



Global Product Certification
EMC-EMF Safety Approvals

Melbourne 176 Harrick Road
Keilor Park, Vic 3042
Tel: +61 3 9365 1000

Sydney Unit 3/87 Station Road
Seven Hills, NSW 2147
Tel: +61 2 9624 2777

Email: emc-general@emctech.com.au
Web: www.emctech.com.au

EMI TEST REPORT for CERTIFICATION of 47 CFR Part 15 Subpart C (Section 15.225)

Test Report Number: S211114-1 v2

FCC ID: 2ACXQ-CL4NXPLUS-MR-1

Manufacturer: Sato Vicinity Pty Ltd
Test Sample: MR-1
Model Number: MR-1 Module

Issue Date: 9 February 2021

EMC Technologies Pty Ltd reports apply only to the specific samples tested under stated test conditions. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. EMC Technologies Pty Ltd shall have no liability for any deductions, interferences or generalisations drawn by the client or others from EMC Technologies Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Technologies Pty Ltd.



Accreditation No. 5292

Accredited for compliance with ISO/IEC 17025.

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REVISION TABLE

Version	Change Made	Date
1	Initial issue of document	22 December 2021
2	Update to FCC ID	9 February 2022



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EMI TEST REPORT FOR CERTIFICATION FOR CERTIFICATION OF FCC Part 15.225

CONTENTS

1. SUMMARY OF TEST RESULTS

2. GENERAL INFORMATION

3. TEST RESULTS

4. COMPLIANCE STATEMENT

5. UNCERTAINTIES

APPENDIX A. PHOTOGRAPHS TEST SETUP

APPENDIX B. PHOTOGRAPHS TEST SAMPLE (EXTERNAL)

APPENDIX C. PHOTOGRAPHS TEST SAMPLE (INTERNAL)



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RADIO REPORT FOR CERTIFICATION

Device under Test: MR-1
Model Number: MR-1 Module

FCC ID: 2ACXQ-CL4NXPLUS-MR-1

Manufacturer: Sato Vicinity Pty Ltd

Tested for: Sato Vicinity Pty Ltd
Address: 32 Burrows Road, St Peters, NSW, 2038

Phone: +61 2 9562 9886

Contact: Tai Wai Pong
Email: taiwai.pong@sato-global.com

Standards: **47 CFR Part 15** – Radio Frequency Devices
Subpart C – Intentional Radiators
Section 15.225 – Operation within the band 13.110-14.010 MHz

Result: The MR-1 complied with the applicable requirements of the above standards. Refer to Reort S211114-1 v2 for full details.

Test Date(s): 23rd November 2021 to 24th November 2021

Issue Date: 9 February 2022

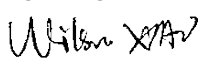
Attestation: I hereby certify that the Test Sample described herein was tested as described in this report and that the data included is that which was obtained during such testing.

Test Engineer:



Dong Feng

Authorised Signatory:



Wilson Xiao – Lead Engineer Radio
EMC Technologies Pty Ltd

Issued by: EMC Technologies Pty. Ltd.,
Unit 3, 87 Station Road, Seven Hills, NSW, 2147, Australia.
Phone: +61 2 9624 2777

E-mail: emc-general@emctech.com.au **Web:** www.emctech.com.au



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EMI TEST REPORT FOR CERTIFICATION of FCC PART 15.225

1.0 SUMMARY of RESULTS

This report details the results of EMI tests and measurements performed on the MR-1, with Model Number: MR-1 Module, in accordance with:

- Federal Communications Commission (FCC) regulations as detailed in Title 47 CFR, Part 15 Rules for intentional radiators.

Section	FCC Part 15 Subpart C	Test Performed	Results
3.1	15.203	Antenna requirement	Complied
3.2	15.205	Restricted bands of operation	Complied
3.3	15.207	Conducted limits	Complied
3.4	15.225 (a), (b), (c), (d)	Carrier Signal Field Strength 13.110 – 14.010MHz; Spurious Emission	Complied
3.5	15.225 (e)	Frequency tolerance	Complied
3.6	2.1049	Occupied Bandwidth	23.23 kHz

1.1 Test Procedure

Radio measurements were performed in accordance with the appropriate procedures of ANSI C63.10: 2020

The measurement instrumentation conformed to the requirements of ANSI C63.2: 2016.



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2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 General Description of Test Sample

Manufacturer:	Sato Vicinity Pty Ltd
Test Sample:	MR-1
Model Number:	MR-1 Module
Microprocessor:	AT32UC3B064
Highest Internal Frequency:	27.12MHz
Operating Band:	13.56MHz
Number of Channels:	1
BOM	090-70-001-BOM Version C8 090-10-010-BOM Version C2
Main PCB Circuit	090-10-001-SCH Version B4 090-10-010-SCH Version C2
Modulation:	Phase Jitter Modulation
Antenna type and gain:	Inductive loop antenna, 1.5dBi
Input Supply:	120V, 60Hz
FCC ID:	2ACXQ-CL4NXPLUS-MR-1
Auxiliary Equipment	Sato CL4NXPlus Barcode Printer Laptop, USB Mouse Data Communication and power supply adaptor board

2.2 Test Sample Description

MR-1 Module is a plug-in RFID radio device with integral antenna. It is an RFID read/write device designed to meet the requirements to manage tagging, monitor, and control a small number of items. It is designed to be incorporated in any hosts which has serial communication capability.

The unit consists of a connector for data communication and power source from the host. MR-1 is connected to antenna via a unique connector.

2.3 EUT Configurations

During testing, the MR-1 Transmitter Module will be connected and transmitting. The unit will be polling the antenna during the test cycle. In this mode, the test software will operate the data ports as follow:

- Laptop communicates with MR-1 module via the host, Sato CL4NXPlus printer
- MR-1 operates in normal operating mode in the Sato CL4NXPlus printer



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2.4 Facility

2.4.1 General

EMC Technologies Pty Ltd is listed by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies is listed as an FCC part 47CFR2.948 test lab and may perform the testing required under Parts 15 and 18 – **FCC Registration Number 90560**

EMC Technologies Pty Ltd has also been accredited as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 and 18 of the FCC Commission's rules – **Designation number AU0002.**

EMC Technologies indoor open area test site (iOATS) located at Unit 3, 87 Station Road, Seven Hills, NSW, Australia, 2147 has been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS-Gen, Issue 5 - **Industry Canada iOATS number - IC 4207A.**

Measurements in this report were performed at EMC Technologies' laboratory located at Unit 3, 87 Station Road, Seven Hills, New South Wales, Australia.

2.4.2 NATA Accreditation

NATA is the Australian National laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A²LA).

EMC Technologies is accredited in Australia by the National Association of Testing Authorities (NATA). All testing in this report has been conducted in accordance with EMC Technologies' scope of NATA accreditation.

The current full scope of accreditation can be found on the NATA website:
www.nata.asn.au



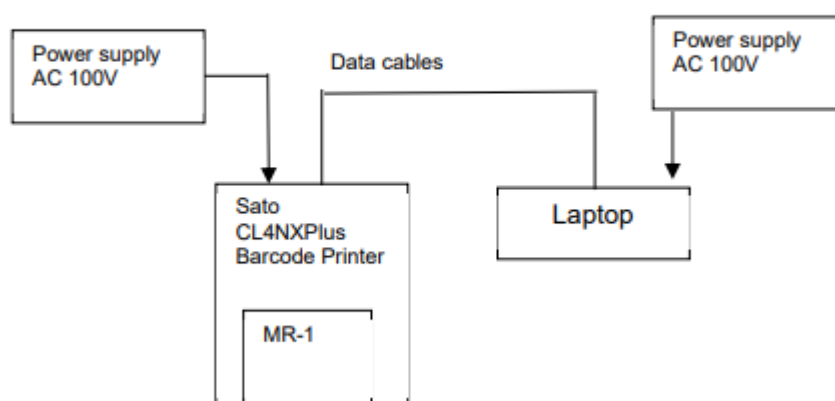
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2.5 Test Equipment Calibration

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory. All equipment calibration is traceable to Australian national standards at the National Measurements Institute.

Equipment Type	Asset No:	Make/Model/Serial Number	Due Date dd/mm/yyyy
EMI Receivers	R-038	Rohde & Schwarz EMI Receiver Model: ESU40 S/N: 100183 20Hz – 40GHz	01/04/2022
	R-029	Rohde & Schwarz EMI Test Receiver Model: ESCI S/N: 100012 9kHz – 3GHz	29/04/2022
Antenna	A-430	Sunar RF Motion Model: JB1 S/N: A021318	14/04/2024
	A-008	EMCO Model: 6502 SN: 9108-2660	12/12/2021
LISN	L-036 L-036-1	R & S, Single Phase, MN: ESH3-Z5, SN: 832479/014 10dB Attenuator Model: R-415410 fixed to LISN	22/04/2022
Limiter	L-003	HP, 9kHz – 200MHz, MN: 11947A, SN: 3107A00857	14/01/2022
RF Cables	SC-028	13m RG214 N-Type, 0.1- 6000MHz	11/01/2022
	SC-003	(0.01 to 1000 MHz) Room 1 MN: RG58 BNC-BNC, SN: C003	06/01/2022

2.6 Test Sample Block Diagram



2.8 Modifications

No modifications were performed on EUT in order to comply with the standard.

3.0 TEST RESULTS

3.1 §15.203 Antenna Requirement

Parameters	
Antenna Gain	1.5dBi
Antenna Type	Inductive loop antenna

The antennas were internal to the device ensuring that they could not be replaced.

3.2 §15.205 Restricted Bands of Operation

The limits of §15.209 were applied across the applicable spectrum and therefore complied with the restricted band requirements.

3.3 §15.207/RSS-Gen 8.8 Conducted limits

3.3.1 Test Procedure

The arrangement specified in ANSI C63.4: 2014 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2: 2016 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured.

The various operating modes of the system were investigated. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

EUT power 120V 60Hz.

The limit applied was in accordance to the conducted limits defined in §15.207.

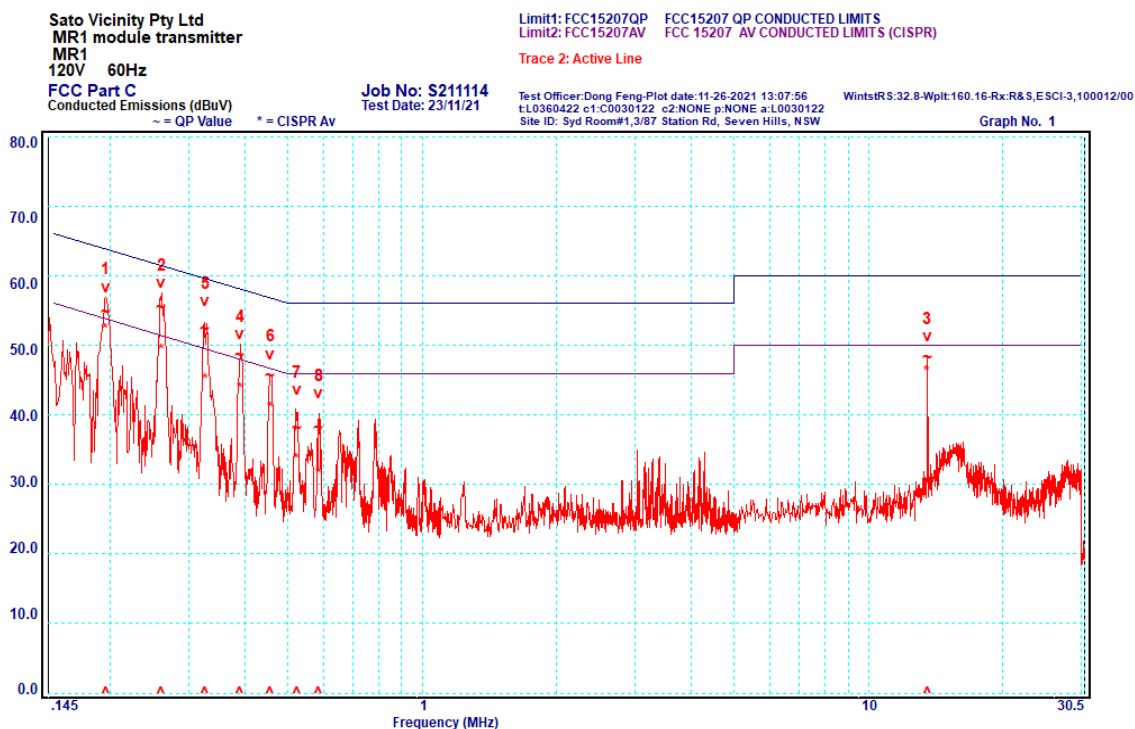


3.3.2 Results

Graph 1

Active Line

0.145 to 30.5MHz



Plot	Frequency [MHz]	Line	Quasi-Peak			Average		
			Level [dBμV]	Limit [dBμV]	Margin [±dB]	Level [dBμV]	Limit [dBμV]	Margin [±dB]
1	0.196	Active	54.7	63.8	-9.1	52.1	53.8	-1.7*
2	0.261	Active	55.4	61.4	-6.0	49.2	51.4	-2.2*
3	13.560	Active	48.3	60.0	-11.7	46.1	50.0	-3.9
4	0.391	Active	48.5	58.0	-9.5	43.6	48.0	-4.4
5	0.327	Active	52.3	59.5	-7.2	45.0	49.5	-4.5
6	0.457	Active	45.6	56.7	-11.1	40.8	46.7	-5.9
7	0.524	Active	38.0	56.0	-18.0	33.5	46.0	-12.5
8	0.587	Active	38.0	56.0	-18.0	31.4	46.0	-14.6

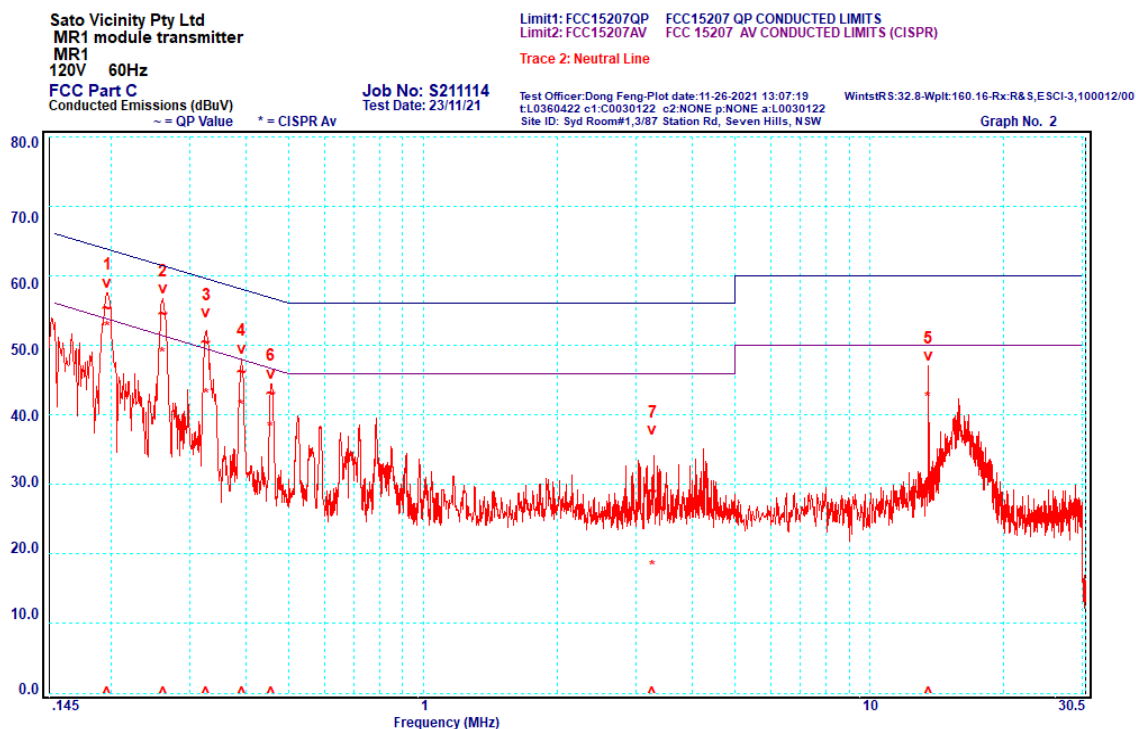
*This result is within the laboratory's measurement uncertainty. Refer to Section 5.0.

Complied with both quasi peak and average limits by margins of at least 6.0dB and 1.7*dB respectively.

Graph 2

Neutral Line

0.145 to 30.5MHz



Plot	Frequency [MHz]	Line	Quasi-Peak			Average		
			Level [dBμV]	Limit [dBμV]	Margin [±dB]	Level [dBμV]	Limit [dBμV]	Margin [±dB]
1	0.196	Neutral	55.3	63.8	-8.5	52.5	53.8	-1.3*
2	0.262	Neutral	54.5	61.4	-6.9	48.7	51.4	-2.7*
3	0.327	Neutral	50.4	59.5	-9.1	42.8	49.5	-6.7
4	0.392	Neutral	46.1	58.0	-11.9	41.1	48.0	-6.9
5	13.560	Neutral	28.7	60.0	-31.3	42.3	50.0	-7.7
6	0.456	Neutral	43.0	56.8	-13.8	38.1	46.8	-8.7
7	3.265	Neutral	29.0	56.0	-27.0	18.1	46.0	-27.9

*This result is within the laboratory's measurement uncertainty. Refer to Section 5.0.

Complied with both quasi peak and average limits by margins of at least 6.9dB and 1.3*dB respectively.

3.4 RADIATED MEASUREMENT TEST

The sample was slowly rotated with the measurement receiver set to Max-Hold. This was performed for at least two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable and by varying the antenna height. This process was performed for both horizontal and vertical antenna polarisations. Devices design for a fixed position were tested in that position, portable devices were tested in three orthogonal orientations.

The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain.

Calculation of field strength

The field strength was calculated automatically by software using pre-stored calibration data. The method of calculation is shown below:

$$E = V + AF - G + L$$

Where: E = Radiated Field Strength in dB μ V/m.

V = EMI Receiver Voltage in dB μ V/m.

AF = Antenna Factor in dB.

G = Preamplifier Gain in dB.

L = Cable loss in dB.

3.4.1 §15.225(d) Transmitter Spurious Emissions

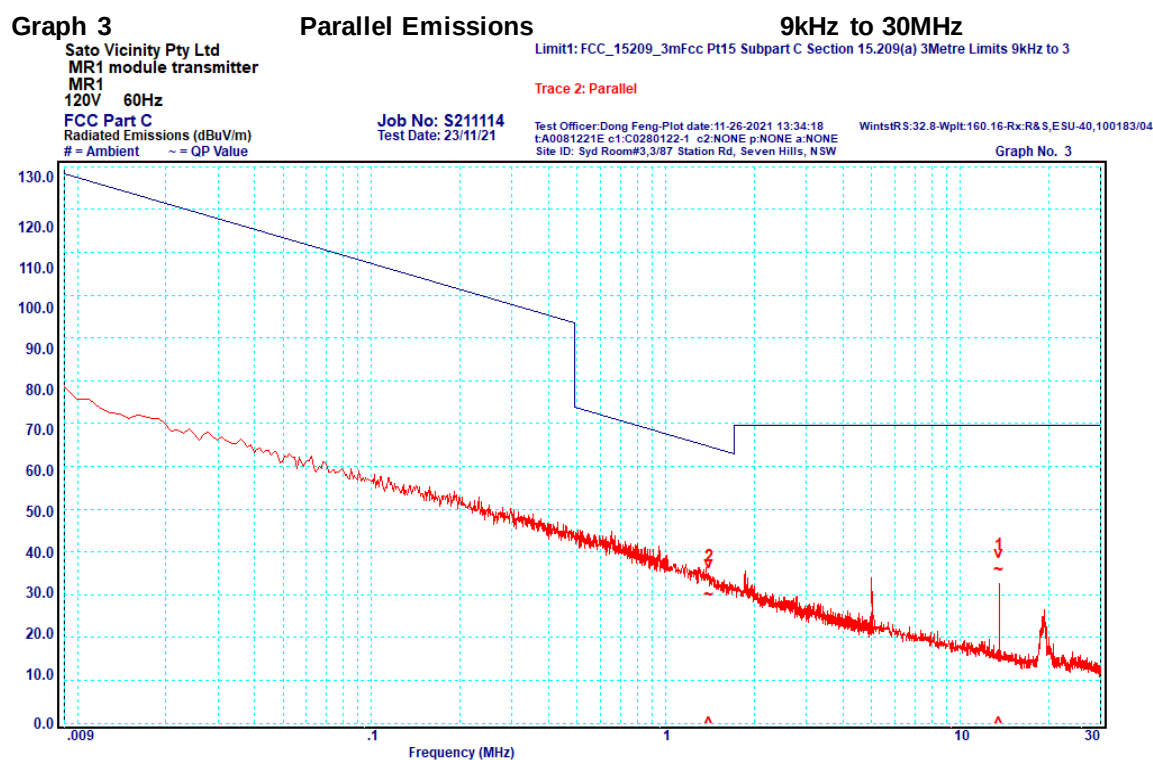
Radiated spurious emission measurements were performed in a semi-anechoic chamber compliant with CISPR 16-1-4.

The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of emissions.

Frequency range [MHz]	Measurement Bandwidth [kHz]	Measurement Distance [m]	Antenna
0.009 to 0.150	0.2	3	0.6 metre loop antenna
0.150 to 30	9	3	
30 to 300	120	3	Biconilog hybrid

The limit applied is in accordance to the radiated emission limits defined in §15.209 Radiated emission limits & §15.225 limit mask.

3.4.1.1 Frequency Band: 9 kHz to 30 MHz



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	13.560	Parallel	35.9	69.5	-33.6
2	1.400	Parallel	29.9	64.7	-34.8

Complied with the limit by a margin greater than 10dB.

Graph 4**Perpendicular Emissions****9kHz to 30MHz**

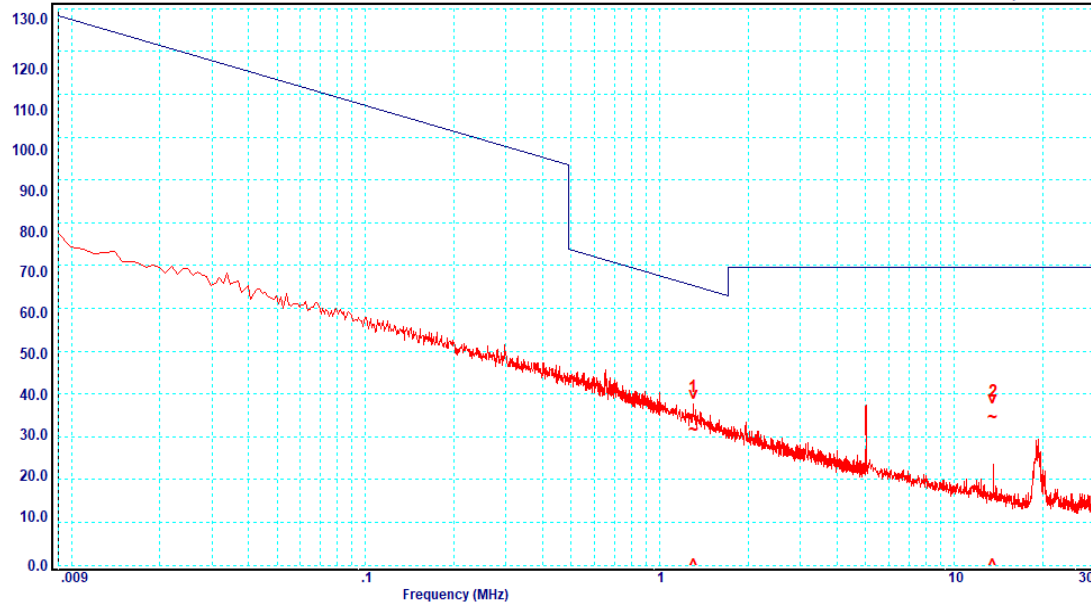
Sato Vicinity Pty Ltd
MR1 module transmitter
MR1
120V 60Hz
FCC Part C
Radiated Emissions (dBuV/m)
= Ambient ~ = QP Value

Job No: S211114
Test Date: 23/11/21

Trace 2: Perpendicular

Test Officer: Dong Feng Plot date: 11-26-2021 13:34:48 Wints(RS:32.8-Wplt:160.16-Rx:R&S,ESU-40,100183/04
t:A0081221E c1:00280122-1 c2:NONE p:NONE a:NONE
Site ID: Syd Room#3,3/87 Station Rd, Seven Hills, NSW

Graph No. 4



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	1.302	Perpendicular	31.4	65.4	-34.0
2	13.560	Perpendicular	34.6	69.5	-34.9

Complied with the limit by a margin greater than 10dB.

Graph 5**Ground Parallel Emissions****9kHz to 30MHz**

Sato Vicinity Pty Ltd
MR1 module transmitter
MR1
120V 60Hz
FCC Part C
Radiated Emissions (dBuV/m)
= Ambient ~ = QP Value

Job No: S211114
Test Date: 23/11/21

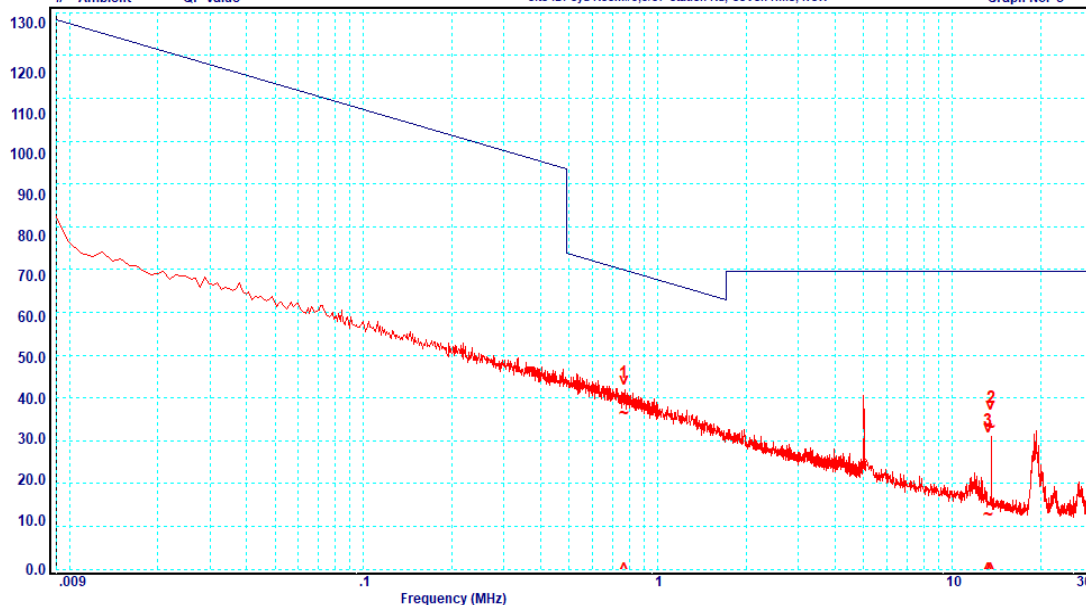
Limit1: FCC_15209_3mFcc Pt15 Subpart C Section 15.209(a) 3Metre Limits 9kHz to 3

Trace 2: Ground Parallel

Test Officer: Dong Feng Plot date: 11-26-2021 13:35:45
t:A0081221E c1:00280122-1 c2:NONE p:NONE a:NONE
Site ID: Syd Room#3,3/87 Station Rd, Seven Hills, NSW

Wints(RS:32.8-Wplt:160.16-Rx:R&S,ESU-40,100183/04

Graph No. 5



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	0.766	Ground Parallel	36.2	69.9	-33.7
2	13.560	Ground Parallel	33.1	69.5	-36.4
3	13.260	Ground Parallel	12.5	69.5	-57.0

Complied with the limit by a margin greater than 10dB.

3.4.1.2 Frequency Band: 30 to 300 MHz

Graph 6

Vertical Emissions

30MHz to 1000MHz

Sato Vicinity Pty Ltd
MR1 module transmitter
MR1
120V 60Hz
FCC Part C
Radiated Emissions (dBuV/m)
= Ambient ~ = QP Value

Job No: S211114
Test Date: 23/11/21

Limit1: FCC-15209

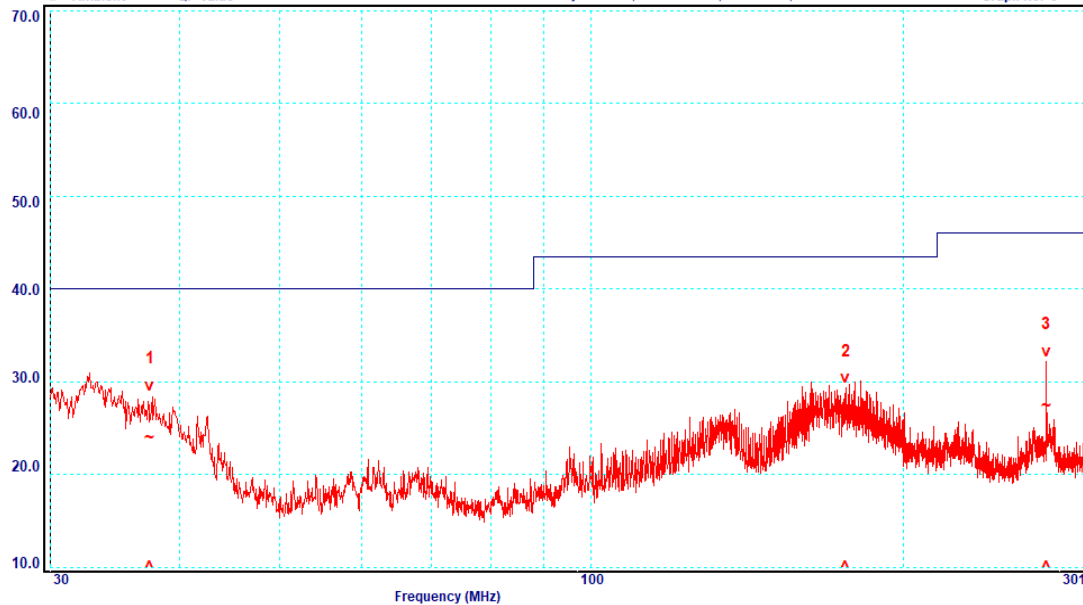
FCC Part 15.209 3 Metre Limits 30MHz to 40GHz

Trace 2: Vertical Emissions

Test Officer: Dong Feng-Plot date: 11-26-2021 13:41:08
t:A4300424+4 c1:C0280122-1 c2:NONE p:NONE a:NONE
Site ID: Syd Room#3,3/87 Station Rd, Seven Hills, NSW

WinstorRS:32.8-Wplt:160.16-Rx:R&S,ESU-40,100183/04

Graph No. 6



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	37.490	Vertical	23.9	40.0	-16.1
2	176.180	Vertical	26.2	43.5	-17.3
3	275.040	Vertical	27.4	46.0	-18.6

Complied with the limit by a margin of greater than 10dB.

Graph 7**Horizontal Emissions****30MHz to 1000MHz**

Sato Vicinity Pty Ltd
MR1 module transmitter
MR1
120V 60Hz
FCC Part C
Radiated Emissions (dBuV/m)
= Ambient ~ = QP Value

Limit1: FCC-15209

FCC Part 15.209 3 Metre Limits 30MHz to 40GHz

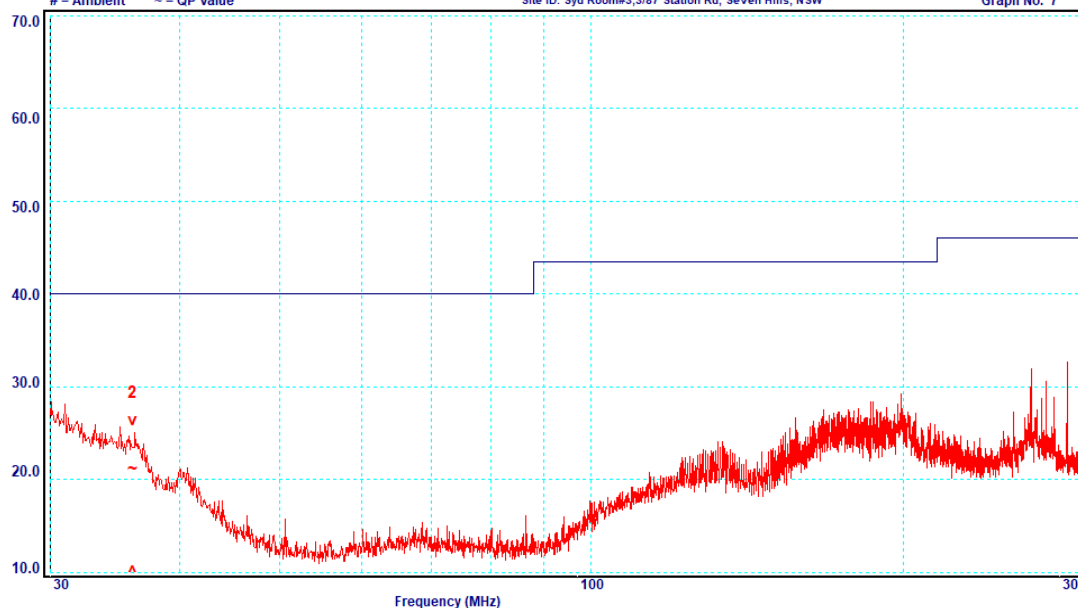
Trace 2: Horizontal Emissions

Job No: S211114
Test Date: 23/11/21

Test Officer: Dong Feng-Plot date: 11-26-2021 13:43:05
t:A4300424+4 c1:C0280122-1 c2:NONE p:NONE a:NONE
Site ID: Syd Room#3,3/87 Station Rd, Seven Hills, NSW

Wints(RS:32.8-Wplt:160.16-Rx:R&S,ESU-40,100183/04

Graph No. 7



Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	300.000	Horizontal	36.1	46.0	-9.9
2	36.060	Horizontal	21.1	40.0	-18.9

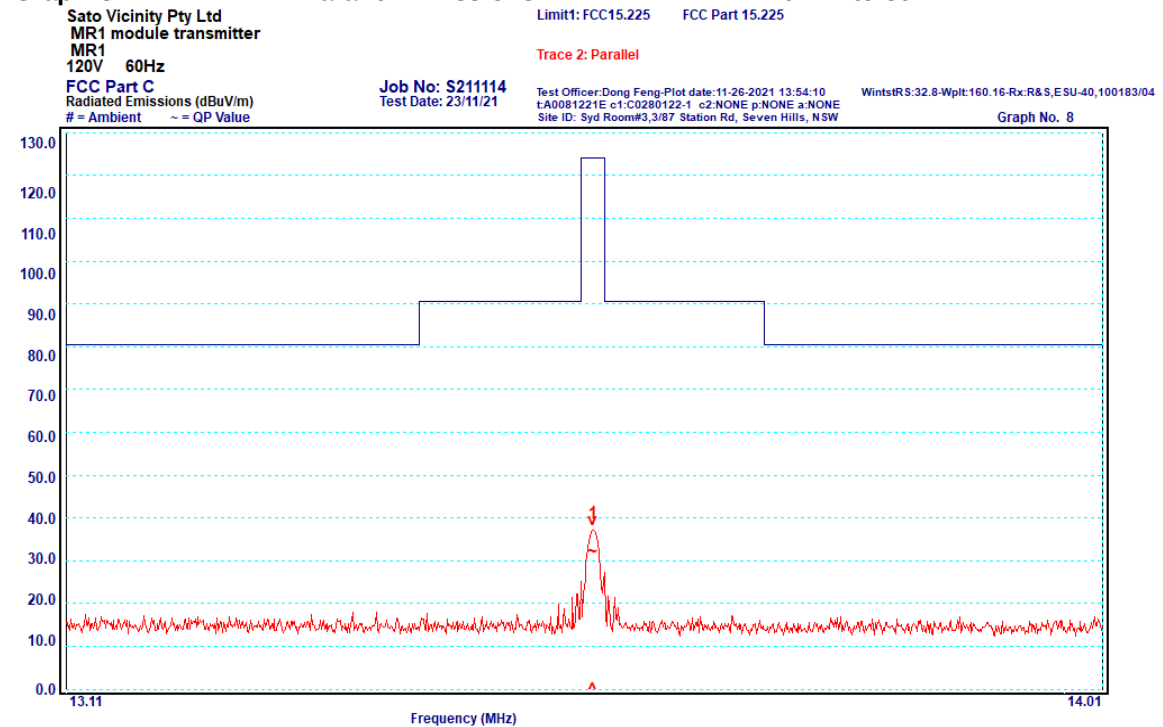
Complied with the limit by a margin of at least 9.9dB.

3.4.1.3 Frequency Band: 13.11 MHz to 14.01 MHz (§15.225 (a), (b), (c))

Graph 8

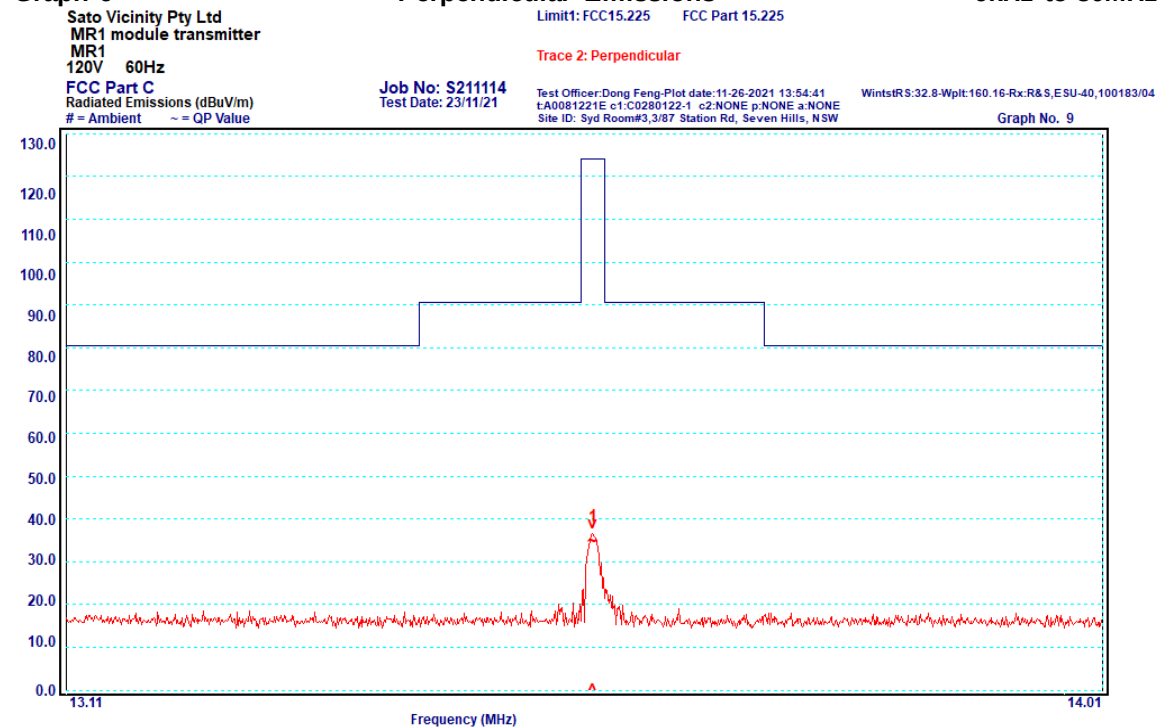
Parallel Emissions

9kHz to 30MHz



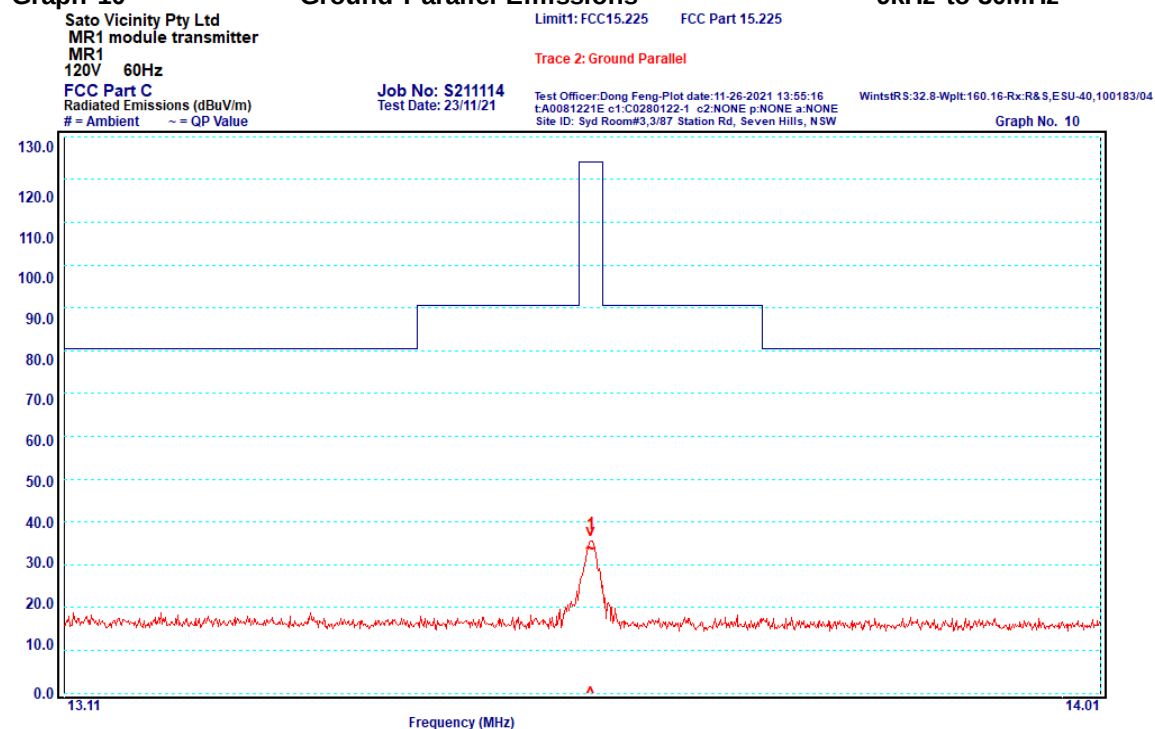
Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	13.560	Parallel	32.1	124.0	-91.9

Complied with the limit by a margin greater than 10dB.

Graph 9**Perpendicular Emissions****9kHz to 30MHz**

Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	13.560	Perpendicular	34.7	124.0	-89.3

Complied with the limit by a margin greater than 10dB.

Graph 10**Ground Parallel Emissions****9kHz to 30MHz**

Peak	Frequency (MHz)	Antenna Polarisation	Quasi Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	13.560	Ground Parallel	33.6	124.0	91.4

Complied with the limit by a margin greater than 10dB.

3.5 §15.225(e) Frequency Tolerance

The Frequency Tolerance was measured using the procedure from ANSI C63.10 section 6.8.

3.5.1 Supply Voltage Variation

The mains supply was lowered from 120V 60Hz to 102V (85% of nominal supply) and maintained until the frequency was stable. The mains supply was then increased from 120V 60Hz to 138V (115% of nominal supply) and maintained until the frequency was stable.

Temperature	Supply Voltage	Frequency Reading [MHz]	Frequency Variation [%]
20°C	85% (102 V)	13.56	0%
20°C	115% (138 V)	13.56	0%

Maximum Frequency Variation to Nominal Frequency:

13.6	0%
------	----

The frequency tolerance of the carrier signal was maintained within $\pm 0.01\%$ of the operating frequency during the voltage variation test.

3.5.2 Temperature Variation

The ambient temperature with a supply voltage of 120V 60Hz was varied between -20°C and +50°C. The frequency of the carrier was observed and compared to the nominal frequency.

Supply Voltage	Temperature	Frequency Reading [MHz]	Frequency Variation [%]
120 V	-20°C	13.56	0%
120 V	-10°C	13.56	0%
120 V	0°C	13.56	0%
120 V	10°C	13.56	0%
120 V	20°C	13.56	0%
120 V	30°C	13.56	0%
120 V	40°C	13.56	0%
120 V	50°C	13.56	0%

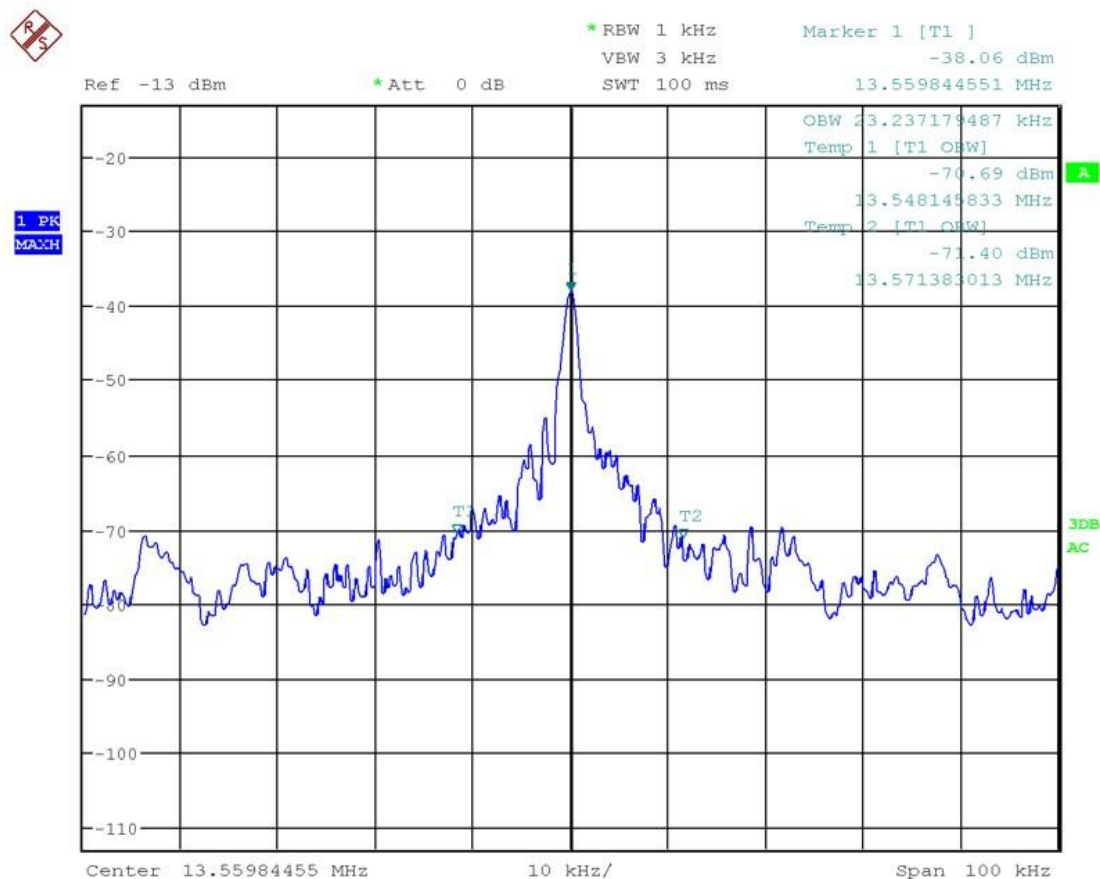
Maximum Frequency Variation to Nominal Frequency:	13.56	0%
---	-------	----

The frequency tolerance of the carrier signal was maintained within $\pm 0.01\%$ of the operating frequency during the temperature variation test.

3.6 §2.1049 Occupied bandwidth – 99% power

The bandwidth containing 99% power of the transmitted signal was measured using the procedure from ANSI C63.10 section 6.9.

The 99% power bandwidth was **23.23kHz**.



4.0 COMPLIANCE STATEMENT

The MR-1 with Model: MR-1 Module, complied with the requirements of FCC Part 15 Rules for an intentional radiator when tested in accordance with FCC Part 15.225.

5.0 Uncertainties

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainties for emissions tests shown within this report are as follows:

Conducted Emissions

9kHz to 30 MHz ± 3.2 dB

Radiated Emissions

9kHz to 30MHz ± 4.1 dB

30MHz to 300MHz ± 5.1 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.



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