SERVICE MANUAL

Horizon II *macro*

GMR-01

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Manual Revision

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Incorporate this GMR only in the manual number and version listed below:

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Problem reports

This revision provides a fix to the following problem reports:

No new Service Requests fixed in this revision.

Reason for revision

This revision provides additional and updated information as follows:

Tech. Chap. 1:	Page Tech. 1-13: Table Tech. 1-4 revised – current supply figures corrected. Table Tech. 1-5 revised – cabinet power consumption figures updated and PSU output figures added. Battery backup section moved here from page Tech 1-15.
	Page Tech. 1-14: Thermal dissipation section deleted. Minor change to Table Tech. 1-7. Note added to clarify measurement point for RF output power.
	Page Tech. 1-15: Sensitivity section rewritten.
Tech. Chap. 4:	Page Tech. 4-9: Text clarified to refer to Horizon*macro* indoor only.
	Page Tech. 4-19: Text clarified to refer to Horizon*macro* indoor only.
Tech. Chap. 5:	Page Tech. 5-5: Note added
Maint. Chap. 2:	Page Maint. 2-17: M4 Torx driver changed to T20 Torx driver in step 3 and step 7.
	Page Maint. 2-21: M4 Torx driver changed to T20 Torx driver in step 6.
	Page Maint. 2-22: M4 Torx driver changed to T20 Torx driver in step 4.
	Page Maint. 2-38: **`cal_test_mode on`** command added to Rx bay level calibration procedure.
	Page Maint. 2-55: Note added.
Maint. Chap. 3:	Page Maint. 3-16: **`cal_test_mode on`** command added to Tx output power calibration procedure.
	Page Maint. 3-17: Steps 9 and 11 of Tx output power calibration procedure rewritten.
	Page Maint. 3-18: RF channel and frequency numbers changed.

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Horizon II *macro*

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Issue status of this manual

Introduction

The following shows the issue status of this manual since it was first released.

Version information

The following table lists the versions of this manual in order of manual issue:

Manual issue	Date of issue	Remarks
A	02 May 2003	Original issue.

Resolution of Service Requests

The following Service Requests are now resolved in this manual:

Service Request	GMR Number	Remarks
1063561 1065322	n/a	CTU2 calibration procedures updated prior to final release.

General information

Important notice

If this manual was obtained when attending a Motorola training course, it will not be updated or amended by Motorola. It is intended for TRAINING PURPOSES ONLY. If it was supplied under normal operational circumstances, to support a major software release, then corrections will be supplied automatically by Motorola in the form of General Manual Revisions (GMRs).

Purpose

Motorola cellular communications manuals are intended to instruct and assist personnel in the operation, installation and maintenance of the Motorola cellular infrastructure equipment and ancillary devices. It is recommended that all personnel engaged in such activities be properly trained by Motorola.

WARNING	Failure to comply with Motorola's operation, installation and maintenance instructions may, in exceptional circumstances, lead to serious injury or death.

These manuals are not intended to replace the system and equipment training offered by Motorola, although they can be used to supplement and enhance the knowledge gained through such training.

About this manual

The manual contains technical descriptions of the hardware elements and repair procedures and parts lists for the Horizon II *macro* equipment.

The objectives of this manual are to help the reader:

- Gain an overview of the equipment and interconnection of components.
- Understand the function and operation of all components.
- Recognize configurations and equivalent module functions to previous cabinet designs (M-Cell*6* and Horizon*macro*).
- Understand how to inspect, maintain, and repair the equipment.
- Be aware of the **warnings** (potential for harm to people) and **cautions** (potential for harm to equipment) to be observed when working on the equipment.
- Have a clear ready reference for all dedicated information in one manual.

NOTE	For installation and commissioning information refer to *Installation and Configuration,* Horizon II *macro, 68P02902W97*.

Feature references

Most of the manuals in the set, of which this manual is part, are revised to accommodate features released at Motorola General System Releases (GSRn) or GPRS Support Node (GSNn) releases. In these manuals, new and amended features are tagged to help users to assess the impact on installed networks. The tags are the appropriate Motorola Roadmap DataBase (RDB) numbers or Research and Development Prioritization (RDP) numbers. The tags include index references which are listed in the manual Index. The Index includes the entry **feature** which is followed by a list of the RDB or RDP numbers for the released features, with page references and hot links in electronic copy.

The tags have the format: {nnnn} or {nnnnn}

Where:	**is:**
{nnnn}	the RDB number
{nnnnn}	the RDP number

The tags are positioned in text as follows:

New and amended feature information	Tag position in text
New sentence/s or new or amended text.	Immediately before the affected text.
Complete new blocks of text as follows: • Full sections under a main heading • Full paragraphs under subheadings	Immediately after the headings as follows: • Main heading • Subheading
New or amended complete Figures and Tables	After the Figure or Table number and before the title text.
Warning, Caution and Note boxes.	Immediately before the affected text in the box.
General command syntax, operator input or displays (in special fonts).	On a separate line immediately above the affected item.

For a list of Roadmap numbers and the RDB or RDP numbers of the features included in this software release, refer to the manual *System Information: GSM Overview (68P02901W01)*, or to the manual *System Information: GPRS Overview (68P02903W01)*.

Data encryption

In order to avoid electronic eavesdropping, data passing between certain elements in the GSM and GPRS network is encrypted. In order to comply with the export and import requirements of particular countries, this encryption occurs at different levels as individually standardised, or may not be present at all in some parts of the network in which it is normally implemented. The manual set, of which this manual is a part, covers encryption as if fully implemented. Because the rules differ in individual countries, limitations on the encryption included in the particular software being delivered, are covered in the Release Notes that accompany the individual software release.

Cross references

Throughout this manual, cross references are made to the chapter numbers and section names. The section name cross references are printed bold in text.

This manual is divided into uniquely identified and numbered chapters that, in turn, are divided into sections. Sections are not numbered, but are individually named at the top of each page, and are listed in the table of contents.

Text conventions

The following conventions are used in the Motorola cellular infrastructure manuals to represent keyboard input text, screen output text and special key sequences.

Input

Characters typed in at the keyboard are shown like this.

Output

Messages, prompts, file listings, directories, utilities, and environmental variables that appear on the screen are shown like this.

Special key sequences

Special key sequences are represented as follows:

CTRL–c	Press the Control and c keys at the same time.
ALT–f	Press the Alt and f keys at the same time.
|	Press the pipe symbol key.
CR or **RETURN**	Press the Return key.

Reporting safety issues

Introduction

Whenever a safety issue arises, carry out the following procedure in all instances. Ensure that all site personnel are familiar with this procedure.

Procedure

Whenever a safety issue arises:

1. Make the equipment concerned safe, for example by removing power.
2. Make no further attempt to adjust or rectify the equipment.
3. Report the problem directly to the Customer Network Resolution Centre, Swindon +44 (0)1793 565444 or China +86 10 68437733 (telephone) and follow up with a written report by fax, Swindon +44 (0)1793 430987 or China +86 10 68423633 (fax).
4. Collect evidence from the equipment under the guidance of the Customer Network Resolution Centre.

Warnings and cautions

Introduction

The following describes how warnings and cautions are used in this manual and in all manuals of this Motorola manual set.

Warnings

Definition of Warning

A warning is used to alert the reader to possible hazards that could cause loss of life, physical injury, or ill health. This includes hazards introduced during maintenance, for example, the use of adhesives and solvents, as well as those inherent in the equipment.

Example and format

WARNING	Do not look directly into fibre optic cables or data in/out connectors. Laser radiation can come from either the data in/out connectors or unterminated fibre optic cables connected to data in/out connectors.

Failure to comply with warnings

Observe all warnings during all phases of operation, installation and maintenance of the equipment described in the Motorola manuals. **Failure to comply with these warnings, or with specific warnings elsewhere in the Motorola manuals, or on the equipment itself, violates safety standards of design, manufacture and intended use of the equipment. Motorola assumes no liability for the customer's failure to comply with these requirements.**

Cautions

Definition of Caution

A caution means that there is a possibility of damage to systems, software or individual items of equipment within a system. However, this presents no danger to personnel.

Example and format

CAUTION	Do not use test equipment that is beyond its due calibration date; arrange for calibration to be carried out.

General warnings

Introduction

Observe the following specific warnings during all phases of operation, installation and maintenance of the equipment described in the Motorola manuals:

- Potentially hazardous voltage
- Electric shock
- RF radiation
- Laser radiation
- Heavy equipment
- Parts substitution
- Battery supplies
- Lithium batteries

Failure to comply with these warnings, or with specific warnings elsewhere in the Motorola manuals, violates safety standards of design, manufacture and intended use of the equipment. Motorola assumes no liability for the customer's failure to comply with these requirements.

Warning labels

Warnings particularly applicable to the equipment are positioned on the equipment. Personnel working with or operating Motorola equipment must comply with any warning labels fitted to the equipment. Warning labels must not be removed, painted over or obscured in any way.

Specific warnings

Specific warnings used throughout the GSM manual set are shown below. These will be incorporated into procedures as applicable.

These must be observed by all personnel at all times when working with the equipment, as must any other warnings given in text, in the illustrations and on the equipment.

Potentially hazardous voltage

WARNING	This equipment operates from a hazardous voltage of 230 V ac single phase or 415 V ac three phase supply. To achieve isolation of the equipment from the ac supply, the ac input isolator must be set to off and locked.

When working with electrical equipment, reference must be made to the Electricity at Work Regulations 1989 (UK), or to the relevant electricity at work legislation for the country in which the equipment is used.

NOTE	Motorola GSM equipment does not utilise high voltages.

Electric shock

WARNING	Do not touch the victim with your bare hands until the electric circuit is broken. Switch off. If this is not possible, protect yourself with dry insulating material and pull or push the victim clear of the conductor. ALWAYS send for trained first aid or medical assistance IMMEDIATELY.

In cases of low voltage electric shock (including public supply voltages), serious injuries and even death, may result. Direct electrical contact can stun a casualty causing breathing, and even the heart, to stop. It can also cause skin burns at the points of entry and exit of the current.

In the event of an electric shock it may be necessary to carry out artificial respiration. ALWAYS send for trained first aid or medical assistance IMMEDIATELY.

If the casualty is also suffering from burns, flood the affected area with cold water to cool, until trained first aid or medical assistance arrives.

RF radiation

WARNING	High RF potentials and electromagnetic fields are present in this equipment when in operation. Ensure that all transmitters are switched off when any antenna connections have to be changed. Do not key transmitters connected to unterminated cavities or feeders.

Relevant standards (USA and EC), to which regard should be paid when working with RF equipment are:

- ANSI IEEE C95.1-1991, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*.
- CENELEC 95 ENV 50166-2, *Human Exposure to Electromagnetic Fields High Frequency (10 kHz to 300 GHz)*.

Laser radiation

WARNING	Do not look directly into fibre optic cables or optical data in/out connectors. Laser radiation can come from either the data in/out connectors or unterminated fibre optic cables connected to data in/out connectors.

Lifting equipment

WARNING	When dismantling heavy assemblies, or removing or replacing equipment, a competent responsible person must ensure that adequate lifting facilities are available. Where provided, lifting frames must be used for these operations.

When dismantling heavy assemblies, or removing or replacing equipment, the competent responsible person must ensure that adequate lifting facilities are available. Where provided, lifting frames must be used for these operations. When equipments have to be manhandled, reference must be made to the Manual Handling of Loads Regulations 1992 (UK) or to the relevant manual handling of loads legislation for the country in which the equipment is used.

Parts substitution

WARNING	Do not install substitute parts or perform any unauthorized modification of equipment, because of the danger of introducing additional hazards.Contact Motorola if in doubt to ensure that safety features are maintained.

Battery supplies

WARNING	Do not wear earth straps when working with standby battery supplies.

Lithium batteries

WARNING	Lithium batteries, if subjected to mistreatment, may burst and ignite. Defective lithium batteries must not be removed or replaced. Any boards containing defective lithium batteries must be returned to Motorola for repair.

Contact your local Motorola office for how to return defective lithium batteries.

General cautions

Introduction

Observe the following cautions during operation, installation and maintenance of the equipment described in the Motorola manuals. Failure to comply with these cautions or with specific cautions elsewhere in the Motorola manuals may result in damage to the equipment. Motorola assumes no liability for the customer's failure to comply with these requirements.

Caution labels

Personnel working with or operating Motorola equipment must comply with any caution labels fitted to the equipment. Caution labels must not be removed, painted over or obscured in any way.

Specific cautions

Cautions particularly applicable to the equipment are positioned within the text of this manual. These must be observed by all personnel at all times when working with the equipment, as must any other cautions given in text, on the illustrations and on the equipment.

Fibre optics

CAUTION	Fibre optic cables must not be bent in a radius of less than 30 mm.

Static discharge

CAUTION	Motorola equipment contains CMOS devices. These metal oxide semiconductor (MOS) devices are susceptible to damage from electrostatic charge. See the section **Devices sensitive to static** in the preface of this manual for further information.

Devices sensitive to static

Introduction

Certain metal oxide semiconductor (MOS) devices embody in their design a thin layer of insulation that is susceptible to damage from electrostatic charge. Such a charge applied to the leads of the device could cause irreparable damage.

These charges can be built up on nylon overalls, by friction, by pushing the hands into high insulation packing material or by use of unearthed soldering irons.

MOS devices are normally despatched from the manufacturers with the leads shorted together, for example, by metal foil eyelets, wire strapping, or by inserting the leads into conductive plastic foam. Provided the leads are shorted it is safe to handle the device.

Special handling techniques

In the event of one of these devices having to be replaced, observe the following precautions when handling the replacement:

- Always wear an earth strap which must be connected to the electrostatic point (ESP) on the equipment.
- Leave the short circuit on the leads until the last moment. It may be necessary to replace the conductive foam by a piece of wire to enable the device to be fitted.
- Do not wear outer clothing made of nylon or similar man made material. A cotton overall is preferable.
- If possible work on an earthed metal surface or anti-static mat. Wipe insulated plastic work surfaces with an anti-static cloth before starting the operation.
- All metal tools should be used and when not in use they should be placed on an earthed surface.
- Take care when removing components connected to electrostatic sensitive devices. These components may be providing protection to the device.

When mounted onto printed circuit boards (PCBs), MOS devices are normally less susceptible to electrostatic damage. However PCBs should be handled with care, preferably by their edges and not by their tracks and pins, they should be transferred directly from their packing to the equipment (or the other way around) and never left exposed on the workbench.

Motorola manual set

Introduction

The following manuals provide the information needed to operate, install and maintain the Motorola equipment. CD-ROMs are available, with full navigation, for GSM, and GPRS manual sets.
Each CD-ROM includes all manuals related to a specified main GSM or GPRS software release, together with current versions of appropriate hardware manuals. A snapshot copy of online documentation is also included, though it will not be updated in line with subsequent point releases.
The CD-ROM does not include Release Notes or documentation supporting specialist products such as MARS or COP.

Generic GSM manuals

The following are the generic manuals in the GSM manual set, these manuals are release dependent:

Identification/Order number	Name
68P02901W01	System Information: GSM Overview
68P02901W14*	Operating Information: GSM System Operation
68P02901W19	Operating Information: OMC-R System Administration
68P02901W34**	Technical Description: OMC-R Database Schema
68P02901W36	Technical Description: BSS Implementation
68P02901W23	Technical Description: BSS Command Reference
68P02901W17	Installation & Configuration: GSM System Configuration
68P02901W43	Installation & Configuration: BSS Optimization
68P02901W47	Installation & Configuration: OMC-R Clean Install
68P02901W26	Maintenance Information: Alarm Handling at the OMC-R
68P02901W58	Maintenance Information: BSS Timers
68P02901W57	Maintenance Information: Device State Transitions
68P02901W51	Maintenance Information: BSS Field Troubleshooting
68P02901W56	Maintenance Information: GSM Statistics Application
68P02901W72	Software Release Notes: BSS/RXCDR
68P02901W74	Software Release Notes: OMC-R System

* Not on paper - In the OMC-R Online Help as *Network Operations*. A snapshot of online help is available on CD-ROM.

** Not on paper - On CD-ROM only.

Related GSM manuals

The following are related Motorola GSM manuals:

Identification/Order number	Name
68P02900W21	System Information: BSS Equipment Planning
68P02900W22	System Information: DataGen
68P02900W76	Software Release Notes: DataGen
68P02900W25	System Information: GSM Advance Operational Impact
68P02900W36	System Information: Network Health Analyst
68P02900W77	Software Release Notes: Network Health Analyst
68P02900W90	System Information: Cell Optimization (COP)
68P02900W94	System Information: Motorola Analysis and Reporting System (MARS)
68P02900W69	Software Release Notes: Cell Optimization (COP)
68P02900W68	Software Release Notes: Motorola Analysis and Reporting System (MARS)
68P02901W10	Operating Information: OMC-R System Administration (OSI)
68P02901W39	Installation & Configuration: OSI Clean Install
68P02901W70	Software Release Notes: OMC-R OSI System

Generic GPRS manuals

The following are the generic manuals in the GPRS manual set, these manuals are release dependent:

Identification/Order number	Name
68P02903W01	System Information: GPRS Overview
68P02903W03	Operating Information: OMC-G System Administration
68P02903W37	Operating Information: GSN System Administration
68P02903W46	Technical Description: OMC-G Database Schema
68P02903W18 *	Technical Description: GSN Command Reference
68P02903W47	Installation & Configuration: GSN Clean Install
68P02903W04	Installation & Configuration: OMC-G Clean Install
68P02903W19 *	Maintenance Information: Alarm Handling at the OMC-G
68P02903W20	Maintenance Information: GSN Statistics Application
68P02903W76	Software Release Notes: GSN System
68P02903W70	Software Release Notes: OMC-G System

* Not on paper - In the OMC-G Online Help as *Alarm Handling* and *GSN Commands/Parameters*. A snapshot of online help is available on CD-ROM.

Related GPRS manuals

The following are related Motorola GPRS manuals:

Identification/Order number	Name
68P02903W02	System Information: GPRS Equipment Planning
68P02903W38	System Information: GSN Advance Operational Impact

BSS service manuals

The following are the Motorola Base Station Subsystem service manuals, these manuals are not release dependent. The internal organization and makeup of service manual sets may vary, they may consist of from one to four separate manuals, but they can all be ordered using the overall catalogue number shown below:

Identification/Order number	Name
68P02901W37	Service Manual: BTS
68P02901W38	Service Manual: BSC/RXCDR
68P02901W75	Service Manual: M-Cell*2*
68P02901W85	Service Manual: M-Cell*6*
68P02901W95	Service Manual: M-Cell*city* and M-Cell*city*+
68P02901W65	Service Manual: M-Cell*access*
68P02901W90	Service Manual: M-Cell*micro*
68P02902W36	Service Manual: Horizon*micro*
68P02902W15	Service Manual: Horizon*compact*
68P02902W06	Service Manual: Horizon*macro* Indoor
68P02902W12	Service Manual: Horizon*macro* Outdoor
68P02902W61	Service Manual: Horizon*micro2* Horizon*compact2*
68P02902W66	Service Manual: Horizon*macro* 12 Carrier Outdoor
68P02902W96	Service Manual:Horizon II *macro*
68P02902W97	Installation & Configuration: Horizon II *macro*

GPRS service manuals

The following are the Motorola GPRS service manuals, these manuals include the Packet Control Unit (PCU) service manual which becomes part of the BSS for GPRS:

Identification/Order number	Name
68P02903W05	Service Manual: GPRS Support Node (GSN)
68P02903W07	Installation & Configuration: GSN (legacy cabinets)
68P02903W23	Installation & Configuration: GSN (common data cabinets)
68P02903W10	Service Manual: Packet Control Unit (PCU)
68P02903W12	Installation & Configuration: PCU (legacy cabinets)
68P02903W24	Installation & Configuration: PCU (common data cabinets)

Order number

The Motorola 68P order (catalogue) number is used to order manuals.

Ordering manuals

All orders for Motorola manuals must be placed with your Motorola Local Office or Representative. Manuals are ordered using the order (catalogue) number.

Manuals are available on the following media:

Printed hard copy

Electronic:

- On the Motorola service web.
- CD-ROM library produced in support of a major system software release.

GMR amendment

Introduction to GMRs

Changes to a manual that occur after the printing date are incorporated into the manual using General Manual Revisions (GMRs). GMRs are issued to correct Motorola manuals as and when required. A GMR has the same identity as the target manual. Each GMR is identified by a number in a sequence that starts at 01 for each manual at each issue.

GMR availability

GMRs are published as follows:

- Printed hard copy - Complete replacement content or loose leaf pages with amendment list.
  - Remove and replace pages in this manual, as detailed on the GMR instruction sheet.
- Motorola service web - Updated at the same time as hard copies.
- CD-ROM - Updated periodically as required.

GMR amendment record

GMR instructions

When a GMR is inserted in this manual, the amendment record below is completed to record the GMR. Retain the instruction sheet that accompanies each GMR and insert it in a suitable place in this manual for future reference.

Amendment record

Record the insertion of GMRs in this manual in the following table:

GMR number	Incorporated by (signature)	Date
01	**Incorporated (this GMR)**	**26 Sep 2003**
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		
13		
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15		
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23		
24		
25		

CHAPTER 1
EQUIPMENT INTRODUCTION AND SPECIFICATIONS

CHAPTER 2
CABINET STRUCTURE

CHAPTER 3
POWER DISTRIBUTION

CHAPTER 4
RF MODULES

CHAPTER 5
DIGITAL MODULES

MOTOROLA

Technical Description (Tech.)

MOTOROLA

Chapter 1

Introduction to the

Horizon II *macro*

Equipment introduction

Overview of the Horizon II *macro*

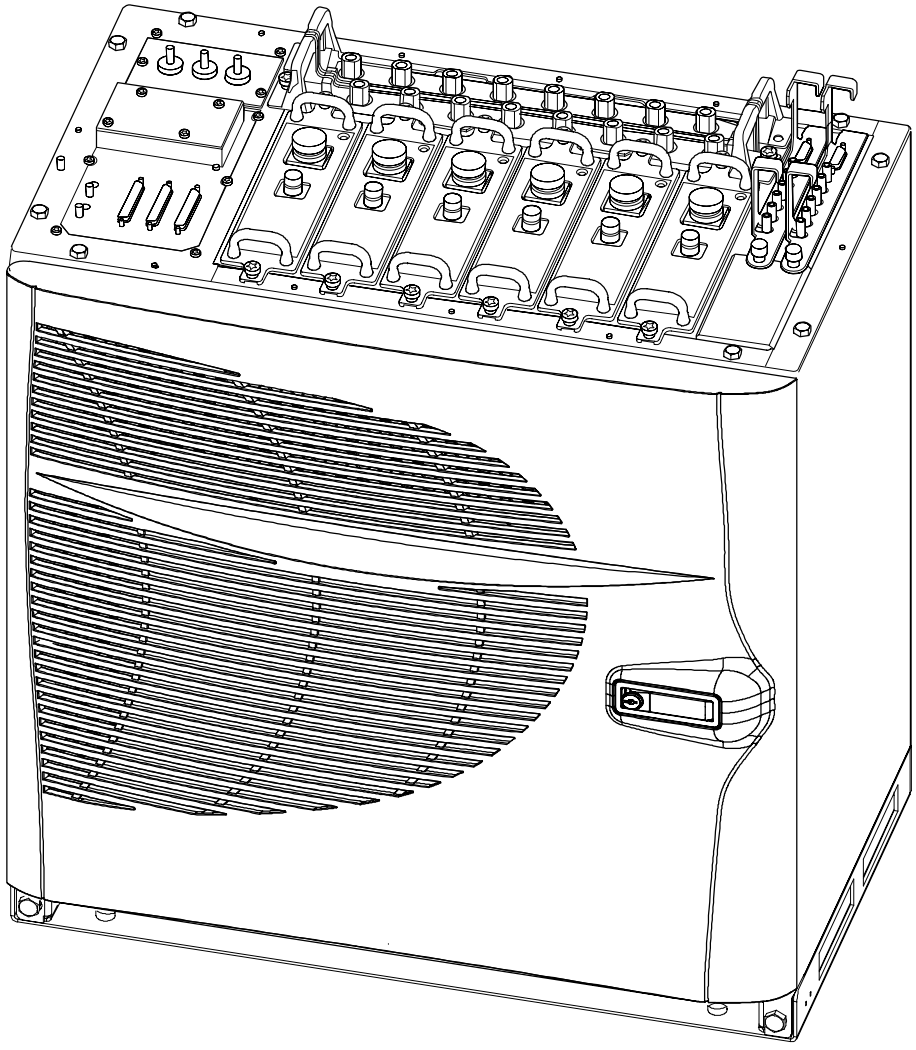
The Horizon II *macro* is a 12 carrier base transceiver station (BTS) cabinet, with variants that operate in the GSM/EGSM900 and DCS1800 frequency bands.

The BTS cabinets are designed for indoor use. They can operate from either –48/60 V dc (positive earth), +27 V dc (negative earth), or wide input, nominal 120/240 V, ac single phase supplies.

Cabinet cooling is provided by circulation fans located in the bottom of the cabinet. In addition, each power supply contains an integral cooling fan.

Figure Tech. 1-1 shows an external view of a standard Horizon II *macro* cabinet.

Figure Tech. 1-1 Horizon II *macro* cabinet on plinth



Finding information in this manual

A full table of contents (TOC) is provided at the front of this manual. Headings are designed to convey contents accurately, to simplify searching for specific information. The index at the back of the manual provides an alternative method of finding subsections of information. This chapter provides a summary of the equipment, to enable readers to understand terminology and thus locate information via the TOC and index.

The service manual comprises two main sections:

- **Technical Description**

  Provides an introduction, specifications, and technical descriptions of all Horizon II *macro* components.

- **Maintenance and Parts**

  Provides information on maintenance and repair, with procedures to change field replaceable units (FRUs). Lists of options and spares, with diagrams to illustrate FRUs, are also included.

Each section is divided into chapters. The information in each chapter is grouped according to functionality, as shown in Figure Tech. 1-2.

NOTE	Installation information for the Horizon II *macro* is **not** provided in this manual (refer to Horizon II *macro: Installation and Configuration, 68P02902W97* for installation and configuration information).

Names and acronyms for main cabinet equipment

This section provides an overview of the equipment in the Horizon II *macro* cabinet.

The Horizon II *macro* cabinet consists of the cabinet frame structure (including door), a main cage with integrated backplane and a top panel. It contains the following equipment, as shown in Figure Tech. 1-2, listed from the base up:

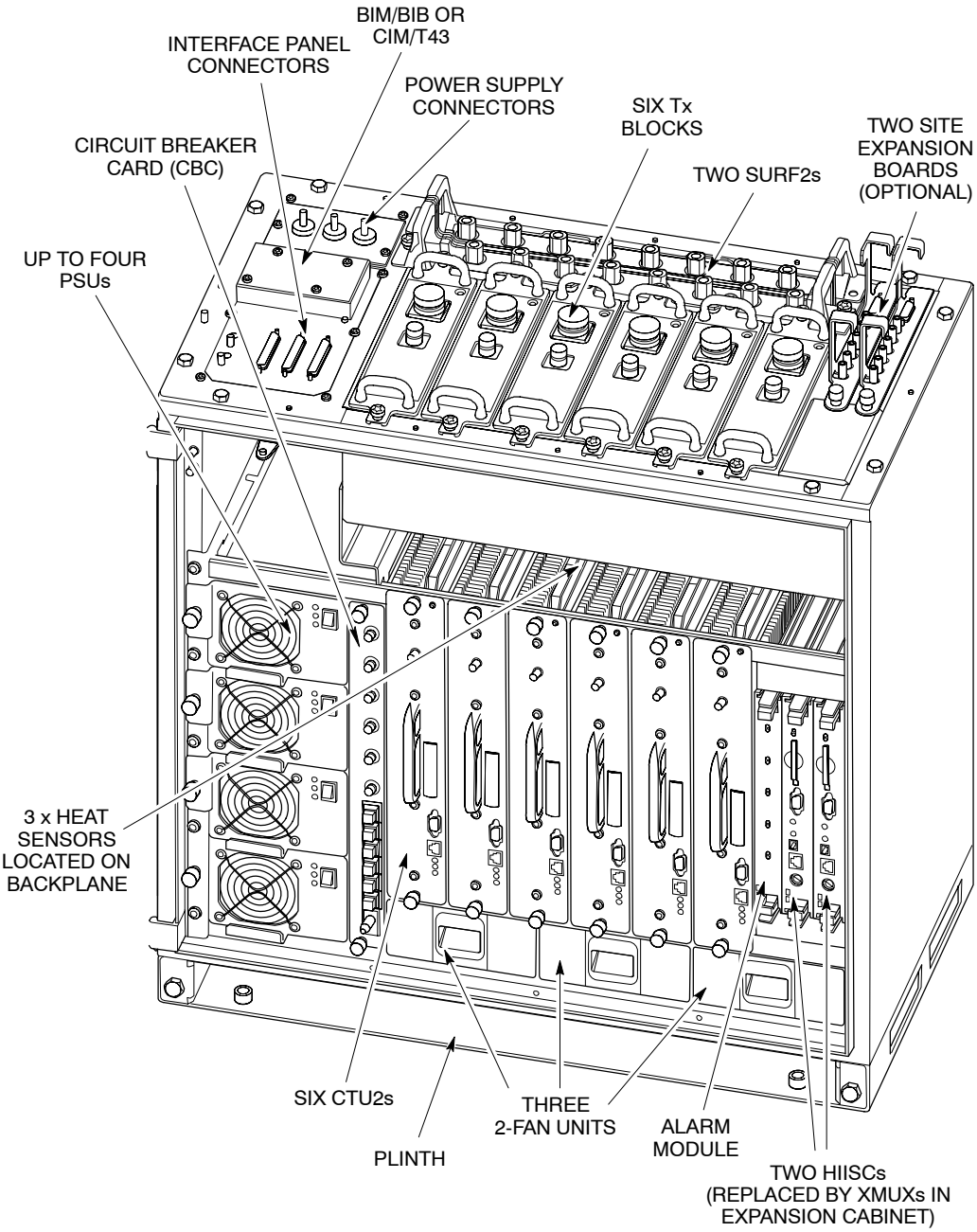
- Plinth.
  This secures the cabinet firmly to the floor (or to the stacking bracket in a stacked configuration).
- Fan module (x3).
  These provide cooling for the cabinet, and especially for the CTU2 transceivers and digital modules mounted directly above.
- Power supply unit (PSU).
  The PSUs are load sharing. In a fully equipped cabinet, a fourth PSU provides 3 + 1 redundancy. The PSUs contain integral cooling fans.
- Circuit breaker card (CBC).
  The CBC provides circuit protection and the facility to manually isolate individual modules within the Horizon II *macro* cabinet.
- Compact transceiver unit (CTU2).
  Provides amplification and signal conditioning for outgoing (Tx) signals and receives Rx signals from the SURF2. The CTU2 provides 2 x GSM/GPRS and 1 x EDGE capability. It is backwards compatible with the Horizon*macro* CTU (with BBH limitations in double density form). Up to six CTU2s may be fitted in the cabinet to provide 12 GSM/GPRS carriers (double density).
- Alarm module.
  This handles all cabinet alarm I/O signals and provides current sensing for external site alarms (via the PIX connectors).
- Site controller unit (HIISC).
  Provides the site processing functions for the BTS (equivalent to the MCUF in Horizon*macro*). Includes an integrated XMUX and NIU. Provision is made for an additional HIISC to be fitted, if redundancy is required.
- Expansion multiplexer module (XMUX).
  An optional module that replaces the site controller unit in an expansion (slave) cabinet to provide multiplexer connections to the master cabinet. An additional XMUX can be installed if redundancy is required.
- Power distribution assembly (PDA).
  Mounted on the left side of the top panel assembly. Provides the connectors for ac or dc power input. Also contains the interface panel for customer communications connectors.
- Sectorized universal receiver front end (SURF2) module.
  Mounted at the rear of the top panel assembly. Provides amplification and signal conditioning functions for incoming (Rx) signals. One or two SURF2s may be fitted to provide 2 or 4 branch receive diversity.

- Tx blocks.
  Up to six Tx blocks can be fitted in the basket in the top panel. There are three types of Tx block available for the Horizon II *macro*: duplexer (DUP), hybrid combiner unit (HCU) and dual hybrid combiner unit (DHU).
- Site expansion board.
  An optional module that is mounted in the right side of the top panel assembly. Provides fibre optic connections to expansion cabinets. An additional site expansion board can be installed if redundancy is required.

Cabinet inside view

Figure Tech. 1-2 shows the location and identification of components in a fully equipped Horizon II *macro* cabinet.

Figure Tech. 1-2 Cabinet with components identified (door removed)

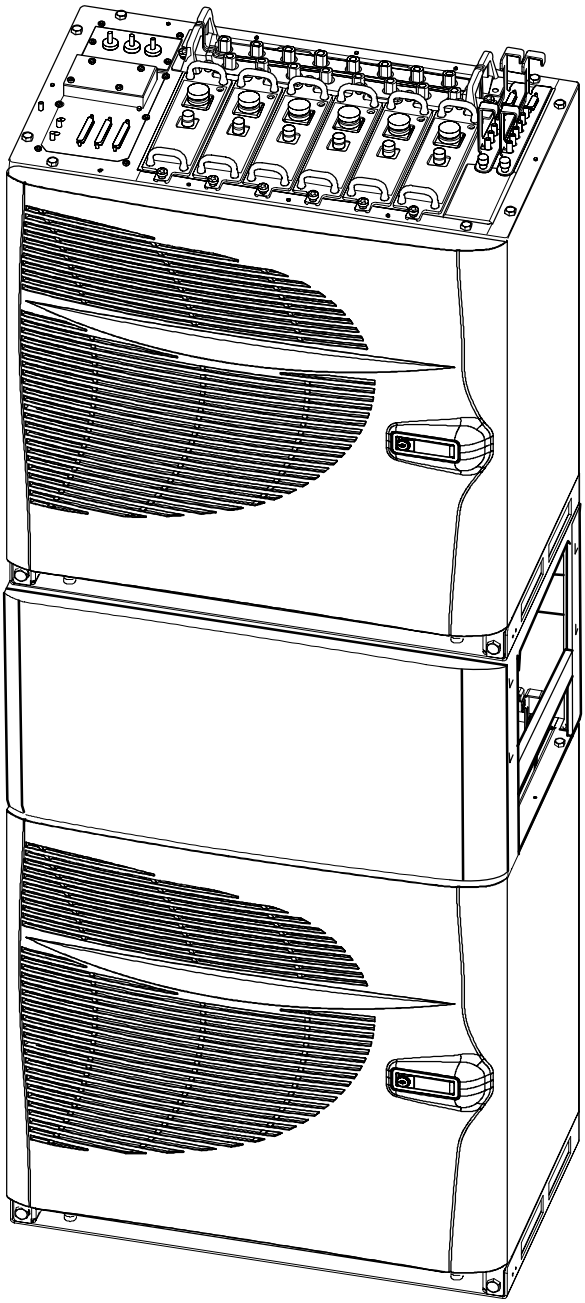


Horizon II *macro* stacking capability

An optional stacking bracket enables a Horizon II *macro* to have a second cabinet mounted on top of the first, as shown in Figure Tech. 1-3.

NOTE	The stacking capability of the Horizon II *macro* is compatible with that of the Horizon*macro* indoor cabinet. This means that a Horizon II *macro* can be stacked on top of a Horizon*macro* indoor cabinet, or vice versa.

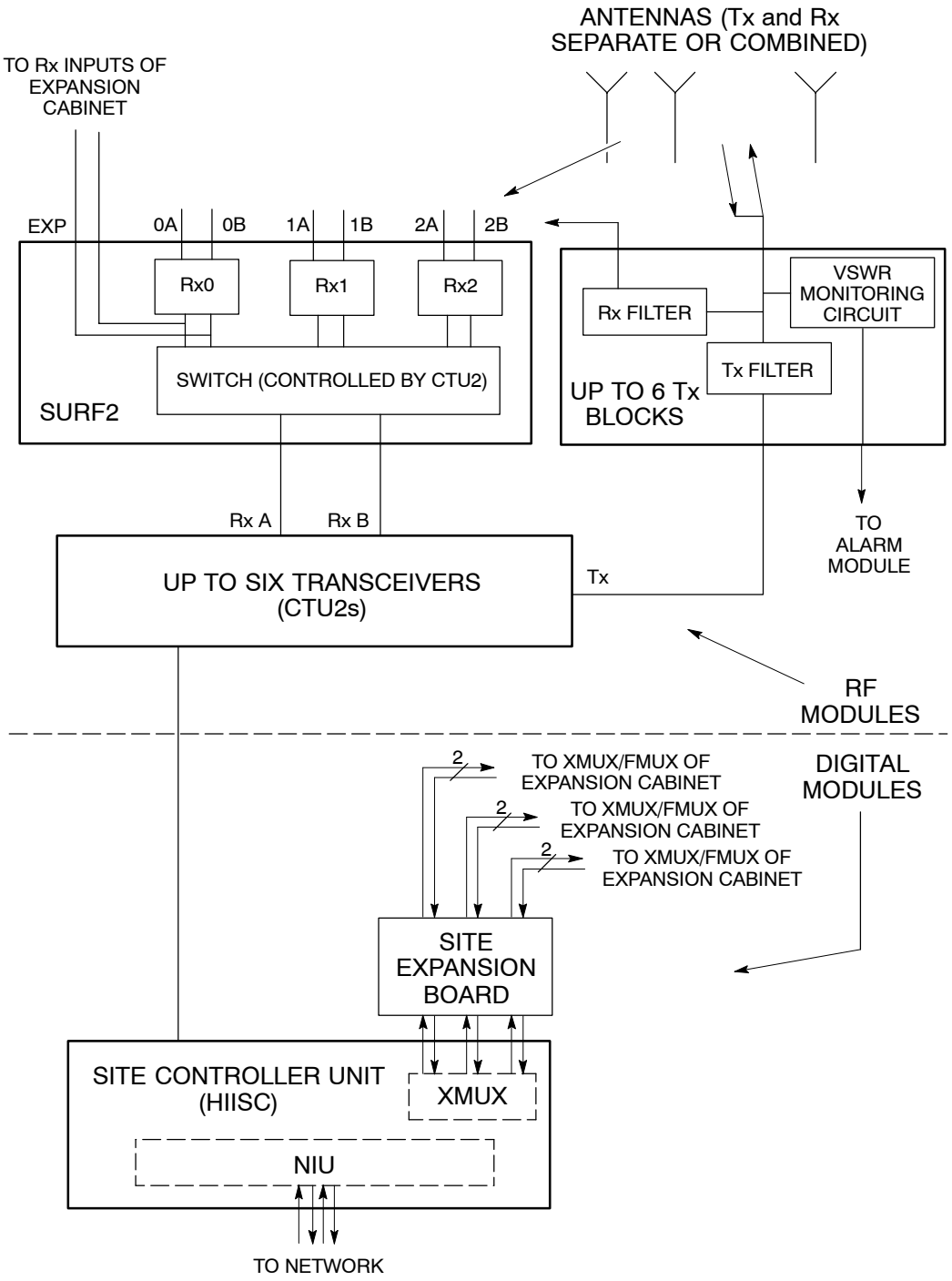
Figure Tech. 1-3 View of two stacked Horizon II *macro* cabinets



Functional diagram of Horizon II *macro*

Figure Tech. 1-4 shows the functional modules of a Horizon II *macro*. For clarity, only one transceiver and one Tx block is shown.

Figure Tech. 1-4 Functional diagram of cabinet components



Horizon II *macro* comparison with Horizon*macro*

Comparison overview

The Horizon II *macro* is a development of and a replacement for the Horizon*macro* indoor BTS, and is directly compatible with it. For example, a mix of up to four Horizon II *macro* and Horizon*macro* indoor (or even M-Cell*6*) BTSs can be combined to form a single site, with either a Horizon II *macro*, a Horizon*macro* indoor, or a M-Cell*6* being in control of the other units.

NOTE	In cases where a Horizon*macro* MCUF or M-Cell*6* MCU is the master site controller with a Horizon II *macro* as an expansion cabinet, the MCUF/MCU **MUST** have a PCMCIA card (running CSFP) installed to accommodate the additional memory requirements of the Horizon II *macro*.

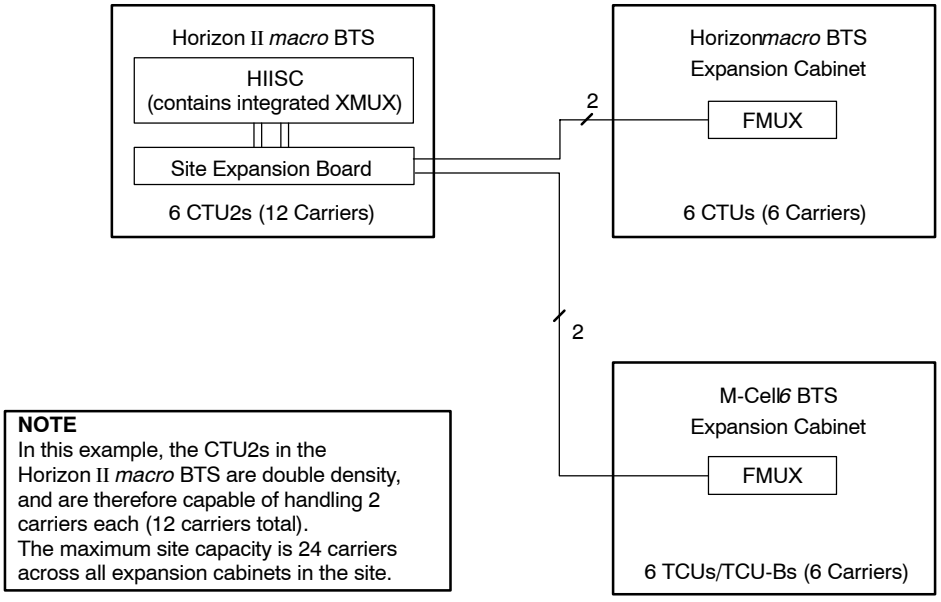
Compatibility with Horizon*macro* and M-Cell*6*

A 24-carrier BTS site (in an 8/8/8 configuration) can be achieved by combining a maximum of four units. The units can be any combination of Horizon II *macro*, Horizon*macro* and M-Cell*6*, any of which can be the controlling (master) BTS, subject to the requirements described in the note above.

NOTE	A MCUF (from Horizon*macro*) can be fitted into an M-Cell*6* and will then function as a MCU. A MCU cannot be fitted into a Horizon*macro*. The HIISC fitted in the Horizon II *macro* is not compatible with Horizon*macro*.

Figure Tech. 1-5 shows an illustration of a mixed three cabinet site, with a Horizon II *macro* BTS as the controller (master).

Figure Tech. 1-5 Example of a mixed BTS site



Comparison of Horizon II *macro* with Horizon*macro*

Table Tech. 1-1 compares the functionality of main components of the Horizon II *macro* with equivalent components of the previous generation Horizon*macro* indoor.

Table Tech. 1-1 Main components of Horizon II *macro* vs Horizon*macro* indoor

Function	Horizon II *macro* component	Horizon*macro* equivalent
Input power conversion units (max. fitted)	PSU (4)	PSM (3)
Power to transceivers and signal routeing	Backplane	BPSM and backplane
Transceivers (max. fitted)	CTU2 (6)	CTU (6)
Main processor module (max. fitted)	HIISC (2)	MCUF (2)
Processor module connection to transceivers in another cabinet	Internal XMUX in HIISC (1) and separate site expansion boards (1 or 2)	Internal FMUX in MCUF (2) or external FMUX (2)
Slave cabinet multiplexer	XMUX	FMUX
Rx components (max. fitted)	SURF2 (2)	SURF (1)
Transceiver to Rx components	SURF2 harness	SURF harness
Tx blocks (max. fitted internally)	DUP, HCU and DHU (6)	DCF, TDF, DDF and HCU (3)
DC power supply for digital modules (max. fitted)	Integrated in HIISC, supplied via backplane	BPSM (2)
Equipment protection/isolation	CBC	CBM
Links to terrestrial network (max. fitted)	Internal NIU in HIISC	NIU (4)
Alarm handling	Alarm module *	Alarm module
E1/T1 links	CIM/T43 or BIM/BIB	CIM/T43 or BIM/BIB

* Not compatible with the Horizon*macro* alarm module.

Specifications

Overview of specifications

All Horizon II *macro* specifications are included in this section.

Software requirements

All Horizon II *macro* BTSs require software release GSR6 (Horizon II) or later in the network.

Approval and safety

Table Tech. 1-2 lists the specifications with which the Horizon II *macro* complies.

Table Tech. 1-2 Horizon II *macro* specification compliance

Type approval	ETS 301 502
EMC	EN301 489-8
Safety	EN 60215, IEC 60215, EN 60950, IEC 950, CSA 22.2 No. 950, UL 1950

Environmental limits

Table Tech. 1-3 lists the environmental limits for Horizon II *macro* operation and storage.

Table Tech. 1-3 Environmental limits

Environment	Temperature	Relative Humidity
Operating	–5 °C to + 45 °C.	5% to 100% relative humidity, not to exceed 0.029 g water / m^3 dry air.
Storage	–45 °C to +70 °C.	8% to 100% relative humidity, not to exceed 0.029 g water / m^3 dry air.

NOTE This specification is valid up to 3 km altitude, corresponding to an atmospheric pressure range of 648 to 1048 millibars.

Power requirements

Cabinet power supply requirements

Table Tech. 1-4 lists the power supply requirements for the different power supply options.

Table Tech. 1-4 Horizon II *macro* cabinet power supply requirements

Nominal Voltage	Voltage supply range	Current supply maximum
+27 V dc (negative earth)	+19.5 to +30 V dc	204 A (at nominal voltage)
–48 V dc (positive earth)	–39 to –72 V dc	99 A (at nominal voltage)
120/240 V ac (50 to 60 Hz)	88 to 270 V	45 A (at nominal voltage)

NOTE Voltage transients must be less than 35 V peak amplitude (never below 0 V). Ripple and noise must be less than 200 mV p-p (30 mV rms) over 10 Hz to 14 MHz. Voltage application stabilization must be within the specified range in less than 1 second.

Power consumption

Table Tech. 1-5 lists typical and worst case power consumption values for example Horizon II *macro* configurations.

Table Tech. 1-5 Horizon II *macro* power consumption details

Example configuration	Cabinet consumption (W)		PSU output (W)	
	Typical	Worst case	Typical	Worst case
1800 MHz 2/2/2	1107	1664	957	1331
1800 MHz 4/4/4	2152	3155	1862	2524
900 MHz 2/2/2	1365	1835	1180	1468
900 MHz 4/4/4	2668	3498	2308	2798

NOTE In Table Tech. 1-5, “Typical” is defined as using a –48 V dc power source with no redundancy.
“Worst case” figures are theoretical, including fault condition (fans) and redundancy.

Battery backup

The Horizon II *macro* cabinet has no internal battery backup as standard.

Additional battery backup capacity can be provided by installation of an optional external battery back up system (BBS). Contact the Motorola local office for further details.

RF power output

Table Tech. 1-6 and Table Tech. 1-7 list the RF power output of the CTU2 for the 900 MHz and 1800 MHz frequency bands in the various configuration options available.

Table Tech. 1-6 CTU2 RF power output (in Horizon II *macro* cabinet)

CTU2 configuration	Combining	Output power (+/–2 dB)	
		EGSM900	DCS1800
Single density	No external combining	63 W	50 W
Double density	No external combining	20 W	16 W
2 x double density	1 internal + 1 external stage hybrid combining	9 W	7 W

Table Tech. 1-7 CTU2 RF power output (when installed in Horizon*macro* indoor cabinet)

CTU2 configuration	Combining	Output power (+/–2 dB)	
		EGSM900	DCS1800
Single density	No external combining	40 W	32 W
Single density	1 external stage hybrid combining	20 W	16 W
Double density	No external combining	10 W	10 W
2 x double density	1 internal + 1 external stage hybrid combining	5 W	5 W

NOTE In Table Tech. 1-6 and Table Tech. 1-7 the RF output power is measured at the antenna port at the top of the cabinet.

Sensitivity

The receiver sensitivity performance of the equipment is shown in Table Tech. 1-8.

Table Tech. 1-8 Rx sensitivity performance

Conditions	EGSM900		DCS1800	
	Typical	Guaranteed	Typical	Guaranteed
Static channel	–111.5 dBm	–110.5 dBm	–112.5 dBm	–111.5 dBm
Faded channel	–108.5 dBm	–107.5 dBm	–109.5 dBm	–108.5 dBm
Faded with diversity	Up to –113.5 dBm	Up to –112.5 dBm	Up to –114.5 dBm	Up to –113.5 dBm

Notes to Table Tech. 1-8

- GMSK performance for a nominal 2–2–2 configuration with a duplexer on the main receiver branch.
- Typical values are the average expected performance over the frequency band when measured at the main branch BTS antenna port, i.e. the duplexer antenna port.
- There is approximately 0.5 dB degradation of performance over the frequency band compared to mid-band. Mid-band performance is typically 0.5 dB better than values quoted above which are intended to cover the entire receive band.
- Guaranteed values are the worst expected performance over the frequency band when measured at the main branch BTS antenna port, i.e. the duplexer antenna port.
- Diversity performance (2 branch) is shown above to be up to 5 dB due to its dependence on the BTS configuration, antenna spacing/orientation and radio propagation environment.

NOTE	All values cited assume the use of qualified and calibrated BTS BER test equipment. All signal sources, faders, attenuators and RF cables are assumed to have been accurately calibrated in order determine the true power level being applied to the BTS antenna port.

CTU2 sensitivity when used in Horizon*macro*

Use of a CTU2 in a legacy Horizon*macro* cabinet will result in the receiver sensitivity value being the same of that as using a legacy CTU in a similar application. This is due to the Horizon*macro* receiver noise figure being dominated by the Horizon*macro* receive front-end modules and the CTU2 having a receiver noise figure similar to that of a CTU. For reference, the published Horizon*macro* faded sensitivity values are –107 dBm for 900 MHz and –108.5 dBm for 1800 MHz.

BSC connectivity options

Options exist for E1, T1 and HDSL (star and daisy chain) connection.

Cabinet dimensions

The dimensions of cabinets are shown in Table Tech. 1-9.

Table Tech. 1-9 Cabinet dimensions

Cabinet type	Height	Width	Depth
Cabinet (without hood)	750 mm	700 mm	430 mm
Cabinet with optional hood	870 mm	700 mm	430 mm
Cabinet with stacking bracket	1025 mm	700 mm	430 mm
Two cabinets, with stacking bracket between, and optional hood on top	1900 mm	700 mm	430 mm

The optional hood allows cables to enter the cabinet from the back and above.

The stacking bracket allows a second cabinet to be stacked on top of the first cabinet.

Weights

The maximum weight of the cabinet is shown in Table Tech. 1-10.

CAUTION Consider future expansion. A second cabinet may be added by stacking on top of the existing cabinet. This could result in a total weight of up to 290 kg. Ensure the floor is capable of supporting this weight.

Table Tech. 1-10 Horizon II *macro* cabinet weights

Item	Weight
Cabinet, empty	52.7 kg
Cabinet, fully populated	135 kg
Plinth	7.8 kg
Hood	2.03 kg
Stacking bracket (excluding CCB basket)	9.3 kg

Torque values

Table Tech. 1-11 details torque values used during installation, maintenance and repair procedures.

Table Tech. 1-11 Torque values for all cabinet screws/bolts and RF connectors

Screw/bolt size	M4	M6	M8	M10	SMA	N-type	7/16
Torque value	2.2 Nm	3.4 Nm	5 Nm	10 Nm	1 Nm	3.4 Nm	25 Nm

NOTE The HCU and DHU use a QMA snap-on/snap-off connector instead of the N-type connector commonly used on Tx blocks.
Torque values used with M12 anchor bolts will depend on the anchor bolt manufacturer. Check manufacturer's data for correct values.

Frequency capability

Frequency hopping

The Horizon II *macro* supports baseband frequency hopping (BBH) and synthesizer frequency hopping (SFH).

NOTE	BBH is not supported if CTU2s are installed in a Horizon*macro* cabinet, used in double density mode, and controlled by a MCUF.

Frequency band characteristics

BTS radio channels (RF carriers) are full duplex (transmit and receive) with the characteristics listed in Table Tech. 1-12.

Table Tech. 1-12 Horizon II *macro* frequency band characteristics

	GSM900	EGSM	DCS1800
Transmit frequency band (MHz)	935 to 960	925 to 960	1805 to 1880
Receive frequency band (MHz)	890 to 915	880 to 915	1710 to 1785
Transmit/receive duplex separation (MHz)	45	45	95
Channel width (kHz)	200	200	200
Number of channels	124	174	374
Transmit frequency guard bands (MHz)	935.0 to 935.1 959.9 to 960.0	925.0 to 925.1 959.9 to 960.0	1805.0 to 1805.1 1879.9 to 1880.0
Receive frequency guard bands (MHz)	890.0 to 890.1 914.9 to 915.0	880.0 to 880.1 914.9 to 915.0	1710.0 to 1710.1 1784.9 to 1785.0
Transmit channel centre frequency (MHz)	Even 10ths of a MHz from 935.2 to 959.8	Even 10ths of a MHz from 925.2 to 959.8	Even 10ths of a MHz from 1805.2 to 1879.8
Receive channel centre frequency (MHz)	Even 10ths of a MHz from 890.2 to 914.8	Even 10ths of a MHz from 880.2 to 914.8	Even 10ths of a MHz from 1710.2 to 1784.8

Structural considerations

Adequate clearance must be provided at the front of the cabinet for operation and maintenance purposes. There must be adequate side clearance (50 mm) to enable the door to open beyond 90° (see Figure Tech. 1-6). The door can also stop at 95° and 150° , but this is only to protect the door, or give optional additional operator space.

The cabinet ventilation entry can be solely from the bottom front of the cabinet. This allows a cabinet to be placed against a wall. However, if the unit is placed 50 mm from back or side obstructions, such as wall or other cabinets, the ventilation will be improved, and fan noise reduced.

Up to 100 mm rear space may be required for cables if using a stacking bracket.

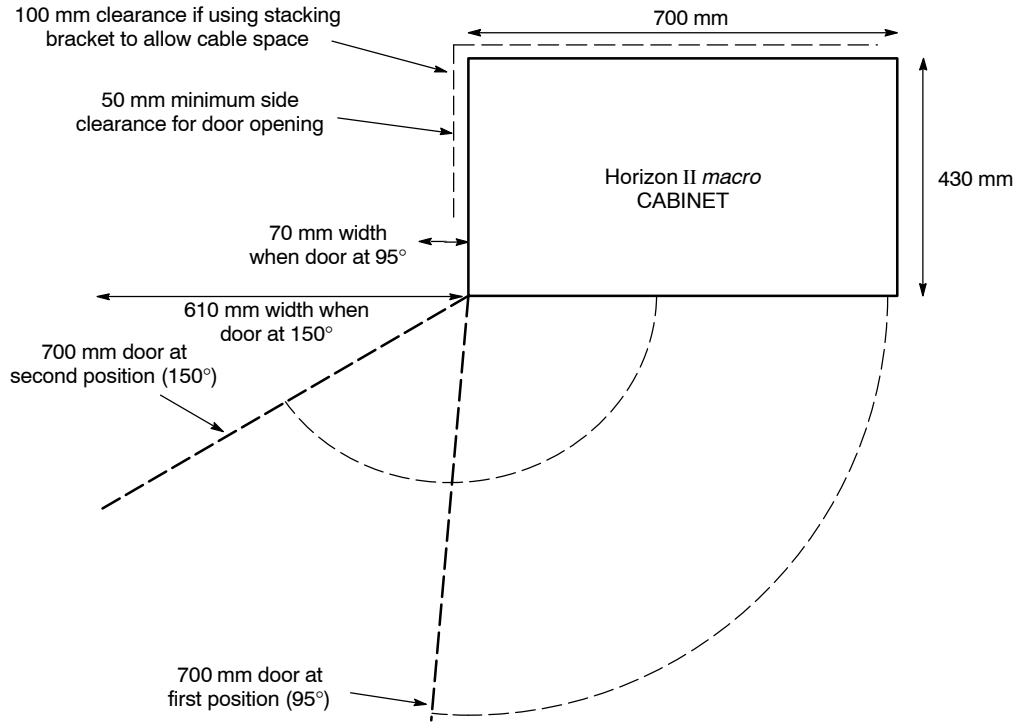
The foundation or structure on which the BTS cabinet is mounted must be of sufficient strength to support the maximum gross weight of the equipment, as defined in Table Tech. 1-10.

NOTE	In seismically active areas, Motorola suggest using a qualified structural engineer to assess frame mounting requirements, such as floor construction, mounting anchors, cell site construction and to provide a suitable design for top frame support if a stacked configuration is required.

Layout plan

Figure Tech. 1-6 shows the cabinet installation layout plan.

Figure Tech. 1-6 Horizon II *macro* cabinet site layout plan



MOTOROLA

Chapter 2

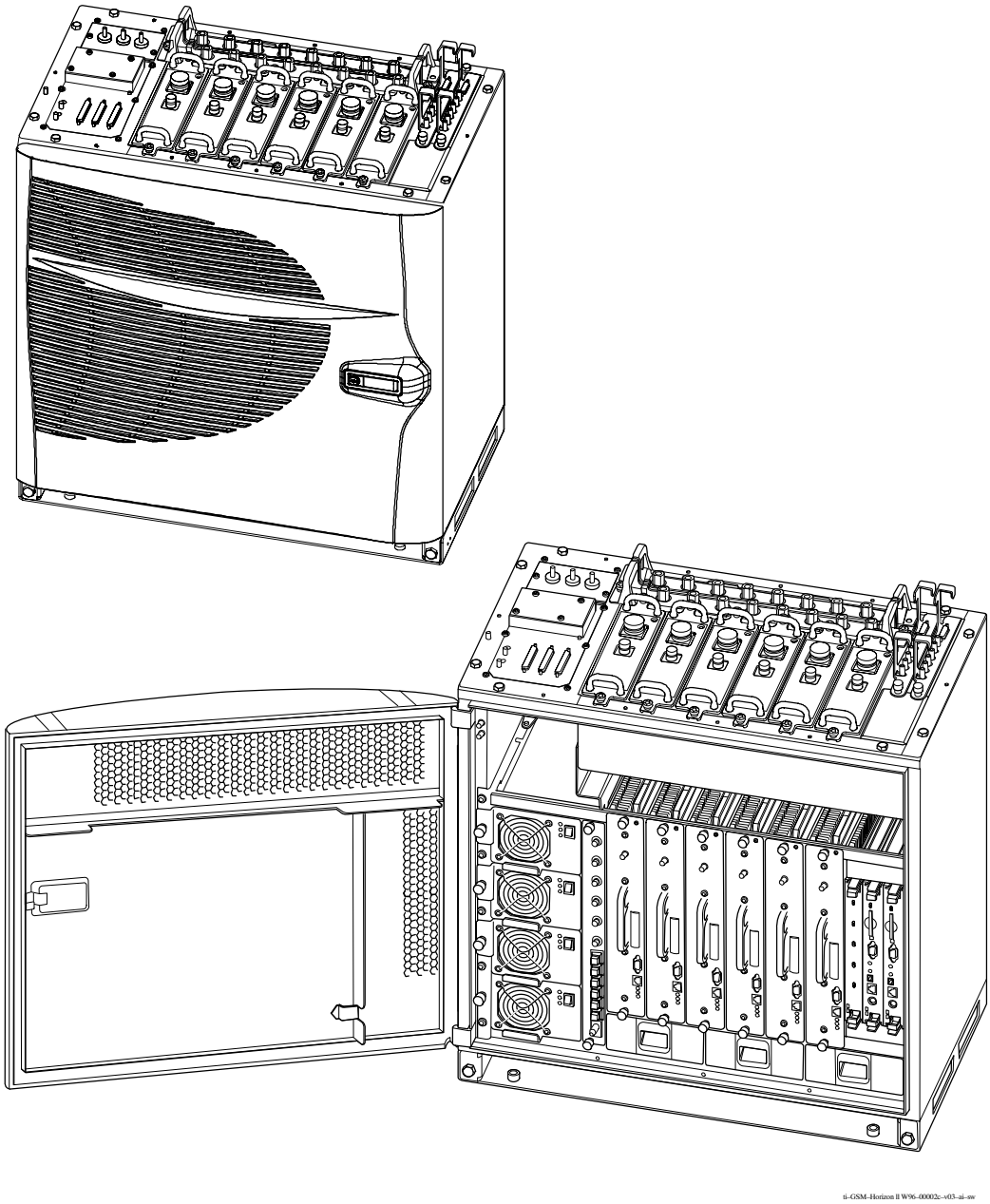
Cabinet structure

Horizon II *macro* cabinet structure

External cabinet views

Figure Tech. 2-1 shows an external view of a closed cabinet and a cabinet with the door open.

Figure Tech. 2-1 Horizon II *macro* cabinet views – closed and open



Overview of structure description

The equipped cabinet is shown in Figure Tech. 2-2. The cabinet is designed for minimum maintenance and maximum ease of module replacement, and has access only from the front and the top.

This chapter describes the cabinet structure and inner connections to assist understanding of the cabinet functions. There should be no need to dismantle the cabinet beyond field replaceable unit (FRU) level.

The cabinet structure components are explained in the following sections:

Cabinet and SURF2 harness

This section describes the empty cabinet and the SURF2 harness connections between the SURF2 and the backplane and transceivers.

Top panel

This section describes the bare top panel with all the modules removed.

Cage backplane interface panel harness assembly (CBIA)

This section describes the CBIA. It also describes the backplane connections between all modules, and the harness from the backplane to the interface top panel connectors.

Cabinet temperature control

This section describes the cabinet temperature control system.

Door and hood

This section describes the structure and function of the door and optional hood.

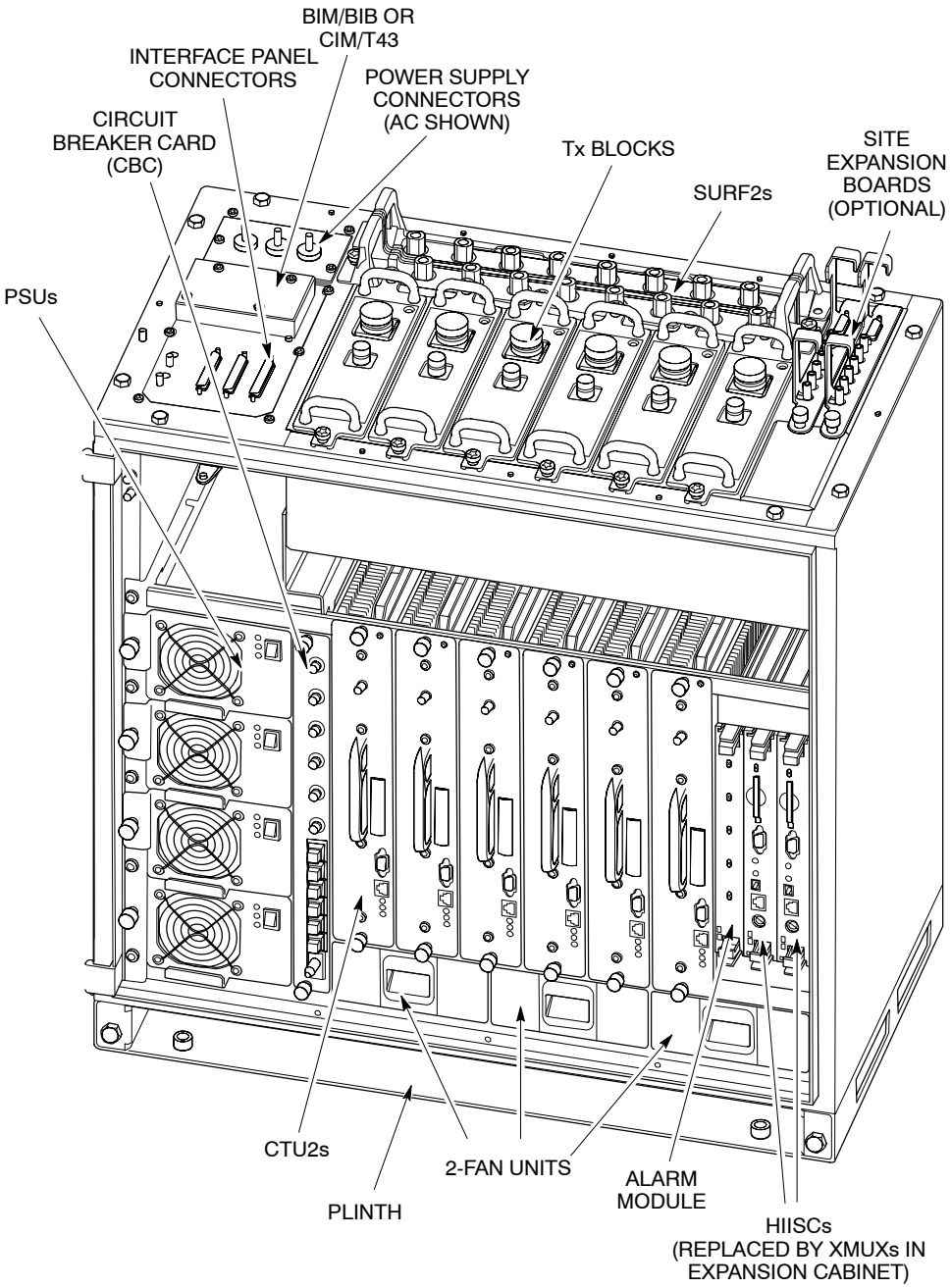
Stacking bracket

This section describes the optional stacking bracket, used for mounting a second cabinet on top of the first.

Filled cabinet view

Figure Tech. 2-2 shows a cabinet with maximum number of modules installed. Individual modules are described in detail in later chapters of this technical description.

Figure Tech. 2-2 Cabinet showing main components (door removed)



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Empty cabinet and SURF2 harness

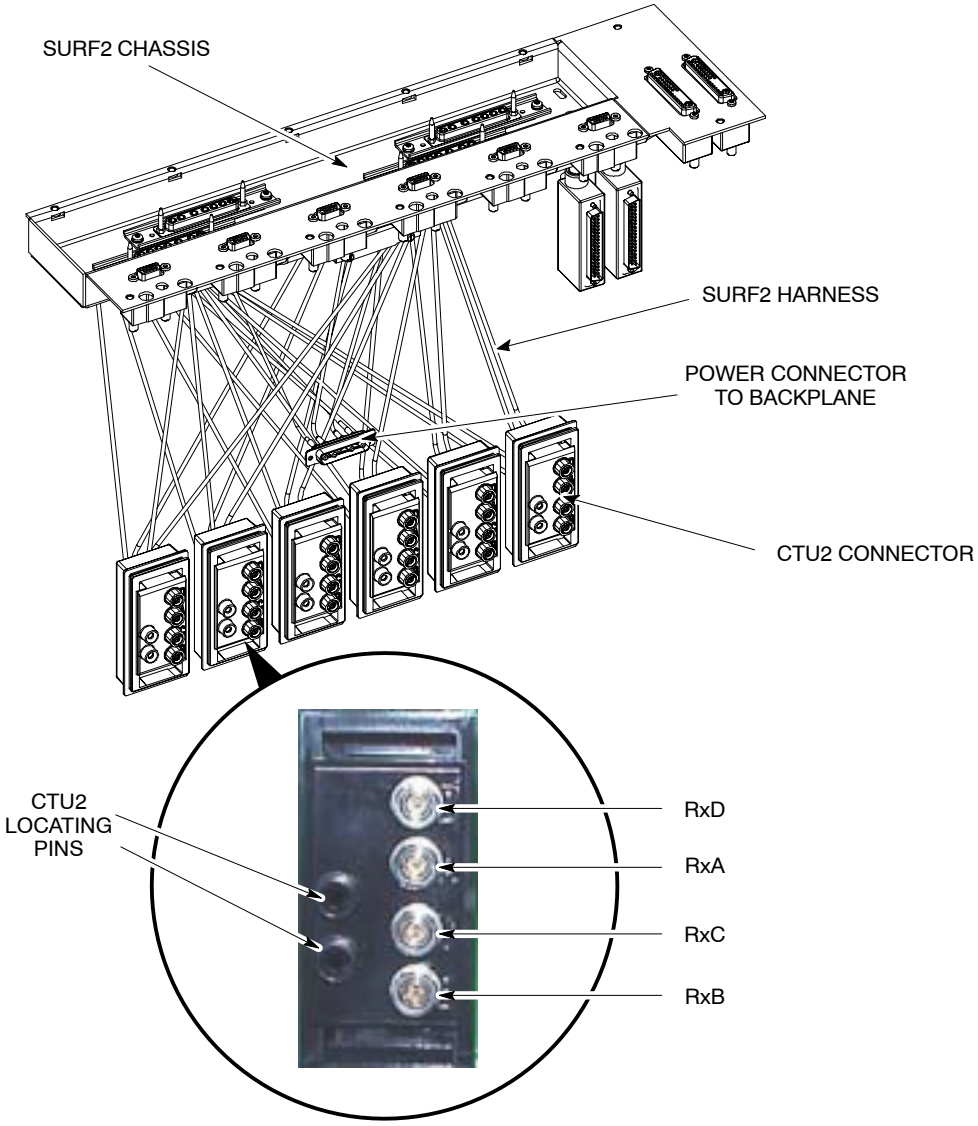
SURF2 harness and components

The SURF2 harness connects between the SURF2 chassis and the CTU2 connectors fitted on the back wall of the cabinet. The SURF2 chassis supports the SURF2 modules.

The harness provides:

- Two connectors to each SURF2 for RF and power.
- One RF connector to each CTU2, consisting of four inputs, one each for RxA, RxB, RxC and RxD, as shown in Figure Tech. 2-3. The RF connectors are free floating to ensure correct fitting of the CTU2 modules.
- One connector to the backplane is supplied, for power from the PSUs.

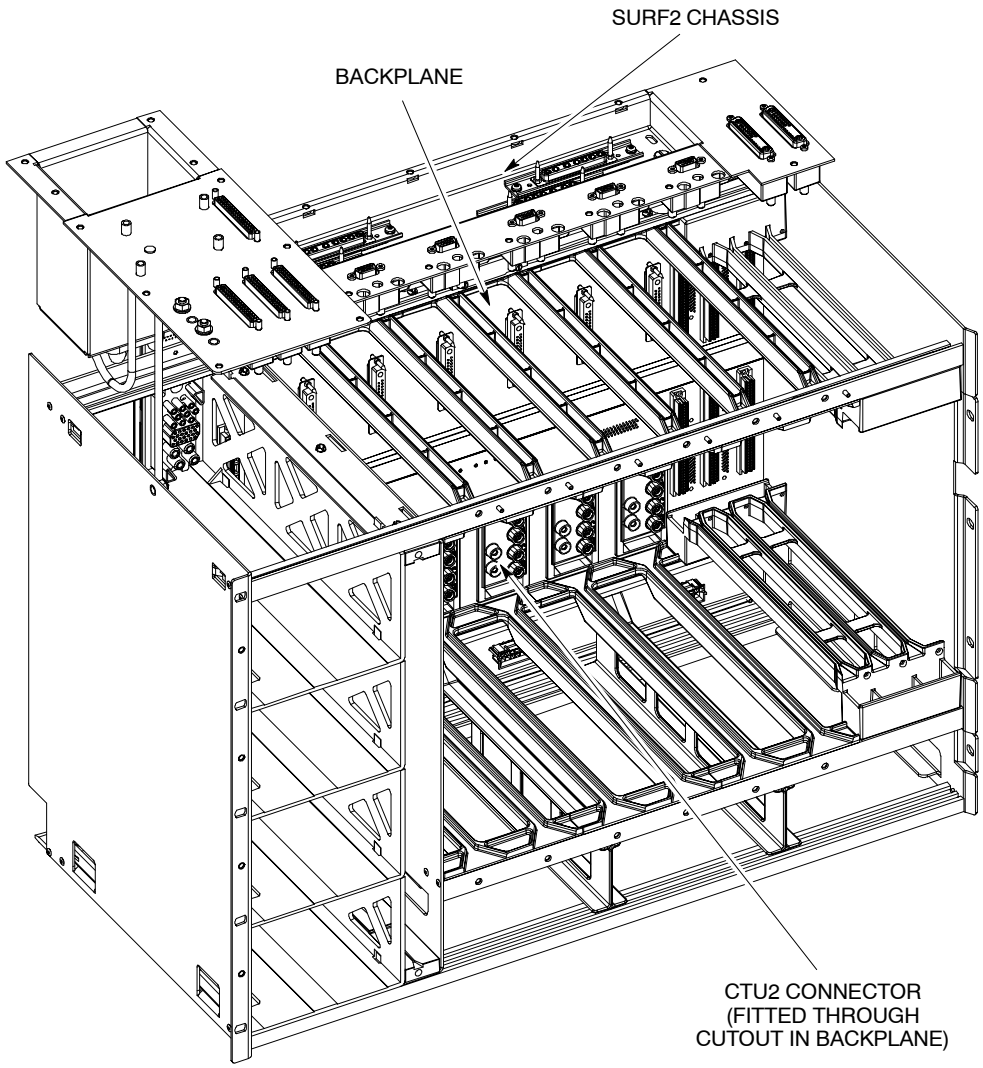
Figure Tech. 2-3 SURF2 harness components



Cabinet view with installed SURF2 harness components

Figure Tech. 2-4 shows the SURF2 harness components installed in an empty cabinet.

Figure Tech. 2-4 SURF2 harness components installed in empty cabinet



Top panel

Top panel description

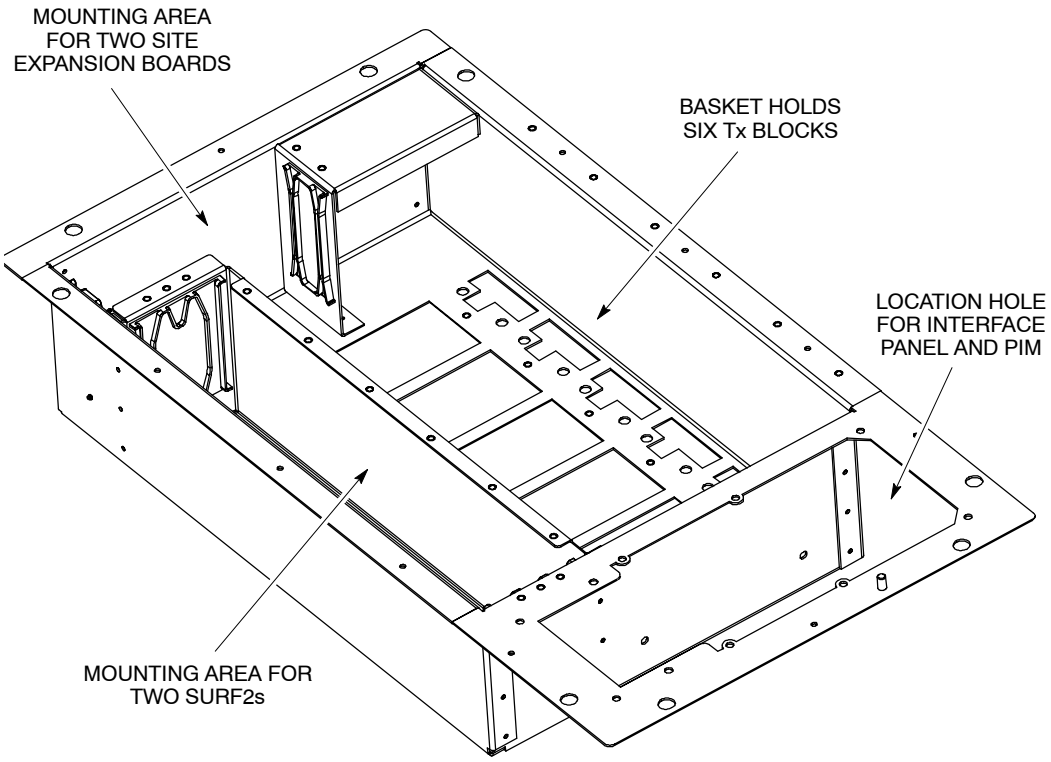
The top panel provides:

- A basket to hold up to six Tx blocks, plus two SURF2s and two site expansion boards.
- A location hole for the interface panel.
- An area for ventilation purposes above the PSUs.

Top panel view

Figure Tech. 2-5 shows a top panel with major features labelled.

Figure Tech. 2-5 Top panel with major features labelled



Cage backplane interface panel harness assembly (CBIA)

CBIA overview

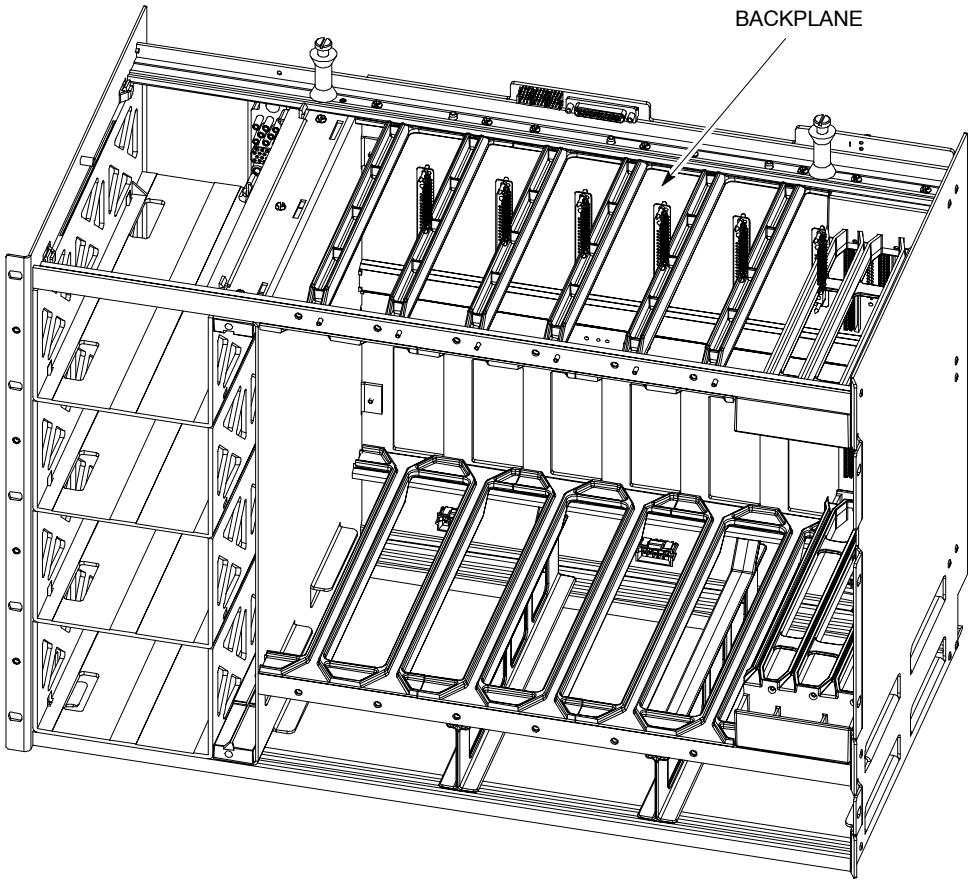
The CBIA provides a platform for module installation and power and digital signal interconnection to cabinet modules. The CBIA consists of:

- The main cage - providing compartments for fans, CTU2s, digital modules, PSUs and CBC.
- The backplane and harness - routes power and signals for all cage modules and power to the SURF2s.
- The interface panel - carries the T43/BIB and the required power and communications connectors.

CBIA diagram

Figure Tech. 2-6 shows the bare CBIA main cage with backplane identified.

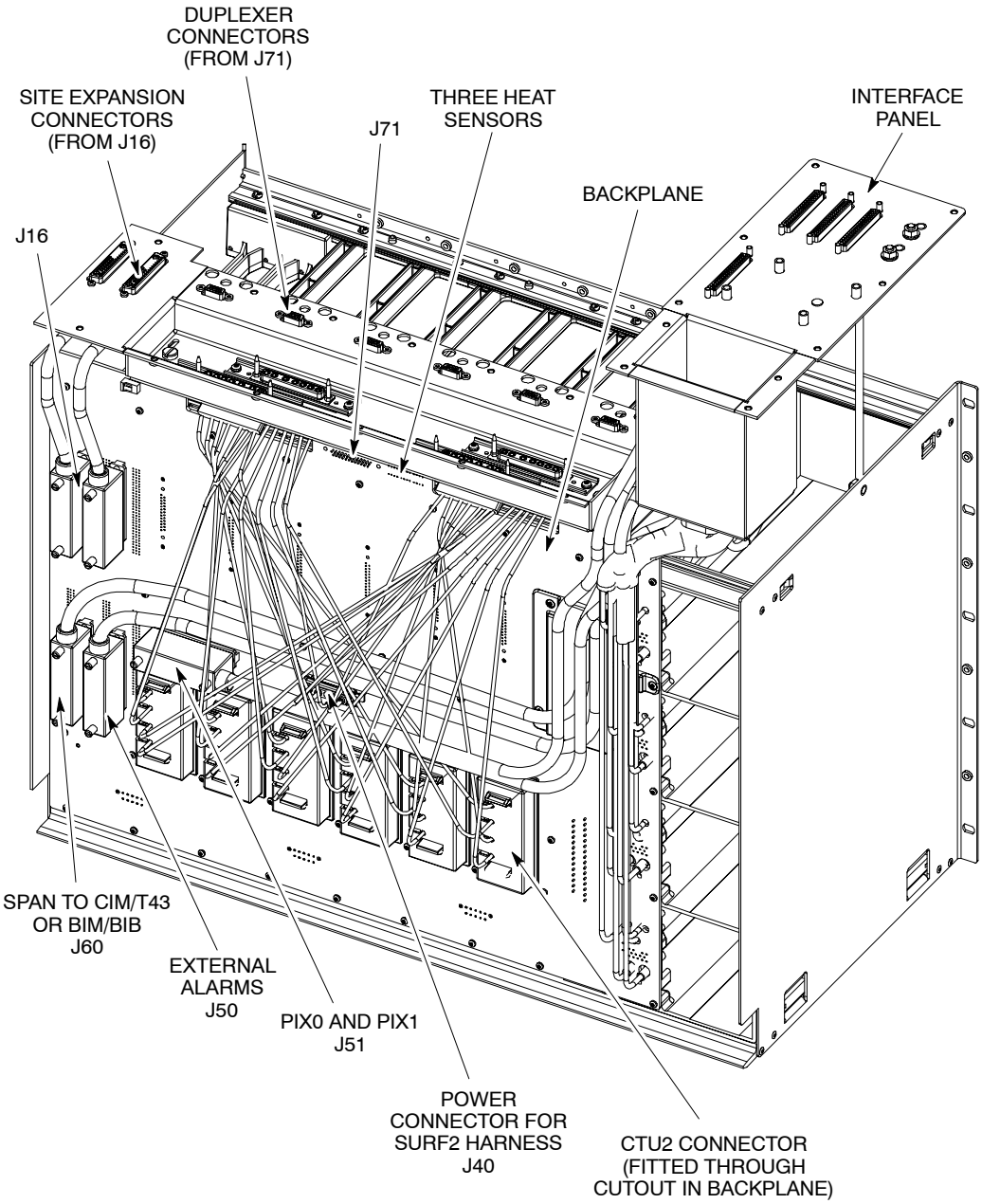
Figure Tech. 2-6 CBIA bare cage



Backplane and harness view

Figure Tech. 2-7 shows the CBIA harness linking the interface panel and the backplane at the rear of the main cage. Each backplane harness connector is identified.

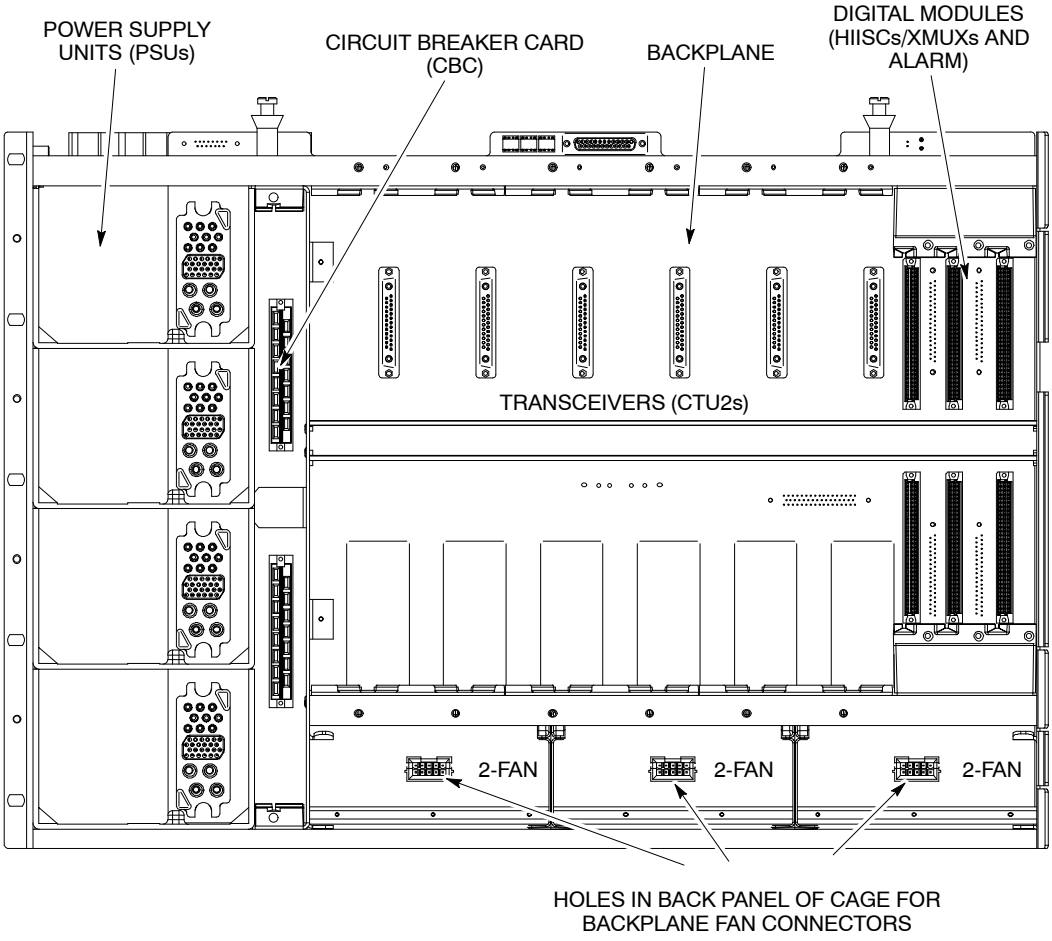
Figure Tech. 2-7 CBIA showing backplane and harness connectors



CBIA cage function and diagram

The main cage holds the modules and supports the backplane. Each compartment has appropriate sliders for insertion of the modules. Figure Tech. 2-8 shows the module compartments of the cage.

Figure Tech. 2-8 Front view of CBIA cage showing module locations



CBIA harness function

The harness provides cables to link connectors on the backplane with connectors on the underside of the interface panel.

CBIA backplane function and diagram

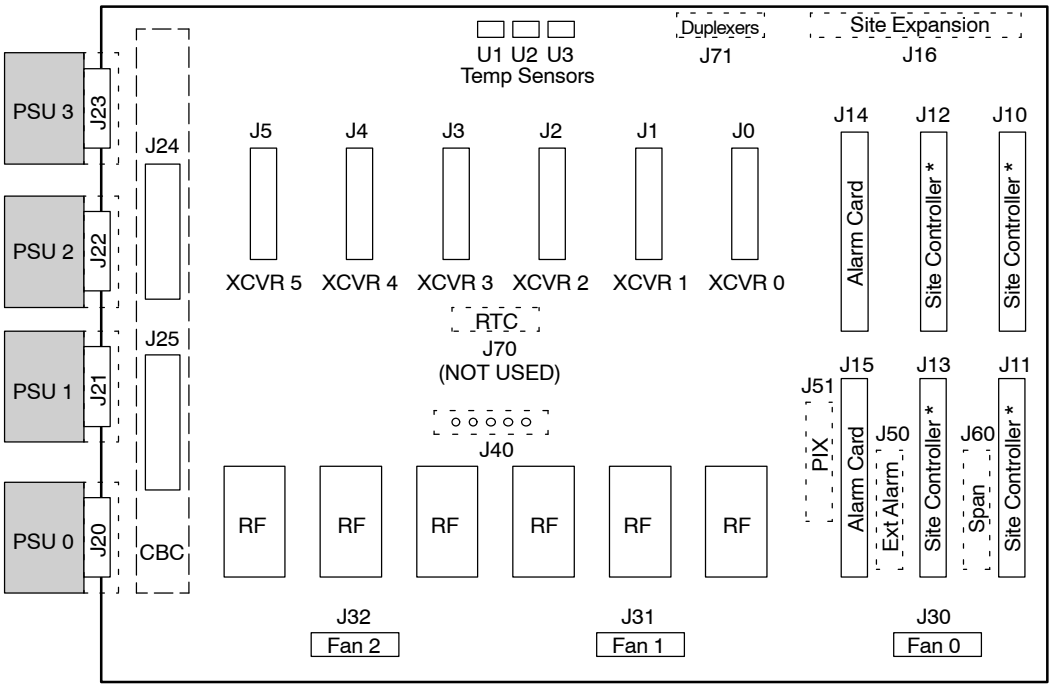
The cabinet design enables all possible RF and digital module combinations to be served by the same backplane. The only module-to-module cabling required are the Tx cables from the CTU2s to the Tx blocks. Any external attachments will also require separate cabling.

The backplane is a multilayered printed circuit board with attached connectors on front and back. The backplane:

- Routes power and digital signals throughout the cabinet.
- Provides connectors for the harness cables linking to the interface panel.
- Provides connectors for plug in modules.
- Provides power to the SURF2 harness, when the main cage is inserted into the cabinet.
- Provides connectors for three heat sensors in the main cage above the CTU2s.

Figure Tech. 2-9 shows the connector locations on the backplane.

Figure Tech. 2-9 Backplane connector locations



* The site controller (HIISC) may be replaced by an XMUX in expansion cabinets.

NOTE	J10/J11 is for the master HIISC/XMUX and J12/J13 is for the redundant HIISC/XMUX.

Attachment of cage to cabinet

The CBIA is fitted to the cabinet at the factory and is not intended to be removed in the course of normal maintenance or FRU replacement procedures.

Interface panel function

The interface panel provides all connection points to:

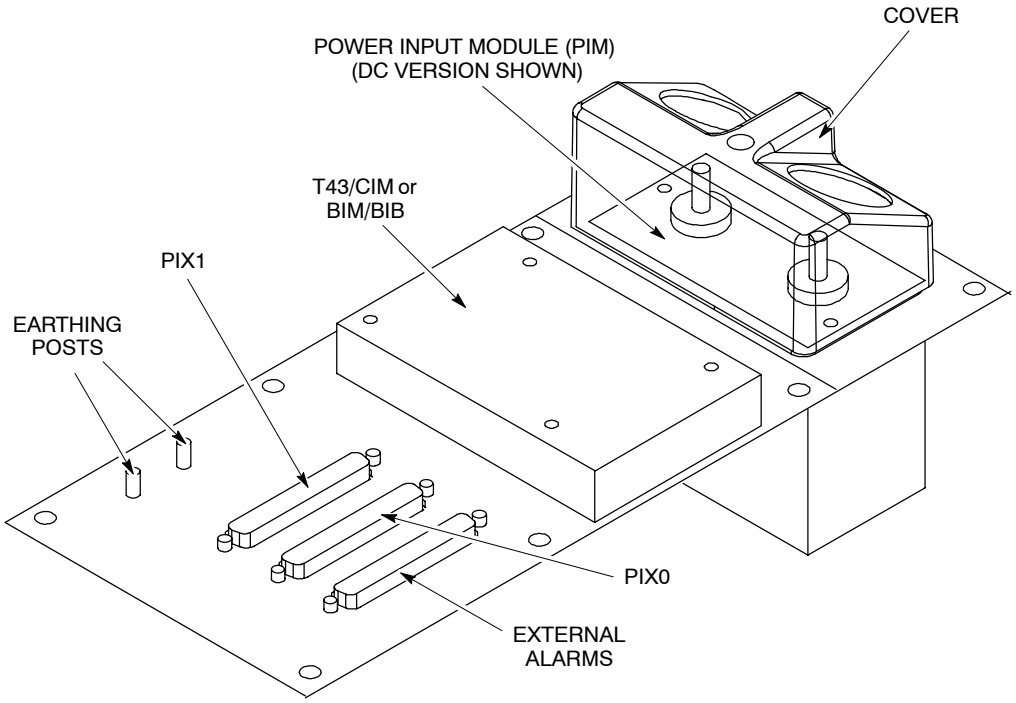
- The required power sources via removable power interface module (PIM).
- External alarms (for example battery backup system alarms).
- Connection points to all telecommunications links.

All connectors are linked to the backplane via the CBIA harness. Plastic connector covers, supplied by Motorola, keep unused connectors protected from damage by static or foreign matter and should be retained.

Interface panel diagram

Figure Tech. 2-10 shows the locations of the interface panel connectors. It also shows the removable PIM, which may be ac (three terminals) or dc (two terminals), depending on requirements.

Figure Tech. 2-10 Interface panel connector locations



Interface panel pinouts

Interface panel pinouts are detailed in Chapter 2 of *68P02902W97,* Horizon II *macro: Installation and Configuration* .

Cabinet temperature control

Temperature control overview

The Horizon II *macro* cabinet contains equipment that has to be maintained within the operational temperature range to ensure correct operation of the equipment and to guard against premature failure of the individual components. The internal temperature is maintained within these limits by internal fans.

Cabinet overtemperature control

Under overheat conditions, as the temperature rises above preset levels, temperature sensors located in various areas within the cabinet provide alarms. A further increase in temperature causes dual sensors, set at a higher threshold temperature to initiate PSU and cabinet shutdown. The cabinet is restarted when the sensors are reset by a substantial fall in temperature.

The CTU2s have their own shutdown responses to overheating. The CTU2s shutdown if the ambient temperature exceeds 57 °C.

The CTU2 shutdown response to overheating provides a second level of cabinet protection, independent of the cabinet heat sensors.

Temperature sensors

The three cabinet temperature sensors are located above the transceiver rack (see Figure Tech. 2-7) and consist of the following:

- One sensor provides a cabinet overtemperature alarm when air detected at the sensor reaches 75 °C. The alarm is processed by the alarm board and site controller unit, and sent on to the OMC-R via the BSC.

NOTE	The ambient cabinet temperature will vary, depending on cabinet configuration and operating conditions.

- Two sensors shut down the PSUs to protect the cabinet equipment from heat damage when air detected at the sensors reaches 85 °C. Both sensors must detect excess temperature for the shutdown to take place; this reduces the risk of an unnecessary shutdown. No prior notification of shutdown is given to the OMC-R, except for the original 75 °C sensor alarm. This is because the site controller unit and CTU2s immediately lose power and functionality.

Cabinet restart after shutdown

The cabinet is restarted when the overtemperature condition initiating shutdown has reset. The two 85 °C temperature sensors reset at 55 °C. This re-establishes an earth point for the PSU internal detectors connected to the cabinet heat sensors, which then reactivate the PSU outputs. The site controller unit then reboots as in a normal power up.

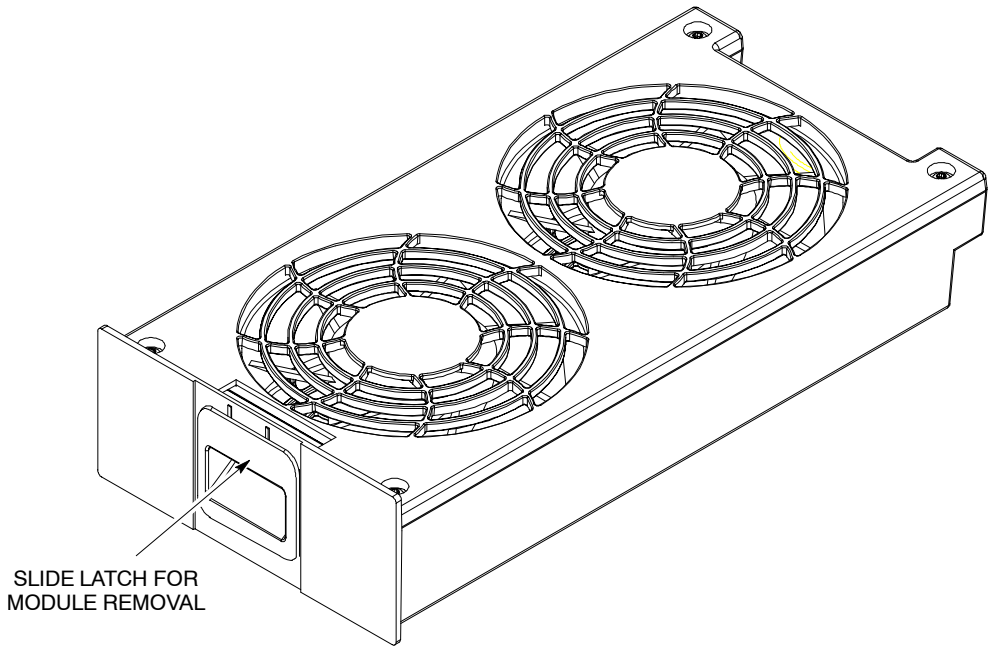
Fan unit description

Fan unit overview

Cooling for the cabinet is provided by three fan units, located beneath the CTU2s and digital modules. Each fan unit contains two fans, as shown in Figure Tech. 2-11.

NOTE	The fan units do not provide cooling for the PSUs or SURF2s. Each PSU contains an integral fan, which draws in air through the grille on the door and an additional vent near the SURF2.

Figure Tech. 2-11 View of a 2-fan unit



Fan operation

The fans draw in air from beneath the cabinet, and the air is expelled through the door grille. The fans run continuously, and respond to temperature changes to ensure adequate flow. The speed of each fan is controlled by a heat sensor mounted on the fan hub.

Cabinet door and optional hood

Door function

The cabinet is fitted with a door and may also be fitted with an optional hood. The hood cannot be fitted in conjuction with a stacking bracket.

The door has the following functions:

- Protects the modules from damage.
- Ensures the correct air ventilation.
- Provides EMC shielding.

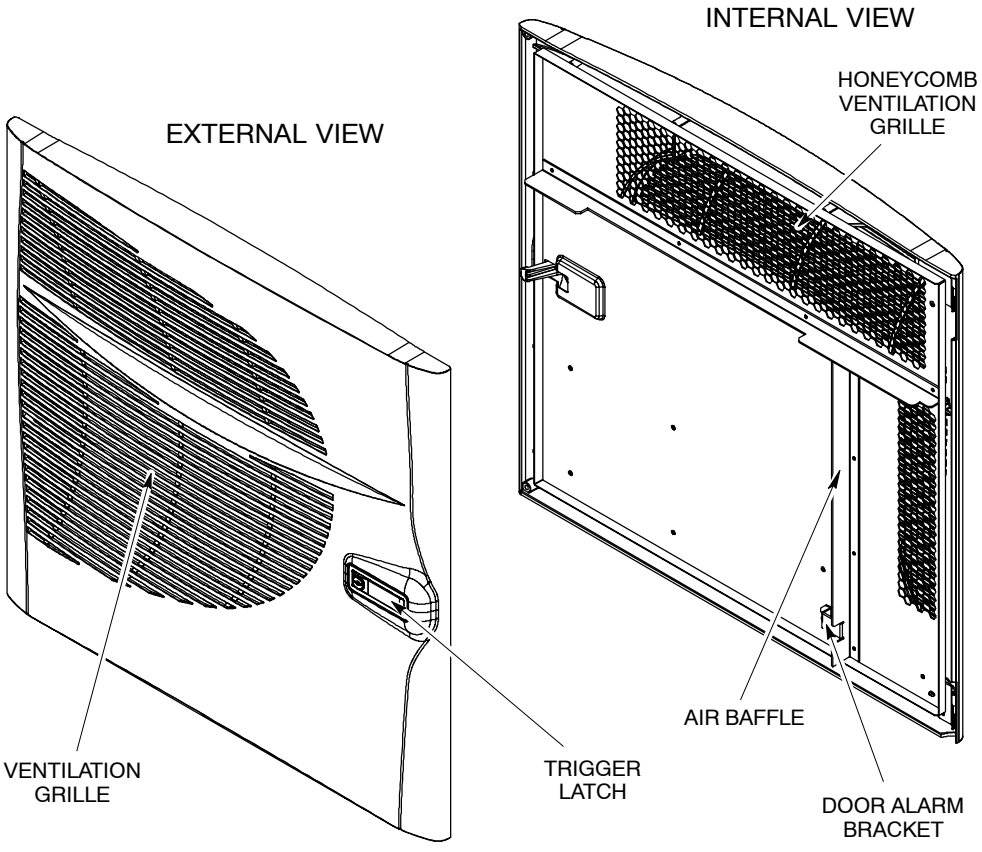
The door has an external ventilation grille with internal honeycomb grille and a vertical aluminium air baffle. The door hinges allow detent opening positions of 95° and 150°.

The lock is a trigger latch, opened (if unlocked) by pressing the middle button. There is also a door alarm bracket, which presses against the cabinet door alarm switch, mounted at the bottom of the CBC front panel.

Door external and internal view

Figure Tech. 2-12 shows both sides of the cabinet door.

Figure Tech. 2-12 External and internal view of cabinet door



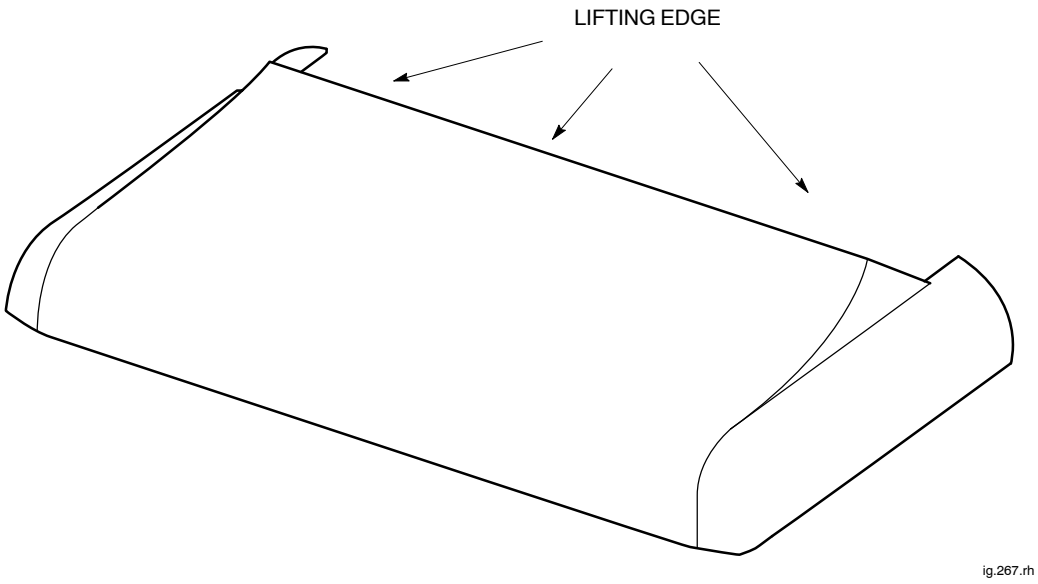
Hood function

The optional hood can be fitted to keep unsightly cables and connectors out of view, where this is important.

View of hood

Figure Tech. 2-13 shows a top view of the hood.

Figure Tech. 2-13 View of hood as seen from the front of the cabinet



Securing pins and hood removal

The hood mounts on four pins that screw into the cabinet top panel, replacing existing screws.

The hood can be easily lifted off the cabinet by pulling on the lifting edge at the rear, as shown in Figure Tech. 2-13.

Stacking bracket

Stacking bracket function

The stacking bracket has two main functions:

- To enable a Horizon II *macro* cabinet to be stacked on top of either a Horizon*macro* indoor or another Horizon II *macro* cabinet.
- To house CCBs in a dedicated optional CCB basket.

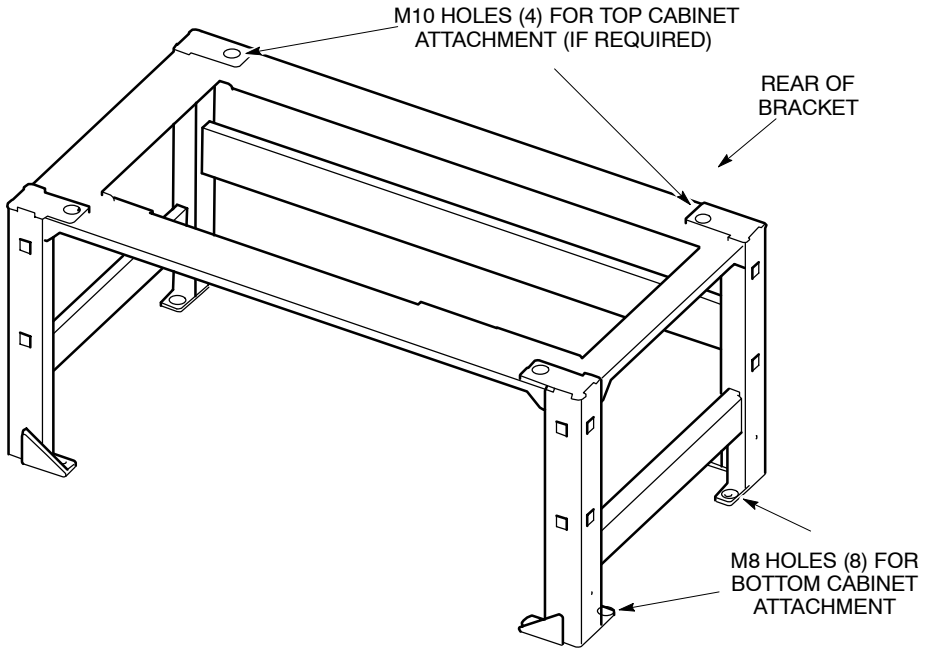
NOTE	A CCB basket is not required as the Horizon II *macro* BTS does not support the use of CCBs.

The stacking bracket is fixed to the top of the cabinet by eight M8 screws. If the stacking bracket is replacing an existing hood, then the four hood securing pins must first be removed to accommodate four of the stacking bracket screws. A second cabinet may be attached on top of the stacking bracket by four M10 screws.

Stacking bracket diagram

Figure Tech. 2-14 shows a view of the stacking bracket.

Figure Tech. 2-14 View of the stacking bracket



Stacking bracket front cover function

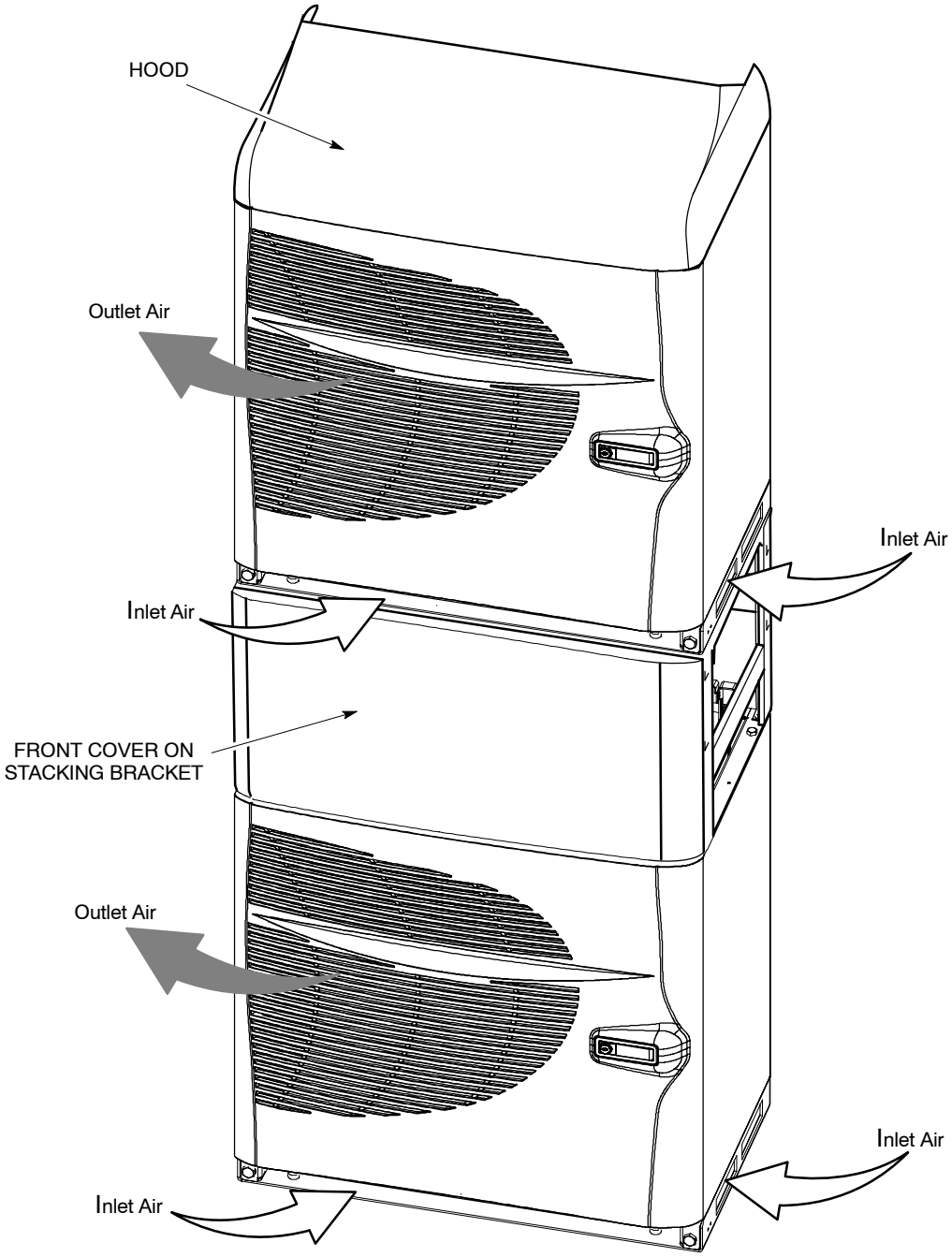
The stacking bracket front cover clips onto the front of the stacking bracket and provides the following functions:

- Blanking panel to match the appearance of the cabinet door.
- Protection for CCBs on systems where fitted (not Horizon II *macro*).

View of stacked cabinets

Figure Tech. 2-15 shows a view of two stacked Horizon II *macro* cabinets with front covers attached to the two stacking brackets.

Figure Tech. 2-15 View of two stacked Horizon II *macro* cabinets showing airflow



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Chapter 3

Power distribution

Horizon II *macro* power supplies

Power supply overview

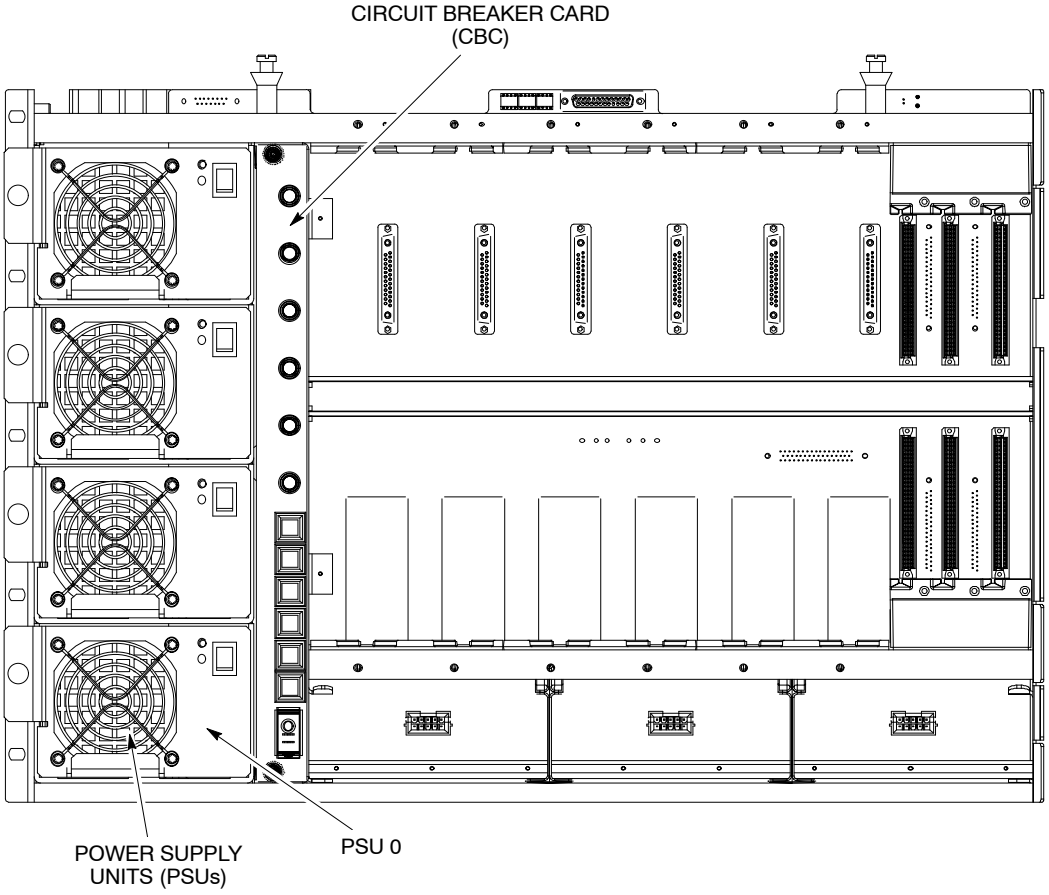
The Horizon II *macro* power supplies consist of the following elements:

- The power supply units (PSUs):
  - +27 V dc PSU (negative earth input).
  - –48/60 V dc PSU (positive earth input).
  - 120/240 V ac (nominal) PSU.
- The circuit breaker card (CBC).

Location of power modules

Figure Tech. 3-1 shows the CBIA with the power modules indicated.

Figure Tech. 3-1 Location of power modules



Power supply unit (PSU)

Types and overview of PSU

There are two types of dc PSU:

- Nominal +27 V (negative earth input).
- Nominal –48 V (positive earth input).

There is one type of ac PSU:

- Nominal 120/240 V.

All PSUs have the same external appearance and are located in the same positions. Different types are identified only by front panel labels.

The PSUs are fed from a backplane connector and use pulse width modulation to generate output supply. A front panel switch (shown in Figure Tech. 3-2) disables the output, reducing the input current as shown in Table Tech. 3-1.

Table Tech. 3-1 Input currents for power supply unit

Type of PSU	Output voltage full load	Input current full load	Input load when output switch off
+27 V nominal dc	+27 V	68 A	1 A
–48 V nominal dc	+27 V	33 A	0.5 A
120/240 V nominal ac	+27 V	15 A	0.1 A

NOTE There are several manufacturers of the PSUs. Each is fully compatible with the same type of PSU from a different manufacturer.

PSU location and redundancy

The PSUs are mounted vertically above each other on the left-hand side of the cabinet. There are four slots, three for maximum cabinet configuration plus one for redundancy. Table Tech. 3-2 shows the recommended number of PSUs for different operational configurations.

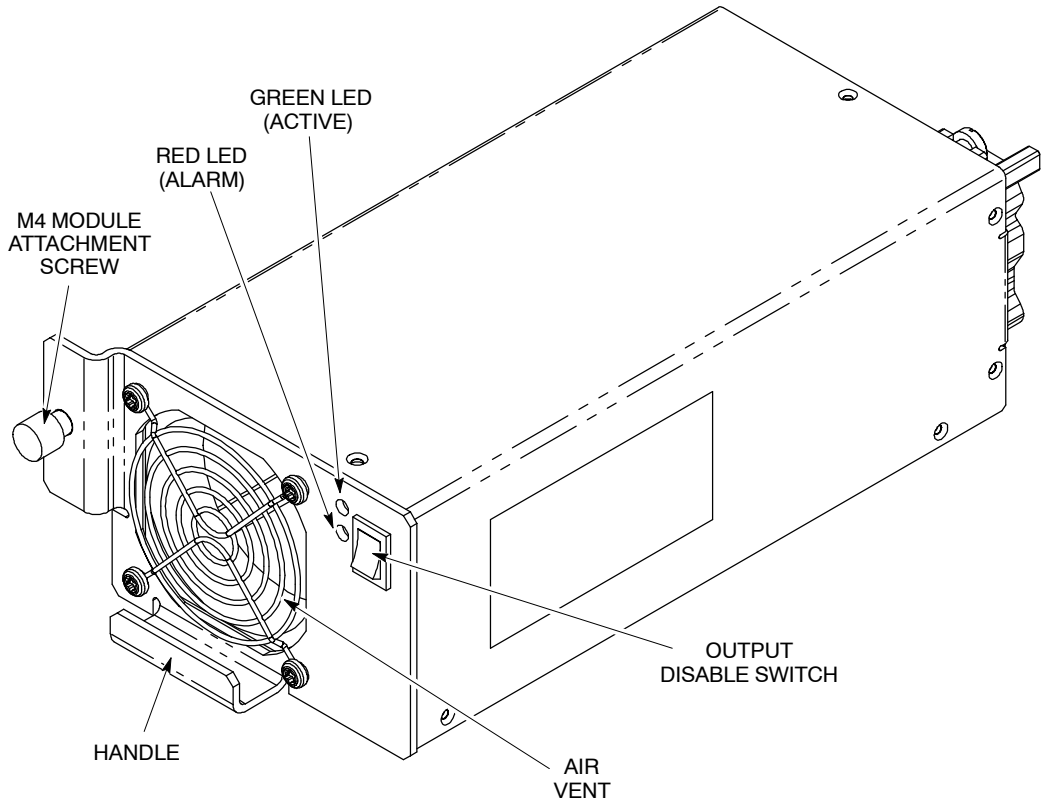
Table Tech. 3-2 PSU operational configurations

Number of PSUs fitted	Maximum load capability
2	Complete operation of cabinet for up to three CTU2s.
3	Complete operation of cabinet for up to six CTU2s.
4	Redundancy and power load sharing (further enhancing reliability by reducing temperature of operation).

PSU module view

Figure Tech. 3-2 shows a view of the PSU with LEDs identified.

Figure Tech. 3-2 View of Horizon II *macro* PSU



PSU alarms

There are five alarm conditions for each PSU:

- Output overvoltage.
- Output undervoltage.
- Input undervoltage.
- Overtemperature.
- Fan failure.

The likely cause of the alarm is indicated by a combination of the front panel LEDs (see Table Tech. 3-3).

PSU LEDs

The front panel LEDs indicate the conditions shown in Table Tech. 3-3.

Table Tech. 3-3 Power supply unit LED functions

Green LED (ACTIVE)	Red LED (ALARM)	Indication
OFF	OFF	1. Cabinet power supply off, or 2. PSU not connected.
ON	OFF	Normal operation.
OFF	ON	1. PSU connected and output disable switch off, or 2. Alarm condition with PSU unable to supply power.
ON	ON	Internal problem (such as overtemperature), but still able to maintain supply.

PSU backplane protection

If a power track on the backplane is broken or short-circuited, the PSU detects the fault and shuts down to prevent further damage.

Circuit breaker card (CBC)

CBC overview

The CBC provides circuit protection and manual isolation for all parts of the cabinet, except the PSUs. It is mounted vertically in its own slot, to the right of the PSUs.

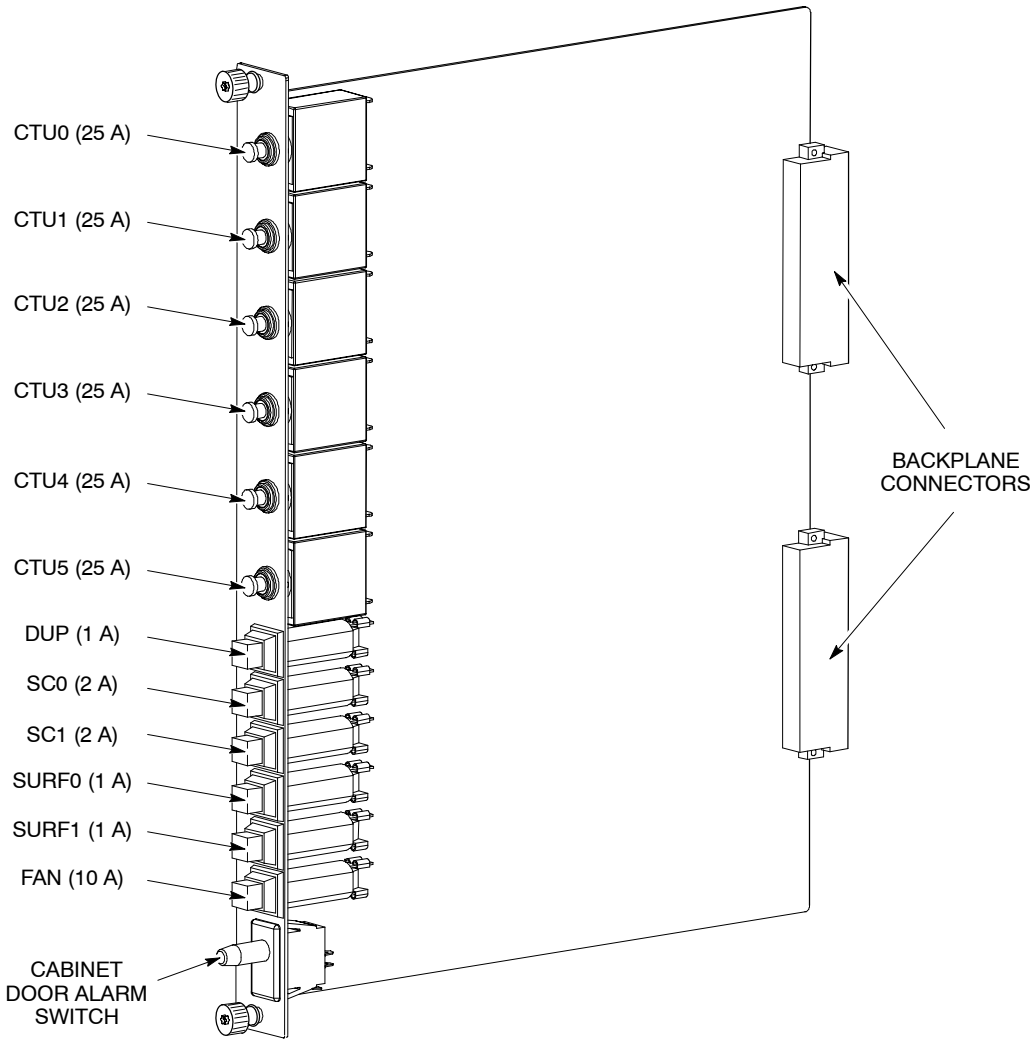
A cabinet door switch is mounted at the bottom of the CBC front panel. Opening the door causes the switch to be released, sending a door open alarm signal to the alarm module.

The CBC is connected to the backplane to provide isolator switches and overload protection for the equipment indicated in Figure Tech. 3-3.

View of the CBC

Figure Tech. 3-3 shows views of the CBC with circuit breaker buttons identified.

Figure Tech. 3-3 CBC, with circuit breaker buttons identified



Operation of the CBC

Power for each protected module is supplied via the appropriate circuit breaker button. Overload of any circuit results in the appropriate circuit breaker button tripping to the off (out) position. The button can be pressed to the on (in) position when the overload problem has been corrected.

Each protected module (identified in Figure Tech. 3-3) can be isolated by pressing and releasing the appropriate button to the off (out) position. Power is restored by pushing the appropriate button to the on (in) position.

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Chapter 4

RF modules

RF equipment description

Overview of RF equipment

This chapter describes the functional operation of radio frequency (RF) modules used in the Horizon II *macro* cabinet. All descriptions are presented at a block diagram level.

RF modules described

The following equipment is described:

- Compact transceiver unit (version 2) (**CTU2**). The CTU2 supports both the EGSM900 and DCS1800 frequency bands.
- Sectorized universal receiver front-end module (version 2) (**SURF2**). Two versions of the SURF2 are available for the Horizon II *macro*: one operates in the 900 MHz frequency band and the other operates in the 1800 MHz frequency band.

NOTE	900 MHz and 1800 MHz SURF2s cannot be installed in the same cabinet. Similarly, CTU2s operating at 900 MHz and 1800 MHz cannot be mixed in the same cabinet.

- Several types of transmit block (**Tx block**). Tx blocks are used for various configurations of transmit path, depending on number of antennas, CTU2s and functionality, including potential shared receive path.

RF general information and VSWR monitoring function

The following additional information is provided in this chapter:

- General definition of transmit and receive functions.
- An **RF overview and VSWR monitoring function** description.
- A brief explanation of **CTU2 frequency hopping**.

These descriptions are intended to assist the reader in understanding the information on the RF modules.

RF specifications

All equipment meets or exceeds ETSI regulations. Frequency information is listed in the **Specifications** section of Chapter 1.

Receive (Rx) RF hardware

Receiver RF hardware consists of the SURF2 module and the receive section of the CTU2. The DUP is required for Rx filtering on the main (A) path and is optional for the Rx diversity (B) path.

The SURF2 module provides bandpass filtering and low-noise amplification for up to three sectors, with two branch diversity receive antenna signals, together with switching to CTU2s.

NOTE	Four branch diversity is possible as a field upgrade with two SURF2s and an additional SURF2 harness installed in the cabinet.

CTU2 Rx role

The CTU2 provides the following receive functions:

- Receiver tuning (on a timeslot basis) to any receive channel frequency.
- Demodulation and equalization of the receive channel signal.
- Measurement of the received signal strength indication (RSSI) and signal quality.
- Recovery of received data from the demodulated radio channel.
- Channel decoding of the received data and processing of the recovered signal. Traffic data is passed on to the site controller module for routeing to the MSC.
- Digital interface to the SURF2 module, which controls selection by the SURF2 switch of the receive signals from the appropriate antenna.
- Comparison and processing of an additional receive path from a second diversity antenna input to compensate for multipath fading and interference.

Transmit (Tx) RF hardware

Transmit RF hardware consists of Tx blocks in appropriate combinations to meet requirements of antenna sharing for the transceivers.

CTU2 Tx role

The CTU2 provides the following transmit functions:

- Transmit tuning (on a timeslot basis) for generation of any transmit channel RF frequency.
- Encoding transmit data output.
- Digital modulation of transmit data onto the transmit radio channel signal.
- Final RF power amplification and output power level control of the transmit radio channel RF signal.
- Channel encoding of the data to be transmitted, interleaving signal and traffic channel data, as defined by ETSI.

Rx/Tx single antenna duplexing

Duplexers allow a single antenna to be used for both transmit and receive operations. Normally duplexed RF signals pass through one antenna, with a second receive antenna to provide diversity.

CAUTION	If a single antenna (non-diversity) is required, the duplex antenna RF receive cable from the transmit block must be connected to the RxA path at the SURF2. Simply switching off diversity at the OMC-R without the correct SURF2 configuration will cause a loss of reception.

RF overview and antenna VSWR monitoring function

RF overview

This section explains the RF functional blocks and additional antenna VSWR monitoring function.

The terminology, functionality, and optional capabilities, are set out as a basis for understanding more detailed descriptions in the RF module sections of this chapter.

RF main components

The following description should be read in conjunction with Figure Tech. 4-1.

The RF equipment consists of three main blocks:

- The CTU2.
- The SURF2.
- The Tx block.

CTU2

The CTU2 can operate at 900 MHz and 1800 MHz (dual carrier). It can receive two (single density or EDGE) or four (double density) Rx inputs from the SURF2. These inputs are converted into digital voice/data. The Rx signals provide diversity of the Rx function from the MS (uplink).

The CTU2 generates a Tx data signal, translated from received digital voice/data, which is transmitted by cable to the Tx block for transmission via the antenna to the MS (downlink).

SURF2 module

Two types of SURF2 module are available for use in the Horizon II *macro*. One provides 900 MHz reception capability and the other provides 1800 MHz reception capability.

Each SURF2 module accepts up to three pairs of antenna inputs. The SURF2 switches the inputs to the appropriate CTU2s under the control of the database via the HIISC. There are two inputs to each CTU2 for Rx diversity.

The SURF2 does not contain any loopback test circuitry.

Tx block

Up to six Tx blocks can be installed in the Horizon II *macro* cabinet.

Tx blocks filter the transmit signal for the required Tx band. They also use filters to enable the Rx frequency signal to be passed to the SURF2, if one antenna is used for both Tx and Rx signals.

Antenna VSWR monitoring

Purpose

The antenna VSWR monitoring function is used to detect faults in antennas or antenna path connections. This is achieved by sending a known signal power level to the antenna and then measuring the reflected power.

Hardware

The test signal for antenna VSWR monitoring is generated by the CTU2. The DUP contains a VSWR monitoring circuit that monitors the reflected power. If the return loss from the antenna port is less than 6 dB, a VSWR alarm signal is sent to the alarm module.

RF loopback

Purpose

The loopback test function is primarily used to identify faults within the RF system. The loopback test function provides a diagnostic capability at the OMC-R, by creating a test signal to identify if the fault is either:

- Software (that the OMC-R can correct).
- Hardware (requires a site visit).

The result is a reduction in site assessment visits, and avoidance of unnecessary visits when hardware is functioning correctly.

Hardware

The RF loopback test function is essentially a hardware capability built into the CTU2. Software instructions activate the test hardware, causing a loopback signal to be injected internally into the Rx input of the CTU2 to test its receive section.

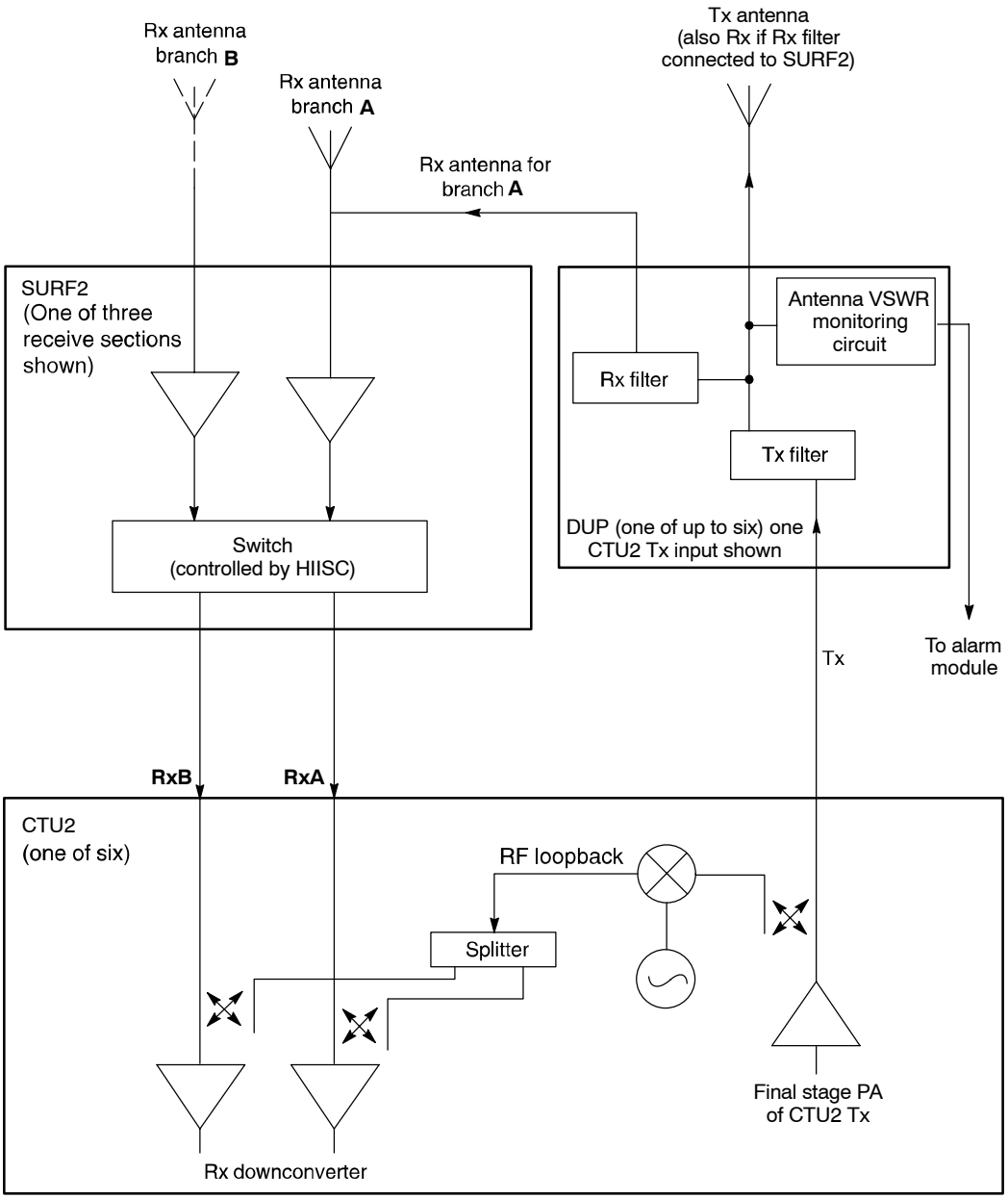
Software operation

The loopback test function is normally carried out under the control of the OMC-R.

RF functional diagram

Figure Tech. 4-1 shows the basic RF, antenna VSWR monitoring, and CTU2 loopback test functions. For clarity, only one CTU2, one Tx block, and part of the SURF2 are shown.

Figure Tech. 4-1 RF functional diagram



Compact transceiver unit (CTU2)

Overview of the CTU2

This section provides the technical description of the CTU2.

NOTE	Two versions of the CTU2 are available for the Horizon II *macro*. One version operates in the EGSM900 frequency band and the other operates in the DCS1800 frequency band.

The CTU2:

- Generates the RF frequencies required to perform the transmit and receive functions.
- Contains the digital circuits required for 32 timeslots of channel equalization, encoding and decoding, and transceiver control logic.

The CTU2 provides the air interface between a BSS and MSs, with the following features:

- Capability of diversity reception (input from up to four antennas) which improves the quality reception in the presence of multipath fading and interference.
- Frequency change on a timeslot basis for frequency hopping and equipment sharing.
- Transmit power control.

CTU2 features

The CTU2 has the following features:

- Single or double density mode in a Horizon II *macro* cabinet. Single density mode provides single carrier GSM Tx capability. Double density mode provides 2 carrier GSM Tx capability (both carriers must be in the same sector).
- Single carrier EDGE Tx capability.
- Backwards compatible with CTU used in Horizon*macro* indoor (with restrictions).
- Transmit diversity.
- Two or four branch Rx diversity. (Four branch diversity requires 2 x SURF2 modules and a second SURF2 harness cable to be installed.)
- Hardware support for AMR (upgrade required for pre-GSR7 software).

CTU2 Tx RF output specification

For Tx RF output refer to **Specifications** in Chapter 1.

Location and requirements

The CTU2 shelf is located below the basket for the Tx blocks, and takes up the majority of the space in the cabinet.

The cabinet can contain up to six CTU2s. At least one CTU2 must be fitted in each cabinet. All CTU2s in the cabinet must operate at the same frequency (either 900 MHz or 1800 MHz).

CTU2 internal boards

The CTU2 is a single field replaceable unit (FRU), which contains:

- CTU2 transceiver (XCVR) board.
- Power amplifier (PA) board.
- Power supply unit.

Alarm reporting

The CTU2 status is displayed by LED indicators on the front panel, as shown in Figure Tech. 4-2, and detailed in Table Tech. 4-1. Major sub-systems, such as synthesizers and RF amplifiers, are monitored with alarm signals as necessary.

Table Tech. 4-1 CTU2 front panel status indicators

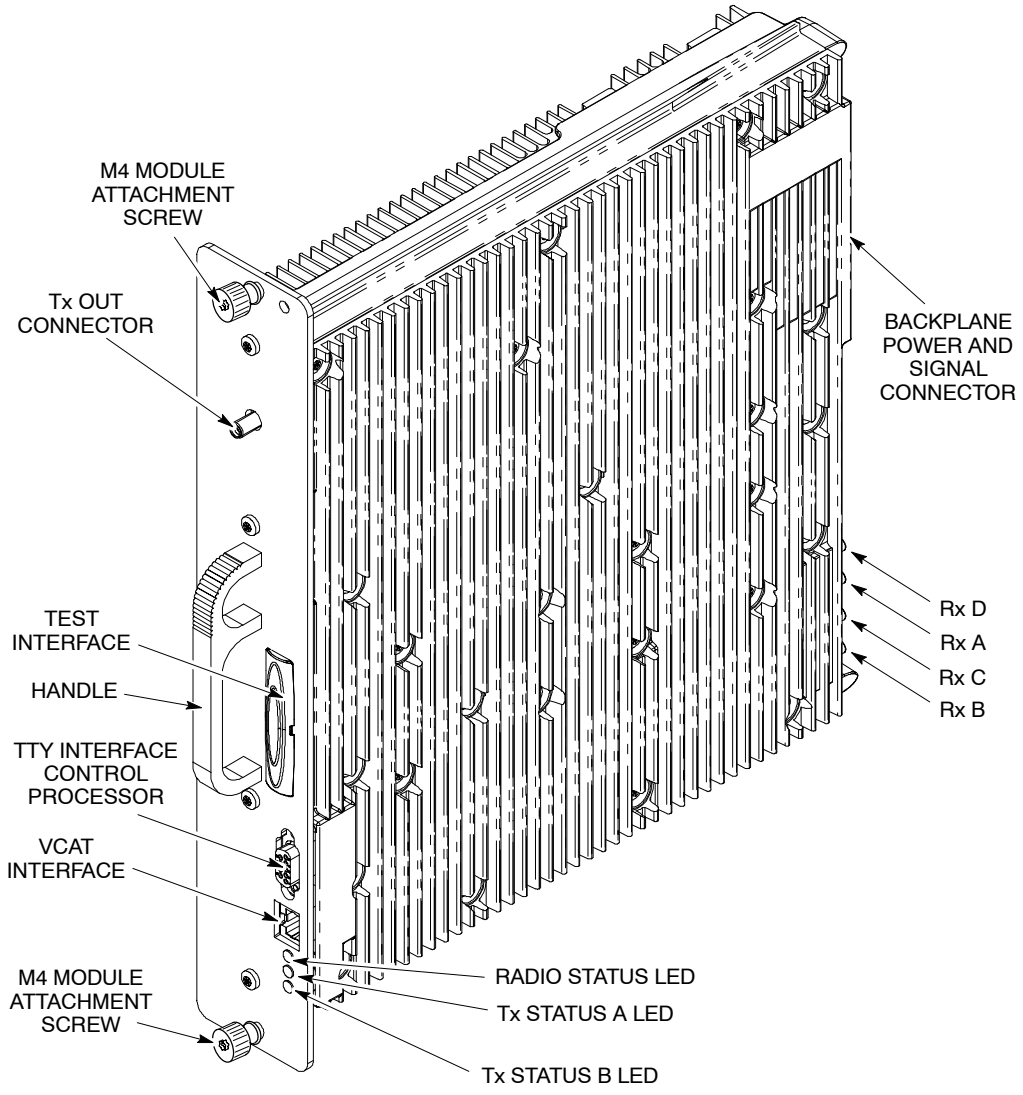
LED	Status	Meaning
RADIO STATUS	Unlit	CTU2 is off.
	Flashing green	Boot code being loaded. (Do not remove power or reset – see CAUTION below.)
	Green	Normal operational mode.
	Flashing yellow	Test mode.
	Yellow	Transceiver inhibited.
	Red	Alarm condition.
	Alternately flashing red and green	Flash reprogramming in progress. (Do not remove power or reset – see CAUTION below.)
TRANSMIT (Tx) STATUS A	Unlit	Transmitter A is off.
	Yellow	Transmitter A is keyed on.
TRANSMIT (Tx) STATUS B	Unlit	Transmitter B is off.
	Yellow	Transmitter B is keyed on.

CAUTION	Removing power or resetting the cabinet while the boot code is downloading or flash reprogramming is taking place will cause memory corruption. If the boot code is corrupted, contact Motorola Customer Network Resolution Centre requesting the boot code restoration procedure and the appropriate boot code file.

View of a CTU2

Figure Tech. 4-2 shows the CTU2 with main features identified.

Figure Tech. 4-2 CTU2, showing main external features



NOTE	Rx A (main branch) and Rx B (diversity branch) are the only Rx connectors used in a cabinet containing a single SURF2. Rx C (branch 3) and Rx D (branch 4) are only used when a second SURF2 is installed in the cabinet to provide four branch Rx diversity.

CTU2 front panel detail

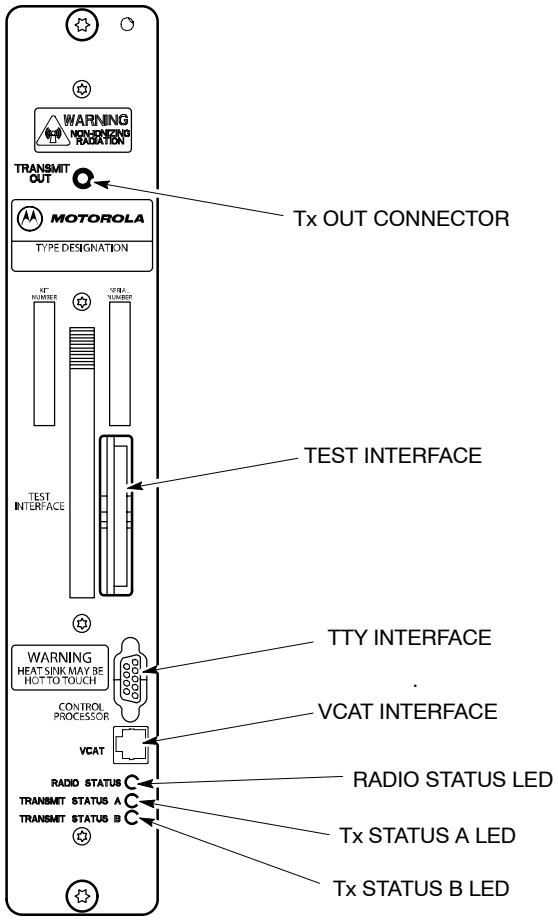
The TTY RS-232 serial port has three serial links onto the 9-way connector:

- Radio subsystem (RSS).
- Equalizer and control processor (EQCP).
- Channel coder control processor (CCCP).

A test interface port on the CTU2 front panel provides access to critical test points for factory calibration and maintenance.

Figure Tech. 4-3 shows the front panel and Table Tech. 4-2 lists connector functions.

Figure Tech. 4-3 CTU2 front panel



NOTE The CTU2 does not have a reset button. A reset is acheived using the apppropriate CTU2 circuit breaker on the CBC.

Table Tech. 4-2 CTU2 front panel connectors

Front panel legend	Function	Connection to
TRANSMIT OUT	Transmitter RF output	Tx block
TTY INTERFACE	Test access to processor	Three RS-232s
TEST INTERFACE	Factory use	Test equipment
VCAT INTERFACE	Factory use	Test equipment

CTU2 Tx connector

The CTU2 Tx connector is a short SMA to SMA link to the base of the appropriate Tx block or feedthrough plate.

NOTE	The Tx cable has a 90° SMA connector at one end and a straight SMA connector at the other end. The 90° end is designed for connection to the Tx port of the CTU2.

CTU2 Rx function

The receiver part of the CTU2 can accept two amplified and filtered receive antenna signals from each SURF2 module (four Rx signals in total). These two signals are applied to inputs (branch A and branch B) of the CTU2 transceiver board.

The transceiver can be configured to provide double density receive capacity or 4 branch Rx diversity. In double density mode, the receiver provides demodulation of a main and diversity path for two RF channels. In 4 branch Rx diversity mode, the receiver provides four independent Rx paths for one RF channel.

The input from the SURF2 module is filtered, amplified and down converted to ensure the signal level and frequency range are correct for the next stage.

CTU2 interface function

The CTU2 interface function provides the air interface timing and transceiver control circuitry required for Rx (uplink) and Tx (downlink) control functions.

The CTU2 interface includes:

- Master GSM air interface timing function.
- Independent Rx gain control interface for each diversity receiver branch.
- Baseband Rx data interface for each diversity receiver branch.
- Receiver front end control.
- Tx data interface including GMSK modulator which provides baseband data to the transmitter.
- Tx and power amplifier power control interface.
- Rx and Tx frequency synthesizer control which supports RF frequency hopping.
- CTU2 and cabinet alarm data collection.
- Alarms sampling and multiplexing.

CTU2 frequency hopping

Overview of CTU2 frequency hopping

The CTU2 supports two types of frequency hopping, synthesizer frequency hopping (SFH) and baseband frequency hopping (BBH). This section provides an explanation of both types. In either type, the MS switches channels after every transmit/receive (Tx/Rx) burst pair. The difference between SFH and BBH is in the method by which channel switching is achieved at the BTS.

NOTE	BBH is not possible if the CTU2 is used in double density mode in a Horizon*macro* cabinet which is controlled by a MCUF site controller (refer to *System Information: BSS Equipment Planning (68P02900W21)* for further details).

Synthesizer frequency hopping (SFH)

SFH can only be used with wideband combining.

A minimum of two CTU2s are required per cell due to BCCH requirements. Timeslot 0 of CTU2 0 is used for the BCCH carrier and therefore CTU2 0 cannot use SFH. Only CTU2 1 and additional CTU2s can use SFH.

Baseband frequency hopping (BBH)

BBH can use either Tx blocks or CCB Tx combining equipment (not available for Horizon II *macro*). The main reason for using BBH instead of SFH is to enable frequency hopping when using CCBs, because the mechanical tuning of CCBs is too slow for SFH.

The number of CTU2s required to support BBH is equal to the number of frequencies used.

SURF2 module

SURF2 module overview

The sectorized universal receiver front end (SURF2) module performs low noise amplification, RF bandpass filtering, and antenna to CTU2 routeing through a switch/splitter matrix. One SURF2 can route any of three Rx antenna inputs to any of six different CTU2s for both a main and diversity path. The SURF2 also provides an expansion path from the antenna 0 input for both main and diversity paths.

The SURF2 is single band and two versions are available for use in the Horizon II *macro* cabinet:

- 900 MHz, for EGSM900 systems.
- 1800 MHz, for DCS1800 systems.

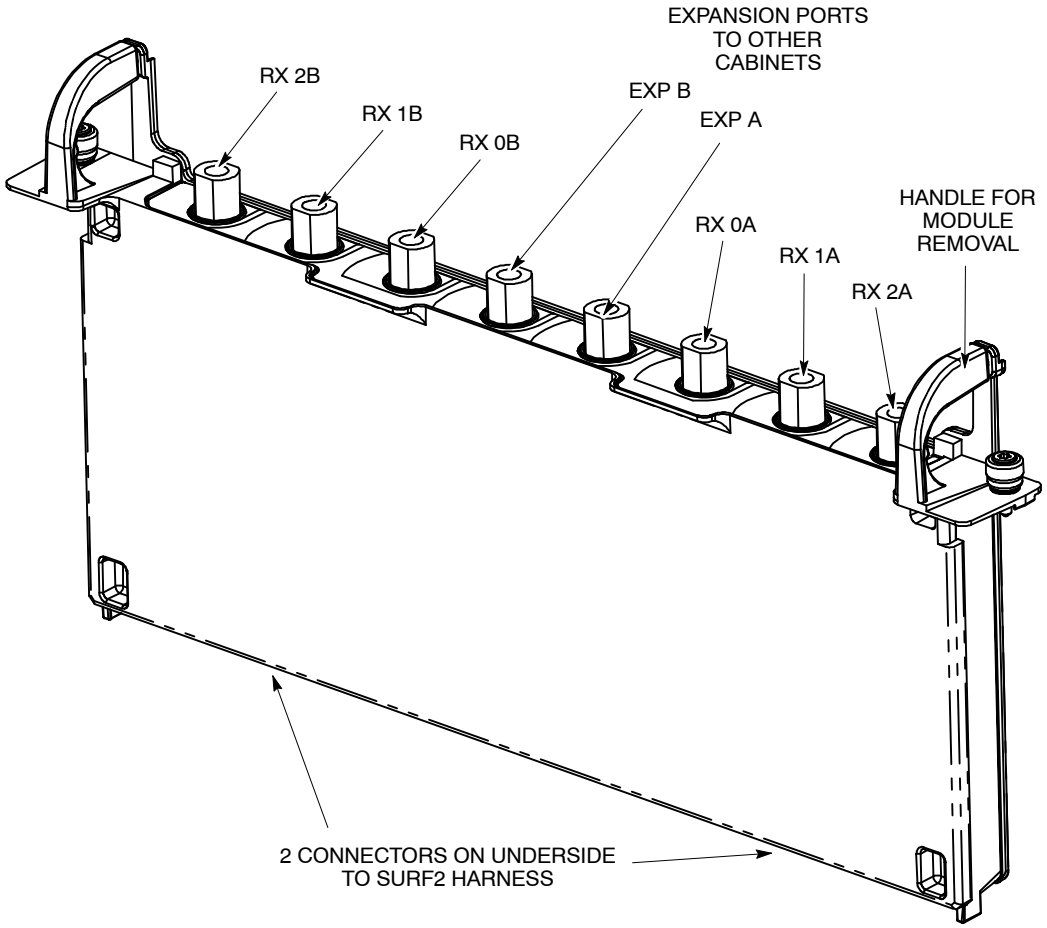
One or two SURF2 modules may be installed side by side in a slot at the rear of the cabinet top panel. Two connectors on the underside of each module connect to individual SURF2 harnesses which provide connectivity to up to six CTU2s. Antenna connections are located on the top of the unit.

NOTE	Dual band operation in a single cabinet is not supported. That is, 900 and 1800 MHz SURF2s cannot be mixed in the same cabinet.

SURF2 module view

Figure Tech. 4-4 shows a view of the SURF2 module with features identified.

Figure Tech. 4-4 SURF2 module with features identified



NOTE	The optional second SURF2 has different port labelling – "C" replaces "B" and "D" replaces "A" in Figure Tech. 4-4.

SURF2 functional description

The SURF2 module provides front end filtering, amplification, and matrix control of the RF receive signal between the antenna and the CTU2. It has three antenna pair connections providing frequency reception.

The SURF2 functional sections (Figure Tech. 4-5) consist of filtering, amplification, splitting, digital processing and power selection.

NOTE	The SURF2 does not support loopback mode and antenna VSWR monitoring.

Each section is duplicated for the second diversity path except for the digital and dc power section which is shared by the two diversity paths. There are three antenna pair inputs (ANT 0, ANT 1 and ANT 2) for each of the two diversity branches (Branch A and Branch B). There are six outputs to the CTU2 for each of the two diversity branches. There is also an output for an expansion cabinet for ANT 0 on each branch.

Digital codes are transmitted from the CTU2s to the digital section. The digital codes are dissimilar in order that CTU2s programmed for the 900 MHz or 1800 MHz frequency bands can be recognized and appropriate switching can be made to the required antenna for transmission and reception.

The digital and power supply section is also responsible for manual overrides, alarms and dc voltages.

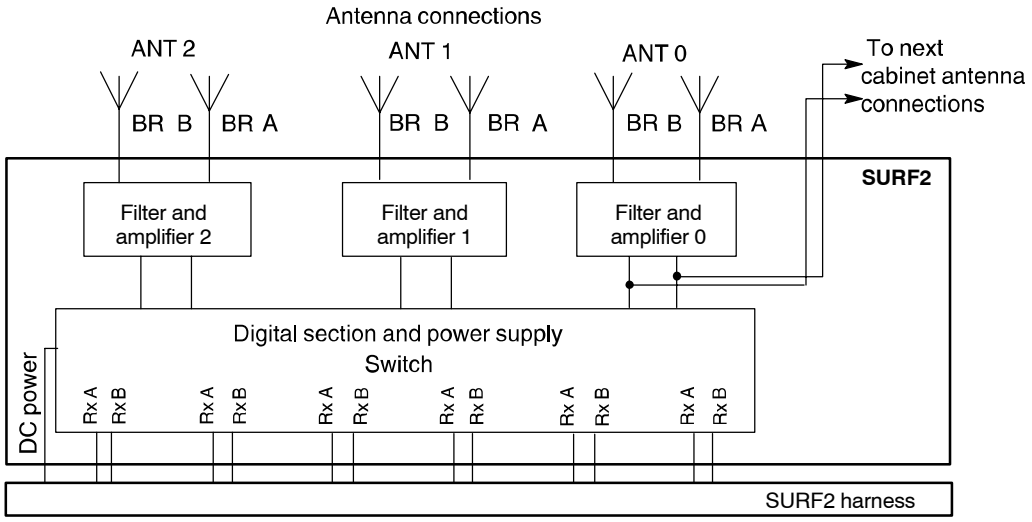
Alarms

The alarm signal from the SURF2 is active low (0 V) and is multiplexed onto the branch 1 (and branch 3) RF connection. An alarm generated at an individual CTU2 is caused by an unexpected number of antenna select pulses being read. An alarm generated at all CTU2s connected to the SURF2 is caused by one of the amplifiers drawing too much or too little current.

SURF2 functional diagram

Figure Tech. 4-5 shows a functional diagram of the SURF2 module.

Figure Tech. 4-5 SURF2 functional diagram



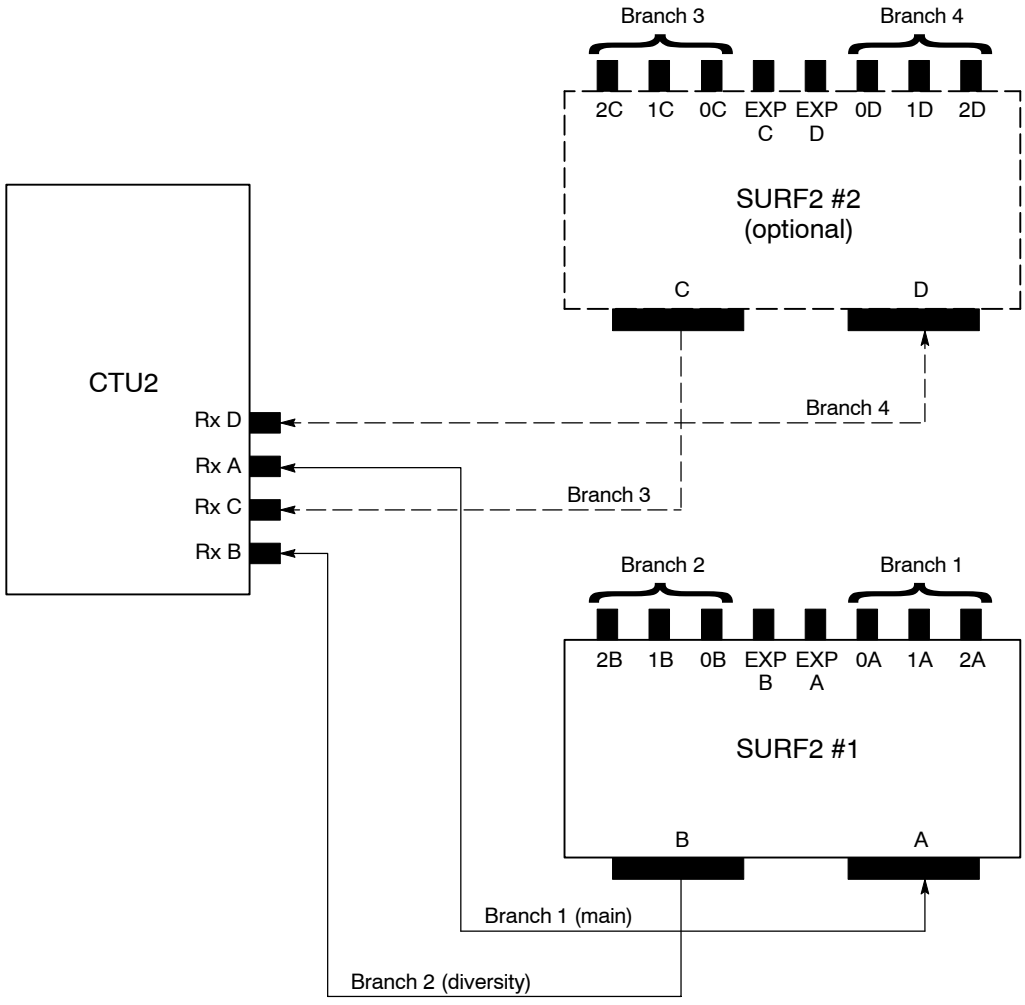
SURF2 to CTU2 interface

Interface block diagram

Figure Tech. 4-6 shows the interconnections between the SURF2 and the CTU2, both for 2–branch Rx diversity (double density) and for 4-branch Rx diversity (single carrier).

NOTE	4-branch diversity requires an optional second SURF2 and harness cable to be installed in the cabinet.

Figure Tech. 4-6 SURF2 to CTU2 connections (2 and 4-branch diversity)



NOTE	Rx A and Rx C on the CTU2 carry the SURF2 control and alarm signals. The 7-pin connector A on the base of the SURF2s carries 6 x RF signals + 1 earth and connector B carries 6 x RF signals + 1 power.

Interface description – 2 carrier, 2-branch Rx diversity

The physical interface between the SURF2 and the CTU2 consists of two connections, one bi-directional and the other directional. The bi-directional connection is for the RF receive main branch (branch 1) and for digital communication between the SURF2 and the CTU2. The directional connection is for the RF receive diversity branch (branch 2) only.

Interface description – 1 carrier, 4-branch Rx diversity

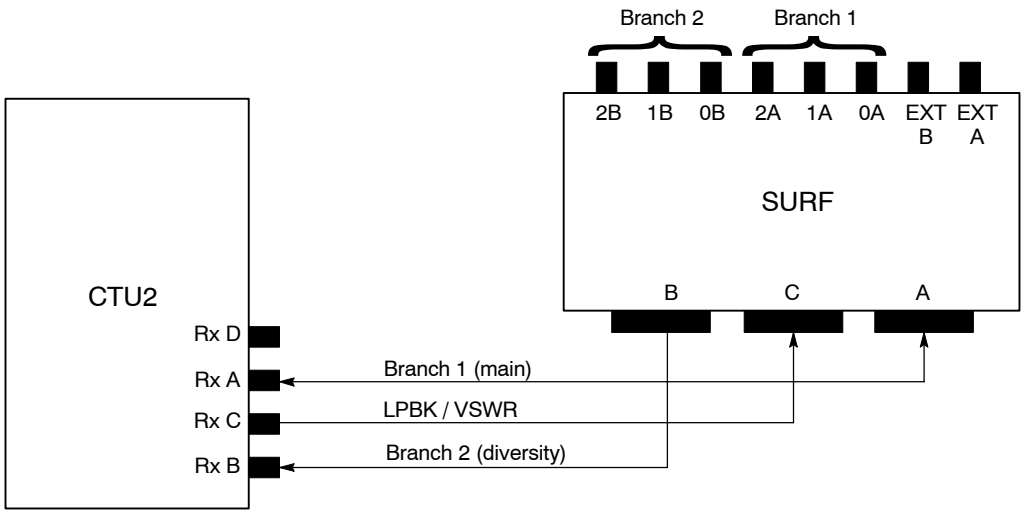
The physical interface for one carrier / four branch diversity requires two SURF2 modules and one CTU2. It is similar to the interface for two carrier / two branch diversity, with the third and fourth diversity branches connected to the second SURF2 as shown in Figure Tech. 4-6.

SURF to CTU2 interface (Horizon*macro* indoor compatibility)

As the CTU2 is backwards compatible with Horizon*macro* indoor (with restrictions), this section explains how the Horizon*macro* SURF interfaces with the CTU2.

Figure Tech. 4-7 shows the interconnections between the SURF and the CTU2 for 2 carrier / 2-branch diversity, with loopback (LPBK) and VSWR.

Figure Tech. 4-7 Horizon*macro* SURF to CTU2 interconnections



NOTE	Rx A on the CTU2 carries the SURF control and alarm signals. The 7-pin connectors A and C on the base of the SURF carry 6 x RF signals + 1 earth and connector B carries 6 x RF signals + 1 power.

The physical interface between the SURF and the CTU2 consists of three connections, one bi-directional and two directional. The bi-directional connection is for the RF receive main branch (branch 1) and for digital communication between the SURF and the CTU2. One directional connection is for the RF receive diversity branch (branch 2), and the other is for the loopback or VSWR mode selection and the LPBK / VSWR signal.

Tx blocks overview

Introduction to transmit blocks

Transmit (Tx) blocks are located in up to six positions in the basket above the CTU2s. There are three types of internal Tx blocks:

- **DUP** = Duplexer.
- **HCU** = Hybrid combiner unit.
- **DHU** = Dual hybrid combiner unit.

These Tx blocks are cooled by airflow underneath.

Two types of plate can be located in the basket, one as a blanking plate and one to interface CTU2 Tx cables:

- **Blanking plate**. This ensures proper air flow and EMI shielding for an unused Tx block location in the basket.
- **Feedthrough plate**. This converts a single SMA connector to a single N-type connector, used for connecting a Tx cable from a CTU2 to an expansion cabinet.

CAUTION	Unused Tx block locations must be covered with a blanking plate for correct air flow and EMC shielding.

Screw retention in Tx block locations

The HCU, DHU and the blanking or feedthrough plates are secured to the floor of the top panel basket using three M4 screws.

The duplexers are secured to the top surface of the top panel using two M4 screws.

To ensure correct EMC shielding and general containment, it is important to ensure that all Tx block/plate screw locations have a screw in place and tightened to the correct torque.

Tx block connectors

The transmit block connector types are shown in Table Tech. 4-3.

Table Tech. 4-3 Tx block connectors

RF module	Type of connector	Destination
DUP	SMA (underneath)	CTU2, HCU or DHU
	N-type	SURF2
	7/16	Antenna
HCU	QMA (underneath)	DUP, DHU or feedthrough plate
	SMA (underneath)	CTU2
DHU	QMA (underneath)	DUP
	SMA (underneath)	CTU2, HCU or feedthrough plate
Feedthrough plate	SMA (underneath)	CTU2 or another Tx block
	N-type (on top)	Feedthrough plate in expansion cabinet

NOTE All unused SMA inputs to the Tx blocks must be fitted with 50 ohm load terminations.

Blanking plate

Blanking plate function

The blanking plate is fitted in locations where a Tx block is not required. The blanking plate ensures the correct air flow through the cabinet.

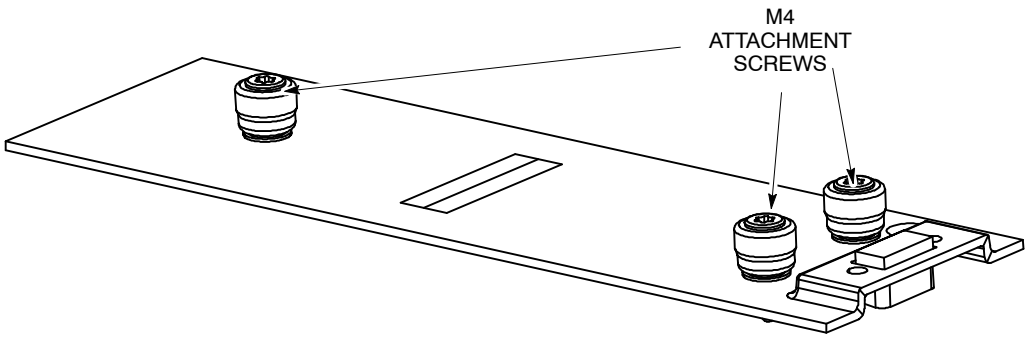
The plate is secured to the floor of the top panel basket using three M4 screws.

NOTE	It is important to ensure that all unused Tx block screw locations have a screw in place and these are tightened to the correct torque (see **Torque values**. in Chapter 1). This is to ensure maximum quality of EMC and general containment.

Blanking plate view

Figure Tech. 4-8 shows a view of a blanking plate.

Figure Tech. 4-8 Blanking plate



Feedthrough plate

Feedthrough plate function

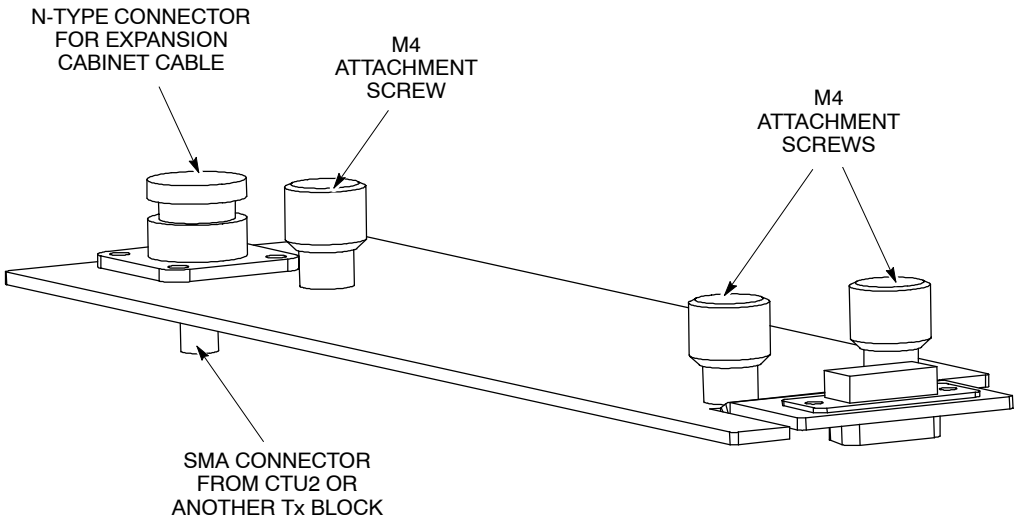
The feedthrough plate converts a normal SMA connector from the CTU2 to a N-type connector. The N-type connector is used to connect to a feedthrough plate in an expansion cabinet

The plate is secured to the floor of the top panel basket using three M4 screws.

Feedthrough plate view

Figure Tech. 4-9 shows a view of the top side of a feedthrough plate.

Figure Tech. 4-9 Feedthrough plate



Feedthrough plate connectors

Each feedthrough plate connects to:

- The Tx output of a single CTU2, using a SMA connector.
- A feedthrough plate in an expansion cabinet, using a N-type connector.

Duplexer (DUP)

DUP function

The purpose of the DUP is to enable each antenna to serve one CTU2 for both Tx and Rx. This is achieved by the use of bandpass filters, contained within the duplexer.

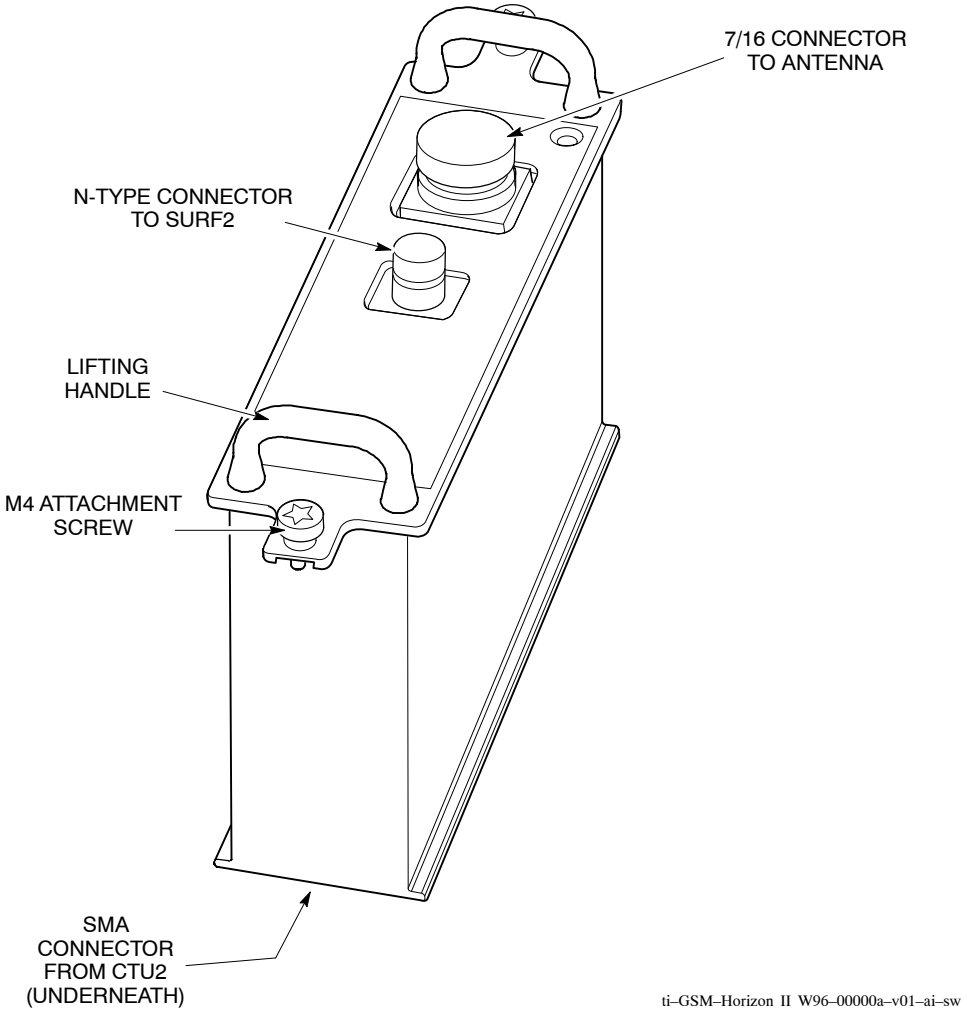
The DUP also contains a VSWR monitor that can detect and generate alarms for transmit antennas with a VSWR of 3:1 or worse.

The DUP is located in the basket above the CTU2s, and is attached to the top panel using two M6 screws.

DUP view

Figure Tech. 4-10 shows the DUP Tx block with connectors identified.

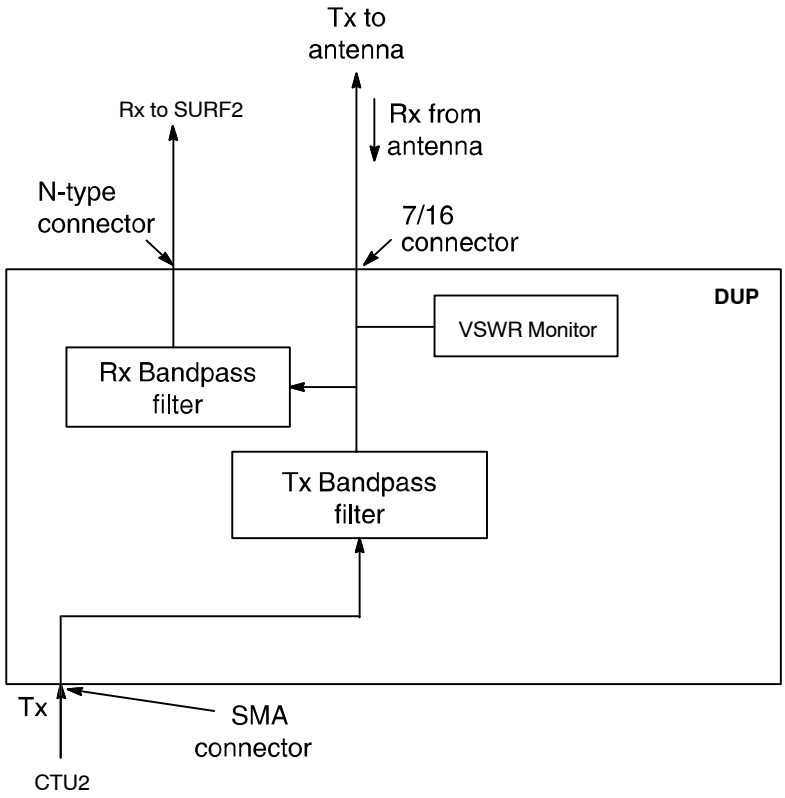
Figure Tech. 4-10 Duplexer with connectors identified



DUP functional diagram

Figure Tech. 4-11 shows a functional diagram of the DUP.

Figure Tech. 4-11 DUP functional diagram



DUP connectors

Each DUP connects to:

- The Tx output from a CTU2, using an SMA connector. The connector is underneath the DUP.
- One antenna, for both Rx and Tx, using a 7/16 connector. This connector is on top of the DUP.
- The SURF, using one N-type connector. This connector is on top of the DUP.

Hybrid combiner unit (HCU)

HCU function

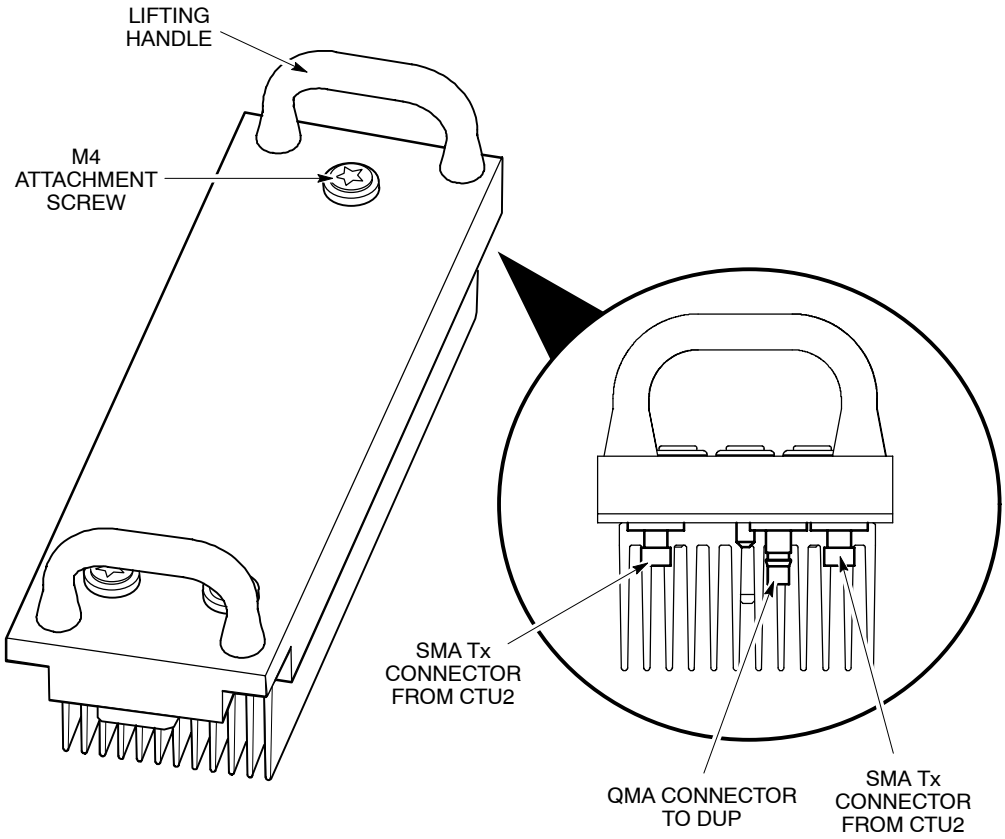
The HCU combines two CTU2 Tx outputs for input to the DUP. This enables up to four carriers (CTU2 operating in double density mode) to be combined onto one antenna

The HCU is attached to the floor of the Tx block basket using three M4 screws.

HCU view

Figure Tech. 4-12 shows the HCU with connectors identified.

Figure Tech. 4-12 HCU Tx block with connectors identified

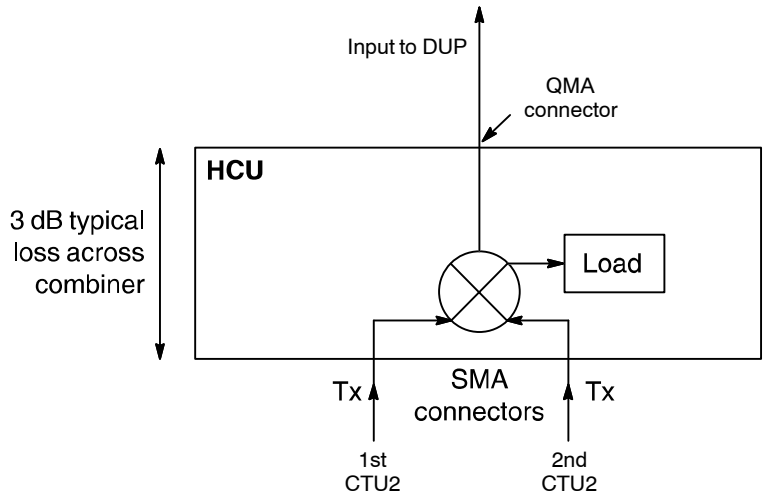


ti–GSM–Horizon II W96–00000b–v01–ai–sw

HCU functional diagram

Figure Tech. 4-13 shows a functional diagram of the HCU.

Figure Tech. 4-13 HCU functional diagram



HCU connectors

Each HCU connects to:

- The Tx outputs of two CTU2s, using SMA connectors.
- The Tx input of a DUP, using a QMA snap-on/snap-off connector.

NOTE	All unused SMA inputs to HCU modules must be fitted with 50 ohm load terminations.

Dual hybrid combiner unit (DHU)

DHU function

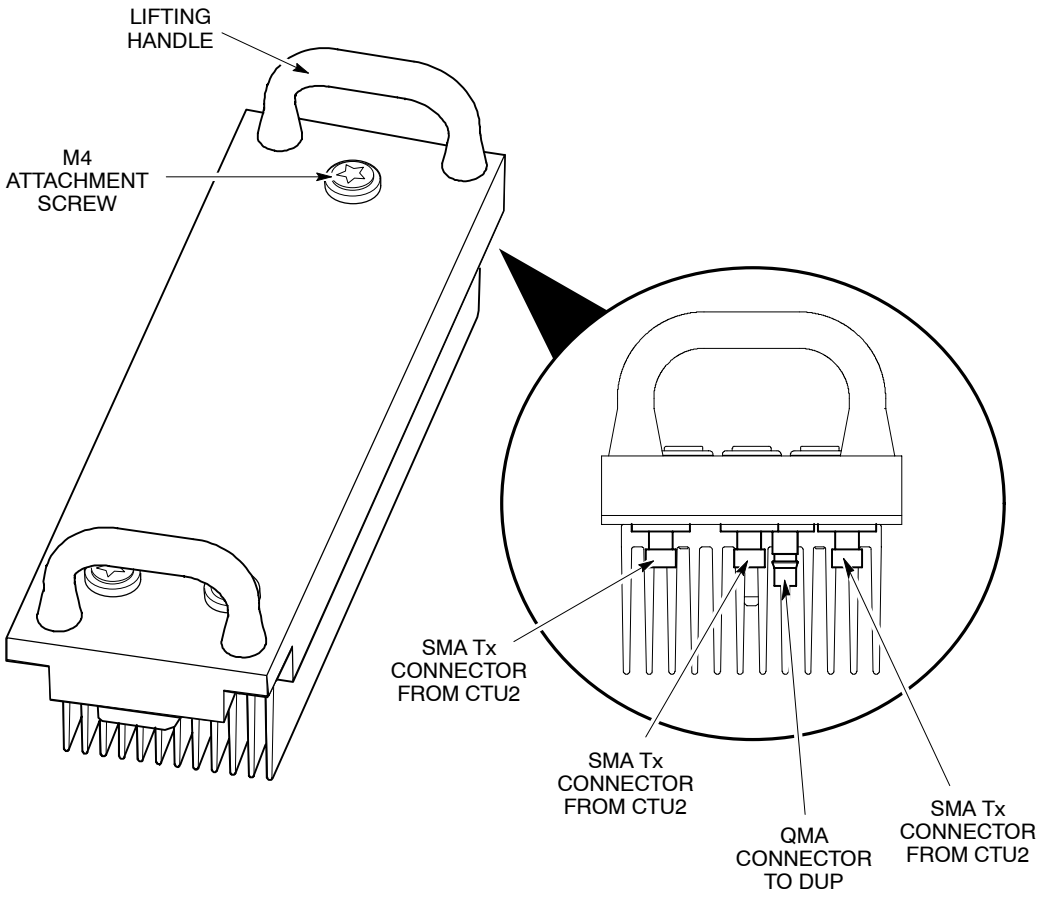
The DHU is basically two HCUs, combined in a single unit. The DHU has three Tx inputs, thus enabling six carriers (CTU2 operating in double density mode) to be combined onto one antenna. Eight carriers can be combined onto a single antenna if one of the Tx inputs is fed through a HCU before being fed to the DHU.

The DHU is located in the basket above the CTU2s, and attached to the floor of the Tx basket using three M4 screws.

DHU view

Figure Tech. 4-14 shows a view of the DHU with connectors identified.

Figure Tech. 4-14 DHU Tx block with connectors identified



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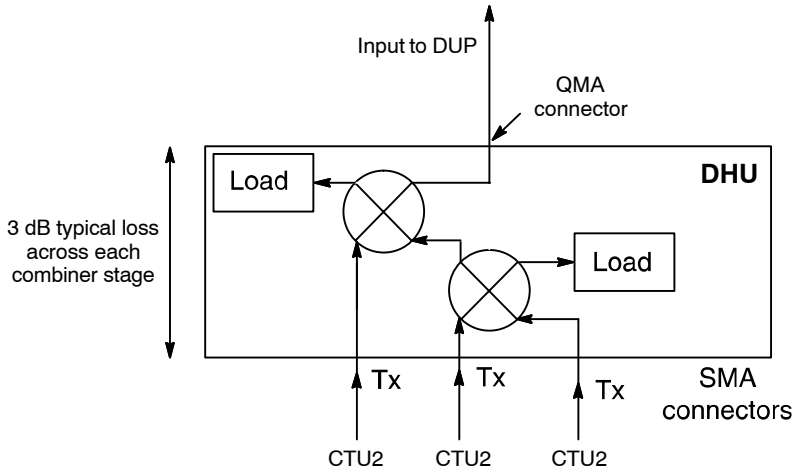
DHU functional diagram

Figure Tech. 4-15 shows a functional diagram of the DHU.

Figure Tech. 4-15 DHU functional diagram



DHU connectors

The DHU connects to:

- The Tx outputs of up to three CTU2s, using the SMA connectors underneath the DHU.
- The Tx input of a DUP, using a QMA snap-on/snap-off connector.

NOTE	All unused SMA inputs to the DHU must be fitted with 50 ohm load terminations.

MOTOROLA

Chapter 5

Digital modules

Overview of digital modules

Introduction to digital modules

The digital modules contained in the Horizon II *macro* cabinet are as follows:

- Site controller unit (HIISC).

  The HIISC provides the processing power, interfacing, and expansion capability for the BTS.

  The HIISC is the equivalent of (but not a replacement for) the MCUF in the Horizon*macro*. One or two HIISCs can be installed in the cabinet, the second one (slave) provides redundancy in case of failure of the master. The master HIISC is mounted in the first slot (0) on the right side of the cabinet. If fitted, the slave is mounted in the slot (1) to the left of the master.

- Expansion multiplexer (XMUX) module (optional).

  The XMUX replaces the HIISC in expansion cabinets, where it connects to the HIISC in the master cabinet via the site expansion board.

  The XMUX is the equivalent of the FMUX in the Horizon*macro*. A single XMUX is incorporated into the HIISC for communication with the site expansion board.

  XMUX redundancy in expansion cabinets is supported.

- Site expansion board (optional).

  The site expansion board provides the control interface and physical link connections between the master and expansion cabinets via fibre optic connectors. The board is only fitted if site expansion is required and must be fitted in both master and expansion cabinets.

  Site expansion board redundancy is supported.

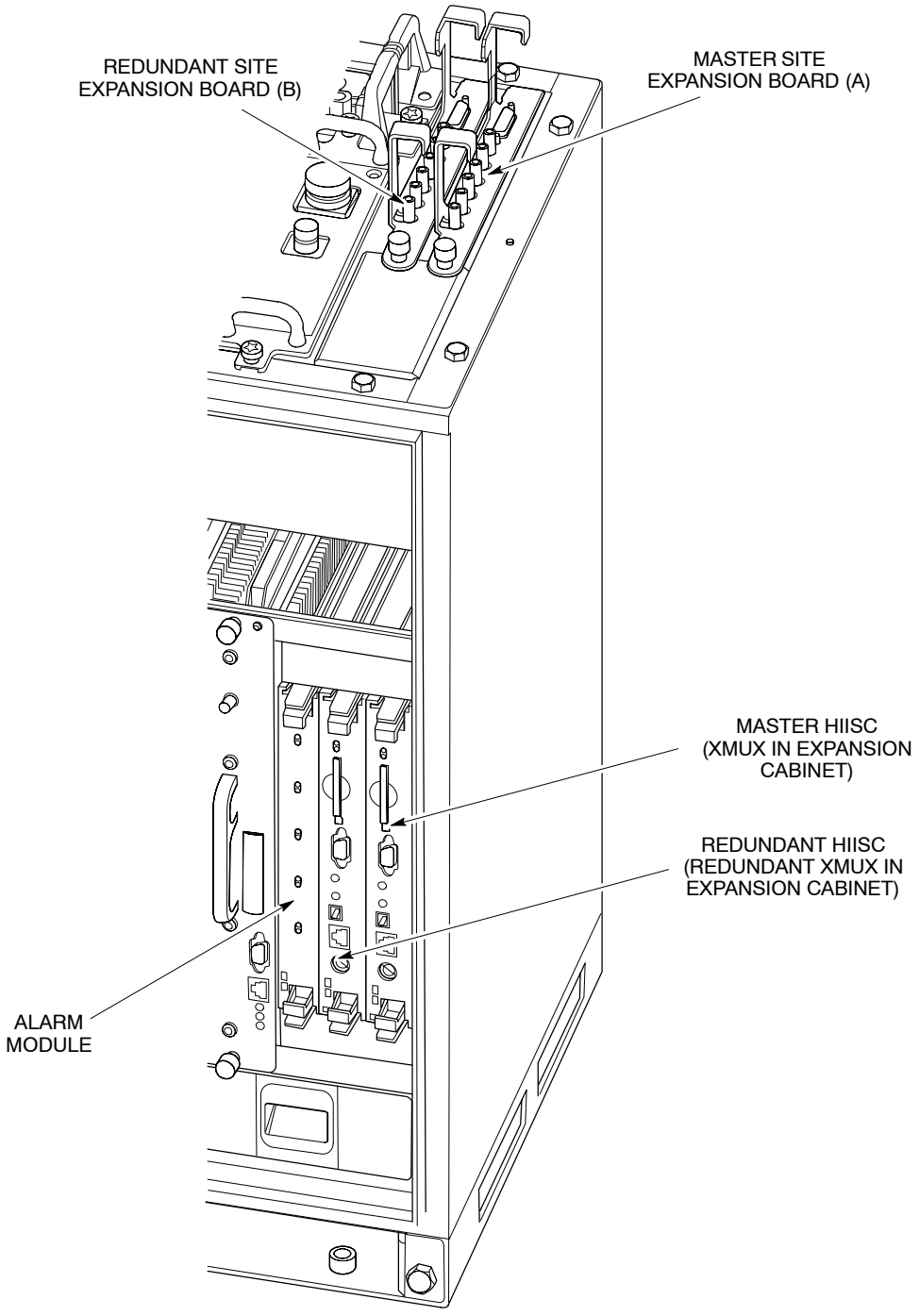
- Alarm module.

  The alarm module provides all the monitoring and reporting facilities required for site and customer alarms. An alarm module is required in all cabinets, whether master or expansion.

Digital module locations

Figure Tech. 5-1 shows the position of the digital modules in the Horizon II *macro* cabinet.

Figure Tech. 5-1 Digital module locations



NOTE	Site expansion boards are only required when expansion cabinets are used.

Redundancy

Redundancy capability for each of the digital modules is described below.

HIISC

The master cabinet must contain at least one HIISC (master), installed as shown in Figure Tech. 5-1. A second HIISC (slave) may also be installed to provide redundancy.

NOTE	Any situation which causes a switch to the redundant HIISC (e.g. master HIISC failure or use of the **`swap_devices`** command) will cause a site reset.

XMUX

All expansion cabinets must contain at least one XMUX, installed in the same slot location as the master HIISC in the master cabinet. A second XMUX may also be installed to provide redundancy. XMUX redundancy is coupled to redundancy of the HIISC in the master cabinet; that is, the XMUX is only redundant if the HIISC is also redundant.

Site expansion board

A site expansion board is only required when expansion cabinets are used. In such cases a site expansion board must be fitted in slot A (see Figure Tech. 5-1) in each cabinet. expansion board redundancy is coupled to HIISC and XMUX redundancy. If the master cabinet has a redundant HIISC and the expansion cabinets have redundant XMUXs, each cabinet (including the master) must also have a redundant site expansion board installed in slot B.

Alarm module

An alarm module must be installed in each cabinet, master or slave. Alarm module redundancy is not supported.

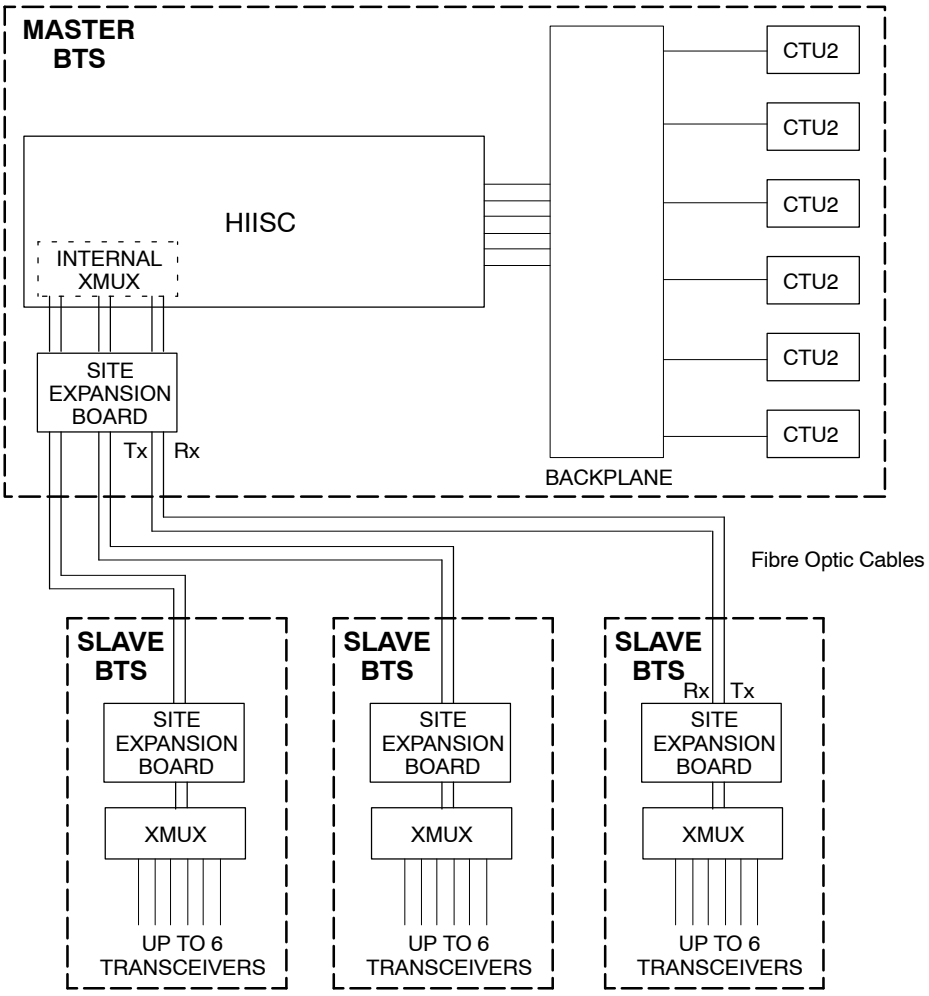
Communication between the HIISC and transceivers

The HIISC is connected to the CTU2s in the same cabinet through the cabinet backplane.

Where an additional slave cabinet is used, the data streams for up to six external transceivers are multiplexed onto a single line by the internal XMUX in the HIISC and then transmitted to the site expansion board. Fibre optic transceivers on the site expansion board convert the TTL signals for transmission to the site expansion boards in the slave cabinets via fibre optic cables. The receiving expansion board converts the data stream back to TTL signals before it is forwarded to the XMUX for demultiplexing. The individual data streams are then distributed to the appropriate transceivers.

Figure Tech. 5-2 shows the communication path in block diagram form.

Figure Tech. 5-2 HIISC to transceiver communication path



Horizon II *macro* site controller (HIISC)

HIISC overview

The HIISC provides all the site processing functions (except for the CTU2 RF functions). The functionality of the separate MCUF, NIU, FMUX, and BPSM modules in the Horizon*macro* cabinet are all integrated within the HIISC.

The Horizon II *macro* cabinet may contain up to two HIISC modules (one master and one for redundancy). Each site and module has an electronic ID for remote identification.

NOTE	Although the HIISC provides the equivalent functionality of the MCUF in Horizon*macro*, it is NOT backwards compatible and cannot be used in a Horizon*macro* cabinet.

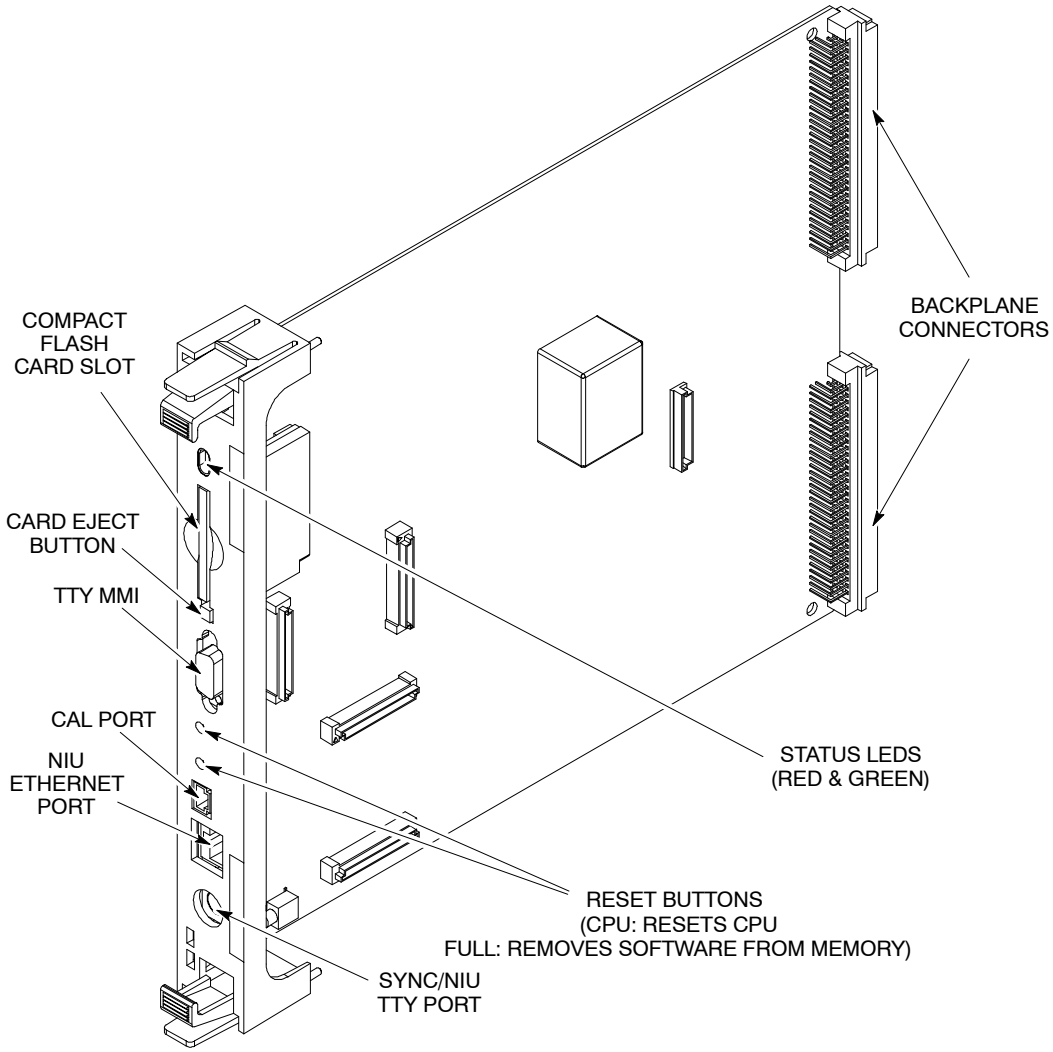
The main features of the HIISC are as follows:

- Processors for software and NIU functionality.
- Programmable timeslot interchanger (TSI) that supports the following:
  - TDM links for single (legacy) and double density GSM and single density EDGE.
  - Three expansion links (FMUX equivalent). These links can connect to additional Horizon II *macro* cabinets (with double density GSM or single density EDGE transceivers) or legacy Horizon*macro* cabinets (with single/double density GSM or single density EDGE transceivers).
  - BBH routeing for GSM/GPRS (single or double density) or EDGE transceivers.
- Six integrated E1/T1 span line interfaces. (An upgrade for the CIM/BIM will support eight E1/T1 spans on later equipment.)
- Programmable synchronization/timimg block for support of multiple air interfaces. A GPS interface is included to support Compact EDGE and other air interfaces that require inter-site synchronization.

HIISC module view

Figure Tech. 5-3 shows a HIISC module.

Figure Tech. 5-3 View of the HIISC



Link to redundant HIISC

The link to the redundant HIISC is similar to a transceiver link, but does not have the BBH capability, or the link delay measurement and compensation facility. The 6.12 s, and 60 ms signals, are inserted into timeslots 8 and 16.

When the HIISC is in slave mode, timeslot and E1/T1 clock information is extracted from the HIISC link and passed to the sync block.

The main processor HDLC link to the redundant HIISC can be routed in any unused timeslot(s) of this link.

The ASIC can switch any timeslot on the redundancy link to any timeslot on any of the other links connected to it such as the transceiver links, network links, redundancy link or processor links.

Front panel interfaces

Compact flash card interface

The compact flash card slot is located on the front panel of the HIISC, and is used for:

- Code Storage Facility Processor (CSFP) memory.
- Rapid site initialization.

The 32 Mbyte card can be write enabled, for upgrade of site information, or disabled to protect card use for other sites or secure the site code.

TTY MMI interface

A standard TTY interface is provided on the front panel, of 9.6 kbit/s (8 bits, no parity, 1 stop bit (8 N 1)). A local maintenance terminal can be attached to this port to use the MMI (Man Machine Interface) of the HIISC.

CAL port

The CAL port on the front panel of the HIISC can be used to calibrate the sync block clock via MMI commands. The 8 kHz reference output is used in the GCLK calibration procedure (see Chapter 2 of **Maintenance and Parts** later in this manual.

NIU ethernet port and SYNC/NIU TTY port

These ports are for Motorola test purposes only.

Front panel switches and indicators

The front panel of the HIISC has two reset switches as shown in Figure Tech. 5-3:

- **FULL** is a hard reset (power up - removes software from the memory).
- **CPU** is a soft reset (this resets the HIISC main processors, but the software remains in RAM).

A hard reset results in the software being reloaded to the DRAM in the same way as normal power up.

NOTE	During the CPU (soft) reset, pressing CPU reset again causes a hard reset. Pressing the CPU reset button twice thus has the same effect as a hard reset.

The HIISC has two front panel LEDs (one green and one red) as shown in Figure Tech. 5-3, with indications as shown in Table Tech. 5-1.

Table Tech. 5-1 HIISC front panel LED indication

Red	Green	Status
Off	Off	Board not powered up or in reset cycle.
Off	On	Normal operation.
On	Off	Fault condition.
Flashing	Flashing	Non-volatile memory boot code upgrade. (Do not remove power nor reset – see CAUTION.)

CAUTION	When red and green LEDs are flashing, the boot code is downloading into non-volatile memory for software upgrade. Do not remove power or reset the cabinet until downloading has been completed, as this will corrupt the non-volatile memory. If boot code is corrupted, contact the Motorola Customer Network Resolution Centre, requesting the boot code restoration procedure and the appropriate boot code file.

PIX interfaces

The HIISC provides a serial interface for the PIX outputs. These are routed to the cabinet alarm board and enable relay contact control of external customer equipment.

SDRAM, flash EPROM and code loading functions

SDRAM

The 32 Mbyte SDRAM provides operational code and data storage for the main processors.

Flash EPROM

The 8 Mbyte flash EPROM has the following functions:

- Storing boot code and executive process code. It has a fast access time (< 75 ns), enabling direct execution. The boot code is factory set, and reprogrammed only in major software upgrades.
- Non-volatile data storage of diagnostic data and module ID information.

Code loading

The boot and executive code held in the flash EPROM initiates the HIISC on power up or reset. If a compact flash card is fitted, operational code may be obtained and copied to the SDRAM for execution. If no card or code is available, the operational code is obtained from the BSC.

Before execution, the operational code held in SDRAM is checked with code held at the BSC. The BSC downloads any changed code objects to the SDRAM.

After successful checking of the SDRAM operational code, the code is executed and the compact flash card is updated with any changed objects.

CSFP code loading

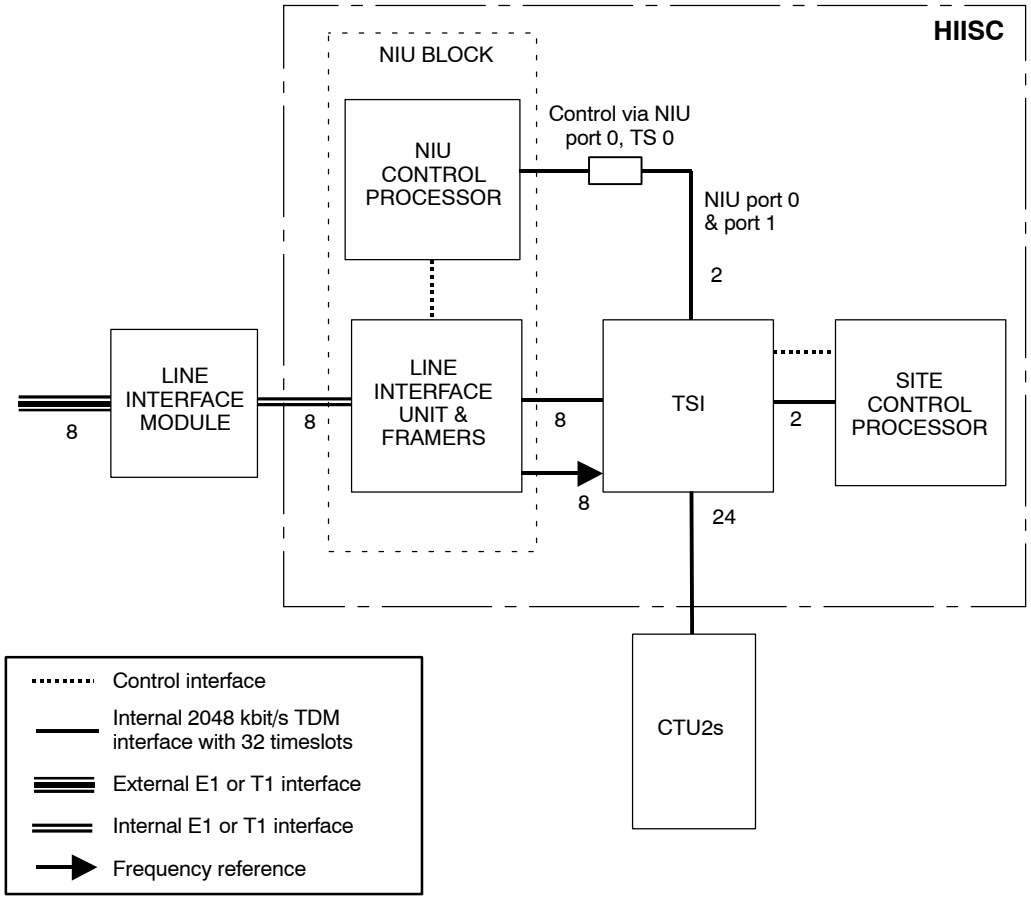
If a compact flash card is available, then a code storage facility processor (CSFP) function can be supported. A new software load can be downloaded in the background, without any reduction in service, and stored on the compact flash card.

Once the complete load has been transferred to the compact flash card, a code swap can be initiated. The site is reset and the new software brought into service (< 10 minutes). As a precaution, the old version is held on the compact flash card to support a roll back to the original version if required.

HIISC internal architecture

This section describes the internal connections and individual elements of the HIISC, relating to site control. Figure Tech. 5-4 shows the internal architecture of the HIISC.

Figure Tech. 5-4 HIISC internal architecture



Line interface module

The line interface module consists of passive analogue components and is responsible for physical termination and protection. It provides connections for six span lines.

75 ohm coax and 120 ohm twisted pair are provided for E1 termination. Each provides a 120 ohm interface to the NIU line interface unit (LIU). An alternative unit conforming to ANSI T.403 is available for T1 termination, if required. This is the only physical difference between an E1 and T1 capable site controller cabinet.

LIU and framers

Dual mode E1/T1 LIU and framers are used, thus permitting the soft selection of either E1 or T1 span line connections.

To maintain compatibility with existing GSM BTS and BSC equipment, the line driver is set for 120 ohm termination for E1 mode and > 600 ft (approx. 183 m) for T1 mode.

The LIU/framer bridges between the internal 32 timeslot 2048 kbit/s TDM highway and the external E1 2048 kbit/s and T1 1544 kbit/s TDM formats. (For T1 this is achieved using a timeslot-mapping schema.)

Timeslot interchanger (TSI)

The TSI is controlled by the site control processor (the NIU control processor is not be equipped with a TSI control interface). A 64 kbit/s timeslot switch is responsible (within the context of backhaul and RSL requirements) for switching the following:

- Timeslots containing TRAU between the CTU2s and NIU framer / LIU.
- Timeslots containing RSL traffic between the NIU framer / LIU and NIU control processor.
- Timeslots containing NIU control messages and RSL traffic stripped of LAPD between the NIU control processor and the site control processor.
- Inserting 16 kbit/s RSL links into a bit-pair of a designated timeslot.

The use of the TSI in this fashion allows a RSL to be placed into any timeslot (other than timeslot 0 in E1 systems) on any of the 6 spans. The design provides complete flexibility in the number of timeslots on any span that can be used for RSL traffic. Indeed, all 6 could be placed on a single span. However, each RSL has the limitation that the uplink (BTS to BSC) and downlink (BSC to BTS) timeslot mappings are identical.

NIU control processor and RSL termination

The NIU control processor terminates the LAPD protocol layer for each RSL. It supports up to 8 separate and simultaneous LAPD connections. Each LAPD connection may be configured as either a 64 kbit/s link or as a 16 kbit/s link.

The NIU control processor also configures and monitors the LIU / framer. To facilitate these functions the NIU control processor is provisioned with a control interface to the LIU / framer and a dual 32 timeslot 2048 kbit/s TDM interface to the TSI.

The NIU control processor terminates up to 16 full duplex HDLC channels – up to 8 for LAPD transport to the BSC and up to 8 for RSL (including one for control) transport to the site control processor.

Site control processor

The site control processor is provisioned with a control interface for the TSI and two 2048 kbit/s TDM interfaces to the TSI. It is responsible for configuration of the TSI and control and monitoring of the NIU.

NIU control processor to site control processor interface

The interface between the NIU control processor and the site control processor consists of NIU control messages plus RSL messages stripped of the LAPD protocol. Each RSL connection to the BSC utilizes a 64 kbit/s timeslot between the NIU control processor and the site control processor.

NOTE	A 64 kbit/s connection is used, regardless of whether the connection to the BSC is operating at 64 kbit/s or 16 kbit/s.

NIU control messages, including those used to establish, reconfigure and disconnect RSL links, are always carried within timeslot 0 on the NIU TDM port 0. These messages are multiplexed with traffic comprising the first established RSL. The site control processor dynamically assigns additional RSL connections to any of the other remaining 31 timeslots of NIU TDM port 0 or 32 timeslots of NIU TDM port 1.

Daisy chains

The HIISC supports backhaul daisy chain configurations. Traffic for upstream sites is routed via the TSI, allowing for multiplexing over shared spans with local site traffic.

Span type selection

The NIU defaults to the E1 interface type for all span lines, but supports a message interface with the site control processor that allows the span type to be changed to T1.

E1 framing options

The NIU can enable and disable timeslot 0 CRC-4 multi-framing (enabled by default). Selection is supported by a message interface with the site control processor. In either case, timeslot 16 multi-framing is disabled (allowing timeslot 16 to used for TRAU or RSL traffic) and HDB3 line coding is used.

E1 N-bit facility

The NIU can enable and disable the use E1 N-bits for alarm indications. Selection is supported by a message interface with the site control processor.

T1 framing options

The NIU can select either T1 D4 framing with AMI line coding or T1 ESF framing with B8ZS line coding (default). Selection is supported by a message interface with the site control processor.

Timing extraction

A 2048/1544 kHz frequency reference and a 125 μs timing reference is extracted by the framer / LIU from each span. This unit also performs jitter and wander attenuation.

Each of the extracted references are fed into a switch that is under site control processor supervision. This is used to select the reference used for phase locking the SYNC function.

TRAU

Span lines transporting TRAU are switched to the appropriate CTU2 by the TSI.

RSL configuration and control

LAPD links

Each LAPD link is configured with the following default parameters:

T203 = 10 seconds.
The maximum I frame size (N201 = 610 bytes).

The site control processor is able to configure the following parameters for each LAPD connection via the control message interface to the NIU control processor:

Rate (64 kbit/s or 16 kbit/s).
Bit-pair for 16 kbit/s connections.
SAP.
TEI.
The maximum number of outstanding I frames (k value).
T200.
The maximum number of retransmissions (N200).

NOTE	The span line timeslot and span line are not required as the site control processor sets these directly at the TSI.

Additionally, the site control processor specifies the following internal connection parameters:

NIU port and timeslot for the connection between the NIU control processor and the site control processor.

NIU port and timeslot for the connection between the NIU control processor and the TSI.

16 kbit/s RSLs

Any or all of the 8 RSL links can be configured at either 16 kbit/s or 64 kbit/s. When configured at 16 kbit/s, a RSL occupies a bit-pair within a single timeslot. Four bit-pair positions are supported; bits 0 and 1, bits 2 and 3, bits 4 and 5, bits 6 and 7.

For downlink flows, the TSI switches the entire timeslot containing the 16 kbit/s bit-pair onto a NIU port timeslot. The NIU control processor recovers the LAPD from the designated bit-pair.

For uplink flows, the NIU control processor places the LAPD within the designated bit-pair and timeslot on its TSI connection. The TSI then inserts this bit-pair into a designated timeslot, while preserving the content of the other six bits within that timeslot.

RSL and span alarms

LAPD link management events for each LAPD connection and span alarm events for each span are reported to the site control processor by the NIU control processor.

Flow control

The interface between the NIU control processor and the site control processor supports flow control. This enables the NIU processor to throttle RSL traffic from the site control processor in the event of an overload condition. This condition may occur when 16 kbit/s RSL links are active or when multiple heavily loaded 64 kbit/s RSL links are active.

To reduce the possibility of overloading, the processing delay within the NIU control processor is minimized and the RSL message buffer depth is maximized. A fully loaded NIU (up to 8 established RSL links) maintains a maximum processor delay of less than 25 ms per message. Delay is measured from receipt of the end of the incoming frame to the start of transmission of the outgoing frame. The NIU control processor has 2000 kbytes of message buffers.

Integral HIISC XMUX functionality

The equivalent functionality of a separate XMUX module is integrated within the HIISC, thus enabling the HIISC in the master cabinet to communicate with the CTU2s in up to three expansion cabinets via fibre optic links between the site expansion boards.

XMUX module

Overview of the XMUX module

The expansion multiplexer (XMUX) module replaces the HIISC in expansion cabinets and provides the interface to the master cabinet.

Two XMUX modules may be installed in an expansion cabinet, one for the master HIISC, and one for the slave. An expansion cabinet only requires one XMUX to connect to six CTU2s within the cabinet (plus one for redundancy if required).

NOTE	If Horizon II *macro* expansion cabinets are added, the master cabinet and expansion cabinets must also contain optional site expansion boards.

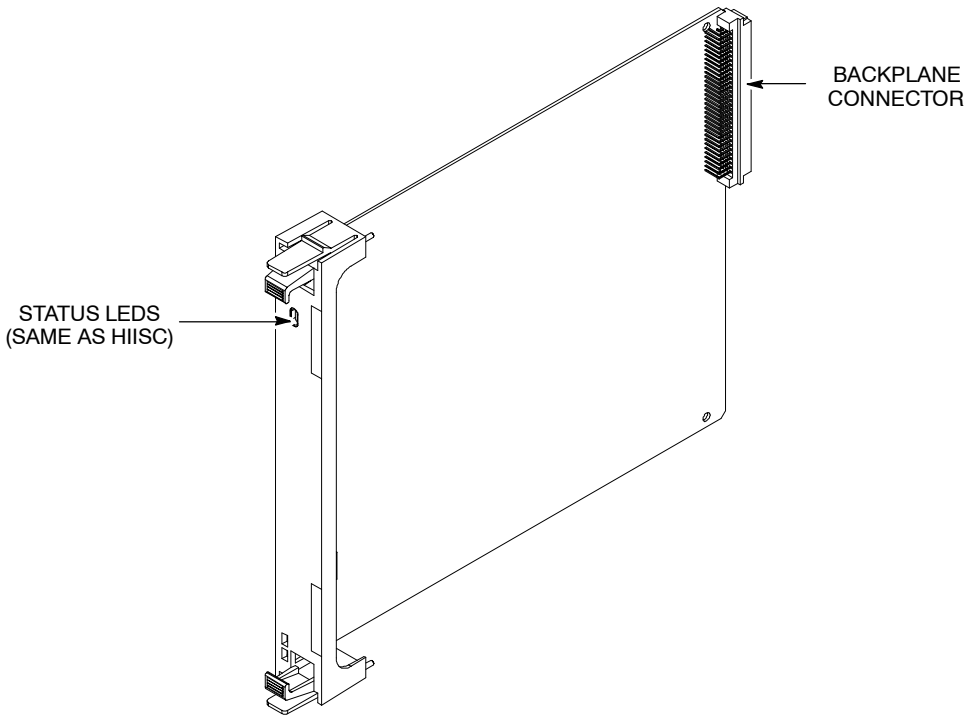
The XMUX can support up to six transceiver links. It uses a 16.384 Mbit/s Manchester encoded serial data link, organized as 256 x 8-bit timeslots in a 125 microsecond frame. Manchester coding is used to detect errors, indicated at timeslot 0 for each transceiver, enabling error correction at the receiving XMUX.

NOTE	Although the XMUX provides the equivalent functionality of the FMUX in Horizon*macro*, it is NOT backwards compatible and cannot be used in a Horizon*macro* cabinet.

XMUX module view

Figure Tech. 5-5 shows a XMUX module.

Figure Tech. 5-5 View of the XMUX module



XMUX functional description

The HIISC transmits and receives a 2.048 Mbit/s data stream link to each operational CTU2. In the master cabinet this is achieved by the backplane, without the need for a XMUX.

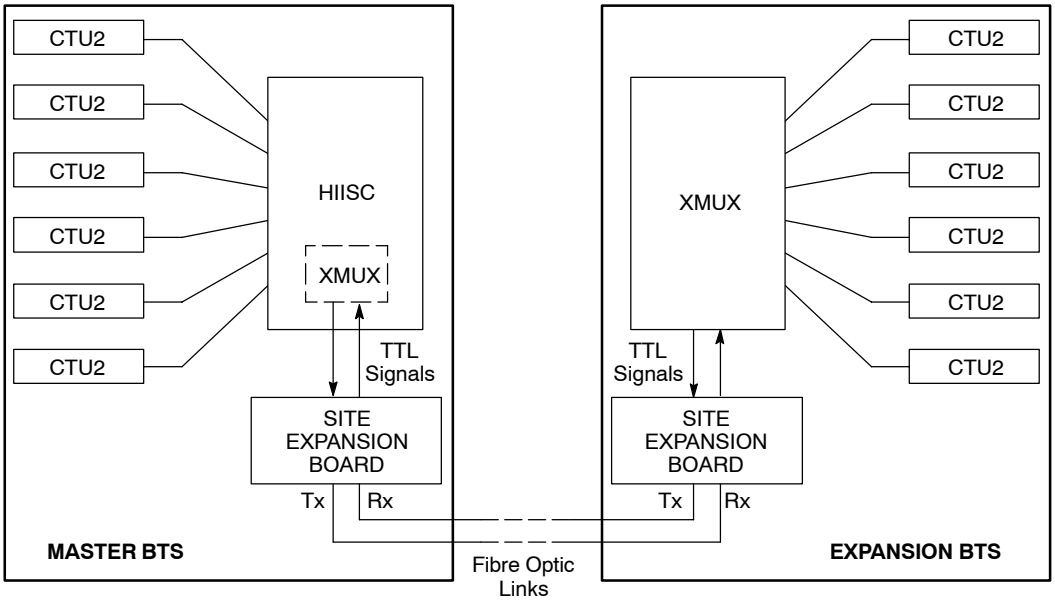
If the CTU2 is in an expansion cabinet, the integrated XMUX in the HIISC combines the data stream with up to five others and then sends the multiplexed signal to the site expansion board via the backplane. The site expansion board performs a TTL to fibre optic signal conversion, for onward transmission to the expansion cabinet via fibre optic cables.

At the expansion cabinet, another site expansion board converts the fibre optic signal back to electronic form and sends this to the XMUX. The XMUX demultiplexes the signal and sends the data stream to the appropriate CTU2.

The data stream return path from the CTU2 in the expansion cabinet is a reversal of the above.

Figure Tech. 5-6 illustrates the above description.

Figure Tech. 5-6 XMUX interconnection block diagram



NOTE	Site expansion is not restricted to using Horizon II *macro* cabinets as slaves. Horizon*macro* and/or M-Cell*6* (equipped with a FMUX) can also be used. Similarly, the master BTS can be a Horizon*macro* or FMUX-equipped M-Cell*6*, with a Horizon II *macro* as one or more slaves. Refer to **Installation & Configuration: Horizon II *macro*** (68P02902W97) for full details of BTS interoperability.

Site expansion board

Expansion board description

The site expansion board is an optional module that is only required for site expansion. One or two boards may be installed in the Horizon II *macro* cabinet, depending on whether redundancy is required.

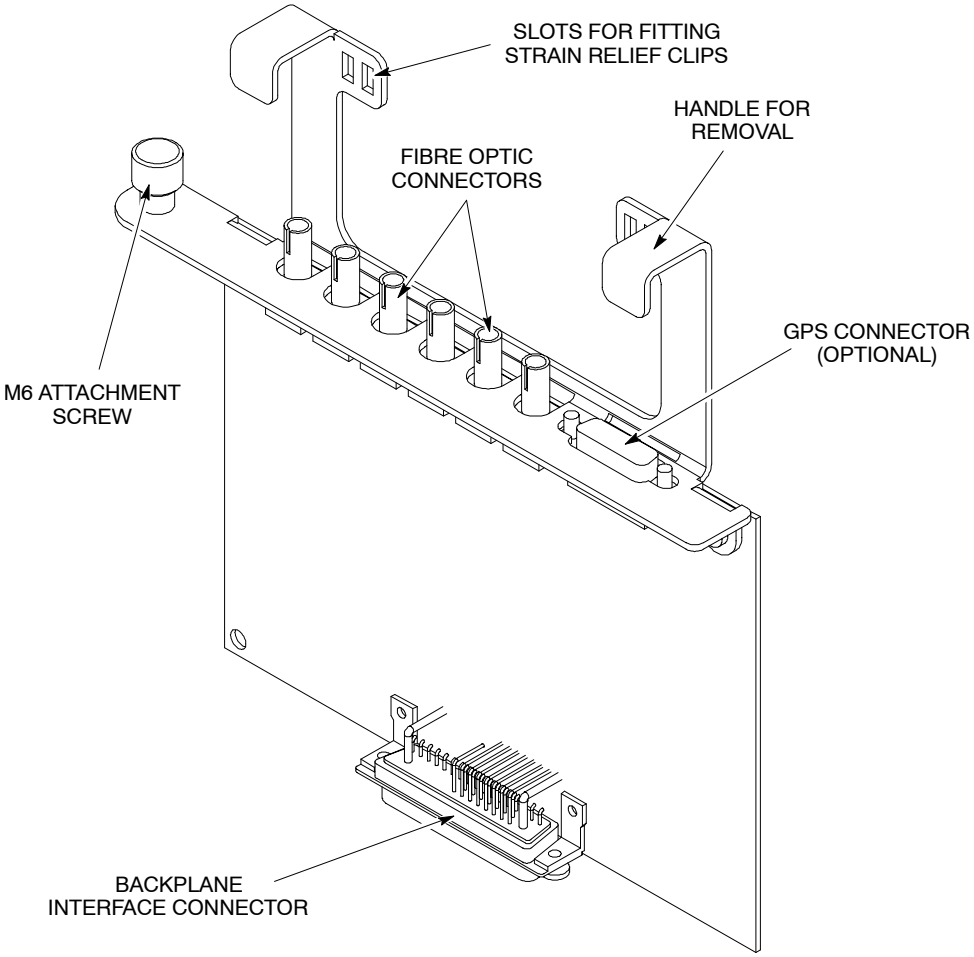
The primary function of the expansion board is to convert TTL signals to fibre optic signals (and vice versa) to enable the master and slave cabinets to communicate with each other.

The board contains the following I/O connectors (see Figure Tech. 5-7):

- 6 x fibre optic connectors (three Tx/Rx (OUT/IN) pairs), for connecting up to three expansion cabinets. Each fibre optic link is full duplex 16.384 Mbit/s and is capable of driving up to 1 km.
- Optional 1 x 15-pin D-sub connector for GPS.

Redundancy is determined by the complement of HIISCs in the master cabinet. If the cabinet contains two HIISCs (1 + 1 redundant), two XMUXs must be installed in each Horizon II *macro* slave cabinet and two site expansion boards are also required in the master and each slave cabinet.

Figure Tech. 5-7 Site expansion board view



Alarm module

Alarm module overview

The alarm module is located on the left side of the digital module shelf. It provides the cabinet equipment with an external alarm monitoring system to report operational status. The alarm module:

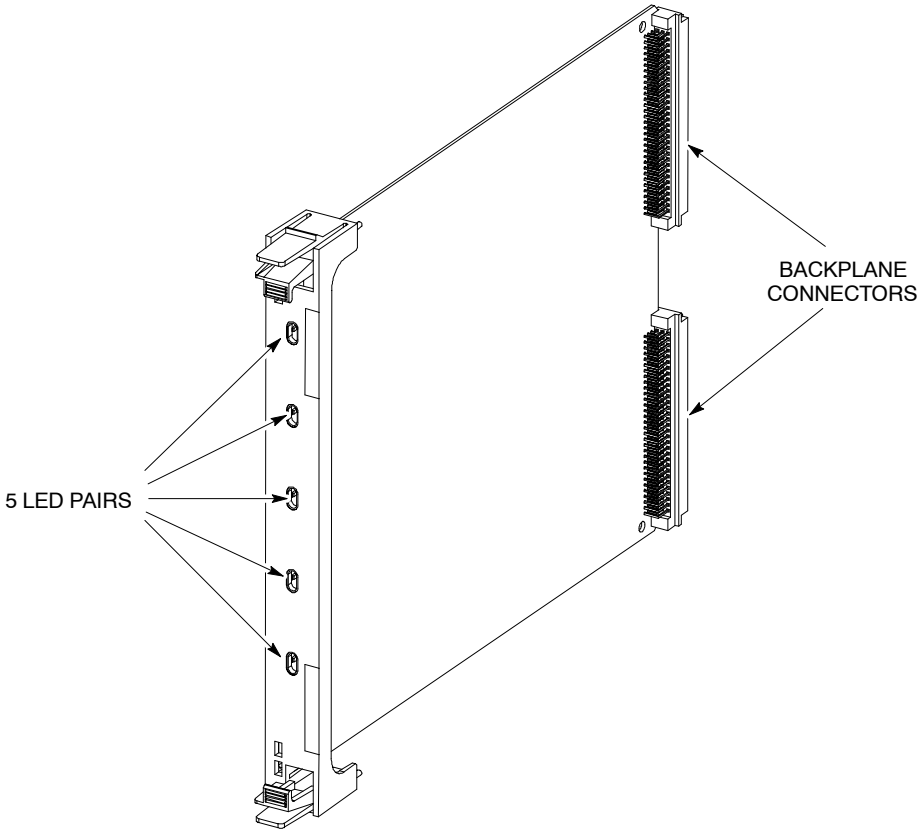
- Collects all cabinet alarms (received from the backplane).
- Provides current sensing for 16 customer inputs (referred to as site alarms). These inputs are provided by the PIX connectors PIX0 and PIX1.
- Controls up to four relay driven outputs linked to customer equipment (changeover contacts 30 V 1 A maximum). These outputs are provided by the PIX0 connector.
- Transmits alarm information to all CTU2s in the same cabinet.
- Processes antenna VSWR monitor alarm signals.

NOTE	The alarm module is not backwards compatible with the alarm module used in Horizon*macro*.

Alarm module view

Figure Tech. 5-8 shows an alarm module.

Figure Tech. 5-8 Alarm module view



Alarm module functionality

The alarm module receives inputs from:

- The external alarm connector on the interface panel, (from the optional batery backup system (the BBS)).
- Cabinet PSUs (identifying manufacturer code and slot number).
- Environmental control devices.
- Customer defined alarms.
- Antenna VSWR monitoring circuit within Tx blocks.

The alarm board receives these inputs, encodes them, and then passes the code word to all CTU2s in the cabinet via the backplane.

Alarm module replacement – effect on alarms

The alarm module can be replaced while the cabinet system is running (hot swap). This will temporarily interrupt alarms, with the OMC-R receiving an additional **alarm module out of service** alarm, which automatically clears upon correct insertion of the replacement module.

Alarm collection from expansion cabinets

Alarms detected by the alarm module in an expansion cabinet are forwarded to the transceivers. These then transmit the alarms to the HIISC in the master cabinet via the XMUX and site expansion board in the expansion cabinet and the site expansion board in the master cabinet.

Alarm module display presentation

All alarm LEDs are green (OK) when equipment is functioning correctly or red (alarm) when equipment is faulty. Table Tech. 5-2 shows the LED designations.

Table Tech. 5-2 Alarm module LEDs

LED location	Legend	LED colour states	Equipment monitored (Green = OK, Red = FAULT)
1 (top)	MAINS	Unlit/Red	Not used.
2	RECTFR	Unlit/Red	Not used.
3	DOOR 1	Unlit/Red	Cabinet door open alarm.
4	DOOR 2	Unlit/Red	Not used.
5	LVD	Unlit/Red	Low voltage disconnect (LVD) alarm (battery backup option).
6	FAN 0	Green/Red	Fan Tray 0 fully operational (2-fan tray).
7	FAN 1	Green/Red	Fan Tray 1 fully operational (2-fan tray).
8	FAN 2	Green/Red	Fan Tray 2 fully operational (2-fan tray).
9	HMS 1	Unlit/Red	Not used.
10	HMS 2	Unlit/Red	Not used.

CHAPTER 1
ROUTINE MAINTENANCE

CHAPTER 2
FRU REPLACEMENT

CHAPTER 3
SITE VERIFICATION

CHAPTER 4
PARTS LISTS

MOTOROLA

Maintenance and Parts (Maint.)

MOTOROLA

Chapter 1

Routine maintenance

Routine maintenance overview

In this chapter

This chapter contains the procedures for the routine maintenance of a Horizon II *macro* base transceiver station (BTS).

NOTE	Since a Horizon II *macro* BTS operates as part of a network, the procedures in this chapter must be performed in conjunction with the relevant network procedures in the associated OMC-R manuals. Before attempting any work on the cabinet, contact the OMC-R to advise on the proposed activity.

Safety

WARNING	Potentially lethal voltages and high energy sources are present in the cabinet when the external ac mains isolator switch is set to the **on** position and/or batteries are connected. Remove rings, watches and jewellery before starting these procedures, and exercise extreme caution when working on the equipment. Maintenance procedures on this equipment must only be carried out by suitably qualified personnel.

Safety features are built into the equipment to protect against the potentially lethal hazards that exist. All statements regarding safety within these routine maintenance procedures must be adhered to when working on the equipment.

Reporting faulty devices

During routine maintenance and FRU replacement procedures, it may be possible to identify signs of damage that might indicate a problem that could repeat, cause additional damage, or be a symptom of a failure elsewhere. Analysis of the problem may identify the fault and make corrective action possible.

Whenever a safety issue arises:

- Inform the OMC-R that an equipment safety problem has been identified.
- Make the equipment concerned safe, for example, by removing power.
- Make no further attempt to tamper with the equipment..
- Report the problem directly to GSM Customer Network Resolution Centre +44 (0)1793 565444 (telephone) and follow up with a written report by fax +44 (0)1793 430987 (fax).
- Collect evidence from the equipment under the guidance of the Customer Network Resolution Centre.
- Seek local office advice.

Routine maintenance intervals

Routine maintenance for Horizon II *macro* installations is recommended at the intervals shown in Table Maint. 1-1:

Table Maint. 1-1 Horizon II *macro* routine maintenance schedule

6 months	12 months	24 months
Ensure that cabinet air inlets, exhaust grilles and filter (if fitted) are not blocked.	Annual check of the installation.	Inspect general mechanical condition of the cabinet.
	Check normal operation, including fans. Also cable integrity and state of all connections.	Inspect locks, handles, and hinges of door. Lubricate if required.

These procedures are described in subsequent sections of this chapter, one to cover 6 monthly, one 12 monthly, and one 24 monthly.

Cleaning agents

The following is a list of cleaning and lubricant materials required for routine maintenance:

- Dustpan
- Soft brush
- Vacuum cleaner.
- Mild detergent
- De-ionized water.
- Soft cloth.
- Lubricant (WD40 or equivalent).
- Light grease (TBI or equivalent).

Tools

The only tools required are torque spanners, torque wrenches and torxdrivers, as listed in Horizon II *macro: Installation & Configuration* (68P02902W97). This manual is supplied with the equipment.

Assumptions – door, hood, and stacking bracket

Any requirement to open a door, or remove any hood (if fitted), is assumed in all procedures. Shutting the door, or replacing the optional hood is also assumed at the end of any procedure.

SURF2 and Tx block replacement is possible without having to remove the stacking bracket, if one is fitted.

Door operation

The door lock is a trigger latch. To operate the door:

1. Insert the correct key into the lock and turn.
2. Press the middle square panel by the lock to release the lock.
3. Open the door to the initial detent position at 95°.

CAUTION	Avoid damaging honeycomb door vent.

NOTE	If the equipment is active, a door open alarm will be signalled to the OMC-R.

4. To open the door to the maximum 150°, simply pull the door until it reaches the limit of movement.
5. To close, simply push the door to the closed position and then lock.

Hood removal and refitting

The optional hood is held in place by four pins. Remove by lifting the hood rear edge until free of the pins, then lift off.

To fit the optional hood, align the hood to the back pins, lower hood onto the pins, and press down firmly.

Stacking bracket removal

The stacking bracket is secured by eight M8 screws (including four which can be replaced by pins if the optional hood is fitted). To remove or replace a stacking bracket, see **Replacing a stacking bracket** in Chapter 2.

Stacking bracket front cover removal and fitting

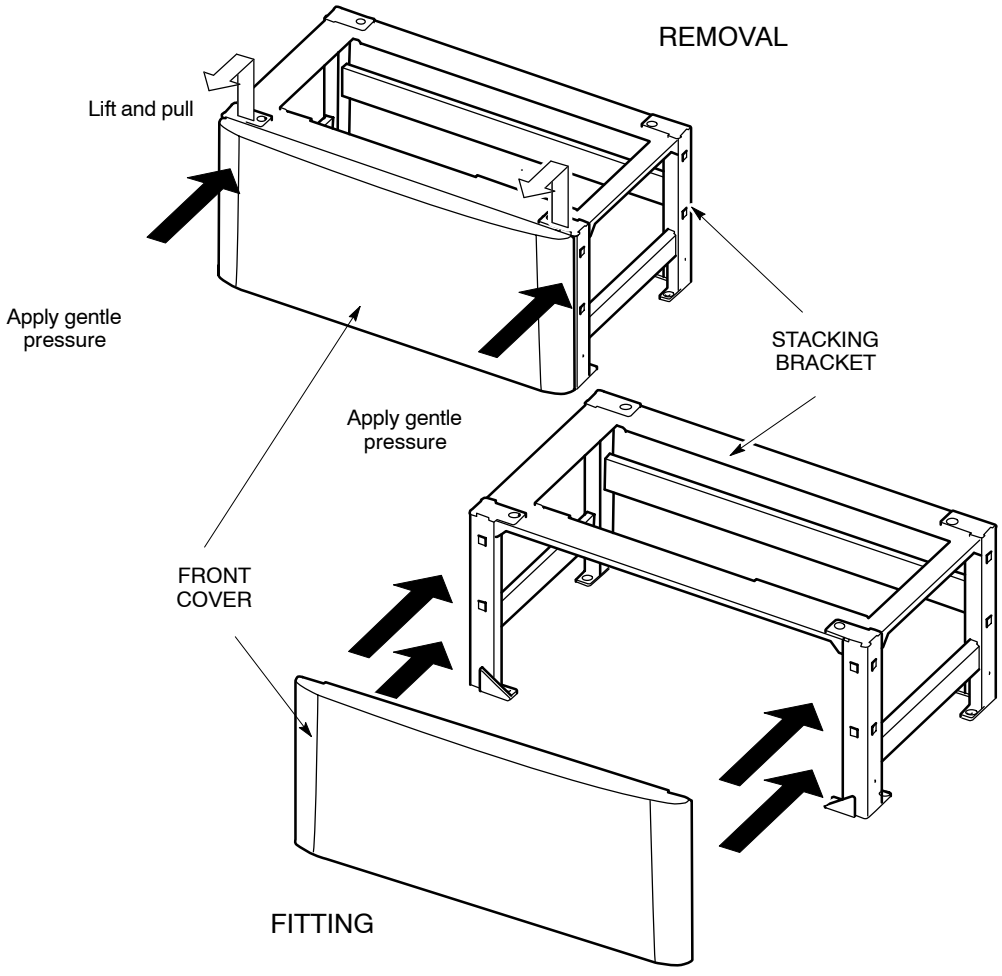
The stacking bracket front cover is attached to the stacking bracket by four locating clips.

To remove a stacking bracket refer to Figure Maint. 1-1 and then remove the stacking bracket front cover by applying gentle pressure to the outer edges, while easing the cover up and pulling it away from the bracket.

To fit the front cover:

1. Align the four locating clips on the front cover with the four square holes in the front of the stacking bracket. Ensure that the cut out slot on each clip is facing downward.
2. Press the cover against the stacking bracket, so that the cut out slot on each locating clip engages with the bottom edge of each square hole. It may be necessary to gently push in and down to ensure the cut out slots are fully engaged and the cover securely in place.

Figure Maint. 1-1 Removing and fitting the stacking bracket front cover



6-monthly maintenance procedures

Type of procedures

The 6-monthly maintenance procedures involve the following:

- Cleaning air inlets and exhaust grilles.
- Examining and, if necessary, replacing the optional air filter.

WARNING	Potentially lethal voltages and high energy sources are present in the cabinet when the external ac mains isolator switch is set to the **on** position and/or batteries are connected. Remove rings, watches and jewellery before starting these procedures, and exercise extreme caution when working on the equipment.

Cleaning inlets and exhaust grilles

CAUTION	If the cabinet is operational, this maintenance procedure should be completed as quickly as possible, in order to minimize duration of air cooling disruption.

Inlets are along the back, sides and front at the base of the cabinet. Air is expelled through the door vent and through the top panel.

The following procedure should be followed to clean inlet and outlet grilles:

- Use a vacuum cleaner or brush to ensure the bottom inlets are clear of debris.
- Open the door and clean the aluminium door vent, taking care to avoid damage.

12-monthly maintenance procedures

Summary of 12-monthly procedures

The 12-monthly maintenance procedures involve the following:

- 6-monthly procedures.
- Checking and cleaning fans.
- Checking normal operation.
- Annual check of the installation.

WARNING	Potentially lethal voltages and high energy sources are present in the cabinet when the ac mains isolator switch is set to the **on** position and/or batteries are connected. Remove rings, watches and jewellery before starting these procedures, and exercise extreme caution when working on the equipment.

Checking and cleaning fans

CAUTION	If the cabinet is operational, this maintenance procedure should be completed as quickly as possible in order to minimize duration of air cooling disruption.

There are three cabinet fan modules, all of which are identical 2-fan units. Table Maint. 1-2 shows the three fan positions.

Table Maint. 1-2 Fan positions

Fan reference	Unit type	Cabinet position
0	2-fan unit	Right side, beneath digital modules and CTU2 0
1	2-fan unit	Middle, beneath CTU2 1, 2 and 3.
2	2-fan unit	Left side, beneath CTU2 3, 4 and 5.

The fans can be checked and cleaned by the following procedure:

- Remove the fan module by lifting the central slide latch and pulling out.
- Use a brush and vacuum cleaner to remove any dust and dirt on the module.
- Refit the fan and check operation.
- Observe the fans through the grilles to ensure correct operation. Listen for excessive noise. If there is excessive noise, identify the module responsible and replace (see **Replacing a fan module** in Chapter 2).

Checking normal operation

Check normal operation by visual inspection in the following procedure:

1. Inspect the inside of the cabinet and note any signs of physical damage, overheating, loose connections, or badly fitting components. Take appropriate action to correct the damage, and inform the OMC-R.
2. Ensure that the LEDs on modules shown in Table Maint. 1-3 are lit, this indicates correct functioning of the cabinet. If any red LEDs are lit, other than the door alarm (alarm 3 on the alarm module), inform the OMC-R.

Table Maint. 1-3 Normal LED indication of cabinet modules

Equipment with LEDs	Colour of LEDs lit
CTU2s	Radio status (GREEN) and Tx status (YELLOW).
PSUs	Top LED on front panel GREEN.
Digital modules (HIISC or XMUX)	Status LED GREEN.
Alarm module	LED 3 RED (because door is open). LEDs 6, 7, 8 GREEN (fans).

Annual check of the installation

It is recommended the following be performed annually:

- Power down cabinet.
- Earth continuity check.
- Power system insulation check.
- Check of electricity company connection.
- Pre-power up check of supply and earth connection security and condition.
- Power up of cabinet.

Log the maintenance activity.

After procedures have been completed, restore the cabinet to operational state and notify the OMC-R of base station availability.

NOTE Refer to 68P02902W97, **Installation & Configuration: Horizon II *macro***, to carry out the above procedures.

24-monthly maintenance procedures

Summary of 24-monthly procedures

WARNING	Potentially lethal voltages and high energy sources are present in the cabinet when the ac mains isolator switch is set to the **on** position and/or batteries are connected. Remove rings, watches and jewellery before starting these procedures, and exercise extreme caution when working on the equipment.

The 24-monthly maintenance procedures involve the following:

- 6-monthly procedures.
- 12-monthly procedures.
- Mechanical inspection of cabinet, including inspection and lubrication of locks and hinges.

Mechanical inspection of cabinet, locks and hinges

The following must be performed every 24 months.

Inspecting the cabinet exterior

NOTE	Use a step ladder or platform for access to a stacked cabinet, where necessary.

To inspect the cabinet exterior:

- Check exterior panels and hood/stacking bracket for dents and structural damage.
- Check cabinet top connections for signs of overheating and security of attachment.

Inspecting the door

To inspect the door:

- Check the cabinet door for distortion, security and correct operation.
- Check the hinges for damage, security and correct operation. Carefully lubricate the hinges. Ensure that all door seals are wiped clean of the lubricant.
- Check the earth connection for damage and security.
- Check the door lock mechanism and inspect for ease of operation. Lubricate the mechanism with light grease. Ensure that lubricated surfaces are grit-free.

Inspecting the cabinet interior

To inspect the cabinet interior:

- Check all rack equipment for security of attachment, especially PSU, CBC and CTU2 attachment screws using a torxdriver. Tighten to the correct torque (see Table Maint. 2-1 in Chapter 2 for torque values).
- Carry out a visual check of all wiring for signs of overheating and security of attachment.

WARNING	Do not overstress the earth connections as this may damage the connector and reduce the protective function.

- Check the earth connections for corrosion and tightness using a torque spanner. Tighten to the correct torque.

MOTOROLA

Chapter 2

FRU replacement procedures

Overview of replacement procedures

Field replaceable units (FRUs)

WARNING	Potentially lethal voltages and high energy sources are present in the cabinet when the external isolator switch is set to the **on** position and/or batteries are connected. Remove rings, watches and jewellery before starting these procedures, and exercise extreme caution when working on the equipment. Maintenance procedures on this equipment must only be carried out by suitably qualified personnel.

This chapter provides information on the replacement of FRUs. Only those components classed as FRUs are covered in this chapter.

Any requirement to open or close a door, or remove and replace the optional hood, is assumed in procedures. Shutting the door, or replacing the hood is assumed at the end of any procedure. SURF2 module and Tx block replacement may be carried out with a stacking bracket in place. For door opening or stacking bracket front panel removal, refer to Chapter 1, **Routine maintenance**.

Where customers wish to perform a minor repair on a FRU in order to save the cost of full replacement, they should consult Motorola for more detailed procedures or replacement components (see **Non-FRU components**).

FRU list

The following is a list of FRUs used in the Horizon II *macro*:

- Door.
- Heat sensors.
- Hood (optional).
- Stacking bracket (optional).
- Fan units.
- Power input module (PIM).
- Circuit breaker card (CBC).
- Power supply unit (PSU).
- CTU2.
- SURF2.
- Tx blocks, including feedthrough plate.
- Digital modules (HIISC, XMUX, site expansion board and alarm module).

Torque values

Table Maint. 2-1 lists torque values to be used during replacement procedures.

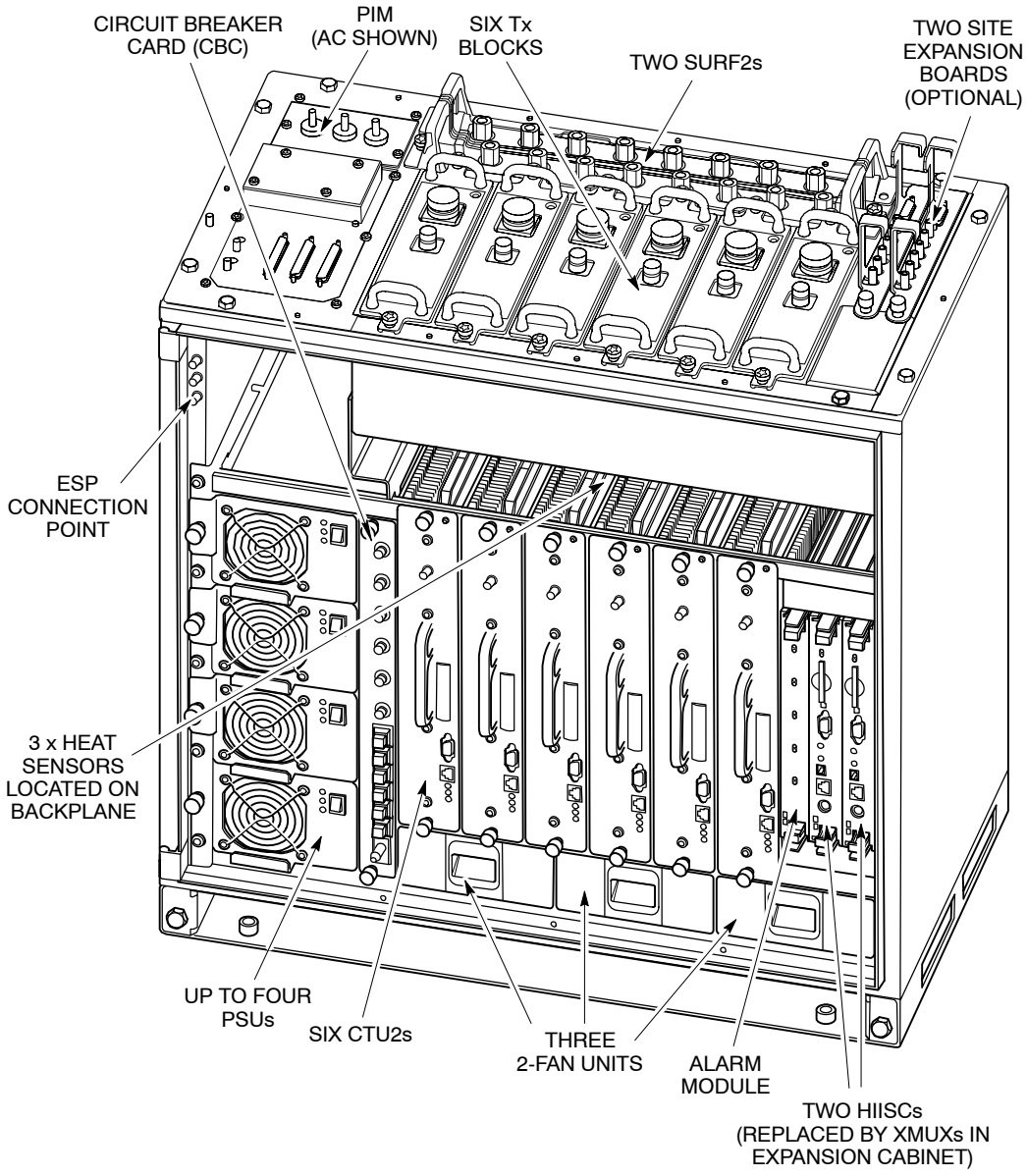
Table Maint. 2-1 Cabinet screw/bolt and RF connector torque values (Nm)

Size of screw/bolt	M4	M6	M8	M10	SMA	N-type	7/16
Torque value	2.2	3.4	5	10	1	3.4	25

FRU cabinet locations

Figure Maint. 2-1 shows a fully equipped cabinet with FRUs identified. The door, optional hood and stacking bracket are shown in the relevant FRU sections.

Figure Maint. 2-1 FRUs in the Horizon II *macro* cabinet (door and hood removed)



Non-FRU components

Policy on non-FRU components

Non-FRU components are:

- Items unlikely to fail, but replacement of which is essential if failure occurs.

or

- Sub-components of FRUs, where local conditions may make it more economical to repair the FRU.

CAUTION	Only qualified personnel should attempt non-FRU component replacement, in order to minimize risk of equipment damage. For example, the CBIA main cage requires care in removal and installation, and Individual fans require care in ensuring correct direction of airflow.

List of non-FRU components

Non-FRU components include the following:

- Door lock.
- Individual fans within a fan module.
- Any part of the CBIA: main cage, harness, interface panel, or backplane.

Procedure for replacing non-FRU components

Customers wanting to replace non-FRU components should:

1. Contact the local Motorola office for availability.
2. Seek Motorola advice for fitting non-FRU components.

CBIA attachment screws

The CBIA is attached to the cabinet by screws which should not be loosened:

- Seven M4 screws to the SURF2 harness (two guide pins lock cage into position).
- Five M6 (left side) and four M6 (right side) screws at the cabinet front.
- Eight M4 T20 screws for interface panel attachment to the top panel.

Replacing a door

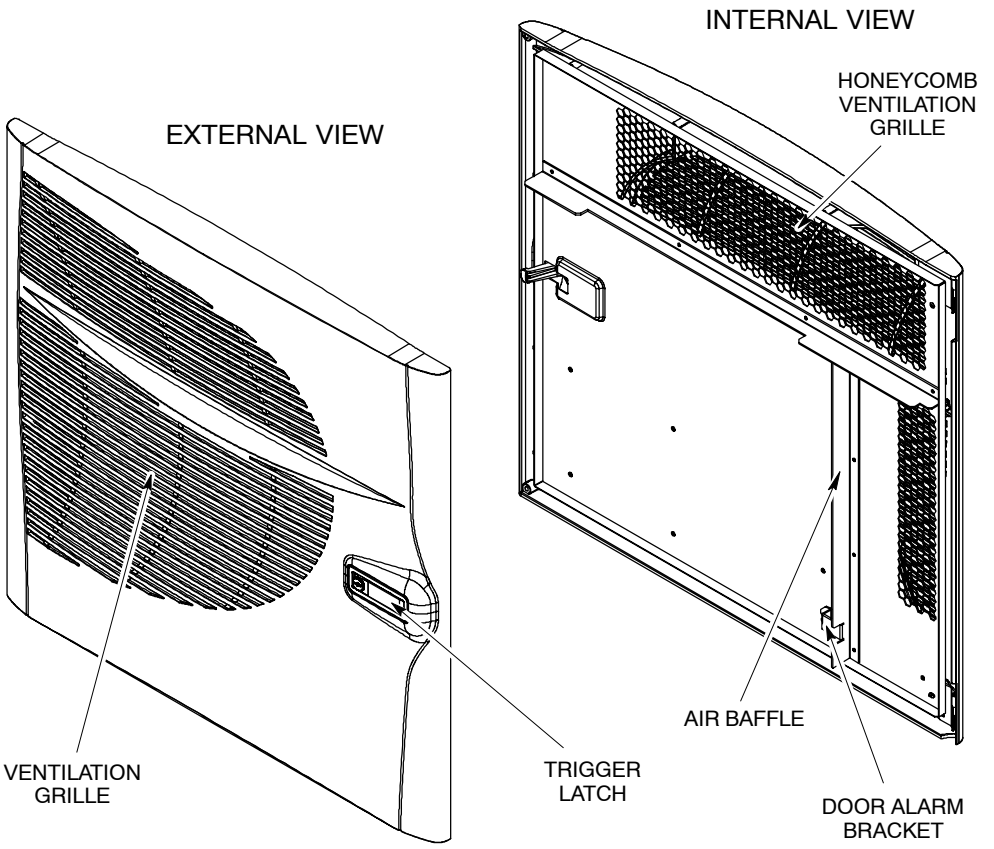
Introduction to door replacement

The door is essential to the correct operation of the ventilation/cooling system. The door also provides protection for the equipment contained inside. For these reasons, the replacement procedure should be completed in one session, and the cabinet then secured.

Views of door

Figure Maint. 2-2 shows an inside and outside view of the cabinet door.

Figure Maint. 2-2 Views of the cabinet door



Door replacement procedure

Removing a faulty door

To remove a door, open and:

1. On the cabinet, unscrew the M6 nut that secures the door earth cable to the cabinet. Retain the nut for re-use.
2. Open the door to about 90° and then lift it off its hinges.

Fitting a replacement door

CAUTION	Avoid damaging the honeycomb door vent.

To fit a replacement door:

1. Hold the door at about the 90° open position and lift onto the door hinges.
2. Attach the door earth cable to the cabinet using the M6 nut. Tighten to the correct torque (see **Overview of replacement procedures**).
3. Close the door and lock using the new key supplied with the door.

Replacing a cabinet heat sensor

Overview of the heat sensors

The heat sensors plug into the backplane from the front, above the CTU2s. Each one can be removed separately, and a replacement inserted. CTU2 2 and CTU2 3 are removed to gain access for this procedure.

There is one 70 °C sensor and two 85 °C sensors. Each sensor is marked with the appropriate temperature.

Heat sensor replacement procedure

To replace the heat sensors:

WARNING	Before disconnecting RF cables, ensure that the RF power is **OFF** by turning off the cabinet PSUs. Severe burns may result if RF power is **ON** when cables are disconnected.

1. Remove CTU2 2 and CTU2 3 (see **Replacing a CTU2**) to access the heat sensors.
2. Identify the faulty heat sensor and unplug it from the backplane.
3. Insert the replacement heat sensor by pushing firmly into place.
4. Refit CTU2 2 and CTU2 3 (see **Replacing a CTU2**).

The heat sensors should now be operational.

Replacing an optional hood

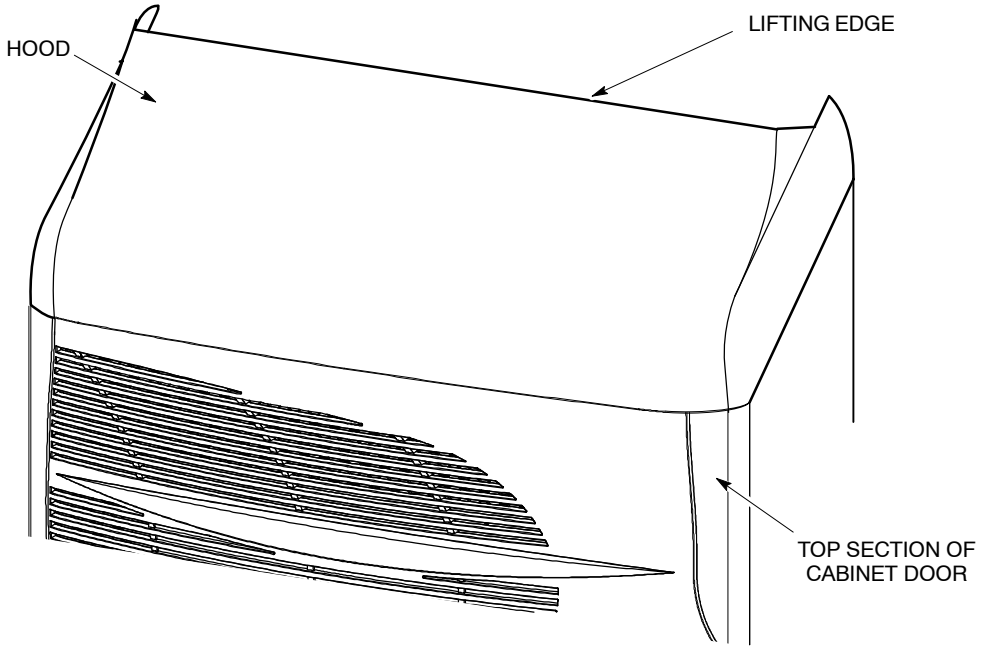
Introduction to hood replacement

This procedure assumes that the optional hood is already fitted, with hood pins located in the correct cabinet locations. If the hood is to replace a stacking bracket, refer to **Replacing a stacking bracket** in this chapter and the relevant section of *Installation and Configuration:* Horizon II *macro (68P02902W97)*.

View of the hood

Figure Maint. 2-3 shows a hood mounted in position on top of the cabinet.

Figure Maint. 2-3 Hood, mounted in position



Replacing the hood

The hood is held in place by four pins. Remove the faulty hood by lifting the rear edge, until free of the pins.

To fit the replacement hood, first align the hood to the rear pins and then lower the hood onto the pins and press firmly into place.

Replacing an optional stacking bracket

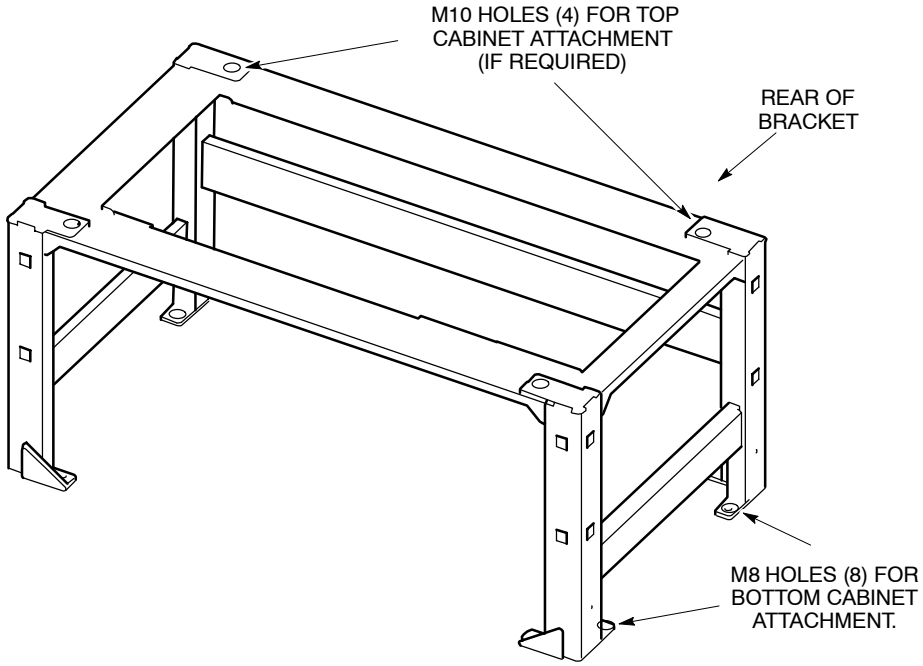
Introduction to stacking bracket replacement

This procedure assumes that the optional stacking bracket is already fitted in position on top of the cabinet.

View of the stacking bracket

Figure Maint. 2-4 shows a stacking bracket.

Figure Maint. 2-4 Stacking bracket view



Stacking bracket replacement procedure

Replace the stacking bracket as follows:

1. Remove the front cover by pulling it away from the stacking bracket.
2. If an upper cabinet is fitted on top of the stacking bracket, decommission and remove this cabinet, as described in the relevant chapter of *Installation and Configuration:* Horizon II *macro (68P02902W97)*.
3. Loosen and remove the eight M8 screws that secure the stacking bracket to the top of the cabinet.

   WARNING The stacking bracket weighs 9.3 kg. Observe the correct lifting precautions.

4. Lift the stacking bracket off the cabinet.
5. Align the replacement stacking bracket onto the top of the cabinet, and fit the eight M8 screws. Tighten to the correct torque (see **Overview of replacement procedures**).
6. If an upper cabinet was removed (step 2 above), install and re-commission it (refer to *Installation and Configuration:* Horizon II *macro (68P02902W97)*).
7. Refit the front cover by attaching it to the side lugs and pushing it into position.

Replacing a fan unit

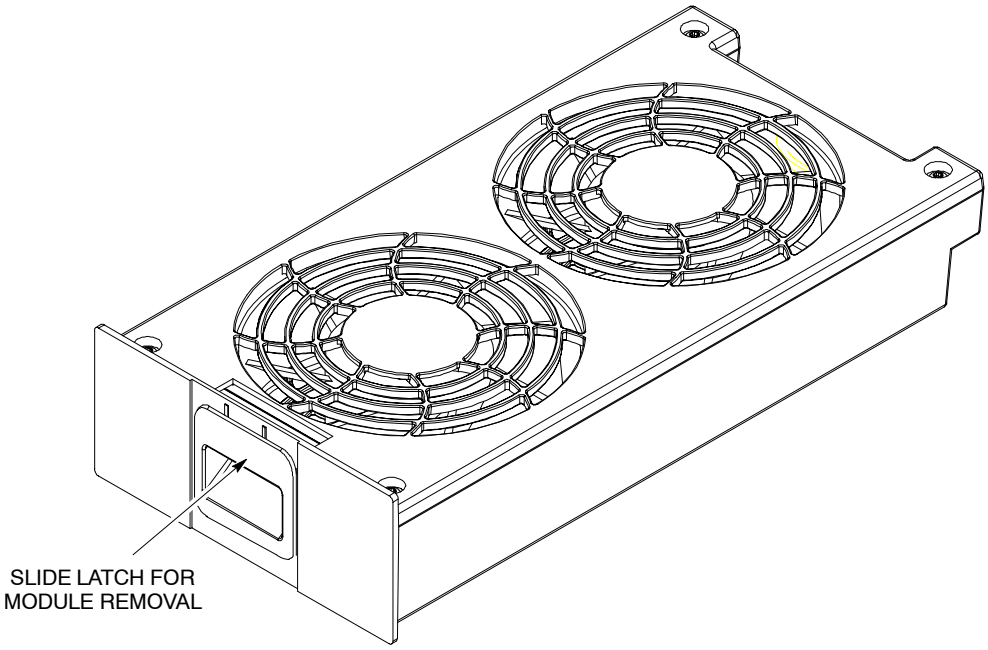
Introduction to fan replacement

Any of the three fan units can be replaced while the cabinet is operational, but be aware that airflow is reduced while fans are out of service and the door is open. This will raise equipment temperature, and could shut down the cabinet by triggering the heat sensors.

View of the fan unit

Figure Maint. 2-5 shows a view of the fan unit fitted in a Horizon II *macro* cabinet.

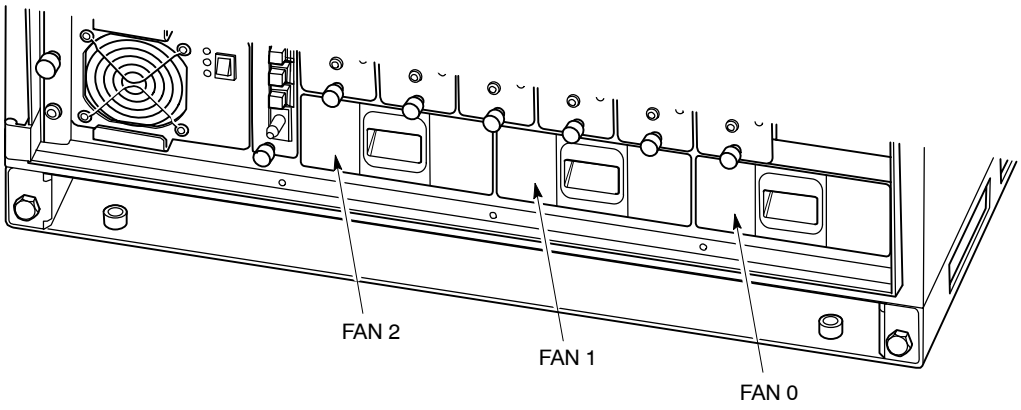
Figure Maint. 2-5 View of the fan unit



Identifying fan units

Figure Maint. 2-6 shows how the three fan units are identified in the cabinet.

Figure Maint. 2-6 Fan unit identification



Replacing fan modules

CAUTION	If the cabinet is operational, this replacement procedure should be completed in the shorted possible time to minimize the duration of air cooling disruption.

To replace a fan unit, open the cabinet door and:

1. Lift the central slide latch on the front of the fan unit.
2. Pull out the fan unit.
3. Insert the replacement unit and push into place, ensuring the slide latch has engaged.
4. Ensure all fans are operating.

Replacing the power input module (PIM)

Introduction to PIM replacement

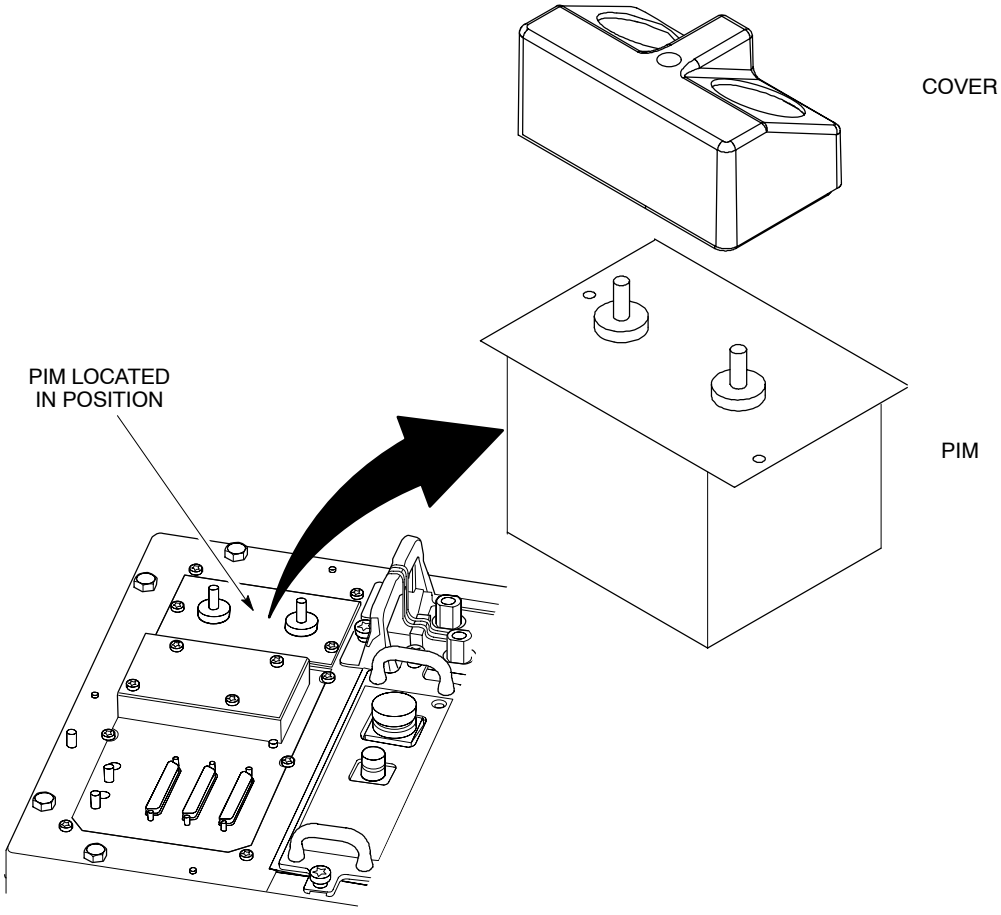
It is unlikely that the PIM will need replacing for any reason other than if the cabinet is to be switched over from operating from a dc supply to an ac supply, or vice versa.

WARNING	Changing the PIM from dc to ac or ac to dc will require that the PSUs are also changed at the same time (see **Replacing a power supply unit (PSU)** later in this chapter).

View of the PIM

Figure Maint. 2-7 shows a detailed view of the dc PIM variant.

Figure Maint. 2-7 Power input module (PIM) – dc variant



Replacing the PIM

The procedure for replacing the PIM is basically the same for both types, regardless of whether the existing and replacement PIM is dc or ac.

To replace the PIM:

1. Verify that the power source isolator is switched to OFF and locked (if possible).
2. Remove the cover to expose the power terminals.
3. Undo the M6 nuts and remove the cables from the terminals. If changing the PIM from dc to ac or vice versa, completely remove the cables from the cable run and lay the cables from the new power source to the cabinet.
4. Undo the two M4 captive screws that secure the PIM in position and then lift the PIM out of its housing.
5. Insert the new PIM into its housing and push fully home to ensure that the connector on its base mates with the connector in the bottom of the housing. Fit and tighten the two M4 Torx screws to the correct torque.
6. If new power cables are being used (in cases when the PIM is being changed from dc to ac or vice versa), fit the cone shaped protective covers onto the power cables and then connect the cables to the terminals on the new PIM. Tighten the M6 terminal nuts to the correct torque.
7. Refit the power terminal cover.
8. If the PIM has been changed from dc to ac or vice versa, replace the PSUs with those of the appropriate type (described later in this chapter).

Replacing a circuit breaker card (CBC)

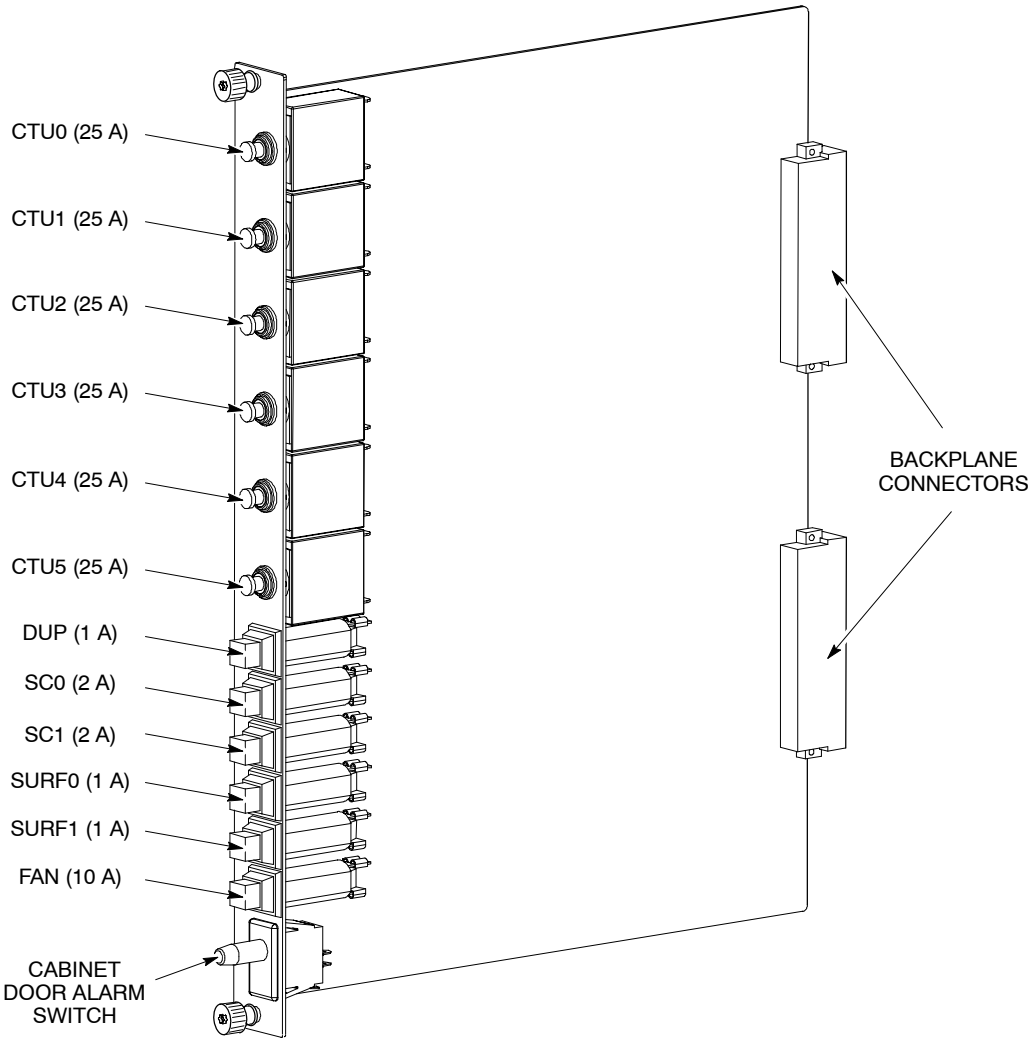
Preconditions for CBC replacement

The CBC controls power for the whole of the cabinet, apart from the PSUs. Consequently, the replacement of a CBC can only take place after the cabinet has been taken out of service and isolated, in agreement with the OMC-R.

View of the CBC

Figure Maint. 2-8 shows the CBC with circuit breaker buttons identified.

Figure Maint. 2-8 Circuit breaker card (CBC)



Replacing the CBC

To replace the CBC:

1. Verify that the power source isolator is switched to OFF, and locked (if possible).
2. Set the switch of each PSU to the OUTPUT DISABLE position.
3. Unscrew both CBC module attachment screws using a T20 Torx driver.
4. Pull the CBC out of its slot in the cabinet.
5. Ensure that all circuit breaker buttons on the new CBC are set to the **out** (off) position.
6. Slide the replacement CBC into its slot and press firmly into place.
7. Tighten both module attachment screws to the correct torque (see **Overview of replacement procedures**), using a T20 Torx driver.

To restore power to the cabinet:

1. Switch on the external power supply to the cabinet.
2. Set each PSU switch to the OUTPUT ENABLE position. Check that the ACTIVE (green) LED is on and the ALARM (red) LED is off on each PSU.
3. Switch on the equipment in the cabinet by pressing the CBC isolator push-buttons in the following sequence:
   - **FAN**.
     Check that each fan (six in total) is operating correctly.
   - **SC0**, and **SC1** if fitted (or XMUX(s) if a slave cabinet).
     Check that the appropriate HIISC/XMUX indicators operate correctly.
   - **SURF0** (and **SURF1**, if fitted).
   - **DUP**.
   - **CTU0 to CTUn** (where n = 1 to 5, depending on the number of CTU2s installed).
     Check that the front panel LEDs for each CTU2 indicate correct operation.
4. Close the door to ensure correct ventilation.

This completes the CBC replacement procedure and power up sequence for a cabinet.

Replacing a power supply unit (PSU)

Introduction to PSU replacement

There are four slots for PSUs in the cabinet. Three PSUs are required to power a fully equipped cabinet. The fourth slot can be used for an additional power supply to provide redundancy. A replacement PSU can be inserted into an available slot without powering down, thereby avoiding any need to take the cabinet out of service.

Preconditions for PSU replacement

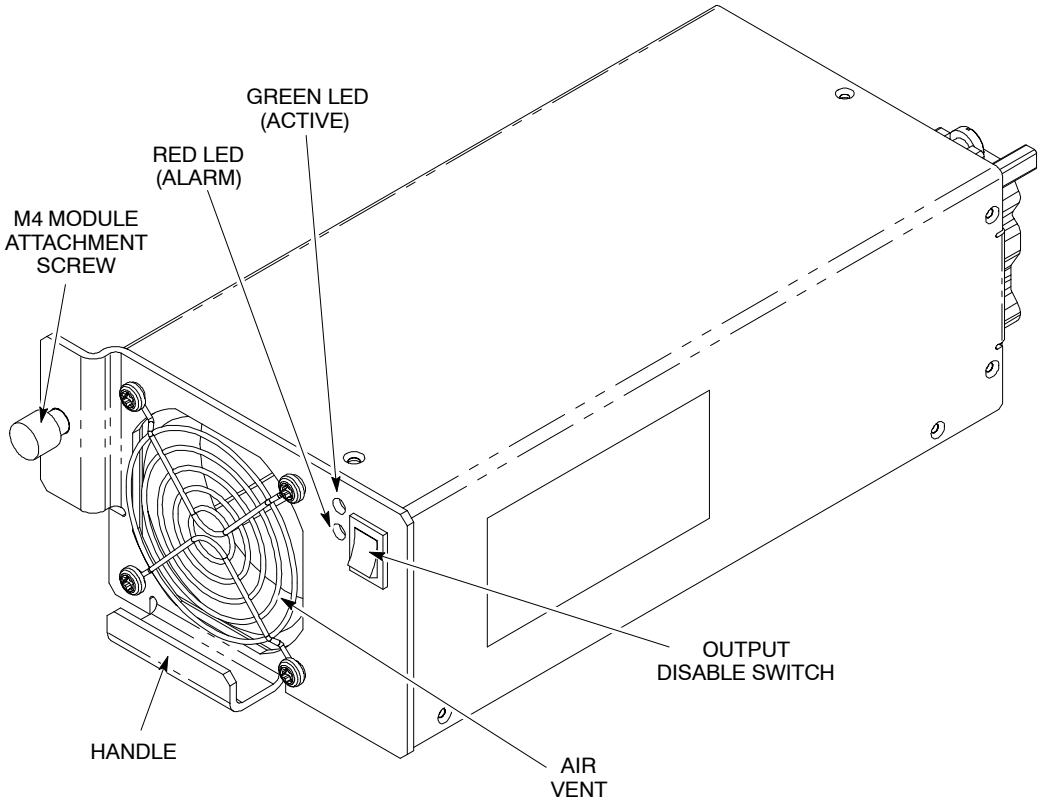
The replacement PSU must be of the correct type for the cabinet (+ 27 V dc, –48/60 V dc, or 120/240 V ac).

CAUTION	The replacement PSU must have the correct input voltage rating for the cabinet.

View of the PSU

Figure Maint. 2-9 shows a view of the PSU with key features identified.

Figure Maint. 2-9 PSU, with key features identified



NOTE	There are several manufacturers of the PSUs. All PSUs of the same type are fully compatible with each other, regardless of manufacturer.

Replacing a non-redundant PSU

Use this procedure if there are two or three PSUs installed in the cabinet. To replace a non-redundant PSU:

1. Set the switch of the replacement PSU to OUTPUT DISABLE.
2. Remove the blanking plate of the spare slot (if fitted) by unscrewing the retaining screw with a Torx driver.
3. Insert the replacement PSU in the resulting available slot. Push the PSU all the way in and secure in position by tightening the M4 retaining screw to the correct torque using a Torx driver.
4. Set the output switch to OUTPUT ENABLE. Check that the **ACTIVE** LED (green) illuminates.
5. Set the output switch of the faulty PSU to OUTPUT DISABLE. The **ACTIVE** LED will extinguish (the **ACTIVE** LED may already be off if a fault has resulted in output failure of that PSU). The **ALARM** LED (red) will illuminate, or will stay on if already lit due to alarm state.
6. Undo the M4 retaining screw on the front of the faulty PSU module and pull the module out of the cabinet using the handle. The **ALARM** LED will extinguish.
7. If required, fit the cover plate in the vacated PSU position and tighten the retaining screw to the correct torque using a Torx driver.

Replacing a redundant PSU

Use this procedure if there are four PSUs fitted. To replace a redundant PSU:

1. Set the switch on the replacement PSU to OUTPUT DISABLE.
2. Set the switch of the faulty PSU to OUTPUT DISABLE. The **ACTIVE** LED will extinguish (the **ACTIVE** LED may already be off if a fault has resulted in output failure of that PSU). The **ALARM** LED (red) will illuminate, or will stay on if already lit due to alarm state.
3. Undo the M4 retaining screw on the front of the faulty PSU module and pull the module out of the cabinet using the handle. The **ALARM** LED will extinguish.
4. Insert the replacement PSU in the empty slot. Push the PSU all the way in and secure in position by tightening the M4 retaining screw to the correct torque using a Torx driver.
5. Set the front panel switch to OUTPUT ENABLE. Check that the **ACTIVE** LED is lit.

Replacing a CTU2

Preconditions for CTU2 replacement

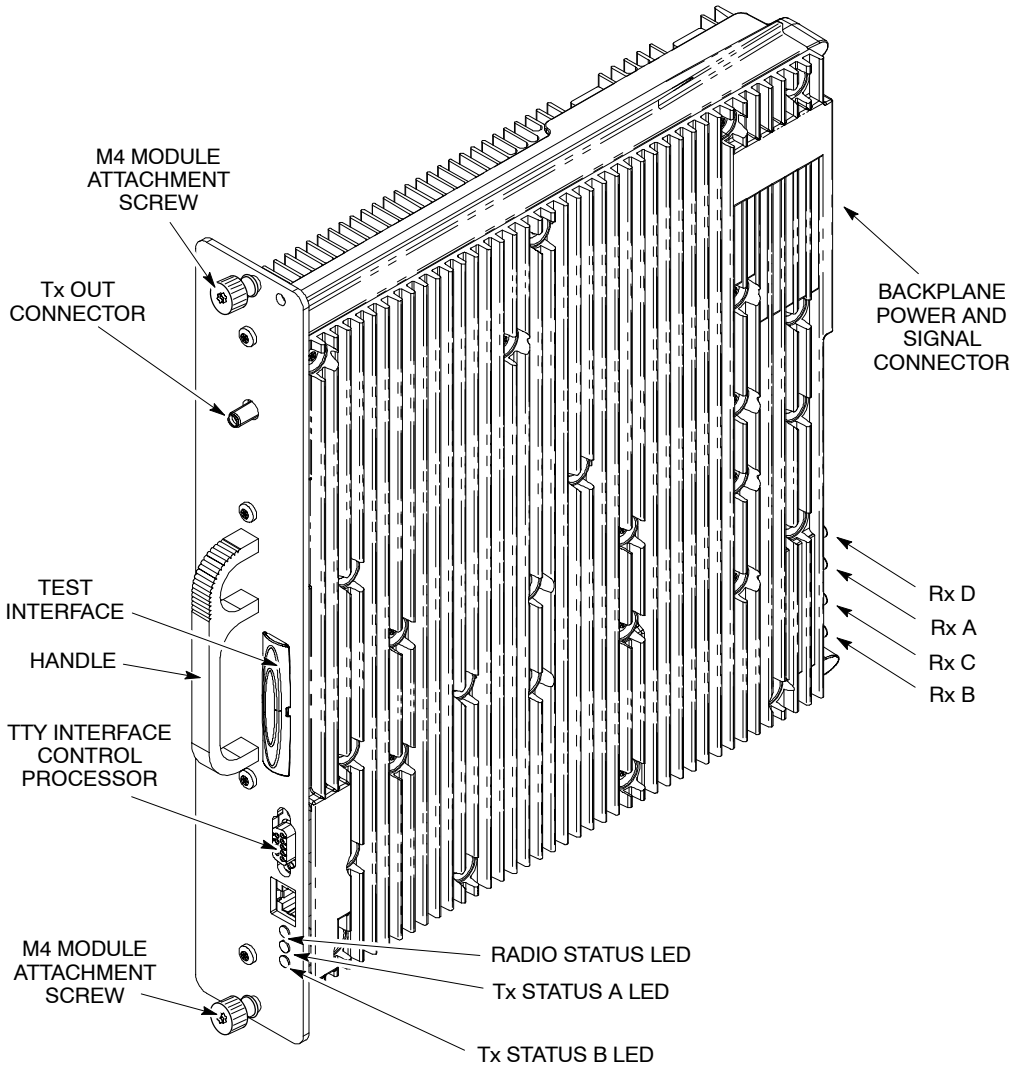
There are up to six CTU2s in a cabinet. Replacing a CTU2 requires removal of RF transmitter power for that CTU2; it is therefore advisable to perform this procedure during periods of low traffic. The OMC-R should be notified of imminent repair activity.

NOTE	The CTU2 replacement procedure is the same for all CTU2s, regardless of frequency rating. Read the **Preserving CTU2 calibration** section later in this chapter prior to removing the CTU2.

View of a CTU2

Figure Maint. 2-10 shows a view of a CTU2 with key features identified.

Figure Maint. 2-10 CTU2 view with key features



CTU2 replacement procedure

CAUTION	An earthing wrist strap must be worn when handling CTU2s. An ESP earthing connection point is provided on the top left at the front of the cabinet (refer to Figure Maint. 2-1).

Removing a faulty CTU2

NOTE	Ensure that the preserve CTU2 calibration data feature is enabled and determine which calibration data exchange scenario applies before proceeding further (refer to **Enabling the preserve CTU2 calibration data feature** and Table Maint. 2-2 respectively, later in this chapter).

To remove a CTU2:

1. Locate the CTU2 to be replaced. CTU2s are sequentially numbered, with CTU2 0 on the right, and CTU2 5 on the left.
2. Disable the CTU2 transmit RF power by using the **`lock_device`** or **`shutdown_device`** command at the OMC-R or from a PC connected to the HIISC.

NOTE	Refer to *Technical Description: BSS Command Reference (68P02901W23)* for information on usage and specific commands.

3. When the CTU2 has been shutdown, check that the yellow Tx STATUS LEDs are unlit.
4. Press and release the appropriate CTU2 circuit breaker button on the CBC to the out (off) position. Ensure the RADIO STATUS LED is unlit.

WARNING	Ensure that RF power is OFF, before disconnecting RF cables. Severe burns may result if RF power is ON when cables are disconnected.

5. Unscrew the coaxial cable from the Tx OUT SMA connector at the top of the CTU2 front panel.
6. Unscrew the two CTU2 attachment screws using a T20 Torx driver.

WARNING	The CTU2 weighs 5 kg. Handle with care.

CAUTION	Take care to avoid damaging the CTU2 rear connectors when handling outside of the cabinet.

7. Withdraw the CTU2 using the handle. Support the unit from underneath as it slides out.

Fitting a replacement CTU2

To fit a replacement CTU2:

1. Ensure that the correct CTU2 circuit breaker push-button on the CBC has been pressed to the out (off) position.
2. Ensure that the transmit RF power of the correct CTU2 has been locked using the **`lock_device`** or **`shutdown_device`** command at the OMC-R or from a PC connected to the HIISC.
3. Insert the replacement CTU2 module, taking care to locate the module on the guide rails. Push firmly into place.
4. Tighten both module attachment screws to the correct torque (see **Overview of replacement procedures**), using a T20 Torx driver.

NOTE	The Tx cable has a 90° SMA connector at one end, and a straight SMA connector at the other end. The 90° end is designed for connection to the Tx port of the CTU2.

5. Screw the 90° SMA connector of the coaxial cable onto the Tx OUT SMA connector at the top of the CTU2 front panel. Tighten to the correct torque (see **Overview of replacement procedures**).
6. Press and release the appropriate CTU2 circuit breaker push-button on the CBC. The RADIO STATUS LED will flash green for about two minutes, and then remain lit.

CAUTION	If the RADIO STATUS LED is flashing green or alternating red and green, boot code is downloading or flash reprogramming is taking place. Do not remove power or reset the cabinet until downloading has been completed as this will corrupt the non-volatile memory. If the boot code is corrupted, contact Motorola Customer Network Resolution Centre requesting the boot code restoration procedure and the appropriate boot code file.

7. Enable the CTU2 transmit RF power by using the **`unlock_device`** or **`ins_device`** command at the OMC-R or from a PC connected to the HIISC. The appropriate Tx STATUS LED (yellow) will be lit if the CTU2 is transmitting.
8. Calibrate the CTU2 using the appropriate procedure, as described in **CTU2 calibration data exchange procedures** later in this chapter.
9. Notify the OMC-R of base station availability and log the maintenance activity.

Preserving CTU2 calibration

NOTE	Although the preserve calibration data feature described here refers specifically to the CTU2, calibration data can be tranferred between the CTU used in Horizon*macro* and the CTU2 using the same procedure.

Introduction to preserving CTU2 calibration

This section describes the preserve CTU2 transceiver calibration feature, which uses commands to store, display and clear calibration data. This feature is used on busy systems where there is a need to replace a CTU2 quickly and thus reduce system down time during peak hours.

NOTE	After the CTU2 has been replaced, it will be necessary to revisit the site at an off-peak period to carry out bay level and cell site power (CSPWR) calibration to fully optimize the hardware. The bay level calibration procedure is described later in this chapter. The CSPWR calibration procedure is described in Chapter 3 of this category.

Calibration data overview

This function enables malfunctioning CTU2s to be replaced without the need to remove the cell from service. The calibration offsets can be displayed and cleared using the **disp_cal_data** and **clear_cal_data** commands.

Display calibration offsets data

The **disp_cal_data** command only displays offsets from the CTU2 if the DRI is in the busy-unlocked (B-U) state. The GPROC CM database values are displayed when the CTU2 is locked or not busy. If the calibration values have been cleared, they will not be available on the specific RAM of the CTU2 or the CM database, and the response will be **NO CALIBRATION DATA AVAILABLE**.

Store calibration data

The **store_cal_data** command sets a flag to indicate that when the CTU2 is unlocked and comes into service, the calibration values will be copied from the RAM in the CTU2 into the GPROC CM database. The values from the RAM in the CTU2 will only be copied to the database if there are no calibration values in the GPROC CM database, and if the CTU2 has values in the RAM to be copied.

If the RAM in the CTU2 has been cleared of all values, and the GPROC CM database has calibration values for that specific CTU2, when the CTU2 is unlocked it will get a copy of these values from the CM database. Different calibration values for the same CTU2 can exist in the CM database and the RAM in the CTU2.

Care has to be taken when calibrating a CTU2. To ensure that the values in the RAM of the CTU2 and CM database have the same calibration data, the existing values have to be cleared using the **clear_cal_data** command before a calibration can be successful and the correct calibration data saved. Calibration data is stored in the master CM database at the BSC, and is used to update the CM database copy at the BTS if it is valid.

NOTE	The value **0800H** must be cleared from all the paths (columns of data) stored in the CTU2, otherwise the calibration data will not be uploaded to the CM database.

Clear calibration data

The **clear_cal_data** command removes the offsets from RAM and the database. To clear the data from a CTU2 that is B-U in the network, the command is issued after the CTU2 is locked. A new CTU2 being put into the network must first be allowed to become B-U and then locked, only after this will the command clear the calibration data for that CTU2. This is explained in the calibration procedure.

Calibration data exchange procedures

The process of uploading/downloading calibration data between the CTU2 and the CM database is automatic, but the actual procedure used is determined by one of the scenarios described in Table Maint. 2-2.

Table Maint. 2-2 CTU2 calibration scenarios and procedures

Scenario: Site initialization with ...	Description	Procedure Used
calibration data held in the CM database, but with invalid/no calibration data in the CTU2.	If a CTU2 malfunctions and has to be replaced, the associated DRI is locked and the malfunctioning CTU2 replaced with a new CTU2 while the cell remains in service. The DRI is then unlocked. When the executive message **Radio Standby Success** is received by the CA at the BTS, the database is queried to determine if any valid offset data is stored. If any is found in the database, this is downloaded to the new CTU2 and the CTU2 is allowed to come into service (B-U).	**Preserve CTU2 calibration data**
invalid/no calibration data held in the CM database and invalid/no calibration data in the CTU2.	Once the CA at the BTS receives the executive message **Radio Standby Success**, it checks the CM database for valid offsets. If none exist, the BTS then queries the CTU2 for valid data. If none exists in the CTU2, the CTU2 is brought into service but the **Invalid transceiver calibration data** alarm is triggered.	**CTU2 calibration**
invalid/no calibration data held in the CM database, but with valid calibration data in the CTU2.	Initially a CTU2 is calibrated and the antenna offsets stored within the CTU2. When the BTS initializes and enters call processing mode, the Central Authority (CA) at the BTS queries Configuration Management (CM) to see if valid offset data exists. If no valid data exists then the CTU2(s) are queried for the offset data, which is sent via the Radio Signalling Link (RSL) to the CM at the BSC.	**CTU2 recalibration**

Calibration data format from the CM database

The format of the calibration data output from the CM database is described here. This information is provided in response to the command:

disp_cal_data <location> DRI <device_id> <device_id2> [<device_id3>]

For example:

disp_cal_data 63 dri 0 0 0

Where:	63	**is:**	site
	dri		dri device
	0		first dev_id
	0		second dev_id
	0		third dev_id

System response:

```
DRI ID: 0 0 0
Data read from database
Store Calibration Data: enabled
Calibration Data (All values in Hex):
Transmit Power Offsets = 0
Receive System Data:
Antenna Number   1    2    3    4    5    6
---------------------------------------------------
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
                e80, e80, e80, e80, e80, e80,
```

Note that the second line of the system response indicates whether the data is read from the CTU2 or the database. In the example above the information is read from the database.

The number of rows of offset calibration data are as follows:

- EGSM900 – 22
- DCS1800 – 47

Test equipment required

The following equipment is needed to carry out the CTU2 calibration/ recalibration procedures:

- An IBM-compatible personal computer (PC).
- Terminal emulator software.
- A 9-way to 9-way cable (BTS).
- A 9-way to 25-way cable (BSC).

Commands used

Table Maint. 2-3 lists the commands required to carry out this procedure.

Table Maint. 2-3 CTU2 calibration commands

BTS Command	Function
`lock_device`	Prevents the device being used (see Note below).
`unlock_device`	Enables the device to be used (see Note below).
OMC-R/BSC Command	**Function**
`store_cal_data`	Stores calibration data for all transceivers in the master CM database at the BSC, which is then used to update the CM database copy at the BTS.
`disp_cal_data`	When transceiver is locked: Displays calibration data in the CM database for the specified transceiver. When transceiver is unlocked: Displays calibration data in the RAM of the specified transceiver.
`clear_cal_data`	Clears calibration data in the CM database at the BSC and BTS for a specified transceiver.

NOTE Use `shutdown_device` instead of `lock_device` if the CTU2 is currently active. Use `ins_device` instead of `unlock_device` if `shutdown_device` was used to lock the CTU2.

NOTE If there is no RSL from the BTS to the BSC then a command will not be executed by the BSC, as the BSC has no knowledge of the command being entered.

All calibration data is stored in the master CM database at the BSC, which is then used to update the CM database copy at the BTS only if the data is valid.

CINDY commissioning tool

Many of the procedures described in this chapter can be carried out automatically using the CINDY commissioning tool. Refer to the relevant CINDY user documentation for details.

Enabling the preserve CTU2 calibration data feature

Introduction to the preserve CTU2 calibration data feature

NOTE	The preserve CTU2 calibration data feature must be enabled at either the OMC-R or the BSC, otherwise none of the calibration data exchange procedures described in Table Maint. 2-2 will work.

Determine the BSC/BTS configuration and cage slot allocation before starting any of the calibration data exchange procedures.

NOTE	Calibration data is interchangeable between the Horizon II *macro* CTU2s and the Horizon*macro* CTUs. This means that a CTU2 can be inserted in a Horizon*macro* cabinet and the original CTU calibration data used.

Enabling the preserve feature at the OMC-R

Proceed as follows to enable the preserve CTU2 calibration data feature at the OMC-R:

1. At the OMC-R man-machine interface (MMI), log in to the required base site controller (BSC).
2. To initiate the preserve feature type:

   ```
   store_cal_data <site_id>
   ```

All calibration data will be stored in the master CM database at the BSC, which is then used to update the CM database copy at the BTS (if the data is valid).

Enabling the preserve feature at the BSC

Proceed as follows to enable the preserve CTU2 calibration data feature at the BSC:

1. Connect the 9-way to 25-way cable from the PC serial A port to the BSP TTY port.
2. At the PC start the terminal emulator program.
3. At the MMI prompt, enter the appropriate level change command and passwords.
4. At the MMI prompt type:

   ```
   store_cal_data <location>
   ```

CTU2 calibration data exchange procedures

Introduction to CTU2 calibration data exchange procedures

The procedures listed in Table Maint. 2-2 are described here in detail. All three procedures assume that the preserve CTU2 calibration data feature (described previously) has been enabled.

Preserve CTU2 calibration data procedure

NOTE	This procedure assumes that the **`store_cal_data`** command has been used on the CTU2 at some time previously while it was operational.

To replace a CTU2 using preserved calibration data, follow the procedures for CTU2 replacement given previously in **CTU2 replacement procedure**.

The calibration data stored in the CM database is downloaded into the RAM of the new CTU2. The data is also stored in the non-volatile CTU2 memory.

NOTE	After the CTU2 has been replaced, it will still be necessary to revisit the site at an off-peak hour, to carry out bay level and CSPWR calibration to fully optimize the hardware.

CTU2 calibration procedures

Calibrating the CTU2

This procedure is used to put a new CTU2 into service. If recalibration of a working CTU2 is required, use the **CTU2 recalibration procedures** provided later in this chapter.

Proceed as follows to calibrate the new CTU2:

NOTE	The CTU2 requires a code load prior to the calibration process. Wait until the CTU2 finishes the code load and stops flashing (in BUSY-UNLOCKED or ENABLED-UNLOCKED state) before proceeding.

1. Lock all the DRIs in the same sector of the CTU2 to be calibrated. **Always lock the CTU2 providing the BCCH last, as this prevents the BCCH switching to an alternative CTU2.** Enter the following command for each of the DRIs.

   lock_device <location> DRI <device_id1> <device_id2> [<device_id3>]

2. Display the data in the CM database for the CTU2 to be calibrated:

   disp_cal_data <location> DRI <device_id1>

3. If valid data is present, proceed to step 4. If the response seen is:

   NO CALIBRATION DATA AVAILABLE

   Enter the following:

   store_cal_data <location>

4. Check there is calibration data present in the CM database for the DRI, then clear that data for the CTU2 to be calibrated:

   clear_cal_data <location> DRI <device_id1>

5. Confirm the data has been cleared from the CM database for the specified CTU2:

   disp_cal_data <location> DRI <device_id1>

   If no problems have occurred, the response will be:

   NO DATA AVAILABLE

NOTE	If there is a different response, ensure the CTU2 is in the LOCKED state and carry out from step 2 again.

6. Carry out bay level and CSPWR procedures, as described in the relevant section of this manual. Record the data.

Checking the CTU2 calibration

Proceed as follows to check the CTU2 calibration:

1. Unlock the DRI of the calibrated CTU2.

NOTE	Ensure the previous calibration data has been cleared before unlocking the CTU2.

   Enter the command:

   unlock_device <location> DRI <device_id1>

   Check that the calibrated CTU2 passes into BUSY-UNLOCKED state. The new calibration data is uploaded to the CM database and is then used to update the copy at the BTS.

2. Check the calibration data of the DRI of the calibrated CTU2 against the values noted in step 6 of the previous procedure.

NOTE	Allow one minute after uploading for the values in the CM database at the BSC to be updated.

   Enter the command:

   disp_cal_data <location> DRI <device_id1>

   The values seen should match the previous ones.

NOTE	If the CTU2 is BUSY-UNLOCKED the data can be read directly from the CTU2. In ENABLED-UNLOCKED or LOCKED state calibration data is read from the CM database.

3. Make test calls in all timeslots of the new DRI to check audio quality and then lock the tested DRI using the command:

   lock_device <location> DRI <device_id1>

4. With the CTU2 LOCKED (or in ENABLED-UNLOCKED state), ensure the calibration process has been carried out correctly by checking that the CM database at the BSC has been updated with the new values.

   Enter the command:

   disp_cal_data <location> DRI <device_id1>

   The values seen should match the previous ones.

5. If everything is in order, the cell can be put back into service. Unlock all the DRIs in the same sector that were locked previously using the command:

   unlock_device <location> DRI <device_id1> <device_id2> [<device_id3>]

CTU2 recalibration procedures

Recalibrating the CTU2

This procedure is used to recalibrate a working CTU2 when there is invalid or no calibration data held in the CM database, but valid calibration data is present in the CTU2.

Proceed as follows to recalibrate the CTU2:

1. At the site BTP, remote login to the serving BSC and enter the following MMI command:

   store_cal_data <location>

2. Lock all the DRIs in the same sector of the CTU2 to be recalibrated. **Always lock the CTU2 providing the BCCH last, as this prevents the BCCH switching to an alternative CTU2.** Enter the following command for each of the DRIs:

   lock_device <location> DRI <device_id1> <device_id2> [<device_id3>]

3. Display the data in the CM database for the CTU2 that is to be recalibrated in the sector:

   disp_cal_data <location> DRI <device_id1>

4. If valid data is present proceed to step 5. If the response seen is:

   NO CALIBRATION DATA AVAILABLE

   Enter the following:

   store_cal_data <location>

5. Check there is calibration data present in the CM database for the DRI, then clear that data for the CTU2 to be recalibrated:

   clear_cal_data <location> DRI <device_id1>

6. Confirm the data has been cleared from the CM database for the specified CTU2:

   disp_cal_data <location> DRI <device_id1>

   If no problems have occurred, the response will be:

   NO DATA AVAILABLE

NOTE	If there is a different response, ensure the CTU2 is in the LOCKED state and proceed from step 3 again.

7. Carry out bay level and CSPWR procedures, as described in the relevant section of this manual. Record the data.

Checking the CTU2 recalibration

Proceed as follows to check the recalibration:

1. Unlock the DRI of the recalibrated CTU2.

NOTE	Ensure the previous calibration data has been cleared before unlocking the CTU2.

   Enter the command:

   unlock_device <location> DRI <device_id1>

   Check that the recalibrated CTU2 passes into UNLOCKED state. The new calibration data is uploaded to the CM database and is then used to update the copy at the BTS (even if the DRI does not have an RTF assigned).

2. Check the calibration data of the DRI of the recalibrated CTU2 against the values noted in step 7 of the previous procedure.

NOTE	Allow one minute after uploading for the values in the CM database at the BSC to be updated.

   Enter the command:

   disp_cal_data <location> DRI <device_id1>

   The values seen should match the previous ones.

NOTE	If the CTU2 is BUSY-UNLOCKED the data can be read directly from the CTU2. In ENABLED-UNLOCKED or LOCKED state calibration data is read from the CM database.

3. Lock the tested DRI using the command:

   lock_device <location> DRI <device_id1>

4. With the CTU2 LOCKED (or in ENABLED-UNLOCKED state), ensure the recalibration process has been carried out correctly, by checking that the CM database at the BSC has been updated with the new values.

   Enter the command:

   disp_cal_data <location> DRI <device_id1>

   The values seen should match the previous ones.

5. If everything is in order, the cell can be put back into service. Unlock all the DRIs in the same sector that were locked previously using the command:

   unlock_device <location> DRI <device_id1> <device_id2> [<device_id3>]

Calibrating CTU2 bay level offset tables

Introduction to bay level offset tables calibration

NOTE	CTU2 bay level offset tables calibration and VSWR checks can be carried out automatically using the CINDY commissioning tool. Refer to the relevant CINDY user documentation for details.

Follow this procedure to calibrate the bay level offset tables to compensate for the losses or gains due to preselectors and RF cabling from the antenna inputs at the Horizon II *macro* to the CTU2 input.

All units are factory calibrated. This procedure is thus necessary only if one of the following changes occur:

- A CTU2 is replaced.
- RF front end equipment is changed.
- The site is reconfigured.
- High power duplexers are fitted.

NOTE	The procedures contained in **Calibrating CTU2 bay level offset tables** are to calibrate a single CTU2. Repeat the procedures for all CTU2s affected by the changes listed above.

Test equipment required

The following test equipment is required:

- An IBM-compatible personal computer (PC).
- Terminal emulator software.
- A 50 ohm 50 W dummy load.
- A signal generator (0 to 2 GHz).
- A 9-way to 9-way HIISC/CTU2 cable.
- A 9-way to 9-way DSP MMI/RSS CTU2 cable.

CAUTION	All test equipment and test leads must be calibrated annually by a recognized laboratory. Test equipment and test leads must not be calibrated in the field. Do not optimize Motorola cellular base stations with test equipment that is beyond its calibration due date. Allow test equipment to warm up for 30 minutes before use.

Commands used

Table Maint. 2-4 details the MMI commands that must be used to carry out the procedure:

NOTE	The symbol **0** used in the commands in this procedure is a zero.

Table Maint. 2-4 MMI commands for CTU2 Rx bay level offset calibration

BSS MMI command	Function
`ins_device`	Initializes the device, bringing it into service.
`lock_device`	Prevents the device being used.
`unlock_device`	Frees the device for further use.
`clear_cal_data`	Clears previously stored calibration data for a specified radio unit on a per DRI basis.
`chglev`	Changes the DSP MMI security level.
`fm test_mode on`	Puts the DSP fault management module in test mode.
`fm_test block none none 0xff`	Blocks all DSP fault management alarms.
`set carrier cara`	Switches DSP MMI control to carrier A.
`set_carrier carb`	Switches DSP MMI control to carrier B.
`ts a txp 0xff`	Turns off Tx closed-loop power control for the current carrier.
`cal_config rx_cab_antennas`	Configures which carriers will be calibrated by the Rx cabinet calibration procedure.
`cal_cabinet rx_cab`	Executes the Rx cabinet calibration procedure.
`cal_store_1`	Stores the calibration data.
`ts a rx_br_sel 2`	Sets the second carrier to Rx double density mode so that the calibration procedure is effective for both branches and both carriers.

Preparation for Rx bay level calibration

The RF path has to be prepared for bay level calibration. All DRIs in the site must be locked, the CTU2 has to be reset, a dummy load must be connected if there is no antenna, and all alarms must be disabled.

In the Horizon II *macro*, a transceiver may now consist of one or two DRIs. If a CTU2 is configured for double density mode (two DRIs), Rx cabinet calibration need only be performed on one of the DRIs because the same cabinet calibration data will be used by both DRIs.

The following will help determine whether a CTU2 is configured as single or double density transceiver and which DRI numbers correspond to which CTU2s.

At the BSC TTY, change to Level 3 and at the MMI-RAM> prompt type the following:

```
disp_eq # dri A * 0
```

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number of the transceiver.

For single density CTU2s the output will look similar to the following:

```
[05/02/03 14:42:37] MMI-RAM 0115 -> disp_eq 81 dri 0 0
DRI identifier: 0 0
DRI Density[dri_density]: SINGLE
Cabinet identifier: 0
Type of connection to the BTP: MASTER
Port to which the TCU is connected[tcu_port]: 0
RTF identifier[pref_rtf_id]:
GSM cell ID where the DRI appears: 001 01  1 91
Antenna select number for this cell[antenna_select]: 1
Tuneable combining used: No
The diversity flag for this DRI is[diversity_flag]: 0
The fm cell type is[fm_cell_type]: 0
```

For double density CTU2s the output will look similar to the following:

```
[05/02/03 14:47:55] MMI-RAM 0115 -> disp_eq 81 dri 0 1
DRI identifier: 0 1
DRI Density[dri_density]: DOUBLE
Associated DRI identifier: 0 2
Cabinet identifier: 0
Type of connection to the BTP: MASTER
Port to which the TCU is connected[tcu_port]: 1
RTF identifier[pref_rtf_id]:
GSM cell ID where the DRI appears: 001 01  1 91
Antenna select number for this cell[antenna_select]: 1
Tuneable combining used: No
The diversity flag for this DRI is[diversity_flag]: 0
The fm cell type is[fm_cell_type]: 0
```

In this case we see that **DRI 0 1** is a double density CTU2 and is associated with DRI 0 2.

Repeating the command for DRI 0 2 yields the following:

```
[05/02/03 14:48:07] MMI-RAM 0115 -> disp_eq 81 dri 0 2
DRI identifier: 0 2
DRI Density[dri_density]: DOUBLE
Associated DRI identifier: 0 1
Cabinet identifier: 0
Type of connection to the BTP: MASTER
Port to which the TCU is connected[tcu_port]: 1
RTF identifier[pref_rtf_id]:
GSM cell ID where the DRI appears: 001 01  1 91
Antenna select number for this cell[antenna_select]: 1
Tuneable combining used: No
The diversity flag for this DRI is[diversity_flag]: 0
The fm cell type is[fm_cell_type]: 0
```

Thus, in this example, DRI 0 1 and DRI 0 2 are on the same CTU2.

In the case of the single density CTU2, cabinet calibration will be performed once on the DRI.

In the case of the double density CTU2, cabinet calibration is still performed on only one of the two DRIs, but the other DRI must be locked for the procedures to be carried out. Furthermore, the **clear_cal_data** commands must be issued for both DRIs.

Rx bay level calibration procedure

Proceed as follows:

1. Connect the 9-way to 9-way HIISC cable from the PC serial A port to the HIISC TTY port.
2. At the PC, start the terminal emulator program.
3. Lock all DRIs in the sector. At the HIISC TTY, change to Level 3 and at the MMI-RAM> prompt type:

   lock_device # dri A * 0

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number of the transceiver.

NOTE	Always lock the transceiver providing the BCCH last as this prevents the BCCH being switched to alternate transceivers.

4. If a Tx antenna is not connected to the transceiver under test, connect a 50 ohm 50 W dummy load to the Tx port.
5. Unlock the CTU2 to be calibrated. Change to Level 3 and at the MMI-RAM> prompt type:

   ins_device # dri A * 0

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number of the transceiver.

NOTE	In the case of a double density CTU2, Rx cabinet calibration only needs to be performed on one of the two DRIs. The other DRI must remain locked.

6. Connect a serial port on the PC to the TTY Interface port on the CTU2 to be calibrated using the 9-way to 9-way DSP MMI/RSS cable.

   If necessary, switch the 9-way to 9-way DSP MMI/RSS cable from providing RSS connectivity to providing DSP connectivity.
7. At the DSP MMI prompt type:

   chglev

   and then enter the following password:

   pizza
8. Enter calibration test mode and disable alarms by typing the following commands:

   cal_test_mode on

   fm test_mode on

   fm_test block none none 0xff

9. If required, set the second carrier to Rx double density mode by typing the following command:

   ts a rx_br_sel 2

   This enables the calibration procedure to take effect on both branches and both carriers.

10. Turn the CTU2's transmitters off by typing the following at the DSP MMI prompt:

    set_carrier cara

    ts a txp 0xff

    set_carrier carb

    ts a txp 0xff

    set_carrier cara

    The response at the DSP MMI should be:

    ```
    CTU2.carA.ts_0>
    ```

11. Configure which Rx antennas are to be calibrated using the following command:

    cal_config rx_cab_antennas <antenna> <antenna> <antenna> <antenna> <antenna> <antenna>

    Where **<antenna>** is one of the following:

    all – All antennas.
    0a – Antenna 0A.
    1a – Antenna 1A.
    2a – Antenna 2A.
    0b – Antenna 0B.
    1b – Antenna 1B.
    2b – Antenna 2B.

    Up to six antenna options can be specified, separated by spaces. The option **all** is equivalent to "0A 1A 2A 0B 1B 2B".

    For example, to calibrate antennas 0A and 0B, type the following command:

    cal_config rx_cab_antennas 0a 0b

    The response will be:

    ```
    Setting RX Cabinet Calibration antennas to: 0A 0B
    ```

    To calibrate all antennas, type the following command:

    cal_config rx_cab_antennas all

    The response will be:

    ```
    Setting RX Cabinet Calibration antennas to: ALL
    ```

12. Start the Rx cabinet calibration procedure by typing the following command at the DSP MMI prompt:

    cal_cabinet rx_cab

    The following message will be displayed on the screen. This includes the SURF2 antenna connector to which the signal generator should be connected (shown in bold text).

    ```
    cal_cabinet rx_cab
    Enabling receive
    [c A, b 0] Setting RX diversity switch to double density
    (inject carrier A into carrier B)
    Enabling transmit
    Number of frequency groups = 47

    Please connect the signal generator to branch 0A
    Press return when the signal generator is connected.

    Press any key to continue
    ```

13. When the signal generator is connected to the appropriate SURF2 antenna connector and configured, press **ENTER** at the DSP MMI prompt.

    The on-screen instructions will list the new signal generator settings required (shown in bold in the sample output below):

    ```
    Please set the signal generator to
    POWER -65.2000 dBm
    FREQ 1710.8052 MHz

    Press any key to continue
    ```

    Be sure to allow for any loss in the cables connecting the signal generator to the antenna connector. For example, if the cables have a loss of 1.5 dB and you are asked to provide –65.2 dBm, set the signal generator to –63.7 dBm.

    Make the appropriate adjustments and then press **ENTER**. The readings for each test frequency will look something like the following:

    ```
    IQ average reading C0B0:  2565696, 0x00272640
    IQ average reading C1B0:  2762909, 0x002a289d
    Measured gain: 14.76 (0x0ec2)
    Measured gain: 15.69 (0x0fb0)

    Frequency group 2 of 47

    Please set the signal generator to
    POWER -65.2000 dBm
    FREQ 1712.4052 MHz

    Press any key to continue
    ```

14. Repeat the calibration procedure in step 13 for all the appropriate test frequencies (22 for EGSM and 47 for DCS1800).

15. Once all frequencies have been calibrated, the program will request the signal generator is moved to the next SURF2 antenna connection (refer to example message in step 12).

16. Repeat steps 13 and 14 for each antenna connection, until all frequencies on all antennas have been calibrated.

17. Type the following command at the DSP MMI prompt when the calibration procedure has been completed:

    cal_store_1

    After a few seconds delay (up to 16 seconds), the result of the data storage is displayed on the screen in the format:

    ```
    cal_store_1
    PASS
    CTU2.carA.ts_0>
    ```

18. Take the CTU2 out of test mode by entering the following command:

    fm test_mode off

19. Connect to the BSC MMI and enter the following command to lock the CTU2 that has been calibrated:

    lock_device # dri A * 0

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number on the transceiver.

20. Clear the calibration data for both DRIs using the following command:

    clear_cal_data # dri A * 0

NOTE	The **clear_cal_data** command clears all calibration data out of the CM database. This is required to override the preserve calibration feature, if enabled.

21. Move the 9-way to 9-way DSP MMI/RSS cable to the CTU2 TTY port of the **next** CTU2 to be calibrated and repeat the procedure from step 4.

Test frequency tables

The EGSM900 and DCS1800 channel numbers and test frequencies are listed in Table Maint. 2-5 and Table Maint. 2-6.

Table Maint. 2-5 EGSM900 test frequencies

Channel	Frequency (MHz)	Channel	Frequency (MHz)
978	880.8052	43	898.4052
986	882.4052	51	900.0052
994	884.0052	59	901.6052
1002	885.6052	67	903.2052
1010	887.2052	75	904.8052
1018	888.8052	83	906.4052
03	890.4052	91	908.0052
11	892.0052	99	909.6052
19	893.6052	107	911.2052
27	895.2052	115	912.8052
35	896.8052	123	914.4052

Table Maint. 2-6 DCS1800 test frequencies			
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
515	1710.8052	707	1749.2052
523	1712.4052	715	1750.8052
531	1714.0052	723	1752.4052
539	1715.6052	731	1754.0052
547	1717.2052	739	1755.6052
555	1718.8052	747	1757.2052
563	1720.4052	755	1758.8052
571	1722.0052	763	1760.4052
579	1723.6052	771	1762.0052
587	1725.2052	779	1763.6052
595	1726.8052	787	1765.2052
603	1728.4052	795	1766.8052
611	1730.0052	803	1768.4052
619	1731.6052	811	1770.0052
627	1733.2052	819	1771.6052
635	1734.8052	827	1773.2052
643	1736.4052	835	1774.8052
651	1738.0052	843	1776.4052
659	1739.6052	851	1778.0052
667	1741.2052	859	1779.6052
675	1742.8052	867	1781.2052
683	1744.4052	875	1782.8052
691	1746.0052	883	1784.4052
699	1747.6052		

Site restoration

After the bay level calibration procedure is completed, restore the site by the following:

1. Remove the signal generator and dummy load and reconnect the site RF cables.
2. Remove the 9-way to 9-way cable from the TTY interface port on the CTU2.
3. Connect the 9-way to 9-way cable from the PC serial A port to the HIISC TTY port.

CAUTION	The following step must be carried out to initialize software and so ensure the CTU2 is correctly brought into service.

4. Reset the CTU2 by switching off the appropriate circuit breaker button on the CBC and then switching on again. (The CTU2 does not have a front panel reset button.)
5. Type:

```
unlock_device # dri A * 0
```

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number on the transceiver.

The CTU2 is now in the **`unlocked_busy`** state.

6. Type:

```
disp_act_alarm # dri A * 0
```

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number on the transceiver.

Confirm that there is no DRI 218 alarm. If there is a DRI 218 alarm, redo the whole bay level calibration procedure

7. Remove the 9-way to 9-way cable from the HIISC TTY port.

Replacing a SURF2 module

Preconditions for SURF2 replacement

The Horizon II *macro* cabinet may contain one or two 900 MHz or 1800 MHz SURF2 modules. **Mixing different frequency SURF2s in the same cabinet is not permitted.** If only one SURF2 is installed, it must be located in the slot nearest the Tx blocks.

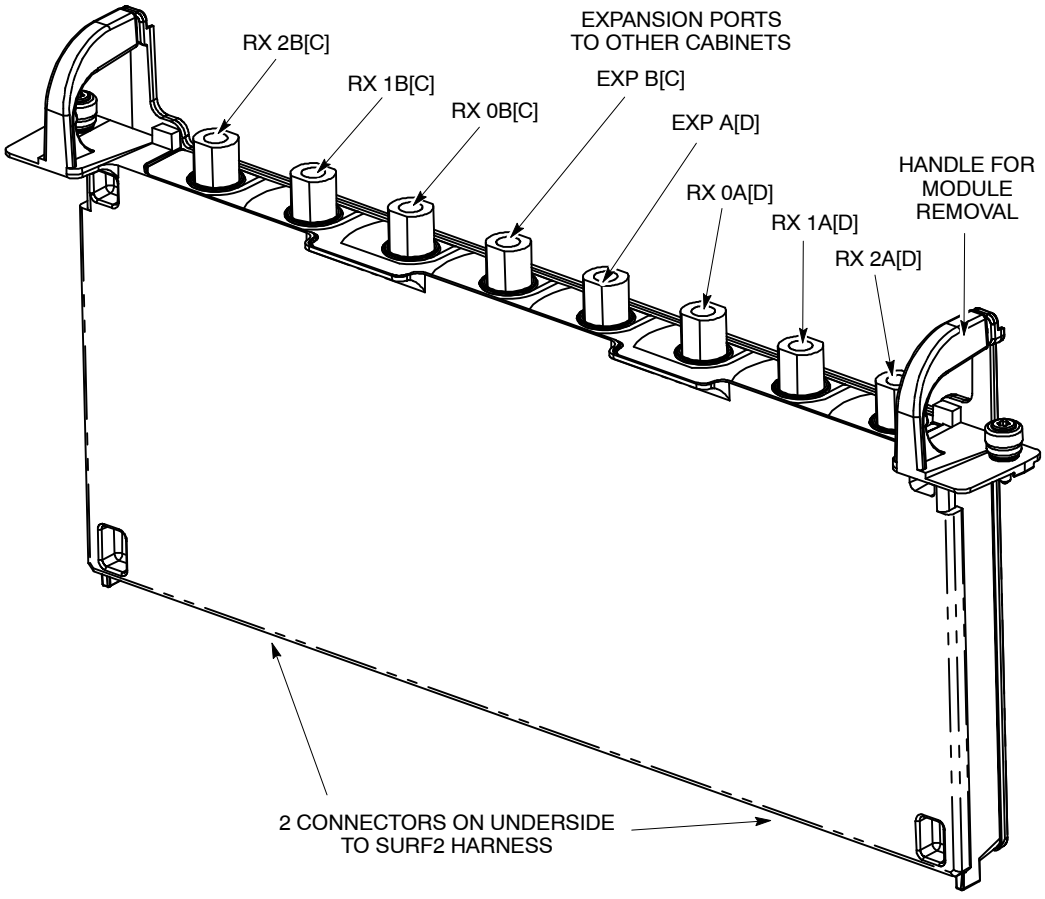
Replacement of a SURF2 can only take place after the cabinet has been taken out of service, in agreement with the OMC-R.

CAUTION	An earthing wrist strap must be worn when handling SURF2 modules. An ESP earthing connection point is provided on the top left at the front of the cabinet (refer to Figure Maint. 2-1).

View of the SURF2

Figure Maint. 2-11 shows the connectors on the SURF2 module.

Figure Maint. 2-11 SURF2, showing connector details



NOTE	Letters in brackets in Figure Maint. 2-11 refer to the port numbering on the second (optional) SURF2.

Replacing a SURF2

Removing a faulty SURF2

To remove a SURF2:

1. Make a note of the RF cable connections to the SURF2 module to enable correct reconnection to the replacement module.

WARNING	Before disconnecting RF cables, ensure that RF power is OFF. If RF power is ON when cables are disconnected, severe burns may result.

2. Disable all CTU2 transmit RF power by using the **`shutdown_device`** command at the OMC-R or from a PC connected to the HIISC.

NOTE	Refer to *Technical Description: BSS Command Reference (68P02901W23)* for information on usage and specific device codes.

3. When all CTU2s have been shutdown, check that all Tx STATUS LEDs (yellow) are unlit.
4. Press and release the CTU2 circuit breaker buttons on the CBC to the out (off) position. Ensure each RADIO STATUS LED is unlit.
5. Press and release the appropriate SURF2 circuit breaker button on the CBC to the out (off) position.
6. Disconnect the coaxial RF cables by carefully unscrewing and pulling them out of the module sockets.
7. Using a Torx driver, unscrew the two M4 captive screws holding the SURF2 module to the top of the cabinet.
8. Using the handles, lift the SURF2 module out of the slot.

Fitting a replacement SURF2 module

To install a replacement SURF2:

1. Transfer the protective caps on the RF connectors from the replacement module to the faulty module.
2. Lower the replacement SURF2 module into the slot. Take care to avoid trapping cables as the module is seated.
3. Tighten the two captive M4 screws to the correct torque (refer to Table Maint. 2-1 at the start of this chapter).
4. Reconnect the coaxial RF cables to the positions noted in the removal procedure. Tighten to the correct torque.
5. Switch on the SURF2 circuit breaker button on the CBC.
6. Reset the CTU2 circuit breaker buttons on the CBC. Each RADIO STATUS LED will flash green for about two minutes, and then remain lit.
7. Enable the CTU2 transmit RF power by using the **`ins_device`** command at the OMC-R or from a PC connected to the HIISC. The appropriate Tx STATUS LED (yellow) will be lit if the CTU2 is transmitting.
8. Notify the OMC-R of base station availability and log the maintenance activity.

The SURF2 module replacement is now complete.

Replacing a Tx block, HCU/DHU or plate

Introduction to Tx block replacement

WARNING	Ensure that RF power is OFF, before disconnecting RF cables. Severe burns may result if RF power is ON when RF cables are disconnected.

CAUTION	An earthing wrist strap must be worn when handling Tx blocks. An ESP earthing connection point is provided on the top left at the front of the cabinet (refer to Figure Maint. 2-1).

There are six slots for Tx blocks in the top panel basket of a cabinet, above the CTU2s. There are three types of Tx block: DUP, HCU and DHU.

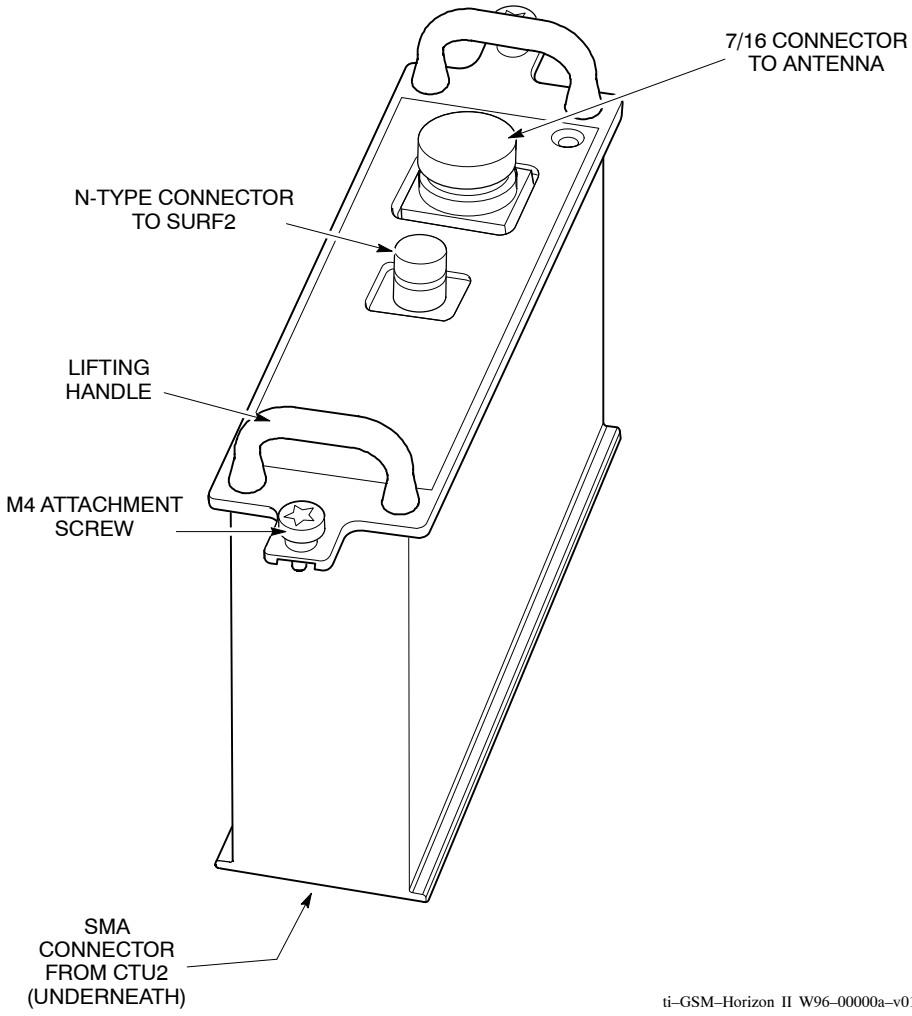
Replacing a Tx block requires removal of RF transmitter power for the CTU2(s) that connect with the faulty Tx block. It is therefore advisable to perform this procedure during periods of low traffic. Notify the OMC-R of imminent repair activity.

It is important to ensure that all Tx block/plate screw locations have a screw in place which is tightened to the correct torque (refer to Table Maint. 2-1 at the start of this chapter). This is to ensure the maximum quality of EMC and general containment.

Views of the duplexer Tx block

Figure Maint. 2-12 shows a duplexer Tx block used in the Horizon II *macro* cabinet.

Figure Maint. 2-12 View of the duplexer Tx block



Replacing a Tx block

Removing a faulty Tx block

To remove a Tx block:

1. Locate the faulty Tx block, and note the RF cable connections to enable correct reconnection to the replacement module.

WARNING	Ensure that **all** CTU2s associated with the faulty Tx block are identified (for example inputs to a HCU).

2. Identify the CTU2s that make Tx connections to the underside of the faulty Tx block, see Table Maint. 2-7.

Table Maint. 2-7 Connectors for each type of Tx block

Tx block	Input connector	Output connector
DUP	1 x SMA	1 x 7/16 Tx/Rx to antenna 1 x N-type to SURF2
HCU	2 x SMA	1 x QMA
DHU	3 x SMA	1 x QMA
Feedthrough plate	1 x SMA	1 x N-type to another cabinet

3. Disable each CTU2 transmit RF power by using the **shutdown_device** command at the OMC-R or from a PC connected to the HIISC.

NOTE	Refer to *Technical Description: BSS Command Reference (68P02901W23)* for information on usage and specific device codes.

4. When each CTU2 has been shutdown, check that the Tx status LEDs (yellow) are unlit.

5. Press and release each CTU2 circuit breaker button on the CBC to the out (off) position. Ensure each RADIO STATUS LED is unlit.

WARNING	Ensure that RF power is OFF, before disconnecting RF cables. Severe burns may result if RF power is ON when RF cables are disconnected.

6. Disconnect all coaxial RF cables by carefully unscrewing and pulling them out of the Tx block sockets. Note the positions for correct replacement.

7. Using a Torx driver, unscrew and retain the two M4 Torx screws holding the Tx block to the top of the cabinet.

WARNING	Tx blocks can weigh as much as 5 kg. Handle with care.

8. Lift the Tx block from the basket using its lifting handles.

Fitting a replacement Tx block

To install a replacement Tx block:

1. Transfer the protective caps on the RF connectors from the replacement Tx block to the faulty Tx block.
2. Carefully insert the replacement Tx block into its basket location on the top panel, adjusting alignment for the retaining screws. Take care to avoid trapping cables as the Tx block is seated.
3. Fit the two M4 Torx screws that secure the Tx block to the top of the cabinet. Tighten to the correct torque (refer to Table Maint. 2-1 at the start of this chapter).
4. Reconnect the coaxial RF cables to the positions noted in the removal procedure. Tighten to the correct torque.

NOTE	Ensure all unused SMA inputs to the Tx blocks are fitted with 50 ohm load terminations.

5. Switch on the appropriate CTU2 circuit breaker buttons on the CBC. Each RADIO STATUS LED will flash green for about two minutes, and then remain lit.
6. Enable the CTU2 transmit RF power by using the **`ins_device`** command at the OMC-R or from a PC connected to the HIISC. The appropriate Tx STATUS LED (yellow) will be lit if the CTU2 is transmitting.
7. Notify the OMC-R of base station availability and log the maintenance activity.

Blanking plate, feedthrough plate or HCU/DHU replacement

The replacement procedure for plates or a HCU/DHU is similar to that described for Tx blocks, but the plates are held by three M4 screws in the base of the Tx block basket. The two M4 Tx block screw locations are not used for plate attachment.

CAUTION	Unused Tx block locations must be covered with a blanking plate, with all screws fitted and tightened to the correct torque (see **Table Maint. 2-1**) to ensure the correct airflow and EMC shielding.

Digital module replacement

Introduction to digital module replacement

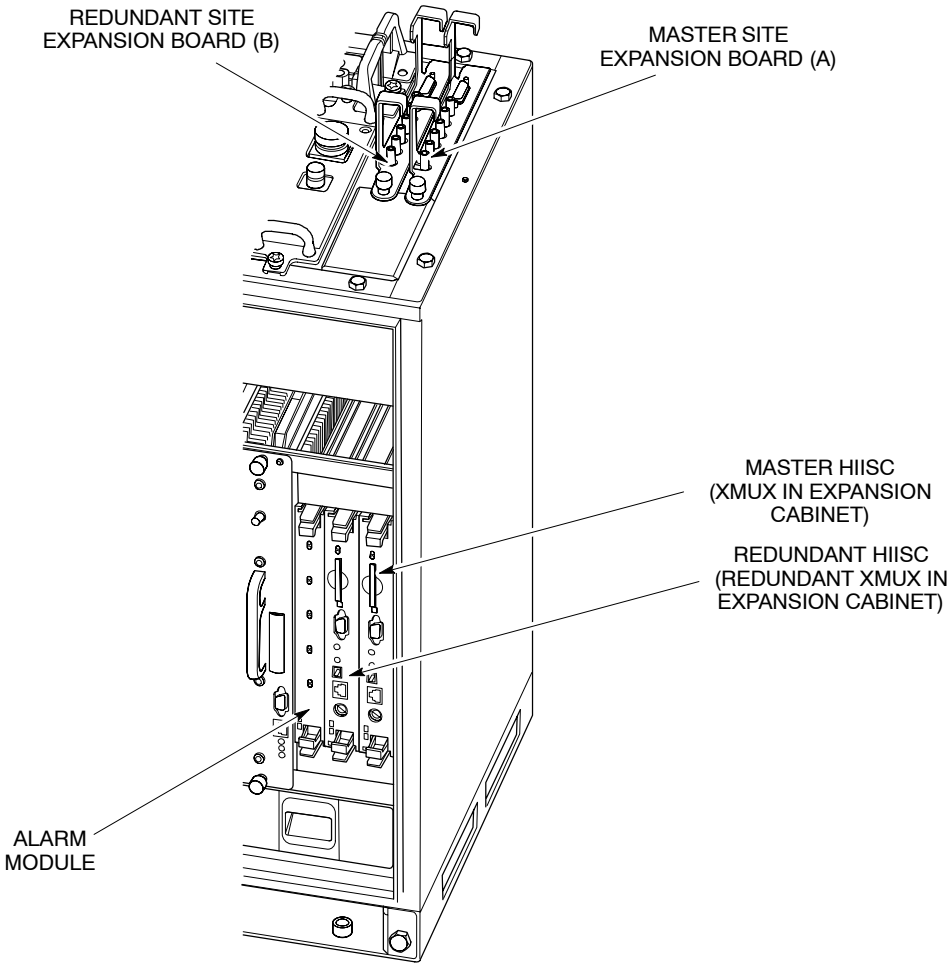
A faulty master HIISC, XMUX or site expansion board will cause a redundant module (if fitted) to take over until the faulty module is replaced. These modules can be hot swapped without harm to the module or affect on normal operation, provided the equivalent redundant module has taken over.

Removal of a faulty digital module that has not had its function taken over by a redundant module, and is still partially functional, will affect service. Inform the OMC-R before replacing such modules.

Diagram of digital modules

Figure Maint. 2-13 shows the location of the digital modules in the cabinet.

Figure Maint. 2-13 Digital module locations in the Horizon II *macro* cabinet



NOTE	Site I/O boards are only required when expansion cabinets are used.

Replacing digital modules

CAUTION	HIISC removal during flash memory programming may result in boot code corruption. This is only repairable by returning the HIISC to Motorola. For this reason, the HIISC should not be removed while the code load is taking place, indicated by flashing red and green front panel LEDs.

Removing a faulty digital module

To remove a digital module:

CAUTION	An earthing wrist strap must be worn when handling digital modules. An ESP earthing connection point is provided on the top left at the front of the cabinet (refer to Figure Maint. 2-1).

1. If the faulty digital module is still partially functional, due to no redundancy option, inform the OMC-R before proceeding.
2. Locate the faulty module, as shown in Figure Maint. 2-13.
3. Note location of any fibre optic cable connections to the module, (site expansion boards only), to enable correct reconnection to the replacement module.

WARNING	There is a possibility of laser radiation when fibre optic cables are disconnected. Do not look directly into cables with or without the use of any optical aids. Radiation can come from either the data in/out connectors or unterminated fibre optic cables connected to data in/out connectors.

4. Remove strain relief clips and disconnect each fibre optic cable by gently pushing the knurled connector in and rotating it through a quarter-turn anticlockwise to disengage, then withdraw the cable carefully.

NOTE	It is advisable to protect the tips of the fibre optic cables with a protective cover and secure the cables to one side.

5. For the HIISC/XMUX or alarm module, unseat the module by gripping the upper and lower pair of ejectors between the thumb and first finger of each hand, then gently squeeze and pull on the ejectors until the module unclips at the top and bottom of the front panel and unplugs from the rear connector.

   Carefully slide the module from its location and place it in an anti-static storage container.
6. For the site expansion board, undo the single M4 attachment screw and carefully lift the board out of its slot using the handles provided and place it in an anti-static storage container.

Fitting replacement digital module

To install a replacement digital module:

1. Remove the replacement module from the anti-static storage container.
2. For the HIISC/XMUX or alarm module, slide the module into the guide rails and push firmly into place. The ejectors will audibly click into place as confirmation of correct insertion.
3. For the site expansion board, lower the board into its slot using the handles provided. Ensure the backplane interface connector on the base is firmly seated in position and then tighten the M4 attachment screw to the correct torque using a Torxdriver.
4. Connect any fibre optic cables by inserting the connector and rotating a quarter-turn clockwise to engage. Fit strain relief clips around the fibre optic cables and secure to one of the site expansion board handles (slots are provided in the handles for this purpose).

NOTE	Ensure fibre optic cables are correctly connected to the locations noted during site expansion board removal.

5. Ensure the appropriate LEDs indicate correct operation.

CAUTION	When the red and green ALARM and STATUS LEDs on the front panel the HIISC are flashing, the boot code is downloading into non-volatile memory for software upgrade. Do not remove power or reset the cabinet until downloading has been completed, as this will corrupt the non-volatile memory. If the boot code is corrupted, contact Motorola Customer Network Resolution Centre requesting the boot code restoration procedure and the appropriate boot code file.

6. When fitting a redundant HIISC, refer to **Redundant HIISC firmware compatibility** for details of further checks required.
7. Notify the OMC-R of base station availability and log the maintenance activity.

Testing HIISC redundancy

Test procedure

The following procedure tests HIISC redundancy (if used) by forcing the master and redundant HIISCs to swap roles. The commands refer to the base transceiver processors (BTPs) within each HIISC.

NOTE	Forcing a switch to the redundant HIISC by using the **swap_devices** command will cause a site reset.

1. Connect a PC to the TTY MMI port on the master HIISC.
2. At the CUST MMI prompt, type:

   state <site #> btp * *

   Where **<site #>** is the site number.

   The status of both BTPs will be displayed as follows:

   ```
   BTP 0 0 0      B-U   NO REASON
   BTP 1 0 0      E-U   NO REASON
   ```

   Where B-U is busy unlocked (master) and E-U is enabled unlocked (redundant).
3. At the CUST MMI prompt type:

   swap_devices <site #> btp 0 0 0 btp 1 0 0

   Where **<site #>** is the site number, **btp 0 0 0** is the master HIISC and **btp 1 0 0** is the redundant HIISC.

   This command will swap HIISC roles by forcing:

- the redundant HIISC into a busy state , and making it master.
- the master HIISC into an enabled state, and making it redundant.

4. At the CUST MMI prompt, confirm the swap by typing:

   state <site #> btp * *

   Where **<site #>** is the site number.

   The status of both BTPs will now show changed roles:

   ```
   BTP 0 0 0      E-U   NO REASON
   BTP 1 0 0      B-U   NO REASON
   ```
5. Make test calls on the site to verify the new master HIISC.
6. At the CUST MMI prompt type, swap the HIISCs back to their original states by typing:

   swap_devices <site #> btp 1 0 0 btp 0 0 0

   Where **<site #>** is the site number, **btp 1 0 0** is the master HIISC and **btp 0 0 0** is the redundant HIISC.

7. At the CUST MMI prompt, confirm the swap by typing:

   `state <site #> btp * *`

   Where **<site #>** is the site number.

   Both BTPs have now reverted to their original roles:

   ```
   BTP 0 0 0      B-U   NO REASON
   BTP 1 0 0      E-U   NO REASON
   ```

8. Make test calls on the site to verify the new master HIISC.

Calibrating the HIISC (GCLK)

Introduction to HIISC (GCLK) calibration

NOTE	GCLK calibration can be carried out automatically using the CINDY commissioning tool. Refer to the relevant CINDY user documentation for details.

This procedure explains how to calibrate the Ovenized Crystal Oscillator (OCXO) in the HIISC GCLK in the Horizon II *macro* product at a BSS site.

When to calibrate the GCLK

The calibration procedure is to be used on the following occasions:

- When more than one frame slip per hour is observed at the OMC-R (typically more than 34/day).
- Whenever calibration is required. (Display the active alarms for a site - if calibration is required, there will be an alarm stating this.)

CAUTION	This procedure should only be carried out by fully trained, GSM qualified personnel. Under **NO** circumstances should this procedure be undertaken, unless all the correct test equipment is readily available.

NOTE	The command **gclk_cal_mode** used in this procedure should only be executed at the BTS where the calibration is being carried out. No call processing can occur involving the HIISC during calibration mode. Allow a period of 15 minutes to elapse after switching the OCXO power on, to give sufficient time for the unit to reach operating temperature and achieve frequency stabilization.

Test equipment required

The test equipment required to carry out the GCLK calibration is as follows:

- An IBM compatible personal computer (PC).
- A 9-way to 9-way TTY cable.
- A caesium or rubidium clock standard with 1 or 10 MHz output frequency.
- A universal counter with external reference, for example, the Hewlett Packard model HP5385A or equivalent.
- A BNC to 3-way HIISC test lead, part number 3086144E01.

Preparation for GCLK calibration

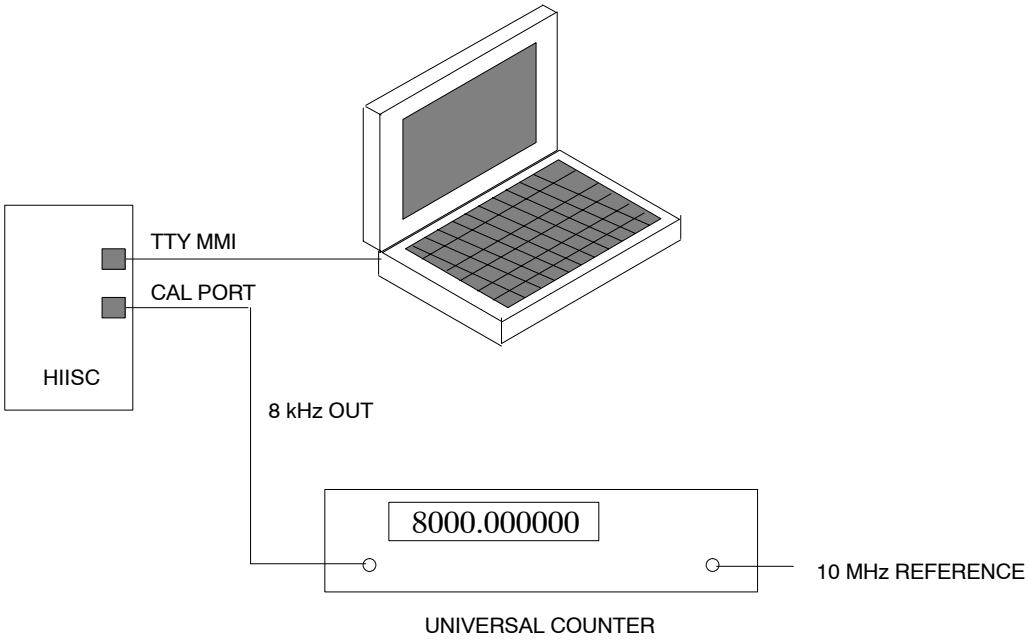
The following procedure is used to prepare the HIISC (GCLK) for calibration:

1. Connect the serial A port of the PC to the HIISC TTY MMI port using the 9-way to 9-way TTY cable (see Figure Maint. 2-14).
2. Start the terminal emulator program.
3. Connect the output from the 10 MHz standard to the reference input of the frequency counter, select external standard.
4. Set the frequency gate time to 10 seconds and the display to 10 significant digits.
5. Connect the test cable extracting the 8 kHz output signal from the CAL port on the front of the HIISC to the input of the frequency counter.

   Pin 3 – Earth (top pin)

   Pin 1 – 8 kHz signal (bottom pin)

Figure Maint. 2-14 Horizon II *macro* GCLK calibration cable connections



GCLK calibration procedure

The following procedure is used to calibrate the HIISC (GCLK).

1. To start the GCLK calibration mode, enter the command:

   gclk_cal_mode

   The **gclk_cal_mode** command is used to tell the sync function and HIISC software that a calibration is to be performed.

NOTE	The **gclk_cal_mode** command is used to tell the sync function and HIISC software that a calibration is to be performed and can only be executed at Horizon II *macro* sites outside sysgen mode. The command is NOT allowed on a master HIISC when a standby HIISC is available.

   When the command is executed the system will prompt for verification:

   ```
   Site  <Local site number> starting GCLK CALIBRATION MODE.  If this is
   a single MCU site, the site will be down until calibration is
   complete.

   Are you sure (y=yes, n=no)?
   ```

   Enter:

   y

   The HIISC will begin calibration mode. The command is aborted if the reply is anything other than y.

2. After a short delay (about 30 seconds) the following prompt will appear:

   ```
   Frequency Counter Connected, Enter y when ready, or a to abort test.
   ```

   Enter:

   y

   The command is aborted and calibration mode exited if the reply is anything other than y.

3. Adjust the OCXO control voltage using the +/– and 0 to 3 keys until the measured frequency is exactly 8000,000000 Hz.

   The values entered here, change the frequency by varying degrees. For example:

   – +0 will increase the output by a small amount.

   – +1 will increase the frequency by approximately 10 times.

   – +2 will increase the frequency by approximately 100 times.

   – +3 will increase the frequency by approximately 1000 times.

   These are not exact values as every OCXO has a different gain. This method gives sufficient control to correct the frequency within a short time.

   A typical sequence of numbers may look as follows:

```
Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >-3
(7.99999898)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >+3
(8.00000020)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >-0
(8.00000019 - 8.00000020)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >-2
(8.00000004)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >+2
(8.00000020)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >-1
(8.00000018)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >-2
(8.00000002 -8.00000003)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >-1
(8.000000--)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >+0
(8.000000-)

Enter a to abort. s to save, +(0..3) to inc, -(0..3) to dec >+0
(8.00000000)
```

4. A prompt will appear for saving the results:

```
Enter a to abort, s to save, +(0..3) to inc, -(0..3) to dec >
```

   Enter:

   s

```
CAL OFFSET is 23654 DAC bits.
```

   After calibration, the HIISC applies a set of voltages to the DAC that feeds the OCXO, requiring the user to input the corresponding output frequency. This is necessary because the OCXO frequency/voltage characteristic is not linear and the HIISC adjusts for this by taking readings across a range of DAC voltages.

5. To calibrate the OCXO, gain, enter the measured frequency value from the counter after the value has settled in response to the MMI prompts.

NOTE	When taking frequency measurements, ensure that a full gate period elapses from the time the new value is set to reading the counter. This wait may be several seconds depending on the counter.

A typical sequence of frequency measurements may be presented as follows:

```
Dac set to 1.0 volts, Enter Freq Value or a to abort > 7999.99853

Dac set to 2.0 volts, Enter Freq Value or a to abort > 7999.99915

Dac set to 3.0 volts, Enter Freq Value or a to abort > 7999.99969

Dac set to 4.0 volts, Enter Freq Value or a to abort > 8000.00020

Dac set to 5.0 volts, Enter Freq Value or a to abort > 8000.00070

Dac set to 6.0 volts, Enter Freq Value or a to abort > 8000.00122

Dac set to 7.0 volts, Enter Freq Value or a to abort > 8000.00176

Calibration Gain 3.865560e-01

SYNC>
```

NOTE	The HIISC is reset when the calibration is complete.

6. On completion, the HIISC will automatically reject the calibration if it is outside the threshold and the following message will be displayed:

```
Computed Gain > Max   WILL RETRY GAIN
```

Calibration must be performed again. If calibration fails the second time with the same or similar value, the OCXO may be operating outside the Motorola specification, in which case the HIISC is deemed faulty and should be replaced.

MOTOROLA

Chapter 3

Site verification procedures

Introduction to Horizon II *macro* verification procedures

Purpose of this chapter

This chapter provides information required for the verification of the Horizon II *macro* hardware equipment.

The procedures described in this chapter are as follows:

- Checking the antenna VSWR and calibrating the transmit output power.
- Checking the database equipage.
- Checking the E1/T1 link.
- Checking the PIX connections and alarm test.

CINDY commissioning tool

Many of the procedures described in this chapter can be carried out automatically using the CINDY commissioning tool. Refer to the relevant CINDY user documentation for details.

Test equipment, leads and plugs

Introduction to test equipment, leads and plugs

This section provides information on the test equipment required for the procedures in this chapter.

CAUTION	Ensure that all test equipment associated with commissioning of Motorola cellular base stations is within calibration date.

Test equipment required

Table Maint. 3-1 provides details of the test equipment required to perform the hardware verification procedures provided in this chapter:

Table Maint. 3-1 Hardware verification equipment

Quantity	Description	Comments
1	PC	To have a serial comms port for sending or configuring messages to the BSC and/or BTS.
1	Signal generator	Up to 2 GHz.
1	Commercial terminal emulator software	**PC PLUS** or similar software.
1	Digital multimeter	Hewlett Packard E2378A or equivalent.
1	30 dB attenuator	100 W minimum.
1	RF adapter kit	RTLXQ98088 or equivalent.
2	N to 7/16 inch adapter	
1	N to N barrel adapter	
1	RF wattmeter with 5 W, 10 W 25 W and 50 W elements	Bird model 43 or equivalent.
1	2 metres of N to N male coaxial cable	Must be calibrated.
1	4 metres of N to N male coaxial cable	Must be calibrated.
2	9-way to 9-way cable	Compatible with PC to TTY port on CTU2/HIISC.
1	9-way to 9-way cable (CTU2 only)	DSP MMI/RSS cable, connecting PC to CTU2 TTY port.

Test leads required

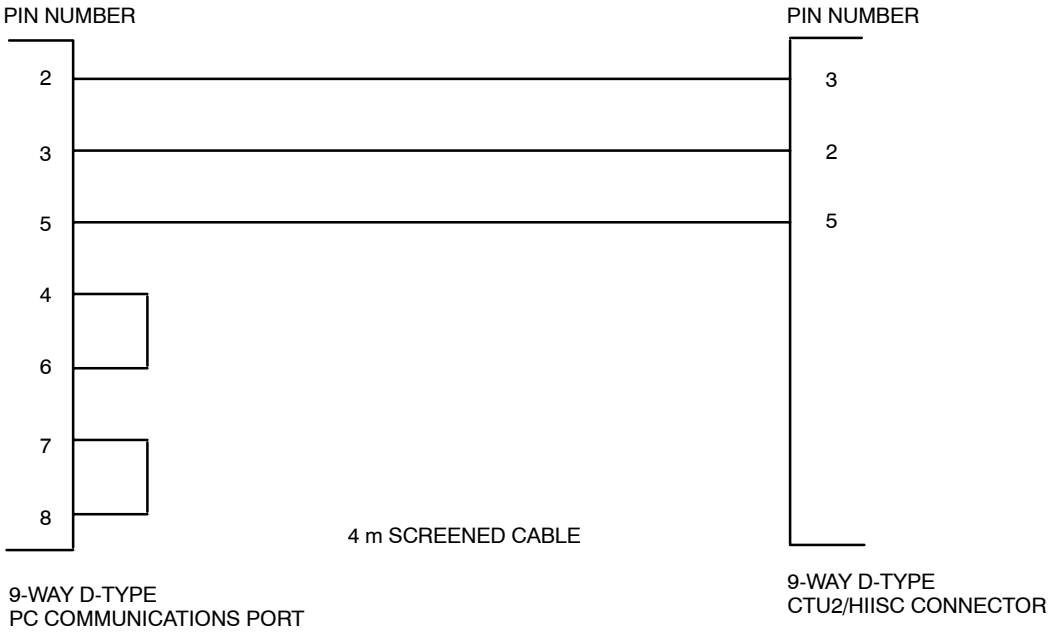
Test lead calibration

To minimize variations in test results, ensure that all appropriate test leads used in hardware verification procedures are calibrated.

CAUTION	A recognized laboratory must calibrate all test equipment and associated test leads annually. Do not calibrate test equipment or test leads in the field.

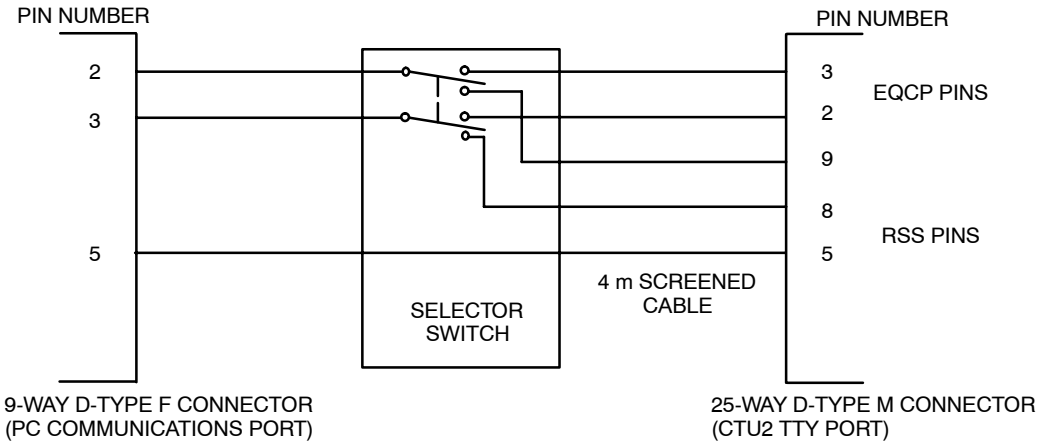
9-way to 9-way CTU2/HIISC cable

Figure Maint. 3-1 Horizon II *macro* 9-way to 9-way hardware verification cable connections



9-way to 9-way CTU2 cable

Figure Maint. 3-2 Horizon II *macro* 9-way to 9-way CTU2 cable connections



NOTE	TCU-B test lead 3086240N01 may alternatively be used instead of CTU2 test lead 3086299N01, but adapter (58C86540N01) is required to attach the 25-way cable connector to the 9-way CTU2 port.

Connections for a PIX test lead

Table Maint. 3-2 shows pinout details to make a PIX test lead.

Table Maint. 3-2 Test plug pin connections

From Pin	To Pin
1	20
2	21
3	22
4	23
5	24
6	25
7	26
8	27
9, 10, 11 not used	28 and 29 not used

NOTE	When making the PIX test lead: Normally open (N/O) PIX inputs should be connected through a 50 ohm resistor. Normally closed (N/C) PIX inputs should be connected through a 50 kohm resistor. Details of N/O and N/C site inputs can be found in the **equip_eas** file in the site commissioning database.

CTU2 VSWR and cell site offset information

Introduction to output power calibration and VSWR check

NOTE	CTU2 cell site offset calibration and VSWR checks can be carried out automatically using the CINDY commissioning tool. Refer to the relevant CINDY user documentation for details.

The objective of the VSWR check and output power calibration procedure is to ensure that antenna feeders and connectors are properly terminated and then set the pre-defined maximum transmitter output power at the top of the cabinet.

When a transceiver is manufactured, it undergoes comprehensive transmit and receive calibration procedures. These procedures aim to produce a transceiver that exhibits a flat frequency response over the GSM band. In the case of the transmitter, this is performed by distributing the channels over three detector groups (the detector being the device that maintains a steady output power level).

In the field, the procedure for setting the transmit output power involves using a set of commands called Cell Site Power (CSPWR). During CSPWR the user can trim the cabinet output power to account for any abnormalities that may occur between the CTU2 and the top of the cabinet. The offset is effectively subtracted from the requested power level, such that for whatever channel is selected, a steady output is maintained at the top of the cabinet.

The **Preparing for test** procedure at the end of this section should be completed before attempting the VSWR and cell site power calibration procedures.

Test equipment required

The following test equipment is required during the VSWR and output power calibration procedure:

- An IBM-compatible personal computer (PC).
- Terminal emulator software.
- A Bird model 43P (Thru-line) wattmeter, or equivalent, with 5 W and 50 W elements.
- A 9-way to 9-way cable (a diagram of this cable is provided in the **Test equipment, leads and plugs** section).
- A 9-way to 9-way DSP MMI/RSS cable.
- A 7/16 N-type adapter.
- A 50 ohm/100 W power attenuator.

CAUTION	All test equipment and test leads must be calibrated annually by a recognized laboratory. Test equipment and test leads must not be calibrated in the field. Do not optimize Motorola cellular base stations with test equipment that is beyond its calibration due date. Allow test equipment to warm up for 30 minutes before use.

Commands used

Table Maint. 3-3 lists the commands for the VSWR and output power calibration procedure.

NOTE	The symbol **0** used in the commands is a zero.

Table Maint. 3-3 VSWR and power calibration commands

BSS MMI Command	Function
`ins_device`	Initializes the device, bringing it into service.
`lock_device`	Prevents the device being used.
`unlock_device`	Frees the device for further use.
`clear_cal_data`	Clears previously stored calibration data for a specified transceiver on a per DRI basis.
`chglev`	Changes the DSP MMI security level.
`fm test_mode on`	Puts the DSP fault management module in test mode.
`fm_test block none none 0xff`	Blocks all DSP fault management alarms.
`cal_config tx_cab_mode <single> / <double>`	Set Tx power calibration mode for single or double density. <single> is the default mode and may be omitted.
`cal_cabinet tx_cab`	Perform Tx power calibration.
`ts a txp 0xff`	Turns off Tx closed-loop power control for the current carrier.
`ts a txp 0x00`	Turns on Tx closed-loop power control for the current carrier.
`ts a modulator unmod`	Turns off modulation.
`ts a state call_proc`	Puts all timeslots into call processing state.
`ts a synth lock`	Locks the synthesizers.
`cal_store_1`	Stores the calibration data.

Test stages

There are four stages to the procedure:

- Preparing for test.
- Checking the VSWR.
- Calibrating the transmit output power.
- Restoring the site.

NOTE	VSWR checks ensure correct antenna matching and can prove the serviceability of the antenna. Repeat the procedures for all antennas on site, including receive antennas.

Preparation for output power calibration and VSWR check

The RF path has to be prepared for bay level calibration. All DRIs in the site must be locked, the CTU2 has to be reset, a dummy load must be connected if there is no antenna, and all alarms must be disabled.

In the Horizon II *macro*, a transceiver may now consist of one or two DRIs. If a CTU2 is configured for double density mode (two DRIs), Tx cabinet calibration need only be performed on one of the DRIs because the same cabinet calibration data will be used by both DRIs.

The following will help determine whether a CTU2 is configured as single or double density transceiver and which DRI numbers correspond to which CTU2s.

At the BSC TTY, change to Level 3 and at the MMI-RAM> prompt type the following:

```
disp_eq # dri A * 0
```

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number of the transceiver.

For single density CTU2s the output will look similar to the following:

```
[05/02/03 14:42:37] MMI-RAM 0115 -> disp_eq 81 dri 0 0
DRI identifier: 0 0
DRI Density[dri_density]: SINGLE
Cabinet identifier: 0
Type of connection to the BTP: MASTER
Port to which the TCU is connected[tcu_port]: 0
RTF identifier[pref_rtf_id]:
GSM cell ID where the DRI appears: 001 01  1 91
Antenna select number for this cell[antenna_select]: 1
Tuneable combining used: No
The diversity flag for this DRI is[diversity_flag]: 0
The fm cell type is[fm_cell_type]: 0
```

For double density CTU2s the output will look similar to the following:

```
[05/02/03 14:47:55] MMI-RAM 0115 -> disp_eq 81 dri 0 1
DRI identifier: 0 1
DRI Density[dri_density]: DOUBLE
Associated DRI identifier: 0 2
Cabinet identifier: 0
Type of connection to the BTP: MASTER
Port to which the TCU is connected[tcu_port]: 1
RTF identifier[pref_rtf_id]:
GSM cell ID where the DRI appears: 001 01  1 91
Antenna select number for this cell[antenna_select]: 1
Tuneable combining used: No
The diversity flag for this DRI is[diversity_flag]: 0
The fm cell type is[fm_cell_type]: 0
```

In this case we see that **DRI 0 1** is a double density CTU2 and is associated with DRI 0 2.

Repeating the command for DRI 0 2 yields the following:

```
[05/02/03 14:48:07] MMI-RAM 0115 -> disp_eq 81 dri 0 2
DRI identifier: 0 2
DRI Density[dri_density]: DOUBLE
Associated DRI identifier: 0 1
Cabinet identifier: 0
Type of connection to the BTP: MASTER
Port to which the TCU is connected[tcu_port]: 1
RTF identifier[pref_rtf_id]:
GSM cell ID where the DRI appears: 001 01  1 91
Antenna select number for this cell[antenna_select]: 1
Tuneable combining used: No
The diversity flag for this DRI is[diversity_flag]: 0
The fm cell type is[fm_cell_type]: 0
```

Thus, in this example, DRI 0 1 and DRI 0 2 are on the same CTU2.

In the case of the single density CTU2, cabinet calibration will be performed once on the DRI.

In the case of the double density CTU2, cabinet calibration is still performed on only one of the two DRIs, but the other DRI must be locked for the procedures to be carried out. Furthermore, the **clear_cal_data** commands must be issued for both DRIs.

Output format for clear_cal_data command

The CTU2 stores calibration data in a higher precision format (UWORDs) than the CTU (UBYTEs). As the two transceivers are interchangeable, the data needs to be stored in the database in a common format and the higher precision UWORD format is now used.

This does not affect the output format of the **clear_cal_data** command when the transceiver is unlocked (UWORDs for the CTU2 and UBYTEs for other transceivers). However, if the transceiver is locked, the data on it cannot be accessed nor can the transceiver type be determined and therefore the data can only be displayed in the format in which it is stored on the database (i.e. UWORD format).

Use one of the following formulae to convert the appropriate **clear_cal_data** output to a gain value (FEG):

For the CTU2: FEG = 2's_complement_16_bit_value / 256

For other transceivers: FEG = 17.5 + (2's_complement_8_bit_value / 10)

Use one of the following formulae to convert the gain value (FEG) to the UWORD or UBYTE format:

UWORD: 2's_complement_16_bit_value = round(FEG x 256)

UBYTE: 2's_complement_8_bit_value = round{(FEG − 17.5) x 10}

Normal CTU2 VSWR and cell site power calibration

Introduction to normal VSWR and cell site power calibration

NOTE	CTU2 cell site power calibration and VSWR checks can be carried out automatically using the CINDY commissioning tool. Refer to the relevant CINDY user documentation for details.

Two methods available for normal VSWR checking are described in this section; one automatic and one manual. The reason for the two methods is as follows:

VSWR method 1 (automatic)

When typing the **cal_cabinet tx_cab** command at the DSP MMI prompt, it effectively executes a small script containing the following commands:

TS A CHAN 38	Set all timeslots to channel 38 (900 MHz).
TS A CHAN 699	Set all timeslots to channel 699 (1800 MHz).
TS A TXP 00	
TS A MODULATOR UNMOD	
TS A STATE CALL_PROC	
TS A SYNTH LOCK	

Prior to executing the **cal_cabinet tx_cab** command, it assumes that the synthesizers are in normal mode (not locked), as is the case after the unit is powered up for the first time.

VSWR method 2 (manual)

To allow a specific channel to be specified (instead of defaulting to channel 38 or 699) additional commands must be entered, rather than using the **cal_cabinet tx_cab** command. One command sets the appropriate channel and the other switches the CTU2 output power on and off.

Automatic VSWR test procedure

The first method for normal VSWR checking uses automatic channel selection. The **cal_cabinet tx_cab** command automatically selects a midpoint channel number. However, if required, manual channel selection can be performed following the steps detailed in the manual test procedure.

WARNING	Full power is transmitted during VSWR checks. Ensure all personnel are clear of the antenna. Do not carry out this check unless antenna installation is complete.

CAUTION	To reduce the possibility of interference with other users, minimize the time that the CTU2 is powered up.

The following procedure automatically checks the VSWR of the transmission path.

1. Disconnect the antenna. Connect a dummy load to the meter, ensuring the meter is fitted with a 50 W element and connect the meter to the Tx output.
2. Bring the CTU2 into service using the **ins_device** command.
3. At the DSP MMI prompt type:

   chglev
   pizza (this is a password and appears on screen as *****)
   fm test_mode on
   fm_test block none none 0xff
   cal_cabinet tx_cab
4. Press **N** to specify that the test should NOT be run in high power mode.
5. Monitor and record the power meter reading (the forward output power).
6. Press **Q**.
7. Replace the 50 W element in the wattmeter with a 5 W element and reverse the direction on the power meter.
8. Remove the dummy load and connect the power meter through to the antenna.
9. At the DSP MMI TEST prompt type:

   cal_cabinet tx_cab
10. Press **N** to specify that the test should NOT be run in high power mode.
11. Monitor and record the reverse power reading indicated on the power meter.

NOTE	Readings should show reflected (reverse) power of no more than 5% of the forward power at the point of measurement, and less than 1 W. If the ratio of the forward and reverse readings is unacceptable, suspect an improper termination of the antenna feeder and connector.

12. Press **Q**.
13. Remove the power meter and reconnect the antenna.

CAUTION	This procedure leaves the transceiver in an overridden state. It must be reset before it can be used.

14. Use the **Site restoration** procedure given in Chapter 2 to return the site to service.

Manual VSWR test procedure

WARNING	Full power is transmitted during VSWR checks. Ensure all personnel are clear of the antenna. Do not carry out this check unless antenna installation is complete.

CAUTION	To reduce the possibility of interference with other users, minimize the time that the CTU2 is powered up.

The second method for normal VSWR checking allows the manual selection of a channel.

VSWR forward power test

The following procedure is used to manually check the VSWR of the transmission path through to the antenna.

1. Disconnect the antenna. Connect a dummy load to the power meter, ensuring the meter is fitted with a 50 W element and connect the meter to the Tx output.
2. Bring the CTU2 into service using the **ins_device** command.
3. At the DSP MMI prompt type:

   chglev
   pizza (this is a password and appears on screen as *****)
   fm test_mode on
   fm_test block none none 0xff
   ts a state call_proc

4. Enter the following command:

   ts a chan nnn

   Where: a **is:** all timeslots (TS).
   nnn the specified channel number.

5. To switch the power on, enter the following command:

   ts a txp 0x00

   Where: a **is:** all timeslots (TS).
   00 maximum output power.

6. Monitor and record the power meter reading (the forward output power).
7. To switch the power off, enter the following command:

   ts a txp 0xff

   Where: a **is:** all timeslots (TS).
   ff zero output power.

VSWR reverse power test

The following procedure is used to manually check the VSWR reverse power.

1. Replace the 50 W element in the power meter with a 5 W element and reverse the direction on the power meter.
2. Remove the dummy load and connect the power meter through to the antenna.
3. To switch the power on, enter:

   ```
   ts a txp 0x00
   ```

4. Monitor and record the reverse power reading indicated on the power meter.

NOTE	Readings should show reflected (reverse) power of no more than 5% of the forward power at the point of measurement, and less than 1 W. If the ratio of the forward and reverse readings is unacceptable, suspect an improper termination of the antenna feeder and connector.

5. To switch the power off, enter:

   ```
   ts a txp 0xff
   ```

Repeat the above forward and reverse power checks for the required number of channels.

When all channels have been checked, at the DSP MMI TEST prompt type:

```
ts a state active_standby
```

Remove the power meter and reconnect the antenna.

CAUTION	This procedure leaves the transceiver in an overridden state. It must be reset before it can be used.

Use the **Site restoration** procedure given in Chapter 2 to return the site to service.

Tx output power calibration procedure

NOTE	Calibration is not required unless the desired configuration is different to the shipped configuration.

The following procedure is used to calibrate CTU2 transmit output power:

1. Connect the 9-way to 9-way HIISC cable from the PC serial A port to the HIISC TTY port.
2. At the PC, start the terminal emulator program.
3. Lock all DRIs in the sector. At the HIISC TTY, change to Level 3 and at the MMI-RAM> prompt type:

   lock_device # dri A * 0

Where:		**is:**
	#	the number of the site logged into.
	A	the antenna/relative cell number (0 to 5).
	*	DRI number of the transceiver.

NOTE	Always lock the transceiver providing the BCCH last as this prevents the BCCH being switched to alternate transceivers.

4. Disconnect the antenna. Connect a dummy load to the power meter, ensuring the meter is fitted with a 50 W element. Connect the meter to the Tx output.
5. Change to Level 3 and at the MMI-RAM> prompt type:

   ins_device # dri A * 0

Where:		**is:**
	#	the number of the site logged into.
	A	the antenna/relative cell number (0 to 5).
	*	DRI number of the transceiver.

6. Connect a serial port on the PC to the TTY Interface port on the CTU2 to be calibrated using the 9-way to 9-way DSP MMI/RSS cable.

   If necessary, switch the 9-way to 9-way DSP MMI/RSS cable from providing RSS connectivity to providing DSP connectivity.
7. At the DSP MMI prompt type:

   chglev

   and then enter the following password:

   pizza
8. Enter calibration test mode and disable alarms by typing the following commands:

   cal_test_mode on

   fm test_mode on

   fm_test block none none 0xff

9. By default, Tx calibration is performed in the mode specified in the database. To force Tx calibration in either single or double density mode for a transceiver, enter one of the following commands as required:

   cal_config tx_cab_mode single

   cal_config tx_cab_mode double

   To reset Tx calibration to the mode specified in the database, enter the following command:

   cal_config tx_cab_mode database

10. Start the Tx cabinet calibration procedure by typing the following command at the DSP MMI prompt:

    cal_cabinet tx_cab

    The following warning message will be displayed on the screen:

```
WARNING! All attenuation is about to be removed.
      Please ensure that appropriate attenuation
      is attached to the CTU2 TX output.
Press any key to continue
```

11. Check the connections to the antenna and then press **ENTER**.

    For calibration in single density mode only, the following information and instructions will be printed:

```
High Power Mode is currently DISABLED (max_tx_bts is >= 0).
High Power Mode will only be used if max_tx_bts database
parameter is set to -1.
If the current site database is accurate, you should run
TX cabinet calibration in the same mode as the database.
Press "H" to calibrate in High Power Mode,
or press "N" to calibrate in Normal Power Mode.
```

NOTE	The above message does not appear if the transceiver is set to high power mode.

    Press **H** or **N** as appropriate.

    The following instructions will be displayed:

```
Press U to increase power, D to decrease power
until the target output power is reached.
Then press "Q" when finished.
```

12. Press **U** to increase output power or **D** to decrease output power until the reading on the power meter matches the target maximum power for the sector.

    As the output power is adjusted, a message similar to the following will be displayed:

```
Setting offset to = 0x13
```

13. Press **Q** when the desired output power level has been reached.

14. Store the new Tx cabinet calibration using the following DSP MMI command:

    cal_store_1

    After a few seconds delay (up to 16 seconds), the result of the data storage is displayed on the screen in the format:

```
cal_store_1
PASS
CTU2.carA.ts_0>
```

15. After the data has been stored, connect the 9-way to 9-way HIISC cable from the PC serial A port to the HIISC MMI TTY port and enter the following command to lock the CTU2 that has been calibrated:

```
lock_device # dri A * 0
```

Where:	#	**is:**	the number of the site logged into.
	A		the antenna/relative cell number (0 to 5).
	*		DRI number on the transceiver.

16. Move the 9-way to 9-way DSP MMI/RSS cable to the CTU2 TTY port of the **next** CTU2 to be calibrated and repeat the procedure from step 4.
17. Remove the power meter and check that all antennas have been reconnected.
18. Use the **Site restoration** procedure in Chapter 2 to return the site to service.

Tx cabinet channel numbers and frequencies

The Tx cabinet channel numbers and frequencies for the Horizon II *macro* are as follows:

EGSM900:	RF channel 23	939.6 MHz
DCS1800:	RF channel 668	1836.4 MHz

Checking the database equipage

Introduction to checking the database

The database equipage checks determine what devices and functions have been equipped in the BSC/Horizon II *macro* database.

There are two stages to the procedure:

- Preparing for the test.
- Checking the database equipage.

Test equipment required

The following test equipment is required during the procedure:

- An IBM-compatible personal computer (PC).
- Terminal emulator software.
- A 9-way to 9-way cable (a diagram of this cable is provided in Figure Maint. 3-1 of the **Test equipment, leads and plugs** section).

CAUTION	All test equipment and test leads must be calibrated annually by a recognized laboratory. Test equipment and test leads must not be calibrated in the field. Do not optimize Motorola cellular base stations with test equipment that is beyond its calibration due date. Allow test equipment to warm up for 30 minutes before use.

Commands used

The following commands are used during the procedure:

`disp_site`	Displays the site number.
`disp_equipment`	Displays the active equipment at a specified site.

Preparation for database checks

To prepare for the database equipage checks:

1. Ensure that the site is in call processing mode.
2. Connect the serial A port on the PC to the HIISC TTY port using the 9-way to 9-way cable.
3. Start the terminal emulator program at the PC.

Database equipage check procedure

To check the database for devices and functions:

1. At the CUST MMI prompt type:

   disp_site

   The following message (from the HIISC) is displayed:

   ```
   current site is #
   ```

   where # = the number of the site logged into.

2. At the CUST MMI prompt type:

   disp_equipment #

   where # = the number of the site logged into.

   A complete list of the equipment and functions in the database is displayed. For example:

```
CSFP        0 0 0
BTP         0 0 0
DRI         0 0 0    (0 1 0)
DRI         0 1 0    (0 0 0)
DRI         0 2 0    (0 3 0)
DRI         0 3 0    (0 2 0)
DRI         1 0 0    (1 1 0)
DRI         1 1 0    (1 0 0)
DRI         1 2 0    (1 3 0)
DRI         1 3 0    (1 2 0)
DRI         2 0 0    (2 1 0)
DRI         2 1 0    (2 0 0)
DRI         2 2 0    (2 3 0)
DRI         2 3 0    (2 2 0)
MSI         0 0 0
MMS         0 0 0
MMS         0 1 0
MMS         0 2 0
MMS         0 3 0
MMS         0 4 0
MMS         0 5 0
RSL         0 0 0
GCLK        0 0 0
EAS         0 0 0
CAB         0 0 0
SITE        0 0 0
PATH        0 0 0
RTF         0 0 0
RTF         0 1 0
RTF         0 2 0
RTF         0 3 0
RTF         1 0 0
RTF         1 1 0
RTF         1 2 0
RTF         1 3 0
RTF         2 0 0
RTF         2 1 0
RTF         2 2 0
RTF         2 3 0
```

3. To check the MSI configuration at the CUST MMI prompt type:

   disp_equipment # MSI 0 0

   Where: # = site number.

   A message similar to the following example is displayed:

```
MSI identifier:  0
MSI type [msi_type]: NIU2
```

Checking the E1/T1 link

Introduction to checking the E1/T1 link

The E1/T1 link checks verify the integrity of the links back to the BSC/MSC.

There are two stages to the procedure:

- Preparing for the test.
- Checking the E1/T1 link.

Test equipment required

The E1/T1 link checks require the following test equipment:

- An IBM compatible personal computer (PC).
- Terminal emulator software.
- A 9-way to 9-way cable (a diagram of this cable is provided in Figure Maint. 3-1 of the **Test equipment, leads and plugs** section).

CAUTION	All test equipment and test leads must be calibrated annually by a recognized laboratory. Test equipment and test leads must not be calibrated in the field. Do not optimize Motorola cellular base stations with test equipment that is beyond its calibration due date. Allow test equipment to warm up for 30 minutes before use.

Commands used

The following command is used to carry out the procedure:

`state`	Displays the status of specified devices or functions.

Preparation for the E1/T1 link check

The following procedure is used to set up the equipment to check the E1/T1 links:

1. Make sure the site is in call processing mode.
2. Connect the serial A port on the PC to the HIISC TTY port using the 9-way to 9-way cable.
3. Start the terminal emulator program at the PC.

The system and the hardware are set up to check the E1/T1 links.

E1/T1 link test procedure

The following procedure is used to check the E1/T1 link:

1. Contact the BSC/MSC of the E1/T1 link to be tested, and request a loopback on the relevant Digital Distribution Frame (DDF) port.

NOTE	Repeat for all E1/T1 links. • If the E1/T1 link has not been installed, perform this test at the DDF in the site. • If no DDF is fitted, do this test at the top of the cabinet.

2. Ascertain the site number, equipment list and MMS configuration.
3. At the CUST MMI prompt enter:

state # MMS * * *

Where:	#	**is:**	location.
	*		dev/func id.
	*		dev/func id.
	*		dev/func id.

For example:

state 2 MMS 0 1 0

The system displays the following message from the HIISC:

```
DEVICE STATUS INFORMATION FOR LOCATION 2:
OPER  STATES:  D:Disabled  E:Enabled   B:Busy
ADMIN STATES:  L:Locked    U:Unlocked  E:Equipped  S:Shutdown

                                          Last  Transition Related
Device      State Reason                  dd/mm   hh:mm:ss Function
----------- ----- ----------------------- ----------------- --------

MMS 0 1 0   B-U   No reason                18/02   13:23:05 None

END OF STATUS REPORT
```

If this display shows `Unlocked` and `Busy`, then the T43, cabling and the E1/T1 link are all good.

If the loop is removed and the command re-entered, the result will be `Unlocked` and `Disabled`.

NOTE	A delay in excess of 20 seconds may be required before a change in status is registered. If the display continues to show `Unlocked` and `Busy`, this may be because: 1. The wrong connection is looped, if the cabling is direct. 2. The MMS may be terminated by a device generating an E1/T1 link.

Checking PIX connections and alarms

Introduction to checking the PIX connections and alarms

The alarm tests check the serial connections and alarm status.

There are two stages to the procedure:

- Preparing for the test.
- Testing the PIX connections using the database external alarm system (EAS).

Test equipment required

The serial and alarm tests require the following test equipment:

- An IBM compatible personal computer (PC).
- Terminal emulator software.
- A 9-way to 9-way cable (a diagram of this cable is provided in Figure Maint. 3-1 of the **Test equipment, leads and plugs** section.

CAUTION	All test equipment and test leads must be calibrated annually by a recognized laboratory. Test equipment and test leads must not be calibrated in the field. Do not optimize Motorola cellular base stations with test equipment that is beyond its calibration due date. Allow test equipment to warm up for 30 minutes before use.

Commands used

The following commands are used to test the PIX connections:

`alarm_mode <site number> on`	Enables alarm reporting for a specified site.
`disp_act_alarm <site number>`	Displays active alarms at the specified site.
`equip <site number> EAS`	Equip the external alarm system at the specified site.

Preparing for the PIX connections and alarms test

The following procedure is used to prepare for the PIX connections and alarms test:

1. Make sure the software download has been completed.
2. Connect the serial A port on the PC to the master HIISC using the 9-way to 9- way cable.
3. Start the terminal emulator program at the PC.
   The system displays the CUST MMI prompt.
4. Enter the password at the CUST MMI prompt.
5. Use the **`equip <site number> EAS`** command to set up reference conditions for checking that the alarms operate correctly when the appropriate relay changes state.

   Refer to *Technical Description: BSS Command Reference, (68P02901W23)* for specific details regarding the **`equip`** command.

PIX connection test procedure

The following procedure can be used to test the PIX connections on each PIX board.

1. At the CUST MMI prompt type:

   `alarm_mode # on`

   Where: # **is:** the site number.

2. Connect a suitable test plug to the PIX input on the cabinet interface panel.

NOTE	Wait at least six seconds before continuing the testing. The time is required to allow polling to detect the presence of the test plug.

3. Type the **`disp_act_alarm`** command to view the alarms.

   The system displays all 8 alarms.

NOTE	The display depends on the database settings, that is, whether a fault condition is indicated by a closed loop or an open loop.

4. Change the state of each alarm using the test plug/lead. If the appropriate relay is operating correctly, the alarm state will change accordingly (alarm either cleared or activated).
5. Remove the test plug.

   The system clears the alarm display.

6. Repeat the procedure for the second PIX board.

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Chapter 4

Parts information for

Horizon II *macro*

Horizon II *macro* parts lists

Introduction to Horizon II *macro* parts list

In the parts lists contained in this chapter, each item consists of a location number (related to the associated diagram), description, and an order number. The order number uniquely identifies the required component. Some components may be used in other equipment in addition to Horizon II *macro*.

FRU items

The majority of items on the parts list are field replaceable units (FRUs). It is not intended to supply sub-units of these spares.

Ordering method

Contact the local Motorola office for ordering information, including cost and delivery.

If an item in the parts list is marked **TBA**, this means that the part number for the item was not available at the time of publication of this manual.

NOTE	Motorola reserves the right to change the design of the product without notice. The information provided in this chapter is intended as a guide. If the customer requires the latest information, then consult the **Motorola local office** who will be able to check on the web and confirm the current situation. Some items, for example PSUs, are produced by different manufacturers, and so a replacement may appear slightly different to the item it is replacing. All items bearing the same order number, regardless of manufacturer, are fully compatible.

Horizon II *macro* FRUs

Figure Maint. 4-1 shows the Horizon II *macro* cabinet modules, including major FRUs, without door or hood/stacking bracket for clarity.

Figure Maint. 4-2 shows those FRU items excluded from Figure Maint. 4-1.

Figure Maint. 4-1 Diagram of Horizon II *macro* cabinet showing major FRUs

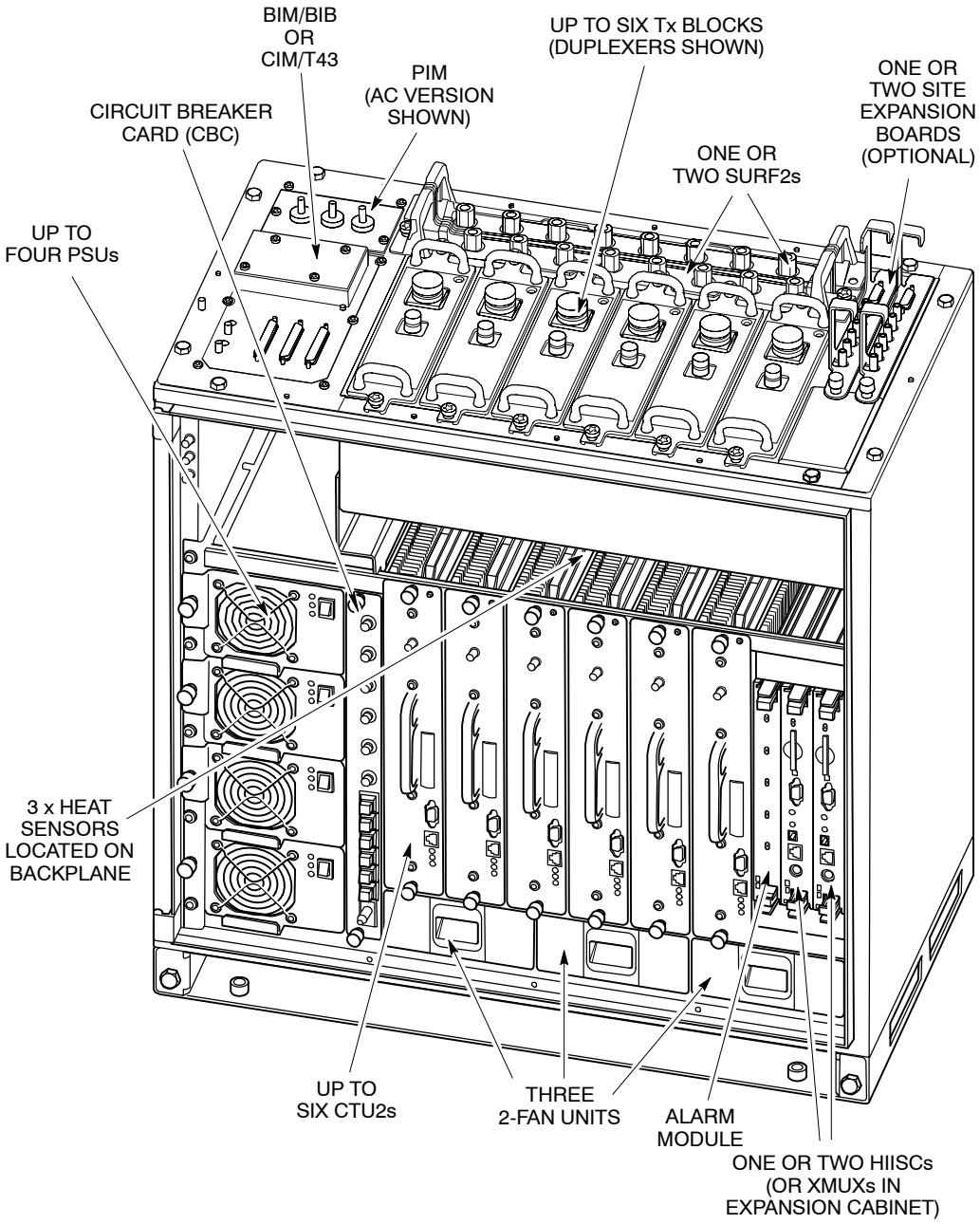
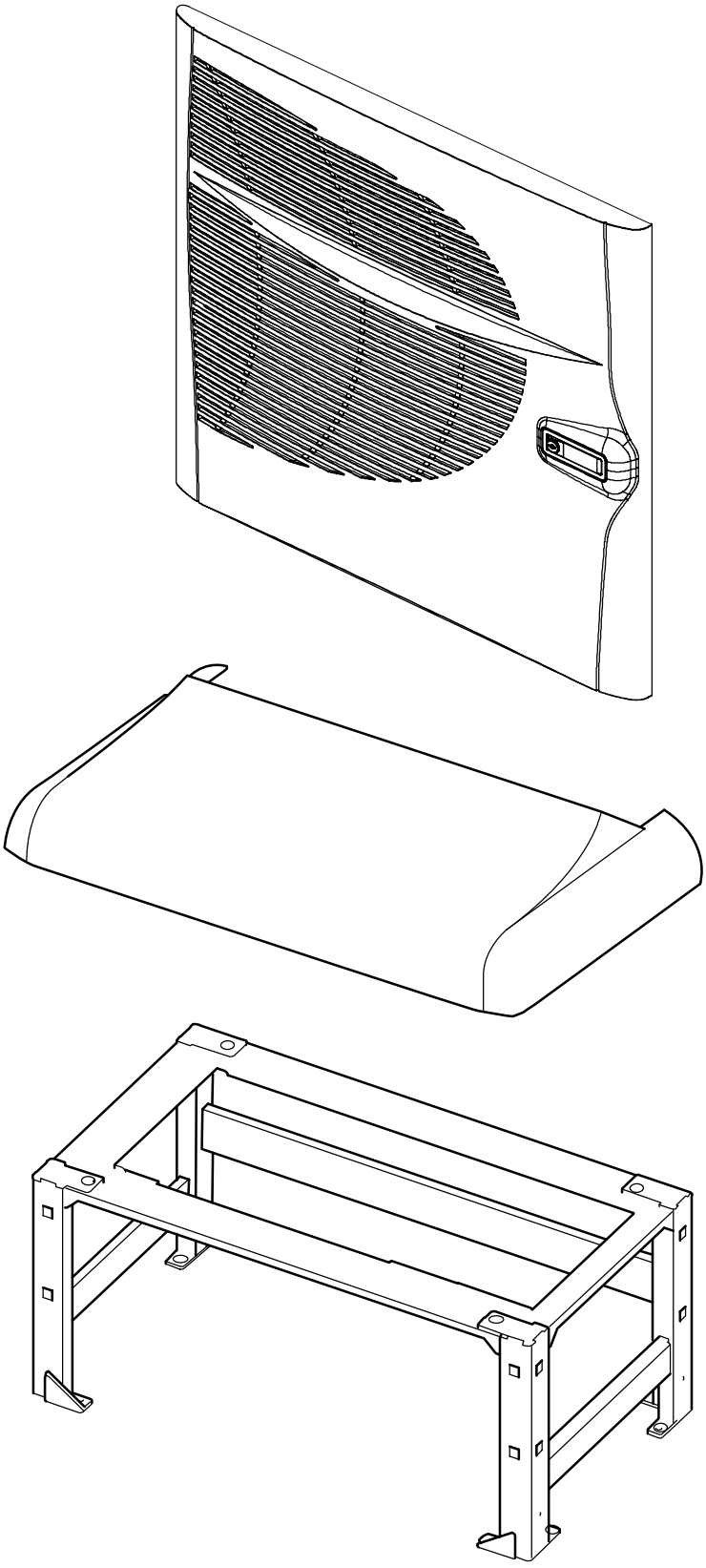


Figure Maint. 4-2 Additional Horizon II *macro* FRU components



Spares tables

Table Maint. 4-1 to Table Maint. 4-5 list the Horizon II *macro* spares, available as at May 2003. Contact the Motorola local office for an up to date list.

Structural and thermal control spares

Table Maint. 4-1 lists the structural and thermal control spares available for the Horizon II *macro*.

Table Maint. 4-1 Horizon II *macro* structural and thermal control spares

Item	Order No.
Cabinet	SVLN9119
Cabinet door	SWHN9128
Cabinet hood	SVLN1231
Plinth	SVLN1247
Stacking bracket	SWHN9133
BIM/BIB	SWLN4024
CIM/T43	SWLN4025
2-fan unit	SWHN9127
Air filter kit (pack of 10)	SVFF1209
Heat sensor, 75 °C	4004825c02
Heat sensor, 85 °C	4004825c03

Power distribution spares

Table Maint. 4-2 lists the power distribution spares available for the Horizon II *macro*.

Table Maint. 4-2 Horizon II *macro* power distribution spares

Item	Order No.
27 V PSU	SVPN9143
–48 V PSU	SVPN9142
110/240 V ac PSU	SVPN9144
Circuit breaker card (CBC)	SWHN9165A
Power interface module (PIM), dc version	SVPN4024A
Power interface module (PIM), ac version	SVPN4025A

RF component spares

Table Maint. 4-3 lists the RF component spares available for the Horizon II *macro*.

Table Maint. 4-3 Horizon II *macro* RF component spares	
Item	**Order No.**
900 MHz CTU2	SWRF9139
1800 MHz CTU2	SWRG9135
900 MHz SURF2	SWRF9146
1800 MHz SURF2	SWRG9164
900 MHz Duplexer (DUP)	SVLF9150
1800 MHz Duplexer (DUP)	SVLG9153
900 MHz Hybrid combiner unit (HCU)	SVLF9152
1800 MHz Hybrid combiner unit (HCU)	SVLG9155
900 MHz Dual hybrid combiner unit (DHU)	SVLF9157
1800 MHz Dual hybrid combiner unit (DHU)	SVLG9158
Blanking plate	SVKN4022
Feedthrough plate	SWGN1147A

Digital module spares

Table Maint. 4-4 lists the digital module spares available for the Horizon II *macro*.

Table Maint. 4-4 Horizon II *macro* digital module spares	
Item	**Order No.**
Horizon II site controller (HIISC)	SWLN9222
Expansion multiplexer (XMUX)	SWLN9166
Alarm module	SWLN9221
Site expansion board	SWLN9159

Miscellaneous spares (cables, etc.)

Table Maint. 4-5 lists the miscellaneous spares available for the Horizon II *macro*.

Table Maint. 4-5 Horizon II *macro* miscellaneous spares

Item	Order No.
Split sector cable pair	SVKN1233
2nd (Expansion) cabinet fibre	SVKN1244
3rd (Expansion) cabinet fibre	SVKN1245
4th (Expansion) cabinet fibre	SVKN1246
SMA 50 ohm load	SVLN1230
Compact flash card	5191096A09
CTU2 Tx cable	SVKN1304
Duplexer cable	SVKN1305

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