

RADIOFREQUENCY RADIATION EXPOSURE EVALUATION: MOBILE DEVICES



REPORT NUMBER: S211114-2 V3

TEST STANDARD: 47 CFR PART 2.1091

CLIENT: SATO VICINITY PTY LTD

DEVICE: MR-1

MODEL: MR-1 MODULE

DATE OF ISSUE: 15 FEBRUARY 2022

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REVISION TABLE

Version	Sec/Para Changed	Change Made	Date
1		Initial issue of document	22 December 2021
2		Update to FCC ID	9 February 2022
3		Update to FCC ID	15 February 2022

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RADIOFREQUENCY RADIATION EXPOSURE EVALUATION

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

FCC ID: 2ACXQ-CL4NXPLUS-MR1

Manufacturer: Sato Vicinity Pty Ltd

Tested for: Sato Vicinity Pty Ltd
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Standards: **47 CFR Part 2.1091**
"Radiofrequency radiation exposure evaluation: mobile devices"
47 CFR 1.1310
"Radiofrequency radiation exposure limits"
KDB 447498 D01 General RF Exposure Guidance v06
"RF exposure procedures and equipment authorization policies for mobile and portable devices".

Result: Based on an assessment of the documentation provided the MR-1, model MR-1 Module complies with the RF exposure requirements of 47 CFR Part 2.1091, however an exclusion zone of 20 cm in front of the radiating elements applies, elsewhere the exposure level was below the MPE limits.. Refer to Report S211114-2 v3 for full details

Assessment Date: 23 November 2021

Issue Date: 15 February 2022

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1 INTRODUCTION

This report is intended to demonstrate compliance of the MR-1, model MR-1 Module with the RF exposure requirements of 47 CFR Part 2.1091. Evaluation was performed in accordance with FCC KDB 447498 D01.

The product sample was provided by the Client. The conclusion herein is based on the information provided by the client.

1.1 Laboratory Overview

EMC Technologies Pty. Ltd. is an independently owned Australian company that is NATA accredited to ISO 17025 for both testing and calibration and ISO 17020 for Inspection. – **Accreditation Number 5292.**

1.2 Test Laboratory/Accreditations

Measurements were performed at EMC Technologies' laboratory in Seven Hills, NSW, Australia.

Table 1-1: Accreditations for Conformity Assessment

Country/Region	Body	
Australia/New Zealand	NATA	Accreditation Number: 5292
Europe	European Union	Notified Body Number: 0819
USA	FCC	Designation Number: AU0002 (Syd)
Canada	ISED Canada	Company Number: 4207A (Syd)
Japan	VCCI	Company Number: 785
Taiwan	BSMI	Lab Code SL2-IN-E-5001R

2 DEVICE DETAILS

(Information supplied by the Client)

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
Nominal Bandwidth:	850kHz
Antenna type and gain:	Inductive loop antenna, 1.5dBi
Input Supply:	120V, 60Hz
FCC ID:	2ACXQ-CL4NXPLUS-MR1
Auxiliary Equipment	Sato CL4NXPlus Barcode Printer Laptop, USB Mouse Data Communication and power supply adaptor board



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Transmit parameters were provided by the customer are shown below:

Transmitter #1	
Brand/Model:	Fujitsu/MBH7BTZ40 and MBH7BTZ52
Operating frequency: (MHz)	2402, 2441, 2480
Max RF output level:	0dBm
Antenna Type:	Monopole
Antenna Gain:	1.4 dBi

Transmitter #2	
Brand/Model:	Silex technology/SX-SDMAN
Operating frequency:	2402 MHz - 2462MHz
Max RF output level:	14.5 dBm
Antenna Type:	Sleeve antenna
Antenna Gain:	1.0 dBi

Transmitter #3	
Brand/Model:	Trimble/RH42G
Operating frequency:	902.75MHz - 927.25MHz, 2402MHz - 2462MHz
Max RF output level:	27.99 dBm (UHF RFID) , 15 dBm (WiFi)
Antenna Type:	RFID Ceramic Patch Ant
Antenna Gain:	-3 dBi

Transmitter #4	
Brand/Model:	Sato/TR3-A302
Operating frequency:	13.56MHz
Max RF output level:	40 dBm
Antenna Type:	Loop Antenna
Antenna Gain:	-65 dBi

Transmitter #5	
Brand/Model:	Sato/MR-1
Operating frequency: (MHz)	13.56MHz
Max ERIP	-50 dBm*
Antenna Type:	Inductive loop antenna
Antenna Gain:	1.5 dBi

*Refer to report S211114-1, section 3.4.1.3, graph 9.

3 LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE), §1.1310

Table 3-1: Occupational and General Public MPE Limits

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500	-	-	f/300	6
1,500-100,000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500	-	-	f/1500	30
1,500-100,000	-	-	1.0	30

Where f = Frequency in MHz, * = Plane-wave power density

4 UNCERTAINTY

EMC Technologies has evaluated the tools and methods used to perform Radiated Electromagnetic Field predictions. The estimated measurement uncertainties for the calculation shown within this report are as follows:

Electromagnetic Modelling;

30 MHz to 100GHz ±2.8 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%.

5 ASSUMPTIONS IN THIS ASSESSMENT

This assessment does not include accumulated RF fields from nearby sites/antennas or possible radio signal reflections or attenuation due to buildings or the general environment.

Antenna Parameters and power settings were supplied by the customer.

A 100% duty cycle is assumed.

The aperture of the radiating element assumed to be a point source in free space and far field conditions.

Power tolerance added to the nominal output power.

6 EVALUATION RESULT

The MPE was evaluated at 20 cm to show compliance with the power density listed in table 2,

The following formula was used to calculate the power density at 20 cm

$$S = \frac{P * G}{4\pi R^2}$$

$$S = \frac{EIRP}{4\pi R^2}$$

Where

(S): Power density (mW/cm^2)

(P): Output power at antenna terminal (mW)

(G): Gain (ratio)

(R): Minimum test separation distance (20 cm)

Table 6-1: Evaluation Result

Technology	Frequency Band (MHz)	Duty Cycle	EIRP	EIRP	Flux Density at 20 cm	Flux Density limit	Percentage of the limit
		%	dBm	mW	mW/cm^2	mW/cm^2	%
RFID	13.56	100	-50.0	0.0	0.0	1.0	0.0%
RFID	13.56	100	-25.0	0.0	0.0	1.0	0.0%
Bluetooth	2402, 2441, 2480	100	1.4	1.4	0.0	1.0	0.0%
Bluetooth	2402 - 2480	100	15.5	35.5	0.0	1.0	0.7%
UHF RFID	902.75 – 927.25	100	24.99	315.5	0.1	0.6	6.3%
WIFI	2402 - 2462	100	12.0	15.9	0.0	1.0	0.3%
Total percentage of the limit at 20 cm (Worst Case)							7.3%

*Refer to report S211114-1, section 3.4.1.3, graph 9.

7 CO-LOCATION CONSIDERATION:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0 .

$$\sum_{1}^N \frac{S_{eqN}}{S_{limN}} = \frac{S_{eq1}}{S_{lim1}} + \frac{S_{eq2}}{S_{lim2}} + \dots + \frac{S_{eqN}}{S_{limN}} \leq 1$$

Where: Seq = Power Spectral density (mw/cm^2) of a specific transmitter
 Slim = MPE limit (mw/cm^2)

The following simultaneous transmissions are possible:

Transmitter1	Transmitter2	Transmitter3	Transmitter4	MPE Ratio Sum	Result
RFID	WIFI	UHF RFID	Bluetooth	0.073	pass

8 CONCLUSION

Based on an assessment of the documentation provided the MR-1, model MR-1 Module complies with the RF exposure requirements of 47 CFR Part 2.1091. An exclusion zone of 20cm in front of the radiating elements applies, elsewhere the exposure level was below the MPE limits.