GSM 1900

NORTEL NETWORKS

AB6OUDS8000 : FCC Part 24 Class II Permissive Change Application : S8000 Indoor BTS

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Abstract / Comments :

The document presents the FCC Part 24 regulatory assessment achieved in order to introduce the S8000 Indoor BTS GSM 1900 variant into AB6OUDS8000 filing.

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DOCUMENT AMENDMENTS

VERSION	DATE	COMMENTS	AUTHOR
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GSM 1900

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1. INTRODUCTION

1.1. OBJECT

This document present the FCC regulatory assessment realized in order to introduce the S8000 Indoor GSM 1900 BTS variant into AB6OUDS8000 filing.

This modification has been evaluated, in agreement with FCC, to be a class II permissive change to the original FCC Part 24 Type Accepted equipment, as described in FCC Part 2 rules:

2.1001 Changes in type accepted equipment.

(a) Equipment of the same type is defined for purposes of type acceptance as being equipment which is electrically and mechanically interchangeable and in addition will have the same basic tube or semiconductor lineup, frequency multiplication, basic frequency determining and stabilizing circuitry, basic modulator circuit and maximum power rating. Variations in electrical and mechanical construction, other than the items indicated above are permitted, provided the variation or change is made in compliance with the requirements of paragraphs (b), (c) and (d) of this section.

(b) Two classes of permissive changes may be made in type accepted equipment without requiring a new application for and grant of type acceptance.

(1) A Class I permissive change includes those modifications in the equipment which do not change the equipment characteristics beyond the rated limits established by the manufacturer and accepted by the Commission when type acceptance is granted, and which do not change the type of equipment as defined in paragraph (a) of this section. No filing with the Commission is required for a Class I permissive change.

(2) A Class II permissive change includes those modifications which bring the performance of the equipment outside the manufacturer's rated limits as originally filed but not below the minimum requirements of the applicable rules, and do not change the type of equipment as defined in paragraph (a) of this section. When a Class II permissive change is made by the grantee, he shall supply the Commission with complete information and results of tests of the characteristics affected by such change. The modified equipment shall not be marketed under the existing grant of type acceptance prior to acknowledgment by the Commission that the change is acceptable.

1.2. SCOPE

This document applies to the S8000 Indoor BTS GSM 1900.

2. RELATED DOCUMENTS

2.1. APPLICABLE DOCUMENTS

[A1]	CFR 47 - Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
[A2]	CFR 47 - Part 24	PERSONAL COMMUNICATIONS SERVICES

2.2. REFERENCE DOCUMENTS

[R1]	AB6OUDS8000	S8000 Outdoor GSM 1900 FCC Part 24 Type Acceptance
[R2]	PCS/BTS/DJD/0723	S8000 Indoor : FCC Part 24 Frequency Stability Test Report
[R3]	Bull 560-215-01/e	EMI measurement about standard CFR 47 part 15 class B and part 24

3. ABBREVIATIONS & DEFINITIONS

3.1. ABBREVIATIONS

DRX	Driver Receiver Unit
BCF	Base Common Function
BTS	Base Transceiving Station
GSM	Global System for Mobile Communications
PA	Power Amplifier
LNA	Low Noise Amplifier
OMC	Operation and Maintenance Center
TCU	Trans-Coding Unit
MSC	Mobile Switching Center
RF	Radio Frequency

3.2. DEFINITIONS

None.

4. ONGOING COMPLIANCE

As part of the Nortel Engineering Change Process, the Product Integrity group reviews all product changes to the S8000 BTS System. These reviews include an assessment of the impact that the changes or additions will have to the ongoing EMC/Radio Compliance of the System. When required, Analysis and Testing are performed to ensure continued compliance of the System.

Below is a list of the type of changes which are flagged during the reviews of product changes:

- Device changes which impact the clock speed or rise time
- Routing changes which could affect the emission and/or immunity profile for a circuit pack
- Changes to Power Supplies (input/output filtering, switching frequency, etc.)
- Addition of new circuit pack (electronic sub-assembly) to the S8000 BTS system (potential change in emission and/or immunity profile)
- Re-configuration of existing S8000 BTS hardware (variants) which change the emission profile (additional units, new combinations of units, etc.)
- Changes to the physical design which could impact Radio and/or EMC performances
- Addition of new sub-systems (variants) to the S8000 BTS system

Where analysis of changes to the S8000 BTS system indicates that verification testing is required to confirm continued compliance, the details of the changes to the system, test configuration and rationale, test results, and conclusions are included in this document for review and approval by the FCC, when required.

The BTS software is released in a controlled batch release format. For each of these releases, there may or may not be hardware content. New features are introduced at these structured release dates.

New features can be both hardware and software, or just one of the two. For all releases with hardware content, the ongoing compliance process outlined in this section is applied. For releases with only software content, no radio, engineering, or testing is required.

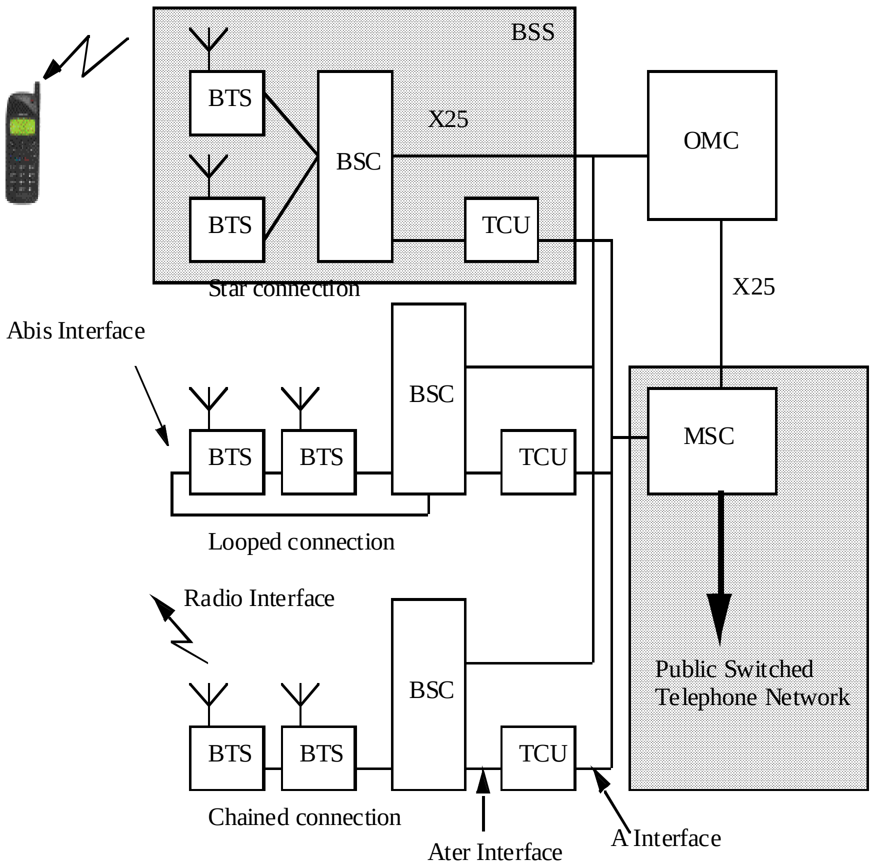
The architecture of the BTS Family of Products is such that the communication links are defined by the hardware (e.g. the ABIS link remains at the same data bit rate regardless of the actual data being transported). As such, the changes to software features which are not accompanied by hardware upgrades do not have any impact on the radio performances of the BTS Family of Products.

During testing, care is taken to ensure “worst case” system operational states are addressed. This ensures that all applications available on the BTS Family Hardware have been evaluated. Until there are updates to the hardware, no further system testing is required.

5. DESCRIPTION OF APPARATUS

5.1. BTS SYSTEM

The Base Transceiver Station (BTS) provides the interface between the fixed network and the mobile stations which is a radio interface.
The radio interface carries signaling and speech/data channels using digitized and encoded signals modulated in GMSK in GSM 1900 MHz band for North American products.
Communication with the fixed network are enabled across a wire interface called the Abis interface. It connects the BTS to its Base Station Controller (BSC). The transmission of signaling, speech, and data channels is carried out on PCM link (also called ABIS interface).
The BTS configures its equipment, establishes, maintains and clears calls to and from mobile stations as directed by the Base Station Controller (BSC). The BTS organizes and manages radio-electric resources, supervises its own equipment and conducts stand-alone defense actions as and when required.



5.2. RF MANAGEMENT

Two frequency bands are allocated to the system as follows:

- downlink or “base to mobile” (TX part),
- uplink or “mobile to base” (RX part).

Both RX and TX bands are frequency divided into 200 kHz channels. Each channel is identified by an Absolute Radio Frequency Channel Number (ARFCN).

The first and the last channel on the edge of the bandwidth are not used for actual RF transmissions, and may be used for testing purposes.

All RF channels are time multiplexed according to the system fundamental TDMA frame, composed of up to eight time slots.

Each time slot is occupied by an RF burst. During the RF burst, the RF carrier may be modulated at a bit rate of 270 kb/s, using GMSK (Gaussian Minimum Shift Keying, with BT = 0.3) modulation.

In order to overcome propagation problems, the system uses slow frequency hopping techniques. The carrier frequency of each transmitter remains constant during each burst, and jumps randomly to any RF channel (over the full RF bandwidth) before transmitting the next burst.

The RF power generated by the transmitters is not constant: the peak power (defined as the r.m.s. power during the burst, excluding the leading and trailing edges) may be adjusted by the network operator for cell dimensioning and frequency reuse purpose.

In addition, the peak power may vary from one burst to the next one by 30 dB depending of the distance between the Base Transceiver Station and the mobiles.

The system may use voice activity detection (V.A.D.) and discontinuous transmission techniques (D.T.X.).

It is consequently impossible to predict, at each transmitter output, if a time slot will be actually used to transmit an RF burst, at which level, and how many carrier.

5.3. S8000 INDOOR BTS SYSTEM

The S8000 Indoor BTS System is subdivided into six major areas:

- Base Common Function (BCF) - This block is made of digital packs and provides management of the system as well as connection to the network.
- Radio Modules (DRX) - The DRX includes the whole set of functions necessary to handle a full TDMA frame including RF reception with diversity and RF transmission at low level.
- Power Amplifiers (PA) - The necessary amplification for transmission is achieved by a separate Power Amplifier.
- RF Combiner modules - They include up to four different modules: VSWR-meter, Duplexer, Low Noise Amplifier/Splitter and Hybrid combiner.
- Power Supplies - Provides energy to the system (made of DC to DC converters).
- A ventilation unit shelf.

The BCF block is set up only in the main cabinet and comprises :

- Up to 3 CPCMI boards
- Up to 2 CMCF boards
- a specific RECAL in charge of alarms collecting.

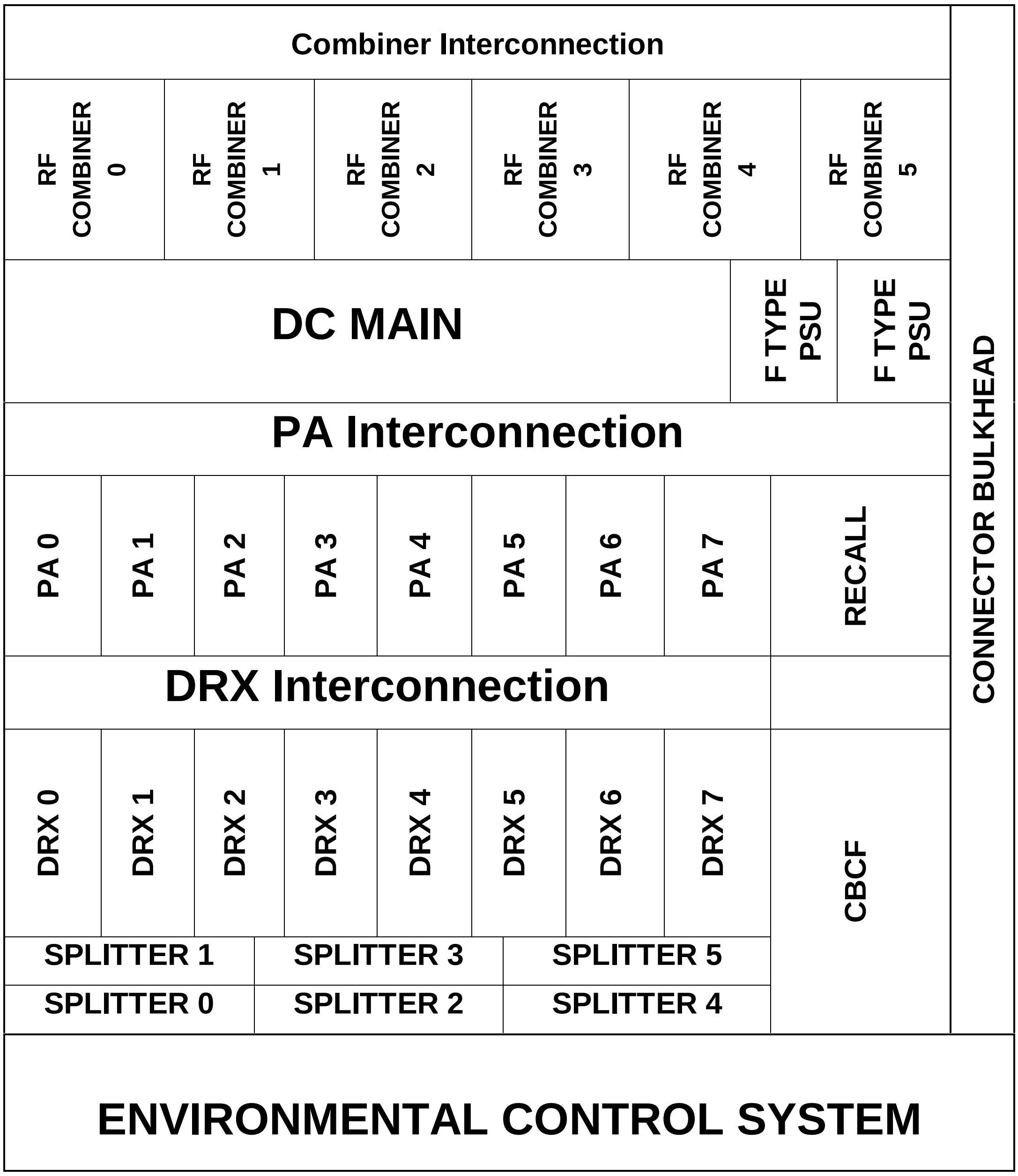
The radio block comprises:

- DRX entities. Each DRX module is composed of:
  a) one radio board offering slow frequency hopping capability, static and dynamic power controls, diversity reception.
  b) one logic board offering channel (de)coding, (de)ciphering and management of the DRX.
  c) two power supplies which convert 48V into +5V, +12V, -12V and +24V.
- Power Amplifier entities, boosting the level of the GMSK modulated pulse, generated by the DRX, up to the RF power level necessary to the transmission.
- One transmission coupling device which concentrates the signals arriving from the transmitters and/or one duplexer module providing transmit and receive band pass filtering, and connected to the transmission/reception antenna port.
- One RX-splitter, composed of one or more splitters fitted together in the same container together with a Low Noise Amplifier (LNA).

A cell can be divided in up to three different sectors. Thus, inside a cabinet, there may be several sectors and several radio channels per sector.

The S8000 Indoor BTS uses exactly the same modules as the S8000 Outdoor BTS today listed in AB6OUDS8000 filing.

The diagram below shows the overall layout of components inside the S8000 Indoor BTS.



6. DESCRIPTION OF APPLICATION

This application aims at introducing the Indoor packaging variant inside the AB6OUDS8000 today only covering the Outdoor packaging variant of Nortel S8000 product family.

The S8000 Indoor BTS uses exactly the same modules as the S8000 Outdoor BTS and performs exactly the same functionality. S8000 Indoor and Outdoor only differ by physical characteristics, energy system (48 VDC vs 220 VAC) and environmental capabilities.

As aforementioned, radio modules are identical between the two variants. Therefore, S8000 Outdoor radio test results are applicable to S8000 Indoor and only the tests involving packaging influence have to be conducted :

- Frequency stability
- Radiated emissions
- RF hazards

7. CONCLUSION

As demonstrated in Exhibit 1, the S8000 Indoor BTS complies with FCC Part 24 requirements.

8. EXHIBIT 1 : TESTS REPORT

8.1. INTRODUCTION

The following information is submitted for update of the type acceptance of a Broadband PCS Base Station for Northern Telecom Inc. in accordance with FCC Part 24, Subpart E and Part 2, Subpart J of the FCC Rules and Regulations. The measurement procedures were in accordance with the requirements of Part 2.999.

8.2. MEASUREMENT RESULTS SUMMARY

Table 1 is a summary of the measurement results for this update.

Table 1 : Measurement Results Summary

FCC Measurement Specification	FCC Limit Specification	Description	Result
2.993, 2.997	24.328	Field Strength of Spurious Radiation	Complies
2.995	24.235	Frequency Stability	Complies
24.51 (d)	24.51 (d)	RF Hazards	Complies

8.3. MEASUREMENT RESULTS

The following sections contain the measurement results.

8.4. 2.993 FIELD STRENGHT OF SPURIOUS RADIATION

8.4.1. FCC REQUIREMENTS

8.4.1.1. FCC Part 24.238

(a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB.

8.4.1.2. FCC Part 2.993

(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 harmonic and other spurious emission.

8.4.2. TEST RESULTS

Measurement is done with transmitters on 1930.2 MHz and 1989.8 MHz.

Table 2 shows the results for radiated spurious emissions measurements.

Table 2 : Test results for spurious emissions

Frequency (MHz)	Antenna Polarization	Measured Level (dBµV)	Correction Factor (dB)	Corrected Level (dBµv/m)	Limit (dBµV/m) @ 1 m
1930.2	Vertical	92.5	27.9	120.4	Fundamental frequency
1979.6	Vertical	72.8	27.9	100.7	Fundamental frequency

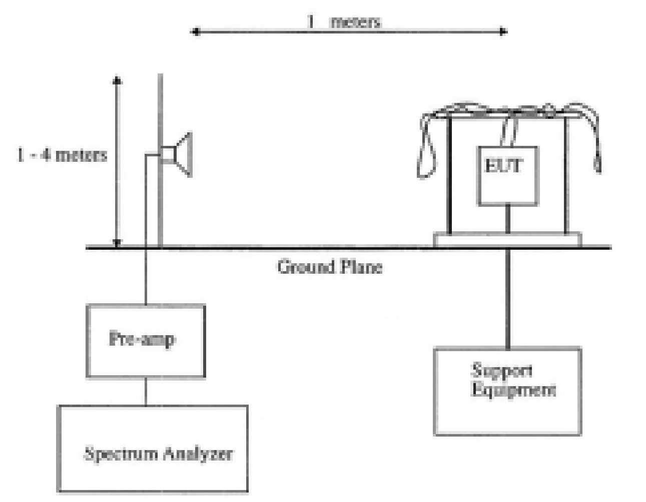
The field strength is calculate by adding the correction factor to the measured level to obtain the corrected level. A sample calculation is as follows :

Correction Factor$_{(dB)}$ = Cable Losses$_{(dB)}$ + Antenna Factor$_{(dB)}$ - pre-amplifier gain$_{(dB)}$
Corrected Level$_{(dB\mu V/m)}$ = Measured Level$_{(dB\mu V/m)}$ + Correction Factor$_{(dB)}$

No spurious emissions were found with a level upper to noise level in 100 kHz bandwidth (17 dBµV) from 1 GHz to 20 GHz.

8.4.3. TEST PROCEDURE

The equipment was configured as shown in figure below.



The BTS was configured to transmit at maximum power (static level 0).
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 :

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

Where,

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

Therefore :

$$E\left(\frac{V}{M}\right)=\frac{\sqrt{30*30*1.64}}{3}$$

E = 12.8 V/m = 142.1 dBµV/m
The spurious emissions must be attenuated by at least 43 + 10*Log(30) = 57.7 dB.
Therefore the field strength limit is :
E = 142.1 dBµV/m - 57.7 dB = 84.4 dBµV/m

8.5. 2.995 FREQUENCY STABILITY

8.5.1. FCC REQUIREMENTS : PART 24.235

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

8.5.2. TEST RESULTS

Table 3 shows the results for Frequency Stability.

It should be noted that instead of having the supply voltage vary in the range 85 - 115 % of nominal voltage, it varied in the range -40 to -60 V (nominal -48 V) which is the broader.

Table 3 : Test results for Frequency Stability

Temperature (°C)	Keyed on time (min)	Carrier Frequency Deviation (Hz)		
		Highest Supply Voltage -40 VDC	Supply Voltage (Nominal) -48 VDC	Lowest Supply Voltage -60 VDC
+50 °C	0	-13.6	10.2	15.3
+50 °C	1	-19.4	22.1	18.7
+50 °C	2	-16.4	19.1	20.4
+50 °C	3	19.2	-20.2	-20.6
+50 °C	4	17.8	-15.4	-16.8
+50 °C	5	-23.9	15.4	-20.0
+50 °C	6	-21.8	-17.9	21.9
+50 °C	7	19.4	-18.3	17.0
+50 °C	8	18.6	-18.0	17.5
+50 °C	9	-17.6	16.5	18.1
+50 °C	10	-19.4	20.4	16.2
+40 °C	0	-23.6	24.5	28.2
+40 °C	1	25.8	22.7	-16.9
+40 °C	2	-14.5	24.8	-15.3
+40 °C	3	-15.7	-15.3	19.2
+40 °C	4	-15.2	-12.7	24.2
+40 °C	5	-15.6	26.8	22.4
+40 °C	6	29.1	22.8	-12.0
+40 °C	7	24.5	23.2	-16.2
+40 °C	8	-12.5	12.7	-13.1
+40 °C	9	-13.8	-16.9	-15.3
+40 °C	10	-16.4	-18.6	21.3

Temperature (°C)	Keyed on time (min)	Carrier Frequency Deviation (Hz)		
		Highest Supply Voltage -40 VDC	Supply Voltage (Nominal) -48 VDC	Lowest Supply Voltage -60 VDC
+30 °C	0	-21.2	-18.9	18.5
+30 °C	1	16.0	14.3	12.3
+30 °C	2	12.9	-20.7	11.1
+30 °C	3	-23.9	-25.6	-28.6
+30 °C	4	-27.2	-26.0	-20.5
+30 °C	5	-23.5	15.2	14.8
+30 °C	6	11.2	13.4	13.9
+30 °C	7	11.7	19.0	15.2
+30 °C	8	-21.2	-25.0	-22.9
+30 °C	9	11.6	-22.1	-26.3
+30 °C	10	12.0	-24.0	13.2
+20 °C	0	-20.4	-21.7	24.8
+20 °C	1	18.7	29.6	25.8
+20 °C	2	15.3	33.7	-13.2
+20 °C	3	-26.4	27.7	14.9
+20 °C	4	32.4	18.3	18.8
+20 °C	5	11.4	-16.2	22.3
+20 °C	6	25.6	-14.3	33.3
+20 °C	7	-12.8	23.2	-13.5
+20 °C	8	15.6	27.5	14.0
+20 °C	9	19.2	-15.8	-17.1
+20 °C	10	-17.3	12.3	33.1
+10 °C	0	-11.6	-13.9	-22.4
+10 °C	1	15.2	24.6	27.5
+10 °C	2	23.8	23.1	9.7
+10 °C	3	25.2	26.4	27.3
+10 °C	4	21.5	21.1	27.1
+10 °C	5	25.5	22.9	23.9
+10 °C	6	-14.3	-12.3	17.8
+10 °C	7	-13.6	-11.4	-15.9
+10 °C	8	-12.5	12.0	26.0
+10 °C	9	24.5	11.2	23.3
+10 °C	10	19.4	-15.4	16.3

Temperature (°C)	Keyed on time (min)	Carrier Frequency Deviation (Hz)		
		Highest Supply Voltage -40 VDC	Supply Voltage (Nominal) -48 VDC	Lowest Supply Voltage -60 VDC
0 °C	0	23.1	-26.1	-25.6
0 °C	1	16.3	19.7	27.6
0 °C	2	13.6	17.2	33.8
0 °C	3	15.2	16.5	32.2
0 °C	4	13.4	15.7	11.8
0 °C	5	16.3	10.4	15.5
0 °C	6	19.6	20.1	16.9
0 °C	7	14.6	12.5	17.5
0 °C	8	14.0	14.3	18.2
0 °C	9	17.6	18.2	21.0
0 °C	10	27.8	16.9	20.0
-10 °C	0	-29.9	26.7	27.1
-10 °C	1	21.1	22.5	-15.8
-10 °C	2	-19.7	21.4	-19.7
-10 °C	3	-19.0	-16.5	-24.6
-10 °C	4	-15.5	-14.9	-29.8
-10 °C	5	12.4	20.6	-23.6
-10 °C	6	20.3	21.1	-27.2
-10 °C	7	18.2	23.3	-26.4
-10 °C	8	22.2	20.5	-24.9
-10 °C	9	21.4	21.5	-43.2
-10 °C	10	20.4	24.1	-40.7
-20 °C	0	-31.2	-26.7	-28.6
-20 °C	1	26.7	26.1	27.2
-20 °C	2	13.4	30.4	24.7
-20 °C	3	14.1	23.3	27.3
-20 °C	4	28.6	13.4	28.8
-20 °C	5	26.1	29.4	23.3
-20 °C	6	25.8	16.0	-10.1
-20 °C	7	12.9	11.6	12.1
-20 °C	8	20.0	21.6	17.2
-20 °C	9	12.3	28.1	18.1
-20 °C	10	26.4	26.7	28.6

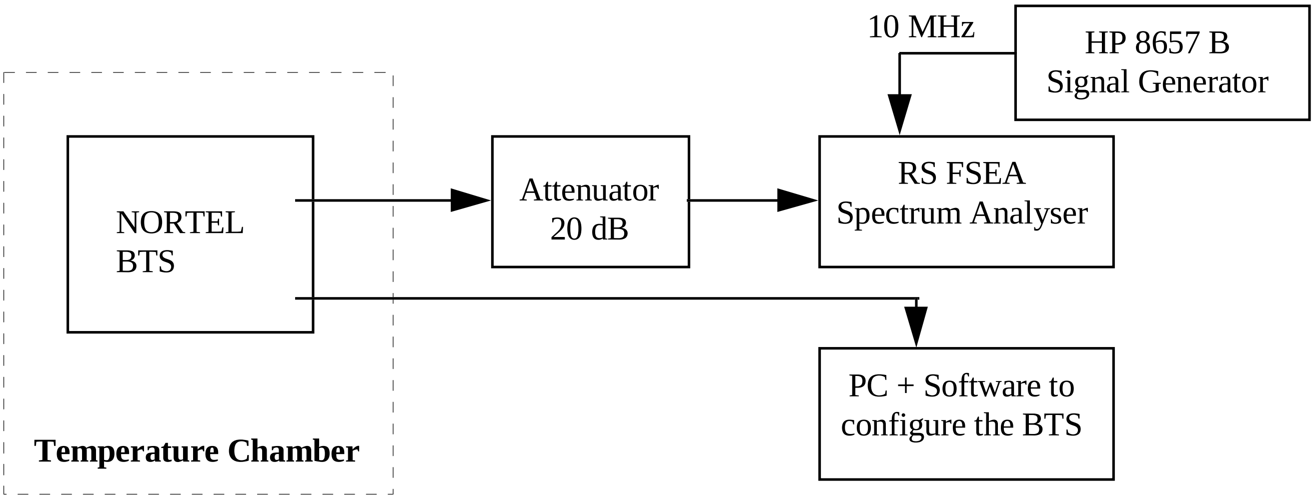
Temperature (°C)	Keyed on time (min)	Carrier Frequency Deviation (Hz)		
		Highest Supply Voltage -40 VDC	Supply Voltage (Nominal) -48 VDC	Lowest Supply Voltage -60 VDC
-30 °C	0	24.0	19.7	19.9
-30 °C	1	15.4	19.8	22.3
-30 °C	2	17.6	18.8	19.6
-30 °C	3	17.1	20.2	15.0
-30 °C	4	20.2	20.4	19.5
-30 °C	5	14.5	16.4	18.6
-30 °C	6	17.8	20.3	16.1
-30 °C	7	16.9	14.7	17.5
-30 °C	8	15.2	18.6	16.4
-30 °C	9	17.7	23.1	17.8
-30 °C	10	18.3	15.3	20.8

Notes :

- From +50°C to +20°C, all TRXs were transmitting full power on all time slots.
- From +10 °C to -30 °C, only TRX 1 was transmitting
- All measurements have been made on TRX 1.

The maximum reported frequency deviation is 43.2 Hz which is more than sufficient to ensure that the fundamental emission stays within the authorized frequency block.

8.5.3. TEST PROCEDURE



The BTS was configured to transmit at maximum power (static level 0). At each temperature, measurements were made with the primary supply voltage of the nominal value. At each of the above specified conditions, the maximum carrier frequency deviation was recorded from the time the transmitter was keyed-on for a period of ten minutes using a R&S FSEA spectrum analyzer.

8.6. NAME OF TEST : 24.51(D) RF HAZARDS

8.6.1. FCC REQUIREMENTS

8.6.1.1. FCC Part 24.51

(d) Applicants for type acceptance of transmitters that operate in these services must determine that the equipment complies with IEEE C95.1-1991, "IEEE Standards for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300.GHz" as measured using methods specified in IEEE C95.3-1991, "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave." The applicant for type acceptance is required to submit a statement affirming that the equipment complies with these standards as measured by an approved method and to maintain a record showing the basis for the statement of compliance with IEEE C.95.1-1991.

8.6.1.2. Limit

The maximum field strength limit was derived from the newly adopted NCPR recommended limits for maximum permissible exposure for uncontrolled environments of 1 mW/cm² as follows :

$$PowerDensity\left(\frac{W}{m^2}\right) = \frac{EField\left(\frac{V}{m}\right)^2}{\eta}$$

$$EField = \sqrt{PowerDensity\left(\frac{W}{m^2}\right) * \eta}$$

$$EField = \sqrt{10\left(\frac{W}{m^2}\right) * 377\Omega}$$

Therefore,
E Field = 61.4 V/m = 155.8 dBµV/m

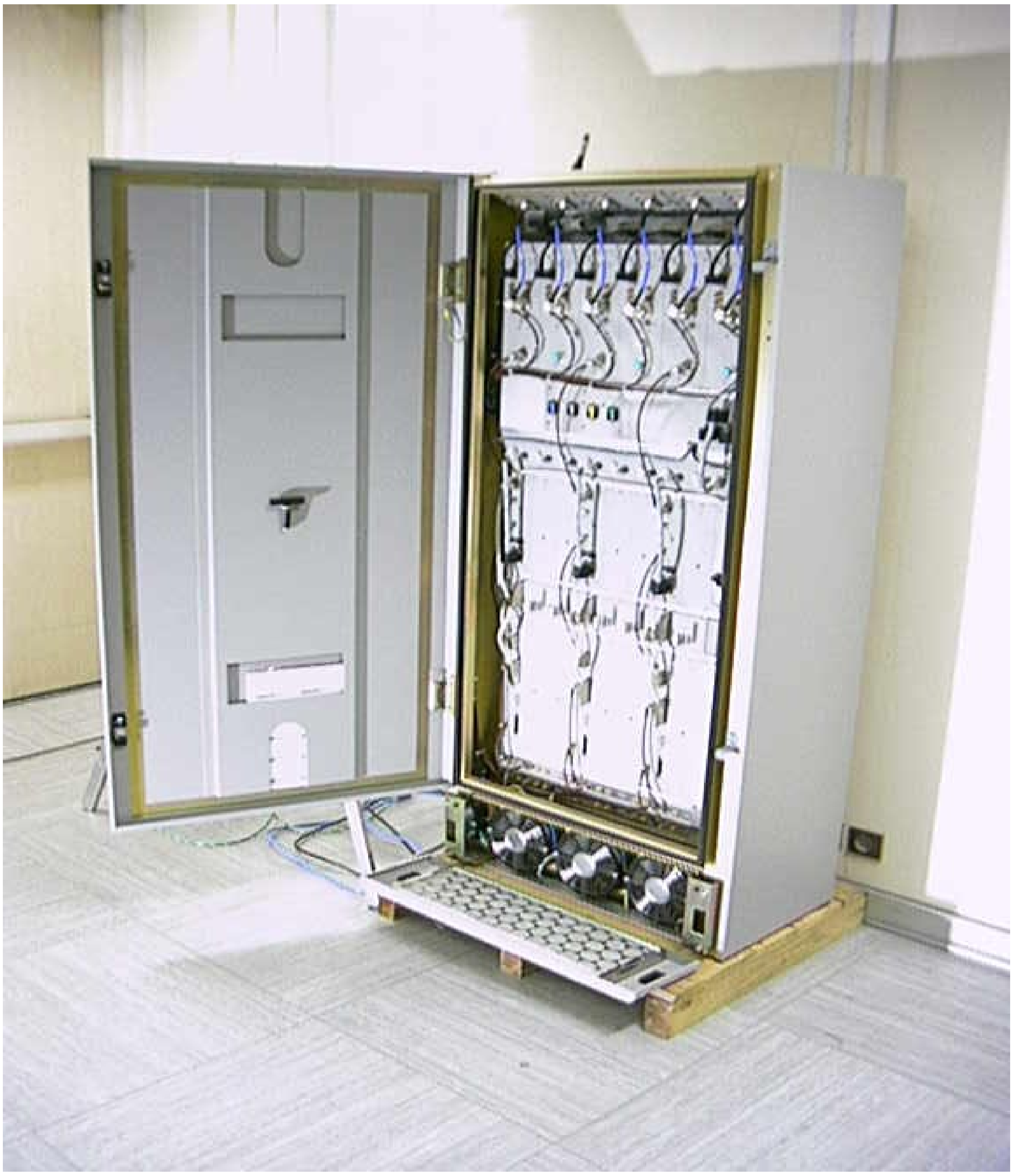
8.6.2. TEST RESULTS

The system is compatible with standard installation practices.
The base station antennas have safe distances of approach (Uncontrolled) similar to those of conventional cellular systems: within the antenna beams, of 1 to 5m. The exposure generated by the base station antennas at ground level are extremely low, ten of thousands of times lower than the limits specified in C95.1-1991.

9. EXHIBIT 2 : USER DOCUMENTATION

Document PE/COM/DD/0007 (39 pages).

10. EXHIBIT 3 : PHOTOGRAPHS



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