Wireless Service Provider Solutions

S12000 BTS Reference Manual

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NORTEL NETWORKS™

Wireless Service Provider Solutions

S12000 BTS Reference Manual

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System release: GSM/BSS V15.1

May 2005

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Removed information on BSC 6000 due to EOL.

March 2005

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Synchronized with V15.01 Standard

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January 2005

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Section 1.6: configuration updated

Feature 25493: section 3.3.1.1 updated with information on EDGE implementation

Chapter 5: reference to document GSM/GPRS/EDGE BSS Engineering Rules updated

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November 2004

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Synchronized with V15.0 Standard

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July 2004

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Added the following statement to Section 2.1: Version 15.1R supports HePA 900 with GSM BTS.

Removed the following statements from the Applicability section: V15.0 features are not supported on the BSC2G. BSC2G functionality is kept on BSCs running the 14.3 software load.

System release: GSM/BSS V15.0

October 2004

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HePA updates

September 2004

Issue 15.08/EN Standard

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Updated Chapter 2 with power consumption information.

Removed customer names from August history 2003.

Issue 15.06/EN Preliminary

Updated for Helmsman release.

Issue 15.05/EN Preliminary

Added Feature 25621 to Chapter 2

May 2004

Issue 15.04/EN Preliminary

Updated according to the following feature:

- 24961: S12000 dual band 850/1900 E1

March 2004

Issue 15.03/EN Preliminary

Updated the power amplifier board description.

March 2004

Issue 15.02/EN Preliminary

Up issued this manual for a preliminary release

December 2003

Issue 15.01/EN Draft

V15.0 features are not supported on the BSC2G. (BSC2G functionality is kept on BSCs running the 14.3 software load).

Update according to the following features:

- 23068
- 24119

For Q00795093, update to Table 2–16, Chapter 2.

Update About this document regarding V15 features not supported on BSC2G.

November 2003

Issue 14.05/EN Standard

For Q00767324, added –25793: S12000 ID/OD 2S888 H4D

- Update according to the following features:
  - 24396: e–PA 1800 or S8000 and S12000
  - 24397: e–PA 900 for S8000 and S12000
  - 24381: e–PA 1900 for S8000 and S12000
  - 24382: e–PA 850 for S8000 and S12000
  - 24981: e–PA redesign 1900 for S8000 and S12000
  - 24982: e–PA redesign 850 for S8000 and S12000

August 2003

Issue 14.04/EN Preliminary

The following changes were made throughout the document:

- Update the dc power supply diagram of the S12000 outdoor BTS
- Update according to the following features:
  - 24915: S12000 ind/out up to 2S666/D (1 or 2) + H2D (1 or 2) with HePA/PA
  - 25043: S12000 ind/outd up to 3S666/D (1 or 2) + H2D (1 or 2) with PA
  - 25044: S12000 ind/out up to 3S121212/H2D (1 or 2) + H4D (1 or 2) with PA

- 23849: S12000 1800/T1
- 24963: S12000 850/E1
- 24964: S12000 1900/E1
- 25248: S12K - 900Mhz/T1
- 24399: eDRX 900 for S8000 and S12000

April 2003

Issue 14.03/EN Preliminary

The following changes were made throughout the document:

- Update power supply description of the S12000 outdoor BTS
- Update GIPS description
- Add frequency band configuration in chapter 1

January 2003

Issue 14.02/EN Preliminary

The following changes were made throughout the document:

- Modify the DCU description
- Modify the GIPS front face

December 2002

Issue 14.01/EN Preliminary

The following changes were made throughout the document:

- Upgrade according to the following feature:
  - PR1505: S8000/S12000 High Power PA (60W)
  - 22472: S12000 configuration priority 2
  - SV1374: Network Level Identification of e-DRL and e-PA presence
- Add the GIPS module and the associated AC box
- Add the four-way hybrid duplexer (H4D 1900 Mhz) RF Combiner

System release: GSM/BSS V13

October 2002

Issue 13.05/EN Standard

Update according to the V13.2b task force

September 2002

Issue 13.04/EN Preliminary

Update after internal review

August 2002

Issue 13.03/EN Preliminary

Update after internal review

The following changes were made after internal review

- 900 and 1800 Mhz features were removed
- all references to DRX were changed to e-DRX
- all references to PA were changed to e-PA
- all references to C-DCS and LNS-DCS were removed
- all references to single-phase and tri-phase AC boxes were removed

The following checks have been performed:

- battery threshold of the PCU
- functioning temperature of the rectifiers
- values of the PCU breaker (modified)
- values of the indoor compartment breaker (modified)
- nominal output voltage and output voltage range of the rectifier subrack

July 2002

Issue 13.02/EN Draft

Creation

March 2002

Issue 13.01/EN Draft

Creation

ABOUT THIS DOCUMENT

This document describes the S12000 Indoor and Outdoor Base Transceiver Stations (BTSs), which are components of the Base Station Subsystem (BSS).

Applicability

This document is part of the BSS Nortel Networks Technical Publications (NTPs).

This document applies to the V15.1 BSS system release.

The S12000 BTS supports the following frequencies:

- Single band GSM 850 T1/E1, 900 T1, 1800 T1 and 1900 T1/E1
- Dual band GSM 850/1900 T1/E1

CAUTION

GSM-R does not apply to the S12000 BTS.

Audience

This document is for operations and maintenance personnel, and for other users who want to know more about the BTSs.

Prerequisites

It is recommended that the readers also become familiar with the following documents:

< 01 > : BSS Overview

< 07 > : BSS Operating Principles

< 124 > : BSS Parameter Dictionary

< 125 > : Observation Counter Dictionary

< 128 > : OMC-R User Manual - Volume 1 of 3: Object and Fault menus

< 129 > : OMC-R User Manual - Volume 2 of 3: Configuration, Performance, and Maintenance menus

< 130 > : OMC-R User Manual - Volume 3 of 3: Security, Administration, SMS-CB, and Help menus

< 143 > : S12000 BTS Fault Numbers

< 144 > : S12000 BTS Maintenance Manual

Document GSM/GPRS/EDGE BSS Engineering Rules (PE/DCL/DD/0138)

Related Documents

The NTPs listed in the above paragraph are quoted in the document.

How this document is organized

Chapter 1 describes the layout and contents of the BTS cabinets.

Chapter 2 describes the functions of the BTS boards and modules, and also describes their front panels.

Chapter 3 examines BTS architecture and describes the physical structure, focusing on the functional architecture of the subsystems.

Chapter 4 lists BTS software entities and shows how they are installed on the hardware units.

Chapter 5 indicates that the dimensioning rules are now contained in GSM BSS Engineering Rules document.

Vocabulary conventions

The glossary is included in the NTP < 00 >.

Regulatory information

Refer to the NTP < 01 >.

1 CABINET DESCRIPTION

1.1 Cabinet compartment layout

1.1.1 S12000 Outdoor BTS

The base cabinet and the extension cabinet are divided into three parts:

- top compartment
- left side
- right side

The layout of the equipment in the base and extension cabinets is identical in the top compartment and on the left side.

The cabinet layout on the right side of the base and extension cabinets is different. In the base cabinet, the CBCF is located in the CBCF compartment. In the same compartment of the extension cabinet, a filling plate replaces the CBCF.

The top compartment opens by means of a cover on the top of the cabinet. The front of the cabinet is perforated to allow air to circulate. The top compartment has two elements: the optional battery box and the climatic system (DACS).

User compartment

This compartment is available for Original Equipment Manufacturer (OEM). For more information, refer to the documentation provided by the equipment manufacturer.

The user interconnection compartment is optional. It is required only when a user kit or a -48 V connection box is used.

PA interconnection compartment

The PA interconnection compartment centralizes the -48 V dc power supply of the Power Amplifiers (PA).

Amplifier compartment

The amplifier compartment receives up to twelve Power Amplifiers (PA).

RECAL compartment

This compartment contains the RECAL board. The RECAL board is connected to one or two external alarm protection boards (ALPRO), located outside the cabinet.

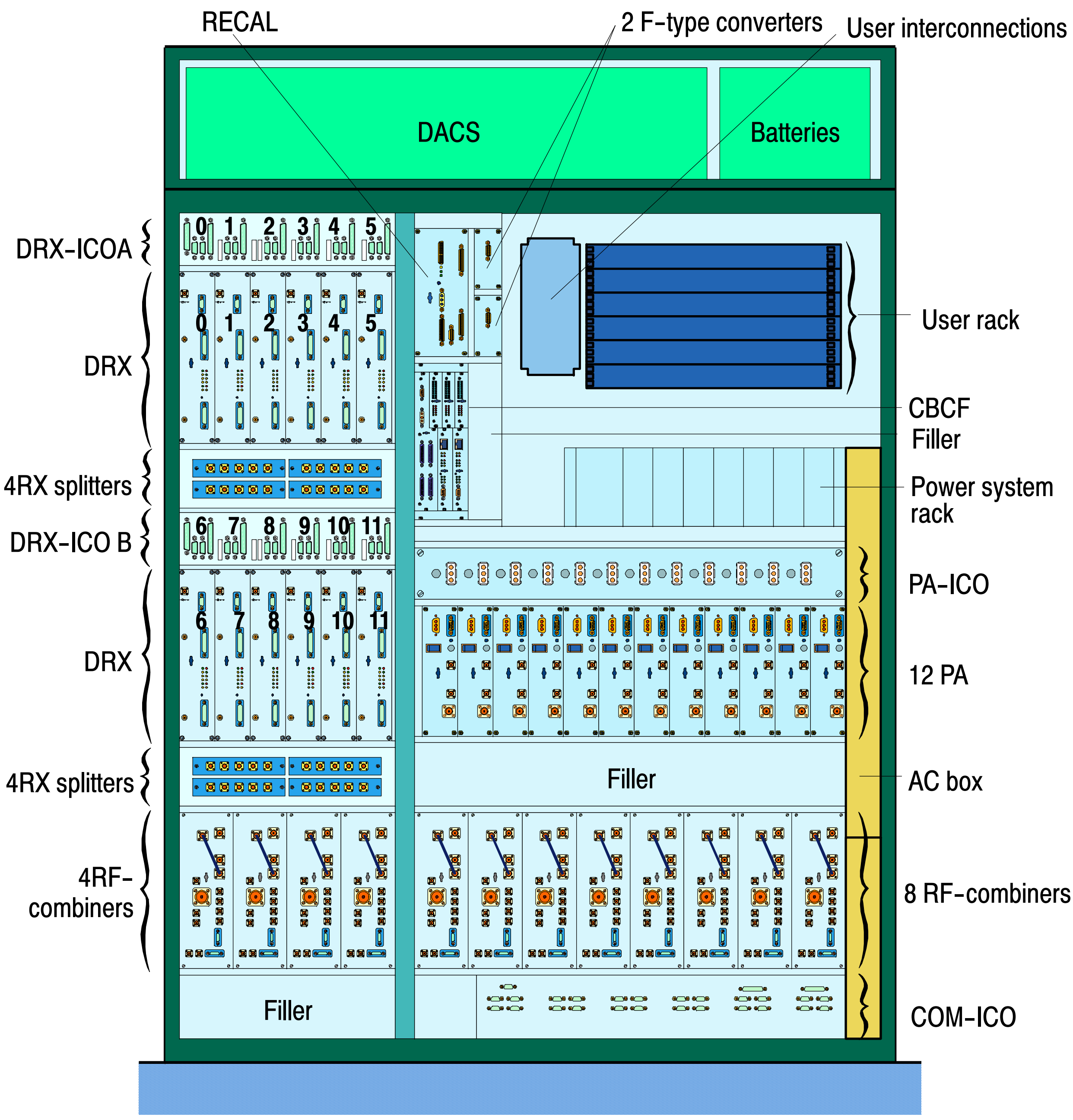


Figure 1-1 S12000 Outdoor BTS: Base cabinet layout

F-type converter

A converter, called F-type converter, supplies ± 15 V dc to the LNA-splitter and the VSWR-meter.

A second F-type converter is available as an option.

RF Combiner and Tx-Filter compartments

The RF Combiner and Tx-Filter compartments can hold a maximum of either of the following combination of modules (4 on the left, 8 on the right):

- twelve RF duplexer (D) plus LNAs
- twelve RF duplexer (D) plus LNAs plus Tx-Filter modules
- twelve two-way RF Hybrid Duplexer type (H2D) plus LNAs
- six RF four-way Hybrid Duplexer type (H4D) plus LNAs

Note: Depending on the coupling system used, an RF-combiner can contain a duplexer, an H2D or H4D transmitter coupler, an LNA splitter, and an optional VSWR meter.

The D, H2D, and H4D RF Combiner modules perform the following functions:

- transmission coupling of two, three, or four channels
- filtering and duplexing of transmission and reception signals on the same antenna port
- amplification of reception signals
- monitoring of the antenna VSWR (option)

The Tx-Filter performs the following functions:

- filtering of transmission signals
- monitoring of the antenna VSWR (option)

Combiner interconnection compartment (COMICO)

The COMICO is the interconnection board for the modules of the RF Combiner compartment that centralizes inputs/outputs on the alarms and the power supplies. COMICO collects and connects alarms to RECAL.

CBCF Compartment

Two CBCF boards are visible on the front panel of the CBCF module:

- Compact Main Common Function (CMCF)
- Compact PCMI (CPMI)

Since there is no CBCF in the extension cabinet, a filling plate occupies the place of these units.

DRX interconnection compartments (DRX–ICO A and DRX–ICO B)

The interconnection compartments centralize DRX outputs. They assure interconnection between DRX via the FH bus, PA, RECAL and CBCF modules.

DRX compartments

These compartments receive up to twelve modules, 6 in each.

RX–splitter compartments

The RX–splitter compartments receive up to eight RX–splitters, which receive RF signals from the LNA splitter and distribute them to the DRXs RX inputs.

Power system compartment

The power system compartment may be configured with:

- a Power Controller Unit (PCU) and up to seven 600W or 680W rectifiers (one of them redundant).
- or a GIPS module including a DC Distribution and Control Unit (DCU), up to seven 680W rectifiers (one of them redundant), and an AC Distribution Unit (ADU).

The rectifiers convert Mains Voltage to –48 V dc to be used in the cabinet. According to the number of DRXs per cell, the number of rectifiers may be decreased.

AC box

This box is located on the right–hand side of the right–hand part of the cabinet. Two types of AC box are available:

- The AC box associated with the power system with PCU. It receives the mains voltage and distributes it to the power system compartment and to the cooling system. The PCU only controls the dc supply. The ac supply connects to the back panel, which is common for all rectifiers.
- The AC box/GIPS associated with the GIPS. It receives the mains voltage and distributes it to the power system compartment and to the user ac plug.

1.1.2 S12000 Indoor BTS

The compartment layout of the base cabinet is presented in *Figure 1-2*.

Cabinet top

The cabinet top (see *Figure 1-5*) can hold a maximum of two ALPRO modules. An ALPRO module consists of an ALPRO board, a protection cover, and an interconnection plate.

Combiner interconnection (COMICO) compartment

This compartment consists of an interconnection board for the combiner compartment modules, which centralizes inputs/outputs on the alarms and the power supplies.

RF combiner and Tx-Filter compartment

The RF Combiner and Tx-filter compartment can hold a maximum of either of the following combination of modules:

- twelve RF duplexer (D) plus LNAs
- twelve RF duplexer (D) plus LNAs plus Tx-Filter modules
- twelve two-way RF Hybrid Duplexer type (H2D) plus LNAs
- six RF four-way Hybrid Duplexer type (H4D) plus LNAs

Note: Depending on the coupling system used, an RF-combiner can contain a duplexer, an H2D or H4D transmitter coupler, an LNA splitter, and an optional VSWR meter.

The RF Combiner modules perform the following functions:

- transmission coupling of the channels
- filtering and duplexing of transmission and reception signals on the same antenna port
- amplification of reception signals
- monitoring of the antenna VSWR (option)

The Tx-Filter performs the following functions:

- filtering of transmission signals
- monitoring of the antenna VSWR (option)

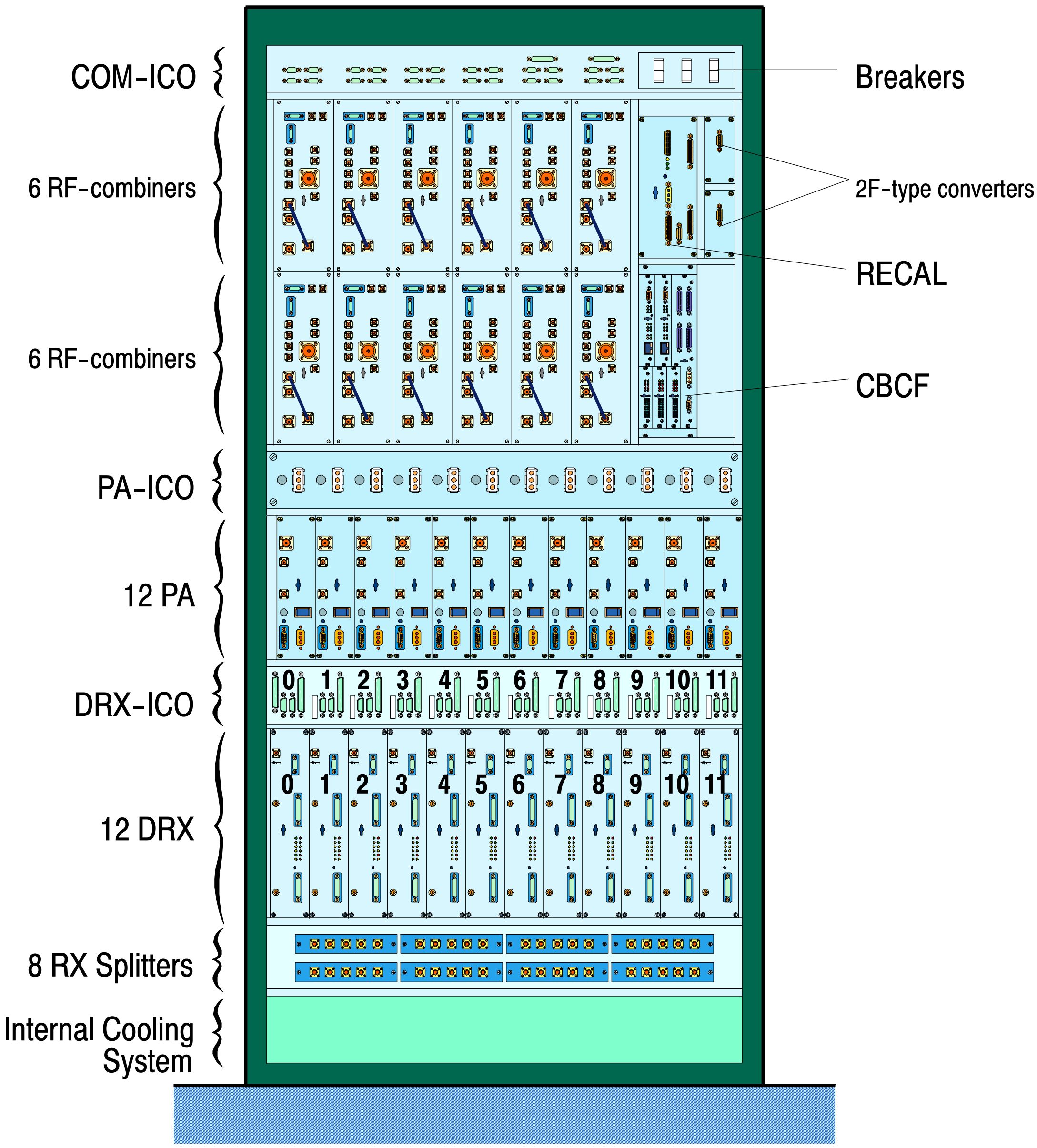


Figure 1-2 S12000 Indoor BTS: Base cabinet layout

DC compartment

This compartment contains three switches to disconnect the power supply to the Power Amplifiers, the fans, and the RECAL/CBCF board.

F-type converters

The compartment also contains an F-type converter, which supplies ± 15 V dc to the LNA-splitter and the VSWR-meter. A second F-type converter is available as an option.

PA interconnection compartment

This compartment centralizes the -48 V dc power supply of the Power Amplifiers (PA).

Power Amplifier compartment

This compartment contains one to twelve power amplifiers (PAs).

RECAL board

The RECAL board can be connected to one or two external alarm protection boards (ALPRO) located on top of the base cabinet.

DRX interconnection compartment

This compartment centralizes DRX outputs. It connects them to the Power Amplifiers (PA) on the one hand , and interconnects them via the FH bus on the other.

DRX Compartment

This compartment contains a maximum of twelve modules.

CBCF Compartment

This compartment contains the CBCF module.

RX-splitter compartment

This compartment contains up to eight RX-splitters, which receive data signals from the units in the coupler compartment and distributes them to the DRXs.

Climatic compartment

This compartment contains two fans, and a board. One fan is optional and is used to ensure redundancy. This board enables the control of the rotation of each fan and sends an alarm (one for each fan) to the RECAL board when the fan speed goes below a fixed threshold.

1.1.3 Additional equipment

1.1.3.1 Battery cabinet

A cabinet, independent from the BTS cabinet, can be added to increase the power autonomy of the BTS in case of a mains power failure. This cabinet may house one of two possible types of battery. The batteries are arranged in four strings, each containing four batteries (see *Figure 1-3*).

The internal batteries must first be disconnected before using these batteries.

These batteries autonomy depend on the configuration and the equipment of the BTS, and can vary between 30 minutes and 14 hours.

The cabinet dimensions are described in NTP < 01 >.

Below the four battery strings is the Heating Ventilation Unit (HVU), consisting of the following:

- a fan
- a heating resistor
- a controller

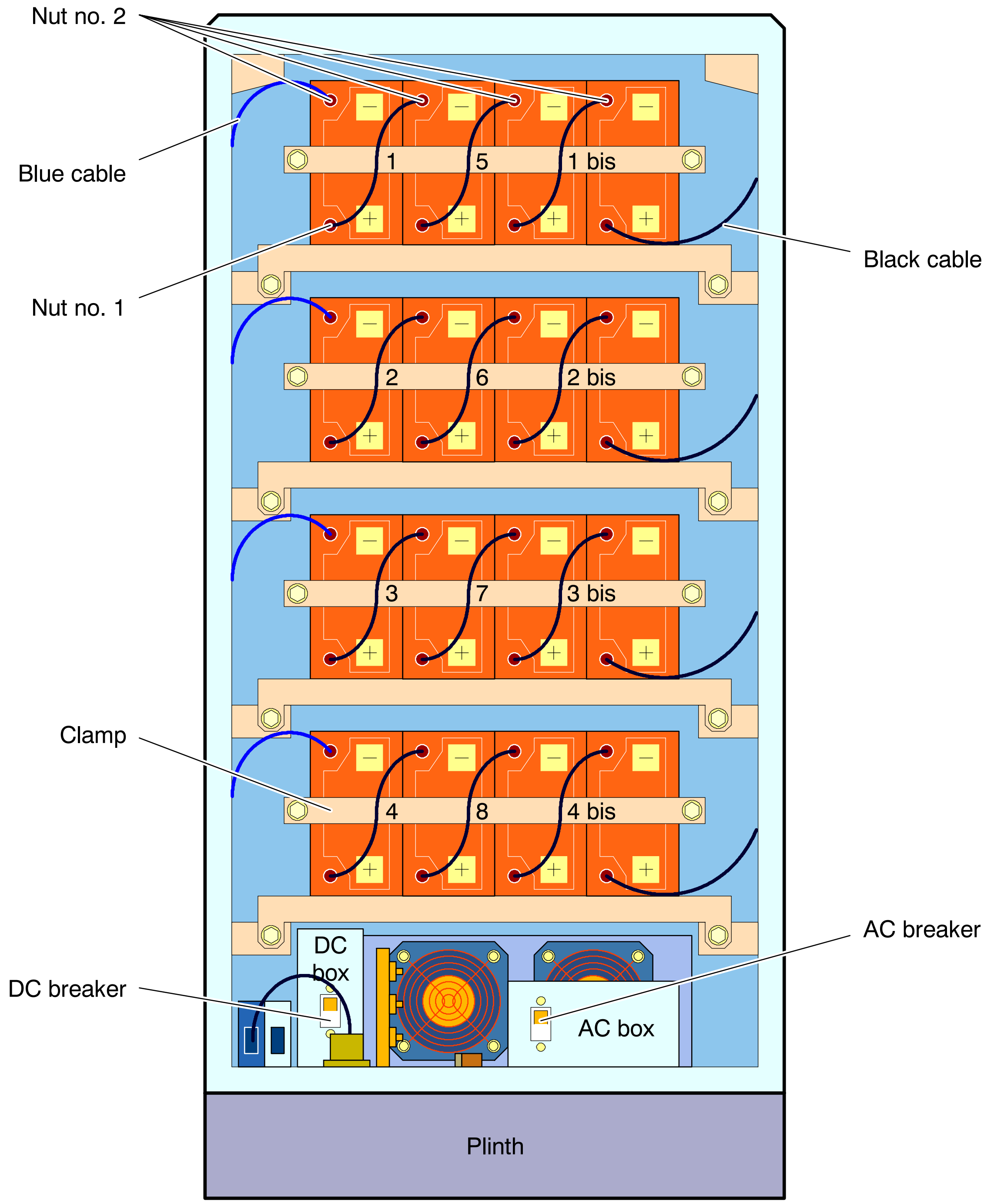


Figure 1-3 External battery cabinet of the S12000 Outdoor BTS (SBS 60 batteries)

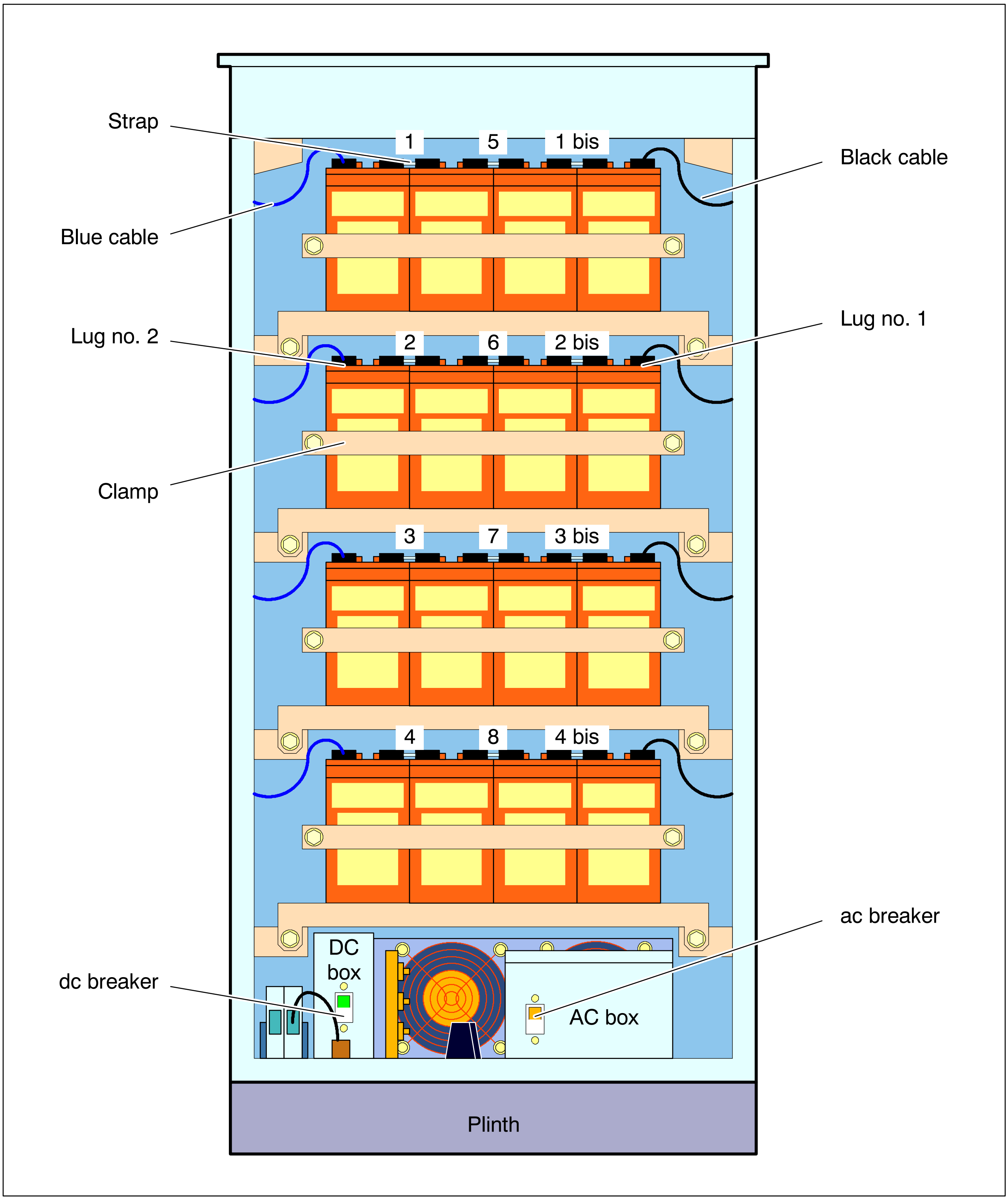


Figure 1-4 External battery cabinet of the S12000 Outdoor BTS (SBS C11 batteries)

1.1.3.2 PCM connection box (S12000 Outdoor BTS option for GSM 850/1900)

This box is available as an option to protect two PCM links. An upgraded kit allows the protection of up to six PCM links.

The PCM connection box is waterproof and can be put either in the BTS plinth or on-site outside the BTS (see *Figure 1-6*).

The box can be fitted as suitable to the customer.

1.1.3.3 -48 V dc connection box (S12000 Outdoor BTS option for GSM 850/1900)

This box is available as an option to provide an external -48 V plug on-site.

The -48 V connection box is waterproof and can be put either in the BTS plinth or on-site outside the BTS (see *Figure 1-7*).

The box can be fitted as suitable to the customer.

1.1.3.4 External alarm connection box (GSM 850/1900)

This box exists in two versions:

- The outdoor version includes one or two ALPRO boards and the related primary protection modules. It protects up to 16 external alarms (8 per ALPRO board) and four remote controls (two per ALPRO board).

The external alarms connection box is waterproof and can be put either in the BTS plinth or on-site outside the BTS (see *Figure 1-8*).

- The indoor version includes one ALPRO board, which protects up to 8 external alarms and two remote controls. Two indoor version boxes can be put on the top of the S12000 indoor BTS (see *Figure 1-5*).

The box can be fitted as suitable to the customer.

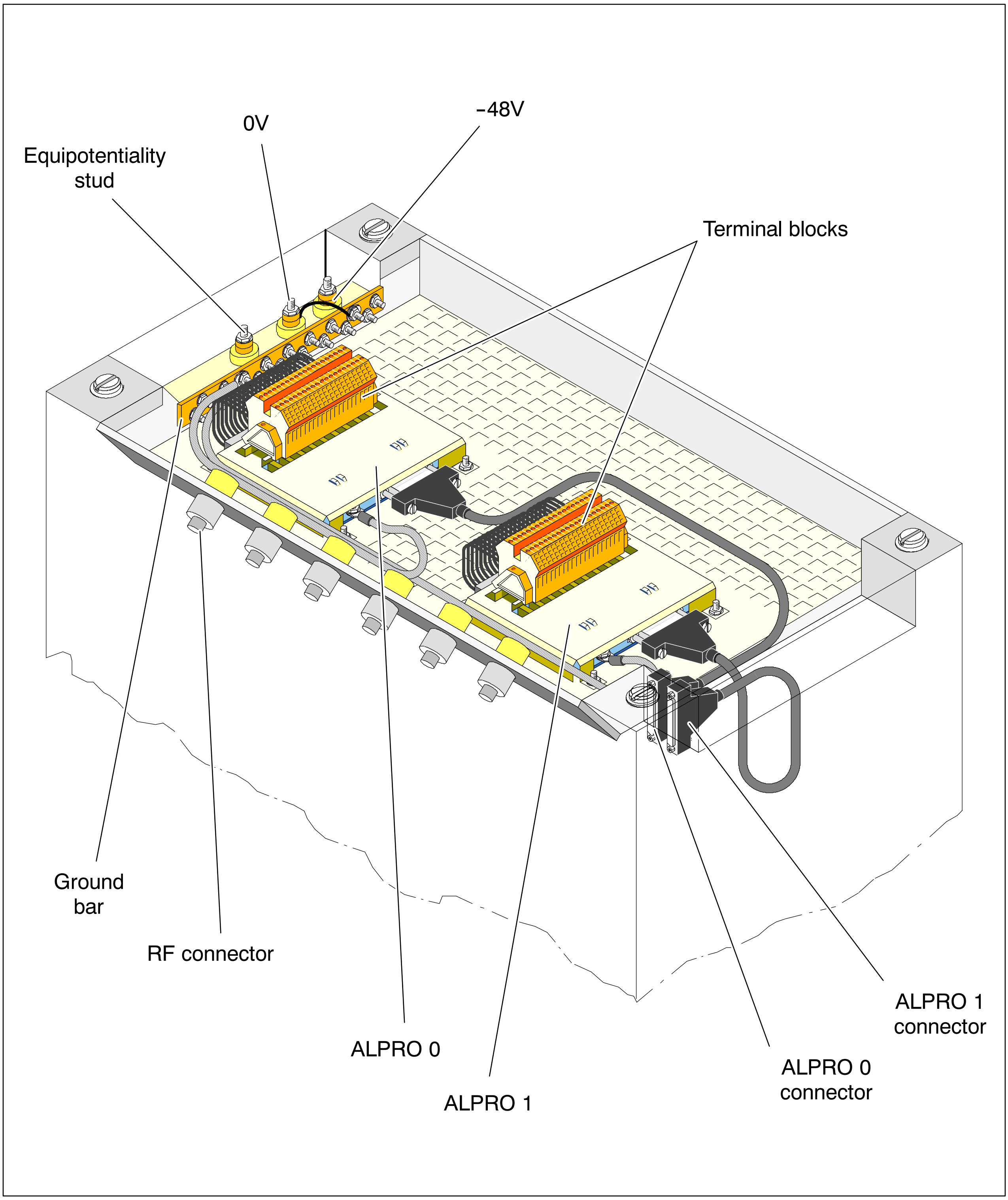


Figure 1-5 S12000 Indoor BTS: Cabinet top

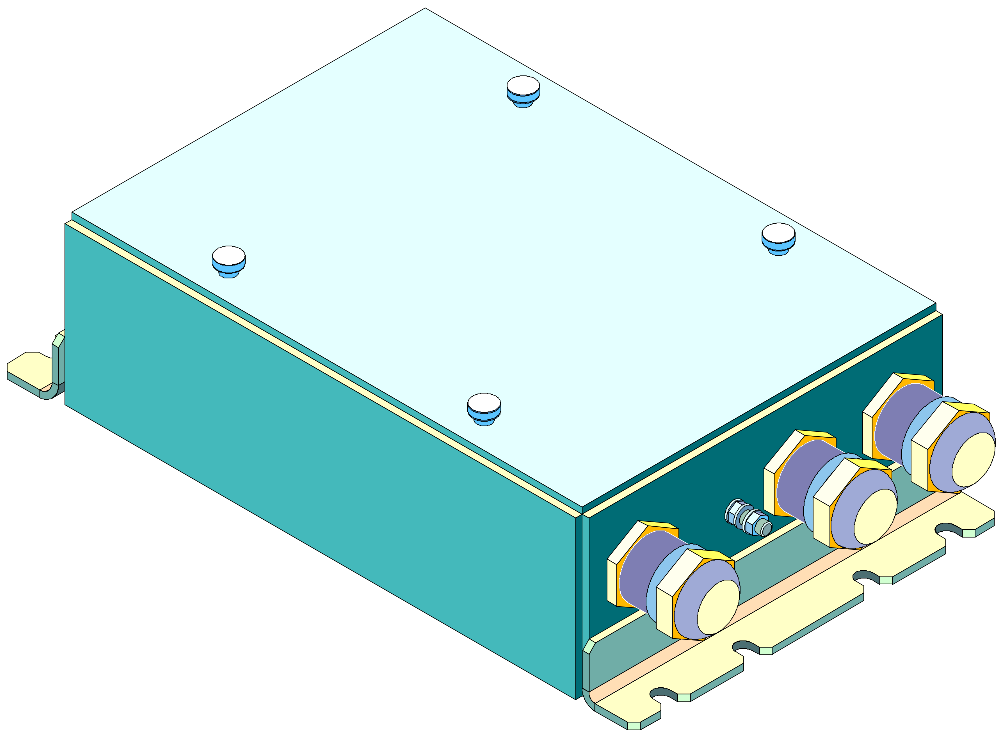


Figure 1-6 S12000 Outdoor BTS: PCM connection box

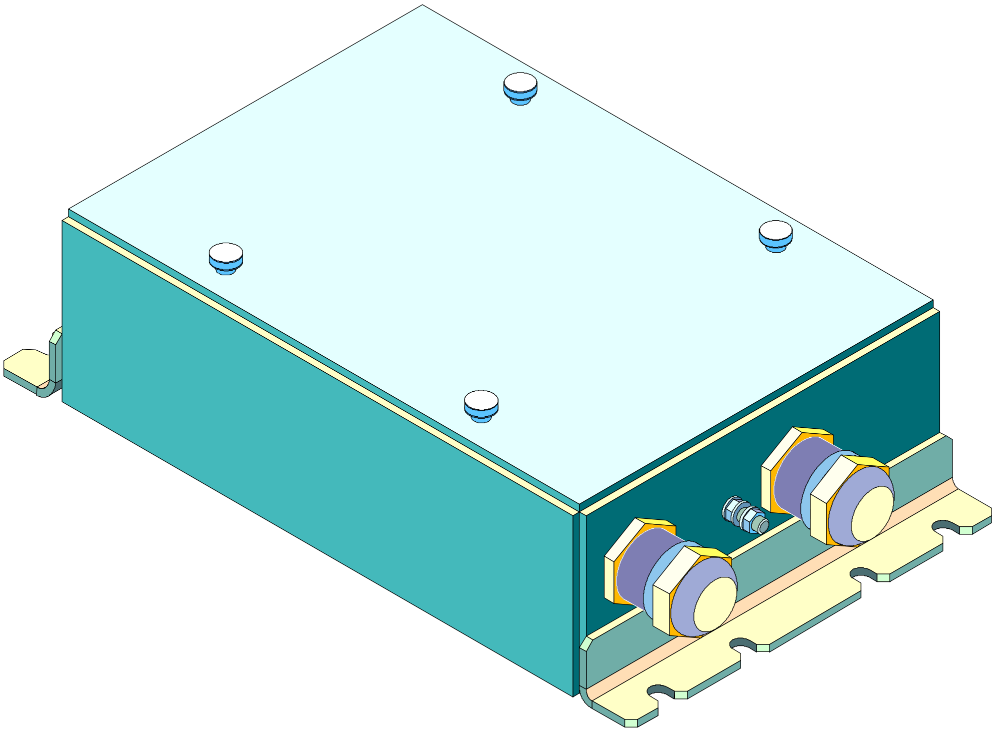


Figure 1-7 S12000 Outdoor BTS: -48 V connection box

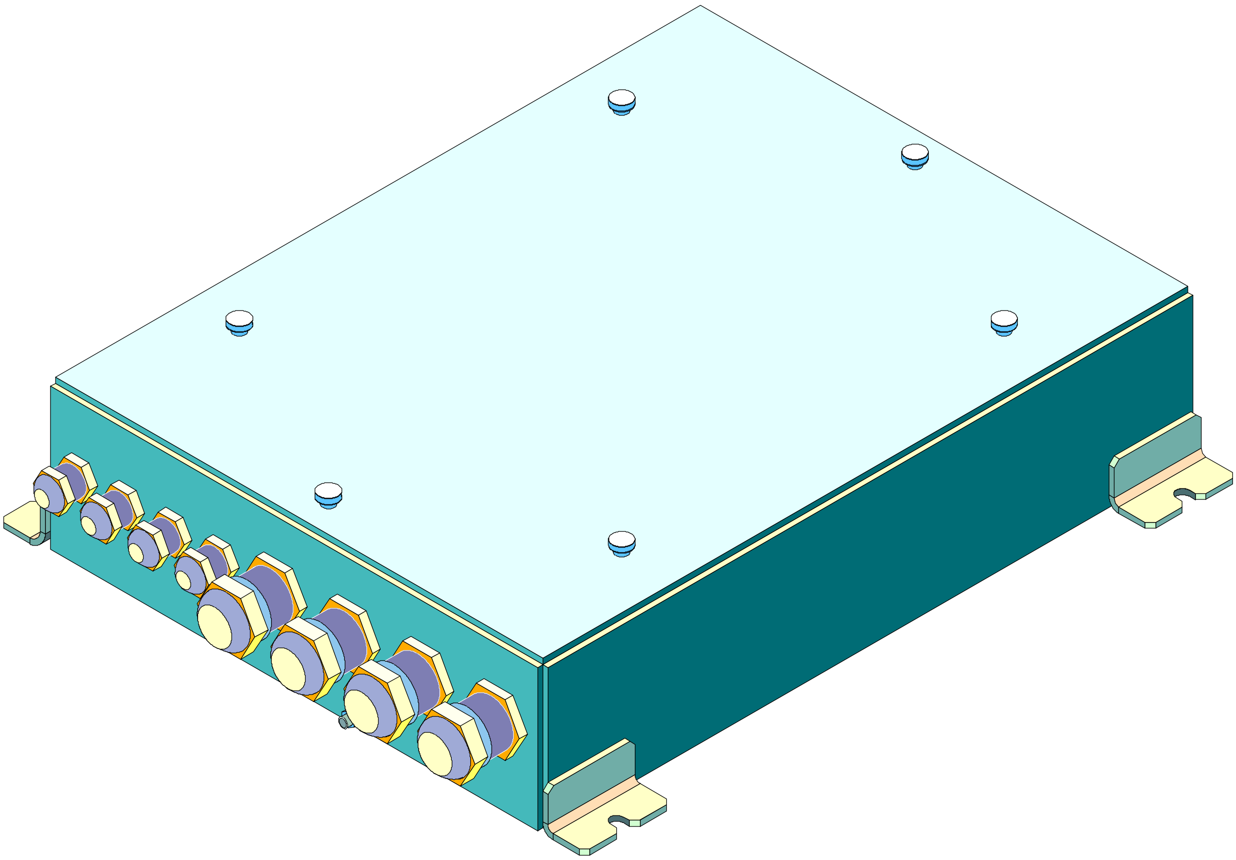


Figure 1-8 External alarm connection box

1.2 Power supply

1.2.1 S12000 Outdoor BTS

The power system supplies 48 V DC power to the modules in the cabinet from the main power supply. Two solutions have been implemented to power supply modules of S12000 Outdoor BTS (either one or the other, but never both together).

- The first system is PCU based system
- The second system is DCU based system: GSM Integrated power system

The PCU based system is implemented only in the 1900/850 BTS at the beginning of the S12000 life cycle. In a second time the DCU based system (GIPS) replaces the first system and is generalized in all types of BTS. Most of the functions are common to both system (PCU and DCU based).

1.2.1.1 General description

This description is applicable to both systems, PCU based and DCU based (GIPS). The basic functions of the power system are the following:

- It accepts AC power and converts it up to 4200 W (PCU based) or 4760W (DCU based) of DC power for the DC loads of the base station.
- It provides an optional redundancy of DC power.
- it provides separate controlled and overload protected DC outputs for each of the DC loads.
- It supports the charging and discharging of batteries that provide operational power when the AC input is not available.
- It monitors the state of the power system and reports the status to the host base stations (alarms to RECAL board).

1.2.1.2 AC Distribution functions

3 types of AC power supply are supported:

- mono phased (only supported by GIPS)
- tri phased (only supported by GIPS)
- split phase (supported by GIPS and PCU based system)

The AC distribution provides:

- surge suppression
- a system level circuit breaker for rectifiers power on/off and overload protection
- a circuit breaker for DACS power on/off and overload protection
- EMI filtering

1.2.1.3 User plug

The user plug is always available in the PCU based system (US plug type only), but is optional for the GIPS.

1.2.1.4 Rectifier modules

The rectifiers convert input AC power into DC power for the DC loads within the base station. The nominal output voltage is -54.6Vdc. The DC control system varies the output voltage from -40Vdc to -58.3Vdc in order to manage the charging of an attached battery string.

PCU based system receives both 600W or 680W rectifiers, but for 680W rectifier use, the output power is limited to 600W.

DCU based system (GIPS) can only receive 680W rectifiers. A mechanical way prevents 600W rectifier insertion.

Up to seven rectifiers (6+1 for redundancy) are housed in a rectifier shelf. Their outputs are connected in parallel through the shelf back plane.

1.2.1.5 Batteries

There are two types of battery units:

- internal batteries mounted on the top of the cabinet, which consist of four 12 V dc batteries in series (one string)
- external batteries located in the external battery cabinet, and configured in a maximum of four strings. Each string consists of four 12V dc batteries in series, the four strings being connected in parallel.

Sealed lead batteries are used.

1.2.1.6 DC Distribution and control functions

The main function consists in the interconnection of the rectifiers set to the modules of the BTS and to the batteries.

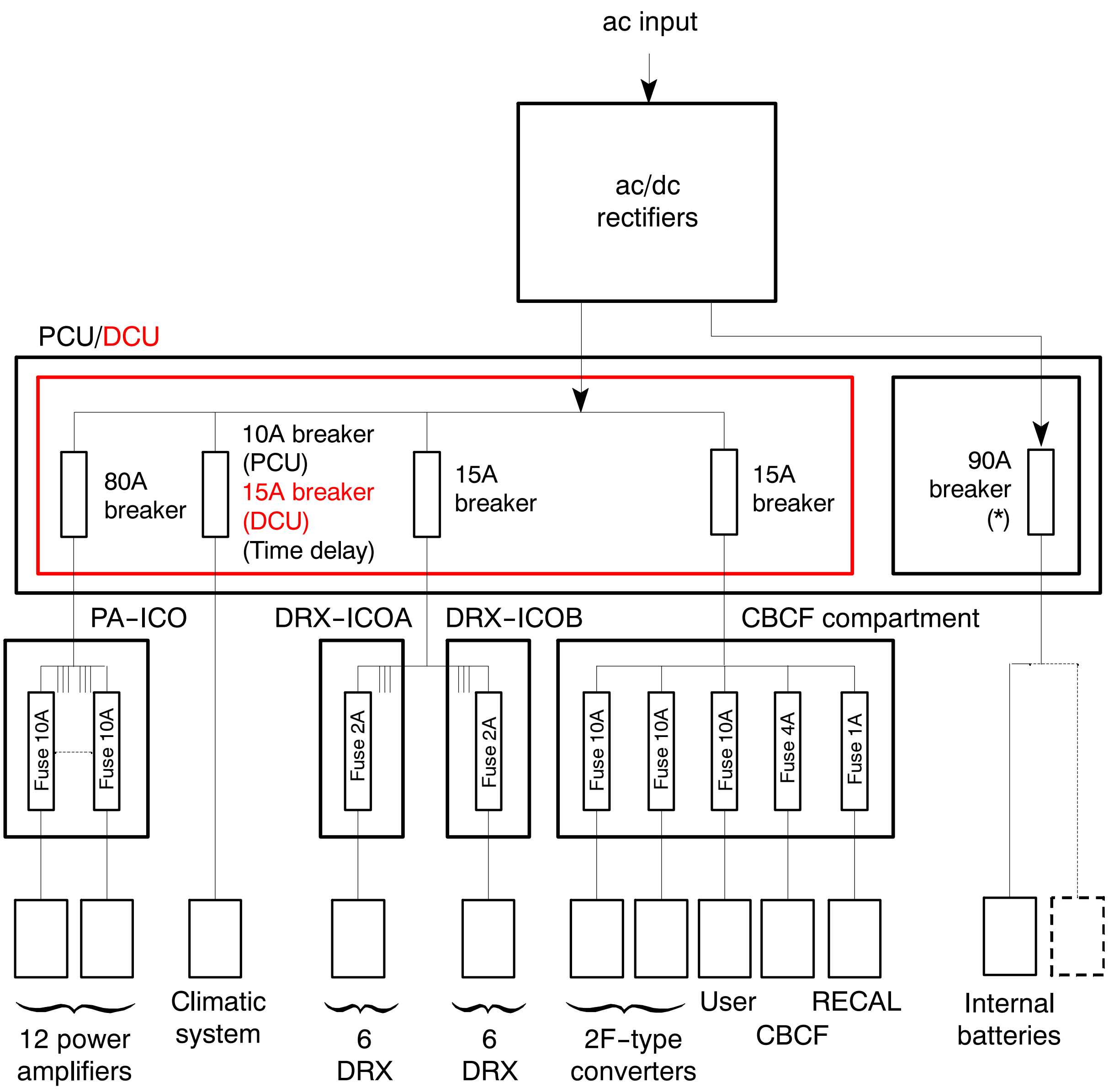
DC distribution

Both power systems provide 4 outputs to the different S12000 modules:

- PA: DC distribution to the power amplifiers set
- DRX: DC distribution to the DRX set
- BCF: DC distribution to the basic functions of the BTS (CBCF, RECAL and the user rack)
- DACS: DC distribution to the cooling unit

It generates a disconnection of its four load outputs depending on :

- the batteries output voltage level
- the internal temperature of the cabinet



Legend:
PA-ICO: Power Amplifier interconnection
DRX-ICO: DRX interconnection

Note: (*) The 90A breaker is used either for the internal battery or the external battery.

Figure 1-9 S12000 Outdoor BTS: dc power supply diagram

Batteries management

When the power system stops supplying DC voltage, the batteries are the only possible DC power supply.

The power system allows the cabinet to run on either internal or external batteries (connection of the internal or external batteries is carried out manually, and it is not possible to connect both types simultaneously). Two operating options are possible.

- Option 1 (for PCU based system only):
  - If AC power is available, the power system powers all the outputs and, if necessary, supplies power to the batteries (charging phase).
  - If the power system does not supply any power, the internal or external batteries energize BCF and DACS outputs (discharging phase).
- Option 2 (for PCU based system and GIPS):
  - If AC power is available, the power system powers all the outputs and, if necessary, supplies power to the batteries (charging phase).
  - If the power system does not supply any power, the internal or external batteries energize all the outputs (discharging phase).

During the discharging phases the battery output voltage decreases over time.

So, when the battery output voltage reaches LVD45 (-45V +/-1%), the power system cuts off power supply to the boards in the cabinet that are connected to PA and DRX outputs. An alarm is generated.

If the battery output voltage continues to decrease and reaches LVD42 (-42V +/-1%), the power system cuts off power supply to the boards in the cabinet that are connected to BCF and DACS outputs.

If the rectifiers recover power supply, the batteries are charging. When voltage is equal to 50.6V +/- 0.5%, the power system reconnects the cabinet boards with its four outputs.

The power system receives an analog signal from a temperature probe located on the batteries (internal or external) and sends a signal to the rectifiers to adjust the rectifier output voltage inversely to battery temperature (floating voltage).

Alarm monitoring

The following alarms are provided to the RECAL board by the power system:

- Load1 threshold (LVD45)
- PCU protective devices (PA & DRX DC Breaker)
- Battery on discharge
- DC fault

- AC fault
- Over temperature

Cabinet extreme ambient temperature management

A signal (CEATS1) is provided by two ambient temperature probes (one is located at the top of the cabinet, the other at the bottom) to the system power.

When activated, this signal causes the disconnection of all outputs connected to the rectifiers and to the batteries

1.2.1.7 PCU based power system description

The PCU based power system is composed of the following parts:

- an AC Main module
- a Power Control Unit (PCU)
- a set of up to seven rectifier units
- a set of batteries

AC main

It provides the AC distribution functions.

It is made of an AC Main box with:

- main power supply connections (split phase only)
- a surge protection
- an EMI filter
- a user plug (US plug type only)
- a main breaker, a DACS breaker, a rectifier breaker and an AC plug breaker

PCU (Power Control Unit)

It provides the DC distribution and control functions.

It includes the PA breaker, the FAN breaker (DACS), the DRX breaker and the BCF breaker. The batteries breaker is mounted on an external front panel.

The PCU is located in the rectifier shelf. It is an integral part of this sub-rack and is not a Field Replaceable Unit (FRU).

Rectifier modules

PCU based system can receive both 600W or 680W rectifiers, but in case of 680W rectifier use, the output power is automatically limited to 600W.

The rectifier shelf accepts up to seven rectifiers providing up to 4200W without redundancy or 3600W with redundancy.

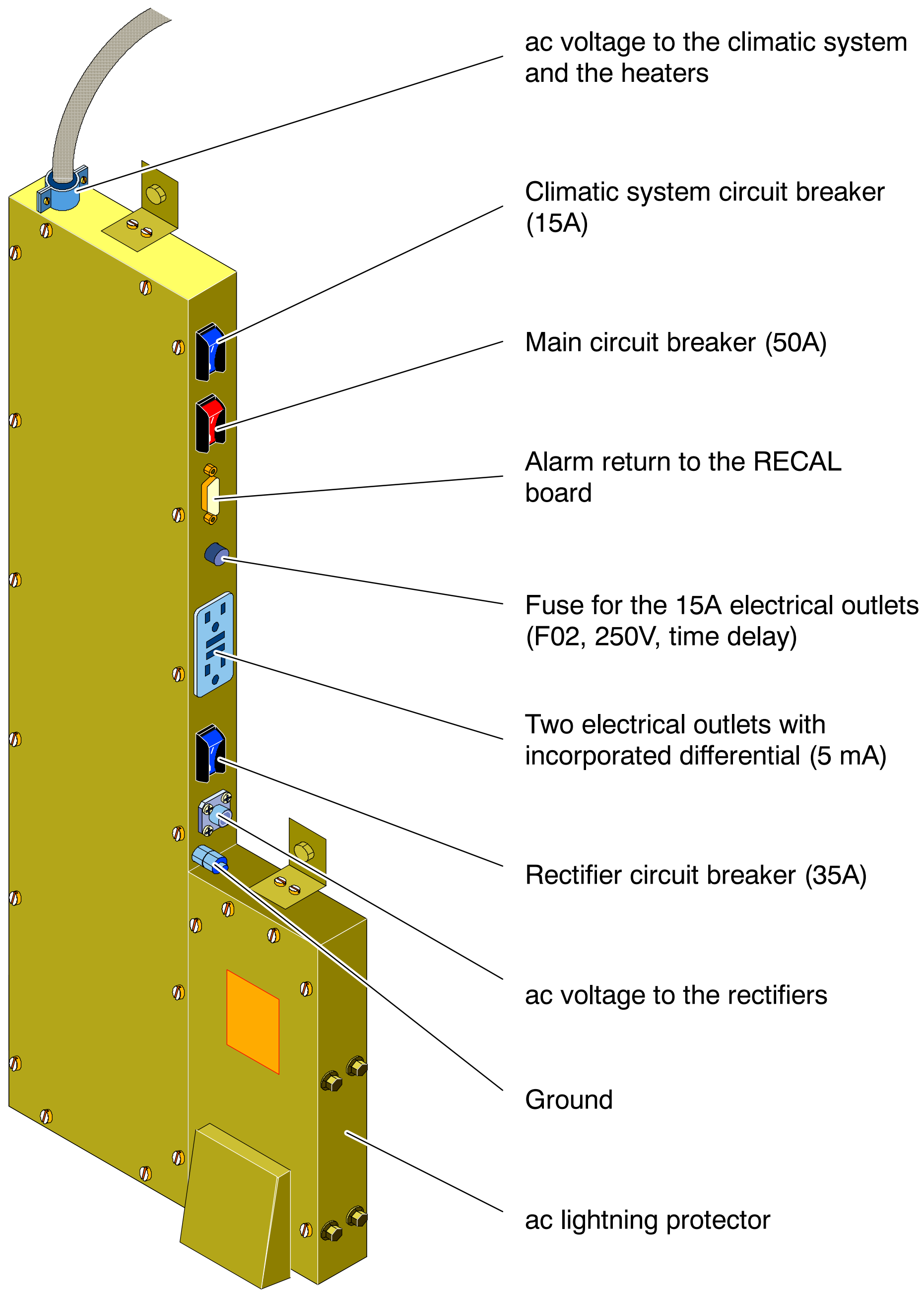


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Figure 1-10 Split single phase ac box

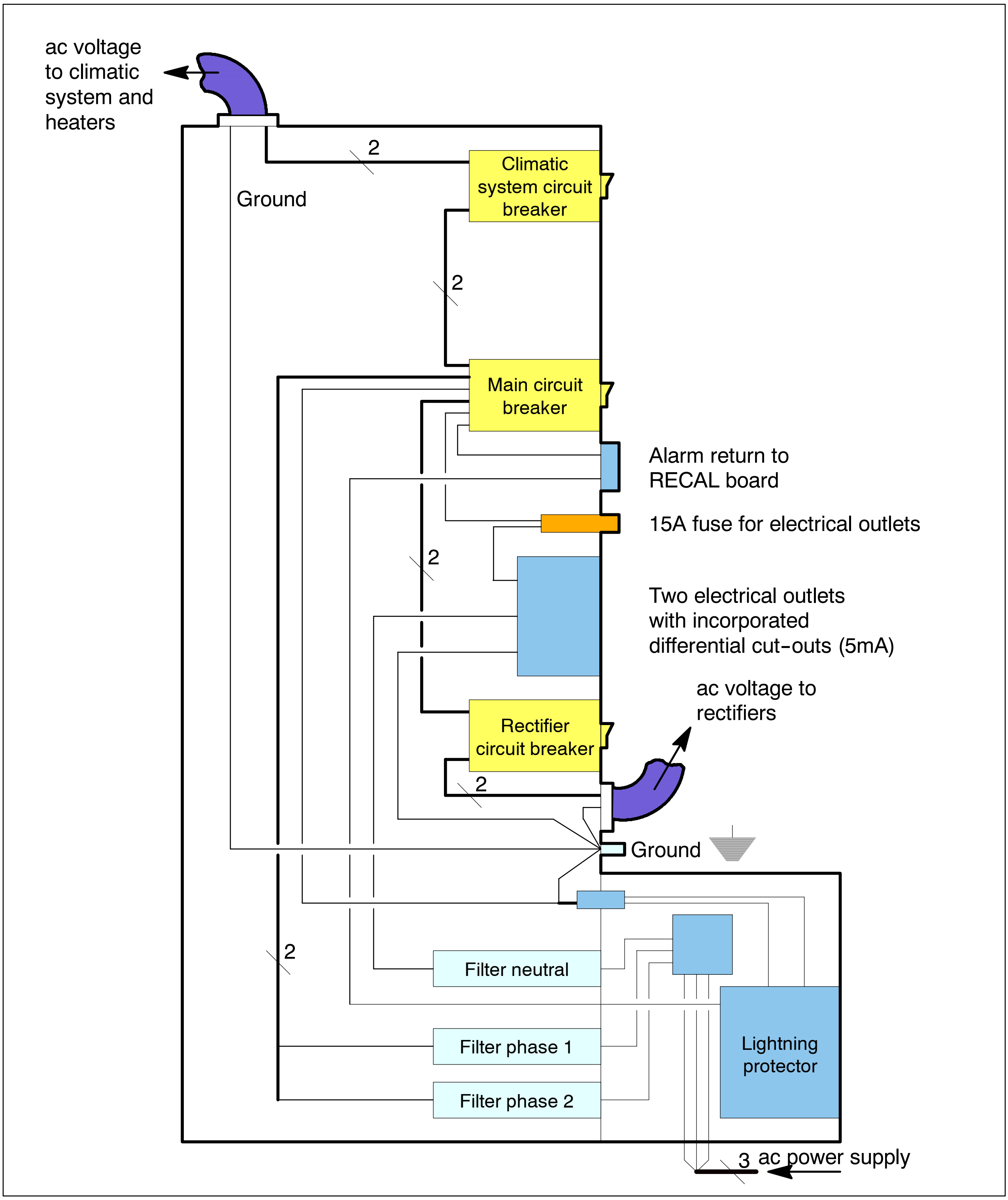


Figure 1-11 Side view of inside of split single-phase ac box

1.2.1.8 DCU based power sytem description (GIPS)

The DCU based power system is composed of the following parts:

- an AC Box module and an optional User AC Plug kit
- an AC Distribution Unit (ADU)
- a DC Distribution and Control Unit (DCU)
- a set of up to seven rectifier units
- a set of batteries

AC BOX/GIPS and user ac plug

It includes only main power supply connection.

The GIPS based power system operates from 3 types of AC power networks depending on the AC Box internal interconnection:

- single phased network
- three phased network
- split phased network

An optional User AC plug kit is connected to the AC Box. Four plug types are available:

- european type E
- european type F
- UK
- US

The user plug kit includes a breaker (differential breaker for European models and fuse for North American models).

ADU (AC Distribution Unit)

It provides the AC distribution functions.

The ADU is located in the rectifier shelf and is a Field Replaceable Unit (FRU).

It includes:

- a surge protection
- EMI filters
- a DACS breaker, rectifier breakers

DCU (DC Distribution and Control Unit)

It provides the DC distribution and control functions.

It includes the PA breaker, the DACS breaker, the DRX breaker and the BCF breaker. The batteries breaker is mounted on an external front panel.

The DCU is located in the rectifier shelf. It is an integral part of this sub-rack and is not a Field Replaceable Unit (FRU).

Rectifier modules

DCU based system (GIPS) receives only 680W rectifiers. A mechanical way prevents 600W rectifier insertion.

The rectifier shelf accepts up to seven rectifiers providing up to 4760 W without redundancy or 4080 W with redundancy.

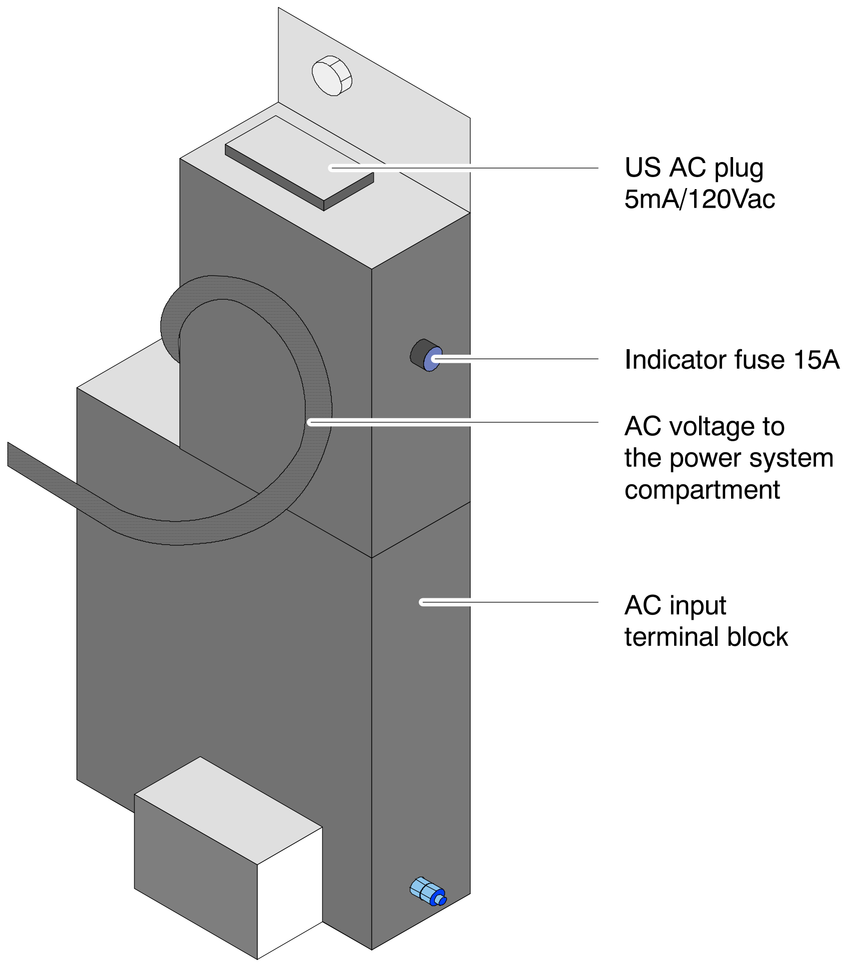


Figure 1-12 AC box/GIPS with US type user AC plug BTS

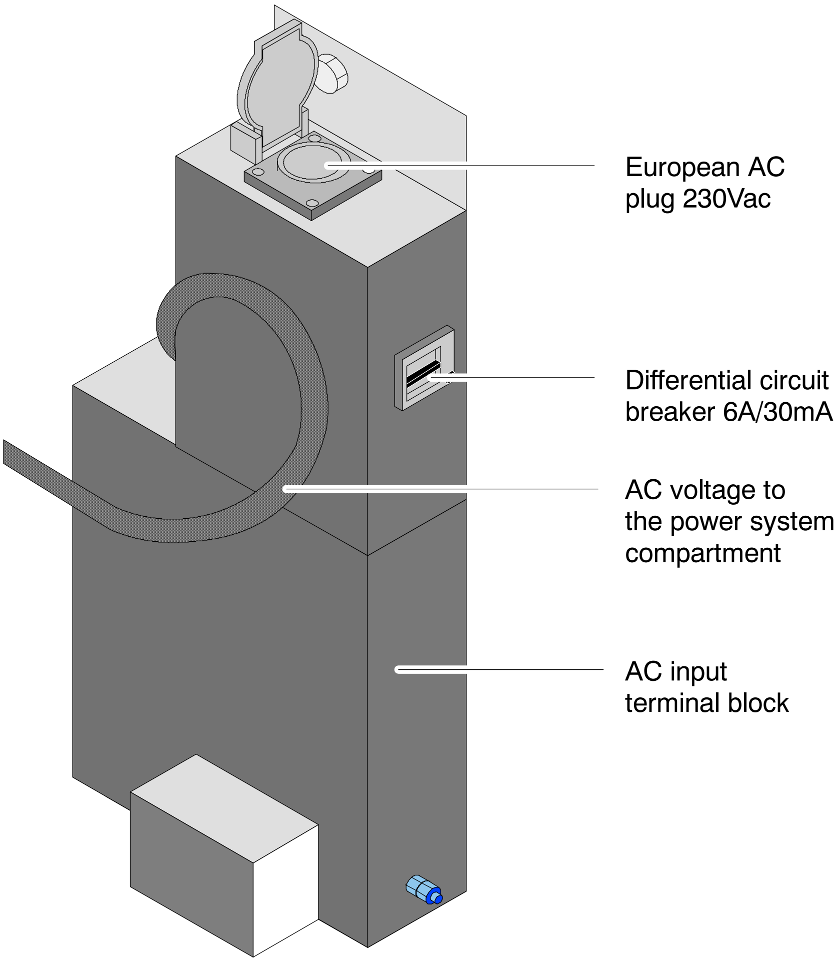


Figure 1-13 AC box/GIPS with E, F, UK type user AC plug

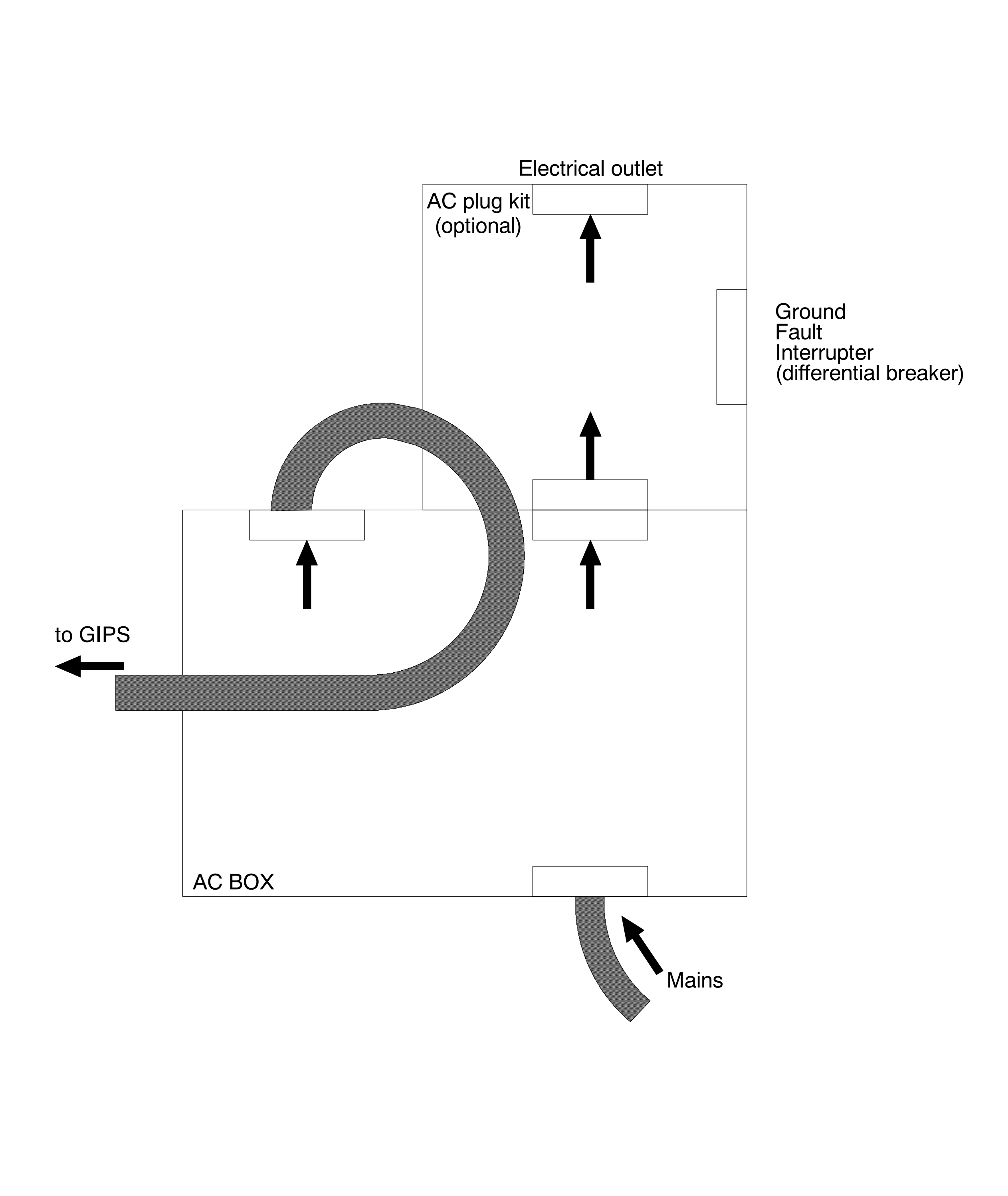


Figure 1-14 Side view of inside of AC box/GIPS

1.2.2 S12000 Indoor BTS

Figure 1-15 shows the dc power supply distribution. Two filters protect the dc distribution input against conducted emission. The dc power supply feeds the dc compartment where four outputs come out to the following equipment groups:

- the twelve power amplifiers and the two F-type converters, through the power amplifier interconnection module
- the two fans, through the fan interconnection module
- the twelve DRXs, through the DRX interconnection module
- the CBCF
- the RECAL board

The dc compartment houses four breakers to disconnect the powering of these equipment groups.

The dc distribution for each group uses three cables:

- +0 V dc
- -48 V dc
- ground

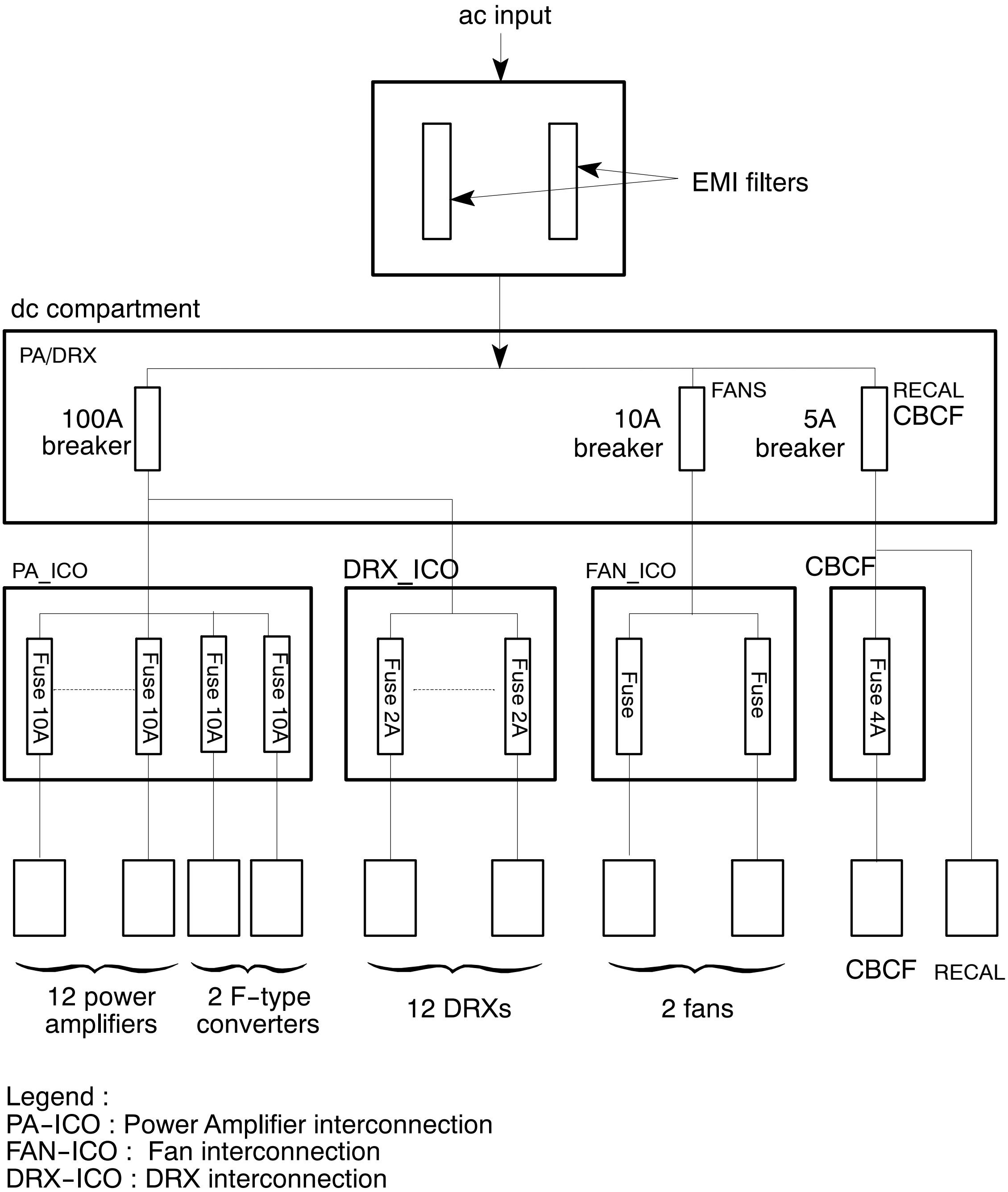


Figure 1-15 S12000 Indoor BTS: dc power supply diagram

1.3 Climatic System

1.3.1 S12000 Outdoor BTS

The climatic system controls the inside temperature of the cabinet. It is located in the top compartment of the cabinet. The climatic system consists of a Direct Ambient Cooling System (DACS).

The operating principle is the following:

- An air damper opens to admit external air (incoming air is filtered) and controls the inner cabinet environment by mixing appropriate amounts of outside and recirculated air.
- Twin blowers drive air down the rear duct and into the equipment enclosure via slots at the rear. Returned air to the cooling system is routed through two sets of holes in the base, with excess air being rejected from vents located on either side of the system.

The internal temperature control is achieved by a high quality thermistor that has an accuracy of ±0.2°C (0.36°F) between 0°C (32°F) and 70°C (158°F). This device is located in the left hand exit duct above a hole on the duct side; the hole ensures that the thermistor is constantly in a moving air stream, regardless of damper position. The operational mode of the Cooling system is solely dictated by the information provided by the thermistor.

There are four operational modes:

- Low temperature -40°C (-56°F) < Tcab < 15°C (59°F)

  The heater is powered on, the damper is closed to the outside and air is recirculated via the holes in the base of the cooling system.
- Medium temperature 15°C (59°F) < Tcab < 40°C (104°F)

  The heater is switched off, the damper remains closed and further heating of the equipment enclosure is achieved solely by the internal equipment loading.
- Normal temperature Tcab = 40°C (104°F)

  The damper position is controlled automatically by the modulating motor, mixing appropriate amounts of recirculated and external air to maintain a constant temperature. Excess air is rejected from the cooling system from vents at either side of the cooling system.
- High temperature Tcab > 40°C (104°F)

  Although the damper is fully open, the cooling system is unable to keep the cabinet temperature to 40°C (104°F) which now rises in sympathy with the external temperature. At an outside temperature of 50°C (122°F), the internal cabinet will rise to a nominal 60°C (140°F) under fully loaded conditions.

The cooling system is supplied with:

- two hard alarm outputs:
  - The first alarm output signals a fault on the cooling system.
  - The second alarm output indicates a maintenance requirement for the filter.
- three alarm LEDs for on-site fault diagnostics:
  - The red LED indicates a critical alarm for fan failure.
  - The yellow LED indicates a critical alarm for heater circuit failure.
  - The green LED indicates a maintenance alarm for clogged filter.

  On the top of the cooling system, there is a window in the lid which allows the user to view the LEDs. The LEDs are normally lit when healthy and off alarm.

The cooling system is dc powered which allows internal or external battery back-up. The dc power consumption of the cooling system is 400-450 W. The cold start-up performance of the unit is controlled by an inbuilt ac to dc converter (for operation of the fans) and by a 2.5 kW heating element.

1.3.2 S12000 Indoor BTS

The Internal Cooling System (ICS) controls the inside temperature of the cabinet. It is located in the lowest compartment of the cabinet. The ICS consists of a rack which contains:

- two blowers
- a filter
- a converter
- a control board
- a front panel which contains three LEDs:
  - FAN1/CONV, which is lit green when there is no failure on the first fan or on the converter.
  - FAN2, which is lit green when there is no failure on the second fan.
  - FILTER, which is lit green when the filter is not clogged.

1.4 Plinth

The S12000 Outdoor BTS cabinet can be installed on a plinth allowing for cable passage. The plinth characteristics are described in NTP < 01 >.

The plinth may contain the external alarm connection box, the PCM connection box and the -48 V dc connection box.

These boxes are screwed into the inside of the plinth.

The S8000 plinth can be used for the S12000 Outdoor BTS.

1.5 Physical characteristics

1.5.1 S12000 Outdoor BTS

Physical characteristics

Refer to NTP < 01 >.

Operating temperature

To operate correctly, the BTS requires a temperature greater than -40°C (-56°F) and less than +50°C (+122°F).

Autonomy of the internal battery

The internal battery is an optional equipment located in the top compartment. The battery backup time depends on the configuration and the BTS equipment, and can vary from 30 minutes to a few hours.

1.5.2 S12000 Indoor BTS

The S12000 Indoor BTS cabinet can be wall-mounted or put on the floor.

Physical characteristics

Refer to NTP < 01 >.

Operating temperature

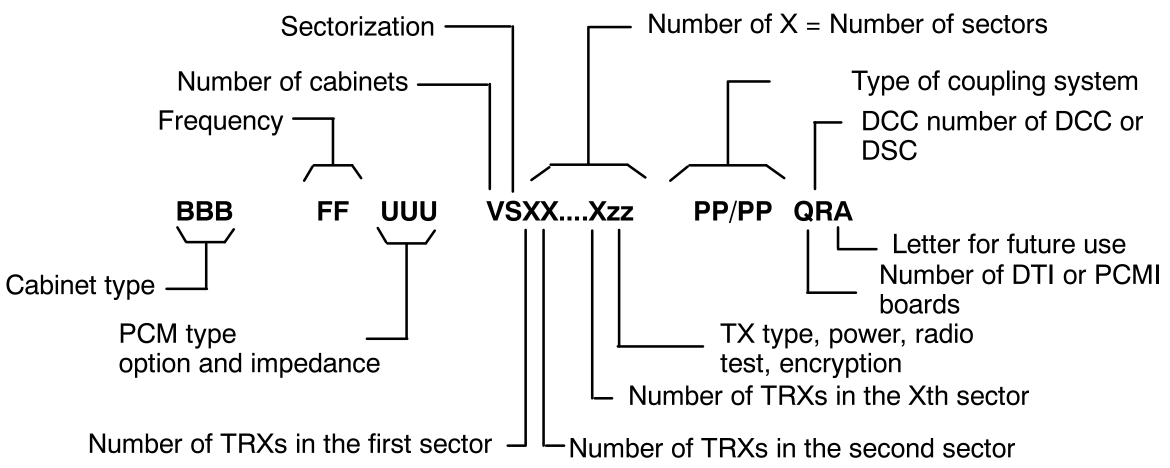
When the base cabinet is turned on, the external ambient air temperature must be between 0°C (32°F) and 45°C (113°F).

Once in operation, the base cabinet requires an external ambient air temperature above -5°C (23°F) and below 45°C (113°F).

1.6 Product names

A BTS contains one or more cabinets and the associated supplies (cables, covers, endings, etc.).

BTS products are identified by six items:



Example: BBB = OUD (S12000 Outdoor BTS)
BBB = IND (S12000 Indoor BTS)

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2 BOARD DESCRIPTION

2.1 Power Amplifier (PA)

The Power Amplifier (PA) amplifies the GUMS signal from a low-level transmission unit and sends it to the transmission coupler.

HePA is compatible with e-DRX (all frequencies) and DRX ND3 (900) and with the indoor and outdoor S8000 and S12000 cabinets. The cabinet can contain a maximum of 12 HePAs.

Three types of PA are available : PA, ePA and HePA (High Power Amplifier). The HePA can be used mixed with PA and ePA.

PA and ePA are class 5 amplifiers, that is, they can provide power of between 20 W and 40 W. Nominal power is 30 W.

HePA is the BTS Power Amplifier with transmit power up to 60 W in GMSK and is Edge compatible.

HePA is compatible with S8000 CBCF and S12000 cabinets (indoor + outdoor) and works with eDRX and DRX ND3. HePA is not compatible with DRX.

The HePA can be mixed with PA in step coupling configurations. It can be mixed with (e)PA in a normal cell if its power is being configured with a value that is compatible with (e)PA (lower than 30 Watt).

The range of value of the OMC parameter ”bsTxPwrMax” that sets the power of the TRX, already permits to configure power up to 60 Watts.

The HePA is differentiated at the OMC from PA and ePA; in the same way the ePA is differentiated from the PA.

It contains its own dc/dc converter and contains a microcontroller which allows it to dialogue with the low-power transmission module. This function makes it possible to move the power amplifier to the top of the tower if necessary.

2.1.1 Amplifier alarms

The power amplifier provides several alarms:

- an overtemperature alarm, whose threshold is set in the PA
- an overvoltage alarm, whose threshold is set in the PA
- an alarm indicating that the PA output reflected power is exceeded

  This alarm is triggered when the reflect power exceeds 6W.
- an alarm dedicated to the DC/DC converter

- a communication alarm

  This alarm is triggered by a parity bit error or control byte error.

- an input power alarm, whose threshold is set in the PA

  The DRX must then reduce its output level (PA input level) to make the alarm disappear

- a consumed current alarm whose threshold is set in the PA

2.1.2 Power supply

The power amplifier receives a 48 V power supply from the cabinet. The converter accepts an input voltage between 36 V and 57 V (nominally 48 V). It then provides the regulated 24 V voltage needed for operation of the PA radio stages.

Maximum consumption is 220 Wfor PA, 200 Wfor ePA and 290 Wfor HePA 1900 MHz or 230 W for HePA 900 MHz. Actual consumptions are lower, with a typical maximum of 170 W for ePAs, 230 W for HePA 1900 and 200 W for HePA 900.

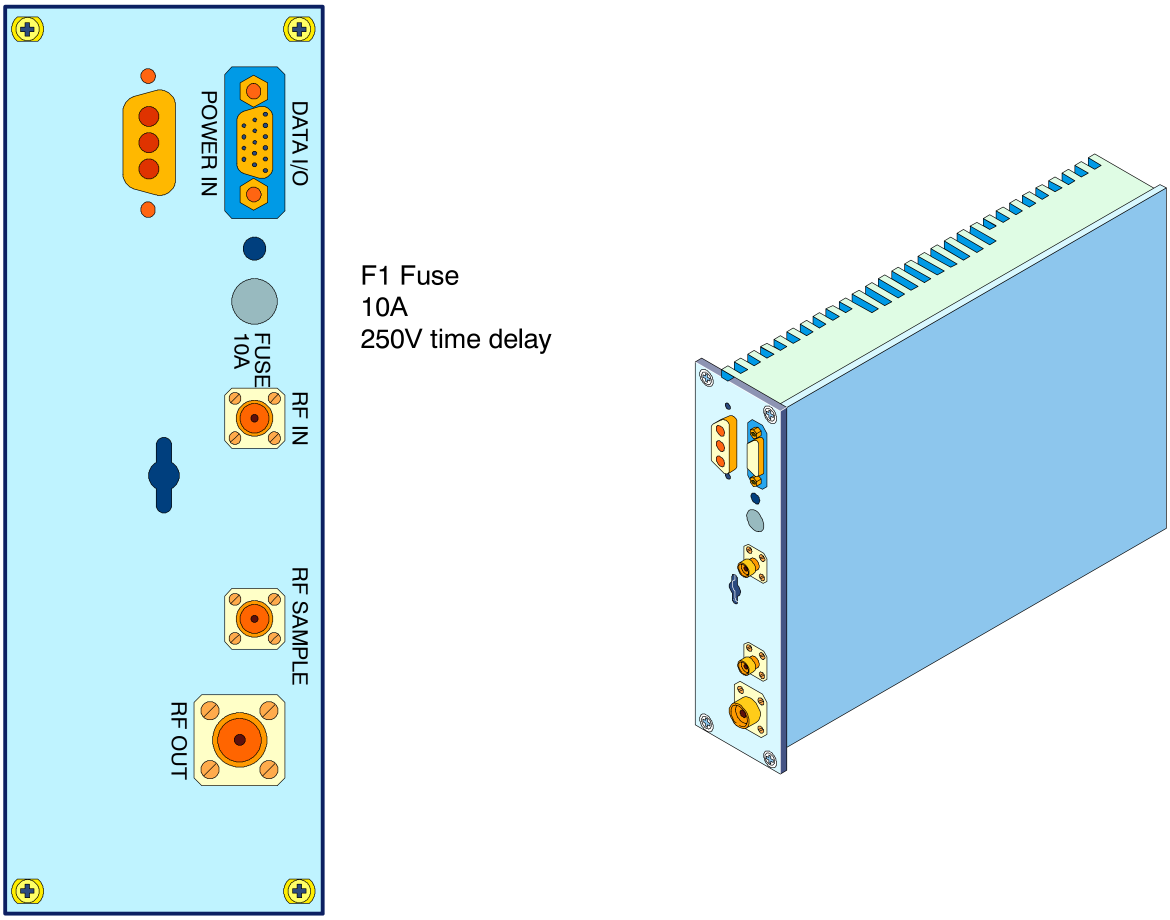
S12000 indoor:

- At low speed:
  The HePA operates 12°C lower in S12000 than in S8000.
  The HePA temperature rise is 4°C lower than specification in S12000 (+26°C above ambient).

- At high speed:
  The HePA operates 17°C lower in S12000 than in S8000.
  The HePA temperature rise is 9°C lower than specification in S12000 (+26°C above ambient).

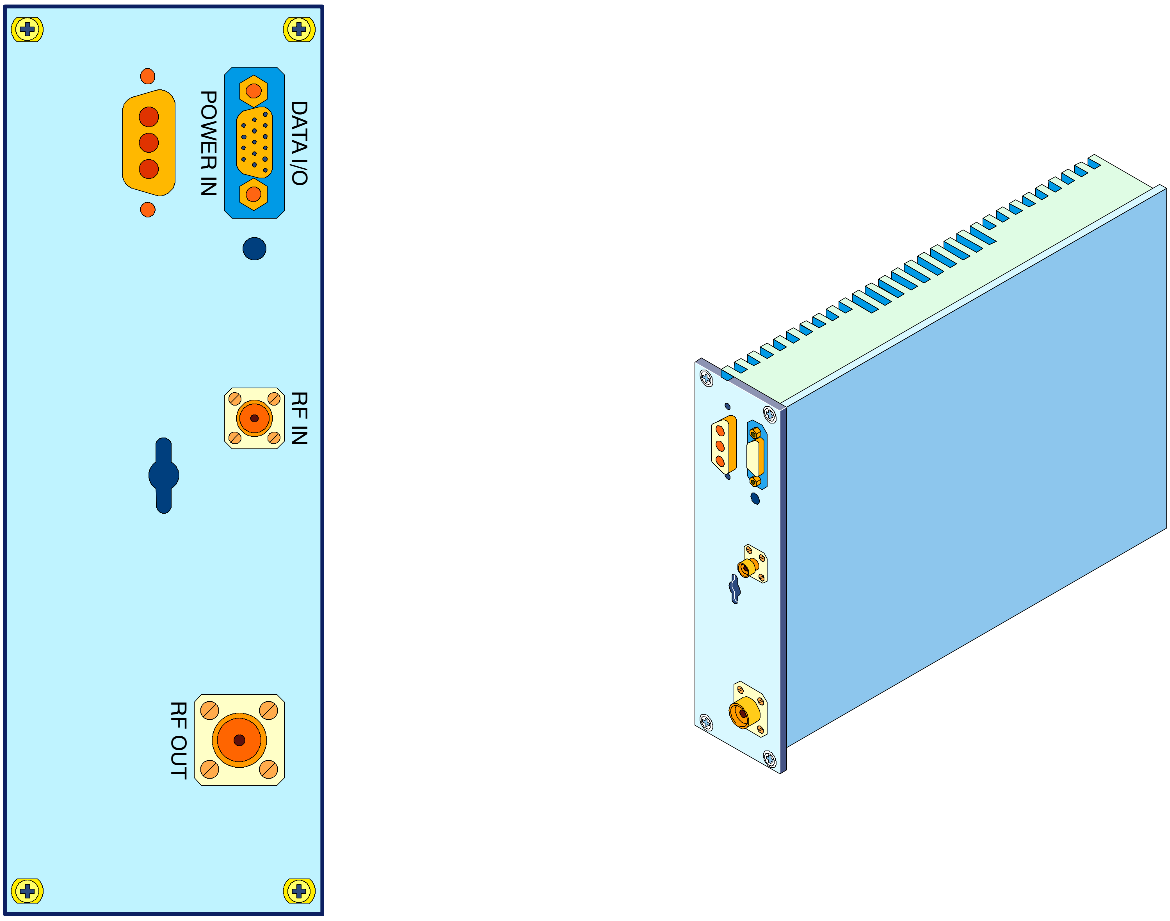
2.1.3 Connectors

The power amplifier connectors are located on the front panel.



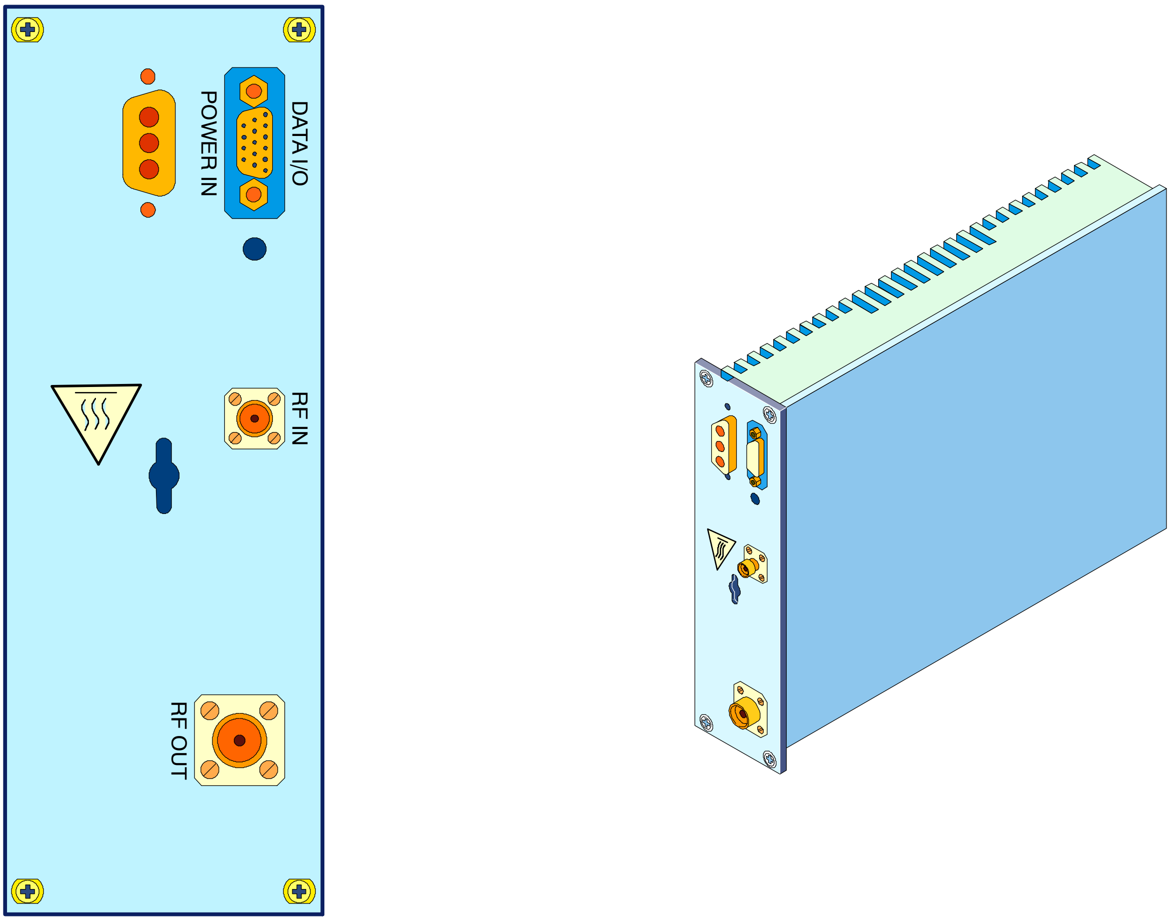
Note: In the S12000 Indoor BTS, the front panel is inverted compared to the figure presented

Figure 2-1 S12000 BTS: Power Amplifier (type 1)



Note: In the S12000 Indoor BTS, the front panel is inverted compared to the figure presented

Figure 2-2 S12000 BTS: Power Amplifier (type 2)



Note: In the S8000 Indoor BTS, the front panel is inverted compared to the figure presented.

Figure 2-3 S12000 BTS: High Power Amplifier (HePA)

2.1.3.1 Radio connectors

There are three radio connectors:

- The radio input connector, marked “RF IN”, is a female, SMA connector.
- The radio output connector, marked “RF OUT”, is a female, N-type connector.
- The test connector, marked “RF SAMPLE”, is a female, SMA connector. According to to the PA type, this connector is optional.

2.1.3.2 Voltage supply connector

The -48 V supply of the PA is supplied through a male, three-pin connector. The pin connections are as follows:

1	48 V (-)
2	GND
3	0 V

Table 2-1 Voltage supply connector

2.1.3.3 Data connector

The data input/output connector is a 20-pin connector. The pin connections are as follows:

1	GND
2	GND
3	SYNC
4	MEU_DATA_OUT
5	Selection of PA operating mode
6	SECT_SEL_0 (not used by the PA)
7	MEU_DATA_IN
8	Test point
9	Test point
10	Test point
11	GND
12	GND
13	NSYNC
14	NMEU_DATA_OUT
15	Test point
16	SECT_SEL_1 (not used by the PA)
17	NMEU_DATA_IN
18	Test point
19	Test point
20	Test point

Table 2-2 Data connector

2.2 RECAL board

2.2.1 Functional description

The RECAL board is the alarm management unit used with the CBCF. The RECAL collects external and internal alarm loops and alarms associated with OEM equipment.

A slave of the CBCF, the RECAL board sends alarms to the CBCF over a Private PCM link. The CBCF signals the BSC when there is an alarm.

There is one RECAL board per cabinet.

The following functional blocks of the RECAL board are shown in *Figure 2-4*:

- Control unit
- Alarms interface
- Communication interface
- Power supply

2.2.1.1 Alarm management

The RECAL board collects three types of alarms:

- Internal alarms
- Unprotected external alarms
- Protected external alarms

Internal alarms

The RECAL board detects up to 56 internal alarms logical signals.

Internal alarms are wire loops that can only be opened or closed by dry contacts or open collectors.

A closed loop forces a low logic level (less than 1.35 V) on the trigger output, which indicates that there is no alarm. An open loop forces a high logic level (greater than 3.15 V) on the trigger output.

The CPU runs polling sequences to recognize the alarm state.

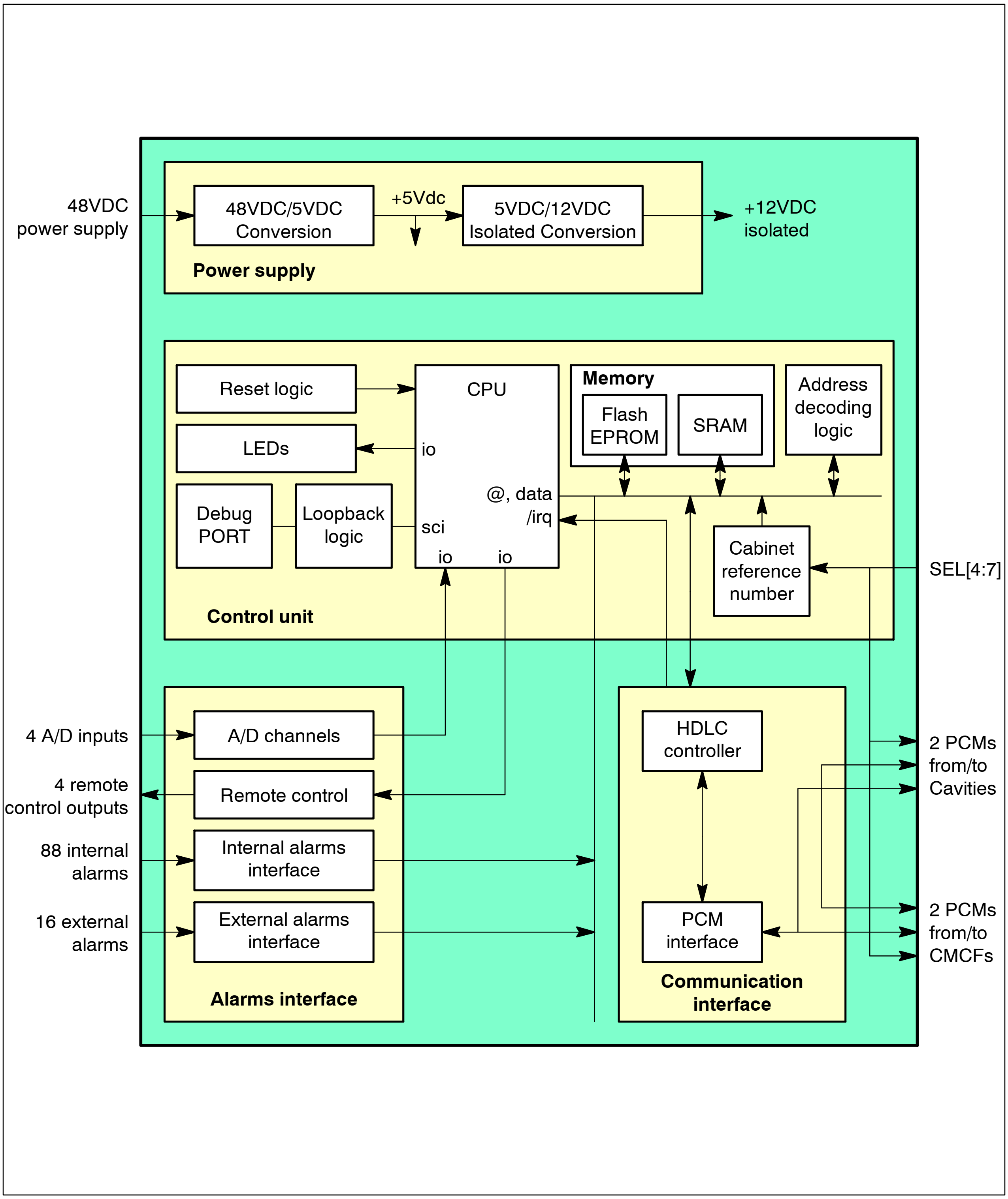


Figure 2-4 RECAL board functional diagram

Unprotected external alarms

The RECAL board detects unprotected external alarms the same as the internal alarms, which can be used inside the cabinet or within a few meters outside the cabinet.

Protected external alarms

The RECAL board detects up to 16 protected external alarms. These alarms can be used outside the cabinet by adding two ALPRO boards, which manage 8 alarms each.

A closed loop forces a low logic level (0 mA) on the optocoupler collector, indicating that there is no alarm. An open loop forces a high logic level (5 mA) on the optocoupler collector, indicating that there is an alarm.

The operation is performed via the external remote commands (close/open relay) accessible via the ALPRO box connected to the EXT. P. connector of the RECAL board.

The EXT. P. (external protected alarm) connector provides pins ETC0A (pin17) and ETC0B (pin18), both connected to an internal relay ETC0 within the RECAL board (see *Table 2-8*).

2.2.1.2 Analog to digital inputs

The RECAL board reads four analog channels (voltage 0 to 5 V DC) that are converted in digital signals by an eight-bits signal into a analog/digital converter.

2.2.1.3 Remote control outputs

Four remote control relay outputs are provided with a maximum current of 80 mA and a maximum voltage of 72 V DC.

2.2.2 Physical description

This section describes the LEDs, connectors, and the electrical characteristics of the RECAL board.

2.2.2.1 Front panel

The front panel of the RECAL board has the following:

- One reset button
- Three LEDs
- Six connectors

The reset button allows a hard reset of the board.

The front panel of the RECAL board is shown in *Figure 2-5*.

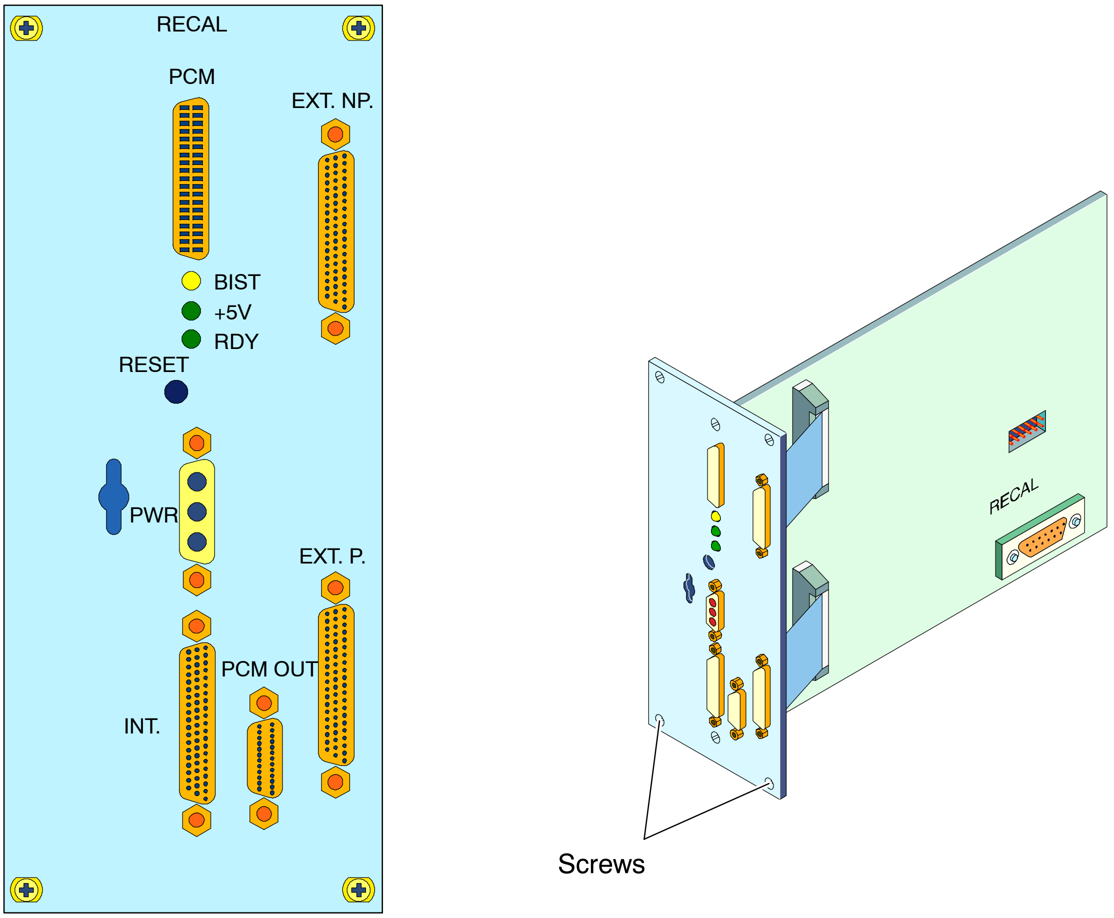


Figure 2-5 RECAL board

2.2.2.2 LEDs

There are three LEDs on the front panel of the RECAL board, described in *Table 2-3*.

Type	No. of LEDs	Label (color)	Meaning (when lit)
Board state indicators	1	BIST (yellow)	The built-in self-test is running or is stopped with a default result.
	1	+5 V (green)	The power is on.
	1	RDY (green)	The board is operating normally.

Table 2-3 LEDs on the front panel of the RECAL board

2.2.2.3 Connectors

There are six connectors on the front panel of the RECAL board, which are wired to corresponding connectors on left/right side of the board (see *Figure 2-5*)

Additionally, there are two connectors that are accessible only from inside the board.

Access	No. of connectors	Label	Type	Purpose
Front panel	1	PCM	SCSI 50-pin female	PCM lines to and from the CBCF and cabinet reference number. Wired to the P4 connector soldered on the inside of the board. The debug port (P0) inside the board is connected to the PCM connector.
	1	PWR	Sub-D 3-pin male Type 3W3	48 V DC Power supply input.
	1	PCM Out	Sub-D 25-pin female	PCM lines to and from cavities. Wired to the P6 connector soldered on the inside of the board.
	1	INT	Sub-D high density 62-pin female	56 internal alarms (32 to 87). Wired to the P3 connector soldered on the inside of the board.
	1	EXT. P.	Sub-D 50-pin female	16 external protected alarms and 4 remote control outputs. Wired to the P5 connector soldered on the inside of the board.
	1	EXT.NP.	Sub-D 50-pin female	32 internal alarms (0 to 31) and 4 analog to digital conversion channels. Wired to the P2 connector soldered on the inside of the board.
Inside the board	1	P0	Sub-D 9-pin male	Debugging port (the connector is not equipped).
	1	P1	10-pin male	EPLD Programming port, used in the factory to program the EPLD.

Table 2-4 RECAL board connectors

Pin connections

The pin connections and their significance are identified in *Table 2-5* to *Table 2-12*.

Pin no.	Purpose	Pin no.	Purpose	Pin no.	Purpose
50				49	TXDBG
47	RXDBG	48	PCBUG0	46	GND
44		45		43	GND
41	GND	42	GND	40	GND
38	NSEL6	39	NSEL7	37	NSEL5
35	GND	36	NSEL4	34	NMICR1
32	NH4M	33	NMICR0	31	NMICE0
29	NMICE1	30	NSY	28	
26		27		25	
23		24		22	
20		21		19	
17	GND	18	GND	16	GND
14	SEL7	15	GND	13	SEL6
11	SEL4	12	SEL5	10	GND
8	MICR0	9	MICR1	7	H4M
5	SY	6	MICE0	4	MICE1
2		3		1	

Legend:
H4M 4 MHz clock
SY Frame synchronization signal
MICE Transmit PCM line
MICR Receive PCM line
GND Ground
SEL/NSEL Cabinet number selection

Table 2-5 PCM pin connections

Pin no.	Purpose	Pin no.	Purpose
		13	GND
25	NSY	12	SY
24	NH4M	11	H4M
23	NMICR1	10	MICR1
22	NMICR0	9	MICR0
21	NMICE1	8	MICE1
20	NMICE0	7	MICE0
19	GND	6	GND
18	GND	5	GND
17	NSEL7	4	SEL7
16	NSEL6	3	SEL6
15	NSEL5	2	SEL5
14	NSEL4	1	SEL4

Legend:
H4M 4 MHz clock
SY Frame synchronization signal
MICE Transmit PCM line
MICR Receive PCM line
GND Ground

Table 2-6 PCM-out pin connections

Pin no.	Purpose	Pin no.	Purpose	Pin no.	Purpose
		42	GND	21	DALI87
62	DALI86	41	DALI85	20	DALI84
61	DALI83	40	DALI82	19	DALI81
60	DALI80	39	DALI79	18	GND
59	DALI78	38	DALI77	17	DALI76
58	DALI75	37	DALI74	16	DALI73
57	DALI72	36	DALI71	15	DALI70
56	DALI69	35	DALI68	14	DALI67
55	DALI66	34	GND	13	DALI65
54	DALI64	33	DALI63	12	DALI62
53	DALI61	32	DALI60	11	DALI59
52	DALI58	31	DALI57	10	DALI56
51	DALI55	30	DALI54	9	DALI53
50	GND	29	DALI52	8	DALI51
49	DALI50	28	DALI49	7	DALI48
48	DALI47	27	DALI46	6	DALI45
47	DALI44	26	DALI43	5	DALI42
46	DALI41	25	GND	4	DALI40
45	DALI39	24	DALI138	3	DALI37
44	DALI36	23	DALI135	2	DALI34
43	DALI33	22	GND	1	DALI32

Legend:
DALI Internal Alarm Detection
GND Ground

Table 2-7 Internal pin connections

Pin no.	Purpose	Pin no.	Purpose	Pin no.	Purpose
50		33	MLC	17	
49	ETC1B_ALPRO1	32	MLC	16	ETC1A_ALPRO1
48	+ 5 V	31	ETC0A_ALPRO1	15	ETC0B_ALPRO1
47	+ 5 V	30		14	
46	ME_ALPRO1	29	DALE6_ALPRO1	13	DALE7_ALPRO1
45	ME_ALPRO1	28	DALE4_ALPRO1	12	DALE5_ALPRO1
44	ME_ALPRO1	27	DALE2_ALPRO1	11	DALE3_ALPRO1
43	ME_ALPRO1	26	DALE0_ALPRO1	10	DALE1_ALPRO1
42	ME_ALPRO1	25		9	
41	MLC	24	ETC1A_ALPRO0	8	ETC1B_ALPRO0
40	MLC	23	ETC0B_ALPRO0	7	+ 5 V
39	ETC0A_ALPRO0	22		6	+ 5 V
38		21	DALE7_ALPRO0	5	ME_ALPRO0
37	DALE6_ALPRO0	20	DALE5_ALPRO0	4	ME_ALPRO0
36	DALE4_ALPRO0	19	DALE3_ALPRO0	3	ME_ALPRO0
35	DALE2_ALPRO0	18	DALE1_ALPRO0	2	ME_ALPRO0
34	DALE0_ALPRO0			1	ME_ALPRO0

Legend:
- DALE: External alarm detection
- ETC: Remote control emission
- ME: External Mass (isolated from logic mass)
- MLC: Common Logic Mass

Table 2–8 EXT. P pin connections

Pin no.	Purpose	Pin no.	Purpose	Pin no.	Purpose
50	GND	33	DALI 21	17	GND
49	DTA3	32	DALI 20	16	DALI 11
48	DTA2	31	DALI 19	15	DALI 10
47	GND	30	GND	14	DALI 9
46	DALI 31	29	DALI 18	13	GND
45	DALI 30	28	DALI 17	12	DALI 8
44	DALI 29	27	DALI 16	11	DALI 7
43	DALI 28	26	GND	10	DALI 6
42	GND	25	GND	9	GND
41	DALI 27	24	DTA1	8	DALI 5
40	DALI 26	23	DTA0	7	DALI 4
39	DALI 25	22	GND	6	DALI 3
38	GND	21	DALI 15	5	GND
37	DALI 24	20	DALI 14	4	DALI 2
36	DALI 23	19	DALI 13	3	DALI 1
35	DALI 22	18	DALI 12	2	DALI 0
34	GND			1	GND

Legend:
DALI Internal Alarm Detection
GND Ground

Table 2-9 Ext. NP. pin connections

Pin no.	Purpose
1	(–) 48 V
2	GND
3	(+) 48 V

Table 2-10 PWR pin connections

Pin no.	Purpose	Pin no.	Purpose
6		1	GND
7		2	RXDBG
8		3	TXDBG
9		4	PCBUG0
		5	GND

Table 2-11 P0 (Debug) pin connections

Pin no.	Purpose	Pin no.	Purpose
1	TCK	2	GND
3	TDO	4	+5
5	TMS	6	
7		8	
9	TDI	10	GND

Table 2-12 P1 (EPLD JTAG) port pin connections

2.2.2.4 Electrical characteristics

The RECAL board is powered by a nominal 48 V DC. The nominal supply current is approximately 600 mA.

A DC/DC converter (48 V to 5 V) on the board supplies logic circuits with +5 V DC. The +5 V DC supply is available on the EXT.P external connector (and P5 internal connector) for the possible heating resistors mounted on the ALPRO boards.

A second DC/DC isolated stages converter (5 V to 12 V) provides external alarm detection circuits with +12 V DC isolated supply.

A EMC filter is designed on the board between 48 V DC input and the primary stage of the DC/DC (48 V to 5 V) converter.

Its maximum consumption is 15 W.

2.2.3 List of connected internal alarms

Connected internal alarms are the only internal alarms that can be used. The list of alarms and the corresponding DALI pins (internal alarm detection) on the INT0 connector are identified in the following tables:

Table 2-13 – S12000 Indoor BTS (base and extension cabinets)

Table 2-15 – S12000 Outdoor BTS (base and extension cabinets)

Origin	Alarm	DALI	RECAL INT connector PIn
F-type converter	High temperature Converter F0	DALI80	60
	Behavior signal Converter F0	DALI81	19
	High temperature Converter F1	DALI82	40
	Behavior signal Converter F1	DALI83	61
Doors	Door alarm	DALI87	21
VSWR-meter	VSWR0 Level 1 fault	DALI33	43
	VSWR0 Level 2 fault	DALI34	2
	VSWR0 Level 3 fault	DALI35	23
	VSWR1 Level 1 fault	DALI37	3
	VSWR1 Level 2 fault	DALI38	24
	VSWR1 Level 3 fault	DALI39	45
	VSWR2 Level 1 fault	DALI41	46
	VSWR2 Level 2 fault	DALI42	5
	VSWR2 Level 3 fault	DALI43	26
	VSWR3 Level 1 fault	DALI45	6
	VSWR3 Level 2 fault	DALI46	27
	VSWR3 Level 3 fault	DALI47	48
	VSWR4 Level 1 fault	DALI49	28
	VSWR4 Level 2 fault	DALI50	49
VSWR-meter	VSWR4 Level 3 fault	DALI51	8
	VSWR5 Level 1 fault	DALI53	9
	VSWR5 Level 2 fault	DALI54	30
	VSWR5 Level 3 fault	DALI55	51
	VSWR6 Level 1 fault	DALI57	31

Origin	Alarm	DALI	RECAL INT connector PIn
	VSWR6 Level 2 fault	DALI58	52
	VSWR6 Level 3 fault	DALI59	11
	VSWR7 Level 1 fault	DALI61	53
	VSWR7 Level 2 fault	DALI62	12
	VSWR7 Level 3 fault	DALI63	33
	VSWR8 Level 1 fault	DALI65	13
	VSWR8 Level 2 fault	DALI66	55
	VSWR8 Level 3 fault	DALI67	14
	VSWR9 Level 1 fault	DALI69	56
	VSWR9 Level 2 fault	DALI70	15
	VSWR9 Level 3 fault	DALI71	36
	VSWR10 Level 1 fault	DALI73	16
	VSWR10 Level 2 fault	DALI74	37
	VSWR10 Level 3 fault	DALI75	58
	VSWR11 Level 1 fault	DALI77	38
	VSWR11 Level 2 fault	DALI78	59
	VSWR11 Level 3 fault	DALI79	39
LNA	LNA0 fault	DALI32	1
	LNA1 fault	DALI36	44
	LNA2 fault	DALI40	4
	LNA3 fault	DALI44	47
	LNA4 fault	DALI48	7
	LNA5 fault	DALI52	29
	LNA6 fault	DALI56	10
	LNA7 fault	DALI60	32
	LNA8 fault	DALI64	54
	LNA9 fault	DALI68	35
	LNA10 fault	DALI72	57
	LNA11 fault	DALI76	17

Origin	Alarm	DALI	RECAL INT connector PIn
Blower	Blower_ALA1	DALI84	20
	Blower_ALA2	DALI85	41
	Blower_ALA3	DALI86	62

Table 2-13 List of alarms and INT0 connector DALIs (S12000 Indoor BTS, base and extension cabinets)

The values of this table correspond to the static wiring scheme between COMICO and RECAL.

In function of the configuration and of the BTS cabling, the logical value associated to the origin of alarms can be different from the static value.

For example, the following table gives the correspondence between static values and logical values for the 3H4D+RxF S444 an 3 H4D S012 configuration.

Static Values	3 H4D+RxF S444	3 H4D S012	DALI
LNA0	X	X	
VSWR0 Level 1 fault	X	X	
VSWR0 Level 2 fault	X	X	
VSWR0 Level 3 fault	X	X	
LNA1	LNA0	LNA0	DALI36
VSWR1 Level 1 fault	VSWR0 Level 1 fault	VSWR0 Level 1 fault	DALI37
VSWR1 Level 2 fault	VSWR0 Level 2 fault	VSWR0 Level 2 fault	DALI38
VSWR1 Level 3 fault	VSWR0 Level 3 fault	VSWR0 Level 3 fault	DALI39
LNA2	X	X	
VSWR2 Level 1 fault	X	X	
VSWR2 Level 2 fault	X	X	
VSWR2 Level 3 fault	X	X	
LNA3	LNA1	LAN1	DALI44
VSWR3 Level 1 fault	VSWR1 Level 1 fault	VSWR1 Level 1 fault	DALI45
VSWR3 Level 2 fault	VSWR1 Level 2 fault	VSWR1 Level 2 fault	DALI46
VSWR3 Level 3 fault	VSWR1 Level 3 fault	VSWR1 Level 3 fault	DALI47
LNA4	X	X	

Static Values	3 H4D+RxF S444	3 H4D S012	DALI
VSWR4 Level 1 fault	X	X	
VSWR4 Level 2 fault	X	X	
VSWR4 Level 3 fault	X	X	
LNA5	LNA2	LNA2	DALI52
VSWR5 Level 1 fault	VSWR2 Level 1 fault	VSWR2 Level 1 fault	DALI53
VSWR5 Level 2 fault	VSWR2 Level 2 fault	VSWR2 Level 2 fault	DALI54
VSWR5 Level 3 fault	VSWR2 Level 3 fault	VSWR2 Level 3 fault	DALI55
LNA6	X	X	
VSWR6 Level 1 fault	X	X	
VSWR6 Level 2 fault	X	X	
VSWR6 Level 3 fault	X	X	
LNA7	LNA7	X	60
VSWR7 Level 1 fault	X	X	
VSWR7 Level 2 fault	X	X	
VSWR7 Level 3 fault	X	X	
LNA8	X	X	
VSWR8 Level 1 fault	X	X	
VSWR8 Level 2 fault	X	X	
VSWR8 Level 3 fault	X	X	
LNA9	LNA9	X	68
VSWR9 Level 1 fault	X	X	
VSWR9 Level 2 fault	X	X	
VSWR9 Level 3 fault	X	X	
LNA10	LNA11	X	72
VSWR10 Level 1 fault	X	X	
VSWR10 Level 2 fault	X	X	
VSWR10 Level 3 fault	X	X	
LNA11	X	X	
VSWR11 Level 1 fault	X	X	
VSWR11 Level 2 fault	X	X	
VSWR11 Level 3 fault	X	X	

Table 2-14 Example of alarm affectation in function of S12000 Indoor configuration

Note: An X in a column indicates that the alarm is not used with a particular configuration

Origin	Alarm	DALI	RECAL INT connector PIn
F-type converter	High temperature Converter F0	DALI80	60
	Behavior signal Converter F0	DALI81	19
	High temperature Converter F1	DALI82	40
	Behavior signal Converter F1	DALI83	61
Doors	Door alarm	DALI87	21
VSWR-meter	VSWR0 Level 1 fault	DALI77	43
	VSWR0 Level 2 fault	DALI78	2
	VSWR0 Level 3 fault	DALI79	23
	VSWR1 Level 1 fault	DALI73	3
	VSWR1 Level 2 fault	DALI74	24
	VSWR1 Level 3 fault	DALI75	45
	VSWR2 Level 1 fault	DALI69	46
	VSWR2 Level 2 fault	DALI70	5
	VSWR2 Level 3 fault	DALI71	26
	VSWR3 Level 1 fault	DALI65	6
	VSWR3 Level 2 fault	DALI66	27
	VSWR3 Level 3 fault	DALI67	48
	VSWR4 Level 1 fault	DALI61	28
	VSWR4 Level 2 fault	DALI62	49
VSWR-meter	VSWR4 Level 3 fault	DALI63	8
	VSWR5 Level 1 fault	DALI57	9
	VSWR5 Level 2 fault	DALI58	30
	VSWR5 Level 3 fault	DALI59	51
	VSWR6 Level 1 fault	DALI53	31
	VSWR6 Level 2 fault	DALI54	52
	VSWR6 Level 3 fault	DALI55	11
	VSWR7 Level 1 fault	DALI49	53
	VSWR7 Level 2 fault	DALI50	12

Origin	Alarm	DALI	RECAL INT connector PIn
	VSWR7 Level 3 fault	DALI51	33
	VSWR8 Level 1 fault	DALI45	13
	VSWR8 Level 2 fault	DALI46	55
	VSWR8 Level 3 fault	DALI47	14
	VSWR9 Level 1 fault	DALI41	56
	VSWR9 Level 2 fault	DALI42	15
	VSWR9 Level 3 fault	DALI43	36
	VSWR10 Level 1 fault	DALI37	16
	VSWR10 Level 2 fault	DALI38	37
	VSWR10 Level 3 fault	DALI39	58
	VSWR11 Level 1 fault	DALI33	38
	VSWR11 Level 2 fault	DALI34	59
	VSWR11 Level 3 fault	DALI35	39
LNA	LNA0 fault	DALI76	1
	LNA1 fault	DALI72	44
	LNA2 fault	DALI68	4
	LNA3 fault	DALI64	47
	LNA4 fault	DALI60	7
	LNA5 fault	DALI56	29
	LNA6 fault	DALI52	10
	LNA7 fault	DALI48	32
	LNA8 fault	DALI44	54
	LNA9 fault	DALI40	35
	LNA10 fault	DALI36	57
	LNA11 fault	DALI32	17
Blower	Cooler_0	DALI84	20
	Cooler_1	DALI85	41
	Hood_Alarm	DALI86	62

Table 2-15 List of alarms and INT0 connector DALIs (S12000 Outdoor BTS, base and extension cabinets)

2.2.4 List of unprotected external alarms

The following pins on the INT1 connector can be used to receive up to 32 unprotected external alarms:

- DALI 0 to DALI 20
- MLC

The above pins presently are not used in the S12000 Indoor BTS.

Table 2-16 identifies the DALIs in the S12000 Outdoor BTS.

Origin	Alarm	DALI number
AC MAIN ALARM	Main breaker	DALI 0
SURGE ALARM	Surge fail	DALI 1
AC-DC RECTIFIERS ALARMS	AC fault	DALI 2
	DC fault	DALI 3
	Over temperature	DALI 4
	Load1 threshold	DALI 5
	PCU protective devices	DALI 6
	Battery on discharge	DALI 7
USER ALARMS	User 1	DALI 8
	User 2	DALI 9
	User 3	DALI 11
	User 4	DALI 12
	User 5	DALI 13
BATTERY BREAKER ALARM	Disconnected battery	DALI 14
EXTERNAL BATTERY ALARM	Thermal fault	DALI 15
	DC breaker fault	DALI 16
	Door open	DALI 17
	AC breaker fault	DALI 18
	Surge	DALI 19
	Spare	DALI 20
Not used		DALI 21
Not used		DALI 22 to DALI 24

Origin	Alarm	DALI number
Not used		DALI 25 to DALI 27
Not used		DALI 28 to DALI 31

Table 2-16 Unprotected external alarms (S12000 Outdoor BTS, base and extension cabinets)

2.3 ALPRO board

The ALPRO board protects up to eight external alarms and up to two remote controls of the RECAL board.

2.3.1 Principle

The external alarms and remote controls are intended to be connected to equipment outside the cabinets. This equipment may be connected, temporarily or permanently, to outside line conductors affected by electrical disturbances. The ALPRO board protects against these disturbances.

One ALPRO board protects half of the external interfaces available in the RECAL board. There may therefore be two ALPRO boards for one RECAL board. Depending on how many external alarms are used, one or two ALPRO boards may be installed.

2.3.2 Description

The ALPRO board (see *Figure 2-6* presented in S12000 Outdoor configuration) provides only secondary protection. Primary protection devices are associated with the board to protect the lines themselves. A cable linking the board ground to a cabinet ground bar discharges energy caused by outside disturbances.

2.3.2.1 External alarm protection circuit

The first part of the external alarm protection circuit comprises a surge arrestor and thermal resistors, which protect the board against power surges and limit the current in wires and connectors.

The second part limits the voltage and current returning to the RECAL board. It consists of transils and thermal resistors.

2.3.2.2 Remote control protection circuit

The first part of the remote control protection circuit comprises a surge arrestor and thermal resistors, which protect the board against power surges and limit the current in wires and connectors.

The second part protects the relays and connections of the RECAL board. It consists mainly of thermal resistors.

2.3.3 S12000 Outdoor BTS environmental conditions

The ALPRO board is located in a sealed environment inside the skirting of the cabinet. It is designed to operate at temperatures between -40°C (-40°F) and +80°C (176°F).

Two thermoresistors supplied with +5 V prevent condensation inside the case of the ALPRO card.

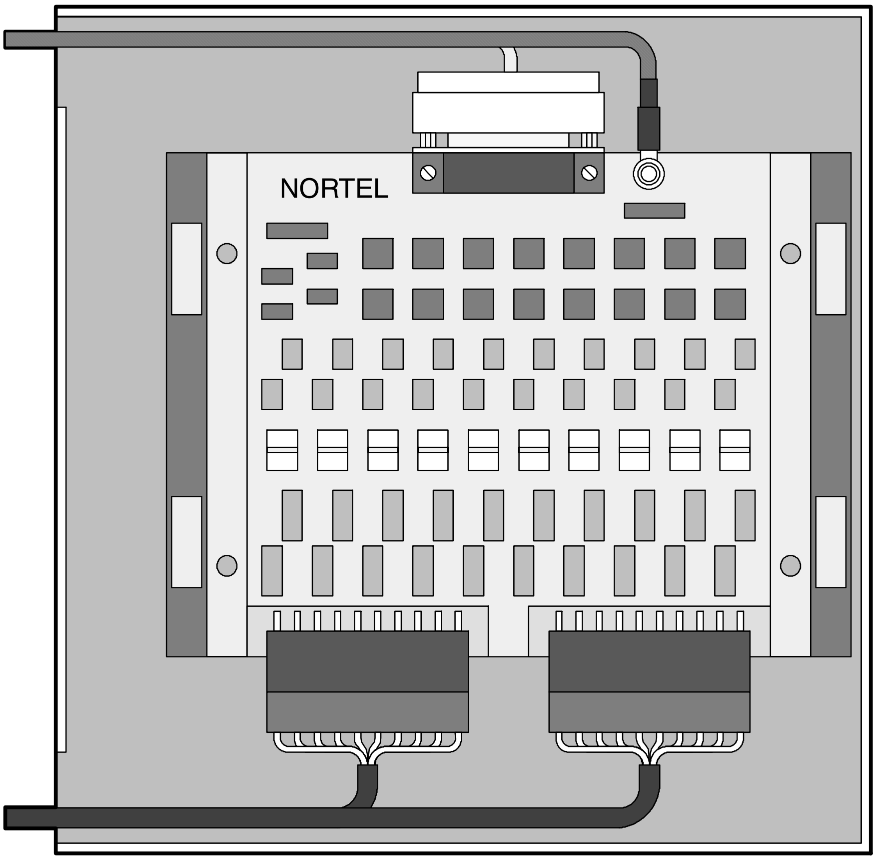


Figure 2-6 ALPRO board

2.3.4 S12000 Indoor BTS environmental conditions

ALPRO modules are located at the top of the radio cabinet. The precise location is presented on the overview figure.

2.3.5 Connectors

The ALPRO board has three connectors:

- A 25-pin male connector connects the ALPRO board to the RECAL board:

Pin no.	Purpose	Pin no.	Purpose
14	DALE0	1	ME
15	ME	2	DALE1
16	DALE3	3	DALE2
17	DALE4	4	ME
18	ME	5	DALE5
19	DALE7	6	DALE6
20		7	ME
21	+5 V	8	
22	ETC0B	9	ETC0A
23	MLC	10	+5 V
24	ETC1B	11	ETC1A
25		12	MLC
		13	
Legend: **ETC** Remote Control **DALE** External Alarm Protected Detection **ME** External ground			

Table 2-17 ALPRO 25-pin connections

- Two 10-pin connectors connect the ALPRO board to the external alarms:

Connector J1

1	TC0A
2	TC0B
3	TC1A
4	TC1B
5	NALE7
6	PALE7
7	NALE6
8	PALE6
9	NALE5
10	PALE5

Connector J2

1	NALE4
2	PALE4
3	NALE3
4	PALE3
5	NALE2
6	PALE2
7	NALE1
8	PALE1
9	NALE0
10	PALE0

Table 2-18 ALPRO 10-pin connections

2.4 F-type converter

2.4.1 Principle

The F-type converter converts a 48 V DC voltage into two power sources, -15 V and +15 V. It powers the radio equipments such as the Low Noise Amplifiers (LNA), the variable gain amplifiers and the VSWR measuring devices.

2.4.2 Description

The F-type converter has a switch on its front panel that can be used to disconnect the input voltage. It also has two outputs that can be connected in parallel with identical outputs of another F-type converter.

2.4.2.1 Input voltage

Nominal input voltage: 48 V (40.5 V to 57 V)

2.4.2.2 Output voltages

The two output voltages supplied by the converter are as follows:

- Source 1:

Nominal voltage: +15 V Nominal current: 7 A

- Source 2:

Nominal voltage: -15 V Nominal current: 4 A

Output voltages can be individually adjusted up to +15% and -5% of nominal voltage.

2.4.2.3 Alarms

Several alarm signals can be generated, in the following cases:

- One of the two output voltages is either lower than the Low Voltage Limit (LVL) or higher than the High Voltage Limit (HVL). These limit voltages are:
  - LVL: 13.25 V ± 0.25 V
  - HVL: 18.5 V ± 0.5 V
- The switch on the front panel is set to “OFF”.
- The converter temperature is too high.

Finally, an event alarm is generated when there is a logic OR between the other alarms.

2.4.3 Front panel

The F-type converter front panel has several connectors and LEDs (see *Figure 2-7*).

2.4.3.1 LEDs

Two green LEDs provide information on the status of the converter.

2.4.3.2 Connectors

Two connectors are on the front panel of the converter:

- A female, Sub-D, 15-pin connector supplies output voltages and alarm signals.
- A male, 3W3, Sub-D connector receives input voltages.

1	GND
2	15 V alarm
3	Switch “OFF” alarm
4	High temperature alarm
5	GND
6	-15 V alarm
7	GND
8	Event alarm
9	GND
10	GND
11	15 V
12	15 V
13	-15 V
14	-15 V
15	GND

Table 2-19 Output voltages and alarm signals connector

1	-48 V
2	Mechanical ground
3	+48 V

Table 2-20 Input voltages connector

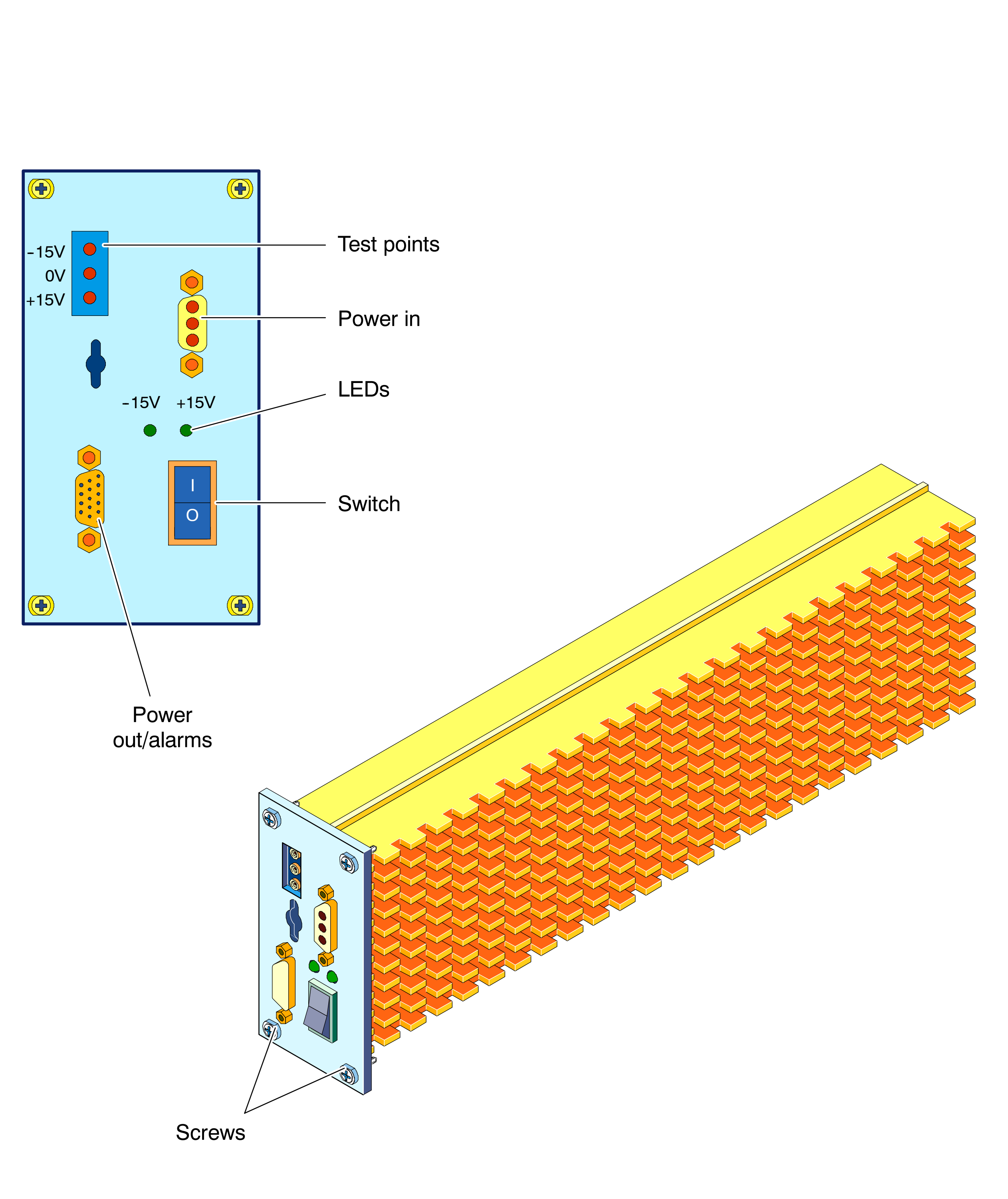


Figure 2-7 F-type converter

2.5 RF Combiner

2.5.1 Principle

There are three types of RF Combiner modules:

- duplexer-only (D)
- hybrid two-way duplexer (H2D)
- hybrid four-way duplexer (H4D)

The functional diagrams of each RF Combiner type are shown in *Figure 2-8*.

Table 2-21 describes the components in each type of RF Combiner module.

RF Combiner Type	Contents
D	- Duplexer - Reception Amplifier (LNA splitter) - VSWR Meter (optional)
H2D	- Duplexer - Reception Amplifier (LNA splitter) - Two-way transmission coupling (H2D) - VSWR Meter (optional)
H4D	- Duplexer - Reception Amplifier (LNA splitter) - Four-way transmission coupling (H4D) - VSWR Meter (optional)

Table 2-21 Content of RF Combiner modules

2.5.1.1 Duplexer

The duplexer allows transmission and reception to occur on the same antenna. This reduces the number of antennas required for a cabinet. The duplexer also performs filtering for reception and transmission.

When no receive filtering or transmit coupling is required, then the Tx-Filter (TxF) module can be used instead of the duplexer.

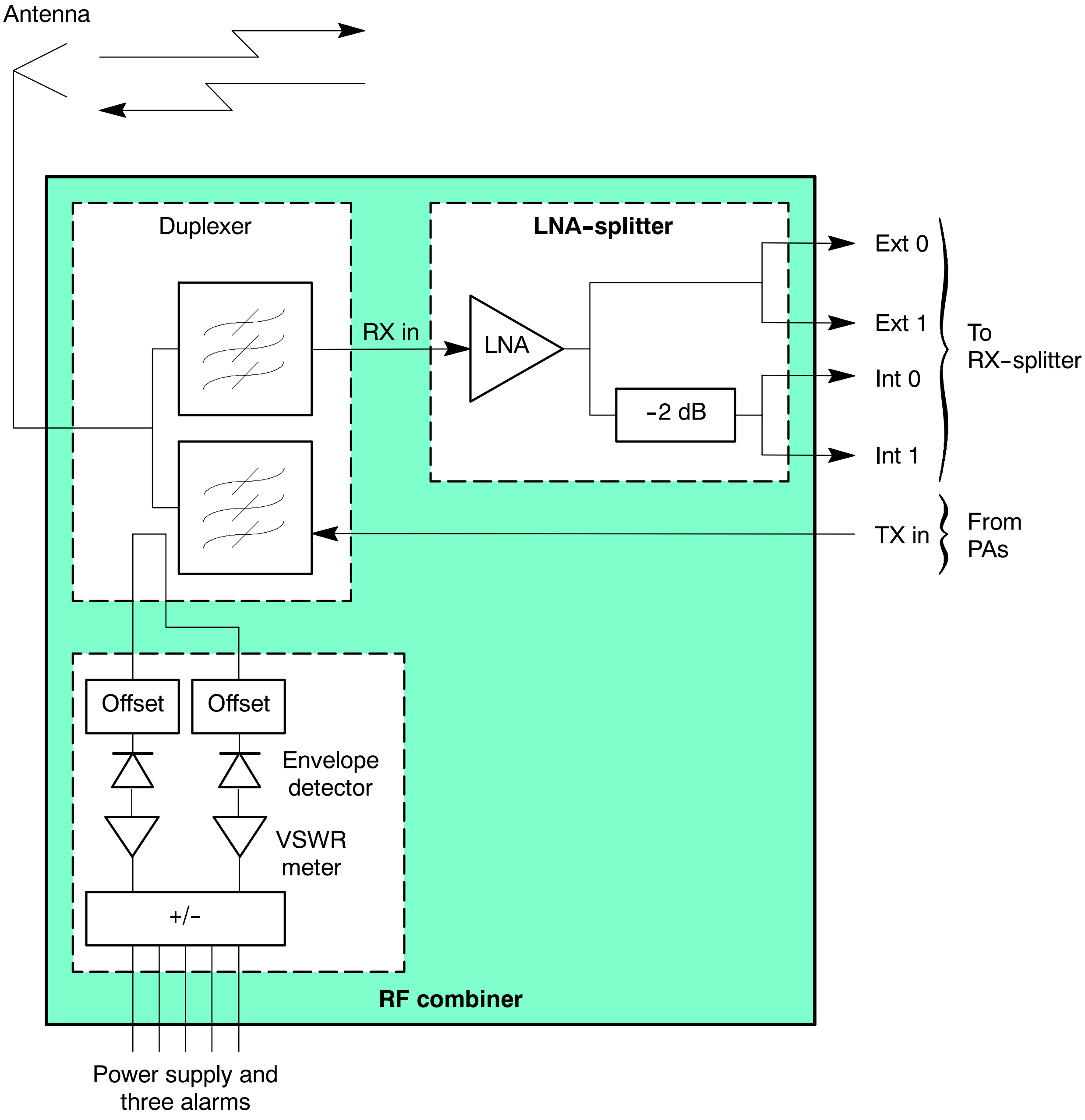


Figure 2-8 Duplexer-only (D) RF Combiner diagram

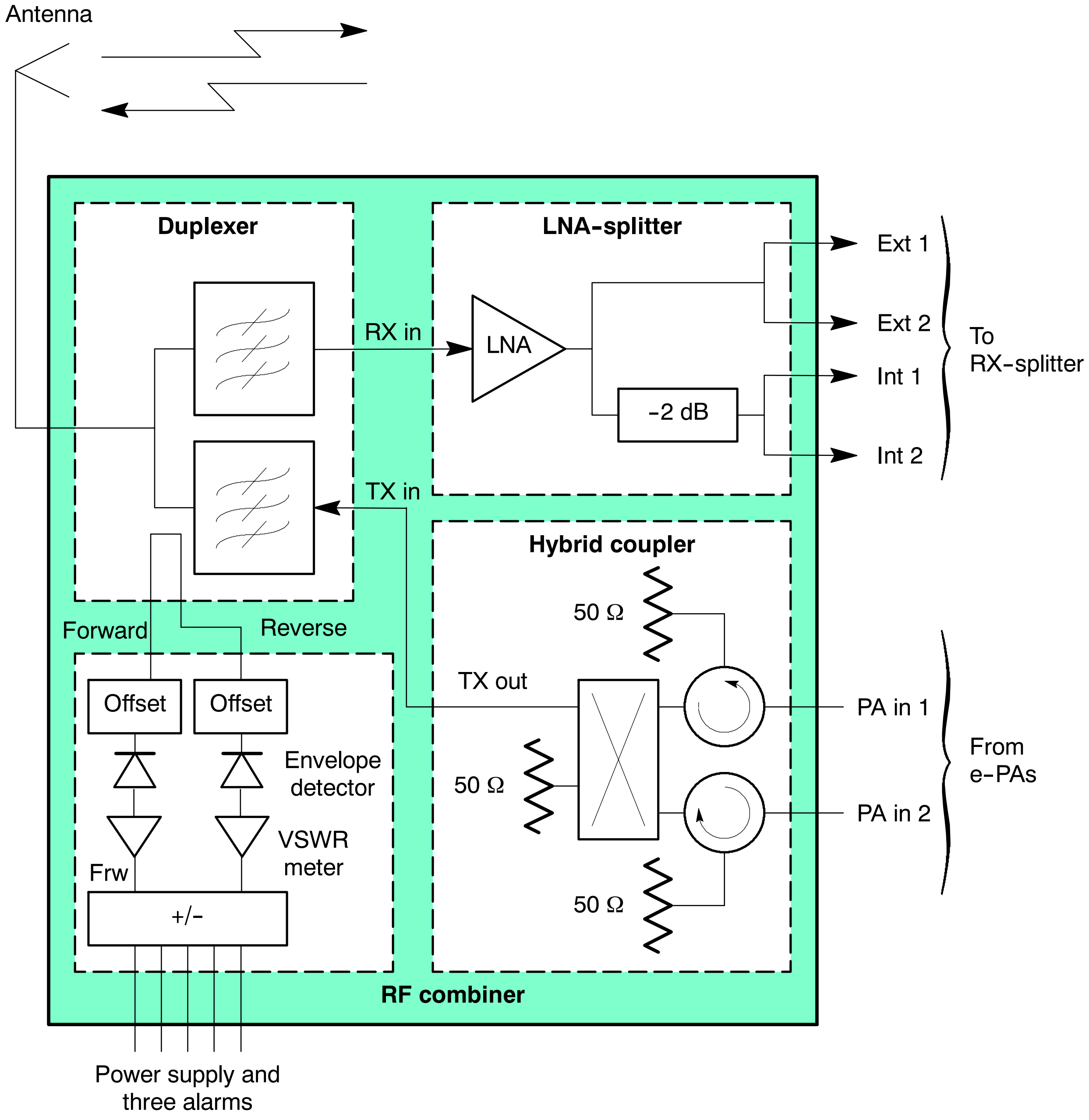


Figure 2-9 H2D RF Combiner diagram

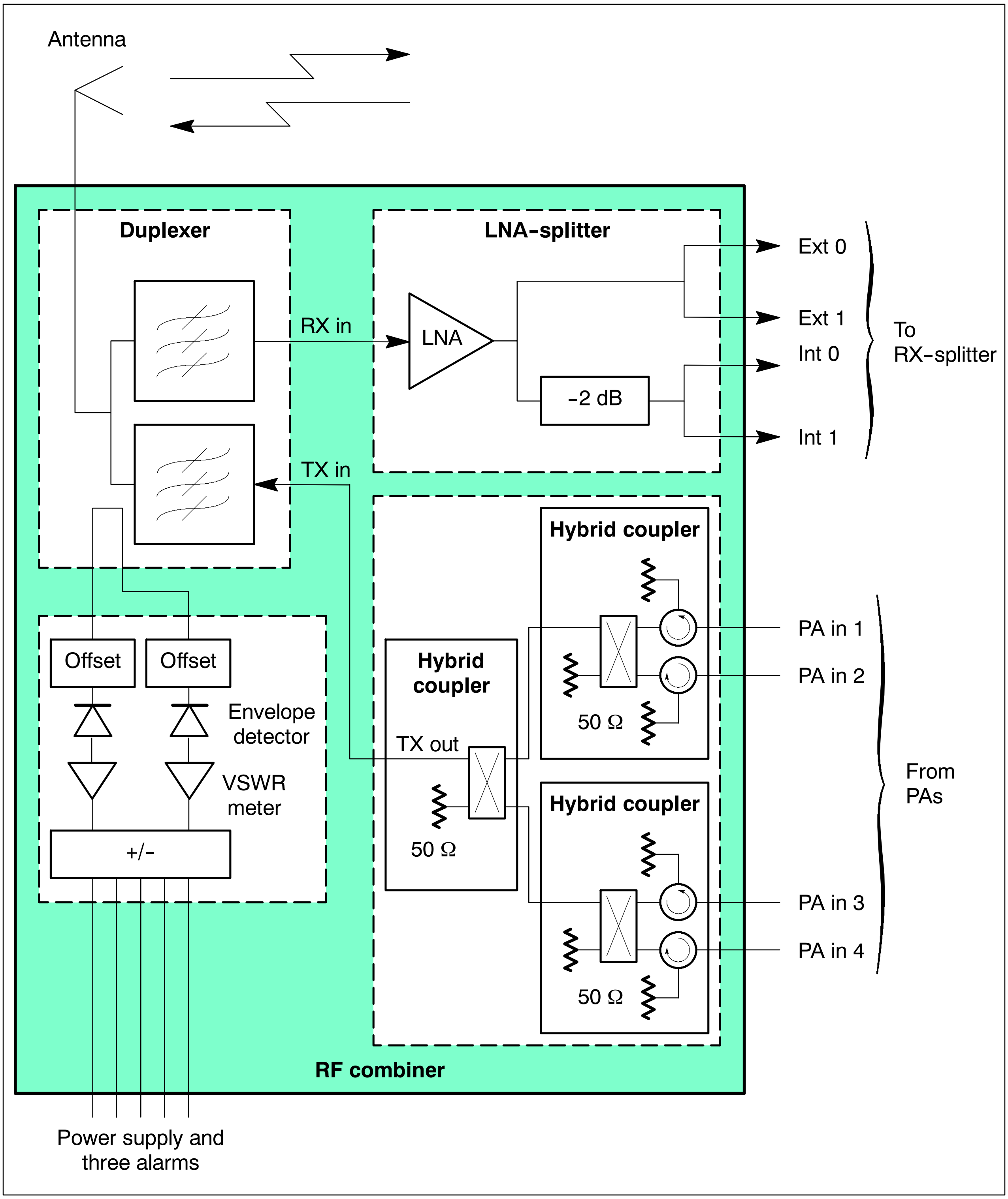


Figure 2-10 H4D RF Combiner diagram

2.5.1.2 Reception amplifier

The reception signal amplifier, also called the LNA-splitter, has two functions:

- amplifies the signal from the antenna using a Low Noise Amplifier (LNA)
- splits the signal from the antenna into four signals

The LNA-splitter has the following attenuation or gain values:

- The LNA has a nominal gain of 28.5 dB (GSM 850) and 32 dB (GSM 1900).
- The two splitter stages cause attenuation less than 7 dB.
- A 2 dB attenuator handles differences in cable attenuation between the two extension outputs (EXT) and the two internal outputs (INT). The two extension outlets, which are not used at present, will make future configuration upgrades possible.

The LNA-splitter is supplied with ± 15 V DC (± 5%) and its maximum current consumption is 370 mA (+ 15 V), 50 mA (- 15 V). The module generates an alarm if LNA consumption deviates by more than 30% from the nominal value.

On the front of the LNA-splitter board, there is a 9-pin male connector whose pin connection is as follows:

1	-15 V
2	0 V
3	Alarm
4	Not used
5	+ 15 V
6	0 V
7	0 V
8	Not used
9	+ 15 V

Table 2-22 Amplifier pin connections

2.5.1.3 Hybrid transmission coupling

According to the hybrid coupling type, transmission coupling consists of a single hybrid coupler for H2D configurations or three hybrid couplers mounted in two stages for H4D configurations.

The two-way hybrid coupler (H2D) consists of:

- two isolators, one at each input port, which allows the protection of the Power Amplifier (PA) against reflected signals, and also permits the isolation necessary between transmitters.
- a hybrid coupler, which combines two transmission signals on only one port.

This subsystem is part of the RF Combiner module (H2D, or H4D).

The maximum attenuation is an RF Combiner module is dedicated to one frequency band.

When any transmission coupling system is requested (in the case of one TRX per antenna), the Tx-Filter (Tx-F) module can be used with two duplexer-only (D) modules in order to provide Rx main and diversity signals.

The Tx-Filter module is dedicated to one frequency band.

Refer to Paragraph 2.6 “Tx-Filter module” on page 2-48 for information about the Tx-Filter.

2.5.1.4 VSWR-meter

The VSWR-meter can be included as an optional unit in the RF Combiner module or in the Tx-Filter module.

The VSWR-meter allows the signal strength of the voltage standing wave ratio (VSWR) to be monitored on the antenna connector and to verify the connection between the antenna and the BTS. This module needs BTS signals transmission to be able to switch on (no alarm with “Receive antenna” only)

The VSWR-meter receives transmitted and reflected signals sampled through two directional antennas located inside the duplexer unit or Tx-Filter unit.

The transmit and receive signals are first converted into two DC voltages by using envelope detection. Two logarithmic amplifiers, one for transmit power signal, and one for reflected power signal, then amplify both converted signals.

The two channels are added and subtracted to obtain the stationary wave ratio. This value is compared to three thresholds (1.7:1, 2:1, and 3:1), each of which triggers an alarm if it is exceeded.

2.5.2 RF Combiner front panels

The front panels of the RF Combiner types are shown in *Figure 2-11 to Figure 2-13*.

2.5.2.1 Duplexer

The duplexer connectors on the front panel of the RF Combiner are:

- a female 7/16 antenna connector
- a female N type transmission connector
- a female, SMA type connector (Rev)
- a female, SMA type connector (Fwd)

A female, SMA type reception connector is present at the rear of the duplexer.

2.5.2.2 LNA-splitter

The connectors on the LNA-splitter front panel are:

- two female, SMA type, output (EXT) connectors to the RX-splitter of the extension rack
- two female, SMA type, RX-splitter output (INT) connectors
- a male, 9-pin power supply connector

A female, SMA type, radio signal input connector is present at the rear of the LNA-splitter.

2.5.2.3 Transmission coupling

For duplexer-only configurations, the transmission signal input connector on the front panel is a female, N type connector (TX-in). Duplexer Tx input is described hereafter.

For H2D configurations, the connectors on the front panel are:

- two female, N type, transmission signal input connectors (PA in)
- a female, N type, output connector (TX-out)
- a female, N type input connector (TX-in). Duplexer Tx input is described hereafter

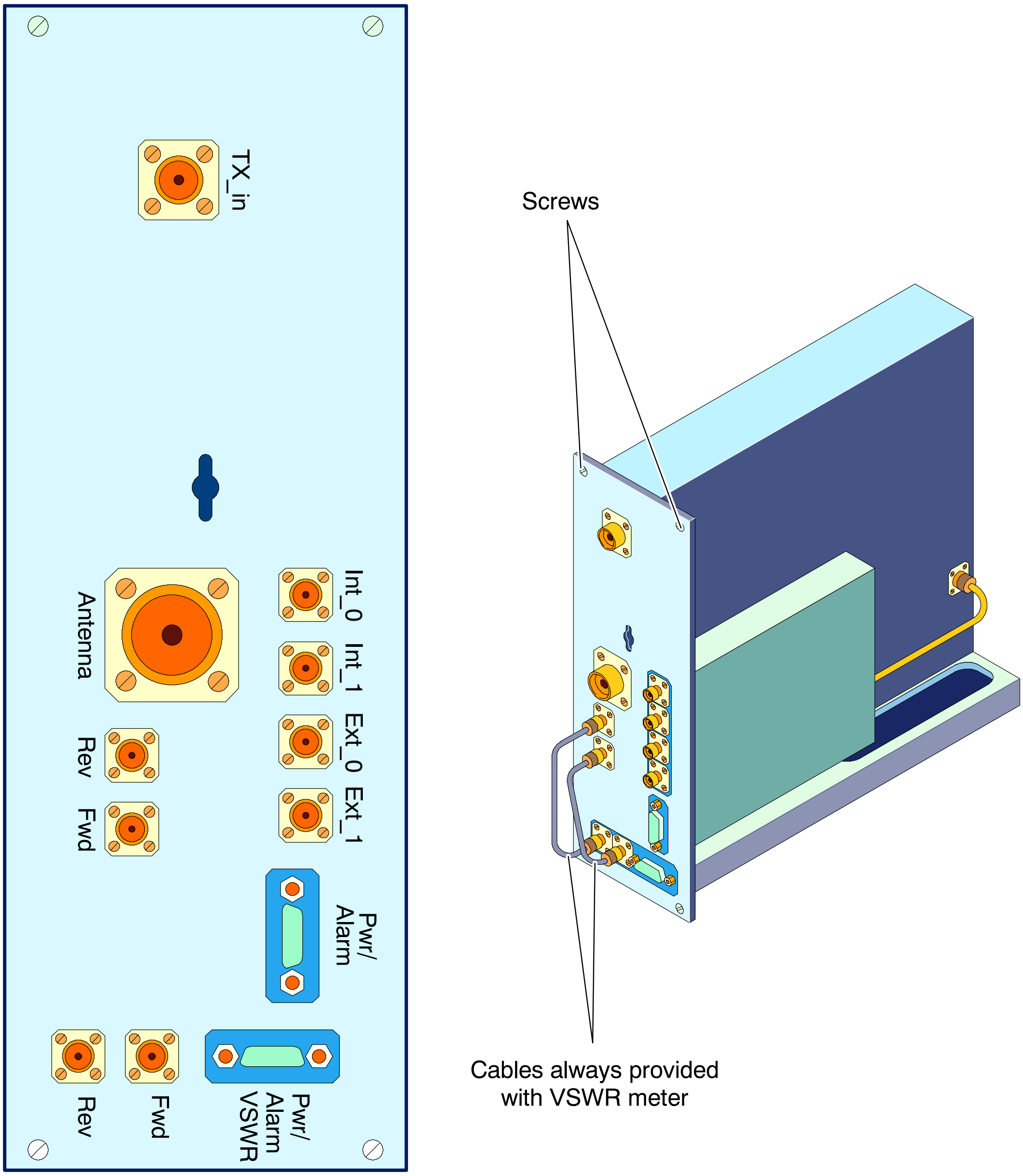


Figure 2-11 Duplexer-only (D) RF Combiner

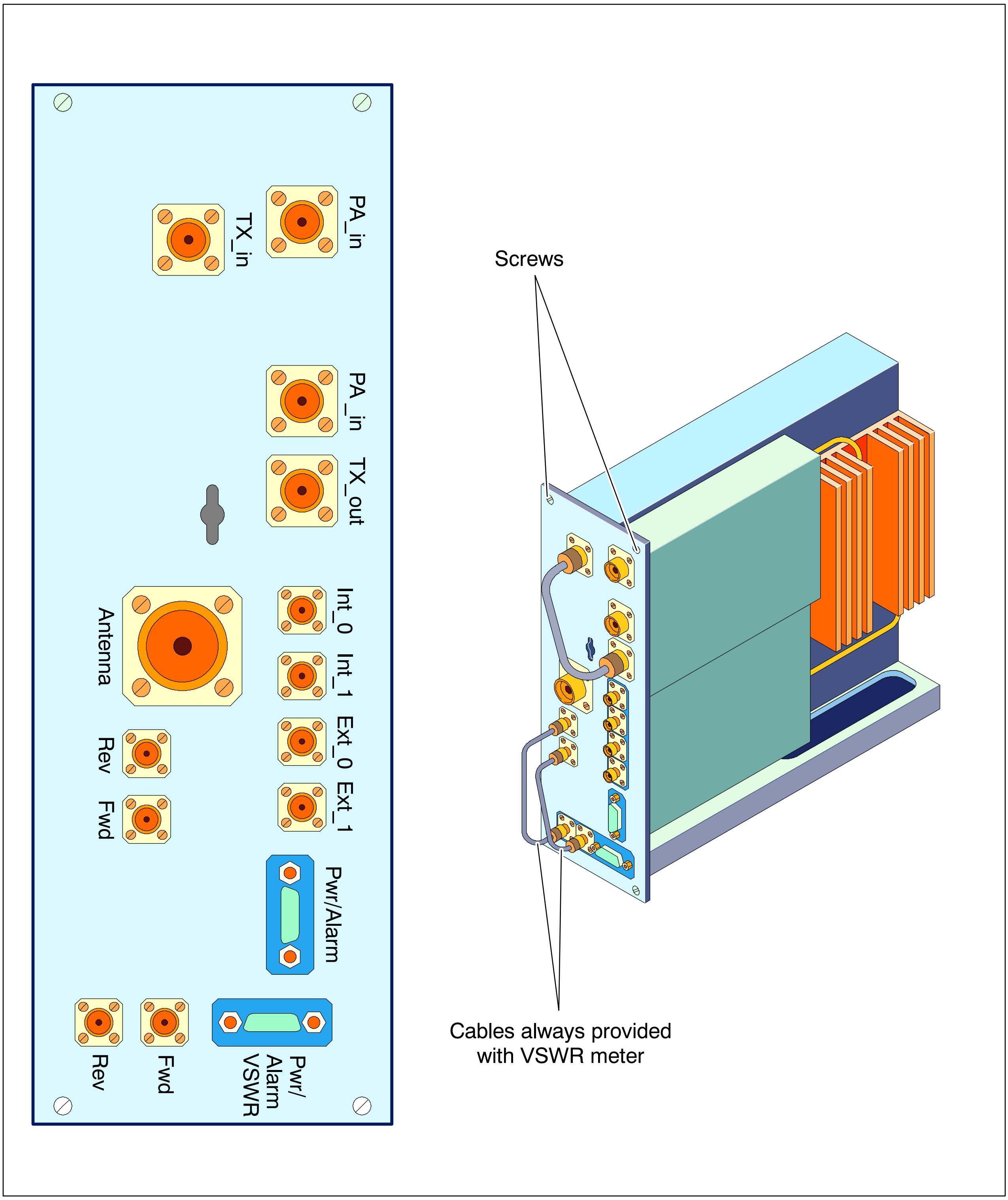


Figure 2-12 Two-way hybrid duplexer (H2D) RF Combiner

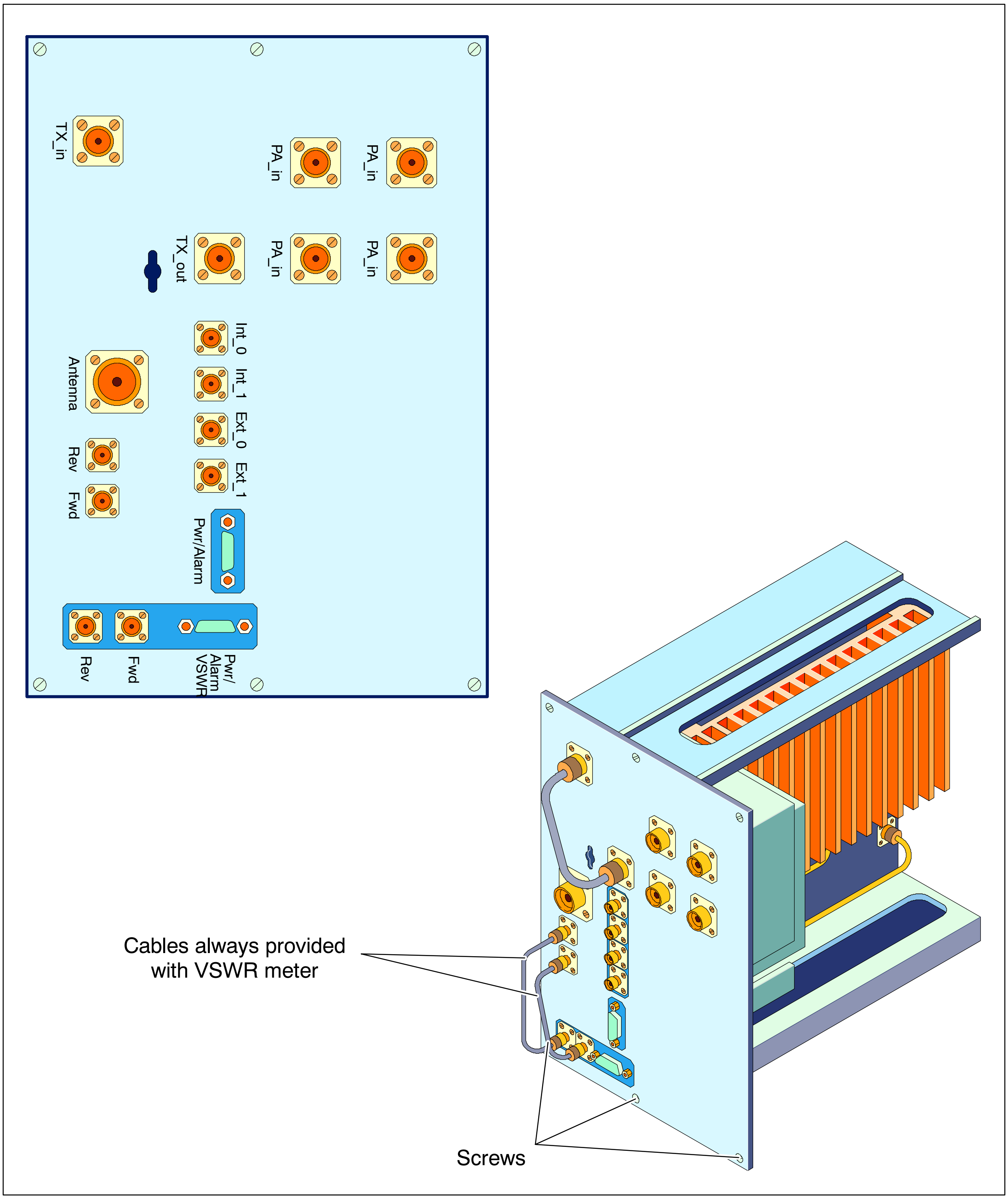


Figure 2-13 Four-way hybrid duplexer (H4D 1800/900 Mhz) RF Combiner

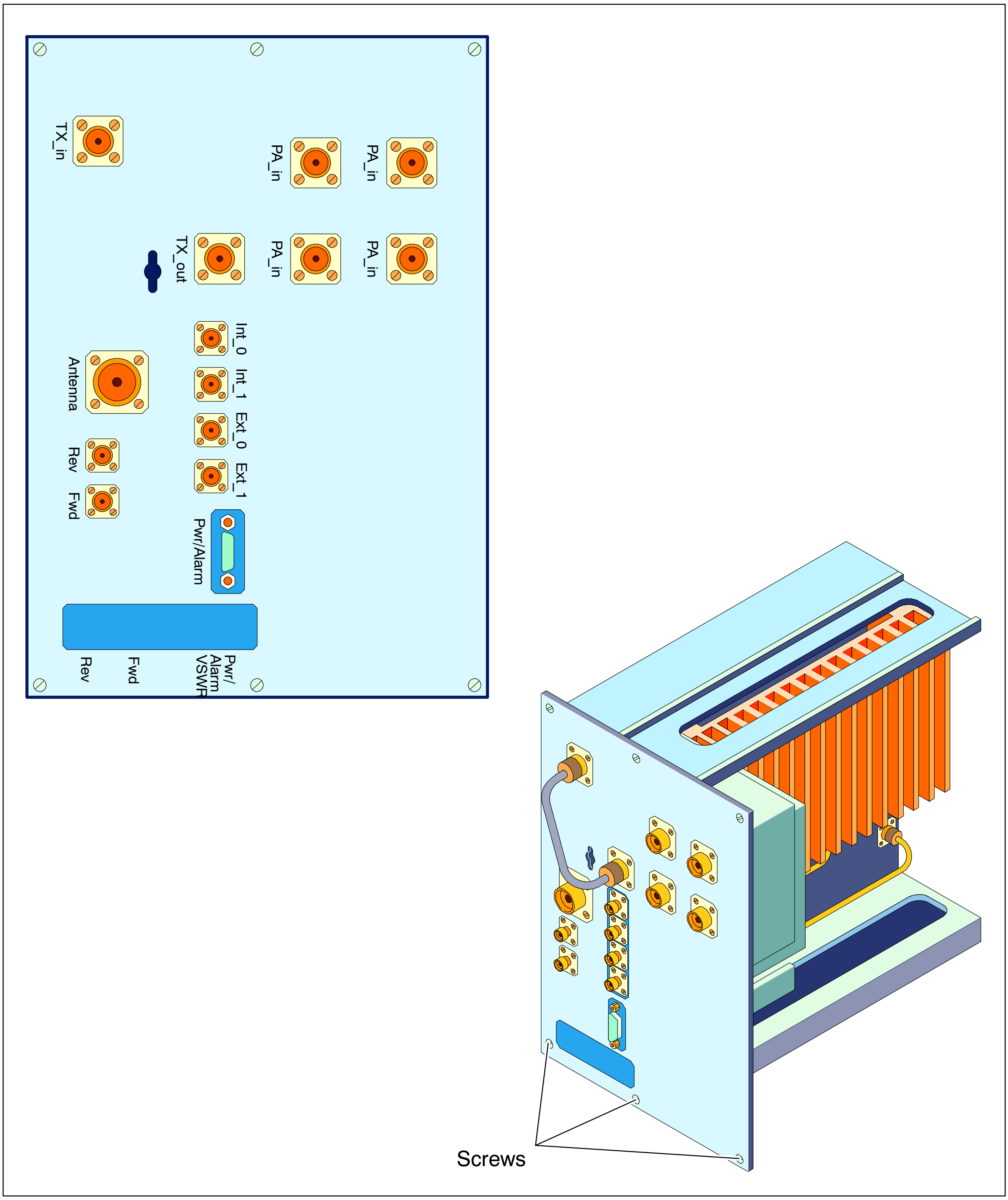


Figure 2-14 Four-way hybrid duplexer (H4D 850/1900 MHz) RF Combiner

For H4D configurations, the connectors on the front panel are:

- four female, N type, transmission signal input connectors (PA-in)
- a female, N type, output connector (Tx-out)
- a female, N type, input connector (Tx-in). Duplexer Tx input is described hereafter.

2.5.2.4 VSWR-meter

The connectors on the VSWR-meter front panel are:

- a female, SMA type, reflected power connector (Rev)
- a female, SMA type, transmitted power connector (Fwd)
- a male 9-pin, sub-D connector for power supply and alarms, with the following pin connection:

1	- 15 V
2	0 V
3	Alarm 1
4	Alarm 2
5	+ 15 V
6	0 V
7	0 V
8	Alarm 3
9	+ 15 V

Table 2-23 VSWR pin connections

2.6 Tx-Filter module

The purpose of the Tx-Filter (Tx-F) is to filter the transmitted signal and to protect the power amplifier (PA). The Tx-F does not contain a transmission coupling system or a receiver filter.

The Tx-Filter module is composed of (see *Figure 2-15*):

- a transceiver filter unit
- a coupling system dedicated to the VSWR-meter
- an optional VSWR-meter that monitors the link between the BTS and the antenna.

The Tx-Filter module is used with the duplexer-only RF Combiner (D) to extend configurations beyond two DRXs per cell. The Tx-Filter does not perform reception functions and must be used with the RF Combiner (D) to ensure reception distribution.

The Tx-Filter module can be equipped with an optional VSWR-meter which shares the same front panel so that there is only one unit to plug into the BTS rack.

With or without the optional VSWR-meter, the Tx-Filter module is half the size of the two-way hybrid (H2D) and duplexer-only (D) RF Combiner.

2.6.1 VSWR-meter

The function of the VSWR-meter (see *Figure 2-16*) is described in the section "RF Combiner".

The VSWR-meter connectors on the front panel of the Tx-Filter are the same as those of the RF Combiner and are described in the section "RF Combiner connectors".

Although the VSWR-meter delivers three alarm lines, only two are reported to the OMC-R because of COMICO constraints.

These alarm thresholds correspond to 2:1 and 3:1 VSWR values.

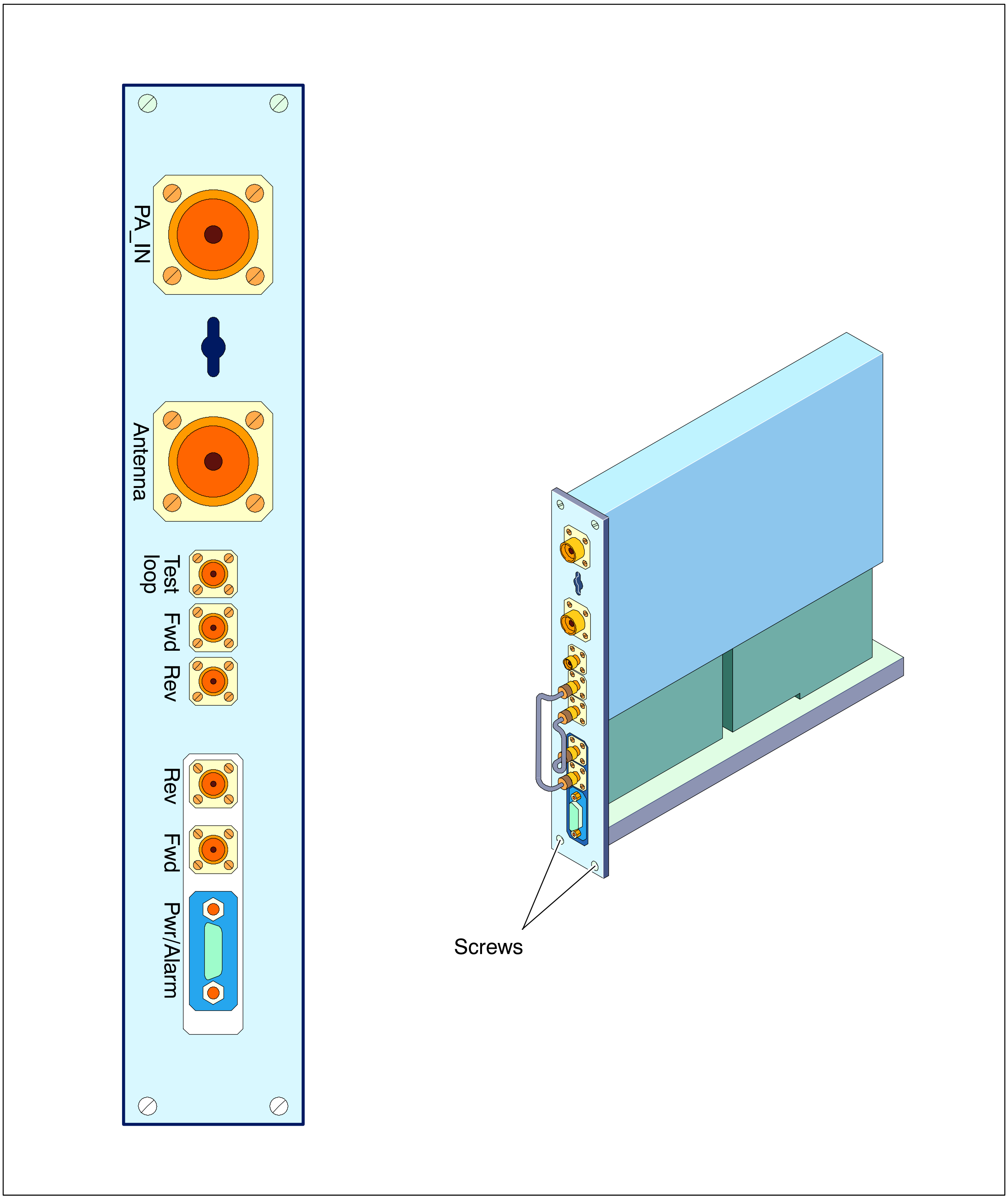


Figure 2-15 Tx-Filter (Tx-F) module

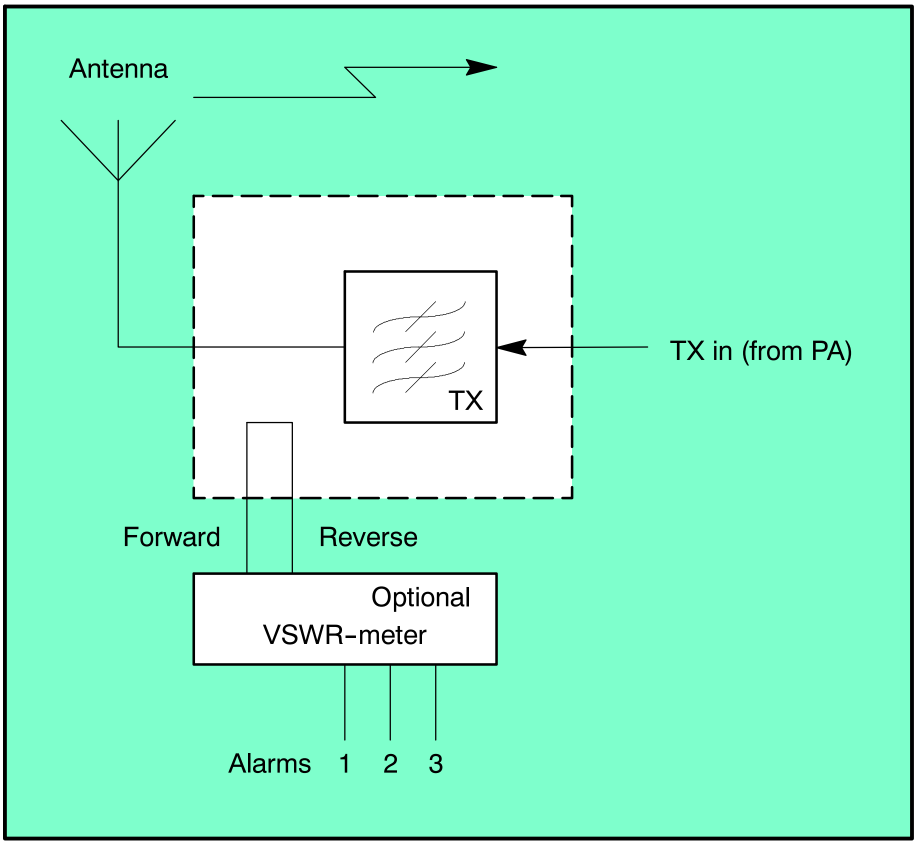


Figure 2-16 Tx-Filter (Tx-F) functional diagram

2.7 Compact BCF (CBCF) module

This section provides a functional and physical description of the CBCF Module and of the following CBCF Module boards:

- CPCMI
- CMCF Phase2
- BCFICO
- CBP
- POWER ICO

2.7.1 Functional description

The CBCF Module performs functions common for a site and also manages its alarm management unit, the RECAL board.

The base common functions of the BTS are performed by two main CBCF Module boards: the CMCF and the CPCMI.

The CMCF Phase2 board performs the concentration, switching, and synchronization functions of the BTS. The CPCMI board ensures the interface between the external PCMs of the A-bis interface and the internal private PCMs.

Private PCM links connect the CBCF (via the CMCF) to the other BTS components. The CBCF also uses private PCMs for internal communication between CBCF boards.

The boards and their functions are identified in *Table 2-24*.

Board*	Function	Quantity
CPCMI	ABIS double PCM link interface	1 to 3
CMCF Phase2	Concentration, routing, and synchronization	1 or 2
BCFICO	Interconnection between the CPCMI, CMCF Phase2 boards and external communication links	1
CBP	Interconnection between CPCMI, CMCF, and BCFICO boards	1
*** Legend:** **CPCMI** Compact PCM Interface **CMCF** Compact Main Common Functions **BCFICO** Base Common Functions Interconnection **CBP** CBCF Back Panel		

Table 2-24 CBCF module boards

2.7.2 Physical description

Although the CBCF Module boards are fitted into a compact module, the CMCF, CPCMI, and BCFICO boards can be accessed from the front panel and replaced. The aim is to reduce the number of boards, to take advantage of the new technologies and to reach a high level of integration to allow software updating from OMC without any intervention on the site.

Figure 2-17 show the CBCF module front panel.

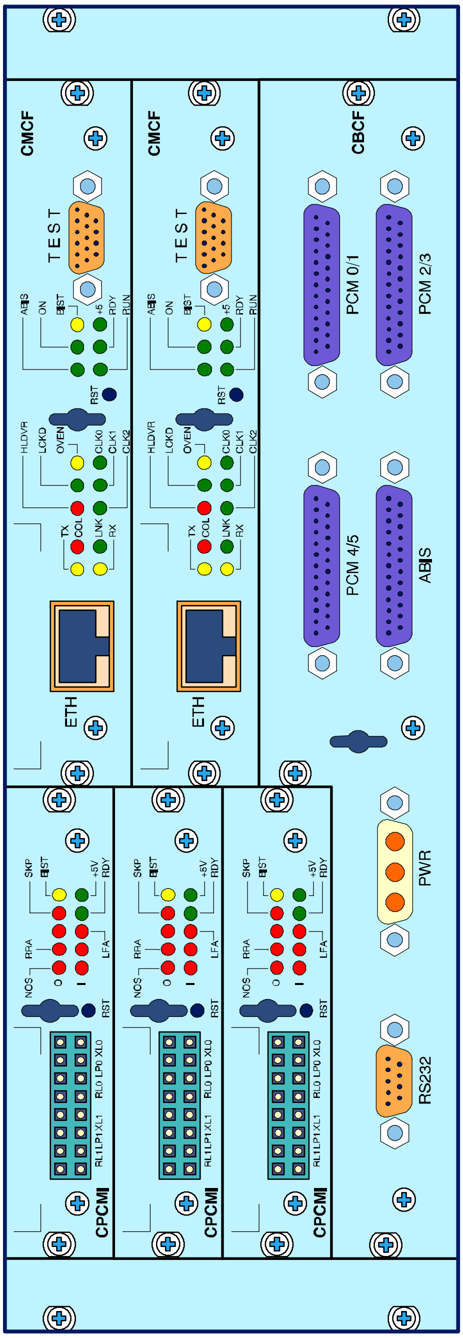


Figure 2-17 S12000 BTS: CBCF module

2.7.3 CPCMI Board

2.7.3.1 S12000 CPCMI board

Depending on the requirements, the CBCF Module can contain one to three CPCMI boards.

This Compact PCM interface board handles two PCMs. Both PCMs can be used for the system Clock of the BTS.

2.7.3.2 Functional description

The CPCMI board ensures the interface between the external PCMs of the A-bis interface and the internal private PCMs. This interfacing task corresponds to an electrical level translation and a frame format conversion depending on the kind of A-bis link (PCM E1/T1 or HDSL).

There are two types of CPCMI boards available used in accordance with the type of A-bis interface:

- CPCMI-E1
- CPCMI-T1

The core of each board is generic and common to all, but each uses a different line interface.

The CPCMI uses the n+1 redundancy scheme depending on:

- the number of required TSs
- the drop and insert scheme
- the number of CPCMIs present in the package (three maximum)

The functional characteristics of the E1 and T1 boards are summarized in *Table 2-25*.

The functional diagram of the CPCMI is shown in *Figure 2-18*.

Function	CPCMI- E1	CPCMI-T1
Reception gain adaptation	X	X
Extraction of the binary rate for transmission to the CMCF	X	X
Reception and transmission buffer on two frames to allow frame alignment	X	X
Transmission alignment on the CMCF clock	X	X
Management of frame loss or doubling	X	X
Management of alarms, signalling, and loop control	X	X
Switch configuration for 120 Ohms or 75 Ohms	X	
Compliant with Recommendation G703 (HDB3 line coding)	X	
Compliant with the G823-G824 standard (jitter permitted)	X	
CRC4 Management	X	
Adaptation of transmission to the cable length		X
Compliant with ANSI T1.403 and T1.102 (B8ZS coding)		X
Management of frame format (SF or ESF)		X
CRC6 Management (for ESF)		X
Alignment of external T1 PCM rate and internal E1 PCM rate		X

Table 2-25 Functions of CPCMI-E1 and CPCMI-T1 boards

Synchronization

The timing signal is extracted from the PCM clock and sent to the CMCF (RCLK). The local time is sent to the CMCF if there is no PCM timing signal (RCLK = HLOC).

The CMCF selects one signal from the six received (one per PCM link) and redistributes it as a reference for all A-bis transmissions (TCLK). This signal is also the long term reference used to create the H4M timing reference.

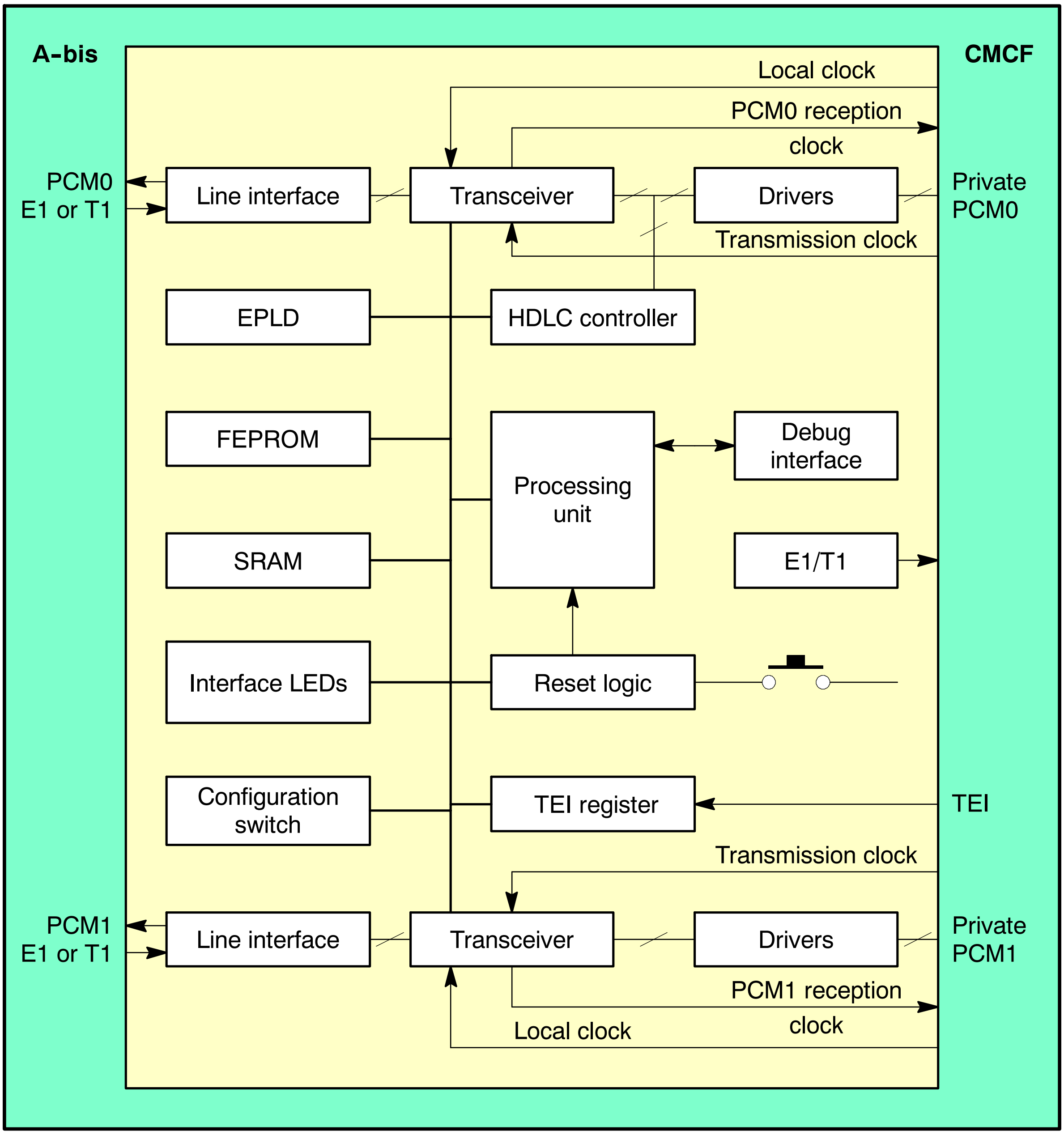


Figure 2-18 CPCMI board functional diagram

2.7.3.3 Physical description

Processing Unit

The CPCMI processing unit has a rate of 4 MHz derived from a 16 MHz external oscillator. It has a 128 Kbytes RAM capacity and a 16 Mbytes FEPROM capacity.

O&M communication occurs using a LAP-D on TS0 of the private PCM MIC0.

Front panel

The front panel contains the following:

- one Reset button
- ten LEDs
- eight connectors

The CPCMI board is shown in *Figure 2-19*.

LEDs

The LEDs used on the front panel of the CPCMI board are described in *Table 2-26*.

Type	No. of LEDs	Label (color)	Meaning (when lit)
Board state indicators	1	BIST (yellow)	The built-in self-test is running or is stopped with a default result.
	1	+5 V (green)	The power is on.
	1	RDY (green)	The board is operating normally.
State indicators of the external PCM link (A-bis)	1	SKP (red)	The FIFO skip indicator is common to both PCMs.
	2	LFA (red)	The frame alignment is lost. One LFA per PCM link.
	2	RRA (red)	The receive remote alarm. One RRA per PCM link.
	2	NOS (red)	There is no signal. One NOS per PCM link.

Table 2-26 LEDs on the front panel of the CPCMI board

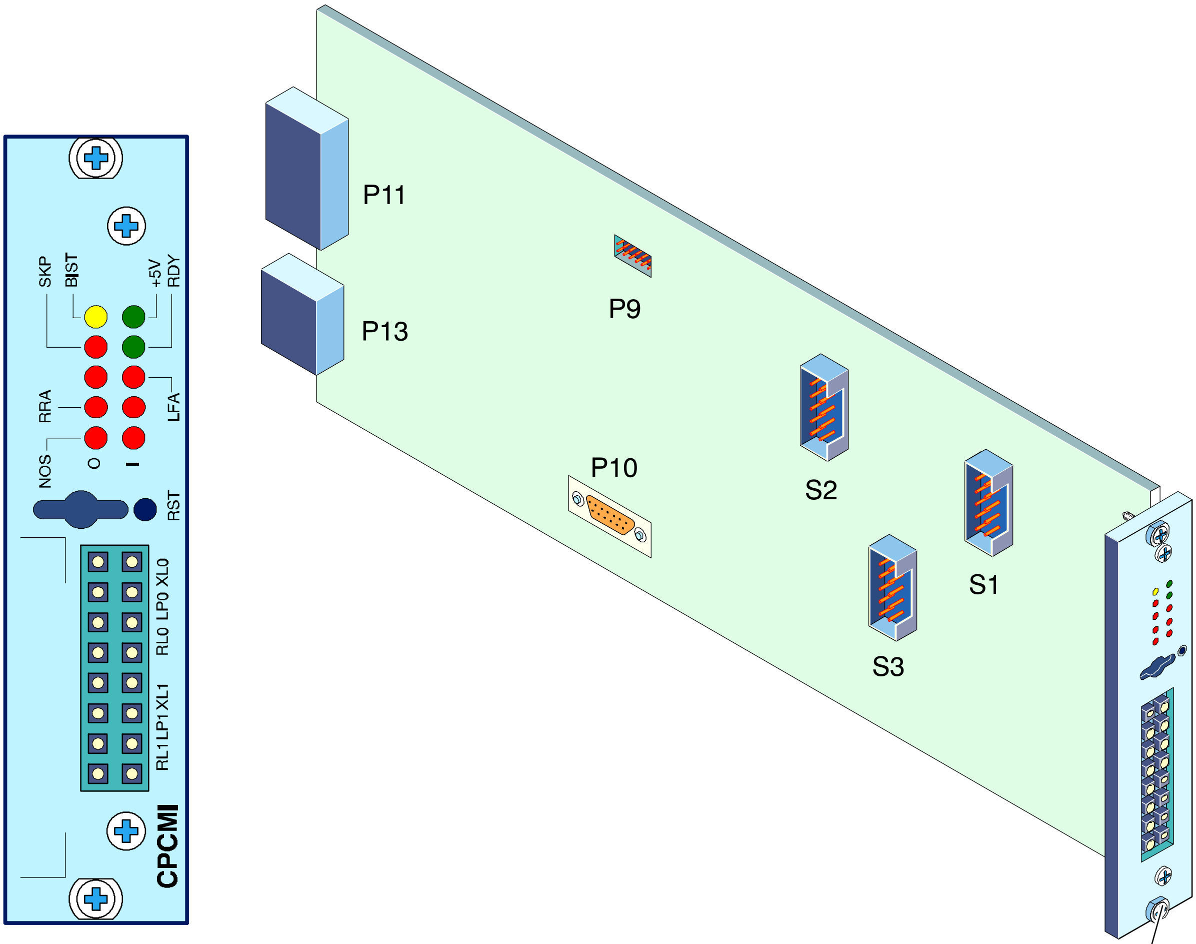


Figure 2-19 CPCMI board

The next table defines the relation between the PCM alarms and the front LED status.

According to the priority order, when the simultaneous alarms are detected, only the alarm with the highest priority is declared active.

PCM alarms		CPCMI LEDs		
Definition	**Priority**	**NOS**	**RRA**	**LFA**
LOS: Loss Of Signal	1 (high)	ON	OFF	OFF
AIS: Alarm Indication Signal	2	ON	ON	ON
LFA: Loss of Frame Alignment	3	OFF	OFF	ON
FE: Frame Error	4	ON	ON	OFF
CRC: loss of multi-frame alignment	5	OFF	ON	ON
RAI: Remote Alarm Indication	6 (low)	OFF	ON	OFF

2.7.3.4 Switches

The switches are used to configure the following board characteristics:

- cable length
- line build out
- line coding mode
- framing mode
- Fs/dl feature

The position of each switch is shown on *Figure 2-20*

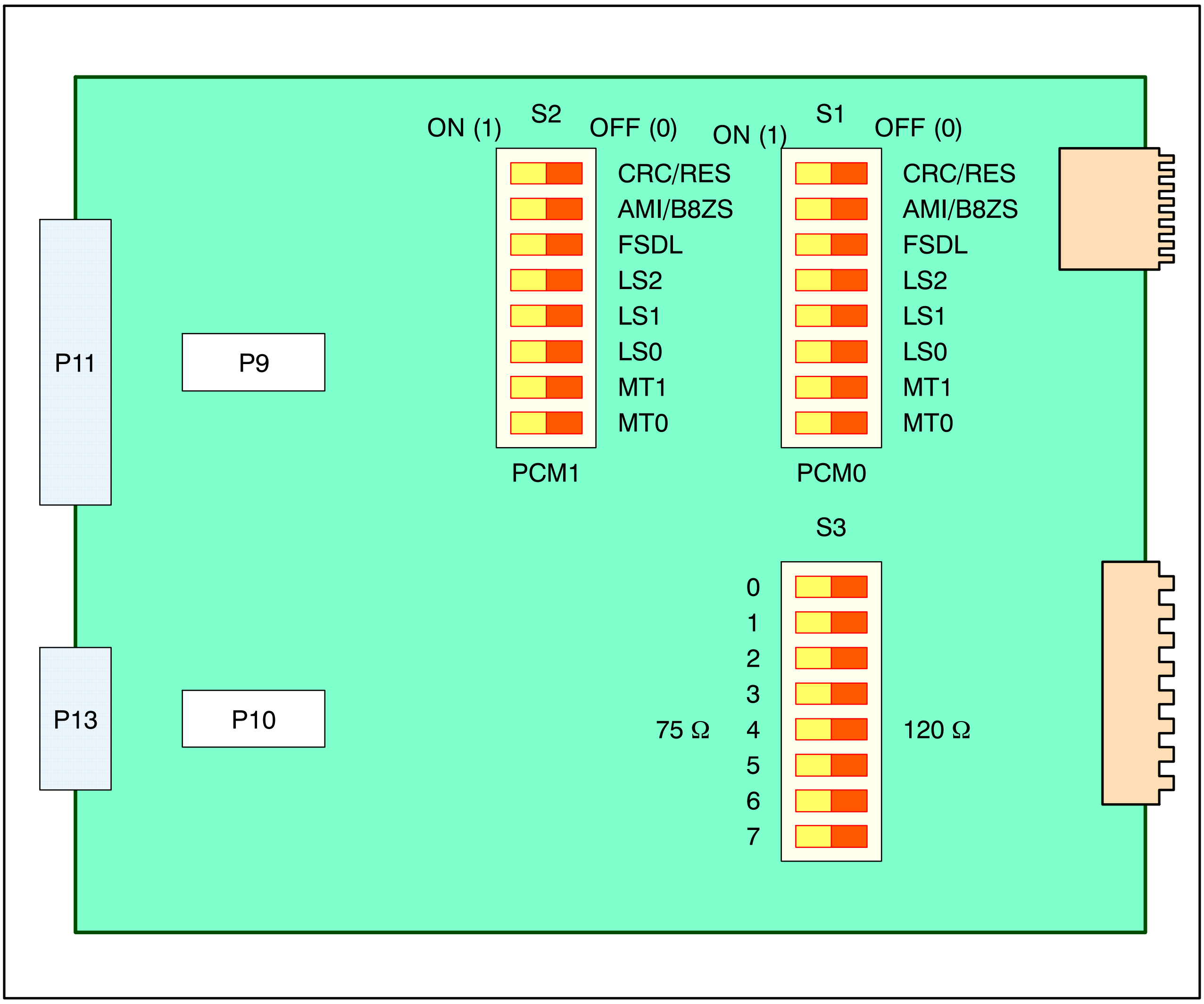


Figure 2-20 CPCMI board: hardware switches

The next tables summarize the settings of each switch of CPCMI board.

- S3 switch:

S3 switch	T1 type	E1 type
(0:3)	-	=120: PCM1 120 Ω =75: PCM1 75 Ω
(4:7)	-	=120: PCM0 120 Ω =75: PCM0 75 Ω

Table 2-27 CPCMI board: S3 switch

- S1 and S2 switches:

S1 and S2 switches		T1 board		E1 board	
MT1	MT0	Framing mode	CRC mode	Framing mode	CRC mode
0	0	F4 not available	-	-	-
0	1	SF (or D4) frame	none	single frame	none
1	0	ESF frame	see CRC/RES	multi-frame	CRC4
1	1	F72 not available	-	-	-

S1 and S2 switches			T1 board Cable length	E1 board Line Build Out
LS2	LS1	LS0		
0	0	0	0 to 133 feet / 0dB (0 to 40.58 meters)	-
0	0	1	133 to 266 feet (40.58 to 81.08 meters)	-
0	1	0	266 to 399 feet (81.08 to 121.61 meters)	75 Ω
0	1	1	399 to 533 feet (121.61 to 162.46 meters)	120 Ω
1	0	0	533 to 655 feet (162.46 to 199.64 meters)	120 Ω
1	0	1	-7.5 dB	-
1	1	0	-15.0 dB	120 Ω
1	1	1	-22.5 dB	-

S1 and S2 switches	T1 board	E1 board
FSDL	=0 : FS/DL disabled =1 : FS/DL enabled	-
AMI/B8ZS	=0 : AMI line coding =1 : B8ZS line coding	-
CRC/RES	=0 : CRC decoding disabled =1 : CRC decoding enabled	-

Table 2-28 CPCMI board: S1 and S2 switches

2.7.3.5 Connectors

The CPCMI uses 12 connectors accessed from the following locations:

- on the front panel (8)
- inside the board (4)

The connectors are identified in the table below.

Access	No. of connectors	Label	Type	Purpose
Front panel	2	XL0		Transmission connectors for PCM0.
	(0)	LP0		A closed loop connection used for testing is attained by using one XL0 and one RL0 connectors.
	2	RL0		Reception connectors for PCM0.
	2	XL1		Transmission connectors for PCM1
	(0)	LP1		A closed loop connection used for testing is attained by using one XL1 and one RL1 connectors.
	2	RL1		Reception connectors for PCM1.
Inside the board	1	P10 (Debug)	Sub-D 9-pin male	Debugging connector that is only available during tests.
	1	P9 (JTAG)	HE10 10-pin male	JTAG programming port used to program the EPLP prior to product delivery.
	1	P11	Millipack1 60-pin female	Used for signals during nominal operation. This connector is plugged into the CBP.
	1	P13 (POWER)	Millipack 1	Power supply input. In this five-row connector, only rows A, C, and E are equipped with a power signal. The rows are staggered to allow the ground connection. This connector is plugged into the CBP.

Table 2-29 CPCMI board connectors

Pin connections

The pin connections and their significance for the CPCMI connectors are identified in *Table 2-30* to *Table 2-33*.

Pin no.	Row E Purpose	Pin no.	Row D Purpose	Pin no.	Row C Purpose	Pin no.	Row B Purpose	Pin no.	Row A Purpose
12	H4M	12	MICE0	12	MICR0	12	MICE1	12	MICR1
11	NH4M	11	NMICE0	11	NMICR0	11	NMICE1	11	NMICR1
10	SY	10	HLOC	10		10		10	
9	NSY	9	NLOC	9	PSYT0	9	PSYT1	9	TCLK
8		8		8	NSYT0	8	NSYT1	8	NTCLK
7	CONFIG0	7	CONFIG1	7		7		7	
6	NCONFIG0	6	NCONFIG1	6	T1E1	6	TEI1	6	TEI0
5	GND	5	GND	5	GND	5	GND	5	GND
4		4		4		4		4	
3	PRPCM0	3	NRPCM0	3		3	PRPCMI1	3	NRPCM1
2		2		2		2		2	
1	PEPCM0	1	NEPCM0	1		1	PEPCMI	1	NEPCM1

Legend:

H4M, NH4M (V11, in)	4.096 MHz Clock received from the CMCF
SY, NSY (V11, in)	Synchro frame of Private PCMs from the CMCF
HLOC, NHLOC (V11, in)	Local clock (1.544 MHz or 2.048 MHz) from the CMCF
MICE, NMICE (V11, in)	Private PCM transmission toward the CMCF
MICR, NMCIR (V11, in)	External PCM reception from the CMCF
TCLK, NTCLK (V11, in)	External PCM transmission clock from the CMCF
CONFIG, NCONFIG (V11, in)	Configuration to the CMCF
T1E1 (TTL, out)	T1 or E1 toward the CMCF
TEI (TTL, in)	Position of the board in the shelf received from the CBP
PRPCM, NRPCM (in)	External PCM reception
PEPCM, NEPCM (out)	External PCM transmission

Table 2-30 Pin connections of the P11 connector

Pin no.	Row E Purpose	Pin no.	Row D Purpose	Pin no.	Row C Purpose	Pin no.	Row B Purpose	Pin no.	Row A Purpose
6	GND	6		6	+48 V	6		6	-48 V
5	GND	5		5	+48 V	5		5	-48 V
4	GND	4		4	+48 V	4		4	-48 V
3	GND	3		3	+48 V	3		3	-48 V
2	GND	2		2	+48 V	2		2	-48 V
1	GND	1		1	+48 V	1		1	-48 V
Legend: **GND** Common logical ground									

Table 2-31 Pin connections of the P13 connector (Power)

Pin no.	Purpose	Pin no.	Purpose
6		1	GND
7		2	RXDBG
8		3	TXDBG
9		4	PCBUG0
		5	GND
Legend: **RXDBG** (RS232, in) Reception Debug **TXDBG** (RS232, out) Transmission Debug **PCBUG0** (TTL, in) Console presence			

Table 2-32 Pin connections of the P10 connector (Debug)

Pin no.	Purpose	Pin no.	Purpose
1	TCK	2	GND
3	TDO	4	
5	TMS	6	
7		8	
9	TDI	10	GND

Legend:
TCK (in) ISP Programming signal
TDO (out) ISP Programming signal
TMS (in) ISP Programming signal
TDI (in) ISP Programming signal

Table 2-33 Pin connections of the P9 connector (JTAG)

Electrical characteristics

The CPCMI board is powered by a nominal -48 V DC supply.

A10 W converter on the board supplies the +5 V at a maximum level of 1 A.

2.7.4 CMCF board

The CBCF Module contains one or two CMCF boards. One CMCF board allows operation in simplex mode, while two CMCF boards provide fully redundant duplex operations.

2.7.4.1 Functional description

The CMCF Phase2 board performs the following functions:

- synchronization of the BTS, through
  - selection of PCM clock
  - PCM link frequency measurement
  - input of external clock
  - generation of the reference frequency for the DRXs
  - generation of GSM Time
- switching
- signalling concentration
- communication with the BSC and with O&M slaves (e.g. DRX, CPCMI, RECAL)

2.7.4.2 Synchronization (SYN)

An oscillator provides the SYN function. The slave CMCF operates in a phase-locked loop so that its H4M clock is in phase with the master CMCF. This ensures that synchronization is maintained during a CMCF switchover.

GSM Time

The processing unit writes the GSM time (72 bits) every 60 ms and the value is stored in the matrix at a rate of one bit per frame. Both the master and slave CMCF re-read the information in the matrix of the master CMCF, which ensures that GSM time is synchronized on both CMCF Phase2 boards.

2.7.4.3 Physical description

The CMCF Phase2 board contains the following parts:

- a master processing unit (33 MHz) that manages
  - 8 Mbytes DRAM
  - 4 Mbytes FLASH
  - one Ethernet link
  - one watchdog
  - 32 64 Kbit/s HDLC links on one PCM
  - one RS232 test link
  - PCM switching matrix
  - one EPLD with configuration registers
  - I/O ports
- a slave processing unit (33 MHz) that manages
  - one RS232 provisional link
  - 32 64Kbit HDLC links on one PCM
  - one inter-CMCF 64 Kbit/s HDLC link
  - I/O ports
- DC-DC converters with filters that provide 5 V, 12 V, and 3.3 V
- a SYN function that synchronizes itself on one of the six signals received from the CPCMI
- a system that synchronizes the PCM clocks and switchover of both CMCF Phase2 boards
- a system that allows the synchronous transmission of GSM time on both CMCF Phase2 boards
- a system that measure the frequency of clock inputs
- a 16 x 16 PCM switching matrix
- a “silence” junctor to emit the A-bis silence code
- a test system that allows the verification of PCM time slots
- a 4-bit TEI register
- an 8-bit register that encodes the position of 4 mini-switches (WD Enable/Disable, Normal/Maintenance, etc.)
- a chain switchover system

Electrical characteristics

The CMCF Phase2 board receives a 48 V DC power supply and generates other required voltages from this single source.

The CMCF Phase2 board owns one DC-DC converter only to create 5 V. Thanks to regulators, 12 V, 3.3 V and 2.5 V derive from 5 V.

The 5 V power supply is required for most CMCF components, including both processing units. It has an 12 W power consumption. Therefore, a converter running at 80% will dissipate about 2.5 W.

The oscillator and DAC parts of the CMCF Phase2 board require a 12 V power supply. The oscillator consumes 1 W during maintenance and up to 10 W in its preheating phase.

The 3.3 V power supply is used strictly for the DRAM.

Synchronization

The CMCF provides synchronization for the radio part of the BTS.

The CMCF hardware allows the selection of a clock from the following sources:

- six clock signals taken from external PCM links (from the CPCMI)
- CMCF master clock

The long term stability of the external PCM link clock ensures the accuracy and stability required.

A frequency meter function on the CMCF Phase2 board measures the clocks to determine their validity.

GSM Time channel

The SYN function generates and distributes the GSM-time channel on the Private PCM. The GSM-time is the local BTS time, so the counters are arbitrarily set to zero after turning on the CMCF.

The GSM time channel emission is dedicated to a special hardware system.

Synchronization between master and slave processing units

The master processing unit fully synchronizes the slave processing unit.

Fully synchronous GSM-time emission is performed through a pulse signal sent from the Master GSM-time generation hardware system to the slave system.

External synchronization connection

An external synchronization interface is provided directly on the SYN part of the CMCF. The software selects the synchronization origin.

Front panel

The front panel of the CMCF contains the following:

- a Reset button
- 16 LEDs
- two connectors

The Reset button allows a hard reset of the board.

The front panel of the CMCF Phase2 board is shown in *Figure 2-21*.

LEDs

Table 2-34 describes the LEDs on the front panel of the CMCF Phase2 board.

Type	LED (color)	Meaning (when lit)
Board state indicators	BIST (yellow)	The built-in self-test is running or is stopped with a default result.
	ON (green)	The board is operating and is providing a PCM clock.
	ABIS (green)	The A-bis link is setup.
	+5 V (green)	The power is on.
	RDY (green)	The board is ready to become operational.
	RUN (green)	The applicative software is mounted.
State indicators of the external PCM link (A-bis)	OVEN (yellow)	The OVCXO is in its preheating phase.
	LOCKED (vert)	The SYN function is synchronized.
	HLDVR (red)	The SYN function is operating on a local clock.
	CLK0 (green)	Indicates the clock source.
	CLK1 (green)	Indicates the clock source.
	CLK2 (green)	Indicates the clock source.
	LNK (green)	The Ethernet link is established.
	TX (yellow)	There is a transmission on the Ethernet link.
State indicators of the external PCM link (A-bis)	COL (red)	There is a collision on the Ethernet link.
	RX (yellow)	There is a reception on the Ethernet link.

Table 2-34 LEDs on the front panel of the CMCF Phase2 Board

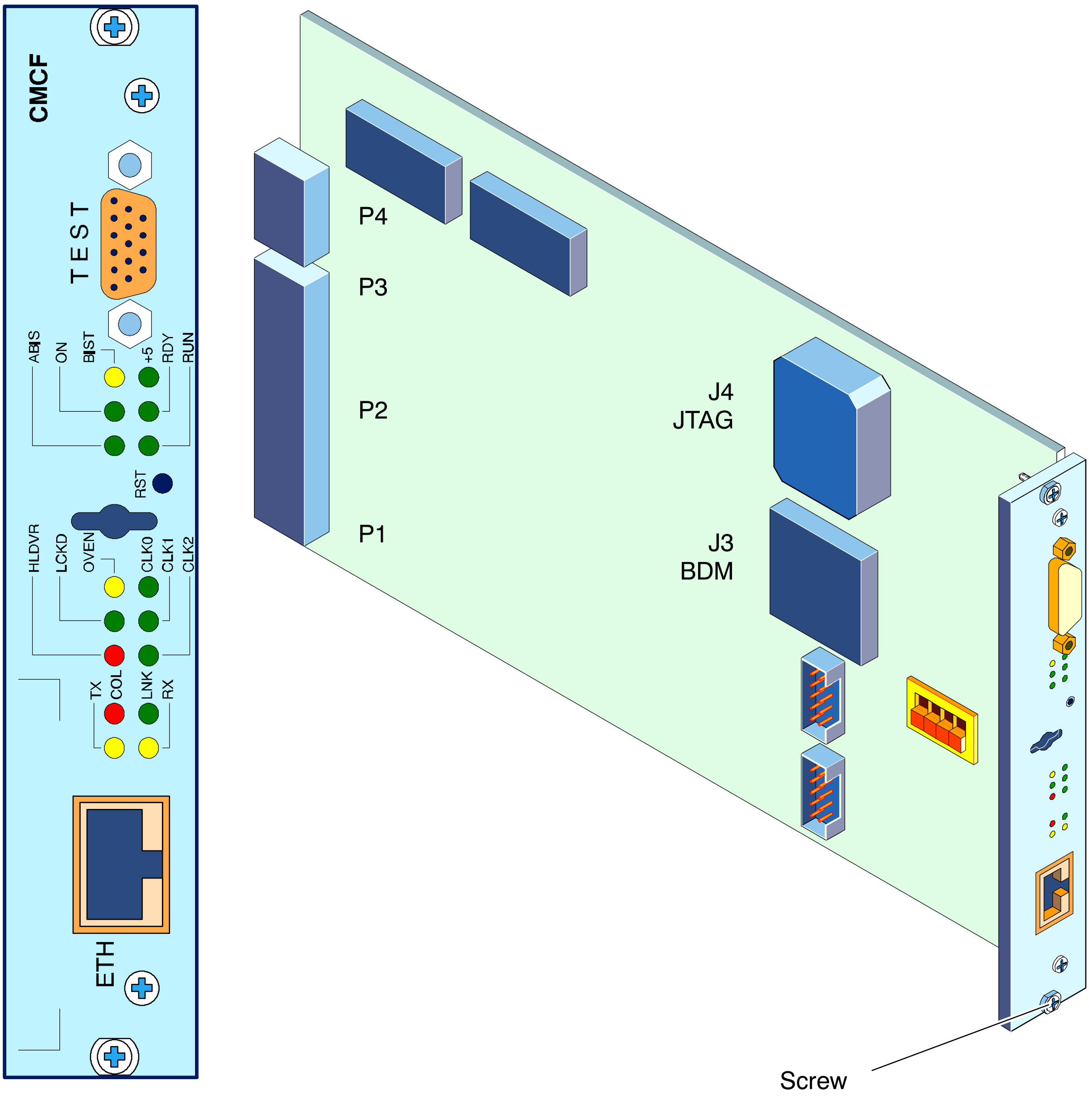


Figure 2-21 CMCF Phase2 board

2.7.4.4 Connectors

The CMCF uses eight connectors accessed from the following locations:

- on the front panel (two)
- inside the board (six)

The connectors are identified in *Table 2-35*.

Access	Connector	Type	Purpose
Front panel	TEST	Sub-D 15-pin male, high density	Connector used for debugging, RACE access, BDM, test clocks, and OCVCXO.
	ETH	RJ45	Connector used to connect the Ethernet link.
Inside the board	J3 BDM	HE10 10-pin male	
	J4 JTAG	HE10 10-pin male	Connector used to program the EPLD.
	P1	60-pin male	Connector that plugs into the CBP.
	P2	60-pin male	Connector that plugs into the CBP.
	P3	60-pin male	Connector that plugs into the CBP.
	P4 (power)	10-pin	Power supply connector, which connects to the CBP.

Table 2-35 CMCF Phase2 board connectors

Pin connections

The pin connections and their significance for the CMCF connectors are identified in *Table 2-36* to *Table 2-43*.

Pin no.	Purpose	Pin no.	Purpose	Pin no.	Purpose
1	NRESETH	6	NDS	11	NBERR
2	FREEZE	7	BKPT	12	IFETCH
3	GND	8	IPIPE0	13	CLKREFIN
4	TX	9	RX	14	TCLK
5	VCO	10	PRESCONS	15	H4M

Legend:

NRESETH	Used for the BDM
FREEZE	Used for BDM
GND	Ground
TX	Debug and RACE
VCO	OCVCXO Voltage control
NDS	Used for BDM
BKPT	Used for BDM
IPIPE0	Used for debug and RACE
RX	Debug (Console presence)
RX	Used for BDM
PRESCONS	Used for BDM
CLKREFIN	Selected reference clock
TCLK	PCM transmission clock
H4M	Private PCM clock

Table 2-36 Pin connections of the TEST connector

Pin no.	Purpose	Used for
1	T+	Output pair +
2	T-	Output pair -
3	R+	Input pair +
4	R-	Input pair -

Table 2-37 Pin connections of the ETH connector

Pin no.	Purpose	Pin no.	Purpose
1	/DS	6	FREEZE
2	/BERR	7	/RESETH
3	GND	8	DSI
4	/BKP	9	NC
5	GND	10	DSO

Legend:

/DS	Data strobe I/O Input
/BERR	Bus error output signal
GND	Electrical ground
/BKP	Clock output signal
GND	Electrical ground
FREEZE	Break point acknowledge output signal
/RESETH	Reset IO signal
DSI	Serial data input signal
NC	Not connected
DSO	Serial data output signal

Table 2-38 Pin connections of the J3 (BDM) connector

Pin no.	Purpose	Pin no.	Purpose
1	TCK	6	
2	GND	7	Reset
3	TDO	8	
4	VCC	9	Data in
5	TMS	10	Ground

Legend:

TCK	Clock
GND	Ground
TDO	Data out
VCC	Power supply
TMS	Selection
TRST	Reset
TDI	Data in

Table 2-39 Pin connections of the J4 (JTAG) Connector

Pin no.	Row A Purpose	Pin no.	Row B Purpose	Pin no.	Row C Purpose	Pin no.	Row D Purpose	Pin no.	Row E Purpose
12	GND	12	GND	12	GND	12	GND	12	GND
11	RS232TX	11		11	P5 V	11		11	RS232RX
10	RS232SP1	10	RS232SP2	10	E1T1	10	RS232SP3	10	RE232SP4
9		9		9	GND	9		9	
8	GPSCLK	8	NGPSCLK	8	GND	8		8	
7	PSYT00	7	NSYT00	7	TCLK	7	CONFIG00	7	NCONFIG00
6	PSYT10	6	NSYT10	6	NTCLK	6	CONFIG10	6	NCONFIG10
5	PSYT01	5	NSYT01	5	SY	5	CONFIG01	5	NCONFIG01
4	PSYT11	4	NSYT11	4	NSY	4	CONFIG11	4	NCONFIG11
3	PSYT02	3	NSYT02	3	H4M	3	CONFIG02	3	NCONFIG02
2	PSYT12	2	NSYT12	2	NH4M	2	CONFIG12	2	NCONFIG12
1	PLUG2	1	GND	1	GND	1	GND	1	PLUG3

Table 2-40 Pin connections of the P1 connector

Pin no.	Row A Purpose	Pin no.	Row B Purpose	Pin no.	Row C Purpose	Pin no.	Row D Purpose	Pin no.	Row E Purpose
12	MICE0	12	NMICE0	12	SY0	12	MICR0	12	NMICR0
11	MICE1	11	NMICE1	11	NSY0	11	MICR1	11	NMICR1
10	MICE2	10	NMICE2	10	H4M0	10	MICR2	10	NMICR2
9	MICE3	9	NMICE3	9	NH4M0	9	MICR3	9	NMICR3
8	MICE4	8	NMICE4	8	SY1	8	MICR4	8	NMICR4
7	MICE5	7	NMICE5	7	NSY1	7	MICR5	7	NMICR5
6	MICE6	6	NMICE6	6	H4M1	6	MICR6	6	NMICR6
5	MICE7	5	NMICE7	5	NH4M1	5	MICR7	5	NMICR7
4	MICE8	4	NMICE8	4	SY2	4	MICR8	4	NMICR8
3	MICE9	3	NMICE9	3	NSY2	3	MICR9	3	NMICR9
2	MICE10	2	NMICE10	2	H4M2	2	MICR10	2	NMICR10
1	MICE11	1	NMICE11	1	NH4M2	1	MICR11	1	NMICR11

Table 2-41 Pin connections of the P2 connector

Pin no.	Row A Purpose	Pin no.	Row B Purpose	Pin no.	Row C Purpose	Pin no.	Row D Purpose	Pin no.	Row E Purpose
12	PLUG0	12	GND	12	GND	12	GND	12	PLUG1
11	SCOUT	11		11	SCIN	11		11	CMCFOUT
10	NSCOUT	10		10	NSCIN	10		10	NCMCFOUT
9	GND	9	GND	9	CMCFIN	9	GND	9	GND
8	RXD	8	NRXD	8	NCMCFIN	8	RXCLK	8	NRXCLK
7	TXD	7	NTXD	7		7	TXCLK	7	NTXCLK
6		6		6		6		6	
5		5		5		5		5	
4	GSMIN	4	NGSMIN	4		4	GSMOUT	4	NGSMOUT
3	GSMSYIN	3	NGSMSYIN	3	GND	3	GSMSYOUT	3	NGSMSYOUT
2	TWI0	2	TEI1	2	AOUB	2	TEI2	2	TEI3
1	GND	1	GND	1	GND	1	GND	1	GND

Table 2-42 Pin connections of the P3 connector

Pin no.	Row A Purpose	Pin no.	Row B Purpose	Pin no.	Row C Purpose	Pin no.	Row D Purpose	Pin no.	Row E Purpose
1	GND	1		1	0 V	1		1	-48 V
2	GND	2		2	0 V	2		2	-48 V

Legend:
GND Common logical ground

Table 2-43 Pin connections of the P4 (Power) connector

2.7.4.5 Electrical characteristics

The CMCF is powered by a nominal dc -48 V power supply. The acceptable range is from 36 V to 72 V.

The maximum power consumption of the board is 0.7 A.

2.7.5 BCFICO board

2.7.5.1 Functional description

The BCFICO board allows the reception and transmission of external signals towards the CMCF and CPCMI boards.

The coding of TEI signals can be set using the switched pull-down resistor inside the BCFICO board.

2.7.5.2 Physical description

The BCFICO contains the following:

- six connectors on the front panel
- four connectors inside the board
- one switch register inside the board

The BCFICO board is shown in *Figure 2-22*.

The connectors are identified in *Table 2-44* and the register is described in the Section "Switch register".

Access	Connector	Type	Purpose
Front panel	PCM0/1	Sub-D, 25-pin female	Connectors used for Private PCM links 0 and 1. Connected to J8 on the inside of the board.
	PCM2/3	Sub-D, 25-pin female	Connectors used for Private PCM links 2 and 3. Connected to J8 on the inside of the board
	PCM4/5	Sub-D, 25-pin female	Connectors used for Private PCM links 4 and 5. Connected to J5 on the inside of the board
	ABIS	Sub-D 25-pin male	Connected to J5 on the inside of the board.
	PWR	Sub-D, 3-pin male	+48 V dc power supply connector. Connected to the J3 connector on the inside of the board.
	RS232	Sub-D, 9-pin male	Connected to the J1 connector on the inside of the board.
Inside the board	J2	10-pin female	Power supply connector, which is plugged into the CBP.
	J4	60-pin female	Connecter that is plugged into the CBP.
	J6	60-pin female	Connecter that is plugged into the CBP.
	J7	60-pin female	Connecter that is plugged into the CBP.

Table 2-44 BCFICO board connectors

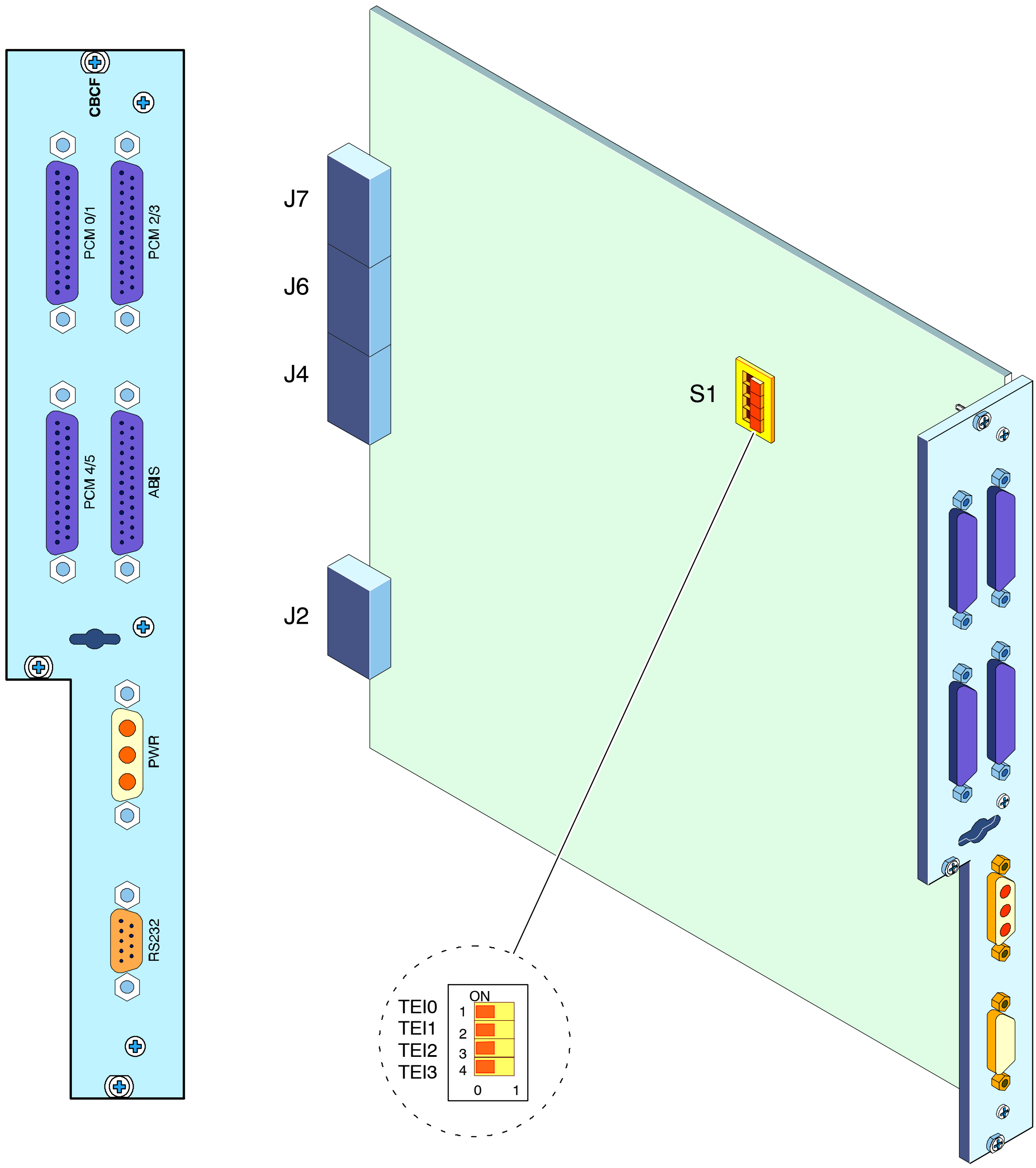


Figure 2-22 BCFICO board

2.7.5.3 Pin connections

The pin connections of the BCFICO connectors are identified in *Table 2–45* to *Table 2–54*.

Pin no.	Purpose	Pin no.	Purpose
1	SEL4	14	NSEL4
2	SEL5	15	NSEL5
3	SEL6	16	NSEL6
4	SEL7	17	NSEL7
5	GND	18	GND
6	GND	19	GND
7	MICE0	20	NMICE0
8	MICE1	21	NMICE1
9	MICR0	22	NMICR0
10	MICR1	23	NMICR1
11	PH40	24	NH40
12	PSY0	25	NSY0
13	GND		

Table 2–45 PCM0/1 pin connections

Pin no.	Purpose	Pin no.	Purpose
1	SEL14	14	NSEL14
2	SEL15	15	NSEL15
3	SEL16	16	NSEL16
4	SEL17	17	NSEL17
5	GND	18	GND
6	GND	19	GND
7	MICE2	20	NMICE2
8	MICE3	21	NMICE3
9	MICR2	22	NMICR2
10	MICR3	23	NMICR3
11	PH41	24	NH41
12	PSY1	25	NSY1
13	GND		

Table 2–46 PCM2/3 pin connections

Pin no.	Purpose	Pin no.	Purpose
1	SEL24	14	NSEL24
2	SEL25	15	NSEL25
3	SEL26	16	NSEL26
4	SEL27	17	NSEL27
5	GND	18	GND
6	GND	19	GND
7	MICE4	20	NMICE4
8	MICE5	21	NMICE5
9	MICR4	22	NMICR4
10	MICR5	23	NMICR5
11	PH42	24	NH42
12	PSY2	25	NSY2
13	GND		

Table 2–47 PCM4/5 pin connections

Pin no.	Purpose	Pin no.	Purpose
1	EHDB0	14	EHDB3
2	NEHDB0	15	NEHDB3
3	RHDB0	16	RHDB3
4	NRHDB0	17	NRHDB3
5	EHDB1	18	EHDB4
6	NEHDB1	19	NEHDB4
7	RHDB1	20	RHDB4
8	NRHDB1	21	NRHDB4
9	EHDB2	22	EHDB5
10	NEHDB2	23	NEHDB5
11	RHDB2	24	RHDB5
12	NRHDB2	25	NRHDB5
13			

Table 2-48 ABIS pin connections

Pin no.	Purpose
1	(-)48 V
2	GND
3	(+)48 V

Table 2-49 PWR pin connections

Pin no.	Purpose
1	RS232SP2
2	RS232RX
3	RS232TX
4	RS232SP1
5	GND
6	RS232SP3
7	RS232SP4
8	GPSCLK
9	NGPSCLK

Table 2-50 RS232 pin connections

	A	B	C	D	E
1	(–)48 V		(+)48 V		GND
2	(–)48 V		(+)48 V		GND
3	(–)48 V		(+)48 V		GND
4	(–)48 V		(+)48 V		GND
5	(–)48 V		(+)48 V		GND
6	(–)48 V		(+)48 V		GND

Table 2-51 J2 pin connections

	A	B	C	D	E
12					
11	NRHDB1	RHDB1		NRHDB0	RHDB0
10					
9	NEHDB1	EHDB1		NEHDB0	EHDB0
8					
7	NRHDB3	RHDB3		NRHDB2	RHDB2
6					
5	NEHDB3	EHDB3		NEHDB2	EHDB2
4					
3	NRHDB5	RHDB5		NRHDB4	RHDB4
2					
1	NEHDB5	EHDB5		NEHDB4	EHDB4

Table 2-52 J4 pin connections

	A	B	C	D	E
12	GND	GND	+5 V	GND	GND
11	RS232RX	RS232SP3	GND	RS232SP2	RS232TX
10	RS232SP4	NGPSCLK	GND	GPSCLK	RS232SP1
9	TEI3	TEI2	TEI1	TEI0	TEI20
8	TEI00	TEI01	NAOUB	TEI11	
7	GND	GND	GND	NHLOC	HLOC
6	NCONFIG00	CONFIG00	TCLK	NSYT00	PSYT00
5	NCONFIG10	CONFIG10	NTCLK	NSYT10	PSYT10
4	NCONFIG01	CONFIG01	PSY	NSYT01	PSYT01
3	NCONFIG11	CONFIG11	NSY	NSYT11	PSYT11
2	NCONFIG02	CONFIG02	PH4	NSYT02	PSYT02
1	NCONFIG12	CONFIG12	NH4	NSYT12	PSYT12

Table 2-53 J6 pin connections

	A	B	C	D	E
12	NMICR0	MICR0	PSY0	NMICE0	MICE0
11	NMICR1	MICR1	NSY0	NMICE1	MICE1
10	NMICR2	MICR2	PH40	NMICE2	MICE2
9	NMICR3	MICR3	NH40	NMICE3	MICE3
8	NMICR4	MICR4	PSY1	NMICE4	MICE4
7	NMICR5	MICR5	NSY1	NMICE5	MICE5
6			PH41	NMICE6	MICE6
5			NH41	NMICE7	MICE7
4			PSY2	NMICE8	MICE8
3			NSY2	NMICE9	MICE9
2			PH42	NMICE10	MICE10
1			NH42	NMICE11	MICE11

Table 2-54 J7 pin connections

2.7.5.4 Switch resistor

The TEI signals can be configured by setting the switch pull-down register inside inside the BCFICO in the positions indicated in *Table 2-55*.

Signal name	Link	Connector pin termination	Logical code
TEI00 TEI01	to CPCMI0 to CPCMI0	grounded on CBP grounded on CBP	0 0
TEI10 TEI11	to CPCMI1 to CPCMI1	left unconnected grounded on CBP	1 0
TEI20 TEI21	to CPCMI2 to CPCMI2	grounded on CBP left unconnected	0 1
TEI0 TEI1 TEI2 TEI3	to 2 CMCF to 2 CMCF to 2 CMCF to 2 CMCF	pull-down serial mounted with a switch on BCFICO pull-down serial mounted with a switch on BCFICO pull-down serial mounted with a switch on BCFICO pull-down serial mounted with a switch on BCFICO	0 or 1 0 or 1 0 or 1 0 or 1
AOUB NAOUB	to CMCF_A to CMCF_B	left unconnected. grounded on CBP	1 0

Table 2-55 TEI Resistor coding on the switch register

2.7.5.5 TEI configuration

WIth the TEI0 to TEI3 (S1) switches of the CBCICO board (voir *Figure 2-22*) you can update the TEI configuration as described in the following table :

TEI number	TEI0 switch	TEI1 switch	TEI2 switch	TEI3 switch
0	1	1	1	1
1	1	1	1	0
2	1	1	0	1
3	1	1	0	0
4	1	0	1	1
5	1	0	1	0
6	1	0	0	1
7	1	0	0	0
8	0	1	1	1
9	0	1	1	0
10	0	1	0	1
11	0	1	0	0
12	0	0	1	1
13	0	0	1	0
14	0	0	0	1
15	0	0	0	0

Key:

0 : Indicates that the switch is in the “ON“ position

1 : Indicates that the switch is in the “OFF“ position

Note: The gray line indicates the factory setting.

Table 2-56 TEI configuration

2.7.5.6 Interfaces specifications

The 48 V power supply is connected to the MAINICO board via power terminals. screw:

- M1 Mechanical ground connected to the DRXs PUPS output ground.
- M2 -48 V supply
- M3 0 V supply
- each 48 V DRX Power connector is protected by a 2A fuse.

2.7.6 CBCF Back Panel (CBP)

2.7.6.1 Functional description

The CBCF Back Panel (CBP) provides the interconnection between the following CBCF Module boards:

- two CMCFs
- three CPCMIs
- one BCFICO

2.7.6.2 Physical description

The CBP contains the following six connectors:

- two CMCF signal connectors
  - CMCF_A
  - CMCF_B
- three CPCMI signal connectors
  - CPCMI_0
  - CPCMI_1
  - CPCMI_2
- one BCFICO connector

The CBP board and its connectors are shown in *Figure 2-23*.

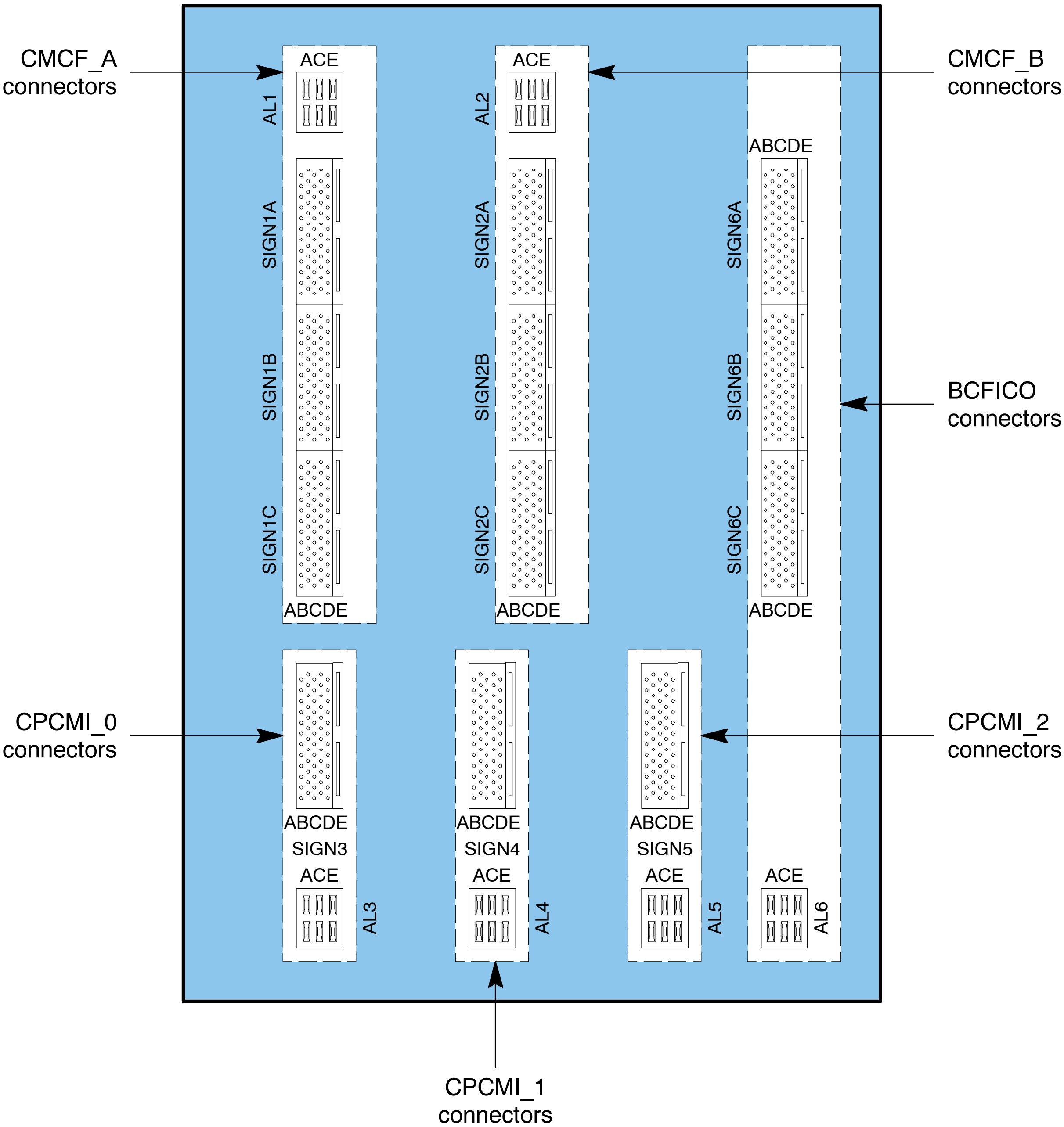


Figure 2-23 CBP board

2.7.6.3 Pin connections

The pin connections of the CBP connectors are identified in *Table 2-57* to *Table 2-69*.

	A	B	C	D	E
12	PLUGA0	GND	GND	GND	PLUGA0
11	CMCFAB		SCBA		SCAB
10	NCMCFAB		NSCBA		NSCAB
9	GND	GND	CMCFBA	GND	GND
8	NCLKBA	CLKBA	NCMCFBA	NDATBA	DATBA
7	NCLKAB	CLKAB		NDATAB	DATAB
6					
5					
4	NGSMAB	GSMAB		NGSMBA	GSMBA
3	NGSMSYAB	GSMSYAB	GND	NGSMSYBA	GSMSYBA
2	TEI3	TEI2	AOUB	TEI1	TEI0
1	GND	GND	GND	GND	GND

Table 2-57 CMCF_A (Sign1A) pin connections

	A	B	C	D	E
12	NMICR0	MICR0	PSY0	NMICE0	MICE0
11	NMICR1	MICR1	NSY0	NMICE1	MICE1
10	NMICR2	MICR2	PH40	NMICE2	MICE2
9	NMICR3	MICR3	NH40	NMICE3	MICE3
8	NMICR4	MICR4	PSY1	NMICE4	MICE4
7	NMICR5	MICR5	NSY1	NMICE5	MICE5
6	NMICR6	MICR6	PH41	NMICE6	MICE6
5	NMICR7	MICR7	NH41	NMICE7	MICE7
4	NMICR8	MICR8	PSY2	NMICE8	MICE8
3	NMICR9	MICR9	NSY2	NMICE9	MICE9
2	NMICR10	MICR10	PH42	NMICE10	MICE10
1	NMICR11	MICR11	NH42	NMICE11	MICE11

Table 2-58 CMCF_A (Sign1B) pin connections

	A	B	C	D	E
12	GND	GND	GND	GND	GND
11	RS232RX		+5 V		RS232TX
10	RS232SP4	RS232SP3	E1T1	RS232SP2	RS232SP1
9			HLOC		
8			NHLOC	NGPSCLK	GPSCLK
7	NCONFIG00	CONFIG00	TCLK	NSYT00	PSYT00
6	NCONFIG10	CONFIG10	NTCLK	NSYT10	PSYT10
5	NCONFIG01	CONFIG01	PSY	NSYT01	PSYT01
4	NCONFIG11	CONFIG11	NSY	NSYT11	PSYT11
3	NCONFIG02	CONFIG02	PH4	NSYT02	PSYT02
2	NCONFIG12	CONFIG12	NH4	NSYT12	PSYT12
1	PLUGA1	GND	GND	GND	PLUGA1

Table 2-59 CMCF_A (Sign1C) pin connections

	A	B	C	D	E
12	PLUGB0	GND	GND	GND	PLUGB0
11	CMCFBA		SCAB		SCBA
10	NCMCFBA		NSCAB		NSCBA
9	GND	GND	CMCFAB	GND	GND
8	NCLKAB	CLKAB	NCMCFAB	NDATAB	DATAB
7	NCLKBA	CLKBA		NDATBA	DATBA
6					
5					
4	NGSMBA	GSMBA		NGSMAB	GSMAB
3	NGSMSYBA	GSMSYBA	GND	NGSMSYAB	GSMSYAB
2	TEI3	TEI2	NAOUB	TEI1	TEI0
1	GND	GND	GND	GND	GND

Table 2-60 CMCF_B (Sign2A) pin connections

	A	B	C	D	E
12	NMICR0	MICR0	PSY0	NMICE0	MICE0
11	NMICR1	MICR1	NSY0	NMICE1	MICE1
10	NMICR2	MICR2	PH40	NMICE2	MICE2
9	NMICR3	MICR3	NH40	NMICE3	MICE3
8	NMICR4	MICR4	PSY1	NMICE4	MICE4
7	NMICR5	MICR5	NSY1	NMICE5	MICE5
6	NMICR6	MICR6	PH41	NMICE6	MICE6
5	NMICR7	MICR7	NH41	NMICE7	MICE7
4	NMICR8	MICR8	PSY2	NMICE8	MICE8
3	NMICR9	MICR9	NSY2	NMICE9	MICE9
2	NMICR10	MICR10	PH42	NMICE10	MICE10
1	NMICR11	MICR11	NH42	NMICE11	MICE11

Table 2-61 CMCF_B (Sign2B) pin connections

	A	B	C	D	E
12	GND	GND	GND	GND	GND
11	RS232RX		+5 V		RS232TX
10	RS232SP4	RS232SP3	E1T1	RS232SP2	RS232SP1
9			HLOC		
8			NHLOC	NGPSCLK	GPSCLK
7	NCONFIG00	CONFIG00	TCLK	NSYT00	PSYT00
6	NCONFIG10	CONFIG10	NTCLK	NSYT10	PSYT10
5	NCONFIG01	CONFIG01	PSY	NSYT01	PSYT01
4	NCONFIG11	CONFIG11	NSY	NSYT11	PSYT11
3	NCONFIG02	CONFIG02	PH4	NSYT02	PSYT02
2	NCONFIG12	CONFIG12	NH4	NSYT12	PSYT12
1	PLUGB1	GND	GND	GND	PLUGB1

Table 2-62 CMCF_B (Sign2C) pin connections

	A	B	C	D	E
1	NEHDB1	EHDB1		NEHDB0	EHDB0
2					
3	NRHDB1	RHDB1		NRHDB0	RHDB0
4					
5	GND	GND	GND	GND	GND
6	TEI01	TEI00	E1T1	NCONFIG10	NCONFIG00
7				CONFIG10	CONFIG00
8	NTCLK	NSYT10	NSYT00		
9	TCLK	PSYT10	PSYT00	NHLOC	NSY
10				HLOC	PSY
11	NMICR7	NMICE7	NMICR6	NMICE6	NH4
12	MICR7	MICE7	MICR6	MICE6	PH4

Table 2-63 CPCMI_0 (Sign3) pin connections

	A	B	C	D	E
1	NEHDB3	EHDB3		NEHDB2	EHDB2
2					
3	NRHDB3	RHDB3		NRHDB2	RHDB2
4					
5	GND	GND	GND	GND	GND
6	TEI11	TEI10	E1T1	NCONFIG11	NCONFIG01
7				CONFIG11	CONFIG01
8	NTCLK	NSYT11	NSYT01		
9	TCLK	PSYT11	PSYT01	NHLOC	NSY
10				HLOC	PSY
11	NMICR9	NMICE9	NMICR8	NMICE8	NH4
12	MICR9	MICE9	MICR8	MICE8	PH4

Table 2-64 CPCMI_1 (Sign 4) pin connections

	A	B	C	D	E
1	NEHDB5	EHDB5		NEHDB4	EHDB4
2					
3	NRHDB5	RHDB5		NRHDB4	RHDB4
4					
5	GND	GND	GND	GND	GND
6	TEI21	TEI20	E1T1	NCONFIG12	NCONFIG02
7				CONFIG12	CONFIG02
8	NTCLK	NSYT12	NSYT02		
9	TCLK	PSYT12	PSYT02	NHLOC	NSY
10				HLOC	PSY
11	NMICR11	NMICE11	NMICR10	NMICE10	NH4
12	MICR11	MICE11	MICR10	MICE10	PH4

Table 2-65 CPCMI_2 (Sign 5) pin connections

	A	B	C	D	E
12	NMICR0	MICR0	PSY0	NMICE0	MICE0
11	NMICR1	MICR1	NSY0	NMICE1	MICE1
10	NMICR2	MICR2	PH40	NMICE2	MICE2
9	NMICR3	MICR3	NH40	NMICE3	MICE3
8	NMICR4	MICR4	PSY1	NMICE4	MICE4
7	NMICR5	MICR5	NSY1	NMICE5	MICE5
6			PH41	NMICE6	MICE6
5			NH41	NMICE7	MICE7
4			PSY2	NMICE8	MICE8
3			NSY2	NMICE9	MICE9
2			PH42	NMICE10	MICE10
1			NH42	NMICE11	MICE11

Table 2-66 BCFICO (Sign6A) pin connections

	A	B	C	D	E
12	GND	GND	+5 V	GND	GND
11	RS232RX	RS232SP3	GND	RS232SP2	RS232TX
10	RS232SP4	NGPSCLK	GND	GPSCLK	RS232SP1
9	TEI3	TEI2	TEI1	TEI0	TEI20
8	TEI00	TEI01	NAOUB	TEI11	
7	GND	GND	GND	NHLOC	HLOC
6	NCONFIG00	CONFIG00	TCLK	NSYT00	PSYT00
5	NCONFIG10	CONFIG10	NTCLK	NSYT10	PSYT10
4	NCONFIG01	CONFIG01	PSY	NSYT01	PSYT01
3	NCONFIG11	CONFIG11	NSY	NSYT11	PSYT11
2	NCONFIG02	CONFIG02	PH4	NSYT02	PSYT02
1	NCONFIG12	CONFIG12	NH4	NSYT12	PSYT12

Table 2-67 BCFICO (Sign6B) pin connections

	A	B	C	D	E
12					
11	NRHDB1	RHDB1		NRHDB0	RHDB0
10					
9	NEHDB1	EHDB1		NEHDB0	EHDB0
8					
7	NRHDB3	RHDB3		NRHDB2	RHDB2
6					
5	NEHDB3	EHDB3		NEHDB2	EHDB2
4					
3	NRHDB5	RHDB5		NRHDB4	RHDB4
2					
1	NEHDB5	EHDB5		NEHDB4	EHDB4

Table 2-68 BCFICO (Sign6C) pin connections

	A	B	C	D	E
1	-48 V		+48 V		GND
2	-48 V		+48 V		GND
3	-48 V		+48 V		GND
4	-48 V		+48 V		GND
5	-48 V		+48 V		GND
6	-48 V		+48 V		GND

Table 2-69 AL1, AL2, AL3, AL4, AL5, AL6 pin connections (Power voltage connectors)

2.8 DRX, e-DRX, or DRX-ND3 module

The module processes reception and transmission signals. It has a receive sensitivity of -110 dBm or -108 dBm.

2.8.1 DRX front panel

The DRX front panel has the following elements (see *Figure 2-24*):

- a 26-pin power supply connector (PWR)
- a 66-pin connector for the private PCM (FH-PCM)
- a 50-pin test connector (TEST)
- a transmission signal output (TX OUT)
- a diversity reception signal input (RXD IN)
- a main reception signal input (RXM IN)
- 12 LEDs:
  - +5 V: Power supply
  - RES1: (Reserved)
  - ALA: Alarm
  - DRX: DRX general status
  - AMNU: AMNU status
  - SPU: SPU or RX status
  - BDT: BDT status
  - TX: TX status
  - LI: Ethernet connection OK
  - CL: Ethernet collision
  - TX: Ethernet transmission
  - RX: Ethernet reception

  The LEDs for the AMNU, SPU, BDT, and TX can be in flashing mode while the corresponding software is being downloaded.

  For further information about the status of LEDs, refer to the document "S12000 BTS Maintenance Manual - Procedures".

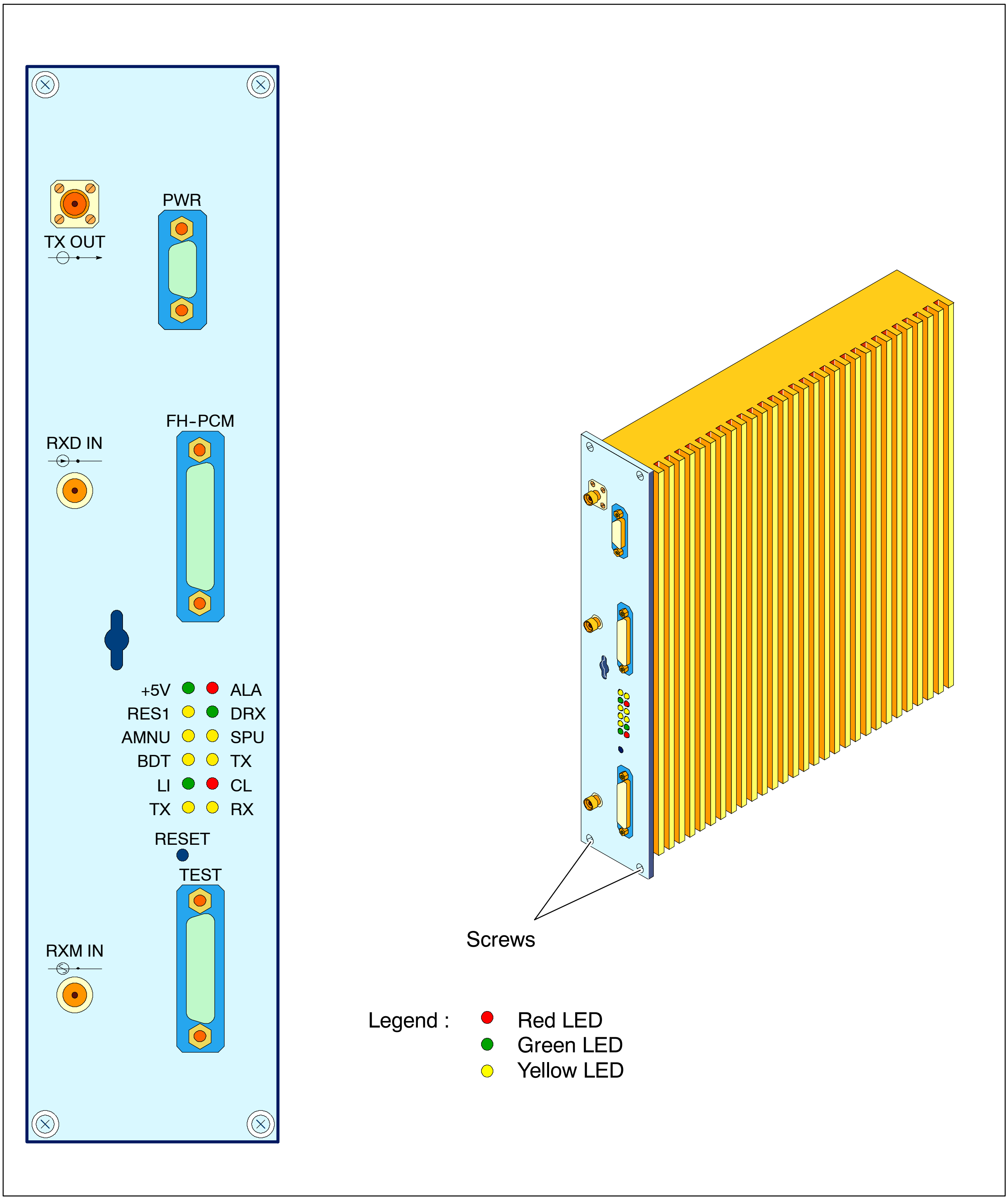


Figure 2-24 DRX module

2.8.2 e-DRX front panel

The e-DRX front panel has the following elements (see *Figure 2-25*):

- a 26-pin power supply connector (PWR)
- a 66-pin connector for the private PCM (FH-PCM)
- a 50-pin test connector (TEST)
- a transmission signal output (TX)
- a diversity reception signal input (RXD IN)
- a main reception signal input (RXM IN)
- 8 LEDs:
  - FWR: TBD
  - SPU: SPU status
  - e-DRX: e-DRX general status
  - ALA: Alarm
  - BIST: Built-In Self Status
  - LI: Ethernet connection OK
  - TX: Ethernet transmission
  - RX: Ethernet reception
- 1 button:
  - RESET: restart the module

For further information about the status of LEDs, refer to NTP < 144 >.

For more details about DRX and e-DRX architectures, please see chapters 3.3 and 3.4.

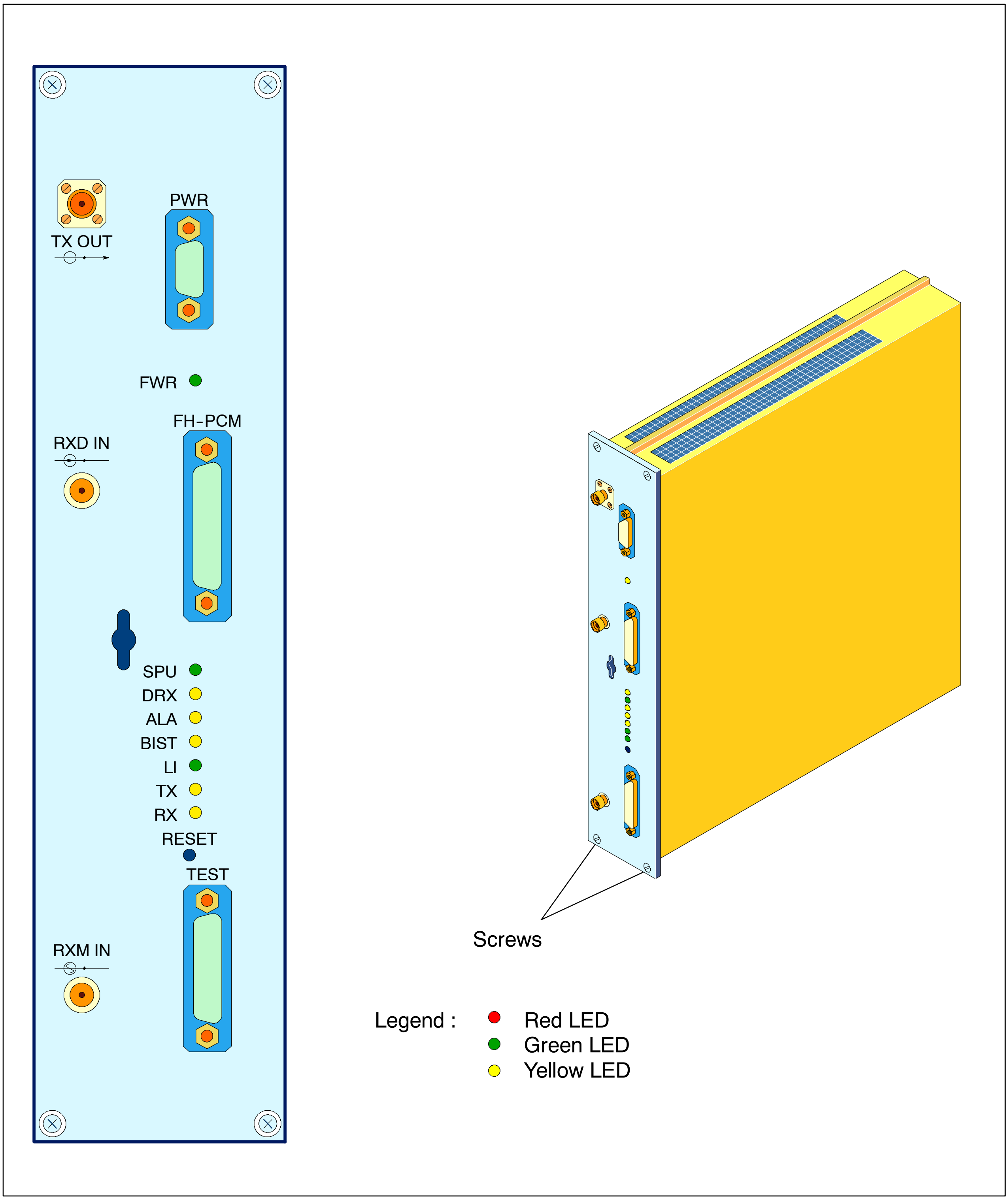


Figure 2-25 e-DRX module

2.9 RX-splitter

The RX-splitter amplifies a reception signal and splits it into several signals that it sends to the receivers.

2.9.1 Principle

The RX-splitter exists in two types: 1x4 and 2x2. It consists of the following elements according to the type :

- Type 1x4: a two-stage, four-channel splitter (see *Figure 2-26*), which splits the signal from the LNA-splitter into four identical signals.
- Type 2x2: a two-stage, two two-channels splitter (see *Figure 2-27*), which splits each of two signals from the LNA-splitter into two identical signals.
- Four Low-Noise Amplifiers (LNA), which amplify one channel each.
- Four resistive attenuators, which adjust the gain to the required value on each LNA channel.
- A remote amplifier, which controls the power of the incoming signal. The DRX supervises the amplifier and sends the information to the BSC.

Each channel of the RX-splitter is connected to a different receiver. The receiver supplies the LNA of the channel to which it is connected by means of the RF cable. The four channels are therefore supplied independently of one another.

Channels which are not connected to any receiver are not supplied with power, and so need not be adapted by a 50 Ω termination.

Nominal gain on the four outputs is + 9.2 dBm (GSM 850), + 8 dBm (GSM 1900).

2.9.2 Consumption

The RX-splitter is supplied with +12 V dc ± 5% or +5.5 V dc ± 5% (GSM 1900). Its maximum consumption is 40 mA (GSM 1900) 50 mA for GSM 850. The receivers to which it is connected trip an alarm if this limit is exceeded.

2.9.3 RX-splitter front panel

The front panel of the RX-splitter has the following elements (see *Figure 2-28*):

- Four RX connectors each supply a signal to a receiver which supplies them with voltage.
- An IN connector is used by the RX-splitter to receive the reception signal.

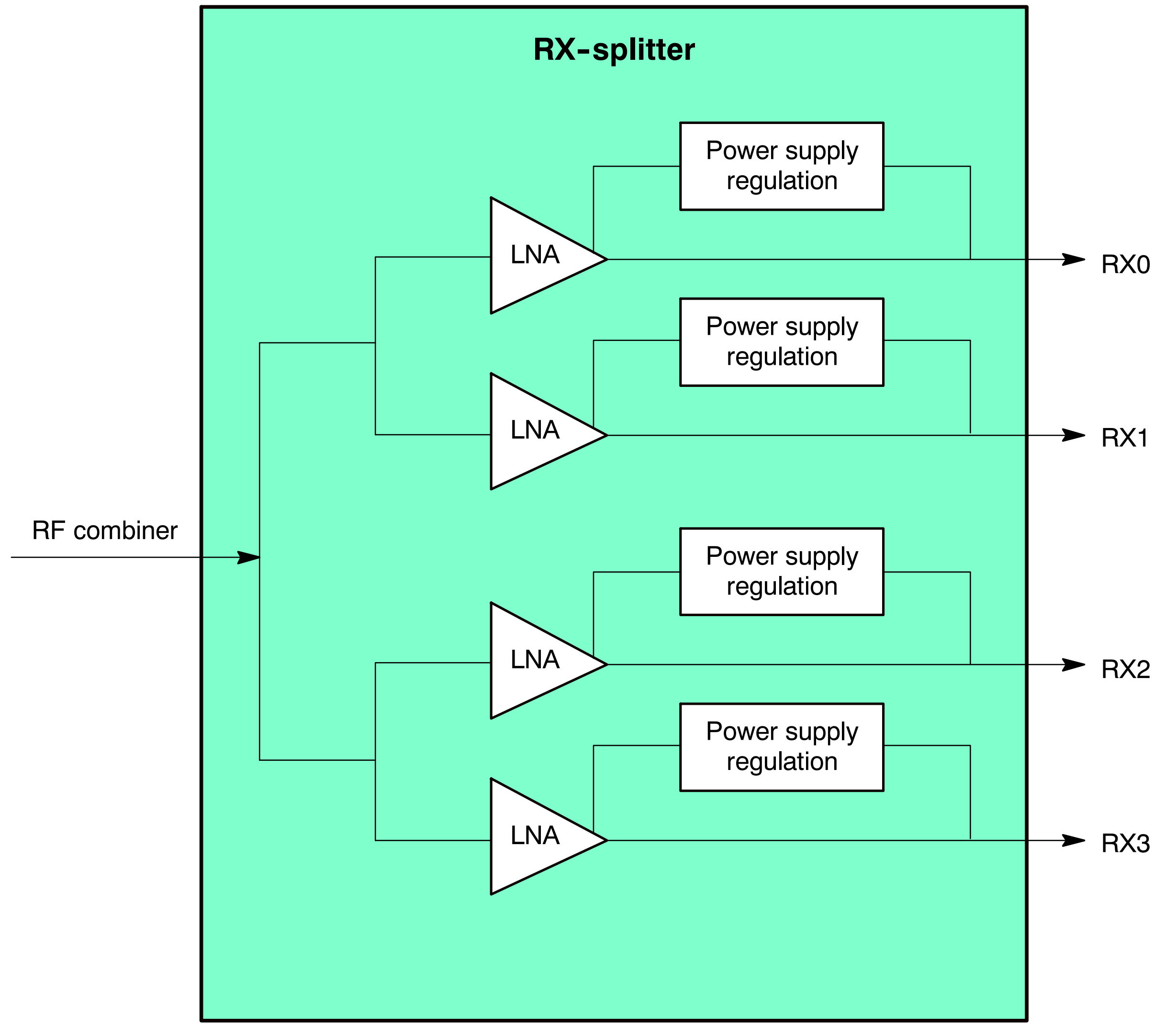


Figure 2-26 RX-splitter diagram type 1x4

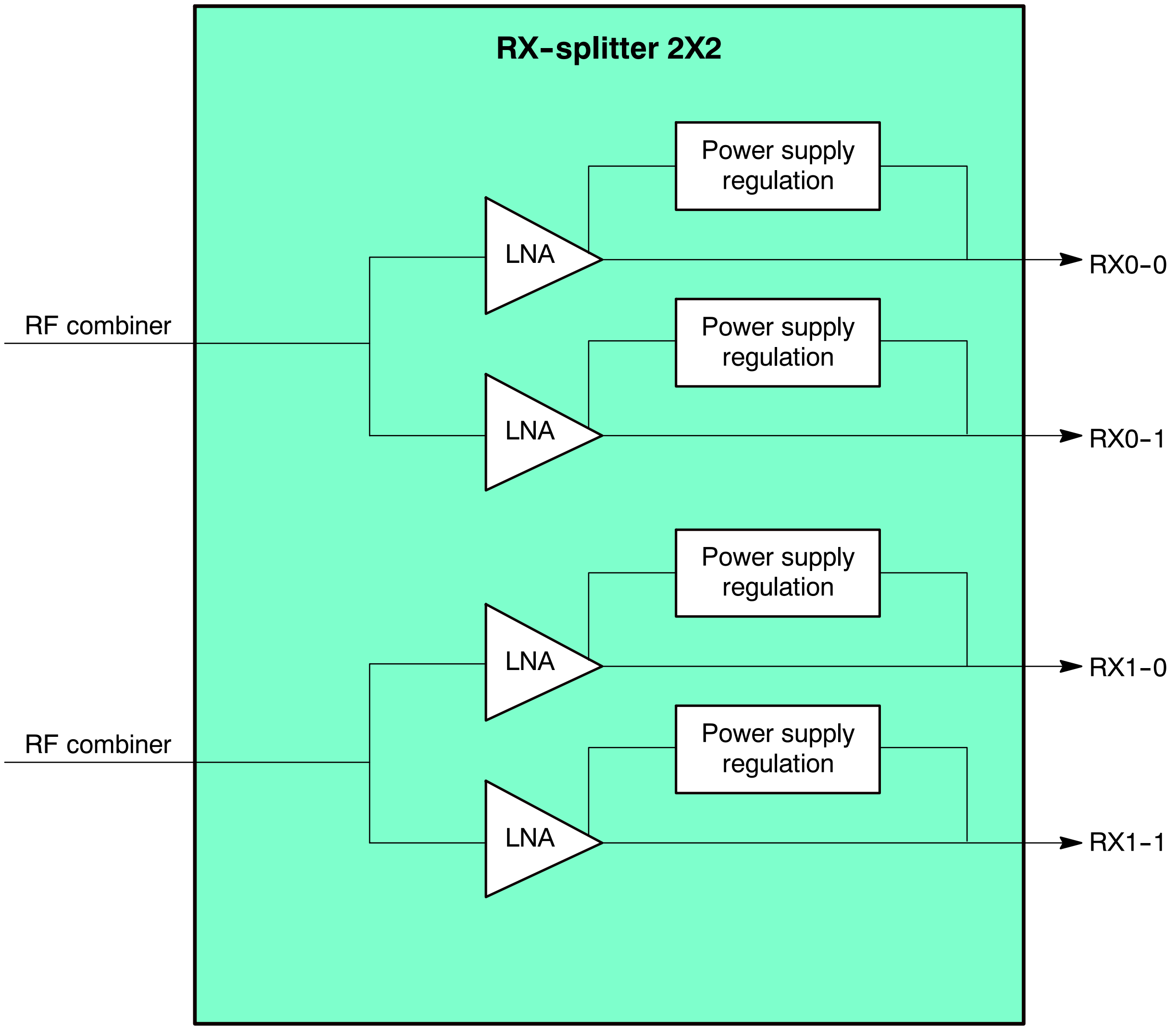


Figure 2-27 RX-splitter diagram type 2x2

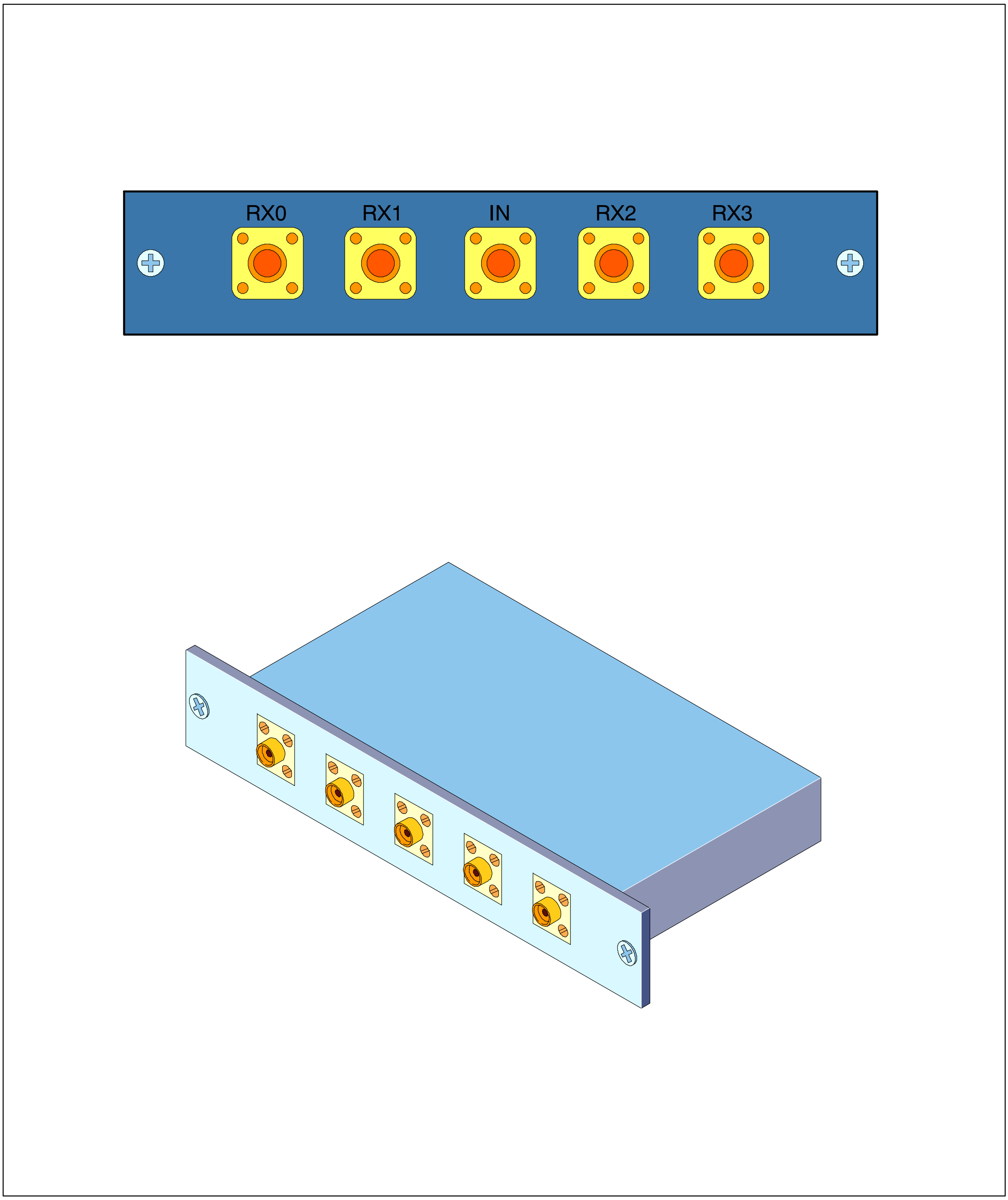


Figure 2-28 RX-splitter type 1x4

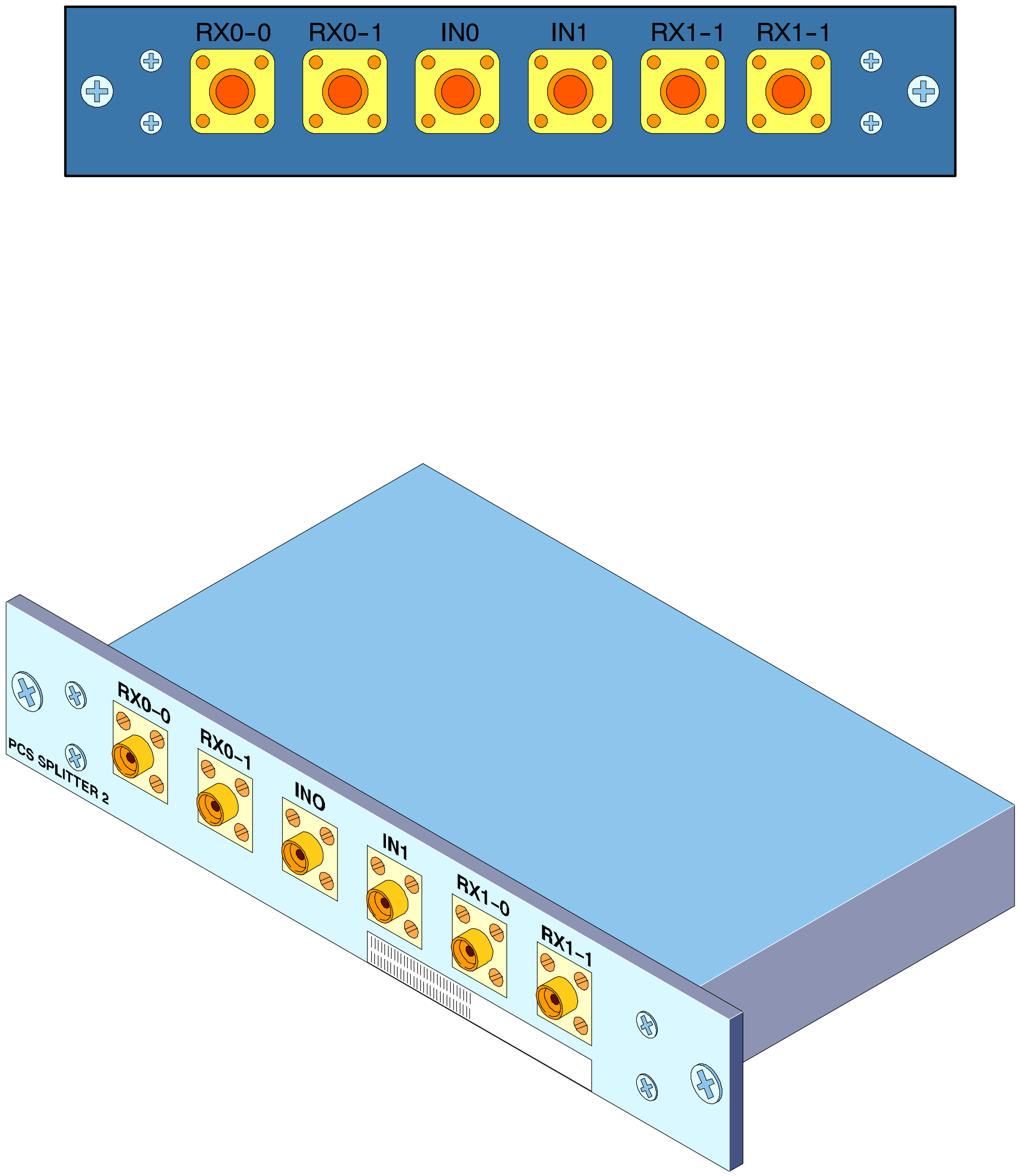


Figure 2-29 Rx-splitter type 2x2

2.10 Power system

2.10.1 Power system description

This system is made up of:

- a Power Controller Unit (PCU) and a set of up to seven Rectifier Units (SRU), each with 600 W output capability (one is for redundancy)
- or a GSM Integrated power System (GIPS)
- a set of batteries (Internal or external)

This system and the batteries constitute the dc energy distribution system used to supply the various modules of the cabinet. The Power System delivers a 54.6 V dc voltage which it generates from the Mains voltage for a 25°C temperature (77°F) of the probe under the batteries.

2.10.2 PCU description

The PCU has the four following separate outputs which supply the modules of the cabinet:

- output 1 (-) to the power amplifiers and F-type converters
- output 2 (-) to the climatic system fans
- output 3 (-) to the DRX units
- output 4 (-) to the CBCF, the user optional accessory, and the RECAL board

The PCU also provides a common 0 V output.

PCU protections

The PCU outputs are protected by these breakers:

- output current 1: breaker L1 (80 A)
- output current 2: breaker L2 (10 A, time delay)
- output current 3: breaker L3 (15 A)
- output current 4: breaker L4 (15 A)

When circuit-breakers L1 or L3 are tripped, an alarm signal is generated.

A manual power supply cut-off is provided on all four outputs by circuit-breakers on the front panel of the PCU.

Alarms

Several alarms are provided in the PCU, in order to detect the following situations:

- ac fault: when the ac supply is interrupted or is outside the voltage range (single alarm for all rectifiers)
- dc fault: when the dc supply is interrupted or is outside the 40 V to 58 V (± 0.5 V) range (single alarm for all rectifiers) or if a temperature sensor is not properly linked to the PCU or if a local bias fails.

- excessive temperature: The rectifier is switched off when the maximum operating temperature is exceeded, and then starts again when the temperature has dropped back to normal (single alarm for all rectifiers).
- batteries on discharge (except for S8006 BTS)
- PCU protection device
- Load1 threshold

Alarm connector

This is a male 15-point SubD connector:

1	ac fault alarm
2	dc fault alarm
3	NC
4	Alarm common
5	Load1 threshold alarm
6	NC
7	Over temperature alarm
8	PCU protection alarm
9	Battery on discharge
10	NC
11	NC
12	NC
13	NC
14	NC
15	NC
Note: Only alarms sent back to the RECAL board are mentionned.	

Table 2-70 Alarm connector

Monitoring connector

This is a female 15-point SubD connector:

1	Alarm common
2	Alarm common
3	NC
4	NC
5	NC
6	NC
7	NC
8	CEATS 1a
9	CEATS 1b
10	NC
11	NC
12	Mechanical ground
13	Mechanical ground
14	NC
15	NC
Note: NC = not connected	

Table 2-71 Monitoring connector

2.10.2.1 PCU Front panel

The front panel includes the following (see *Figure 2-30)*:

- four manual circuit breakers (PA, FAN, DRX and BCF)
- test points:
  - two points for type1 (PROBE1 and PROBE2)
  - one point for type2 (PROBE1 only)
- a terminal for connection with the battery cables
- six lights emitting LEDs
  - The green LED (ON) indicates that the PCU is operating normally.
  - The red LED (AL) indicates that there is a fault in the temperature sensor circuit of the batteries or in the PCU.
  - Four other green LEDs indicates that the four outputs of the PCU are operational.

2.10.2.2 PCU Top panel

The top panel includes alarm and monitoring connectors. The alarm connector (J4) is a male type, while the control connector (J5) is a female type.

LEDs

The LEDs give information on the status of the PCU rectifier:

- The green LED (ON) indicates that the PCU is operating normally.
- The red LED (AL) indicates that there is a fault in the temperature sensor circuit of the batteries or in the PCU local bias system.
- Four other green LEDs indicates that the four outputs of the PCU are operational.

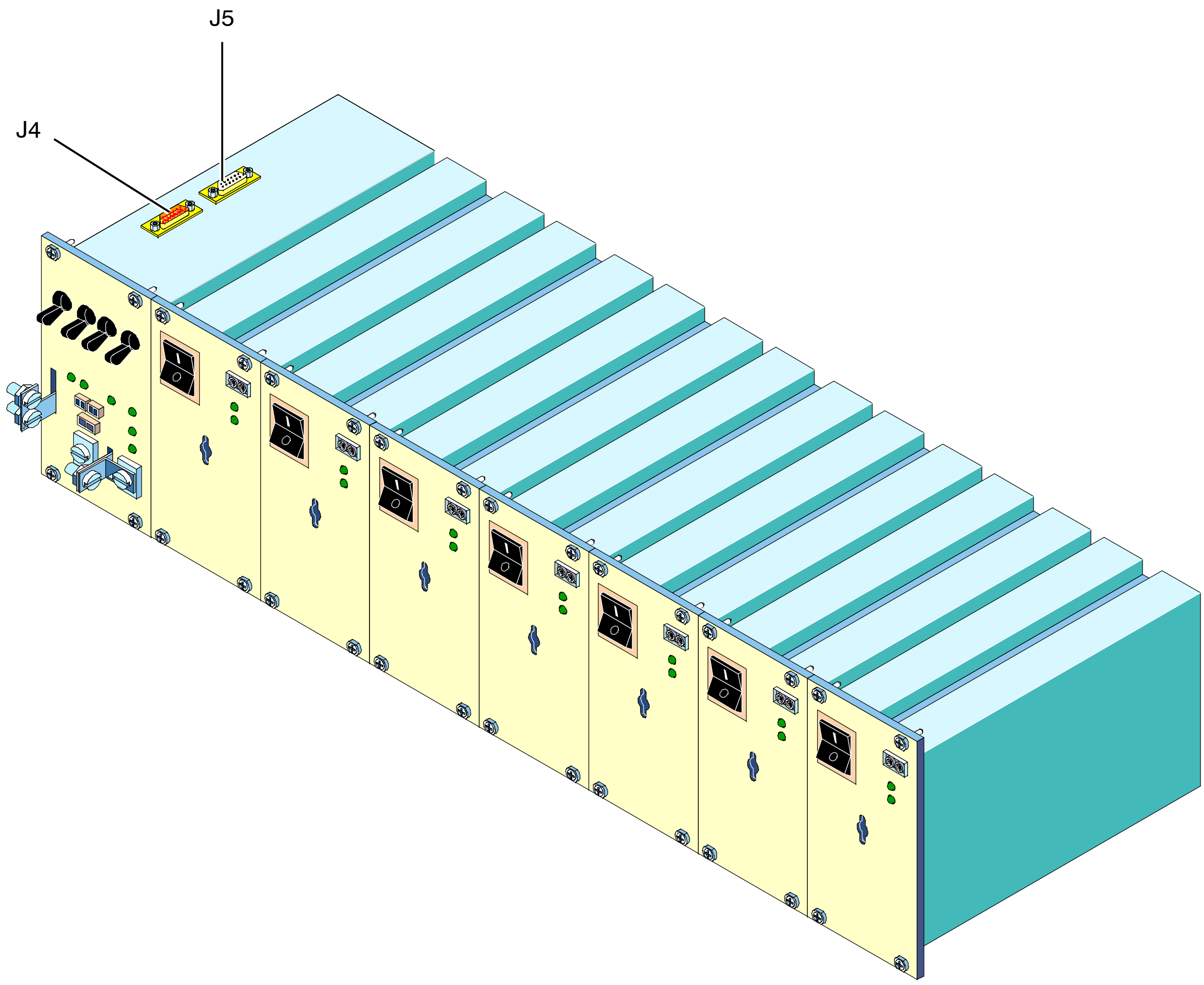


Figure 2-30 Power supply rack (seven-rectifier type)

2.10.3 SRU description

Input voltage

Nominal 230 V ac

Range: 176 V ac to 264 V ac

Output characteristics

Nominal output voltage is 54.6 V ± 0.2 V.

The output voltage range is 40 V to 58 V ± 0.5 V.

Protection against power surges is 59.5 V (+0 V, -1 V).

Nominal current is 11A minimum for Vout = 54.6 V. The output power is constant (600W) for output voltages between 40 V and 58 V.

Alarms

Several alarm signals can be generated, in the following cases:

- overtemperature
- missing module
- ac input voltage interrupted or not within 176 V-264 V thresholds
- dc output voltage not within 40 V-58 V thresholds (± 0.5 V)

An ac alarm leads to a dc alarm, but a dc alarm does not necessarily lead to an ac alarm.

Floating voltage control

The floating voltage leaving the rectifiers is automatically adjusted in inverse ratio to battery temperature. This floating voltage is necessary for an optimum battery service life.

2.10.3.1 SRU Front panel

The front panel includes the following (see *Figure 2-30*):

- a manual circuit switch
- two voltage test points
- two LEDs

The LEDs give information on the status of the rectifier:

- The green LED (ON) is on to indicate that the rectifier is in normal operating mode, that is, the ac supply is within the appropriate voltage range and a dc voltage is supplied at the rectifier output.
- The red LED (AL) is on to indicate that the ac supply is within the appropriate voltage range but rectifier temperature is too high.

2.10.4 GIPS description

This system is made up of a Distribution and Control Unit (DCU), a Set of Rectifier Units, rectifiers of 680 W each (one is for redundancy), and a AC Distribution Unit (ADU). This GIPS and the batteries constitute the dc energy distribution system used to supply the various modules of the cabinet. The Power System delivers a 54.6 V dc voltage which it generates from the Mains voltage for a 25°C temperature (77°F) of the probe under the batteries.

2.10.4.1 DCU description

The DCU has the four following separate outputs which supply the modules of the cabinet:

- output PA (-) to the power amplifiers
- output DACS (-) to the climatic system fans
- output DRX (-) to the DRX, eDRX, or DRX-ND3 units
- output BCF (-) to the BCF (CBCF/RECAL /USER) and F-type converters

The DCU also provides a common 0 V output.

DCU protections

The DCU outputs are protected by the following breakers:

- output current PA: breaker CB1 (80 A)
- output current DACS: breaker CB2 (15 A)
- output current DRX: breaker CB3 (15 A)
- output current BCF: breaker CB4 (15 A)

When circuit-breakers CB1 or CB3 are tripped, an alarm signal is generated.

A manual power supply cut-off is provided on all four outputs by circuit-breakers on the front panel of the DCU.

Alarms

Several alarms are provided to the RECAL board by the power system:

- AC fault: when 1 out of 3 phases is interrupted or is outside the 172V to 176V range (single alarm for all seven rectifiers)
- DC fault: when the dc supply is interrupted (single alarm for all seven rectifiers) or if a temperature sensor is not properly linked to the DCU or if a local bias fails or one slot is empty.

- DCU protection device
- Load1 threshold
- Main breaker fault
- Lightning arrestor fault

Alarm connector

This is a male 15-point SubD connector placed on the top of the DCU.

1	Alarm AC OR
2	Alarm DC OR
3	Alarm load1 threshold
4	Common alarms
5	Remote Control a
6	Remote Control b
7	CEATS1
8	CEATS2
9	NC
10	Mains breaker
11	PCU Protective Devices
12	NC
13	Lightning Arrestor
14	Common Alarm
15	NC
Note: NC = not connected	

Table 2-72 Alarm connector

2.10.4.2 DCU front panel

The front panel includes the following:

- Four manual circuit breakers (PA, DRX, DACS, and BCF)
- a battery temperature probe connector
- four green LEDs
  - The four green LEDs ON indicate that the DCU is operating normally.
  - A green LED OFF indicates that the corresponding module is not powered.

A battery breaker is located above the GIPS.

2.10.4.3 DCU top panel

The top panel includes an alarm interface connector. The alarm connector is male 15-point SubD connector.

2.10.4.4 Rectifier description

Input voltage

Nominal 230 V ac

Range: 176 V ac to 264 V ac

Output characteristics

Nominal output voltage is 54.6 V ± 0.2 %.

The output voltage range is 40 V to 58.3 V.

Protection against power surges is 59.7 V.

Nominal current is 12.45 A minimum for Vout = 54.6 V. The output power is constant (680W) for output voltages between 40 V and 58 V.

Alarms

Several alarm signals are generated, in the following cases:

- overtemperature
- ac input voltage interrupted or not within 176 V-264 V thresholds
- dc output voltage not within 40 V to 58.3 V thresholds

An ac alarm leads to a dc alarm, but a dc alarm does not necessarily lead to an ac alarm.

Floating voltage control

The floating voltage leaving the rectifiers is automatically adjusted in inverse ratio to battery temperature. This floating voltage is necessary for an optimum battery service life.

2.10.4.5 Rectifier front panel

The front panel includes the following:

- a manual circuit switch
- a green LED

The LED gives information on the status of the rectifier. The green LED is on to indicate that the rectifier is in normal operating mode, that is a dc voltage is supplied at the rectifier output.

2.10.4.6 ADU description

The ADU provides:

- the AC input cable
- surge protection
- a system level circuit breaker for rectifiers power on/off and overload protection
- a circuit breaker for DACS power on/off and overload protection
- EMI filtering
- a connector for the DACS

2.10.4.7 ADU front panel

The front panel includes the following:

- three mains circuit breakers:
  - rectifiers 1, 3, 5, 7 Load Circuit Breaker
  - rectiifers 2, 4, 6 Load Circuit Breaker
  - DACS Load Circuit Breaker
- DACS cable
- main cable
- Earth connection point for dielectric test

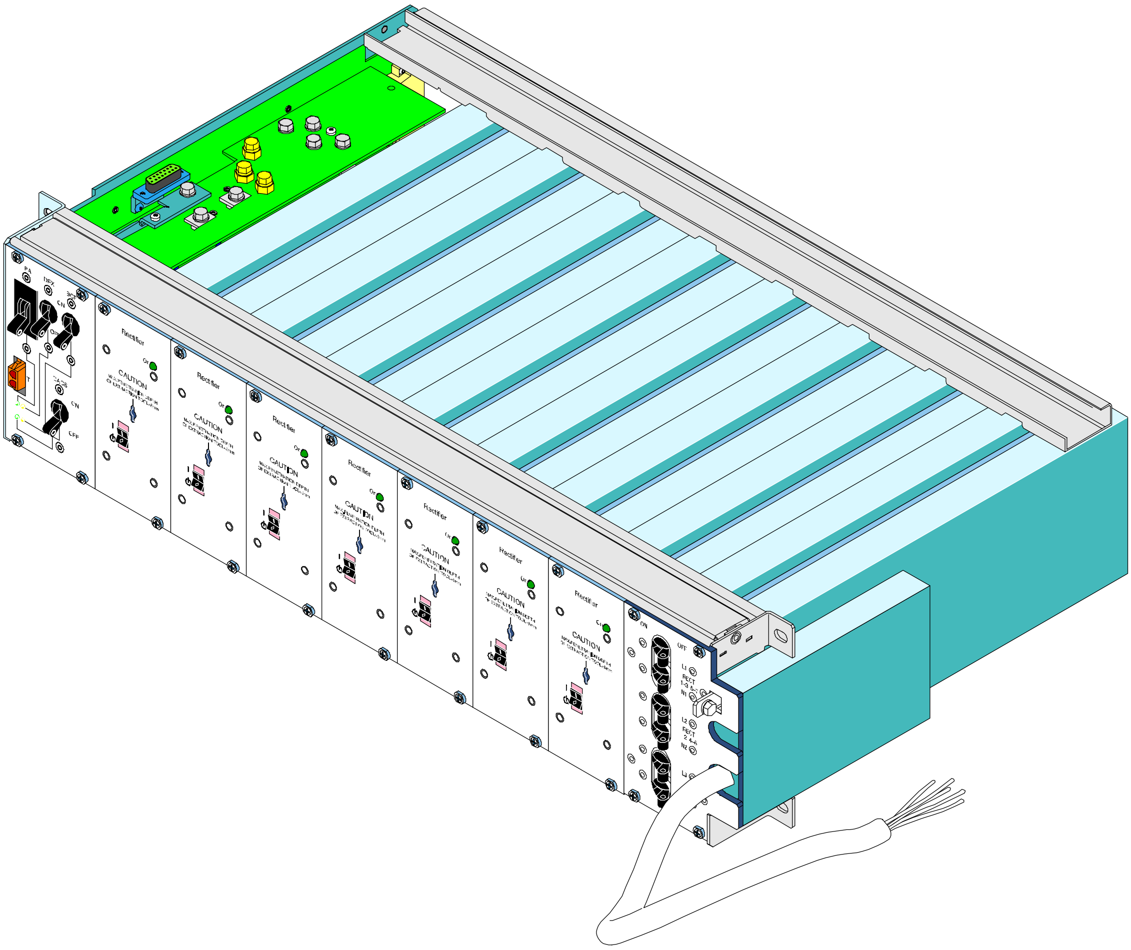


Figure 2-31 **GIPS**

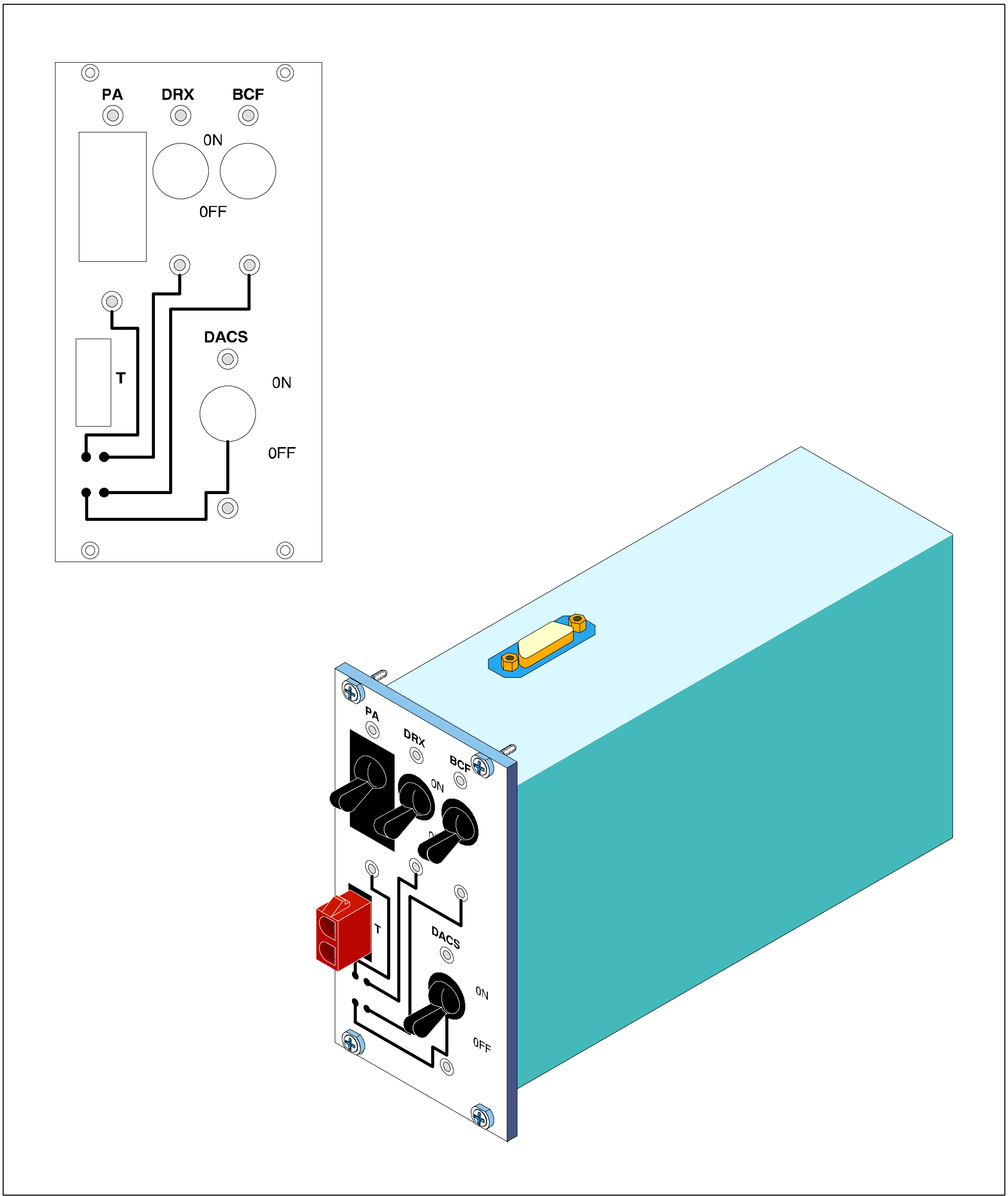


Figure 2-32 DCU module

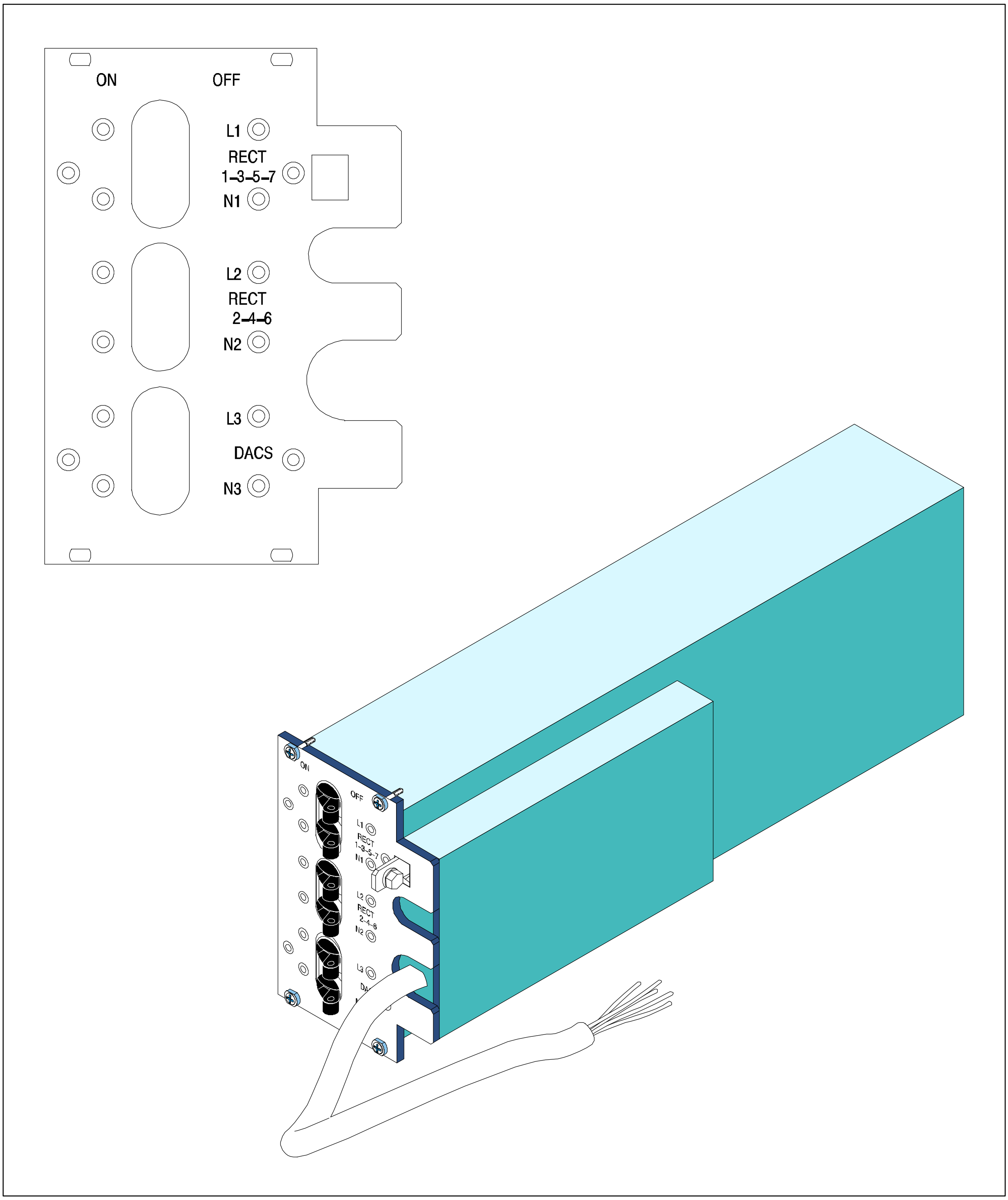


Figure 2-33 ADU module

3 ARCHITECTURE

3.1 Physical architecture

3.1.1 Introduction

This chapter provides an overview of the BTS physical architecture. BTS components are described in detail in Chapters 1 to 5.

The EDGE link quality measurement (LQM) of the uplink is performed at the BTS.

E-DRX and E-PA are necessary on the BTS to utilize the EDGE features.

BSC12000 is required to utilize the EDGE features.

3.1.2 Subsystems

The BTS contains three main subsystems (see *Figure 3-1*):

- one CBCF Module
- one TRX subsystem
- one coupling system

The content of each subsystem is listed in *Table 3-1*.

3.1.3 Internal buses

The following buses, which connect BTS components, are described in this section:

- frequency hopping (FH) bus
- private PCM

Figure 3-1 shows the buses used with the CBCF Module.

Subsystem	Contents*
Compact BCF (CBCF) Module	• Compact PCM Interface board (CPCMI) • Compact Main Common Function board (CMCF) • Remote Control Alarm (RECAL) board • BCF Interconnection board (BCFICO) • CBCF Back Panel (CBP)
TRX	• Driver and Receiver unit (DRX) • Power Amplifier (PA)
Coupling system	• RF Combiner Module(s) of the following types: – Duplexer (D) – Hybrid Two-way (H2D) – Hybrid Four-way (H4D) – Tx Filter(s) (TxF) • Rx Splitter(s) • LNA Splitter
* The number of boards or modules are not indicated and depend on the configuration of the site.	

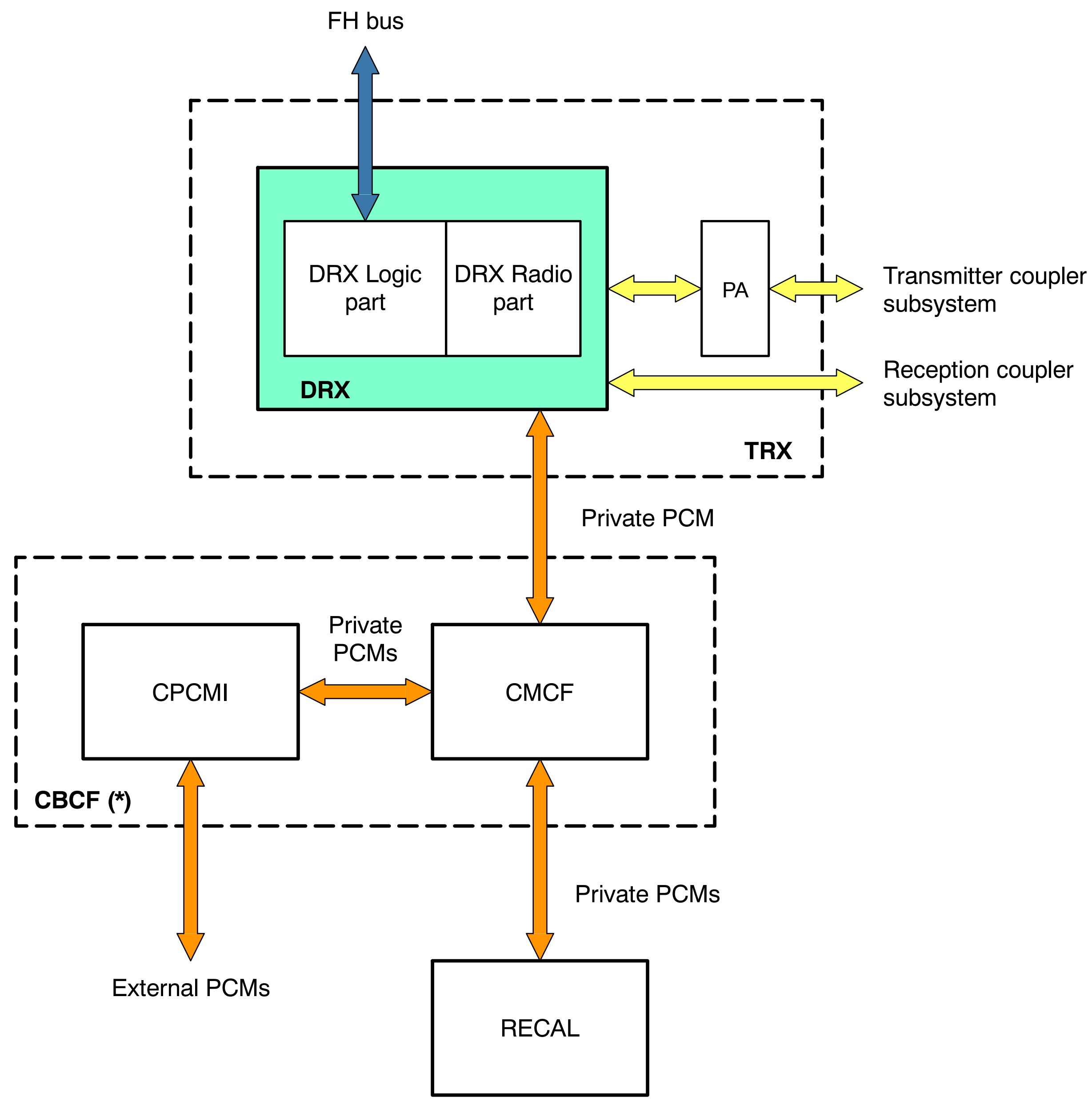
Table 3-1 BTS subsystems

3.1.3.1 FH bus

The FH bus links together all logical DRXs.

The FH bus and the transmitters connected to it ensure the function of frequency hopping and the filling of the BCCH frequency.

The FH bus is a V11 (series) bus. It is one-way and carries the signals according to the RS485 standard.



Note: (*) The two interconnection boards of the CBCF module (BCFICO and CBP) are not shown.

Figure 3-1 Subsystem architecture with CBCF

Each message is transmitted in synchronization with the 4Fbit clock and includes the following:

- the system time in six bytes (flag included)
- the address of the DRX that transmits the information in one byte
- the code of the send frequency on 10 bits
- the send power commands in one byte
- the NRZ message of the send data in 19 bytes

Up to 16 transmitters can be connected to this bus.

For multi-cell sites, all the cells can be connected onto a single FH bus.

3.1.3.2 Private PCM

Up to six private PCMs transport data between the DRXs and the CBCF Module. Each private PCM supports up to four es. Each private PCM has a 64 kbit/s time slot (TS) distributed to all DRXs and carries the GSM TIME signal (TS31).

Each private PCM allocates the following time slots (TS) for each DRX:

- One TS (64 kbit/s logical channels) of transparent data for signaling and 4 TSs for traffic

A group of five TSs, three of which are used, is allocated to each DRX, as follows:

Signaling	Traffic + Joker	Traffic + Joker	Traffic + Joker	Traffic + Joker
1	2	3	4	5

A 4.096 MHz clock, slaved to the 4Fbit clock of the synchronization board, is used for bit synchronization of the private PCM.

The refresh period must be a multiple of an occurrence between the GSM time base (577 μs) and the PCM time base (125 μs). The selected refresh period is 60 ms.

One must make the difference between CMCF/CPCMI which remain with a single rate (4.096 MHz clock and 2.048 Mbps datarate) and CMCF/DRX/RECAL which can have a double rate feature on some TSs(4.096 Mbps double datarate).

The TSs remaining with a single rate are the signaling TSs for the DRX/eDRX/RECAL and the traffic TSs for the DRX.

3.2 CBCF functional architecture

The CBCF performs the following functions:

- switching, synchronization, and concentration
- control of the alarm management unit
- PCM Interface

The CMCF Phase2 board performs the concentration, synchronization, and switching functions. The CMCF also controls the alarm management unit (the RECAL board), which is located outside the CBCF Module.

The CMCF Phase2 board allows operation in duplex mode and in simplex mode.

The CPCMI board is the interface between the external PCM links (A–bis) and the private PCMs in the CBCF.

CBCF modes

The CBCF can be used in simplex mode with only one CMCF board in slot 0 or 1 running in active mode. Simplex/Duplex mode is managed by a micro switch on the CMCF Phase2 board. From duplex to simplex, the transaction is never automatic and always follows a configuration. From simplex to duplex mode, there is no automatic transition when the active board detects the connection with the passive one.

3.2.1 Switching, synchronization, and concentration

The CMCF Phase2 board is duplicated in the CBCF Module to provide redundancy (see *Figure 3–2*).

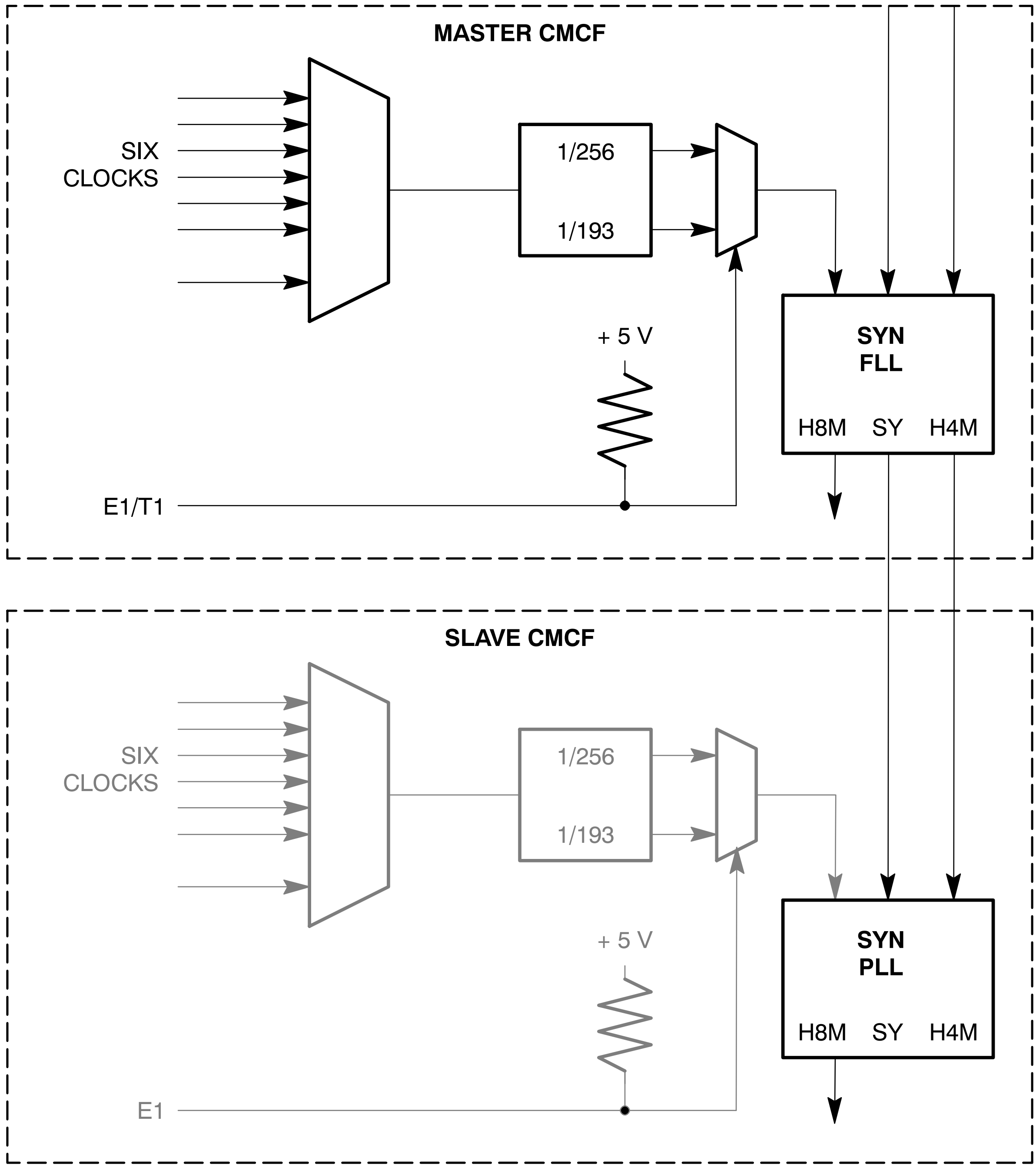
One CMCF central processor manages the switching matrix and the synchronization. The main processor and slave processor share the concentration and routing tasks as described below.

3.2.1.1 Switching

The two switching matrices in the CMCF receive and distribute the traffic of PCMs as follows:

- up to six PCMs communicate with the CPCMI boards (external PCM)
- up to six PCMs communicate with the DRXs (external PCM)
- two PCMs communicate with the processing units (internal PCM)
- one PCM communicates GSM time (internal PCM)
- one PCM for tests (internal PCM)

The 6 PCMs distributed towards the DRX can have a double rate.



PLL : Phase-locked loop
FLL : Frequency locked loop

Figure 3-2 CMCF board synchronization (full configuration)

3.2.1.2 Synchronization

The CMCF Phase2 board provides synchronization to the radio part of the BTS.

Synchronization is obtained through a temperature-controlled oscillator that allows the selection of timing signal from eight signals (six from the external PCMs, one from an external source, and one from the CMCF Phase2 active).

The selected clock signal is routed to a digital phase comparator that authorizes synchronization operations in a frequency locked loop (CMCF Phase2 active) or in a phase locked loop (CMCF Phase2 passive).

The CMCF Phase2 passive operates in a phase locked loop so that its H4M clock is synchronized with that of the CMCF Phase2 active. This ensures that phase hopping does not occur during a CMCF Phase2 switchover.

GSM Time

The processing unit transmits the GSM Time every 60 ms. The GSM Time is transmitted to the switching matrices of the CMCF Phase2 active. The CMCF passive reads the GSM Time in the CMCF Phase2 active, which allows the synchronization of GSM Time on both CMCFs.

Figure 3-2 shows the synchronization process on the CMCF Phase2 board.

Switchover

A switchover occurs in synchronization with the H4M clock. Since the active CMCF and the passive CMCF Phase2 are synchronized (H4M and GSM Time), the switchover does not cause a timing disruption.

The switchover sequence is as follows:

- active CMCF becomes inactive
- inactive CMCF detects the inactivity
- inactive CMCF becomes active

A CMCF processor becomes inactive in the following circumstances:

- H16M clock state is NOK and there is dual chain operation
- the active request is disabled
- master board is not properly connected to the back panel
- the active processor is reset while in dual chain operation

Defence and redundancy management

A switchover from one CMCF Phase2 board to the other in the event of an error on the active CMCF Phase2 board ensures redundancy. The hardware supports duplex and simplex modes.

A redundancy channel between both CMCF Phase2 boards ensures the exchange of data between the boards in the event of a switchover.

The defense connectivity is shown in *Figure 3-3*.

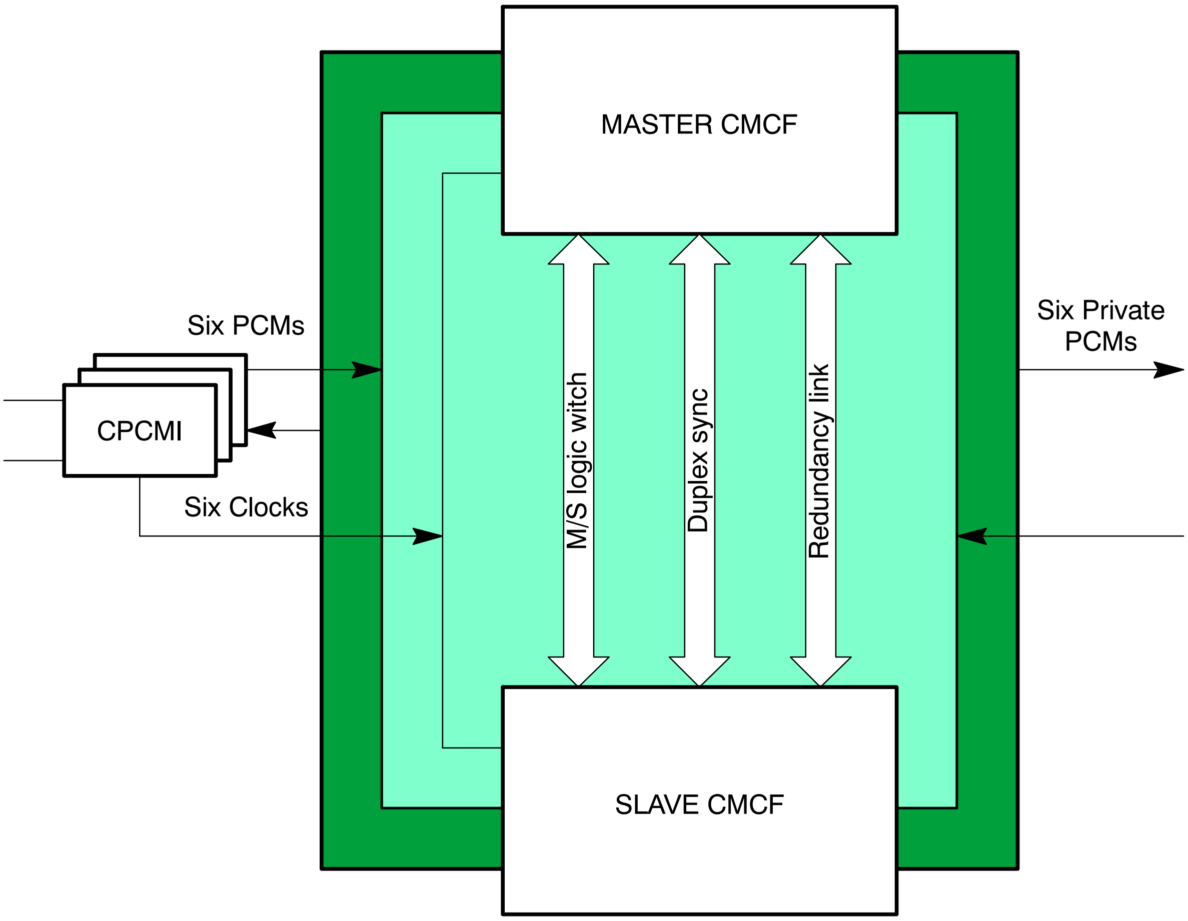


Figure 3-3 **Defense connectivity between the CMCF Phase2 boards (full configuration)**

3.2.1.3 Concentration and routing

The concentration and routing functionality is performed by the active and passive processing units. The master processing unit manages the board resources. The passive processing unit, which operates synchronously with the master unit, manages one PCM, one HDLC link (for active–passive communication), and one RS232 link.

The master processing unit receives an external clock signal at 4.096 MHz and generates a 33 MHz reference frequency. This frequency is supplied to the passive unit so that it can be synchronous with the master unit.

3.2.2 Control of the alarm management unit

The CMCF Phase2 manages the alarm management unit, the RECAL board, located outside the CBCF Module.

The RECAL board collects internal and external alarms and routes them to the CMCF, which routes to the BSC.

The communication between the CMCF Phase2 and the RECAL is done using an LAPD protocol link that uses a channel supported by time slot 25 of PCM0.

3.2.3 PCM Interface

Up to three CPCMI boards provide the interface between six external PCM links (A–bis) and six private PCMs used inside the CBCF Module.

The interface tasks correspond to an electrical level translation and a frame format conversion depending on the type of external PCM link (PCM E1, PCM T1, or HDSL).

The external PCM interface has functional blocs that perform the following functions:

- conversion of analog signals on the A–bis interface and the logical signals of the Framer part of the PCMI
- management of the synchronization clock
- transposition between the A–bis and the private PCMs signals

3.2.3.1 Signalling interfaces

The CPCMI board uses the PCM and HDSL interfaces described below.

PCM A–bis interface

The E1 interface is compatible with the G703 Recommendation. Its impedance is 120 (two pairs of bidirectional symmetrical links) or 75 Ohms (coaxial cables).

The T1 interface is compatible with ANSI T1.403 and T1.102. Its impedance is 100 Ohms (two pairs of bidirectional symmetrical links).

HDSL A-bis interface

The HDSL-E1 format (2B1Q) is on one single twisted copper pair where the transmission rate is 2320 kbps for a full E1 frame. This rate is compatible with the ETSI ETR 152 RTR/TM-06002 standard.

The HDSL-T1 format (2B1Q) is on one single twisted copper pair where the transmission rate is 1552 kbps for a full T1 frame. This rate is not standardized and is considered a proprietary link.

Private PCMs

One CPCMI board is connected to two private PCM links (PCM0 and PCM1). The O&M communication is done through an HDLC link using TS0 of PCM0.

E1/T1

Three bits supplied to the CMCF indicate whether the board is an E1 or T1.

3.3 DRX functional architecture

The DRX board has a digital part, a radio part and a power supply board (*Figure 3-4*).

3.3.1 Types of DRX boards

The DRX boards for S12000 indoor are:

- DRX ND3 GSM 900 MHZ
- DRX ND module 1800 MHZ
- DRX ND PCS 19000 MHZ
- E-GSM DRX ND module

The DRX boards for S12000 outdoor are:

- DRX ND PCS
- DRX ND DCS
- DRX ND E-GSM
- MOD: DRX ND3 GSM

3.3.2 DRX digital part

The DRX digital part consists of four units:

- the Advanced MaNagement Unit (AMNU), which manages the DRX
- the Digital Control Unit for eight chanels (DCU8), which is the signal processing unit
- the Time Base Unit (BDT), which manages the GSM_TIME for the DRX
- TX logic, which is the interface with the transmission part in the DRX Radio board

3.3.2.1 AMNU unit

The AMNU unit manages the DRX. It manages the eight time slots of a TDMA frame and the radio signaling functions.

These functions can be broken down into communication functions (RSL) on the one hand, and operating and maintenance functions (O&M) on the other (see *Figure 3-5*).

Communication functions

Communication functions include:

- routing functions
- concentration functions

Routing functions

The TDMA frame management unit routes messages from the BSC. The messages arrive on the RSL and can be broken down into two categories:

- messages concerning processing of a single time slot
- messages concerning all the time slots in the TDMA frame

Concentration functions

There are two types of messages:

- transparent messages
- non-transparent messages

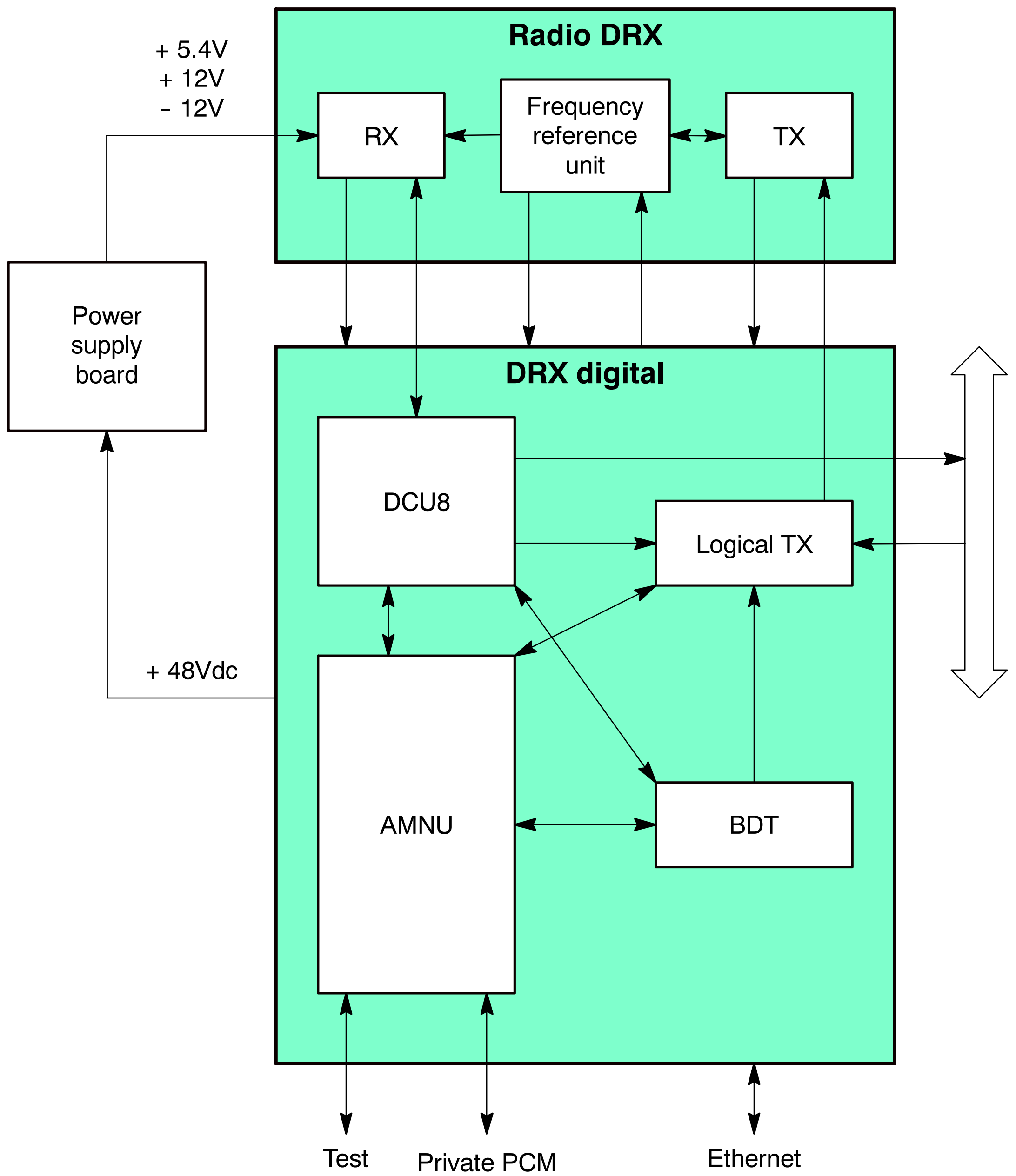


Figure 3-4 DRX board: functional block diagram

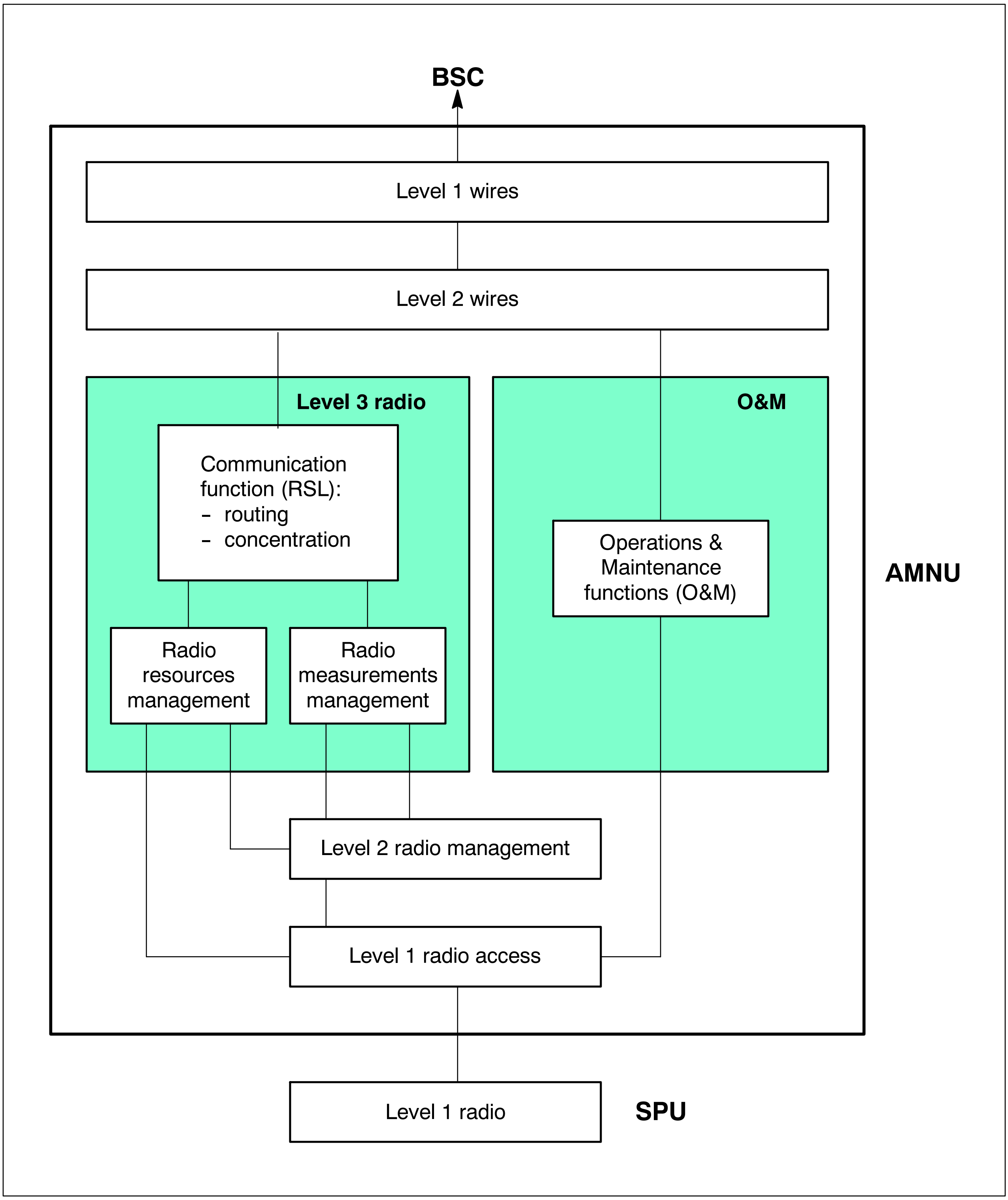


Figure 3-5 AMNU functions

Transparent messages are simply concentrated on a time slot of the internal PCM.

Non-transparent messages are:

- radio measurement messages of the mobile
- interference measurement messages on the inactive channels
- load messages on the RACH channel
- load messages on the PCH channel

Non-transparent messages are transcoded, averaged and grouped in a single message to the BSC. This message is sent to the same time slot as the transparent messages.

Operation & Maintenance functions

The following Operation & Maintenance functions are processed by the Frame management unit (AMNU):

- start-up, downloading, initialization
- configuration
- monitoring/defense

Start-up/Downloading/Initialization

The AMNU is started by a hardware reset or a reinitialization message sent by the BSC. It causes configuration of the LAPD and establishment of the OML link with the BSC.

The DRX subsystem can be downloaded only after the BCF is downloaded, and the units of site management, cell management, and Abis signaling of the DRXs have been configured.

The BSC systematically initiates a downloading phase of the catalogue files and of the following software units:

- AMNU
- SPU
- DLU
- BOOT
- TX
- BDT
- BIST of the SPUs

A re-flashing of the units for which the software versions are different follows the downloading.

Configuration

The DRX is configured by the BSC by means of an OML link on the Abis interface.

Configuration can be broken down into:

- a general configuration:
  - configuration of the TDMA frame
- time slot configurations:
  - configuration of radio time slots
  - configuration of the frequency hop

Configuration of the TDMA frame provides the DRX with parameters shared by the whole cell, such as:

- cell identity (BSIC)
- BCCH frequency
- indication of frequency hopping implementation
- cell type (normal or extended)

and with parameters specific to the DRX:

- the frequency of the TDMA frame if there is no frequency hopping
- indication of implentation of diversity in reception

The TDMA frame cannot be dynamically configured. A change of configuration requires re-start of the downloaded software.

The configuration of the radio time slot specifies the type of logical channel to use for a time slot.

The configuration of the frequency hopping specifies, for a time slot, the list of frequencies to use as well as sequencing. This configuration is optional and only appears if the frequency hopping was requested in the TDMA frame configuration.

Monitoring

The BSC regularly sends status requests to the DRX to detect any problems on the OML link.

LAPD break

The LAPD, OML and RSL links are monitored by a timer. If level 2 loss is detected, the BSC and the AMNU try to reconnect. If connection has not been made by the end of the time-out, the AMNU is reinitialized.

Event reports

The AMNU collects all events detected by the DRX equipment. It performs filtration, and sends error reports to the BSC. Transmission error reports and fault management on RX-splitters alarms are sent through the CBCF.

The AMNU filters to prevent repetition of non-transient events, which means it can send the BSC a single indication.

The AMNU sends errors to the BSC by sending "event report" messages. There are two types of "event report" messages:

- transient messages, which are not acknowledged by the BSC
- non-transient messages, which must be acknowledged by the BSC, and which are repeated by AMNU until they are acknowledged

Radio signaling function

The radio signaling function supports two Signal Processing Units (SPU). Each SPU manages one time slot.

Two versions of the SPU software are available. One corresponds to propagation conditions in rural areas and the other to propagation conditions in urban areas. For rural areas, the algorithm parameter is set at zero. For urban areas, the alogrith parameter is set at 0.5, and the interferer cancellation algorithm is active.

The radio signaling functions can be broken down into four groups of functions:

- level 1 radio access
- level 2 radio management of LAPDm signaling
- level 3 radio management, which is made up of two functions:
  - radio resources management
  - radio measurements management
- operation & maintenance

Level 1 radio access

Level 1 radio access makes it possible to manage dialogue between the AMNU signaling function and the SPU processors that are connected to the AMNU. It offers:

- configuration of operating modes for each SPU
- SPU control
- transmission and reception of data on the radio channel, respecting methods for slaving to the radio frequency

Level 2 radio management

Level 2 radio management manages the LAPDm level 2 signaling on the radio channels.

Radio resources management (level 3 radio)

Radio level 3 provides the following functions:

- level 2 management on the common channels
- control of level 2 functions on dedicated channels
- activation of the common channels
- organization of the Common Control CHannel (CCCH), including chaining and repetition of paging messages and transmission of dedicated channel allocation messages
- activation or deactivation of dedicated channels, implementation of encryption and channel mode changes
- providing SPU processors with system information on the SAACH and BCCH channels
- detection of “random access” and “handover access”
- detection of paging channel (PCH) load
- detection of radio link attenuation (monitoring of the upstream SACCH channel), verifiable by the OMC
- sending of the mobile transmission power change

Radio measurements management (level 3 radio)

This provides the following functions:

- return of interference measurements carried out by the SPU processors on the inactive dedicated channels and transmission of these measurements to the AMNU
- concatenation of measurements made by the SPUs on the active dedicated channels and those transferred by the mobile over the same period

Operation & maintenance functions (O&M)

These functions provide configuration and deconfiguration of the time slots and frequency hopping functions.

Network ID

With the implementation of V15.0, the BTS detects the type of DRX and PA during connection with respect to the BCF and the DRX. Note the following restrictions:

- If a DRX is not yet connected to the BCF, its type is set to “DRX type” until it is connected.
- If a PA is not yet connected to the DRX, its type is set to “PA type” until it is connected.

- If a fault beginning has been sent on the DRX type (or PA type) of equipment, because the real equipment type was unknown, the fault ending must be sent on a DRX or PA type, even if the DRX or PA have connected themselves between the fault begin and fault end.

EDGE implementation

In V15.1, the BSC can configure one TDMA with up to:

- 8 DS0 (joker and main) per TRX (with CBCF, CMCF Phase 2)

The joker channel is used when the size of the frame exceeds the size of the main channel, which is the case for CS3/CS4 in GPRS and MCS3 to MCS9 in E-GPRS. In that case, the main channel is filled with the maximum information (i.e 302 bits of payload) and the remainder is split into N equal pieces that are sent in the Joker channel during the same 20ms period. In order to save PCU CPU Power, the content of the jokers is aligned on a byte boundary.

As the maximum number of joker TS per TDMA is directly linked to the type of site, the following rule is mandatory: both chains of the site must have the same level of hardware.

If this rule is not verified: see the engineering rules for more details.

3.3.2.2 DCU8 unit

The DCU8 unit consists of two signaling processing chains, A and B, as shown in *Figure 3-6*. Each chain handles four calls in full-rate voice mode and eight calls in half-rate voice mode. Chain A and chain B are connected to a subassembly, the BB_FILT ASIC, which is the interface with the radio part and filters reception samples before sending them to the two chains. A second subassembly, the CHIF, which is associated with the BB_FILT ASIC, calculates encryption and decryption masks.

Chain A processes even radio reception time slots and odd radio transmission time slots. Conversely, chain B processes odd radio reception time slots and even radio transmission time slots.

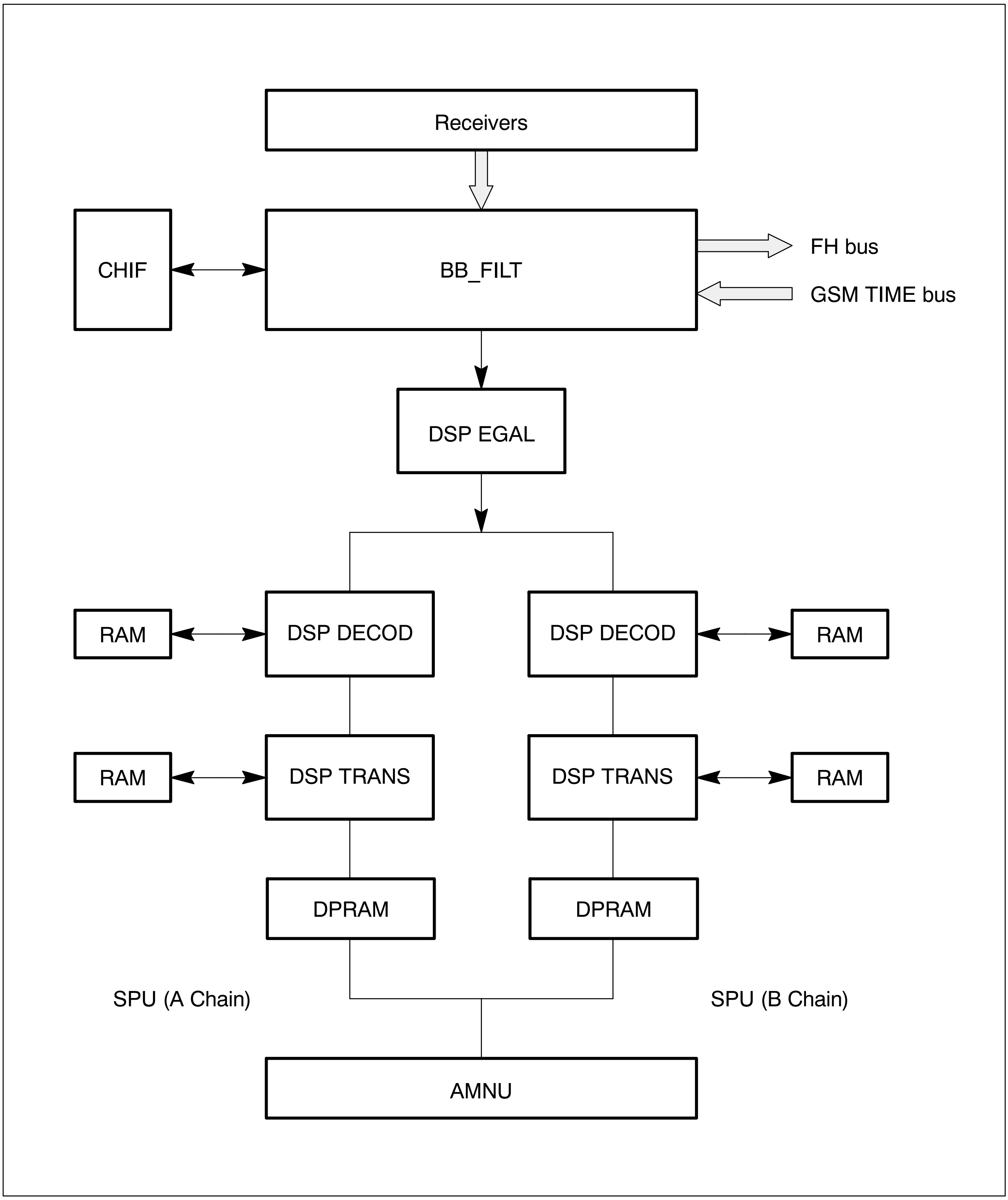


Figure 3-6 DCU8 unit diagram

The DCU8 unit has five DSPs:

- one EGAL DSP, which equalizes the reception signal
- two DECOD DSPs, which handle reception signal decoding and level 1 sequencing
- two TRANS DSPs, which handle transmission signal processing, encoding, and the interface with the remote transcoder

There is one DECOD DSP and one TRANS DSP in each chain.

SPU

The SPU carries out processing associated with the transmission layer (see *Figure 3-7* and *Figure 3-8*). Its functions are:

- demodulation of GMSK signal at reception
- ciphering/deciphering of sent and received data
- encoding/decoding and interleaving/de-interleaving of data from the various channels
- encoding/decoding of voice and data (from 13 kbit/s to 16 kbit/s and vice-versa)
- transfer of discontinuous transmission (DTX) signal
- control of transmitters (GSMK-8PSK) and receivers
- processing of radio measurements

Demodulation function

Demodulation consists of extracting the binary data transmitted from the GMSK signal received, which is 144 bits for a normal burst and 36 bits for an access burst. This is done for the eight time slots of the radio channel.

The demodulation principle selected takes into account the inter-symbol interference resulting from smoothing of the transmission phase transitions (limitation of the transmitted spectrum), multiple path phenomena, and distortion introduced by the channel filter upon reception.

Implementation of this type of demodulator requires modification of the transmission channel as concerns pulse response, frequency deviation, and reception times. Determining these parameters is part of the job of the demodulation function.

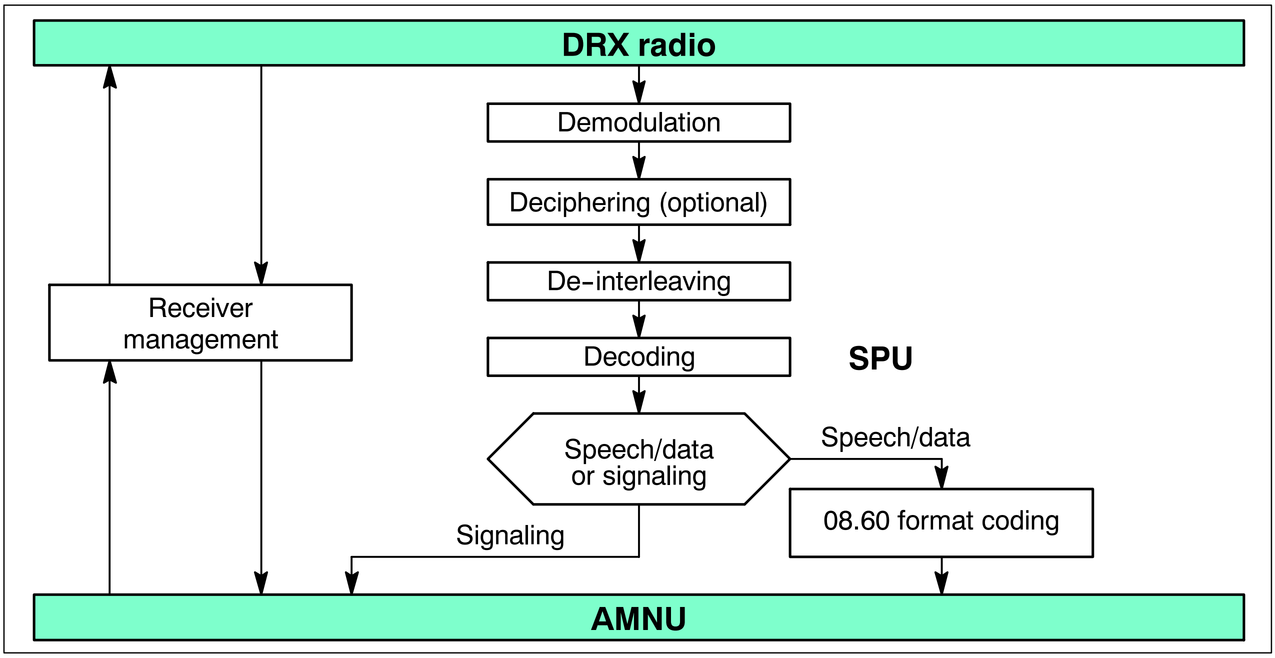


Figure 3-7 SPU reception functions

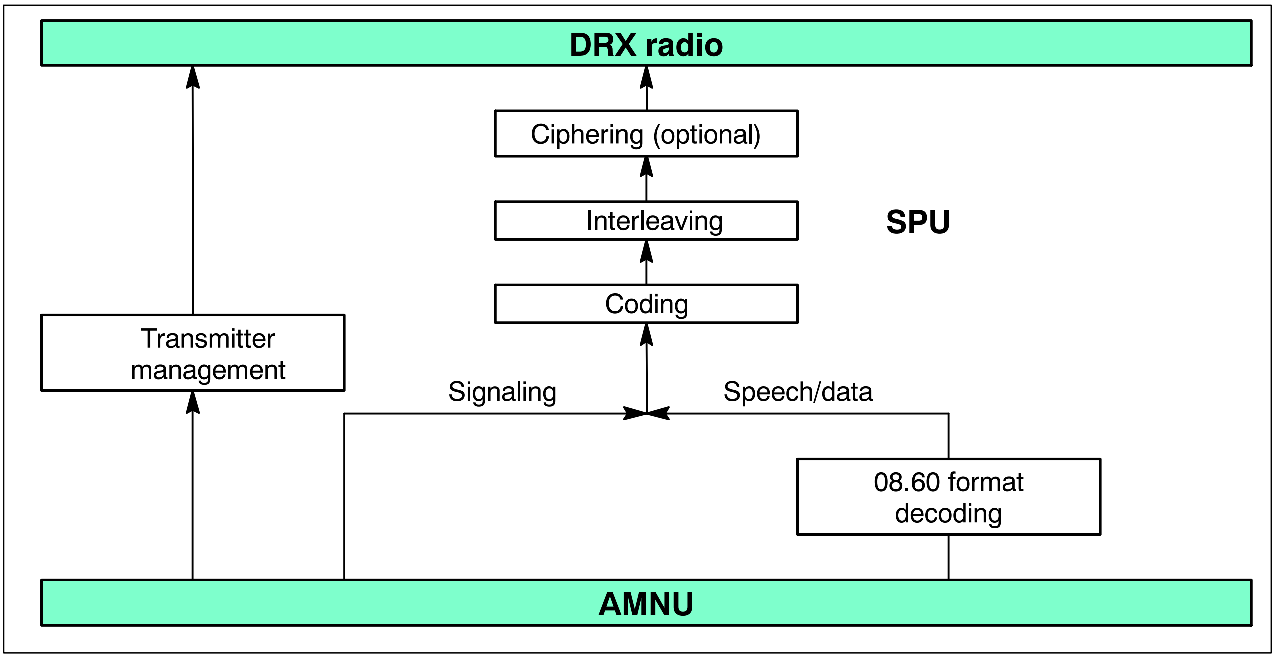


Figure 3-8 SPU transmission functions

The receiver executes the space diversity function. Both received channels are combined in an equalizer which carries out joint equalization.

For each of these channels, the pulse response as well as the C/I+N ratio are estimated. These ratios are used to weight the predictions and samples of each channel.

The symbols from the equalizer are then decrypted, de-interleaved and decoded to restore the control messages and traffic sent by the mobile.

Ciphering/deciphering function

The fluxes of binary symbols sent and received on each time slot on the TCH or SDCCH are encrypted one bit at a time, in compliance with the ciphering/deciphering algorithm.

The ciphering or deciphering operation protects confidentiality of voice and signaling. It consists of adding binary bits, one by one, between sent and received data and a binary train (the ciphering sequence), generated from a ciphering key and the TDMA frame number of the time slot.

Encoding/decoding and interleaving/de-interleaving functions

All traffic and control logic channels are encoded to protect useful information against transmission errors. Each channel has its own encoding scheme, usually including the following steps for each block:

- protection of data bits with parity bits or a block code
- encoding of the “data bits + check bits” unit with a convolutional code. This operation results in encoded bits.
- rearrangement and interleaving of the encoded bits
- burst formating

For data, the encoding procedure depends on the rate: the interleaving level is higher for data than for voice.

Some channels do not use the encoding schemes described above, in particular the RACH, FCCH and SCH channels. For these channels, interleaving on several time slots does not exist.

Mobile transmission timing advance function

The BTS must measure the delay on the received signal when the mobile station makes itself known.

This measurement, known as timing advance, is forwarded in the dedicated channel assignment message (immediate assignment) to the MS, which uses this parameter to anticipate its transmission timing.

During call establishment, the BTS computes the timing advance value and sends it within CHANNEL REQUIRED message to the BSC. If this value is above the threshold, then the BSC rejects call establishment.

In ongoing call conditions, the timing advance is calculated at regular intervals and sent to the MS over the downlink SACCH channel.

The calculation is based on

- other measurements taken during demodulation
- the timing advance used by the mobile station that is returned in the layer 1 header of the uplink SACCH

Discontinuous transmission (DTX)

Discontinuous transmission allows signals to be sent over the radio channel alone when a speech signal is present. This limits interference and MS power consumption. For each call, the MSC indicates whether the BSS “does not use” or “may use” the DTX.

The principle behind discontinuous transmission is as follows:

The base or mobile vocoder has a Voice Activity Detector (VAD) that detects if the frame constructed every 20 milliseconds contains speech. If the frame does not contain speech, the vocoder constructs a special frame called the SIlence Descriptor (SID) that contains all the background noise description elements. This frame is sent to produce a comfort noise at the far end, and radio transmission stops.

The vocoder periodically reassesses the ambient noise and reconstructs the SID frame. The frame produced in this way is sent in step with the SACCH (once every four 26-frame multiframes, or 480 milliseconds).

When the vocoder detects new speech activity, a special SID frame indicating the End Of Silence (EOS) is sent, and normal speech frame sending resumes.

On the receive end, additional processing sequences interpret the incoming traffic frame types (speech, SID, FACCH, nothing) using the related flags (BFI, SID, TAF) and perform the appropriate operations.

The DTX is allowed for data in non-transparent mode.

BCCH filling

The BCCH frequency must be transmitted continuously so mobile stations can perform field strength measurements in neighbouring cells.

Continuous transmission is accomplished in various ways:

- When frequency hopping is not used, the TRX uses the BCCH frequency as the carrier frequency for all the channels it supports. The TRX sends fillers on the BCCH frequency although it may have nothing to send in a given time slot.

- When frequency hopping is being used, one of the following occurs:
  - The hopping laws authorize permanent BCCH transmission, and all the TRXs help fill operations.
  - The hopping laws do not authorize permanent transmission and a transmitter is required to enable BCCH “filling” independently and take over when the hopping laws step down.

Transmitter and receiver control

The SPU controls a transmitter and a receiver. It calculates the frequency hopping law and determines the frequencies to synthesize.

The transmitter is controlled by the FH bus. The SPU sends the following to the transmitter:

- the power and frequency to use
- the bits to send
- the time synchronization signal

The SPU sends the following to the receiver:

- the frequency to use for the following time slot
- the synchronization clock signal
- the GSM TIME synchronization signal

The SPU receives the following from the receiver:

- digitized samples from the reception channel
- the scale factor (gain)
- the receiver alarms

Radio measurement processing

The Radio Measurement Processing performed by the BTS ensures that the network and the mobiles can communicate with each other with minimum interference at the lowest possible transmission power and with the best transmission quality.

Measurements processed by the BTS include signal strength and signal quality. The mobile takes measurements in the downlink direction (BTS -> MS), while the BTS takes them in the uplink direction (MS → BTS). Other measurements include signal strength on the BCCH frequency of the surrounding cells and the MS_BS distance.

The BTS averages these measurements for each connection. The averaged measurements are then used as the basis for a decision-making process for the following:

- power control
- call clearing
- inter-cell handover
- intra-cell handover

The BTS cyclically sends to the BSC the interferences measures done on the inactive channels.

BB_FILT ASIC

The BB_FILT ASIC constitutes the interface between the signal processing unit (SPU) of the DRX and the radio RX module on the one hand, and the enciphering ASIC on the other hand. It carries out the band-pass filtering of the digital samples output by the radio RX module, and generates the FH bus.

A single BB_FILT ASIC processes all eight TSs of the radio frame.

The functions provided by this ASIC include:

- GSM time reception interface providing the synchronization of the DSPs on the radio frame
- on transmission:
  - recording of the TX parameters and of the ciphering key, supplied by the DSP EGAL
  - transfer of the ciphering key to the CHIF ASIC
  - reading of the ciphering template from CHIF ASIC
  - ciphering of the parameters and transmission on the FH bus
- on reception:
  - recording of the RX parameters and of the ciphering key, supplied by the DSP EGAL
  - programming of RX hopping synthesizers
  - generation of channel and sampling frequency selection signals for the analog to digital converter
  - base-band filtering of the digital samples delivered by the dc converter
  - selection of the best gain for each channel (normal and diversity)
  - transfer of these selected filtered samples to the DSP EGAL
  - transfer of the deciphering key to the CHIF ASIC
  - reading of the deciphering template from CHIF ASIC, and transfer of the template to the DSP EGAL

3.3.2.3 BDT unit

The BDT (time base) unit regenerates GSM TIME signals. The GSM time is distributed to the BDT unit of each DRX by means of the GSM TIME channel of the private PCM every 60 ms.

The value of the propagation delay is sent to the DRX by means of the OML link of the private PCM. From these two data, each DRX makes the necessary corrections and regenerates the GSM TIME bus.

If, for any reason, the GSM time is not distributed on the BDT unit, the BDT unit locally maintains the GSM TIME bus signals and continues to provide the GSM time to the DRX units.

The BDT unit is made up of a logic block and a calculation block.

Digital block

The BDT unit receives a 26 MHz clock signal derived from the radio unit clock. This clock signal has the same stability properties as the 4Fbit clock signal provided by the BCF synchronization board and is more stable in the short term. The digital block generates the following signals:

- H4M (4.096 MHz)
- STRTM (recurrent pulse at 577 microseconds)
- TIME_DATA (containing T1, T2, T3 and TN)

Calculation block

The calculation block synchronizes the H4M and STRTM signals with the synchronization unit signals of the BCF. In addition, it updates the values T1, T2, T3 and TN.

The synchronization principle consists of forcing a divider-by-24 counter to divide by 23 (if the BDT is slow) or by 25 (if it is fast). This way, every 23 or 25 periods of 26 MHz (depending on whether the slow BDT is accelerated or the fast BDT is slowed down), the BDT corrects a period of 26 MHz.

3.3.2.4 TX logic unit

The main role of the TX logic unit is to control the radio subassembly in real time. It receives the BCF configuration commands from the AMNU. It carries out the processing and sends back reports.

Once configured, the TX logic unit reads, on each time slot, the data present on the FH bus. Then it calculates the frequency code and the power code to be used with the radio interface.

Transmission power

In general, radio power is determined by two inputs. One controls the maximum static power and the other gives the dynamic attenuation at each time slot.

The static power is given by the CBCF in the CONFIG message. The TX calculates attenuation to compensate for cable loss between the TX-driver and the power amplifier.

The dynamic power is provided by the ASIC of the TX logical unit. Its software reads the value and commands the TX-driver accordingly.

In the case of a BCCH filler, the additional attenuation introduced is always zero.

The power values that the TX and the mobile have to use are fixed by the BTS according to a control algorithm using the measurements results that it makes and the thresholds stockpiled in the OMC. The mobile and the BTS power control can be inhibited by the OMC.

The power control aim is to minimize the interferences, ensure good transmission quality, and save the mobile's batteries.

Power slaving

The setpoint value is slaved to compensate for gain variations of the transmission chain.

Two slaving loops are used to compensate for attenuation in the gain chain.

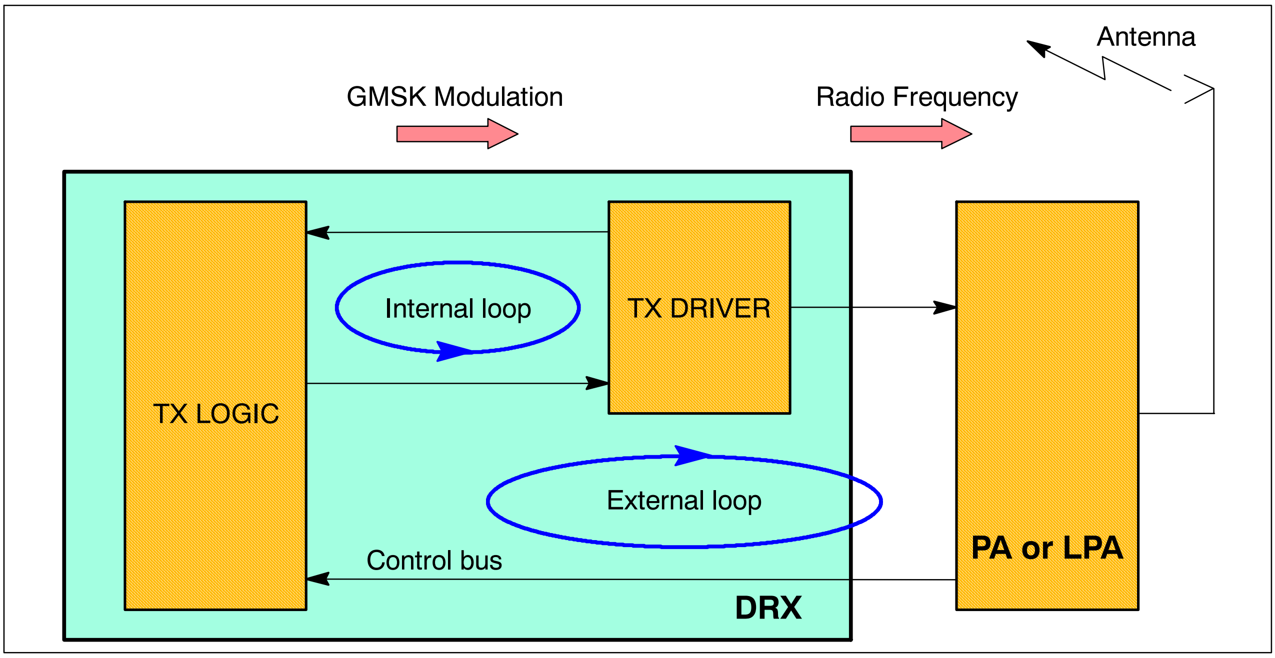


Figure 3-9 Power slaving diagram

These loops can be in the following states:

- Open: This state is used for calibration of the internal loop with the external loop.
- Initialization: This state is used for loop start-up.
- Error: A loop is in error when it is not longer in correspondence with the setpoint.
- Closed: A loop is closed when it is in slow slaved mode.

3.3.3 DRX radio part

The DRX radio part is composed of a power supply board and of the DRX radio board.

The power supply converts common -48 V to specific +5 V/± 12 V power supply signals for the DRX radio board.

The DRX radio board is composed of three units:

- the Frequency reference (Fref) unit
- the receiver unit (RX)
- the transmitter unit (TX)

The DRX boards for S12000 indoor are:

- DRX ND3 GSM 900 MHZ
- DRX ND module 1800 MHZ
- DRX ND PCS 19000 MHZ
- E-GSM DRX ND module

The DRX boards for S12000 outdoor are:

- DRX ND PCS
- DRX ND DCS
- DRX ND E-GSM
- MOD: DRX ND3 GSM

3.3.3.1 Frequency reference unit

The reference frequency for all local oscillators is derived from the Fref frequency supplied by the VCXO, itself derived from the 4.096 MHz signal provided by the DRX digital part (CBCF).

It provides a very steady and spurious-free reference clock for the RX/TX hopping and fixed synthetizers (13 MHz signal).

3.3.3.2 Receiver unit (RX)

The receiver unit (RX) has four main functions. Slot-to-slot frequency hopping is achieved with a dual synthetizer arrangement, that is, one is active while the other is setting to the following frequency. The RX main functions are:

- signal down conversion from radio frequency band to Intermediate Frequency (IF) then to base band frequency
- channel filtering (in IF)
- RX-level dynamic management
- digitization of the base band signal

The base band signal is then sent in binary form with its scale factor to the DRX digital part. The receiver unit works on signal GMSK and on signal 8-PSK.

Receiver configuration

The receiver configuration is done by the DRX digital part, which sends:

- the reception frequency to be used for the following time slot
- the synchronization clock signal
- the GSM time synchronization signal

Receiver monitoring

The receiver monitors internal equipment: microprocessor and Phase Lock Loops (PLL).

If there is a failure or other problem, it generates alarms to signal:

- microprocessor fault
- frequency range not respected (if the frequency to synthesize as requested by the DRX digital part is incorrect)
- PLL loss of alignment (if one of the receiver PLLs is not aligned)

3.3.3.3 Transmitter unit (TX)

The Transmitter unit has two main parts:

- IF and RF chains
- gain control loop (or Automatic Level Control)

IF and RF Chain

An I/Q modulator with a Local Oscillator (LO) phase-locked on a reference frequency transposes the two baseband I/Q signals into the IF chain.

This 125 MHz local oscillator (LO_IF) phase-locked on a 13 MHz signal translates the baseband signals into an intermediate frequency. (The IF is 125 MHz in GSM 850 and 299 MHz in GSM 1900).

The second LO is used for up conversion from IF to RF.

The up-conversion is followed by bandwidth filter, amplifier stages, variable voltage attenuators, and digital attenuators.

The transmitter unit works on signal GMSK and on signal 8-PSK.

Gain Control Loop (or Automatic Level Control)

The driver transmit chain upholds the accuracy of the transmission power compatible with the GSM recommendations against time.

The control dynamics use two components: one voltage variation attenuator (VVA) and a step-by-step digital attenuator that takes target attenuation into account and compensates for it.

The Automatic Level Control also includes the PA.

3.3.4 DRX shutting down

3.3.4.1 DRX soft blocking

The DRX soft blocking consists in setting a DRX "out of service" without stopping the calls established on this DRX. If possible, an intra-cell handover is performed for those calls to release the DRX more quickly. Otherwise, the DRX will be released after the normal completion of the calls.

3.3.4.2 DRX soft blocking coupled with a forced handover

To speed up the DRX shutting down, the DRX soft blocking can be coupled with a forced handover. The calls will be handed over a neighbour cell if the signal strength is over the handover threshold for that cell.

3.3.4.3 Hint

DRX soft blocking and DRX soft blocking coupled with a forced handover can be combined into one command. This allows greater efficiency in DRX shut-down.

3.3.5 Power supply board

The power supply card provides a dc voltage between 40.5 V and 57 V, to be converted into +5 V, +12 V and -12 V. The 48 V voltage is sent first to the logical DRX unit converter, then, after filtering, to the logical DRX unit and the radio DRX unit converter.

The power supply of the board varies according to the DRX types and on the frequencies.

The mechanical and electrical grounds are linked to the common reference zero volts.

3.4 e-DRX functional architecture

The e-DRX board consists of (see *Figure 3-10*):

- an e-LDRX digital board including a dc/dc converter, a frame processor TX logic (GMSK and 8-PSK modulation), and a local time base, working for all frequency bands
- an e-RDRX radio board including a dc/dc converter, a low power driver and a dual receiver

3.4.1 Modifications between the DRX and e-DRX

This paragraph describes the modifications between the current DRX and the e-DRX. The main features of the e-DRX are:

- signal processing capacity improvement
- 8-PSK modulation compatibility
- receive dynamic extension
- TX output power dynamic reduction
- packet backhaul readiness
- double current on internal PCM

3.4.1.1 e-LDRX board modifications

The main modifications concerning the e-LDRX board are:

- the migration of BDT, AMNU, and TX into a single FPGA
- the use of one PowerQuicc
- the introduction of the 52 MHz frequency reference function
- the use of two DSP
- the extension of the memory capacity (8 Mb for SDRAM, 4 Mb for flash and 2 Mb for SRAM)
- the size reduction and integration of the dc/dc converter on the e-LDRX board
- the lower power consumption (<15W)

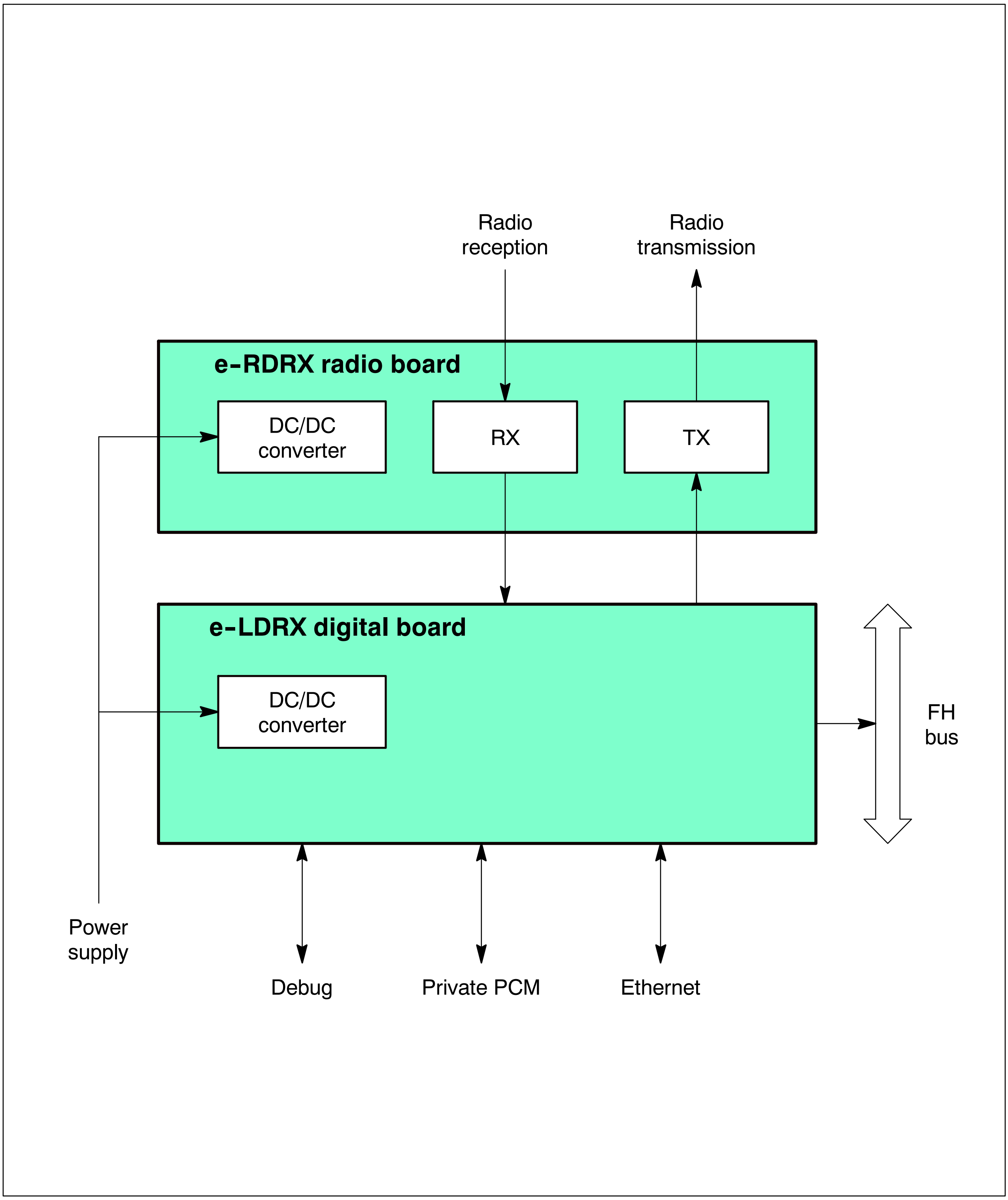


Figure 3-10 e-DRX board: functional block diagram

3.4.1.2 e-RDRX board modifications

The main modifications concerning the e-RDRX board are:

- the removal of the 104 MHz frequency reference
- the use of RXIC2 module (IF => BF transposition)
- the RX dynamic extension provided by an AGC (-13 to -110 dBm)
- the TX output power dynamic reduction
- the integration of the dc/dc converter on the e-RDRX board
- the lower power consumption (<15W)
- double rate on internal PCM

3.4.1.3 e-DRX mechanical/electrical modifications

The main mechanical and electrical modifications applied on the e-DRX are:

- RF shielding provided by a single cover
- new cooling method: direct forced convection for Digital board
- CMS connectors between e-LDRX and e-RDRX
- new RF connectors (long thread)
- Radio and Digital DC/DC converters are mounted respectively on e-RDRX and e-LDRX.
- CMS DC/DC converters
- +5V output e-RDRX DC/DC converter coupled with -5V and +12V discrete DC/DC converter.
- dual tunable output +3.3V/+2.5V or +1.8V e-LDRX DC/DC converter coupled with +5V discrete DC/DC converter

3.4.2 Main external connections

3.4.2.1 Private PCM

A private internal PCM is used to link the e-DRX to the BCF. The proprietary interface has the same definition as the previous internal PCM, except that the clock is fully synchronous with the radio interface.

This bus carries the following information:

- Radio Signaling Link (RSL) and local Operation and Maintenance (OML) on one time slot
- Traffic links on two, three, four, six or eight time slots
- GSM_TIME channel on a separate time slot

The feature allows the e-DRX to be remotely controlled.

The TSs for OML/RSL and GSM Time have a single rate whereas the TSs for traffic may have a double rate when requested by the CMCF Phase2 board.

Furthermore, the eDRX matrix may also have a double rate when requested by the CMCF Phase2 board.

3.4.2.2 FH bus

The FH bus defined for the S4000 BTS is used, allowing frequency hopping and S4000 BTS compatibility. HDLC bus is no longer supported on the e-DRX.

3.4.2.3 e-PA and HePA Control

- an asynchronous bi-directional serial link operating in duplex mode carrying at each RF time slot the mean RF output power of the associated e-PA or the HePA, its temperature, and e-PA and HePA internal alarms (temperature, current, VSWR)
- a discreet burst synchronization signal. The e-DRX e-PA and e-DRX HePA Control interface is compatible with both the standard PA, HePA, and the standard e-PA.

3.4.2.4 Power Supply

The e-DRX is powered by a -48V dc supply. Typical consumption is 25W.

3.4.2.5 Test links

The e-DRX has an Ethernet 10/100 baseT port and an asynchronous serial port. It also has serial lines for emulator connections, and real time trace facilities.

3.4.2.6 RF interfaces

The e-DRX unit provides RF reception with diversity and RF transmission at low level.

- Low level GMSK RF Output (-3dBm typical / 50 Ohms)
- RF Input Main and RF Input diversity (-84 dBm to 0 dBm / 50 Ohms RF inputs multiplexed with provisional +12V dc. Supply for RF devices (splitters).

3.4.3 e-DRX functional description

This paragraph describes the functional architecture of the e-DRX, but does not detail each part. The aim is to give enough information to easily approach the main features.

3.4.3.1 Logic unit (e-LDRX)

The logic unit (e-LDRX) contains (see *Figure 3-11*):

- an FPGA unit which provides:
  - a control and switching matrix management function
  - a time base function
  - a synchronization function
- a management unit (AMNU) which processes:
  - start-up, downloading, initialization
  - configuration
  - monitoring
  - LAPD break
  - event reports
- a transmission unit which provides:
  - a radio signaling function
  - a signal processing function
  - a power regulation function
  - a RX logic function
  - a TX logic function

FPGA unit

Control and switching management function

- Setting up by setup of e-DRX for AMNU, transmission, and other functions

  When the BTS is activated, it must be connected to the BSC to work. A link is set up on an external PCM link.
- Downloading

  When communications have been set up with the BSC, the BTS reports its status. The BSC downloads, if necessary, the software to the BTS.

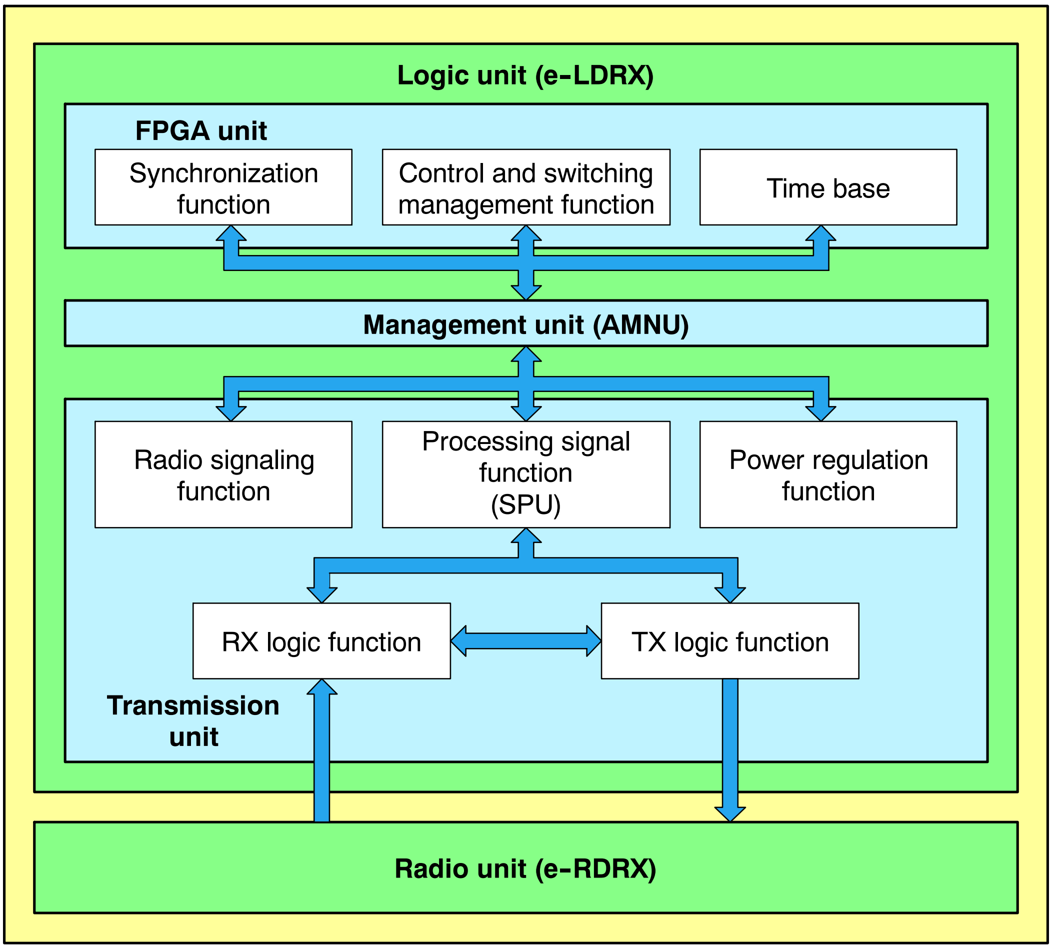


Figure 3-11 Logic unit (e-LDRX): functional architecture

- Synchronization management

  At the start-up, the BTS selects the clock. During LAPD connection, the BTS forces the clock onto the PCM carrying the LAPD.

  The e-DRX board recognizes the S12000 thanks to the SEL and adapts to the private PCM mapping.

- Switching matrix management

  Each PCM link managed by the switching matrix has a transmission test interface, reception test interface, and an idle interface.

  The switching matrix is configured when the BSC requests set up or release of a signaling or traffic channel from the BTS.

  Signaling channels are set up (or broken) between a transmission signaling TS and a non-concentrated link. This operation may entail (dis)connection between a concentrated link TS coming from the BTS and a PCM link TS on the PCM interface.

  Traffic channels are set up (or broken) between a transmission traffic TS and a PCM link TS on the PCM interface.

- Data signaling concentration function

  The BTS uses this function to set up the communication between the BSC and the other entities that make up the BTS. This function is implemented with the LAPD protocol that serves concentrator and routing functions.

Time base

The time base regenerates the GSM_TIME bus with information issued from the GSM_TIME channel.

If for any reason the GSM time is not distributed to the time base, the time base maintains the GSM_TIME bus signals locally and continues to provide the GSM time to the logic unit.

Synchronization function

The synchronization function must synchronize the transmissions on a single reference time: GSM _TIME.

The network provides a radio reference clock via two PCM links that ensures long-term accuracy. This clock is used by the synchronization module to generate an exact reference time for the radio interface.

If the external reference signal is missing, the BTS selects the local clock.

The synchronization function is monitored by internal control and monitoring mechanisms. These mechanisms ensure that the synchronization is operating correctly and that the GSM time is available on the GSM_TIME bus.

AMNU

The AMNU (Advanced MaNagement Unit) monitors site and transmissions and manages the eight time slots of a TDMA frame.

The following functions are processed by the frame management unit (AMNU):

- start-up, downloading, initialization
- configuration
- monitoring
- LAPD break
- event reports

Start-up, downloading, initialization

The AMNU is started by a hardware reset or a re-initialization message sent by the BTS. It configures the LAPD and establishes an OML link with the BSC.

Depending on the BSC request, the BTS systematically initiates a downloading phase of the catalogue files and the following software units:

- boot software and operating system: BOOT
- TRX monitoring and maintenance software: OML AMNU
- site monitoring and maintenance software: BCF
- test software: TOOLS
- TDMA1 & TDMA2 radio signaling link management software: RSL1 & RSL2
- hardware configuration DLU: DLU

A reflashing of the units for which the software versions are different follows the downloading.

Configuration

The transmission is configured by the BSC via the BTS.

The configuration provides:

- a general configuration. It contains the configuration of the TDMA frame and provides the logic unit parameters shared by the whole cell, such as:
  - cell to identity (BSIC)
  - BCCH frequency
  - indication of frequency hop implementation
  - the frequency of the TDMA frame if there is no frequency hopping

- a configuration of the radio TS. It specifies the logic channel type to use for TS.
- a configuration of the frequency hop. It specifies, for TS, the list of frequencies to use as well as sequencing. This configuration is optional and only appears if the frequency hop was requested in the TDMA frame configuration.

Supervision

The BTS regularly sends status requests to detect any problems.

LAPD break

A timer monitors the LAPD with the OML and RSL links. If level two loss is detected, the BSC and the AMNU try to reconnect. If connection is not re-established before the end of the time-out, the AMNU is reinitialized.

Event reports

The AMNU:

- collects all events detected (internal or external alarms)
- provides the filtration and reports errors (transmission/reception) to the BSC
- provides the filtration to prevent repetition of non-transient events, which means it can send to the BSC a single indication

The AMNU sends errors to the BSC by sending “event report” messages through the BTS. There are two types of messages:

- transient messages which are not acknowledged by the BSC
- non-transient messages which must be acknowledged by the BSC and which are repeated by AMNU until they are acknowledged

Transmission unit

Radio Signaling function

The main characteristics of this function are:

- radio access management (level 1)

  It manages a dialog between the AMNU signaling functions and the signal processing function (SPU), which are connected to the AMNU.
- radio management (level 2)

  It manages the LAPDm level 2 signaling on the radio channels.
- radio resources management (level 3)

  It provides level 2 management on the common channels and control of level 2 functions on dedicated and common channels.

- radio measurements management (level 3)

  It provides the return of interference measurements carried out by the one signal-processing unit on the inactive dedicated channels and transmission of these measurements to the AMNU.

- Operation & Maintenance functions (O&M)

  They provide configuration and unconfiguration of the TS and frequency hopping functions.

Signal Processing function

The signal processing (SPU) function performs processing associated with the transmission layer executes a number of functions, such as:

- modulation/demodulation (GMSK or 8-PSK)
- ciphering/deciphering of sent and received data
- coding/decoding and interleaving/de-interleaving of data from the various channels
- processing radio measurements
- mobile transmission timing advance function
- discontinuous transmission (DTX)
- BCCH filling
- transmitter and receiver control

Power regulation function

The Power regulation function performs instantaneous checks on the associated radio subset. It receives configuration instructions via the AMNU unit, launches processing, and returns reports.

When the function is configured, each TS in attendance on the FH bus is in ready state. Then the function calculates the frequency and the power code to be applied to the radio interface. Each function acts as a control of the set point (emission power), to improve the non-linearity of the gain of the transmission chain.

It launches the following:

- frequency hopping management
- power slaving
- transmission power
- alarms management

RX logic function

The logic functions

- maintain the interface between the SPU functions with the RX radio functions on the radio unit (e-RDRX) and the ciphering Uplink/Downlink.
- filter the digital samples, provided by the RX radio functions, to base band signals
- generate the FH bus

Each RX radio functions processes the eight TSs of the radio frame.

The main characteristics of the RX radio function are:

- an interface for the reception of the GSM time to maintain the DSP synchronization on the radio frame
- for the transmission:
  - the recording transmission parameters and the cyphering key
  - the parameters cyphering and the transmission on the FH bus
- for the reception:
  - the recording of the reception parameters and the ciphering key
  - the base band filtering of the digital samples provided by the converter
  - the ciphering key moving

TX logic function

This function maintains the interface between the SPU functions and the TX radio functions of the radio unit (e-RDRX).

The TX logic function processes the eight TSs of the radio frame.

It ensures the digital/analog conversion of samples, and receives:

- information about the burst bits, from the RX function and via the FH bus
- modulated signal samples, according to the modulation format previously set
- digital data (alarms, output power, etc.), from various equipments of the analog part of the transmitter
- ensures corrective actions

3.4.3.2 Radio unit (eRDRX)

The radio unit (see *Figure 3-12*) processes the radio channels for transmission/reception function.

The e-DRX board includes the following functions:

- power supply unit
- receiver unit and transmitter unit
- frequency reference unit

Power supply unit

The power supply unit converts common -48 V to specific +5 V/+12 V power supply signals for the e-DRX radio board.

Frequency reference unit

The reference frequency is synthesized by 13 Mhz Phase-Locked-Loop, referenced with the 4.096 MHz (H4M) provided by the digital board.

Transmitter unit

The transmitter unit contains the transmission channels of lower power which manage the Radio Frequency (RF) signals (GSMK or 8-PSK) and Intermediate Frequency (IF) signals as follows:

- I/Q modulation
- IF filtering and amplification
- IF and RF transposition
- RF band filtering
- amplification and variable attenuation
- output power control

Receiver unit

The receiver unit includes the reception radio channels which manage the RF signals (GSMK or 8-PSK) and the IF signals as follows:

- RF signals from LNA-splitter
- RF to IF transposition
- IF channel filtering and amplification
- RF to BF transposition
- Analog-to-digital conversion

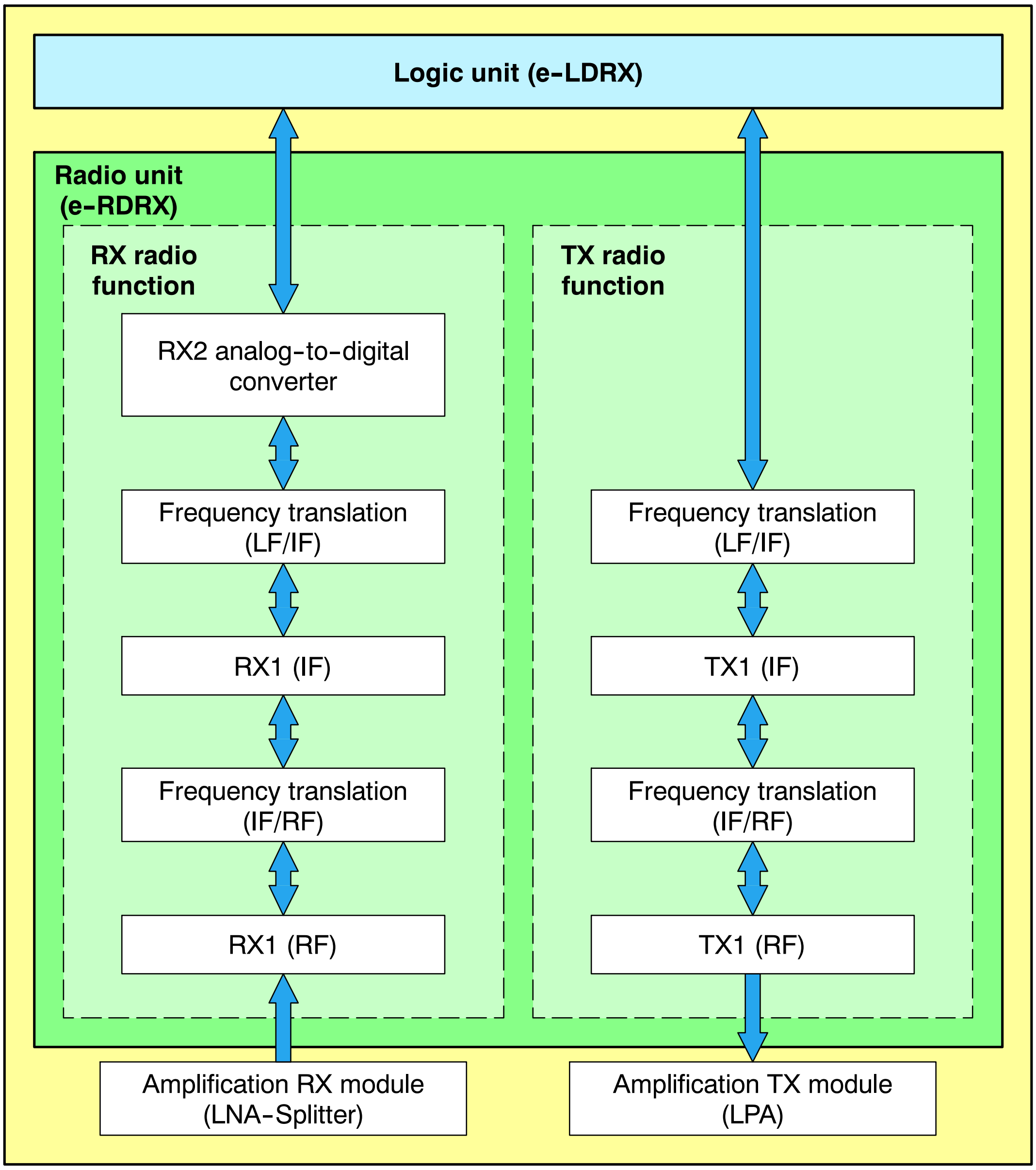


Figure 3-12 Radio unit (e-RDRX): functional unit

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4 SOFTWARE DESCRIPTION

4.1 BTS software presentation

BTS software is divided into downloadable files and an onboard PROM.

4.1.1 Downloadable files

The BSC downloads these files via the A-bis interface.

There are two sets of files: BCF and DRX. Each set is arranged in a file catalogue that contain the list of files and the files themselves.

4.1.2 PROM

PROM chips are read-only memory units used to store software.

They are all installed on all BTS equipment boards.

4.1.2.1 S12000 BTS CBCF Software

The software product associated with the boards and slaves of the CBCF Modules are listed in *Table 4-1*.

Board	Sofware product name	Software product type
CBCF Module	PE_CBCF_B PE_CBCF_DLU0	Boot DLU Code
CPCMI	PE_CPCMI_E1 PE_CPCMI_T1	Load Load
RECAL	PE_RECAL	Load

Table 4-1 CBCF software product names

4.1.2.2 S12000 BTS family DRX Software

As listed in *Table 4-2,* the software products vary depending on whether the BCF or CBCF is used in the BTS. DRX O&M software is used with the BCF. DRX COAM is used with the CBCF or BCF from V12 onward.

Board	Sofware product name	Software product type
DRX O&M/COAM	PE_AMNU_COAM_L PE_AMNU_RSL_L PE_AMNU_B PE_SPU2G_EGAL1_L PE_SPU2G_EGAL2_L PE_SPU2G_1620_L PE_SPU2G_BIST PE_SPU2G_BIST_1620 PE_TX_L_COAM PE_BDT_L PE_TOOLS	O&M AMNU LOAD RSL AMNU LOAD AMNU BOOT SPU EGAL1 SPU EGAL2 SPU 1620 BIST SPU BIST SPU 1620 TX BDT PL TOOLS
DRX	PE_AMNU_COAM_L PE_AMNU_RSL_L_C PE_AMNU_B PE_SPU2G_16410_L PE_TOOLS	O&M AMNU LOAD RSL AMNU LOAD AMNU BOOT SPU 16410 PL TOOLS

Table 4-2 S12000 BTS family : DRX software product names

4.2 BTS software functions

BTS software is distributed among three major units (see *Figure 4-1*):

- The DRX unit is designed to transmit and receive (modulate and demodulate) and manage TDMA frames on the radio channel.
- The CBCF manages its slave units:
  - CPCMI, RECAL, or DRX, CC8
- The TIL unit is used for in-factory testing of the BTS, and to configure, control, and supervise the BTS on site.

The following terms are used in this chapter:

- BIST: Basic hardware self-test programs of a BTS subsystem subassembly. These tests validate a subassembly intrinsically, without disturbing the other subassemblies. An example is the AMNU BIST, which tests the components (such as memory) of the AMNU unit on the DRX logical board.
- Self-tests: Global, functional test programs, which use several subassemblies in order to validate an assembly (such as the DRX). These tests can be broken down into tests of more or less elementary functions. This may require external equipment (so the term may be misleading).
- Downloading: A process which consists of installing, in the DRX (logical part), software from an external entity (terminal, Ethernet network, BSC, etc.).
- Loading: A process used to load, into the subassemblies of the DRX (logical part), the software it requires for its nominal operation.

4.2.1 DRX software functions

The DRX is downloaded by the BSC, configured and supervised by the BSC and the CMCF (CBCF) through a LAPD link and a serial link. It serves as a gateway between the radio channel and the BSC. It handles both signaling and voice for all the logical channels carried by a given TDMA frame.

The module has four functions:

- The AMNU (LAPDm, L3 RSL, L3 O&M) is the DRXs management unit.
- The SPU is a gateway between the radio network and the BSC.
- TX and RX manage radio transmission and transmission.
- The BDT manages the GSM TIME.

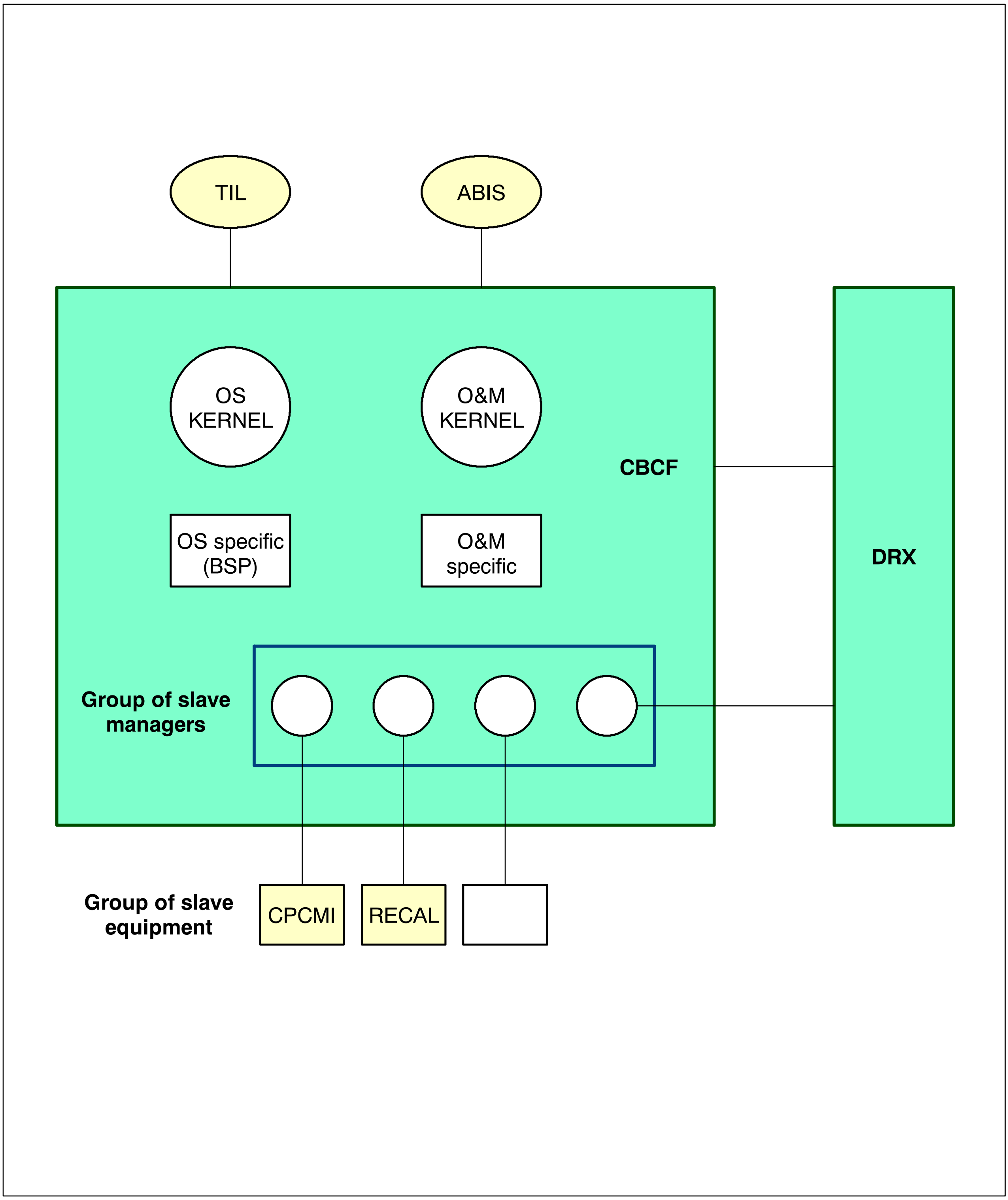

Figure 4-1 Software functions (with CBCF)

L3 O&M AMNU

This software unit centralizes the operating and maintenance functions:

- initialitization and monitoring of BISTs
- connection with Abis and BCF
- downloading and software marking
- configuration
- defense and alarms
- tool functions
- transmission of GSM TIME to BDT, and of O&M to TX

L3 RSL

This software unit represents the Radio Resource (RR) and the radio measurements function (L1M) in the BTS:

- radio link layer management
- dedicated channel management
- common channel management
- TRX management
- error handling
- measurement collecting
- measurement pre-processing (for power control by the BTS, and for call clearing and handover decision for the BSC)

LAPDm

This software unit provides the LAPDm radio level 2 protocol with the mobile.

SPU

This software unit enables the level 1 radio communication with the mobile to transmit and receive:

- gateway between radio and terrestrial network (Abis) for the traffic channel
- multiplexing and demultiplexing of the logical channels on physical channels

RX

This software unit provides the radioelectrical reception function.

L3 TX

This software unit manages and monitors radio transmission. It is installed in each DRX board. It sets the transmitter operation mode, defines the FH bus input from which the TX should read data, and defines the transmission power to be used. It also controls the Power Amplifier (PA).

L1 BDT

This software unit extracts the GSM TIME carried on the PCMp (GSM TIME TS) for the BDT unit.

LAPD

This software unit manages the LAPD link level 2 protocol on PCM between DRX, e-DRX, DRX-ND3 and BSC.

4.2.1.1 Network ID

With the implementation of V15.0, the BTS detects the type of DRX and PA during connection with respect to the BCF and the DRX. Note the following restrictions:

- If a DRX is not yet connected to the BCF, its type is set to “DRX type” until it is connected.
- If a PA is not yet connected to the DRX, its type is set to “PA type” until it is connected.
- If a fault beginning has been sent on the DRX type (or PA type) of equipment, because the real equipment type was unknown, the fault ending must be sent on a DRX or PA type, even if the DRX or PA have connected themselves between the fault begin and fault end.

4.2.1.2 Defense

The DRX board carries out no defense actions by itself.

4.2.2 CBCF software functions

CBCF Software is based on a COAM software architecture, which is composed of three main parts:

- common software for various BTS products
  - OS Kernel
  - O&M Kernel
- BTS-specific software dedicated to a BTS product
  - OS-specific
  - O&M-specific
- slave managers

The COAM architecture is shown in *Figure 4-2*.

The CBCF software manages the following O&M functions:

- PCM management
- configuration and supervision management
- software management
- synchronization management
- test management
- duplex management

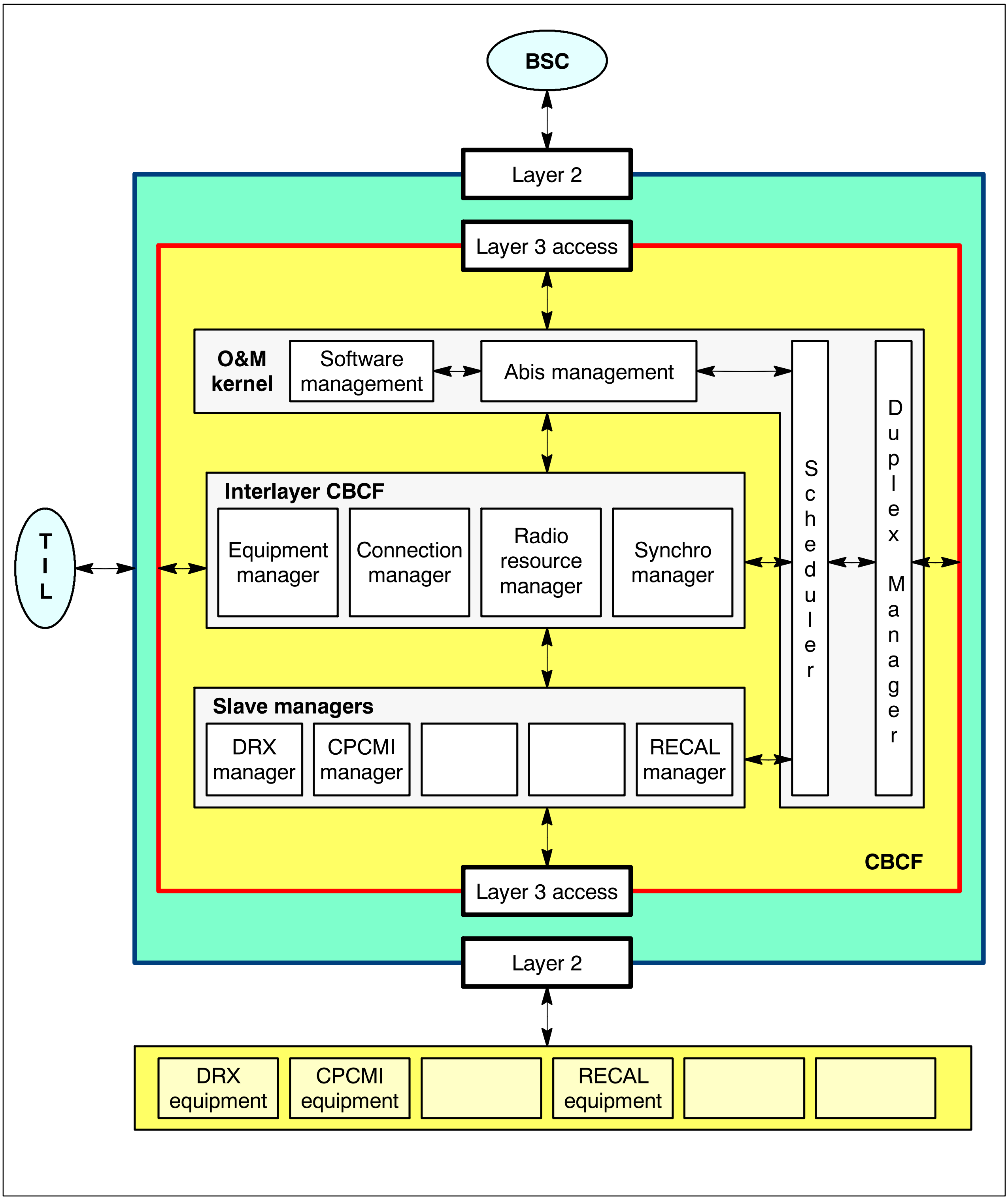

Figure 4-2 COAM architecture on the CBCF

4.2.2.1 PCM Management

This function selects one of the incoming PCMs for communication with the BSC. It then routes PCM TSs to the appropriate equipment in the BTS as the BSC requests. Other PCM TSs are routed toward another PCM to allow drop & insert functionality.

This function also ensures LAPD concentration.

4.2.2.2 Configuration and supervision management

This function translates the OML A-bis model into a physical model to offer a standardized configuration and supervision to the BSC. The CBCF acts as an A-bis front end toward the BSC for configuration and supervision purposes. It is the only link for configuration messages coming from the BSC. The CBCF uses the CBCF/DRX protocol to drive any actions concerning the DRX.

4.2.2.3 Software management

The CBCF performs software management for the BTS and provides the only link for downloading messages from the BSC. When a RECAL or CPCMI board is downloaded, the CBCF/Slave protocol is used.

4.2.2.4 Synchronization management

The CBCF builds the GSM time and provides it to the DRX, e-DRX, or DRX-ND3 via a TS or a private PCM. External PCMs ensure long term stability.

4.2.2.5 Test Management

The CBCF coordinates all BTS tests. When an installation or maintenance action affects a DRX, the DRX is driven by the CBCF using the CBCF/DRX Protocol.

4.2.2.6 Duplex Management

The COAM software manages a cold and hot duplex modes.

4.2.3 Maintenance

The three types of customers include:

- EDGE customer: function is necessary, because EDGE equipment must be differentiated from non-EDGE equipment. An e-DRX must be replaced by an e-DRX. An HePA must be replaced by an HePA.
- Customer who uses an HePA or an e-HePA mixed cell in concentric cell: an HePA must be replaced by an HePA, and an e-PA must be replaced by an e-PA. A CMCF phase 2 must be replaced by a CMCF phase 2.

- Other customer: an e-DRX or a DRX ND3 can replace a failing DRX, an e-PA (or an HePA) can replace a PA, if the number of the (H)(e)PA in the BTS respects the HePA supported configurations. A CMCF phase 1 can replace a CMCF phase 2 (and vice versa), if the CMCF software is compatible with CMCF phase 1. No mixing between phase 1 and phase 2.

4.2.4 TIL software functions

TIL is an application running on a PC in the WINDOWS 95 and WINDOWS 2000 environment. The TIL application is connected to the CBCF through an ethernet connection.

The TIL is designed to do the following:

- validate the BTS in the factory
- install the BTS site
- perform diagnostics of hardware problems
- check equipment substitution
- check the equipment extension within a cabinet

Ethernet

This unit is installed in the PC. It provides the level 1 and 2 communication layer. Level 1 is a hardware driver. The level 2 protocol is an LAPD UI frame. TCP-IP Protocol is used.

L3 TIL

This software unit manages all the boards of the BTS by establishment of a network with all the GSM entities of the BTS. It integrates the factory and installation test environment.

The TIL takes the following testing into consideration:

- the conformity of the cabinet configuration
- the validity of the data links
- the external BTS PCM
- the connectors in the cabinet for cabinet extensions

5 DIMENSIONING RULES

For information on dimensioning, refer to document GSM/GPRS/EDGE BSS Engineering Rules (PE/DCL/DD/0138).

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