



TEST REPORT

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Report No.:
 KR26-SRF0121
 Page(1) of (31)



KCTL

1. Client

- Name : Ettifos Co.
- Address : 405, 41, Beolmal-ro 50beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
- Date of Receipt : 2026-04-10

2. Use of Report : Certification

3. Name of Product / Model : ESAC OBU / ETF-SAC-OC5N01

4. Manufacturer / Country of Origin : Ettifos Co. / Korea

5. FCC ID : 2BHJLETF-SAC-OC5N01

6. Date of Test : 2026-06-01 to 2026-06-08

7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
 (Address: 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

8. Test method used : FCC Part 2
 FCC Part 95 Subpart L

9. Test Result : Refer to the test result in the test report

Affirmation	Tested by	Technical Manager
	Name : Sunghyun Yoon (Signature)	Name : Kwonse Kim (Signature)

2026-06-08

Eurofins KCTL Co.,Ltd.

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REPORT REVISION HISTORY

Date	Revision	Page No
2026-06-08	Originally issued	-

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General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ Statement not required by the standard or client used for type testing

CONTENTS

1.	General information	4
2.	Device information	4
2.1.	Frequency/channel operations.....	5
2.2.	Duty Cycle Factor	5
3.	Antenna information.....	5
4.	Summary of tests.....	6
5.	Measurement uncertainty	7
6.	Measurement results explanation example	8
7.	Test results	9
7.1.	OBU Transmit Power	9
7.2.	99% Occupied Bandwidth & 26dB Bandwidth	12
7.3.	Frequency stability	16
7.4.	Out-of-Band Emissions	19
7.5.	Spurious Emissions	22
7.6.	Radiated Spurious Emissions	27
8.	Measurement equipment	31

1. General information

Client : Ettifos Co.
 Address : 405, 41, Beolmal-ro 50beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
 Manufacturer : Ettifos Co.
 Address : 405, 41, Beolmal-ro 50beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
 Laboratory : Eurofins KCTL Co.,Ltd.
 Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
 Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132
 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
 CAB Identifier: KR0040
 ISED Number: 8035A
 KOLAS No.: KT231

2. Device information

Equipment under test : ESAC OBU
 Model : ETF-SAC-OC5N01
 Modulation technique : C-V2X : 16QAM
 Power source : DC 12 V, 24 V
 Antenna specification : Antenna 1 : Dipole Array Antenna
 Antenna 2 : Dipole Array Antenna
 Antenna gain : Antenna 1 : 2.51 dBi
 Antenna 2 : 3.45 dBi
 Frequency range : C-V2X : 5 905 MHz ~ 5 925 MHz
 Bandwidth : C-V2X : 20 MHz
 Software version : V0.1.1
 Hardware version : V1.0
 Test device serial No. : SAN-ETF261001
 Operation Temperature : -40 °C ~ 70 °C

2.1. Frequency/channel operations

This device contains the following capabilities:

C-V2X

Ch.	Frequency (MHz)
183	5 915

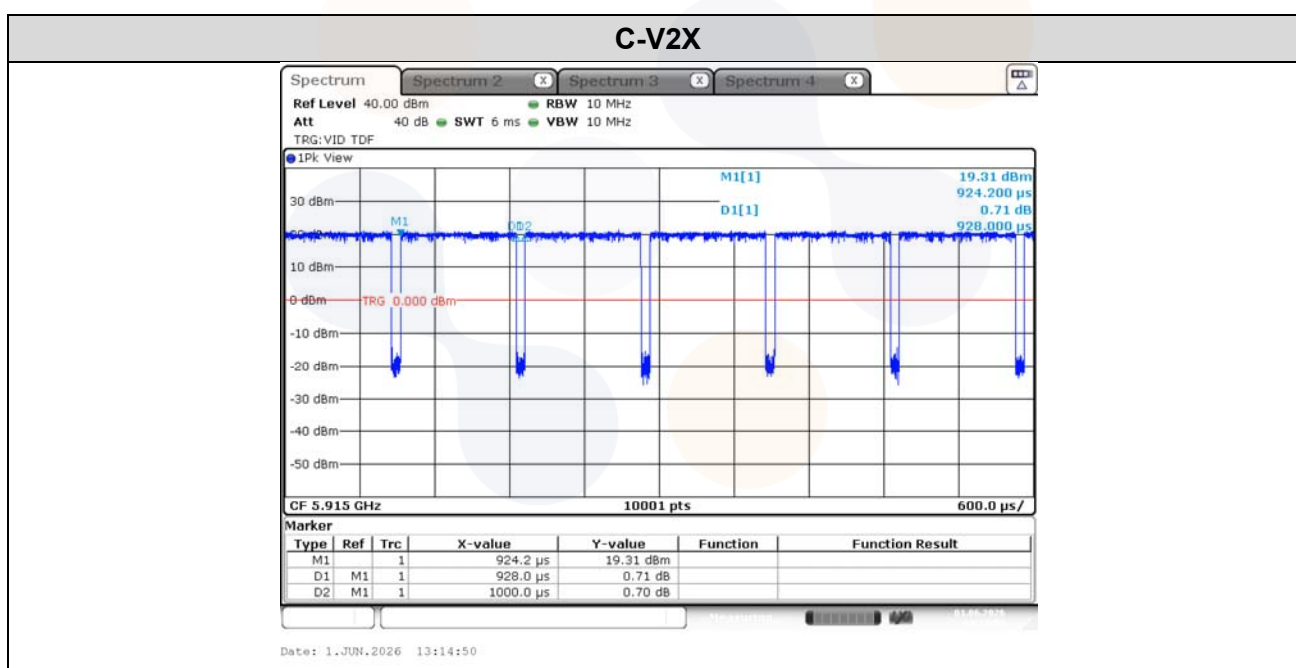
Table 2.1-1. 20M BW

2.2. Duty Cycle Factor

Test mode	Period (ms)	On time (ms)	Duty cycle		Duty Cycle Factor (dB)
			(Linear)	(%)	
C-V2X	1.000 0	0.928 0	0.928 0	92.80	0.32

Notes:

- Duty cycle (Linear) = Ton time / Period
- DCF(Duty cycle factor) = $10\log(1/\text{duty cycle})$



3. Antenna information

Test mode	SISO		MIMO
	ANT 1	ANT 2	ANT 1 + 2
C-V2X	√	√	X

√ = Support, X = Not support

4. Summary of tests

FCC Part section(s)	Parameter	Test Limit	Test Condition	Test results
2.1046 95.3204(a)	OBU Transmit Power (EIRP)	Channel Bandwidth 20 MHz 5 895 – 5 915 MHz : 23 dBm/BW 5 905 – 5 925 MHz : 33 dBm/BW , Reduced to 27 dBm within ± 5 degrees of horizontal	Conducted	Pass ²⁾
2.1049 2.1055 95.3203	Occupied Bandwidth & 26 dB Bandwidth	Permitted to operate in the 5 895–5 925 MHz		Pass
	Frequency stability			Pass
2.1051 95.3205	Out-of-Band Emissions (OOBE)	Refer to Section 7.4 and 7.5		Pass
	Spurious Emissions			Pass
2.1053 95.3205	Radiated Spurious Emissions	< -28 dBm/MHz	Radiated	Pass

Note:

- 1) EUT is C-V2X OBU without geofencing function.
- 2) Maximum EIRP of EUT is less than 27 dBm, so additional testing for ±5 degrees was not tested.
- 3) The orthogonal plan is configured as x-axis because it's installed on the x-axis in the vehicle. Therefore, all radiated testing was performed with the EUT in **X** orientation.
- 4) The test procedure(s) in this report were performed in accordance as following.
 - ◆ ANSI C63.26-2015
 - ◆ ANSI/TIA-603-E-2016
 - ◆ KDB 511808 D01 v02
 - ◆ KDB 971168 D01 v03r01

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014.

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicated a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty ($\pm$)	
Conducted RF power	0.9 dB	
Conducted spurious emissions	1.7 dB	
Radiated spurious emissions	Below 1 000 MHz	2.5 dB
	1 000 MHz ~ 18 000 MHz	2.4 dB
	Above 18 000 MHz	2.6 dB

6. Measurement results explanation example

Frequency (MHz)	Factor(dB)	Frequency (MHz)	Factor(dB)
30	10.23	16 000	13.44
50	10.39	17 000	13.96
100	10.43	18 000	13.30
200	10.44	19 000	13.34
300	10.57	20 000	14.14
400	10.75	21 000	14.72
500	11.18	22 000	14.58
600	11.25	23 000	15.76
700	11.21	24 000	15.81
800	11.18	25 000	15.33
900	11.09	26 000	14.76
1 000	11.14	26 500	14.59
2 000	11.52	27 000	14.40
3 000	11.72	28 000	14.67
4 000	12.09	29 000	14.34
5 000	12.54	30 000	15.15
6 000	12.65	31 000	14.64
7 000	13.41	32 000	14.45
8 000	13.79	33 000	14.87
9 000	13.38	34 000	14.56
10 000	13.42	35 000	15.88
11 000	13.84	36 000	15.40
12 000	12.56	37 000	15.03
13 000	13.31	38 000	16.99
14 000	12.75	39 000	17.63
15 000	13.32	40 000	18.84

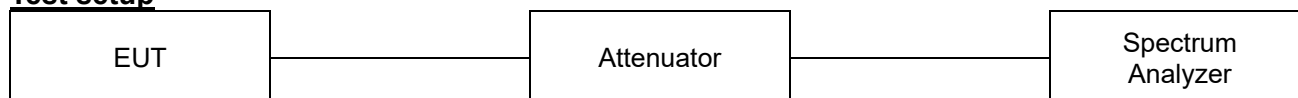
Note:

- Offset(dB) = RF cable loss(dB) + Attenuator(dB)

7. Test results

7.1. OBU Transmit Power

Test setup



Limit

According to §95.3204(a),

(a) The following power limits apply for OBUs without a geofencing capability at all locations and for OBUs with a geofencing capability when operating within any coordination zone specified in §90.387(b) of this chapter:

- (1) 10 MHz channel (5895 - 5905 MHz): 23 dBm/10 MHz EIRP;
- (2) 10 MHz channel (5905 - 5915 MHz): 33 dBm/10 MHz EIRP, reduced to 27 dBm within ±5 degrees of horizontal;
- (3) 10 MHz channel (5915 - 5925 MHz): 33 dBm/10 MHz EIRP, reduced to 27 dBm within ±5 degrees of horizontal;
- (4) 20 MHz channel (5895 - 5915 MHz): 23 dBm/20 MHz EIRP;
- (5) 20 MHz channel (5905 - 5925 MHz): 33 dBm/20 MHz EIRP, reduced to 27 dBm within ±5 degrees of horizontal; and
- (6) 30 MHz channel: 23 dBm /30 MHz EIRP.

Test procedure

511808 D01 v02 – Section 3.2

ANSI C63.26-2015 – Section 5.2.4.4.2

CFR 47 - Section §2.1046

Test settings

When the fundamental condition for average power measurements cannot be realized (i.e., the EUT cannot be configured to transmit at full-power on a continuous basis (i.e., duty cycle < 98%) and the instrumentation cannot be configured to measure only during active full-power transmissions), then the following procedure can be used if the EUT duty cycle is constant (i.e., duty cycle variations are less than or equal to $\pm 2\%$). See 5.2.4.3.4 for guidance on measurement of duty cycle.

- a) Set span to $2 \times$ to $3 \times$ the OBW.
- b) Set RBW = 1% to 5% of the OBW.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
- e) Sweep time:
 - 1) Set = auto-couple, or
 - 2) Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ for single sweep (automation-compatible) measurement.
- f) Detector = power averaging (rms).
- g) Set sweep trigger to "free run."
- h) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.
- i) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function with band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- j) Add $10 \log (1/\text{duty cycle})$ to the measured power level to compute the average power during continuous transmission. For example, add $[10 \log (1/0.25)] = 6 \text{ dB}$ if the duty cycle is a constant 25%.

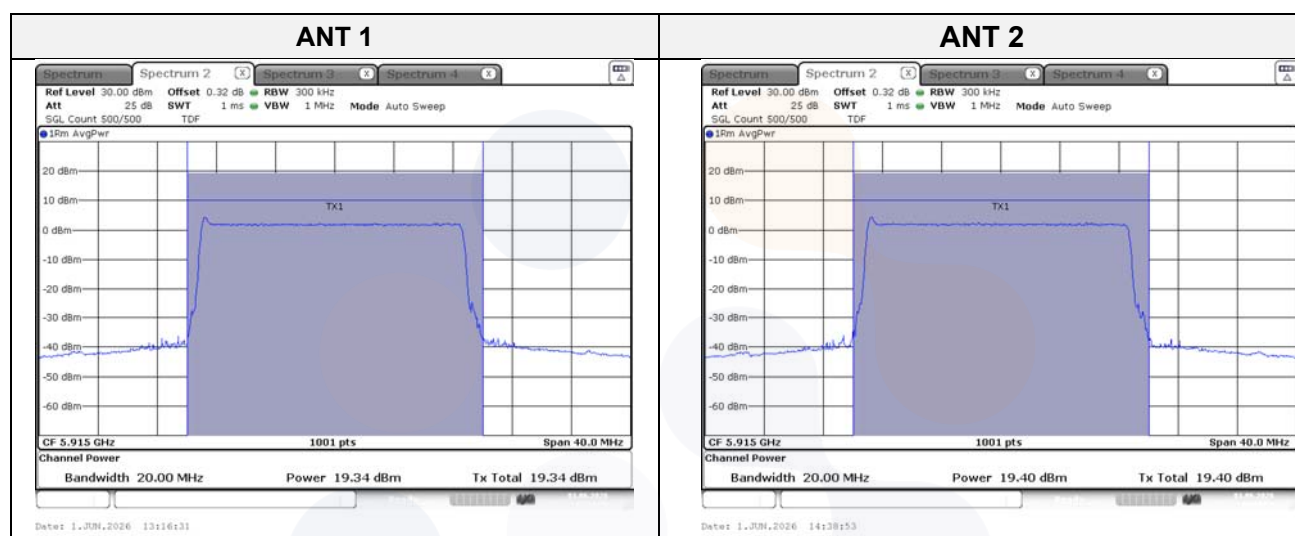
Note:

1. Offset(dB) = Duty Cycle Factor(dB)

Test results

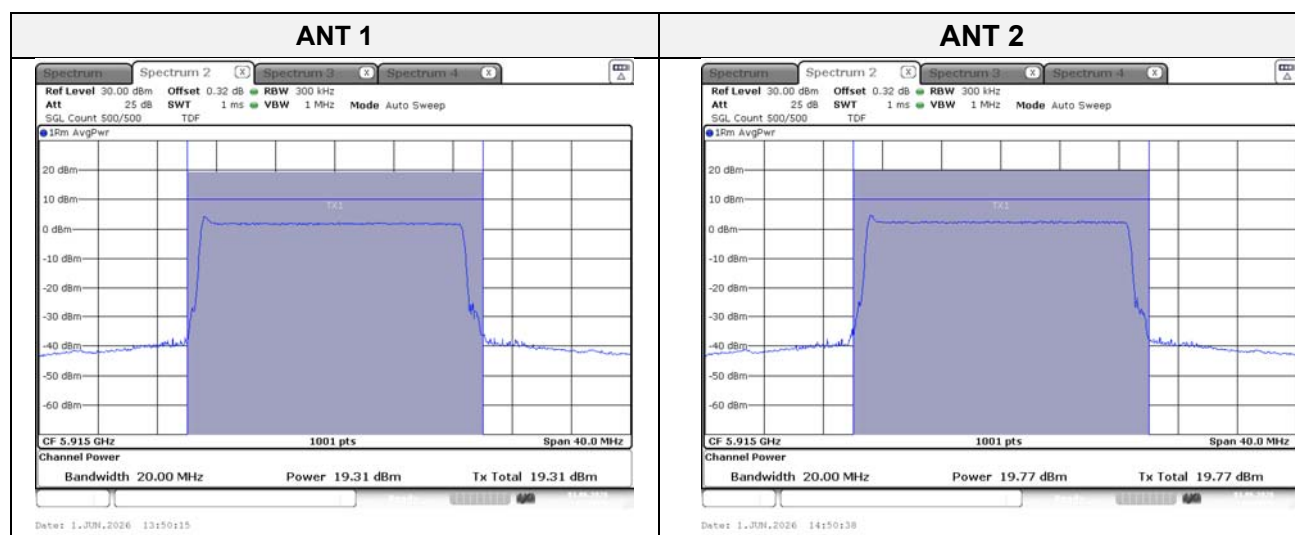
12 V

Test mode	Frequency (MHz)	Bandwidth (MHz)	SISO	Conducted Power (dBm)	Ant gain (dBi)	EIRP (dBm)	Limit (dBm)
C-V2X	5 915	20	ANT 1	19.34	2.51	21.85	33.00
			ANT 2	19.40	3.45	22.85	33.00



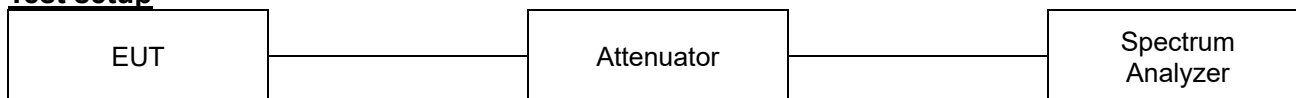
24 V

Test mode	Frequency (MHz)	Bandwidth (MHz)	SISO	Conducted Power (dBm)	Ant gain (dBi)	EIRP (dBm)	Limit (dBm)
C-V2X	5 915	20	ANT 1	19.31	2.51	21.82	33.00
			ANT 2	19.77	3.45	23.22	33.00



7.2. 99% Occupied Bandwidth & 26dB Bandwidth

Test setup



Limit

According to §2.1049,

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

According to §95.3203,

C-V2X OBUs are permitted to operate in the 5 895-5 925 MHz band.

Test procedure

511808 D01 v02 – Section 3.1

ANSI C63.26-2015 – Section 5.4

Test settings

◆ 26dB Bandwidth

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.
- b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- a) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
- d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target “-X dB” requirement, i.e., if the requirement calls for measuring the -26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.
- e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.
- f) Determine the reference value by either of the following:
 - 1) Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
 - 2) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.
- g) Determine the “-X dB amplitude” as equal to (Reference Value - X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.
- h) If the reference value was determined using an unmodulated carrier, turn the EUT modulation on, then either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise the trace from step f) shall be used for step i).

- i) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the “-X dB amplitude” determined in step f). If a marker is below this “-X dB amplitude” value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers.
- j) The spectral envelope can cross the “-X dB amplitude” at multiple points. The lowest or highest frequency shall be selected as the frequencies that are the farthest away from the center frequency at which the spectral envelope crosses the “-X dB amplitude.”
- k) The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

◆ 99% Occupied Bandwidth

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of $1.5 \times \text{OBW}$ is sufficient).
- b) The nominal IF filter 3 dB Bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
- d) Set the detection mode to peak, and the trace mode to max-hold.
- e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.
- f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

Note:

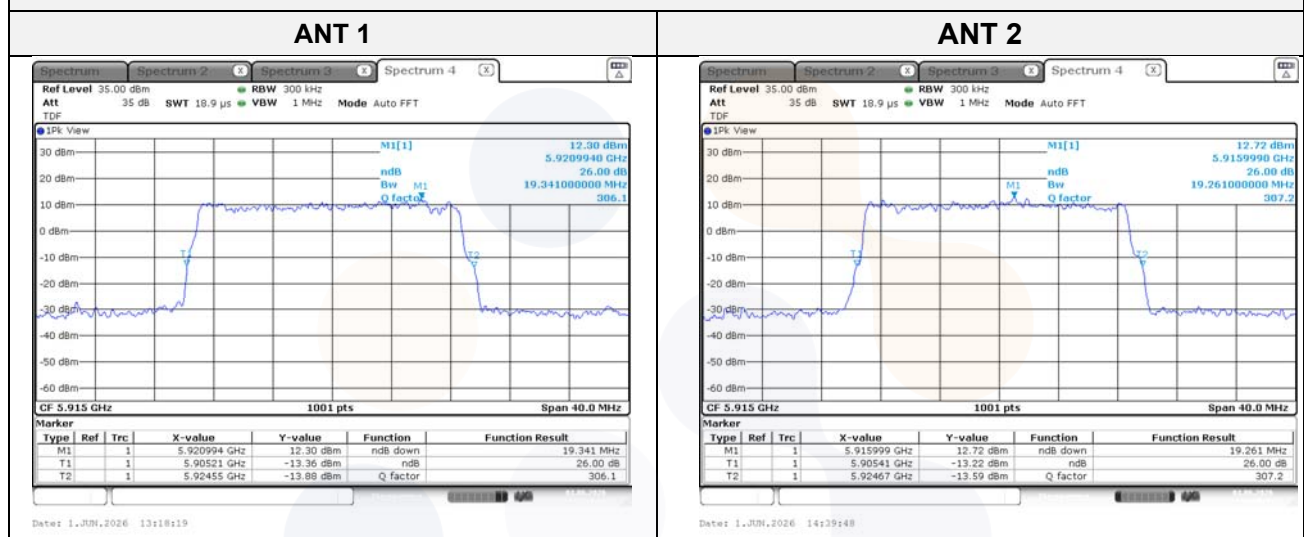
1. EUT operate in the 5 905-5 925 MHz band.

Test results

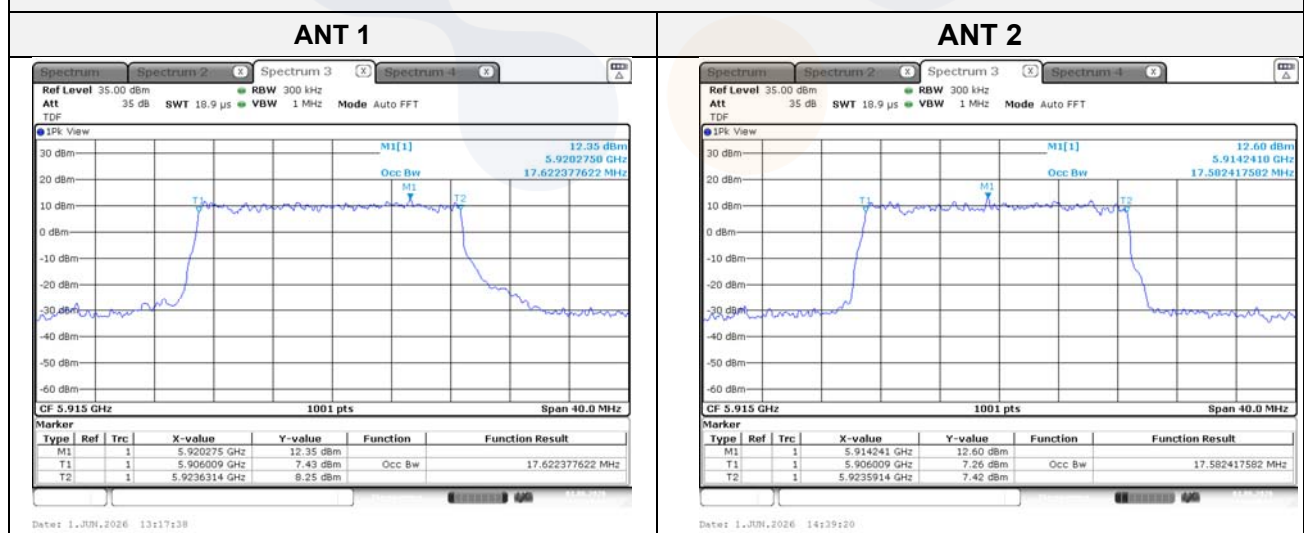
12 V

Test mode	Frequency (MHz)	Bandwidth (MHz)	SISO	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
C-V2X	5 915	20	ANT 1	19.341	17.622
			ANT 2	19.261	17.582

26 dB Bandwidth



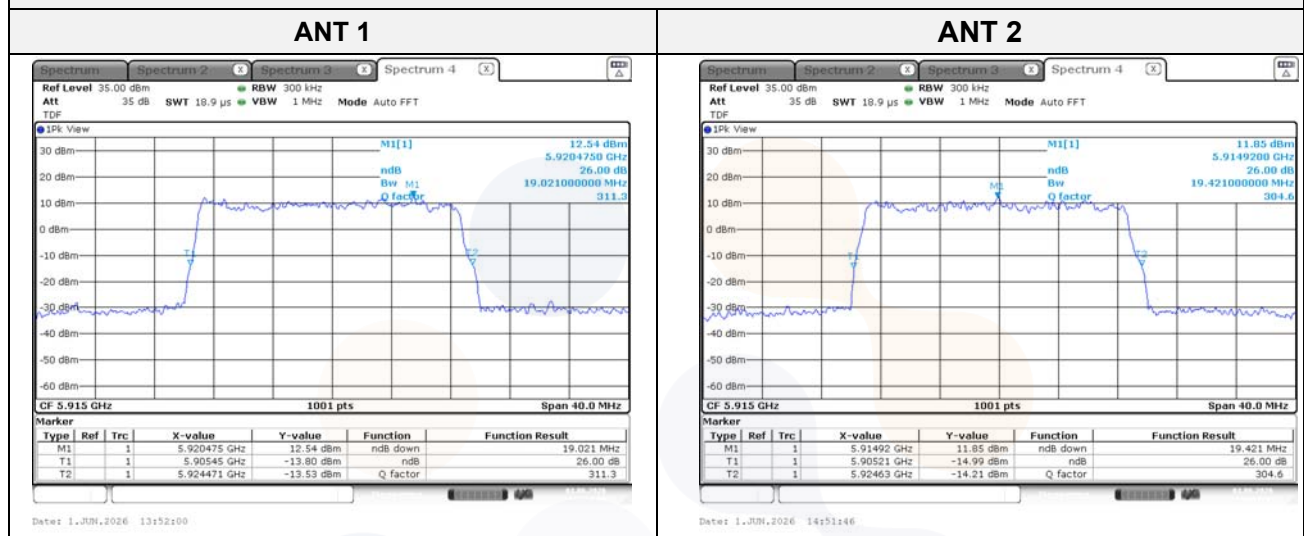
99 % Bandwidth



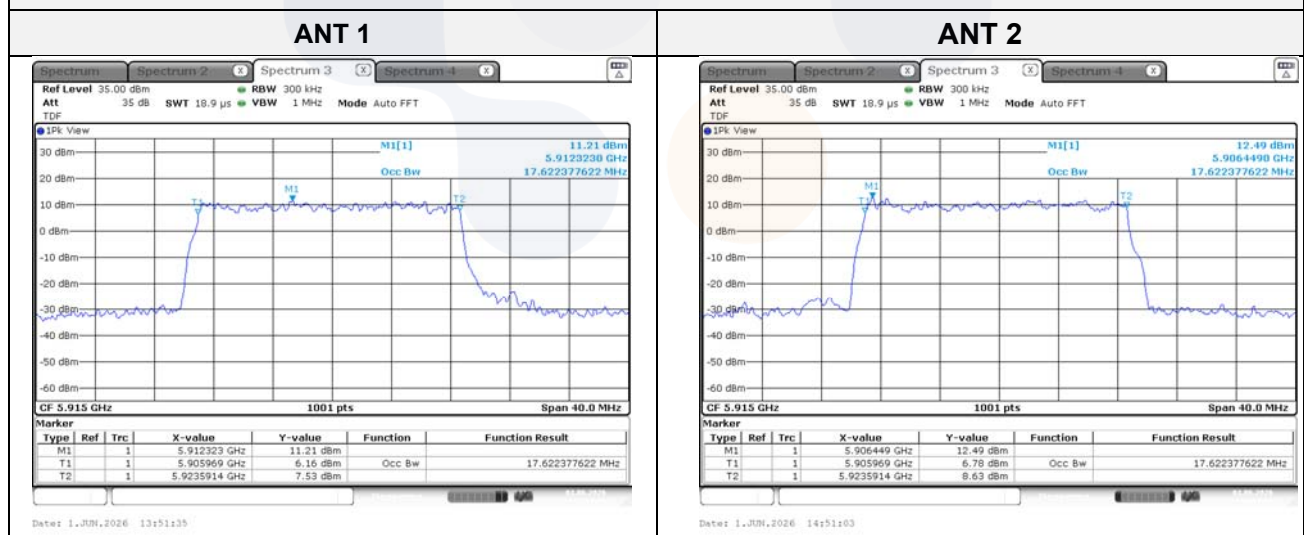
24 V

Test mode	Frequency (MHz)	Bandwidth (MHz)	SISO	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
C-V2X	5 915	20	ANT 1	19.021	17.622
			ANT 2	19.421	17.622

26 dB Bandwidth

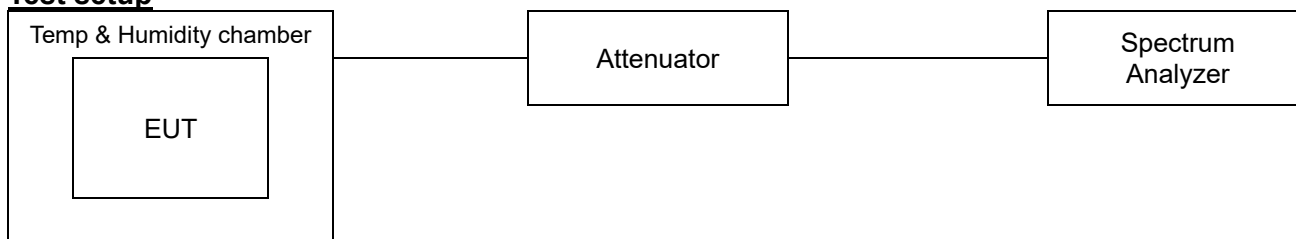


99 % Bandwidth



7.3. Frequency stability

Test setup



Limit

According to §2.1055(a),

The frequency stability shall be measured with variation of ambient temperature as follows:

- 1) From -30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
- 2) From -20° to + 50° centigrade for equipment to be licensed for use in the maritime services under part 80 of this chapter, except for class A, B, and S emergency position indicating radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the local television transmission service and point-to-point microwave radio service under part 21 of this chapter, equipment licensed for use aboard aircraft in the aviation services under part 87 of this chapter, and equipment authorized for use in the family radio service under part 95 of this chapter.
- 3) From 0° to + 50° centigrade for equipment to be licensed for use in the radio broadcast Services under part 73 of this chapter.

According to §2.1055(d),

The frequency stability shall be measured with variation of primary supply Voltage as follows:

- 1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
- 2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating and point which shall be specified by the manufacturer.
- 3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

According to §95.3203,

C-V2X OBUs are permitted to operate in the 5 895-5 925 MHz band.

Test procedure

ANSI 63.26-2015 – Section 5.6

Test settings

- 1) The carrier frequency of the transmitter is measured at room temperature.
(20°C to provide a reference)
- 2) The equipment is turned on in a “standby” condition for one minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
- 3) Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C.
A period of at least one half-hour is provided to allow stabilization of the equipment at each Temperature level.

Test results

Test mode : C-V2X / ANT 1

Frequency (MHz) : 5 915

Voltage (%)	Power (V)	Temp. (°C)	F _L [MHz]	F _L Limit [MHz]	F _H [MHz]	F _H Limit [MHz]
100%	12.00	+22.0(Ref)	5 905.21	5 905.00	5 924.55	5 925.00
		-40	5 905.21		5 924.55	
		-30	5 905.29		5 924.51	
		-20	5 905.25		5 924.67	
		-10	5 905.21		5 924.67	
		0	5 905.25		5 924.67	
		+10	5 905.25		5 924.71	
		+20	5 905.17		5 924.71	
		+30	5 905.21		5 924.71	
		+40	5 905.25		5 924.67	
		+50	5 905.21		5 924.27	
		+60	5 905.17		5 924.71	
		+70	5 905.25		5 924.75	
115%	13.80	+22.0(Ref)	5 905.33	5 905.00	5 924.63	5 925.00
85%	10.20	+22.0(Ref)	5 905.21		5 923.99	

Voltage (%)	Power (V)	Temp. (°C)	F _L [MHz]	F _L Limit [MHz]	F _H [MHz]	F _H Limit [MHz]
100%	24.00	+22.0(Ref)	5 905.45	5 905.00	5 924.47	5 925.00
		-40	5 905.21		5 924.59	
		-30	5 905.33		5 924.07	
		-20	5 905.29		5 924.39	
		-10	5 905.53		5 923.99	
		0	5 905.29		5 924.87	
		+10	5 905.29		5 924.43	
		+20	5 905.29		5 924.71	
		+30	5 905.37		5 924.63	
		+40	5 905.25		5 924.31	
		+50	5 905.33		5 924.67	
		+60	5 905.17		5 924.75	
		+70	5 905.21		5 924.59	
115%	27.60	+22.0(Ref)	5 905.29	5 905.00	5 924.79	5 925.00
85%	20.40	+22.0(Ref)	5 905.21		5 924.31	

Test mode : C-V2X / ANT 2

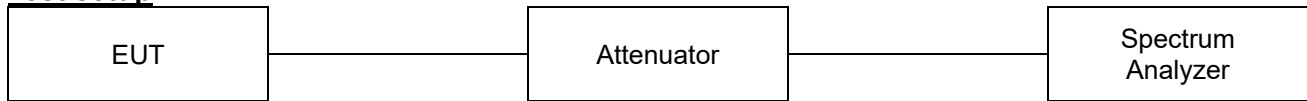
Frequency (MHz) : 5 915

Voltage (%)	Power (V)	Temp. (°C)	F _L [MHz]	F _L Limit [MHz]	F _H [MHz]	F _H Limit [MHz]
100%	12.00	+22.0(Ref)	5 905.41	5 905.00	5 924.67	5 925.00
		-40	5 905.09		5 924.71	
		-30	5 905.61		5 924.59	
		-20	5 905.25		5 923.95	
		-10	5 905.25		5 924.59	
		0	5 905.13		5 924.59	
		+10	5 905.61		5 923.95	
		+20	5 905.29		5 924.35	
		+30	5 905.05		5 924.55	
		+40	5 905.13		5 924.51	
		+50	5 905.21		5 923.99	
		+60	5 905.21		5 924.71	
		+70	5 905.25		5 924.75	
115%	13.80	+22.0(Ref)	5 905.25		5 924.59	
85%	10.20	+22.0(Ref)	5 905.29		5 924.55	

Voltage (%)	Power (V)	Temp. (°C)	F _L [MHz]	F _L Limit [MHz]	F _H [MHz]	F _H Limit [MHz]
100%	24.00	+22.0(Ref)	5 905.21	5 905.00	5 924.63	5 925.00
		-40	5 905.25		5 924.47	
		-30	5 905.21		5 924.79	
		-20	5 905.25		5 924.31	
		-10	5 905.45		5 924.55	
		0	5 905.17		5 924.51	
		+10	5 905.29		5 924.63	
		+20	5 905.53		5 924.71	
		+30	5 905.29		5 924.71	
		+40	5 905.29		5 924.51	
		+50	5 905.17		5 924.59	
		+60	5 905.21		5 924.75	
		+70	5 905.17		5 924.47	
115%	27.60	+22.0(Ref)	5 905.21		5 924.79	
85%	20.40	+22.0(Ref)	5 905.21		5 924.67	

7.4. Out-of-Band Emissions

Test setup



Limit

According to §95.3205,

- (a) C-V2X OBUs must comply with the following out-of-band emissions limits. Conducted Emissions limits measured at the antenna input shall not exceed:
- (1) -16 dBm/100 kHz within 1 megahertz of the band edges;
 - (2) -13 dBm/MHz within 1 megahertz to 5 megahertz of the band edges;
 - (3) -16 dBm/MHz within 5 megahertz to 30 megahertz of the band edges; and
 - (4) -28 dBm/MHz beyond 30 megahertz from the band edges.

Test procedure

511808 D01 v02 - Section 3.3

ANSI C63.26-2015 – Section 5.7.3

Test settings

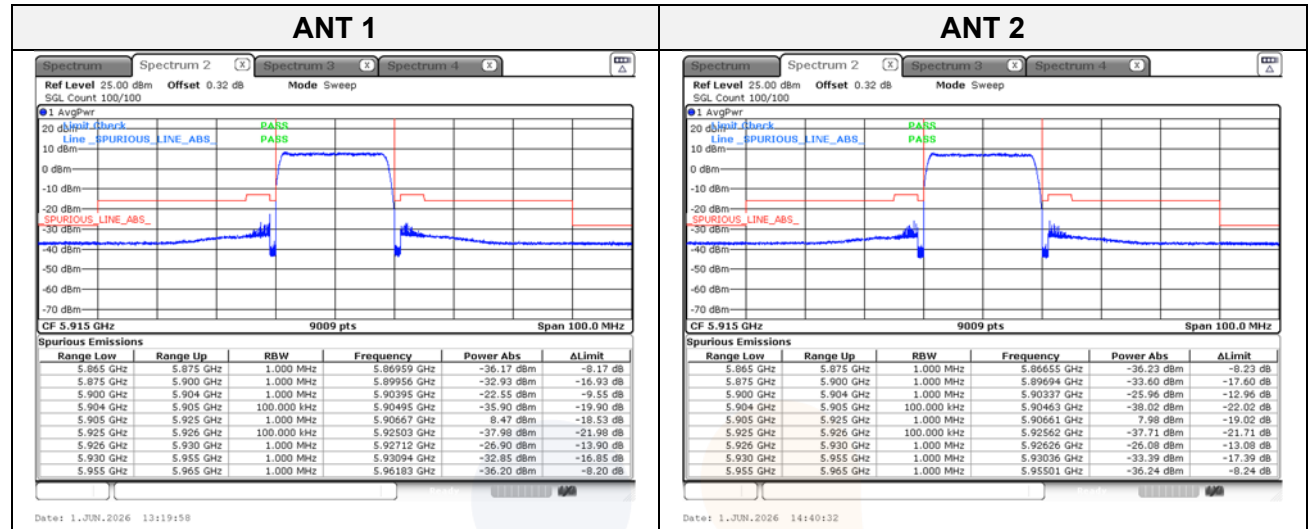
- a) Set the spectrum analyzer center frequency to the block, band, or channel edge frequency.
- b) Set the span wide enough to capture the fundamental emission closest to the authorized block or band edge, and to include all modulation products that spill into the immediately adjacent frequency band. In some cases, it may be possible to set the center frequency and span so as to encompass the fundamental emission and the unwanted out-of-band (band-edge) emissions on either side of the authorized block, band, or channel. This can be accomplished with a single (slow) sweep, if adequate overload protection and sufficient dynamic range can be maintained.
- c) Set the number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$.
- d) Sweep time should be auto for peak detection. For rms detection the sweep time should be set as follows:
 - 1) If the device can be configured to transmit continuously (duty cycle $\geq 98\%$), set the (sweep time) $> (\text{number of points in sweep}) \times (\text{symbol period})$ (e.g., by a factor of $10 \times \text{symbol period} \times \text{number of points}$). Increasing the sweep time (i.e., slowing the sweep speed) will allow for averaging over multiple symbols
 - 2) If the device cannot transmit continuously (duty cycle $< 98\%$), a gated sweep shall be used when possible (i.e., gate triggered such that the analyzer only sweeps when the device is transmitting at full power), set the sweep time $> (\text{number of points in sweep}) \times (\text{symbol period})$ but the sweep time shall always be maintained at a value that is less than or equal to the minimum transmission time.
 - 3) If the device cannot be configured to transmit continuously (duty cycle $< 98\%$) and a freerunning sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time $> (\text{number of points in sweep}) \times (\text{transmitter period})$ (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by $[10 \log (1/\text{duty cycle})]$. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation $\leq \pm 2\%$).
 - 4) If the device cannot be configured to transmit continuously and a free-running sweep must be used, and if the transmissions exhibit a non-constant duty cycle (duty cycle variations $> \pm 2\%$), set the sweep time so that the averaging is performed over the on-period by setting the sweep time $> (\text{symbol period}) \times (\text{number of points})$, while also maintaining the sweep time $< (\text{transmitter on-time})$. The trace mode shall be set to max hold, since not every display point will be averaged only over just the on-time. Thus, multiple sweeps (e.g., 100) in maximum hold are necessary to ensure that the maximum power is measured.
- e) The test report shall include the plots of the measuring instrument display and the measured data.
- f) See Annex I for example emission mask plots.

Note:

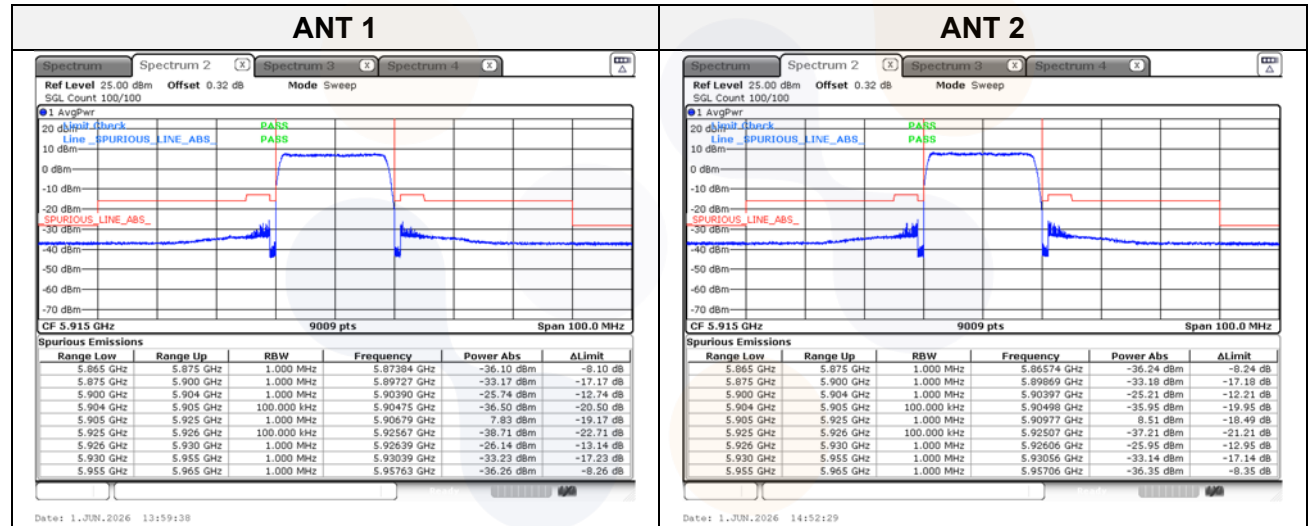
1. Offset(dB) = Duty Cycle Factor(dB)

Test results

12 V



24 V

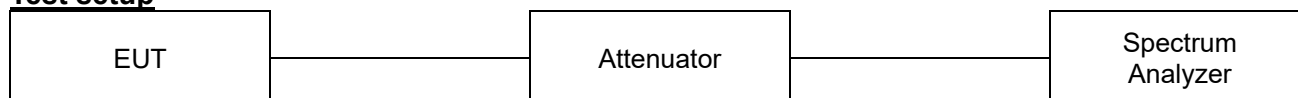


Emission Mask Table

	Range 1	Range 2	Range 3	Range 4	Range 5	Range 6	Range 7	Range 8	Range 9
Range Start	5.865 GHz	5.875 GHz	5.9 GHz	5.904 GHz	5.905 GHz	5.925 GHz	5.926 GHz	5.93 GHz	5.955 GHz
Range Stop	5.875 GHz	5.9 GHz	5.904 GHz	5.905 GHz	5.925 GHz	5.926 GHz	5.93 GHz	5.955 GHz	5.965 GHz
Filter Type	Gaussian	Gaussian	Gaussian	Gaussian	Gaussian	Gaussian	Gaussian	Gaussian	Gaussian
RBW	1 MHz	1 MHz	1 MHz	100 kHz	1 MHz	100 kHz	1 MHz	1 MHz	1 MHz
VBW	3 MHz	3 MHz	3 MHz	300 kHz	3 MHz	300 kHz	3 MHz	3 MHz	3 MHz
Sweep Time Mode	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto
Sweep Time	1.01 ms	1.01 ms	1.01 ms	1.01 ms	1.01 ms	1.01 ms	1.01 ms	1.01 ms	1.01 ms
Detector	RMS	RMS	RMS	RMS	RMS	RMS	RMS	RMS	RMS
Ref. Level	23 dBm	25 dBm	25 dBm	25 dBm	25 dBm	25 dBm	25 dBm	25 dBm	25 dBm
RF Att. Mode	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual
RF Attenuator	35 dB	35 dB	35 dB	35 dB	35 dB	35 dB	35 dB	35 dB	35 dB
Preamp	Off	Off	Off	Off	Off	Off	Off	Off	Off
Sweep Points	1001	1001	1001	1001	1001	1001	1001	1001	1001
Stop After Sweep	Off	Off	Off	Off	Off	Off	Off	Off	Off
Transducer	PORT1	PORT1	PORT1	PORT1	PORT1	PORT1	PORT1	PORT1	PORT1
Limit Check	Absolute	Absolute	Absolute	Absolute	Absolute	Absolute	Absolute	Absolute	Absolute
Abs Limit Start	-28 dBm	-16 dBm	-13 dBm	-16 dBm	27 dBm	-16 dBm	-13 dBm	-16 dBm	-28 dBm
Abs Limit Stop	-28 dBm	-16 dBm	-13 dBm	-16 dBm	27 dBm	-16 dBm	-13 dBm	-16 dBm	-28 dBm

7.5. Spurious Emissions

Test setup



Limit

According to §95.3205,

- (b) C-V2X OBUs must comply with the following out-of-band emissions limits. Conducted Emissions limits measured at the antenna input shall not exceed:
- (1) -16 dBm/100 kHz within 1 megahertz of the band edges;
 - (2) -13 dBm/MHz within 1 megahertz to 5 megahertz of the band edges;
 - (3) -16 dBm/MHz within 5 megahertz to 30 megahertz of the band edges; and
 - (4) -28 dBm/MHz beyond 30 megahertz from the band edges.

Test procedure

511808 D01 v02 - Section 3.3

ANSI C63.26-2015 – Section 5.7.4

Test settings

- a) Set the spectrum analyzer start frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the measurements previously performed in 5.7.3. As an alternative, the stop frequency can be set to the value specified in 5.1.1, depending on the EUT operating range, if the resulting plot can clearly demonstrate compliance for all frequencies not addressed by the out-of-band emissions measurements performed as per 5.7.3.
- b) When using an average power (rms) detector, ensure that the number of points in the sweep $\geq 2 \times (\text{span} / \text{RBW})$. This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements. When average power is specified by the applicable regulation, a peak-detector can be utilized for preliminary measurements to accommodate wider frequency spans. Any emissions found in the preliminary measurement to exceed the applicable limit(s) shall be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.
- c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a power averaging (rms) detector, the sweep time shall be set as described for out-of-band emissions measurements in item d) of 5.7.3.
- d) Identify and measure the highest spurious emission levels in each frequency range. It is not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.
- e) Repeat step b) through step d) for the upper spurious emission frequency range if not already captured by a wide span measurement performed as per the alternative provided in step a). The upper frequency for this measurement is defined in 5.1.1 as a function of the EUT operating range.
- f) Compare the results with the corresponding limit in the applicable regulation.
- g) The test report shall include the data plots of the measuring instrument display and the measured data.

Note:

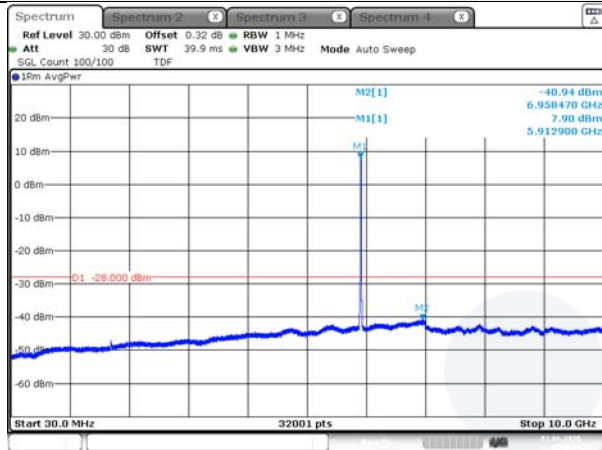
1. Offset(dB) = Duty Cycle Factor(dB)

Test results

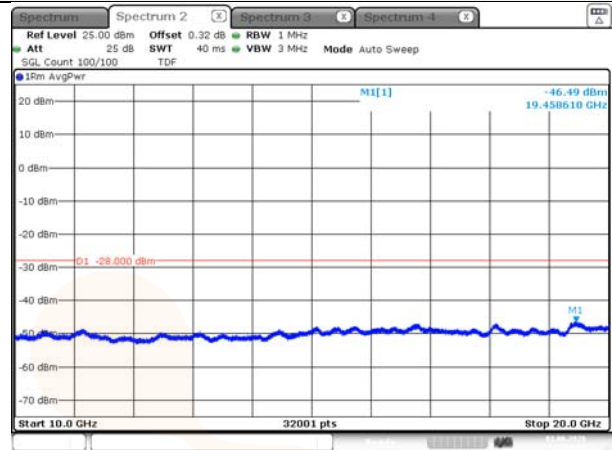
12 V

ANT 1

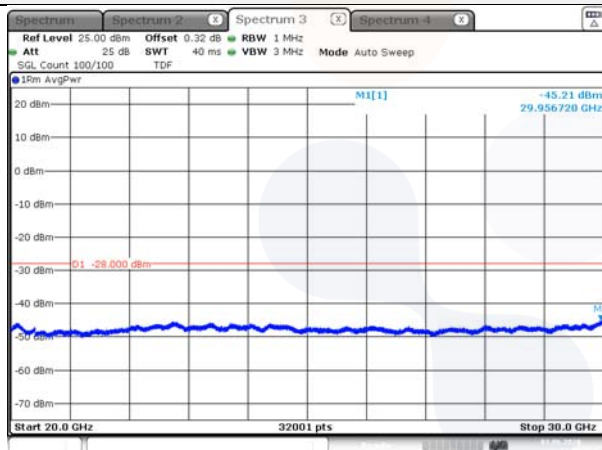
30 MHz ~ 10 GHz



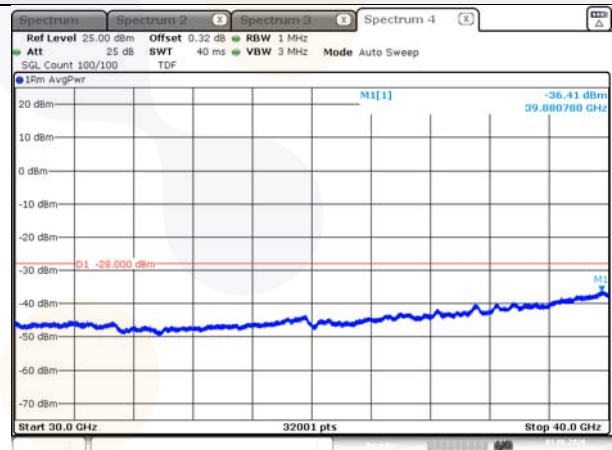
10 GHz ~ 20 GHz



20 GHz ~ 30 GHz

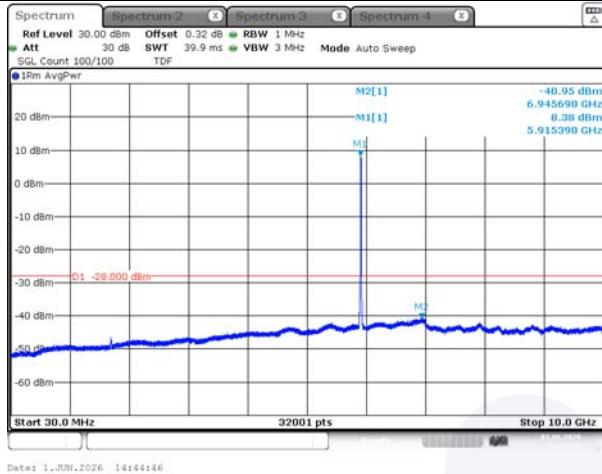


30 GHz ~ 40 GHz

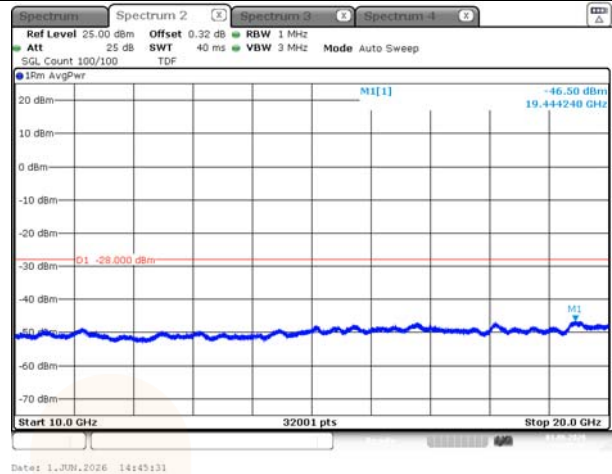


ANT 2

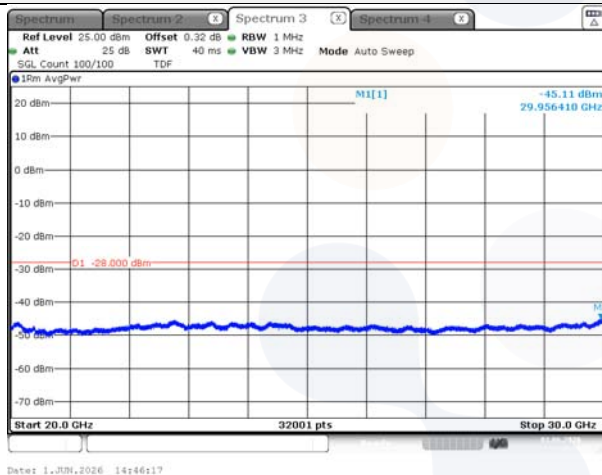
30 MHz ~ 10 GHz



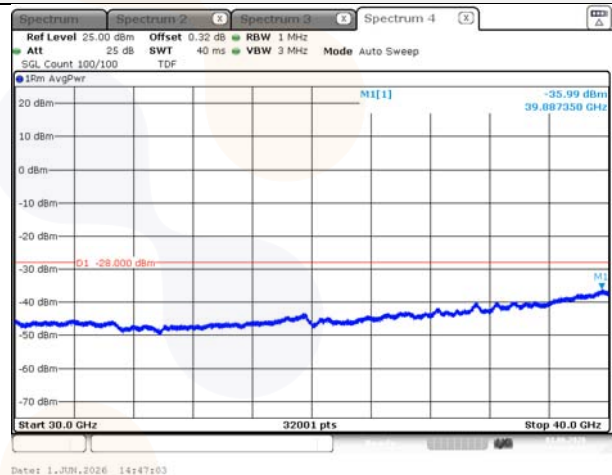
10 GHz ~ 20 GHz



20 GHz ~ 30 GHz



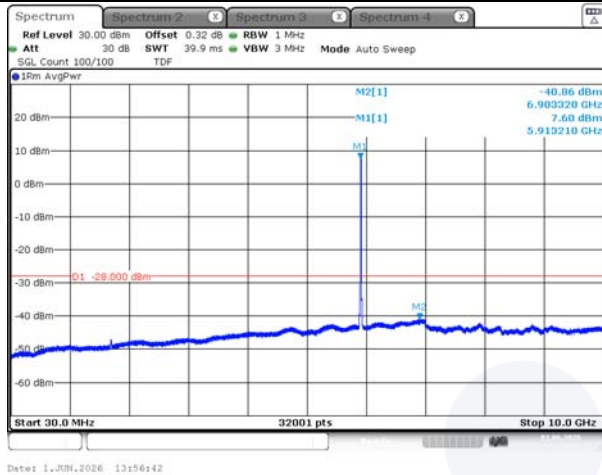
30 GHz ~ 40 GHz



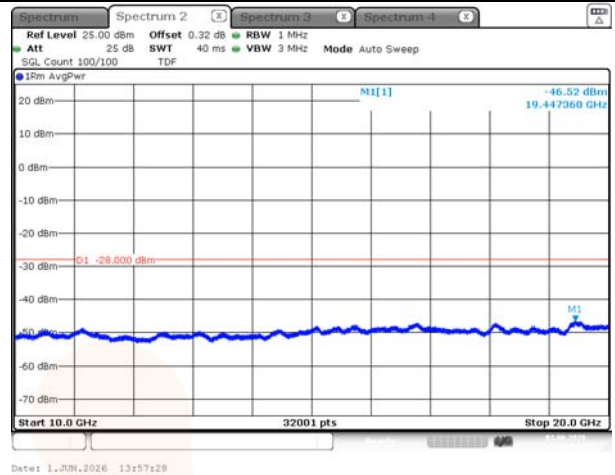
24 V

ANT 1

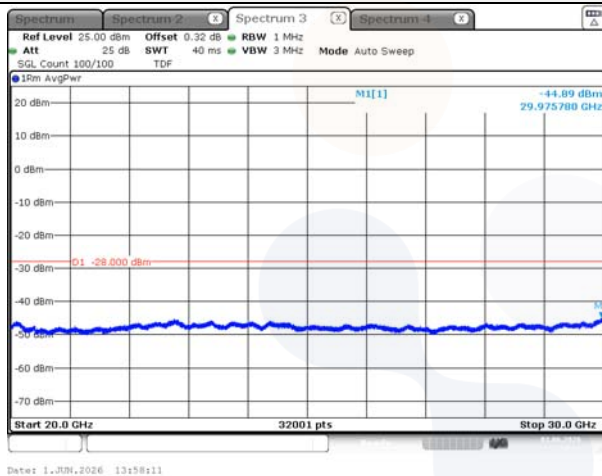
30 MHz ~ 10 GHz



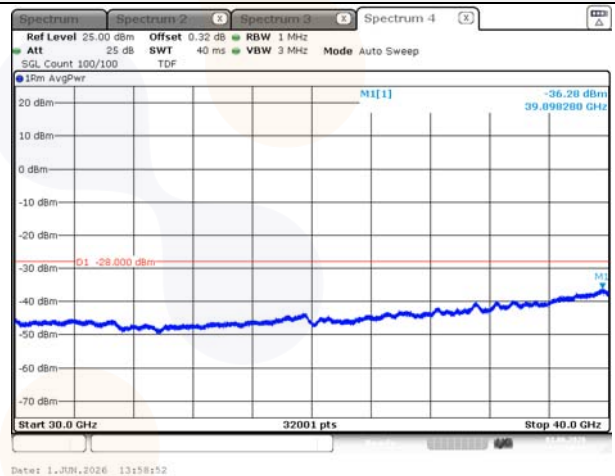
10 GHz ~ 20 GHz



20 GHz ~ 30 GHz

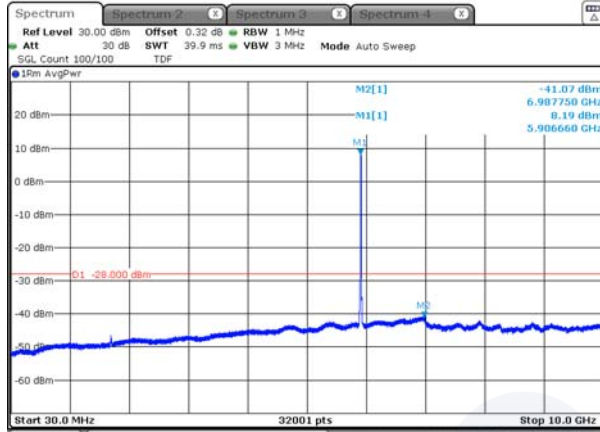


30 GHz ~ 40 GHz

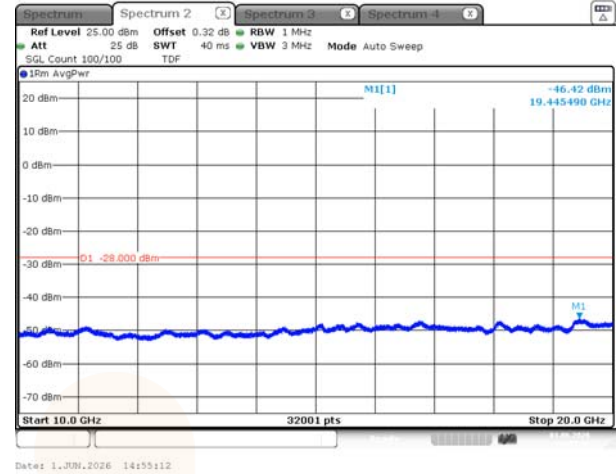


ANT 2

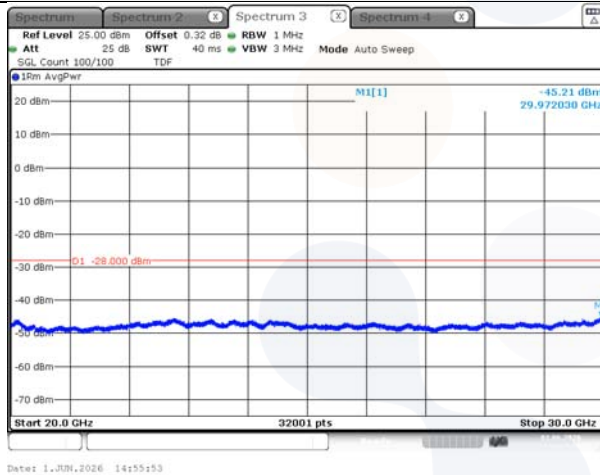
30 MHz ~ 10 GHz



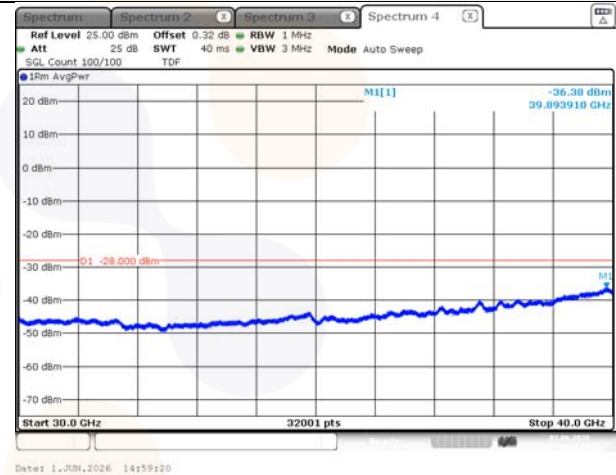
10 GHz ~ 20 GHz



20 GHz ~ 30 GHz



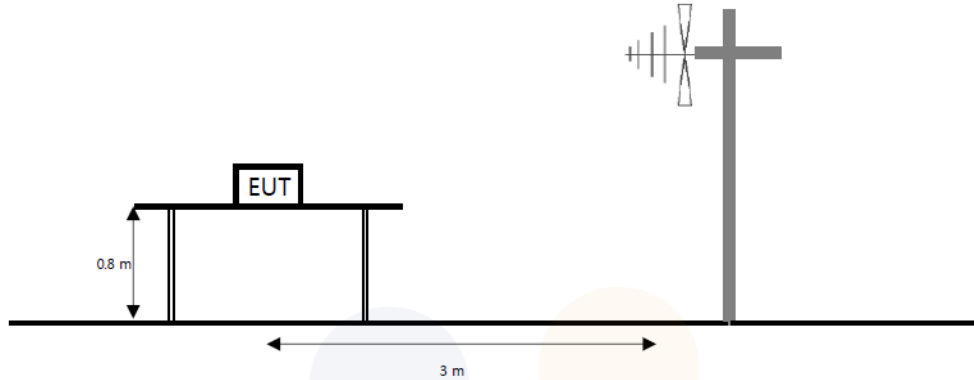
30 GHz ~ 40 GHz



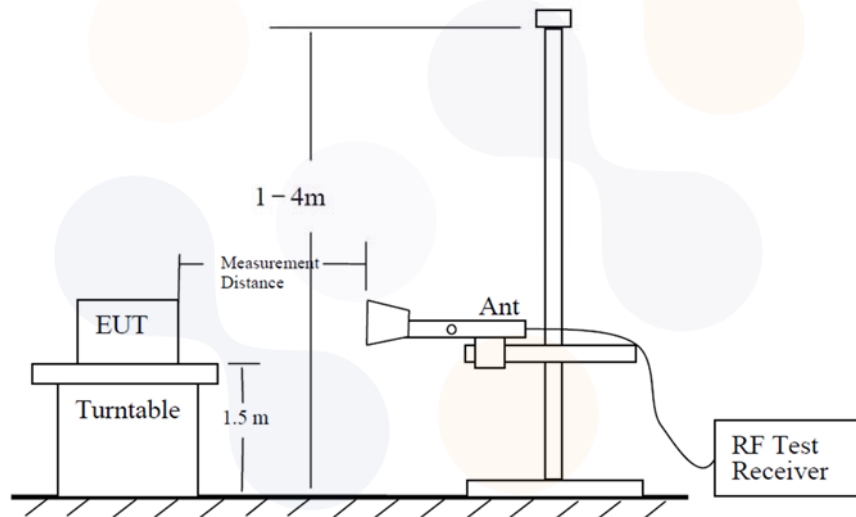
7.6. Radiated Spurious Emissions

Test setup

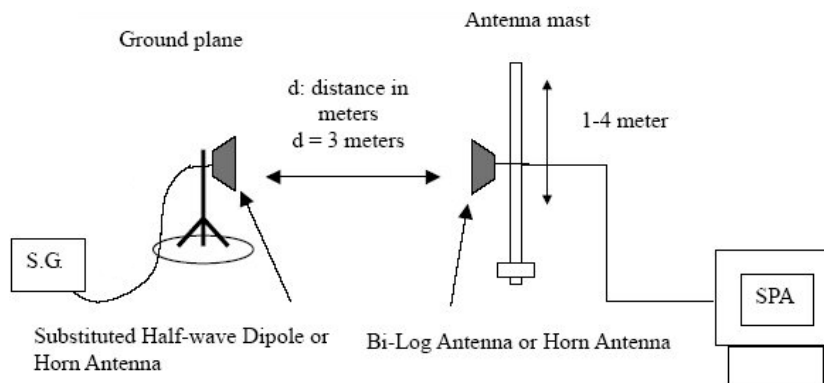
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



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Limit

According to §95.3205,

(c) C-V2X OBU must comply with the following out-of-band emissions limits. Conducted Emissions limits measured at the antenna input shall not exceed:

- (5) -16 dBm/100 kHz within 1 megahertz of the band edges;
- (6) -13 dBm/MHz within 1 megahertz to 5 megahertz of the band edges;
- (7) -16 dBm/MHz within 5 megahertz to 30 megahertz of the band edges; and
- (8) -28 dBm/MHz beyond 30 megahertz from the band edges.

Test procedure

971168 D01 v03r01 - Section 6.2

ANSI 63.26-2015 – Section 5.5

ANSI/TIA-603-E-2016 - Section 2.2.12

Test settings

- 1) RBW = 1 MHz for above 1 GHz.
- 2) VBW $\geq 3 \times$ RBW.
- 3) Detector = RMS
- 4) Trace mode = Max hold
- 5) Sweep time = Auto couple
- 6) Number of sweep points $\geq 2 \times$ span / RBW
- 7) Allow trace to fully stabilize.

Notes:

1. On a test site, the EUT shall be placed at 1.5 m height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to correspond to the fundamental frequency of the transmitter.
3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the Level of the maximized emission.
4. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
5. The maximum signal level detected by the measuring receiver shall be noted.
6. The EUT was replaced by horn antenna (1 GHz above) connected to a signal generator.
7. The test antenna shall be raised and lowered through the specified range of height to ensure that The maximum signal is received.
8. The input signal to the substitution antenna shall be adjusted to the level that produces a level Detected by the measuring corrected for the change of input attenuator setting of the measuring Receiver.
9. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for Any change of input attenuator setting of the measuring receiver.
10. The measurement shall be repeated with the test antenna and the substitution antenna Orientated for horizontal polarization.

Test results

Test mode : C-V2X / ANT 1

Frequency(MHz) : 5 915

Bandwidth(MHz) : 20

Test Voltage	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
12 V	11 830.25	H	13.00	24.46	-38.54	-50.00	-28.00	22.00
	17 742.40	H	13.86	29.90	-34.06	-50.10	-28.00	22.10
	23 663.53	V	12.17	35.76	-27.71	-51.30	-28.00	23.30
	29 576.40	V	13.18	41.17	-24.31	-52.30	-28.00	24.30

Test mode : C-V2X / ANT 2

Frequency(MHz) : 5 915

Bandwidth(MHz) : 20

Test Voltage	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
12 V	11 832.93	H	13.00	24.44	-39.96	-51.40	-28.00	23.40
	17 744.31	V	13.86	29.91	-33.15	-49.20	-28.00	21.20
	23 657.67	V	12.17	35.75	-29.82	-53.40	-28.00	25.40
	29 580.80	H	13.18	41.17	-24.41	-52.40	-28.00	24.40

Note:

1. $E.I.R.P(dBm) = \text{Substitute Level}(dBm) + \text{Antenna gain}(dBi) - C.L(\text{Cable loss})(dB)$

Test mode : C-V2X / ANT 1

Frequency(MHz) : 5 915

Bandwidth(MHz) : 20

Test Voltage	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
24 V	11 827.18	H	13.00	24.49	-39.71	-51.20	-28.00	23.20
	17 742.01	V	13.86	29.89	-32.87	-48.90	-28.00	20.90
	23 662.80	H	12.17	35.76	-30.61	-54.20	-28.00	26.20
	29 577.87	V	13.18	41.17	-24.31	-52.30	-28.00	24.30

Test mode : C-V2X / ANT 2

Frequency(MHz) : 5 915

Bandwidth(MHz) : 20

Test Voltage	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
24 V	11 829.87	V	13.00	24.46	-40.14	-51.60	-28.00	23.60
	17 746.61	H	13.85	29.93	-33.22	-49.30	-28.00	21.30
	23 658.40	V	12.17	35.75	-28.12	-51.70	-28.00	23.70
	29 578.60	V	13.18	41.17	-24.71	-52.70	-28.00	24.70

Note:

1. $E.I.R.P(dBm) = \text{Substitute Level}(dBm) + \text{Antenna gain}(dBi) - C.L(\text{Cable loss})(dB)$

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8. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV40-N	101462	26.09.29
PXA Signal Analyzer	KEYSIGHT	N9040B	US55230151	26.07.01
Attenuator	HUBER+SUHNER	6610_SK-50-1/199_NE	ATT15	26.07.07
Signal Generator	R&S	SMB100A	176206	27.01.15
Vector Signal Generator	R&S	SMBV100A	257566	26.07.01
DC Power Supply	AGILENT	E3632A	MY51220373	27.04.23
DC Power Supply	AGILENT	E3632A	MY40017108	27.04.23
Temp & Humid Chamber	Myeongseong R&P	CTHC-50P-DT	20150824-2	27.01.15
Bi-log Antenna	Teseq GmbH	CBL 6112D	62027	26.10.17
Bi-log Antenna	ETS-LINDGREN	3143B	00228420	27.07.03
Horn Antenna	ETS-LINDGREN	3117	00251528	27.01.23
Horn Antenna	ETS-LINDGREN	3117	00246058	27.01.23
Horn Antenna	ETS-LINDGREN	3116C	00251516	27.01.20
Horn Antenna	ETS-LINDGREN	3116	00086635	27.01.20
Amplifier	SONOMA INSTRUMENT	310N	421822	26.09.29
Amplifier	C&K Technologies, Inc.	BZR-00504000-551028-252525	27736	26.04.30
Amplifier	L-3 Narda-MITEQ	JS44-18004000-33-8P	2000996	27.01.26
High pass Filter	WT	WT-A1699-HS	WT160411002	27.04.23

End of test report