SANMINA-SCI

Product Integrity Laboratory

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Emissions Test Report
Project Code PI80550

(Report PI80550-1)

cBTS a/w06 FCC Part 22

Revision: 1

July 14, 2004

Prepared for: Nortel Networks

Author: Eric Warkentin
EMC Specialist

Approved by: Nick Kobrosly
Lab Manager

Report Summary

Sanmina-SCI Canada

Product Integrity Laboratory
5151-47th Street, N.E. Calgary Alberta T3J 3R2

Accreditation Numbers: FCC 101386
IC 46405-3978 File # IC3978-2
Standards Council of Canada Accredited Laboratory No. 440

Performed For: Nortel Networks Inc.
5111-47th Street, N.E.
Calgary Alberta T3J 3R2
Phone (403) 769-2425

Customer Representative: Daryl Therens

EUT Description:

	Name	Model	Revision	Serial Number
EUT	3 Carrier, 3 Radio BTS	NTRZ61AA	03	SNMN5300R60K

Note: Model, Revision, and Serial Number are for the cBTS Shelf

Test Summary

Appendix	Standards		Description & Range	Deviations* from:			Pass / Fail	Criteria
	Base	Test Basis		Base Standard	Test Basis	Sanmina Procedure		
A	FCC CFR 47 Part 22	ANSI C63.4-2001	Radiated Emissions 30 MHz – 10 GHz	No	No	No	PASS	Subpart H

*Deviation details are outlined in the applicable appendix of this report

Test Log and Signatures

Appendix	Test Case	Start	End	Tester / Date
A	Radiated Emissions – 30 MHz – 10 GHz FCC Part 22	June 30, 2004	July 1, 2004	Signature Not Verified Digitally signed by Eric Warkentin DN: cn=Eric Warkentin, o=Sanmina-SCI, ou=PI, c=CA Date: 2004.07.14 11:17:39 -06'00' Location: Calgary Eric Warkentin, EMC Specialist

The test outlined may not be inclusive of all testing required by the Base Standards or fulfill the applicable regulatory requirements in their entirety.

Test Result: The product presented for testing complied with test requirements as shown above.

Prepared By:

Signature Not Verified Digitally signed by Eric Warkentin DN: cn=Eric Warkentin, o=Sanmina-SCI, ou=PI, c=CA Date: 2004.07.14 11:17:53 -06'00' Location: Calgary

Eric Warkentin
EMC Specialist

Checked By:

Signature Not Verified Digitally signed by Glen Moore DN: cn=Glen Moore, c=US Date: 2004.07.15 09:21:47 -06'00'

Glen Moore
EMC Manager

Table of Contents

REGISTER OF REVISIONS

Revision	Date	Description of Revisions
0	July 13, 2004	Initial Draft Release
1	July 14, 2004	Official release following internal and customer review

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the tests applied by Sanmina-SCI Canada to demonstrate compliance of Nortel Network's cBTS with a/w06 800MHz Radio Modules, to the applicable Electromagnetic Compatibility (EMC) standards as outlined in section 1.3.

The test outlined may not be inclusive of all testing required by the Base Standards or fulfill the applicable regulatory requirements in their entirety.

1.2 ABBREVIATIONS AND DEFINITIONS

The following are the abbreviations and definitions that may be relevant to this document.

Abbreviation	Explanation
AC	Alternating Current
AV	Average
BTS	Base Station Transceiver Subsystem
Cm	centimetre
dB	Decibel
dBµV	Decibel relative to 1 microvolt
DC	Direct Current
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
FCC	Federal Communications Commission
GHz	Giga Hertz
GPS	Global Positioning System
Hpol	Horizontal Polarization
Hz	Hertz
ITE	Information Technology Equipment
LNA	Low Noise Amplifier
m	Metre
MHz	Megahertz
µV	Microvolts
N/A	Not Applicable
NA	Not Available
PI	Product Integrity
QA	Quality Assurance
RF	Radio Frequency
Rx	Receive
SA	Spectrum Analyzer
Tx	Transmit
VAC	Volts Alternating Current
Vpol	Vertical Polarization
W	Watt

Definitions:

Equipment Under Test (EUT): A representative ITE or functionally interactive group of ITE (that is a system), which includes one or more host units and is used for evaluation purposes.

Electromagnetic compatibility: EMC (abbreviation): The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

1.3 REFERENCES

US Code of Federal Regulations

- 47 CFR Part 22 — Federal Communications Commission, Part 22, 10-01-97 edition

American National Standards Institute

- ANSI C63.4-2001 — American National Standards for Methods of Measurements of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipments in the range of 9 KHz to 40 GHz, June 6, 2001

Sanmina-SCI Documentation

- Sanmina-SCI Radiated Emissions 30MHz – 1GHz Automated Test Method E001R7
- Sanmina-SCI Radiated Emissions 1GHz – 18 GHz Manual Test Method E006R4
- Sanmina-SCI Radiated Emissions Substitution 30 MHz – 20 GHz Test Method 11.0

2.0 EUT

2.1 CONFIGURATION

Description of EUT

	Name	Model	Revision	Serial Number
EUT	3 Carrier, 3 Radio BTS	NA	NA	NA
Classification	Floor standing			
Size (m)	NA			
Weight	NA			
Power	-48 VDC			
Functional Description	For this configuration 1 Compact BTS shelf was installed in the lower shelf (BTS 1). In general, 1 to 3 standalone Compact BTS shelves may be installed in the standard Nortel 7-foot CDMA Metro Cell frame. Note that the lower Compact BTS shelf in the 7-foot frame is BTS 1, the middle shelf is BTS 2, and upper shelf is BTS 3. Each Indoor Compact BTS for PI testing will comprise of the following major modules and assemblies: • Compact Dual Voltage Shelf - comprises a common digital/radio shelf with back-plane, and houses the entire Compact BTS that consists of TIIM, GPSTM, CM-2, CEM, RM, CCAM, DC Breaker Module, and Cooling Unit. The back-plane provides the electrical interfaces that support the inter-module communication and DC power distribution to the modules housed within the BTS through a combination of D-sub connectors, 2mm high density connectors, combo D-sub connectors and high power contacts. The DC Breaker Module distributes DC power to the CCAM and fan tray via a 10A breaker, to the digital modules via a 20A breaker, and to each of the radio modules via a separate 40A breaker. The DC Breaker Module also allows for 2, 5A breakers for customer power. • CM-2 - the CM-2 digital module provides the call-processing capability, overall data flow control, the T1/E1 back-haul interface, and OAM functionality plus the CDMA toolbox interface (DMI and Vortex). • RM with duplexer - the RM provides the radio channel compensation and RF conversion. Once the RM is configured it becomes a data processing pipe with little activity that is not OAM related. • GPSTM - the GPSTM provides the timing reference for the BTS. • CEM, any permutation of CEM64-PnP, CEM192, DOM (2 DOM maximum) – there are 3 different CEM digital module variants that can be used in the Compact BTS. The CEM provides the cell site modem function, converting the encoded voice and data between the network and the air interface. The CEM64-PnP and CEM192 provide 1xRTT voice and data capability. The DOM is an OEM unit that provides 1xEV-DO capability, and also provides its own back-haul interface via T1/E1 or Ethernet. • TIIM - the TIIM is designed for use as a secondary surge protection device on T1/E1 data lines and to provide T1/E1 routing to the CM-2 and DOM in the			

Compact BTS. The TIIM is installed in series between primary surge protection (customer supplied) and the CM-2 / DOM to be protected. A single unit can protect up to 8 T1/E1 lines, or eight paired circuits.

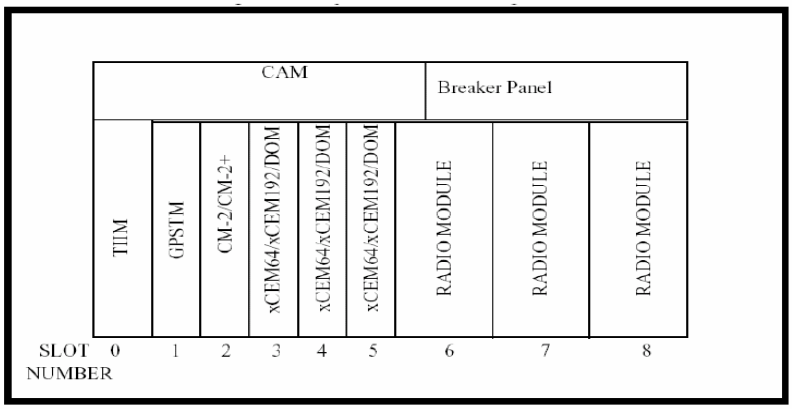
- CCAM – the CCAM supports 24 customer configurable alarms, a shared GPSTM, Cooling Unit alarm monitoring, and input DC voltage monitoring. Through an Inter-Shelf Alarm cable, the CCAM could also monitor the DC power and Cooling Unit alarm from an extension Compact BTS shelf.
- Cooling Unit – the Cooling Unit consists of a fan tray that has temperature controlled fan speed to reduce acoustic noise.

Product Intended Application	Wireless CDMA Base-station supporting both IS-95 and IS-2000 air interfaces
Product Deployment Environments	Indoor, floor standing when installed
Operating Modes in the Field	During test, each shelf was operating 3-carrier/3-sector (typical maximum field configuration per shelf)

Physical Description

For this configuration one Compact BTS shelf was installed in the lower shelf (BTS 1) as shown below.

A diagram of the module positions is given below:



2.1.1 SET UP CONFIGURATION

EUT Description List – The following module information was provided by the client and was not verified by Sanmina-SCI.

Description	P/N RLS	Serial Number
Radio Rack	N/A	N/A
cBTS Shelf	NTRZ61AA 03	SNMN5300R60K
CCAM	NTRZ64AA P5	NNTM74XL1WC7
TIIM Slot 0	NTGS3188 03	NNTM74XL0N3G
GPSTM Slot 1	NTBW50AA 07	NNTM74TC0EIX
CM-2 Slot 3	NTBW40BA T6P	NNTM84C027TE
CEM 64 Slot 4	NTRZ80AA N2	NNTM74X0RR00
DOM Slot 5	NTBW99DO 04	ARVN24420001
DOM Slot 6	NTBW99DO 04	ARVN24420005
RM800 a/w06 Slot RM1	NPRZ71AA P5	NNTM536G2DCL
RM1 Duplexer	NTRZ79CA 02	ALLG74000JXK
RM800 a/w06 Slot RM2	NPRZ71AA P5	NNTM536G2DEN
RM2 Duplexer	NTRZ79CA 02	ALLG74000JX7
RM800 a/w06 Slot RM3	NPRZ71AA P5	NNTM536G2DDM
RM3 Duplexer	NTRZ79CA 02	ALLG74000JXE

2.1.2 TEST PLAN CONFIGURATION DEVIATIONS

Configuration was performed by the customer, no deviations were identified by the customer.

2.1.3 EUT POWER

The following information was provided by the client and was not verified by Sanmina-SCI.

Voltage	-48 VDC
Number of Feeds	1
Gauge of cable	2
Current Draw	Must be capable of 40A
Special Requirements	The power (1 hot and 1 return) was supplied through a two wire power cord into the radio rack.

2.1.4 TEST PLAN POWER DEVIATIONS

None.

2.2 CABLES

EUT Cable List

Quantity	Model	Routing		Description	Cable Length (m)
		From	To		
1	NTGS3518 R01C03	CCAM (50-pin connector)	Looped-back (flying lead)	25-pair alarm cable – unshielded	15
1	NTBW4032 release 01	TIIM (50-pin connector)	Looped-back (flying lead	25-pair T1/E1 cable - shielded	16
1	LMR-400	Bulkhead (N-type male)	Rack GPS Input (N-type male)	LMR-400 RF cable	8
1	LMR-400	RM1 (N-type male)	Bulkhead (N-type male)	LMR-400 RF cable	8
1	LMR-400	RM2 (N-type male)	Bulkhead (N-type male)	LMR-400 RF cable	8
1	LMR-400	RM3 (N-type male)	Bulkhead (N-type male)	LMR-400 RF cable	8
1	N/A	Lab power (hubble connector)	Compact shelf Breaker Module (2 hole lugs)	2 AWG Power Cable	7

2.2.1 TEST PLAN CABLE LIST DEVIATIONS

None.

2.3 FREQUENCIES

EUT Frequency List

Module	Signal	Frequency (MHz)
See Test Plan – Table 34		

2.3.1 TEST PLAN FREQUENCY LIST DEVIATIONS

None.

2.4 EUT SOFTWARE

Software Name	Software Release Number	Software Description
See Test Plan – Section 6.4.3.2		

2.5 MODE OF OPERATION

As defined by Nortel Networks, the EUT was operated in a typical manner. During testing, the customer monitored the system operation. See Section 2.4 for software mode of operation information.

2.5.1 TEST PLAN MODE OF OPERATION DEVIATION

Mode of operation was set by the customer, no deviations were identified by the customer.

2.6 PASS / FAIL CRITERIA

The pass/fail criteria are defined by the emission limits outlined in each reference base standard. The specific limits are described in each test appendices of this report.

3.0 SUPPORT EQUIPMENT

3.1 CONFIGURATION

All support equipment information was supplied by the client and was not verified by Sanmina-SCI.

Co-Located Support Equipment/Assemblies

Position	QTY	Description	P/N	Serial Number
No co-located support equipment was supplied				

Offsite Support Equipment/Assemblies

Position	QTY	Description	P/N	Serial Number	Revision Number
No off-site support equipment information was supplied					

3.2 CABLES

Support Cable List

Quantity	Model	Routing		Description	Cable Length (m)
		From	To		
No support cable information was supplied					

3.3 FREQUENCIES

Support Frequency List

Assembly	Signal	Frequency (MHz)
No support equipment frequency information was supplied		

APPENDICES

APPENDIX A: RADIATED E-FIELD EMISSIONS 30 GHZ – 10 GHZ (ERP MEASUREMENT)

A.1. Base Standard & Test Basis

Base Standard	☒	CFR Title 47 – Telecommunications, Chapter I - FCC Part 22 – Public Mobile Services – Subpart H – Cellular Radiotelephone Sevice
	☐	CFR Title 47 – Telecommunications, Chapter I - FCC Part 24 – Personal Communication Services – Subpart E – Broadband PCS
Test Basis		ANSI C63.4-2001 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Test Method		Sanmina-SCI Radiated Emissions Test Method E006R4 Sanmina-SCI Radiated Emissions Signal Substitution Method 30MHz - 20GHz. EMC Test Method 11.0, Revision 01

A.2. Specifications

Frequency	☒ **47 CFR FCC Part 22** ☐ **47 CFR FCC Part 24**	
	Theoretical Peak @ 3m[1]	**ERP[2]**
MHz	**dBmV/m**	**dBm**
1000 - 18000	84.3	-13

Note 1: Calculated using: Pd-(43 + 10 log(Pw)
where Pd is the EUT power in dBm and Pw is the EUT power in watts
Note 2: Calculated using: 120+20log(SQRT(49.2*Pw)/3)
where Pw is the EUT power in watts

A.3. Measurement Uncertainty

Frequency Range	**Measurement Uncertainty (dB)**	**Expanded Uncertainty (K=2) (dB)**
30 MHz – 1 GHz	+2.32/-2.36	+4.65/-4.72
1 GHz – 10 GHz	+3.48/-3.51	+6.96/-7.02

A.4. Deviations

Deviation Number	**Time & Date**	**Description and Justification of Deviation**	**Deviation Reference**			**Approval**
			Base Standard	**Test Basis**	**Sanmina Procedure**	
None						

A.5. Radiated Emissions Measurement Equipment

Radiated Emissions 30 MHz – 1 GHz Measurement Equipment

Description	Manufacturer	Type/Model	Asset #	Cal Due	Cal Date
10m ANECHOIC CHAMBER					
Bilog Antenna	☒ Chase	CBL 6111B	260301	23APR05	23APR04
	☐ Chase	CBL6112B	260398		
RF Cable	Suhner Succoflex	Ferrite bead loaded cable	260388	07JAN06	07JAN04
CONTROL ROOM					
Test Receiver	☐ Rohde & Schwarz	ESMI	260424 / 260423	27MAR05	27MAR04
	☒ Rohde & Schwarz	ESMI	260424 / 260423		
Mast Controller	EMCO	2090	260166	N/A	N/A
Multi Device Controller TT1 (Turntable)	EMCO	2090	260165	N/A	N/A
RF 10m East site Link				07JAN06	07JAN04
- Cable 1	Suhner Succoflex	NA	263191		
- Cable 2	Suhner Succoflex	NA	263135		
- Cable 3	Suhner Succoflex	NA	263161		
- Cable 4	Suhner Succoflex	NA	263162		
- Switch Matrix Controller	TDL	SMC-002	260162		
- Amplifier	Hewlett Packard	8447F	260164		

Radiated Emissions 1 GHz – 10 GHz Measurement Equipment

Description	Manufacturer	Type/Model	Asset #	Cal Due	Cal Date
10m ANECHOIC CHAMBER					
Horn Antenna (Rx) 1 G – 10 G	☒ EMCO	3115	260092	16JUN05	16JUN04
Standard Gain Horn (Rx) 5.95 G – 8.2G	☐ EMCO	3160-06	260090	27NOV04	27NOV01
Standard Gain Horn (Rx) 8.2G – 12.5 G	☐ EMCO	3160-07	260089	27NOV04	27NOV01
Standard Gain Horn (Rx) 12.5G – 18 G	☐ EMCO	3160-08	260074	27NOV04	27NOV01
High pass filter	K&L	11SH10-3860	263124	08JAN06	08JAN04
High frequency Link				07JAN06	07JAN04
Step Attenuator/Switch (0dB & 10 dB)	HP	11713A	260048 260097		
LNA	Miteq	JSD000121	260477		
Cable from LNA to SA	Succoflex	101PEA	263187		
Spectrum Analyzer 9k-40GHz	Rohde & Schwarz	FSEK	260104	27MAR05	27MAR04
LNA DC Power Supply	Xantrex	LXO 30-2	260483	NA	NA
HPIB Extender	HP	37204	260096	N/A	N/A
10dB Attenuator	Wiltron	41KC-10	260449	05APR05	05APR04
CONTROL ROOM					
PC with FSEK Manual ctrl S/W	N/A	N/A	N/A	N/A	N/A
HPIB Extender	HP	37204	260168	N/A	N/A
Mast Controller	EMCO	2090	260166	N/A	N/A
Multi Device Controller TT1	EMCO	2090	260165	N/A	N/A
VERIFICATION EQUIPMENT					
Horn Antenna (Tx)	☒ EMCO	3115	260088	N/A	N/A
Signal Generator	☒ Rohde & Schwarz	SMP-04	260425	N/A	N/A
	☐ Rohde & Schwarz	SMIQ		N/A	N/A
Cable RX antenna to 3M center bulk head	Succoflex	104	263136	N/A	N/A
Cable 3M center bulk head to Control room	Succoflex	104	263188	N/A	N/A
Cable Control room bulk head to Signal Generator	Succoflex	104	263134	N/A	N/A

A.6. Special Considerations

None.

A.7. Test Results

Compliance Scan Summary

Sanmina	**Project Name:**	PI80550					**Tester:**	Eric Warkentin										
	Model:	cBTS					**Test ID:**	RE03-10m-2004-550										
	Comments:	-48VDC, 3 a/w06 RM800, 1 CEM 64, 2 DOM, 3C 3S, A-band duplexer																
Standard	FCC_22						3 meters											
	Rx Antenna	Tx Antenna	Frequency	E-Field Peak Emission Level	Substituted Measured Rx Level	Rx AF	Rx Link	Rx FL	Total Rx CF	Det	Substituted RX E-Field Emission	Signal Generator	Tx Num Gain	Tx Cable	Total Tx CF	Effective Radiated Power (E.R.P.)	ERP Limit	ERP Margin
			MHz	dBuV/m	dBuV	dB/m	dB	dB	dB		dBuV/m	dBm	dB	dB	dB	dBm	dBm	dB
Hpol	260092	260091	3514.35	41.48	37.08	31.24	-26.46	-0.33	4.45	PK	41.53	-67.10	9.75	9.81	-0.06	-67.16	-13.00	**54.16**
Vpol	260092	260091	1755.03	50.88	43.87	26.37	-19.26	0.00	7.11	PK	50.98	-55.20	7.17	6.72	0.46	-54.74	-13.00	**41.74**

AF: Antenna Factors Link: Link Loss FL: Filter Loss CF: Correction Factor Det: Detector Type RX: Receive TX: Transmit
Link = Attenuator Loss+Cable Loss + Amplifier Loss Rx E-Field Emission = Measured Rx Level + AF + Link + FL. E.R.P. = Signal Generator +Tx Num Gain - Tx Cable

The EUT is in compliance with the limits as specified above.

Notes:

- No radio emissions seen below 1.7 GHz or above 3.6 GHz
- Frequencies chosen from compliance are radio harmonics, all other emissions are digital harmonics and fall under Part 15 tests.

A.8. Observations

None

A.9. Deviations from Normal Operating Mode During Test

None

A.10. Sample Calculation

3m Limit = 10m Limit – 20 * log (3/10)
Emission Level = Measured Level + Correction Factors
Margin = Limit – Emission Level
ERP Limit (dBm) = Pd-(43 + 10 log(Pw)
where Pd is the EUT power in dBm and Pw is the EUT power in watts
Theoretical ERP Limit (dBuV/m) 120+20log(SQRT(49.2*Pw)/3)
where Pw is the EUT power in watts

A.11. Test Data & Photographs

The test data and photographs collected during this test appear following this page.

A.12. Tested By

This testing was conducted in accordance with the ISO 17025:1999 scope of accreditation, table 1; Quality Manual.

Name: Eric Warkentin
Function: EMC Specialist

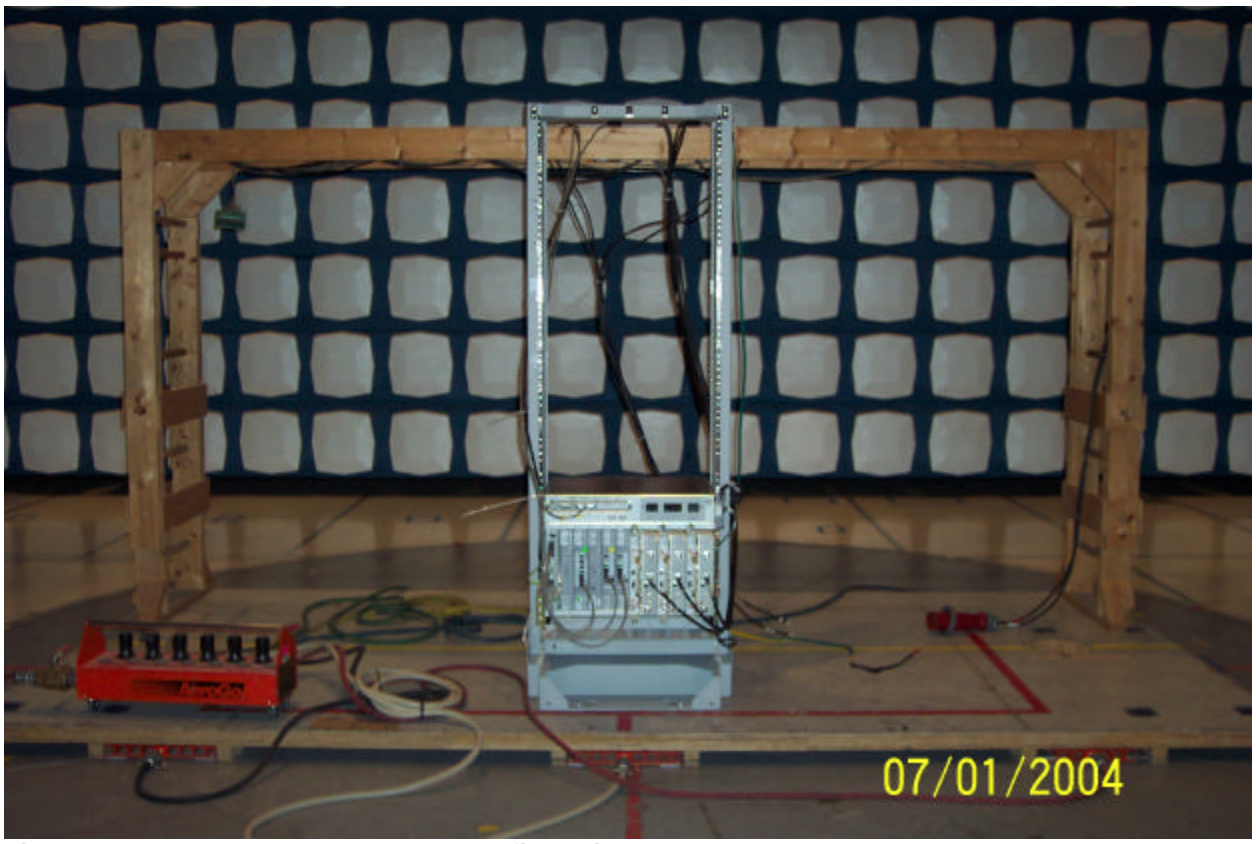


Figure 1 RE 30 MHz - 1 GHz EUT Configuration

Figure 2 RE 1 GHz – 18 GHz EUT Configuration

APPENDIX B: TEST PLAN

Refer to Nortel CDMA BTS Development Group document “Compact BTS 800 MHz aw06 RM and DOM PI Test Plan” Stream: 00 Issue: 0.1.

APPENDIX C: SUPPLEMENTARY INFORMATION

Not attached

END OF DOCUMENT

Sanmina-SCI Product Integrity Laboratory, 5151-47th Street N.E. Tel: 403-295-5134, Fax: 403-295-4091