COMPLIANCE TESTING REPORT
FCC TITLE 47 PART 15
SUBPART C

Client:	Sato Vicinity Pty Ltd
Address:	32 Burrows Road, St. Peters, NSW 2044, Australia
Report Number:	0829SAT_MDR-4330AT_FCCPT15C
Date of Testing:	29th November 2017 to 22nd June 2018
File Number:	SAT171103
Equipment Name:	Desktop RFID 3D Reader
Equipment Model Number:	MDR-4330AT
Equipment Serial Number:	BH500053
Equipment FCC ID:	2ACXQ-MDR-4330ATE
Equipment Description:	ISO 18000-3 Mode 2 Compliant RFID Reader
Result:	**COMPLIES** (refer page 4)
Tested by:	Richard Turner Test Engineer
	Steve Garnham Test Engineer
Approved by:	Colin Gan Assessment Engineer
Date of Issue:	29 August 2018

AUSTEST (NSW) FCC REGISTRATION NUMBER 520620

Table of Contents:

Report Revision History:

Date	Report Number	Changes
06 August 2018	0806SAT_MDR-4330AT_FCCPT15C	Original Report.
16 August 2018	0816SAT_MDR-4330AT_FCCPT15C	Change in FCC ID & Clause 6.4 statement added.
29 August 2018	0829SAT_MDR-4330AT_FCCPT15C	Modification to FCC ID label.

1 TEST SUMMARY

Austest makes no claim regarding the consistency of production versions of the EUT.

The results in this report apply only to the tested EUT described in Section 4 of this report.

FCC Section	Test	Result	Notes
FCC Part 15, Subpart C – Intentional Radiators			
15.203	Antenna Requirement	COMPLIED	-
15.205	Restricted Bands of Operation	COMPLIED	-
15.207	Conducted Limits	COMPLIED	-
15.209	Radiated Emission Limits, General Requirements	COMPLIED	(i), (ii)
15.225	Operation within the Band 13.110-14.010MHz	COMPLIED	(i), (ii)

Notes (applicable only if referenced in "Notes" column of above summary table):
(i) EUT complied (the measurement results were below the applicable limits), but some emissions were within the range of measurement uncertainty of the limits.
(ii) EUT complied (when modified as described in Section 2 of this report).
(iii) There were deviations from the applied standard as described in Section 6.2 of this report.

2 MODIFICATIONS

1. To reduce radiated emissions below limits specified in section 15.209 (a), a ferrite with one turn was fitted to the USB cable connecting to the EUT USB device port. The ferrite should be fitted in such a manner to prevent accidental removal.
   Ferrite details: Wurth Elektronik p/n 742 711 12S, one turn impedance 321Ω@100MHz

USB Modification

Ferrite Details

2. To reduce radiated emissions below limits specified in section 15.225 (b), transmit power setting for the external wand antenna was reduced from level 3 to level 1, by the client.

3 REFERENCES

Document	Title	Issue/ Amendments
FCC Title 47 Part 15	Radio Frequency Devices – Subpart C – Intentional Radiators	1 October 2017
ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless	2013
KDB 174176 D01	AC Power-line Conducted Emissions Frequently Asked Questions	v01r01 03 June 2015

4 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

EUT Name:	Desktop RFID 3D Reader
EUT Description:	ISO 18000-3 Mode 2 Compliant RFID Reader
EUT Model:	MDR-4330AT
EUT Serial Number:	BH500053
EUT FCC ID:	2ACXQ-MDR-4330ATE
Manufacturer:	Sato Vicinity Pty Ltd
Power Supply & Rating:	100-240VAC 1.5A 47-63Hz (supplied plug pack)
Highest Clock/Operating Frequency:	50MHz
Lowest Internal Frequency source	32kHz real time clock
Transmit Frequency Range:	13.56MHz only
Transmit Power:	Internal antenna: Level 3* External wand antenna: Level 1*
Modulation Technique:	Phase Jitter Modulation
Number of Channels:	Not applicable
Antenna Specifications:	Internal antenna: 430 x 280mm PCB antenna (p/n: 083-10-1003-PCB vB1) External wand antenna: Tethered-124, (p/n: 031-70-035) The client indicated both antennas have a theoretical gain of 2.15dBi.

*Power level settings as defined in the EUT operating firmware and set by the manufacturer.

The equipment under test (EUT) was an RFID read/write system operating at 13.56MHz. The EUT had two antennas. One was installed inside the reader. Second antenna was an external hand wand antenna, which connected to an external antenna port mounted on the reader. The EUT was designed to energise and communicate with passive RFID tags.

In normal operation, the EUT switched transmission between both antennas. Only one antenna would be transmitting at any one time.

The EUT was supplied with a Gingon Electronics Co. Ltd. AC adaptor, model TRH50A120, input 110-240VAC 1.5A 47-63Hz, output 12VDC 4.2A.
The AC adaptor was connected to a 120VAC 60Hz mains supply.

5 EUT TEST SETUP & CONFIGURATION

Refer to the photographs in APPENDIX C – EUT TEST SETUP PHOTOGRAPHS for the EUT test setup and physical configuration.

The client supplied a laptop PC that provided transmission control and selection of antenna. This was connected to the EUT by Ethernet.
Since only one antenna transmitted at a time, testing was done with either the internal antenna selected, or external wand antenna selected.

Following transmit power settings were set by the client:
Internal Antenna: Level 3
External Antenna: Level 1

5.1 Supporting Equipment

Equipment	Brand & Model
Passive RFID Tag	Client supplied
RF Dummy Load	Client supplied
Test PC	HP EliteBook 8530P
AC adaptor	Gingon Electronics Co. Ltd. TRH50A120

5.2 Cables

Connection / Port	Connecting Cable *	Source / Load
LAN	1.5m unshielded CAT5 cable	Test PC**
USB Host***	None	-
USB device	1.7m shielded USB cable, with ferrite fitted at EUT connection	-
Ant	1.3m shielded coaxial cable	Permanently fitted to the external wand antenna
Power	70cm shielded DC power cable, with ferrite fitted at EUT connection	Permanently fitted to the supplied AC adaptor
Mains Power (AC adaptor)	1.8m unshielded 3 core IEC mains lead	120VAC 60Hz mains supply

* Cables were bundled in accordance with ANSI C63.10.
** For radiated emissions test the test PC was placed away from the test area.
*** This port would only be used for programming/maintenance. No permanent cable connection.

5.3 RF Channels

The EUT could only transmit on one frequency 13.56MHz.

6 TEST SPECIFICATIONS

6.1 Accreditations & Listings

Austest Laboratories has been found to be in compliance with the requirements of 47 CFR Section 2.948 of the FCC Rules and Test Site Criteria (ANSI C63.4-2014) by the FCC Laboratory Division for Certification testing under Parts 15 or 18 of the FCC Rules.

Austest Laboratories (NSW)'s Yarramalong test facilities are registered with the FCC under Registration Number 520620.

Austest Laboratories (NSW)'s Yarramalong test facilities are accredited by A2LA. The tests reported herein have been performed in accordance with its terms of accreditation.

6.2 Deviations from Standards and/or Accreditations

None.

6.3 Test Facility

Testing was performed in New South Wales at Austest Laboratories (NSW)'s Yarramalong test facilities located at 46 Glenola Farm Lane in Yarramalong Valley, New South Wales, Australia.

Radiated emission testing was performed at an Open Area Test Site (OATS), where some ambient signals may exceed the continuous disturbance limit. The possibility of missing an emission during testing was removed by use of pre-scans, performed in a shielded enclosure, prior to the final OATS measurements.

6.4 Test Equipment

ID	Brand/Model	Description	Last calibrated	Calibration due
72	HP8574B	Spectrum Analyser / EMI Receiver	28/07/2017	28/07/2019
100	HP8447	RF Preamp	19/05/2017	19/05/2019
225	EM6876	Loop Antenna	19/09/2017	19/09/2019
297	EM6912	Bicon Antenna	10/08/2017	10/08/2019
298	EM6950	Log Antenna	17/08/2017	17/08/2019
320	Chorima 6512	AC Source	Verified	
336	EM 93146	Bicon Antenna *	12/12/2014	12/12/2017
337	EM 93110	Log Antenna *	12/12/2014	12/12/2017
827	Com-Power LI-215A	AMN	17/08/2017	17/08/2019
873	GDW-128	Temperature chamber	Verified	
884	Extech SD700	Thermometer	30/03/2017	30/03/2019
1385	FSP40	Spectrum Analyser	16/08/2017	16/08/2018
-	Huber + Suhner	Coax Cables	30/11/2017	30/11/2019
-	HP85869C	Test Software	Verified	

* These antennas were only used for measurements within the calibration period of the antennas. Beyond their due dates, the other set of antennas (EM6912 & EM6950) were used.

All test equipment was checked and performance verified prior to testing.

6.5 Measurement Uncertainties

The following uncertainties are for a 95% level of confidence, based on a coverage factor, k=2.

Test	Measurement Uncertainty
Mains Conducted Emissions	±2.6dB
Radiated Emissions, <1GHz	±4.7dB
Frequency	±5 part in 10^{10}

7 FCC Part 15C, Section 15.203 – ANTENNA REQUIREMENT

For the external antenna port, the EUT used a unique reversed polarity TNC connector.

The EUT complied with the requirement of this Section due to use of this unique antenna connector.

8 FCC Part 15C, Section 15.205 – RESTRICTED BANDS OF OPERATION

The EUT complied with the requirements of this Section since it did not operate within the listed Restricted Bands of Operation. The EUT operated at 13.56MHz.

9 FCC Part 15C, Section 15.207 - CONDUCTED LIMITS

Test Date:	8th May, 5th, 6th and 22nd June 2018	Temperature:	18-23°C
Test Officer:	Steve Garnham	Humidity:	38%-54%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

9.1 EUT Operating Mode

Refer to section 5.
The following four configurations were used in testing:

1. Constant transmission with internal antenna selected.
2. Constant transmission with external antenna selected.
3. Constant transmission with external antenna selected, but with external antenna port terminated in a non-radiating dummy load. Test level 3 selected.
4. Constant transmission with external antenna selected, but with external antenna port terminated in a non-radiating dummy load. Test level 1 selected.

Configuration 3 would satisfy internal antenna port measurement, since transmission was at the internal antenna power level setting (level 3).
Mains supply voltage to the adaptor input was set to 120VAC 60Hz.

9.2 Test Method

a. Measurements were performed in accordance with ANSI C63.10-2013.
b. The EMI Receiver BW was set to 9kHz for the test.
c. The EUT was set up on a non-conductive table, 0.8m above a conductive ground plane, with the rear of the whole EUT setup 0.4m away from a conductive vertical reference plane (in electrical contact with the ground plane), and 0.8m away from any other conductive surface.
d. The EUT power was supplied through the EUT LISN. Power for supporting equipment (if any) was supplied through the supporting equipment LISN. Both LISNs were grounded to the ground plane and kept 0.8m away from the EUT test setup.
e. The power cable length between the EUT and the EUT LISN was maintained between 0.8m to 1m. Excess power cable lengths were bundled together in the centre of the cable to form a bundle 30cm to 40cm long.
f. All interconnection cables were draped over the table edge and kept at least 40cm above the ground plane. Any excess cables were bundled in the centre of the cable to form a bundle 30cm to 40cm long.
g. Conducted emission measurements were made on both Active and Neutral lines of the EUT.
h. In accordance with KDB174176, measurements were repeated with the external antenna port connected to a dummy load supplied by the client.

9.3 Sample Calculation Example

The final voltage levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$V_c = V + L_{cbl} + L_{LISN} + L_{limiter}$$

Where:

V_c	=	Corrected voltage level in dBµV for comparison to the limit.
V	=	EMI Receiver measured signal input voltage in dBµV.
L_{cbl}	=	Total cable insertion loss in dB.
L_{LISN}	=	Voltage division factor (insertion loss) of LISN in dB.
$L_{limiter}$	=	Insertion loss of voltage limiter, where applicable, in dB.

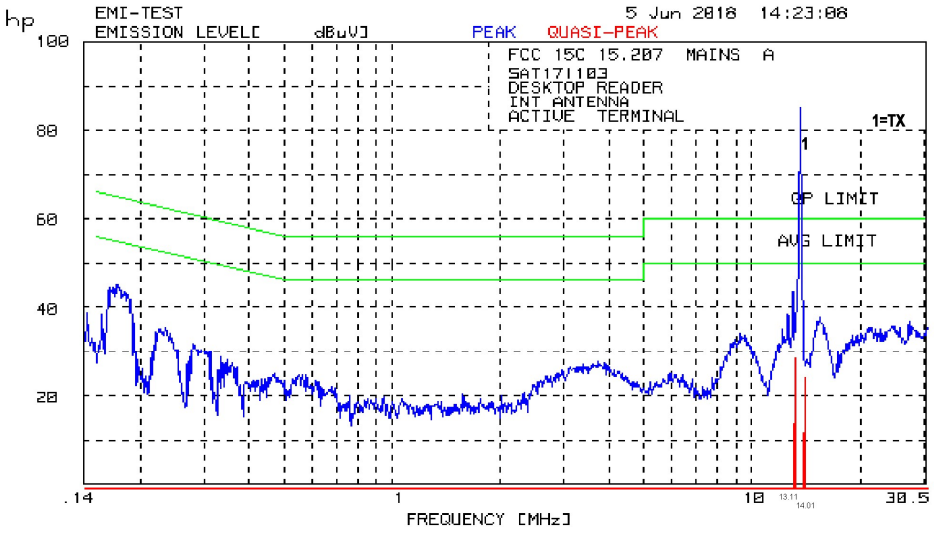
Frequency (MHz)	Receiver Level, V (dBµV)	L_{cbl} (dB)	L_{LISN} (dB)	$L_{limiter}$ (dB)	Corrected Level, Vc (dBµV)
1.0	40.0	0.1	0.1	N.A.	40.2

9.4 Test Results

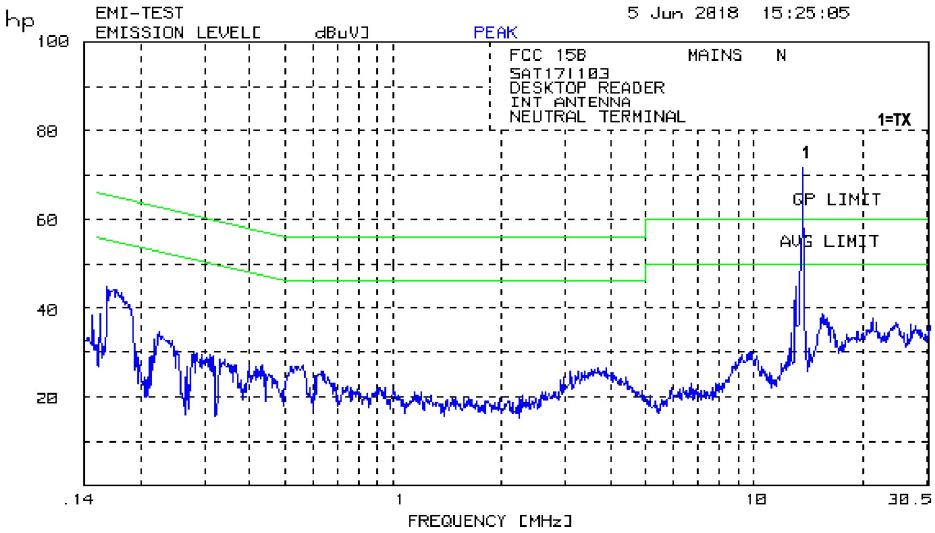
9.4.1 Configuration 1

Constant transmission, internal antenna selected.

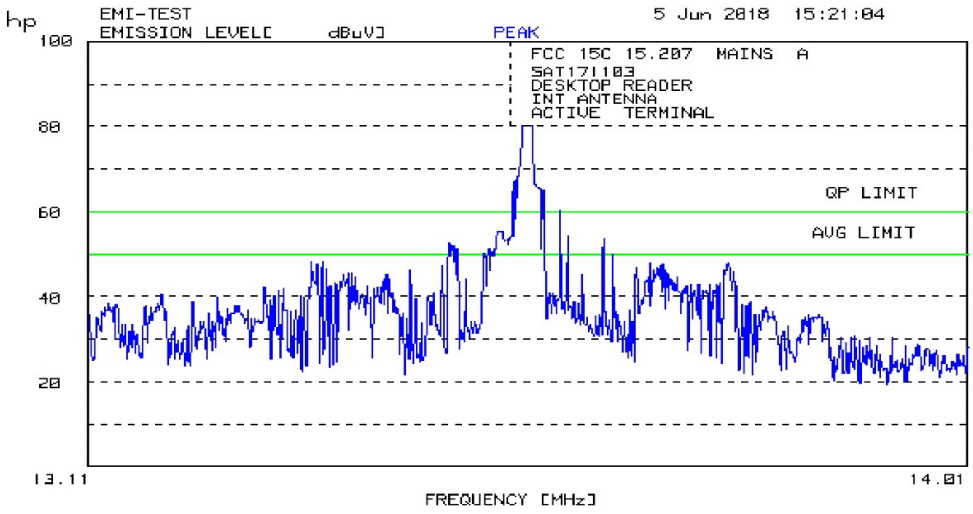
All measured emissions were greater than 10dB below the Quasi-peak and Average levels specified in section 15.207.
Average levels were not measured when Quasi-peak levels were below Average limits.



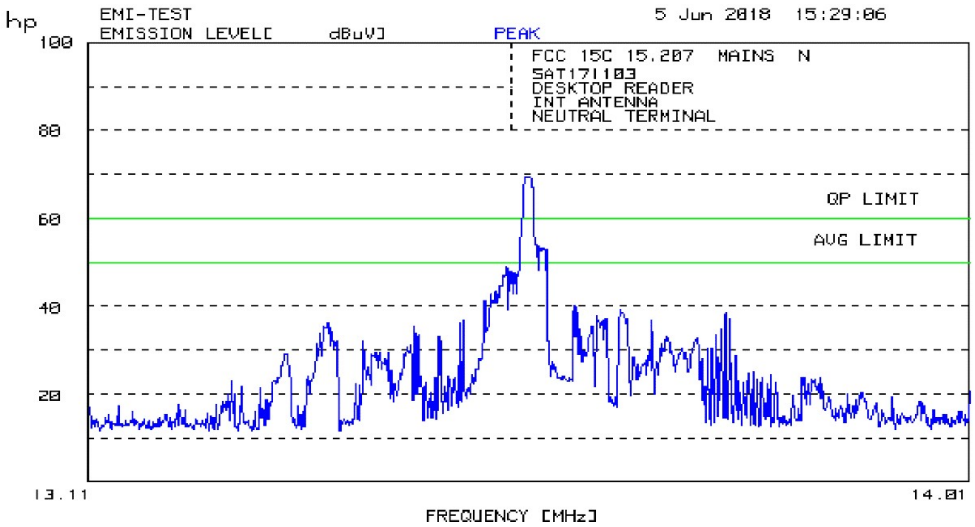
Conducted Emissions Plot 150kHz to 30MHz (Active Line)



Conducted Emissions Plot 150kHz to 30MHz (Neutral Line)



Conducted Emissions Plot 13.11MHz to 14.01MHz (Active Line)

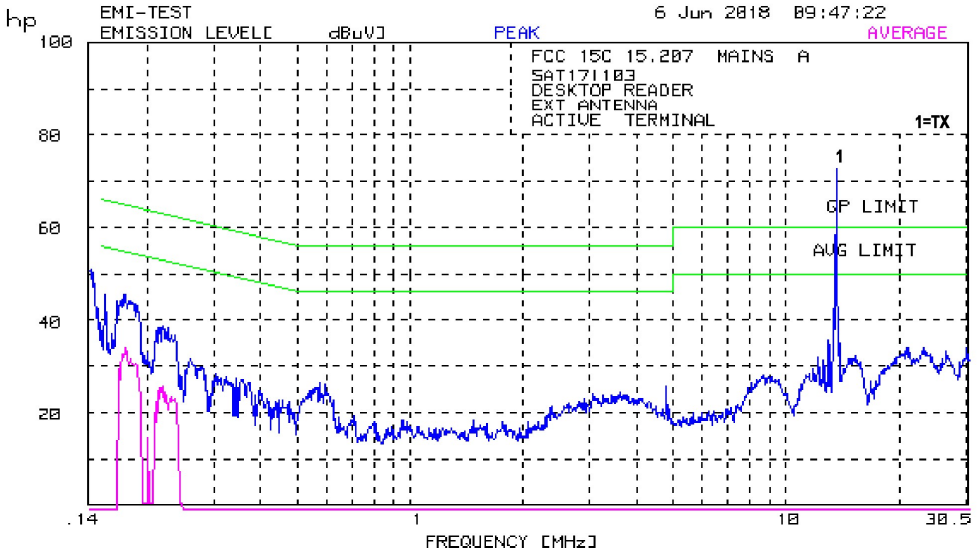


Conducted Emissions Plot 13.11MHz to 14.01MHz (Neutral Line)

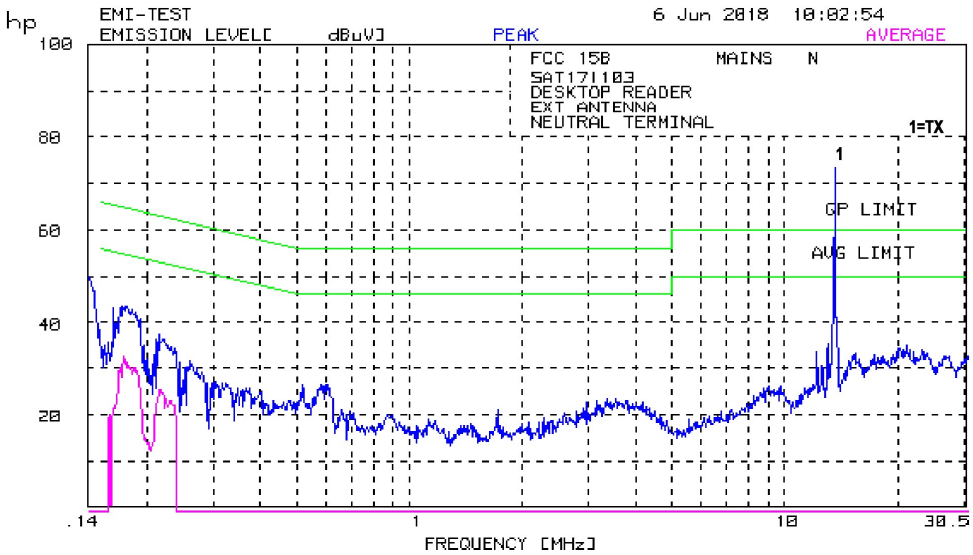
9.4.2 Configuration 2

Constant transmission, external antenna selected.

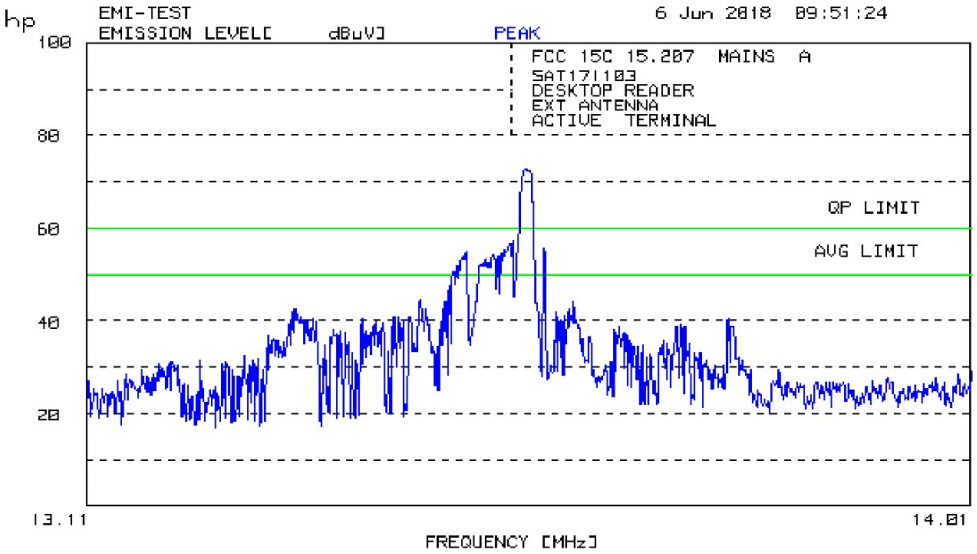
All measured emissions were greater than 10dB below the Quasi-peak and Average levels specified in section 15.207.



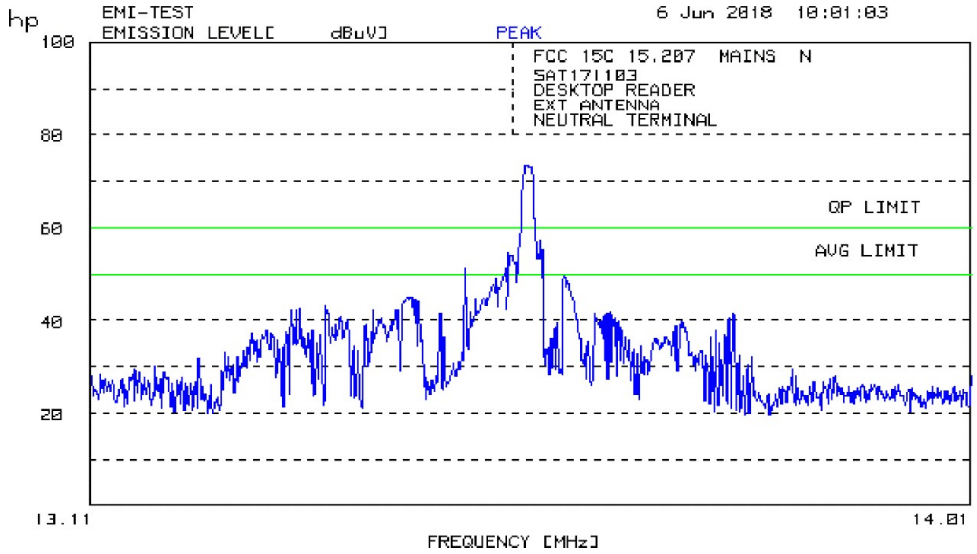
Conducted Emissions Plot 150kHz to 30MHz (Active Line)



Conducted Emissions Plot 150kHz to 30MHz (Neutral Line)



Conducted Emissions Plot 13.11MHz to 14.01MHz (Active Line)

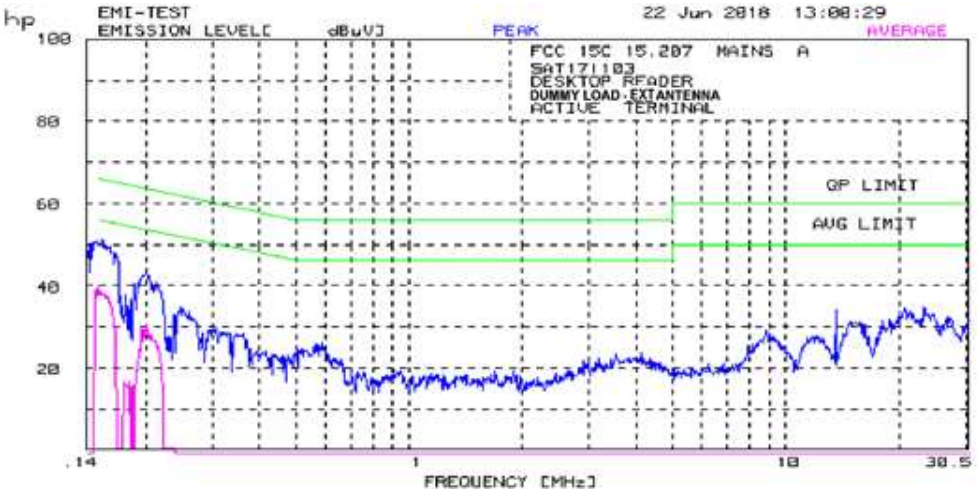


Conducted Emissions Plot 13.11MHz to 14.01MHz (Neutral Line)

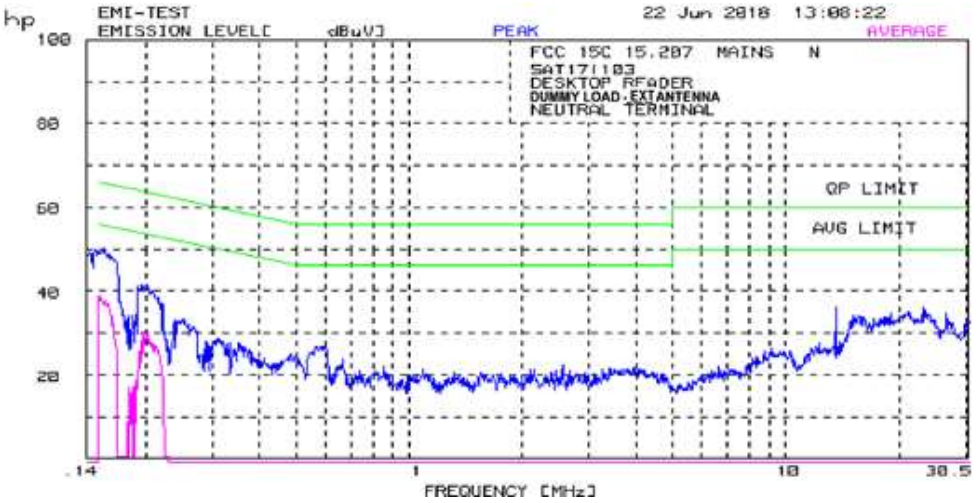
9.4.3 Configuration 3

Constant transmission, external antenna selected with dummy load connected to external antenna port. Transmit power level 3 (internal antenna setting).

All measured emissions were greater than 10dB below the Quasi-peak and Average levels specified in section 15.207.



Conducted Emissions Plot 150kHz to 30MHz (Active Line)

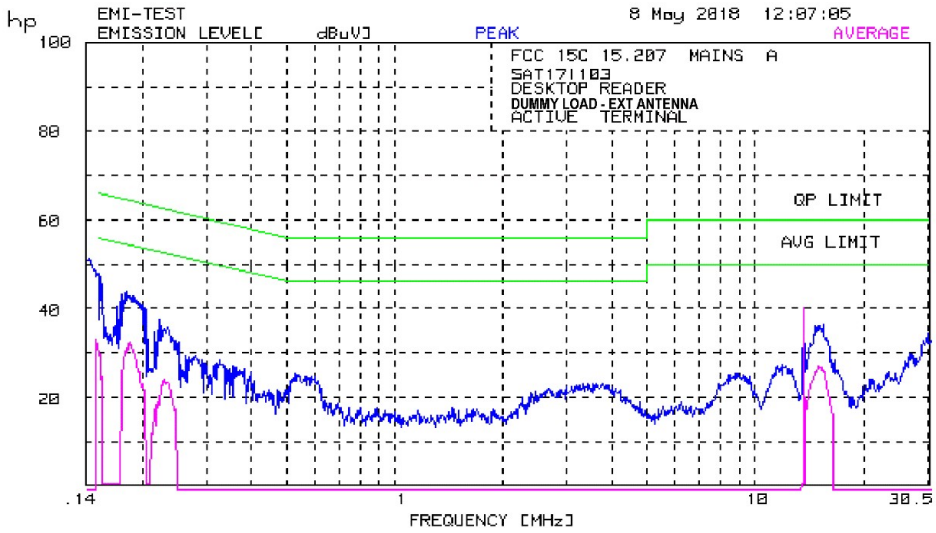


Conducted Emissions Plot 150kHz to 30MHz (Neutral Line)

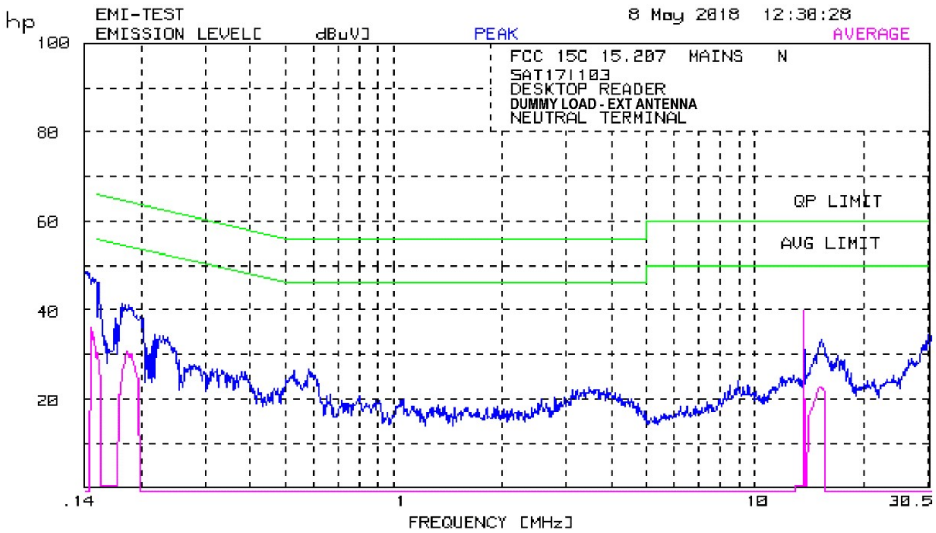
9.4.4 Configuration 4

Constant transmission, external antenna selected with dummy load connected to external antenna port. Transmit power level 1 (external antenna setting).

Highest measured Average level was 9.8dB below the Average limit specified in 15.207 at 13.56MHz.
All measured emissions were greater than 10dB below the Quasi-peak levels specified in section 15.207.



Conducted Emissions Plot 150kHz to 30MHz (Active Line)



Conducted Emissions Plot 150kHz to 30MHz (Neutral Line)

10 FCC Part 15C, Section 15.209 - RADIATED EMISSION LIMITS, GENERAL REQUIREMENTS

Test Date:	29th November 2017, 7th May 2018 and 13th June 2018	Temperature:	20-28°C
Test Officer:	Richard Turner / Steve Garnham	Humidity:	54-62%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

10.1 EUT Operating Mode

Refer to section 5.
The following two configurations were used in testing:

1. Constant transmission with internal antenna selected.
2. Constant transmission with external antenna selected.

Mains supply voltage was set to 120VAC 60Hz.

10.2 Test Method

a. Measurements were performed in accordance with ANSI C63.10-2013.
b. The measuring receiver BW settings were:
   i. 200Hz (9kHz to 150kHz) EMI Receiver RBW.
   ii. 9kHz (150kHz to 30MHz) EMI Receiver RBW.
   iii. 120kHz (30MHz to 1GHz) EMI Receiver RBW.
   iv. 1MHz (above 1GHz) RBW, 1MHz or more VBW, using a Spectrum Analyser for Peak measurements.
   v. 1MHz (above 1GHz) RBW, 10Hz VBW, using a Spectrum Analyser for Average measurements.
c. The EUT was setup on a non-conductive turntable, 0.8m above the OATS conductive ground plane, and at the indicated test distance away from the measuring antenna.
d. For measurements above 1GHz, the EUT was paced on a 1.5m non-conductive support.
e. To maximise emissions, the EUT was rotated through 360° and the measuring antenna height was varied between 1m to 4m in the following antenna orientations:
   i. Loop antenna (150kHz to 30MHz) – Coaxial and coplanar orientations.
   ii. Biconical and Log-Periodic antennas (30MHz to 1GHz) - Both vertical and horizontal polarizations.
   iii. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.
f. For measurements above 1GHz, RF absorber was placed between the measuring antenna and EUT. Refer ANSI C63.10 clause 5.2.
g. The maximised emissions were measured and the above was repeated for all measurement frequencies.
h. Average level measurements were not performed where the peak level did not exceed the average limit.
i. Linearity of the measuring system was checked, reducing gain when required.
j. For portable or hand-held devices, the EUT was placed in three orientations to determine worse case emission levels.

10.3 Sample Calculation Example

The final radiated emission levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$E = V + AF + L_{cbl} - G_{pre}$$

Where:

E = Radiated Electric Field Strength in dBµV/m at the specified distance.
V = EMI Receiver measured signal input voltage in dBµV.
AF = Antenna Factor of the measuring antenna in dB/m.
L_{cbl} = Total cable insertion loss in dB.
G_{pre} = Preamplifier gain in dB.

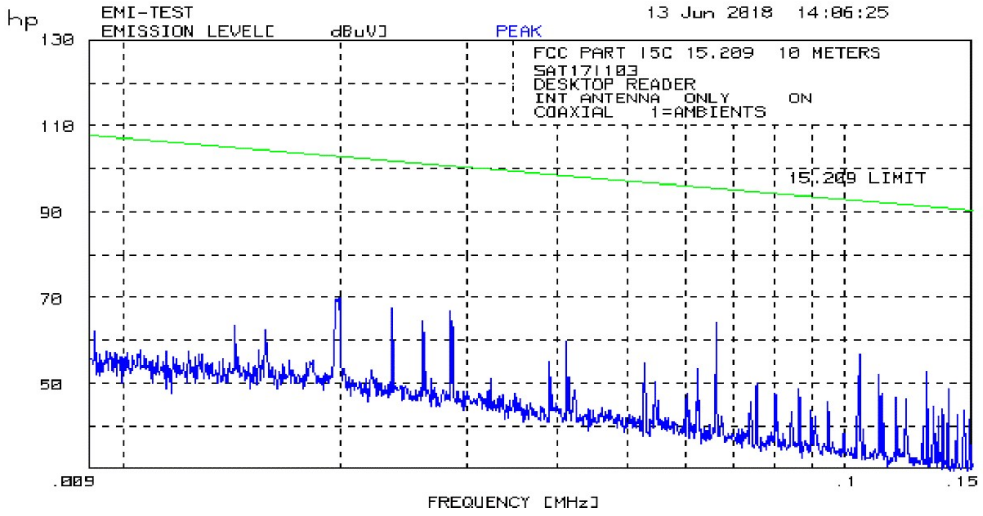
Frequency (MHz)	Receiver Level, V (dBµV)	AF (dB/m)	Lcbl (dB)	Gpre (dB)	Corrected Level, E (dBµV/m)
100.0	40.0	12.0	2.9	22.5	32.4

10.4 Test Results – Transmission from Internal Antenna

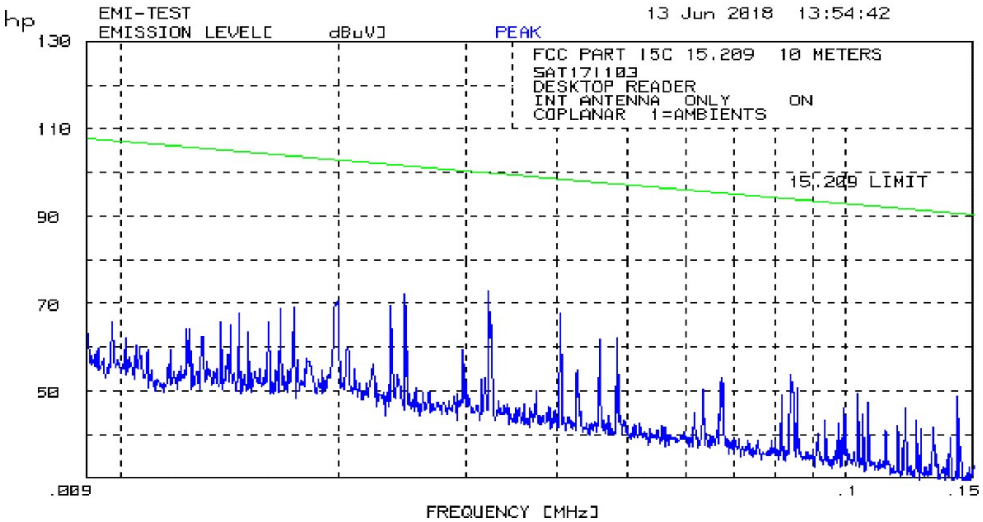
10.4.1 Radiated Emissions: 9kHz to 150kHz at 10m distance*

All measured emissions were greater than 10dB below the 15.209 limit.

*Measured at a 10m distance. In accordance with section 15.31 (e) (2), measured field strength values would be extrapolated to a 300m distance using an extrapolation factor of 40dB/decade.



Radiated Emissions Plot 9kHz to 150kHz (Coaxial Orientation)

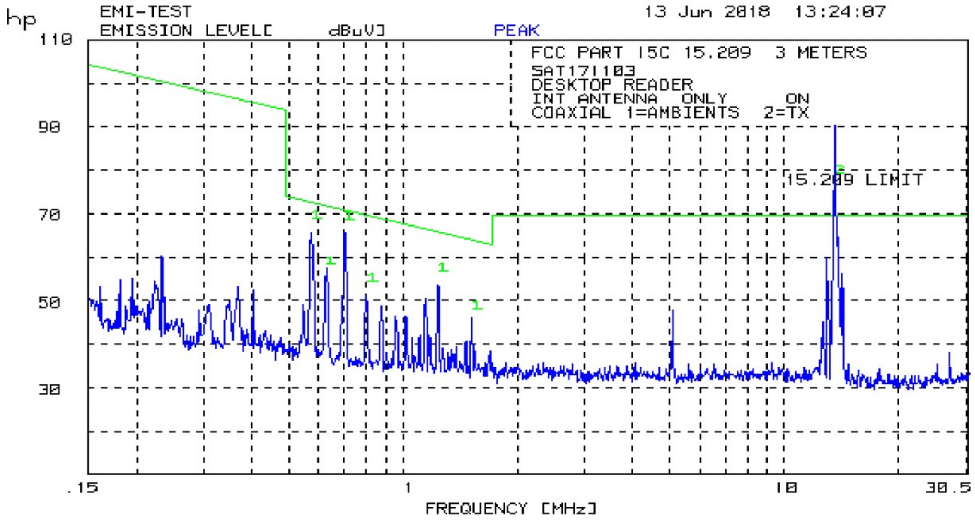


Radiated Emissions Plot 9kHz to 150kHz (Coplanar Orientation)

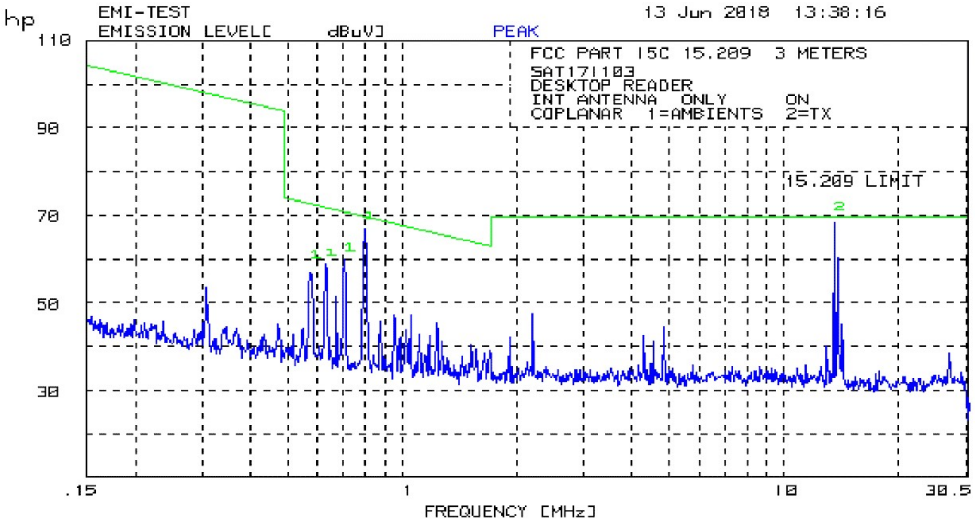
10.4.2 Radiated Emissions: 150kHz to 30MHz at 3m distance*

The highest measured emission level was 6.2dB below the Quasi-peak limit a 12.92MHz, measured in both Coaxial and Coplanar orientations. Refer to section 11.1.7.1 of this report.

*Measured at a 3m distance. In accordance with section 15.31 (e) (2), measured field strength values would be extrapolated to a 30m distance using an extrapolation factor of 40dB/decade.



Radiated Emissions Plot 150kHz to 30MHz (Coaxial Orientation)



Radiated Emissions Plot 150kHz to 30MHz (Coplanar Orientation)