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EMI TEST REPORT
for
CERTIFICATION of
FCC PART 15.225 & FCC PART 15.207 TRANSMITTER

FCC ID: Q47-CID1B
Manufacturer: ERG Ltd
Test Sample: Card Interface Device (CID1B)
Model: 18186
Serial No: 03222860

Date: 13th November 2003

NATA Accredited Laboratory
Number: 5292

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EMI TEST REPORT FOR CERTIFICATION
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FCC ID: Q47-CID1B
EMC Technologies Report No. T31109_F
Date: 13th November 2003

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Report Number:	T31109_F
Test Sample Name:	Card Interface Device (CID1B)
Model Number:	18186
Serial Number:	03222860
FCC ID:	Q47-CID1B
Manufacturer:	ERG Ltd
Tested For:	ERG Ltd
Address:	247 Balcatta Road Balcatta WA 6021
Phone:	(08) 9273 1100
Fax:	(08) 9273 1570
Responsible Party:	Mr Gino Bertino
Test Standards:	**FCC Part 15.225 Intentional Radiators** **FCC Part 15.207 Conducted Limits** **ANSI C63.4:1992** **OET Bulletin No. 63**
Test Dates:	07/11/03, 10/11/03 and 12/11/03

Testing Officers:

Bruce Holdsworth **Kumar Thambiaiah**

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:

Les Dickenson
Branch Manager
EMC Technologies Pty Ltd

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EMI TEST REPORT FOR CERTIFICATION of FCC PART 15.225 & FCC PART 15.207 TRANSMITTER on the Card Interface Device (CID1B)

1. SUMMARY of RESULTS

This report details the results of EMI tests and measurements performed on the Card Interface Device (CID1B), Model: 18186, in accordance with the Federal Communications Commission (FCC) regulations as detailed in Title 47 CFR, Part 15 Rules for intentional radiators. All results are detailed in this report. The EUT complied with the requirements of Part 15.225 and the conducted emision requirements of FCC Part 15.207.

Section 15.225(a)	Carrier Signal Field Strength:	Complied, margin of > 10dB.
Section 15.209	Radiated Emissions	Complied, margin of 1.1dB.
Section 15.225(c)	Frequency Tolerance:	Complied.
Section 15.207	Conducted Emissions:	Complied, margin of 1.0dB.

2. GENERAL INFORMATION

2.1 General Description of Test Sample

Manufacturer	:	ERG Ltd
Test Sample	:	Card Interface Device
Model	:	18186
Serial No	:	03222860
FCC ID	:	Q47-CID1B
Equipment Type	:	Intentional Radiator

2.2 Test Sample Functional Description

The CID1B is used on buses. It allows the patron to pay for their fare by tagging on and tagging off the bus. The test sample features a diagnostic application that exercises internal sections (memory, comms ports, wlan, display, etc) during test loops.

2.3 Technical Specifications and System Overview

RF Control Chip:	
Input Supply:	24V, 15W max
Microprocessor:	Motorola MC68340
Crystal Frequency MHz:	32.768kHz, 5.0688MHz, 7.3728MHz, 20.000MHz

Refer to Appendix H (User Manual), Appendix I (Installation Guide) and Appendix E (Block Diagram/Operational Description).

2.4 Test Sample Support Equipment

Data communications cable to talk to a test PC to exercise the RS232 interface. The EUT was powered from a AC to DC Convertor during testing.

2.5 Test Sample Block Diagram

Refer to Appendix E – Test Sample Block Diagram/Operational Description.

2.6 EUT Configuration

CID1B has a 128x64 backlit LCD. The unit has a 13.56MHz contactless card reader and connects to a Driver Console.
The EUT was set up and connected to a windows based PC to exercise the RS232 port.
Refer to Appendix E (Block Diagram/Operational Description) & Appendix B (Test Setup Photographs).

2.7 Modifications

No modifications were performed.

2.8 Test Procedure

Radiated Emissions measurements were performed in accordance with the procedures of ANSI C63.4:1992. The measurement distance for radiated emissions was 3 metres from the EUT for ranges: 0.009-1000MHz.

2.9 Test Facility

2.9.1 General

Conducted Emission measurements and fundamental frequency 13.56 MHz stability were performed at EMC Technologies Laboratory in Castle Hill, New South Wales, Australia. Radiated Emission measurements in the ranges 9kHz – 30MHz (H-Field) and 30-1000MHz (E-Field) were performed at EMC Technologies open area test site (OATS) situated at Upper Colo, NSW, Australia.

The above sites have been fully described in a report submitted to the FCC office, and accepted in a letter dated November 27th 2002, **FCC Registration number is 90561**.

2.9.2 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 18GHz 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).

2.10 Units of Measurements

2.10.1 Conducted Emissions

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

2.10.2 Radiated Emissions

Measurements are reported in units of dB relative to one microvolt per metre (dBμV/m). The measurement distance was 3 metres from the EUT for ranges: 0.009-1000MHz.

2.11 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 Measurement Laboratory. The reference antenna calibration was performed by NML and the working antennas (active loop, biconical & 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 of this report.

2.12 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.

3. CONDUCTED EMISSION MEASUREMENTS

3.1 Test Procedure

The arrangement specified in ANSI C63.4-1992 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 C63.2-1987 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 duration peaks were captured.

3.2 Peak Maximizing Procedure

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 was then invoked to measure the actual Quasi-Peak 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:

$V_{EMI} = V_{Rx} + L_{BPF}$

Where:

V_{EMI} = The Measured EMI voltage in dBµV to be compared to the limit.
V_{Rx} = The Voltage in dBµV read directly at the EMI receiver.
L_{BPF} = The insertion 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 graphs.

3.5 Conducted EMI Results

Freq. (MHz)	Line	Quasi Peak (dBmV)	Quasi Peak Limit (dBmV)	D Limit (dB)	Average (dBmV)	Average Limit	DAverage Limit
13.56*	Neutral	63.0	60.0	3.0	63.0	50.0	13.0
13.56*	Active	62.7	60.0	2.7	62.7	50.0	12.7
27.12	Active	48.9	60.0	-11.1	49.0	50.0	-1.0
27.12	Neutral	45.3	60.0	-14.7	45.1	50.0	-4.9
0.579	Neutral	39.3	56.0	-16.7	38.2	46.0	-7.8
0.579	Neutral	39.3	56.0	-16.7	38.2	46.0	-7.8
0.290	Neutral	42.8	60.5	-17.7	42.5	50.5	-8.0
0.576	Active	37.9	56.0	-18.1	36.4	46.0	-9.6
0.576	Active	38.0	56.0	-18.0	36.4	46.0	-9.6
0.288	Active	41.5	60.6	-19.1	41.0	50.6	-9.6

* Fundamental Frequency of Transmitter.

Note: As per the requirements of FCC Part 15 Clause 15.207b3 the transmit carrier was excluded from the test. The test sample complied with a margin of at least 1.0dB.

The measurement uncertainty for conducted emissions is ±1.8 dB

Appendix G, Graphs 1 to 2.

3.6 Results of Conducted Emission Measurement

The EUT complied with the conducted limits of FCC Rule Part 15.207 by a margin of at least 1.0dB. Emissions at the fundamental frequency of 13.56 MHz are excluded from the results as per clause 15.207b3.

4. RADIATED EMISSION MEASUREMENTS – 0.009 MHz to 1 GHz

4.1 Test Procedure

Radiated emissions measurements were performed in accordance with the procedures of ANSI C63.4:1992 Radiated emission tests from 9 kHz to 30 MHz were performed at the Open Area Test Site (OATS) an EUT distance of 3 metres. Tests in the range 30-1000MHz were performed at an EUT distance of 3m at the Open Area Test Site (OATS). OET Bulletin 63 was used for reference.

The EUT was set up on the turntable above the ground plane and operated in accordance with section 2 of this report. The EMI Receiver was operated under software control via the PC Controller.

4.1.1 0.009 – 30 MHz Range

The 0.009 MHz to 30 MHz 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. The EUT was slowly rotated with the Peak Detector set to Max-Hold. The receive loop antenna was set to 1m above the ground plane with the Quasi-Peak detector ON. The measurement data for each frequency range was automatically corrected by the software for cable losses, antenna factors and preamplifier gain and all data was then stored on disk in sequential data files. The orientation of the receive loop antenna was varied to ensure that the emissions were maximised. This process was performed with the receive antenna both parallel and perpendicular to the EUT.

4.1.2 30 – 1000 MHz Range

The 30 MHz to 1000 MHz 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. The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two receiver antenna heights. Each significant peak was then investigated and maximised by rotating the turntable and scanning the height of the receiver antenna between 1 to 4 metres with the Quasi-Peak detector ON. The measurement data for each frequency range was automatically corrected by the software for cable losses, 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 receive antenna polarisation.

4.2 Plotting of Measurement Data for Radiated Emissions

4.2.1 0.009 – 30 MHz Range

The stored measurement data was combined to form a single graph which comprised of all the frequency sub-ranges over the range 0.009 – 30 MHz. The fundamental frequency (H-Field) was measured at the OATS. The worst case radiated EMI peak measurements as recorded using the Max-Hold data are presented as the **RED** trace.

4.2.2 30 – 1000 MHz Range

The stored measurement data was combined to form a single graph which comprised of all the frequency sub-ranges over the range 30 – 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 "#" symbol.

The highest recorded EMI signals are shown on the Peaks List on the bottom right hand side of the graph. For radiated EMI, each numbered peak is listed as a frequency, peak field strength, Quasi-peak field strength, limit, antenna height 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 AFTER the MAX-HOLD trace has been stored. This will be apparent when the peaks list at the foot of the graphs shows the quasi peak level higher than the peak level.

4.3 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 (stored as a data array)
- **G** = Preamplifier Gain in dB. (stored as a data array)
- **L** = Cable insertion loss in dB. (stored as a data array)

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 1.9dB while the preamplifier gain is 20dB.

34.0 + 9.2 - 20 + 1.9 = 25.1 dBmV/m

4.4 Radiated Field Strength Measurement Results

The following test were performed with the mains supply varied betewwn 85 to 115% as per the requirments of Section 15.31e. No change in either frequecy or amplitued were noted. All testing were performed with nominal 120V 60Hz supply.

4.4.1 Carrier Field Strength Measurement (Zoom 13.56 MHz)

Frequency MHz	Peak Level DBmV/m	Limit @ 3m dBmV/m	Result ± dB
13.56	72.5	120.0	-47.5

The worst case polarisation is reported. The EUT complied with a margin of greater than 10dB. The measurement uncertainty is ±4.6dB. Refer to Appendix G, Graph 4.

4.4.2 9 kHz to 30 MHz Field Strength Spurious Emissions

Frequency MHz	Peak Level dBmV/m	Limit @ 3m dBmV/m	Result ± dB
13.56*	73.5	120.0	-46.5

*Fundamental frequency

No spurious emissions were recorded. Complied with a margin of greater than 10dB. The measurement uncertainty is ±4.6dB. Refer to Appendix G, Graph 3.

4.4.3 30 - 1000MHz Field Strength Spurious Emissions

Frequency (MHz)	Rx Antenna Polarisation	Quasi Peak Level (dBmV/m)	Limit @ 3m (dBmV/m)	DResult (dB)
339.03	Vertical	38.1	46.0	-7.9
226.47	Horizontal	44.9	46.0	-1.1
276.81	Horizontal	40.0	46.0	-6.0
251.65	Horizontal	38.8	46.0	-7.2
301.22	Horizontal	36.8	46.0	-9.2
300.16	Horizontal	36.7	46.0	-9.3

Summary of Results

The highest radiated spurious emission was 1.1dB below the limit at 226.47MHz for horizontal Polarisation. The measurement uncertainty is ±4.6dB.
Refer to Appendix G, Graphs 5 and 6.

5.0 FREQUENCY TOLERANCE

The frequency tolerance of the carrier signal was within 0.01% of the operating frequency over the temperature variation of –20degrees C to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at the temperature of 20 degrees C.
The EUT complied with the frequency tolerance of the carrier signal with a worst case of 0.0037%.

6. CONCLUSION

The Card Interface Device (CID1B), Model: 18186, FCC ID: Q47-CID1B, complied with the requirements of FCC Part 15 Rules for low power transmitters when tested in accordance with FCC Part 15.225 and FCC Part 15.207.

Part 15.225

Section 15.225(a) Carrier Signal Field Strength:	Complied, margin of > 10dB.
Section 15.209 Radiated Emissions	Complied, margin of 1.1dB*.
Section 15.225(c) Frequency Tolerance:	Complied.
Section 15.207 Conducted Emissions:	Complied, margin of 1.0dB*.

*Note: Result within the band of measurement uncertainty around the limit.

TEST REPORT APPENDICES

(Submitted as Attachments)

APPENDIX A:	**MEASUREMENT INSTRUMENTATION DETAILS**
APPENDIX B:	**TEST SETUP AND IDENTIFICATION PHOTOGRAPHS**
APPENDIX C:	**TEST SAMPLE SCHEMCATICS**
APPENDIX D:	**TEST SAMPLE PCB LAYOUTS**
APPENDIX E:	**TEST SAMPLE BLOCK DIAGRAM/OPERATIONAL DESCRIPTION**
APPENDIX F:	**LABELLING – LOCATION**
APPENDIX G:	**GRAPHS OF EMI MEASUREMENT**
APPENDIX H:	**USER MANUAL**
APPENDIX I:	**PARTS LIST/BILL OF MATERIALS**