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EMI TEST REPORT
for
CERTIFICATION to
FCC PART 15 Subpart B (Section 15.121)

FCC ID:	HNL-G9P
Test Sample:	Software-defined DDC-based Radio Receiver
Model Number:	G3 Series
Manufacturer:	Radixon Group Pty Ltd
Tested for:	Robotron Pty Ltd
Report Number:	M110933_Cert_G3_Series_PCI
Issue Date:	7th December 2011

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EMI TEST REPORT FOR CERTIFICATION
of
Software-defined DDC-based Radio Receiver
to
FCC PART 15 Subpart B (Section 15.121)

EMC Technologies Report No. M110933_Cert_G3_Series_PCI

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Report Number:	M110933_Cert_G3_Series_PCI
Test Sample:	Software-defined DDC-based Radio Receiver
Model Number:	G3 Series
Serial Number:	11C30029
Part Number:	G39DDCi
FCC ID:	HNL-G9P
Manufacturer:	Radixon Group Pty Ltd
Trading Name:	WiNRADiO Communications
Tested for:	Robotron Pty Ltd
Address:	15 Stamford Road, Oakleigh, VIC 3166 Australia
Phone:	+61 3 9568 2568
Fax:	+61 3 9568 1377
Responsible Party:	Milan Hudecek
Equipment Type:	Unintentional Radiator (Scanning Receiver)
Test Standards:	FCC Part 15 Section 101 Unintentional Radiators FCC Part 15 Section 121 Scanning Receivers FCC Part 15 Section 107 Conducted limits FCC Part 15 Section 109 Radiated limits ANSI C63.4-2009
Test Dates:	5th October to 2nd November 2011
Test Officers:	**Matthew Grimwood** **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 Signature:	**Chieu Huynh** **EMC Technologies Pty Ltd**

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart B (Section 15.121)
on the
Software-defined DDC-based Radio Receiver

1. INTRODUCTION

This report details the results of EMI tests and measurements performed on the Software-defined DDC-based Radio Receiver, model: G3 Series in accordance with the Federal Communications Commission (FCC) regulations as detailed in Title 47 CFR, Part 15 Subpart B Rules for Unintentional Radiators and Title 47 CFR, Part 15.121 for Scanning Receivers.

The results and technical details of the test sample are detailed in this report. The test sample was found to comply with the conducted and radiated emission requirements of Part 15.107 and Part 15.109 respectively.

1.1 Summary of Results

Conducted Emissions:	
FCC Part 15.107	Complies Class B limit, margin of 7.5 dB
Radiated Emissions:	
FCC Part 15.109 (30 – 1000 MHz)	
Config #1: (Tune Frequency - 30 MHz)	Complies Class B limit, margin of 6.2 dB
Config #2: (Tune Frequency - 475 MHz)	Complies Class B limit, margin of 5.1 dB
Config #3: (Tune Frequency - 960 MHz)	Complies Class B limit, margin of 5.1 dB
FCC Part 15.109 (1 GHz to 37 GHz):	
Config #1: (Tune Frequency - 30 MHz)	Complies Class B limit, margin of > 10 dB
Config #2: (Tune Frequency - 475 MHz)	Complies Class B limit, margin of > 10 dB
Config #3: (Tune Frequency - 960 MHz)	Complies Class B limit, margin of > 10 dB

The measurement procedure used was in accordance with ANSI C63.4-2009. 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 from a support PC (via PCI express bus).

1.3 Modifications

Refer to Appendix B1 - Internal photos.

2. GENERAL INFORMATION

(Information supplied by Client)

2.1 Product Specifications

Test Sample:	Software-defined DDC-based Radio Receiver
Manufacturer:	Radixon Group Pty Ltd
Model Number:	G3 Series
Serial Number:	11C30029
Part Number:	G39DDCi
Microprocessors:	FPGA type EP3C10F256C7 is used as control unit
Crystal Frequencies:	10 MHz and 100 MHz
Input Supply:	12V DC at 1.6A, 3.3VDC at 0.35A via PCI express bus
Equipment Type:	Unintentional Radiator (Scanning Receiver)

2.2 Test Sample Operational Description

This is a scanning radio receiver, which can tune from 9 kHz to 3500 MHz.
The device is a computer peripheral which is installed into a PCI express slot inside a personal computer. All user control is via the PC.

Refer to Appendix D – Operational Descriptions

2.3 Test sample configuration

The following cables were connected to the EUT: Receiving Antenna and IF Output/Control.

The EUT was set-up /configured as per below:

Below 1 GHz (30 MHz to 1000 MHz):
- Radiated emission measurement was performed with antenna port connected to a load
- Conducted spurious emission measurement was performed at an antenna port

Above 1 GHz (1 GHz to 37 GHz):
- Radiated emission measurement was performed with an antenna connected

Refer to Appendix B3 - Test Setup Photographs.

2.4 Test Sample Block Diagram

Refer to Appendix C - Test Sample Block Diagram

2.5 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-2009. Radiated emissions tests were performed at a distance of 3 metres from the EUT.

2.6 Test Facility

2.6.1 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.

2.6.2 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 Units of Measurements

2.7.1 Conducted Emissions

Measurements are reported in units of dB relative to one microvolt. (dBμV).

2.7.2 Radiated Emissions

Measurements are reported in units of dB relative to one microvolt per metre (dBμV/m).

2.8 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

Testing was performed in accordance with the requirements of FCC Part 15.107

3.1 Test Procedure

The arrangement specified in ANSI C63.4-2009 was adhered to for the conducted EMI measurements. The EUT was placed in the RF screened enclosure and a CISPR EMI Receiver as defined in ANSI C63.2-1996 was used to perform the measurements.

The EMI Receiver was operated under program control using the Max-Hold function and automatic frequency scanning, measurement and data logging techniques. The specified 0.15 MHz to 30 MHz frequency range was sub-divided into sub-ranges to ensure that all short duration peaks were captured.

3.2 Peak Maximising Procedure

The various operating modes of the system were investigated. For each of the sub-ranges, the EMI receiver was set to continuous scan with the Peak detector set to Max-Hold mode. The Quasi-Peak detector and the Average detector were then invoked to measure the actual Quasi-Peak and Average level of the most significant peaks, which were detected.

3.3 Calculation of Voltage Levels

The voltage levels were automatically measured in software and compared to the test limit. The method of calculation was as follows:

VEMI = **VRx + LBPF**

Where: **VEMI =** the Measured EMI voltage in dBµV to be compared to the limit.
VRx = the Voltage in dBµV read directly at the EMI receiver.
LBPF = the loss in dB of the cables and the Limiter and Pass Filter.

3.4 Plotting of Conducted Emission Measurement Data

The measurement data pertaining to each frequency sub-range were then concatenated to form a single graph of (peak) amplitude versus frequency. This was performed for both Active and Neutral lines and the composite graph was subsequently plotted. A list of the highest relevant peaks and the respective Quasi-Peak and Average values were also plotted on the graph.

3.5 Results of Conducted Emission Measurement

Testing was performed with the EUT tuned to three different frequencies: 30 MHz, 475 MHz and 960 MHz.

The worst case conducted EMI complied with the quasi peak and average limits by margins of 13.2 dB and 7.5 dB respectively. Refer to Appendix H - Graphs 1 to 6.

4.0 RADIATED EMISSION MEASUREMENTS

Testing was performed in accordance with the requirements of FCC Part 15.109.

4.1 Test Procedure

The measurement of emissions was measured at a distance of 3 metres.

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 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 GHz to 37 GHz.

The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

The measurements of emissions above 1000 MHz were measured with the resolution bandwidth = 1 MHz and the video bandwidth = 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

4.4 Radiated EMI Results

4.4.1 30 – 1000 MHz

Radiated emission measurement was performed with antenna port connected to a load

Testing was performed with the EUT tuned to 30 MHz (low), 475 MHz (middle) and 960 MHz (high) frequencies channels. All results are reported.

4.4.1.1 Configuration 1 - Tuned Frequency.: 30 MHz

Frequency MHz	Polarisation	QP Measured dBµV	QP Limit dBµV	ΔQP ± dB
700.0	Horizontal	39.8	46.0	-6.2
699.99	Vertical	38.9	46.0	-7.1

Result: The highest radiated emission complied with FCC Class B limit by a margin of 6.2 dB at 700.0 MHz. Refer to Appendix H - Graphs 7 and 8.

4.4.1.2 Configuration 2 - Tuned Frequency.: 475 MHz

Frequency MHz	Polarisation	QP Measured dBµV	QP Limit dBµV	ΔQP ± dB
699.99	Horizontal	40.9	46.0	-5.1
700.0	Vertical	39.6	46.0	-6.4

Result: The highest radiated emission complied with FCC Class B limit by a margin of 5.1 dB at 699.99 MHz. Refer to Appendix H - Graphs 9 and 10.

4.4.1.3 Configuration 3 - Tuned Frequency.: 960 MHz

Frequency MHz	Polarisation	QP Measured dBµV	QP Limit dBµV	ΔQP ± dB
699.99	Horizontal	40.9	46.0	-5.1
700.0	Vertical	39.3	46.0	-6.7

Result: The highest radiated emission complied with FCC Class B limit by a margin of 5.1 dB at 699.99 MHz. Refer to Appendix H - Graphs 11 and 12.

4.4.2 1 GHz to 37 GHz

Radiated emission measurement was performed with an antenna connected

Testing was performed with the EUT tuned to 30 MHz (low), 475 MHz (middle) and 960 MHz (high) frequencies channels. All results are reported.

Results: The highest radiated emission complied with FCC Class B average limit by a margin of greater than 10 dB.

5.0 ANTENNA PORT MEASURMENTS – 30 MHz to 1000 MHz

Conducted spurious emission measurement was performed at an antenna port as per FCC Part 15.111

Testing was performed with the EUT tuned to 30 MHz (low), 475 MHz (middle) and 960 MHz (high) frequencies channels. All results are reported.

Results: The highest radiated emission complied with FCC limit by a margin of greater than 10 dB.

6.0 COMPLIANCE STATEMENT

The Software-defined DDC-based Radio Receiver, model: G3 Series, tested on behalf of Robotron Pty Ltd complied with the requirements of the FCC Part 15 Subpart B Rules for Unintentional Radiators and FCC Part 15.121 Rules for Scanning Receivers.

The compliance margins were as follows:

Conducted Emissions:	
FCC Part 15.107	Complies Class B limit, margin of 7.5 dB
Radiated Emissions:	
FCC Part 15.109 (30 – 1000 MHz)	
Config #1: (Tune Frequency - 30 MHz)	Complies Class B limit, margin of 6.2 dB
Config #2: (Tune Frequency - 475 MHz)	Complies Class B limit, margin of 5.1 dB
Config #3: (Tune Frequency - 960 MHz)	Complies Class B limit, margin of 5.1 dB
FCC Part 15.109 (1 GHz to 37 GHz):	
Config #1: (Tune Frequency - 30 MHz)	Complies Class B limit, margin of > 10 dB
Config #2: (Tune Frequency - 475 MHz)	Complies Class B limit, margin of > 10 dB
Config #3: (Tune Frequency - 960 MHz)	Complies Class B limit, margin of > 10 dB

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:

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%.