

RF VENUE, INC. TEST REPORT

SCOPE OF WORK

Emissions Testing of the 6-to-1 Active RF Combiner

REPORT NUMBER

105431768BOX-001R1

ISSUE DATE

01/12/2024

[REVISED DATE]

06/27/2024

DOCUMENT CONTROL NUMBER

Non-Specific Radio Report Shell Rev. October 2022
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EMISSIONS TEST REPORT (FULL COMPLIANCE)

Report Number: 105431768BOX-001R1

Project Number: G105431768

Report Issue Date: 01/12/2024

Report Revision Date: 06/27/2024

Model(s) Tested: RF VENUE COMBINE 6

Model(s) Partially Tested: None

Model(s) Not Tested but declared equivalent by the client: None

Standards: FCC PART 74, Subpart H:2024 – Low Power Auxiliary Stations
KDB 935210 D02 Signal Boosters Certification v04r02
KDB 935210 D05 Industrial Booster Basic Meas v01r04
KDB 971168 D03 IM Emission Repeater Amp v01

Tested by:
Intertek
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
RF Venue, Inc.
72 Nickerson Rd
Ashland, MA 01721
USA

Report prepared by



Vathana Ven / Senior Staff Engineer

Report reviewed by



Kouma Sinn / Senior Staff Engineer

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	RF Output Power FCC Part 74.861(e)(1)(ii), KDB 935210 D05 Industrial Booster Basic Meas v01r04 Section 3.5	Pass
7	Occupied Bandwidth FCC Part 74.861(e)(5), KDB 935210 D05 Industrial Booster Basic Meas v01r04 Section 3.4	Pass
8	Transmitter Unwanted Emissions (Radiated or Conducted), Intermodulation Emissions FCC Part 74.861(e)(6), KDB 971168 D03 IM Emission Repeater Amp v01	Pass
9	Emission Masks FCC Part 74.861(e)(7)	Pass
10	Conducted Emissions on AC Mains FCC Part 15.207	Pass
11	Revision History	--

3 Client Information**This EUT was tested at the request of:**

Client: RF Venue, Inc.
72 Nickerson Rd.
Ashland, MA 01721
USA

Contact: Matt Glass
Telephone: (800) 795-0817
Email: matt@rfvenue.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: RF Venue, Inc.
72 Nickerson Rd.
Ashland, MA 01721
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
6-to-1 Active RF Combiner	RF Venue, Inc.	RF Venue Combine 6	003

Receive Date:	11/14/2023
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The EUT is a 6-to-1 Active RF Combiner

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
100-240 VAC	1.0 A	50/60 Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Passing signals continuously

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	N/A

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Radio/Receiver Characteristics	
Frequency Band(s)	470-608 MHz
Modulation Type(s)	Modulated Carrier
Maximum Output Power	13.30 dB(m) Mean Power
Test Channels	Low Channel: 470.1 MHz Mid Channel: 539 MHz High Channel: 608 MHz
Occupied Bandwidth	184.34 kHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	6-to-1 Active RF combiner
Equipment Type	Standalone
Antenna Type and Gain	External, Antenna gain: 11.15 dBi

Variant Models:

The following variant models were not tested as part of this evaluation and are not eligible for certification; but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

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5 System Setup and Method

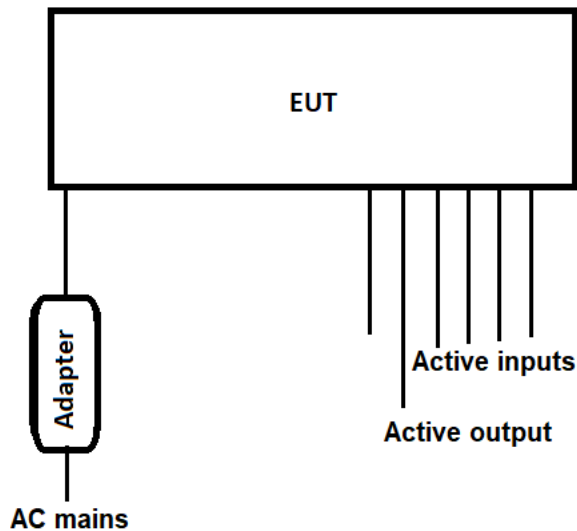
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	AC mains cable	2	None	None	AC mains
2	Coaxial cable (5)	5	Braid	None	Unterminated
3	Coaxial cable	5	Braid	None	Signal generator

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
AC adapter	Mean Well	GST40A12-P1J	Not labeled
CP Beam Antenna	RF Venue, Inc	Not labeled	Not labeled

5.1 Method:

Configuration as required by FCC Part 75, Subpart H: 2024, ANSI C63.26:2015, KDB 935210 D02 Signal Boosters Certification v04r02, KDB 935210 D05 Indus Booster Basic Meas v01r04, and KDB 971168 D03 IM Emission Repeater Amp v01.

5.2 EUT Block Diagram:



6 RF Output Power (Mean Input Power vs. Mean Output Power)**6.1 Method**

Tests are performed in accordance with FCC Part 74.861(e)(1)(ii), ANSI C63.26, and KDB 935210 D05.

TEST SITE: AMAP Lab

6.2 Test Equipment Used:

Test equipment used on 05/10/2024

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS005-2'	Vector Signal Generator	Rohde & Schwartz	SMB-100A	178319	11/02/2023	11/02/2024
DAV009'	weather station	Davis Instruments	6351 Vantage VUE	DAV009	04/05/2024	04/05/2025
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/28/2024	02/28/2025
CBLHF2012-2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252675002	02/27/2024	02/27/2025
CBLHF2012-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/27/2024	02/27/2025

Software Utilized:

Name	Manufacturer	Version
None	N/A	N/A

6.3 Results:

The sample tested was found to Comply.

6.4 Setup Photograph:

Photo not available due to confidentiality request by the client

6.5 Plots/Data:

Mean Input Power vs. Mean Output Power, 75 kHz Peak Deviation and 2.5 kHz modulation

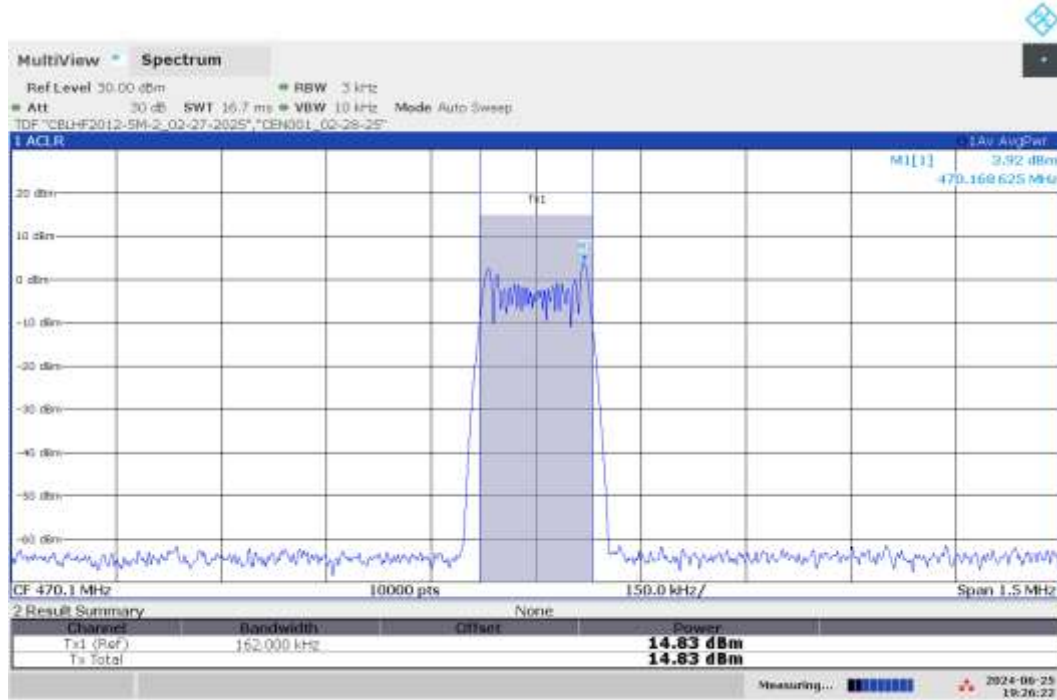
Frequency (MHz)	Rated Power dB(m)	Measured input power dB(m)	Measured output power dB(m)	Measured Output Power (mW)	FCC Limit (mW)
470.1	15	14.83	10.83	12.106	250
539	15	14.74	13.20	20.893	250
608	15	14.95	13.01	20.000	250

Mean Input Power vs. Mean Output Power, 75 kHz Peak Deviation and 15 kHz modulation

Frequency (MHz)	Rated Power dB(m)	Measured input power dB(m)	Measured output power dB(m)	Measured Output Power (mW)	FCC Limit (mW)
470.1	15	14.73	10.85	12.162	250
539	15	14.77	13.30	21.380	250
608	15	14.89	12.91	19.543	250

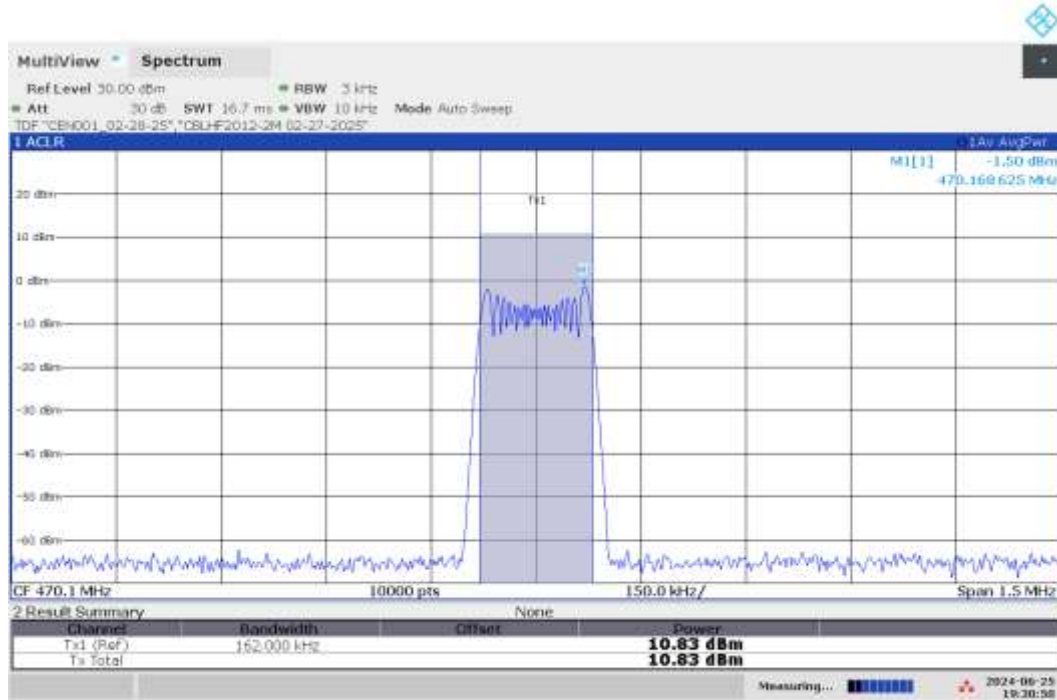
Mean Input power vs. Mean Output power, Signal passed through at Low Channel 470.1 MHz

Mean Input power, 2.5 kHz modulation, 75 kHz Peak Deviation



07:26:23 PM 06/25/2024

Mean Output power, 2.5 kHz modulation, 75 kHz Peak Deviation

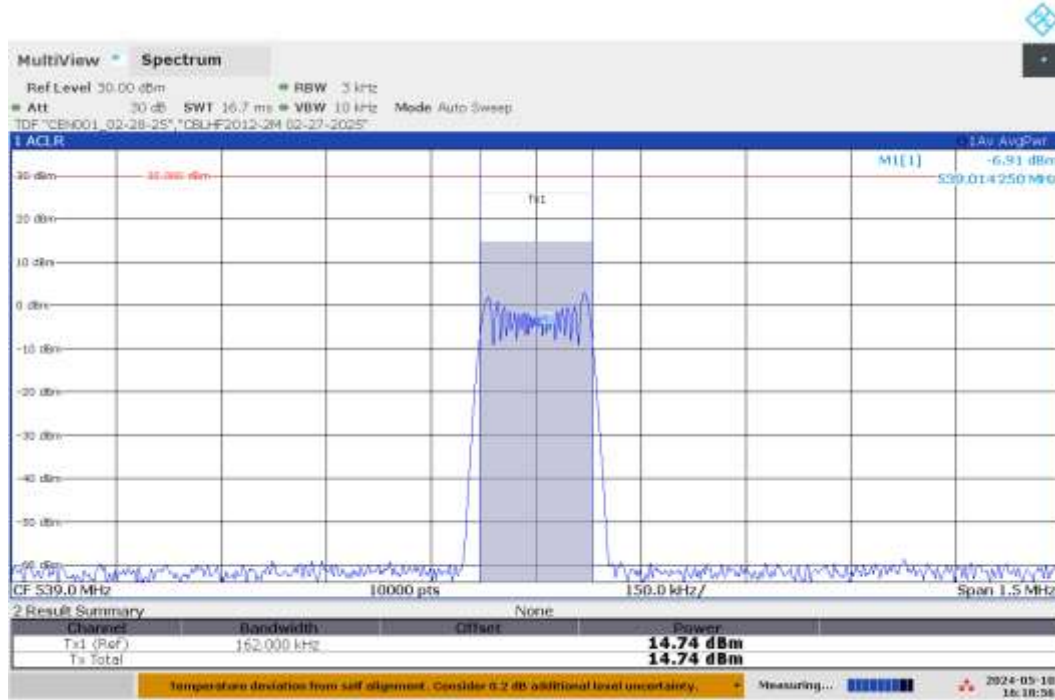


07:30:51 PM 06/25/2024

Note: Attenuator and cable factors were internally compensated.

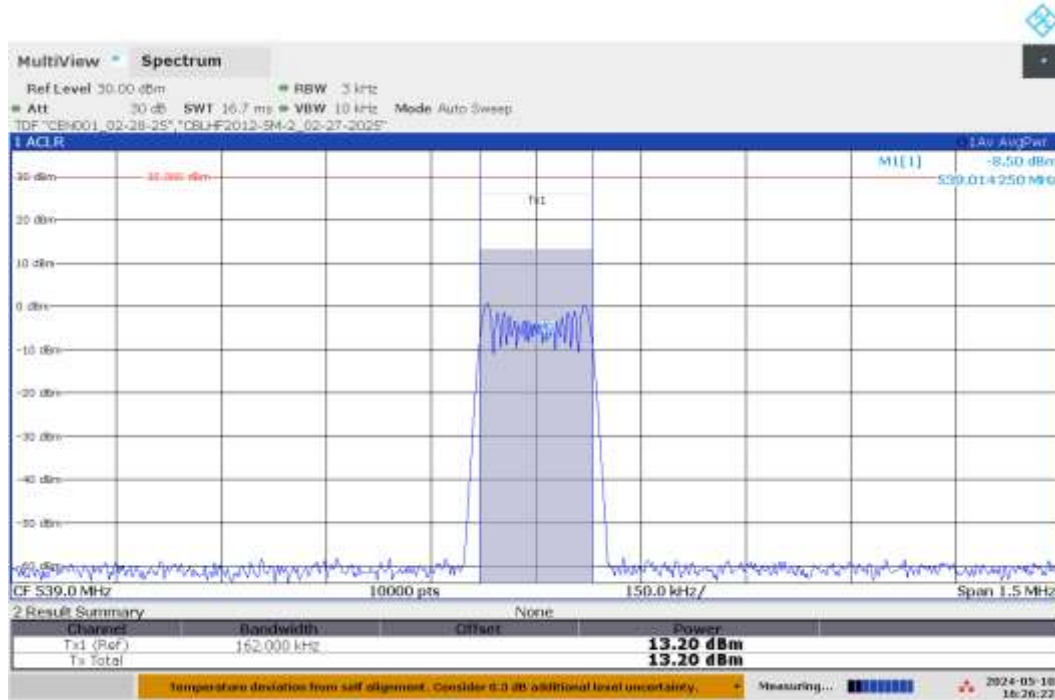
Mean Input power vs. Mean Output power, Signal passed through at Mid Channel 539 MHz

Mean Input power, 2.5 kHz modulation, 75 kHz Peak Deviation



04:18:56 PM 05/10/2024

Mean Output power, 2.5 kHz modulation, 75 kHz Peak Deviation

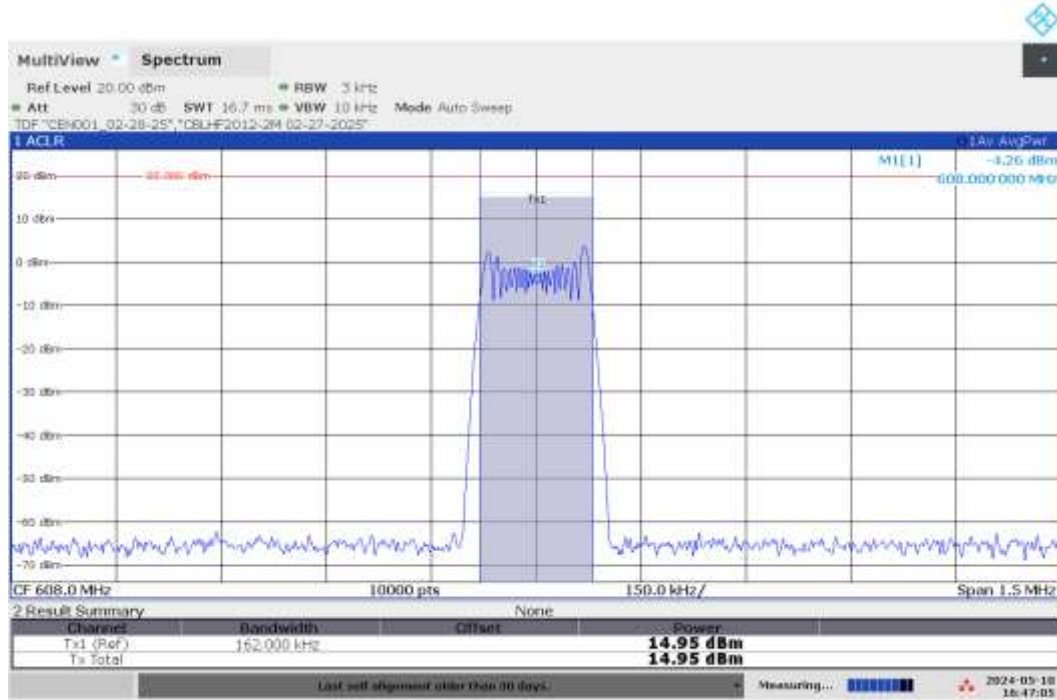


04:26:22 PM 05/10/2024

Note: Attenuator and cable factors were internally compensated.

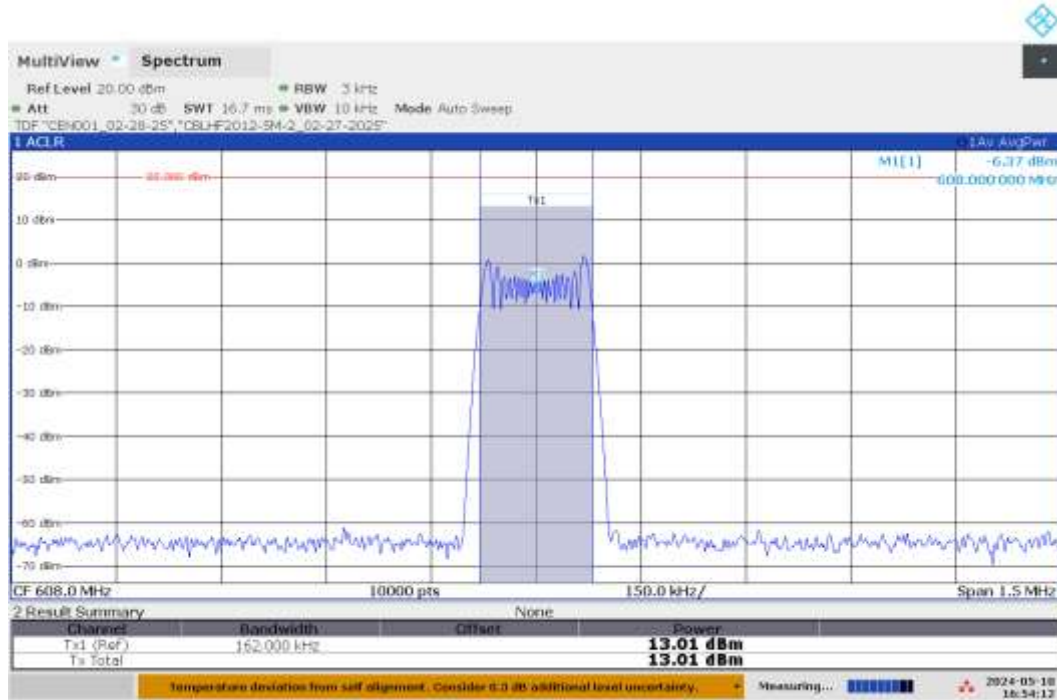
Mean Input power vs. Mean Output power, Signal passed through at High Channel 608 MHz

Mean Input power, 2.5 kHz modulation, 75 kHz Peak Deviation



04:47:05 PM 05/10/2024

Mean Output power, 2.5 kHz modulation, 75 kHz Peak Deviation

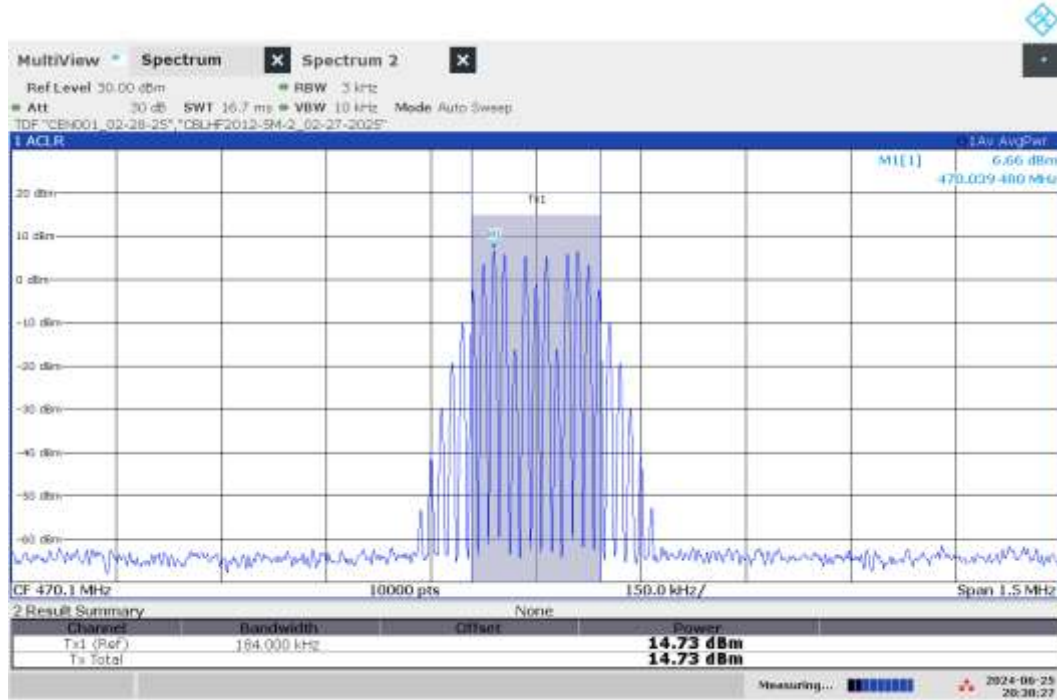


04:54:12 PM 05/10/2024

Note: Attenuator and cable factors were internally compensated.

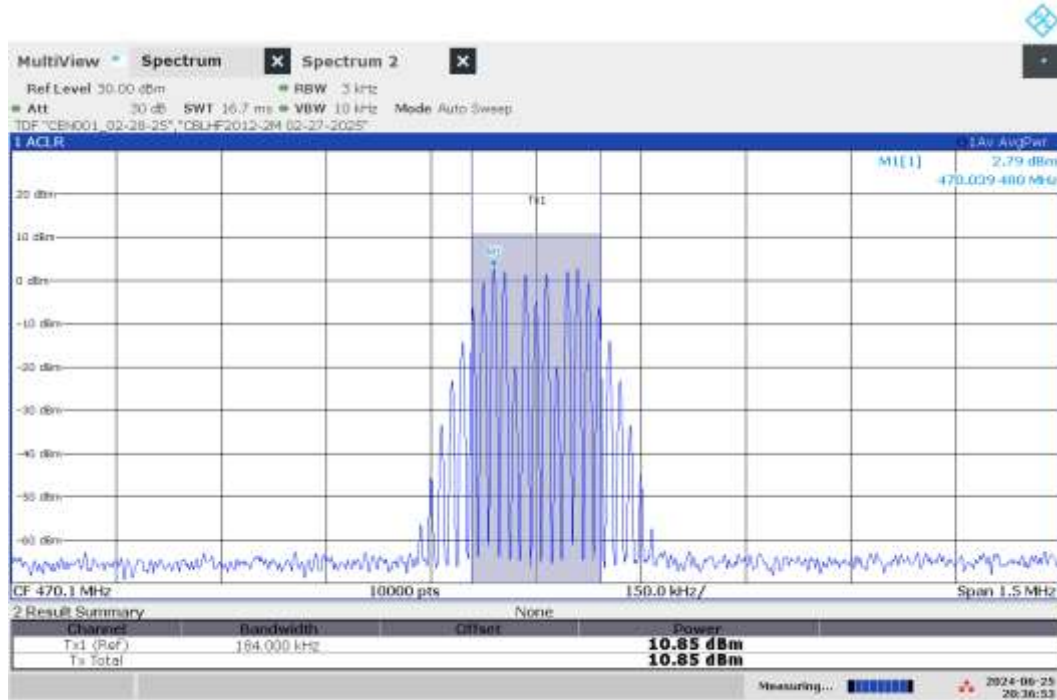
Mean Input power vs. Mean Output power, Signal passed through at Low Channel 470.1 MHz

Mean Input power, 15 kHz modulation, 75 kHz Peak Deviation



08:38:27 PM 06/25/2024

Mean Output power, 15 kHz modulation, 75 kHz Peak Deviation

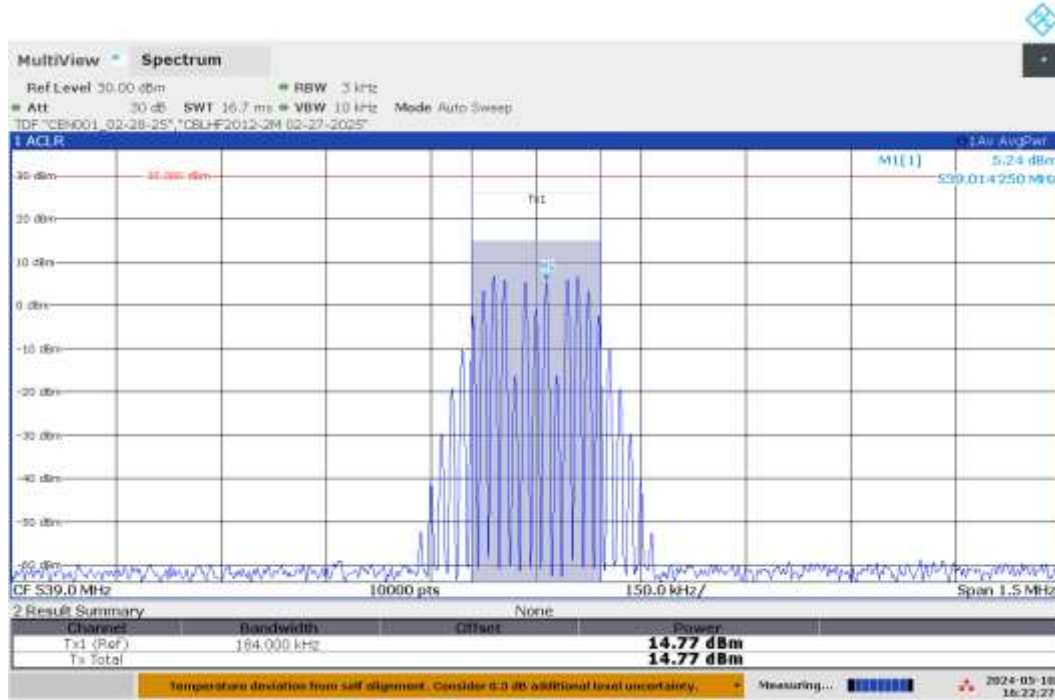


08:36:53 PM 06/25/2024

Note: Attenuator and cable factors were internally compensated.

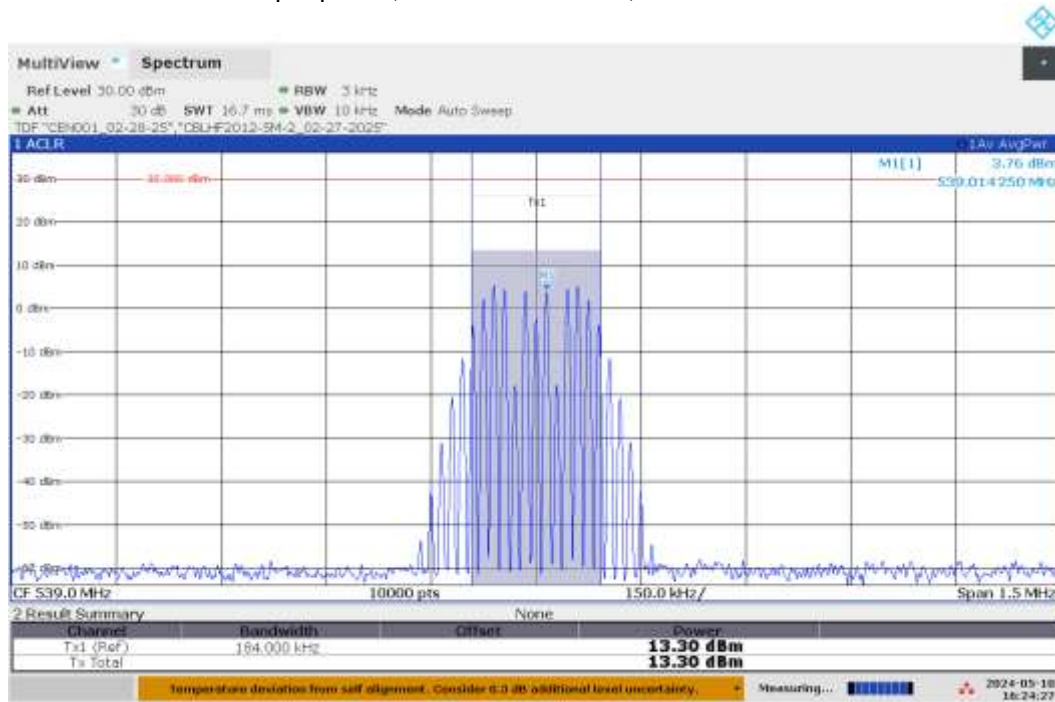
Mean Input power vs. Mean Output power, Signal passed through at Mid Channel 539 MHz

Mean Input power, 15 kHz modulation, 75 kHz Peak Deviation



04:22:27 PM 05/10/2024

Mean Output power, 15 kHz modulation, 75 kHz Peak Deviation

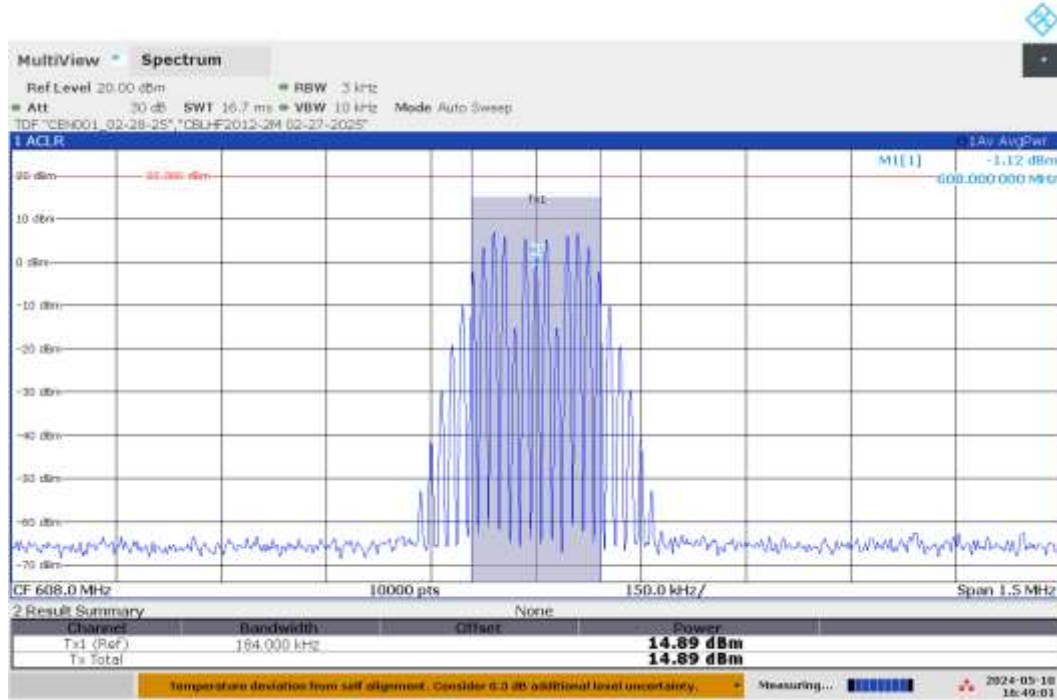


04:24:27 PM 05/10/2024

Note: Attenuator and cable factors were internally compensated.

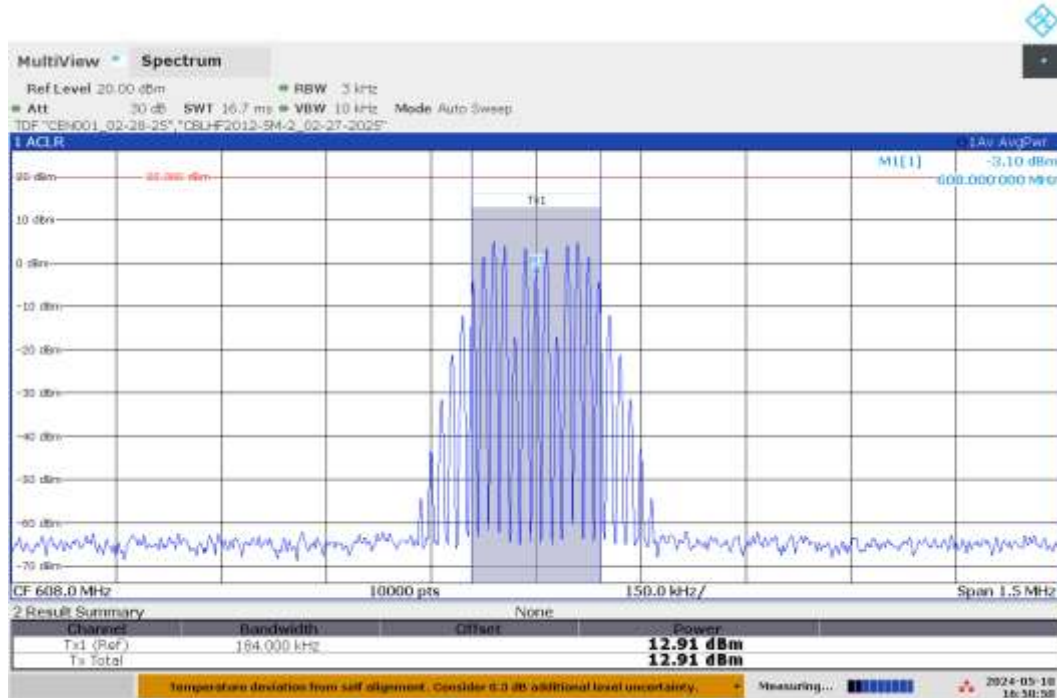
Mean Input power vs. Mean Output power, Signal passed through at High Channel 608 MHz

Mean Input power, 15 kHz modulation, 75 kHz Peak Deviation



04:49:01 PM 05/10/2024

Mean Output power, 15 kHz modulation, 75 kHz Peak Deviation



04:50:50 PM 05/10/2024

Note: Attenuator and cable factors were internally compensated.

Intertek

Report Number: 105431768BOX-001R1

Issued: 01/12/2024
Revised: 06/27/2024

Product Standard: FCC Part 74H				Limit applied: See section 6.5 Pretest Verification w/BB source: N/A			
Test Date	Test Personnel/ Initials	Supervising Engineer/ Initials	Input Voltage	Mode	Atmospheric Data		
					Temp C°	Relative Humidity %	Atmospheric Pressure mbar
05/28/2024	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	25	26	999
06/25/2024	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	20	40	999

Deviations, Additions, or Exclusions: None

7 Occupied Bandwidth (Input vs. Output)**7.1 Method**

Tests are performed in accordance with FCC Part 74.861(e)(1)(ii), ANSI C63.26, and KDB 935210 D05.

TEST SITE: AMAP Lab

7.2 Test Equipment Used:

Test equipment used on 05/09/2024

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS005-2'	Vector Signal Generator	Rohde & Schwartz	SMB-100A	178319	11/02/2023	11/02/2024
DAV009'	weather station	Davis Instruments	6351 Vantage VUE	DAV009	04/05/2024	04/05/2025
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/28/2024	02/28/2025
CBLHF2012-2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252675002	02/27/2024	02/27/2025
CBLHF2012-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/27/2024	02/27/2025

Software Utilized:

Name	Manufacturer	Version
None	N/A	N/A

7.3 Results:

The sample tested was found to Comply.

7.4 Setup Photograph:

Photo not available due to confidentiality request by the client

7.5 Plots/Data:

Input OBW vs. Output OBW, 2.5 kHz modulation, 75 kHz Peak Deviation

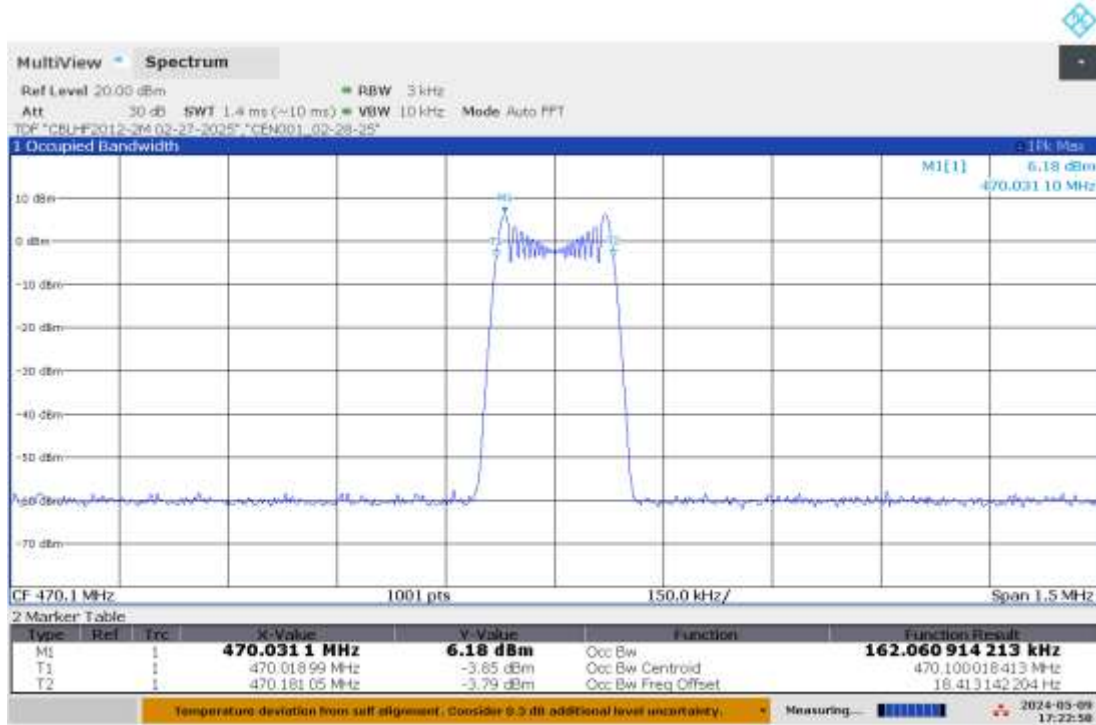
Frequency (MHz)	Measured Input OBW (kHz)	Measured Output OBW (kHz)	FCC Limit (kHz)
470.1	162.06	162.07	200
539	162.06	162.08	200
608	162.02	162.04	200

Input OBW vs. Output OBW, 15 kHz modulation, 75 kHz Peak Deviation

Frequency (MHz)	Measured Input OBW (kHz)	Measured Output OBW (kHz)	FCC Limit (kHz)
470.1	184.30	184.34	200
539	184.32	184.33	200
608	184.26	184.27	200

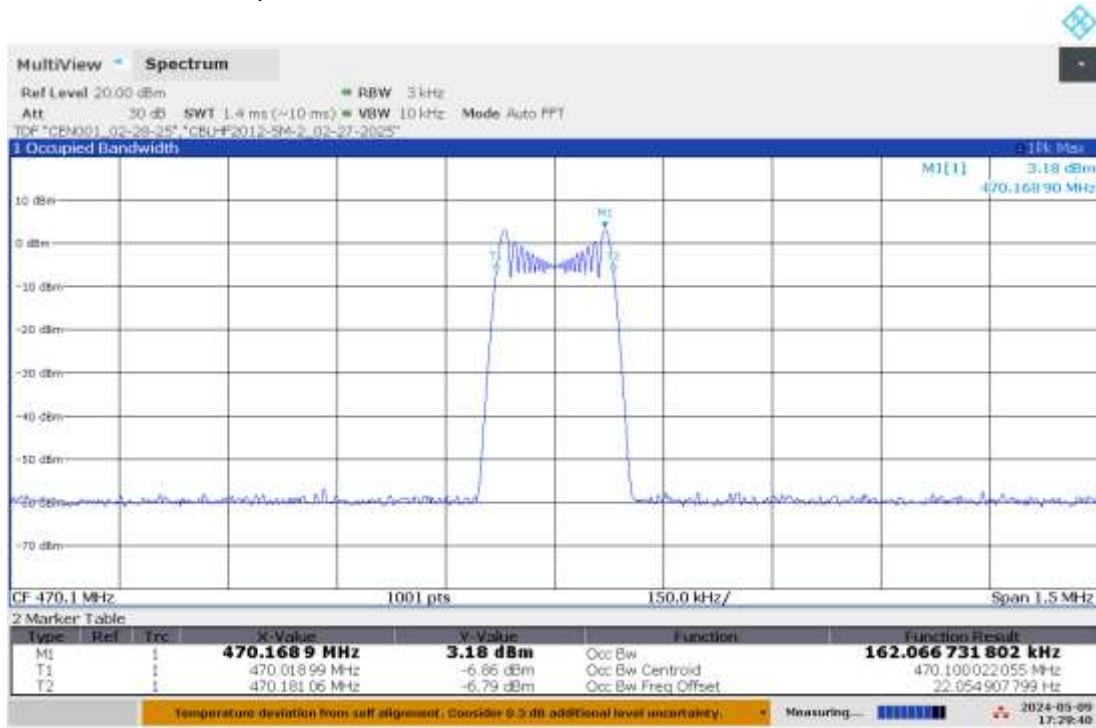
Input OBW vs. Output OBW, Signal passed through at Low Channel 470.1 MHz

Input OBW, 2.5 kHz modulation, 75 kHz Peak Deviation



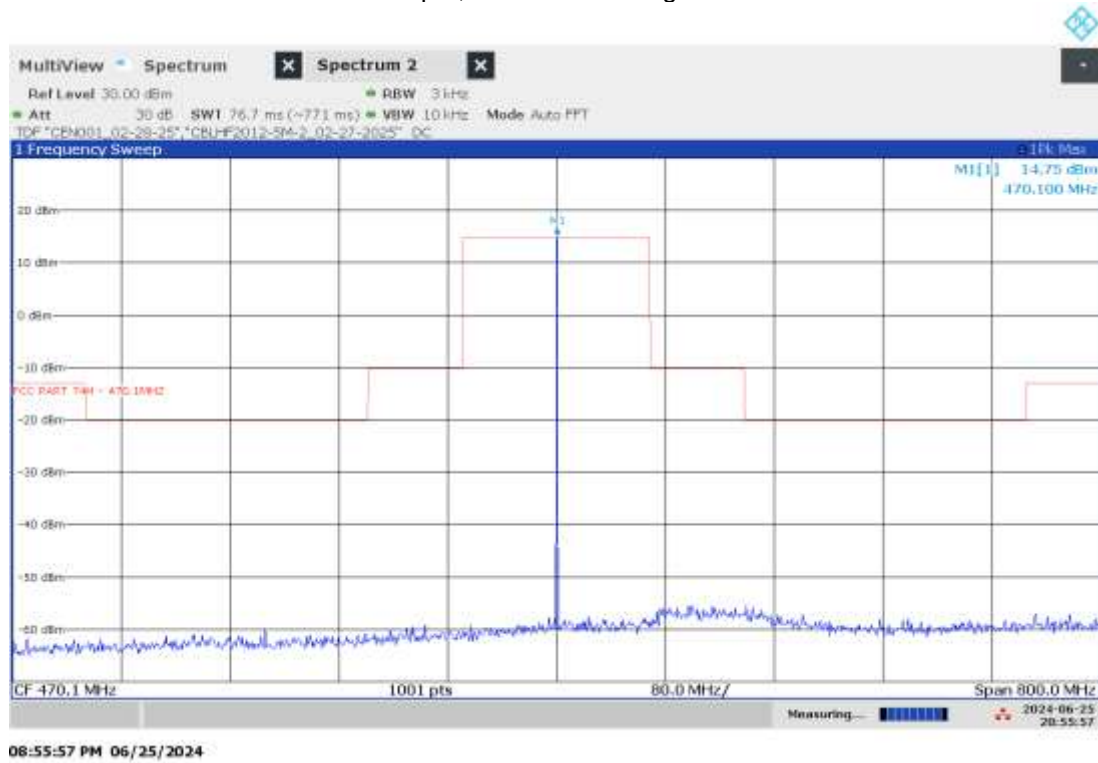
05:22:58 PM 05/09/2024

Output OBW, 2.5 kHz modulation, 75 kHz Peak Deviation

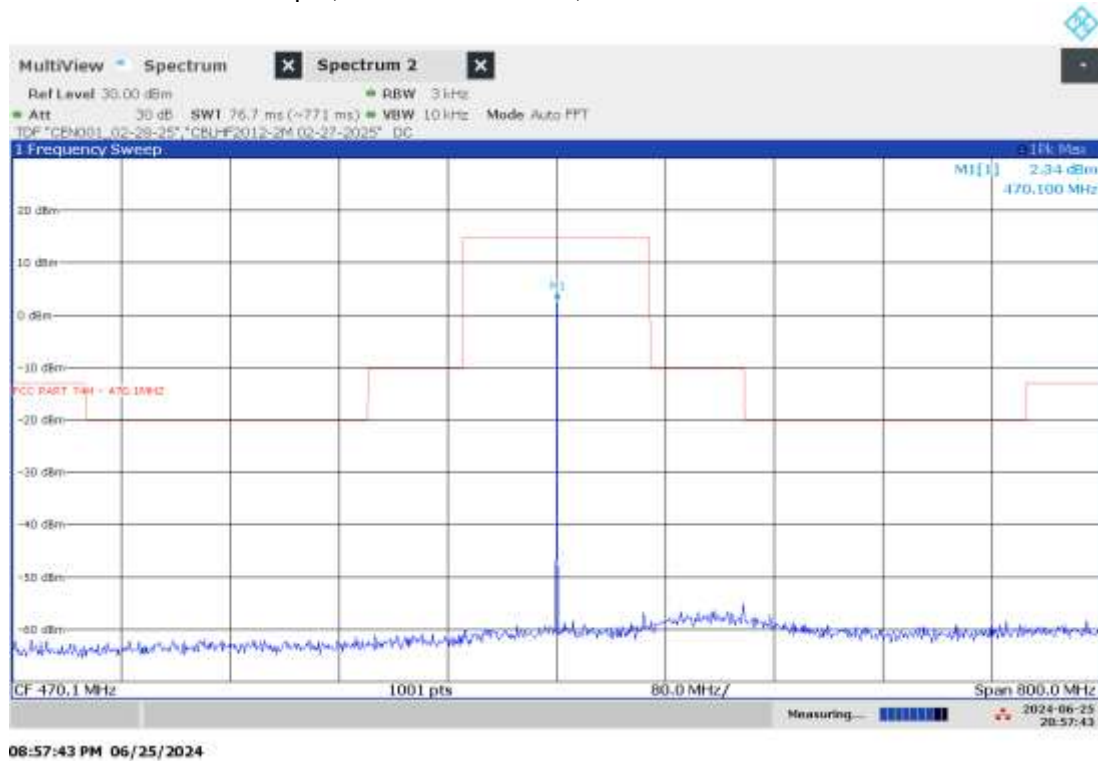


05:29:40 PM 05/09/2024

Input, Unmodulated Signal

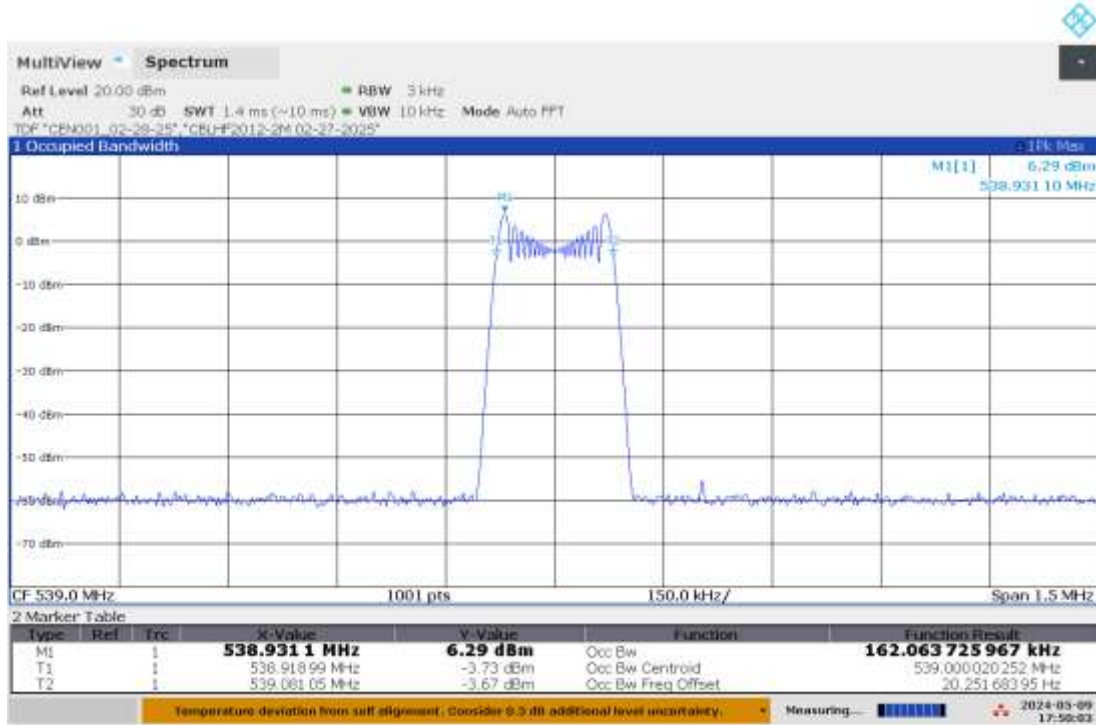


Output, 2.5 kHz modulation, 75 kHz Peak Deviation



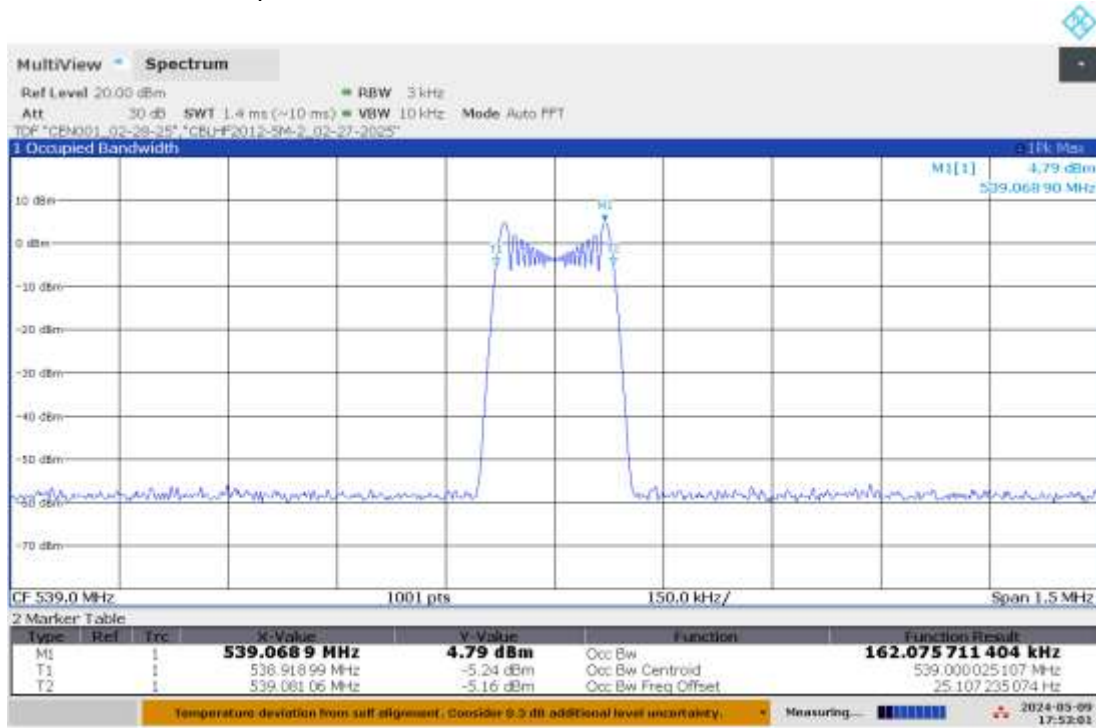
Input OBW vs. Output OBW, Signal passed through at Mid Channel 539 MHz

Input OBW, 2.5 kHz modulation, 75 kHz Peak Deviation



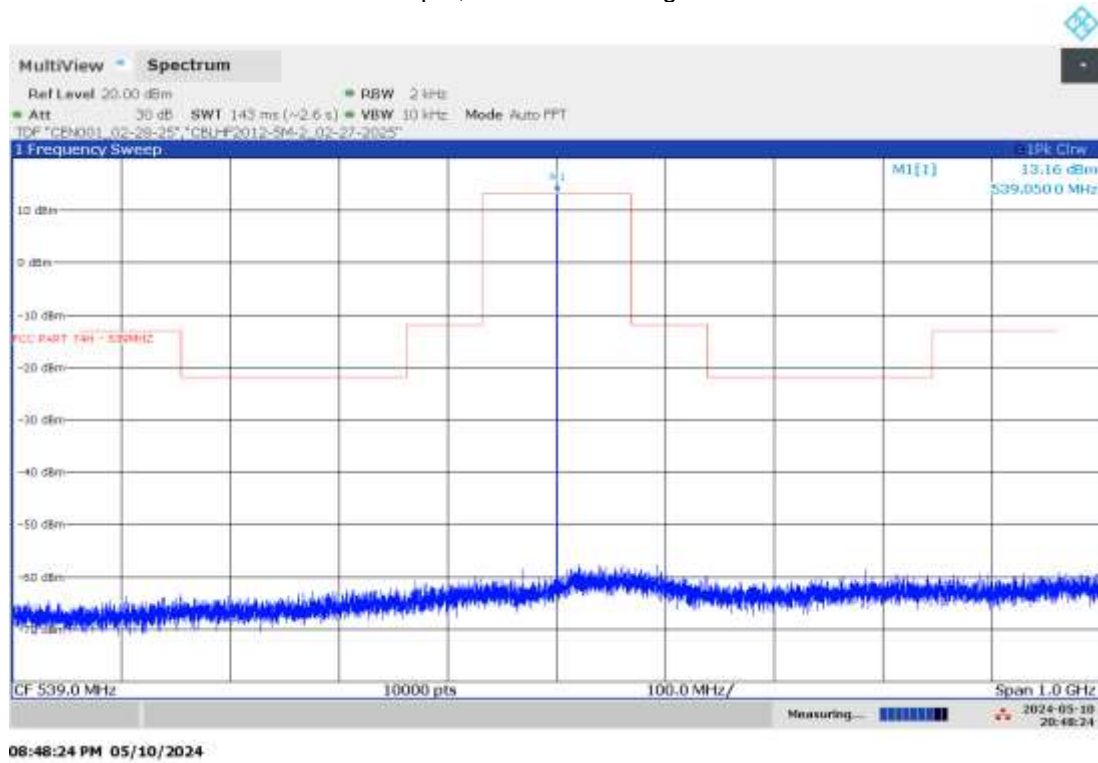
05:50:04 PM 05/09/2024

Output OBW, 2.5 kHz modulation, 75 kHz Peak Deviation

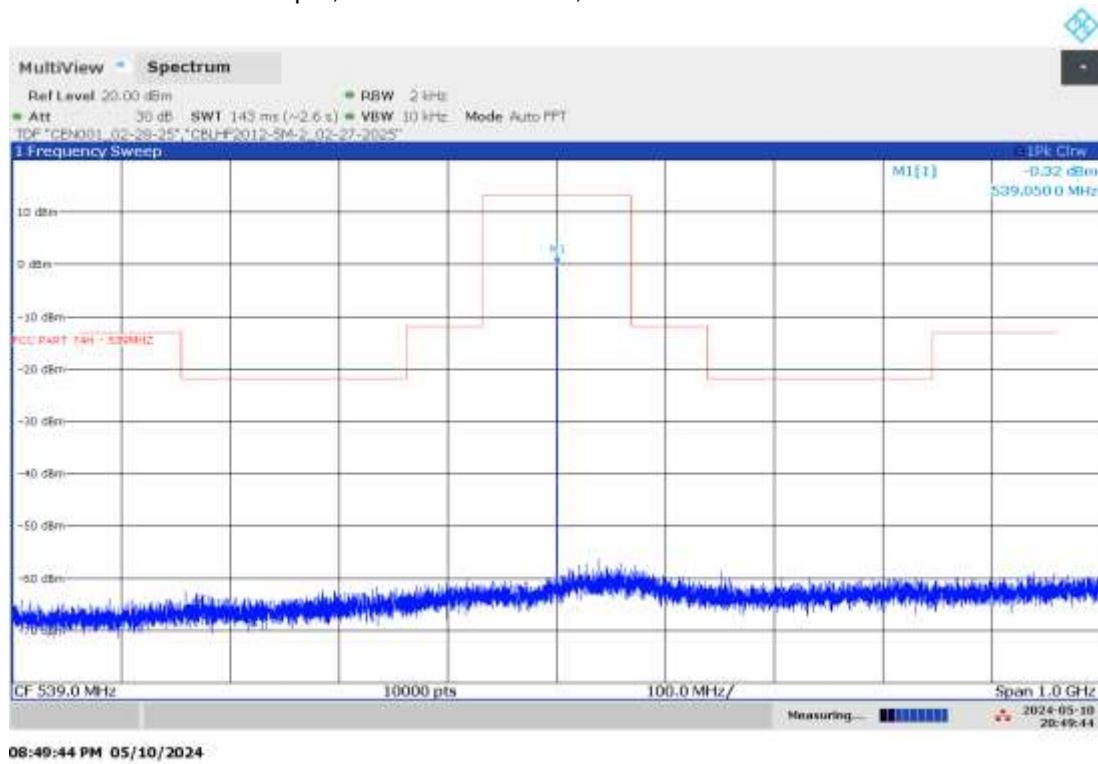


05:53:02 PM 05/09/2024

Input, Unmodulated Signal

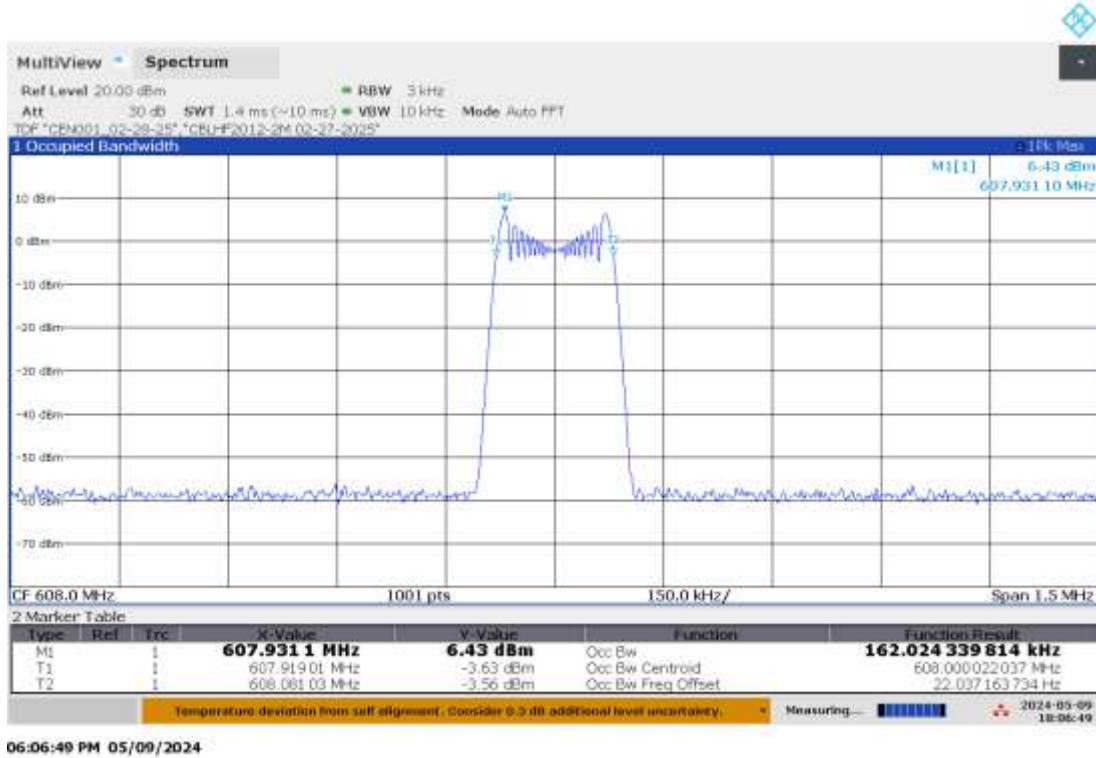


Output, 2.5 kHz modulation, 75 kHz Peak Deviation

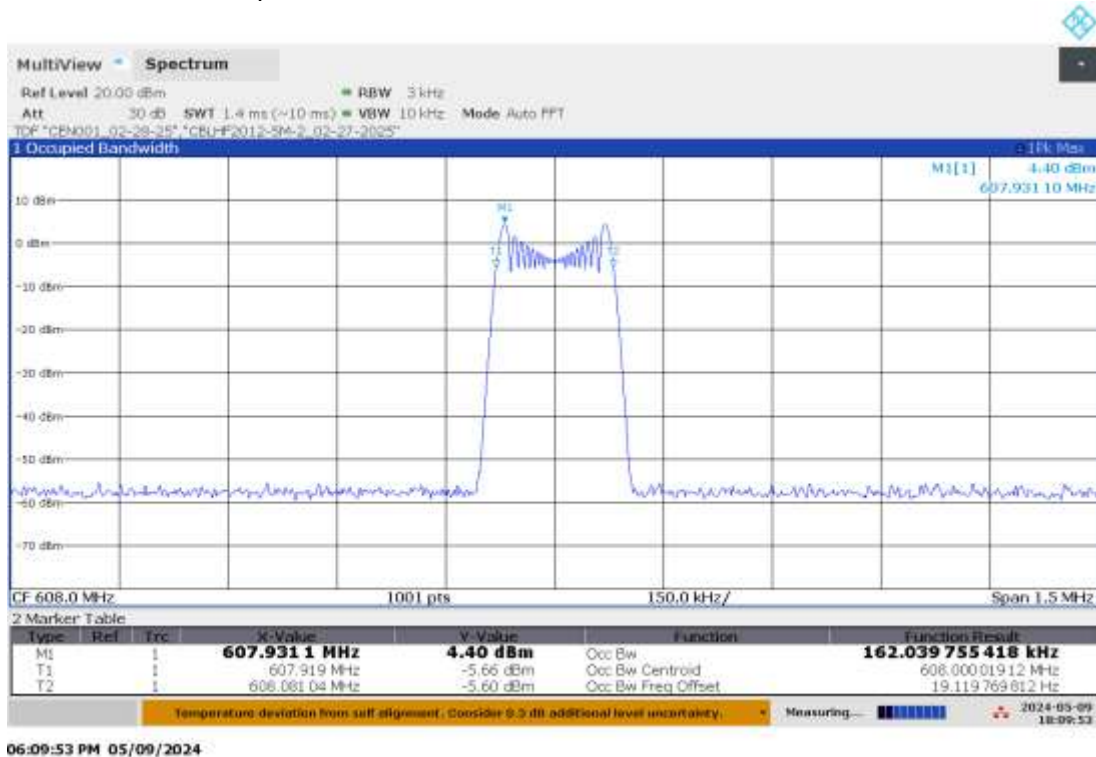


Input OBW vs. Output OBW, Signal passed through at High Channel 608 MHz

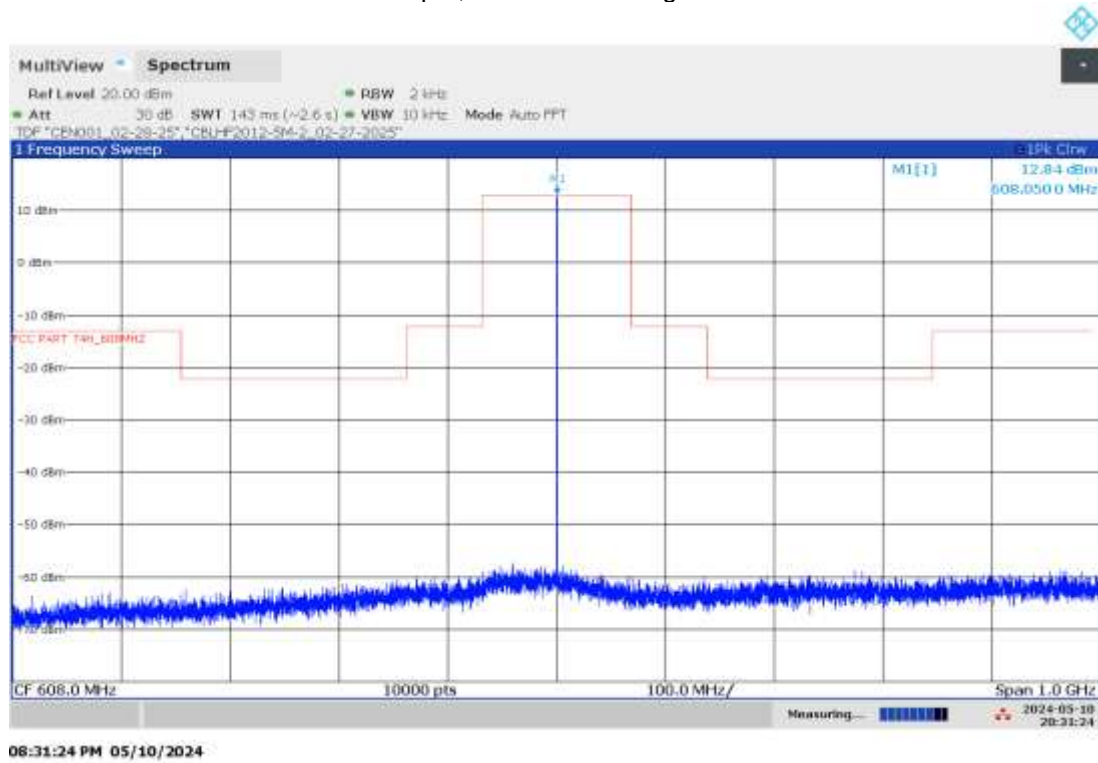
Input OBW, 2.5 kHz modulation, 75 kHz Peak Deviation



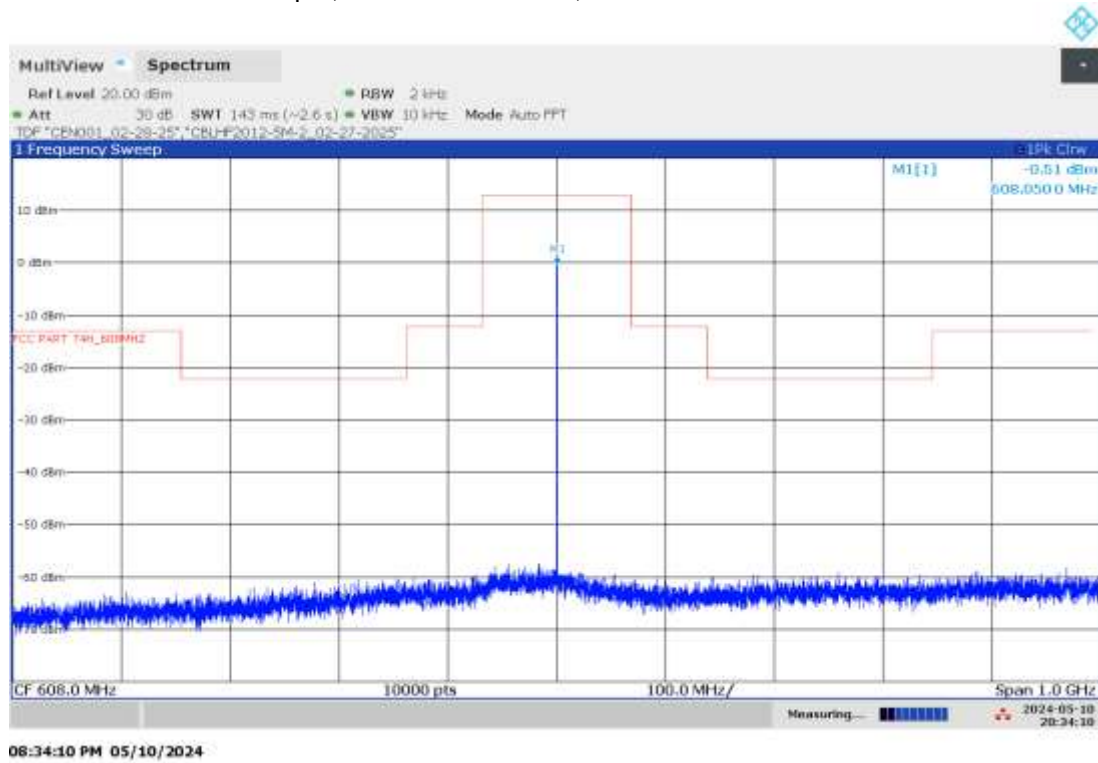
Output OBW, 2.5 kHz modulation, 75 kHz Peak Deviation



Input, Unmodulated Signal

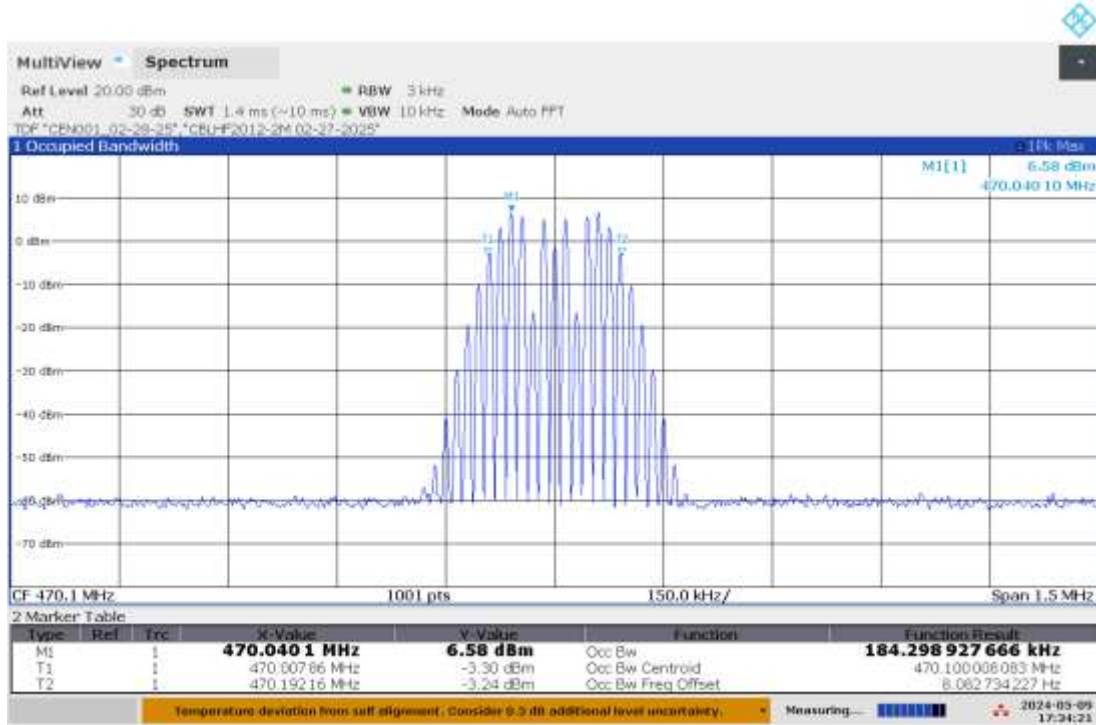


Output, 2.5 kHz modulation, 75 kHz Peak Deviation



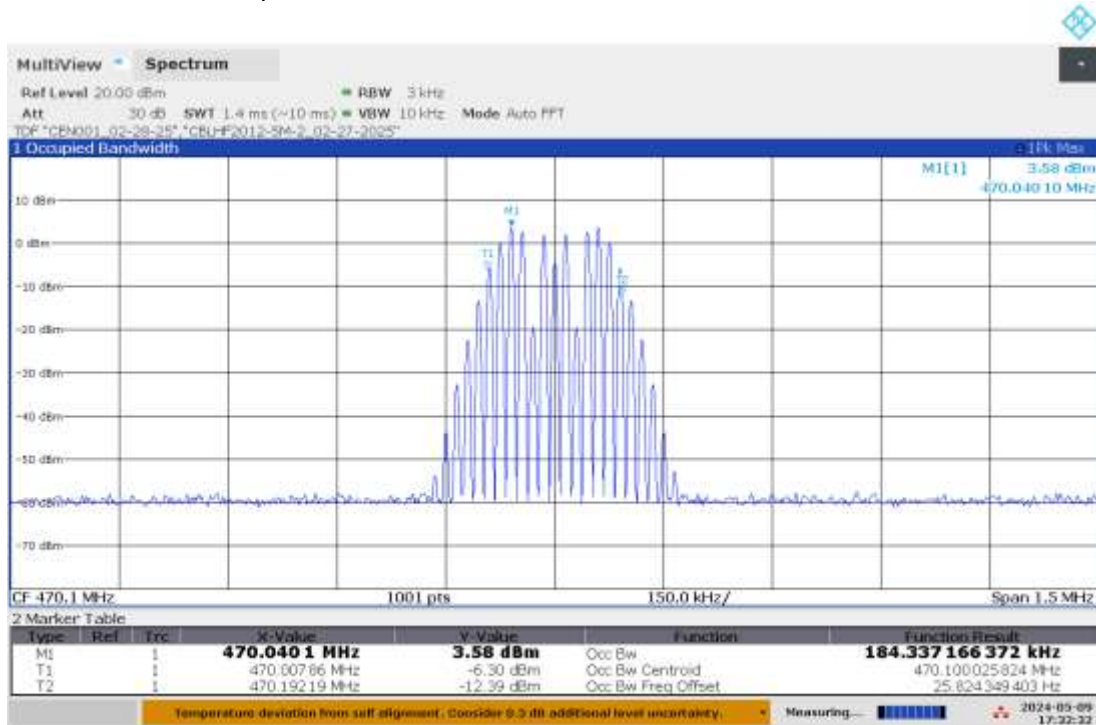
Input OBW vs. Output OBW, Signal passed through at Low Channel 470.1 MHz

Input OBW, 15 kHz modulation, 75 kHz Peak Deviation



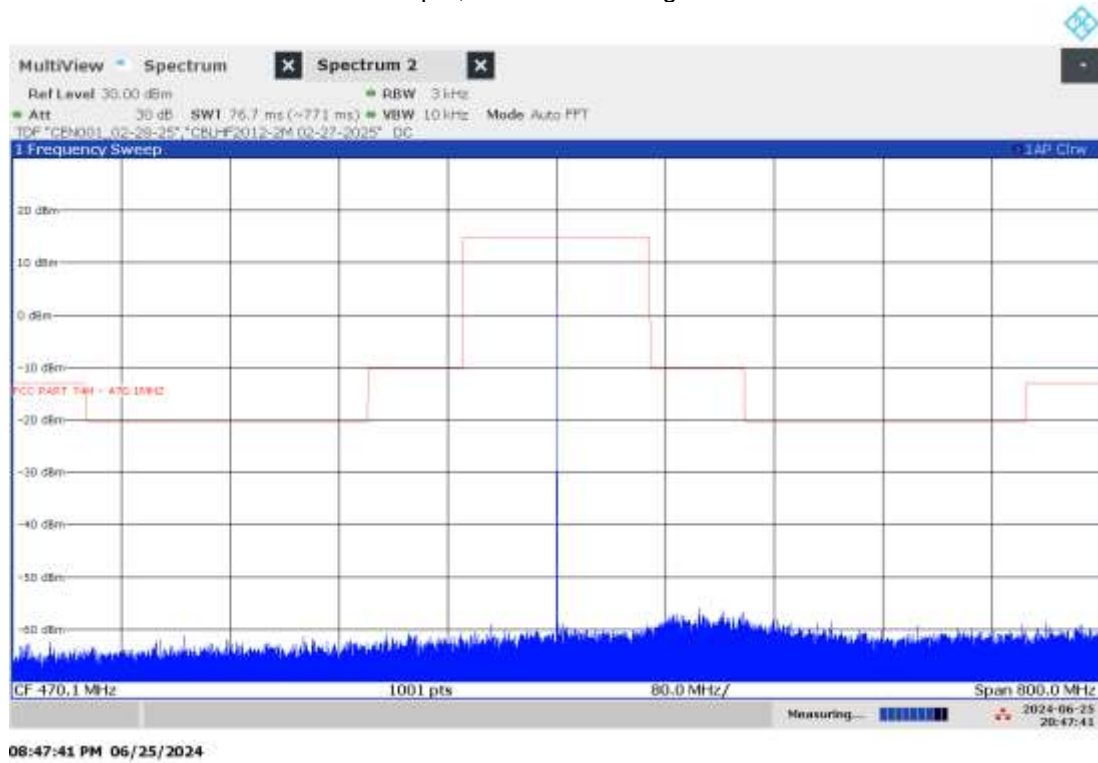
05:34:21 PM 05/09/2024

Output OBW, 15 kHz modulation, 75 kHz Peak Deviation

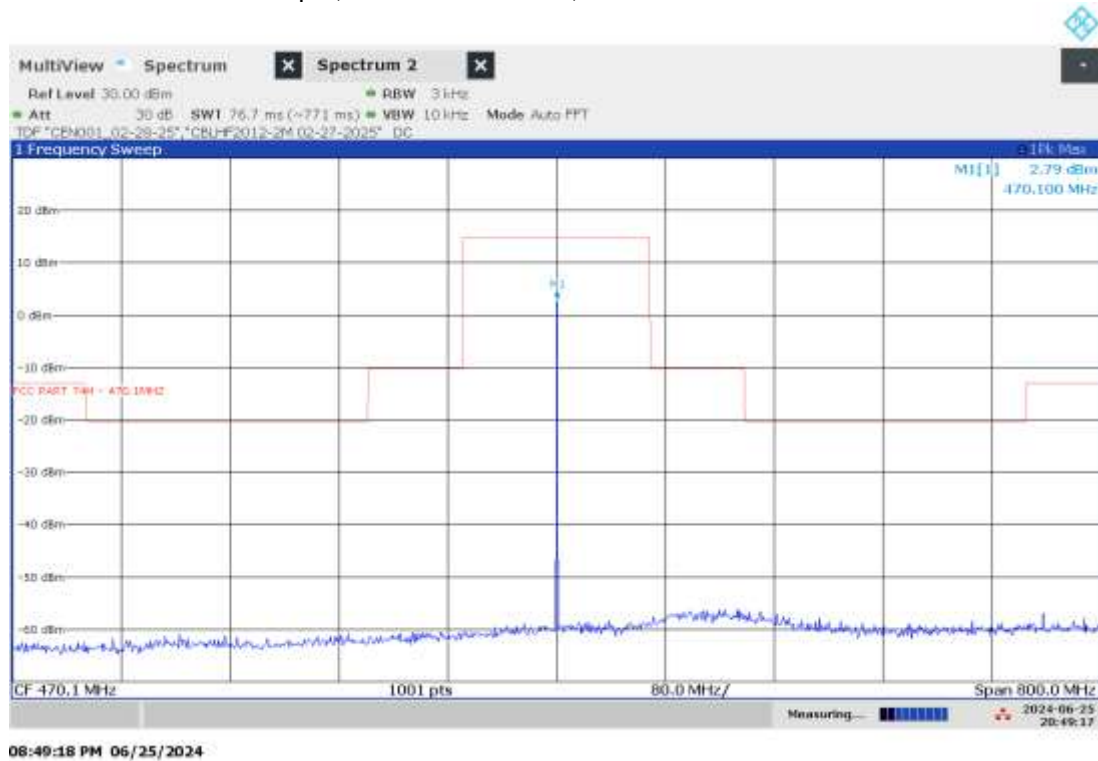


05:32:32 PM 05/09/2024

Input, Unmodulated Signal

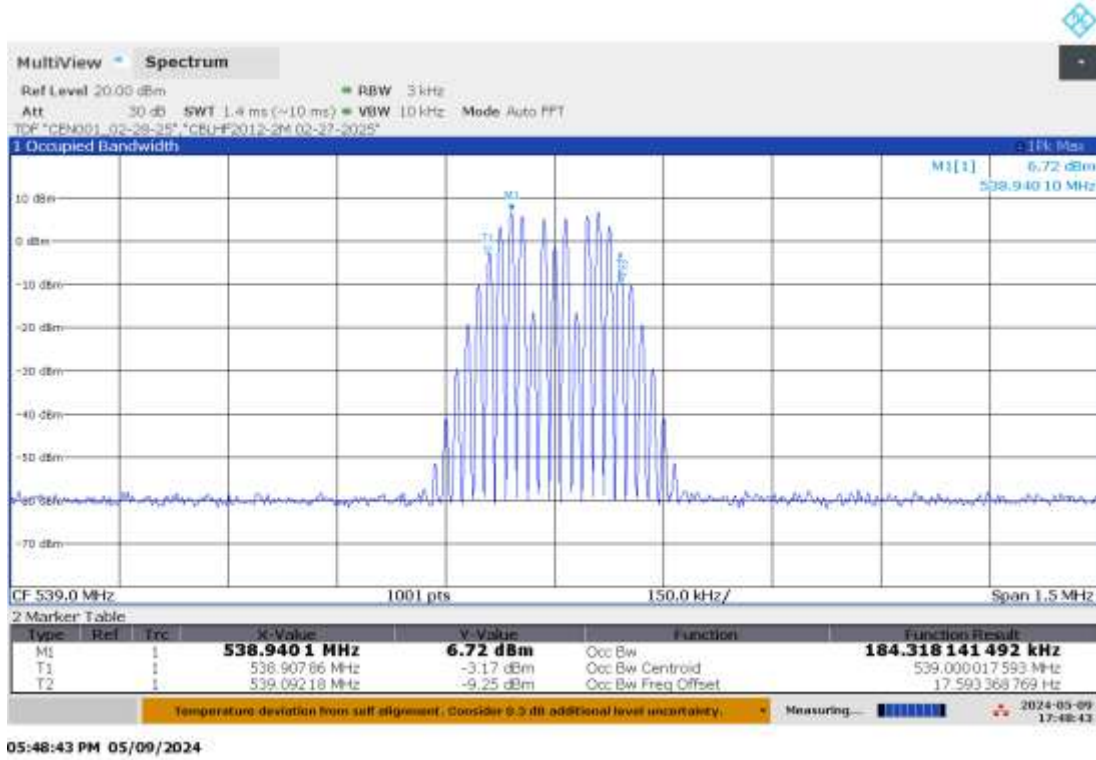


Output, 15 kHz modulation, 75 kHz Peak Deviation

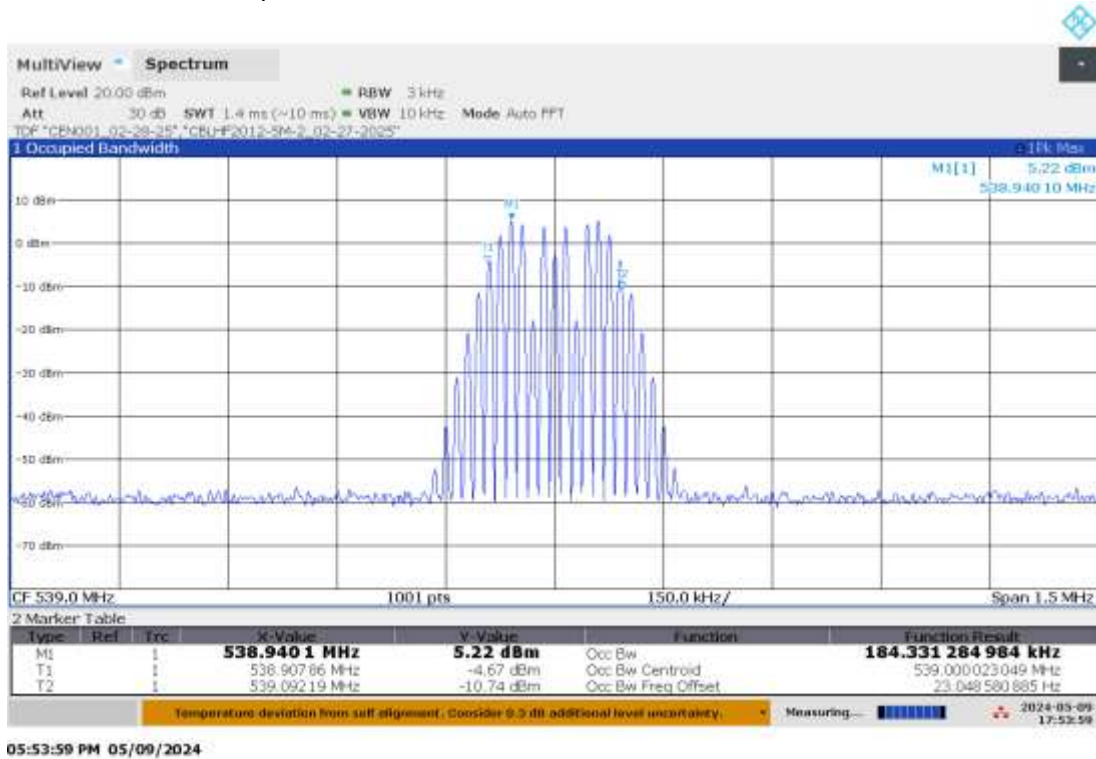


Input OBW vs. Output OBW, Signal passed through at Mid Channel 539 MHz

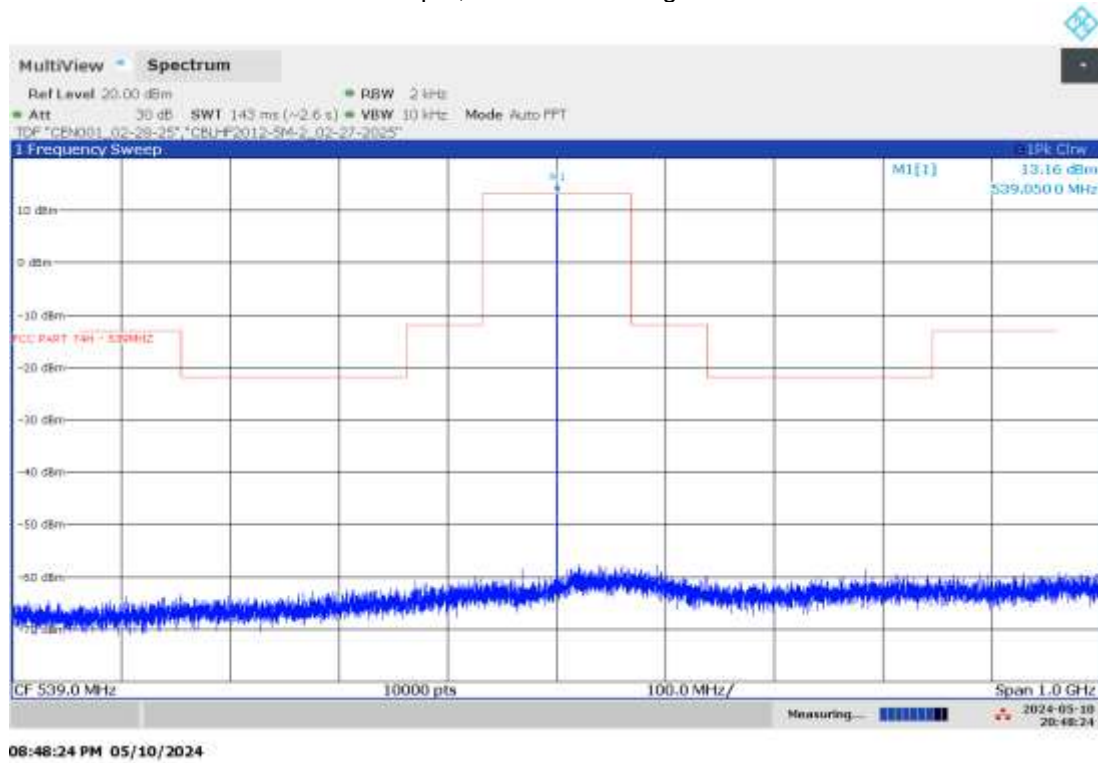
Input OBW, 15 kHz modulation, 75 kHz Peak Deviation



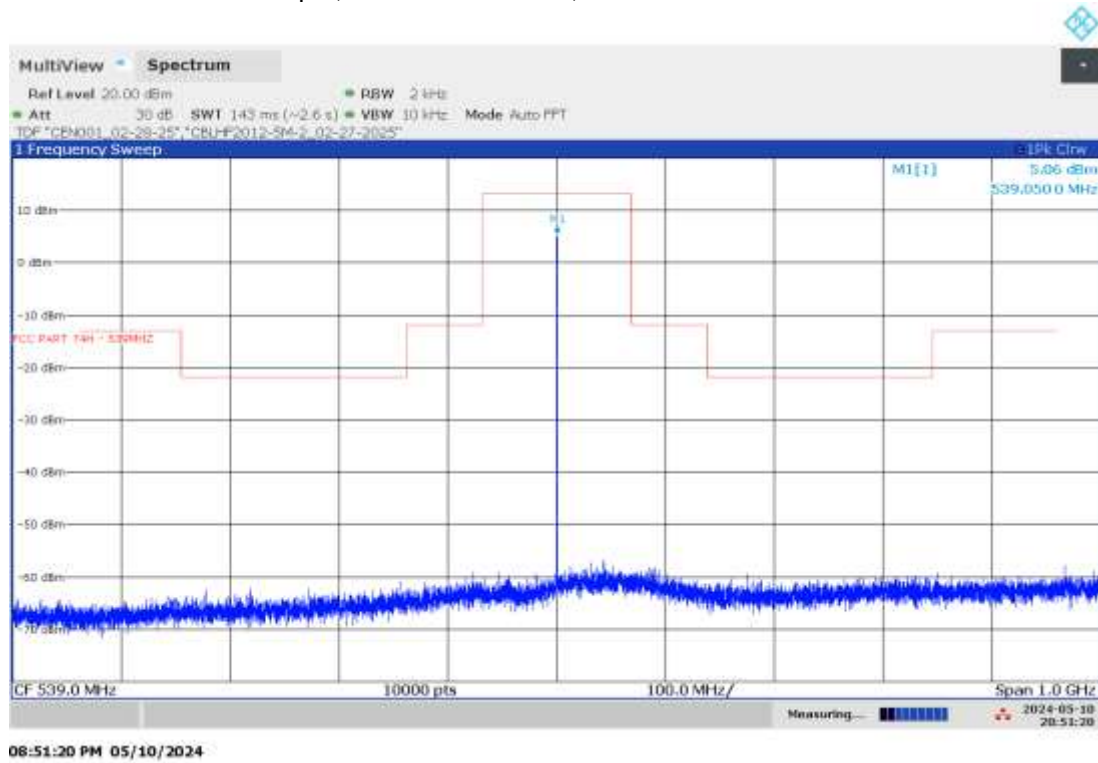
Output OBW, 15 kHz modulation, 75 kHz Peak Deviation



Input, Unmodulated Signal

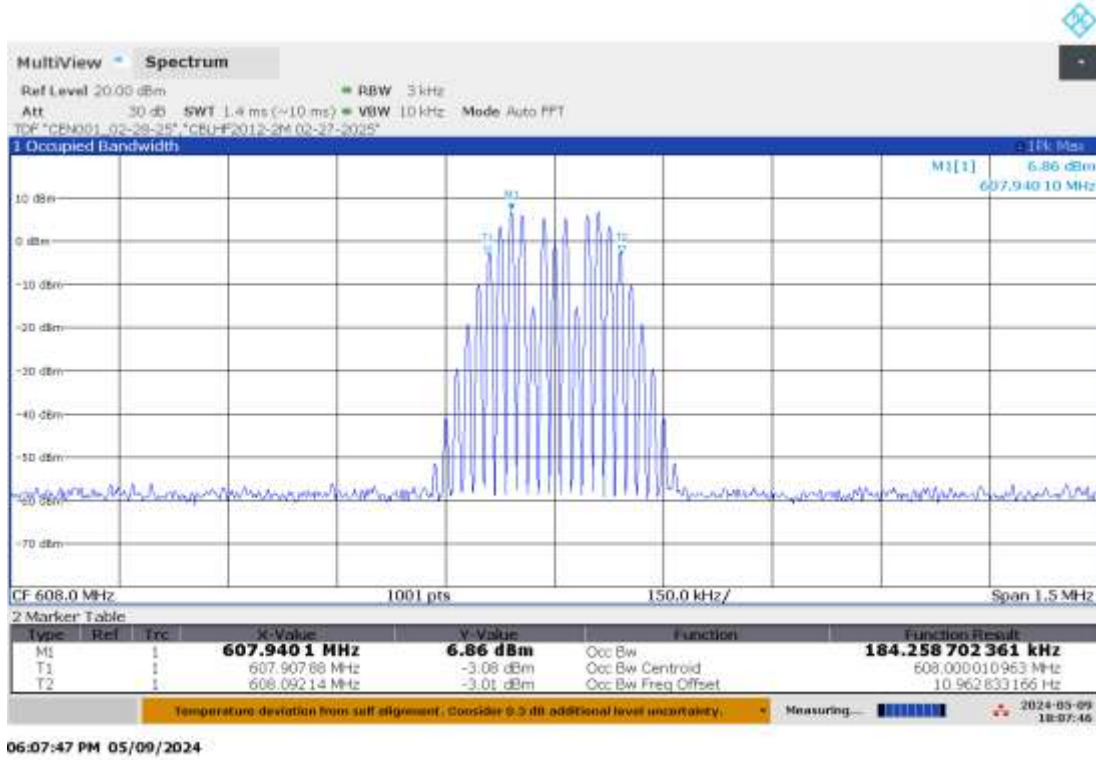


Output, 15 kHz modulation, 75 kHz Peak Deviation

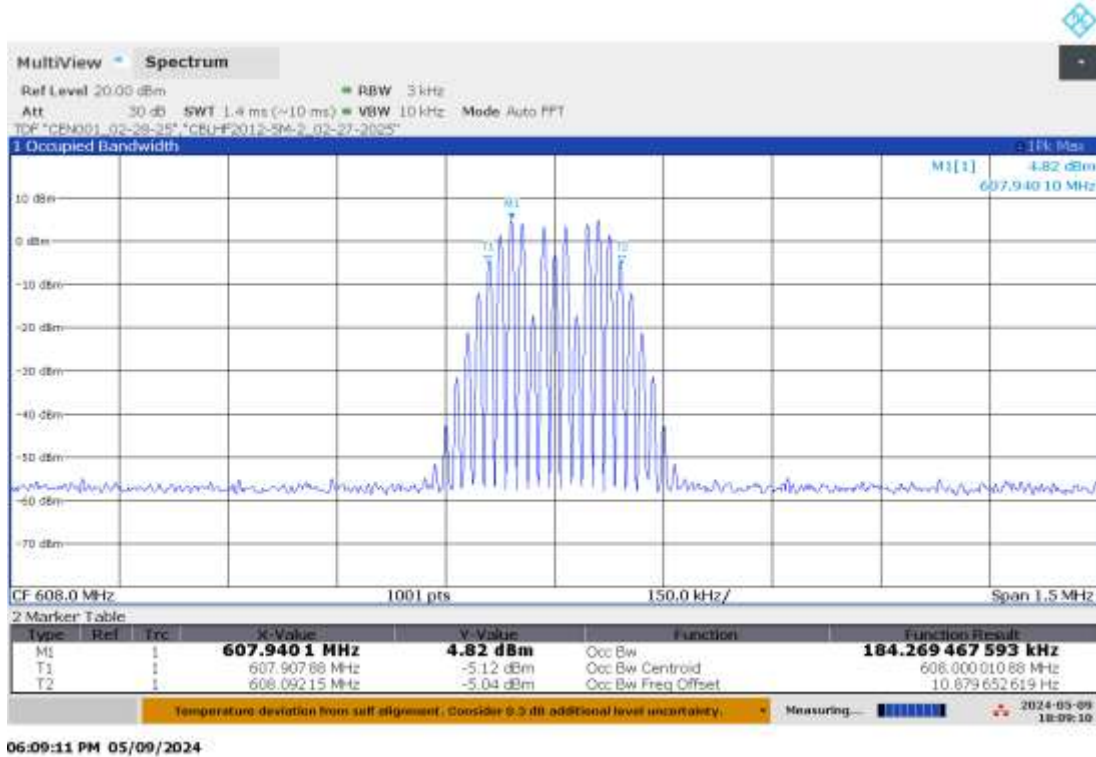


Input OBW vs. Output OBW, Signal passed through at High Channel 608 MHz

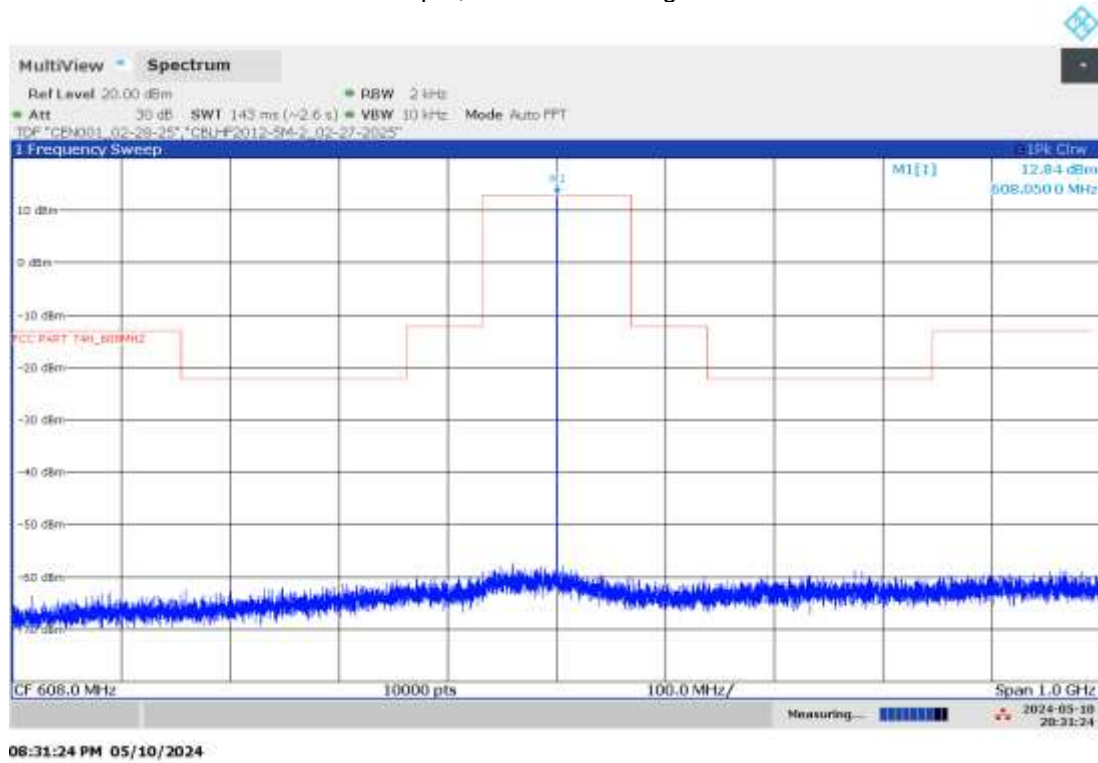
Input OBW, 15 kHz modulation, 75 kHz Peak Deviation



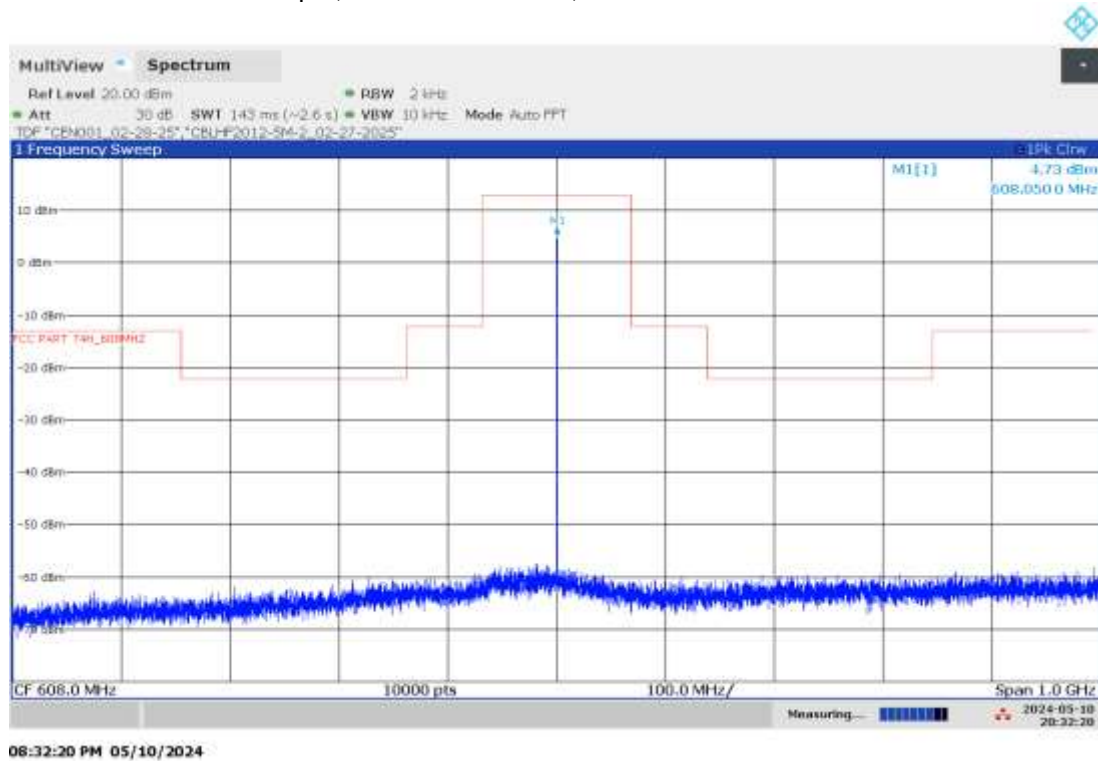
Output OBW, 15 kHz modulation, 75 kHz Peak Deviation



Input, Unmodulated Signal





Output, 15 kHz modulation, 75 kHz Peak Deviation



Intertek

Report Number: 105431768BOX-001R1

Issued: 01/12/2024
Revised: 06/27/2024

Product Standard: FCC Part 74H				Limit applied: See section 7.5 Pretest Verification w/BB source: N/A			
Test Date	Test Personnel/ Initials	Supervising Engineer/ Initials	Input Voltage	Mode	Atmospheric Data		
					Temp C°	Relative Humidity %	Atmospheric Pressure mbar
05/09/2024	Vathana Ven 	N/A	120VAC 60Hz	Active mode	25	34	999
06/25/2024	Vathana Ven 	N/A	120VAC 60Hz	Active mode	20	40	999

Deviations, Additions, or Exclusions: None

8 Transmitter Unwanted Emission (Radiated or Conducted)

8.1 Method

Tests are performed in accordance with FCC Part 74.861(e)(1)(ii), ANSI C63.26.

TEST SITE: 10m ALSE and AMAP Lab

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisprr
Radiated Emissions, 10m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.5 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.8 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.8 dB	N/A

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB/m
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB/m and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

UF = 10^(NF / 20) where UF = Net Reading in μ V
NF = Net Reading in dB μ V

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
UF = 10^(32 dB μ V / 20) = 39.8 μ V/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

8.2 Test Equipment Used:

Test equipment used for conducted measurements

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV009'	weather station	Davis Instruments	6351 Vantage VUE	DAV009	03/27/2023	03/27/2024
147275'	Signal Generator	Rohde & Schwarz	SML01	100931	09/29/2023	09/29/2024
CBLBNC2012-2'	50 Ohm Coaxial Cable	Pomona	RG-58 C/U	CBLBNC2012-2	03/21/2023	03/21/2024
CBLBNC2012-1'	50 Ohm Coaxial Cable	Pomona	RG-58 C/U	CBLBNC2012-1	09/29/2023	09/29/2024
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/28/2023	02/28/2024

Test equipment used for radiated measurements

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007'	Weather Station Vantage Vue	Davis	6250	MS191212003	03/15/2023	03/15/2024
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/28/2023	06/28/2024
PRE10'	30-1000MHz pre-amp	ITS	PRE10	PRE10	02/17/2023	02/17/2024
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/23/2023	06/23/2024
IW001'	Receiver to floor cable	Utiflex	UFB311A-2-0591-70070	145-420	02/18/2023	02/18/2024
145-420'	Receiver to floor cable	Utiflex	UFB311A-2-0591-70070	145-420	02/18/2023	02/18/2024
HS002'	DC-18GHz cable 1.5M long	Huber & Suhner	SucoFlex 106A	HS002	07/19/2023	07/19/2024
145-422'	10Amp Pre-amp to under floor	Utiflex	UFB311A-0-2756-70070	145-422	02/18/2023	02/18/2024
145-408'	10m Chamber - 3m Track B In-floor Cable	Huber + Suhner	sucocflex 106-11000mm	001	07/19/2023	07/19/2024
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	10/09/2023	10/09/2024
CBLHF2012-5M-2	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/25/2023	02/25/2024
CBLHF2012-5M-2	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/25/2023	02/25/2024
145-414'	Cable 145-414	Huber + Suhner	3m Track A cable	145-414	07/19/2023	07/19/2024
BONN001'	1-18GHz low noise pre-amp	Bonn	BLMA 0118-M	1811749	07/19/2023	07/19/2024
CBL051'	9kHz to 1GHz BNC/ BNC Cable	Belden	RG58A/U	none	06/11/2023	06/12/2024
145019'	Active Loop Antenna (9 KHz to 30 MHz)	EMCO	6502/1	9902-3267	02/27/2023	02/27/2024
145-424'	9kHz to 40GHz Cable	Huber and Suhner	Sucoflex	145-424	02/18/2023	02/18/2024
HS001'	DC-18GHz cable 1.5m long	Huber & Suhner	SucoFlex 106A	HS001	01/25/2023	01/25/2024
HS003'	10m under floor cable	Huber-Schuner	10m-1	HS003	02/18/2023	02/18/2024
145106'	Bilog Antenna (30MHz - 5GHz)	Sunol Sciences	JB5	A111003	09/14/2023	09/14/2024
CBLHF2012-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/25/2023	02/25/2024
ROS011'	ESW44 receiver 1Hz-44GHz	Rhode and Schwarz	ESW44	103296	06/28/2023	06/28/2024
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	10/25/2023	10/25/2024
ROS005-2'	Vector Signal Generator	Rohde & Schwartz	SMB-100A	178319	11/02/2023	11/02/2024
ETS003'	9kHz-30MHz Active Loop Antenna	ETS Lindgren	6502	00143396	09/20/2023	09/20/2024
145019'	Active Loop Antenna (9 KHz to 30 MHz)	EMCO	6502/1	9902-3267	02/27/2023	02/27/2024
DAV009'	weather station	Davis Instruments	6351 Vantage VUE	DAV009	03/27/2023	03/27/2024
147275'	Signal Generator	Rohde & Schwarz	SML01	100931	09/29/2023	09/29/2024
CBLBNC2012-2'	50 Ohm Coaxial Cable	Pomona	RG-58 C/U	CBLBNC2012-2	03/21/2023	03/21/2024
CBLBNC2012-1'	50 Ohm Coaxial Cable	Pomona	RG-58 C/U	CBLBNC2012-1	09/29/2023	09/29/2024

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	NEXIO	2022.0.27.0
EMI Boxborough.xls	Intertek	08/27/2010

8.3 Results:

The sample tested was found to Comply.

8.4 Setup Photographs:

Photo not available due to confidentiality request by the client

Intertek

Report Number: 105431768BOX-001R1

Issued: 01/12/2024
Revised: 06/27/2024

9 kHz-30 MHz, Antenna on X-Axis

Photo not available due to confidentiality request by the client

9 kHz-30 MHz, Antenna on Y-Axis

Photo not available due to confidentiality request by the client

Intertek

Report Number: 105431768BOX-001R1

Issued: 01/12/2024
Revised: 06/27/2024

9 kHz-30 MHz, Antenna on Z-Axis

Photo not available due to confidentiality request by the client

Intertek

Report Number: 105431768BOX-001R1

Issued: 01/12/2024
Revised: 06/27/2024

30-1000 MHz

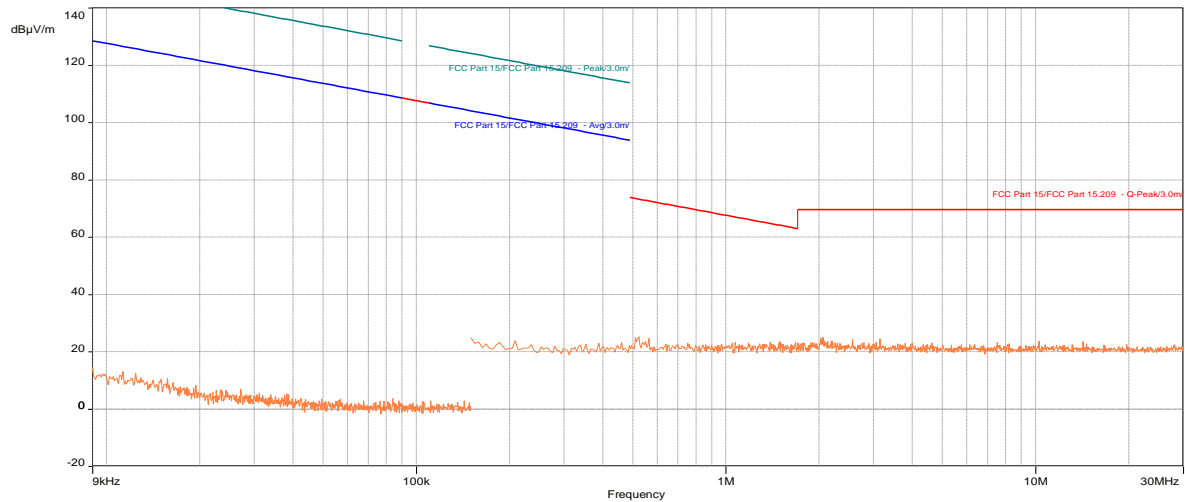
Photo not available due to confidentiality request by the client

1-13 GHz

Photo not available due to confidentiality request by the client

8.5 Plots/Data:**Test Information:**

Date and Time	11/28/2023 5:29:33 PM
Client and Project Number	RF Venue_G105431768
Engineer	Vathana Ven
Temperature	22 deg C
Humidity	19%
Atmospheric Pressure	998 mB
Comments	RE 9kHz-30MHz Loop antenna, Electric Field, 3M Location (FCC 15.209) Low, Mid, High CH

Graph:

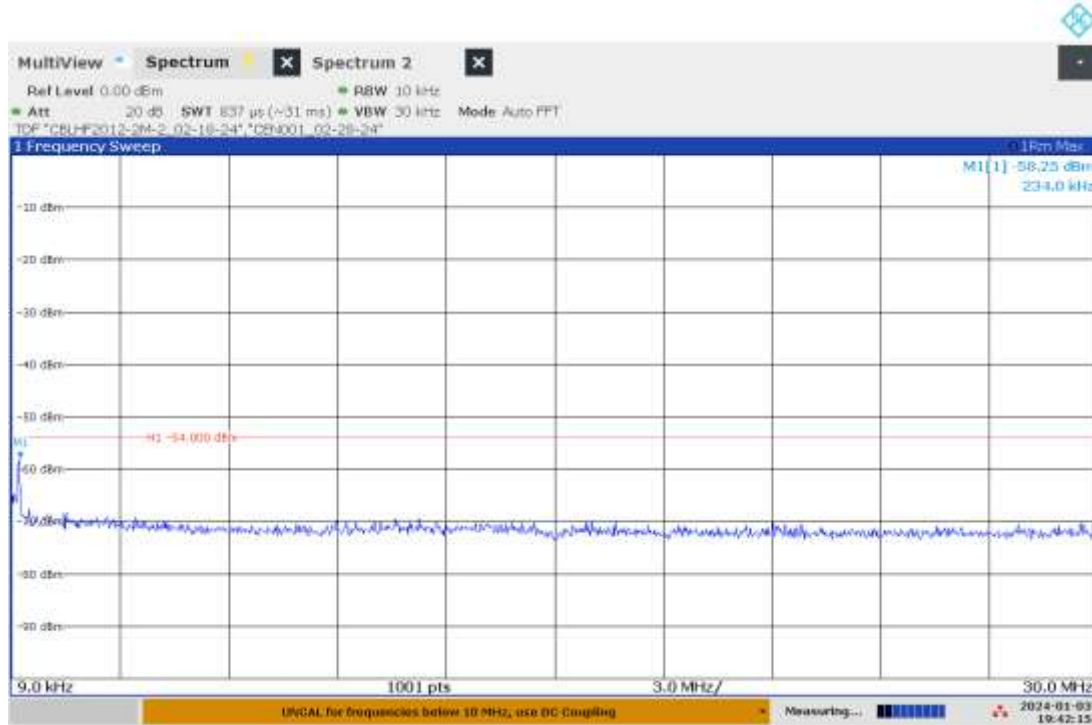
Results: No emissions were detected. Worst-case channel and orientation.

Radiated Emissions, Substitution

Company: RF Venue
 Model #: 6-to-1 RF active RF combiner
 Serial #: 003
 Engineer(s): Vathana Ven
 Project #: G105431768
 Standard: FCC PART 15H/RSS-210
 Barometer: DAV006 Temp/Humidity/Pressure: 22 deg C 17% 1012 mB
 Location: 10M Chamber
 Date(s): 01/05/24
 Rx Antenna: 145-145 ETS002
 Rx Cable(s): 145-422, IW003, 145-424, HS001, HS003, 145-420
 Rx Preamp: PRE10, BONN001 Receiver: ROS011
 Tx Antenna: 145-106 HORN3
 Tx Cable(s): CBLHF2012-5M-2
 Tx Signal Generator: ROS005-2
 ERP or EIRP?: ERP
 Test Distance (m): 3 & 10 Voltage/Frequency: 120VAC 60Hz Frequency Range: 30MHz-13GHz
 Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain (dBi or dBd)
 Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor RB = Restricted Band; Bandwidth denoted as RBW/VBW

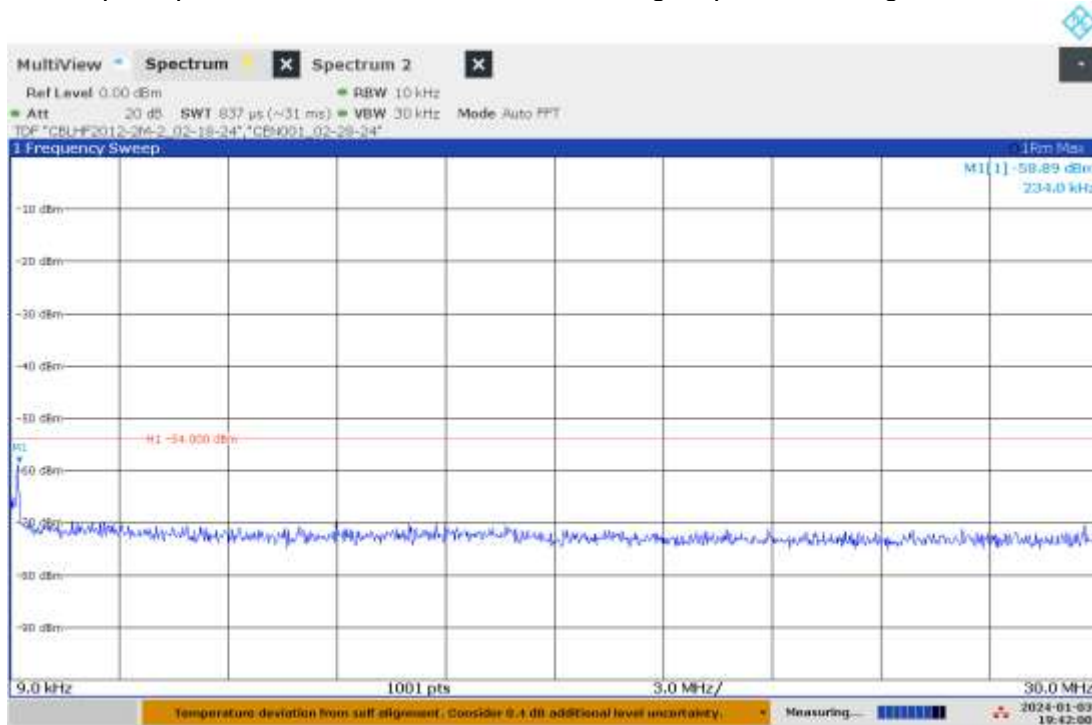
Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Operating conditions: Low, Mid, High channels (worst-case was reported here)											
PK	V	81.594	49.25	90.75	0.66	-5.10	-20.00	-69.41	-36.00	-33.41	120/300 kHz
PK	V	89.270	57.43	88.85	0.66	-4.60	-20.00	-58.83	-54.00	-4.83	120/300 kHz
PK	V	142.454	61.49	83.58	0.95	-5.90	-20.00	-51.09	-36.00	-15.09	120/300 kHz
PK	V	144.608	61.21	83.90	0.95	-5.70	-20.00	-51.49	-36.00	-15.49	120/300 kHz
PK	V	160.728	51.67	85.94	0.95	-3.90	-20.00	-61.27	-36.00	-25.27	120/300 kHz
PK	H	940.146	33.52	74.48	2.12	1.20	-20.00	-64.03	-36.00	-28.03	120/300 kHz
PK	V	2106.250	61.63	102.37	2.94	8.78	-20.00	-57.05	-30.00	-27.05	1/3 MHz
PK	V	2345.450	61.26	102.02	3.22	9.60	-20.00	-56.53	-30.00	-26.53	1/3 MHz
PK	V	2538.700	60.68	101.66	3.35	9.55	-20.00	-56.93	-30.00	-26.93	1/3 MHz

Antenna port spurious emissions, 9 kHz-30 MHz, signal passed through at Low Channel



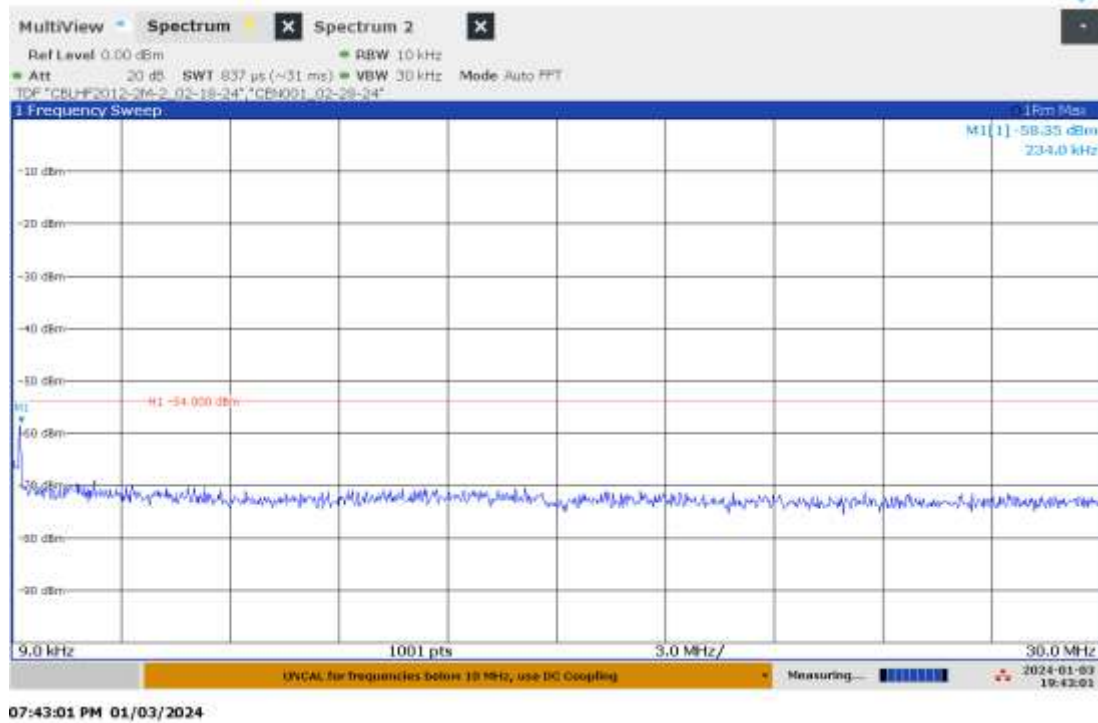
07:42:16 PM 01/03/2024

Antenna port spurious emissions, 9 kHz-30 MHz, signal passed through at Mid Channel

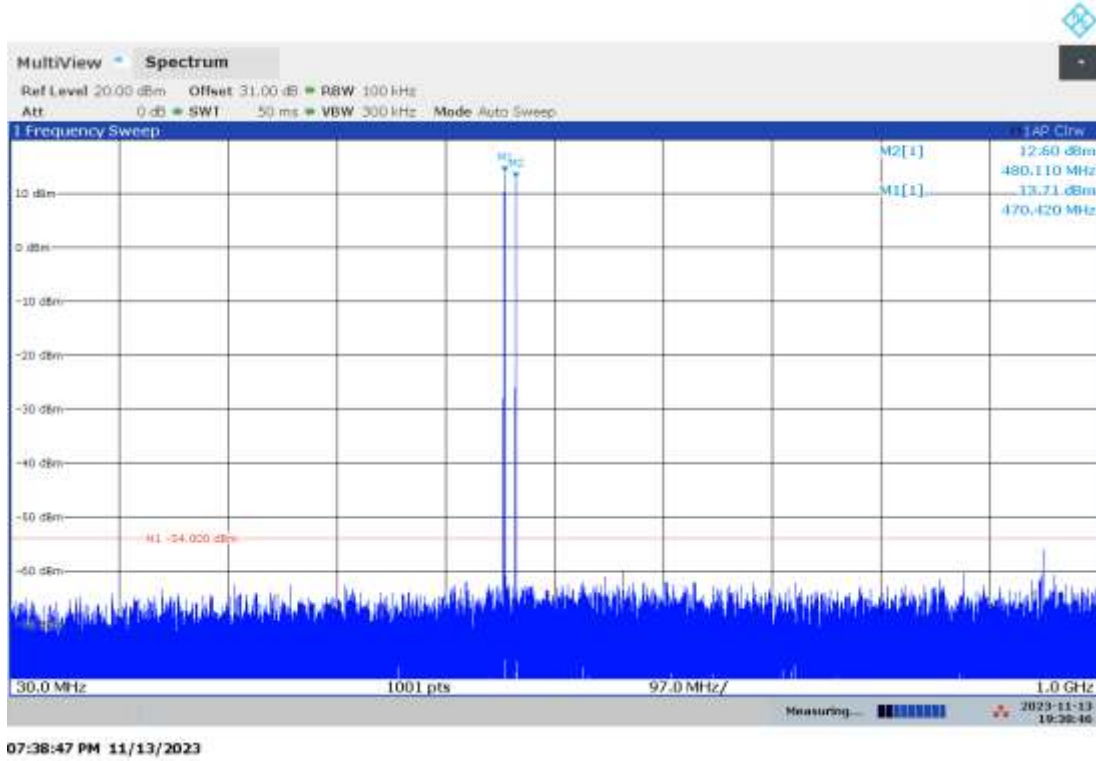


07:42:00 PM 01/03/2024

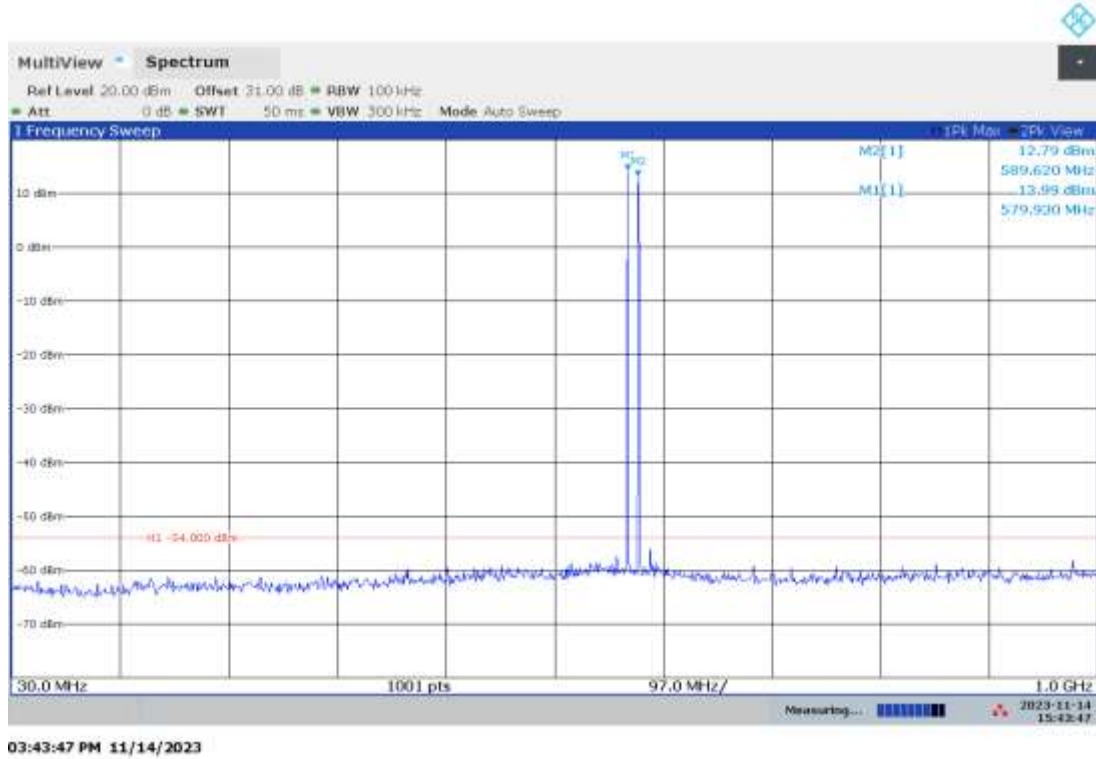
Antenna port spurious emissions, 9 kHz-30 MHz, signal passed through at High Channel



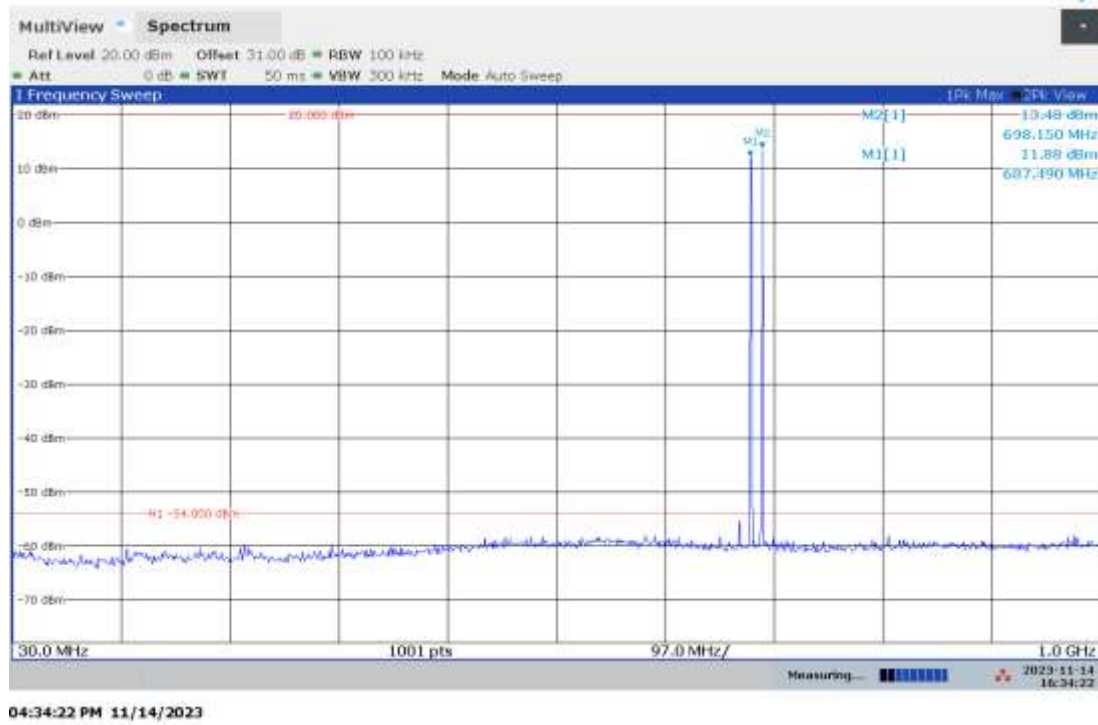
Antenna port spurious emissions, 30-1000 MHz, signal passed through at Low Channel



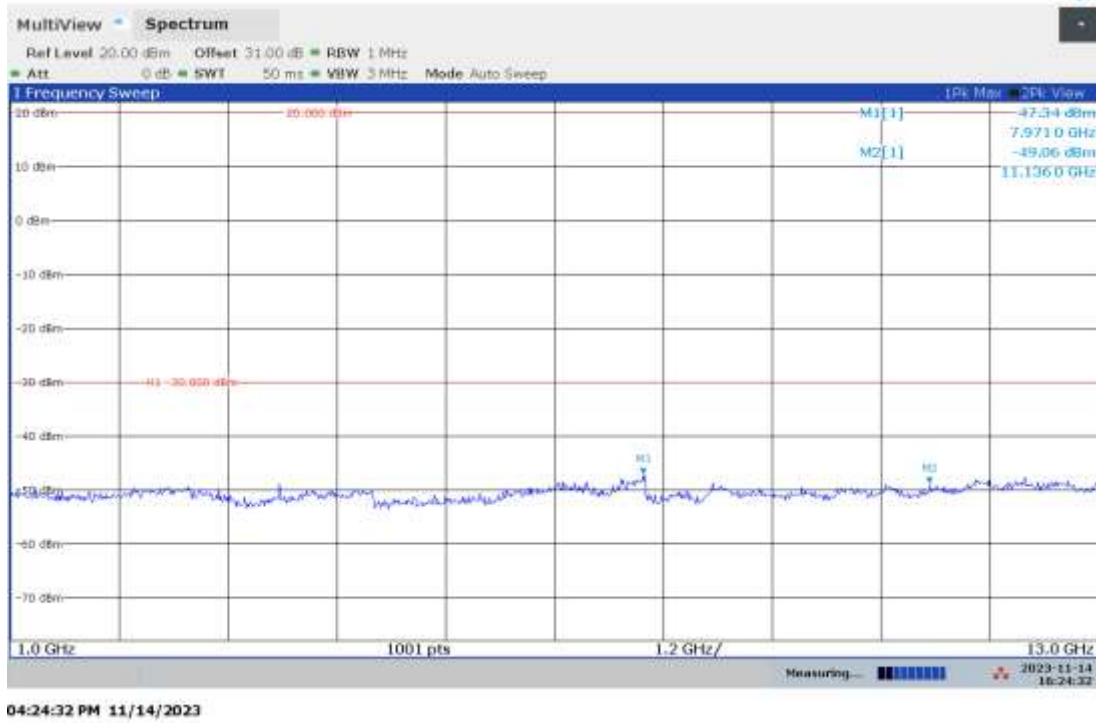
Antenna port spurious emissions, 30-1000 MHz, signal passed through at Mid Channel



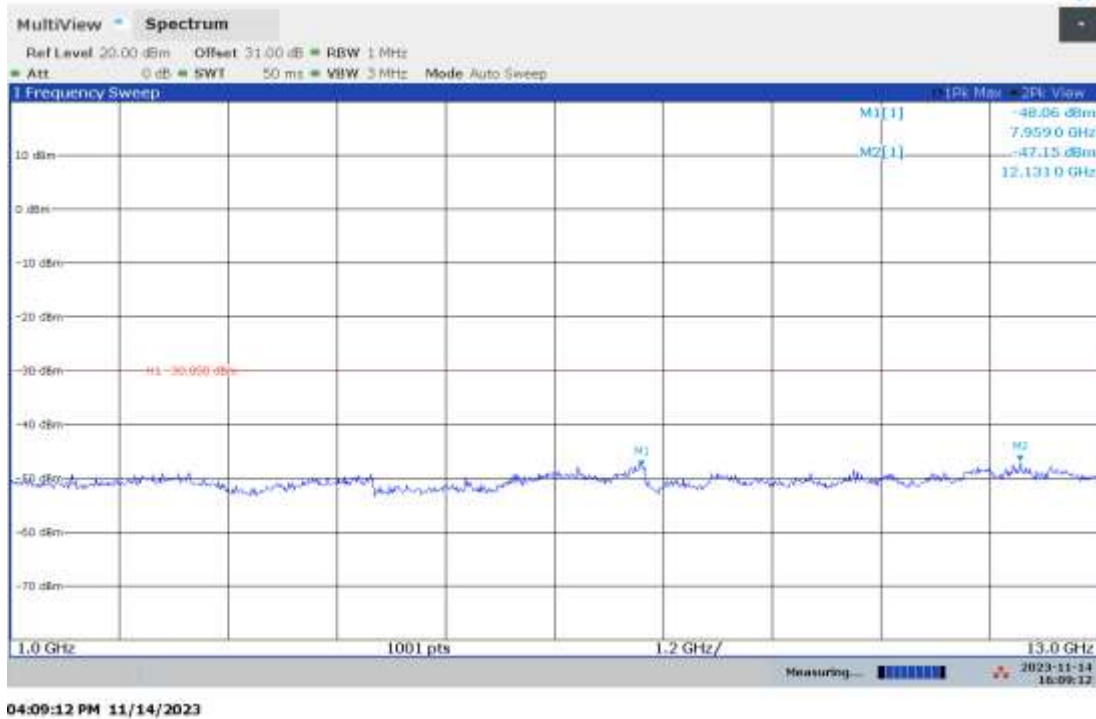
Antenna port spurious emissions, 30-1000 MHz, signal passed through at High Channel



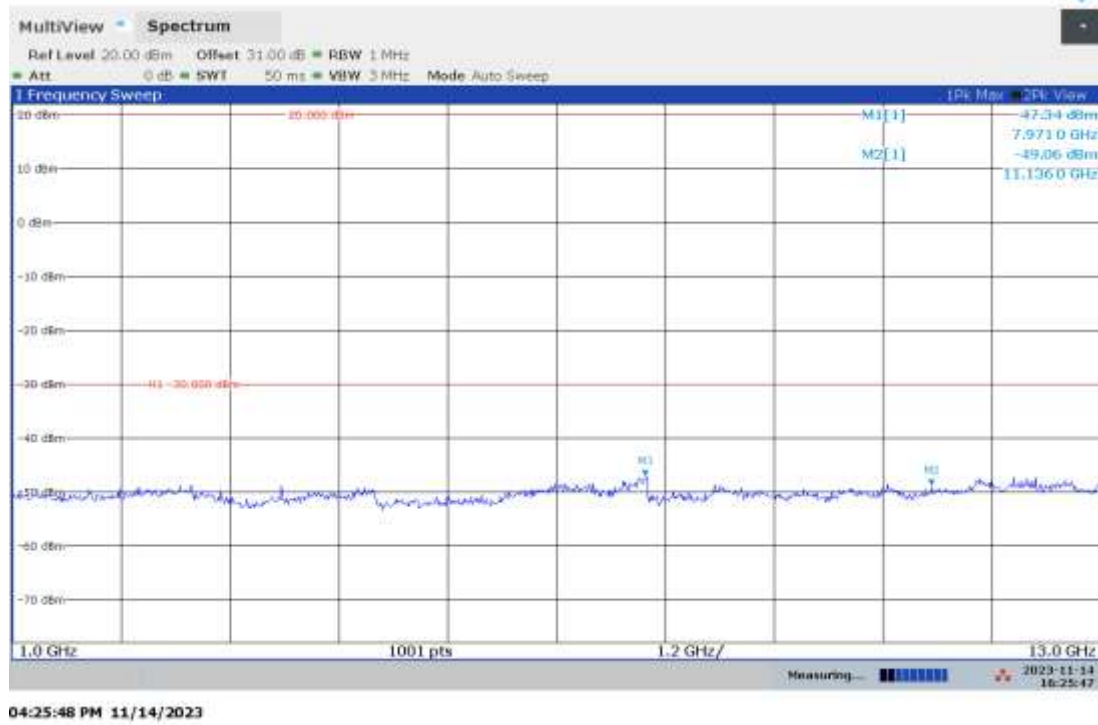
Antenna port spurious emissions, 1-13 GHz, signal passed through at Low Channel



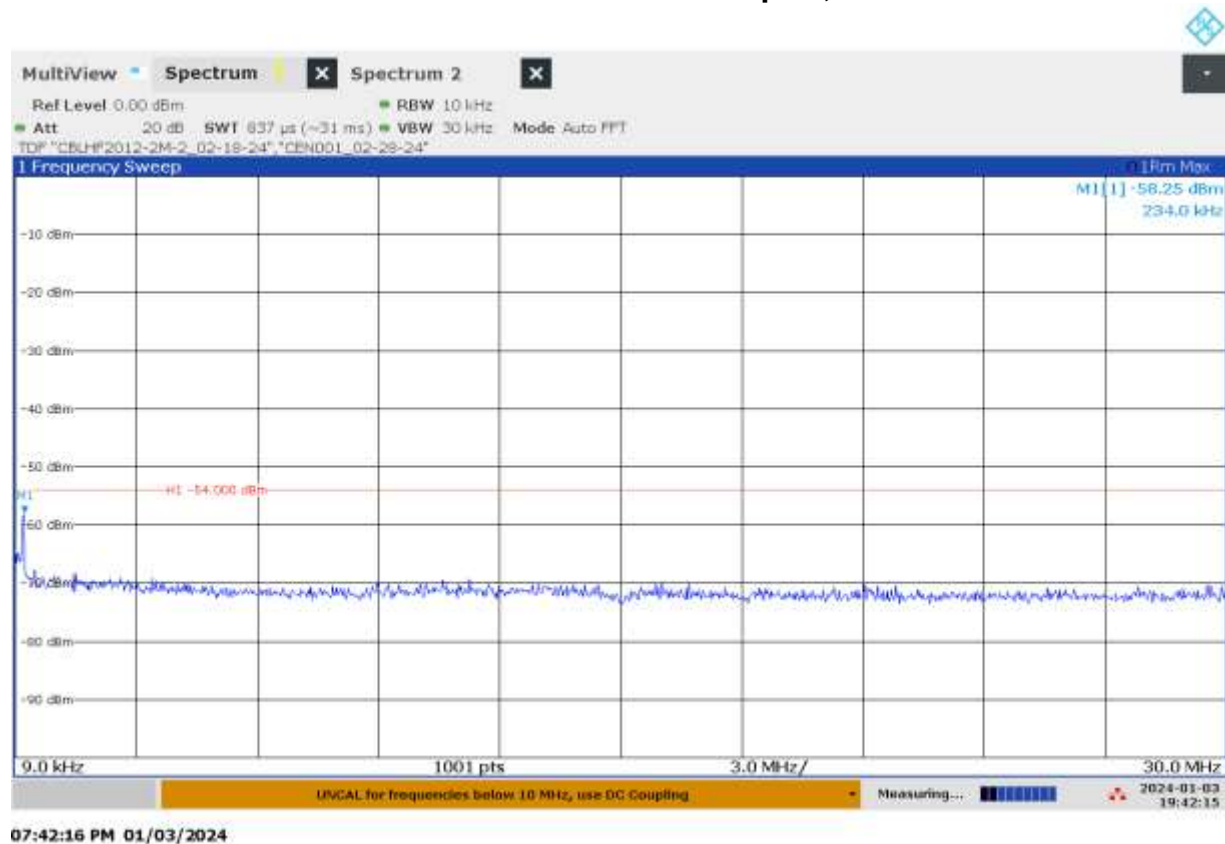
Antenna port spurious emissions, 1-13 GHz, signal passed through at Mid Channel



Antenna port spurious emissions, 1-13 GHz, signal passed through at High Channel

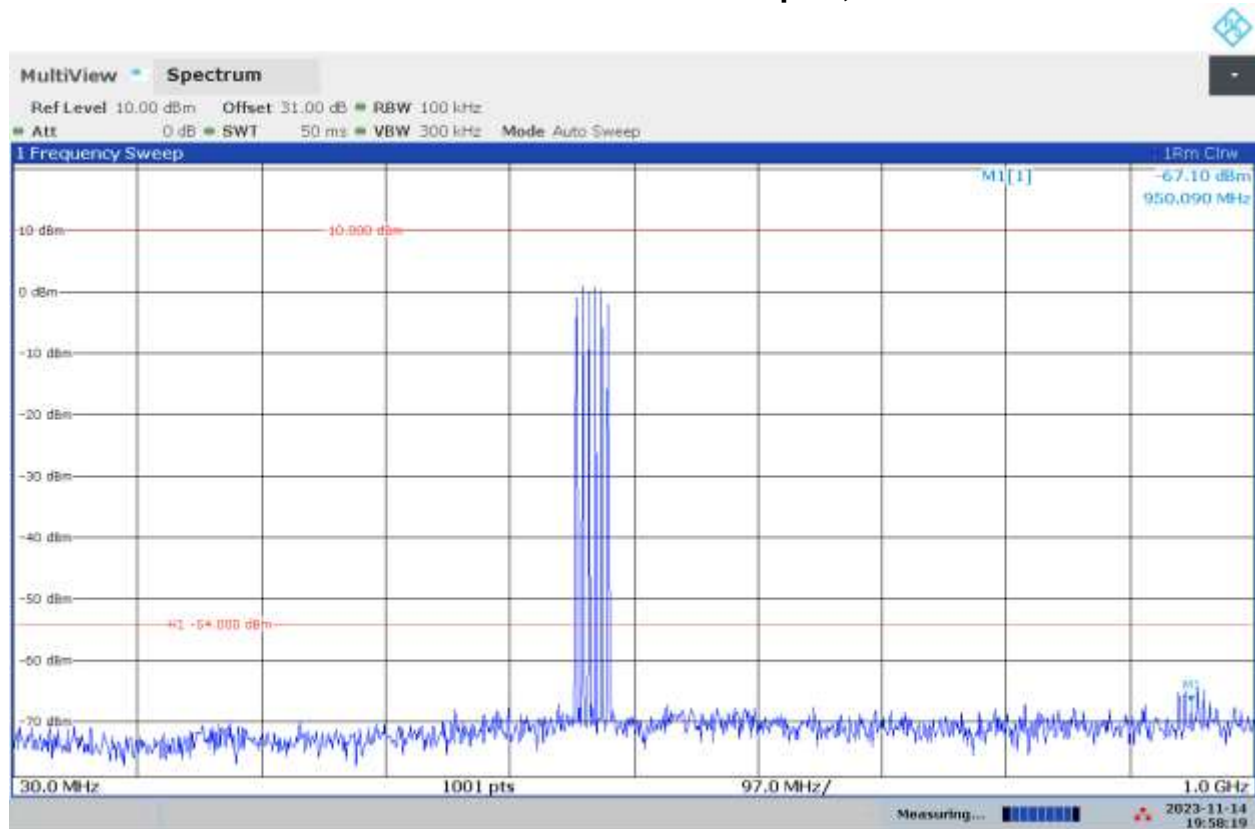


Intermodulation Emission – Antenna port, 9 kHz-30 MHz



Note: Six carriers at 15 dBm were injected into the inputs. Measurements were made at the output and it showed that the intermodulation signals were all under -54 dBm.

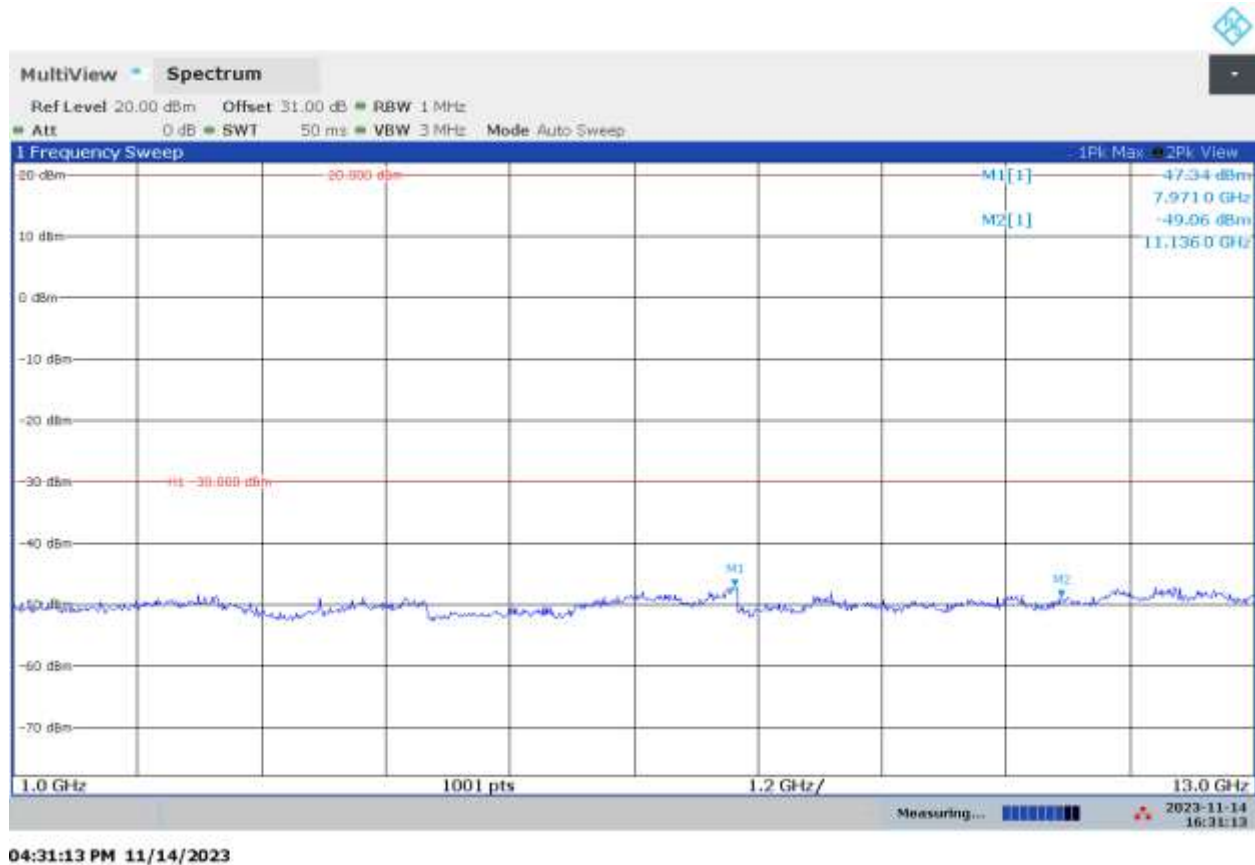
Intermodulation Emission – Antenna port, 30-1000 MHz



07:58:19 PM 11/14/2023

Note: Six carriers at 15 dBm were injected into the inputs. Measurements were made at the output and it showed that the intermodulation signals were all under -54 dBm.

Intermodulation Emission– Antenna port, 1-13 GHz



Note: Six signals at 15 dBm were injected into the inputs. Measurements were made at the output and it showed that the intermodulation signals were all under -30 dBm.

Product Standard: FCC Part 74H				Limit applied: See section data section Pretest Verification w/BB source: N/A			
Test Date	Test Personnel/ Initials	Supervising Engineer/ Initials	Input Voltage	Mode	Atmospheric Data		
					Temp C°	Relative Humidity %	Atmospheric Pressure mbar
11/13/2023	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	23	27	996
11/14/2023	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	23	23	1027
11/28/2023	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	22	28	998
01/03/2024	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	22	21	1016
01/05/2024	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	22	17	1012

Deviations, Additions, or Exclusions: None

9 Emission Masks

9.1 Method

Tests are performed in accordance with FCC Part 74.861(e)(7).

TEST SITE: AMAP Lab

9.2 Test Equipment Used:

Test equipment used on 05/09/2024

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS005-2'	Vector Signal Generator	Rohde & Schwartz	SMB-100A	178319	11/02/2023	11/02/2024
DAV009'	weather station	Davis Instruments	6351 Vantage VUE	DAV009	04/05/2024	04/05/2025
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	02/28/2024	02/28/2025
CBLHF2012-2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252675002	02/27/2024	02/27/2025
CBLHF2012-5M-2'	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/27/2024	02/27/2025

Software Utilized:

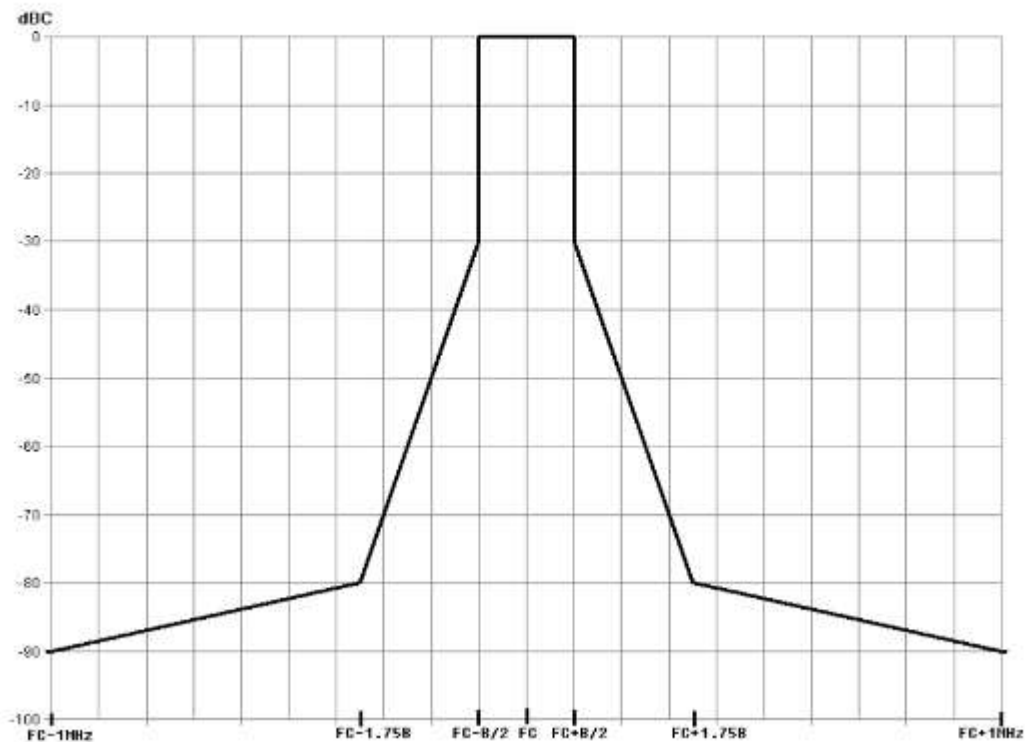
Name	Manufacturer	Version
None	N/A	N/A

9.3 Results:

The sample tested was found to Comply.

8.3.2.2 Limits

The transmitter output spectrum shall be within the mask defined in figure 4. This mask may also be used for analogue.



9.4 Setup Photograph:

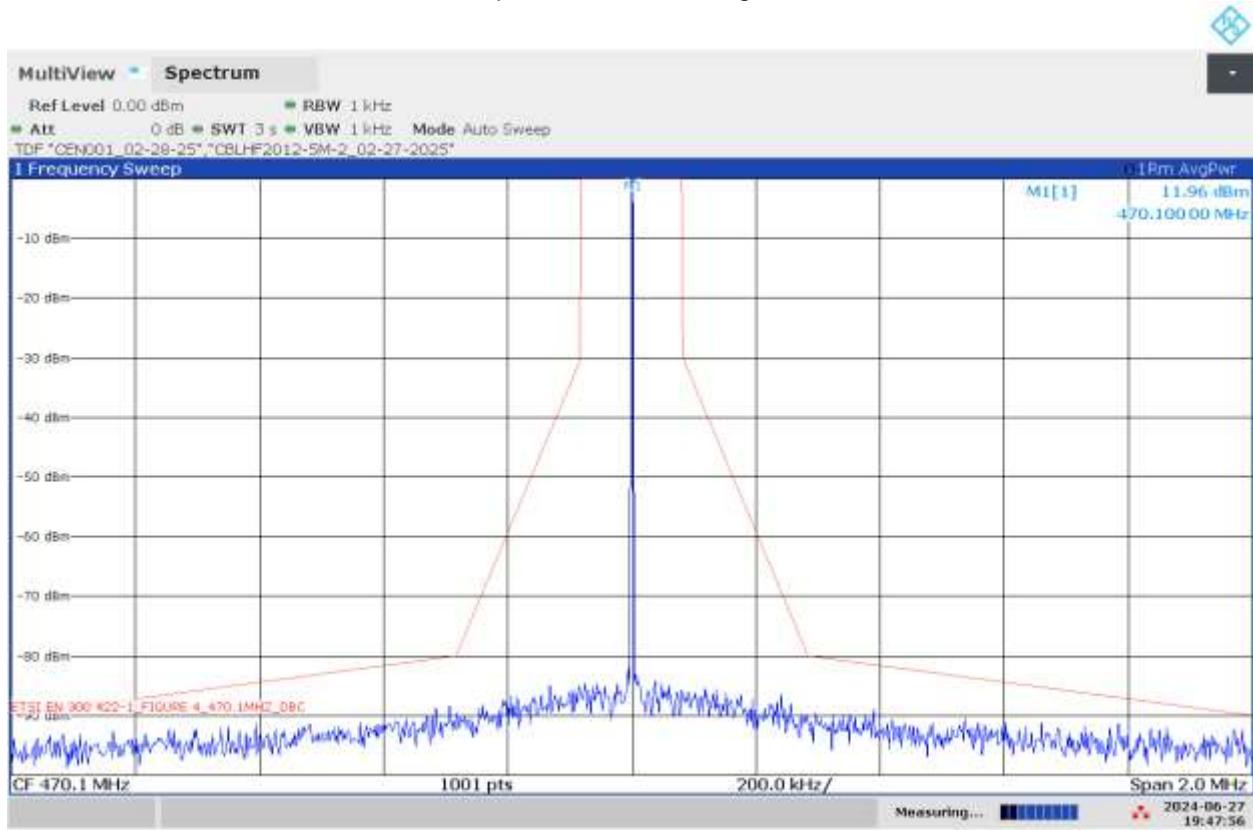
Photo not available due to confidentiality request by the client

9.5 Plots/Data:

Emission mask, Signal passed through at Low Channel 470.1 MHz

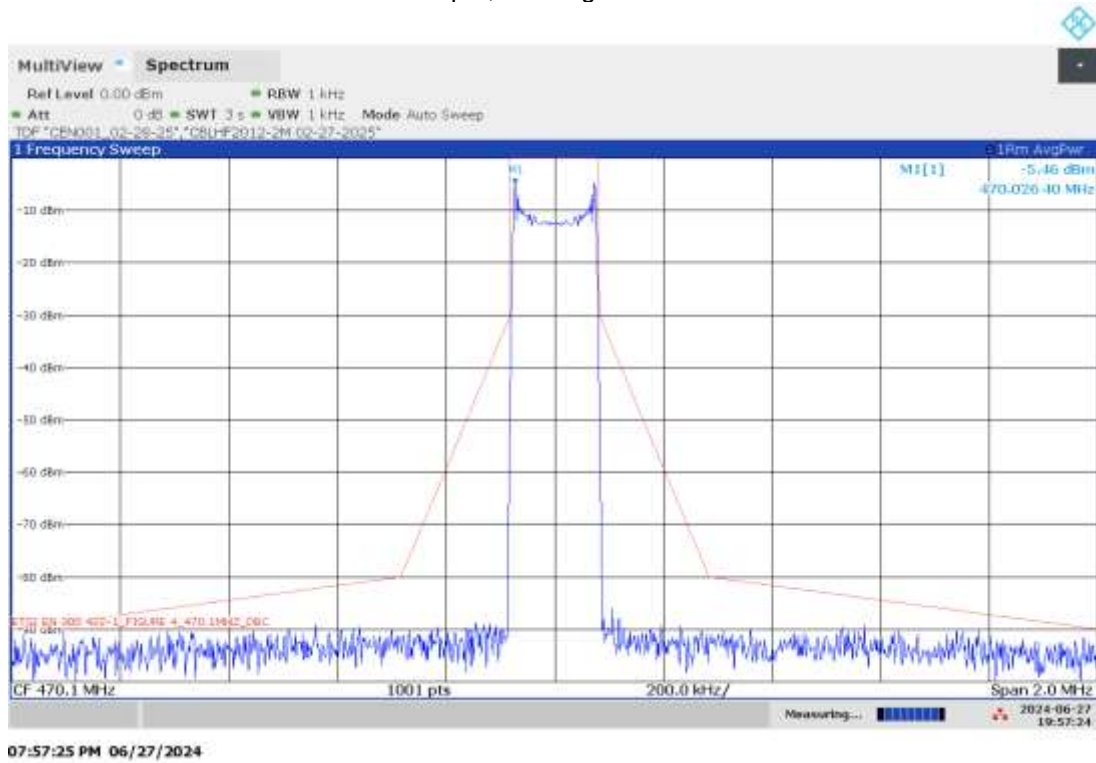
Test signal 1 kHz

Input, Unmodulated Signal

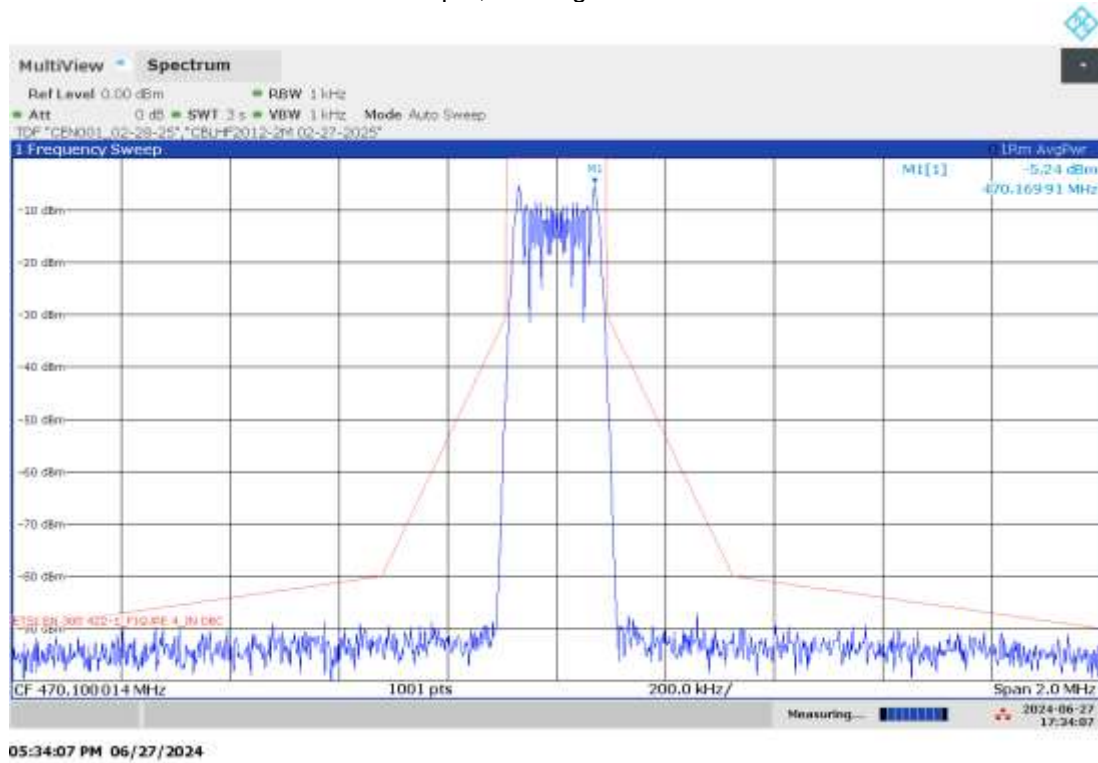


07:47:56 PM 06/27/2024

Output, Test signal 1kHz



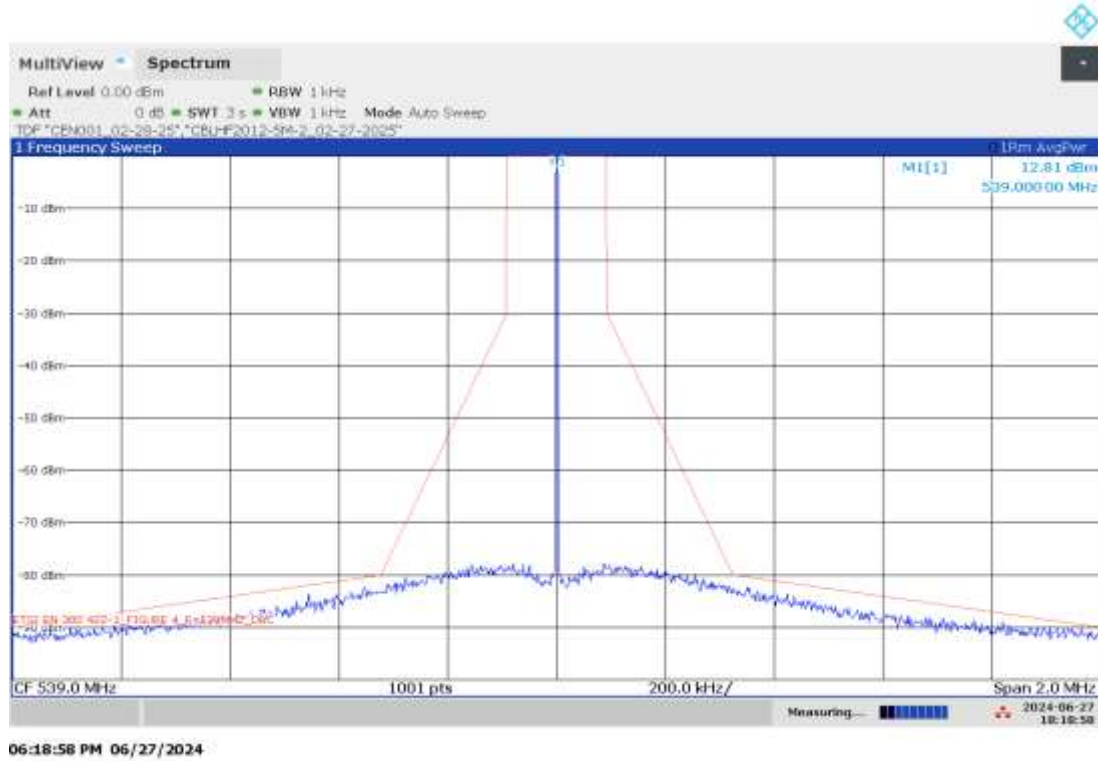
Output, Test signal 10 kHz



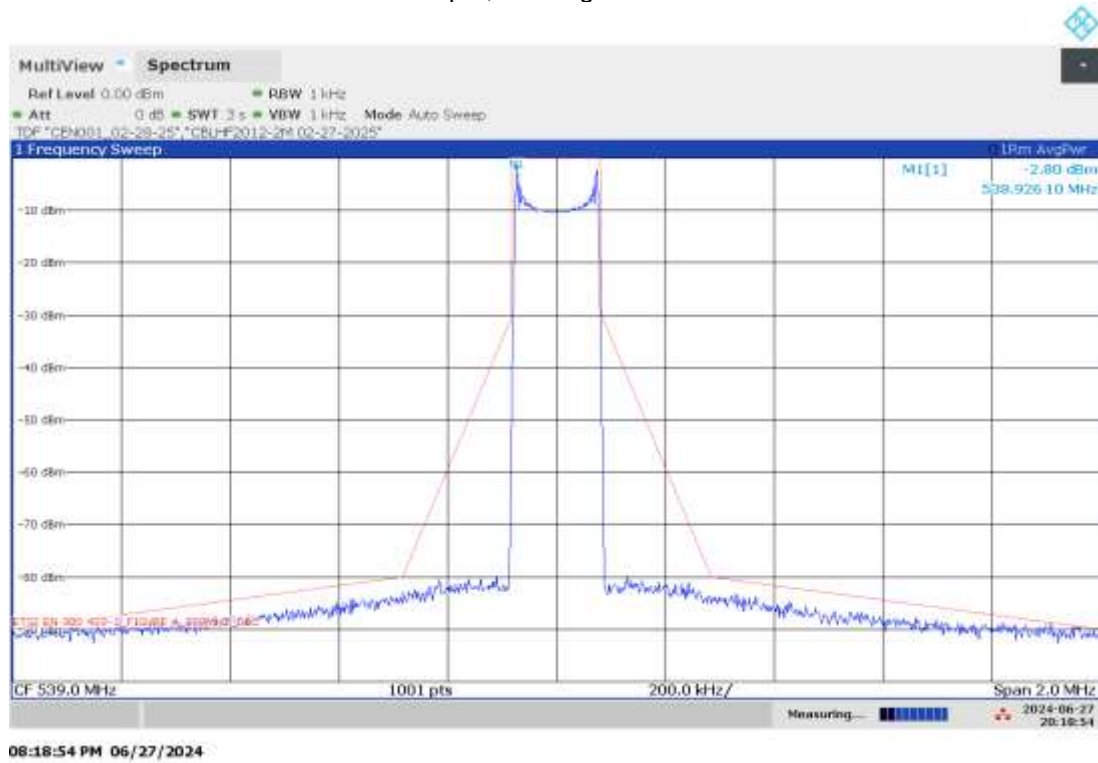
Emission mask, Signal passed through at Mid Channel 539 MHz

Test signal 1 kHz

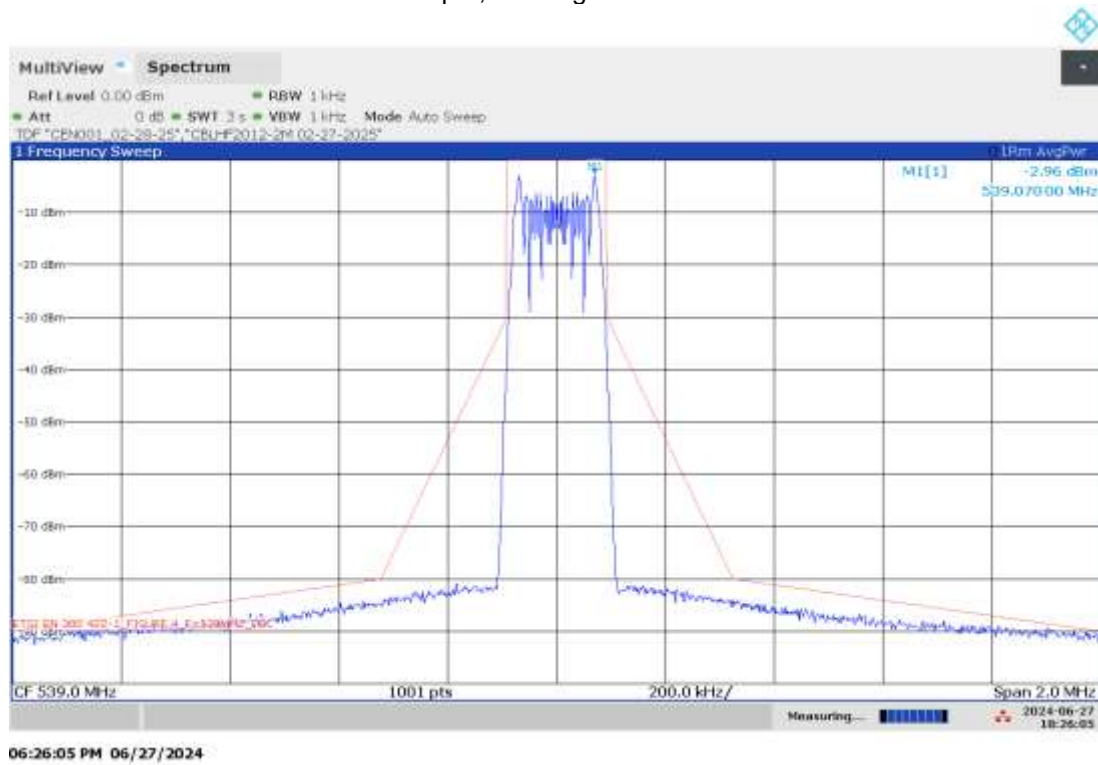
Input, Unmodulated Signal



Output, Test signal 1 kHz



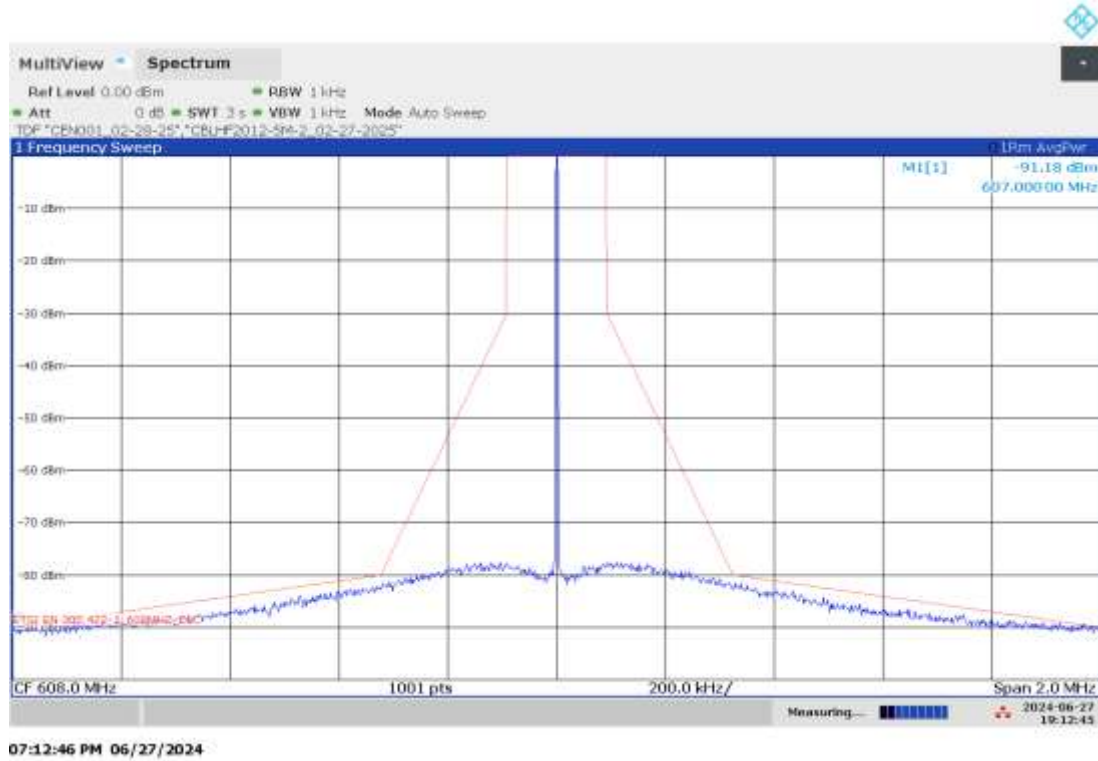
Output, Test signal 10 kHz



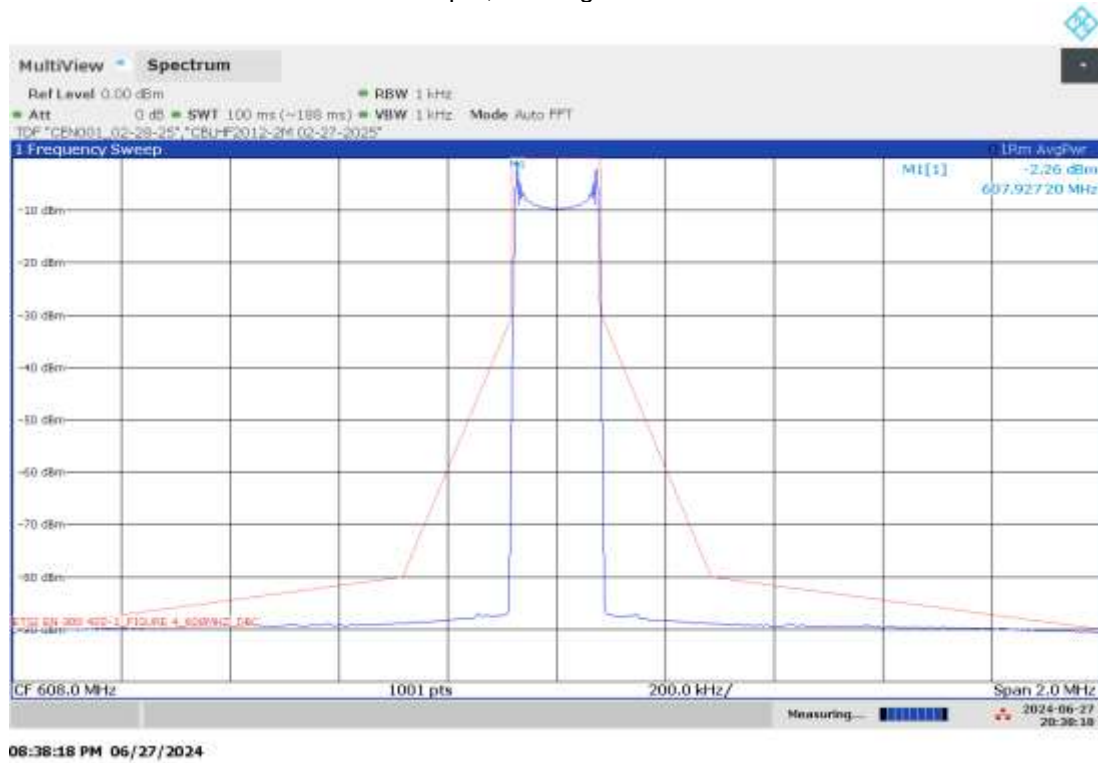
Emission mask, Signal passed through at High Channel 608 MHz

Test signal 1 kHz

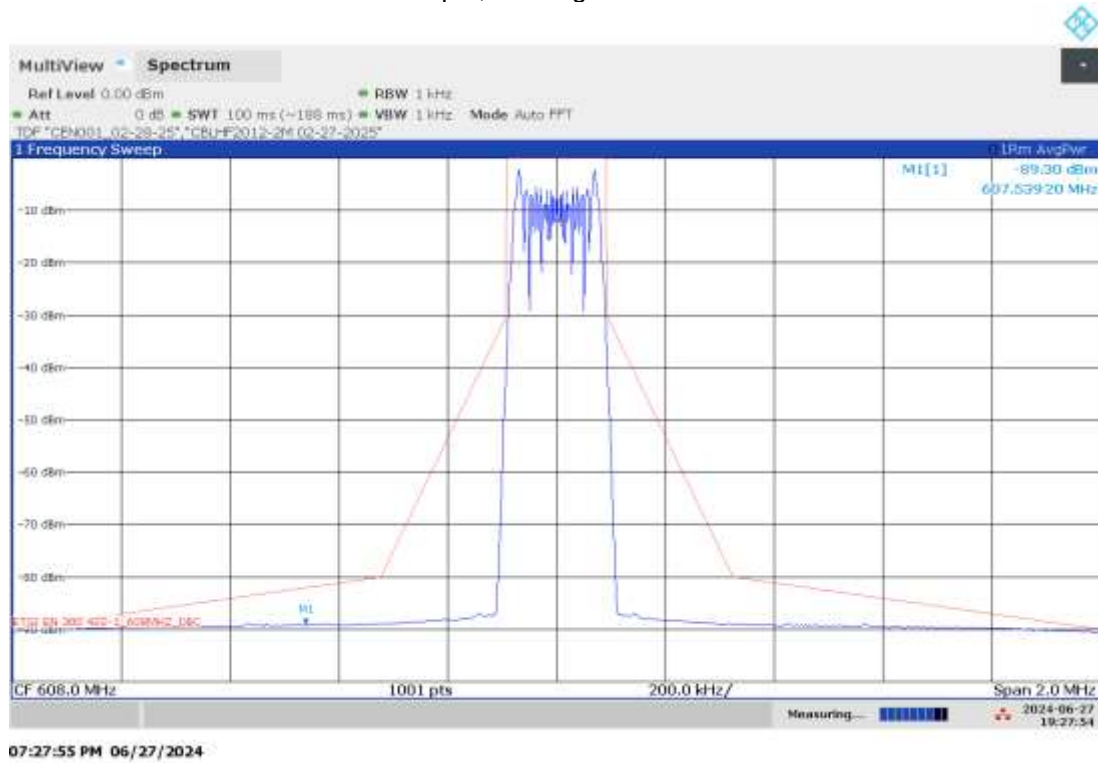
Input, Unmodulated Signal



Output, Test signal 1 kHz



Output, Test signal 10 kHz



Product Standard: FCC Part 74.861(e)(7)				Limit applied: See section 9.3 Pretest Verification w/BB source: N/A			
Test Date	Test Personnel/ Initials	Supervising Engineer/ Initials	Input Voltage	Mode	Atmospheric Data		
					Temp C°	Relative Humidity %	Atmospheric Pressure mbar
06/27/2024	Vathana Ven VSV	N/A	120VAC 60Hz	Active mode	22	49	1002

Deviations, Additions, or Exclusions: None

10 AC Mains Conducted Emissions**10.1 Method**

Tests are performed in accordance with ANSI C63.4 and FCC Part 15.207.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV007	Weather Station Vantage Vue	Davis	6250	MS191212003	03/15/2023	03/15/2024
ROS002	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	07/20/2023	07/20/2024
CBL310E	30' CABLE, BNC/BNC	Alpha	RG58B/U	CBL310E	03/21/2023	03/21/2024
WEI32	10 dB 18GHz 5W Attenuator	Weinschel	WA2-10-0403	WEI32	12/16/2022	12/16/2023
LISN31	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191957	07/03/2023	07/03/2024

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	2022.0.27.0

10.3 Results:

The sample tested was found to Comply.

10.4 Setup Photographs:

Photo not available due to confidentiality request by the client

10.5 Plots/Data:

Test Information:

Date and Time	11/16/2023 4:28:16 PM
Client and Project Number	RF Venue_G105431768
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	1023mbars
Comments	LC_150kHz to 30 MHz ESCI_120VAC 60Hz

Graph:

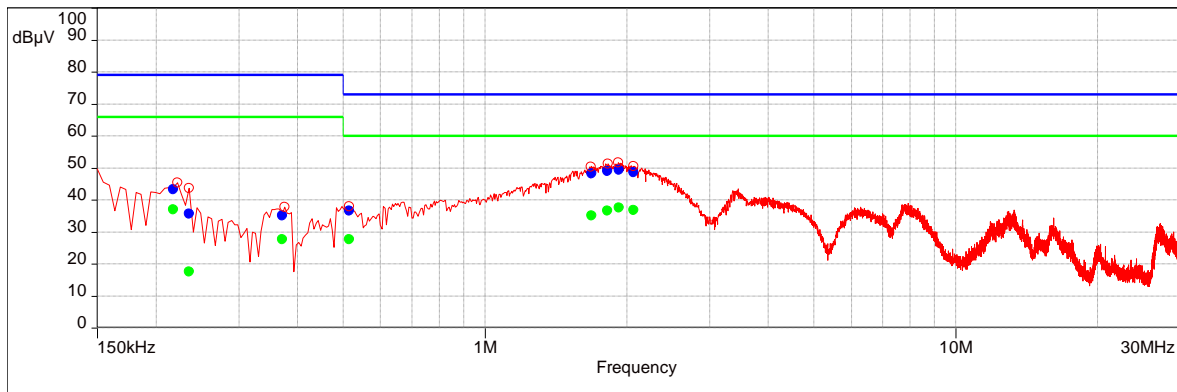
- Conducted Emissions Limit Lines/FCC Part 15 Subpart B CE Main Ports A - Average/
- Conducted Emissions Limit Lines/FCC Part 15 Subpart B CE Main Ports A - QPeak/
- Peak (Manual finals) (RF Output Measure)
- Peak (RF Output Measure)
- AVG Level (Average(Pass)) (RF Output Measure)
- QP Level (QuasiPeak(Pass)) (RF Output Measure)

Sub-range 1

Frequencies: 150 kHz - 30 MHz (Mode: Lin - Step: 4.5 kHz)

Settings: RBW: 9kHz, VBW: Auto, Sweep time: 5 ms/Pts, Attenuation: Auto, Sweep count: 1, Preamp: Off, LN Preamp: Off, Preselector: On

Line:RF Output Measure



test name LC_150kHz to 30 MHz ESCI_120VAC 60Hz Time at 16/11/2023 16:45

Intertek

Report Number: 105431768BOX-001R1

Issued: 01/12/2024

Revised: 06/27/2024

Results:

QuasiPeak(Pass) (8)

Frequency (MHz)	QP Level (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Line	RBW	Meas.Time	Correction (dB)
0.21878	43.24	79.00	-35.76	Phase 1	9k	0.01	9.85
0.23496	35.63	79.00	-43.37	Phase 1	9k	0.01	9.85
0.37218	35.09	79.00	-43.91	Neutral	9k	0.01	9.92
0.513	36.66	73.00	-36.34	Phase 1	9k	0.01	9.88
1.685	48.13	73.00	-24.87	Phase 1	9k	0.01	9.95
1.82146	49.01	73.00	-23.99	Phase 1	9k	0.01	9.95
1.92096	49.39	73.00	-23.61	Phase 1	9k	0.01	9.96
2.06596	48.65	73.00	-24.35	Phase 1	9k	0.01	9.96

Average(Pass) (8)

Frequency (MHz)	AVG Level (dBμV)	AVG Limit (dBμV)	AVG Margin (dB)	Line	RBW	Meas.Time	Correction (dB)
0.21878	37.01	66.00	-28.99	Phase 1	9k	0.01	9.85
0.23496	17.45	66.00	-48.55	Phase 1	9k	0.01	9.85
0.37218	27.61	66.00	-38.39	Neutral	9k	0.01	9.92
0.513	27.63	60.00	-32.37	Phase 1	9k	0.01	9.88
1.685	35.12	60.00	-24.88	Phase 1	9k	0.01	9.95
1.82146	36.66	60.00	-23.34	Phase 1	9k	0.01	9.95
1.92096	37.45	60.00	-22.55	Phase 1	9k	0.01	9.96
2.06596	36.82	60.00	-23.18	Phase 1	9k	0.01	9.96

Product Standard: FCC Part 15.207				Limit applied: Class B Pretest Verification w/ signal generator: Yes			
Test Date	Test Personnel/ Initials	Supervising Engineer/ Initials	Input Voltage	Mode	Atmospheric Data		
					Temp C°	Relative Humidity %	Atmospheric Pressure mbar
11/16/2023	Vathana Ven <i>VSV</i>	N/A	120VAC 60Hz	Active mode	23	23	1027

Deviations, Additions, or Exclusions: None

Report Number: 105431768BOX-001R1	Issued: 01/12/2024 Revised: 06/27/2024
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11 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	01/12/2024	105431768BOX-001	VFV <i>VFV</i>	KPS <i>KPS</i>	Original Issue
1	05/28/2024	105431768BOX-001	VFV <i>VFV</i>	KPS <i>KPS</i>	Removed ISED and some frequency bands, added mid and high channel data for 470-608MHz band, added FCC KDBs
2	06/27/2024	105431768BOX-001R1	VFV <i>VFV</i>	KPS <i>KPS</i>	Addressed TCB reviewer's comments