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

FCC ID:	Q47-MCR500
Manufacturer:	SCI-SANMINA
Test Sample:	3 V PC Card Type II + with Contactless Reader and 2xSAMS
Model:	MCR500
Serial No:	None
Date:	11th May 2005

NATA Accredited Laboratory
Number: 5292

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

FCC ID: Q47-MCR500
EMC Technologies Report No. T50307_A
Date: 11th May 2005

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

Report Number:	T50307_A
Test Sample Name:	3 V PC Card Type II + with Contactless Reader and 2xSAMS
Model Number:	MCR500
Serial Number:	None
Part Number:	11081
FCC ID:	Q47-MCR500
Manufacturer:	SCI-SANMINA 249 Balcatta Road Balcatta WA 6021
Tested For:	ERG Transit Systems
Address:	247 Balcatta Road BALCATTA WA 6021
Phone:	08 9273-1100
Fax:	08 9273-1570
Responsible Party:	Mr Dan Zorde
Test Standards:	**FCC Part 15.225 Intentional Radiators** **FCC Part 15.207 Conducted Emission Limits** **ANSI C63.4:2003** **OET Bulletin No. 65**
Test Dates:	09/03/05, 30/03/05 and 10/05/05

Testing Officers:

Bruce Holdsworth **Joel Mulig**

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 3 V PC Card Type II + with Contactless Reader and 2xSAMS

1. SUMMARY of RESULTS

This report details the results of EMI tests and measurements performed on the 3 V PC Card Type II + with Contactless Reader and 2xSAMS, Model: MCR500, 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.

Part 15.31e	
Amplitude stability with supply variation:	Complied
Part 15.207	
Conducted Emissions:	Complied
Part 15.225 a, b &c	
Carrier Signal Field Strength 13.110 – 14.010MHz:	Complied
Part 15.225 d (15.209)	
Field Strength Outside 13.110 – 14.010MHz:	Complied
Part 15.225 e	
Frequency Tolerance:	Complied

2. GENERAL INFORMATION

2.1 General Description of Test Sample

Manufacturer	:	SCI-SANMINA
Test Sample	:	3 V PC Card Type II + with Contactless Reader and 2xSAMS
Model	:	MCR500
Serial Number	:	None
Part Number	:	11081
FCC ID	:	Q47-MCR500
Equipment Type	:	Intentional Radiator
Accessories	:	HP 5550 (iPaq) and PC Card expansion pack
Power Supply	:	Phihong, Model: PSC 10S-050

2.2 Test Sample Functional Description

The MCR500 is a plug in PC Card, it has an EPLD which asynchronously decodes signals from the iPaq PC Card Pocket. The iPaq runs ERG drivers and software on a Windows CE Pocket PC 2003 Platform. The configuration is a s per deployment, except typically additional moulds and leather cases will be provided for field use.

2.3 Technical Specifications and System Overview

Crystal frequency(s)	:	14.7428MHz and 13.56MHz
Microprocessor	:	iPaq has a 400MHz Xscale
Input Supply	:	3.3V, 500mA

Refer to Appendix G (User Manual), Appendix H (Operation Instructions) and Appendix I (Operational Description).

2.4 EUT Configurations

The EUT was tested as a table top unit in accordance with the guidelines contained in the relevant standard.

Refer to diagram below in Clause 2.6 and Appendix B, Test Setup Photographs.

2.5 Test Sample Support Equipment

HP 5550 (iPaq) and PC Card expansion pack.

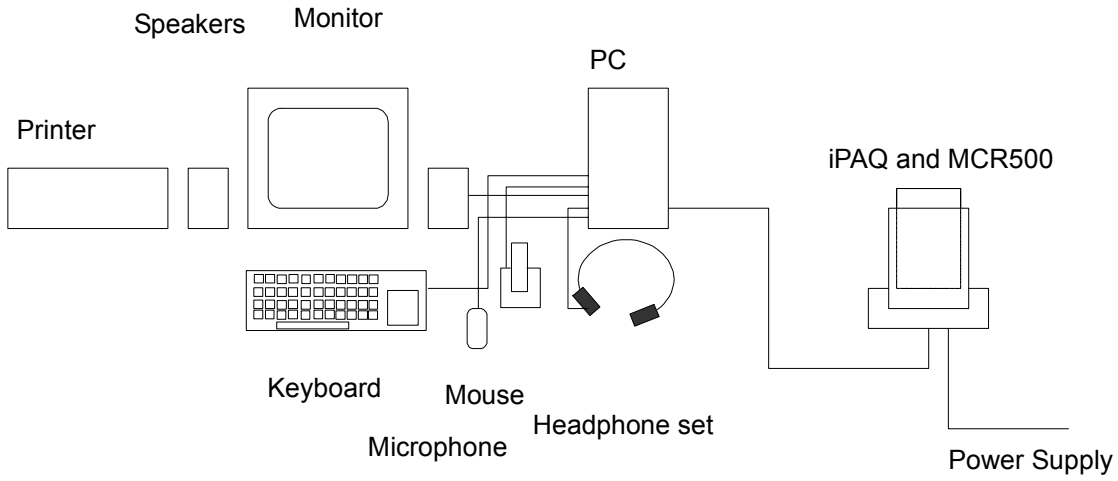
2.5.1 Computer

Motherboard:	ASUS MEW
Processor:	Intel Celeron 366
Case:	A OPEN, P/N: 91.93320.004, S/N: 92119821JK
Power Supply:	A OPEN, Model: FSP250-60GTA, S/N: 02301312KS
Hard Drive:	Quantum Fireball, P/N: CR43A001, S/N: 824914519409
CD Rom:	Creative 48X, Model: BCD48SB, S/N: H229883F

2.5.2 Peripherals

Mouse:	Microsoft, Model: 92841, S/N: 04186682
Keyboard:	Cherry, Model: RS6000M, S/N: G00163176L5131
Printer:	HP Deskjet 400, S/N: SG3R1644F, FCC ID: B94C2642X
Monitor:	Tatung, Model: CM15VDE, S/N: 76490818
Speakers:	Digitor, Model: C-4198
Microphone:	Verbatim Multimedia Headset
Line Out:	Line Out Cable

2.6 Test Sample Block Diagram



2.7 EUT Operation Conditions

Operation condition during testing: Place provided contactless card on MCR500 antenna and run EMC test software from menu by pressing the start button. Two SAM's have been fitted prior for testing. The software will indicate failures if they occur.

2.8 Modifications

No modifications were performed.

2.9 Test Procedure

Radiated Emissions measurements were performed in accordance with the procedures of ANSI C63.4:2003. The measurement distance for radiated emissions was 3 metres from the EUT for ranges: 30-1000MHz and 3 metres from the EUT for the range: 9kHz – 30MHz.

2.10 Test Facility

2.10.1 General

Conducted Emission measurements in the range 0.15 – 30 MHz (fundamental frequency 13.56 MHz) were performed at EMC Technologies Laboratory in Castle Hill, New South Wales, Australia. Radiated Emission measurements in the ranges 9kHz – 30MHz and 30-1000MHz 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**.

2.10.2 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 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).

2.11 Units of Measurements

2.11.1 Conducted Emissions

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

2.11.2 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: 30-1000MHz and 3 metres from the EUT for ranges: 9kHz-30MHz.

2.12 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 Institute (NMI). 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 (loop, 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.

2.13 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 C63.4:2003 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 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.

The highest recorded EMI signals are shown on the Peaks List on the bottom right side of the graph. Peaks that were greater than 20dB below the limit were not measured. For each numbered peak the frequency, peak field strength, Quasi-peak field strength, and the margin relative to the limit in dB is listed. A negative margin is the level below the limit.

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 – Antenna Connected

3.5.1 On with Card Reader Module & Type A Card:

Frequency MHz	Line	Measured QP Value dBµV	QP Limit dBµV	Δ QP ±dB	Measured Av. Value dBµV	AV Limit dBµV	ΔAV ±dB
13.56	Neutral	52.6	60.0	-7.4	50.3	50.0	0.3*
13.56	Active	51.9	60.0	-8.1	49.9	50.0	-0.1
0.537	Active	44.3	56.0	-11.7	40.1	46.0	-5.9
0.301	Active	45.5	60.2	-14.8	43.4	50.2	-6.8
0.338	Neutral	43.9	59.3	-15.3	41.7	49.3	-7.6

* Fundamental Frequency of Transmitter

Note: The transmit carrier was excluded from the test with the antenna connected. The highest emission occurred at 0.537MHz on the active line and was found to be 11.7db below the Quasi-peak and 5.9dB below the Average limits.

The measurement uncertainty for conducted emissions is ± 1.8 dB.

Refer to Appendix C, Graphs 1 and 2.

3.5.2 Tested with Resistive Dummy Load:

Frequency MHz	Line	Measured QP Value dBμV	QP Limit dBμV	Δ QP ±dB	Measured Av. Value dBμV	AV Limit dBμV	ΔAV ±dB
0.328	Active	46.0	59.5	-13.5	44.2	49.5	-5.3
0.572	Active	44.3	56.0	-11.7	40.5	46.0	-5.5
0.655	Active	44.0	56.0	-12.0	40.4	46.0	-5.6
0.900	Active	45.1	56.0	-10.9	40.0	46.0	-6.0
0.900	Active	45.1	56.0	-10.9	39.4	46.0	-6.6
0.652	Neutral	43.2	56.0	-12.8	38.6	46.0	-7.4
0.326	Neutral	44.3	59.6	-15.2	42.1	49.6	-7.5
0.412	Active	43.5	57.6	-14.1	40.0	47.6	-7.6
0.895	Neutral	44.2	56.0	-11.8	37.4	46.0	-8.6
1.146	Active	44.9	56.0	-11.1	36.9	46.0	-9.1
0.865	Active	42.3	56.0	-13.7	36.8	46.0	-9.2
0.576	Neutral	41.9	56.0	-14.2	36.3	46.0	-9.7
4.544	Neutral	46.8	56.0	-9.2	30.0	46.0	-16.0

Note: The highest emission occurred at 0.328MHz on the active line and was found to be 13.5db below the Quasi-peak, and 5.3dB below the Average limits.

The measurement uncertainty for conducted emissions is ± 1.8 dB.

Refer to Appendix C, Graphs 3 and 4.

3.6 Results of Conducted Emission Measurement

The EUT complied with the limits of FCC Rule Part 15 Subpart C – Intentional Radiators. Emissions at the fundamental frequency of 13.56 MHz are excluded from the results with the antenna loop connected.

4. RADIATED EMISSION MEASUREMENTS – 30 MHz to 1 GHz

4.1 Test Procedure

Radiated emissions measurements were performed in accordance with the procedures of ANSI C63.4:2003 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 65 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. The EUT was further rotated through three orthogonal directions to ensure worst case emissions are measured. The carrier test was performed at the worst-case operation voltage.

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. The EUT was further rotated through three orthogonal directions to ensure worst case emissions are measured. 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 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

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 + 1.9 – 20 = 25.1 dBμV/m

4.4 Radiated Field Strength Measurement Results – Section 15.225

4.4.1 13.56 MHz Carrier Field Strength Measurement

Frequency MHz	Quasi Peak Level dBμV/m	Limit @ 3m dBμV/m	Result ± dB
13.56	59.0	124.0	-65.9

The mains supply was varied as per Section 15.31e between 100V 60 Hz to 138V 60Hz to determine if the carrier amplitude varied with supply voltage. No significant variation was recorded. The test was performed at 120V, 60Hz.

Complied with a margin of greater than 20dB with Section 15.225 Subpart a, b & c.
The measurement uncertainty was ±4.6dB. **Refer to Appendix C, Graph 6**.

4.4.2 9 kHz to 30 MHz Field Strength Spurious Emissions

Complied with a margin of greater than 20dB with Section 15.225 Supart d (15.209). The measurement uncertainty was ±4.6dB. **Refer to Appendix C, Graph 5**.

4.4.3 30 - 1000MHz Field Strength Spurious Emissions –Section 15.225 d (15.209)

Frequency (MHz)	Rx Antenna Polarisation	Quasi Peak Level (dBμV/m)	Limit @ 3m (dBμV/m)	ΔResult (dB)
40.68	Vertical	38.2	40.0	-1.8
745.87	Vertical	41.5	46.0	-4.5
759.42	Vertical	39.9	46.0	-6.1
800.11	Vertical	39.1	46.0	-6.9
813.66	Vertical	38.9	46.0	-7.1
772.97	Vertical	38.7	46.0	-7.3
81.36	Vertical	32.0	40.0	-8.0
840.80	Vertical	37.6	46.0	-8.4
827.23	Vertical	37.6	46.0	-8.4
786.55	Vertical	37.4	46.0	-8.6
718.75	Vertical	37.2	46.0	-8.8
40.68	Horizontal	30.7	40.0	-9.3

The highest radiated spurious emission was 1.8dB below the limit at 40.68MHz for Vertical Polarisation. Up to 16 highest points on both Vertical and Horizontal polarity are reported on the graphs in Appendix C. The measurement uncertainty was ±4.6dB.
Refer to Appendix I, Graphs 7 and 8.

5.0 FREQUENCY TOLERANCE (FCC Part 15 Sections 15.225e)

The frequency stability of the unit was verified under abnormal operating supply voltage and temperature

FCC Sub Part C Section 15.225 e

The mains supply was lowered from 120V 60Hz to 100V (85% of nominal supply) and maintained until the frequency was stable. No change in frequency was recorded.

The mains supply was then increased from 120V 60Hz to 138V (115% of nominal supply) and maintained until the frequency was stable. No change in frequency was recorded.

The ambient temperature with a supply voltage of 120V 60Hz was taken from 20°C to –20°C and maintained until the EUT temperature had stabilised. The frequency of the carrier was observed during the test. No change in operating frequency was recorded.

The ambient temperature with a supply voltage of 120V 60Hz was taken from 20°C to 50°C and maintained until the EUT temperature had stabilised. The frequency of the carrier was observed during the test. No change in operating frequency was recorded.

6. CONCLUSION

The 3 V PC Card Type II + with Contactless Reader and 2xSAMS, Model: MCR500, FCC ID: Q47-MCR500, complied with the requirements of FCC Part 15 Rules for intentional radiator when tested in accordance with FCC Part 15.31e, 15.207 and 15.225.

Part 15.31e	
Amplitude stability with supply viariation:	Complied
Part 15.207	
Conducted Emissions:	Complied
Part 15.225 a, b &c	
Carrier Signal Field Strength 13.110 – 14.010MHz:	Complied
Part 15.225 d (15.209)	
Field Strength Outside 13.110 – 14.010MHz:	Complied
Part 15.225 e	
Frequency Tolerance:	Complied

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