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

Entel VHF Analogue & Digital Handheld Radio-DX425

(Additional variants: DX422, DX522-IS, DX525-IS, DX522E-IS, DX525E-IS)

tested to the

Code of Federal Regulations (CFR) 47

Part 90 –Private Land Mobile Services

for

Entel UK 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 **Entel VHF Analogue & Digital Handheld Radio-DX425** complies with the limits defined in 47 CFR Part 90 and 47 CFR Part 2 when tested in-accordance with the test methods described in 47 CFR Part 2 and ANSI / TIA-603-E: 2016.

- The present test report showing compliance after testing of samples from model no: DX425.

- The client has requested for the addition of variants: DX422, DX522-IS, DX525-IS, DX522E-IS, DX525E-IS IS to this test report based on their technical assessment. At the end of the test report, the request letter has been appended for reference.

- EMC Technologies, NZ has not tested the variants and is not responsible to perform assessment for the variants.

2. RESULT SUMMARY

The results of testing carried out between February 2023 and April 2023 are summarised below.

Clause	Description	Result
90.203	Certification required	Noted
2.1046 90.205	RF power output Power and antenna height limits	Noted Complies
2.1049 2.202 90.207 90.209 90.210	Occupied bandwidth Bandwidths Types of emissions Bandwidth limitations Emission masks	Noted Noted Complies Complies Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Complies
2.1055 90.213	Frequency stability Frequency stability	Noted Complies
90.214	Transient frequency behaviour	Complies
-	Audio filter response	Included.
1.1310	Radio frequency exposure limits	Complies

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.

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.

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

CLIENT INFORMATION

Company Name	Entel UK Ltd
Postal Address	320 Centennial Avenue Elstree, WD6 3TJ
Country	UK
Contact	Dzenan Omanovic, Jim Rimington, Metin Pallenberg

4. TEST SAMPLE DESCRIPTION

Brand Name	Entel
Model Number	DX425
Additional variants:	DX422, DX522-IS, DX525-IS, DX522E-IS, DX525E-IS (Refer letter below.)
Product	VHF Radio
Manufacturer	Entel
Manufactured in	Philippines
Serial Number	DPDF00214
Controller Firmware Version:	0.1.04
Radio firmware version:	2.3.15.
FCC ID:	RV6DX425

Receiver Intermediate frequency IF[1] 3.6 kHz (The product uses direct receiver conversion)

Highest Clock Frequency in use Receiver LO is direct conversion type, CPU 48 MHz, Clock 50.4 MHz.

Configuration Application A Communication tool was provided by the client for product control during testing (CommsIntegrationTest.exe)

Antenna connector Reverse SMA (Male) connector available on the product.

Rated Transmitter Output Power

High power setting: 5 Watt

Low Power setting: 1 Watt

Transmitter Certification Range

Part 90: 150.000-174.000 MHz

Test frequencies

Frequency (MHz)	Power (Watts)	Channel Bandwidth (kHz)	Emission
155.000	5 Watt / 1 Watt	12.5	Analog FM and DMR modulations
173.975	5 Watt / 1 Watt	12.5	

* A few tests were performed on frequencies within the products operational band other than those tabulated above.

* All the tests have been carried out at **maximum rated output power** of the product unless otherwise stated.

* The product supports D-M4 modulation when operated in digital mode.

The letter supplied by Entel, UK regarding the addition of variants to the report:

Entel

To whom it may concern

Regarding model DX425 and variants;

This declaration is to confirm that the following models use identical hardware as the DX425. The differences being that some models have no display or associated front buttons, some models are approved and conform to the UL913 (intrinsically safe apparatus) standard and some are aimed at different markets.

DX422	No display
DX522-IS	No display, UL913 approved
DX525-IS	UL913 approved
DX522E-IS	No display, UL913 approved
DX525E-IS	UL913 approved
DX542-IS	No display, For marine use, Only for FCC Part 15
DX544-IS	UL913 approved, For marine use, Only for FCC Part 15

Signed:

Name: Dzenan Omanovic

Position: Chief Technical Officer

Date: 13/Feb/2023

Entel UK Ltd
320 Centennial Avenue, Centennial Park
Elstree, Herts, WD63TJ

Reg no.031433328
VAT no. GB 668-154-215

Standard Temperature and Humidity

Temperature:	+15 °C to + 30 °C maintained.
Relative Humidity:	20% to 75% observed.

Standard Test Power Source

Standard Test Voltage:	7.4 Vdc

Extreme Temperature

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

Extreme Test Voltages

High Voltage:	8.6 Vdc
Low Voltage:	6.3 Vdc

Normal Test Power Source

The equipment is a handheld radio and is typically powered by the company supplied lithium ion battery. For test purposes, a jig has been used to facilitate testing.

Product Overview:

The product under test is a handheld VHF radio can be configured for Digital or Analogue channels and operates over the frequency range from 136.000 MHz to 174.000 MHz.

The power levels are selectable with 5 Watt and 1 Watt switch.

The product supports following modulator designators:

- 7K60FXE
- 7K60FXD
- 9K7F3E

6. TEST RESULTS

Certification required

Part 90.203(j): Except where otherwise specially provided for, transmitters operating on frequencies in the 150.0-174.0 MHz and 406.0-512.0 MHz bands must comply with the following:

- The product tested operates in the frequency range 150.0-174.0 MHz which falls within 150.0-174.0 MHz band and hence certification is required

1) Applications for certification of mobile and portable equipment designed to transmit voice on public safety frequencies in the 150-174 MHz or 450-470 MHz band will be granted only if the mobile/portable equipment is capable of operating in the analog FM mode on the nationwide public safety interoperability channels in the 150-174 MHz band or 450-470 MHz band, as appropriate

- The product under test is a handheld radio cable of transmitting at a 5 Watt rated output power on Analog FM and DMR channels. The requirement is satisfied.

2) Applications for certification received on or after February 14, 1997 but before January 1, 2005 will only be granted for equipment with the following channel bandwidths:

(i) 12.5 kHz or less for single bandwidth mode equipment or multi-bandwidth mode equipment with a maximum channel bandwidth of 12.5 kHz;

- The requirement is satisfied. Product supports 12.5 kHz analog FM channels

(ii) 25 kHz for multi-bandwidth mode equipment with a maximum channel bandwidth of 25 kHz if it is capable of operating on channels of 12.5 kHz or less; and

(iii) 25 kHz if the equipment meets the efficiency standard of paragraph (j)(3) of this section.

- Requirement not applicable, certification is being applied after March 2023.

Certification required (cont.)

3) Applications for part 90 certification of transmitters designed to operate on frequencies in the 150.8-162.0125 MHz, 173.2-173.4 MHz, and/or 421-512 MHz bands, received on or after February 14, 1997 must include a certification that the equipment meets a spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth. Additionally, if the equipment is capable of transmitting data, has transmitter output power greater than 500 mW, and has a channel bandwidth of more than 6.25 kHz, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of channel bandwidth.

- The product complies with the spectrum efficiency requirement of one voice channel per 12.5 kHz of channel bandwidth.

- The product under test operates as a digital mobile radio supporting digital voice and data operating with 4 state FSK modulations, which creates four possible symbols over the air at a rate of 4800 symbols/s, corresponding to 9600 bit/s.

- In reference to 579009 D03 Applications Part 90 Reframing Bands v01 dated April 10, 2015, the product meets the following condition:

Certification required (cont.)

III. SPECIAL CASES: The efficiency standard for digitized voice can be satisfied either by having multiple emissions such as four separate emissions on a 25 kHz channel, or having multiple voice channels on a single emission (e.g., TDMA). The Ritron Waiver (DA 13-431) permits one voice channel per 12.5 kHz bandwidth and waives the multi-bandwidth mode requirement of § 90.203(j)(4)(ii). The efficiency standard for data for single bandwidth mode or multi-bandwidth mode devices requires at least 4800 bps per 6.25 kHz of bandwidth or 9600 bps per 12.5 kHz channel. A 25 kHz single mode device must have a single emission rated at 4 × 4800 bps or a mode that has four individual but simultaneous emissions at 4800 bps per emission. Radios designed to operate on a 6.25 kHz channel do not need to meet the 4800 bps efficiency standard

4) Applications for part 90 certification of transmitters designed to operate on frequencies in the 150.8-162.0125 MHz, 173.2-173.4 MHz, and/or 421-512 MHz bands, received on or after January 1, 2011, except for hand-held transmitters with an output power of two watts or less, will only be granted for equipment with the following channel bandwidths:

(i) 6.25 kHz or less for single bandwidth mode equipment;

- Requirement not applicable, the product operates over multi bandwidth mode.

(ii) 12.5 kHz for multi-bandwidth mode equipment with a maximum channel bandwidth of 12.5 kHz if it is capable of operating on channels of 6.25 kHz or less;

- The product complies and supports 12.5 kHz channel bandwidth.

(iii) 25 kHz for multi-bandwidth mode equipment with a maximum channel bandwidth of 25 kHz if it is capable of operating on channels of 6.25 kHz or less; and

(iv) Up to 25 kHz if the equipment meets the efficiency standard of paragraph (j)(5) of this section.

- Not offered for testing

III. SPECIAL CASES (cont.)

(5), Applications for part 90 certification of transmitters designed to operate on frequencies in the 150.8–162.0125 MHz, 173.2–173.4 MHz, and/or 421–512 MHz bands, after January 1, 2011, must include a certification that the equipment meets a spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth;

- The product tested supports DMR voice/data modulations operating with a channel bandwidth of 12.5 kHz with TDMA implemented. It has shown to meet spectrum efficiency masks for 12.5 kHz channel bandwidth. Exclusion to this requirement is requested based on reference to FCC KDB, 579009 D03 Applications Part 90 Reframing Bands v01 dated April 10, 2015.

Additionally, if the equipment is capable of transmitting data, has transmitter output power greater than 500 mW, and has a channel bandwidth of more than 6.25 kHz, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of channel bandwidth:

- The product under test operates as a digital mobile radio supporting digital voice and data operating with 4 state FSK modulations, which creates four possible symbols over the air at a rate of 4800 symbols/s, corresponding to 9600 bit/s.

Result: Complies.

Clause 90.205 RF power output

Measurements were carried out at the RF output terminals of the transmitter using a power attenuator and a RF Power meter.
Measurements were carried out when the transmitter was not being modulated.
Testing was carried out at maximum power output.

Minimum transmitter power (CW) - Rated 1.0 W (+30.0 dBm)

Frequency (MHz)	Voltage (Vdc)	Carrier Power (dBm)		
		+22° C	+55° C	-20° C
155.000	Low	29.9	29.7	29.6
	Mid	29.8	29.7	29.6
	High	29.8	29.7	29.6
173.975	Low	29.5	29.5	29.4
	Mid	29.5	29.5	29.4
	High	29.5	29.5	29.4

Maximum transmitter power (CW) – Rated 5W (+37.0 dBm)

Frequency (MHz)	Voltage (Vdc)	Carrier Power (dBm)		
		+22° C	+55° C	-20° C
155.000	Low	36.5	36.6	36.2
	Mid	36.5	36.6	36.2
	High	36.5	36.6	36.2
173.975	Low	35.5	36.1	36.0
	Mid	36.0	36.1	36.0
	High	36.0	36.1	36.0

Limits: Part 90 does not specify the transmitter output power

Result: Complies. **Measurement Uncertainty**: ± 0.5 dB

Equipment used (for details see section 7):

- Power meter - Transmit path switch, H&S cables, attenuation.

Clause 90.207 and Clause 90.209 Emission types and bandwidth limitations:

The following emission types are used:

Following emission designators have been declared by the client:

Analog FM mode:

9K7F3E for 12.5 kHz channel bandwidth

Digital mobile radio mode: This mode operates using TDMA frames, the product will receive a TDMA signal and it activates both slots in the outbound.

Digital Voice DMR: 7K60FXE
Digital Data DMR: 7K60FXD

The authorised bandwidth is taken to be the necessary bandwidth.

Measurements have been made to verify this declared bandwidth using the various modulation types and data rates that this radio can support at each test frequency. For simplicity of the test report limited no of plots at representative test frequencies have been provided in the test report.

Measurements were made using a spectrum analyser that was operating in occupied bandwidth mode with the 99% power points being determined automatically.

The analyser was set up with a resolution bandwidth video bandwidth as per 47 CFR Part 2 and ANSI / TIA-603-E-2016.

Testing of analog FM channels has been performed by modulating the product using 2500 Hz external audio signal at a level 16 dB higher than that causes 50% frequency deviation corresponding to the channel bandwidth under test.

Testing of digital channels has been performed using the products internal modulation.

Clause 90.207 and Clause 90.209 Emission types and bandwidth limitations: (cont.)

Attached to the input of the spectrum analyser was an external power attenuator. The attenuation factor of the power attenuator has been included as a correction in the plots Peak detector has been employed with max hold to capture the worst case results.

All the measurements that have been tabulated were made but only the representative plots have been included in the test report in order to simplify the test report.

Result: Complies

Emission-12.5 kHz spacing.

Mode tested	Frequency (MHz)	Measured (kHz)	Designated
Analog FM/12.5 kHz	155.000	9.661	11.250 kHz
Analog FM/12.5 kHz	173.975	9.661	
Digital Voice DMR	155.000	7.313	
Digital Data DMR	173.975	7.546	

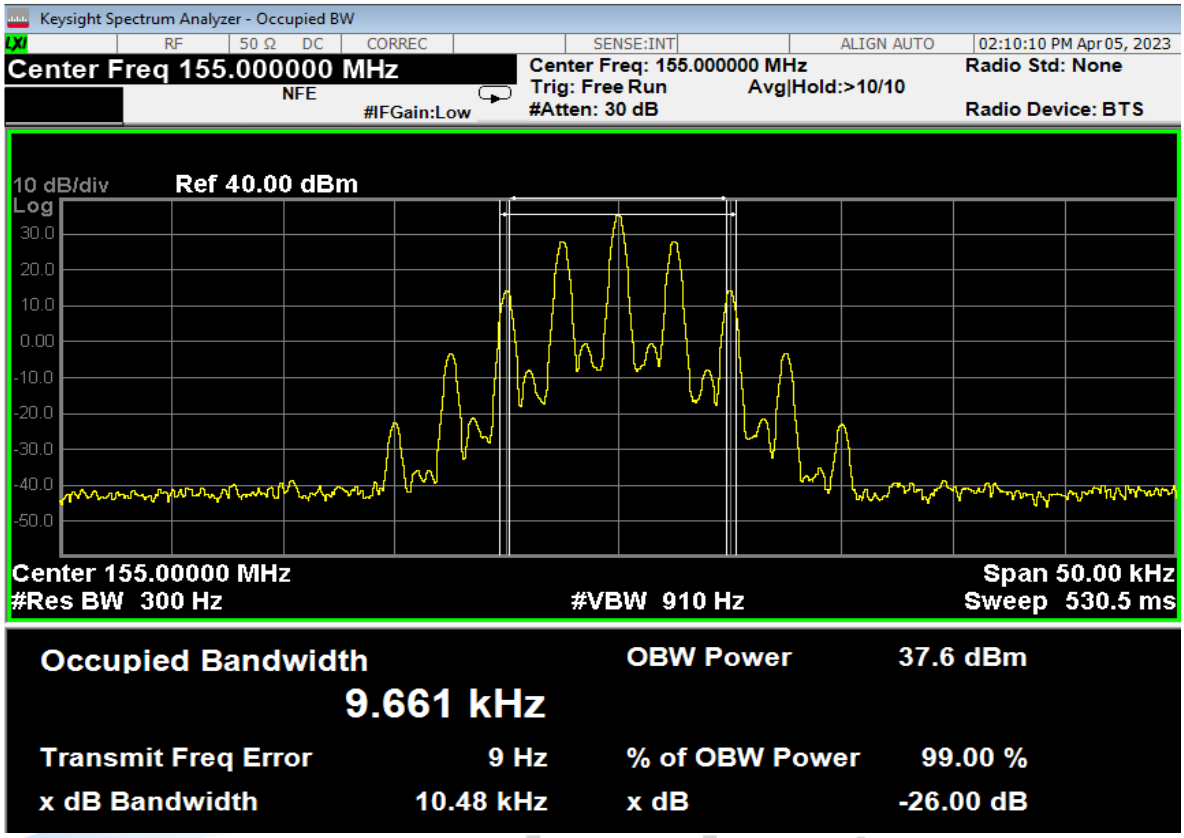
Equipment used (for details see section 9):

- Spectrum analyser-Keysight
- Synthesized audio level generator.
- Transmit path switch, H&S cables, attenuation.

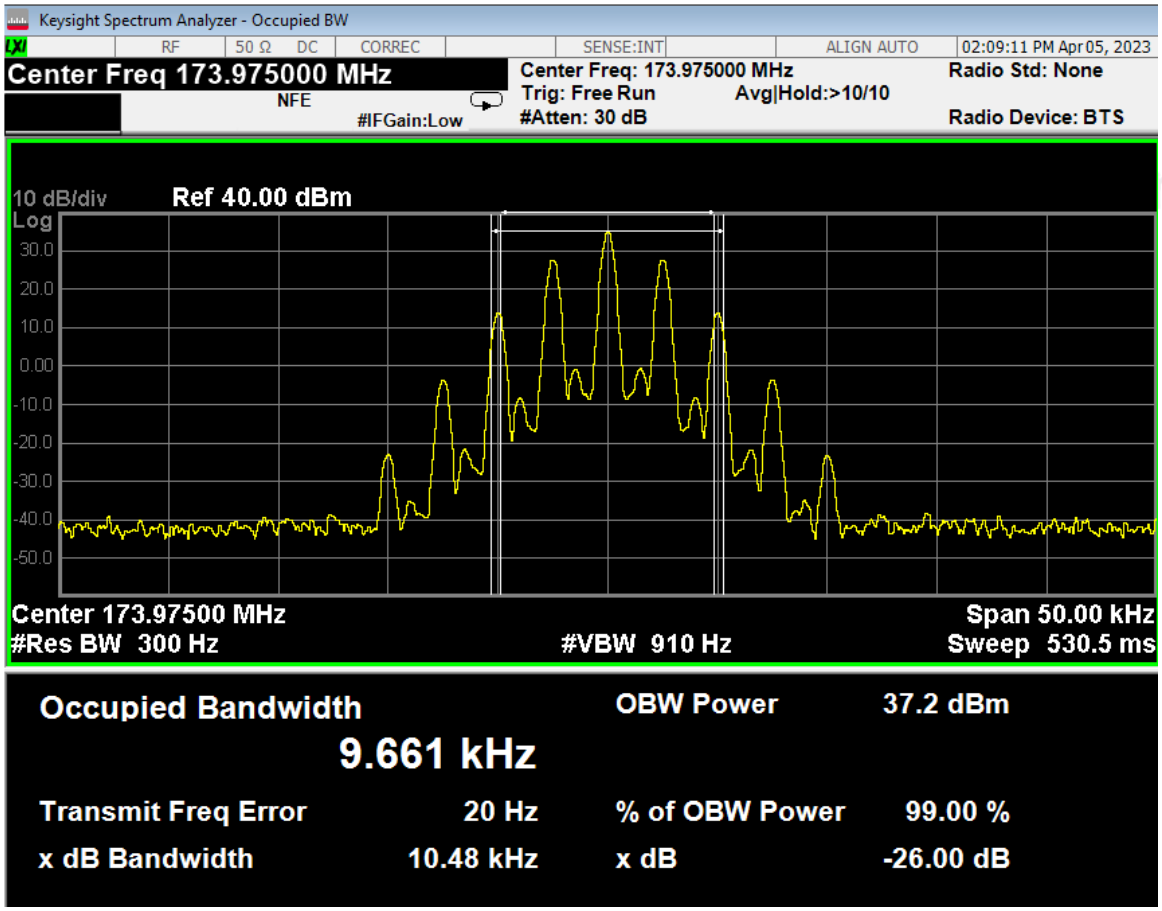
Result: Complies.

Measurement plots:

155.000 MHz, FM Analog, 12.5 kHz

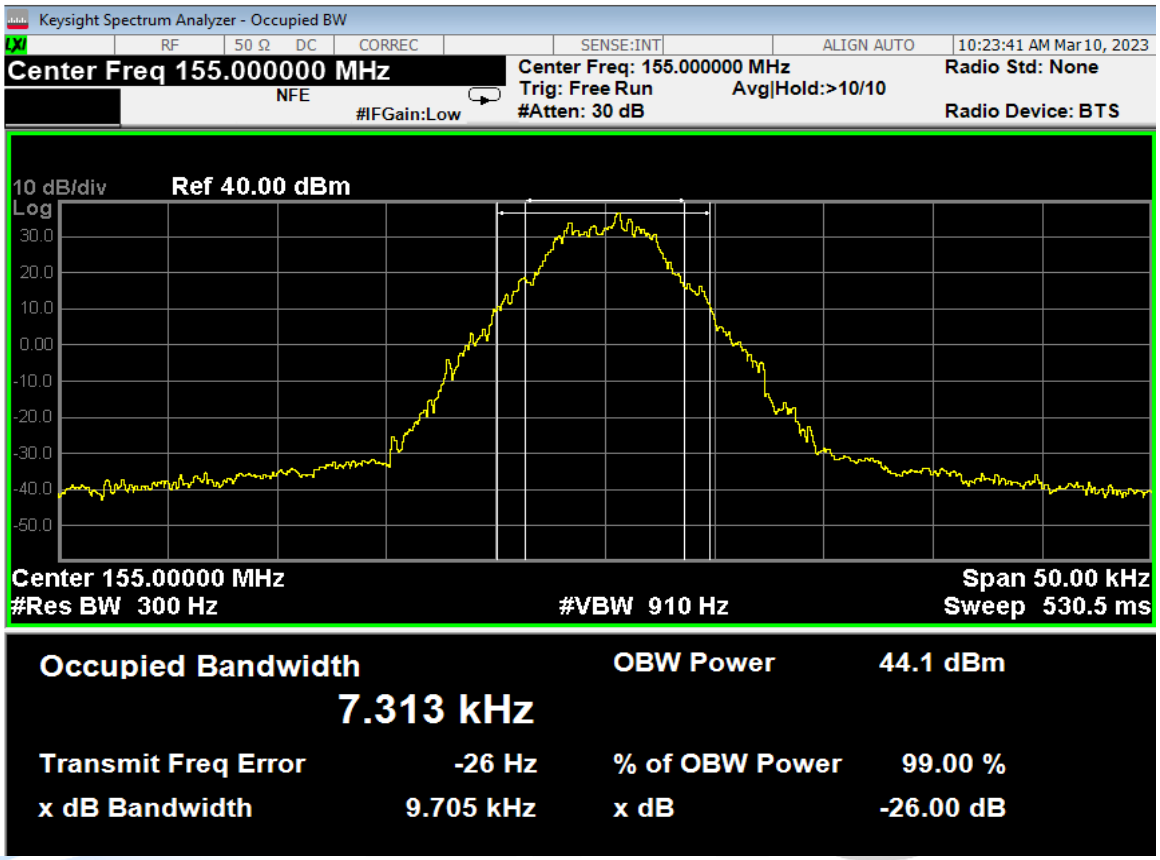


173.975 MHz, FM Analog, 12.5 kHz

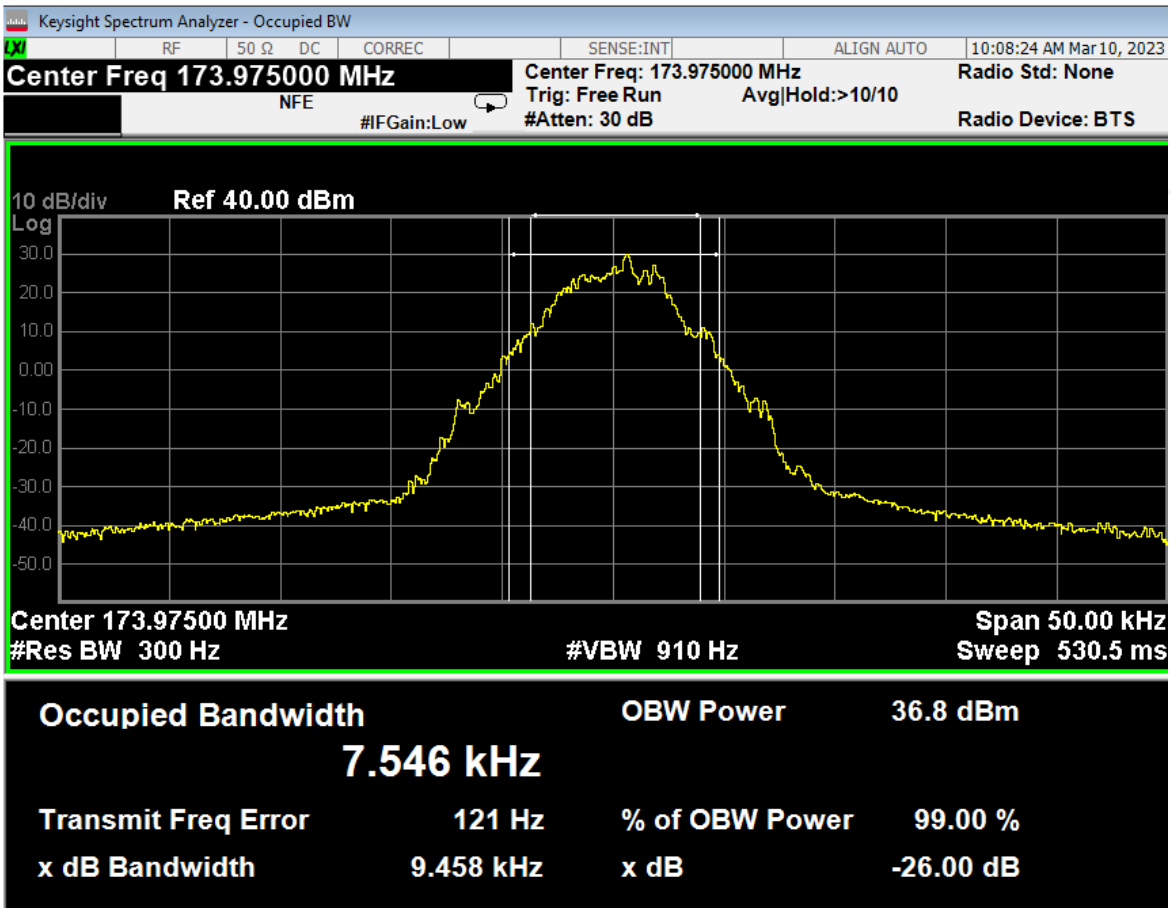


Measurement plots:

155.000 MHz, Digital Voice/Data DMR, 12.5 kHz



173.975 MHz, Digital Voice/Data DMR, 12.5 kHz



Clause 90.210 Spectrum Emission Mask measurements

As the product operates with an audio low pass filter, following masks have been applied:

Section 90.210(d) – Mask D have been applied as the transmitter can operate in the 150.0-174.0 MHz using an authorised bandwidth 12.5 kHz as per Section 90.209(b)(5).

The reference level for the following emission mask measurements has been determined using a resolution bandwidth of 120 kHz with the transmitter modulated.

For all measurements a power attenuator is placed between the transmitter and the spectrum analyser, corresponding correction factors have been included in the measured plots. Measurements were made using a peak detector in max hold function.

Testing of analog FM channels has been performed by modulating the product using 2500 Hz external audio signal at a level 16 dB higher than that causes 50% frequency deviation corresponding to the channel bandwidth under test.

Testing of digital channels has been performed using the products internal modulation.

Attached to the input of the spectrum analyser was an external power attenuator. The attenuation factor of the power attenuator has been included as a correction in the plots Peak detector has been employed with max hold to capture the worst case results.

All the measurements that have been tabulated were made but only the representative plots have been included in the test report in order to simplify the test report.

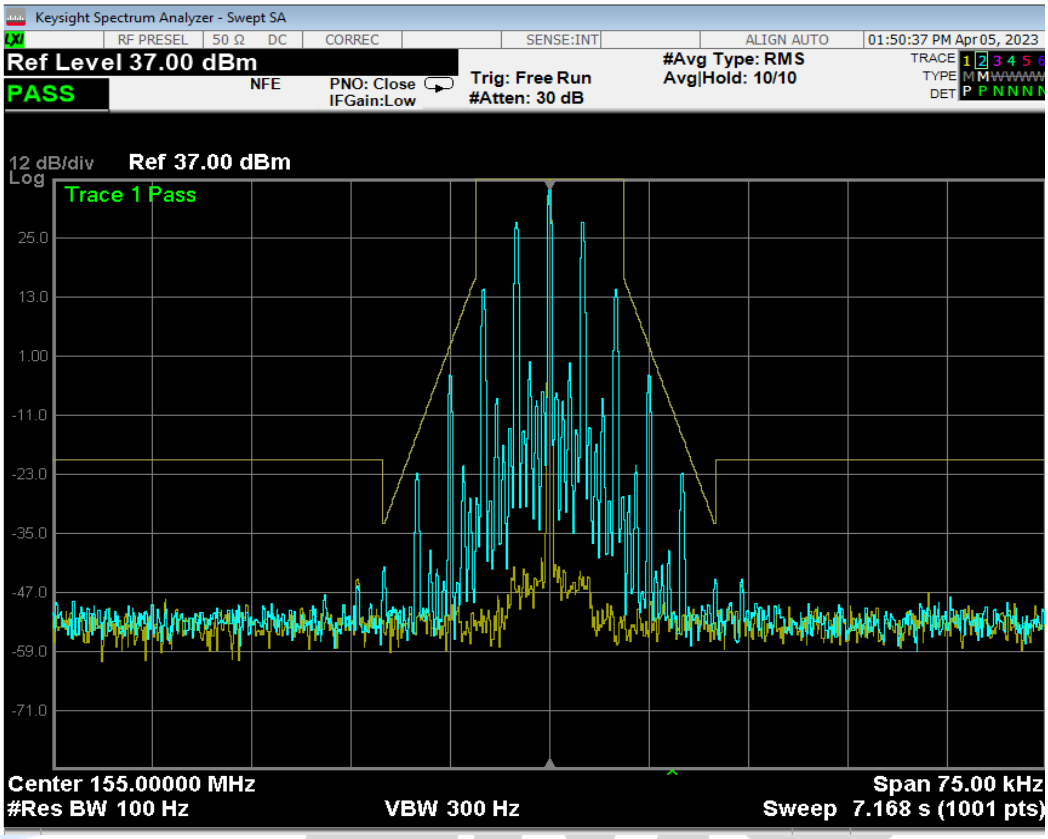
Yellow trace in the plots corresponds to unmodulated maximum power output. Blue trace corresponds to the modulated signal under test.

For the purpose of simplicity of the test report, only representative plots have been provided from the tested frequency band.

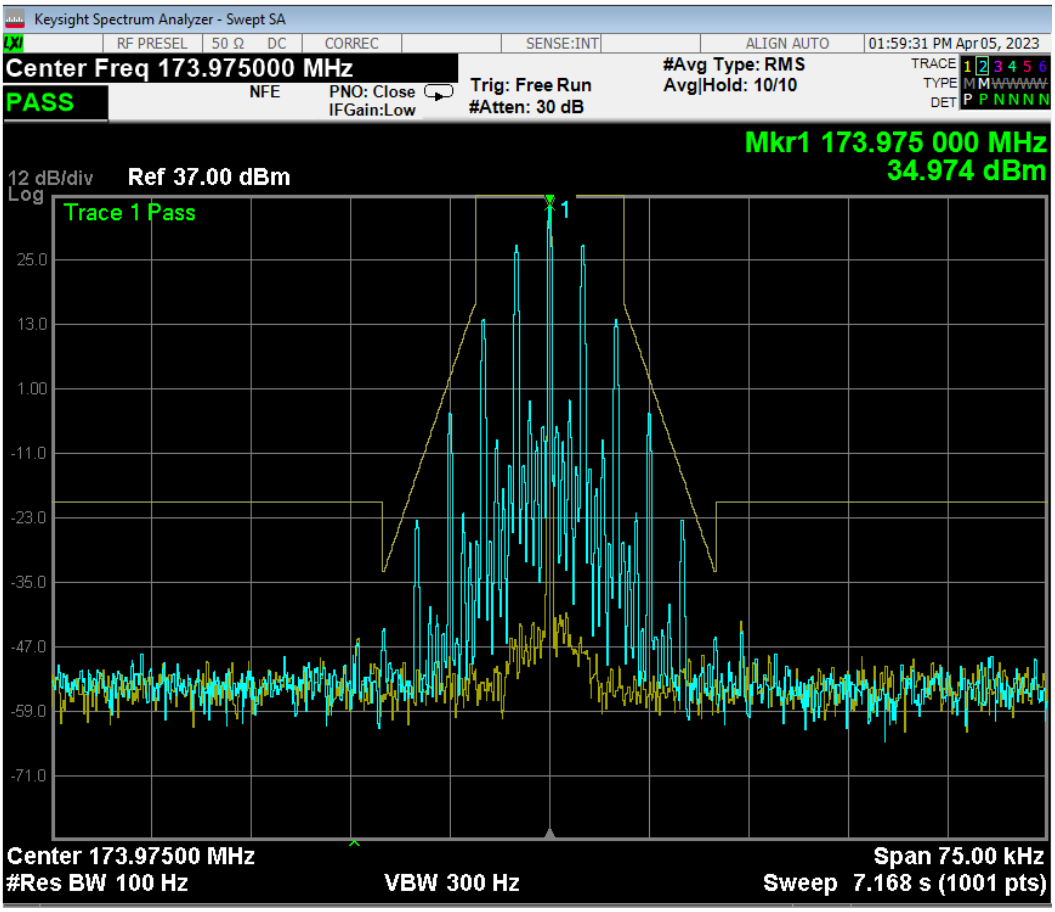
Result: Complies.

Spectrum Masks

Mask D, 155.000 MHz, FM 12.5 KHz, 5 W

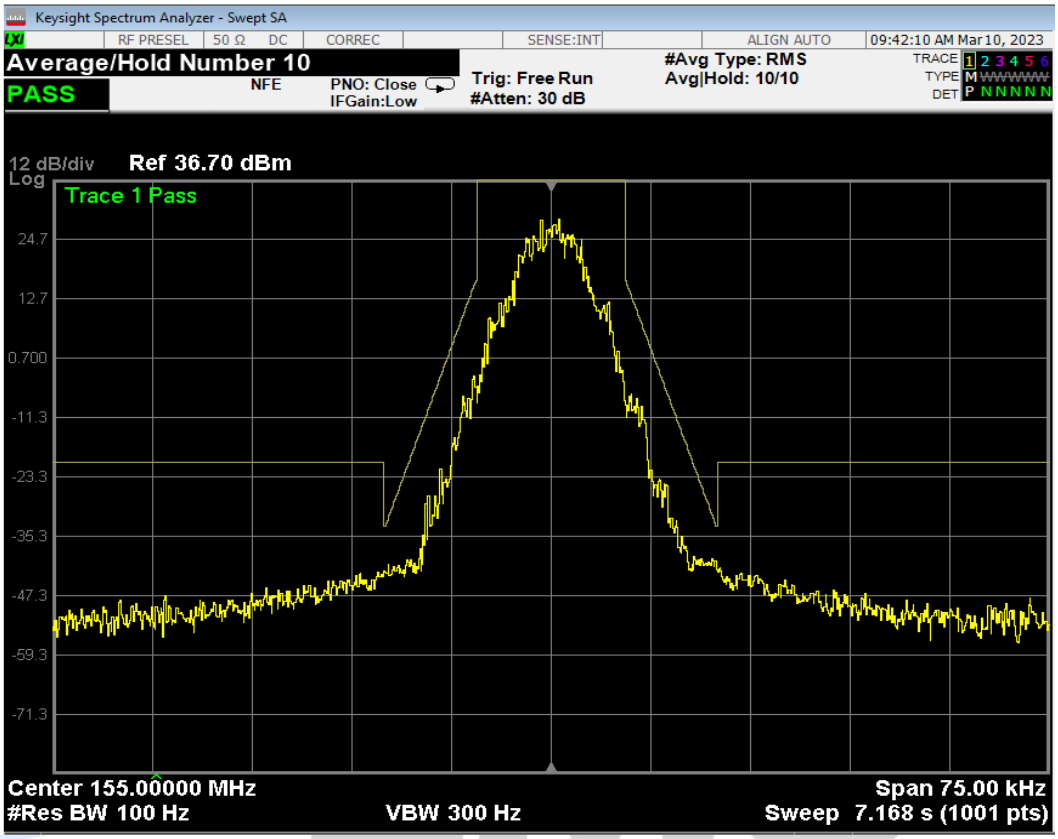


Mask D, 173.975 MHz, FM 12.5 KHz, 5 W

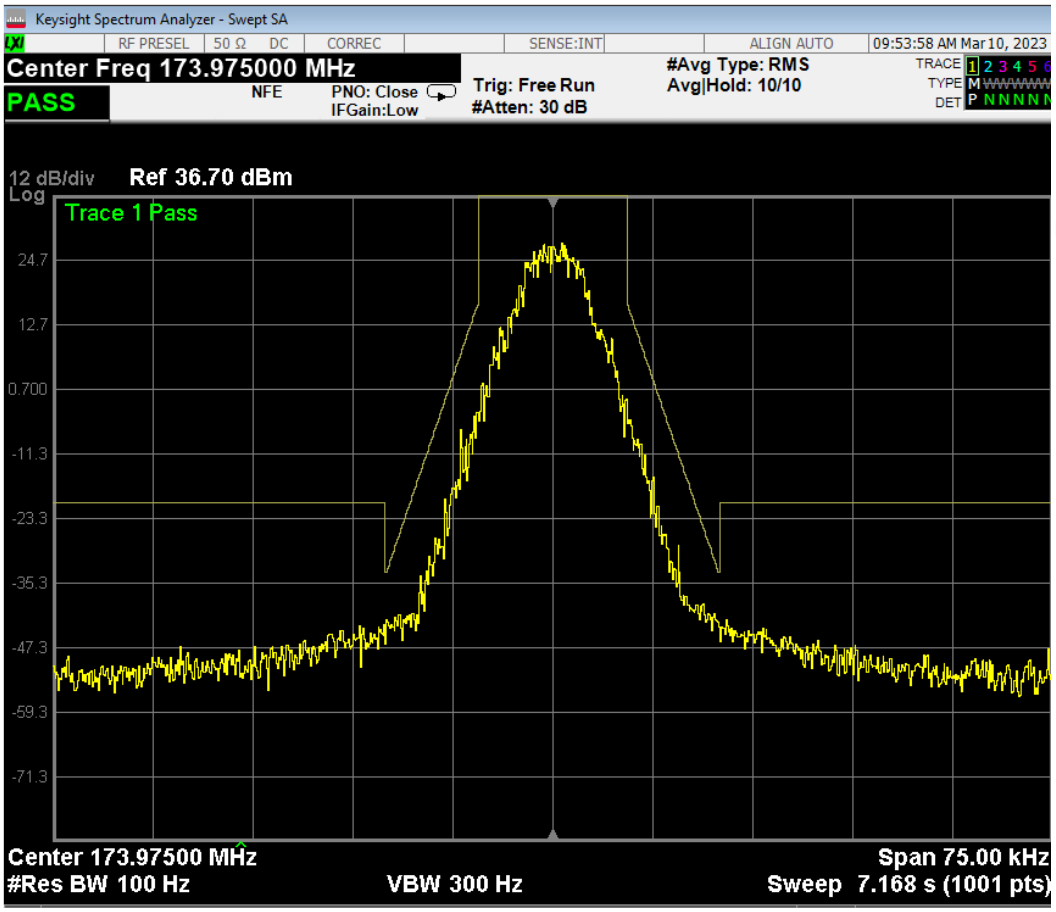


Spectrum Masks

Mask D, 155.000 MHz, DMR 12.5 KHz, 5 W



Mask D, 173.975 MHz, DMR 12.5 KHz, 5 W



Clause 2.1051 Transmitter spurious emissions at the antenna terminals

Attached to the input of the spectrum analyser was an external power attenuator. The attenuation factor of the power attenuator has been included as a correction in the plots

Peak detector has been employed with max hold to capture the worst case results.

The product was tested at unmodulated carrier output at maximum rated power.

The test was conducted at standard and extreme test conditions and the worst case has been tabulated as below:

Equipment used (for details see section 7):

- Spectrum analyser-Keysight
- Transmit path switch, H&S cables, attenuation.
- Receive path switch and H&S cables.

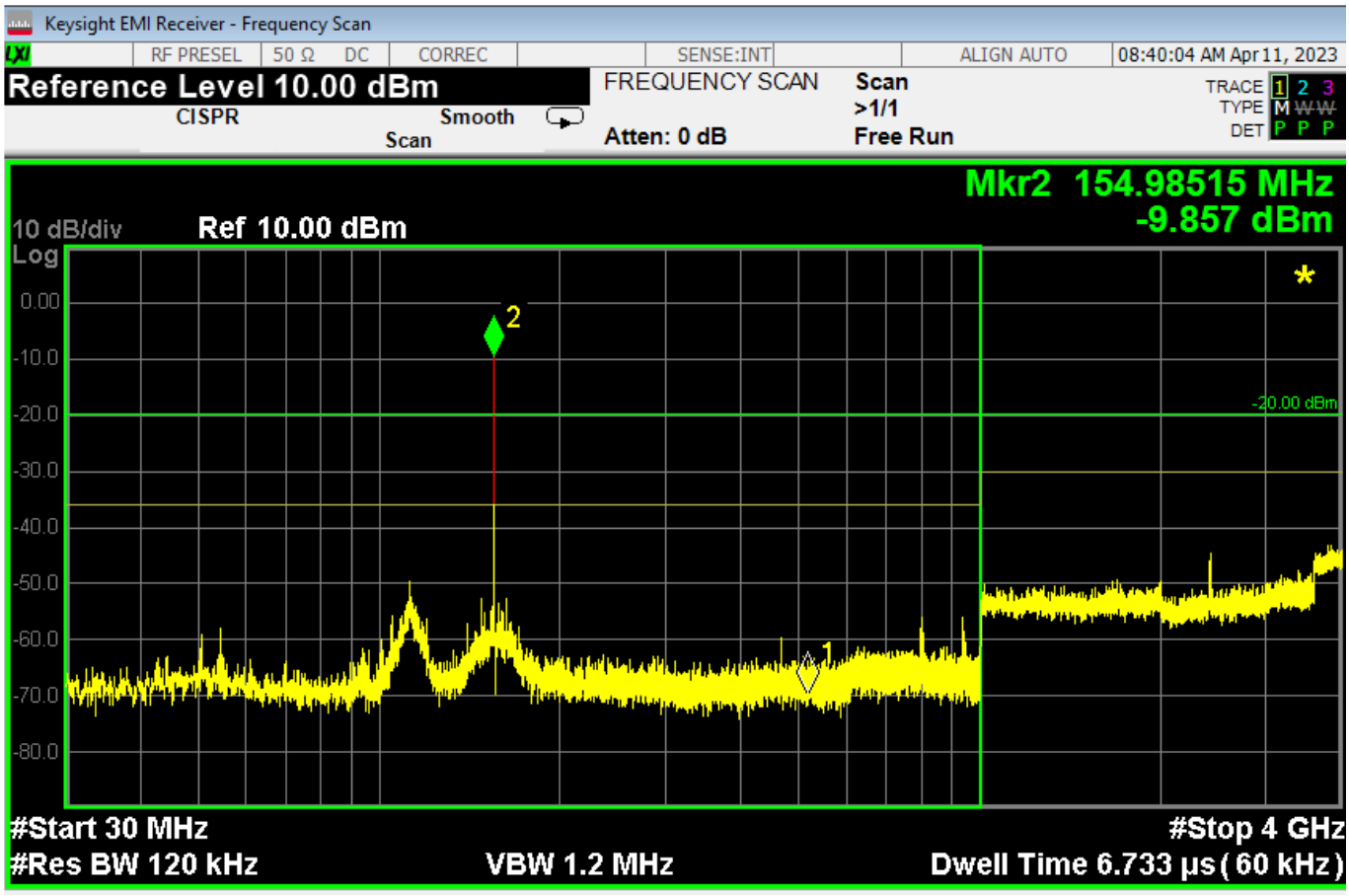
Frequency: 155.000 MHz

Spurious emission Harmonic (MHz)	Emission level (dBm)	Limit (dBm)
310.000	-52.0	-20.0
465.000	-51.8	-20.0
620.000	<-60.0	-20.0
775.000	<-60.0	-20.0
930.000	<-50.0	-20.0
1085.000	<-50.0	-20.0
1240.000	<-50.0	-20.0
1395.000	<-50.0	-20.0
1550.000	<-50.0	-20.0

Frequency: 173.975 MHz

Spurious emission Harmonic (MHz)	Emission level (dBm)	Limit (dBm)
347.950	-60.0	-20.0
521.925	-51.4	-20.0
695.900	<-60.0	-20.0
869.875	<-60.0	-20.0
1043.850	<-50.0	-20.0
1217.825	<-50.0	-20.0
1391.800	<-50.0	-20.0
1565.775	<-50.0	-20.0
1739.750	<-50.0	-20.0

Transmitter Harmonics with Notch filter when operated on full power at 155.000 MHz, Fundamental appears Red in the plot below:



Limit:

Part 90.210(d) Mask D, (3) 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.

The spurious emission limit defined by Mask D has been applied as this transmitter can operate using channel spacing of 12.5 kHz.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified.

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

No measurements were made above the 10th harmonic.

Result: Complies. **Measurement Uncertainty**: ± 0.5 dB

Clause 2.1053 Field strength of the transmitter spurious emissions

Radiated emission testing was carried out over the frequency range of 30 MHz to 2000 MHz.

The measurements were carried out in transmit and standby/receive modes.

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.

The device tested when placed in the centre of the test table flat 0.8 m above the test site ground plane.

All interconnecting cables were bundled in 40 cm long bundles.

The device under test was powered by its battery pack at 7.4 Vdc. the radio was placed on its charger supplied by the client. During transmitter measurements the charger was disconnected from the AC supply.

- A resistive dummy load that was attached to the antenna port.

- The device was operated at maximum output power.

- Attached to the device under test was a microphone which was opened to tap push to talk lines and facilitate testing.

When operating in transmit mode no significant emissions were detected between the harmonic emissions that were detected.

Testing was carried out by manually scanning between 30 MHz and 2000 MHz in 100 kHz steps while aurally and visually monitoring for emissions.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height, where appropriate, with an automated antenna tower.

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 - 6000 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)

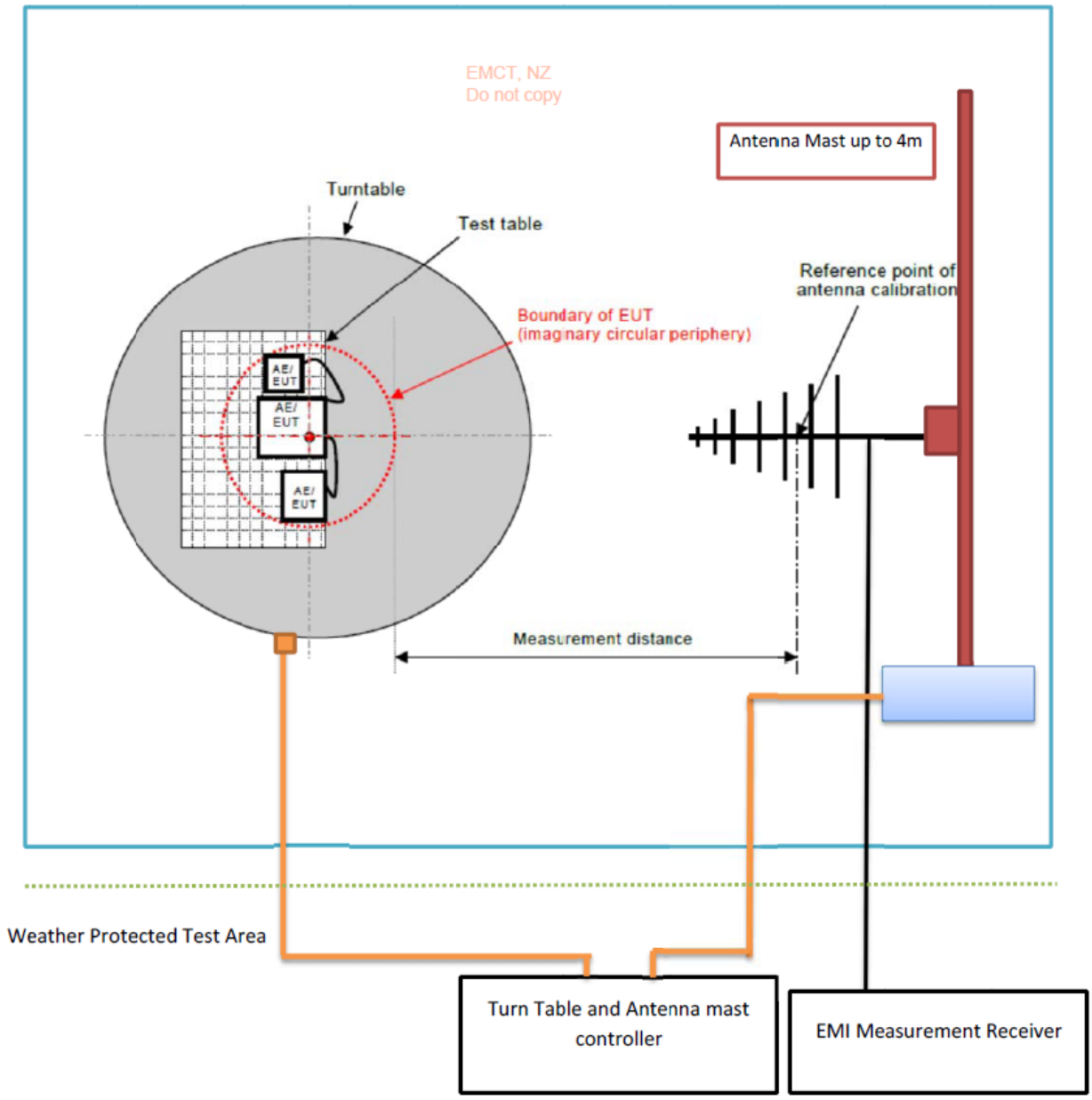
For example, if an emission of 30 dBµV was observed at 30 MHz.

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

Transmitter spurious emissions results:

Nominal Frequency: 155.000 MHz

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
310.000	32.8	-64.6	-20.0	Vertical	44.6	Pass
310.000	33.9	-63.5	-20.0	Horizontal	43.5	Pass
465.000	29.0	-68.4	-20.0	Vertical	48.4	*Pass
465.000	30.2	-67.2	-20.0	Horizontal	47.2	*Pass
620.000	32.0	-65.4	-20.0	Vertical	45.4	*Pass
620.000	33.5	-63.9	-20.0	Horizontal	43.9	*Pass
775.000	38.0	-59.4	-20.0	Vertical	39.4	*Pass
775.000	37.9	-59.5	-20.0	Horizontal	39.5	*Pass
930.000	35.5	-61.9	-20.0	Vertical	41.9	*Pass
930.000	35.8	-61.6	-20.0	Horizontal	41.6	*Pass
1085.000	43.4	-54.0	-20.0	Vertical	34.0	*Pass
1085.000	44.0	-53.4	-20.0	Horizontal	33.4	*Pass
1240.000	45.0	-52.4	-20.0	Vertical	32.4	*Pass
1240.000	45.0	-52.4	-20.0	Horizontal	32.4	*Pass
1395.000	46.0	-51.4	-20.0	Vertical	31.4	*Pass
1395.000	46.0	-51.4	-20.0	Horizontal	31.4	*Pass
1550.000	48.0	-49.4	-20.0	Vertical	29.4	*Pass
1550.000	47.0	-50.4	-20.0	Horizontal	30.4	*Pass

Nominal Frequency: 173.975 MHz

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
347.950	39.9	-57.5	-20.0	Vertical	37.5	Pass
347.950	36.4	-61.0	-20.0	Horizontal	41.0	Pass
521.925	35.0	-62.4	-20.0	Vertical	42.4	*Pass
521.925	34.0	-63.4	-20.0	Horizontal	43.4	*Pass
695.900	32.0	-65.4	-20.0	Vertical	45.4	*Pass
695.900	33.0	-64.4	-20.0	Horizontal	44.4	*Pass
869.875	43.0	-54.4	-20.0	Vertical	34.4	*Pass
869.875	36.0	-61.4	-20.0	Horizontal	41.4	*Pass
1043.850	43.5	-53.9	-20.0	Vertical	33.9	*Pass
1043.850	41.8	-55.6	-20.0	Horizontal	35.6	*Pass
1217.825	45.0	-52.4	-20.0	Vertical	32.4	*Pass
1217.825	45.5	-51.9	-20.0	Horizontal	31.9	*Pass
1391.800	47.0	-50.4	-20.0	Vertical	30.4	*Pass
1391.800	45.5	-51.9	-20.0	Horizontal	31.9	*Pass

Transmitter spurious emissions results (cont.)

Nominal Frequency: 173.975 MHz

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
1565.775	49.0	-48.4	-20.0	Vertical	28.4	*Pass
1565.775	49.1	-48.3	-20.0	Horizontal	28.3	*Pass
1739.750	51.0	-46.4	-20.0	Vertical	26.4	*Pass
1739.750	50.5	-46.9	-20.0	Horizontal	26.9	*Pass

*** Noise floor measurement**

Limit:

All spurious emissions are to be attenuated by at least 50 + 10 log (P) from below the mean power of the transmitter.

No measurements were made above the 10th harmonic.

Result: Complies.

Measurement Uncertainty: ± 4.1 dB

General/Standby emissions:

Results: 30 – 2000 MHz

Measurements between 30 – 2000 MHz have been made at a distance of 3 metres.

The Class B limits been applied.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Antenna Polarisation	Result
32.040	24.5	24.0	40.0	15.5	Pass	Vertical
36.000	25.5	23.6	40.0	14.5	Pass	Vertical
49.400	23.8	20.0	40.0	16.2	Pass	Vertical
58.400	24.9	17.2	40.0	15.1	Pass	Vertical
82.000	17.5	15.6	40.0	22.5	Pass	Vertical
130.640	25.0	28.0	43.5	15.5	Pass	Horizontal
143.200	30.8	28.4	43.5	12.7	Pass	Vertical
197.440	35.0	26.7	43.5	8.5	Pass	Vertical
207.520	26.6	34.0	43.5	9.5	Pass	Horizontal
224.440	32.2	-	46.0	13.8	Pass	Vertical
235.160	-	30.0	46.0	16.0	Pass	Horizontal
332.600	24.7	-	46.0	21.3	Pass	Vertical
368.600	-	27.8	46.0	18.2	Pass	Horizontal
415.960	36.9	-	46.0	9.1	Pass	Vertical
732.000	33.0	-	46.0	13.0	Pass	Vertical

All other emissions were observed to have a margin to the limit that exceed at least 15 dB of the limit when the measurements were carried out between 30 - 2000 MHz using both vertical and horizontal polarisations.

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 - 2000 MHz) ± 4.1 dB

Clause 90.213 Frequency Stability

Frequency stability measurements were between - 30 °C and + 50°C in 10°C increments.

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.

Test Frequency: 155.000 MHz

Temperature (°C)	Low Vdc Error (Hz)	Nominal Vdc Error (Hz)	High Vdc Error (Hz)
+50	+10	+10	+10
+40	+10	+10	+10
+30	+10	+10	+10
+20	+10	+10	+10
+10	+10	+10	+10
0	+10	+10	+10
-10	+10	+10	+10
-20	-20	-20	-20
-30	-50	-50	-50

Test Frequency: 173.975 MHz

Temperature (°C)	Low Vdc Error (Hz)	Nominal Vdc Error (Hz)	High Vdc Error (Hz)
+50	+10	+10	+10
+40	+30	+30	+30
+30	+20	+20	+20
+20	+10	+10	+10
+10	+10	+10	+10
0	+10	+10	+10
-10	+10	+10	+10
-20	-20	-20	-20
-30	-60	-60	-60

Equipment used (for details see section 7):

- Modulation Analyser - Transmit path switch, H&S cables, attenuation -Temperature Chamber -Calibrated Thermometer

Limits:

Part 90.213 states that Mobile stations transmitters operating between 150.000-174.000 MHz with 12.5 kHz channelling operating over 2 watts output power are required to have a frequency tolerance of 5.0 ppm (Note-6 applied concurrently).

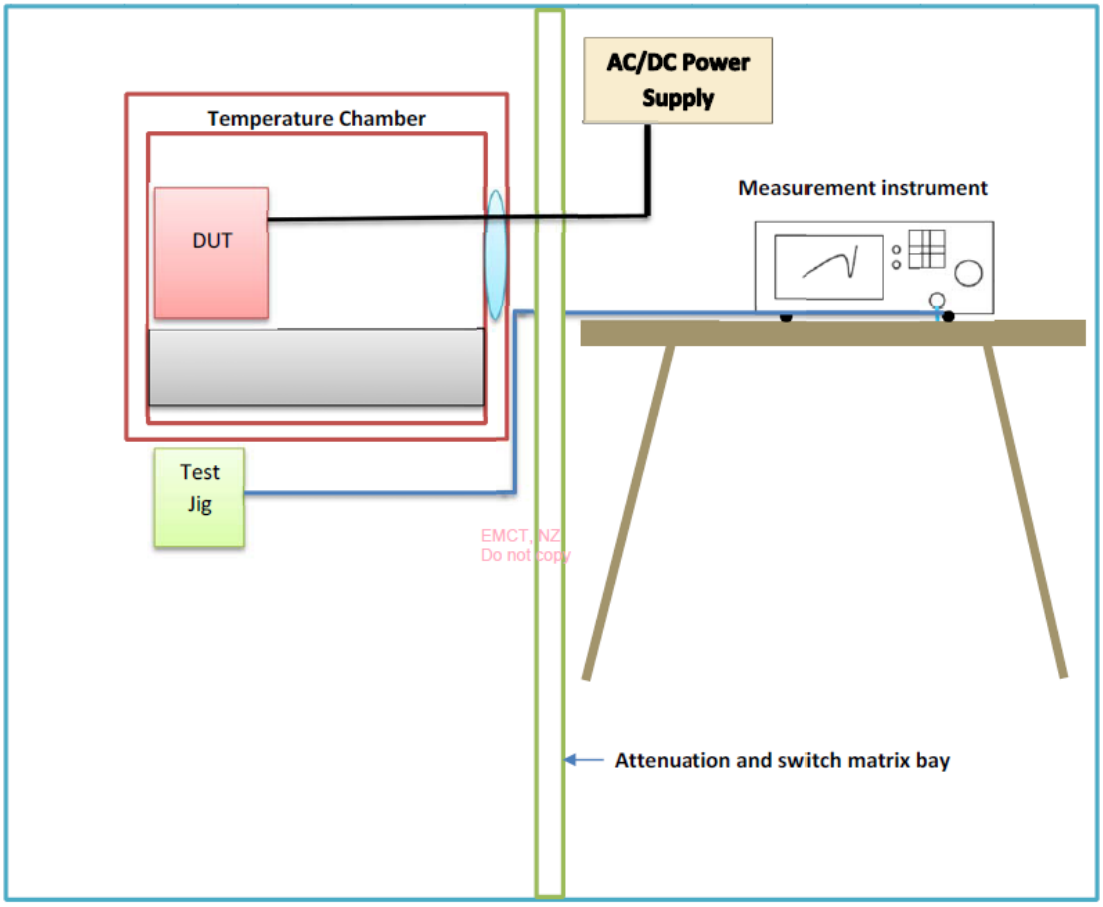
Part 90.213 Note-6 states: In the 150-174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.

Results: Complies

A worst case error of 0.3 ppm (-50 Hz / 155 MHz) was observed.

Measurement Uncertainty: ± 30 Hz

Radio bay measurement setup



Transient frequency behaviour

Measurements were carried out using the method described in TIA-603 and EN 300-086.

The modulation analyser produces an amplitude difference signal and a frequency difference signal, which are applied to the input of a storage oscilloscope.

The unmodulated transmitter is then keyed which produces a trigger pulse that is AC coupled to the oscilloscope that produces a display on the screen.

The result of the change in the ratio of power between the test signal from the signal generator and the transmitter output will produce 2 separate sides on the oscilloscope picture. One will show the 1000 Hz test modulation and the other will be the frequency difference of the transmitter versus time.

Limits:

Time Interval	Period (ms)		6.25 kHz Deviation (kHz)	12.5 kHz Deviation (kHz)	25 kHz Deviation (kHz)
	UHF	VHF			
t_1	10	5	± 6.25	± 12.5	± 25.0
t_2	25	20	± 3.125	± 6.25	± 12.5
t_3	10	5	± 6.25	± 12.5	± 25.0

Result: Complies.

Measurement Uncertainty: Frequency difference ± 1.6 kHz, Time period ±1 ms.

Equipment used (for details see section 7):

- Oscilloscope
- Transmit path switch, H&S cables, attenuation
- Signal Generator

12.5 kHz transmitter turn on (155.000 MHz)

Green Trace = 1 kHz tone with FM deviation of 12.5 kHz.

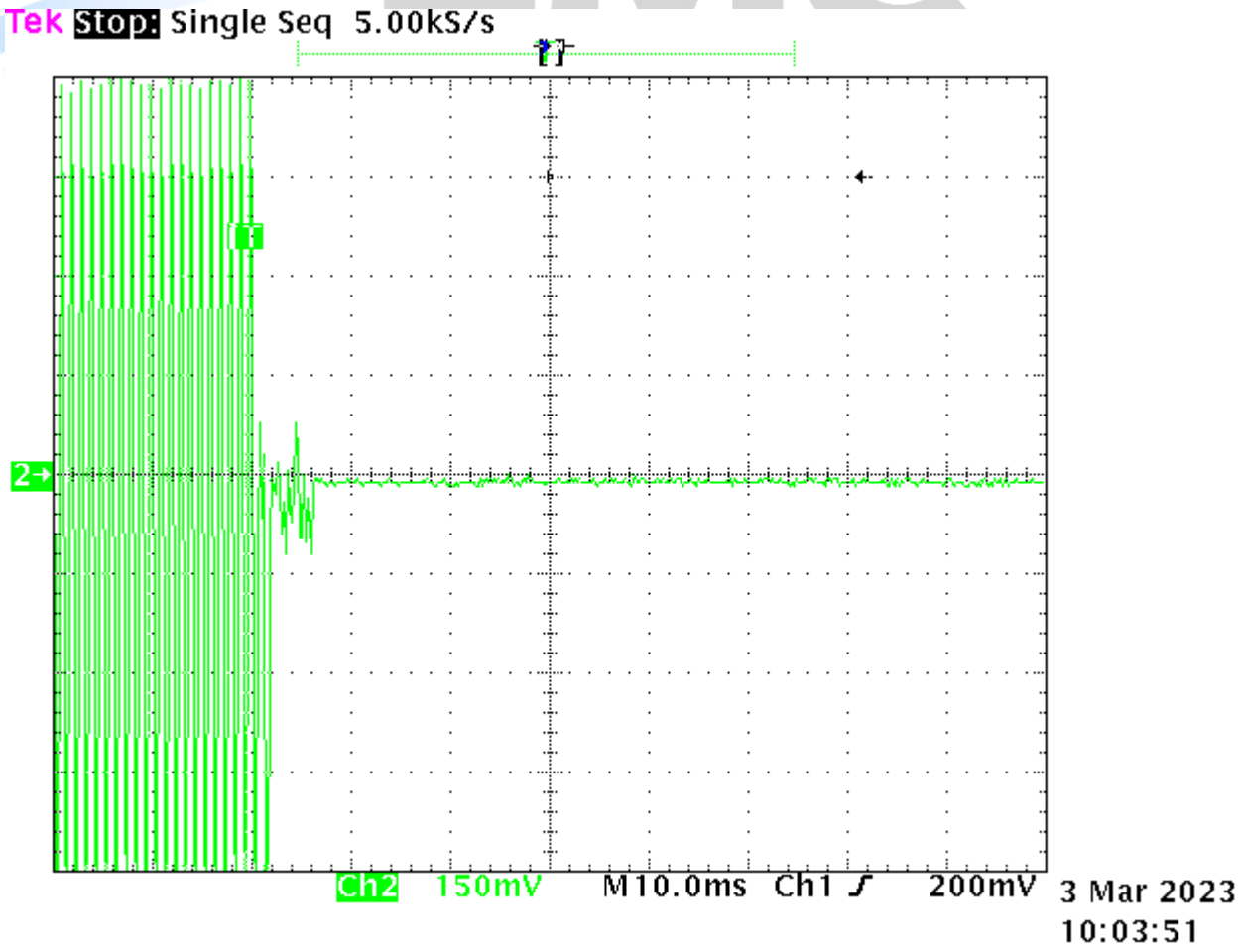
Green trace has been maximised to give full screen indication of +/- 12.5 kHz.
The X axis has been set to a sweep rate of 10 ms/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 ms).

*t*on occurs at 20 ms.

*t*1 occurs between 2.0 and 3.0 divisions from the left hand edge.
t2 occurs between 3.0 and 5.5 divisions from the left hand edge.

Transient response can be observed during t1 and t2.



12.5 kHz transmitter turn off (155.000 MHz)

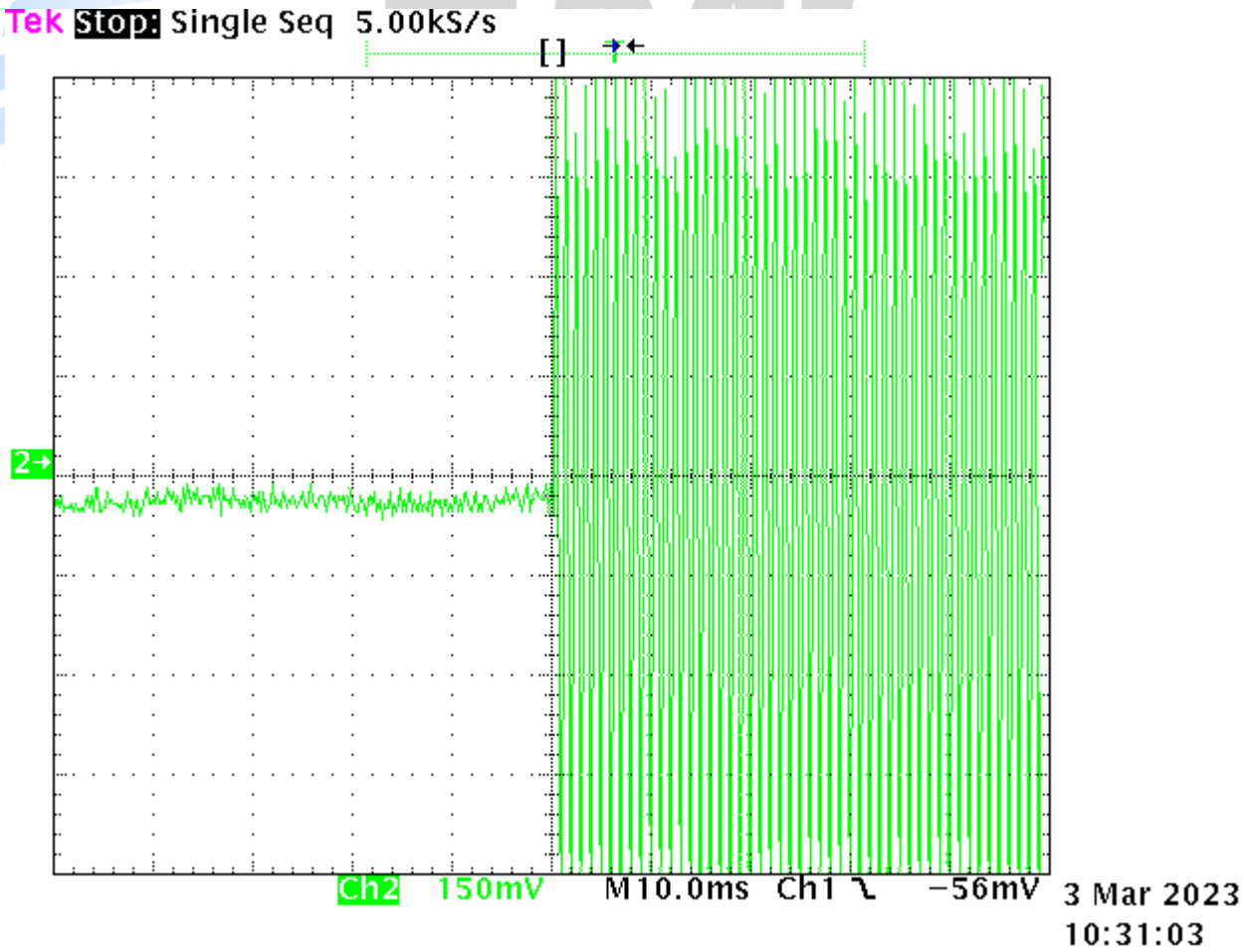
Green Trace = 1 kHz tone with FM deviation of 12.5 kHz.

Green trace has been maximised to give full screen indication of +/- 12.5 kHz.
The X axis has been set to a sweep rate of 10 ms/division

The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 ms). This is position *t*off.

*t*3 occurs between 4.0 and 5.0 divisions from the left hand edge.

Transient response can be observed before *t*off.



Modulation Characteristics

a) This transmitter is capable of producing analogue speech modulation.

Frequency response of the audio frequency low pass filter between 100 Hz and 15 kHz.

This measurement was carried out using an audio signal generator and an audio modulation analyser.

At 1 kHz an audio signal was applied which was used as a 0 dB response reference.

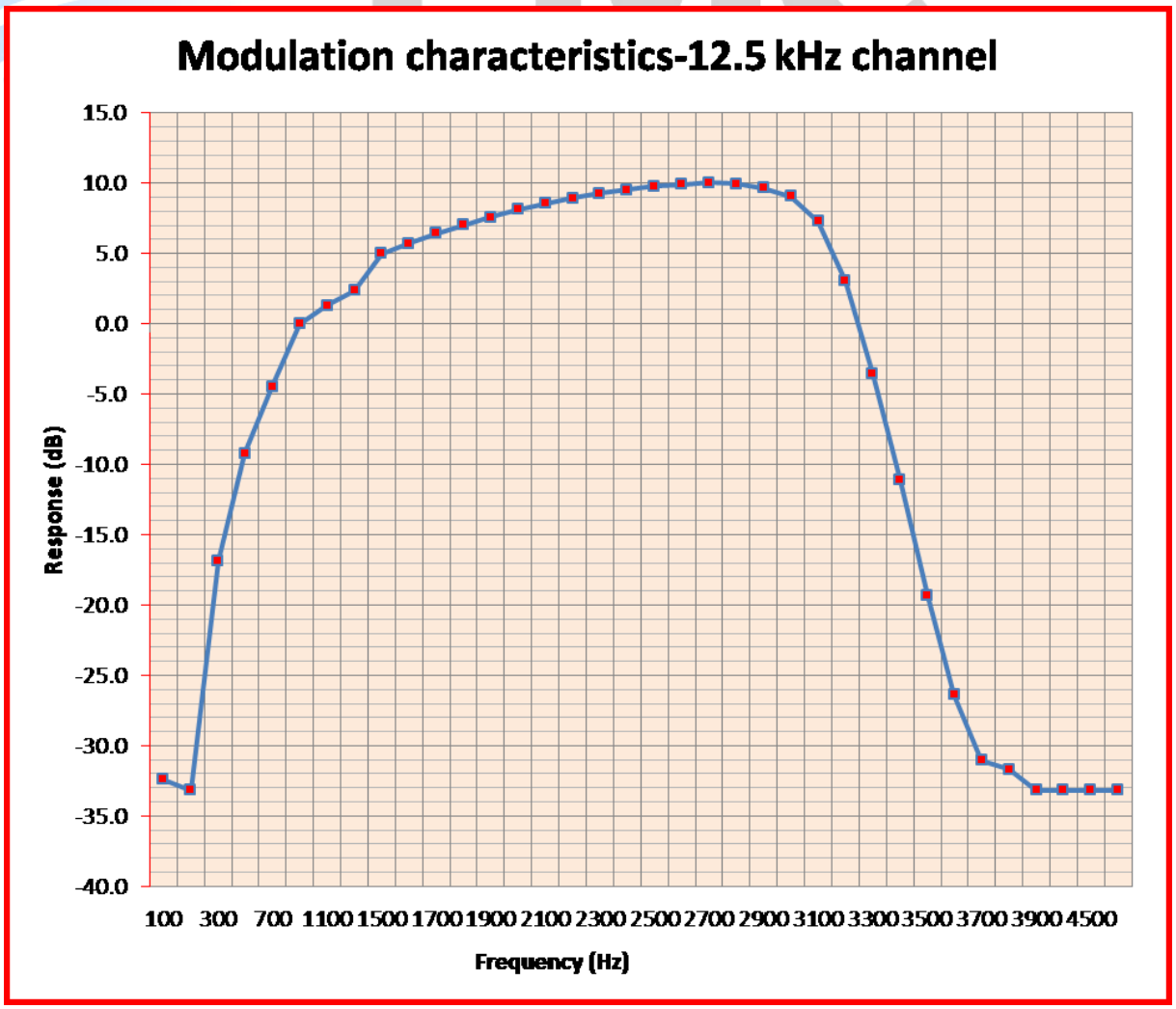
The frequency of the input signal was then varied and the output response noted.

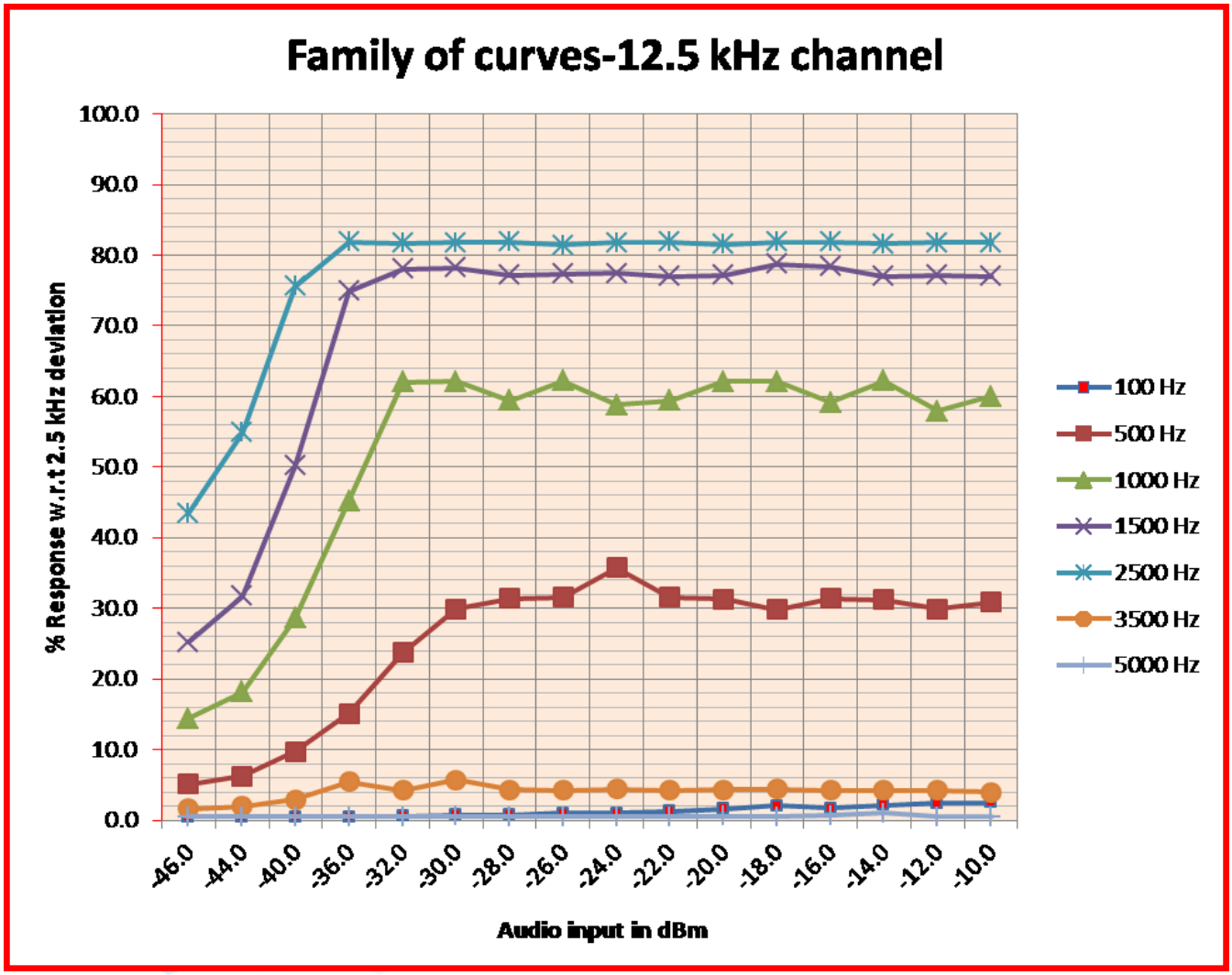
This measurement was carried out from 100 Hz to 5000 Hz as required by Part 2 with further measurements carried out in order to show the full range of this filter.

b) A family of curves showing the percentage of modulation versus the modulation input voltage.

Measurements were made between 100 Hz to 5 kHz.

At each frequency the input voltage was slowly increased with the resulting frequency deviation of the transmitter being recorded.





Equipment used (for details see section 7):

- Modulation Analyser
- Transmit path switch, H&S cables, attenuation
- Synthesised audio level generator
-Audio Analyser

Exposure of humans to RF fields

The product under test is a Handheld VHF mobile radio.

SAR test is applicable to the product to assess safety to Human exposure.

Result: Noted.

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Cal Due	Interval
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	9594	23/11/23	2.0 years
Log Periodic Antenna	Schwarzbeck	VUSLP 91111	9111-112	16/11/23	2.0 years
Horn Antenna	EMCO	3115	9511-4629	01/06/23	3.0 years
Modulation Analyzer	Rohde & Schwarz	FMA	837807/020	13/04/23	1.0 year
Power Attenuator	Tenuline	8322	-	N/a	N/a
Power Attenuator	DTS	-	-	N/a	N/a
Modulation Analyser	Hewlett Packard	8901B	SN2608A00782	13/07/23	3.0 years
Signal Generator	Rohde & Schwarz	SMHU	E1493	28/05/23	2.0 years
Power meter	Hewlett Packard	436A	2512A22439	17/06/23	2.5 years
Oscilloscope	Tektronics	745A	B010643	4/10/24	2.0 Years
Signal Generator	Agilent	E4433B	ESG-D	28/02/24	2.0 Years
Notch Filter	TelonicAltair	TTR 190-3EE	60501-2	-	VBU
DC Power Supply	Hewlett Packard	HP6032A	2743A-02859	-	-
Heliax Cable	L6PNM-RPD	OATS	22869	23/12/23	1.0 Years
Transmit switch matrix+H&S Cables	Various	-	EMCT		VBU
Receive switch matrix+H&S Cables	Various	-	EMCT		VBU
Combiner	JFW	50PD-669	EMCT	-	VBU
Receiver	Rohde & Schwarz	ESIB-40	100295	03/06/23	2.0 years
Spectrum Analyzer	Keysight	N9038A	MY57290153	29/07/23	2.0 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
Software	Rohde & Schwarz	ES-K1 140	-	N/a	N/a
Measurement Receiver	Rohde & Schwarz	ESHS 10	828404/005	23/11/23	2.0 years
Impedance Stabilisation Network	TESEQ, ISN T8-Cat6	59957	3809	02/08/23	2.0 years

VBU: Verified before use.

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

8. ACCREDITATIONS

The tests were carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ ISO 17025.

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

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

International Accreditation New Zealand has International Laboratory Accreditation Council (ILAC) 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.

11. PHOTOGRAPHS

Front

Rear

Radio with battery

Side

Side

Antenna connector and dials location

Connections and labels

Microphone

Microphone label

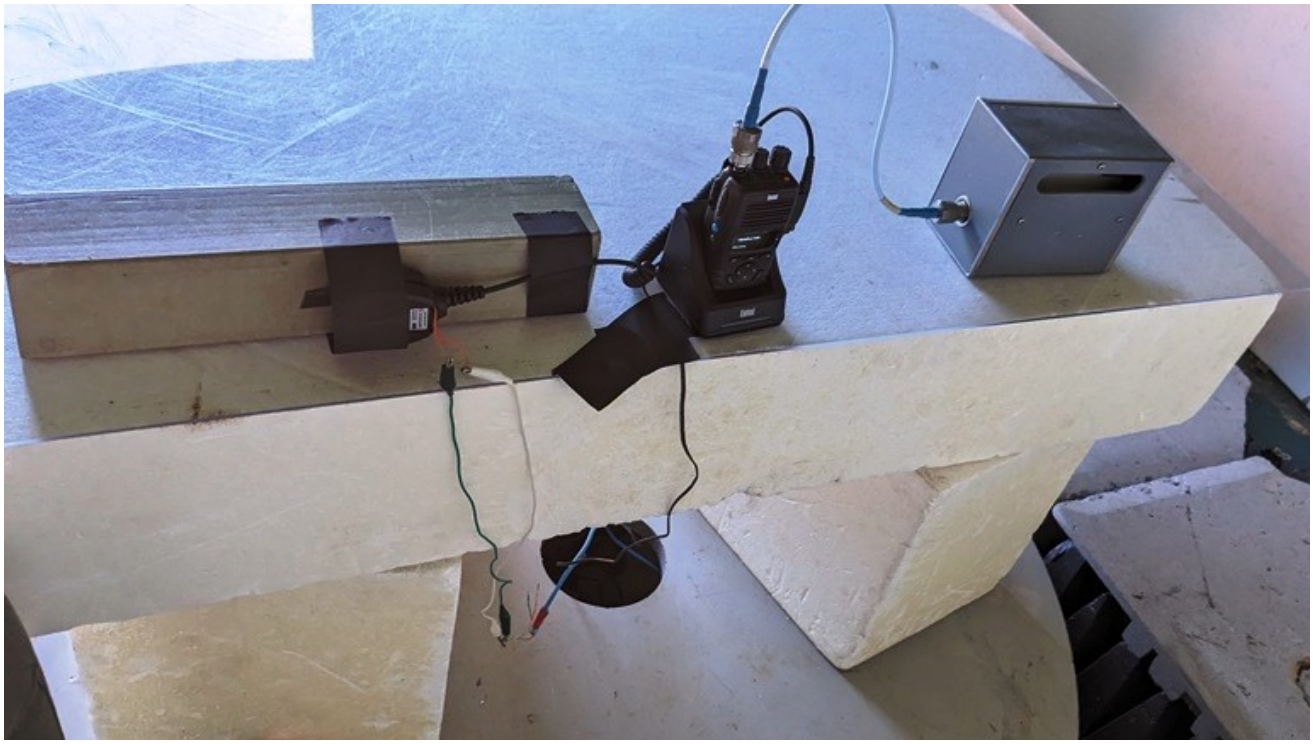
Photos of the test jig supplied to facilitate testing

Charger supplied with the radio

Charger label

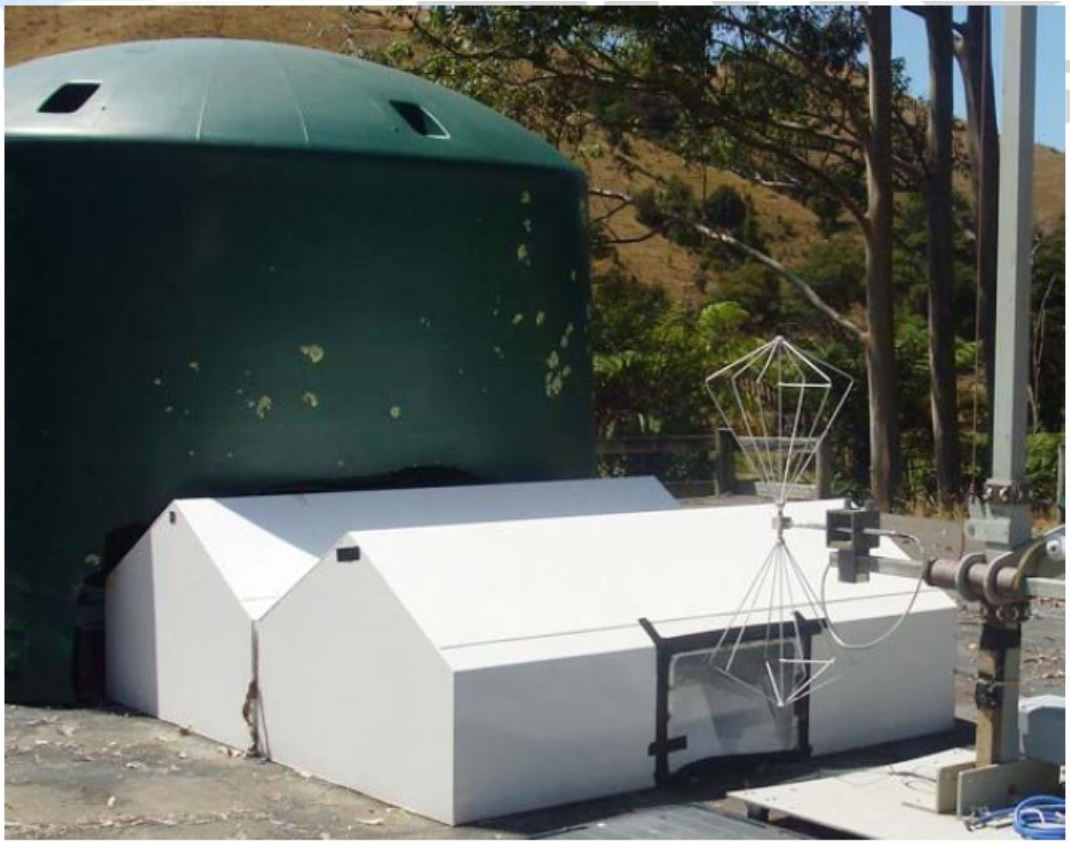
Conducted Emissions Test Setup

Radiated Emissions Test Setup



Radiated Emissions Test Setup

Test Shed showing the use of a Biconical Antenna



Test Shed showing the use of a Log periodic Antenna