CERTIFICATION TEST REPORT

Report Number	**:**	13372962-E1V3
Applicant	**:**	CODAR OCEAN SENSORS LTD. 1914 PLYMOUTH S STREET, MOUNTAIN VIEW, CA 94043, U.S.A.
Model	**:**	SSTX 100
FCC ID	**:**	2AVPX-SSRS-100-0405
EUT Description	**:**	OCEANOGRAPHIC SURFACE WAVE RADAR SYSTEM
Test Standard	**:**	FCC 47 CFR PART 90 SUBPART F

Date Of Issue:
June 07, 2021

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
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U.S.A.
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Cert. #0751.05

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	03/16/2021	Initial Issue	GP Chin
V2	05/17/2021	Updated Description of EUT in Section 5.1 Added Antenna Gain in Section 5.2 Updated Peak EIRP with Ant. Gain in Section 5.3 and Section 8.3 Updated the Orientation of Loop Antenna on tabulated data in Section 8.6	GP Chin
V3	06/07/2021	Removed Rx Unit Model Updated Test Procedure in Section 8.6	GP Chin

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TABLE OF CONTENTS

UL VERIFICATION SERVICES INC
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CODAR OCEAN SENSORS, LTD.
1914 PLYMOUTH STREET,
MOUNTAIN VIEW, CA 94043, U.S.A.

EUT DESCRIPTION: OCEANOGRAPHIC SURFACE WAVE RADAR SYSTEM

MODEL: SSTX 100

SERIAL NUMBER: 2018536

DATE TESTED: OCTOBER 29TH – NOVEMBER 13TH, 2020

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 90.103F	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Approved & Released For
UL Verification Services Inc. By:

GIA-PIAO (GP) CHIN
SENIOR TEST ENGINEER
UL Verification Services Inc.

Tested By:

STEVE AGUILAR
TEST ENGINEER
UL Verification Services Inc.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CRF 47 Part 2, Part 90 Subparts F & I, ANSI 63.26-2015 and Rec. ITU-R SM.329-10.

3. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company No.	FCC Registration
☐	Building 1: 47173 Benicia Street, Fremont, California, USA	US0104	2324A	208313
☐	Building 2: 47266 Benicia Street, Fremont, California, USA	US0104	22541	208313
☒	Building 4: 47658 Kato Rd, Fremont, California, USA	US0104	2324B	208313

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4. CALIBRATION AND UNCERTAINTY

4.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

4.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U_{LAB}
Worst Case Conducted Disturbance, 9 kHz to 0.15 MHz	3.39 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 dB
Worst Case Conducted Disturbance 30 MHz to 1 GHz	2.90 dB
Worst Case Radiated Disturbance, 9 kHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Temperature	±0.9 °C
Voltages	±0.45 %
Time	±0.02 %

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The SeaSonde® is a simplified, compact oceanographic Doppler radar system for use in coastal ocean observing systems. A network of two or more units, physically separated by tens of kilometers along the coast, can combine data to produce two-dimensional surface current maps. In some situations, measurements of wind direction, ocean surface waves and tsunamis can be made as well. The surface current maps are the primary data product and are used by ocean scientists for a variety of research topics and by organizations like the National Oceanic and Atmospheric Administration (NOAA) and the US Coast Guard (USCG) for applications such as Search & Rescue and Spill Response.

Near real-time surface current data for the U.S. can be accessed at:
https://hfradar.ndbc.noaa.gov

Introductory videos on oceanographic radar applications can be found at the following URLs:
Search and Rescue: https://youtu.be/9A9LXT2cHZM
Spill Response: https://youtu.be/Ii83ob2cwhE

Frequency bands defined by the International Telecommunications Union (ITU) for use by oceanographic radars are listed below.

ITU Ocean Radar Frequency Bands (MHz)	
4.438 - 4.488	26.200 - 26.350[a]
5.250 - 5.275	26.200 - 26.420[b]
9.305 - 9.355[a]	39.000 - 39.500[a]
13.450 - 13.550	41.015 - 41.665[c]
16.100 - 16.200	42.000 - 42.500[d]
24.450 - 24.600[a]	43.350 - 44.000[c]
24.450 - 24.650[b]	
a – Regions 1 & 3 only	b – Region 2 only
c – U.S. and South Korea only	d – Region 1 only

The SeaSonde transmits a FMCW waveform over tens to hundreds of kHz, depending on the licensed bandwidth, with a center frequency in the HF or lower VHF frequency bands, between 4 & 50 MHz. Typically, SeaSondes are licensed to sweep over a frequency range that corresponds with all or part of one of the ITU Bands listed above, with radiated power up to 80 Watts peak and 40 Watts average. Patented high precision GPS-assisted sweep timing allows multiple SeaSondes to transmit simultaneously within the same frequency range without interference to each other and without data acquisition interruption.

Fc (kHz)	Bandwidth (kHz)		Power (W) Note 2		Antenna Gain (dBi)
	Maximum	Minimum Note 1	Min	Max	
4463	50	25	1	40	5
5262.5	25	25	1	40	5

Note 1: Device will support smaller bandwidths but values given above are considered minimum practical bandwidths.
Note 2: Typically, devices are operated in the 25 - 40 W (44 - 46 dBm) peak conducted power range with +1 dB tolerance and with a 50% duty cycle. This is the power at the antenna port.
Note 3: The pulse rate is determined by the expected range of the system and range from 300 Hz at the lower bands to as much as 5kHz for the highest bands. The duty factor approaches 50%, being reduced by increased tapering desired at the ends between 6.25% and 25%. Chirp (sweep) rates range from 1 Hz at the lowest bands to 8 Hz at the upper bands.

A Typical SeaSonde unit consists of the following core components:

- Model SSTX 100 Transmitter and 75 m coax cable
- Model SSRX 100 A Receiver and 100 m coax cable
- Data acquisition and processing computer
- Radial Suite Software Package
- Combined Transmit/Receive Antenna on a single mast, attached by three coaxial cables to transmitter and receiver

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radar system utilizes external antennas which come in the form of a co-located three element receive antenna system consisting of two receive loop antennas and one transmit/receive vertical monopole element with a maximum gain of 5 dBi. The transmit antenna is connected to the output port of transmitter via a minimum of 75 m coax cable. All antenna port measurements were made at the end of the minimum cable length to determine the power of fundamental and spurious emissions at the antenna input.

5.3. MAXIMUM OUTPUT POWER

The highest peak output power under normal environmental conditions (+20°C and 110 VAC) in each mode is as followed:

Mode	Peak Power (dBm EIRP)	Peak Power (W)
4.438 to 4.488 MHz	51.59	144.21
5.250 to 5.275 MHz	50.70	117.49

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing were Radial Suite Release 8 update 2 and SeaSondeAcquisition Version 11.7.9.

The AWG Firmware used during testing was 3.42.

6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	Apple	A1342 Mac book	45168C2QFSW
Laptop Power supply	Delta Electronics	ADP-60ADP	--
GPS Antenna	Garmin	GA38GPS/GLONASS	--
Receiver	Codar	SSRX100 A (Rx)	2019558

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC	2	3-prong	Unshielded	2	--
2	AC	1	3-prong	Unshielded	1.8	--
3	Ant	1	N-Type	Shielded	75	--
4	DC	1	Mag set	Shielded	1.8	----
5	Drive	1	BNC	Shielded	1	
6	Xmit Cntrol	1	DB 9-pin	Shielded	0.8	--
7	Data	1	USB A and B	Shielded	5-10	--
8	GPS	1	BNC	Shielded	7	Optional

TEST SETUP

The EUT set (Tx and Rx) is connected to a laptop computer. Software within the computer is used to configure and exercise the EUT set.

All measurements of Duty Cycles, Occupied Bandwidth, Peak Output Power, TX Conducted Spurious Emissions and Bandedge were performed at 20°C and 110 VAC nominal, utilizing the conducted test setup with spectrum analyzer.

The total Correction Factor of attenuators and cables was applied as “Offset” to the taken plots of Measured Peak on this report, therefore,

Peak EIRP (dBm) = Measured Peak (dBm) + EUT Ant. Gain (dBi)

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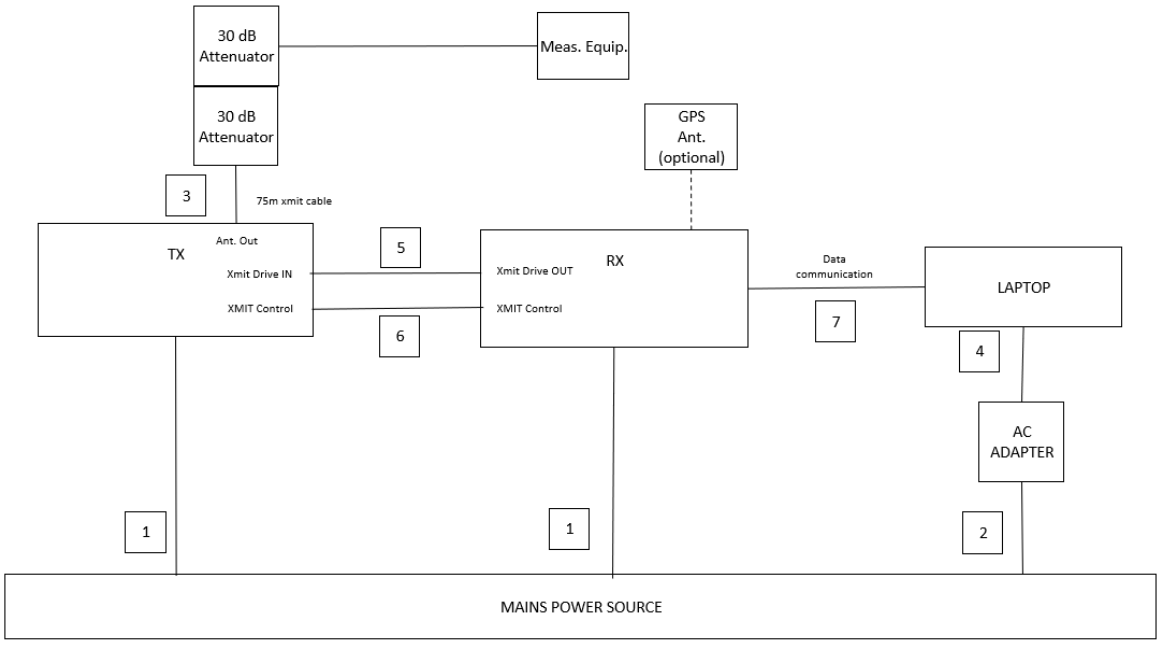
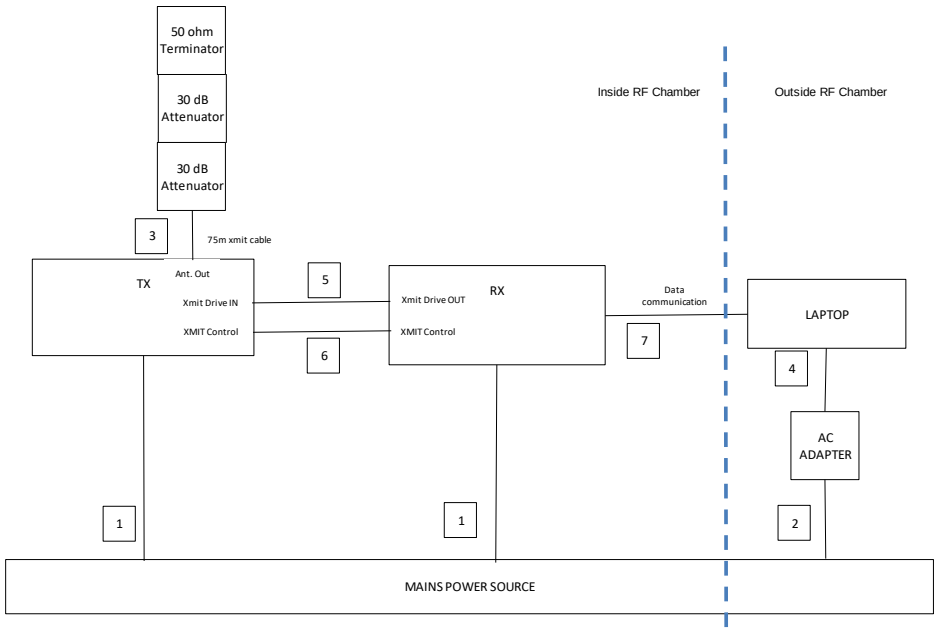
SETUP DIAGRAMS FOR TESTS

TX CONDUCTED RF TESTS



TX RADIATED RF TESTS



7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	**Manufacturer**	**Model**	**Local ID**	**Last Cal**	**Cal Due**
EMI Test Receiver	Rohde & Schwarz	FSW50	PRE0211337	4/30/2020	4/30/2021
Variable Transformer	Powerstat	3PN126	SCL16981	CNR	CNR
Coaxial Attenuator, 30 dB 100W	Bird Electronic Corporation	8323	2147	CNR	CNR
Coaxial Attenuator, 30 dB 100W	Bird Electronic Corporation	8323	2181	CNR	CNR
50 Ohm Terminator	--	--	--	CNR	CNR
ESW EMI Test Receiver 44 GHz	Rohde & Schwartz	ESW44	PRE0179376	4/03/2020	4/03/2021
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T477	9/24/2020	9/24/2021
Amplifier, 9KHz to 1GHz, 32dB	Sonoma Instruments	310	175953	1/23/2020	1/23/2021
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T863	8/31/2020	8/31/2021
Amplifier, 100MHz-18GHz	AMPLICAL	AMP0.1G18-47-20	PRE0197319	5/4/2020	5/4/2021
30Hz-1MHz Loop Ant.	Electro-Metrics	EM-6871	PRE0179465	7/27/2020	7/27/2021
100KHz-30MHz Loop Ant	Electro-Metrics	EM-6872	PRE0179467	7/27/2020	7/27/2021
Temperature Chamber	Espec	EWPX 674(2)-(2)12NAL	135568	1/7/2020	1/31/2021
Digital Multimeter	Fluke	87V	PRE0073921	1/22/2020	1/22/2021
UL EMC Radiated Software	Version:	Rev 9.5.30 Apr 2020			

8. APPLICABLE LIMITS AND TEST RESULTS

8.1. DUTY CYCLE

LIMIT

For reporting purposes only.

TEST PROCEDURE

All measurements were performed with the CW signals of Fc = 4.463 MHz and Fc = 5.263 MHz, representing 4.438 to 4.488 MHz Mode and 5.250 to 5.275 MHz Mode, respectively.

The duty cycle factor is calculated as:

Duty Cycle Factor (dB) = 10 * Log (1 / x)
Where X = Duty Cycle (linear)

RESULTS

Employee ID: 19470
Location: Environmental Chamber
Test Date: 11/11/2020 – 11/13/2020

Mode		ON Time	Period	Duty Cycle	Duty Cycle
Band	CW (Fc)	(usec)	(usec)	(linear)	(%)
4.438 - 4.488 MHz	4.463 MHz	932.25	1948.70	0.478	47.84
5.250 - 5.275 MHz	5.263 MHz	936.25	1948.35	0.481	48.05

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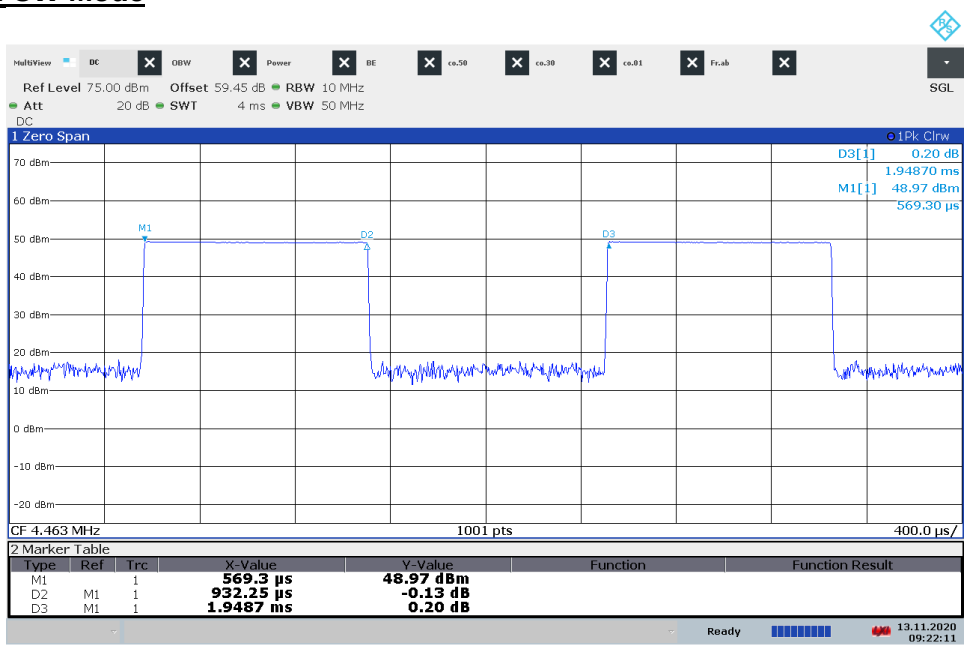
4.463 MHz CW Mode



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5.263 MHz CW Mode

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8.2. OCCUPIED BANDWIDTH

RULE PART

§2.1049

LIMIT

99% Bandwidth measured shall fall within the frequency band listed in FCC Part 90.103F.

Applicable limits for bands tested in this report is as follows:

Frequency Band
4.438 to 4.488 MHz
5.250 to 5.275 MHz

TEST PROCEDURE

ANSI 63.26-2015 Clause 5.4.4

99% bandwidth measurement function of the spectrum analyzer was used to measure 99% occupied bandwidth.

RESULTS

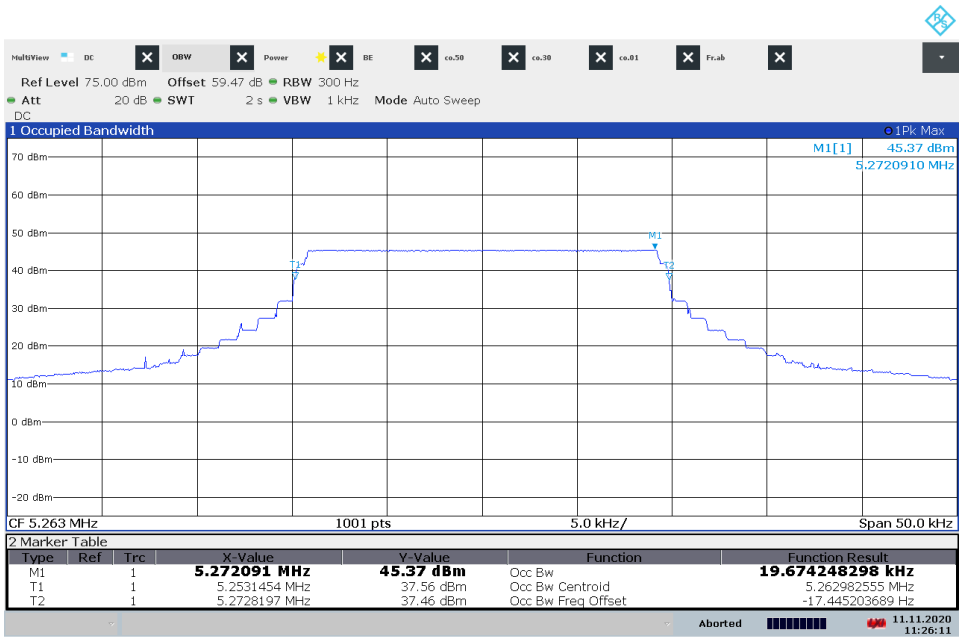
Employee IDs: 19470 & 17774
Location: Environmental Chamber
Test Date: 11/11/2020 – 11/13/2020

Mode	Meas. 99% BW (kHz)	Meas. FL (MHz)	Limit (MHz)	Pass/Fail	Meas. FH (MHz)	Limit (MHz)	Pass/Fail
4.438 to 4.488 MHz	45.151	4.4405	> 4.438	Pass	4.4856	< 4.488	Pass
5.250 to 5.275 MHz	19.674	5.2531	> 5.25	Pass	5.2728	< 5.275	Pass

4.438 - 4.488 MHz Mode

08:47:44 13.11.2020

5.250 - 5.275 MHz Mode



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8.3. PEAK OUTPUT POWER

RULE PARTS

§2.1046 & §90.205 (r)

LIMIT

§90.103 (c)(3) Operations in this band are limited to oceanographic radars using transmitters with a peak equivalent isotropically radiated power (EIRP) not to exceed 25 dBW (316 W or +55 dBm). Oceanographic radars shall not cause harmful interference to, nor claim protection from interference caused by, stations in the fixed or mobile services as specified in §2.106, footnotes 5.132A, 5.145A, and US132A. See Resolution 612 of the ITU Radio Regulations for international coordination requirements and for recommended spectrum sharing techniques.

Resolution 612 (REV. WRC-12), Clause d) 2 that the Peak e.i.r.p. of an oceanographic radar shall not exceed 25 dBW (316 W or +55 dBm).

TEST PROCEDURE

ANSI 63.26-2015 Clause 5.2.3.5

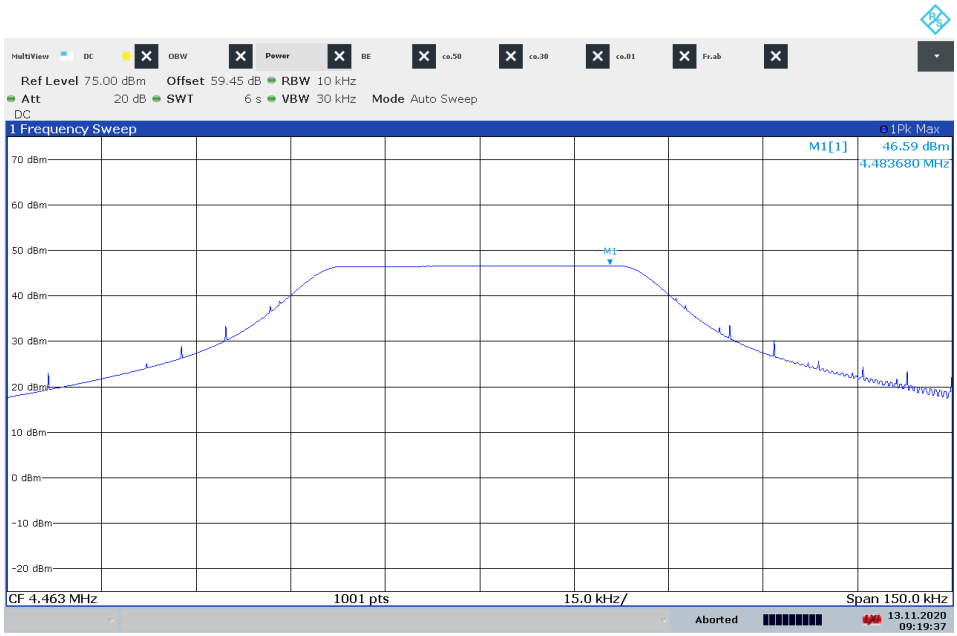
RESULTS

Employee IDs: 19470 & 17774
Location: Environmental Chamber
Test Date: 11/11/2020 – 11/13/2020

Mode	Frequency (MHz)	Meas. Peak (dBm)	EUT Ant. Gain (dBi)	Peak EIRP (dBm)	Peak EIRP (W)	Limit (W)	Pass or Fail
4.438 to 4.488 MHz	4.4836	46.59	5.00	51.59	144.2	316	Pass
5.250 to 5.275 MHz	5.2546	45.70	5.00	50.70	117.5	316	Pass

Peak EIRP is based on the use of monopole antenna which has a maximum gain of 5 dBi. The actual peak EIRP values are based on a minimum cable length of 75m between the RF output and the antenna (power measurement was made at the end of the cable).

4.438 to 4.488 MHz Mode



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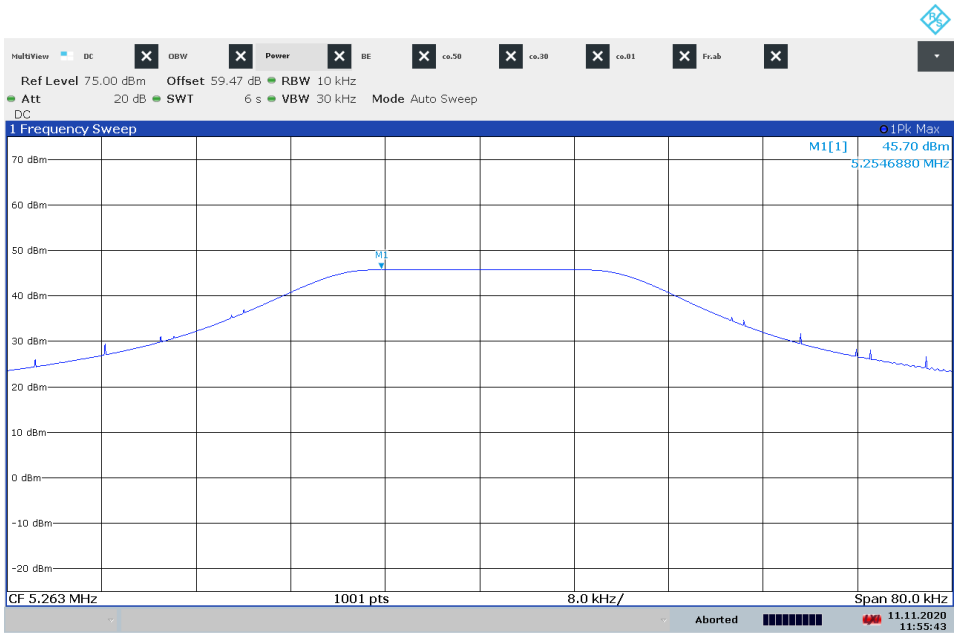
5.250 to 5.275 MHz Mode



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8.4. FREQUENCY STABILITY

RULE PARTS

§2.1055 (a)(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

§2.1055 (d)(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

The EUT is operated near the coast and installed only in climate-controlled enclosure or building with the following conditions:

Temperature: -18°C to +32°C (0°F to +90°F)
Nominal Voltage: 110 VAC

LIMIT

§90.213 (a)

TABLE 1 TO §90.213(a)—MINIMUM FREQUENCY STABILITY

[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1 2 3]100	100	200

Applicable Limit: 100 ppm

TEST PROCEDURES

ANSI C63.26-2015 Clause 5.6.5

All measurements were performed with the CW signals of Fc = ~4.463 MHz and Fc = ~5.263 MHz, representing 4.438 - 4.488 MHz Mode and 5.250 - 5.275 MHz Mode, respectively.

Test procedures for temperature variation:

a. Position the EUT in temperature/humidity chamber.
b. Set chamber temperature to +20°C, stabilize the EUT for at least 45 minutes and record the Fc.
c. Adjust chamber temperature from -18°C to +32°C at 10°C interval. Record maximum change in Fc at each temperature.
d. A period of at least 45 minutes is provided to allow stabilization of the equipment at each temperature level.

Test procedures for voltage variation:

a. Position the EUT in temperature/humidity chamber.
b. Set chamber temperature to +20°C.
c. The primary supply voltage is varied from 85% to 115% of the nominal value.

- Voltages:

Nominal: 110 VAC
85% of the Nominal: 93.5 VAC
115% of the Nominal: 126.5 VAC

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RESULTS

Employee IDs: 19470 & 17774
Location: Environmental Chamber
Test Date: 11/10/2020 – 11/13/2020

4.438 to 4.488 MHz Mode				
Temp (°C)	Input Power (AC)	CW (Fc)		
		Meas. Freq. (MHz)	Freq. Drift (ppm)	Pass/Fail
32	Nominal	4.46299	0.0000	Pass
30	Nominal	4.46299	0.0000	Pass
20	Nominal	4.46299	--	--
10	Nominal	4.46299	0.0000	Pass
0	Nominal	4.46299	0.0000	Pass
-10	Nominal	4.46299	0.0000	Pass
-18	Nominal	4.46299	0.0000	Pass
20	85%	4.46299	0.0000	Pass
20	115%	4.46299	0.0000	Pass

5.250 to 5.275 MHz Mode				
Temp (°C)	Input Power (AC)	CW (Fc)		
		Meas. Freq. (MHz)	Freq. Drift (ppm)	Pass/Fail
32	Nominal	5.26299	0.0000	Pass
30	Nominal	5.26299	0.0000	Pass
20	Nominal	5.26299	--	--
10	Nominal	5.26299	0.0000	Pass
0	Nominal	5.26299	0.0000	Pass
-10	Nominal	5.26300	1.9001	Pass
-18	Nominal	5.26300	1.9001	Pass
20	85%	5.26299	0.0000	Pass
20	115%	5.26299	0.0000	Pass

8.5. TX CONDUCTED SPURIOUS EMISSIONS AND BAND EDGE

RULE PARTS

§2.1057 (a) (1) In all of the measurements set forth in §§2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below: If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

10th harmonic of highest fundamental freq = 10*(5.275 MHz) = 52.75 MHz
Thus, the spurious emission is investigated from 9 kHz to 1 GHz.

LIMIT

§ 90.210 (n) Other frequency bands. Transmitters designed for operation under this part on frequencies other than listed in this section must meet the emission mask requirements of Emission Mask B. Equipment operating under this part on frequencies allocated to but shared with the Federal Government, must meet the applicable Federal Government technical standards.

§ 90.210 (b) Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

The more stringent Peak power limit on § 90.210 (b)(3), which is the same limit as Rec ITU-R SM.329-10 Standard, is applied for spurious emissions and bandedge.

Determination of Limit:

Maximum Declared Peak Conducted Power of EUT = 46 dBm (40 W)

Applicable Peak Limit: 46 – (43 + 10 log (46)) = 46 – 59 = -13 dBm

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TEST PROCEDURE

ANSI 63.26-2015 Clause 5.7

The widest emission bandwidth of EUT was used at 9 kHz – 1 GHz spurious emission tests.

For Band Edge, the measurements were measured by transmitting the CW signals of low-end (F_L) and the high-end (F_H) of each frequency band.

RESULTS

Employee IDs: 19470 & 17774
Location: Environmental Chamber
Test Date: 11/11/2020 – 11/12/2020

Mode	9 - 150 kHz	150 kHz - 30 MHz	30 MHz - 1 GHz	Bandedge
4.438 - 4.488 MHz	Pass	Pass	Pass	Pass
5.250 - 5.275 MHz	Pass	Pass	Pass	Pass

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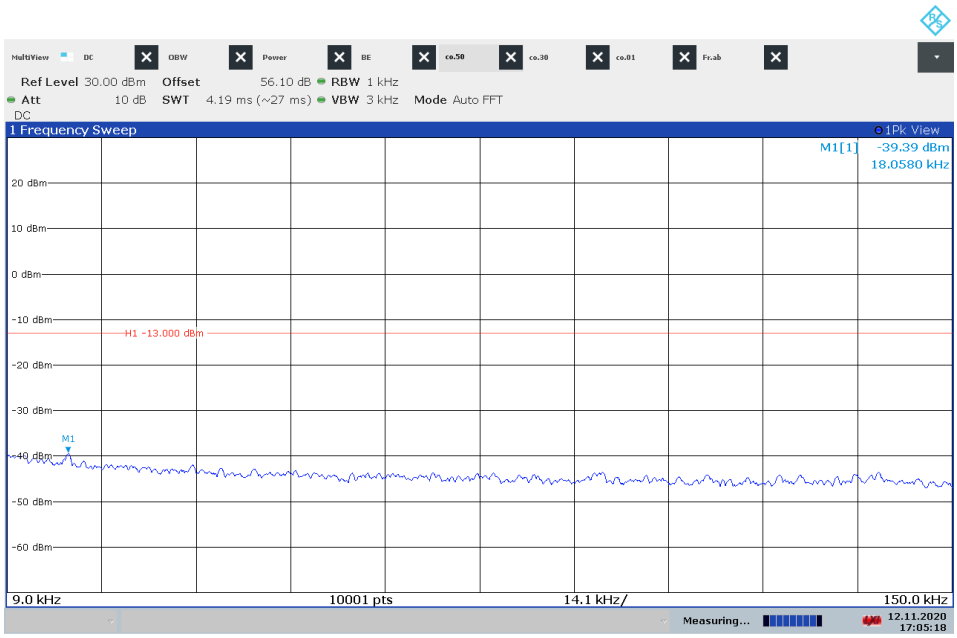
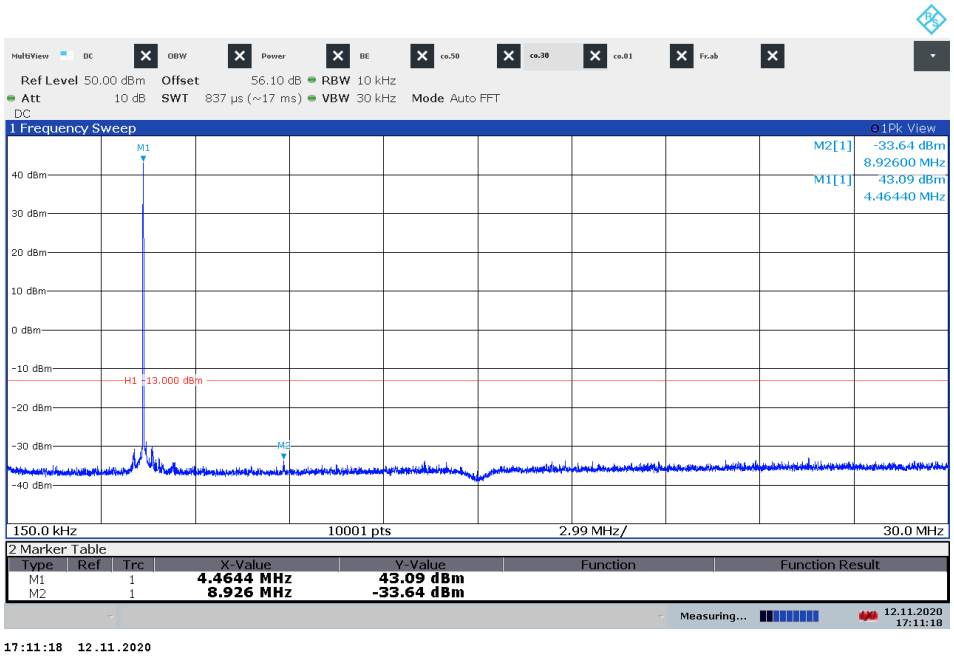
8.5.1. SPURIOUS EMISSIONS

4.438 to 4.488 MHz Mode, 9 - 150 kHz

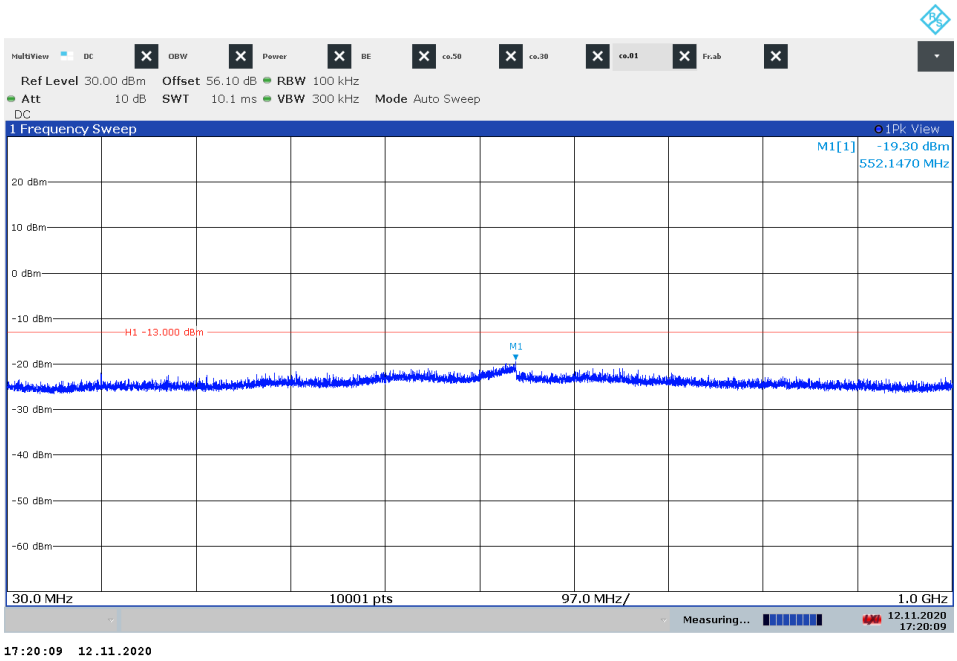


4.438 to 4.488 MHz Mode, 150 kHz - 30 MHz

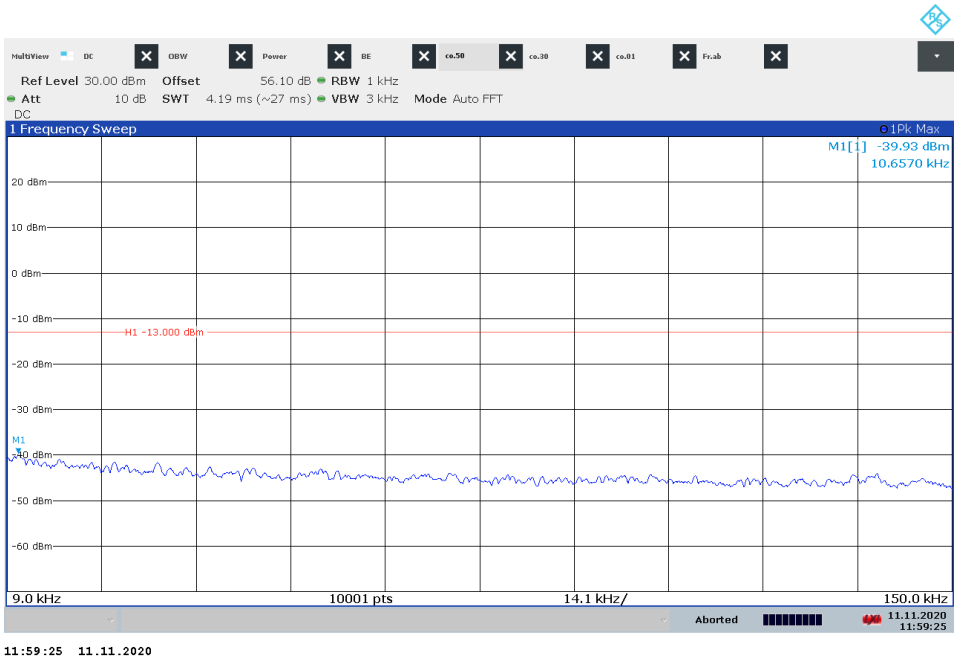


*Marker M1 is the fundamental signal.

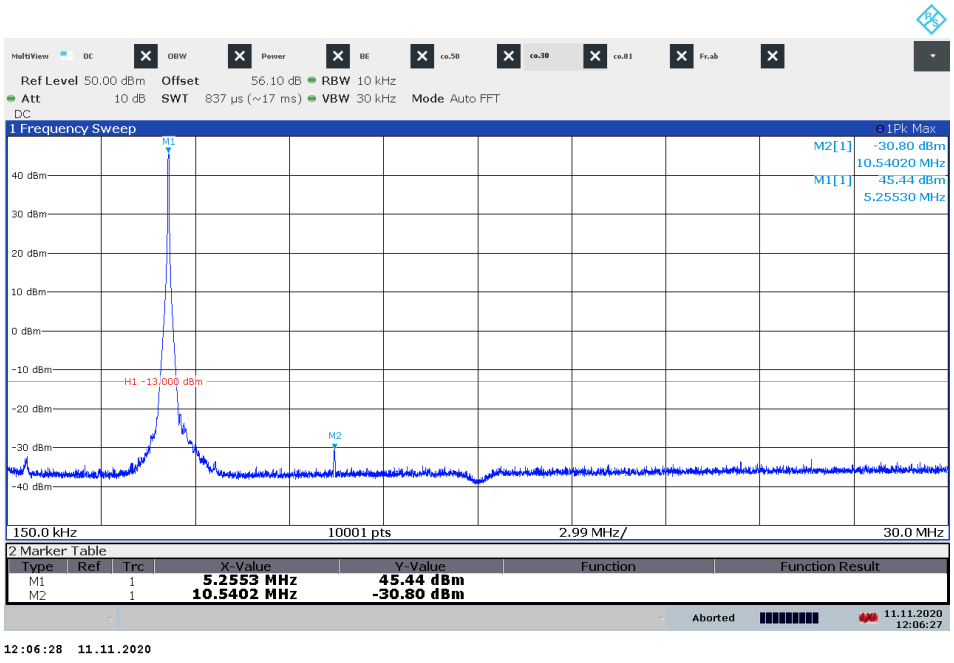
4.438 to 4.488 MHz Mode, 30 MHz – 1 GHz



5.250 to 5.275 MHz Mode, 9 - 150 kHz

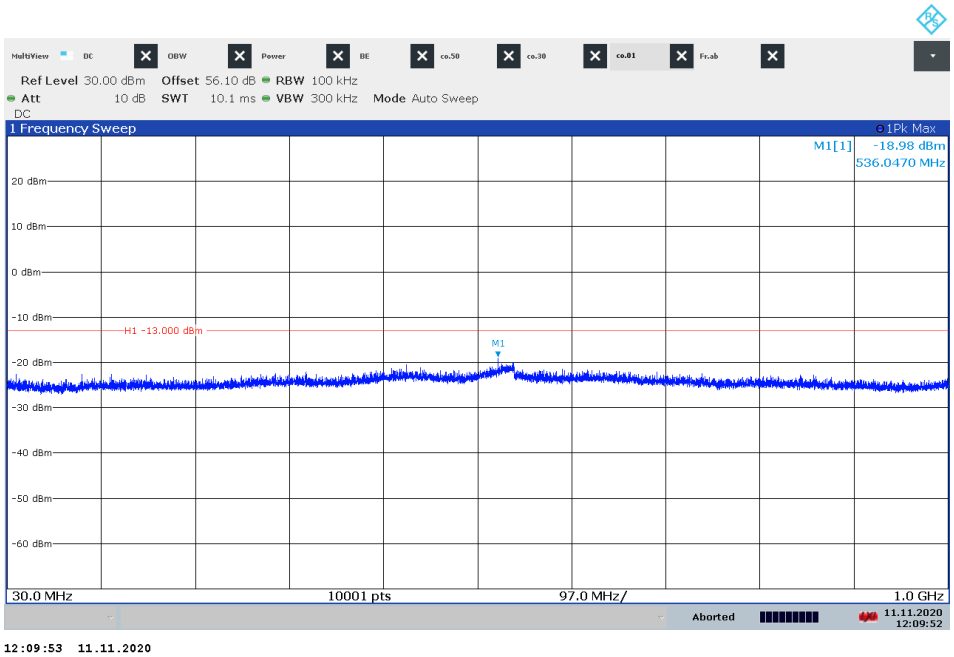


5.250 to 5.275 MHz Mode, 150 kHz to 30 MHz



*Marker M1 is the fundamental signal.

5.250 to 5.275 MHz Mode, 30 MHz – 1 GHz



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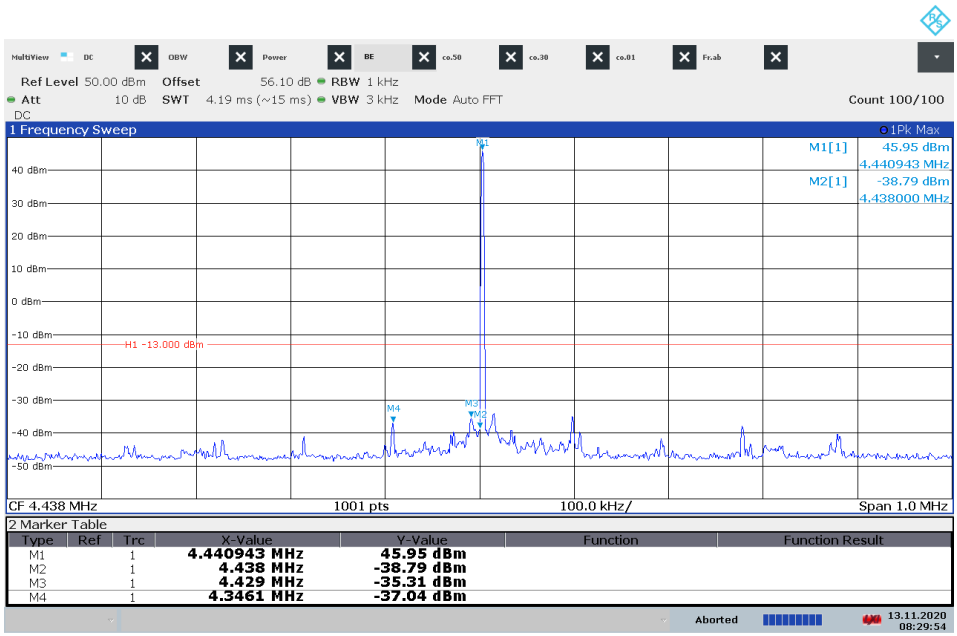
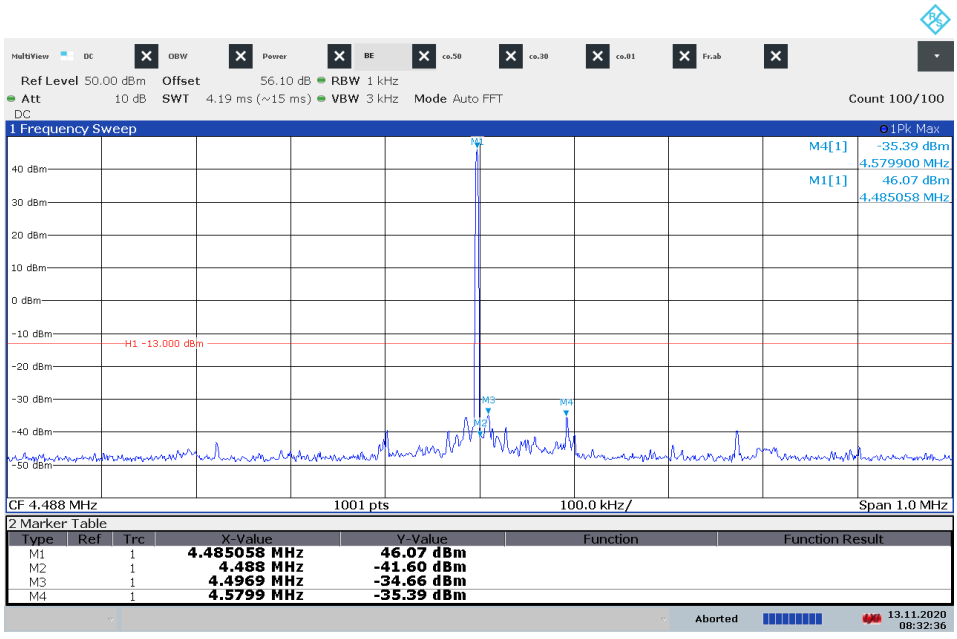
8.5.2. BAND EDGE

4.438 to 4.488 MHz Mode, Low End



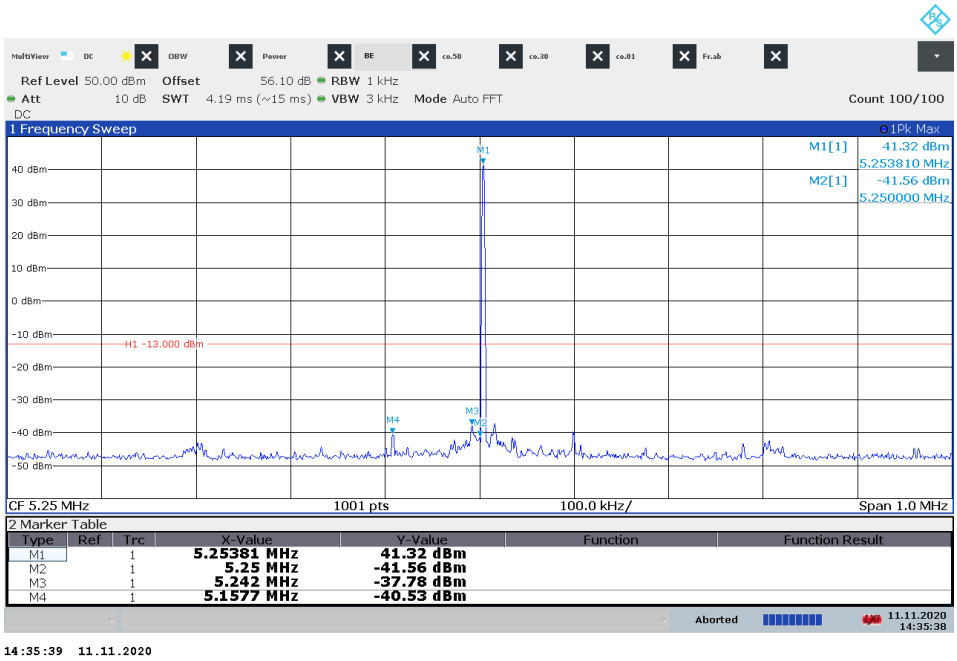
08:29:55 13.11.2020

4.438 to 4.488 MHz Mode, High End



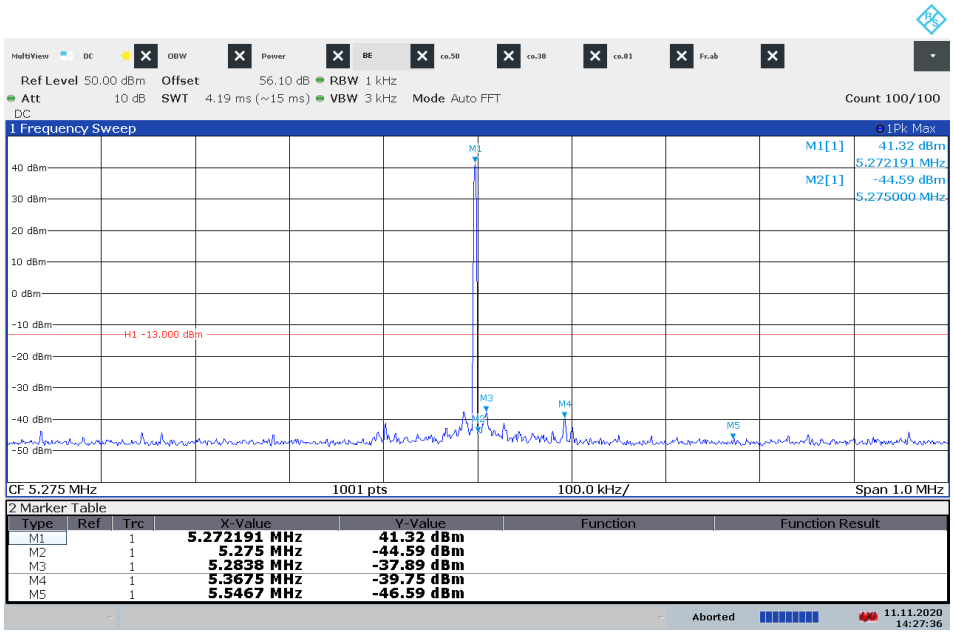
08:32:37 13.11.2020

5.250 to 5.275 MHz Mode, Low End



14:35:39 11.11.2020

5.250 to 5.275 MHz Mode, High End



14:27:36 11.11.2020

8.6. TX RADIATED SPURIOUS EMISSIONS

RULE PARTS

§2.1057 (a) (1) In all of the measurements set forth in §§2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below: If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

10th harmonic of highest fundamental freq = 10*(5.275 MHz) = 52.75 MHz
Thus, the spurious emission is investigated from 9 kHz to 1 GHz.

LIMIT

§ 90.210 (n) Other frequency bands. Transmitters designed for operation under this part on frequencies other than listed in this section must meet the emission mask requirements of Emission Mask B. Equipment operating under this part on frequencies allocated to but shared with the Federal Government, must meet the applicable Federal Government technical standards.

§ 90.210 (b) Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

The more stringent Peak power limit on § 90.210 (b)(3), which is the same limit as Rec ITU-R SM.329-10 Standard, is applied for spurious emissions.

Determination of Limit:

Maximum Declared Peak Conducted Power of EUT = 46 dBm (40 W)

Applicable Peak Limit: 46 – (43 + 10 log (46)) = 46 – 59 = -13 dBm

TEST PROCEDURE

ANSI C63.26-2015 Clause 5.5.4

Below 30 MHz spurious emission testing was performed in chamber other than open area test site. Adequate comparison measurements were confirmed against 30 meter open area test site and sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

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RADIATED EMISSION

Where relevant, the following sample calculations are provided:

EIRP (dBm) = Meter Reading (dBuV) + Antenna Factor (dB/m) + Pre-Amp Gain/Cbl Loss (dB)
+ dBuV-to-dBm Unit Conversion Factor @ 3m
= 34.27 dBm + 48.3 dB/m + (-32.2) dB + (-95.2)
= -44.83 dBm

EIRP (dBm) = Meter Reading (dBm) + Antenna Factor (dB/m) + Pre-Amp Gain/Cbl Loss (dB)
+ dBm-to-dBm Unit Conversion Factor @ 3m
= -60 dBm + 28 dB/m + (-27) dB + 11.7
= -48.3 dBm

RESULTS

Employee ID: 45256
Location: Chamber K
Test Date: 10/29/2020

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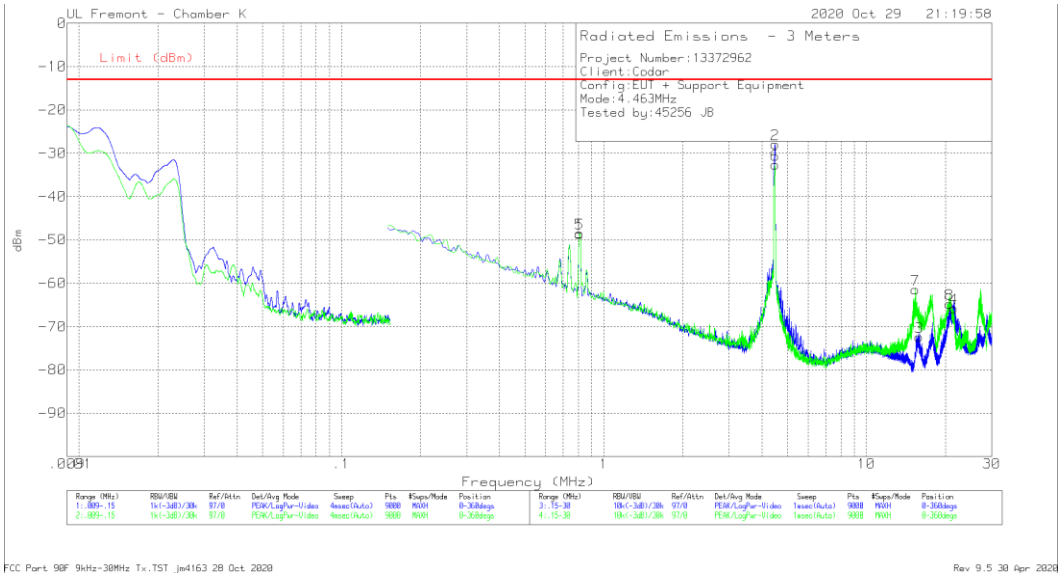
4.438 to 4.488 MHz MODE, 9 kHz to 30 MHz



Trace Markers
Pre-scan

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (E ACF)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Antenna Face
1	.80677	30.48	Pk	48.3	-32.2	-95.2	-48.62	-13	-35.62	0-360	On
2*	4.482	62.62	Pk	36.6	-32	-95.2	-27.98	--	--	0-360	On
3	15.87921	20	Pk	34.5	-31.7	-95.2	-72.4	-13	-59.4	0-360	On
4	21.4949	27.12	Pk	33.9	-31.6	-95.2	-65.78	-13	-52.78	0-360	On
5	.80677	30.55	Pk	48.3	-32.2	-95.2	-48.55	-13	-35.55	0-360	Off
6*	4.48532	57.96	Pk	36.6	-32	-95.2	-32.64	--	---	0-360	Off
7	15.33191	31.02	Pk	34.4	-31.7	-95.2	-61.48	-13	-48.48	0-360	Off
8	20.71208	28.04	Pk	34	-31.6	-95.2	-64.76	-13	-51.76	0-360	Off

Pk - Peak detector

Note: Marker 2 & 6 are the leakage of fundamental signals.

Radiated Emissions
Final Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (E ACF)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Antenna Face
1	.81069	32.87	Pk	48.3	-32.2	-95.2	-46.23	-13	-33.23	293	On
3	15.884	23.88	Pk	34.5	-31.7	-95.2	-68.52	-13	-55.52	333	On
4	21.4978	31.64	Pk	33.9	-31.6	-95.2	-61.26	-13	-48.26	313	On
5	.80909	32.2	Pk	48.3	-32.2	-95.2	-46.9	-13	-33.9	60	Off
7	15.3184	32.37	Pk	34.4	-31.7	-95.2	-60.13	-13	-47.13	290	Off
8	20.7236	30.96	Pk	34	-31.6	-95.2	-61.84	-13	-48.84	270	Off

Pk - Peak detector

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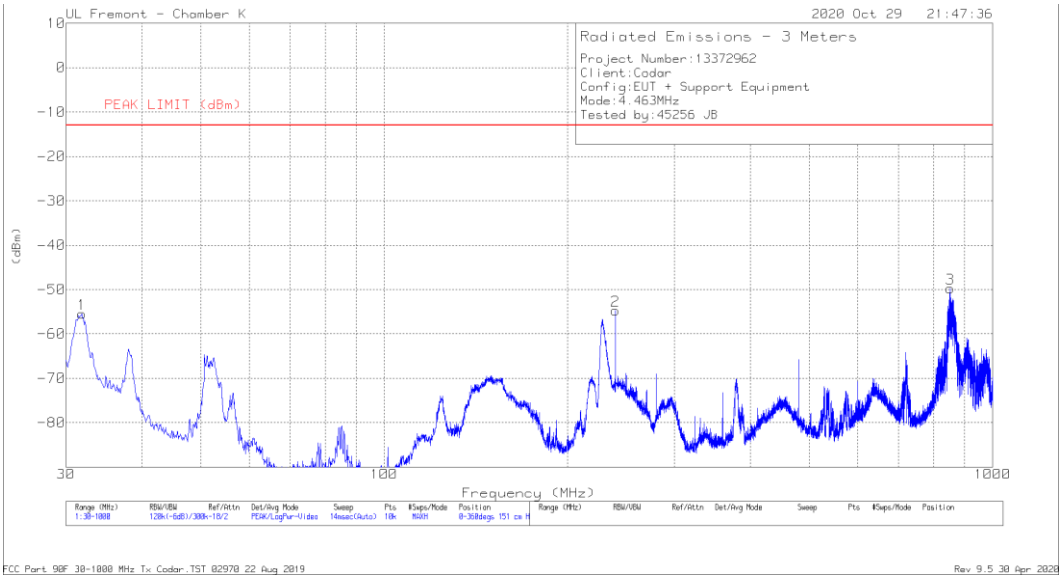
4.438 to 4.488 MHz MODE, 30 to 1000 MHz



Trace Markers
Pre-scan

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	AF 81560 (dB/m)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.843	-65.06	Pk	26.6	-31.6	11.7	-58.36	-13	-45.36	0-360	151	H
2	239.908	-56.61	Pk	18	-30.1	11.7	-57.01	-13	-44.01	0-360	151	H
3	851.978	-60.4	Pk	28	-27.6	11.7	-48.3	-13	-35.3	0-360	151	H
4	31.843	-51.64	Pk	26.6	-31.6	11.7	-44.94	-13	-31.94	0-360	151	V
5	239.908	-54.56	Pk	18	-30.1	11.7	-54.96	-13	-41.96	0-360	151	V
6	849.941	-64.37	Pk	28	-27.6	11.7	-52.27	-13	-39.27	0-360	151	V

Pk - Peak detector

Radiated Emissions
Final Data

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	AF 81560 (dB/m)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.6718	-62.41	Pk	26.7	-31.6	11.7	-55.61	-13	-42.61	299	202	H
2	240.0051	-55.66	Pk	18	-30.1	11.7	-56.06	-13	-43.06	175	135	H
3	851.9272	-59.62	Pk	28	-27.6	11.7	-47.52	-13	-34.52	316	156	H
4	31.8555	-46.76	Pk	26.6	-31.6	11.7	-40.06	-13	-27.06	39	104	V
5	240.0004	-51.6	Pk	18	-30.1	11.7	-52	-13	-39	88	98	V
6	850.1673	-63.43	Pk	28	-27.6	11.7	-51.33	-13	-38.33	269	143	V

Pk - Peak detector

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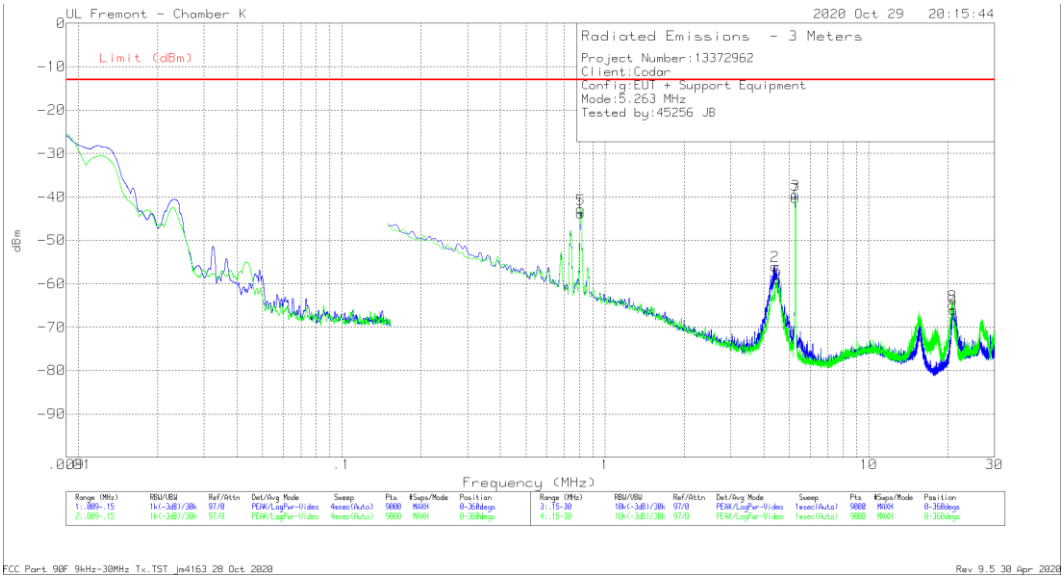
5.250 to 5.275 MHz MODE, 9 kHz to 30 MHz



Trace Markers
Pre-scan

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (E ACF)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Antenna Face
1	.80842	35.32	Pk	48.3	-32.2	-95.2	-43.78	-13	-30.78	0-360	On
2	4.39576	34.56	Pk	36.7	-32	-95.2	-55.94	-13	-42.94	0-360	On
3*	5.25818	51.86	Pk	35.8	-31.9	-95.2	-39.44	-13	-26.44	0-360	On
4	20.98076	26.8	Pk	33.9	-31.6	-95.2	-66.1	-13	-53.1	0-360	On
5	.80677	36.37	Pk	48.3	-32.2	-95.2	-42.73	-13	-29.73	0-360	Off
6	4.51186	31.54	Pk	36.6	-32	-95.2	-59.06	-13	-46.06	0-360	Off
7*	5.26481	51.05	Pk	35.8	-31.9	-95.2	-40.25	-13	-27.25	0-360	Off
8	20.78837	28.06	Pk	33.9	-31.6	-95.2	-64.84	-13	-51.84	0-360	Off

Pk - Peak detector

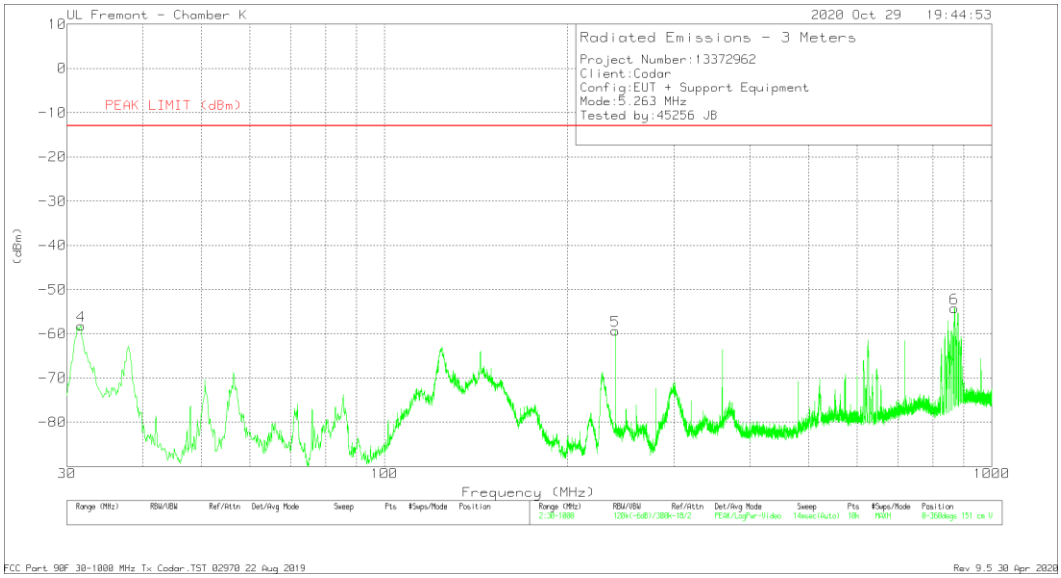
Note: Marker 3 & 7 are the leakage of fundamental signals.

Radiated Emissions
Final Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (E ACF)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Antenna Face
1	.81058	35.82	Pk	48.3	-32.2	-95.2	-43.28	-13	-30.28	68	On
2	4.41246	33.93	Pk	36.7	-32	-95.2	-56.57	-13	-43.57	302	On
4	20.9612	26.05	Pk	33.9	-31.6	-95.2	-66.85	-13	-53.85	282	On
5	.80993	37.42	Pk	48.3	-32.2	-95.2	-41.68	-13	-28.68	69	Off
6	4.50683	30.78	Pk	36.6	-32	-95.2	-59.82	-13	-46.82	73	Off
8	20.7973	29.97	Pk	33.9	-31.6	-95.2	-62.93	-13	-49.93	313	Off

Pk - Peak detector

5.250 - 5.275 MHz MODE, 30 to 1000 MHz



Trace Markers
Pre-scan

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	AF 81560 (dB/m)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.164	-69.8	Pk	27.1	-31.6	11.7	-62.6	-13	-49.6	0-360	151	H
2	240.005	-58.49	Pk	18	-30.1	11.7	-58.89	-13	-45.89	0-360	151	H
3	869.923	-60.5	Pk	28.4	-27.3	11.7	-47.7	-13	-34.7	0-360	151	H
4	31.649	-57.37	Pk	26.7	-31.6	11.7	-50.57	-13	-37.57	0-360	151	V
5	239.908	-54.29	Pk	18	-30.1	11.7	-54.69	-13	-41.69	0-360	151	V
6	868.177	-62.3	Pk	28.4	-27.3	11.7	-49.5	-13	-36.5	0-360	151	V

Pk - Peak detector

Radiated Emissions
Final Data

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	AF 81560 (dB/m)	Amp/Cbl (dB)	Unit Conversion @ 3m	Corrected Reading (dBm)	Peak Limit (dBm)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.3975	-67.18	Pk	26.9	-31.6	11.7	-60.18	-13	-47.18	306	389	H
2	240.0003	-57.45	Pk	18	-30.1	11.7	-57.85	-13	-44.85	181	135	H
3	869.7067	-57.84	Pk	28.4	-27.3	11.7	-45.04	-13	-32.04	320	154	H
4	31.5814	-55.94	Pk	26.8	-31.6	11.7	-49.04	-13	-36.04	23	95	V
5	240	-51.52	Pk	18	-30.1	11.7	-51.92	-13	-38.92	80	95	V
6	867.9459	-60.85	Pk	28.4	-27.3	11.7	-48.05	-13	-35.05	291	134	V

Pk - Peak detector