FCC IC RF Test Report

Report No.:	FCC_IC_RF_SL21020501-JAD-001R1 Rev_1.4
Models:	SUB-10038, SUB-10039
FCC ID:	QV5MERCURY3ET
IC:	5407A-MERCURY3ET
Received Date:	04/19/2021
Test Date:	04/19/2021/-04/30/2021
Issued Date:	12/9/2021
Applicant name:	JADAK, a business unit of Novanta Corporation
IC Applicant name:	Novanta Corporation
Address:	125 Middlesex Turnpike, Bedford, MA 01730
Manufacturer:	JADAK, a business unit of Novanta Corporation
Address:	7279 William Barry Blvd. North Syracuse, NY 13212
Issued By:	Bureau Veritas Consumer Products Services, Inc.
Lab Address:	775 Montague Expressway, Milpitas, CA 95035
FCC Registration / Designation Number:	540430
ISED# / CAB identifier:	4842D

ACCREDITED
TESTING CERT # 2742-01

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Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL21020501-JAD-001R1	Initial Release	05/15/2021
FCC_IC_RF_SL21020501-JAD-001R1 Rev_1.0	Update per client review	6/30/2021
FCC_IC_RF_SL21020501-JAD-001R1 Rev_1.1	Update Section 4.1.7, 4.2	10/14/2021
FCC_IC_RF_SL21020501-JAD-001R1 Rev_1.2	Update Section 4.1.7	11/17/2021
FCC_IC_RF_SL21020501-JAD-001R1 Rev_1.3	Added RF Exposure Section	12/12/2021
FCC_IC_RF_SL21020501-JAD-001R1 Rev_1.4	Updated 4.1.7	12/13/2021

1 Certificate of Conformity

Product:	M3E LF/HF Embedded RFID Module
Brand:	JADAK, a business unit of Novanta Corporation
Test Model:	SUB-10038, SUB-10039
Sample Status:	Engineering sample
Applicant:	JADAK, a business unit of Novanta Corporation
Test Date:	04/19/2021-05/01/2021
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.207/15.209) ANSI C63.10:2013 RSS Gen Issue 5, February 2021

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 : _____ **Date:** 05/15/2021

Said Abdelwafi / Compliance Engineer

Approved by : _____ **Date:** 12/9/2021

Deon Dai / 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	Embedded RFID Module
Brand	JADAK, a business unit of Novanta Corporation
Test Model	SUB-10038, SUB-10039
Status of EUT	Engineering sample
Power Supply Rating	5Vdc
Modulation Type	ASK
Operating Frequency	125KHz /134.62 KHz
Antenna Type	Coil Antenna
Antenna inductance	The nominal inductance for an external, 125kHz/134.62kHz differentially driven coil antenna is 505 uH. The series resistance of the antenna should be lower than 6.5 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	0.1346

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 **PLC:** Power Line Conducted Emission
FS: Frequency Stability **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	1	1	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	1	1	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	1	1	ASK

Test Condition:

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

3.3 Description of Support Units

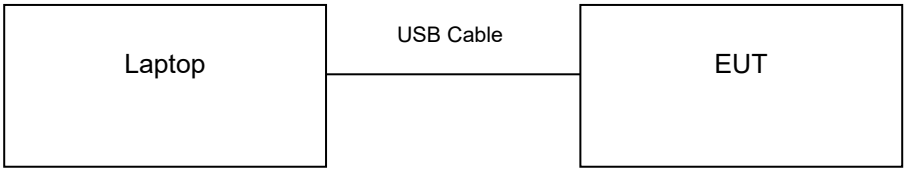
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

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, February 2021

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 (<30MHz) = 40 log (specific distance / test distance)
   Limit Line (dBuV/m) = 20 log Emission level (uV/m) + 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 Keysight	ESW 44	1328.4100K-101662-MH	08/30/2020	08/30/2021
Spectrum Analyzer Keysight	N9030B	0240376	06/15/2020	06/15/2021
Passive Loop Antenna (9k-30MHz)	6512	49120	11/25/2019	11/25/2021
Hybrid Antenna Sunol	JB1	A030702	09/04/2020	09/03/2021
Horn Antenna ETS-Lindgren	3117	218554	11/22/2020	11/22/2021
Preamplifier RF-Lambda	RAMP00M50GA	17032300048	06/18/2020	06/18/2021

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:

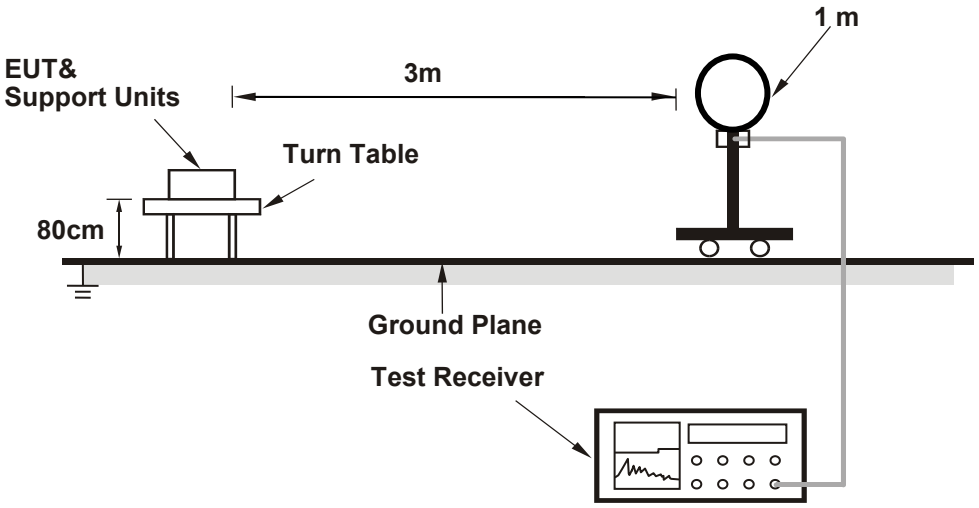
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 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

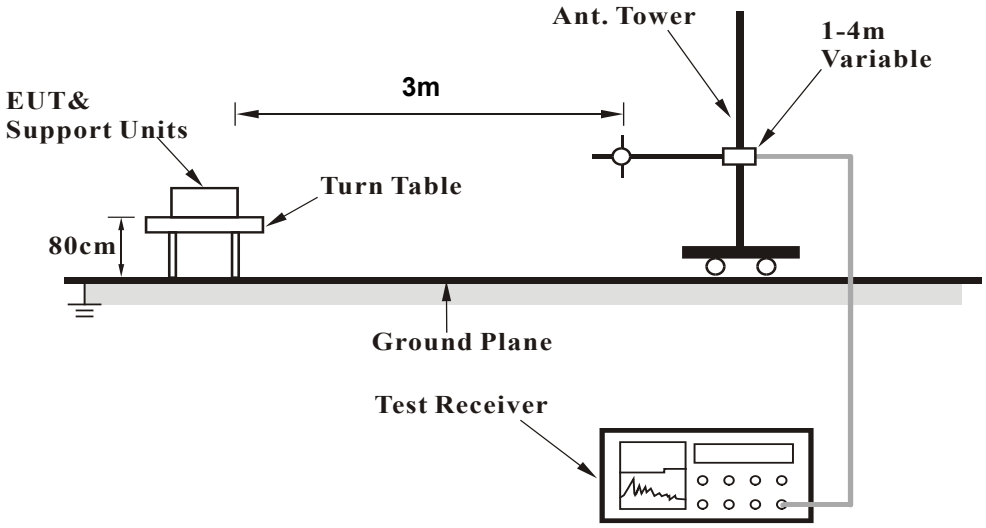
No deviation.

4.1.5 Test Setup

For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



4.1.6 EUT Operating Conditions

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

b. Controlling software has been activated to set the EUT on specific status.

4.1.7 Test Results

Radiated Emissions (9 kHz~30 MHz)

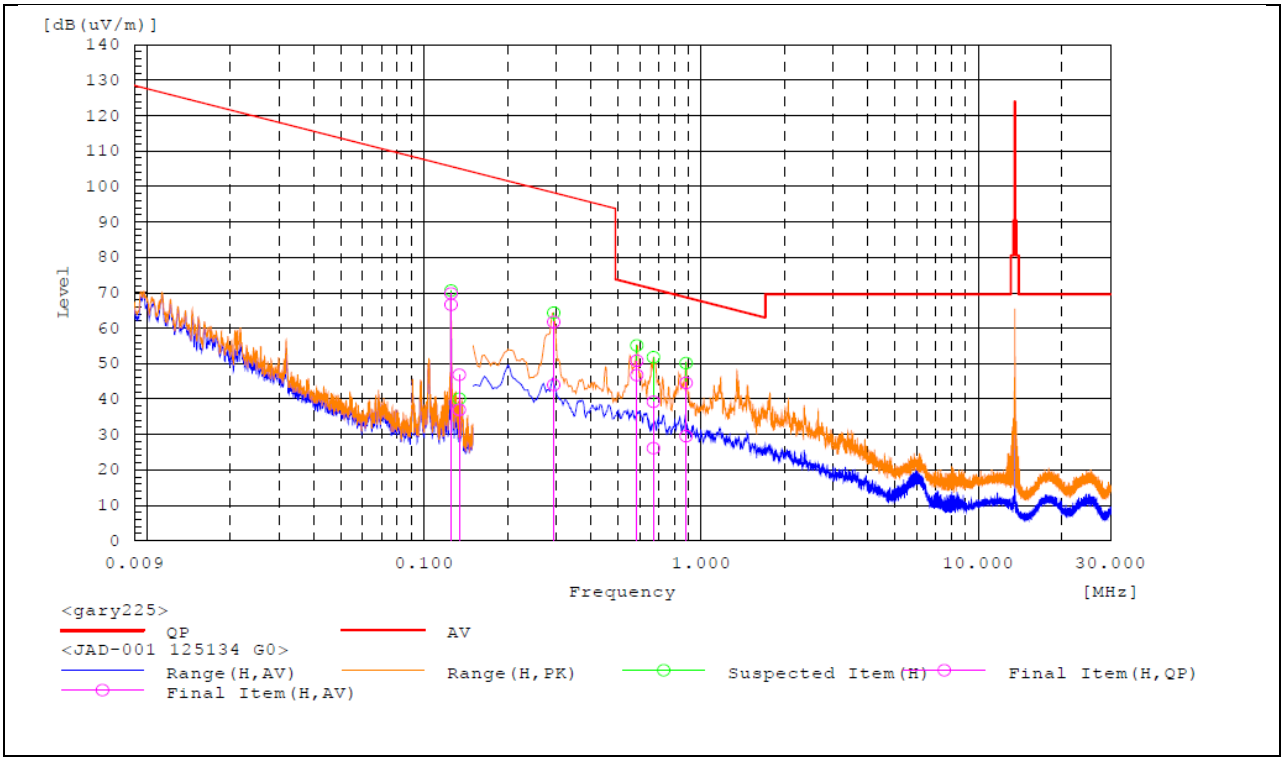
EUT Test Condition		Measurement Detail	
Frequency	125 kHz / 134.62 kHz	Frequency Range	9 kHz~30 MHz
Input Power	DC5V	Detector Function	See Remarks
Environmental Conditions	25 deg. C, 70% RH	Tested By	Said Abdelwafi

Antenna Polarity & Test Distance: Loop Antenna 0 degree At 3m												
Frequency (MHz)	Reading PK [dB(uV)]	Reading AV [dB(uV)]	Factor [dB(1/m)]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK dB(uV/m)	Limit AV dB(uV/m)	Margin PK [dB]	Margin AV [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
0.125	41.2	37.2	29.4	70.6	66.6	125.7	105.7	55.1	39.1	100.0	166.4	Pass
0.134	35.4	32.2	28.9	64.3	61.1	125.1	105.1	60.8	44	100.0	197.9	Pass
0.293	31.3	21.0	23.0	54.3	44	118.3	98.3	64	54.3	100.0	284.2	Pass

Antenna Polarity & Test Distance: Loop Antenna 0 degree At 3m								
Frequency (MHz)	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
0.586	33.7	17.1	50.8	72.2	21.4	100.0	287.6	Pass
0.672	23.1	16.1	39.2	71.1	31.9	100.0	139.6	Pass
0.881	30.6	13.9	44.5	68.7	24.2	100.0	303	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 = Limit - Level (dBuV)
4. Distance correction factor of 80dB was applied to the limits using Equation 4 in ANSI C63.10-2013.
5. Peak and average measurements were made between 9kHz – 90kHz and 110kHz – 490kHz. Q-Peak was used for the remaining measurements in the frequency range.
6. For FCC measurements, the limit was converted to logarithmic voltage terms using the following equation: dBuV/m = 20 * log(uV/m).
7. For ISED Canada measurements, the limit was converted to logarithmic voltage terms with the free-space impedance of 377 ohms using the following equation: dBuV/m = 20 * log(uA/m * 377ohms)


[dB(uV/m)]
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Level
0.009
0.100
1.000
10.000
30.000
Frequency
[MHz]
<gary225>
QP
AV
<JAD-001 125134 G0>
Range(H,AV)
Range(H,PK)
Suspected Item(H)
Final Item(H,QP)
Final Item(H,AV)

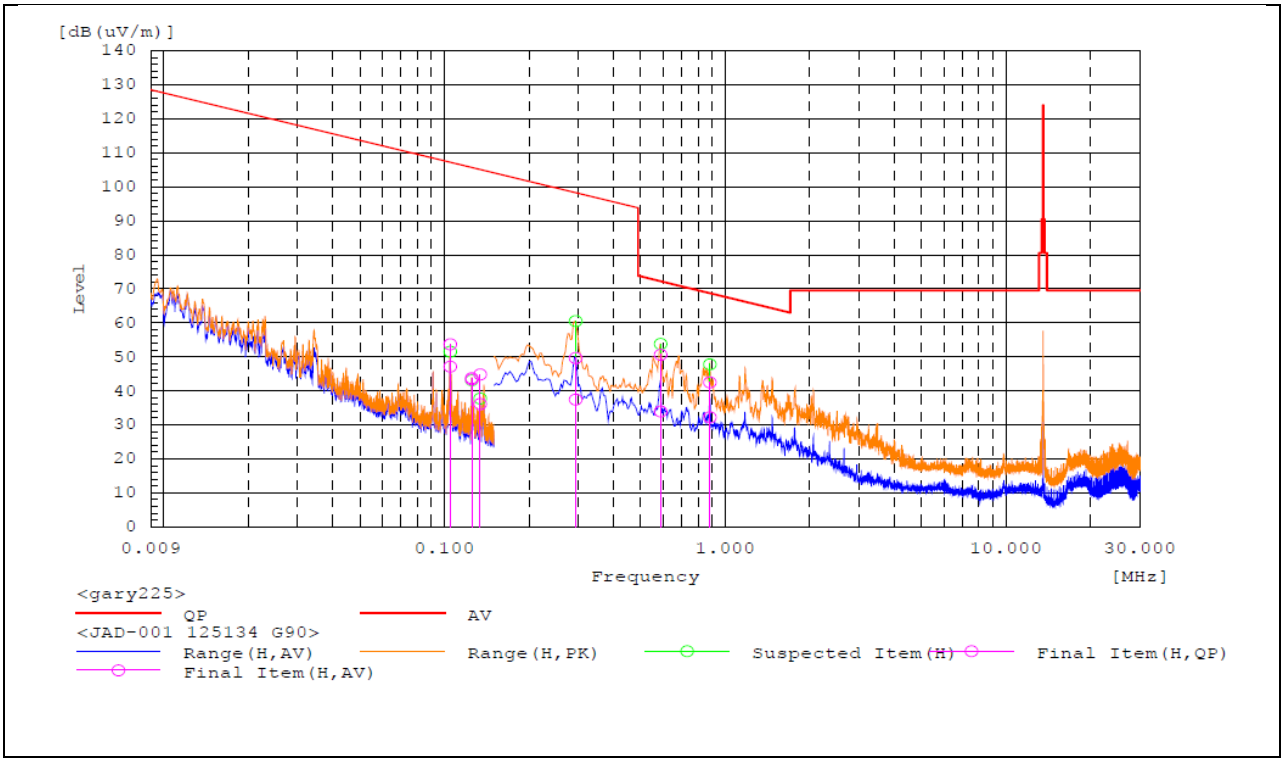
EUT Test Condition		Measurement Detail	
Frequency	125 kHz / 134.62 kHz	Frequency Range	9 kHz~30 MHz
Input Power	DC5V	Detector Function	See Remarks
Environmental Conditions	25 deg. C, 70% RH	Tested By	Said Abdelwafi

Antenna Polarity & Test Distance: Loop Antenna 90 degree At 3m												
Frequency (MHz)	Reading PK [dB(uV)]	Reading AV [dB(uV)]	Factor [dB(1/m)]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK dB(uV/m)	Limit AV dB(uV/m)	Margin PK [dB]	Margin AV [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
0.105	20.6	16.2	30.9	51.5	47.1	127.2	107.2	75.7	60.1	100.0	232.6	Pass
0.125	16.3	14.0	29.4	45.7	43.4	125.7	105.7	80	62.3	100.0	141.6	Pass
0.134	9.8	7.2	28.9	38.7	36.1	125.1	105.1	86.4	69	100.0	223.8	Pass
0.293	32.5	14.4	23	55.5	37.4	118.3	98.3	62.8	60.9	100.0	0	Pass

Antenna Polarity & Test Distance: Loop Antenna 90 degree At 3m								
Frequency (MHz)	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
0.589	33.5	17.1	50.6	72.2	21.6	100.0	214.6	Pass
0.881	28.6	13.9	42.5	68.7	26.2	100.0	244.7	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 = Limit - Level (dBuV)
4. Distance correction factor of 80dB was applied to the limits using Equation 4 in ANSI C63.10-2013.
5. Peak and average measurements were made between 9kHz – 90kHz and 110kHz – 490kHz. Q-Peak was used for the remaining measurements in the frequency range.
6. For FCC measurements, the limit was converted to logarithmic voltage terms using the following equation: dBuV/m = 20 * log(uV/m).
7. For ISED Canada measurements, the limit was converted to logarithmic voltage terms with the free-space impedance of 377 ohms using the following equation: dBuV/m = 20 * log(uA/m * 377ohms)


[dB(uV/m)]
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Level
0.009
0.100
1.000
10.000
30.000
Frequency
[MHz]
<gary225>
QP
AV
<JAD-001 125134 G90>
Range(H,AV)
Range(H,PK)
Suspected Item(H)
Final Item(H,QP)
Final Item(H,AV)

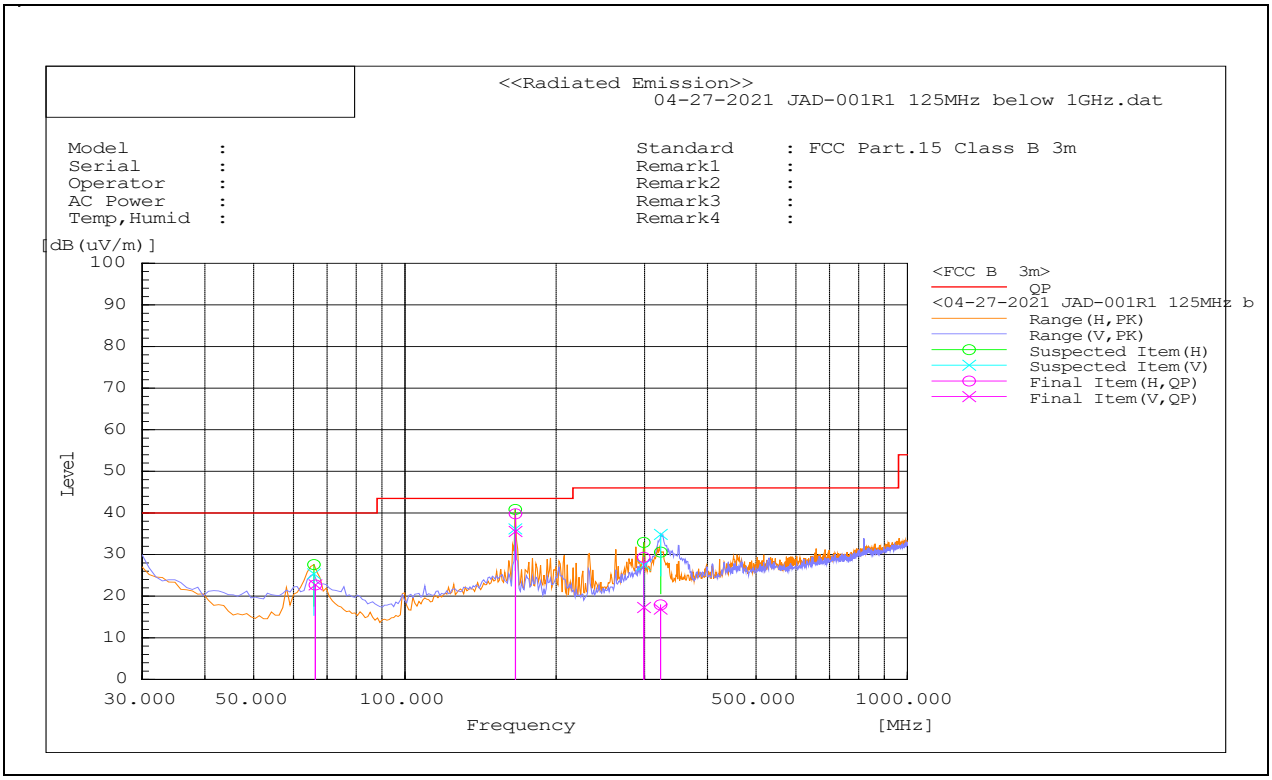
Radiated Emissions (30 MHz~1000 MHz)

EUT Test Condition		Measurement Detail	
Frequency	125KHz	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	66.365	H	9.4	13.3	22.7	40	17.3	161.9	98	Pass
2	66.375	V	9.6	13.1	22.7	40	17.3	100	274	Pass
3	165.987	H	21.2	18.6	39.8	43.5	3.7	137.6	34	Pass
4	165.96	V	16.8	18.8	35.6	43.5	7.9	205	0	Pass
5	298.745	V	8.8	20.5	29.3	46	16.7	100	199	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 = Limit – Level (dBuV).
4. The emission levels of other frequencies were less than 20dB margin against the limit.

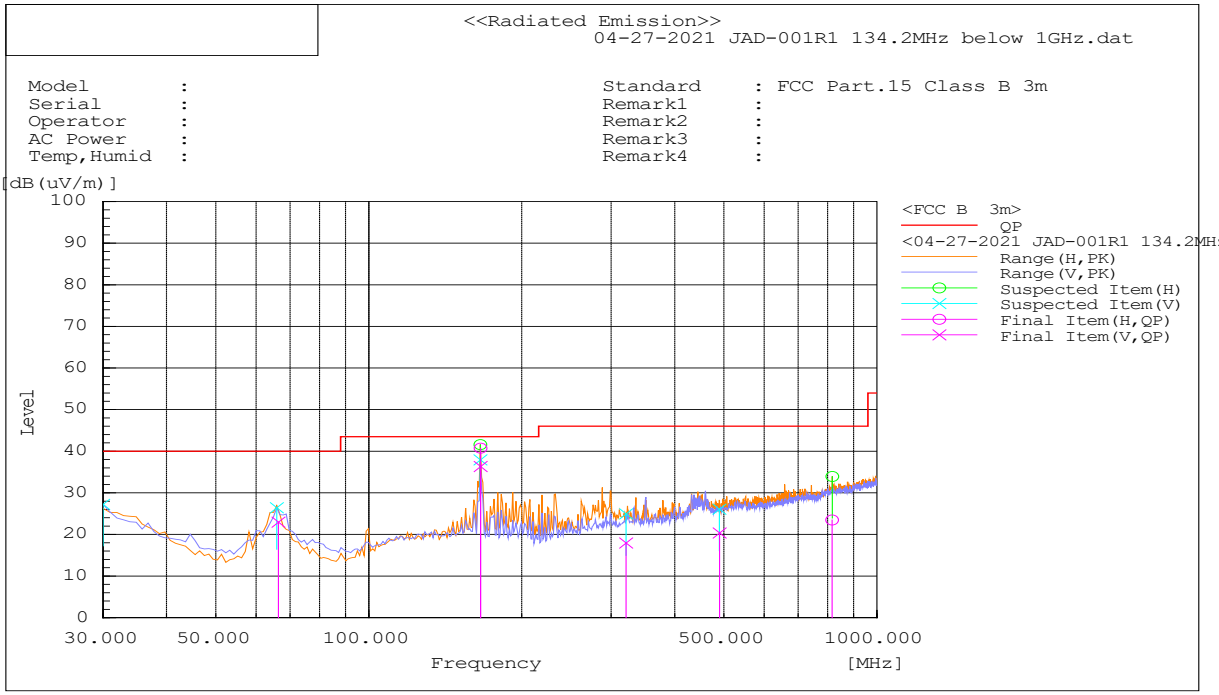


EUT Test Condition		Measurement Detail	
Frequency	134.62KHz	Frequency Range	30MHz ~ 1000 MHz
Input Power	DC5V	Detector Function	Quasi-Peak
Environmental Conditions	25 deg. C, 70% RH	Tested By	Said Abdelwafi

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	165.982	H	22.1	18.6	40.7	43.5	2.8	158.1	144	Pass
2	165.98	V	17.5	18.8	36.3	43.5	7.2	238.5	205	Pass
3	320.784	H	-2.7	20.7	18	46	28	153.7	48	Pass
4	489.976	V	-4.3	24.6	20.3	46	25.7	207.6	124	Pass
5	816.494	H	-6.5	30	23.5	46	22.5	299.5	0	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 = Limit – Level (dBuv)
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
Spectrum Analyzer Keysight	N9030B	0240376	07/22/2020	07/22/2022
Passive Loop Antenna (9k-30MHz)	6512	49120	11/25/2019	11/25/2021

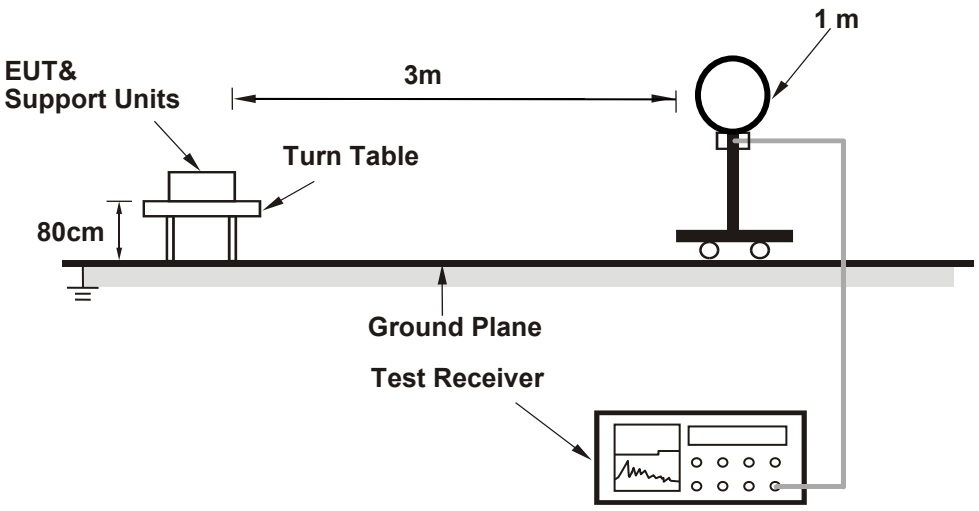
4.2.2 Test Procedures

Reference to ANSI C63.10 Sectio 6.9.3

a. Set resolution bandwidth (RBW) = 100Hz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the 99% emission bandwidth

The bandwidth of the fundamental frequency was measured by spectrum analyzer.

4.2.3 Test Setup



4.2.4 EUT Operating Conditions

a.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	2.199	N/a	PASS
134.62	2.151	N/a	PASS

Test Plots:

125KHz

134.23KHz

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	01/29/2021	01/29/2022
Transient Limiter ELECTRO-METRICS	EM-7600-5	106	01/29/2021	01/29/2022
LISN EMCO	3816/2NM	214372	01/29/2021	01/29/2022

4.3.3 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.

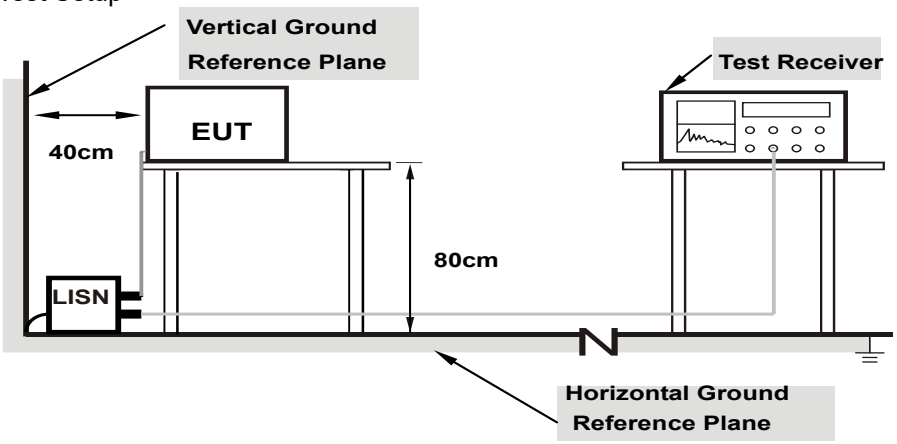
c. The frequency range from 150 kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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 Test Setup



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

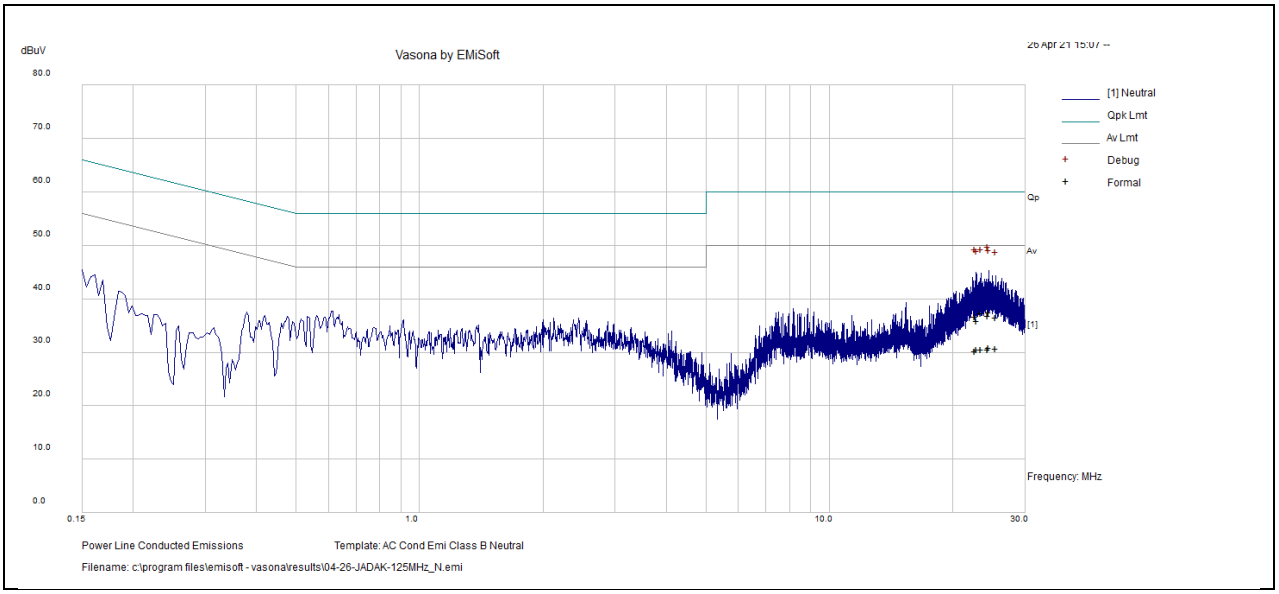
125kHz Transmite

Phase	Line (L)	Detector Function	Quasi-Peak / Average

No	Freq.	Raw	Cale Loss	Factors	Level	Measurement Type	Line	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB)	(dB)	(dBuV)			(dBuV)	(dB)	
1	0.15	32.54	9.29	0.04	41.87	Quasi Peak	Live	66	-24.13	Pass
2	2.622778	21.05	9.5	0.05	30.61	Quasi Peak	Live	56	-25.39	Pass
3	3.555906	17.72	9.54	0.07	27.32	Quasi Peak	Live	56	-28.68	Pass
4	0.623195	24.18	9.46	0.04	33.68	Quasi Peak	Live	56	-22.32	Pass
5	0.165668	29.9	9.32	0.04	39.26	Quasi Peak	Live	65.17	-25.91	Pass
6	2.233575	20.88	9.48	0.06	30.42	Quasi Peak	Live	56	-25.58	Pass
7	0.15	7.84	9.29	0.04	17.18	Average	Live	56	-38.82	Pass
8	2.622778	14.4	9.5	0.05	23.96	Average	Live	46	-22.04	Pass
9	3.555906	13.42	9.54	0.07	23.02	Average	Live	46	-22.98	Pass
10	0.623195	20.37	9.46	0.04	29.87	Average	Live	46	-16.13	Pass
11	0.165668	3.4	9.32	0.04	12.76	Average	Live	55.17	-42.41	Pass
12	2.233575	9.04	9.48	0.06	18.58	Average	Live	46	-27.42	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.

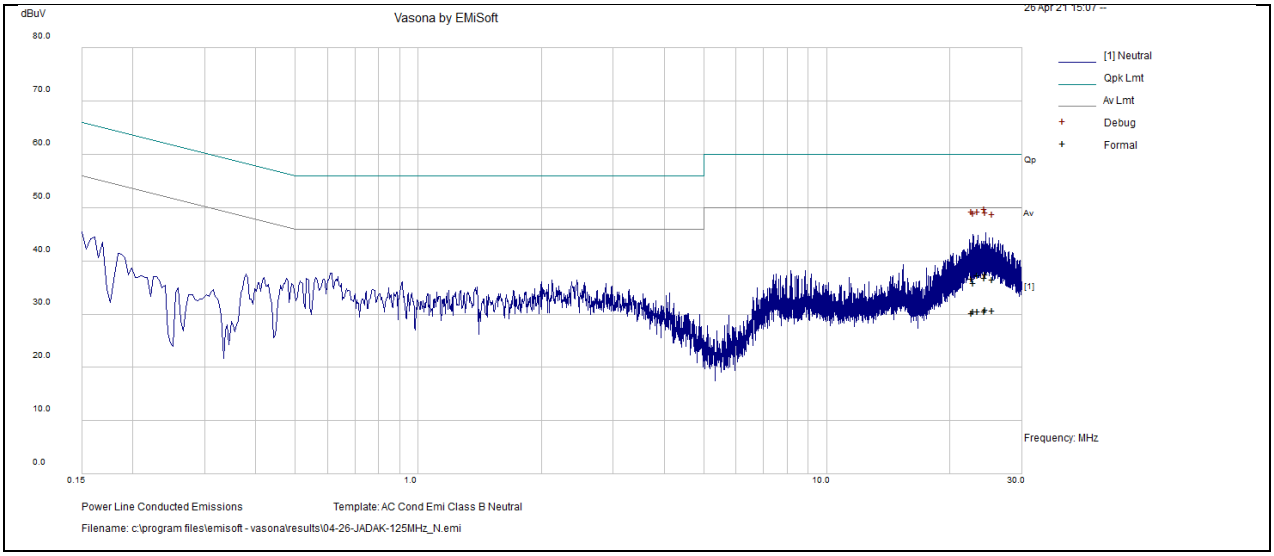


Phase	Neutral (N)	Detector Function	Quasi-Peak / Average

No	Freq.	Raw	Cale Loss	Factors	Level	Measurement Type	Line	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB)	(dB)	(dBuV)			(dBuV)	(dB)	
1	22.78015	26.3	9.83	0.62	36.75	Quasi Peak	Neutral	60	-23.25	Pass
2	22.78015	19.75	9.83	0.62	30.2	Average	Neutral	50	-19.8	Pass
3	22.91798	20.12	9.84	0.62	30.59	Average	Neutral	50	-19.41	Pass
4	22.91798	25.39	9.84	0.62	35.85	Quasi Peak	Neutral	60	-24.15	Pass
5	23.52282	20.08	9.84	0.64	30.56	Average	Neutral	50	-19.44	Pass
6	23.52282	26.88	9.84	0.64	37.36	Quasi Peak	Neutral	60	-22.64	Pass
7	24.46663	26.4	9.83	0.66	36.89	Quasi Peak	Neutral	60	-23.11	Pass
8	24.46663	20.02	9.83	0.66	30.51	Average	Neutral	50	-19.49	Pass
9	24.59495	20.33	9.82	0.67	30.82	Average	Neutral	50	-19.18	Pass
10	24.59495	26.97	9.82	0.67	37.46	Quasi Peak	Neutral	60	-22.54	Pass
11	25.52911	20.16	9.85	0.69	30.7	Average	Neutral	50	-19.3	Pass
12	25.52911	25.95	9.85	0.69	36.49	Quasi Peak	Neutral	60	-23.51	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.



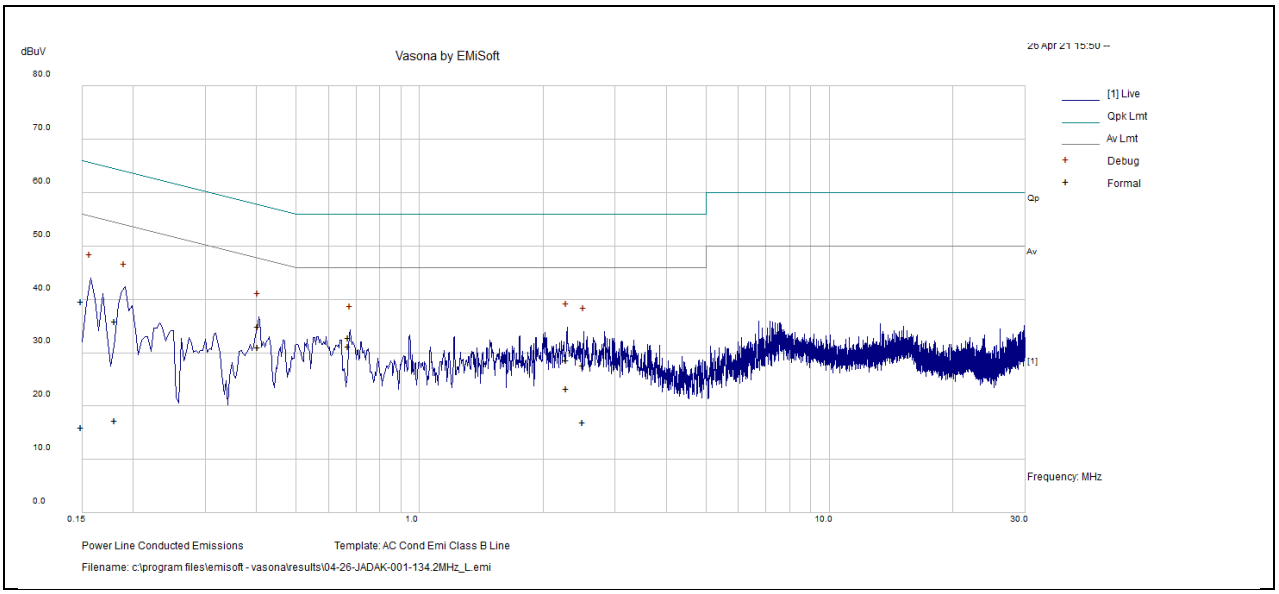
134.2kHz Transmite

Phase	Line (L)	Detector Function	Quasi-Peak / Average

No	Freq.	Raw	Cale Loss	Factors	Level	Measurement Type	Line	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB)	(dB)	(dBuV)			(dBuV)	(dB)	
1	0.404177	25.43	9.44	0.04	34.91	Quasi Peak	Live	57.77	-22.85	Pass
2	2.284817	19.1	9.49	0.05	28.65	Quasi Peak	Live	56	-27.35	Pass
3	0.15	30.35	9.29	0.04	39.68	Quasi Peak	Live	66	-26.32	Pass
4	0.180421	26.54	9.34	0.04	35.92	Quasi Peak	Live	64.47	-28.54	Pass
5	0.673263	23.28	9.46	0.04	32.78	Quasi Peak	Live	56	-23.22	Pass
6	2.513539	18.02	9.5	0.05	27.57	Quasi Peak	Live	56	-28.43	Pass
7	0.404177	21.57	9.44	0.04	31.06	Average	Live	47.77	-16.71	Pass
8	2.284817	13.76	9.49	0.05	23.3	Average	Live	46	-22.7	Pass
9	0.15	6.66	9.29	0.04	15.99	Average	Live	56	-40.01	Pass
10	0.180421	7.9	9.34	0.04	17.28	Average	Live	54.47	-37.19	Pass
11	0.673263	21.7	9.46	0.04	31.21	Average	Live	46	-14.79	Pass
12	2.513539	7.45	9.5	0.05	17	Average	Live	46	-29	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.

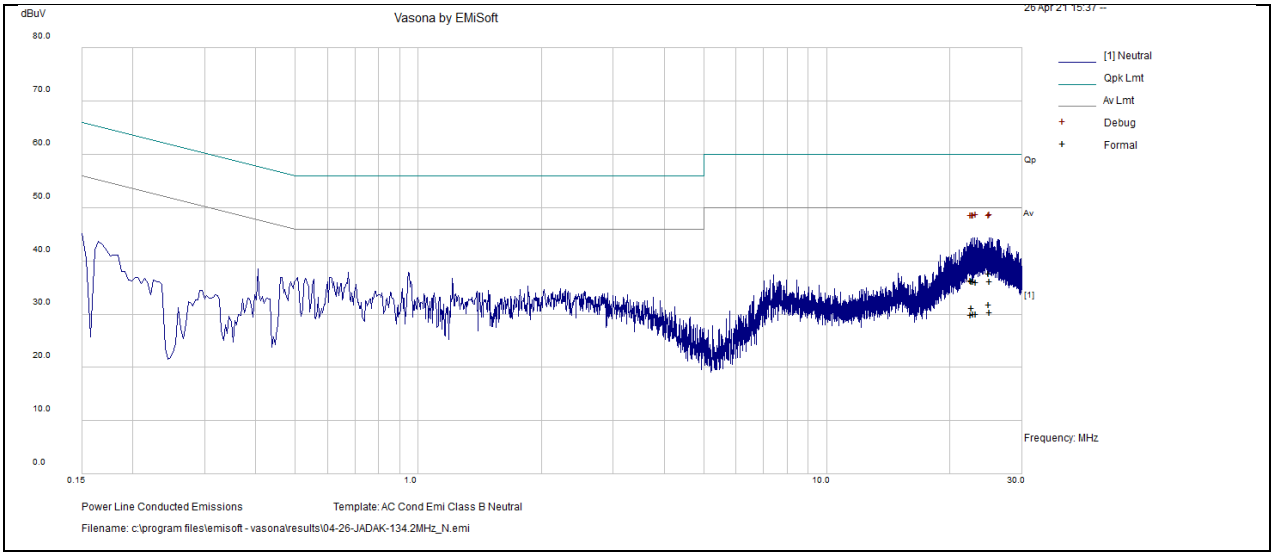


Phase	Neutral (N)	Detector Function	Quasi-Peak / Average

No	Freq.	Raw	Cale Loss	Factors	Level	Measurement Type	Line	Limit	Margin	Pass /Fail
	[MHz]	(dBuV)	(dB)	(dB)	(dBuV)			(dBuV)	(dB)	
1	25.22309	25.71	9.83	0.68	36.22	Quasi Peak	Neutral	60	-23.78	Pass
2	23.33283	25.63	9.84	0.63	36.11	Quasi Peak	Neutral	60	-23.89	Pass
3	25.0393	27.23	9.82	0.68	37.73	Quasi Peak	Neutral	60	-22.27	Pass
4	22.79877	25.79	9.84	0.62	36.25	Quasi Peak	Neutral	60	-23.75	Pass
5	23.00532	25.8	9.85	0.62	36.28	Quasi Peak	Neutral	60	-23.72	Pass
6	22.58616	25.95	9.82	0.61	36.39	Quasi Peak	Neutral	60	-23.61	Pass
7	25.22309	19.92	9.83	0.68	30.44	Average	Neutral	50	-19.56	Pass
8	23.33283	19.56	9.84	0.63	30.04	Average	Neutral	50	-19.96	Pass
9	25.0393	21.32	9.82	0.68	31.82	Average	Neutral	50	-18.18	Pass
10	22.79877	20.73	9.84	0.62	31.18	Average	Neutral	50	-18.82	Pass
11	23.00532	19.62	9.85	0.62	30.09	Average	Neutral	50	-19.91	Pass
12	22.58616	19.56	9.82	0.61	29.99	Average	Neutral	50	-20.01	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 RF Exposure

The transmitter output is less than 1mW. Therefore the transmitter is exempt for routine SAR evaluation based on FCC 1.1307(b)(3)(i)(A).

Measured Field Strength @ 125kHz = 66.6 dBuV/m@3m
Measured Field Strength @ 134kHz = 61.1 dBuV/m@3m

$$\mathrm{EIRP} = E_{\mathrm{Meas}} + 20\log\left(d_{\mathrm{Meas}}\right) - 104.7$$

Output power @ 125kHz = 0.0014 mW EIRP
Output Power @ 134kHz = 0.0004 mW EIRP

6 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.

If you have any comments, please feel free to contact us at the following:

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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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