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Document:Introduction
Last saved on:Tue, Nov 6, 2001 09:50:56
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Document:tabs 1 to 5
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CATEGORY 323
TECHNICAL DESCRIPTION

CATEGORY 423
INSTALLATION AND
CONFIGURATION

CATEGORY 523
MAINTENANCE
INFORMATION

CATEGORY 623
PARTS INFORMATION

INDEX

Horizon*macro* outdoor

Including:

68P02902W02-A
68P02902W03-A
68P02902W04-A
68P02902W05-A

Service Manual
GSM-204-020

CONTROLLED INTRODUCTION

68P02902W12-A

Horizon*macro* outdoor

Service Manual

GSM-204-020

CONTROLLED INTRODUCTION

Horizon*macro*
outdoor

Including:

68P02902W02-A
68P02902W03-A
68P02902W04-A
68P02902W05-A

Service Manual

CONTROLLED INTRODUCTION

68P02902W12-A

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MOTOROLA

GSM-204-020

Service Manual
Horizon*macro* outdoor

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Chapter 3
Installing the BTS cabinet i

Chapter 6
Interoperability between different Motorola BTSs i

Chapter 7
Commissioning of outdoor cabinet i

Chapter 3
FRU replacement procedures i

Issue status of this manual

Introduction

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

Version information

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

Manual issue	Date of issue	Remarks
O	12th Jan 00	Original issue.
A	31st Oct 01	Updated to include details for GSM850 and PCS1900.

Resolution of Service Requests

The following Service Requests are now resolved in this manual:

Service Request	GMR Number	Remarks
N/A	N/A	

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 description of the hardware elements, installation and configuration information, repair procedures and parts lists for the Horizon*macro* outdoor equipment in Motorola GSM850, GSM/EGSM900, DCS1800 and PCS1900 systems.

The objectives 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 M-Cell*6* (a previous BTS type, interchangeable with Horizon*macro*).
- 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.
- Understand how to install and commission the equipment.
- Understand how to inspect, maintain, and repair the equipment.
- Have a clear ready reference for all dedicated information in one manual.

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 (Enter) key. The Return key is identified with the ↵ symbol on both the PC and the Sun keyboards. The keyboard Return key may also be identified with the word Return.

First aid in case of electric shock

Warning

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.

Artificial respiration

In the event of an electric shock it may be necessary to carry out artificial respiration. Send for medical assistance immediately.

Burns treatment

If the patient is also suffering from burns, then, without hindrance to artificial respiration, carry out the following:

1. **Do not attempt to remove clothing adhering to the burn.**
2. If help is available, or as soon as artificial respiration is no longer required, cover the wound with a **dry** dressing.
3. Do **not** apply oil or grease in any form.

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 tamper with 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.

Cautions

Definition of Warning

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 calibration due date when testing Motorola base stations.

General warnings

Introduction

Observe the following 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, 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

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

Warnings particularly applicable to the equipment are positioned on the equipment and 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 warnings given in text, on the illustrations and on the equipment.

High voltage

Certain Motorola equipment operates from a dangerous high voltage of 230 V ac single phase or 415 V ac three phase supply which is potentially lethal. Therefore, the areas where the ac supply power is present must not be approached until the warnings and cautions in the text and on the equipment have been complied with.

To achieve isolation of the equipment from the ac supply, the ac input isolator must be set to off and locked.

Within the United Kingdom (UK) regard must be paid to the requirements of the Electricity at Work Regulations 1989. There may also be specific country legislation which need to be complied with, depending on where the equipment is used.

RF radiation

High RF potentials and electromagnetic fields are present in the base station 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.

Refer to the following standards:

- 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

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

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.

Do not ...

... substitute parts or modify equipment.

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

Battery supplies

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

Toxic material

Certain equipment may incorporate components containing the highly toxic material Beryllium or its oxide Beryllia or both. These materials are especially hazardous if:

- Beryllium materials are absorbed into the body tissues through the skin, mouth, or a wound.
- The dust created by breakage of Beryllia is inhaled.
- Toxic fumes are inhaled from Beryllium or Beryllia involved in a fire.

Beryllium warning labels are fitted to equipment incorporating Beryllium or Beryllium Oxide. Observe all safety instructions given on warning labels.

Beryllium Oxide is used within some components as an electrical insulator. Captive within the component it presents no health risk whatsoever. However, if the component should be broken open or burnt, the Beryllium Oxide, in the form of dust or fumes, could be released, with the potential for harm.

Lithium batteries

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.

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

The bending radius of all fibre optic cables must not be less than 30 mm.

Static discharge

Motorola equipment contains CMOS devices that are vulnerable to static discharge. Although the damage caused by static discharge may not be immediately apparent, CMOS devices may be damaged in the long term due to static discharge caused by mishandling. Wear an approved earth strap when adjusting or handling digital boards.

See **Devices sensitive to static** 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. 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 GSM manual set

Introduction

The following manuals provide the information needed to operate, install and maintain the Motorola equipment.

Generic GSM manuals

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

Classification number	Name	Order number
GSM-100-101	System Information: General	68P02901W01
GSM-100-201	Operating Information: GSM System Operation	68P02901W14
GSM-100-202	Operating Information: OMC-R System Administration	68P02901W19
GSM-100-313	Technical Description: OMC-R Database Schema	68P02901W34
GSM-100-320	Technical Description: BSS Implementation	68P02901W36
GSM-100-321	Technical Description: BSS Command Reference	68P02901W23
GSM-100-403	Installation & Configuration: GSM System Configuration	68P02901W17
GSM-100-423	Installation & Configuration: BSS Optimization	68P02901W43
GSM-100-413	Installation & Configuration: OMC-R Clean Install	68P02901W47
GSM-100-501	Maintenance Information: Alarm Handling at the OMC-R	68P02901W26
GSM-100-520	Maintenance Information: BSS Timers	68P02901W58
GSM-100-521	Maintenance Information: Device State Transitions	68P02901W57
GSM-100-523	Maintenance Information: BSS Field Troubleshooting	68P02901W51
GSM-100-503	Maintenance Information: GSM Statistics Application	68P02901W56
GSM-100-721	Software Release Notes: BSS/RXCDR	68P02901W72
GSM-100-712	Software Release Notes: OMC-R System	68P02901W74

Related GSM manuals

The following are related Motorola GSM manuals:

Classification number	Name	Order number
GSM-001-103	System Information: BSS Equipment Planning	68P02900W21
GSM-002-103	System Information: DataGen	68P02900W22
GSM-002-703	Software Release Notes: DataGen	68P02900W76
GSM-005-103	System Information: GSM Advance Operational Impact	68P02900W25
GSM-008-103	System Information: Network Health Analyst	68P02900W36
GSM-008-703	Software Release Notes: Network Health Analyst	68P02900W77
GSM-TOOLS-001	System Information: Cell Optimization (COP)	68P02900W90
GSM-TOOLS-002	System Information: Motorola Analysis and Reporting System (MARS)	68P02900W94
GSM-TOOLS-701	Software Release Notes: Cell Optimization (COP)	68P02900W69
GSM-TOOLS-702	Software Release Notes: Motorola Analysis and Reporting System (MARS)	68P02900W68
GSM-006-202	Operating Information: OMC-R System Administration (OSI)	68P02901W10
GSM-006-413	Installation & Configuration: OSI Clean Install	68P02901W39
GSM-006-712	Software Release Notes: OMC-R OSI System	68P02901W70

Generic GPRS manuals

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

Classification number	Name	Order number
GPRS-300-101	System Information: GPRS Overview	68P02903W01
GPRS-300-202	Operating Information: OMC-G System Administration	68P02903W03
GPRS-300-222	Operating Information: GSN System Administration	68P02903W37
GPRS-300-313	Technical Description: OMC-G Database Schema	68P02903W46
GPRS-300-321	Technical Description: GSN Command Reference	68P02903W18
GPRS-300-423	Installation & Configuration: GSN Clean Install	68P02903W47
GPRS-300-413	Installation & Configuration: OMC-G Clean Install	68P02903W04
GPRS-300-501	Maintenance Information: Alarm Handling at the OMC-G	68P02903W19
GPRS-300-503	Maintenance Information: GSN Statistics Application	68P02903W20
GPRS-300-722	Software Release Notes: GSN System	68P02903W76
GPRS-300-712	Software Release Notes: OMC-G System	68P02903W70

Related GPRS manuals

The following are related Motorola GPRS manuals:

Classification number	Name	Order number
GPRS-001-103	System Information: GPRS Equipment Planning	68P02903W02
GPRS-005-103	System Information: GSN Advance Operational Impact	68P02903W38

BSS service manuals

The following are the Motorola Base Station 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:

Classification number	Name	Order number
GSM-100-020	Service Manual: BTS	68P02901W37
GSM-100-030	Service Manual: BSC/RXCDR	68P02901W38
GSM-105-020	Service Manual: M-Cell*2*	68P02901W75
GSM-106-020	Service Manual: M-Cell*6*	68P02901W85
GSM-201-020	Service Manual: M-Cell*city* and M-Cell*city+*	68P02901W95
GSM-202-020	Service Manual: M-Cell*access*	68P02901W65
GSM-203-020	Service Manual: Horizon*micro*	68P02902W36
GSM-206-020	Service Manual: Horizon*compact*	68P02902W15
GSM-205-020	Service Manual: Horizon*macro* Indoor	68P02902W06
GSM-204-020	Service Manual: Horizon*macro* Outdoor	68P02902W12
GSM-207-020	Service Manual: Horizon*office*	68P02902W46
GSM-209-020	Service Manual: Horizon*micro2* Horizon*compact2*	68P02902W61
GSM-208-020	Service Manual: Horizon*macro* 12 Carrier Outdoor	68P02902W66

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:

GPRS-301-020	Service Manual:GPRS Support Nodes (GSN)	68P02903W05
GPRS-302-020	Service Manual: Packet Control Unit (PCU)	68P02903W10

Classification number

The classification number is used to identify the type and level of a manual. For example, manuals with the classification number GSM-100-2xx contain operating information.

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. Motorola manual sets may also be ordered on CD-ROM.

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. GMRs are issued in the form of loose leaf pages, with a pink instruction sheet on the front.

GMR procedure

When a GMR is received, remove and replace pages in this manual, as detailed on the GMR pink instruction sheet.

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 pink 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		
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		
13		
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15		
16		
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20		
21		
22		
23		
24		
25		

CHAPTER 1
OVERVIEW AND
SPECIFICATIONS

CHAPTER 2
CABINET STRUCTURE

CHAPTER 3
THERMAL MANAGEMENT
SYSTEM

CHAPTER 4
CABINET POWER SUPPLIES

CHAPTER 5
RF MODULES

CHAPTER 6
DIGITAL MODULES

CHAPTER 7
AUXILIARY EQUIPMENT
HOUSING

CHAPTER 8
CABLE SHROUD

Category 323

Technical Description (Tech.)

MOTOROLA

Chapter 1

Overview and specifications

Chapter 1
Overview and specifications i

Equipment introduction and manual definition

Overview of Horizon*macro* outdoor

The Horizon*macro* outdoor is a six carrier Base Transceiver Station (BTS) cabinet, with variants that operate in the following frequency bands: GSM850, GSM/EGSM900, DCS1800 and PCS1900.

Outdoor cabinets operate from nominal 110 V single phase or nominal 230 V, single or three phase, ac supply. Cabinet temperature control is provided by a thermal management system (TMS) located in the bottom of the unit.

This section provides the reader with a introduction to the equipment, and describes the structure of the manual.

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

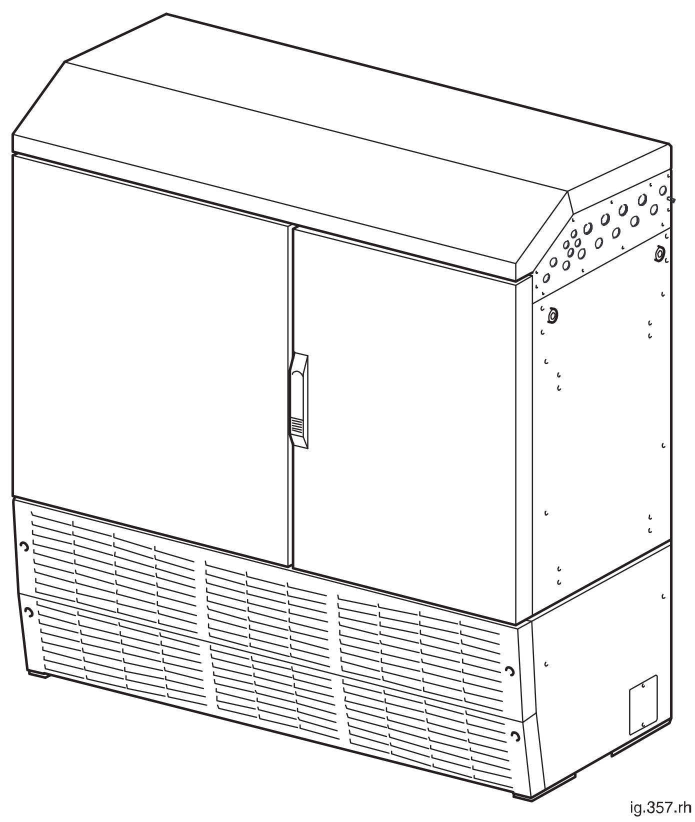

Figure 1-1 External view of the Horizon*macro* outdoor cabinet

Names and acronyms for main cabinet equipment

This section is intended to give the reader a basic understanding of how components interconnect.

The outdoor BTS cabinet consists of a top section, a centre section (containing the radio enclosure and the power supply enclosure), and a bottom section.

On the left side of the centre section is the radio enclosure, and this contains the CIBA main cage.

The main cage contains the following equipment (see Figure 1-2):

- A digital module shelf, located in the lower right side of the cabinet. This contains master and optional redundant digital modules:

  Fibre optic multiplexer (FMUX), 1 + 1 redundant (if required).

  Main Control Unit with dual FMUX (MCUF), 1 + 1 redundant (if required).

  Network Interface Units (NIUs).

  An alarm board (no redundancy option).

  One or two (for redundancy) μBCU Power Supply Modules (BPSMs).
- Up to three Power Supply Modules (PSMs) and one Circuit Breaker Module (CBM) in the upper right part of the cage. The PSMs are load sharing, with the third PSM providing optional redundancy.
- Up to six Compact Transceiver Units (CTUs), located in the left side of the cage.

The right side of the centre section is the power supply enclosure. It contains the Power Supply Unit (PSU), an alarms interface board and 6 U of standard rack space for customer specific equipment.

The PSU includes the following equipment (see Figure 1-2):

- The number 2 ac distribution box, located in the upper right side of the unit.
- A dc circuit breaker panel, located in the upper left side of the unit.
- An internal battery tray, located in the lower right side of the unit.
- Up to three of The Outdoor Power Supply Modules (TOPSMs), in the lower left side of the unit. The TOPSMs are load sharing, with the third TOPSM providing optional redundancy.
- A Control and Alarm Board (CAB).

The top section contains the following equipment (see Figure 1-2):

- RF modules, comprising transmit (Tx) blocks and a receive (Rx) module, the Sectorized Universal Receiver Front end (SURF). The various Tx blocks are listed in **Specifications** in this chapter.
- The interface panel for internal, power and alarm connectors and customer communications connectors.
- The number 1 ac distribution box.
- Krone blocks for customer defined alarms and customer communications.
- An ac outlet socket for installation and maintenance use.

The bottom section contains:

- The Thermal Management System (TMS).

Configuration information

Configuration information can be found in *Installation and Configuration: (GSM-204-423)*in this manual.

Finding information in this manual

This service manual comprises the four categories below:

- Category 323

  Provides an introduction, specification, and technical description.

- Category 423

  Provides information for installation and commissioning.

- Category 523

  Provides information on maintenance and repair, with procedures to change Field Replaceable Units (FRUs).

- Category 623

  Provides the range of options and spares, with diagrams to illustrate FRUs.

The Category 323 technical description is divided into chapters based on functionality, as shown in Figure 1-2:

- **Overview and specifications**

  This chapter provides a summary of the equipment to enable the reader to understand terminology, and thus locate information via the TOCs and index.

- **Cabinet structure**, including:

  Interface panel, main cage,power supply enclosure, doors and lid.

- **Thermal management system (TMS)**, describing:

  TMS units.

- **Cabinet power supply**, including:

  Power distribution, TOPSM, PSM, BPSM and circuit breaker module.

- **RF modules**, including:

  CTU, SURF and Tx Blocks.

- **Digital modules**, including:

  MCUF, NIU, T43/BIB connections, FMUX and alarm module.

Information regarding optional equipment is also provided:

- **Auxiliary equipment housing**.
- **Cable shroud**.

Cabinet view

Figure 1-2 shows the location of components and main headings for detailed information in this technical description category of the manual.

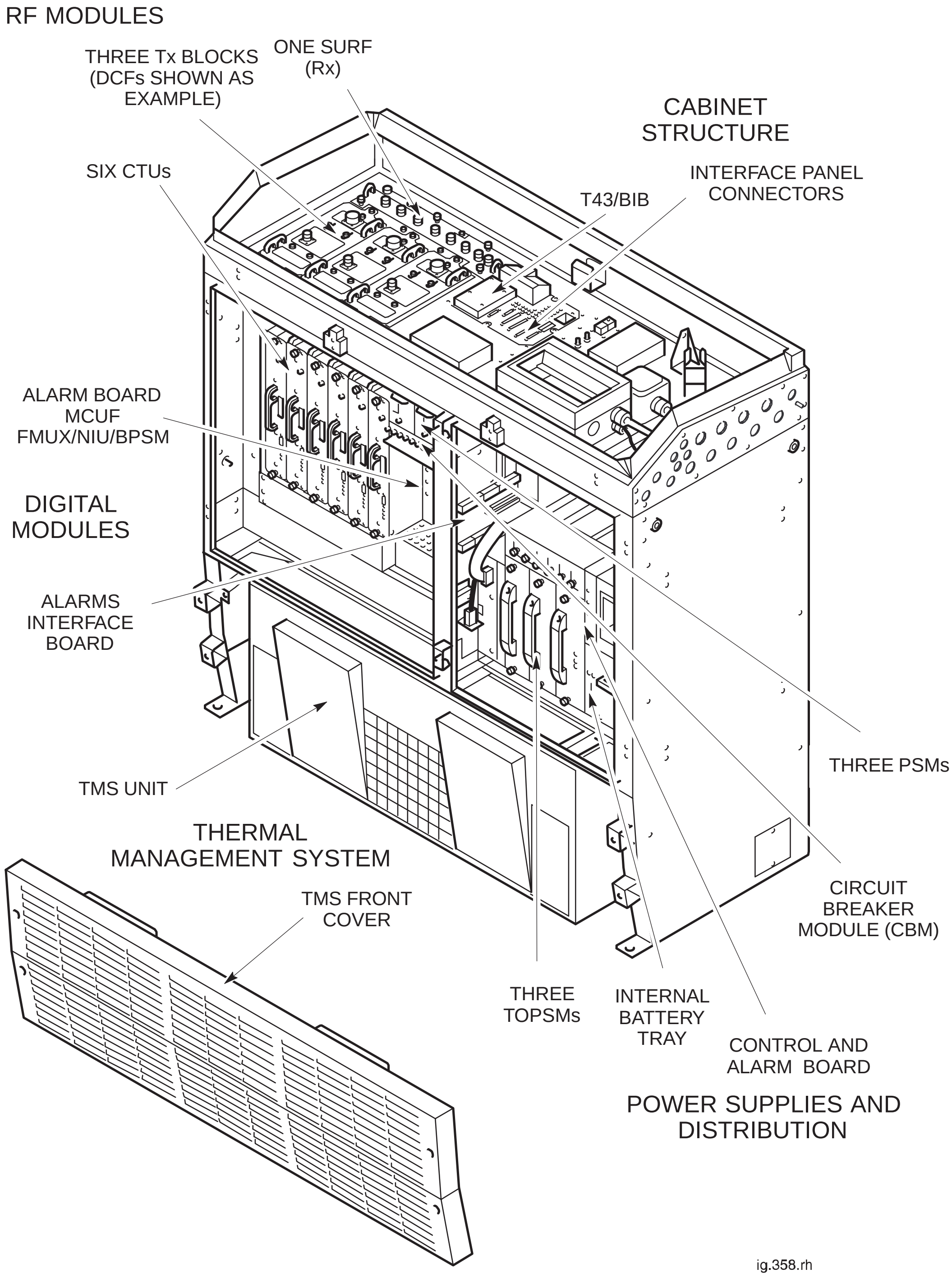

Figure 1-2 Cabinet with components identified (doors and lid removed)

Functional diagram of Horizon*macro* outdoor

Figure 1-3 shows the functional modules of a Horizon*macro*. Only one transceiver and one Tx block have been shown, and the thermal management system and power supplies are also omitted, for clarity.

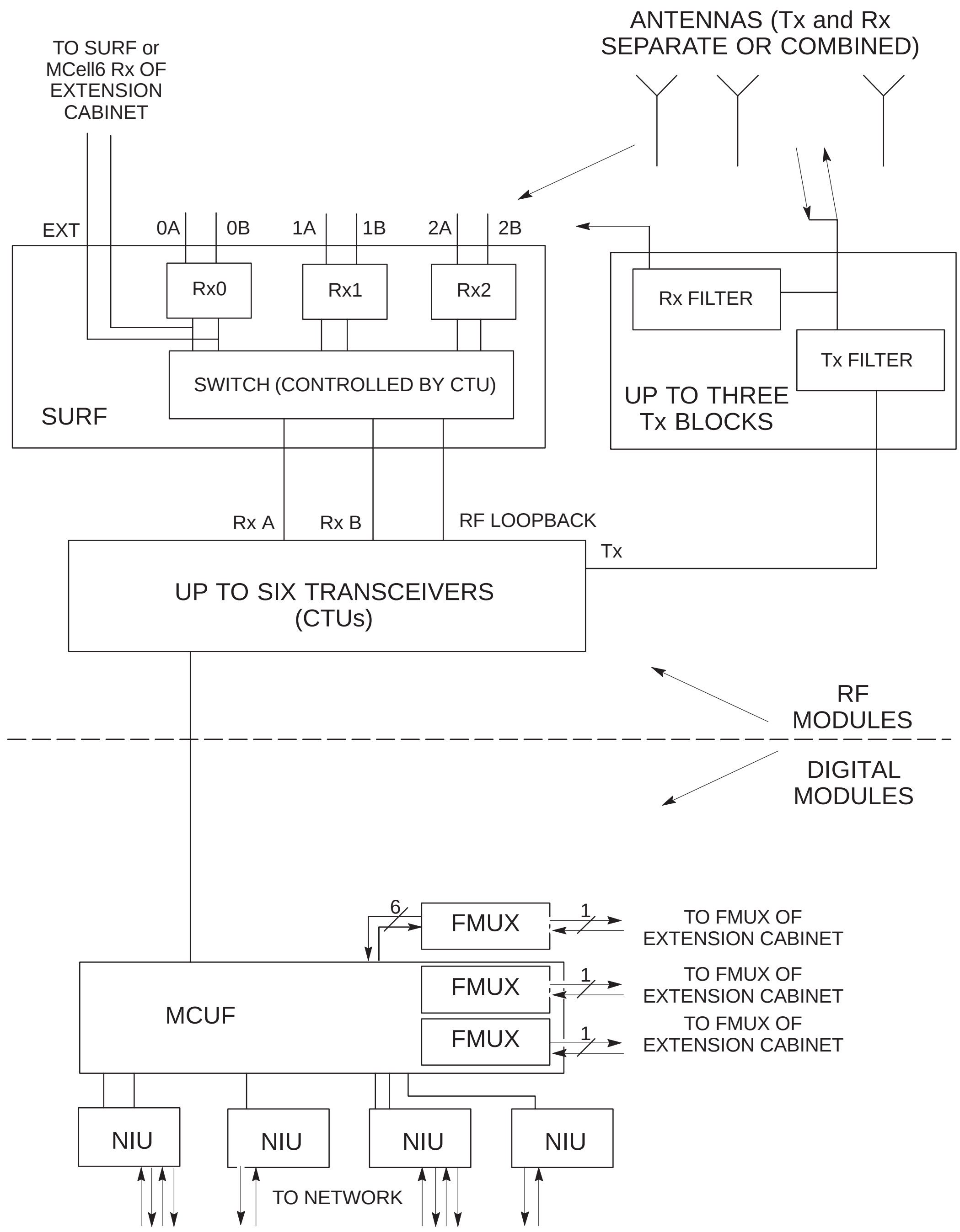

Figure 1-3 Functional diagram of cabinet components

M-Cell*6* comparison with Horizon*macro* outdoor

Comparison overview

The Horizon*macro* is a replacement for M-Cell™ *2/6* base stations, and the GSM/EGSM900 and DCS1800 Horizon*macro* outdoor variants are directly compatible with M-Cell*6*. For example, a combination of up to four Horizon*macro* and M-Cell*6* BTSs can be combined to form a single site, with either a Horizon*macro* or an M-Cell*6* being in control of the other units. Since many customers are familiar with M-Cell*6* and will use Horizon*macro* with M-Cell*6*, equivalent components are described in this section to assist understanding.

The Horizon*macro* outdoor BTS cabinet uses reduced size and higher reliability components. Horizon*macro* outdoor sites can also have auxiliary equipment housings installed to enable extended battery backup equipment to be fitted.

Horizon*macro* and M-Cell*6* compatibility

A 24-carrier BTS site (in an 8/8/8 configuration) can be achieved by combining four units as shown in Figure 1-4. This is the maximum BTS size. Each unit can be either a Horizon*macro* or an M-Cell*6*. Either a Horizon*macro* or an M-Cell*6* can control the other three units; the MCU of M-Cell*6* and the MCUF of Horizon*macro* having identical control functions.

An MCUF can be fitted into an M-Cell*6* and will then function as an MCU. However, an MCU cannot be fitted into a Horizon*macro*. Figure 1-4 shows a schematic diagram of the digital connectons in a four cabinet BTS site.

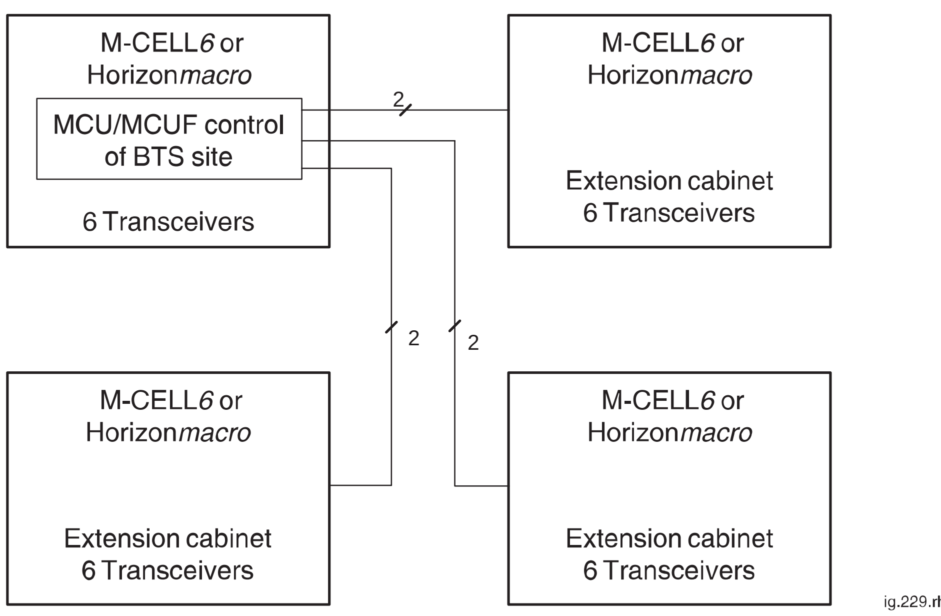

Figure 1-4 Digital connections in maximum BTS site

Comparison of Horizon*macro* and M-Cell*6* connections and modules

Table 1-1 compares the main components of the Horizon*macro* outdoor with equivalent components of M-Cell*6* (the previous generation of equipment).

Table 1-1 Main components of Horizon*macro* compared with M-Cell*6*

Function	Horizon*macro* component	M-Cell*6* equivalent
Power supply modules (ac to dc)	TOPSM	APSM
Input power conversion units (dc to dc)	PSM	PSM (different)
Power to radios and BPSM	Backplane	Cables
Transceiver	CTU	TCU/TCU-B
Main processor board (formerly GPROC, KSW and GCLK boards in BTS4/5/6 (pre–M-Cell) equipment)	MCUF	MCU
Connection radio to MCU	Backplane	FOX
Connection MCU to transceivers in another cabinet	MCUF internal FMUX (two) or external FMUX (one)	FMUX
Rx components and distribution	SURF	DNLB and IADU
Radio to Rx components	SURF Harness	Cables
Tx components	DCF, TDF, DDF, and HCU	CBF, MPDM, HPDM and HC
Links to terrestrial network	NIU	NIU
E1/T1 links	T43/BIB	T43/BIB
Power for digital boards	BPSM	BPSM

Specifications

Introduction to specifications

All Horizon*macro* outdoor specifications, including frequency band characteristics, are included in this section.

Software requirements

The GSM/EGSM900 and DCS1800 BTSs require software release GSR4 (or later) in the network.

The GSM850 and PCS1900 BTSs require software release GSR5.1 (or later) in the network.

Approval and safety

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

Table 1-2 Specification compliance

	GSM/EGSM900 & DCS1800	GSM850 & PCS1900
Type approval	EN 301 502	EN 301 502
		CFR47 Parts 2, 22 and 24
EMC	EN 301 489–8	EN 301 489–8
		CFR Parts 2, 15, 22 and 24
Safety	EN 60950, IEC 950, EN 60215, IEC 215, CSA 22.2 No. 950, UL1950	EN 60950, IEC 950, EN 60215, IEC 215, CSA 22.2 No. 950, UL1950

The Horizon*macro* outdoor is designed to comply with BS7671 (16th edition).

Environmental limits

Table 1-3 lists the operating and storage environmental limits.

Table 1-3 Environmental limits

Environment	Temperature	Relative Humidity
Operating	–40 °C to +50 °C plus a solar gain of 1.2 kW/m^2	5% to 100% relative humidity, not to exceed 30 g water / m^3 air.
Storage	–45 °C to +70 °C	8% to 100% relative humidity, not to exceed 30 g water / m^3 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 input power supply requirements

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

Table 1-4 Main outdoor cabinet power requirements

Nominal voltage	Supply voltage and frequency range	Current supply maximum
110 V ac single phase	88 to 134 V ac at 45 to 66 Hz	54.4 A (at nominal voltage)
230 V ac single phase	176 to 265 V ac at 45 to 66 Hz	26.1 A (at nominal voltage)
230 V ac three phase and neutral (star)	176 to 265 V ac at 45 to 66 Hz	26.1 A (at nominal voltage)
230 V ac three phase without neutral (delta)	176 to 265 V ac at 45 to 66 Hz	26.1 A (at nominal voltage)

Power consumption (dc and ac)

Table 1-5 lists typical and maximum power consuption values.

Table 1-5 Power consumption of full cabinet, including digital redundancy and external battery charging

Typical measured consumption	Maximum power consumption
2200 W	5600 W

NOTE	Maximum power consumption figures are theoretical values derived under extreme conditions and are affected by variables such as temperature, component tolerances, transmission power and supply voltage. Although these figures must be considered when planning site power requirements, typical measured consumption values will be lower.

Maximum thermal dissipation

Thermal dissipation has to remove the energy of maximum power consumption, less RF power output of the six transceivers.

Maximum power consumption:	5600 W.
Six CTUs at full power at DCF Tx blocks:	
1800 MHz:	(6 x 16 = 96) approx. 100 W.
900 MHz:	(6 x 20 = 120) 120 W.
Maximum thermal dissipation 1800 MHz:	5600 – 100 = 5500 W.
Maximum thermal dissipation 900 MHz:	5600 – 120 = 5480 W.

NOTE	Thermal dissipation figures are not currently available for when 850 MHz or 1900 MHz CTUs are used.

RF power output

Table 1-6 lists the RF power output of the CTU types.

Table 1-6 RF power output at CTU Tx connector

GSM850 and EGSM900	DCS1800 and PCS 1900
60 W (47.8 dBm) +/–1.0 dBm	50 W (47.0 dBm) +/– 1.0 dBm

Table 1-7 lists the expected power output from the various Tx blocks for both types of CTU.

Table 1-7 RF power output at cabinet after Tx blocks

Tx block	GSM850	EGSM900	DCS1800	PCS1900
TDF	40 W (46.0 dBm)		32 W (45.1 dBm)	
DCF	20 W (43.0 dBm)		16 W (42.1 dBm)	
DDF	8.5 W (39.3 dBm)		7 W (38.5 dBm)	

Sensitivity

The receive sensitivity of the equipment is shown in Table 1-8.

Table 1-8 Rx sensitivity *

Frequency Band	Without Duplexer	With Duplexer
850 MHz	–107 dBm	–106 dBm
900 MHz	–107 dBm	–106 dBm
1800 MHz	–108.5 dBm	–107.5 dBm
1900 MHz	–107 dBm	–106 dBm

* Guaranteed over all channel types, fading profiles, RF frequencies and operating conditions.

Battery backup

The Horizon*macro* outdoor cabinet is fitted with minimal battery backup (sufficient to send a low voltage disconnect imminent alarm). Optional additional battery backup capacity is provided by installation of an optional auxiliary equipment housing.

Table 1-9 lists the capacity and the typical duration of the various battery backup options.

Table 1-9 Backup power specifications

Location	Capacity	Typical power duration
Internal batteries	15 Ah	5 to 15 minutes
External batteries	200 Ah	Up to 8 hours

BSC connectivity options

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

Outdoor cabinet dimensions

The dimensions of the outdoor cabinets are shown in Table 1-10.

Table 1-10 Cabinet dimensions

Cabinet type	Height	Width	Depth
Horizon*macro* outdoor cabinet	1364 mm	1300 mm	594 mm
Auxiliary equipment housing (AEH)	1364 mm	604 mm	594 mm

Weights

The weights of cabinets are shown in Table 1-11.

Table 1-11 Outdoor cabinet weights

BTS cabinet with six transceivers	Auxiliary equipment housing empty / 16 batteries fitted
360 kg	110 kg / 500 kg

NOTE	Consider future expansion. The foundation or structure on which the BTS cabinet is mounted must be of sufficient strength to support a maximum gross weight of 360 kg for each BTS cabinet and 500 kg for each AEH.

Torque values

The torque values for Horizon*macro* outdoor are listed in Table 1-12.

Table 1-12 Torque values for all cabinet screws/bolts and RF connectors

Size of screw/bolt	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	Torque values used with M12 anchor bolts will depend on the anchor bolt manufacturer. Check manufacturer’s data for correct values.

Cabinets enhancements

External cabinet colours

The external cabinets are finished in one of the following colours:

- Standard dark grey.
- M-Cell match.
- Dark brown.
- Green.
- Brick red.

Frequency capability

Frequency hopping

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

NOTE	Baseband frequency hopping is not supported in the GSM850 and PCS1900 Horizon*macro* outdoor variants.

Frequency band characteristics

BTS radio channels (RF carriers) are full duplex (transmit and receive) with the characteristics listed in Table 1-13 for GSM/EGSM900 and DCS1800 BTSs and in Table 1-14 for GSM850 and PCS1900 BTSs.

Table 1-13 Frequency band characteristics – GSM/EGSM900 and DCS1800

	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

Table 1-14 Frequency band characteristics – GSM850 and PCS1900

	GSM850	**PCS1900**
Transmit frequency band (MHz)	869 to 894	1930 to 1990
Receive frequency band (MHz)	824 to 849	1850 to 1910
Transmit/receive duplex separation (MHz)	45	80
Channel width (kHz)	200	200
Number of channels	124	299
Transmit frequency guard bands (MHz)	869.0 to 869.1 893.9 to 894.0	1930.0 to 1930.1 1989.9 to 1990.0
Receive frequency guard bands (MHz)	824.0 to 824.1 848.9 to 849.0	1850.0 to 1850.1 1909.9 to 1910.0
Transmit channel centre frequency (MHz)	Even 10ths of a MHz from 869.2 to 893.8	Even 10ths of a MHz from 1930.2 to 1989.8
Receive channel centre frequency (MHz)	Even 10ths of a MHz from 824.2 to 848.8	Even 10ths of a MHz from 1850.2 to 1909.8

Structural considerations

There must be adequate clearance at the front of (648 mm), and above (1900 mm), the equipment for operation and maintenance purposes. It is also recommended that there is adequate side clearance to open the doors to 120° (see Figure 1-5), and to fit the optional shroud on the cable entry side.

The foundation or structure on which the BTS cabinet is mounted must be of sufficient strength to withstand 105 knot (120 mph) winds on the cabinet front or rear and a maximum gross weight of 360 kgs.

The cabinet ventilation entry and exhaust is solely from the bottom front of the cabinet, allowing a cabinet to be placed against a wall. However, a minimum clearance of 240 mm is required on the cable entry side, between the cabinet and obstructions, such as a wall or another cabinet.

Allow 1000 mm clearance at front and side where possible, to facilitate installation and maintenance.

NOTE	In seismically active areas, Motorola suggest using a qualified structural engineer to assess frame mounting requirements, such as floor construction, mounting anchors and cell site construction.

Outdoor site dimensions

Basic outdoor site

Figure 1-5 shows the site layout plan for a single cabinet with dimensions and required clearances (optional auxiliary equipment housing not shown).

NOTE	Allow 180 mm additional side clearance if a cable shroud is to be fitted.

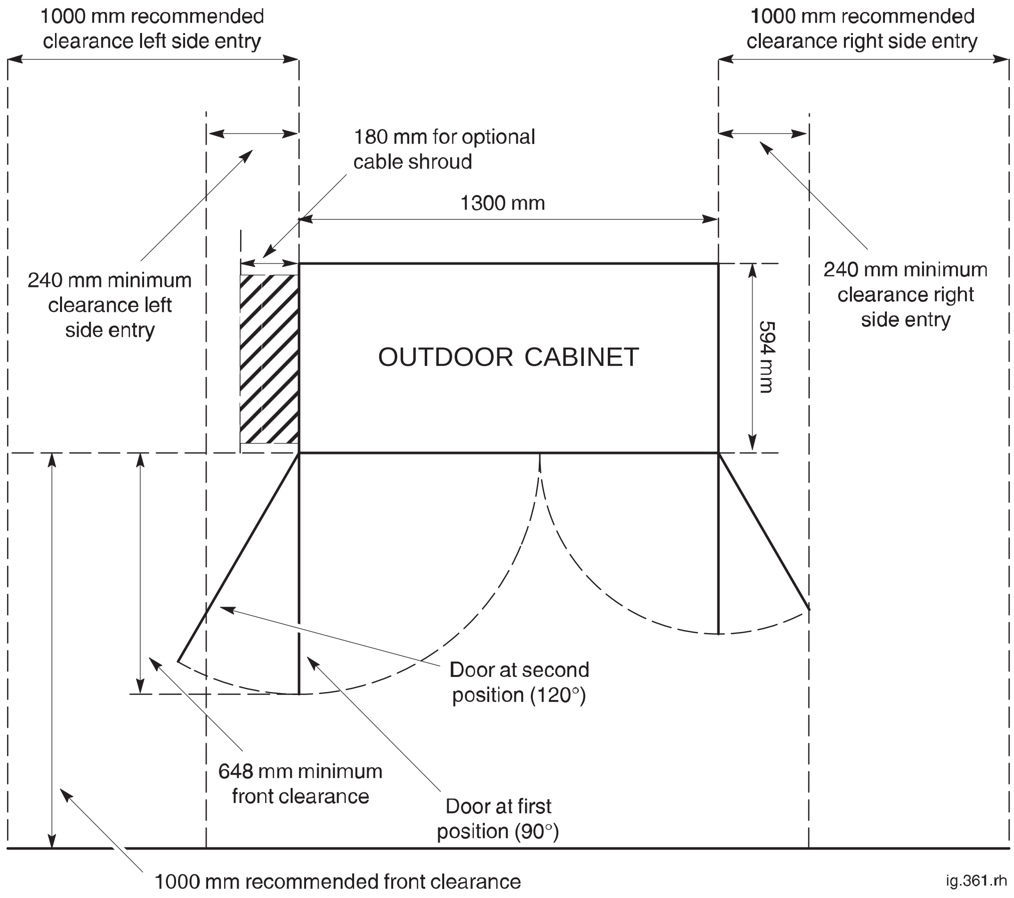

Figure 1-5 Outdoor cabinet site layout plan view (cable entry on left side)

Outdoor site with auxiliary equipment housing

Figure 1-6 shows the site layout plan for a single cabinet and optional auxiliary equipment housing with dimensions and required clearances.

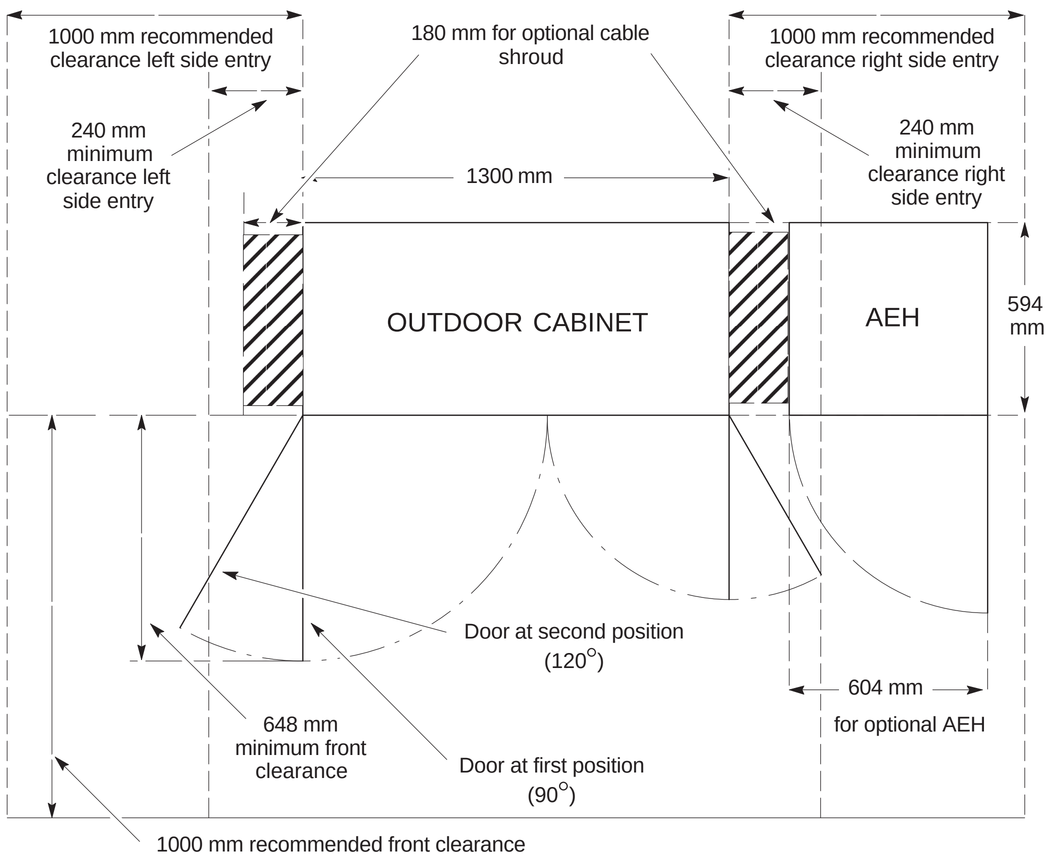

Figure 1-6 Outdoor cabinet site layout plan view (including optional equipment)

View of maximum site template layout

Figure 1-7 shows a plan view of the template layout for the maximum site configuration. Using the dimensions and clearances shown, the site layout for any combination of BTS cabinets and auxiliary equipment housings can be calculated.

NOTE	If a steel structure is to be used instead of a concrete base, the dimensions shown in Figure 2-3 can be used to determine the location of the mounting bolt holes. Figure 1-7 only shows template and mounting hole dimensions and clearances, cabinet dimensions are slightly larger.

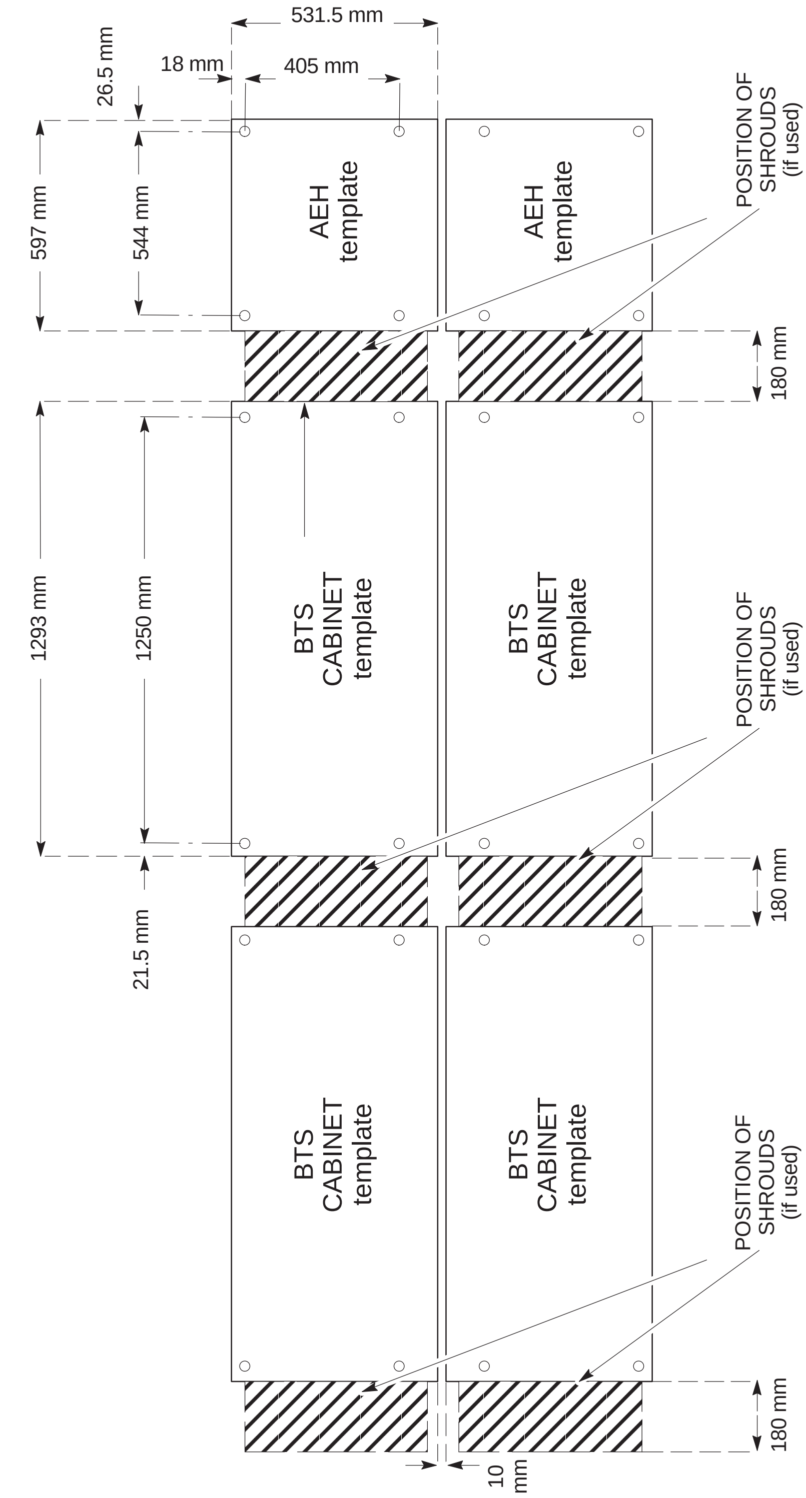

Figure 1-7 Plan view of template layout for maximum site configuration

MOTOROLA

Chapter 2

Cabinet structure

Chapter 2
Cabinet structure i

Outdoor cabinet structure

External cabinet view

Figure 2-1 shows an external view of a closed outdoor cabinet, and the cabinet with doors and lid open, (right door omitted for clarity).

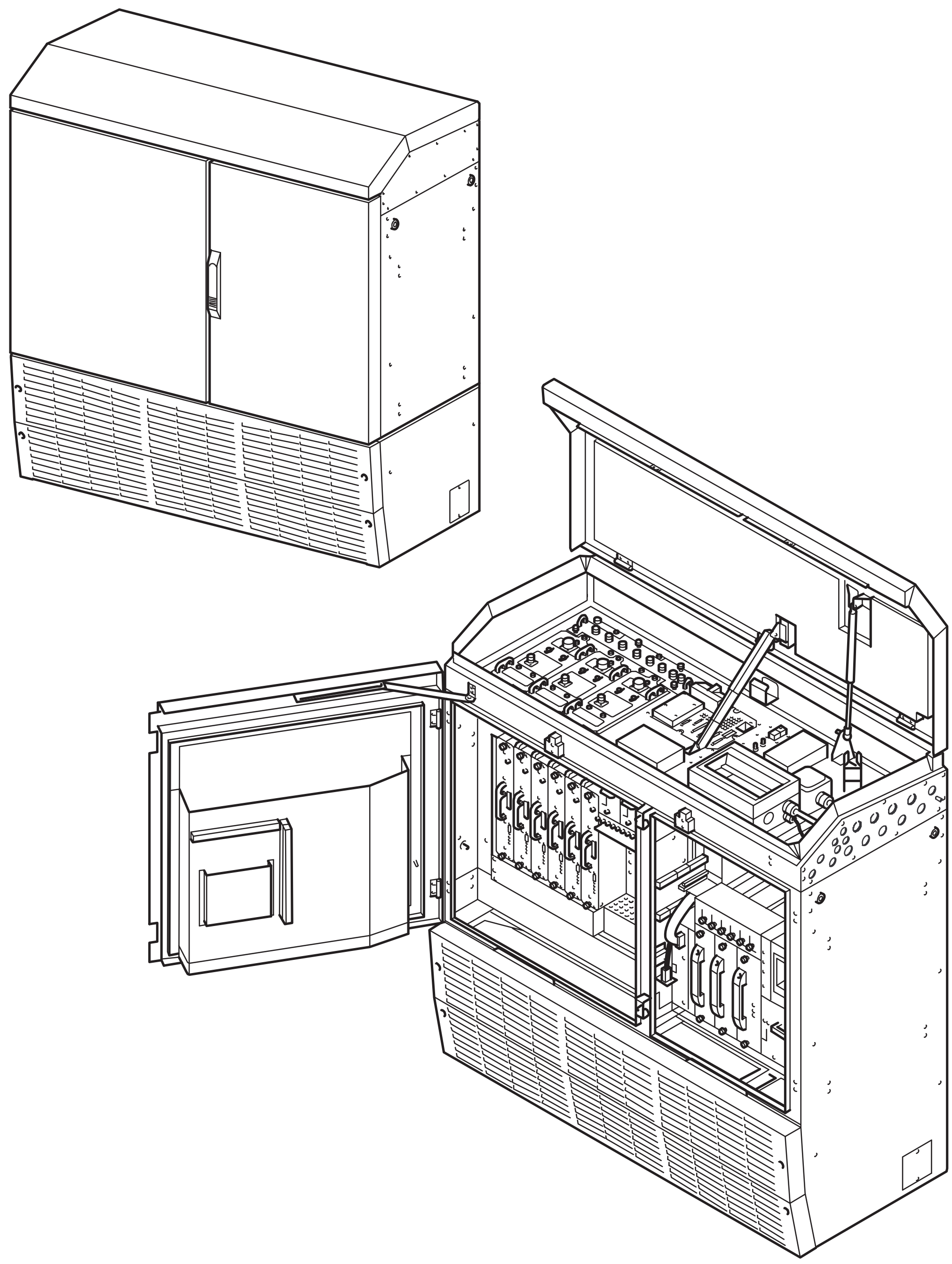

Figure 2-1 Closed cabinet and cabinet with lid and doors open

Overview of structure description

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

This chapter describes the cabinet structure and the inner connections to assist understanding 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:

SURF harness

This section describes the SURF harness connections between the SURF and the backplane and transceivers. These are not normally visible in a fully equipped cabinet.

Top section

This section describes the top section holding the Tx blocks, the interface panel, the SURF module, the number 1 ac distribution box and an ac outlet socket.

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. These are not normally accessible in a fully equipped cabinet.

Power supply enclosure

This section shows the location of the Power Supply Unit (PSU) and the racking for customer equipment.

Doors, lid and cable shrouds

This section describes the structure and function of the doors, lid and cable shrouds.

Space required around cabinet

See **Specifications** in Chapter 1.

Filled cabinet view

Figure 2-2 shows a front view of the outdoor cabinet with the maximum number of modules installed, The main components visible from the front are identified. The doors and TMS front cover have been omitted for clarity.

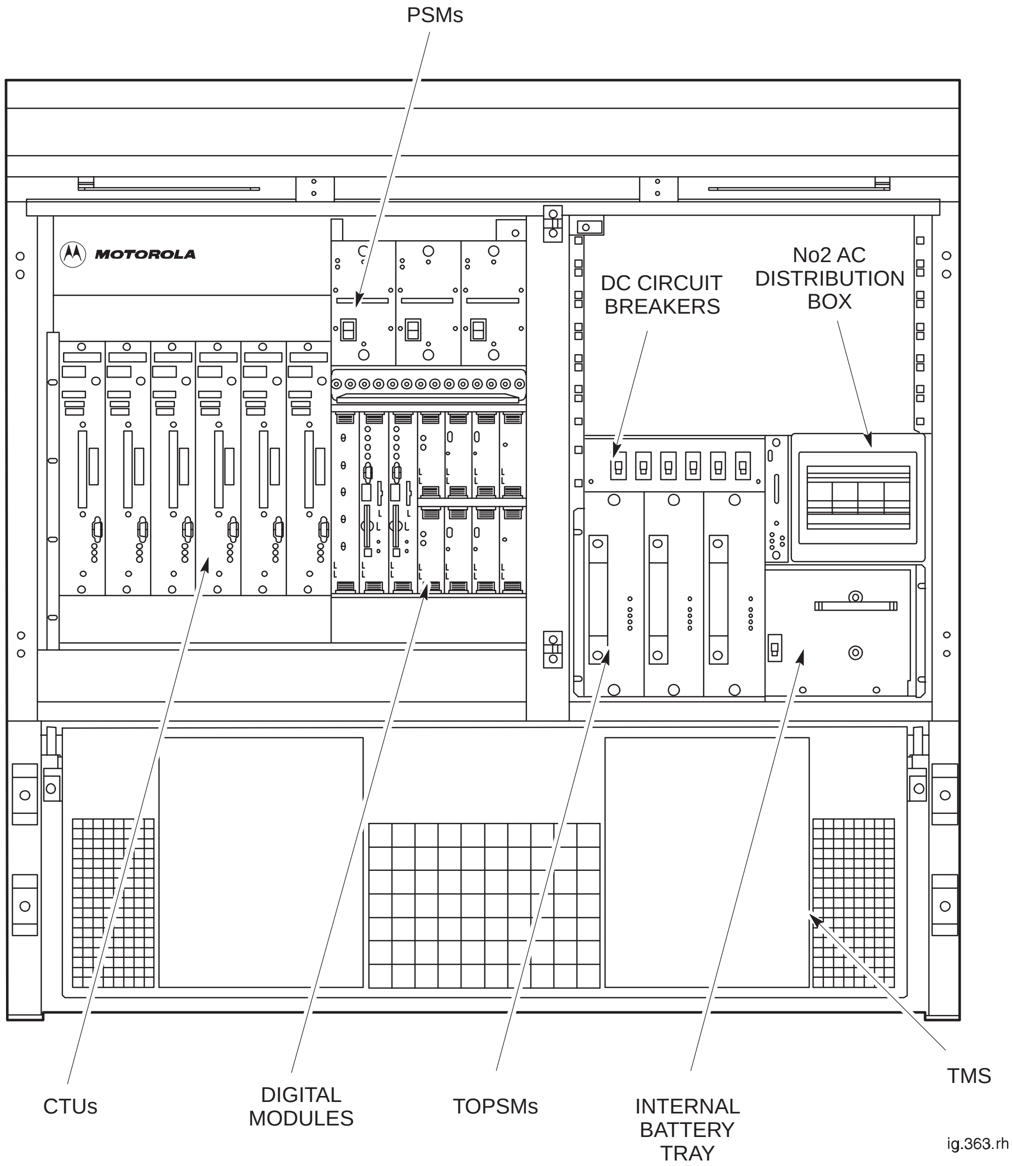

Figure 2-2 Horizon*macro* outdoor cabinet showing main components

SURF harness

SURF harness detail

The SURF harness is fitted on the back wall of the cabinet. The chassis of the harness supports the SURF module.

The SURF harness provides:

- Three connectors to the SURF, for RF and power.
- One RF connector to each CTU, consisting of three inputs, one each for RxA, RxB and RF loopback test, as shown in Figure 2-4. The RF connectors are free floating to ensure fitting of CTU modules.
- One connector to the backplane, for power from the PSMs.

Cabinet view with installed SURF harness

Figure 2-3 shows the SURF harness installed in an empty cabinet. The SURF harness cables have been omitted for clarity.

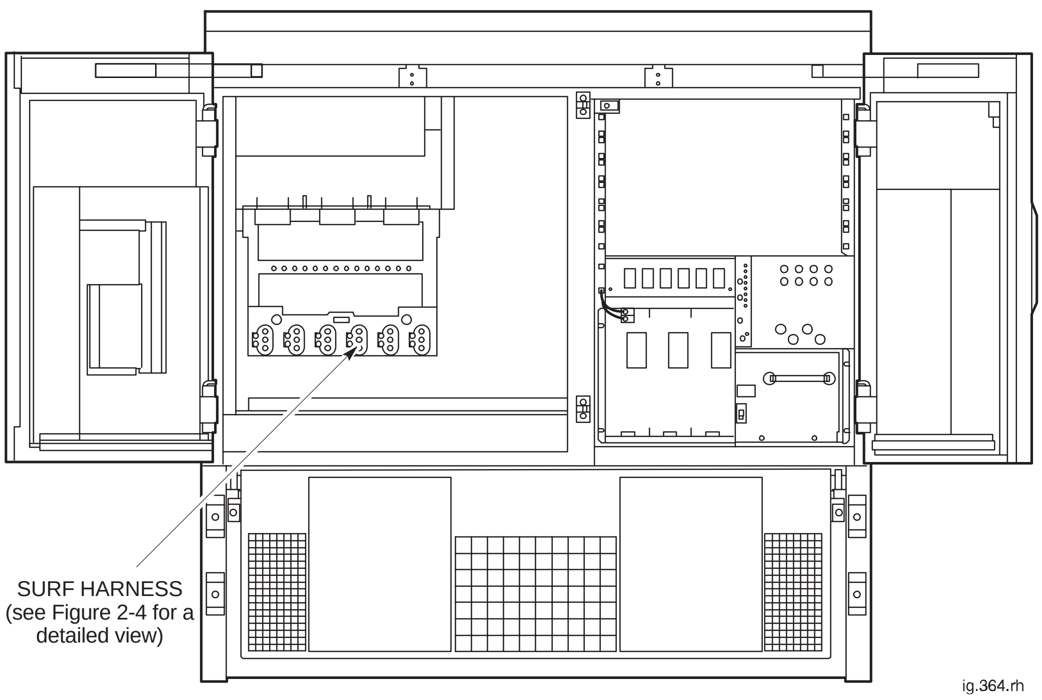

Figure 2-3 Location of the SURF harness in the cabinet

SURF harness view

Figure 2-4 shows the SURF harness with connectors indicated.

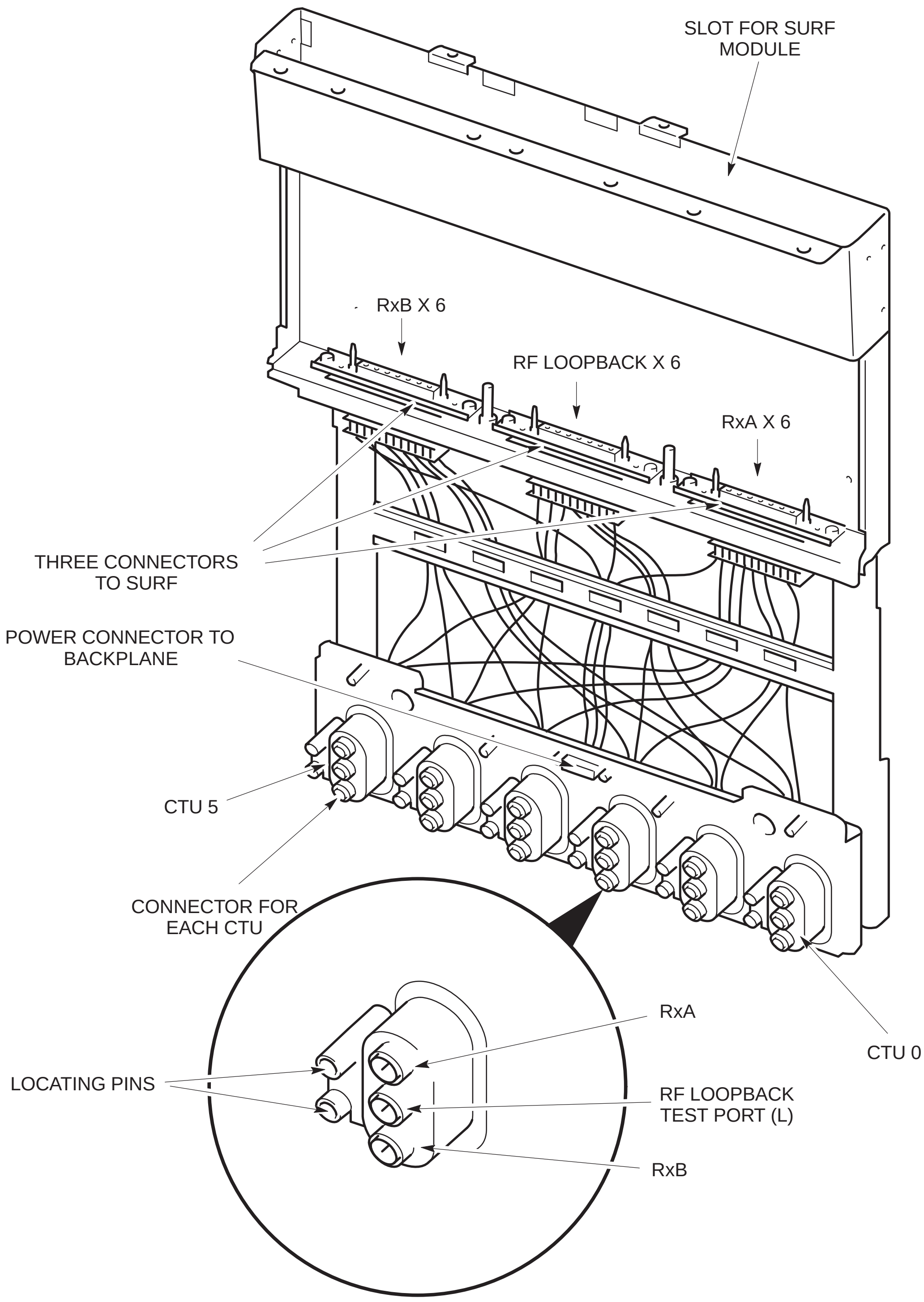

Figure 2-4 SURF harness with connectors indicated

Top section

Top section description

The top section provides:

- A basket to hold up to three Tx blocks. This includes three holes to enable connection of CTU Tx cables to the underside of each Tx block. The holes also allow cooling of the Tx blocks from underneath.
- A slot for insertion of the SURF module.
- A location hole for the interface panel. The interface panel is positioned into the top section from underneath and fixed from the top.
- Cable holes for fibre optic extension cables (from the MCUF FMUX to an FMUX of another cabinet), and alarm cables.
- Earth plates fitted to the ends of the top wrap. The earth plate contains the RF cabling, which allows the connection of external antennas to internal RF cabling, at the cable entry side. A blank plate or expansion plate is fitted at the opposite end of the top wrap.
- A panel for the power supply unit dc output and external battery cables.
- A location hole for the number 1 ac distribution box (the power supply input connection and switching). The number 1 ac distribution box slots into the top section from underneath.
- The top section also houses krone blocks and an ac outlet socket.

Top section diagram

Figure 2-5 shows the top section with the major features labelled.

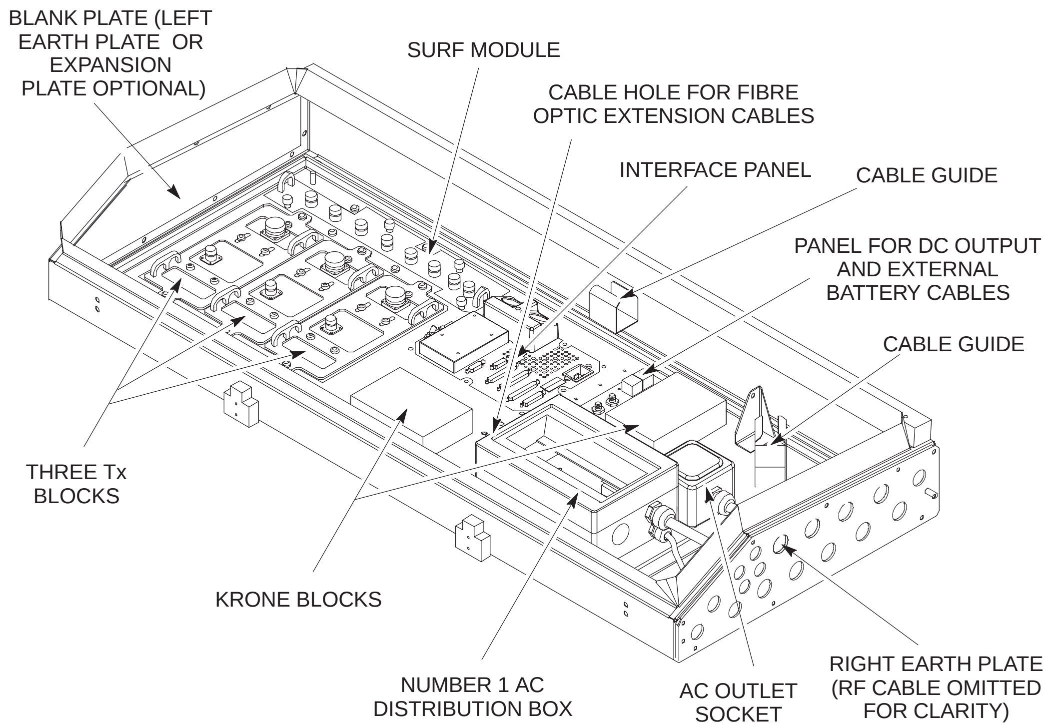

Figure 2-5 Top section with major features labelled

Krone blocks

Two krone blocks are mounted on the top panel as an interface for:

- Customer alarms.
- Customer communications.

AC outlet socket

The ac outlet socket is described in **Power distribution** in Chapter 4 of this category *Technical Description: (GSM-204-323)*

Earth plates

An earth/connector plate is fitted to the cable entry side of the cabinet. The earth plate is supplied with:

- Three N-type to 7/16 bulkhead cables, (for connection between earth plate and SURF module).
- Three 7/16 to 7/16 bulkhead cables, (for connection between earth plate and Tx block ANT connector).
- Provision to fit up to three extra long RF cables, (for connection between cabinets in multiple cabinet site configurations).
  – Rx0B, Rx1B and Rx2B on the right side plate.
  – Rx0A, Rx 1A and Rx2A on the left side plate.

The cabinet earth plate has the following functions:

- Provision of the main cabinet earth connection.
- Provision of a connection point for customer antennas.
- Weatherproof pass-through for: ac power, external battery and customer communications cables.

Figure 2-6 shows the layout of the right earth/connector plate viewed from inside the top section (the layout for the left plate is a mirror image of this). The six permanently connected RF cables are omitted for clarity.

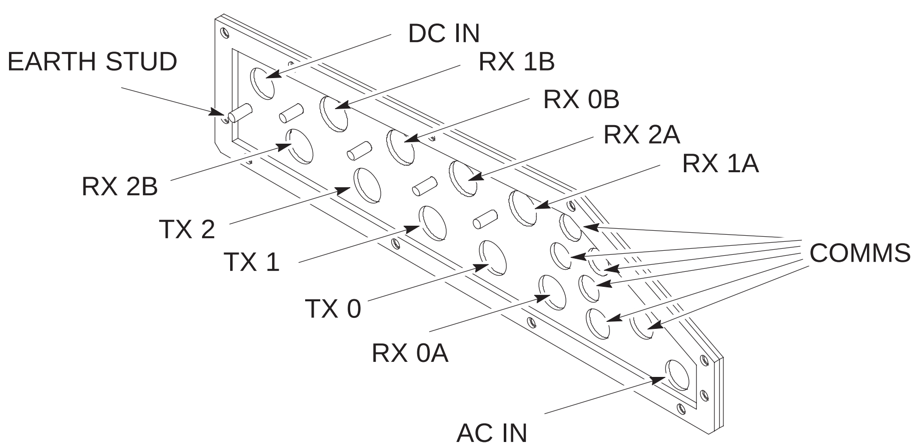

Figure 2-6 Cable entry side earth plate

Blank and expansion plates

A blank or expansion plate is fitted to the opposite end of the cabinet. The expansion plate provides:

- Weatherproof pass-through for: ac power, external battery and customer communications cables.
- RF cable pass-through for multiple cabinet sites.

The expansion plate is supplied with the cable pass-throughs sealed by blanking plugs. The plug must be removed from each pass-through before the it can be used.

Figure 2-7 shows a right side expansion plate, (left side expansion plate is a mirror image of right side plate).

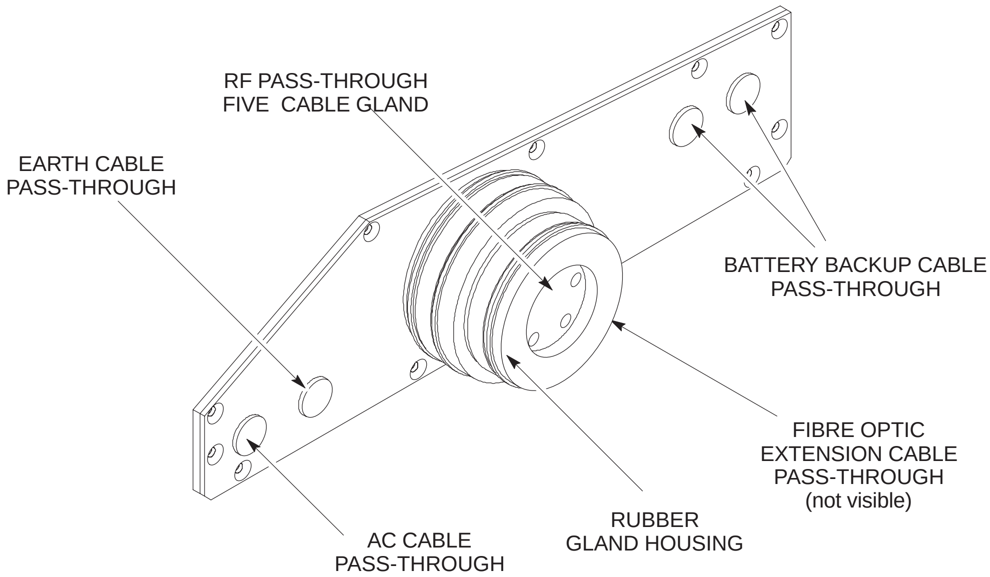

Figure 2-7 Expansion plate (right side)

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 – provides compartments for fans, CTUs, digital modules, BPSMs, PSMs and CBM.
- The backplane – routes power and signals for all cage modules and power to the SURF.
- The harness – links the backplane to the interface panel.
- The interface panel – carries the T43/BIB, the internal dc power and communications connectors.

CBIA and interface panel schematic view

Figure 2-8 shows the CBIA main cage and interface panel.

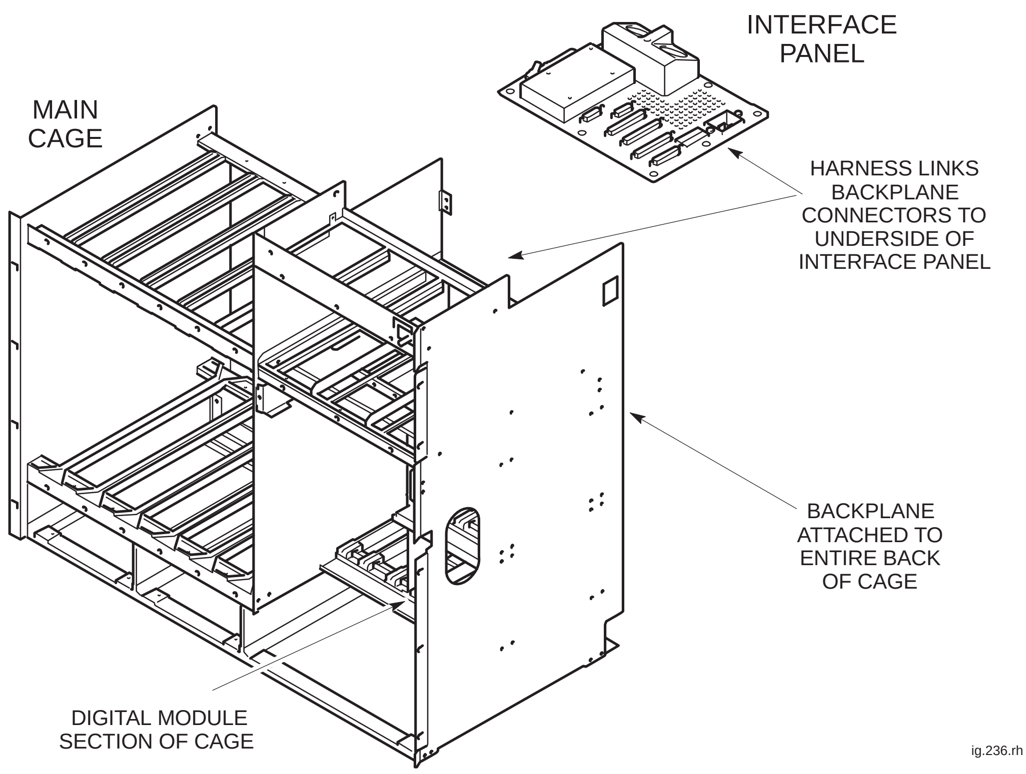

Figure 2-8 View of CBIA cage and interface panel

Backplane and harness view

Figure 2-9 shows the CBIA harness linking the interface panel and the backplane at the rear of the main cage, including the temperature sensors. Each backplane harness connector is identified.

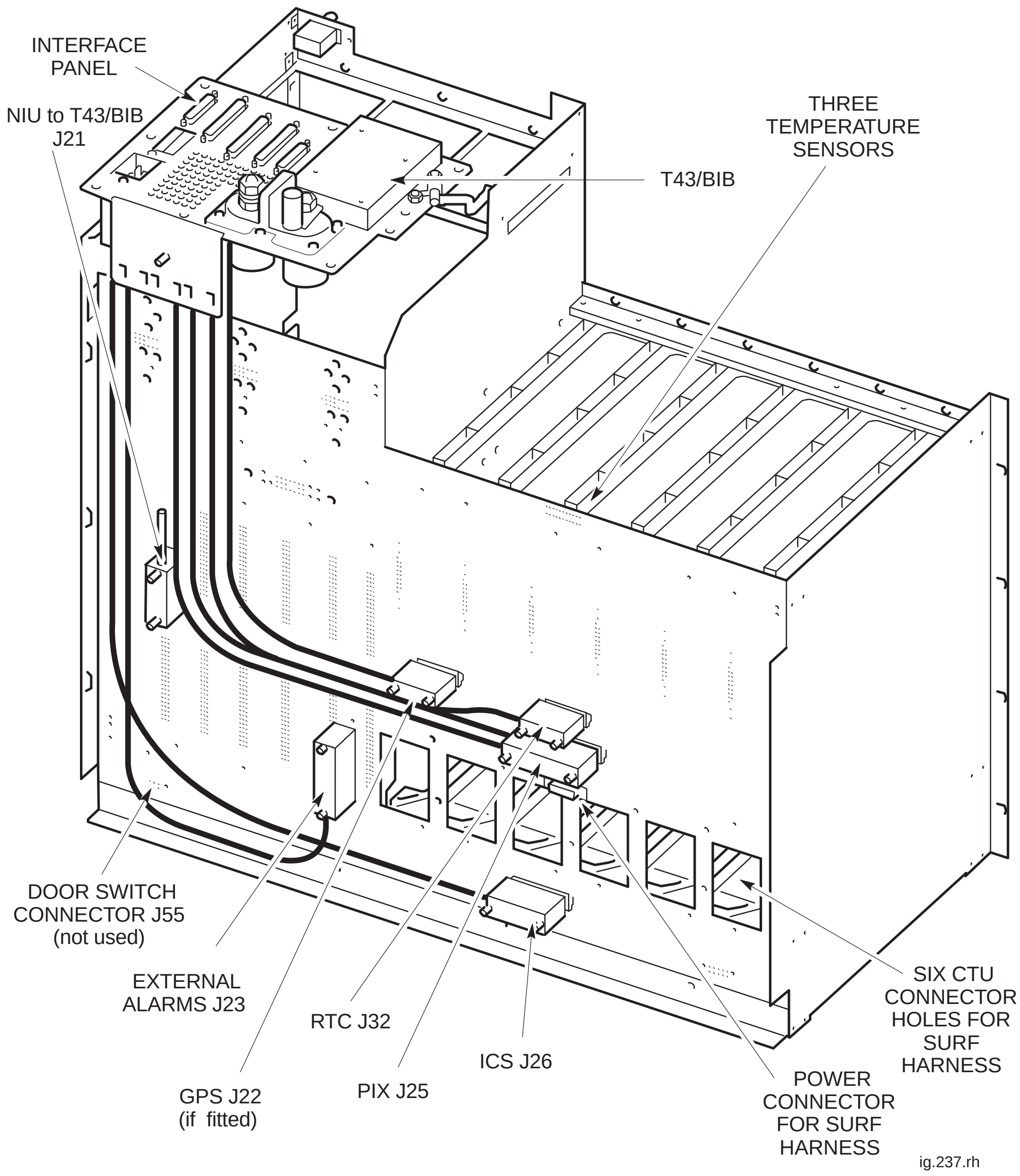

Figure 2-9 Rear view of cage showing backplane and harness

CBIA cage function and diagram

The main cage holds modules and supports the backplane. Each compartment has appropriate sliders for insertion of the modules. Figure 2-10 shows the module compartments of the cage.

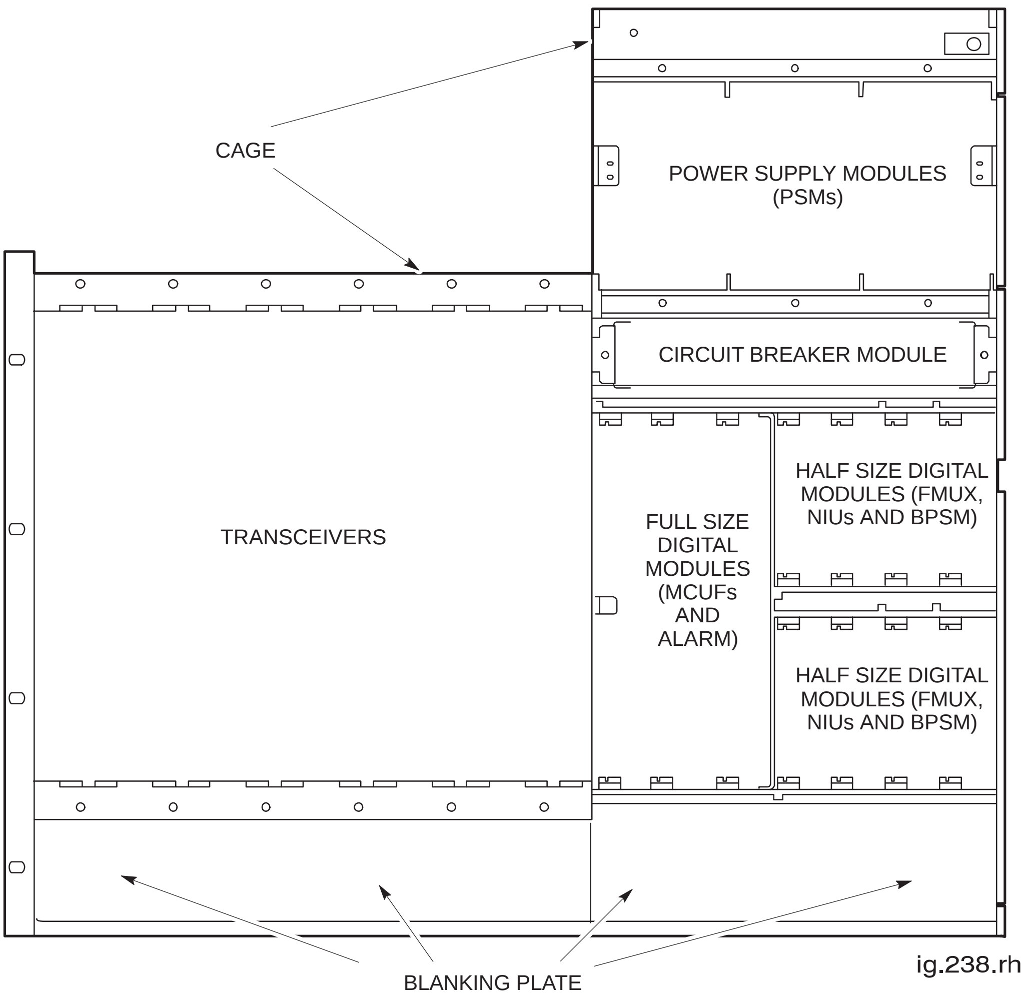

Figure 2-10 Front view of cage showing where modules fit

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

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 within the radio enclosure are the Tx cables from the transceivers to the Tx blocks.

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 SURF harness, when the main cage is inserted into the cabinet.
- Provides a connector for the door switch cable.
- Provides connectors for three heat sensors in the main cage above the CTUs.
- Provides a connection (Fan 0) for the TMS fan fail alarm cable.

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.

CBIA interface panel

Interface panel function

The interface panel provides internal connection points to:

- The power supply unit dc output.
- PSU and TMS alarms.
- Connection points to all telecommunications links.

All connectors are linked to the backplane through the CBIA harness. Plastic connector covers (supplied by Motorola) protect unused connectors from damage by static electricity or foreign matter.

Interface panel diagram

Figure 2-11 shows the functions of the interface panel connectors.

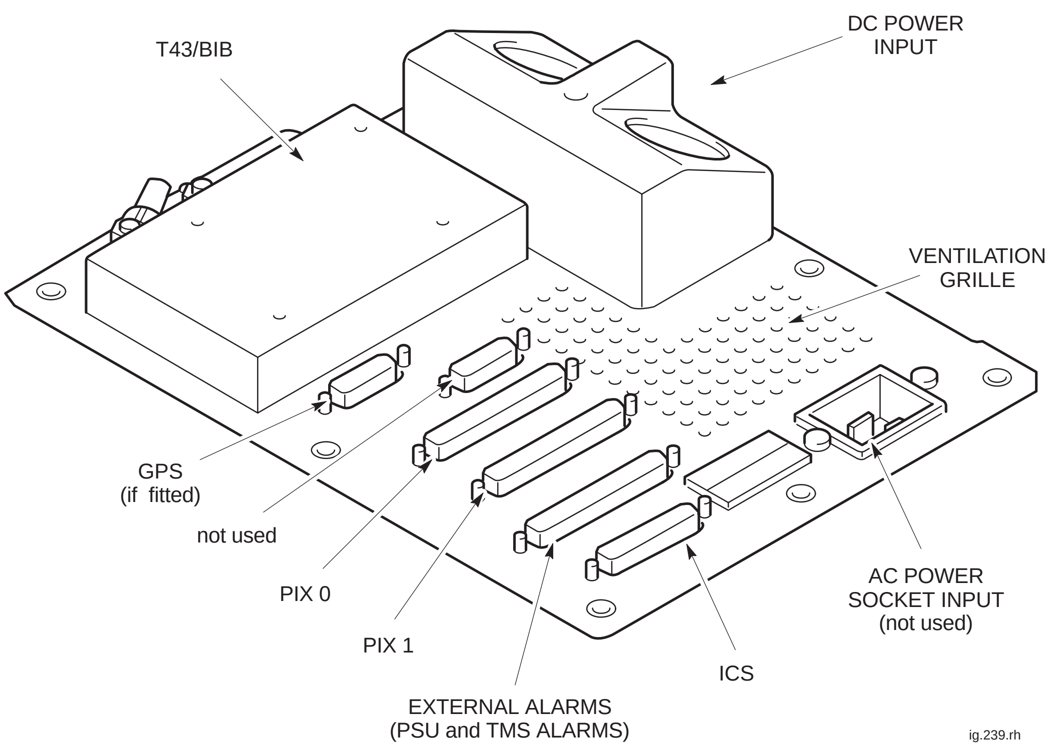

Figure 2-11 Layout of the interface panel

Interface panel pinouts

Interface panel pinouts are detailed in *Installation and Configuration: (GSM-204-423)* **Interface panel cabling**

Power supply enclosure

Power supply enclosure overview

The power supply enclosure contains:

- The Power Supply Unit (PSU), complete with up to three TOPSMs.
- An alarm interface board to connect PSU and TMS alarms.
- The door open alarm microswitch, located in the upper left corner.
- Six U height of standard 19 inch rack space for customer equipment.

View of power supply enclosure

Figure 2-12 shows an isometric and a front view of the power supply enclosure of the cabinet.

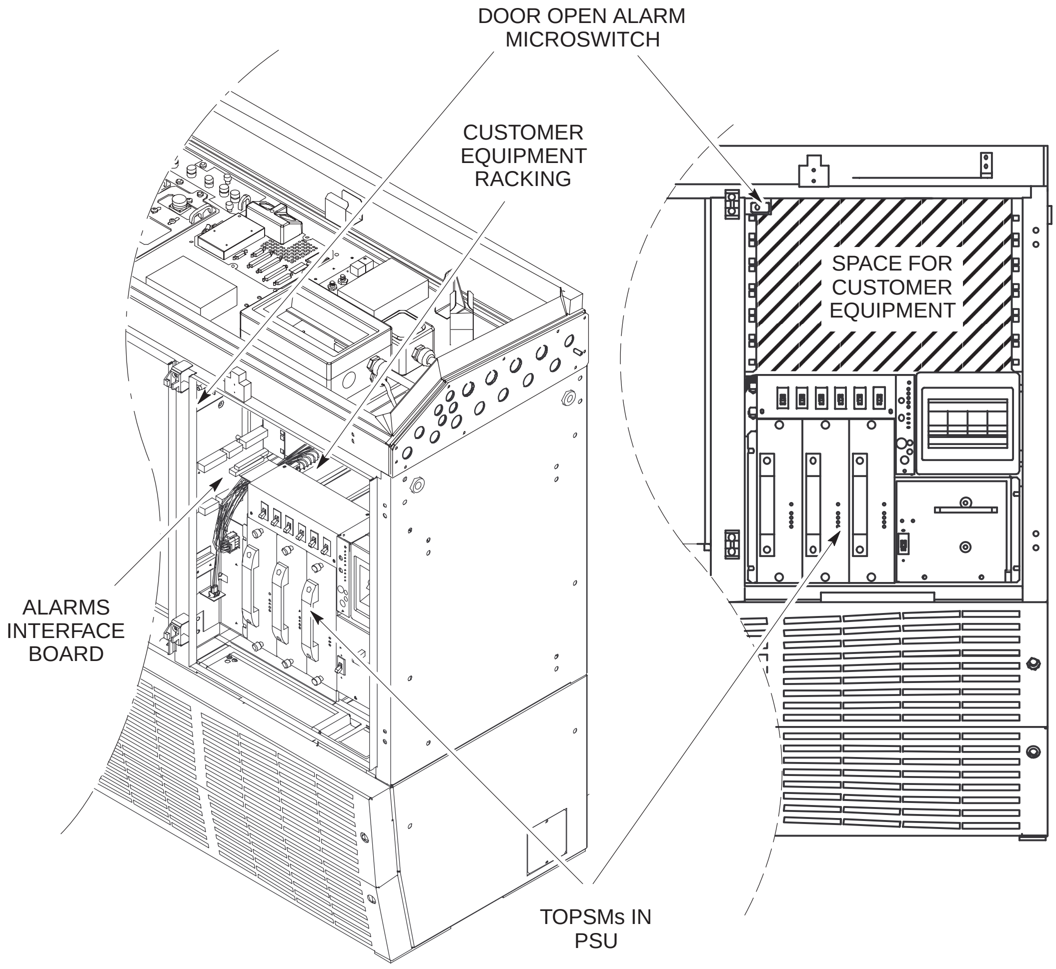

Figure 2-12 The power supply enclosure

Power supply unit

The PSU contains:

- Up to three TOPSMs for input power conversion.
- Minimal battery backup.
- Circuit isolation and protection devices.
- A control and alarm board.

The PSU is described in detail in Chapter 4 of this category (Cabinet power supplies, **Power distribution**).

Alarms interface board

The alarms interface board provides a connection point for alarms generated by the auxiliary equipment housing, PSU and TMS. The alarms are then routed to the external alarm connector of the interface panel, with the exception of the TMS fan fail, which is routed through the main cage backplane (Fan 0 connector) to the alarm module.

The alarms interface board also houses the TMS test switches.

Figure 2-13 Shows the layout of the alarms interface board.

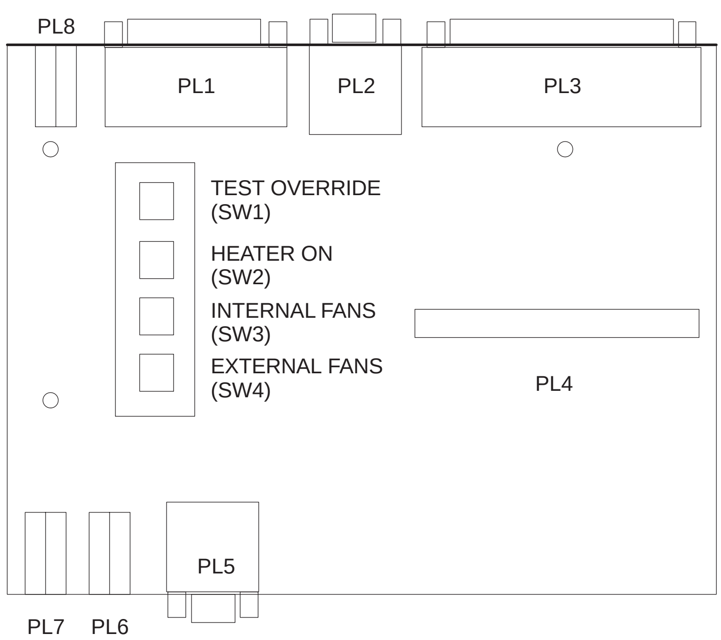

Figure 2-13 Layout of the alarms interface board

Alarms interface board connectors

The function of each alarms interface board connector is described below:

PL1	Connects to the auxiliary equipment housing alarm output signal cable.
PL2	Connects to the interface panel PIX0 connector, to enable remote initiation of battery tests.
PL3	Connects to the interface panel external alarms connector.
PL4	Connects to the PSU control interface board.
PL5	Connects TMS test inputs and alarm outputs.
PL6	Connects TMS fan alarm outputs to main cage backplane.
PL7	Connector for smoke alarms (not in use).
PL8	Connector for door microswitches.

NOTE	PIX0 connector PL2 is normally disconnected and stowed. If remote initiation/reporting functionality of internal battery capacity test is to be used, PL2 must be connected to alarms interface board.

TMS test switches

Four TMS test switches are mounted on the alarms interface board. Operation of the override switch causes the TMS control board to set the fans to minimum speed and the heaters to off, regardless of environmental conditions. The override switch must be held to enable further test steps. Subsequent operation of the individual fan switches will set the corresponding fans to maximum speed.

Operation of the heater switch sets the heaters to on, indicated by the illumination of an LED in the recirculation air return aperture of the power supply enclosure.

Figure 2-14 shows the interconnection diagram of the TMS push button test switches.

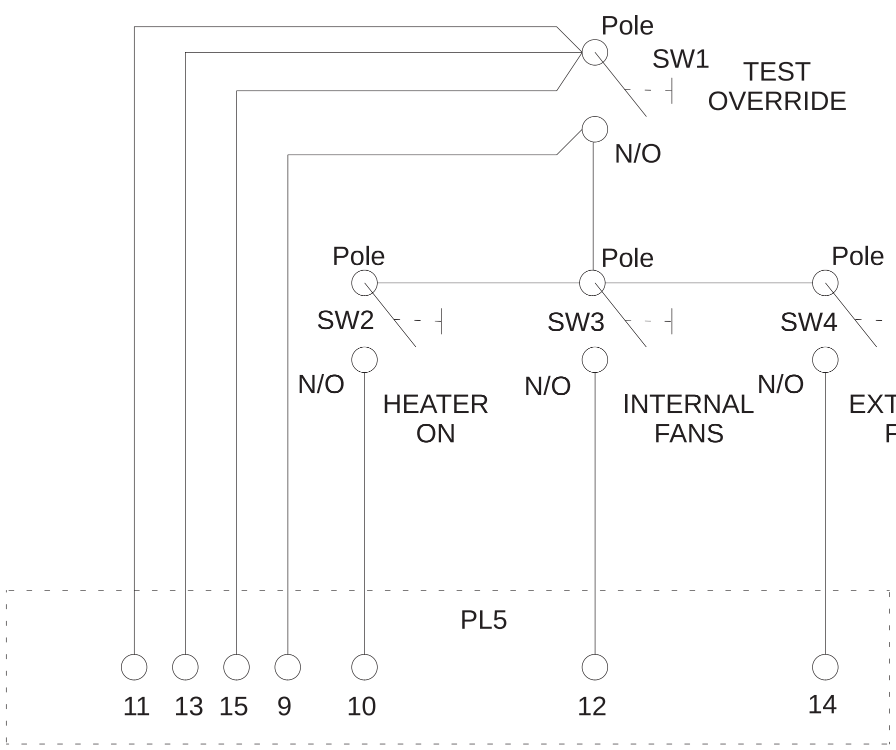

Figure 2-14 Interconnection diagram of the TMS test switches

Customer equipment racking

Provision is made within the power supply enclosure for the fitting of customer specific equipment, in 6 U of standard 19 inch equipment racking. Adjacent to the racking are four 125 W power outlets (– 55 V dc and earth), labelled COMMS 1 to COMMS 4. These are supplied from individual 5 A dc circuit breakers on the outdoor PSU.

Outdoor cabinet doors and lid

Door function

The doors have the following functions:

- Provide physical security and environmental protection.
- Assist in correct thermal management by ducting return airflow.
- Provide EMC shielding.

The door wind stops enable the doors to to be latched open at the 90° or 120° position. The power supply enclosure door, when closed, overlaps the radio enclosure door. The doors also overlap the TMS front cover and the latches of the lid. The power supply enclosure door therefore provides the single locking point for the cabinet and has the striker for the door open alarm microswitch.

NOTE	When the Horizon*macro* outdoor is delivered, the keys for the door are contained in a plastic bag, fastened to the front grille of the TMS.

Door views

Figure 2-15 shows the cabinet doors with major features labelled.

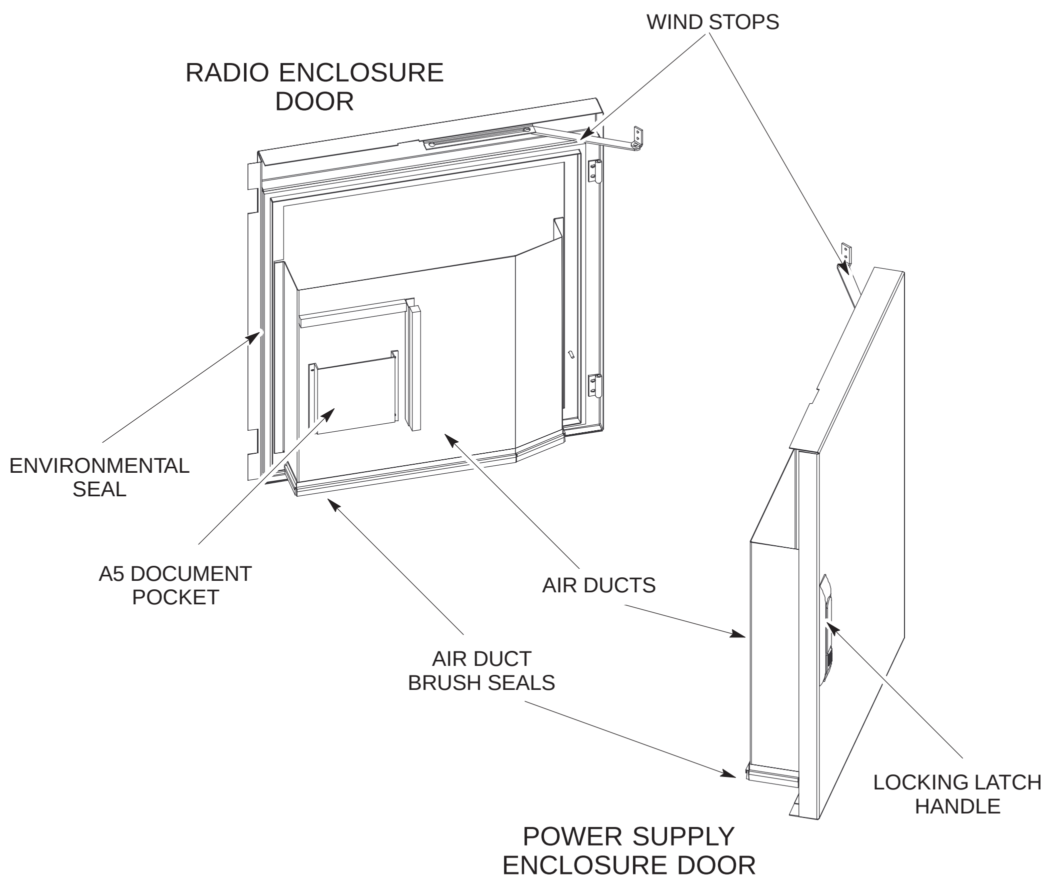

Figure 2-15 View of cabinet doors

Lid function

The lid has the following functions:

- Provides physical security.
- Provides environmental protection.

The lid has a gas strut to assist in opening and a mechanical stay to limit movement when open in windy conditions. The securing latches can only be accessed when the cabinet doors are open.

Lid view

Figure 2-16 shows the lid and the cabinet top wrap with the main features labelled.

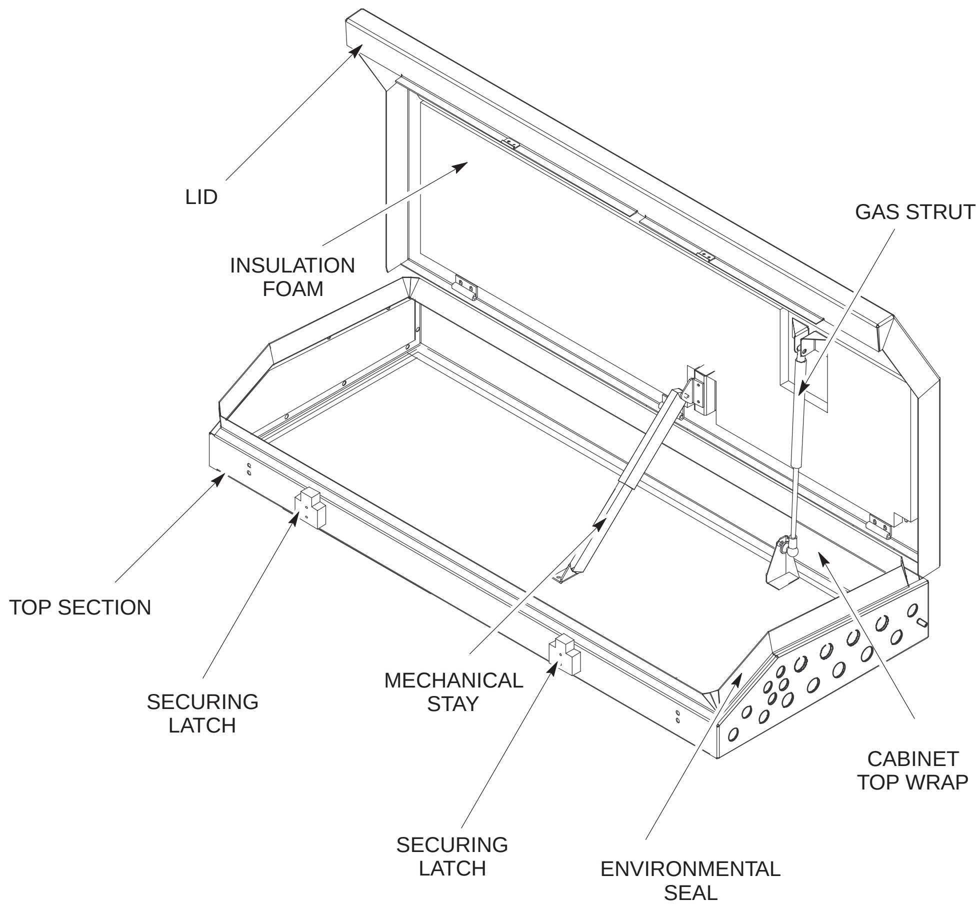

Figure 2-16 View of the cabinet lid

MOTOROLA

Chapter 3

Thermal management system

Chapter 3
Thermal management system i

Horizon*macro* outdoor temperature control

Temperature control overview

The Horizon*macro* outdoor 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.

Cabinet over temperature 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 sensors, set at higher temperature thresholds, to initiate PSM or cabinet shutdown. The cabinet is restarted when the sensors are reset by a substantial fall in temperature.

TOPSMs and CTUs have their own internal total shutdown responses to overheating. The CTUs shutdown at 92 °C.

850/900 MHz CTUs also have an internal 4 dB power reduction shutdown response to overheating, at 85 °C. 1800/1900 MHz CTUs have a 0.6 dB cut back at 70 °C in addition to the 4 dB power reduction at 85 °C.

Both the CTU and TOPSM shutdowns provide a second level of cabinet protection, independent of the cabinet heat sensors.

Temperature sensors

Radio enclosure temperature sensors

Temperature sensors are located above the transceiver compartment (see **Cage backplane interface panel harness assembly Figure 2-9**) and consist of the following:

- One 70 °C sensor, providing sensing for a cabinet overtemperature alarm when the EMC enclosure temperature exceeds the preset level. The alarm is processed by the alarm module and the MCUF, and sent on to the OMC-R, via the BSC.
- Two 85 °C sensors initiate shutdown of the PSMs to protect the cabinet equipment from heat damage. Both sensors must detect excess temperature for the shutdown to take place; this reduces the risk of an unnecessary shutdown due to sensor failure. If a shutdown occurs, there is no prior notification to the OMC-R.

Power supply enclosure temperature sensors

The power supply enclosure temperature sensors are located on the control and alarm board (see **Outdoor PSU control and alarm board (CAB)**) and consist of the following:

- One 70 °C sensor, providing sensing for a cabinet overtemperature alarm when the non EMC enclosure temperature exceeds the planned level. The alarm is generated by the control and alarm board, and passed as an external alarm to the alarm module, where it is sent on to the OMC-R via the BSC. Operation of this sensor will also reduce the TOPSM output voltage as described in **Outdoor PSU control and alarm board (CAB)**.
- One 78 °C sensor, which initiates disconnection of the battery contactor, the comms contactor and shutdown of the TOPSMs. This will shut down the BTS. If a shutdown occurs, there is no prior notification to the OMC-R.

TMS temperature sensors

The two TMS temperature sensors are located within the TMS unit (see **Thermal management system (TMS) Figure 3-2**), in the returned recirculation airflow from the EMC and non EMC enclosures. They have the following functions:

- Either sensor provides sensing for the TMS overtemperature alarm when the TMS returned recirculation air temperature exceeds 68°C. The alarm is generated by the TMS control board, processed by the control and alarm board, and passed as an external alarm to the alarm module, where it is sent on to the OMC-R via the BSC.
- The TMS temperature sensors also provide the TMS control board with thermal data used in controlling fan speed and heater operation.

Cabinet restart after shutdown

The cabinet is restarted when the overtemperature condition initiating shutdown has reset.

- The CAB re-enables the TOPSMs when the 78 °C temperature sensor has reset at 60 °C.
- The two 85 °C temperature sensors reset at 55 °C. This re-establishes an earth point for the PSM internal detectors connected to the cabinet heat sensors, which then reactivate the PSM outputs.

The cabinet then restarts as a normal power up.

Thermal management system (TMS)

TMS overview

The equipment installed in the cabinet emits heat, which must be removed in order to maintain the correct working temperature.

The thermal management system (TMS) unit maintains the cabinet internal temperature within the operational range of the installed equipment, provided the external ambient temperature is within the range of –40 °C to +50 °C.

An alarm is generated if the return air temperature from the BTS enclosures exceeds 68 °C.

The TMS unit contains:

- Two recuperators.
- Two ambient air fans (external fans).
- Two recirculation air fans (internal fans).
- Two ac electric heater elements.
- One TMS control board.
- Two temperature sensors.

View of TMS unit

Figure 3-1 shows a view of the TMS unit with airflows indicated and access panels and air ducts omitted for clarity.

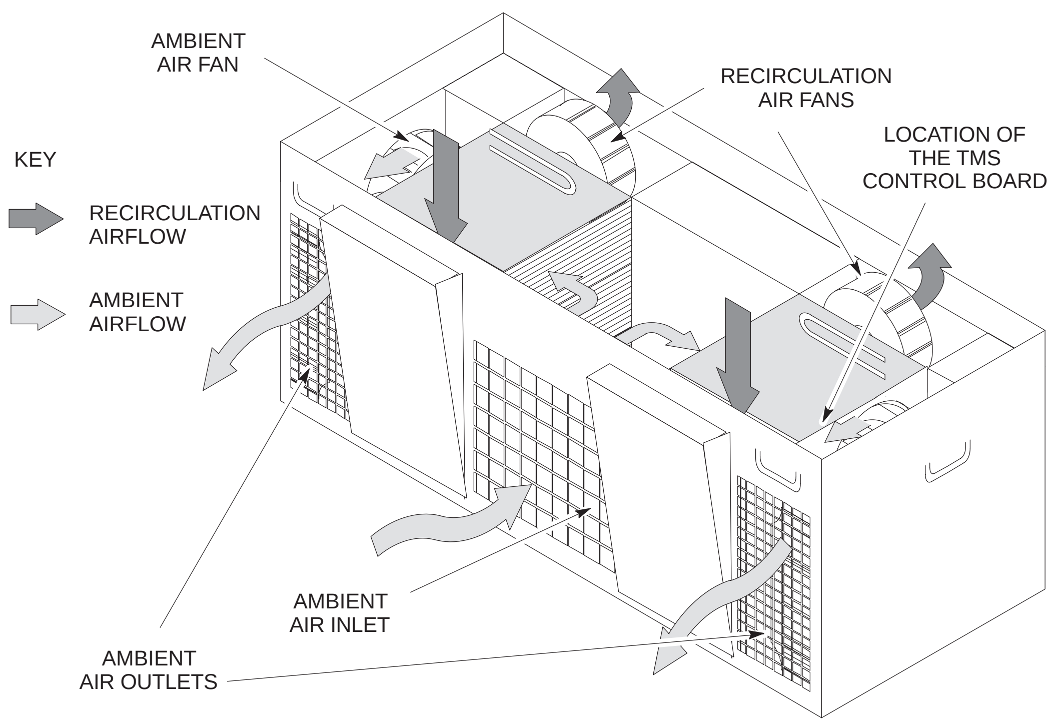

Figure 3-1 View of the TMS unit

Heat exchanger components

The heat exchanger consists of the following items:

Recuperators

The recuperators are manufactured from a series of epoxy resin coated aluminium sheets, sealed at alternate edges to form two sets of narrow air passages, one set for the ambient air and one set for the recirculated air, but the air streams do not mix.

Ambient air fans (external fans)

The two ambient air fans are located one on each side of the unit. The fans are of the radial type with backward curved blades for maximum efficiency. The fan impeller is direct driven by a –48 V dc motor with a solid state commutator. The fan contains its own pulse width modulation (PWM) speed control circuitry.

Recirculation air fans (internal fans)

The recirculation air fans are located at the rear of the unit. The fans are of the same type and operate the same way as the ambient air fans.

AC heater elements

The ac heater elements are located in the recirculation air inlet to the cabinet enclosures, at the top of the unit. There are two individual heaters, each with its own high limit thermostat attached.

TMS control board

The control board is located in the top right side of the TMS unit behind the cable well. The control board has the following functions:

- Interpretation of thermal data from the TMS temperature sensors.
- Control of the speed of ambient and recirculation fans.
- Control of the operation of ac heater elements.
- Generation of TMS alarm signals.
- Configuration of heater elements for 230 V ac or 110 V ac input voltages.

Temperature sensors

The temperature sensors are located at the top of the TMS unit in the recirculation air return aperture. The functions of the TMS temperature sensors are described in **Horizon*macro* outdoor temperature control** in this chapter.

TMS functional description

The TMS unit provides either cooling or heating to maintain the internal temperature of the Horizon*macro* outdoor BTS cabinet within the operational range of the installed equipment. The TMS temperature sensors measure the temperature of the returned recirculation air from the cabinet equipment enclosures.

Cooling

The TMS employs an indirect cooling system to protect the radio equipment against atmospheric contaminants. Cooling is provided by recirculating air through two air to air heat exchangers. Two separate airflow paths are driven through the two recuperators by fans; the warmer air stream gives off heat to the colder air stream.

The TMS control board manages the speed of both sets of fans. The control board initiates an increase in fan speed when either TMS temperature sensor detects an increase in temperature, above a control threshold. A reduction in fan speed is only achieved when both sensors detect a decrease in temperature below the control threshold.

The recirculation air fans run continuously. As the temperature rises, the ambient air fans start. A further temperature rise causes both fans ramp up to full speed.

The recirculation air fans run at 60% of full speed at all temperatures, up to 55 °C. Fan speed increases linearly as the temperature rises, until it reaches full speed at 60 °C.

The ambient air fans are inhibited at temperatures below 40 °C and run at 60% of full speed between 40 °C and 55 °C. Fan speed then increases linearly as the temperature rises, until it reaches full speed at 60 °C.

Heating

At low temperatures and in cold start conditions, ac electric heaters are used to maintain the cabinet internal temperature at operational levels. Only the recirculation air fans operate when the TMS is heating the cabinet.

Heater element operation is managed by the TMS control board. The control board switches the heaters on when either TMS temperature sensor detects a decrease in temperature to below 10 °C, but only switches the heaters off when both TMS temperature sensors detect a corresponding rise in temperature to above 20 °C.

Heater function is indicated by the illumination of an LED, mounted on the rear verical wall at the top right of the recirculation air outlet aperture, below and in front of the power supply enclosure.

Heat exchanger functional diagram

Figure 3-2 shows a representation of the airflow paths through the Horizon*macro* outdoor cabinet.

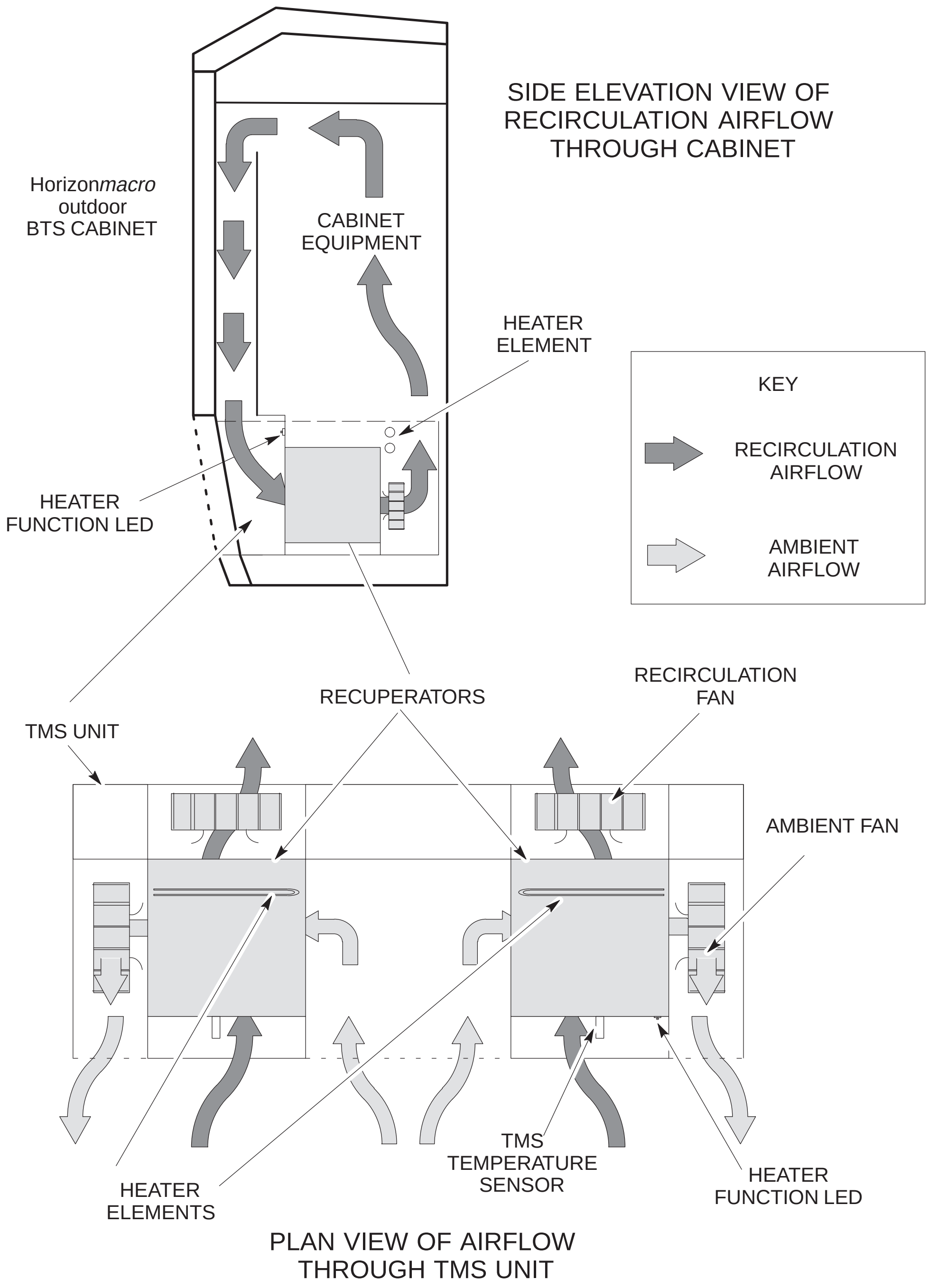

Figure 3-2 Functional diagram of TMS airflow

Chapter 4

Cabinet power supplies

Chapter 4
Cabinet power supplies

Horizon*macro* outdoor power supplies

Power supply overview

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

- The power supply unit (PSU) containing:
  - AC distribution and input ac supply connection.
  - DC distribution and internal battery back-up.
  - The PSU Control and Alarm Board (CAB).
  - The Outdoor Power Supply Modules (TOPSMs).
- The main cage Power Supply Modules (PSMs).
- The Circuit Breaker Module (CBM).
- The μBCU Power Supply Module (BPSM).

Optional external battery back-up can also be fitted, housed in the AEH.

Power supply unit view

Figure 4-1 shows the power supply unit (with its associated distribution boxes and the CAB), and the TOPSMs. The cabinet structure has been omitted for clarity.

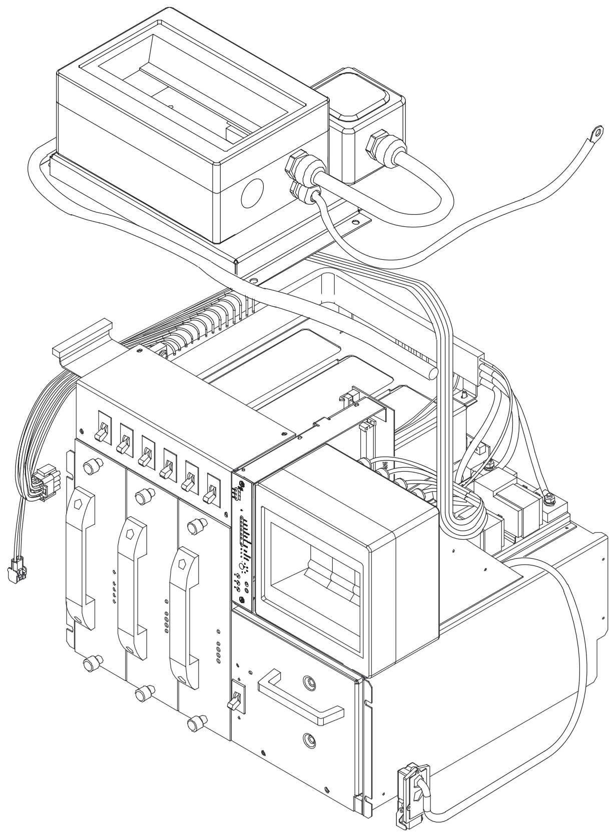

Figure 4-1 Horizon*macro* outdoor PSU

View of main cage power modules

Figure 4-2 shows the main cage with its power modules indicated.

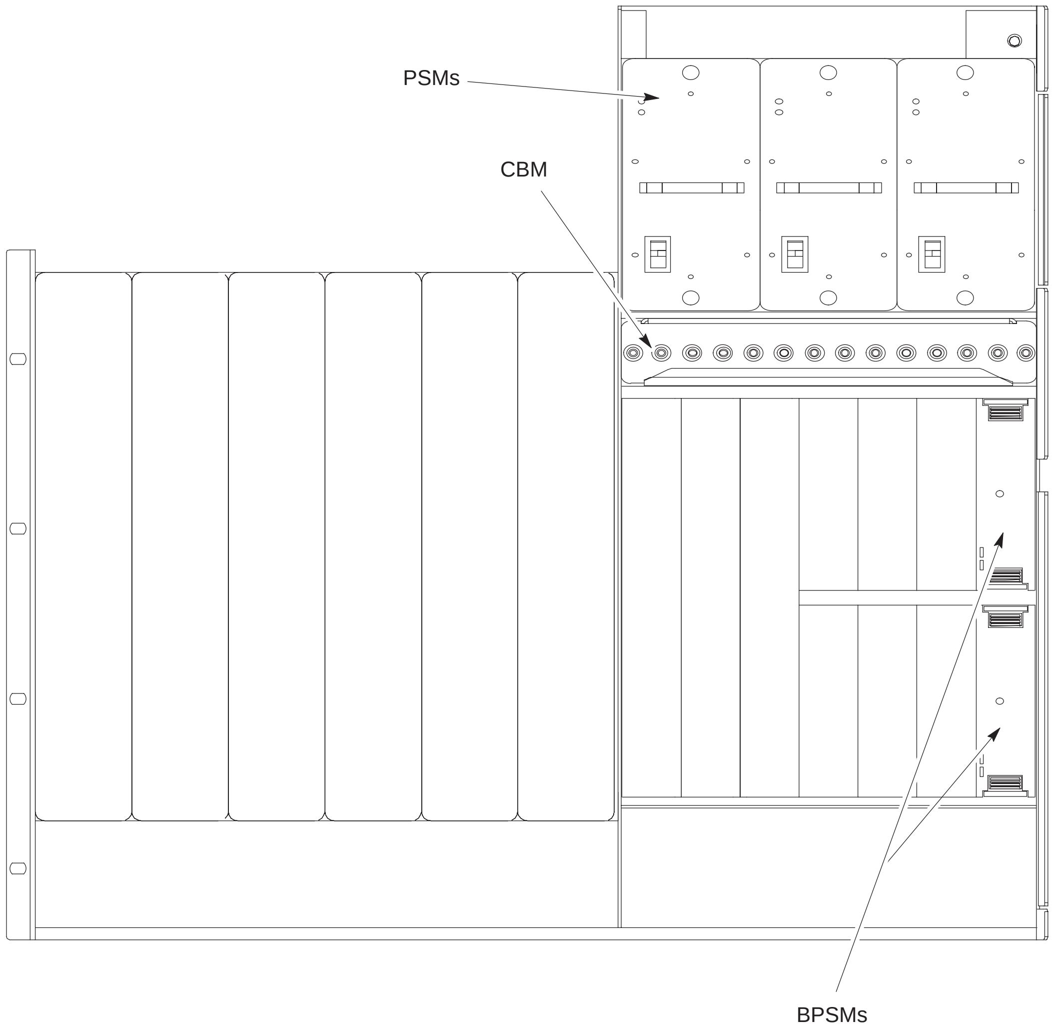

Figure 4-2 Main cage power modules

Introduction to power distribution

Power distribution overview

The power supply unit cage is the main power distribution assembly within the Horizon*macro* outdoor BTS cabinet.

The power distribution system consists of two main functional elements:

- Two ac distribution boxes and their associated cables.
- Six dc circuit breakers, two contactors, the multilayer busbar and dc cables.

View of power supply unit cage

Figure 4-3 shows the power supply unit cage, its associated distribution boxes and cables, with the cabinet structure omitted for clarity.

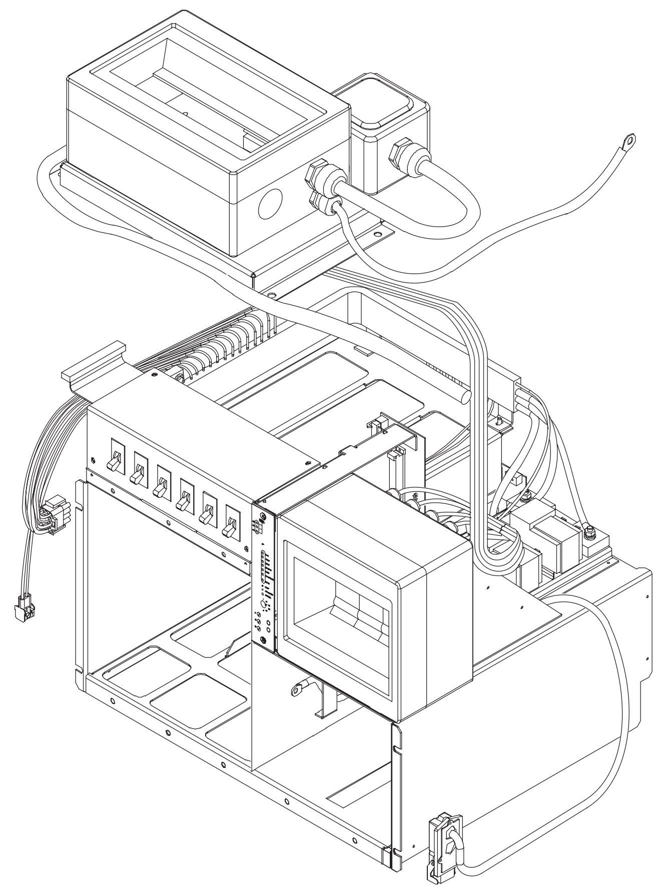

Figure 4-3 AC power supply unit cage

AC power distribution

View of ac power components

Figure 4-4 shows the ac power distribution components and the associated cables (shaded), with the cabinet structure omitted for clarity.

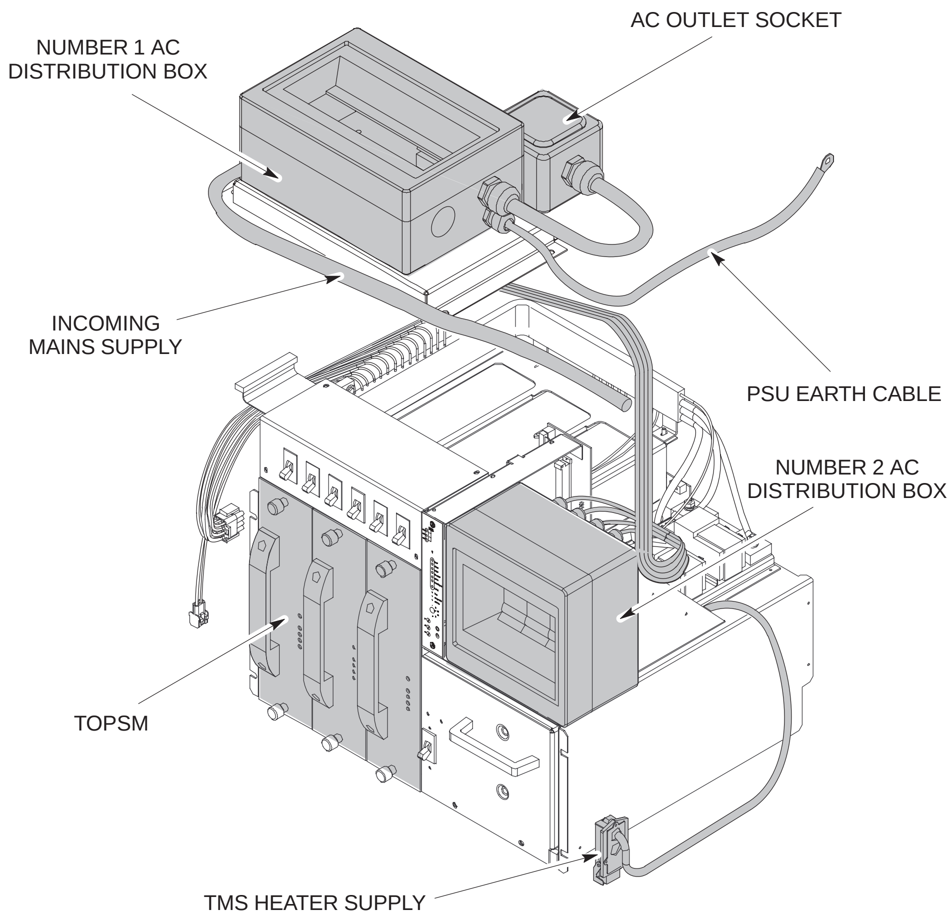

Figure 4-4 AC power distribution components

AC distribution description

There are two ac distribution boxes and an ac power outlet socket associated with the Horizon*macro* outdoor PSU.

Number 1 ac distribution box

The number 1 ac distribution box (see Figure 4-5) is located in the top panel of the cabinet. It contains circuit protective devices and a terminal block, and provides:

- The termination point for the incoming mains supply.
- A four pole 32 A main circuit breaker (also used as a switched disconnect for external ac power supplies).
- A double pole 6 amp (30 mA) residual current breaker with overcurrent protection (RCBO) to supply the ac power outlet socket.
- The means of configuring the BTS to accept the following incoming mains supply voltages:
  - 230 V ac 50 Hz single phase and neutral.
  - 230 V ac 50 Hz three phase and neutral (star configuration).
  - 230 V ac 50 Hz three phase (delta configuration).
  - 110 V ac 60 Hz single phase and neutral.

NOTE	When the Horizon*macro* is supplied by 110 V single phase, the 4 pole main circuit breaker is configured as two parallel pairs – one pair breaking the live phase and one pair breaking the neutral. This provides circuit protection at a total of 64 amps.

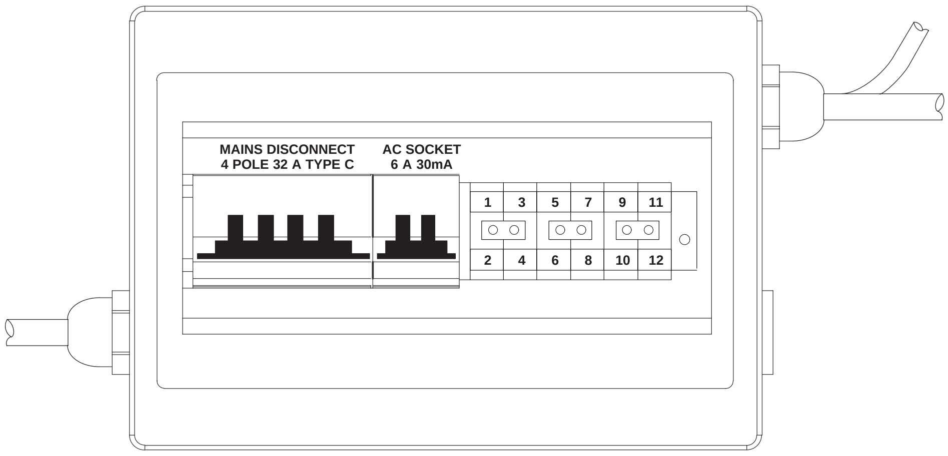

Figure 4-5 The number 1 ac distribution box

Number 2 ac distribution box

The number 2 ac distribution box (see Figure 4-6) is located in the upper right of the PSU and contains circuit protective devices as follows:

- Three 20 amp double pole circuit breakers to supply the outdoor power supply modules (TOPSMs).
- One 10 amp double pole circuit breaker to supply the thermal management system (TMS) heaters.

Each double pole circuit breaker also acts as a switched disconnect for its respective circuit, breaking both feed and return lines. The output of each circuit breaker is fed to its load by discrete cables.

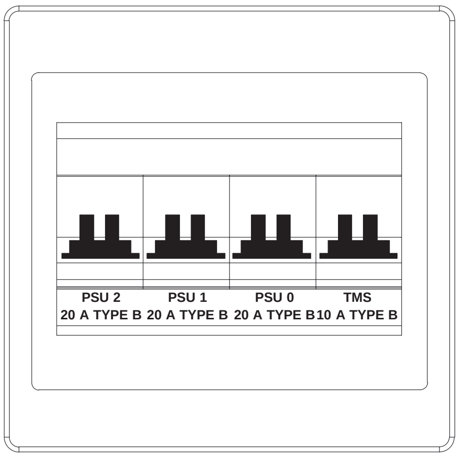

Figure 4-6 The number 2 ac distribution box

AC outlet socket

The socket (see Figure 4-7) is a European domestic type and is housed in a weatherproof enclosure which has an IP56 protection rating. It is nominally rated at 230 V, 5 A max and is supplied from a 30 mA RCBO in the number 1 ac distribution box.

The purpose of the socket is to allow site engineers to use standard 230 V portable test and diagnostic equipment when installing, commissioning or servicing the Horizon*macro* outdoor BTS.

View of the ac outlet socket

Figure 4-7 shows a view of the ac outlet socket.

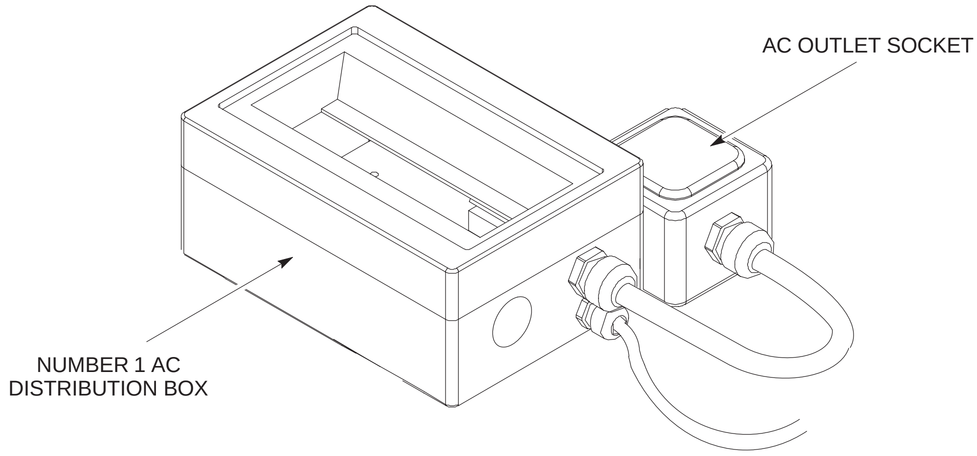

Figure 4-7 AC outlet socket

AC distribution diagram

Figure 4-8 shows a block diagram of the ac distribution within the Horizon*macro* BTS cabinet.

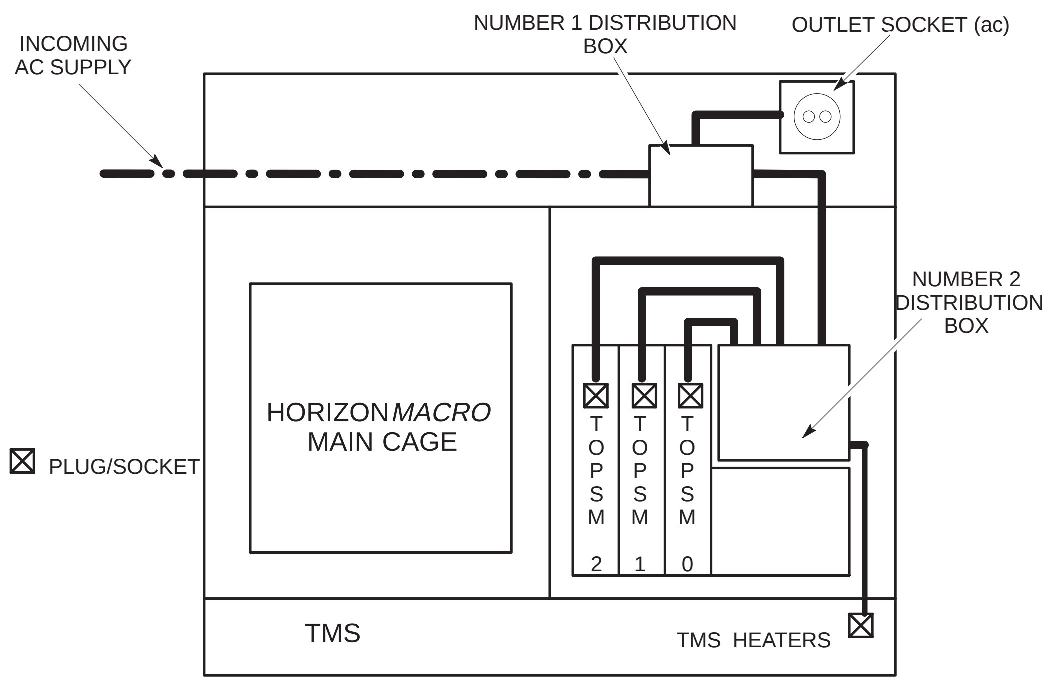

Figure 4-8 AC distribution block diagram

DC power distribution

DC distribution overview

The regulated dc output of the TOPSM is distributed through the multilayer busbar to:

- The main cage PSMs.
- TMS fans.
- Customer specific equipment racking power outlets (COMMS 1 to 4).
- Internal battery backup.
- The connectors for optional external battery backup, (located on the dc interface panel, within the top panel enclosure).

View of dc power components

Figure 4-9 shows the dc power distribution components and the associated cables (shaded), with the cabinet structure omitted for clarity.

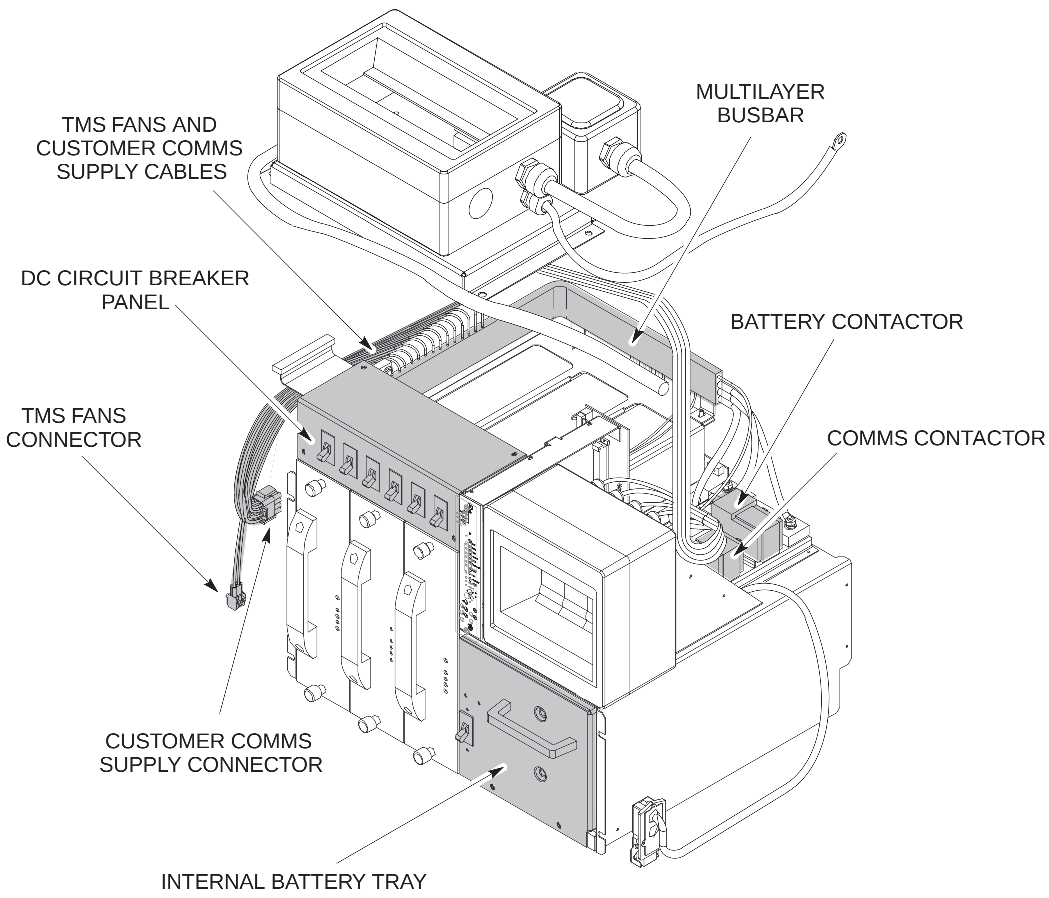

Figure 4-9 DC power distribution components

DC distribution diagram

Figure 4-10 shows the –55 V dc distribution as a block diagram.

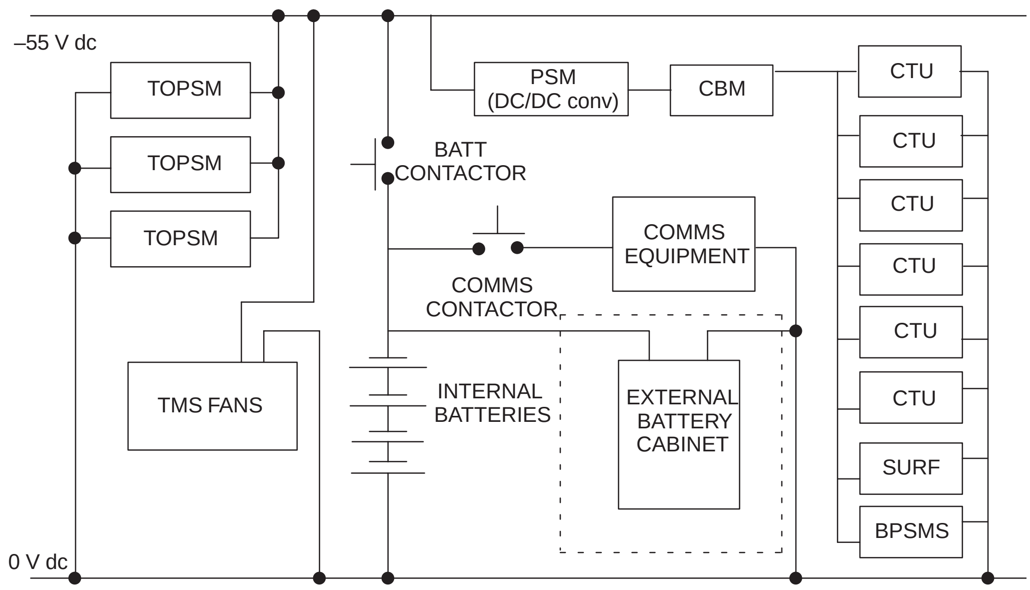

Figure 4-10 DC distribution block diagram

DC distribution description

The main cage dc supply is routed from the left side of the multilayer busbar through the dc interface panel (see Figure 4-14) to the main cage interface panel. Circuit protection for the main cage is provided by the CBM and internal fusing in the PSMs.

The other circuits supplied from the multilayer busbar are protected by individual circuit breakers. Six of the circuit breakers are mounted on the dc circuit breaker panel of the outdoor PSU, as shown in Figure 4-11. The internal batteries have a separate 80 A circuit breaker, housed within the battery mounting tray. The circuit breakers also function as switched disconnects for their respective loads.

The PSU cage has two contactors as part of the dc distribution system. During periods of battery back-up, the contactors will progressively disconnect battery loads as battery voltage decreases, to prevent deep discharge of backup batteries. The operation of these contactors is controlled by the control and alarm board and is described in detail in **Outdoor PSU control and alarm board (CAB)**

View of the dc circuit breaker panel

Figure 4-11 shows a front view of the dc circuit breaker panel.

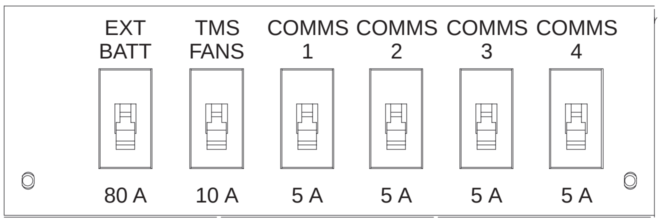

Figure 4-11 The dc circuit breaker panel

Customer equipment power supplies

The four power outlets mounted adjacent to the customer equipment racks are supplied from the multilayer busbar by individual 5 A circuit breakers, (see Figure 4-11).

Internal battery backup

The internal battery tray, located at the lower right side of the PSU, holds four 12 V batteries connected in series to provide a total output of 48 V dc, with a capacity of 15 Ah.

The internal batteries are protected by an 80 A circuit breaker, mounted on the battery tray front panel. The circuit breaker also functions as a disconnect switch for the internal batteries.

Battery voltage sensing leads are fed from the negative terminal of each battery to a four way connector on the battery tray. This is connected to the control and alarm board (CAB). The sensed voltages are used by the battery capacity test and battery selector switch functions of the CAB.

Internal battery arrangement

Figure 4-12 shows how the batteries are arranged in the battery tray.

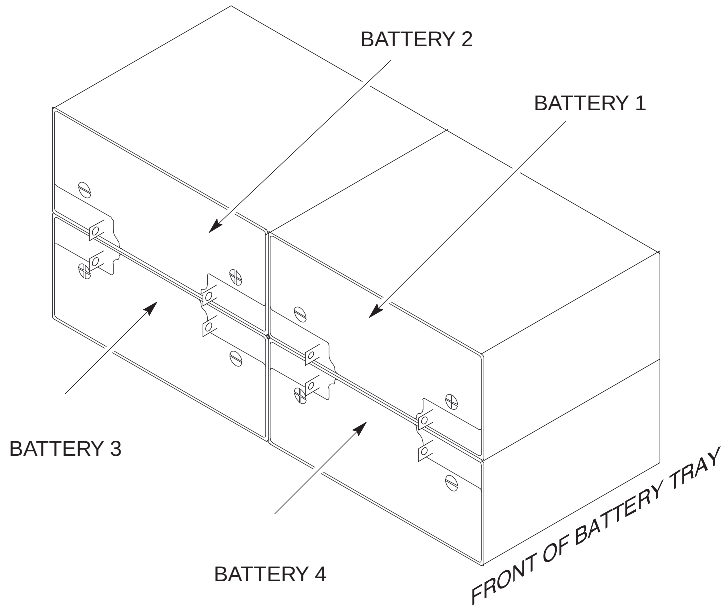

Figure 4-12 Internal battery arrangement in the battery tray

View of battery sense lead

Figure 4-13 show the internal battery sense lead.

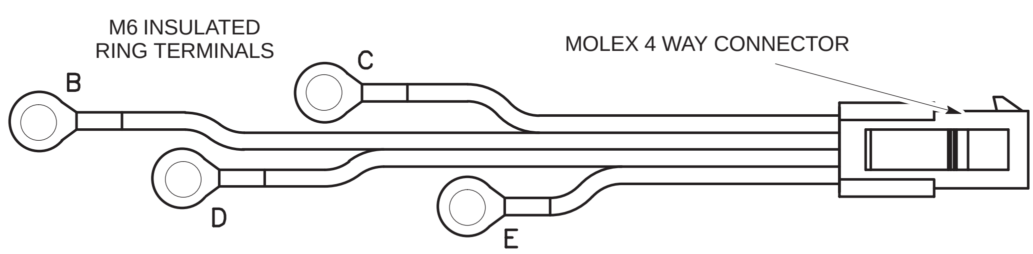

Figure 4-13 Battery sense lead assembly

Table 4-1 details the wiring schedule of the battery sense lead.

Table 4-1 Battery sense lead to Molex connector

Molex connector pin	Terminal ident	Location
1	C	Battery 1 –ve terminal
2	B	Battery 2 –ve terminal
3	D	Battery 3 –ve terminal
4	E	Battery 4 –ve terminal at circuit breaker top terminal

External battery backup connection

The external battery connection cables are routed from the left side of the multilayer busbar to connectors on the dc interface panel (see Figure 4-14). Circuit protection and disconnect switching are provided by an 80 A circuit breaker mounted on the dc circuit breaker panel. External battery backup is further described in **Common applications for the auxiliary equipment housing** in Chapter 7.

View of the dc interface panel

Figure 4-14 shows a view of the dc interface panel.

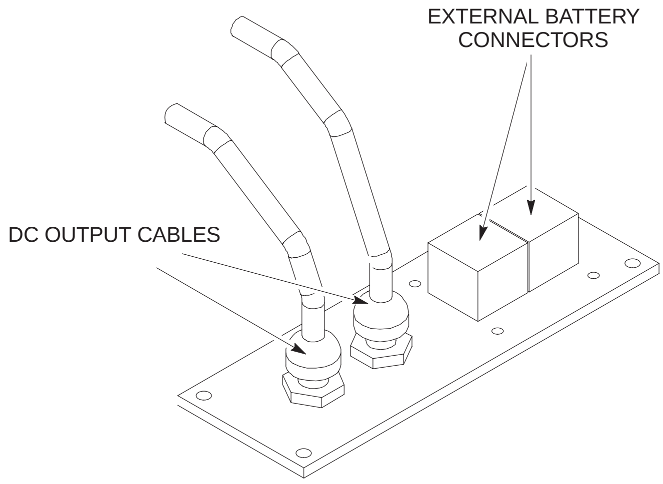

Figure 4-14 The dc interface panel

Control and alarm board (CAB)

Introduction to the CAB

The CAB is located in the outdoor PSU between the dc circuit breaker panel and the number 2 ac distribution box. It provides the following functions:

- Control of TOPSM output voltage (voltage trim).
- TOPSM disable relay control.
- Control of battery and communications contactors:
  - During cabinet power up.
  - During low voltage disconnect (LVD).
- Monitoring of battery voltage and temperature.
- Monitoring of TOPSM input and output failure signals.
- Monitoring of non EMC enclosure temperature.
- Monitoring of alarms from the cabinet, the TMS, and the auxiliary equipment housing.
- Performing a battery charge capacity test on the internal batteries.

The CAB sources dc power from all of the following:

- The distributed dc regulated output of the TOPSMs.
- The TOPSM auxiliary output.
- The communications equipment side of the outdoor PSU communications contactor.

CAB views

Figure 4-15 shows views of the CAB and its front panel.

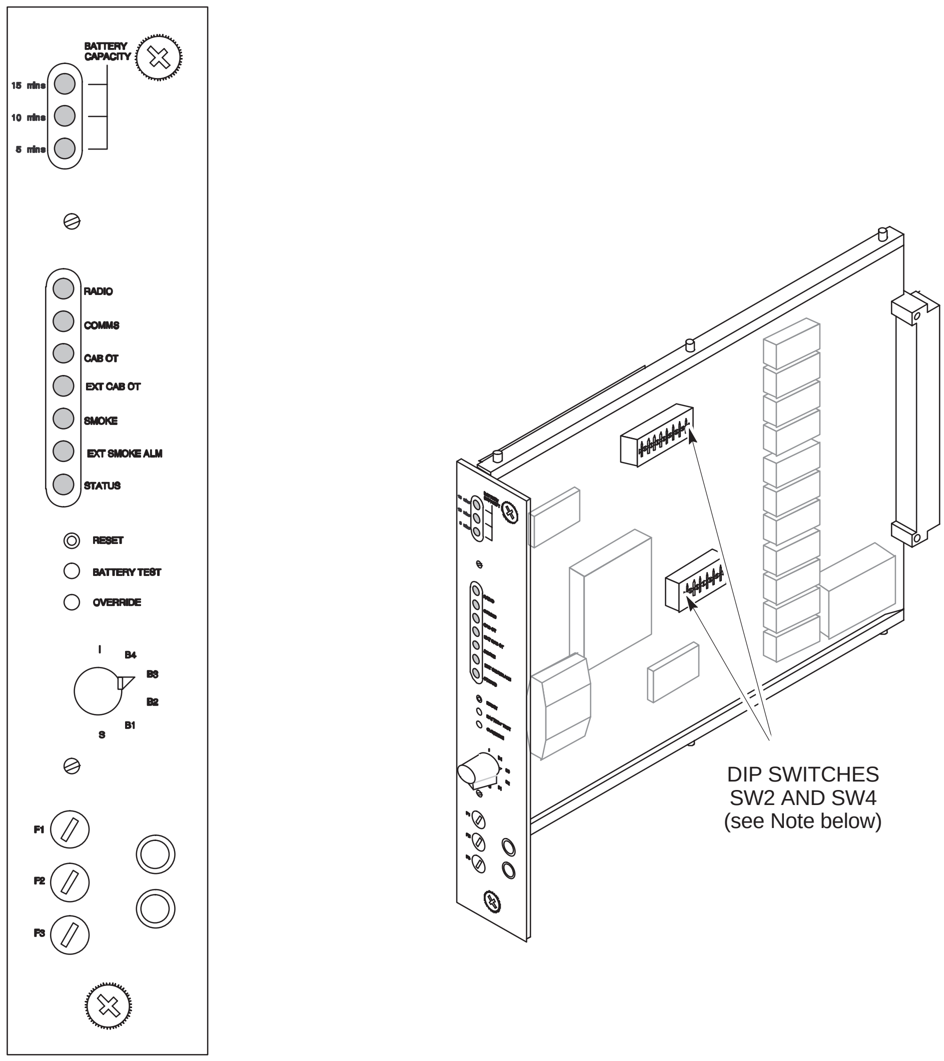

Figure 4-15 Control and alarm board

NOTE	There are two manufacturers of the CAB. Each is fully compatible with the PSU, although circuit board layout may differ.

CAB indicators and controls

Front panel indicators

- BATTERY CAPACITY (green).
  - >15 mins.
  - >10 mins.
  - >5 mins.

  One LED is lit, displaying result of last battery capacity test. The three LEDs flash during the test and one remains lit to indicate test result.
- RADIO (green).

  Normally lit, this LED indicates that the battery contactor is closed and that radio loads are connected to the backup batteries, (where fitted).
- COMMS (green).

  Normally lit, this LED indicates that the communications contactor is closed and that customer communications loads are being supplied.
- CAB OT (red).

  Normally unlit, this LED indicates a cabinet over temperature alarm state.
- EXT CAB OT (red).

  Normally unlit, this LED indicates an auxiliary equipment housing over temperature alarm state.
- SMOKE (red).

  Normally unlit, this LED indicates a cabinet (optional) smoke detector alarm state.

NOTE	The smoke detector alarm functions are only activated by optional customer supplied smoke detectors. No provision has been made for the fixing of a smoke detector within the main cabinet or the auxiliary equipment housing.

- EXT SMOKE ALM (red).

  Normally unlit, this LED indicates an auxiliary equipment housing (optional) smoke detector alarm state.
- STATUS (green).

  Normally lit, this LED indicates that the cabinet is within normal operating conditions, and will flash on and off when any alarm signal is present. The status indicator will flash if either the battery or communications contactor is open.

NOTE	Opening the door triggers the door open alarm, causing the status LED to flash. To check the true status, press the door microswitch to simulate closing the door.

Front panel switches and buttons

Front panel switches and buttons are provided for the following:

- BATTERY TEST.

  Initiates battery charge capacity test of internal batteries.
- Battery selector switch.

  Connects two 4 mm sockets on front panel to internal batteries to allow monitoring of battery condition.
- OVERRIDE.

  Overrides disconnected enable signals to the TOPSMs for fault diagnosis.
- RESET.

  Resets the CAB after an auxiliary equipment housing over temperature trip.

CAB front panel fuses

The CAB front panel has three cartridge fuses, providing circuit protection for:

- Battery contactor (F1).
- Communications contactor (F2).
- Control and alarm board (F3).

CAB control functions

The CAB has the following control functions:

- Voltage trim.
- TOPSM disable relay control.
- Control of contactors during power up.
- Low voltage disconnect (LVD).
- Over temperature trip.
- Smoke trip.

Voltage trim

The CAB generates the control signal voltage (V trim) used to regulate TOPSM output to produce a temperature-compensated battery charging voltage. The temperature sensor is mounted on the CAB for internal batteries, and mounted in the auxiliary equipment housing for external batteries. A dip switch on the CAB (SW2–8) is used to select either internal or external battery temperature sensing.

TOPSM disable relay control

On detection of an over temperature trip alarm or a smoke alarm from the BTS cabinet, the CAB energises the coil of the TOPSM disable relay, interrupting the enable in signal and shutting down the TOPSM –55 V outputs. The TOPSM disable relay will remain energized until the alarm condition has cleared and, in the case of a smoke alarm longer than 30 seconds, the cabinet ac supply has been cycled or the CAB front panel reset switch has been operated. Operation of the CAB front panel override switch will interrupt this function, for a 30 second period, to allow fault diagnosis to be performed.

Control of contactors during power up

The CAB monitors the following signals during power up of the Horizon*macro* cabinet:

- TOPSM auxiliary voltage within 9 to 15 V dc range
- Cabinet over temperature alarm.
- Cabinet smoke alarm.

If the alarm signals are inactive, the CAB will close the battery and communications contactors, to supply customer communications equipment and charge the backup batteries.

If the CAB detects a cabinet over temperature or cabinet smoke alarm during power up, then the TOPSM disable relay operates, as described in **TOPSM disable relay control** in this section.

Low voltage disconnect (LVD)

The CAB constantly monitors battery voltage. During periods of back-up battery operation, the CAB will progressively reduce the load to prevent deep discharge of the batteries.

The CAB generates a low voltage disconnect imminent alarm when the battery terminal voltage reaches –44 V. As the battery voltage level drops further, the CAB de-energizes the battery contactor at –41 V, disconnecting the radios from the battery power. At 39.5 V, the communications contactor is de-energized to prevent extreme deep discharge of the back up batteries.

The LVD threshold for the communications contactor is lower than that of the battery contactor, to ensure customer communications equipment remains powered for as long as possible after radio power has been lost.

NOTE	Once the communications contactor has opened the CAB will lose all power input connections. CAB functions are only re-established when the ac supply is restored to the cabinet. The cabinet then restarts as a normal power up.

Over temperature trip

The CAB generates a cabinet over temperature trip signal when both the 78 °C sensor and the 70 °C sensor are active (see **Horizon*macro* outdoor temperature control**).

The cabinet over temperature trip signal disconnects the battery contactor, the communications contactor, and disables the TOPSMs. This will shut down the BTS, and if a shutdown occurs, there is no prior notification to the OMC-R other than the over temperature alarm.

The CAB re-enables the TOPSMs when both temperature sensors have reset at 60 °C. The cabinet then restarts as a normal power up.

Smoke trip

NOTE	The following smoke trip functions have not been implemented in the main cabinet or the auxiliary equipment housing.

The CAB generates smoke trip control signals after it has been in receipt of a smoke alarm for 30 seconds.

- The Horizon*macro* outdoor cabinet smoke trip signal disconnects the battery contactor, the communications contactor and disables of the TOPSMs. The BTS will shut down without prior notification to the OMC-R, other than the smoke alarm.
- A smoke trip signal from the auxiliary equipment housing initiates a remote disconnection of the external batteries.

Once generated, the smoke trip control signals remain active until the input mains ac is cycled, or the CAB front panel reset button is operated.

CAB alarm functions

The CAB generates or processes the following alarms:

- Over temperature alarms:
  - Power supply enclosure over temperature.
  - TMS over temperature.
  - TMS 2 over temperature (not used).
  - Auxiliary equipment housing over temperature.
- Power supply alarms:
  - TOPSM dc output fail.
  - Mains input fail.
  - Low voltage disconnect imminent.
- TMS fail alarms:
  - TMS fail.
  - TMS 2 fail (not used).
- Smoke alarms:
  - Optional smoke detector.
  - Optional auxiliary equipment housing smoke detector.
- Door open alarms:
  - BTS cabinet door open.
  - Auxiliary equipment housing door open.

Except for TOPSM dc output fail, the alarms originate at sensors which use voltage-free contacts to indicate an alarm by going open contact.

The CAB sends the alarms through the alarms interface board and the interface panel as external alarms to the digital alarm module. All alarms to this module indicate an alarm by going open-circuit. The alarms are processed by the alarm module and MCUF, and sent on to the OMC-R via the BSC.

Auxiliary equipment housing alarms can be inhibited using the SW2 DIP switches mounted on the CAB pcb.

Over temperature alarms

The operation of the over temperature alarms associated with the CAB is described in **Horizon*macro* outdoor temperature control**.

Power supply alarms

The TOPSM dc output fail and mains input fail alarm signals are generated by a single changeover relay within each TOPSM.

- A single TOPSM alarm signal is interpreted by the CAB as a TOPSM dc output fail.
- A fail signal from all installed TOPSMs is interpreted by the CAB as an ac supply input fail.

TMS fail alarm

A TMS fail alarm is generated by the TMS control board when any fan or heater fails. The alarm signal is routed to the CAB through the alarms interface panel. It is then processed by the CAB and sent to the digital alarm module.

A separate fan fail signal, generated by the TMS control board, is fed to the digital alarm module without processing by the CAB.

Smoke alarms

Smoke alarms originate at optional (customer supplied and fitted) smoke detectors. The alarm is then processed by the CAB and sent to the digital alarm module. Dip switches mounted on the CAB printed circuit board are used to inhibit the alarm signals when smoke detectors are not fitted.

Door open alarms

The BTS cabinet door open alarm is generated by the CAB when the microswitch mounted in the top left corner of the power supply enclosure is open-circuit.

The auxiliary equipment housing door open alarm signal originates at a door mounted microswitch, and is generated by the CAB when the microswitch mounted in the auxiliary equipment housing is open-circuit.

CAB additional functions

The CAB also provides the following functions:

- Internal battery capacity test.
- Battery selector.
- Debug.

Internal battery capacity test

The CAB performs an internal battery capacity test when:

- CAB front panel BATTERY TEST push button switch is operated.
- Automated self-test carried out periodically.
- Initiated remotely from the OMC-R.

During the battery capacity test, the CAB sets the TOPSM outputs to –43 V by adjusting the voltage trim signal so that the internal batteries supply the cabinet loads. The CAB then monitors the time taken for the battery terminal voltage to drop to –44 V or times out after 15 minutes. The CAB front panel battery capacity LEDs indicate the discharge time, and a relay-generated signal is sent to the OMC-R. The LEDs and relays remain active displaying the result of the last test conducted.

The internal battery capacity test is remotely initiated by short circuiting the site output relay 1 common and normally open contacts (C and NO) of PIX0. The results of the test are reported by site alarm inputs 1 to 3 to the OMC-R.

> 5 mins	PIX0 site alarm input 3 short circuit.
>10 mins	PIX0 site alarm inputs 2 and 3 short circuit.
>15 mins	PIX0 site alarm inputs 1, 2 and 3 short circuit.

Internal battery capacity test cannot be initiated if there are system alarms active, the door microswitch must be pressed to override the door open alarm. If an alarm occurs during the test, the TOPSM is reset to its normal temperature compensated operating voltage and the battery discharge test is interrupted. The CAB then responds to the alarm signal as normal.

The dip switches SW 4 inhibit or set periodicity (between 1 and 30 days) of automated internal battery capacity test, (default setting is inhibited).

NOTE	PIX0 site alarms are connected to the CAB through PL2 of the alarms interface board. PL2 is disconnected and tied back when supplied, if this functionality is required PL2 must be connected to the alarms interface board. The battery capacity test discharges the internal batteries to –44 V dc. If an external power supply failure occurs immediately after the test, the battery back up duration is reduced to approximately 3 minutes. The internal batteries recharge to approximately 80% capacity in less than one hour.

Battery selector

The battery selector switch connects two 4 mm DM sockets on the CAB front panel to the internal batteries, to allow measurement of:

- Total battery voltage.
- Individual battery voltage.
- Battery current, measured by millivolt equivalent (0.75 mV equals 1 A).

Figure 4-16 shows the battery selector test circuit.

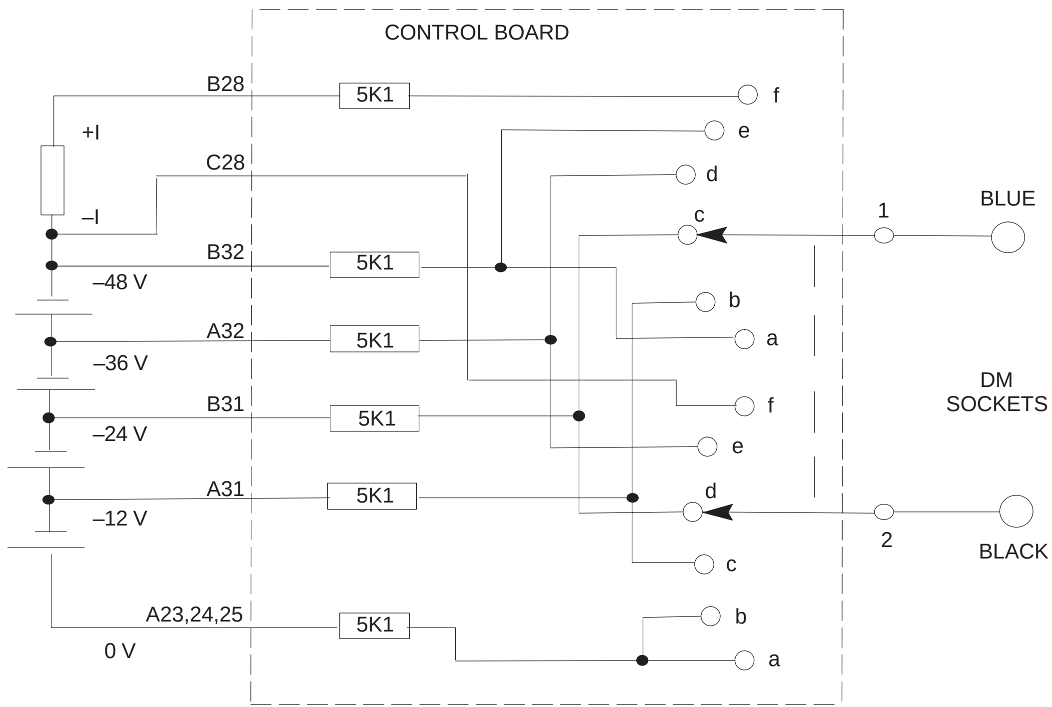

Figure 4-16 Diagram of the battery selector test circuit

Table 4-2 shows the expected DMM values for each position of the test switch.

Table 4-2 Battery selector switch test values

Test switch setting	Reading	Cell under test
a	– 48 V dc	All
b	–12 V dc	Cell 1
c	–12 V dc	Cell 2
d	–12 V dc	Cell 3
e	–12 V dc	Cell 4
f	Battery charge current	All

Debug

The CAB front panel LEDs can be remapped to indicate alarm status to assist in fault finding, particularly before connection of the Horizon*macro* site to the network. Operation of a dip switch (SW 4–5) and resetting the CAB causes the front panel LEDs to illuminate when the alarm is clear.

The CAB front panel LEDs are remapped as shown in Table 4-3

Table 4-3 Remapping of CAB front panel LEDs

Front panel LED	Colour	Debug function
15 mins	Green	Mains fail
10 mins	Green	TOPSM output
5 mins	Green	TOPSM auxiliary voltage
RADIO	Green	Not used
COMMS	Green	Not used
CAB OT	Red	Cabinet over temperature
EXT CAB OT	Red	External cabinet over temperature
SMOKE	Red	Smoke alarm
EXT SMOKE ALM	Red	External smoke alarm
STATUS	Green	Status

DIP switches

Two of the banks of DIP switches mounted on the CAB circuit board are used to configure alarm board functions (SW2 and SW4). The location on the board and exact appearance varies with manufacturer.

- SW2 used to inhibit auxiliary equipment housing and optional smoke alarm signals.
- SW4 used to inhibit or set periodicity of automated internal battery capacity test and to set the CAB into debug mode.

Table 4-4 shows the function of SW2 individual dip switches.

Table 4-4 SW2 DIP switch settings

Switch No	Function	Position
1	Auxiliary equipment housing over temperature alarm	ON to inhibit
2	Auxiliary equipment housing over temperature trip input	ON to inhibit
3	TMS 2 over temperature alarm	ON to inhibit
4	Auxiliary equipment housing door alarm	ON to inhibit
5	TMS 2 fail alarm	ON to inhibit
6	BTS cabinet smoke alarm	ON to inhibit
7	Auxiliary equipment housing smoke alarm	ON to inhibit
8	Internal/external battery temperature sensing	ON for internal

Table 4-5 shows the function of SW4 individual dip switches.

NOTE	If more than one switch is selected, delay timing is cumulative up to a maximum of 30 days. If no switches are set, the delay period is 1 day. By default, the CAB is configured with automated battery capacity test inhibited and the delay DIP switches set to 30 days.

Table 4-5 SW4 DIP switch settings

Switch No	Function	Position
1	2 day delay setting	OFF to select
2	4 day delay setting	OFF to select
3	8 day delay setting	OFF to select
4	16 day delay setting	OFF to select
5	Debug	OFF to select
6	Automated battery capacity test inhibit	ON to select

The outdoor power supply module (TOPSM)

TOPSM overview

This section describes the TOPSM used in the Horizon*macro* outdoor cabinets.

Three TOPSMs provide adequate operating power for all the modules within the base station and full battery charging (including external extended battery backup). Under normal operating conditions, two TOPSMs provide sufficient power to operate all BTS modules and trickle charge the batteries and the third TOPSM then provides redundancy.

View of TOPSM

Figure 4-17 shows a view of the TOPSM.

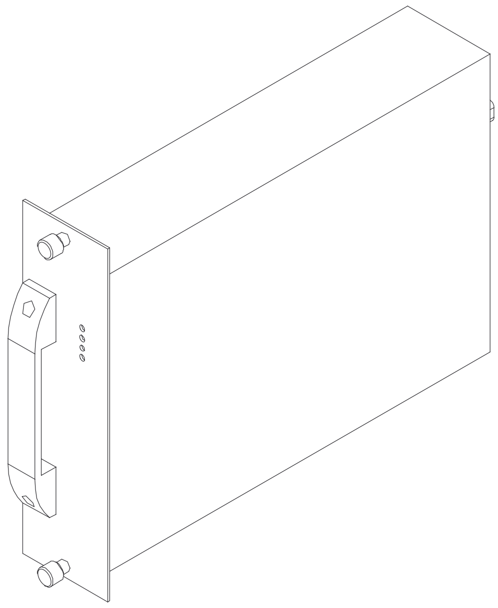

Figure 4-17 The outdoor power supply module (TOPSM)

TOPSM functional description

The TOPSM system is a power factor-corrected, wide input, ac power supply module. Each TOPSM is a switching type ac/dc power converter with the following regulated dc output:

- –55 V at 23.5 A (maximum output current).
- 1200 W (nominal).

The outputs of each TOPSM are connected in parallel by the power supply cage. The TOPSMs in the system actively share the load.

The regulated dc output is fed through the multilayer busbar to the interface panel and the dc circuit breaker panel to power the base station.

LED display

There are four LEDs mounted on the front of the TOPSM, which indicate the following:

- **I/P HEALTHY** (yellow) - lit when the input voltage is present and within specified limits (88 to 264 V ac).
- **OVERVOLTAGE** (red) - lit when the TOPSM has shut down due to an output voltage in excess of –59.9 V dc.
- **OVERCURRENT** (red) - lit when the TOPSM is in current limit and delivering a current in the range 22 A to 24 A. The LED is normally unlit, but when lit does not necessarily indicate the existence of a fault as this may be due to recharging of the batteries after an ac supply interruption.
- **O/P HEALTHY** (green) - lit when output voltage is present and within specified limits (–39 to –59.9 V dc).

Functional diagram

Figure 4-18 shows a functional representation of the outdoor power supply module (TOPSM).

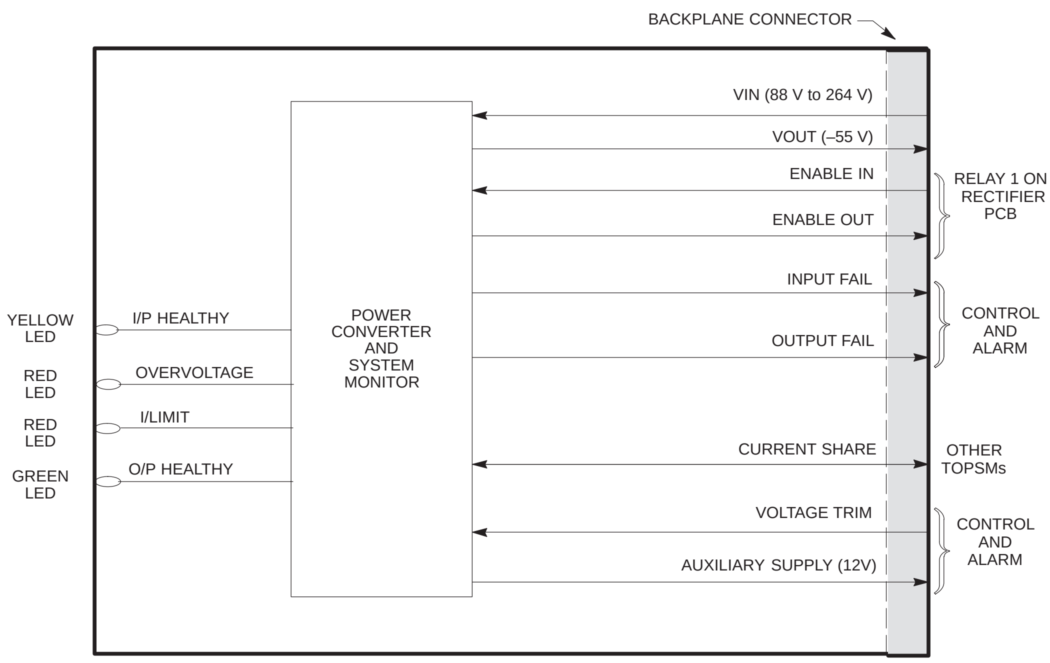

Figure 4-18 Functional diagram of TOPSM

Monitoring

Internal

Internal TOPSM circuits monitor for the following:

- –55 V output voltage regulation.
- The –55 V output is also regulated to provide temperature compensation for the float charging of the internal batteries (battery backup) in the range –52.88 V at 40 °C to –56.72 V at 0 °C.
- Overvoltage protection – provides shutdown if the output voltage exceeds –59.9 V.
- Overcurrent protection – provides constant current limiting at 22 to 24 A, unless output voltage drops below 39.6 V, when the output current will fold back to between 3 and 8 A.
- Enable control of TOPSM from the control and alarm board.

External

The control and alarm board monitors common alarm signals generated by the changeover relays fitted within the TOPSMs. The possible alarms are:

- Mains input fail - This alarm is active if all the fitted TOPSMs lose their input supply or the input drops below their operating minimum value.
- DC output fail - This alarm is active if the output from one or more fitted TOPSMs fails, or goes outside the preset tolerance level.

Alarm conditions generated by the TOPSM may be detected by one of the red LEDs being lit, or by the dc output fail and mains input healthy LEDs being unlit.

Protection circuits

Activation of the protection circuits causes the TOPSM to shut down. During a shutdown, the output circuits of the malfunctioning TOPSM are isolated and its output healthy LED is switched off. The malfunctioning TOPSM informs the control and alarm board of the shutdown condition. An alarm signal is also activated and sent to the control and alarm board if all TOPSMs detect loss of ac input voltage. After an alarm condition has ceased, normal TOPSM operation is automatically restored.

Thermal protection

The TOPSM is provided with additional internal thermal protection. If the ambient temperature of the TOPSM exceeds a safe level then it shuts down, causing an alarm message to be sent to the control and alarm board. Normal TOPSM operation resumes after the temperature returns to a safe level.

Control and alarm signals

The following signals are associated with TOPSM control and alarms:

- Enable out

  An independent –55 V output from each TOPSM commoned together and connected to the normally closed contacts of the disable relay (relay 1), on the backplane of the power supply unit cage.

- Enable in

  This signal, fed from the normally closed contacts of the disable relay (relay 1) on the backplane of the power supply unit cage, enables the TOPSM output (the relay is operated by the the control and alarm board under fault conditions).

- Voltage trim

  A variable voltage signal, generated by the control and alarm board, used to regulate the TOPSM output in order to produce a temperature compensated battery charging voltage, to ensure that the internal or external batteries are not overcharged.

- Current share

  A signal representing the average current for the total system. Each TOPSM compares its output current with the average current and adjusts its output voltage so as to equalize its output current with the average system current.

- Auxiliary supply

  A 12 V supply independent of the TOPSM output, but referenced to it, used to power the control and alarm board circuitry when the TOPSM output is inhibited.

- Input healthy

  The normally open contact of the isolated changeover relay used to indicate that the input is within specification.

- Output healthy

  The normally closed contact of the isolated changeover relay used to indicate that the output is within specification.

TOPSM pinouts

Table 4-6 lists the TOPSM pinout connections.

Table 4-6 TOPSM pin connections (29-way Elcon)

Pin No	Signal/Description	Pin No	Signal/Description
1	+0 V output	16	Relay N/C (TOPSM output healthy)
2	–55 V output	17	Relay N/O (TOPSM mains input healthy)
3	Not connected	18	Not connected
4	Not connected	19	Not connected
5	Voltage trim	20	Not connected
6	Link enable input	21	Opto input
7	Not connected	22	Forced current share
8	Not connected	23	Not connected
9	Link enable output	24	Not connected
10	Not connected	25	Opto common
11	Not connected	26	Earth
12	Not connected	27	Not connected
13	+12 V auxiliary supply	28	AC input (neutral)
14	Not connected	29	AC input (live)
15	Relay common		

Power supply module (PSM)

PSM overview

The PSM is a dc to dc converter, providing a stabilized +27 V output to power all the main cage equipment.

Only one type of PSM is used in the Horizon*macro* outdoor:

- Nominal –48 V (positive earth).

The PSMs are fed from a backplane connector, and use pulse width modulation to generate output supply. A front panel switch (shown in Figure 4-19) disables the output, reducing the input current as shown in Table 4-7.

Table 4-7 Input currents for power supply module

Type of PSM	Output voltage full load	Input current full load	Input load when output switch off
–48 V nominal dc	+27 V	18 A	0.5 A

NOTE	There are several manufacturers of the PSMs. Each is fully compatible with the same type of PSM of a different manufacturer.

PSM location and redundancy

The PSMs are located above the digital cage and circuit breaker module. There are three slots, two for maximum main cage configuration and one for redundancy. Table 4-8 shows the recommended number of PSMs for different operational configurations.

Table 4-8 PSM operational configurations

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

PSM module view

Figure 4-19 shows a view of the PSM with LEDs identified.

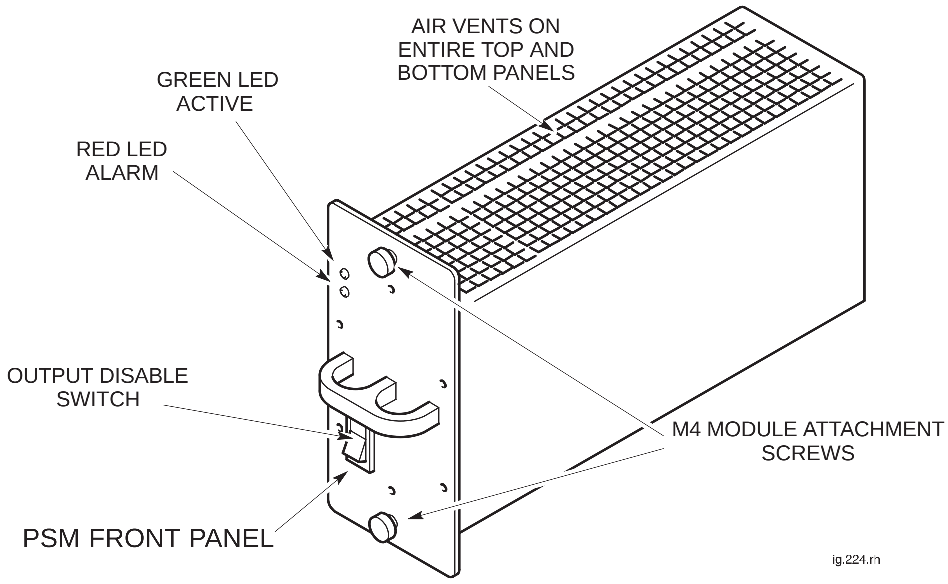

Figure 4-19 View of PSM

PSM alarms

There are three alarms for each PSM, indicated by LEDs (see Table 4-9):

- Output fail.
- Input fail.
- Over temperature.

PSM LEDs

The PSM LEDs function with the properties shown in Table 4-9.

Table 4-9 Power supply module LEDs function

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

PSM backplane protection

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

Circuit breaker module (CBM)

CBM overview

The CBM provides circuit protection and manual isolation for the CTUs, SURF and BPSMs. The CBM is located above the digital module shelf and below the PSMs. The honeycomb casing permits cabinet ventilation through the module.

The CBM is connected to the backplane, providing isolator switches and overload protection for equipment indicated on its front panel (see Figure 4-20).

View of the CBM

Figure 4-20 shows views of the CBM with circuit breaker buttons identified.

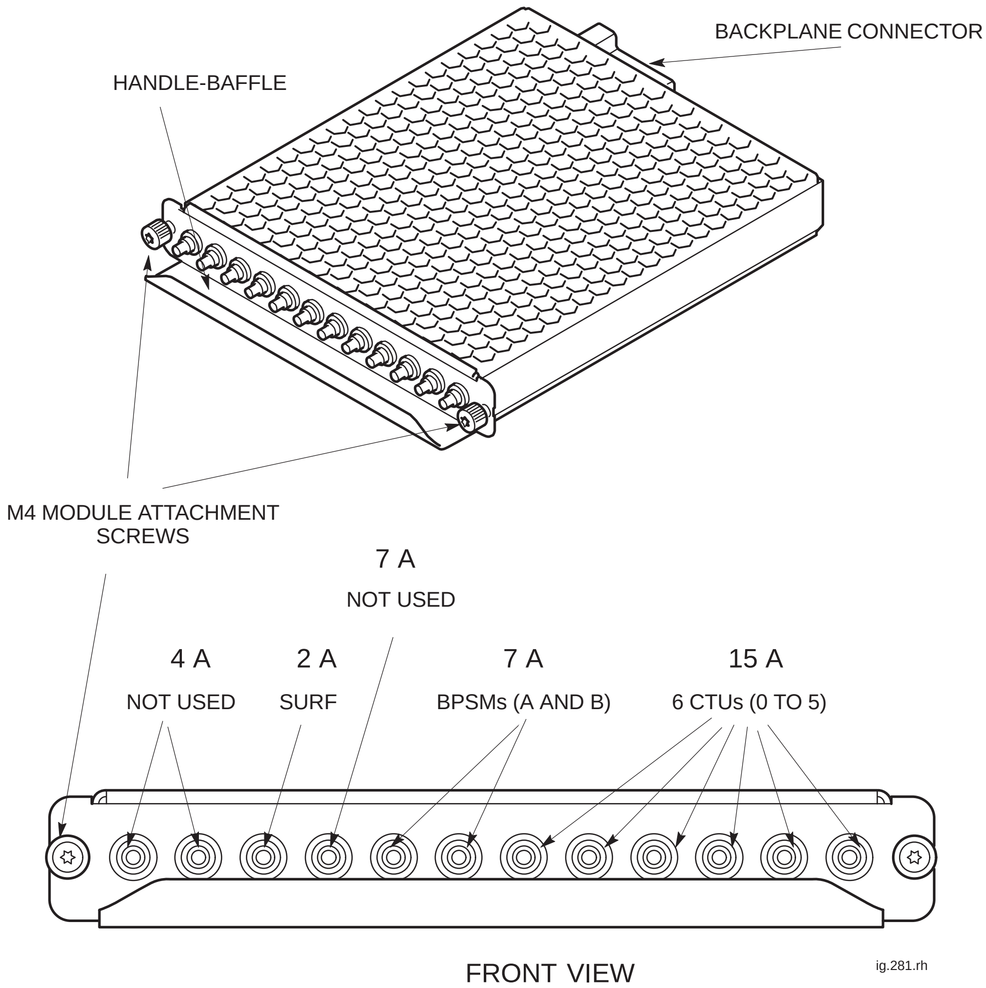

Figure 4-20 Views of CBM with circuit breaker buttons identified

Operation of the CBM

Power for each module is supplied via the appropriate circuit breaker switch. Overload of any circuit results in appropriate front panel 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.

CTUs, BPSMs, and the SURF 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.

MicroBCU power supply module (BPSM)

Introduction to the BPSM

This section describes the μBCU power supply module (BPSM). The BPSM, located in the digital module shelf of the main cage, supplies regulated dc power to the digital modules.

A single master BPSM mounted in the lower half of the digital module shelf can provide sufficient power for:

- One MCUF.
- One FMUX.
- Two NIUs.
- The alarm module.

An optional second BPSM can be fitted in the upper half of the digital module shelf to supply any or all of the following:

- Backup power to the alarm module, which is the only digital module supplied by both BPSMs (for redundancy).
- Optional redundant MCUF and associated FMUX.
- Power for up to two additional NIUs.

During normal operation, with all the outputs within their regulation limits, a green LED located on the front panel is illuminated. No alarms are generated by the BPSM.

BPSM diagram

Figure 4-21 shows a BPSM.

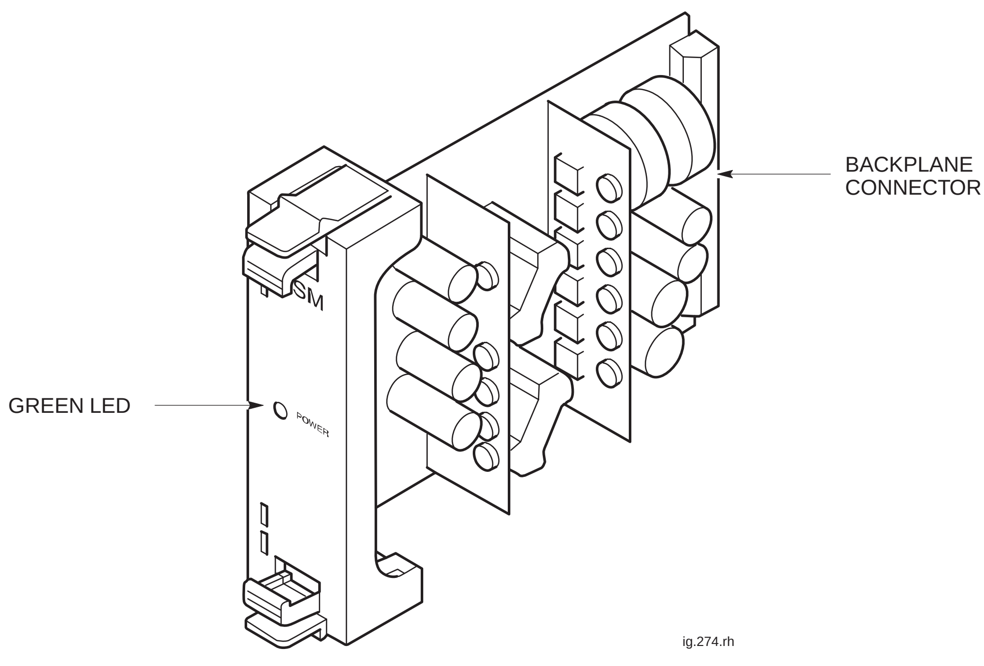

Figure 4-21 BPSM view

Functional description

The BPSM is a switching type dc/dc power converter that converts the cabinet +27 V dc power to the following regulated dc outputs:

- +3.3 V ± 1 % at 10 A (full load current)
- +5 V ± 2 % at 10 A (full load current).
- +12 V ± 5 % at 4 A (full load current).
- –12 V ± 5 % at 2 A (full load current).

Internal BPSM circuits monitor the +3.3 V, +5 V, +12 V and –12 V outputs for the following purposes:

- Output voltage regulation.
- Overvoltage protection - provides shutdown if the output voltage exceeds 1.1 to 1.2 times the rated output.
- Overcurrent protection - maximum output current has the following limits:
  - 1.1 to 1.8 times full load rating of +3.3 V output.
  - 1.1 to 1.8 times full load rating of +5 V output.
  - 1.25 to 2 times full load rating of +12 V and –12 V outputs.

Circuit protection

Additional internal circuitry protects the BPSM:

- Input dc reverse polarity protection, achieved by an input series diode.
- Thermal protection by automatic BPSM shutdown. Normal BPSM operation resumes after BPSM temperature returns to a safe level.
- A 10 A fuse is located near the backplane connector.

LED display

An active (green) LED mounted on the front of the BPSM is lit when all output voltages are present and within specified limits. A functional diagram is shown in Figure 4-22.

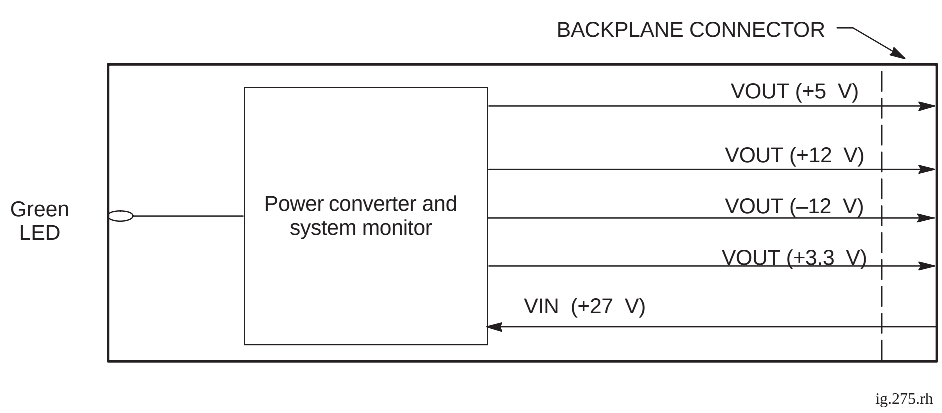

Figure 4-22 Functional diagram of BPSM

Chapter 5

RF modules

Chapter 5

RF equipment detail

Overview of RF equipment

This chapter describes the functional operation of the Radio Frequency (RF) modules used in the cabinet.

The RF equipment provides a transmit and receive path between the Mobile Station (MS) and the cabinet transceiver. All descriptions are presented at a block diagram level.

RF modules

The following RF modules are described in this chapter:

- Compact Transceiver Unit (CTU).
- Sectorized Universal Receiver Front-end (SURF) module (for receive path), both single and dual band variants.
- Several types of transmit block, with the generic name of Tx block. Tx blocks are used for various configurations of the transmit path, depending on the number of antennas, transceivers and functionality.

RF general information and loopback test function

The following additional information is presented in this chapter:

- General definition of transmit and receive functions in this **RF equipment detail** section.
- An **RF overview and RF test function** description in the next section.
- An explanation of **CTU frequency hopping** in a section immediately after the CTU section.

These sections 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** part of this manual.

Receive (Rx) RF hardware

Receiver RF hardware consists of the SURF module and optional Tx block receive path, and the receive section of the CTU.

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

CTU Rx role

The CTU 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 MCUF for routeing to the MSC.
- Digital interface to the SURF module, which controls selection by the SURF 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.

CTU Tx role

The CTU 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. Duplexers exist within several of the transmit blocks. Normally duplexed RF signals are used 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 SURF. Simply switching off diversity at the OMC-R without the correct SURF configuration will cause a loss of reception.

RF overview and RF test function

RF overview

This section explains the RF functional blocks and additional RF loopback test capability.

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

RF main component explanation

The following description should be read in conjunction with Figure 5-1.

The RF equipment consists of three main blocks:

- The CTU.
- The SURF module.
- The Tx block.

CTU

The CTU can operate at 850 MHz, 900 MHz, 1800 MHz or 1900 MHz, depending on the BTS variant ordered. It can receive two inputs, RxA and RxB, from the SURF. These inputs are converted into digital voice/data. The two Rx signals provide diversity of the Rx function from the MS (uplink).

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

The third (middle) port provides an RF loopback test signal capability, for automatic transmission of RF test signals to the SURF.

SURF modules

One of six variants of the SURF module can be installed in the Horizon*macro* outdoor:

- Single band 850 MHz SURF.
- Single band 900 MHz SURF.
- Dual band 900 MHz SURF.
- Single band 1800 MHz SURF
- Dual band 1800 MHz SURF.
- Single band 1900 MHz SURF.

The single band SURF modules accept up to three pairs of antenna inputs, and the dual band SURF modules accept up to four pairs of antenna inputs. The SURF switches the inputs to the appropriate CTUs under the control of the database via the MCUF. There are two inputs to each CTU for Rx diversity.

The SURF also contains loopback test circuitry, connecting with a test signal from each CTU.

Tx block

There are up to three Tx blocks, each block serving two CTUs.

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

RF loopback test function

The loopback test function is primarily used to identify faults when the RF system has failed. The loopback test function enables 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).
- Particular hardware (CTU or SURF).

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

NOTE	The RF loopback test feature available on the Horizon*macro* is not available on previous generations of equipment.

RF loopback hardware

The RF loopback test function is essentially a hardware capability built into the CTU and the SURF. Software instructions activate the test hardware, to route test signals through the RF system.

RF loopback software operation

When installed with suitable software, GSR5 or later, the OMC-R can operate the loopback test functions, and receive the results of the tests.

Functional diagram of RF

Figure 5-1 shows the basic RF and loopback/VSWR test functions. For clarity, only one CTU and one Tx block is shown, together with part of the SURF.

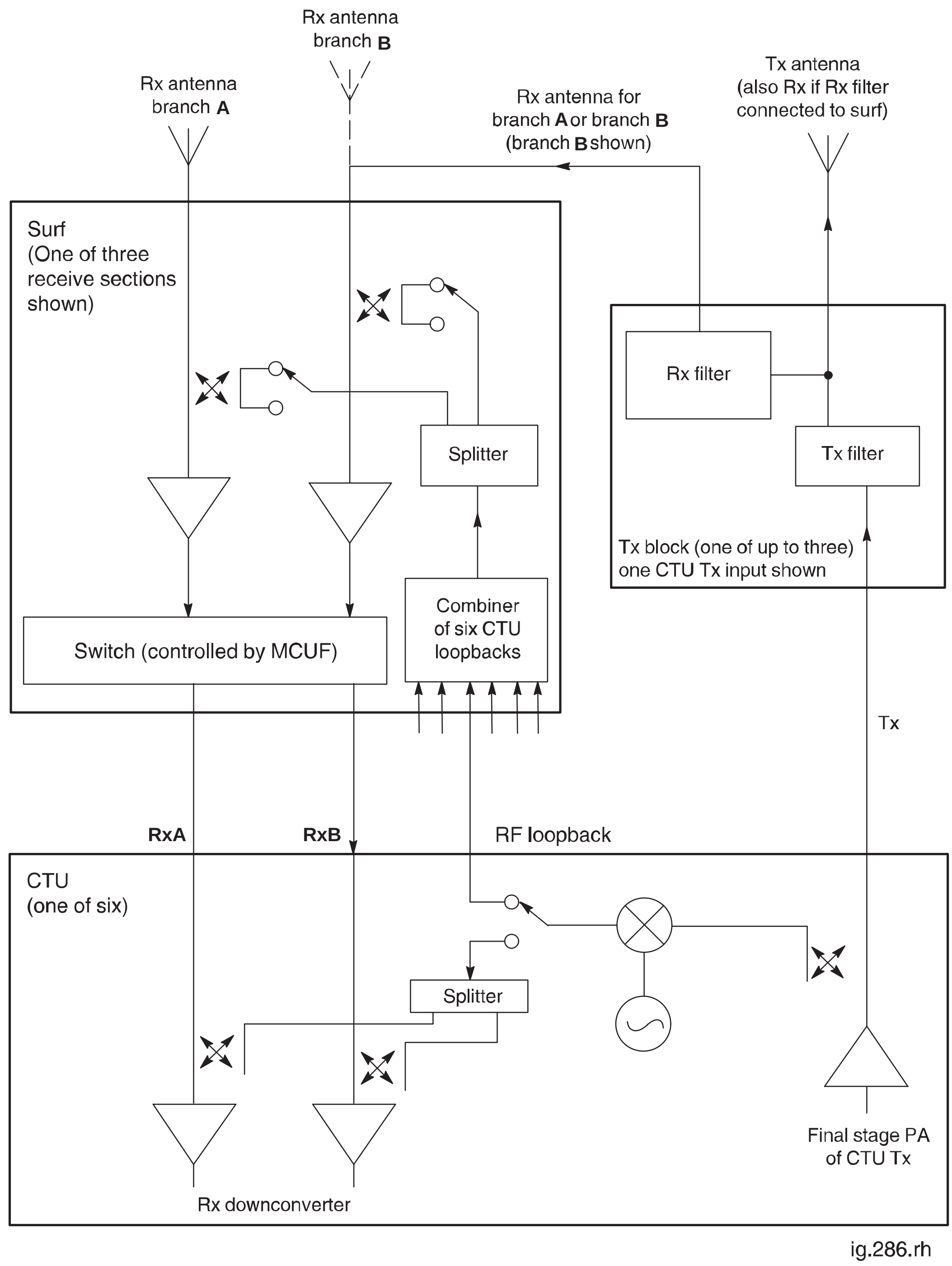

Figure 5-1 RF functional diagram

Description of RF test modes

The following description should be read in conjunction with Figure 5-1.

NOTE	The RF test capability described requires software load GSR5 or later.

The loopback test hardware picks up an attenuated signal by coupled link from the normal CTU transmit signal.

The signal is mixed down to the receive band for testing the Rx functionality of the SURF and CTU. Power to the loopback circuitry is automatically turned off when the radio is in normal operation.

SURF test mode

The loopback signal is injected into the antenna receive path of the SURF by coupled link. This tests the complete SURF and CTU Rx system path.

Test of CTU Rx circuitry

The loopback signal is injected directly into the Rx input of the CTU. This tests the receive circuitry of the CTU.

VSWR test mode

The test signal, at Rx frequency, is injected into the antenna port through a coupled link on the SURF. Reflected power is monitored by the receive system to calculate VSWR. Detection of a high VSWR may indicate the presence of a cable or antenna fault.

Compact transceiver unit (CTU)

Overview of the CTU

This section provides the technical description of the CTU.

NOTE	The CTU may be an 850 MHz, 900 MHz, 1800 MHz or a 1900 MHz transceiver, depending on requirements. The functionality of the CTU is the same for all variants.

The CTU:

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

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

- Diversity reception capability (input from two antennas). This improves the reception quality in the presence of multipath fading and interference.
- Frequency change on a timeslot basis for frequency hopping and equipment sharing.
- Transmit power control.

CTU Tx RF output specification

For Tx RF output, see *Technical Description: GSM-205-323* **Specifications**.

Location and requirements

The CTU shelf is adjacent to the digital module shelf in the base of the cabinet.

The cabinet can contain six CTUs. A minimum of one CTU must be fitted in each cabinet.

CTU internal boards

The CTU is a single Field Replaceable Unit (FRU), which contains:

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

Alarm reporting

The CTU status is displayed by LED indicators on the front panel, as shown in Figure 5-2, and detailed in Table 5-1. Major sub-systems, such as synthesizers and RF amplifiers, are monitored with alarm signals as necessary.

Table 5-1 CTU front panel status indicators

Indicator LED	When the LED is	Then CTU
RADIO STATUS	OFF	Module off
	Flashing green	Code required or being loaded
	Green	Normal operational mode
	Flashing yellow	Test mode
	Yellow	Radio inhibited
	Red	Alarm condition
Transmit (Tx) STATUS	OFF	Transmitter is off
	Yellow	Transmitter is keyed on
RADIO STATUS AND TRANSMIT (Tx) STATUS	Both LEDs flashing rapidly	Non-volatile memory boot code upgrade (Do not remove power nor reset) (see CAUTION)

CAUTION	When both LEDs are flashing, the boot code is downloading into non-volatile memory for software upgrade. Power should not be removed, nor the cabinet reset, 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.

View of CTU

Figure 5-2 shows a CTU with its main features identified.

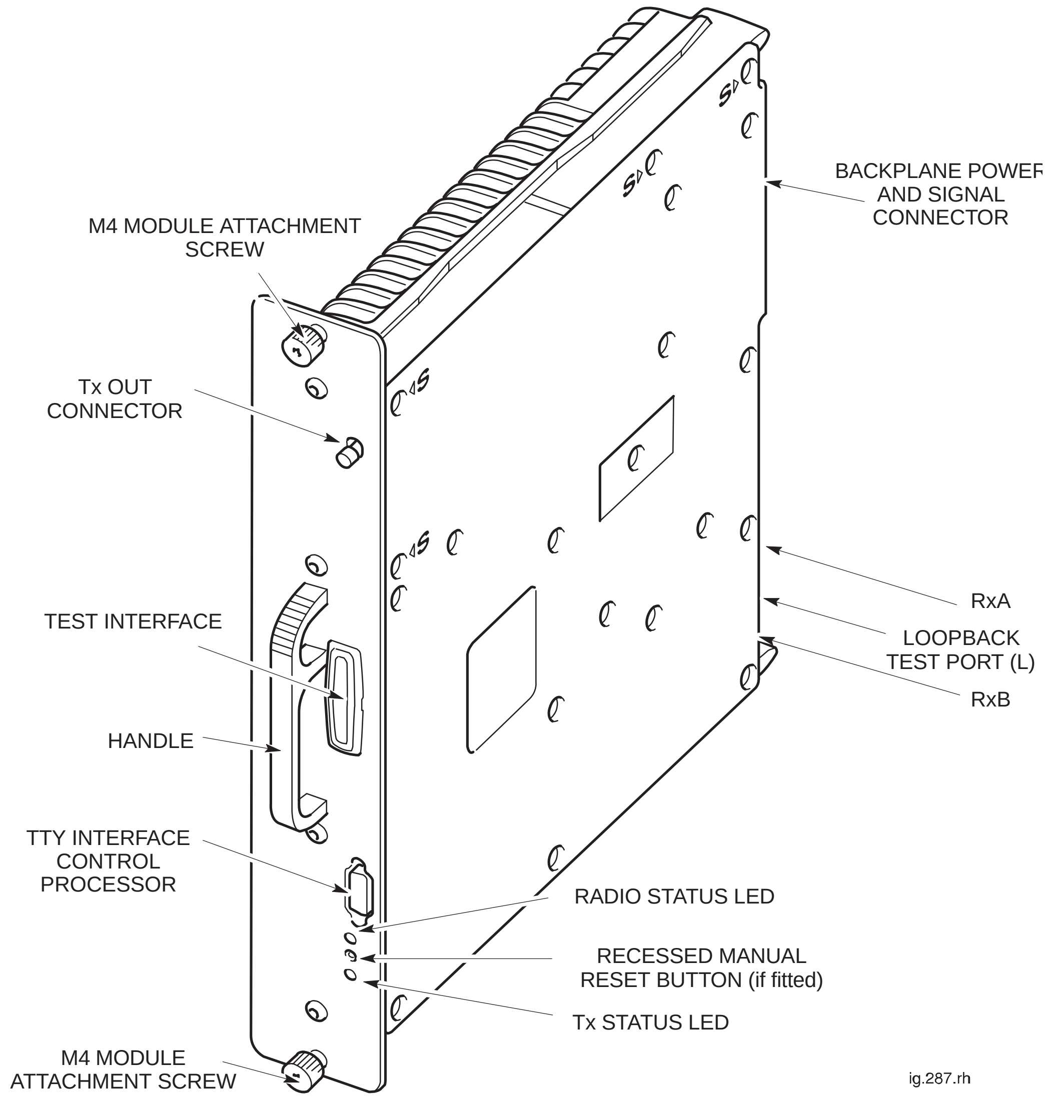

Figure 5-2 View of CTU showing main external features

CTU connectors and reset

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 CTU front panel provides access to critical test points for factory alignment and maintenance.

Pressing the reset push button generates a hard reset of the processor, initiating a normal power-up. Later versions of the CTU (mid 2001 onward), have no reset button, reset is acheived by operation of the appproriate CTU circuit breaker on the CBM.

Figure 5-3 shows the front panel and Table 5-2 shows connector functions.

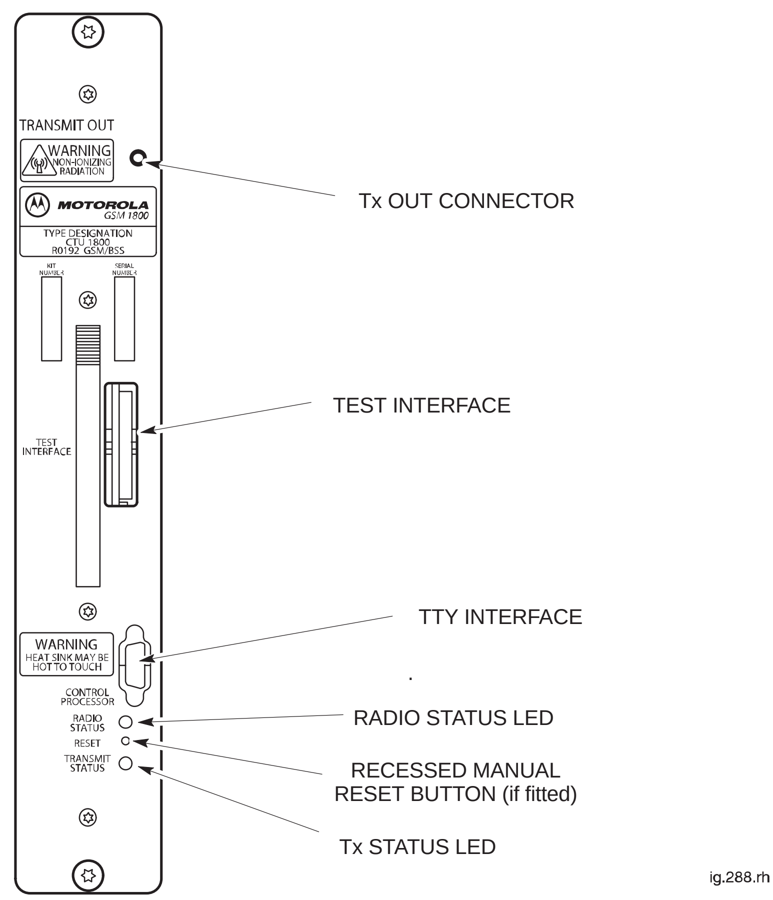

Figure 5-3 CTU front panel showing connectors and reset button

Table 5-2 CTU 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

CTU input/output diagram

Figure 5-4 shows a block diagram of the CTU with the inputs/outputs annotated.

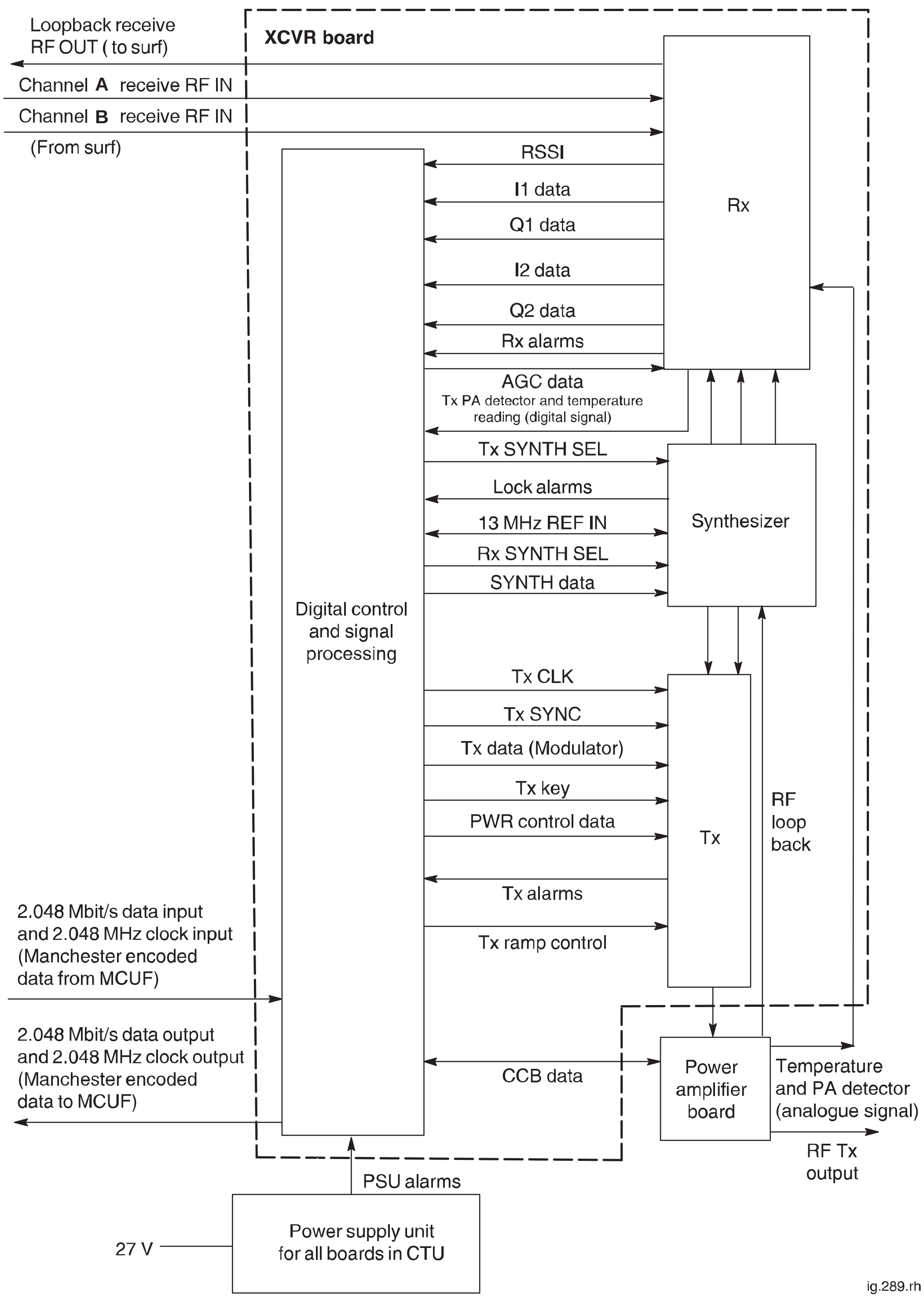

Figure 5-4 CTU block diagram

CTU Tx connector

The CTU Tx connector is a short SMA to SMA link to the base of the appropriate Tx block or feed through 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 a CTU.

CTU Rx function

The receiver part of the CTU accepts two amplified and filtered receive antenna signals from the SURF module. These two signals are applied to inputs (branch A and branch B) of the CTU transceiver board. Figure 5-5 shows a CTU receiver functional diagram for one branch.

The input from the SURF module is filtered to ensure the signal level and frequency range are correct for the next stage.

RSSI data is used for Automatic Gain Control (AGC) to ensure signal strength is correct for the Intermediate Frequency (IF) stage.

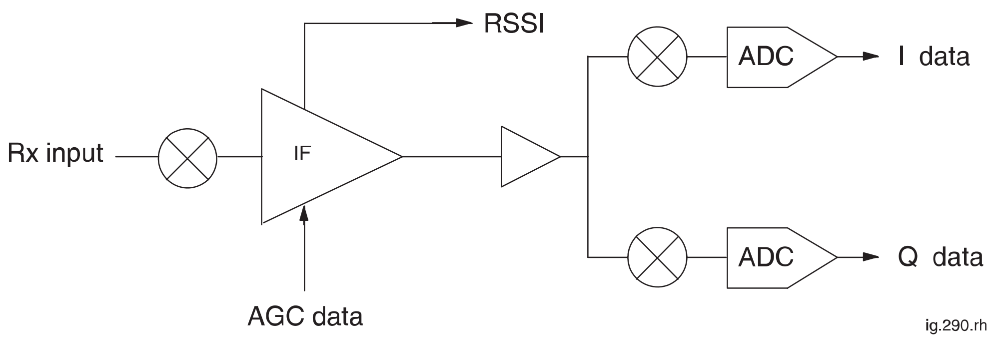

Figure 5-5 CTU receiver functional diagram for one branch

The primary signal flow of the IF is to support traffic and control data.

The path is demodulated into quadrature signals and filtered by baseband analogue filters. These signals are then digitized (I1/I2 data and Q1/Q2 data) and made available to the equalizer for the purposes of receive synchronization and data recovery.

CTU Tx function

IQ modulator

Figure 5-6 shows a functional diagram of the IQ modulator. IQ modulator data for eight timeslot channels is applied to the modulator state machine. This data is encoded, serial-to-parallel converted, Gaussian filtered and split into quadrature components. The quadrature components are D/A converted and applied to a quadrature modulator to create a Gaussian Minimum Shift Keyed (GMSK) carrier at an intermediate frequency.

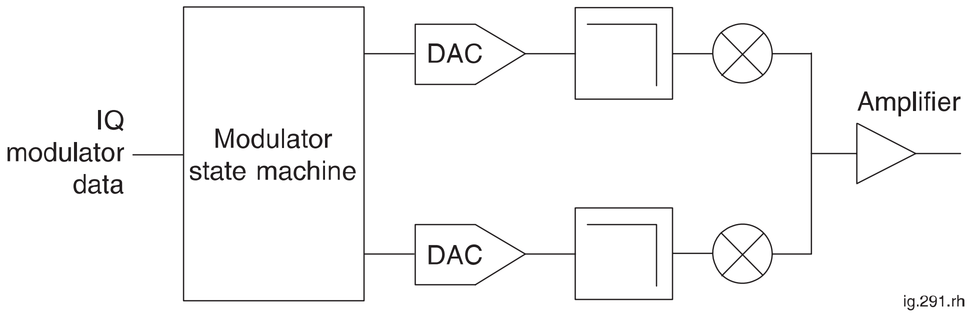

Figure 5-6 IQ modulator functional diagram

IF and exciter stages

Figure 5-7 shows a functional diagram of the IF and exciter stages. The low level modulated carrier is applied to a combination of analogue and digital attenuators for RF power control. The power control data comes from the digital sections of the XCVR. The output of the power control elements is further amplified by an exciter chain to drive the power amplifier.

The GMSK modulated IF is filtered and applied to the input of a controlled gain amplifier for transmitter pulse sloping (ramped). The ramped signal is filtered and then mixed with the main transmitter injection and is up converted to the final transmit channel frequency.

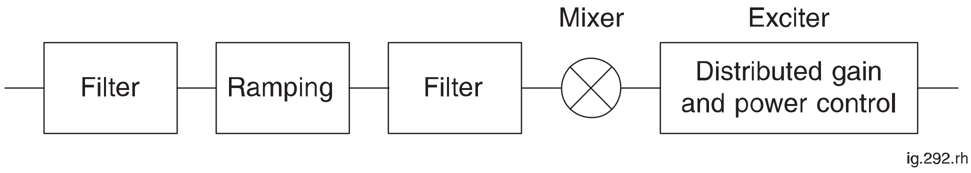

Figure 5-7 IF and exciter functional diagram

Power amplifier board

Figure 5-8 shows a functional diagram of the power amplifier (PA). The PA board provides amplification and a forward power detector. The isolator protects the PA board amplifiers. The detected output is used to adjust the final CTU RF power output level by the digital sections of the XCVR.

The PA board consists of six functional blocks:

- RF power amplifier.
- RF forward power directional coupler.
- RF forward power detector.
- Temperature sensor.
- CCB control.
- RF loopback circuit.

The isolator performs two functions:

- Isolates multiple transmitters to reduce intermodulation distortion.
- Protects the RF power amplifier from possible damage resulting from load mismatches.

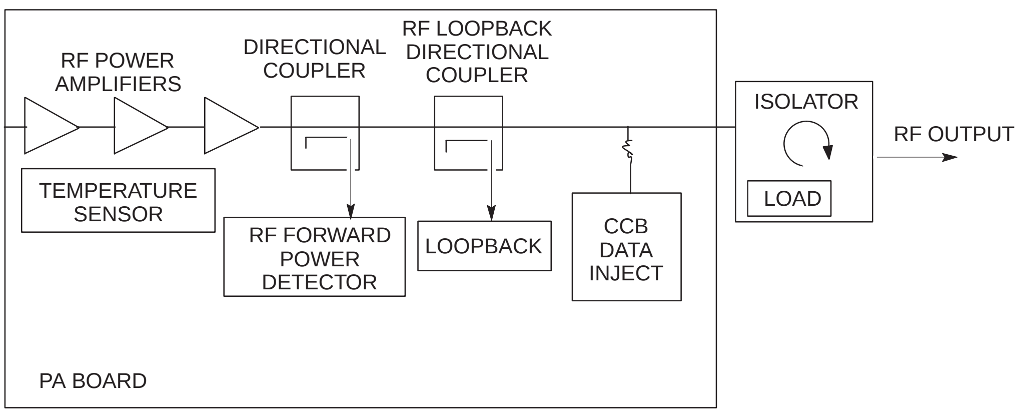

Figure 5-8 Power amplifier board functional diagram

CTU digital processing and control functions

The CTU digital processing and control function provides control and RF processing for that CTU. These functions include:

- 2.048 Mbit/s links which interface with up to two MCUFs for redundancy.
- A software processing platform for the Radio Sub System (RSS)
- Digital Signal Processors (DSPs) for radio control and channel equalization (EQCP).
- DSPs for channel coding, data routeing, and baseband hopping (CCCP).
- Control of RF systems: diversity receiver, transmitter, and power amplifier.
- Alarm monitoring of internal devices and external cabinet elements.
- Control of external modules, including CCBs (not used in the Horizon*macro* outdoor) and the SURF.
- Maintenance ports for processor TTY, test point sub system, and CTU test connections.

Figure 5-9 shows a CTU digital functional diagram.

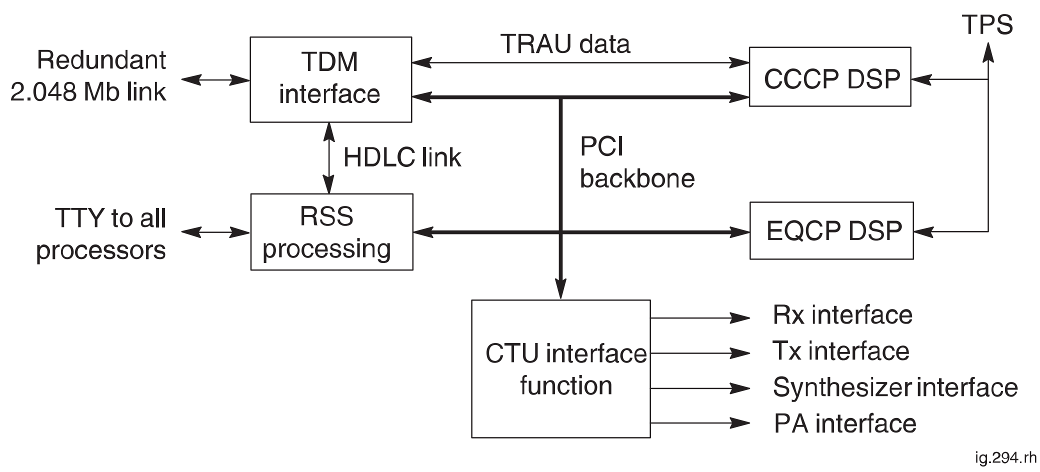

Figure 5-9 CTU digital functional diagram

2 Mbit/s TDM Links

The CTU interfaces to the redundant MCUF are by 2.048 Mbit/s links on the backplane (or FMUX modules in extension cabinets). These links are Manchester encoded, thus providing both clock and data in a single connection. The recovered clock provides a frequency reference for the CTU. The Rx and Tx circuitry supports FMUX fibre optic lengths of up to 1 km.

The TDM links are formatted into 32 x 64 kbit/s timeslots to provide:

- Downlink and uplink TRAU speech data.
- Downlink baseband hopping data to be routed to/from other CTUs.
- Cell site air interface synchronization.
- HDLC channel for control information between RSS and MCUF.
- Baseband routeing information to indicate source of downlink baseband hopping data.

RSS processor

The RSS processor function communicates with:

- The MCUF via dedicated 64 kbit/s timeslots in the TDM link.
- The rest of the digital control functions by the peripheral communications interface (PCI) bus.
- A dual port interface for communication with the CCCP.

A TTY interface is also provided for user support.

The RSS processor memory includes flash EPROM and 8 Mbytes of DRAM. Flash EPROM is used for code storage.

EQCP processor

The EQCP processor handles all radio control functions and the channel equalizer function. The EQCP controls the Rx and Tx function via the CTU control function on a per timeslot basis. These EQCP functions include:

- Alarm management.
- Downlink burst building and modulator control.
- Transmitter power control.
- Synthesizer channel control.
- RF frequency hopping.
- Receiver front end and remote tune combiner control.
- Uplink synchronization and equalization.
- Diversity receiver control.
- Receiver Automatic Gain Control (AGC).
- Receive signal strength (RXLEV) calculation.
- Timing advance calculation.
- Support of front panel indicators.

The EQCP communicates with the rest of the digital control functions via the common PCI bus interface. A TTY interface is provided for radio level calibration, system monitoring, and CTU level test.

CCCP processor

The CCCP processor handles all the GSM specified layer 1 channel encoding and decoding functions for speech and control data associated with the air interface. In addition, it manages the routeing of TRAU frames and baseband hopping (BBH) data, via the TDM interface, to and from the MCUF. The CCCP functions include:

- Uplink channel decoding.
- Downlink channel encoding.
- GSM specified encryption algorithms.
- Baseband frequency hopping (not supported in GSM850 or PCS1900 BTS variants).
- TRAU frame collection and synchronization.
- Alarms management.

The CCCP communicates with the rest of the digital control functions via the common PCI bus interface. A dual port RAM (DPR) is also used in the downlink direction for communications from RSS. In addition to the TDM function, a serial link is provided to support uplink and downlink TRAU data.

CTU interface function

The CTU interface function provides the air interface timing and radio control circuitry required for Rx (uplink) and Tx (downlink) control functions. A common PCI bus allows all the processing elements, including the RSS processor, EQCP, and CCCP, to communicate with the various CTU functions. The CTU 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 and remote tune combiner 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.
- CTU and cabinet alarm data collection.
- Alarms sampling and multiplexing.

CTU uplink/downlink

Downlink traffic data flow

Downlink TRAU data is received by the TDM function from the MCUF. This data is then routed to the CCCP function, where it is encoded (cyclic, block, and convolutional), interleaved, and encrypted to GSM recommendations. Signalling messages are also received from the RSS processor and encoded. These traffic and control messages are built into air interface frames and then routed back to the MCUF via the TDM function for baseband hopping. The CCCP calculates a BBH routeing word, which informs the MCUF as to which fibre link it would like to be the source of its post-hopped data. The post-hopped data is then once again sent back down to the appropriate CTU where it is received by the TDM function and passed to the EQCP function. The EQCP inserts training sequence and guard bits to the data bits and forwards the data on to the modulator for transmission. The EQCP also programs the CTU for the correct RF channel and transmit power level for this transmitted burst.

Uplink traffic data flow

Baseband uplink traffic and control data messages are received by the CTU interface function and sent to the EQCP where they are equalized. The EQCP also calculates timing advance and RXLEV information, which is forwarded to the RSS process. The recovered data bits are forwarded into the CCCP process, where it is de-interleaved, decoded, and decrypted into TRAU frames. Control messages are passed to the RSS function, while TRAU frames are sent to the MCUF via the TDM interface.

CTU frequency hopping

Overview of CTU frequency hopping

The CTU supports two types of frequency hopping, Synthesizer Frequency Hopping (SFH) and BaseBand frequency Hopping (BBH). This section provides an explanation of both types.

In both cases, 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.

Synthesizer frequency hopping (SFH)

SFH uses the frequency agility of the CTU to change Tx/Rx frequency on any timeslot (TS), without affecting other timeslots.

Only wideband (CBF/Hybrid) combining can be used with SFH.

With SFH, each TS is allocated a number of frequencies (max 64) over which to perform the hopping. When determining the hardware requirement for CTUs using SFH, the following rules apply:

- A minimum of two CTUs are required per cell due to BCCH requirements. Timeslot 0 of CTU 0 is used for the BCCH carrier as shown in Figure 5-10. CTU 0 cannot use SFH. Only CTU 1 and additional CTUs can use SFH.
- Hopping through the BCCH carrier (using the BCCH carrier frequency as one of the SFH frequencies) is permitted except for timeslot 0. However, the corresponding timeslot for the BCCH CTU will be switched off for this period.

Figure 5-10 shows the minimum SFH requirement.

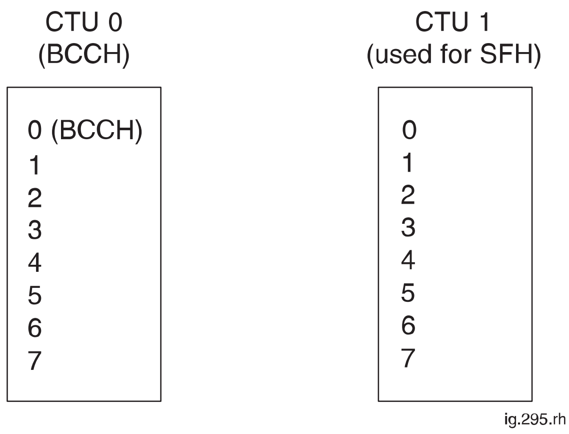

Figure 5-10 Minimum SFH requirement

SFH example not through BCCH

CTU 0

In this example of SFH, CTU 0 provides the BCCH and cannot frequency hop. CTU 0 has to transmit at maximum cell site power to meet the BCCH requirement. Timeslots are used as shown below:

- TS 0 = Combined BCCH TS (BCCH/CCCH/DCCH). Transmitted at maximum cell site power.
- TS 1-7 = Traffic channels, all non-hopping. All traffic channels transmit at maximum cell site power.

CTU 1 and additional CTUs

CTU 1 and any additional CTUs provide SFH traffic channels as shown below:

- TS 0-7 = Frequency hopping traffic channels. The frequency allocated to the BCCH of CTU 0 cannot be used for frequency hopping purposes.

SFH example hopping through BCCH carrier

CTU 0

In this example of SFH, CTU 0 provides the BCCH and cannot frequency hop. CTU 0 has to transmit at maximum cell site power to meet the BCCH requirement. Timeslots are used as shown below:

- TS 0 = Combined BCCH timeslot (BCCH/CCCH/DCCH). Transmitted at maximum cell site power.
- TS 1-7 = Unused timeslots transmitting dummy bursts for BCCH. All channels transmit at maximum cell site power.

CTU 1 and additional CTUs

CTU 1 and any additional CTUs provide SFH traffic channels as shown below:

- TS 0 = Frequency hopping traffic channel, but prevented from using BCCH frequency.
- TS 1-7 =Frequency hopping traffic channels, using all available frequencies, including BCCH.

When the SFH selects the BCCH frequency, the CTU transmits at maximum cell site power and the corresponding TS on CTU 0 is switched off for this period.

Baseband frequency hopping (BBH)

BBH requires all eight timeslots of the CTU Tx (downlink) at the same frequency. In the Rx (uplink) direction, the frequency agility of the CTU is used to change timeslot frequencies on a timeslot basis. The BCCH frequency is always transmitted at maximum cell site power.

BBH can use either Tx blocks or CCB Tx combining equipment. 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 CTUs required to support BBH is equal to the number of frequencies used.

NOTE	BBH is not supported on GSM850 or PCS1900 BTSs.

BBH example

In Figure 5-11 MSs A, B and C are using TS 5 of CTUs 0, 1 and 2 respectively.

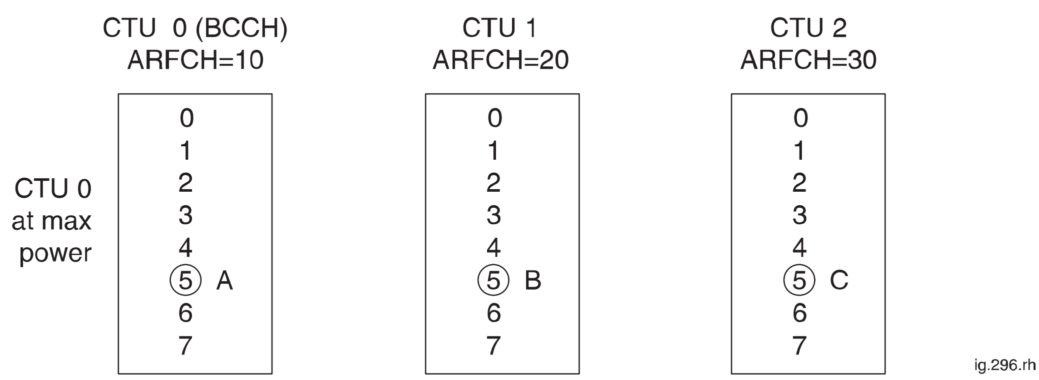

Figure 5-11 Diagram of BBH example using three CTUs

If the MSs are using cyclic hopping across ARFCNs 10, 20, 30 (an example using EGSM900), each MS must transmit a burst of information each TDMA frame (4.615 ms) on a different frequency. The data for the burst is received by each CTU in turn (ARFCN 10, 20, 30), as shown in Table 5-3:

Table 5-3 BBH sequence example (EGSM900)

Burst Sequence Steps	CTU 0		CTU 1		CTU 2	
	Tx	Rx	Tx	Rx	Tx	Rx
1	A_{10}	A_{10}	B_{20}	B_{20}	C_{30}	C_{30}
2	C_{10}	A_{20}	A_{20}	B_{30}	B_{30}	C_{10}
3	B_{10}	A_{30}	C_{20}	B_{10}	A_{30}	C_{20}
4 (same as 1)	A_{10}	A_{10}	B_{20}	B_{20}	C_{30}	C_{30}
5 (same as 2)	C_{10}	A_{20}	A_{20}	B_{30}	B_{30}	C_{10}
6 (same as 3)	B_{10}	A_{30}	C_{20}	B_{10}	A_{30}	C_{20}

In the uplink direction, the controlling CTU (for example CTU 0 for MS A in Figure 5-11) tunes TS 5 in accordance with the frequency expected from the MS for that particular burst.

Transmit

The transmit is described by the following, as shown in Figure 5-12:

1. Traffic data from the network is passed through the NIU to the MCUF. Within the MCUF an ASIC switches the data to CTU 0 (the dedicated CTU for this particular MS call example).
2. The CTU, having processed the data (channel coding, interleaving, encryption and routeing information) then passes the data back to the ASIC.
3. The ASIC follows the BBH routeing information to direct the data to the next Tx CTU in the sequence of Table 5-3.

NOTE	BBH differs from normal and SFH CTU Tx procedures, in that the data is directed to CTUs in a cyclic sequence at stage 3. Without BBH, stage 3 always routes data to the original CTU.

Figure 5-12 shows a schematic diagram of an example of baseband hopping.

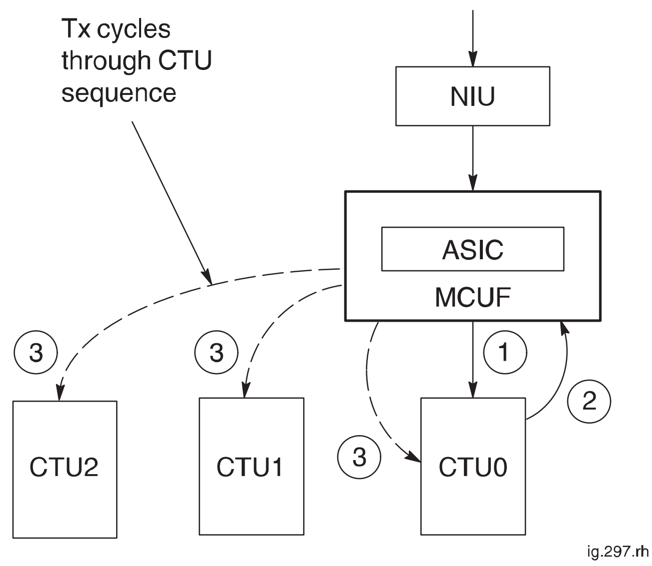

Figure 5-12 Schematic of baseband hopping (BBH) example

Receive

Data from the MS is received by one CTU allocated to that MS (in this case CTU 0). The CTU will synthesize hop to the Rx signal. This ensures that the handover and equalizers within only one CTU will be connected to a particular MS.

SURF module

SURF module overview

The sectorized universal receiver front end (SURF) module is located in a slot at the rear of the cabinet top panel. Three connectors on the underside of the module connect to the SURF harness which provides connectivity to up to six compact transceiver units (CTUs). Antenna connections are located on the top of the unit.

There are six types of SURF module available for the Horizon*macro* outdoor BTS, depending on the frequency variant:

- 850 (MHz) single band SURF.
- 900 (MHz) single band SURF.
- 900 (MHz) dual band SURF.
- 1800 (MHz) single band SURF.
- 1800 (MHz) dual band SURF.
- 1900 (MHz) single band SURF.

The single band SURFs contains three amplifier sections for connection to three pairs of receive antenna inputs providing reception at the appropriate frequency.

The 900 dual band SURF contains three amplifier sections for connection to three pairs of antennas providing 900 MHz reception and, being dual band, a further amplifier section for connection to a pair of 1800 MHz receive antennas.

The 1800 dual band SURF similarly contains three amplifier sections for connection to three pairs of antennas providing 1800 MHz reception and a further amplifier section for connection to a pair of 900 MHz receive antennas.

Each amplifier section provides two receive outputs which may be directed to any of the six CTUs, by the switch section. There are three connections to each CTU; RxA, RxB and loopback test (L).

The two receive outputs from amplifier 0 are split and may be used as extensions to other cabinets if required. These act as extended antenna connections from antenna 0. The extension cables are connected to the receive antenna connection ports on the SURF of the extension cabinet (which is able to respond to each amplified signal as if it were a normal antenna input).

Single band SURF module view

Figure 5-13 shows a view of a single band SURF module, with features identified.

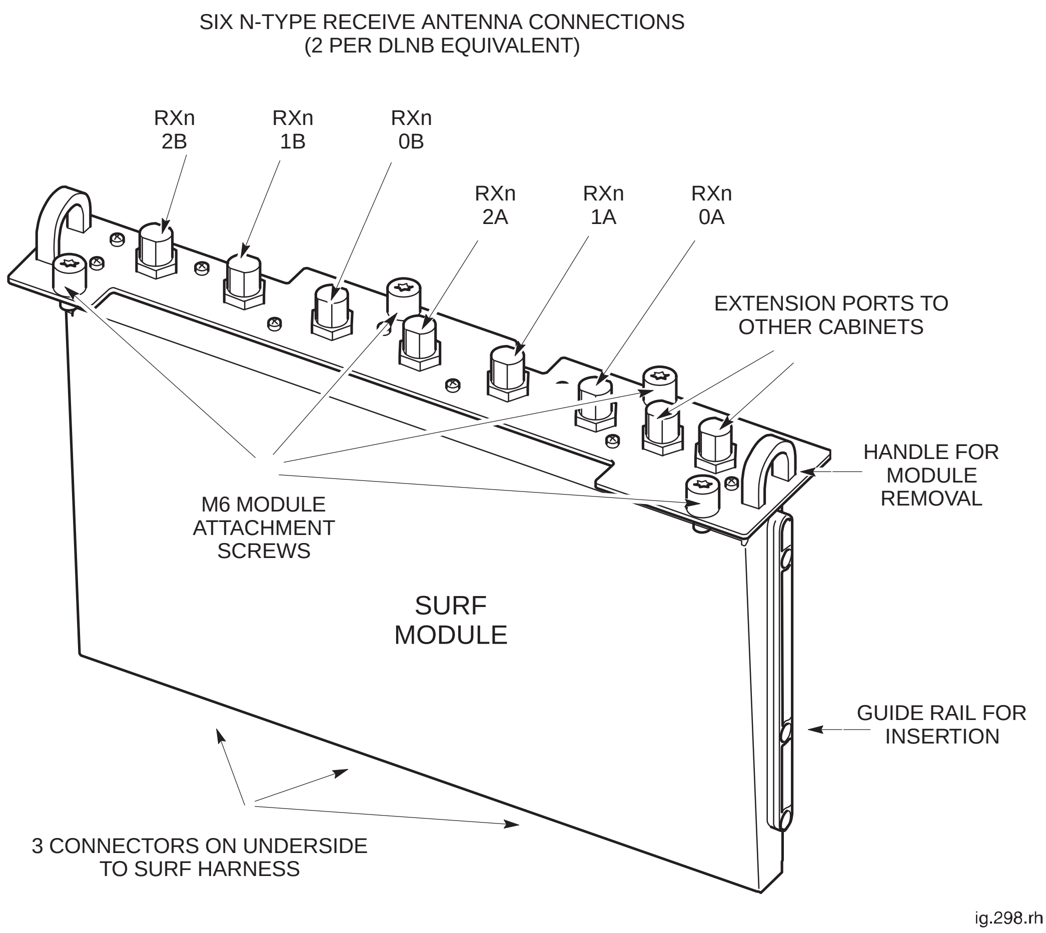

Figure 5-13 View of single band SURF module

NOTE	Where **RXn** appears in Figure 5-13, the **n** may be 850, 900, 1800 or 1900, depending on the frequency of the SURF module.

Functional description of the single band SURF

The single band SURF provides front end filtering, amplification, and matrix control of the RF receive signal between the antenna and the CTU

The single band SURF functional sections (Figure 5-14) consist of loopback, filtering, amplification, splitting, digital processing and power selection.

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 CTU for each of the two diversity branches as well as one input from the CTU for the loopback (LPBK) signal. There is also an output for an expansion cabinet for ANT 0 on each branch.

The software database must be configured at the OMC-R to accept CTUs of the same frequency in the appropriate cabinet locations.

The digital section switch, under the control of the database (signalled through the MCUF and CTUs), routes the six amplifier outputs to the appropriate CTUs. The digital and power supply section is also responsible for loopback switch control, manual overrides, alarms and dc voltages.

The RF loopback test function is described in **RF overview and RF test function** in this chapter.

Single band SURF functional diagram

Figure 5-14 shows a functional diagram of the single band SURF module.

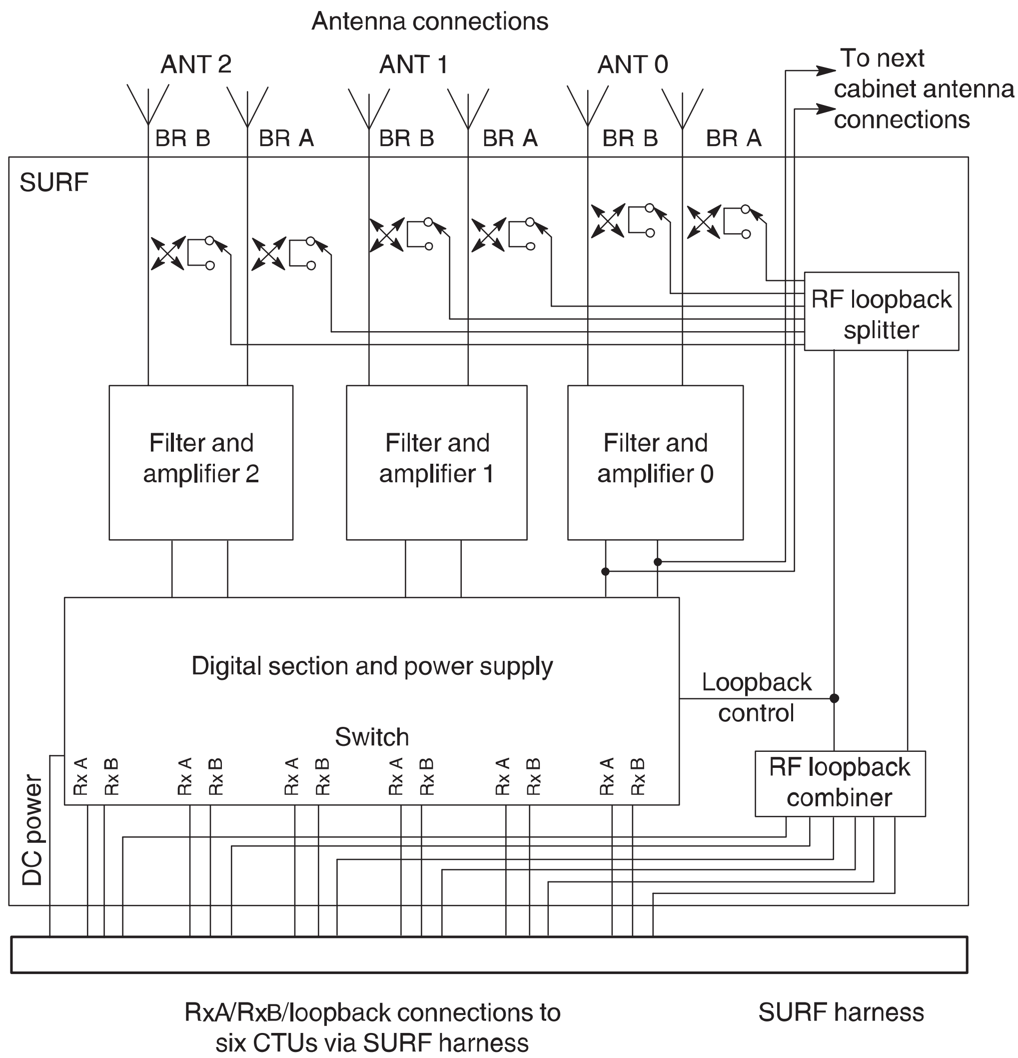

Figure 5-14 Functional diagram of the single band SURF module

Dual band SURF module view

Figure 5-15 shows a view of a dual band SURF module with features identified, both the 900 and 1800 variants are similar in appearance.

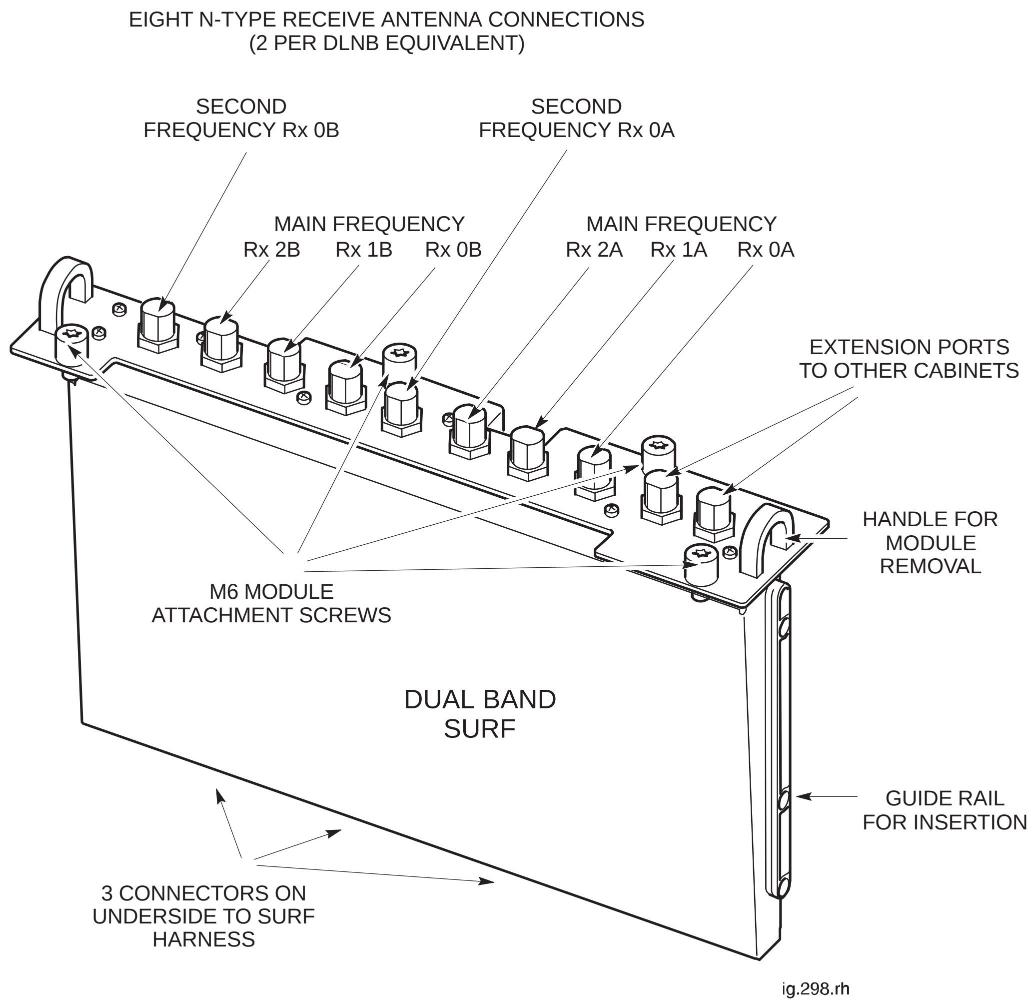

Figure 5-15 View of dual band SURF module with features identified

Functional description of dual band SURF modules

The dual band SURF modules provide front end filtering, amplification, and matrix control of the RF receive signal between the antenna and the CTU. The dual band SURFs each have three antenna pair connections providing main frequency reception, and one antenna pair providing reception on a second frequency. The two types of dual band (DB) SURF enable 900 CTUs to be mixed with 1800 CTUs in any combination, up to the maximum total of six CTUs per cabinet.

The dual band SURF functional sections (see Figure 5-16) consist of loopback, filtering, amplification, splitting, digital processing and power selection.

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 four antenna pair inputs (ANT 0, ANT 1, ANT 2 and ANT DB) for each of the two diversity branches (branch A and branch B). There are six outputs to the CTU for each of the two diversity branches, as well as one input from the CTU for the loopback (LPBK) signal. There is also an output for an expansion cabinet for ANT 0 on each branch.

The software database has to be configured at the OMC-R to accept 1800 CTUs and 900 CTUs in the appropriate cabinet locations.

Digital codes are transmitted from the 900 CTUs and 1800 CTUs to the digital section. The digital codes are different, so that 900 or 1800 CTUs 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 loopback switch control, manual overrides, alarms and dc voltages.

The RF loopback test function is described in **RF overview and RF test function** in this chapter.

Dual band SURF functional diagram

Figure 5-16 shows a functional diagram of the dual band SURF module.

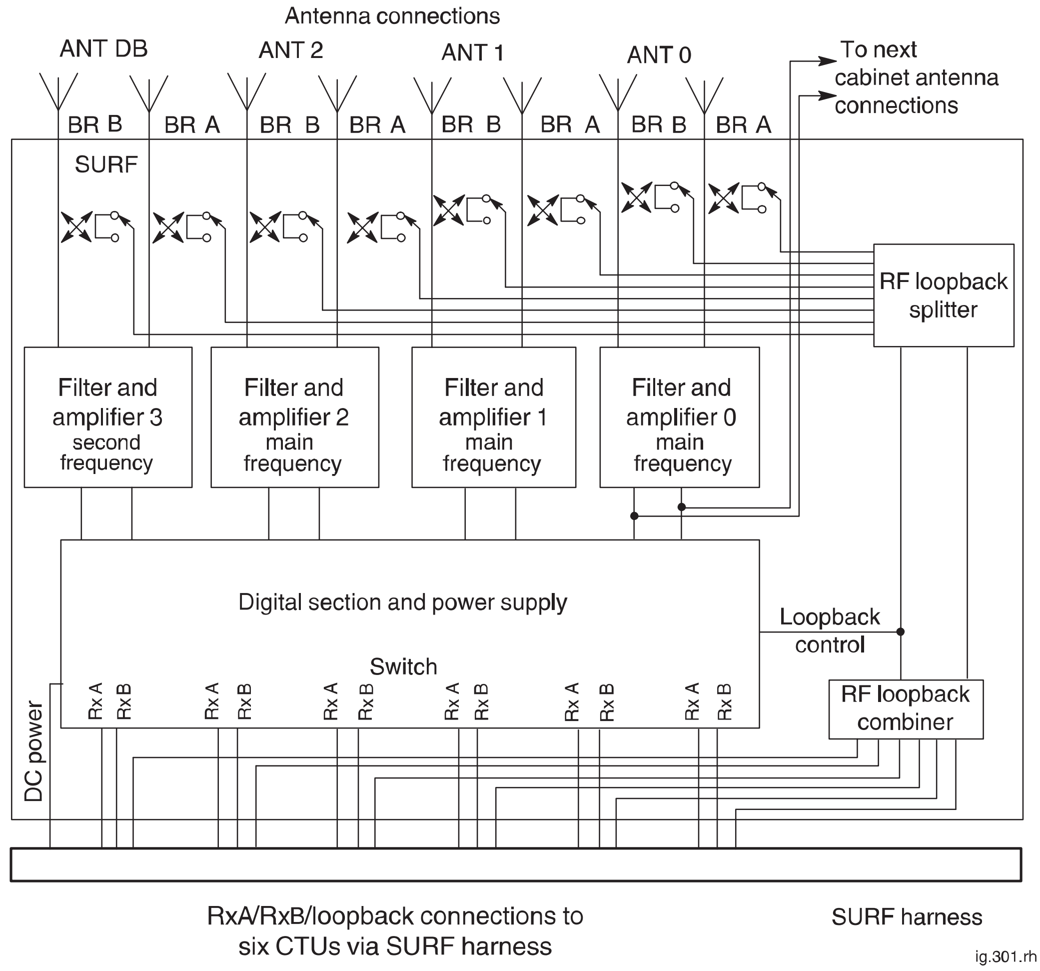

Figure 5-16 Functional diagram of the dual band SURF module

Transmit blocks overview

Introduction to transmit blocks

Transmit (Tx) blocks are located in three positions in the basket above the CTUs. There are four types of transmit (Tx) blocks, three of which are available as 850, 900, 1800 or 1900 variants, and one dual band variant (for use with 900 MHz or 1800 MHz BTSs only).

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

- **TDF (850, 900, 1800 or 1900)** = Twin Duplexed Filter.
- **Dual band TDF (900/1800)** = Dual band twin duplexed filter.
- **DCF (850, 900, 1800 or 1900)** = Duplexed Combining bandpass Filter.
- **DDF (850, 900, 1800 or 1900)** = Dual-stage Duplexed combining Filter.

These Tx blocks are cooled by airflow from underneath. The DDF has fins, whereas the TDF, dual band TDF and DCF do not.

Tx blocks are attached to the top surface of the top panel using two M6 screws.

Three types of plate can be located in the basket, one as blanking plate and two to interface CTU Tx cables:

- **Blanking plate**. This ensures proper airflow and EMC shielding for an unused basket Tx Block location.
- **Feedthrough plate**. This converts two SMA connectors to two N-type connectors, used for connecting Tx cables to DDFs.
- **Hybrid Combining Unit (HCU)**. This combines two SMA connectors to one N-type, enabling two additional CTUs to be connected to a DDF.

The plates are attached to the base of the top panel basket using six M4 screws.

Screw retention in Tx block locations

The plates are attached to the base of the top panel basket using six M4 screws.

Tx blocks are attached to the top surface of the top panel using two M6 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 correct torque.

View of basket for Tx blocks

Figure 5-17 shows the top section basket which holds the Tx blocks.

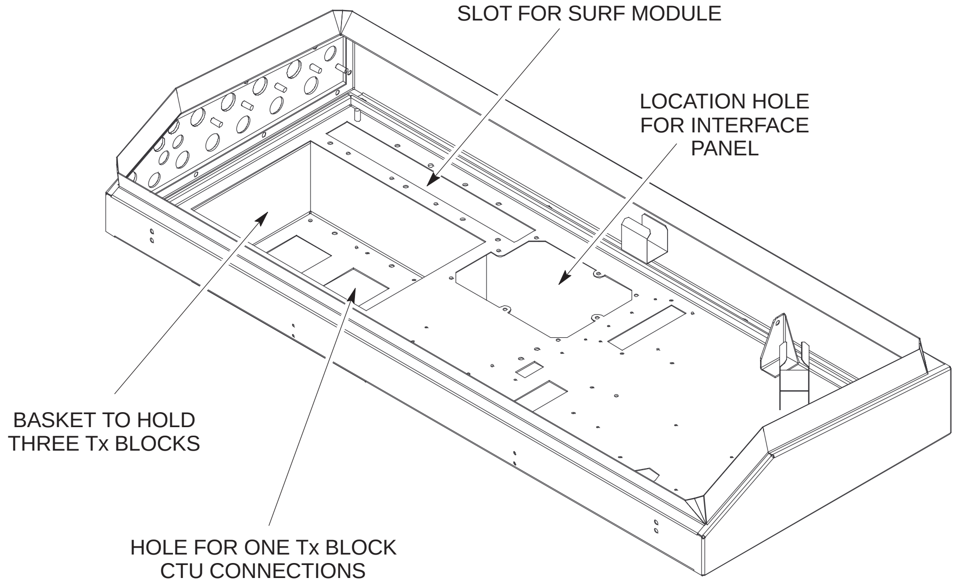

Figure 5-17 View of top section showing Tx block basket

Transmit block connectors

The transmit block connectors are of the following types:

- SMA connectors for cables to transceivers.
- 7/16 connectors to antennas.
- N-type duplex receive connectors; also used by HCU inputs and the feedthrough plate.

The SMA connectors are underneath the unit (for ease of connection to the CTUs), and the other connectors are on top, as shown in Figure 5-18.

View of Tx block connectors

Figure 5-18 shows a typical Tx block with connector locations.

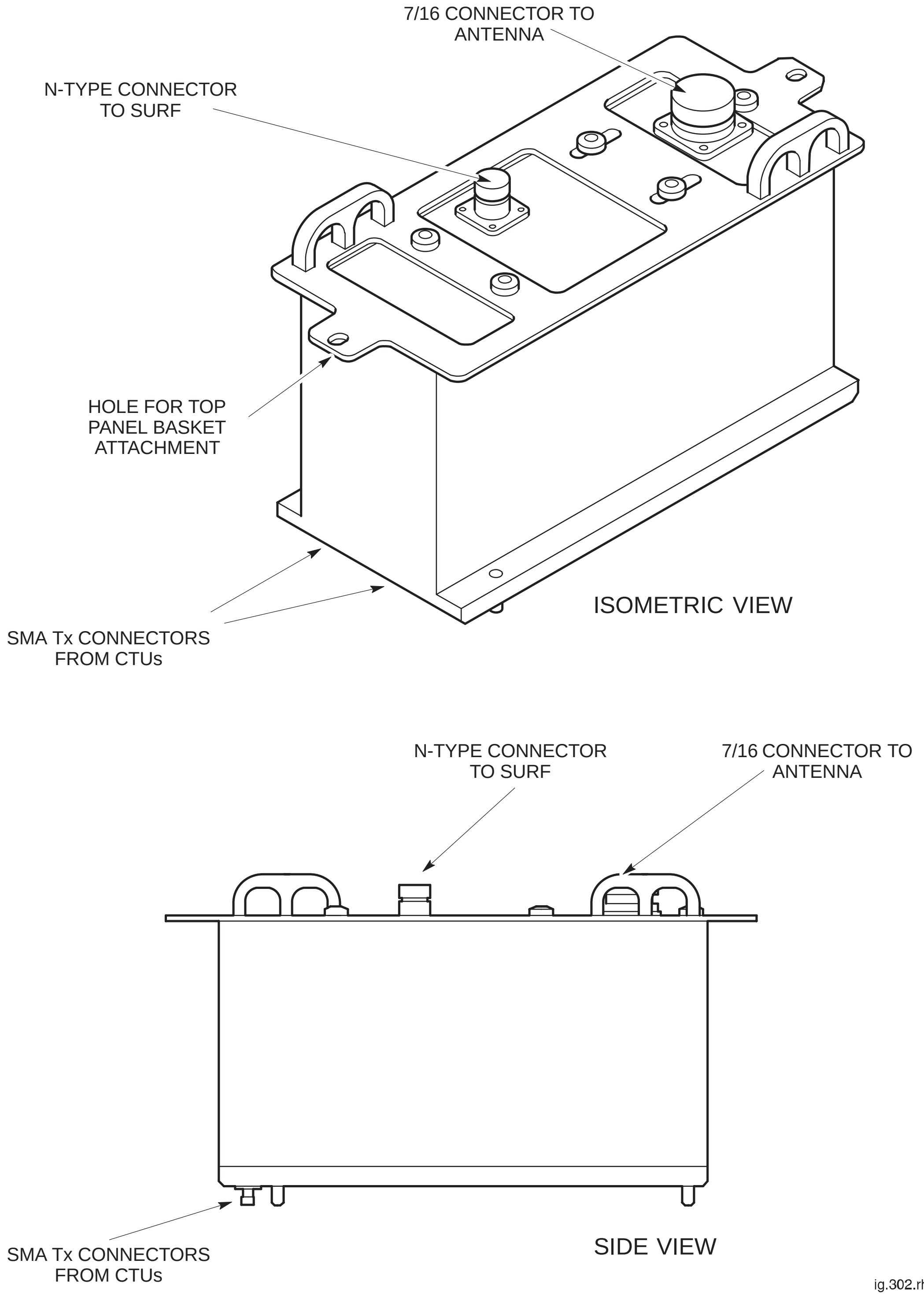

Figure 5-18 Typical Tx block

Tx block blanking plate

Purpose of Tx block blanking plate

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

The plate is attached to the base of the top panel basket using six M4 screws.

View of Tx block blanking plate

Figure 5-19 shows a view of the Tx block blanking plate.

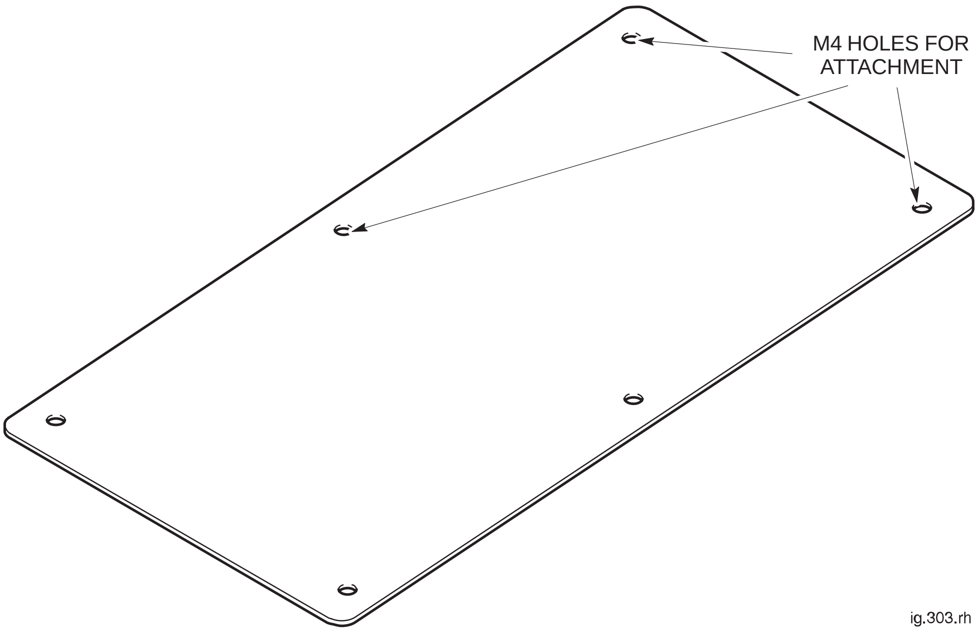

Figure 5-19 View of Tx block blanking plate

Feedthrough plate

Purpose of feedthrough plate

The feedthrough plate converts the normal SMA connector from the CTU to an N-type connector. Each feedthrough plate has a pair of these converters, one for each of two CTUs. The top N-type connectors are used to connect with the (optional) third Tx port on the top of a DDF Tx block.

The plate is attached to the base of the top panel basket using six M4 screws.

View of feedthrough plate

Figure 5-20 shows a top view of a feedthrough plate.

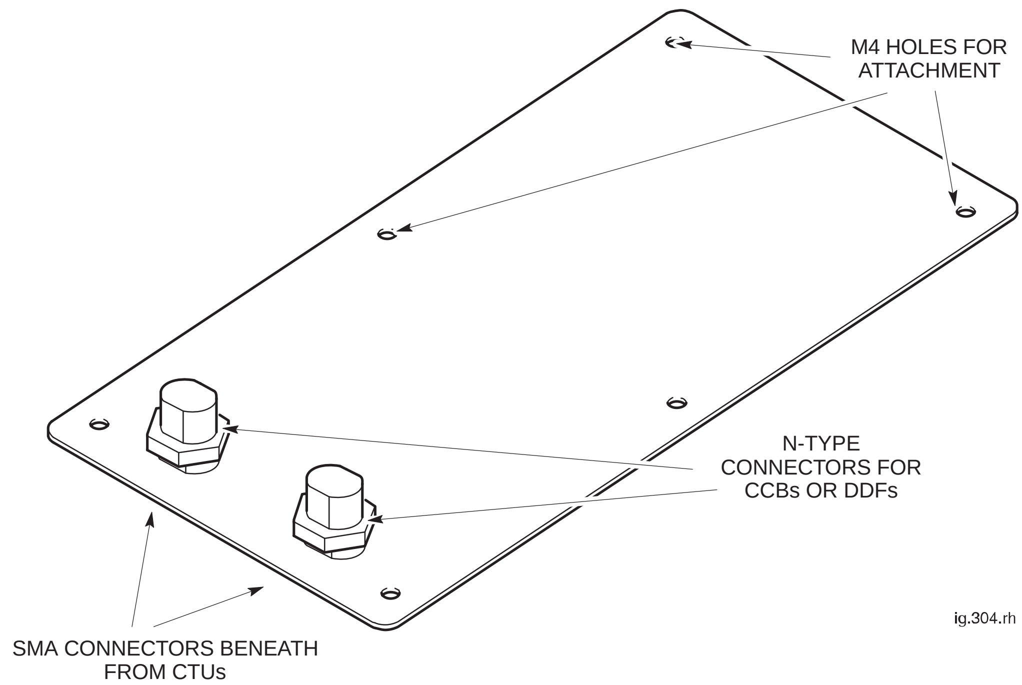

Figure 5-20 View of feedthrough plate

Feedthrough plate connectors

Each feedthrough plate connects to:

- The Tx outputs of two CTUs, using SMA connectors.
- Tx inputs of DDFs, using N-type connectors.

HCU plate

HCU overview

The hybrid combining unit (HCU) combines two CTU Tx outputs.

There are six holes for attachment into the bottom of the Tx block basket.

HCU view

Figure 5-21 shows the HCU plate with connectors identified.

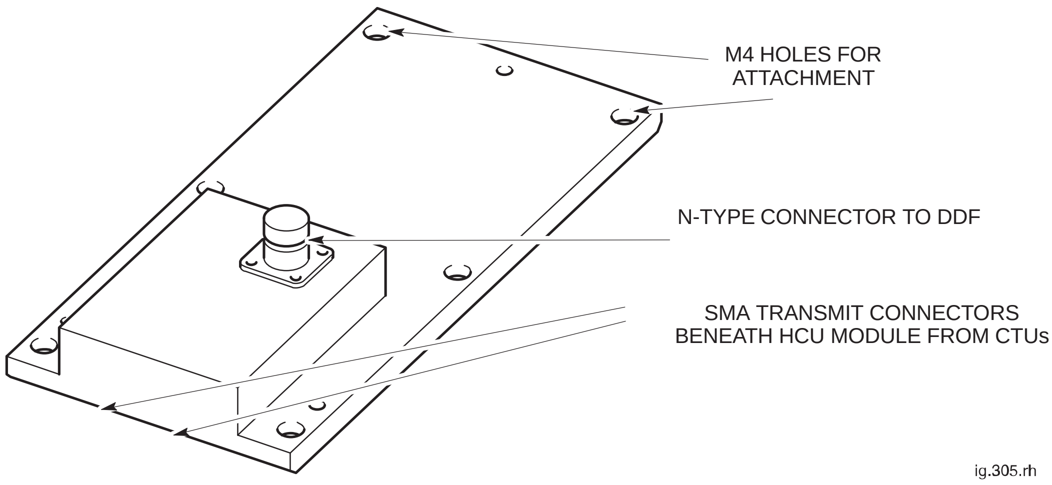

Figure 5-21 HCU plate view showing connectors

HCU functional diagram

Figure 5-22 shows a functional diagram of the HCU.

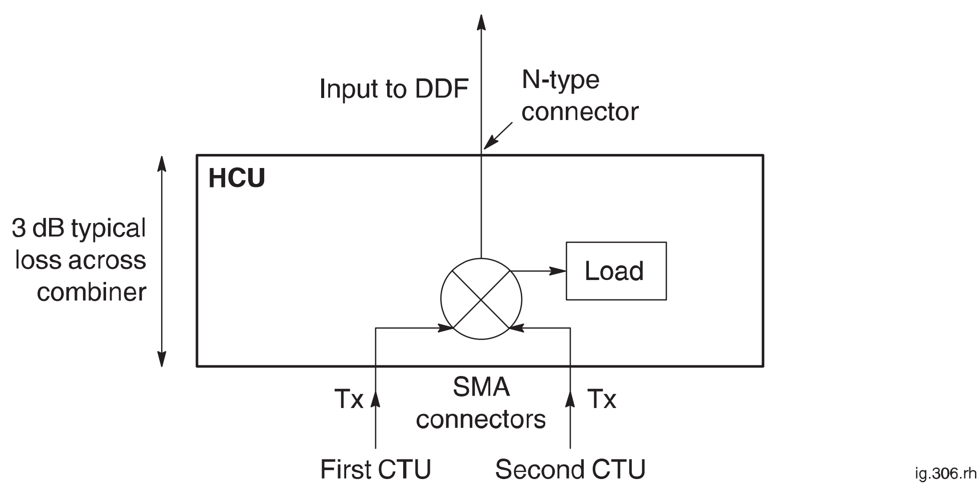

Figure 5-22 HCU functional diagram

HCU connectors

Each HCU connects to:

- The Tx outputs of two CTUs, using SMA connectors.
- A Tx input of a DDF, using an N-type connector.

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

TDF

Overview of TDF

The purpose of the twin duplexed filter (TDF) Tx block is to enable each antenna to serve one CTU for both Tx and Rx.

The TDF has two identical sections, each providing a single path from a CTU to a separate antenna. There is no combining in the TDF.

The TDF is located in the basket above the CTUs and is attached to the top surface of the top panel using two M6 screws.

TDF view

Figure 5-23 shows the TDF Tx block with connectors identified.

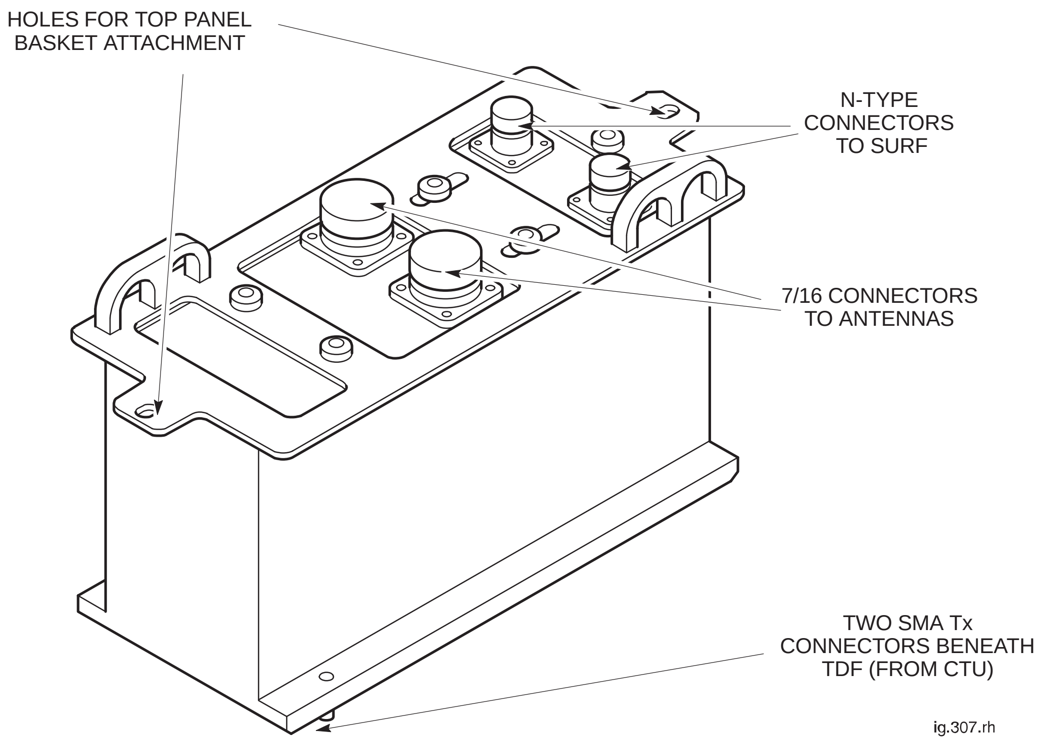

Figure 5-23 View of TDF Tx block with connectors identified

TDF functional diagram

Figure 5-24 shows a functional diagram of the TDF.

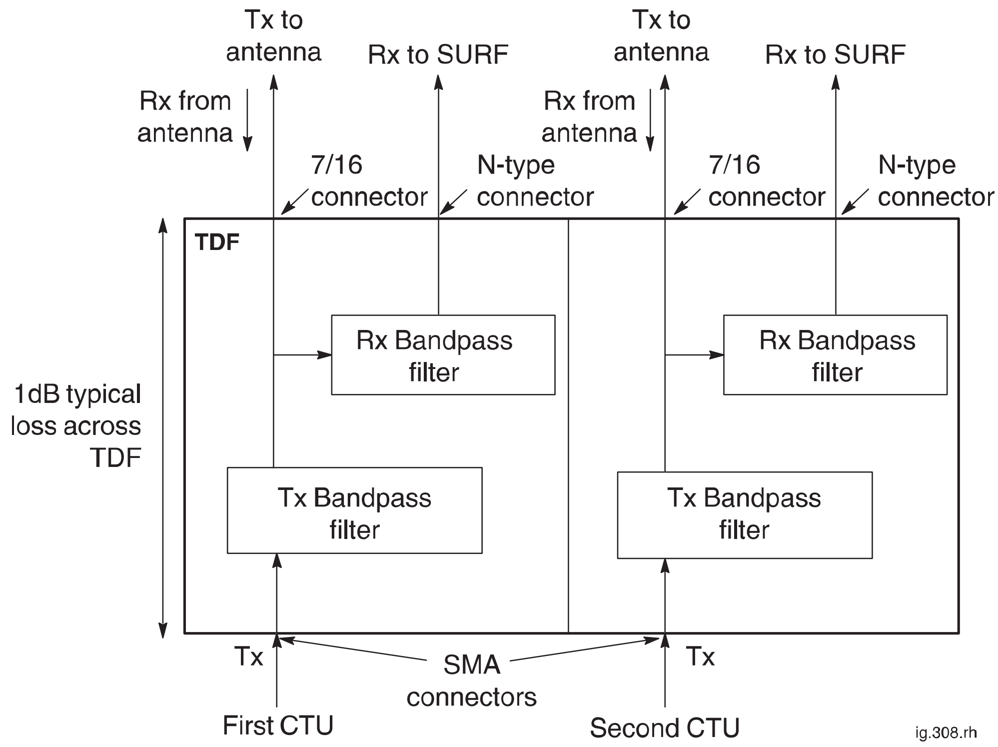

Figure 5-24 TDF functional diagram

TDF connectors

Each TDF connects to:

- The Tx outputs of two CTUs, using SMA connectors. The two connectors are underneath the TDF.
- Two antennas, each for both Rx and Tx, using 7/16 connectors. These connectors are on top of the TDF.
- The SURF, using two N-type connectors. These connectors are on top of the TDF.

Dual band TDF

Overview of Dual band TDF

The purpose of the dual band twin duplexed filter (dual band TDF) Tx block is to enable one 900 MHz antenna to serve one EGSM900 CTU for both Tx and Rx, and an 1800 MHz antenna to serve one DCS1800 CTU for both Tx and Rx.

NOTE	A dual band TDF is not currently available for use with the GSM850 or PCS1900 BTS variants.

The dual band TDF is essentially a TDF with one section providing a path for 900 MHz signals and another section providing a path for 1800 MHz signals. There is no combining in the dual band TDF.

The dual band TDF is located in the basket above the CTUs, and attached to the top surface of the top panel using two M6 screws.

Dual band TDF view

Figure 5-25 shows the dual band TDF Tx block with connectors identified:

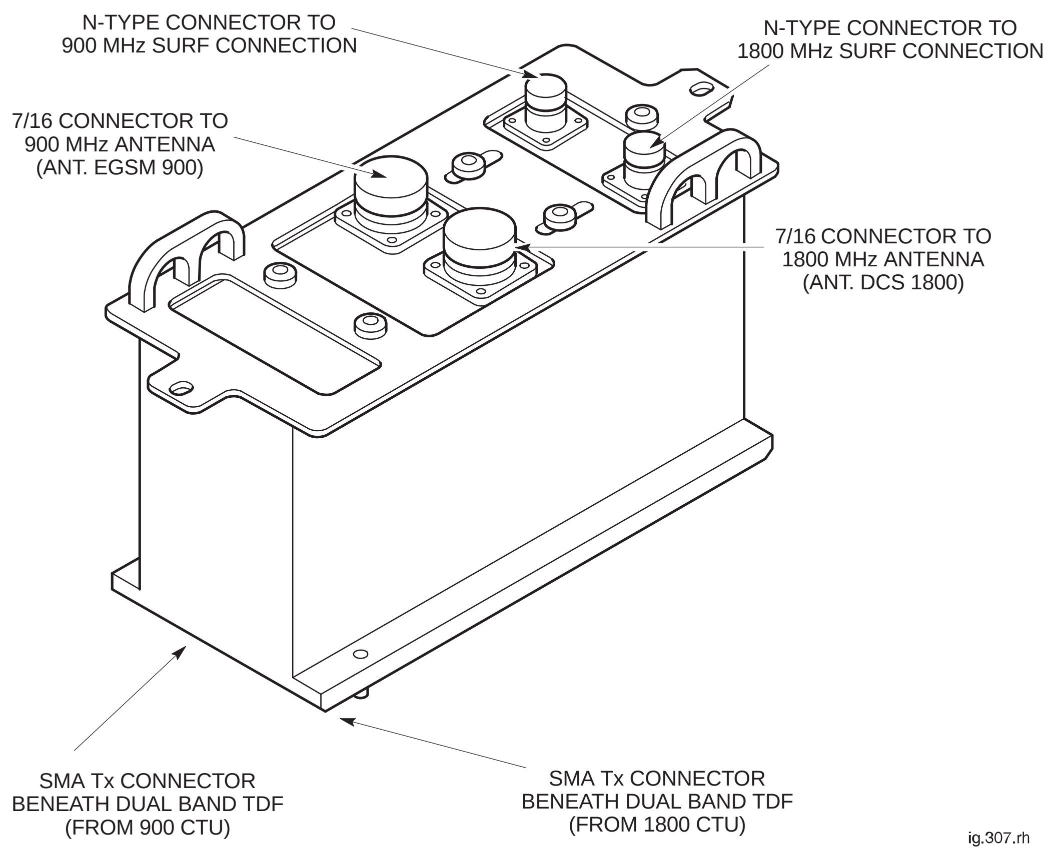

Figure 5-25 View of dual band TDF Tx block with connectors identified

Dual band TDF functional diagram

Figure 5-26 shows a functional diagram of the dual band TDF.

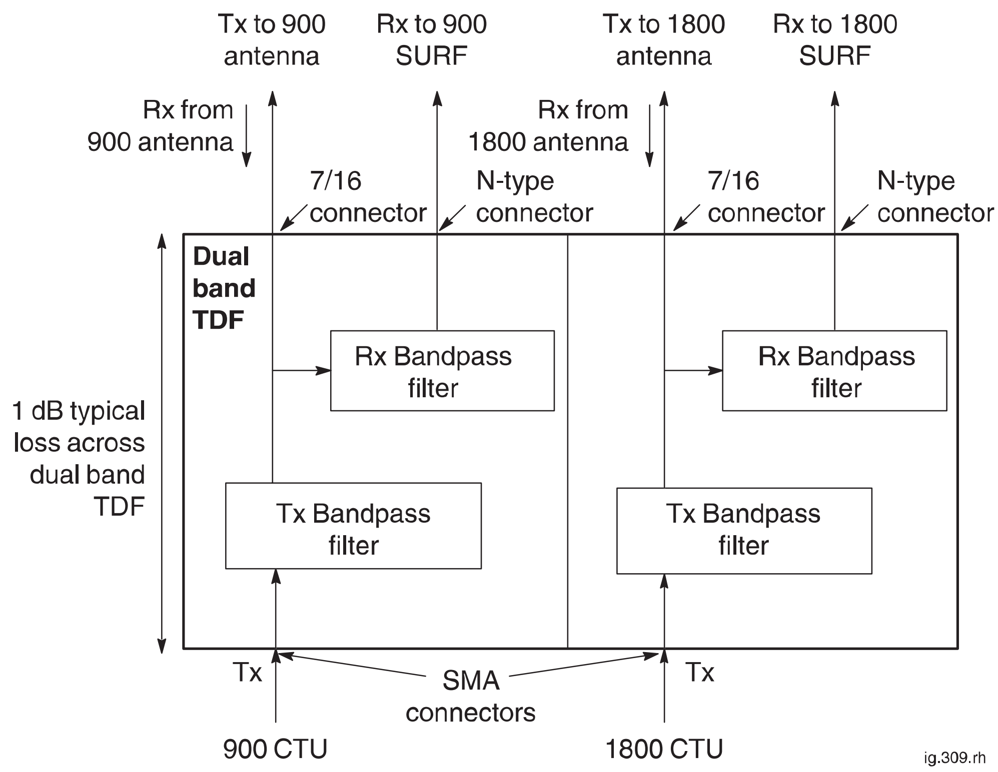

Figure 5-26 Dual band TDF functional diagram

Dual band TDF connectors

Each dual band TDF connects to:

- The Tx output of one 900 CTU and one 1800 CTU, using SMA connectors. The two connectors are underneath the dual band TDF.
- One 900 MHz antenna and one 1800 MHz antenna. Each antenna is used for both Rx and Tx, and each is connected to the dual band TDF using 7/16 connectors. These connectors are on top of the dual band TDF.
- A SURF module with dual band capability. Two N-type connectors, located on top of the dual band TDF, connect one receive path to the SURF's 900 MHz input and one receive path to the SURF's 1800 MHz input.

DCF

DCF overview

The purpose of the duplexed combining bandpass filter (DCF) Tx block is to enable each antenna to serve two CTUs for both Tx and Rx.

The DCF combines two Tx inputs, dissipating half the power within an internal load.

The signal then passes through a bandpass filter and out to the antenna.

A receive bandpass filter passes only the Rx signal to the SURF module.

The DCF is located in the basket above the CTUs and is attached to the top surface of the top panel using two M6 screws.

DCF view

Figure 5-27 shows a DCF with connectors identified.

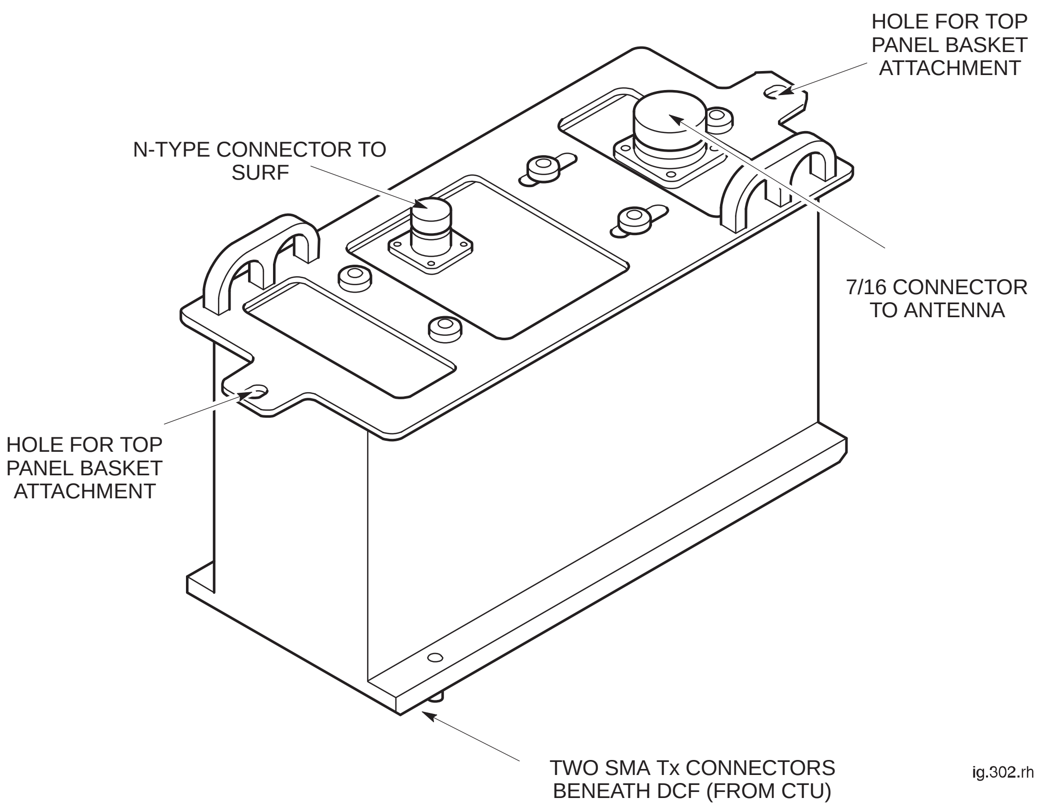

Figure 5-27 DCF Tx block view with connectors identified

DCF functional diagram

Figure 5-28 shows a functional diagram of the DCF.

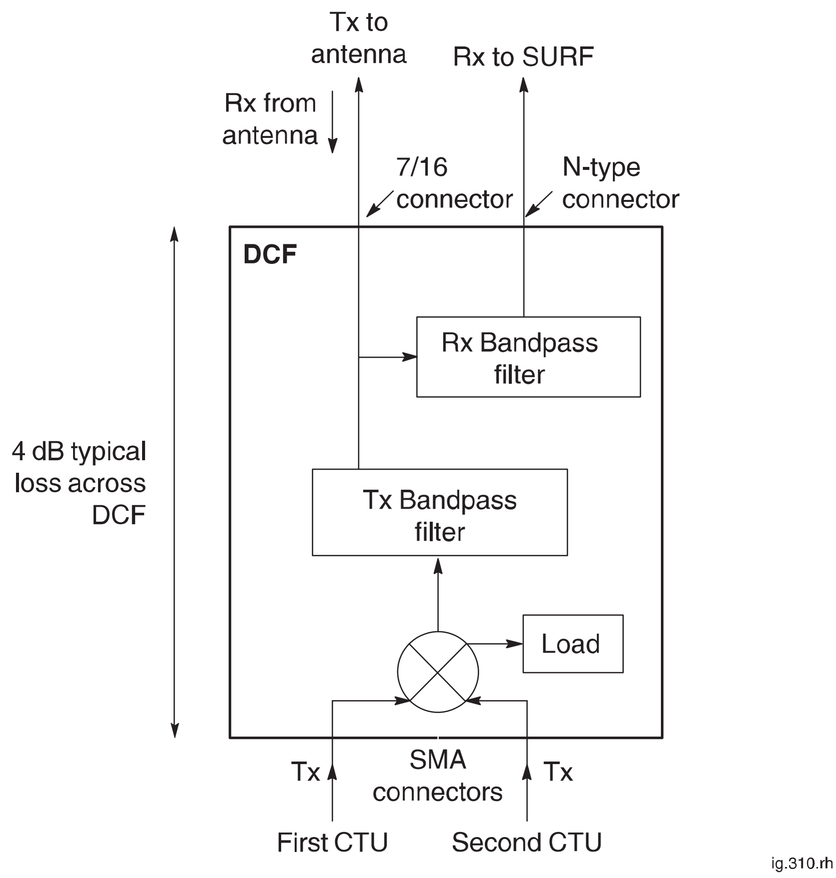

Figure 5-28 Functional diagram of DCF

DCF connectors

Each DCF connects to:

- The Tx outputs of two CTUs, using SMA connectors. The two connectors are underneath the DCF.
- A single antenna for both Rx and Tx, using a 7/16 connector. This connector is on top of the DCF.
- The SURF, using an N-type connector. This connector is on top of the DCF.

DDF

Overview of DDF

The dual-stage duplexed combining filter (DDF) differs from the DCF in having a second stage of combining to allow a third CTU Tx input. This third CTU Tx input is connected to either:

- A feedthrough plate connector for a single additional CTU or
- An HCU plate connector for combining two additional CTUs.

The DDF is located in the basket above the CTUs and is attached to the top surface of the top panel using two M6 screws.

DDF view

Figure 5-29 shows a view of the DDF Tx block with connectors identified.

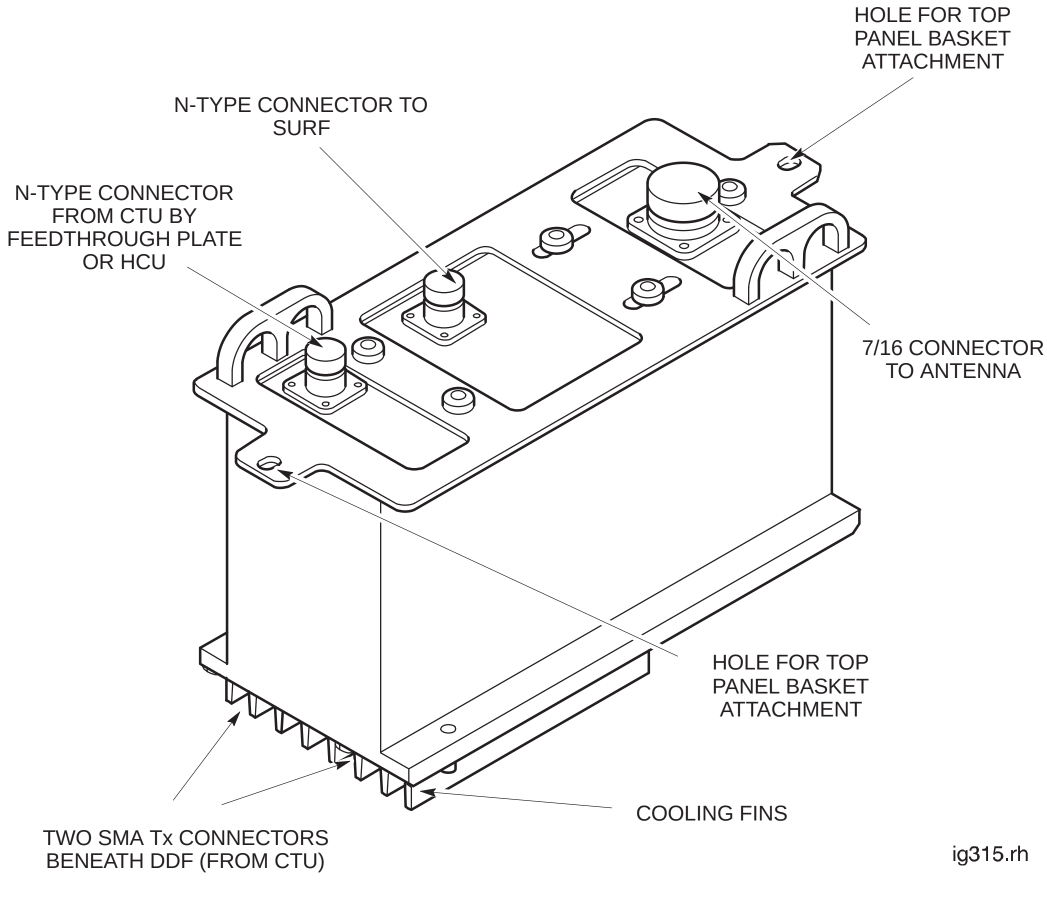

Figure 5-29 DDF Tx block view with connectors identified

DDF functional diagram

Figure 5-30 shows a functional diagram of the DDF.

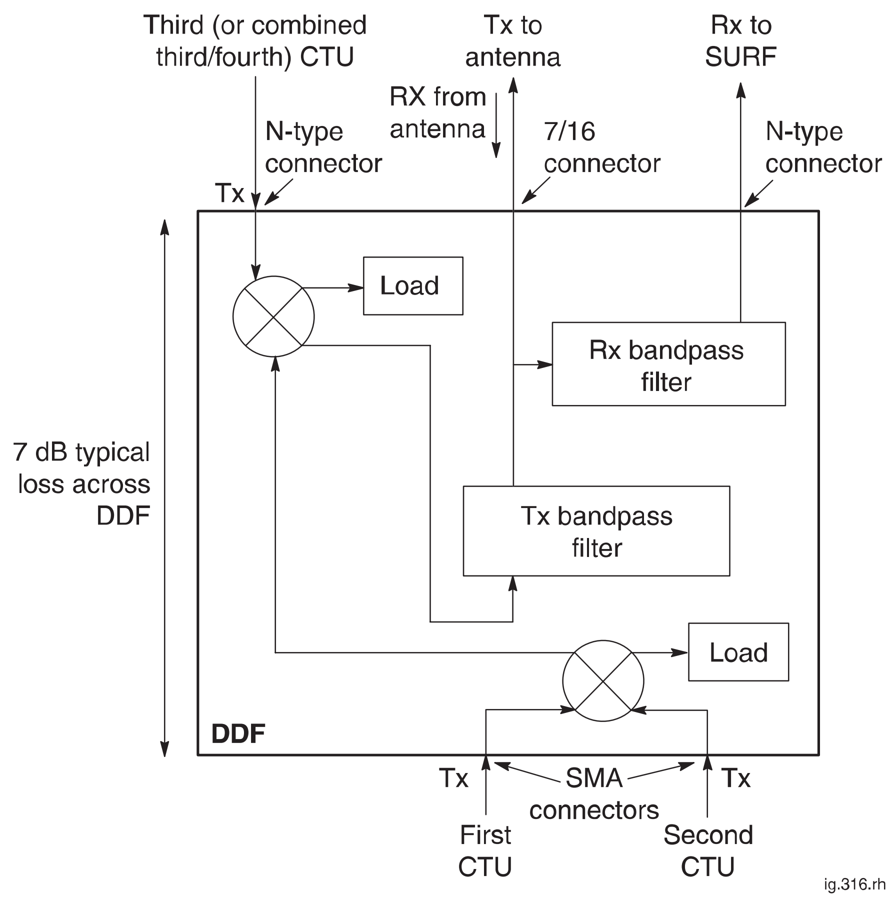

Figure 5-30 Functional diagram of the DDF

DDF connectors

Each DDF connects to:

- The Tx outputs of three or four CTUs, using:

  Two SMA connectors underneath the DDF.

  An N-type connector on top of the DDF for connection to a feedthrough plate (for a third CTU) or HCU plate (for combined third/fourth CTUs).
- A single antenna for both Rx and Tx, using a 7/16 connector. This connector is on top of the DDF.
- The SURF, using an N-type connector. This connector is on top of the DDF.

Chapter 6

Digital modules

Chapter 6
Digital modules i

Overview of digital modules

Overview and redundancy

Digital modules provide the equivalent of M-Cell*6* micro base control unit (μBCU) functionality for the Horizon*macro.* They are located in the bottom right side of the main cage, and are electronically interconnected through the backplane. Fibre optic connections are at the front of the appropriate modules.

Each digital module is assigned A or B, with one BPSM for A and one BPSM for B. The alarm module is not assigned to A or B, as it is supplied by both BPSMs for redundancy.

The master MCUF is assigned to A, and the redundant MCUF to B, each with an associated FMUX.

The four NIUs are used by the operational MCUF, but two NIUs are powered by BPSM A and two NIUs by BPSM B.

All slots are annotated with the legend of the appropriate module and located as shown in Figure 6-1.

Digital module and BPSM locations

Figure 6-1 shows the position of modules within the digital module section of the main cage

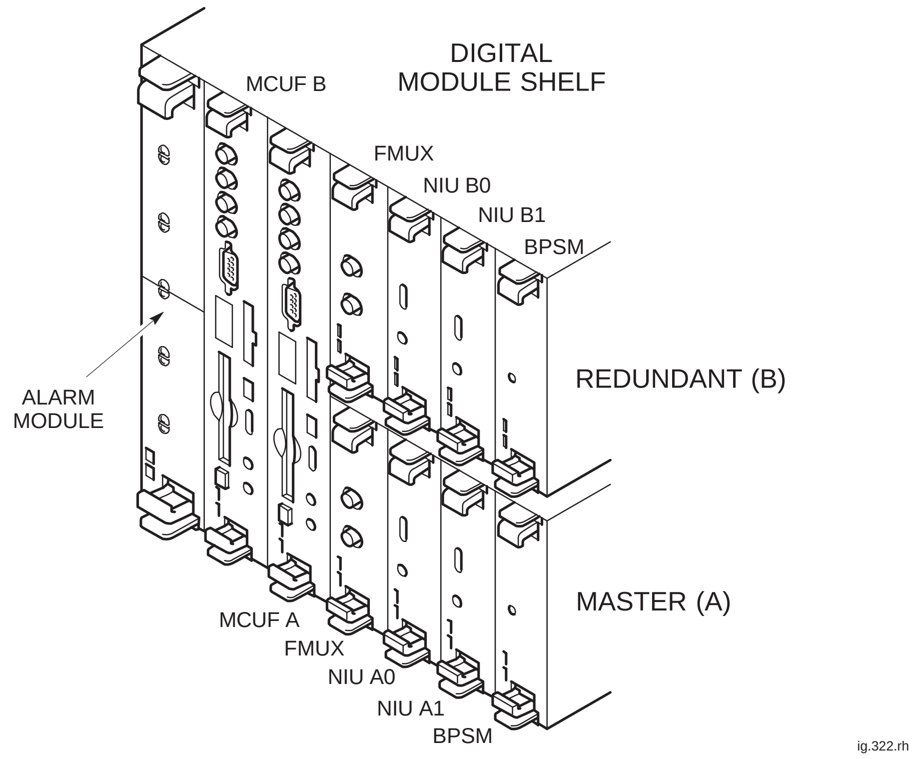

Figure 6-1 Digital and BPSM module locations, including optional redundancy

MCUF and NIU redundancy

The digital module shelf can:

- Support two MCUFs at a BTS site, one master, one slave (for redundancy).
- Enable master MCUF failure to result in slave MCUF becoming master after reset.
- Enable OMC-R operator to initiate master/slave MCUF swap.
- Configure CTUs by the master MCUF.

All four NIUs operate from the master MCUF, but each pair of NIUs depend on a BPSM for power. All NIUs configure to the master MCUF clock.

NOTE	When fitting a replacement redundant MCUF, care must be taken to ensure firmware compatibility with the master MCUF. Firmware incompatibility may result in a loss of communication between the two MCUFs so that the redundant MCUF is not in a position to take control in the event of a failure of the master MCUF.

Full size and half size modules

Modules are full size and half size as shown in Table 6-1.

Table 6-1 Full size and half size digital modules

Full size modules	**Half size modules**
Main Control Unit with dual FMUX (MCUF)	Network Interface Unit (NIU)
Alarm module	Fibre optic Multiplexer (FMUX)
	BPSM (µBCU Power Supply Module)

Digital module and CTU connections

The MCUF is connected to the CTUs in the same cabinet through the backplane. Optional connection to CTUs in up to three additional cabinets (six CTUs per cabinet) is by fibre optic links. FMUXs, two internal to the MCUF and one half size module, convert the electronic data stream into a fibre optic signal. An FMUX module in each extension cabinet converts the fibre optic signal back to electronic data stream, for transmission to CTUs via the backplane.

The NIU modules convert signals for terrestrial E1 or T1 lines.

Diagram of digital module and CTU connections

Figure 6-2 shows a block diagram of digital module and CTU connections, without redundancy.

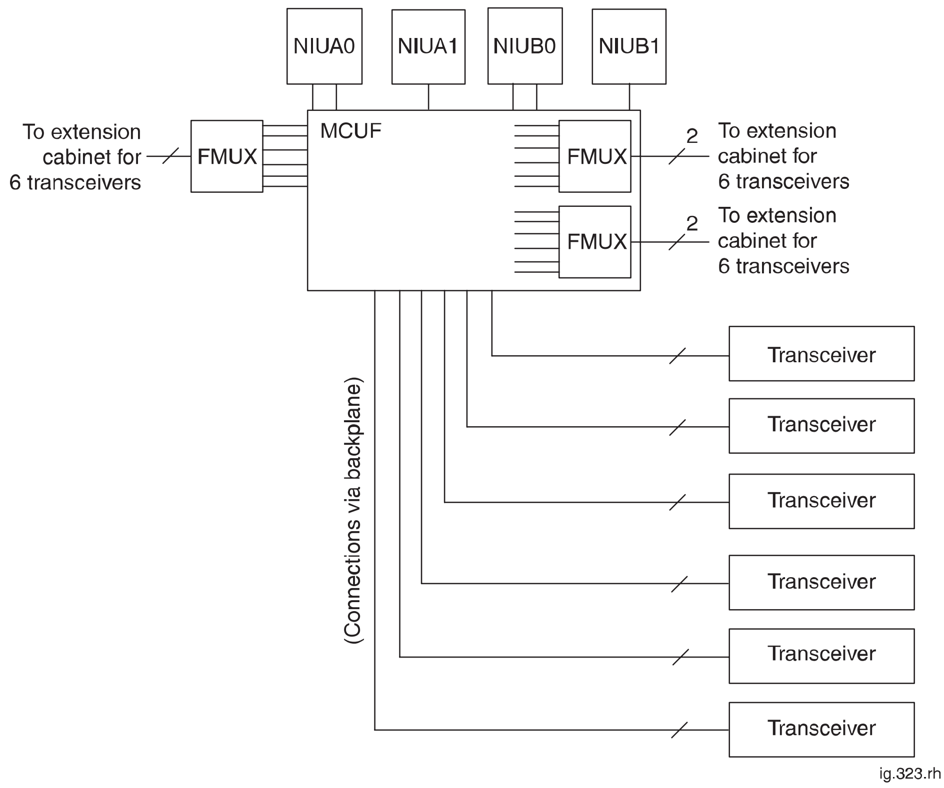

Figure 6-2 Digital module and CTU connections

MCUF

MCUF overview

The main control unit with dual FMUX(MCUF) provides the site processing functions, apart from RF functions of the transceiver. The MCUF also provides switching for up to six network interfaces (via four NIUs) and up to 24 transceivers.

The cabinet may contain up to two MCUF modules, (one master and one for redundancy). Each site and module has an electronic ID for remote identification.

The MCUF provides the following functions:

- Maintenance and operational/control processing.
- Call processing (for example resource management and switching of baseband hopping data).
- Switching of traffic and control information.
- Timing reference and network/BTS master clock synchronization.
- The functionality of two FMUX.
- Support of up to six transceivers via backplane in first cabinet and up to an additional 18 transceivers via FMUX connections to other cabinets.
- Support of up to six E1 or T1 circuits, via NIU modules.
- Support of the CSFP function via the PCMCIA flash memory card.

Capability to replace MCU of M-Cell*6* and M-Cell*2*

The MCUF combines the MCU function of M-Cell*6* with two FMUX modules. If the MCUF is installed in an M-Cell*6* or M-Cell*2*, it automatically reverts to the functionality of an MCU and the integral FMUX devices no longer operate. In M-Cell*2*, reverting to MCU mode includes the ability to directly connect to two transceivers by modified use of the front panel FMUX fibre optic connections.

NOTE	This capability to use MCUF in M-Cell*6* and M-Cell*2* is only possible with GSR4 software release or later.

GPROC TSW and GLCK functions

The MCU section of the MCUF module combines functions of older generation equipment:

- The BTP (Base Transceiver Processor) functions and CSFP (Code Storage Facility Processor) functions (provided PCMCIA card fitted), formerly achieved by generic processor boards (GPROCs).
- The timeslot switch (TSW).
- The generic clock (GCLK).

MCUF module view

Figure 6-3 shows an MCUF module.

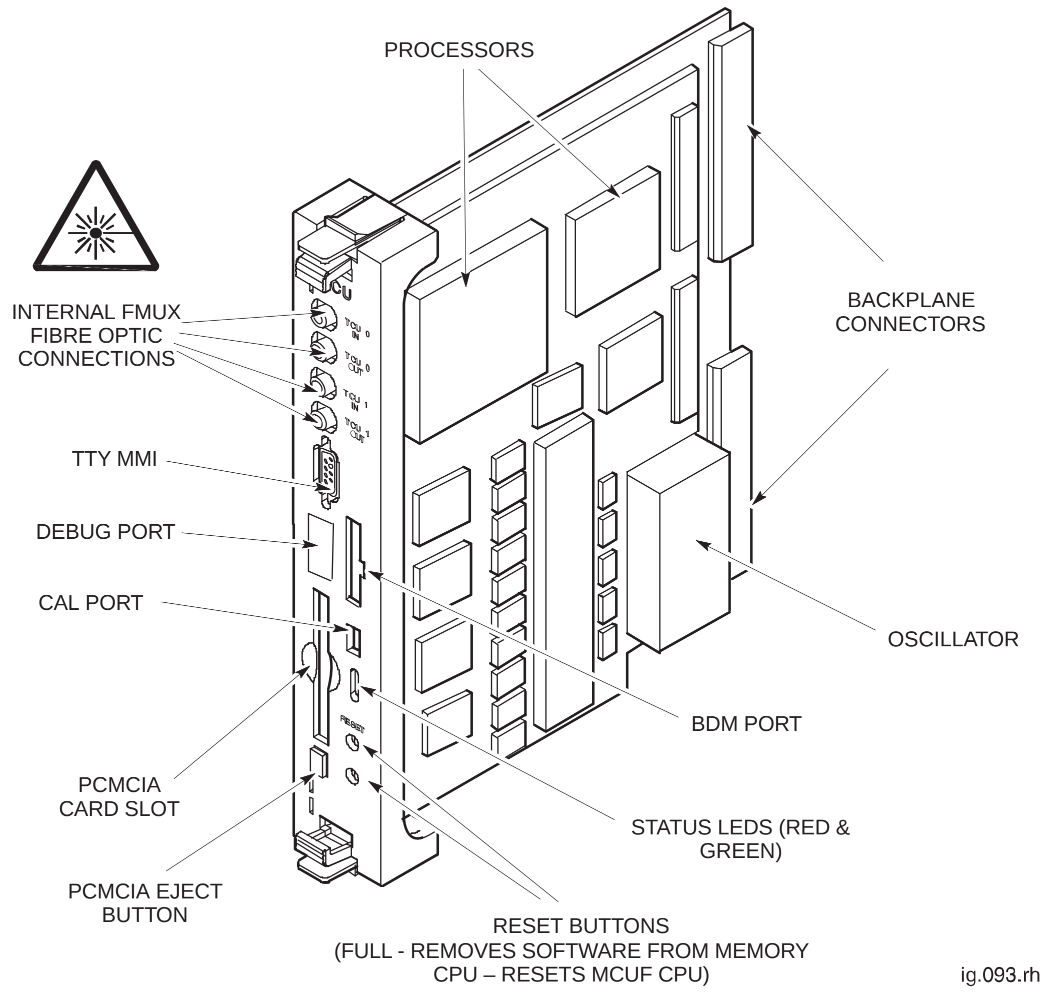

Figure 6-3 View of the MCUF

MCUF functional diagram

Figure 6-4 shows a functional diagram of the MCUF.

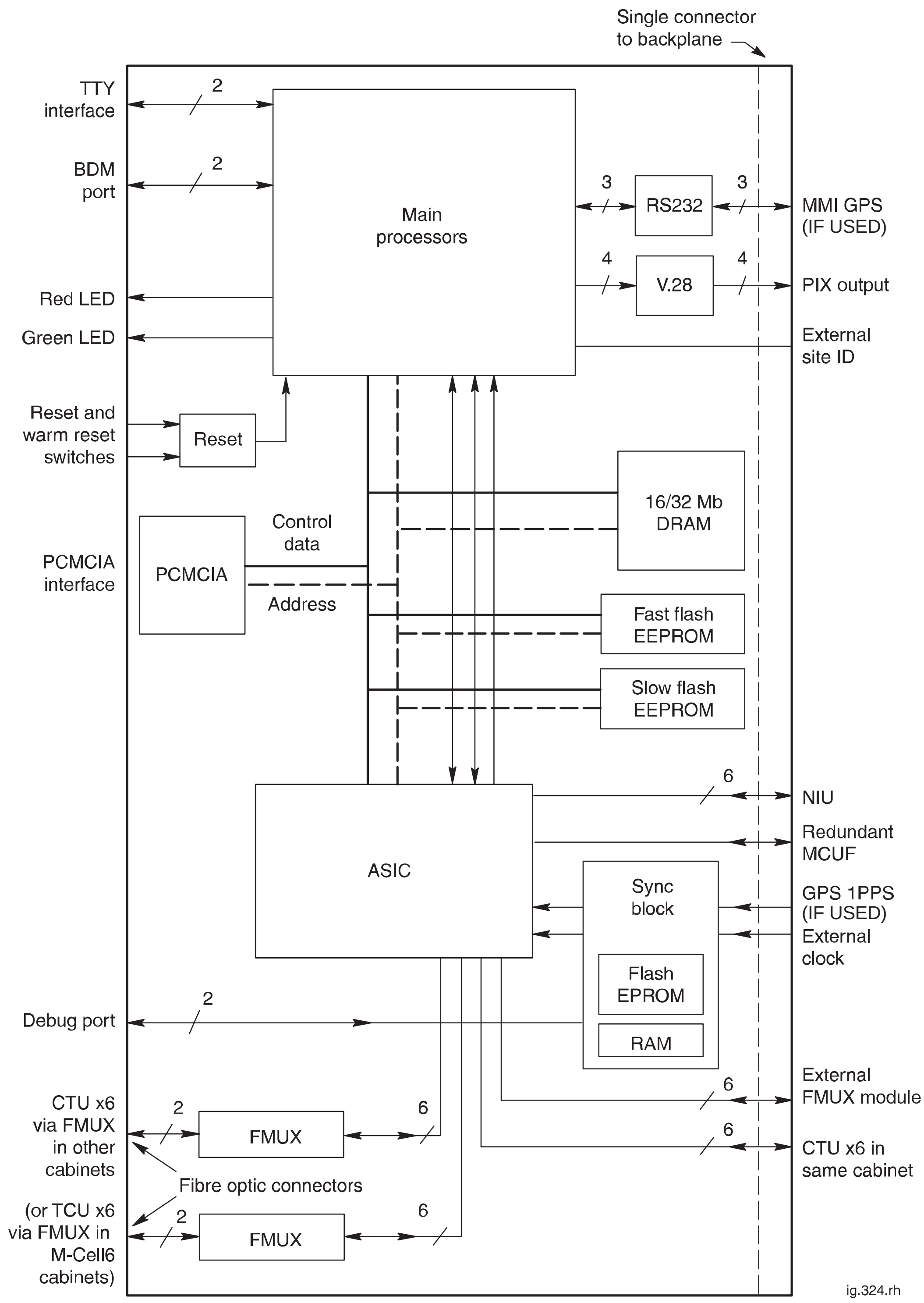

Figure 6-4 Functional diagram of MCUF in MCUF mode

Link to redundant MCUF

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

The main processor HDLC link to the redundant MCUF 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

TTY 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 Man Machine Interface (MMI) of the MCUF.

Debug and BDM ports

Two front panel ports are for Motorola factory and development use only:

- The debug port, consists of a TTY connection to the sync processor to access sync firmware, together with other connections to the ASIC and main processors.
- The Background Debug Mode (BDM) port is used for low level debugging of the main processors.

FMUX fibre optic connections

There are fibre optic connections from the integral FMUX functionality of the MCUF. The fibre optic connectors enable connection to MCUF or FMUX modules in other cabinets for additional transceivers.

CAL port

The CAL port on the front panel of the MCUF can be used to calibrate the sync block clock via MMI commands. The 8 kHz reference output is used in GCLK calibration procedure (see *Installation & Configuration BSS Optimization (GSM-100-423)*).

PCMCIA interface

The PCMCIA card is located on the front panel of the MCUF, and is used for:

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

The PCMCIA socket is an industrial standard 68 pin single socket, fitted with an ejector. The PCMCIA interface supports rev 2.1 type I and II cards.

The 20 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.

Front panel switches and indicators

The front panel of the MCUF module has two reset switches as shown in Figure 6-3:

- FULL is a hard reset (power up - removes software from the memory).
- CPU is a soft reset (this resets the MCUF 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 will perform a hard reset. Double pressing of the CPU reset thus has the same effect as a hard reset.

The MCUF has two front panel LEDs (one green and one red) as shown in Figure 6-3, with indications as shown in Table 6-2.

CAUTION	When red and green LEDs are flashing, the boot code is downloading into non-volatile memory for software upgrade. Power should not be removed, nor the cabinet reset, 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.

Table 6-2 MCUF front panel LED indications

Red	Green	Status
Off	Off	Board not powered up or in rest cycle
Off	On	Normal operation
On	Off	Fault condition
Flashing	Flashing	Non-volatile memory boot code upgrade (Do not remove power or reset – see above CAUTION)

PIX interfaces

The MCUF provides four PIX outputs on the backplane, driven at V. 28 levels. The four PIX outputs, routed to the cabinet alarm board, enable relay contact control of external customer equipment.

DRAM, flash EPROM and code loading functions

DRAM

The 16 Mbyte DRAM provides operational code and data storage for the main processors. There is also a SIMM socket in the circuit board, enabling the addition of a further 16 Mbytes if required. After software initialization, the DRAM uses ECC protection. Memory protection is provided by the main processors.

Fast flash EPROM

The fast flash 1 Mbyte bank is used for 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.

Slow flash EPROM

The slow flash 0.5 Mbyte bank is used for non-volatile data storage of diagnostic data and module ID information.

Code loading

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

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

After successful checking of the DRAM operational code, the code is executed, and the PCMCIA memory card updated with any changed objects.

CSFP code loading

If a PCMCIA memory 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 PCMCIA card.

Once the complete load has been transferred to the PCMCIA 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 PCMCIA card to support a roll back to the original version if required.

ASIC functionality

The Application Specific Integrated Circuit (ASIC) provides central switching capabilities for the MCUF. It is capable of supporting up to 24 transceivers, together with up to six network interfaces and two links to the on-board processors, one link to the sync processor and a link to the redundant MCUF. The link to the sync processor is used for code loading purposes only. The ASIC supports baseband hopping across the 24 transceiver links.

The ASIC provides interface features associated with the transceiver links, these include synchronization features to allow for delay in the link to the transceivers, and the necessary framing and encoding to support the link.

All of the serial links into the ASIC are internal lines (I lines), 125 μs framed, with 32 eight bit timeslots per frame.

ASIC transceiver link features

The ASIC interfaces to a maximum of 24 transceiver links. The ASIC can switch any timeslot on any of the transceiver links to any timeslot on other links connected to the ASIC; transceiver links, network links, MCUF redundancy link or processor links.

The ASIC provides the following features associated with the transceiver links:

- Link advance/delay compensation

  The ASIC will continually measure the round trip delay on each transceiver link to calculate a timing advance for each link. The link advance is applied, and can be adjusted, by the main processor via the processor parallel interface.

- BBH data switching

  BBH switching is performed automatically on any timeslot configured as BBH data. A single timeslot from the transceiver is selected for BBH routeing information, and defines which transceiver link (0-23) should be used for downlink.

- Timing reference insertion

  The ASIC receives timing pulses from the sync block and inserts the appropriate bits into the transceiver downlink synchronization and framing timeslots. The sync block will provide a version of the 6.12 s and 60 ms signals that is advanced by 125 μs for this purpose.

- Manchester coding/decoding

  The transceiver links are all Manchester coded/decoded by the ASIC. This function can be switched on or off (default on) on a per link basis. The disable feature is for applications outside of the MCUF module.

ASIC/network and processor link switching

The ASIC supports a maximum of six network links and two main processor links. The data to/from these links can be switched to/from any timeslot on other links connected to the ASIC.

The two links to the main processor allow it to route HDLC and other links to the appropriate place:

- 24 HDLC timeslots for the BCF RSS channel to each transceiver.
- Four timeslots for NIU control channels (two local, two redundant).
- Sync processor code load channel.
- Two channels for RSL links.
- One HDLC channel occupying up to three timeslots to the redundant MCUF.

Sync block functionality

The sync block is controlled via the parallel interface of the main processors and is responsible for site synchronization functions. It generates all required local references from a high stability local clock source. This clock source may also be locked to the incoming network clocks.

The sync clock source is in the form of a crystal oscillator (OCXO) which warms up for phase locking in 4 minutes, and achieves frequency stabilization in 15 minutes.

Site frame reference generation and re-timing includes:

- 2.048 MHz - For serial communications.
- 16.384 MHz - For FMUX communications.
- 125 μs - For NIU framing and transceiver framing.
- 60 ms- For transceiver GSM timing.
- 6.12 s - For GSM superframe.

The reference clocks available to the sync block are:

- Six network extracted clocks (E1/T1 source via NIUs). Any of the NIU modules under control of the MCUF can extract a reference clock from an E1/T1 link and pass to the Sync block.
- CAL port. The CAL port can be used to calibrate the sync block clock via MMI commands. The reference output provides a monitoring point.
- Redundant MCUF link.

Phase lock loop (PLL) operating modes

The PLL uses the selected reference signal as the loop reference clock. It includes an OCXO accurate to 0.05 ppm, a phase comparator and a loop filter. The PLL has the following operating modes:

- Warm-up

  The PLL is open loop and using the calibration frequency, but the OCXO is not yet warmed up.

- Set frequency

  The PLL is open loop and using the calibration frequency, and the OCXO is warmed up.

- Fast tune

  Closed loop with wide filter for coarse locking to the reference (extracted from network clock).

- Fine tune

  Closed loop with narrow filter for accurate locking to the reference (extracted from network clock).

When in fine tune closed loop mode, the accuracy is 0.01 ppm.

Sync block code load

The sync block controller has a dedicated 2.048 Mbit/s serial link into the ASIC enabling a 64 kbit/s HDLC channel to the main processors for code loading.

The sync block includes 256 kbytes of flash EPROM, which is used to store:

- Boot code.
- Operational code.

The boot code, which cannot be altered, queries the main processors on the current version of the sync operational code.

If the stored operational code is the correct version, the boot code will move the operational code to RAM and execute the code.

If the query results in the need for new operational code, the sync processor will download the operational code from the main processors via the ASIC to the RAM in the sync block.

After a successful download, the boot code programmes the flash EPROM with the new operational code and runs the operational code in RAM.

GSM counters

The following counters are provided:

- GSM frame incremented every 4.615 ms; range 0 - 1325.
- GSM superframe incremented every 6.12 s; range 0 - 2047.

Integral MCUF FMUX functionality

The equivalent function of two FMUX modules exists integral to the MCUF, enabling two extension cabinets to be connected. To enable total of four cabinets to be joined together as one BTS site, an FMUX module is also required in the master cabinet to connect the third extension cabinet. A single cabinet site has no need for the FMUX functionality, because the MCUF connects with the cabinet CTUs through the backplane.

Each fibre optic multiplexer (FMUX) function multiplexes and demultiplexes six, full duplex, transceiver links to one (TX/Rx) pair of fibre optic cables. This enables up to six transceivers in a single extension cabinet (either Horizon*macro* or M-Cell*6*) to be linked to the master cabinet.

Each FMUX fibre optic link is full duplex 16.384 Mbit/s. The FMUX optical link is capable of driving up to 1 km.

For functional description of FMUX see **FMUX module and FMUX function** in this chapter.

NIU

Overview of NIU

The network interface unit (NIU) module provides two E1 or two T1 termination links to the terrestrial network. The NIU E1/T1 outputs are connected to a T43 or BIB board, depending on the impedance matching requirement of the customer terrestrial circuits.

There are two types of NIU board, one for E1, one for T1. The NIU layout is common to both E1 and T1, the only differences being in the associated crystal oscillators and line matching resistor values.

An on-board NIU control processor provides network interface configuration and supervision, controlled by the MCUF.

NIU locations

The cabinet may contain up to four NIU modules in the digital module shelf, as shown in Figure 6-1. Two NIUs are located in the master (lower) part of the cage. Two NIUs are in the redundant (upper) part of the cage, though these upper NIUs are also used for non-redundant purposes.

An NIU in slot A0 supports two E1/T1 links.

An NIU in slot A1 supports one E1/T1 link.

An NIU in slot B0 supports two E1/T1 links.

An NIU in slot B1 supports one E1/T1 link.

NIU command identity number

Each NIU is identified in the database by an identity number, from 0 to 3. Table 6-3 shows the NIU slots and equivalent identity number.

Table 6-3 NIU slot and equivalent command identity

NIU (MSI) identity number used in commands	NIU slot
0	A0
1	B0
2	A1
3	B1

NIU view and LEDs

Figure 6-5 shows an NIU module.

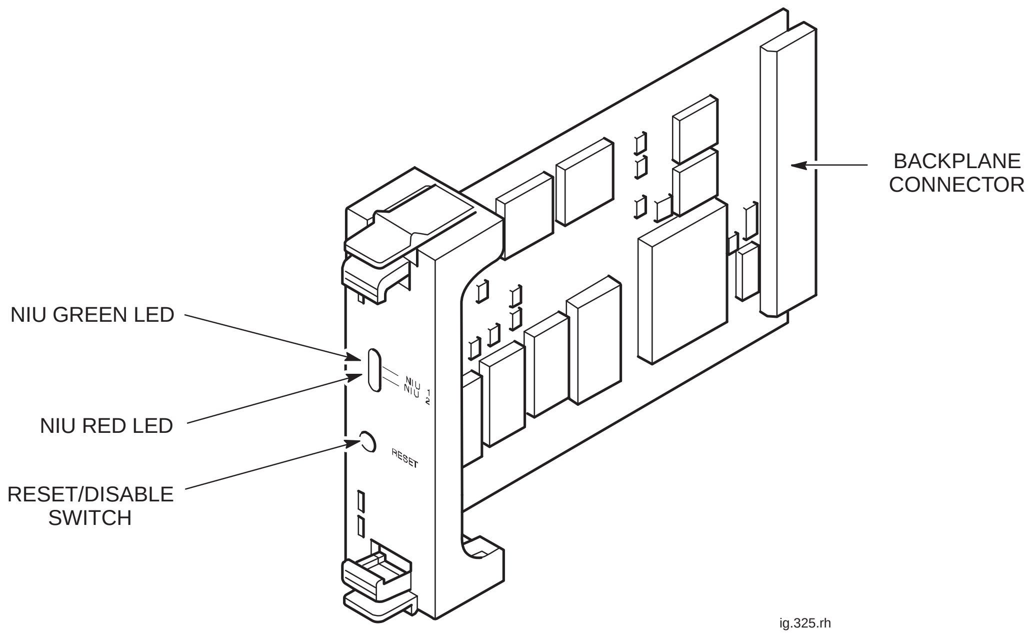

Figure 6-5 View of NIU module

The NIU status is indicated by the two front panel LEDs, one green and one red, controlled by the on-board processor, as shown in Table 6-4.

Table 6-4 NIU LED Display

Red LED	Green LED	Status of NIU board
Off	Off	NIU not powered up or in reset cycle.
Off	On	Normal operation.
Flashing	Flashing	NIU undergoing system code download.
On	On	NIU self testing following switch on or reboot. Red LED extinguishes after 20 seconds, or after 50 seconds following a reboot due to code download.

NIU functionality

The NIU provides two E1/T1 interfaces into the network (link 0 and link 1) as well as LAPD encoding/decoding and clock recovery from a selected E1/T1 link. The second E1/T1 interface (link 1) is not used for NIUs placed in positions at A1 and B1, as shown in Figure 6-1.

An NIU control processor provides network interface configuration and supervision, controlled by the MCUF. The NIU control processor maintains two independent control links in the redundant configuration (one to each MCUF), each using timeslot 0 of MCUF link 0.

NIU diagram

Figure 6-6 identifies the functional blocks in the NIU.

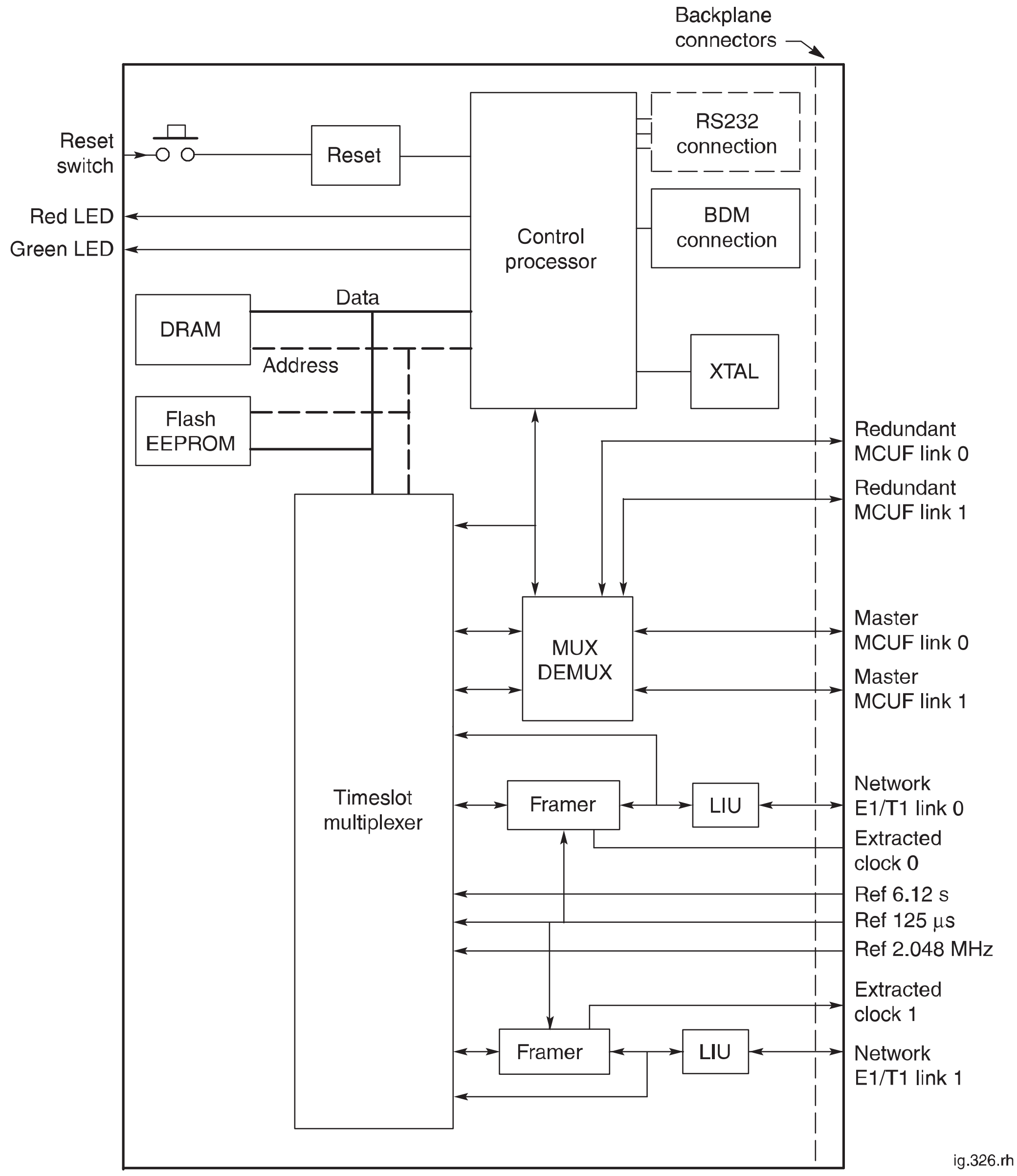

Figure 6-6 Functional diagram of NIU module

Control processor

The control processor interfaces to timeslot 0 of link 0 from each connected MCUF.

The processor uses 512 kbytes of flash EPROM for boot code, operational code storage and module ID. Code is executed directly from the flash EPROM. The boot code can be overwritten under control of the MCUF, if required.

The processor also has an on-chip 1 Mbyte of DRAM.

TTY Ports

The processing section provides two TTY ports for Motorola debugging purposes only.

Resets

The processor is capable of soft resetting itself. The front panel reset causes a hard reset of the entire board. Power-on also resets the processor.

The MCUF is able to reset the NIU via a message on the HDLC link.

NIU/MCUF framing and clocks

The control processor is supplied with a clock from an on-board crystal oscillator, which has an output enable pad for test purposes. The framer devices also have their own crystal oscillators on-board.

The framer devices provide the decoded and jitter attenuated receive data, for passing to the MCUF.

The framer devices also extract a clock signal from an E1/T1 link, which is then passed to the MCUF synchronization circuit. At the MCUF, this signal is used to phase lock a local 16.384 MHz clock signal. Once phase locked, three reference clock signals are provided for NIU use:

- REF 2.048 MHz clock signal.
- REF 6.12 s clock signal.
- REF 125 µs clock signal.

The NIU transmit and receive framing is controlled by this 125 µs reference pulse received from the MCUF.

Distance measurement

The NIU provides the ability to perform network distance delay measurement on either of the two network links. Measurement can only be performed on one link at a time.

Three modes of operation are possible:

- Mode 1. A pattern is transmitted in a selected network timeslot and the corresponding receive timeslot is monitored for its return. The delay is measured to an accuracy of ± 488 ns. The pattern is transmitted on the 6.12 second reference signal.
- Mode 2. The receive link is monitored for the pattern. When received, the pattern is transmitted back in the next frame. The time between receipt and transmission of the pattern is measured to an accuracy of +/–488 ns.
- Mode 3. The receive link is monitored for the pattern. When it is detected, a strobe is generated for the MCUF sync block.

Radio signalling links (RSLs)

The radio signalling links (RSL) to the BSC from the main processor on the MCUF are 64 kbit/s LAPD links. The LAPD encoding of this RSL data is performed on the NIU by the NIU control processor.

The RSL links between the MCUF and NIU must be sent as follows:

- RSL link 1 is embedded in the NIU control link; that is, it will be in timeslot 0 of link 0 to the NIU. This link is important for initialization.

NOTE	When the NIU is on a network link to a BSC or another BTS, the RSL can be placed on either link on any default timeslot other than zero.

- RSL link 2 is on a different timeslot from that used for the network connection

The NIU will support a maximum of two RSL links. The RSL links may both be on a single network link or shared between the two network links.

The NIU hardware supports switching for 64 k and 16 k LAPD channels.

T1 NIU need to set link type

T1 NIUs and E1 NIUs cannot be interchanged. A T1 link line consists of 24 timeslots, as opposed to 32 timeslots for an E1 link line. A T1 link generates specific T1 alarms, referred to as **Red alarms**. A T1 NIU supports the same MSI type of device transitions as an E1 NIU.

The OMC-R operator should set the link type, or it will default the site to an E1 system. In ROM, it is set by a ROM-only MMI command. In RAM, it is a database parameter set by a **chg_element** command.

The RSL default timeslots are the same for a T1 NIU and an E1 NIU. The basic mechanism for communicating and configuring is also the same.

T43/BIB-NIU - E1/T1 mapping

Overview of T43/BIB-NIU connection

The NIU network interface (E1/T1) links connect to a single T43 (CIM) or BIB (BIM) board on top of the cabinet by a single backplane connector and cable.

NIU to T43/BIB mapping and command ID

One T43 or BIB board is connected to the μBCU. Only six network interfaces are used, three pairs to the master NIU modules, and three pairs to the redundant NIU modules. Each NIU is identified in the database by an identity number, from 0 to 3, as shown in the final column of Table 6-5.

NOTE	The redundant NIU modules are only redundant in the sense of being supplied by a different BPSM, and can thus continue to operate if the Master BPSM fails. All NIUs are available for separate use.

Table 6-5 defines the mapping from the T43/BIB connector to NIU boards.

Table 6-5 T43/BIB connector to NIU boards

T43 network side connector	37-way D-type connections (BIB)	NIU location	NIU identity (MSI) used in commands
J1	1,20	NIU A0 - Tx1	MSI(NIU) 0
J2	2,21	NIU A0 - Rx1	
J7	7,26	NIU A0 - Tx2	MSI(NIU) 0
J8	8,27	NIU A0 - Rx2	
J13	13,32	NIU A1 - Tx1	MSI(NIU) 2
J14	14,33	NIU A1 - Rx1	
J4	4,23	NIU B0 - Tx1	MSI(NIU) 1
J5	5,24	NIU B0 - Rx1	
J10	10,29	NIU B0 - Tx2	MSI(NIU) 1
J11	11,30	NIU B0 - Rx2	
J16	16,35	NIU B1 - Tx1	MSI(NIU) 3
J17	17,36	NIU B1 - Rx1	

Diagram of T43 connection to NIUs

Figure 6-7 shows a diagram of T43 connection to NIUs.

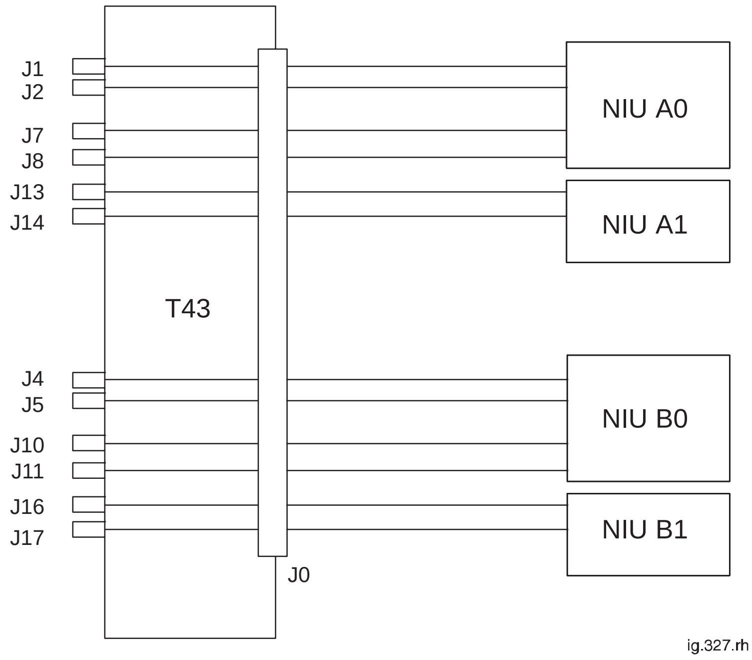

Figure 6-7 Diagram of T43 connection to NIUs

FMUX module and FMUX function

Overview of FMUX module

The fibre optic multiplexer (FMUX) module multiplexes and demultiplexes six, full duplex, transceiver links to one (TX/Rx) pair of fibre optic cables. This enables up to six transceivers in a single extension cabinet (either Horizon*macro* or M-Cell*6*) to be linked to the master cabinet.

The FMUX module has two modes of operation:

- Working in conjunction with the MCUF to multiplex/demultiplex transceiver links to/from a third extension cabinet.
- Operating in the extension cabinet to supply the transceivers in that cabinet.

To enable a total of four cabinets to be joined together as one BTS site, an FMUX module is required in the master cabinet to connect the third extension cabinet. A single cabinet site has no need for an FMUX module, because the MCUF connects with the cabinet CTUs through the backplane.

Two FMUX modules may be fitted in the digital module shelf, one for the master MCUF, and one for the slave. An extension cabinet only requires one FMUX to connect to six transceivers within the cabinet, (plus one for redundancy if required).

Each FMUX fibre optic link is full duplex 16.384 Mbit/s. The FMUX optical link is capable of driving up to 1 km.

FMUX module view

Figure 6-8 shows an FMUX module.

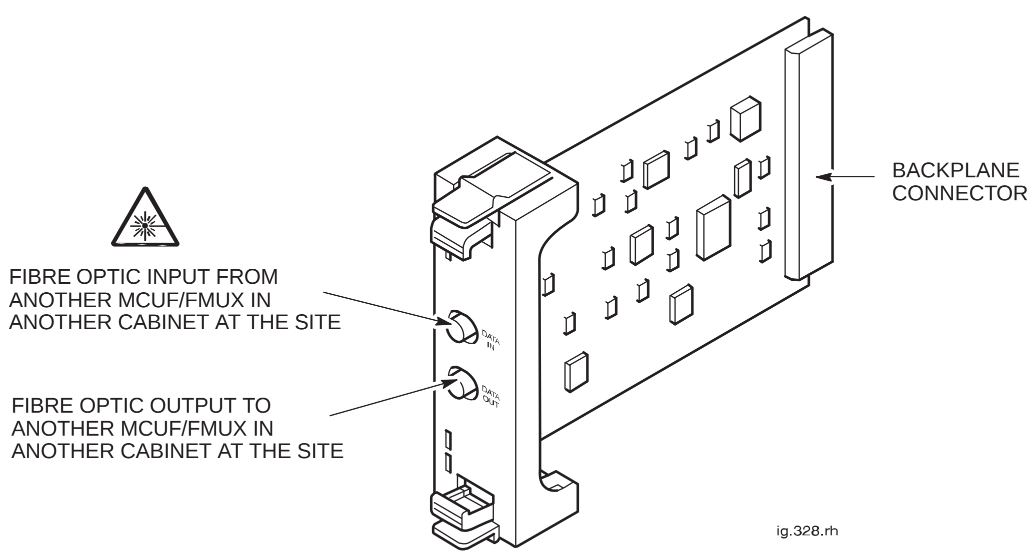

Figure 6-8 View of FMUX module

FMUX functional diagram

Figure 6-9 shows a block diagram of the FMUX module.

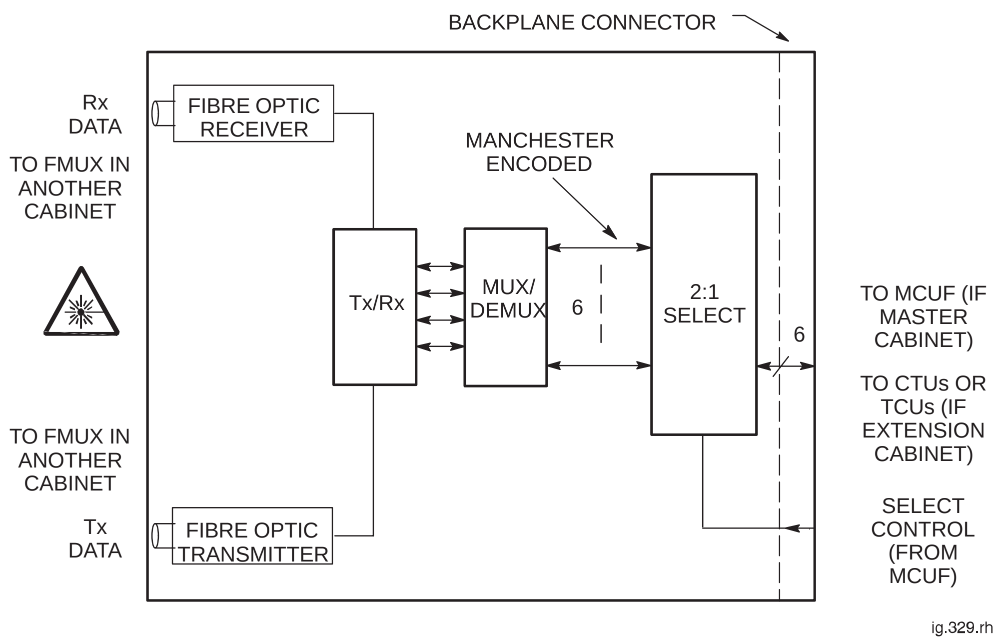

Figure 6-9 Functional diagram of FMUX module

FMUX functional explanation

The MCUF transmits and receives a 2.048 Mbit/s data stream link to each operational transceiver. In the master cabinet this is achieved by the backplane, without using an FMUX.

If the transceiver is in an extension cabinet, the master cabinet FMUX combines the data stream with up to five others (see Figure 6-9), and then converts the electronic signal to fibre optic, for onward transmission to the extension cabinet.

At the extension cabinet, another FMUX converts the fibre optic signal back to electronic form, for transmission to the transceivers.

The data stream return from the extension cabinet is a reverse of the above.

The multiplexer/demultiplexer can support up to six transceiver links. It uses a 16.384 Mbit/s Manchester encoded serial data link organized as 256 x eight bit timeslots in a 125 μs frame. Manchester coding is used to detect errors, indicated at timeslot zero for each transceiver, enabling error correction at the other FMUX.

Alarm module

Alarm module overview

The alarm module is located in the digital module shelf, adjacent to the MCUFs. It provides the cabinet equipment with an external alarm 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 CTUs in the same cabinet.

Alarm module view

Figure 6-10 shows an alarm module.

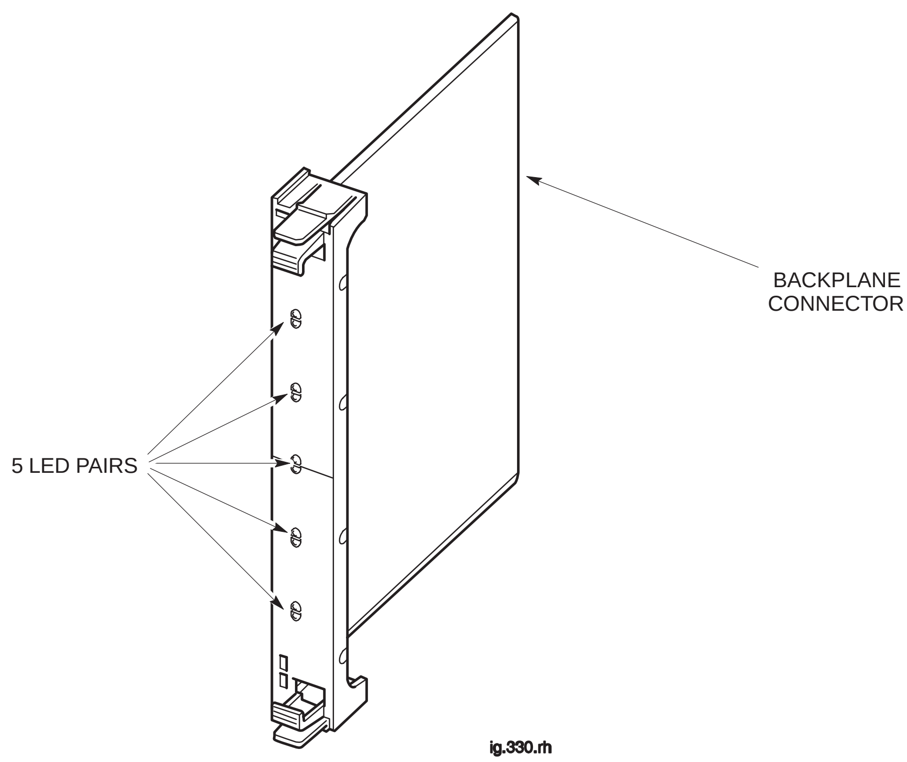

Figure 6-10 Alarm module view

Alarm module functionality

The alarm module receives inputs from:

- The external alarm connector on the interface panel, (from the CAB and the alarms interface board).
- Cabinet PSMs (identifying type, manufacturer and slot number).
- Environmental control devices.
- Customer defined alarms.

The alarm board receives these inputs, encodes them, and then passes the code word to all CTUs 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 replacement). 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 extension cabinets

Extension cabinet alarms are sent from the extension cabinet alarm module to the extension cabinet CTUs. The CTUs transmit the alarms to the main cabinet, by using the normal FMUX connection, for transmission to the MCUF.

Alarm module display presentation

All alarms indicators are green when equipment is functioning correctly, and red when equipment is faulty. The locations are shown in Table 6-6.

NOTE	Seven of the LEDs are used in the Horizon*macro* outdoor. LEDs marked red in Table 6-6 are **on** in alarm state, and **off** in normal operation. LEDs marked bicolour in Table 6-6 (fans) are **green** when all fans are operating correctly, and **red** if one or more fans are faulty.

Table 6-6 Alarm module LEDs

LED location	Light colour states	Equipment monitored by light (Green = OK, Red = FAULT)
1 (top)	red	AC supply to ac input failed.
2	red	Rectifier output failed.
3	red	Not used (LED permanently off).
4	red	Cabinet door or auxiliary equipment housing door open alarm.
5	red	Low voltage disconnect (LVD) alarm (battery backup option).
6	bicolour	TMS fans fully operational.
7	bicolour	Not used (LED permanently green).
8	bicolour	Not used (LED permanently green).
9	red	TMS 1 failed (thermal management system).
10 (bottom)	red	TMS 2 failed (auxiliary equipment housing).

MOTOROLA

Chapter 7

Auxiliary equipment housing

Auxiliary equipment housing overview

Introduction to the auxiliary equipment housing

The auxiliary equipment housing is an optional multi-purpose secure enclosure for use with the Horizon*macro* outdoor cabinet. It can be installed on either side of the BTS cabinet and provides space for the installation of additional equipment at the site. Additional auxiliary equipment housings may be installed adjacent to one another.

Auxiliary equipment housing mechanical design

The external design of the auxiliary equipment housing is based on that of the Horizon*macro* outdoor cabinet – the procedure for opening/closing the door and lid are identical (except that there is only one lid catch on the auxiliary equipment housing).

The auxiliary equipment housing contains 23 U of standard equipment racking, with shelving fitted as standard.

Additional equipment can include:

- External battery backup system.
- Customer supplied equipment.

Cable entry to the auxiliary equipment housing is through either side, dependant on site configuration. The cables pass through the earth plates, fitted on both sides of the housing. Internal connections are made through a power distribution box containing circuit breakers, mounted on the inside of the lid.

This box also contains an external alarms interface board, which sends alarm signals to the main cabinet.

Two pairs of Anderson connectors are fitted to the underside of the power distribution box. The rear pair is for the dc power connection to the main cabinet. The front pair is for an extension connection, either to another main cabinet, or to an additional auxiliary equipment housing.

View of auxiliary equipment housing

Figure 7-1 shows an external view of an unequipped auxiliary equipment housing with the lid open.

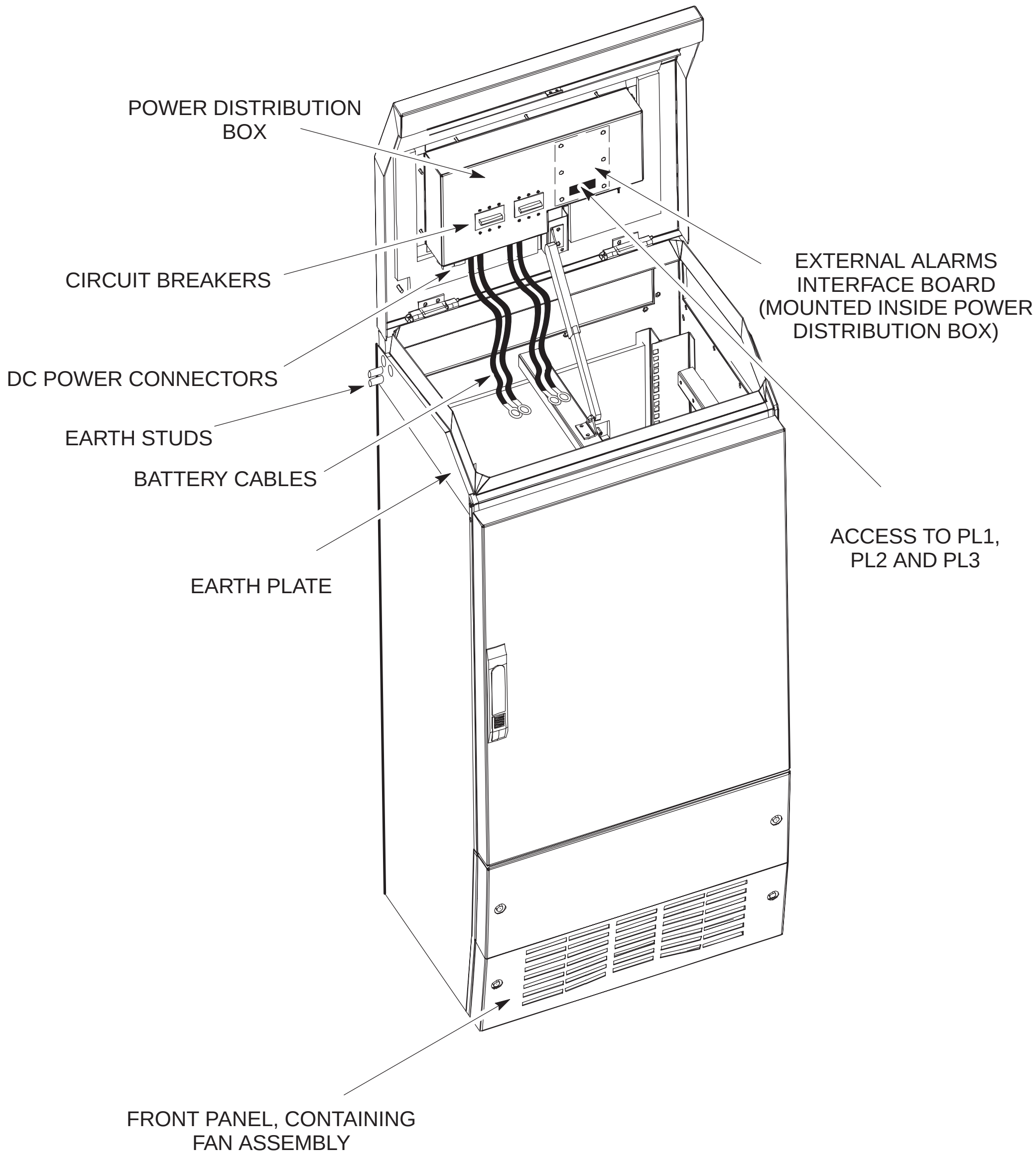

Figure 7-1 Auxiliary equipment housing, showing major components

Temperature control within the auxiliary equipment housing

Temperature control equipment

The temperature within the auxiliary equipment housing is regulated by the following equipment:

- A fan, mounted in the lower front panel, to provide cooling and warm air circulation.
- Heater mats, bonded to a metal plate and fitted to the battery trays below each battery monoblock, to provide heating.

Operation of the temperature control equipment

The fan operates from a –48 V dc supply, connected through PL7 on the external alarms interface board and protected by a 500 mA anti-surge fuse. The heater mats each require –48 V dc, connected through PL8, PL9, PL10 and PL11 for heater mats 1 to 4 respectively on the external alarms interface board. The supply voltage to each mat is protected by a 5 A fuse.

The 8 W fan operates continually regardless of ambient temperature. The heater mats operate the ambient temperature is less than 12 °C (+/–3 °C).

The auxiliary equipment housing contains two temperature sensors, providing sensing for an over temperature alarm and an over temperature trip control signal.

If the over temperature alarm sensor is triggered (cabinet temperature reaches 55 to 60 °C), this causes an alarm signal to be sent to the OMC-R via the CAB in the main cabinet. If the over temperature trip sensor is triggered (cabinet temperature reaches 65 °C, +/–3 °C), the external alarms interface board disconnects the remote operation circuit breakers, thus removing the supply to the main cabinet. When the temperature drops to 5 °C below the trip level, the external alarms interface board causes the circuit breakers to close, thus restoring the supply to the main cabinet.

External alarms interface board

Function of the external alarms interface board

The external alarms interface board is mounted in the power distribution box, in the lid of the auxiliary equipment housing. It has the following functions:

- Provides power to the temperature control equipment in the auxiliary equipment housing.
- Relays alarm signals from the auxiliary equipment housing through the alarms interface board in the Horizon*macro* outdoor BTS cabinet to the CAB.
- Provides facilities to extend control and alarm functions to a second BTS cabinet or auxiliary equipment housing.

External alarms interface board connections

Power, control and alarm signals are relayed through the external alarms interface board as described below.

NOTE	Cables for connecting the heater mats, fan and control/alarm signals are extended to the outside of the power distribution box.

Power connections

External power (–48 V dc) is connected to PL12, pins 1 and 2 on the interface board via the rear pair of Anderson connectors on the bottom left side of the power distribution box. If a second BTS cabinet is connected, the supply voltage is connected to PL12 pins 3 and 4 via the front pair of Anderson connectors. The fan is powered from PL7. The four heater mats are individually connected to PL8, PL9, PL10 and PL11.

Control connections

Control signals to trip the circuit breakers in the event of an overtemperature alarm signal (temperature reaches 65 °C, +/–3 °C) or a low voltage supply signal (supply voltage drops below 38 V dc).

Alarm connections

The following alarm signals are routed through the interface board to the CAB:

- Overtemperature alarm signal (PL1, pins 5 and 6).
- Door open signal (PL4).

Common applications for the auxiliary equipment housing

Auxiliary equipment housing as a battery box

The most common application for the auxiliary equipment housing is to use it for battery backup for the Horizon*macro* outdoor cabinet, by fitting optional batteries (see Figure 7-2).

Up to 16 x 6 V batteries can be mounted on four shelves. Each bank of eight batteries must be wired in series to provide –48 V dc, and the two banks are normally wired in parallel to provide increased backup duration.

Alternatively, each of the two banks of batteries can be independently connected to separate BTS cabinets.

Additional auxiliary equipment housings may be installed with the batteries connected in parallel to provide extra battery capacity, further increasing backup duration.

View of auxiliary equipment housing as battery box

Figure 7-2 shows an auxiliary equipment housing with the door and lid open and batteries installed.

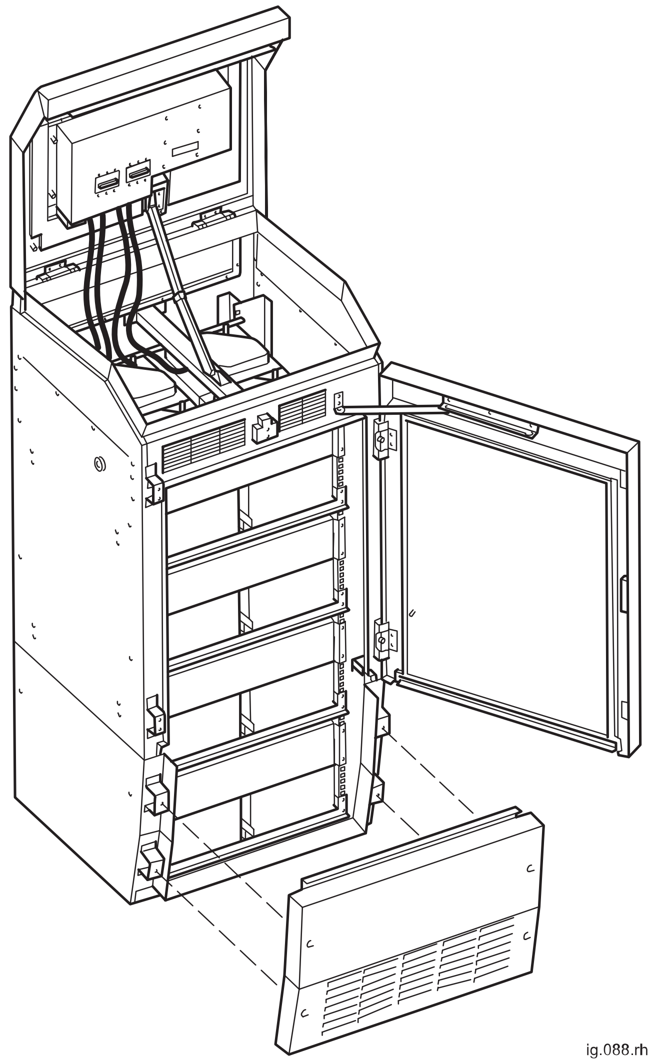

Figure 7-2 Auxiliary equipment housing with batteries installed

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Chapter 8

Cable shroud

Chapter 8
Cable shroud i

Introduction to the cable shroud

Overview of the cable shroud

The cable shroud is an optional kit which is designed specifically for use with Horizon*macro* outdoor cabinets and the auxiliary equipment housing. It provides concealment for the power supply input to the main cabinet and the antenna feed cables, connections between the main cabinet and the auxiliary equipment housing, connections between two main cabinets, or connections between two auxiliary equipment housings.

Cable shroud configurations

Although only one cable shroud kit is available, it can be used for each of the following configurations:

NOTE	Chapter 5 of the installation part of this manual provides illustrations of how some of these configurations can be implemented.

- Below ground cable entry concealment for the Horizon*macro* outdoor cabinet.
- Ground level cable entry concealment for the Horizon*macro* outdoor cabinet.
- High level cable entry concealment for the Horizon*macro* outdoor cabinet.
- Cable entry concealment between two Horizon*macro* outdoor cabinets.
- Cable entry concealment between an Horizon*macro* outdoor cabinet and an auxiliary equipment housing.
- Cable entry concealment between two auxiliary equipment housings.

In addition to the above configurations, the shroud can be fitted on either the left side or the right side of a cabinet.

The cable shroud assembly

Description of the cable shroud assembly

The cable shroud comprises a metal frame fitted with several metal panels, which are attached to the frame with anti-tamper screws. Panels can be removed from or attached to the frame, depending on how the shroud is used.

The frame of the shroud is secured to the side of a cabinet using screws.

View of the cable shroud

The cable shroud is delivered fully assembled, with all the metal plates attached to the frame, as shown in Figure 8-1.

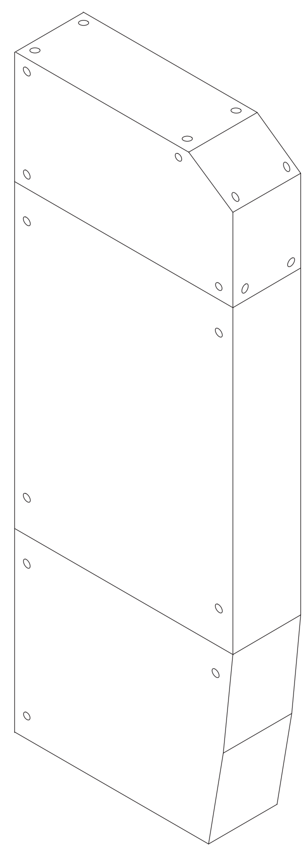


Figure 8-1 Cable shroud assembly

CHAPTER 1
INTRODUCTION TO
INSTALLATION

CHAPTER 2
SITE PREPARATION

CHAPTER 3
INSTALLING THE BTS
CABINET

CHAPTER 4
INSTALLING THE CABLE
SHROUD

CHAPTER 5
INSTALLING THE AUXILIARY
EQUIPMENT HOUSING

CHAPTER 6
INTEROPERABILITY

CHAPTER 7
COMMISSIONING THE
OUTDOOR CABINET

CHAPTER 8
DECOMMISSIONING THE
EQUIPMENT

MOTOROLA

Category 423

Installation & Configuration (Inst.)

Chapter 1

Introduction to installation

Introduction to installation and configuration

Manual scope

This category (GSM-204-423) covers installation and commissioning for the cabinet, arranged in the following chapters:

Chapter 1 Introduction

General information, safety precautions, and information about tools needed to install the equipment.

Chapter 2 Site preparation

Describes the procedures to be followed for initially preparing the site and installing the necessary ducting and concrete base.

Chapter 3 Installation of outdoor cabinet

All procedures necessary to install the cabinet ready for operation, with an overview of the different configurations available.

Chapter 4 Installing the cable shroud

Procedures for installing the optional cable shroud in various configurations.

Chapter 5 Installing the auxiliary equipment cabinet

All procedures necessary to install the optional auxiliary equipment cabinet, ready for operation.

Chapter 6 Commissioning of outdoor cabinet

All procedures necessary to enable the cabinet to be fully operational.

Chapter 7 Decommissioning of outdoor cabinet

All procedures necessary to decommission the outdoor cabinet.

NOTE	For hardware optimization and base site integration, refer to *Installation and Configuration: BSS Optimization: (GSM-100-423) 68P2901W43*.

Safety instructions

WARNING	This equipment must only be installed by trained personnel.

The following safety instructions must be observed when installing the equipment described in this manual:

- The installation and configuration procedures described in this manual must only be carried out by suitably trained personnel.
- Installation and commissioning must comply with all relevant national and regional regulations.
- The equipment must only be installed in a location to which unauthorized access can be prevented.
- Cabinets must be bolted down.

Software requirements

The GSM/EGSM900 and DCS1800 BTSs require BSS and OMC-R software release GSR4 (or later) in the network.

The GSM850 and PCS1900 BTSs require BSS and OMC-R software release GSR5.1 (or later) in the network.

Horizon*macro* outdoor tool list

Overview of tool list

This section lists the recommended tools required for installing, commissioning and maintaining the Horizon*macro* outdoor cabinet.

Tool list

Table 1-1 lists the recommended tools for Horizon*macro* outdoor.

Table 1-1 Horizon*macro* outdoor tool list

Quantity	Description
1 pair	Safety goggles
1	Hard hat
1	Dust mask
1 pair	Ear defenders
1	Antistatic wrist strap with coiled lead
1	Antistatic mat
1	Marker pen
1	Torch
1	Socket set (A/F/Metric 13 mm or 1/2 sq drive)
1	280 mm insulated adjustable spanner
1 each	Combination spanners A/F: 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 7/8, 3/4, 1.
1 each	Combination spanners metric: 8 mm to 25 mm
1	Ratchet ring spanner (15 mm x 13 mm)
1	Torque spanner (12 mm)
1	Torque wrench (1–25 Nm)
1	Torx driver set (T10 to T30) and Security Torx driver set (T10 to T30)
1	6 mm torque spanner (for SMA Tx Block connectors)
1	Security Allen key set
1	Claw hammer
1	Pipe cutter
1	Junior hacksaw
1	300 mm hacksaw
1 pair	150 mm side cutters
1 pair	150 mm heavy duty side cutters

Quantity	Description
1 pair	Flush cut wire cutters
1 pair	Light duty cable cutters
1 pair	Cable shears
1	Knife with retractable blade
1 pair	General purpose pliers
1 pair	Snipe nose pliers
1 pair	Industrial scissors
1 pair	GP serrated jaw pliers
1	Set of jeweller’s screwdrivers
1	Screwdriver set (including flat and cross-head blades)
1	Isolating transformer (suitable for site use)
1	Piston drill (suitable for drilling concrete and capable of accepting an M20 drill bit)
1	M20 drill bit
1	Drill bit set
1	6 m 240 V extension cable (twin outlet)
1	Soldering iron (dual temperature) with holder
1	Coax cable stripper for 2002 (75 ohm coaxial cable)
1	Hand crimp tool
1	Crimp tool for type 43 connectors
1	BNC crimp tool with inserts
1	Telephone plug crimp tool
1	50 mm crimp tool
1	Cable tie gun
1	1.5 m wooden step ladder
1	Table vice
1	250 mm vice grips
1	7.5 m tape measure
1	300 mm steel rule
1	Spirit level (1 m)
1	Centre punch
1	Pocket scriber
1	250 mm half round file
1 pair	Straight point tweezers
1	Null modem

Quantity	Description
1	RS232 mini tester
1	M to M gender changer
4	M16 collared eye bolts (min. rating 400 kg) Bolts must be manufactured to CE conformity.

Chapter 2

Site preparation

Chapter 2

Preparation overview

Overview to site preparation

This chapter contains:

- Information that should be read for initial planning.
- Information that should be read for safe completion of procedures.
- Pre-installation procedures to be followed to prepare the site before beginning the installation.

Pre-installation procedures

Pre-installation for the cabinet comprises the sections listed in Table 2-1.

Table 2-1 Pre-installation sections in this chapter

Section	Description
Site requirements and considerations	Details mechanical, electrical and structural parameters to be taken into account when selecting a site.
Visiting the site	Defines the site operating procedures.
Preparing the site	Details general site construction parameters.
Earthing the site	Earthing techniques.
Preparing the foundation	Details the procedures for laying the cabinet foundations and fitting the cabinet template.

Site requirements and considerations

Overview of requirements

The base site area, where the equipment is to be installed, must meet:

- Structural requirements including:
  - Space for all conditions, including maintenance, expansion and associated cables.
  - Allowance for cabinet height.
  - Allowance for weight, including that for potential additions on expansion.
  - Additional space to allow doors to be fully opened to 120 degrees.
- Environmental and power requirements, as defined in manual specifications.

Outdoor cabinet dimensions

The dimensions of cabinets are shown in Table 2-2.

Table 2-2 Cabinet dimensions

Cabinet type	Height	Width	Depth
Horizon*macro* outdoor cabinet	1364 mm	1300 mm	594 mm
Horizon*macro* auxiliary equipment housing	1364 mm	604mm	594 mm

Cabinet weights

The cabinet weights are shown in Table 2-3.

Table 2-3 Outdoor cabinet weights

BTS cabinet with six transceivers	Auxiliary equipment housing empty / 16 batteries fitted
360 kg	110 kg / 500 kg

Torque values

Use the torque values listed in Table 2-4 during installation (see **NOTE** for M12).

Table 2-4 Torque values for all cabinet screws/bolts or RF connectors

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

NOTE The setting of torque value for M12 anchor screws/bolts depends on local supplies. Refer to the manufacturer’s data for correct values.

Power requirements

The power requirements of cabinets depends on the configuration.

Power consumption (dc and ac)

Table 2-5 lists typical and maximum power consumption values.

Table 2-5 Power consumption of full cabinet, including digital redundancy and external battery charging

Typical measured consumption	Maximum power consumption
2200 W	5600 W

NOTE	Maximum power consumption figures are theoretical values derived under extreme conditions and are affected by variables such as temperature, component tolerances, transmission power and supply voltage. Although these figures must be considered when planning site power requirements, typical measured consumption values will be lower.

Cabinet input power supply requirements

WARNING	All cabinets and supply cables must be protected by an upstream fuse or circuit breaker.

Table 2-6 lists the power supply requirements for the different power supply options.

Table 2-6 Main outdoor cabinet power requirements

Nominal voltage	Supply voltage and frequency range	Current supply maximum
110 V ac single phase	88 to 134 V ac at 45 to 66 Hz	54.4 A (at nominal voltage)
230 V ac single phase	176 to 265 V ac at 45 to 66 Hz	26.1 A (at nominal voltage)
230 V ac three phase and neutral (star)	176 to 265 V ac at 45 to 66 Hz	26.1 A (at nominal voltage)
230 V ac three phase without neutral (delta)	176 to 265 V ac at 45 to 66 Hz	26.1 A (at nominal voltage)

RF output power

Table 2-7 lists the RF power output of the CTU types.

Table 2-7 CTU RF power output at Tx connector

GSM850 and EGSM900	DCS1800 and PCS1900
60 W (47.8 dBm) +/–1.0 dBm	50 W (47.0 dBm) +/– 1.0 dBm

Table 2-8 lists the expected power output from the various Tx blocks for both types of CTU.

Table 2-8 RF power output at cabinet after Tx blocks

Tx block	GSM850	EGSM900	DCS1800	PCS1900
TDF	40 W (46.0 dBm)		32 W (45.1 dBm)	
DCF	20 W (43.0 dBm)		16 W (42.1 dBm)	
DDF	8.5 W (39.3 dBm)		7 W (38.5 dBm)	

Environmental requirements

Table 2-9 lists the operating environmental limits.

Table 2-9 Environmental limits

Environment	Temperature	Relative Humidity
Operating	–40 °C to +50 °C plus a solar gain of 1.2 kW/m^2	5% to 100% relative humidity, not to exceed 30 g water / m^3 air.
Storage	–45 °C to +70 °C	8% to 100% relative humidity, not to exceed 30 g water / m^3 air.

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

Structural requirements

There must be adequate clearance at the front of (648 mm), and above (1900 mm), the equipment for operation and maintenance purposes. It is also recommended that there is adequate side clearance to open the doors to 120° (see Figure 2-1), and to fit the optional shroud on the cable entry side.

The foundation or structure on which the BTS cabinet is mounted must be of sufficient strength to withstand 105 knot (120 mph) winds on the cabinet front or rear and a maximum gross weight of 360 kgs.

The cabinet ventilation entry and exhaust is solely from the bottom front of the cabinet, allowing a cabinet to be placed against a wall. However, a minimum clearance of 240 mm is required on the cable entry side, between the cabinet and obstructions, such as a wall or another cabinet.

Allow 1000 mm clearance at front and side where possible, to facilitate installation and maintenance.

NOTE	In seismically active areas, Motorola suggest using a qualified structural engineer to assess frame mounting requirements, such as floor construction, mounting anchors and cell site construction.

Outdoor site dimensions

Basic outdoor site

Figure 2-1 shows the site layout plan for a single cabinet with dimensions and required clearances (optional auxiliary equipment housing not shown).

NOTE	Allow 180 mm additional side clearance if a cable shroud is to be fitted.

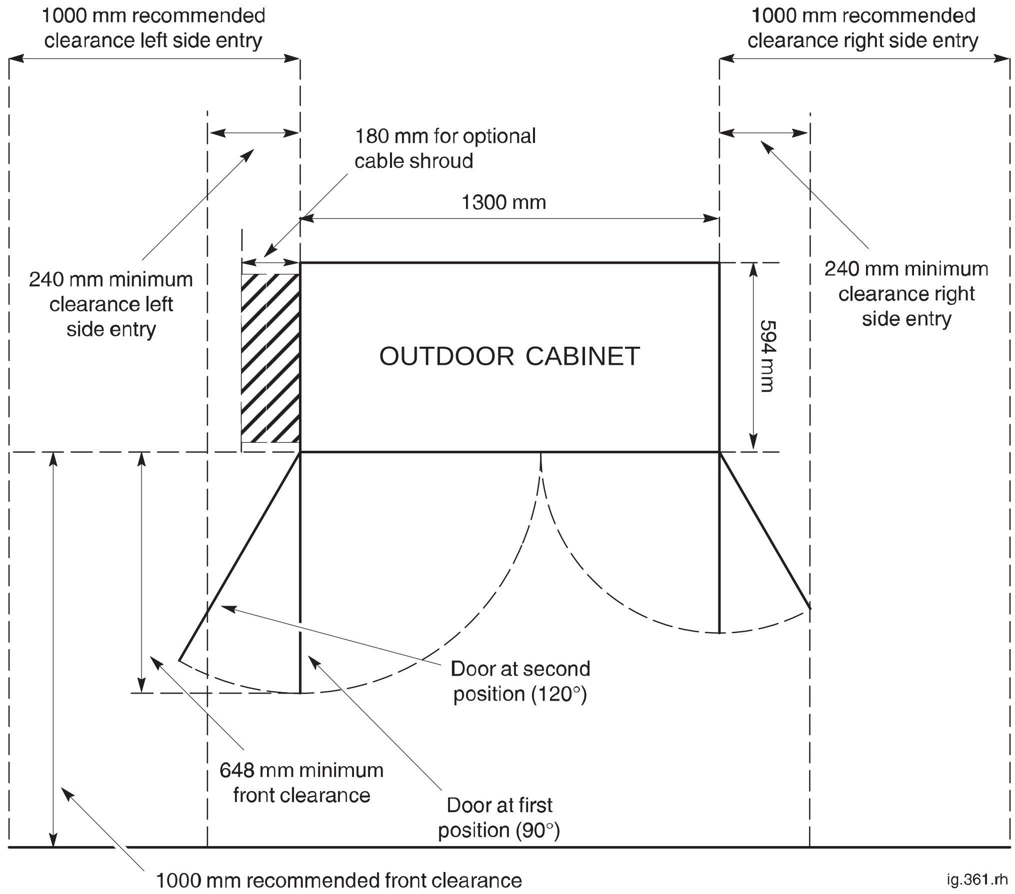


Figure 2-1 Outdoor cabinet site layout plan view (cable entry on left side)

Outdoor site with auxiliary equipment housing

Figure 2-2 shows the site layout plan for a single cabinet and optional auxiliary equipment housing with dimensions and required clearances.

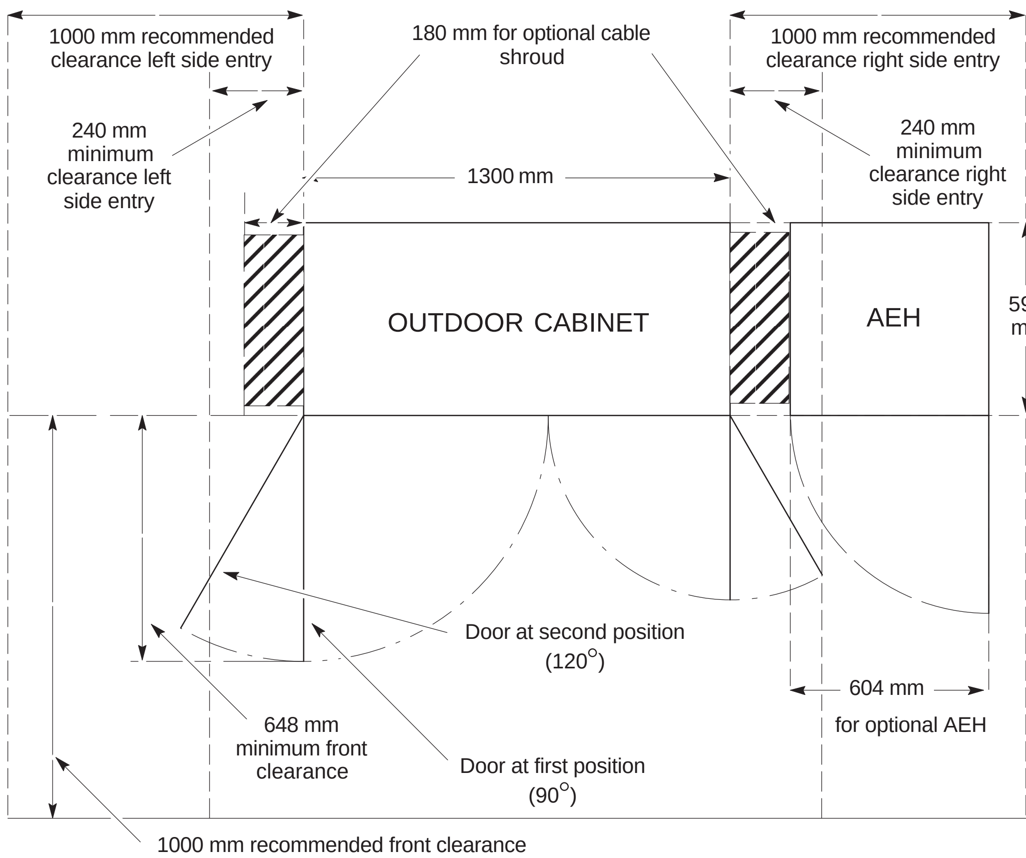


Figure 2-2 Outdoor cabinet site layout plan view (including optional equipment)

View of maximum site template layout

Figure 2-3 shows a plan view of the template layout for the maximum site configuration. Using the dimensions and clearances shown, the site layout for any combination of BTS cabinets and auxiliary equipment housings can be calculated.

NOTE	If a steel structure is to be used instead of a concrete base, the dimensions shown in Figure 2-3 can be used to determine the location of the mounting bolt holes. Figure 2-3 only shows template and mounting hole dimensions and clearances, cabinet dimensions are slightly larger.

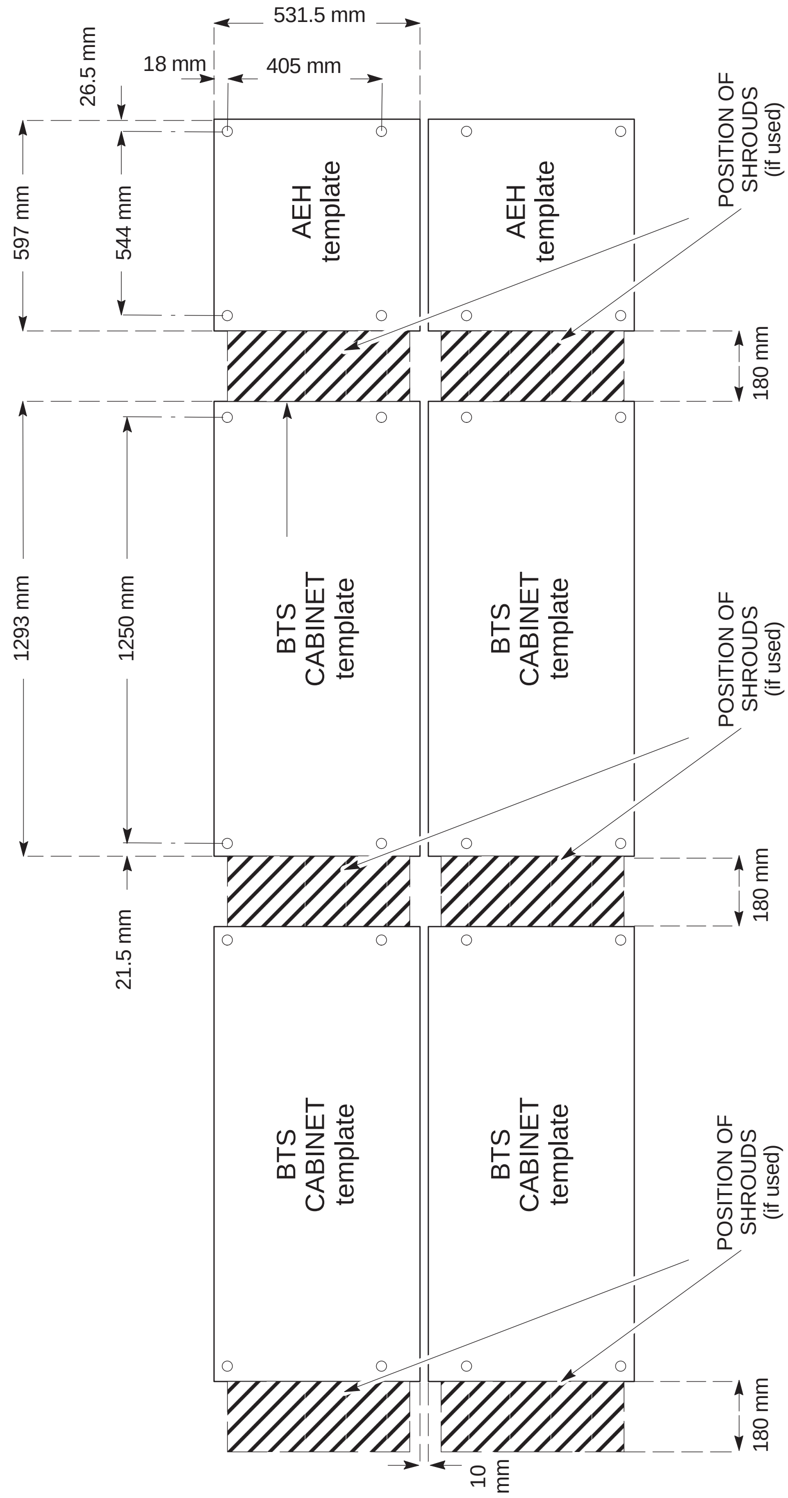


Figure 2-3 Plan view of template layout for maximum site configuration

Visiting the site

Overview of visiting the site

When preparing to do work at a site and upon arrival, follow the instructions provided in this section.

Before departure to site

Before departing to the site:

1. Ensure that team members have adequate test equipment, tools, and hardware to carry out the task. Check for any special requirements.
2. Contact the person in charge of the site to advise of the team's estimated time of arrival and the expected duration of their stay on the site. This will usually have been dealt with previously, but it is always advisable to make sure that the information has been passed on.
3. Ensure that the team read the site access details on each visit to a site as local regulations may change.

Arrival at all sites

When entering any site:

1. Do not enter the site until contact has been made with the OMC-R or MSC. Contact the local OMC-R and local MSC to announce the team's arrival before entering the site.
2. Enter the site and check for site alarms, for example intruder alarms, that may have been activated by entry.
3. Read any local instructions.

Arriving at occupied sites

In any exchange or occupied building, contact the person in charge or caretaker of the site, who will explain local regulations. This person may also advise teams on parking, rubbish removal, and canteen facilities.

Arriving at unoccupied sites

When entering an unoccupied site:

1. Do not enter the site until contact has been made with the OMC-R or MSC. Contact the local OMC-R and local MSC to announce the team's arrival before entering the site.
2. Enter the site and check for site alarms, for example intruder alarms, that may have been activated by entry.
3. Advise the local OMC-R or MSC that the team is on site and indicate the expected duration of time on site.
4. Arrange with the OMC-R or MSC to check the E1/T1 links as soon as possible.

Leaving site during installation and optimization

When leaving a site:

1. Contact the local OMC-R or MSC to announce the team's departure.
2. Out of hours, if an alarm is fitted and the local MSC staff have gone home, contact the Network Control Centre or OMC-R and inform them of the team's departure.
3. Sign out of the site as necessary.

Rubbish removal

Clear rubbish from the site on completion of the job, unless otherwise indicated by the customer.

WARNING	Do not burn rubbish, as packaging might give off toxic gases.

Rural sites

It is the responsibility of the senior member of the team to ensure that all personnel on site are aware of the country code and, especially with respect to water authority sites, any relevant health regulations.

Adhere to these points of the Country Code:

- Guard against all risk of fire.
- Fasten all gates (remember site visits could be traced back if a complaint is made).
- Leave no litter.
- Drive carefully on country roads and observe speed restrictions at all times.
- Keep to the paths/tracks across farm land.

On site safety

All personnel must:

- Ensure that under no circumstances should anyone move cabinets without assistance. Cabinets must be safely positioned at all times.
- Wear supplied safety helmets when antenna or overhead work is in progress, and when local regulations require them.
- Wear supplied safety goggles and dust masks when drilling. This is particularly important when drilling overhead ironwork.
- Wear supplied ear protectors while drilling is in progress.
- Wear approved safety footwear when moving heavy equipment.

Stop any work that you are supervising should any person in your team not be properly protected, or be unaware of safety requirements.

When installing cable ties, even temporarily, cut the excess or tail properly. This is to prevent sharp edges inflicting injury when not cut flush with the locking edge.

Preparing the site

Introduction to site preparation

This section provides a general overview on the preparation of a site, and site requirements. For specific sites, refer to the site-specific documentation.

Base site structure

The base site structure should be designed to meet accepted cellular system specifications. Additionally, the site must meet the environmental and electrical operating criteria. See **Site requirements and considerations** earlier in this chapter.

Site requirements

The customer should provide secure access, free from unauthorized personnel, ample protection from fire, and adequate lighting and clearance at the front and rear of the equipment for operation and maintenance. Additionally, four cable ducts with sufficient space for communications cables, power cables, earth cables, and antenna RF cables should be provided.

Site access

The site access road and equipment receiving area must be constructed of asphalt, concrete, or other suitable load bearing aggregate, capable of supporting the transportation vehicle and the cabinet. The area available and overhead clearance must be sufficient to accommodate turning or reversing of the transportation vehicle, and to allow the vehicle to depart after unloading.

Ensure there is a minimum overhead clearance of 6 m to enable the Horizon*macro* cabinet to be lifted from the transport vehicle. Take special care if the cabinet has to be lifted in the vicinity of overhead cables.

NOTE	Ensure the areas, for unloading and installation are clear of standing water, fallen leaves, mud, and building debris.

Site layout

The site layout plans are provided in the **Site requirements and considerations** section. Figure 2-1, Figure 2-2 and Figure 2-3 show the site layout plans with dimensions.

Earthing the site

Overview

The following provides information on suggested earthing procedures for an outdoor site.

The separate earth systems must be isolated from each other to facilitate periodic testing of the earth systems. Earth inspection pits are provided for this purpose.

Earthing requirements

Each cabinet site external earth must be assessed on an individual site basis, as conditions will vary considerably depending on local soil conditions and site topography. It is essential that a site survey and soil resistance test be performed before installation. The site architect defines the site and foundation earthing requirements to ensure a resistance of less than 10 ohms. A typical site earthing plan is shown in Figure 2-4.

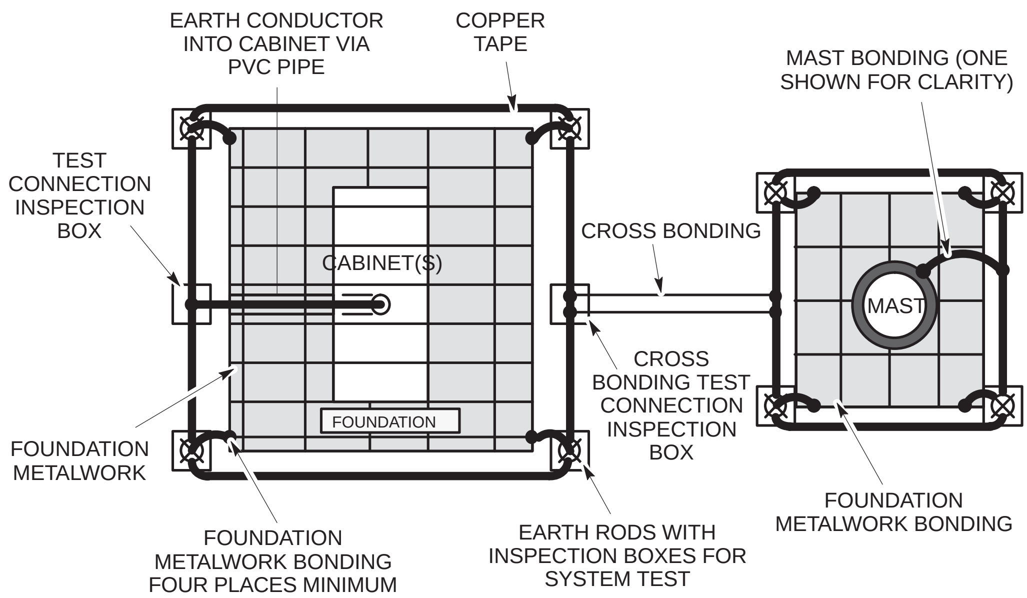


Figure 2-4 Typical site earthing plan for open field site

Earth electrode system

The earth electrode system consists of a series of interconnected earth electrodes (minimum of four) that are located outside the foundation reinforcing metalwork. Refer to Figure 2-4 for details. The earth rods should be connected together using TCO30 solid tape conductors, avoiding any sharp bends; a minimum bend radius of 250 mm is recommended.

Cross bonding

Foundation metalwork must be connected to the earth electrode network. The earth system must also be cross-bonded to an adjacent antenna mast, with two connections made between the two systems. All earth cable terminations must be crimped, clamped or welded; soldered joints are not permitted.

Earthing procedure

The cabinet equipment must be earthed as detailed in this procedure. Make provision for routeing the earth cables into the site and to the cabinet before beginning installation of the system racks.

Excavate the site to accommodate the foundation to a depth determined by the site architect. For the earth components to be used, refer to Figure 2-4 and proceed as follows:

1. Drive a minimum of four copper earth rods 2.4 m long below the surface, and connect these rods together with 70 mm cross-sectional area (CSA) solid conductor.
2. Connect the earth rods to the cabinet earth busbar via a 70 mm CSA solid conductor.
3. Check that the earth electrode installation resistance is less than 10 ohms. If the resistance is greater than 10 ohms, install more earth rods to bring the resistance within specification.
4. Cross-bond the earth system to the adjacent antenna mast earth with conductors of 70 mm CSA, buried at a depth of not less than 500 mm.
5. Bond equipment such as fences, fuel tanks, metal buildings, or steel building skids associated with the site to the closest earthing rod or bonding wire.

Earth electrode testing

Earth electrodes should be tested as detailed in BS7671 16th Edition or equivalent national and regional regulations. One of three methods of earth electrode test (earth mat) is used:

- Fall of potential.
- 61.8% rule.
- Slope method.

The method of test to be used at a specific site is determined by the site conditions, the extent of the earth system and the limitations of the site boundaries. The method used at the site is to be determined from the earth electrode compliancy certificate and repeated annually. Before proceeding with the test, ensure that the resistance of the test leads is less than 0.05 ohms.

Fall of potential

This method of testing is used for measuring resistance of earth electrodes but is only practical on single earth electrode systems.

Drive the current test spike and potential spike into the ground as shown in Figure 2-5. Perform the three resistance tests and check that the average of the three tests is less than 10.0 ohms.

61.8% Rule

This method applies when the three electrodes (earth, potential and current) can be positioned in a straight line, the soil is homogenous and also when single electrode systems are being used.

Set up the test equipment as shown in Figure 2-5 with the potential spike placed at a distance of 61.8% of the distance from the earth electrode to the current test spike. A greater accuracy can be achieved by increasing the number of readings.

Slope method

This method applies to large earth systems. Refer to Figure 2-5, but insert the potential spike at a number of points between the earth system and the current spike. A minimum of six readings must be taken to plot a graph and this graph compared to published tables to calculate the resistance.

On completion of testing, complete and sign the earth electrode test documentation (Forms of Completion and Inspection Certificate).

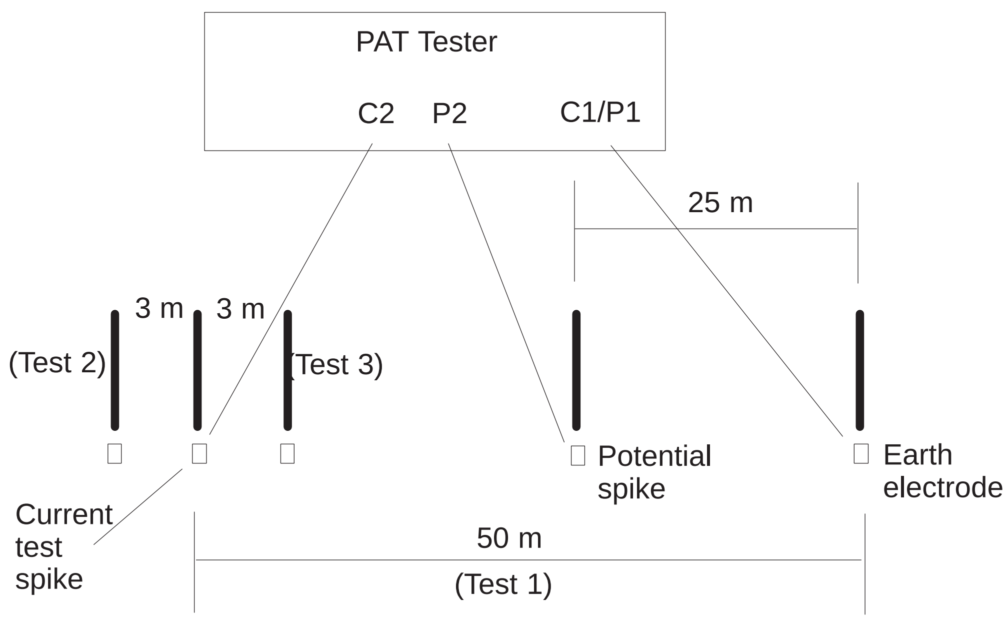


Figure 2-5 Earth electrode test setup

Preparing the foundation

Overview of foundation preparation

Motorola recommend the cabinet be installed on a separate concrete base of sufficient size and construction to accommodate the Horizon*macro* cabinet size and weight, as determined by a structural engineer.

WARNING	Excavations exceeding 1.2 m in depth must be adequately shored to prevent land slip or trench collapse. Excavated earth must **not** be placed within 1 m of the excavation edge.

NOTE	At the customers discretion a steel structure may also be used, with size, construction and layout determined by a structural engineer. Reference should be made to **Site requirements and considerations** in this chapter for details of equipment weights and dimensions.

The foundation depth is determined by a soil survey performed by the site architect, but must be of sufficient strength to withstand 105 knot (120 mph) winds on the cabinet front or rear and a maximum gross weight of 360 kgs.

Horizon*macro* foundation

The following cross-sectional diagram in Figure 2-6 shows a typical foundation for the Horizon*macro* (bolts and anchors not to scale).

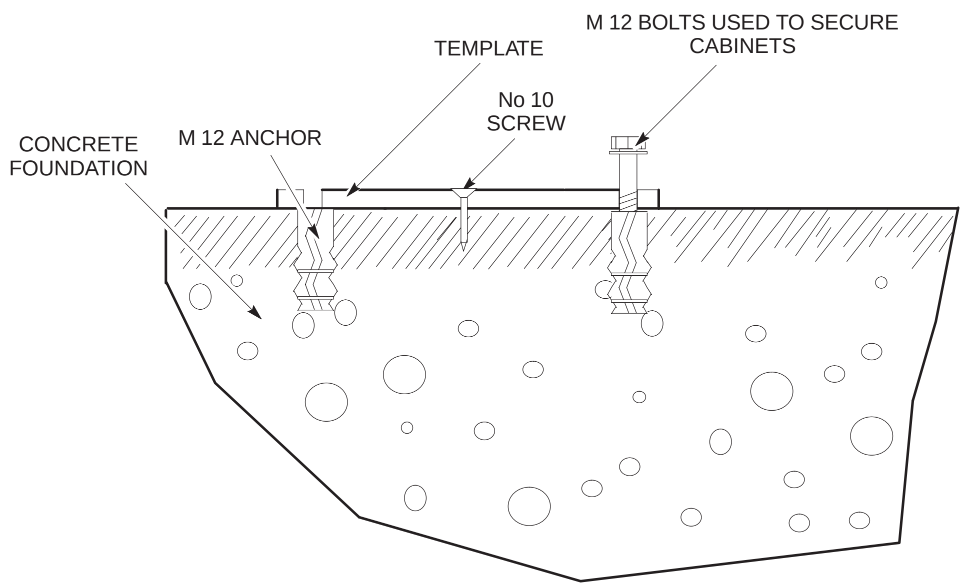


Figure 2-6 Typical Horizon*macro* foundation

Preparing the foundation

To prepare the foundation:

1. Excavate the foundation (refer to Figure 2-6).

WARNING	Do not place excavated earth within 1 m of the excavation edge.

2. Erect the concrete shuttering to produce the required base.
3. Position the cable ducts (if low level cable entry method is in use). Ensure that they are positioned so that they face towards the cabinet entry point.
4. Make the foundation from 20 mm mix concrete with the cable ducts (If used) mounted in position. If required, locally thicken the areas around the foundation bolts.

CAUTION	Ensure the concrete is laid to give a water run off with tapered edges. Where a field site, other than an already permanent hard standing, is laid, the foundation must have a bevelled finish. To avoid over stressing the cabinet, use a spirit level or theodolite to check that the concrete plinth surface is level to 3 mm across diagonals.

Chapter 3

Installing the BTS cabinet

Chapter 3
Installing the BTS cabinet i

Installation overview

Introduction to installation

This chapter provides the information required to install the Horizon*macro* outdoor cabinet and its internal and external interfaces.

CAUTION	Ensure that all site associated equipment is completely installed before commissioning the cabinet for operation.

NOTE	Some site equipment may not be produced by Motorola, including battery chargers, power supplies, and antennas. Refer to site-specific documentation and non-Motorola vendor instructions.

Before starting an installation, ensure the site has been prepared according to the description summarised in **Preparation overview** in Chapter 2, and the site-specific documentation.

Installation sections

Installing cabinets comprises the sections shown in Table 3-1.

Table 3-1 Installation sections in this chapter

Section	Description
Equipment delivery and unpacking	Information on delivery packaging, and how to unpack the equipment.
Fitting outdoor cabinet onto base	Provides procedure for attaching cabinet to prepared plinth.
Earthing and transient protection	Describes site earthing procedures and cabinet internal earths.
Connecting the internal batteries	Describes the procedure for connecting up the internal batteries.
Installing power and earth cabling	Describes the power supply earthing requirements.
Connecting input power	Describes the correct sequence for power connection.
Connecting antennas and RF configurations	Describes setting up antenna connections and sample RF configurations.
Interface cabling	Describes cabling to the interface panel.

E1/T1 line testing

If an E1/T1 line has been provided, contact the local MSC and, at the earliest opportunity, arrange to test the line back to the MSC.

Cabinet view

Figure 3-1 shows a filled cabinet, with main components identified, doors and lid omitted for clarity.

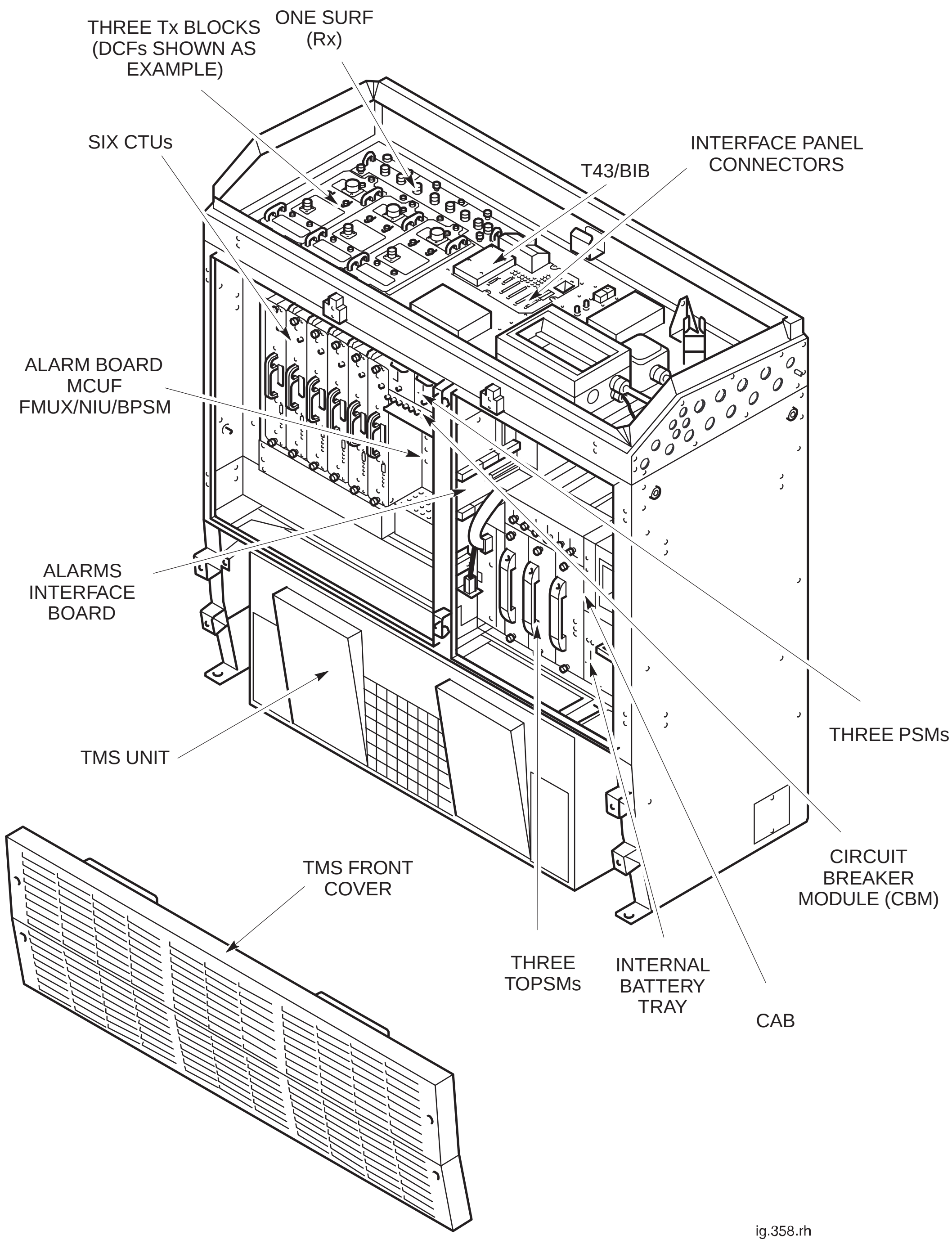


Figure 3-1 Cabinet with components identified (door and hood removed)

Equipment package units

The cabinet equipment is supplied already fitted to the cabinet. The only exceptions to this are:

- Installation template, (supplied with cabinet).
- Cable shroud (this is optional equipment).
- Auxiliary equipment housing (this is optional equipment).
- Equipment to be installed in the auxiliary equipment housing, (this is optional equipment).
- Installation anchor bolts, eye bolts and small fixing screws, (not supplied).

Cabinet equipment

Horizon*macro* cabinet equipment fitted and tested prior to shipping includes:

- CTU modules.
- Digital modules.
- Power distribution and alarm interface equipment.
- Internal batteries.
- Thermal management system.
- All intra-cabinet cabling, (RF and fibre optic).
- Comms cables and power cable feed-through glands.
- Cable assembly BIB to krone block.
- Any additional blanks, (CTU, RF, digital module, TOPSM or PSM).

Items not supplied with Horizon*macro*

The installer must supply the following equipment:

- 4 x M16 collared eye bolts (minimum rating 400 kg each).

  Bolts must be manufactured to CE conformity.
- Number 10 screws and expanding plastic plugs.
- 4 x M12 anchor bolts and expanding anchors.

Equipment delivery and packaging

Delivery and packaging overview

Before the cabinet equipment arrives, installation personnel should designate an area at the site where the equipment can be unloaded. This area should also be suitable for unpacking the equipment, if necessary. Consult with the heavy freight or moving company and the owners of the site to select this area.

CAUTION	The cabinet equipment should be delivered to the site while still contained in its packaging. This is to protect the cabinet from damage and moisture whilst in transit.

The equipment should be carefully delivered to the site by the freight company, along with the necessary moving dollies and padding. Use the dollies and padding to move the equipment from the unloading area to the installation point.

NOTE	Keep all paperwork, whether attached to the packaging or found inside the cabinet.

Packaging

The equipment cabinets are shipped in crates of a similar construction to that shown in Figure 3-2.

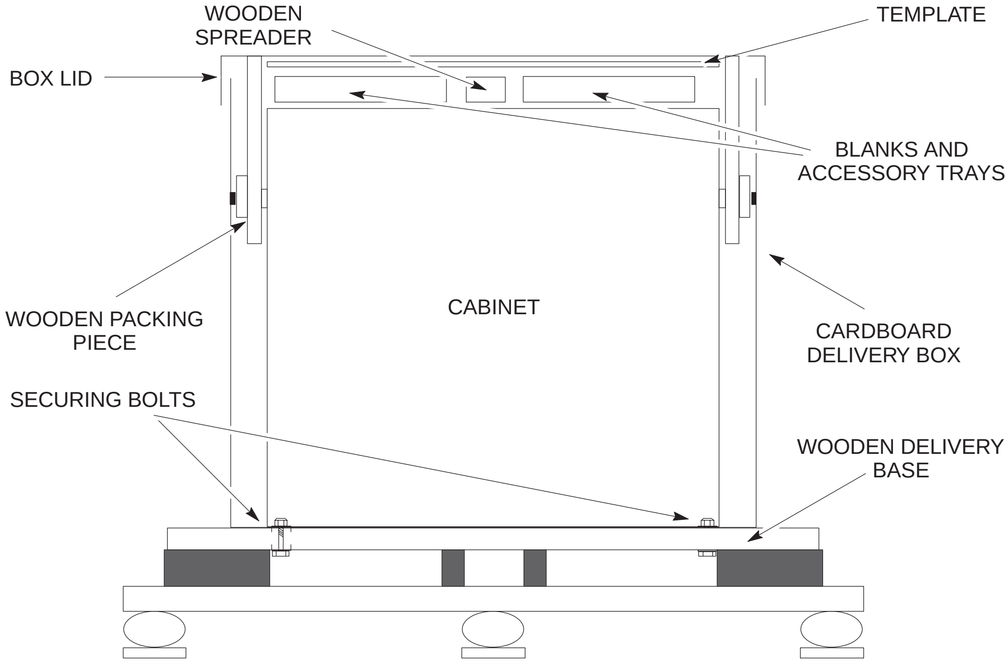


Figure 3-2 Typical shipping crate

Weather conditions affecting unpacking/installation

Overview of weather considerations

Before beginning the unpacking/installation process, it is important to read and take into account the following information concerning the climatic conditions at the intended site.

Weather conditions

WARNING	Due consideration should be given to the hazards of wind and other inclement weather conditions when installing the Horizon*macro* equipment. This is especially important when using a ladder to gain access. Use your discretion at all times. **Do not climb a ladder, scaffolding, or use some other similar method of access, if you feel unsafe to do so under these weather conditions**. Do not attempt to open the cabinet doors if the wind speed exceeds 25 knots (30 mph).

Maintenance cover

Motorola recommend the use of a maintenance cover for access to the Horizon*macro* cabinets during inclement weather conditions.

NOTE	The maintenance cover is not supplied with the Horizon*macro* equipment and should be provided by the customer, if required.

Installation and configuration procedures for the Horizon*macro* cabinets are dependent on the weather conditions. There are three situations where the recommended guidelines should be considered before commencing work:

- No access.
- Access with maintenance cover.
- Access without maintenance cover.

No access

Access should **not** be attempted to the cabinets during the following actual or imminent inclement weather conditions, with or without the maintenance cover:

- Winds in excess of 25 knots (30 mph).
- Heavy persistent rain, snow, hail or sleet.
- During an electrical storm.

Access with maintenance cover

Access may be made to the cabinet under the following conditions with the use of the maintenance cover:

- Wind speeds of less than 25 knots (30 mph).
- Persistent rain, snow, hail or sleet.
- Where airborne substances (such as leaves or dust) may cause a problem.

Access without maintenance cover

Access may be made under the following conditions without the use of the maintenance cover:

- Wind speeds of less than 25 knots (30 mph).
- No precipitation occurring or likely to occur during the maintenance period.
- When the temperature is between –30 °C to 40 °C.

Under these conditions the cover of the cabinet may be removed.

Unpacking and preparing the cabinet

Tools

Use these tools to unpack, prepare and fit the cabinet:

Knife.
Screwdriver set.
Spirit level.
Socket set.
280 mm adjustable spanner.
Torque wrench.
Lifting straps and 4 x M16 collared eyebolts and suitable hydraulic lifting gear.

Safety considerations

For each of the cabinets to be installed, consider the following notes:

WARNING	Fully equipped Horizon*macro* outdoor BTS cabinets can weigh up to 360 kg. Handle cabinets with extreme caution, and in accordance with any local health and safety regulations. Horizon*macro* cabinets are heavy and should not be installed without the use of lifting equipment unless sufficient personnel are available to ensure that Health and Safety regulations are not breached. Horizon*macro* outdoor cabinets are fitted with four lifting points, designed to accommodate M16 eyebolts, built into the cabinet sides. Eyebolts used to lift the cabinet must be of the collared type, must be manufactured to CE conformity, and must have a safe working load of 400 kg each. Eyebolts, must be visually checked for damage before use. If any damage is apparent, DO NOT USE. The eyebolts must not be overtightened; hand tight is sufficient. Motorola recommend the use of slings in conjunction with hydraulic lifting apparatus for moving and positioning Horizon*macro* cabinets. In addition to these points, refer to and comply with any local regulations that govern the use of lifting equipment.

For the subsequent use of eyebolts, there may be local regulations that govern the use of lifting equipment and stipulate a test and/or examination regime. If the eyebolts are to be used, ensure that all such regulations are met.

The installation support procedures are described in the following sections.

Cabinet access procedures

Cabinet access procedures include:

- Door and lid opening and closing.
- TMS front cover removal and refitting.

Door opening and closing

The door lock has a spring loaded handle. The door is operated as follows:

1. Insert key into lock and turn clockwise until spring loaded handle releases.
2. Turn handle a quarter turn anti-clockwise to open the lock.
3. Open power supply enclosure door to 90° locking position.
4. Open radio enclosure door to 90° locking position.

NOTE	If the equipment is active, a door open alarm will be generated.

5. To open doors to 120°, lift up middle of appropriate wind stop.
6. To close, lift up middle of wind stop, close doors firmly, radio enclosure door first.
7. Turn handle a quarter turn clockwise, push handle flush and remove key to lock the door.

Lid opening and closing

NOTE	The lid can only be opened and closed when both doors are open.

The lid is opened as follows:

1. Ensure both cabinet doors are open to the 90° position.
2. Undo the two draw latches by turning anti-clockwise, and ensure the catch hook is clear of lip on the lid.
3. Lift the lid until the mechanical stay audibly locks.

The lid is closed as follows:

1. Press the lock stud on the mechanical stay to release.
2. Lower the lid.
3. Hook the draw latches over the lip and turn clockwise to lock.
4. Ensure operating tab is stowed flat.

TMS front cover removal and refitting

To remove the TMS front cover:

NOTE	The TMS front cover can only be removed and refitted when both doors are open.

1. Remove and retain the four push in plastic covers.
2. Using a cross point screwdriver, undo the four captive fasteners by turning anticlockwise until they release.
3. Lift the TMS front cover away from the cabinet and store safely.

To refit the TMS front cover:

1. Refit the TMS front cover and line up the four fasteners.
2. Using a cross point screw driver, tighten the four captive fasteners.
3. Refit the four push in plastic covers.

Procedures for unpacking and preparing the cabinet

The following describes the procedure for unpacking the equipment.

NOTE	It is recommended that the installer reads through the following procedure before starting to unpack and install the equipment.

Dismantling the shipping packaging and obtaining template

To dismantle the shipping packaging and obtain template:

1. Cut the plastic banding that secures the packaging.
2. Lift the lid free of the box.
3. Remove separate template from the inside of the box lid, and deliver to the site for site preparation.
4. Remove the wooden spreader and the blanks and accessory trays from the box.
5. Undo the taped fastening on the box side.
6. Unwrap the box from around the cabinet, (the wrap-around box is secured by velcro).
7. Unbolt the two wooden packing pieces from the lifting points in the cabinet sides.

The cabinet is now ready to be prepared for lifting.

Preparing the cabinet for lifting

WARNING	The cabinet can weigh up to 360 kg. Handle with extreme caution, and in accordance with local health and safety regulations.

To prepare the cabinet for lifting and remove it from the wooden delivery base:

CAUTION	Care must be taken to avoid damaging the cabinet in any way, especially by scratching the outer surfaces.

1. Carefully remove the cling wrap surrounding the cabinet.
2. Inspect the equipment immediately for damage. Report the extent of any damage to the transport company.
3. Insert the eyebolts into the threaded lifting points on the cabinet sides, ensuring that no cross-threading occurs.

WARNING	Before attempting to insert the eyebolts, visually check each one for damage. If any damage is apparent, DO NOT USE. Do not overtighten the eyebolts; hand tight is sufficient. **Do not tighten eyebolts with a t-bar or spanner.** Screw the eyebolt fully into the lifting point so that no thread is left exposed.

4. Attach lifting straps to the eyebolts and connect to lifting gear.
5. Open the cabinet doors and remove the TMS front cover (see **Cabinet access procedures** this section) and the two rear mounting bolt cover plates and store safely.
6. Refer to **Figure 3-2** and remove the four nuts securing the cabinet to the wooden delivery base.
7. Unscrew the securing bolts from underneath the wooden delivery base until they are clear of the cabinet.

CAUTION	The cabinet may be subject to bending and distortion during installation. To minimize this the TMS front cover must be fitted and the cabinet doors must be closed, before lifting the cabinet.

8. Refit the TMS front cover and close the cabinet doors.

Visual inspection

After unpacking and preparation for lifting carry out a visual inspection on:

Cabinet exterior

Examine the exterior of the cabinets for structural, paint or mechanical damage and report any damage to Motorola.

Cabinet interior

Examine the interior of the cabinet for structural, paint or mechanical damage and report any damage to Motorola.

The cabinet can now be lifted gently and manoeuvred to the concrete base.

Safe disposal of packing material

The packing material used by Motorola is non-returnable, and should be disposed of safely.

CTU module allotted slot retention

CTUs are supplied already fitted into the cabinet, with Tx cable correctly attached at the factory. The CTUs must remain in the allotted slots for factory calibrations to be valid.

Installing the template and mounting bolt anchors

Introduction to template and mounting bolt anchor installation

The Horizon*macro* outdoor BTS cabinet is supplied with an alloy template. The template is installed before the cabinet to show the locations of the cabinet mounting bolt anchors. There is no need to remove the template after installation of the expanding bolt anchors.

View of template

Figure 3-3 shows the template used in installing the Horizon*macro* outdoor cabinet.

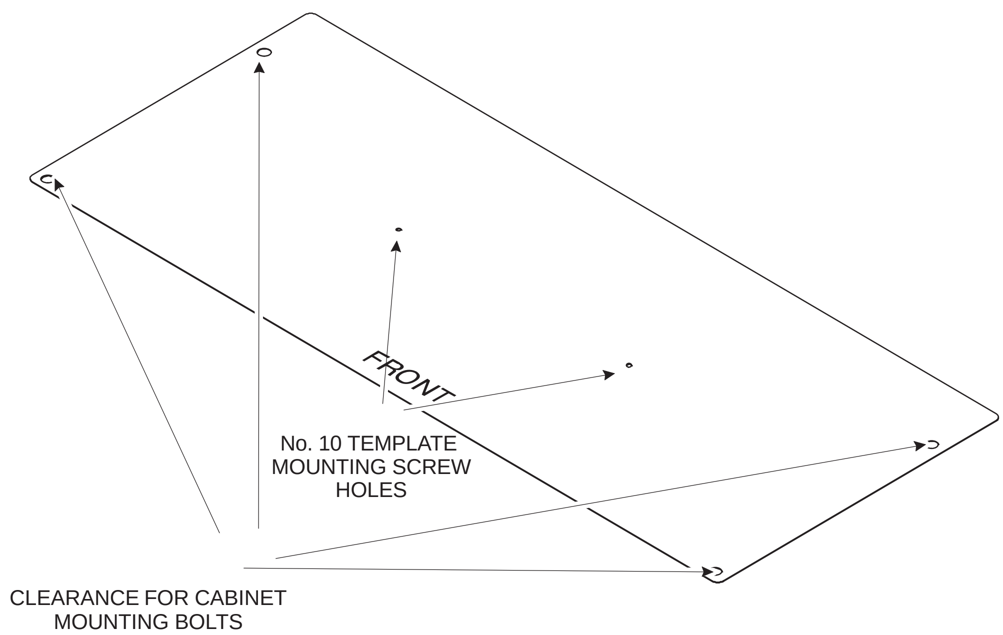


Figure 3-3 Horizon*macro* outdoor template

Procedure for installing template

The template must be secured to the concrete base before drilling the mounting holes for the M12 anchor bolts.

1. Move the cabinet template to the selected mounting position.
2. Mark the positions of the two template mounting screw holes in the template.

WARNING	Wear safety glasses and a dust mask when drilling holes.

CAUTION	Drilling concrete flooring produces cement dust, which is harmful to equipment and wiring. Protect the cabinets and any nearby equipment from dust. Use a tarpaulin, cloth, or plastic sheeting to cover exposed equipment. Clean up any accumulated debris from the anchor installation carefully before exposing the equipment. Use drilling equipment suitable for cutting steel reinforced concrete.

3. Drill out the two holes to a depth and clearance for No. 10 screws.
4. Fit plastic expanding plugs into the mounting holes.
5. Position the template over the mounting holes and secure using No. 10 screws.
6. When satisfied that the template is correctly installed, carry out procedure for installing the cabinet anchor bolts.

Recommended bolt length for concrete base

The length of the M12 steel anchor bolts must be determined by a structural engineer, but must be of sufficient strength to withstand 105 knot (120 mph) winds on the cabinet front or rear for a maximum gross weight of 360 kg.

Procedure for installing cabinet bolt anchors

The concrete base must be drilled to accept the M12 anchor bolts. Washers, bushes and M12 steel bolts must be supplied by the customer.

WARNING	Wear safety glasses and a dust mask when drilling holes.

CAUTION	Drilling concrete flooring produces cement dust, which is harmful to equipment and wiring. Protect the cabinets and any nearby equipment from dust. Use a tarpaulin, cloth, or plastic sheeting to cover exposed equipment. Clean up any accumulated debris from the anchor installation carefully before exposing the equipment. Use drilling equipment suitable for cutting steel reinforced concrete.

1. Using the four holes in the template as a guide, drill the concrete base to a depth and clearance for the M12 anchor bolts.
2. Fit the M12 mounting anchors to the holes in the base.
3. Fit the anchor bolts with the supplied bushes and washers, through the template, to each anchor.
4. Tension up the anchor bolts to expand the anchors.
5. Remove and retain the M12 bolts and washers for later use.

Fitting the outdoor cabinet onto its base

Procedure for fitting a BTS cabinet

To fit a Horizon*macro* outdoor BTS cabinet onto a prepared concrete base, (or steel structure):

WARNING	An equipped Horizon*macro* BTS cabinet can weigh up to 360 kg. Observe proper lifting precautions and handle each cabinet with extreme caution to avoid tipping.

1. Place the Horizon*macro* outdoor BTS cabinet onto the template, (or steel structure).
2. Open the cabinet doors and remove the TMS front cover see **Unpacking and preparing the cabinet (cabinet access procedures)**.
3. Line up the fixing holes in the bottom of the cabinet with the previously installed anchors, (or holes in steel structure).
4. Place a flat washer onto each M12 mounting bolt and fit the four mounting bolts loosely. Do not tighten yet.
5. Use a spirit level to verify that the cabinet is level. If necessary, use shims to level the cabinet. Tighten up the mounting bolts to the correct torque, (the setting of torque value for M12 anchor screws/bolts depends on local supplies. Refer to the manufacturer’s data for correct values).
6. Refit the bottom front panel and the two rear mounting bolt cover plates, previously retained.
7. Remove each of the eyebolts from their threaded holes (located on the sides of the cabinet), and return the eyebolts to the tool kit for future use.

Mounting additional cabinets

At this stage, additional Horizon*macro* outdoor BTS cabinets, optional cable shrouds and/or optional auxiliary equipment housings may be installed, depending on the site configuration (see **Site requirements and considerations**). Refer to Chapters 2, 4 and 5 in this category for information on installing, multiple cabinet layouts, cable shrouds and auxiliary equipment housings.

Earthing and transient protection

Site earthing

This part of the manual summarizes general procedures for earthing the site. Refer to the *Grounding guidelines for cellular radio installations 68P81150E62*, for detailed earthing information.

WARNING	Each cabinet must be earthed separately. Cabinets must **not** be daisy chained together.

- The cell site equipment must be earthed (in the same common earth point as its power source).
- Provision should be made for earthing the site before beginning the installation of the system cabinets. See **Earthing the site** in Chapter 2 of this Category.
- There is an earthing terminal (stud) located on the earth/connector plate on the cable entry side of each BTS cabinet, and auxiliary equipment housing.
- Refer to the site-specific documentation for detailed site earthing information.

Secondary transient and lightning protection

All E1/T1 lines connected to Motorola equipment have secondary transient protection as part of the BIB or T43 board. Ensure the receive and transmit antenna connections to the cabinet are fed through coaxial electromagnetic protection (EMP) devices.

CAUTION	The end–user is responsible for transient protection of the E1/T1 lines connected to Motorola equipment.

Connecting the internal batteries

Introduction to connecting the internal batteries

The Horizon*macro* outdoor cabinet is delivered with the internal batteries disconnected (for safety reasons).

CAUTION	The batteries must be reconnected before external ac power is connected to the cabinet.

Internal battery connection procedure

To connect the internal batteries (refer to Figure 3-4):

1. Ensure battery circuit breaker is set to off.
2. Undo the two battery tray retaining screws and pull the tray forward until the two battery cables and the battery sense lead (4-way Molex connector) can be accessed.
3. Remove the heatshrink sleeves from the battery cable terminations. Connect the blue cable to the bottom breaker terminal and the black cable to the front (red) positive terminal.
4. Ensure the four battery sense leads are connected as shown in Figure 3-4 and plug the black Molex 4-way connector into its socket on the battery retaining strap.
5. Push the tray back into the cage and tighten the retaining screws.

View of internal battery tray

Figure 3-4 shows a view of the internal battery tray.

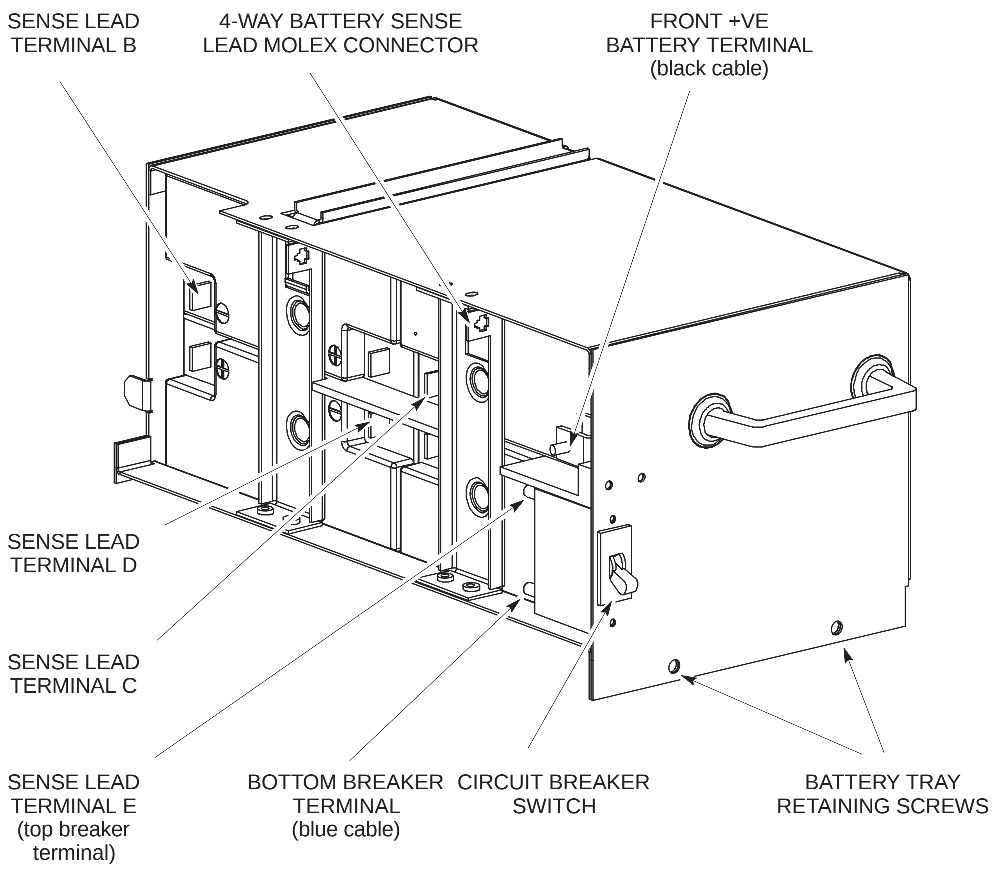


Figure 3-4 Making the connections on the internal battery tray

Installing and connecting power and earth cabling

Overview of power and earth cabling

On delivery, the Horizon*macro* outdoor BTS cabinet is configured for a 230 V ac single phase power supply. The possible configurations of ac power supplies are:

- Single phase (110 V).
- Single phase (230 V) – default configuration.
- Three phase star (230 V).
- Three phase delta (230 V).

This section describes the procedures for connecting power and earth cabling to the cabinet.

WARNING	Do not daisy chain cabinet earths together. Do not make ac input power connections at the main power source at this time. **Connecting input power** is the final installation procedure, carried out as part of commissioning in Chapter 6 of this category. Cabinets must be earthed with a conductor capable of carrying the full fault current of the overcurrent protection device.

Power specifications can be found in Chapter 2 **Site requirements and considerations**.

Cable routeing

CAUTION	Ensure that covers are fitted to any unused connectors on the cabinet interconnect panel. The covers protect the connectors from damage by static electricity or foreign matter.

Adequate means should be provided for routeing cables from the main power source to the equipment, such as a cable trough or conduit.

NOTE	The current-carrying capacity of a cable for continuous service is affected by all of the following factors (references: IEC 364, BS7671): – Ambient temperature. – Grouping. – Partial or total enclosure in thermal insulating material. – Frequency (ac only).

Cabinet earthing points

The main earth connection point is located on the earth/connector plate on the cable entry side. This connection is for protective earthing, lightning protection and functional earthing of the cabinet.

To earth the BTS cabinet:

1. Ensure the M8 chassis earth studs, located in rear corners of the top section, are connected to the BTS cabinet earth plate.
2. Connect the earth plate stud to the site earth using a 35 mm^2 cross-sectional area, green and yellow sheathed, stranded conductor.

Additional internal earths are:

- Two M8 chassis earth studs, located in rear corners of the top section.
- Number 1 ac distribution box in the top section.
- Number 2 ac distribution box in the power supply unit (PSU).
- PSU cage earth stud, located behind the number 2 ac distribution box.
- An M6 threaded stud on the top interface panel, adjacent to the dc input.
- Main cage to underside of interface panel above PSM.
- AC socket to underside of interface panel at rear of panel.
- Earth bonding from doors and lid to the cabinet chassis.
- Earth bonding from the TMS heat exchanger to the cabinet chassis.

Power supply cable colour coding

To connect an outdoor cabinet to the EXTERNAL ac power source, observe the following rules.

Single-phase supply

For single-phase ac connections:

- The **line** power cable is **brown** or **red**.
- The **neutral** cable is **blue** or **black**.
- The **earth** cable is **green and yellow**.

Three-phase supply

For three-phase ac connections:

- The **phase A** power cable is **red**.
- The **phase B** power cable is **blue**.
- The **phase C** power cable is **yellow**.
- The **neutral** cable is **black**.
- The **earth** cable is **green and yellow**.

Preparing for connection

To prepare for connecting ac power cables to an Horizon*macro* outdoor cabinet:

1. Unscrew the four captive securing screws and remove and retain number 1 ac distribution box insulated cover.
2. Disconnect and remove the remains of the factory test cable from the number 1 ac distribution box.
3. Tighten all screws disturbed in step 2.
4. Position the screened power cable, complete with earth, in a conduit. Route the conduit to the ac power outlet point.
5. Feed the ac power cable into the Horizon*macro* cabinet through the AC IN hole in the earth plate (see Figure 3-5) and through one of the supplied cable glands. From the outside of the cabinet, push the cable gland (with the sealing ring) into the AC IN hole, and from the inside, fit the earth tag and secure with the locking nut.

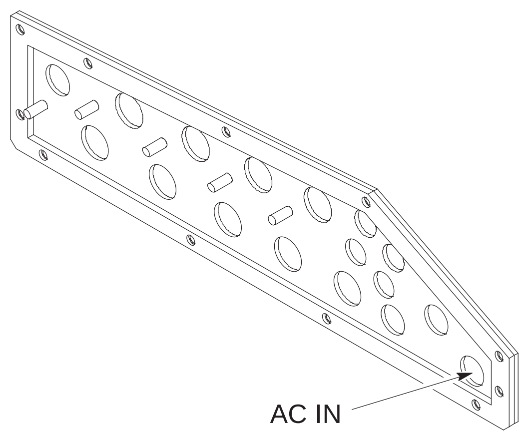


Figure 3-5 Earth plate, showing location of entry hole for ac supply cable

Connecting 230 V single phase ac power cables

Configuring the number 1 ac distribution box

WARNING	Ensure that the mains input isolator is set to position **O** (off) and source is isolated before proceeding.

On delivery, the Horizon*macro* outdoor BTS cabinet is configured for a 230 V ac single phase power supply.

If connecting to a single phase 230 V ac supply, no configuration of the number 1 ac distribution box is required.

Connecting 230 V ac single phase mains input cables

CAUTION	230 V single phase link is fitted to the four pole MCB and must remain fitted for safety requirements.

To connect a 230 V earth, live, and neutral power cable to the number 1 ac distribution box:

1. Connect the ac power input earth cable (green/yellow) to terminal 1 of the earth terminal block in the number 1 ac distribution box, and check the connection of the cabinet earth cable to terminal 2. Secure both cables.
2. Secure the screen at the cabinet entry gland.
3. Connect the live ac cable (brown or red) to linked terminals B2, C2, D2 of the four pole MCB in the number 1 ac distribution box, and secure.
4. Connect the neutral ac cable (blue or black) to terminal A2 of the four pole MCB in the number 1 ac distribution box, and secure.
5. Check the security of all connections within the number 1 ac distribution box.
6. Refit the previously retained cover of the number 1 ac distribution box.

230 V ac single phase wiring diagram

Figure 3-6 shows the wiring diagram for the number 1 ac distribution box when configured for a 230 V ac single phase power supply.

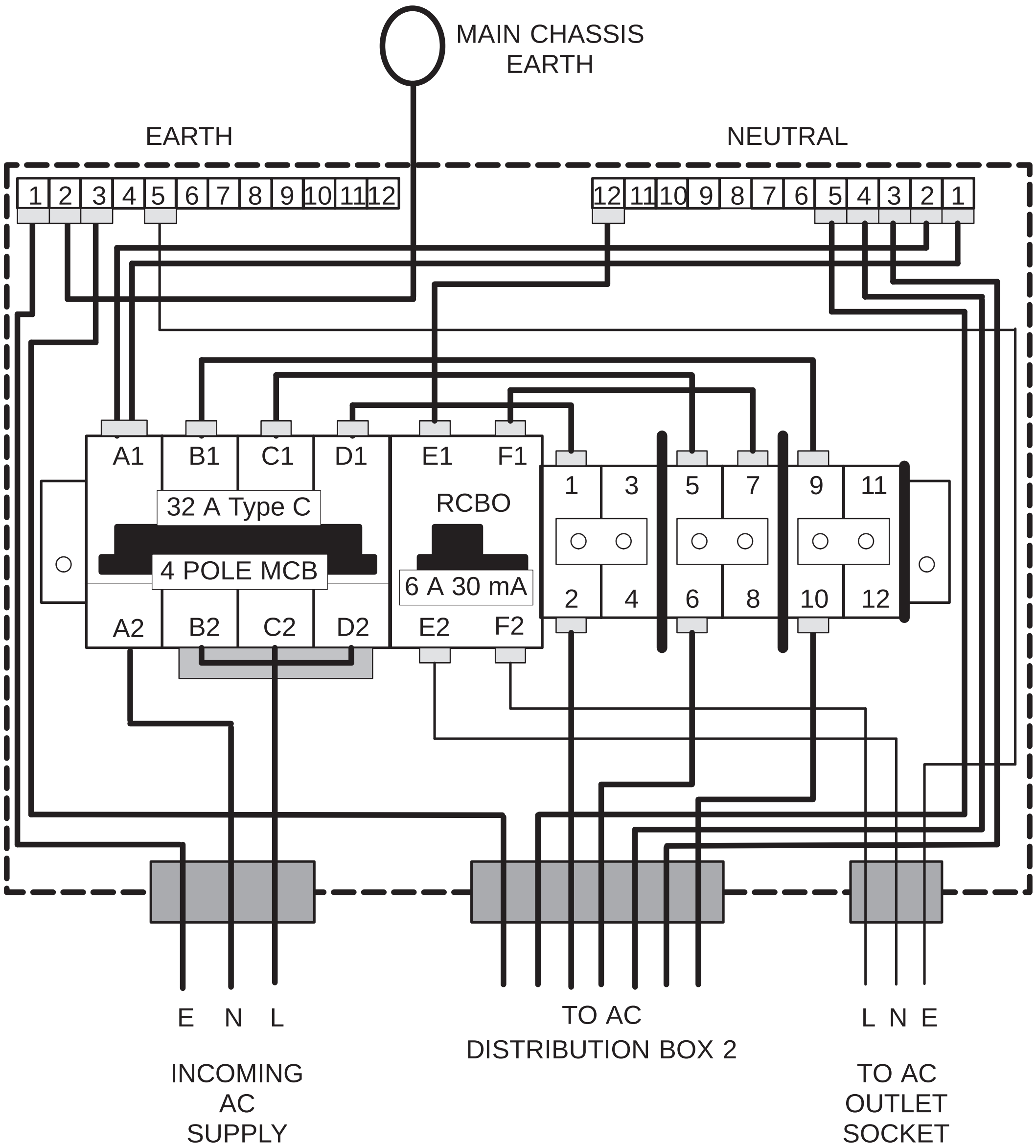


Figure 3-6 Wiring diagram (230 V ac single phase)

Connecting 110 V single phase ac power cables

Configuring the number 1 ac distribution box

WARNING	Ensure that the mains input isolator is set to position **O** (off) and source is isolated before proceeding.

On delivery the Horizon*macro* outdoor BTS cabinet is configured for a 230 V ac single phase power supply.

If connecting to a single phase 110 V ac supply configure the number 1 power distribution box as follows (refer to Figure 3-7):

1. Retain the single phase link fitted across terminals B2, C2 and D2 on the four pole MCB.
2. Disconnect the neutral cables from Terminal A1 of the four pole MCB.
3. Disconnect and remove the neutral cables from terminals 1 and 2 on the neutral terminal block.
4. Tighten all screws disturbed in this procedure.

NOTE	Pole A of the four pole MCB is not used in 110 V ac configurations.

The procedure for configuring the number 1 distribution box for 110 V operation is now complete.

Connecting 110 V ac single phase mains input cables

To connect a 110 V ac earth, live, and neutral power cable to the number 1 ac distribution box:

1. Connect the mains input earth cable (green/yellow) to terminal 1 of the earth terminal block in the number 1 ac distribution box, and check the connection of the cabinet earth cable to terminal 2. Secure both cables.
2. Secure the screen at the cabinet entry gland.
3. Connect the neutral cable (blue or black) to terminal 1 of the neutral terminal block in the number 1 ac distribution box, and secure.
4. Connect the live cable (brown or red) to linked terminals B2, C2 and D2 of the four pole MCB in the number 1 ac distribution box, and secure.
5. Check the security of all connections within the distribution box and then refit the previously retained cover.

110 V ac single phase wiring diagram

Figure 3-7 shows the wiring diagram for the number 1 ac distribution box when configured for a 110 V ac single phase power supply.

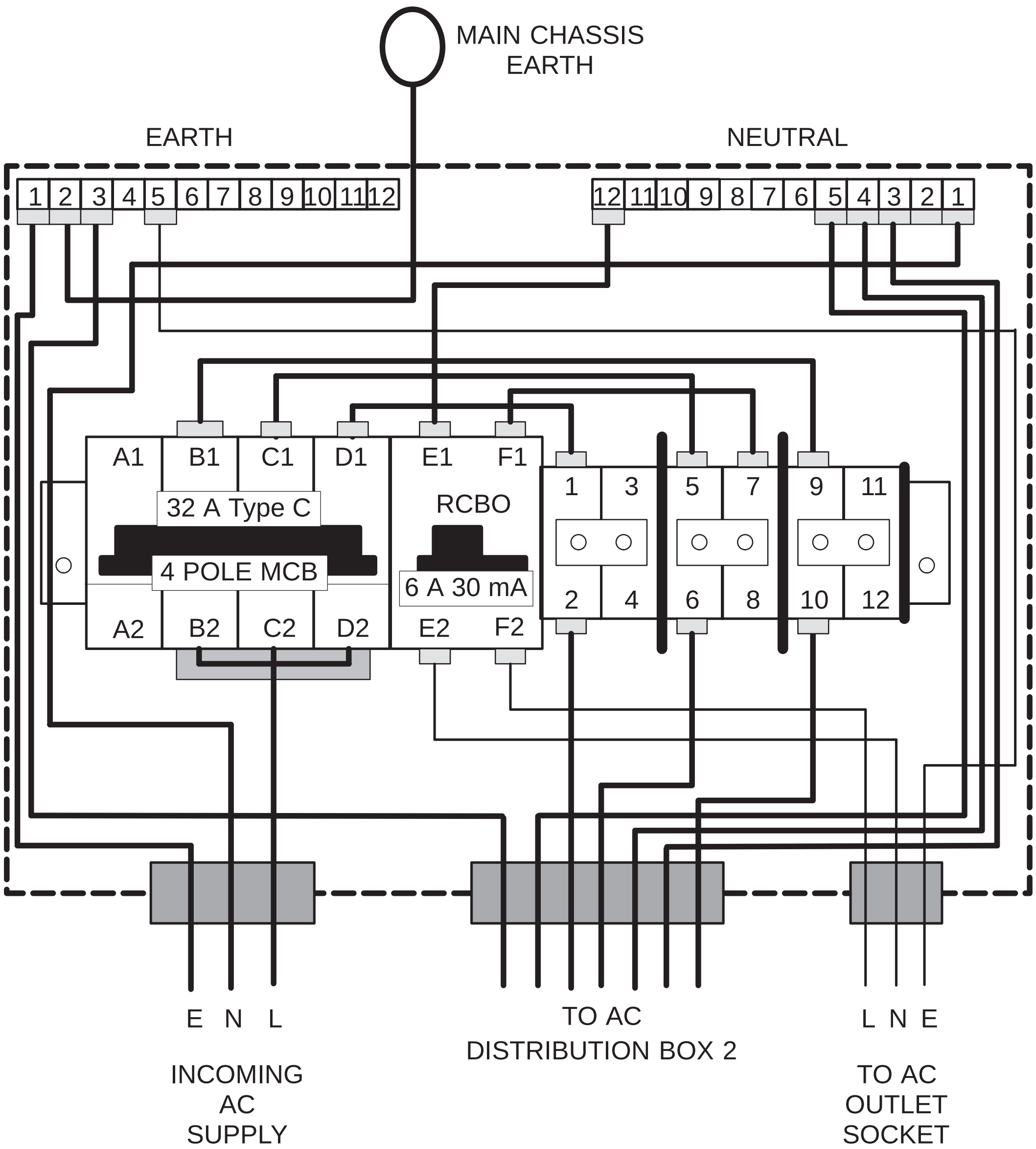


Figure 3-7 Wiring diagram (110 V ac single phase)

Connecting 230 V 3-phase (star) ac power cables

Configuring the number 1 ac distribution box

WARNING	Ensure that the mains input isolator is set to position **O** (off) and source is isolated before proceeding.

On delivery the Horizon*macro* outdoor BTS cabinet is configured for a 230 V ac single phase power supply.

If connecting to a three phase and neutral (star) 230 V ac supply, remove the 230 V single phase link fitted to terminals B2, C2 and D2 on the four pole MCB before proceeding further.

Connecting 230 V ac 3-phase (star) mains input cables

To connect the earth, 3-phase (star), and neutral power cables to the number 1 ac distribution box:

1. Connect the mains input earth cable (green/yellow) to terminal 1 of the earth terminal block in the number 1 ac distribution box, and check the connection of the cabinet earth cable to terminal 2. Secure both cables.
2. Secure the screen at the cabinet entry gland.
3. Connect the neutral cable (black), to terminal A2 of the four pole MCB in the number 1 ac distribution box, and secure.
4. Connect the phase 1 cable (red), to terminal D2 of the four pole MCB in the number 1 ac distribution box, and secure.
5. Connect the phase 2 cable (yellow), to terminal C2 of the four pole MCB in the number 1 ac distribution box, and secure.
6. Connect the phase 3 cable (blue), to terminal B2 of the four pole MCB in the number 1 ac distribution box, and secure.
7. Refit the previously retained cover of the number 1 ac distribution box.

230 V ac 3-phase (star) wiring diagram

Figure 3-8 shows the wiring diagram for the number 1 ac distribution box when configured for a 230 V ac 3-phase and neutral (star) power supply.

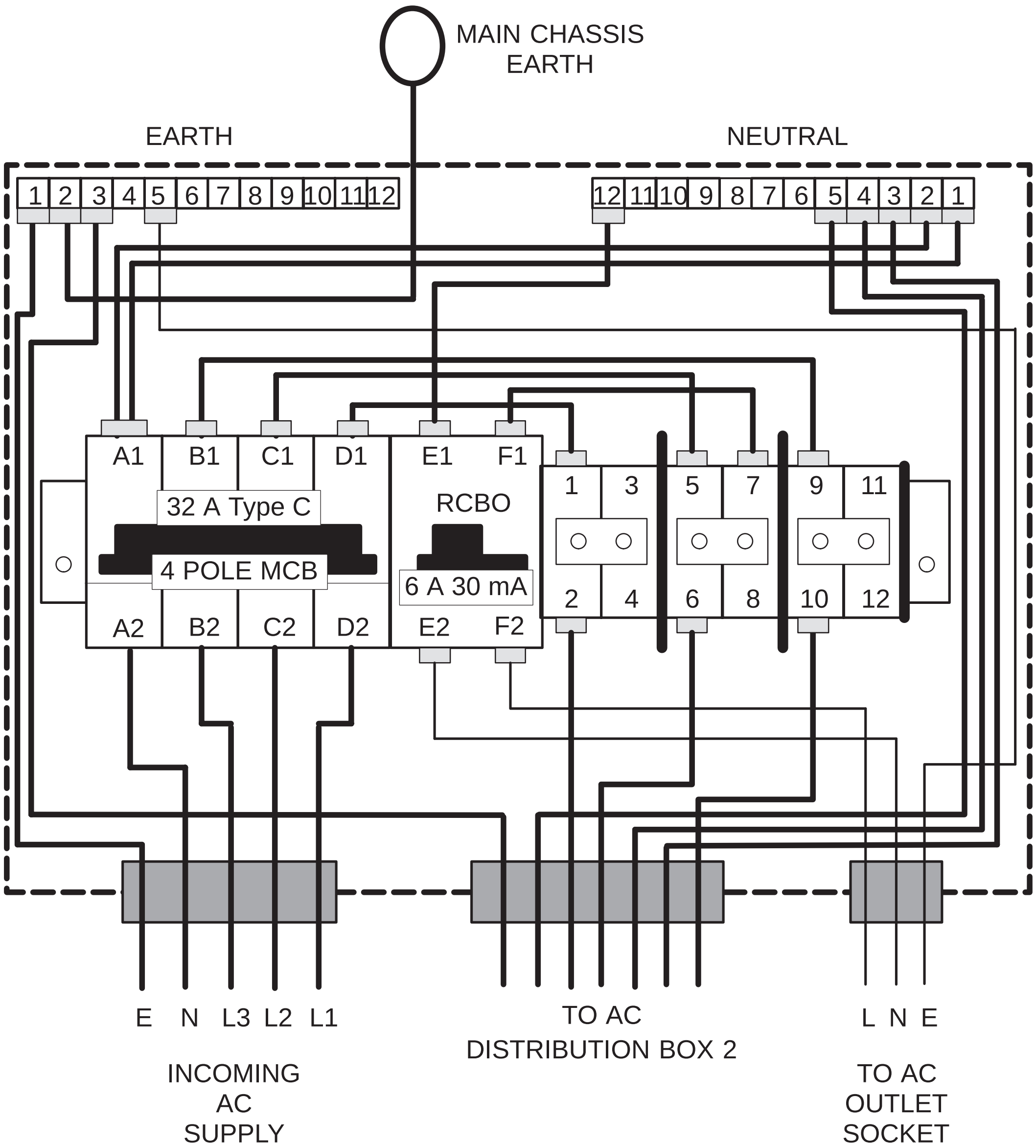


Figure 3-8 Wiring diagram for 230 V ac 3-phase (star)

Connecting 230 V 3-phase (delta) ac power cables

Configuring the number 1 ac distribution box

WARNING	Ensure that the mains input isolator is set to position **O** (off) and source is isolated before proceeding.

On delivery the Horizon*macro* outdoor BTS cabinet is configured for a 230 V ac single phase power supply.

If connecting to a 230 V 3-phase (delta) ac supply, configure the number 1 power distribution box as follows (refer to Figure 3-9):

1. Remove the wire from terminal 12 on the neutral terminal block and connect it to terminal 3 on the connector block.
2. Remove the wire from terminal 5 on the neutral terminal block and connect it to terminal 8 on the connector block.
3. Remove the wire from terminal 4 on the neutral terminal block and connect it to terminal 12 on the connector block.
4. Remove the wire from terminal 3 on the neutral terminal block and connect it to terminal 4 on the connector block.
5. Remove the 230 V single phase link fitted to terminals B2, C2 and D2 on the four pole MCB

The procedure for configuring the number 1 distribution box for 230 V 3-phase (delta) operation is now complete.

Connecting 230 V ac 3-phase (delta) mains input cables

To connect the earth, 3-phase (delta) cables to the number 1 ac distribution box:

1. Connect the mains input earth cable (green/yellow) to terminal 1 of the earth terminal block in the number 1 ac distribution box, and check the connection of the main chassis earth cable to terminal 2. Secure both cables.
2. Secure the screen at the cabinet entry gland.
3. Connect the phase 1 cable (red), to terminal D2 of the four pole MCB in the number 1 ac distribution box, and secure.
4. Connect the phase 2 cable (yellow), to terminal C2 of the four pole MCB in the number 1 ac distribution box, and secure.
5. Connect the phase 3 cable (blue), to terminal B2 of the four pole MCB in the number 1 ac distribution box, and secure.
6. Refit the previously retained cover of the number 1 ac distribution box.

230 V ac 3-phase (delta) wiring diagram

Figure 3-9 shows the wiring diagram for the number 1 ac distribution box when configured for a 230 V ac 3-phase (delta) power supply.

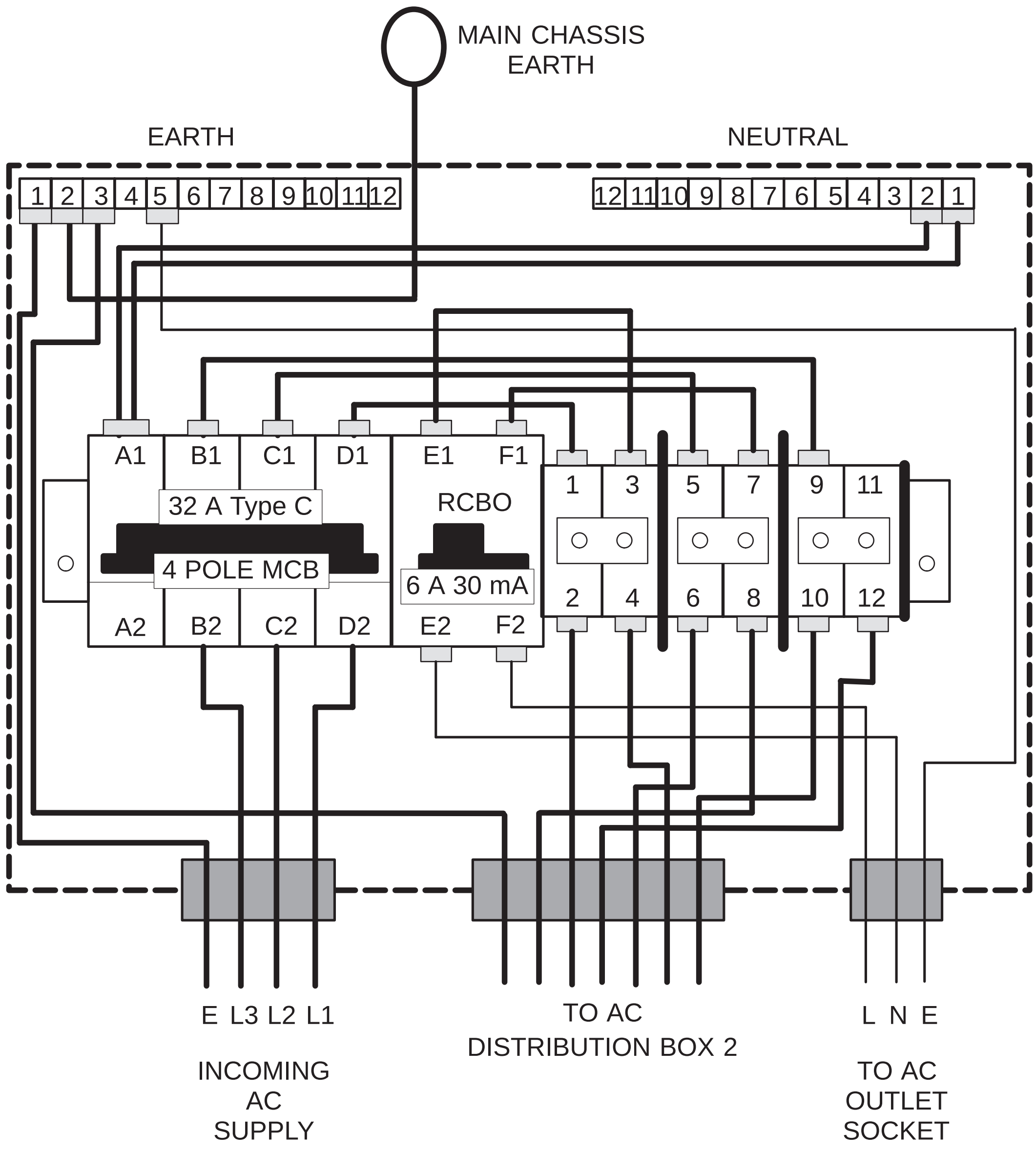


Figure 3-9 Wiring diagram for 230 V ac 3-phase (delta)

Connecting antennas

Overview of antenna connections

The components shown in Figure 3-10 provide all the RF connections to the cabinet and internally within the cabinet. Up to four cabinets can be interconnected to form a single BTS site.

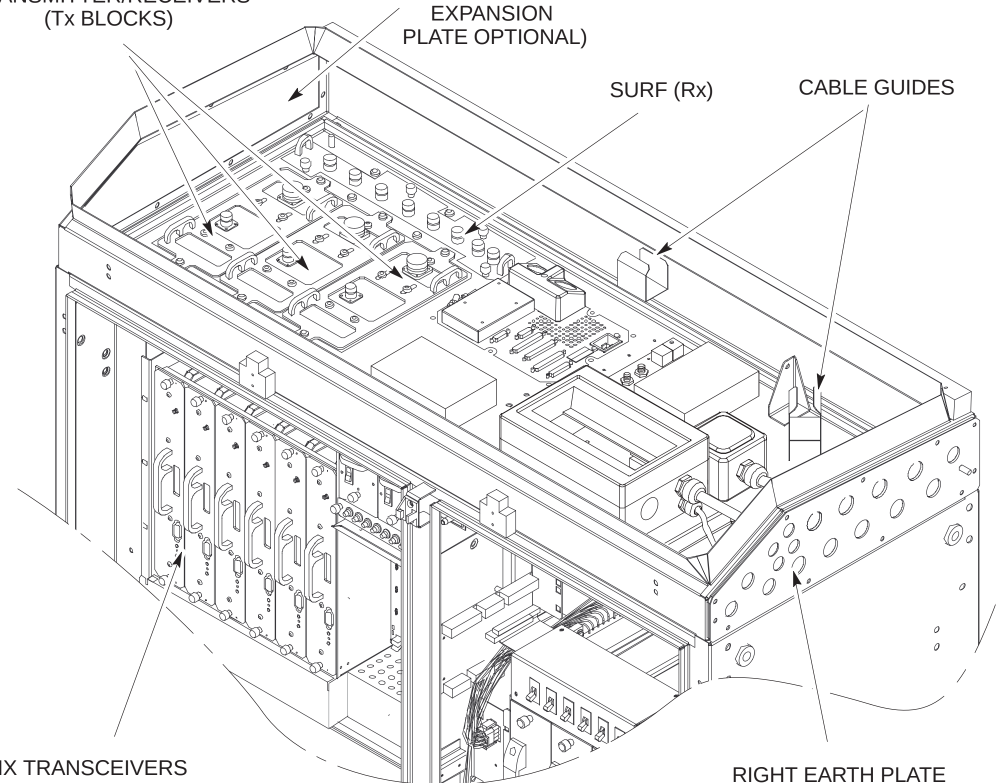


Figure 3-10 Location of RF components

Site configurations supplied by Motorola have appropriate earth, expansion or blanking plates fitted and all internal RF cables supplied. Antennas need only be connected to the earth/connector plate as all RF connections internal to the cabinet, (those between CTUs, Tx blocks, SURF and earth/connector plates), are cabled correctly for the cabinet configuration supplied.

Multiple cabinet configurations have additional RF cabling, stored, for shipping, in the master cabinet. These cables will need to be routed to the expansion cabinets and connected as shown in the **Suggested RF configurations** Variations in site layout and RF configuration may require the fitting of left side cable entry earth plates and/or expansion plates.

Cable entry earth plates

The standard cabinet is supplied with the earth/connector plate, with attached RF cables, located on the right side of the top section. If required, an optional earth/connector plate can be fitted on the left side of the top section instead.

Figure 3-11 shows the layout of the right earth/connector plate viewed from inside the top section (the layout for the left plate is a mirror image of this). The six permanently connected RF cables are omitted for clarity.

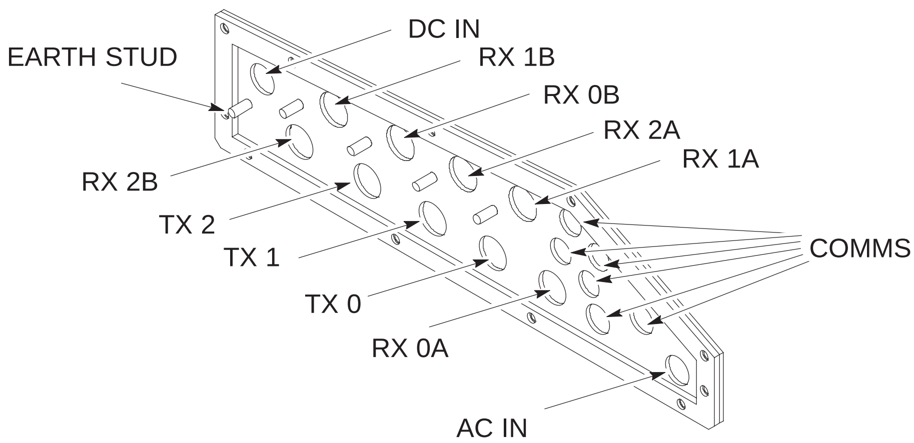


Figure 3-11 Diagram of left earth/connector plate connections

Fitting inter-cabinet RF cables to earth plates

When installing a multiple cabinet configuration or expanding an existing site it may be necessary to fit long RF cables to an existing earth plate. Extension RF cables are listed in Table 3-4 in this chapter.

To fit extension RF cables to an earth plate:

1. Remove the grey weather seal from an unused RF position, on the earth plate and discard.
2. Remove the nut and washer from the fixed bulkhead connector of the extetsion RF cable.
3. Feed the threaded portion of the bulkhead connector through the earth plate from the inside.
4. Refit the washer and nut to the bulkhead connector and tighten to the correct torque, (see **Site requirements and considerations** in Chapter 2 of this category).

Routeing RF cables between cabinets.

When routeing RF cables between cabinets in Motorola supplied configurations:

1. Remove the expansion plate pass through blanks, as required.
2. Undo the two hose clips securing each RF cable gland housing and remove gland assembly.
3. Feed any RF cables through the expansion plates.

Refer to **Cable shroud installation procedures** (Installation between cabinets and Cable routeing for multiple cabinet sites) in Chapter 4 of this category for full details of RF gland refitting and shroud installation.

Types of RF connector

Table 3-2 list the RF module connectors with their destinations.

Table 3-2 RF module connectors and destinations

RF module	Type of connector	Destination
CTU transceiver	SMA	Tx block (underneath)
Tx block	SMA	CTU transceiver
	N-type	SURF
	7/16	Earth/connector plate
SURF	N-type	Rx N-type of Tx Block
Earth/connector plate	7/16	Antenna or additional cabinets

Torque of RF connectors

For correct torque of connectors, see *Installation & Configuration: GSM-204-423* Chapter 2 **Site requirements and considerations**.

CAUTION	Care should be taken when tightening SMA connectors to avoid damage by excessive force.

Fitting left side (cable entry) earth plate

To fit the left side (cable entry) earth plate:

1. Remove and retain the eleven M6 anti-tamper Torx screws securing the left side blanking plate, (if fitted). Remove the blanking plate.
2. Fit left side (cable entry) earth plate and secure with previously retained Torx screws. Tighten securing screws to the correct torque (see **Site requirements and considerations** in Chapter 2 of this category).
3. Connect the short earth cable to the left side cabinet earth stud and tighten to the correct torque.
4. Route RF cables and long earth cable from left side earth plate through top section cable guides, indicated in Figure 3-10.
5. Remove the earth cable from the interface panel earth stud and fit long earth cable from left side earth plate. Tighten to correct torque (see **Site requirements and considerations** in Chapter 2 of this category).

CAUTION	Incorrect connection of RF cables could result in network planning and optimization difficulties, care must be taken to ensure that the correct RF configuration for the site is maintained.

6. Note the identification of the existing connections between the right earth plate and RF components. Disconnect each cable from the SURF module or Tx block, one at a time, and connect corresponding RF cable from left side earth plate, until all RF cables, appropriate for the desired RF configuration, are connected.
7. Disconnect the short earth cable from the right side cabinet earth stud.
8. Remove and retain the eleven M6 anti-tamper Torx screws securing the right side earth plate. Remove the right side earth plate, complete with cables.
9. Fit right side blanking plate and secure using with previously retained Torx screws. Tighten securing screws to the correct torque (see **Site requirements and considerations** in Chapter 2 of this category).

Fitting expansion plates

To fit an expansion plate:

1. Remove and retain the eleven M6 anti-tamper Torx screws securing the earth plate or blanking plate, (if fitted), and remove.
2. Fit the expansion plate and secure with previously retained Torx screws. Tighten securing screws to the correct torque (see **Site requirements and considerations** in Chapter 2 of this category).
3. To make the RF, dc power, fibre optic and signal connections between multiple cabinets, (see **Cable shroud installation procedures** in Chapter 4 of this category).

Figure 3-12 shows an expansion plate, with cable pass-through ports indicated.

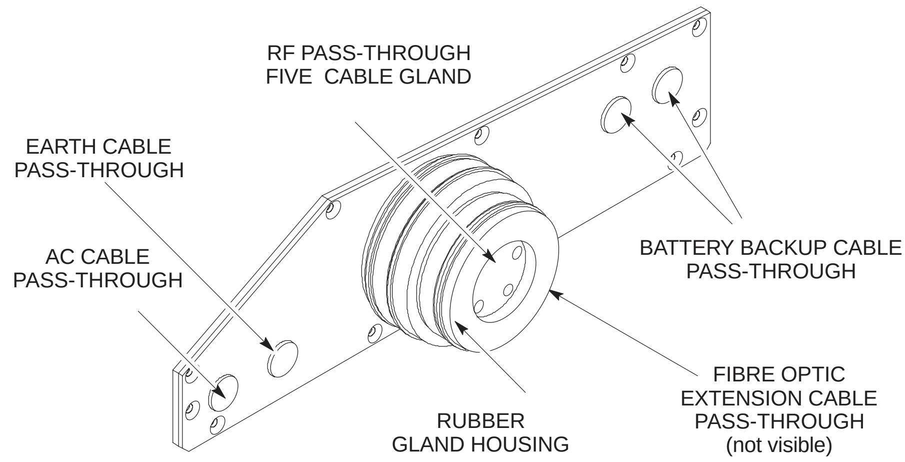


Figure 3-12 Expansion plate

RF connection principles

The primary receive path is connected to the A branch of the SURF module, either directly or from the Rx connector on the Tx block in non-diversity configurations. The diversity receive path is connected to the B path on the SURF. This is normally duplexed with the transmit signal on a single antenna, and fed to the SURF from the Rx connector on the Tx block. Within any single cabinet the lowest numbered sector is normally connected to amplifier 0 connections, and higher numbered sectors to amplifiers 1 and 2 as appropriate. For example, sector one is connected to SURF connectors 0A and 0B, sector two to 1A and 1B, and sector three to 2A and 2B. However, if a sector is split between two cabinets, the split sector antennas must be connected to amplifier 0, (this is the only path with connection to the extension ports). Extension ports must be connected to the correct branch at the destination cabinet.

The transmit path feeds from the CTUs to the Tx block or feedthrough plate immediately above. Two signals are combined in most Tx blocks, A third signal can be combined using a feedthrough plate and the third input of a DDF. The Tx blocks then duplex the Tx signal with the diversity Rx signal, before feeding to the antenna.

Rx/Tx single antenna duplexing

Duplexers allow a single antenna to be used for both transmit and receive operations. Duplexers exist within several of the transmit blocks. Normally duplexed RF signals are used through one antenna, with a second receive antenna to provide diversity.

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

Suggested RF configurations

Overview of configuration diagrams

The following series of RF configuration diagrams show suggested ways of connecting together Horizon*macro* SURF and Tx blocks to meet different operational requirements. The series of diagrams is by no means exhaustive, and numerous alternative configurations may be adopted to achieve the same aim.

Each Horizon*macro* cabinet is represented by a SURF module, three Tx blocks and an earth plate. In a standard cabinet the Tx blocks and SURF module are supplied connected to a right side entry earth plate, (left side cable entry requires fitting of optional earth plate kit). A blanking panel, or expansion plate (for multiple cabinet configurations), is fitted on the opposite side of the cabinet top section. Antenna connecting cables, not supplied as part of the Horizon*macro* equipment, connect to the outside of the earth plate. Interconnecting cables are not individually identified as different cables are used, dependant on physical layout.

With the exception of Figure 3-33 and Figure 3-34 the diagrams are applicable for single band operation at 850, 900, 1800 or 1900 MHz, although only the 1800 MHz SURF module is illustrated. Connections to the dual band 900 or 1800 SURF are identified in the same way as those to the single band SURF, with the addition of two extra connectors provided for dual band use.

Figure 3-33 shows one way of achieving dual band operation using two Horizon*macro* cabinets. A single band 1800 SURF is installed in one cabinet and a dual band 900 SURF in the other. Figure 3-34 shows another, using one of each type of dual band SURF.

NOTE	Dual band SURFs are not available for GSM850 or PCS1900 BTS variants.

Diversity is assumed in all the RF configuration diagrams shown here, except for Figure 3-14. Other non-diversity configurations can be derived from this figure by ensuring that the single receive path is always connected to branch A at the SURF module.

Digital connections

Digital connections between cabinets are not shown in the following diagrams. Fibre optic cables used to provide digital connections between cabinets are described in **Connecting fibre optic cables**.

Depopulated site configurations

The purpose of a depopulated site configuration is to allow customers to provide a future expansion capability, at the time of installation. The diagram showing the final target configuration is to be used to connect TX blocks, SURF and antennas. Depopulated site configurations are supplied with fully equipped RF section to achieve the target configuration, with CTUs only fitted to alternate slots. CTUs are fitted in slots 0, 2 and 4. Unused Tx block SMA connectors must be fitted with 50 ohm terminating loads.

Single cabinet connection kits and cables

Table 3-3 lists cable types and kits used for SURF/Tx block and antenna interconnections for a single cabinet.

Table 3-3 SURF/Tx block and antenna interconnecting kits and cables

Part number	Description	Use
3086225N01	34.5 cm coaxial cable terminated at either end with straight N-type plugs.	Tx block to SURF (inside cabinet)
3086225N02	28 cm coaxial cable terminated at one end with a straight N-type plug, and at the other end with a right-angle N-type plug.	Tx block to Tx block (inside cabinet)
SVLN1320	Left side entry earth plate kit contains three each of: – N-type to 7/16 bulkhead cables – 7/16 to 7/16 bulkhead cables	Interface between antenna cables and Tx blocks and/or SURF
SVLN1321	Right side entry earth plate kit contains three each of: – N-type to 7/16 bulkhead cables – 7/16 to 7/16 bulkhead cables	Interface between antenna cables and Tx blocks and/or SURF
SVLN1322	Left side blanking panel	Blank plate
SVLN1323	Right side blanking panel	Blank plate
SVLN1324	Left side expansion plate, with five cable gland	Multiple cabinet configurations
SVLN1325	Right side expansion plate, with five cable gland	Multiple cabinet configurations

Multiple cabinet connection kits and cables

Table 3-4 lists interconnection cable kits used in multiple cabinet layouts.

Table 3-4 Multiple cabinet interconnection kits

Part number	Description	Use
SVKN1313	3 m coaxial cable terminated at each end with N-type plugs. Intercabinet RF cable.	SURF to SURF in back to back layouts
SVKN1314	2 m coaxial cable terminated at each end with N-type plugs. Intercabinet RF cable.	SURF to SURF in side by side layouts
SVKN1315	2.15 m coaxial cable terminated at each end with N-type plugs. Intercabinet RF cable.	DDF to HCU in side by side layouts
SVKN1316	2 m coaxial cable terminated with an N-type plug at one end, and a 7/16 at the other. Intercabinet RF cable.	SURF to earth plate in left side of adjacent cabinet
SVKN1317	2.85 m coaxial cable terminated with an N-type plug at one end, and a 7/16 at the other. Intercabinet RF cable.	SURF to earth plate in right side of adjacent cabinet
SVKN1318	2.15 m coaxial cable terminated at each end with 7/16-type plugs. Intercabinet RF cable	Tx block to earth plate in left side of adjacent cabinet
SVKN1319	3 m coaxial cable terminated at each end with 7/16-type plugs. Intercabinet RF cable	Tx block to earth plate in right side of adjacent cabinet

Configuration for omni 1

Figure 3-13 shows a suggested configuration, using one Horizon*macro* cabinet, for omni 1 with twin duplexed filter.

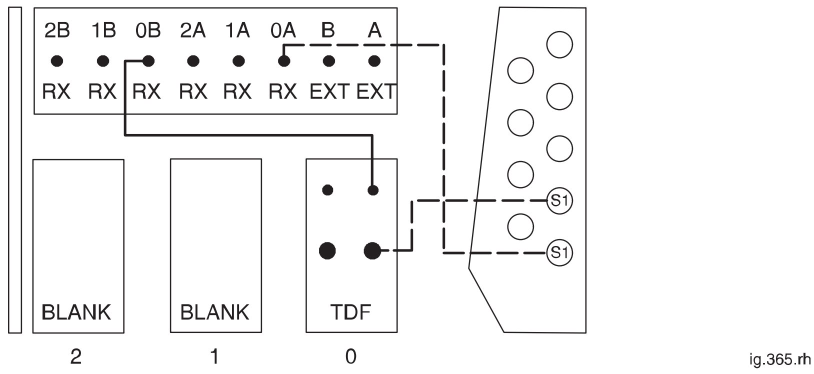


Figure 3-13 Single cabinet omni 1 with TDF

Configuration for omni 1 or 2 (with/without diversity)

Figure 3-14 shows suggested single Horizon*macro* cabinet configurations, with and without diversity, for omni 1 or omni 2 with duplexed combining bandpass filter.

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 SURF. Simply switching off diversity at the OMC-R without the correct SURF configuration will cause a loss of reception.

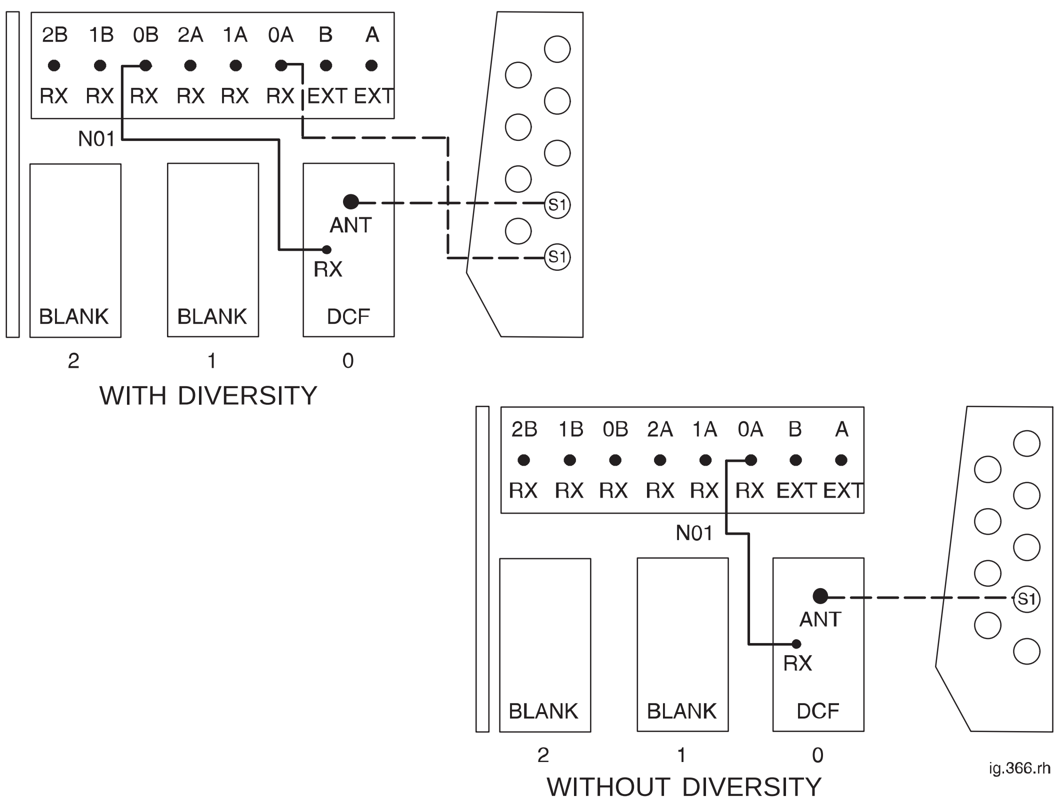


Figure 3-14 Single cabinet omni 1 or 2 with DCF

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
omni 1	DCF 0

Configuration for omni 3 or 4

Figure 3-15 shows a suggested configuration, using a single Horizon*macro* cabinet, for omni 3 or omni 4 with duplexed combining bandpass filter.

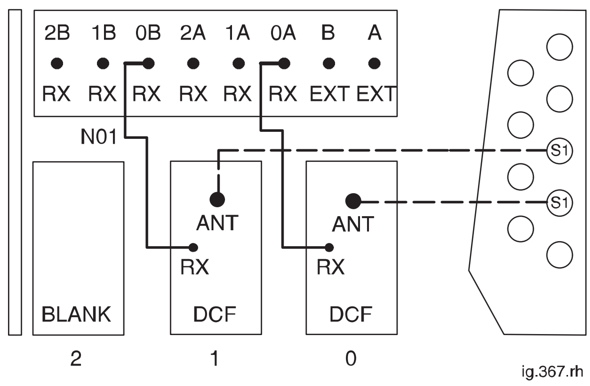


Figure 3-15 Single cabinet omni 3 or 4 with DCF

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
omni 3	DCF 1

Configuration for omni 3

Figure 3-16 shows a suggested configuration, using one Horizon*macro* cabinet, for omni 3 with dual stage duplexed combining filter.

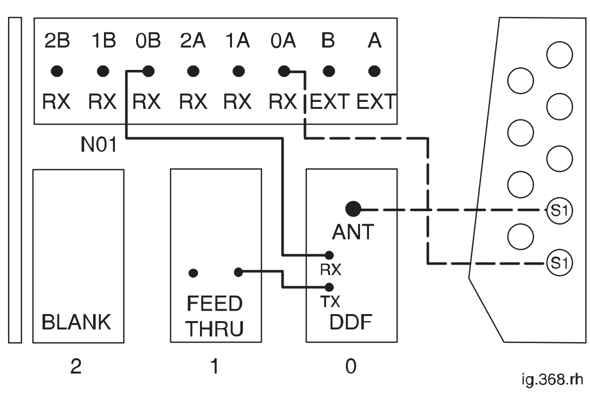


Figure 3-16 Single cabinet omni 3 with DDF

Configuration for omni 4

Figure 3-17 shows a suggested configuration, using a single Horizon*macro* cabinet, for omni 4 with dual stage duplexed combining filter and hybrid combining unit.

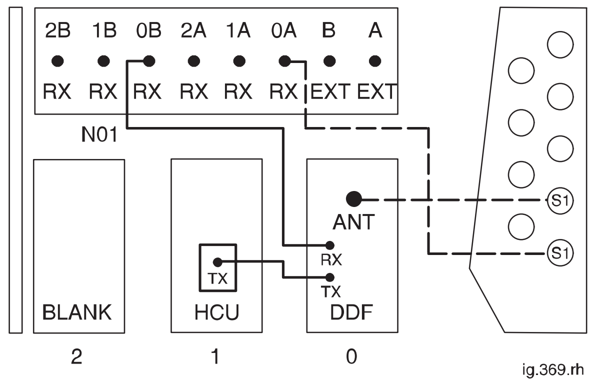


Figure 3-17 Single cabinet omni 4 with DDF and HCU

Configuration for omni 5 or 6

Figure 3-18 shows a suggested configuration, using one Horizon*macro* cabinet, for omni 5 or 6 with dual stage duplexed combining filter and air combining.

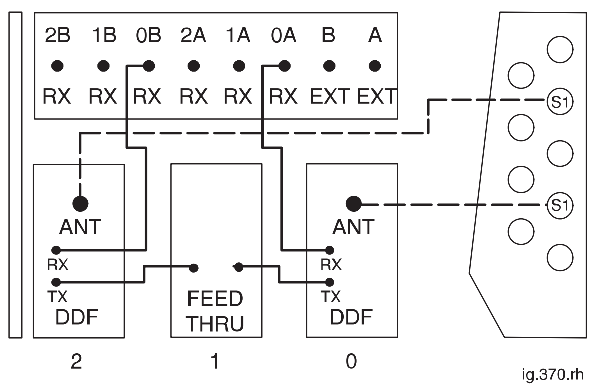


Figure 3-18 Single cabinet omni 5 or 6 with DDF and air combining

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
omni 5	DDF 2
omni 3 (depopulated omni 6)	all Tx modules from radio slots 1, 3, and 5

Configuration for sector 1/1 or 2/2

Figure 3-19 shows a suggested configuration, using a single Horizon*macro* cabinet, for sector 1/1 or 2/2 with duplexed combining bandpass filter.

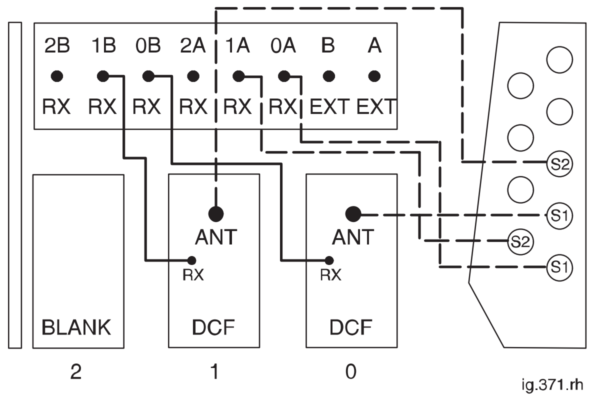


Figure 3-19 Single cabinet sector 1/1 or 2/2 with DCF

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
sector 1/1	DCF 0 and DCF 2

Configuration for sector 1/1

Figure 3-20 shows a suggested configuration, using one Horizon*macro* cabinet, for sector 1/1 with twin duplexed filter.

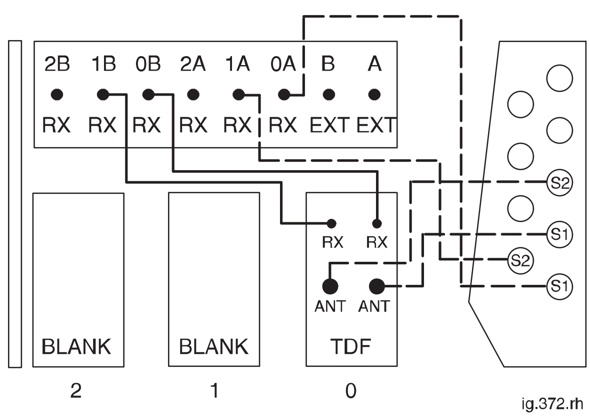


Figure 3-20 Single cabinet sector 1/1 with TDF

Configuration for single cabinet sector 3/3

Figure 3-21 shows a suggested configuration, using one Horizon*macro* cabinet, for sector 3/3 with dual stage duplexed combining filter.

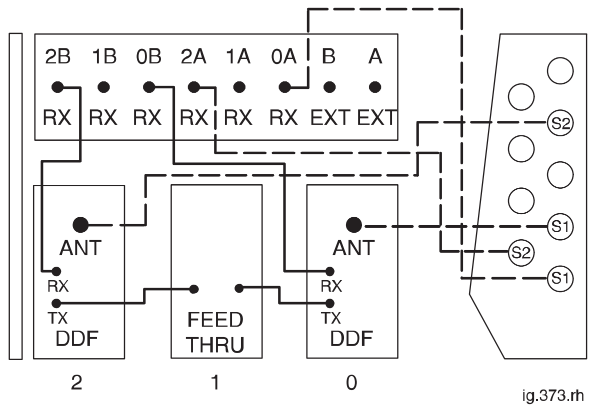


Figure 3-21 Single cabinet sector 3/3 with DDF

Configuration for 2 cabinet sector 3/3

Figure 3-22 shows a suggested configuration, using two Horizon*macro* cabinets, for sector 3/3 with dual stage duplexed combining filter.

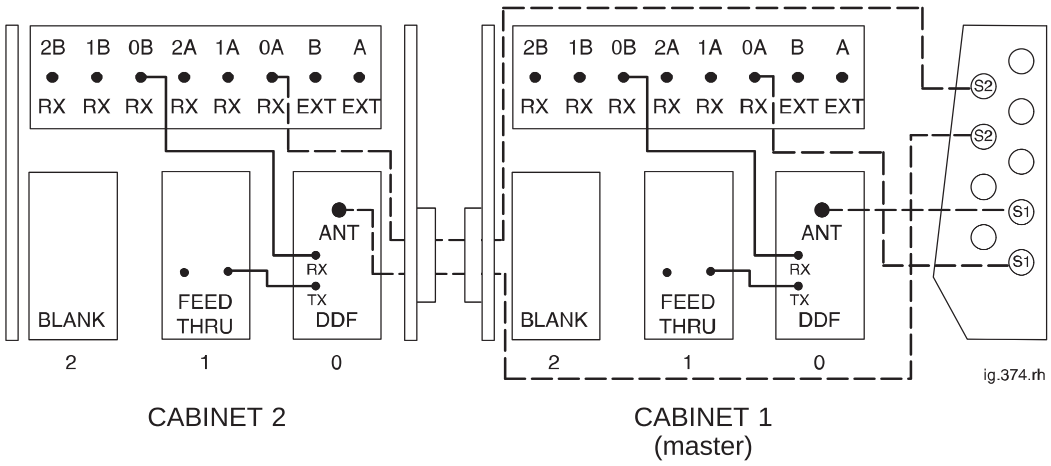


Figure 3-22 Two cabinet sector 3/3 with DDF

Configuration for 2 cabinet sector 4/4

Figure 3-23 shows a suggested configuration, using two Horizon*macro* cabinets, for sector 4/4 with dual stage duplexed combining filter and hybrid combining unit.

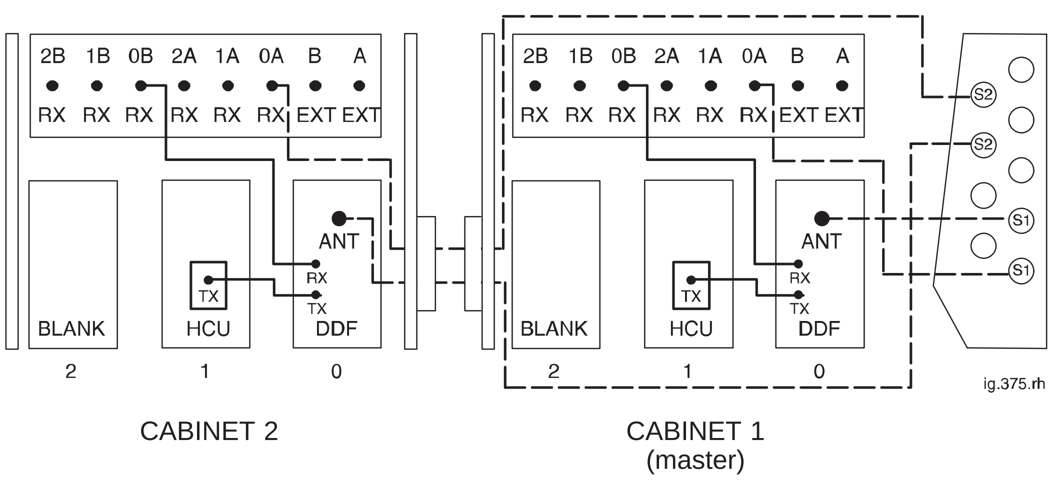


Figure 3-23 Two cabinet sector 4/4 with DDF and HCU

Configuration for 2 cabinet sector 5/5 or 6/6

Figure 3-24 shows a suggested configuration, using two Horizon*macro* cabinets, for sector 5/5 or 6/6 with dual stage duplexed combining filter and air combining.

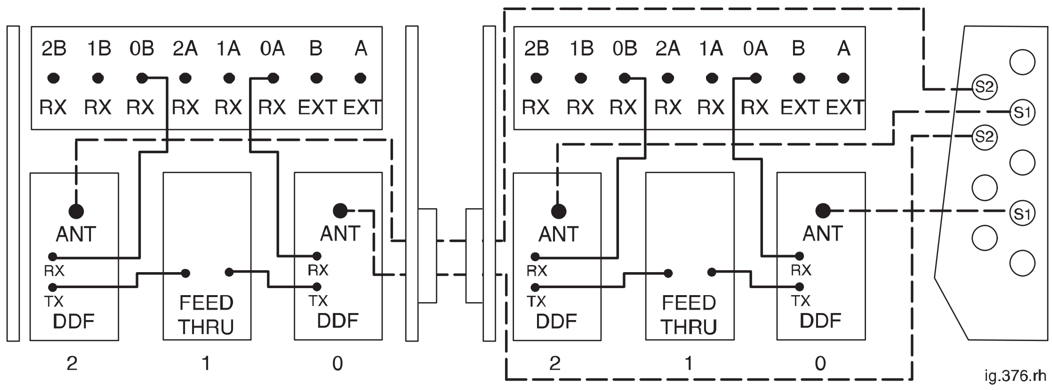


Figure 3-24 Two cabinet sector 5/5 or 6/6 with DDF and air combining

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
sector 5/5	both DDF 2 modules

Configuration for single cabinet sector 1/1/1, 1/1/2, 1/2/2 or 2/2/2

Figure 3-25 shows a suggested configuration, using a single Horizon*macro* cabinet, for sector 1/1/1, 1/1/2, 1/2/2 or 2/2/2 with duplexed combining bandpass filter.

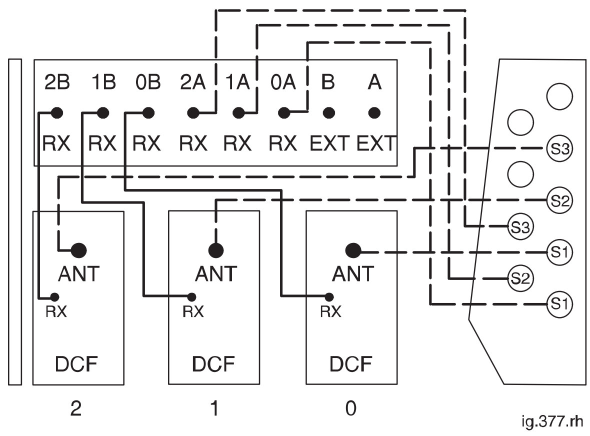


Figure 3-25 Single cabinet sector 1/1/1, 1/1/2, 1/2/2 or 2/2/2 with DCF

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
Sector 1/1/1	DCF 0, 1 and 2
Sector 1/1/2	DCF 1 and 2
Sector 1/2/2	DCF 2

Configuration for 2 cabinet sector 2/2/2

Figure 3-26 shows a suggested configuration, using two Horizon*macro* cabinets, for sector 2/2/2 with duplexed combining bandpass filter.

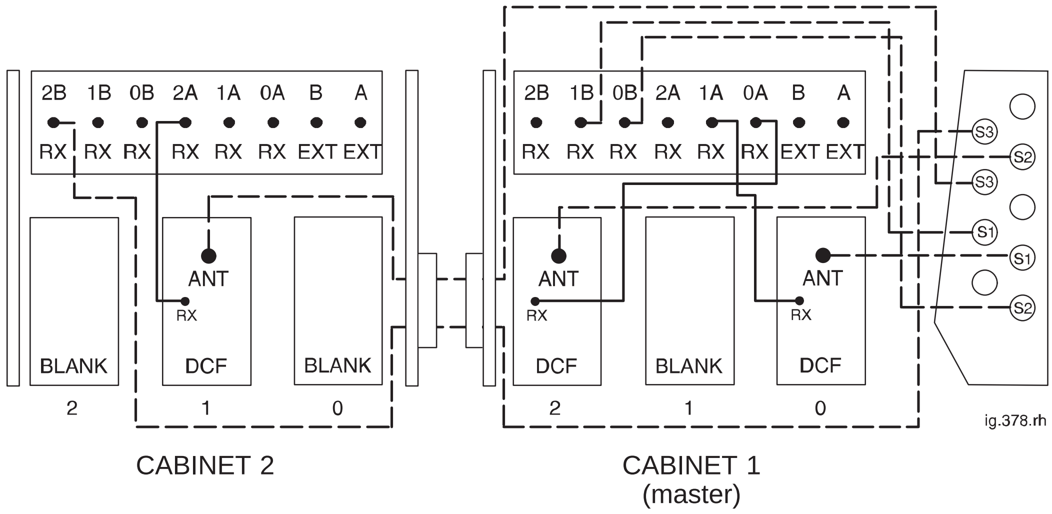


Figure 3-26 Two cabinet sector 2/2/2 with DCF

Configuration for 2 cabinet sector 3/3/3 or 4/4/4

Figure 3-27 shows a suggested configuration, using two Horizon*macro* cabinets, for sector 3/3/3 or sector 4/4/4 with duplexed combining bandpass filter and air combining.

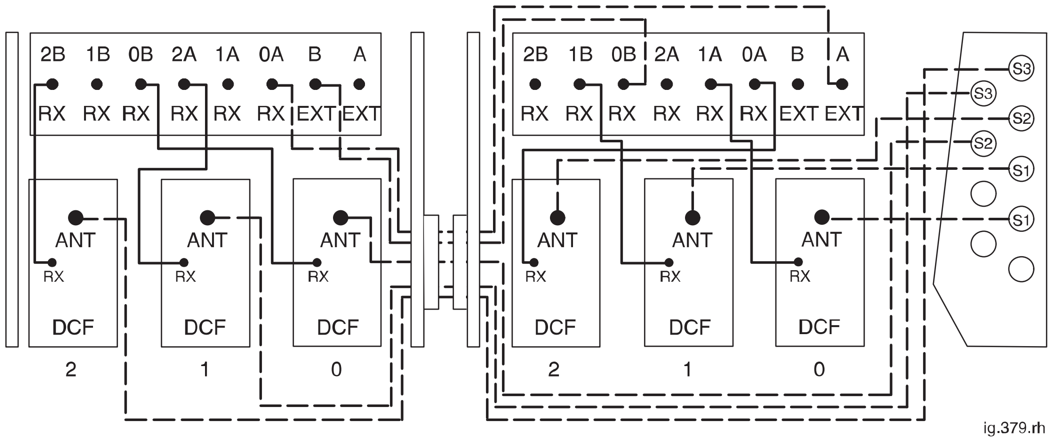


Figure 3-27 Two cabinet sector 3/3/3 or sector 4/4/4 with DCF and air combining

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
sector 3/3/3	cabinet 1, DCF 1 cabinet 2, DCF 0 and DCF 2
2/2/2 (depopulated 4/4/4)	all Tx modules from radio slots 1, 3, and 5

Configuration for 3 cabinet sector 3/3/3

Figure 3-28 shows a suggested configuration, using three Horizon*macro* cabinets, for sector 3/3/3 with dual stage duplexed combining filter.

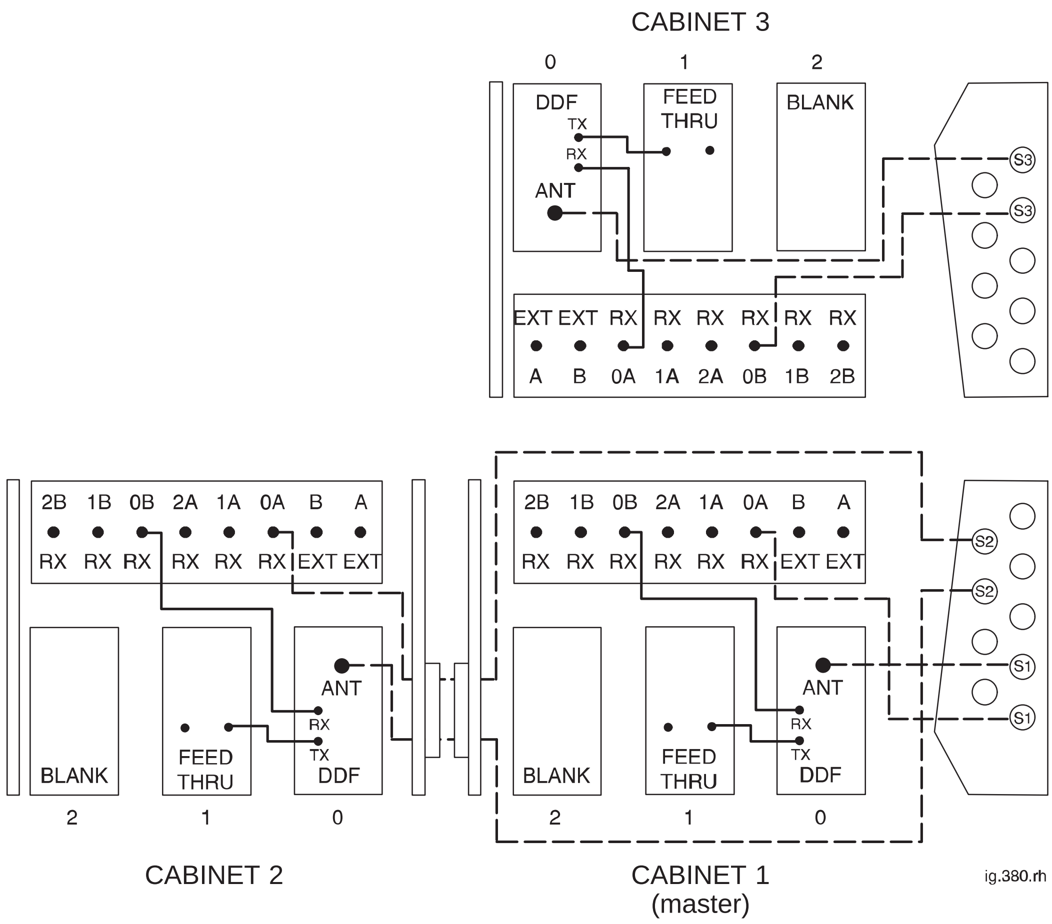


Figure 3-28 Three cabinet sector 3/3/3 with DDF

Configuration for 2 cabinet sector 4/4/4

Figure 3-29 shows a suggested configuration, using two Horizon*macro* cabinets, for sector 4/4/4 with dual stage duplexed combining filter and hybrid combining unit.

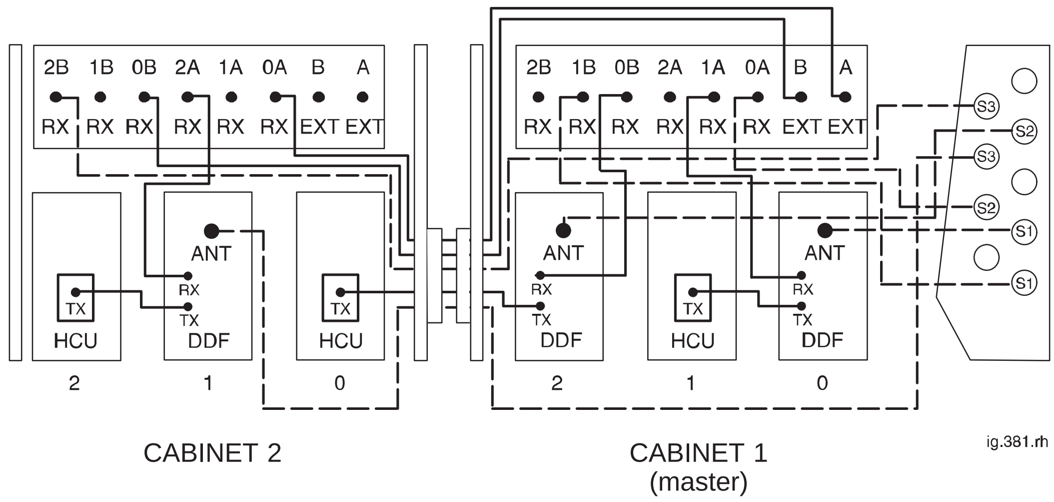


Figure 3-29 Two cabinet sector 4/4/4 with DDF and HCU

Configuration for 3 cabinet sector 4/4/4

Figure 3-30 shows a suggested configuration, using three Horizon*macro* cabinets, for sector 4/4/4 with dual stage duplexed combining filter and hybrid combining unit.

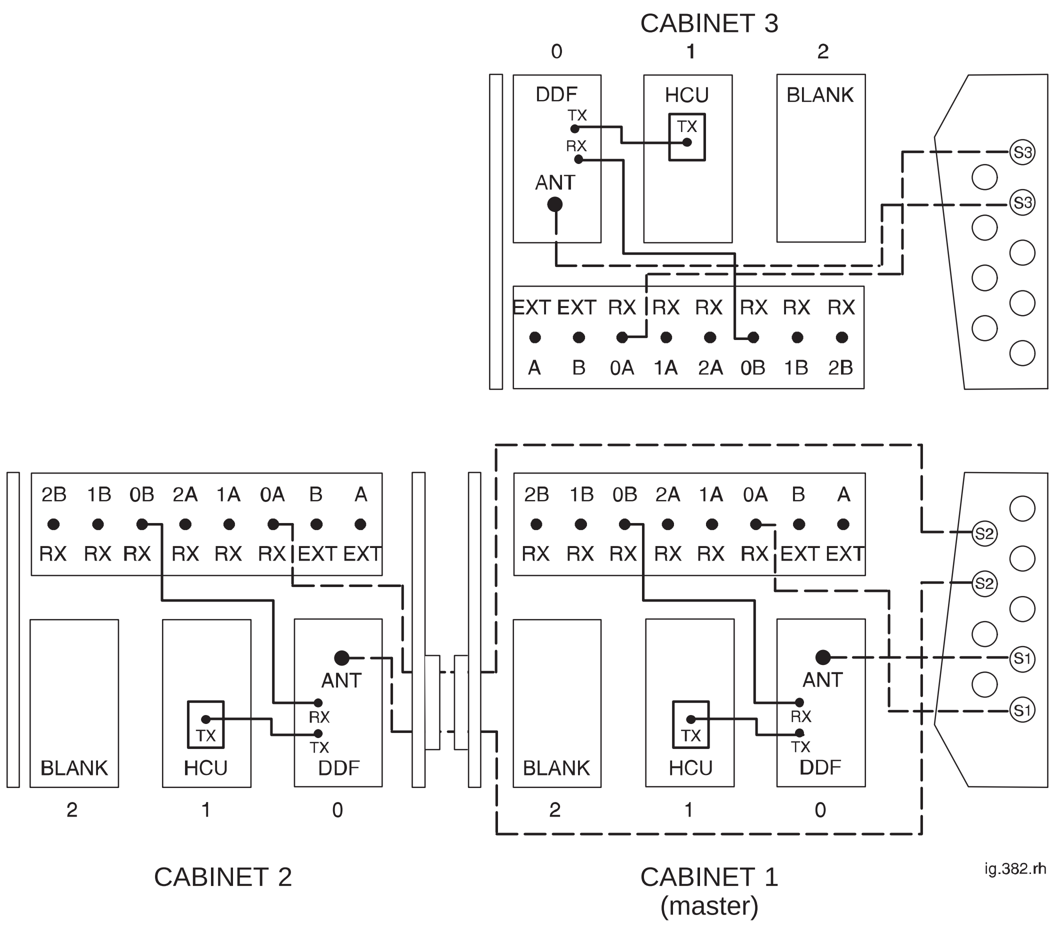


Figure 3-30 Three cabinet sector 4/4/4 with DDF and HCU

Configuration for sector 5/5/5 or 6/6/6

Figure 3-31 shows a suggested configuration, using three Horizon*macro* cabinets, for sector 5/5/5 or sector 6/6/6 with dual stage duplexed combining filter and air combining.

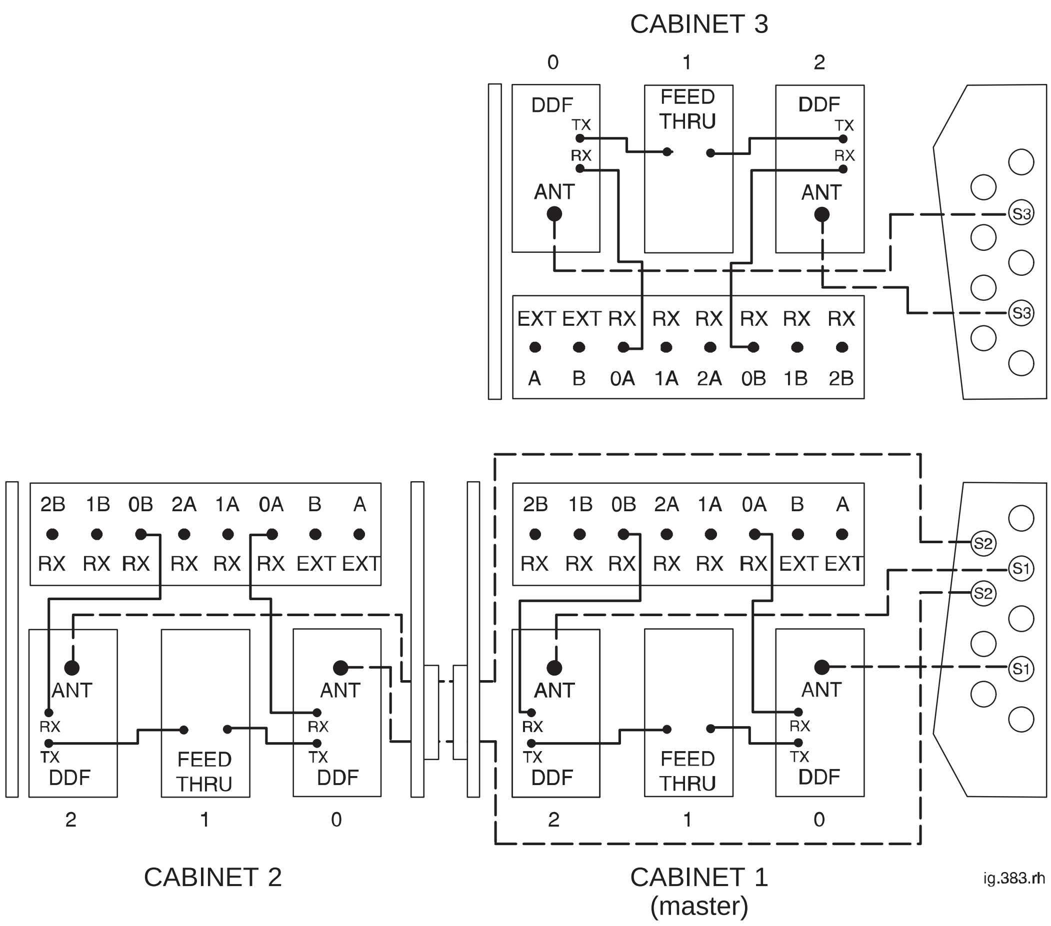


Figure 3-31 Sector 5/5/5 or sector 6/6/6 with DDF and air combining

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
sector 5/5/5	all DDF 2 modules
3/3/3 (depopulated 6/6/6)	all Tx modules from radio slots 1, 3, and 5

Configuration for sector 8/8/8

Figure 3-32 shows a suggested configuration, using four Horizon*macro* cabinets, for sector 8/8/8 with dual stage duplexed combining filter, hybrid combining unit and air combining.

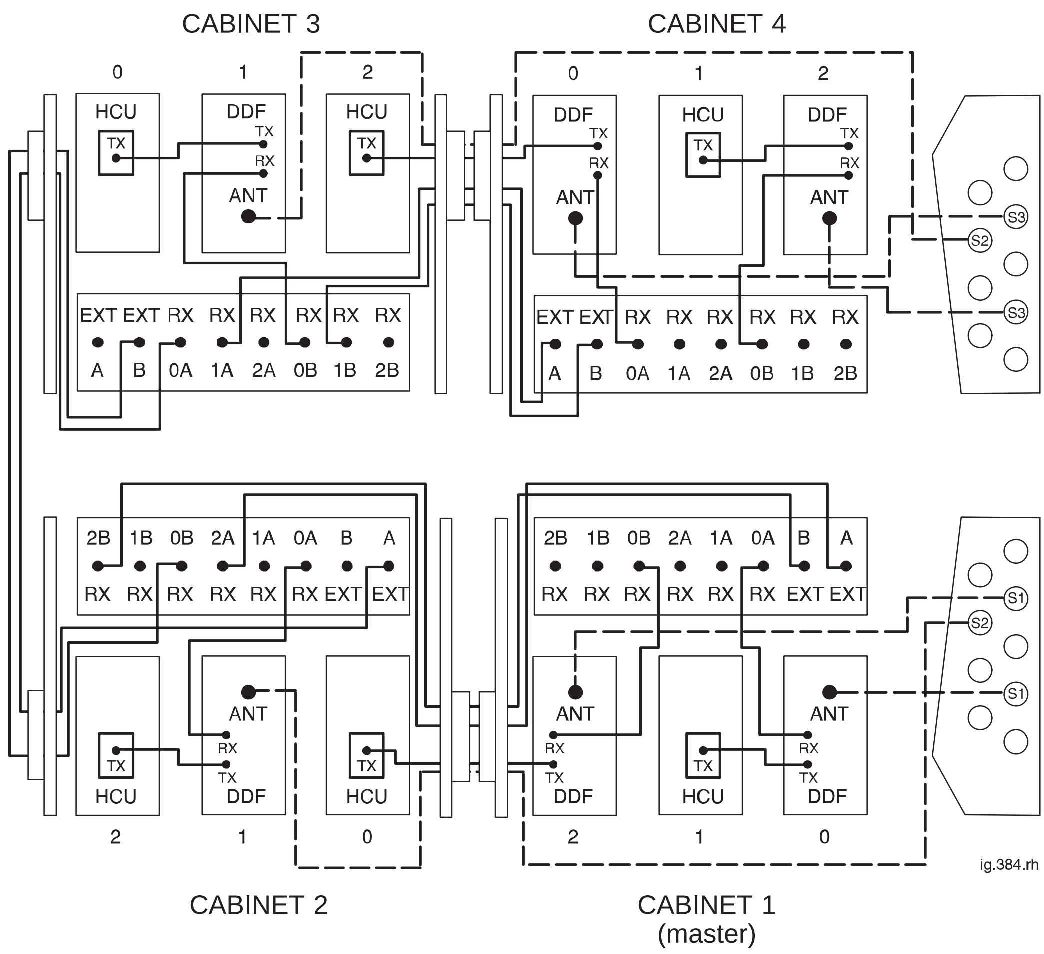


Figure 3-32 Sector 8/8/8 with DDF, HCU and air combining

Unused SMA connectors must be fitted with 50 ohm terminating loads as shown below.

If configured for...	Then 50 ohm load required on unused SMA input to...
4/4/4 (depopulated 8/8/8)	all Tx modules from radio slots 1, 3, and 5

Configuration for dual band 1/1/1-3/3/3

Figure 3-33 shows a suggested configuration, using two Horizon*macro* cabinets, for dual band sector 1/1/1–3/3/3 operation, where sector 1/1/1 is EGSM900 and sector 3/3/3 is DCS1800. This dual band configuration requires one single band 1800 SURF and one dual band 900 SURF.

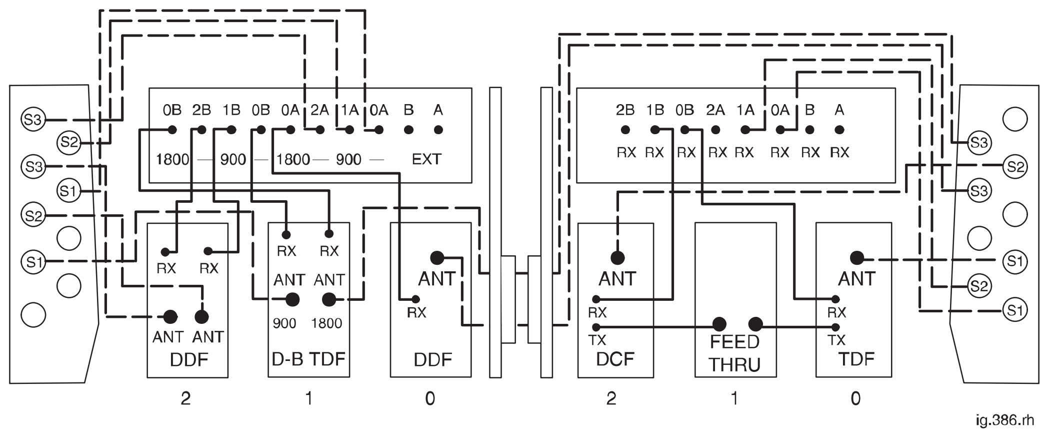


Figure 3-33 Two cabinet dual band sector 1/1/1-3/3/3

Unused SMA connectors must be fitted with 50 ohm terminating loads.

Configuration for dual band 3/3/3-1/1/1

Figure 3-34 shows a suggested configuration, using two Horizon*macro* cabinets, for dual band sector 3/3/3–1/1/1 operation, where sector 3/3/3 is EGSM900 and sector 1/1/1 is DCS1800. This dual band configuration requires one dual band 1800 SURF and one dual band 900 SURF.

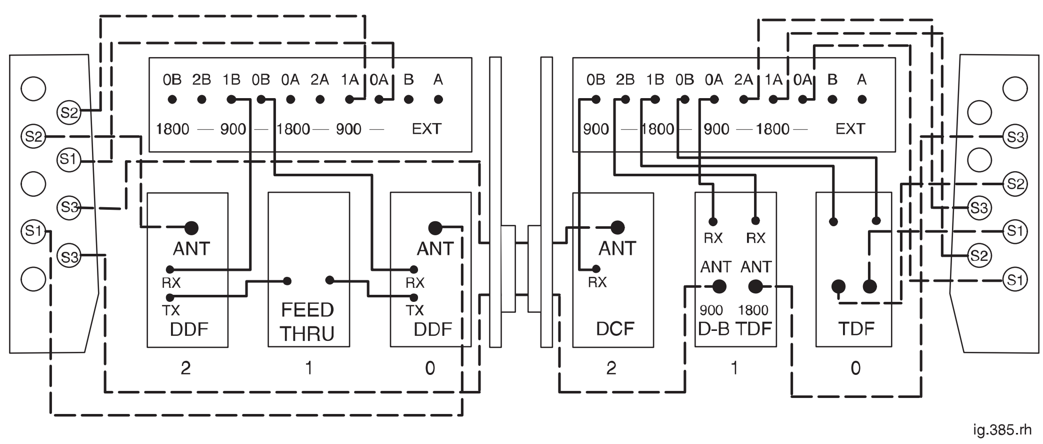


Figure 3-34 Two cabinet dual band sector 3/3/3-1/1/1

Unused SMA connectors must be fitted with 50 ohm terminating loads.

Connecting fibre optic cables

Location of fibre optic connections

In an installation configuration with more than one Horizon*macro* outdoor cabinet, fibre optic connections are used to link the MCUF in the master cabinet to the extension cabinets. A maximum of three extension cabinets can be added to the master cabinet.

Connections from the master cabinet are provided by three fibre optic multiplexers (FMUXs). Two are located integral to the MCUF, and the third is a separate module located in the slot next to the master MCUF. Additional redundant modules may be installed for both MCUF and FMUX modules.

Extension cabinets have only a single FMUX, with optional redundancy, for fibre optic connectivity to the master cabinet.

Tx and Rx data connections to the MCUF and FMUXs are located on the front panel of each module.

Three different types of fibre optic cable, coloured orange and terminated with ST fibre connectors, are available for use. These are described in Table 3-5.

Table 3-5 Extension cabinet fibre optic cables

Order number	Length	Description
SVKN1244	5.6 m long	connects master cabinet to first extension
SVKN1245	7.6 m long	connects master cabinet to second extension
SVKN1246	7.6 m long	connects master cabinet to third extension

WARNING Do not look directly into a fibre optic cable or the data in/out connectors of the FMUX or MCUF, with or without the use of optical aids. Laser radiation can come from either the data in/out connectors or unterminated fibre optic cables connected to data in/out connectors.

Care of fibres

Optical fibre cables contain an inner core, which is a strand of glass coated by a cladding (sometimes in two layers), and an outer protective sheath which provides mechanical protection.

The fibre acts as a light waveguide. In order for the link to work correctly light must be propagated with minimal losses from end-to-end of the fibre. A number of problems can prevent this from happening, resulting in a potentially faulty link. Care must be taken to ensure that the conditions that follow are met.

Minimum bend radius

All optical fibres have a minimum bend radius. This represents the smallest circle that is allowed to be formed from a loop of fibre, that is how tight it can be coiled, looped or bent.

CAUTION	Under no circumstances should fibres be bent tighter than the minimum bend radius.

If fibres are bent tighter than the minimum bend radius then two possible effects can happen:

- Excessive light loss can occur from the outside of the bend, resulting in a loss of performance.
- The fibre can fracture due to microscopic imperfections in the surface. This type of break is invisible externally. If such a break occurs, excessive light loss would be permanent and light would be scattered and reflected from the break in the fibre. Returning the fibre to straight will not help and the whole assembly will require replacement.

For glass fibres (orange or green outer sheath) the long term minimum bend radius is approximately 30 mm.

Figure 3-35 illustrates the minimum bend radius for fibre optic cables.

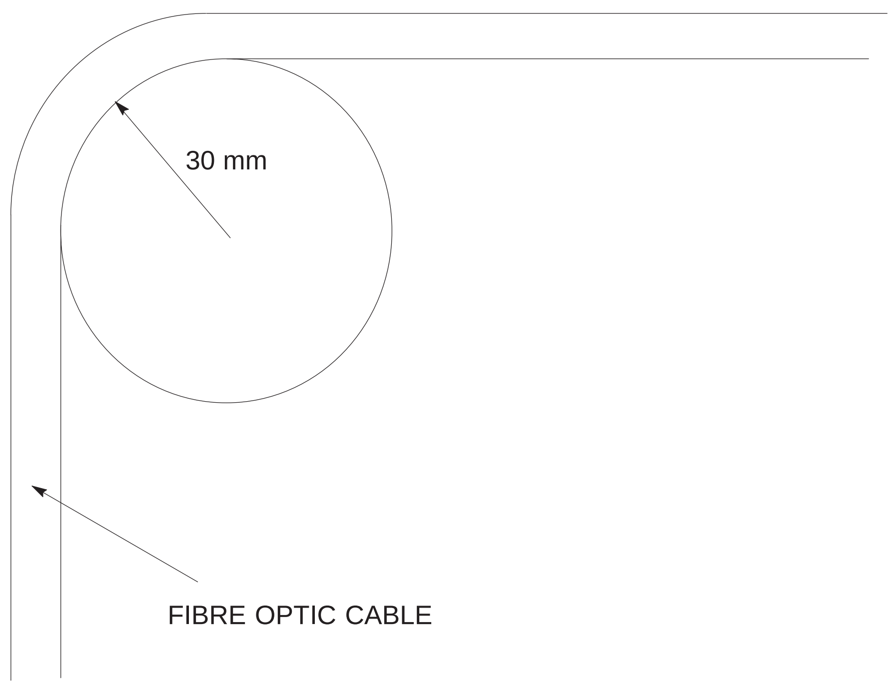


Figure 3-35 Minimum bend radius of 30 mm

If the fibre is under tension (being stretched), the bend radius should be much larger, at least doubled. This is because the tension in the fibre can increase the possibilities of damage.

If in doubt about the radius, the fibre should be allowed to form its natural bend radius by allowing it to bend under gravity only. This natural bend radius is normally greater than 30 mm.

Protecting fibres and connectors

To maintain good light transmission through the fibre optic link it is essential to maintain cleanliness of the connector end surfaces and/or bare fibre ends.

At all times when fibres are not connected into the system, the connector protective caps (normally red) should be fitted and kept in place. This is especially important when routeing fibres during installation.

Cleaning fibres and connectors

Cleanliness of fibre terminations and connectors is essential. If cleaning of contaminated optical components is required, then all areas should be wiped gently with a lint free cloth soaked in a suitable cleaning solution. Care should be taken to ensure the ends of the fibres are not scratched in any way.

Connecting glass fibre cables

Fibre-ST connectors are used to terminate the fibre optic cables. These are push fit and should not be tightened when connecting. Table 3-6 shows the fibre optic interconnections between master and extension cabinets in multiple cabinet sites.

Table 3-6 Fibre optic interconnections

Master cabinet connection	Extension cabinet	FMUX connection
MCUF TCU0 FMUX0 IN	2nd cabinet	DATA OUT
MCUF TCU0 FMUX0 OUT	2nd cabinet	DATA IN
MCUF TCU1 FMUX1 IN	3rd cabinet	DATA OUT
MCUF TCU1 FMUX1 OUT	3rd cabinet	DATA IN
FMUX module DATA IN	4th cabinet	DATA OUT
FMUX module DATA OUT	4th cabinet	DATA IN

Connecting fibre optic cables between cabinets

WARNING	Do not look directly into a fibre optic cable or the data in/out connectors of the FMUX or MCUF, with or without the use of optical aids. Laser radiation can come from either the data in/out connectors or unterminated fibre optic cables connected to data in/out connectors.

To connect fibre optic cables between master and extension cabinets in multiple cabinet sites.

1. Open master and extension cabinet doors and lids.

CAUTION	Under no circumstances should fibres be bent tighter than the minimum bend radius.

2. Route the appropriate length extension cabinet fibre optic cable from the digital module compartment of the master cabinet, through the aperture in the right side of the main cage, to the top section of the cabinet.

CAUTION	Under no circumstances should any tools, such as pliers, be used to connect ST fibre connectors.

3. Connect the push fit ST connector of the fibre optic cables to the appropriate ports on the master MCUF, or master FMUX module, front panel (see Table 3-6).
4. Lay the fibre optic cable into the cable guides and route through the expansion panels to the extension cabinet.
5. Route the fibre optic cable, following existing cable layout as far as possible, through the fibre optic cable hole in the cabinet top section to the extension cabinet FMUX.
6. Connect the push fit ST connector of the fibre optic cables to the data ports on the extension cabinet master FMUX front panel.
7. Repeat steps 2 to 6 for digital redundancy MCUF and FMUX, if fitted.
8. Repeat steps 2 to 7 for additional extension cabinets.

Interface panel cabling

Interface panel diagram and pinout overview

All maincage connectors are located on the interface panel. Each connector is marked with the appropriate label. Power connectors are also located on the interface panel.

An extension cabinet fibre optic cable is not connected to the interface panel, but directly connected to the FMUX digital module in the main cage. The fibre optic cable enters the cabinet through a hole on the top panel in front of the interface panel.

Figure 3-36 shows the locations of all the interface panel connectors.

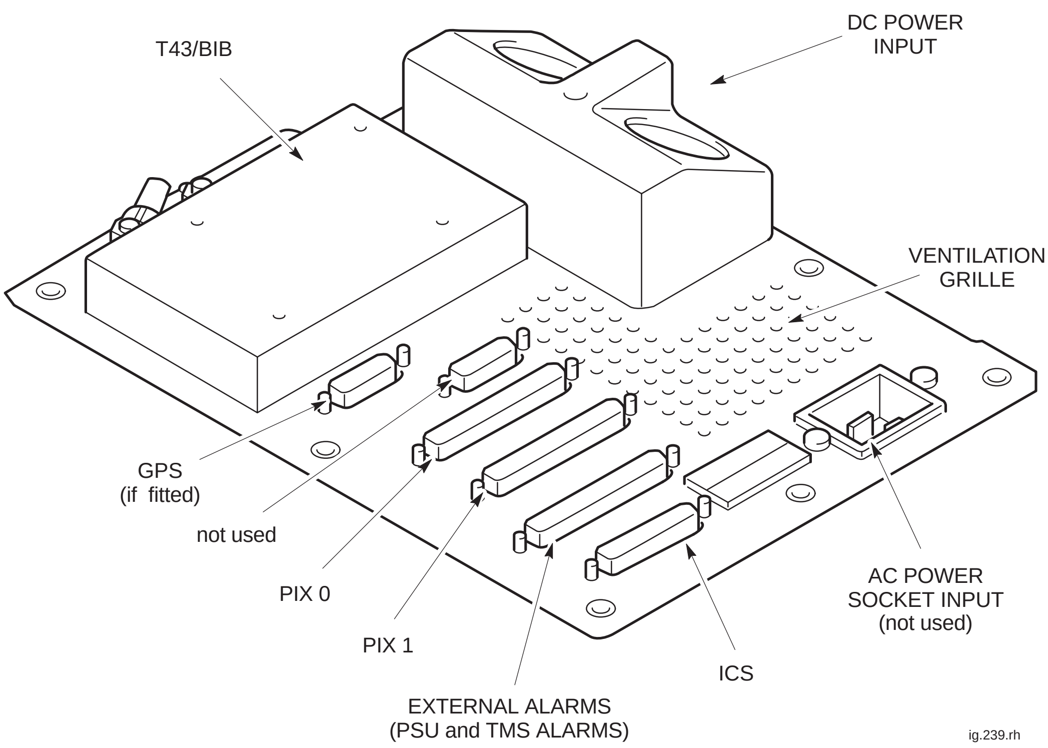


Figure 3-36 Interface panel connector locations

Interface panel connector pinout tables

CAUTION	Keep the plastic connector covers (supplied by Motorola) on unused connectors to protect from damage by static or foreign matter.

The following tables list the connector pinouts:

- GPS, see Table 3-7.
- RTC, see Table 3-8.
- BIB, see Table 3-9.
- T43, see Table 3-10.
- PIX0, see Table 3-11.
- PIX1, see Table 3-12.
- ICS, see Table 3-13.
- External alarms, see Table 3-14.

NOTE	Some pin connections only refer to indoor or outdoor cabinets.

GPS connector

Table 3-7 lists the GPS pin out connections.

NOTE	The GPS connector is optional on later BTS cabinets.

Table 3-7 GPS pin connections (15-way D-type)

Pin no.	Signal/Description	Pin no.	Signal/Description
1	GPS power 1	9	GPS return 1
2	Rx negative	10	GPS power 2
3	Rx positive	11	PPS positive
4	Tx negative	12	PPS negative
5	Tx positive	13	Not connected
6	Spare (not connected)	14	Not connected
7	VPP (not connected)	15	Not connected
8	GPS return 2		

RTC connector (not used)

Table 3-8 lists the RTC connector pinouts:

Table 3-8 RTC pin connections (15-way D-type)

Pin no.	Signal/Description	Pin no.	Signal/Description
1	Not connected	9	Not connected
2	Not connected	10	Not connected
3	RTC0 27 V	11	Earth
4	RTC0 27 V	12	Earth
5	Not connected	13	Not connected
6	RTC1 27 V	14	Earth
7	RTC1 27 V	15	Earth
8	Not connected		

BIB (BIM) interconnection

The Balanced-line Interconnect Board (BIB), also known as BIM, provides the line isolation between the E1/T1 circuit lines and the the CBIA backplane. The board provides an interface for up to six input and six output balanced 120 ohm lines. 12 transformers are used to provide line isolation while maintaining impedance matching between the E1/T1 circuit lines and the NIU module. Each transformer has a 1:1 turns ratio to match the external and backplane 120 ohm connections.

Connection is made using a 37-pin D-type connector to both the BIB and the external PCM twisted pair circuit lines. Figure 3-37 shows a typical BIB and Table 3-9 lists the BIB interconnections.

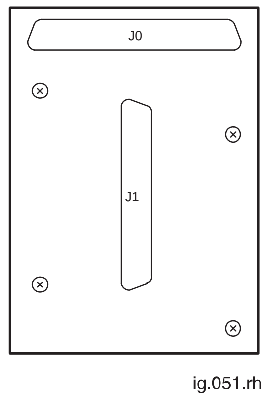


Figure 3-37 Balanced-line interconnect board (BIB)

Table 3-9 BIB interconnections

NIU/ port	Pin no.	Equipment/Ext	Pin no.	Pin no.	Equipment/Ext	Pin no.
0/0	J0-1	Tx1+	J1-1	J0-20	Tx1–	J1-20
	J0-2	Rx1+	J1-2	J0-21	Rx1–	J1-21
not used	J0-4	Tx4+	J1-4	J0-23	Tx4–	J1-23
	J0-5	Rx4+	J1-5	J0-24	Rx4–	J1-24
0/1	J0-7	Tx2+	J1-7	J0-26	Tx2–	J1-26
	J0-8	Rx2+	J1-8	J0-27	Rx2–	J1-27
not used	J0-10	Tx5+	J1-10	J0-29	Tx5–	J1-29
	J0-11	Rx5+	J1-11	J0-30	Rx5–	J1-30
1/0	J0-13	Tx3+	J1-13	J0-32	Tx3–	J1-32
	J0-14	Rx3+	J1-14	J0-33	Rx3–	J1-33
not used	J0-16	Tx6+	J1-16	J0-35	Tx6–	J1-35
	J0-17	Rx6+	J1-17	J0-36	Rx6–	J1-36
Connector J0 and J1, pins 3,6,9,12,15,18,19, 22, 25, 28, 31, 34 and 37 are **connected to earth**						

T43 (CIM) interconnection

The Type 43 Interconnect Board (T43), also known as CIM, provides the impedance matching and line isolation between the E1/T1 circuit lines and the CBIA backplane. The board provides an interface for up to six input and six output unbalanced coaxial 75 ohm lines. 12 transformers are used to provide impedance matching and line isolation between the E1/T1 circuit lines and the NIU module. Each transformer has a 1:1.25 turns ratio to match the external 75 ohm and backplane 120 ohm connections.

Connection is made using a 37-pin D-type connector to the interconnect board and twelve type 43 coaxial connectors to the external E1/T1 circuit lines.

Figure 3-38 shows a typical T43, and Table 3-10 lists the T43 interconnections.

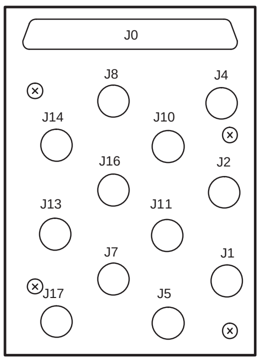


Figure 3-38 Type 43 interconnect board (T43)

Table 3-10 T43 interconnections

NIU/ port	Pin no.	Equipment / Ext	Pin no.	Pin no.	Equipment / Ext	Pin no.
0/0	J0-1	Tx1+	J1 centre	J0-20	Tx1–	J1 shield
	J0-2	Rx1+	J2 centre	J0-21	Rx1–	J2 shield
not used	J0-4	Tx4+	J4 centre	J0-23	Tx4–	J4 shield
	J0-5	Rx4+	J5 centre	J0-24	Rx4–	J5 shield
0/1	J0-7	Tx2+	J7 centre	J0-26	Tx2–	J7 shield
	J0-8	Rx2+	J8 centre	J0-27	Rx2–	J8 shield
not used	J0-10	Tx5+	J10 centre	J0-29	Tx5–	J10 shield
	J0-11	Rx5+	J11 centre	J0-30	Rx5–	J11 shield
1/0	J0-13	Tx3+	J13 centre	J0-32	Tx3–	J13 shield
	J0-14	Rx3+	J14 centre	J0-33	Rx3–	J14 shield
not used	J0-16	Tx6+	J16 centre	J0-35	Tx6–	J16 shield
	J0-17	Rx6+	J17 centre	J0-36	Rx6–	J17 shield
Connector J0, pins 3,6,9,12,15,18,19, 22, 25, 28, 31, 34 and 37 are **not used**						

PIX inputs and outputs

PIX outputs

PIX outputs comprise four relay contacts controlled by the alarm board and MCUF. The relays have multiple contacts, some normally open and some normally closed. The contacts are rated for 1 A at 30 V. The contacts may be used for control of external equipment such as fans or audible alarms.

PIX inputs

PIX inputs comprise 16 connections to external sensors. These inputs report alarms to the BSC, via the alarm board and MCUF, which forwards the alarms to the OMC-R. The end-user supplies the external sensors. Each sensor connects across an opto-coupled pair of PIX inputs (eight per PIX connector).

All sensors **must** be dry-contact type with the following specification:

- 5 kohms or greater across sense inputs for logic 1 (PIX opto-coupler **off**).
- 500 ohms or less across sense inputs for logic 0 (PIX opto-coupler **on**).

Table 3-11 shows PIX0 connections and Table 3-12 shows PIX1 connections.

Table 3-11 PIX0 pin connections (37-way D-type)

Pin no.	Signal/Description	Pin no.	Signal/Description
1	Site input Ext 1–1	19	Not connected
2	Site input Ext 2–1	20	Site input Ext 1–2
3	Site input Ext 3–1	21	Site input Ext 2–2
4	Site input Ext 4–1	22	Site input Ext 3–2
5	Site input Ext 5–1	23	Site input Ext 4–2
6	Site input Ext 6–1	24	Site input Ext 5–2
7	Site input Ext 7–1	25	Site input Ext 6–2
8	Site input Ext 8–1	26	Site input Ext 7–2
9	Not connected	27	Site input Ext 8–2
10	Not connected	28	spare
11	Site output relay 1 – NO	29	Site output relay 1 – NC
12	Site output relay 2 – NO	30	Site output relay 1 – COM
13	Site output relay 2 – NC	31	Site output relay 2 – COM
14	Site output relay 3 – NO	32	Site output relay 3 – NC
15	Site output relay 4 – NO	33	Site output relay 3 – COM
16	Site output relay 4 – NC	34	Site output relay 4 – COM
17	Not connected	35	Not connected
18	Not connected	36	Not connected

Pin no.	Signal/Description	Pin no.	Signal/Description
1	Site input Ext 9–1	19	Not connected
2	Site input Ext 10–1	20	Site input Ext 9–2
3	Site input Ext 11–1	21	Site input Ext 10–2
4	Site input Ext 12–1	22	Site input Ext 11–2
5	Site input Ext 13–1	23	Site input Ext 12–2
6	Site input Ext 14–1	24	Site input Ext 13–2
7	Site input Ext 15–1	25	Site input Ext 14–2
8	Site input Ext 16–1	26	Site input Ext 15–2
9	Not connected	27	Site input Ext 16–2
Pins 10 to 18 not connected		Pins 28 to 37 not connected	

Table 3-12 PIX1 pin connections (37-way D-type)

ICS connector

Table 3-13 lists the Integrated Cell Site (ICS) connector pinouts. This is a future feature.

Pin no.	Signal/Description	Pin no.	Signal/Description
1	ICS0 TTY earth	10	ICS3 TTY earth
2	ICS0 TTY Rx	11	ICS3 TTY Rx
3	ICS0 TTY Tx	12	ICS3 TTY Tx
4	ICS1 TTY earth	13	ICS4 TTY earth
5	ICS1 TTY Rx	14	ICS4 TTY Rx
6	ICS1 TTY Tx	15	ICS4 TTY Tx
7	ICS2 TTY earth	16	ICS5 TTY earth
8	ICS2 TTY Rx	17	ICS5 TTY Rx
9	ICS2 TTY Tx	18	ICS5 TTY Tx
Pins 19 to 25 not connected			

Table 3-13 ICS pin connections (25-way D-type)

External alarm connector

This connector is connected to the alarms interface board PL3 by the factory. Table 3-14 lists the external alarms connections. Ten alarms are also shown on the alarm board front panel LEDs.

Table 3-14 External alarms pin connections (37-way D-type)

Pin no.	Signal/Description	Pin no.	Signal/Description
1	Mains AC fail	20	Rectifier return
2	Mains AC return	21	Not connected
3	Not connected	22	Not connected
4	Not connected	23	AUX TMS overtemp
5	TMS 1 failure	24	AUX TMS overtemp return
6	TMS 1 return	25	Door 2 open
7	TMS 2 failure	26	Door 2 return
8	TMS 2 return	27	Optional smoke alarm
9	Not connected	28	Optional smoke alarm return
10	Not connected	29	AUX EQUIP overtemp alarm
11	Not connected	30	AUX EQUIP overtemp return
12	Not connected	31	Not connected
13	Overtemp alarm	32	Not connected
14	Overtemp return	33	Not connected
15	Low voltage alarm	34	Not connected
16	Low voltage return	35	Not connected
17	Not connected	36	CAB overtemp
18	Not connected	37	CAB overtemp return
19	Rectifier fail		

MOTOROLA

Chapter 4

Installing the cable shroud

Chapter 4
Installing the cable shroud i

Introduction to cable shroud installation

Preparing to install the cable shroud

The cable shroud is installed after the BTS cabinet is in position. If the shroud is to be used for cable concealment between two BTS cabinets or a BTS cabinet and an auxiliary equipment housing, 182 mm space must be allowed between templates, (see **Site requirements and considerations** in Chapter 2 of this category). This will ensure the correct spacing between the cabinets for the shroud. A shroud template is provided, with the shroud, as an aid to determine the space required.

Considerations when installing the cable shroud

The cable shroud is normally installed on the right side of the BTS cabinet. It can be installed on the left side of the cabinet, if the cabinet has been fitted with the earth/connector plate mounted on the left side. The cable shroud can also be installed between adjacent BTS cabinets or between a BTS cabinet and an auxiliary equipment housing (AEH).

Only the procedures for attaching the cable shroud to the right side of the cabinet, and between cabinets, are described in this chapter. The procedures for attaching the cable shroud to the left side of the cabinet are the same, but mirrored. The side panels of the shroud can be attached to either side of the shroud frame to allow this.

Cable shroud installation procedures

Attaching the cable shroud frame to the BTS cabinet

The procedure for attaching the cable shroud frame to the right side of the BTS cabinet is as follows (letters in parentheses refer to Figure 4-2):

1. Remove the side panels from the cable shroud frame.
2. Separate the two flanges from the left side of the shroud top panel (see Figure 4-1) and remove one of them.

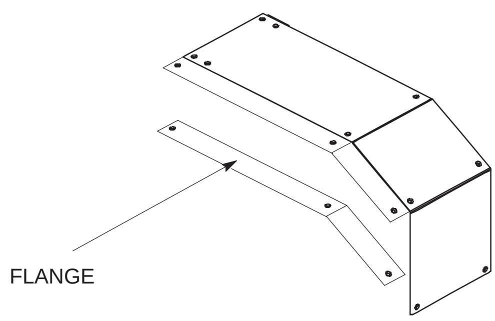


Figure 4-1 Shroud top panel detail showing the left hand flanges

3. Open the lid of the BTS cabinet.
4. Screw three M8 bolts loosely into the holes indicated by the arrows STEP (4) in (A).
5. Slide the rear panel of the shroud onto the rear two bolts and then screw two M8 bolts into the holes indicated by the arrows STEP (5) in (B). Tighten all four bolts.
6. Slide the shroud front panel onto the previously installed bolt and then screw two M8 bolts into the holes indicated by the arrows for STEP (6) in (C). Tighten all four bolts.
7. Mount the shroud top cover (flanges already fitted) in place and secure to the cabinet side by inserting an M8 bolt in the position indicated STEP (7) in (C).
8. Secure the top cover to the shroud rear panel by tightening the two anti-tamper screws indicated by the arrows STEP (8) in (D).
9. Secure the top cover to the shroud front panel by tightening the two anti-tamper screws indicated by the arrows STEP (9) in (D).

The procedure for attaching the cable shroud frame is now complete. The procedures for attaching the shroud side panels are described later in this chapter and vary according to the method of cable entry required.

Figure 4-2 Shows the fitting of a cable shroud frame to a cabinet.

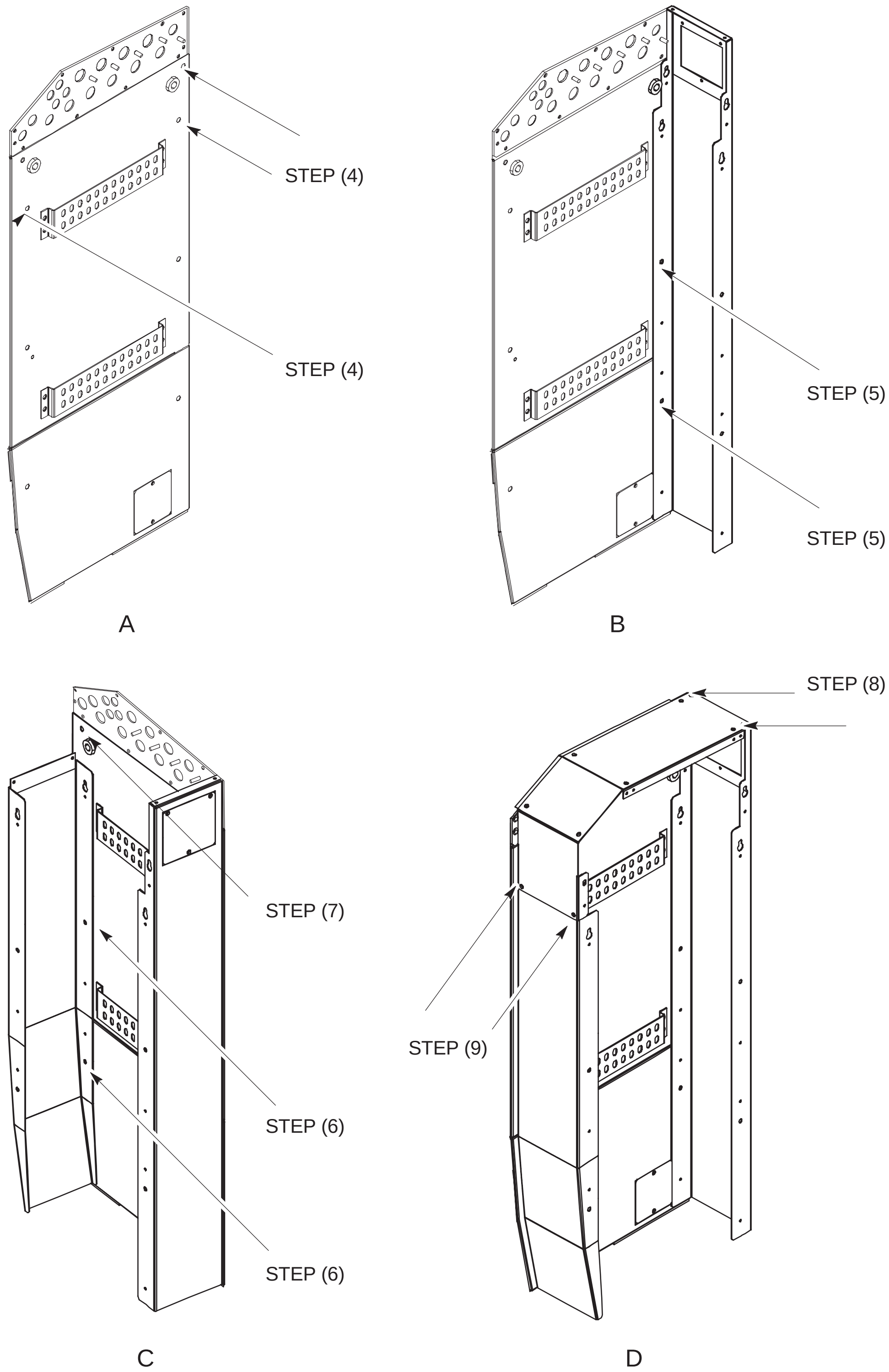


Figure 4-2 Fixing the cable shroud frame to the left side of the cabinet

Adapting the shroud for cable entry from below ground

If cable entry to the cabinet is from below ground, connect the cables to the cabinet earthing plate and fit the three side panels to the shroud frame using anti-tamper screws, as shown in Figure 4-3.

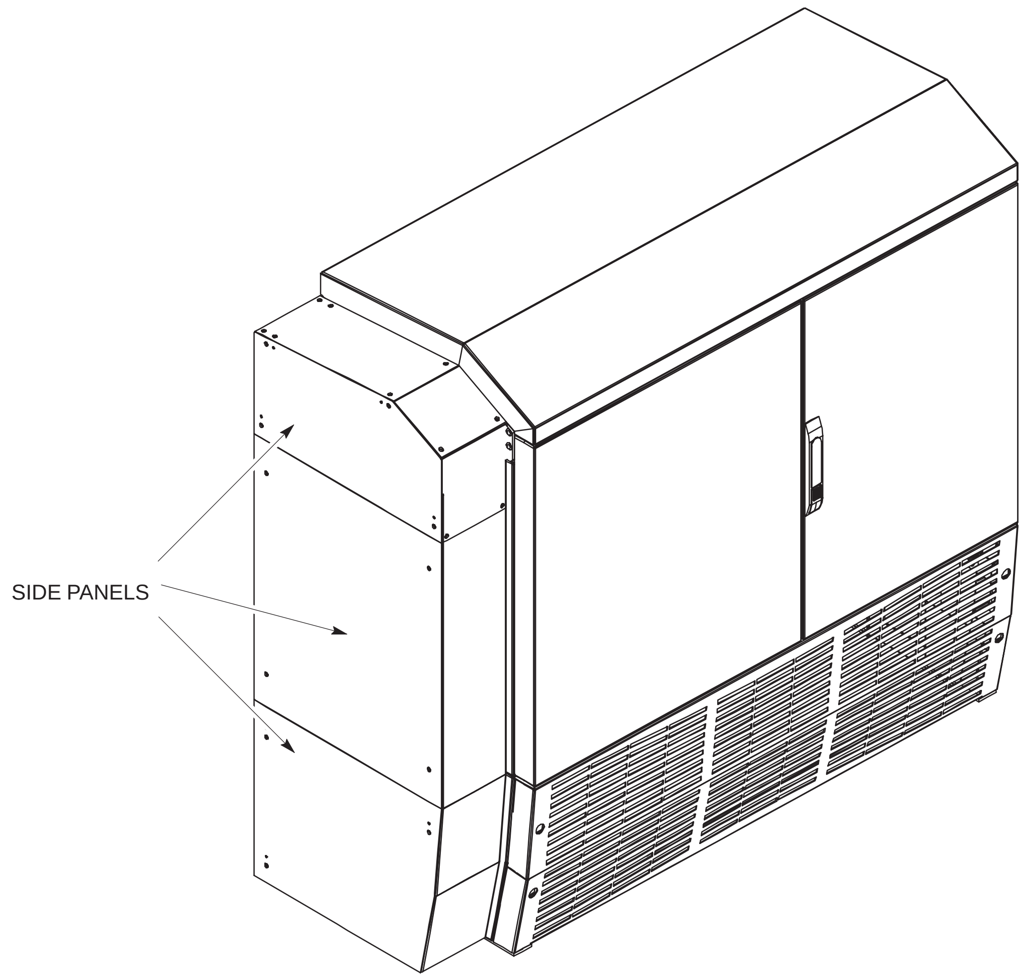


Figure 4-3 Cable shroud adapted for cable entry from below ground

Adapting the shroud for cable entry from ground level

If cable entry to the cabinet is from ground level, connect the cables to the cabinet earthing plate and fit the two side panels to the shroud frame using anti-tamper screws, as shown in Figure 4-4.

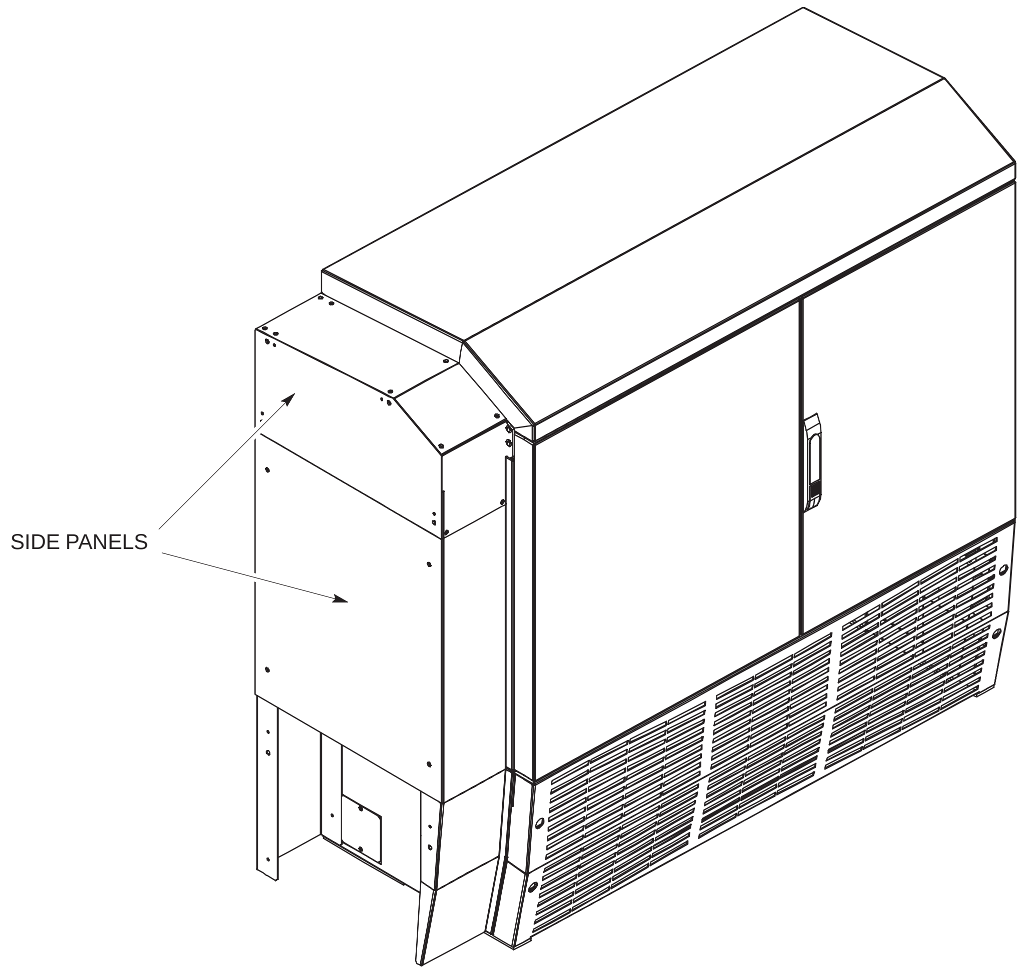


Figure 4-4 Cable shroud adapted for cable entry from ground level

Adapting the shroud for high level cable entry

If high level cable entry to the cabinet is required, connect the cables to the cabinet earthing plate and fit the side panel to the shroud frame using anti-tamper screws, as shown in Figure 4-5.

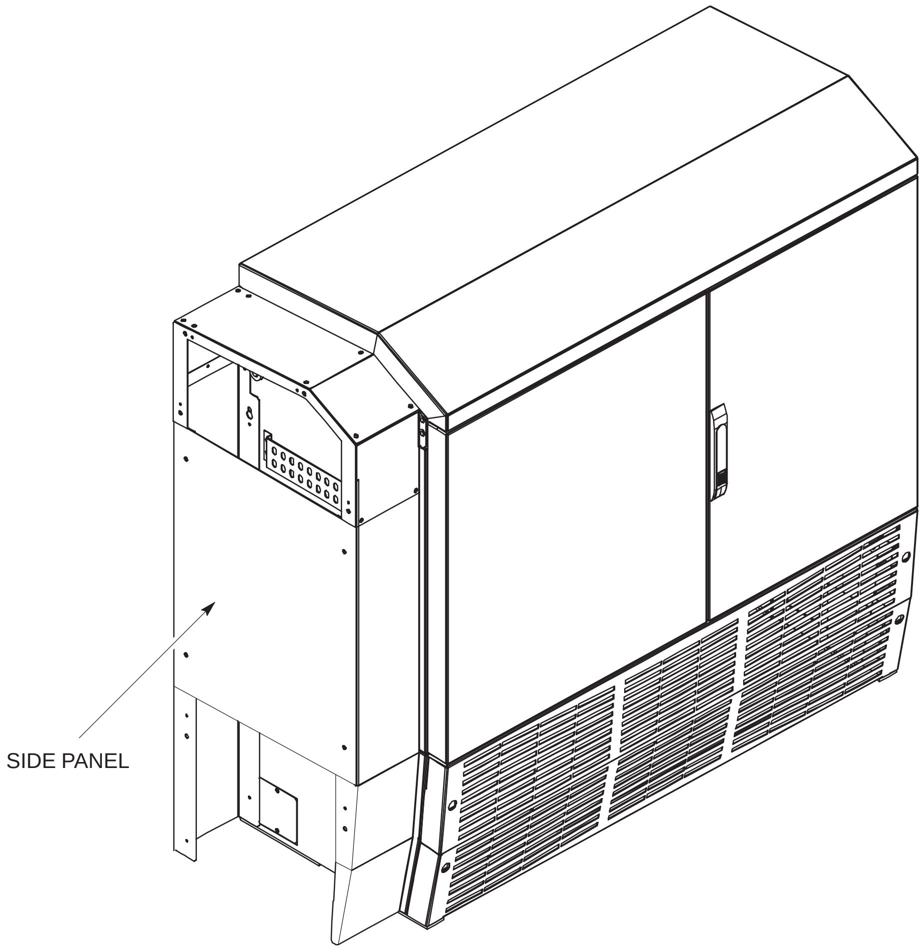


Figure 4-5 Cable shroud adapted for high level cable entry

Installation between cabinets (or the AEH)

This procedure must be carried out after the first cabinet has been bolted in position and before any additional cabinet or auxiliary equipment housing (AEH) is bolted down. Use the shroud template as an aid to determine spacing.

NOTE	The procedure for installing the shroud between two BTS cabinets or two auxiliary equipment housings is basically the same and is described below.

To install the cable shroud between adjacent cabinets or between a cabinet and the auxiliary equipment housing, proceed as follows:

1. Open the lids on both cabinets.
2. Remove the two cabinet end plates from the cabinet sides facing each other and replace with expansion plates, (see **Connecting antennas** in Chapter 3 of this category).
3. Attach the rear panel of the shroud to the first cabinet and then attach the front panel, as described previously in **Procedure for attaching the cable shroud frame to the BTS cabinet**.
4. Prior to manoeuvring a second BTS cabinet or AEH into final position:
   – Remove the expansion plate pass through blanks, as required.
   – Undo the two hose clips securing each RF cable gland housing and remove gland assembly, (if RF connection required).
   – Feed any dc power cables through the expansion plates.
5. Adjust the position of the second cabinet or AEH, if necessary, so that its side is flush against the sides of the shroud and the bolt holes identified in Figure 4-2 and Figure 4-6 are aligned. Bolt the rear and front panels of the shroud to the side of the housing through these holes.
6. Make the dc power, fibre optic and signal connections between the two cabinets, (see Figure 4-8 for routeing), and then bolt the cabinet or AEH to the floor.
7. Make any RF connections, appropriate to the site configuration (see Figure 4-8 for routeing and **Suggested RF configurations**), between the cabinets. Remove the required number of blanking plugs and fit both multi-cable glands over the RF cables.
8. Fit rubber housing around left cable gland and insert into left side expansion plate, as shown in Figure 4-7 secure with two hose clips. Repeat for right side gland.
9. Slide the shroud top cover in place and secure to the rear panel and front panel by tightening the four anti-tamper screws, as described previously in **Procedure for attaching the cable shroud frame to the BTS cabinet**.

The procedure for installing the cable shroud between cabinets and/or the auxiliary equipment housing is now complete.

Shroud attachment points

Figure 4-6 shows the shroud attachment points on the auxiliary equipment housing.

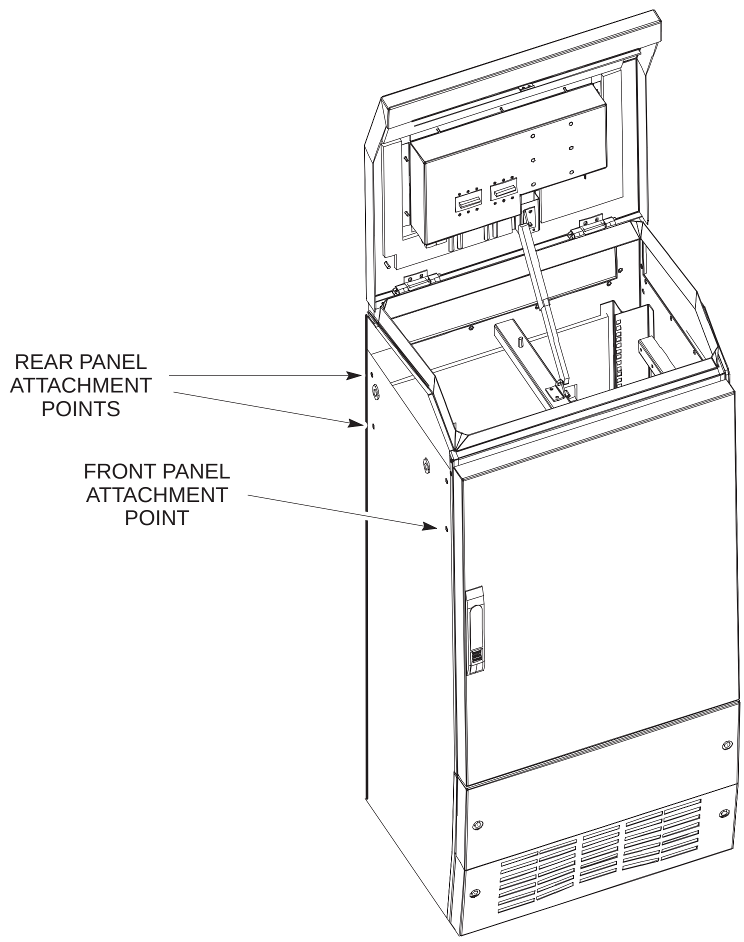


Figure 4-6 Shroud attachment points on the auxiliary equipment housing

Cabinet expansion

Figure 4-7 shows the BTS cabinet expansion plate and two views showing the recommended installation configurations.

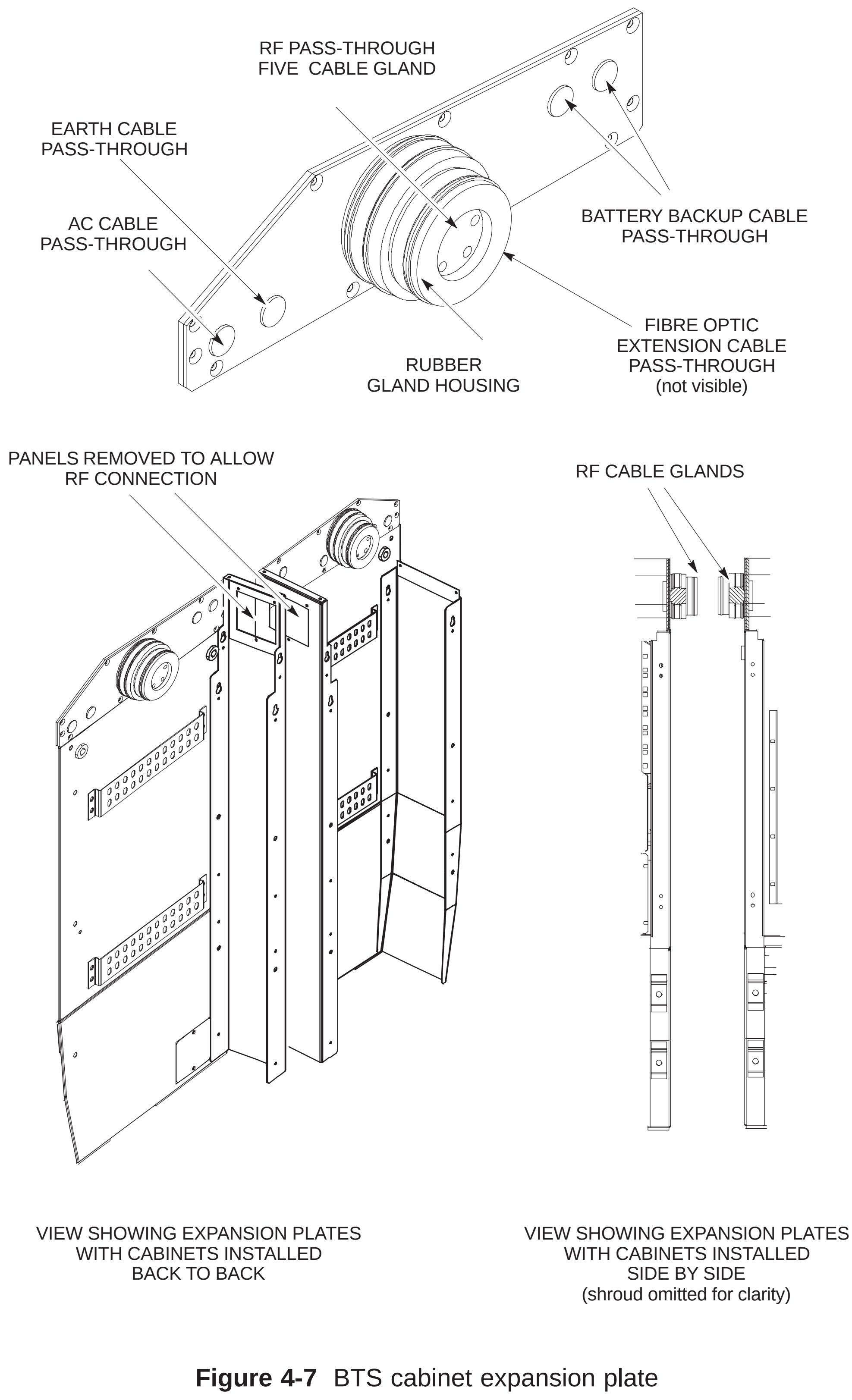


Figure 4-7 BTS cabinet expansion plate

Cable routeing for multiple cabinet sites

Figure 4-8 shows a representation of the RF interconnection cable routeing through the cabinets for multiple cabinet sites. FIbre optic interconnections follow similar routeing. Cable routeing for more complex layouts may be derived from these basic diagrams.

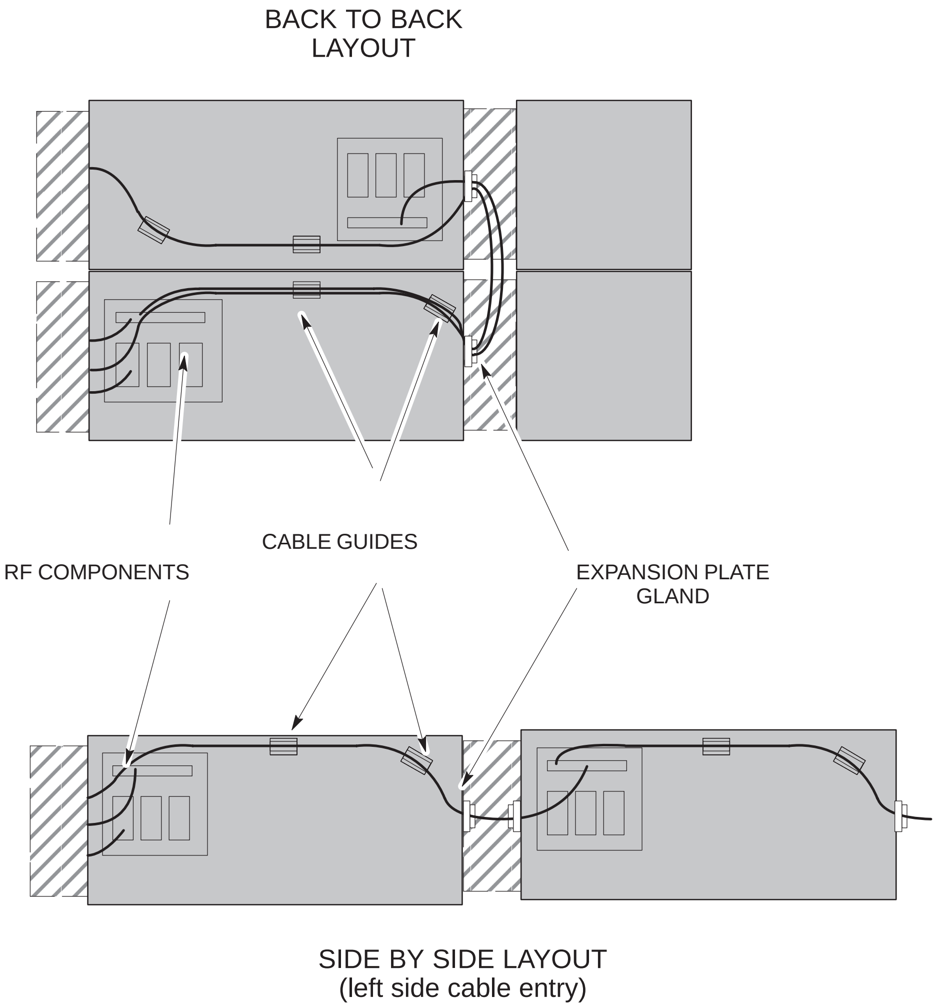


Figure 4-8 Guide to cable routeing through multiple cabinets

Chapter 5

Installing the auxiliary equipment housing

Chapter 5
Installing the auxiliary equipment housing i

Procedures for installing the auxiliary equipment housing

Assumptions regarding site preparation

The information contained in this chapter assumes that the site and the foundation for the auxiliary equipment housing has been prepared in a similar manner to that for the Horizon*macro* outdoor cabinet, as described in Chapter 2 of this category.

Most of the information contained in Chapter 3 regarding equipment delivery, weather conditions affecting unpacking/installation and safety considerations is also applicable to the auxiliary equipment housing.

Layout of the auxiliary equipment housing

Figure 5-1 shows the layout of the auxiliary equipment housing.

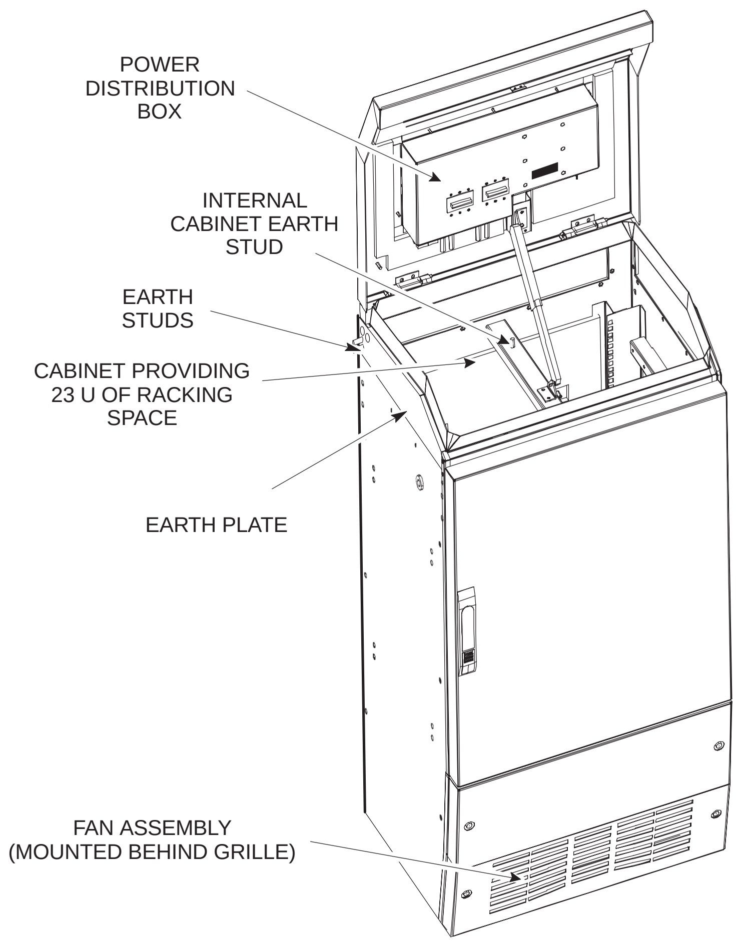


Figure 5-1 The auxiliary equipment housing

Auxiliary equipment housing packaging

The design of the packaging for the auxiliary equipment housing is similar to that used for the BTS cabinet. The main difference is that the box is not wrapped, but is of the “all in one” type and goes over the auxiliary equipment housing.

Introduction to installing the auxiliary equipment housing

The auxiliary equipment housing can be installed on either side of the BTS cabinet, normally on the opposite side to the antenna cable entry.

The auxiliary equipment cabinet is supplied with an alloy template (shown in Figure 5-2), included in the packaging. The template is installed before the cabinet to show the locations of the cabinet mounting bolt anchors. There is no need to remove the template after installation of the expanding bolt anchors.

NOTE	Ensure the template is installed on the correct side of the BTS cabinet. If a cable shroud is to be fitted between the BTS cabinet and the auxiliary equipment housing, its mounting template must be placed on the ground between the BTS cabinet and the auxiliary equipment housing template to ensure that the spacing between the two cabinets is correct. The shroud should be secured to the BTS cabinet before the auxiliary equipment housing is fixed in position.

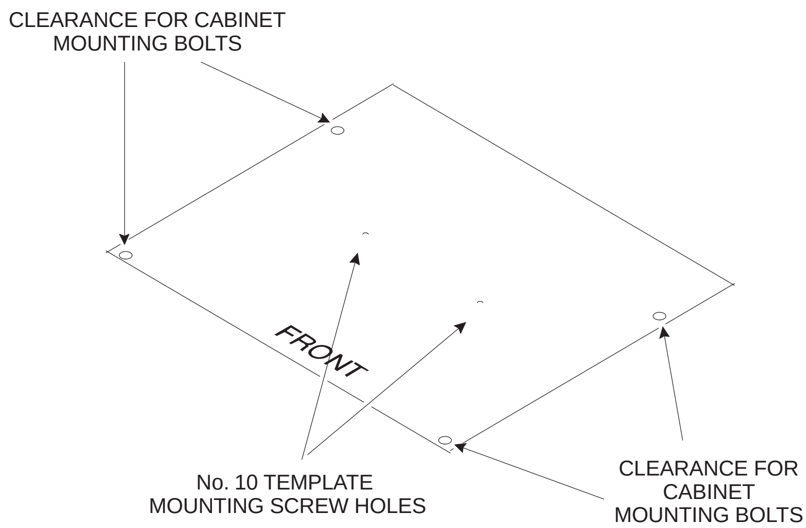


Figure 5-2 Auxiliary equipment housing template

Installing the auxiliary equipment housing template

The template (shown in Figure 5-2) must be secured to the concrete floor before drilling the holes for the M12 anchor bolts.

1. If required, place the cable shroud template on the ground against the appropriate side of the BTS cabinet, so it will act as a spacer between the BTS cabinet and the auxiliary equipment housing.
2. Move the auxiliary equipment cabinet template to the selected mounting position, flush against the cable shroud template.
3. Mark the positions of the two template mounting screw holes in the template.

WARNING	Wear safety glasses and a dust mask when drilling holes.

CAUTION	Drilling concrete flooring produces cement dust, which is harmful to equipment and wiring. Protect the cabinet and any nearby equipment from dust. Use a tarpaulin, cloth, or plastic sheeting to cover exposed equipment. Clean up any accumulated debris from the anchor installation carefully before uncovering the equipment. Use drilling equipment suitable for cutting steel reinforced concrete.

4. Drill out the two holes to a depth and clearance for No. 10 screws.
5. Fit plastic expanding plugs into the mounting holes.
6. Position the template over the mounting holes and secure using No. 10 screws.
7. When satisfied that the template is correctly installed, carry out procedure for installing the cabinet anchor bolts.

Installing auxiliary equipment housing bolt anchors

The concrete floor must be drilled to accept the M12 anchor bolts. Washers, bushes and M12 steel bolts must be supplied by the customer.

The recommended length of the M12 steel anchor bolts is 105 mm minimum.

WARNING	Wear safety glasses and a dust mask when drilling holes.

CAUTION	Drilling concrete flooring produces cement dust, which is harmful to equipment and wiring. Protect the cabinets and any nearby equipment from dust. Use a tarpaulin, cloth, or plastic sheeting to cover exposed equipment. Clean up any accumulated debris from the anchor installation carefully before exposing the equipment. Use drilling equipment suitable for cutting steel reinforced concrete.

1. Using the four holes in the template as a guide, drill the concrete floor to a depth and clearance for the M12 anchor bolts.
2. Fit the M12 mounting anchors to the holes in the floor.
3. Fit the anchor bolts with the supplied bushes and washers, through the template, to each anchor.
4. Tension up the anchor bolts to expand the anchors.
5. Remove and retain the M12 bolts and washers for later use.

Bolting the auxiliary equipment housing to the floor

WARNING	An unequipped auxiliary equipment housing weighs 110 kg. Observe proper lifting precautions and handle the cabinet with extreme caution to avoid tipping. The auxiliary equipment housing must be lifted by fitting eyebolts to the sides of the cabinet. Refer to **Safety considerations** in **Unpacking and preparing the cabinet** for information about eyebolt selection and use.

1. Manoeuvre the empty auxiliary equipment housing onto the template, but do not bolt in position yet.
2. Remove each of the eyebolts from their threaded holes and return the eyebolts to the tool kit for future use.
3. Open the housing lid and install the dc power and alarm signal cables between the BTS cabinet and the auxiliary equipment housing.

NOTE	The auxiliary equipment cabinet can be secured to the cable shroud, if one is used. Refer to Chapter 4 of this category for information regarding the installation of a cable shroud between a BTS cabinet and the auxiliary equipment housing. The cable shroud and dc power cable must be installed before the housing is bolted to the floor.

4. Disconnect the power cable to the fan and remove the front panel containing the fan assembly. Also remove all the battery trays.
5. Line up the fixing holes in the bottom of the housing with the previously installed anchors.
6. Place a flat washer onto each M12 mounting bolt and fit the four mounting bolts loosely. Do not tighten yet.
7. Using a spirit level, verify that the auxiliary equipment housing is level.
8. Tighten up the mounting bolts to the correct torque, (see **Site requirements and considerations** in Chapter 2 of this category).
9. Refit the bottom front panel, previously retained.

Installing batteries in the auxiliary equipment housing

Introduction to battery installation

The auxiliary equipment housing can be fitted with two banks of eight 6 V batteries, mounted on four battery trays. Each bank is wired together in series to provide –48 V dc backup power for the Horizon*macro* outdoor cabinet. The two banks can be wired in parallel, to provide increased backup duration for a single BTS cabinet, or fed separately to two BTS cabinets.

NOTE	Batteries must be fully charged and load tested before installation.

Figure 5-3 shows a typical battery arrangement in the auxiliary equipment housing when a full complement of 16 batteries is installed.

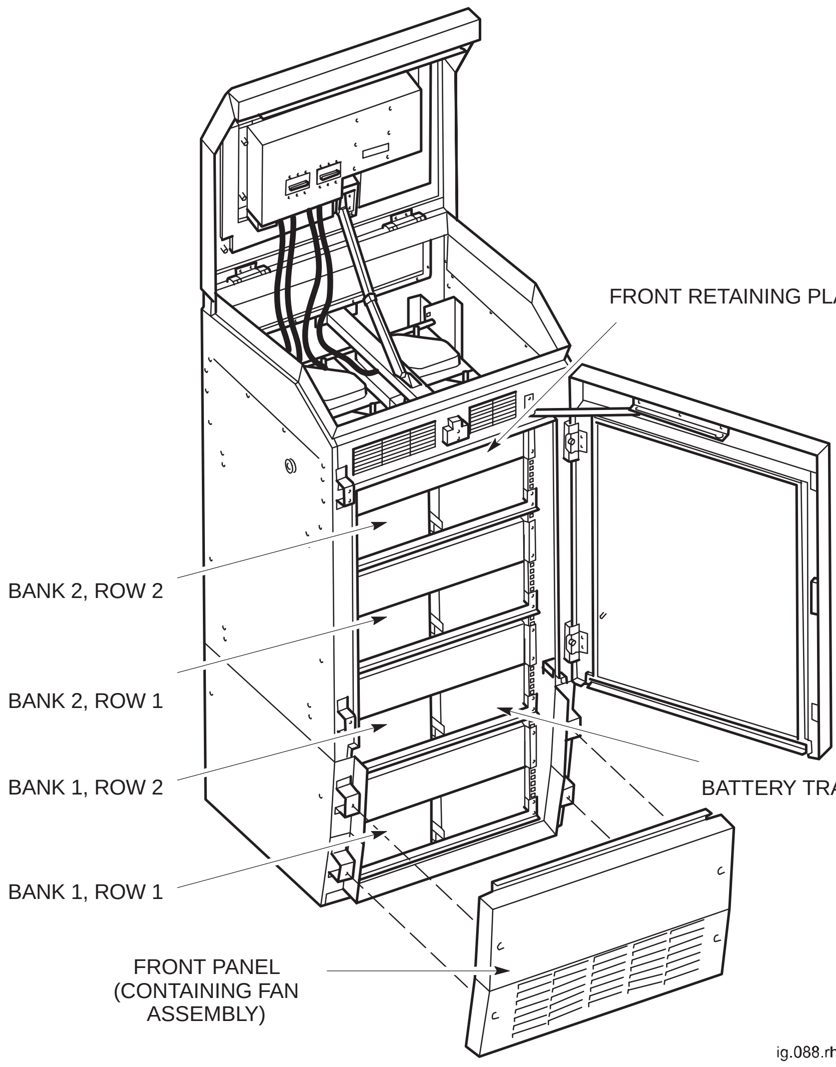


Figure 5-3 Battery arrangement in the auxiliary equipment housing

Installing batteries

NOTE	Battery trays, retaining plates and leads are supplied with the auxiliary equipment housing (AEH). Batteries are not supplied with the AEH. They must be obtained separately by the customer. Motorola recommend the use of Yuasa or Hawker 6 V batteries (kit number SVPN1216 contains eight batteries).

WARNING	The batteries are capable of supplying high short circuit currents and as such provides a high energy hazard.

To install batteries in the auxiliary equipment housing:

1. Ensure that batteries to be installed are fully charged and load tested in accordance with battery manufacturers handbook.
2. Remove the front panel from the housing by undoing the six retaining screws and disconnecting the cable to the fan assembly (contained within the front panel).
3. Disconnect the heater mat power connectors at each tray and remove the upper three battery trays in the auxiliary equipment housing (if not already removed).
4. Install the four batteries onto the bottom tray in the cabinet so that the positive and negative terminals match the arrangement shown in Figure 5-4.
5. Connect the leads to the terminals as shown in Figure 5-5 and then fit the front retaining plate.
6. Install the battery tray for row 2 in the auxiliary equipment housing, reconnecting the heater mat power connector at the tray.
7. Install the four batteries onto the row 2 tray so that the positive and negative terminals match the arrangement shown in Figure 5-6.
8. Connect the leads from the batteries in row 1 to the terminals of the batteries in row 2 as shown in Figure 5-7. Fit the front retaining plate.
9. Connect the black cable from the power distribution box on the lid to the positive terminal on the left rear battery in row 2.
10. Connect the blue cable from the power distribution box on the lid to the negative terminal on the right rear battery in row 2.

Repeat steps 3 to 9 of the above procedure if a second bank of batteries is to be installed in the housing above the first bank.

Figure 5-4 show a plan view of the batteries in row 1.

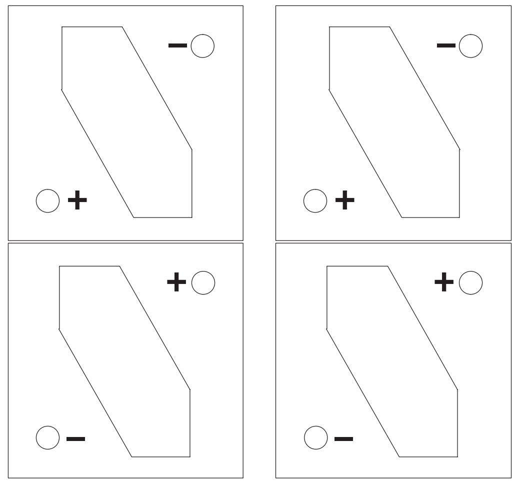


Figure 5-4 Layout for batteries in row 1

Figure 5-5 shows the battery and cable arrangement in row 1.

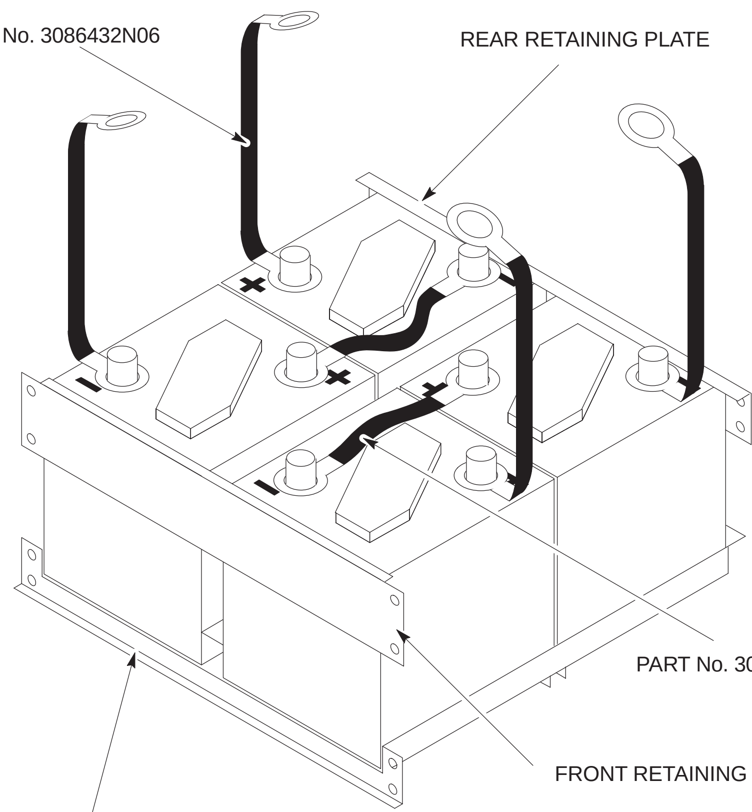


Figure 5-5 Battery arrangement in row 1 with cables attached

Figure 5-6 show a plan view of the batteries in row 2.

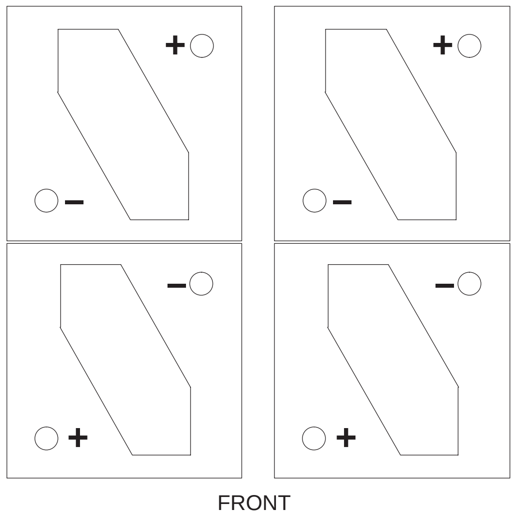


Figure 5-6 Layout for batteries in row 2

Figure 5-7 shows the battery and cable arrangement in row 1.

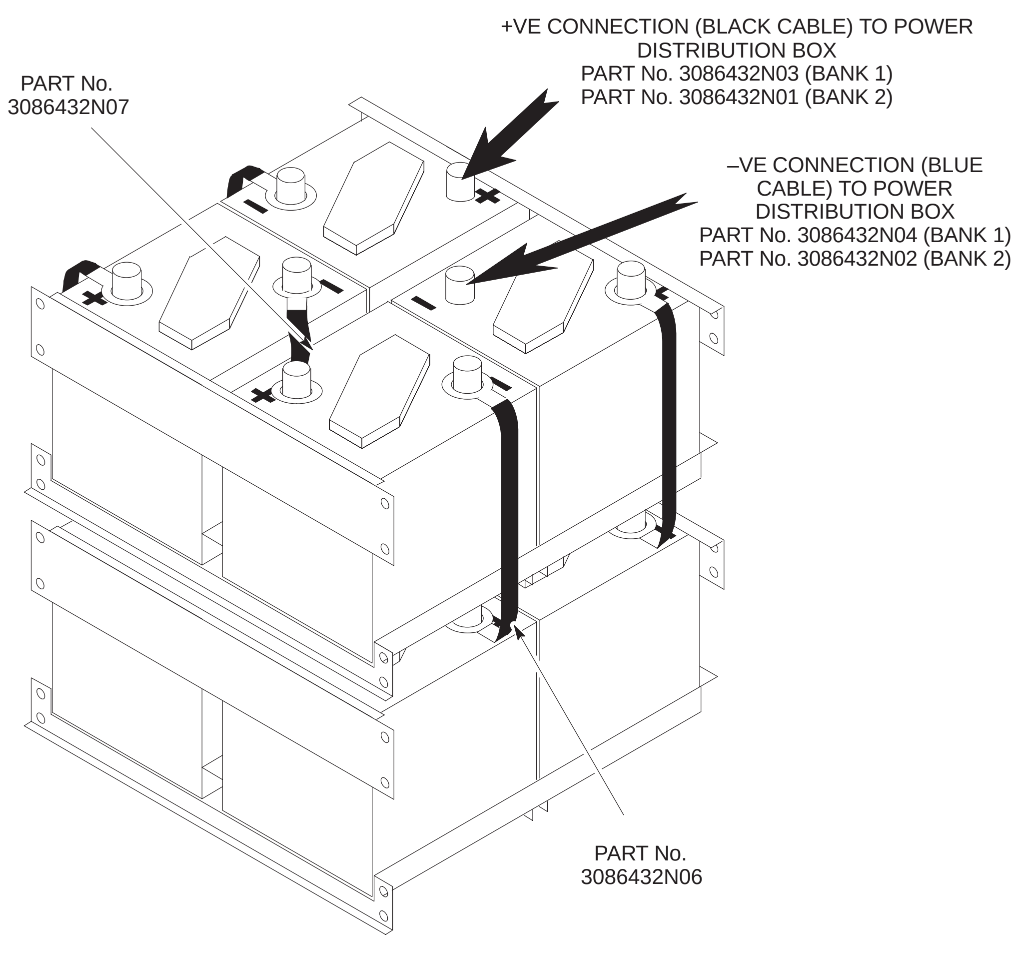


Figure 5-7 Battery arrangement in row 2 with cables attached

Auxiliary equipment housing (AEH) connections

Earthing the AEH

WARNING	Do not daisy chain cabinet earths together. Do not make ac input power connections at the main power source at this time. **Connecting input power** is the final installation procedure, carried out as part of commissioning in Chapter 6 of this category. Cabinets must be earthed with a conductor capable of carrying the full fault current of the overcurrent protection device.

To earth the AEH:

WARNING	The AEH centre cross beam earth stud is connected to the right side earth plate when supplied. The AEH can be earthed at either side, however, if left side AEH earth plate is to be connected to site earth, centre cross beam earth stud **must** be disconnected from right side and reconnected to left side AEH earth plate.

1. Connect the earth plate stud to the site earth using a 35 mm^2 cross-sectional area, green and yellow sheathed, stranded conductor.
2. Ensure the earth stud on the cabinet centre cross beam is connected to the AEH earth plate that is to be connected to the site earth, or to the BTS cabinet earth plate, through the expansion plate.

Connecting dc cables to the AEH

CAUTION	When using external batteries, the Horizon*macro* outdoor BTS cabinet internal batteries must be switch isolated to ensure correct operation of the temperature-compensated battery charging system.

The auxiliary equipment cabinet requires –48 V dc connections to operate. The dc cables come from the Anderson connectors on the dc interface panel in the BTS cabinet. The dc cables from the BTS cabinet connect to the rear pair of Anderson connectors at the base of the power distribution box.

The supply to the auxiliary equipment housing can be isolated using the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet.

Battery power from the auxiliary equipment housing to the main cabinet can be isolated using the circuit breakers on the front of the power distribution box.

The front pair of Anderson connectors on the power distribution box can be used to connect either a second BTS cabinet, (refer to **Configuring battery backup** in this chapter), or an additional auxiliary equipment housing, thus connecting the batteries in parallel to provide extra battery capacity, further increasing backup duration..

Connecting the alarm signal cables

The alarm signal cable from the alarms interface board in the main BTS cabinet plugs into the connector PL1 on the front right of the power distribution box. PL2 is for connection to the alarms interface board of a second BTS cabinet, and PL3 is to allow connection of a second AEH The cables are labelled for identification. PL1, PL2 and PL3 are accessed through an opening in the front face of the power distribution box.

Internal connections in the AEH

Six additional flying leads are connected to the power distribution box:

- One provides power to the fan.
- Four provide power to the heater mats
- One connects to the door microswitch.

All leads are labelled clearly for identification.

Configuring battery backup to supply two BTS cabinets

Introduction to configuring battery backup

The circuit breakers in the power distribution box are linked in parallel when supplied. The links must be removed if two BTS cabinets are to be connected to one auxiliary equipment housing.

The power distribution box must be removed to gain access to the parallelling links and refitted after the links have been removed.

Removing the power distribution box

The procedure for removing the power distribution box from the auxiliary equipment housing is as follows:

WARNING	The batteries are capable of supplying high short circuit currents and as such provides a high energy hazard. Isolate the auxiliary equipment housing from the main cabinet by switching off the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet before commencing work.

1. Open the cabinet door, release the lid latch and raise the lid.
2. Switch off the circuit breakers on the front of the power distribution box and then disconnect the dc input cables, (if fitted), from the Anderson connectors on the left side of the power distribution box.
3. Unplug the alarm signal cables from PL1, PL2 and PL3 on the front of the power distribution box.
4. Disconnect the two cables which connect the top bank of batteries (bank 2, row 2) to the power distribution box and tie the cables safely out of the way. Undo the battery terminal connections between bank 2, row 2 and bank 2, row 1 and then remove the row 2 battery tray, followed by the row 1 battery tray.
5. Disconnect the two cables which connect battery bank 1, row 2 to the power distribution box and tie the cables safely out of the way.
6. Undo the eight M4 nuts which secure the power distribution box to the lid and then remove the box.
7. Unplug the door microswitch alarm cable from the external alarm interface board.
8. Unplug the power cables for the heater mats and the fan from the external alarm interface board.

The parallelling links can now be removed.

Interior view of power distribution box

Figure 5-8 shows the interior of the power distribution box, with the components for battery backup configuration identified.

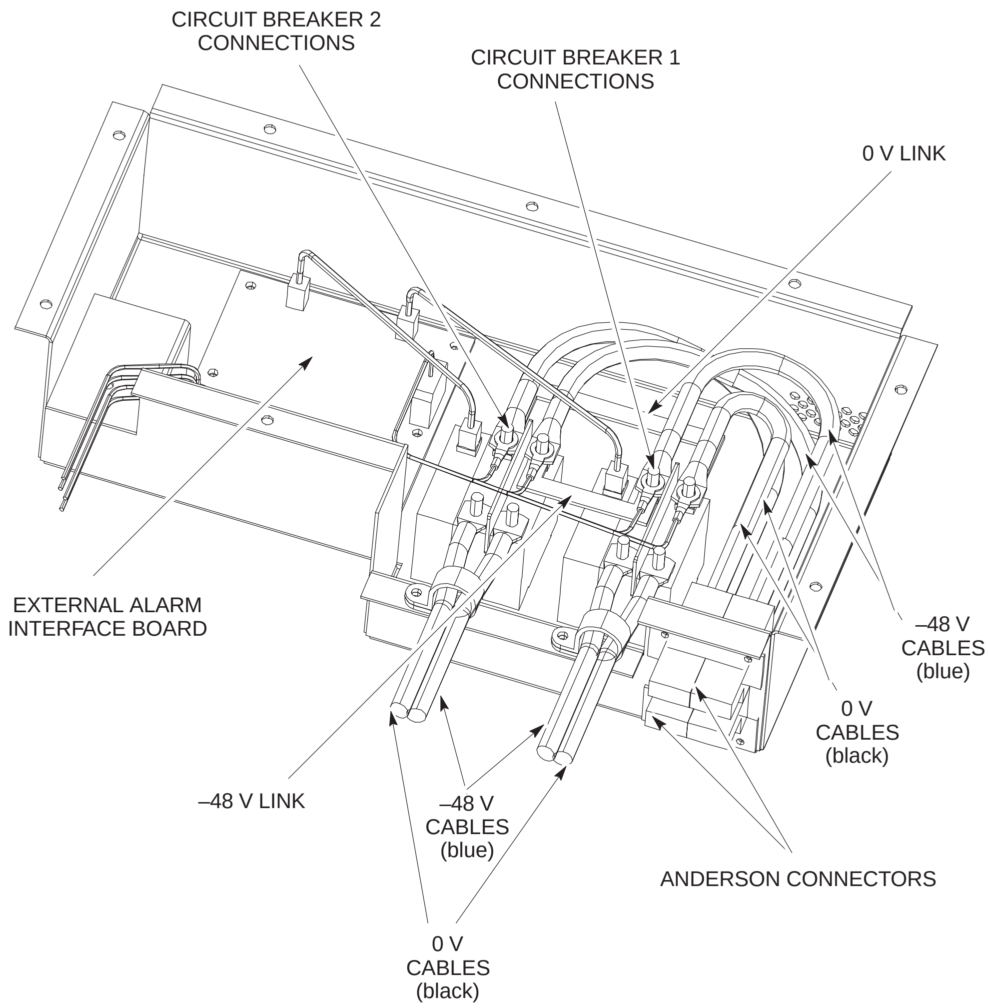


Figure 5-8 Interior of power distribution box

Removing the parallelling links

To remove the parallelling links refer to Figure 5-8 and:

1. Ensure the power distribution box is disconnected from the –48 V dc supply and the batteries.
2. Remove the four M6 nuts, plain washers and star washers, securing the cables from the Anderson connectors to the circuit breakers, and retain.
3. Note the location and insulation colour of the four ring terminals connected to the external alarm interface board, and remove from the circuit breaker studs.
4. Remove the four terminals connecting the Anderson connectors to the circuit breakers, noting the position of each terminal.
5. Remove the 0 volt link and the –48 volt link from the circuit breakers.
6. Refit the black 0 volt and the blue –48 volt cable terminals to the outer stud on each circuit breaker, in the position previously noted in step 4.
7. Refit the four ring terminals from the external alarms interface board to the circuit breakers, in the locations noted in step 3.
8. Ensure that the insulation colour of all refitted cables is correctly matched.
9. Refit the four M6 star washers, plain washers and nuts, and tighten to the correct torque, (see **Site requirements and considerations** in Chapter 2 of this category).

The power distribution box can now be refitted.

Refitting the power distribution box

The procedure for refitting the power distribution box is as follows:

1. Connect the power cables for the heater mats and the fan to the external alarm interface board.
2. Connect the alarm cables for the door microswitch to the external alarm interface board.
3. Mount the power distribution box onto the underside of the lid and secure in position using the M4 nuts.
4. Connect the longer pair of battery cables from the power distribution box to their terminals on battery bank 1, row 2. The blue cable connects to negative and the black cable connects to positive.
5. Install the bank 2, row 1 battery tray, followed by the bank 2, row 2 battery tray and then remake the terminal connections between the two rows (refer to *Installation and Configuration: (GSM-204-423)* **Installing batteries in the auxiliary equipment housing** if necessary. Connect the remaining pair of battery cables to the positive and negative terminals on the top bank of batteries.
6. Connect the alarm signal cables to PL1, PL2 and PL3 on the front of the power distribution box.
7. Connect the dc power cables from one BTS cabinet to the rear pair of Anderson connectors on the power distribution box. Connect the dc power cables from the second BTS cabinet to the front pair of Anderson connectors.
8. Switch on the circuit breakers on the front of the power distribution box and then close the lid and the cabinet door.
9. Switch on the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet.

The procedures for configuring the battery backup to supply two BTS cabinets are now complete.

MOTOROLA

Chapter 6

Interoperability between different Motorola BTSs

Introduction to interoperability

Mixed product sites

This chapter describes how the Horizon*macro* 6 carrier outdoor can be used in conjunction with other Motorola BTS products.

Different Motorola product types can be collocated at the same physical site without restriction, provided they are configured as logically separate installations, and in accordance with the normal product engineering rules.

When mixed product types are installed at the same logical site, a number of technical issues arise that restrict the hardware that can be configured, and the way it is interfaced. This chapter explains which product types can be mixed in this way, and how they are interfaced.

NOTE	This chapter only applies to the Horizon*macro* GSM/ EGSM900 and DCS1800 BTS variants. GSM850 and PCS1900 Horizon*macro* BTS variants cannot be mixed with other Motorola BTS types.

Architectural constraints

To enable different product types to be used at the same logical site, one product type is chosen as master, which is connected to the extender equipment so that the two product types can function as a single, logical BTS. This approach is viable when the product types to be interfaced have similar architectures.

Motorola BTS product types that can be interfaced for collocation at a single logical site are therefore restricted to those shown in Table 6-1 below.

Table 6-1 BTS compatibility for collocation at a single logical site

Master	**Extender**			
	InCell	M-Cell*2*	M-Cell*6*	Horizon*macro*
InCell	Discontinued	No	No	No
M-Cell*2*	No	Yes*	Yes*	No
M-Cell*6*	No	No	Yes*	Yes
Horizon*macro*	No	No	Yes*	Yes

* Check for availability before ordering

Indoor and outdoor cabinets can be mixed, but different mechanical arrangements may be required for routeing the inter-cabinet cabling.

BTS architectures and interoperability

M-Cell*6* and Horizon*macro* architectures

Figure 6-1 represents the high level architecture of the M-Cell*6* and Horizon*macro* BTSs. Both systems provide an optical interface for connection to remote transceivers, which in a normal installation would be used to connect to transceivers of the same product type.

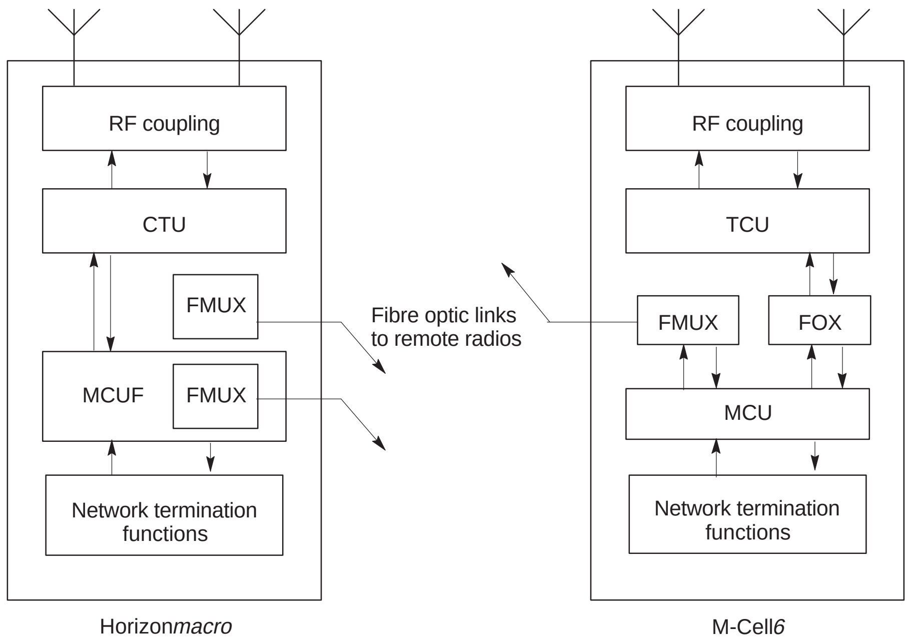


Figure 6-1 High level architecture of M-Cell*6* and Horizon*macro* BTSs

However, since the optical interface is identical for both products, it can be used to link an M-Cell*6* to Horizon*macro* transceivers, or a Horizon*macro* to M-Cell*6* transceivers. The principle is shown in Figure 6-2.

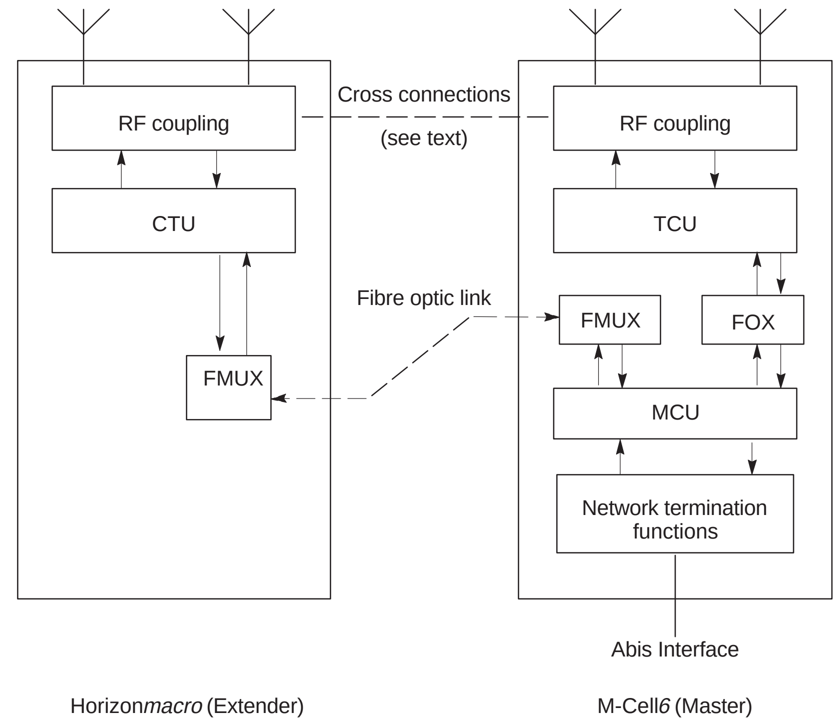


Figure 6-2 Example of interfacing different products at a single logical site

When two product types are interfaced in this way, the control function for the entire BTS is implemented by the master product. In Figure 6-2, this is the M-Cell*6*. In practice, either BTS can be configured as master according to the needs of the network concerned.

Example mixed site

A multi-cabinet mixed site can typically be achieved in several ways. Figure 6-3 shows the alternatives layouts for a four cabinet mixed BTS site.

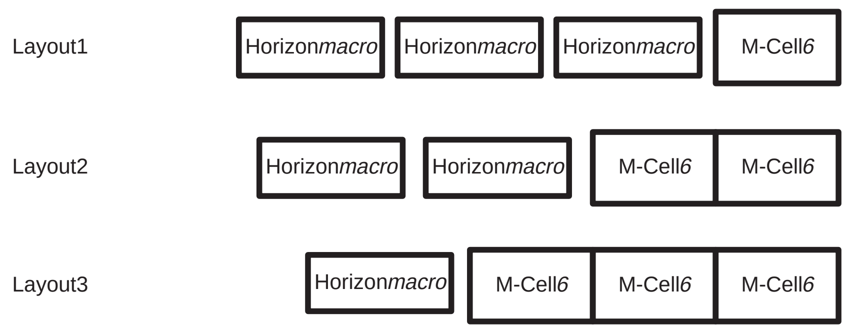


Figure 6-3 Example of alternative layouts for a 4-cabinet mixed BTS site

Technical issues

When mixing different BTS types, the interface may be required to resolve some or all of the following issues, depending on the site configuration:

- The interface must deliver both Rx and Rx_{div} (receive diversity) signals to each transceiver.
- The interface must not change the uplink (receive) signal level delivered to any transceiver.
- The interface must ensure that in the mixed BTS configuration, RF combiners remain correctly loaded.

Receive path

When a cell is wholly configured within one cabinet, there is no requirement to connect the uplink or downlink RF signals between the master and extender cabinets. The only interface between the cabinets in this type of mixed BTS configuration is therefore at digital level, between FMUXs via the fibre optic link.

When a cell is split between two cabinets, the uplink signals must be connected between the cabinets since both Rx and Rx_{div} signals are required at each transceiver. In this situation the downlink signal may or may not require connection between cabinets, depending on the site configuration. The uplink connectivity requirements are shown in Figure 6-4 (DCS1800) and Figure 6-5 (GSM900).

DCS1800

Refer to Figure 6-4. In the Horizon*macro* cabinet, low noise amplification in the SURF module first boosts the Rx signal by +13 dB. Separate Rx outputs from the SURF are then discretely routed to relevant transceivers in the master cabinet, and to the LNA in the extender cabinet. Since the LNA boosts the Rx signal by a further +13 dB, a 13 dB attenuator is placed in the signal path to offset this additional signal gain, which would otherwise result in signal levels outside the permitted range for the transceivers.

The Rx_{div} signal is similarly given a +13 dB boost by the LNA in the extender cabinet. Separate Rx_{div} outputs from the LNA are then discretely routed to relevant receivers in the extender cabinet, and to the SURF module in the master cabinet. Since the SURF provides a further +13 dB boost, a 13 dB attenuator is again placed in the signal path to offset this additional gain.

In this way, the arrangement shown in Figure 6-4 delivers Rx and Rx_{div} signals to the uplink path in both cabinets, at the required signal level.

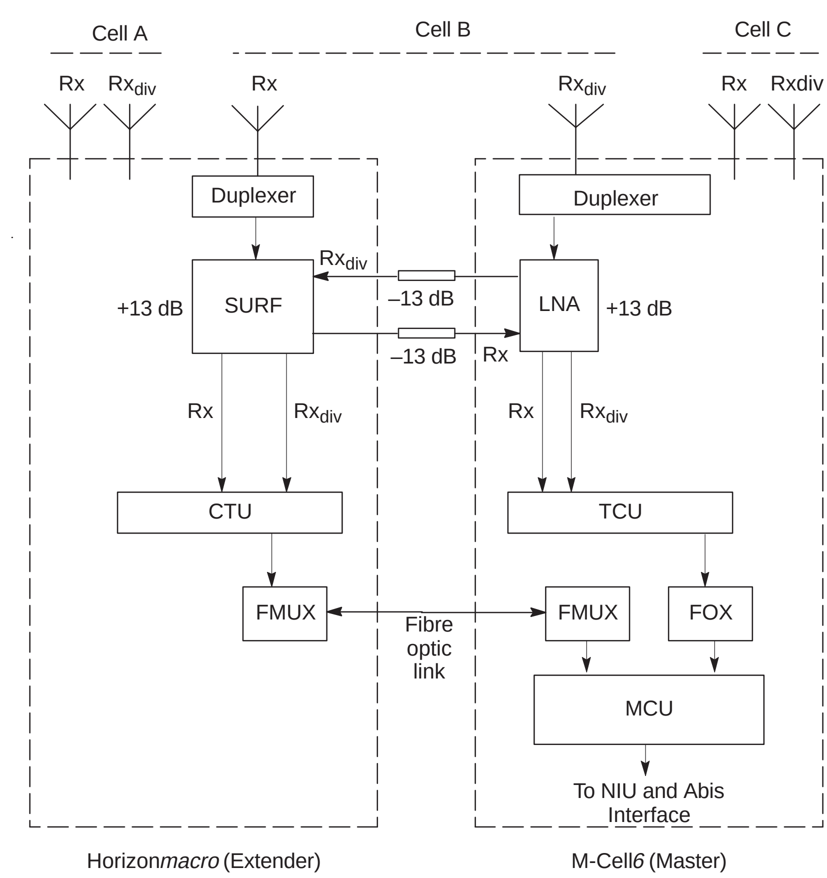


Figure 6-4 Functional overview of the receive path for a DCS1800 split cell configuration

GSM900

Refer to Figure 6-5. In GSM900 products, RF gain for the IADU and SURF is configurable. A split cell configuration is therefore dealt with in the same way as that described for DCS1800, except that the 13 dB attennuators are not required. Instead, the required signal level is maintained by using appropriate gain settings for the IADU and SURF.

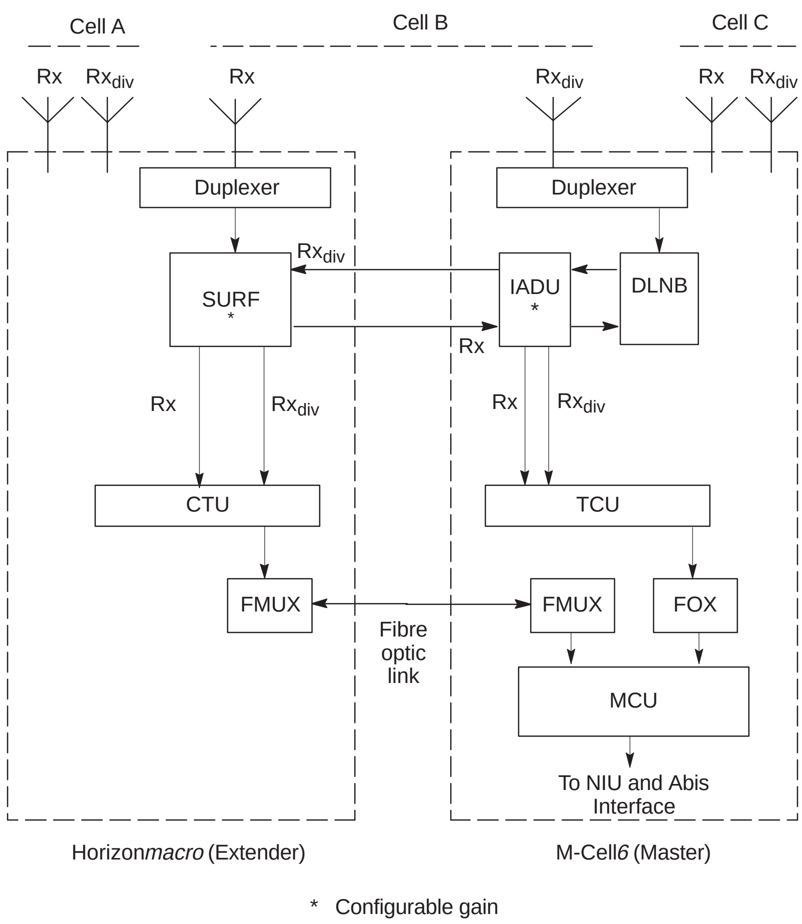


Figure 6-5 Functional overview of the receive path for a GSM900 split cell configuration

Transmit path

M-Cell*6* combining

When configuring the downlink paths for a cell using three carriers or more, it may be necessary to provide additional external RF load(s) for the combiners. This is illustrated by Figure 6-6, which shows a typical M-Cell*6* combining arrangement for a 4-carrier cell.

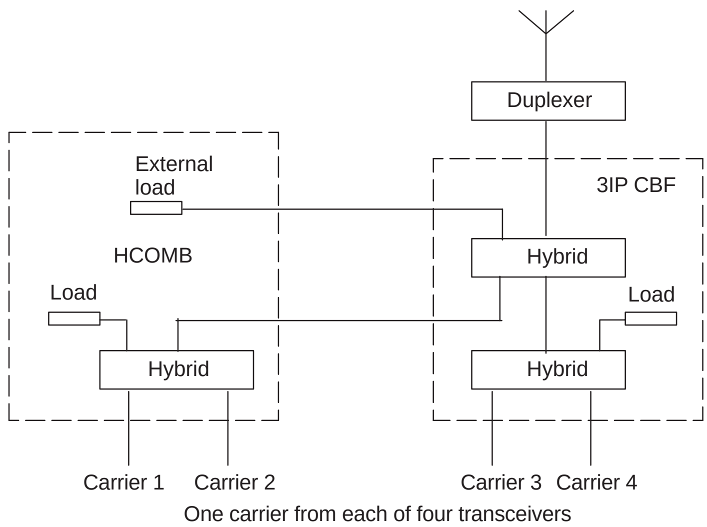


Figure 6-6 Typical M-Cell*6* arrangement for combining four carriers

Carriers 1 and 2 are combined in a hybrid combiner (HCOMB) module. The output from this module provides one of the three inputs to the 3IP CBF. The HCOMB is equipped with an internal RF load, and is therefore self–contained. The 3IP CBF requires one RF load for each of the two hybrids it contains, but is equipped with only a single internal RF load. An additional load is therefore provided for this purpose on the HCOMB casing.

Horizon*macro* combining

A similar arrangement is used in the Horizon*macro*, which uses a Hybrid Combiner Unit (HCU) and Dual stage Duplexed combining Filter (DDF), as shown in Figure 6-7. The DDF has three input ports together with two internal RF loads, and therefore does not require the addition of any external load.

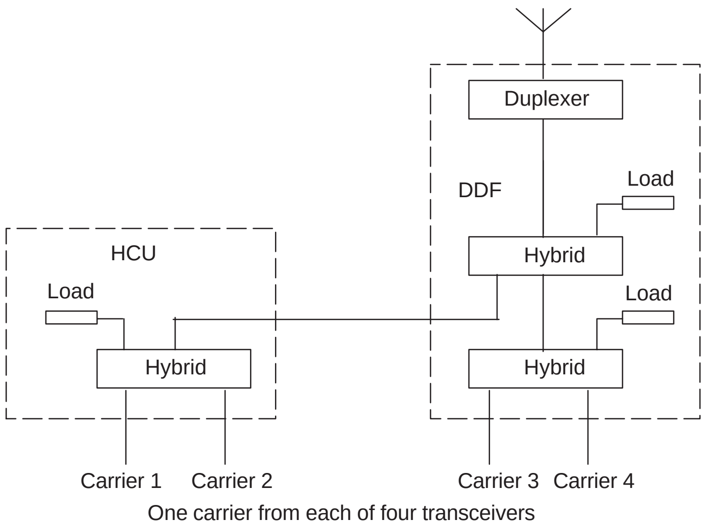


Figure 6-7 Typical Horizon*macro* arrangement for combining four carriers

Mixed equipment combining

When the two different product types are interfaced, a situation can arise where a 3IP CBF is connected to an HCU, as shown in Figure 6-8. In this configuration it is therefore necessary to provide an additional external RF load for this 3IP CBF. The example in Figure 6-8 shows downlink connections for a 4/4/4 configuration using mixed BTS types.

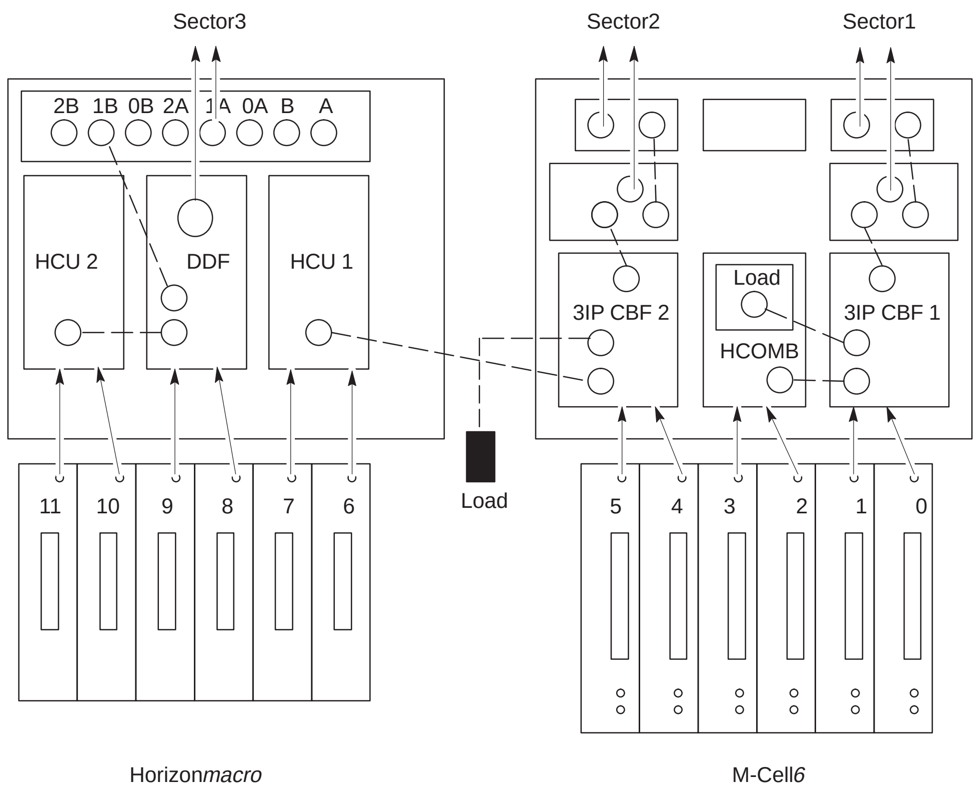


Figure 6-8 Downlink configuration for a 4/4/4 mixed cabinet installation.

Inputs for the DDF are carriers 8 and 9, together with the output of HCU2. The DDF contains two RF loads and is therefore self-contained. Inputs to 3IP CBF1 are carriers 0 and 1, together with the combined output of HCOMB. 3IP CBF1 contains a single load and is therefore connected to the external load mounted on HCOMB. Inputs for 3IP CBF2 are carriers 4 and 5, together with the output of HCU1, from the master cabinet. 3IP CBF2 contains a single load and therefore requires the addition of an external 50 ohm load, as shown.

M-Cell*6* and Horizon*macro* hardware equivalents

Table 6-2 shows the RF hardware equivalents for the Horizon*macro* and M-Cell*6* BTSs.

Table 6-2 RF hardware equivalents for Horizon*macro*/M-Cell*6*

Horizon*macro* 900/1800	**M-Cell 900**	**M-Cell 1800**
DCF	CBF + duplexer	Hybrid + duplexer
DDF	3- input CBF* + duplexer	2 x hybrid + dup/BPF
HCU	Hybrid	Hybrid
Feedthrough plate	Non-hybrid	(no equivalent)
TDF	TBF + duplexer	2 x dup/BPF
CCB master	CCB master	CCB master
CCB extender	CCB extender	CCB extender
SURF	3 x DLNB + IADU	3 x LNA
Split Sector Cable	Rx Extender	(no equivalent)

* 3-input CBF contains only one internal 50 ohm load.

Further configuration information

Provided the functional guidelines described in this chapter are followed, the steps involved in upgrading an existing site with mixed equipment are essentially the same as with a conventional upgrade:

- Determine the number of additional carriers required in the upgraded site.
- Based on the required site configuration (for example, 4/4/4), use the functional guidelines provided in this chapter to decide the most effective hardware configuration for the additional cabinet(s).
- Special upgrade kits are available for specified configurations.
- Configuration diagrams and product ordering help are available from the Motorola local office.

Example configurations

Configuration diagrams provided by the Motorola local office show top of rack cable and antenna connections for mixed product configurations, together with details of external RF loads required. Figure 6-9, Figure 6-10 and Figure 6-11 are examples of the type of diagram that can be provided.

GSM900 2/2/2 configuration using two cabinets

In this configuration, there are no split cells, and therefore no uplink/downlink connections between the cabinets. The CBFs are 2-input devices, consequently no external RF loads are required.

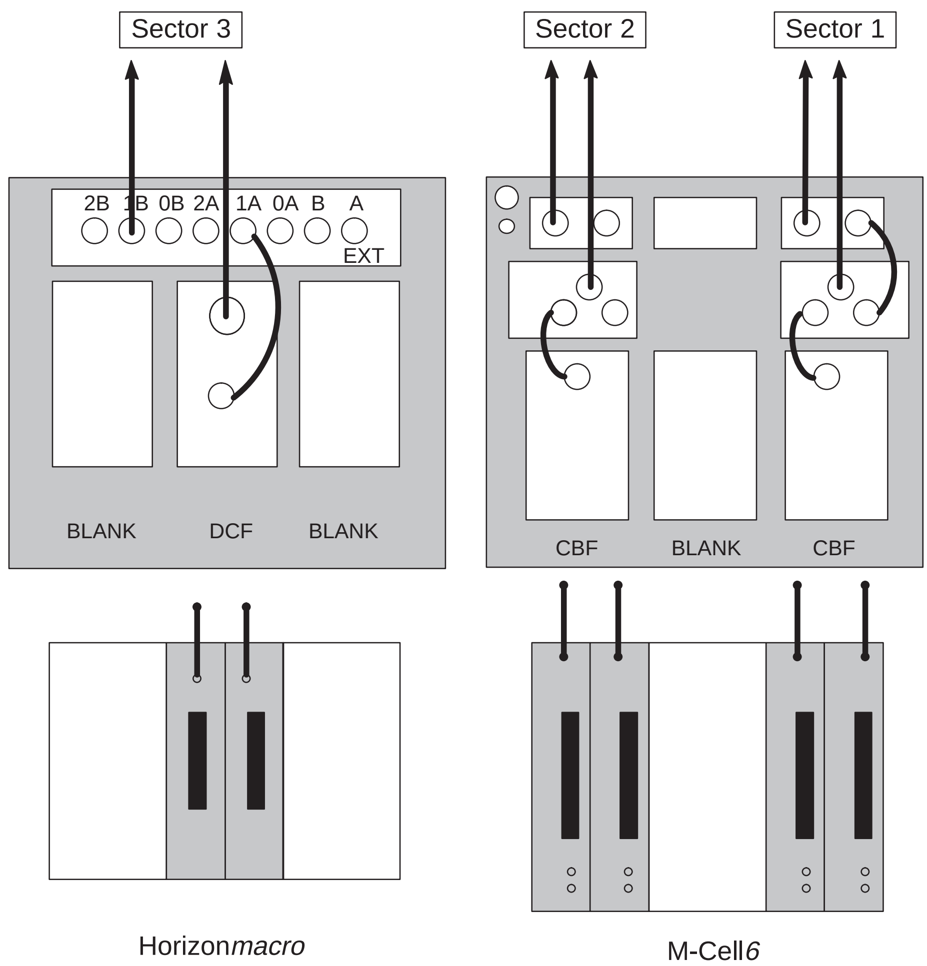


Figure 6-9 GSM900 mixed Horizon*macro* / M-Cell*6* 2/2/2 configuration using two cabinets

GSM900 5/5 configuration using two cabinets

In this configuration, there are no split cells, and therefore no uplink or downlink connections between the cabinets. In the M-Cell*6* cabinet, both 3IP CBFs are configured with external loads provided by the NON HYB. In the Horizon*macro,* one DDF has two direct RF inputs, plus a third input via the FEEDTHRU. The second DDF has two RF inputs, one direct and one via the FEEDTHRU. This arrangement facilitates using the transceivers in sequence. The two 50 ohm loads are required to terminate the unused DDF/3IP CBF input ports.

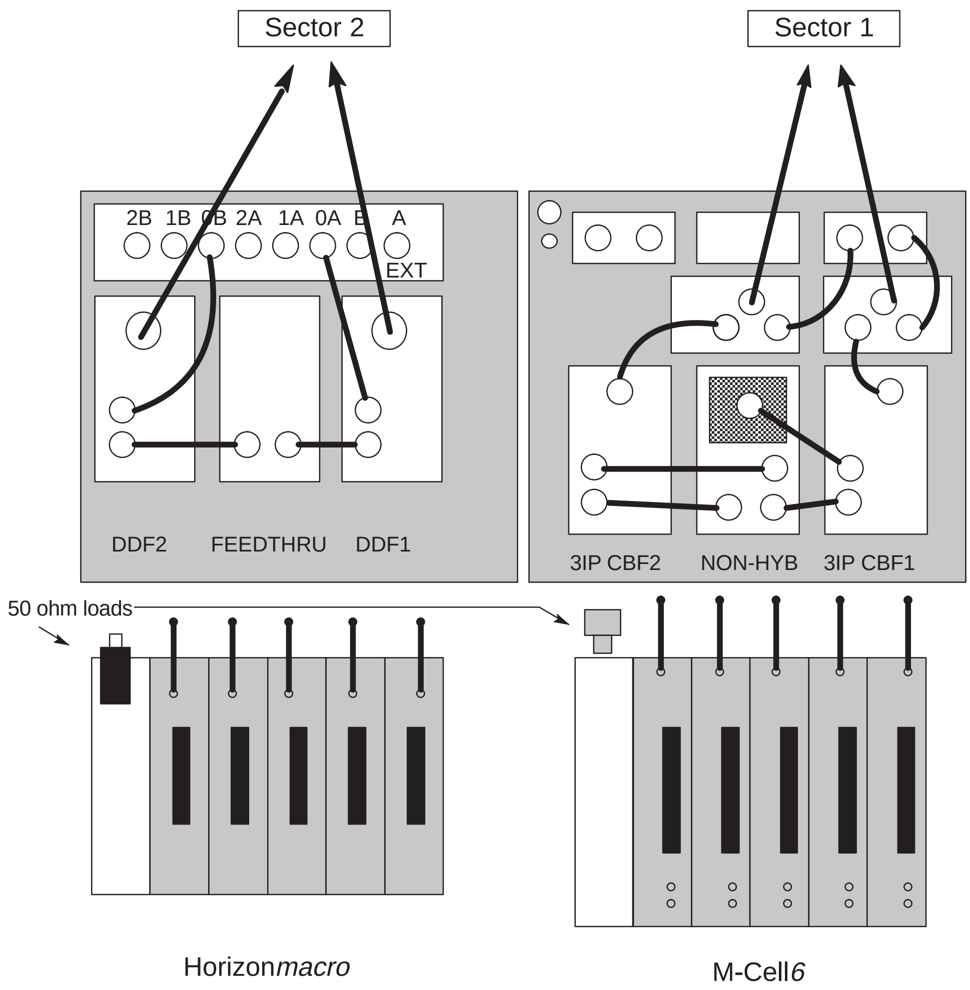


Figure 6-10 GSM900 mixed Horizon*macro* / M-Cell*6* 5/5 configuration using two cabinets

DCS1800 4/4/4 configuration using two cabinets

In this configuration, sector 2 is split between the cabinets. The uplink Rx and Rx_{div} signals for sector 2 are therefore connected between the BTS types to ensure the availability of both signals in both cabinets. In the M-Cell*6* cabinet, 2-input hybrids are used for combining, each configured with a discrete external load.

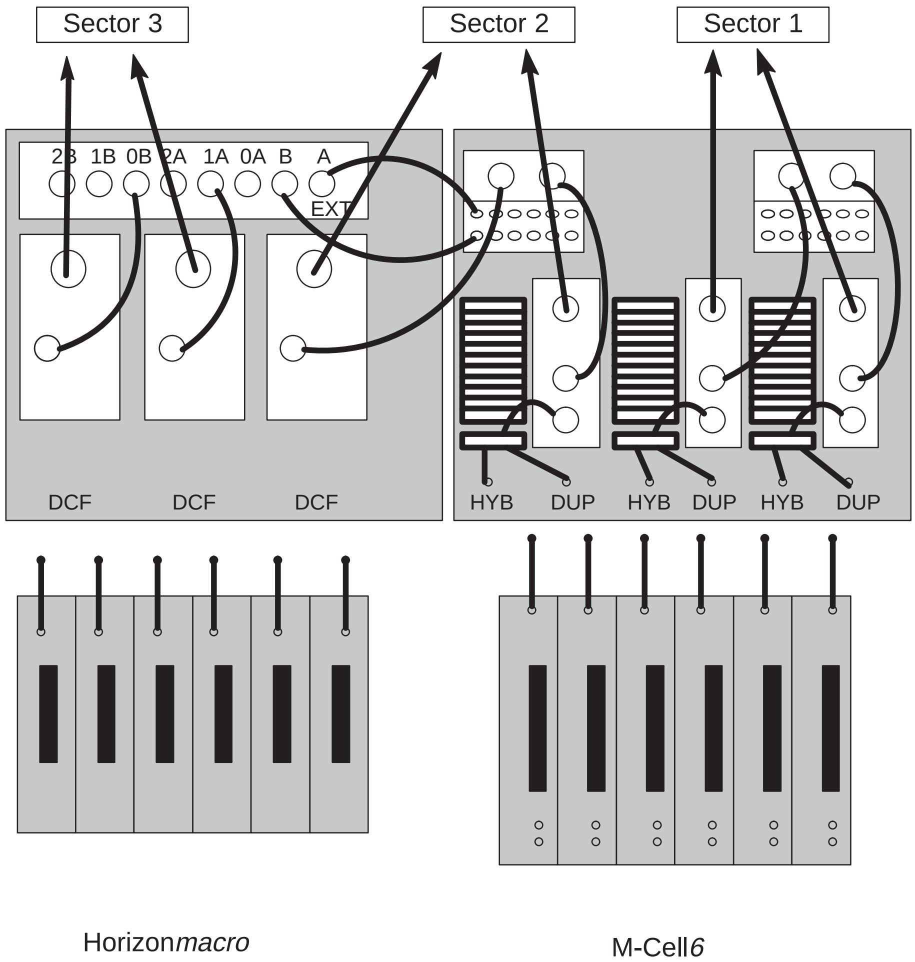


Figure 6-11 DCS1800 Mixed Horizon*macro* / M-Cell*6* 4/4/4 configuration using two cabinets

Special hardware

A range of cables is available for uplink, downlink and fibre optic connections, together with the uplink attenuators described earlier. Contact the Motorola local office for further details.

In addition, the mounting plate and snap-in multi cable gland shown in Figure 6-12 are required when expanding M-Cell*6* outdoor sites with Horizonmacro cabinets. In this type of configuration, the Horizon*macro* equipment is located to the left of the M-Cell*6* cabinets.

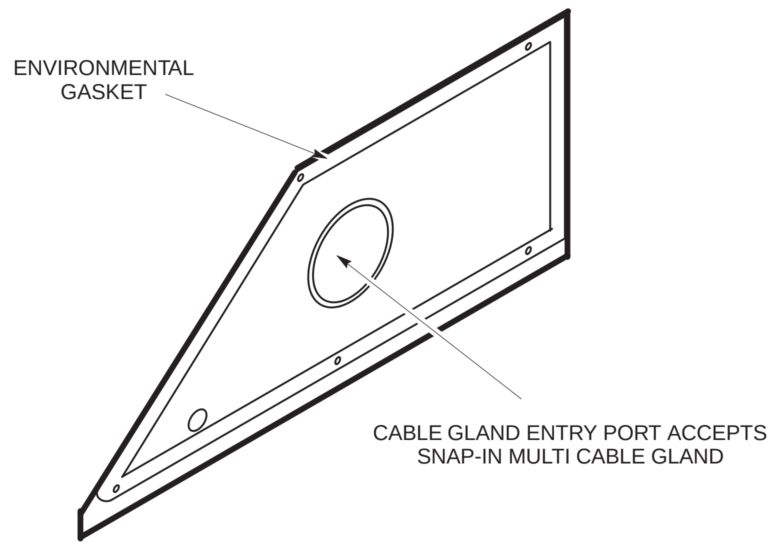


Figure 6-12 Special cable gland plate required for mixed M-Cell*6* and Horizon*macro* installations

The mounting plate is located as shown in Figure 6-13 in place of the original blanking plate fitted to the M-Cell*6*.

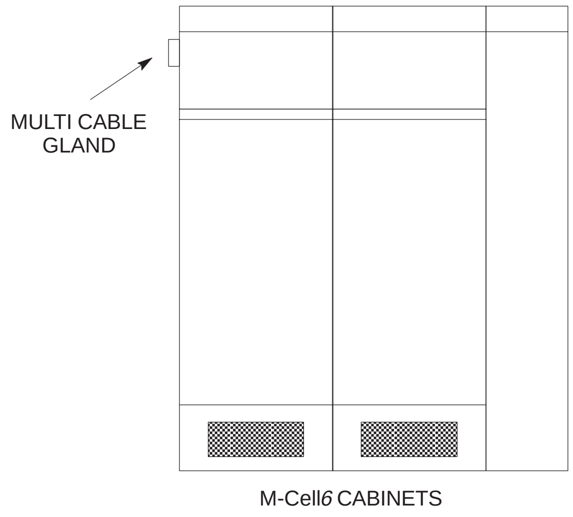


Figure 6-13 Location of the snap-in multi cable gland and mounting plate in the M-Cell*6*

MOTOROLA

Chapter 7

Commissioning of outdoor cabinet

Chapter 7
Commissioning of outdoor cabinet i

Commissioning overview

Overview of commissioning

This chapter provides information required for the commissioning of cabinets and their internal and external interfaces.

NOTE	Some equipment at the site may not be produced by Motorola, including power supplies, customer communications equipment and antennas. Refer to site specific documentation and the non-Motorola vendor instructions.

All site preparation (Chapter 2) and equipment installation (Chapter 3) must be completed before commissioning. Commissioning consists of the following:

- Pre-power up checks.
- Powering up the cabinet.
- Optimization procedures as described in *Installation and Configuration: BSS Optimization (GSM-100-423) 68P02901W43*, issue G or later.

PC to MCUF cable pin connections

Figure 7-1 shows the pin connections for the personal computer (PC) to MCUF test cable. These are standard null modem pin connections.

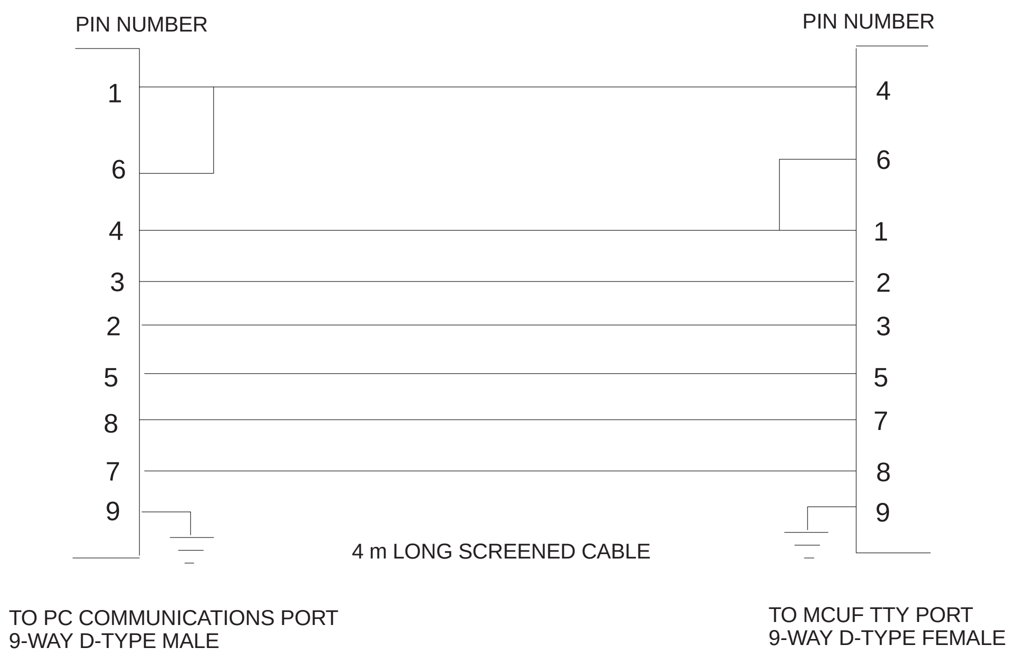


Figure 7-1 9-way to 9-way PC to MCUF cable pin connections

Test equipment

Table 7-1 provides details of the test equipment required to perform the commissioning procedures in this chapter.

Table 7-1 Test equipment required for commissioning

Quantity	Description	Comments
1	IBM compatible portable Personal Computer (PC) (486 DX2 or DX4 minimum)	The basic requirements are: TFT colour screen. 170 Mbyte hard drive (minimum). Minimum 4 Mbyte RAM (8 Mbyte recommended). 3.5 inch floppy drive. Serial port. CD-ROM drive (recommended) PCMCIA (Type 2) compatible slot. Windows 3.1 loaded and running in 386 enhanced mode. Battery power.
1	Commercial terminal emulator software	PC PLUS or similar software (suitable for PC being used)
1	Digital multimeter (must be sensitive enough to measure 0.05 ohms)	Hewlett Packard E2378A or equivalent.
1	ESD protection kit	
1	9-way male D-type to 9-way female D-type	For PC to MCUF. Pin connections shown in Figure 7-1.
1	PAT tester	Insulation and earth tester.

Pre-power up checks

Overview of pre-power up checks

This section contains procedures for testing the power system prior to applying power to the cabinet.

WARNING	The power system checks provided in this section must be performed before the equipment is powered up.

WARNING	Up to 415 V ac is present within the cabinet when the cabinet is directly connected to an ac supply. Earth straps are not to be worn during the commissioning of the ac and dc power system. Watches and other jewellery should be removed. Only insulated tools should be used.

CAUTION	This equipment contains CMOS devices and is vulnerable to static discharge. Although the damage may not be immediately apparent, CMOS devices may be damaged in the long term due to mishandling causing barrier breakdown. The approved earth strap (high impedance) must be worn at all times when adjusting or handling the processor cards (but see the warning above, regarding the use of earth straps). If the cabinet door is kept open for long periods of time during commissioning, an alternative method of cooling must be provided to avoid damage to the equipment through overheating.

Visual inspection

Inspect the installation for damage in accordance with BS 7671, 16th Edition (Section 712), or the IEC 364 or local equivalent.

WARNING	If damage is discovered during the visual inspection, the commissioning must not proceed further until the damage has been inspected and rectified by the manufacturers or their representatives.

Power equipment

Examine the power equipment for mechanical damage and report any damage to Motorola.

Ensure all cabinet earth plates are connected to the site earth.

Cabinet structure

Examine the exterior and interior of the cabinets for structural, paint or mechanical damage and report any damage to Motorola.

Weather protection

Check all environmental seals to ensure they are not damaged.

Check that all cables entering the cabinet have grommets fitted at the point of entry to prevent the ingress of water. If any holes in the earth plates are not used, these must have rubber bungs fitted to prevent water entering the cabinet.

Request for connection

Ensure that all correct **Request for connection** and **Completion and inspection form** certificates have been sent to the local electricity supply board.

NOTE	Samples of a typical **Request for connection** and a **Completion and inspection form** are shown in **Sample form 1** and **Sample form 2** at the end of this chapter.

Apply conductive non-oxidizing grease to the earth mat connection on the earth busbar if an earth mat connection is used.

Earth continuity check

Ensure an earth continuity check has been performed on appropriate equipment, if required. Use the digital multimeter to check that the resistance of the test equipment leads is less than 0.05 ohms.

Main equipment earths

Connect the PAT tester to the earth terminal and to the following earth points:

- Antenna feeders.
- AC supply input earth.
  - The local electricity company termination point.
  - AC supply isolator.
  - Number 1 ac distribution box earth terminal block.

NOTE	The external switched isolator will not be connected to earth if it is a double insulated device and will therefore not need to be tested.

- Cabinet earth/connector plates.
- TMS unit chassis.
- Cabinet chassis (rear right stud).
- Power supply unit chassis.
- Doors and lid.
- Auxiliary equipment housing chassis.

Check that the measured resistance is less than 0.1 ohms with the tester connected to a conductive surface (bare metal) at extreme ends of the earth cables.

AC power system insulation check

Ensure an insulation check has been performed on all ac power cables which supply the site up to the ac input to the cabinet. Testing must be carried out in accordance with the BS 7671, 16th Edition (section 713-04–01 to 713-04-06), or IEC 364 equivalent, at the voltage levels shown in Table 7-2, using an approved insulation tester. Check that the resistance at each point is as shown in Table 7-2.

Table 7-2 BS7671 (16th edition) Table 71A (part of)

Parameter	AC test voltage (volts)	Minimum insulation (megaohms)
Up to and including 500 V	500	0.5

When the test has been completed, sign the completion and inspection certificate, a sample of which may be found in **Sample form 2**.

Connecting input power

Pre-connection checks

At this point in the installation, ensure that:

- All cabinet earth plates are connected to the site earth.
- The cabinets are not already connected to the external ac power source.
- The cabinets are connected to the ac power cabling.
- The ac power cabling is routed to the electricity supply company outlet.

WARNING	Do not wear an anti static wrist strap while servicing the power supplies or power distribution cabling, as serious personal injury can result.

Connecting ac power

The **Request for connection** should have been sent to the local electricity supply board when the equipment left the manufacturer.

- Ensure that the **Request for connection** and the **Completion and inspection certificate** have been sent to the electricity supply company.
- Ensure that the cabinet door is open when the electricity company representative is in attendance.

NOTE	If a cable shroud and/or an auxiliary equipment cabinet is to be installed, the installation should be carried out before connecting the ac supply to the main cabinet.

Connecting to a single phase ac power supply

To connect the single phase and earth power cable to the electricity supply outlet:

1. Connect the earth ac cable (green/yellow) to the earth point in the power supply outlet, and secure.
2. Connect the line ac cable (brown or red) to the line connection in the power supply outlet, and secure.
3. Connect the neutral ac cable (blue or black), to the neutral connection in the power supply outlet and secure.
4. Do not connect the screen, but cut it back level with the outer insulation.
5. Refit and secure the ac terminal block insulated cover, and refit the screws and washers.

Connecting to a three phase (star) ac power supply

To connect the earth, 3-phase, and neutral power cables to the electricity supply outlet:

1. Connect the earth ac cable (green/yellow), to the earth point in the power supply outlet and secure.
2. Connect the phase A cable (red), to the red phase connection in the power supply outlet and secure.
3. Connect the phase B cable (yellow), to the blue phase connection in the power supply outlet and secure.
4. Connect the phase C cable (blue), to the yellow phase connection in the power supply outlet and secure.
5. Connect the neutral ac cable (black), to the neutral connection in the power supply outlet and secure.
6. Do not connect the screen, but cut it back level with the outer insulation.
7. Refit and secure the ac terminal block insulated cover, and refit the screws and washers.

Connecting to a three phase (delta) ac power supply

To connect the earth and 3-phase power cables to the electricity supply outlet:

1. Connect the earth ac cable (green/yellow), to the earth point in the power supply outlet and secure.
2. Connect the phase A cable (red), to the red phase connection in the power supply outlet and secure.
3. Connect the phase B cable (yellow), to the blue phase connection in the power supply outlet and secure.
4. Connect the phase C cable (blue), to the yellow phase connection in the power supply outlet and secure.
5. Do not connect the screen, but cut it back level with the outer insulation.
6. Refit and secure the ac terminal block insulated cover, and refit the screws and washers.

Powering up the cabinet

Power-up overview

This procedure assumes all previous procedures have been completed.

CAUTION	Ensure the correct –48/60 V dc PSMs are fitted. Ensure that there is no blockage to ventilation at the base of the cabinet.

Relevant components to power up procedures are shown in Figure 7-2.

Power up procedure without code load

The following procedure should be carried out to power up the cabinet, with no code load. This proves the cabinet hardware is capable of operation. The procedure for cabinet code load is described in the next section.

WARNING	Earth straps are not to be worn during the commissioning of the power system, and watches and other jewellery should be removed. Only insulated tools should be used. The power source must be supplied to the cabinet via a suitable overcurrent protective device and be isolated from the BTS cabinet.

Procedure to prepare the cabinet for power up without code load

Proceed as follows to prepare the cabinet prior to power up:

1. Verify that the power source isolator is set to off.
2. Disconnect all E1/T1 lines from the BTS.
3. If fitted, remove the optional PCMCIA card from the MCUF slot.
4. Set the switch of each PSM to the OUTPUT DISABLE position.
5. Set all circuit breakers in both ac distribution boxes to off.
6. Set all circuit breakers on the PSU dc circuit breaker panel to off.
7. Set the internal and external battery circuit breakers to off.
8. Press and release all push on/push off circuit breaker buttons on the CBM to the **out** (off) position.

Initial power up

To apply initial power to the cabinet:

1. Switch on the external power supply to the cabinet.
2. Set the four pole MCB and the 6 A RCBO in the number 1 ac distribution box to on.
3. Set the TMS fans circuit breaker on the PSU dc circuit breaker panel to on.
4. Set the TMS heater and TOPSM circuit breakers, in the number 2 ac distribution box to on. Check that input healthy (yellow) and output healthy (green) LEDs of each TOPSM illuminate as it is switched on. Check that the radio and comms contactor LEDs on the CAB are illuminated.
5. Carry out a test of the TMS as described in **Testing the thermal management system (TMS)**.

Radio and digital Power up without code load

To apply power radios and digital modules:

1. Turn each PSM switch to the OUTPUT ENABLE position. Check that each PSM has the active (green) LED on and the alarm (red) LED off.
2. Press the CBM circuit breaker button marked **SURF**.
3. Press the CBM circuit breaker button marked **BPSM A** and (if redundant BPSM fitted) **BPSM B**. Check all associated digital module LEDs operate correctly; green LEDs lit on BPSM, NIU and MCUF, and red LEDs off on NIU and MCUF.

NOTE	Both red and green LEDs are initially lit on the NIU while the unit performs a self-test. The red LED will extinguish after approximately 20 seconds, indicating a normal condition.

4. Press the CBM circuit breaker buttons appropriate for the CTUs fitted, and check that the RADIO STATUS LED for each CTU flashes green.

Battery backup and comms power up

To apply power to the backup batteries and communications equipment:

CAUTION	When using external batteries, the Horizon*macro* outdoor BTS cabinet internal batteries must be switch isolated to ensure correct operation of the temperature-compensated battery charging system.

1. Set the external battery or internal battery circuit breaker, depending on backup battery configuration, to on.
2. Test operation of battery backup as described in **Testing the batteruy backup**.
3. Set any comms circuit breakers, appropriate for the customer communications equipment fitted, to on.
4. Close the doors and lid to ensure correct thermal management.

This completes the power up of the cabinet.

Power down of the cabinet

If the cabinet is not required to remain powered up, power down the cabinet as follows:

1. Press all CBM circuit breaker buttons to the **out** (off) position.
2. Switch each PSM to the OUTPUT DISABLE position.
3. Set the internal and external battery circuit breakers to off.
4. Set all circuit breakers on the PSU dc circuit breaker panel to off.
5. Set the number 2 ac distribution box circuit breakers to off.
6. Switch the four pole MCB and 6 A RCBO circuit breakers in the number 1 ac distribution box to off.
7. Switch off the external power supply to the cabinet.

This completes the power down of the cabinet.

Power up procedure with code load

The following procedure should be carried out to power up the cabinet, with code load. The code will be provided either direct from the BSC from the E1/T1 line, or from a PCMCIA card installed in the PCMCIA socket of the master MCUF.

CAUTION	This procedure should only be carried out by experienced field personnel.

Preparing the cabinet for power up with code load

Proceed as follows to prepare the cabinet prior to power up:

1. Make the E1/T1 connection to BSC.
2. Insert (optional) PCMCIA card in MCUF PCMCIA socket.
3. Connect the 9 to 9-way cable from the PC serial A port to MCUF TTY port.
4. Start the terminal emulator program at the PC.
5. Change to Level 3, and at the MMI-RAM> prompt type: **`CTRL N`**
6. Set all circuit breakers in both ac distribution boxes and the PSU dc circuit breaker panel to off.
7. Set the internal and external battery circuit breakers to off.
8. Set the switch of each PSM to the OUTPUT DISABLE position.
9. Press and release all push on/push off circuit breaker buttons to the **out** (off) position.

Initial power up

To apply initial power to the cabinet:

CAUTION	When the two LEDs of the CTU, or the MCUF 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 and request the boot code restoration procedure and the appropriate boot code file.

1. Switch on the external power supply to the cabinet.
2. Set the four pole MCB and the 6 A RCBO, in number 1 ac distribution box, to on.
3. Set the TMS fans circuit breaker on the PSU dc circuit breaker panel to on.
4. Set the TMS heater and TOPSM circuit breakers, in the number 2 ac distribution box to on. Check that input healthy (yellow) and output healthy (green) LEDs of each TOPSM illuminate as it is switched on. Check that the radio and comms contactor LEDs on the CAB are illuminated.
5. Carry out a test of the TMS as described in **Testing the thermal management system (TMS)**.

Radio and digital Power up with code load

To apply power radios and digital modules:

1. Turn each PSM switch to the OUTPUT ENABLE position. Check that each PSM has the active (green) LED on and the alarm (red) LED off.
2. Press the CBM circuit breaker button marked **SURF**.
3. Press the CBM circuit breaker button marked **BPSM A** and (if a redundant BPSM is fitted) **BPSM B**. Check all associated digital module LEDs operate correctly; green LEDs lit on BPSM, NIU and MCUF, and red LEDs off on NIU and MCUF.

   MCUF initialization will commence at power up. A connection to the BSC will be established and code download will take place. After completion of the download, the site will be initialized.

NOTE	Both red and green LEDs are initially lit on the NIU while the unit performs a self-test. The red LED will extinguish after approximately 50 seconds when rebooting after a code download.

CAUTION	If the code is a different version, the non-volatile memory will be upgraded at this point. Both LEDs will be flashing, and a warning message will appear on the PC terminal. Do not power down or reset the cabinet as this will corrupt the non-volatile memory. If this happens, contact Motorola Customer Network Resolution Centre and request the boot code restoration procedure and the appropriate boot code file.

4. Press the CBM circuit breaker buttons for the appropriate CTUs fitted, and check that the **RADIO STATUS** LED for each CTU flashes green.

   At this point, after the MCUF has initialized, the CTUs will download code from the MCUF.

CAUTION	If the code is a different version, the non-volatile memory will be upgraded at this point. Both LEDs will be flashing. Do not power down or reset the cabinet as this will corrupt the non-volatile memory. If this happens, contact Motorola Customer Network Resolution Centre and request the boot code restoration procedure and the appropriate boot code file.

5. Once fully initialized, the **RADIO STATUS** LED on the front of each CTU should be green, and each **TRANSMIT STATUS** LED should be either off or yellow.
6. Disconnect the 9 to 9-way cable from the MCUF TTY port.

Battery backup and comms power up

To apply power to the backup batteries and communications equipment.

CAUTION	When using external batteries, the Horizon*macro* outdoor BTS cabinet internal batteries must be switch isolated to ensure correct operation of the temperature-compensated battery charging system.

1. Set the external battery or internal battery circuit breaker, depending on the backup battery configuration, to on.
2. Test operation of battery backup as described in **Testing the batteruy backup**.
3. Set any comms circuit breakers, appropriate for the customer communications equipment fitted, to on.
4. Close the doors and lid to ensure correct thermal management.

This completes the power up of the cabinet.

Installation and configuration

Consult *Installation and Configuration: BSS Optimization (GSM-100-423 68P02901W43)* for further procedures associated with ensuring a new site is fully operational and optimized.

Components involved in power up procedures

Figure 7-2 shows the cabinet components involved in power up procedures.

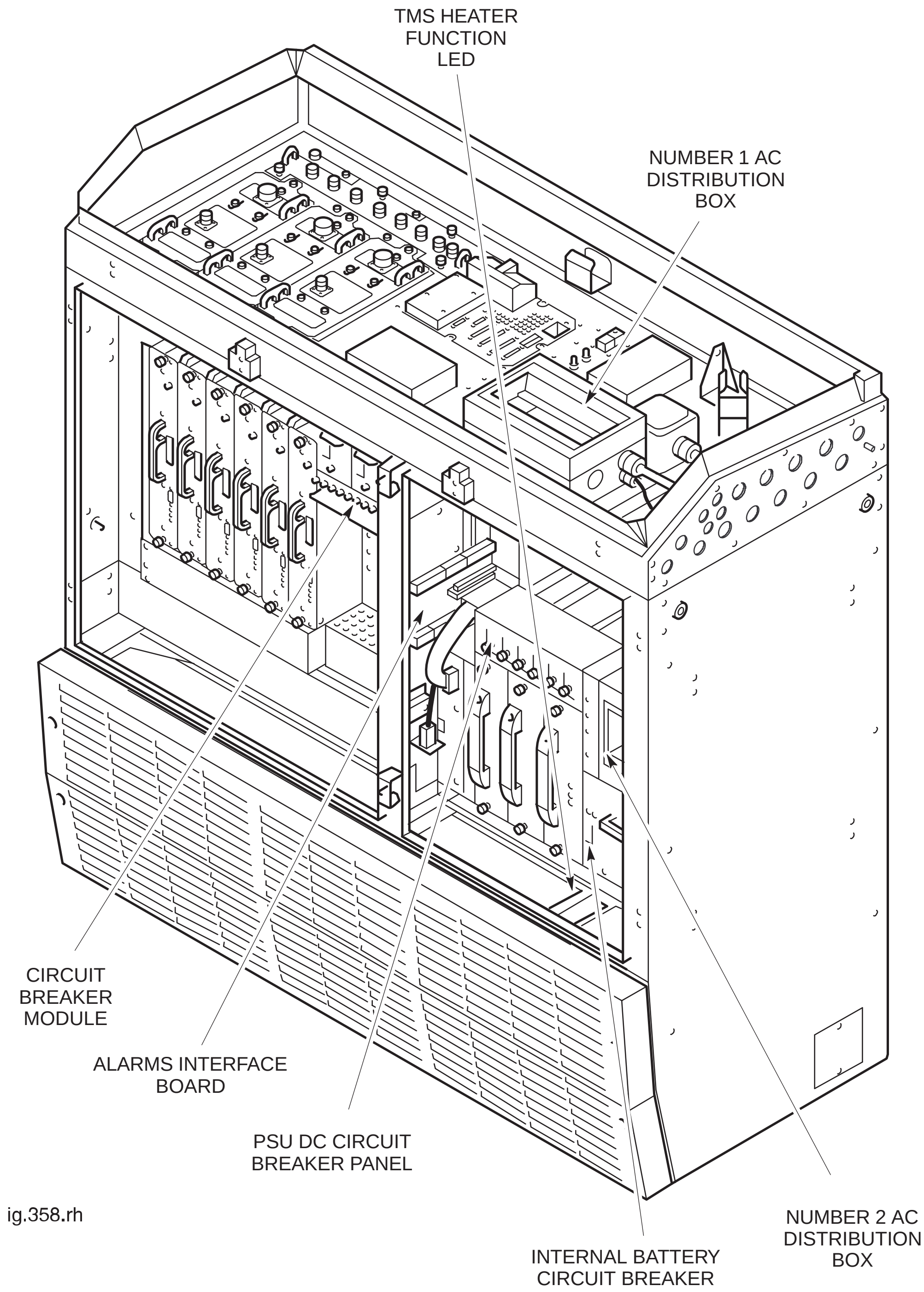


Figure 7-2 Location of components involved in power up procedures

Testing the thermal management system (TMS)

Overview of TMS test

Objective

The TMS test verifies whether or not the TMS is operating correctly.

Test equipment

The TMS test does not require any test equipment.

Commands

The TMS test does not require any software commands.

Test facilities

A four button test switch is mounted on the alarms interface board next to the power supply unit (PSU).

Provision is made to perform the following tests:

- Operate the fans (minimum speed).
- Change the recirculation air (internal) fan speed.
- Change the ambient air (external) speed.
- Operate the heater.

NOTE	Heater function is indicated by the illumination of an LED, mounted on the rear vertical wall at the top right of the recirculation air outlet aperture, below and in front of the power supply enclosure.

Diagram of TMS airflow

Figure 7-3 shows the airflow paths through the cabinet and TMS unit.

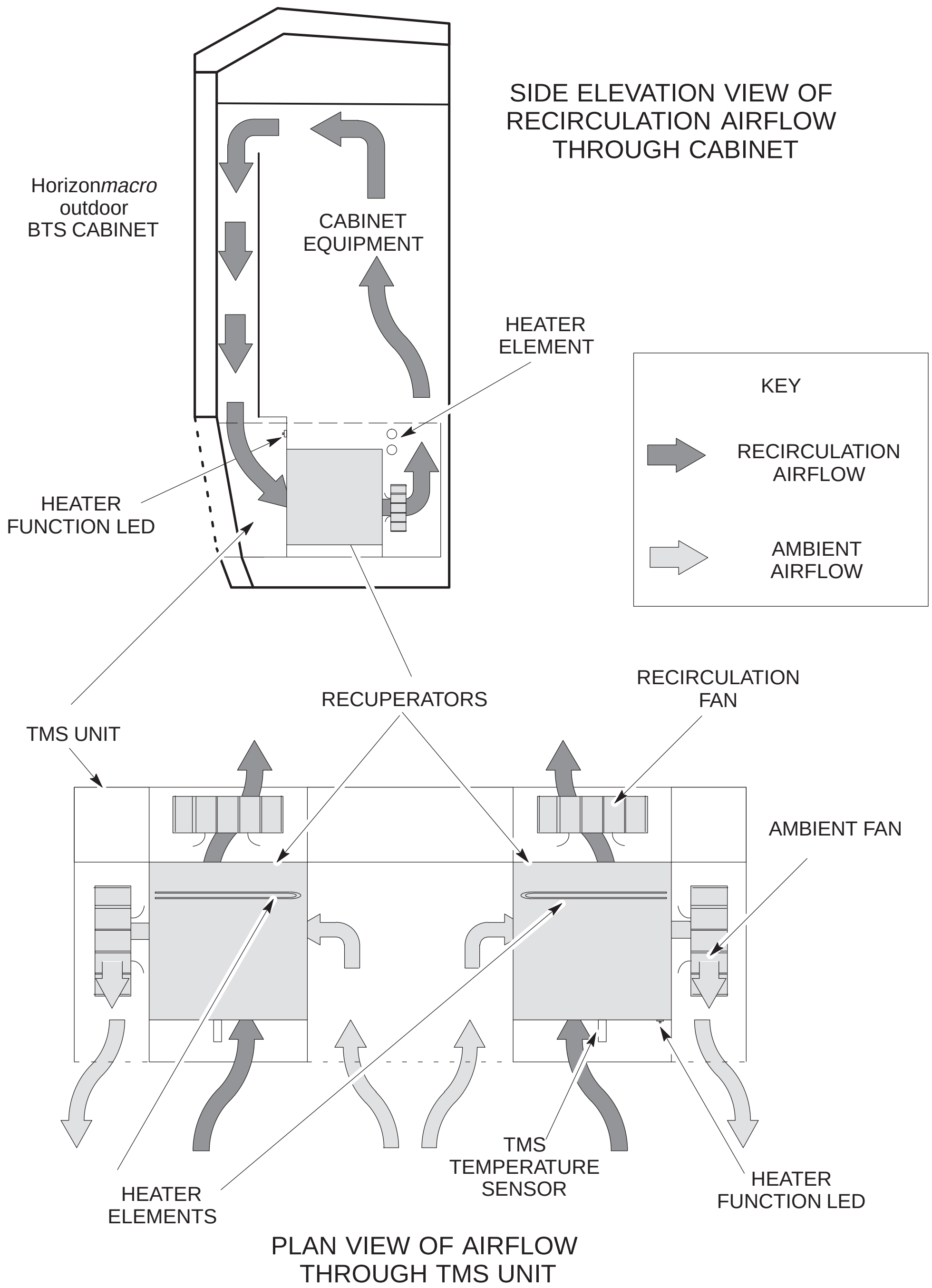
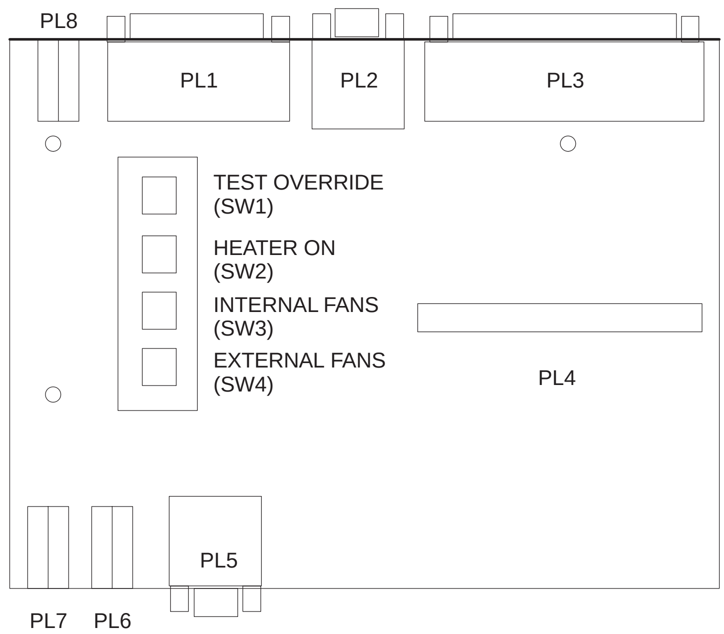


Figure 7-3 TMS airflow paths

Test procedure

Figure 7-4 shows the layout of the alarms interface board and shows the location of the TMS test switches.



CAUTION	Do not operate the unit in test mode for more than 4 minutes, otherwise damage to the electronic equipment may occur.

Figure 7-4 Layout of alarms interface board and TMS test switches

1. Open the power supply enclosure (right) cabinet door.
2. Press and hold the test override switch and check that the four fans are rotating at minimum speed and the heater LED is off.
3. Press the internal fans switch and check that both recirculation fans increase speed.
4. Release the internal fans switch and check that both recirculation fans return to minimum speed.
5. Press the external fans switch and check that both ambient air fans increase speed.
6. Release the external fans switch and check that both ambient air fans return to minimum speed.
7. Press the heater switch and check that the heater LED is lit.
8. Release the heater and test override switches.
9. Close the cabinet doors and verify (by listening) that the TMS recirculation fans are operating.

NOTE	In step 9 ambient air fans may also run, depending on site conditions.

Testing the battery backup

Overview of battery backup test

Objective

The battery backup test verifies whether or not the battery backup is operating correctly.

Test equipment

The battery backup test does not require any test equipment.

Commands

The battery backup test does not require any software commands.

Battery backup test procedures

The test procedure carried out will depend on battery backup configuration.

NOTE	If the BTS cabinet is operational or otherwise visible to the OMC-R, alarms will be generated. Notify the OMC-R before carrying out these test procedures. The internal or external batteries must be fully charged before carrying out these test procedures. The battery capacity test discharges the internal batteries to –44 V dc. If an external power supply failure occurs immediately after the test, the battery back up duration is reduced to approximately 3 minutes. The internal batteries recharge to approximately 80 % capacity in less than one hour.

Internal battery backup

To test operation of internal battery backup:

1. Operate the CAB front panel **BATTERY TEST** button to initiate internal battery capacity test.
2. Check that the **BATTERY CAPACITY** LEDs flash during the test.
3. Check the **15 mins** battery capacity LED is illuminated at the end of the test.

The test of internal battery backup operation is now complete.

External battery backup (AEH)

To test operation of external battery backup:

1. Switch the main 32 A circuit breaker to off to disconnect the external ac supply.
2. Check that the yellow **I/P HEALTHY** and green **O/P HEALTHY** LEDs on the three TOPSMs are extinguished.
3. Check that the green **RADIO** LED on the CAB remains illuminated.
4. Check that the **RADIO STATUS** LED for each CTU continues to flash green.
5. Verify (by listening) that the TMS recirculation fans are operating.

NOTE	In step 5 ambient air fans may also run, depending on site conditions.

6. Switch the main 32 A circuit breaker to on to reconnect the external ac supply.
7. Check that the yellow **I/P HEALTHY** and green **O/P HEALTHY** LEDs on the three TOPSMs illuminate, and that the indications checked in steps 3 to 5 remain unchanged.

The test of external battery backup operation is now complete.

Sample form 1: Request for connection

XXXXXXXXXX ELECTRIC

REQUEST FOR A CONNECTION OF A

CUSTOMER'S INSTALLATION

The electrical installation at the following address will be ready for connection
on (date) ....

NOTE : At least 4 full working days' notice is required.

Address ....

.... Telephone No. ....

DETALS OF INSTALLATION

The installation to be connected is :
tick as appropriate

A completely new installation ☐ An alteration ☐ A rewire ☐

TYPE OF EQUIPMENT **CONNECTED LOAD (kW)**

Cooker
Water heater
Storage radiators
Other *list below*

METHOD OF EARTHING *tick as appropriate*

PME ☐
Cable Sheath ☐
RCD ☐
Other ☐ Give Details

NO OF PHASES

1 ☐
3 ☐
Other ☐ Give Details

DECLARATION

The electrical installation, summarised above, complies with the current edition of the Regulations for Electrical Installations published by the Institution of Electrical Engineers and is now ready for connection to xxxxxxxxx Electric's supply network.
It is understood that xxxxxxxxxx Electric will carry out tests, required by law, prior to connection, but these tests will NOT confirm that the installation complies with the IEE Wiring Regulations, NOR will its connection imply that it is approved by xxxxxxxxxx Electric in any way.

Electrical Installer's Name ....

Address ....

.... Telephone No. ....

Signed .... Date ....

PARTICULARS OF THE INSTALLATION

(Delete or complete items as appropriate)

Type of Installation New/alteration/addition/to existing installation

Type of earthing (312–03): TN–C TN–S TN–C–S TT IT
(Indicate in the box)

Earth Electrode Resistance . . . . ohms

Method of Measurement . . . .

Type (542–02–01) and Location . . . .

Characteristics of the supply at the origin of the installation (313–01):

Nominal voltage . . . . volts
Frequency . . . . Hz . . . . . . Number of phases . . . .

	ascertained by enquiry	determined by calculation	measured
Prospective short–circuit current . . . . kA			
Earth fault loop impedance (Z_e) . . . . ohms			

Maximum demand . . . . A per phase

Overcurrent protective device – Type BS . . . . Rating . . . . A

Main switch or circuit–breaker (460–01–02): Type BS . . . . Rating . . . . A No of poles . . . . .

(if an r.c.d., rated residual operating current I . . . . mA.)

Method of protection against indirect contact:

1. Earthed equipotential bonding and automatic disconnection of supply

or

2. Other (Describe) . . . .

Main equipotential bonding conductors (413–02–01/02, 547–02–01): Size . . . . mm^2

schedule of Test Results: Continuation . . . . pages

Details of departures (if any) from the Wiring Regulations (120–04, 120–05) . . . .

Comments on existing installation, where applicable (743–01–01): . . . .

Sample form 2: Completion and inspection form

FORMS OF COMPLETION AND INSPECTION CERTIFICATE

(as prescribed in the IEE Regulations for Electrical Installations)

DETAILS OF THE INSTALLATION

Client:

Address: (1.) (see Notes overleaf)

DESIGN

I/We being the person(s) responsible (as indicated by my/our signatures below) for the Design of the electrical installation, particulars of which are described on Page 3 of this form CERTIFY that the said work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with the Regulations for Electrical Installations published by the Institution of Electrical Engineers, 16th Edition, amended to (3.) (date . . . .) except for the departures, if any, stated in this Certificate.

The extent of liability of the signatory is limited to the work described above as the subject of this Certificate.

For the DESIGN of the installation:

Name (In block Letters): Position:

for and on behalf of:

Address:

(2.) Signature: (3.) Date

CONSTRUCTION

I / We being the person(s) responsible (as indicated by my/our signatures below) for the Construction of the electrical installation, particulars of which are described on Page 3 of this form CERTIFY that the said work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with the Regulations for Electrical Installations published by the Institution of Electrical Engineers, 16th Edition, amended to (3.) (date . . . .) except for the departures, if any, stated in this Certificate.

The extent of liability of the signatory is limited to the work described above as the subject of this Certificate.

For the CONSTRUCTION of the installation:

Name (In block Letters): Position:

for and on behalf of:

Address:

(2.) Signature: (3.) Date

INSPECTION AND TEST

I / We being the person(s) responsible (as indicated by my / our signatures below) for the Inspection and Test of the electrical installation, particulars of which are described on Page 3 of this form CERTIFY that the said work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with the Regulations for Electrical Installations published by the Institution of Electrical Engineers, 16th Edition, amended to (3.) (date . . . .) except for the departures, if any, stated in this Certificate.

The extent of liability of the signatory is limited to the work described above as the subject of this Certificate.

For the INSPECTION AND TEST of the installation:

Name (In block Letters): Position:

for and on behalf of:

Address:

I RECOMMEND that this installation be further inspected and tested after an interval of not more than . . . . years (5.)

(2.) Signature: (3.) Date

(6) page 1 of . . . . pages

1. This document is intended for the initial certification of a new installation or of an alteration or addition to an existing installation and of an inspection.

2. The signatures appended are those of the persons authorised by the companies executing the work of design, construction and inspection and testing respectively. A signatory authorised to certify more than one category of work shall sign in each of the appropriate places.

3. Dates to be inserted.

4. Where particulars of the installation recorded herein constitute a sufficient schedule for the purpose of Regulation 514–09–01 further drawings / schedules need not be provided. For other installations the additional drawings/schedules listed below apply.

5. Insert here the time interval recommended between periodic inspections. Regard should be paid to relevant National or Local legislation and reference should be made to chapter 13.

6. The page numbers of each sheet should be indicated together with the total number of sheets involved.

(4) Schedule of additional records.

(6) page 2 of . . . . pages

MOTOROLA

Chapter 8

Decommissioning the equipment

Chapter 8
Decommissioning the equipment

Introduction to decommissioning the Horizon*macro* outdoor cabinet

Overview

This chapter describes how to decommission the Horizon*macro* outdoor cabinet. To decommission equipment not supplied by Motorola, for example E1/T1 links, power supplies and antennas, refer to the vendor's instructions.

WARNING	Hazardous voltages exist inside the Horizon*macro* outdoor cabinet. Use extreme caution when working on a cabinet with power applied. Remove all rings, watches and other jewellery.

Prerequisite

Read all the earlier chapters of this installation section, before attempting to decommission a Horizon*macro* outdoor cabinet.

Lifting cabinets

Horizon*macro* outdoor cabinets are fitted with four lifting points, designed to accommodate M16 swivel head eyebolts, built into the cabinet sides. If swivel head eyebolts are used to lift the cabinet, they must be manufactured to CE conformity, and must have a safe weight load of 400 kg each.

Refer to Safety considerations from **Unpacking and preparing the cabinet** in Chapter 3 of this category before lifting cabinets.

1. Carefully remove the plastic insert from the M16 threaded lifting point.
2. Insert the eyebolt into the thread, ensuring that no cross-threading occurs.

WARNING	Before attempting to insert the eyebolts, visually check each one for damage. If any damage is apparent, DO NOT USE. Do not overtighten the eyebolts; hand tight is sufficient. **Do not tighten eyebolts with a t-bar or spanner.** Screw the eyebolt fully into the lifting point so that no thread is left exposed.

3. Repeat the procedure until all four eyebolts have been correctly fitted.

For continued use of eyebolts, there may be local regulations that govern the use of lifting equipment and stipulate a test and/or examination regime. If the eyebolts are to be used, ensure that all such regulations are met.

Remember to remove the eyebolts and refit the plastic inserts when the lifting operation is complete.

Decommissioning the Horizon*macro* outdoor cabinet

Introduction

Use the following procedure to decommission the Horizon*macro* outdoor cabinet, and use the checklist to check off each action as it is completed. Photocopy the checklist as often as required. Do not write on the original.

To decommission using checklist

The following procedure should be recorded by use of the checklist, to check that each action has been completed. Photocopy the checklist as often as required; do not write on the original manual copy.

Before starting

Before starting to decommission the cabinet, ensure that:

- The main power source is switched off and that no power is connected to the cabinet. If an auxiliary equipment housing is connected to provide battery backup, ensure that the dc power is isolated from the Horizon*macro* outdoor cabinet.
- Suitable packing crates and cartons are available to pack the decommissioned equipment.
- The OMC-R has taken the cabinet out of service.
- The cabinet has been powered down, as described in **Powering down the cabinet** in this section.
- Any unused items have been retrieved from storage elsewhere.

Power down of the cabinet

If the cabinet is not to remain powered up, power down as follows:

1. Press all CBM circuit breaker buttons to the **out** (off) position.
2. Switch each PSM to the OUTPUT DISABLE position.
3. Set the internal and external battery circuit breakers to off.
4. Set all circuit breakers on the PSU dc circuit breaker panel to off.
5. Set the number 2 ac distribution box circuit breakers to off.
6. Switch the four pole MCB and 6 amp RCBO circuit breakers in the number 1 ac distribution box to off.
7. Switch off the external power supply to the cabinet.

This completes the power down procedure for the cabinet.

Procedure

To decommission the cabinet:

1. Check the cabinet and its contents for signs of damage.
2. Use a digital voltmeter to ensure that power is not present in the cabinet.

WARNING	Untidy disconnected cables can create a trip hazard to personnel using the site.

3. Disconnect the cabinet input ac power cable from the power source and the main input terminals. Withdraw the cable through the earthing plate and store it in suitable packaging. Do not remove the cabinet earth lead until all other cables have been disconnected.
4. Disconnect all antenna cables from their connections on the earthing plate, and any transmit and receive RF cables from other cabinets.
5. Disconnect fibre optic cables between master cabinet and any extension cabinets.
6. Disconnect the following cables (if fitted) from their connectors on the top panel of the cabinet and withdraw the cables through the earthing plate:
   - E1/T1 cables.
   - Alarm cables.
   - DC power cables (from auxiliary equipment housing, if fitted).

   Refit the protective covers to all exposed terminals on the top panel.
7. Disconnect the cabinet earth cable and stow disconnected cables so that they do not constitute a hazard to personnel using the site.
8. Unbolt the cabinet from the floor and move it to a location where it can be safely packed into a wooden transit case.
9. Unbolt the alloy template and repack it with the cabinet.

BTS checklist

NAME ____________________________________ DATE __________

SIGNATURE ______________________________

SITE NAME ______________________________

EQUIPMENT TYPE __________________________

NAT ID __________________________________

ACTION	Yes	No	N/A
Outdoor cabinet taken out of service by the OMC-R.			
Packing material (including polythene bag) on site.			
Is cabinet damaged? If yes, detail in comments box.			
Power cable disconnected.			
RF cables disconnected from earthing plate.			
Interface panel cables disconnected.			
DC power cables disconnected (if used).			
Protective covers refitted to top panel connectors.			
Earth cable disconnected from the cabinet.			
Doors and lid closed and locked. Key stored safely.			
Cabinet packed in transit case.			
Cabinet base fixings removed and packed.			
Cabinet template removed and packed.			

COMMENTS

CHAPTER 1
INTRODUCTION TO
MAINTENANCE

CHAPTER 2
GENERAL MAINTENANCE

CHAPTER 3
FRU REPLACEMENT
PROCEDURES

CHAPTER 4
AUXILIARY EQUIPMENT
HOUSING MAINTENANCE

MOTOROLA

Category 523

Maintenance Information (Maint.)

Chapter 1

Introduction to maintenance

Maintenance information introduction

Safety

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.

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.

Tools

The tools required are those listed in *Installation and Configuration: GSM-204-423* Chapter 1 **Horizon*macro* outdoor tool kit**.

Weather conditions affecting access

Overview of weather considerations

Before beginning any maintenance procedure, it is important to read and take into account the following information concerning the climatic conditions at the intended site.

Weather conditions

WARNING	Due consideration should be given to the hazards of wind and other inclement weather conditions. Use your discretion at all times. **Do not climb a ladder, scaffolding or use a similar method of access if you feel unsafe to do so under such weather conditions.**

Maintenance cover

Motorola recommend the use of a maintenance cover for access to the Horizon*macro* cabinets during inclement weather conditions.

NOTE	The maintenance cover is not supplied with the Horizon*macro* equipment and should be provided by the customer if required.

Installation and configuration procedures for the Horizon*macro* cabinets are dependent on the weather conditions. There are three situations where the recommended guidelines should be considered before commencing work:

- No access.
- Access with maintenance cover.
- Access without maintenance cover.

No access

Access to the cabinet should **not** be attempted during the following actual or imminent inclement weather conditions, with or without the maintenance cover:

- Winds in excess of 25 knots (30 mph).
- Heavy persistent rain, snow, hail or sleet.
- During an electrical storm.

Access with maintenance cover

Access to the cabinet may be made under the following conditions with the use of the maintenance cover:

- Wind speeds of less than 25 knots (30 mph).
- Persistent rain, snow, hail or sleet.
- Where airborne substances (such as leaves or dust) may cause a problem.

Access without maintenance cover

Access may be made under the following conditions without the use of the maintenance cover:

- Wind speeds of less than 25 knots (30 mph).
- No precipitation occurring or likely to occur during the maintenance period.
- When the temperature is between –30 °C to +40 °C (–22 °F to +104 °F).

Under these conditions the cover of the cabinet may be removed.

Chapter 2

General maintenance

Chapter 2
General maintenance i

General maintenance overview

In this chapter

This chapter contains the procedures for the general maintenance of a Horizon*macro* outdoor BTS. There is no schedule for routine maintenance on Horizon*macro* outdoor equipment. General maintenance procedures are to be carried out during site visits in response to alarms (as required), or at intervals deemed appropriate by the customer, (determined by the type of installation, its use and operation, the frequency of maintenance and the external influences to which it is subjected).

NOTE	Since a Horizon*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.

It is recommended that the following general maintenance procedures are carried out for Horizon*macro* outdoor installations:

- Ensure that cabinet air inlets and exhaust grilles are not blocked.
- Check normal operation, including TMS fans. Also check cable integrity and the condition of all connections.
- Check battery backup operation and battery capacity.
- Inspect general mechanical condition and finish of the cabinets.
- Inspect locks, handles and hinges and door seals. Lubricate if required.

Reporting faulty devices

During general 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 common faults 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.

Cleaning agents

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

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

Torque values

Table 2-1 details torque values used during FRU replacement procedures.

Table 2-1 Torque values for all cabinet screws/bolts and RF connectors

Size of screw/bolt	**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

Maintenance support procedures

The maintenance support procedures include the following:

- Door and lid opening and closing.
- TMS front cover removal and refitting.

Door opening and closing

The door lock has a spring loaded handle. The door is operated as follows:

1. Insert key into lock and turn clockwise until spring loaded handle releases.
2. Turn handle a quarter turn anticlockwise to open the lock.
3. Open power supply enclosure door to 90° locking position.
4. Open radio enclosure door to 90° locking position.

NOTE	If the equipment is active, a door open alarm will be generated.

5. To open doors to 120°, lift up middle of appropriate wind stop.
6. To close, lift up middle of wind stop, close doors firmly, radio enclosure door first.
7. Turn handle a quarter turn clockwise, push handle flush and remove key to lock.

Lid opening and closing

NOTE	The lid can only be opened and closed when both doors are open.

The lid is opened as follows:

1. Ensure both cabinet doors are open to the 90° position.
2. Undo the two draw latches by turning anti clockwise, and ensure the catch hook is clear of lip on the lid.
3. Lift the lid until the mechanical stay audibly locks.

The lid is closed as follows:

1. Press the lock stud on the mechanical stay to release.
2. Lower the lid.
3. Hook the draw latches over the lip and turn clockwise to lock.
4. Ensure operating tab is stowed flat.

TMS front cover removal and refitting

To remove the TMS front cover:

NOTE	The TMS front cover can only be removed and refitted when both doors are open.

1. Remove and retain the four push in plastic covers.
2. Using a crosspoint screwdriver, undo the four captive fasteners by turning anticlockwise until they release.
3. Lift the TMS front cover away from the cabinet and store safely.

To refit the TMS front cover:

1. Refit the TMS front cover and line up the four fasteners.
2. Using a crosspoint screw driver, tighten the four captive fasteners.
3. Refit the four push in plastic covers.

General maintenance procedures

Type of procedures

The general maintenance procedures involve the following:

- Cleaning air inlet and outlet grilles.
- Checking and cleaning fans (only necessary if an overtemperature alarm has occurred).
- Checking normal operation.
- Mechanical inspection of the cabinet, including inspection and lubrication of locks and hinges.
- Periodic check of the installation.

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.

Assumptions - door, lid and TMS front cover

Any requirement to open or close a door, a lid, or remove/refit a TMS front cover is assumed in the following procedures. Shutting the door or the lid is assumed at the end of any procedure. Detailed descriptions of cabinet access procedures are given in **Maintenance support procedures**.

Cleaning inlet and outlet grilles

Air is drawn in and expelled through the TMS front cover grille, at the base of the front of the cabinet.

The following procedure should be followed to clean inlets, ducts and outlet grilles:

- Open the cabinet doors and examine door ducts and recirculation air apertures. Clean as necessary, taking care to avoid damage.
- Remove the TMS front cover and clean the grilles as necessary.
- Examine the TMS unit ambient air inlet and outlet grilles. Clean as necessary, taking care to avoid damage.
- Use a brush to ensure the area under and around the TMS is clear of debris.
- Refit the TMS front cover.
- Close the doors.

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. Note the LEDs lit on modules shown in Table 2-2 to ensure 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 2-2 Normal LED indication of cabinet modules

Equipment with LEDs	Colour of LEDs lit
CTUs in locations 0 to 5	Tx status ORANGE or Operational status GREEN
PSMs in locations 0 to 2	Top LED GREEN
Digital modules (NIU, MCUF, FMUX, BPSM)	GREEN
Alarm module	6, 7, 8 GREEN (fans) 3 RED (as door is open)
TOPSM	Input healthy YELLOW Output healthy GREEN
CAB	Radio GREEN Comms GREEN Status FLASHING (as door is open)

3. Verify (by listening) that the TMS recirculation fans are operating.

NOTE	In step 3 ambient air fans may also run, depending on site conditions.

Inspection of cabinet, locks and hinges

Inspecting the cabinet exterior

Inspect the cabinet exterior using the following procedure:

- Check exterior panels for dents and structural damage.
- Check cabinet top connections for signs of overheating and security of attachment.
- Check cabinet exterior finish for signs of damage or deterioration. Restore exterior finish as necessary.

Inspecting the doors and hood

Inspect the doors and hood using the following procedure:

- Check cabinet doors and hood for distortion, security and correct operation.
- Check hinges for damage, security and correct operation. Carefully lubricate the hinges. Ensure that all door seals are wiped clean of the lubricant.
- Check the hood mechanical stay and gas strut for damage, security and correct operation. Carefully lubricate the moving parts of the mechanical stay and gas strut and ensure that lubricated surfaces are dirt-free.
- Check earth connection for damage and security.
- Check door lock mechanism and inspect for ease of operation. Lubricate the mechanism with light grease. Ensure that lubricated surfaces are dirt-free.

Inspecting the cabinet interior

Inspect the cabinet interior using the following procedure:

- Check all rack equipment for security of attachment, especially the TOPSM PSM, CBM and CTU module attachment screws using a Torx driver. Tighten to correct torque(see torque values in **General maintenance overview** in this chapter).
- Carry out a visual check of all wiring for signs of overheating and security of attachment.

WARNING	Do not over stress 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 wrench. Tighten to the correct torque (see torque values in **General maintenance overview** in this chapter).

Periodic check of the installation

NOTE	Refer to *Installation and Configuration: (GSM-204-423)* to carry out the following procedures.

It is recommended that the following be performed periodically:

- Inspection and testing in accordance with BS7671 (16th Edition Chapter 73), the IEC 364 equivalent or in accordance with local regulations.
- Earth electrode test.
- TMS testing.
- Test backup battery capacity and operation.

The frequency of such periodic inspection and testing to be determined by the type of installation, its use and operation, the frequency of maintenance and the external influences to which it is subjected.

TMS testing

Test facilities

A four button test switch is mounted on the alarms interface board next to the power supply unit (PSU).

Provision is made to perform the following tests:

- Operate the fans (minimum speed).
- Change the recirculation air (internal) fan speed.
- Change the ambient air (external) speed.
- Operate the heater.

NOTE	Heater function is indicated by the illumination of an LED, mounted on the rear vertical wall at the top right of the recirculation air outlet aperture, below and in front of the power supply enclosure.

TMS Test procedure

CAUTION	Do not operate the unit in this position for more than 4 minutes, otherwise damage to the electronic equipment may occur.

Figure 2-1 shows the layout of the alarms interface board and shows the position of the TMS test switches.

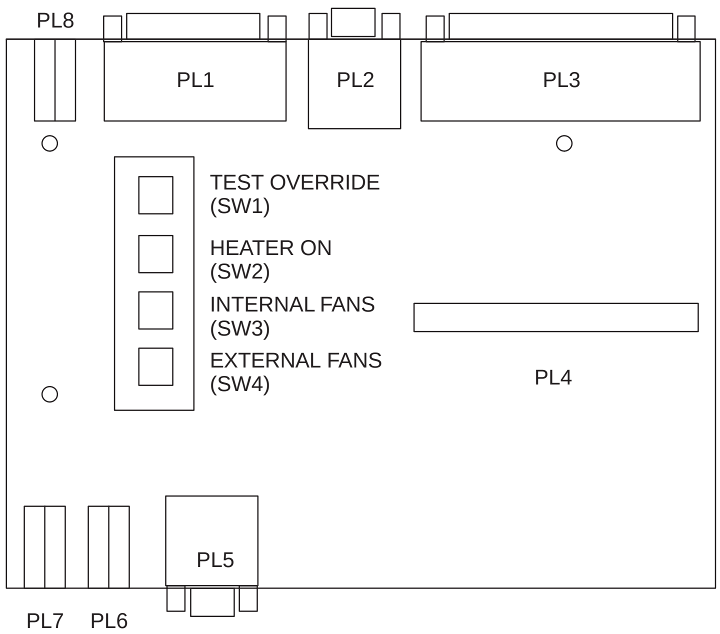


Figure 2-1 Layout of alarms interface board and TMS test switches

1. Open the power supply enclosure (right) cabinet door.
2. Press and hold the test override switch and check that the four fans are rotating at minimum speed and the heater LED is off.
3. Press the internal fans switch and check that both recirculation fans increase speed.
4. Release the internal fans switch and check that both recirculation fans return to minimum speed.
5. Press the external fans switch and check that both ambient air fans increase speed.
6. Release the external fans switch and check that both ambient air fans return to minimum speed.
7. Press the heater switch and check that the heater LED is lit.
8. Release the heater and test override switches.
9. Close the cabinet doors and verify (by listening) that the TMS recirculation fans are operating.

NOTE	In step 9 ambient air fans may also run, depending on site conditions.

Battery backup test procedures

The test procedure carried out will depend on battery backup configuration.

NOTE	If the BTS cabinet is operational or otherwise visible to the OMC-R, alarms will be generated. Notify the OMC-R before carrying out these test procedures. The internal or external batteries must be fully charged before carrying out these test procedures. The battery capacity test discharges the internal batteries to –44 V dc. If an external power supply failure occurs immediately after the test, the battery back up duration is reduced to approximately 3 minutes. The internal batteries recharge to approximately 80% capacity in less than one hour.

Internal battery backup

To test operation of internal battery backup:

1. Operate the CAB front panel **BATTERY TEST** button to initiate internal battery capacity test.
2. Check that the **BATTERY CAPACITY** LEDs flash during the test.
3. Check the **15 mins** battery capacity LED is illuminated at the end of the test.

The test of internal battery backup operation is now complete.

External battery backup (AEH)

To test operation of external battery backup:

1. Switch the main 32 A circuit breaker to off to disconnect the external ac supply.
2. Check that the yellow **I/P HEALTHY** and green **O/P HEALTHY** LEDs on the three TOPSMs are extinguished.
3. Check that the green **RADIO** LED on the CAB remains illuminated.
4. Check that the **RADIO STATUS** LED for each CTU continues to flash green.
5. Verify (by listening) that the TMS recirculation fans are operating.

NOTE	In step 5 ambient air fans may also run, depending on site conditions.

6. Switch the main 32 A circuit breaker to on to reconnect the external ac supply.
7. Check that the yellow **I/P HEALTHY** and green **O/P HEALTHY** LEDs on the three TOPSMs illuminate, and that the indications checked in steps 3 to 5 remain unchanged.

The test of external battery backup operation is now complete.

Return to service

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

Log the maintenance activity.

Chapter 3

FRU replacement procedures

Chapter 3
FRU replacement procedures i

Overview of FRU replacement procedures

Field replaceable units (FRUs)

WARNING	Maintenance procedures on this equipment must only be carried out by suitably qualified personnel.

This chapter provides information on replacement of Field Replaceable Units (FRUs). Only components classed as FRUs are described in this chapter.

Any requirement to open or close a door, a lid, or remove/refit a TMS front cover is assumed in procedures. Shutting the door, or the lid is assumed at the end of any procedure. Detailed descriptions of cabinet access procedures are given in **Maintenance support procedures**.

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

FRU list

The following is a list of FRUs used in this equipment:

- Door.
- Lid.
- Environmental seals.
- TMS unit.
- TMS fans.
- TMS control board.
- Main cage temperature sensors.
- DC circuit breaker panel.
- Control and alarm board (CAB).
- The outdoor power supply modules (TOPSMs).
- Power supply module (PSM).
- Circuit breaker module (CBM).
- Internal battery tray.
- CTUs.
- SURF module.
- Tx blocks including feedthrough plate.
- Krone blocks.
- Digital modules (MCUFs, NIUs, FMUXs, alarm board and also BPSMs).

Torque values

Table 3-1 details torque values used during FRU replacement procedures.

Table 3-1 Torque values for all cabinet screws/bolts and RF connectors

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

FRU view of cabinet

Figure 3-1 shows a cabinet with FRUs identified. Doors and lid are shown in relevant FRU sections.

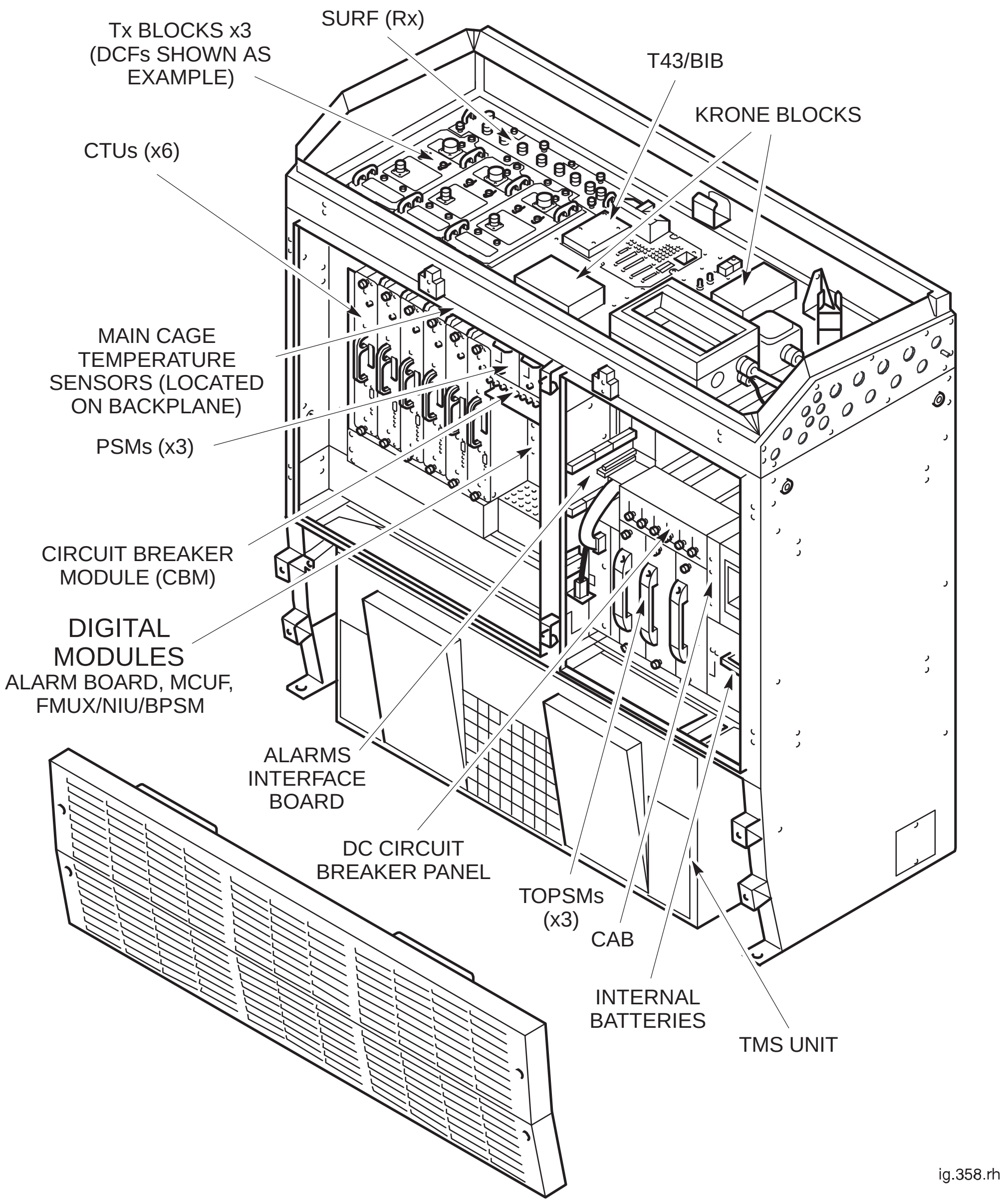


Figure 3-1 Cabinet, without doors or lid, showing FRU components

Replacing a door

Introduction to door replacement

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

Views of the cabinet doors

Figure 3-2 shows the cabinet doors with major features labelled.

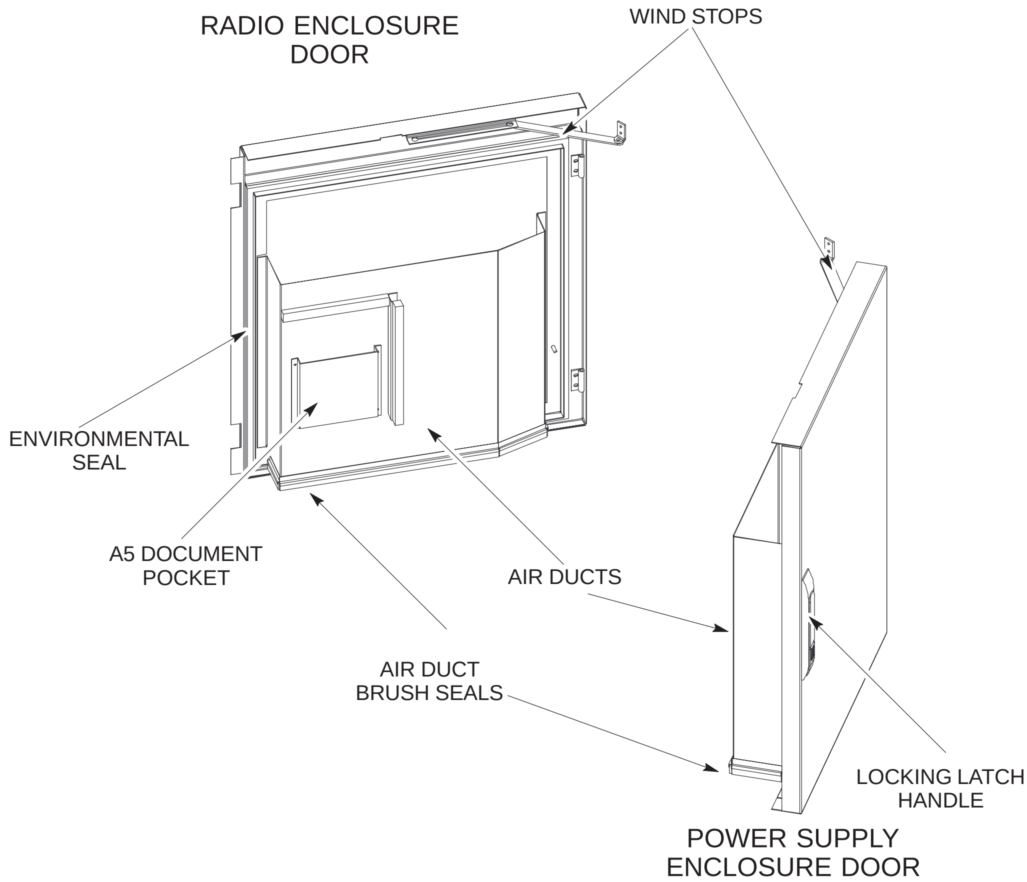


Figure 3-2 View of cabinet doors

Door replacement procedure

Removing a faulty door

To remove a door proceed as follows:

1. Unscrew the M6 nut and star washer which secures the door earth cable to the cabinet body.
2. Unscrew the wind stop from the cabinet.
3. Remove the circlips from the bottom of the hinge pins.

WARNING	The radio enclosure door weighs 20 kg and the power supply enclosure door weighs 15 kg. Handle with care and observe proper lifting precautions.

4. Support the door and remove the two hinge pins by pulling their lugs in the required direction, using long nose pliers.
5. Remove the door and place safely to one side.

Fitting a replacement door

CAUTION	Take care to avoid damaging the door air duct seals.

To fit a replacement door proceed as follows:

1. Support the door, in position, so that the hinges line up.
2. Insert the two hinge pins fully into the hinges.
3. Fit the circlips into the recesses in the bottom of the hinges.
4. Screw the wind stop to the cabinet.
5. Attach the door earth cable to the cabinet using the M6 nut and star washer. Tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).
6. Check door operation and that door locking mechanism functions correctly.

Replacing the lid

Introduction to lid replacement

The lid provides environmental protection to equipment inside. For this reason, the replacement procedure should be completed in one session, and the cabinet then closed.

View of the cabinet lid

Figure 3-3 shows the lid and the cabinet top wrap with the main features labelled.

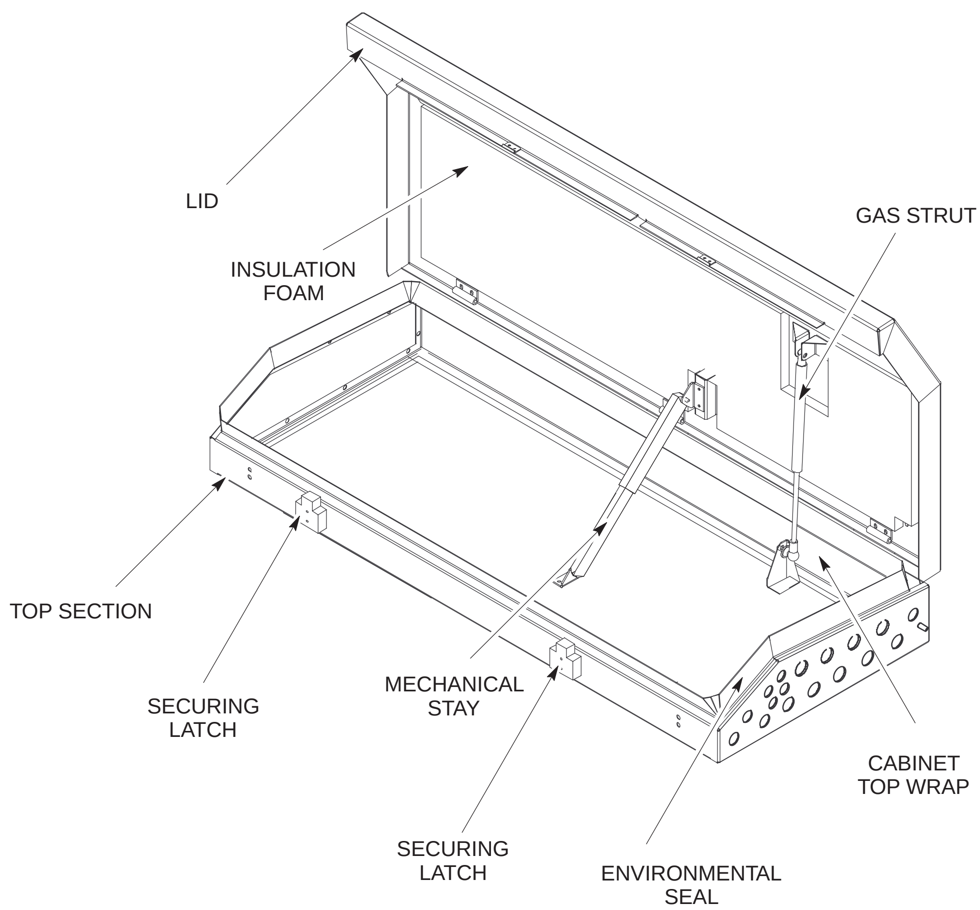


Figure 3-3 Inside view of the lid

Replacing a lid

Removing a faulty lid

To remove the lid proceed as follows:

1. Unscrew the M6 nut and star washer which secures the lid earth cable to the cabinet.
2. Remove the circlips from the hinge pins.
3. Unbolt gas strut from the lid.

WARNING	The cabinet lid weighs 15 kg. Handle with care and observe proper lifting precautions.

4. Support the lid and unscrew the mechanical stay from the lid.
5. Remove the three hinge pins by pulling their lugs in the required direction, using long nose pliers.
6. Remove the lid and place safely to one side.

Fitting a replacement lid

To install a replacement lid proceed as follows:

1. Support the lid in position, so that the hinges line up.
2. Insert the three hinge pins fully into the hinges.
3. Screw the mechanical stay to the lid.
4. Bolt the gas strut to the lid.
5. Fit the circlips into the recesses in the hinges.
6. Attach the lid earth cable to the cabinet using the M6 nut and star washer. Tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).

Replacing environmental seals

Introduction to environmental seal replacement

A faulty environmental seal can allow moisture to enter the cabinet, which in turn can lead to equipment failure. It is important that the seals are inspected for signs of wear or damage whenever the cabinet doors or lid are opened.

Replacing an environmental seal for the lid

The environmental seal for the lid consists of a U-shaped rubberized seal that fits over the metal lip on the top of the cabinet (see Figure 3-3).

The procedure for replacing the seal for the lid is as follows:

1. Open the cabinet doors, release the lid catches and then lift the lid so that it locks in position.
2. Pull the old seal off the metal lip.
3. Measure the length of the new seal against the old seal and trim to the correct length, if necessary.
4. Starting at the centre, press the new seal firmly onto the metal lip all the way around. Ensure that both ends of the seal meet at the centre of the front lip.
5. Close the lid and the cabinet doors.

The procedure for replacing the environmental seal for the lid is now complete.

Replacing an environmental seal on a door

The environmental seals for the doors consist of four strips of self-adhesive gasket, fixed to the inside panel of each door.

The procedure for replacing the seal for a door is as follows:

1. Open the cabinet doors.
2. Trace a line around the inside edge of each seal strip as a marker for positioning the new seal strips.
3. Remove the old seal strips. Remove all traces of adhesive using a suitable solvent.
4. Fit the new seal strips, ensuring that the inside edges align with the marks made prior to removing the old seals.
5. Close the doors.

The procedure for replacing the environmental seal for a door is now complete.

Replacing a thermal management system (TMS) unit

Introduction to TMS replacement

The TMS units can be replaced while the cabinet is operational, but be aware that forced air cooling is stopped and cooling is only by natural convection while the TMS is out of service. This will raise equipment temperature, and could shut down the cabinet by triggering the temperature sensors.

CAUTION	If the cabinet is operational, this replacement procedure should be completed without delay, in order to minimize duration of air cooling disruption.

View of the TMS unit

Figure 3-4 shows a view of the TMS unit, removed from the cabinet, with upper panels and air ducts omitted for clarity.

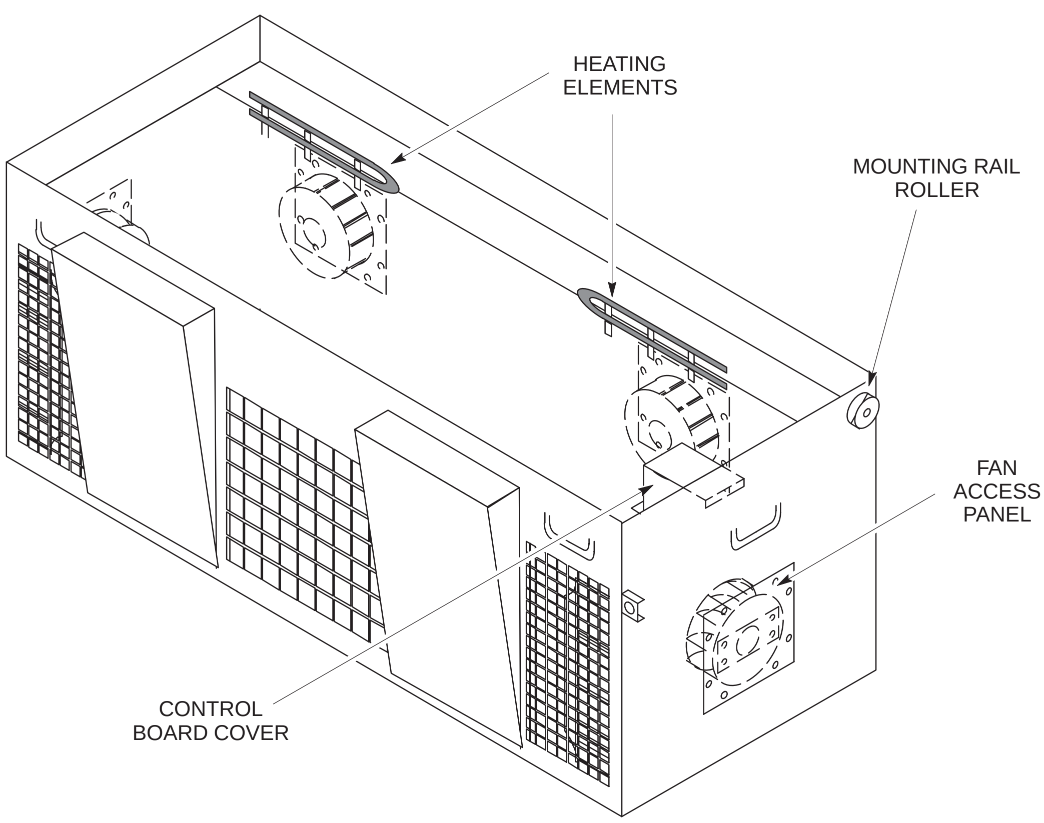


Figure 3-4 TMS unit showing major features

Removing the TMS unit

To remove the TMS unit:

1. Remove the TMS front access panel at the base of the cabinet.
2. Shut down the TMS by switching off the TMS FANS at the dc circuit breaker panel and the TMS heater ac circuit breaker at the number 2 ac power distribution box.

CAUTION	Care must be taken at all times to avoid cable damage caused by abrasion as cables pass through cabinet apertures.

3. Disconnect the following TMS cables:
   – The ac cable from the plug at the front right of the power supply enclosure.
   – The dc cable from the connector at the front left of the power supply enclosure.
   – The alarm cable from the connector PL5 at the alarms interface board.
4. Feed the cables through the aperture into the cable well and tie them safely out of the way.
5. Disconnect the earth bonding cable from the TMS unit.
6. Remove and retain the two TMS securing screws and washers, on the front of the TMS unit, using a crosspoint screwdriver.

WARNING	The TMS unit can weigh up to 40 kg. Handle with care and observe proper lifting precautions.

7. Pull the unit forwards, using the front two built-in handles, lowering the front edge to ease pressure on the seals.

NOTE	The TMS unit is supported by rollers at the rear (see Figure 3-4). These run on rails in the bottom wrap of the cabinet.

8. When the TMS unit is fully withdrawn, carefully lift it out of cabinet, using the built-in handles on the sides and place it on a dry surface in a position suitable for further work.

Refitting the TMS unit

To refit the TMS unit:

1. Examine the TMS unit gasket for damage or degradation, replace if necessary as described in **Replacing TMS unit components**.

WARNING	The TMS unit can weigh up to 40 kg. Handle with care and observe proper lifting precautions.

2. Carefully lift the rear of the TMS unit into place, positioning the two rollers onto the rails in the bottom wrap of the cabinet.
3. Push the TMS unit into place, lifting the front into position before locating the front fixing brackets.
4. Feed the power supply and alarm cables through the aperture into the power supply enclosure.
5. Fit the two, previously retained, screws and washers to secure the TMS unit and tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).
6. Connect the earth bonding cable to the TMS unit.
7. Reconnect the following TMS cables:
   – The ac cable to the plug at the front right of the power supply enclosure.
   – The dc cable to the connector at the front left of the power supply enclosure.
   – The alarm cable to the connector PL5 at the alarms interface board.
8. Switch on the TMS heater ac circuit breaker in the number 2 distribution box and the TMS FANS at the dc circuit breaker panel.
9. Test the operation of the TMS unit as described in *Installation and Configuration: (GSM-204-423)* **Testing the thermal management system**.

Replacing TMS unit components

Introduction to TMS unit component replacement

The following TMS unit internal components can be replaced as FRUs:

- TMS fans.
- TMS control board.
- TMS gasket (only needs to be checked when replacing other TMS FRUs).

The information contained here assumes that the TMS unit has been removed from the Horizon*macro* outdoor cabinet, as previously described.

Replacing a TMS fan

Each of the four fans in the TMS can be replaced as follows (refer to Figure 3-5):

1. Remove the fan access panel by undoing the panel retaining screws using a Torx screwdriver.
2. Gently lift off the access panel and partially withdraw the fan. (The fan is bolted to the rear of the access panel.)
3. Unplug the floating connector and withdraw the fan assembly from the TMS unit.
4. Place the fan assembly on a flat surface. Undo the four mounting plate retaining bolts and remove the fan and mounting plate from the spacers on the access panel.
5. Remove the fan from the mounting plate by undoing the four fan securing bolts on the underside of the mounting plate.

Replacement is a reversal of the removal procedure.

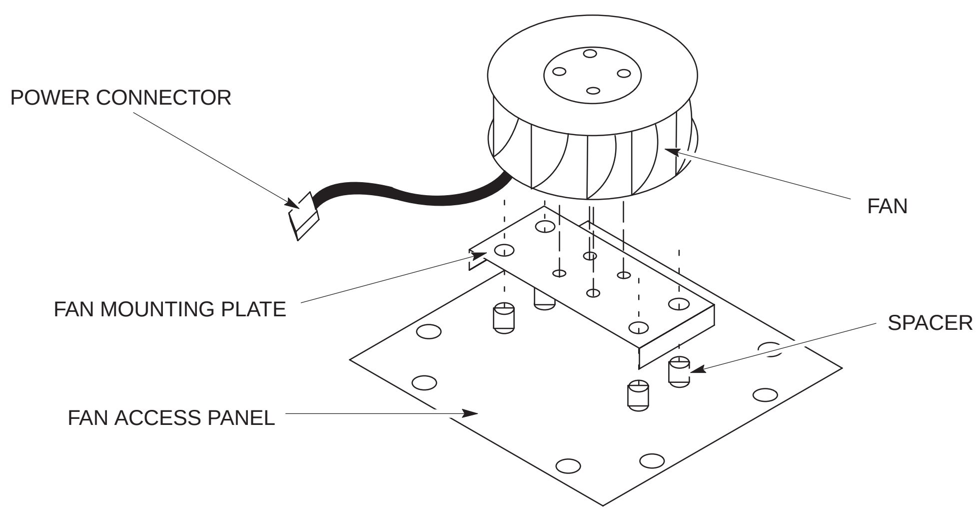


Figure 3-5 TMS fan assembly

Replacing the TMS control board

The TMS control board is mounted under a metal cover on the right side of the TMS (see Figure 3-4).

Carry out the following procedure to replace the control board:

1. Undo the two cover retaining screws and remove the cover.
2. Undo the six screws that secure the board in position.
3. One by one, unplug the connectors and plug them onto the corresponding connectors on the new board. Remove the old board once all the connectors have been removed.
4. Mount the new board and secure in position using the six screws.
5. Refit the metal cover and tighten the cover retaining screws.

The procedure for replacing the TMS control board is now complete.

Replacing the TMS gasket

The TMS gasket is designed to last the lifetime of the equipment. However, should it become damaged, it can easily be replaced as follows:

1. Strip off the old gasket from the flange.
2. Clean all traces of adhesive from the flange using a suitable solvent.
3. Carefully fit the new gasket onto the flange.

The procedure for replacing the gasket is now complete.

Replacing a cabinet temperature sensor

Overview of main cage temperature sensor FRUs

Three temperature sensors plug into the backplane from the front above the CTUs. Each one can be removed separately, and a replacement inserted.

Replaceing a main cage temperature sensor

WARNING	Severe burns may result if CTU power is **ON** when RF cables are disconnected.

The procedure for replacing a main cage temperature sensor is as follows:

1. Turn cabinet PSMs off, to ensure that the CTU power is **OFF**, before disconnecting RF cables.
2. Remove the CTUs (see **Replacing a CTU**).
3. Identify the faulty temperature sensor.
4. Unplug the faulty temperature sensor.
5. Insert the replacement temperature sensor.
6. Install the CTUs (see **Replacing a CTU**).

The temperature sensors should now be operational.

Replacing a dc circuit breaker

Introduction to dc circuit breaker replacement

The procedure for replacing an individual dc circuit breaker in the dc circuit breaker panel is described here.

View of the dc circuit breaker panel

Figure 3-6 show a view of the dc circuit breaker panel.

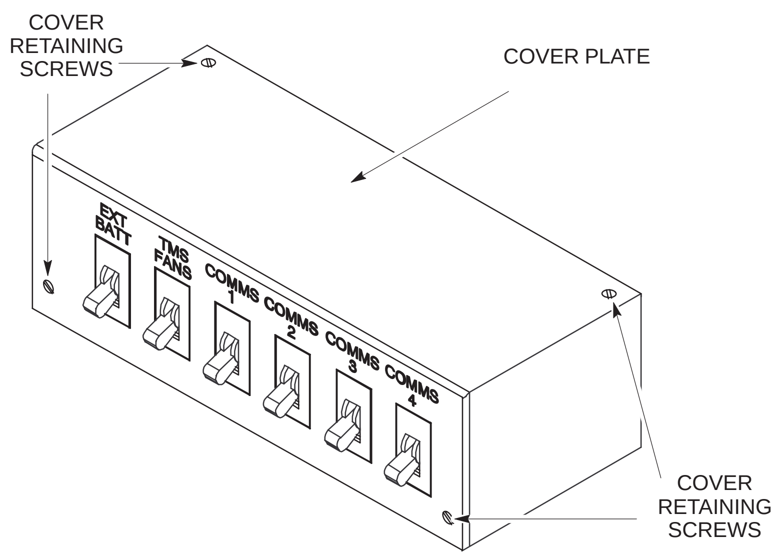


Figure 3-6 DC circuit breaker panel

Replacing a dc circuit breaker

The procedure for replacing a circuit breaker is as follows:

1. Remove the L-shaped cover plate by undoing the four retaining screws.
2. Pull out the faulty circuit breaker.
3. Push the new circuit breaker into the bullet type connector. Ensure that the replacement circuit breaker is of the same rating as the one removed.
4. Refit the cover and tighten the four retaining screws.

The procedure for replacing the dc circuit breaker is now complete.

Replacing the control and alarm board (CAB)

Introduction to CAB replacement

This procedure describes how to remove and replace a CAB in the Horizon*macro* outdoor cabinet PSU.

The CAB is located in the PSU cage in the power supply enclosure half of the cabinet, to the left of the number 2 ac power distribution box.

WARNING	Potentially lethal voltages, up to 415 V ac, and other high energy sources are present within the cabinet when the ac supply disconnect switch is set to the ON position and/or batteries are connected.

Replacing a CAB does not require the removal of power. The CAB can be hot swapped without harm to the module or affecting normal service operation.

Notify the OMC-R of imminent repair activity.

View of CAB

Figure 3-7 shows a typical CAB. The front panel and circuit board layout may vary slightly, depending on the manufacturer.

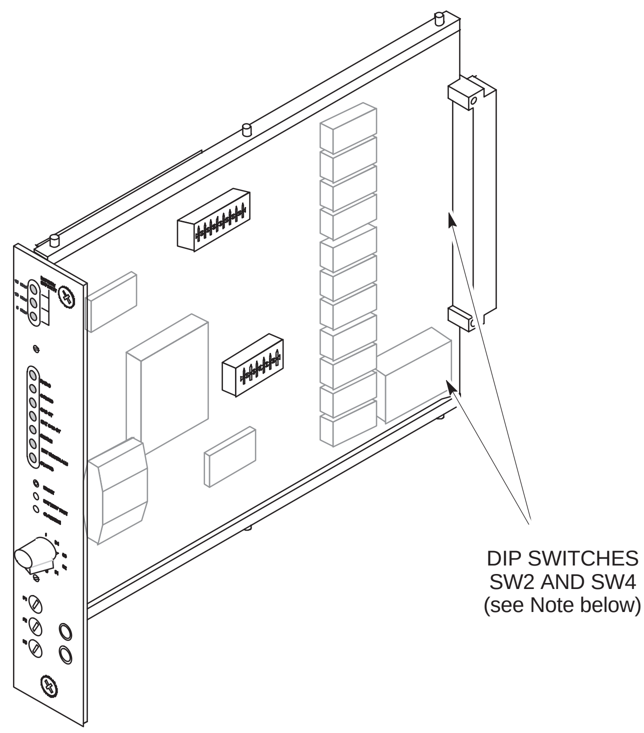


Figure 3-7 Control and alarm board (CAB)

Replacing a CAB

A faulty CAB may be replaced using the following procedure:

1. Unscrew the two front panel fasteners using a Torx driver or crosspoint screwdriver.
2. Withdraw the CAB until the edge connector at the rear unplugs.
3. Carefully slide the CAB from its location.
4. Remove the replacement CAB from its anti-static storage container. Check that the DIP switch settings on the replacement CAB match those on the original board.
5. Place the original CAB in an anti-static storage container.
6. Slide the CAB along the guide rails and push firmly into place.
7. Tighten both front panel attachment screws. Tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).
8. Check the CAB front panel LEDs for alarm indications.
9. Notify the OMC-R of base station availability and log the maintenance activity.

Replacing the outdoor power supply module (TOPSM)

TOPSM replacement

This procedure describes how to remove and replace a TOPSM in an Horizon*macro* outdoor cabinet.

Up to three TOPSMs can be located in the PSU cage in the power supply enclosure half of the cabinet.

WARNING	Potentially lethal voltages, up to 415 V ac, and other high energy sources are present within the cabinet when the ac supply disconnect switch is set to the ON position and/or batteries are connected.

Replacing an TOPSM does not require the removal of power, however it is advisable to perform this procedure during periods of low traffic, as available power is reduced.

Notify the OMC-R of imminent repair activity.

View of TOPSM

Figure 3-8 shows a view of the TOPSM.

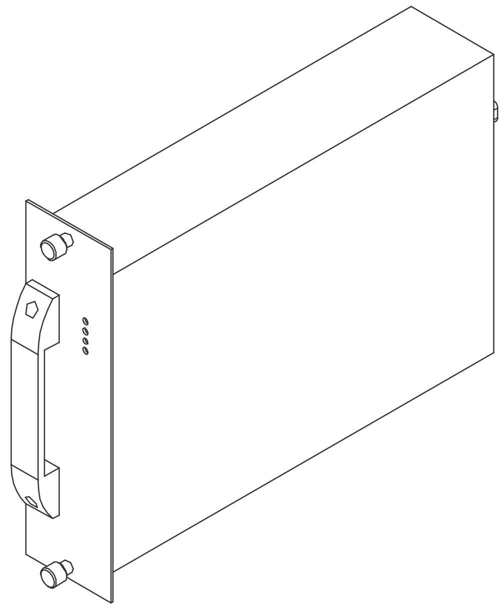


Figure 3-8 The outdoor power supply module (TOPSM)

Replacing a TOPSM

To remove a TOPSM

1. Switch OFF the appropriate circuit breaker for the TOPSM being replaced (TOPSM 0 to TOPSM 2) on the number 2 ac distribution box.
2. Unscrew the two M6 captive fasteners that secure the TOPSM to the PSU cage.

CAUTION	Handle the TOPSM with care; the unit weighs 4.6 kg.

3. Slide the TOPSM out of the PSU cage, supporting it from beneath with the other hand as it emerges. Place it securely to one side.

The procedure for removing the TOPSM is now complete.

To install a replacement TOPSM

1. Repeat the removal procedure in reverse order.
2. Ensure that the TOPSM is pushed fully home into its connector on the backplane before tightening the two M6 screws. Tighten to a torque of 3.4 Nm.
3. Switch on the circuit breaker for the TOPSM.
4. Check the operation of the TOPSM LEDs, as described in *Installation and Configuration, Category 423.*

The procedure for replacing the TOPSM is now complete.

Notify the OMC-R of base station availability and log the maintenance activity.

Replacing a power supply module (PSM)

Introduction to PSM replacement

Only one type of PSM is used in Horizon*macro* outdoor, –48V dc positive earth.

There are three slots for PSMs. A single PSM can power a cabinet containing up to three CTUs therefore, a cabinet populated with six CTUs only requires two PSMs to be fully operational. The third slot can be used for an additional power supply to provide redundancy. A replacement PSM can be inserted into a vacant slot without powering down, thereby avoiding any need to take the cabinet out of service.

View of PSM

Figure 3-9 shows a view of the PSM with key features identified.

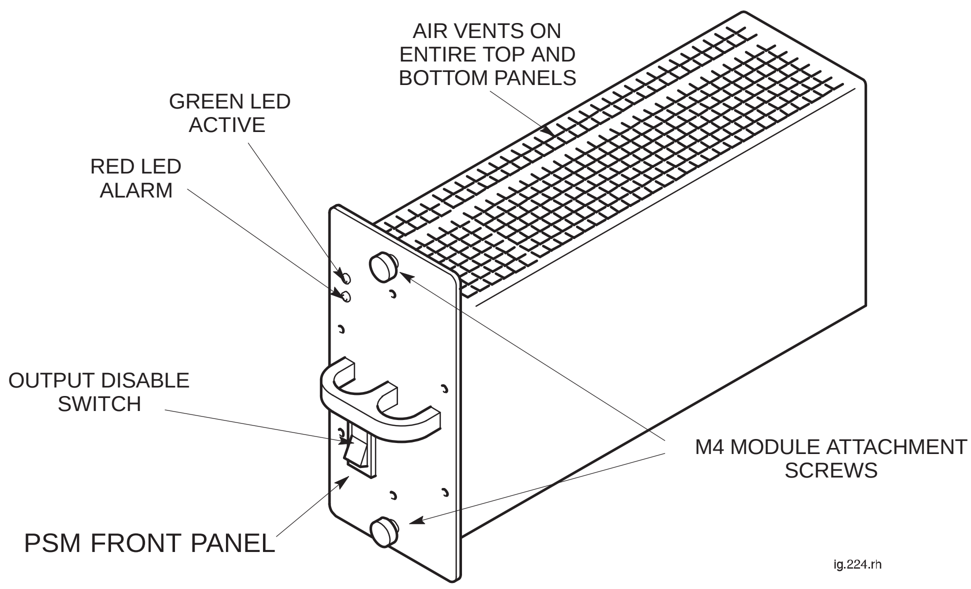


Figure 3-9 View of PSM with key features identified

Replacing a non-redundant PSM

The following procedure should be followed if only two PSMs are fitted in the cabinet:

CAUTION	Only –48/60 V dc PSMs can be used in Horizon*macro* outdoor cabinets. Ensure that the replacement PSM is of the appropriate type (kit number SVPN1221).

1. Verify that the switch of the replacement PSM is set to output disable.
2. Remove the blanking assembly of the spare slot, by unscrewing the attachment screws using an M4 Torx driver.
3. Insert the replacement PSM in spare slot.
4. Ensure the replacement PSM is firmly in position and tighten both module attachment screws using the M4 Torx driver. Tighten to correct torque (see **Overview of FRU replacement procedures** in this chapter).
5. Set the switch to OUTPUT ENABLE. Check that the green LED (ACTIVE) is lit.
6. Set the switch on the faulty PSM to OUTPUT DISABLE. The green ACTIVE LED will go off (the green light may already be off if PSM failure has resulted in output failure of that PSM). The red LED, if already ON due to alarm state, will stay ON.
7. Undo the module attachment screws using the M4 Torx driver, and remove the module. The red LED will go OFF.
8. Fit the cover plate by tightening the attachment screws using the M4 Torx driver. Tighten to correct torque as stated in step 4.

Replacing a redundant PSM

The following procedure should be followed if three PSMs are fitted in the cabinet:

CAUTION	Only –48/60 V dc PSMs can be used in Horizon*macro* outdoor cabinets. Ensure that the replacement PSM is of the appropriate type (kit number SVPN1221).

1. Verify that the switch of the replacement PSM is set to output disable.
2. Set the switch on the faulty PSM to OUTPUT DISABLE. The green LED (ACTIVE) will go off (the green light may already be off if PSM failure has resulted in output failure of that PSM). The red LED, if already ON due to alarm state, will stay ON.
3. Undo the module attachment screws using an M4 Torx driver, and remove module. The red LED will go OFF.
4. Insert the replacement PSM.
5. Ensure the replacement PSM is firmly in position and tighten both module attachment screws using the M4 Torx driver. Tighten to correct torque (see **Overview of FRU replacement procedures** in this chapter).
6. Set the switch to OUTPUT ENABLE. Check that the green ACTIVE LED is lit.

BPSM replacement

The procedure for replacing a BPSM is described in **Digital module replacement** in this chapter.

Replacing a circuit breaker module (CBM)

Preconditions for CBM replacement

The CBM controls power for the power supply enclosure, apart from the PSMs. Consequently, the replacement of a CBM can only take place after the cabinet has been taken out of service, in agreement with the OMC-R.

Views of CBM

Figure 3-10 shows views of the CBM with circuit breaker buttons identified.

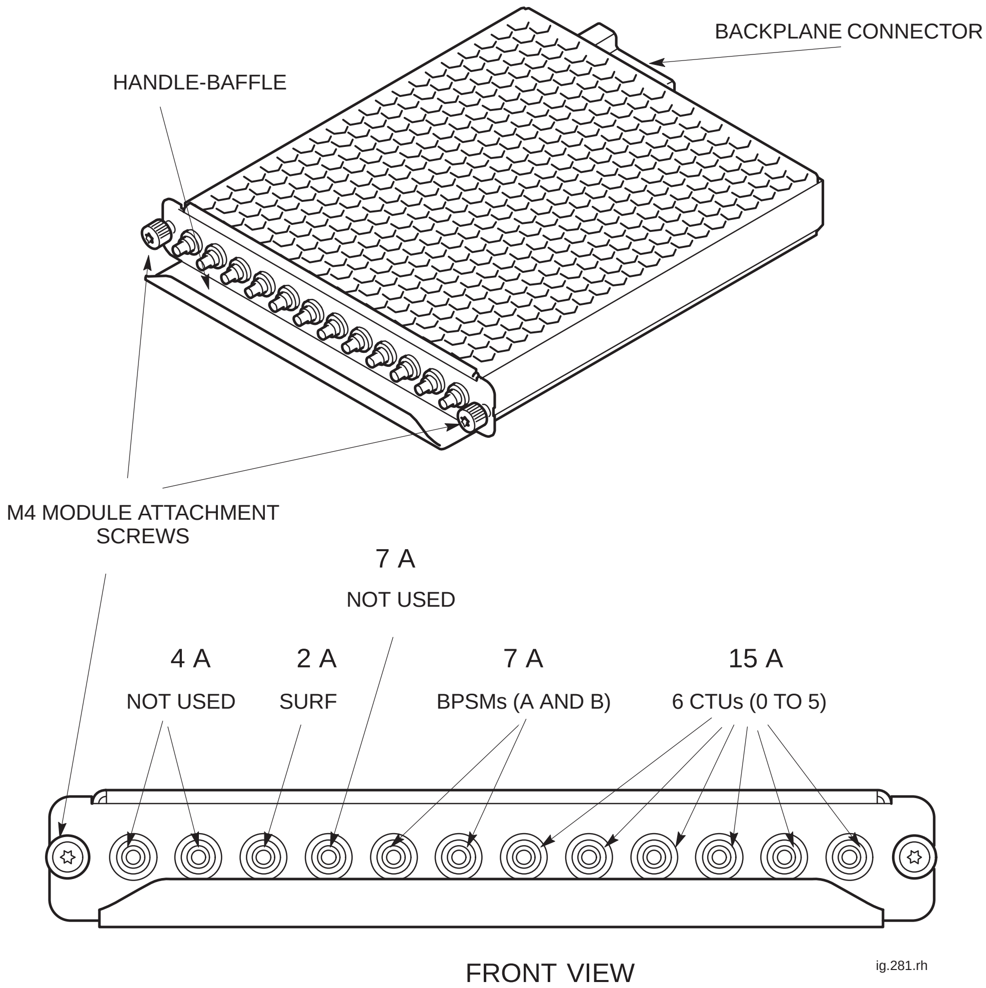


Figure 3-10 Views of CBM with circuit breaker buttons identified

Replacing a CBM

To replace a CBM:

1. Set the main circuitbreaker in the number 1 ac distribution box to OFF.
2. Set the three PSUcircuit breakers in the number 2 ac distribution box to OFF.
3. Set the switch of each PSM to the OUTPUT DISABLE position.
4. Unscrew both CBM module attachment screws (shown in Figure 3-10) by using an M4 Torx driver.
5. Pull the module out, using the handle-baffle.
6. Check that all push on/push off circuit breaker buttons of the new CBM module are in the **out** (off) position.
7. Install the new module and press firmly into place.
8. Tighten both module attachment screws to correct torque (see **Overview of FRU replacement procedures** in ths Chapter), using an M4 Torx driver.

To restore power to the cabinet:

1. Set the main circuitbreaker in the number 1 ac distribution box to ON.
2. Set the three PSUcircuit breakers in the number 2 ac distribution box to ON.
3. Turn each PSM switch to the OUTPUT ENABLE position. Check that each PSM has the ACTIVE (green) light on and the ALARM (red) light off.
4. Press the CBM circuit breaker button marked **BPSM A** and (if redundant BPSM fitted) **BPSM B**. Check all associated digital module indicators operate correctly.
5. Press the CBM circuit breaker button marked **SURF**.
6. Press the CBM appropriate circuit breaker buttons for the CTUs fitted, and check that the LEDs for each CTU indicate correct operation.
7. Close the door to ensure correct ventilation.

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

Replacing the internal batteries

Introduction to internal battery replacement

The internal backup battery tray is mounted in the lower right side of the PSU cage, below the number 2 ac distribution box. Four 12 V batteries are mounted on their sides in the battery tray, connected in series to provide –48 V dc.

It is usual to replace the battery tray, complete with Yuasa long life batteries as an FRU item, although the batteries may be replaced separately, if required. Be aware that if a different make of battery is fitted, however, the original cables supplied may not fit and the cables may also have to be replaced.

NOTE	Power does not need to be removed from the cabinet to replace the batteries. Use the circuit breaker switch on the battery tray front panel to isolate the batteries from the system prior to removal.

Figure 3-11 shows the battery tray, with the batteries installed.

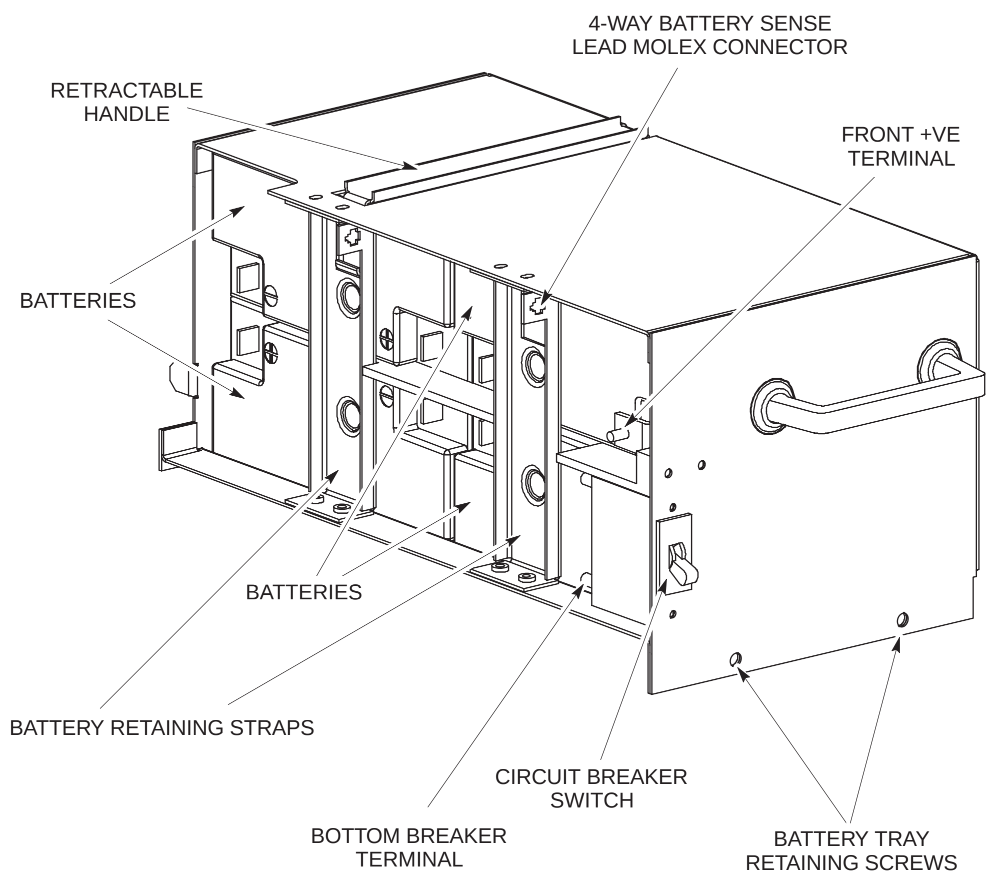


Figure 3-11 Internal batteries, mounted in the battery tray

Battery arrangement

Figure 3-12 shows how the batteries are arranged in the battery tray.

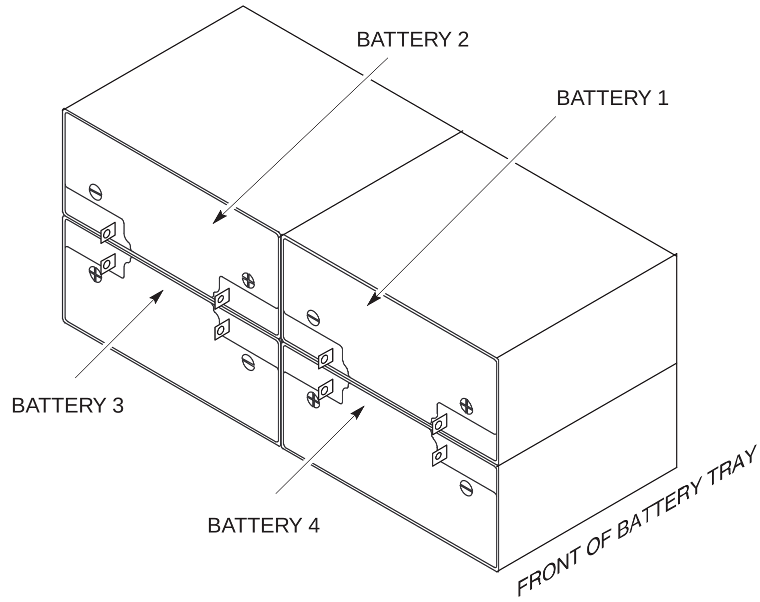


Figure 3-12 Internal battery arrangement in the battery tray

Removing the battery tray

Carry out the following procedure to remove the internal battery tray from the Horizon*macro* outdoor cabinet:

WARNING	The batteries are capable of supplying high short circuit currents and thus provide a high energy hazard.

CAUTION	The battery tray is heavy. Take care when removing it from the cage. Each battery cable must be insulated as soon as it is disconnected from the terminal.

1. Isolate the batteries by switching off the circuit breaker on the battery tray front panel.
2. Undo the two battery tray retaining screws on the lower front panel (see Figure 3-11), and PARTIALLY withdraw the battery tray from the cage.
3. Using insulated spanners, disconnect the cables from the front positive terminal and then the bottom breaker terminal. Disconnect the 4-way battery sense lead Molex connector.
4. Slowly withdraw the tray until the retractable handle is exposed. With one hand on the handle on the front panel and the other on the top handle, lift the rear of the tray to disengage it from the cage and then gently pull the tray completely out of the cage.

The procedure for removing the battery tray is now complete.

Replacement is a reversal of the removal procedure.

Removing and replacing the batteries

If it is necessary to remove the batteries from the battery tray, use the following procedure (letters and numbers in parentheses refer to Figure 3-13). Table 3-2 details the wiring schedule of the battery sense lead for reference.

NOTE	This procedure assumes that the battery tray has been removed from the cabinet, as described previously.

CAUTION	Each battery cable must be insulated as soon as it is disconnected from the battery terminal. Battery sense leads must be connected to the negative terminal of the correct battery as shown in Figure 3-13.

1. Using spanners with insulated handles, undo the M5 screws and remove the interconnection cable and the battery sense lead (B) from the rear battery terminals (1).
2. Undo the M5 screws and remove the interconnection cables and battery sense leads (C and D) from the middle battery terminals (2).
3. Disconnect the braid and battery sense lead (E) from the top terminal of the circuit breaker (3).
4. Remove the two battery retaining brackets (4) by undoing the eight M4 screws.
5. Lift out the central insulation block (5) from between the middle terminals.
6. Remove the front insulator block (6) by undoing the two M4 screws on the front panel of the battery tray.
7. Remove the circuit breaker (3) by undoing the two M3 screws on the front panel of the battery tray.
8. Raise the upper rear battery (7) slightly, then disengage and remove the handle (8).
9. Remove the rear battery, followed by the remaining batteries.

The procedure for removing the batteries is now complete. Remove the L-shaped battery terminal (9) from from the upper battery terminal and fit onto the new battery to be installed in that position.

Battery replacement is a reversal of the removal procedure.

View showing battery replacement components

Figure 3-13 shows a view of the internal batteries with the components identified to assist in battery replacement.

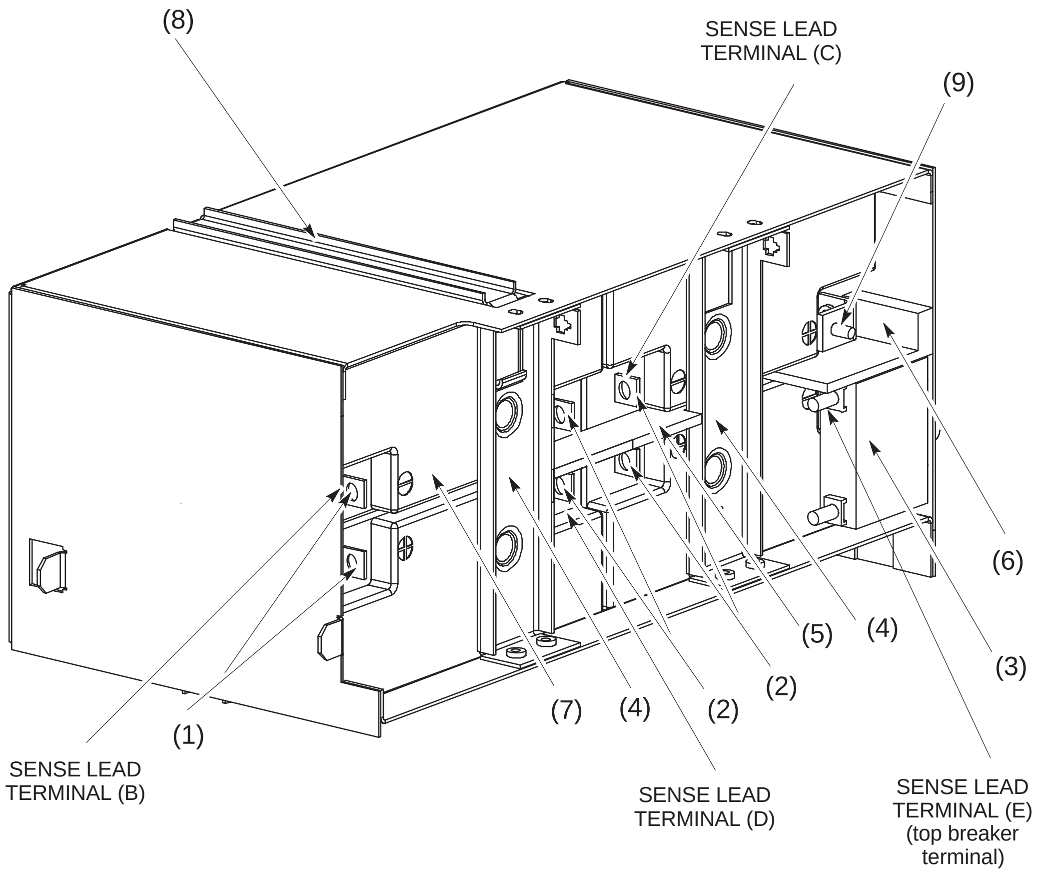


Figure 3-13 Component identification for battery replacement

Table 3-2 details the wiring schedule of the battery sense lead.

Table 3-2 Battery sense lead to Molex connector

Molex connector pin	Terminal ident	Location
1	C	Battery 1 –ve terminal
2	B	Battery 2 –ve terminal
3	D	Battery 3 –ve terminal
4	E	Battery 4 –ve terminal at circuit breaker top terminal

Replacing a CTU

Preconditions to CTU replacement

There are six CTUs in a cabinet. Replacing a CTU requires removal of RF transmitter power for that CTU; 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 CTU replacement procedure is the same for all CTUs, regardless of frequency rating.

View of CTU

Figure 3-14 shows a view of a CTU with key features identified.

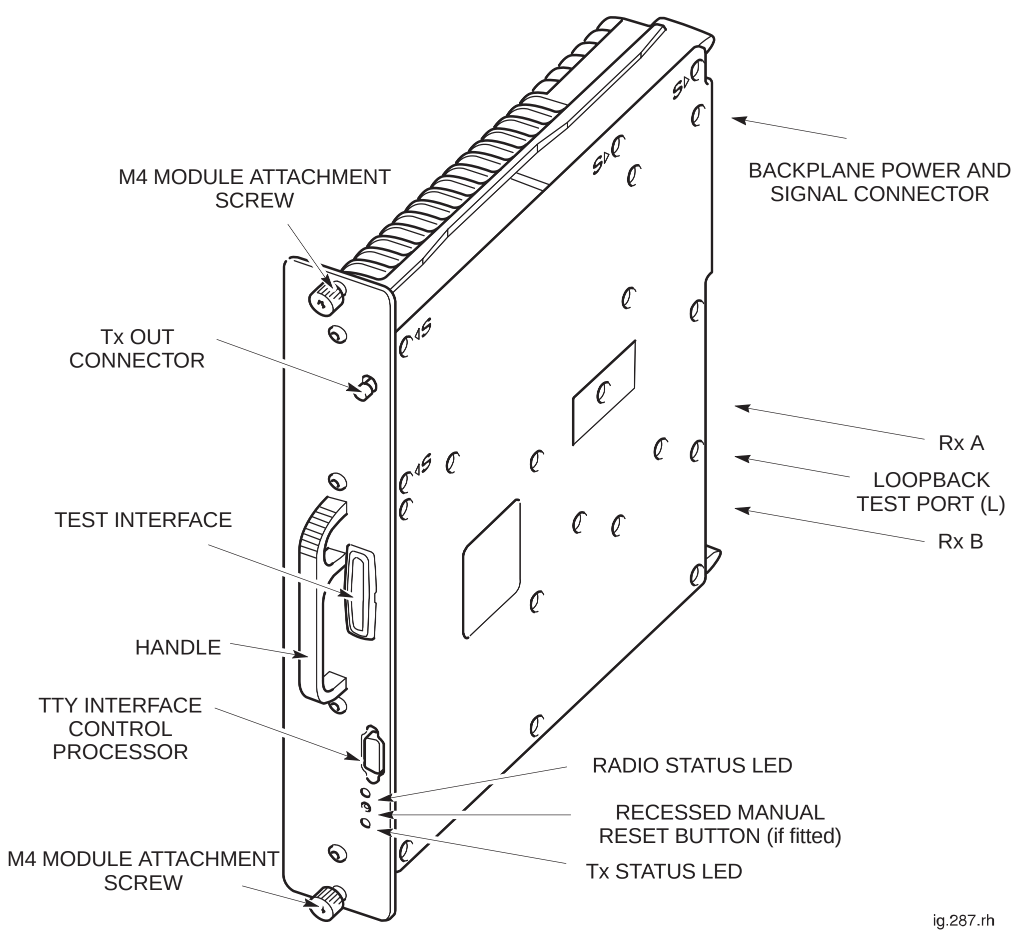


Figure 3-14 CTU view with key features identified

Replacement procedure for CTU

CAUTION	An earthing wrist strap must be worn when handling CTUs. An ESP earthing connection point is provided above the leftmost PSM.

Removing a faulty CTU

To remove a CTU:

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

NOTE	Refer to *Technical Description: BSS Command Reference (GSM-100-321)* for information on usage and specific commands.

3. When the CTU has been shutdown, check that the Tx STATUS LED (solid yellow) is extinguished.
4. Press and release the appropriate CTU circuit breaker button on the CBM to the out (off) position. Ensure the RADIO STATUS LED is extinguished.

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 CTU front panel.
6. Unscrew the two CTU attachment screws using an M4 Torx driver.

WARNING	The CTU weighs 5 kg. Handle with care.

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

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

Fitting a replacement CTU

To fit a replacement CTU:

1. Ensure that the correct CTU push-on/push-off circuit breaker button on the CBM has been pressed to the out (off) position.
2. Ensure that the transmit RF power of the correct CTU has been removed using the **`shutdown_device`** command at the OMC-R or from a PC connected to the MCUF.
3. Insert replacement CTU module, taking care to locate the module on the guide rails. Press firmly in place.
4. Tighten both module attachment screws to the correct torque (see **Overview of FRU replacement procedures** in this chapter), using an M4 Torx driver.
5. Attach the coax cable to the appropriate Tx block or feedthrough plate for the CTU. Tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).

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

6. Screw the coaxial cable onto the Tx OUT SMA connector at the top of the CTU front panel. Tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).
7. Press and release the appropriate CTU circuit breaker button on the CBM. The RADIO STATUS LED will flash green for about two minutes, and then remain lit.

CAUTION	If both RADIO STATUS and Tx STATUS LEDs are flashing, the boot code is downloading into non-volatile memory for software upgrade. Power should not be removed, nor the cabinet reset, until downloading has been completed, as this will corrupt the non-volatile memory. If the boot code is corrupted, contact the Motorola Customer Network Resolution Centre, requesting the boot code restoration procedure and the appropriate boot code file.

8. Enable the CTU transmit RF power by using the **`ins_device`** command at the OMC-R, or from a PC connected to the MCUF. The Tx STATUS LED (yellow) will be lit if the CTU is transmitting.
9. Notify the OMC-R of base station availability and log the maintenance activity.

Replacing a SURF module

Preconditions for SURF replacement

The cabinet contains only one SURF module, either a dual band SURF or a single band SURF. Consequently, the replacement of a SURF module 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 SURF modules. An ESP earthing connection point is provided above the leftmost PSM.

View of the SURF

Figure 3-15 shows a single band SURF module. Where **RXn** appears in Figure 3-15, the **n** may be 850, 900, 1800 or 1900, depending on the frequency of the SURF module.

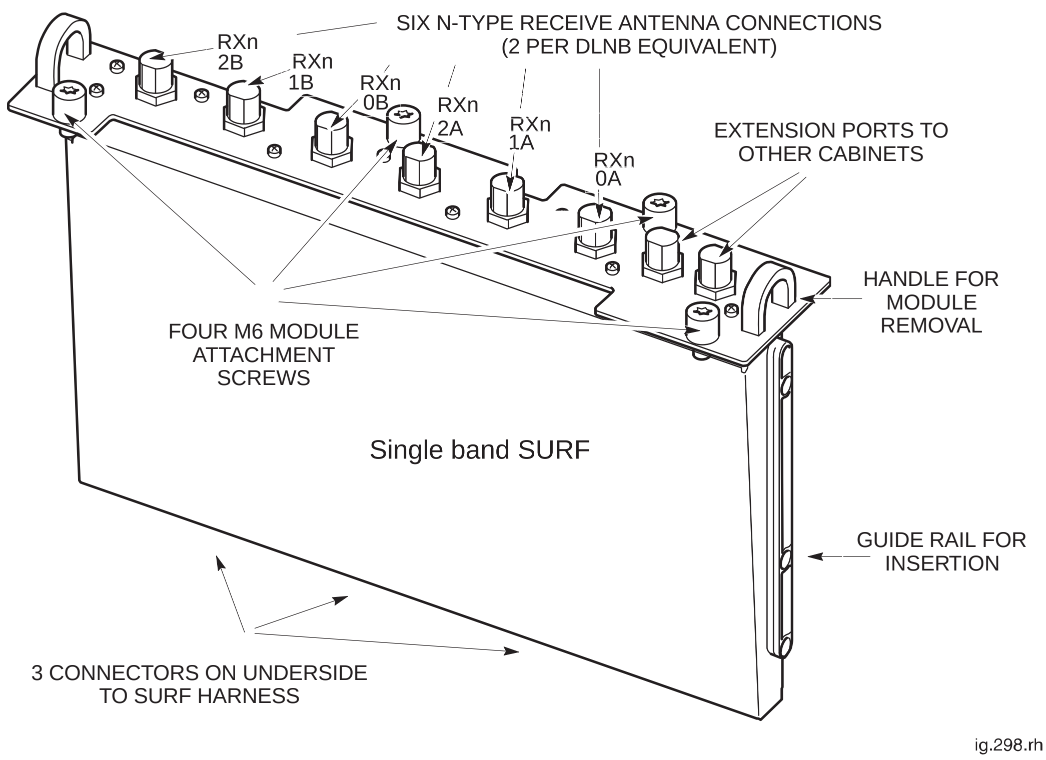


Figure 3-15 View of a single band SURF module

NOTE	The dual band SURF replacement procedure is almost identical, with the addition of the extra two second frequency antenna connections.

Replacing a SURF module

Removing a faulty SURF module

To remove a SURF proceed as follows:

NOTE	The procedure for replacing a faulty SURF module is the same for both single and dual band SURF variants.

1. Note the RF cable connections to the SURF module to enable correct reconnection to the replacement module.

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

2. Disable all CTU transmit RF power by using the **`shutdown_device`** command at the OMC-R, or from a PC connected to the MCUF.

NOTE	Refer to *Technical Description: BSS Command Reference (GSM-100-321)* for information on usage and specific device codes.

3. When all CTUs have been shutdown, check that the Tx STATUS LED (yellow) is extinguished.
4. Press and release the CTU circuit breaker buttons on the CBM to the out (off) position. Ensure that each RADIO STATUS LED is extinguished.
5. Press and release the SURF circuit breaker button on the CBM to the out (off) position.
6. Disconnect the coaxial RF cables by carefully unscrewing and pulling them out of the module sockets. Note the positions for correct replacement.
7. Using a Torx driver, unscrew the four M6 torx captive screws holding the SURF module to the top of the cabinet.
8. Using the handles, lift the SURF block from the slot.

Installing a replacement SURF module

To install a replacement SURF:

1. Transfer the protective caps on the RF connectors from the replacement module to the faulty module.
2. Insert the replacement SURF module firmly into place. Take care to avoid trapping cables as the module is seated.
3. Tighten the four captive M6 torx screws to the correct torque (see **Overview of FRU replacement procedures** in this chapter).
4. Reconnect the coaxial RF cables to the positions noted in the removal procedure. Tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).
5. Reset the SURF circuit breaker button on the CBM.
6. Reset the CTU circuit breaker buttons on the CBM. Each RADIO STATUS LED will flash green for about two minutes and then remain lit.
7. Enable the CTU transmit RF power by using the **`ins_device`** command at the OMC-R, or from a PC connected to the MCUF. The Tx STATUS LED (yellow) will be lit if the CTU is transmitting.
8. Notify the OMC-R of base station availability and log the maintenance activity.

The SURF module is now installed and operational.

Replacing a Tx block

Preconditions 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 cables are disconnected.

CAUTION	An earthing wrist strap must be worn when handling Tx blocks. An ESP earthing connection point is provided above the leftmost PSM.

There are three slots for Tx blocks in the top panel basket of a cabinet, above the CTUs. There are four types of Tx block: DCF, TDF, DDF and HCU.

Replacing a Tx block requires the removal of RF transmitter power for the CTU(s) that connect with the faulty Tx block. It is therefore advisable to perform this procedure during periods of low traffic. The OMC-R should be notified of imminent repair activity.

It is important to ensure that all Tx Block M6 screw locations have a screw in place and tightened to the correct torque (see **Overview of FRU replacement procedures** in this chapter). This is to ensure correct EMC shielding and general containment.

Views of typical Tx block

Figure 3-16 shows a typical Tx block module used in the Horizon*macro* outdoor cabinet.

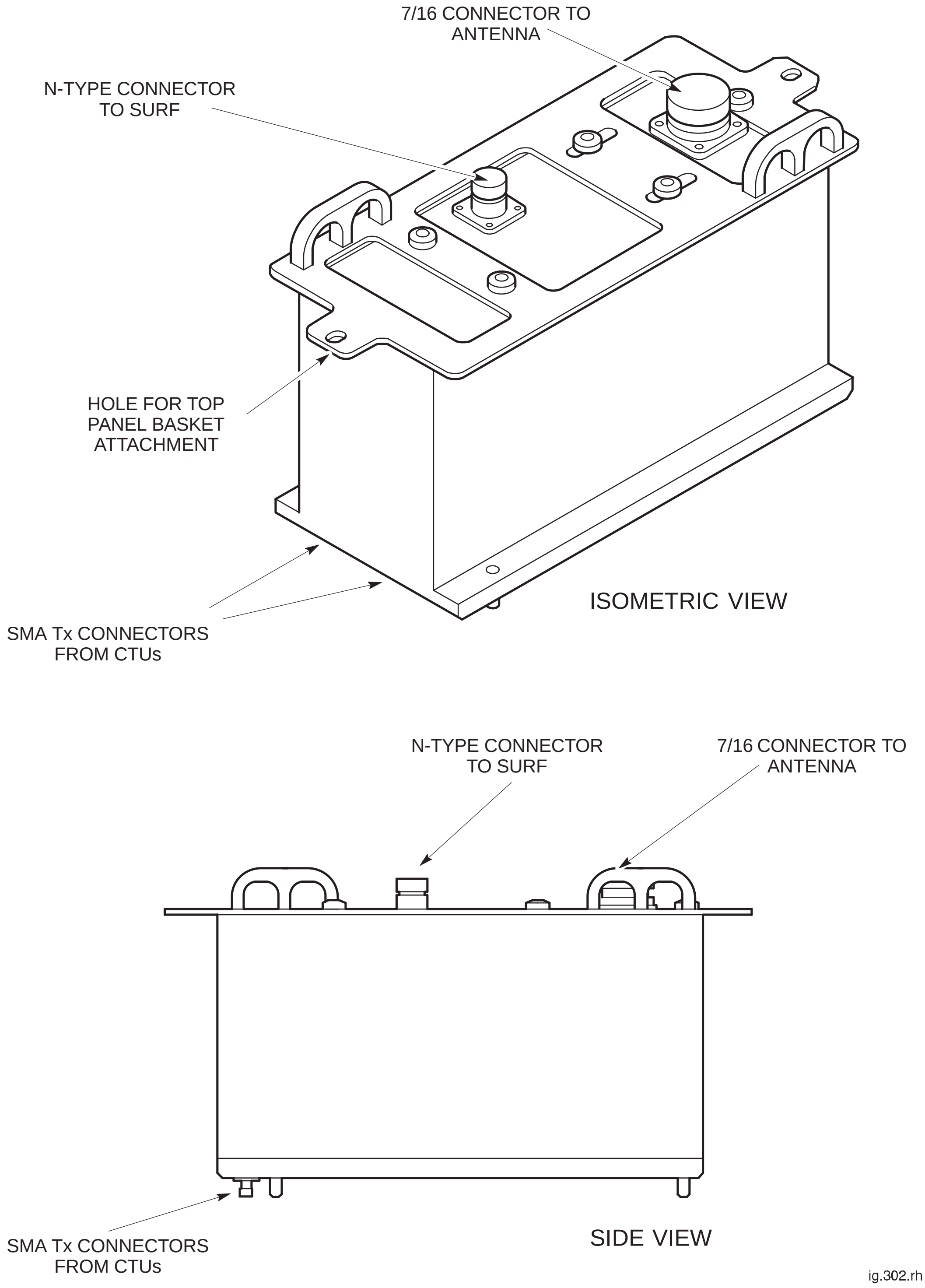


Figure 3-16 View of a typical Tx block

Replacing a Tx block

Removing a faulty Tx block

To remove a Tx block module:

1. Locate the faulty Tx block, and note the RF cable connections to enable correct reconnection to the replacement module.

WARNING	Ensure that **all** CTUs associated with the faulty Tx block are identified (for example inputs to an HCU or feedthrough plate connected to a DDF).

2. Identify the CTUs that make Tx connections to the underside of the faulty Tx block (plus any CTUs connected to the third Tx connector on top of a DDF). See Table 3-3.

Table 3-3 Connectors for each type of Tx block module

Tx block	SMA from transceiver TX	7/16 Rx/Tx to antenna	N-type Rx to SURF
DCF	2 (beneath Tx block)	1	1
TDF (including dual band)	2 (beneath Tx block)	2	2
DDF	3 (2 beneath Tx block) (1 on top of Tx block from HCU)	1	1
HCU	2	0	1 to next Tx block

3. Disable each CTU transmit RF power by using the **`shutdown_device`** command at the OMC-R, or from a PC connected to the MCUF. Refer to *Technical Description: BSS Command Reference (GSM-100-321)* for information on usage and specific device codes.
4. When each CTU has been shutdown, check that the Tx status LED (yellow) is extinguished.
5. Press and release each CTU circuit breaker button on the CBM to the out (off) position. Ensure that all RADIO STATUS LEDs are extinguished.

WARNING	Ensure that RF power is OFF, before disconnecting RF cables. Severe burns may result if RF power is ON when 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 M6 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. Using the handles, lift the Tx block from the basket.

Fitting a replacement Tx block

To install a replacement Tx block:

1. Transfer the protective caps on the RF connectors from the replacement module to the faulty Tx block.
2. Carefully insert the replacement Tx block into its basket location on the top panel, adjusting alignment for retaining screws. Take care to avoid trapping cables as the Tx block is seated.
3. Fit the two M6 torx screws to hold the Tx block to the top of the cabinet. Tighten to the correct torque (see **Overview of FRU replacement procedures** in this chapter).
4. Reconnect the coaxial RF cables to the positions noted in the removal procedure. Tighten to correct torque (see **Overview of FRU replacement procedures** in this chapter).

NOTE	Ensure all unused SMA inputs to DCF, DDF and HCU modules are fitted with 50 ohm load terminations.

5. Reset the appropriate CTU circuit breaker buttons on the CBM. Each RADIO STATUS LED will flash green for about two minutes, and then remain lit.
6. Enable the CTU transmit RF power by using the **`ins_device`** command at the OMC-R, or from a PC connected to the MCUF. The Tx STATUS LED (yellow) will be lit if the CTU is transmitting.
7. Notify the OMC-R of base station availability and log the maintenance activity.

Tx block blanking plate, feedthrough plate or HCU replacement

The procedure for plates is the same as for Tx blocks, but the plates are held by six M4 screws in the base of the Tx block basket. The two M6 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 **Overview of FRU replacement procedures** in this chapter) to ensure correct airflow and EMC shielding.

Krone block replacement

Introduction to Krone block replacement

This procedure describes how to remove and replace a Krone block in Horizon*macro* outdoor cabinet.

Two Krone blocks for external alarms and communications interfaces are mounted on the top panel of the cabinet. Since they are an identical fit, the following procedure describes how to replace either of them.

The Krone blocks can be replaced without interruption to normal operation of the equipment, provided the associated customer alarms and communications signal losses are accounted for.

Krone block location diagram

Figure 3-17 shows the location of the two Krone blocks on the top panel of a Horizon*macro* outdoor cabinet.

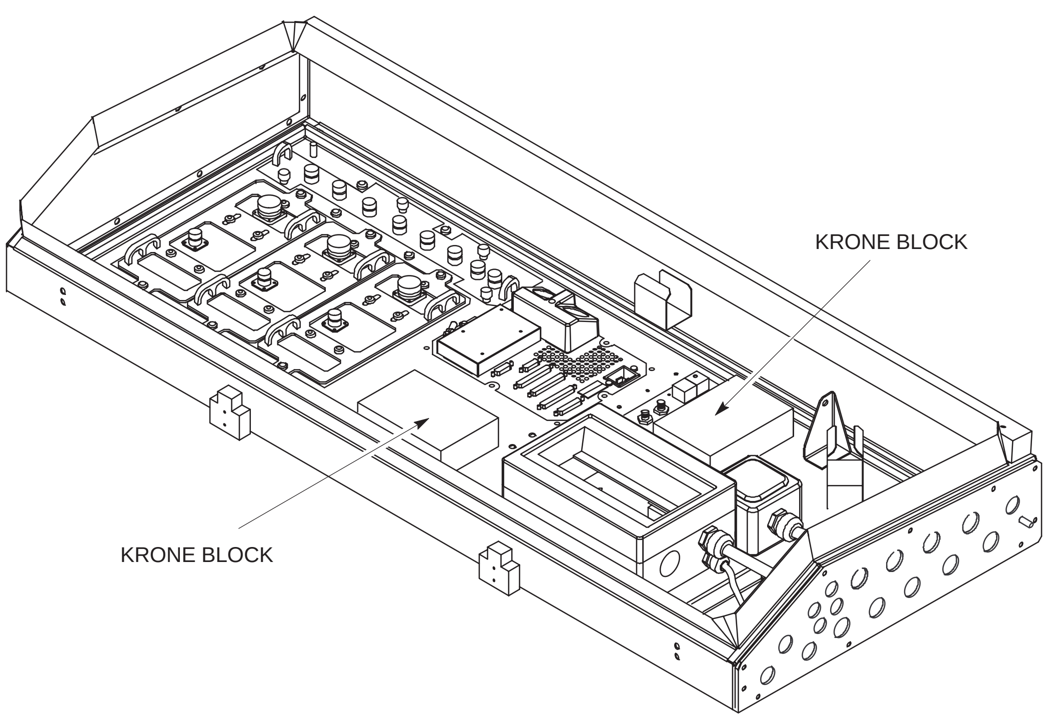


Figure 3-17 Horizon*macro* outdoor cabinet top panel, showing the position of the Krone blocks

Replacing a Krone block

Removing a Krone block

To remove a Krone block:

1. Locate the Krone block to be replaced on the top panel and unscrew the two 4 mm captive screws at diagonal corners of the block. Remove the cover.
2. Note the location of the wires into the terminal blocks and cut them using insulated wire cutters.
3. Undo the two screws securing the 37-pin D-type connector and remove the cable along with all other wiring from the block.

CAUTION	Take care in the following steps when removing the Krone block not to drop the nuts or plain washers down the interior of the cabinet.

4. Using a T20 Torx driver, unscrew and remove the four M3 x 8 screws securing the block to the bulkhead.

The procedure for removing the Krone block is now complete.

Installing a replacement Krone block

To install a replacement Krone block:

1. Repeat the removal procedures in reverse order.

NOTE	When refitting the nuts and washers, tighten to a torque of 1.0 Nm using a 5.5 mm torque wrench. Re-insert the disconnected wires to the positions noted in the removal procedure using an insertion tool.

2. Check the Krone block connections.
3. Notify the OMC-R of the base station availability and log the maintenance activity.

The procedure for installing a new Krone block is now complete.

Digital module and BPSM replacement

Preconditions for digital module replacement

CAUTION	MCUF removal during flash memory programming may result in boot code corruption. This is only repairable by returning the MCUF to Motorola. For this reason, the MCUF should not be removed while the code load is taking place, indicated by a flashing LED.

A faulty master MCUF, FMUX or BPSM will enable a redundant module (if fitted) to take over until the faulty module is replaced. Faulty MCUF, FMUX and BPSM modules can be hot swapped without harm to the module or effect on normal operation, provided the redundant module has taken over. Any faulty module which has not had its function taken over by a redundant module will affect service when removed. Inform the OMC-R before carrying out such procedures.

Digital module location diagram

Figure 3-18 shows the location of modules within the digital module shelf.

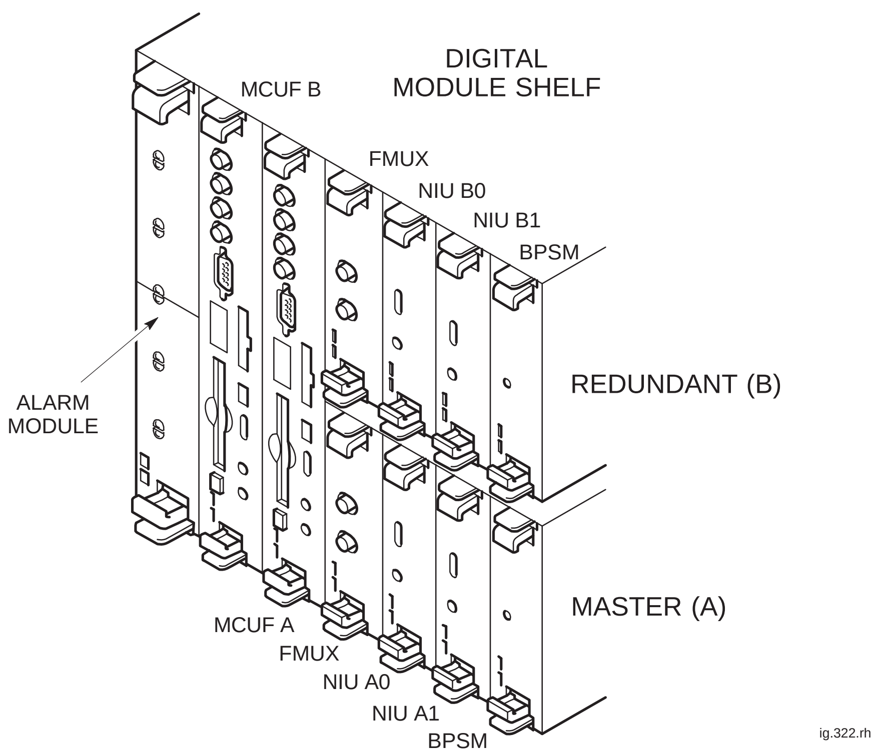


Figure 3-18 Digital and BPSM module locations, including optional redundancy

Replacing a digital module

Removing a faulty digital module

To remove a digital 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.

CAUTION	An earthing wrist strap must be worn when handling digital modules. An ESP earthing connection point is provided above the leftmost PSM.

1. If the faulty digital module is still partially operating, due to no redundant alternative module, inform the OMC-R before proceeding.
2. Locate the faulty module, as shown in Figure 3-18.
3. If an MCUF or FMUX module is being replaced, note any fibre optic cable connections to the module, to enable correct reconnection to the replacement module.
4. Disconnect each fibre optic cable by gently pushing the knurled connector in and rotating it through a quarter-turn anti-clockwise to disengage, and then carefully withdraw the cable.

NOTE	It is advisable to protect the tips of the fibre optic cables with a protective cover and then secure the cables to one side.

5. 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.
6. Carefully slide the module from its location and place it in an anti-static storage container.

Fitting a replacement digital module

To install a replacement digital module:

1. Remove the replacement module from the anti-static storage container. In the case of the NIU, ensure it is of the correct type (E1 or T1).
2. 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. Connect any fibre optic cables by inserting the connector and rotating a quarter-turn clockwise to engage.
4. Ensure appropriate LEDs indicate correct operation.

CAUTION	When the two LEDs of the MCUF, are flashing, the boot code is downloading into non-volatile memory for software upgrade. Power should not be removed, nor the cabinet reset, until downloading has been completed, as this will corrupt the non-volatile memory. If the boot code is corrupted, contact the Motorola Customer Network Resolution Centre, requesting the boot code restoration procedure and the appropriate boot code file.

NOTE	Following an NIU switch on or reboot, both red and green LEDs are initially lit. After approximately 20 seconds, the red LED will extinguish, indicating normal condition. This waiting period may be extended to 50 seconds after rebooting due to a code download.

5. When fitting a redundant MCUF refer to **Redundant MCUF firmware compatibility** for details of further checks required.
6. Notify the OMC-R of base station availability and log the maintenance activity.

Redundant MCUF firmware compatibility

Overview of MCUF firmware compatibility

In many installations a redundant MCUF is fitted and configured to assume control in the event of a failure of the master MCUF. Under normal circumstances, the redundant MCUF accepts code downloads from the master MCUF and so remains updated and available for use.

If the redundant MCUF is replaced with a module containing firmware which is incompatible with the master MCUF firmware, then the communicating link between MCUFs will not be established. The redundant MCUF will therefore not be updated and will not be available to take over when required.

Checking MCUF firmware compatibility

To check firmware compatibility between MCUFs, check the state of the base transceiver processor (BTP) within each MCUF as follows:

1. Connect a PC to the TTY connection on the master MCUF.
2. At the CUST MMI prompt, enter:

   `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
```

or,

```
BTP 0 0 0      B–U   NO REASON
BTP 1 0 0      D–U   No Redundant Link
```

If `No Redundant Link` is indicated then the master MCUF is not in communication with the redundant MCUF and firmware incompatibility may be assumed. Refer to **Updating redundant MCUF firmware**.

Updating redundant MCUF firmware

The following procedure to update firmware in the redundant MCUF requires a PCMCIA card containing current network configuration data. The procedure assumes that the PCMCIA card is already in the master MCUF.

NOTE	No call processing can take place during the MCUF firmware update process. The entire process should take approximately one hour.

Site preparation

To prepare for the firmware update the site must first be taken out-of-service as follows:

1. Connect a PC to the TTY connection on the master MCUF.
2. At the CUST MMI prompt, disable all CTUs in turn by typing:

   `shutdown_device <site #> dri * * * <seconds>`

Where **<site #>** is the site number, *** * *** is the DRI identifier and **<seconds>** is the time delay before shutdown occurs.

3. Confirm this action by observing each CTU Tx status LED, which should extinguish shortly after issuing the shutdown command.
4. Disconnect the 2.048 Mbit/s link

Redundant MCUF firmware update procedure

The following procedure shows how to update redundant MCUF firmware by placing the redundant MCUF into the master position and downloading code from a PCMCIA card.

1. Remove the uploaded PCMCIA card from the master MCUF, and ensure that write protect is switched to OFF.
2. Remove both MCUFs. Insert the PCMCIA card into the original redundant MCUF then insert this MCUF into the master position.
3. Connect a PC to the TTY connection on the MCUF front panel.
4. At the MMI-ROM prompt, type:

   `burn`

This will flash object 8, the MCUF boot object, from the PCMCIA card onto the MCUF card. The flash download takes approximately 30 seconds, then the MCUF will reset.

5. At the MMI ROM prompt, type:

   `set_site <site #>`

Where **<site #>** is the site number.

The MCUF now carries out a system initialization using data from the PCMCIA card. After a short wait the screen displays:

```
Initialization complete. All commands accepted.
```

The MCUF firmware update is complete and both MCUFs now hold identical firmware. The MCUF originally removed from the master position may now be used in the redundant position.

6. Insert the original master MCUF into the redundant position.

The redundant MCUF now requires a 15 minute sync warm up period, followed by a further delay of four minutes while the two MCUFs achieve phase lock. Once phase lock is achieved the master MCUF immediately begins codeloading to the redundant MCUF. Codeloading takes a further 15 minutes.

The process is complete when the following message is displayed on screen:

```
Redundant MSW is INS
<*><*><*> NEW STANDBY Switch CONFIGURED <*><*><*>
```

7. To confirm correct MCUF status, at the CUST MMI prompt, enter:

   `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).

8. Reconnect the 2.048 Mbit/s link.

NOTE	There is no need to unlock the CTUs as these are automatically unlocked during the initialization procedure.

NOTE	If a PCMCIA card is not available then the firmware in the redundant MCUF may be updated by removing the master MCUF and placing the redundant MCUF in the master position. Code download from the BSC will ensure the newly installed MCUF is fully updated. This procedure however is likely to take up to 30 minutes longer than the procedure involving a PCMCIA card, resulting in a longer out of service time for the BTS.

Testing MCUF redundancy

The following procedure tests MCUF redundancy by forcing the master and redundant MCUFs to swap roles. The commands refer to the base transceiver processors (BTPs) within each MCUF.

1. Connect a PC to the TTY connection on the master MCUF.
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 MCUF and **btp 1 0 0** is the redundant MCUF.

This command will swap MCUF roles by forcing:

- the redundant MCUF into a busy state , and making it master.
- the master MCUF 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 MCUF.
6. At the CUST MMI prompt type, swap the MCUFs 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 MCUF and **btp 0 0 0** is the redundant MCUF.

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 MCUF.

Additional replacement parts

Policy on non-FRU parts

Non-FRU parts are:

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

or

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

CAUTION	Only qualified personnel should attempt non-FRU replacement, in order to minimize risk of equipment damage. For example, the CBIA main cage requires care in removal and installation.

List of non-FRU parts

Non-FRU parts include the following:

- Door lock.
- Any part of CBIA: main cage, harness, interface panel, backplane.
- The PSU cage.
- The cabinet.

Procedure for replacing non-FRU parts

Customers requiring non-FRU replacement should:

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

CBIA attachment screws

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

- Seven M4 screws to the SURF harness (two guide pins lock the cage into position).
- Four M6 (left side) and five M6 (right side) screws at the cabinet front.
- Eight M6 T30 screws for interface panel attachment to the top panel.

MOTOROLA

Chapter 4

Auxiliary equipment housing maintenance

Chapter 4 Auxiliary equipment housing maintenance

Introduction to auxiliary equipment housing maintenance

Auxiliary equipment housing FRUs

The following items are considered as field replaceable units within the auxiliary equipment housing (AEH):

- Power distribution box.
- Cabinet lid.
- Cabinet door.
- Front panel.
- Fan.
- Heater mats.
- Environmental seals.

Auxiliary equipment housing FRU view

Figure 4-1 shows the auxiliary equipment housing, with FRUs identified.

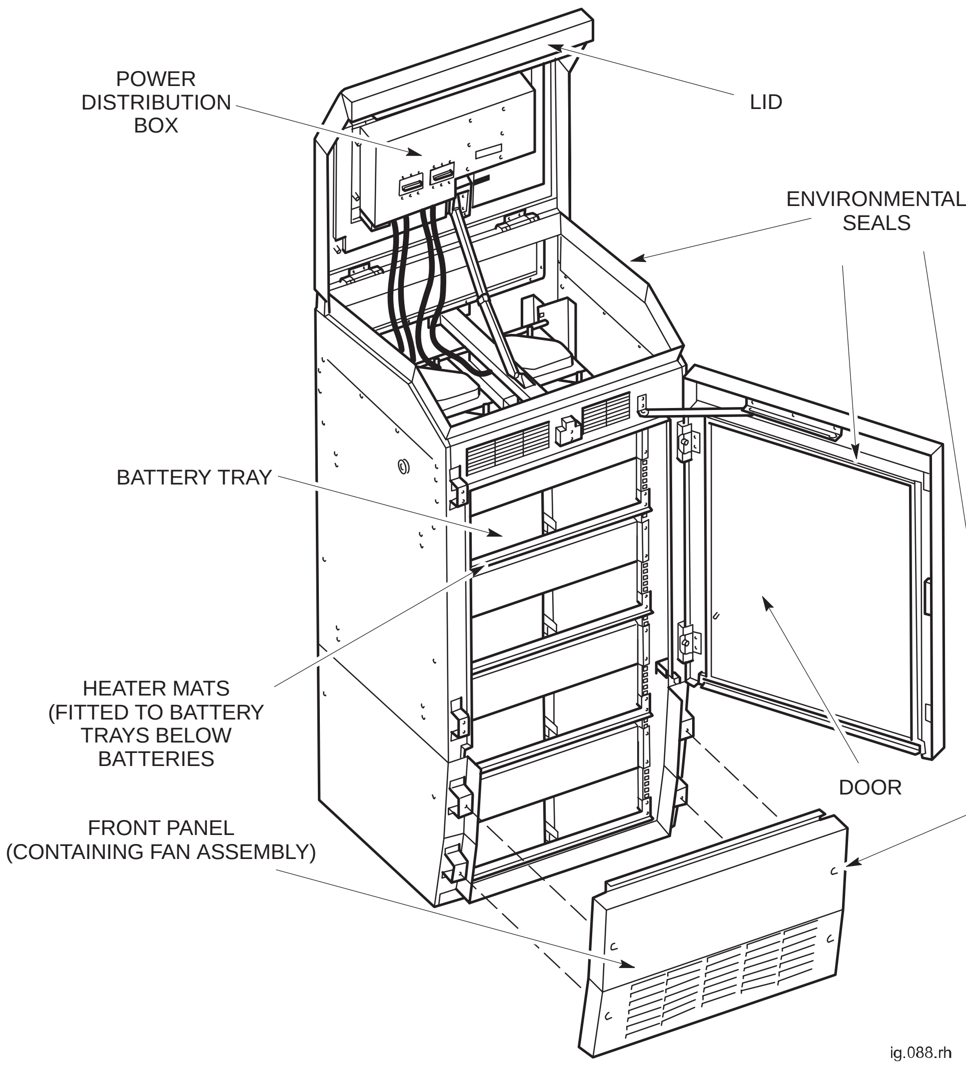


Figure 4-1 Auxiliary equipment housing, showing field replaceable units

Replacing the power distribution box

Introduction to power distribution box replacement

The circuit breakers in the power distribution box switch off if an overtemperature alarm signal is received, and switch on again when the temperature reset level is reached. The power distribution box will need to be replaced if one or both of the circuit breakers fail to operate correctly.

Removing the power distribution box

To remove the power distribution box from the auxiliary equipment housing:

WARNING	The batteries are capable of supplying high short circuit currents and as such provides a high energy hazard. Isolate the auxiliary equipment housing from the main cabinet by switching off the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet before commencing work.

1. Check that the AEH has been isolated from the main cabinet.
2. Open the cabinet door, release the lid latch and raise the lid.
3. Switch off the circuit breakers on the front of the power distribution box and then disconnect the dc input cables from the rear pair of Anderson connectors on the left side of the power distribution box. If used, disconnect the extension cables to another cabinet from the front pair of Anderson connectors.
4. Unplug the alarm signal cables from PL1, PL2 and PL3 on the front of the power distribution box.
5. Disconnect the two cables which connect the top bank of batteries (bank 2, row 2) to the power distribution box and tie the cables safely out of the way. Undo the battery terminal connections between bank 2, row 2 and bank 2, row 1 and then remove the row 2 battery tray, followed by the row 1 battery tray.
6. Disconnect the two cables which connect battery bank 1, row 2 to the power distribution box and tie the cables safely out of the way.
7. Undo the eight M4 nuts which secure the power distribution box to the lid and then remove the box.
8. Unplug the door microswitch alarm cable from the external alarm interface board.
9. Unplug the power cables for the heater mats and the fan from the external alarm interface board.

The procedure for removing the power distribution box is now complete.

Fitting a replacement power distribution box

To fit a new power distribution box:

1. Configure the new power distribution box to supply one or two BTS cabinets as appropriate, see *Installation and Configuration: (GSM-204-423)* Chapter 5 **Configuring battery backup** in this manual.
2. Connect the power cables for the heater mats and the fan to the external alarm interface board.
3. Connect the alarm cables for the door microswitch to the external alarm interface board.
4. Mount the new power distribution box onto the underside of the lid and secure in position using the M4 nuts.
5. Connect the longer pair of battery cables from the power distribution box to their terminals on battery bank 1, row 2. The blue cable connects to negative and the black cable connects to positive.
6. Install the bank 2, row 1 battery tray, followed by the bank 2, row 2 battery tray and then remake the terminal connections between the two rows (refer to *Installation and Configuration: (GSM-204-423)* **Installing batteries in the auxiliary equipment housing** if necessary. Connect the remaining pair of battery cables to the positive and negative terminals on the top bank of batteries.
7. Connect the alarm signal cables to PL1, PL2 and PL3 on the front of the power distribution box.
8. Connect the dc power cable from the main cabinet to the rear pair of Anderson connectors on the power distribution box. If used, connect the extension cables from another cabinet to the front pair of Anderson connectors.
9. Switch on the circuit breakers on the front of the power distribution box and then close the lid and the cabinet door.
10. Switch on the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet.

The procedure for installing a new power distribution box is now complete.

Replacing the lid on the auxiliary equipment housing

Detailed view of the cabinet lid

The major features of the auxiliary equipment housing lid are shown in Figure 4-2.

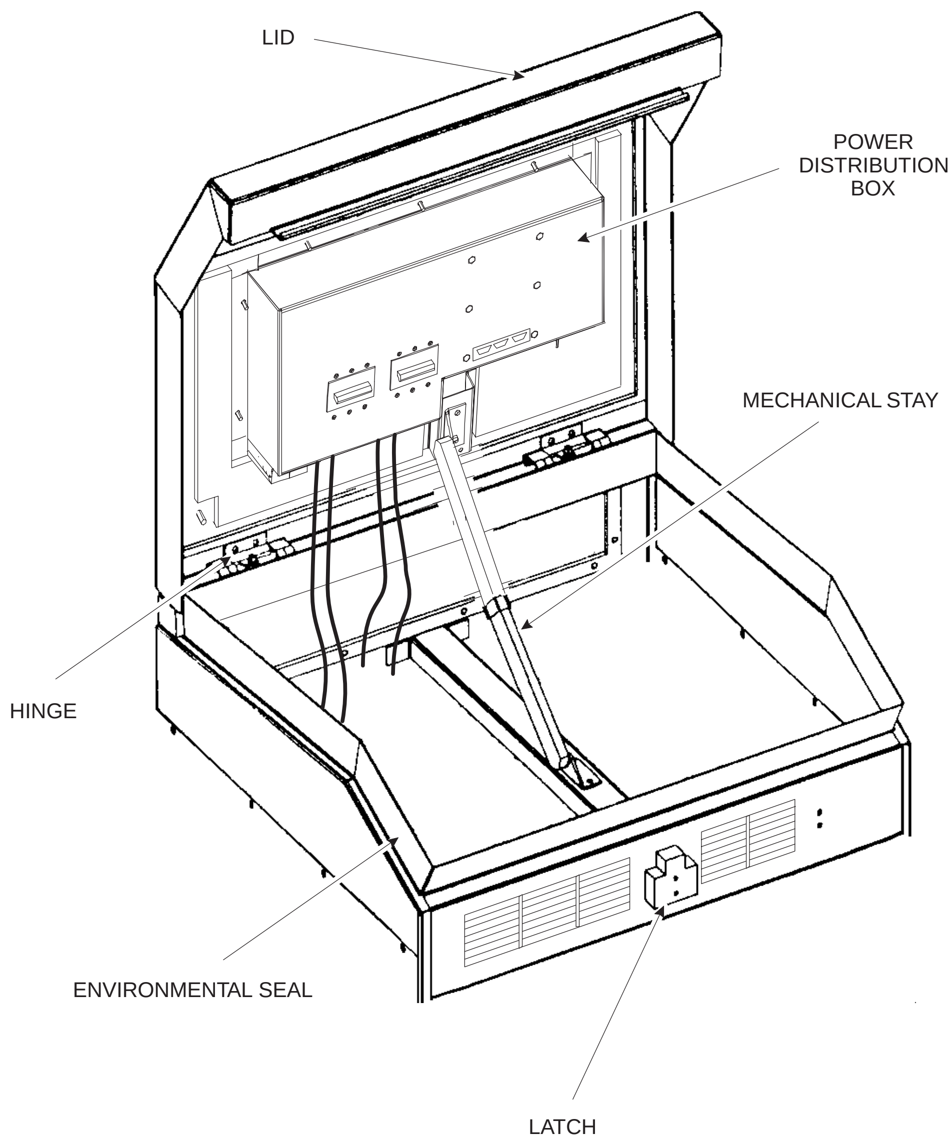


Figure 4-2 Detailed view of the auxiliary equipment housing lid

Removing the lid

The lid provides environmental protection for the equipment contained within. For this reason, the following lid removal and replacement procedures should be completed in one session and the cabinet then closed.

To remove the lid:

WARNING	Isolate the auxiliary equipment housing from the main cabinet by switching off the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet before commencing work.

1. Open the cabinet door, release the lid latch and raise the lid until the mechanical stay locks in position.
2. Switch off the circuit breakers on the front of the power distribution box and then undo the eight M4 nuts which secure the box to the lid. Place the power distribution box safely in the top area of the auxiliary equipment housing.
3. Unscrew and remove, the M6 nut, plain washer and star washer which secure the lid earth cable to the cabinet.
4. Remove the circlips from the hinge pins.
5. Support the lid and unscrew the mechanical stay from the lid.

WARNING	The cabinet lid on its own weighs 8.5 kg. Handle with care and observe proper lifting precautions.

6. Remove the two hinge pins by pulling their lugs in the required direction, using long nose pliers.
7. Remove the lid and place safely to one side.

The procedure for removing the lid is now complete.

Fitting a new lid

To fit a new lid:

1. Support the new lid in position, so that the hinges line up.
2. Insert the two hinge pins fully into the hinges.
3. Screw the mechanical stay to the lid.
4. Fit the circlips into the recesses in the hinges.
5. Attach the lid earth cable to the cabinet using the star washer, plain washer and M6 nut. Tighten to the correct torque (see **Overview of FRU replacement procedures** in Chapter 2 of this category).
6. Mount the power distribution box in position on the inside of the lid and tighten the eight M4 nuts.
7. Switch on the circuit breakers on the front of the power distribution box and then close the lid and the cabinet door.
8. Switch on the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet.

The procedure for fitting the new lid is now complete.

Replacing the door on the auxiliary equipment housing

Removing the cabinet door

To remove the cabinet door:

1. Unscrew the M6 nut, plain washer and star washer which secures the door earth cable to the cabinet body.
2. Unscrew the wind stop from the cabinet.
3. Remove the circlips from the bottom of the hinge pins.

WARNING	The cabinet door weighs 15 kg. Handle with care and observe proper lifting precautions.

4. Support the door and remove the two hinge pins by pulling their lugs in the required direction, using long nose pliers.
5. Remove the door and place safely to one side.

Fitting a replacement door

To fit a replacement door:

1. Support the door in position, so that the hinges line up.
2. Insert the two hinge pins fully into the hinges.
3. Fit the circlips into the recesses in the bottom of the hinges.
4. Screw the wind stop to the cabinet.
5. Attach the door earth cable to the cabinet using the star washer, plain washer and M6 nut. Tighten to the correct torque (see **Overview of FRU replacement procedures** in Chapter 2 of this category).

Replacing the front panel or fan

Replacing the front panel

To replace the front panel:

WARNING	Isolate the auxiliary equipment housing from the main cabinet by switching off the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet before commencing work.

1. Open the cabinet door. Open the cabinet lid and switch off the circuit breakers on the power distribution box.
2. Unplug the cable which supplies dc power to the fan from its connector, fixed to a bracket on the right side of the rear of the front panel.
3. Unscrew and remove, the M6 nut, plain washer and star washer which secure the front panel earth cable to the cabinet.
4. Undo the six screws which secure the front panel to the cabinet and lift the panel away.

WARNING	The front panel (excluding fan assembly) weighs 4.5 kg. Handle with care and observe proper lifting precautions.

5. If the panel is to be replaced but the fan is to be retained, separate the fan assembly from the front panel by following the instructions in the section **Removing the fan**.

The procedure for removing the front panel is now complete.

Replacement is a reversal of the removal procedure. If the fan assembly has been separated from the old front panel, refer to **Installing the fan** for instructions about how to mount the fan assembly in the new front panel.

Replacing the fan

To remove the fan refer to Figure 4-3 and:

1. Remove the front panel, as described in **Replacing the front panel**.
2. Release the fan power cable from the cable clamp and feed through the bracket on the rear of the front panel.
3. On the rear of the front panel, undo the 10 M4 nuts which secure the fan cover to the front panel and then remove the cover and fan.
4. Undo the four screws that secure the fan assembly to the fan cover and remove the fan assembly and its power cable.

The procedure for removing the fan is now complete.

The procedure for installing a new fan is a reversal of the removal procedure.

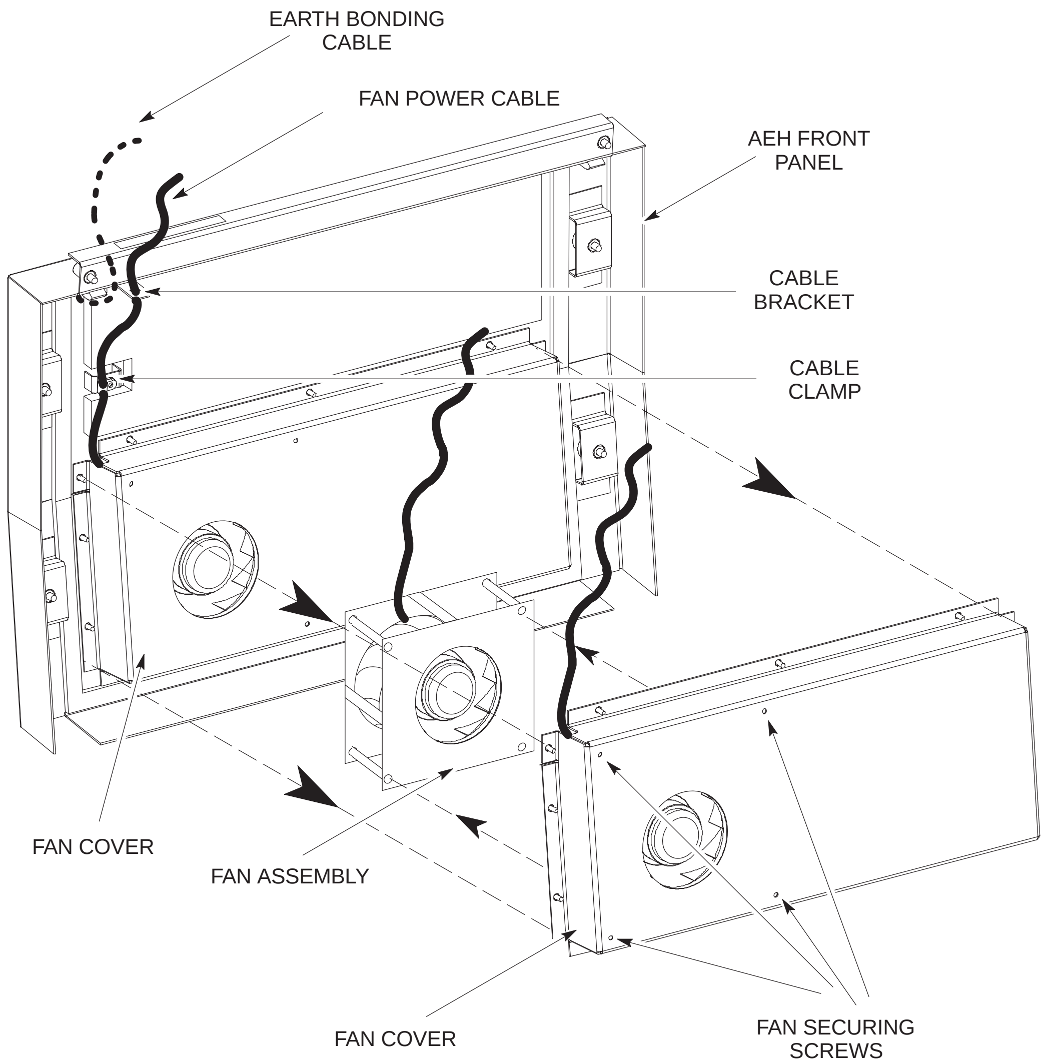


Figure 4-3 Removing the fan assembly

Replacing a heater mat

Introduction to heater mat replacement

The auxiliary equipment housing contains four heater mats; mounted on each battery tray. Equipment installed in the housing, such as batteries, must be removed to gain access to the mats.

Heater mat replacement procedure

To replace a heater mat:

WARNING	Isolate the auxiliary equipment housing from the main cabinet by switching off the EXT BATT circuit breaker on the dc circuit breaker panel in the main cabinet before commencing work.

1. Open the cabinet door, then open the lid and switch off the circuit breakers on the power distribution box.
2. Disconnect the fan cable, the front panel earth bonding cable and remove the front panel.
3. Remove any equipment or batteries that are installed in the cabinet.
4. Unplug the power connector at the battery tray for the heater mat that is to be replaced.
5. Remove the mat from the battery tray.

The procedure for removing the heater mat is now complete.

Replacement is a reversal of the removal procedure.

Replacing an environmental seal on the housing

Introduction to replacing a seal

A faulty environmental seal can allow moisture to enter the housing, which in turn can lead to equipment failure. It is important that the seals are inspected for signs of wear or damage whenever the housing door or lid are opened.

Replacing the lid environmental seal

The environmental seal for the lid consists of a U-shaped rubberized seal that fits over the metal lip on the top of the housing (see Figure 4-1).

To replace the the lid seal:

1. Open the housing door, release the lid catch and then lift the lid so that it locks in position.
2. Pull the old seal off the metal lip.
3. Measure the length of the new seal against the old seal and trim to the correct length, if necessary.
4. Press the new seal firmly onto the metal lip all the way around and ensure that the free ends meet centrally on the front edge.
5. Close the lid and the housing door.

The procedure for replacing the environmental seal for the lid is now complete.

Replacing the door environmental seal

The environmental seal for the door consists of four strips of self-adhesive gasket, fixed to the inside door panel.

To replace the door seal:

1. Open the housing door.
2. Trace a line around the inside edge of each seal strip as a marker for positioning the new seal strips.
3. Remove the old seal strips. Remove all traces of adhesive using a suitable solvent.
4. Fit the new seal strips, ensuring that the inside edges align with the marks made prior to removing the old seals.
5. Close the door.

The procedure for replacing the environmental seal for the door is now complete.

CHAPTER 1
PARTS LIST

MOTOROLA

Category 623

Parts Information (Parts)

MOTOROLA

Chapter 1

Parts list

Chapter 1
Parts list

Parts information introduction

Horizon*macro* outdoor parts lists

The parts lists for this manual reflect the availability of items for the product.

Each item consists of a description and an order number. This uniquely identifies the required component. Some components are used in different equipment in addition to Horizon*macro* outdoor. Some items are common to both Horizon*macro* and M-Cell*6*.

FRU items

The majority of items on the parts list are Field Replaceable Units (FRUs). It is not intended that sub-units of these parts will be supplied.

Ordering method

Contact the local Motorola office for ordering information, including cost and delivery.

If an item in a 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 PSMs, 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.

Diagram of Horizon*macro* outdoor FRU modules

Figure 1-1 shows the outdoor cabinet modules, including major FRUs, with doors and lid omitted for clarity.

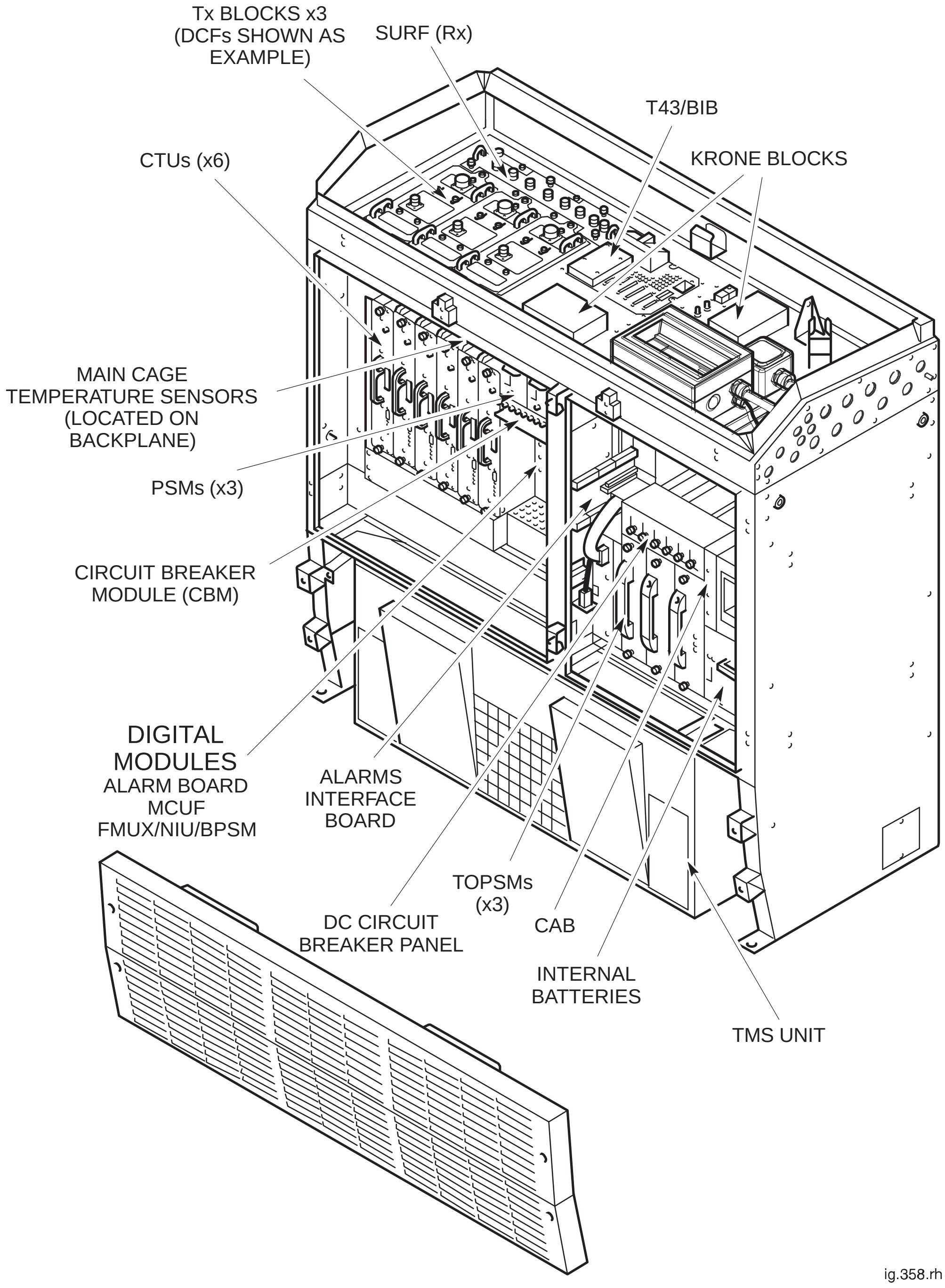


Figure 1-1 Horizon*macro* outdoor cabinet, showing major FRUs

Diagram of auxiliary equipment housing FRU modules

Figure 1-2 shows the location of the FRUs for the auxiliary equipment housing.

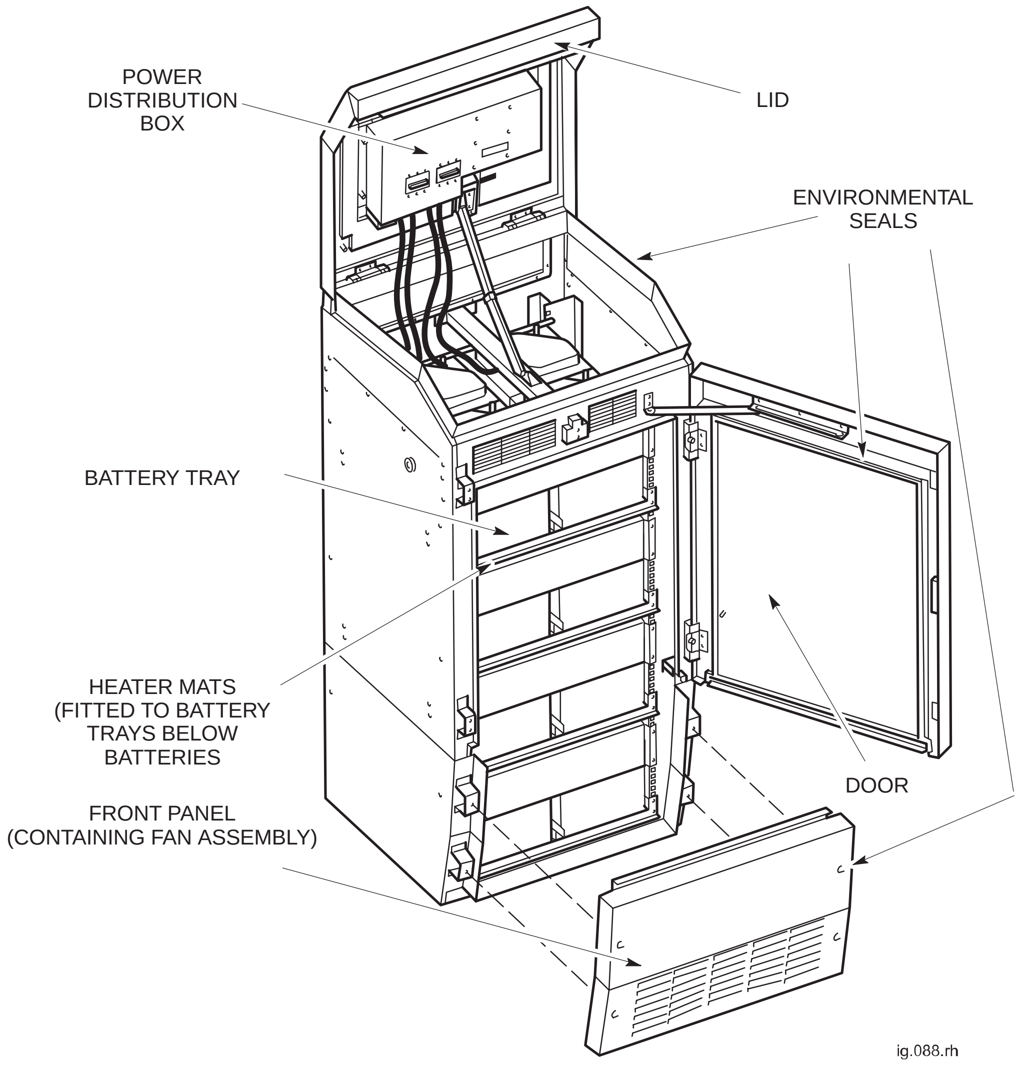


Figure 1-2 Auxiliary equipment housing, showing FRUs

Parts for Horizon*macro* outdoor

Spares Table

The Horizon*macro* outdoor spares are listed in Table 1-1 to Table 1-7, available as at October 2001. Contact the Motorola local office for an up to date list, or if replacement parts are required that are not listed here.

Table 1-1 List of Horizon*macro* outdoor cabinet spares

Description	Order No.
Outdoor BTS cabinet – standard colour	SV1001
Outdoor BTS cabinet – M-Cell match	SV1002
Outdoor BTS cabinet – dark green	SV1003
Outdoor BTS cabinet – dark brown	SV1004
Outdoor BTS cabinet – brick red	SV1005
Gas strut for lid	SVLN1332
Touch up paint – standard colour	SVLN1333
Touch up paint – M-Cell match	SVLN1335
Touch up paint – dark green	SVLN1337
Touch up paint – dark brown	SVLN1338
Touch up paint – brick red	SVLN1339

Table 1-2 List of Horizon*macro* outdoor line interface spares

Description	Order No.
Line interface NIU-E1 and CIM/T43 (75 ohm)	SWLN2922
Line interface NIU-E1 and BIM/BIB (120 ohm)	SWLN2923
BIM/BIB	SWLN4024
CIM/T43	SWLN4025

Table 1-3 List of Horizon*macro* outdoor digital spares

Description	Order No.
NIU-E1	SWLN4403
NIU-T1	SWLN4404
FMUX	SWLN4406
MCUF	SWLN5227
Alarm module	SWLN5228
Alarm module with GPS functionality	SWLN8510
GPS cable	SWKN8115
PCMCIA memory card	SWLN5239
BPSM	SWPN2567

Table 1-4 List of Horizon*macro* outdoor RF spares

Description	Order No.
CBIA	SVLN1240
CTU Tx cable	SVKN1304
Duplexer cable	SVKN1305
SURF harness	SWHN5538
850 CTU	TBA
900 CTU	SWRF5193
1800 CTU	SWRG5197
1900 CTU	TBA
850 SURF	TBA
900 SURF (single band)	TBA
900 SURF (dual band)	SWRF2879
1800 SURF (single band)	SWRG2880
1800 SURF (dual band)	TBA
1900 SURF	TBA
850 DCF	TBA
850 DDF	TBA
850 TDF	TBA
850 HCU	TBA
900 DCF	SVLF1224
900 DDF	SVLF1225
900 TDF	SVLF1226
900 HCU	SVLF1227
1800 DCF	SVLG1224
1800 DDF	SVLG1225
1800 TDF	SVLG1226
1800 HCU	SVLG1227
1900 DCF	TBA
1900 DDF	TBA
1900 TDF	TBA
1900 HCU	TBA
SMA 50 ohm load	SVLN1230
Outdoor blanks set	SVLN1236
Feedthrough plate assembly	SVLN1243
Dual band TDF	SVLX1198

Table 1-5 List of Horizon*macro* outdoor power supply spares	
Description	**Order No.**
Outdoor internal battery tray	SVPN1162
–48/60V PSM	SVPN1221
CBM	SWHN5519
Power cage	SWHN5995
CAB	SWLN6618
TOPSM	SWPN5996

Table 1-6 List of Horizon*macro* outdoor temperature control spares	
Description	**Order No.**
TMS control board	SVLN1330
TMS fan	SVLN1331
TMS unit	SWLN6001

Table 1-7 List of Horizon*macro* outdoor site expansion spares	
Description	**Order No.**
Outdoor Horizon*macro* to M-Cell*6* split sector cable pair	SVKN1193
Outdoor Horizon*macro* to M-Cell*6* duplexer link cable	SVKN1195
2nd (Extension) cabinet fibre	SVKN1244
3rd (Extension) cabinet fibre	SVKN1245
4th (Extension) cabinet fibre	SVKN1246
Long SURF to SURF cable pair	SVKN1313
Short SURF to SURF cable pair	SVKN1314
Short DDF to HCU cable pair	SVKN1315
Short SURF to earth plate cable	SVKN1316
Long SURF to earth plate cable	SVKN1317
Short Tx block to earth plate cable	SVKN1318
Long Tx block to earth plate cable	SVKN1319
3 input CBF 50 ohm load (used with M-Cell*6*)	SVLN1196
RF cable plate (left)	SVLN1320
RF cable plate (right)	SVLN1321
Blanking panel (left)	SVLN1322
Blanking panel (right)	SVLN1323
Expansion plate assembly (left)	SVLN1324
Expansion plate assembly (right)	SVLN1325
Right side cable entry conversion kit	SWKN5999

Parts for optional equipment

Introduction to optional equipment parts lists

Table 1-8 and Table 1-9 list the spares for the optional equipment for the Horizon*macro* outdoor, available as at October 2001. Contact the Motorola local office for an up to date list, or if replacement parts are required that are not listed here.

Spares table for the cable shroud

Table 1-8 List of spares for the cable shroud

Description	Order No.
Cable shroud assembly – dark grey	SVLN1217
Cable shroud assembly – M-Cell match	SVLN1300
Cable shroud assembly – dark green	SVLN1301
Cable shroud assembly – dark brown	SVLN1302
Cable shroud assembly – brick red	SVLN1303

Spares table for the auxiliary equipment housing

Table 1-9 List of spares for the auxiliary equipment housing

Description	Order No.
Long dc cable	SVKN1352
Auxiliary equipment housing cabinet – dark grey	SVLN1215
Battery tray	SVLN1216
Auxiliary equipment housing cabinet – M-Cell match	SVLN1296
Auxiliary equipment housing cabinet – dark green	SVLN1297
Auxiliary equipment housing cabinet – dark brown	SVLN1298
Auxiliary equipment housing cabinet – brick red	SVLN1299
External alarm board	SVLN1340
Fan	SVLN1341
Heater mat	SVLN1342
Battery pack	SVPN1216

Glossary of terms unique to this equipment

Overview of the glossary

These glossary terms are unique to Horizon*macro* and M-Cell*6*™ equipment. These and other GSM terms can be found in *System Information: General: (GSM-100-101)*.

Glossary of terms

AEH

Auxiliary Equipment Housing

BPSM

Micro BSU Power Supply Module

CAB

Control and Alarm Board

CBM

Circuit Breaker Module

CTU

Compact Transceiver Unit

DCF

Duplexed Combining bandpass Filter

DDF

Dual-stage Duplexed combining Filter

FMUX

Fibre optic Multiplexer

HCU

Hybrid Combining Unit

MCUF

Main Control Unit with dual FMUX

NIU

Network Interface Unit

SURF

Sectorized Universal Receiver Front-end

TDF

Twin Duplexed Filter

TMS

Thermal Management System

TOPSM

The Outdoor Power Supply Module

Index

A

B

C

G

H

I

K

L

M

N

O

P

V

W