





EMC Technologies (NZ) Ltd
47 Mackelvie St, Grey Lynn
Auckland 1021
New Zealand
Phone 09 360 0862
Fax 09 360 0861
E-Mail Address: aucklab@emctech.co.nz
Web Site: www.emctech.co.nz

TEST REPORT

MiMOMax MWL-TORNADO-*GC*

Fixed Digital Transceiver

tested to the

Code of Federal Regulations (CFR) 47

Part 101 –Fixed Microwave Services

for

MiMOMax Wireless Ltd

This Test Report is issued with the authority of:

A handwritten signature in black ink, appearing to read "Andrew Cutler", is positioned above a horizontal line.

Andrew Cutler - General Manager



All tests reported herein
have been performed in
accordance with the
laboratory's scope of
accreditation

Table of Contents

1.	STATEMENT OF COMPLIANCE	3
2.	RESULTS SUMMARY	3
3.	INTRODUCTION	4
4.	CLIENT INFORMATION	5
5.	DESCRIPTION OF TEST SAMPLE	5
6.	TESTING OVERVIEW	8
7.	TEST RESULTS	9
8.	TEST EQUIPMENT USED	24
9.	ACCREDITATIONS	24
10.	PHOTOGRAPHS	25

EMC
Technologies

1. STATEMENT OF COMPLIANCE

The **MiMOMax MWL-TORNADO-*GC* Fixed Digital Transceiver** complies with CFR 47 Part 101 and 47 CFR Part 2, as detailed below, when tested in-accordance with the test methods described in 47 CFR Part 2 and ANSI / TIA-603-E: 2016 and ANSI C63.26 – 2015.

2. RESULTS SUMMARY

The results of testing carried out between 3rd and 10th of November 2021 are summarised below.

Clause	Description	Result
101.107	Frequency tolerance	Complies
101.109	Bandwidth	Complies
101.111	Emission limitations	Complies
	Spurious emission at antenna port	Complies
	Spurious emissions field strength	Not tested
101.113	Transmitter power limitations	Complies

3. INTRODUCTION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

This report does not contain corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate FCC regulations.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Industry Canada standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

4. CLIENT INFORMATION

Company Name MiMOMax Wireless Ltd
Address 540 Wairakei Road
Burnside
Christchurch
Country New Zealand
Contact Mr James Dowle

5. DESCRIPTION OF TEST SAMPLE

Brand Name MiMOMax
Model Number MiMOMax MWL-TORNADO-*GC*
Product Fixed Digital Transceiver
Manufacturer MiMOMAX Wireless Ltd
Manufactured in New Zealand
Serial Numbers 23005126
FCC ID XMK-MMXTRNB003

The sample tested has the following specifications:

Rated Transmitter Output Power

Two transmitters each outputting +24 dBm (0.25 Watt) average

Transmitter FCC Frequency Bands

928.0 – 929.0 MHz
932.5 – 935.0 MHz
941.0 – 941.5 MHz
941.5 – 944.0 MHz
952.0 – 958.0 MHz
958.0 – 960.0 MHz

Testing was performed on a single frequency that is representative of the performance of the radio over the range 928.0 – 960.0 MHz

Test frequencies – Transmit

952.775 MHz

Test frequencies – Receive

928.775 MHz

Channel bandwidths

12.5 kHz, 25.0 kHz, 50.0 kHz and 75.0 kHz

Declared Authorised Bandwidths

10.0 kHz, 20 kHz, 41 kHz, 62.2 kHz

Modulation Types

QPSK, QAM16, QAM64, QAM256

Emission Designators / Modes of operation

10k0W1W	digital speech and data
20k0W1W	digital speech and data
41k0W1W	digital speech and data
62K2W1W	digital speech and data

Power Supply

DC voltage supply over the range of 10.5 Vdc to 60 Vdc

Typically 12.0 Vdc or 24.0 Vdc using lead acid batteries

Standard Temperature and Humidity

Temperature: +15°C to + 30°C maintained.

Relative Humidity: 20% to 75% observed.

Standard Test Power Source

Standard Test Voltage: 24.0 Vdc

Extreme Test Voltages

High Voltage: 60.0 Vdc
Low Voltage: 10.5 Vdc

Extreme Temperature

High Temperature: + 50°C maintained.
Low Temperature: - 30 °C maintained.



6. TESTING OVERVIEW

The product that has been tested has previously certified to FCC part 101 with FCC ID-XMK-MMXTRNB003.

This certification supported various modulation types and bandwidths up to 50 kHz.

This test report contains additional testing in order that a 75 kHz channel bandwidth can be added to the FCC certification for this product.

An assessment was carried out on the product and a limited range of tests carried out to confirm the acceptability of the addition channel bandwidth and to ensure that the existing certification conditions have been maintained.

The client has stated that apart from the addition of the 75 kHz channel bandwidth no changes have been made for to the carrier output of the transmitter or to the transmitter hardware.

The radio has two transmit ports labelled as V and H.

Both ports have been tested for emission masks and transmit power.

Frequency stability testing has been performed on port H, with port V terminated with a resistive dummy load.

The radio was been tuned to transmit with 75 kHz bandwidth.

The carrier and different modulation modes were selected using the client supplied test software.

7. TEST RESULTS

Part 101.107 Frequency Tolerance

Frequency tolerance measurements were between - 30 °C and + 50°C.

The testing was performed on a modulation analyser.

At each temperature the transmitter was given a period of 30 minutes to stabilise. The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Frequency: 952.775 MHz / Port H

Temperature (°C)	Voltage 10.5 Vdc	Voltage 24.0 Vdc	Voltage 60.0 Vdc
+50	-20 Hz	-20 Hz	-20 Hz
+20	+28 Hz	+27 Hz	+30 Hz
0	-100 Hz	-100 Hz	-100 Hz
-10	-48 Hz	-42 Hz	-45 Hz
-30	-40 Hz	-40 Hz	-40 Hz

Limit:

Part 101.107 (a) states that for multiple address master stations a frequency tolerance of +/- 0.00015 % will apply.

Transmitter was tested on 952.775 MHz: +/- 0.00015 % = +/- 1429 Hz.

Result: Complies

Measurement Uncertainty: ±30 Hz

Part 101.109 Bandwidth limitations:

The transmitter tested has been designed to operate using four modulation types: QPSK, 16QAM, 64QAM and 256QAM.

An emission designator of W1W has been applied by the client with the transmitter being capable of operating with the following declared bandwidths: 10.0 kHz, 20.0, 41.0 kHz and 62.2 kHz.

The authorised bandwidths that would apply to this transmitter would be: 12.5 kHz, 25 kHz, 50 kHz and 75 kHz.

This report contains the measurement results for 75 kHz bandwidth.

Measurements were made when the transmitter was operating on 952.775 MHz.

The occupied bandwidth has been measured and compared against the occupied bandwidth declared by the client.

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and an external 30 dB attenuator applied which has been accounted for in the spectrum plots below.

The measurement of occupied bandwidth was conducted using occupied bandwidth function available in the spectrum analyser.

The resolution bandwidth for this measurement was maintained between 1% to 5 %, of the measured occupied bandwidth.

Result: Complies

Test Frequency: 952.775 MHz

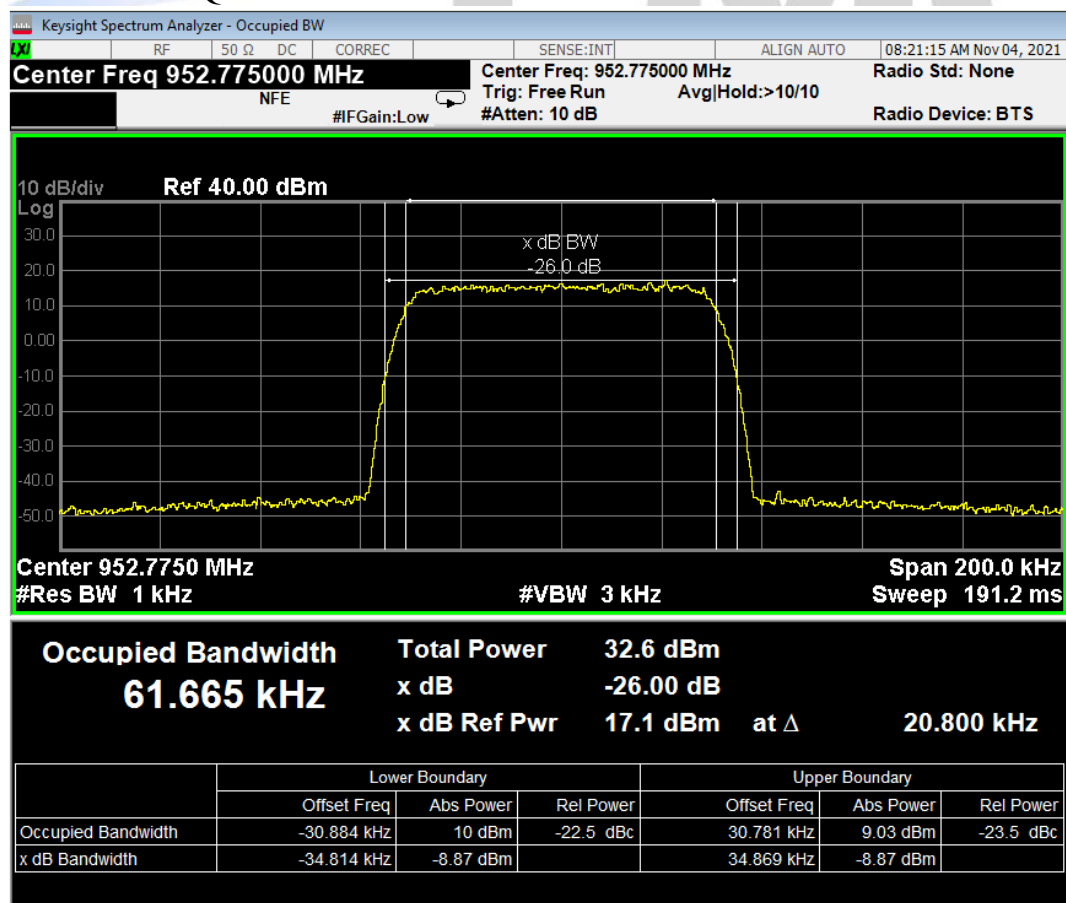
Port Tested: V

Modulation	Emission	Measured	Designated	Authorised	Plot no
QPSK	W1W	61.665 kHz	62.2 kHz	75.0 kHz	Plot-1
16QAM	W1W	61.809 kHz	62.2 kHz	75.0 kHz	Plot-2
64QAM	W1W	61.868 kHz	62.2 kHz	75.0 kHz	Plot-3
256QAM	W1W	62.084 kHz	62.2 kHz	75.0 kHz	Plot-4

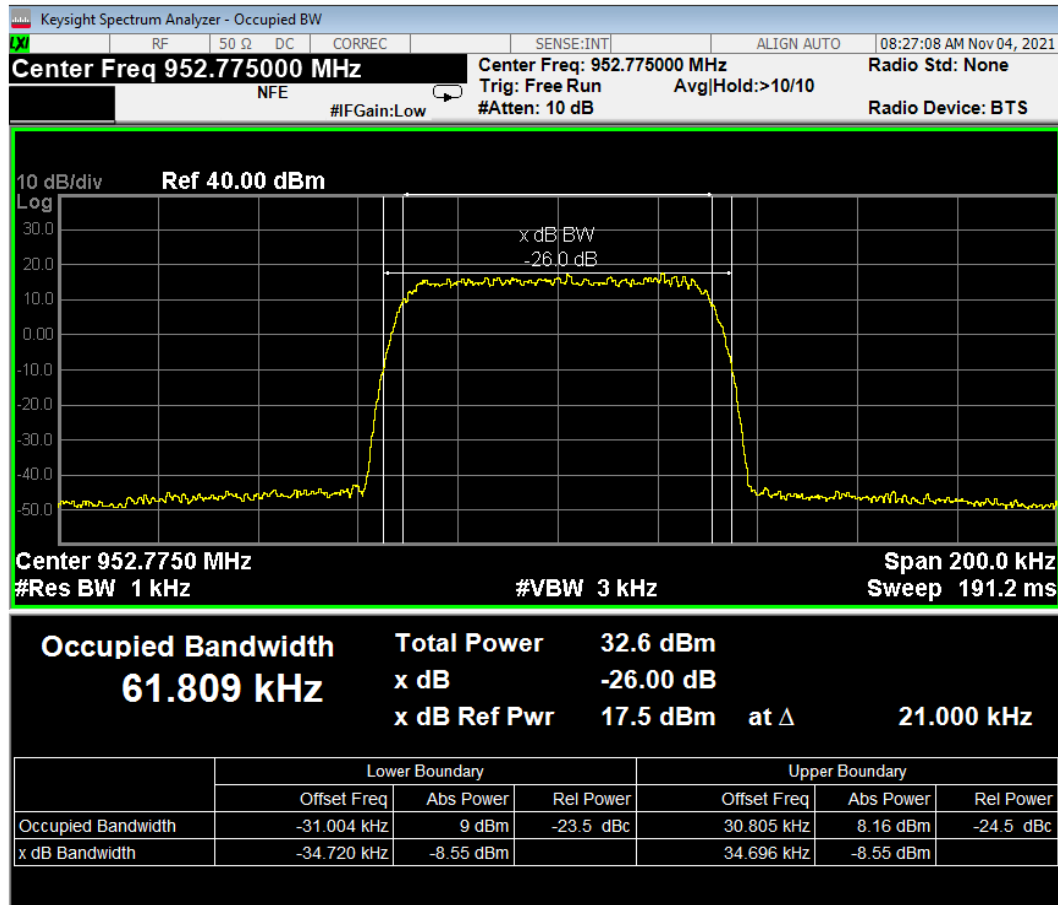
Port Tested: H

Modulation	Emission	Measured	Designated	Authorised	Plot no
QPSK	W1W	61.865 kHz	62.2 kHz	75.0 kHz	Plot-5
16QAM	W1W	61.919 kHz	62.2 kHz	75.0 kHz	Plot-6
64QAM	W1W	61.760 kHz	62.2 kHz	75.0 kHz	Plot-7
256QAM	W1W	61.802 kHz	62.2 kHz	75.0 kHz	Plot-8

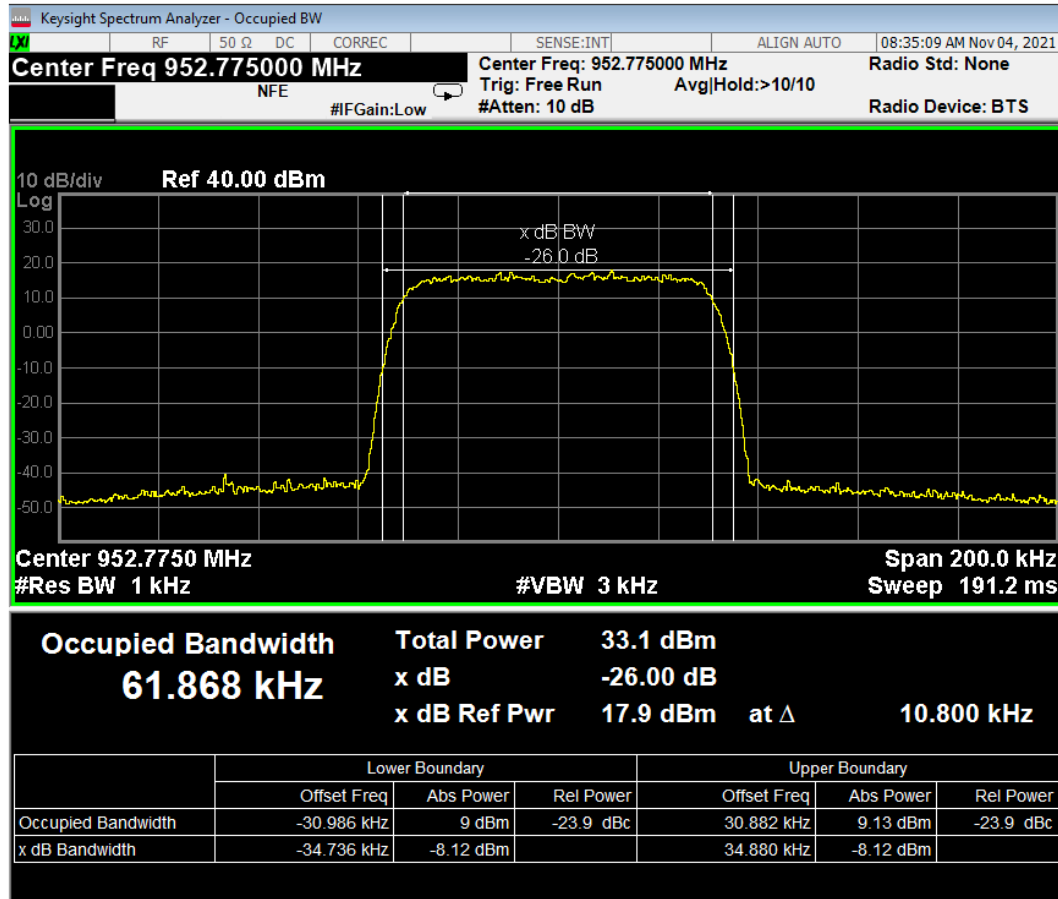
Plot-1/ Port-V-QPSK



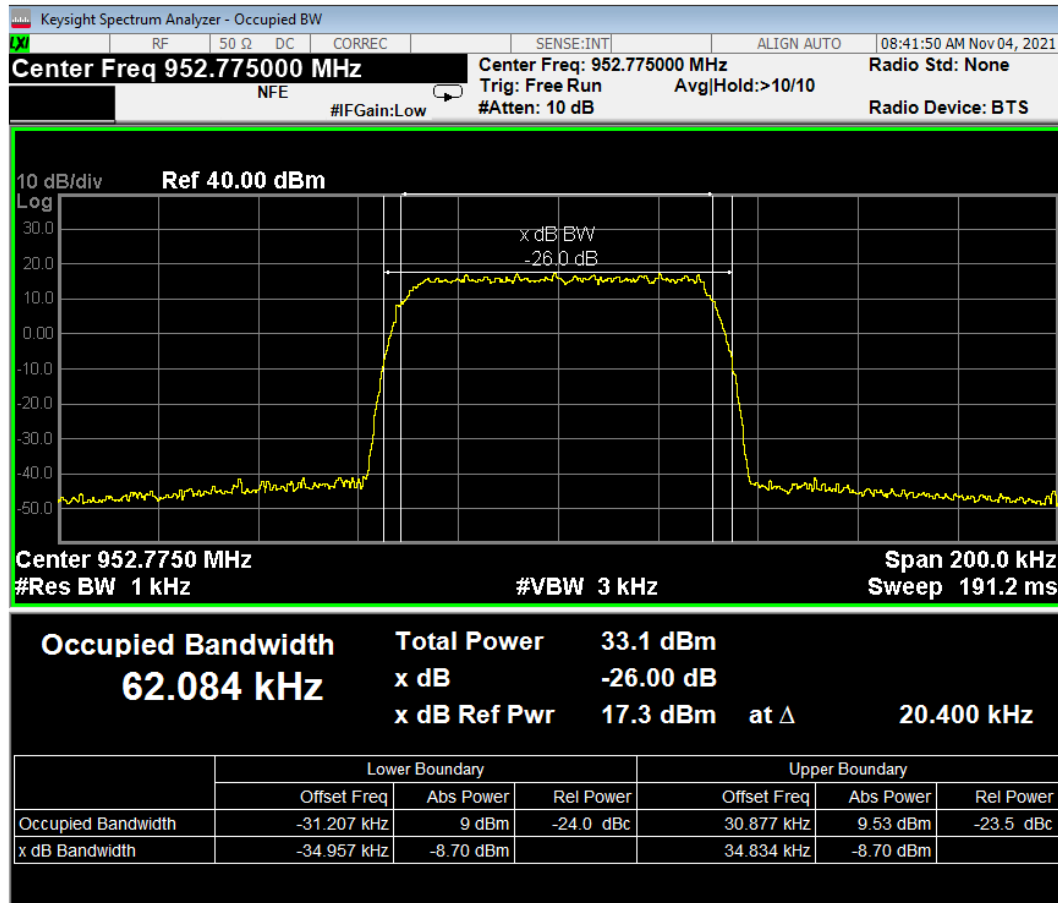
Plot-2/ Port-V-16QAM



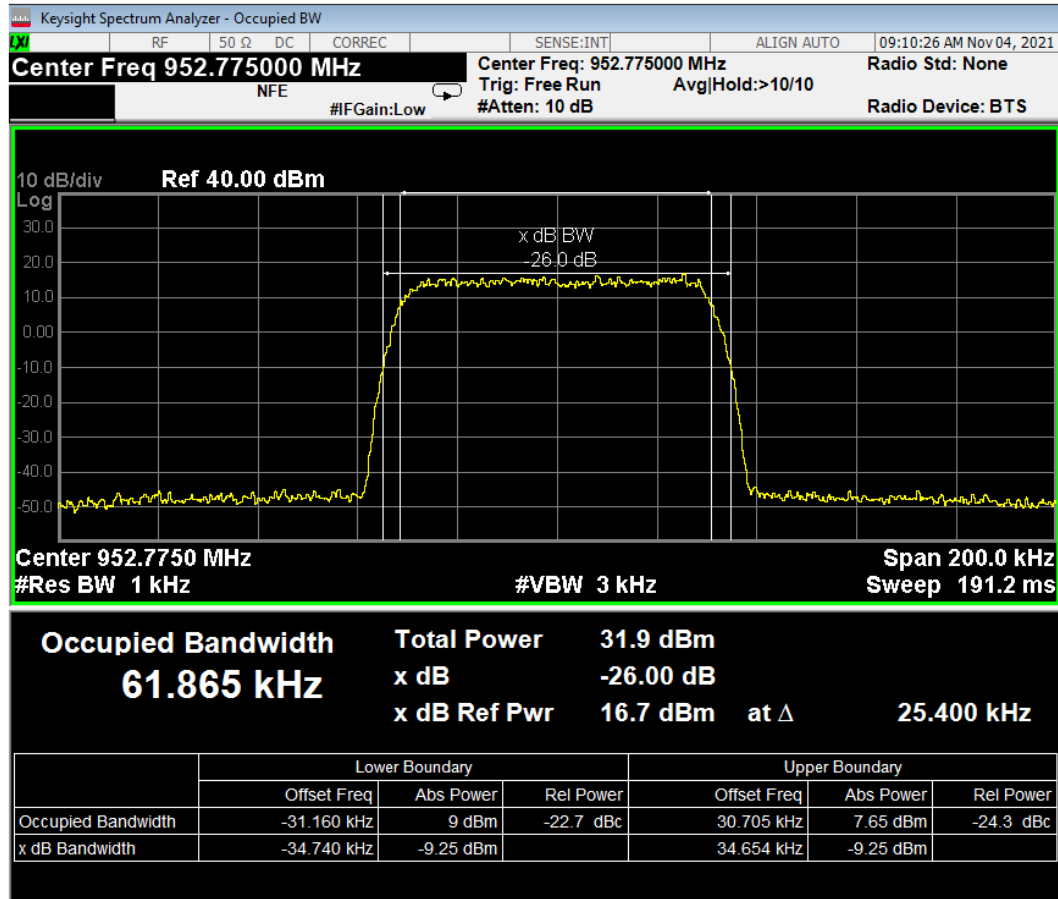
Plot-3/ Port-V-64QAM



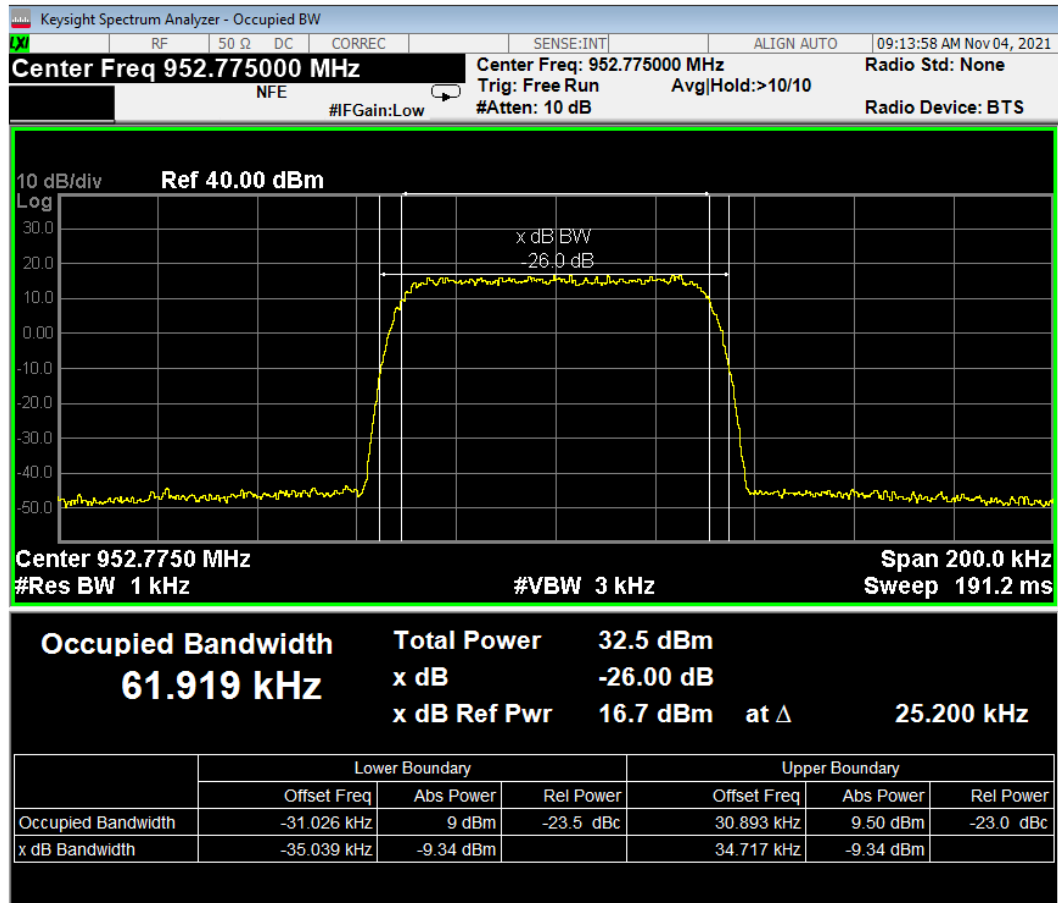
Plot-4/ Port-V-256QAM



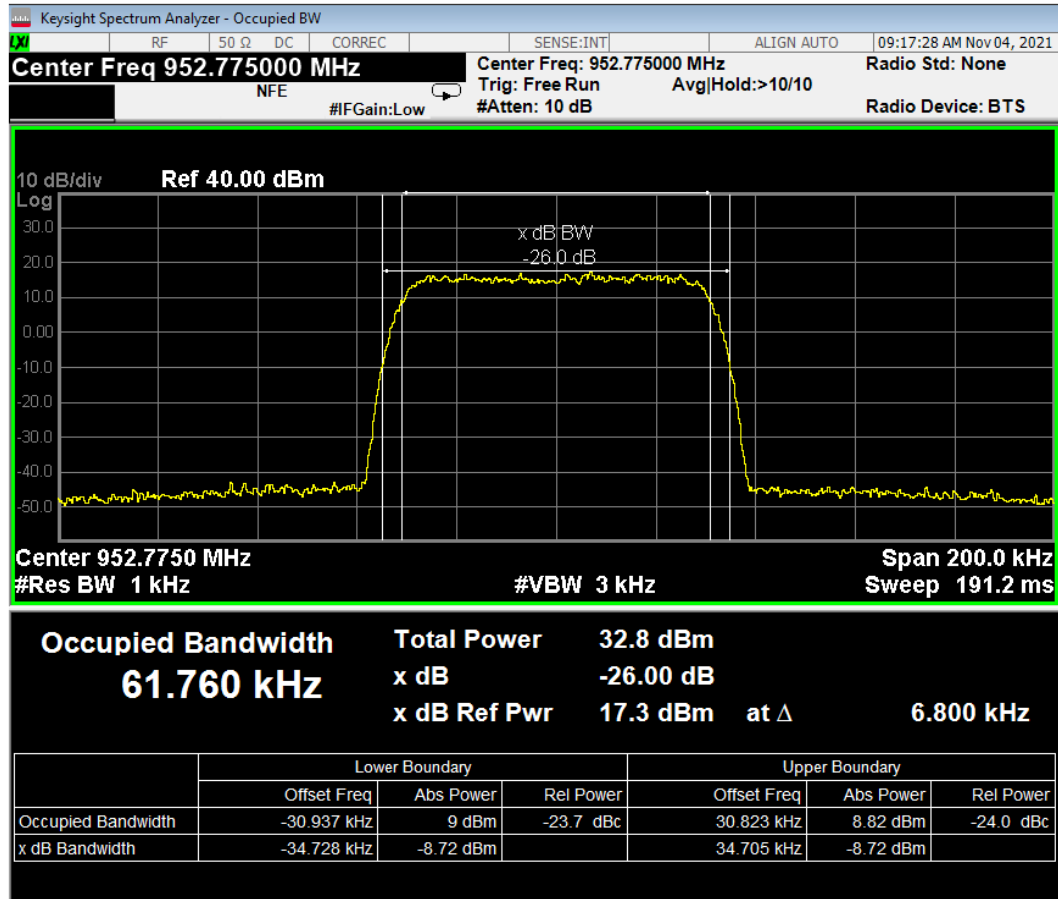
Plot-5/ Port-H-QPSK



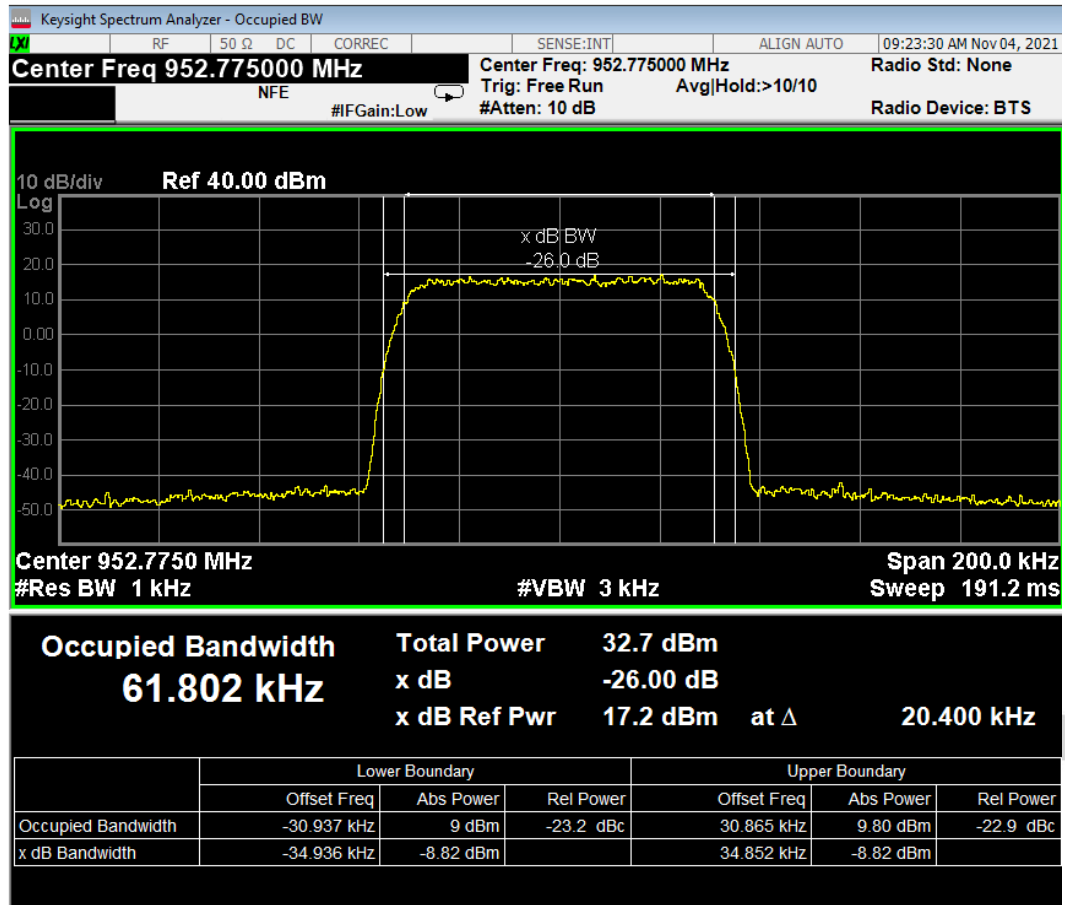
Plot-6/ Port-H-16QAM



Plot-7/ Port-H-64QAM



Plot-8/ Port-H-256QAM



101.111 Emission limitations

As this transmitter uses digital modulation in the 900 MHz band using 12.5 kHz, 25 kHz, 50 kHz and 75 kHz authorised bandwidths the emission masks as per section 101.111 (a) (5) and (6) have been applied.

This report contains the measurement results for 75 kHz bandwidth.

The reference level for the following emission mask measurements has been determined using a resolution bandwidth of 120 kHz using a peak detector when the transmitter was operating in each of the modulation modes.

All measurements have been made using spectrum analyser operating in average mode with the transmitter operating on 952.775 MHz.

A 30 dB attenuator was placed between the output of transmitter and the input of spectrum analyser.

The transmitter was modulated using modulation sources internal to the transmitter as supplied by the client.

When the 12.5 kHz bandwidth mask (a)(5) was applied.

When the 25.0 kHz bandwidth mask (a)(6) was applied.

When the 75.0 kHz bandwidth mask (a)(5) was applied to show compliance when using 6 x 12.5 kHz channels.

When the 75.0 kHz bandwidth mask (a)(6) was applied to show compliance when using 3 x 25.0 kHz channels.

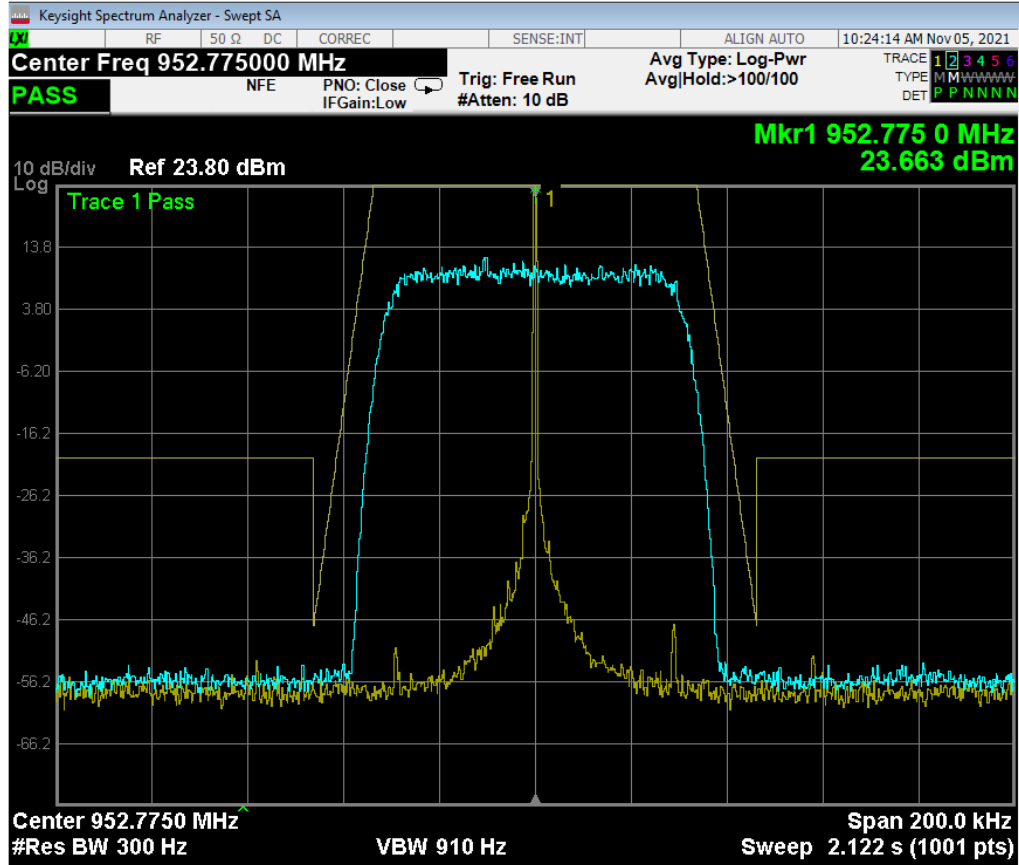
The mask measurement was performed on port H and is representative of compliance for port V and port H of the product.

The yellow trace represents the unmodulated carrier, while the blue trace indicates the emission mask of the modulated signal.

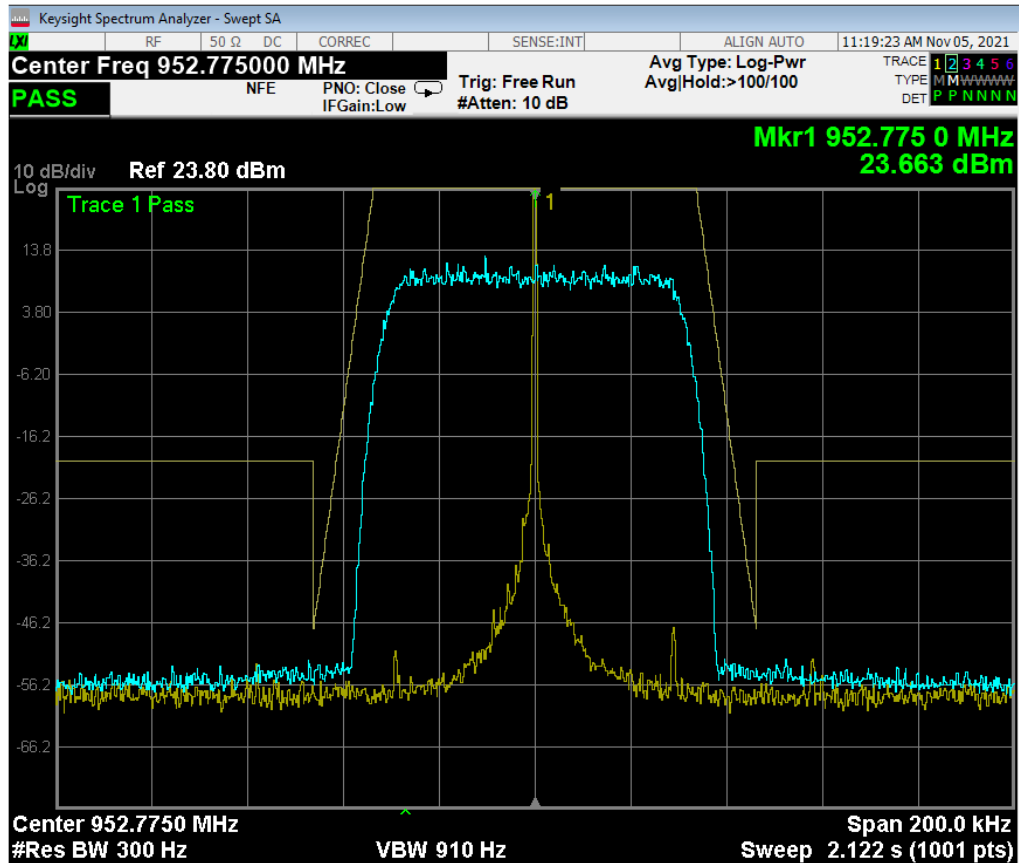
Result: Complies.

6 x 12.5 kHz mask (a)(5) applied

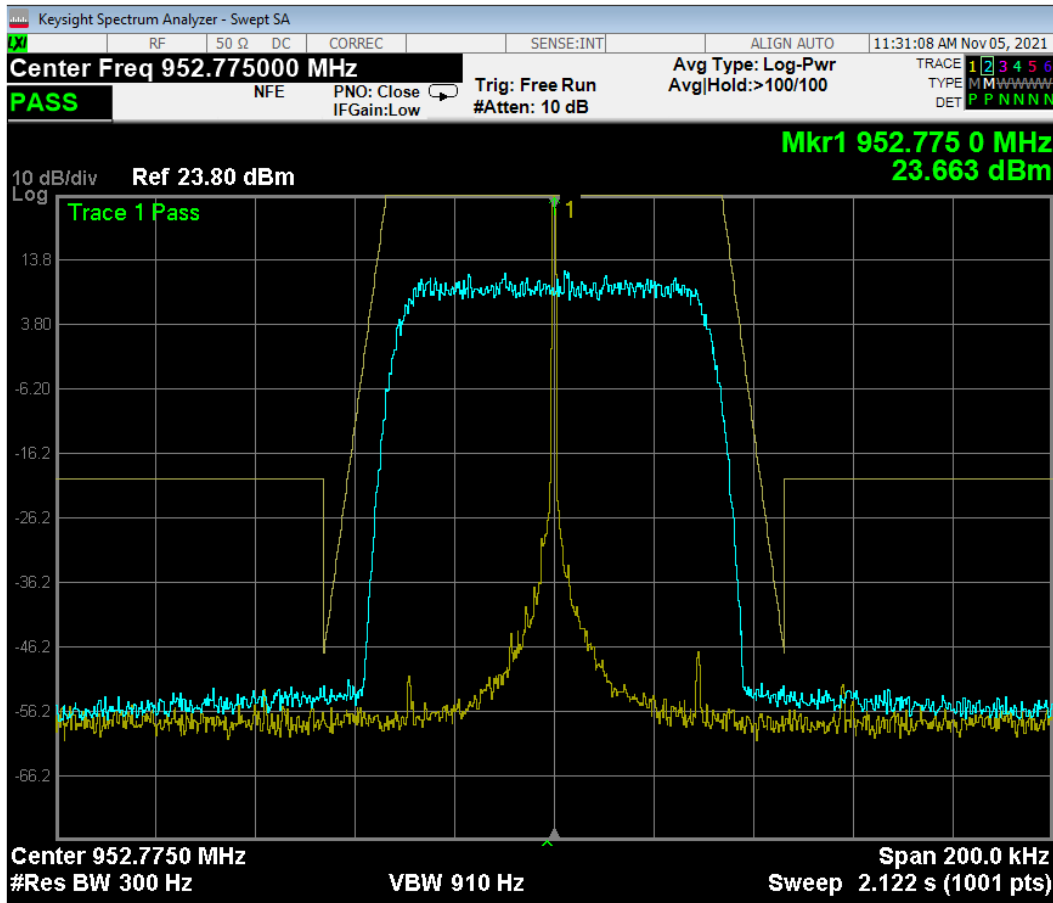
QPSK / 75 kHz



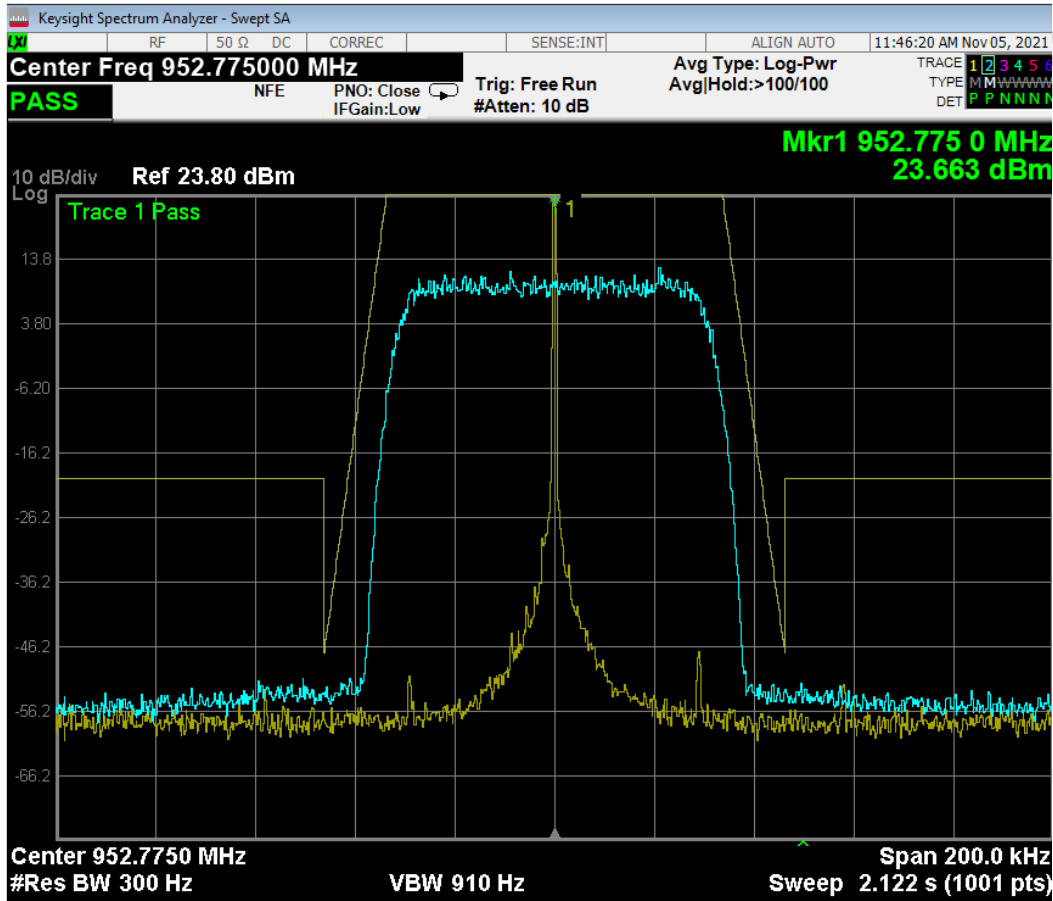
16QAM / 75 kHz



64QAM / 75 kHz

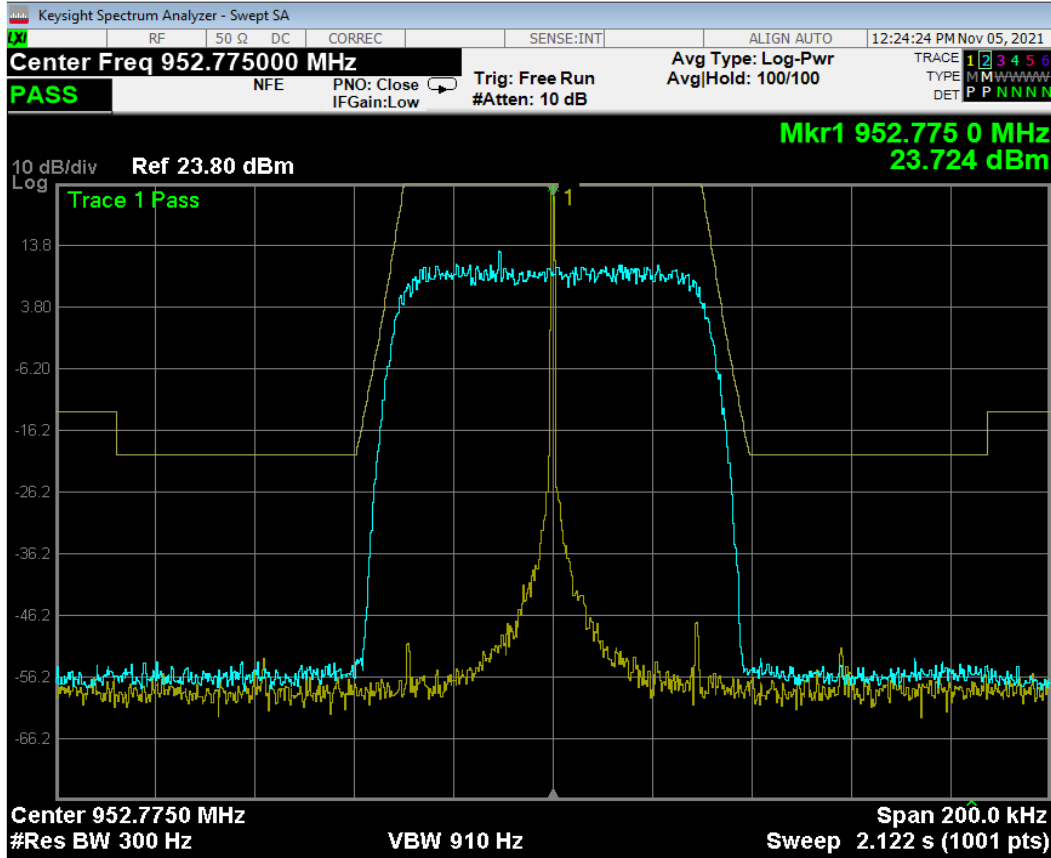


256QAM / 75 kHz

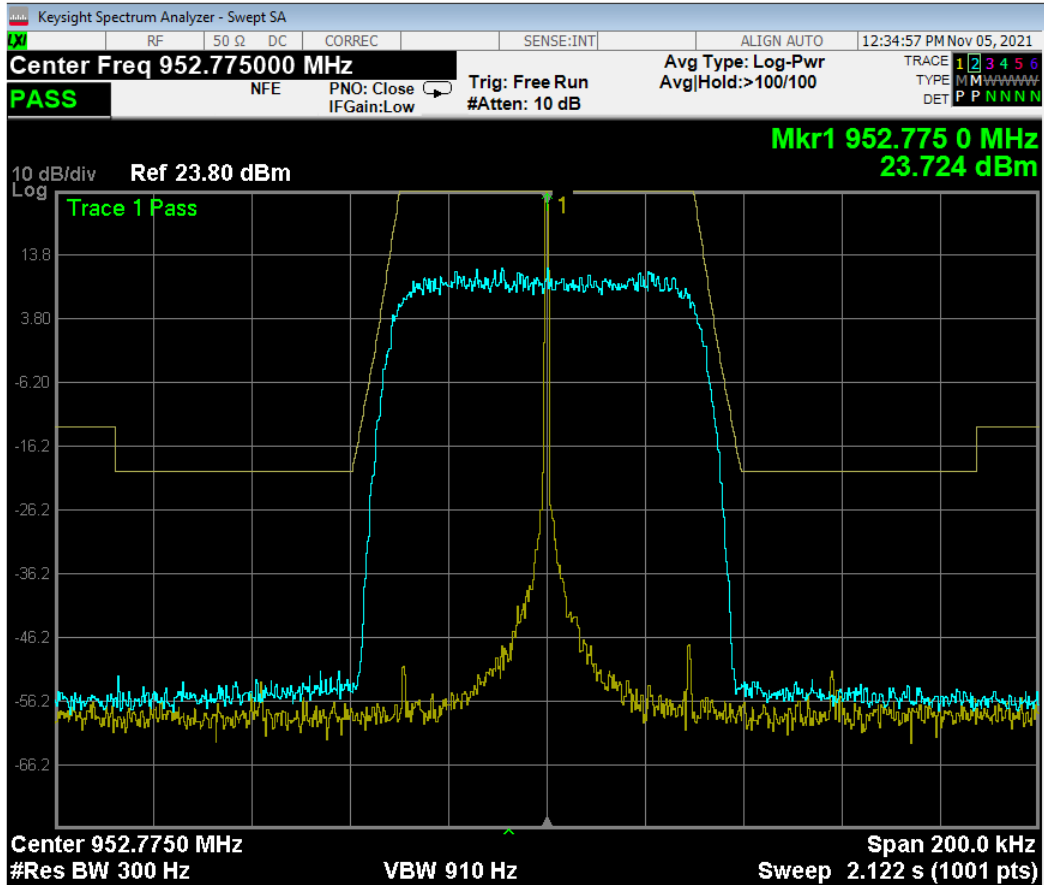


3 x 25.0 kHz mask (a)(6) applied

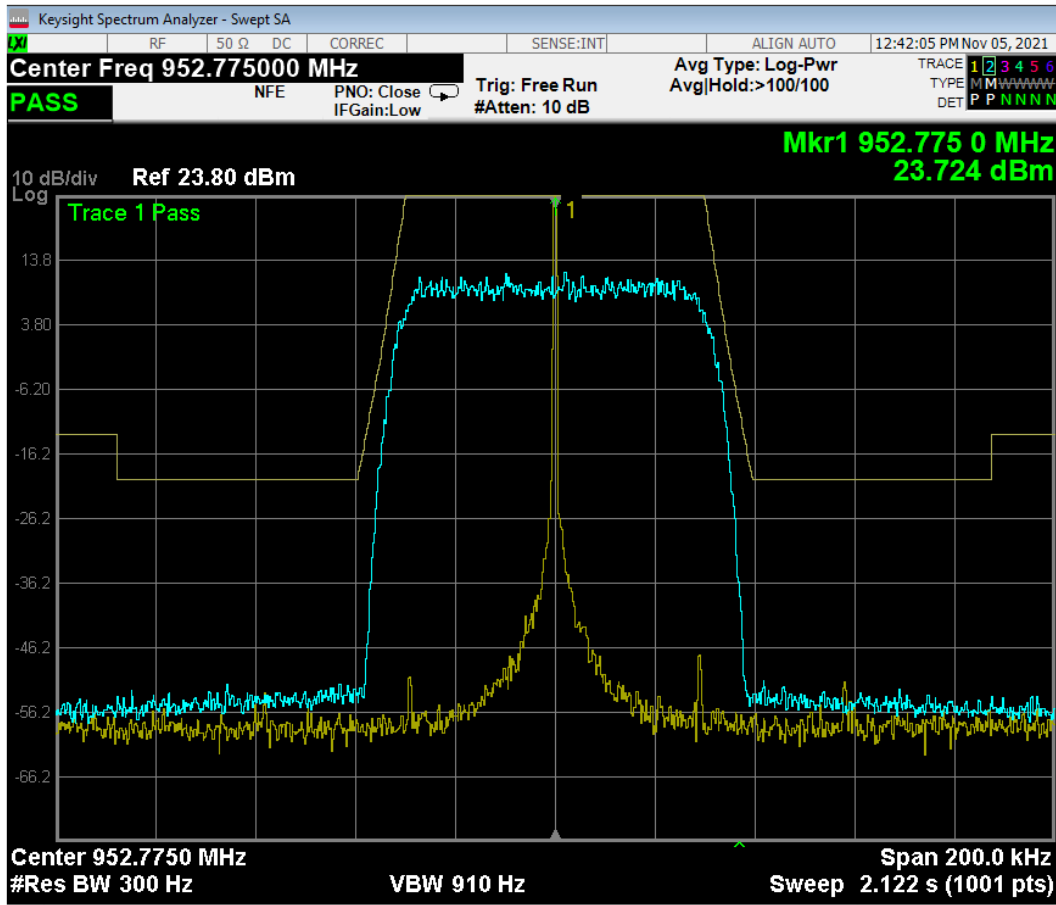
QPSK / 75 kHz



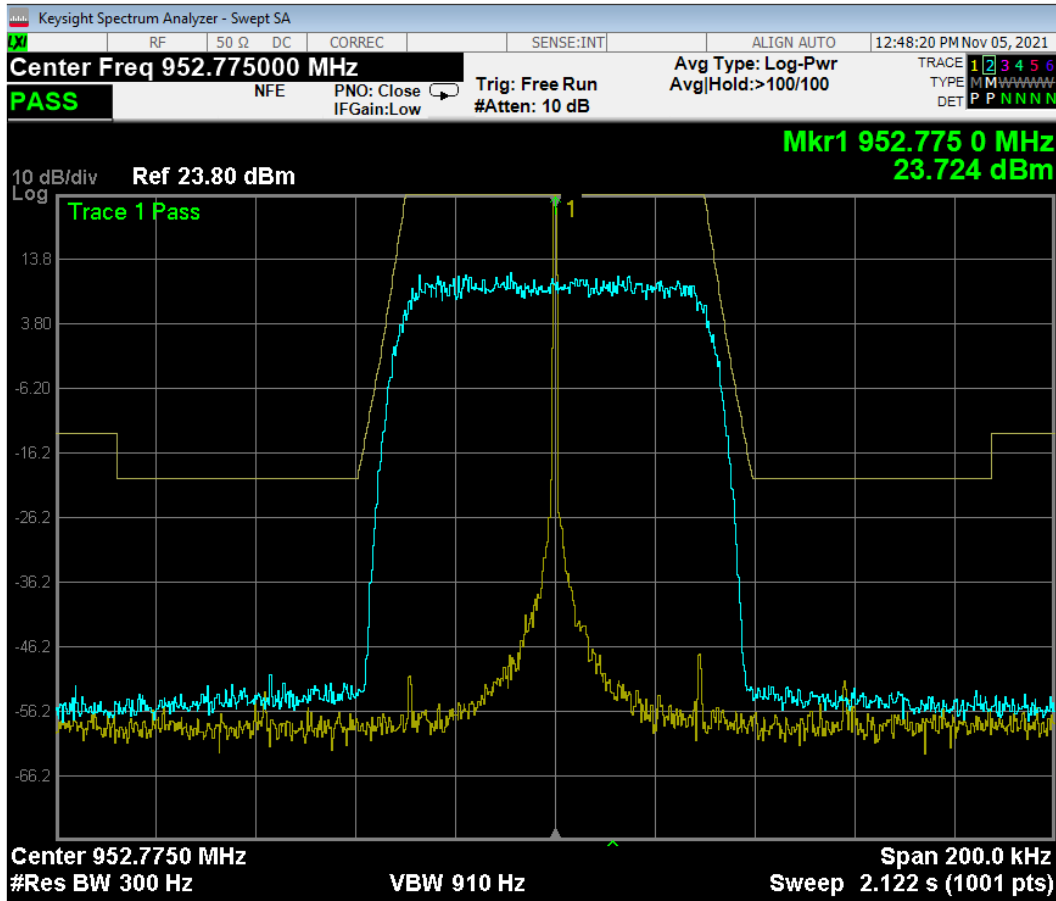
16QAM / 75 kHz



64QAM / 75 kHz



256QAM / 75 kHz



Transmitter unwanted emissions – antenna terminal

As per section 2.1051 spurious emission measurements were made at the antenna port of the transmitter.

The spectrum analyser bandwidth was set to 100 kHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz.

Frequency (fc): 952.775 MHz

Spurious emission (Harmonic)	Emission level (dBm)	Limit (dBm)
1905.550	-62.3	-20.0
2858.325	-66.9	-20.0
3811.100	<-60	-20.0
4763.875	<-60	-20.0
5716.650	<-60	-20.0
6669.425	<-60	-20.0
7622.200	<-60	-20.0
8574.975	<-60	-20.0
9527.750	<-60	-20.0

Limit:

Section 101.111 (a)(5) states that on any frequency removed from the centre of the authorised bandwidth by a displacement frequency of more than 12.5 kHz shall be attenuated by at least $50 + 10 \log (P)$ or 70 dB whichever is the lesser attenuation.

All spurious emissions are to be attenuated by at least $50 + 10 \log (P)$. The rated power of +24 dBm gives a limit of -20 dBm.

The spectrum has been investigated up to the 10th harmonic of the transmitter.

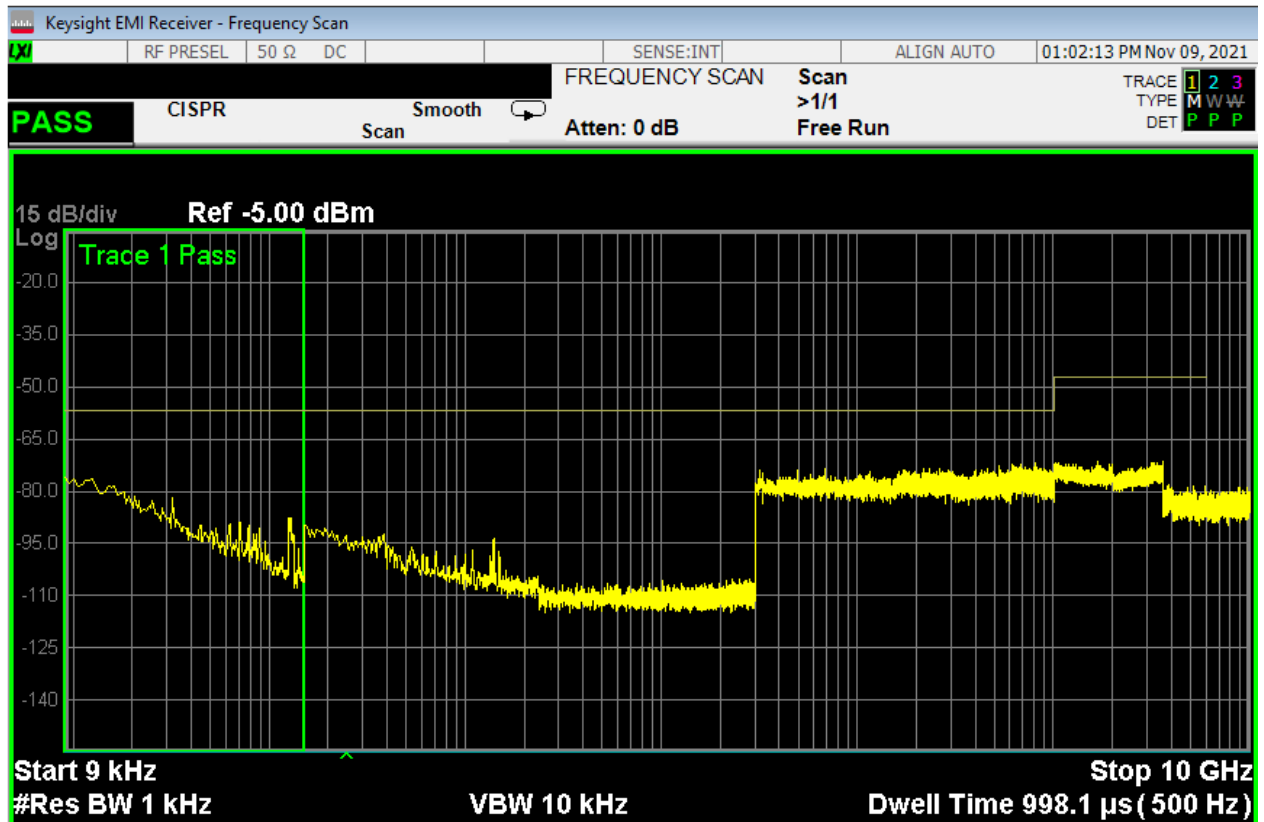
Result: Complies

Measurement Uncertainty: ± 3.3 dB

Receiver Spurious emissions- antenna terminal

The device was put in standby mode and the emissions were measured up to the 10th harmonic of the receive frequency.

The radio was tuned to the receive frequency of 928.775 MHz.



Result: Complies

Measurement Uncertainty: ± 3.3 dB

101.113 Transmitter power limitations

Output power test

Measurements were carried out at the RF output terminals of the transmitter using a spectrum analyser with a 120 kHz resolution bandwidth with measurements made using an average when the transmitter was modulated using the various modulation modes.

The rated output power is 0.25 Watt (+24 dBm) average to each of the transmitter output ports.

Testing was carried out on both output ports with the supply voltage being varied when the device was operating on 952.775 MHz with the levels being recorded directly in dBm.

Test Frequency: 952.775 MHz

Vertical output port in Average

Channel bandwidth	Modulation	Voltage 10.5 (Vdc)	Voltage 24.0 (Vdc)	Voltage 60.0 (Vdc)
75.0 kHz	QPSK	23.7	23.7	23.7
75.0 kHz	16QAM	23.7	23.7	23.7
75.0 kHz	64QAM	23.8	23.8	23.8
75.0 kHz	256QAM	23.9	23.9	23.9

Horizontal output port in Average

Channel bandwidth	Modulation	Voltage 10.5 (Vdc)	Voltage 24.0 (Vdc)	Voltage 60.0 (Vdc)
75.0 kHz	QPSK	23.6	23.6	23.6
75.0 kHz	16QAM	23.5	23.5	23.5
75.0 kHz	64QAM	23.8	23.8	23.8
75.0 kHz	256QAM	23.8	23.8	23.8

Measurements were made to show that the declared power output of the transmitter measured power was within +/- 1 dB of the measured output power (+24.0 dBm).

A power limit of +40.0 dBW EIRP per polarisation applies to Fixed Equipment operating in the 952.0 - 960.0 MHz band.

Result: Complies

Measurement Uncertainty: ±0.5 dB

8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset	Interval	Cal Due
Power Attenuator	Weinschel	49-20-43	GC104	E1308	N/a	N/a
Power Supply	Hewlett Packard	6032A	2743A-02859	E1069	N/a	N/a
RF Power Meter	Hewlett Packard	HP 436A	2512A22439	E1198	2.5 years	17 June 2022
Thermal chamber	Contherm	M180F	86025	E1129	N/a	N/a
Thermometer	DSIR	RT200	035	E1049	5.5 years	10 Mar 2022
Modulation Analyser	Rohde & Schwarz	FMA	837807/020	E1552	3 years	9 May 2022
Spectrum Analyser	Keysight	N9038A	MY57290153	E4033	2 years	29 Jul 2022

9. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd designation as a FCC Accredited Laboratory by International Accreditation New Zealand, designation number: NZ0002 under the APEC TEL MRA.

All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

10. PHOTOGRAPHS

Top View



Side View



Face with antenna ports



Labels that would be affixed on the product

mimomax	S/N : 23005126
	Model: MWL-TORNADO-BGCA
FCC ID : XMK-MMXTRNB003	
MAC Air : 00:0D:CA:00:1B:F2	Made in
MAC Wired : c8:df:84:c8:d8:1b	New Zealand

Label

RRU-T

Tx: 952.775MHz

Rx: 928.775MHz

IP: 192.168.0.3/ 24

Back View

