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TEST REPORT

Mark-IV Dual Band Broadband Bi-Directional Amplifier (Repeater)
Model: M4BBDAUU

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 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 **Mark-IV Dual Band Broadband Bi-Directional Amplifier (Repeater) Model: M4BBDAUU** 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 D05 v01r04 April 3, 2020 as a Class B Industrial Signal Booster.

2. RESULT SUMMARY

The results of testing carried out between the 9th September 2025 and the 22nd October 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
250504.4	Initial Issue	22nd Oct 2025
250504.4A	Class A changed to B on page 7. Radiation hazard assessment revised.	15th April 2026

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	M4BBDAUU
Product	Dual Band Broadband Bi-Directional Amplifier (Repeater)
Manufacturer	Canam Technology Inc
Manufactured in	United States of America
Serial Number	723
Rated supply	110 – 240 Vac
FCC ID:	TCJ-M4BBDAUU

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

The sample testing has the following specifications:

FCC Band of operations:

406.100 – 430.000 MHz
450.000 – 470.000 MHz

Test Frequencies:

406.200 MHz, 415.000 MHz, 429.900 MHz - Uplink and Downlink
450.100 MHz, 460.000 MHz, 469.900 MHz - Uplink and Down link

Downlink Composite Channel Power +37 dBm (5 W)

Uplink Composite Channel Power +0 dBm (1 mW)

Channel Spacing: 12.5 kHz

Modulations supported:

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

Modulation designators:

11k3F3E,
8k10F1W,
9k80D7W

Transmitter Duty Cycle: 100%

High clock frequency in use: 25 MHz

The sample tested was fitted with 8 RF ports which were terminated using various attenuators and dummy loads when that port was not being tested.

When under test the port combination would be terminated using suitable attenuators to the required measurement equipment.

Testing was carried out with reference to the test plan supplied by the client.

6. TEST RESULTS

Certification required

As this device will transmit in the 406.1 – 430.0 MHz band and the 450.0 – 470.0 MHz band certification of this Dual Band Broadband Bi-Directional Amplifier (Repeater) will be required as an FCC Class B Industrial Signal Booster in accordance with FCC part 90.

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.

Downlink at +25 °C – Maximum Gain. Input level -33.0 dBm

Frequency (MHz)	120 Vac (dBm)
406.200	37.3
415.000	37.6
429.900	34.4
450.100	37.3
460.000	37.4
469.900	36.2

Uplink at +25 °C – Maximum Gain. Input level -42.0 dBm &-41.0 dBm

Frequency (MHz)	120 Vac (dBm)
406.200	-0.4
415.000	+0.4
429.900	-3.2
450.100	-0.5
460.000	+0.3
469.900	-1.1

The client has stated that the rated power of the device operating in Downlink mode is 5 W (+37 dBm).

The client has stated that the rated power of the device operating in Uplink mode is 1 mW (+0.0 dBm).

Part 90 does not specify the transmitter output power.

Result: Complies.
Measurement Uncertainty: ± 0.5 dB

KDB 4.2 Automatic Gain 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.

The client has stated that the AGC Threshold Level is specified as the “iALC Start Level”.

For the Down Link this has been stated to be -33.0 dBm.

For the Up Link frequencies this has been stated to be -41 dBm.

Measurements were made to confirm these input levels for 3 input modulation types.

Down Link

Frequency (MHz)	Modulation Type	Input Level AGC Threshold
415.000	No modulation	-33.0 dBm
415.000	11K3F3E	-33.3 dBm
415.000	8K10F1W	-33.5 dBm
415.000	9K8D7W	-36.0 dBm
460.000	No modulation	-33.9 dBm
460.000	11K3F3E	-33.9 dBm
460.000	8K10F1W	-33.9 dBm
460.000	9K8D7W	-36.6 dBm

Down Link

Frequency (MHz)	Modulation Type	Input Level AGC Threshold
415.000	No modulation	-42.2
415.000	11K3F3E	-42.2
415.000	8K10F1W	-42.3
415.000	9K8D7W	-44.6
460.000	No modulation	-41.8
460.000	11K3F3E	-41.8
460.000	8K10F1W	-41.9
460.000	9K8D7W	-44.5

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.

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.

Testing was carried out in Down and Up link modes on 460 MHz and 415 MHz with the input level being -3 dB below the level required to achieve ALC limiting.

Frequency (MHz)	Modulation Type	Up Link BW kHz	Down Link BW kHz
415.000	11K3F3E	11.065	11.072
415.000	8K10F1W	9.775	-
415.000	9K8D7W	-	10.319
460.000	11K3F3E	11.073	10.518
460.000	8K10F1W	9.723	-
460.000	9K8D7W	-	10.352

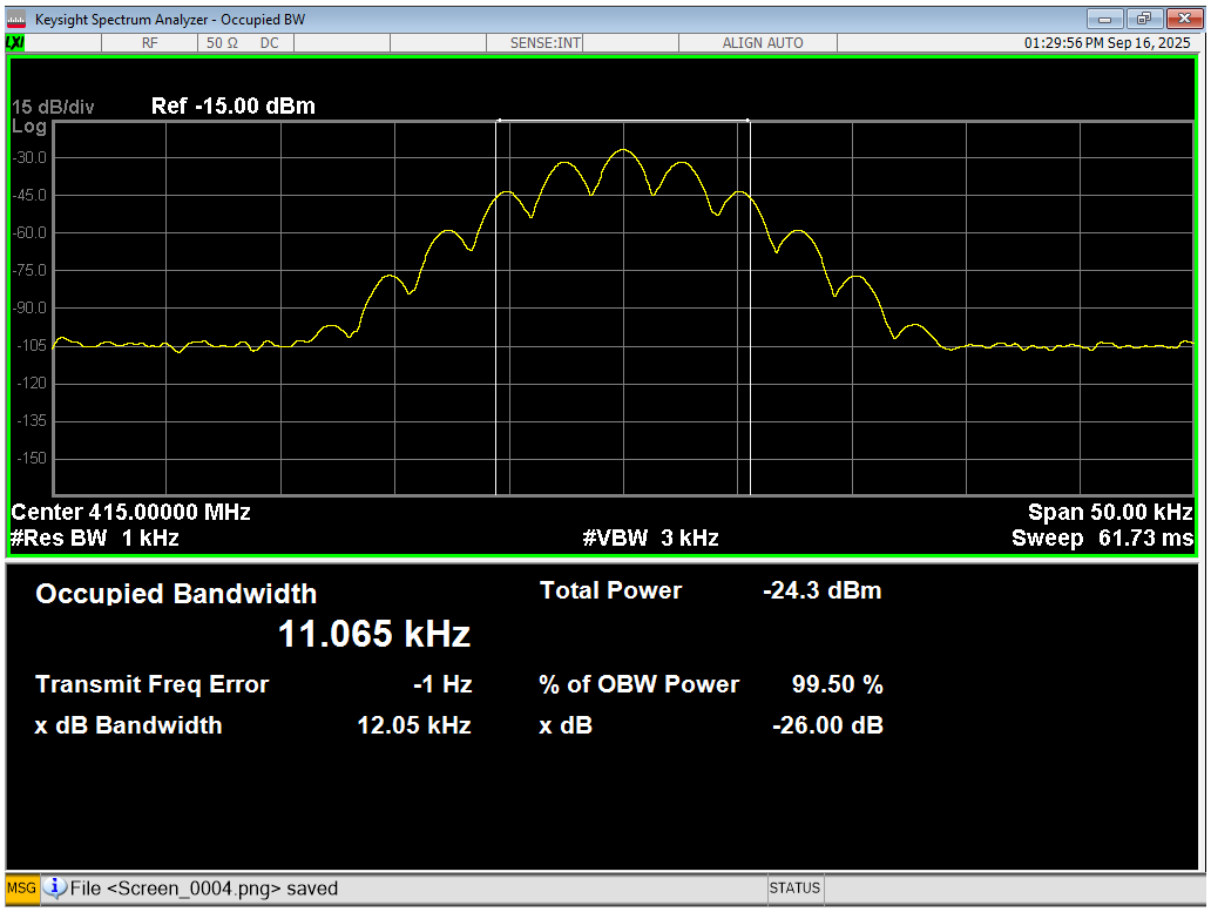
The measured occupied bandwidths closely approximate the bandwidths declared by the client.

Result: Complies.

Occupied Bandwidth

415 MHz Uplink

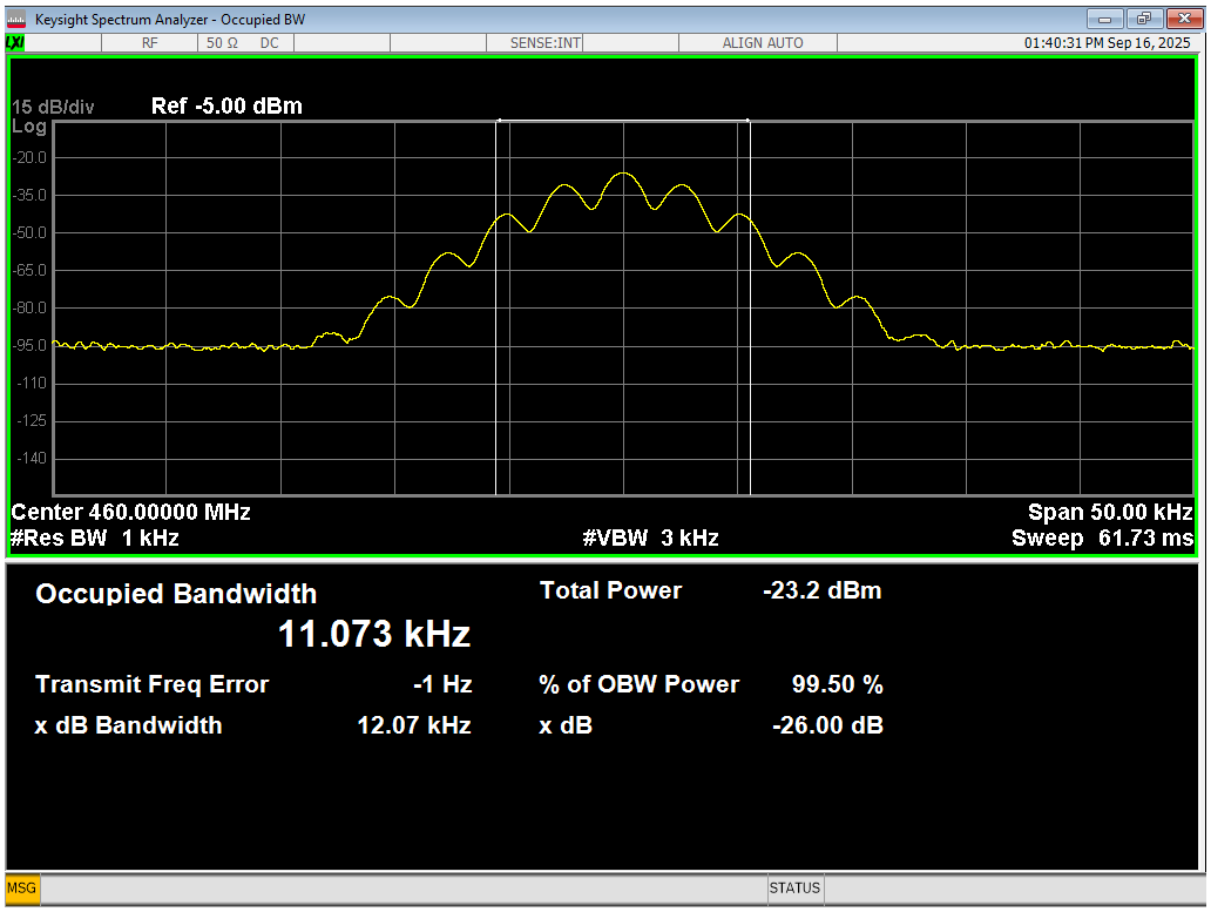
F3E 11K3 bandwidth – 12.5 kHz channel spacing with a frequency deviation of 2.5 kHz with a 2550 Hz tone.



Occupied Bandwidth

460 MHz Uplink

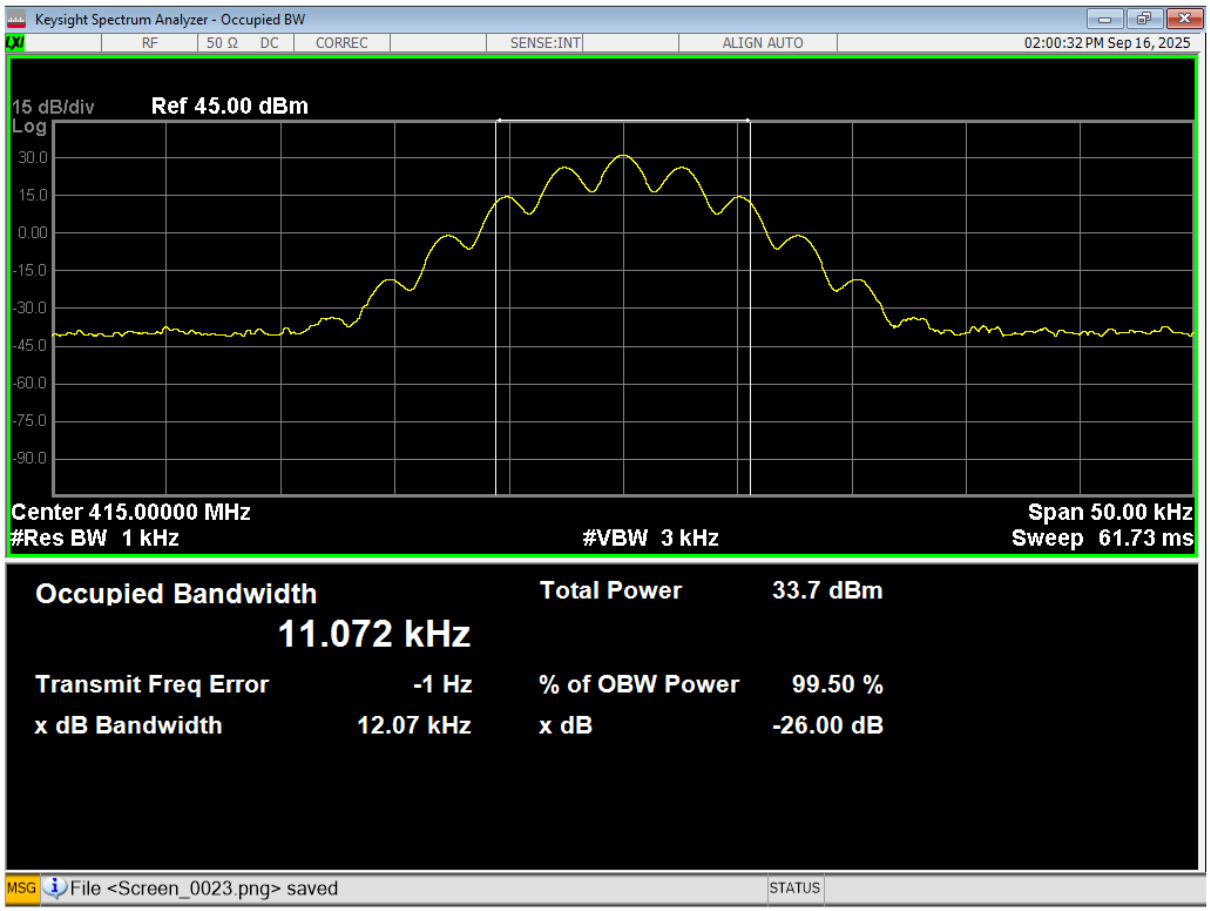
F3E 11K3 bandwidth – 12.5 kHz channel spacing with frequency deviation of 2.5 kHz with a 2550 Hz tone.



Occupied Bandwidth

415 MHz Downlink

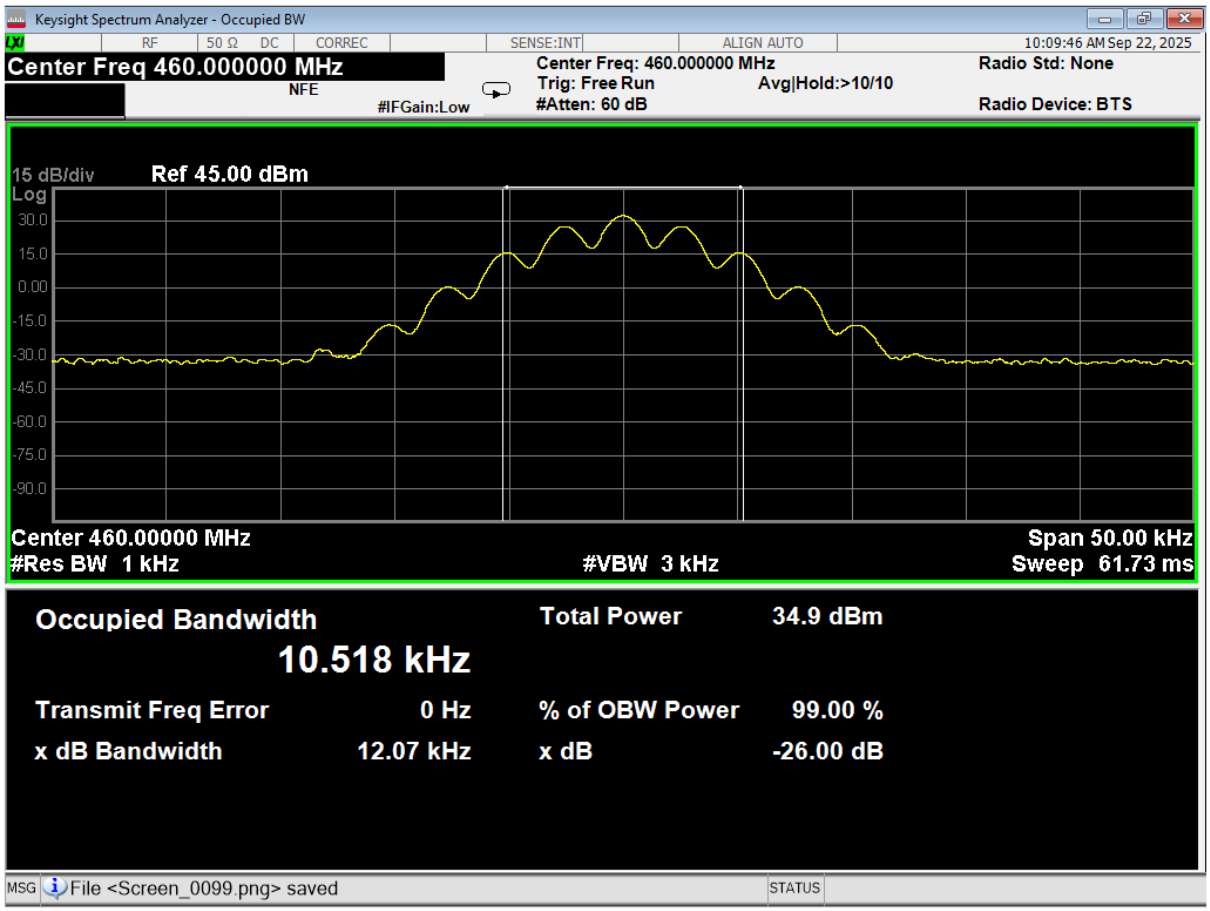
F3E 11K3 bandwidth – 12.5 kHz channel spacing with frequency deviation of 2.5 kHz with a 2550 Hz tone



Occupied Bandwidth

460 MHz Downlink

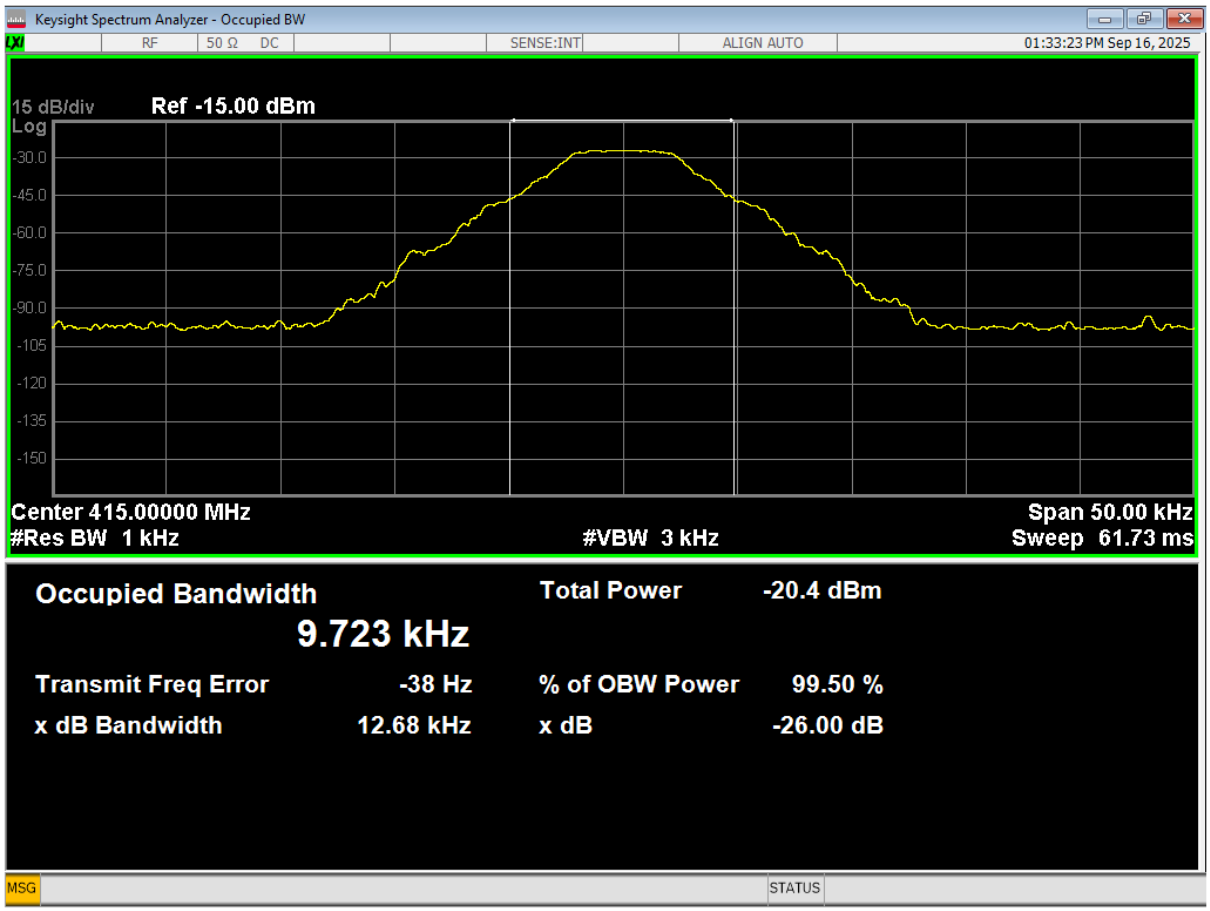
F3E 11K3 bandwidth – 12.5 kHz channel spacing with frequency deviation of 2.5 kHz with a 2550 Hz tone



Occupied Bandwidth

415 MHz Uplink

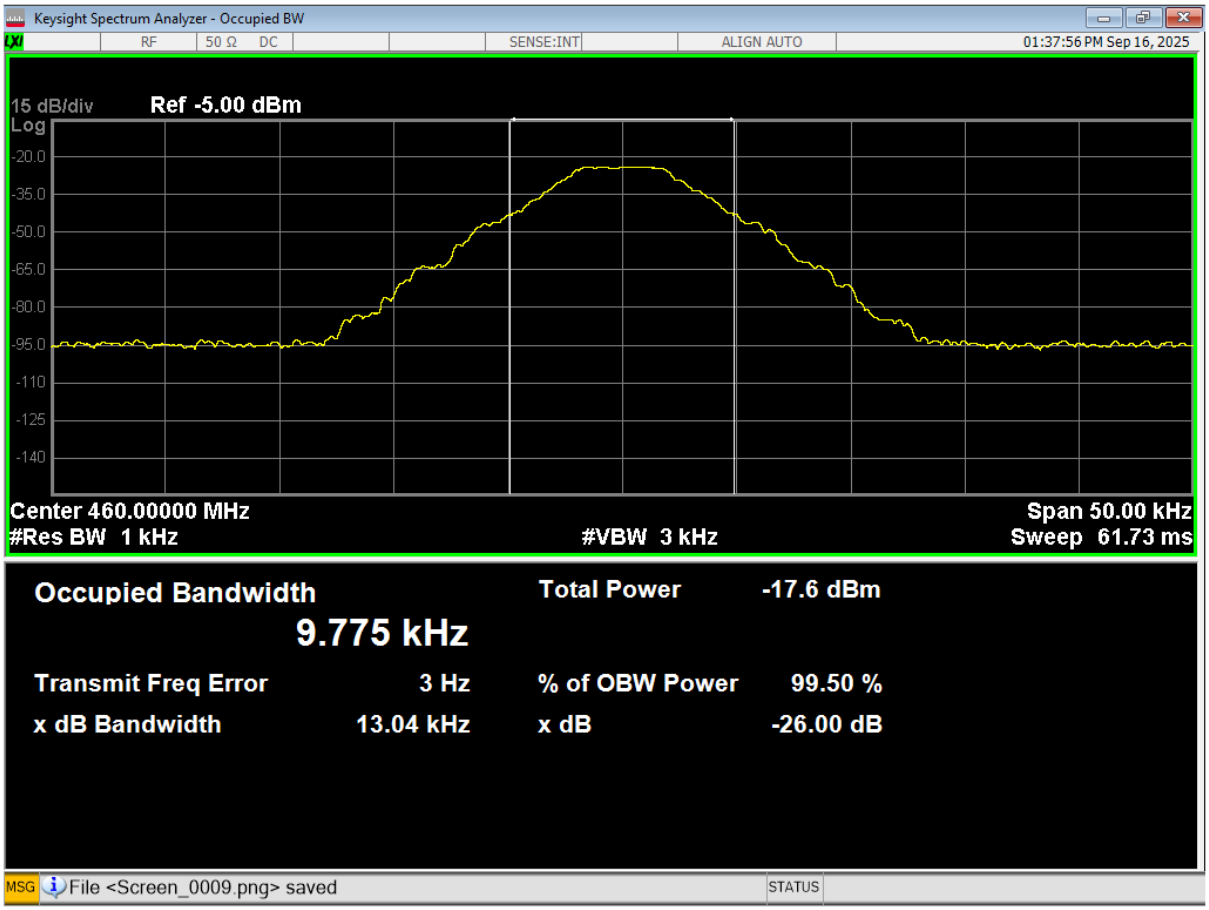
8K10F1W – C4FM with a deviation of 1.8 kHz and 6000 symbols/sec



Occupied Bandwidth

460 MHz Uplink

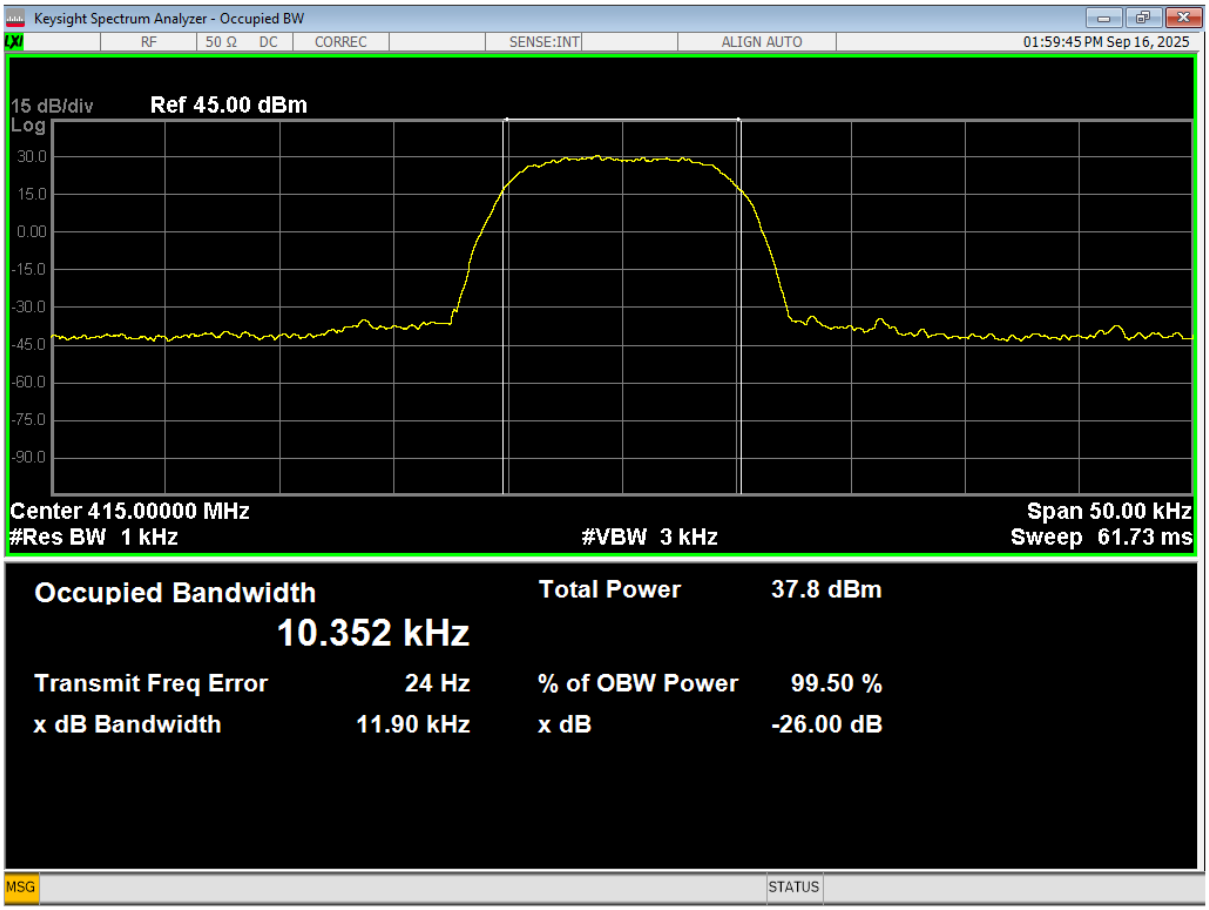
8K10F1W – C4FM with a deviation of 1.8 kHz and 6000 symbols/sec



Occupied Bandwidth

415 MHz Downlink

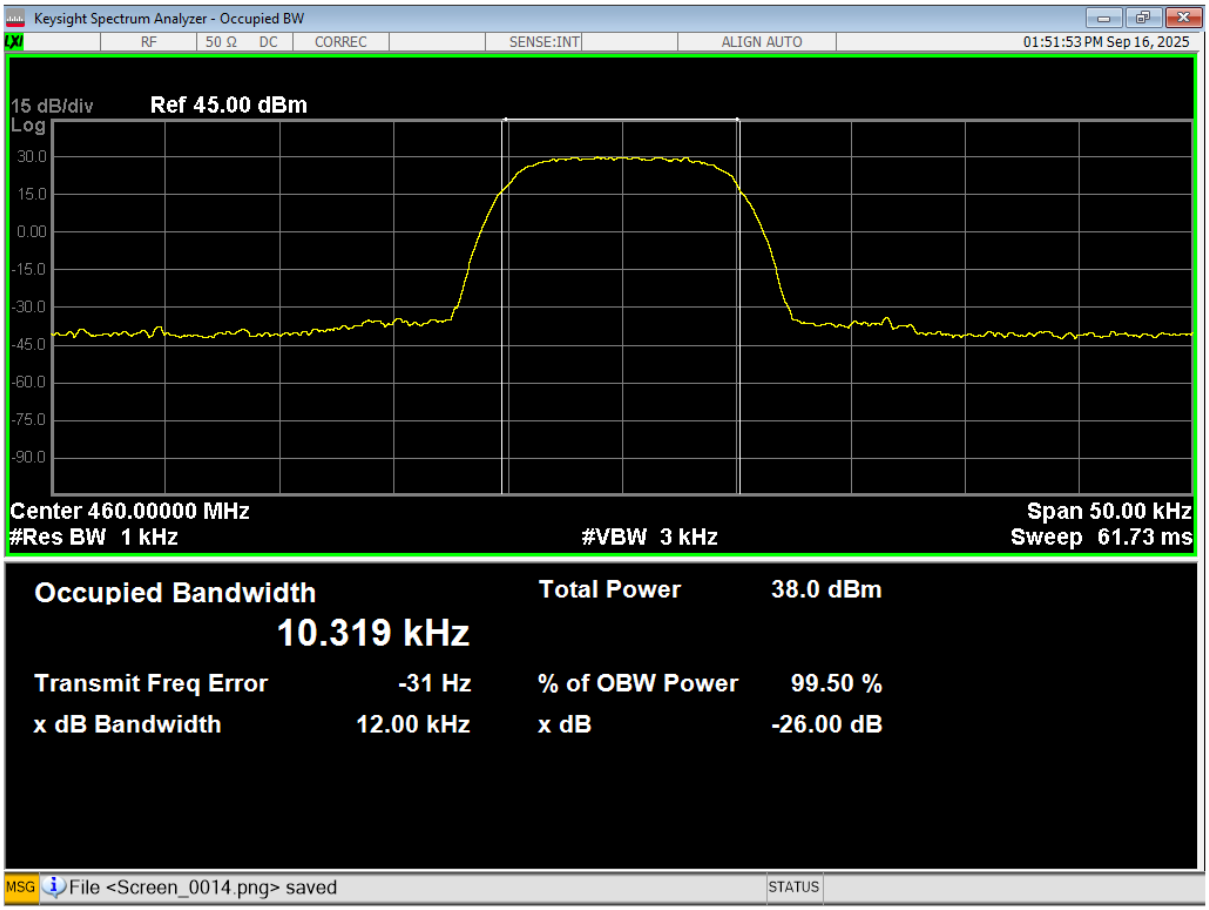
9K80D7W – PI/4 DQPSK using 8000 symbols/sec



Occupied Bandwidth

460 MHz Downlink

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



Clause 90.210: Spectrum Emission Mask measurements

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

Testing was carried out in Down and Up link modes on 460 MHz and 415 MHz with the input level being -1 dB below the level required to achieve ALC limiting and +3dB above the level required to achieve ALC limiting .

Mask measurements have been made on the input signal and the output signal.
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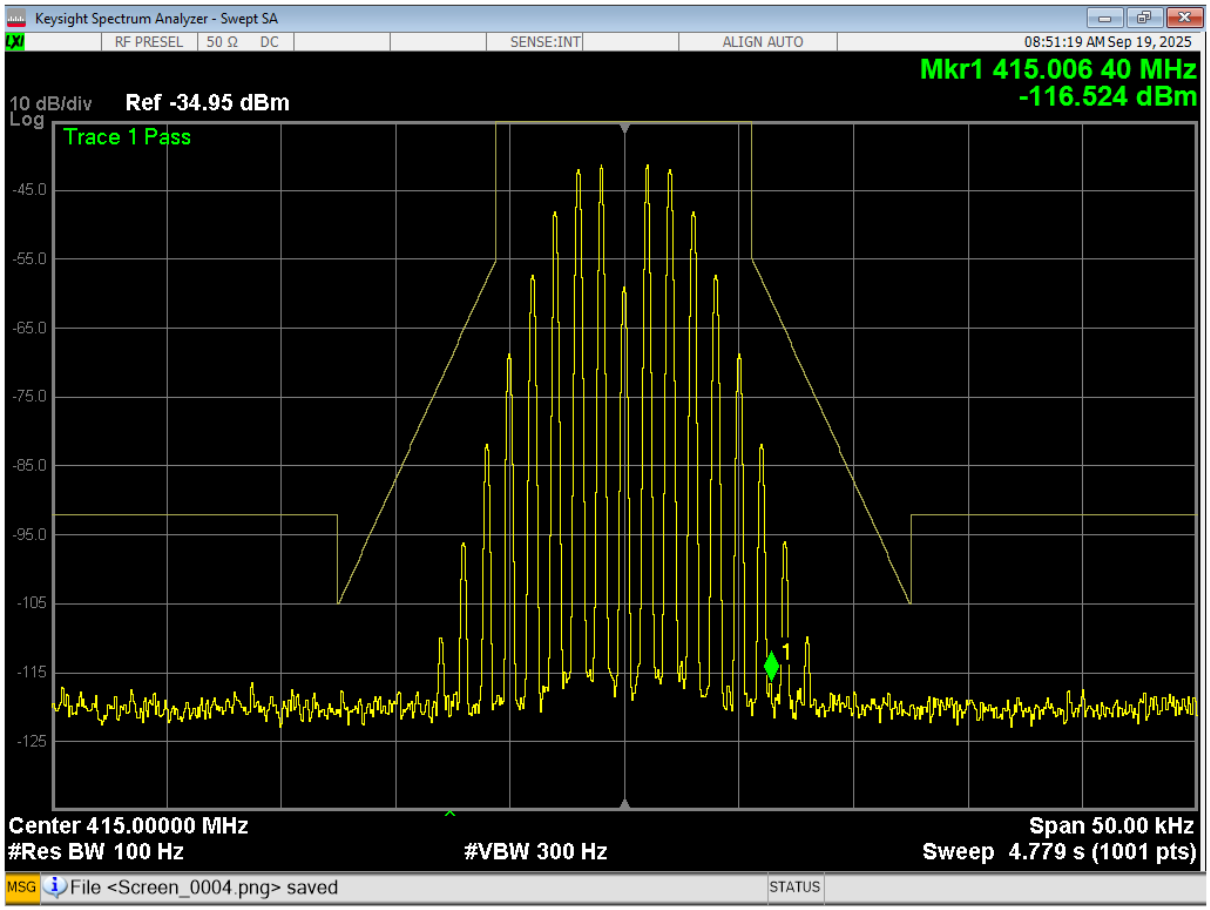
Result: Complies.

Emission Mask (Downlink)

Input

415 MHz Input ALC -1 dB

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

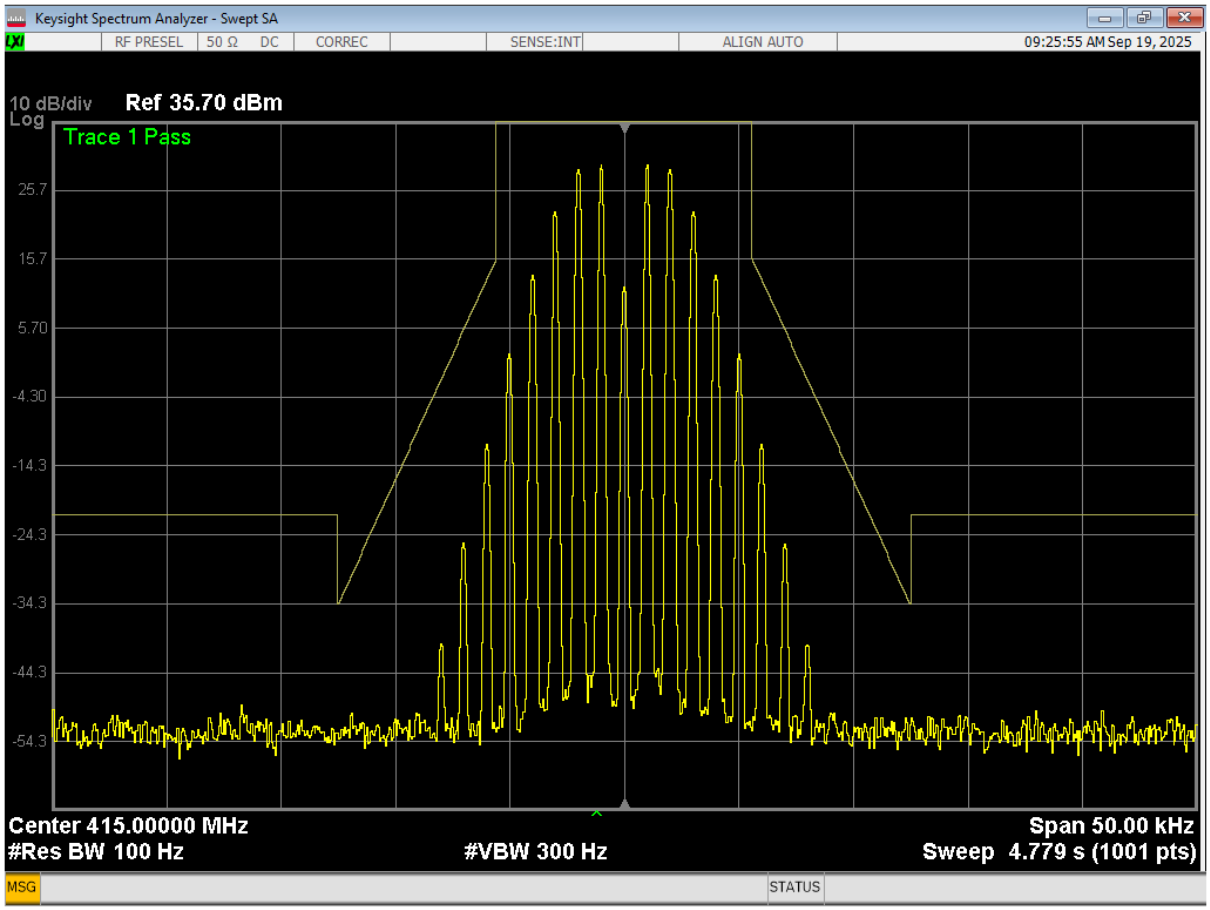


Emission Mask (Downlink)

Output

415 MHz Input ALC -1 dB

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

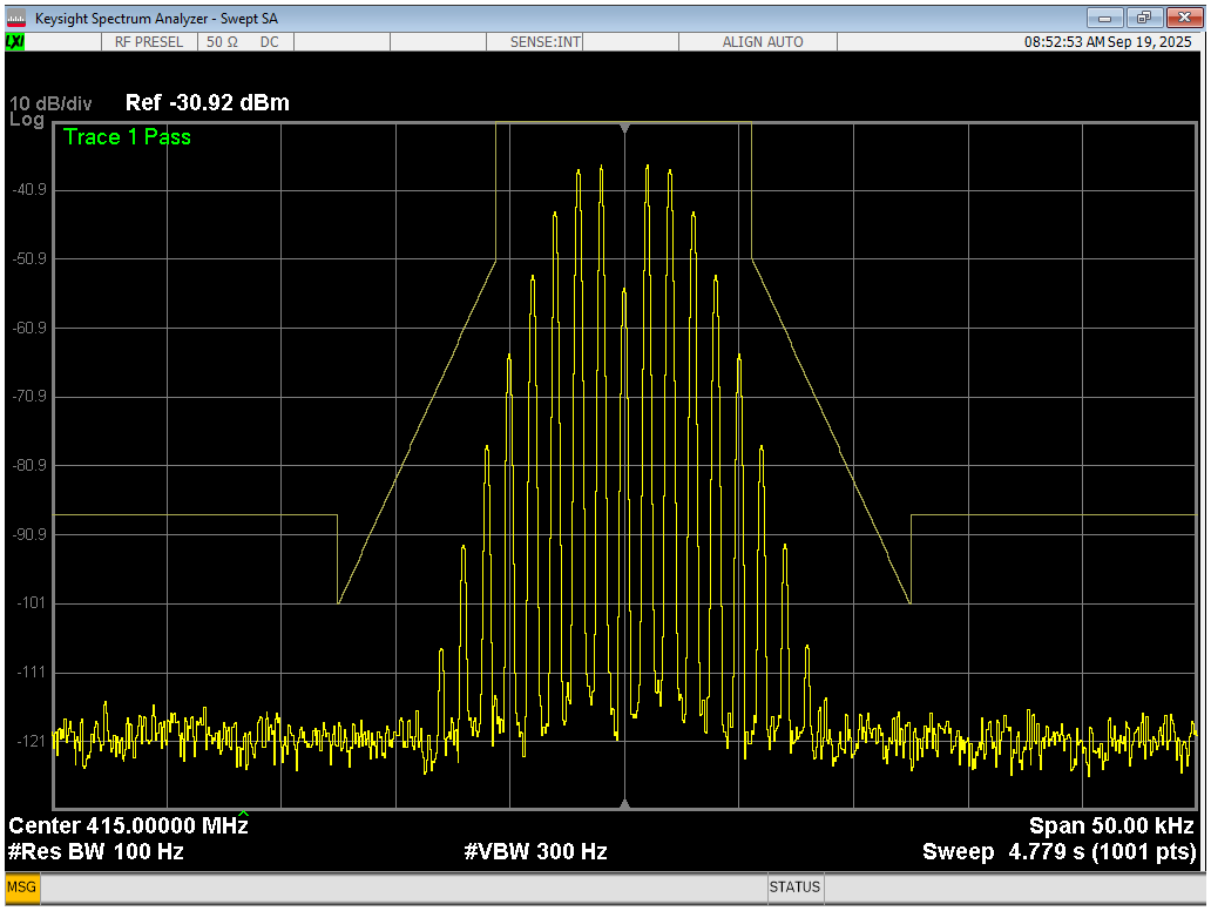


Emission Mask (Downlink)

Input

415 MHz Input ALC +3 dB

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

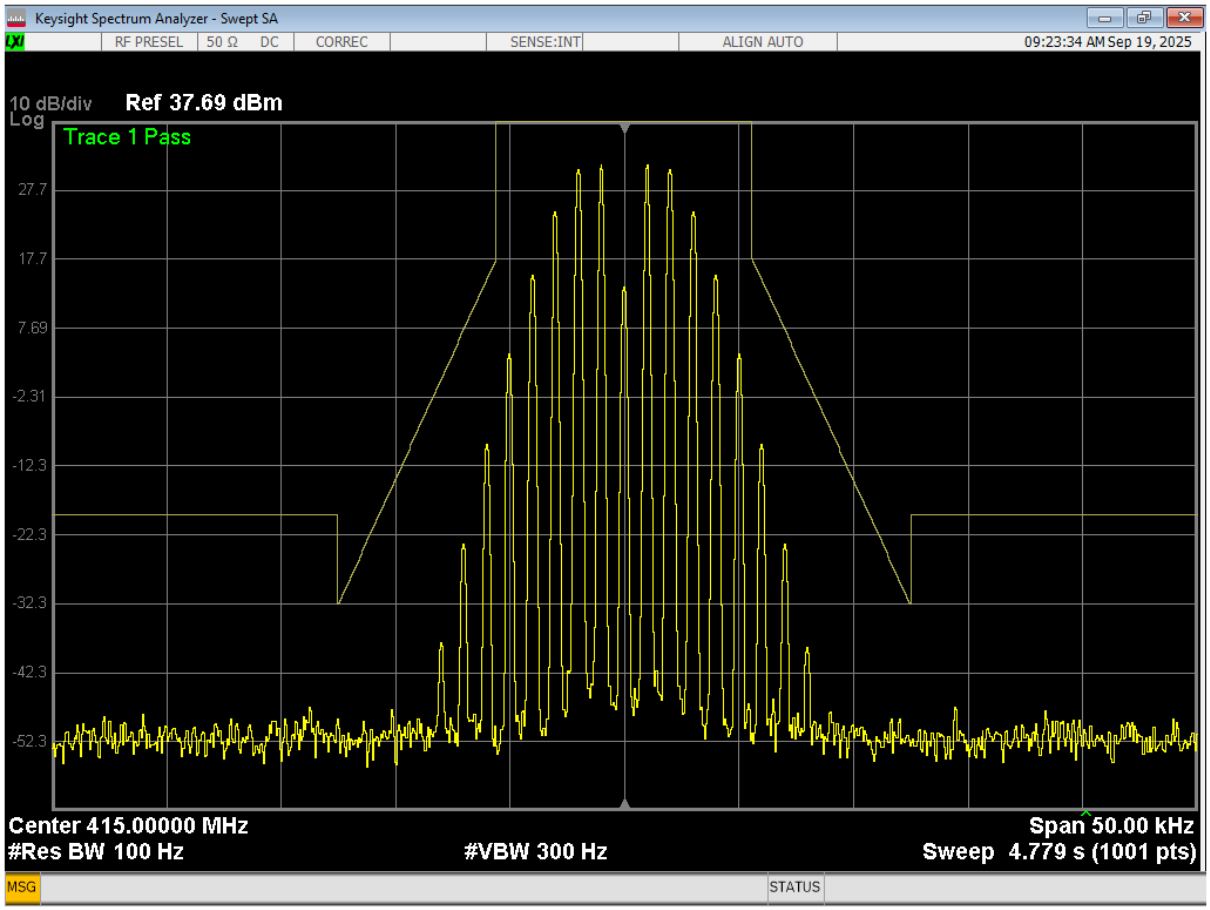


Emission Mask (Downlink)

Output

415 MHz Input ALC +3 dB

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

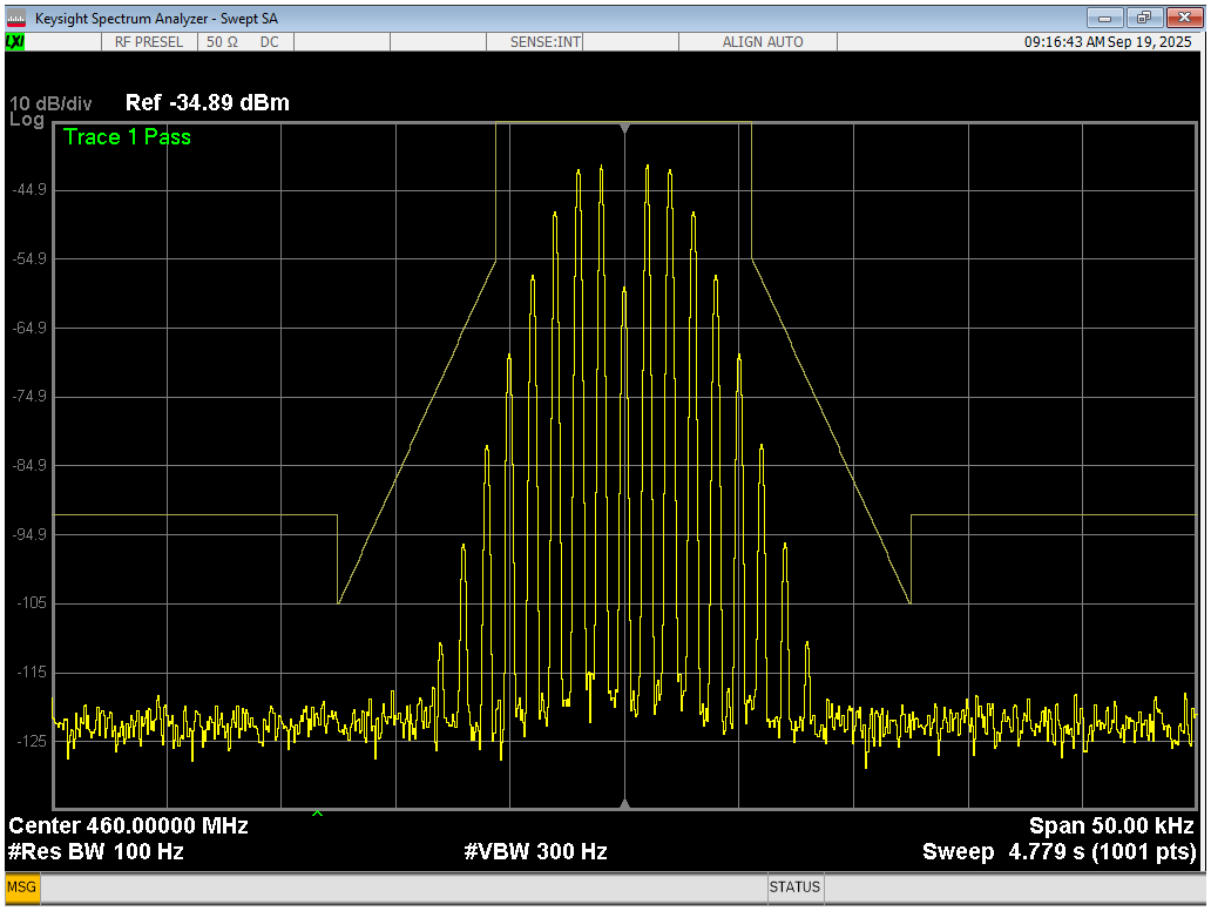


Emission Mask (Downlink)

Input

460 MHz Input ALC -1 dB

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

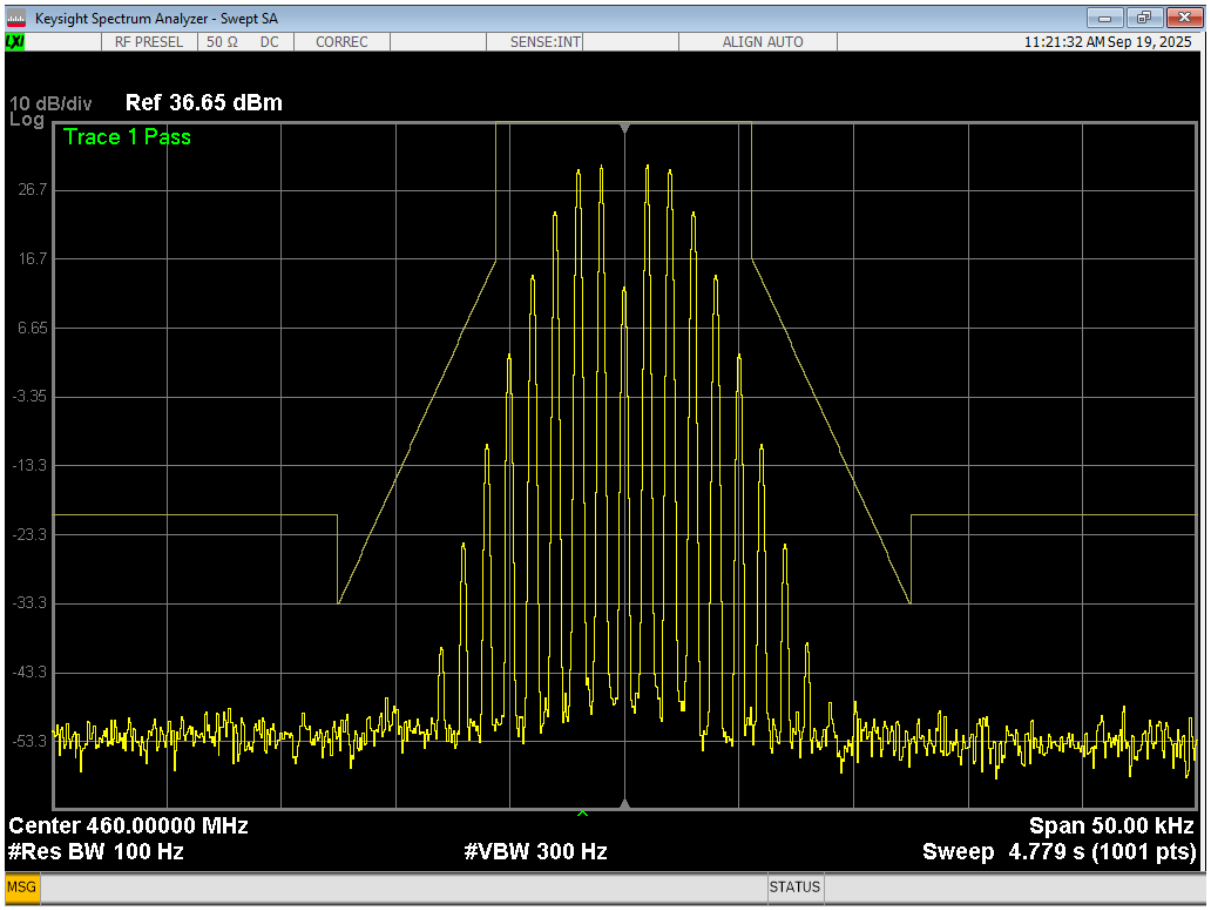


Emission Mask (Downlink)

Output

460 MHz Input ALC -1 dB

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

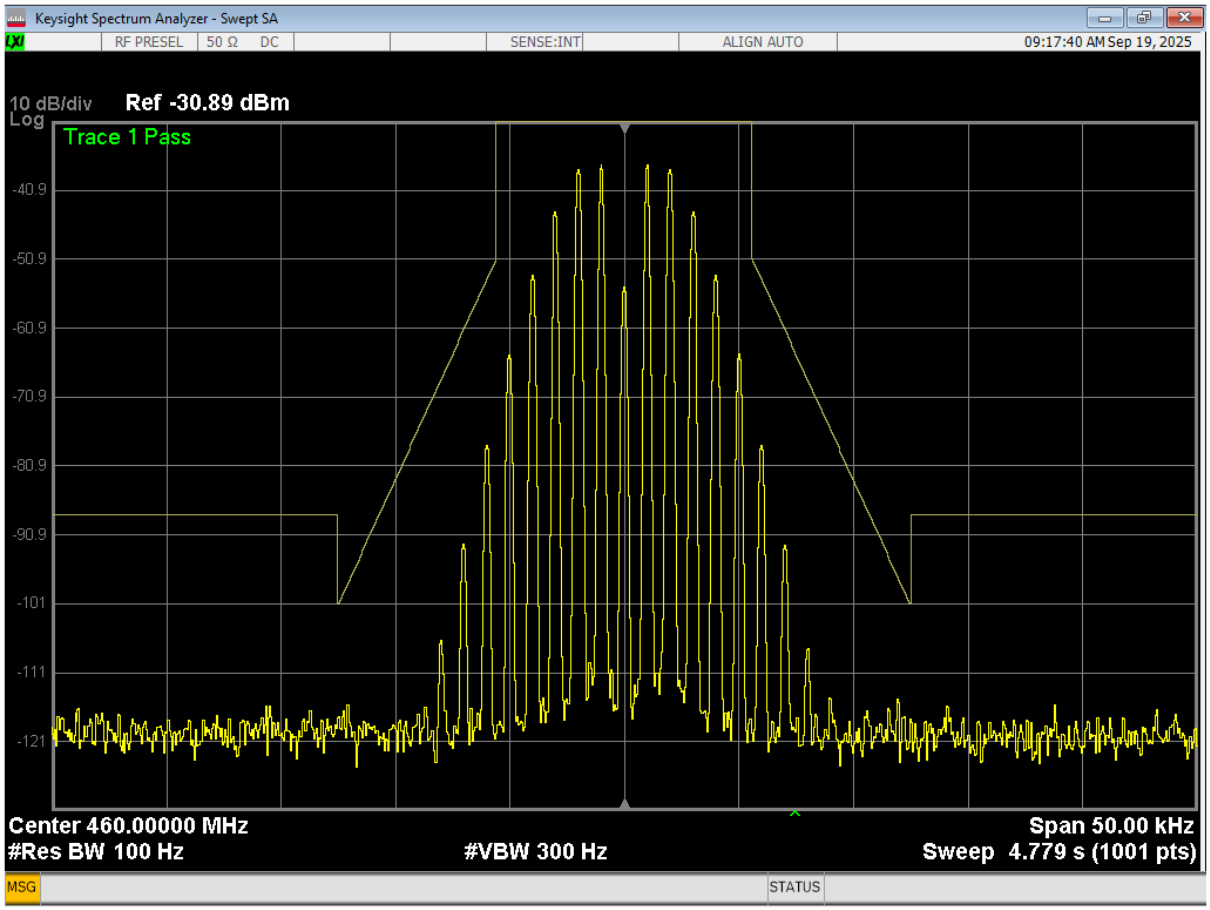


Emission Mask (Downlink)

Input

460 MHz Input ALC +3 dB

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

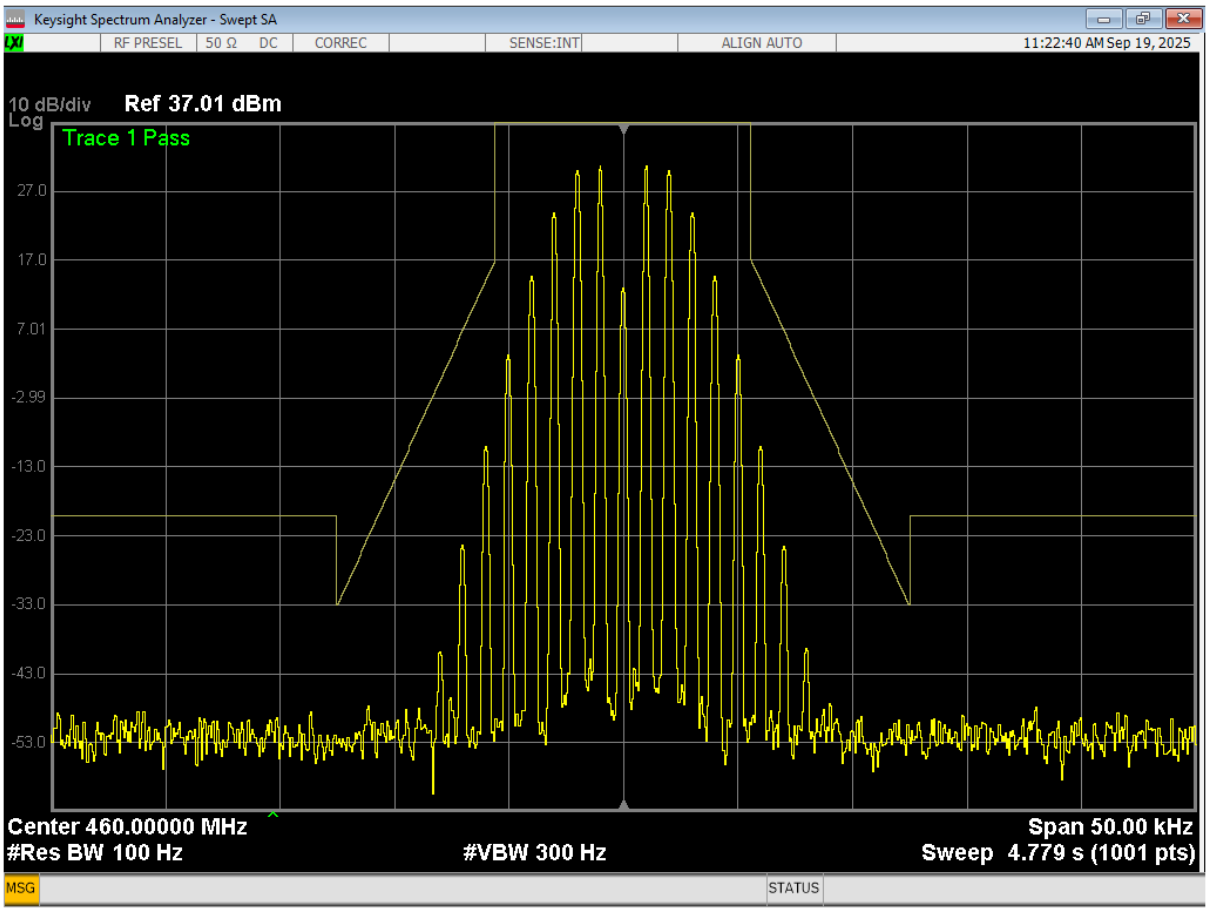


Emission Mask (Downlink)

Output

460 MHz Input ALC +3 dB

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

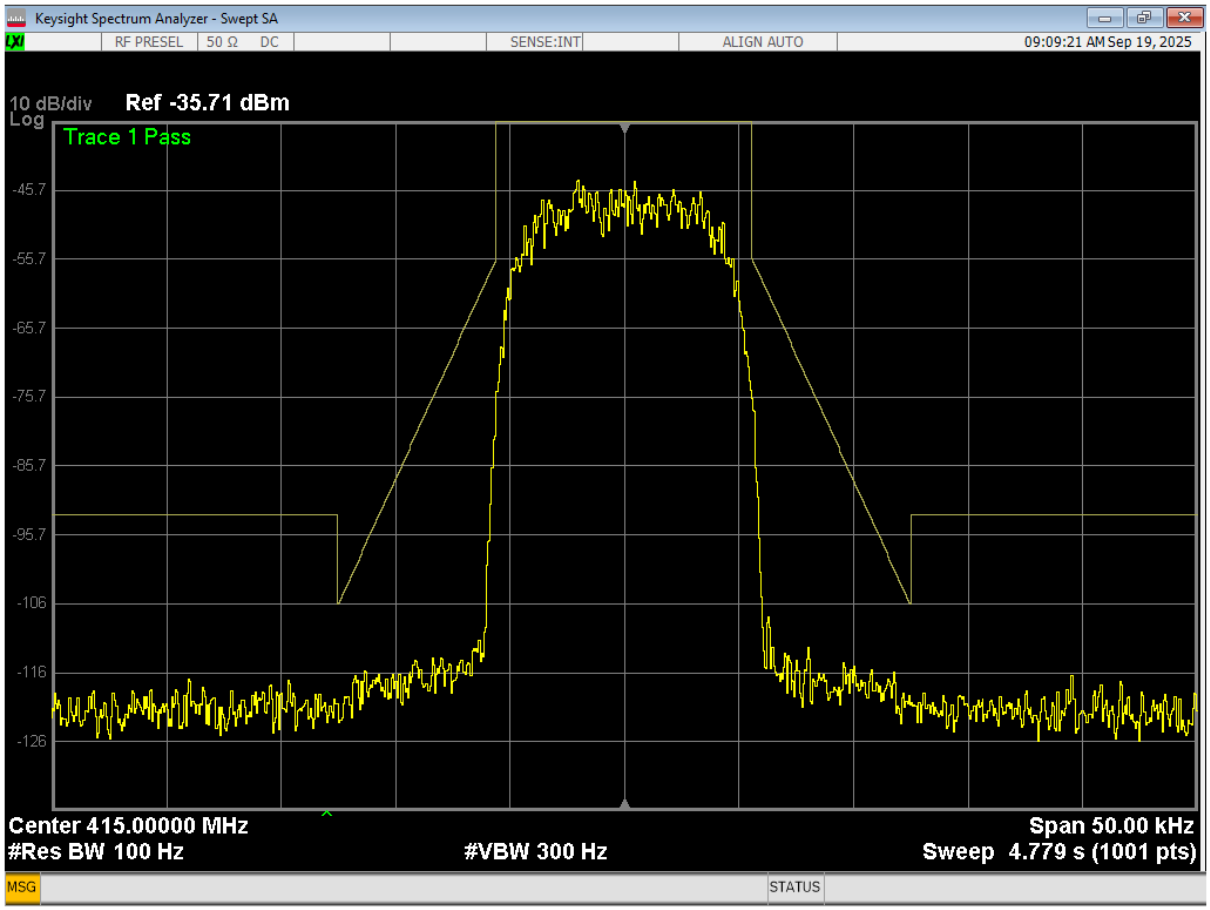


Emission Mask (Downlink)

Input

415 MHz Input ALC -1 dB

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

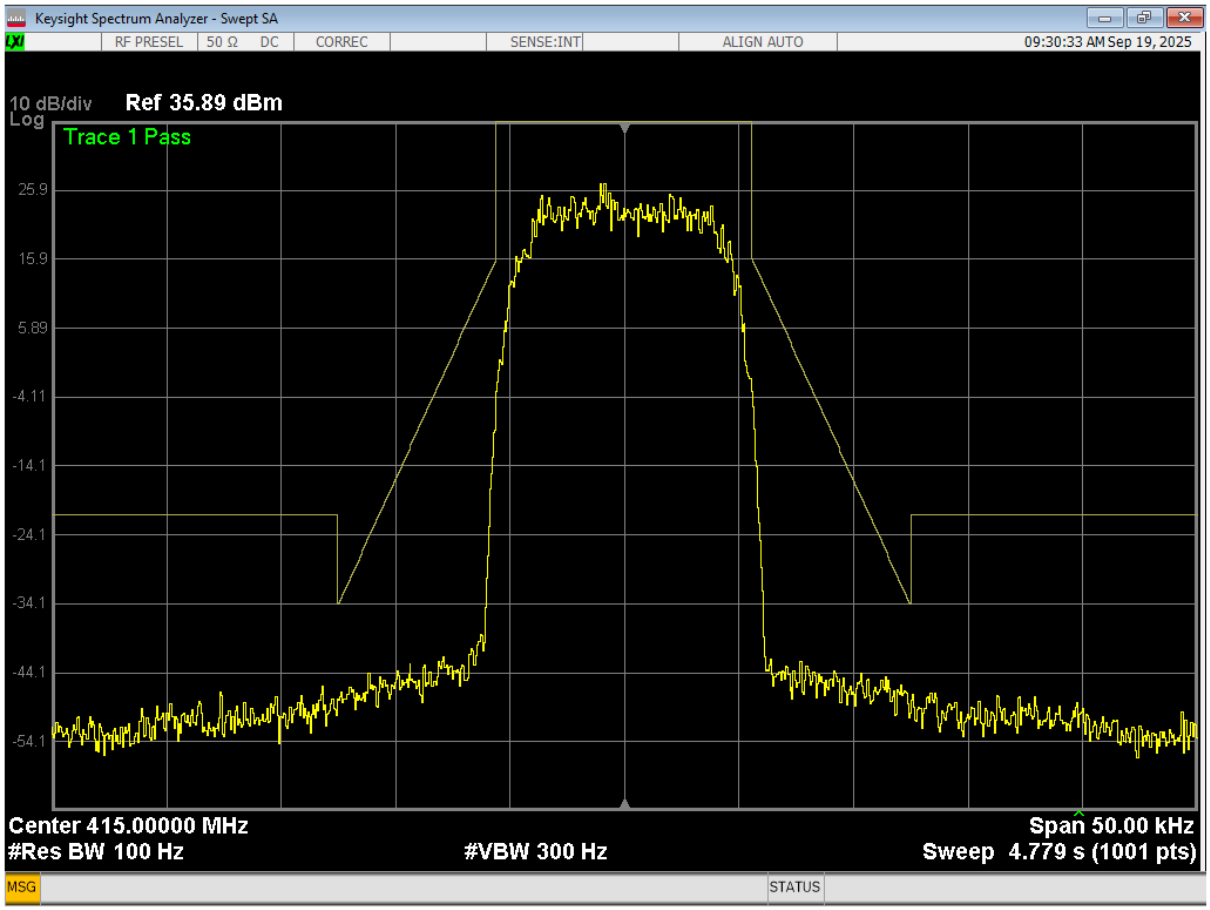


Emission Mask (Downlink)

Output

415 MHz Input ALC -1 dB

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

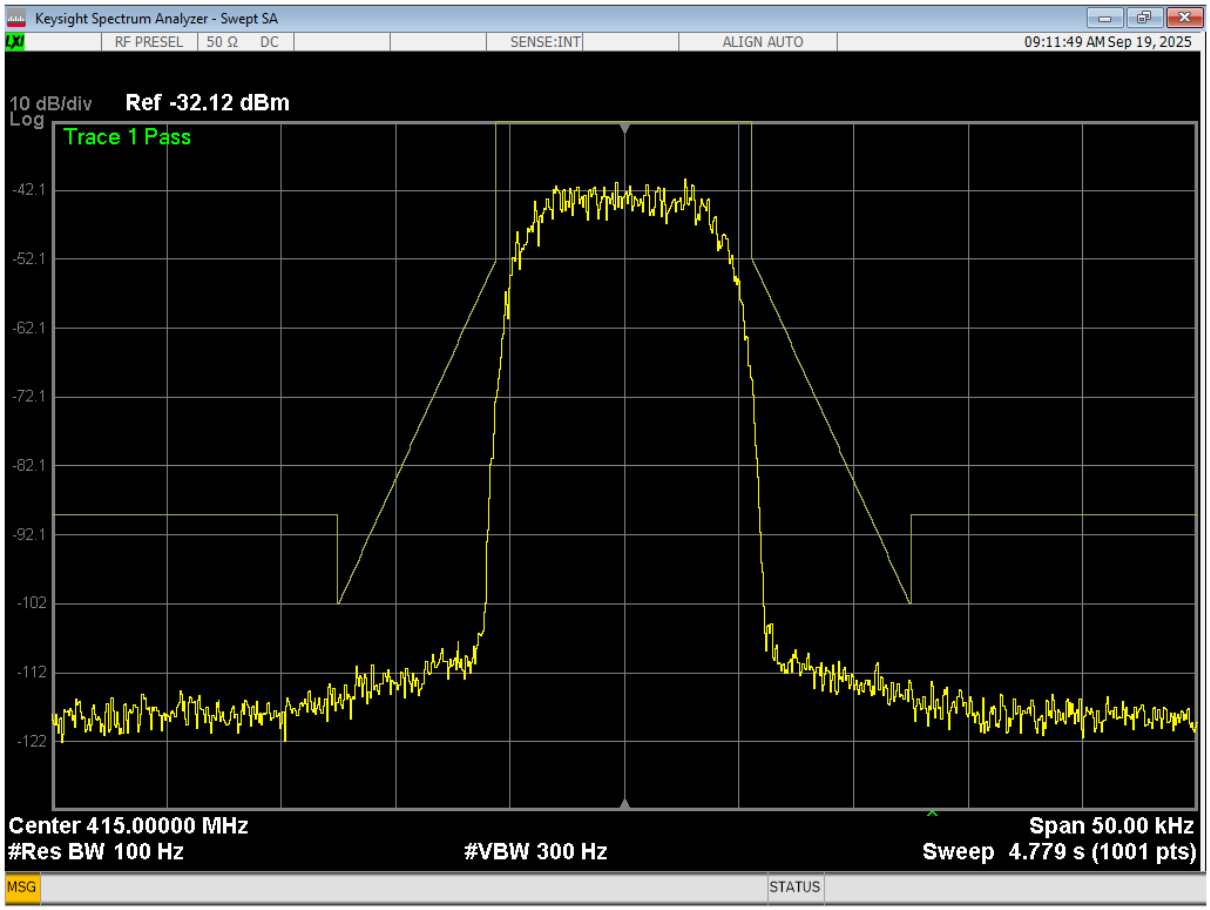


Emission Mask (Downlink)

Input

415 MHz Input ALC +3 dB

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

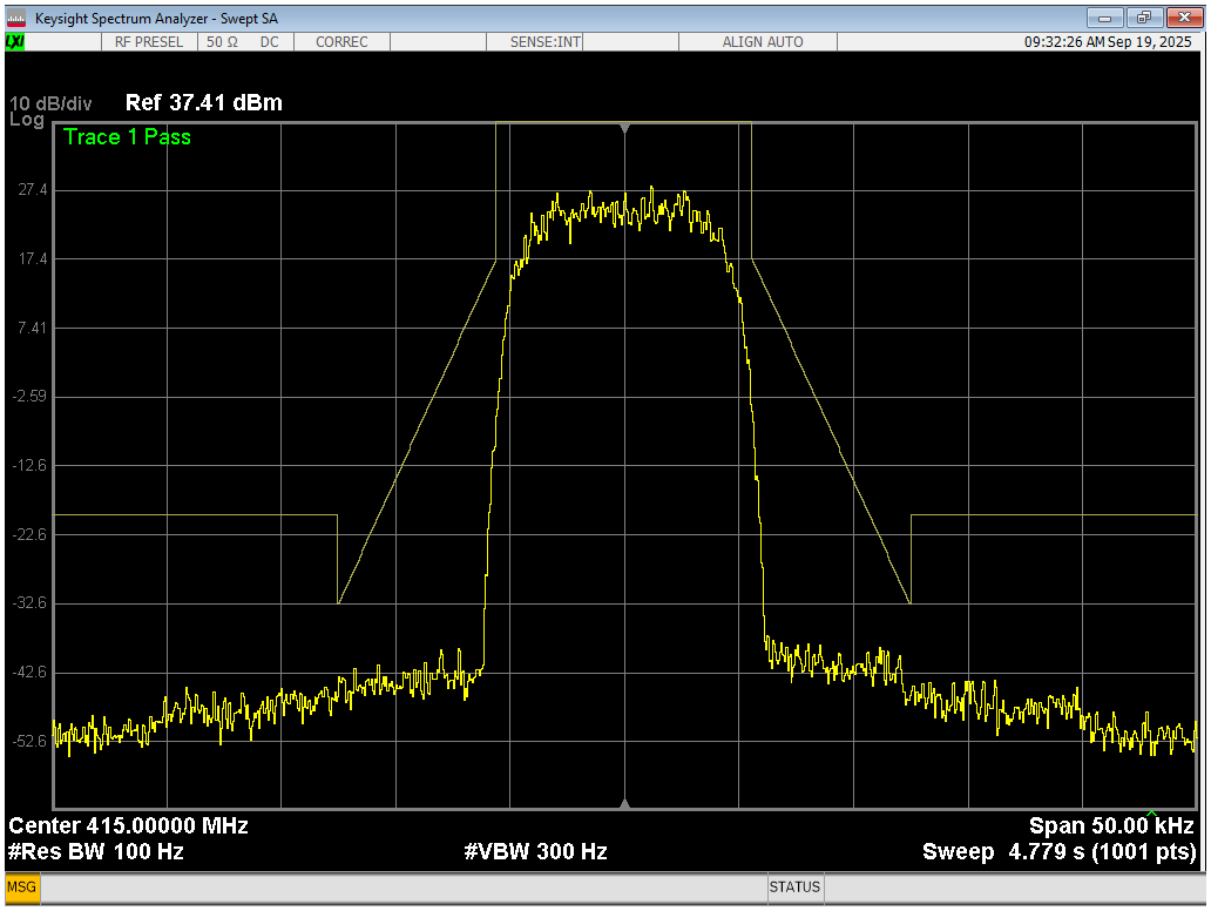


Emission Mask (Downlink)

Output

415 MHz Input ALC +3 dB

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

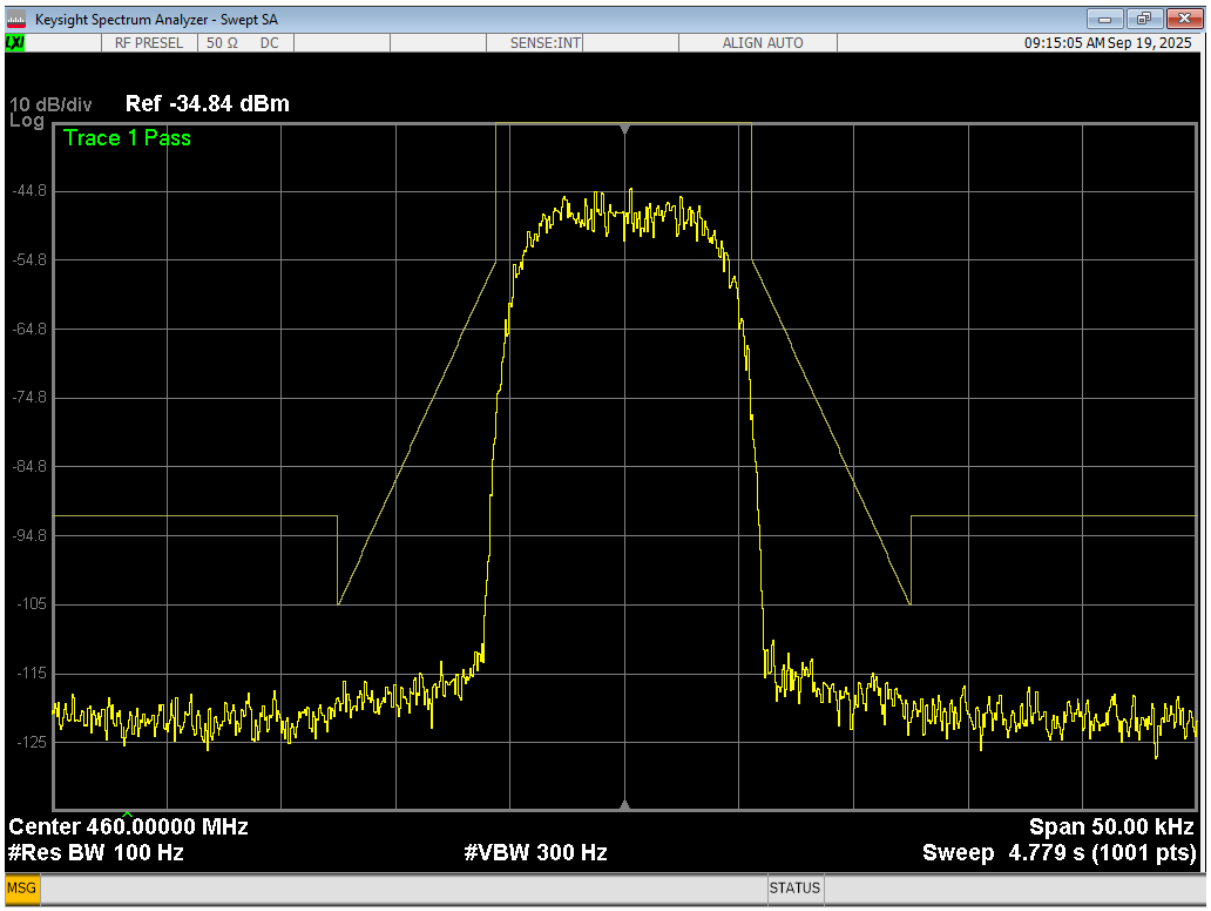


Emission Mask (Downlink)

Input

460 MHz Input ALC -1 dB

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

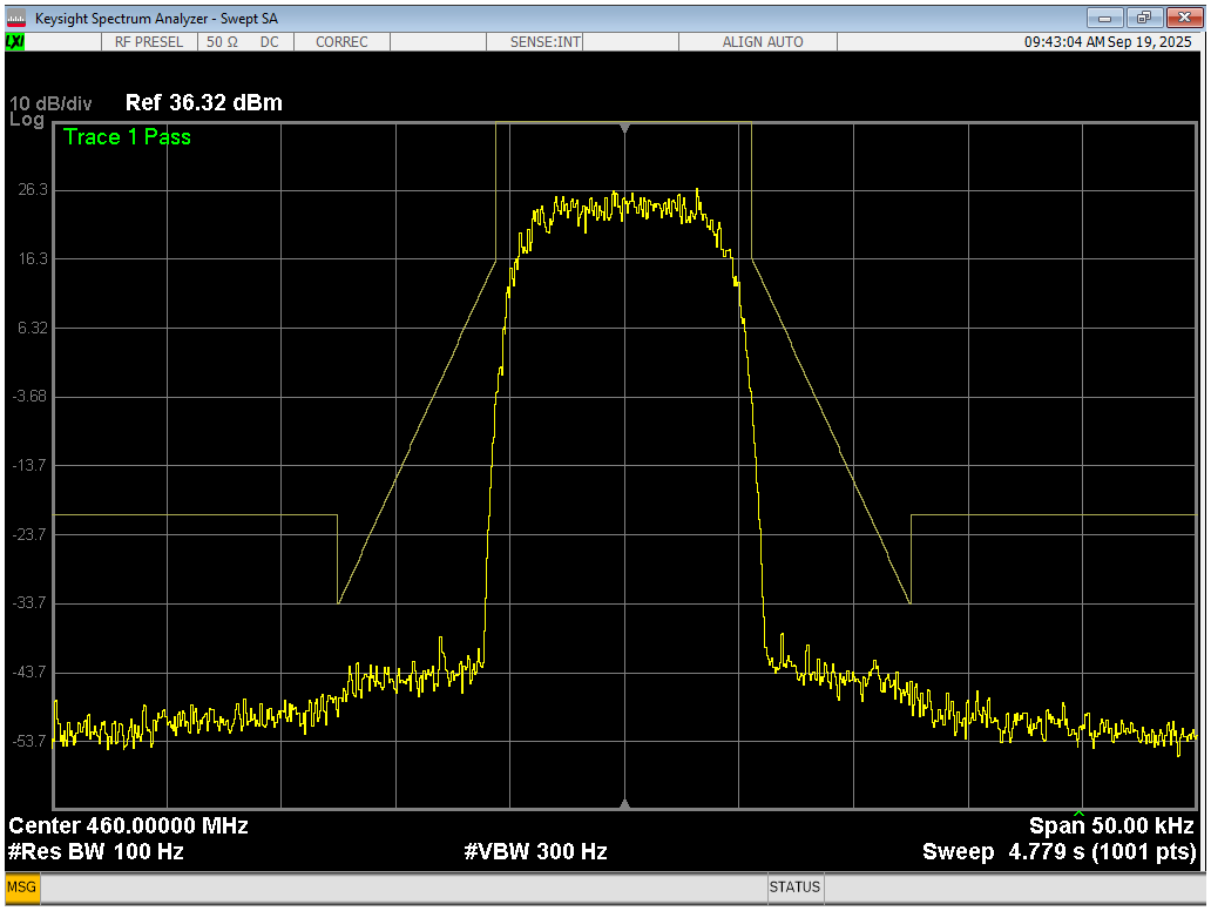


Emission Mask (Downlink)

Output

460 MHz Input ALC -1 dB

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

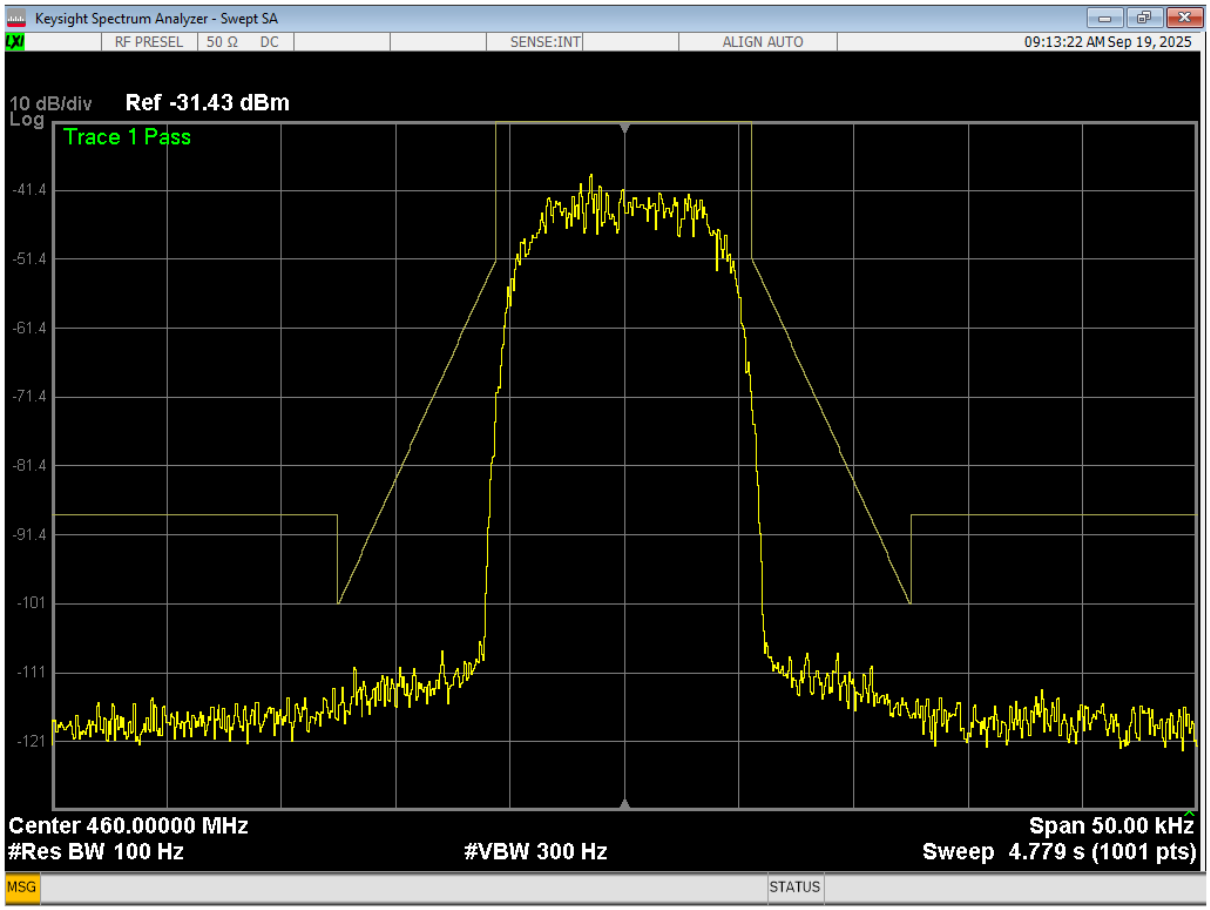


Emission Mask (Downlink)

Input

460 MHz Input ALC +3 dB

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

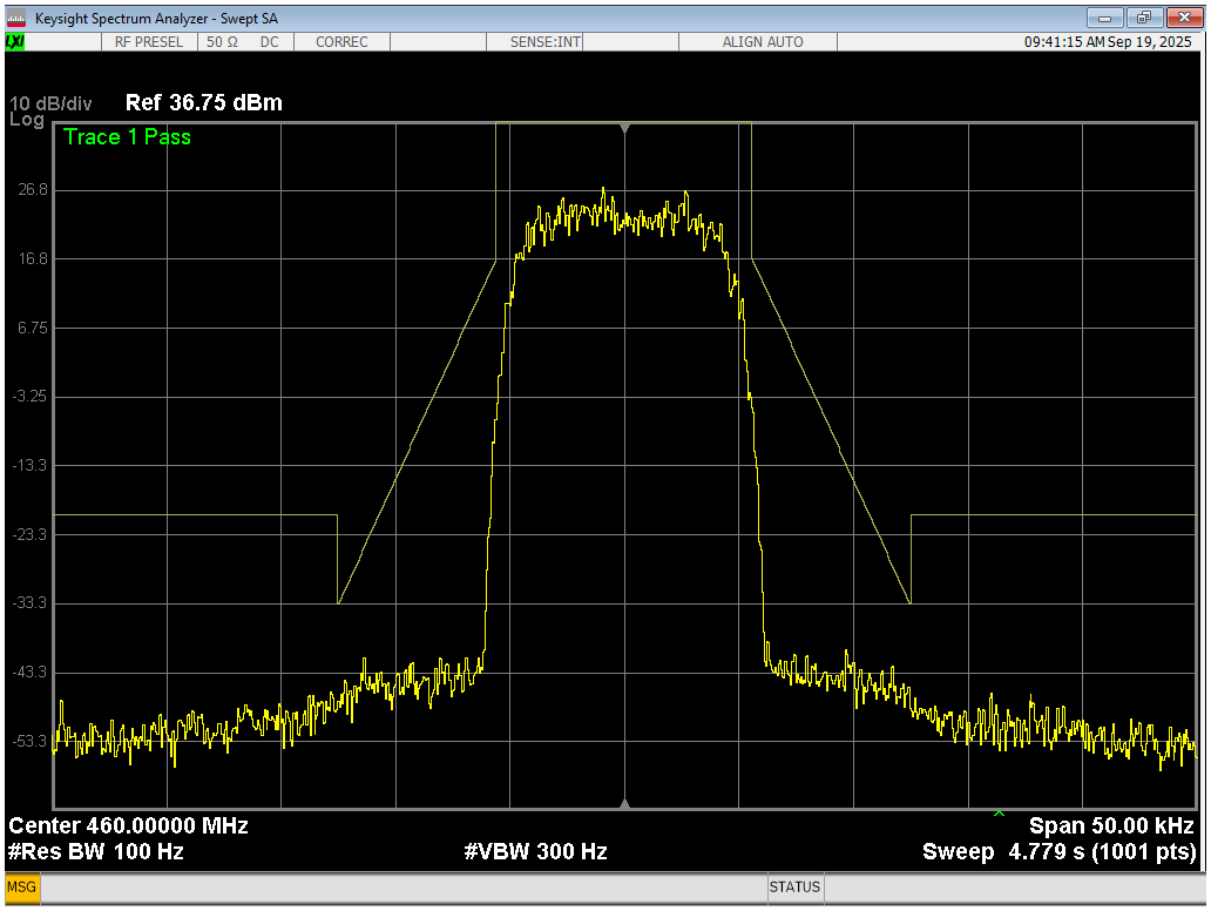


Emission Mask (Downlink)

Output

460 MHz Input ALC +3 dB

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

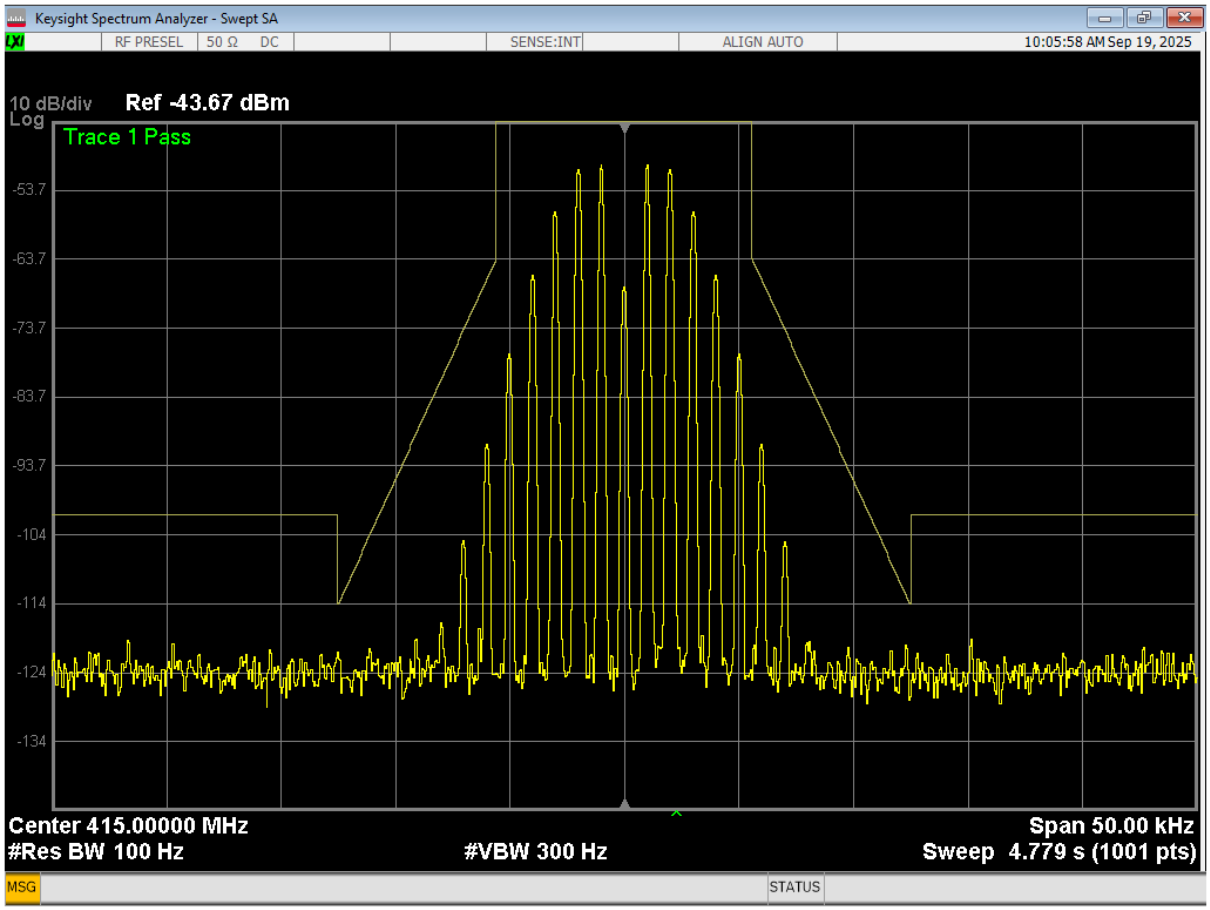


Emission Mask (Uplink)

Input

415 MHz Input ALC -1 dB

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

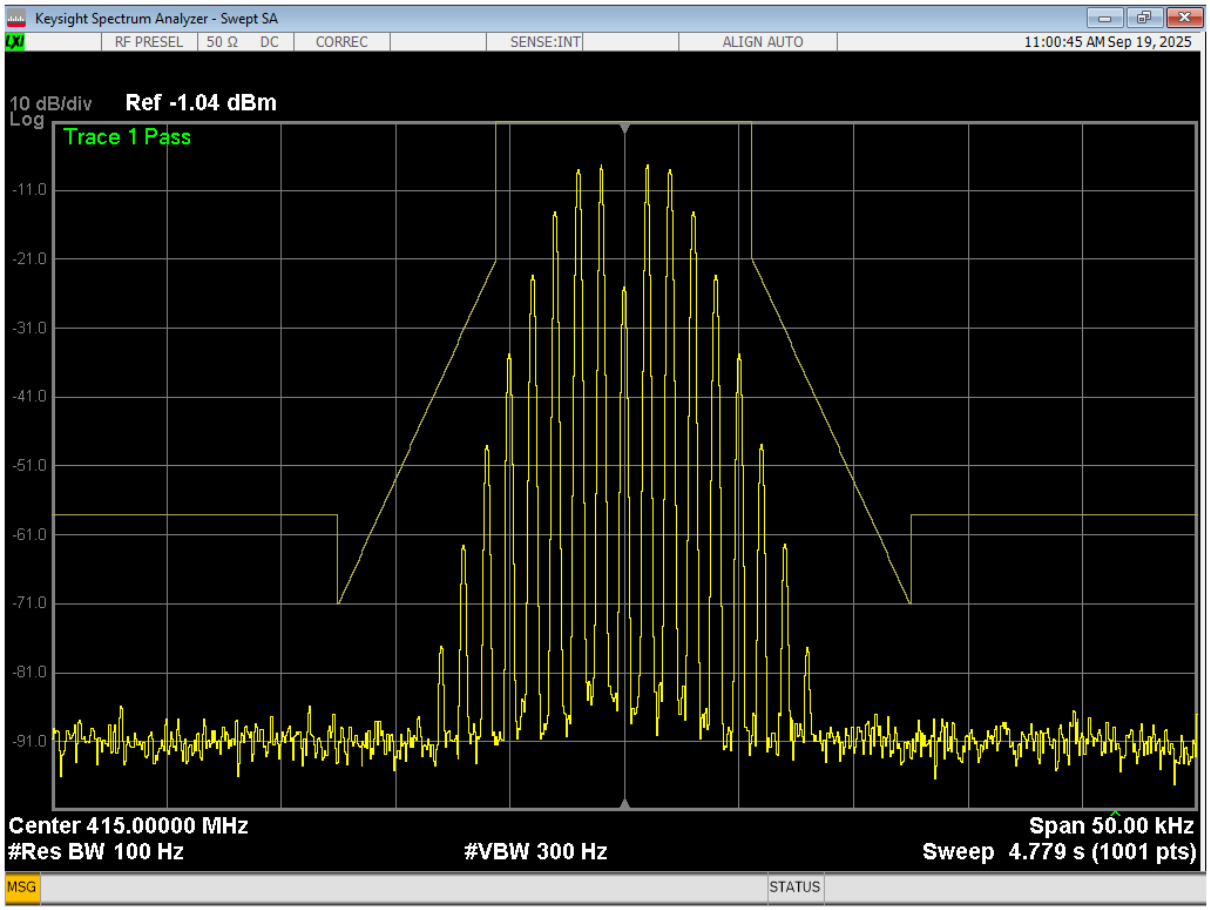


Emission Mask (Uplink)

Output

415 MHz Input ALC -1 dB

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

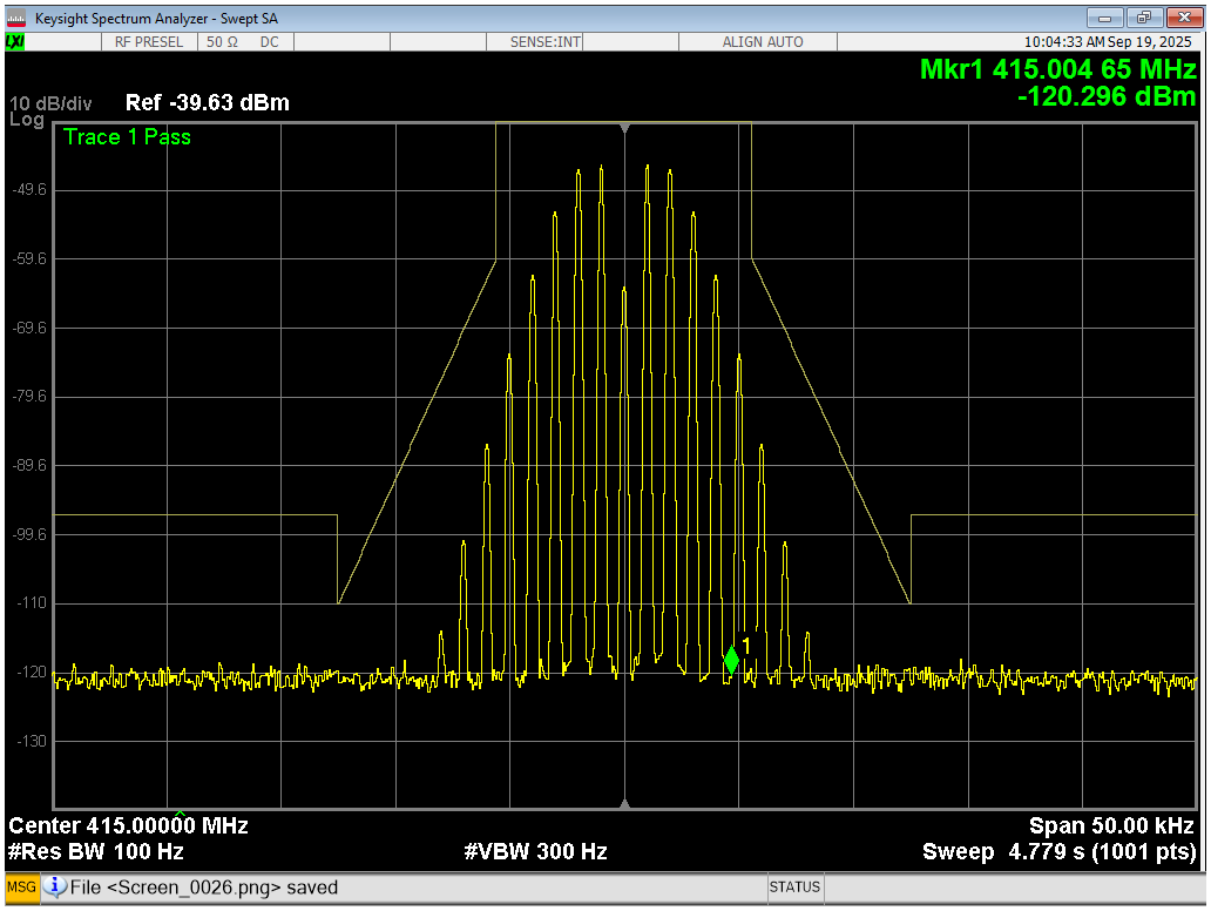


Emission Mask (Uplink)

Input

415 MHz Input ALC +3 dB

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

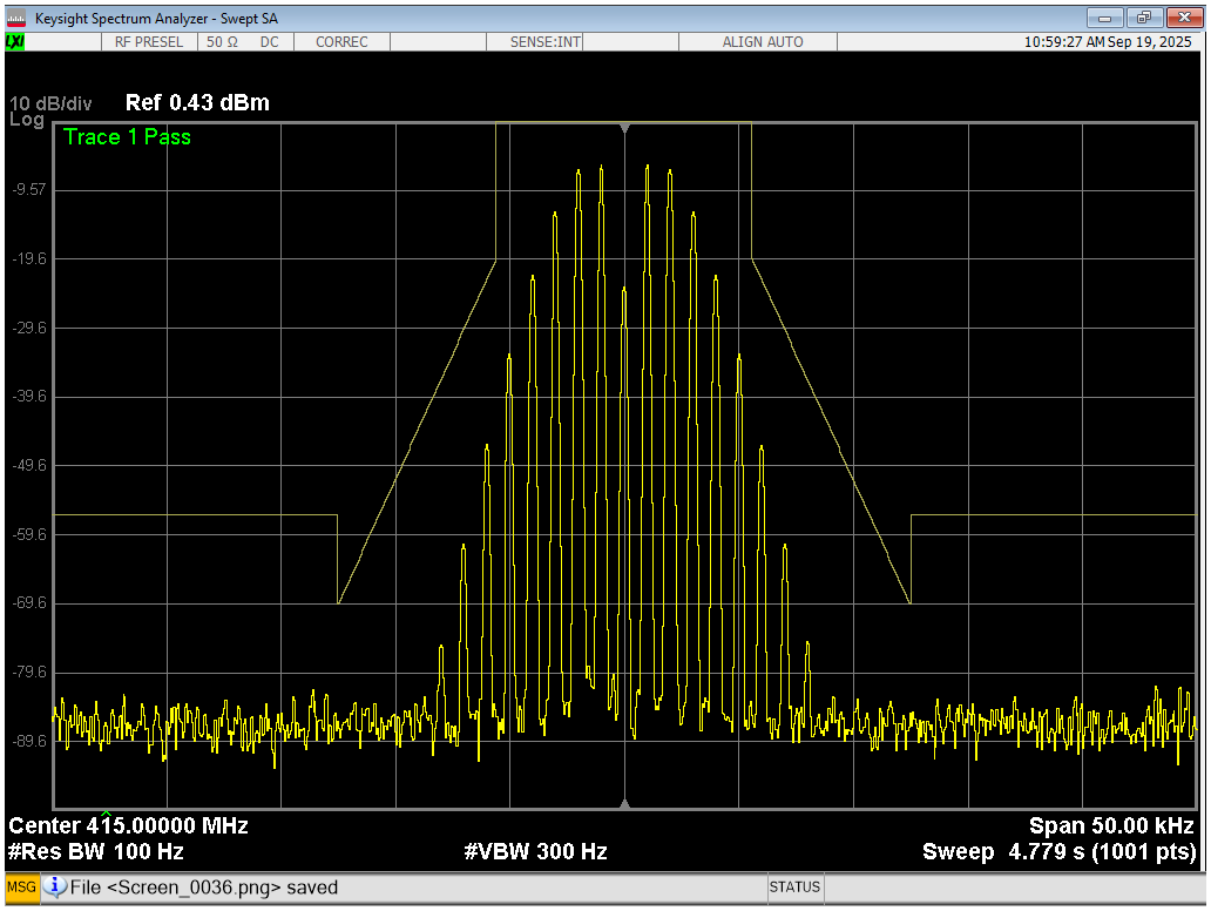


Emission Mask (Uplink)

Output

415 MHz Input ALC +3 dB

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

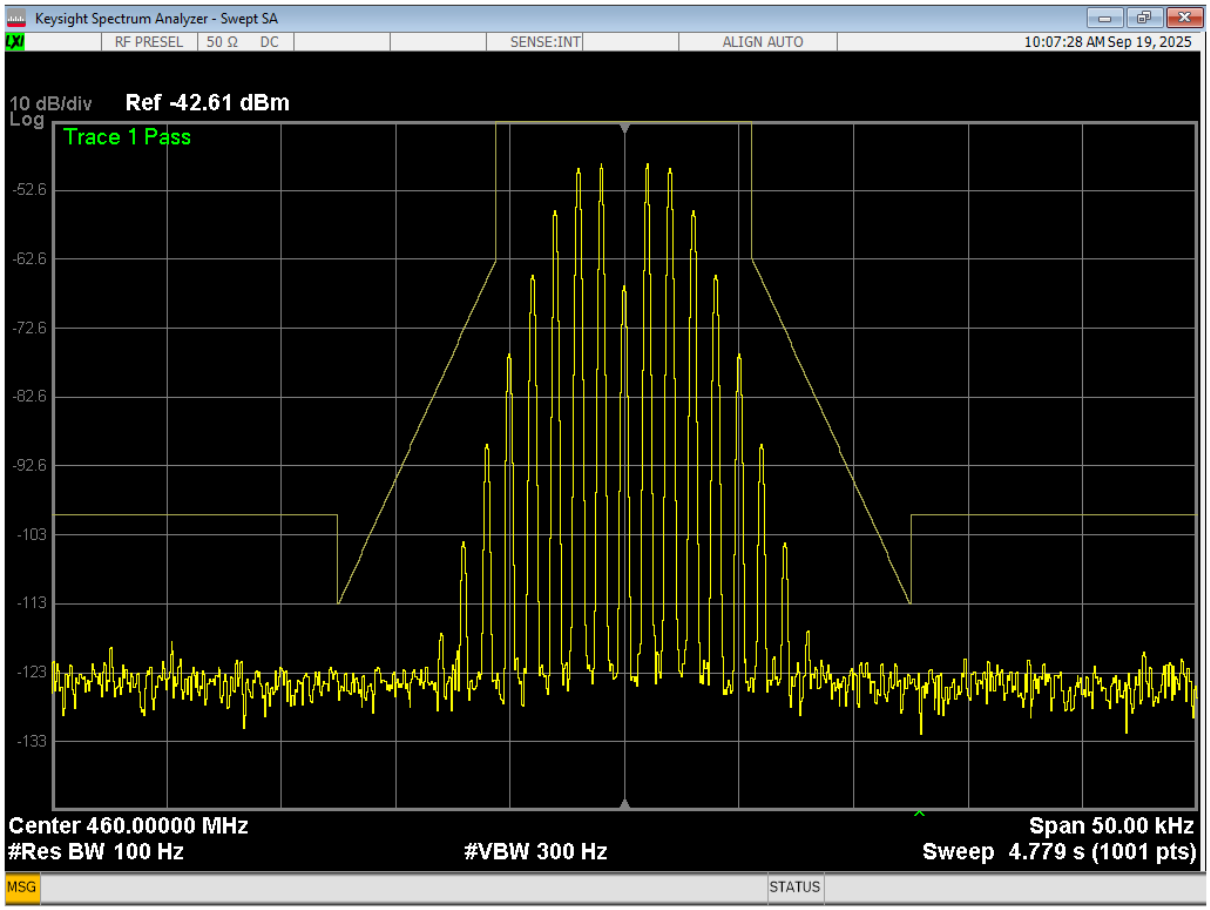


Emission Mask (Uplink)

Input

460 MHz Input ALC -1 dB

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

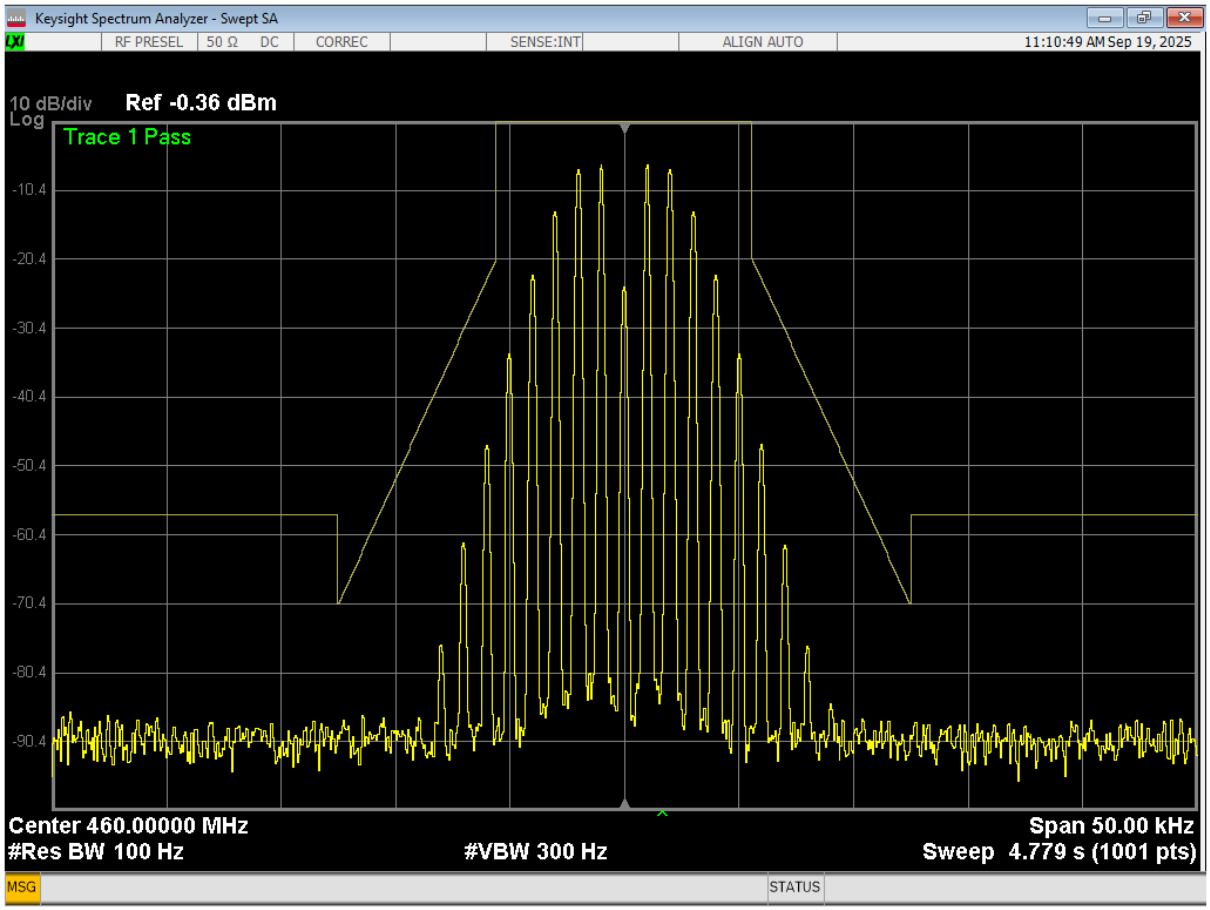


Emission Mask (Uplink)

Output

460 MHz Input ALC -1 dB

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

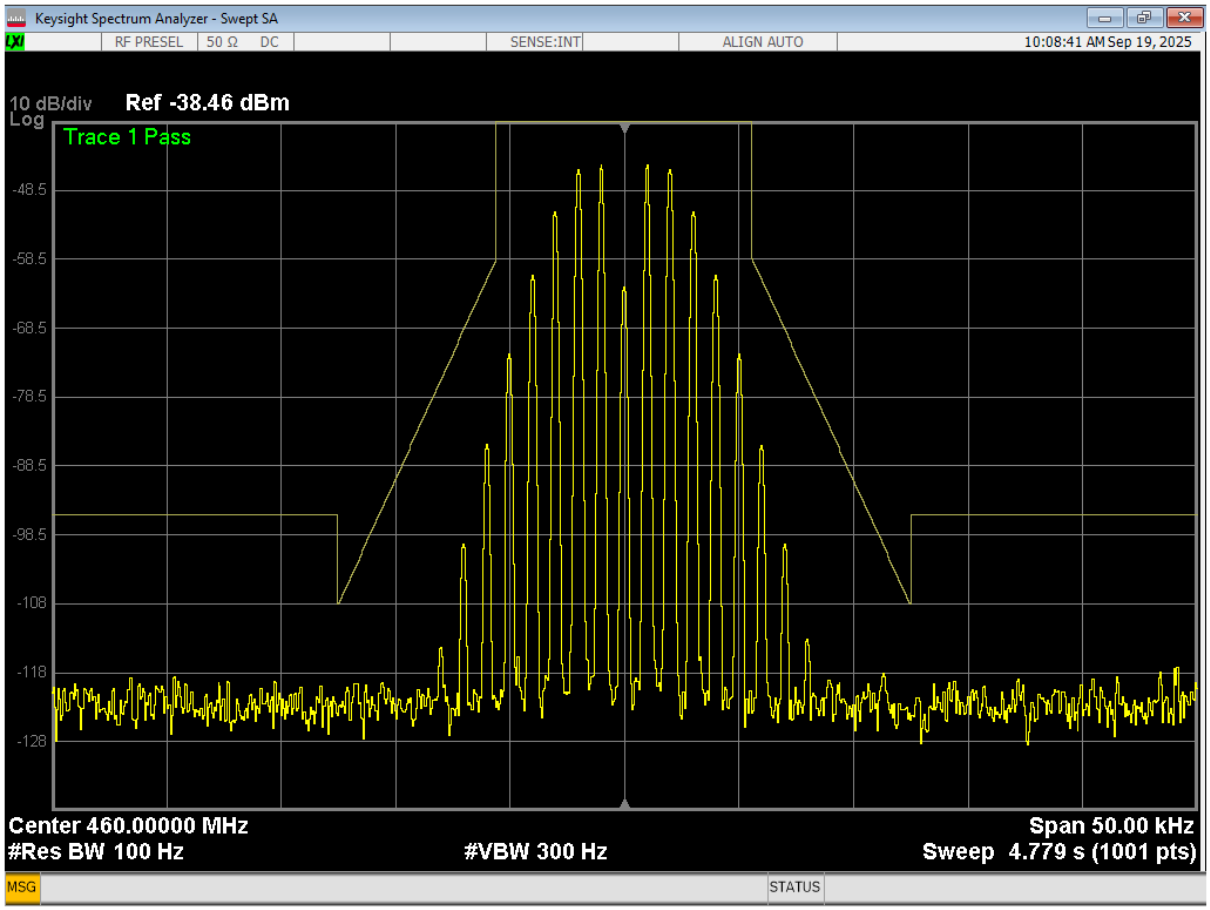


Emission Mask (Uplink)

Input

460 MHz Input ALC +3 dB

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

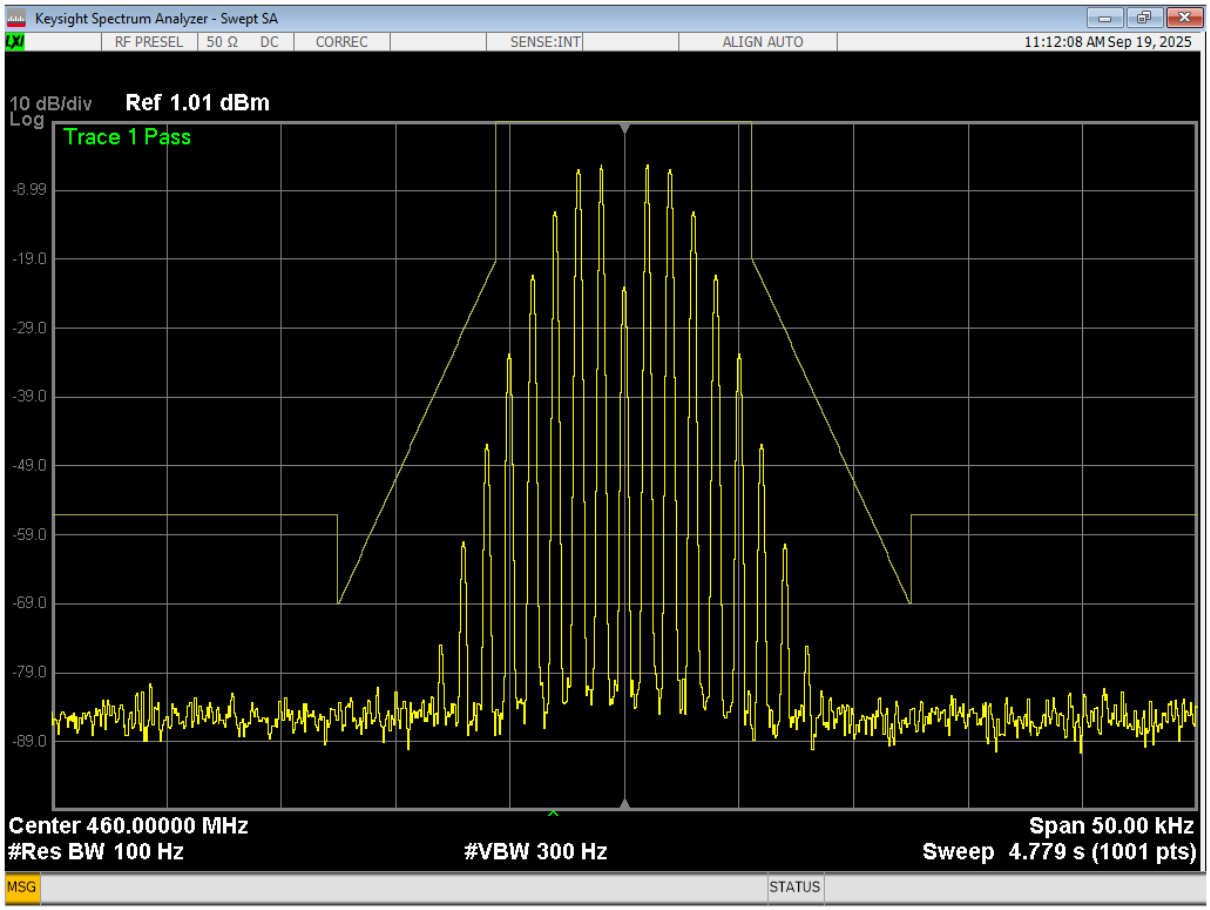


Emission Mask (Uplink)

Output

460 MHz Input ALC +3 dB

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

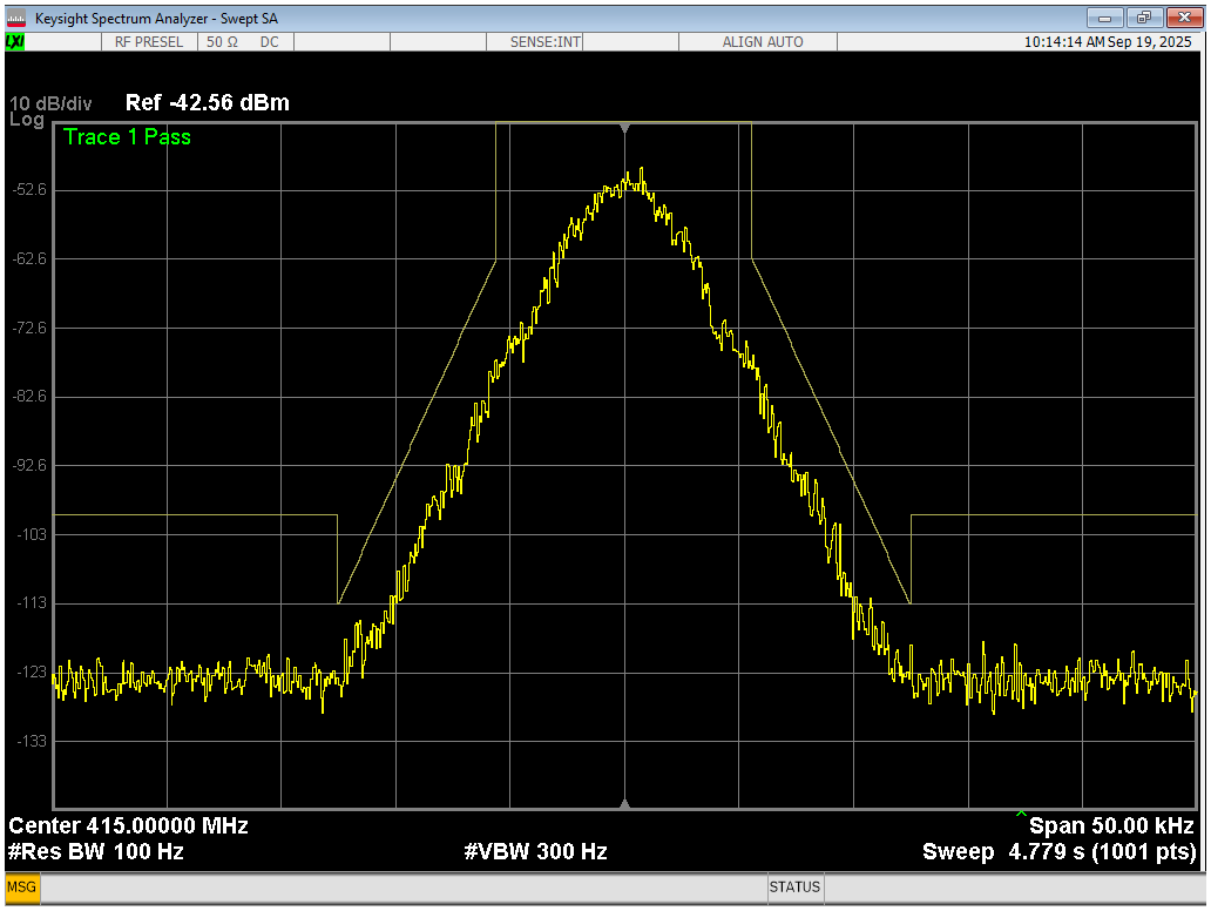


Emission Mask (Downlink)

Input

415 MHz Input ALC -1 dB

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

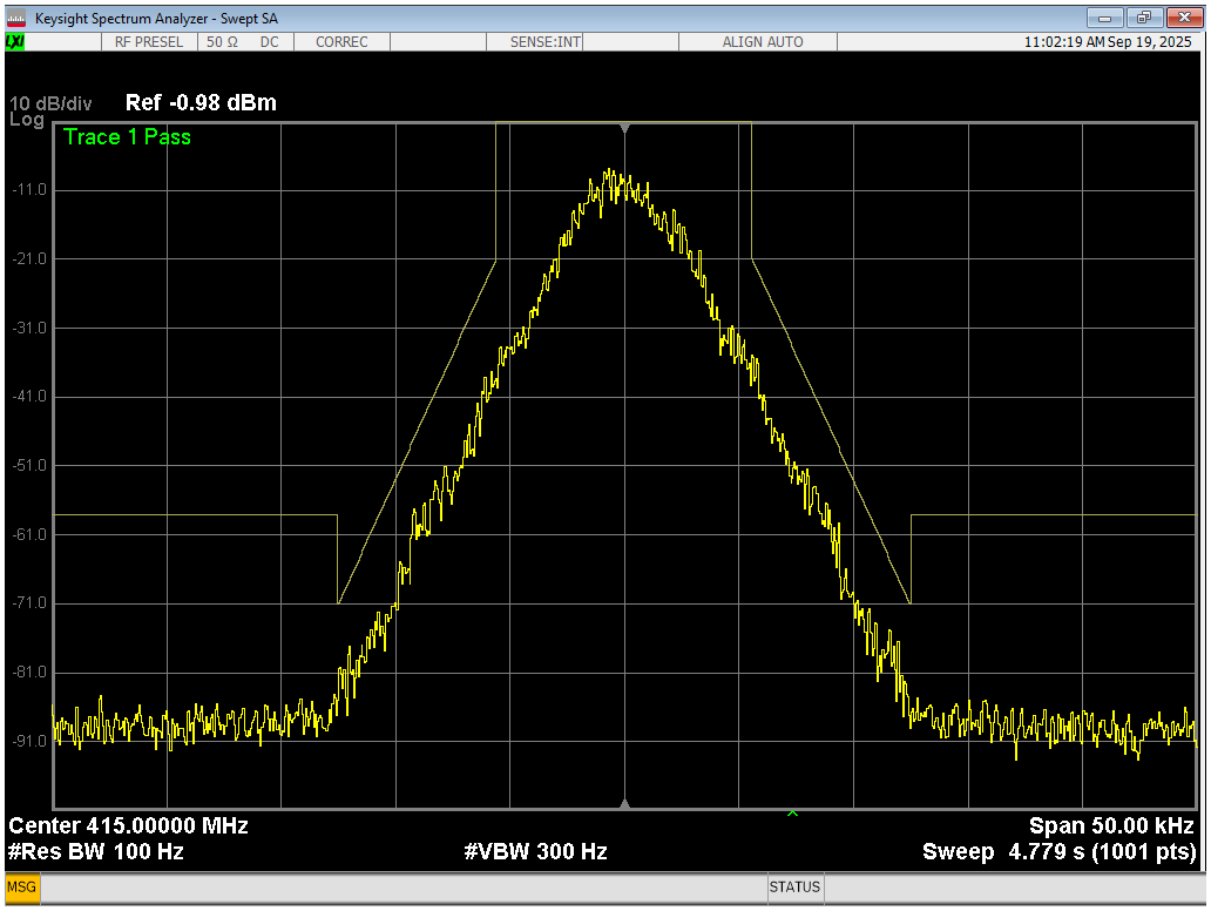


Emission Mask (Uplink)

Output

415 MHz Input ALC -1 dB

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

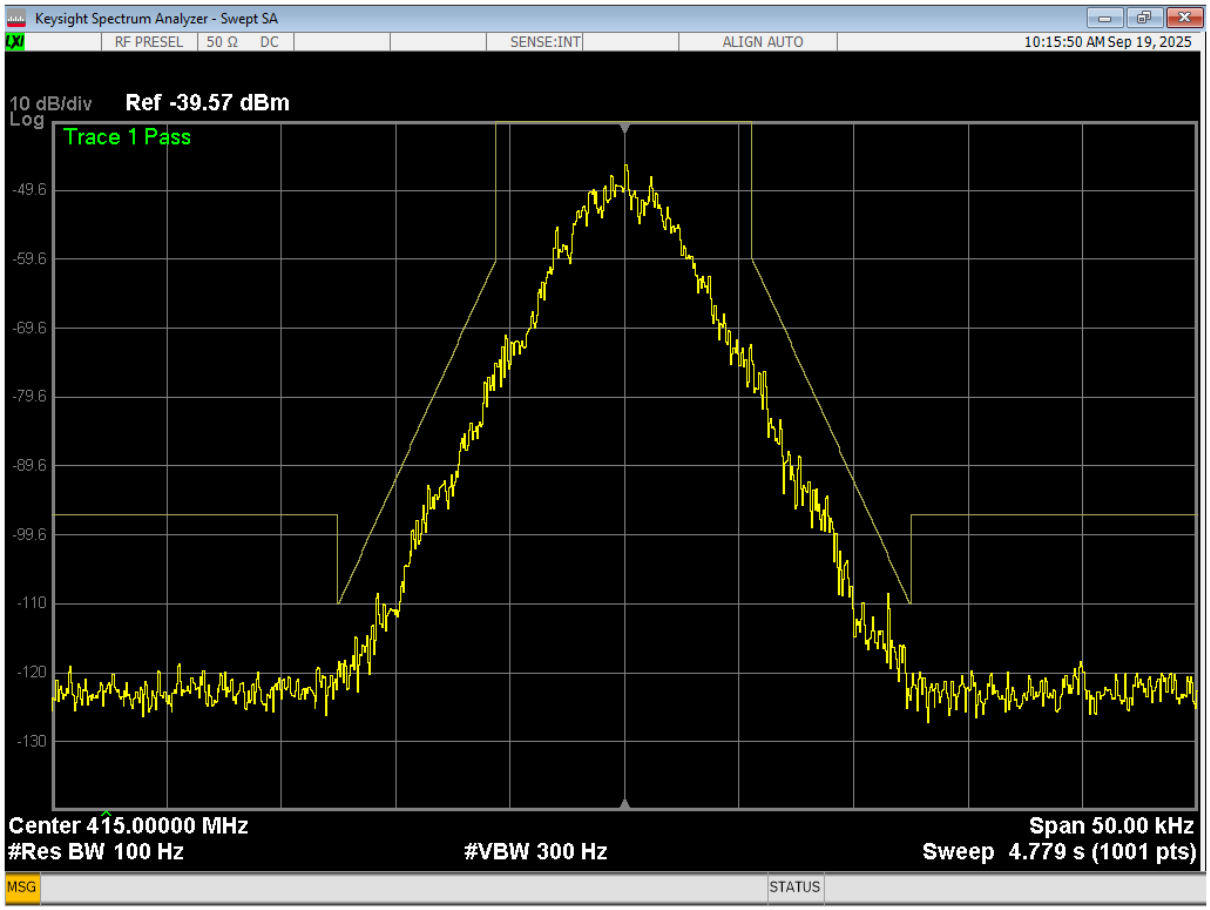


Emission Mask (Uplink)

Input

415 MHz Input ALC +3 dB

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

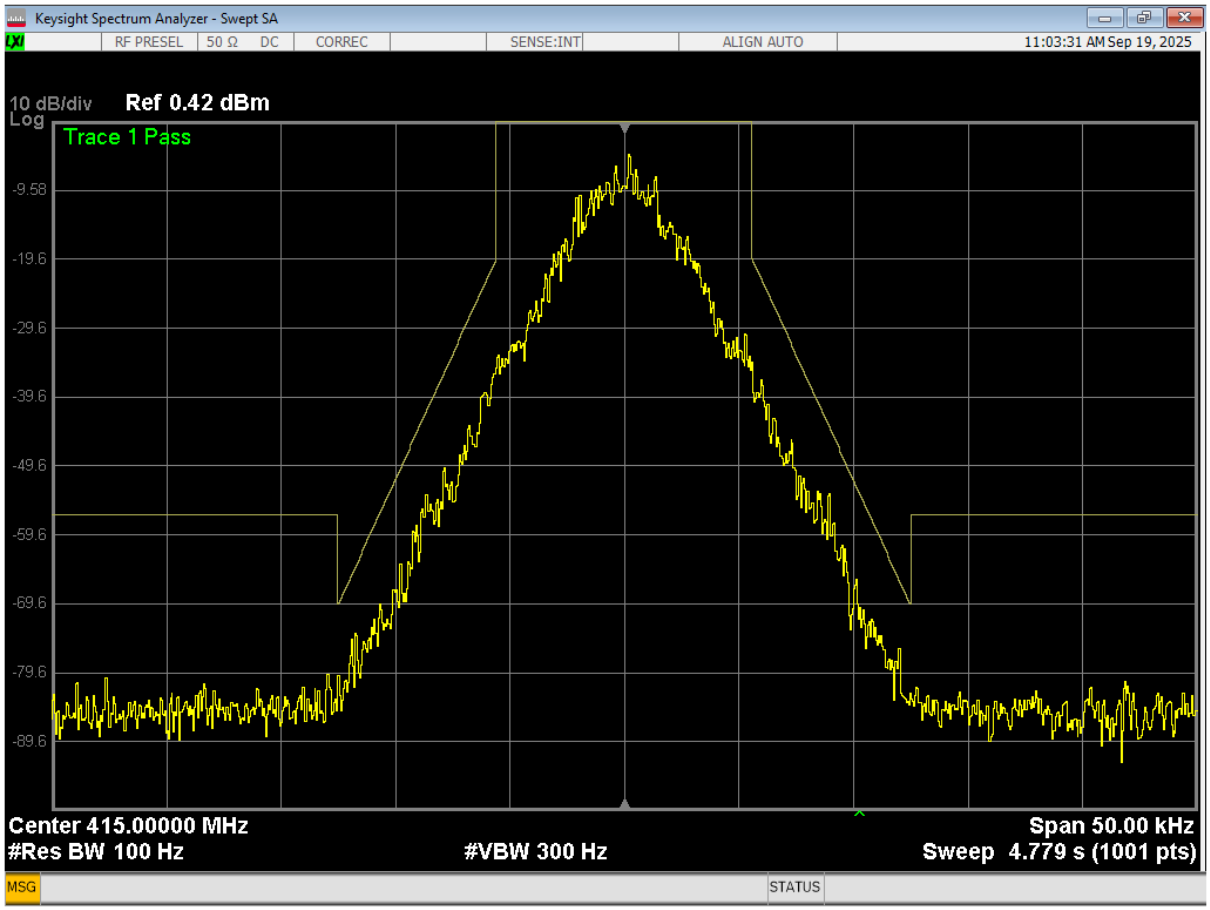


Emission Mask (Uplink)

Output

415 MHz Input ALC +3 dB

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

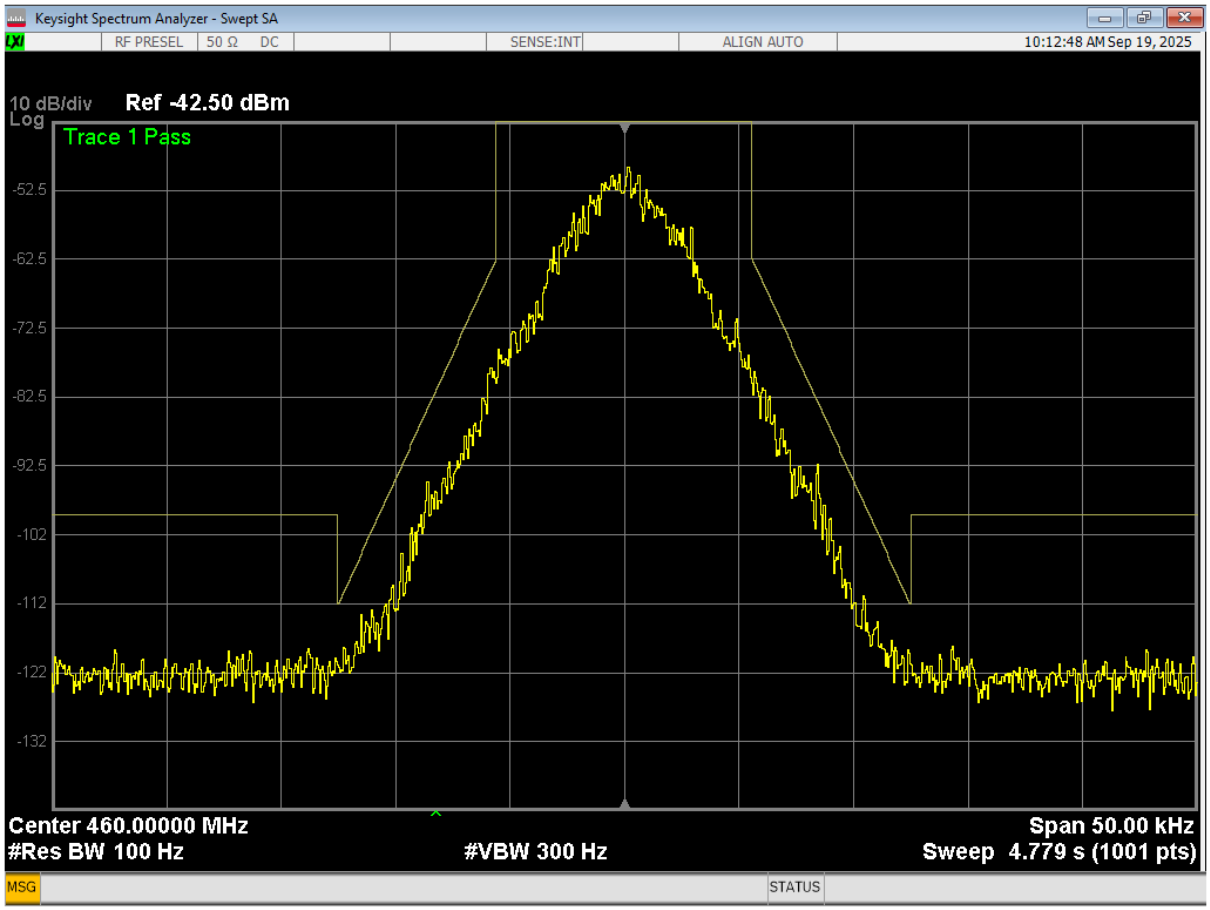


Emission Mask (Uplink)

Input

460 MHz Input ALC -1 dB

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

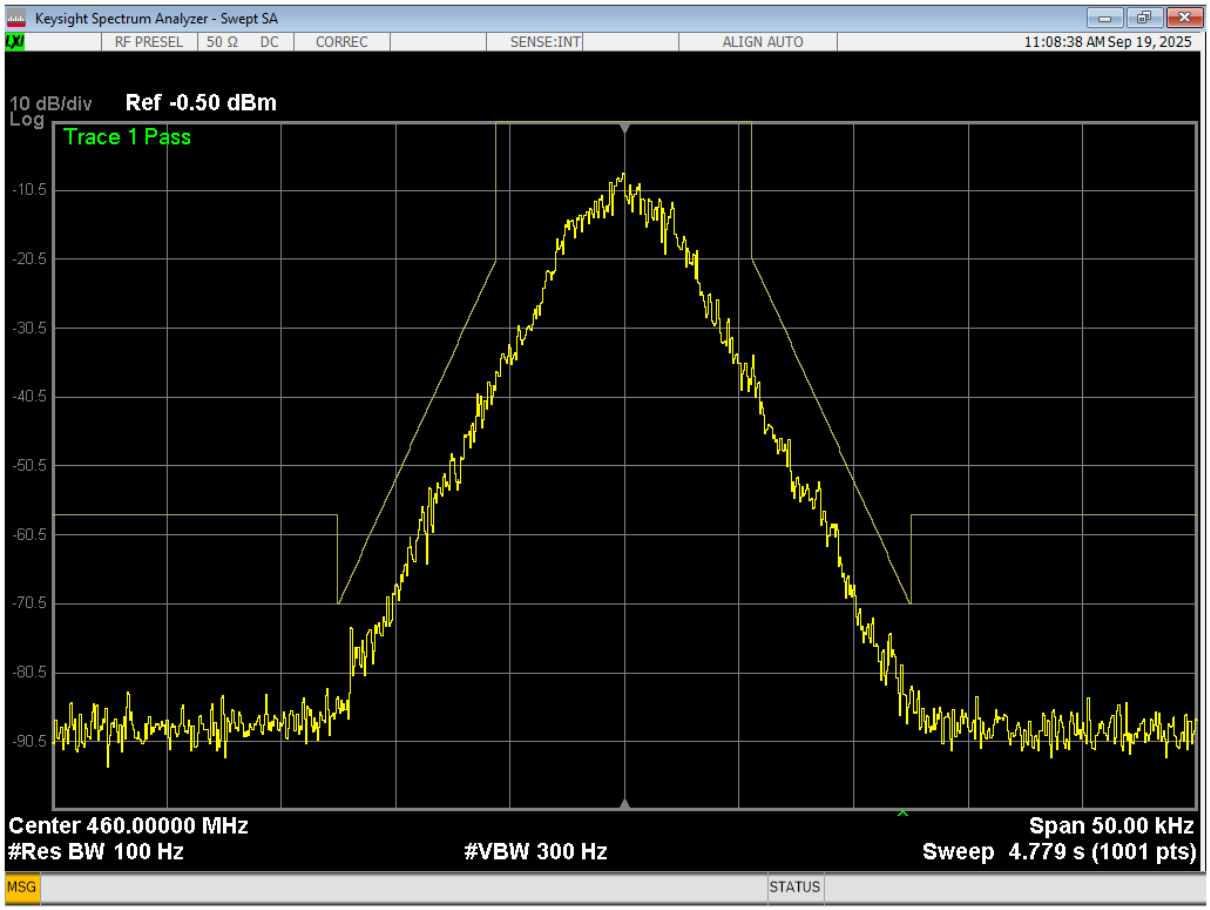


Emission Mask (Uplink)

Output

460 MHz Input ALC -1 dB

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

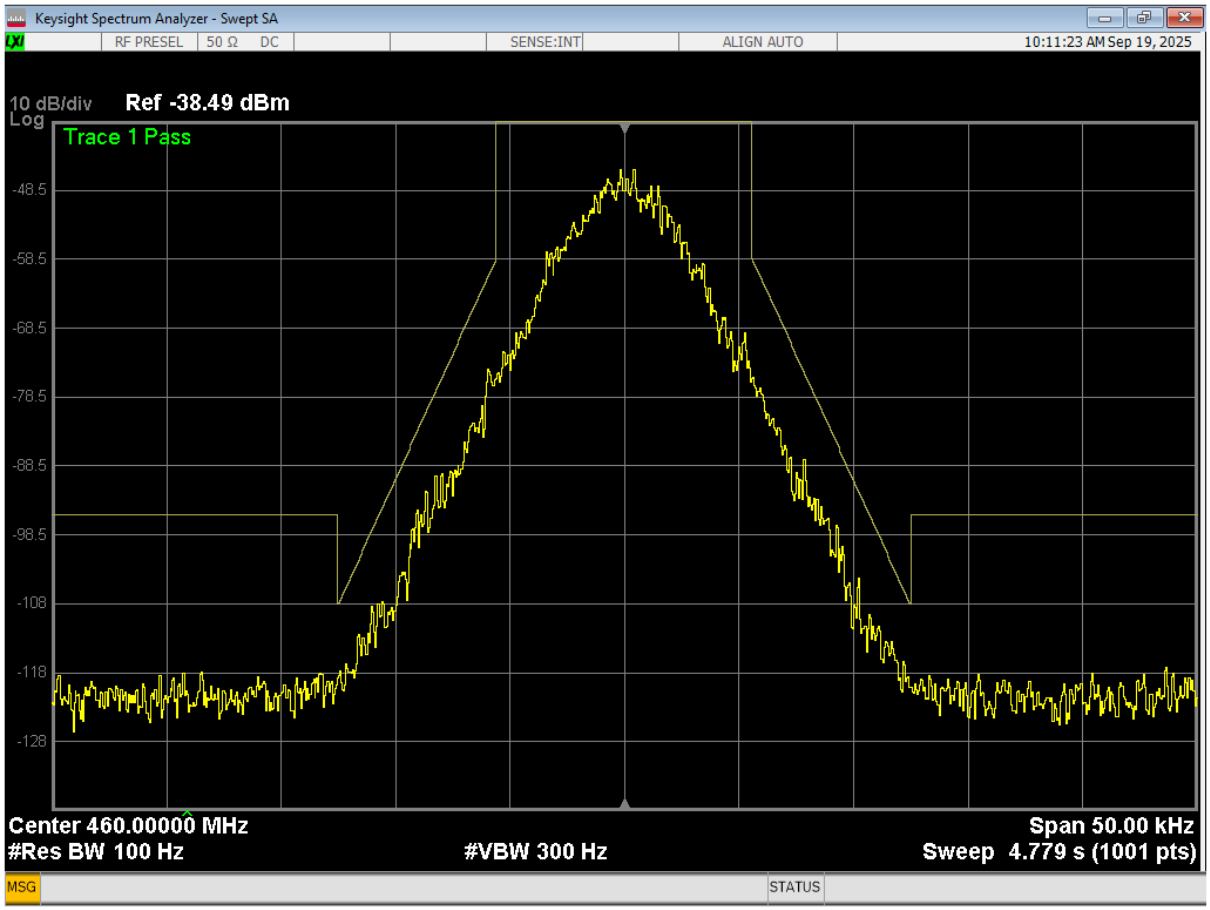


Emission Mask (Uplink)

Input

460 MHz Input ALC +3 dB

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

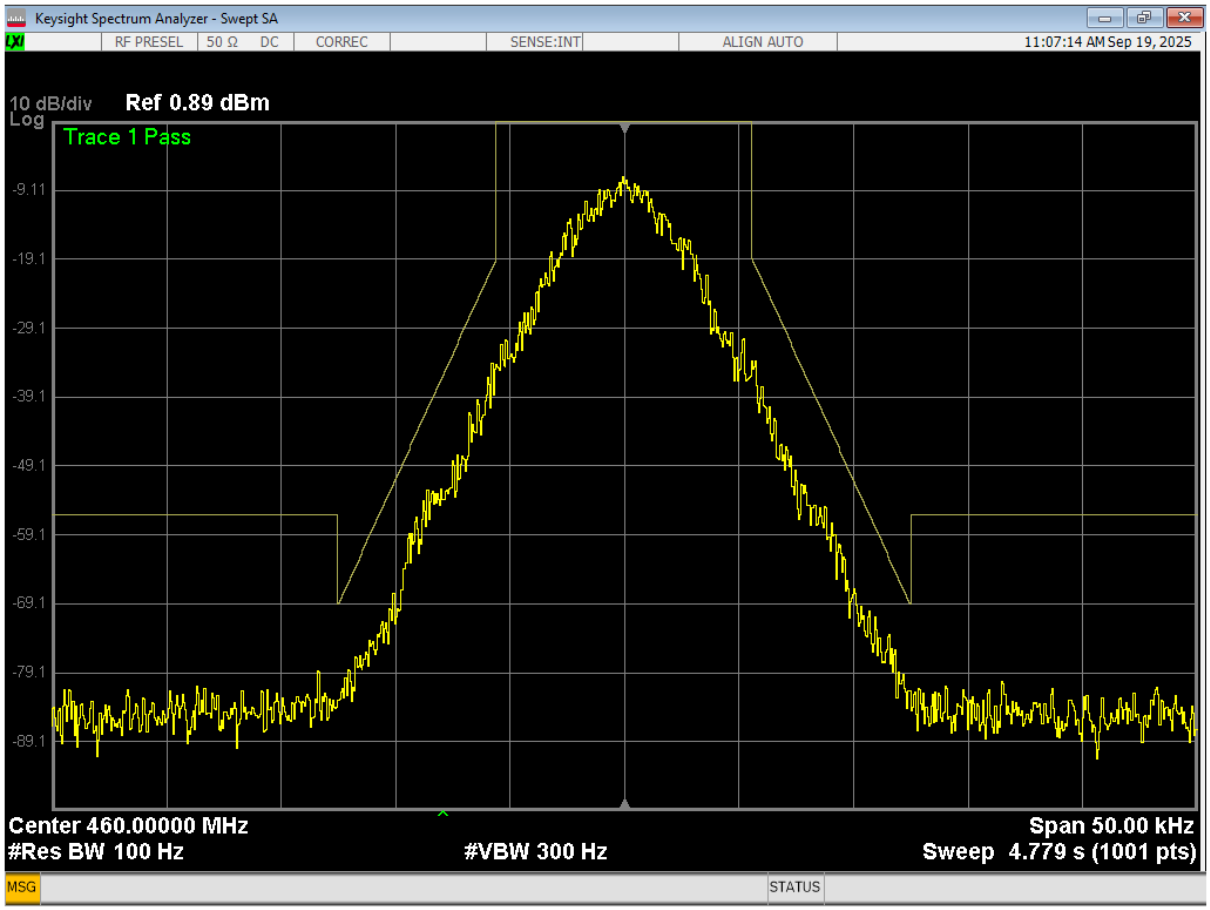


Emission Mask (Uplink)

Output

460 MHz Input ALC +3 dB

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



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.

Testing was carried out in Uplink and Downlink modes with no input attached.

Testing was also carried out in Uplink and Downlink modes with an un modulated carrier input that was -3 dB below the ALC start level.

Measurements were made between 9 kHz and 10 x Fc which equates to 4600 MHz

Part 90.219(e)(3) defines a limit of -13.0 dBm

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.

A Measurement Uncertainty of ± 0.5 dB will apply to these measurements.

Uplink - Frequency: 415.000 MHz

No input applied - No spurious emissions detected exceeding a level of -55 dBm

Input carrier applied - No spurious emissions detected exceeding a level of -55 dBm

Result: Complies

Uplink - Frequency: 460.000 MHz

No input applied - No spurious emissions detected exceeding a level of -55 dBm

Input carrier applied - No spurious emissions detected exceeding a level of -55 dBm

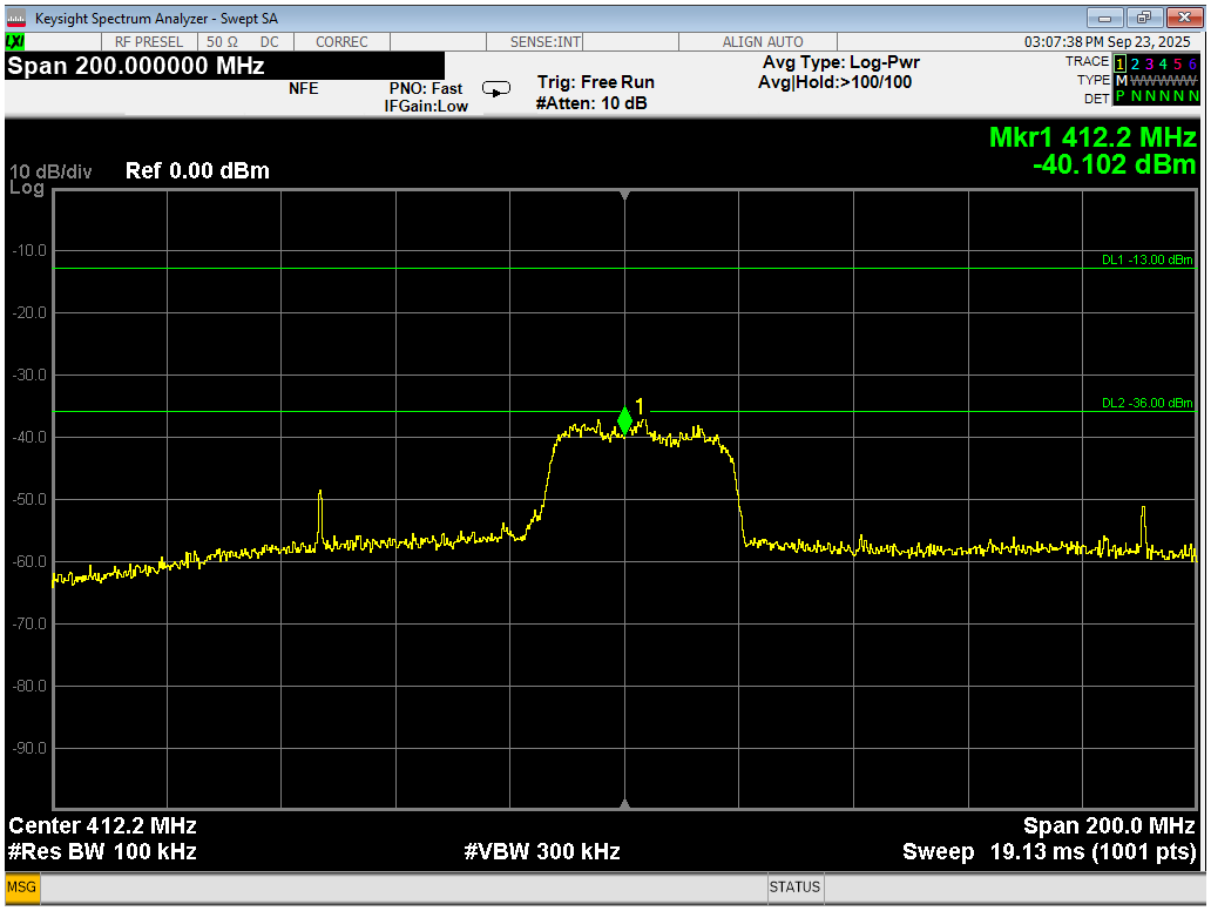
Result: Complies

Downlink - Frequency: 415.000 MHz

No input applied

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)
359.200	-48.4	-13.0
406.550	-35.5	-13.0
405.350	-35.6	-13.0
407.400	-35.7	-13.0
431.000	-43.3	-13.0
503.000	-51.1	-13.0

Downlink plot – No input – 362.5 to 462.5 MHz



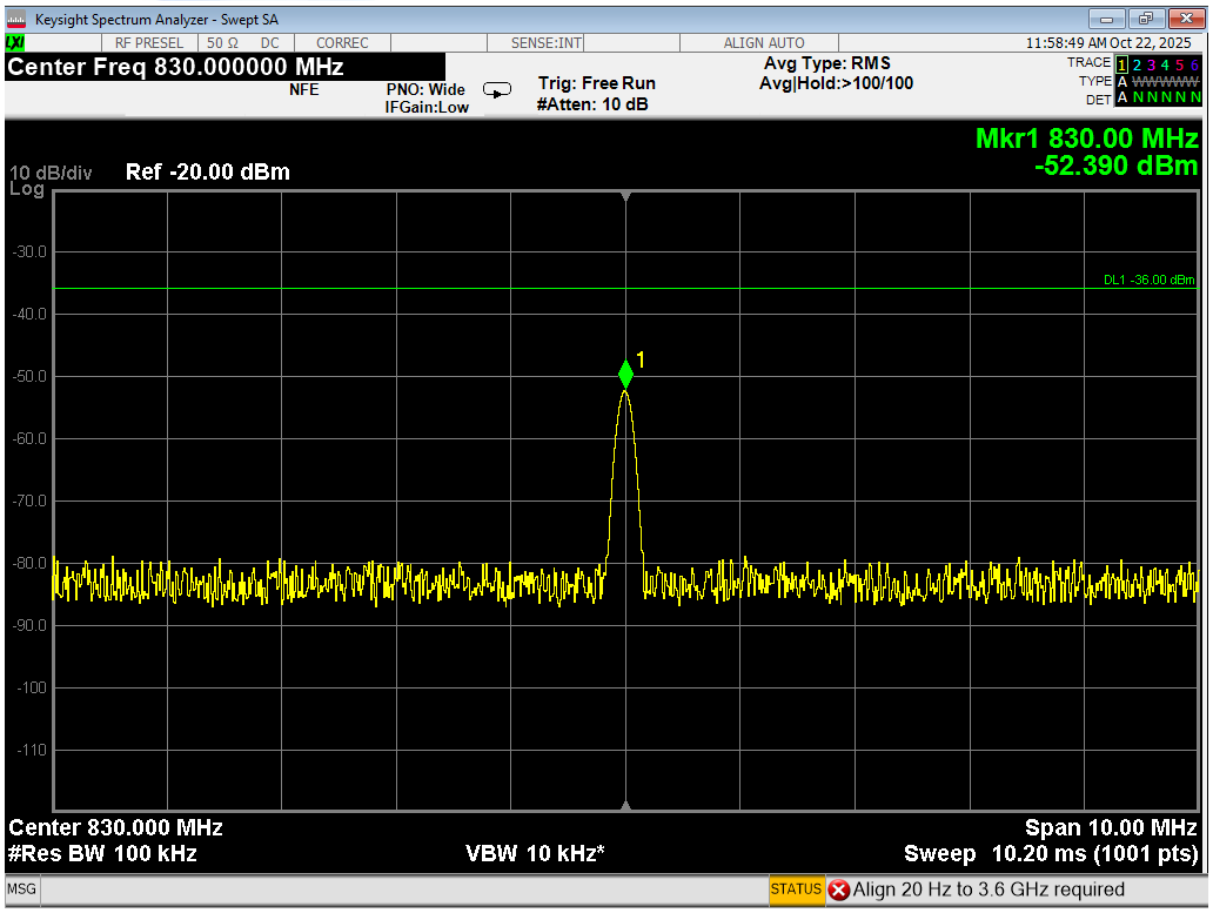
Result: Complies

Downlink - Frequency: 415.000 MHz

Unmodulated carrier input applied

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)
359.200	-48.4	-13.0
503.000	-51.1	-13.0
830.000	-52.4	-13.0
1245.000	Less than -70 dBm	-13.0
1660.000	Less than -70 dBm	-13.0
2075.000	Less than -70 dBm	-13.0
2490.000	Less than -70 dBm	-13.0
2905.000	Less than -70 dBm	-13.0
3320.000	Less than -70 dBm	-13.0
3750.000	Less than -70 dBm	-13.0
4150.000	Less than -70 dBm	-13.0

2nd Harmonic of 415 MHz



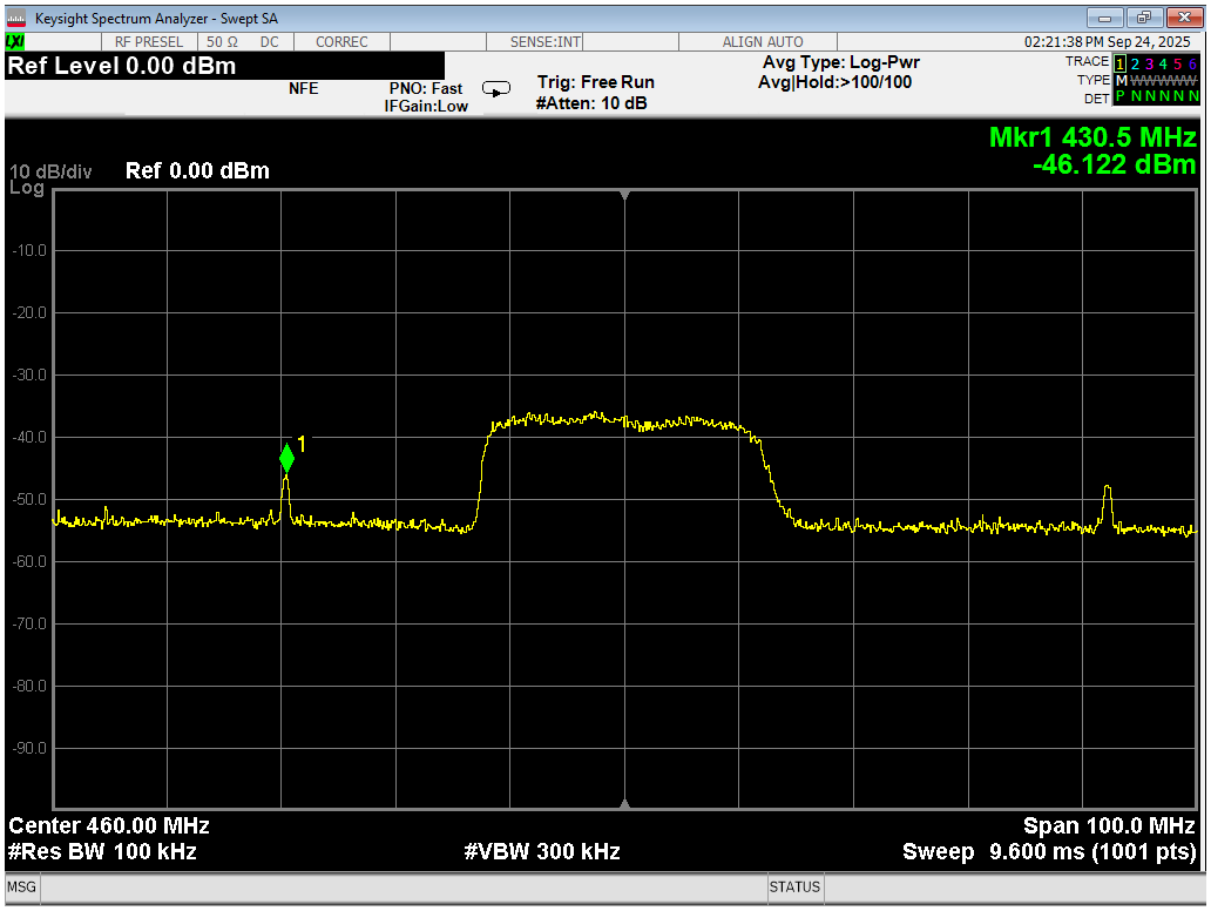
Result Complies

Downlink - Frequency: 460.000 MHz

No input applied

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)
430.500	-46.1	-13.0
456.800	-36.2	-13.0
457.900	-35.3	-13.0
458.650	-35.8	-13.0
467.500	-35.1	-13.0
502.200	-47.7	-13.0

Downlink plot – No input – 410.0 to 510.0 MHz



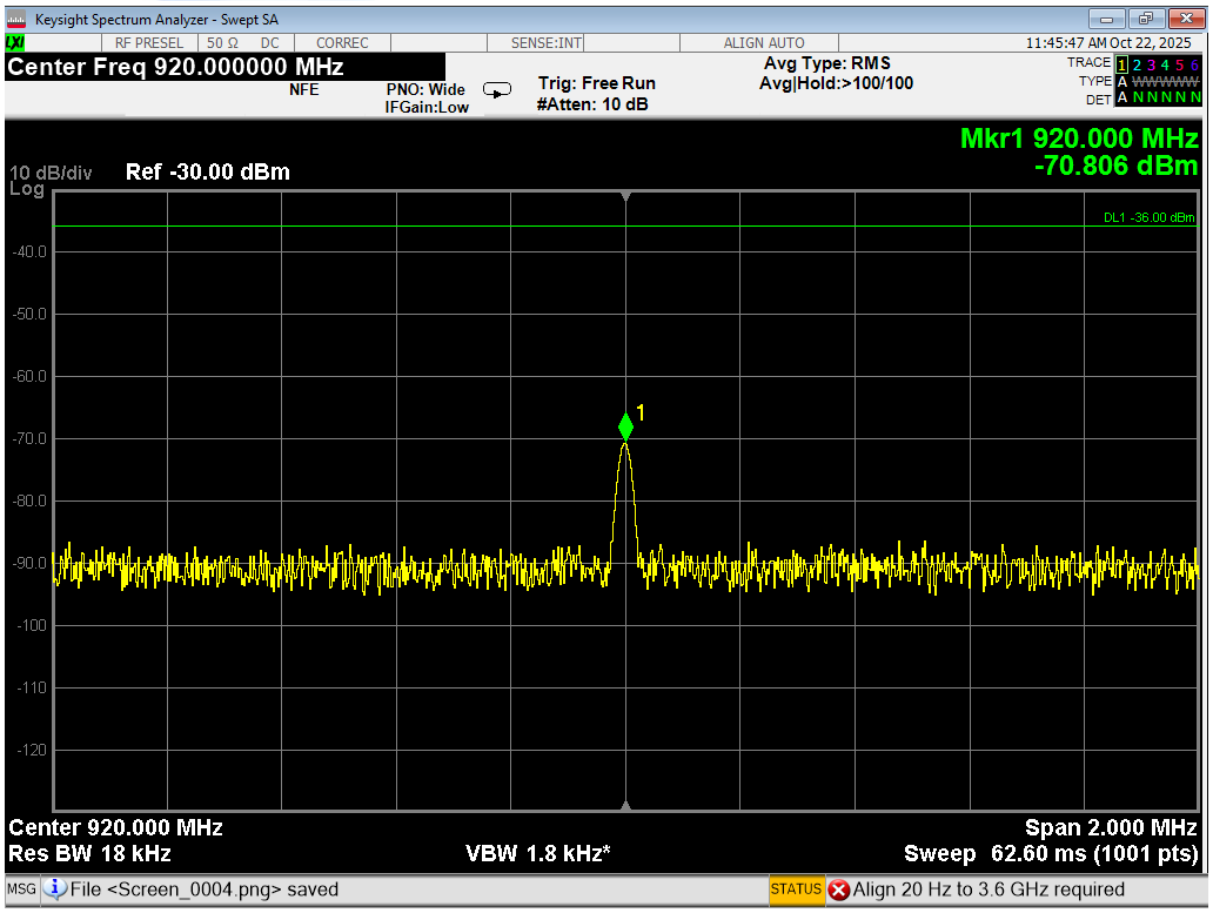
Result: Complies

Downlink - Frequency: 460.000 MHz

Unmodulated carrier input applied

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)
430.600	-48.4	-13.0
502.200	-51.1	-13.0
920.000	-70.8	-13.0
1380.000	Less than -70 dBm	-13.0
1840.000	Less than -70 dBm	-13.0
2300.000	Less than -70 dBm	-13.0
2760.000	Less than -70 dBm	-13.0
3220.000	Less than -70 dBm	-13.0
3680.000	Less than -70 dBm	-13.0
4140.000	Less than -70 dBm	-13.0
4600.000	Less than -70 dBm	-13.0

2nd Harmonic of 460 MHz



Result: Complies

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 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.

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.

Testing was carried out when two signal generators were used to apply an un-modulated signal on the 415 MHz and 460 MHz on each of the Uplink ports at a level of ALC–3 dB.

Each Uplink output port was terminated with approximately 40 dB of attenuation and applied in turn to each of the Downlink input ports on 415 MHz and 460 MHz.

Each Downlink output port was then terminated in at least a 20 watt resistive dummy load.

All testing was carried out with maximum output power settings (+37 dBm).

The software indicated a power level of approximately +34 dBm on each output port.

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.

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.

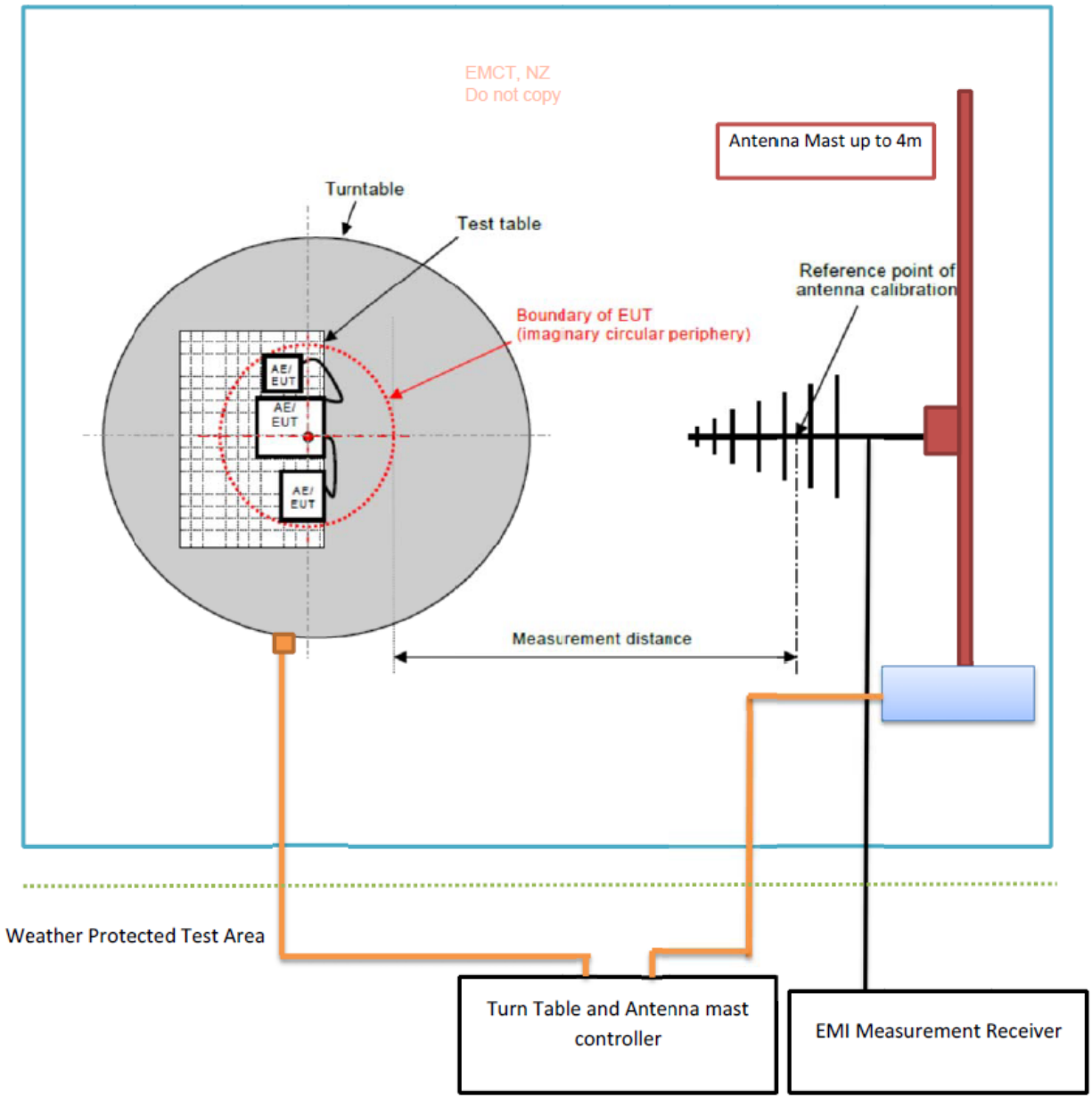
Emissions were measured in both vertical and horizontal antenna polarisations at a distance of 3 metres using a Peak detector with a 120 kHz bandwidth.

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:

General Emissions – Repeater Transmitting Continuously

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
33.240	34.0	-63.4	-20.0	Horizontal	43.4	Pass
35.920	36.3	-61.1	-20.0	Vertical	41.1	Pass
47.080	28.6	-68.8	-20.0	Horizontal	48.8	Pass
55.840	31.8	-65.6	-20.0	Vertical	45.6	Pass
72.320	36.6	-60.8	-20.0	Vertical	40.8	Pass
147.000	35.5	-61.9	-20.0	Horizontal	41.9	Pass
199.320	27.8	-69.6	-20.0	Vertical	49.6	Pass
200.000	31.7	-65.7	-20.0	Vertical	45.7	Pass
214.760	27.7	-69.7	-20.0	Vertical	49.7	Pass
415.000	46.8	-50.6	-20.0	Horizontal		Transmitter
435.000	39.1	-58.3	-20.0	Horizontal	38.3	Pass
445.000	37.8	-59.6	-20.0	Horizontal	39.6	Pass
460.000	53.7	-43.7	-20.0	Horizontal		Transmitter
480.000	35.4	-62.0	-20.0	Horizontal	42.0	Pass
485.000	35.6	-61.8	-20.0	Horizontal	41.8	Pass
495.000	34.5	-62.9	-20.0	Horizontal	42.9	Pass

Uplink / Downlink: 415.000 MHz **Power:** +0 dBm / +37.0 dBm

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
830.000	33.9	-63.5	-20.0	Vertical	43.5	Pass
830.000	40.9	-56.5	-20.0	Horizontal	36.5	Pass
1245.000	43.9	-53.5	-20.0	Vertical	33.5	Pass
1245.000	43.5	-53.9	-20.0	Horizontal	33.9	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

Transmitter spurious emissions results:

Uplink / Downlink: 460.000 MHz **Power:** +0 dBm / +37.0 dBm

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
920.000	36.6	-60.8	-20.0	Vertical	40.8	Pass
920.000	37.5	-59.9	-20.0	Horizontal	39.9	Pass
1380.000	49.9	-47.5	-20.0	Vertical	27.5	Pass
1380.000	45.3	-52.1	-20.0	Horizontal	32.1	Pass
1840.000	-	-	-20.0	Vertical	-	Pass
1840.000	-	-	-20.0	Horizontal	-	Pass
2300.000	-	-	-20.0	Vertical	-	Pass
2300.000	-	-	-20.0	Horizontal	-	Pass
2760.000	-	-	-20.0	Vertical	-	Pass
2760.000	-	-	-20.0	Horizontal	-	Pass
3220.000	-	-	-20.0	Vertical	-	Pass
3220.000	-	-	-20.0	Horizontal	-	Pass
3680.000	-	-	-20.0	Vertical	-	Pass
3680.000	-	-	-20.0	Horizontal	-	Pass
4140.000	-	-	-20.0	Vertical	-	Pass
4140.000	-	-	-20.0	Horizontal	-	Pass
4600.000	-	-	-20.0	Vertical	-	Pass
4600.000	-	-	-20.0	Horizontal	-	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
- 450.0 – 470.0 MHz which gives an operating range of 20 MHz

The following setting were applied when operating in Uplink and Downlink modes

Repeater FCC range: 406.1 – 430.0 MHz
Signal Generator Range: 330 – 500 MHz
Signal Generator Settings: 50 kHz steps. Dwell Time: 100 ms
Input level: ALC start level -3 dB

Repeater FCC range: 450.0 – 470.0 MHz
Signal Generator Range: 400 – 520 MHz
Signal Generator Settings: 50 kHz steps. Dwell Time: 100 ms
Input level: ALC start level -3 dB

Plots of these observations are attached.

The FCC does not specify a spurious emission limit.

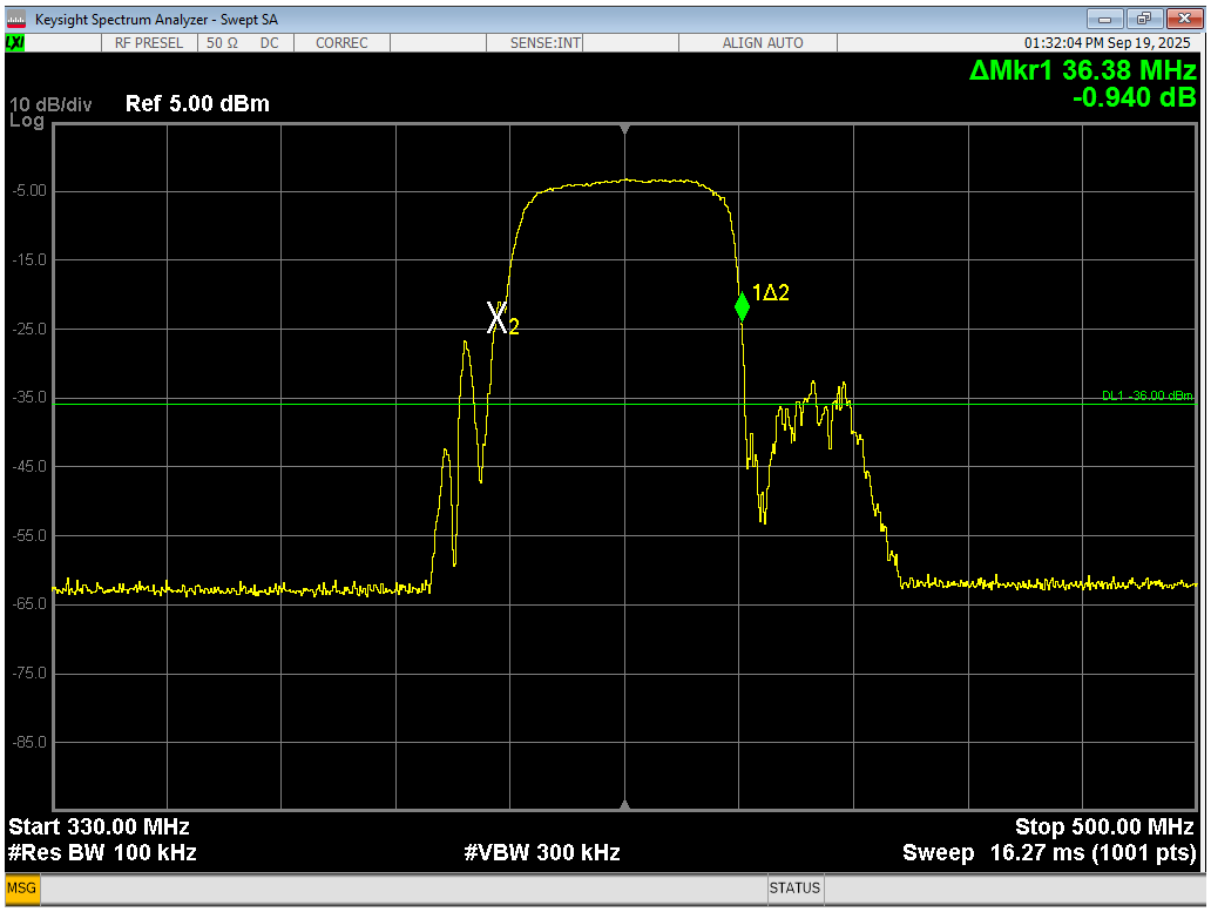
The KDB only requires that the observed -20 dBc operation frequency range is reported

Centre Frequency (MHz)	Operating Mode	-20 dB Operating Range (MHz)
415.0	Up Link	36.880
460.0	Up Link	27.000
415.0	Down Link	36.890
460.0	Down Link	26.880

Result: Complies

Uplink

406.1 – 430.0 MHz band of operation

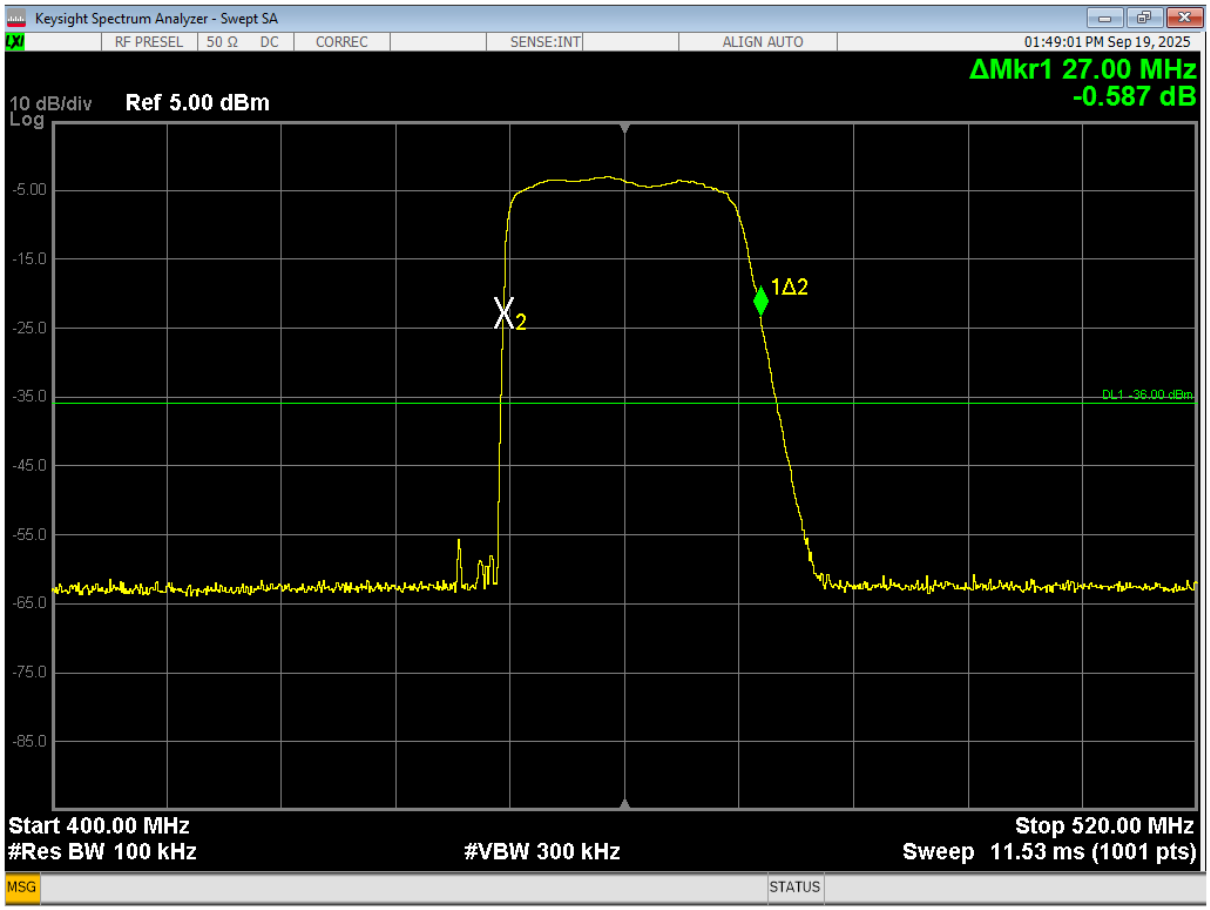


The following emissions were observed

Frequency (MHz)	Level (dBm)
391.370	-26.7
443.090	-32.5

Uplink

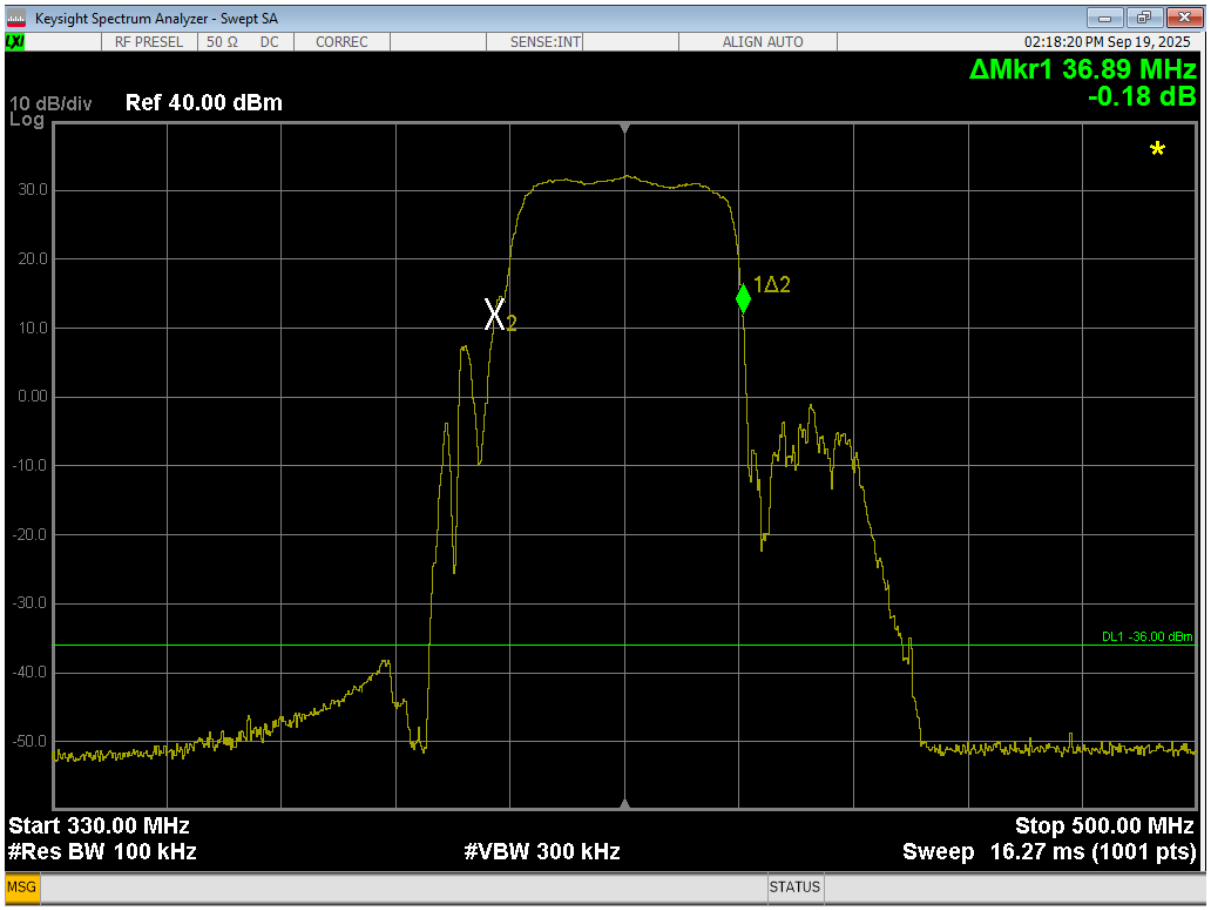
450.0 – 470.0 MHz band of operation



No significant emissions observed

Downlink

406.1 – 430.0 MHz band of operation

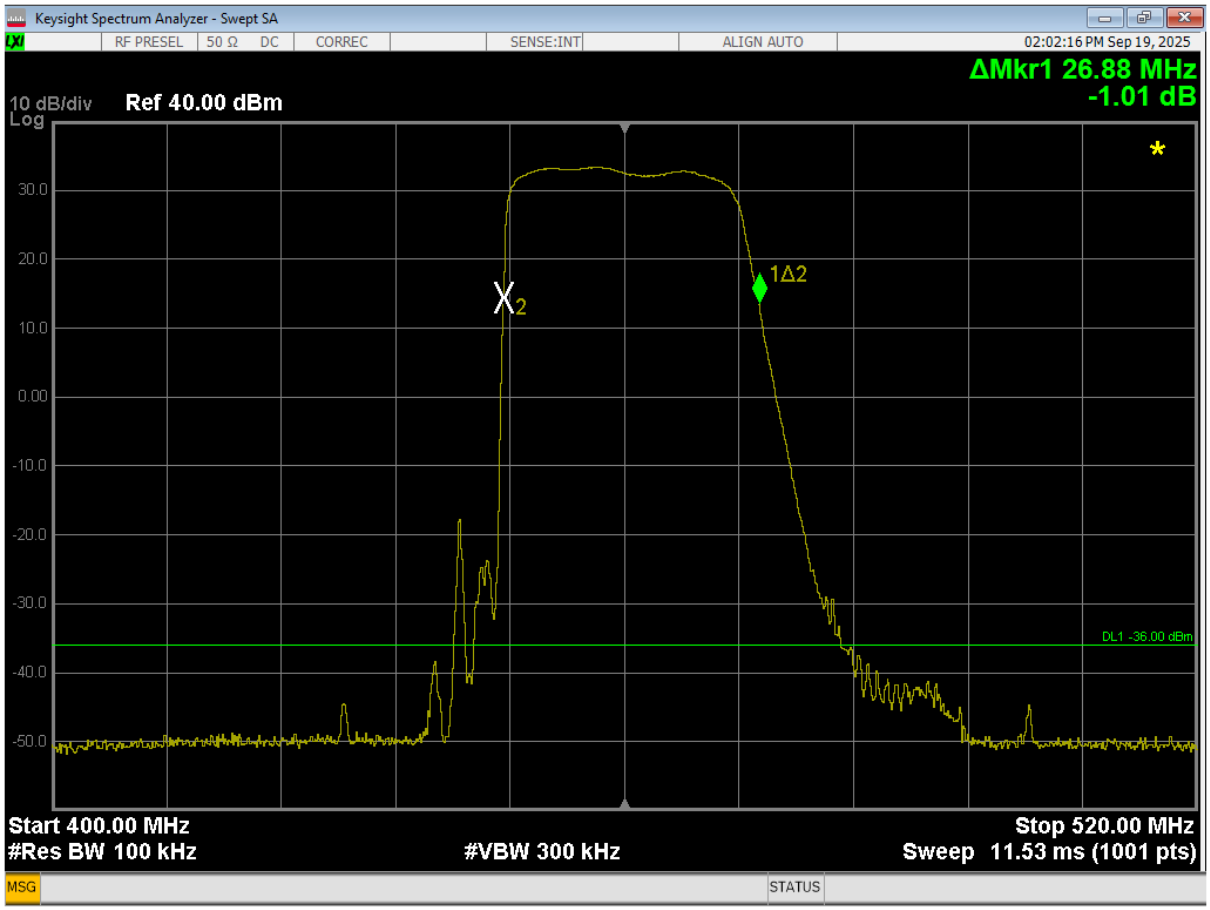


The following emissions were observed

Frequency (MHz)	Level (dBm)
388.650	-3.7
391.030	+7.4
442.710	-1.1

Downlink

450.0 – 470.0 MHz band of operation



The following emissions were observed

Frequency (MHz)	Level (dBm)
442.840	-17.7

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 apart, were applied to the input of the amplifier at a level in order that two +25 dBm downlink output signals were observed or two -12.0 dBm uplink output signals were observed.

A second test was carried out with the input level being increased by 10 dB in both the downlink mode and the uplink mode.

The following intermodulation products were observed.

A limit of -13 dBm has been applied as per Section 90.219(e)(3)

Intermodulation Characteristics

Uplink Input: 414.900 MHz and 415.100 MHz

Output: -12 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
415.300	Nil observed	-13.0
414.700	Nil observed	-13.0
830.000	Nil observed	-13.0

No plot made

Result: Complies

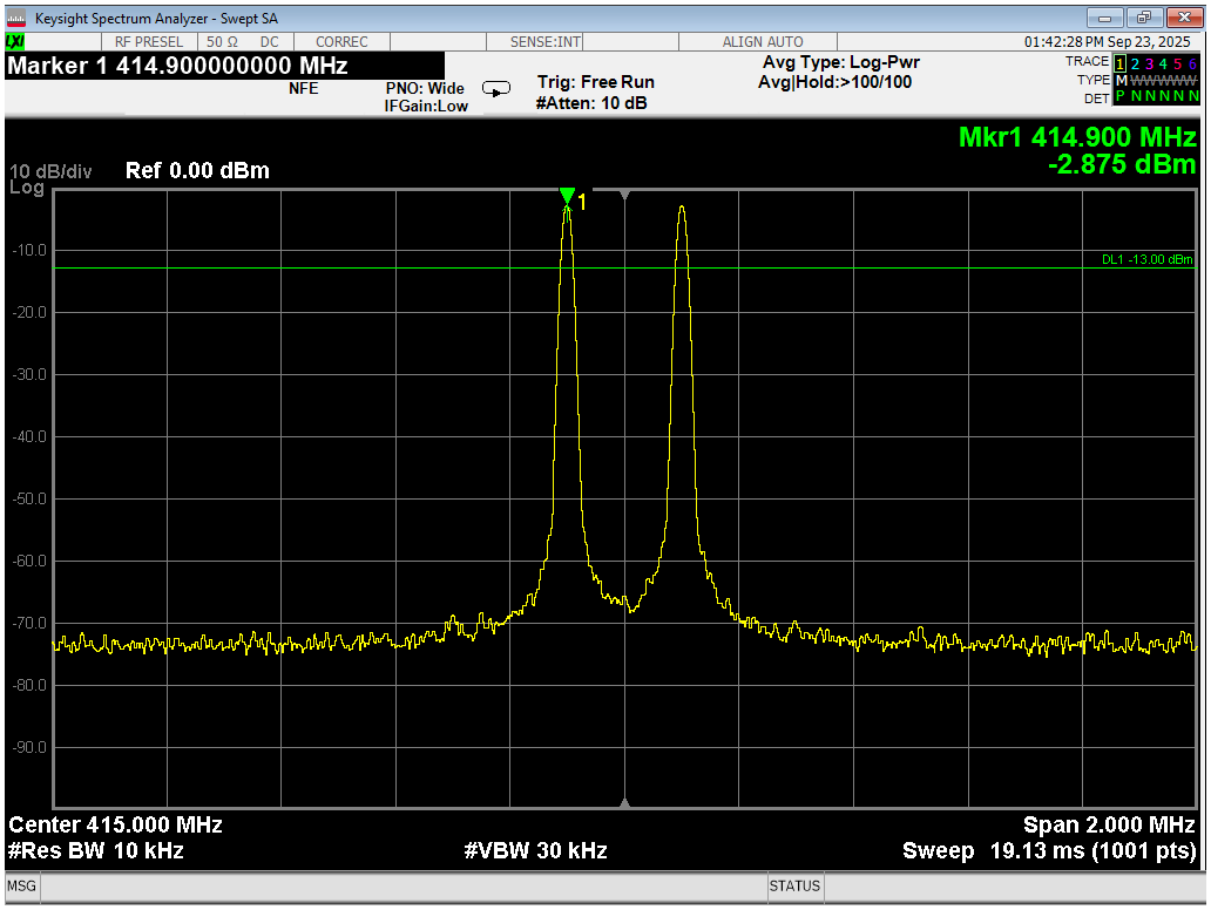
Intermodulation Characteristics

Uplink Input: 414.900 MHz and 415.100 MHz

Output: -2 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
414.700	Nil observed	-13.0
415.300	Nil observed	-13.0
415.500	Nil observed	-13.0
414.500	Nil observed	-13.0
830.000	Nil observed	-13.0
1244.900	Nil observed	-13.0
1245.100	Nil observed	-13.0

Downlink Plot centred on 415.00 MHz



Result: Complies

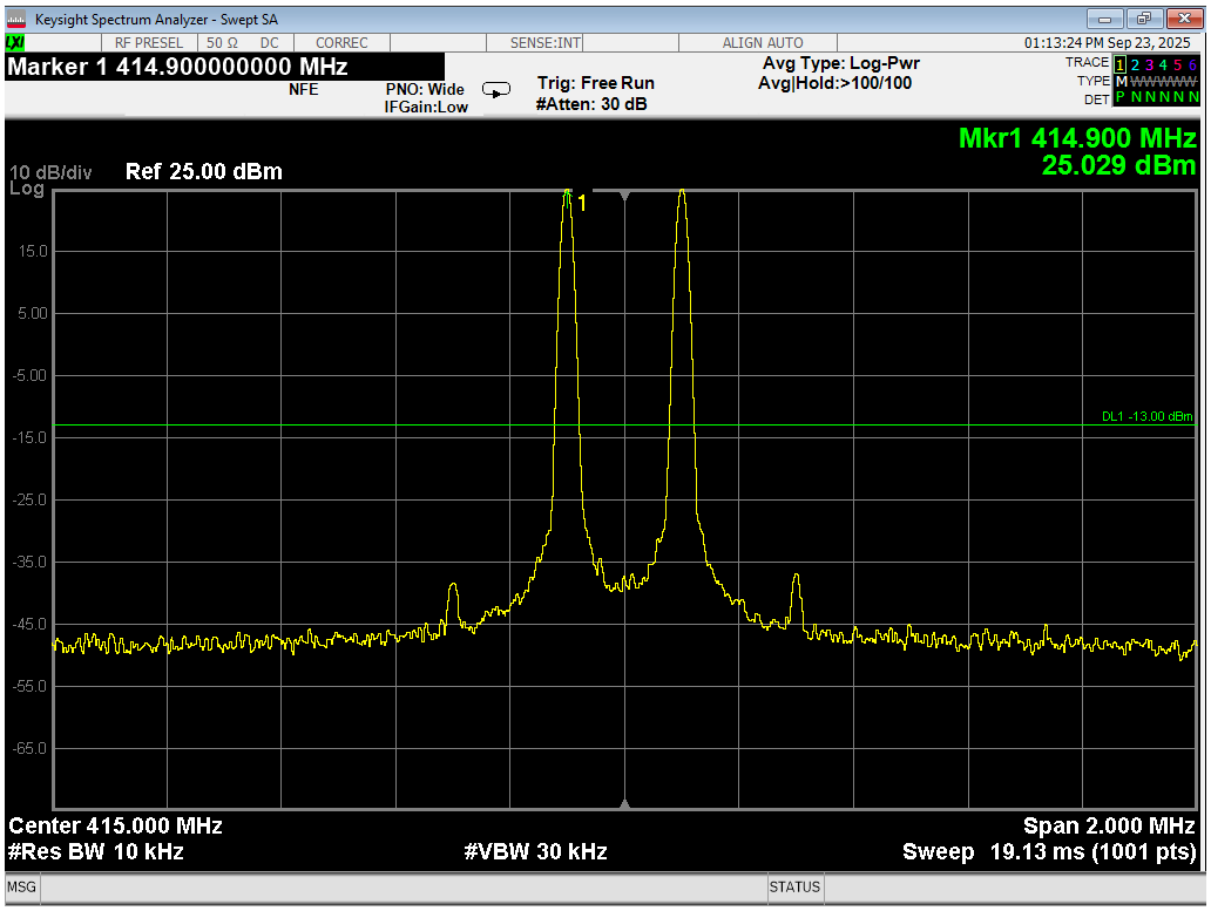
Intermodulation Characteristics

Downlink Input: 414.900 MHz and 415.100 MHz

Output: +25 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
415.300	-36.7	-13.0
414.700	-37.5	-13.0
830.000	-46.5	-13.0

Downlink Plot centred on 415.00 MHz



Result: Complies

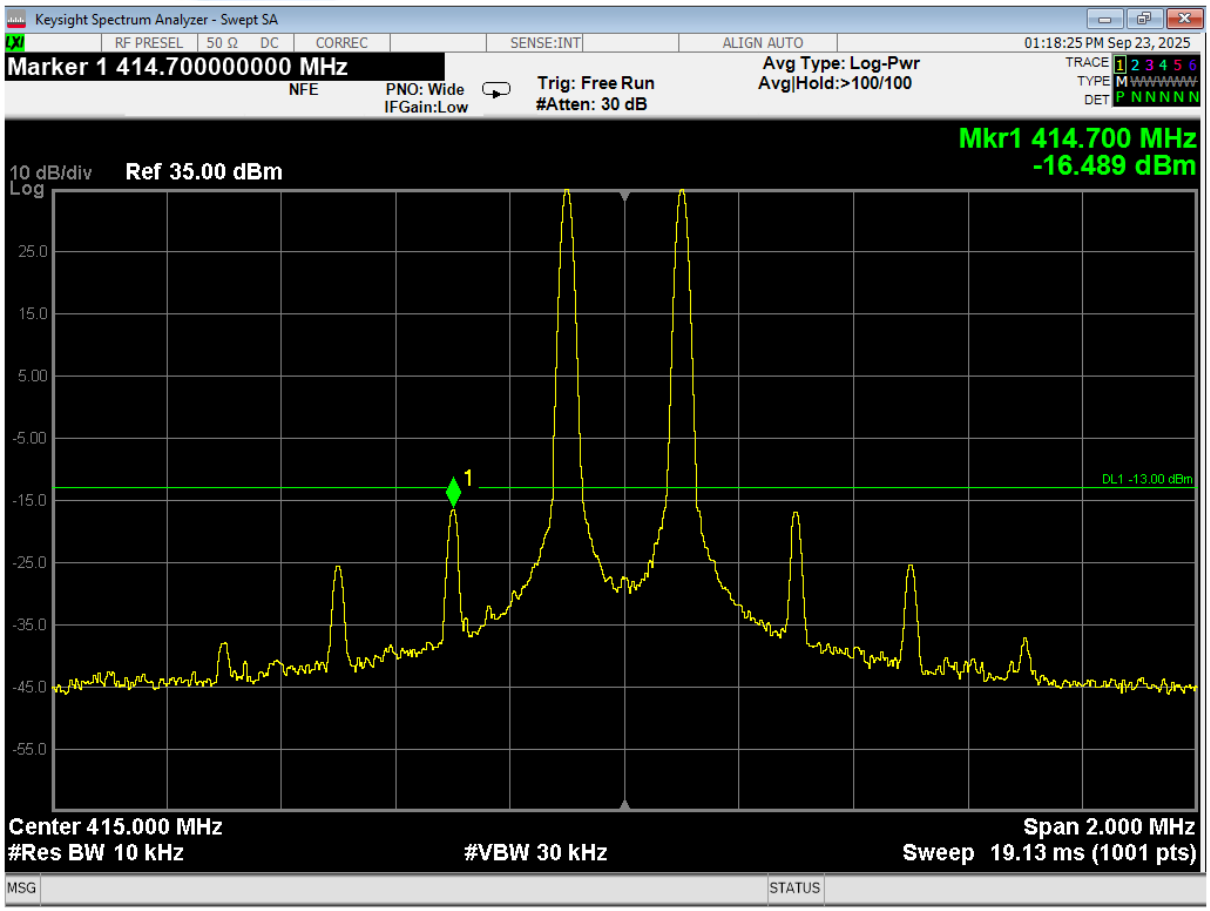
Intermodulation Characteristics

Downlink Input: 414.900 MHz and 415.100 MHz

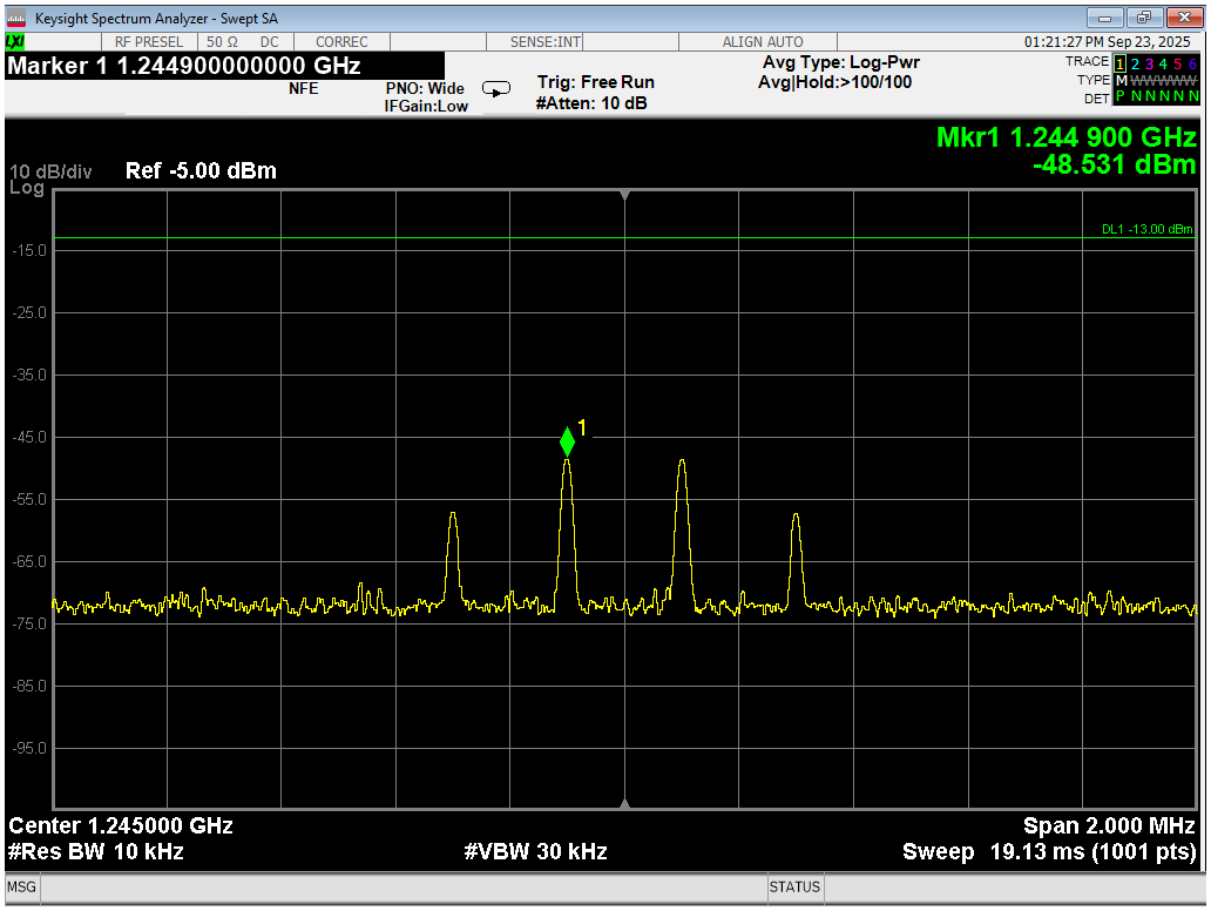
Output: +35 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
414.700	-16.5	-13.0
415.300	-16.8	-13.0
415.500	-25.3	-13.0
414.500	-25.2	-13.0
830.000	-38.4	-13.0
1244.900	-485	-13.0
1245.100	-48.5	-13.0

Downlink Plot centred on 415.00 MHz



Downlink plot centred on 1245 MHz



Result: Complies

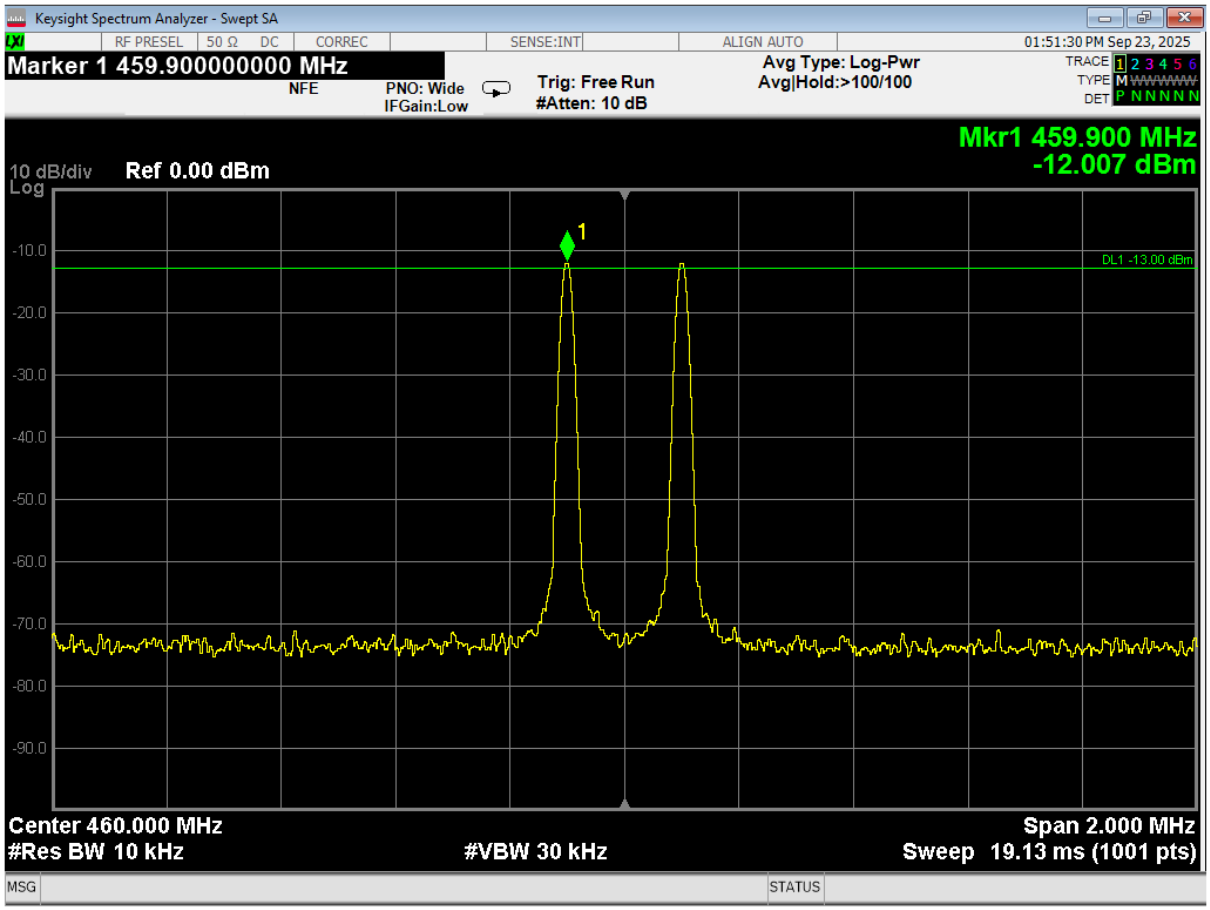
Intermodulation Characteristics

Uplink Input: 459.900 MHz and 460.100 MHz

Output: -12 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
459.700	Nil observed	-13.0
460.300	Nil observed	-13.0
920.000	Nil observed	-13.0

Uplink plot centred on 460 MHz



Result: Complies

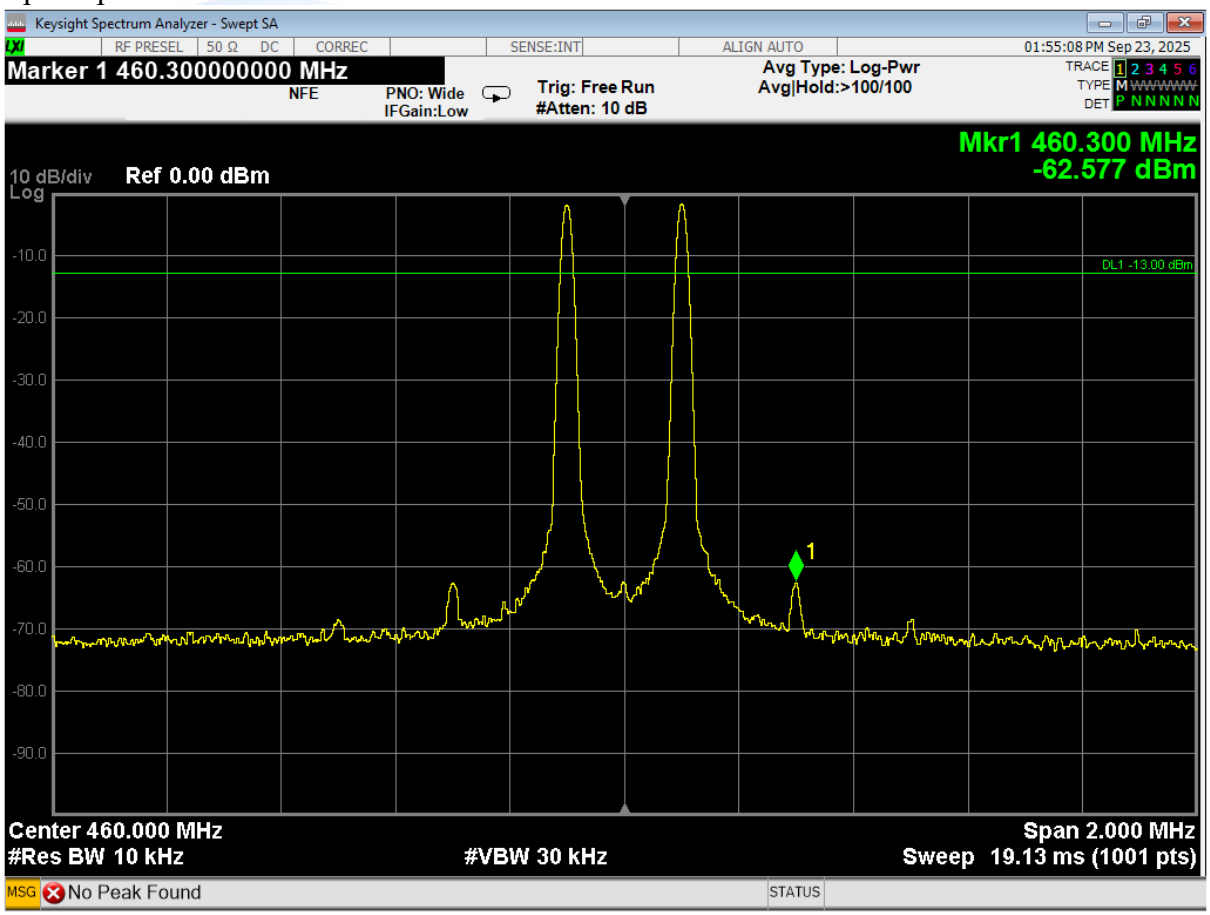
Intermodulation Characteristics

Uplink Input: 459.900 MHz and 460.100 MHz

Output: -2 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
459.700	-62.9	-13.0
460.300	-62.5	-13.0
460.500	Nil observed	-13.0
459.500	Nil observed	-13.0
920.000	Nil observed	-13.0
1379.900	Nil observed	-13.0
1380.100	Nil observed	-13.0

Uplink plot centred on 460 MHz



Result: Complies

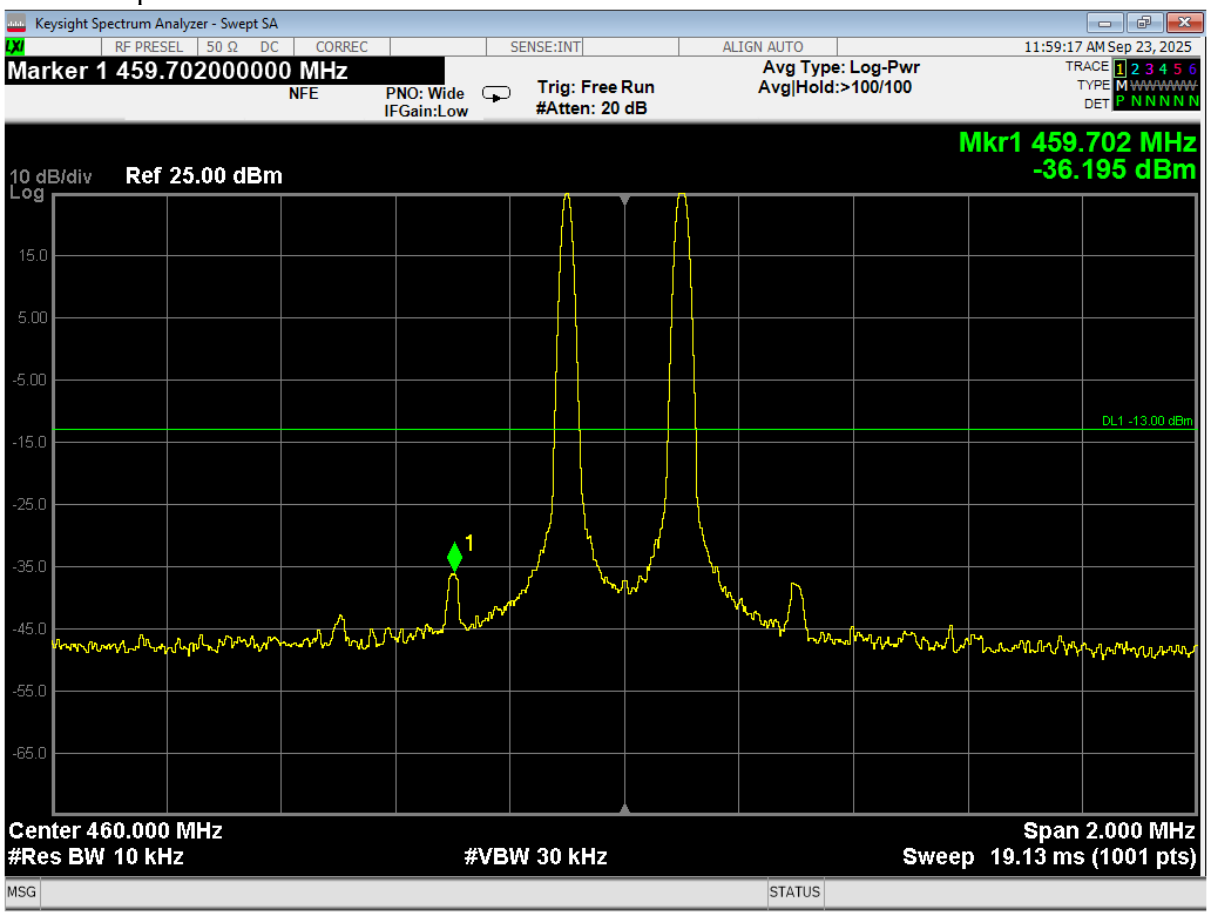
Intermodulation Characteristics

Downlink Input: 459.900 MHz and 460.100 MHz

Output: +25 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
459.700	-36.2	-13.0
460.300	-37.7	-13.0
920.000	-37.1	-13.0

Downlink plot centred on 460 MHz



Result: Complies

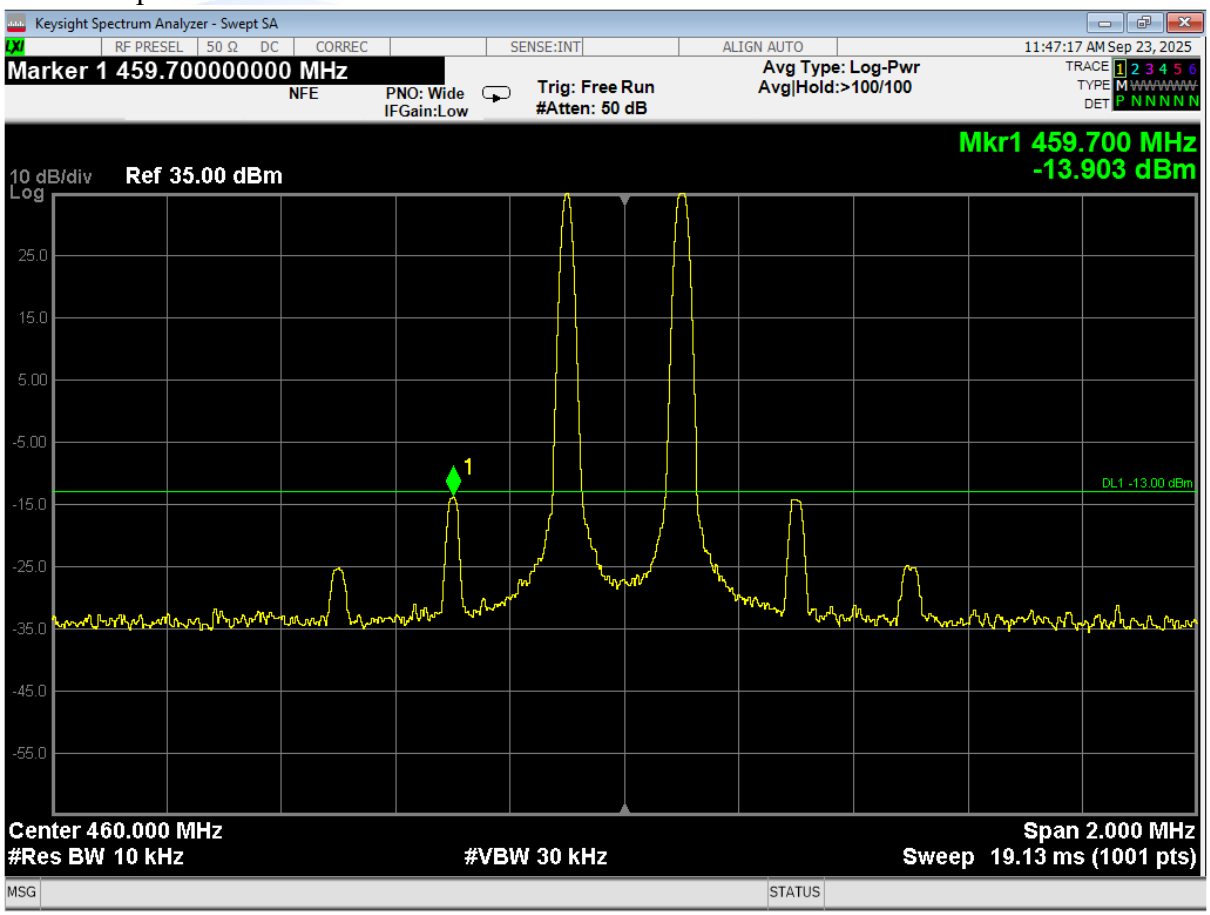
Intermodulation Characteristics

Downlink Input: 459.900 MHz and 460.100 MHz

Output: +35 dBm

Frequency (MHz)	Level (dBm)	Limit (dBm)
459.700	-13.9	-13.0
460.300	-14.2	-13.0
460.500	-24.7	-13.0
459.500	-25.2	-13.0
920.000	-19.4	-13.0
1379.900	-46.6	-13.0
1380.100	-46.6	-13.0

Downlink plot centred on 460 MHz



A plot of the worst case level only has been provided.

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	+/- 0.0	+/- 0.0	+/- 0.0
+40	+/- 0.0	+/- 0.0	+/- 0.0
+30	+/- 0.0	+/- 0.0	+/- 0.0
+20	+/- 0.0	+/- 0.0	+/- 0.0
+10	+/- 0.0	+/- 0.0	+/- 0.0
0	+/- 0.0	+/- 0.0	+/- 0.0
-10	+/- 0.0	+/- 0.0	+/- 0.0
-20	+/- 0.0	+/- 0.0	+/- 0.0
-30	+/- 0.0	+/- 0.0	+/- 0.0

Nominal Frequency: 460 MHz

Temp (°C)	100 Vac (Hz)	230 Vac (Hz)	253 Vac (Hz)
+55	+/- 0.0	+/- 0.0	+/- 0.0
+40	+/- 0.0	+/- 0.0	+/- 0.0
+30	+/- 0.0	+/- 0.0	+/- 0.0
+20	+/- 0.0	+/- 0.0	+/- 0.0
+10	+/- 0.0	+/- 0.0	+/- 0.0
0	+/- 0.0	+/- 0.0	+/- 0.0
-10	+/- 0.0	+/- 0.0	+/- 0.0
-20	+/- 0.0	+/- 0.0	+/- 0.0
-30	+/- 0.0	+/- 0.0	+/- 0.0

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.

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 450.0 – 470 MHz.

It has been assumed that the connecting cables are short and have no associated losses.

The client advises that high gain directional antennas will be used.

The composite power of the amplifier when operating with a duty cycle of 100% is +37 dBm (5 watts) where 16 channels are used each with an output power of +25 dBm (316 mW).

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 403 MHz

- Occupational /Controlled exposure is f/300 which gives a limit of 1.343 mW/cm2

- General Population / Uncontrolled exposure is f/1500 which gives a limit of 0.269 mW/cm2

Minimum safe distances have been calculated below.

For a Controlled Environment
Power Density = 1.343 mW/cm2 = E2/3770
E= √ 1.343*3770
E = 71.2 V/m

For an Uncontrolled Environment
Power Density = 0.269 mW/cm2 = E2/3770
E= √ 0.269*3770
E = 31.8 V/m

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

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

The client advises an antenna gain of +11.3 dBi which equates to a numeric gain of 13.5.

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 = 5.0 W
FS = E = 71.2 V/m
G = 13.5
DC = 1
D = (√ (30 * 5.0 * 13.5 * 1)) / 71.2
D = 0.632 m or 63.2 cm

For Controlled environments, the minimum distance is:

D = (√ (30 * P * G * DC)) / FS
P = 5.0 W
FS = E = 31.8 V/m
G = 13.5
DC = 1
D = (√ (30 * 5.0 * 13.5 * 1)) / 31.8
D = 1.415 m or 141.5 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	28/02/28	3.0 years
Signal Generator	Agilent	E4433B	ESG-D	24/07/26	2.0 years
Heliax Cable	L6PNM-RPD	OATS	22869	23/12/25	1.0 years
Receiver	Rohde & Schwarz	ESIB-40	100295	30/05/26	2.0 years
Spectrum Analyzer	Keysight	N9038A	MY57290153	20/11/26	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.

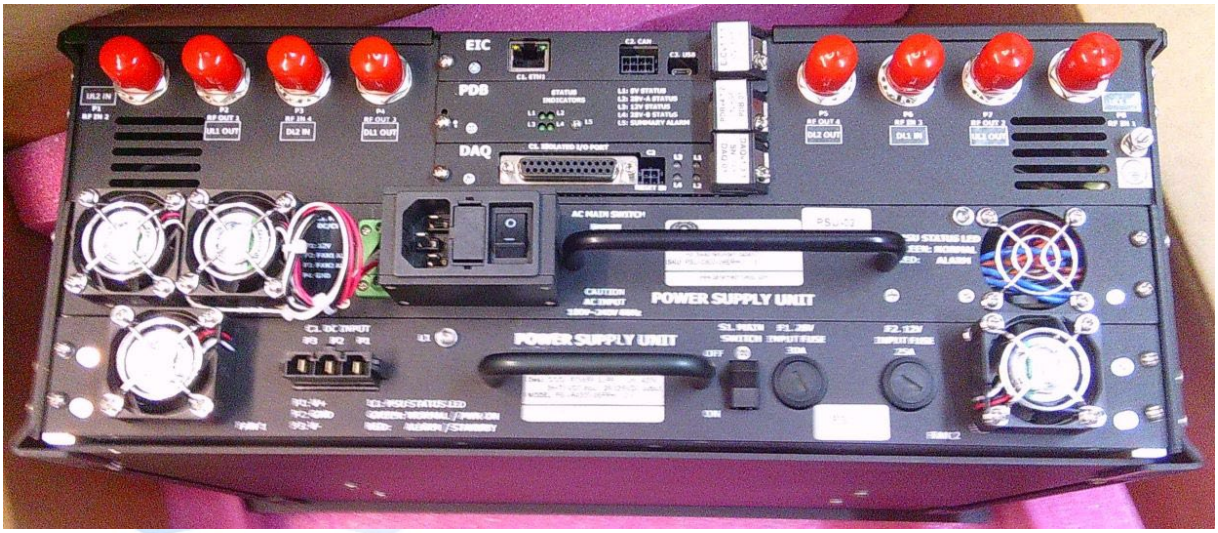
All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

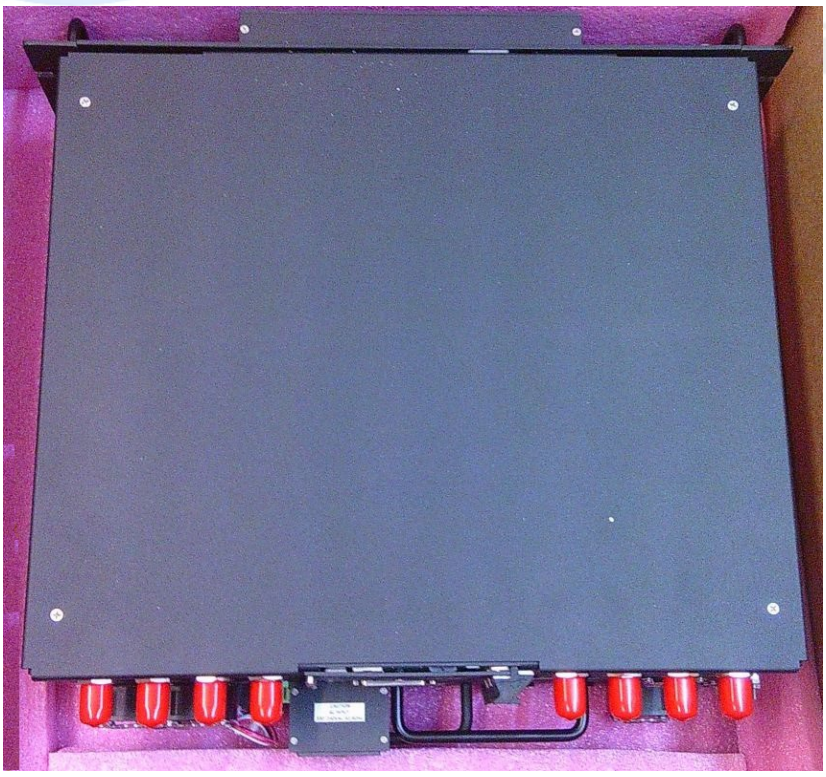
International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies.

This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

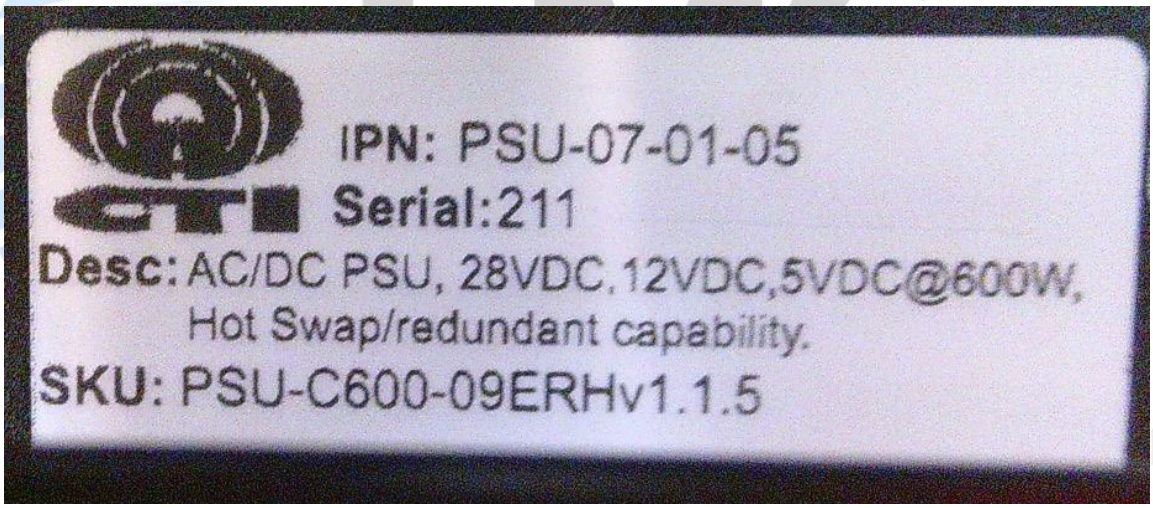
9. PHOTOGRAPHS

Equipment Under Test

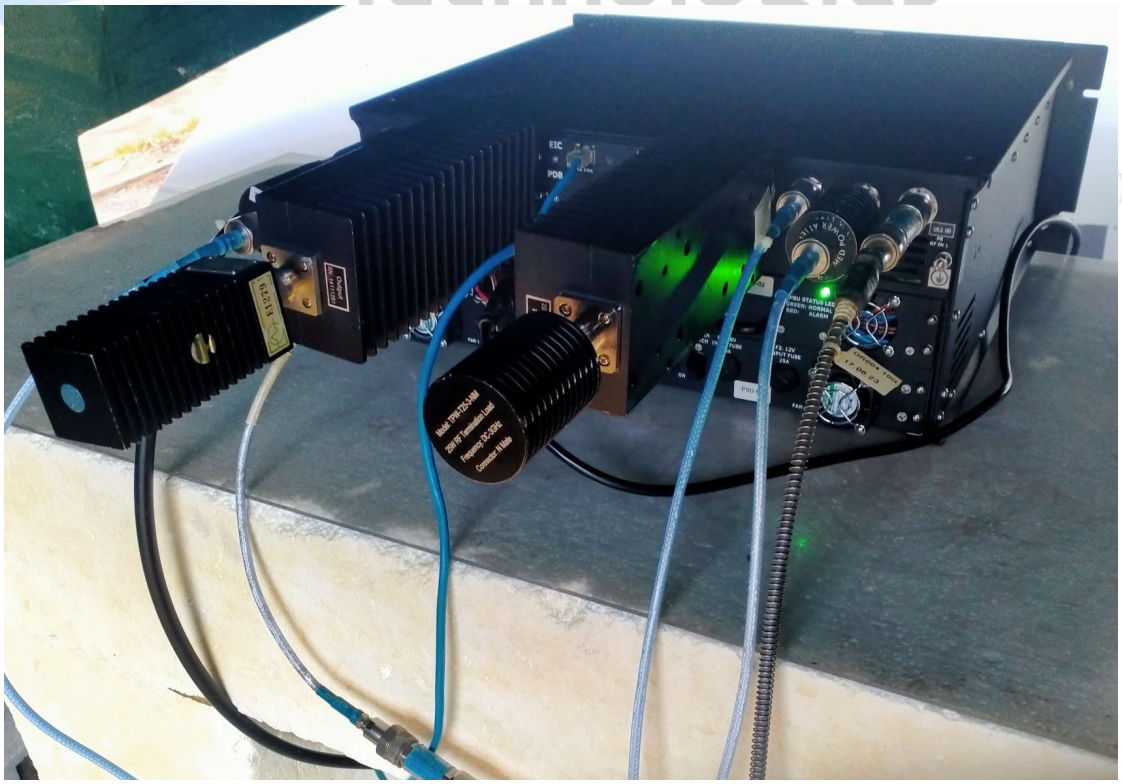


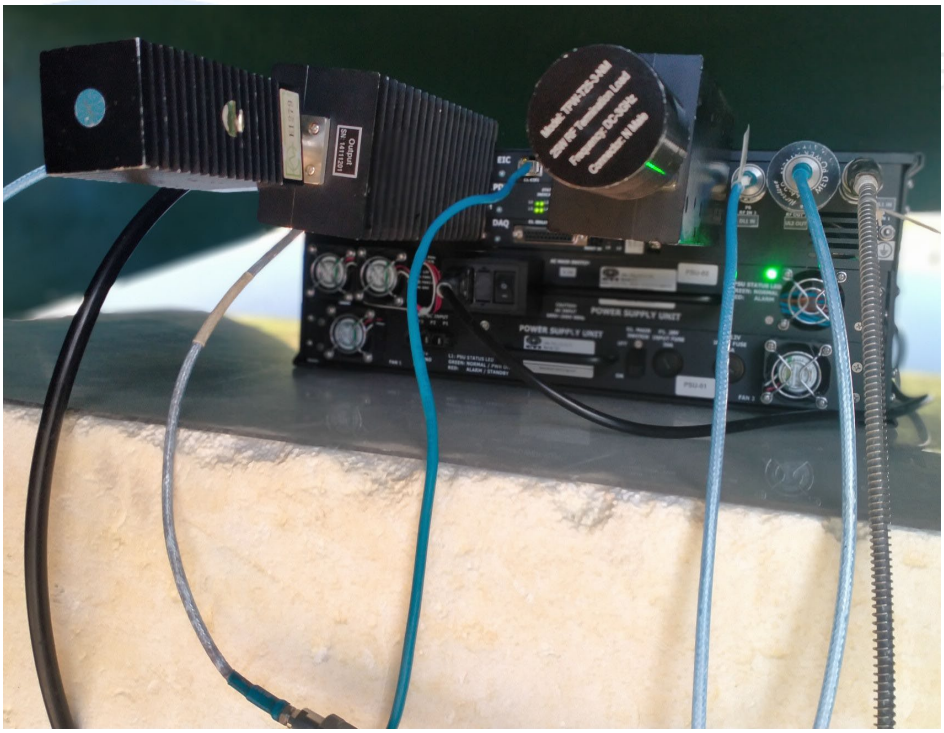


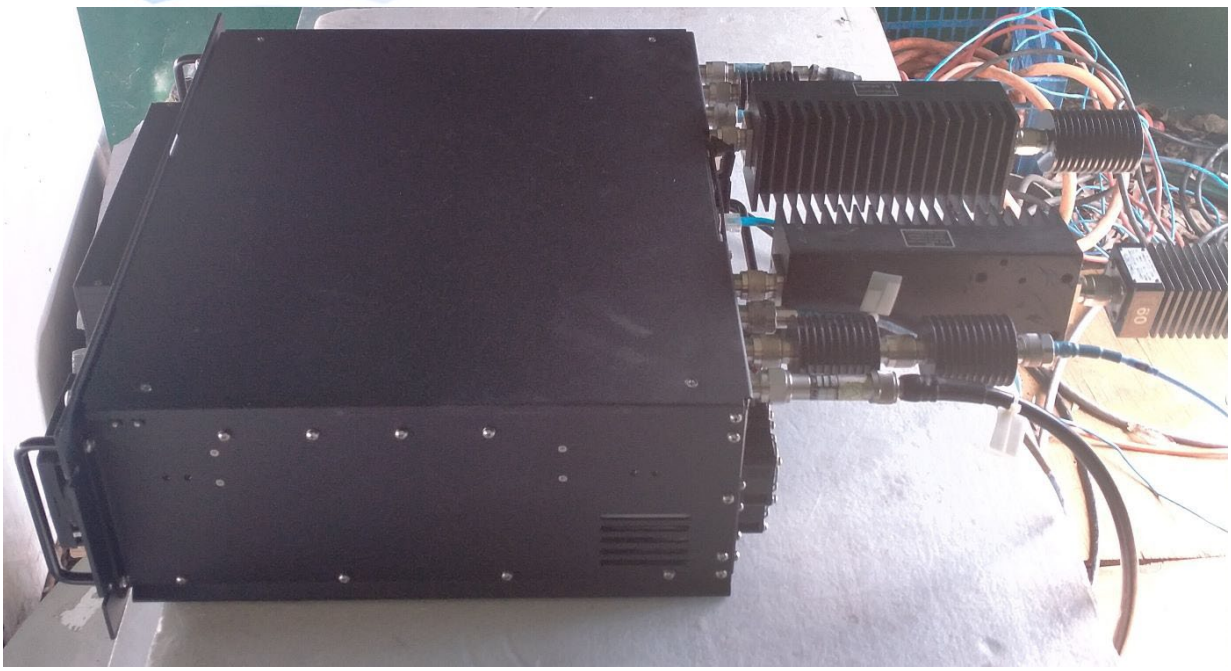
Equipment Under Test Labels

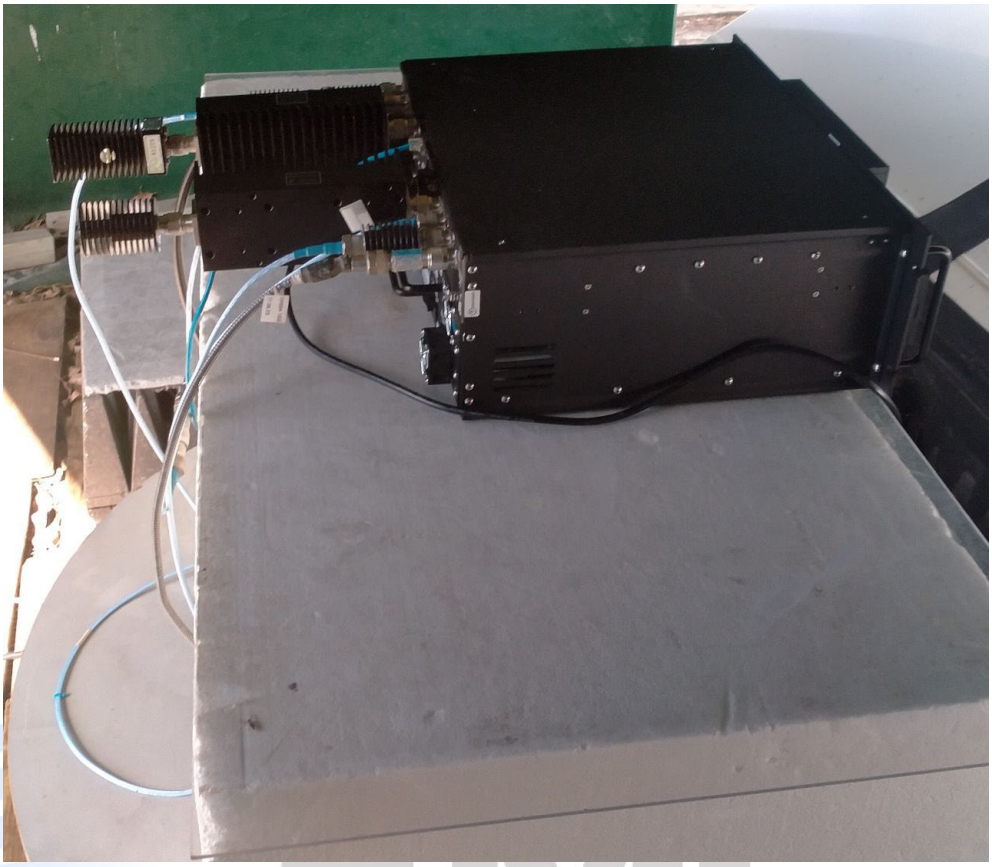


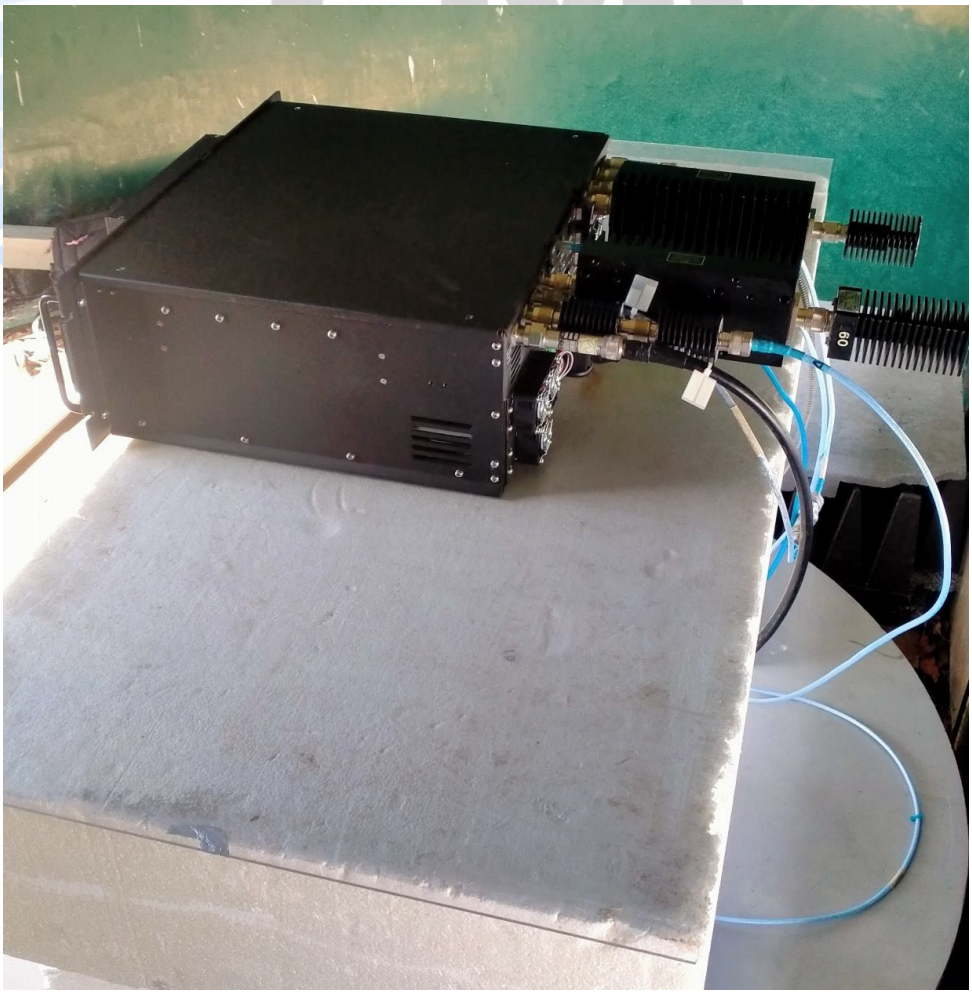
Radiated Emissions Test Set Ups











Ancillary Equipment