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 15 Subpart C (Section 15.249)

FCC ID:	Z4C-1010
Test Sample:	2.4 GHz Wireless Link
Installed in Host:	Metal Detector
Model Number:	CTX3030
Report Number	M110613_FCC_Cert
Tested for:	Minelab Electronics Pty Ltd
Issue Date:	03rd October 2011

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Report Number:	M110613_FCC_Cert
Test Sample:	2.4GHz Wireless Link
FCC ID:	Z4C-1010
Equipment Type:	Intentional Radiator
Installed in Host:	Metal Detector
Model Number:	CTX3030
Tested for:	Minelab Electronics Pty Ltd
Address:	118 Hayward Avenue, Torrensville, SA 5031 Australia
Phone:	+61 8 8238 0888
Fax:	+61 8 8238 0890
Contact:	David Kitchener
Email:	David.kitchener@minelab.com.au
Responsible Party:	Tony Stevens
Test Standards:	FCC Part 15, Subpart C – Intentional Radiators Section 15.249: Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 – 24.25 GHz. ANSI C63.4 – 2003
Test Dates:	9th to 16th June 2011
Test Engineer:	**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** **EMC Technologies Pty Ltd**

Issued by EMC Technologies Pty. Ltd., 176 Harrick Road, Keilor Park, VIC, 3042, Australia.
Phone: +61 3 9365 1000 Fax: +61 3 9331 7455 www.emctech.com.au

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.249)

1.0 INTRODUCTION

EMI testing was performed on the 2.4 GHz Wireless Link, installed in host CTX3030 Metal Detector.

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.249.

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

47 CFR, Part 15, Subpart C:	Rules for intentional radiators (particularly section 15.249)
Section 15.203:	Antenna requirements
Section 15.209:	Radiated Emission Limits (General requirements)
Section 15.249:	Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 – 24.25 GHz.

1.1 Summary of Results

FCC Part 15, Subpart C	Test Performed	Result
15.203	Antenna Requirement	**Not Applicable**
15.207	Conducted Emissions	**Not Applicable**
15.209	Radiated Emissions	**Complied**
15.249 (a)	Fundamental Field Strength	**Complied**
15.249 (a)	Harmonics Emissions	**Complies**
15.249 (b)	Fixed, point to point	**Not Applicable**
15.249 (c)	Field strength limits @ 3 meters	**Noted**
15.249 (d)	Spurious Emissions	**Complied**
15.249 (e)	20 dB Peak to Average	**Complied**
15.249 (f)	Requirements – Manufacturing, etc	**Noted**

The measurement procedure used was in accordance with ANSI C63.4-2003. The instrumentation conformed to the requirements of ANSI C63.2-1996.

1.2 EUT – Voltage Power Conditions

Testing was performed with the test sample powered off its internal battery.

1.3 Modifications

No modifications were performed.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample:	2.4 GHz Wireless Link
Number of Channels:	15
Bit Rate:	250 kbps
Duty Cycle:	Appro. 14%
Antenna Type:	Inverted F
Antenna Gain:	3.3dBi
Installed in Host:	Metal Detector
Model Number:	CTX3030
Input Supply:	6.5 VDC to 14 VDC

2.2 Operational Description

The Wireless Audio Receiver Module receives audio information via the wireless communications link and generates audio either out of the integrated speaker, or headphones if connected. It is battery operated.

The wireless interface operates in the band 2.4 - 2.483 GHz with 1 of 15 discrete manually selected channels used at any one time.

The wireless electronics uses reference design for the CC2500 device from Texas Instruments in conjunction with an inverted-F PCB antenna. The same electronics and antenna design is used in the User Interface Pod and Wireless Audio Receiver Module.

The User Interface contains a wireless transceiver which transmits detected target audio data to the Wireless Audio Receiver Module. This data is transmitted as a packet every 10mS.

2.3 Test Configuration

The 2.4 GHz Wireless Link was transmitting and receiving continuously during the test.

2.4 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-2003. 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 also been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS 212, Issue 1 (Provisional) - **Industry Canada number 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).

2.7 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 (biconical, log-periodic and horns) calibrated by the EMC Technologies. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in the Measurement Instrument Details.

3.0 CONDUCTED EMISSION MEASUREMENTS

Conducted emission testing was not applicable as the EUT is battery powered.

4.0 RADIATED EMISSION MEASUREMENTS

4.1 Test Procedure

Testing was performed in accordance with the requirements of FCC Part 15.249.

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 0.009 MHz to 30 MHz**.** A calibrated Biconical antenna was used for measurements between 30 MHz to 200 MHz and a calibrated Logperiodic antenna used for measurements between 200 MHz to 1000 MHz. Calibrated EMCO 3115, EMCO 3116 and ETS standard gain horn antennas were used for measurements between 1 to 25 GHz.

The Receiver bandwidth was set to 6.0 dB.

The following bandwidth settings were used:
RBW = 1 kHz and VBW = 3 kHz for frequency band 9 kHz – 150 kHz
RBW = 9 kHz and VBW = 30 kHz for frequency band 150 kHz – 30 MHz
RBW = 120 kHz and VBW = 300 kHz for frequency band 30 MHz – 1000 MHz
RBW = 200 Hz and VBW = 10 Hz for frequency bands 9 kHz – 90 kHz and 110 kHz – 490 kHz
Peak measurements above 1 GHz: RBW = VBW = 1 MHz
Average measurements above 1 GHz: RBW = 1 MHz and VBW = 10 Hz

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 with the Quasi-Peak/Average Detectors. The software for cable losses automatically corrected the measurement data for each frequency range, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. This process was performed for both horizontal and vertical antenna polarisations.

4.2 Calculation of field strength

The 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 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 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

4.3 Fundamental and Spurious Emissions

4.3.1 Frequency Band: 1 – 25 GHz

Low Frequency - Tx at 2411 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2411	91.6	75.6	114.0	94.0	Complied
4822	67.1	52.2	74.0	54.0	Complied
7233	61.5	45.1	74.0	54.0	Complied
4804	54.0	37.1	74.0	54.0	Complied
1396.7	47.1	42.8	74.0	54.0	Complied

Middle Frequency - Tx at 2440 MHz

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2440	90.6	74.8	114.0	94.0	Complied
4880	67.4	52.5	74.0	54.0	Complied
7320	62.1	45.6	74.0	54.0	Complied
4864	55.5	37.3	74.0	54.0	Complied
1396.7	49.8	44.7	74.0	54.0	Complied

High Frequency - Tx at 2471 MHz

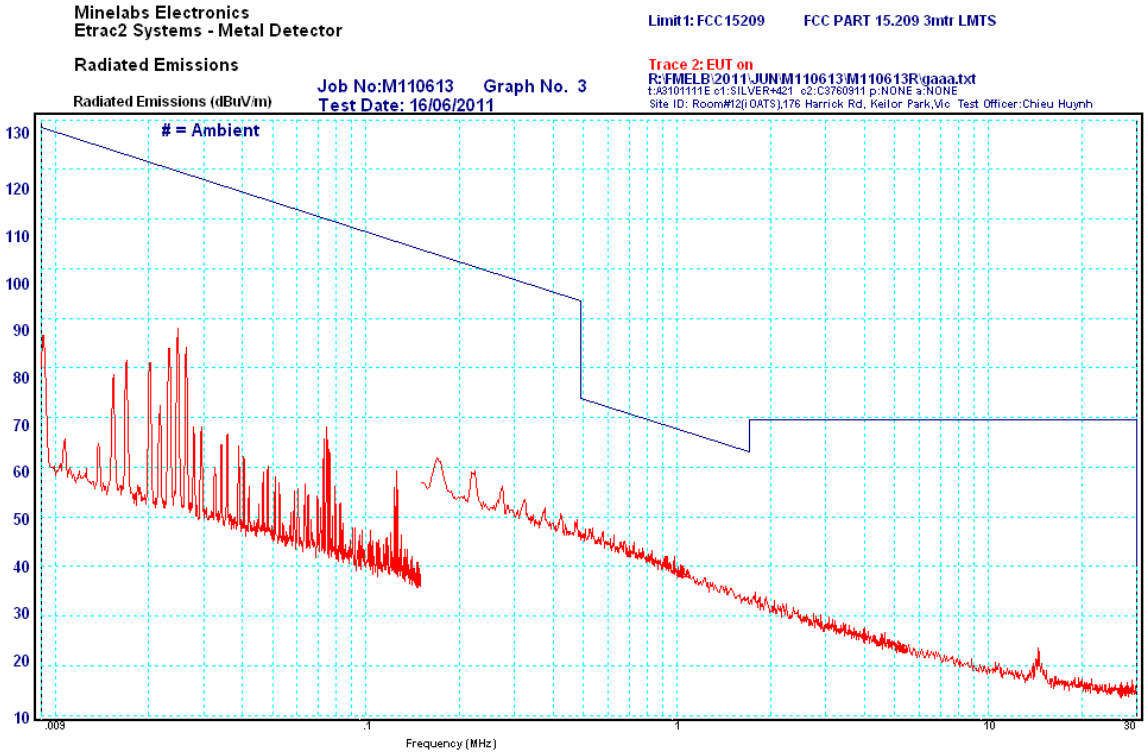
Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2471	90.5	74.6	114.0	94.0	Complied
4942	65.3	50.2	74.0	54.0	Complied
7413	62.4	45.0	74.0	54.0	Complied
4926	54.7	37.2	74.0	54.0	Complied
1396.7	49.6	44.6	74.0	54.0	Complied

Results: The fundamental and harmonic emissions complied with the FCC limits in sections 15.209 and 15.249.

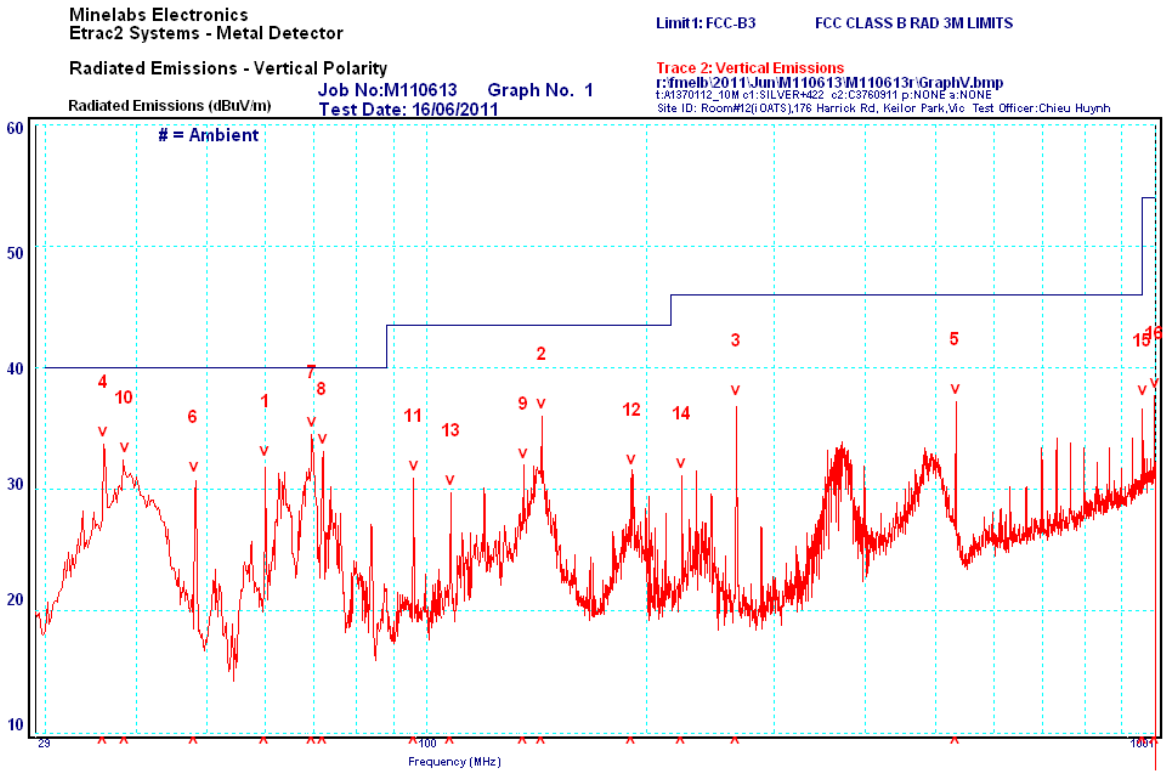
4.3.2 Frequency Band: 9 kHz - 1000 MHz

Initial investigations were performed with all three frequencies (low, middle and high). No significant differences in emissions were observed. Final testing was performed while the transmitter continuously operated at 2.411 GHz.

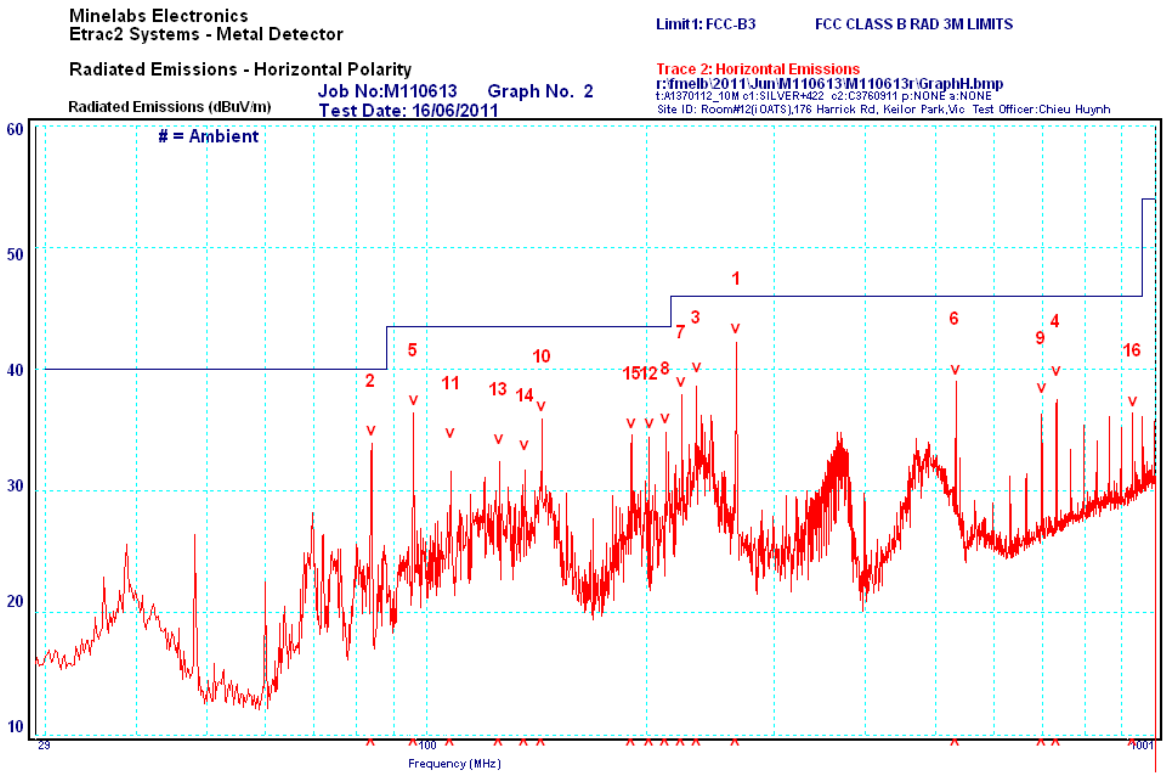
9 kHz to 30 MHz



No peaks were within 20dB below the limits.



Peak	Frequency MHz	Polarisation	Measured QP Level dBµV/m	QP Limit dBµV/m	ΔQP ±dB
1	59.92	Vertical	32.1	40.0	-7.9
2	143.79	Vertical	35.1	43.5	-8.4
3	266.06	Vertical	37.1	46.0	-8.9
4	35.97	Vertical	31.0	40.0	-9.0
5	532.08	Vertical	36.4	46.0	-9.6
6	47.93	Vertical	29.8	40.0	-10.2
7	69.65	Vertical	29.0	40.0	-11.0
8	71.92	Vertical	28.6	40.0	-11.4
9	135.80	Vertical	31.6	43.5	-11.9
10	38.48	Vertical	27.6	40.0	-12.4
11	95.87	Vertical	30.4	43.5	-13.1
12	190.95	Vertical	29.1	43.5	-14.4
13	107.84	Vertical	27.6	43.5	-15.9
14	223.69	Vertical	29.9	46.0	-16.1
15	960.13	Vertical	37.1	54.0	-16.9
16	997.64	Vertical	36.8	54.0	-17.2

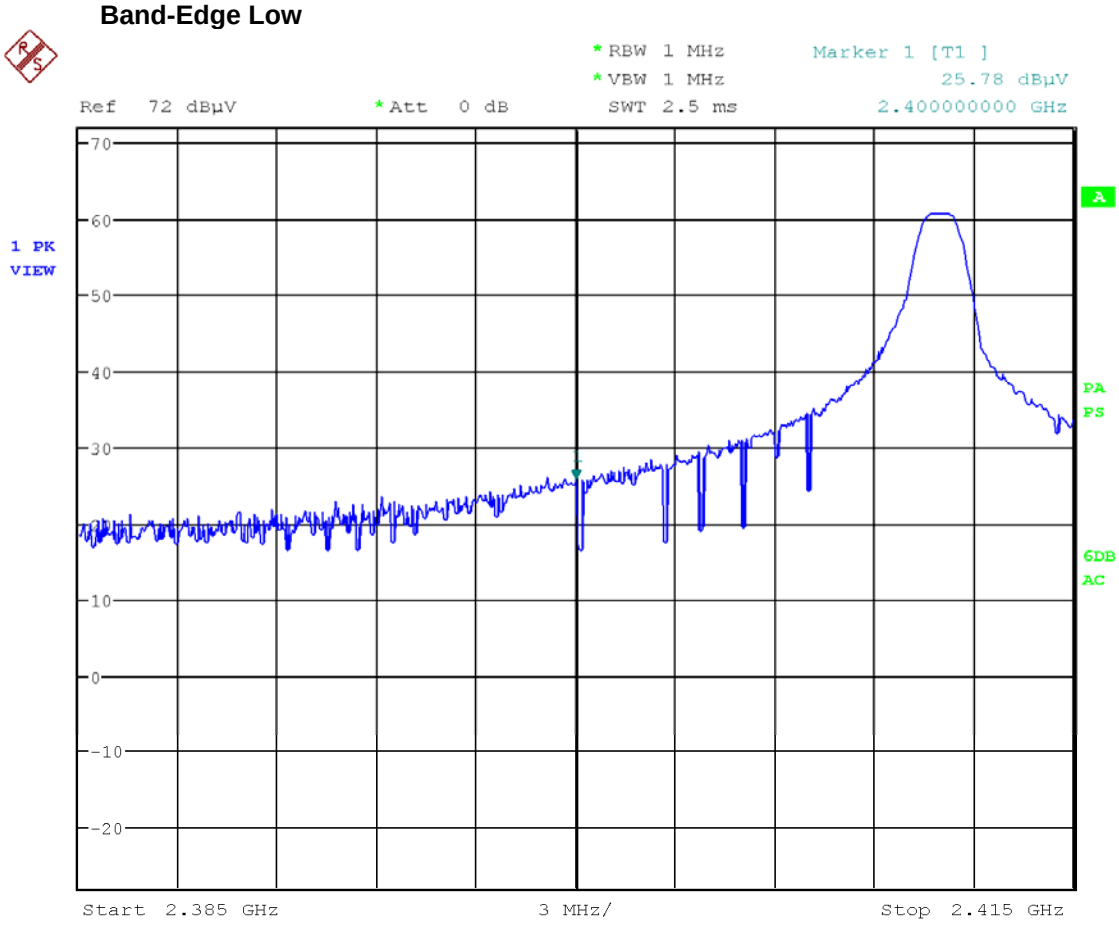


Peak	Frequency MHz	Polarisation	Measured QP Level dBµV/m	QP Limit dBµV/m	ΔQP ±dB
1	266.06	Horizontal	42.3	46.0	-3.7
2	83.89	Horizontal	33.5	40.0	-6.5
3	234.60	Horizontal	39.1	46.0	-6.9
4	731.61	Horizontal	38.8	46.0	-7.2
5	95.87	Horizontal	35.3	43.5	-8.2
6	532.08	Horizontal	37.8	46.0	-8.2
7	223.68	Horizontal	37.7	46.0	-8.3
8	212.77	Horizontal	34.9	43.5	-8.6
9	698.34	Horizontal	37.4	46.0	-8.6
10	143.79	Horizontal	34.7	43.5	-8.8
11	107.84	Horizontal	33.7	43.5	-9.8
12	201.87	Horizontal	33.6	43.5	-9.9
13	125.49	Horizontal	33.2	43.5	-10.3
14	136.40	Horizontal	32.7	43.5	-10.8
15	190.95	Horizontal	32.5	43.5	-11.0
16	931.08	Horizontal	33.7	46.0	-12.3

4.3.3 Band Edge Measurements

Frequency MHz	Peak Detector dBuV/m	Average Detector dBuV/m	Peak Limit dBuV/m	Average Limit dBuV/m	Result
2400	56.6	35.8	74.0	54.0	Complied
2483.5	53.9	33.1	74.0	54.0	Complied

Band-Edge Low



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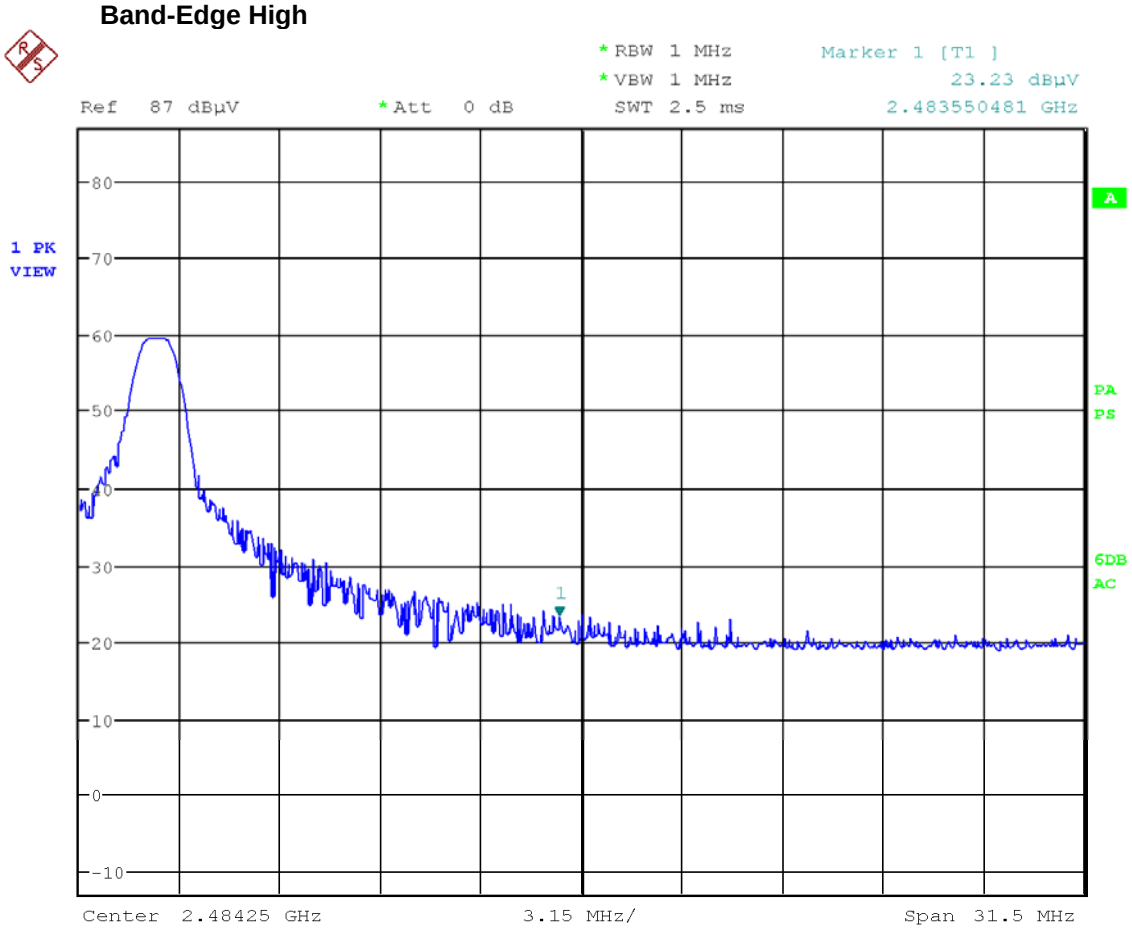
Band-Edge High



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5.0 ANTENNA REQUIREMENT

This intentional radiator was designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.0 COMPLIANCE STATEMENT

The 2.4 GHz Wireless Link, installed in host CTX3030 Metal Detector tested on behalf of Minelab Electronics Pty Ltd, **complies** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.249 - Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 – 24.25 GHz.

Results were as follows:

FCC Part 15, Subpart C	Test Performed	Result
15.203	Antenna Requirement	**Not Applicable**
15.207	Conducted Emissions	**Not Applicable**
15.209	Radiated Emissions	**Complied**
15.249 (a)	Fundamental Field Strength	**Complied**
15.249 (a)	Harmonics Emissions	**Complies**
15.249 (b)	Fixed, point to point	**Not Applicable**
15.249 (c)	Field strength limits @ 3 meters	**Noted**
15.249 (d)	Spurious Emissions	**Complied**
15.249 (e)	20 dB Peak to Average	**Complied**
15.249 (f)	Requirements – Manufacturing, etc	**Noted**

7.0 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:

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%.

8.0 MEASUREMENT INSTRUMENT

EQUIPMENT TYPE	MANUFACTURER, MODEL NUMBER and SERIAL NUMBER	CALIBRATION DUE DD/MM/YY
EMI RECEIVER	Rohde & Schwarz, Model ESU40 SN 1302.6005.40, 20 Hz – 40 GHz	08/12/11
	HP 8546A Sn: 3549A00290 (R-009)	11/08/12
ANTENNAS	Narda Standard Gain Horn, M/N: 644	19/11/12
	ETS Standard Gain Horn, M/N: 3160-03	19/11/12
	ETS Standard Gain Horn, M/N: 3160-05	19/11/12
	ETS Standard Gain Horn, M/N: 3160-06	19/11/12
	ETS Standard Gain Horn, M/N: 3160-07	19/11/12
	ETS Standard Gain Horn, M/N: 3160-08	19/11/12
	ETS Standard Gain Horn, M/N: 3160-09	08/02/14
	EMCO 6502 LOOP ANTENNA 9 kHz – 30 MHz Sn: 2021	29/11/11
	EMCO 93110B BICONICAL 20 - 300 MHz Sn. 96122801	02/05/12
	EMCO 93146A LOG PERIODIC 200 -1000MHz Sn. 98035033	17/01/12
	EMCO 3115 DOUBLE RIDGED HORN 1 - 18 GHz Sn: 8908-3282	12/01/12