Westwinds Innovation Centre

Dual Voltage Global Positioning System Timing Module (GPSTM) OEM General Specification

Dataset Name: GSBW50AA
Document Status: **Approved**
Stream: 00 Issue: 05
Issue date: December 21, 2001
Security status: Nortel Networks Confidential
Author: Jeremy Hebert

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Revision History

Stream/Issue	Revision Date	Reason for Change	Author/ Department
00/01 Approved	October 13/00	Document approval and release with minor changes to sections 6 and 8.	Jeremy Hebert 2M56
00/1.1	February 2, 2001 through June 26, 2001	Corrected table 6, added connector designations to Figure 1. Removed transition from Man. Hold. to Recovery in Figure 6. Added requirement to section "5.1.14.4.8 Set Antenna Delay" to not impact BTS performance. Removed draft revisions from Revision History. Minor typographical corrections. Added full description of fault insertion testing (FIT) functionality to be included in the firmware (section 5.1.14.7). Added LED testing functionality (section 5.1.4). Submitted GS to vendor for review of FIT testing specifications.	Jeremy Hebert 2U43
00/1.2	June 27, 2001	Corrected Time Interval Query to indicate response in nanoseconds, not seconds (section 5.1.14.4.30). Added description of +/- 7µs offset requirement as part of 9.8304MHz frequency output specification. Moved diagnostic log information into a dedicated section, "5.1.14.1 Diagnostic Log"; added non-volatile log functionality to this section.	Jeremy Hebert 2U43
00/1.3	June 28, 2001	Added option of resetting the GPSTM to indicate the end of FIT session (Section 5.1.14.7).	Jeremy Hebert 2U43
00/1.4	July 5, 2001	Corrected NBSS release numbers from 10.1 to 11.x. Re-worded section 5.1.3.1.1 to correctly reflect redundant operation.	Jeremy Hebert 2U43
00/02	July 10, 2001	Document approval and release.	Jeremy Hebert 2U43
00/2.1	July 13, 2001	Corrected GPSTM product structure in Section 4.3. Added Leonard Selinger to Consultants List.	Jeremy Hebert 2U43
00/3.0	July 16, 2001	Approved document with limited review distribution to Len Selinger and Stuart Krahn only (only mechanical list in section 4.3 needed review).	Jeremy Hebert 2U43
00/ Draft 3.1	Sept 13, 2001	Added description of firmware changes to address PRN22 GPS failure (Section 5.1.14.6: GPSTM Error Detection). Updated Consultants list. Sent for review. Clarified "Commit" command, Section 5.1.14.4.49.	Jeremy Hebert 2U43

Stream/Issue	Revision Date	Reason for Change	Author/ Department
00 / Draft 3.2	Sept 18, 2001	Modified 5.1.14.6 to indicate “fall outside of specified operating range”.	Jeremy Hebert 2U43
00 / Draft 3.3	Sept 19, 2001	Changed 5.1.14.6 to clarify which HSR bits are affected. Updated references to ADGS50AA to ADBW50AA. Added definition of “PDOP”.	Jeremy Hebert 2U43
00 / Draft 3.4	Oct 11, 2001	Changed wording of spurious data sentence in Table 25, section 5.5.	Jeremy Hebert 2U43
00 / 04	Oct 12, 2001	Document approval and release to vendor.	Jeremy Hebert 2U43
00 / Draft 4.1	Oct 23, 2001	Corrected Table 5 (Section 5.1.3) to indicate that new LED strategy will be implemented not in 11.X but in a future unscheduled release. Corrected 5.1.14.4.53 (flash copy query description) to indicate that the command is not required to respond with %complete. Improved clarity of 9.8304 MHz Specification (section 5.1.9.1).	Jeremy Hebert 2U43
00 / 05	Dec 21, 2001	Released approved document.	Jeremy Hebert 2U43

Major revisions will be marked by a change bar on the left of the table.

Preface

This document describes the general specifications of the Dual Voltage (-48V or +24V) Global Positioning System Timing Module (GPSTM). The GPSTM will be designed to operate in both the -48V and +24V versions of the Nortel Networks CDMA Metrocell base station.

Any errors or omissions should be referred to the author so that these errors can be corrected in future issues of this document.

Table of Contents

Documentation Control **3**
Document Storage **3**
Authors **4**
Consultants **4**
Decision Makers **4**
Ratifiers **4**
Revision History **5**
Preface **7**
Table of Contents **8**
List of Figures **13**
List of Tables **14**
Related Documents **15**
Glossary **17**
1.0) Design Requirements 19
1.1) Scope 19
1.2) General Product Architecture 19
2.0) General Description 20
2.1) Principal Functions 20
2.2) Feature List 20
2.3) Backward Compatibility 20
2.4) Product Identification 21
3.0) Block Diagram and Partitioning 22
3.1) Block Diagram 22
3.2) Functional Block Descriptions 22
4.0) Mechanical Specifications 23
4.1) General 23
4.2) Construction and Design 23
4.3) Dimensions 23
4.4) Weight 23
4.5) Interface Specifications 23
4.6) Cooling 25
4.7) Surface Treatments 25
4.8) Product Marking 25
4.8.1) Product Identification Label--Rear Vendor Identification Label 26
4.8.2) Serial/PEC/Release (SPR) Label 27
4.8.3) Common Language Equipment Identifier (CLEI) Label 27
4.8.4) Regulatory Label 28
4.8.5) Warranty Void Label 28
4.8.6) Product Packaging Label 28
4.9) Grounding Strategy 29
4.10) Shielding Strategy and EMI Control 29
5.0) Electrical Specifications 31
5.1) General 31

5.1.1) Operating Conditions 31
5.1.2) Absolute Maximum Conditions 33
5.1.3) Modes of Operation 34
5.1.3.1) Functional Modes 34
5.1.3.1.1) Systems with Redundant GPSTMs 36
5.1.3.1.2) Power Up Mode 36
5.1.3.1.3) Over/Under Temperature Alarm Mode 37
5.1.3.1.4) Failed Mode 37
5.1.3.1.5) No Communication With CM Mode 37
5.1.3.1.6) In Service Mode 37
5.1.3.2) Operational Modes 38
5.1.3.2.1) Power Up Mode 39
5.1.3.2.2) Failed Mode 40
5.1.3.2.3) Locked Mode 40
5.1.3.2.4) Holdover Modes 41
5.1.3.2.4.1) Auto Holdover Mode 41
5.1.3.2.4.2) Manual Holdover Mode 42
5.1.3.2.5) Recovery Mode 42
5.1.3.2.6) Free-Run Mode 42
5.1.4) Testing LEDs 42
5.1.5) CDMA System I/O Connector Definition 43
5.1.6) User I/O Connector Definition 47
5.1.7) Clock_Edge_Sync Interface Definition 47
5.1.8) SYS_CLK Output (9.8304 MHz--CDMA System) 48
5.1.9) SYS_CLK Reference Output (9.8304 MHz--J5) 50
5.1.9.1) Spurious Outputs 50
5.1.10) 10 MHz Reference Output 52
5.1.11) Even_Second Output (CDMA System) 52
5.1.12) Even_Second Reference Output 54
5.1.13) Recovered E1 Clock Input 55
5.1.14) Serial Interface 56
5.1.14.1) Diagnostic Log 57
5.1.14.2) Physical Layer 58
5.1.14.3) Communication Protocol 59
5.1.14.4) Serial Interface Message Description 59
5.1.14.4.1) Time Code Query 64
5.1.14.4.2) Accumulated Leap Seconds Query 65
5.1.14.4.3) Time of Next Leap Second Correction Query 65
5.1.14.4.4) Preset GPSTM Command 65
5.1.14.4.5) GPSTM Identification Query 65
5.1.14.4.6) Set GPSTM Position 66
5.1.14.4.7) Get Receiver Position 66
5.1.14.4.8) Set Antenna Delay 66
5.1.14.4.9) Get Antenna Delay 66
5.1.14.4.10) GPSTM Survey Command 66
5.1.14.4.11) GPSTM Survey Query 66
5.1.14.4.12) Set Manual Holdover Mode 67

5.1.14.4.13) Set Manual Holdover Recovery 67
5.1.14.4.14) Holdover Duration Query 67
5.1.14.4.15) List of Satellites being Tracked 67
5.1.14.4.16) List of Predicted Satellites in View 67
5.1.14.4.17) Run Self Test Command 67
5.1.14.4.18) Oscillator Control Value Query 67
5.1.14.4.19) Holdover Reason Query 67
5.1.14.4.20) GREEN LED Command 67
5.1.14.4.21) GREEN LED Query 68
5.1.14.4.22) YELLOW LED Command 68
5.1.14.4.23) YELLOW LED Query 68
5.1.14.4.24) RED LED Command 68
5.1.14.4.25) RED LED Query 68
5.1.14.4.26) LOCK LED Query 68
5.1.14.4.27) HOLDOVER LED Query 68
5.1.14.4.28) Last Held Position Query 68
5.1.14.4.29) Immediate Synchronization Command 68
5.1.14.4.30) Time Interval Query 69
5.1.14.4.31) Receiver Language Command 69
5.1.14.4.32) Receiver Firmware Download 69
5.1.14.4.33) Erase FLASH Memory Command 69
5.1.14.4.34) Module Language Query 69
5.1.14.4.35) Frequency Figure of Merit Query 69
5.1.14.4.36) Initialization Assistance Command 69
5.1.14.4.37) Survey Progress Query 69
5.1.14.4.38) Clear Error Queue 70
5.1.14.4.39) Log Data Query 70
5.1.14.4.40) Clear Log Entries Command 70
5.1.14.4.41) Log Entries Query 70
5.1.14.4.42) Operation Status Register Query 70
5.1.14.4.43) Hardware Status Register Query 70
5.1.14.4.44) Lifetime Counter Query 70
5.1.14.4.45) Repeat Last Response Request 70
5.1.14.4.46) Antenna System Interface Query 70
5.1.14.4.47) Operational Mode Query 70
5.1.14.4.48) Switch Firmware Load Command 71
5.1.14.4.49) Commit Firmware Load Command 71
5.1.14.4.50) Firmware Load Query 71
5.1.14.4.51) Serial Port Initialization Command 71
5.1.14.4.52) Initiate FLASH Copy Command 71
5.1.14.4.53) FLASH Copy Status Query 71
5.1.14.5) Software Error Detection 71
5.1.14.6) GPSTM Error Detection 72
5.1.14.7) Fault Insertion (Simulating Errors) 75
5.1.14.8) Firmware Download 75
5.1.14.9) GPS Week Rollover/Year 2000 76
5.2) Input Power 76

5.2.1) Start-up/Turn-off 76
5.2.1.1) Supply Characteristics 77
5.2.1.2) In-rush Current 77
5.2.1.3) Input Overcurrent Protection 77
5.3) Antenna Interface 77
5.3.1) Antenna Unit 77
5.4) Front Panel LED Indicators 77
5.5) Other 79
6.0) Environmental Specifications 81
6.1) Temperature Range 81
6.2) Humidity Range 81
6.3) Altitude 81
6.4) Fungus Resistance 81
6.5) Shipping and Storage 81
6.5.1) Temperature and Thermal Shock 82
6.5.2) Humidity 82
6.5.3) Packaged Drop 82
6.5.4) Unpackaged Installer/Service Drop 82
6.5.5) Shock Frailty 82
6.5.6) Transportation Vibration 82
7.0) Electromagnetic Environment 83
7.1) Indirect Electrostatic Discharge Immunity 83
7.2) Direct Electrostatic Discharge Immunity 83
7.3) Electrical Fast Transient 83
7.4) Radiated Immunity 83
7.5) Conducted Immunity 83
7.6) Lightning Protection 83
8.0) Regulatory Requirements 85
8.1) General 85
8.2) Electromagnetic Interference 85
8.2.1) Radiated Emissions 85
8.2.2) Conducted Emissions 85
8.3) Product Safety 85
8.4) Materials Flammability 85
8.5) Regulatory Submission and Maintenance 86
9.0) Quality Assurance and Qualification 87
9.1) General 87
9.2) Vendor Supplied Data 87
9.3) Production Test Plan 87
9.4) Product Qualification Tests 87
9.4.1) Test Methodology to Verify Holdover Capability 87
9.4.1.1) Holdover Test 1 87
9.4.1.2) Holdover Test 2 88
9.4.1.3) Holdover Test 3 89
9.5) Acceptance Testing 90
9.6) Traceability 90
9.7) Reliability Monitor 91

9.8) Design Inspection 91
9.9) Workmanship Evaluation 91
10.0) Preparation For Delivery 92
10.1) Packaging 92
10.2) Operation Manual 92
10.3) Commissioning Tool 92
11.0) Product Changes 93
12.0) Reliability Assurance 94
12.1) Reliability 94
12.2) Eliminating Infant Mortality Failures 94
12.3) Statistical Product Monitoring 94
12.4) Field Performance Monitoring 94
12.5) Product Reliability Growth 94
12.6) Yield Improvement Program 95

List of Figures

Figure 1: GPSTM Block Diagram 22
Figure 2: Date Code Label Example Text 26
Figure 3: Regulatory Label 28
Figure 4: Warranty Void Label 28
Figure 5: GPSTM Functional Modes 36
Figure 6: GPSTM Operational Modes 39
Figure 7: SYS_CLK Low Voltage Differential Signalling Configuration 49
Figure 8: 9.8304MHz Phase Noise and Fixed Spurious Levels Specification 51
Figure 9: Even_Second Differential Low Voltage Differential Signalling Configuration 54
Figure 10: Recovered 2.048 MHz (E1) Interface Circuitry 56
Figure 11: Flow diagram of diagnostic log queue 58

List of Tables

Table 1: GPSTM Product Identification....21
Table 2: GPSTM Interface....25
Table 3: GPSTM Operating Conditions for -48V Supply....31
Table 4: GPSTM Operating Conditions for +24V Supply....32
Table 5: GPSTM Absolute Conditions....33
Table 6: GPSTM/BTS Software Compatibility Matrix....34
Table 7: LED Patterns of GPSTM Functional Modes....35
Table 8: LED Patterns of GPSTM Operational Modes....38
Table 9: CDMA System I/O Connector Definition (J2)....46
Table 10: CDMA System I/O Connector Physical Pinout (J2)....46
Table 11: User I/O Connector Definition (J3)....47
Table 12: SYS_CLK (9.8304 MHz) Output Requirements (CDMA SYSTEM)....49
Table 13: 9.8304 MHz Reference Output....50
Table 14: 9.8304 MHz Spurious Levels and Phase Noise Specifications....51
Table 15: 10 MHz Reference Output (J4)....52
Table 16: Even_Second Output Requirements (CDMA System)....53
Table 17: Even_Second Reference Output (J6)....55
Table 18: Recovered E1 Clock Specifications....55
Table 19: CDMA System Serial Interface Physical Requirements....58
Table 20: User Serial Interface Physical Requirements....59
Table 21: Serial Interface Message Description....64
Table 22: GPSTM Operation Status Register....73
Table 23: GPSTM Hardware Status Register....74
Table 24: Front Faceplate LED Indicators....78
Table 25: GPSTM, Other Requirements....79

Related Documents

The following documents, of the issue in effect on the date of purchase order, form part of this specification to the extent specified herein:

[1] Network Equipment - Building System, Generic Equipment Requirements, Bellcore GR-63-CORE, Issue 1, October 1995.

[2] Reliability Prediction Procedure for Electronic Equipment, Bellcore Technical Advisory TA-NWT-000332, Issue 5, September 1992.

[3] Generic Requirements for Electronic Equipment Cabinets, Bellcore Technical Advisory, GR-487-CORE, Issue 1, June 1996.

[4] Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunication Equipment, Bellcore, GR-1089-CORE, Issue 1, November 1994.

[5] General Requirements of OEM Material, NPS50561 General specification, Issue 3.

[6] FCC, Part 15 of Title 47, Code of Federal Regulations, Title 47 - Telecommunications, Part 15

[7] Electromagnetic Compatibility Requirements and Test Methods for Telecommunication Equipment and Systems, TAD 8465, Issue 1, April 1992.

[8] Nortel Networks Standard 9101.01, Product Safety Reference Data.

[9] Safety of Information Technology Equipment, UL 1950, Third Edition, CAN/CSA-C22.2 No. 950-95, Third Edition.

[10] Underwriter Laboratories (UL) Standard UL94.V1.

[11] ASTM D2863-77 Oxygen Index.

[12] Electromagnetic Compatibility for Electrical and Electronic Equipment, Part 5: Surge Immunity Requirements, IEC 801-5.

[13] CISPR Publication 22, First Edition 1985, Second impression 1991, International Special Committee on Radio Interference.

[14] EIA-TIA-422-B, 1993, Electrical Characteristics of Balanced Voltage Interface Circuitry

[15] Can/CSA-C22.2, No. 950-95, Safety of Information Technology Equipment, Including Electrical Business Equipment, A National Standard of Canada.

[16] Nortel Networks 1523.00, 1523.01, Design for Product Environment Conditions.

[17] Nortel Networks 1524, Test Methods for Product Environment Conditions.

[18] Nortel Networks 9009.01, BNR/NT Global Limits for System Electromagnetic Compatibility.

[19] Electromagnetic Compatibility For Industrial-Process Measurement and Control Equipment, IEC 801-2, Part 2: Electrostatic Discharge Requirements.

[20] Electromagnetic Compatibility For Industrial-Process Measurement and Control Equipment, IEC 801-4, Part 4: Electrical Fast Transient/Burst Requirements.

[21] Basic Environmental Testing Procedures, Tests A: Cold, IEC 68-2-1, fifth edition, 1990.

[22] Basic Environmental Testing Procedures, Tests B: Dry Heat, IEC 68-2-2, Second Impression, 1987.

[23] Basic Environmental Testing Procedures, Tests Ca: Damp Heat Steady State, IEC 68-2-3, Second Impression, 1985.

[24] Basic Environmental Testing Procedures, Tests M: Low Air Pressure, IEC 68-2-13.

[25] Basic Environmental Testing Procedures, Tests N: Change of Temperature, IEC 68-2-14, fifth edition, 1984.

[26] Global Positioning System Standard Positioning Service Signal Specification, 2nd Edition, June 1995.

[27] Synchronization Interface Standard, ANSI T1.101-1994.

[28] Standard Commands for Programmable Instruments (SCPI), Version 1994.0.

[29] EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

[30] EIA-485 Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems, April 1983.

[31] EIA/TIA-574 9-Position Non-Synchronous Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

[32] DSGS20AA, Stream 00, Issue 09. MCBTS Digital Equipment Packaging Design Specification.

[33] Nortel Networks Corporate Standard 1517.00, Labels and Marking.

[34] Nortel Networks Corporate Standard 5014.00, Serialization Codes for Telecommunications Products.

[35] Nortel Networks Serial Number PEC Release Drawing #3298-01a.

[36] Nortel Networks Three-Part Faceplate Label #3297-01a.

[37] Nortel Networks Corporate Standard 9017.00, Vendor Labels.

[38] Bellcore TR-STS-00383.

[39] Nortel Networks Procurement Specification NPS-90963, CLEI Bar Code Labels.

[40] GSGS50AA, Stream 01, Issue 2. Global Positioning System Timing Module General Spec.

[41] VNBW50AA, Stream 00, Issue 01. Dual Voltage Global Positioning System Timing Module Verification Report.

[42] GPSINTSP.AA06, Nortel CDMA Base Station GPS Receiver / GPS Timing Module Serial Interface Specification, March 1999.

Glossary

Term/Abbreviation	Meaning
C	Celsius
CDMA	code division multiple access
CLEI	Common Language Equipment Identifier
CM	controller module
CORE	configuration resource
CPC	common product code
DE	digital enclosure
dual voltage	can accept input voltages from -48Vdc to +24Vdc
E	electric
EMC	electromagnetic compatibility
ESD	electrostatic discharge
GPS	Global Positioning System; GPS time does not include leap seconds
GPSTM	global positioning system timing module
GS	general specification
HSR	Hardware Status Register
LED	light emitting diode
LNA	low noise amplifier
m	metre
ms	millisecond
ns	nanosecond
OEM	original equipment manufacturer
OSR	Operations Status Register
PCS	personal communication system
PEC	product engineering code
PDOP	Position Dilution of Position; a GPS condition that means the acquired satellites are not yet able to give an accurate location based on their positions in the sky.

Term/Abbreviation	Meaning
PUPS	point-of-use power supply
RF	radio frequency
SPR	serial/PEC/release code
UTC	Universal Co-ordinated Time
V	volts

1.0 Design Requirements

1.1 Scope

This general specification describes the GPSTM used in the -48V and the +24V MetroCell Products. This module functions identically to the -48V GPSTM (NTGS50AA) with the exception of a new LED strategy, where some slight changes are introduced to the conditions for illumination of the LEDs on the front of the GPSTM. This document is intended for the use of prospective vendors to prepare submissions to Nortel Networks in the procurement process of the GPSTM.

The GPSTM operates within the Digital Enclosure framework of the CDMA system. The GPSTM is the primary source of reference frequency and timing signals. The frequency and timing reference signals from the GPSTM are synchronized to the Global Positioning System satellite constellation via a dedicated active antenna that amplifies the 1575.42 MHz +/-1.023 MHz (L1) carrier.

Although it is not mandatory at this time, the capability to use the geostationary Wide Area Augmentation System (WAAS) satellite signal (spread spectrum signal also centred about the 1575.42 MHz L1 carrier) is permitted (when the WAAS system becomes operational) and encouraged.

1.2 General Product Architecture

Within the CDMA base station, there may be one or two GPSTMs within the Digital Enclosure. The GPSTM is intended to be a stand-alone module capable of supplying the frequency and timing reference signals, but a provision is incorporated within the GPSTM to allow synchronization of the output signals from two GPSTM (via an allocated inter-GPSTM backplane link) within a single Digital Enclosure for redundancy purposes.

2.0 General Description

2.1 Principal Functions

1. The GPSTM provides 9.8304 MHz (8x chip clock) frequency outputs to the CM and CORE modules.

2. The GPSTM provides 1/2 Hz (Even_Second) timing outputs to the CM and CORE modules.

3. The GPSTM provides a communication interface to one CM for control/query purposes.

4. The GPSTM provides a 10 MHz output to the user to synchronize test equipment.

5. The GPSTM provides a 9.8304 MHz output to the user to synchronize test equipment.

6. The GPSTM provides a 1/2 Hz (Even_Second) output to the user to synchronize test equipment.

7. The GPSTM provides a communication interface (RS-232) to the user for control/query purposes.

8. The GPSTM provides an input to power the active antenna and receive the GPS satellite constellation L1 carrier signal.

9. The GPSTM provides different LEDs patterns to indicate the operational modes.

2.2 Feature List

1. A single configuration to accommodate all new CDMA base station applications.

2. Appropriate electrical characteristics to facilitate the interconnection of the GPSTM with the CM and CORE modules.

3. Frequency, timing, and serial interface ports for test and synchronization purposes.

2.3 Backward Compatibility

The dual voltage GPSTM must be backward compatible with existing -48V Metrocell CDMA basestation systems.

The dual voltage GPSTM is also intended to be backward compatible with basestation software loads previous to release 10.1. The implication of this is that the LED commands from CMs in older systems will still work with the new GPSTM, following the old LED strategy. The LED commands from the GPSTM_Monitor software must also function correctly and not inadvertently trick the GPSTM into obeying CM LED commands. See section 5.1.3 for details.

2.4 Product Identification

The Digital Enclosure of the GPSTM shall accommodate up to two GPSTMs. The Nortel Networks codes that are assigned to the GPSTM are shown in the following table.

Product Description	Product Engineering Code	Common Product Code
Dual Voltage Global Positioning System Timing Module	NTBW50AA	A0827372

Table 1: GPSTM Product Identification

3.0 Block Diagram and Partitioning

3.1 Block Diagram

A high-level block diagram describing the connectors, indicators, and I/O signals is shown in Figure 1.

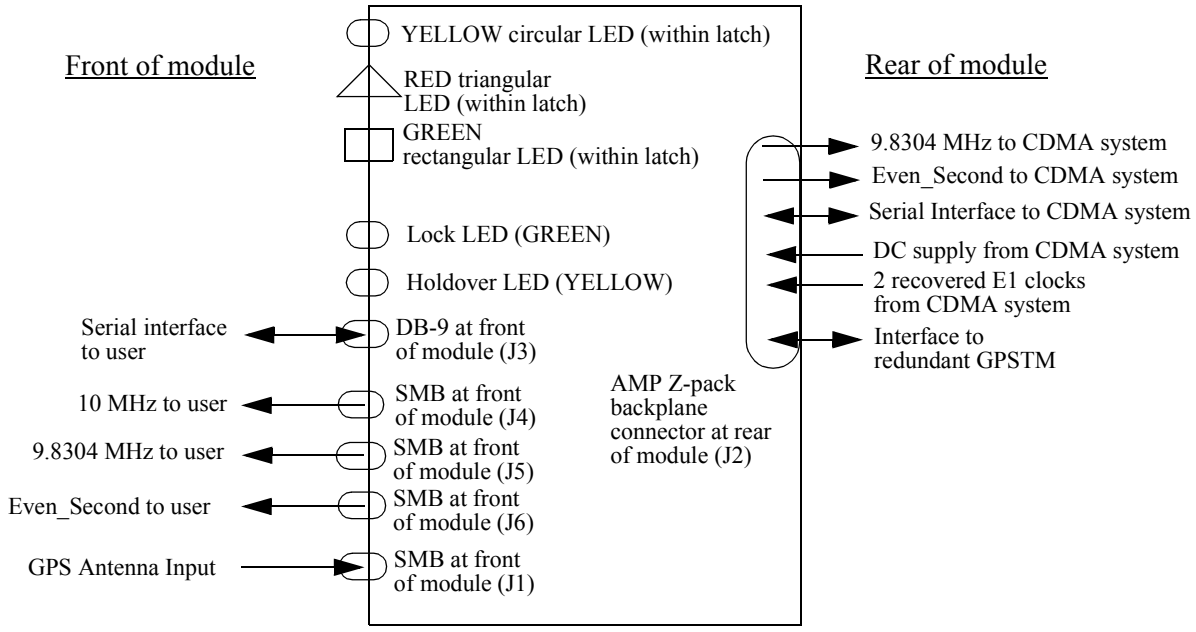


Figure 1: GPSTM Block Diagram

3.2 Functional Block Descriptions

Not Applicable

4.0 Mechanical Specifications

4.1 General

The following section provides the mechanical specifications for the GPSTM.

4.2 Construction and Design

Once this specification has been finalized, it shall be the responsibility of the GPSTM supplier to direct questions relating to this specification to the Nortel Networks purchasing department for resolution. Nortel Networks-approved vendors for components not produced by the GPSTM supplier (i.e.: metal chassis and plastic faceplate) are highly recommended.

4.3 Dimensions

The following Nortel Networks product structure defines all of the mechanical drawings required to produce the GPSTM. The current revisions of the drawings associated with this product structure are stored electronically in the Nortel Networks repository (DDME) in the current CIL (compatible issue line-up) and they will be provided by Nortel Networks upon request.

NTBW50AAGPS MODULE DUAL VOLTAGE 24/-48V

NTBW51AADUAL VOLTAGE GPS PCP (24/-48V)

NTGS5006PLASTIC FACEPLATE ASSEMBLY, GPS MODULE

P0873552 GPS ID LABEL

P0943072FACEPLATE, GPS

P0943722GPS LABEL

P0943436CHASSIS BASE, GPS

P0943437 CHASSIS COVER, GPS

4.4 Weight

The complete GPSTM shall not exceed 3.6 kg (8.0 lbs).

4.5 Interface Specifications

The various interfaces of the GPSTM and their associated connectors are described in the following table.

Interface	Connector	Signal(s)	M/F	Ref. Des.	Notes
Antenna	Type SMB (M/A-Com 5134-5002-09, Nortel CPC#A0602272 suggested)	GPS Signal & Power Supply to antenna and in-line amplifiers	F	J1	1
CORE_1	110-pin AMP Z-pack	See Table 9, Table 13 and Table 18	F	J2	2,3
CORE_2	110-pin AMP Z-pack	See Table 9, Table 13 and Table 18	F	J2	2,3
CM_1	110-pin AMP Z-pack	See Table 9, Table 13, Table 18, Table 19 and Table 20	F	J2	2,3
CM_2	110-pin AMP Z-pack	See Table 9, Table 13, Table 18, Table 19 and Table 20	F	J2	2,3
Supply	110-pin AMP Z-pack	See Table 3, Table 4, Table 9 and Table 10	F	J2	2,3
User I/O (TEST)	DB-9	See Table 11 and Table 21	F	J3	1,4
10 MHz Reference	Type SMB (M/A-Com 5134-5002-09, Nortel CPC#A0602272 suggested)	See Table 15	F	J4	1
9.8304 MHz Reference	Type SMB (M/A-Com 5134-5002-09, Nortel CPC#A0602272 suggested)	See Table 13	F	J5	1
Even_Second Reference	Type SMB (M/A-Com 5134-5002-09, Nortel CPC#A0602272 suggested)	See Table 17	F	J6	1
Clock_Edge_Sync Port	110-pin AMP Z-pack	See Table 9 and Table 12	F	J2	2

Interface	Connector	Signal(s)	M/F	Ref. Des.	Notes
Recovered E1 Clock Input	110-pin AMP Z-pack	See Table 9 and Table 18	F	J2	2,3

Table 2: GPSTM Interface

Notes:

1. Located on the front faceplate.
2. Located at the rear of the module.
3. The timing and frequency outputs and the serial interface to the CDMA system are via a single connector at the rear of the GPSTM.
4. With SAE screw lock captive hardware.

4.6 Cooling

The unit shall be fan cooled within the equipment frame. No internal fans are allowed within the GPSTM. The air flow will be from bottom to top and the unit shall be capable of operation in the presence of air flow at 200 linear feet per minute. The physical location of the GPSTM (within the digital enclosure) shall be in the lowest shelf.

Since the GPSTM is to be placed in a shelf directly below another module within the DE frame, Nortel Networks reserves the right to approve component placement within the GPSTM (i.e.: crystal oscillator) to ensure that air flow through the GPSTM to the next module is not impeded in a manner that would negatively impact the performance and MTBF of the GPSTM or the other modules within the DE enclosure.

4.7 Surface Treatments

This information is contained within the drawings of the product structure defined in Section 4.3. Any Nortel Networks Finish specification called out in the drawings will be provided to the vendor upon request.

4.8 Product Marking

Product Identification Marking may be silkscreened directly onto the GPSTM module. A label may be employed as an alternative, provided that the vendor is able to demonstrate that the label is sufficiently resistant to damage. Drawings describing the location of labels on the chassis or faceplate are included in the drawings for the product structure called out in Section 4.3. Nortel Networks Component Engineering shall be responsible for providing further definition of labels and placements not defined in existing drawings.

The warning and manufacturing labels shall be affixed using a pressure sensitive adhesive. Any adhesive which is found to secure the labels permanently during the product life is acceptable. Artwork shall be plotted with a minimum resolution of 1200 dots per inch. It shall be the responsibility of the GPSTM supplier to obtain details of the Nortel Networks Corporate Logo from the Nortel Networks purchasing department. All label designs shall be submitted to Nortel Networks for approval prior to production. Label specifications are as follows unless described otherwise in the relevant section.

Refer to Nortel Networks Corporate Standard 1517.00, Labels and Marking. All product labelling shall be procured from a UL-approved vendor.

4.8.1 Product Identification Label--Rear Vendor Identification Label

The rear product identification label for the GPSTM will include:

- Vendor model number (arbitrarily chosen by the vendor).

- Vendor product serial number (arbitrarily chosen by the vendor), compliant to the guidelines defined in Nortel Networks Corporate Standard 5014.00, Serialization Codes for Telecommunications Products.

- Oscillator type. **Oscillator "XXX"** will identify which OCXO was used in the particular device. XXX is to be either "T", "Oak", or "T2". The "T" identifies the Tekelec DOC-1903 device and the "Oak" indicates the OFC-4895 device from Oak Frequency Control Group. A "T2" will indicate the Tekelec DOC-2127 device.

- Nortel Networks Common Product Code (A0827372), compliant to the guidelines defined in Nortel Networks Corporate Standard 1517.00, Labels and Marking.

- Nortel Networks Product Engineering Code (NTBW50AA), compliant to the guidelines defined in Nortel Networks Corporate Standard 1517.00, Labels and Marking.

- Nortel Networks Current Release (Rel XX), compliant to the guidelines defined in Nortel Networks Corporate Standard 1517.00, Labels and Marking, where XX is a two-digit number assigned by Nortel Networks Component Engineering.

- Product manufacturing date code. This label shall indicate the week and year of manufacture of the GPSTM. The week format shall follow the Nortel Networks week calendar for the given year. Refer to Nortel Networks Corporate Standard 1516.00, Product Date Codes for additional guidelines.

Figure 2: Date Code Label Example Text

YYWW

- Description of part: GPSTM

The specific rear panel location, orientation, and size of the label is at the discretion of the vendor, subject to approval by Nortel Networks Component engineering. Use Nortel Networks Corporate Standard 1517.00, Labels and Marking, Section 4.5.

4.8.2 Serial/PEC/Release (SPR) Label

The Serial/PEC/Release (SPR) bar code label is used for asset and product management by Nortel Networks. The label is made up of human and machine readable codes detailing the serial number, PEC code, and Release number. The label shall be affixed to the front faceplate of the GPSTM chassis as shown in the Nortel Networks Drawing #ADBW50AA.

The following are the minimum requirements for the SPR label:

- Nortel Networks Serial Number PEC Release Drawing #3298-01a.

    - Serial Number as per Nortel Networks Corporate Standard 5014.00, Serialization Codes for Telecommunications Products.

    - The serialization unique identifier as per Nortel Networks Corporate Standard 5014.00, Serialization Codes for Telecommunications Products (not the same as the rear label serial number as defined by the vendor). The identifier for the GPSTM shall be NNTMvvvxxxxx, where vvv shall be the 3-digit vendor-specific code as assigned by Nortel Networks Component Engineering and xxxxx shall be the 5-digit alpha-numeric code assigned by the vendor (unique to each GPSTM).

    - Nortel Networks Product Engineering Code (NTBW50AA), compliant to the guidelines defined in Nortel Networks Corporate Standard 1517.00, Labels and Marking, followed by Nortel Networks Current Release (XX), compliant to the guidelines defined in Nortel Networks Corporate Standard 1517.00, Labels and Marking, where XX is a two-digit number assigned by Nortel Networks Component Engineering. Refer to Nortel Networks Serial Number PEC Release Drawing #3298-01a.

Optionally, the vendor may adopt the Nortel Networks WNC 3-Part Label (map 3297-01a). This is available from Nortel Networks Component Engineering upon request.

4.8.3 Common Language Equipment Identifier (CLEI) Label

The CLEI bar code label is used to meet Bellcore customer requirements as defined in Bellcore TR-STS-00383. The label is made up of human and machine readable codes detailing a Bellcore-assigned product identifier. The label shall be affixed to the front faceplate of the GPSTM chassis as shown in the Nortel Networks Drawing #ADBW50AA.

The following are the minimum requirements for the CLEI label:

- Refer to Nortel Networks Procurement Specification NPS-90963, CLEI Bar Code Labels for aesthetic guidelines.

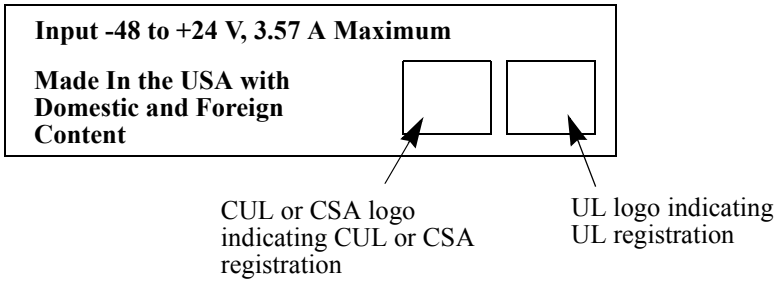
- Refer to Nortel Networks 3-Part Faceplate Label (Blank), Drawing #3297-01a, for dimensioning purposes.

- The CLEI label content shall be provided to the vendor by Nortel Networks Component Engineering.

4.8.4 Regulatory Label

Regulatory information shall be affixed to the rear of the GPSTM chassis. The label shall contain the information presented in the following figure.

Figure 3: Regulatory Label



The specific rear panel location, orientation, and size of the label is at the discretion of the vendor, subject to approval by Nortel Networks Component engineering. Use Nortel Networks Corporate Standard 1517.00, Labels and Marking, Section 4.5 for reference.

4.8.5 Warranty Void Label

The Warranty Void Label shall be affixed over a screw head or package joint so that the label must be removed to gain access to the internal portion of the module. Any material and adhesive combination which ensures destruction of the label upon removal is acceptable. An example of label content is shown in the following figure. The GPSTM vendor may use their own label for these purposes if approval has been granted by Nortel Networks Component Engineering.

Figure 4: Warranty Void Label

4.8.6 Product Packaging Label

The product identification label for the shipping carton of the GPSTM will include, in human readable and in bar code format:

- Nortel Networks Common Product Code (A0827372), compliant to the guidelines defined in Nortel Networks Corporate Standard 9017.00, Vendor Labels.

- Nortel Networks Product Engineering Code (NTBW50AA), compliant to the guidelines defined in Nortel Networks Corporate Standard 9017.00, Vendor Labels.

- Nortel Networks Current Release (Rel XX), compliant to the guidelines defined in Nortel Networks Corporate Standard 9017.00, Vendor Labels where XX is a two-digit number assigned by Nortel Networks Component Engineering.

- Product manufacturing date code. Refer to Section 4.8.4.

- quantity contained in the shipping carton.

The product identification label for the shipping carton of the GPSTM will include, in human readable format:

- Vendor name.

- Product Description

- Lot number.

- Nortel Networks purchase order number.

4.9 Grounding Strategy

- The shield of the coaxial connectors will be grounded to the GPSTM chassis.
- Digital Ground is the return side of all secondary power supplies within the GPSTM. These returns are tied to chassis ground on the printed circuit boards. (Digital Ground and Chassis Ground are also tied together at the points where the shield of the coaxial connectors attach to the chassis.)
- The primary (-48V or +24V) supply return shall not be connected to chassis ground; it shall remain isolated from chassis ground via the CDMA system power supply.
- The chassis ground connection shall be brought out via pins in the AMP Z-pack connector at the backplane, as denoted in Table 5.
- The connection between the GPSTM chassis and the chassis ground pins in the connector has to be sufficiently robust to handle 20A DC at room temperature. This is for fault testing where 20A DC is passed through the GPSTM chassis to the DE frame ground for several minutes and the voltage drop (<4V) and safety (no overheating) are checked. This fault condition is not applicable to hot insertion, high temperature, reliability or derating. The GPSTM must survive without damage.

4.10 Shielding Strategy and EMI Control

EMI testing requires that the doors of the Digital Enclosure be open during EMI tests. Therefore, EMI must be contained inside the GPSTM and must not be allowed to radiate from the Backplane or Digital Shelf.

Two Grounds are used:

Chassis Ground - Chassis Ground will connect to the Backplane Enclosure, the outside layers of the Backplane Board, the connector EMI gaskets, and the module enclosures to provide effective shielding to contain EMI within the Digital Shelf. Chassis Ground is connected to “earth” at the power source.

Digital Ground - Digital Ground is the logic return (+/-12V, +5V, +3.3V returns) for all circuits in the Digital Shelf. All logic returns inside all modules are connected to several Digital Ground layers of the Backplane Board.

A DC connection exists at certain points on the Backplane Board between Chassis Ground and Digital Ground. This is to ensure a DC safety connection. Digital ground and chassis ground are tied together on the GPSTM printed circuit board. In addition, high frequency AC connections exist between these grounds at certain points inside the modules.

The -48VDC/+24VDC and -48VRTN/24VRTN are input to the DC to DC converter (Point-of-Use-Power-Supply, i.e.: PUPS) inside the module. The output of the PUPS and Digital Ground are isolated from the input -48VDC/+24VDC and -48VRTN/+24VRTN. All Digital Grounds inside all modules are connected together on the Backplane. Inside each module is an EMI filter at the -48V/+24V input before the PUPS. The EMI filter has its internal “Y” capacitors connected to Chassis Ground. The EMI filter couples all noise currents from the (-48/+24VDC)/(-48/+24VRTN) onto the Chassis Ground and safely back to the power source. Using separate grounds for the PUPS output and EMI filter is the only effective means of properly containing PUPS switching noise and EMI within the modules and preventing corruption of logic signals. An additional benefit of using separate grounds is that all high speed signals are shielded from the -48V/+24V and Chassis Ground by sandwiching these signals between Digital Ground layers of the module PWB and Backplane PWB. Hence, high frequency noise radiation from the -48V/+24VDC cables within the MCBTS is minimized. Definition of the EMI requirements is called out in Section 8.2.

5.0 Electrical Specifications

5.1 General

The following section provides the electrical specifications for the GPSTM.

5.1.1 Operating Conditions

The GPSTM shall start and operate within its electrical specifications over any combination of the following conditions:

Parameter	Minimum	Maximum	Notes
Supply Voltage (-48V supply)	-40Vdc	-60Vdc	11
Supply Current (steady-state)		0.6Adc (@-36V), 2.08Adc for oscillator warm-up period during cold start	
Supply Current (in-rush)		4.0Apk (50 ms max duration)	
Supply Voltage Noise		Voice band, <55 dBrnC	7
Supply Voltage Ripple and Noise		350 mV_{pp} (DC to 150 MHz)	7
Supply Voltage Transients	+1V	-100V	9
Temperature	-5C	+70C	1, 3
Temperature Rate of Change		+/-10^{o}C/hour (Holdover Mode) +/-30^{o}C/hour (all other Modes)	
Relative Humidity	5%	95%	2
Altitude	-60m	4000m	
Load VSWR		Infinite	4
Maximum Acoustic Noise Level		see notes	5
Airborne Contamination		see notes	6
Air Flow	200 linear feet/minute		
Operational Vibration		see notes	10

Table 3: GPSTM Operating Conditions for -48V Supply

Parameter	Minimum	Maximum	Notes
Supply Voltage (+24V supply)	20Vdc	30Vdc	11
Supply Current (steady-state)		1.03Adc(@21V), 3.571Adc for oscillator warm up period during cold start	
Supply Current (in-rush)		8.0Apk (50 ms max duration)	
Supply Voltage Noise		Voice band, <55 dBrnC	7
Supply Voltage Ripple and Noise		<240 mV_{pp} (DC to 150 MHz)	7
Supply Voltage Transients	-1V	+50V	8
Temperature	-5C	+70C	1, 3
Temperature Rate of Change		+/-10^{o}C/hour (Holdover Mode) +/-30^{o}C/hour (all other Modes)	
Relative Humidity	5%	95%	2
Altitude	-60m	4000m	
Load VSWR		Infinite	4
Maximum Acoustic Noise Level		see notes	5
Airborne Contamination		see notes	6
Air Flow	200 linear feet/minute		
Operational Vibration		see notes	10

Table 4: GPSTM Operating Conditions for +24V Supply

Notes for Tables 3 and 4:

1. Temperature is specified as being internal ambient within the GPSTM.

2. Non-condensing; 100% R.H. shall be used as a design objective.

3. The maximum operational ambient temperature shall be reduced by 2^{o}C for every 300 metres altitude above 1500 metres. The GPSTM shall include a high temperature sensor that will trigger an alarm (detectable via software) when the internal ambient temperature within the GPSTM chassis exceeds +70C.

4. The GPSTM shall not be damaged when the antenna cable is shorted (centre conductor to shield or centre conductor to ground) or left open with the GPSTM powered.

5. The GPSTM shall operate in an environment with acoustic noise not exceeding that defined in GR-487 CORE requirement R3-157.

6. The GPSTM shall operate in an environment with airborne contamination not exceeding that defined in GR-487 CORE requirement R3-158.

7. This specification applies to the voltage at the GPSTM connector that connects to the backplane.

8. (+24V supply) In no event shall the supply voltage transient exceed -1V or +50V. The following may be superimposed on the DC supply voltage (mutually exclusive):

   - power system transients (supply/load changes): max. +/-3 Vdc step at less than 5V/ms rate and staying within the min/max DC limits.

   - fault clearing (i.e.: fuse blowing): up to +/-7 Vp for <10 ms.

   - voltage surges (from lightning): up to +/-20 Vp for <10 µs.

9. (-48V supply) In no event shall the supply voltage transient exceed +1V or -100V. The following may be superimposed on the DC supply voltage (mutually exclusive):

   - power system transients (supply/load changes): max. +/-7 Vdc step at less than 5V/ms rate and staying within the min/max DC limits.

   - fault clearing (i.e.: fuse blowing): up to +/-15 Vp for <10 ms.

   - voltage surges (from lightning): up to +/-40 Vp for <10 µs.

10. The GPSTM shall have no damage or loss of function while the CDMA system is being subjected to vibrations of magnitude 0.1 g peak acceleration applied over the frequency range 5-100 Hz in accordance with Bellcore GR-487-CORE requirement R3-171 and in accordance with Bellcore GR-63-CORE Section 4.4.3.

11. The GPSTM shall operate in both -48V and +24V CDMA systems.

5.1.2 Absolute Maximum Conditions

The GPSTM shall be capable of withstanding any of the following conditions without damage. and shall meet all operational requirements defined in this document after exposure.

Parameter	Minimum	Maximum	Notes
Supply Voltage	-100V	+100V	3
Storage Temperature (Ambient)	-40C	+85C	
Altitude (Non-operating)	-60m	9000m	1
Relative Humidity	5%	95%	2
Load VSWR		Infinite	4

Table 5: GPSTM Absolute Conditions

Notes:

1. Transport and/or storage.

2. Non-condensing; 100% R.H. shall be used as a design objective.

3. The GPSTM shall not be damaged if the polarity on the power leads is reversed.

4. The GPSTM shall not be damaged when the antenna cable is shorted (centre conductor to shield or centre conductor to ground) or left open with the GPSTM powered.

5.1.3 Modes of Operation

There are two independent classes of modes that describe the operation of the GPSTM: Functional Modes and Operational Modes. The Functional modes describe the status of the GPSTM within the basestation and are visually displayed using mainly the three LEDs on the GPSTM top latch. The Functional modes of the GPSTM are described in section 5.1.3.1. The Operational modes describe the status of the GPSTM's lock with the GPS system and are visually displayed using the two LEDs behind the faceplate cover of the GPSTM. The Operational Modes of the GPSTM are described in section 5.1.3.2.

These two classes of modes operate independently such that a change in the state of a Functional mode does not affect the Operational modes, and vice-versa. There are two exceptions: the Failed Mode and the Power-Up Mode. Since these two modes impact both sets of LEDs, they are described in both sections of this document.

In a future basestation software release, it is intended for the GPSTM to control the illumination and extinguishing of the LEDs. However, the GPSTM must remain reverse compatible with older basestation software loads. Table 6 summarizes the different software compatibility scenarios.

Table 6: GPSTM/BTS Software Compatibility Matrix

	New GPSTM	**Old GPSTM (v. 1.90 and older)**
Future release of NBSS Software	There is no compatibility issue. The new LED strategy will be implemented.	A future release of CM software will query the GPSTM version information and detect that the GPSTM firmware version is 1.88 or older. The CM will then control the GPSTM LEDs as in older systems.
Existing NBSS Software (11.x and previous)	The new GPSTM will determine that the CM software is an older version. The GPSTM firmware will then function the same way as version 1.88.	There is no compatibility issue. The old LED strategy will be implemented.

5.1.3.1 Functional Modes

The functional modes of the unit are shown in the following figure and described in the proceeding paragraphs. A "mode" of function is defined by both the performance requirements of the mode and the circumstances causing a transition to the mode.

Transitions between functional modes shall not result in any discontinuities in clock phasing. The exception to this rule applies to:

- the transition from the Power-up mode to the In Service mode;
- the transition from any functional mode to the Failed mode;
- the transition from the Failed mode to the In-Service mode.

When an internal hardware alarm occurs while the GPSTM is in any functional mode, the GPSTM shall transition into the Failed mode. When the internal ambient temperature of the GPSTM falls outside the specified operating range (0ºC-70ºC), the GPSTM shall transition into the Over/Under Temperature Alarm mode (except when the module is already in Failed mode). "Figure 5: GPSTM Functional Modes" on page 36 shows all the GPSTM functional modes and transitions.

The functional mode of the GPSTM is reflected by the five LEDs that are mounted on the front panel of the module. These LEDs are either ON (illuminated) or OFF (extinguished) to visually indicate the status of the GPSTM. Please refer to Table 24, "Front Faceplate LED Indicators," on page 78 for more information regarding the location of the LEDs.

Table 7shows LED patterns of some of the GPSTM functional modes.

Table 7: LED Patterns of GPSTM Functional Modes

LED Patterns	Functional Modes
Y R G L H	Power Up Mode (Initially)
Y R G - -	Power Up Mode (after successful self test)
- R - - -	Failed Mode
Y - G X X	Over/Under Temperature Alarm Mode
Y - - X X	No Communication with CM Mode
- - G X X	In Service Mode

Legend - indicates which LEDs are ON (illuminated):

Y = YELLOW circular LED (within latch),

R = RED triangular LED (within latch),
G =GREEN rectangular LED (within latch),

L = Lock LED (GREEN),
H = Holdover LED (YELLOW),

X = LED may be ON or OFF.

- = LED is OFF.

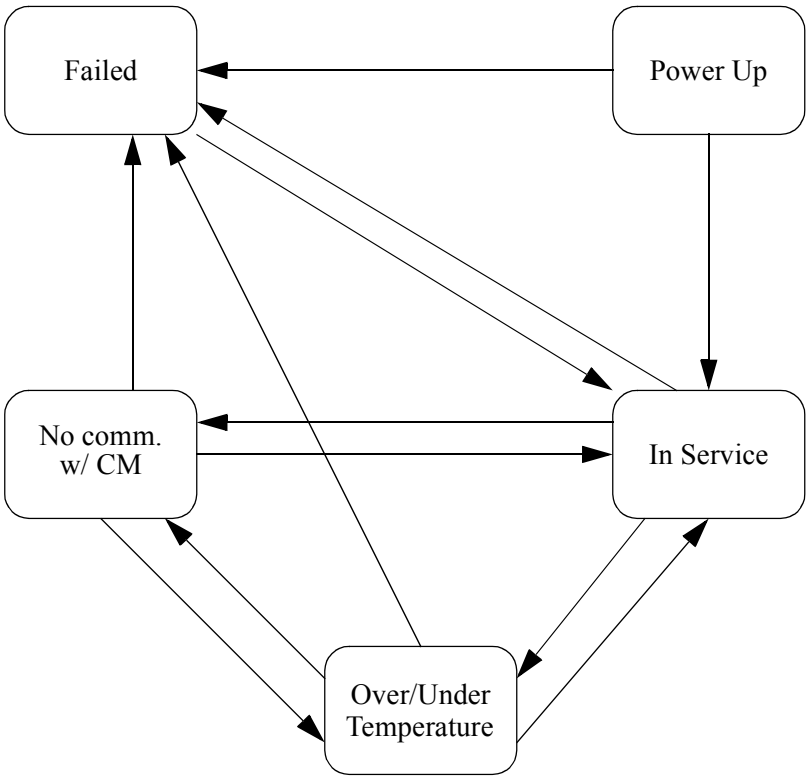


Figure 5: GPSTM Functional Modes

5.1.3.1.1 Systems with Redundant GPSTMs

In a BTS system where two GPSTMs are provisioned for redundant operation, both GPSTMs will enter into the 'In Service' mode of operation after successful power-up. After 60 seconds, they will enter into the 'No Comm. with CM' mode. The system software will then initialize one GPSTM, causing it to enter into the 'In Service' mode. The process of swapping from one GPSTM to the other is called "swact" ("switch of activity").

The same LED rules apply to both the standby and active GPSTMs.

5.1.3.1.2 Power Up Mode

This mode is described in detail in section 5.1.3.2.1. The GPSTM transitions automatically from this mode to the In-Service mode, illuminating the GREEN LED and extinguishing the YELLOW and RED LEDs.

5.1.3.1.3 Over/Under Temperature Alarm Mode

When the internal ambient temperature of the GPSTM exceeds 70ºC or falls below 0ºC, the GPSTM shall enter the Over/Under Temperature Alarm Mode. In this mode of function, the GREEN and YELLOW LEDs are illuminated and the RED LED is extinguished, regardless of the status of the Lock and Holdover LEDs. The purpose of this mode is to provide a visual alarm for conditions of ambient temperature extremes.

When the internal ambient temperature of the GPSTM returns to within the normal operating range (0ºC-70ºC), the status of the GREEN and YELLOW LEDs shall change to reflect the functional state of the GPSTM as described in the adjoining sections of this document.

5.1.3.1.4 Failed Mode

The GPSTM transitions to the Failed mode when an internal hardware alarm condition occurs. The type of alarm is defined in the Operations Status and Hardware Status registers (see Table 22, page 73 and Table 23, page 74). In this mode of function, only the RED LED is illuminated. The GPSTM is not synchronized with the GPS satellite constellation; the GPSTM unit is not providing service. The unit is safe to be pulled from the shelf and to be replaced.

The GPSTM transitions automatically to the In-Service mode if the internal critical fault is cleared. See “Failed Mode” on page 40 for details about the operational transition.

5.1.3.1.5 No Communication With CM Mode

If the active GPSTM detects that communication between itself and the CM is interrupted for more than 60 seconds, the GPSTM shall enter the No Communication with CM mode. Every time the GPSTM transitions into this mode, it shall place an entry into the diagnostic log. In this mode of function, the YELLOW LED is illuminated and the RED and GREEN LEDs are extinguished, regardless of the Lock and Holdover LEDs. The GPSTM unit shall operate normally, and monitor the communication between GPSTM and CM.

If it has been detected that communication with CM is regained, the GPSTM transitions automatically to the In Service mode, the GREEN LED is illuminated and YELLOW and RED LEDs are extinguished, regardless of the status of the Lock and Holdover LEDs.

If an internal critical fault is detected in the No Communication With CM mode of operation, the GPSTM transitions automatically to the Failed mode and all LEDs except the RED LED are extinguished.

5.1.3.1.6 In Service Mode

The GPSTM will be in In Service mode if normal serial communication with the CM exists. In this mode, the GREEN LED is illuminated and the RED and YELLOW LEDs are extinguished regardless the status of the Lock and Holdover LEDs.

The GPSTM transitions automatically to the Failed mode if an internal critical fault is detected.

The GPSTM transitions automatically to the No Communication With CM mode if communication between the GPSTM and CM is not detected for more than 60 seconds.

5.1.3.2 Operational Modes

The operational modes of the unit are shown in the following figure and described in the proceeding paragraphs. A “mode” of operation is defined by both the performance requirements of the mode and the circumstances causing a transition to the mode.

Transitions between operational modes shall not result in any discontinuities in clock phasing. The exception to this rule applies to:

- the transition from any operational mode to the Failed mode;
- the transition from the Failed mode to the Auto Holdover mode.

When an internal hardware alarm occurs while the GPSTM is in any operational mode, the GPSTM shall transition into the Failed mode. “Figure 6: GPSTM Operational Modes” on page 39 shows all the GPSTM operational modes and transitions.

The operational mode of the GPSTM is reflected by the five LEDs that are mounted on the front panel of the module. These LEDs are either ON (illuminated) or OFF (extinguished) to visually indicate the status of the GPSTM. Please refer to Table 24, “Front Faceplate LED Indicators,” on page 78 for more information regarding the location of the LEDs.

Table 8 shows LED patterns of some of the GPSTM operational modes.

Table 8: LED Patterns of GPSTM Operational Modes

LED Patterns	Operational Modes
Y R G L H	Power Up Mode (Initially)
X - X L -	Locked Mode
X - X - H	Holdover Modes (Auto Holdover and Manual Holdover Modes)
X - X L’ -	Recovery Mode
X - X - H’	Free-Run Mode

Legend - indicates which LEDs are ON (illuminated):

Y = YELLOW circular LED (within latch),

R = RED triangular LED (within latch),
G = GREEN rectangular LED (within latch),

L = Lock LED (GREEN),

H = Holdover LED (YELLOW),

L’= Flashing Lock LED (GREEN),
H’ = Flashing Holdover LED (YELLOW),

X = LED may be ON or OFF.

- = LED is OFF.

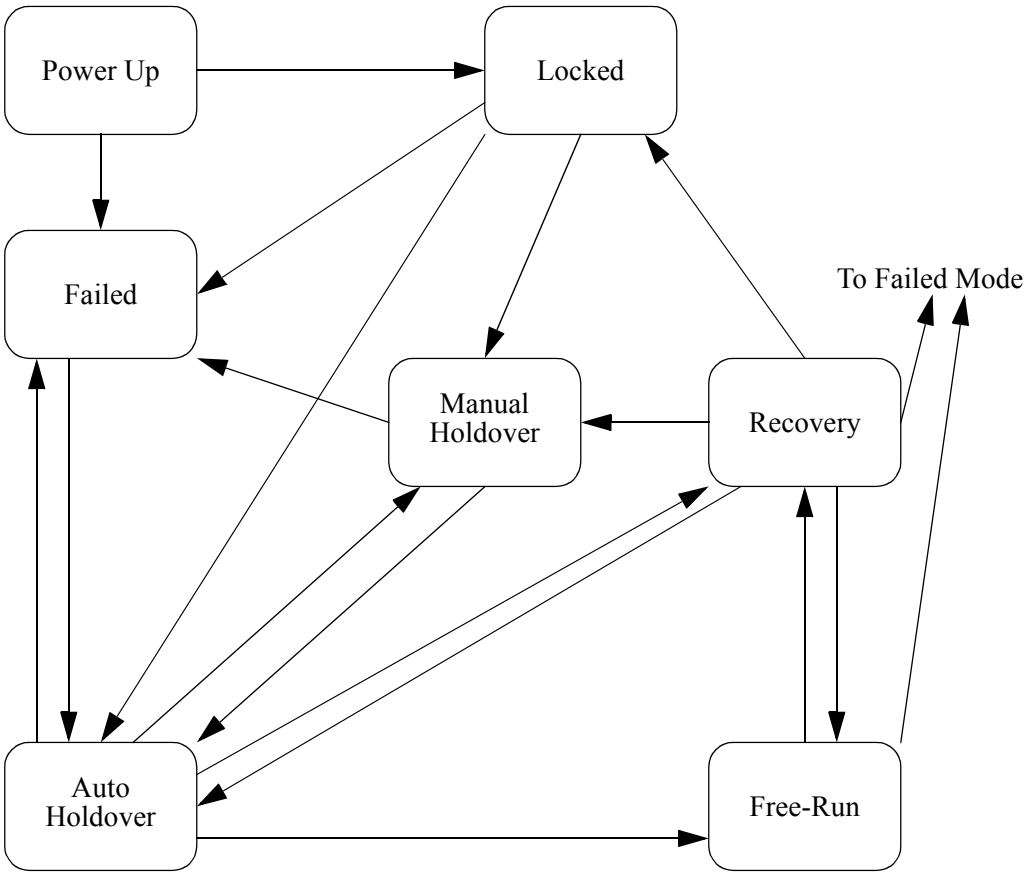


Figure 6: GPSTM Operational Modes

5.1.3.2.1 Power Up Mode

Upon the application of power, the following occurs:

- All LEDs are illuminated.
- Unit self test is performed. (if the GPSTM detects an internal critical fault, the GPSTM transitions automatically to the Failed mode and all LEDs except the RED LED are extinguished)
- Lock and Holdover LEDs are deactivated if the self test is successful, but the remaining LEDs remain illuminated.
- 9.8304 MHz, Even_Second, and 10 MHz Reference signals become available. These signals shall remain available while the GPSTM is active, regardless of the operational mode.
- Serial Interface becomes available for operation.

- The oscillator begins to stabilize.
- The GPS Constellation is acquired.
- Position is determined if the position already in memory is inaccurate (GPSTM relocation) or not present.
- The timing and frequency output signals are brought into agreement with GPS system time.
- The GPSTM transitions automatically to the Locked operational mode, illuminates the Lock LED and extinguishes all other LEDs.
- The GPSTM transitions automatically to the No Communication functional mode, illuminates the YELLOW LED and extinguishes GREEN and RED LEDs.

The GPSTM shall attain lock with the GPS satellite constellation less than 60 minutes from the commencement of a survey (no current almanac, position or time, with four satellites in view for survey). This time shall also be met with the position set through the Serial Interface and a single satellite in view. The GPSTM shall automatically perform a survey if it determines that its stored position is erroneous; the GPSTM shall still attain the Locked mode of operation within the 60 minute window.

The unit transitions to the Locked mode of operation once its timing and frequency outputs are within the specifications required for the Locked mode of operation. (This event can occur prior to the end of a survey, provided that the survey continues to completion and the unit's position is determined and stored in memory.) Information can be provided via the Serial Interface to assist or to speed up this mode. One example is that the position can be entered so that the time required for a survey is shortened. (An approximate date, time, and position can be entered to speed up a survey.)

In the Power Up mode of operation, if the GPSTM detects an internal critical fault, the GPSTM transitions automatically to the Failed mode and all LEDs except the RED LED are extinguished.

5.1.3.2.2 Failed Mode

The GPSTM transitions to the Failed mode when an internal hardware fault occurs. The failure modes are defined in the Operations Status and Hardware Status registers (see Table 22, page 73 and Table 23, page 74). In this mode of function, only the RED LED is illuminated. The GPSTM is not synchronized with the GPS satellite constellation; the GPSTM unit is not providing service. The unit is safe to be pulled from the shelf and to be replaced.

If the hardware fault is remedied, the GPSTM shall attempt to transition automatically to the "Auto Holdover" mode to ensure the GPS signal is available and stable prior to a transition to Locked mode via Recovery mode. See "Failed Mode" on page 37 for details about the functional transition out of the Failed mode.

5.1.3.2.3 Locked Mode

In the Locked mode of operation, the unit is synchronized with the GPS satellite constellation; its position is known and normal disciplining of the oscillator to GPS system time is taking place.

In a system containing a redundant GPSTM, Lock LEDs are illuminated on both GPSTMs in this mode.

After a transition from the Power Up mode to the Locked mode, the unit's oscillator is in the initial stages of stabilizing. This is considered to be a normal part of the Locked mode of operation even though the unit cannot yet meet the 24 hour holdover requirement. Upon initial installation at a cell site, the GPSTM shall meet the 24 hour holdover requirement after a 48 hour warm-up/training period. The GPSTM will be permitted a 48 hour warm-up/training period in the event of a power loss and the 24 hour holdover requirement shall be met following this training period.

The GPSTM transitions automatically to the Failed mode if the internal critical fault is detected. All LEDs except the RED LED are extinguished.

The standby GPSTM that is in Lock mode transitions to the In Service mode when a swact process is initiated.

5.1.3.2.4 Holdover Modes

There are two holdover modes: Auto Holdover and Manual Holdover. Regardless of the type of holdover mode, the Holdover LED is illuminated.

5.1.3.2.4.1 Auto Holdover Mode

The decision to transition into the Auto Holdover mode is determined by the unit. Reasons for this transition include:

- Loss of GPS lock (i.e.: due to impaired view of the sky causing temporary loss of the constellation or antenna system failure).
- The GPS signal becomes unbelievable (i.e.: a GPS satellite broadcasts faulty data).
- The user has initiated a firmware download switchover process. The validity of the timing and reference outputs shall be maintained during the download process and the serial interface shall remain available.
- An internal hardware fault that caused the GPSTM to enter into the Failed mode was cleared.

If any of the above occurs, the unit must create the required frequency and timing signals on its own. The GPSTM may rely solely on its internal oscillator for the timing and frequency signals or the GPSTM may use a recovered E1 (2.048 MHz) clock as a secondary discipline for its internal oscillator. The recovered 2.048 MHz clock will be provided via the backplane. The GPSTM continually monitors the GPS signal and tries to acquire a stable GPS signal. Once the unit determines that a stable GPS signal is available, it can transition over to the Recovery mode. Hysteresis shall be included in this decision making process to keep the unit from oscillating between Auto Holdover and Recovery modes for questionable GPS signals. There shall be a built-in delay of one minute before the GPSTM indicates (via register and faceplate LED) a switch to the Auto Holdover mode.

5.1.3.2.4.2 Manual Holdover Mode

A manual holdover occurs when commanded by the user. The unit must then create the required frequency and timing signals on its own. The GPSTM may rely solely on its internal oscillator for the timing and frequency signals or the GPSTM may use a recovered E1 (2.048 MHz) clock as a secondary discipline for its internal oscillator. The recovered 2.048 MHz clock will be provided via the backplane. The unit will remain in this mode until commanded otherwise. Once commanded out of this mode, the unit transitions to "Auto Holdover" mode to ensure the GPS signal is available and stable prior to a transition to Locked mode via Recovery mode.

This mode of operation is intended solely for test purposes in Nortel Networks labs.

5.1.3.2.5 Recovery Mode

In the Recovery mode of operation, the Lock LED is flashing and the Holdover LED is extinguished. The error between GPS system time and the unit's time is reduced to the normal steady state value. The error is dependent on the holdover period and the drift properties of the oscillator. During recovery the Even_Second signal is allowed to be corrected by up to 101.725 ns in 200 milliseconds. (This specification is defined in EIA/TIA/IS-95, Section 7.1.5.2 and represents 1/8 PN chip.) In this mode only, when commanded by the user, an immediate synchronization to GPS time shall occur. When in this mode, the SYS_CLK accuracy requirement is reduced to $<5*10^{-8}$.

The time required by the GPSTM to realign the Even_Second pulse with GPS system time shall not exceed five minutes once the GPS satellite signal is again available, assuming that the Even_Second pulse has drifted a maximum of seven microseconds after 24 hours in the Holdover mode. Refer to Section 5.1.14.4.29 for an explanation of the exception to this rule, known as Immediate Synchronization from Recovery mode.

5.1.3.2.6 Free-Run Mode

The GPSTM enters the Free-Run mode when it has exceeded the duration of the Holdover period. In this mode, the Holdover LED is flashing and the Lock LED is extinguished. When in this mode, the SYS_CLK accuracy requirement is reduced to +/-2 ppm with the SYS_CLK and Even_Second signals in random alignment with the GPS system time, although still within the required alignment of each other. The GPSTM shall internally track the duration of the Holdover period in order to know when to transition to the Free-Run mode. If the GPSTM has not regained the Locked mode after 24 hours in the Auto Holdover/Recovery modes, the total time spent in these modes prior to transition to the Free-Run Mode shall be cumulative and included in the decision to transition to the Free-Run Mode.

5.1.4 Testing LEDs

The GPSTM shall include the following mechanism to deal with front panel LED commands given to a GPSTM installed in a BTS with BTS software that implements the new LED strategy (see Table 6):

- If a serial communication connection is established via the front panel, the GPSTM retains control of the LEDs and updates them to correctly reflect the status of the module until an LED Set or Clear command is received.
- When an LED set or clear command is given via the GPSTM front panel serial interface, the GPSTM relinquishes control of all LEDS to the user of the application connected to the front serial port.

- The LED Set and Clear commands function as they do with previous firmware versions. For instance, selecting "Green LED State>Set" in the Trimble GPS_Monitor program illuminates the Green LED if it is off, and leaves the Green LED illuminated if it is already illuminated. Selecting "Green LED State>Clear" in the Trimble GPS_Monitor program extinguishes the Green LED if it is illuminated, and leaves the Green LED extinguished if it is already extinguished. When the serial connection is broken by the termination of the software application or by disconnecting the serial cable, the GPSTM automatically resumes control of the LEDs and updates them to correctly reflect the module's state.
- During the period that the LEDs are controlled by the front panel serial connection, the GPSTM has to track the changes of its operating state such that when the front panel connection is terminated, it can correctly display the actual operating state.
- When the front panel connection is terminated, it does not mean that the GPSTM automatically resumes control of the LEDs. This should depend on whether the GPSTM was controlling the LEDs before or the BTS was controlling it. This previous controlling source should be restored as opposed to the GPSTM automatically resumes control.

Upon receiving LED commands via the rear connector interface the new GPSTM firmware must revert is LED operation to perform identically to the version 1.88 firmware currently used in production units.

5.1.5 CDMA System I/O Connector Definition

There are four major interface signal types: SYS_CLK (9.8304 MHz) Output, Even_Second Output, Supply, and the Serial Interface. These interfaces are incorporated into a single connector that is used to provide timing, frequency and communication information to separate, redundant Base Station Transceiver Subsystem Controller (CM) and CORE modules via the system backplane. As far as the Serial Interface is concerned, the GPSTM is considered as Data Terminal Equipment (DTE). The connector is a female 110-pin AMP Z-pack device (AMP #1-100147-9, Nortel Networks CPC#A0640650). The male backplane connector that mates with the GPSTM is AMP#1-188398-9 (Nortel Networks CPC#A0640641). Table 9 summarizes this connector's pinout and signal descriptions. (Note: The pin-out given in Table 9 has no pins allocated for rows 12-14 inclusive. This reflects the mechanical keying that is part of the connector.) Table 10 illustrates the layout of the signals on the connector. All I/Os (timing, frequency, and communication) shall be continually available (including during warm-up and holdover). The Serial Interface will be used by the CM to determine the health of the GPSTM, the validity of the SYS_CLK and Even_Second Outputs, and to activate/deactivate LEDs on the front faceplate of the GPSTM. Only a single CM at a time shall interface with a GPSTM; there shall be a "wired-OR" layout on the backplane and appropriate configuration of the redundant CM modules so that only a single CM will communicate with a single GPSTM at a time. The CM and CORE modules shall use the SYS_CLK and Even_Second signals for timing and frequency reference. DC power shall also be provided to the GPSTM via this connector. An interface port shall be available via this connector to interface with the redundant GPSTM (if present) within the DE.

The serial data interchange (transmitted data and received data) must conform to EIA-485 characteristics, EIA-404-A, and EIA-363. The serial interface to the CM module must be operable simultaneously with an external user (J3) without interfering with the operation of the CDMA system. The serial interface shall be configured by the vendor to operate in the half-duplex mode.

All pins in this interface shall be protected against ESD as described in Section 7.0.

Module being Accessed	Signal Name	Pin Number	Comments
CORE_1	SYS_CLK	25e 25d	Low Voltage Differential Signalling GPSTM output 9.8304 MHz_- 9.8304 MHz_+
CORE_1	Even_Second	23d 23e	Low Voltage Differential Signalling GPSTM output Even_Second_- Even_Second_+
CORE_2	SYS_CLK	25b 25a	Low Voltage Differential Signalling GPSTM output 9.8304 MHz_- 9.8304 MHz_+
CORE_2	Even_Second	23a 23b	Low Voltage Differential Signalling GPSTM output Even_Second_- Even_Second_+
CM	Transmitted Data	15d 15e	RS-485, GPSTM output Tx_+ (B) Tx_- (A)
CM	Received Data	15a 15b	RS-485, GPSTM input Rx_+ (B) Rx_- (A)
CM	GPSTM Reset	9a	TTL logic levels, active LOW
CM_1	SYS_CLK	21e 21d	Low Voltage Differential Signalling GPSTM output 9.8304 MHz_1- 9.8304 MHz_1+
CM_1	Even_Second	19d 19e	Low Voltage Differential Signalling GPSTM output Even_Second_- Even_Second_+
CM_1	2.048 MHz	17e 17d	Low Voltage Differential Signalling GPSTM input 2.048 MHz_- 2.048 MHz_+

Module being Accessed	Signal Name	Pin Number	Comments
CM_2	SYS_CLK	21b 21a	Low Voltage Differential Signalling GPSTM output 9.8304 MHz_- 9.8304 MHz_+
CM_2	Even_Second	19a 19b	Low Voltage Differential Signalling GPSTM output Even_Second_- Even_Second_+
CM_2	2.048 MHz	17b 17a	Low Voltage Differential Signalling GPSTM input 2.048 MHz_- 2.048 MHz_+
GPSTM	Clock_Edge_Sync Port	7a, 7b, 7c, 7d, 7e	Individual Tx lines (inter-GPSTM pairing is a7-a8, b7-b8, c7-c8, d7-d8, e7-e8)
GPSTM	Clock_Edge_Sync Port	8a, 8b, 8c, 8d, 8e	Individual Rx lines (inter-GPSTM pairing is a7-a8, b7-b8, c7-c8, d7-d8, e7-e8)
Shelf Backplane	Supply	1a, 1b, 1c, 1d, 1e	-48V or +24V
Shelf Backplane	Supply_Return	4a, 4b, 4c, 4d, 4e	48V_Return or 24V_Return
Shelf Backplane	Digital Backplane Ground	6a, 6b, 6c, 6d, 6e, 15c, 16a, 16b, 16c, 16d, 16e, 17c, 18a, 18b, 18c, 18d, 18e, 19c, 20a, 20b, 20c, 20d, 20e, 21c, 22a, 22b, 22c, 22d, 22e, 23c, 24a, 24b, 24c, 24d, 24e, 25c	
Shelf Backplane	Module/Chassis Ground	5a, 5b, 5c, 5d, 5e	Frame Ground
No connection	N/C	2a, 2b, 2c, 2d, 2e, 3a, 3b, 3c, 3d, 3e, 9b, 9c, 9d, 9e, 10a, 10b, 10c, 10d, 10e, 11a, 11b, 11c, 11d, 11e	no internal connection; the N/C pins in rows 9, 10, and 11 will be kept as spares.

Table 9: CDMA System I/O Connector Definition (J2)

Table 10: CDMA System I/O Connector Physical Pinout (J2)

	E	D	C	B	A
1	+24/-48Vdc	+24/-48Vdc	+24/-48Vdc	+24/-48Vdc	+24/-48Vdc
2	N/C	N/C	N/C	N/C	N/C
3	N/C	N/C	N/C	N/C	N/C
4	+24/-48VRTN	+24/-48VRTN	+24/-48VRTN	+24/-48VRTN	+24/-48VRTN
5	Frame ground	Frame ground	Frame ground	Frame ground	Frame ground
6	Digital ground	Digital ground	Digital ground	Digital ground	Digital ground
7	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port
8	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port	Clock_Edge_ Sync Port
9	N/C	N/C	N/C	N/C	GPSTM Reset
10	N/C	N/C	N/C	N/C	N/C
11	N/C	N/C	N/C	N/C	N/C
15	GPSTM Tx Data_-	GPSTM Tx Data_+	Digital ground	GPSTM Rx Data_-	GPSTM Rx Data_+
16	Digital ground	Digital ground	Digital ground	Digital ground	Digital ground
17	CM_1 2.048 MHz_-	CM_1 2.048 MHz_+	Digital ground	CM_2 2.048 MHz_-	CM_2 2.048 MHz_+
18	Digital ground	Digital ground	Digital ground	Digital ground	Digital ground
19	CM_1 Even_Sec_+	CM_1 Even_Sec_-	Digital ground	CM_2 Even_Sec_+	CM_2 Even_Sec_-
20	Digital ground	Digital ground	Digital ground	Digital ground	Digital ground
21	CM_1 SYS_CLK_-	CM_1 SYS_CLK_+	Digital ground	CM_2 SYS_CLK_-	CM_2 SYS_CLK_+
22	Digital ground	Digital ground	Digital ground	Digital ground	Digital ground
23	CORE_1 Even_Sec_+	CORE_1 Even_Sec_-	Digital ground	CORE_2 Even_Sec_+	CORE_2 Even_Sec_-
24	Digital ground	Digital ground	Digital ground	Digital ground	Digital ground

Table 10: CDMA System I/O Connector Physical Pinout (J2)

	E	D	C	B	A
25	8fc- (CORE_1 SYS_CLK_-)	8fc+ (CORE_1 SYS_CLK_+)	Digital ground	8fc- (CORE_2 SYS_CLK_-)	8fc+ (CORE_2 SYS_CLK_+)

5.1.6 User I/O Connector Definition

There will be a Serial Interface I/O connector provided for the user (craft) to query the operation of the GPSTM. The serial data interchange (transmitted data and received data) must conform to EIA/TIA-232-E characteristics (as per EIA/TIA-574), EIA-404-A, and EIA-363. This interface may be used while the GPSTM is installed within an operating CDMA system without causing interference to the system; this interface shall also be configured by the vendor for half-duplex operation. Refer to the following table for the requirements of this interface. The pin configuration shown in the following table ensures that a null modem cable is ***not*** required to interface between a personal computer and the GPSTM.

All pins in this interface shall be protected against ESD as described in Section 7.0.

Signal Name	Pin Number	Comments
Transmitted Data	2	RS-232, GPSTM output
Received Data	3	RS-232, GPSTM input
Signal Ground	5	Signal Ground
DTE Ready	4	Used by GPSTM to sense when an external user is present.

Table 11: User I/O Connector Definition (J3)

5.1.7 Clock_Edge_Sync Interface Definition

There will be a Clock_Edge_Sync interface to permit the GPSTM to communicate with another GPSTM (if present) within the DE. This feature will permit the leading edges of the SYS_CLK and Even_Second outputs to be aligned to within +/-5 ns of each other (SYS_CLK edges compared to each other and Even_Second edges compared to each other) to minimize the impact to the CDMA system when the CM and CORE modules switch between the timing and frequency reference inputs from one GPSTM to another GPSTM. Under normal system operating conditions, the CM and CORE modules will monitor the timing and frequency signals from both GPSTM (if two are present). In the event a problem is detected by the CM or CORE modules (i.e.: loss of SYS_CLK), the system will switch to the timing and frequency inputs from the redundant GPSTM.

***** This synchronization spec. has not been enforced because Nortel Networks has determined that some customers do not calibrate the propagation delays of the antenna system. This makes it impossible for the GPSTM to meet this requirement. Also, in the event that multiple GPSTM vendors are qualified, they could not communicate with each other for synchronization purposes because the communication protocol is not standardized.**

The pin assignment for this interface is generically defined in Table 5. The vendor may use the ten pins as required for messaging between the two modules, subject to approval from Nortel Networks (i.e.: data rate) to ensure that there will be no negative impact to the CDMA system (i.e.: corruption of other backplane signals) arising from this interface.

This interface shall be used while the GPSTM is installed within an operating CDMA system without causing interference to the system. The GPSTM is required to align its clock edges through the use of the inter-GPSTM link only when two GPSTM from the same vendor are co-located within the DE.

The vendor shall make available (internal to the module) a connector that Nortel Networks may use to monitor the signals using external equipment. This is required so that Nortel Networks is able to verify (for product verification purposes only) the integrity of the signals passing via the backplane link. The vendor shall provide documentation to Nortel Networks describing the operation of the interface to assist Nortel Networks with verification of the link in the DE.

All pins in this interface shall be protected against ESD as described in Section 7.0.

5.1.8 SYS_CLK Output (9.8304 MHz--CDMA System)

The following table shows the requirements on the 9.8304 MHz signal provided by the GPSTM via J2 to the CORE and CM modules in the CDMA system. (The Frequency Accuracy specification for the oscillator prior to acquiring Lock is to enable the CDMA system to be brought to the threshold of operation for system diagnostic and maintenance purposes. The CDMA system will not broadcast until Lock has been attained.)

All pins in this interface shall be protected against ESD as described in Section 7.0.

Parameter	Requirement
Frequency	9.8304 MHz
Frequency Accuracy	$<0.8 \times 10^{-10}$ (1 day average; Locked and Holdover modes*) $<5 \times 10^{-8}$ (Recovery mode) $<2 \times 10^{-6}$ (Power-up mode prior to Lock and in Free-Run mode.) * This accuracy requirement translates to a maximum offset of +/- 6.912µs over 24 hours with respect to GPS time, or about +/- 7µs.

Parameter	Requirement
Phase Noise (as measured about the 9.8304 MHz fundamental frequency)	-120 dBc/Hz max. at 100 Hz -135 dBc/Hz max. at 1 kHz -135 dBc/Hz max. at 10 kHz -135 dBc/Hz max. at 100 kHz -135 dBc/Hz max. at 1 MHz
Spurious	See Section 5.1.9.1
Isolation - between any of the 9.8304 MHz outputs	>39 dB
Waveform	Square Wave, duty cycle 44% to 56% (including timing corrections)
Level	Low Voltage Differential Signalling

Table 12: SYS_CLK (9.8304 MHz) Output Requirements (CDMA SYSTEM)

The recommended line driver for this signal is the National Semiconductor DS90LV031A. (The required line receiver is the National Semiconductor DS90LV032A.) Nortel Networks has chosen to standardize with these devices for all of the modules. This driver must be independent from the driver used for Even_Second distribution to limit phase noise. The following figure shows the low voltage differential signalling configuration. This circuit shall be used when performing measurements of the low voltage differential 9.8304 MHz Output.

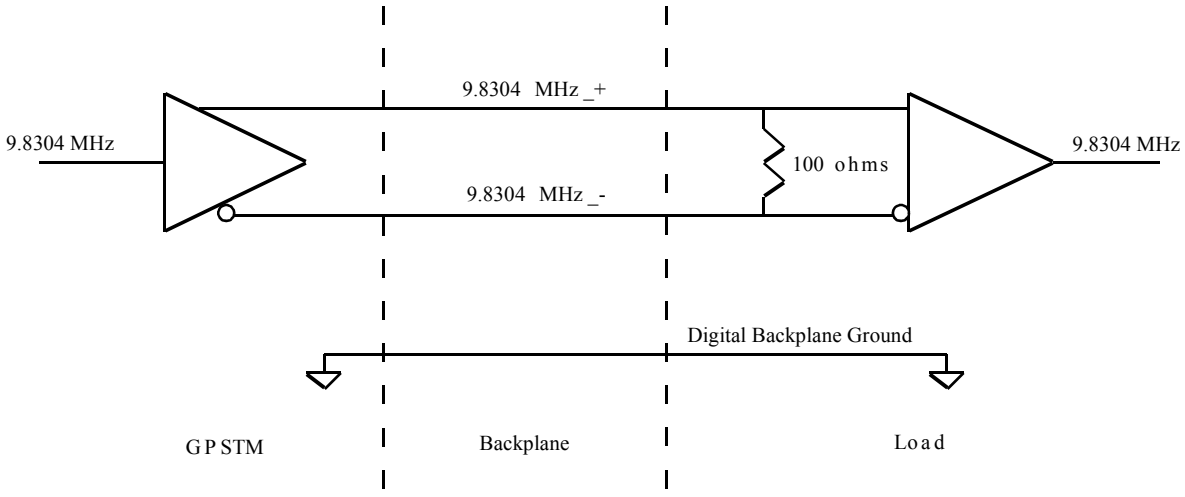


Figure 7: SYS_CLK Low Voltage Differential Signalling Configuration

5.1.9 SYS_CLK Reference Output (9.8304 MHz--J5)

This output is for reference only and it shall be located on the front faceplate of the GPSTM. The 9.8304 MHz signal shall have the following parametric requirements and physical interface. The SYS_CLK reference output shall be phase-aligned with the SYS_CLK output to the CDMA system.

Parameter	Requirement
Frequency	9.8304 MHz
Source Impedance	50Ω nominal
Return Loss	-10 dB maximum
Coupling	DC
Protection Terminating Impedance Voltage Reverse RF Power ESD	 ×Infinite VSWR, any angle maximum +/-5 V_{DC} maximum +20 dBm maximum Refer to Section 7.0
Waveform	Square Wave, duty ratio 44% to 56% (including timing corrections)
Connector	SMB, female; (M/A-Com 5134-5002-09, Nortel CPC#A0602272 suggested)
Level	TTL

Table 13: 9.8304 MHz Reference Output

5.1.9.1 Spurious Outputs

The SYS_CLK (9.8304 MHz) output is used as a clock reference to the CDMA system. It is important that this signal be as free of frequency spurs as possible. It is acknowledged that due to the physical nature of the unit a certain number of and magnitude of frequency spurs will exist (due to extra, unwanted vibration modes in the oscillator's crystal). It is also understood that the number and level of frequency spurs can be minimized by careful electrical and mechanical design.

The vibration or temperature in the GPSTM operational environment (i.e.: from nearby highway, rail track, etc.) shall not affect equipment performance. The GPSTM shall remain within functional requirements during exposure to swept sine vibration from 2 - 200 - 5Hz, 1g, at a rate of 0.25 octaves/minute as described in Bellcore GR-63 CORE, Section 5.4.2 Alternative Test Procedure for Electronic Subassemblies Only. No performance degradation is permitted for operational vibration. Spurious frequencies (due to internal or external noise or other mechanisms) as measured about the 9.8304MHz

fundamental frequency shall be below the levels shown in Table 14 and Figure 8 for all operating conditions.

Parameter	NT Internal	Minimum MetroCell Requirements for GPSTM (as defined in the "1900/800 MHz MCBTS clock and reference source budget document", Draft Issue 04)
Phase Noise	-120 dBc/Hz max. at 100 Hz offset -135 dBc/Hz max. at 1 kHz offset -135 dBc/Hz max. at 10 kHz offset -135 dBc/Hz max. at 100 kHz offset -135 dBc/Hz max. at 1 MHz offset -135 dBc/Hz max. at >1 MHz offset	-100 dBc/Hz max. at 100 Hz offset -110 dBc/Hz max. at 1 kHz offset -115 dBc/Hz max. at 10 kHz offset -120 dBc/Hz max. at 100 kHz offset -120 dBc/Hz max. at 1 MHz offset -120 dBc/Hz max. at >1 MHz offset
Fixed Spurious Levels	-135 dBc/Hz max. at 1 kHz offset -135 dBc/Hz max. at 10 kHz offset -115 dBc/Hz max. at 100 kHz offset -95 dBc/Hz max. at 1 MHz offset -95 dBc/Hz max. at >1 MHz offset	

Table 14: 9.8304 MHz Spurious Levels and Phase Noise Specifications

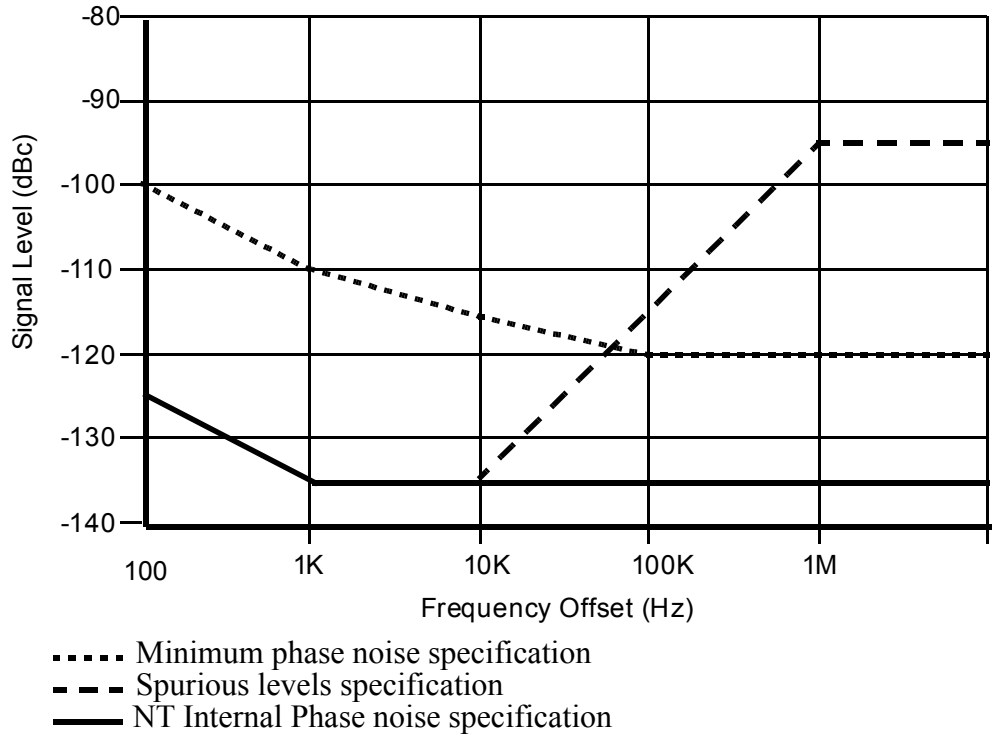


Figure 8: 9.8304MHz Phase Noise and Fixed Spurious Levels Specification

5.1.10 10 MHz Reference Output

The 10 MHz Reference output will be used for synchronizing test equipment; there may be a future application beyond this for the 10 MHz reference output. The 10 MHz reference shall be phase-aligned with the Even_Second reference output. This interface shall be available on the front faceplate with the following parametric requirements and physical interface:

Parameter	Requirement
Frequency	10 MHz
Waveform	Sine wave
Frequency Accuracy	$<0.8 \times 10^{-10}$ (1 day average; Locked and Holdover modes)
Spurious	See Section 5.1.9.1
Level	2.0 V_{pp} +/-0.5V
Source Impedance	50Ω nominal
Return Loss	-10 dB maximum
Coupling	AC
Protection Terminating Impedance Voltage Reverse RF Power ESD	 ×Infinite VSWR, any angle maximum +/-5 V_{DC} maximum +20 dBm maximum Refer to Section 7.0
Connector	SMB, female; (M/A-Com 5134-5002-09, Nortel CPC#A0602272 suggested)

Table 15: 10 MHz Reference Output (J4)

5.1.11 Even_Second Output (CDMA System)

The following table shows the requirements of the Even_Second signal provided by the GPSTM to the CDMA system via J2.

All pins in this interface shall be protected against ESD as described in Section 7.0.

Parameter	Requirement
Frequency	1/2 Hz
Frequency Accuracy	Exactly once every $19.6608*10^6$ SYS_CLK cycles. The falling edge of Even_Second shall occur 0-5 ns after the falling edge of SYS_CLK.
Accuracy of "on-time" edge (Even_Second pulse output with GPSTM locked to the GPS constellation)	+/-1 µs traceable to and synchronous with GPS Time Even_Second with at least one satellite in view. The error is due to calibration error, tolerance in measurement, position fix error and selective availability (SA) error. The GPSTM Even_Second output shall be associated with a Time Code message (Section 5.1.13.3.1) that denotes an even number of seconds elapsed since the start of GPS system time (January 6, 1980 at 12:00 AM). (The vendor must demonstrate compliance with this specification because of the specialized test equipment required.)
Accumulated time error (all causes, aging, temperature etc.)	Less than +/-7 µs over a single, contiguous 24 hour period (unlocked, after the training period for holdover operation). Refer to Section 5.1.3.2.3 for definition of the training period.
Rate of Change for Timing Corrections	<= 101.725 ns per 200 ms (EIA/TIA/IS-95 requirement)
Jitter	No jumps in Even_Second greater than 200 nsec between pulses. No sequence of jumps accumulating more than +/-1 µs per day (locked to the GPS constellation). (The vendor shall demonstrate compliance with this specification because of the specialized test equipment required.)
Waveform	Negative pulse, 40-60 ns wide
Level	Low Voltage Differential Signalling

Table 16: Even_Second Output Requirements (CDMA System)

The recommended line driver for this signal is the National Semiconductor DS90LV031A. (The required line receiver is the National Semiconductor DS90LV032A.) Nortel Networks has chosen to standardize with these devices for all of the modules. This driver must be independent from the driver used for SYS_CLK distribution to limit phase noise. The following figure shows the low voltage differential signalling configuration. This circuit shall be used when performing measurements of the low voltage differential Even_Second Output.

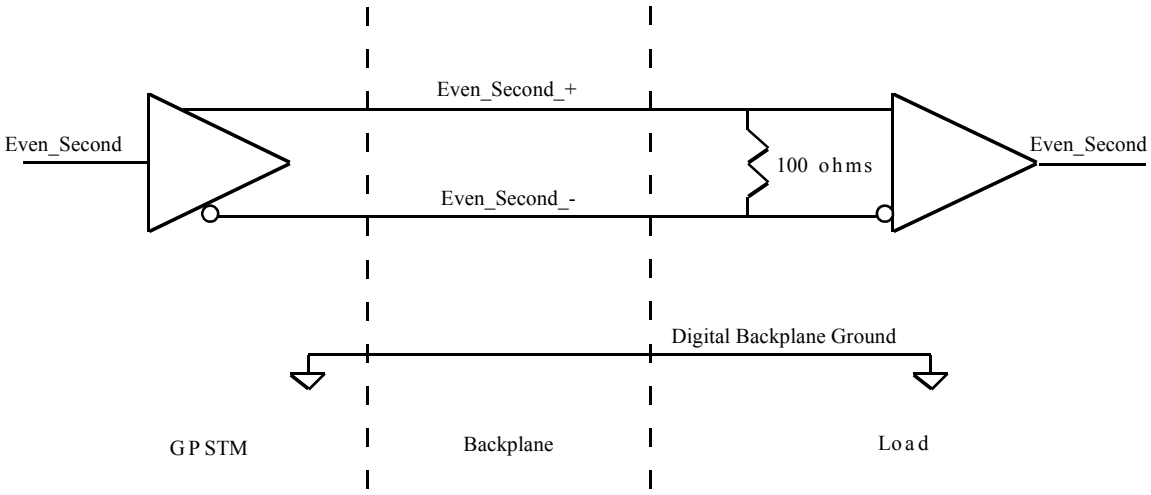


Figure 9: Even_Second Differential Low Voltage Differential Signalling Configuration

5.1.12 Even_Second Reference Output

The Even_Second Reference output is used for synchronizing test equipment to the GPSTM output. This interface will have the same parametric requirements as in the previous table with the physical interface described in the following table. The Even_Second reference output shall be phase-aligned with the Even_Second output to the CDMA system.

Parameter	Requirement
Frequency	1/2 Hz
Source Impedance	50Ω nominal
Return Loss	-10 dB maximum
Coupling	DC
Protection Terminating Impedance Voltage Reverse RF Power ESD	 ×Infinite VSWR, any angle maximum +/-5 V_{DC} maximum +20 dBm maximum Refer to Section 7.0
Connector	SMB, female; (M/A-Com 5134-5002-09, Nortel CPC#A0602272 suggested)

Parameter	Requirement
Pulse Duration	50-100 ns
Level	TTL

Table 17: Even_Second Reference Output (J6)

5.1.13 Recovered E1 Clock Input

In order to permit the vendor(s) to take advantage of new methods of disciplining the GPSTM oscillator to meet the +/-7 µs (Even_Second) drift requirement, Nortel Networks will be providing a recovered 2.048 MHz (Stratum 4) E1 clock signal from each CM via the GPTSM interface (J2). The use of this signal as a secondary disciplining reference is not mandatory, although proper termination of the clock signal is required. The characteristics of the recovered 2.048 MHz signal are shown in the following table.

Parameter	Requirement
Frequency	2.048 MHz
Frequency Accuracy	$<3.2*10^{-5}$ (1 day average)
Level	Low Voltage Differential Signalling

Table 18: Recovered E1 Clock Specifications

The termination method applied to the incoming 2.048 MHz LVPECL signal is dependent upon whether or not the GPSTM vendor intends to use this signal for secondary disciplining of the oscillator. The required termination method for a vendor using the recovered 2.048 MHz signal is shown in the upper portion of the following figure. If the vendor intends to use the recovered 2.048 MHz signal, the recommended line receiver for this signal is the National Semiconductor DS90LV032A. (The recommended line driver in the CM is the National Semiconductor DS90LV031A.) These drivers and receivers must be independent from the drivers and receivers used for SYS_CLK and Even_Second distribution. The required termination method for a vendor not making use of the recovered 2.048 MHz signal is shown in the lower portion of the following figure.

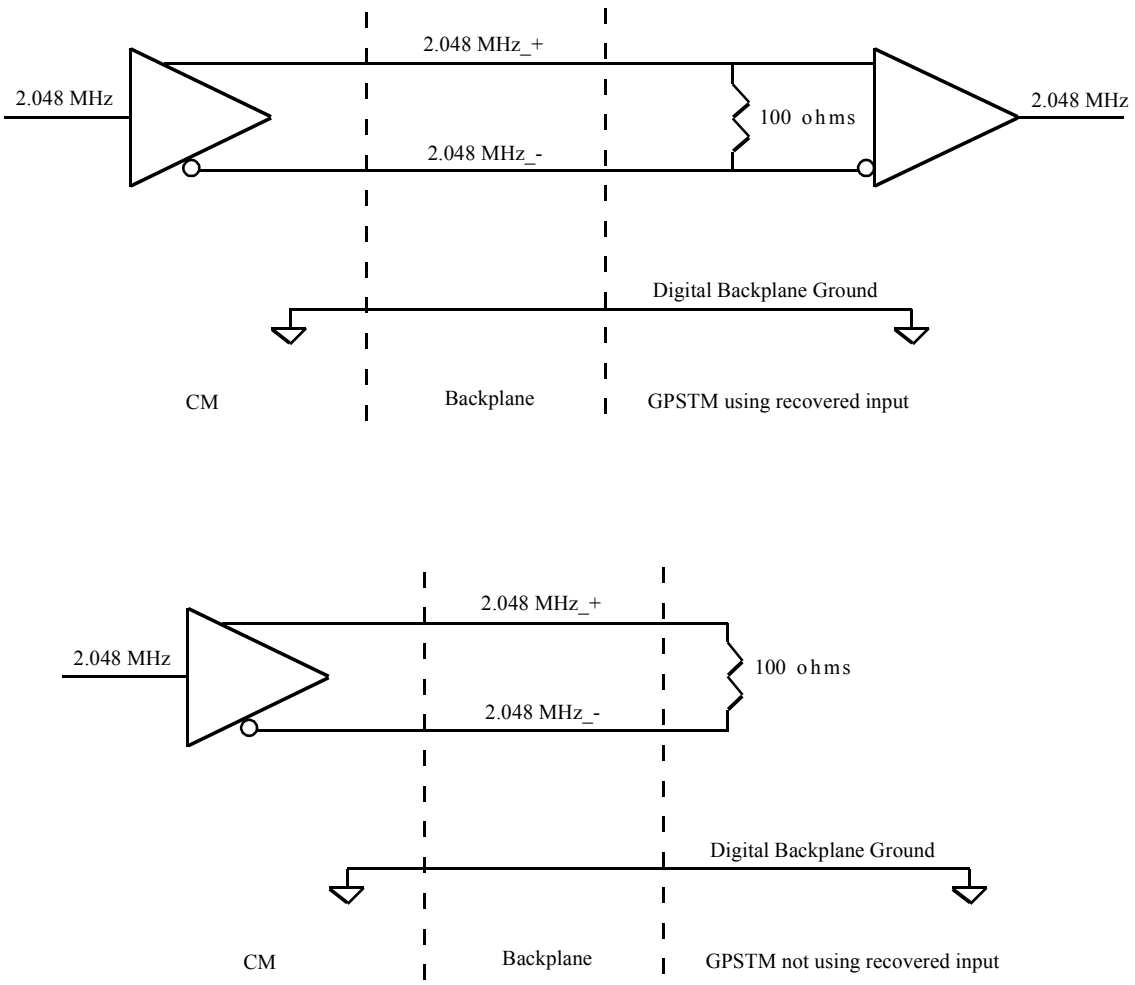


Figure 10: Recovered 2.048 MHz (E1) Interface Circuitry

5.1.14 Serial Interface

The serial interface provides a bi-directional interface for the purpose of performing the following main functions:

- Retrieving Time of Day information and leap second corrections.
- Status reporting such as alarm and mode notifications.
- Configuration of the GPSTM such as setting a precise location.
- Coordinating diagnostic tests.
- Manually overriding certain modes of operation such as forcing the GPSTM to perform a survey.

- Firmware download.

Information can be passed in one of the following ways:

- Specific information can be sent to and returned by the GPSTM by using specific commands (sent to the GPSTM) or responses (from the GPSTM).
- Events recorded in a log in the GPSTM (see section 5.1.14.1).
- Errors are stored as messages by the GPSTM. These are accessed by using commands sent to the GPSTM.
- The GPSTM has two Status Registers. They are:
    - Operation Status
    - Hardware Status

The manufacturer shall configure the serial interface so that the product in which the GPSTM resides shall be able to communicate (with the GPSTM or the user) in half-duplex mode.

The manufacturer shall configure the serial interface to permit the GPSTM to be in simultaneous communication with the CDMA system and with an external user. The CDMA system shall have priority status and the presence of an external user shall not interfere with communication between the CDMA system and the GPSTM.

A mask can be used with each register. This mask, which is set by a command, allows the user to define which items stored in the register are returned when requested.

It is a requirement that, for Nortel Networks OA&M purposes, the GPSTM be able to inform the CDMA system (when queried via the serial interface) of 95% of all faults that could occur within the GPSTM. The vendor shall provide Nortel Networks with a list of internal hardware/software faults, their method of identification (via hardware/software), their severity, and their impact to the CDMA system.

The GPSTM must be capable of accepting a new revision of firmware via the serial interface without disrupting the operation of the CDMA system. Transition to the Holdover mode of operation is permitted during this operation but there can be no disruption in the provision of the SYS_CLK and Even_Second signals to the CDMA system.

The Serial Interface utilizes a layered architecture. The physical layer is described in Section 5.1.14.2. Message descriptions are given in Section 5.1.14.4.

5.1.14.1 Diagnostic Log

The GSPTM shall contain a diagnostic log that records significant events. This log is accessed by using commands sent to the GPSTM. Each log entry shall be time-stamped in the same manner as the time-of-day message (section 5.1.14.4.1). Each log entry shall be a maximum of 128 characters in length and the log shall be capable of storing a minimum of 500 entries. The log, when filled, shall begin to discard entries on a first-in, first-out basis.

The diagnostic shall store a minimum of 200 of the most recent log entries in non-volatile memory such that they are saved when power is removed from the GPSTM. If not all log entries are saved in this fashion, the non-volatile entries shall not appear any differently than the volatile entries when accessing the log. The non-volatile section of the log shall be updated every time that a log entry is added such that the most recent entries are always stored in non-volatile memory and older entries are moved to the volatile section of memory (see Table 11).

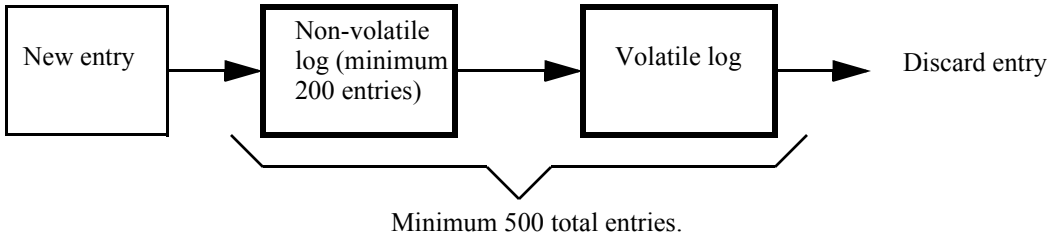


Figure 11: Flow diagram of diagnostic log queue

5.1.14.2 Physical Layer

The serial interface to the CDMA system (CM) is an RS-485 compatible interface consisting of the following signals.

- Transmitted Data
- Received Data
- Signal Ground (provided via Digital Backplane Ground plane)

The following table lists requirements for the CDMA system serial interface physical layer.

Parameter	Requirement
Data Rate	19.2 kbps
Data Format	Asynchronous, 1 start bit, 1 stop bit, 7 bits per character and odd parity.
Data Communication Standard	EIA-485 compatible. See EIA-485, EIA-363 and EIA-404-A.
ESD protection	Refer to Section 7.0

Table 19: CDMA System Serial Interface Physical Requirements

The following table lists requirements for the user serial interface physical layer.

Parameter	Requirement
Data Rate	19.2 kbps
Data Format	Asynchronous, 1 start bit, 1 stop bit, 7 bits per character and odd parity.
Data Communication Standard	RS-232 compatible. See EIA/TIA-232-E, EIA/TIA-574, EIA-363 and EIA-404-A.

Table 20: User Serial Interface Physical Requirements

5.1.14.3 Communication Protocol

The GPSTM shall use the Standard Commands for Programmable Instruments (SCPI), V1994.0 communication protocol. The GPSTM shall be SCPI compliant through the implementation of the IEEE-mandated commands denoted in Section 4.1.1 of SCPI V1994.0, Volume 1.

5.1.14.4 Serial Interface Message Description

The following table shows the list of message types that are exchanged over the serial interface. Some of these messages may be carried out in a series of command messages instead of in single messages.

#	Command	Parameters/Response	Reference
1	Time code query	**send:** request GPS time code **returns:** GPS time code	5.1.14.4.1
2	Accumulated leap seconds query	**send:** request difference between UTC and GPS time scales **returns:** Difference between GPS time and UTC time in seconds	5.1.14.4.2
3	Time of next leap second correction query	**send:** request time of next GPS system leap second adjustment **returns:** GPS time of next pending leap second	5.1.14.4.3
4	Preset GPSTM command	**send:** return GPSTM to original factory settings **returns:** none	5.1.14.4.4

#	Command	Parameters/Response	Reference
5	Receiver Identification query	**send:** request GPSTM identification **returns:** Nortel CPC, PEC, release, Manufacturer, and revision information	5.1.14.4.5
6	Set Receiver Position	**send:** Hold stored location **returns:** none	5.1.14.4.6
7	Get Receiver Position	**send:** Survey estimation, or last location. **returns:** Location	5.1.14.4.7
8	Set antenna delay	**send:** antenna delay in decimal seconds **returns:** none	5.1.14.4.8
9	Get antenna delay	**send:** request antenna delay **returns:** antenna delay in seconds	5.1.14.4.9
10	GPSTM survey command	**send:** initiate position survey **returns:** none	5.1.14.4.10
11	GPSTM survey query	**send:** is the GPSTM surveying to determine its geographic location? **return:** indication if unit is surveying	5.1.14.4.11
12	Set manual holdover mode	**send:** manual holdover mode command. **returns:** none	5.1.14.4.12
13	Set manual holdover recovery	**send:** recover from manual holdover mode command. **returns:** none	5.1.14.4.13
14	Holdover duration query	**send:** request holdover duration **returns:** holdover duration in seconds	5.1.14.4.14
15	List of satellites being tracked	**send:** request list of tracked satellites **returns:** List of satellites IDs.	5.1.14.4.15
16	List of predicted satellites in view	**send:** list of satellites predicted to be in view **returns:** List of satellites that are over the horizon based on current time and position.	5.1.14.4.16

#	Command	Parameters/Response	Reference
17	Run self test command	**send:** initiate internal self test **returns:** 0 if unit passes, non zero for specific error code	5.1.14.4.17
18	Oscillator control value query	**send:** request oscillator control voltage **returns:** current percentage of the maximum oscillator control voltage	5.1.14.4.18
19	Holdover reason query	**send:** request holdover reason **returns:** reason GPSTM is currently in a holdover mode.	5.1.14.4.19
20	GREEN LED command	**send:** On/Off value **returns:** none	5.1.14.4.20
21	GREEN LED query	**send:** request status of the LED **returns:** On/Off value	5.1.14.4.21
22	YELLOW LED command	**send:** On/Off value **returns:** none	5.1.14.4.22
23	YELLOW LED query	**send:** request status of the LED **returns:** On/Off value	5.1.14.4.23
24	RED LED command	**send:** On/Off value **returns:** none	5.1.14.4.24
25	RED LED query	**send:** request status of the LED **returns:** On/Off value	5.1.14.4.25
26	LOCK LED query	**send:** request status of the LED **returns:** On/Off value	5.1.14.4.26
27	HOLDOVER LED query	**send:** request status of the LED **returns:** On/Off value	5.1.14.4.27
28	Last held position query	**send:** request last geographic position stored in the GPSTM memory **returns:** Location	5.1.14.4.28
29	Immediate synchronization command	**send:** synchronize GPS system and unit's Even_Second outputs immediately (used during Recovery mode only) **returns:** none	5.1.14.4.29

#	Command	Parameters/Response	Reference
30	Time interval query	**send:** request Even_Second offset **returns:** Time interval between the internal oscillator Even_Second and GPS Even_Second	5.1.14.4.30
31	Module language command	**send:** 'INSTALL' for firmware download, 'PRIMARY' for all other commands. **returns:** none	5.1.14.4.31
32	Module firmware download	**send:** download new version of product firmware to GPSTM. **returns:** none	5.1.14.4.32
33	Erase memory command	**send:** erase flash memory **returns**: flash memory erased	5.1.14.4.33
34	Module language query	**send:** Is the GPSTM in the PRIMARY or the INSTALL language? **returns**: status of flash memory	5.1.14.4.34
35	Frequency figure of merit query	**send:** request internal frequency figure of merit (FFOM) **returns:** frequency figure of merit	5.1.14.4.35
36	Initialization assistance command	**send:** estimated time, date and position; used to speed up initialization. **returns:** none	5.1.14.4.36
37	Survey progress query	**send:** request progress of current survey **returns:** percentage completion of the survey process	5.1.14.4.37
38	Clear error queue command	**send:** clear the error queue **returns:** Error queue clear indication	5.1.14.4.38
39	Log data query	**send:** Log number to be read **returns:** Log string	5.1.14.4.39
40	Clear log entries command	**send:** clear the log **returns:** none	5.1.14.4.40
41	Log entries query	**send:** request the number of entries in the log **returns:** Log count	5.1.14.4.41

#	Command	Parameters/Response	Reference
42	Operation Status Register query	**send:** request numerical value of the Operation Status register **returns:** contents of Operation Status register	5.1.14.4.42
43	Hardware Status Register query	**send:** request numerical value of the Hardware Status register **returns:** contents of Hardware Status register	5.1.14.4.43
44	Lifetime Counter query	**send:** request the value of the lifetime counter **returns:** The current value in the lifetime counter	5.1.14.4.44
45	Return Last Response query	**send:** request the last response sent by the GPSTM **returns:** last response sent by GPSTM	5.1.14.4.45
46	Antenna System Interface query	**send:** request the status of the Antenna interface **returns:** status of the Antenna Interface	5.1.14.4.46
47	Operational Mode query	**send:** request the GPSTM's current operational mode **returns:** GPSTM's current operational mode	5.1.14.4.47
48	Switch between internal firmware loads	**send:** switch to operation of the firmware in the inactive FLASH **returns:** success/failure	5.1.14.4.48
49	Commit to new internal firmware load	**send:** reset a flag to switch the status of the active and INACTVE FLASH devices **returns:** success/failure	5.1.14.4.49
50	Determine firmware revisions and which revision is active	**send:** query the GPSTM to determine the revision of firmware stored in each flash device **returns:** firmware revision and flag status of each FLASH device	5.1.14.4.50
51	Port initialization	**send:** carriage return**,** new line **returns:** prompt	5.1.14.4.51

#	Command	Parameters/Response	Reference
52	Initiate FLASH copy command	**send:** copy the active FLASH contents to the inactive FLASH **returns:** prompt	5.1.14.4.52
53	Query FLASH copy status	**send:** query the status of the FLASH copy task **returns:** percentage completed	5.1.14.4.53

Table 21: Serial Interface Message Description

All messages sent by the GPSTM are in response to the commands sent by the user. The following sections describe the functions and purposes of these messages in detail. The exact syntax of the SCPI commands is contained in the GPS_INTSP document [42]. This document is stored in the Nortel Networks electronic repository (DDME) and will be provided to the vendor upon request.

5.1.14.4.1 Time Code Query

This command returns the timecode message 980ms to 20ms (inclusive) prior to the next Even_Second of indicated time. An example of the response is: T1#H20AF16AC41+00B4

- T1 = Format identifier.
- #H = Number representation identifier.
- 20AF16AC = GPS time in seconds of the next 1 PPS on-time edge. The 1 PPS edge being referenced is the internal 1 PPS used by the GPSTM and does not appear as an output from the GPSTM. (If two requests for the time of day query occur one second apart, one response will be associated with both the internal 1 PPS and the external Even_Second, while the other response will only be associated with the internal 1 PPS signal.)
- 4 = Time figure of merit (TFOM).
- 1 = Frequency figure of merit (FFOM).
- + = Leap second information. A '+' sign indicates a pending GPS leap second, while a '0' to indicate no pending GPS leap second.
- 0 = Alarm indication.
- 0 = Service request.
- B4 = Checksum.

The format of GPS time is a 32-bit integer represented in HEX. The TFOM message is defined as the integer part of 10*log(time error in ns);

- 0 <1 ns
- 1 1ns to 10ns
- 2 10ns to 100ns
- 3 100ns to 1µs
- 4 1µs to 10 µs
- 5 10 µs to 100 µs
- 6 100 µs to 1 ms
- 7 1 ms to 10 ms
- 8 10 ms to 100 ms
- 9 >100 ms

5.1.14.4.2 Accumulated Leap Seconds Query

This returns the accumulated time difference in seconds between GPS and UTC time in seconds.

5.1.14.4.3 Time of Next Leap Second Correction Query

This returns the GPS time of the next pending leap second. This shall have the same format as the GPS Time message; see Section 5.1.14.4.1.

5.1.14.4.4 Preset GPSTM Command

This command returns the GPSTM to the following state:

- Returns the unit to the manufacturer's factory settings.
- The unit assumes the Power-up mode and starts to survey.

5.1.14.4.5 GPSTM Identification Query

The GPSTM returns the following information, in the order described below, about its identification when requested:

- Manufacturer name (alpha-numeric, vendor-defined)
- Manufacturer Model number (alpha-numeric, vendor-defined)
- Manufacturer Serial number (alpha-numeric, vendor-defined)

- Firmware revision (alpha-numeric, vendor-defined; shall be capable of being overwritten if a new revision of firmware is downloaded to the module)
- Nortel Networks Common Product Code (A0827372)
- Nortel Networks Product Engineering Code (NTBW50AA)
- Nortel Networks Release Number (Rel XX, where XX = two digit number assigned by Nortel Networks and applicable to the hardware revision of the module; may be overwritten to a new value via a firmware download if deemed appropriate by Nortel Networks change management)

The above information shall be returned as a string not exceeding 128 characters in length, with the seven fields delimited by commas.

5.1.14.4.6 Set GPSTM Position

This places the unit in 'position hold' mode at the designated position.

5.1.14.4.7 Get Receiver Position

This returns the last 'position hold' location or the current position estimate if the GPSTM is performing a survey.

5.1.14.4.8 Set Antenna Delay

This command sets the delay from the antenna unit to the GPSTM measured in decimal seconds (i.e.: “0.0000001” for a 100 nanosecond delay). This command accepts **positive** values in the range of 0-50ms (0.000 to 0.050 seconds).

Setting the antenna delay while the GPSTM is providing service shall not impact the performance of the Nortel base station. The 9.8304MHz SYS_CLK signal shall remain within its frequency accuracy specification for Locked mode of operation (Table 12, page 49). The Even Second signal shall remain within its specification for rate of change for timing corrections (Table 16, page 53).

5.1.14.4.9 Get Antenna Delay

This query returns the delay from the antenna unit to the GPSTM measured in decimal seconds (i.e.: 1e-7 for a 100 nanosecond delay).

5.1.14.4.10 GPSTM Survey Command

This command forces the GPSTM to perform a survey to determine its geographic location.

5.1.14.4.11 GPSTM Survey Query

This query will return a message indicating if the GPSTM is surveying.

5.1.14.4.12 Set Manual Holdover Mode

This command places the GPSTM in a holdover mode. The GPSTM will stay in this mode until commanded otherwise. This mode of operation is intended solely for test purposes in Nortel Networks labs.

5.1.14.4.13 Set Manual Holdover Recovery

This commands the termination of the manual holdover mode; see Section 5.1.13.3.12.

5.1.14.4.14 Holdover Duration Query

The unit returns the length of time that the unit has been in a holdover mode. If not currently in a holdover mode, the unit will return the length of the last holdover mode; units are in seconds.

This message has two parts; the first, duration, has been described. The second indicates if the unit is in holdover at the time of the query.

5.1.14.4.15 List of Satellites being Tracked

The unit returns a list of satellite ID numbers (SVID) of the satellites currently being tracked by the unit. A "0" returned means no satellites are currently being tracked.

5.1.14.4.16 List of Predicted Satellites in View

The GPSTM will return a list of satellite ID numbers (SVID) of the satellites predicted to be over the horizon. This prediction is based upon the almanac, date, time and position. If any of these are in error the prediction will be incorrect.

5.1.14.4.17 Run Self Test Command

This commands the unit to perform a self test. This test will interfere with the unit's operation. This command returns a "0" if the unit passes, and a non-zero specific code if the unit fails. No commands/ queries can be sent to the unit during self test.

5.1.14.4.18 Oscillator Control Value Query

The GPSTM returns the current percent of the maximum control voltage to the oscillator.

5.1.14.4.19 Holdover Reason Query

The GPSTM returns the reason why it is in a holdover mode.

5.1.14.4.20 GREEN LED Command

This command toggles the status of the LED. This LED shall be deactivated by the GPSTM if the RED LED is activated by the GPSTM to indicate an internal hardware alarm condition as defined in the Hardware Status register.

5.1.14.4.21 GREEN LED Query

This query returns the status of the LED.

5.1.14.4.22 YELLOW LED Command

This command toggles the status of the LED. The GPSTM will maintain this LED OFF as long as communication between the CM and the GPSTM is not interrupted for longer than 60 seconds. The LED shall be deactivated after communication is re-established. The GPSTM shall place an entry into the diagnostic log each time the LED is activated due to a communication fault.

5.1.14.4.23 YELLOW LED Query

This query returns the status of the LED.

5.1.14.4.24 RED LED Command

This is a command toggles the status of the LED. This LED will be toggled ON by the GPSTM to indicate a internal critical fault is detected. Once activated by the GPSTM to indicate an internal alarm condition, the GPSTM is safe to be removed from shelf.

5.1.14.4.25 RED LED Query

This query returns the status of the LED.

5.1.14.4.26 LOCK LED Query

The unit returns the current status of this LED which is controlled independently by the GPSTM.

5.1.14.4.27 HOLDOVER LED Query

The unit returns the current status of this LED which is controlled independently by the GPSTM.

5.1.14.4.28 Last Held Position Query

The unit will return the last position held in memory.

5.1.14.4.29 Immediate Synchronization Command

This system impacting command allows the unit to immediately synchronize the 10 MHz reference, SYS_CLK, and Even_Second outputs to the GPS system. It is intended to be used when an extended holdover has occurred and once the Recovery mode has been re-achieved the time interval (TI, defined in Section 5.1.13.3.30) is either too large for proper system operation or the time required for normal correction to bring the TI within acceptable limit is too great. This command is only available in the Recovery mode and it will force the GPSTM to immediately synchronize its Even_Second output to within +/- 1 μs of the GPS constellation Even_Second. This command shall be ignored by the GPSTM if the module is not in the Recovery mode of operation.

5.1.14.4.30 Time Interval Query

The unit returns the difference (in nanoseconds) between the output Even_Second and the GPS system Even_Second signals. This query is intended for use only in Nortel Networks test applications when the GPSTM is in the Manual Holdover mode which is also intended to be a mode only used in Nortel Networks test applications.

5.1.14.4.31 Receiver Language Command

This command changes the I/O mode between 'INSTALL' for firmware downloading and 'PRIMARY' for normal operation. When the user returns the GPSTM to the ‘PRIMARY’ mode from the ‘INSTALL’ mode after a firmware download, the GPSTM shall transition out of the Holdover mode via the Recovery mode and return to the Locked mode of operation.

5.1.14.4.32 Receiver Firmware Download

When requested, this command installs a new version of product firmware to the FLASH device (active/inactive) specified in the command syntax. This command is available only in the 'INSTALL' mode.

5.1.14.4.33 Erase FLASH Memory Command

The unit erases its flash memory upon receipt of this command. This command is only available once the 'INSTALL' language has been invoked.

5.1.14.4.34 Module Language Query

The GPSTM response to this query specifies which language it is using (PRIMARY/INSTALL).

5.1.14.4.35 Frequency Figure of Merit Query

The unit returns this value indicating the uncertainty of the 9.8304 MHz output of the unit. This value is defined as:

- 0 - indicates that the output is stable; unit is locked.
- 1 - indicates that the output is stabilizing; unit is locked.
- 2 - indicates that the unit is unlocked and in holdover.
- 3 - indicates that the unit is unlocked but not in holdover (still in initial power-up).

5.1.14.4.36 Initialization Assistance Command

The user sends an estimated time, date and position with these commands. The unit uses these to speed up the initialization process.

5.1.14.4.37 Survey Progress Query

The unit returns the percent complete of the survey process.

5.1.14.4.38 Clear Error Queue

This command clears the error queue and returns a clear queue indication.

5.1.14.4.39 Log Data Query

The user sends log number to be read and the unit returns the contents of this log entry. An optional numeric parameter can be used to identify a specific log entry. If no numeric parameter is provided, the most recent log entry is returned.

5.1.14.4.40 Clear Log Entries Command

The unit clears the log.

5.1.14.4.41 Log Entries Query

This unit returns the number of entries in the log.

5.1.14.4.42 Operation Status Register Query

The GPSTM returns the contents of this register as a decimal value.

5.1.14.4.43 Hardware Status Register Query

The GPSTM returns the contents of this register as a decimal value.

5.1.14.4.44 Lifetime Counter Query

The unit returns the current value in the lifetime counter. This counter is initially zero at the factory and is incremented by one for every three hours of operation.

5.1.14.4.45 Repeat Last Response Request

This command is used in an error recovery process. The unit will return the last message that it had sent through the Serial Interface.

5.1.14.4.46 Antenna System Interface Query

This query returns a text response from the GPSTM that determines if there is an open/short on the antenna interface.

5.1.14.4.47 Operational Mode Query

This query returns a response from the GPSTM to indicate which mode the unit is operating in. Refer to Section 5.1.3 for the definition of the operational modes.

5.1.14.4.48 Switch Firmware Load Command

This command causes the GPSTM to load new firmware from the inactive FLASH. This operation may initiate a temporary switch to the Holdover mode of operation but shall not be service impacting. The capability shall exist to switch between either load of firmware, regardless of the vintage contained in either FLASH device. This command is only available once the 'INSTALL' language has been invoked.

5.1.14.4.49 Commit Firmware Load Command

This command causes the GPSTM to change the flag status of each FLASH device to indicate a change of status for each FLASH. (The inactive FLASH becomes the active FLASH and vice-versa. The next time the GPSTM reboots, it will load from the active FLASH.) This operation may initiate a temporary switch to the Holdover mode of operation but shall not be service impacting. This command is only available once the 'INSTALL' language has been invoked.

5.1.14.4.50 Firmware Load Query

This query to the GPSTM requests the revision number of the firmware stored in the active and the inactive FLASH devices, along with an indication of which firmware load is currently active.

5.1.14.4.51 Serial Port Initialization Command

This command is a response to a carriage return, new line sequence sent to the GPSTM. The GPSTM shall respond with a prompt as defined in the GPS_INTSP document [42].

5.1.14.4.52 Initiate FLASH Copy Command

This command will initiate a process by which the firmware in the active FLASH memory device is copied to the inactive FLASH device. The GPSTM shall maintain the capability of providing all of its timing, frequency, and communication capabilities during this process.

5.1.14.4.53 FLASH Copy Status Query

The response to this query will allow the user to track the progress of the FLASH copy command. The user will then be able to determine when the task has been completed.

5.1.14.5 Software Error Detection

If the GPSTM detects a syntax error while receiving a message from the user, the GPSTM increments the error count and ignores the entire message. The GPSTM does not respond to the user in any way. In such a case, the user is expected to re-send the original query to the GPSTM as a complete, separate message. If the GPSTM receives a message with an unrecognizable header or an incorrect parameter format, it considers the message erroneous and does not respond to the message. Such messages in error do not affect the performance of the GPSTM.

5.1.14.6 GPSTM Error Detection

It is a Nortel Networks requirement that the CDMA system be able to identify at least 95% of the possible faults within the GPSTM through queries by the CM. The GPSTM vendor must ensure that the failure modes are identified through the Operation Status and Hardware Status registers. The TOD Alarm and Service Request Bits are defined in Section 5.1.14.4.1. The mapping of these registers is contained in the following two tables (Table 22 and Table 23).

Spurious signals or data generated by the GPS system that do not cause the SYS_CLK (9.8304MHz) or Even_Second GPSTM system signal outputs to fall outside of their specified operating range (as specified in sections 5.1.8 and 5.1.11) shall not result in the setting of the Hardware Status Register alarms that monitor these signals (HSR bits 2 and 3).

Bit	Information Reported	Comments	Transitions from Locked to Holdover Mode?	TOD Alarm Bit	TOD Service Request Bit	GPSTM RED LED	Event written to Diagnostic Log?
0	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
1	Locked Operation	Set = 1 if the unit is operating in the Locked mode; set = 0 otherwise.	N	0	0	0	Y
2	Holdover Status	Set = 1 if the module is operating in the Auto Holdover, Manual Holdover, Recovery, or Free-Run Modes; set = 0 otherwise.	Y	1	0	0	Y
3	Position Hold operation	Set = 1 when a survey is completed and the position is stored in the unit's memory; set = 0 otherwise.	N	0	0	0	Y
4	Sufficient satellites to Lock	Set = 1 if the unit is tracking sufficient satellites to synchronize its timing and frequency outputs to the GPS constellation; set = 0 otherwise.	N	0	0	0	N
5	Hardware Status summary	Set = 1 if hardware register value > 0; set = 0 otherwise.	N	1	0	0	N
6	Diagnostic log almost full	Set = 1 if diagnostic log nearly full. The user may want to read and clear the log; set = 0 otherwise.	N	0	0	0	N
7	Module over-temperature fault	Set = 1 if the internal temperature sensor detects an internal ambient temperature > 70C; set = 0 otherwise. (The bit shall be set when the GPSTM detects an internal temperature of 71C or higher.)	N	1	0	0	Y

Bit	Information Reported	Comments	Transitions from Locked to Holdover Mode?	TOD Alarm Bit	TOD Service Request Bit	GPSTM RED LED	Event written to Diagnostic Log?
8	Module under-temperature fault	Set = 1 if the internal temperature sensor detects an internal ambient temperature < 0C; set = 0 otherwise. (The bit shall be set when the GPSTM detects an internal temperature of -1C or lower.)	N	1	0	0	Y
9	Antenna circuit fault	Set = 1 if open/short circuit detected by internal GPSTM circuitry; set = 0 otherwise.	Y	1	1	0	Y
10	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
11	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
12	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
13	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
14	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
15	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A

Table 22: GPSTM Operation Status Register

Bit	Information Reported	Comments	Transitions from Locked to Holdover Mode?	TOD Header Alarm Bit	TOD Header Service Request Bit	GPSTM RED LED	Event written to Log?
0	Self-test failure fault	Set = 1 if power-up or user-initiated self-test reports internal failure; set = 0 otherwise.	N	0	0	1	Y
1	Internal power supplies out of range	Continuously monitored and set = 1 if any of the internal power supplies exceed operational bounds; set = 0 otherwise.	N	1	1	1	Y
2	GPS 1 PPS fault	Continuously monitored and set = 1 if the OCXO drifts such that the OCXO-derived 1 PPS signal internal threshold is exceeded; set = 0 otherwise.	N	1	0	0	Y
3	10 MHz OCXO frequency fault	Continuously monitored and set = 1 if the internal threshold of the 10 MHz crystal output is exceeded due to excessive drift; set = 0 otherwise.	N	1	0	0	Y

Bit	Information Reported	Comments	Transitions from Locked to Holdover Mode?	TOD Header Alarm Bit	TOD Header Service Request Bit	GPSTM RED LED	Event written to Log?
4	10 MHz OCXO steering voltage fault	Continuously monitored and set = 1 if the internal D/A converter that steers the OXCO approaches either of its power supply rails (within 10%); set = 0 otherwise.	N	1	1	1	Y
5	9.8304 MHz PLL circuitry failure	Continuously monitored and set = 1 if the circuitry that generates the 9.8304 MHz frequency reference output fails; set = 0 otherwise.	N	1	1	1	Y
6	EEPROM check fault	Set = 1 if the EEPROM check fails during a self-test; set = 0 otherwise.	N	0	0	1	Y
7	RAM check fault	Set = 1 if the RAM check fails during a self-test; set = 0 otherwise.	N	0	0	1	Y
8	FPGA check fault	Set = 1 if the RAM check fails during a self-test; set = 0 otherwise.	N	0	0	1	Y
9	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
10	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
11	No usable GPS satellites	Continuously monitored and set = 1 if the GPSTM GPS algorithm determines that all GPS satellite information is erroneous; set = 0 otherwise.	Y	1	0	0	Y
12	PDOP (Position Dilution of Position) too high	Continuously monitored and set = 1 if the PDOP information from the decoded GPS constellation exceeds upper threshold (overdetermined GPS position solution); set = 0 otherwise.	Y	1	0	0	Y
13	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
14	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A
15	Not currently used	N/A	N/A	N/A	N/A	N/A	N/A

Table 23: GPSTM Hardware Status Register

5.1.14.7 Fault Insertion (Simulating Errors)

The GPSTM shall have the ability to simulate all of the alarms that can be reported in the Operations Status and Hardware Status Registers (OSR and HSR), represented by bits 1-9 of the OSR and by bits 0-8, 11 and 12 of the HSR. The purpose of this function is to test the response of the Nortel CDMA Metro Cell system to GPSTM errors, called Fault Insertion Testing (FIT).

A user shall have the capability to toggle any of the alarms at will through the use of an application that communicates via the GPSTM front serial port (J3). The GPS_Monitor application must not have this capability. The user must have the capability to turn on or off any valid combination of alarms, with the ability to simultaneously activate all alarms at once. Invalid combinations of alarms (such as "module over-temperature fault" in combination with "module under-temperature fault") are not required to be supported, but may be supported.

The user must have the capability to communicate to the GPSTM when a FIT session begins and when it ends. The GPSTM shall include the following mechanism to deal with FIT:

- When an alarm toggle command is given via the GPSTM front panel serial interface, the GPSTM relinquishes control of the HSR and OSR to the user of the application connected to the front serial port. The OSR and HSR report the actual GPSTM status until an alarm toggle command is issued.
- When the FIT session is ended, the GPSTM automatically resumes control of the HSR and OSR and updates them to correctly reflect the module's state. The end of a session must be indicated by one or more of: the termination of the software application, disconnecting the serial cable, resetting the GPSTM (by power cycle or software reset), or a software command.
- During the period that the HSR and OSR are controlled by the front panel serial connection, the GPSTM has to track the changes of its operating state such that when the FIT session is terminated, it can correctly report the actual operating and hardware status.

5.1.14.8 Firmware Download

Firmware shall be downloaded into the unit from the user by using the 'INSTALL' language mode. The 'INSTALL' language consists of six commands/queries:

- Erase FLASH Command
- Download Firmware Command
- Switch FLASH Load Command
- Commit Command
- Initiate FLASH Copy Command
- FLASH Copy Status Query

The GPSTM shall be capable of receiving a firmware download remotely via the CDMA system interface (J2) or locally via the user I/O port (J3) without causing interruption to the operation of the CDMA system. (The GPSTM may transition into the Holdover mode for the duration of the firmware installation.)

5.1.14.9 GPS Week Rollover/Year 2000

The GPSTM shall be designed in such a manner that upon expiration of GPS week 1023, the necessary conversions will be made in calculation of a calendar date from GPS time. Refer to the GPS SPS Signal Specification, 2nd Edition, Section 2.3.5. The GPSTM shall also accommodate Gregorian calendar dates in the year 2000 and beyond.

5.2 Input Power

The GPSTM shall be supplied with power from the shelf backplane via the CDMA System connector (J2). Power will be supplied to the GPSTM from a rectifier set that is constantly charging a bank of batteries and powering the equipment at the site. In the event of a mains failure, the equipment at the site (including the GPSTM) will operate from the batteries until the mains are restored or until the battery voltage is out of the operating range. The GPSTM shall be designed such that it can continuously operate in a stable condition at any supply voltage in the specified range for an indefinite period. This implies that if any device internal to the GPSTM is switched in or out as a function of supply voltage, the switching shall not introduce any transients which violate any requirement of this specification and hysteresis shall be utilized to keep the unit from oscillating between states under any combination of operating conditions.

5.2.1 Start-up/Turn-off

The GPSTM shall include circuitry which will automatically activate and deactivate the GPSTM as described here. The voltage values indicated are DC values and do not include transient voltage swings (see Tables 3 and 4).

For +24V operation:

- the GPSTM shall operate at 21.0 Vdc
- the GPSTM shall be shut down at 18.0 Vdc
- between these, there shall be 2.0 ± 1.0V hysteresis
- the GPSTM may shut down over 31Vdc
- if it does shut down, it shall be restarted at 30.0Vdc and there shall be at least 1V hysteresis

For -48V operation:

- the GPSTM shall operate at -38.0 Vdc
- the GPSTM may shut down below -36.0 Vdc
- if it does shut down, there shall be at least 2.0Vdc hysteresis
- the GPSTM shall operate at -60.0Vdc

- the GPSTM may shut down above -60Vdc
- if it does shut down, it shall restart at -58.0Vdc and there shall be at least 2V hysteresis

5.2.1.1 Supply Characteristics

Refer to Section 5.1 for the specifications as applicable to the incoming DC power provided to the GPSTM by the CDMA system.

5.2.1.2 In-rush Current

The (in-rush) current shall not exceed 4 amperes when the GPSTM is installed in a -48V system, and shall not exceed 8 amperes when installed in a +24V system. (There will be a 10A slow-blow fuse upstream from the GPSTM.)

5.2.1.3 Input Overcurrent Protection

Although a 10A, (slow-blow) fuse shall be located upstream from the unit an internal PCB mount fuse or Positive Thermal Coefficient (PTC) device can be used internally to protect the GPSTM. An internal (non-field replaceable) fuse or PTC shall open only in the event of a catastrophic internal failure such that a fault within the GPSTM will not trip the external 10A slow-blow fuse. Its purpose is to prevent fire and additional damage to the unit and it shall not be field accessible.

5.3 Antenna Interface

The Antenna Interface accepts the GPS signal from the antenna and supplies power via the center conductor for the antenna and in-line amplifiers. Antenna feed runs from 30 to 1000 feet are required. A different coaxial cable shall be used for the external portion of the cable run and for the indoor portion of the cable run between the GPSTM and antenna with a maximum diameter equivalent of RG-8. External refers to the environment outside the digital enclosure. Internal refers to the environment within the digital enclosure of the CDMA system. (LMR-400 is the preferred cable type for the external portion while RG-223 is the preferred cable type for the indoor portion.) An in-line surge suppressor (Polyphaser IS-MR50LNZ+6) shall be used to interface between the two cable types as a bulkhead connection on the DE. The HP58509A line amplifier, powered through the coaxial cable by the GPSTM, is acceptable for runs in which the total antenna cable path loss exceeds 20 dB. The antenna interface output circuitry shall not be damaged if the output is shorted to ground for an indefinite period. The GPSTM shall be capable of detecting an open/short on the antenna interface for troubleshooting purposes (information accessible via software interface). Once Lock has been initially achieved, detection of a problem on the antenna interface shall be included as a reason for the GPSTM being in Holdover (Refer to Section 5.1.13.3.17).

5.3.1 Antenna Unit

The GPSTM shall be expected to operate with the Aromat GPS-A-32-TNC-02-W (Matsushita CCA532ST02) antenna providing the RF input. This antenna requires a +5V +/-0.5V supply via the antenna cable centre conductor. The antenna cable shield shall provide the return path for the DC supply.

5.4 Front Panel LED Indicators

Front panel status indicators shall be limited to five LEDs to report the status of the GPSTM. The device status indicators are defined in Table 24. Three LEDs shall be located on the upper module latch (from Top to Bottom: YELLOW circle, RED triangle, GREEN rectangle) while two LEDs shall be located behind the faceplate cover (From Top to Bottom: GREEN rectangle, YELLOW rectangle). The manufacturer's manual shall provide Nortel Networks with the list of conditions that would illuminate the RED LED (internal hardware alarm conditions).

Each LED must be supplied with 20 mA (driven from +5V) to ensure uniform luminance of the LEDs on all modules within the DE.

Table 24: Front Faceplate LED Indicators

Location	Faceplate Aperture Shape	Color	Controlled by	Description
Top latch	Rectangle	GREEN	GPSTM	This LED (Nortel CPC#A0732721, QT Optoelectronics #MV8412F.MP7) shall illuminate for the In Service mode of operation. Refer to Section 5.1.3 for functionality.
Top latch	Circle	YELLOW	GPSTM	This LED (Nortel CPC#A0732717, QT Optoelectronics #MV8112F.MP7) shall illuminate for the No Communication with CM mode of operation. Refer to Section 5.1.3 for functionality.
Top latch	Triangle	RED	GPSTM/User	This LED (Nortel CPC#A0732716, QT Optoelectronics #MV8313F.MP7) shall illuminate for the Failed mode of operation, and shall be extinguished for all other modes of operation (except for Power-Up mode). Refer to Section 5.1.3 for functionality.
Behind faceplate cover	Round	GREEN	GPSTM	This LED (Nortel CPC#A0732721, QT Optoelectronics #MV8412F.MP7) shall illuminate when the GPSTM has attained lock with the GPS satellite constellation (which includes Locked, In Service, and No Communication modes of operation). When the GPSTM enters the Recovery mode, this LED shall blink at a 0.5 Hz rate (1 second ON, 1 second OFF). This LED shall be deactivated for all other modes of operation.

Location	Faceplate Aperture Shape	Color	Controlled by	Description
Behind faceplate cover	Round	YELLOW	GPSTM	This LED (Nortel CPC#A0732716, QT Optoelectronics #MV8313F.MP7) shall illuminate when the GPSTM has changed from the Locked mode of operation to the Holdover mode of operation. In the Recovery mode, this LED shall remain illuminated until the Locked mode is reacquired. When the GPSTM enters the Free-Run mode after the expiration of the Auto Holdover mode, this LED shall blink at a 0.5 Hz rate (1 second ON, 1 second OFF).

5.5 Other

Table 25 shows other requirements on the GPSTM.

Table 25: GPSTM, Other Requirements

Parameter	Requirement
Acquisition Time (all outputs meet specified performance levels)	Less than 60 minutes from the commencement of a survey (no current almanac, position or time, with four satellites in view for survey). This time shall also be met with the position set through the Serial Interface and a single satellite in view. If the GPSTM determines that its stored position is erroneous (due to relocation of the GPSTM), it shall autonomously initiate a survey in order to assure that the GPSTM has attained the Locked mode within 60 minutes, given the satellite conditions just described.
Data retention	All settings and configuration information for the unit (stored internally in memory) must survive an indefinite power outage.
Simultaneous Satellite Processing	The GPSTM is required to simultaneously track multiple satellites (when available). The data from the satellites shall be sanity checked as part of timing and/or frequency corrections. Spurious signals or data from a GPS satellite shall be excluded from timing or frequency corrections to the GPSTM signal outputs.
Averaging	The affects of Selective Availability must be averaged out such that the requirements shown in Section 5 are met.

Parameter	Requirement
Continuous Outputs	The 10 MHz reference, SYS_CLK, and Even_Second outputs are to be continuously operational while the GPSTM is transferring between satellites, the antenna is being replaced, etc. The term “operational” means meeting all specifications in Section 5.
Multi-path	The GPSTM design must be able to combat multi-path when the antenna is mounted well below the roof line of adjacent buildings. (Example 7 floors).
Periodic Outages	The GPSTM must be able to operate with periodic GPS system outages. Many antenna placements will not afford a full sky view. Operational means meeting all specifications in Section 5.
Hot Swap	The GPSTM shall support the capability to be inserted/removed to/from an operational CDMA system without causing interference to the system’s operation, provided that a redundant GPSTM is already in operation within the system when the swap is performed.
Internal Batteries	Not Allowed

6.0 Environmental Specifications

The GPSTM shall be capable of meeting all electrical specifications over the following environmental conditions.

6.1 Temperature Range

The GPSTM shall be capable of meeting all the electrical requirements outlined in Section 5 of this document over a temperature range of -5C to +70C. The maximum ambient temperature shall be reduced by 2 degrees Celsius for every 300 metres altitude above 1800 metres (per Bellcore GR-63-CORE).

The GPSTM shall be able to start and operate properly at a high temperature of +70C. High temperature test procedures are defined in IEC 68-2-2. The duration of the test shall last 72 hours. The rate of change in temperature shall be 10C/hour.

The GPSTM shall be able to start and operate properly at a low temperature of -5C. Low temperature test procedures are defined in IEC 68-2-1. The duration of the test shall be 72 hours. The rate of change in temperature shall be 10C/hour.

The GPSTM shall be able to withstand 5 (non-operational) cycles of -55 C to +70 C. Thermal shock test procedures are defined in IEC 68-2-14, Test N2.

6.2 Humidity Range

The GPSTM shall be capable of meeting all the electrical requirements outlined in Section 5 of this document over a relative humidity range of 5% to 95% (max 0.024 lbs of water per 1 lb of dry air). The test procedures are outlined in IEC 68-2-3 with a test duration of 4 days.

6.3 Altitude

The GPSTM shall be capable of meeting all the electrical requirements outlined in Section 5 of this document over an elevation range of -60 metres below sea level to 4000 metres above sea level. The maximum operating temperature requirement shall be derated by 2 degrees C per 300 metres for altitudes beyond 1800 metres (per Bellcore GR-63-CORE).

6.4 Fungus Resistance

All GPSTM components made from polymeric components shall have a fungus growth rate of zero as described and tested according to ASTM G-21.

6.5 Shipping and Storage

6.5.1 Temperature and Thermal Shock

The GPSTM shall not sustain any damage or deterioration in functional performance after being exposed to storage temperatures of -55 C to +85 C. The duration of the test shall last 72 hours. The rate of change in temperature shall be 30C/hour. Tests shall be performed according to Bellcore GR-63 CORE, Sections 5.1.1.1 and 5.1.1.2.

6.5.2 Humidity

The GPSTM shall not sustain any damage or deterioration in functional performance after being exposed to 96 hours of 40C, 90% - 95% relative humidity. The test procedure guidelines are detailed in section 5.1.1.3. of the Bellcore document GR-63-CORE.

6.5.3 Packaged Drop

The packaged GPSTM should sustain no physical damage after being subjected to a series of free falls onto a hard surface in accordance with the test procedures in section 5.3.1 of the Bellcore document GR-63-CORE.

6.5.4 Unpackaged Installer/Service Drop

The GPSTM should not sustain any physical damage or deterioration on functional performance when subjected to unpackaged drop tests in accordance with the test procedures in section 5.3.2 of the Bellcore document GR-63-CORE.

6.5.5 Shock Frailty

The packaged GPSTM should sustain no physical or functional damage after being subjected to impact loads resulting from railroad car coupling. Product shall be subjected to 3 successive 50g, 11ms half sine shocks, in each direction of three mutually perpendicular axes, in accordance with test procedures in IEC-68-2-27, Test Ea, 3rd edition, 1987.

6.5.6 Transportation Vibration

A packaged GPSTM will withstand loads applied by simulated transportation vibrations using procedures outlined in section 5.4.3, curve 2 of the Bellcore document GR-63-CORE. This exposure shall not result in damage to, or loosening of, component parts.

7.0 Electromagnetic Environment

The GPSTM shall meet all electromagnetic standards detailed in this section.

7.1 Indirect Electrostatic Discharge Immunity

The GPSTM shall be immune to indirect ESD up to 8kV contact discharge (severity level 4 + 1kV margin) with no perceptible disturbance in operation. This is defined in Bellcore GR-1089 CORE, section 2.2 and the suitable test method is defined in IEC-801-2 or Bell Canada Standard TAD8465.

7.2 Direct Electrostatic Discharge Immunity

The GPSTM shall be able to withstand direct ESD up to 15kV (severity level 4 + 15% margin) air discharge and 8kV (severity level 4 + 1kV margin) contact discharge with no perceptible disturbance in operation. This is defined in Bellcore GR-1089 CORE, section 2.2 and the suitable test method is defined in IEC-801-2 or Bell Canada Standard TAD8465. Also, ESD up to 20kV air discharge should not result in any hardware damage during operation or handling. All ports on the GPSTM shall comply with this requirement.

7.3 Electrical Fast Transient

The GPSTM shall withstand Electrical Fast Transients with no perceptible loss of operation when subjected to disturbance on Power or Signal leads. The requirement is IEC-801-4 level 2, plus 20% margin, with a suitable test method provided by that document.

7.4 Radiated Immunity

The GPSTM, when packaged in the module chassis enclosure defined by Nortel Networks, shall meet the radiated immunity requirements with doors closed in section 3.5 of the Bellcore document GR-1089-CORE with a 3 dB test margin. The test shall be performed with the GPS antenna and surge suppressor installed.

7.5 Conducted Immunity

The GPSTM, when packaged in the module chassis enclosure defined by Nortel Networks, shall meet the conducted immunity requirements in section 3.5.6 of the Bellcore document GR-1089-CORE with a 3 dB test margin. This requirement is applicable only to the GPS antenna port at the front of the module.

7.6 Lightning Protection

The Polyphaser IS-MR50LNZ+6 surge protection device shall be used with the GPSTM. This device is provided external to the GPSTM as part of the CDMA system, functioning as a bulkhead connection and ground between the interior and the exterior of the CDMA system cabinet. The GPSTM shall not be damaged and continue to operate after the system enclosure is subjected to lightning transients on its RF interface with the surge protection device installed. Specifically, at least two transients per IEC 801-5 at 19.8 kA, 1kV using the 8/20µs waveform shall be applied to the input of the surge protection device. The requirement shall be met with the Polyphaser surge protector connected to the GPSTM Antenna interface.

The GPSTM shall be totally immune to lower level surges entering via the DC power leads, as specified in requirement IEEE C62.41-1991 (Table 9, system exposure medium) for surge voltages with 5000Wp, 1 ohm, 10/1000µs. No temporary or permanent upset is allowed.

8.0 Regulatory Requirements

8.1 General

All regulatory requirements and standards shall be met over any combination of the operating conditions outlined in Section 5 of this document for all GPSTM configurations. The vendor is expected to provide the required documentation which demonstrates the products conformance to the following standards.

8.2 Electromagnetic Interference

8.2.1 Radiated Emissions

The GPSTM, when packaged in the module chassis enclosure defined by Nortel Networks, shall comply with FCC part 15, ICES-003 Class B limits and CISPR 22 Class B limits. Emissions levels shall not exceed 6 dB below the limits specified.

The GPSTM, when packaged in the module chassis enclosure defined by Nortel Networks, shall not exceed 6 dB below the radiated emissions requirements for “doors closed”, class B equipment in sections 3.2.1 and 3.2.2 in the Bellcore document GR-1089-CORE.

Also, the radiated emission levels should not exceed 6 dB below the objective specified in Bell Canada TAD 8465 section E1B which is similar to GR-1089-CORE but with different limits depending on the distance.

8.2.2 Conducted Emissions

The conducted emissions levels on the GPSTM antenna cable shall not exceed 3 dB below the limits specified in section 3.2.4 Class B limits in the Bellcore document GR-1089-CORE. The applicable frequency band is 10 kHz-30 MHz.

8.3 Product Safety

The GPSTM shall comply with the standard UL 1950, 3rd Edition with compliance to both US and Canadian requirements and Nortel Networks Corporate Standard 9101.00 Series, Product Safety Reference Data. The GPSTM shall also comply with IEC 60950 and shall be provided with a CB Scheme report. The power input to the GPSTM shall be considered as being provided by a Safety Extra Low Voltage.

8.4 Materials Flammability

All GPSTM configurations shall comply with the customer expectations for flammability as specified by UL, CSA and ASTM. These requirements are defined in Bellcore GR-63-CORE, Section 4.2, which includes the following:

Underwriter Laboratories (UL) Standard UL94.V-1, with all printed circuit boards having a minimum 94.V-0 rating

ASTM D2863-77 Oxygen Index of 28%

UL Standard UL94, VW-1 on Cables

8.5 Regulatory Submission and Maintenance

Nortel Networks and the OEM vendor will be jointly responsible for testing and compiling all data necessary for obtaining initial regulatory approvals. It is the responsibility of the OEM GPSTM vendor to submit and maintain these filings.

9.0 Quality Assurance and Qualification

9.1 General

Requirements for quality assurance and qualification shall be in accordance with NPS50561, except as specified differently in the section.

9.2 Vendor Supplied Data

Each GPSTM shall be supplied with the vendor factory test data as proof of its performance.

9.3 Production Test Plan

The GPSTM supplier testing shall be performed in accordance with the requirements specified within this document. GPSTM testing shall be performed in accordance with a test plan and procedures developed by the supplier and approved by Nortel Networks.

9.4 Product Qualification Tests

Qualification testing shall consist of detailed measurements and environmental exposure to determine that the major components/subsystems performance characteristics have been achieved prior to conducting acceptance tests. Nortel Networks reserves the right to witness and monitor the qualification tests to be conducted at the supplier's facility or other Nortel Networks approved locations. The test plan and procedures shall include specific pass/fail criteria and shall thoroughly demonstrate complete compliance of the equipment with all applicable performance specifications.

9.4.1 Test Methodology to Verify Holdover Capability

The following procedure outlines the test methods that shall be used to verify compliance of the Even_Second signal to the +/-7 µs accumulated time error specification.

There shall be three tests performed that will encompass the 65^{o}C operating range of the GPSTM (see Table 3 and Table 4 for operating conditions). The entire temperature range shall not be covered in a single holdover test; rather, it is intended that a realistic diurnal cycle be used for both training and holdover purposes.

9.4.1.1 Holdover Test 1

Prior to the commencement of this test, it is mandatory that the GPSTM under test be kept at room temperature for a period of 24 hours with no DC power applied to it. This is to permit the oscillator to cool completely and to simulate the conditions that the GPSTM would encounter prior to installation at a cell site. The test conditions should also include the air flow that the GPSTM will be exposed to under the operating conditions defined in Section 5.1.1.

The test data may be recorded visually using an oscilloscope to monitor the Even_Second output of the GPSTM under test against the Even_Second output of a control GPSTM that is kept locked to the GPS constellation throughout the entire 48 hour test period.

The test data may also be gathered automatically with a PC by forcing the GPSTM under test into manual holdover after the 24 hour training period (without disconnecting the antenna) and monitoring the Time Interval for the 24 hours of holdover (see Section 5.1.13.3.27). This method allows the user to configure the necessary timers (in software), thus removing the need for constant supervision of the test process.

- Put the GPSTM into the temperature chamber at 8C. Ensure that all required test connections are made.
- Activate the GPSTM to start the test procedure.
- Ramp the temperature chamber down to 0C at -2^{o}C/hour for four hours.
- Maintain 0C for four hours.
- Ramp the temperature chamber up to 20C at 3.3^{o}C/hour for six hours.
- Maintain 20C for four hours.
- Ramp the temperature chamber down at -2^{o}C/hour for six hours.
- Repeat the previous 5 steps to complete the second 24 hour training period.
- Force the GPSTM into holdover mode.
- Continue the temperature ramp at -2^{o}C/hour for four hours, reaching 0C as a final temperature.
- Maintain 0C for four hours.
- Ramp the temperature chamber up to 30C at 3.3^{o}C/hour for nine hours.
- Maintain 30C for four hours.
- Ramp the temperature chamber down to 0C at -10^{o}C/hour for three hours.
- Record the deviation of the Even_Second output. (If using an automated data collection method, a one-minute sampling interval is suggested for the 24 hour holdover period to permit a visual record to be constructed from the data.)

9.4.1.2 Holdover Test 2

Prior to the commencement of this test, it is mandatory that the GPSTM under test be kept at room temperature for a period of 24 hours with no DC power applied to it. This is to permit the oscillator to cool completely and to simulate the conditions that the GPSTM would encounter prior to installation at a cell site.

The test data may be recorded visually using an oscilloscope to monitor the Even_Second output of the GPSTM under test against the Even_Second output of a control GPSTM that is kept locked to the GPS constellation throughout the entire 48 hour test period.

The test data may also be gathered automatically with a PC by forcing the GPSTM under test into manual holdover after the 24 hour training period (without disconnecting the antenna) and monitoring the Time Interval for the 24 hours of holdover (see Section 5.1.13.3.27). This method allows the user to configure the necessary timers (in software), thus removing the need for constant supervision of the test process.

- Put the GPSTM into the temperature chamber at 28C. Ensure that all required test connections are made.
- Activate the GPSTM to start the test procedure.
- Ramp the temperature chamber down to 20C at -2^{o}C/hour for four hours.
- Maintain 20C for four hours.
- Ramp the temperature chamber up to 40C at 3.3^{o}C/hour for six hours.
- Maintain 40C for four hours.
- Ramp the temperature chamber down at -2^{o}C/hour for six hours.
- Repeat the previous 5 steps to complete the second 24 training period.
- Force the GPSTM into holdover mode.
- Continue the temperature ramp at -2^{o}C/hour for four hours, reaching 20C as a final temperature.
- Maintain 20C for four hours.
- Ramp the temperature chamber up to 50C at 10^{o}C/hour for three hours.
- Maintain 50C for four hours.
- Ramp the temperature chamber down at -2^{o}C/hour for nine hours.
- Record the deviation of the Even_Second output. (If using an automated data collection method, a one-minute sampling interval is suggested for the 24 hour holdover period to permit a visual record to be constructed from the data.)

9.4.1.3 Holdover Test 3

Prior to the commencement of this test, it is mandatory that the GPSTM under test be kept at room temperature for a period of 24 hours with no DC power applied to it. This is to permit the oscillator to cool completely and to simulate the conditions that the GPSTM would encounter prior to installation at a cell site.

The test data may be recorded visually using an oscilloscope to monitor the Even_Second output of the GPSTM under test against the Even_Second output of a control GPSTM that is kept locked to the GPS constellation throughout the entire 48 hour test period.

The test data may also be gathered automatically with a PC by forcing the GPSTM under test into manual holdover after the 24 hour training period (without disconnecting the antenna) and monitoring the Time Interval for the 24 hours of holdover (see Section 5.1.13.3.27). This method allows the user to configure the necessary timers (in software), thus removing the need for constant supervision of the test process.

- Put the GPSTM into the temperature chamber at 43C. Ensure that all required test connections are made.
- Activate the GPSTM to start the test procedure.
- Ramp the temperature chamber down to 35C at -2^{o}C/hour for four hours.
- Maintain 35C for four hours.
- Ramp the temperature chamber up to 55C at 3.3^{o}C/hour for six hours.
- Maintain 55C for four hours.
- Ramp the temperature chamber down at -2^{o}C/hour for six hours.
- Repeat the previous 5 steps to complete the second 24 training period.
- Force the GPSTM into holdover mode.
- Continue the temperature ramp at -2^{o}C/hour for four hours, reaching 35C as a final temperature.
- Maintain 35C for four hours.
- Ramp the temperature chamber up to 65C at 10^{o}C/hour for three hours.
- Maintain 65C for four hours.
- Ramp the temperature chamber down to at -2^{o}C/hour for nine hours.
- Record the deviation of the Even_Second output. (If using an automated data collection method, a one-minute sampling interval is suggested for the 24 hour holdover period to permit a visual record to be constructed from the data.)

9.5 Acceptance Testing

Each deliverable GPSTM, when fabricated, shall undergo acceptance testing to verify proper workmanship, identify manufacturing defects and determine that all components of the GPSTM function properly before delivery.

9.6 Traceability

For auditing purposes, the GPSTM supplier shall retain all original notes, test data and prototypes for a period of one calendar year. The supplier shall supply this information to Nortel Networks or regulatory agencies when requested.

9.7 Reliability Monitor

The supplier shall establish a reliability program which provides for environmental stress testing on a sample basis. The test results shall be made available to Nortel Networks upon request.

9.8 Design Inspection

The GPSTM supplier shall provide detailed design schematics of all interface circuitry to Nortel Networks for purposes of design inspection.

9.9 Workmanship Evaluation

The GPSTM shall be dismantled, where necessary, to allow inspection. The GPSTM shall conform to NPS50561.

10.0 Preparation For Delivery

10.1 Packaging

Items covered by this specification shall be packaged in a manner which will provide protection against damage during shipment, handling and storage in reasonably dry, unheated quarters. Packing shall be in accordance with NPS50561.

10.2 Operation Manual

The vendor shall provide a copy of an operation manual with each GPSTM. (The implementation of this requirement shall be negotiated between Nortel Networks and the vendor.)

10.3 Commissioning Tool

The vendor shall provide a copy of a software tool for field commissioning purposes with each GPSTM. (The implementation of this requirement shall be negotiated between Nortel Networks and the vendor.) The Trimble Navigation GPS_Monitor.exe (V1.3b) and WLOAD.exe (V1.03a) shall not be revised or updated further without approval from Nortel Networks.

11.0 Product Changes

The vendor shall provide a “Manufacturing Baseline” defining the criteria requiring Change Management Approval by Nortel Networks. The Manufacturing Baseline will include:

- Production Processes

- Test Processes

- Critical Components (i.e.: oscillators, DC-DC converters)

- Module Pass/Fail Criteria

The Manufacturing Baseline shall be agreed to by both parties.

The vendor shall notify the Nortel Networks component engineering prime for the GPSTM of all changes affecting the design or manufacture of the GPSTM. Any change covered by the Manufacturing Baseline will required the written approval of the Nortel Networks component engineer.

The Manufacturing Baseline shall, at the request of either party, be reviewed and, if mutually agreed, changed.

Approval by Nortel Networks of the vendor’s request for change shall not waive the vendor’s obligation and in no way shall relieve the vendor of their obligation to meet or exceed all the specifications for the GPSTM.

12.0 Reliability Assurance

The intent of this section to define the reliability and quality requirements for this product and to ensure that it will be able to meet all technical specifications through its life time.

12.1 Reliability

The GPSTM shall have a minimum calculated MTBF of greater than 250,000 hours when operated in a ground, fixed, uncontrolled environment as defined in Bellcore document TR-NWT-000332, Issue 4, at an ambient temperature of 40C. The vendor shall use Bellcore Method I for these calculations.

12.2 Eliminating Infant Mortality Failures

The vendor must implement a program/process in production to minimize infant mortality of this product. Production units must pass all functional specifications. The expectation is to encounter no more than one failure per specified lot or 1% failure of total production per month. If failures occur, they must be analyzed, root cause must be determined, and corrective action must be implemented.

12.3 Statistical Product Monitoring

The vendor will implement Statistical Process Monitoring during production testing. The supplier must provide a monthly report of Cpk values on critical parameters. Cpk values will be measured on the top three critical parameters of this product.

12.4 Field Performance Monitoring

The supplier will track and document all field performance data on all deployed products to customers. In the occurrence of a product failure in the field, Nortel Networks will transfer all failed units to the vendor for failure analysis.

The supplier will failure analyze the failed units and release a report, to Nortel Networks, describing the failures which were found. The report should include a failure log, a “Time to Failure Plot”, and a Pareto of failure causes and the corrective action to be implemented.

12.5 Product Reliability Growth

During the ongoing manufacturing of this product, it is expected, as part of a joint commitment to quality products, that the supplier demonstrate a continual product reliability growth. The supplier will provide information to demonstrate ongoing product reliability growth.

This can be accomplished by design improvements (within the form, fit and function of the product specification) improved manufacturing processes, new suppliers, or by any means the supplier so chooses.

A report is required monthly that illustrates the current reliability level and a list of actions that were used to create growth.

12.6 Yield Improvement Program

The supplier must continually identify the five top reasons for poor yield on this product and take the appropriate steps to address these issues.