TEST REPORT

CFR 47 Part 15
and CFR 47 Part 24

UMTS 1900 Outdoor iBTS

N°149026DK

Technical control: O.ROY	**GYL technologies** Parc d'activités de Lanserre 21, rue de la Fuye 49610 Juigné sur Loire Tel. : 02.41.57.57.40 - Fax : 02.41.45.25.77	Quality Control: L.MONTIEL

Summary

1 GENERAL INFORMATION

1.1 APPLICANT:

SANMINA SCI
46 Rue Pierre Curie
78376 PLAISIR - FRANCE

1.2 MANUFACTURER:

NORTEL NETWORKS
38, rue Paul Cézanne
78928 Guyancourt Yvelines – France

1.3 APPLICANT REPRESENTATIVE:

Patrick GALOPIN

1.4 TEST DATE:

July 9 to July 10, 2003

1.5 TEST SITE:

GYL Technologies
Parc d'activités de Lanserre
49610 Juigné sur Loire – France
FCC registration Number: 90469

2 INTRODUCTION

The following test report for a Base Station Transmitter is written in accordance with Part 15 and 24 of the Federal Communications Commissions. The Equipment Under Test (EUT) was the UMTS 1900 Outdoor iBTS. The test results reported in this document relate only to the item that was tested.

All measurements contained in this Application were conducted in accordance with ANSI C63.4 Methods of Measurement of Radio Noise Emissions of 2001. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Some accessories are used to increase sensitivity and prevent overloading of the measuring instrument. These are explained in this report. Calibration checks are performed regularly on the instruments, and all accessories including the high pass filter, preamplifier and cables.

All radiated and conducted emissions measurements were performed manually at GYL TECHNOLOGIES. The radiated emissions measurements required by the rules were performed on the three to ten meters, open field, test site maintained by GYL Technologies Parc d'activités de Lanserre, 49610 Juigné sur Loire , France. Complete description and site attenuation measurement data have been placed on file with the Federal Communications Commission.

The power line conducted emission measurements were performed in a shielded enclosure also located at the Parc d'activités de Lanserre, 49610 Juigné sur Loire, France facility

3 MEASUREMENT EQUIPMENT LIST

PART TYPE	MANUFACTURER	MODEL	SERIAL NUMBER	CALIBRATION DATE
RECEIVERS				
Receiver	Rohde & Schwarz	ESI 7	M02020	Mar-03
Spectrum analyzer	Rohde & Schwarz	FSEM 30	M02021	Dec-02
ARTIFICIAL MAINS NETWORKS				
LISN (50µH / 5/50Ω)	Rohde & Schwarz	ESH2-Z5	M02034	Oct-02
ANTENNAS				
Bilog (30-2000MHz)	CHASE	CBL-6112	M02031	Nov-02
Horn (1 to 18GHz)	EMCO	3161-01	M01138	

4 TESTED SYSTEM DETAILS

The equipment tested is a **B**ase **T**ransceiver **S**tation for **U**niversal **M**obile **T**elecommunications **S**ystem also considered as an Information Technology Equipment. The equipment provides Personal Communications Services in the 1930 – 1990 MHz frequency band.

5 EQUIPMENT DESCRIPTION

5.1 PRODUCT TYPE:

UMTS 1900 Outdoor iBTS (STSR 3D Configuration see appendix C13):

5.1.1 Equipment Release Status:

TRM 1900 (all): P1
CCM: 14
CEM: E6 - E8 - G5
GPSAM: D7
MCPA 1900 (all): D2
DDM 1900 (all): D1
iDACS: D3
INTERCO: D1
Digital shelf: D2
User ICO: D2
AC main: D2
Filtering box: D1
LPPCM: D2
External alarm kit: D2
SPCM: D3
Rectifiers: 6*D1 and 1*D2

5.2 AUXILIARY EQUIPMENT:

Attenuators and 50 ohms load

5.3 PRODUCT PICTURES:

Doors opened

5.4 PRODUCT COMPOSITION

The table given here under gives the features details of the equipment under test

ARTICLE	PEC code	Release	Serial number
TRM 1900	NTUM10EA	P1	NNTM7502DFME
TRM 1900	NTUM10EA	P1	TRM1900010
TRM 1900	NTUM10EA	P1	NNTM7502DNTF
CCM	NTGY25AA	14	NNTM5330LJ0C
CEM	NTUM00AA	E8	NNTM7503CBPB
CEM	NTUM00AA	G5	NNTM7503ERKX
CEM	NTUM00AA	E8	NNTM7503CBOY
CEM	NTUM00AA	E6	NNTM7503C38V
CEM	NTUM00AA	E8	NNTM7503CBP2
CEM	NTUM00AA	E8	NNTM7503D5Z8
GPSAM	NTUM24AA	D7	NNTM7503QSRS
MCPA 1900	NTUM30PA	D2	PWWT03D97J8N Firmware 1.12
MCPA 1900	NTUM30PA	D2	PWWT03DC0NC6 Firmware 1.12
MCPA 1900	NTUM30PA	D2	PWWT03DC0NF7 Firmware 1.12
MCPA 1900	NTUM30PA	D2	PWWT03D9L76D Firmware 1.12
MCPA 1900	NTUM30PA	D2	PWWT03D9RGYN Firmware 1.12
MCPA 1900	NTUM30PA	D2	PWWT03D9L777 Firmware 1.12
DDM 1900	NTUM42AA	D1	FORM01428019
DDM 1900	NTUM42AA	D1	FORM01428022
DDM 1900	NTUM42AA	D1	FORM01428021
IDACS	NTUM80AA	D3	HIRSA211W3E9
INTERCO	NTUM60AA	D1	FCIN25000404
DIGITAL SHELF	NTUM20AA	D2	SNMN7500B3O6
User ICO	NTUM37AA	D2	SNMN7500B1X8
LPPCM	NTUM98BA	D2	SNMN75005IZ1
External alarm kit	NTUM98AA	D2	SNMN75005IDG
MCA	NTUM7200	D1	SNMN7500B0CS
RECTIFIER SHELF	NTUM87AA		
SPCM	NTUM85AA	D3	PITS01U31646
Rectifier	NTUM86AA	D1	PITS01H35618
Rectifier	NTUM86AA	D1	PITS01032287
Rectifier	NTUM86AA	D1	PITS01032290
Rectifier	NTUM86AA	D1	PITS01H35590
Rectifier	NTUM86AA	D1	PITS01H35463
Rectifier	NTUM86AA	D1	PITS01H35873
Rectifier	NTUM86AA	D2	PITS01030219
AC main	NTUM39AA	D2	SNMN7500BD8V
Filtering box split phase	NTUM90BA	D1	SNMN7500BGLG
PCM installation cable	NTQG41HA		
Antenna RF cable for TMA			

6 EXERCISING TEST CONDITIONS

Measurements are done in transmitter mode (all transmitters at maximum power 30 watts).
Installation diagram and cables list on appendix C7

6.1 CHANNELS TEST CONFIGURATION:

TRM	CHANNEL #	Definition
2	B	TRM 2 output on PA 1 and 6 transmitting at 1932.4 MHz and 44.8 dBm
3	M	TRM 3 output on PA 2 and 3 transmitting at 1960 MHz and 44.8 dBm
9	T	TRM 9 output on PA 4 and 5 transmitting at 1987.6 MHz and 44.8 dBm

6.2 EUT EXERCISING SOFTWARE

The EUT was provided with the software to continuously transmit during testing. The carrier was also checked to verify that the information was being transmitted.

Modules software version: V03E2.1E05.6_2
PI bench: V03D0304
Visual TRM: V03D0305
Visual BBS for CEM : V03D3.0_E02

7 CONFORMANCE STATEMENT

7.1 STANDARDS REFERENCED FOR THIS REPORT

PART 2: 1999	Frequency allocations and Radio Treaty Matters General Rules and Regulations
PART 15: 2002	Radio frequency devices
ANSI C63.4-2001	Standard format measurements/technical report personal computer and peripherals
PART 24 Subpart E" (2000)	Broadband Personal communications services

7.2 JUSTIFICATION

As mentioned in paragraph 5 of this report, the equipment is an information technology equipment providing public mobiles services and Personal Communication Services and as it may be installed in residential commercial or light industry areas the following sub clause of the standard mentioned above are

- Part 15.107 and 15.109 (subpart B) for respectively conducted and radiated emission.
- Part 24.238 (subpart E) for broadband PCS emission limits

8 Interpretation and remarks:

This equipment complies with the rules of the FCC.

8.1 IMPORTANT REMARK:

Since no emissions were detected in the pre-scan measurement, substitution method was not performed on UMTS 1900 Outdoor iBTS

The EUT Plot on pages 22 and 25 show measured noise floor levels detected while testing the UMTS 1900 Outdoor iBTS

9 TEST ACCORDING TO CFR 47 Part 15 Class B

Tests performed by Olivier ROY at GYL Technologies laboratories, on July 9 to10, 2003.

9.1 REFERENCE DOCUMENTATION:

FCC part 15 (Sub part B) §15.107 and 15.109 of 2002

9.2 CONDUCTED EMISSIONS MEASUREMENTS

The power line conducted emission measurements were performed in a semi anechoic chamber manufactured by SIDT. The EUT was assembled on a non conductive 10 centimeters high wooden pallet. Power was fed to the EUT through a 50 ohm / 50 micro-Henry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 7 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 7 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or average mode if applicable

9.3 RESULTS: (§ 15.107 class B)

The following table lists worst-case conducted emission date. Specifically: Emission Frequency, Test Detector, Analyzer Reading, Site Correction Factor, corrected Emission Level, Quasi Peak Limit and Margin, and the Average Limit and Margin.

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. If the conducted emissions exceed the limit with the instrument set to the quasi-peak mode, then measurements are made in the average mode.

The conducted test was performed with the EUT exercise program loaded, and the emissions were scanned between 150 kHz to 30 MHz on the NEUTRAL SIDE and LIVE SIDE, herein referred to as Neutral, Live1 and Live2 respectively.

ESI 7 EMI TEST RECEIVER IN RECEIVER MODE	
Peak measurement time	5 ms
step size	4KHz
Preamplifier	OFF
Preselector	ON
Resolution, Band With	9 kHz
Final Quasi Peak measurement time	1 s minimum
Final average measurement time	1 sec minimum

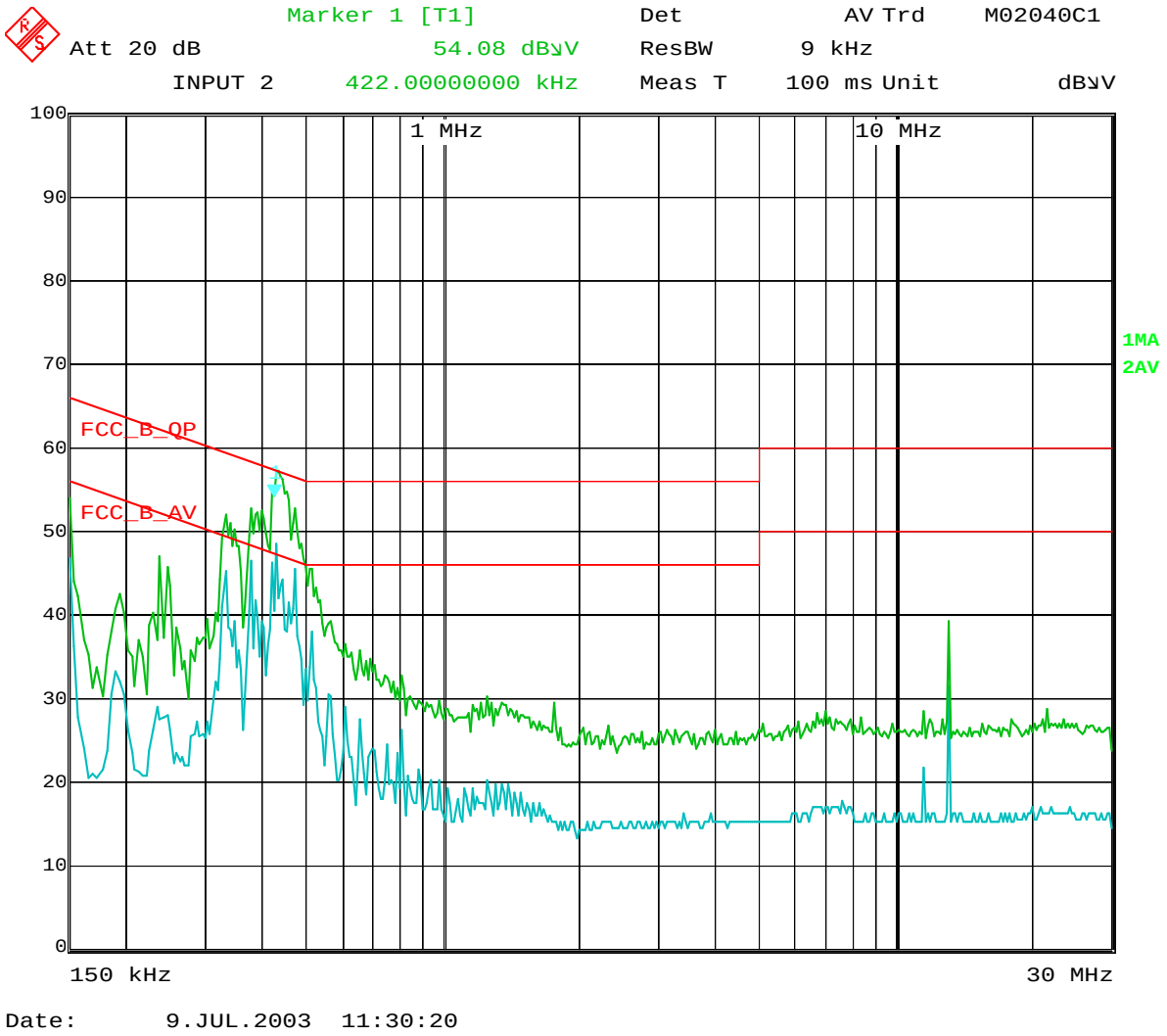
All readings are quasi-peak unless stated otherwise.

9.3.1 Live 1

Green Curve: Peak value
Blue curve: average value

Frequency (MHz)	Quasi-peak (dBµV)	QP margin (dB)
0.330	50.02	-9.43
0.422	53.23	-4.17
0.434	55.87	-1.31

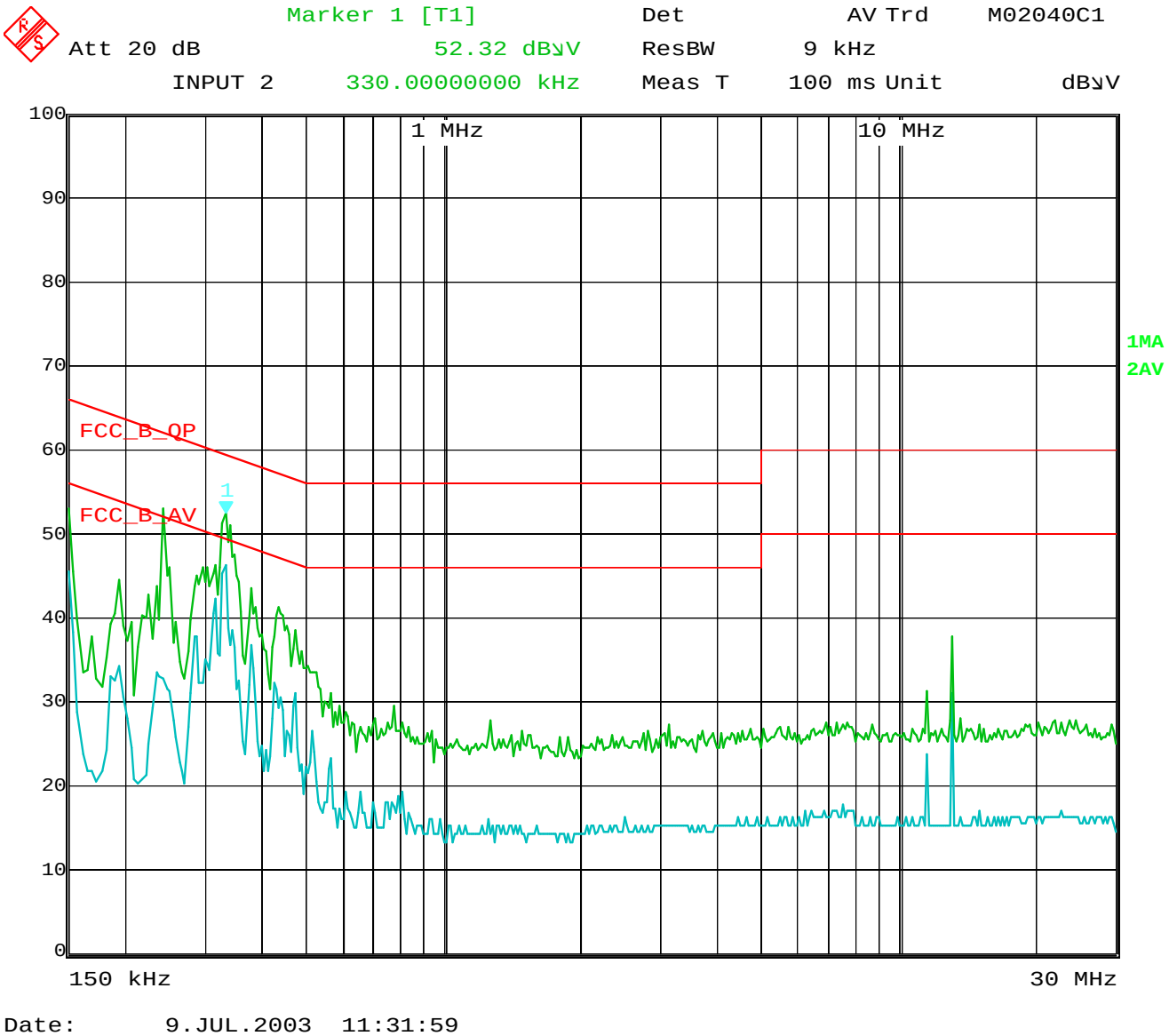
Frequency (MHz)	Average (dBµV)	AV. margin (dB)
0.150	45.01	-10.99
0.330	41.24	-8.21
0.374	42.32	-6.09
0.422	45.67	-1.74
0.426	44.49	-2.84
0.470	41.60	-4.91
0.514	35.39	-10.61



9.3.2 LIVE 2

Frequency (MHz)	Quasi-peak (dBµV)	QP margin (dB)
0.150	51.90	-14.10
0.242	44.56	-17.47
0.330	50.84	-8.62
0.374	42.15	-16.26

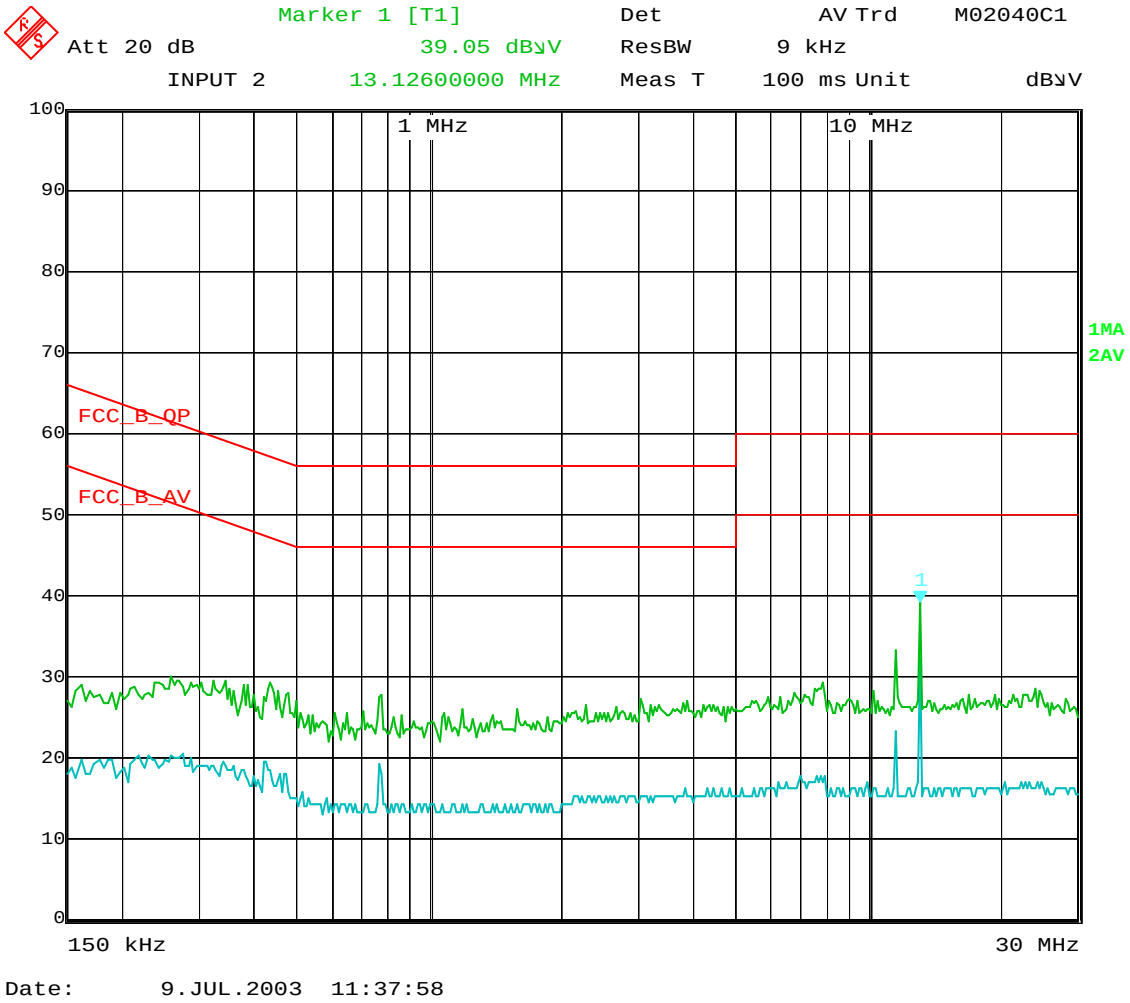
Frequency (MHz)	Average (dBµV)	AV. margin (dB)
0.150	44.71	-11.29
0.314	38.08	-11.78
0.330	42.44	-7.01
0.374	33.16	-15.25
0.422	28.73	-18.68
0.470	27.36	-19.15



9.3.3 Neutral

Frequency (MHz)	Quasi-peak (dBµV)	QP margin (dB)
0.434	24.95	-32.22
3.054	17.47	-38.53
11.582	30.95	-29.05
13.126	37.59	-22.41

Frequency (MHz)	Average (dBµV)	AV. margin (dB)
0.422	18.54	-28.87
0.770	17.84	-28.16
11.578	24.57	-25.43
11.582	24.10	-25.90
13.126	30.96	-19.04



9.4 INTERPRETATION AND REMARKS:

The equipment complies with the §15.107 requirements

9.5 RADIATED EMISSIONS MEASUREMENTS

Before final measurements of radiated emissions were made on the open-field three/ten meter range; the EUT was pre-scanned in the semi anechoic at one meter distance. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained. As Part 24 radiated requirements was tested in conjunction with the Part 15 testing. The spectrum was searched to identify emissions. A complete scan of the applicable spectrum was completed (up to 10^{th} harmonic of fundamental). The transmitters were then turned off, with the rest of the equipment powered on. A complete scan of the spectrum was done and referred to as "ambient" without the transmitter keyed on. Emissions emanating from the transmitter were identified from comparing these two scans. The identified emissions (from the transmitter) were measured and the levels recorded with the transmitter keyed on at full rated power output.

Final radiated emissions measurements were made, as outlined in Section 8 of the ANSI C63.4 measurement standard, on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.1 meter above the ground plane. The iBTS was tested to the applicable limits of the FCC rules. The measurement distance between the center of the measurement antenna and the equipment under test is 10 meters (or less for frequencies above 1 GHz .At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. No video filter less than 10 times the resolution bandwidth was used. The range of the frequency spectrum to be investigated is specified in FCC Part 15. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Summary of settings

ESI 7 EMI TEST RECEIVER IN RECEIVER MODE	
Peak measurement time	5 ms
step size	40 KHz
Preamplifier	ON
Preselector	ON
Resolution, Band With	120 kHz
Final Quasi Peak measurement time	1 s minimum
Final average measurement time	1 second

All readings are quasi-peak unless stated otherwise.

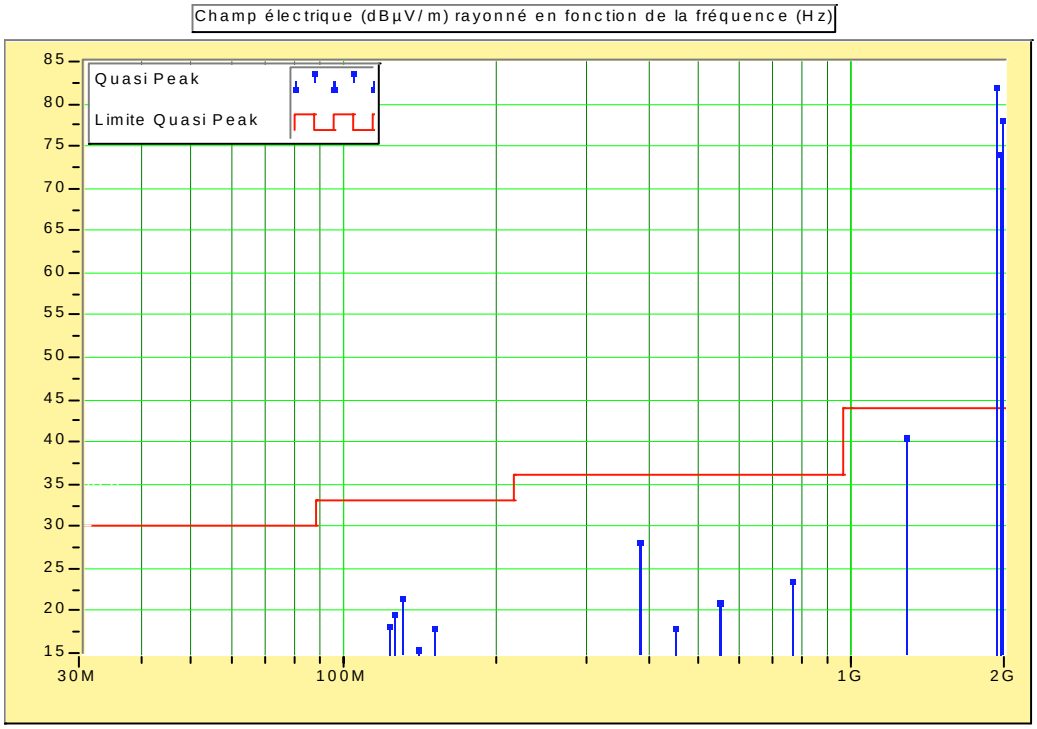
9.5.1 Test Set up

9.6 RESULTS (§ 15.109 class B):

The following data table lists the most significant emission frequencies, measured level, correction factor (includes cable and antenna corrections), corrected reading and the limit. The highest peaks are measured in quasi-peak detection mode at 10 meters distance, except for emissions radiated above 1 GHz where an average detector with 1 MHz resolution bandwidth was used.

Results

F (MHz)	PK (dBµV/m)	QP (dBµV/m)	Margin (dB)	Pol	H (cm)	Angle (degrees)	Corr. Fact (dB)	RBW (kHz)	Comments
122.052	21.28	18.24	-14.76	V	107	186	12.95	120	
126.150	23.42	19.63	-13.37	V	100	175	12.96		
129.997	23.88	21.56	-11.44	V	103	166	14.51		
139.991	18.3	15.47	-17.53	V	140	175	14.12		
149.984	19.82	17.95	-15.05	V	127	289	11.42		
383.362	30.53	28.21	-7.79	V	100	345	19.4		
447.328	22.73	17.98	-18.02	V	102	327	20.8		
550.523	24.69	21.14	-14.86	V	100	359	22.26		
766.807	27.47	23.65	-12.35	V	104	349	24.58		
1277.935		40.5	-3.5	V	166	9	29.17	1 MHz	Average
1932.400		82		V	137	359	32.83	1 MHz	Transmitter
1960.000		74		V	221	359	32.66	1 MHz	Transmitter
1987.600		78		V	266	359	32.48	1 MHz	Transmitter



For indicative level

F (MHz)	AV (dBµV/m)	Pol	H (cm)	A (degrees)	Corr. fact (dB)	RBW (kHz)	Comments
1932.400	82	V	103	137	32.83	1000	transmitter
1960.000	74	V	103	221	32.66	1000	transmitter
1987.600	78	V	246	266	32.48	1000	transmitter

No spurious signal found between 1 GHz and 20 GHz

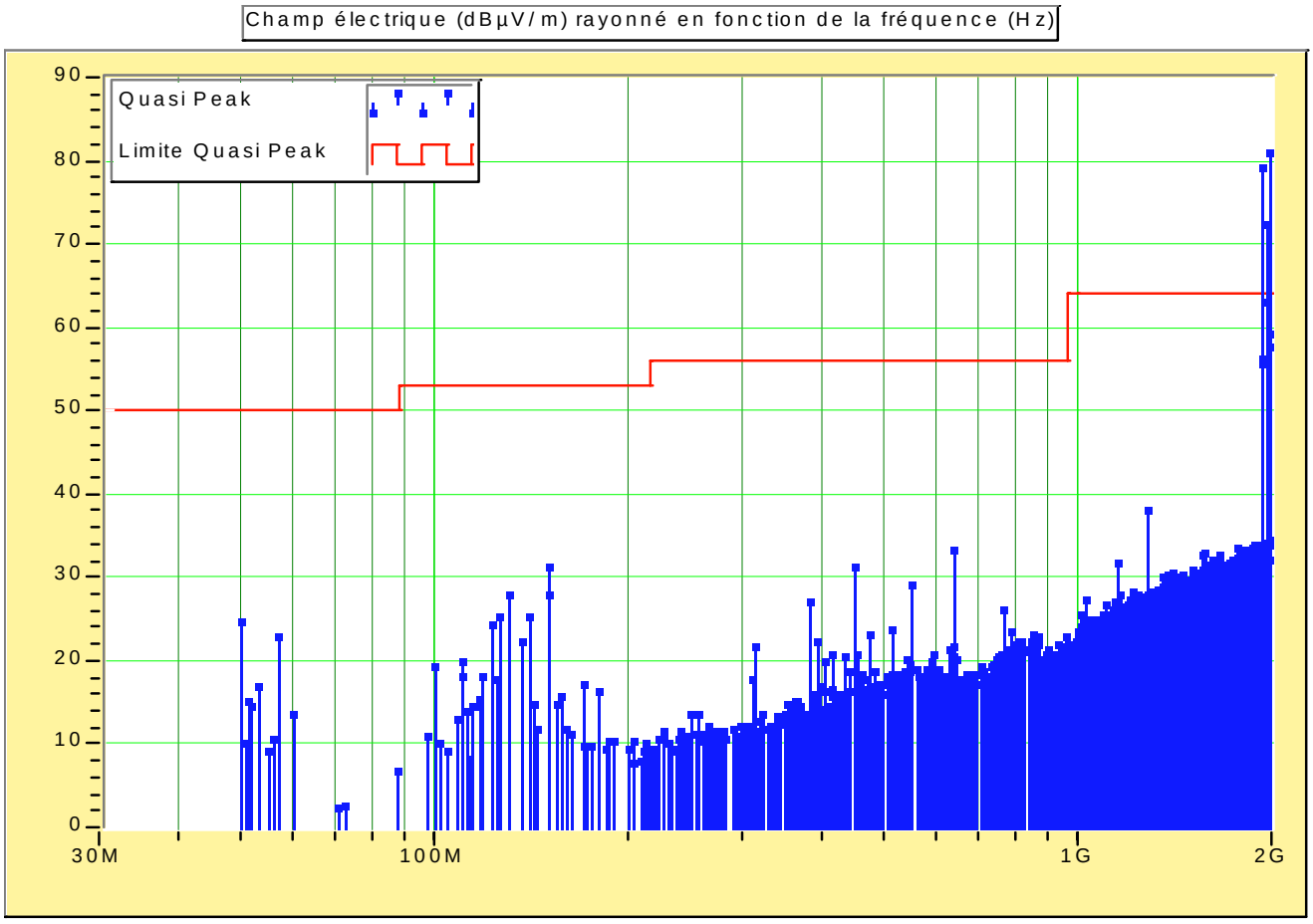
9.7 INTERPRETATION AND REMARKS:

The equipment complies with the §15.109 requirements

9.8 PRE-SCAN MEASUREMENT TO IDENTIFY SPURIOUS EMISSIONS FROM EUT

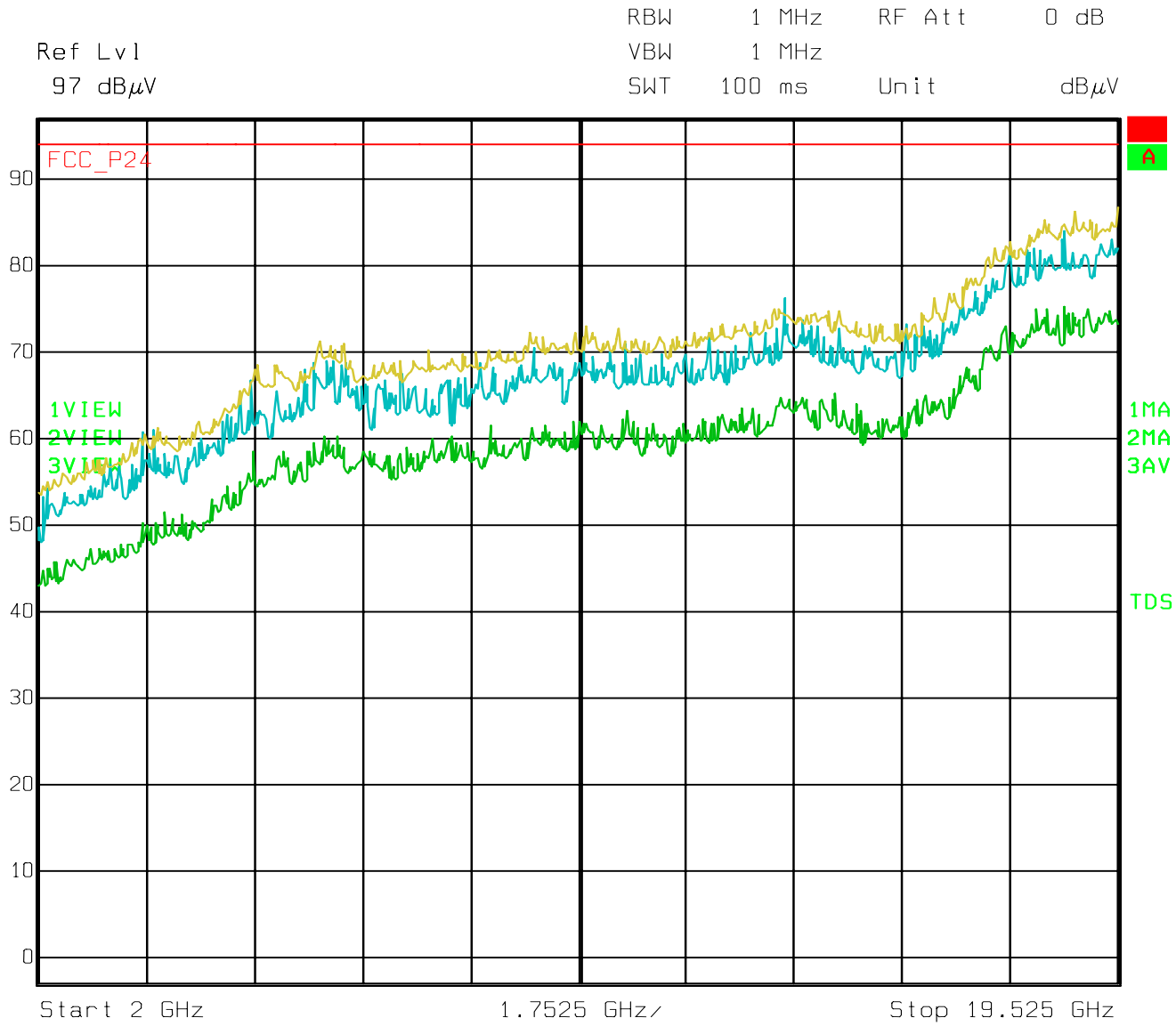
at D = 1m:

F (MHz)	PK (dBµV/m)	Margin (dB)	Pol	H (cm)	Angle (degrees)	Corr. Fact. (dB)	Comments
50.039	24.63	-25.37	V	134	56	11.05	
56.736	23.02	-26.98	V	134	56	9.25	
122.101	24.54	-28.46	H	134	56	14.47	
126.199	25.34	-27.66	H	134	56	14.66	
129.997	28.12	-24.88	H	134	56	14.51	
136.093	22.38	-30.62	H	134	56	14.27	
139.991	25.36	-27.64	H	134	56	14.12	
150.036	27.87	-25.13	H	134	56	13.38	
150.261	31.21	-21.79	V	134	56	13.38	
383.362	27.02	-28.98	H	134	56	19.4	
447.328	31.35	-24.65	H	134	56	20.8	
550.523	29.21	-26.79	H	134	56	22.26	
638.975	33.44	-22.56	H	134	56	22.45	
766.807	26.34	-29.66	H	134	56	24.58	
1277.935	38.1	-25.9	H	134	56	29.17	
1768.623	33.63	-30.37	V	134	56	33.12	
1869.170	33.64	-30.36	V	134	56	34.28	
1871.369	33.67	-30.33	V	134	56	34.31	
1883.862	33.81	-30.19	H	134	56	34.45	
1885.561	33.83	-30.17	H	134	56	34.47	
1889.559	33.88	-30.12	V	134	56	34.52	
1896.555	33.31	-30.69	V	134	56	34.6	
1897.655	33.33	-30.67	H	134	56	34.61	
1925.590	33.33	-30.67	H	134	56	34.43	transmitters
1925.990	33.33	-30.67	V	134	56	34.42	
1930.737	55.74	-8.26	H	134	56	34.38	
1933.585	56.22	-7.78	H	134	56	34.36	
1934.035	79.24	15.24	V	134	56	34.35	
1956.123	34.37	-29.63	H	134	56	34.17	
1958.672	72.42	8.42	V	134	56	34.15	
1959.222	63.2	-0.8	H	134	56	34.14	
1959.422	72.33	8.33	V	134	56	34.14	
1961.471	72.46	8.46	V	134	56	34.12	
1968.717	34.23	-29.77	H	134	56	34.06	
1977.712	34.68	-29.32	V	134	56	33.99	
1979.811	34.09	-29.91	H	134	56	33.97	
1981.960	34.62	-29.38	V	134	56	33.95	
1983.759	34.03	-29.97	V	134	56	33.94	
1986.607	57.77	-6.23	H	134	56	33.91	
1987.906	81.17	17.17	V	134	56	33.9	
1988.956	59.24	-4.76	H	134	56	33.89	


Champ électrique (dBµV/m) rayonné en fonction de la fréquence (Hz)
Quasi Peak
Limite Quasi Peak
90
80
70
60
50
40
30
20
10
0
30M
100M
1G
2G

Spectrum of noise level from 1GHz to 20GHz including loss cable and antenna factors

Legend:
Yellow curve represents the peak measurement in max hold mode
Blue curve represents the peak measurement in sweeping mode
Green curve represents the average measurements



10 TEST ACCORDING TO CFR 47 Part 24 subpart E

Tests performed by Olivier ROY at GYL Technologies laboratories, in July 9 to 10, 2003.

10.1 REFERENCE DOCUMENTATION:

CFR 47 part 24 subpart E (§ 24.238) of 2000

10.2 RADIATED DISTURBANCE:

10.2.1 General measurement conditions.

Conforms to Section 8 of the ANSI C63.4 measurement standard.
Diagram in 0° position, angles are positives in the reverse clock wise.

Equipment under test set up:

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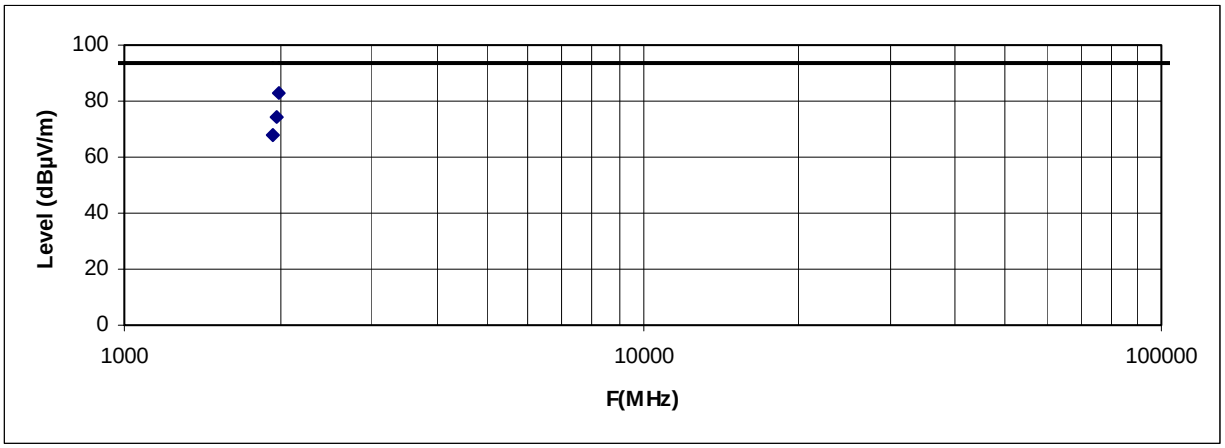
10.2.2 Method of measurement.

Measurements are done at 10m in an open area test site and maximum at all frequencies is analyzed by moving the product orientation and antenna polarization. The height of the antenna can vary from 1 m to 4 m Since no emission were detected above 1 GHZ a less than 30 cm scan was performed
Measurements are done in transmitter mode (all transmitters at maximum power 30Watts)

10.2.3 RESULTS (§24.238):

Measurement at transmitters' frequencies **for indicative level**
Transmitters output connected to resistive 50 ohms loads

FREQUENCY (MHz)	Measure (dBµV)	AF A	Loss cable B	Correc. Factor A+B	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1 932.4	**38.1**	**27.9**	**2**	**29.9**	**68**	**93.9**	**-25.9**
1 960.0	**44.1**	**27.9**	**2**	**29.9**	**74**	**93.9**	**-19.9**
1 987.6	**53.1**	**27.9**	**2**	**29.9**	**83**	**93.9**	**-10.9**



10.2.4 Spurious emissions measurement.

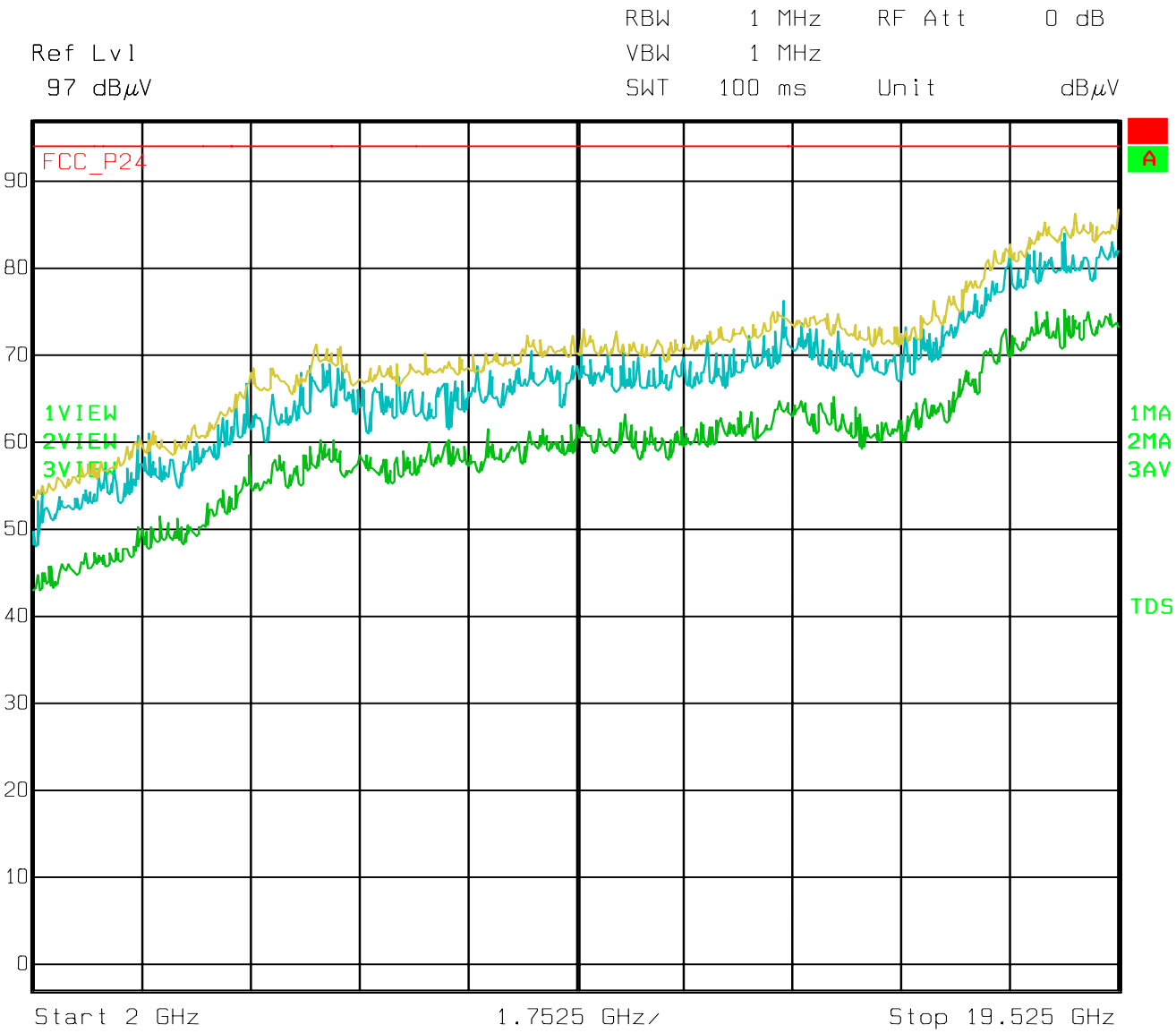
No spurious emission found which level upper to noise level in 1 MHz bandwidth (harmonics transmitters' frequencies under noise level)

10.3 INTERPRETATION AND REMARKS:

The equipment complies with the §24.238 requirements

Spectrum of noise level from 1GHz to 20GHz including loss cable and antenna factors

Legend:
Yellow curve represents the peak measurement in max hold mode
Blue curve represents the peak measurement in sweeping mode
Green curve represents the average measurements



SANMINA-SCI

UMTS 1900 Outdoor iBTS: EMC test plan

Reference:	**PLN-T-030352-6G1**
Version:	**B**
Status:	**Approved**
Date:	**09/07/2003**

Product Name:	**UMTS 1900 Outdoor iBTS**
Frequency:	**UMTS-1900**
Discipline:	**EMC**

Author:	Marc CANCOUËT
Verified by:	Patrick GALOPIN
Approved by:	Christian CHANSARD

PUBLICATION HISTORY

VERSION	DATE	AUTHOR	MODIFICATION
A	06/06/2003	M. CANCOUËT	Creation of the document
B	09/07/2003	M.CANCOUET	Correction of the document

CONTENTS

1 INTRODUCTION

The purpose of this document is to present the plan for the EMC qualification of the UMTS 1900 Outdoor iBTS used for the US Market. The conformity with the test program presented below will be used to demonstrate the compliance of the UMTS 1900 Outdoor iBTS with the Electromagnetic Compatibility applicable standard.

For North America, applicable standard for EMC Base stations are the FCC part 15 Class B and the FCC Part 24.

This document applies to:

Product:	UMTS 1900 Outdoor iBTS
Manufacturer:	NORTEL NETWORKS
Frequencies:	1930 – 1990 MHz
Configuration:	STSR3D
Option:	PCM lightening protection kit External alarm module

2 RELATED DOCUMENTS

2.1 APPLICABLES DOCUMENTS

[A1]	47CFR Part 2	FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations - Frequency allocations and radio treaty matters; general rules and regulations - dated 10/1/01
[A2]	47 CFR Part 15	FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations - Radio frequency devices - dated 10/1/01
[A3]	47 CFR Part 24	FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations - Personal communications services - dated 10/1/01
[A4]	47 CFR Part 15 08/20/02	FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations – Radio frequency devices – dated 08/20/02

2.2 REFERENCE DOCUMENTS

[R1]	UMT/BTS/DD/0017	E-Mobility iBTS Platform / UMTS Product Specification
[R2]	UMT/COM/DD/001	UMTS Product Overview
[R3]	UMT/DCL/DD/002	IBTS Reference Manual
[R4]	UMT/BTS/DD/0110	IBTS UMTS Outdoor Modular Structure
[R5]	UMT/ICM/DD/001	IBTS Outdoor Site Specification – V01.02
[R6]	UMT/BTS/DD/091	Digital cabling requirements for Mark II outdoor BTS
[R7]	UMT/BTS/DD/092	Radio cabling requirements for Mark II outdoor BTS
[R8]	PLN-V-030355-6G1	1900 MHz UMTS PI Qualification Plan

3 REQUIREMENTS BEFORE EMC ASSESSMENT

3.1 HARDWARE TECHNICAL STATUS

Details on the technical status of the system will be available in the document, supplied by Nortel Networks during the commissioning & acceptance phase form for UMTS 1900 Outdoor iBTS.

The following table presents the hardware status of the Nortel Networks UMTS 1900 Outdoor iBTS during the qualification phase.

Modules Designation		***Supplier***
Outdoor precabled CABINET with Batteries	NTUM70AA	SANMINA
Digital shelf –48V/AV	NTUM20AA	NORTEL
Interco	NTUM60AA	NORTEL
CEM alpha	NTUM00AA	NORTEL
FBBC	NTUM01AA	NORTEL
RBBC	NTUM02AA	NORTEL
TRM	NTUM10AA	NORTEL
RTRX	NTUM11AA	NORTEL
DTRX	NTUM12AA	NORTEL
CCM module	NTGY25AA	NORTEL
AXE	NTGY26AA	NORTEL
BRIC	NTGY27AA	NORTEL
GPSAM	NTUM24AA	NORTEL
MCPA	NTUM30PA	POWERWAVE
DDM	NTUM42AA	FOREM
Rectifier Shelf	NTUM87AA	MITRA / CHEROKEE
Rectifier Control board SPCM	NTUM85AA	MITRA / CHEROKEE
Rectifier	NTUM86AA NTUM86AB	MITRA / CHEROKEE
Filtering Box Slipt phase	NTUM90BA	SANMINA
LPPCM	NTBY98BA	
EAM lightning protection	NTBY98AA	
TMA Kits	NTUM35AA	
PCM external cable 100 Ω	NTQG41HA	

iDACS	NTUM80AA	LIEBERT
Battery	NTUM92AA	HAWKER
User ICO	NTUM37AA	SANMINA
MCA	NTUM7200	SANMINA
AC Main	NTUM39AA	SANMINA

3.2 LIST OF KITS & CABLES

3.2.1 LIST OF KITS

In fact, protections modules are optional but can be used to protect the PCM links & the Alarms links. These modules are made only with passive components and then are not critical modules for the system.
Kits are the following :

Kits: PCM lightning protection (NTUM98BA)
EAM lightning protection (NTUM98AA)

The TMA Kit (NTUM35AA) as ancillary equipments already comply with FCC standard, and is under the responsibility of the OEM supplier.

3.3 LIST OF CABLES

The following ports of the UMTS 1900 Outdoor iBTS were available and connected :

- Iub port (telecom port) : cable referenced NTQG41HA 25 meters 100Ω. This cable has been looped in order to transmit TX signals on RX ones.
- Alarms externs ports: cable referenced NTUM41JA 25 meters. 1 cable has been looped and the other cable has been in open circuit.
- Radio port (signal port) : 6 RF cables RADIALL SHF9TD – DC-2GHz – Insertion loss < 5.5 dB at 2 GHz (15 meters). Attenuators and loads have also been used on RF links.
- DC port : Lab cable (about 10 meters).

3.4 SOFTWARE NEEDS FOR IBTS UMTS 1900 OUTDOOR IBTS

As the objective is to perform the FCC marking on the UMTS 1900 Outdoor iBTS STSR3D, we need to use performance criteria as defined in the EMC applicable standard for UMTS project.
Consequently, for emissions, we have to configure the equipment with the power amplifiers set at their maximum rated level, and looped back the Iub link in order to generate activity inside this cable.

If one of the above functionality is not available for the testing phase, we will not be able to perform the FCC marking based on the tests realized.

4 TEST PLAN SUMMARY

4.1 TESTS MATRIX FOR QUALIFICATION

The following table lists the tests to be done, the severity level to apply, the configuration to test and comment when necessary.

	Test case	Application	Standard	Test requirement	Performance criteria	Comment
	Emission tests					
1	Radiated emissions	Enclosure of iBTS Indoor	FCC Part 15 § 15.109	30MHz – 18 GHz	Class B	**This EMC test is realized with the normal configuration.**
2	Radiated emissions	Enclosure of iBTS Indoor	FCC Part 24 § 24.238	30 MHz – 20GHz	The spurious emissions must be attenuated by at least 43 + 10 Log(P) P = Transmitter rated Power in Watts	**This EMC test is realized with the normal configuration.**
3	Conducted emissions	AC Power	FCC Part 15	150 kHz – 30 MHz	Class B	**This EMC test is realized in Split phase AC Power**

4.2 TEST DESCRIPTION OF THE RADIATED EMISSION

Standard Coverage : FCC Part 15.109, FCC Part 24.238

Intend :

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonics and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of 2.989, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open filed measurements (e.g., a broadcast transmitter installed in a building) measurements will be acceptable of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment :

- (1) Those in which the spurious emission are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz.
- (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
- (4) Other types of equipment as required, when deemed necessary by the Commission.

Test Procedure :

Radiated emission measurement procedures shall be performed as outlined in Section 8 of the ANSI C63.4 measurement standard. The iBTS will be tested to the applicable limits of the FCC rules. For radiated emission measurements the measurement distance between the center of the measurement antenna and the equipment under test shall be 3 meters (or less for frequencies above 1 GHz). In order to maximize all emission levels from the equipment, the emissions will be searched with the receive antenna at varied height levels. The equipment shall also be rotated a full 360 degrees on the turntable with the receive antenna at varying height levels (1 to 4 meters). Tests shall be made with the antenna positioned in both the horizontal and vertical planes of polarization. The iBTS shall be placed on the turntable as per ANSI C63.4 measurement procedures. Please see the Part 15 test plan as Part 24 radiated requirements will be tested in conjunction with the Part 15 testing. The spectrum shall be searched to identify emissions. A complete scan of the applicable spectrum shall be completed (up to 10^{th} harmonic of fundamental). The transmitter shall then be turned off, with the rest of the equipment powered on. A complete scan of the spectrum shall be done and referred to as “ambient” without the transmitter keyed on. Emissions emanating from the transmitter shall be identified from comparing these two scans. The identified emissions (from the transmitter) shall be measured and the levels recorded with the transmitter keyed on at full rated power output.

Important remark :

Substitution measurements must be made on all detected emissions given that the limits for the FCC are given in power measurements. If no emissions are detected, measurements should be made et the noise floor levels for each of the transmitter harmonic frequencies and a statement should be placed in the test report indicating that no emissions were detected.

The equipment was configured as shown in the next figure.

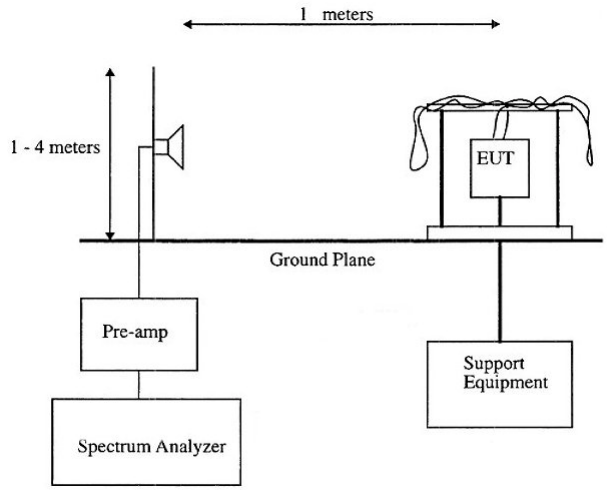


Figure 7 : Test configuration for Radiated Spurious emissions

Limits for radiated emissions from FCC Part 24.

Frequency range	**Minimum requirement (e.r.p.)/Reference Bandwidth**
30 MHz≤ f <20 GHz	The spurious emissions must be attenuated by at least 43 + 10 Log(P) P = Transmitter rated Power in Watts

Limits for radiated emissions (FCC Part 15 class B)

Frequency range MHz	Distance m	Electrics fields	
		µV/m	dBµV/m
30-88	3	100	40
88-216	3	150	43.5
216-960	3	200	46
>960	3	500	54

Measurements were made according to the procedures outline in ANSI C63.4
The emissions were investigated up to the tenth harmonic of the fundamental emission (20 GHz).
The measured level of the emissions was recorded and compared to the limit.
The reference level for spurious radiation was taken with reference to an ideal dipole antenna excited by the rated output power according to the following relationship :

$$E(V/m) = \frac{1}{R(m)} * \sqrt{30 * Pt * G}$$

Where,

E = Field Strength in Volts/meter,
R = Measurement distance in meters,
P_t = Transmitter Rated Power in Watts (30 Watts),
G = Gain of ideal Dipole (linear)

Therefore :

$$\mathbf{E(V/m) = \sqrt{30 * 30 * 1.64}}$$

E = 38.42 V/m = 151.69 dBµV/m
The spurious emissions must be attenuated by at least 43 + 10*Log(30) = 57.7 dB.
Therefore the field strength limit at 1 meters is :
E = 151.69 dBµV/m – 57.7 dB = 93.9 dBµV/m

Spectrum Analyzer setting during measurements shall be as following :

Receiver Setting	**Pre-Scan (to identify spurious emissions from EUT)**	**Final Measurements**
Detector Type	Peak	Quasi-Peak (CISPR)
Mode	Max Hold	Not Applicable
Bandwidth	100 kHz or 1 MHz (for > 1GHz)	120 kHz*
Amplitude Range	60 dB	20 dB
Measurement Time	Not Applicable	> 1s
Observation Time	Not Applicable	> 15s
Step size	Continuous sweep	Not Applicable
Sweep Time	Coupled	Not Applicable
Measuring Distance	3m for 30 MHz - 1GHz 1m for 1GHz - 20GHz	10m for 30 MHz - 1GHz 1m for 1GHz - 20GHz

Pass / Fail criteria :

- For 30 MHz to 1 GHz :
  Measurement distance : **10 m**
  Limit : [30 MHz-88 MHz] **30 dBµV/m**
  [88 MHz-216 MHz] **33.5 dBµV/m**
  [216 MHz-960 MHz] **36 dBµV/m**
  Above 960 MHz **43.5 dBµV/m**

- For 1 GHz to 20 GHz :
  Measurement distance : 1 m
  Limit : **93.9 dBµV/m**

Limits for radiated emissions from FCC Part 24.

Frequency range	**Minimum requirement (e.r.p.)/Reference Bandwidth**
30 MHz≤ f <20 GHz	The spurious emissions must be attenuated by at least 43 + 10 Log(P) P = Transmitter rated Power in Watts

Limits for radiated emissions (FCC Part 15 class B)

Frequency range MHz	Distance m	Electrics fields	
		µV/m	dBµV/m
30-88	3	100	40
88-216	3	150	43.5
216-960	3	200	46
>960	3	500	54

4.2.1.1 CONDUCTED EMISSIONS

Limits for conducted emissions (FCC Part 15 class B)

Frequency range	**Quasi-peak**	**Average**
> 0,15-0,5 MHz	66 - 56 dBµV	56 - 46 dBµV
> 0.5- 5 MHz	56 dBµV	46 dBµV
> 5-30 MHz	60 dBµV	50 dBµV
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

4.3 IBTS EMISSION TESTS CONFIGURATIONS

In agreement with the Nortel requirements specification [R1], EMC tests will be carried out for North America according to the standard FCC part 15 Class B.
The iBTS will be configured with the maximum hardware activation in order to simulate the worst case. The hardware configuration will then be equivalent to a STSR3D.
We will have the following number of modules:
- 6 CEM
- 3 TRM
- 2 CCM
- 1 GPSAM
- 6 MCPA
- 3 DDM

For a functional point of view, the test configuration shall be as close to the normal intended use and the base station shall transmit with the maximum power declared by Nortel with all the transmitters active. So the 6 MCPA have to transmit a UMTS radio signal at the maximum power for this configuration (30W). The iBTS UMTS Indoor 2 will be configured to transmit a radio signal corresponding to test model 2 (according to the 3 GPP standard) on all the MCPA. One carrier per MCPA is expected.
Following the software, we can activate the RF links as follow:
- TRM 2 output on PA 1 and 6 transmitting at 1932.4 MHz and 44.7dBm
- TRM 3 output on PA 2 and 3 transmitting at 1960 MHz and 44.7dBm
- TRM 9 output on PA 4 and 5 transmitting at 1987.6 MHz and 44.7dBm

In the same time, some data are looped back on the Iub link (external cable with TX and RX looped back together).

All the input/output ports will be connected to representative cables and load. The nominal external cables shall be supplied to Sanmina EMC team before the tests.

Internal protection module is optional but can be used to protect the Alarm links. This module is made only with passive components and then are not critical modules for the system. Nevertheless, this optional module will be used in the system for the emissions tests.

External protection module is optional but can be used to protect the PCM links. This module is made only with passive components and then are not critical modules for the system. Nevertheless, this optional module will be used in the system for the emission tests.

5 CONCLUSION

The tests presented in this document, if compliant with the EMC standard, will allow determining the compliance of the UMTS 1900 Outdoor iBTS with the FCC standards.

6 ABBREVIATIONS AND DEFINITIONS

6.1 ABBREVIATIONS

The following abbreviations are relevant to this document.

Abbreviation	Explanation
3GPP	Third Generation Partnership Project
3-ϕ	Three Phase
A	Ampere
AC	Alternating Current
AMN	Artificial Mains Network
ATM	Asynchronous Transfer Mode
BIP	Breaker Interface Panel
BLER	Block Error Ratio
BS	Base Station
BTS	Base station Transceiver System
CB	Circuit Breaker
CCM	Core Control Module
CE	Compliance Europe
CEM	Channel Element Module
CPICH	Common Pilot Channel
CPC	Common Product Code
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
dB	Decibel
dBm	Power unit (in Decibels) referenced to 1 mW
dBµV	Voltage unit (in Decibels) referenced to 1 µV
dBµV/m	Field Strength unit (in Decibels) referenced to 1 µV/m.
DC	Direct Current
DDM	Dual Duplexer Module
DPCH	Dedicated Physical Channel
EFT	Electrical Fast Transients
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Norms
ESD	Electrostatic Discharge
EUT	Equipment Under Test
f	Frequency
fc	Chip frequency in IS-95 standard. fc = 1.2288MHz
FCC	Federal Communications Commission
FDD	Frequency Division Duplexing
GHz	Gigahertz
GPS	Global Positioning System
GPSAM	Global Positioning System Alarm Module
HSSL	High Speed Serial Links
HW	Hardware (also H/W)
Hz	Hertz
iaw	In Accordance With

iBTS	Internet Base station Transceiver System
IEC	International Electrotechnical Commission
I/O	Input/Output
ITU	International Telecommunications Union
kHz	Kilohertz
kV	Kilovolt
LISN	Line Impedance Stabilization Network
m	Meter
MCPA	Multichannel Power Amplifier (also PA).
MHz	Megahertz
mm	Millimeter
mW	Milliwatt
N/A	Not Applicable
OEM	Original Equipment Manufacturer
PA	Power Amplifier
PCB	Printed Circuit Board
PCCPCH	Primary Common Control Physical Channel
PEC	Procurement Engineering Code
PFM	Power Filter Module
PI	Product Integrity
PICH	Page Indication Channel
PP and G	Power Protection and Ground
RF	Radio Frequency
R&TTE	Radio and Telecommunications Equipment
SF	Spreading Factor
STSR3D	Sector Transmit Sector Receive
TBT	Test Bench Tools
TDD	Time Division Duplexing
TMA	Tower Masthead Antenna
TRM	Transmit Receive Module
ULC	Unlimited Liability Corporation
UMTS	Universal Mobile Telecommunications System
µV	Microvolts
V	Volts
VAC	Volts AC
VDC	Volts DC
W	Watt

6.2 DEFINITIONS

The following are definitions of terms used throughout this test plan.

Ancillary Equipment - Equipment (apparatus), used in connection with a receiver, transmitter or transceiver is considered as an ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction with a receiver, transmitter or transceiver to provide additional operational and/or control features to the radio equipment, (e.g. to extend control to another position or location); and
- the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver, transmitter or transceiver; and
- the receiver, transmitter or transceiver to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

Base Station Equipment - Radio and/or ancillary equipment intended for operation at a fixed location and powered directly or indirectly (e.g. via an AC/DC converter or power supply) by AC mains network, or an extended local DC mains network.

BLER - BLER is block error ratio. The BLER calculation shall be based on evaluating the CRC on each transport block.

Continuous phenomena (continuous disturbance) **-** Electromagnetic disturbance, the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects (IEC 60050-161).

Radio communications equipment **-** Telecommunications equipment , which includes one or more transmitters and/or receivers and/or parts thereof for use in a fixed, mobile or portable application. It can be operated with ancillary equipment but if so, is not dependent on it for basic functionality.

Port **-** A particular interface, of the specified equipment (apparatus), with the electromagnetic environment. For example, any connection point on equipment intended for connection of cables to or from that equipment is considered as a port (see Figure 2-1).

Signal and control **-** Port which carries information or control signals, excluding antenna ports.

Spurious Emission – Emissions on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of band emissions.

Effective Radiated Power (ERP) – The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction.

Equivalent Isotropically Radiated Power (e.i.r.p.) – The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

Mean power (of a radio transmitter) – The average power supplied to the antenna transmission line by a transmitter during an interval of tile sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions.

Telecommunication port **-** Ports, which are intended to be connected to telecommunication networks (e.g. public switched telecommunication networks, integrated services digital networks), local area networks (e.g. Ethernet, Token Ring) and similar networks.

Transient phenomena **-** Pertaining to or designating a phenomena or a quantity, which varies between two consecutive steady states during a time interval short, compared with the time-scale of interest (IEC 60050-161).

fc -Chip frequency in IS-95 standard. fc = 1.2288MHz

Node B - A logical node responsible for radio transmission/reception in one or more cells to/from the User Equipment.
Iub - Interface between a Node B and an RNC.

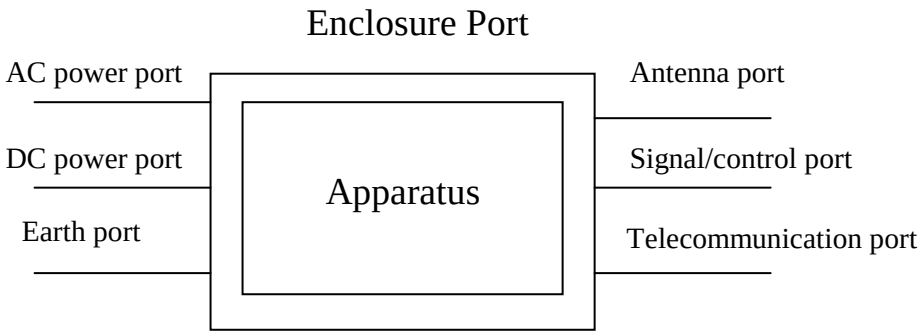


Figure 1: Examples of Ports.

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