

FCC IC RF Test Report

Report No.: FCC_IC_RF_SL20020301_JAD_001_125KHz134KHz Rev 2.0

FCC ID: QV5HS1RS

IC: 5407A-HS1RS

Models: HS-1RS, HS1RS, FlexTap, FlexTap RS

Received Date: 05/18/2020

Test Date: 05/18/2020-6/02/2020

Issued Date: 06/17/2020

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IC Applicant name: Novanta Corporation

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Manufacturer: JADAK, a business unit of Novanta Corporation

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Issued By: Bureau Veritas Consumer Products Services, Inc.

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**FCC Registration /
Designation Number:** 540430

ISED# / CAB identifier: 4842D



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Table of Contents

Release Control Record	3
1 Certificate of Conformity.....	4
2 Summary of Test Results	5
2.1 Measurement Uncertainty	5
2.2 Modification Record	5
3 General Information.....	6
3.1 General Description of EUT	6
3.2 Description of Test Modes	7
3.2.1 1 channel is provided to this EUT	7
3.2.2 Test Mode Applicability and Tested Channel Detail	7
3.3 Description of Support Units	8
3.3.1 Configuration of System under Test	8
3.4 General Description of Applied Standards	8
4 Test Types and Results	9
4.1 Radiated Emission Measurement	9
4.1.1 Limits of Radiated Emission Measurement	9
4.1.2 Test Instruments	10
4.1.3 Test Procedures.....	11
4.1.4 Deviation from Test Standard	11
4.1.5 Test Setup.....	12
4.1.6 EUT Operating Conditions.....	12
4.1.7 Test Results	13
4.2 Occupied Bandwidth	18
4.2.1 Test Instruments	18
4.2.2 Test Procedures.....	18
4.2.3 Test Setup.....	18
4.2.4 EUT Operating Conditions.....	18
4.2.5 Test Results	19
4.3 Conducted Emission Measurement	20
4.3.1 Limits of Conducted Emission Measurement	20
4.3.2 Test Instruments	20
4.3.3 Test Procedures.....	20
4.3.4 Deviation from Test Standard	20
4.3.5 Test Setup.....	21
4.3.6 EUT Operating Conditions.....	21
4.3.7 Test Results	22
5 Pictures of Test Arrangements.....	24
Appendix – Information on the Testing Laboratories	25

Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL20020301_JAD_001_125KHz134KHz	Initial Release	05/19/2020
FCC_IC_RF_SL20020301_JAD_001_125KHz134KHz Rev 1.0	Add Occupied Bandwidth Test Result	06/02/2020
FCC_IC_RF_SL20020301_JAD_001_125KHz134KHz Rev 2.0	Update Antenna info	06/17/2020

1 Certificate of Conformity

Product: Secure Access Handheld Barcode & RFID

Brand: JADAK, a business unit of Novanta Corporation

Test Model: HS-1RS

Serial Model: HS1RS, FlexTap, FlexTap RS

Sample Status: Engineering sample

Applicant: JADAK, a business unit of Novanta Corporation

Test Date: 05/18/2020-06/02/2020

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.207/15.209)
ANSI C63.10:2013
RSS Gen Issue 5, March 2019

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Gary Chou, **Date:** 06/02/2020
Gary Chou / Compliance Engineer

Approved by : Chen Ge, **Date:** 06/17/2020
Chen Ge / Engineer Reviewer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (15.207/15.209) , RSS Gen Issue 5			
FCC IC Clause	Test Item	Result	Remarks
15.207 RSS Gen 8.8	AC Power Conducted Emission	Pass	Meet the requirement of limit.
RSS Gen	Occupied Bandwidth	Pass	Meet the requirement of limit.
15.209 RSS Gen	Transmitter Radiated Emission	Pass	Meet the requirement of limit.
15.203 RSS Gen	Antenna Requirement	Pass	The EUT uses a Coil Antenna to permanently attach to the device.

2.1 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	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Secure Access Handheld Barcode & RFID
Brand	JADAK, a business unit of Novanta Corporation
Test Model	HS-1RS (with USB and RS232 interfaces)
Variant Model(s)	HS1RS, FlexTap, FlexTap RS
Status of EUT	Engineering sample
EUT Software Version	FW-HS1RX-00-A02-814
Power Supply Rating	5Vdc
Modulation Type	ASK
Operating Frequency	125KHz / 134.23KHz
Antenna Type	Coil Antenna (Ferrite core)
Antenna Gain	2.15 dBi
Antenna inductance	490uH with DCR<10 ohms

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

3.2.1 1 channel is provided to this EUT

Channel	Freq. (MHz)
1	0.125
1	0.13423

3.2.2 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE	PLC	FS	EB	
A	-	-	-	-	Power from battery
B	√	√	-	-	Power from USB via laptop

Where **RE:** Radiated Emission
FS: Frequency Stability

PLC: Power Line Conducted Emission
EB: 20dB Bandwidth measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.

NOTE: "-" means no effect.

Radiated Emission Test:

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
B	2	2	ASK

Power Line Conducted Emission Test:

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
B	2	2	ASK

Frequency Stability:

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
B	2	2	ASK

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE	25deg. C, 65%RH	5Vdc	Gary Chou
PLC	25deg. C, 65%RH	5Vdc	Gary Chou

3.3 Description of Support Units

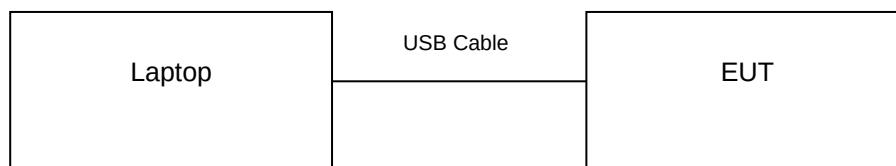
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Thinkpad	0578-CTO	LR-16MAW	-	Provided by Customer
B.						

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB cable	1	0.8	N	0	Provided by Customer

Note: The core(s) is(are) originally attached to the cable(s).

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

47 CFR FCC Part 15, Subpart C (Section 15.207)

47 CFR FCC Part 15, Subpart C (Section 15.209)

ANSI C63.10:2013

RSS Gen Issue 5, March 2019

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

4 Test Types and Results

4.1 Radiated Emission Measurement

4.1.1 Limits of Radiated Emission Measurement

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. Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$
Limit Line (dBuV/m) = $20 \log \text{Emission level (uV/m)} + \text{Distance extrapolation factor}$
3. 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.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Test Receiver ROHDE & SCHWARZ	ESW 44	100179	08/30/2019	08/30/2020
Passive Loop Antenna (9k-30MHz)	6512	49120	07/14/2019	07/14/2020
Hybrid Antenna SUNAR	JB6	A111717	03/09/2020	03/09/2021
Preamplifier RF-BAY	LPA-6-30	11170602	05/06/2019	05/06/2020*
Preamplifier RF-BAY	LNA-150	12170607	02/16/2020	02/16/2021

* 3 month extension

4.1.3 Test Procedures

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna 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. 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.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

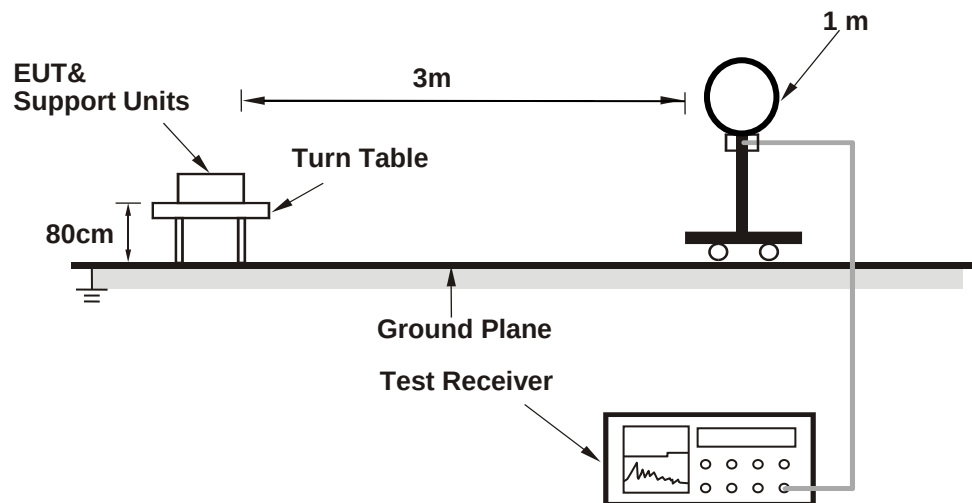
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

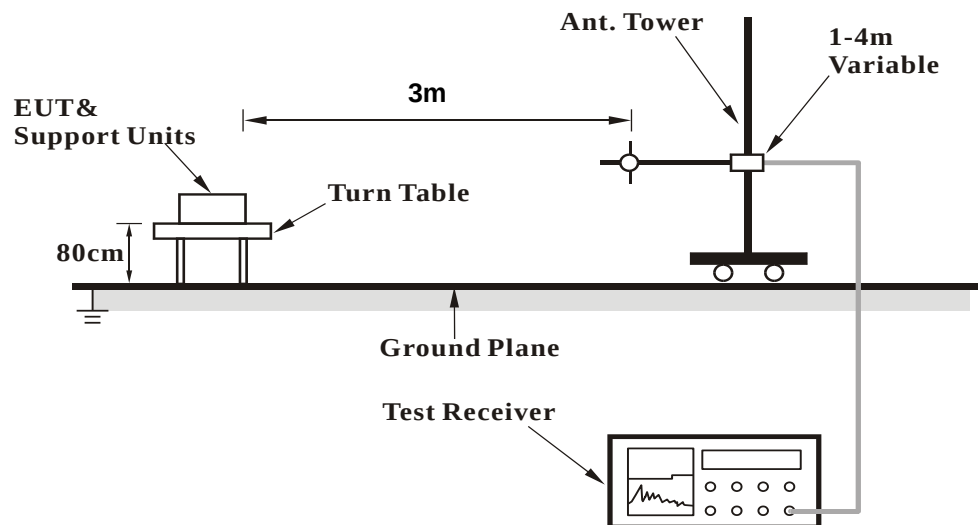
No deviation.

4.1.5 Test Setup

For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



4.1.6 EUT Operating Conditions

- Connected the EUT with the Notebook Computer which is placed on remote site.
- Controlling software has been activated to set the EUT on specific status.

4.1.7 Test Results

Radiated Emissions (9 kHz~30 MHz)

EUT Test Condition		Measurement Detail	
Frequency	125KHz / 134.23KHz	Frequency Range	9 kHz~30 MHz
Input Power	DC5V	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 70% RH	Tested By	Gary Chou

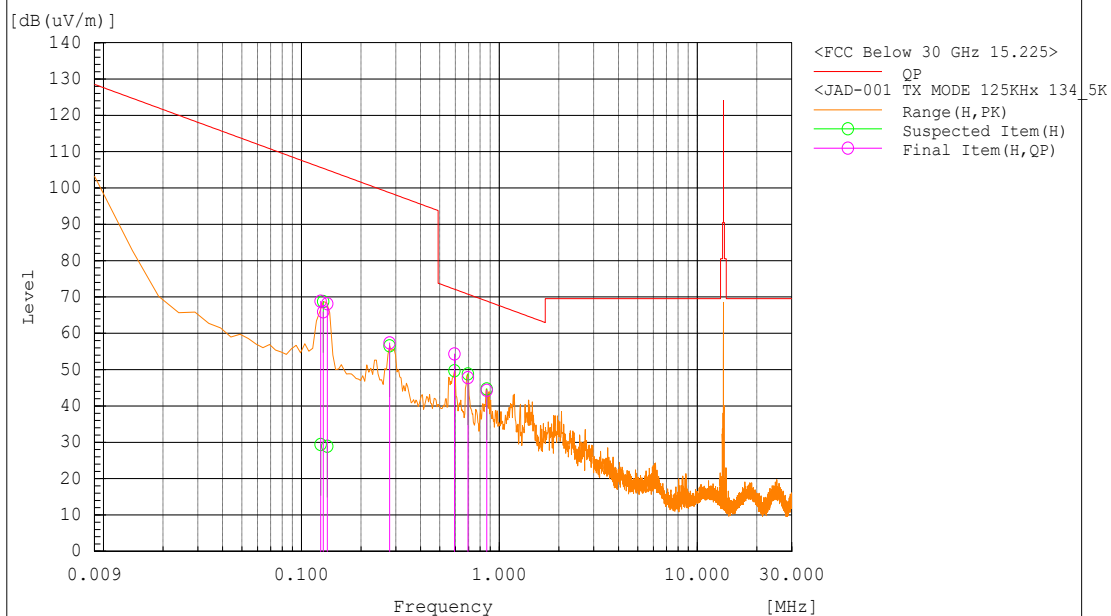
Antenna Polarity & Test Distance: Loop Antenna 0 degree At 3m										
No.	Frequency (MHz)	Polarization	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	0.279	0 degree	33.9	23.5	57.4	98.7	-41.3	100	218.8	Pass
2	0.594	0 degree	37.3	17	54.3	72.1	-17.8	100	207.4	Pass
3	0.694	0 degree	32	15.8	47.8	70.8	-23	100	211.9	Pass
4	0.864	0 degree	30.2	14.1	44.3	68.9	-24.6	100	214.8	Pass
5	0.125	0 degree	39.4	29.4	68.8	105.7	-36.9	100	152.2	Pass
6	0.135	0 degree	39.3	28.8	68.1	105	-36.9	100	188.1	Pass
7	0.129	0 degree	36.7	29.2	65.9	105.4	-39.5	100	178.9	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.

<<Radiated Emission>> 18 May, 2020 19:47
JAD-001 TX MODE 125KHx 134_5KHz below 30MHz 0dgree.dat

Model : JAD-001 TX MODE 125KHx 134_5KHz below 30MHz :
Serial : NA Remark1 :
Operator : Remark2 :
AC Power : Remark3 :
Temp, Humid : 23deg, 60% Remark4 :



EUT Test Condition		Measurement Detail	
Frequency	125KHz / 134.23KHz	Frequency Range	9 kHz~30 MHz
Input Power	DC5V	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 70% RH	Tested By	Gary Chou

Antenna Polarity & Test Distance: Loop Antenna 90 degree At 3m										
No.	Frequency (MHz)	Polarization	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	0.124	90 degree	33.2	29.5	62.7	105.7	-43	100	267.2	Pass
2	0.135	90 degree	32.5	28.8	61.3	105	-43.7	100	306.2	Pass
3	0.289	90 degree	32.3	23.1	55.4	98.4	-43	100	247.3	Pass
4	0.554	90 degree	25.5	17.6	43.1	72.7	-29.6	100	253.8	Pass
5	0.879	90 degree	28.5	13.9	42.4	68.7	-26.3	100	254	Pass
6	1.179	90 degree	29.1	11.7	40.8	66.2	-25.4	100	253.9	Pass

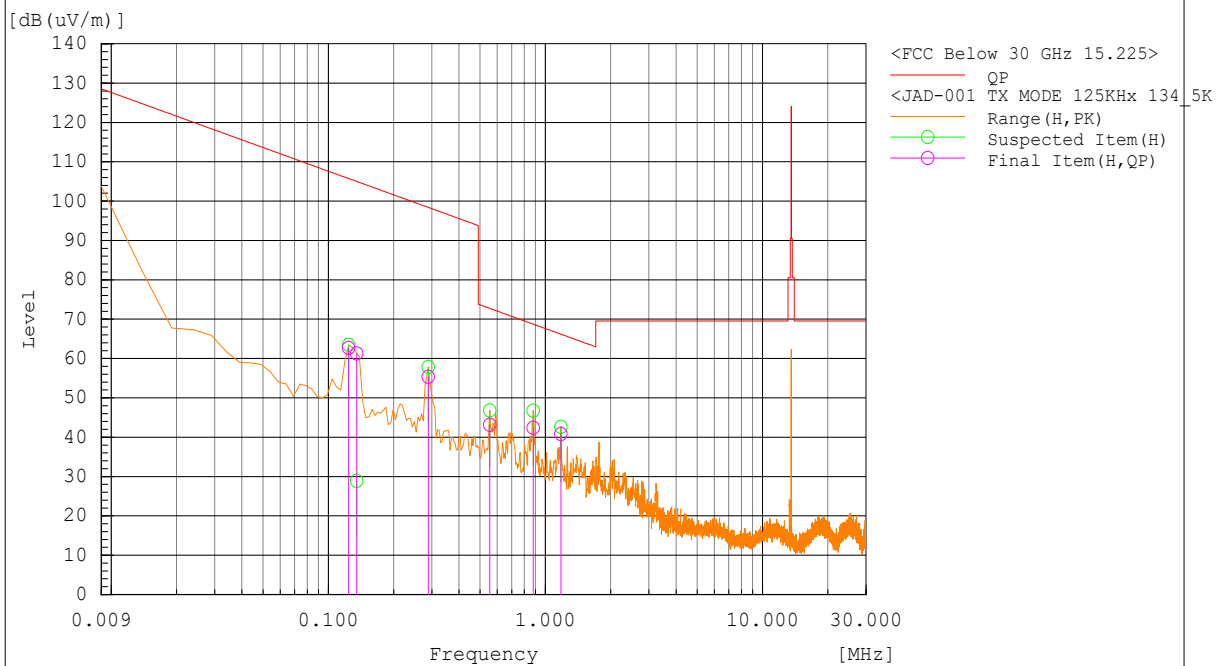
REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.

<<Radiated Emission>> 19 May, 2020 05:44
JAD-001 TX MODE 125KHz 134_5KHz below 30MHz 90degree.dat

Model : JAD-001 TX MODE 125KHz 134_5KHz below 30MHz 90degree
Serial : NA
Operator :
AC Power :
Temp, Humid : 23deg, 60%

Remark1 :
Remark2 :
Remark3 :
Remark4 :



Radiated Emissions (30 MHz~1000 MHz)

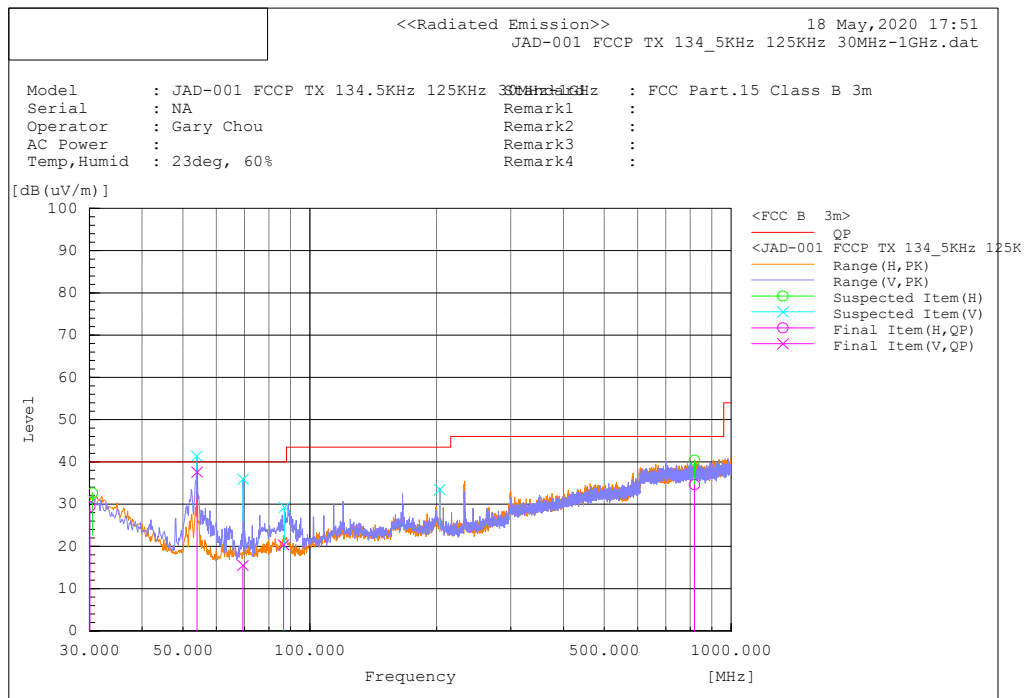
EUT Test Condition		Measurement Detail	
Frequency	125KHz / 134.23KHz	Frequency Range	30MHz ~ 1000 MHz
Input Power	DC5V	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 70% RH	Tested By	Gary Chou

Antenna Polarity & Test Distance: Horizontal & Vertical at 3 m

No.	Frequency (MHz)	Polarization	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	30.058	H	2.5	26.9	29.4	40	-10.6	201	359.9	Pass
2	53.987	V	24.7	12.9	37.6	40	-2.4	104	239	Pass
3	69.336	V	2.5	13	15.5	40	-24.5	297	351.2	Pass
4	86.637	V	6.8	13.6	20.4	40	-19.6	137	256.5	Pass
5	818.345	H	4	30.6	34.6	46	-11.4	337	295	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin value = Emission level – Limit value.
4. The emission levels of other frequencies were less than 20dB margin against the limit.



4.2 Occupied Bandwidth

4.2.1 Test Instruments

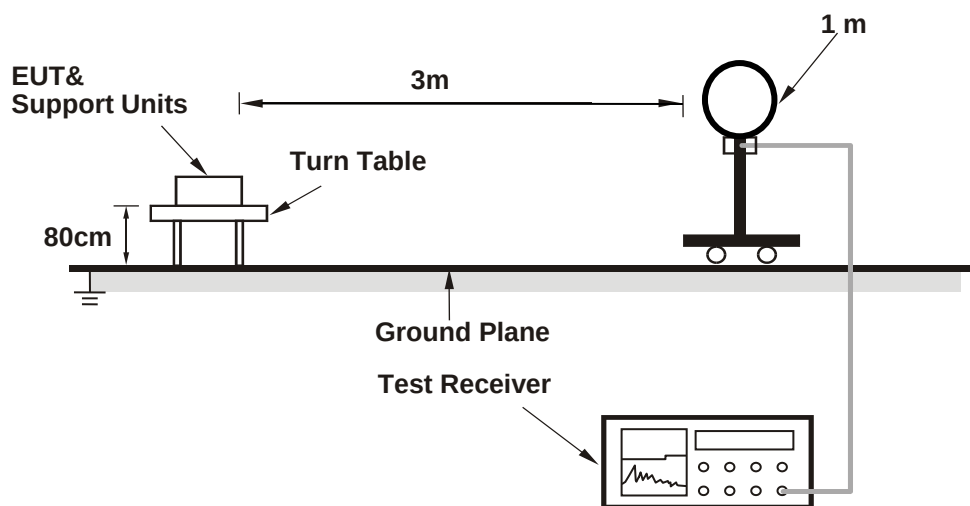
DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Test Receiver ROHDE & SCHWARZ	ESW 44	100179	08/30/2019	08/30/2020
Passive Loop Antenna (9k-30MHz)	6512	49120	07/14/2019	07/14/2020

4.2.2 Test Procedures

- Set resolution bandwidth (RBW) = 100Hz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the 99% emission bandwidth

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100Hz RBW and 300Hz VBW.

4.2.3 Test Setup



4.2.4 EUT Operating Conditions

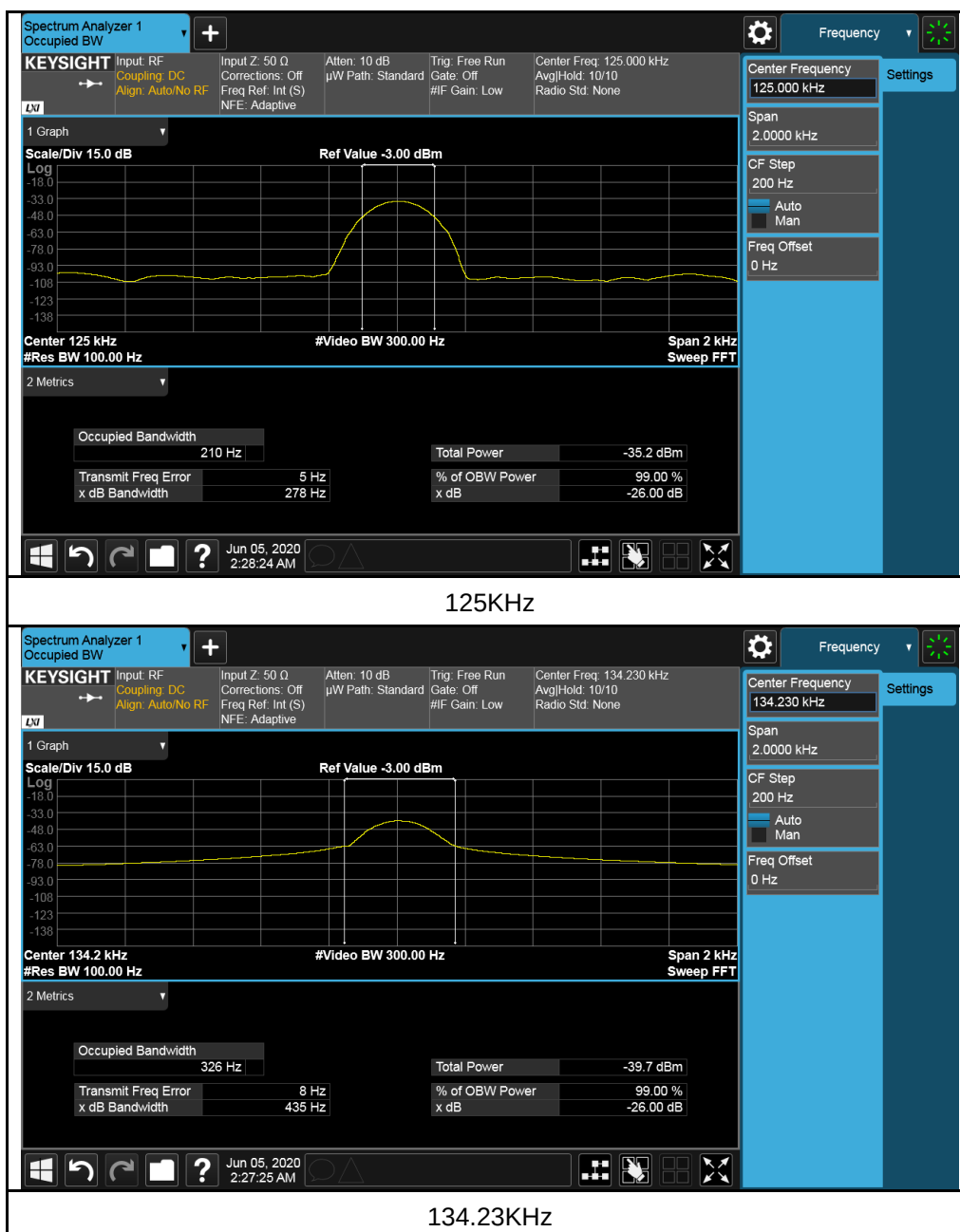
- Connected the EUT with the Notebook Computer which is placed on remote site.

4.2.5

Test Results

Frequency (KHz)	99% Bandwidth (KHz)	Limit (KHz)	Pass / Fail
125	0.210	/	PASS
134.23	0.326	/	PASS

Test Plots:



4.3 Conducted Emission Measurement

4.3.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	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.

4.3.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
EMI Test Receiver ROHDE & SCHWARZ	ESIB 40	100179	08/28/2019	08/28/2020
Transient Limiter ELECTRO-METRICS	EM-7600-5	106	12/31/2019	12/31/2020
LISN EMCO	3816/2NM	214372	01/14/2020	01/14/2021

4.3.3 Test Procedures

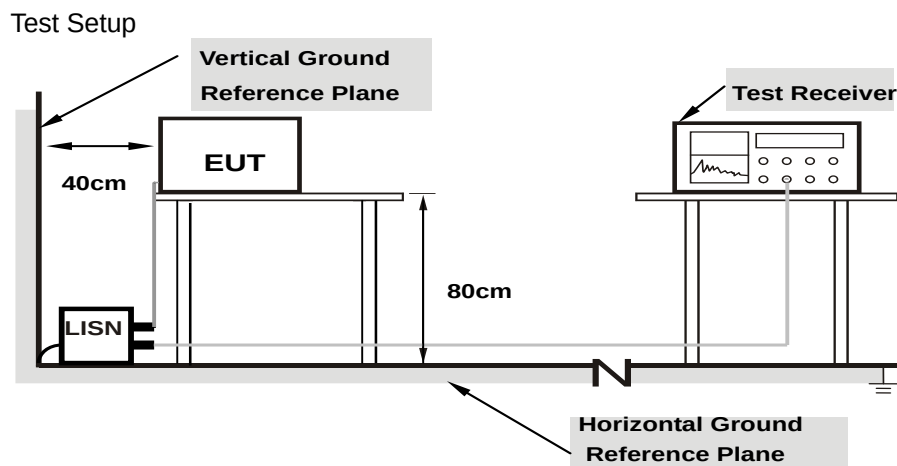
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.3.4 Deviation from Test Standard

No deviation.

4.3.5



Note: 1.Support units were connected to second LISN.

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

4.3.6 EUT Operating Conditions

Same as 4.1.6.

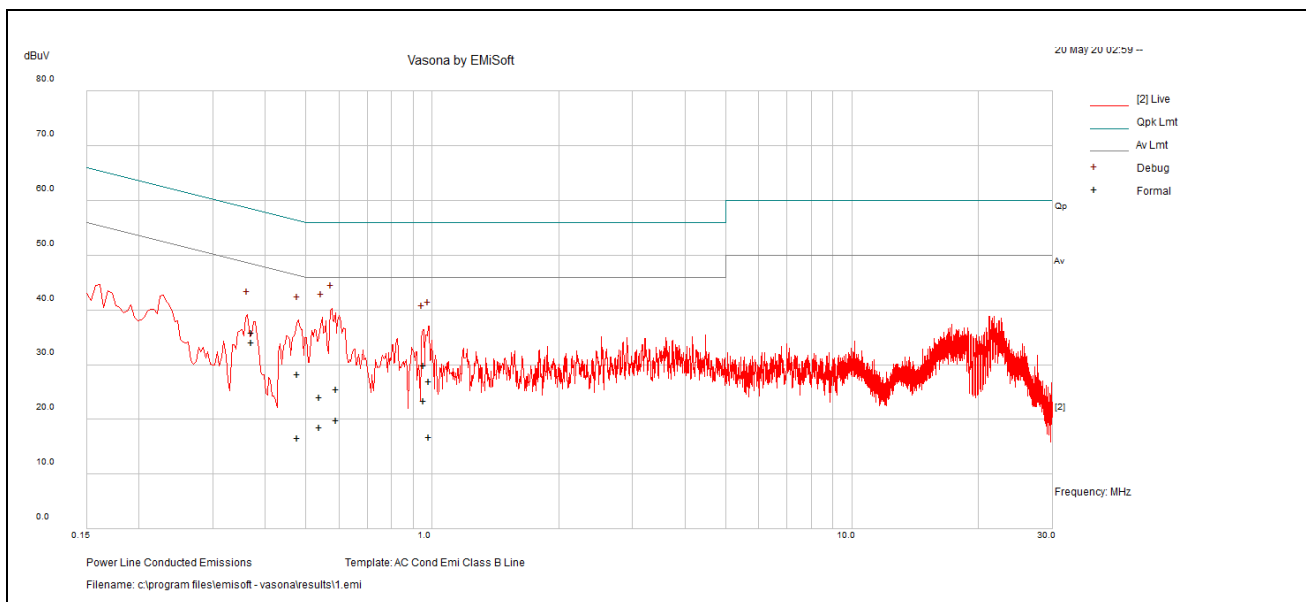
4.3.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak / Average
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No	Freq. [MHz]	Raw (dBuV)	Cale Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
1	0.591992	16.02	9.46	0.04	25.52	Quasi Peak	Live	56	-30.48	Pass
2	0.54101	14.61	9.45	0.04	24.11	Quasi Peak	Live	56	-31.89	Pass
3	0.478172	18.8	9.45	0.04	28.28	Quasi Peak	Live	56.37	-28.09	Pass
4	0.985828	17.45	9.48	0.05	26.98	Quasi Peak	Live	56	-29.02	Pass
5	0.957066	20.43	9.48	0.05	29.96	Quasi Peak	Live	56	-26.04	Pass
6	0.372782	26.47	9.44	0.04	35.95	Quasi Peak	Live	58.44	-22.48	Pass
7	0.591992	10.42	9.46	0.04	19.92	Average	Live	46	-26.08	Pass
8	0.54101	9.09	9.45	0.04	18.58	Average	Live	46	-27.42	Pass
9	0.478172	7.12	9.45	0.04	16.6	Average	Live	46.37	-29.77	Pass
10	0.985828	7.28	9.48	0.05	16.8	Average	Live	46	-29.2	Pass
11	0.957066	13.87	9.48	0.05	23.4	Average	Live	46	-22.6	Pass
12	0.372782	24.72	9.44	0.04	34.2	Average	Live	48.44	-14.24	Pass

REMARKS:

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

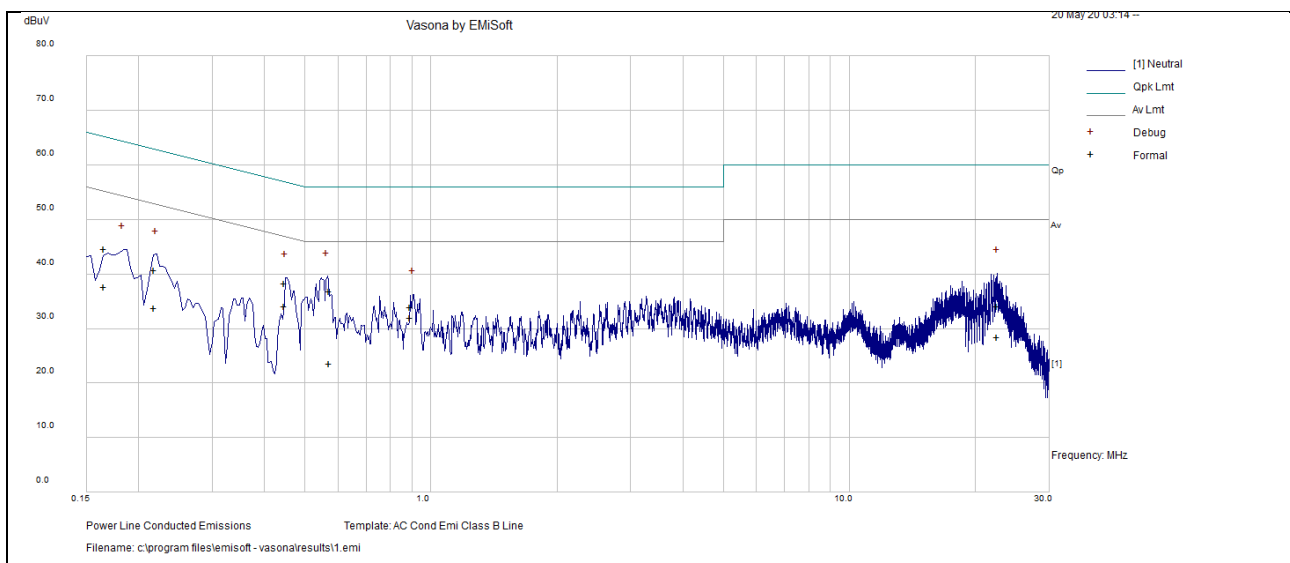


Phase	Neutral (N)	Detector Function	Quasi-Peak / Average
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No	Freq.	Raw	Cale Loss	Factors	Level	Measurement Type	Line	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB)	(dB)	(dBuV)			(dBuV)	(dB)	
1	0.572333	27.33	9.46	0.04	36.82	Quasi Peak	Neutral	56	-19.18	Pass
2	0.447535	28.85	9.45	0.04	38.34	Quasi Peak	Neutral	56.92	-18.58	Pass
3	0.218417	31.31	9.4	0.04	40.75	Quasi Peak	Neutral	62.88	-22.13	Pass
4	0.894	24.47	9.48	0.04	33.98	Quasi Peak	Neutral	56	-22.02	Pass
5	0.166088	35.26	9.32	0.04	44.62	Quasi Peak	Neutral	65.15	-20.53	Pass
6	22.592192	23.72	9.82	0.55	34.09	Quasi Peak	Neutral	60	-25.91	Pass
7	0.572333	14.08	9.46	0.04	23.58	Average	Neutral	46	-22.42	Pass
8	0.447535	24.71	9.45	0.04	34.2	Average	Neutral	46.92	-12.72	Pass
9	0.218417	24.43	9.4	0.04	33.87	Average	Neutral	52.88	-19.01	Pass
10	0.894	22.52	9.48	0.04	32.03	Average	Neutral	46	-13.97	Pass
11	0.166088	28.26	9.32	0.04	37.62	Average	Neutral	55.15	-17.53	Pass
12	22.592192	18.16	9.82	0.55	28.53	Average	Neutral	50	-21.47	Pass

REMARKS:

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



5 Pictures of Test Arrangements

Please see setup photo file.

Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

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The address and road map of all our labs can be found in our web site also.

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