Global Product Certification

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TEST REPORT

Mark-IV Bi-Directional Amplifier (Repeater)
Model: M4DBDAUU

tested to the

Code of Federal Regulations (CFR) 47

Part 90 –Private Land Mobile Services

for

Canam Technology Inc

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

Table of Contents

1. COMPLIANCE STATEMENT

The **Mark-IV Bi-Directional Amplifier (Repeater) Model: M4DBDAUU** 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 ANSI C63.26: 2015 and FCC KDB 935210 D04 v01r04 April 3, 2020 as a Class A Industrial Signal Booster.

2. RESULT SUMMARY

The results of testing carried out between February 4th and March 12th , May 22nd and June 17th 2025 are summarised below.

Clause	Description	Result
90.203	Certification required	Noted
2.1046 (KDB 4.5) 90.205	RF power output Power and antenna height limits	Noted Complies
2.1049 2.202 90.207 90.209 90.210 (KDB 4.4)	Occupied bandwidth Bandwidths Types of emissions Bandwidth limitations Emission masks	Noted Noted Complies Complies Complies
2.1051 (KDB 4.7.3)	Spurious emissions at antenna terminals	Complies
2.1053 (KDB 4.9)	Field strength of spurious radiation	Complies
2.1055 90.213	Frequency stability Frequency stability	Noted Complies
90.214	Transient frequency behaviour	Not applicable
1.1310	Radio frequency exposure limits	Complies
KDB 4.2	Automatic Gain Threshold	Complies
KDB 4.3	Out of Band Rejection	Complies
KDB 4.7.2	Intermodulation Products	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.

Any corrections or erasures in this report are detailed in the revision table below.

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
241101.4	Initial Issue	27th March 2025
241101.4A	Operating band changed to 406.1 – 430 MHz	29th May 2025
241101.4B	Composite Power measurements included	17th June 2025

4. CLIENT INFORMATION

Company Name	Canam Technology Inc
Postal Address	5318 East 2nd Street, #700 Long Beach
State	CA 90803
Country	United States of America
Contact	Victor Bermudez

5. TEST SAMPLE DESCRIPTION

Model Number	M4DBDAUU
Product	Bi-Directional Amplifier (Repeater)
Manufacturer	Canam Technology Inc
Manufactured in	United States of America
Serial Number	1153
Rated supply	110 – 240 Vac
FCC ID:	TCJ-M4DBDAUU

The sample tested is a Bi-Directional Amplifier (Repeater) that is defined as an FCC Class A Industrial Signal Booster

The sample testing has the following specifications:

Receive band: 406.1 – 430.0 MHz, Transmit band: 500.0 – 512.9 MHz
Receive band: 500.0 – 512.0 MHz, Transmit band: 406.1 – 430.0 MHz

The majority of tests were carried using the following configuration:

Input: 415.000 MHz Output: 506.000 MHz
Input: 506.000 MHz Output: 415.000 MHz

High clock frequency in use: 737.280 MHz

Transmitter power: Channel Power +25 dBm (316 mW)

Number of channels in use: 16

Composite Power: +37 dBm (5 watts) – 16 channels x 316 mW = 5 watts (+37 dBm)

Channel Spacing: 12.5 kHz

Receiver Intermediate Frequency: 70 MHz

Modulations supported: Analogue speech (FM), Digital Speech and Data (P25 protocols)

Modulation designators: 11k3F3E, 8k10F1W, 9k80D7W

Transmitter Duty Cycle: 100%

6. TEST RESULTS

Certification required

As this device will transmit in the 406.1 – 430.0 MHz and the 500.0 – 512.0 MHz FCC part 90 bands certification of this Bi- Directional Amplifier (Repeater) will be required as a FCC Class A Industrial Signal Booster.

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 when the transmitter was un-modulated as detailed below.

Rated transmitter output power: +25.0 dBm (316 mW)

400 MHz band at +25 °C

Frequency (MHz)	100 Vac (dBm)	230 Vac (dBm)	253 Vac (dBm)
406.100	+24.9	+24.9	+24.9
415.000	+24.3	+24.3	+24.3
430.000	+24.6	+24.6	+24.6

500 MHz band at +25 °C

Frequency (MHz)	100 Vac (dBm)	230 Vac (dBm)	253 Vac (dBm)
500.000	+25.8	+25.8	+25.8
506.000	+25.4	+25.4	+25.4
512.000	+25.2	+25.2	+25.2

The client has stated that the composite power of the device is 5 watts (+37 dBm)

The rated power of the transmitter is 316 mW (+25.0) dBm and 16 channels are in use which gives a composite power of +37 dBm.

The composite power was measured when the client configured the device, for test purposes only, to transmit on a single frequency as shown in the table below.

Composite power at +25 °C. Rated: +37.0 dBm (5 watts)

Frequency (MHz)	100 Vac (dBm)	230 Vac (dBm)	253 Vac (dBm)
415.000	+37.2	+37.2	+37.2
506.000	+37.3	+37.3	+37.3

Part 90 does not specify the transmitter output power.

The power output should remain within +/- 1 dB of the rated power.

Result: Complies.
Measurement Uncertainty: ± 0.5 dB

KDB 4.2 Automatic Garin Threshold

All measurements were made when the input level was set to -60 dBm.

Checks were made over the over the input range of the amplifier.

At no point was there a 1 dB increase in output level when the input level was increased by 1 dB.

Between the turn ON at approximately -104 dB the output level decreased from +26.9 dBm down to +25.7 dBm at -70 dBm and then remained constant as the input level was increased.

The device was observed to turn off when the input level went below -109 dBm

This gives a hysteresis of approximately 4 dB

Result: Noted

Clause 90.207 and Clause 90.209: Emission types and bandwidth limitations:

The following modulation types have been declared by the client along with a description as to how these input signals to the power amplifier were simulated by the laboratory.

11K3F3E:
11.3 kHz occupied bandwidth
FM modulation
Frequency deviation is set to 2.5 kHz and an audio tone of 1 kHz is used.

8K70D1W:
8.7 kHz occupied bandwidth.
C4FM modulation
Frequency deviation of 1.8 kHz and 6000 symbols/sec.
This simulates a H-CPM P25 Phase 2 UL TDMA Subscriber Unit.

9K80D7W:
9.8 kHz occupied bandwidth
PI/4 DQPSK modulation
8000 symbols/ second
This simulate a H-DQPSK P25 Phase 2 DL Fixed Base

Occupied Bandwidth testing for each of the three emission types to be used was carried out where a 12.5 kHz channel step size is used:

Testing was carried out using a Keysight Spectrum Analyser that was operating in Occupied Bandwidth mode.

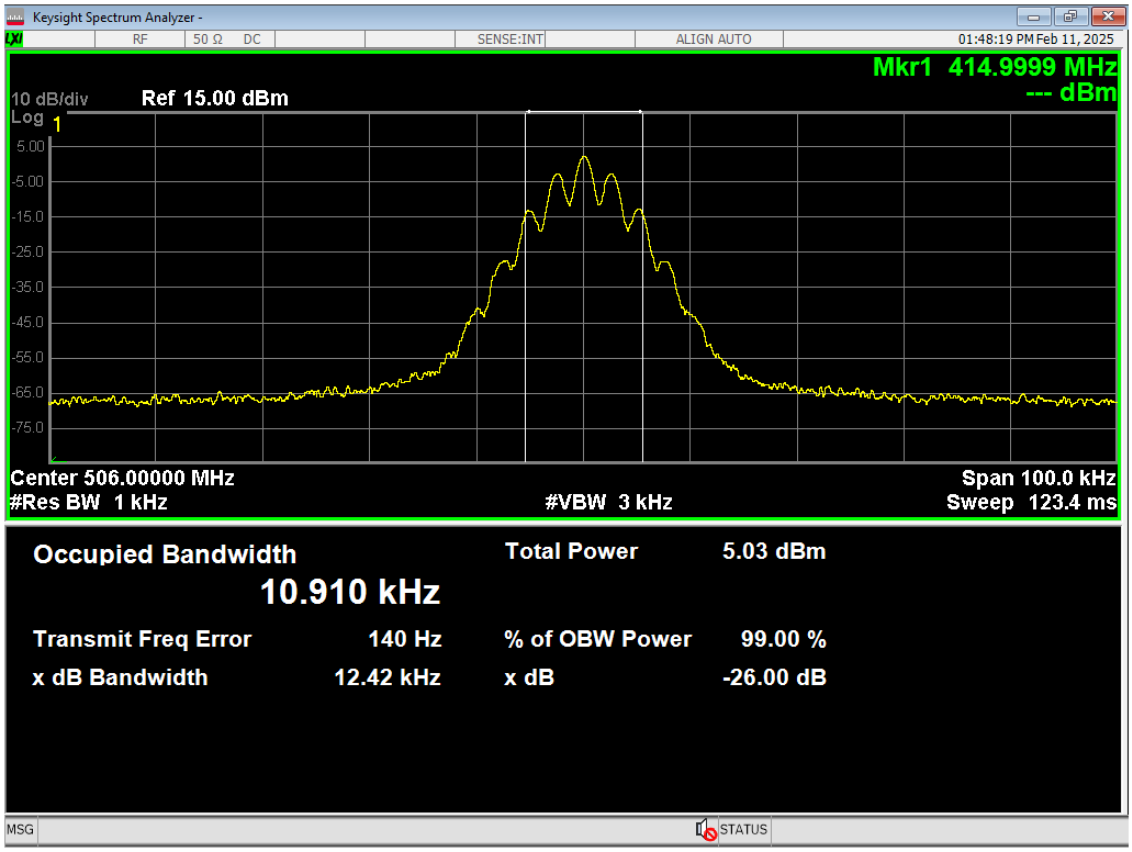
The measured occupied bandwidths closely approximate the bandwidths declared by the client.

An authorised bandwidth of 11.25 kHz which is typically applied to transmitters operating with channel spacing's of 12.5 kHz in the bands where this amplifier is used.

Result: Complies.

Occupied Bandwidth

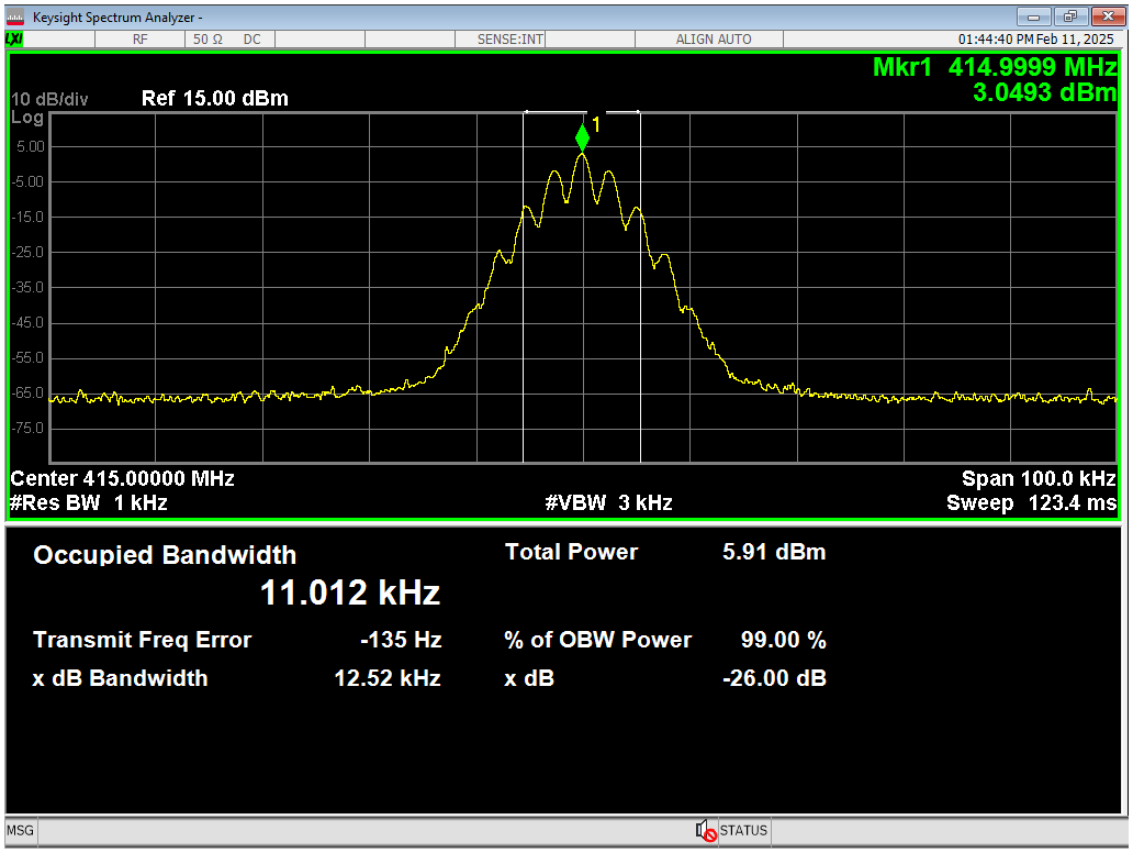
F3E 11K3 bandwidth – 12.5 kHz channel spacing with a frequency deviation of 2.5 kHz with a 2550 Hz tone.



Occupied Bandwidth

F3E 11K3 bandwidth – 12.5 kHz channel spacing with frequency deviation of 2.5 kHz with a 2550 Hz tone.

415.000 MHz



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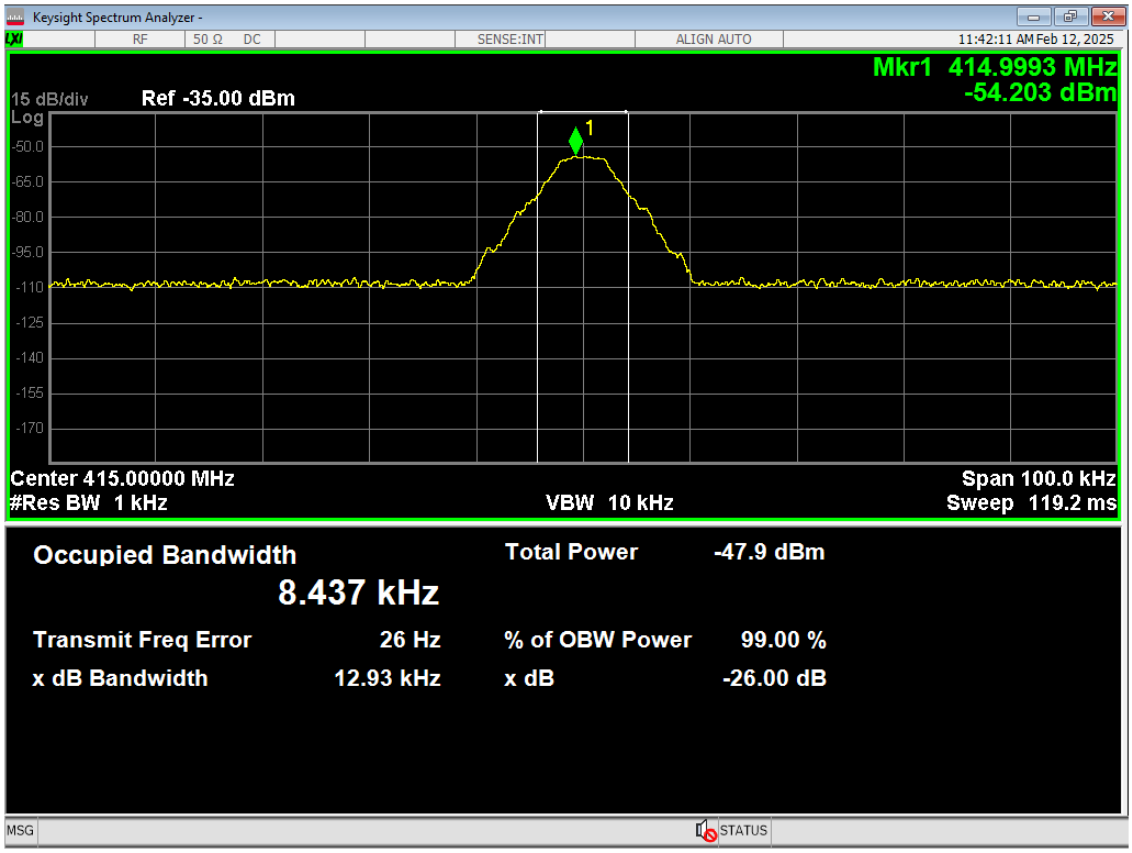
Occupied Bandwidth

8K10F1W – C4FM with a deviation of 1.8 kHz and 6000 symbols/sec

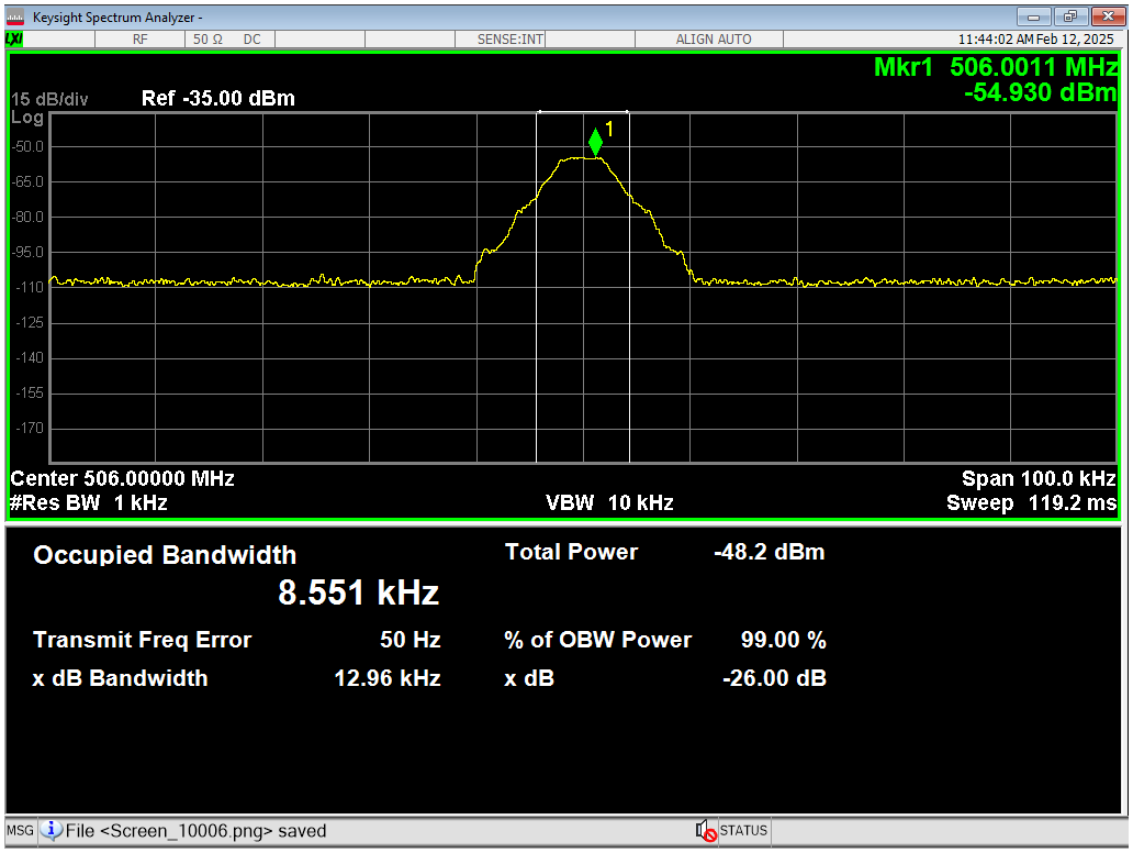
415.000 MHz



Occupied Bandwidth

8K10F1W – C4FM with a deviation of 1.8 kHz and 6000 symbols/sec

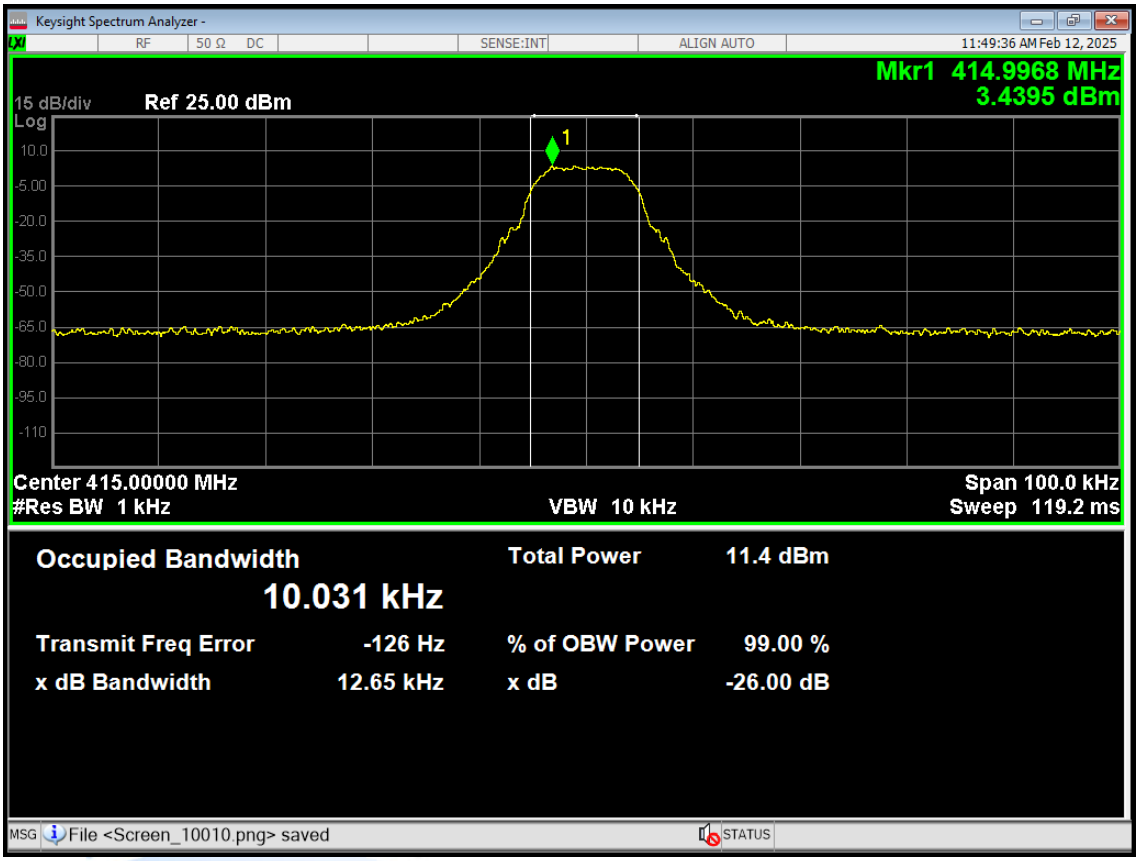
415.000 MHz



Occupied Bandwidth

9K80D7W – PI/4 DQPSK using 8000 symbols/sec

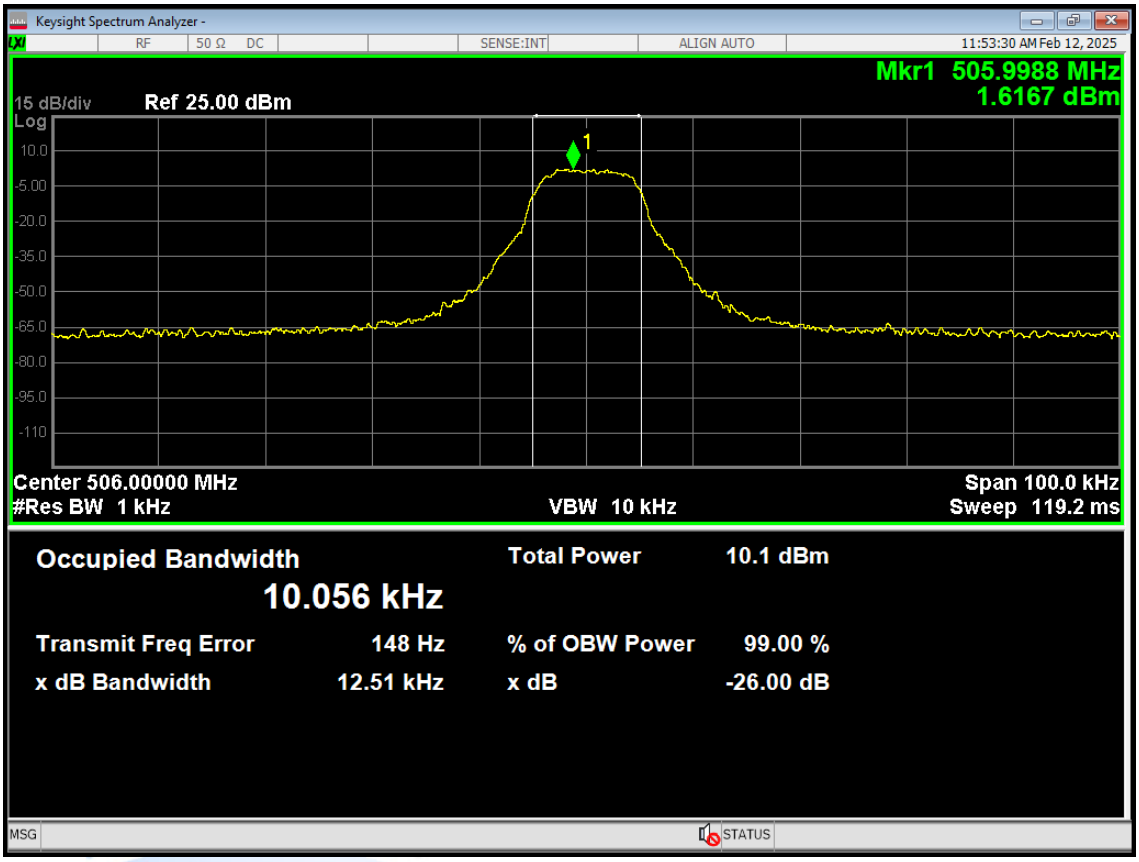
415.000 MHz



Occupied Bandwidth

9K80D7W – PI/4 DQPSK with 8000 symbols/sec

506.000 MHz



Clause 90.210: Spectrum Emission Mask measurements

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

As per Section 90.210(d) – Mask D have been applied as the transmitter is designed to using an authorised bandwidth of 11.25 kHz and a channel spacing of 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.

The following modulation types were generated using a signal generator and applied to

11K3F3E: 11.3 kHz occupied bandwidth. Frequency deviation is set to 2.5 kHz and an audio tone of 1 kHz is used.

8K70D1W: 8.7 kHz occupied bandwidth. C4FM modulation. Frequency deviation of 1.8 kHz and 6000 symbols/sec. This simulates a H-CPM P25 Phase 2 UL TDMA Subscriber Unit.

9K80D7W: 9.8 kHz occupied bandwidth. PI/4 DQPSK modulation 8000 symbols/ second This simulates a H-DQPSK P25 Phase 2 DL Fixed Base

Mask measurements have been made on the input and output signals on both 415 MHz and 506 MHz

The Yellow trace corresponds to the modulated signal under test.

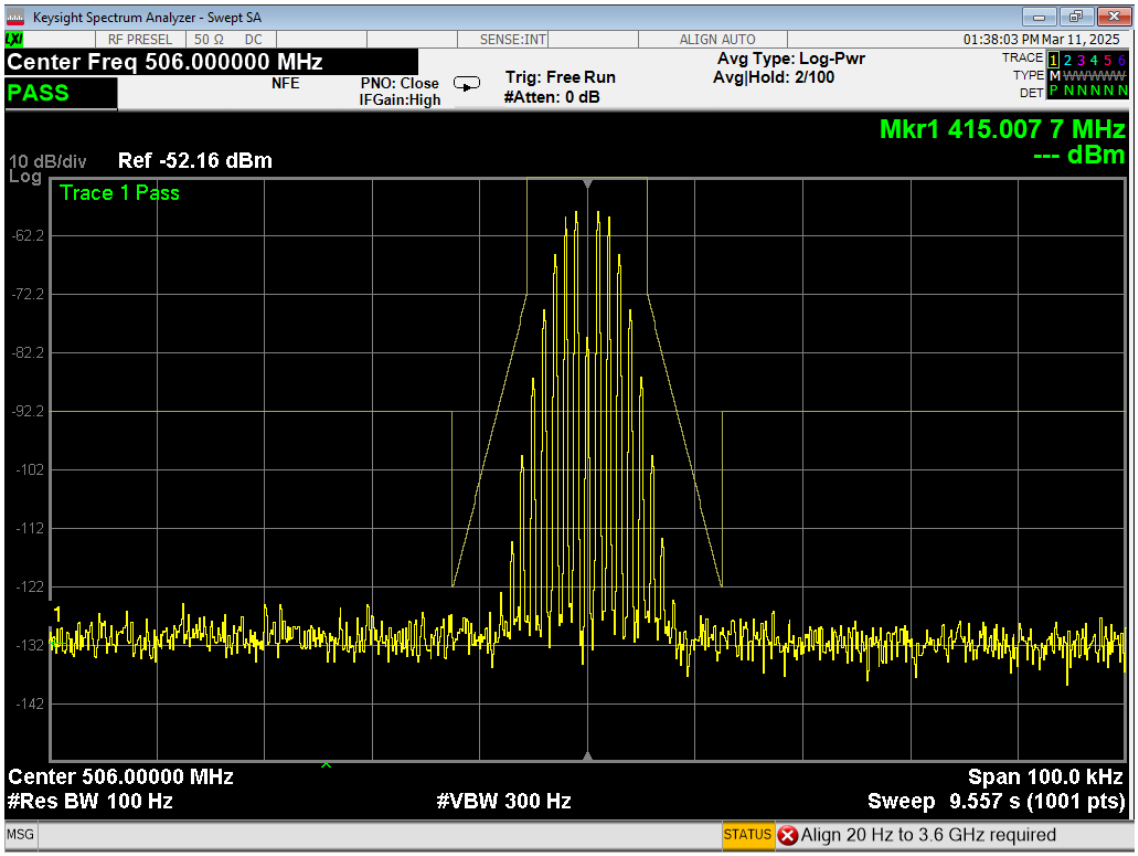
Mask measurements have been made using high power only.

Result: Complies.

Emission Mask (Input)

Mask D – F3E – 1 kHz tone with a deviation frequency of 2.5 kHz

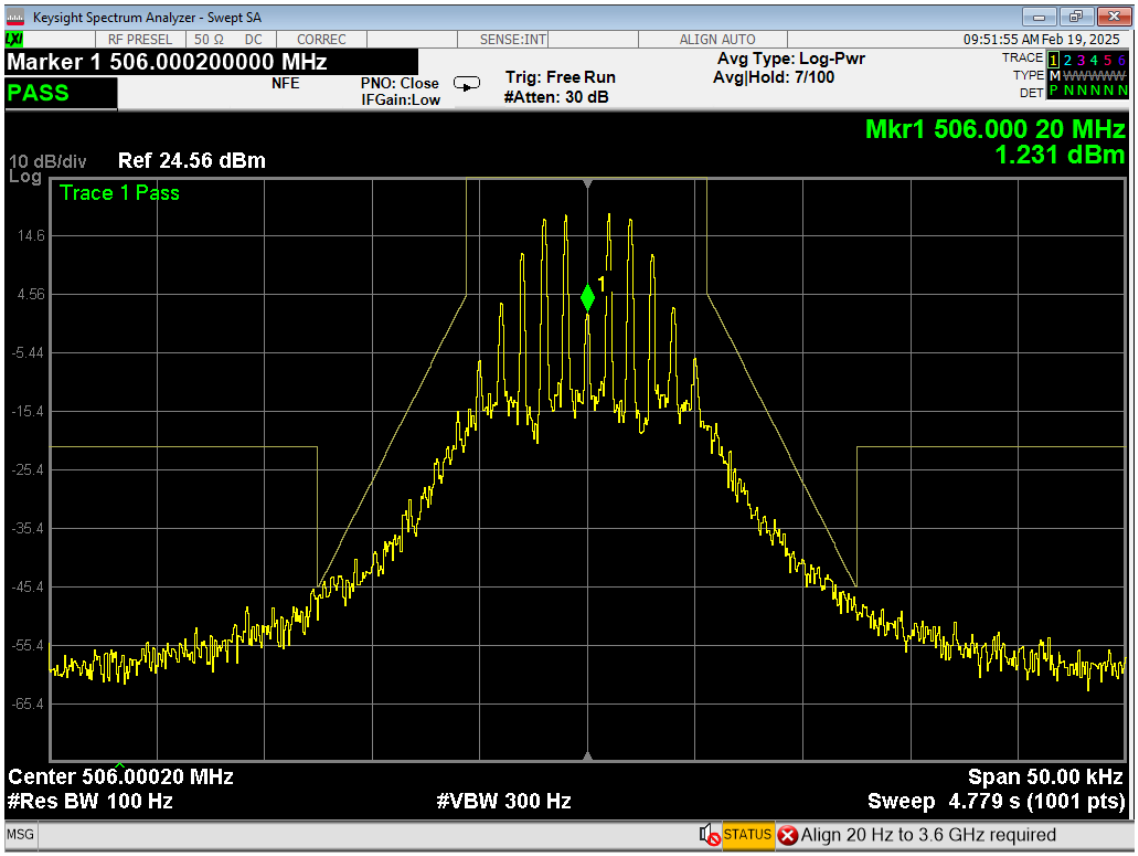
506.000 MHz



Emission Mask (Output)

Mask D – F3E – 1 kHz tone with a deviation frequency of 2.5 kHz

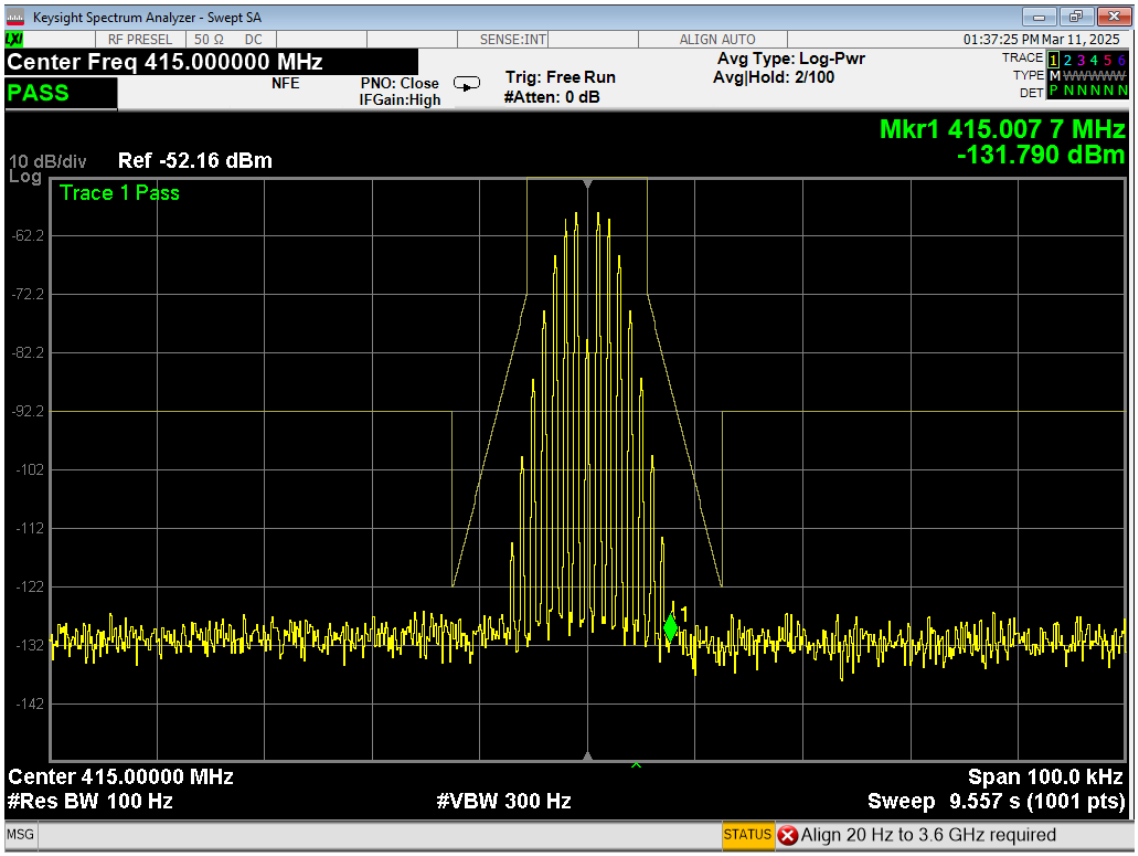
506.000 MHz



Emission Mask (Input)

Mask D – F3E – 1 kHz tone with a deviation frequency of 2.5 kHz

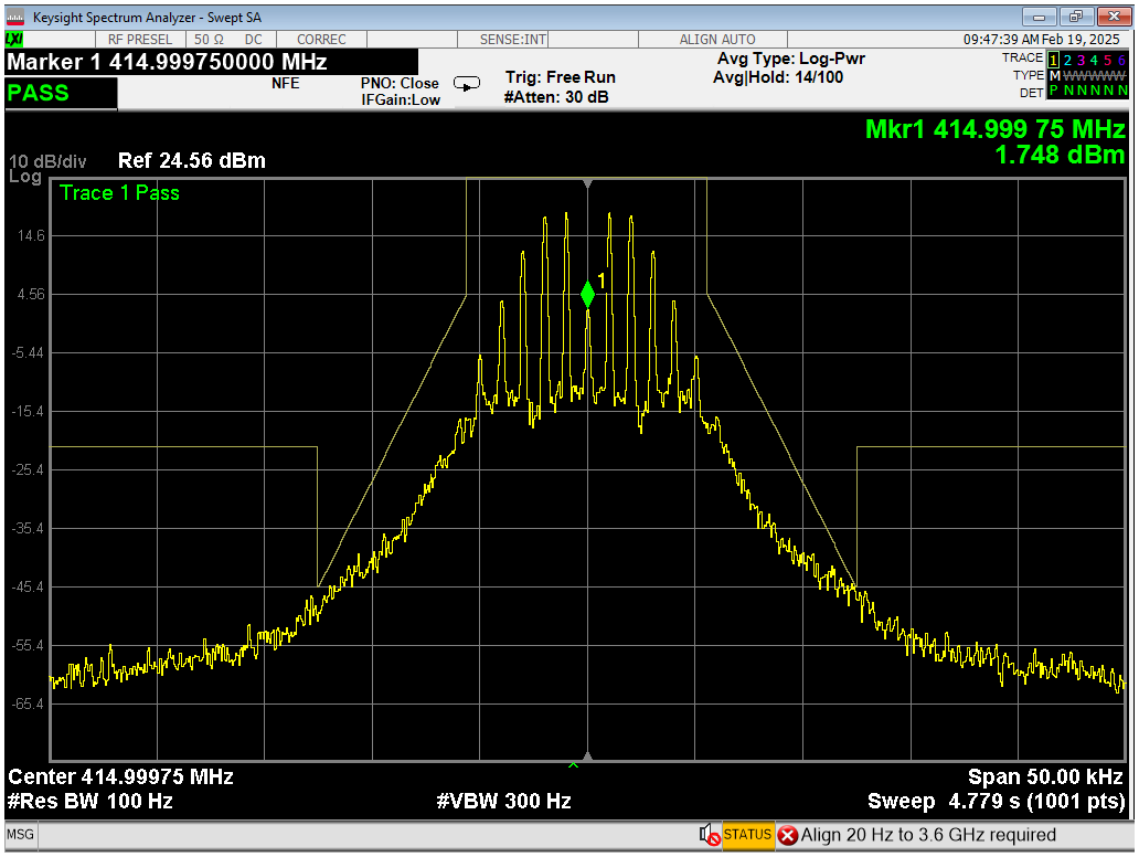
415.000 MHz



Emission Mask (Output)

Mask D – F3E – 1 kHz tone with a deviation frequency of 2.5 kHz

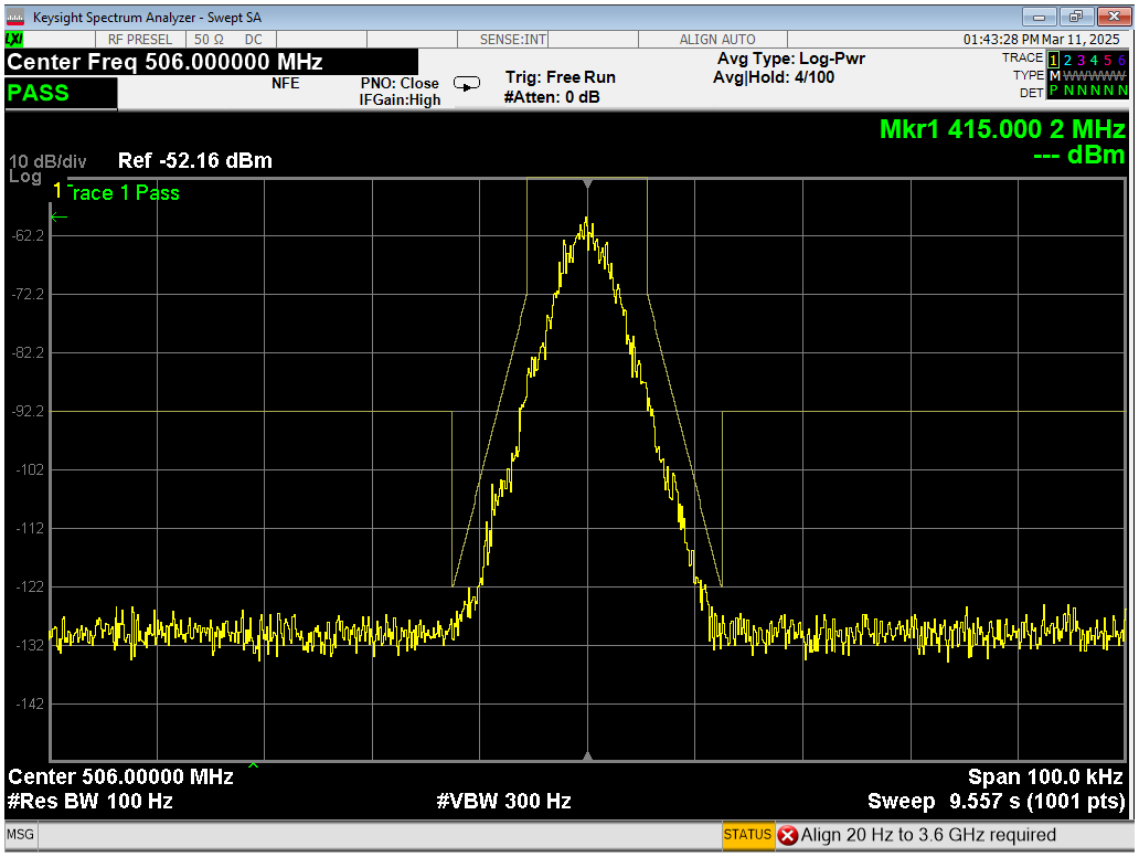
415.000 MHz



Emission Mask (Input)

Mask D – 8K10F1W – C4FM – 1.8 kHz deviation with 6000 symbols/sec

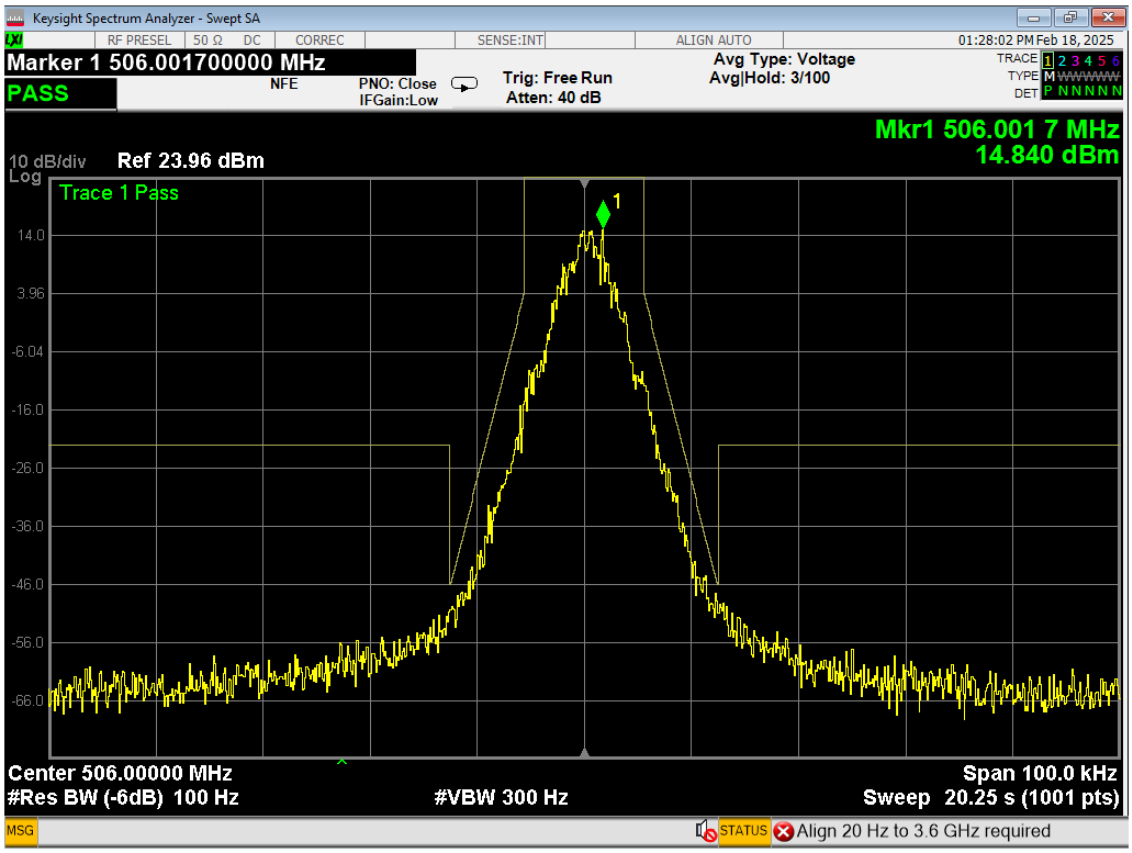
506 MHz



Emission Mask (Output)

Mask D – 8K10F1W – C4FM – 1.8 kHz deviation with 6000 symbols/sec

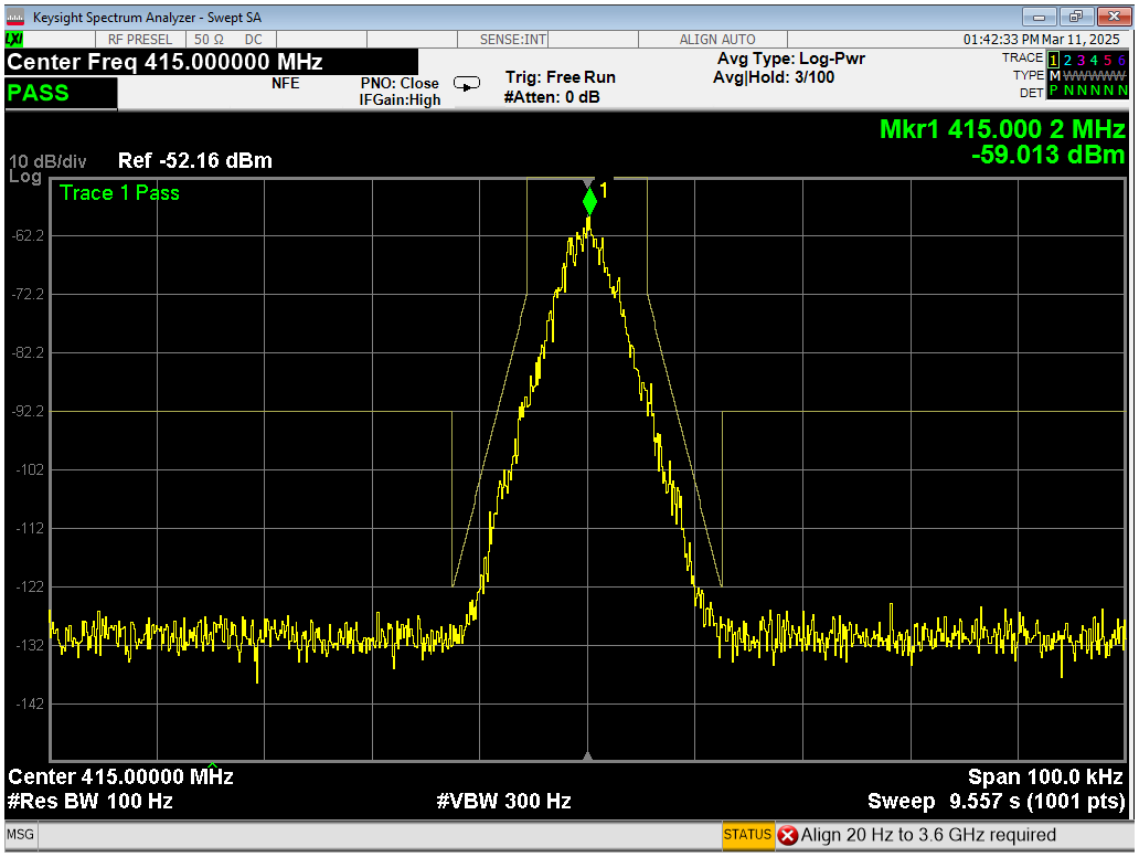
506 MHz



Emission Mask (Input)

Mask D – 8K10F1W – C4FM – 1.8 kHz deviation with 6000 symbols/sec

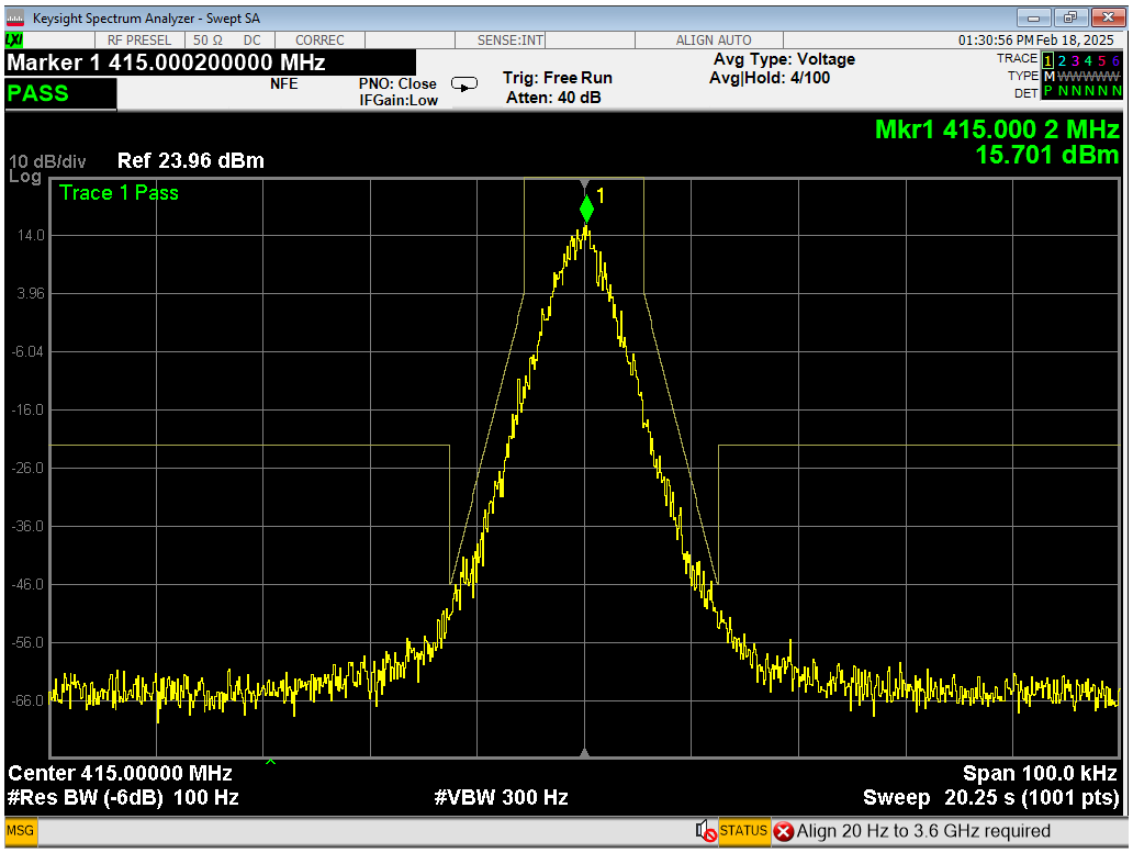
415 MHz



Emission Mask (Output)

Mask D – 8K10F1W – C4FM – 1.8 kHz deviation with 6000 symbols/sec

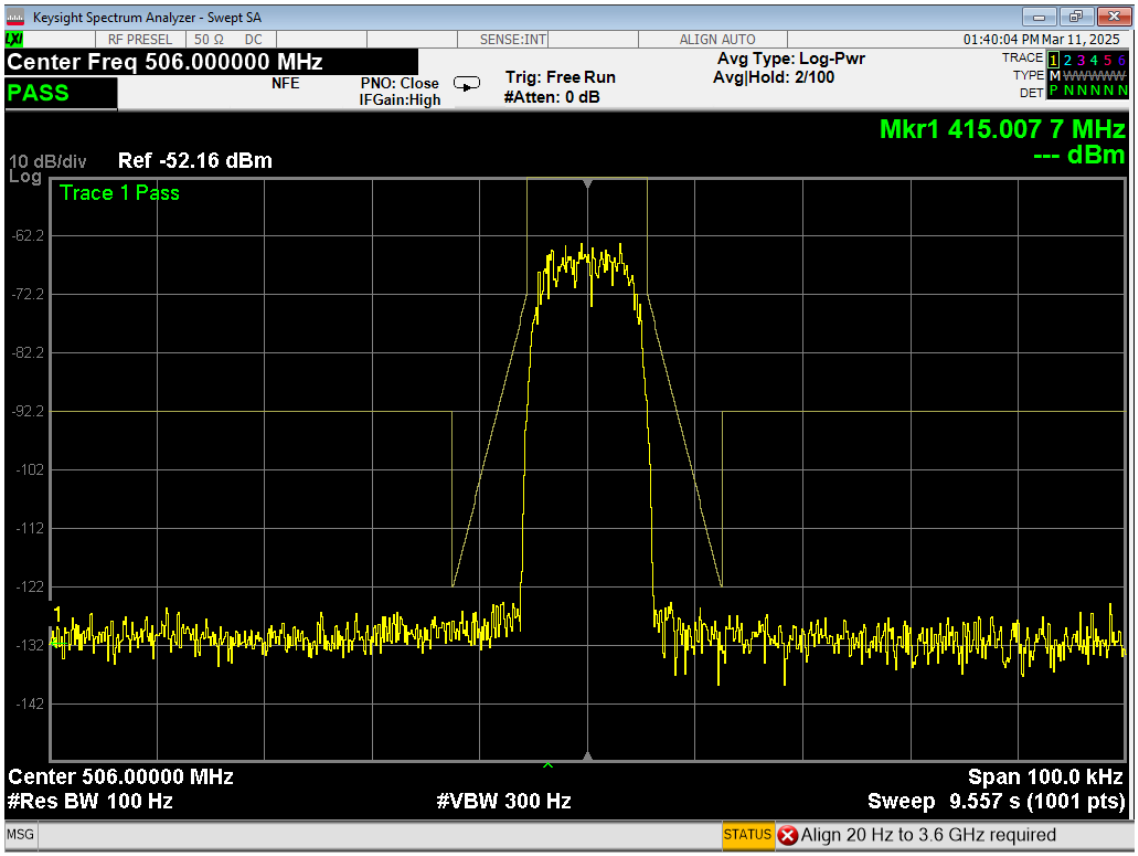
415 MHz



Emission Mask (Input)

Mask D – 9K80D7W - Pi/4DQPSK – 8000 symbols/sec

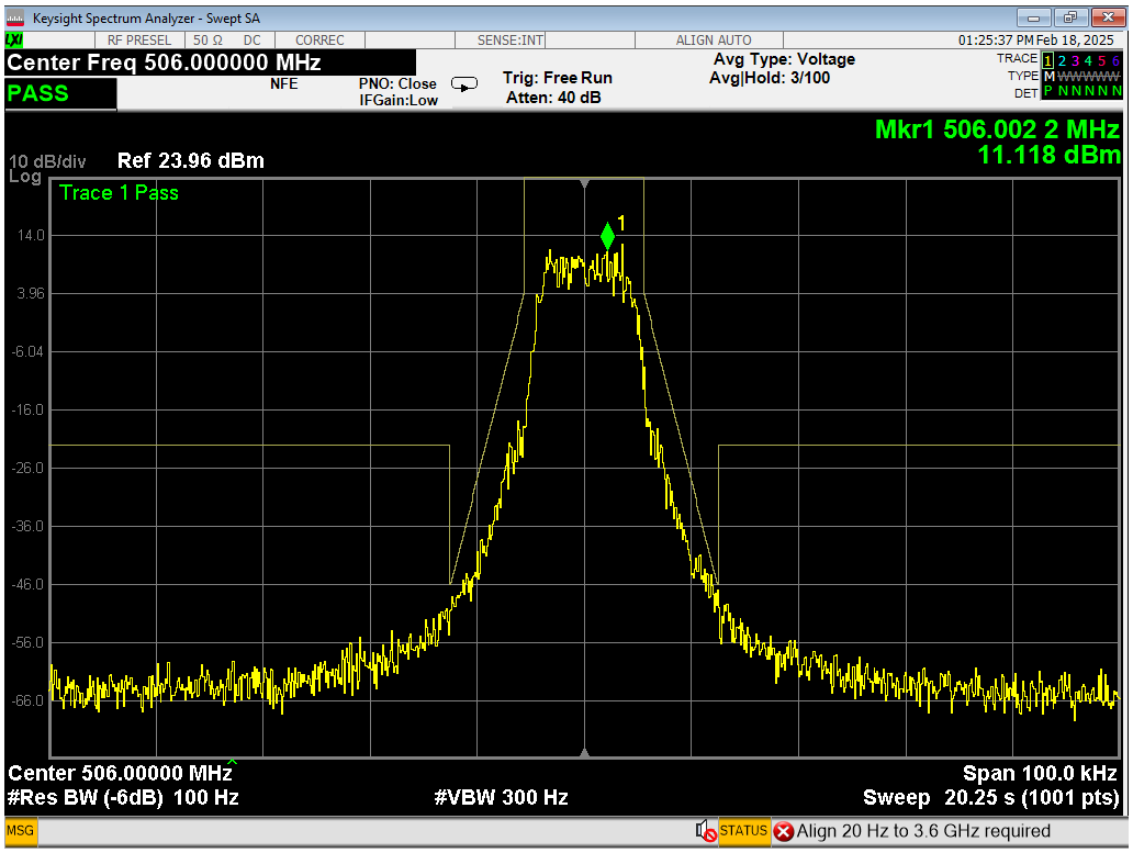
506.000 MHz



Emission Mask (Output)

Mask D – 9K80D7W - Pi/4DQPSK – 8000 symbols/sec

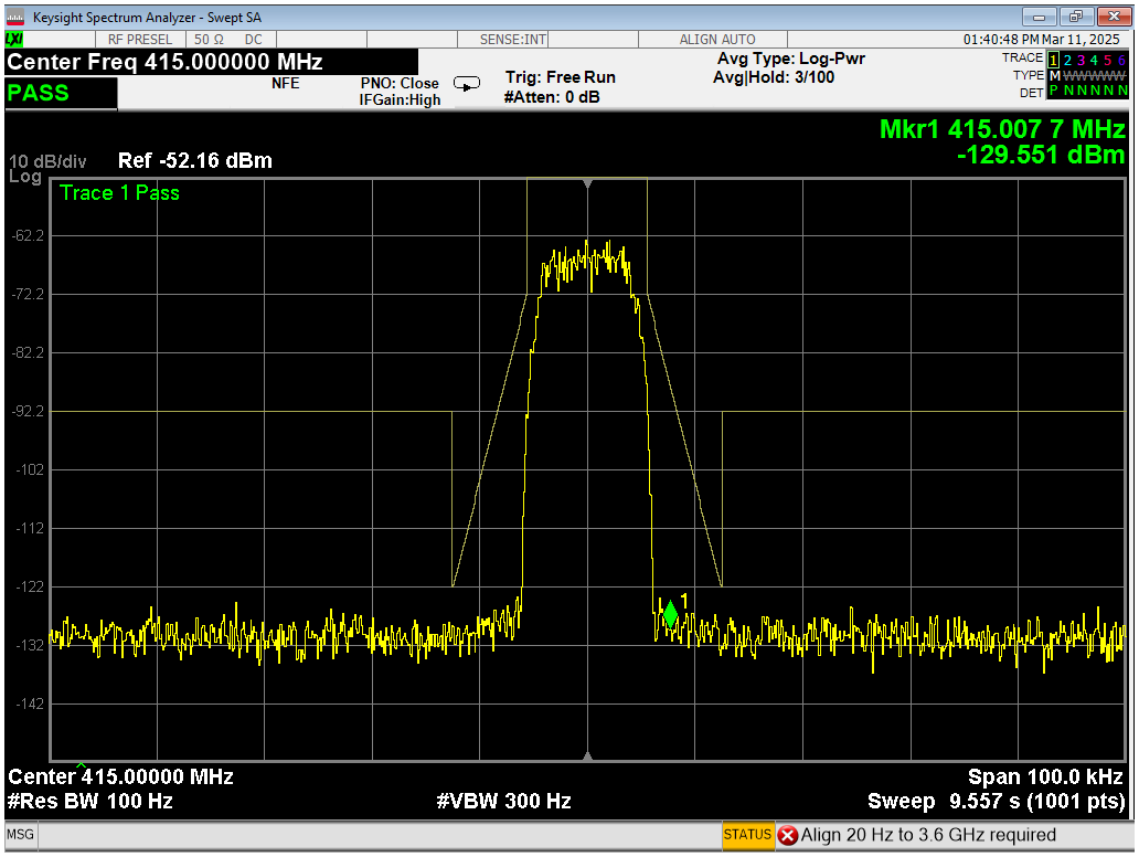
506.000 MHz



Emission Mask (Output)

Mask D – 9K80D7W - Pi/4DQPSK – 8000 symbols/sec

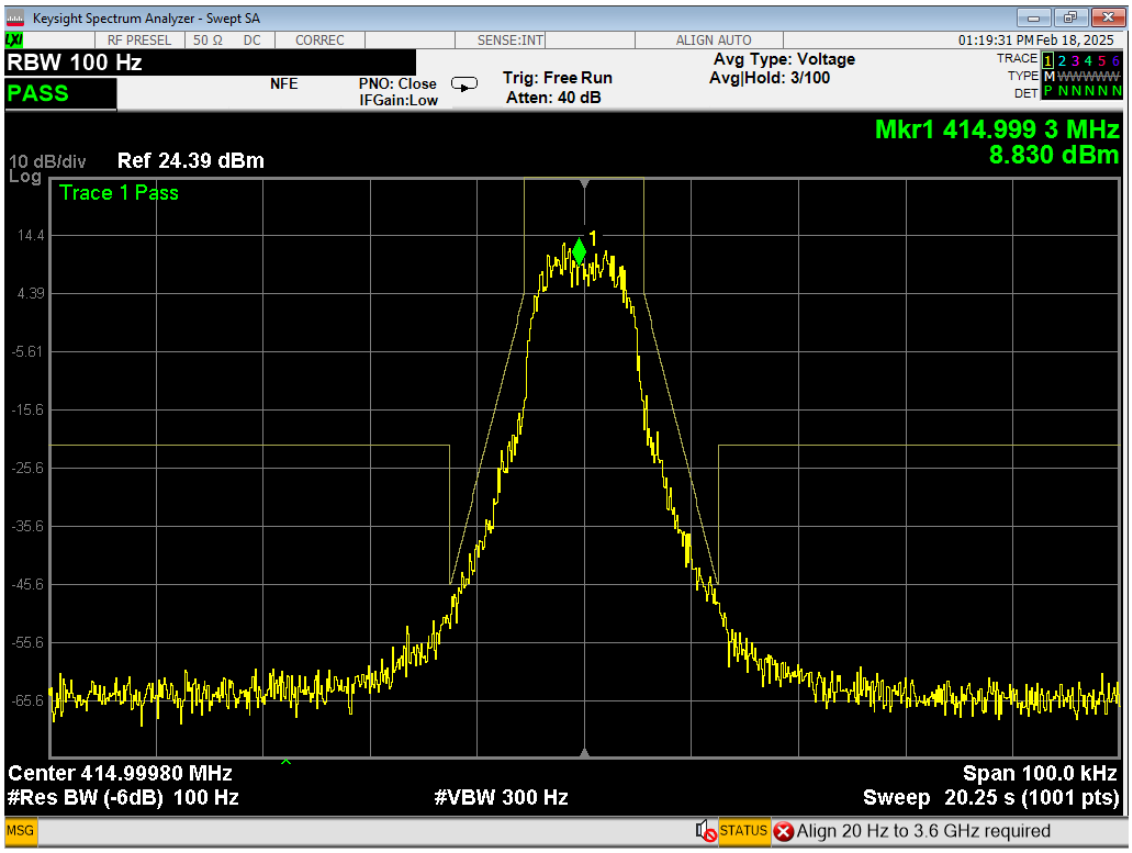
415.000 MHz



Emission Mask (Output)

Mask D – 9K80D7W - Pi/4DQPSK – 8000 symbols/sec

415.000 MHz



Clause 2.1051: Transmitter spurious emissions at the antenna terminals

Attached to the input of the Keysight spectrum analyser was an external power attenuator and a notch filter where appropriate.

Measurements were made using a peak detector with a 100 kHz resolution bandwidth when transmitting an unmodulated carrier output at maximum rated power.

Frequency: 415.000 MHz

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)
830.0	-52.1	-20.0
1245.0	-65.0	-20.0
1660.0	-66.0	-20.0
2075.0	-70.0	-20.0
2490.0	-70.0	-20.0
2905.0	-70.0	-20.0
3320.0	-70.0	-20.0
3725.0	-70.0	-20.0
4150.0	-70.0	-20.0

Frequency: 506.500 MHz

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)
1012.0	-46.5	-20.0
1518.0	-65.0	-20.0
2024.0	-66.0	-20.0
2530.0	-70.0	-20.0
3036.0	-70.0	-20.0
3542.0	-70.0	-20.0
4048.0	-70.0	-20.0
4554.0	-70.0	-20.0
5060.0	-70.0	-20.0

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 6000 MHz.

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 using 120 Vac mains.

Resistive dummy loads were attached to each of the output antenna ports (2).

A single generator was attached to the input port with the 2nd input port being resistively terminated.

All testing was carried out at maximum output power (+25 dBm)

Attached to the amplifier was a laptop computer using a 40 metre long Ethernet cable that was used to remotely monitor it's performance during 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 6000 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.

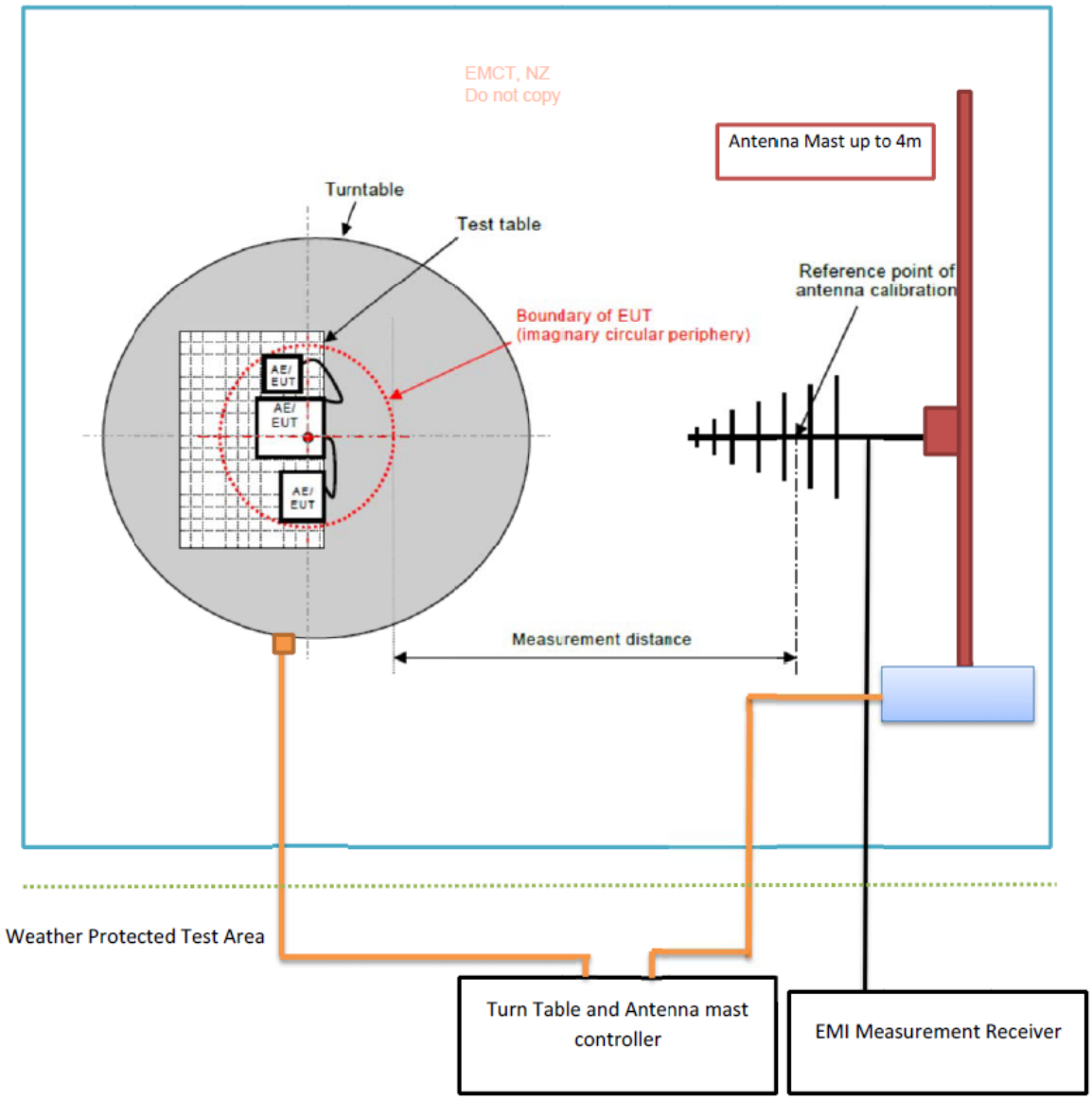
Between 30 - 6000 MHz the emission is measured in both vertical and horizontal antenna polarisations at a distance of 3 metres using a Peak detector with a 120 kHz bandwidth.

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

Radiated Emissions Test setup at Open area test site



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: ESIB-40

Transmitter spurious emissions results:

Nominal Frequency: 415.000 MHz **Power:** +25.0 dBm

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
830.000	-	-	-20.0	Vertical	-	Pass
830.000	-	-	-20.0	Horizontal	-	Pass
1245.000	-	-	-20.0	Vertical	-	Pass
1245.000	-	-	-20.0	Horizontal	-	Pass
1660.000	-	-	-20.0	Vertical	-	Pass
1660.000	-	-	-20.0	Horizontal	-	Pass
2075.000	-	-	-20.0	Vertical	-	Pass
2075.000	-	-	-20.0	Horizontal	-	Pass
2490.000	-	-	-20.0	Vertical	-	Pass
2490.000	-	-	-20.0	Horizontal	-	Pass
2905.000	-	-	-20.0	Vertical	-	Pass
2905.000	-	-	-20.0	Horizontal	-	Pass
3320.000	-	-	-20.0	Vertical	-	Pass
3320.000	-	-	-20.0	Horizontal	-	Pass
3735.000	-	-	-20.0	Vertical	-	Pass
3735.000	-	-	-20.0	Horizontal	-	Pass
4150.000	-	-	-20.0	Vertical	-	Pass
4150.000	-	-	-20.0	Horizontal	-	Pass

No transmit harmonic spurious emissions detected

Nominal Frequency: 506.000 MHz **Power:** +25.0 dBm

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
1012.000	-	-	-20.0	Vertical	-	Pass
1012.000	-	-	-20.0	Horizontal	-	Pass
1518.000	-	-	-20.0	Vertical	-	Pass
1518.000	-	-	-20.0	Horizontal	-	Pass
2024.000	-	-	-20.0	Vertical	-	Pass
2024.000	-	-	-20.0	Horizontal	-	Pass
2530.000	-	-	-20.0	Vertical	-	Pass
2530.000	-	-	-20.0	Horizontal	-	Pass
3036.000	-	-	-20.0	Vertical	-	Pass
3036.000	-	-	-20.0	Horizontal	-	Pass
3542.000	-	-	-20.0	Vertical	-	Pass
3542.000	-	-	-20.0	Horizontal	-	Pass
4048.000	-	-	-20.0	Vertical	-	Pass
4048.000	-	-	-20.0	Horizontal	-	Pass
4554.000	-	-	-20.0	Vertical	-	Pass
4554.000	-	-	-20.0	Horizontal	-	Pass
5060.000	-	-	-20.0	Vertical	-	Pass
5060.000	-	-	-20.0	Horizontal	-	Pass

No transmit harmonic spurious emissions detected

Continued…

Standby mode

Test carried out when the signal generator output was less than -110 dBm which caused the amplifier to stop transmitting.

Frequency (MHz)	Level (dBuV/m)	Level (dBm)		Limit (dBm)	Polarity	Margin (dB)	Result
30.600	28.1	-69.3		-20.0	Vertical	49.3	Pass
32.000	27.9	-69.5		-20.0	Vertical	49.5	Pass
41.680	29.1	-68.3		-20.0	Vertical	48.3	Pass
44.840	34.3	-63.1		-20.0	Vertical	43.1	Pass
47.080	36.5	-60.9		-20.0	Vertical	40.9	Pass
48.000	35.9	-61.5		-20.0	Vertical	41.5	Pass
49.040	27.5	-69.9		-20.0	Horizontal	49.9	Pass
51.880	26.6	-70.8		-20.0	Horizontal	50.8	Pass
53.880	32.8	-64.6		-20.0	Vertical	44.6	Pass
79.200	28.5	-68.9		-20.0	Vertical	48.9	Pass
81.240	26.5	-70.9		-20.0	Horizontal	50.9	Pass
142.400	25.6	-71.8		-20.0	Horizontal	51.8	Pass
226.000	26.3	-71.1		-20.0	Horizontal	51.1	Pass
252.520	26.3	-71.1		-20.0	Horizontal	51.1	Pass
283.680	32.2	-65.2		-20.0	Horizontal	45.2	Pass
379.320	36.7	-60.7		-20.0	Vertical	40.7	Pass
381.880	32.9	-64.5		-20.0	Horizontal	44.5	Pass

Limit:

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

This gives a limit of -20 dBm

No measurements were made above the 10th harmonic.

Result: Complies.
Measurement Uncertainty: ± 4.1 dB

KDB 4.3 - Out of Band Rejection

As required by FCC part 90 out of band rejection measurements were carried out.

The operating range of the amplifier has been declared to be

- 406.1 – 430.0 MHz which gives an operating range of 27 MHz
- 500.0 – 515.0 MHz which gives an operating range of 15 MHz

The input filters for the amplifier were configured to generate an output at the bottom and top frequencies of operation and on several other random frequencies.

When the 500 MHz transmitter was observed the following setting were applied

Input range: 406.1 – 430.0 MHz
Signal Generator Range: 349.0 – 484.0 MHz
Signal Generator Settings: 50 kHz steps. Dwell Time: 100 ms

Output range: 500.0 – 515.0 MHz
Spectrum Analyser Range: 476.0 – 536 MHz
Spectrum Analyser Settings: Res BW 100 kHz, Video BW 300 kHz

Observations: No frequency responses detected.

When the 400 MHz transmitter was observed the following setting were applied

Input range: 500.0 – 515.0 MHz
Signal Generator Range: 476.0 – 536 MHz
Signal Generator Settings: 50 kHz steps. Dwell Time: 100 ms

Output range: 406.1 – 430.0 MHz
Spectrum Analyser Range: 349.0 – 484.0 MHz
Spectrum Analyser Settings: Res BW 100 kHz, Video BW 300 kHz

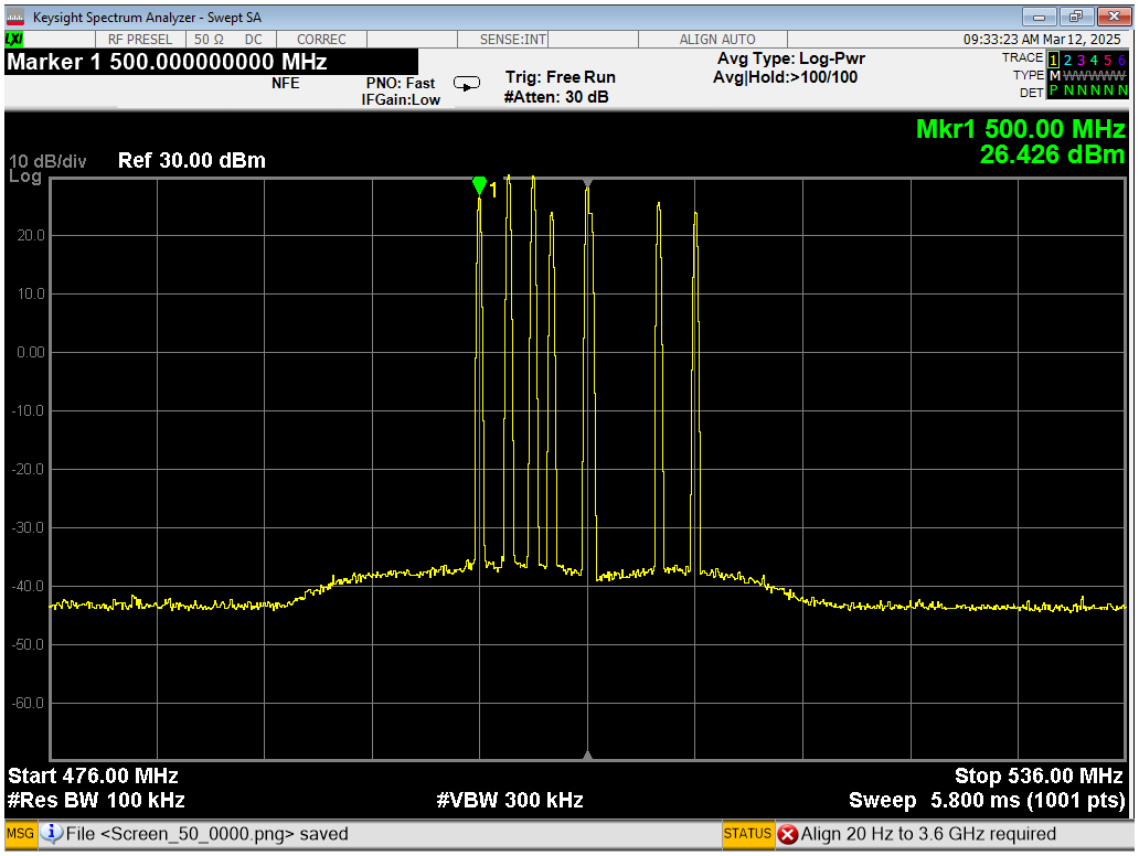
Plots of these observations are attached.

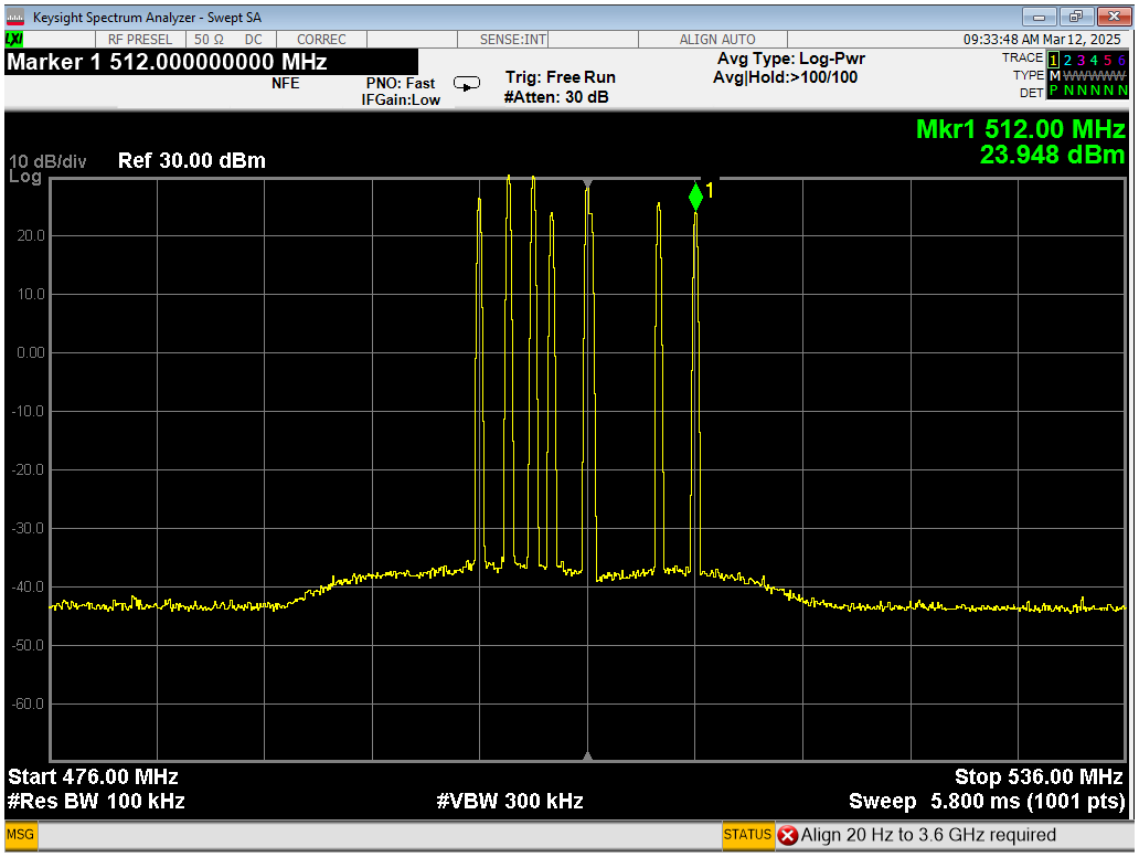
A limit of -36 dBm will apply

Observations: No frequency responses detected.

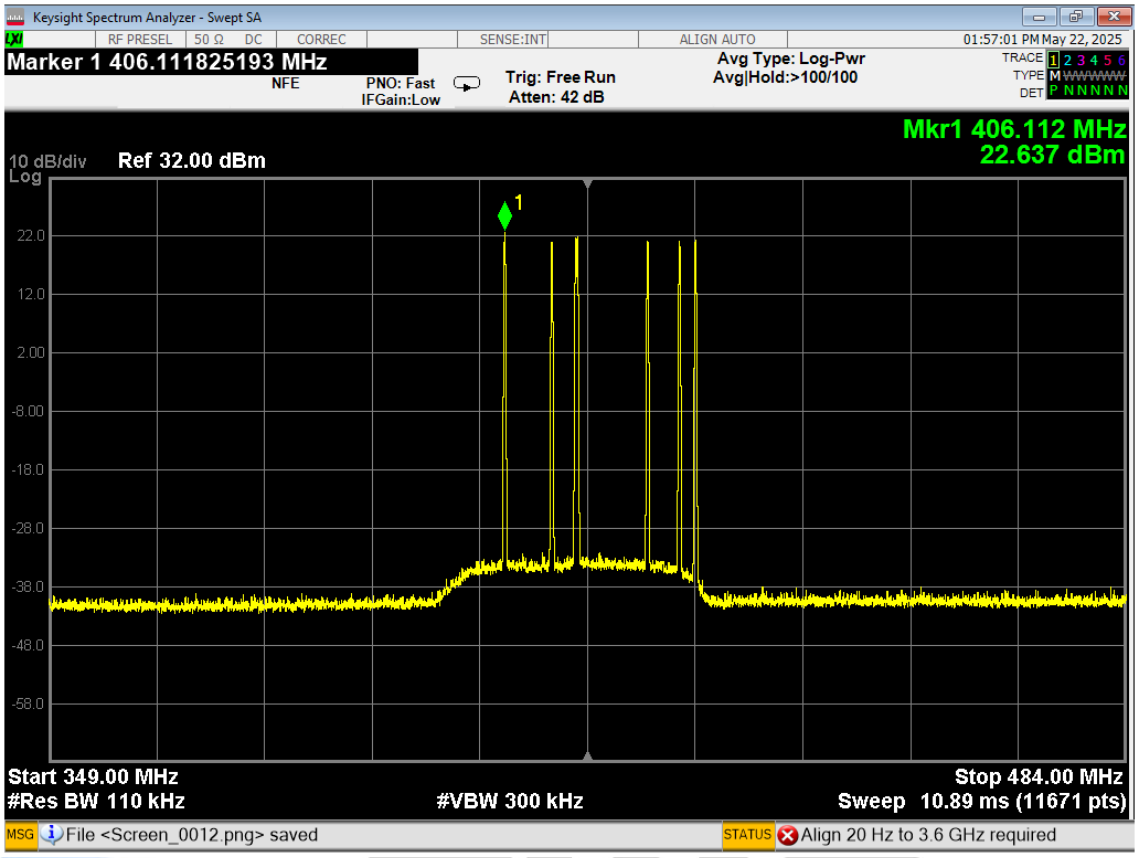
Result: Complies

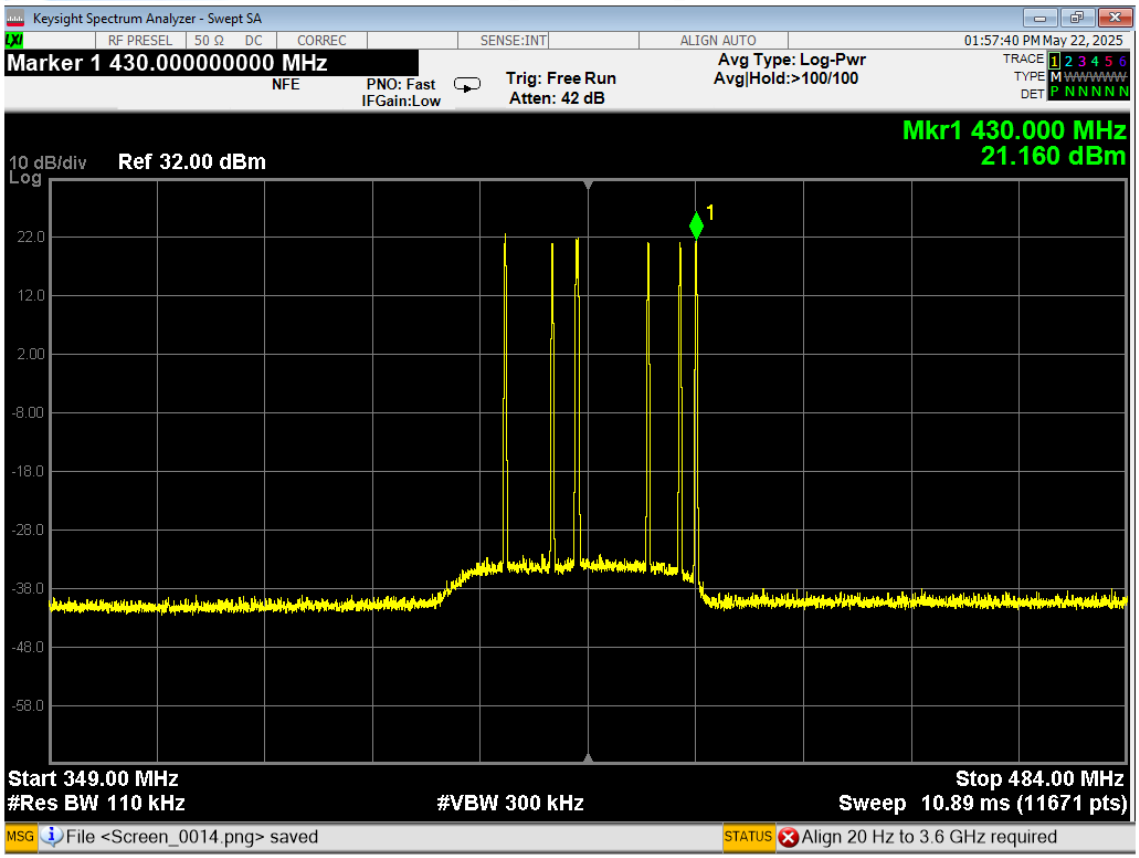
500.0 – 515 MHz band of operation





406.1 – 435.0 MHz band of operation





KDB 4.7.2 - Intermodulation Characteristics

Testing was carried out as per FCC part 2 section 2.1047 and FCC Part 90 Section 90.210.

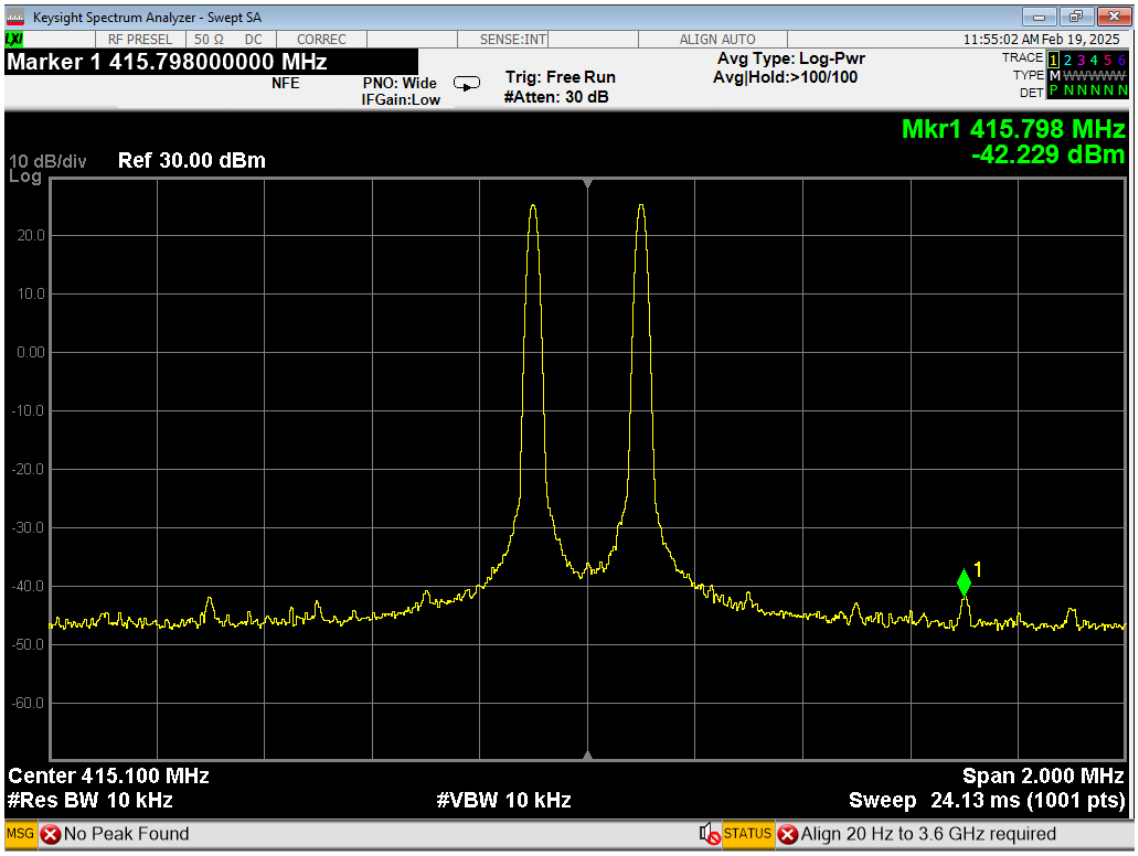
Two signals 200 kHz were applied to the input of the amplifier at a level of -60 dBm.

The filters on the transmitter out were reconfigured in order that two output signals were generated 200 kHz apart at a level of approximately +25 dBm each.

The following intermodulation products were observed.

A limit of -20 dBm has been applied.

Input 415.000 MHz and 415.200 MHz – Output at + 25 dBm



Frequency (MHz)	Level (dBm)	Limit (dBm)
414.3980	-41.5	-20.0
414.8000	-40.8	-20.0
415.4000	-40.9	-20.0
415.6000	-42.7	-20.0
415.7980	-42.2	-20.0
415.9960	-43.7	-20.0

Result: Complies

Intermodulation Characteristics

Input 415.000 MHz and 415.200 MHz – Output +25 dBm

2nd Harmonic Observations

No plot recorded

Frequency (MHz)	Level (dBm)	Limit (dBm)
830.0000	-53.8	-20.0
830.2000	-48.2	-20.0
830.4000	-53.6	-20.0

No 3rd harmonic emissions observed

Result: Complies

Clause 90.213 Frequency Stability

For completeness 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.

Nominal Frequency: 415 MHz

Temp (°C)	100 Vac (Hz)	230 Vac (Hz)	253 Vac (Hz)
+55	+263	+263	+263
+40	+193	+193	+193
+30	+237	+237	+237
+20	+237	+237	+237
+10	+237	+237	+237
0	+39	+39	+39
-10	-89	-89	-89
-20	+133	+133	+133
-30	+437	+437	+437

Nominal Frequency: 506 MHz

Temp (°C)	100 Vac (Hz)	230 Vac (Hz)	253 Vac (Hz)
+55	-236	-236	-236
+40	-236	-236	-236
+30	-275	-275	-275
+20	-213	-213	-213
+10	-134	-134	-134
0	-7	-7	-7
-10	+44	+44	+44
-20	-120	-120	-120
-30	-413	-413	-413

FCC Part 90 specifies a limit of 1.5 ppm for base and fixed equipment using 12.5 kHz channel spacing in the band 412 – 512 MHz.

This gives a worst-case limit of 600 Hz in the 400 MHz band and 750 Hz in the 500 MHz band.

Result: Complies.
Measurement Uncertainty: ± 30 Hz.

Exposure of humans to RF fields

The product under test is a UHF bi-directional amplifier (repeater) that transmits in the 406.1 – 430.0 MHz band and the 500.0 – 512.0 MHz.

At this point the type of antennas and coax to be used hav4 not been defined.

For the purposes of the Exposure of humans to RF fields evaluation it will be assumed that the connecting cables are short and have no associated losses and high gain directional antennas have been used which have a gain of at least 10 dBi when the amplifier is operating with a duty cycle of 100% when all 16 channels are operating with the power is set to maximum, +25 dBm (316 mW), which gives a composite power of +37 dBm (5 W).

As per FCC KDB 447498 D01 and Section 2.1091 radio frequency transmitters are required to be operated in a manner that ensures the public is not exposed to RF energy levels.

Calculations have been made using the General Public/Uncontrolled Exposure limits that are defined in Section 1.1310.

The limits for maximum permissible exposure (MPE) have been calculated below for a worst case at 406.1 MHz

- Occupational /Controlled exposure is f/300 which gives a limit of 1.353 mW/cm2

- General Population / Uncontrolled exposure is f/1500 which gives a limit of 0.271 mW/cm2

Minimum safe distances have been calculated below.

For a Controlled Environment
Power Density = 1.353 mW/cm2 = E2/3770
E= $\sqrt{}$ 1.353*3770
E = 71.4 V/m

For an Uncontrolled Environment
Power Density = 0.271 mW/cm2 = E2/3770
E= $\sqrt{}$ 0.271*3770
E = 32.0 V/m

The rated maximum channel power = 0.316 W (+25 dBm).

The client has stated that the composite power of the device is 5 watts (+37 dBm)

The rated power of each channel is 316 mW (+25.0) dBm and 16 channels are in use which gives a composite power of +37 dBm.

A worst case scenario duty cycle of 100% has been used for the calculations.

The antenna gain has been assumed to +10 dBi which equates to a numeric gain of 10.

The minimum distance from the antenna at which the MPE is met is calculated from the following:

Field strength in V/m (FS),
Transmit power in watts (P)
Transmit antenna gain (G)
Transmitter duty cycle (DC)
Separation distance in metres (D)

The calculation is as follows:

FS = (√ (30 * P * G * DC)) / D

For Uncontrolled environments, the minimum distance is:

D = (√ (30 * P * G * DC)) / FS
P = 0.316 W x 16 = 5 Watts
FS = E = 71.4 V/m
G = 10
DC = 1
D = (√ (30 * 5 * 10 * 1)) / 71.4
D = 0.542 m or 54.2 cm

For Controlled environments, the minimum distance is:

D = (√ (30 * P * G * DC)) / FS
P = 0.316 W x 16 = 5 Watts
FS = E = 32.0 V/m
G = 10
DC = 1
D = (√ (30 * 5 * 10 * 1)) / 32.0
D = 1.21 m or 121 cm

Result: Complies if the safe distances shown above are applied based upon the assumptions presented.

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	23/11/26	2.0 years
Log Periodic Antenna	Schwarzbeck	VUSLP 91111	9111-112	16/11/26	2.0 years
Horn Antenna	EMCO	3115	9511-4629	01/06/26	3.0 years
Signal Generator	Rohde & Schwarz	SMHU	E1493	28/05/25	2.0 years
Signal Generator	Agilent	E4433B	ESG-D	28/02/26	2.0 years
DC Power Supply	Hewlett Packard	HP6032A	2743A-02859	-	-
Heliax Cable	L6PNM-RPD	OATS	22869	23/12/25	1.0 years
Receiver	Rohde & Schwarz	ESIB-40	100295	03/06/25	2.0 years
Spectrum Analyzer	Keysight	N9038A	MY57290153	29/07/25	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

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.

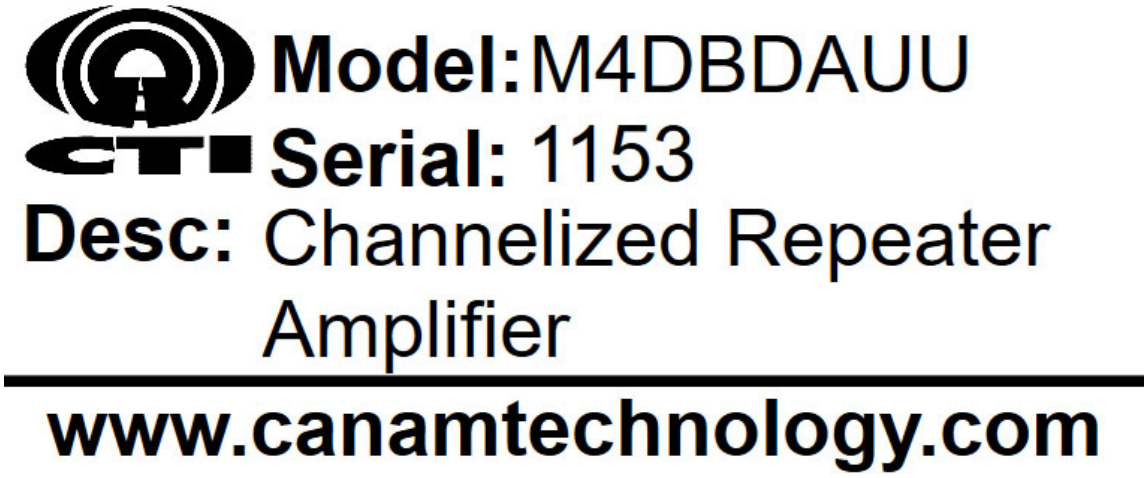
All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

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.

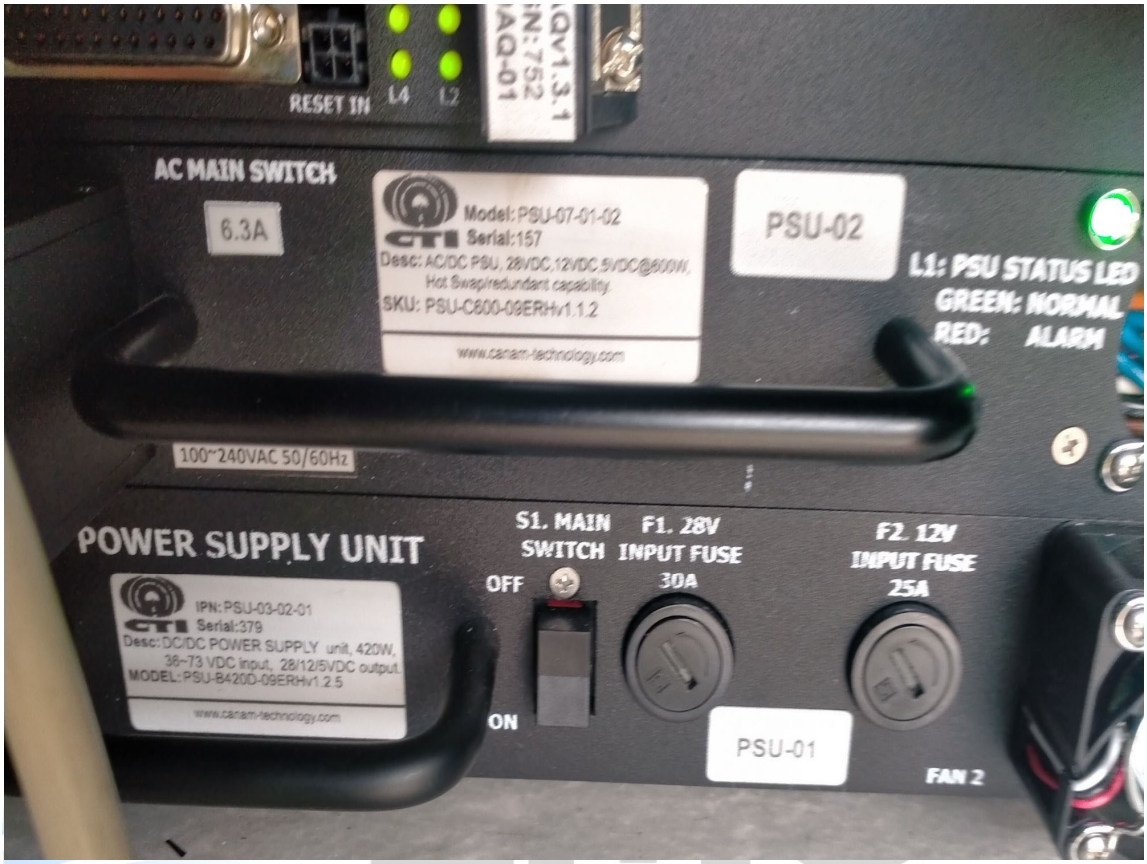
9. PHOTOGRAPHS

Equipment Label



Equipment label on product tested which was not correct

Power supply serial number details



Radiated Emissions Test Set Up