

Global EMC Inc. Labs

EMC Test Report

As per

ICES-003:2004

&

FCC Part 15 Subpart B:2006

Class B Equipment

on the

A102d, A200d

T1/E1 Interface cards



Ashwani Malhotra
Global EMC Inc.
180 Brodie Dr, Unit 2
Richmond Hill, ON L4B 3K8
Canada
Ph: (905) 883-3919

Testing produced for



See Appendix A for full customer & EUT details.



FCC REGISTRATION
#612361



Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Table of Contents

Table of Contents	2
Report Scope	3
Summary	4
Test Results Summary	4
Justifications or Deviations	5
Applicable Standards, Specifications and Methods	5
Sample calculation(s)	6
Document Revision Status	6
Definitions and Acronyms	7
Testing Facility	8
Calibrations and Accreditations	8
Testing Environmental Conditions and Dates	8
Detailed Test Results Section	9
Power Line Conducted Emissions	10
Radiated Emissions	15
Appendix A – Customer Provided Details	24
Appendix B – EUT and Test Setup Photographs	27

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Report Scope


This report addresses the EMC verification testing and test results of the A102d and A200d T1/E1 interface cards, herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

ICES-003 Issue 4:2004 / FCC Part 15 Subpart B 15:2006

Power line conducted and radiated emissions' testing was evaluated on the EUT. Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Summary

The results contained in this report relate only to the item(s) tested.

Equipment under test	A102d/A200d T1/E1 interface cards
EUT Passed all tests performed.	Yes
Tests conducted by	Ashwani Malhotra


Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.107 ICES-003:2004	Power line conducted emissions	B	PASS
FCC 15.109 ICES-003:2004	Radiated emissions	B	PASS
Overall Result			PASS

All tests were performed by

If the product as tested complies with the specification, the EUT is deemed to comply with the standard and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' or 'FAIL' grade is independent of any measurement uncertainties.

A 'PASS' or 'FAIL' grade within measurement uncertainty is marked with a '*'.

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	


Justifications or Deviations

The following justifications for tests not performed or deviations from the above listed specifications apply:

No deviations are recorded.

Applicable Standards, Specifications and Methods

- ANSI C63.4:2003 - Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- CFR 47 FCC 15 - Code of Federal Regulations – Radio Frequency Devices
- CISPR 22:1997 - Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
- ICES-003:2004 - Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
- ISO 17025:2005 - General Requirements for the competence of testing and calibration laboratories

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)


Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)

Margin = 8.5 dB

Document Revision Status

Revision 1 -

First revision issued on 8/22/2006.

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxillary Equipment.

Class A device – A digital device that is marketed for use in a commercial, industrial or business environment. A ‘Class A’ device should not be marketed for use by the general public. A ‘Class A’ device should contain the following or similar warning in it’s user manual: “**Warning:** This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.”

Class B device – A digital device that is marketed for use in a residential environment and may also be used in a commercial, business or industrial environments. A ‘Class B’ device may also be defined as a device to which a broadcast radio or television receivers would be expected to be common within a distance of 10 m of the device concerned.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity


EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.


Calibrations and Accreditations

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The chamber used is lined with ferrite tiles and absorption cones to minimize any undesired reflections. Global EMC Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratories current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.


Testing Environmental Conditions and Dates

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (°C)	Humidity (%)	Pressure (kPa)
July 6 2007	RE	AM	23°C	45%	100.1kPa
July 6 2007	CE	AM	23°C	45%	100.1kPa

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Detailed Test Results Section

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.107


Method is as defined in ANSI C64:2003

Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

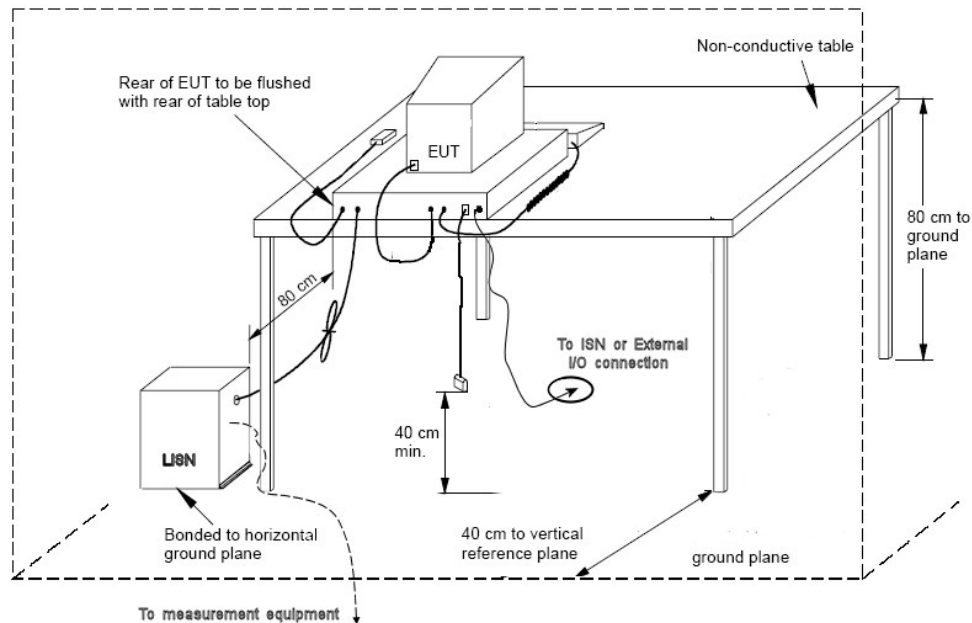
The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth .

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Typical Setup Diagram



Note: The vertical reference plane is optional as per ANSI C63.4 section 5.2.2

Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ± 3.6 dB with a 'k=2' coverage factor and a %95 confidence level.

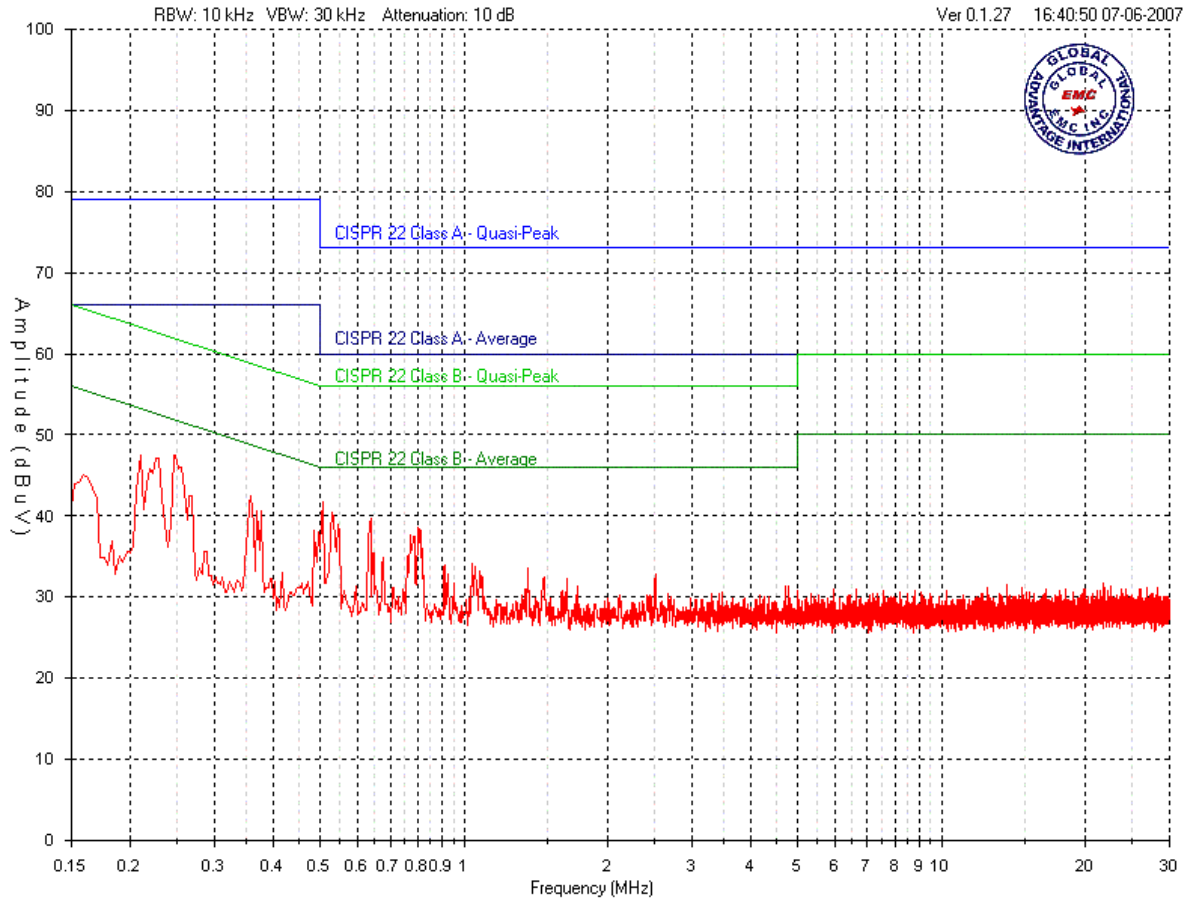
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graph shown below is a peak measurement graph, measured with a resolution bandwidth greater than or equal to the final required detector. This graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.

Client	Sangoma Technologies Corp.
Product	A102d/A200d T1/E1 Interface cards
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006



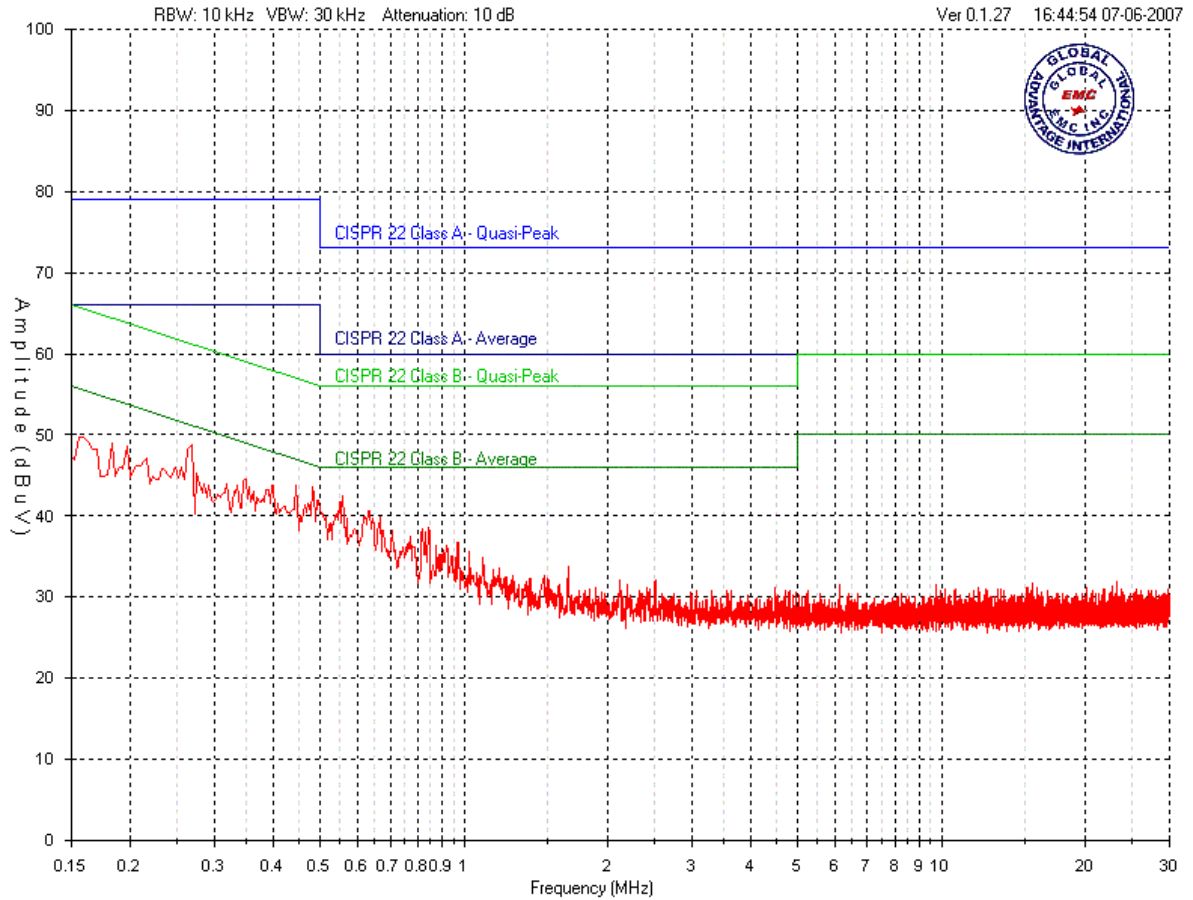
Phase




Client	Sangoma Technologies Corp.
Product	A102d/A200d T1/E1 Interface cards
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006



Neutral



Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Final Measurements

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up for the highest line conducted emission.


Since the EUT are PCI cards that are on the SELV of the desktop computer, all power line emissions recorded were from the power supply of the desktop computer. Since the recorded plots are from the power supply of the computer no further investigation was carried out once the peak limits met the Class B average limits.

All peak readings measured were below the average limits hence no Average or Quasi peak readings were recorded for these tests.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2006-08-09	2007-08-09	GEMC 6
Quasi Peak Adapter	85650A	HP	2006-08-07	2007-08-07	GEMC 7
LISN	FCC-LISN-50/250-16-2-01	FCC	2007-05-02	2008-05-02	GEMC 65
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s)

The method is as defined in ANSI C63.4:2003.

The limits are as defined in FCC Part 15, Section 15.109(g):

30 MHz – 230 MHz , 40 dBuV/m at 10m, 50.5 dBuV/m at 3m¹


230 MHz – 1000 MHz, 47 dBuV/m at 10m, 57.5 dBuV/m at 3m¹

Above 1000 MHz³, 300 uV/m (49.5 dBuV/m) at 10m, 60 dBuV/m at 3m²

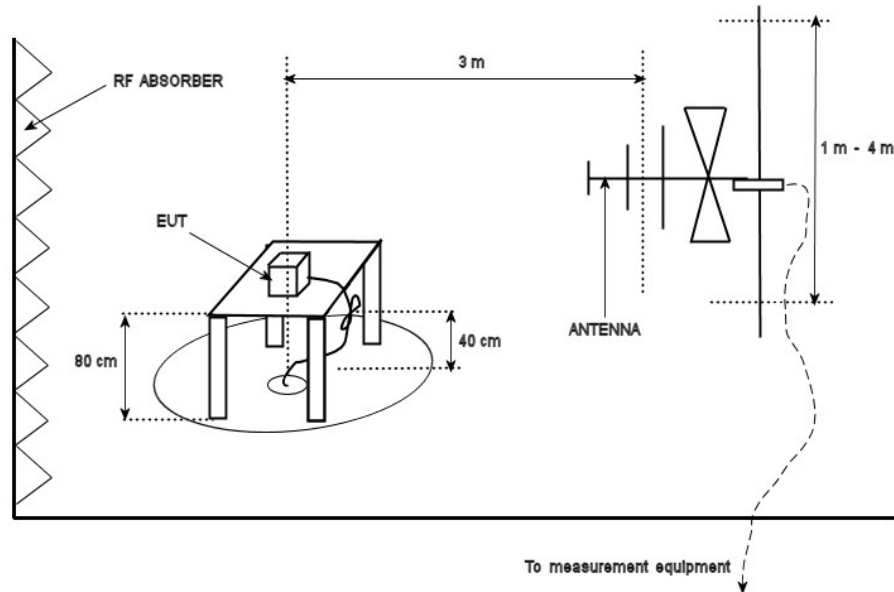
¹Limit is with 120 kHz measurement bandwidth and a using a Quasi Peak detector.

²Limit is with 1 MHz measurement bandwidth and using an Average detector

³The frequency range scanned was in accordance 15.33(b)

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Typical Radiated Emissions Setup




Note: In accordance with FCC Part 15, section 15.31(f)(1) testing was performed at a 3 meter test distance and an extrapolation factor of 10.5 dB was applied.

Measurement Uncertainty

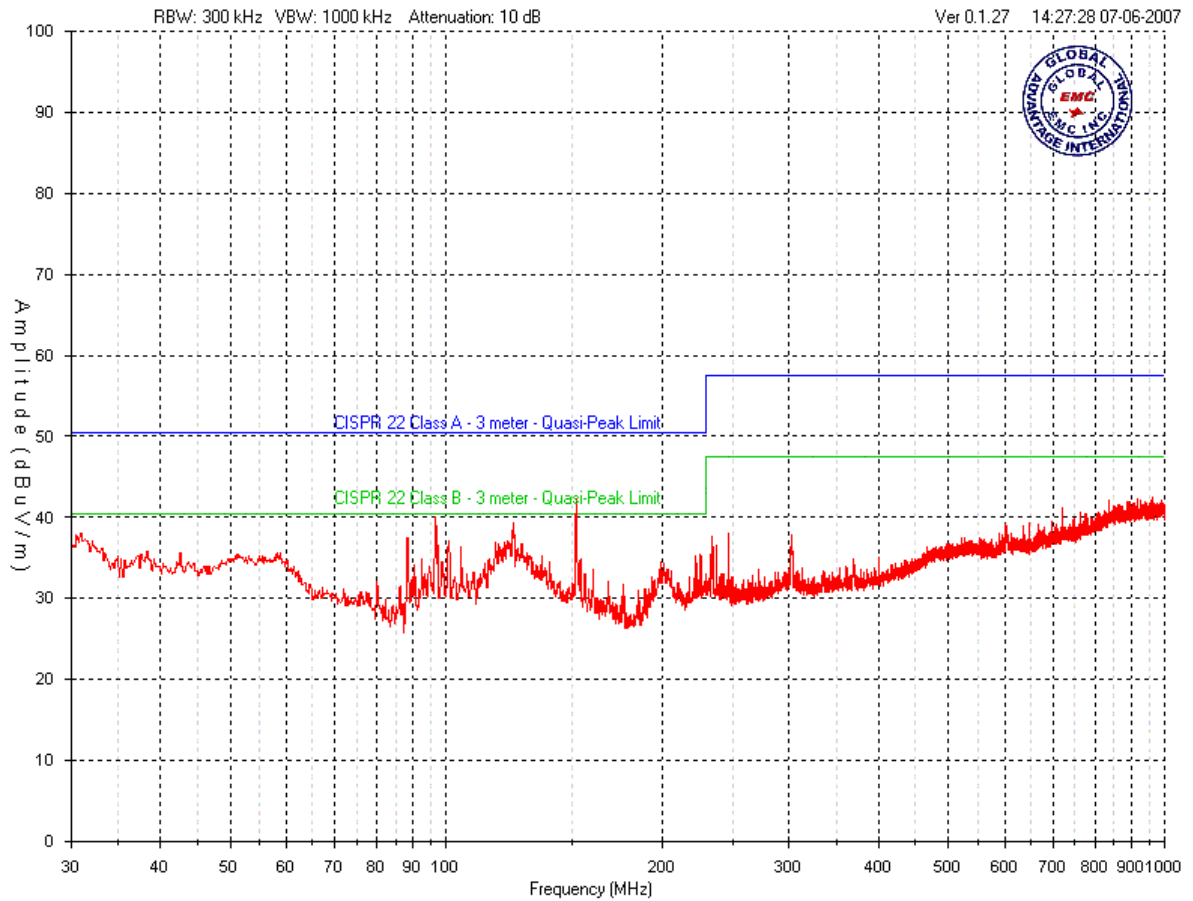
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a %95 confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater than the final required detector and over a full 0-360 rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

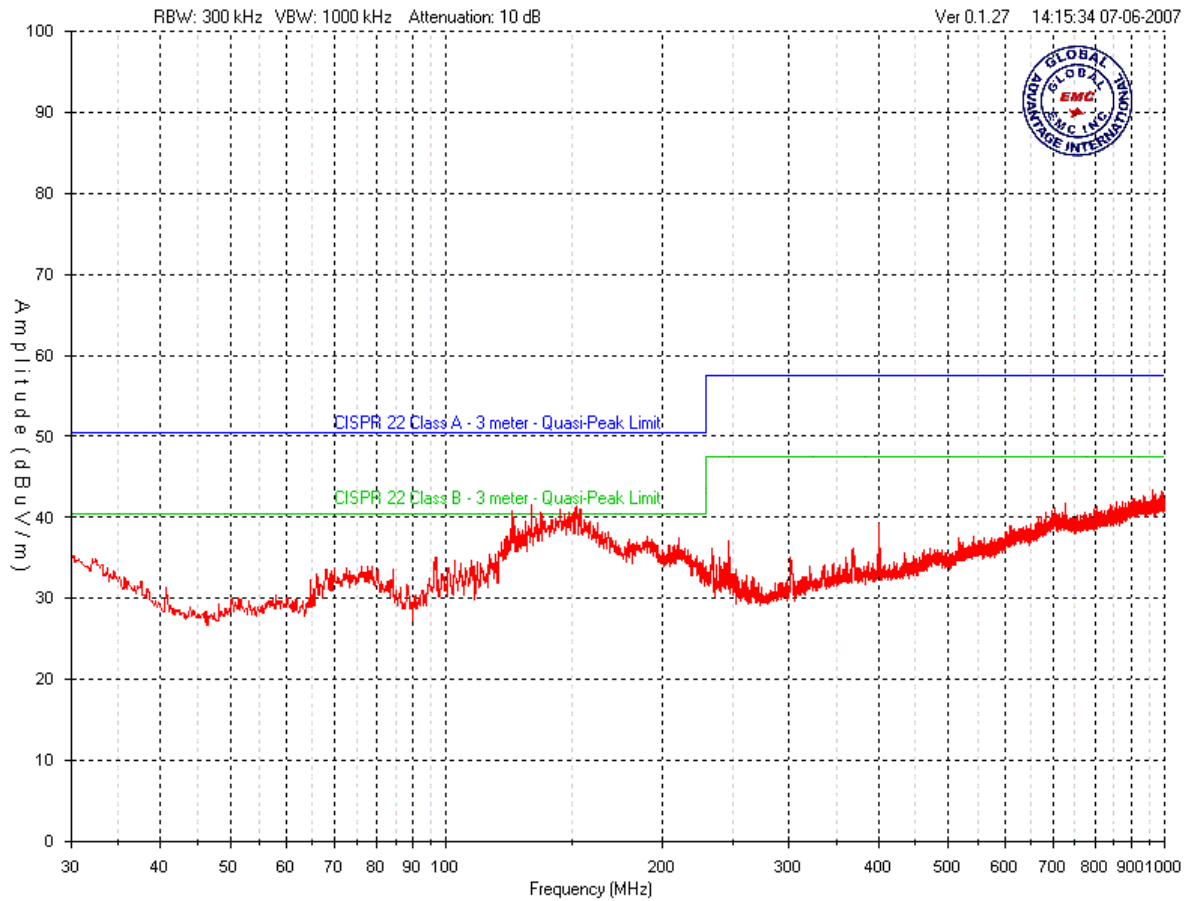
Vertical – Peak Emissions Graph A102d



Client	Sangoma Technologies Corp.
Product	A102d/A200d T1/E1 Interface cards
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006



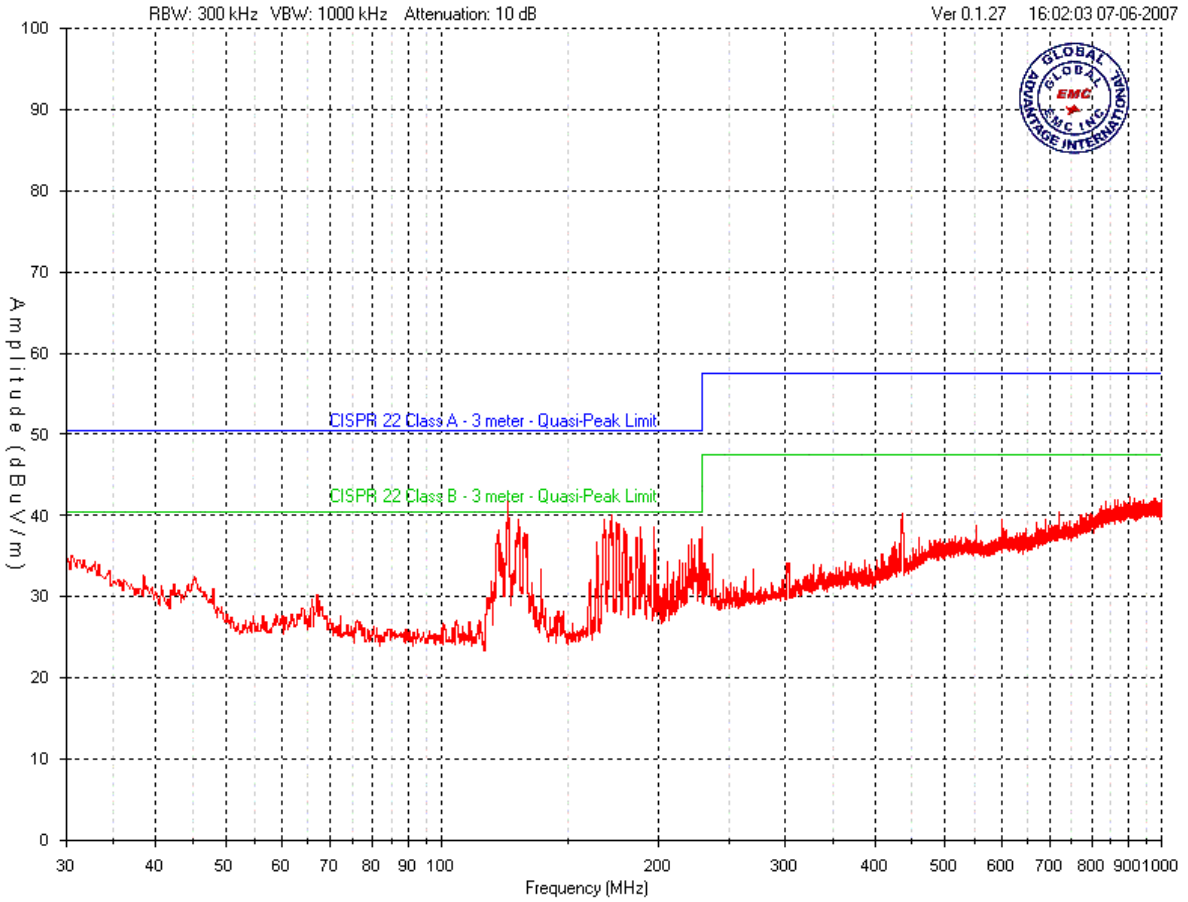
Horizontal – Peak Emissions Graph A102d




Client	Sangoma Technologies Corp.
Product	A102d/A200d T1/E1 Interface cards
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006

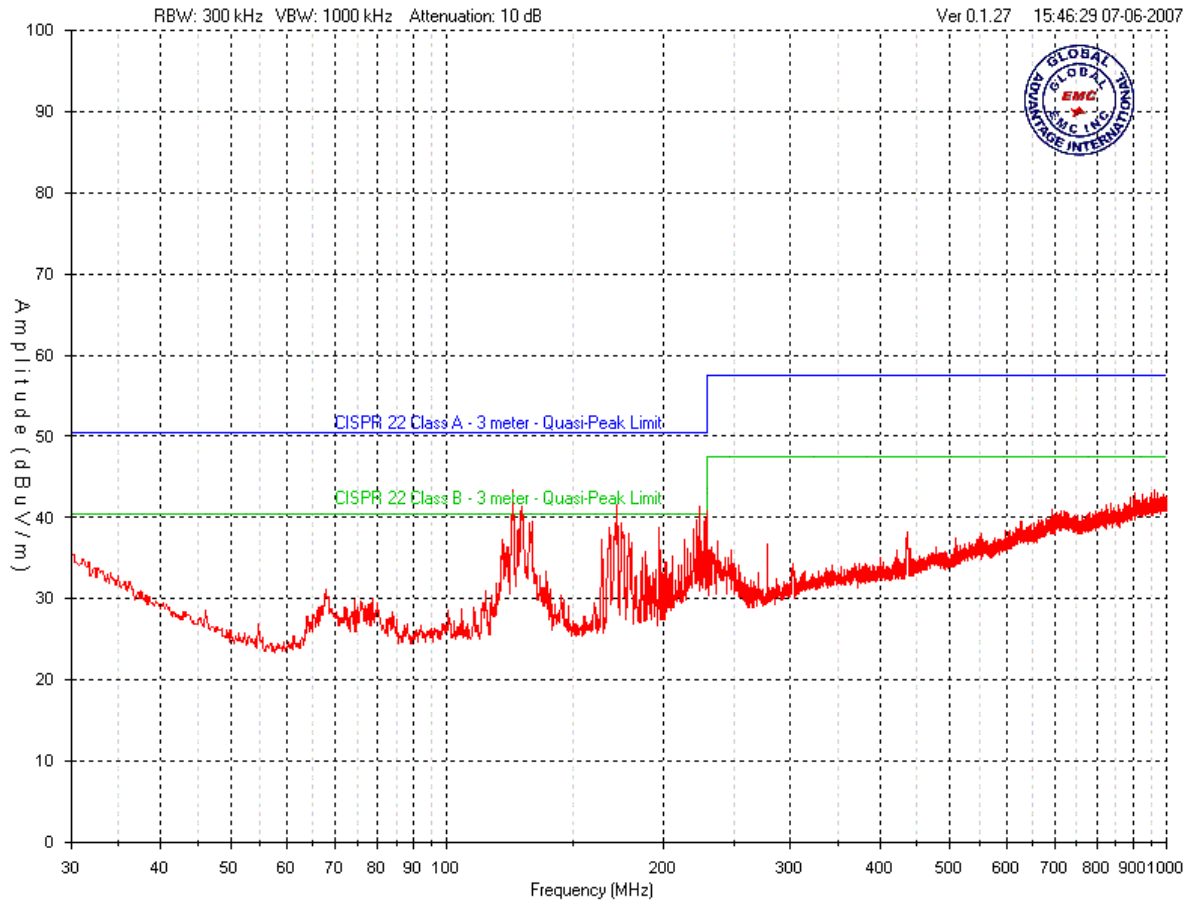



Vertical – Peak Emissions Graph
A200d



Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Horizontal – Peak Emissions Graph A200d




Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Final Measurements


Quasi Peak Emissions Table

Product category	Class B Group 1										
Limits	FCC 15 Subpart B										
Test Frequency (MHz)	Detection mode (Q-Peak)	Antenna polarity (Horz/Vert)	Raw signal dB(μV)	Antenna factor dB	Cable loss dB	Attenuator dB	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
A102d											
151.5	QP	Horz	40.6	9.6	1.1	3.0	21.6	32.7	40.5	7.8	PASS
127.1	QP	Horz	33.0	8.2	1.1	3.0	21.8	23.5	40.5	17.0	PASS
123.5	QP	Horz	43.6	8.2	1.1	3.0	21.8	34.1	40.5	6.4	PASS
151.6	QP	Vert	47.4	9.0	1.1	3.0	21.6	38.9	40.5	1.6	PASS
123.5	QP	Vert	46.7	6.9	1.1	3.0	21.8	35.9	40.5	4.6	PASS
96.2	QP	Vert	46.6	7.5	0.9	3.0	21.8	36.2	40.5	4.3	PASS
88.03	QP	Vert	43.9	8.1	0.9	3.0	21.8	34.1	40.5	6.4	PASS
A200d											
122.8	QP	Horz	49.5	8.2	1.1	3.0	21.8	40.0	40.5	0.5	PASS
124.9	QP	Horz	40.3	8.2	1.1	3.0	21.8	30.8	40.5	9.7	PASS
172.03	QP	Horz	42.7	10.2	1.1	3.0	21.8	35.2	40.5	5.3	PASS
196.62	QP	Horz	41.4	10.1	1.1	3.0	21.8	33.8	40.5	6.7	PASS
229.4	QP	Horz	40.7	11.4	1.1	3.0	21.6	34.6	40.5	5.9	PASS
122.8	QP	Vert	48.1	8.2	1.1	3.0	21.8	38.6	40.5	1.9	PASS

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

124.9	QP	Vert	38.5	8.2	1.1	3.0	21.8	29.0	40.5	11.5	PASS
167.54	QP	Vert	37.5	9.9	1.1	3.0	21.8	29.7	40.5	10.8	PASS
196.62	QP	Vert	42.5	10.1	1.1	3.0	21.8	34.9	40.5	5.6	PASS
231.45	QP	Vert	33.3	12.4	1.1	3.0	21.6	28.2	47.5	19.3	PASS


Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up for the highest radiated emission

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2006-08-09	2007-08-09	GEMC 6
Quasi Peak Adapter	85650A	HP	2006-08-07	2007-08-07	GEMC 7
BiLog Antenna	3142-C	ETS	2006-08-06	2008-08-06	GEMC 8
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Pre-Amplifier	PA-2.5-26	Vican	2006-09-12	2007-09-12	GEMC 9
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC – Radiated Emissions Class A_Rev2"


Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Appendix A – Customer Provided Details

General EUT Description

Manufacturer Details	
Organization	Sangoma Technologies Corp.
Contact	Igor Arganovski
Phone	1-905-474-1990 x 111
Email	igor@sangoma.com
Client Details	
Organization	Sangoma Technologies Corp.
Contact	Igor Arganovski
Phone	1-905-474-1990 x 111
Email	igor@sangoma.com
EUT Name	A100d / A200d
EUT Revision	Revision of previously tested product
EUT Software version	Wanpipe driver 2.3.4
Equipment Category (Commercial / Residential / Medical)	Telecom equipment
Input Voltage and Frequency	3.3V, 5V for A102d; 3.3V, 5V, 12V for A200d
Rated Input Current	0.5A
Intentional RF (If yes describe)	N/A
Table Top / Wall mount / Floor standing	Installed inside desktop computer
I/O Connectors available on EUT	A102d – RJ45 A200d – RJ11
Peripherals required for test	Desktop computer setup
Types and lengths of all I/O cables	RJ45 and RJ11 cables used. Less than 9ft length
Frequencies of all clocks and oscillators	8.192 MHz, 12.352MHz, 33.3 MHz
Release type & Condition	Final

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see ‘Appendix B – EUT & Test Setup Photographs’.

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

EUT Functional Description

A102d and A200d are telecom line cards that are installed inside the chassis of a desktop computer in a PCI slot. These cards are used to transfer voice and data over T1 and E1 lines.

EUT Configuration

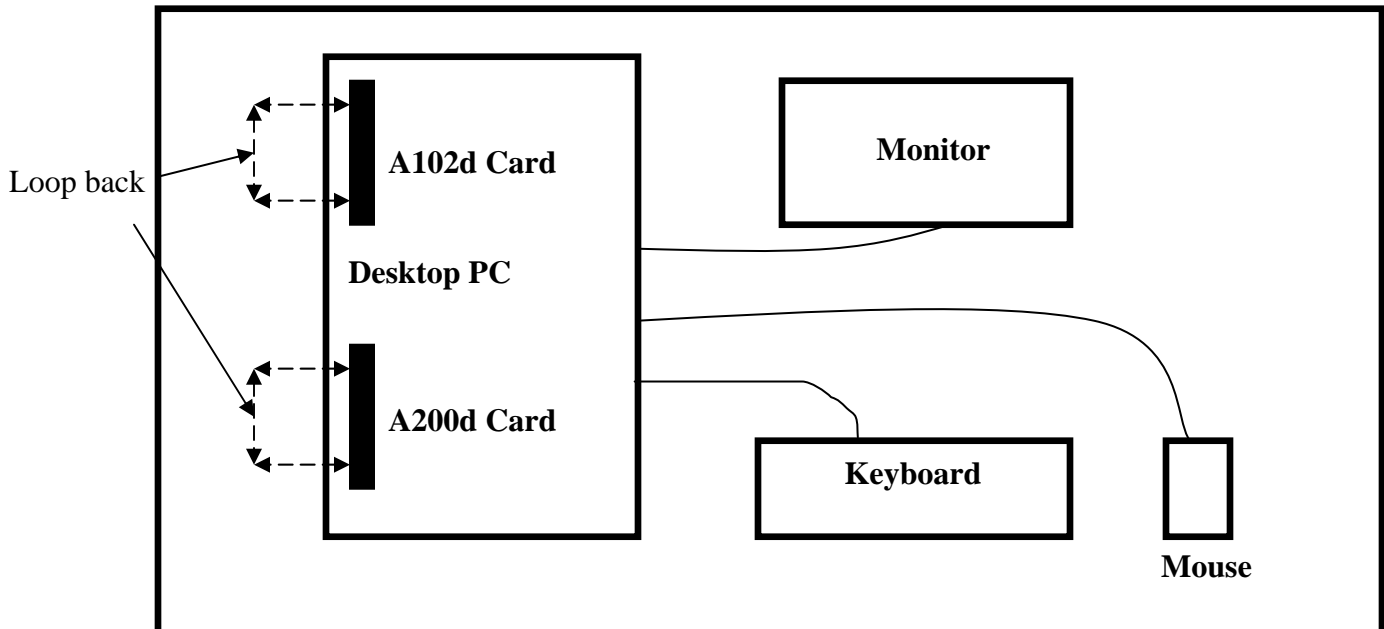
The EUT was configured in the following way during the tests as per manufacturer's specification.


A102d/A200d card (one at a time) was installed inside the desktop and RJ45/RJ11 cables were used for loop back. Software on the desktop was initialized and executed to transfer data over the lines. This software was written and maintained by Sangoma Technologies Corp. (Wanpipe driver 2.3.4)

Both RJ45 and RJ11 cables were shielded in order to meet the Class B specifications.

Operational Setup

These devices are required to be attached to the EUT for its normal operation.




Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Test Signals Required For Test


Test signals generated by the TX and RX ports of the cards were looped back in to the card. These signals were generated from the software that was installed and executed on the host PC.

Modifications Required for Compliance

Shielded cables for RJ45 and RJ11 connectors were used in order to meet Class B specifications.

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

Appendix B – EUT and Test Setup Photographs

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

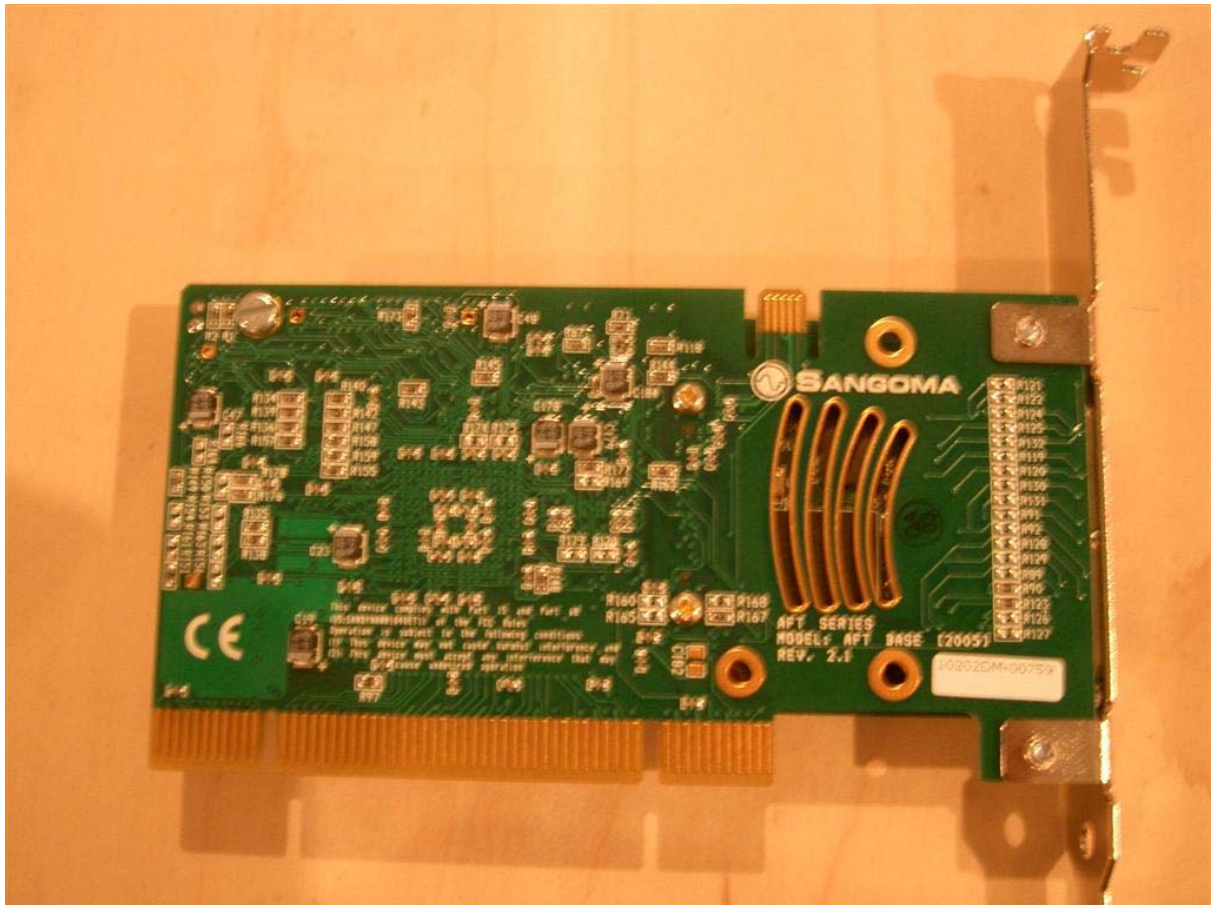



Figure 1: EUT – PCI card

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

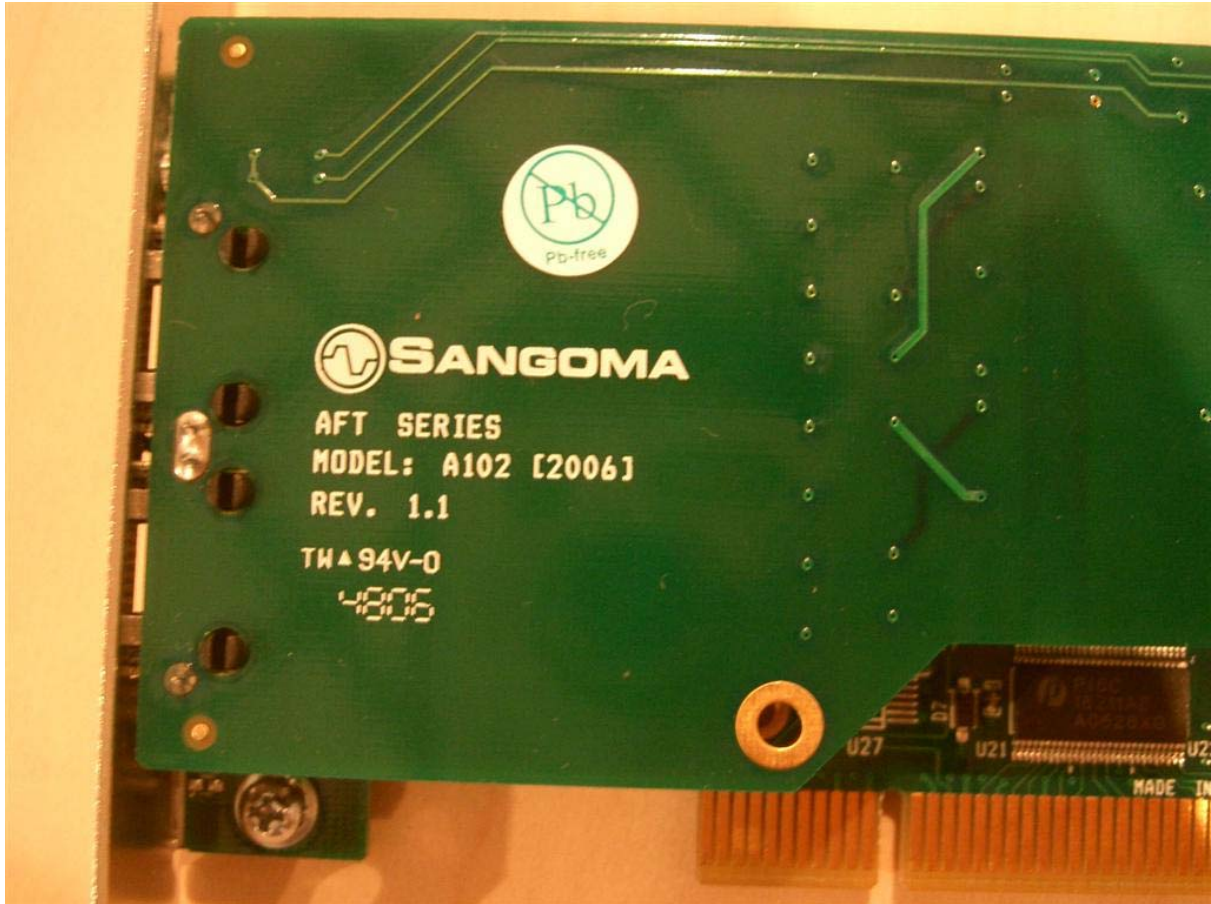



Figure 2: EUT backview

Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	

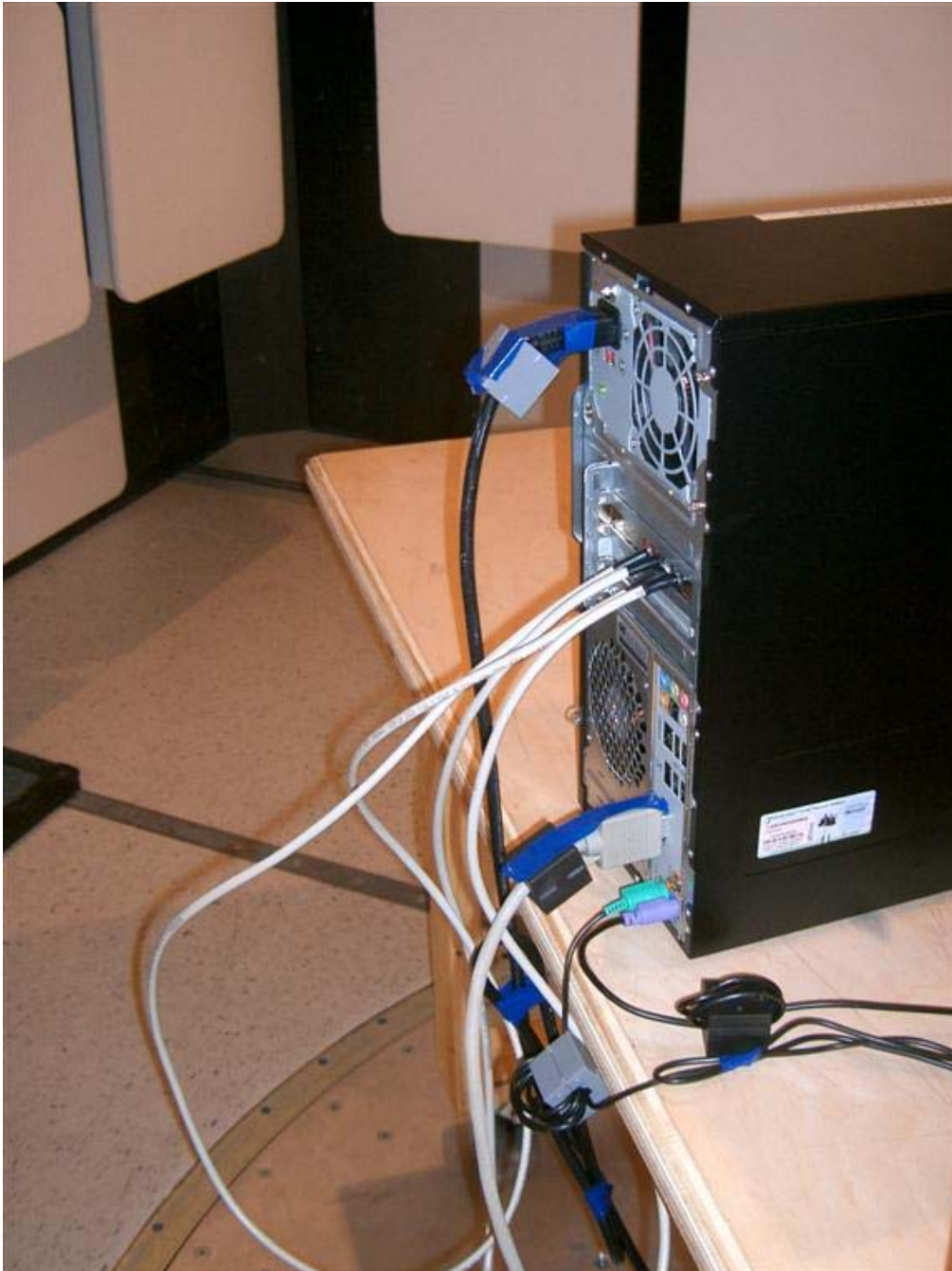


Figure 3: EUT installed inside the chassis with RJ11 shielded loop back cables shown.


Client	Sangoma Technologies Corp.	
Product	A102d/A200d T1/E1 Interface cards	
Standard(s)	ICES-003 Issue 4:2004 / FCC Part 15 Subpart 15:2006	



Figure 4: Conducted emissions setup