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-*G?A
Fixed Digital Microwave Transceiver

tested to the

Code of Federal Regulations (CFR) 47

Part 15 - Radio Frequency Devices
Subpart A and B – Unintentional Radiators

for

MiMOMax Wireless Ltd

This Test Report is issued with the authority of:

Andrew Cutler- General Manager

ACCREDITED IANZ TESTING LABORATORY

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

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1. COMPLIANCE STATEMENT

The **MiMOMax MWL-TORNADO-*G?A Fixed Digital Microwave Transceiver** complies with FCC Part 15 Subpart Subpart A + B as Class B devices when the methods as described in ANSI C63.4 – 2014 and ANSI C63.10–2020.

Note: Please refer to Client's letter appended to the test report for more details about the product's model number nomenclature.

2. RESULT SUMMARY

The results of testing carried out in 23rd July and 5th September 2024 are summarised below.

Clause	Parameter	Result
15.101	Equipment authorisation requirement.	Certification as per FCC part 90 is required. Contains transmitter.
15.103	Exempted devices.	The Device is a receiver and not a digital device.
15.107	Conducted Emissions 0.15 - 30 MHz	Not applicable. DC Powered device
15.109	Radiated Emissions 30 - 10000 MHz	Complies, Class B limits applied.
15.111	Antenna Terminal Disturbance 30 – 950 MHz	Complies.

To comply with the Supplier Declaration of Conformity process when this equipment is sold in the USA the following will need to be addressed:

- Identify the product with a name, model number, serial number etc

- The following statement needs to be applied to the product

This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions

(1) This device may not cause interference, and

(2) This device must accept any interference that may cause undesired operation

- The FCC logo may also be applied to the product.

- Supply with the product the name, contact address, phone number, email address etc of the responsible party in the USA.

3. ATTESTATION

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.

The corrections or erasures in the test report are indicated in the report revision table.

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.

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

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

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission 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

Report Revision Table

Version	Change Made	Date
240702.3	Initial Issue.	25th September 2024

4. CLIENT INFORMATION

Company Name	MiMOMax Wireless Ltd
Address	540 Wairakei Rd Burnside Christchurch 8053
Country	New Zealand
Contact	James Dowle, Sha Luo

5. TEST SAMPLE DESCRIPTION

Brand Name	MiMOMax
Model Number	MWL-TORNADO-BGCA (Tested Sample) MWL-TORNADO-*G?A (Nomenclature as per Client)
Product	Fixed Digital Microwave Transceiver
Manufacturer	MiMOMAX Wireless Ltd
Manufactured in	New Zealand
Serial Numbers	23004892
FCC ID	XMK-MMXTRNB009

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 low, mid and high frequency in the product operating range.

Test frequencies

Modulations	Transmit Frequency	Receive Frequency
QPSK, QAM16, QAM64, QAM256	928.5375	952.5375
	933.5000	942.5000
	942.5000	933.5000
	952.5375	928.5375

Full testing was carried out when product was tuned to 928.5375 MHz. At other frequencies, the testing was carried out suitably on limited test modes to cover the compliance requirements.

Change of Duplexers inside the product was required to test each frequency mentioned in the above table.

Channel bandwidths

12.5 kHz, 25.0 kHz, 50.0 kHz, 75 kHz

Declared Bandwidths

10.5 kHz, 20.0 kHz, 42.0 kHz, 63.0 kHz

Modulation Types

QPSK, QAM16, QAM64, QAM256

Emission Designators / Modes of operation

10k5W1W digital speech and data
20k0W1W digital speech and data
42K0W1W digital speech and data
63K0W1W 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

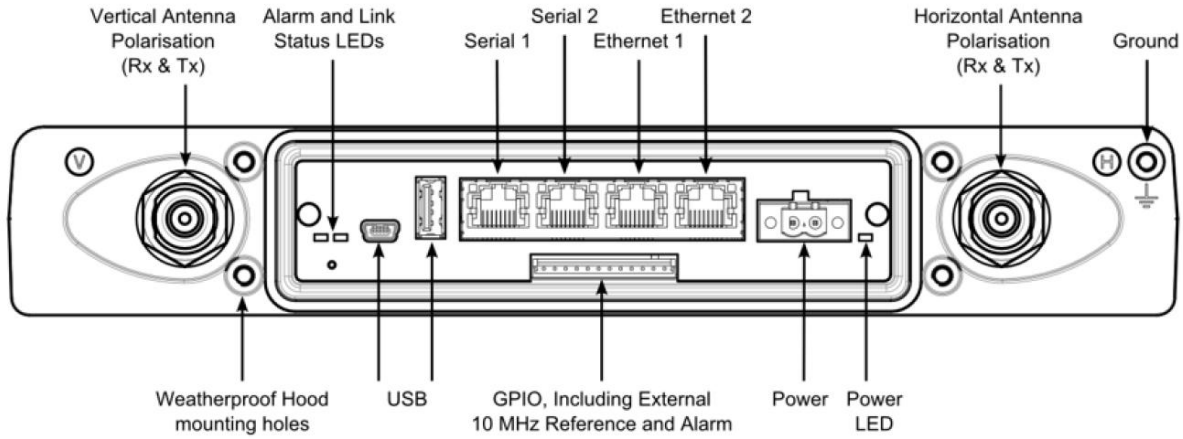
High Temperature: + 50°C maintained.
Low Temperature: - 30 °C maintained.

Product Description (From user manual)

The Product is used in SCADA, Protection and Linking applications. These radios provide a radio wireless infrastructure for connecting devices used by various applications to form a network through which IP data, RS-232 serial data or RS485 synchronous serial data can seamlessly flow.

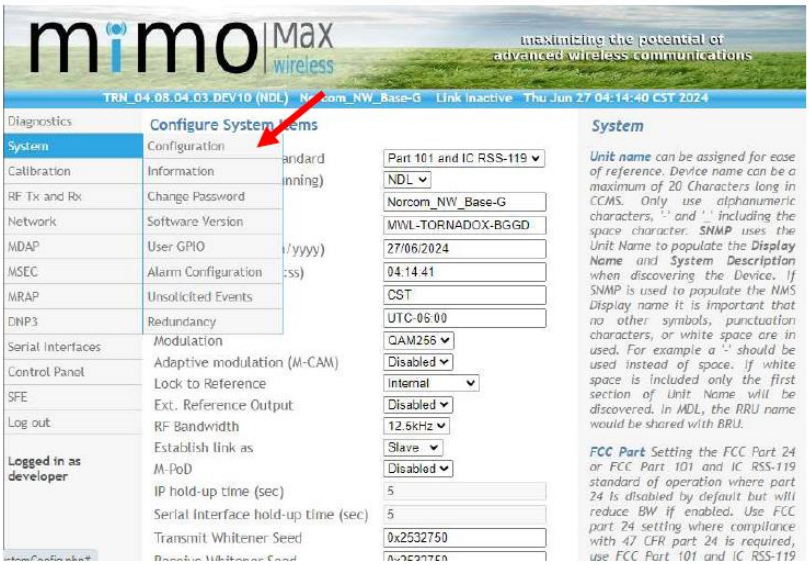
Features include isolated power supply with low power consumption, full duplex operation with built in duplexers and supporting a combination of interfaces, with scalable data rates, remote over the air network management, optional SNMP, ModBus and DNP3 support and a very efficient random-access protocol.

For testing on multiple test frequencies, the duplexers were changed inside the product a per the client test instructions.



Connection diagram of the product

The product control was performed using the CLI commands and Putty interface. Shown below is the software interface which can be alternatively used for product control.



6. TEST RESULTS

Section 15.109 Radiated Emissions Testing

Radiated emission testing was carried out over the frequency range of 30 MHz to 10000 MHz.

The measurements were carried out in standby mode.

Testing was carried out at the laboratory's open area test site - located at Driving Creek Orere Point, RD5, Papakura, New Zealand.

Before testing was carried out a receiver self-calibration was undertaken along with a check of all cables and programmed antenna factors was carried out.

All interconnecting cables were bundled in 40 cm long bundles.

The device was powered at 12 VDC using lead acid batteries.

Attached to the device was a test laptop using a 2 meter long Ethernet cable, A USB and a 1.5 meter long USB-C cable that facilitated product control using software.

Between 30 - 1000 MHz the emission is measured in both vertical and horizontal antenna polarisations at a distance of 3 metres using a Quasi Peak detector with a 120 kHz bandwidth is used.

Between 1000 - 10000 MHz the emission is measured in both vertical and horizontal antenna polarisations at a distance of 3 metres using an Average detector and a Peak detector with bandwidths of 1 MHz.

The emission level was determined in field strength by taking the following into consideration:

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB/m) + Coax Loss (dB)

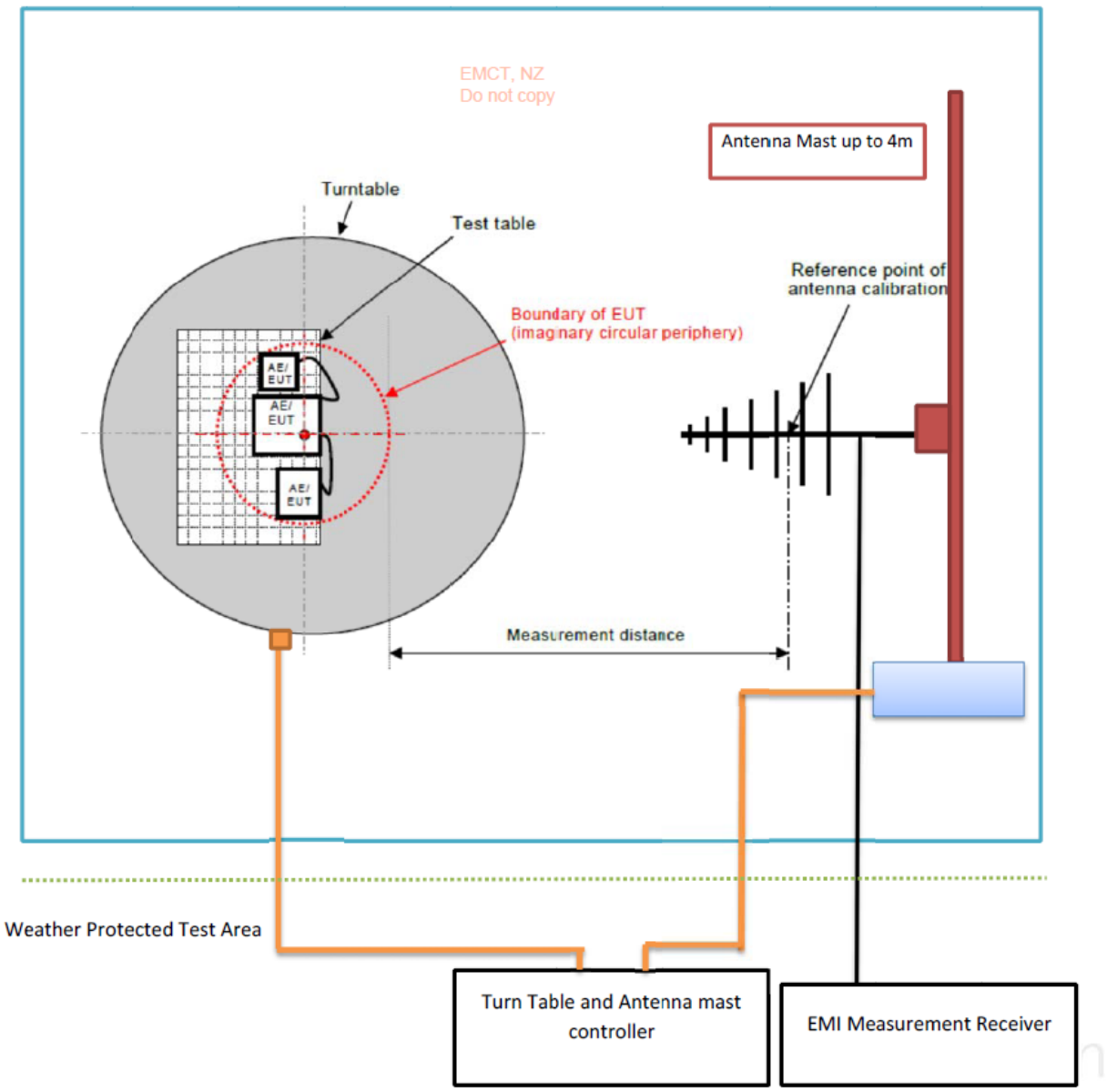
For example, if an emission of 30 dBµV was observed at 30 MHz.

45.5 dBµV/m = 30.0 dBµV + 14 dB/m + 1.5 dB

Result: Complies.

Measurement Uncertainty: ± 4.1 dB

Radiated Emissions Test setup at Open area test site



Below 30 MHz: Loop Antenna; Measurement distance: 10 m

30 MHz-300 MHz: Bi conical Antenna; Measurement distance: 3 m

300 MHz- 1000 MHz: Log Periodic Antenna; Measurement distance: 3 m

Above 1 GHz: Horn Antenna; Measurement distance: 3 m

EMI Receiver Used: ESIB40

Section 15.109 General/Standby emissions:

Measurements between 30 – 10000 MHz have been made at a distance of 3 metres and Class B limits have been applied.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result	Antenna
30.400	32.9	24.7	40.0	7.1	Pass	Vertical
31.960	32.1	24.8	40.0	7.9	Pass	Vertical
32.760	-	26.0	40.0	14.0	Pass	Horizontal
40.720	26.8	-	40.0	13.2	Pass	Vertical
47.960	27.0	-	40.0	13.0	Pass	Vertical
72.360	23.3	-	40.0	16.7	Pass	Vertical
75.960	31.6	20.1	40.0	8.4	Pass	Vertical
118.720	32.3	-	43.5	11.2	Pass	Vertical
123.680	30.0	-	43.5	13.5	Pass	Vertical
136.400	37.4	25.3	43.5	6.1	Pass	Vertical
143.200	34.5	29.3	43.5	9.0	Pass	Vertical
145.920	-	35.7	43.5	7.8	Pass	Horizontal
151.280	34.1	-	43.5	9.4	Pass	Vertical
243.760	31.3	31.6	46.0	14.4	Pass	Horizontal
325.600	37.7	28.1	46.0	8.3	Pass	Vertical
462.560	31.2	32.1	46.0	13.9	Pass	Horizontal

All other emissions were observed to have a margin to the limit that exceeds at least 15 dB of the limit when the measurements were carried out between 30 - 10000 MHz using both vertical and horizontal polarisations.

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 - 10000 MHz) ± 4.1 dB

15.111 Antenna Terminal Disturbance 30 – 950 MHz

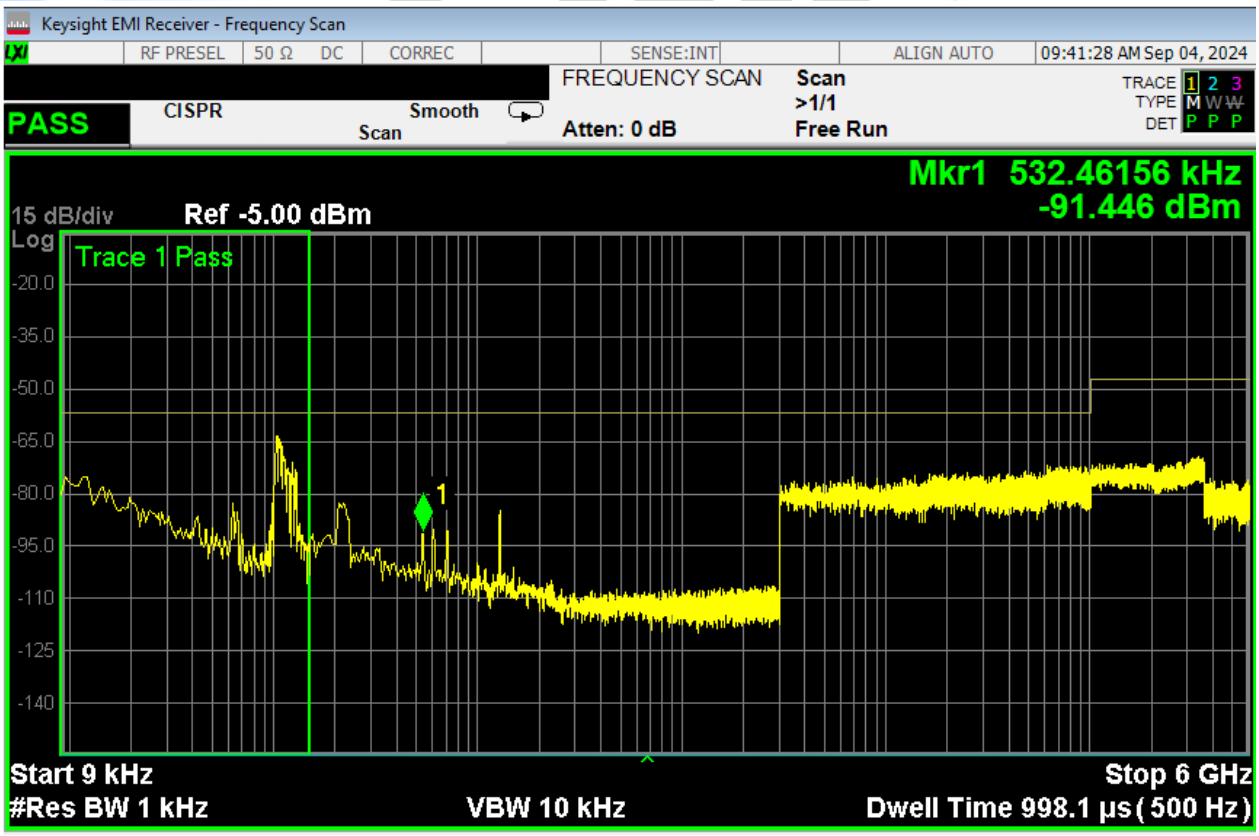
Part 15.111 states following applicability and requirements:

(a) In addition to the radiated emission limits, receivers that operate (tune) in the frequency range 30 to 960 MHz and CB receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of § 15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in § 15.33 shall not exceed 2.0 nanowatts (-57.0 dBm).

(b) CB receivers and receivers that operate (tune) in the frequency range 30 to 960 MHz that are provided only with a permanently attached antenna shall comply with the radiated emission limitations in this part, as measured with the antenna attached.

Measurement plot:

H port receive/standby emission plot for 896.000 MHz



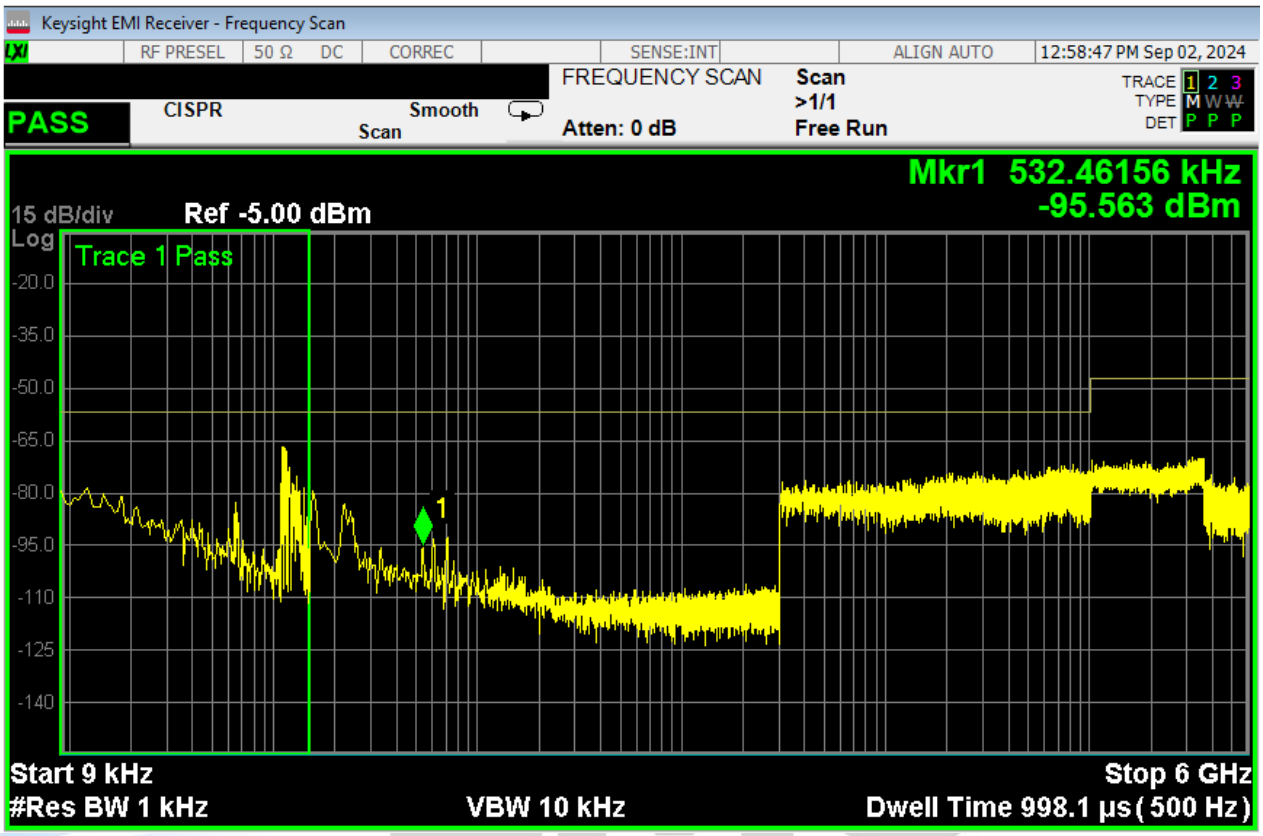
* Ambient's can be seen in FM band in the above plot.

Result: Complies.

Measurement Uncertainty: ± 1.5 dB

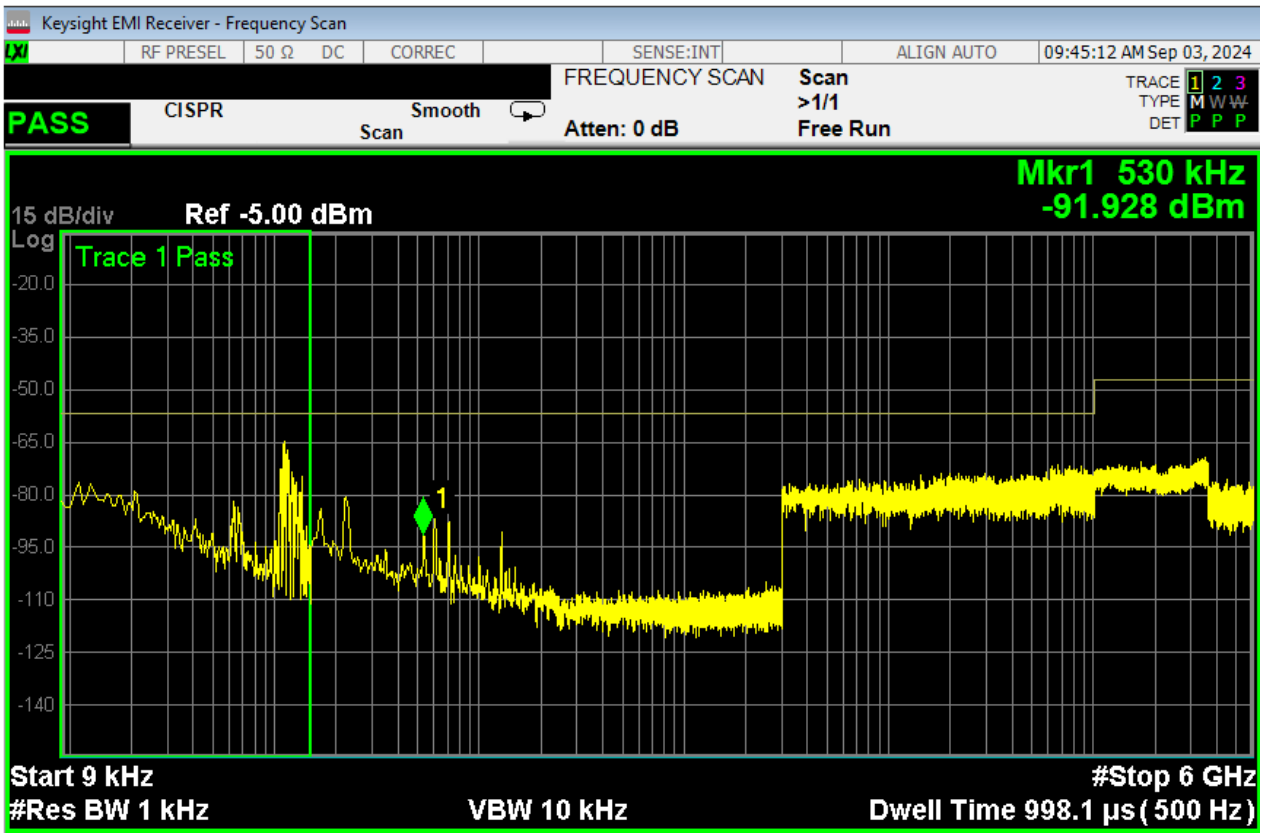
Measurement plot:

V port receive/standby emission plot for 933.000 MHz



* Ambient's can be seen in FM band in the above plot.

V port receive/standby emission plot for 952.500 MHz



* Ambient's can be seen in FM band in the above plot.

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial/ID #	Cal Due	Interval
Power Supply	Hewlett Packard	6654A	-	N/a	N/a
Aerial Controller	EMCO	1090	9112-1062	N/a	N/a
Aerial Mast	EMCO	1070-1	9203-1661	N/a	N/a
Biconical Antenna	Schwarzbeck	BBA 9106	11042021A	22/11/24	3.0 years
Log Periodic	Schwarzbeck	VUSLP 9111	9111-112	15/11/24	3.0 years
Horn Antenna	EMCO	3115	9511-4629	03/03/25	3.0 years
Modulation Analyzer	Rohde & Schwarz	FMA	837807/020	13/04/25	3.0 year
Power Attenuator	Tenuline	8322	-	N/a	N/a
Power Attenuator	DTS	-	-	N/a	N/a
Modulation Analyser	Hewlett Packard	8901B	SN2608A00782	30/04/25	2.0 years
Level Generator	Anritsu	MG443B	M61689	7/08/25	2.0 years
Power meter	Hewlett Packard	436A	2512A22439	19/04/25	2.0 years
Power Sensor	Hewlett Packard	8482A	2237A07036	19/04/25	2.0 years
Oscilloscope	Tektronics	745A	B010643	4/10/24	2.0 Years
Signal Generator	Rohde & Schwarz	SMHU	E1493	28/11/24	2.5 Years
Heliax Cable	L6PNM-RPD	OATS	22869	22/12/24	2.0 Years
Receiver	Rohde & Schwarz	ESIB-40	100295	06/10/24	2.0 years
Spectrum Analyzer	Keysight	N9038A	MY57290153	21/11/24	1.0 year
Thermal chamber	Contherm	M180F	86025	N/a	N/a
Thermometer	DSIR	RT200	35	11/04/27	5.0 years
Turntable	EMCO	1080-1-2.1	9109-1578	N/a	N/a
VHF Balun	Schwarzbeck	VHA9103	-	N/a	N/a

At the time of testing all test equipment was within calibration.

8. 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.

9. PHOTOGRAPHS

Top face

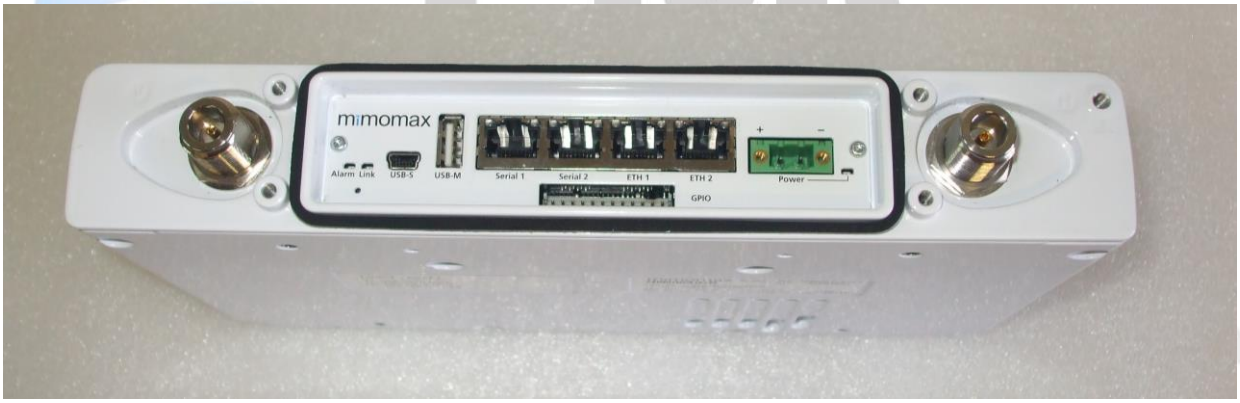
Side face

Side face

Back face

Bottom face

Connector face



Label

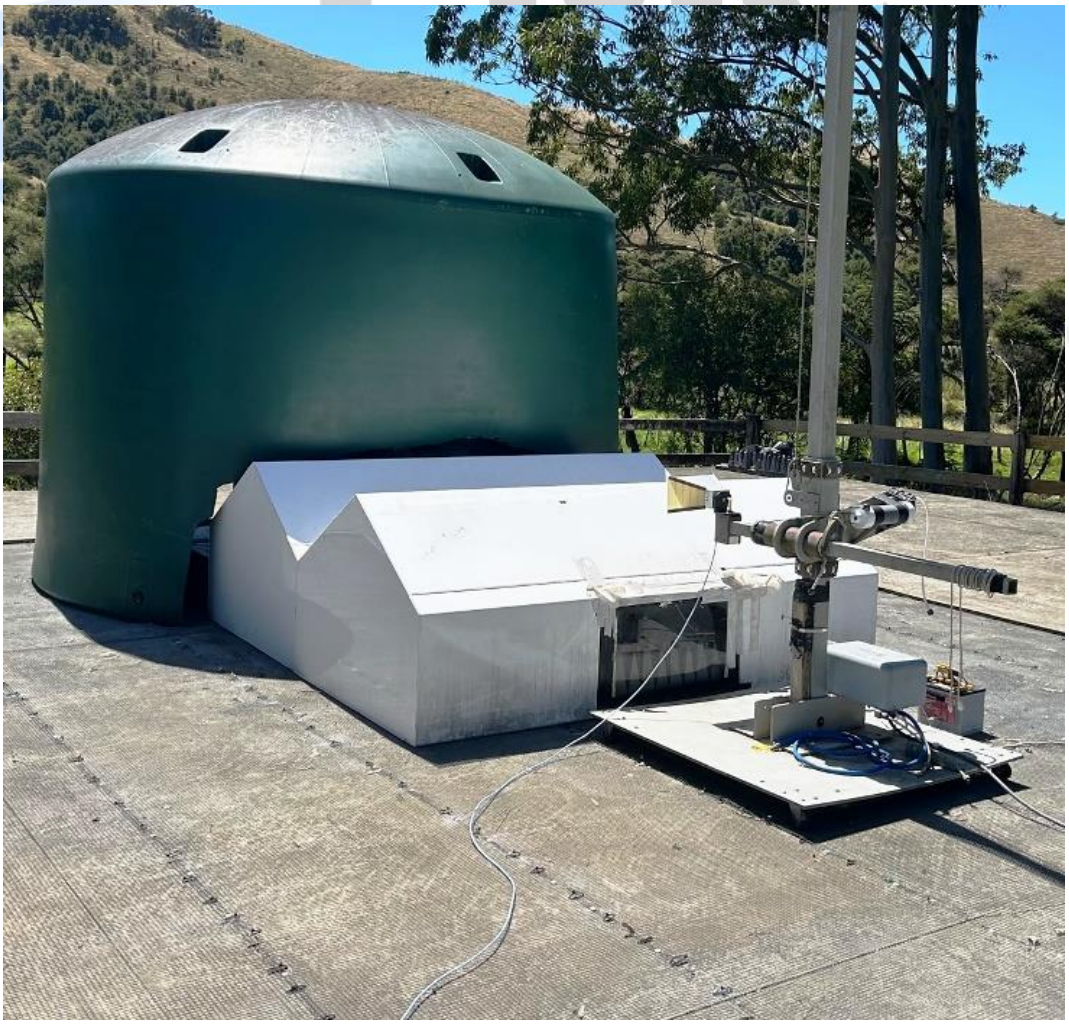
Radiated Emissions Test Setup

Radiated Emissions Test Setup

Biconical Antenna pointing towards Test Enclosure

Log Periodic Antenna pointing towards Test Enclosure

Horn Antenna pointing towards Test Enclosure



10. APPENDIX 1 – CLIENT LETTER's

Letter Stating similarity of RF performances at two ports

Mimomax Wireless Ltd, trading as Ubiik Mimomax
540 Wairakei Road
PO Box 20003
Christchurch, New Zealand

Date: 2024-09-11

To Whom It May Concern:

There are two RF transmitting output ports, named horizontal and vertical ports, in each of 900MHz Tornado radio MWL-TORNADO-BGCA. There are slight differences in layout design between these two transmitters. In order to compensate for the layout differences, some values of passive components used in these two transmitters are different, aiming to achieve the same RF performances. All the active components used in both transmitters are the same. Therefore, the RF performances out from the horizontal and vertical ports are very similar.

Thank you for your attention to this matter.

Yours Sincerely,

Signatory

James Dowle

Name: James Dowle

Title: R&D Manager

Company name: Mimomax Wireless Limited (Trading as Ubiik Mimomax)

Letter explaining the product's model number nomenclature used by the client.

Mimomax Wireless Ltd, trading as Ubiik Mimomax
540 Wairakei Road
PO Box 20003
Christchurch, New Zealand

Date: 25th September 2024

To: Federal Communications Commission,
Authorization & Evaluation Division,
7435 Oakland Mills Road,
Columbia, MD 21046

Re: Variants for FCC ID: XMK-MMXTRNB009

Model number for Approval

MWL-TORNADO-*G?A, The * and ? are wildcards and are explained below.

The * can be B or A, when the * = B this means the radio is encryption capable, when the * = A this means the radio is not encryption capable.

For Example: The MWL-TORNADO-AGCA and MWL-TORADNO-BGCA differ only in that the MWL-TORNADO-BGCA radio uses a processor with a hardware encryption co-processor, whereas MWL-TORNADO-AGCA radio does not have this hardware encryption co-processer, all other parts and radio configuration parameters are identical.

All Tornado radios use a strong whitener in the physical layer signal processing which ensures that the spectrum is not affected by the data regardless of the whiteness of the data, this also ensures that encryption or lack of encryption also has no effect on the spectrum and emissions from the product.

The ? can be a A, B or C, when the ? = C this means the radio is fitted with a 60kHz bandwidth receiver filter, when the ? = B this means the radio is fitted with a 30kHz bandwidth receiver filter, when the ? = A this means the radio is fitted with a 15kHz bandwidth receiver filter

For Example: The MWL-TORNADO-AGCA, MWL-TORADNO-AGBA and MWL-TORADNO-AGAA differ only in that the bandwidth of the crystal filter in the receiver intermediate frequency stage, all other parts and radio configuration parameters are identical.

The bandwidth of the receiver intermediate frequency filter being 15kHz, 30kHz or 60kHz makes no difference to the spectrum and emissions from the product.

Sincerely,

James Dowle

James Dowle

MiMOMax Wireless Limited (Trading as Ubiik Mimomax)