

NCC RADIO TEST REPORT

Product name	M1 Control module
Applicant	Asia Institute Technology Limited
Manufacture	Panasonic Industrial Devices Europe GmbH
Rating(s)	DC12V from adapter
Trademark	MSA
Model and/or type reference	10198774
Standard	LP0002:2020
Test Result	PASS

Date of receipt : 02-24-2021

Date of Issue : 03-09-2021

signature :



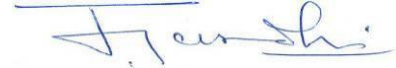
NCC RADIO TEST REPORT

Report Reference No...... M210224N2-3

Compiled by (+ signature)..... Kevin Bothmann



Approved by (+ signature)..... Jay Gandhi



Date of issue..... 2021-03-09

Applicant's name Asia Institute Technology Limited

Address 3F., No.446, Sec. 2, Zhongshan Rd., Zhonghe Dist., New Taipei City, 23557, Taiwan

Manufacture's Name Panasonic Industrial Devices Europe GmbH

Address Zeppelinstr. 19 21337 Luneburg Germany

Test specification:

Standard LP0002: 2020

Test procedure EIA 603, ANSI, FCC/47 CFR/2.1046, 2.1047, 2.1049, 2.1051, 2.1053 and 2.1055

Non-standard test method..... N/A

Test item description

Product name : M1 Control module

Brand name : MSA

Model and/or type reference : 10198774

Rating(s)..... : DC12V from adapter

Testing Laboratory information:

Testing Laboratory Name : Electro Magnetic Test, Inc.

Address : 1547 Plymouth Street, Mountain View, CA 94043

CAB Identifier Number : US0036

Tel : (650) 965-4000

Fax : (650) 965-3000

E-mail..... : jgandhi@emtlabs.com

Testing.....

Date of receipt of test item..... Feb. 24, 2021

Date (s) of performance of tests..... Feb. 24~Mar. 09, 2021

Date of Issue Mar. 09, 2021

Test Result **Pass**

GENERAL REPORT SUMMARY

This electromagnetic emission test report is generated by Electro Magnetic Test, Inc., which is an independent testing and consulting firm. The test report is based on testing performed Electro Magnetic Test, Inc. personnel according to the measurement procedure described in the test specification given below and in the "Test Procedures" section of this report.

The measurement data and conclusions appearing herein relate only to the sample tested and this report may not be reproduced in any form unless done so in full.

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Federal Government.

Electro Magnetic Test, Inc. is recognized by the following agencies for performing EMI/EMC testing:

COUNTRY	AGENCY	IDENTIFYING #
USA	Federal Communications Commission (FCC) (EMT's test site is recognized by the FCC)	Registration Number: 90576
USA, Canada, Taiwan, Australia/New Zealand, European Community	National Voluntary Lab Accreditation Program (NVLAP) (EMT is accredited by NVLAP. A copy of the NVLAP Scope Of Accreditation is available upon request.)	Lab Code: 200147-0
Canada	Industry Canada	File No.: IC 2804
Japan	Voluntary Control Council For Interference (VCCI)	A-0118
	Open Field Test Site "A"	-
	Mains Conducted Emissions Test Site "A"	-
	Telecom Conducted Emissions Test Site "A"	-
	3 Meter Semi-Anechoic Chamber Site "E"	-
	3 Meter Semi-Anechoic Chamber Site "E" (1GHz – 6GHz)	-
	Mains Conducted Emissions Test Site "E"	-
	Telecom Conducted Emissions Test Site "E"	-
Korea	Ministry of Information and Communication's Radio Research Laboratory (RRL) under the Asia Pacific Economic Cooperation (APEC) Mutual Recognition Arrangement (A copy of the Scope Of Accreditation is available upon request)	US0036
Taiwan	Bureau Of Standards, Metrology and Inspection (BSMI)	Reference Number: SL2-IN-E-1024
Australia / New Zealand	Australian Communications Authority (AUSTEL)	*

***THESE AGENCIES DO NOT ISSUE AN IDENTIFYING NUMBER TO TEST LABS.**

Table of Contents	Page
GENERAL REPORT SUMMARY	3
1 . SUMMARY OF TEST RESULTS	6
1.1 MEASUREMENT UNCERTAINTY	7
2 . GENERAL INFORMATION	8
2.1 GENERAL DESCRIPTION OF EUT	8
2.2 DESCRIPTION OF TEST MODES	10
2.3 TABLE OF PARAMETERS OF TEXT SOFTWARE SETTING	10
2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	11
2.5 DESCRIPTION OF SUPPORT UNITS (CONDUCTED MODE)	12
3 . EMC EMISSION TEST	15
3.1 CONDUCTED EMISSION MEASUREMENT	15
3.1.1 POWER LINE CONDUCTED EMISSION LIMITS	15
3.1.2 TEST PROCEDURE	16
3.1.3 DEVIATION FROM TEST STANDARD	16
3.1.4 TEST SETUP	16
3.1.5 TEST RESULTS	17
3.2 RADIATED EMISSION MEASUREMENT	19
3.2.1 RADIATED EMISSION LIMITS	19
3.2.2 TEST PROCEDURE	20
3.2.3 TEST SETUP	20
3.2.4 EUT OPERATING CONDITIONS	21
3.2.5 TEST RESULTS (BLOW 30MHZ)	22
3.2.6 TEST RESULTS (BETWEEN30 – 1000 MHZ)	23
3 FIELD STRENGTH OF FUNDAMENTAL MEASUREMENT	25
3.1 RADIATED EMISSION LIMITS	25
3.2.7 TEST RESULTS (BETWEEN30 – 1000 MHZ)	26
4 . OCCUPIED BANDWIDTH TEST	27
4.1 APPLIED PROCEDURES / LIMIT	27
4.1.1 TEST PROCEDURE	27
4.1.2 TEST SETUP	27
4.1.3 EUT OPERATION CONDITIONS	27
4.1.4 TEST RESULTS	28
5 . FREQUENCY STABILITY	30
5.1 APPLIED PROCEDURES / LIMIT	30
5.1.1 TEST PROCEDURE	30

Table of Contents	Page
5.1.2 MANUFACTURER DECLARATION	30
5.1.3 EUT OPERATION CONDITIONS	30
5.1.4 TEST RESULTS	31
6 . VOLTAGE VARIATION	32
6.1 APPLIED PROCEDURES / LIMIT	32
6.1.1 TEST PROCEDURE	32
6.1.2 EUT OPERATION CONDITIONS	32
6.1.3 TEST RESULTS	33
7 . ANTENNA REQUIREMENT	34
7.1 STANDARD REQUIREMENT	34
7.2 EUT ANTENNA	34
9. EUT TEST PHOTO	35

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

LP0002 : 2020			
Standard Section	Test Item	Judgment	Remark
3.3	Conducted Emission	PASS	None
4.2.1.2/3.6	Radiated Spurious Emission	PASS	None
4.2.1.1	Field Strength of Fundamental	PASS	None
4.10.1(6.2.1)	20dB &99%Occupied Bandwith	PASS	None
4.2.1.3	Frequency Stability	PASS	None
4.2.1.3	Voltage Variation	PASS	None
4.10.1(3)	Antenna Requirement	PASS	None

NOTE:

(1) "N/A" denotes test is not applicable in this Test Report

1.1 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Conducted Emission Test	1.38dB
2	Radiated Emission Test	3.17dB

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	M1 Control module	
Brand Name	MSA	
Model Name	10198774	
OEM Brand/Model Name	N/A	
Product Description	The EUT is a M1 Control module.	
	Operation Frequency:	13.553-13.567 MHz
	Modulation Type:	ASK
	Antenna Designation:	1CH .Please see Note 2.
	Field Strength@distance	94.54 dB μ V/m@3m
Channel List	Please refer to the Note 2.	
Power Rating	DC12V from adapter	
Connecting I/O Port(s)	Please refer to the User's Manual	
Products Covered	N/A	
EUT Modification(s)	N/A	
Adapter Manufacturer /Model No.	Model:EPU26-105 I/P: AC100-240V, 47-63Hz, 0.7A	
	O/P: DC12V, 2.08A max	

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2.

Table for Filed Antenna

Ant	Manufacturer	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	STMicroelectronics	PCB Loop Antenna	PCB Loop Antenna	N/A	N/A	NFC ANT

3. Operation Frequency each of channel

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
1	13.56	-	-	-	-	-	-

2.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	TX mode

For Conducted Emission	
Final Test Mode	Description
Mode 1	TX charge mode

For Radiated Emission	
Final Test Mode	Description
Mode 1	TX mode

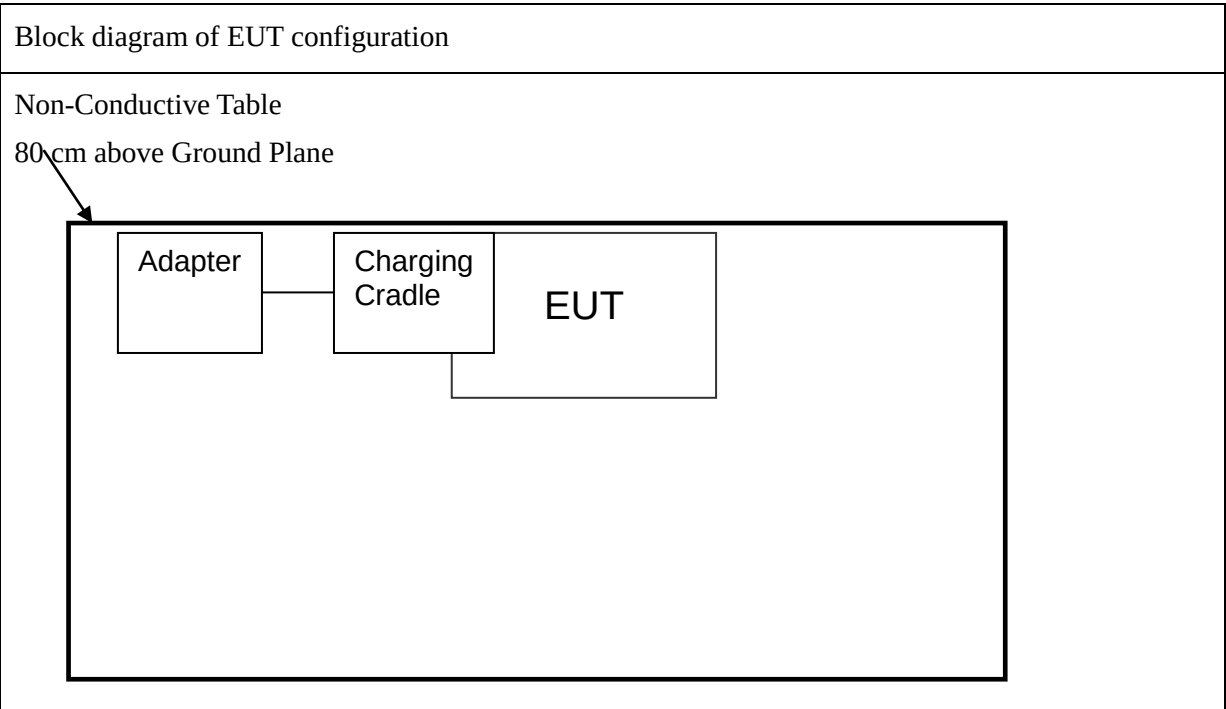
Note:

(1) The measurements are performed at the highest, middle, lowest available channels.

2.3 TABLE OF PARAMETERS OF TEXT SOFTWARE SETTING

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters.

2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



2.5 DESCRIPTION OF SUPPORT UNITS (CONDUCTED MODE)

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.

Item	Equipment	Mfr/Brand	Model/Type No.	NCC ID	Series No.	Note
1	M1 Control module	MSA	10198774	N/A	N/A	EUT
2	Charging Cradle	MSA	M1 Control Module	N/A	N/A	AE
3	Adapter	SINPRO	EPU-26-105	N/A	N/A	AE

Item	Shielded Type	Ferrite Core	Length	Note
-	N/A	N/A	N/A	N/A

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
- (3) “YES” means “shielded” or “with ferrite core”; “NO” means “unshielded” or “without ferrite core”
- (4) These accessories are only provided by the laboratory or customer for testing purpose and are not sold with the product together.

2.5.1 EQUIPMENTS LIST FOR ALL TEST ITEMS

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. CYCLE
Spectrum Analyzer	Hewlett Packard	8566B	3013A07296	April 29, 2020	1 Year
RF Preselector	Hewlett Packard	85685A	3010A01157	April 29, 2020	1 Year
Quasi-Peak Adapter	Hewlett Packard	85650	2521A00584	April 29, 2020	1 Year
Preamplifier	Com Power	PA-102	1482	April 29, 2020	1 Year
RF Attenuator	Mini-Circuits	CAT-10	Asset #1000	December 8, 2020	1 Year
LISN	Com Power	LI-200	12012	September 10, 2020	1 Year
LISN	Com Power	LI-200	12214	September 10, 2020	1 Year
LISN	Com Power	LI-200	1767	September 10, 2020	1 Year
LISN	Com Power	LI-200	1768	September 10, 2020	1 Year
Biconical Antenna	Com Power	AB-100	01557	December 29, 2020	1 Year
Log Periodic Antenna	Com Power	AL-100	16037	December 22, 2020	1 Year
Horn Antenna	Com Power	AHA-118	711054	December 22, 2020	1 Year
Antenna Mast	Com Power	AM-400	N/A	N/A	N/A
Turntable	Com Power	TT-100	N/A	N/A	N/A
Computer	Dell, Inc.	DHS	DNSV641	N/A	N/A
Printer	Hewlett Packard	C8124A	CN39B2234T	N/A	N/A
Plotter	Hewlett Packard	7470A	2308A96499	N/A	N/A

EMI Test Equipment (Continued)

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. CYCLE
EMI Receiver	Rohde & Schwarz	ESU40	100127	June 12, 2020	1 Year
BiConiLog Antenna	ETS-Lindgren	3142D	00102183	August 14, 2020	1 Year
Horn Antenna	ETS-Lindgren	3117	00109294	May 6, 2021	1 Year
Preamplifier	Rohde & Schwarz	TS-PR18	100056	June 12, 2020	1 Year
Antenna Mast	ETS-Lindgren	2175	00095727	N/A	N/A
Turntable	ETS-Lindgren	2187-3.0	00118231	N/A	N/A
Computer	Acer	Aspire 8930	85100050123	N/A	N/A
Multi-Function Controller	ETS-Lindgren	2090	00102270	N/A	N/A
Loop Antenna	ARA	PLA-1030/B	1029	May 19, 2020	1 Year

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION Limits (Frequency Range 150kHz-30MHz)

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)		Standard
	Quasi-peak	Average	Quasi-peak	Average	
0.15 -0.5			66 - 56 *	56 - 46 *	CISPR
0.50 -5.0			56.00	46.00	CISPR
5.0 -30.0			60.00	50.00	CISPR

0.15 -0.5			66 - 56 *	56 - 46 *	LP0002
0.50 -5.0			56.00	46.00	LP0002
5.0 -30.0			60.00	50.00	LP0002

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

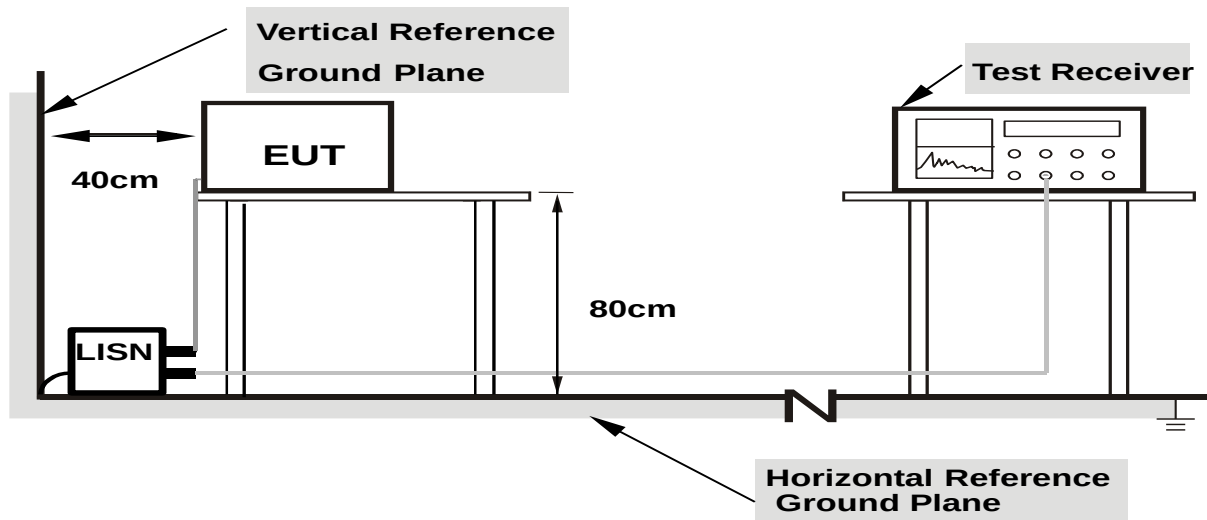
3.1.2 TEST PROCEDURE

- The EUT was placed 0.4 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.1.3 DEVIATION FROM TEST STANDARD

No deviation

3.1.4 TEST SETUP



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

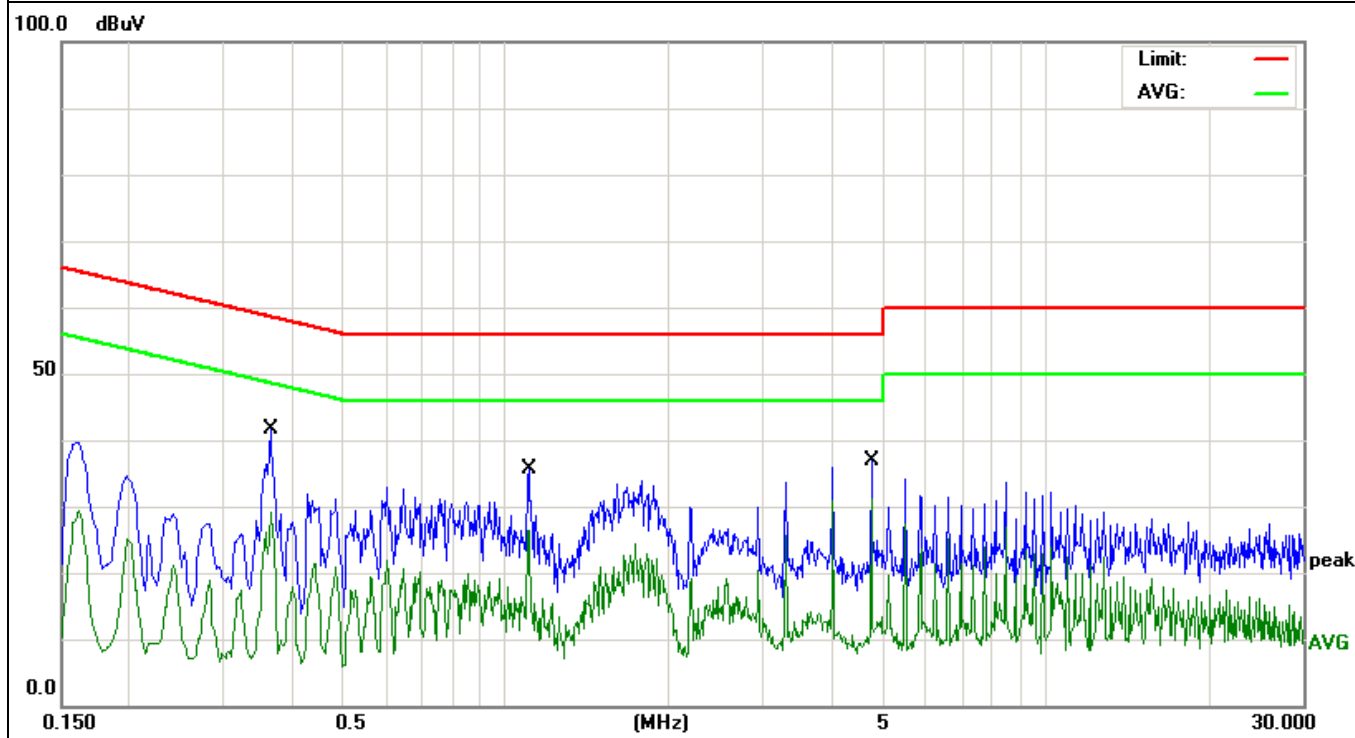
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.1.5 TEST RESULTS

EUT :	M1 Control module	Model Name. :	10198774
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Test Date :	2021-03-01
Test Mode :	Running	Phase :	L
Test Voltage :	DC12V from adapter		

Frequency (MHz)	Meter Reading (dBμV)	Factor(dB)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Detector
0.3660	32.58	10.11	42.69	58.59	-15.90	Quasi-Peak
0.3660	19.42	10.11	29.53	48.59	-19.06	Average
1.1019	26.03	9.90	35.93	56.00	-20.07	Quasi-Peak
1.1019	18.09	9.90	27.99	46.00	-18.01	Average
4.7660	27.75	10.04	37.79	56.00	-18.21	Quasi-Peak
4.7660	21.76	10.04	31.80	46.00	-14.20	Average

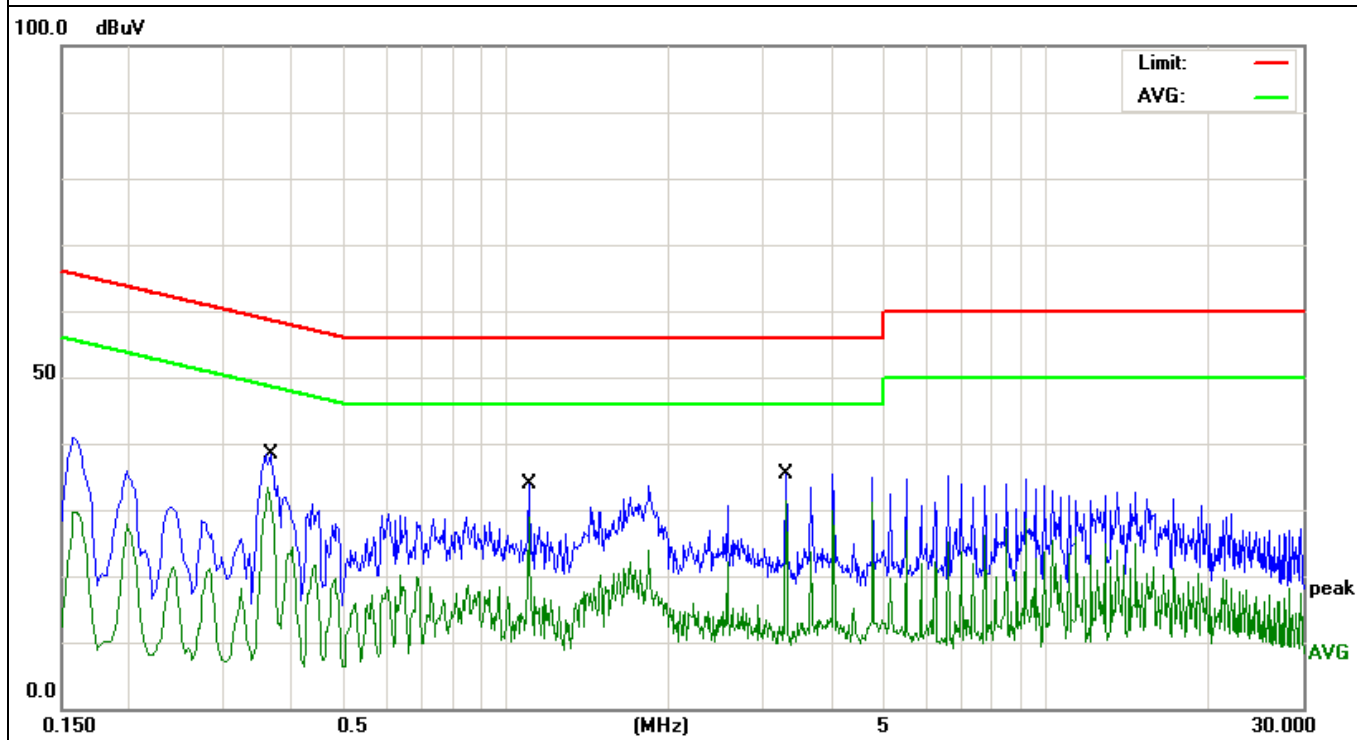
Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



EUT :	M1 Control module	Model Name. :	10198774
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Test Date :	2021-03-01
Test Mode :	Running	Phase :	N
Test Voltage :	DC12V from adapter		

Frequency (MHz)	Meter Reading (dBμV)	Factor(dB)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Detector
0.3660	28.68	10.11	38.79	58.59	-19.80	Quasi-Peak
0.3620	24.02	10.12	34.14	48.68	-14.54	Average
1.1019	24.84	9.90	34.74	56.00	-21.26	Quasi-Peak
1.1019	19.46	9.90	29.36	46.00	-16.64	Average
3.3100	26.04	9.98	36.02	56.00	-19.98	Quasi-Peak
3.3100	21.65	9.98	31.63	46.00	-14.37	Average

Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



Test result: The unit does meet the NCC requirements.

3.2 RADIATED EMISSION MEASUREMENT

3.2.1 RADIATED EMISSION LIMITS (Frequency Range 9kHz-1000MHz)

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 3.5, then the 3.6 limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/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

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Class A (dBuV/m) (at 3M)		Class B (dBuV/m) (at 3M)	
	PEAK	AVERAGE	PEAK	AVERAGE
Above 1000	80	60	74	54

Notes:

- (1) The limit for radiated test was performed according to LP0002.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

FREQUENCY RANGE OF RADIATED MEASUREMENT (For unintentional radiators)

Highest frequency generated or Upper frequency of measurement used in the device or on which the device operates or tunes (MHz)	Range (MHz)
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

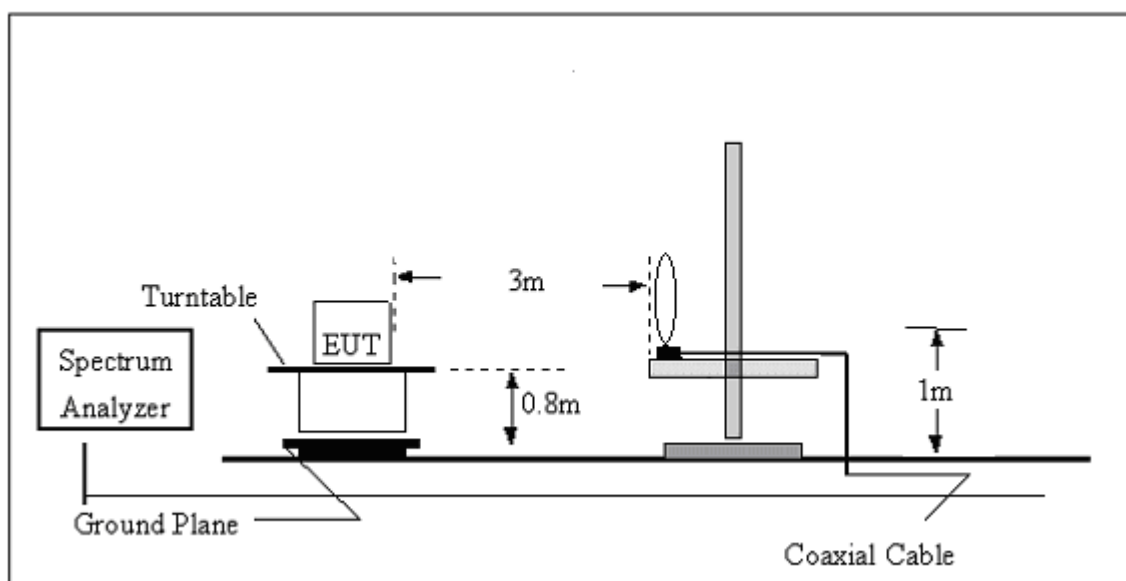
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

3.2.2 TEST PROCEDURE

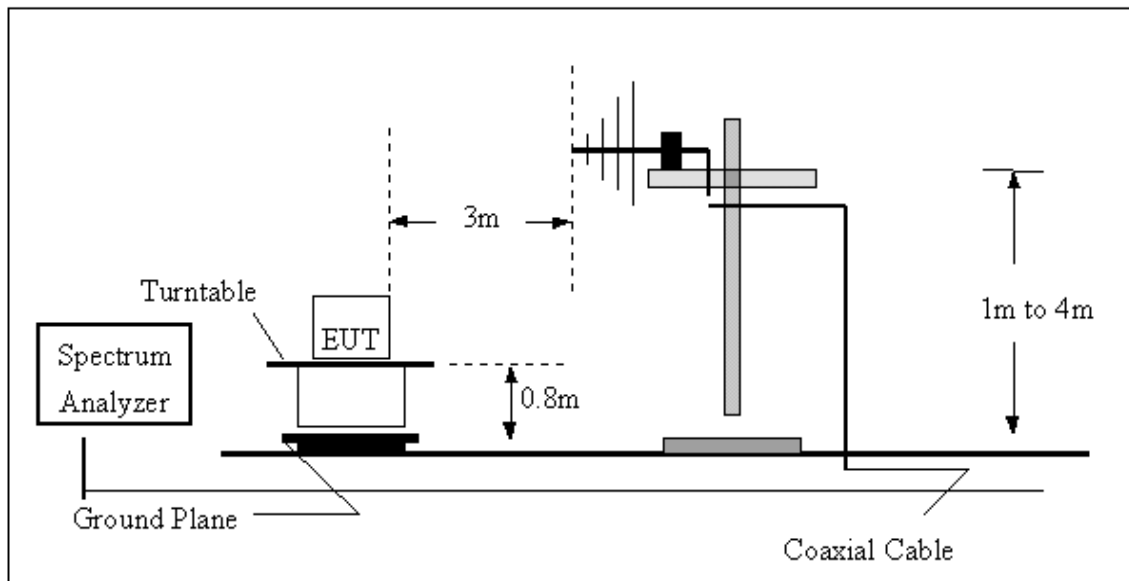
- The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall 1 m(below 30MHz) ; The height of the test antenna shall vary between 1 m to 4 m(above 30MHz). Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.2.3 TEST SETUP

(A) Radiated Emission Test Set-Up, Frequency 9kHz-30 MHz



(B) Radiated Emission Test Set-Up Frequency between 30MHz-1000MHz



3.2.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

3.2.5 TEST RESULTS (BLOW 30MHZ)

EUT :	M1 Control module	Model Name :	10198774
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Date :	2021-03-01
Test Mode :	Mode 1	Polarization :	Horizontal
Test Power :	DC12V from adapter		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
0.0225	94.15	-26.15	68.00	120.47	-52.47	Quasi-Peak
0.0798	83.16	-26.16	57.00	109.51	-52.51	Quasi-Peak
0.2760	79.07	-26.07	53.00	98.77	-45.77	Quasi-Peak
0.8804	68.66	-25.66	43.00	68.68	-25.68	Quasi-Peak
2.2196	73.33	-25.33	48.00	69.50	-21.50	Quasi-Peak
8.8857	76.05	-25.05	51.00	69.50	-18.50	Quasi-Peak

Remark:

1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.



Note:

Pre-scan in the all of mode and antenna was aligned along the site axis, orthogonal to the axis, the worst case in of was recorded.

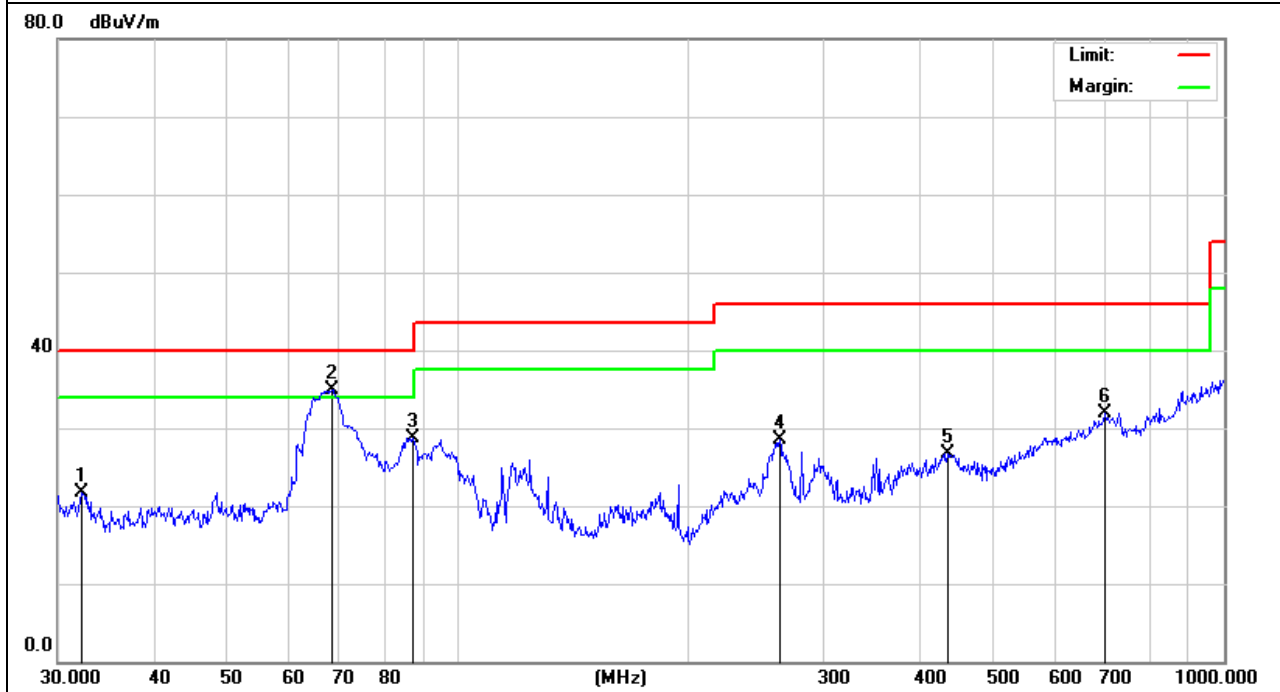
3.2.6 TEST RESULTS (BETWEEN 30 – 1000 MHZ)

EUT :	M1 Control module	Model Name :	10198774
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Date :	2021-03-01
Test Mode :	Mode 1	Polarization :	Horizontal
Test Power :	DC12V from adapter		

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
32.1795	37.01	-15.32	21.69	40.00	-18.31	Quasi-Peak
68.3908	53.35	-18.48	34.87	40.00	-5.13	Quasi-Peak
87.1117	46.17	-17.38	28.79	40.00	-11.21	Quasi-Peak
262.8955	41.41	-12.88	28.53	46.00	-17.47	Quasi-Peak
435.5898	33.37	-6.63	26.74	46.00	-19.26	Quasi-Peak
699.3046	31.44	0.44	31.88	46.00	-14.12	Quasi-Peak

Remark:

1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.

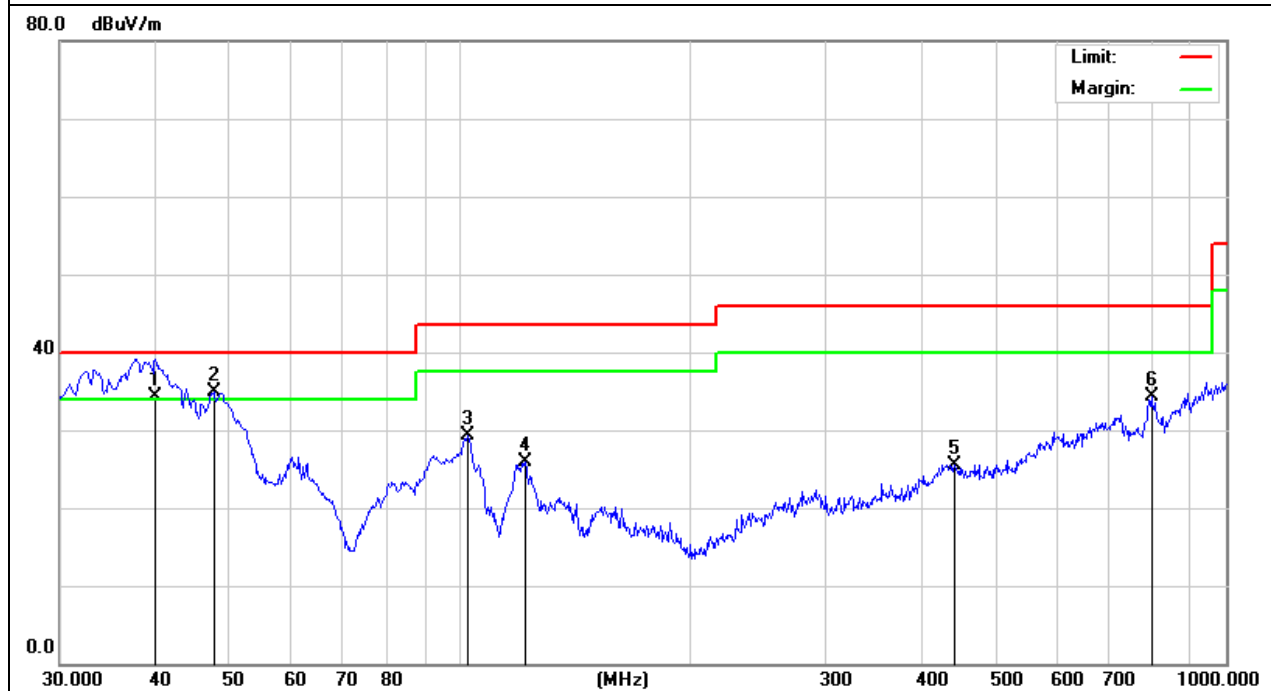


EUT :	M1 Control module	Model Name :	10198774
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Date :	2021-03-01
Test Mode :	Mode 1	Polarization :	Vertical
Test Power :	DC12V from adapter		

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
39.9942	51.00	-16.60	34.40	40.00	-5.60	Quasi-Peak
47.6586	53.13	-18.28	34.85	40.00	-5.15	Quasi-Peak
102.3597	43.09	-13.78	29.31	43.50	-14.19	Quasi-Peak
121.5486	40.82	-14.98	25.84	43.50	-17.66	Quasi-Peak
441.7426	32.29	-6.71	25.58	46.00	-20.42	Quasi-Peak
798.9797	30.78	3.44	34.22	46.00	-11.78	Quasi-Peak

Remark:

1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.



Test result: The unit does meet the NCC requirements.

3 FIELD STRENGTH OF FUNDAMENTAL MEASUREMENT

3.1 RADIATED EMISSION LIMITS

LIMITS OF FIELD STRENGTH OF FUNDAMENTAL MEASUREMENT

The RF fundamental field strength requirement is the power radiated in the direction of the maximum level under specified conditions of measurements in the presence of modulation.

The RF fundamental field strengths shall not exceed LP0002:2020 Section 4.2.1.1

The field strength of any emission in the band of 13.553 and 13.567 MHz shall be less than 84 dBuV/m (15848 uV/m) at 30 meter distance; or 124 dBuV/m at 3 meter.

Fundamental Frequency (MHz)	Field Strength of Fundamental (dBμV/m @ 3m)	Field Strength of Harmonics (dBμV/m @ 3m)
13.56	124.0	84.0

Notes:

- (1) The limit for radiated test was performed according to LP0002.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

3.2.7 TEST RESULTS (BETWEEN 30 – 1000 MHz)

EUT :	M1 Control module	Model Name :	10198774
Temperature :	24 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Date :	2021-03-01
Test Mode :	TX	Polarization :	Horizontal
Test Power :	DC 12V from Adapter		

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only

Antenna Type: Integrated

Power Setting: Fixed at Chipset

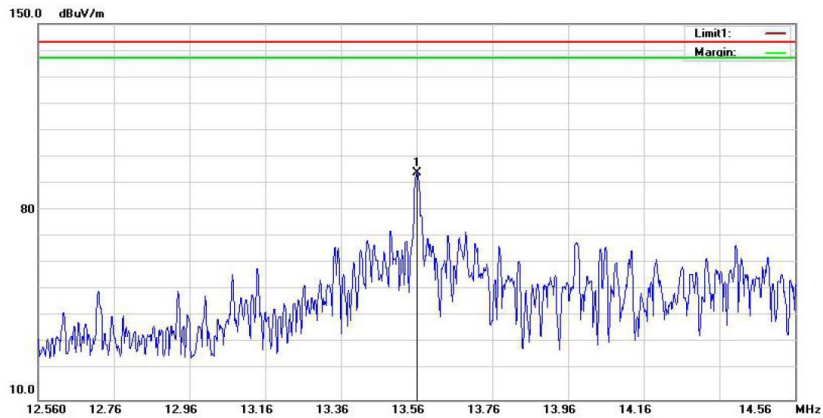
Signal State: Modulated

Duty Cycle: See below.

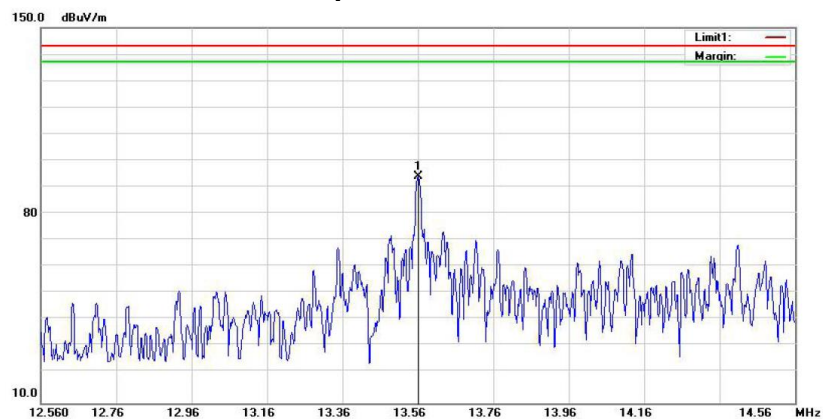
Operating Frequency:	Test Results					
13.56 MHz	Measured Level [dBuV/m]	Loop Ant Position	Table [degree]	Antenna [cm]	Limit [dBuV/m]	Margin [dB]
	94.53	0	103	100	124.00	-29.47
	94.54	90	89	100	124.00	-29.46

Note: Measurements were taken at 3 meter distance, and the limit was extrapolated accordingly.

Loop Ant Position 0



Loop Ant Position 90



Test result: The unit does meet the NCC requirements.

4. OCCUPIED BANDWIDTH TEST

4.1 APPLIED PROCEDURES / LIMIT

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

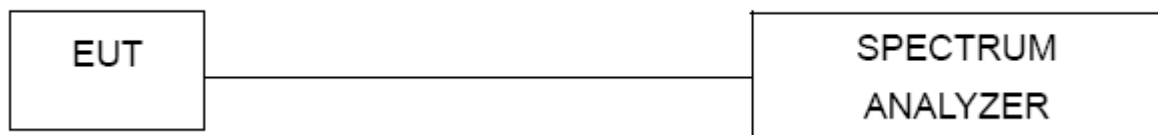
The 20dB bandwidth is defined the bandwidth of 20 dBr from highest transmitted level of the fundamental frequency.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	100 kHz (6dB Bandwidth) / 100 kHz (Channel Separation)
VB	300 kHz (6dB Bandwidth) / 300 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

4.1.1 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- Spectrum Setting: RBW= 100KHz, VBW=100KHz, Sweep time = Auto.

4.1.2 TEST SETUP



4.1.3 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

4.1.4 TEST RESULTS

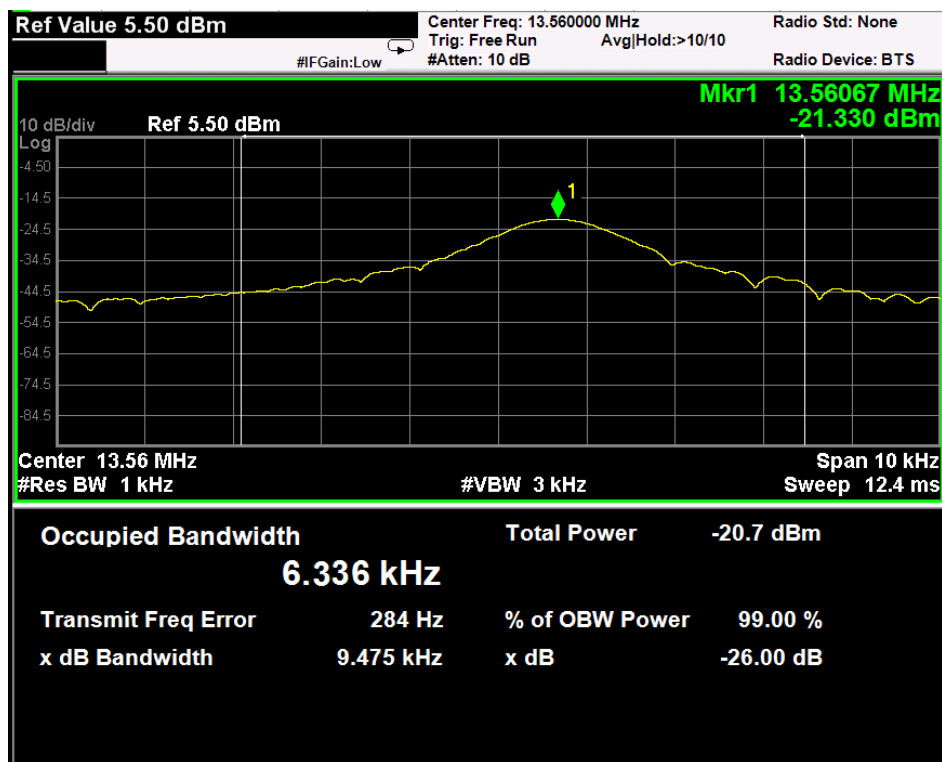
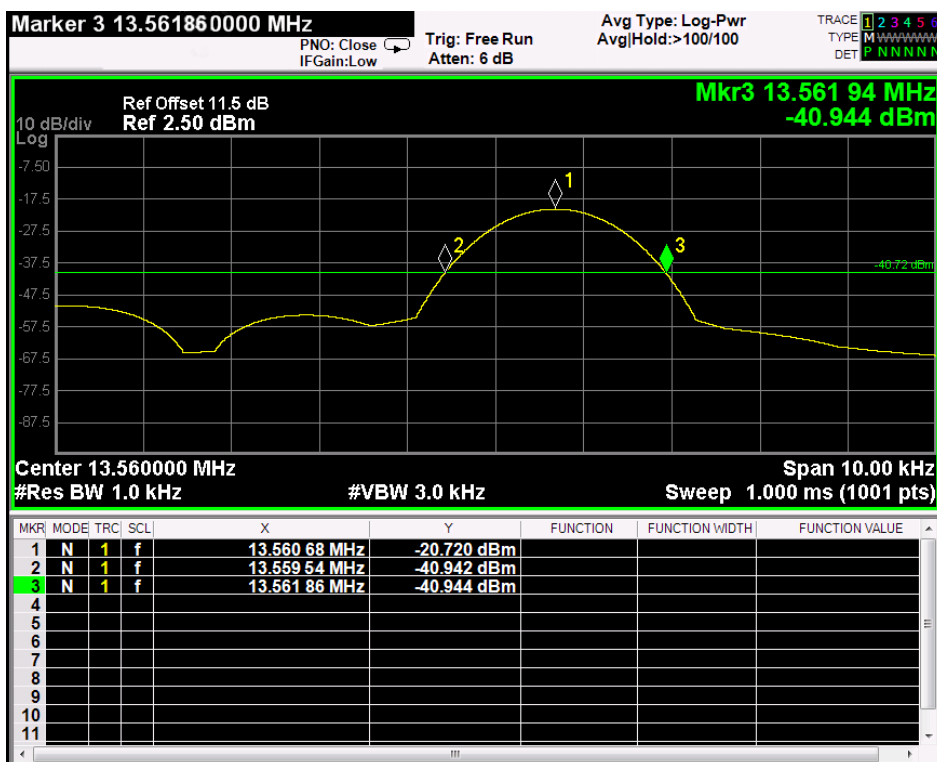
EUT :	M1 Control module	Model Name :	10198774
Temperature :	24 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Date :	2021-03-01
Signal State:	Modulated	Power Setting:	Fixed at Chipset
Test Mode :	Mode 1	Duty Cycle:	See below
Test Conditions:	Conducted Measurement, Normal Temperature and Voltage only		

Occupied Bandwidth – Test Results

Occupied Bandwidth for 13.56 MHz			
Mode	Limit (kHz)	99% BW (kHz)	20 dB BW (kHz)
ASK Modulation	Na	6.336	2.320
Note: All lower and upper markers of 99% Bandwidth and 20 dB Bandwidth are within the allowable band; 13.553 MHz to 13.567 MHz			

20 dB Bandwidth Frequency – Test Results

20 dB Bandwidth Frequencies for 13.56 MHz				
Mode	Occupied Band Limit (MHz)	Lower Freq. (MHz)	Upper Freq. (MHz)	Results
ASK Modulation	$13.553 < X < 13.567$	13.55954	13.56186	Pass
Note: All lower and upper markers of 20 dB Bandwidth are within the allowable band; 13.553 MHz to 13.567 MHz the lower frequency and upper frequency.				



5. FREQUENCY STABILITY

5.1 APPLIED PROCEDURES / LIMIT

In accordance with LP0002 section 4.2.1.3 the frequency stability of RFID devices must be such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual. The Manufacturer declares the operating temperature ranges of -20° to +70° C.

5.1.1 TEST PROCEDURE

- a. The manufacturer of the equipment is responsible for ensuring that the frequency stability is such that emissions are always maintained within the band of operation under all conditions.

5.1.2 MANUFACTURER DECLARATION

The frequency stability of the reference oscillator sets the frequency stability of the RF transceiver signals. Per LP0002 section 4.2.1.3, all of the RF signal should have $\pm 0.01\%$ or $\pm 100\text{ppm}$ stability. This stability accounts for room temp tolerance of the crystal oscillator circuit, frequency variation across temperature, and crystal ageing.

Worst case:

$\pm 100\text{ppm}$ at 13.56 GHz translates to a maximum frequency shift of $\pm 1.356\text{ kHz}$.

5.1.3 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

5.1.4 TEST RESULTS

EUT :	M1 Control module	Model Name :	10198774
Temperature :	24 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Date :	202X-0X-XX
Signal State:	Modulated	Power Setting:	Fixed at Chipset
Test Mode :	Mode 1	Duty Cycle:	See below
Test Conditions:	Conducted Measurement		

Frequency Stability – Test Results

Temperature	Time	PPM
-20°C	Start	4.71
	2 Min.	-3.42
	5 Min	0.16
	10 min	-2.57
-10°C	Start	-0.13
	2 Min.	-4.78
	5 Min	3.15
	10 min	1.69
0°C	Start	4.34
	2 Min.	4.32
	5 Min	1.14
	10 min	-2.87
10°C	Start	2.87
	2 Min.	1.70
	5 Min	1.09
	10 min	-2.44
20°C	Start	3.39
	2 Min.	-0.42
	5 Min	2.47
	10 min	5.13
30°C	Start	2.47
	2 Min.	5.83
	5 Min	-3.46
	10 min	-1.31
40°C	Start	1.26
	2 Min.	-1.92
	5 Min	0.29
	10 min	-0.93
50°C	Start	5.11
	2 Min.	3.69
	5 Min	3.75
	10 min	2.01
Note: All frequency drifts from 13.56 MHz were less than ± 100 ppm.		

6. VOLTAGE VARIATION

6.1 APPLIED PROCEDURES / LIMIT

In accordance with LP0002 section 4.2.1.3 intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

6.1.1 TEST PROCEDURE

- a. The NFC was designed to operating within 4.5 Vdc to 5.5 Vdc . The fundamental frequency was observed during the variation. The module was powered by 5 Vdc by variable DC power supply. The voltage input on the connection was varied from 4.5 Vdc to 5.5 Vdc mean while the fundamental frequencies were observed and recorded for the maximum drift in ppm; part per millions.

6.1.2 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

6.1.3 TEST RESULTS

EUT :	M1 Control module	Model Name :	10198774
Temperature :	24 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Date :	2021-03-02
Signal State:	Modulated	Power Setting:	Fixed at Chipset
Test Mode :	Mode 1	Duty Cycle:	See below
Test Conditions:	Conducted Measurement		

Voltage Variation – Test Results

Voltage	PPM
4.5 V DC	-1.49
5.0 V DC	1.14
5.5 V DC	1.42
Note: All frequency drifts were less than ± 100 ppm from 13.56 MHz No frequency change was observed with time.	

The fundamental frequencies drifted less than ± 100 ppm.

Test result: The unit does meet the NCC requirements.

7. ANTENNA REQUIREMENT

7.1 STANDARD REQUIREMENT

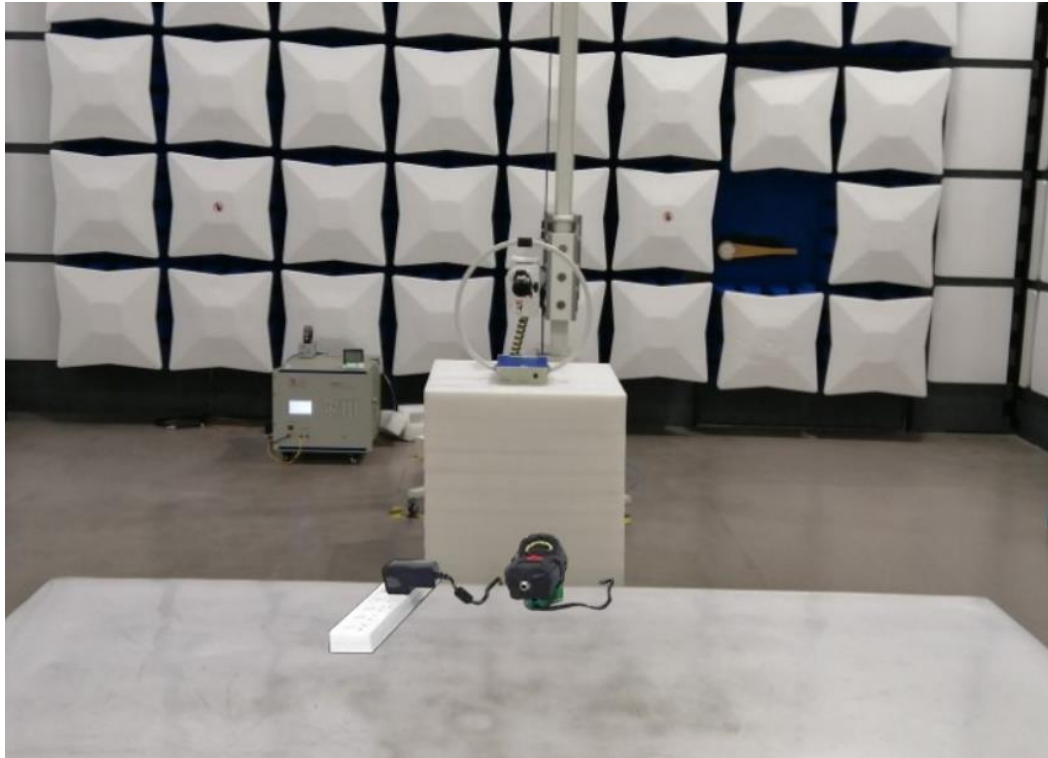
LP0002/3.2 section -Antenna transmitter or transceiver motor of low power radio frequency used, the sections of this specification except as otherwise provided, shall be for the whole Fixed and semi-fixed or unique coupling (unique coupling) connected body. The manufacturer may be designed for users. And the replacement of the antenna due to damage, but not design or using an antenna or connection of other than the original certification standards for various types of cable's dayJack or electrical connector, such as: BNC, F type, N type, M type, UG type, RCA, SMA, SMB ...Etc., and other types of industrial or communication standard connectors.

7.2 EUT ANTENNA

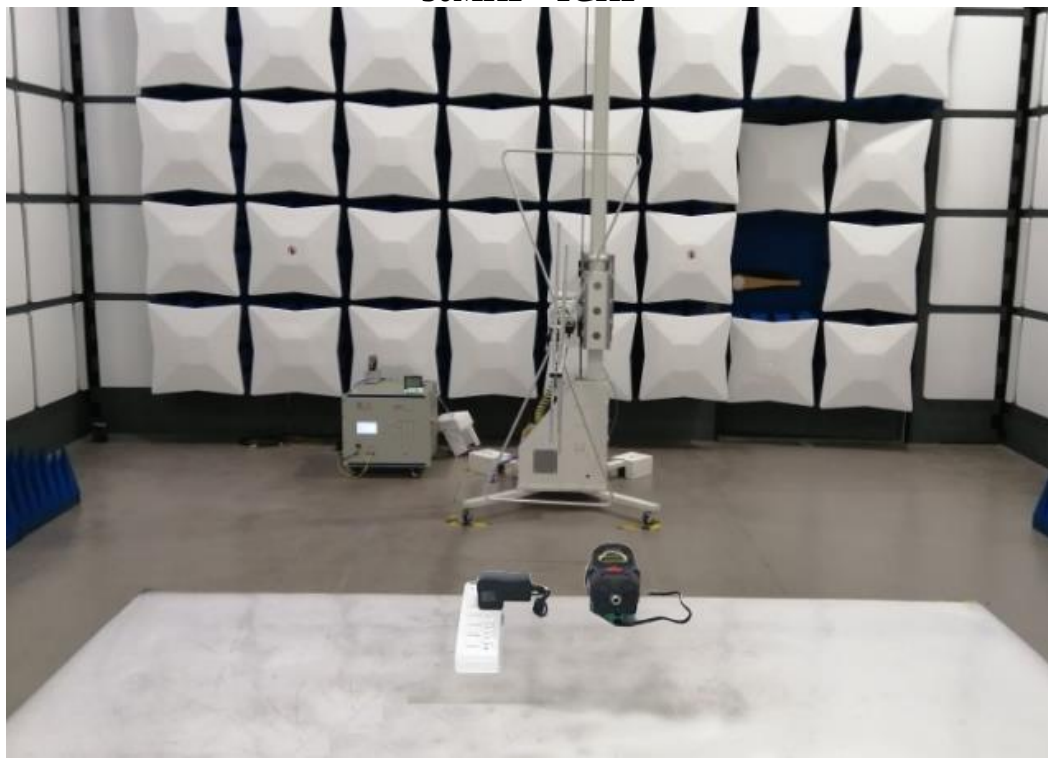
The antenna is a LOOP PCB antenna and no consideration of replacement.

9. EUT TEST PHOTO

**Radiated Measurement Photos
Below 30MHz**



**Radiated Measurement Photos
30MHz ~ 1GHz**



Conducted Measurement Photos

**** End of Report ****