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

FCC ID: PDEMEDIOL122EAS
Manufacturer: TAGSYS Australia Pty Ltd
Test Sample: Smarto L122 EAS System

Report Number: M020411FCC

Issue Date: 4th June 2002

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This Laboratory is accredited by the National Association of Testing Authorities, Australia. The tests reported herein have been performed in accordance with its terms of accreditation for FCC Part 15.

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EMI TEST REPORT FOR CERTIFICATION OF FCC PART 15.225 & FCC PART 15.207 TRANSMITTER

Report Number:	M020411FCC
Test Sample:	Smarto L122 EAS (Electronic Article Surveillance) System
Model Number:	Smarto L122
Serial Number:	AC01B021146
Part Number:	HWP106468
FCC ID:	PDEMEDIOL122EAS
Manufacturer:	TAGSYS Australia Pty Ltd
Tested for:	TAGSYS Australia Pty Ltd Ground Floor, 212 Pirie Street Adelaide SA 5000 Australia
Phone:	+ 61 8 8100 8300
Fax:	+ 61 8 8232 3720
Responsible Party:	Alastair McArthur Managing Director TAGSYS Australia Pty Ltd
Equipment Type:	Intentional Radiator, Low Power Transmitter
Test Standards:	FCC Part 15 Section 225 Intentional Radiators. FCC Part 15 Section 207 Conducted limits ANSI C63.4-1992 OET Bulletin No. 63
Test Dates:	12th December 2001 - 25th May 2002
Test Officers:	Chieu Huynh 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
EMC Technologies Pty Ltd

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

Smarto L122 EAS (Electronic Article Surveillance) System

1.0 SUMMARY of RESULTS

This report details the results of EMI tests and measurements performed on the Smarto L122 EAS (Electronic Article Surveillance) System 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 requirements for fundamental frequencies and spurious emissions of Part 15.225 and the conducted limits of Part 15.207.

Part 15.225	Carrier Signal Field Strength:	Complied, margin of 3.9 dB
	Radiated Emissions (Section 15.209)	*Complied, margin of 0.0 dB
	Frequency Tolerance:	Complied
Part 15.207	Conducted Emissions:	Complied, margin of 2.2 dB

The measurement procedure was in accordance with ANSI C63.4-1992, and OET Bulletin No. 63. The instrumentation conformed to these requirements.

* Refer to Section 6.0 Conclusion

2.0 GENERAL INFORMATION

2.1 General Description of Test Setup

Test Sample:	Electronic Article Surveillance System
Model Number:	Smarto L122
Serial Number:	AC01B021146
Part Number:	HWP106468
FCC ID:	PDEMEDIOL122EAS
Equipment Type:	Intentional Radiator, Low Power Transmitter

2.2 Test Sample Functional Description

Refer to Appendix H - Technical manual

2.3 Technical Specifications and System Overview

Refer to Appendix H - Technical manual

2.4 Test sample configuration

Refer to Appendix B - Test Setup Photographs
Refer to Appendix H - Technical manual

2.5 Test Sample Block Diagram

Refer to Appendix E - Test Sample Block Diagram

2.6 Test Facility

FCC Registration
Radiated Emission measurements of fundamental frequency 13.56 MHz (H-Field) and 30 MHz - 1000 MHz (E-Field) were performed at EMC Technologies open area test site (OATS) situated at Lerderderg Gorge, near the town of Bacchus Marsh, Victoria, Australia. Radiated Emission measurements in the ranges 9 kHz – 30 MHz (H-Field) and conducted emission measurements were performed at EMC Technologies Laboratory in Tullamarine, Victoria Australia.

The above sites have been fully described in a report submitted to the FCC office, and accepted in a letter dated June 24, 1999, **FCC Registration Number 90560**.

EMC Technologies Pty. Ltd. is also accredited by NATA (National Association of Testing Authorities) for most parts of FCC Part 15. NATA has Mutual Recognition Agreement (MRA) with A2LA and NVLAP.

2.7 Units of Measurements

Conducted Emissions
Measurements are reported in units of dB relative to 1 microVolt. (dBμV)

Radiated Emissions
Measurements are reported in units of dB relative to one microvolt per metre (dBμV/m). The measurement distance was 10 metres from the EUT for ranges: 30 – 1000 MHz and 3 metres from the EUT for ranges: 9 kHz– 30 MHz.

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 Limited. All equipment calibration is traceable to Australia national standards at the National Measurements Laboratory (NML).

The Loop Antenna and reference Dipole antennas were calibrated by NML and the working antennas (biconical, log-periodic) calibrated by the direct comparison method. 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 OATS site 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 AM, HF, FM radio, VHF and UHF television bands. Radiated pre-scan measurements were performed in the semi-anechoic enclosure to check for possible masking of radiated emissions at the frequencies where the OATS ambient signals exceeded the test limit.

3.0 CONDUCTED EMISSIONS RESULTS

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 0.45 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. The EUT transmit loop antennas were moved to maximise emissions. 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:

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 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 values were also plotted on the graph.

3.5 Measurement Data-Conducted Emissions

Frequency MHz	Line Act/Neutral	Quasi Peak (dBmV)	Limit (dBmV)	Result ± dB
13.56	Active	45.8	48.0	-2.2
13.56	Neutral	39.2	48.0	-8.8

The highest conducted emission level was 45.8 dBµV at 13.56 MHz.
Refer to Appendix G, Graphs 1 & 2.

3.6 Results of Conducted Emission Measurement

The EUT complied with the FCC Part 15 Class B limits with a worst case margin of 2.2 dB.

4.0 RADIATED EMISSION MEASUREMENTS

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 in the semi-anechoic chamber at an EUT distance of 3 metres. The fundamental frequency 13.56 MHz was re-measured at the OATS. There was no significant differences. Tests in the range 30 – 1000 MHz were performed at an EUT distance of 10 metres at the 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 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.

4.1.2 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.

4.2 Plotting of Measurement Data for Radiated Emissions

4.2.1 30 – 1000 MHz

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 the "#" 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.

4.2.2 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 and the plot shown is from the Semi-Anechoic Chamber. The worst case radiated EMI *peak* measurements as recorded using the Max-Hold data are presented as the **RED** trace.

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^{-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 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 dBmV/m

4.4 Radiated Field Strength Measurement Results

4.4.1 9 kHz to 30 MHz Field Strength Measurements

Antenna	Frequency MHz	Peak Level dBµV/m	Limit @ 3m dBµV/m	Result ±dB
Tx Antenna	13.56	96.1	100.0	-3.9

The measurement uncertainty was 3.7 dB. Refer to Appendix G, graphs 5 & 6.

4.4.2 30 – 1000 MHz Field Strength Emissions

Rx Antenna Polarisation	Frequency MHz	Quasi-Peak Level dBµV/m	Limit @ 10m dBµV/m	Result ±dB
Vertical	433.91	36.0	36.0	-0.0*
Vertical	406.79	35.9	36.0	-0.1*
Horizontal	461.04	35.8	36.0	-0.2*
Horizontal	854.26	34.8	36.0	-1.2*
Horizontal	433.90	33.3	36.0	-2.7*

*Notice of these readings should be taken with a measurement uncertainty of 3.7 dB.

Summary of Results
The highest radiated spurious emission was 0.0 dB below the limit at 433.91 MHz for Vertical Polarisation. The fundamental frequency was 3.9 dB below the specified limit at 13.56 MHz.
Refer to Appendix G, graphs 3, 4, 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 –20 degrees 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 maximum frequency tolerance over the temperature variation of –20 to +50 degrees was 250Hz.
The maximum frequency tolerance for a variation in the primary supply voltage from 85% to 115% was 500 Hz.
The EUT complied with the frequency tolerance of the carrier signal with a worst case of 0.0037%

6.0 CONCLUSION

The Smarto L122 EAS (Electronic Article Surveillance) System, FCC ID: PDEMEDIOL122EAS complied with the requirements of the FCC Part 15 Rules for low power transmitters tested in accordance with FCC Part 15.225 & FCC Part 15.207. The results were as follows:

Part 15.225	Carrier Signal Field Strength:	Complied, margin of 3.9 dB
	Radiated Emissions (Section 15.209)	*Complied, margin of 0.0 dB
	Frequency Tolerance:	Complied
Part 15.207	Conducted Emissions:	Complied, margin of 2.2 dB

The recorded levels of radiated EMI were within the measurement uncertainty of 3.7 dB.

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	12/12/01	12/12/02	1 YEAR *2
ANTENNAS	EMCO 93110B BICONICAL	07/08/01	07/08/02	1 YEAR *3
	20 - 300MHz Sn. 9804-3092			
	EMCO 93146A LOG PERIODIC	11/07/01	11/07/02	1 YEAR *3
	300 -1000MHz Sn. 5033			
	EMCO 6502 ACTIVE LOOP	22/12/99	22/12/02	3 YEAR *1
	0.009 – 30MHz Sn. 9108-2660			
LISN	EMCO 3810/2 50Ù & 50/250 ì H	15/01/02	15/01/03	1 YEAR *1
	0.009 – 30MHz Sn.9607-2567			

Note *1. National Measurements Laboratory calibration.
Note *2. NATA calibration by Agilent Technologies (Aust) Pty Ltd
Note *3. In-house calibration. Refer to Quality Manual.
Note *4 Calibration not required

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			*3
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)	05/01/02	05/01/03	1 Year *3

Note *1. National Measurements Laboratory calibration.
Note *2. NATA calibration by Agilent Technologies (Aust) Pty Ltd
Note *3. In-house calibration. Refer to Quality Manual.

APPENDIX B

PHOTOGRAPHS OF TEST SETUP

SUBMITTED AS ATTACHMENT

APPENDIX C

TEST SAMPLE SCHEMATICS

SUBMITTED AS ATTACHMENT

APPENDIX D

TEST SAMPLE PCB LAYOUTS

SUBMITTED AS ATTACHMENT

APPENDIX E

TEST SAMPLE BLOCK DIAGRAM

SUBMITTED AS ATTACHMENT

APPENDIX F

FCC ID LABELLING

SUBMITTED AS ATTACHMENT

APPENDIX G

GRAPHS OF EMI MEASUREMENTS

SUBMITTED AS ATTACHMENT

APPENDIX H

TECHNICAL (USER) MANUAL

SUBMITTED AS ATTACHMENT