TEST REPORT

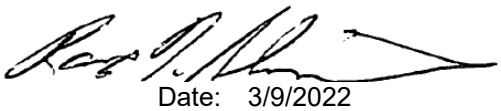
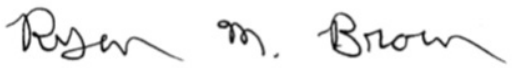
Applicant	Novanta
Address	125 Middlesex Turnpike, Bedford, MA 01730

FCC ID	QV5MERCURY7EP
ISED IC:	5407A-MERCURY7EP
Product Marketing Name	M7e-Pico, M7e-Petite
FVIN:	SUB-10045, SUB-10041
Model	M7e-Pico, M7e-Petite
Date of tests	1/26/2022 – 1/28/2022

the tests have been carried out according to the requirements of the following standards:

☒ **FCC Part 15, Subpart C, Section 15.247 and ISED Canada RSS-247 Issue 2**

CONCLUSION: The submitted sample was found to COMPLY with the test requirements

Tested by Randle Sherian Project Engineer / EMC Department	Approved by Ryan Brown Assistant Manager / EMC Department
 Date: 3/9/2022	 Date: 4/6/2022

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
EV1855-4	Original release	3/14/2022
EV1855-4 Issue 2	Removed Note From Page 60	4/6/2022

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C and RSS-247				
FCC	**ISED**	**TEST TYPE AND LIMIT**	**RESULT**	**REMARK**
15.207	RSS-GEN 8.8	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.247(a)(1)(i)	RSS-247 5.1 (c)	Number of Hopping Frequency Used	PASS	Meet the requirement of limit.
15.247(a)(1)(i)	RSS-247 5.1 (c)	Dwell Time on Each Channel	PASS	Meet the requirement of limit.
15.247(a)(1)	RSS-247 5.1 (a)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	PASS	Meet the requirement of limit.
15.247(b)(2)	RSS-247 5.4 (a)	Conducted Output Power	PASS	Meet the requirement of limit.
15.247(d)	RSS-247 3.3	Transmitter Radiated Emission	PASS	Meet the requirement of limit.
15.247(d)	RSS-247 5.5	Out of band Emission Measurement	PASS	Meet the requirement of limit.
15.203		Antenna Requirement	PASS	No antenna connector is used.

2 SITE INFORMATION

2.1 TEST LOCATION AND SITE ACCREDITATIONS

Unless otherwise specified, all testing was performed at One Distribution Center Circle, Littleton, MA 01460.

This location is accredited to ISO/IEC 17025 by A2LA for the specific scope of accreditation under Certificate Number 1627-01.

The FCC Accredited Test Site Number is US1028 and recognized with ISED Canada under the CAB Identifier of US0106.

2.2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Expanded Uncertainty k=2	Maximum allowable uncertainty
Radiated Emissions (30-1000MHz) NIST CISPR	 5.6dB 4.6dB	 N/A 5.2dB (Ucispr)
Radiated Emissions (1-26.5GHz)	4.6dB	N/A
Radiated Emissions (above 26.5GHz)	4.9dB	N/A
Conducted Emissions NIST CISPR	 3.9dB 3.6dB	 N/A 3.6dB (Ucispr)
Telco Conducted Emissions (Voltage)	4.4dB	N/A
Radio frequency (@ 2.4GHz)	3.23×10^{-8}	1×10^{-7}
RF power, conducted	0.40dB	0.75dB
Maximum frequency deviation: • Within 300Hz and 6kHz of audio frequency / Within 6kHz and 25kHz of audio frequency	 3.4% 0.3dB	 5% 3dB
Adjacent channel power	1.9dB	3dB
Conducted spurious emission of transmitter, valid up to 12.75GHz	2.39dB	3dB
Conducted emission of receivers	1.3dB	3dB
Radiated emission of transmitter, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of transmitter, valid up to 80GHz	3.3dB	6dB
Radiated emission of receiver, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of receiver, valid up to 80GHz	3.3dB	6dB
Humidity	2.37%	5%
Temperature	0.7°C	1.0°C
Time	4.1%	10%
RF Power Density, Conducted	0.4dB	3dB
DC and low frequency voltages	1.3%	3%
Voltage (AC, <10kHz)	1.3%	2%
Voltage (DC)	0.62%	1%

The uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	UHD RFID Module
MODULATION TECHNOLOGY	FHSS
MODULATION TYPE	ASK
OPERATING FREQUENCY	902.75MHz to 927.25MHz
NUMBER OF CHANNEL	50
PEAK OUTPUT POWER	0.68 W (Max. Measured)
ANTENNA TYPE	Patch Antenna 6dBi and Dipole Antenna 6.15dBi Gain

NOTE:

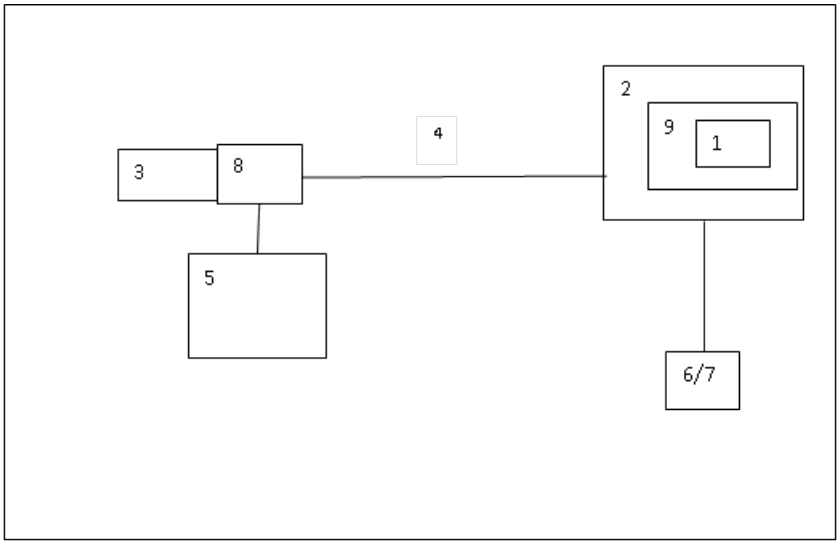
1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

3.2 DESCRIPTION OF TEST MODES

The EUT is an RFID reader operating in the 902MHz to 928MHz band. For testing, a custom GUI interface was used to control the EUT. The RF output settings were as follows:
Software Setting of 27 for M7e-Petite
Software Setting of 24 for M7e-Pico

See Theory of Operations for Hopping Channels

3.2.1. CONFIGURATION OF SYSTEM UNDER TEST



Item	Type	Description	Manufacturer	Serial Number	Model
1	EUT	Transmitter	Novanta	022210045801106 Sample 1	M7e-Petite M7e-Pico
1a	EUT	Transmitter	Novanta	022210045801110 Sample 2	M7e-Petite
2	Support Equipment	Bread Board	Novanta	M6E-Dev Kit	540-0136-01 0A
3	Support Equipment	Power Supply	GW Instek	N/a	PST-3202
4	Support Equipment	6 Wire Cable	N/a	N/a	N/a
5	Support Equipment	Laptop	Lenovo	N/a	Thinkpad
6	Antenna	Patch Antenna	Mi Wireless	N/a	MT-242043/TR H/A/K
7	Antenna	Dipole Antenna	Laird	N/a	S8964B
8	Support Equipment	Communication Board	Novanta	M6E-Dev Kit	M6E-Dev Kit
9	Support Equipment	Breadboard	Novanta	PCBA-10173	M7e-pico carrier board

3.2.2 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis, power supply voltage range and antenna ports
The worst case was found when positioned on X axis for radiated emission. Following channel(s) was (were) selected for the final test as listed below:

EUT CONFIGURE SAMPLE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
1				√	Tx function
2	√	√	√		Tx function

Where **RE<1G:** Radiated Emission below 1GHz **RE≥1G:** Radiated Emission above 1GHz
PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

RADIATED EMISSION TEST:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED FREQUENCY	MODULATION TECHNOLOGY	MODULATION TYPE
A	1 to 50	902.75MHz 915.25MHz 927.25MHz	FHSS	ASK

For the test results, only the worst case was shown in test report.

POWER LINE CONDUCTED EMISSION TEST:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and packet types.

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	TESTED CONDITION
A	TX on

ANTENNA PORT CONDUCTED MEASUREMENT:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and packet types.

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED Frequency	MODULATION TECHNOLOGY	MODULATION TYPE
A	1 to 50	902.75MHz 915.25MHz 927.25MHz	FHSS	ASK

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE (SYSTEM)	TESTED BY
RE<1G	22deg. C, 22%RH	5 VDC	Randy Sherian
RE≥1G	22deg. C, 22%RH	5 VDC	Randy Sherian
RF Conducted	22deg. C, 22%RH	5 VDC	Randy Sherian
PLC	22deg. C, 22%RH	5 VDC	Randy Sherian

3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C. Section 15.247

RSS-247 Issue 2

RSS-Gen Issue 2 + A1/A2

KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

4 TEST TYPES AND RESULTS

4.1. CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	60	50

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

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	AT	N9010A-526;N	MY51170076	8/5/2021	8/5/2022
Artificial Mains Network	Com-Power	ENV216	201092	12/15/2021	12/15/2022
Artificial Mains Network	Com-Power	ESH3-Z5	201093	12/15/2021	12/15/2022
Cable	C-S	N/a	CEMI-15	2/21/2021	2/21/2022
Attenuator	Narda	766-20	8710	12/12/2021	12/12/2022

NOTES:

1. The test was performed on CEMI1.

4.1.3 TEST PROCEDURES

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

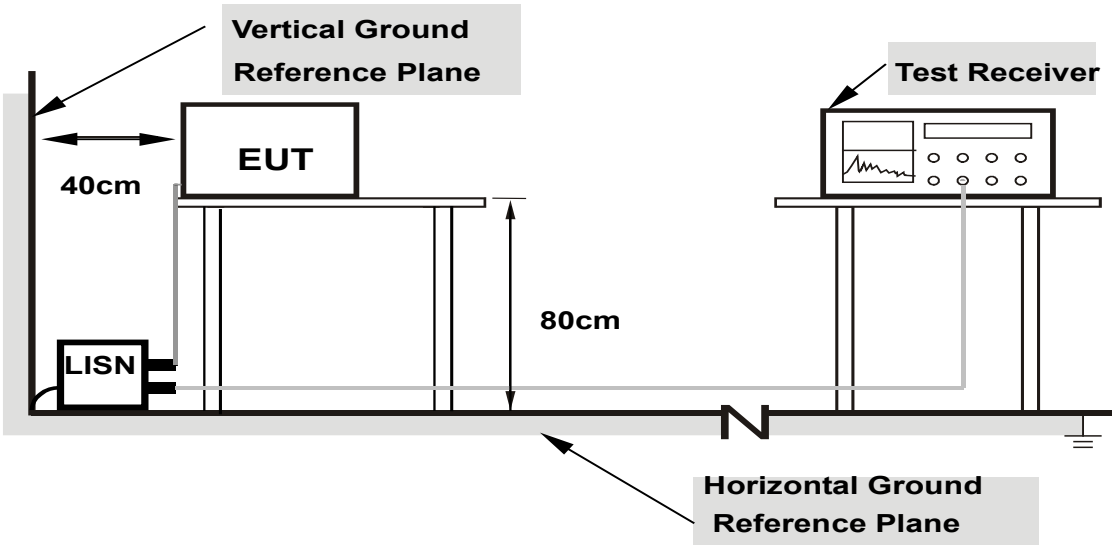
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit -20dB) was not recorded.

NOTE: All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

4.1.5 TEST SETUP



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

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT OPERATING CONDITIONS

a. EUT powered and transmitter turned on.

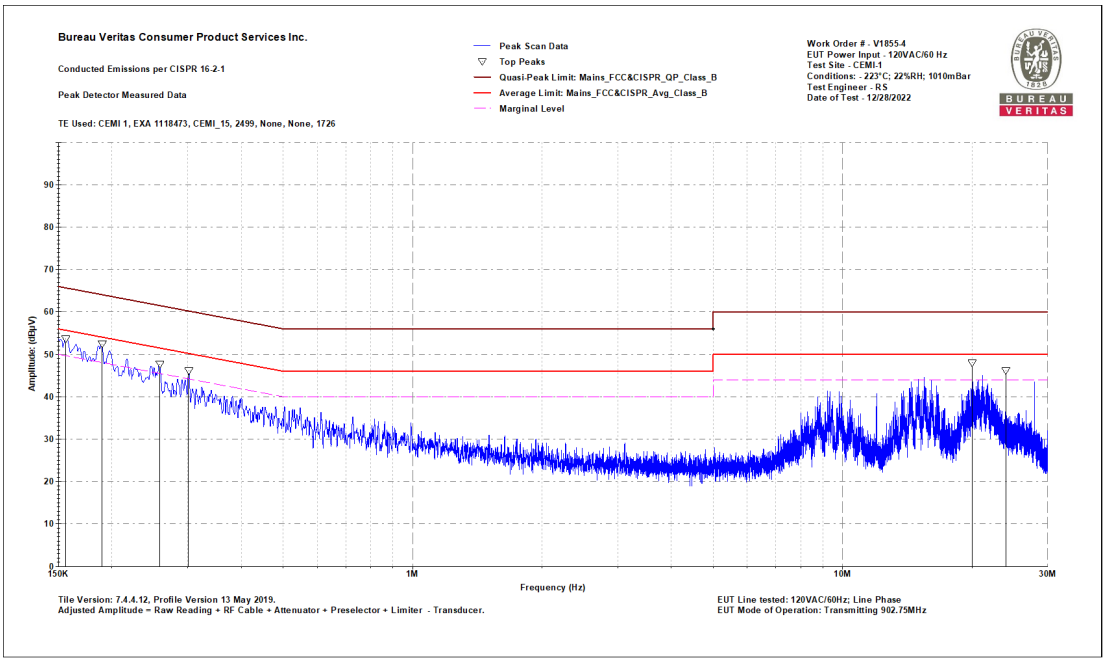
4.1.7 TEST RESULTS

CONDUCTED WORST-CASE DATA:

PHASE	Line	6dB BANDWIDTH	9kHz

Freq	Raw Pk	Correction Factor	Adjusted Pk Amplitude	QP Lim:	Margin to the QP Limit	Pk to QP Limit Result	Av Lim:	Margin to Avg Limit	Pk to Avg Limit Results
(MHz)	(dBµV)	(dB)	(dBµV)	(dBµV)	(dB)	(Pass/ Fail)	(dBµV)	(dB)	(Pass/Fail)
0.156	33.4	20.2	53.6	65.7	-12	PASS	55.7	-2	PASS
0.19	32.2	20.2	52.4	64.1	-11.7	PASS	54.1	-1.7	PASS
0.258	27.4	20.2	47.7	61.5	-13.8	PASS	51.5	-3.8	PASS
0.301	25.9	20.2	46.2	60.2	-14	PASS	50.2	-4	PASS
20.002	27.3	20.8	48.1	60	-11.9	PASS	50	-1.9	PASS
24.002	25.4	20.8	46.2	60	-13.8	PASS	50	-3.8	PASS

REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Raw Value.


Bureau Veritas Consumer Product Services Inc.
Conducted Emissions per CISPR 16-2-1
Peak Detector Measured Data
TE Used: CEMI 1, EXA 1118473, CEMI_15, 2499, None, None, 1726
Peak Scan Data
Top Peaks
Quasi-Peak Limit: Mains_FCC&CISPR_QP_Class_B
Average Limit: Mains_FCC&CISPR_Avg_Class_B
Marginal Level
Work Order # - V1855-4
EUT Power Input - 120VAC/60 Hz
Test Site - CEMI-1
Conditions: - 223°C; 22%RH; 1010mBar
Test Engineer - RS
Date of Test - 12/20/2022
Amplitude: (dBµV)
Frequency (Hz)
150K
1M
10M
30M
Tile Version: 7.4.4.12, Profile Version 13 May 2019.
Adjusted Amplitude = Raw Reading + RF Cable + Attenuator + Preselector + Limiter - Transducer.
EUT Line tested: 120VAC/60Hz; Line Phase
EUT Mode of Operation: Transmitting 902.75MHz

PHASE	Neutral	6dB BANDWIDTH	9kHz

Freq	Raw Pk	Correction Factor	Adjusted Pk Amplitude	QP Lim:	Margin to the QP Limit	Pk to QP Limit Result	Av Lim:	Margin to Avg Limit	Pk to Avg Limit Results
(MHz)	(dBµV)	(dB)	(dBµV)	(dBµV)	(dB)	(Pass/ Fail)	(dBµV)	(dB)	(Pass/Fail)
15.499	23.1	20.7	43.8	60	-16.2	PASS	50	-6.2	PASS
20.002	24.9	20.8	45.6	60	-14.4	PASS	50	-4.4	PASS
20.711	23.6	20.8	44.4	60	-15.6	PASS	50	-5.6	PASS
21.187	24.5	20.8	45.3	60	-14.7	PASS	50	-4.7	PASS
24.002	23.7	20.8	44.5	60	-15.5	PASS	50	-5.5	PASS
28.002	23	20.8	43.8	60	-16.2	PASS	50	-6.2	PASS

REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Emission level - Limit value
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Raw Value.

4.2. RADIATED EMISSION AND BANDEDGE MEASUREMENT

4.2.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a). Other emissions shall be at least 20dB below the highest level of the desired power.

FREQUENCIES (MHz)	FIELD STRENGTH (microvolts/meter)	MEASUREMENT DISTANCE (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.2.2 TEST INSTRUMENTS

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
2093 MXE EMI Receiver	20Hz-26.5GHz	N9038A	Agilent	MY51210181	2093	I	2/14/2022	1/14/2021
Radiated Emissions Sites	**FCC Code**	**IC Code**	**VCCI Code**	**Range**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
EMI Chamber 1	719150	2762A-6	A-0015	30-1000MHz	1685	I	12/6/2022	12/6/2020
EMI Chamber 1	719150	2762A-6	A-0015	1-18GHz	1685	I	12/8/2022	12/8/2020
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
2111 HF Preamp	0.5-18GHz	PAM-118A	COM-POWER	551063	2111	II	10/26/2022	10/26/2021
8447F Rental PA	9KHz-1.3GHz	84477F	HP	3113A05395		II	10/18/2022	10/18/2021
2130 BRF	9KHz-10GHz	BRM18770	Micro-Tronics	1	2130	II	1/21/2023	1/21/2022
Antennas	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
Red-White Bilog	30-2000MHz	JB1	Sunol	A091604-1	1105	I	10/25/2023	11/25/2021
Blue Horn	1-18Ghz	3117	ETS	157647	1861	I	4/26/2023	4/26/2021
Small Loop	10kHz-30MHz	PLA-130/A	ARA	1024	755	I	8/25/2022	8/25/2020
Meteorological Meters/Chambers		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	11/23/2022	11/23/2020
Asset #2654		1235C97	Control Company	200477432	2654	I	8/13/2022	8/13/2020
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**	**Calibrated on**
Asset #2464	9KHz-18GHz		MegaPhase			II	11/9/2022	11/9/2021
Asset #2580	9KHz-18GHz		Pasternack			II	1/21/2023	1/21/2022
Asset #2681	9KHz-18GHz		Pasternack			II	1/21/2023	1/21/2022
Asset #2464	9KHz-18GHz		MegaPhase			II	11/9/2022	11/9/2021
Asset #2580	9KHz-18GHz		Pasternack			II	1/21/2023	1/21/2022
Asset #2681	9KHz-18GHz		Pasternack			II	1/21/2023	1/21/2022

4.2.3 TEST PROCEDURES

a. The EUT was placed on the top of a rotating table 1.5 meters(above 1GHz) and 0.8 meters(below 1GHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the receive antenna, which was mounted on the top of a variable-height antenna tower.

c. From 30MHz to 1GHz, a bilog antenna was used, and above 1GHz, a horn antenna was used and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. Below 30MHz a loop antenna was used. The loop was placed at 1 meter height above the ground plane. Scans were performed with the loop was set to perpendicular to the EUT, parallel to the EUT and parallel with the ground plane.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. For below 30MHz, a loop antenna with its vertical plane is place 3m from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. And the center of the loop shall be 1m above the ground.

h. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables. For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

NOTE:

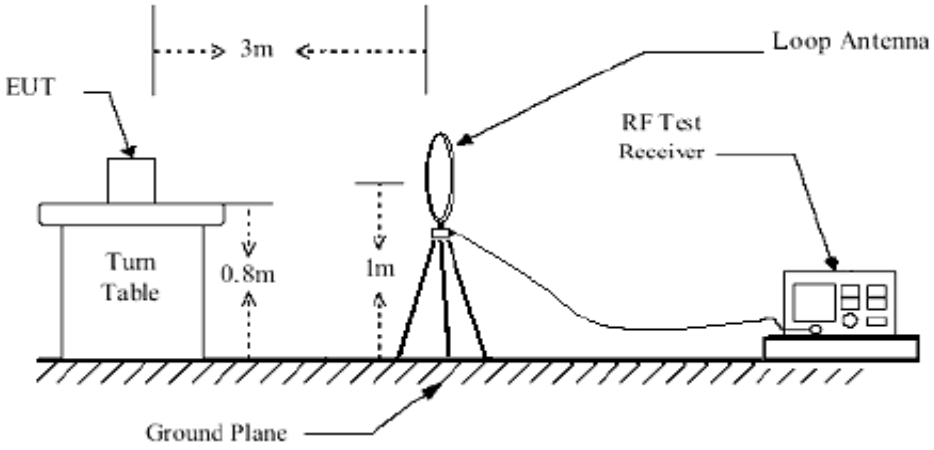
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequencies between 30MHz to 1GHz and 9kHz below 30MHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz. The average function was used to make average measurements in this range.
3. All modes of operation were investigated and the worst-case emissions are reported.
4. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

4.2.4 DEVIATION FROM TEST STANDARD

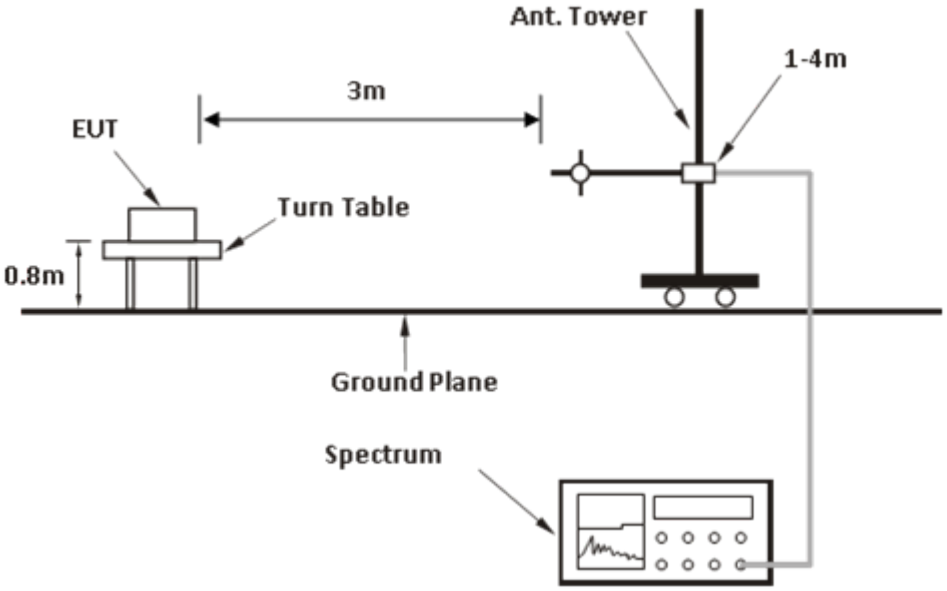
No deviation.

4.2.5 TEST SETUP

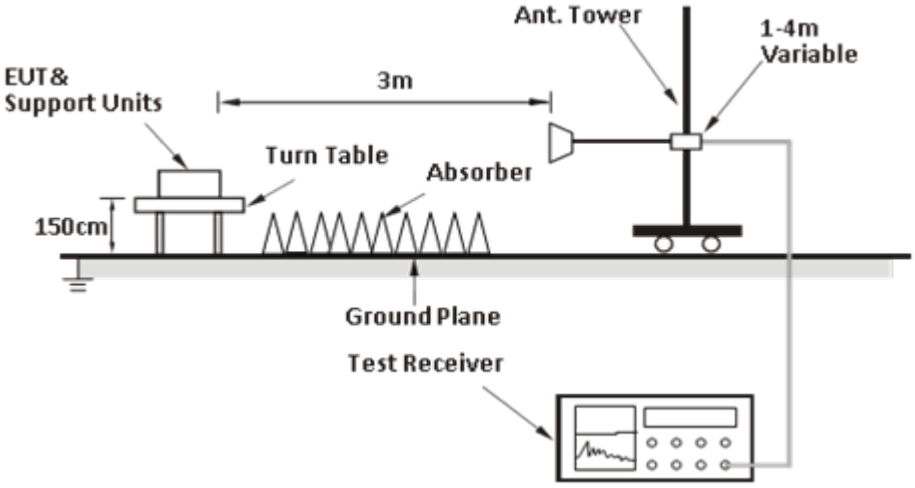
Below 30MHz test setup



Below 1GHz test setup



Above 1GHz test setup



4.2.6 EUT OPERATING CONDITIONS

a. Turn transmitter on to transmit continuously at specific channel frequency.

TEST RESULTS

BELOW 1GHz WORST-CASE DATA:

Patch Antenna

CHANNEL	902.75MHz, 915.25MHz, 927.25MHz	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

Radiated Emissions Table

Date: 27-Jan-22 **Company:** Novanta **Work Order:** V1855-4

Engineer: RTS **EUT Desc:** 900MHz FHSS Tx **EUT Operating Voltage/Frequency:** 5VDC

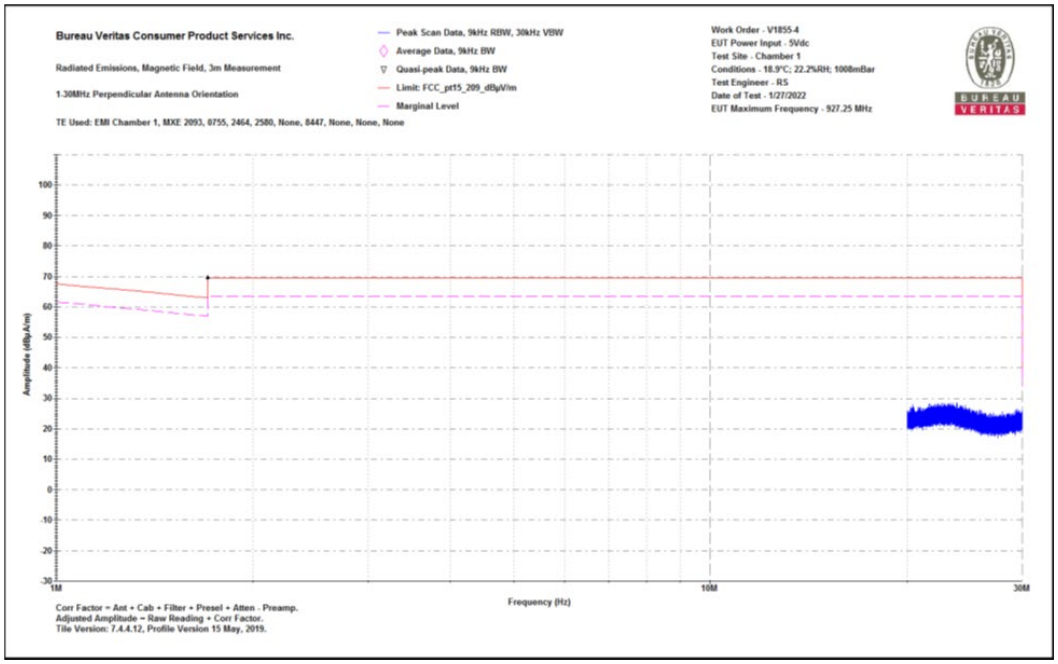
Frequency Range: 30MHz - 1GHz **Measurement Distance:** 3 m

Notes: Patch Antenna x-plane **EUT Max Freq:**

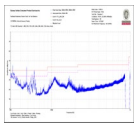
Antenna					Preamp	Antenna	Cable	Adjusted	QP/Average			Peak		
Polarization	Turntable	Antenna	Frequency	Reading	Factor	Factor	Factor	Reading	Limit	Margin	Result	Limit	Margin	Result
(H / V)	Deg.	Height cm	(MHz)	(dBµV)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	(Pass/Fail)	(dBµV/m)	(dB)	(Pass/Fail)
Low Channel														
V	183	166	108.6	38.8	26.3	16.6	1.3	30.4	43.5	-13.1	Pass	---	---	---
V	153	141	166.67	42.3	26.0	16.6	1.9	34.8	43.5	-8.7	Pass	---	---	---
V	8	108	998.79	33.9	25.3	28.0	5.9	42.5	54.0	-11.5	Pass	---	---	---
H	131	400	116.43	42.5	26.2	17.8	1.4	35.5	43.5	-8.0	Pass	---	---	---
H	232	156	166.67	44.6	26.0	16.6	1.9	37.1	43.5	-6.4	Pass	---	---	---
Mid Channel														
V	207	321	110.46	42.4	26.3	17.0	1.3	34.4	43.5	-9.1	Pass	---	---	---
V	151	100	168.66	41.5	26.0	16.5	1.9	33.9	43.5	-9.6	Pass	---	---	---
H	115	400	108.44	44.4	26.3	16.6	1.3	36.0	43.5	-7.5	Pass	---	---	---
H	99	372	164.68	41.8	26.0	16.7	1.8	34.3	43.5	-9.2	Pass	---	---	---
H	116	207	166.66	44.0	26.0	16.6	1.9	36.5	43.5	-7.0	Pass	---	---	---
High Channel														
V	28	281	110.46	40.1	26.3	17.0	1.3	32.1	43.5	-11.4	Pass	---	---	---
V	204	100	164.68	40.7	26.0	16.7	1.8	33.2	43.5	-10.3	Pass	---	---	---
V	0	100	960.0	32.3	25.5	27.5	5.6	39.9	46.0	-6.1	Pass	---	---	---
H	91	400	110.48	45.6	26.3	17.0	1.3	37.6	43.5	-5.9	Pass	---	---	---
H	81	216	164.7	46.2	26.0	16.7	1.8	38.7	43.5	-4.8	Pass	---	---	---
H	121	109	960.0	31.7	25.5	27.5	5.6	39.3	46.0	-6.7	Pass	---	---	---

REMARKS:

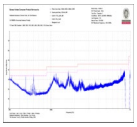
1. Adjusted Reading (dBuV/m) = Reading (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The highest emissions in the restricted bands were measured.
4. 9KHz~30MHz margin is greater than 20dB.
5. Margin value = Emission level – Limit value



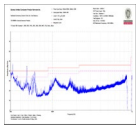
Below 30MHz Patch Antenna x-plane



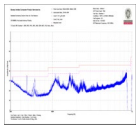
Low Channel Vertical 30MHz to 1GHz Patch Antenna x-plane



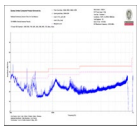
Low Channel Horizontal 30MHz to 1GHz Patch Antenna x-plane



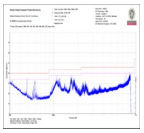
Mid Channel Vertical 30MHz to 1GHz Patch Antenna x-plane



Mid Channel Horizontal 30MHz to 1GHz Patch Antenna x-plane



High Channel Vertical 30MHz to 1GHz Patch Antenna x-plane



High Channel Horizontal 30MHz to 1GHz Patch Antenna x-plane

Dipole Antenna

CHANNEL	902.75MHz, 915.25MHz, 927.25MHz	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

Radiated Emissions Table

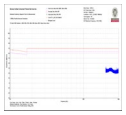
Date: 27-Jan-22 **Company:** Novanta **Work Order:** V1855-4
Engineer: RTS **EUT Desc:** 900MHz FHSS Tx **EUT Operating Voltage/Frequency:** 5VDC

Frequency Range: 30MHz - 1GHz **Measurement Distance:** 3 m
Notes: Dipole Antenna x-plane **EUT Max Freq:**

Antenna					Preamp	Antenna	Cable	Adjusted	QP/Average			Peak		
Polarization	Turntable	Antenna	Frequency	Reading	Factor	Factor	Factor	Reading	Limit	Margin	Result	Limit	Margin	Result
(H / V)	Deg.	Height cm	(MHz)	(dBµV)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	(Pass/Fail)	(dBµV/m)	(dB)	(Pass/Fail)
Low Channel														
V	6	345	110.36	39.7	26.3	17.0	1.3	31.7	43.5	-11.8	Pass	---	---	---
V	345	100	124.38	34.4	26.2	18.4	1.5	28.1	43.5	-15.4	Pass	---	---	---
V	240	119	166.6	40.4	26.0	16.6	1.9	32.9	43.5	-10.6	Pass	---	---	---
H	281	346	116.54	38.5	26.2	17.9	1.4	31.6	43.5	-11.9	Pass	---	---	---
H	93	134	166.6	43.0	26.0	16.6	1.9	35.5	43.5	-8.0	Pass	---	---	---
H	78	236	245.0	34.8	25.6	16.3	2.5	28.0	46.0	-18.0	Pass	---	---	---
Mid Channel														
V	173	241	108.03	40.4	26.3	16.5	1.3	31.9	43.5	-11.6	Pass	---	---	---
V	321	100	166.6	40.2	26.0	16.6	1.9	32.7	43.5	-10.8	Pass	---	---	---
V	0	100	995.0	30.6	25.4	27.9	5.9	39.0	54.0	-15.0	Pass	---	---	---
H	141	395	110.4	41.4	26.3	17.0	1.3	33.4	43.5	-10.1	Pass	---	---	---
H	75	193	166.6	43.3	26.0	16.6	1.9	35.8	43.5	-7.7	Pass	---	---	---
High Channel														
V	78	161	108.6	39.0	26.3	16.6	1.3	30.6	43.5	-12.9	Pass	---	---	---
V	0	100	168.6	36.8	26.0	16.5	1.9	29.2	43.5	-14.3	Pass	---	---	---
V	217	121	960.0	30.3	25.5	27.5	5.6	37.9	46.0	-8.1	Pass	---	---	---
H	63	400	109.4	41.4	26.3	16.8	1.3	33.2	43.5	-10.3	Pass	---	---	---
H	21	135	166.7	44.0	26.0	16.6	1.9	36.5	43.5	-7.0	Pass	---	---	---
H	0	100	960.0	31.3	25.5	27.5	5.6	38.9	46.0	-7.1	Pass	---	---	---

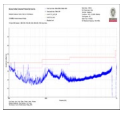
REMARKS:

1. Adjusted Reading (dBuV/m) = Reading (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The highest emissions in the restricted bands were measured.
4. 9KHz~30MHz margin is greater than 20dB.
5. Margin value = Emission level – Limit value

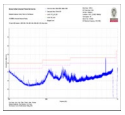


Below 30MHz Dipole Antenna Loop Parallel

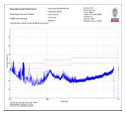
Below 30MHz Patch Antenna Loop Perpendicular



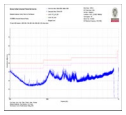
Low Channel Vertical 30MHz to 1GHz Dipole Antenna x-plane



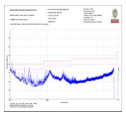
Low Channel Horizontal 30MHz to 1GHz Dipole Antenna x-plane



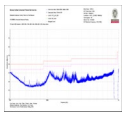
Mid Channel Vertical 30MHz to 1GHz Dipole Antenna x-plane



Mid Channel Horizontal 30MHz to 1GHz Dipole Antenna x-plane



High Channel Vertical 30MHz to 1GHz Dipole Antenna x-plane



High Channel Horizontal 30MHz to 1GHz Dipole Antenna x-plane

ABOVE 1GHz DATA

Patch Antenna

CHANNEL	902.75MHz, 915.25MHz, 927.25MHz	**DETECTOR FUNCTION**	Peak and Average
FREQUENCY RANGE	1GHz ~ 10GHz		

Radiated Emissions Table

Date: 27-Jan-22 **Company:** Novanta **Work Order:** V1855-4

Engineer: RTS **EUT Desc:** 900MHz FHSS Tx **EUT Operating Voltage/Frequency:** 5VDC

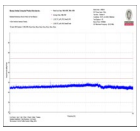
Frequency Range: 1GHz to 10GHz **Measurement Distance:** 3 m

Notes: Patch Antenna x-plane **EUT Max Freq:**

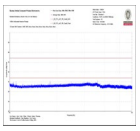
Antenna				Peak		Preamp	Antenna	Cable	Adjusted	Peak			QP/Average		
Polarization	Turntable	Antenna	Frequency	Reading	Reading	Factor	Factor	Factor	Reading	Limit	Margin	Result	Limit	Margin	Result
(H / V)	Deg.	Height cm	(MHz)	(dBµV)	(dBµV)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	(Pass/Fail)	(dBµV/m)	(dB)	(Pass/Fail)
Low Channel															
V	183	229	1094.75	51.1	39.4	41.4	27.8	6.2	32.0	74.0	-30.3	Pass	54.0	-22.0	Pass
V	356	100	2708.25	52.29	41.5	42.9	32.5	10.4	41.5	74.0	-21.7	Pass	54.0	-12.5	Pass
V	26	229	3611.0	55.45	48.0	43.4	33.5	12.2	50.3	74.0	-16.2	Pass	54.0	-3.7	Pass
H	50	135	2708.25	56.88	42.8	42.9	32.5	10.4	42.8	74.0	-17.1	Pass	54.0	-11.2	Pass
H	0	100	2871.125	51.6	36.7	42.8	32.5	10.6	37.0	74.0	-22.1	Pass	54.0	-17.0	Pass
H	54	100	3611.0	56.0	50.0	43.4	33.5	12.2	52.3	74.0	-15.7	Pass	54.0	-1.7	Pass
Mid Channel															
V	0	292	1107.0	50.63	38.7	41.4	27.9	6.3	31.5	74.0	-30.6	Pass	54.0	-22.5	Pass
V	252	247	2720.75	51.4	37.3	42.9	32.5	10.4	37.3	74.0	-22.6	Pass	54.0	-16.7	Pass
V	218	100	3623.5	50.63	36.7	43.4	33.6	12.4	39.3	74.0	-20.8	Pass	54.0	-14.7	Pass
H	18	225	1107.0	51.98	42.4	41.4	27.9	6.3	35.2	74.0	-29.2	Pass	54.0	-18.8	Pass
H	63	100	2720.75	53.4	39.0	42.9	32.5	10.4	39.0	74.0	-20.6	Pass	54.0	-15.0	Pass
H	283	100	3623.5	50.38	36.7	43.4	33.6	12.4	39.3	74.0	-21.0	Pass	54.0	-14.7	Pass
High Channel															
V	0	100	2732.75	50.48	36.8	42.9	32.5	10.4	36.8	74.0	-23.5	Pass	54.0	-17.2	Pass
V	12	123	3635.5	52.25	36.9	43.4	33.6	12.5	39.6	74.0	-19.0	Pass	54.0	-14.4	Pass
V	0	100	3661.125	51.25	37.0	43.3	33.6	12.8	40.1	74.0	-19.6	Pass	54.0	-13.9	Pass
H	0	125	1107.0	51.25	36.9	41.4	27.9	6.3	29.7	74.0	-29.9	Pass	54.0	-24.3	Pass
H	174	100	2732.75	50.7	36.8	42.9	32.5	10.4	36.8	74.0	-23.3	Pass	54.0	-17.2	Pass
H	331	143	3635.5	51.25	37.0	43.4	33.6	12.5	39.7	74.0	-20.0	Pass	54.0	-14.3	Pass

REMARKS:

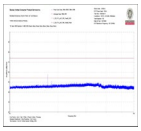
1. Adjusted Reading (dBuV/m) = Reading (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The highest emissions in the restricted bands were measured.
4. Margin value = Emission level – Limit value



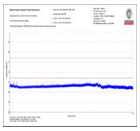
Low Channel Vertical 1GHz to 6GHz Patch Antenna x-plane



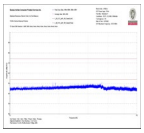
Low Channel Horizontal 1GHz to 6GHz Patch Antenna x-plane



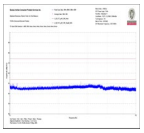
Mid Channel Vertical 1GHz to 6GHz Patch Antenna x-plane



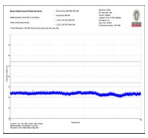
Mid Channel Horizontal 1GHz to 6GHz Patch Antenna x-plane



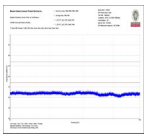
High Channel Vertical 1GHz to 6GHz Patch Antenna x-plane



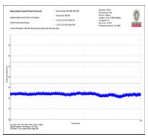
High Channel Horizontal 1GHz to 6GHz Patch Antenna x-plane



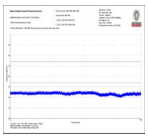
Low Channel Vertical 6GHz to 10GHz Patch Antenna x-plane



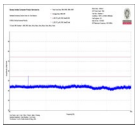
Low Channel Horizontal 6GHz to 10GHz Patch Antenna x-plane



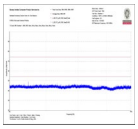
Mid Channel Vertical 6GHz to 10GHz Patch Antenna x-plane



Mid Channel Horizontal 6GHz to 10GHz Patch Antenna x-plane



High Channel Vertical 6GHz to 10GHz Patch Antenna x-plane



High Channel Horizontal 6GHz to 10GHz Patch Antenna x-plane

Dipole Antenna

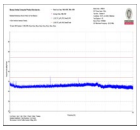
CHANNEL	902.75MHz, 915.25MHz, 927.25MHz	**DETECTOR FUNCTION**	Peak and Average
FREQUENCY RANGE	1GHz ~ 10GHz		

Radiated Emissions Table

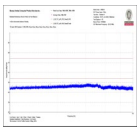
Date: 27-Jan-22 **Company:** Novanta **Work Order:** V1855-4
Engineer: RTS **EUT Desc:** 900MHz FHSS Tx **EUT Operating Voltage/Frequency:** 5VDC

Frequency Range: 1GHz to 10GHz **Measurement Distance:** 3 m
Notes: Dipole Antenna x-plane **EUT Max Freq:**

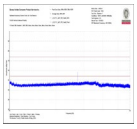
Antenna				Peak		Preamp	Antenna	Cable	Adjusted	Peak			QP/Average		
Polarization	Turntable	Antenna	Frequency	Reading	Reading	Factor	Factor	Factor	Reading	Limit	Margin	Result	Limit	Margin	Result
(H / V)	Deg.	Height cm	(MHz)	(dBµV)	(dBµV)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	(Pass/Fail)	(dBµV/m)	(dB)	(Pass/Fail)
Low Channel															
V	14	172	1094.75	51.25	41.2	41.4	27.8	6.2	33.8	74.0	-30.1	Pass	54.0	-20.2	Pass
V	72	121	2708.25	61.69	52.2	42.9	32.5	10.4	52.2	74.0	-12.3	Pass	54.0	-1.8	Pass
V	100	188	3611.0	56.24	46.2	43.4	33.5	12.2	48.5	74.0	-15.5	Pass	54.0	-5.5	Pass
H	23	164	2708.25	53.46	45.3	42.9	32.5	10.4	45.3	74.0	-20.5	Pass	54.0	-8.7	Pass
H	153	148	2871.125	50.21	36.7	42.8	32.5	10.6	37.0	74.0	-23.5	Pass	54.0	-17.0	Pass
H	115	134	3611.0	52.58	41.4	43.4	33.5	12.2	43.7	74.0	-19.1	Pass	54.0	-10.3	Pass
Mid Channel															
V	136	243	2720.75	51.0	36.7	42.9	32.5	10.4	36.7	74.0	-23.0	Pass	54.0	-17.3	Pass
V	276	242	2745.5	61.8	53.9	42.9	32.5	10.4	53.9	74.0	-12.2	Pass	54.0	-0.1	Pass
V	0	153	3623.5	51.17	36.8	43.4	33.6	12.4	39.4	74.0	-20.2	Pass	54.0	-14.6	Pass
H	308	133	2720.75	50.92	36.8	42.9	32.5	10.4	36.8	74.0	-23.1	Pass	54.0	-17.2	Pass
H	207	295	2745.5	60.95	53.6	42.9	32.5	10.4	53.6	74.0	-13.0	Pass	54.0	-0.4	Pass
H	281	239	3623.5	50.33	36.8	43.4	33.6	12.4	39.4	74.0	-21.1	Pass	54.0	-14.6	Pass
High Channel															
V	316	121	2732.75	50.5	36.8	42.9	32.5	10.4	36.8	74.0	-23.5	Pass	54.0	-17.2	Pass
V	187	100	2782.125	58.97	52.0	42.9	32.6	10.3	52.0	74.0	-15.0	Pass	54.0	-2.0	Pass
V	77	133	3635.5	50.71	36.7	43.4	33.6	12.5	39.4	74.0	-20.6	Pass	54.0	-14.6	Pass
H	244	100	2732.75	50.7	36.9	42.9	32.5	10.4	36.9	74.0	-23.3	Pass	54.0	-17.1	Pass
H	22	100	2782.125	58.62	53.8	42.9	32.6	10.3	53.8	74.0	-15.4	Pass	54.0	-0.2	Pass
H	202	161	3635.5	50.87	36.8	43.4	33.6	12.5	39.5	74.0	-20.4	Pass	54.0	-14.5	Pass



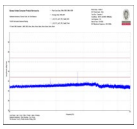
Low Channel Vertical 1GHz to 6GHz Dipole Antenna x-plane



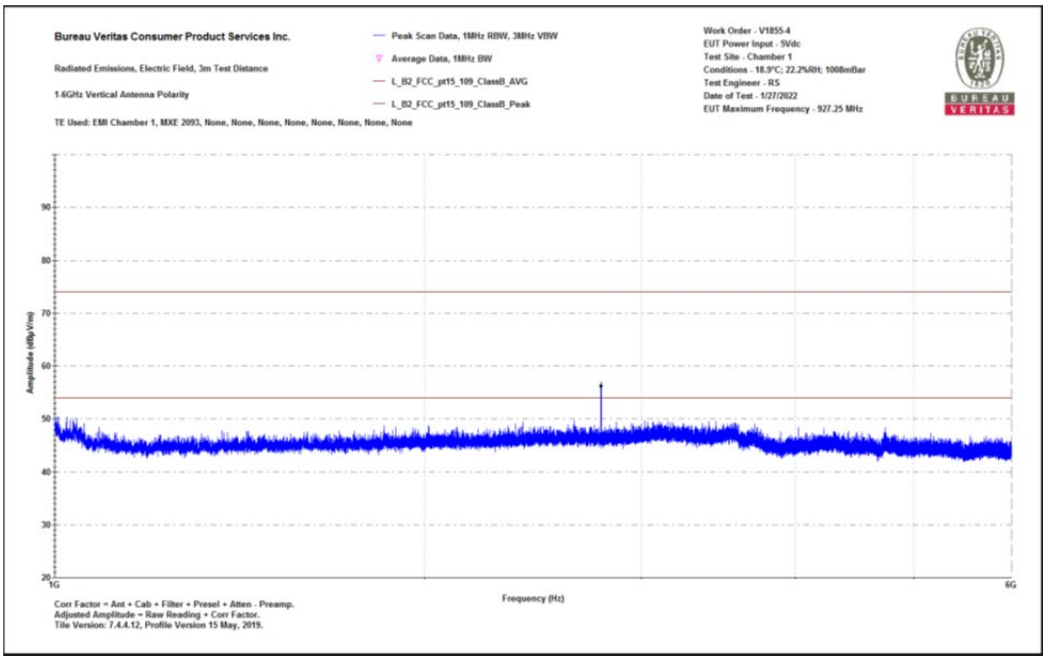
Low Channel Horizontal 1GHz to 6GHz Dipole Antenna x-plane



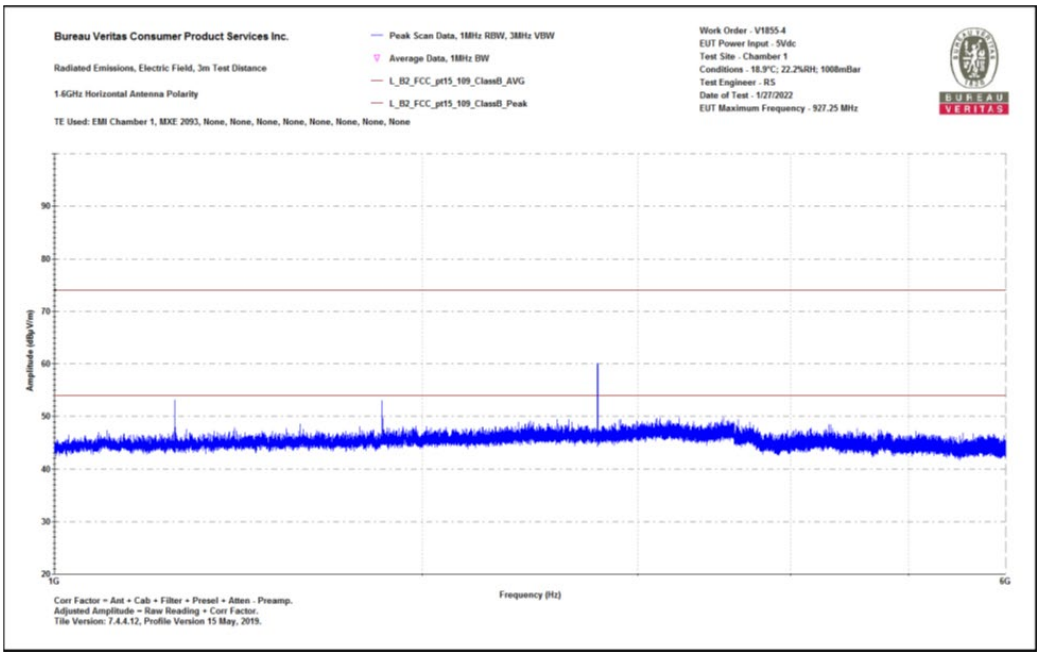
Mid Channel Vertical 1GHz to 6GHz Dipole Antenna x-plane



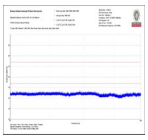
Mid Channel Horizontal 1GHz to 6GHz Dipole Antenna x-plane



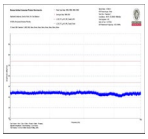
High Channel Vertical 1GHz to 6GHz Dipole Antenna x-plane



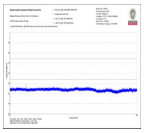
High Channel Horizontal 1GHz to 6GHz Dipole Antenna x-plane



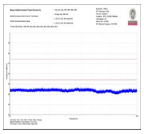
Low Channel Vertical 6GHz to 10GHz Dipole Antenna x-plane



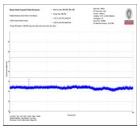
Low Channel Horizontal 6GHz to 10GHz Dipole Antenna x-plane



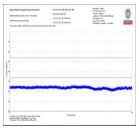
Mid Channel Vertical 6GHz to 10GHz Dipole Antenna x-plane



Mid Channel Horizontal 6GHz to 10GHz Dipole Antenna x-plane



High Channel Vertical 6GHz to 10GHz Dipole Antenna x-plane



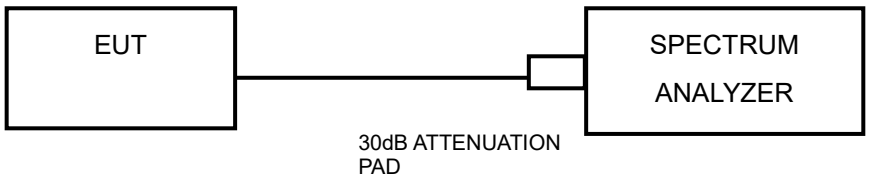
High Channel Horizontal 6GHz to 10GHz Dipole Antenna x-plane

4.3 NUMBER OF HOPPING FREQUENCY USED

4.3.1 LIMIT OF HOPPING FREQUENCY USED

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

4.3.2 TEST SETUP



4.3.3 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Cable	Carlisle	N/a	Asset 2595	1/21/2022	1/21/2023
Spectrum Analyzer	Rohde & Schwarz	FSV40	101551	10/26/2021	10/26/2022
Attenuator	API Weinschel	89-30-11	703	2/21/2021	2/21/2022

4.3.4 TEST PROCEDURE (ANSI C63.10: 2013 SECTION 7.8.3)

a. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.

b. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

c. VBW ≥ RBW.

d. Sweep: Auto.

e. Detector function: Peak.

f. Trace: Max hold.

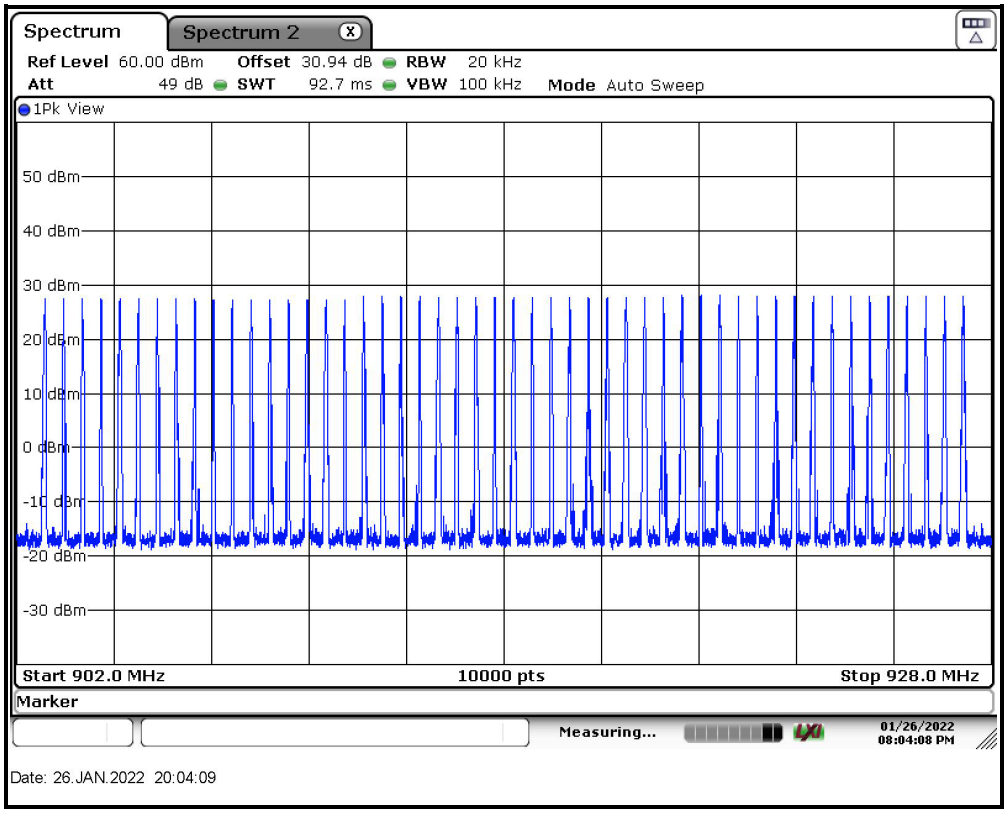
g. Allow the trace to stabilize

4.3.5 DEVIATION FROM TEST STANDARD

No deviation.

4.3.6 TEST RESULTS

There are 50 hopping frequencies in the hopping mode.

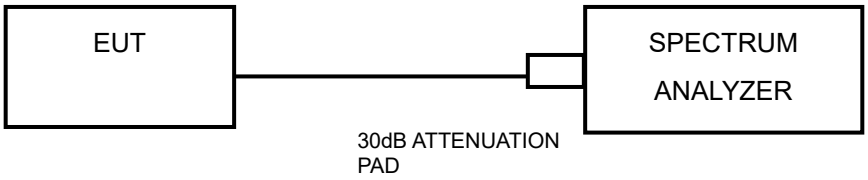


DWELL TIME ON EACH CHANNEL

4.3.7 LIMIT OF DWELL TIME USED (ANSI C63.10: 2013 SECTION 7.8.4)

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

4.3.8 TEST SETUP



4.3.9 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.3.10 TEST PROCEDURES

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a. Span: Zero span, centered on a hopping channel.

b. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.

c. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.

d. Detector function: Peak.

e. Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements.

4.3.11 DEVIATION FROM TEST STANDARD

No deviation.

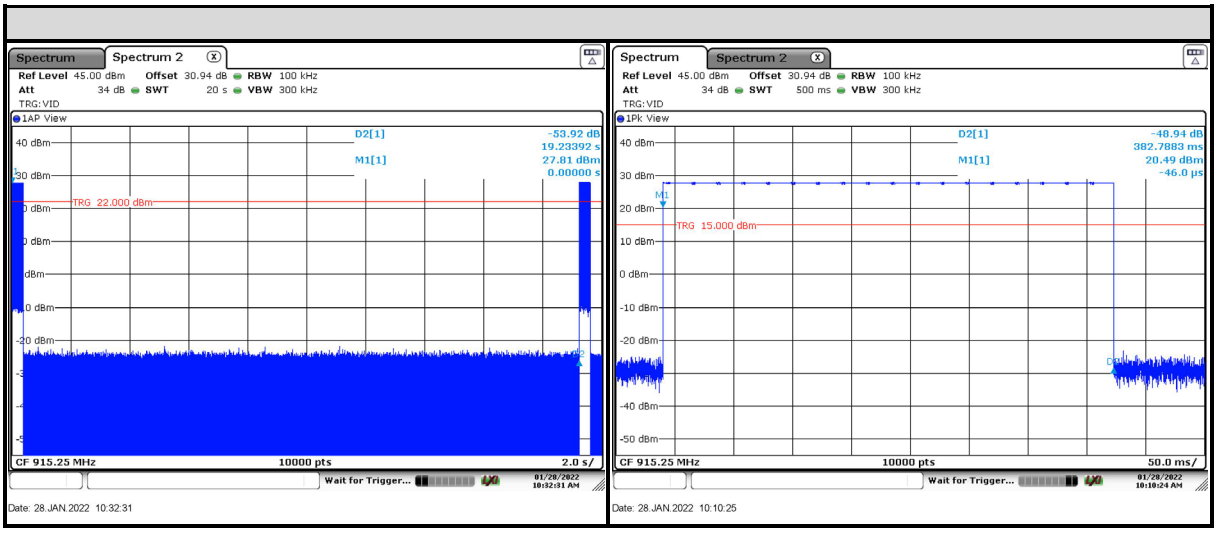
4.3.12 TEST RESULTS

Mode	Number of Hopping Channel	# of hops =Sweep Time/period			Length of transmission time (msec)	Max On Time Result (msec)	Limit (msec)	PASS / FAIL
		period (sec)	Sweep Time	# of Hops in a Sweep Time				
Hop	50	19.23	20	1.04	382.79	398.10	400	PASS

Calculation: **# of Hops in Sweep Time = Sweep Time/Period**

Max On Time = # of Hops in Sweep Time * Length of transmission

NOTE: Test plots of the transmitting time slot are shown on next page.

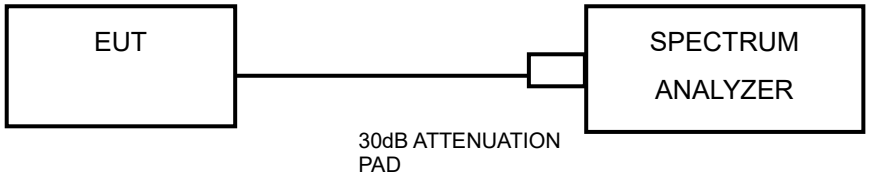

Spectrum
Spectrum 2
Ref Level 45.00 dBm Offset 30.94 dB RBW 100 kHz
Att 34 dB SWT 20 s VBW 300 kHz
TRG: VID
1AP View
D2[1] -53.92 dB
19.23392 s
M1[1] 27.81 dBm
0.00000 s
TRG 22.000 dBm
CF 915.25 MHz
10000 pts
2.0 s/
Wait for Trigger...
Date: 28.JAN.2022 10:32:31
Spectrum
Spectrum 2
Ref Level 45.00 dBm Offset 30.94 dB RBW 100 kHz
Att 34 dB SWT 500 ms VBW 300 kHz
TRG: VID
1Pk View
D2[1] -48.94 dB
382.7883 ms
M1[1] 20.49 dBm
-46.0 µs
TRG 15.000 dBm
CF 915.25 MHz
10000 pts
50.0 ms/
Wait for Trigger...
Date: 28.JAN.2022 10:10:25

CHANNEL BANDWIDTH 20dB BW and 99% OBW

4.3.13 LIMITS OF CHANNEL BANDWIDTH

For frequency hopping systems operating in the 902-928 MHz band: the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz..

4.3.14 TEST SETUP



4.3.15 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.3.16 TEST PROCEDURE (ANSI C63.10: 2013 SECTION 7.8.7)

20dB BW

a. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.

b. The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.

c. Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d. Steps a) through c) might require iteration to adjust within the specified tolerances.

e. The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “−xx dB down” requirement; that is, if the requirement calls for measuring the −20 dB OBW, the instrument

noise floor at the selected RBW shall be at least 30 dB below the reference value.

f. Set detection mode to peak and trace mode to max hold.

g. Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h. Determine the "−xx dB down amplitude" using [(reference value) − xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i. If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and 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 g) shall be used for step j).

j. Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "−xx dB down amplitude" determined in step h). If a marker is below this "−xx dB down amplitude" value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "−xx dB down amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

99% OBW

a. The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b. The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c. Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d. Step a) through step c) might require iteration to adjust within the specified range.

e. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f. Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

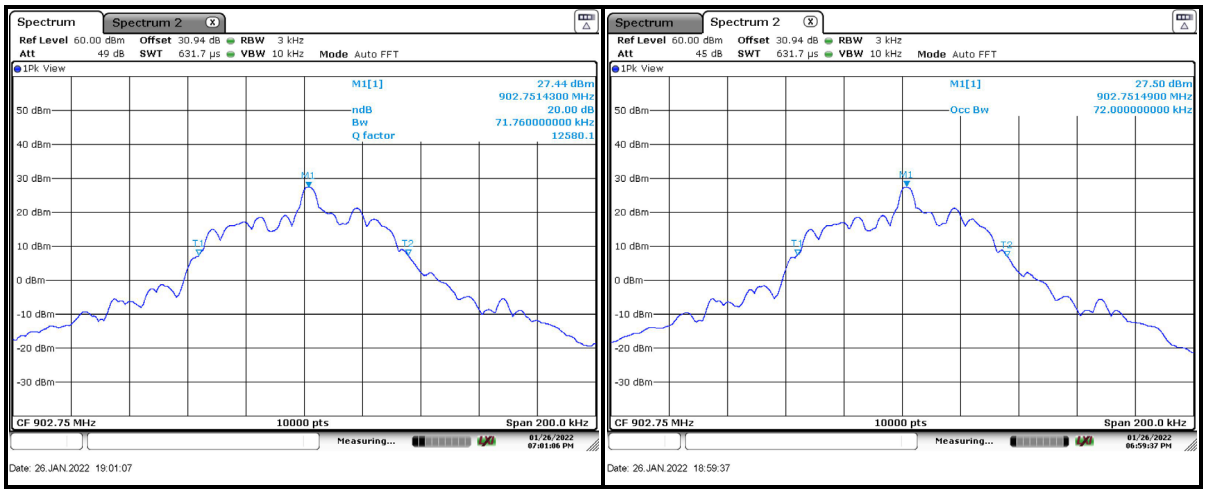
4.3.17 DEVIATION FROM TEST STANDARD

No deviation.

4.3.18 TEST RESULTS

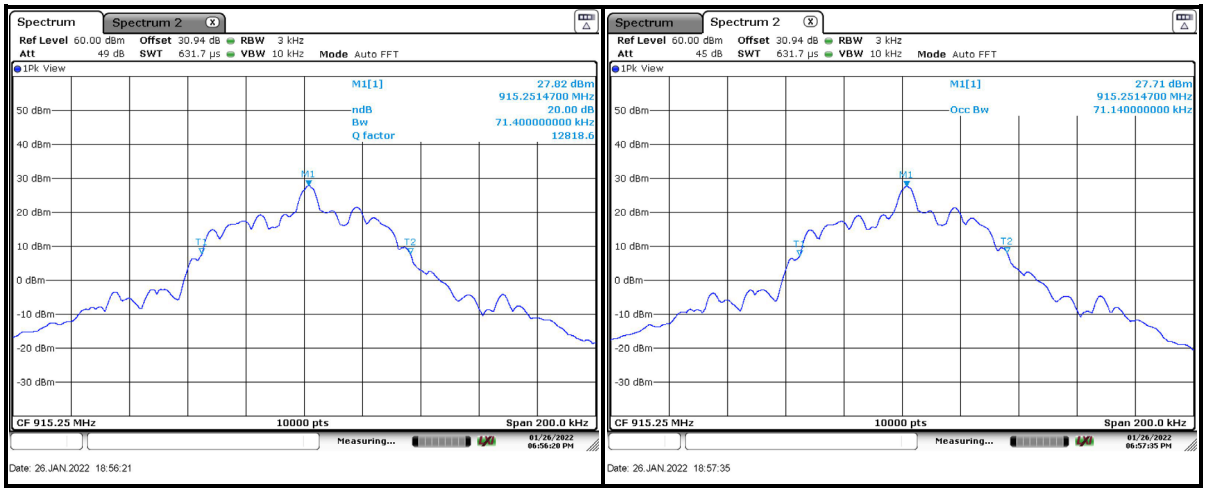
CHANNEL	CHANNEL FREQUENCY (MHz)	99% OBW (kHz)	20dB BANDWIDTH (kHz)
1	902.75	72.00	71.76
26	915.25	71.14	71.40
50	927.25	75.42	73.12

CH 1



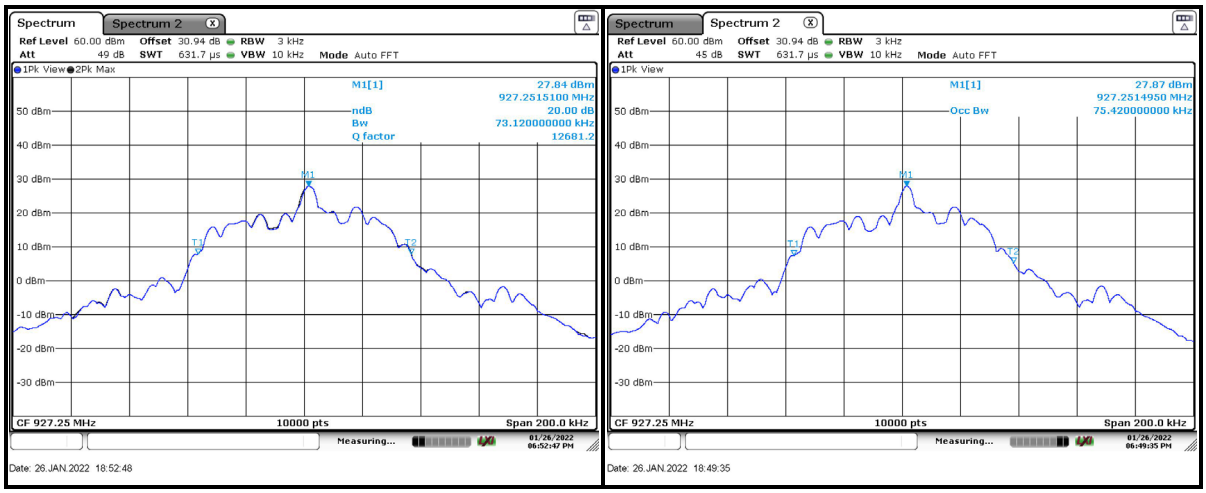
20dB BW 99%OBW

CH 26



20dB BW 99%OBW

CH 50



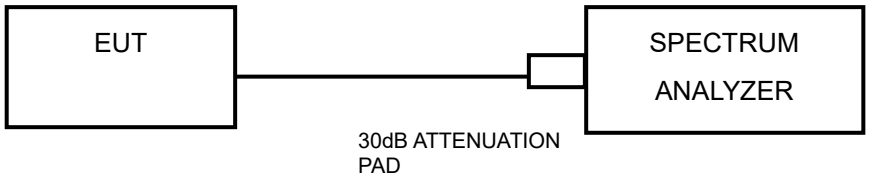
20dB BW 99%OBW

HOPPING CHANNEL SEPARATION

4.3.19 LIMIT OF HOPPING CHANNEL SEPARATION

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

4.3.20 TEST SETUP



4.3.21 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.3.22 TEST PROCEDURES (ANSI C63.10: 2013 SECTION 7.8.2)

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a. Span: Wide enough to capture the peaks of two adjacent channels.

b. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

c. Video (or average) bandwidth (VBW) ≥ RBW.

d. Sweep: Auto.

e. Detector function: Peak.

f. Trace: Max hold.

g. Allow the trace to stabilize.

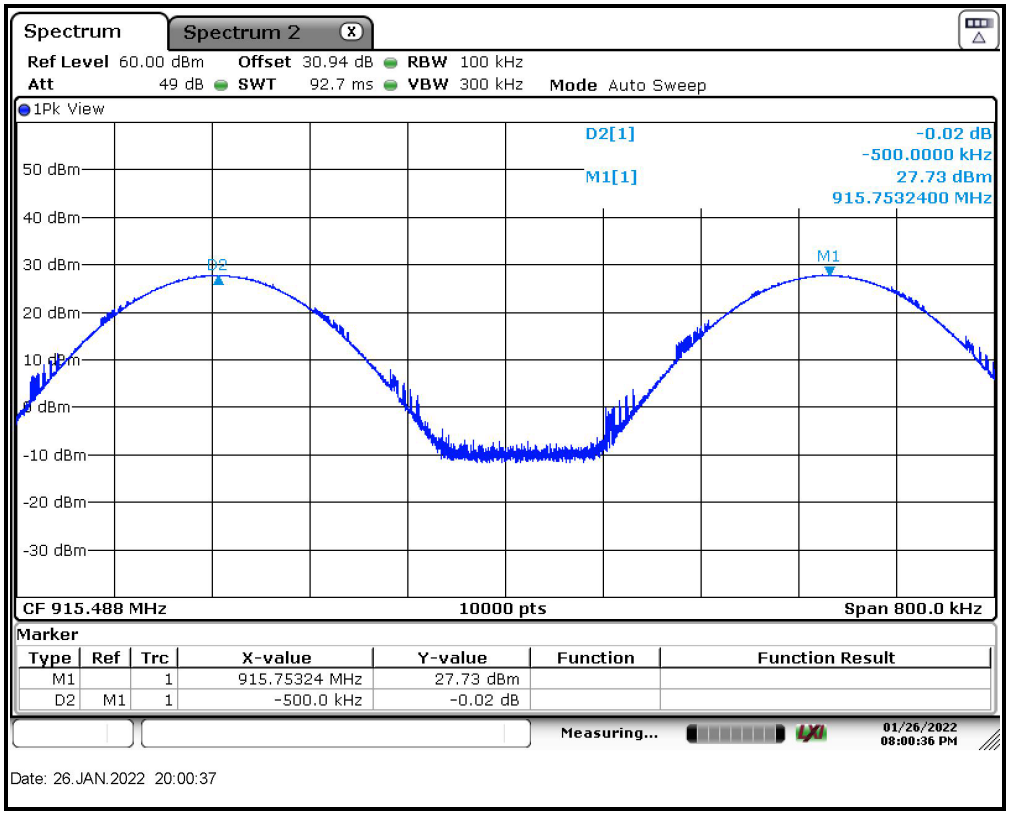
Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

4.3.23 DEVIATION FROM TEST STANDARD

No deviation.

4.3.24 TEST RESULTS

ADJACENT CHANNEL SEPARATION (KHz)	20dB BANDWIDTH (KHz)	MINIMUM LIMIT (KHz)	PASS / FAIL
500	71.40	71.40	PASS

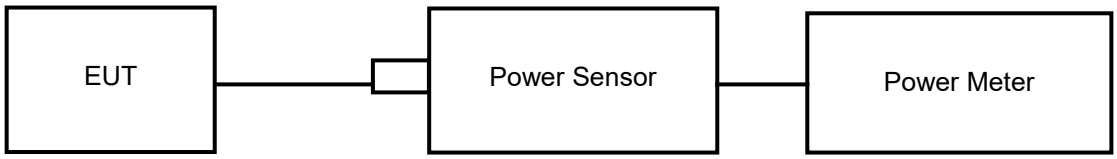


CONDUCTED OUTPUT POWER

4.3.25 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels.

4.3.26 TEST SETUP



30dB ATTENUATION
PAD

4.3.27 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.3.28 TEST PROCEDURES (ANSI C63.10: 2013 SECTION 7.8.5)

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a. Use the following spectrum analyzer settings:
    i. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
    ii. RBW > 20 dB bandwidth of the emission being measured.
    iii. VBW ≥ RBW.
    iv. Sweep: Auto.
    v. Detector function: Peak.
    vi. Trace: Max hold.
b. Allow trace to stabilize.
c. Use the marker-to-peak function to set the marker to the peak of the emission.
d. The indicated level is the peak output power, after any corrections for external attenuators and cables.

4.3.29 DEVIATION FROM TEST STANDARD

No deviation.

4.3.30 TEST RESULTS

MAXIMUM PEAK OUTPUT POWER

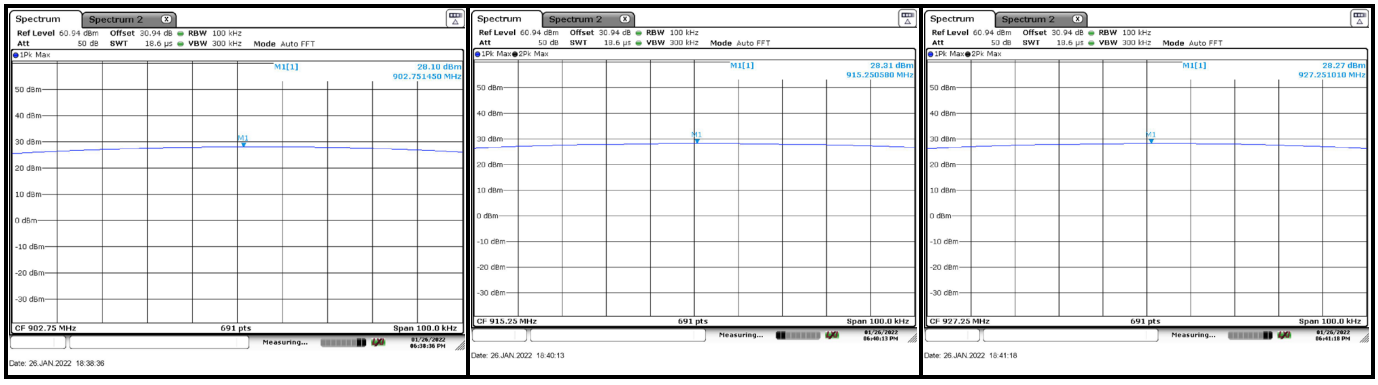
Petite

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (W)	PEAK POWER LIMIT (W)	PASS/FAIL
1	902.75	28.10	0.65	1.0	PASS
26	915.25	28.31	0.68	1.0	PASS
50	927.25	28.27	0.67	1.0	PASS

Pico

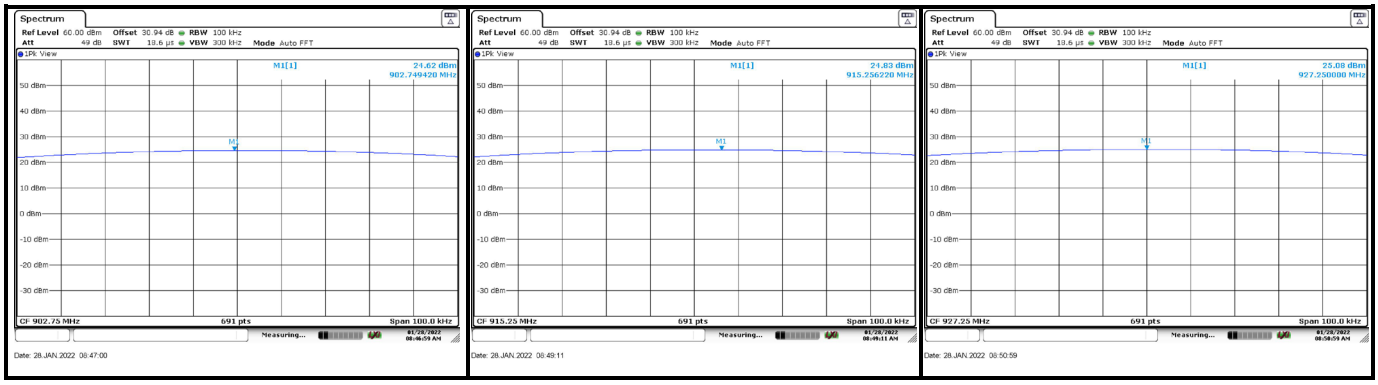
CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (W)	PEAK POWER LIMIT (W)	PASS/FAIL
1	902.75	24.62	0.29	1.0	PASS
26	915.25	24.83	0.30	1.0	PASS
50	927.25	25.08	0.32	1.0	PASS

Petite



Low Mid Hi

Pico



Low Mid Hi

OUT OF BAND EMISSION MEASUREMENT

4.3.31 LIMITS OF OUT OF BAND EMISSION MEASUREMENT

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.

4.3.32 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.3.33 TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer via a low loss cable. of Spectrum Analyzer was set RBW to 100 kHz and VBW to 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. Detector = PEAK and Trace mode = Max Hold. The band edges was measured and recorded.

4.3.34 DEVIATION FROM TEST STANDARD

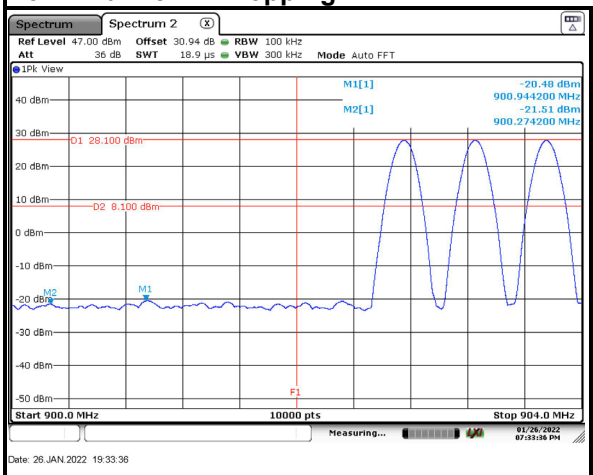
No deviation.

4.3.35 TEST RESULTS

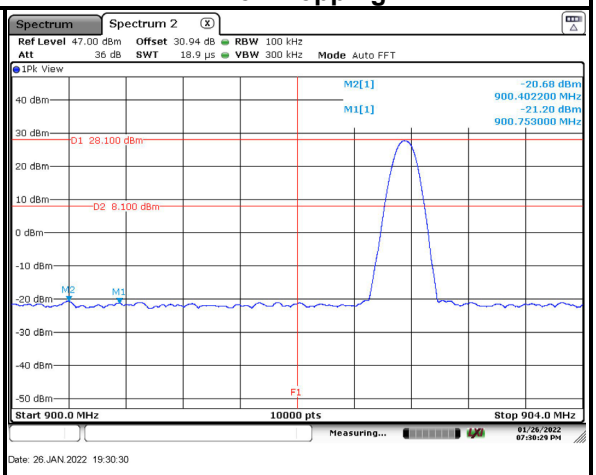
The spectrum plots are attached on the following images. D1 line indicates the highest level. D2 line indicates the 20dB offset below D1. It shows compliance to the requirement.

Band-edge

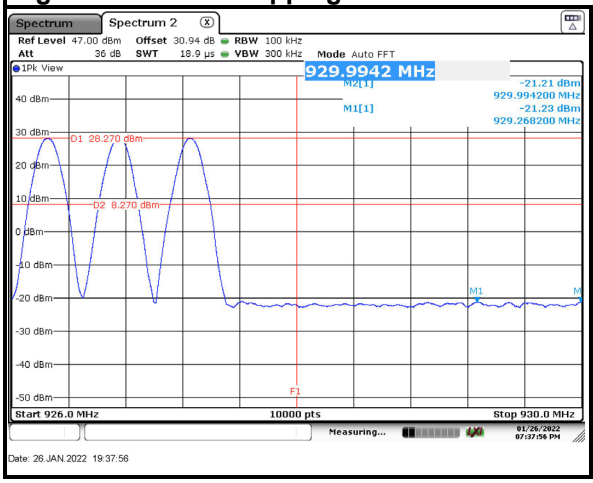
Low Channel Hopping



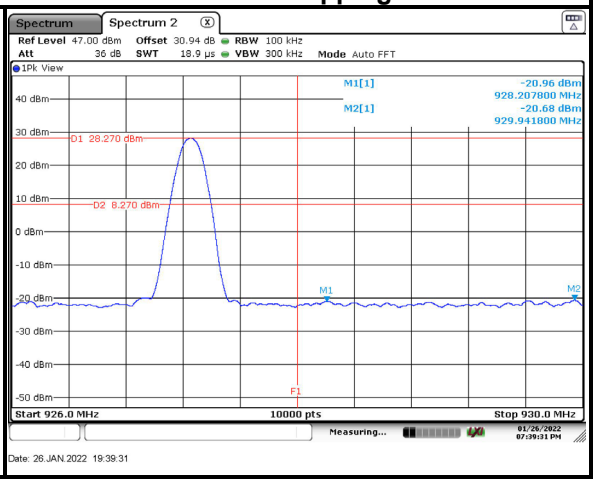
Non-Hopping



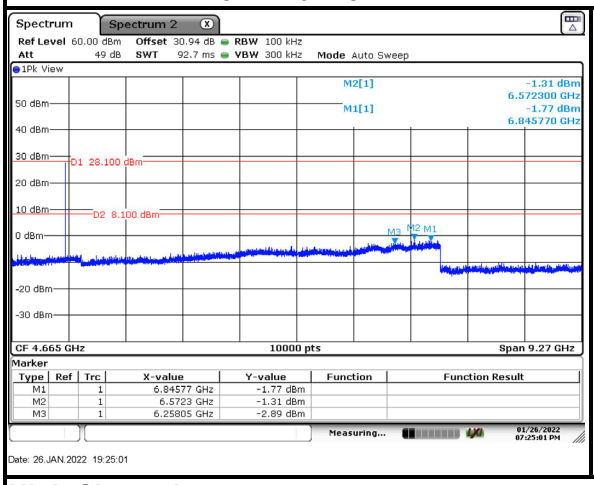
High Channel Hopping



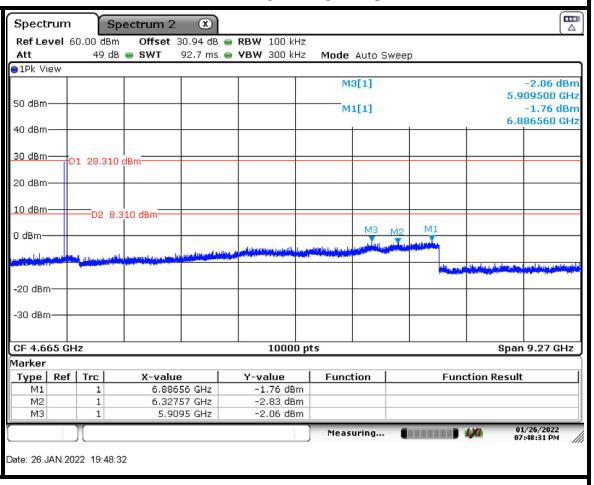
Non-Hopping



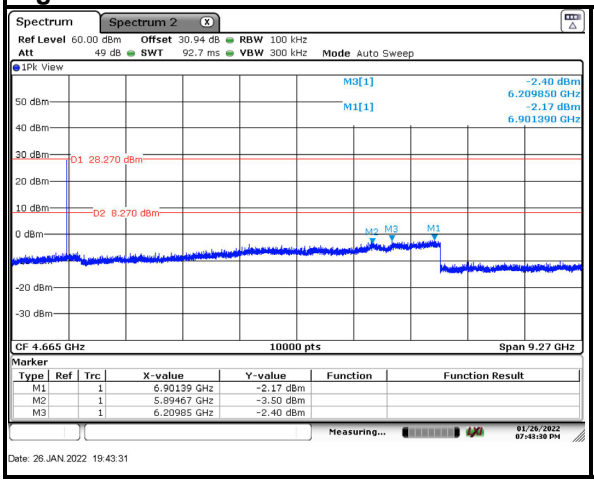
Low Channel



Mid Channel



High Channel



5 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the Test Setup Photo Exhibit.

6 APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---