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

FCC ID:	HNL-G5P
Manufacturer:	WiNRADiO Communications
Test Sample:	WiNRADiO G3 Internal Radio Receiver (1800MHz)
Model Number:	G3
Tested for:	Robotron Pty Ltd
Report Number:	M060139_Cert_G3_Internal_Receiver
Issue Date:	21st February 2006

EMC Technologies Pty Ltd reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. EMC Technologies Pty Ltd shall have no liability for any deductions, inferences or generalisations drawn by the client or others from EMC Technologies Pty Ltd issued reports. This report shall not be used to claim, constitute or imply product endorsement by EMC Technologies Pty Ltd.

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to national standards of measurement. This document shall not be reproduced, except in full.

NATA Accredited Laboratory
Number: 5292

EMI TEST REPORT FOR CERTIFICATION
of
WiNRADiO G3 Internal Radio Receiver (1800MHz)
to
FCC PART 15 Subpart B (Section 15.121)

EMC Technologies Report No. M060139_Cert_G3_Internal_Receiver

Issue Date: 21st February 2006

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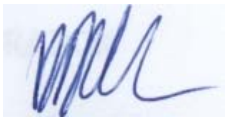
EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart B (Section 15.121)

Report Number:	M060139_Cert_G3_Internal_Receiver
Test Sample:	WiNRADiO G3 Internal Radio Receiver (1800 MHz)
Model Number:	G3
Serial Number:	06A16001
FCC ID:	HNL-G5P
Manufacturer:	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 C63.4-2003 OET Bulletin No. 65
Test Dates:	30th January to 3rd February 2006



Test Officer: _____
Kevin Hansen

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: _____
Chris Zombolas
Technical Director
EMC Technologies Pty Ltd

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EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart B (Section 15.121)
on the
WiNRADiO G3 Internal Radio Receiver (1800MHz)

1. INTRODUCTION

This report details the results of EMI tests and measurements performed on the WiNRADiO G3 Internal Radio Receiver (1800MHz) 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 5.3 dB
Radiated Emissions:	
FCC Part 15.109 (30 – 1000 MHz)	
Config #1: (Tune Frequency - 30 kHz)	Complies Class B limit, margin of 1.1 dB
Config #2: (Tune Frequency - 495 MHz)	Complies Class B limit, margin of 2.2 dB
Config #3: (Tune Frequency - 960 MHz)	Complies Class B limit, margin of 1.1 dB
FCC Part 15.109 (above 1 GHz):	Complies Class B limit, margin of > 10 dB

The measurement procedure used was in accordance with ANSI C63.4-2003 and OET Bulletin No. 65. The instrumentation conformed to the requirements of ANSI C63.2-1996.

1.2 Modifications

No modifications were required.

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2. GENERAL INFORMATION

(Information supplied by Client)

2.1 Product Specifications

Test Sample:	WiNRADiO G3 Internal Radio Receiver (1800 MHz)
Tested for:	Robotron Pty Ltd
Manufacturer:	WiNRADiO Communications
Model Number:	G3
Serial Number:	06A16001
FCC ID:	HNL-G5P
Equipment Type:	Unintentional Radiator (Scanning Receiver)

2.2 Test Sample Operational Description

This is a PC-controlled Software-Defined Receiver, where the incoming frequency (9 kHz to 1800 MHz), is first up-converted to 109.65 MHz IF, and then down-converted to 12 or 16 kHz IF, after which it is further processed (demodulated) entirely in software. The demodulator software can run either on the inbuilt DSP, or optionally directly on the PC (after being digitized by the PC sound card).

There is also a separate path for wide-FM signals, which are down-converted from 109.65 MHz to 10.7 MHz, and demodulated conventionally, in hardware.

There are 6 main functional modules:

1. The **RF module** which contains switchable front-end filters, an attenuator and an amplifier
2. The **IF1 module** which contains a mixer and the 109.65 MHz first IF.
3. The **IF2 module** which contains a 109.662 or 109.666 MHz local oscillator and 12 or 16 kHz second IF.
4. The **PLL module** which provides variable frequency 109.659 to 1690.350 MHz used for the first IF mixer.
5. The **WFM module**, which down converts the first IF to 10.7 MHz, and demodulates the WFM signal to audio.
6. The **USB backplane** which contains the control CPU, USB interface, DSP and master reference oscillator (20 MHz).

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2.3 Technical Specifications

Type:	Dual Conversion Superheterodyne
Frequency Range:	0.009 - 1800 MHz
Modes:	AM, AMN, AMS, LSB, USB, CW, FM, WFM
Tuning Steps:	1 Hz
IF Shift:	3 kHz
Audio Output:	Line Output to Sound Card or 200 mW @ 8 Ω
Antenna:	50 Ω, SMA Connector
Dynamic Range:	90 dB
IP3:	+0 dBm
Power Supply:	PCI bus, +5, +12V, -12VDC
Microprocessor:	PIC16F877, ADSP2185M
Typical Sensitivity:	1 uV (AM), 0.3uV (LSB, USB), 0.5uV (FM), 2uV (WFM)

Oscillator Frequencies:
The master reference crystal oscillator is 20 MHz. From the first reference oscillator, two VCO/PLL oscillators are derived:
First IF: 109.659 to 1690.350 MHz
Second IF: 109.662 or 109.666 MHz

The DSP uses a 32.768 MHz oscillator

2.4 Test sample configuration

The EUT was installed in the host personal computer (PC).

The following cables were connected to the EUT: Receiving antenna and sound card audio cable.

Refer to Appendix B - Test Setup Photographs.

2.5 Test Sample Block Diagram

Refer to Appendix C - Test Sample Block Diagram

2.6 Test Sample Support PCs

Hewlett Packard Vectra VEi8 (Radiated Emissions)
Model Number: DTPC-17
Serial Number: SG94072639

Dell Dimension 4700 (Conducted Emissions)
Model Number: DMC
Serial Number: 1TJCF1S

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2.7 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. OET Bulletin 65 dated June 2001 was used for reference.

2.8 Test Facility

2.8.1 General

Radiated Emission measurements were performed at EMC Technologies open area test site (OATS) situated at Lerderderg Gorge, near the township of Bacchus Marsh in Victoria, Australia. Conducted measurements at an antenna ports were performed at EMC Technologies' laboratory in Tullamarine, Victoria Australia.

The above test sites have been accepted for testing by the Federal Communications Commission (FCC) - **FCC Registration Number 90560**.
EMC Technologies open area test site (OATS) has also been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS 212, Issue 1 (Provisional).
Industry Canada File Number IC 4161.

2.8.2 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 emission, 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 Laboratory (NML) 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).

2.9 Units of Measurements

2.9.1 Conducted Emissions

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

2.9.2 Radiated Emissions

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

2.10 Test Equipment Calibration

All 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 Laboratory (NML). All equipment calibration is traceable to Australia national standards at the National Measurements Laboratory. The reference antenna calibration was performed by NML and the working antennas (biconical and log-periodic) calibrated by the NATA approved procedures. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in Appendix A

2.11 Ambients at OATS

The Open Area Test Site (OATS) is an area of low background ambient signals. No significant broadband ambients are present however commercial radio and TV signals exceed the limit in the FM radio, VHF and UHF television bands. Radiated prescan measurements were performed in the shielded enclosure to check for possible radiated emissions at the frequencies where the OATS ambient signals exceeded the test limit.

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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 C63.4-2003 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 kHz, 495 MHz and 960 MHz. There were no significant differences in emissions observed.

The worst case conducted EMI complied with the quasi peak and average limits by margins of 11.6 dB and 5.3 dB respectively. The measurement uncertainty was ±2.0 dB. Refer to Appendix H - Graphs 1 and 2.

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4.0 RADIATED EMISSION MEASUREMENTS

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

4.1 Test Procedure

Radiated emissions were made at the open area test site. 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 232 MHz and a calibrated Logperiodic antenna used for measurements between 230 MHz to 1000 MHz. Calibrated EMCO 3115 Horn antenna was used for measurements between 1 to 5 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 measurement of emissions above 1000 MHz was measured with the resolution bandwidth of 1 MHz and the video bandwidth of 10 kHz.

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

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (1000 MHz – 18,000 MHz) ± 4.1 dB
  (30 MHz – 1,000 MHz) ± 3.7 dB

4.3 Plotting of Measurement Data for Radiated Emissions

The stored measurement data was combined to form a single graph which comprised of all the frequency sub-ranges over the range 0009-1000 MHz. The accumulated EMI (EUT ON) was plotted as the Red trace while the Ambient signals (AMBIENT) were plotted as Green trace. The worst case radiated EMI *peak* measurements as recorded using the Max-Hold data are presented as the upper or **RED** trace while the respective ambient signals are presented as the lower or **GREEN** trace. Occasionally, an intermittent ambient arose during the EUT ON measurement (RED trace) and could not be captured when the Ambient trace was being stored. The ambient peaks of significant amplitude with respect to the limit are tagged with the "#" symbol while EMI peaks are identified with a numeral. Ambient peaks that were present during the EUT ON measurement (RED trace) and not captured during the AMBIENT measurement were also tagged with the "#" symbol.

The highest recorded EMI signals are shown on the Peaks List on the bottom right side of the graph. For radiated EMI, each numbered peak is listed as a frequency, peak field strength, quasi-peak field strength and the margin relative to the limit in dB. A negative margin is the deviation of the recorded value below the limit.

At times, the quasi peak level may appear to be higher than the peak level. This happens because the individual peak is further maximised with the QP detector. This will be apparent when the peaks list at the foot of the graphs shows the quasi peak level higher than the peak level.

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4.4 Radiated EMI Results

4.4.1 30 – 1000 MHz

Testing was performed with the EUT tuned to 30 MHz (low), 495 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
66.55	Horizontal	38.9	40.0	-1.1
66.47	Vertical	38.3	40.0	-1.7
67.08	Horizontal	38.1	40.0	-1.9
67.02	Vertical	36.6	40.0	-3.4
63.93	Vertical	35.3	40.0	-4.7
32.20	Vertical	34.3	40.0	-5.7
400.88	Horizontal	40.2	46.0	-5.8
40.33	Vertical	34.0	40.0	-6.0
39.86	Vertical	33.8	40.0	-6.2
806.03	Horizontal	39.6	46.0	-6.4
806.29	Vertical	39.3	46.0	-6.7
598.12	Horizontal	39.2	46.0	-6.8
502.43	Horizontal	39.1	46.0	-6.9
502.97	Vertical	38.8	46.0	-7.2
597.92	Vertical	38.1	46.0	-7.9

Result: The highest radiated emission peak complied with FCC Class B limit by a margin of 1.1 dB at 66.55 MHz. The measurement uncertainty for radiated EMI was ±3.7 dB. Refer to Appendix H - Graphs 3 and 4.

4.4.1.2 Configuration 2 - Tuned Frequency.: 495 MHz

Frequency MHz	Polarisation	QP Measured dBµV	QP Limit dBµV	ΔQP ± dB
66.51	Vertical	37.8	40.0	-2.2
66.56	Horizontal	35.1	40.0	-4.9
806.27	Horizontal	39.6	46.0	-6.4
400.87	Horizontal	39.6	46.0	-6.4
502.97	Horizontal	38.7	46.0	-7.3
806.06	Vertical	38.4	46.0	-7.6
171.83	Horizontal	34.8	43.5	-8.7
100.67	Horizontal	34.0	43.5	-9.5
Other peaks were similar to configuration 1.				

Result: The highest radiated emission peak complied with FCC Class B limit by a margin of 2.2 dB at 66.51 MHz. The measurement uncertainty for radiated EMI was ±3.7 dB. Refer to Appendix H - Graphs 5 and 6.

4.4.1.3 Configuration 3 - Tuned Frequency.: 960 MHz

Frequency MHz	Polarisation	QP Measured dBµV	QP Limit dBµV	ΔQP ± dB
66.49	Vertical	38.9	40.0	-1.1
Other peaks were similar to configurations 1 and 2.				

Result: The highest radiated emission peak complied with FCC Class B limit by a margin of 1.1 dB at 66.49 MHz. The measurement uncertainty for radiated EMI was ±3.7 dB. Refer to Appendix H - Graphs 7 and 8.

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4.4.2 1 to 5 GHz

Testing was performed with the EUT tuned to 495 MHz and 960 MHz.
The worst case emissions were found to be greater than 10 dB of the limits. The measurement uncertainty for radiated field strength emissions was ±4.1 dB.

5.0 COMPLIANCE STATEMENT

The WiNRADiO G3 Internal Radio Receiver (1800 MHz), 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 5.3 dB
Radiated Emissions:	
FCC Part 15.109 (30 – 1000 MHz)	
Config #1: (Tune Frequency - 30 MHz)	Complies Class B limit, margin of 1.1 dB
Config #2: (Tune Frequency - 495 MHz)	Complies Class B limit, margin of 2.2 dB
Config #3: (Tune Frequency - 960 MHz)	Complies Class B limit, margin of 1.1 dB
FCC Part 15.109 (above 1 GHz):	Complies Class B limit, margin of > 10 dB

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TEST REPORT APPENDICES

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