EMC Technologies Pty Ltd
ABN 82 057 105 549
176 Harrick Road
Keilor Park Victoria Australia 3042

Ph: + 613 9365 1000
Fax: + 613 9331 7455
email: melb@emctech.com.au

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 90.217

FCC ID: **XZ4-1000-0730**

Test Sample: Agile Data RTU
Part Number: 1000-0730
Manufacturer: Square One Laboratories Pty Ltd

Report Number: M091201R_FCC_1000-0730

Issue Date: 17th December 2012

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Test Sample:	Agile Data RTU
Part Number:	1000-0730
Manufacturer:	Square One Laboratories Pty Ltd
FCC ID:	XZ4-1000-0730
Equipment Type:	Intentional Radiator (Transceiver)
Tested for:	Square One Laboratories Pty Ltd
Address:	2/25 Manton Road, Oakleigh South, VIC 3167 Australia (PO Box 303, Oakleigh MDC VIC 3166 Australia)
Phone:	+61 3 9545 5777
Fax:	+61 3 9545 6777
Responsible Party:	Motti Grinberg
Test Standards:	FCC Part 90.217 FCC Part 2 ANSI/TIA/EIA-603-C ANSI C63.4
Test Dates:	4th December 2009 to 13th December 2012
Test Officers:	**Kevin Hansen** **Chieu Huynh**
Attestation:	*I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*
Authorised Signatory:	**Chieu Huynh** **Senior EMC Engineer** **EMC Technologies Pty Ltd**

EMI TEST REPORT FOR CERTIFICATION
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FCC PART 90.217

1.0 INTRODUCTION

EMI testing was performed on the Agile Data RTU, Part number: 1000-0730. The test results and procedures were performed in accordance with the following Federal Communications Commission (FCC) standards/regulations. The test sample **complied** with the requirements of FCC: 47 CFR, Part 90.217.

Test results and procedures were performed in accordance with the following Federal Communications Commission (FCC) standards/regulations:

FCC Part 90.217 and FCC Part 2 Clauses	Test Description	Results
FCC 2.1046	Output Power	**Complied**
FCC 2.1049	Occupied Bandwidth	**Complied**
FCC 2.1049	Emission mask	**Complied**
FCC 2.1051	Conducted Emissions	**Complied**
FCC 2.1053	Radiated Emissions	**Complied**
FCC 2.1055	Frequency stability	**Complied**

The measurement procedure used was in accordance with ANSI/TIA/EIA-603-C and ANSI C63.4.

1.1 EUT – Voltage Power Conditions

The Data RTU is DC powered (12V DC from Host unit).

1.2 Modifications

No modifications were required.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT Details

Agile Data RTU:	(also sold under the name RadioNET RTU)
Part Number:	1000-0730
Serial Number:	20214029
Power Rating:	6V DC, 1.8W max
Frequency Range:	450 – 470 MHz
Antenna Type:	¼ Wave Whip
Gain:	Unity
Microprocessor:	MSP430
Crystal Frequency:	14.7456 MHz
Real Time Clock Freq:	32768 Hz
Manufacturer:	Square One Laboratories Pty Ltd

2.2 Description supplied by Client

The Data RTU (1000-0730) is part of an Agile Radio System. The minimum system consist of a Base Station, a Control RTU (1000-0710) &/ a Data RTU (1000-0730) and a Host (unintentional).

Base Station*:* The Base unit is connected via a 2m standard cable which is supplied with the Host. The Base unit manages the radio network and mediates all communications between the RTUs and the Host.

RTU: RTUs are powered by 6V DC provided by 4 x AA batteries, or by optional solar power. RTUs are available in two flavours: a Control RTU designed to control and directly drive up to 9 valves; and a Data RTU designed to collect data.

Host: The host interfaces a PC for configuration and a controller to the Base Station. The host is designed to be powered by a 12V DC rechargeable battery. All command and data sent to and from the PC and the controller are managed by the host unit. The host communicates with, and supplies power to, the Base Station.

2.3 Test Configuration

The Data RTU was configured in transmitting mode.

2.4 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI/TIA/EIA-603-C and ANSI C63.4. Radiated emissions tests were performed at a distance of 3 metres from the EUT.

2.5 Test Facility

2.5.1 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 & 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

EMC Technologies has been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS 212, Issue 1 (Provisional) - **Industry Canada OATS number - IC 3569B.**

Measurements were performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia.

2.5.2 NATA Accreditation

EMC Technologies is accredited in Australia to test to the following standards by the National Association of Testing Authorities (NATA).

"FCC Part 15 unintentional and intentional emitters in the frequency range 9kHz to 18 GHz excluding TV receivers (15.117 and 15.119), TV interface devices (15.115), cable ready consumer electronic equipment (15.118), cable locating equipment (15.213) and unlicensed national information infrastructure devices (Sub part E)."

The current full scope of accreditation can be found on the NATA website: www.nata.asn.au
It also includes a large number of emissions, immunity, SAR, EMR and Safety standards.

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 (A^2LA).

2.6 Test Equipment Calibration

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent Technologies (Australia) Pty Ltd or the National Measurement Institute (NMI). All equipment calibration is traceable to Australia national standards at the National Measurements Institute. The reference antenna calibration was performed by NMI and the working antennas (loop, biconilog and horn) calibrated by the NATA approved procedures. The complete list of test equipment used for the measurements, including calibration due dates are contained in this report

FCC Part 90.217

Radiated emissions field strength was measured using a HP8546A receiver connected to a calibrated antenna located 3m away from the EUT.

The EUT was set up on the table top (placed on turntable) of total height 80 cm above the ground plane, and operated as described in section 2 of this report. The EMI Receiver was operated under software control via the PC Controller through the IEEE.488 Interface Bus Card Adaptor. The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks while also permitting fast frequency scan times. A calibrated Loop antenna was used for measurements between 9 kHz to 30 MHz. A calibrated Biconilog antenna was used for measurements between 30 MHz to 4.7 GHz.

The resolution bandwidth and video bandwidth settings were:

9 kHz – 150 kHz:	1 kHz RBW, 3 kHz VBW
150 kHz – 30 MHz:	10 kHz RBW, 30 kHz VBW
30 MHz – 1000 MHz:	120 kHz RBW, 300 kHz VBW
1 GHz – 4.7 GHz:	1 MHz RBW, 1MHz VBW

The receiver bandwidth was set to 6 dB.

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for 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. Each significant peak was investigated. This process was performed for both horizontal and vertical antenna polarisations.

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

E = V + AF - G + L Where:

E = Radiated Peak Field Strength in dBµV/m.
V = EMI Receiver Voltage in dBµV. (measured value)
AF = Antenna Factor in dB(m^{-1}). (stored as a data array)
G = Preamplifier Gain in dB. (stored as a data array)
L = Cable loss in dB. (stored as a data array of Insertion Loss versus frequency)

- **Example Peak Field Strength Calculation**

Assuming a receiver reading of 34.0 dBµV is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9 dB while the preamplifier gain is 20 dB. The resulting Field Strength is therefore as follows:

34.0 + 9.2 + 1.9 - 20 = 25.1 dBµV/m

3.0 OUTPUT POWER

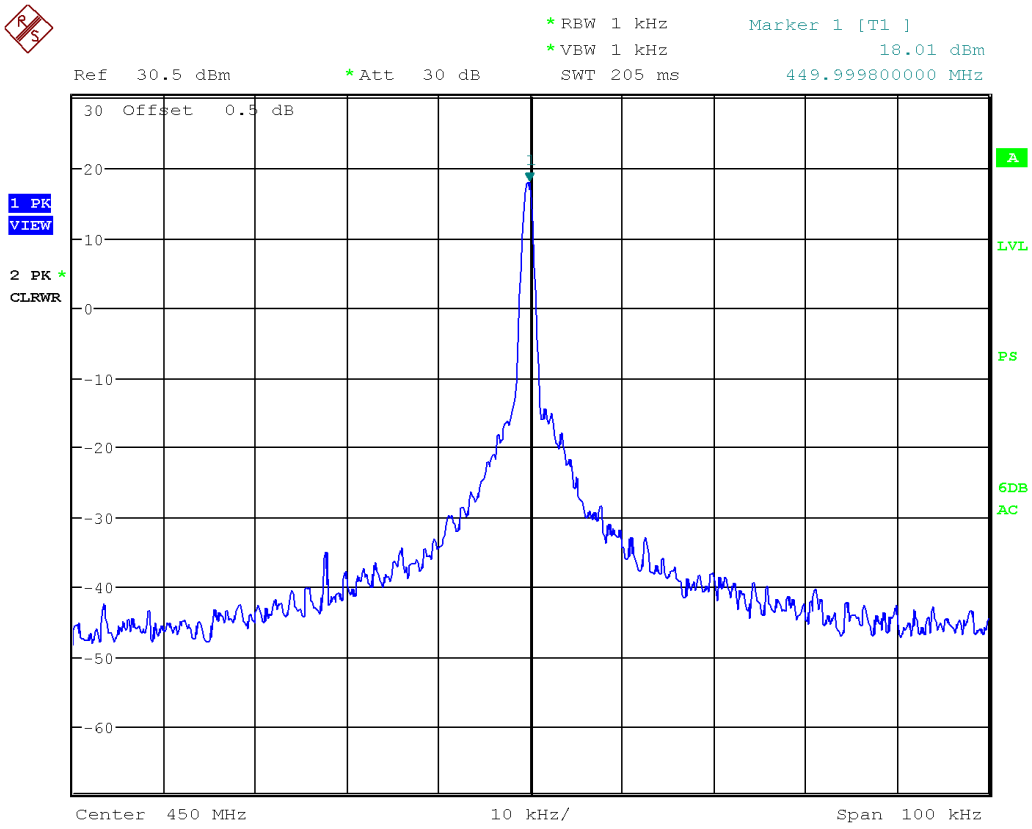
3.1 Radiated Measurements

Measurements were performed at a distance of 3 metres from the EUT.

Tx Frequency MHz	Measured Field Strength dBµV/m	Calculated Measured Power mW	Limit mW	Results
450	114.0	75.4	120	Pass
460	112.5	53.3	120	Pass
470	109.8	28.7	120	Pass

Substitution measurements were performed. The EUT was replaced with a calibrated dipole antenna that was connected to a signal generator. The output level of the signal generator was adjusted until the same level on the receiver observed. The level of the signal generator output in dBµV or dBm less any loss due to the connecting cable and added the gain of the substitute antenna.

3.2 Conducted Measurements - Antenna Port



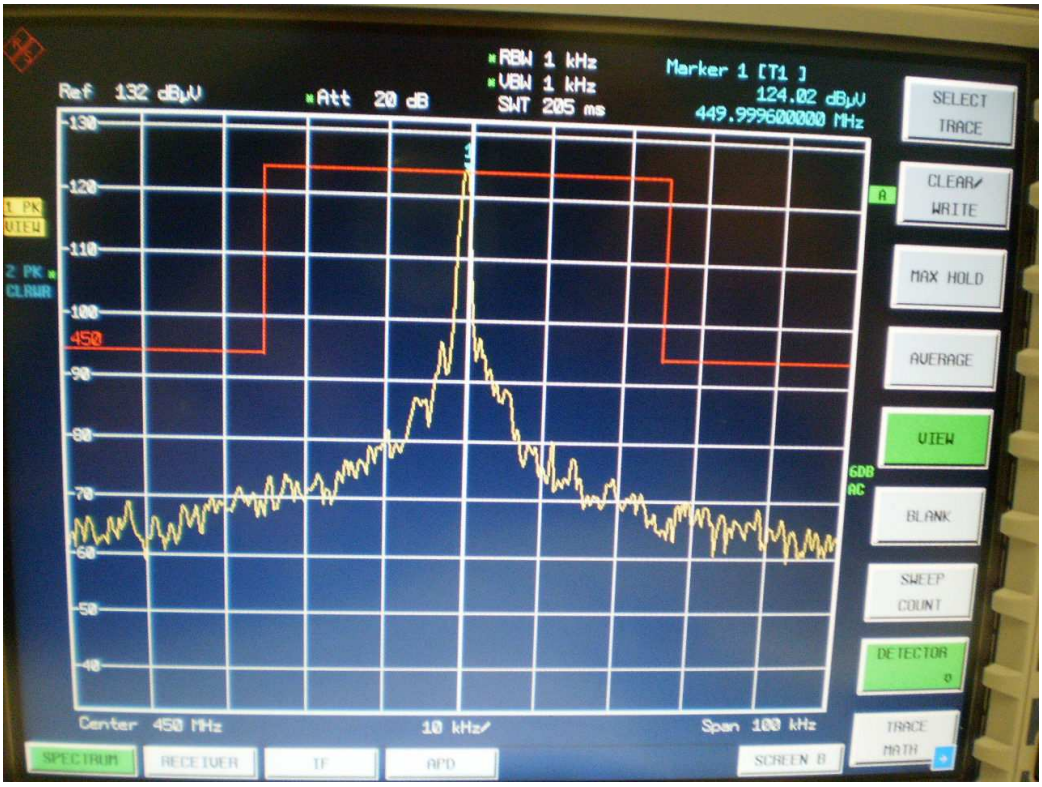
Tx Frequency MHz	Antenna Gain dBi	Measured Power dBm	Calculated Power mW	Limit mW	Results
450	Unity	18.01	79.6	120	Pass
460		18.03	80.0		Pass
470		17.63	72.9		Pass

4.0 OCCUPIED BANDWIDTH – Antenna Port

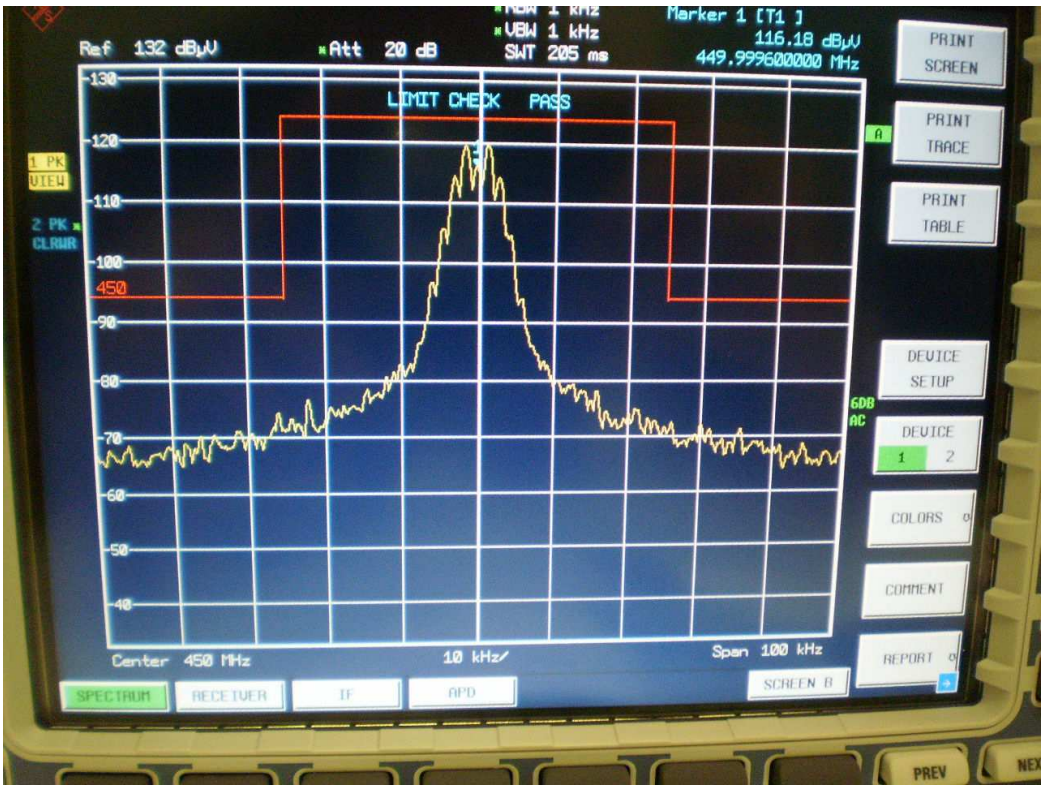
Frequency MHz	Measured Bandwidth kHz	Limit kHz	Results
450	8.9	12.5	Pass
460	8.9	12.5	Pass
470	8.9	12.5	Pass

5.0 EMISSION MASK – Antenna Port

450 MHz Carrier

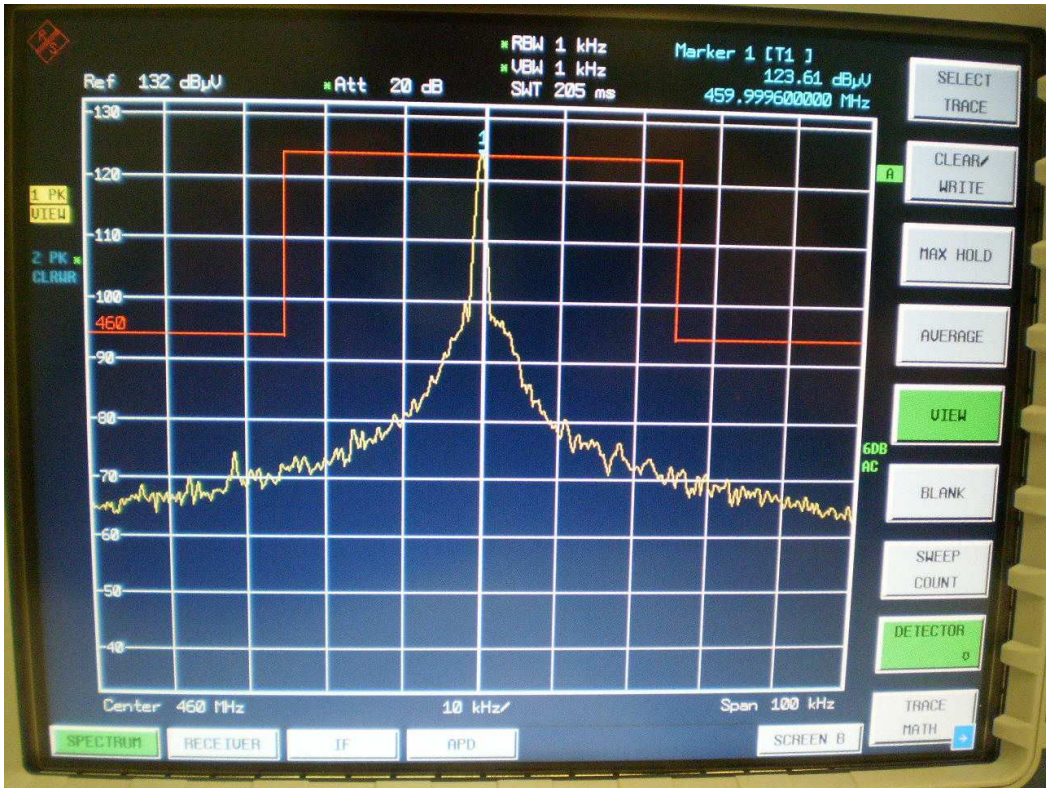


450 MHz Modulated

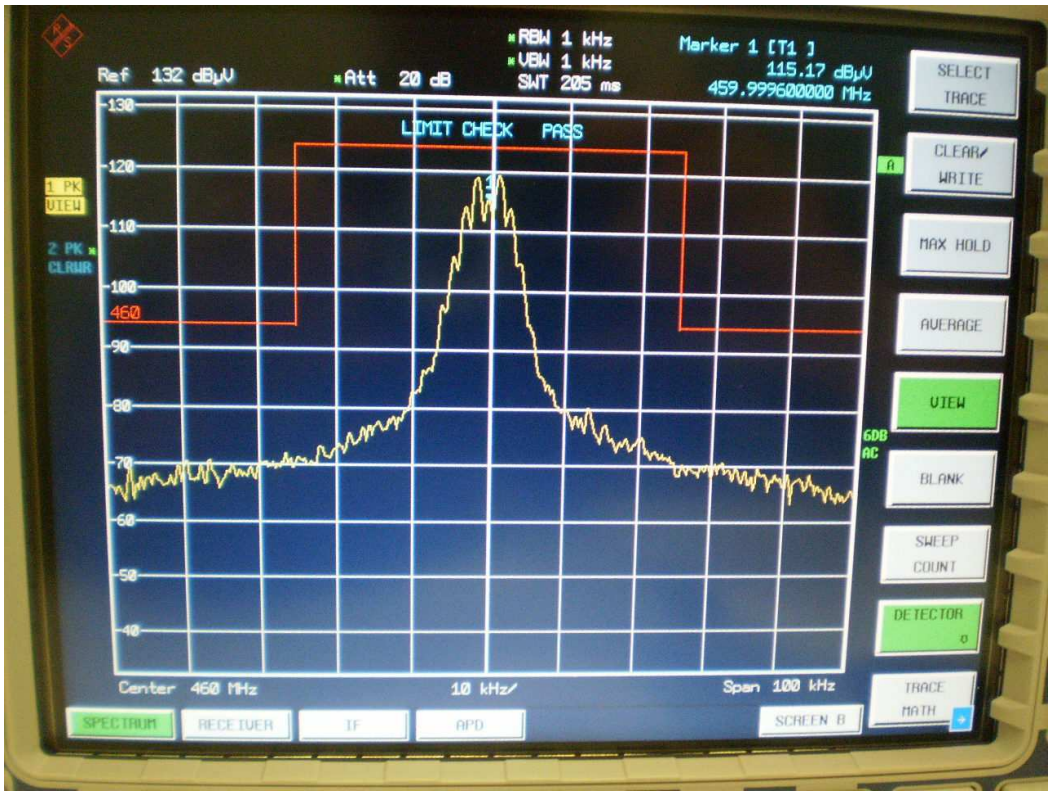


Results - Complied

460 MHz Carrier

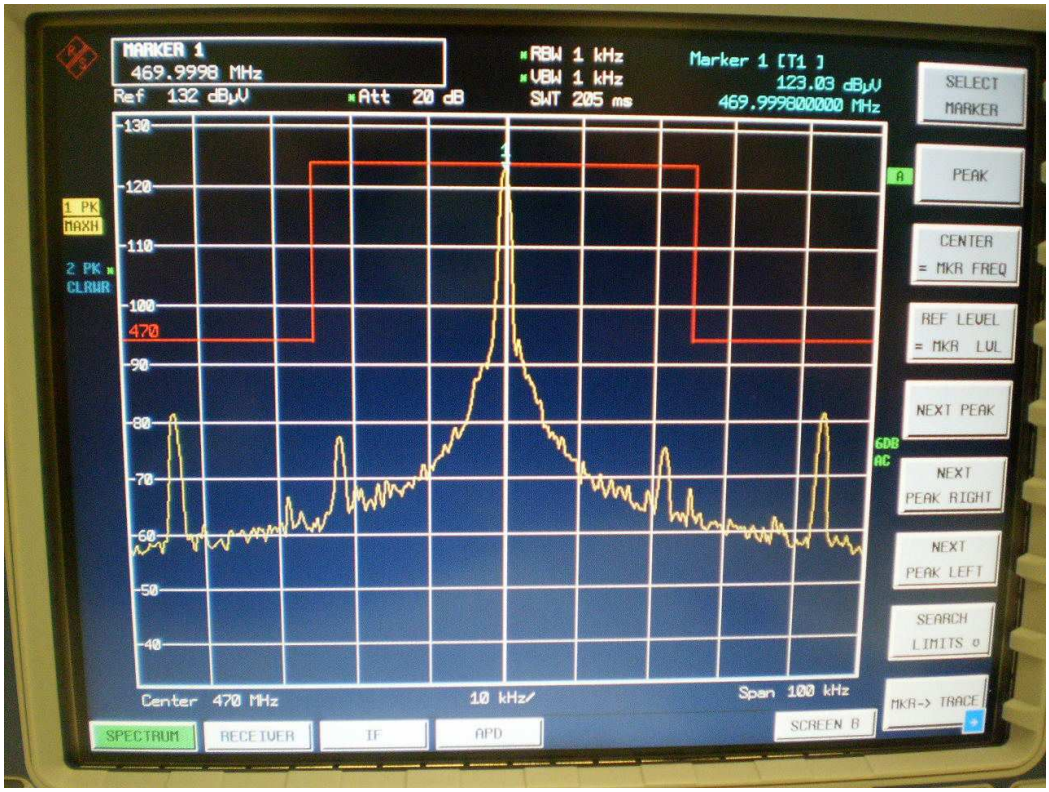


460 MHz Modulated

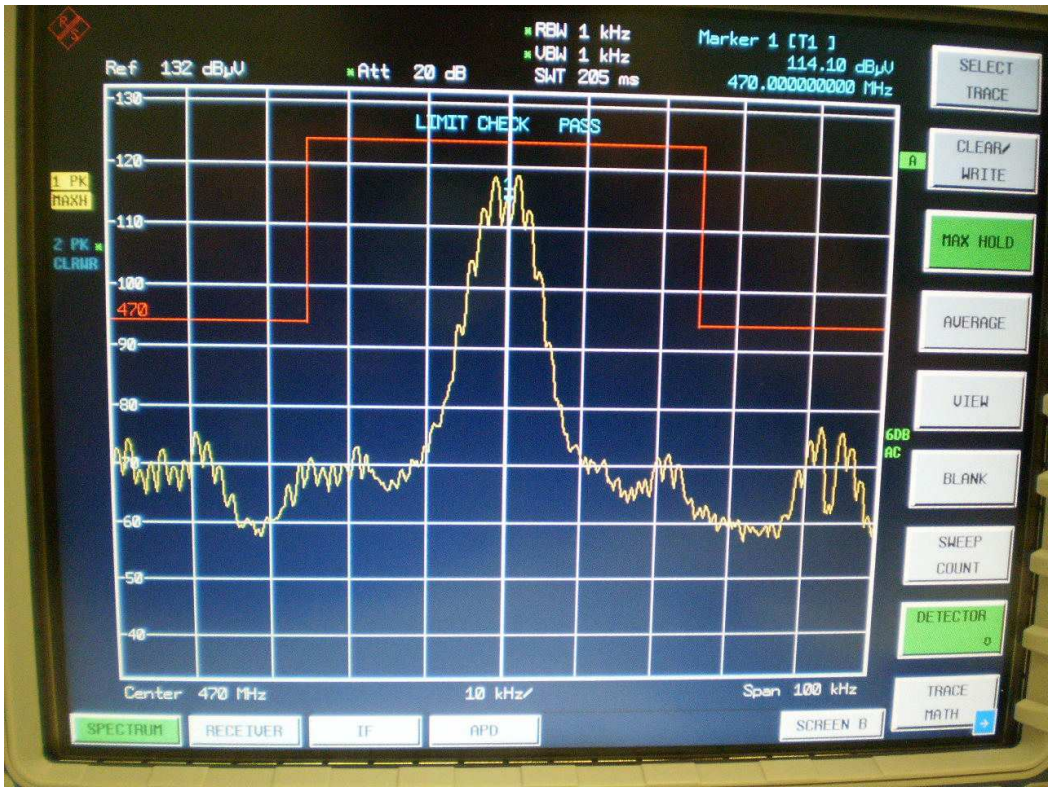


Results - Complied

470 MHz Carrier



470 MHz Modulated



Results - Complied

The Conducted Spurious emissions (out of band emissions from 9 kHz up to the 10th harmonic) measured at the antenna terminal were greater than 20 dB below the limit.

6.0 CONDUCTED EMISSIONS

Not applicable, test sample is DC powered.

7.0 RADIATED EMISSIONS

Measurements were performed at a distance of 3 metres from the EUT.

The limits of any emissions outside the frequency band shall be attenuated by at least 30dBc.

7.1 Frequency Band: 0.009 - 30 MHz

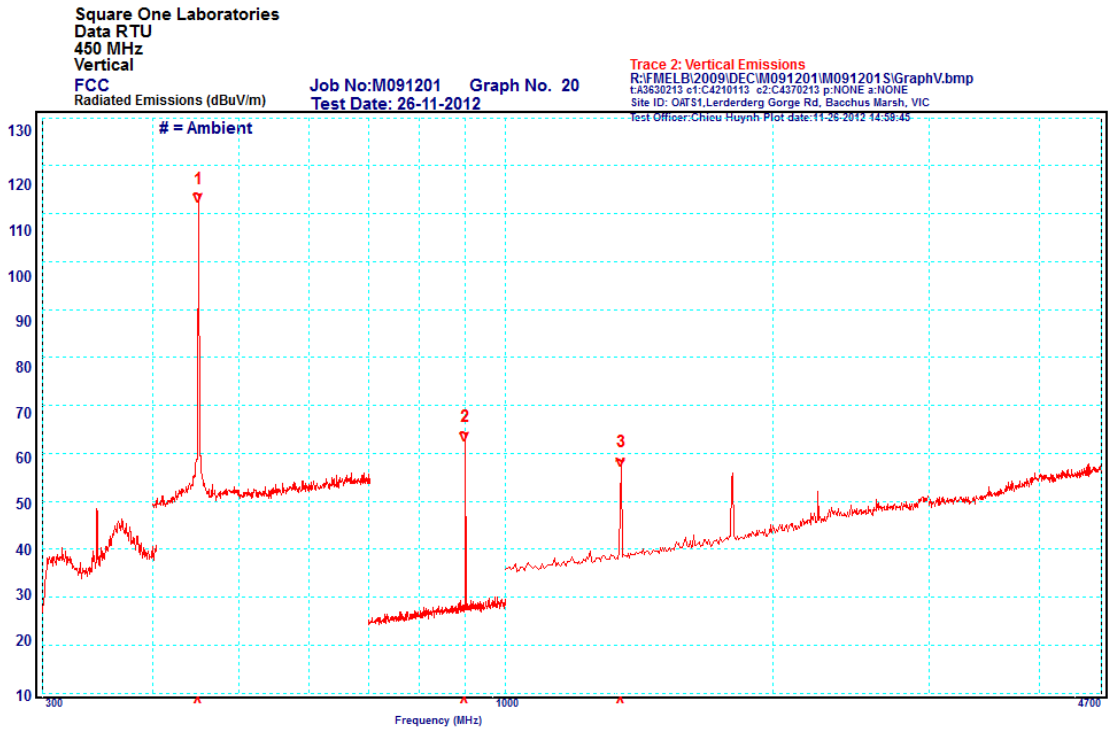
Result: Complied by a margin of greater than 10 dB (no emissions were recorded within 40 dB below the carrier).

7.2 Frequency Band: 30 - 300 MHz

Result: Complied by a margin of greater than 10 dB (no emissions were recorded within 40 dB below the carrier).

7.3 Frequency Band: 300 MHz – 4.7 GHz

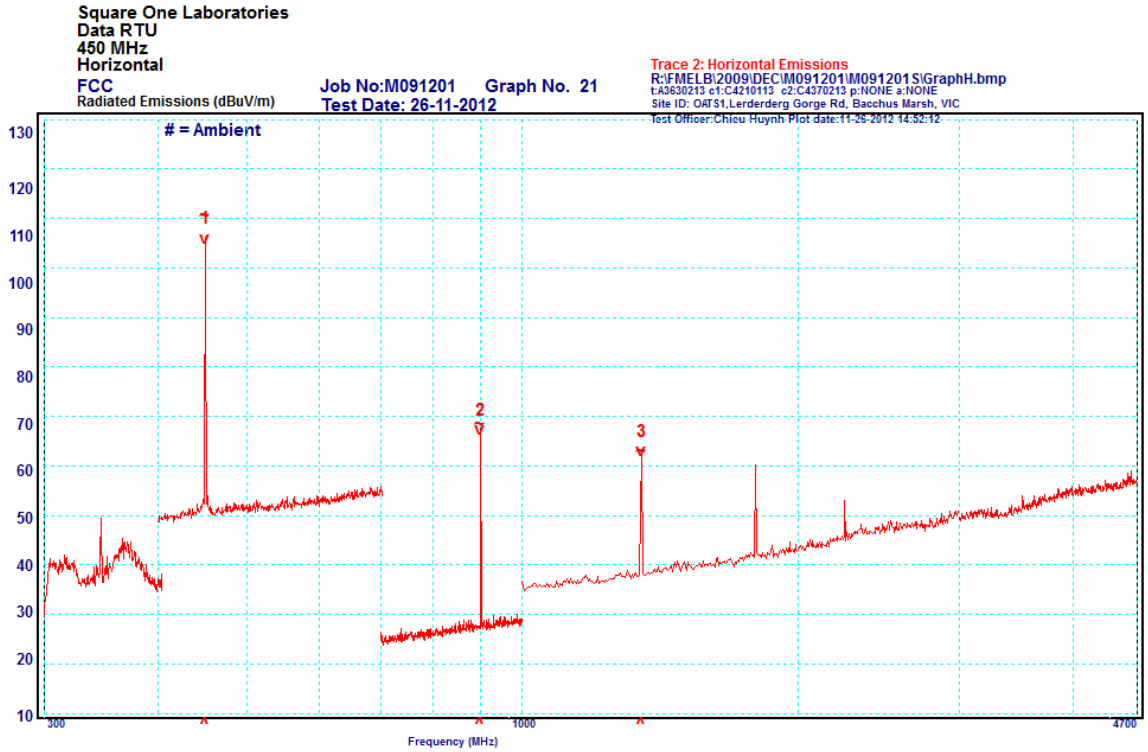
450 MHz – Vertical



Peak	Frequency MHz	Polarity	Level Measured dBuV/m	Limit dBµV/m	Δ ± dB
1	450.00	Vertical	114.0	116.0	-2.0*
2	900.00	Vertical	64.2	84.0	-19.8
3	1349.98	Vertical	58.4	84.0	-25.6

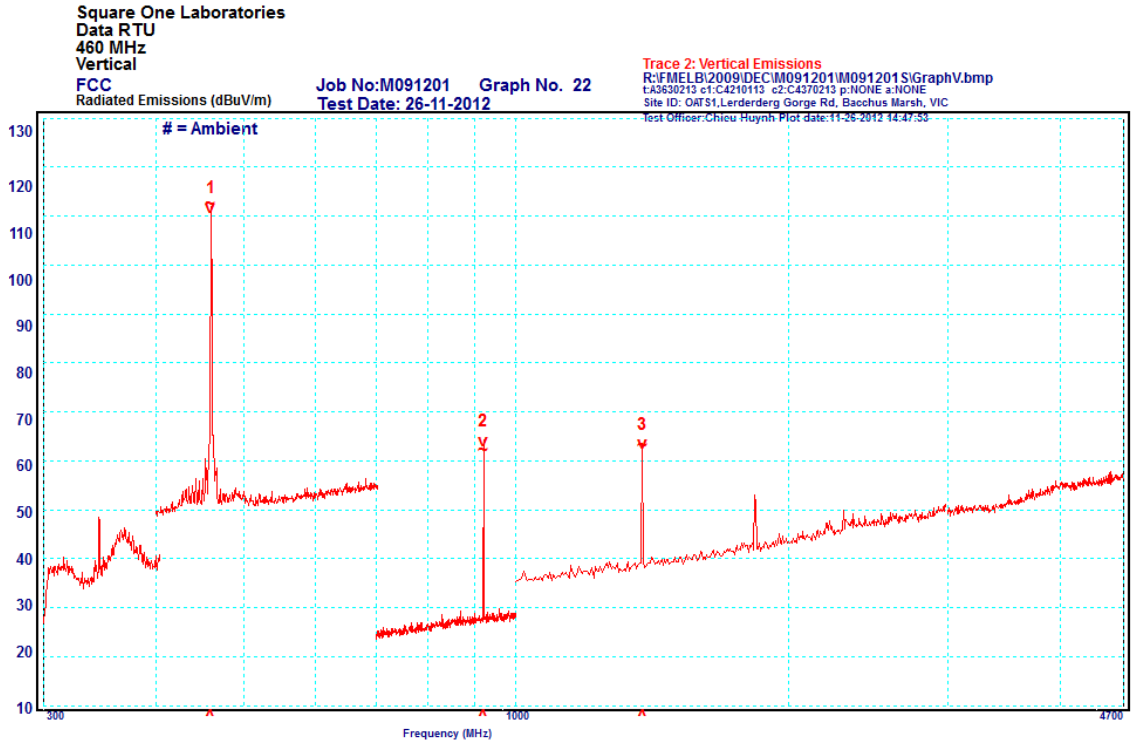
*This result falls within the laboratory's measurement uncertainty. Refer to Section 11.0.

450 MHz – Horizontal



Peak	Frequency MHz	Polarity	Level Measured dBuV/m	Limit dBµV/m	Δ ± dB
1	450.00	Horizontal	110.7	116.0	-5.3
2	900.00	Horizontal	68.5	80.7	-12.2
3	1349.97	Horizontal	62.9	80.7	-17.8

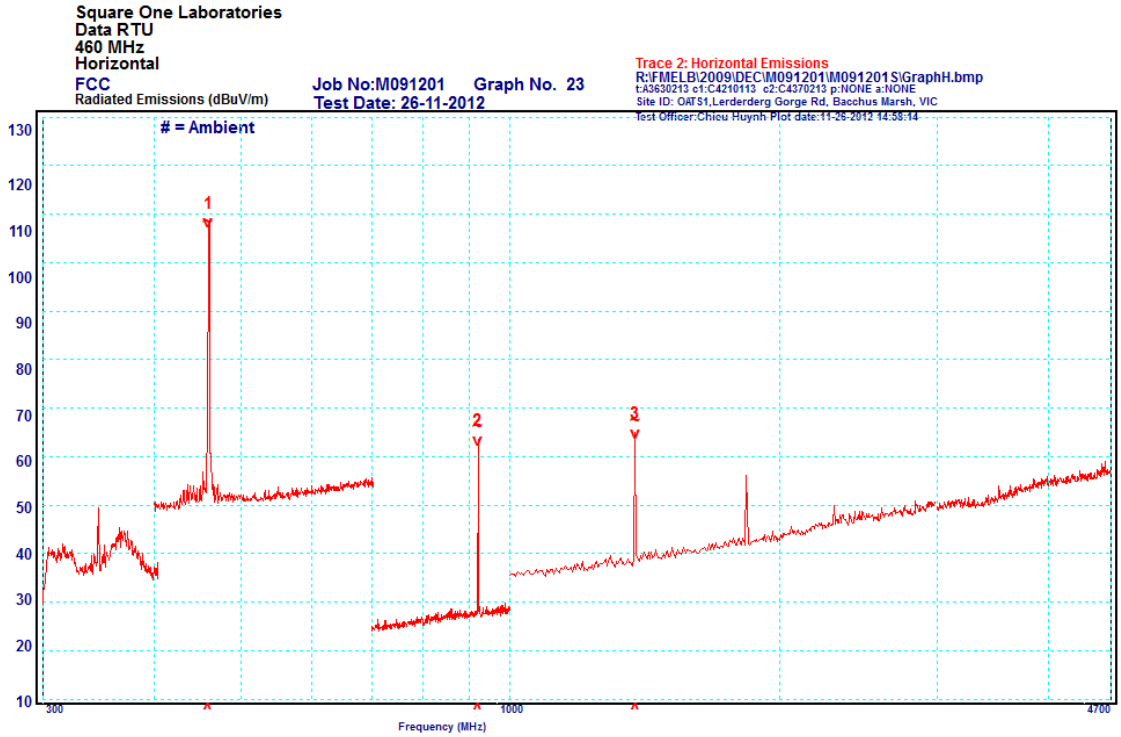
460 MHz – Vertical



Peak	Frequency MHz	Polarity	Level Measured dBuV/m	Limit dBµV/m	Δ ± dB
1	460.00	Vertical	112.5	116.0	-3.5*
2	920.00	Vertical	62.2	82.5	-20.3
3	1379.96	Vertical	63.3	82.5	-19.2

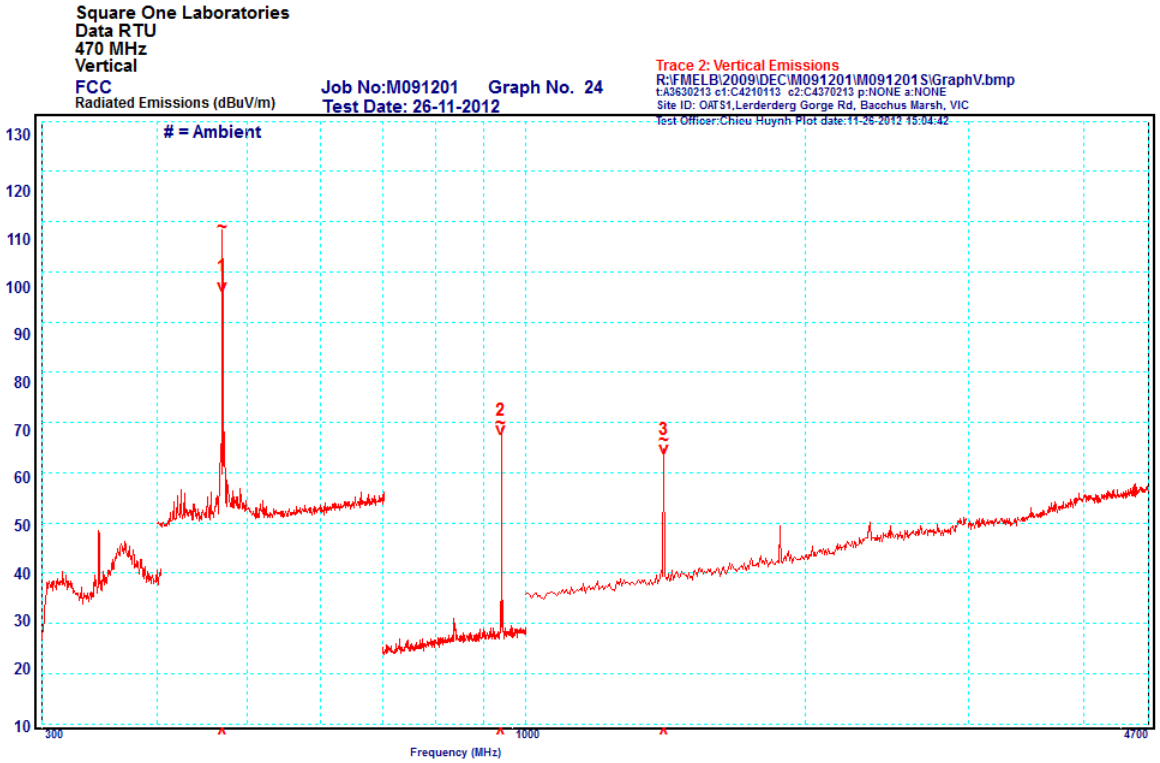
*This result falls within the laboratory's measurement uncertainty. Refer to Section 11.0.

460 MHz - Horizontal



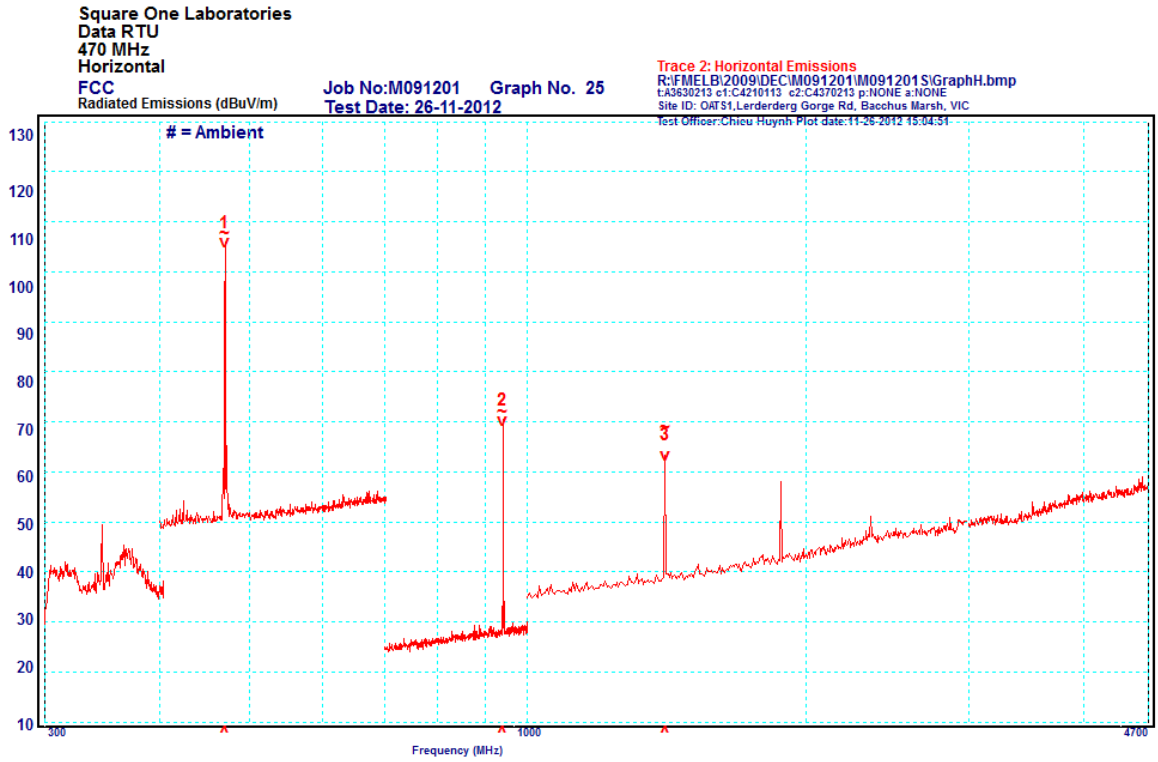
Peak	Frequency MHz	Polarity	Level Measured dBuV/m	Limit dBµV/m	Δ ± dB
1	460.00	Horizontal	108.5	116.0	-7.5
2	920.00	Horizontal	66.2	78.5	-12.3
3	1379.96	Horizontal	67.5	78.5	-11.0

470 MHz – Vertical



Peak	Frequency MHz	Polarity	Level Measured dBuV/m	Limit dBµV/m	Δ ± dB
1	470.00	Vertical	109.8	116.0	-6.2
2	940.00	Vertical	70.0	79.8	-9.8
3	1409.96	Vertical	66.7	79.8	-13.1

470 MHz - Horizontal



Peak	Frequency MHz	Polarity	Level Measured dBuV/m	Limit dBµV/m	Δ ± dB
1	470.00	Horizontal	107.8	116.0	-8.2
2	940.00	Horizontal	72.1	77.8	-5.7
3	1409.97	Horizontal	68.9	77.8	-8.9

Substitution measurements were performed. The EUT was replaced with a calibrated dipole antenna (below 1 GHz) or horn antenna (above 1 GHz) that was connected to a signal generator. The output level of the signal generator was adjusted until the same level on the receiver observed. The level of the signal generator output in dBµV or dBm less any loss due to the connecting cable and added the gain of the substitute antenna.

8.0 FREQUENCY STABILITY

Low Channel (450 MHz)

Temperature (˚C)	Frequency MHz	Frequency Error Hz	Frequency Error ppm	Limits ppm	Results
-30	449.99965	350	0.78	1.5	Pass
-25	449.99970	300	0.67		
-15	449.99995	50	0.11		
-5	450.00010	100	0.22		
+5	450.00010	100	0.22		
+15	450.00010	100	0.22		
+25	450.00010	100	0.22		
+35	450.00000	0	0		
+45	449.99985	150	0.33		
+55	449.99950	500	1.11		

High Channel (470 MHz)

Temperature (˚C)	Frequency MHz	Frequency Error Hz	Frequency Error ppm	Limits ppm	Results
-30	469.99970	300	0.64	1.5	Pass
-25	469.99970	300	0.64		
-15	469.99990	100	0.21		
-5	470.00010	100	0.21		
+5	470.00010	100	0.21		
+15	470.00010	100	0.21		
+25	470.00005	50	0.11		
+35	469.99990	100	0.21		
+45	469.99980	200	0.43		
+55	469.99935	650	1.38		

Measurements were also performed with varying the supply voltage. The maximum transmitter frequency error of 650 Hz was recorded.

9.0 TRANSIENT FREQUENCY

Transmitters designed to operate in the 421-512 MHz frequency band must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated.

Transient frequency behaviour for equipment designed to operate on 12.5 kHz channels:

Time Intervals	Maximum Frequency Difference	421 – 512 MHz Equipment	Results
t_1	± 12.5 kHz	**10.0 ms**	**Complied Refer to plots**
t_2	± 6.25 kHz	**25.0 ms**	
t_3	± 12.5 kHz	**10.0 ms**	

t_1 is the time period immediately following t_{on}
t_2 is the time period immediately following t_1
t_3 is the time period from the instant when the transmitter is turned off until t_{off}

Turn ON

Turn OFF

10.0 COMPLIANCE STATEMENT

The Agile Data RTU, Part number: 1000-0730, tested on behalf of Square One Laboratories Pty Ltd **complied** with the requirements of 47 CFR, Part 90.217

FCC Part 90.217 and FCC Part 2 Clauses	Test Description	Results
FCC 2.1046	Output Power	**Complied**
FCC 2.1049	Occupied Bandwidth	**Complied**
FCC 2.1049	Emission mask	**Complied**
FCC 2.1051	Conducted Emissions	**Complied**
FCC 2.1053	Radiated Emissions	**Complied**
FCC 2.1055	Frequency stability	**Complied**

11.0 MEASUREMENT 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:	9 kHz to 30 MHz	±3.2 dB
Radiated Emissions:	9 kHz to 30 MHz	±4.1 dB
	30 MHz to 300 MHz	±5.1 dB
	300 MHz to 1000 MHz	±4.7 dB
	1 GHz to 18 GHz	±4.6 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%.

12.0 MEASUREMENT INSTRUMENT

EQUIPMENT TYPE	MANUFACTURER, MODEL NUMBER and SERIAL NUMBER	CALIBRATION DUE DD/MM/YYYY
EMI RECEIVER	HP 8546A Sn: 3549A00290 (R-009)	05/09/2013
	Rohde & Schwarz, Model ESU40 Sn: 1302.6005.40, 20 Hz – 40 GHz	12/01/2013
ANTENNA	EMCO 6502 LOOP ANTENNA 9 kHz – 30 MHz Sn: 2021	19/11/2012
	Sunol Sciences Corp (USA) JB6 Biconilog 30 MHz - 6 GHz Sn: A012312	02/02/2013
	EMCO 3115 DOUBLE RIDGED HORN 1 - 18 GHz Sn: 8908-3282	16/01/2015
	EMCO 3121C Dipole	01/02/2013
	ComPower Horn, Model: AH-118, Sn: 71168	19/01/2015
Signal Generator	HP8340B Sn: 2819A00943	Calibration or verify before use
	Rohde & Schwarz, Model SML 01 Sn: 1090 3000 11	Calibration or verify before use
Attenuator	HP8496B, S/N: 2827A18252	Calibration or verify before use
Power Divider or Splitter	Weinschel Engineering 1870A	Calibration or verify before use
	Weinschel Engineering 1506A	Calibration or verify before use
Oscilloscope	Yokogawa DL9140	27/07/2013
Thermal Chamber	Haereus Votsch Model HT4033 Temp Range -40^{0}C-180^{0}C	Not Required