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EMI TEST REPORT
for
CERTIFICATION to
FCC PART 15.231

FCC ID: **QQY8V00GH40001**

Test Sample: Remote Key Transmitter
Model Number: GMX281
Tested for: Australian Arrow Pty Ltd

Report Number: M021022_Certification

Issue Date: 27th August 2003

NATA Accredited Laboratory Number: 5292

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Test Sample:	Remote Key Transmitter
Model Number:	GMX281
FCC ID:	QQY8V00GH40001
Manufacturer:	Australian Arrow Pty Ltd
Tested for:	Australian Arrow Pty Ltd
Address:	65 Lathams Road, Carrum Downs, VIC 3201 Australia
Phone:	+613 9775 1566
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Responsible Party:	Trevor Sykes Hardware Operations Leader ENGINEERING DIVISON
Equipment Type:	Low Power Transmitter (Intentional radiator)
Test Standards:	FCC Part 15, Subpart C - Intentional Radiators FCC Part 15.231 Periodic operation in the band 40.66 – 40.70 MHz and above 70 MHz FCC Part 15.205 Operation in Restricted Bands FCC Part 15.209 Radiated Emissions ANSI C63.4-1992 OET Bulletin No. 63
Test Dates:	10th October 2002 to 20th August 2003
Test Officer:	**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:	**Chris Zombolas** **Technical Director** **EMC Technologies Pty Ltd**

EMI TEST REPORT FOR CERTIFICATION
to
FCC PART 15.231

1.0 INTRODUCTION

This report details the results of EMI tests and measurements performed on the Remote Key transmitter, Model: GMX281 in accordance with the Federal Communications Commission (FCC) regulations as detailed in Title 47 CFR, Part 15 Subpart C Rules for intentional radiators, particularly Section 15.231 (Periodic operation in the band 40.66 – 40.70 MHz and above 70 MHz).

The results and technical details of the test sample are detailed in this report. The test sample **complies** with the requirements of 47 CFR, Part 15 Subpart C - Radio Frequency Devices (intentional radiators), Section 15.231.

1.1 Summary of Results

FCC Part 15, Subpart C Clauses	Test Performed	Result
15.203	Antenna Requirement	***Not applicable**
15.205	Operation in Restricted Band	**Complies**
15.209	Radiated Emissions	**Complies**
15.231 (b)	Field Strength Emissions	**Complies**
15.231 (c)	Bandwidth	**Complies**

*Test Sample has no external antenna port – antenna is located internally.

The measurement procedure used was in accordance with ANSI C63.4-1992 and OET Bulletin No. 96-43. The instrumentation conformed to the requirements of ANSI C63.2-1987.

1.2 Modifications by EMC Technologies

No modifications were required.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 Product Details

Test Sample:	Remote Key Transmitter
Model Number:	GMX281
FCC ID:	QQY8V00GH40001
Equipment Type:	Low Power Transmitter (Intentional Radiator)

2.2 Test Sample Operational Description

The test sample is a remote key transmitter (low power transmitter). It is a manually operated transmitter powered via the push button switches located on the device. The transmitter ceases transmission when the push button switch on the device is released and is programmed to transmit for approximately 5 seconds if the button is continually depressed.

Refer to Appendix C – GMX 281 Remote Key Assembly (Operational Description)

2.3 Test sample configuration

Testing was performed with the EUT fitted with new batteries and rotated around 3 orthogonal planes. No significant variations in results were recorded and the worst case test results are reported.
Refer to Appendix B - Test Setup Photographs.

2.4 Test Sample Block Diagram

Refer to Appendix D – Test Sample Block Diagram

2.5 Test Procedure

Emissions measurements were performed in accordance with the procedures of ANSI C63.4-1992. Radiated emissions tests were performed at a distance of 3 metres from the EUT. OET Bulletin 63 dated October 1993 was used for reference.

2.6 Test Facility

2.6.1 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. Bandwidth and duty cycle measurements were performed at EMC Technologies' laboratory in Tullamarine, (Melbourne) Victoria Australia.

The above sites have been fully described in a report submitted to the FCC office, and accepted in a letter dated June 14, 2002, **FCC Registration Number 90560**.

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 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).

2.7 Units of Measurements

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

2.8 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 of this report.

2.9 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.

3.0 RADIATED EMISSION MEASUREMENTS

3.1 Test Procedure

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 above 1GHz.

Testing was performed at a distance of 3 metres.

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two antenna heights. Each significant peak was then investigated and maximised with the Quasi-Peak detector. 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 antenna polarisations.

3.2 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 30-1000 MHz and above 1 GHz. 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, after the peak trace is recorded. This will be apparent when the peaks list at the foot of the graphs shows the quasi peak level.

3.3 Calculation of Peak and Average Field Strength

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 insertion 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

The average field strength level was calculated from the peak field strength measurement (uV/m) multiply with the duty cycle over 100 mS. The duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train including blanking interval. Refer to Appendix K for pulsewidths duty cycle and blanking.

3.4 Results:

The transmitter is manually operated (powered via the push button switches located on the device), employing a switch that automatically deactivates transmission within not more than 5 seconds of being released (as per FCC Part 15.231(a)(1).
The worst case transmission duration observed was 100 ms.

Testing was carried out in accordance with the requirements of FCC Part 15.231(b), 15.205(a) and 15.209(a).
Three samples were tested - (sample # 21, sample # 22 and sample # 23).

Duty Cycle Results:

Sample	Pulsewidth Duty Cycle (%)	Blanking mS	Duty Cycle over 100mS (%)
21	25	5.5	22.5
22	24	5.5	21.6
23	25	5.5	22.5

Field Strength Emissions (Fundamental and Spurious) – 30 to 3050 MHz

3.4.1 Sample # 21

Graph No:	Frequency MHz	Polarisation	Peak Level Measured dBμV/m	**Calculated Average Level dBuV/m	Average Limit dBμV/m	Δ Average ± dB
1	912.01	Vertical	56.3	43.3	54.2	-10.9
1	304.00	Vertical	61.8	48.8	74.2	-25.4
1	608.01	Vertical	47.4	34.4	54.2	-19.8
2	303.98	Horizontal	79.9	66.9	74.2	-7.3
2	911.96	Horizontal	66.4	53.4	54.2	-0.8*
2	607.97	Horizontal	59.1	46.1	54.2	-8.1
3	1214.68	Vertical	51.8	38.8	54.2	-15.1
4	1215.00	Horizontal	52.7	39.7	54.2	-14.5

*Notice of this reading should be taken with a measurement uncertainty of ±3.7 dB.
**Duty cycle = 22.5%, Refer to Appendix K for pulsewidths duty cycle

Result : The highest radiated field strength emission complied with FCC average limit by a margin of 0.8 dB at 911.96 MHz. The measurement uncertainty for radiated field strength emissions was ±3.7 dB. Refer to Appendix H, graphs 1 to 4.

NB: The limits on these graphs were not considering the duty cycle of the transmitter.

3.4.2 Sample # 22

Graph No:	Frequency MHz	Polarisation	Peak Level Measured dBμV/m	**Calculated Average Level dBuV/m	Average Limit dBμV/m	Δ Average ± dB
5	911.58	Vertical	54.1	40.8	54.2	-13.4
5	303.84	Vertical	61.5	48.2	74.2	-26.0
5	607.73	Vertical	47.0	33.7	54.2	-20.5
6	303.84	Horizontal	79.9	66.6	74.2	-7.6
6	911.55	Horizontal	65.0	51.7	54.2	-2.5*
6	607.70	Horizontal	58.6	45.3	54.2	-8.9
7	1214.68	Vertical	50.0	36.7	54.2	-17.5
8	1214.21	Horizontal	54.6	41.3	54.2	-12.9
8	1519.21	Horizontal	46.1	32.8	54.2	-21.4

*Notice of this reading should be taken with a measurement uncertainty of ±3.7 dB.
**Duty cycle = 21.6%, Refer to Appendix K for pulsewidths duty cycle

Result : The highest radiated field strength emission complied with FCC average limit by a margin of 2.5 dB at 911.55 MHz.. The measurement uncertainty for radiated field strength emission was ±3.7 dB. Refer to Appendix H, graphs 5 to 8.

NB: The limits on these graphs were not considering the duty cycle of the transmitter.

3.4.3 Sample # 23

Graph No:	Frequency MHz	Polarisation	Peak Level Measured dBμV/m	**Calculated Average Level dBuV/m	Average Limit dBμV/m	Δ Average ± dB
9	912.17	Vertical	52.8	39.9	54.2	-14.3
9	304.06	Vertical	61.1	48.2	74.2	-26.0
9	608.13	Vertical	47.7	34.8	54.2	-19.4
10	304.07	Horizontal	80.0	67.1	74.2	-7.1
10	912.22	Horizontal	65.5	52.6	54.2	-1.6*
10	608.14	Horizontal	58.9	46.0	54.2	-8.2
11	1214.68	Vertical	49.3	36.4	54.2	-17.8
12	1214.68	Horizontal	55.1	42.2	54.2	-12.0
12	1519.21	Horizontal	45.7	32.8	54.2	-21.4

*Notice of this reading should be taken with a measurement uncertainty of ±3.7 dB.
**Duty cycle = 22.5%, Refer to Appendix K for pulsewidths duty cycle

Result : The highest radiated field strength emission complied with FCC average limit by a margin of 1.6 dB at 912.22. The measurement uncertainty for radiated field strength emission was ±3.7 dB. Refer to Appendix H, graphs 9 to 12.

NB: The limits on these graphs were not considering the duty cycle of the transmitter.

4.0 BANDWIDTH

Testing was performed in accordance with the requirements of FCC Part 15.231(c).
The bandwidth of the emission shall be no wider than 0.25% of the centre frequency.

A resolution bandwidth of 10kHz was utilised

The 20 dB bandwidth for the three samples were:

	Bandwidth kHz	Limit kHz	Result
Sample # 21	62.5	< 760	Complies
Sample # 22	63.8	< 760	Complies
Sample # 23	60.0	< 760	Complies

Refer to Appendix I for bandwidth plots

Conclusion: Complies.

5.0 COMPLIANCE STATEMENT

The Remote Key Transmitter, Model: GMX281, tested on behalf of Australian Arrow Pty Ltd, **complies** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.231 – Periodic operation in the band 40.66 – 40.70 MHz and above 70 MHz.

Results were as follows:

FCC Part 15, Subpart C Clauses	Test Performed	Result
15.203	Antenna Requirement	***Not Applicable**
15.205	Operation in Restricted Band	**Complies**
15.209	Radiated Emissions	**Complies**
15.231 (b)	Field Strength Emissions	**Complies**
15.231 (c)	Bandwidth	**Complies**

*Test Sample has no external antenna port – antenna is located internally.

APPENDIX A

MEASUREMENT INSTRUMENTATION DETAILS

EQUIPMENT TYPE	MAKE/MODEL SERIAL NUMBER	LAST CAL. DD/MM/YY	DUE DATE DD/MM/YY	CAL. INTERVAL
EMI RECEIVER	HP 8546A Sn.3549A00290 EMI Receiver	13/01/03	13/03/04	1 YEAR *2
SPECTRUM ANALYSER	HP8593EM Sn. 3146A-01297 9 kHz –26 GHz	23/05/02	23/05/03	1 YEAR *2
ANTENNAS	EMCO 93110B BICONICAL	07/08/02	07/08/03	1 YEAR *1
	20 - 300 MHz Sn. 9804-3092			
	EMCO 93146A LOG PERIODIC	26/07/02	26/07/03	1 YEAR *1
	200 -1000MHz Sn. 5033			
	EMCO 3115 DOUBLE RIDGED HORN 1 - 18 GHz Sn: 8908-3282	29/01/03	29/01/04	1 YEAR *1

Note *1. In-house calibration. Refer to Quality Manual.
Note *2. NATA calibration by Agilent Technologies (Aust) Pty Ltd

TEST SITES

Shielded Room Test Laboratory	**Melbourne** 11m x 8m x 4m Chamber-semi-anechoic 8.8m x 5.8m x 3.1m Test Chamber 3.4m x 6.1m x 2.5m Test Chamber 3.4m x 7.3m x 7.5m Test Chamber			*1
Open Area Test Site	**Melbourne** 3/10 Metre site. 1-4 metre antenna mast. 1.2 metre/400 kg Turntable. (Situated at Lerderderg Gorge, near Bacchus Marsh, Victoria)	21/01/03	21/01/04	1 Year *1

Note *1. In-house calibration. Refer to Quality Manual.

TEST REPORT APPENDICES

APPENDIX B: TEST SAMPLE PHOTOGRAPHS

APPENDIX C: GMX 281 REMOTE KEY ASSEMBLY
(Australian Arrow Report No. 183-005 – Theory of Operation)

APPENDIX D: TEST SAMPLE BLOCK DIAGRAM

APPENDIX E: TEST SAMPLE SCHEMATIC

APPENDIX F: TEST SAMPLE PCB LAYOUT

APPENDIX G: FCC ID LABELLING

APPENDIX H: GRAPHS of EMI MEASUREMENTS

APPENDIX I: CHANNEL BANDWIDTH PLOTS

APPENDIX J: USER MANUAL

APPENDIX K: PULSEWIDTHS DUTY CYCLE