

FCC RF Test Report

Test Report Number SUB-24041751-C-FCC-DTS-900M

FCC ID 2AS4H-BLINC3

Applicant Subeca, Inc.

Applicant Address 4514 Cole Avenue Suite 600, Dallas, TX 75205

Product Name Subeca BLINC S2

Model (s) BLINC S2

Date of Receipt 06/11/2024

Date of Test 06/15/2024- 08/08/2024

Report Issue Date 08/16/2024

Test Standards 47 CFR Part 15.247

Test Result PASS



Issued by:

Vista Compliance Laboratories

1261 Puerta Del Sol, San Clemente, CA 92673 USA

www.vista-compliance.com

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REVISION HISTORY

Report Number	Version	Description	Issued Date
SUB-24041751-C-FCC-DTS-SideWalk	01	Initial report	08/16/2024

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1 Test Summary

Test Item	Test Requirement	Test Method	Result
Antenna Requirement	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
AC Power Line Conducted Emissions	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Occupied Bandwidth	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
DTS (6 dB) Channel Bandwidth	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Conducted Maximum Output Power	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Power Spectral Density	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Conducted Band-Edge & Unwanted Emissions	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass

2 General Information

2.1 Applicant

Applicant	Subeca, Inc.
Applicant address	4514 Cole Avenue Suite 600, Dallas, TX 75205
Manufacturer	Subeca, Inc.
Manufacturer Address	4514 Cole Avenue Suite 600, Dallas, TX 75205

2.2 Product information

Product Name	Subeca BLINC S2
Product Description	Subeca BLINC S2
Model Number	BLINC S2
Family Models	N/A
Serial Number	N/A
Frequency Band	Sidewalk: 902.5-926.5MHz
Type of modulation	SubG-CSS
Equipment Class	DTS
Antenna Information	P/N: Taoglas PC91.07.0100A, db(915 MHz PCB antenna), peak gain: 2.67 dBi P/N: Taoglas iLA.09 (915 MHz Ceramic loop antenna), Chip Antenna, Peak gain: 1.57 dBi
Clock Frequencies	N/A
Input Power	DC 3.6V
Power Adapter Manufacturer/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	BLE and 900MHz can transmit simultaneously
Additional Info	EUT supports BLE and 900 MHz LoRA/Sidewalk protocols. The 900MHz LoRA is under DSS equipment class as hopping device; the 900MHz Sidewalk is under DTS equipment class as digital modulation device. EUT is soldered onto a development board for testing purpose.

2.3 Test standard and method

Test standard	47 CFR Part 15.247
Test method	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02

3 Test Site Information

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	23.5°C	55.1%	996 mbar
Radiated Emission Testing	23.5°C	55.1%	996 mbar

4 Modification of EUT / Deviations from Standards

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

5 Test Configuration and Operation

5.1 EUT Test Configuration

The EUT is mounted onto a development board to support testing. EUT is set to different transmission mode in terms of radio mode bandwidth, power level, test channel, etc.

The following software was used for testing and to monitor EUT performance

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing
Tera Term	Set EUT into RF test mode

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #
Development board	Subeca	PROP PLUG	N/A

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

7 Test Results

7.1 Antenna Requirement

7.1.1 Requirement

Per § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

7.1.2 Result

Analysis:

- EUT has two types of antennas connection: one is using on board unique u.FL connector, for connecting to a external PCB antenna (peak gain: 2.67 dBi); one is a on board ceramic loop antenna (1.57 dBi), which is soldered to the mainboard and considered permantely attached.

Conclusion:

- EUT complies with antenna requirement in § 15.203.

7.2 Conducted Emissions

7.2.1 Requirement

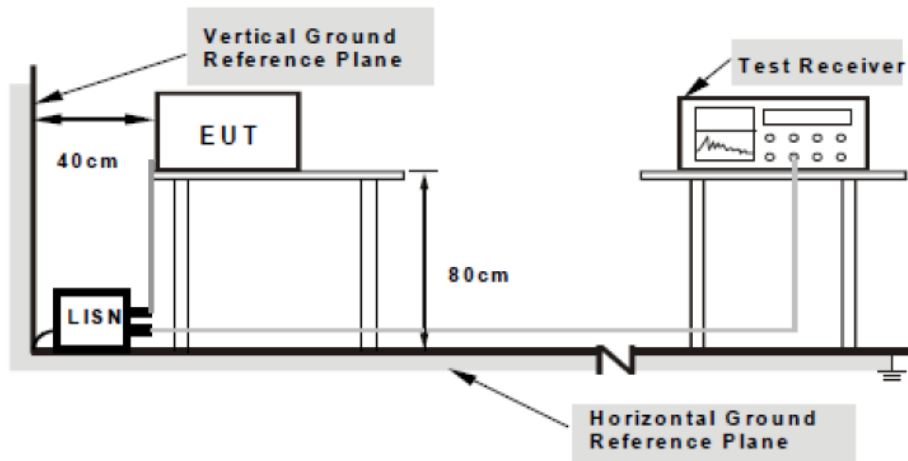
Per § 15.207 (a), an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Limits for Conducted Emissions at the Mains Ports

Section	Frequency ranges (MHz)	Limit (dBuV)	
		QP	Average
Class B devices	0.15 - 0.5	66 - 56	56 - 46
	0.5 - 5	56	46
	5 - 30	60	50

NOTE 1 The lower limit shall apply at the transition frequencies.

7.2.2 Test setup



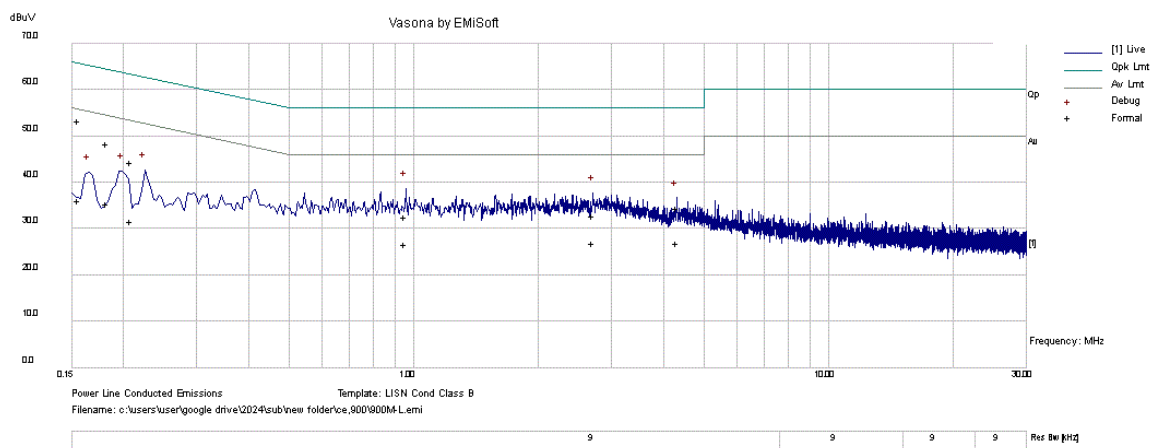
Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

7.2.3 Test Procedure

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50 Ω /50 μ H EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment was powered separately from another main supply.
5. The EUT was switched on and allowed to warm up to its normal operating condition.
6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
7. High peaks, relative to the limit line, were then selected.
8. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. For FCC tests, only Quasi-peak measurements were made; while for CISPR/EN tests, both Quasi-peak and Average measurements were made
9. All possible modes of operation were investigated. Only the worst-case emissions were measured and reported. All other emissions were relatively insignificant.

7.2.4 Test Result

Test Standard:	Part 15.207	Mode:	TX, Live
Frequency Range:	0.15-30MHz	Test Date:	08/08/2024
Antenna Type/Polarity:	N/A	Test Personnel:	Minoush Niknam
Remark:	Class B, 120VAC, 60Hz	Test Result:	Pass

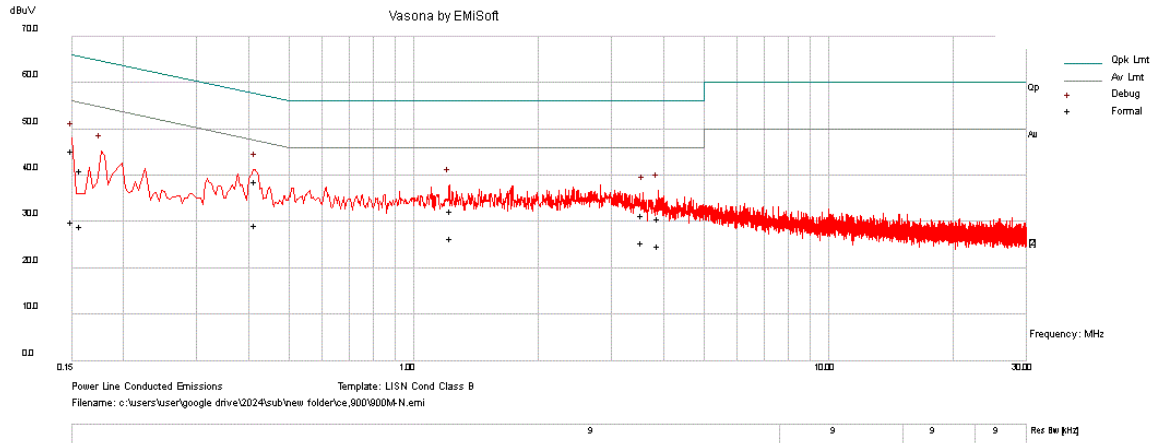


No.	Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Meas. Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
1	0.957	22.5	10.0	0.1	32.6	Quasi Peak	Live	56.0	-23.4	Pass
2	2.699	22.6	10.1	0.1	32.8	Quasi Peak	Live	56.0	-23.2	Pass
3	4.303	24.2	10.1	0.1	34.5	Quasi Peak	Live	56.0	-21.5	Pass
4	0.209	34.3	10.0	0.2	44.5	Quasi Peak	Live	63.3	-18.8	Pass
5	0.182	38.1	10.0	0.2	48.3	Quasi Peak	Live	64.4	-16.1	Pass
6	0.156	43.2	10.0	0.2	53.4	Quasi Peak	Live	65.7	-12.2	Pass
7	0.957	16.6	10.0	0.1	26.7	Average	Live	46.0	-19.3	Pass
8	2.699	16.7	10.1	0.1	26.9	Average	Live	46.0	-19.1	Pass
9	4.303	16.8	10.1	0.1	27.0	Average	Live	46.0	-19.0	Pass
10	0.209	21.4	10.0	0.2	31.6	Average	Live	53.3	-21.6	Pass
11	0.182	25.2	10.0	0.2	35.5	Average	Live	54.4	-18.9	Pass
12	0.156	25.8	10.0	0.2	36.0	Average	Live	55.7	-19.6	Pass

REMARKS:

1. The emission levels of other frequencies were very low against the limit.
2. Factor = Inert loss of LISN
3. Margin value = Emission level - Limit value
4. Emission Level = Raw Value + Cable loss + Factors Value.

Test Standard:	Part 15.207	Mode:	TX, Neutral
Frequency Range:	0.15-30MHz	Test Date:	08/08/2024
Antenna Type/Polarity:	N/A	Test Personnel:	Minoush Niknam
Remark:	Class B, 120VAC, 60Hz	Test Result:	Pass



No.	Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Meas. Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
1	0.417	28.5	10.0	0.1	38.7	Quasi Peak	Neutral	57.5	-18.8	Pass
2	0.150	35.1	10.0	0.2	45.3	Quasi Peak	Neutral	66.0	-20.7	Pass
3	1.233	22.1	10.1	0.1	32.3	Quasi Peak	Neutral	56.0	-23.7	Pass
4	3.890	20.4	10.1	0.1	30.6	Quasi Peak	Neutral	56.0	-25.4	Pass
5	0.158	30.8	10.0	0.2	41.1	Quasi Peak	Neutral	65.6	-24.5	Pass
6	3.559	21.2	10.1	0.1	31.4	Quasi Peak	Neutral	56.0	-24.6	Pass
7	0.417	19.1	10.0	0.1	29.3	Average	Neutral	47.5	-18.2	Pass
8	0.150	19.8	10.0	0.2	30.1	Average	Neutral	56.0	-25.9	Pass
9	1.233	16.2	10.1	0.1	26.4	Average	Neutral	46.0	-19.6	Pass
10	3.890	14.6	10.1	0.1	24.8	Average	Neutral	46.0	-21.2	Pass
11	0.158	18.9	10.0	0.2	29.2	Average	Neutral	55.6	-26.4	Pass
12	3.559	15.3	10.1	0.1	25.6	Average	Neutral	46.0	-20.4	Pass

REMARKS:

1. The emission levels of other frequencies were very low against the limit.
2. Factor = Inert loss of LISN
3. Margin value = Emission level - Limit value
4. Emission Level = Raw Value + Cable loss + Factors Value.

7.3 DTS (6 dB) Bandwidth

7.3.1 Requirement

§ 15.247 (a)(2)

Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

7.3.2 Test Setup



7.3.3 Test Procedure

According to section 8.2, option 2, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.8 of ANSI C63.10-2013:

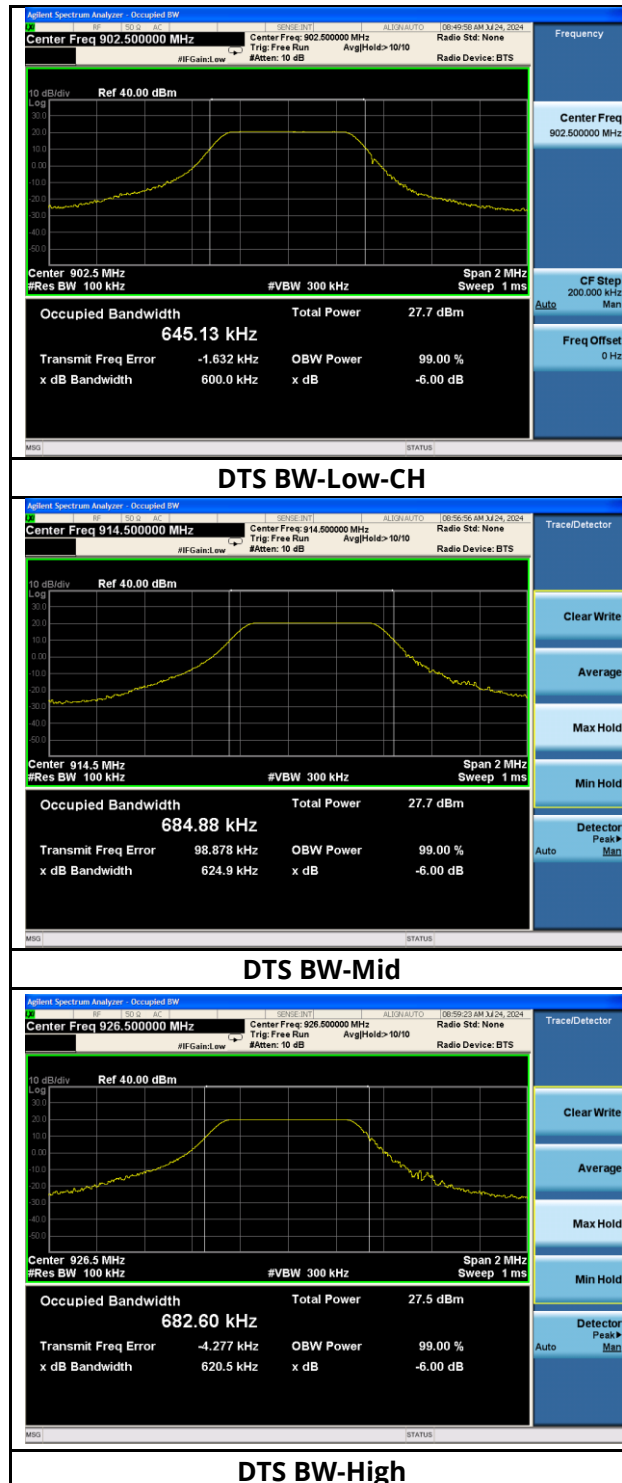
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW $\geq 3 \times$ RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

7.3.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
900 M CW	902.5	600.0	500	Pass
	914.5	624.9	500	Pass
	926.5	620.5	500	Pass

7.3.5 Test Plots



7.4 Maximum Output Power

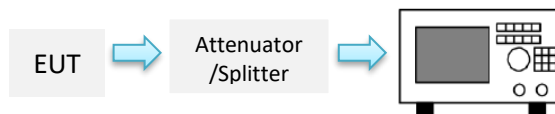
7.4.1 Requirement

§ 15.247 (b)(3),

or systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: the maximum output power is 1 Watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.4.2 Test Setup



7.4.3 Test Procedure

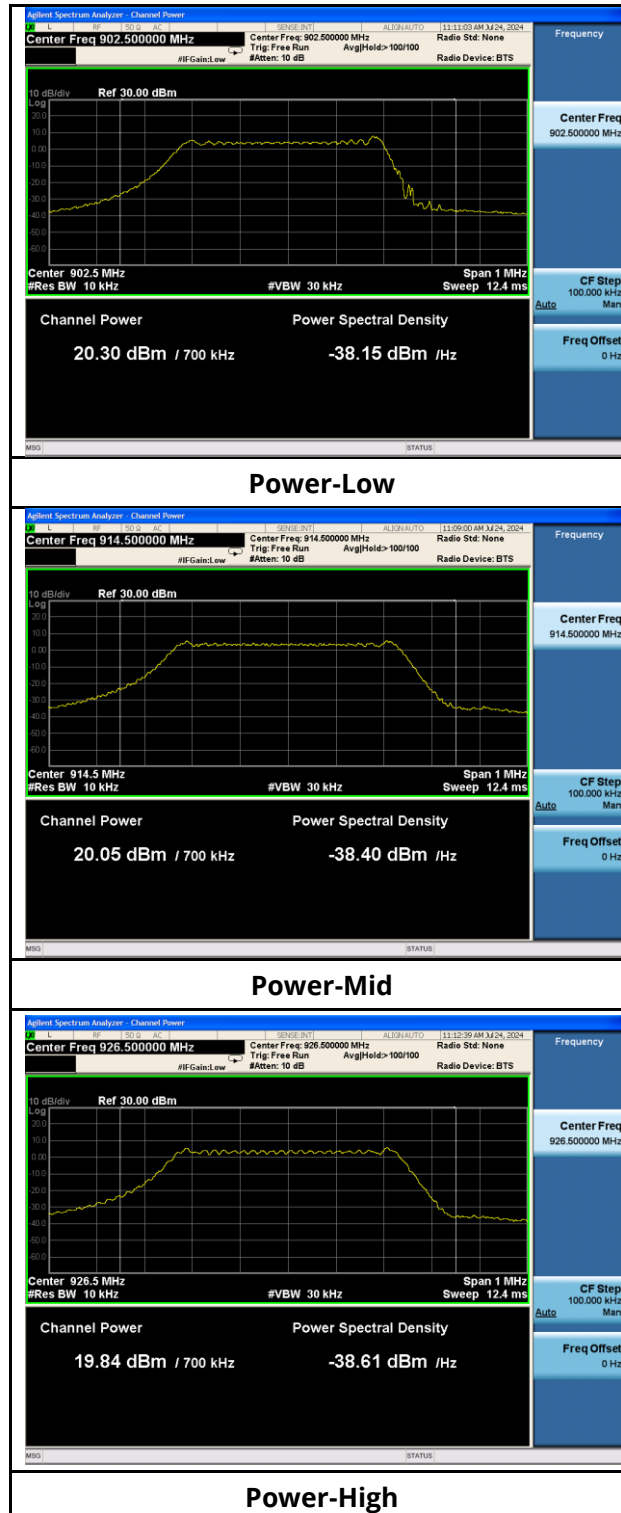
For DTS, power measurement is according to subclause 11.9.2.2.2 of ANSI C63.10-2013:

1. Set span to at least 1.5 times the OBW.
2. Set RBW=1% to 5% of the OBW, not to exceed 1 MHz.
2. Set VBW $\geq [3 \times \text{RBW}]$.
3. Number of the points in the sweep $\geq [2 \times \text{span} / \text{RBW}]$. (This gives bin-to-bin spacing $\leq \text{RBW}/2$, so that narrowband signals are not lost between frequency bins.)
4. Sweep time=auto.
5. Detector=RMS (i.e., power averaging), if available, Otherwise, use sample detector mode.
6. If transmit duty cycle < 98%, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at the maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no OFF intervals) or at duty cycle 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run."
7. Trace average at least 100 traces in power averaging (rms) mode.
8. Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

7.4.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Measured Output Power (dBm)	Max Output Power (dBm)	Result
900 M CW	902.5	20.30	30	Pass
	914.5	20.05	30	Pass
	926.5	19.84	30	Pass

7.4.5 Test Plots



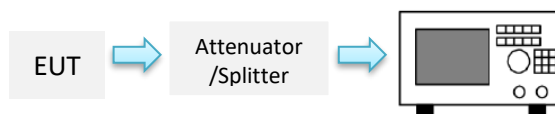
7.5 Power Spectral Density

7.5.1 Requirement

§ 15.247 (e),

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power is used to determine the power spectral density.

7.5.2 Test Setup



7.5.3 Test Procedure

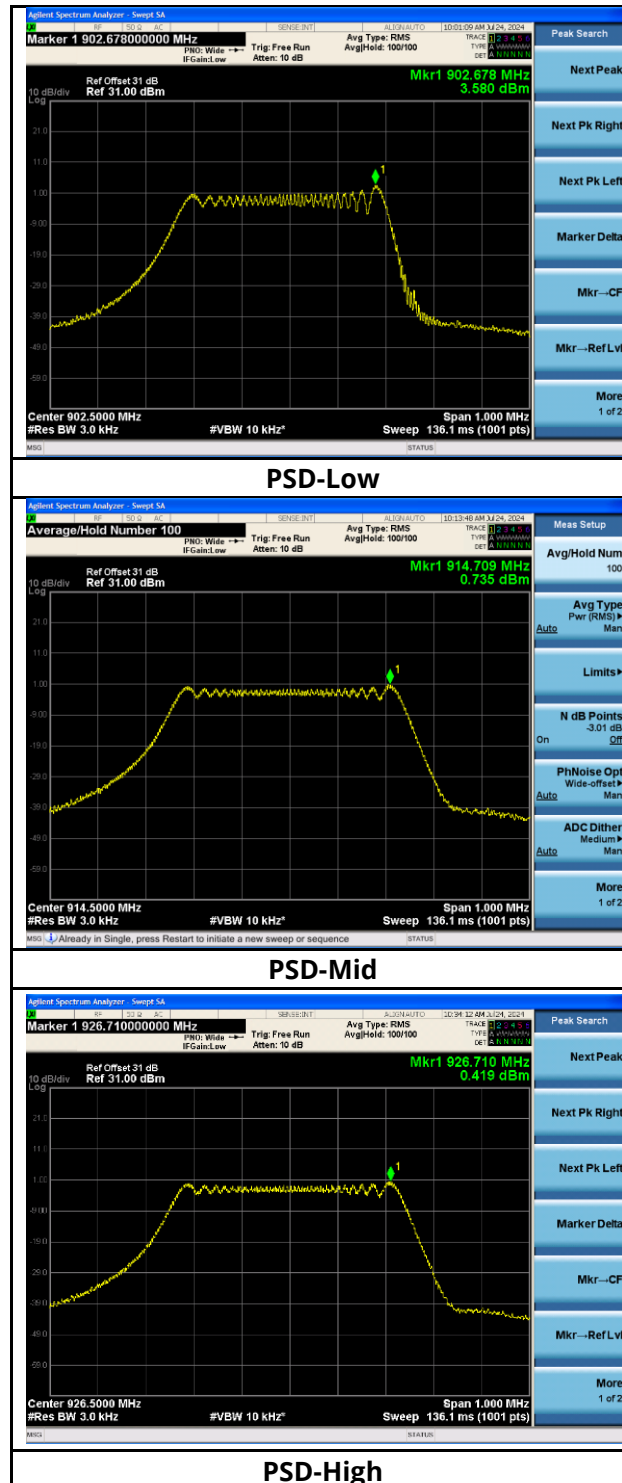
According to section 8.4 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.10.1 AVGPS-1 of ANSI C63.10-2013:

1. The EUT transmits continuously (or with a $D \geq 98\%$).
2. Sweep triggering can be implemented in such a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep is equal to or shorter than the duration T of each transmission from the EUT, and if those transmissions exhibit full power throughout these durations.

7.5.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Measured PSD (dBm/3KHz)	Max PSD (dBm/3KHz)	Result
900 M CW	902.5	3.580	8	Pass
	914.5	0.735	8	Pass
	926.5	0.419	8	Pass

7.5.5 Test Plots



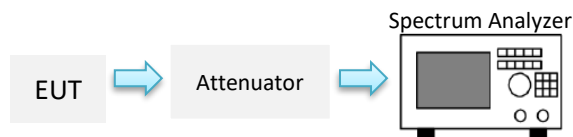
7.6 Conducted Band-Edge & Unwanted Emissions

7.6.1 Requirement

§ 15.247 (d),

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

7.6.2 Test Setup



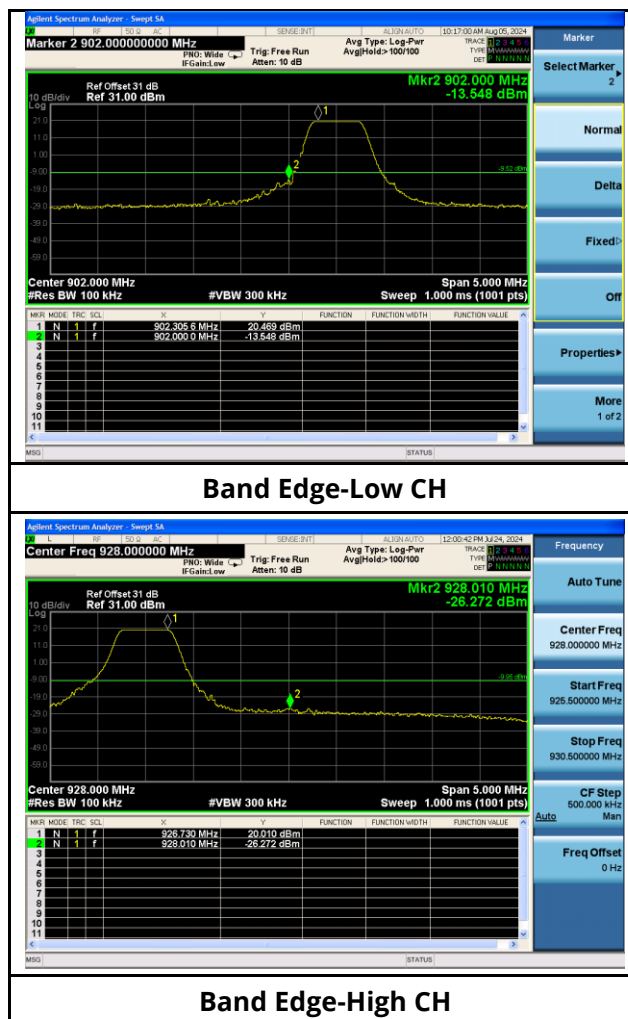
7.6.3 Test Procedure

According to ANSI C63.10-2013 clause 11 (DTS devices);

Band-edge occupied BW: Minimum 6 dB BW is 500 kHz for DTS devices. Band-edge attenuation: -20 dB or -30 dB in a 100 kHz BW relative to highest fundamental channel PSD in 100 kHz (based on power measurement method used). Band edge: 15.209 applies to adjacent and nearby restricted bands for 2400 MHz to 2483.5 MHz band operations.

7.6.4 Test Result

Conducted Band edge



7.7 Radiated Band-Edge & Spurious Emissions into Restricted Frequency Bands

7.7.1 Requirement

§ 15.247 (d),

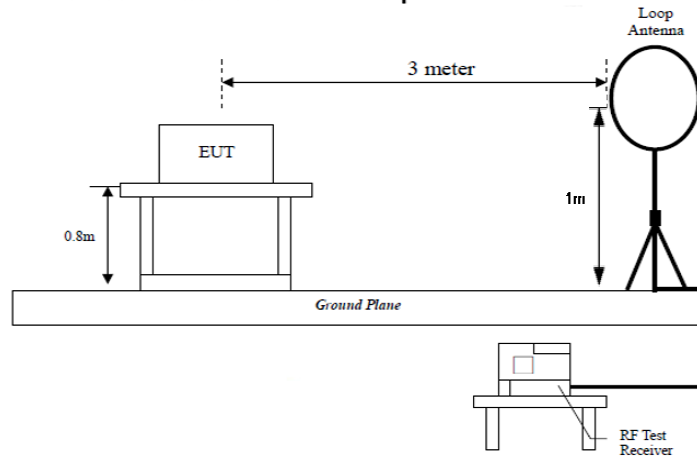
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

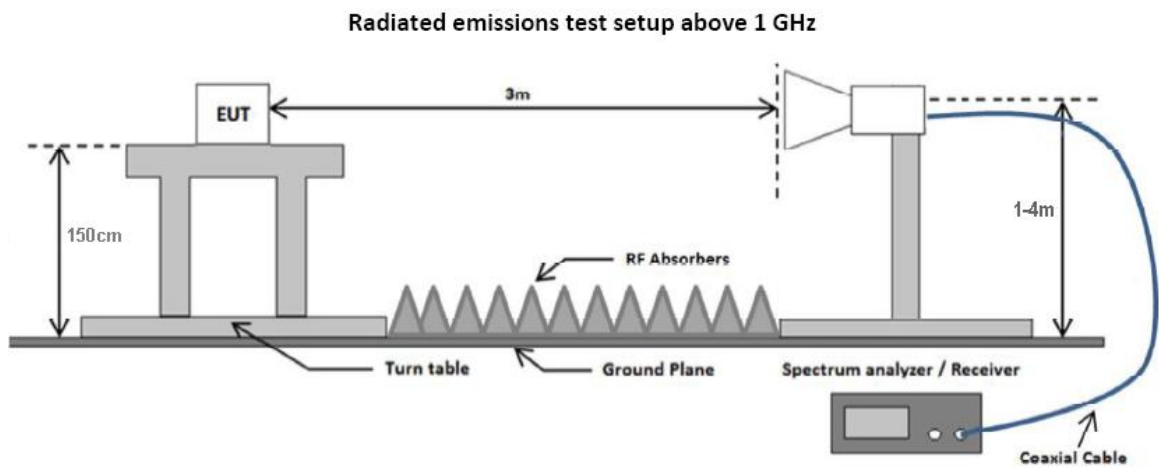
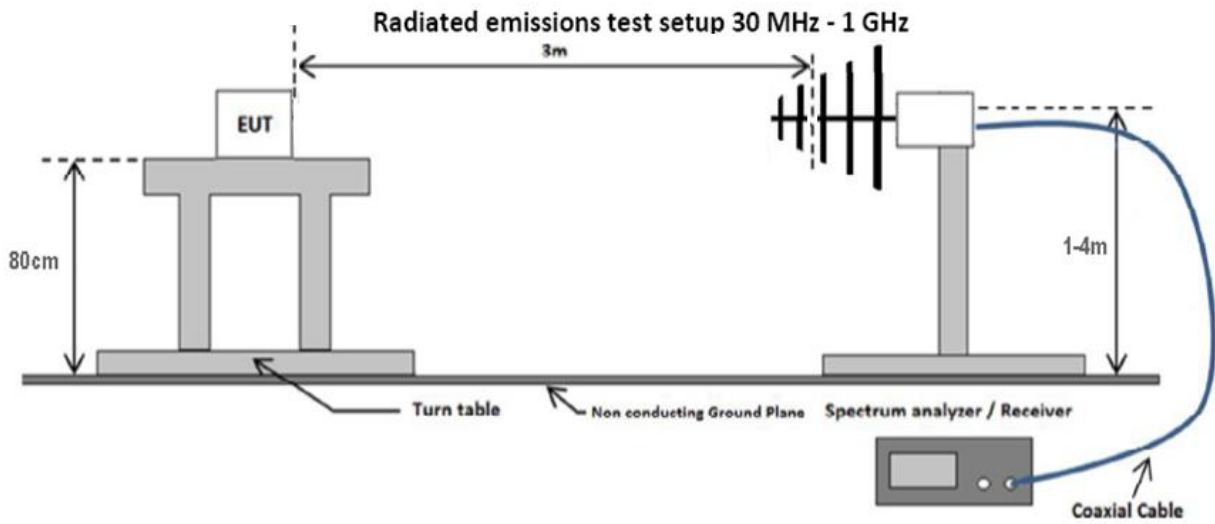
Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency Range (MHZ)	Field Strength (µV/m)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

7.7.2 Test Setup

Radiated emissions test setup 9KHz - 30MHz





7.7.3 Test Procedure

According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C62.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

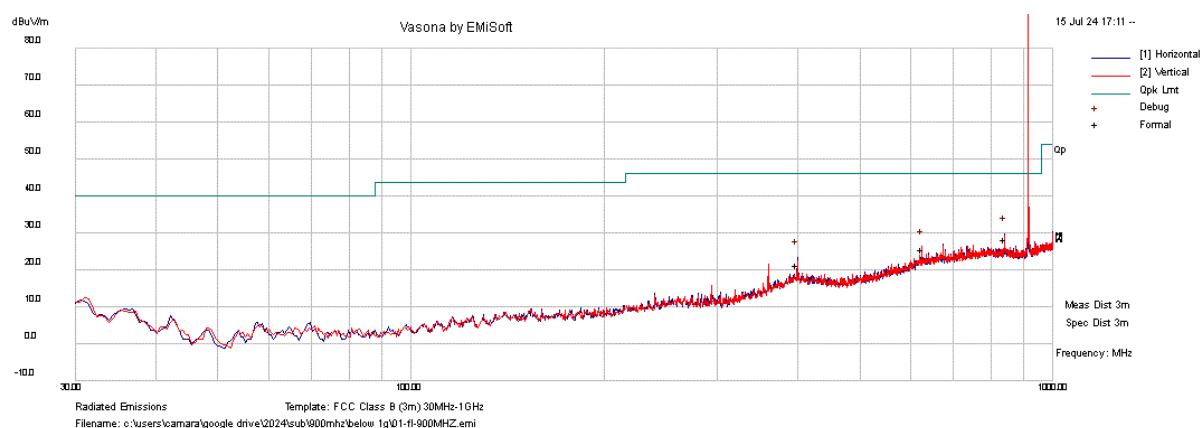
7.7.4 Test Result

Radiated Emission between 9KHz – 30MHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	15.247, 15.209	Mode:	Transmit mode
Frequency Range:	30 MHz - 1 GHz	Test Date:	06/15/2024
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	900 M CW + External Antenna	Test Result:	Pass



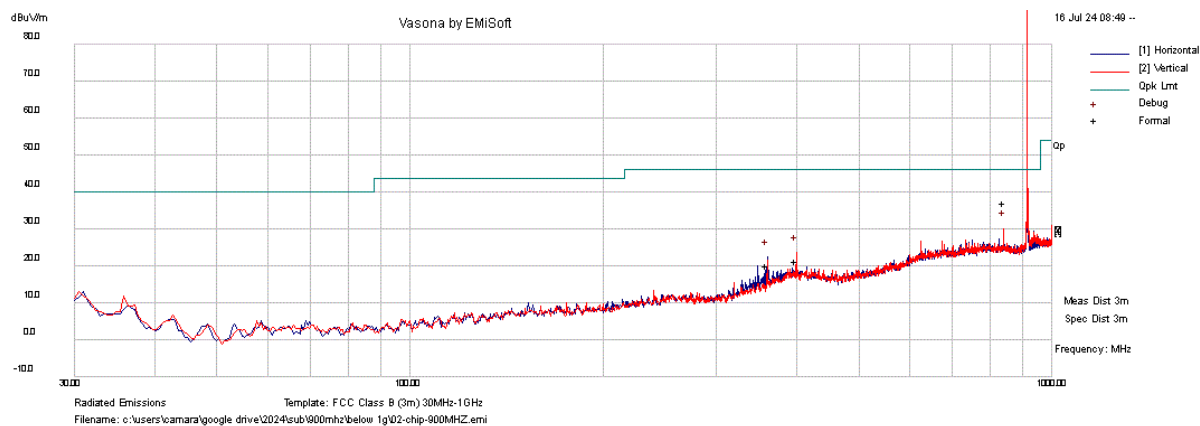
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	839.994	20.2	7.4	0.6	28.2	Quasi Max	H	106	0	46	-17.8	Pass
2	625.044	20.4	7.2	-2	25.7	Quasi Max	V	376	0	46	-20.4	Pass
3	399.709	22.5	6.4	-7.5	21.3	Quasi Max	H	101	116	46	-24.7	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Around 900 MHz, emission is fundamental.

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	15.247, 15.209	Mode:	Transmit mode
Frequency Range:	30 MHz - 1 GHz	Test Date:	06/15/2024
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	900 M CW + Chip antenna	Test Result:	Pass



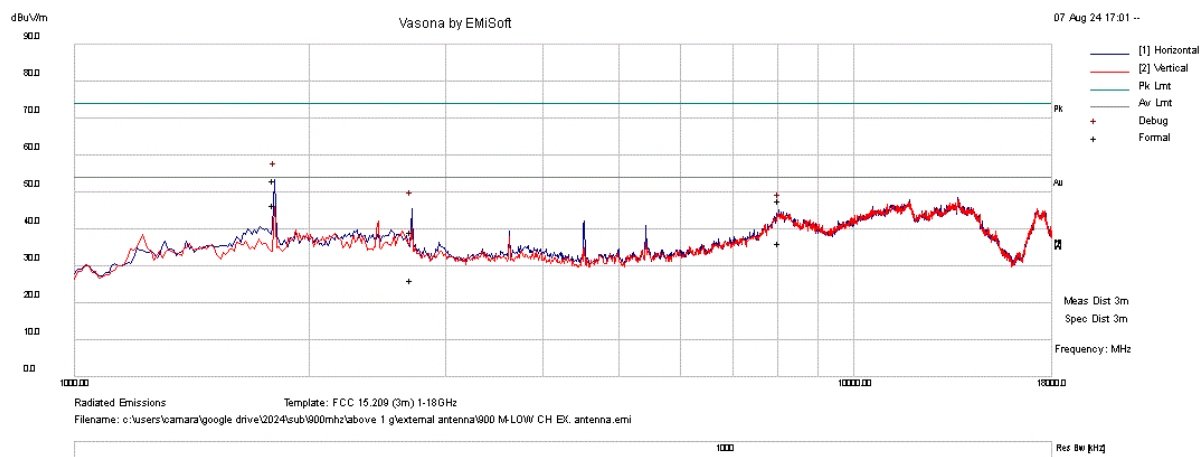
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	839.992	29.2	7.4	0.6	37.2	Quasi Max	H	146	209	46	-8.8	Pass
2	399.724	22.6	6.4	-7.5	21.4	Quasi Max	V	323	254	46	-24.6	Pass
3	359.743	23.9	6.1	-9.8	20.2	Quasi Max	H	159	0	46	-25.8	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Around 900 MHz, emission is fundamental.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, 15.209	Mode:	Transmit mode
Frequency Range:	1 GHz - 18 GHz	Test Date:	08/07/2023
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	Low Ch-External Antenna	Test Result:	Pass



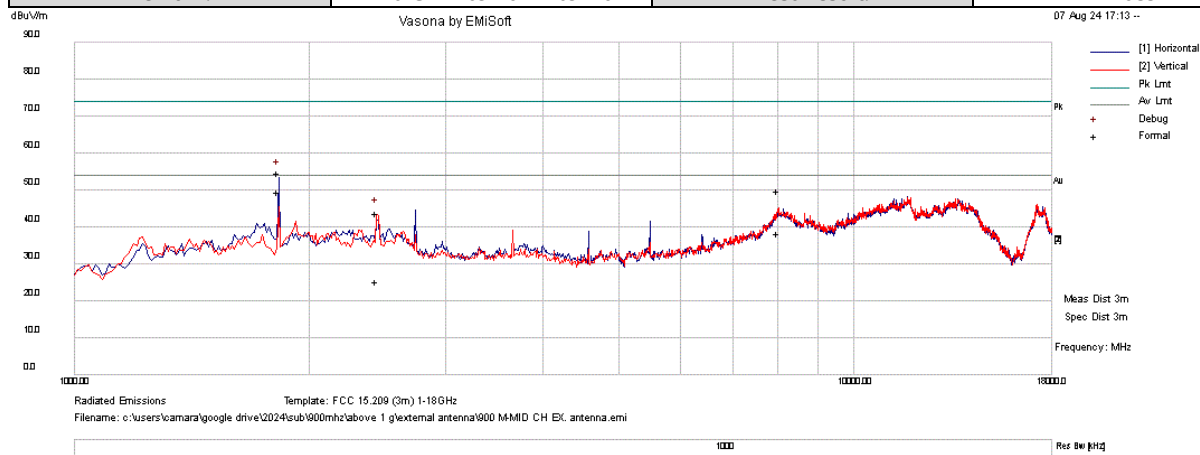
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	1805.513	47.4	6.1	-0.2	53.2	Peak Max	H	123	10	74	-20.8	Pass
2	2708.658	31	7.2	1.1	39.3	Peak Max	H	198	66	74	-34.7	Pass
3	8034.698	17.7	14.3	15.8	47.7	Peak Max	H	169	1	74	-26.3	Pass
4	1805.513	40.6	6.1	-0.2	46.5	Average Max	H	123	10	54	-7.5	Pass
5	2708.658	18	7.2	1.1	26.3	Average Max	H	198	66	54	-27.7	Pass
6	8034.698	6.2	14.3	15.8	36.3	Average Max	H	169	1	54	-17.7	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Emission around the second harmonica, 1805.513 MHz, is not in the restricted band.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, 15.209	Mode:	Transmit mode
Frequency Range:	1 GHz - 18 GHz	Test Date:	08/07/2023
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	Mid Ch-External Antenna	Test Result:	Pass



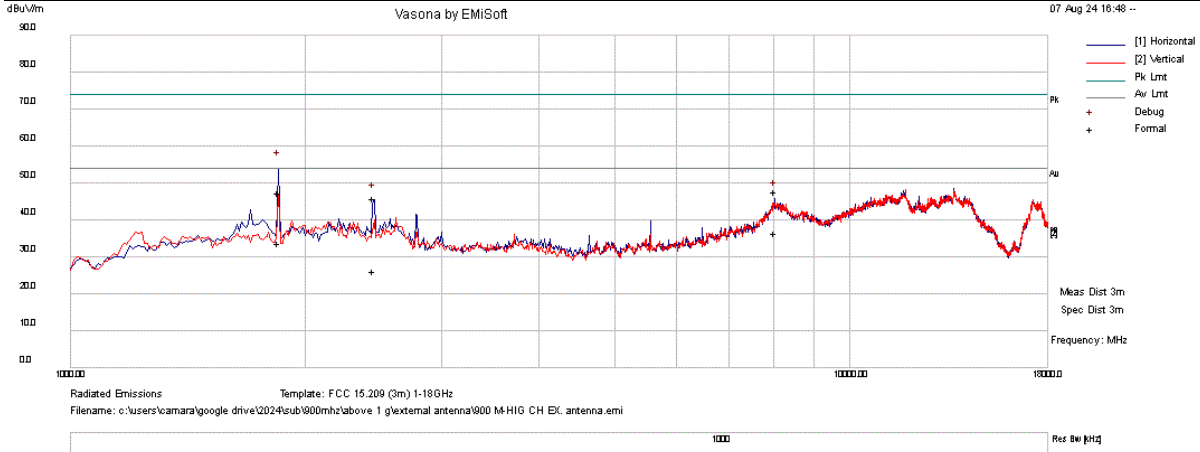
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	1829.333	48.4	6.1	0.1	54.7	Peak Max	H	102	18	74	-19.3	Pass
2	8012.255	19.7	14.3	15.9	49.9	Peak Max	V	125	120	74	-24.1	Pass
3	2446.625	36.5	6.8	0.4	43.6	Peak Max	V	100	27	74	-30.4	Pass
4	1829.333	43.3	6.1	0.1	49.6	Average Max	H	102	18	54	-4.4	Pass
5	8012.255	8.2	14.3	15.9	38.3	Average Max	V	125	120	54	-15.7	Pass
6	2446.625	18.2	6.8	0.4	25.3	Average Max	V	100	27	54	-28.7	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Emission around the second harmonica, 18029 MHz, is not in the restricted band.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, 15.209	Mode:	Transmit mode
Frequency Range:	1 GHz - 18 GHz	Test Date:	08/07/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	High Ch- External Antenna	Test Result:	Pass



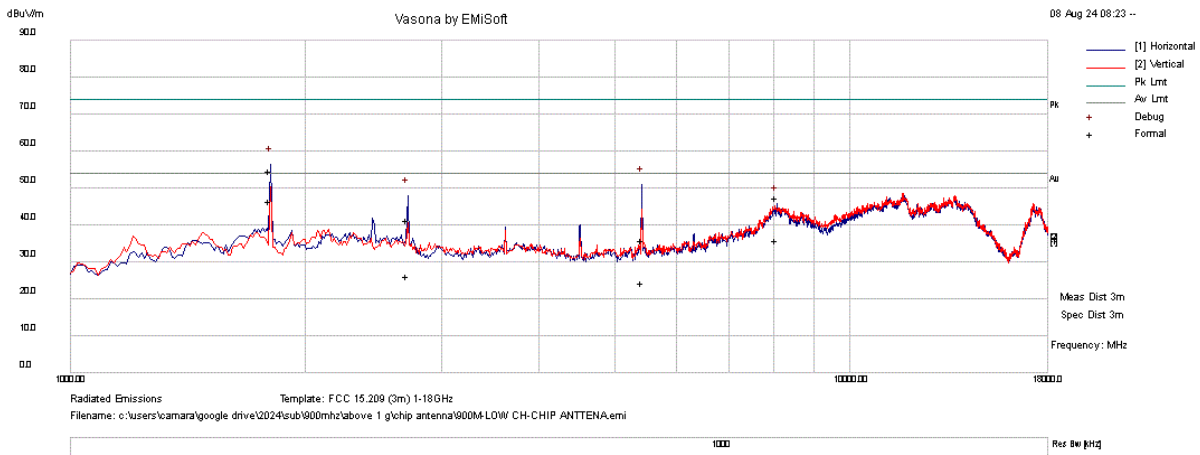
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	1851.995	40.7	6.1	0.4	47.2	Peak Max	H	145	17	74	-26.8	Pass
2	8021.243	17.7	14.3	15.8	47.8	Peak Max	H	183	135	74	-26.2	Pass
3	2455.74	38.6	6.8	0.4	45.8	Peak Max	H	130	81	74	-28.2	Pass
4	1851.995	27.1	6.1	0.4	33.7	Average Max	H	145	17	54	-20.3	Pass
5	8021.243	6.4	14.3	15.8	36.5	Average Max	H	183	135	54	-17.5	Pass
6	2455.74	19.1	6.8	0.4	26.3	Average Max	H	130	81	54	-27.7	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Emission around the second harmonica, 1851 MHz, is not in the restricted band.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, 15.209	Mode:	Transmit mode
Frequency Range:	1 GHz – 18 GHz	Test Date:	08/07/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	Low Ch-Chip Antenna	Test Result:	Pass



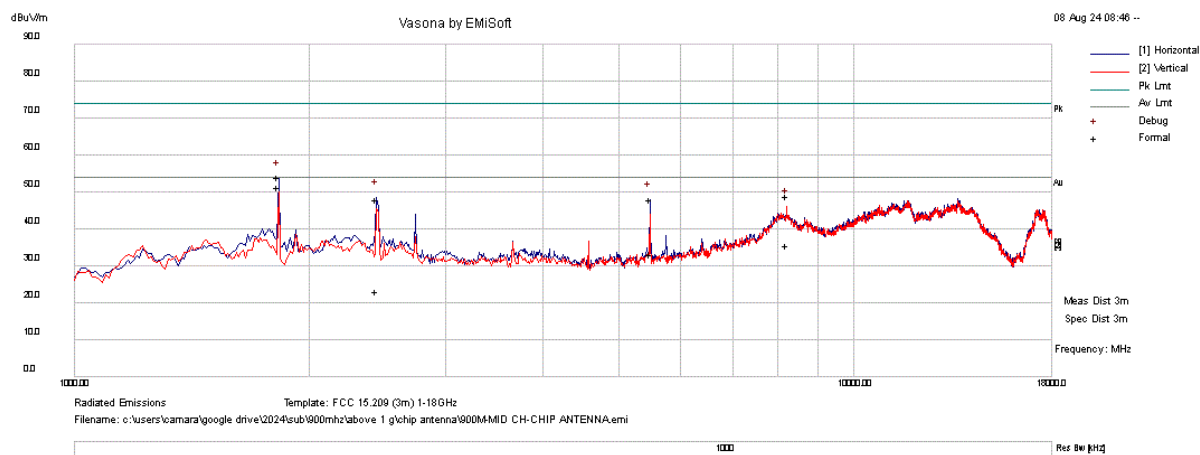
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	1805.568	48.8	6.1	-0.2	54.7	Peak Max	H	195	38	74	-19.4	Pass
2	5421.938	19.3	10.6	6.1	35.9	Peak Max	H	118	174	74	-38.1	Pass
3	2708.673	33	7.2	1.1	41.2	Peak Max	H	108	0	74	-32.8	Pass
4	8067.555	17.3	14.2	15.8	47.4	Peak Max	H	165	0	74	-26.6	Pass
5	1805.568	40.8	6.1	-0.2	46.6	Average Max	H	195	38	54	-7.4	Pass
6	5421.938	7.7	10.6	6.1	24.4	Average Max	H	118	174	54	-29.6	Pass
7	2708.673	18	7.2	1.1	26.3	Average Max	H	108	0	54	-27.7	pass
8	8067.555	5.9	14.2	15.8	35.9	Average Max	H	165	0	54	-18.1	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Emission around the second harmonic, 1805MHz, is not in the restricted band.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, 15.209	Mode:	BLE Transmit mode
Frequency Range:	1 GHz - 18 GHz	Test Date:	08/07/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	Mid Ch- Chip Antenna	Test Result:	Pass



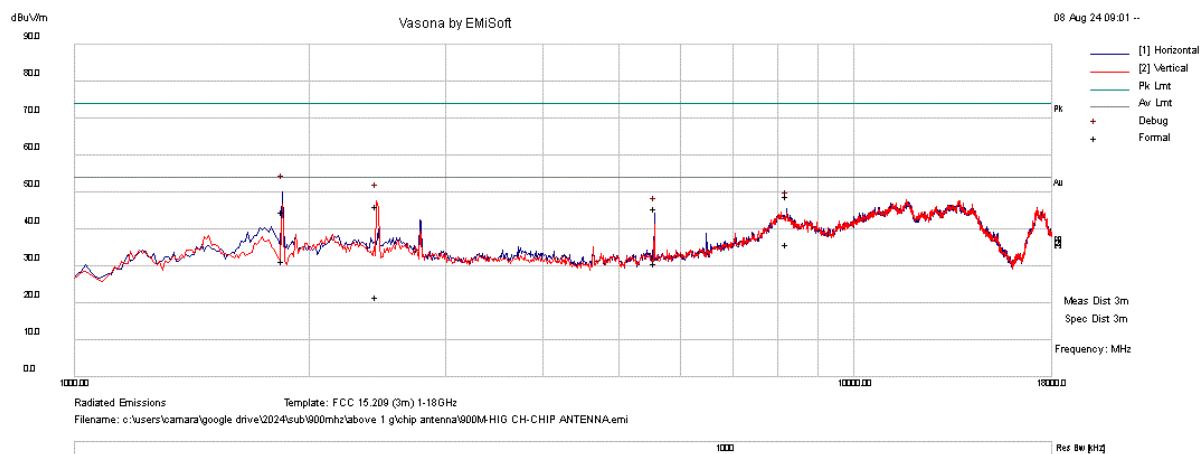
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	1828.938	47.8	6.1	0.1	54.1	Peak Max	H	100	26	74	-19.9	Pass
2	2445.555	40.7	6.8	0.4	47.9	Peak Max	H	175	153	74	-26.1	Pass
3	5485.558	31.3	10.7	5.9	48	Peak Max	H	150	0	74	-26	Pass
4	8212.8	19	14.2	15.6	48.8	Peak Max	V	156	180	74	-25.2	Pass
5	1828.938	45	6.1	0.1	51.2	Average Max	H	100	26	54	-2.8	Pass
6	2445.555	15.9	6.8	0.4	23.1	Average Max	H	175	153	54	-30.9	Pass
7	5485.558	16.5	10.7	5.9	33.1	Average Max	H	150	0	54	-20.9	Pass
8	8212.8	5.9	14.2	15.6	35.7	Average Max	V	156	180	54	-18.3	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Emission around the second harmonica, 1829 MHz, is not in the restricted band.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, 15.209	Mode:	Transmit mode
Frequency Range:	1 GHz - 18 GHz	Test Date:	08/07/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush Niknam
Remark:	High Ch- Chip Antenna	Test Result:	Pass



No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	1852	38.2	6.1	0.4	44.8	Peak Max	H	103	0	74	-29.2	Pass
2	2446.953	39	6.8	0.4	46.1	Peak Max	V	120	134	74	-27.9	Pass
3	8214.783	19	14.2	15.6	48.8	Peak Max	H	175	21	74	-25.2	Pass
4	5557.51	28.8	10.9	5.8	45.6	Peak Max	H	127	15	74	-28.4	Pass
5	1852	24.8	6.1	0.4	31.4	Average Max	H	103	0	54	-22.6	Pass
6	2446.953	14.4	6.8	0.4	21.6	Average Max	V	120	134	54	-32.4	Pass
7	8214.783	6.1	14.2	15.6	35.9	Average Max	H	175	21	54	-18.1	Pass
8	5557.51	14.1	10.9	5.8	30.9	Average Max	H	127	15	54	-23.1	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)
4. Emission around the second harmonica, 1852MHz, is not in the restricted band.

Radiated Emission between 18GHz - 40GHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

8 EUT and Test Setup Photos

See FCC exhibits

9 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/2023	10/18/2024
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A1)	N/A1)
Spectrum Analyzer	Keysight	N9020A	MY50110074	06/09/2024	06/09/2025
EMC Test Receiver	R&S	ESL6	100230	06/07/2024	06/07/2025
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	07/12/2024	07/12/2025
Bi-Log Antenna	ETS-Lindgren	3142E	217921	07/19/2024	07/19/2025
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	07/21/2024	07/21/2025
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	07/21/2024	07/21/2025
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	07/16/2024	07/16/2025
True RMS Multi-meter	UNI-T	UT181A	C173014829	06/07/2024	06/07/2025
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	06/07/2024	06/07/2025
RF Attenuator	Pasternack	PE7005-3	VL061	N/A2)	N/A2)
EM Center Control	ETS-Lindgren	7006-001	160136	N/A1)	N/A1)
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A1)	N/A1)
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A1)	N/A1)
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	06/09/2024	06/09/2025
RE test cable (below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	07/16/2024	07/16/2024
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	07/16/2024	07/16/2025
RE test cable (>18GHz)	Sucoflex	104	344903/4	07/16/2024	07/16/2025
Pulse limiter	Com-Power	LIT-930A	531727	07/16/2024	07/16/2025
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	07/16/2024	07/16/2025
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	07/16/2024	07/16/2025

Note:

- 1) These pieces of equipment are not for measurement purposes and only require functional verification. Calibration is not required.
- 2) This equipment is part of the test system that is to be calibrated as a system. It's verified together with the test system prior to testing.

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