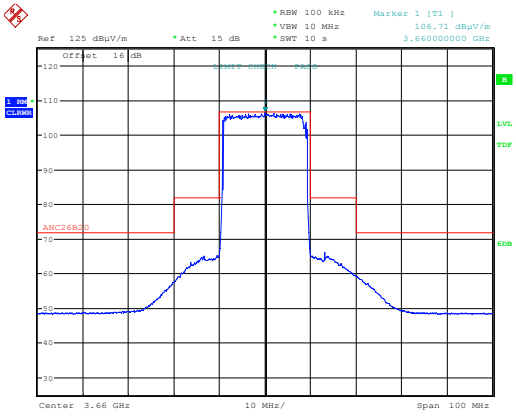


Emission Mask; QPSK; 3675 MHz; MIMO A.

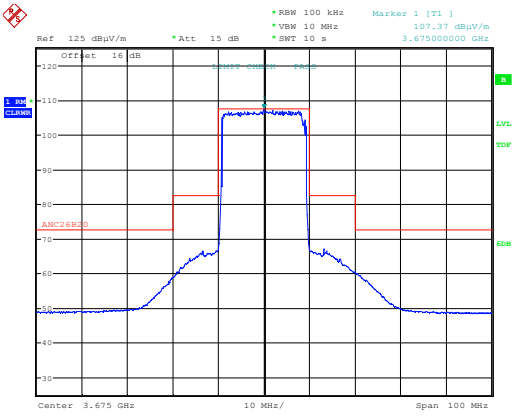


Emission Mask; QPSK; 3690 MHz; MIMO A.

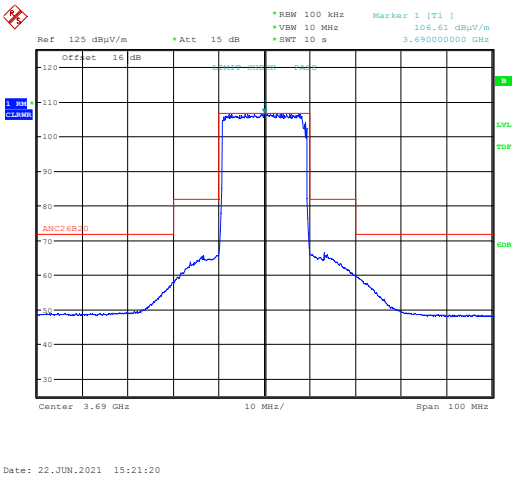
MU-MIMO 20 MHz Emission Mask



Emission Mask; QPSK; 3660 MHz; MIMO A.



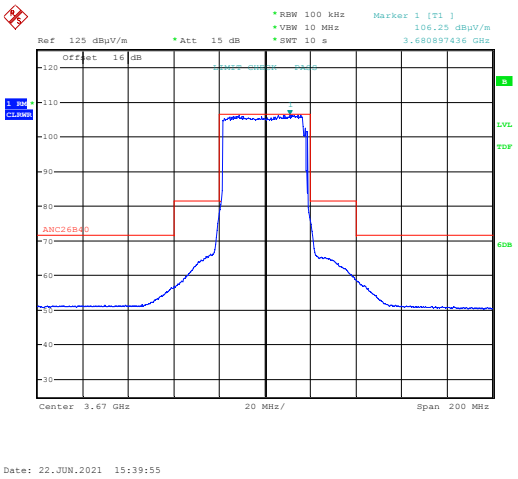
Emission Mask; QPSK; 3675 MHz; MIMO A.



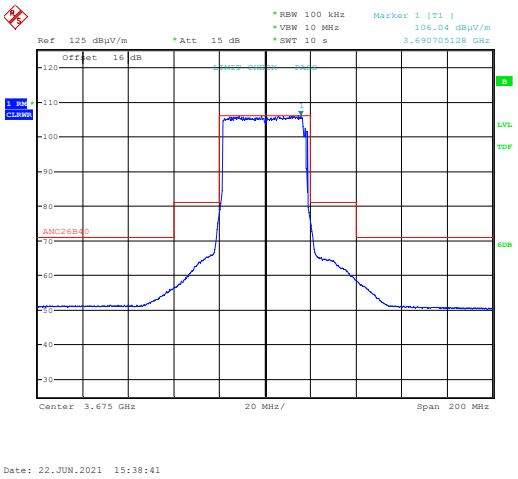
Emission Mask; QPSK; 3690 MHz; MIMO A.

GUI Power settings 40 MHz Bandwidth			
Transmission Mode	Bottom Channel	Middle Channel	Top Channel
Beamforming	41.5	41.5	41.5
Sector	37.5	37.5	37.5
MU-MIMO	39.0	39.0	39.0

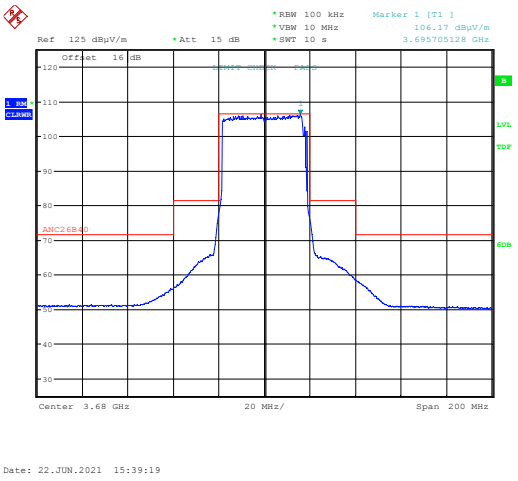
Beamforming 40 MHz Emission Mask



Emission Mask; QPSK; 3670 MHz; MIMO A.

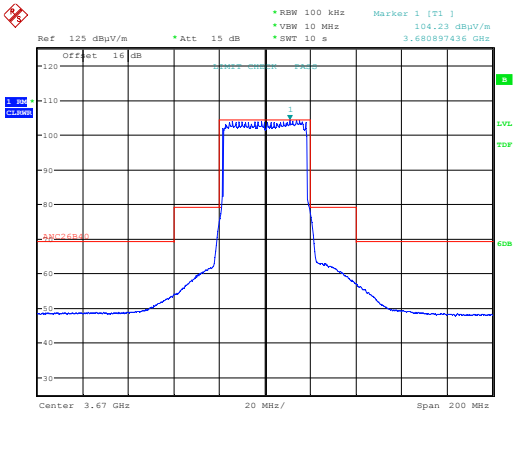


Emission Mask; QPSK; 3675 MHz; MIMO A.

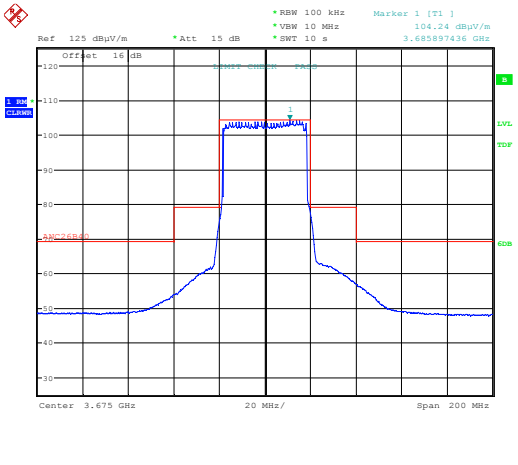


Emission Mask; QPSK; 3680 MHz; MIMO A.

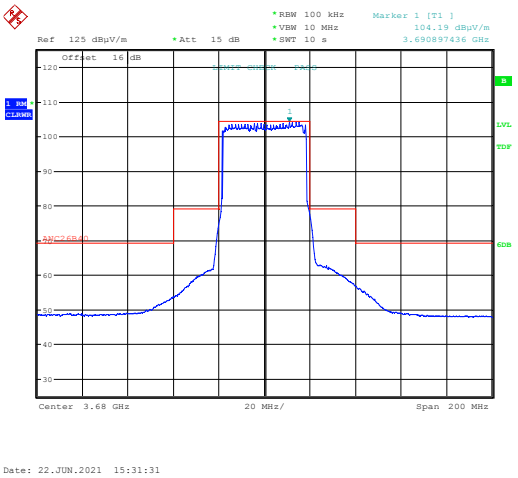
Sector 40 MHz Emission Mask



Emission Mask; QPSK; 3670 MHz; MIMO A.

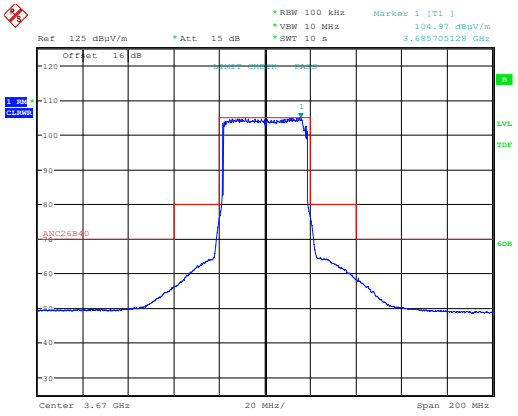


Emission Mask; QPSK; 3675 MHz; MIMO A.

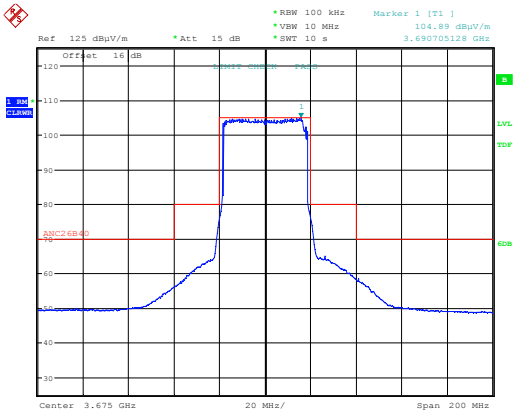


Emission Mask; QPSK; 3680 MHz; MIMO A.

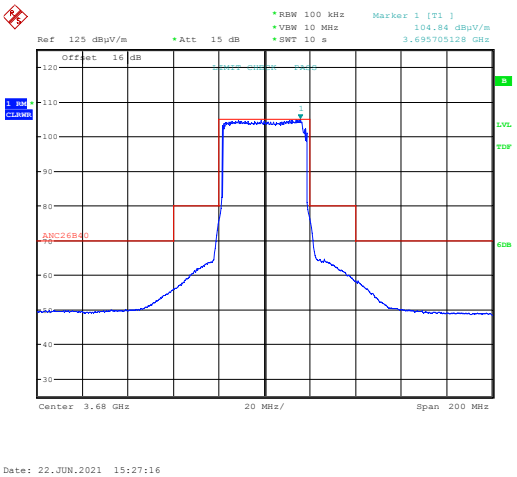
MU-MIMO 40 MHz Emission Mask



Emission Mask; QPSK; 3670 MHz; MIMO A.



Emission Mask; QPSK; 3675 MHz; MIMO A.



Emission Mask; QPSK; 3680 MHz; MIMO A.

14 Frequency stability

14.1 Definition

Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Blocking Laboratory
Test Standard and Clause:	90.213
Channels / Frequencies Measured:	3652.5 MHz, 3675 MHz and 3697.5 MHz
Resolution Bandwidth: (Requirement 1 % of the Occupied Channel Bandwidth):	50 kHz; 200 kHz and 400 kHz
Modulation:	Off
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	-30 to +50 C
Voltage Extreme Environment Test Range:	Power = ±15% of Nominal;

Environmental Conditions (Normal Environment)

Temperature: 24 °C	Standard Requirement: +20 ºC
Humidity: 60 %RH	20 % RH to 75 % RH (as declared)

14.3 Test Limit

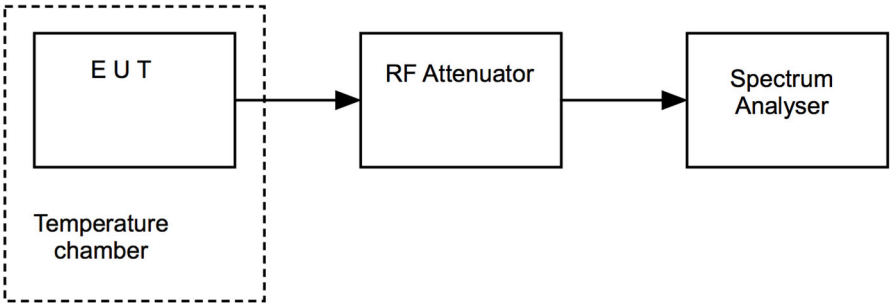
The applicant shall ensure frequency stability by showing that f_L minus the frequency offset and f_H plus the frequency offset shall be within the 3650-3700 MHz band.

14.4 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.

Figure v Test Setup



14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Spectrum Analyser	R&S	FSW 43	U728	2022-04-20
Multimeter	Agilent	34405a	REF976	2021-11-26
Power Supply	Farnell	AP60/50	U194	Use REF976
Temperature Indicator	Fluke	52 Series II	L426	2021-07-02
Temperature Chamber	ETS-S1000CHS	ETS	U522	Use L426

14.6 Test Results

EUT Frequency: 3652.5 MHz					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (kHz)***	***Drift (ppm)***	***Result***
-30 C	$V_{nominal}$	3652.50528	7.20	1.97	PASS
-20 C	$V_{nominal}$	3652.50240	4.32	1.18	PASS
-10 C	$V_{nominal}$	3652.50176	3.68	1.01	PASS
0 C	$V_{nominal}$	3652.50032	2.24	0.61	PASS
+10 C	$V_{nominal}$	3652.49872	0.64	0.18	PASS
+20 C	$V_{minimum}$	3652.49808	0.00	0.00	PASS
	$V_{nominal}$	3652.49808	0.00	0.00	N/A
	$V_{maximum}$	3652.49808	0.00	0.00	PASS
+30 C	$V_{nominal}$	3652.49712	-0.96	-0.26	PASS
+40 C	$V_{nominal}$	3652.49648	-1.60	-0.44	PASS
+50 C	$V_{nominal}$	3652.49584	-2.24	-0.61	PASS

EUT Frequency: 3675 MHz					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (kHz)***	***Drift (ppm)***	***Result***
-30 C	$V_{nominal}$	3675.00430	6.20	1.69	PASS
-20 C	$V_{nominal}$	3675.00240	4.30	1.17	PASS
-10 C	$V_{nominal}$	3675.00170	3.60	0.98	PASS
0 C	$V_{nominal}$	3675.00050	2.40	0.65	PASS
+10 C	$V_{nominal}$	3674.99880	0.70	0.19	PASS
+20 C	$V_{minimum}$	3674.99800	-0.10	-0.03	PASS
	$V_{nominal}$	3674.99800	-0.10	-0.03	N/A
	$V_{maximum}$	3674.99810	0.00	0.00	PASS
+30 C	$V_{nominal}$	3674.99710	-1.00	-0.27	PASS
+40 C	$V_{nominal}$	3674.99650	-1.60	-0.44	PASS
+50 C	$V_{nominal}$	3674.99590	-2.20	-0.60	PASS

EUT Frequency: 3697.5					
Test Environment		***Measured Frequency (MHz)***	***Frequency error (kHz)***	***Drift (ppm)***	***Result***
-30 C	$V_{nominal}$	3697.50420	6.30	1.70	PASS
-20 C	$V_{nominal}$	3697.50280	4.90	1.33	PASS
-10 C	$V_{nominal}$	3697.50160	3.70	1.00	PASS
0 C	$V_{nominal}$	3697.50070	2.80	0.76	PASS
+10 C	$V_{nominal}$	3697.49880	0.90	0.24	PASS
+20 C	$V_{minimum}$	3697.49790	0.00	0.00	PASS
	$V_{nominal}$	3697.49790	0.00	0.00	N/A
	$V_{maximum}$	3697.49790	0.00	0.00	PASS
+30 C	$V_{nominal}$	3697.49710	-0.80	-0.22	PASS
+40 C	$V_{nominal}$	3697.49650	-1.40	-0.38	PASS
+50 C	$V_{nominal}$	3697.49590	-2.00	-0.54	PASS

15 Peak EIRP Density and Equivalent Isotropically Radiated Power (EIRP)

15.1 Definition

The power per unit bandwidth.

15.2 Test Parameters

Test Location:	Pershore Airfield
Test Chamber:	Air field
Test Standard and Clause:	RSS-197, Issue 1, February 2010, Clause 5.6.2
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	5 MHz, 20 MHz and 40 MHz
Deviations From Standard:	None
Measurement BW:	1 MHz
Spectrum Analyzer Video BW:	3 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 50 % RH	20 % RH to 75 % RH (as declared)
Supply: 48 V dc	48 V dc (as declared)

15.3 Test Limit

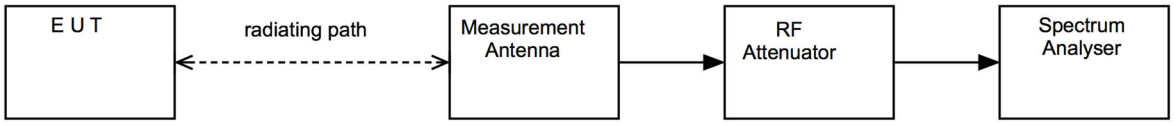
The maximum transmitter output power density of equipment, other than mobile and portable equipment, shall not exceed 1W in any 1 MHz bandwidth.

15.4 Test Method

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

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

Figure vi Test Setup



15.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Horn Antenna	A Info Inc	LB-10180-NF	REF2242	2022-07-13
FSU50	R&S	Spectrum Analyser	U544	2022-06-22
3161	EMCO	2- 4 GHz Horn	9910-1058	2022-05-21

15.6 Test Results

Bottom channel; Bandwidth: 5 MHz;						
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Max. Output Power Density (W/MHz)***	***Limit (W)***	***Result***
3652.5	Sector	QPSK	A	1.0	1	PASS
3652.5	MuMIMO		A	0.7	1	PASS
3652.5	Beamform		A	1.0	1	PASS

Middle channel; Bandwidth: 5 MHz						
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Max. Output Power Density (W/MHz)***	***Limit (W)***	***Result***
3675	Sector	QPSK	A	0.9	1	PASS
3675			B	0.9	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	1.0	1	PASS
3675	Sector	16 QAM	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	1.0	1	PASS
3675	Sector	64 QAM	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	1.0	1	PASS
3675	Sector	256 QAM	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	1.0	1	PASS

Top channel; Bandwidth: 5 MHz						
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Max. Output Power Density (W/MHz)***	***Limit (W)***	***Result***
3697.5	Sector	QPSK	A	0.8	1	PASS
3697.5	MuMIMO		A	1.0	1	PASS
3697.5	Beamform		A	0.9	1	PASS

Bottom channel; Bandwidth: 20 MHz						
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Max. Output Power Density (W/MHz)**	**Limit (W)**	**Result**
3660	Sector	QPSK	A	1.0	1	PASS
3660	MuMIMO		A	1.0	1	PASS
3660	Beamform		A	0.9	1	PASS

Middle channel; Bandwidth: 20 MHz						
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Max. Output Power Density (W/MHz)**	**Limit (W)**	**Result**
3675	Sector	QPSK	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	0.5	1	PASS
3675	Sector	16 QAM	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	0.9	1	PASS
3675	Beamform		A	0.3	1	PASS
3675	Sector	64 QAM	A	0.8	1	PASS
3675			B	0.8	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	0.1	1	PASS
3675	Sector	256 QAM	A	0.6	1	PASS
3675			B	0.6	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	0.9	1	PASS

Top channel; Bandwidth: 20 MHz						
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Max. Output Power Density (W/MHz)**	**Limit (W)**	**Result**
3690	Sector	QPSK	A	0.3	1	PASS
3690	MuMIMO		A	0.4	1	PASS
3690	Beamform		A	0.6	1	PASS

Bottom channel; Bandwidth: 40 MHz						
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Max. Output Power Density (W/MHz)**	**Limit (W)**	**Result**
3670	Sector	QPSK	A	0.8	1	PASS
3670	MuMIMO		A	1.0	1	PASS
3670	Beamform		A	1.0	1	PASS

Middle channel; Bandwidth: 40 MHz						
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Max. Output Power Density (W/MHz)**	**Limit (W)**	**Result**
3675	Sector	QPSK	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	1.0	1	PASS
3675	Sector	16 QAM	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	0.5	1	PASS
3675	Sector	64 QAM	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	0.2	1	PASS
3675	Sector	256 QAM	A	1.0	1	PASS
3675			B	1.0	1	PASS
3675	MuMIMO		A	1.0	1	PASS
3675	Beamform		A	0.6	1	PASS

Top channel; Bandwidth: 40 MHz						
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Max. Output Power Density (W/MHz)**	**Limit (W)**	**Result**
3680	Sector	QPSK	A	0.7	1	PASS
3680	MuMIMO		A	1.0	1	PASS
3680	Beamform		A	0.9	1	PASS

15.7 Test Results – Equivalent Isotropic Radiated Power (EIRP)

Bottom channel; Bandwidth: 5 MHz								
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Peak EIRP Density (W/MHz)***	***1 MHz to 5 MHz Correction (dB)***	***EIRP (W/25MHz)***	***Limit (W/25MHz)***	***Result***
3652.5	Sector	QPSK	A	1.0	7.0	5.0	25	PASS
3652.5	MU-MIMO		A	0.7	7.0	3.5	25	PASS
3652.5	Beamforming		A	1.0	7.0	5.0	25	PASS

Middle channel; Bandwidth: 5 MHz								
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Peak EIRP Density (W/MHz)***	***1 MHz to 5 MHz Correction (dB)***	***EIRP (W/25MHz)***	***Limit (W/25MHz)***	***Result***
3675	Sector	QPSK	A	0.9	7.0	4.5	25	PASS
3675			B	0.9	7.0	4.5	25	PASS
3675	MU-MIMO		A	1.0	7.0	5.0	25	PASS
3675	Beamforming		A	1.0	7.0	5.0	25	PASS
3675	Sector	16QAM	A	1.0	7.0	5.0	25	PASS
3675			B	1.0	7.0	5.0	25	PASS
3675	MU-MIMO		A	1.0	7.0	5.0	25	PASS
3675	Beamforming		A	1.0	7.0	5.0	25	PASS
3675	Sector	64QAM	A	1.0	7.0	5.0	25	PASS
3675			B	1.0	7.0	5.0	25	PASS
3675	MU-MIMO		A	1.0	7.0	5.0	25	PASS
3675	Beamforming		A	1.0	7.0	5.0	25	PASS
3675	Sector	256QAM	A	1.0	7.0	5.0	25	PASS
3675			B	1.0	7.0	5.0	25	PASS
3675	MU-MIMO		A	1.0	7.0	5.0	25	PASS
3675	Beamforming		A	1.0	7.0	5.0	25	PASS

Bottom channel; Bandwidth: 5 MHz								
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Peak EIRP Density (W/MHz)***	***1 MHz to 5 MHz Correction (dB)***	***EIRP (W/25MHz)***	***Limit (W/25MHz)***	***Result***
3697.5	Sector	QPSK	A	0.8	7.0	4.0	25	PASS
3697.5	MU-MIMO		A	1.0	7.0	5.0	25	PASS
3697.5	Beamforming		A	0.9	7.0	4.5	25	PASS

Bottom channel; Bandwidth: 20 MHz								
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Peak EIRP Density (W/MHz)**	**1 MHz to 20 MHz Correction (dB)**	**EIRP (W/25MHz)**	**Limit (W/25MHz)**	**Result**
3660	Sector	QPSK	A	1.0	13.0	20.0	25	PASS
3660	MU-MIMO		A	1.0	13.0	20.0	25	PASS
3660	Beamforming		A	0.9	13.0	18.0	25	PASS

Middle channel; Bandwidth: 20 MHz								
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Peak EIRP Density (W/MHz)**	**1 MHz to 20 MHz Correction (dB)**	**EIRP (W/25MHz)**	**Limit (W/25MHz)**	**Result**
3675	Sector	QPSK	A	1	13.0	20.0	25	PASS
3675			B	1	13.0	20.0	25	PASS
3675	MU-MIMO		A	1	13.0	20.0	25	PASS
3675	Beamforming		A	0.5	13.0	10.0	25	PASS
3675	Sector	16QAM	A	1.0	13.0	20.0	25	PASS
3675			B	1.0	13.0	20.0	25	PASS
3675	MU-MIMO		A	0.9	13.0	18.0	25	PASS
3675	Beamforming		A	0.3	13.0	6.0	25	PASS
3675	Sector	64QAM	A	0.8	13.0	16.0	25	PASS
3675			B	0.8	13.0	16.0	25	PASS
3675	MU-MIMO		A	1.0	13.0	20.0	25	PASS
3675	Beamforming		A	0.1	13.0	2.0	25	PASS
3675	Sector	256QAM	A	0.6	13.0	12.0	25	PASS
3675			B	0.6	13.0	12.0	25	PASS
3675	MU-MIMO		A	1.0	13.0	20.0	25	PASS
3675	Beamforming		A	0.9	13.0	18.0	25	PASS

Top channel; Bandwidth: 20 MHz								
Channel Frequency (MHz)	**Transition Mode**	**Modulation**	**MIMO**	**Peak EIRP Density (W/MHz)**	**1 MHz to 20 MHz Correction (dB)**	**EIRP (W/25MHz)**	**Limit (W/25MHz)**	**Result**
3690	Sector	QPSK	A	0.3	13.0	6.0	25	PASS
3690	MU-MIMO		A	0.4	13.0	8.0	25	PASS
3690	Beamforming		A	0.6	13.0	12.0	25	PASS

Bottom channel; Bandwidth: 40 MHz								
Channel Frequency (MHz)	Transition Mode	Modulation	MIMO	Peak EIRP Density (W/MHz)	1 MHz to 25 MHz Correction (dB)	EIRP (W/25MHz)	Limit (W/25MHz)	Result
3670	Sector	QPSK	A	0.8	14.0	20.0	25	PASS
3670	MU-MIMO		A	1.0	14.0	25.0	25	PASS
3670	Beamforming		A	1.0	14.0	25.0	25	PASS

Middle channel; Bandwidth: 40 MHz								
Channel Frequency (MHz)	Transition Mode	Modulation	MIMO	Peak EIRP Density (W/MHz)	1 MHz to 25 MHz Correction (dB)	EIRP (W/25MHz)	Limit (W/25MHz)	Result
3675	Sector	QPSK	A	1.0	14.0	25.0	25	PASS
3675			B	1.0	14.0	25.0	25	PASS
3675	MU-MIMO		A	1.0	14.0	25.0	25	PASS
3675	Beamforming		A	1.0	14.0	25.0	25	PASS
3675	Sector	16QAM	A	1.0	14.0	25.0	25	PASS
3675			B	1.0	14.0	25.0	25	PASS
3675	MU-MIMO		A	1.0	14.0	25.0	25	PASS
3675	Beamforming		A	0.5	14.0	12.5	25	PASS
3675	Sector	64QAM	A	1.0	14.0	25.0	25	PASS
3675			B	1.0	14.0	25.0	25	PASS
3675	MU-MIMO		A	1.0	14.0	25.0	25	PASS
3675	Beamforming		A	0.2	14.0	5.0	25	PASS
3675	Sector	256QAM	A	1.0	14.0	25.0	25	PASS
3675			B	1.0	14.0	25.0	25	PASS
3675	MU-MIMO		A	1.0	14.0	25.0	25	PASS
3675	Beamforming		A	0.6	14.0	15.0	25	PASS

Top channel; Bandwidth: 40 MHz								
Channel Frequency (MHz)	Transition Mode	Modulation	MIMO	Peak EIRP Density (W/MHz)	1 MHz to 25 MHz Correction (dB)	EIRP (W/25MHz)	Limit (W/25MHz)	Result
3680	Sector	QPSK	A	0.7	14.0	17.5	25	PASS
3680	MU-MIMO		A	1.0	14.0	25.0	25	PASS
3680	Beamforming		A	0.9	14.0	22.5	25	PASS

Bottom channel; Bandwidth: 40 MHz						
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Peak EIRP Density (W/MHz)***	***1 MHz to 40 MHz Correction (dB)***	***EIRP (W/40MHz)***
3670	Sector	QPSK	A	0.8	16.0	32
3670	MU-MIMO		A	1.0	16.0	40
3670	Beamforming		A	1.0	16.0	40

Middle channel; Bandwidth: 40 MHz						
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Peak EIRP Density (W/MHz)***	***1 MHz to 40 MHz Correction (dB)***	***EIRP (W/40MHz)***
3675	Sector	QPSK	A	1.0	16.0	40
3675			B	1.0	16.0	40
3675	MU-MIMO		A	1.0	16.0	40
3675	Beamforming		A	1.0	16.0	40
3675	Sector	16QAM	A	1.0	16.0	40
3675			B	1.0	16.0	40
3675	MU-MIMO		A	1.0	16.0	40
3675	Beamforming		A	0.5	16.0	20
3675	Sector	64QAM	A	1.0	16.0	40
3675			B	1.0	16.0	40
3675	MU-MIMO		A	1.0	16.0	40
3675	Beamforming		A	0.2	16.0	8
3675	Sector	256QAM	A	1.0	16.0	40
3675			B	1.0	16.0	40
3675	MU-MIMO		A	1.0	16.0	40
3675	Beamforming		A	0.6	16.0	24

Top channel; Bandwidth: 40 MHz						
Channel Frequency (MHz)	***Transition Mode***	***Modulation***	***MIMO***	***Peak EIRP Density (W/MHz)***	***1 MHz to 40 MHz Correction (dB)***	***EIRP (W/40MHz)***
3680	Sector	QPSK	A	0.7	16.0	28
3680	MU-MIMO		A	1.0	16.0	40
3680	Beamforming		A	0.9	16.0	36

16 Measurement Uncertainty

Calculated Measurement Uncertainties

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

[1] Radiated spurious emissions

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

[2] AC power line conducted emissions

Uncertainty in test result = **3.2 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.58 %**

[4] Conducted carrier power

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

[5] Conducted RF power out-of-band

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

[6] Radiated RF power out-of-band

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

[7] Power spectral density

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

[8] ERP / EIRP

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