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TEST REPORT

Millar Instruments / Telemetry Research TR181
Smartpad Wireless Charger / Receiver

tested to the

Code of Federal Regulations (CFR) 47

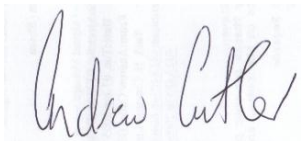
Part 15 – Radio Frequency Devices,
Subpart C – Intentional Radiators

Section 15.249 – Operation in the band
2400 – 2483.5 MHz

for

Millar Instruments Ltd / Telemetry Research Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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1. STATEMENT OF COMPLIANCE

The **Millar Instruments / Telemetry Research TR181 Smartpad Wireless Charger / Receiver** complies with 47 CFR Part 15 and in particular Sections, 15.205, 15.207, 15.209, 15.215 and 15.249 as detailed below when tested in accordance with ANSI C63.4 – 2003.

2. RESULTS SUMMARY

The results of testing carried out in December 2012 and March 2013 are detailed below.

Clause	Description	Result
15.201	Equipment authorisation requirement	Applied
15.203	Antenna requirement	Complies
15.204	External power amplifiers	Not applicable
15.205	Operation in restricted bands	Complies
15.207	Conducted emissions	Complies
15.209	Radiated emissions	See below
15.215	Additional provisions	Complies
15.249 (a)	Field strength of fundamental	Complies
15.249 (a)	Field strength of harmonics	Complies
15.249 (b)	Fixed, point to point operations	Not applicable
15.249 (c)	3 metre measurement distance	Noted
15.249 (d)	Spurious emission levels except harmonics	Complies
15.249 (e)	Detectors above 1000 MHz	Noted
15.249 (f)	Reference to section 15.37(d)	Noted

3. CLIENT INFORMATION

Company Name Millar Instruments Ltd / Telemetry Research Ltd

Address Level 1, 70 Symonds Street
Grafton

City Auckland 1010

Country New Zealand

Contact Mr David Budgett

4. DESCRIPTION OF TEST SAMPLE

Brand Name	Millar Instruments / Telemetry Research
Model	TR181
Product	SmartPad Wireless Charger plus Receiver
Manufacturer	Telemetry Research Ltd
Country of Origin	New Zealand
Serial Number	4658
FCC ID	V58HU71

5. EQUIPMENT PARAMETERS

The 2.4 GHz transceiver in this device has the following RF specifications:

FCC Band:	2400 MHz – 2483.5 MHz
Test Frequencies:	2405, 2440, 2480 MHz
Operating Frequencies:	16 channels between 2405 – 2480 MHz in 5 MHz steps
Rated Power:	1.00 mW (+0 dBm)
Modulation Type:	38 ms GFSK packet sent every 66 ms
Antenna Type:	Integral
Power Supply:	External 120 Vac to 48 Vdc external power supply
Clock frequencies	200 kHz wireless power derived from 400 kHz oscillator 16 MHz clock for the microcontroller 32.768 kHz in pressure sensor 62 kHz for PWM control of power level 48 kHz for voltage regulators 100 kHz for switched capacitor filters

The device that was is a 2.4 GHz transceiver that is used to communicate with Telemeter devices which are placed on the charging pad in order to be charged up.

The Telemeter and Charge pad communicate automatically and determine whether the Telemeter needs to be charged and if so for how long.

The device under test also includes a 198.7 kHz low frequency device which enables the Telemeter devices to be charged.

This device is cover by FCC part 18 and is subject to a separate test report.

Typically the device would be used in a laboratory environment and would be used to charge telemeter devices that are attached to rats and mice.

6. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

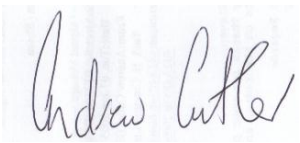
This report does not contain corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

7. TEST RESULTS

Section 15.201: Equipment authorisation requirement

Certification as detailed in Subpart J of Part 2 is required for this device as it contains a 2.4 GHz transmitter.

Section 15.203 – Antenna requirement

This device uses a 2.4 GHz antenna that is integral to the device

Result: Complies

Section 15.204: External radio frequency power amplifiers and antenna modifications

An external power amplifier is not supplied with this device and it is not possible to attach an external power amplifier.

Result: Complies.

Section 15.205 – Restricted bands of operation

Refer to measurements made with reference to Section 15.249 (a).

This device operates in the 2400 – 2483.5 MHz which is not a restricted band.

Result: Complies

Section 15.207: Conducted limits

Conducted emission testing has been carried out when the device was powered at 120 Vac 60 Hz using the supplied AC power supply.

Conducted emission testing was carried out over the frequency range of 150 kHz to 30 MHz at the Laboratory's MacKelvie Street premises in a 2.4 m x 2.4 m x 2.4 m screened room.

Testing was carried out in accordance with section 15.207(a) using a measuring receiver and a 50 uH / 50 ohm artificial mains network which is also known as a line impedance stabilisation network (LISN).

Measurements on both the phase and neutral lines were made using either a Quasi Peak or an Average detector with a 9 kHz bandwidth.

The supplied conducted emission plot is a combined plot showing the worst case of the Peak, Quasi Peak and Average levels for both phase and neutral.

The Class B conducted limits have been applied

Testing was carried out when the 198.7 kHz Wire Charging Transmitter was disabled.

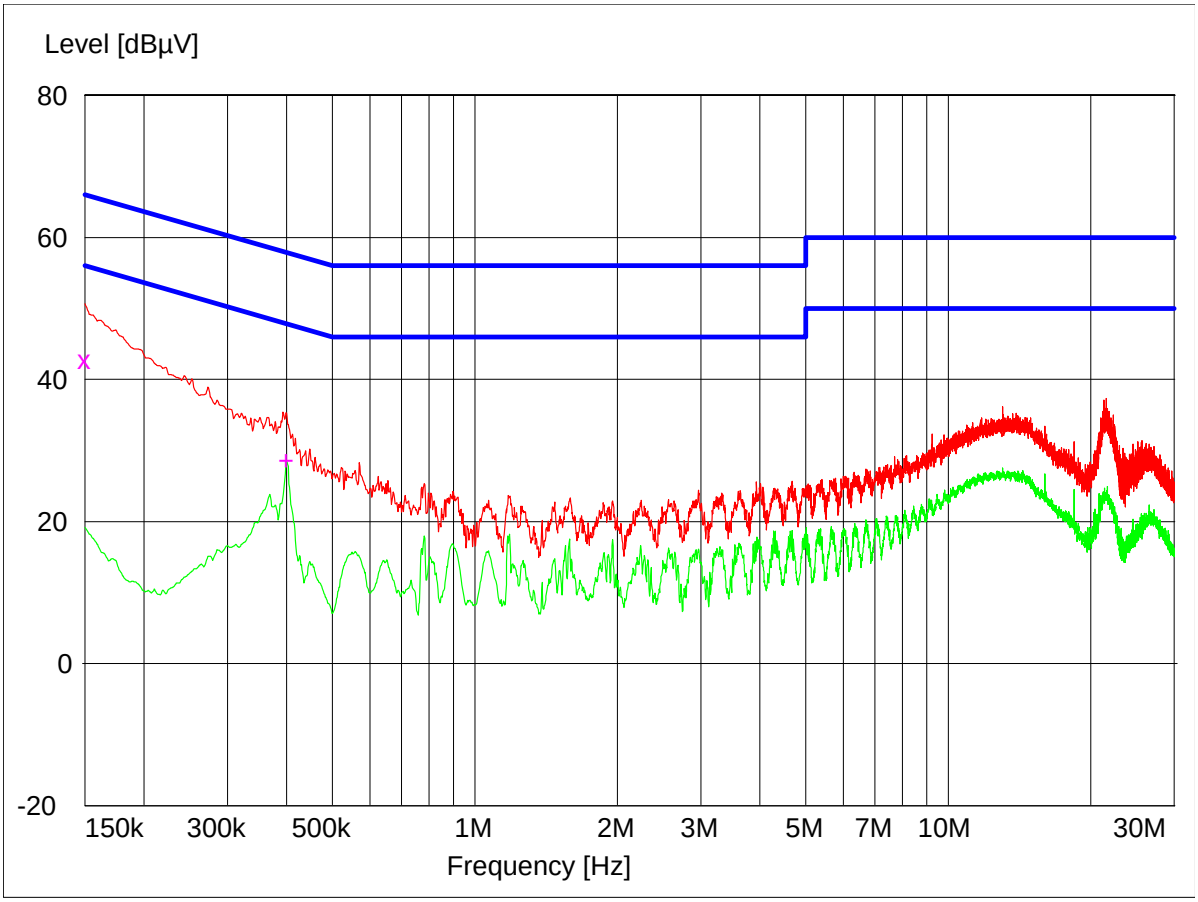
This device is covered separately in a report to FCC Part 18.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
Conducted emissions tests (0.15 - 30 MHz) ± 2.2 dB

Conducted Emissions – AC Input Power Port

Setup:	Test carried out at 115 Vac 60 Hz with the 198 kHz transmitter turned off and the 2.4 GHz transmitter transmitting continuously on 2405 MHz

Peak ---	Average --	Quasi Peak X	Average +



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.150000	42.90	66.0	23.1	L1	

Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.399000	28.50	47.9	19.4	L1	

Section 15.209 – Radiated emissions below 30 MHz

In accordance with section 15.249 (d) the general emission limits specified in Section 15.209 (a) have been applied to all emissions except the transmitter harmonics.

See Section 15.249 (a) for further details.

As this device contains digital devices that operate using various frequencies below 30 MHz, low frequency measurements were attempted between 9 kHz – 30 MHz at the open area test site over a distance of 10 metres using a loop antenna the centre of which was 1 metre above the ground.

Testing was carried out using a representative AC power supply system that was powered at 120 Vac 60 Hz which supplied 48 Vdc to the device under test.

Testing was carried out with the device being placed in the centre of the test table laying flat.

The device was transmitting continuously on 2405 MHz with the Smart Pad Wireless Charger, that transmits on 198.7 kHz, disabled.

The general limits described in 15.209 have been applied with the 300 metre and 30 metre limits being extrapolated by a factor of 40 dB per decade as allowed for in section 15.31(d)(2).

Between 9 – 90 kHz and between 110 – 490 kHz an Average detector and a Peak detector were used.

Where a peak detector was used the limit was increased by +20 dB

Between 90 kHz and 110 kHz band between 490 kHz and 30 MHz a Quasi Peak detector was used.

No emissions were detected on these frequencies of interest and no other emissions were detected from this device over the range of 9 kHz – 30 MHz

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (9 kHz – 30 MHz) ± 4.8 dB

Section 15.209 – Radiated emissions above 30 MHz

In accordance with section 15.249 (d) the general emission limits specified in Section 15.209 (a) have been applied to all emissions except the transmitter harmonics.

See Section 15.249 (a) for further details.

Testing for general radiated emissions was carried out over the frequency range of 30 MHz to 1000 MHz as the highest frequency in use by the digital device is less than 108 MHz (16 MHz highest frequency in use).

Testing was carried out at the laboratory's open area test site - located at Driving Creek, Orere Point, Auckland, New Zealand. This site conforms to the requirements of CISPR 16 and ANSI C63.4 - 2003.

Testing was carried out using a representative AC power supply system that was powered at 120 Vac 60 Hz which supplied 48 Vdc to the device under test.

Testing was carried out with the device being placed in the centre of the test table laying flat.

The device was transmitting continuously on 2405 MHz with the Smart Pad Wireless Charger, that transmits on 198.7 kHz, disabled.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height, where appropriate, with an automated antenna tower.

Above 30 MHz the emission is measured in both vertical and horizontal antenna polarisations, where appropriate, using a quasi peak detector.

The emission level was determined in field strength by taking the following into consideration:

Level (dBμV/m) = Receiver Reading (dBμV) + Antenna Factor (dB) + Coax Loss (dB)

No general emissions were observed from this device

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 – 1000 MHz) ± 4.1 dB

Section 15.215 (c) – Additional provisions to the general radiated emission limitations

The device operates in the 2400 – 2483.5 MHz band.

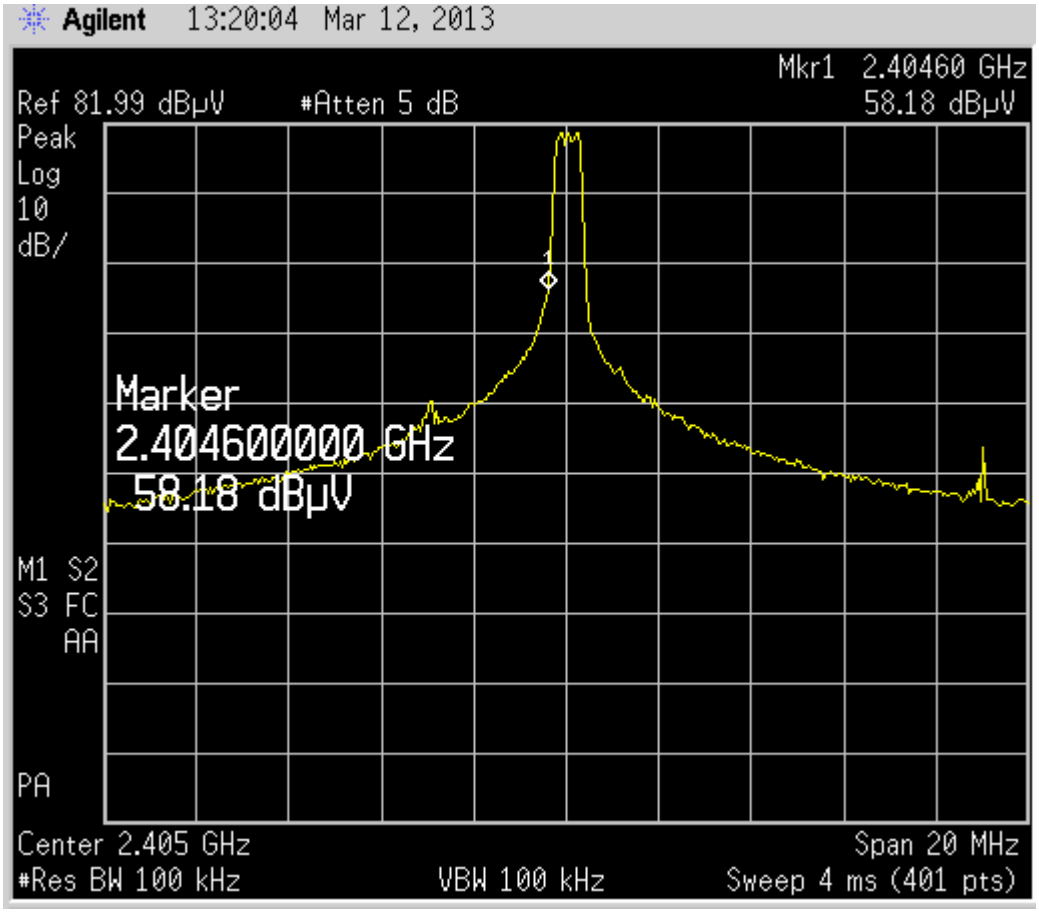
Relative spectrum mask measurements have been made when the device was operating on Channel 1 – 2405 MHz and Channel 16 – 2480 MHz.

Measurements have actually been made at the -20 dB points.

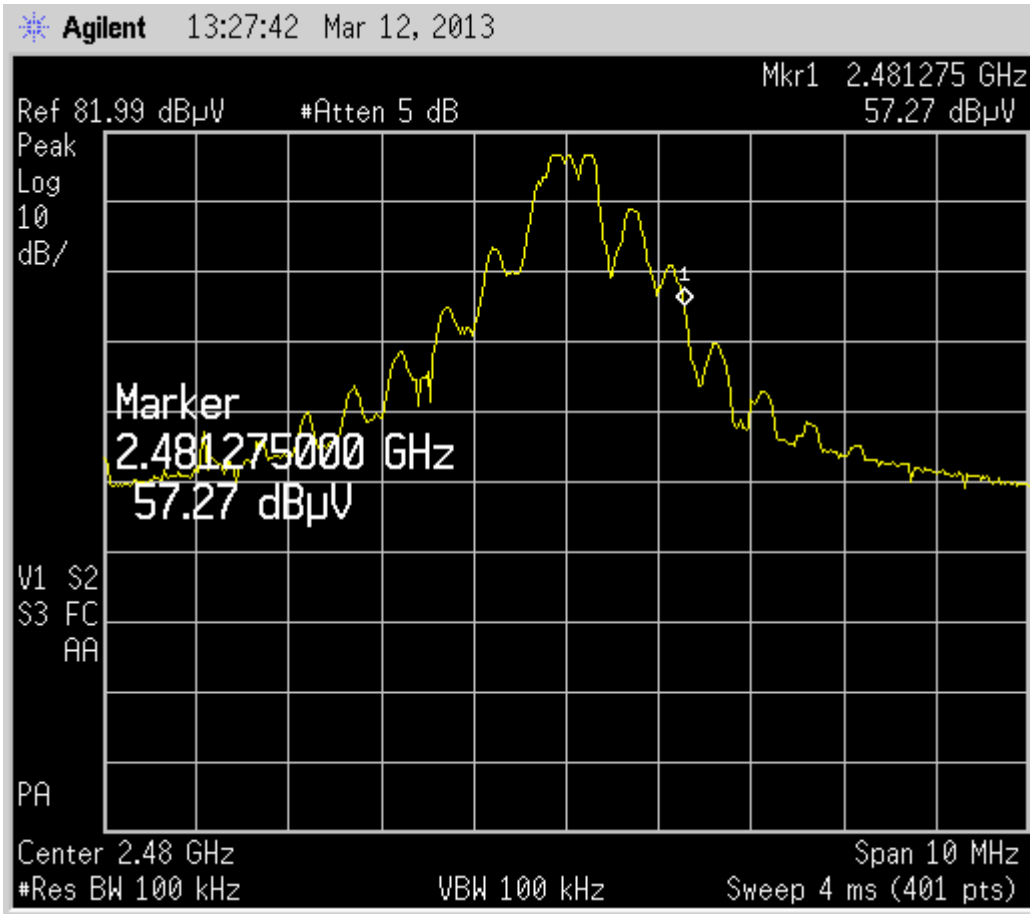
Frequency (MHz)	F low (MHz)	F high (MHz)
2405.000	2404.600	-
2480.000	-	2481.275

The device can be seen to stay within the band of 2400 – 2483.5 MHz at the -20 dB points

2405 MHz



2480 MHz



Results: Complies

Section 15.249 (a) – Field strength of the Fundamental and Harmonics

Radiated emission measurements were carried out with the limits as per section 15.249 (a) being applied to the Fundamental and Harmonics of each transmitter.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland.

The transmitter was placed on the test table top which was a total of 0.8 m above the test site ground plane.

Measurements of the radiated field were made 3 metres from the transmitting antenna.

Measurements below 1000 MHz were made using a Quasi Peak Detector with a bandwidth of 120 kHz.

Measurements above 1000 MHz were made using an average detector with a bandwidth of 1.0 MHz and also a peak detector with a bandwidth of 1.0 MHz.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height with an automated antenna tower.

All emissions were measured in both vertical and horizontal antenna polarisations.

The emission is measured in both vertical and horizontal antenna polarisations with no measurements were made above the 10^{th} harmonic

Testing was carried out using a representative AC power supply system that was powered at 120 Vac 60 Hz which supplied 48 Vdc to the device under test.

Testing was carried out with the device being placed in the centre of the test table laying flat.

The device was tested transmitting on various test frequencies with the Smart Pad Wireless Charger operating continuously on 198.7 kHz.

The emission level is determined in field strength by taking the following into consideration:

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB) + Coax Loss (dB) – Amplifier Gain (dB)

Fundamental emission

Testing was carried out as detailed below

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector	BW
2405.000	92.1	97.7	114.0	16.3	Horizontal	Peak	1 MHz
	84.3	90.1	94.0	3.9	Horizontal	Average	1 MHz
2440.000	93.2	97.3	114.0	16.7	Horizontal	Peak	1 MHz
	85.4	89.7	94.0	4.3	Horizontal	Average	1 MHz
2480.000	94.7	98.4	114.0	15.6	Horizontal	Peak	1 MHz
	85.1	90.2	94.0	3.8	Horizontal	Average	1 MHz

Section 15.249 specifies a limit of 50 mV/m (94 dBuV/m) when an average detector is used for devices operating in the band of 2400 – 2483.5 MHz.

A peak limit of 114 dBuV/m has also been applied.

This limit has been converted to dBuV/m using the formula 20 * (log 0.050 / 0.000001)

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 – 25,000 MHz) ± 4.1 dB

Spurious emissions

Transmitting on 2405 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector	BW
4810.000	61.2	61.7	74.0	12.3	Horizontal	Peak	1 MHz
	49.1	50.5	54.0	3.5	Horizontal	Average	1 MHz
7215.000	57.1	58.7	74.0	15.3	Horizontal	Peak	1 MHz
	43.5	44.1	54.0	9.9	Horizontal	Average	1 MHz
9620.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
12025.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
14430.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
16835.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
19240.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
21645.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
24050.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz

Transmitting on 2440 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector	BW
4880.000	61.6	59.1	74.0	12.4	Vertical	Peak	1 MHz
	50.5	48.1	54.0	3.5	Vertical	Average	1 MHz
7320.000	57.1	58.7	74.0	15.3	Horizontal	Peak	1 MHz
	43.5	44.1	54.0	9.9	Horizontal	Average	1 MHz
9760.000	< 59	< 59	74.0	> 15	Horizontal	Peak	1 MHz
	< 46	< 46	54.0	> 8	Horizontal	Average	1 MHz
12200.000	< 59	< 59	74.0	> 15	Horizontal	Peak	1 MHz
	< 46	< 46	54.0	> 8	Horizontal	Average	1 MHz
14640.000	< 59	< 59	74.0	> 15	Horizontal	Peak	1 MHz
	< 46	< 46	54.0	> 8	Horizontal	Average	1 MHz
17080.000	< 59	< 59	74.0	> 15	Horizontal	Peak	1 MHz
	< 46	< 46	54.0	> 8	Horizontal	Average	1 MHz
19520.000	< 59	< 59	74.0	> 15	Horizontal	Peak	1 MHz
	< 46	< 46	54.0	> 8	Horizontal	Average	1 MHz
21960.000	< 59	< 59	74.0	> 15	Horizontal	Peak	1 MHz
	< 46	< 46	54.0	> 8	Horizontal	Average	1 MHz
24400.000	< 59	< 59	74.0	> 15	Horizontal	Peak	1 MHz
	< 46	< 46	54.0	> 8	Horizontal	Average	1 MHz

Transmitting on 2480 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector	BW
4960.000	58.5	56.3	74.0	15.5	Vertical	Peak	1 MHz
	45.8	43.1	54.0	8.2	Vertical	Average	1 MHz
7440.000	58.6	61.1	74.0	12.9	Horizontal	Peak	1 MHz
	45.5	48.2	54.0	5.8	Horizontal	Average	1 MHz
9920.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
12400.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
14880.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
17360.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
19840.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
22320.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz
24800.000	< 59	< 59	74.0	> 15	Vert/Hort	Peak	1 MHz
	< 46	< 46	54.0	> 8	Vert/Hort	Average	1 MHz

Measurements were attempted at a distance of 3 metres using vertical and horizontal polarisations with a peak and an average detector with a 1 MHz bandwidth being used.

As per section 15.249 a limit of 500 uV/m applies to the harmonic emissions when an average detector is used.

This limit has been converted to dBuV/m using the formula 20 * (log 500) with a factor of + 20 dB being added to determine the peak limit.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 – 25,000 MHz) ± 4.1 dB

8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Interval
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applic	-
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	Not applic	-
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic	-
Receiver	R & S	ESHS 10	828404/005	3728	21 Aug 2013	1 year
Mains Network	R & S	ESH2-Z5	881362/032	3628	21 Aug 2013	1 year
Receiver	R & S	ESIB 40	100171	R-27-1	21 Oct 2013	1 year
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3771	20 Mar 2013	1 year
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2014	1 year
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2014	1 year
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2014	1 year
Horn Antenna	EMCO	3115	9511-4629	E1526	10 May 2013	1 year
SG Horn Antenna	EMCO	3160-04	00224819	-	11 Sept 2015	3 years
SG Horn Antenna	EMCO	3160-05	00114635	-	11 Sept 2015	3 years
SG Horn Antenna	EMCO	3160-06	00114821	-	11 Sept 2015	3 years
SG Horn Antenna	EMCO	3160-07	00144919	-	11 Sept 2015	3 years
SG Horn Antenna	EMCO	3160-08	00114637	-	11 Sept 2015	3 years
Horn Antenna	EMCO	3116	92035	-	10 May 2013	1 year
Loop Antenna	EMCO	6502	9003-2485	3798	12 Dec 2013	1 year

9. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was updated in February 2011.

In addition testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ISO 17025.

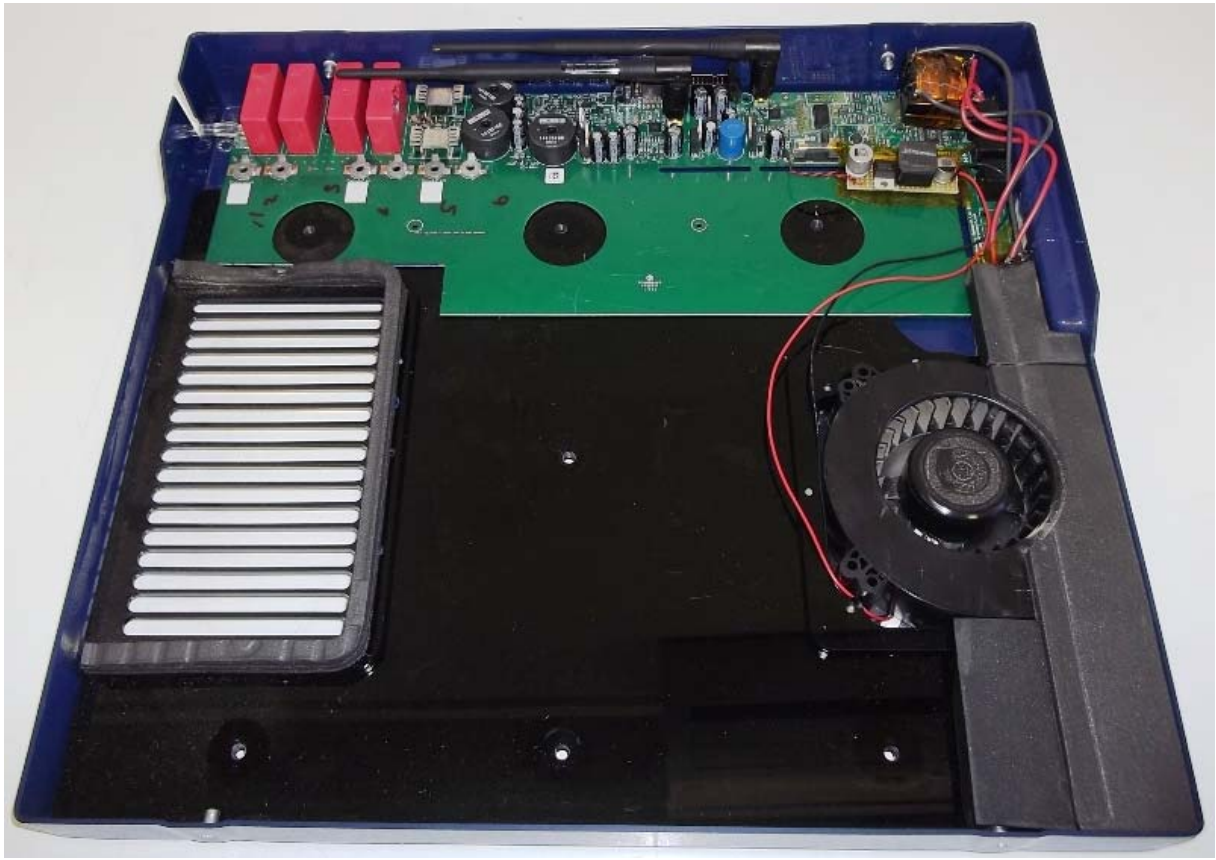
All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ISO 17025.

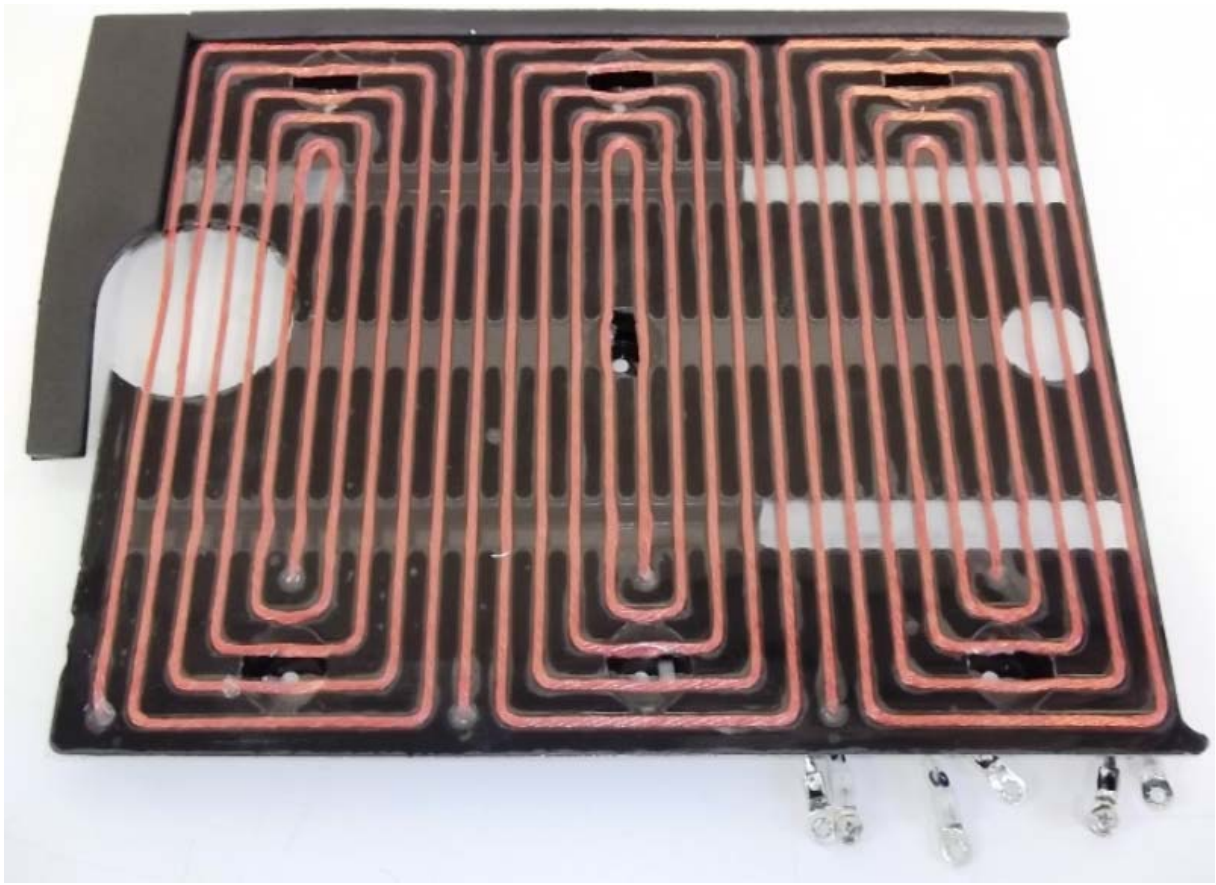
International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with a number of accreditation bodies in various economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

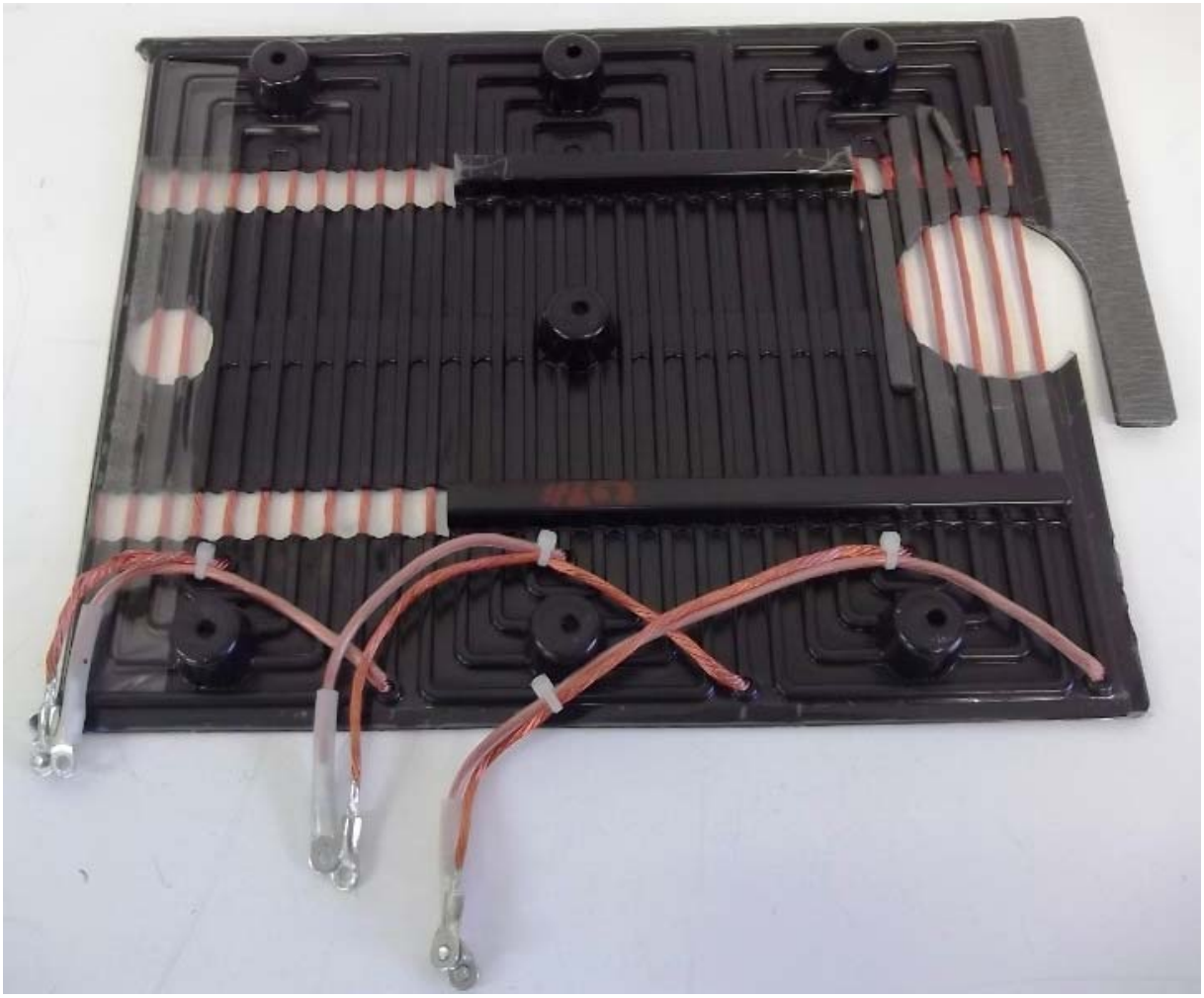
10. PHOTOGRAPHS

External photos

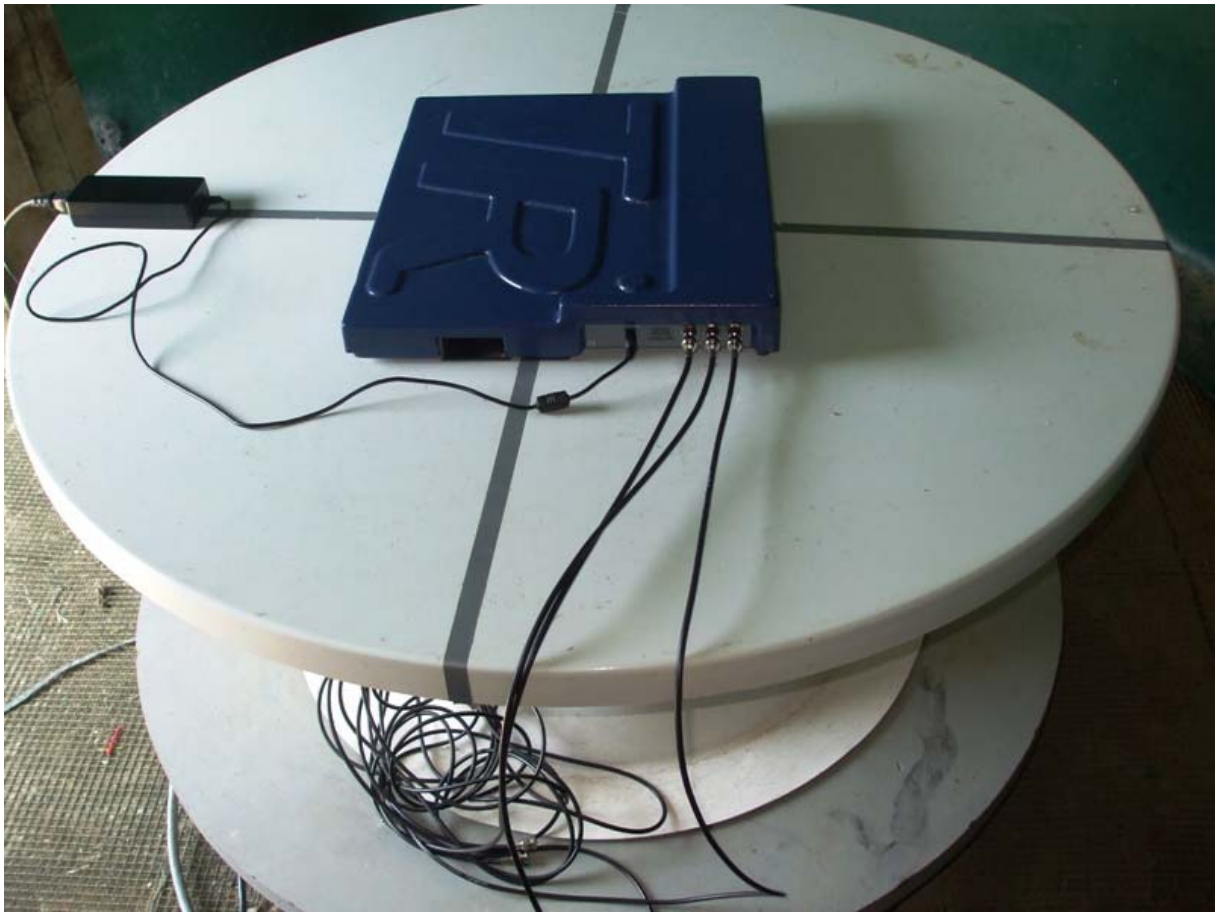
Internal Photos







Radiated emissions test set up photos



Conducted emissions test set up photos