Wireless Service Provider Solutions

BTS18000 Reference Manual

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BTS18000 Reference Manual

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Updated the *"North American regulatory requirements compliance"* section.

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Issue 15.103/EN Standard

Removed the information about GSM 850.

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Added the following feature:

- Feature 28784 "IFM1 card" (modified *Section 4.2 "Interface Module (IFM)"*).

April 2005

Issue 15.101/EN Preliminary

Synchronized with V15.0.1 Standard.

Removed information on BSC6000 due to EOL.

Updated for review comments.

Added the following features:

- Feature 29295 "BTS18000 S444_222 dual band in single cabinet"
- Feature 29068 "BTS18000 E-GSM Support"

February 2005

Issue 15.100/EN Draft

Updated document for the feature 27978 "BTS18000 support on BSC12000HC".

System release: GSM/BSS V15.0.1

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Issue 15.36/EN Standard

Updated the document for CR Q01105139 (inserted *Section 4.21.5 "User alarm pin connections for GSM use"*).

Modified the "BTS interconnection compliance" part of the *"North American regulatory requirements compliance"* section.

April 2005

Issue 15.35/EN Standard

Updated the document with review comments.

Updated the document for feature 29066 "BTS18000 H4 Hybrid Coupler" (inserted *Section 4.9 "H4 module"*).

January 2005

Issue 15.34/EN Preliminary

Updated document for requested changes relating to:

- BTS18000 naming (BTS18010 for indoor version, BTS18020 for outdoor version),
- BTS18000 consumption (detailed information for full GSM BTS18020, and for BTS18020 combo and MCPA variants − see *Section 4.19.4*),
- back up time of internal batteries (detailed information for full GSM BTS18020, and for BTS18020 combo and MCPA variants − see *Section 4.19.4*).

November 2004

Issue 15.33/EN Preliminary

Incorporated review comments.

October 2004

Issue 15.02/EN Preliminary

Restructured chapter 3, chapter 5 and chapter 6.

Added new type of information in modules description.

July 2004

Issue 15.01/EN Draft

Creation for feature 25808 – BTS18000 introduction ready.

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ABOUT THIS DOCUMENT

This document describes the new BTS18000 Base Transceiver Station (BTS), which is a component of the Base Station Subsystem (BSS).

It applies to:

- BTS18010 (also known as the BTS18000 Indoor)
- BTS18020 (also known as the BTS18000 Outdoor)
- BTS18000 - GSM MCPA (for GSM MCPA configuration)
- BTS18000 - GSM-UMTS (for GSM-UMTS combo configurations)

Applicability

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

Audience

This document is intended for operation and maintenance personnel, and for any user who needs information relating to the BTS18000.

Prerequisites

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

< 000 > : BSS Product Documentation Overview

< 001 > : BSS Overview

< 007 > : BSS Operating Principles

< 039 > : BSS Maintenance 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

< 161 > : BTS18000 Fault Number Description - Volume 9 of 9

< 162 > : BTS18000 Maintenance Manual

The following engineering document: GSM/GPRS/EDGE BSS Engineering Rules (PE/DCL/DD/0138) also contains relevant information.

Related Documents

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

How this document is organized

Chapter 1 presents the BTS18000 offer.

Chapter 2 describes the BTS18000 functionality.

Chapter 3 describes the layout and content of the BTS18000 cabinets.

Chapter 4 describes the BTS18000 modules.

Chapter 5 examines the BTS18000 functional architecture.

Chapter 6 describes the BTS18000 software.

Chapter 7 presents the BTS18000 operated in a synchronized co-location mode.

Chapter 8 describes the GSM-UMTS dual mode configurations.

Chapter 9 describes the MCPA BTS18000 configurations.

Chapter 10 indicates where the dimensioning and configuration rules are described.

Vocabulary conventions

The glossary is included in the NTP < 000 >.

Regulatory information

This part which provides the regulatory information concerning the BTS is split into the following items:

- European regulatory requirement compliance,
- North American regulatory requirement compliance,
- Compliances for other regions/countries,
- Operation conditions,
- Cable specifications,
- Product labeling.

European regulatory requirement compliance

As a radio product, the Nortel Networks BTS18000 falls under the requirement of the RTTE (Radio and Telecom Terminal Equipment) European directive 1999/5/EEC. The RTTE directive covers essential requirements in the field of:

- protection of the Health and Safety of the user and any other person, including the objectives with respect to safety requirements contained in the Low Voltage directive (73/23/EEC).
- the protection requirements with respect to EMC contained in Directive 89/336/EEC.

  The equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, the equipment may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference.

  The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial, and light industrial environments. The levels however, do not cover extreme cases which may occur in any location but with a low probability of occurrence. In particular, it may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena, or continuous phenomena, is permanently present, for example a radar or broadcast site in the near vicinity. In such a case it may be necessary to either limit the source of interference, or use special protection applied, to the interfered part, or both.

  Note: For operation or maintenance inside Nortel Networks systems, the antistatic wrist shall always be used to maintain the integrity of the product.

- effective use of the Radio spectrum allocated to terrestrial/space radio communication and orbital resources so as to avoid harmful interference. The routes and standards used to demonstrate compliance with there essential requirements are outlined in the following paragraphs.

- BTS EMC

Compliance with the essential requirements of EMC has been demonstrated using EN301489-1 & -23 standard.

- BTS radio compliance

Compliance with the essential requirements of effective use of the radio spectrum has been demonstrated using EN301908-1 & -3 standard.

- BTS safety

Compliance with the essential requirements of Safety has been demonstrated using EN 60950 Standard.

- BTS health protection

Compliance with the essential requirement of health requirement has been demonstrated using EN50385.

North American regulatory requirements compliance

The Nortel Networks BTS18000 has been qualified according to North American market requirements for the Indoor, Outdoor, and MCPA versions.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- reorient or relocate the receiving antenna.

- increase the separation between the equipment and receiver.

- connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- consult the dealer or an experienced radio/TV technician for help.

- BTS safety

Nortel Networks BTS18000 complies with UL60950 and CAN/CSA C22.2 No. 60950-00 Safety Standards. The CSA mark is applied on the BTS and demonstrates compliance with both US and Canadian Standards.

- BTS EMC and radio compliance

Nortel Networks BTS18000 complies with 47CFR Part 15 class B and 47 CFR Part 24 for EMC and radio emission limits according to US regulatory requirements as indicated on the regulatory label.

- BTS interconnection compliance

The Nortel Networks BTS18000 complies with 47 CFR Part 68 of the FCC rules and the requirements adopted by the ACTA.

On the top right of this equipment is a label that contains, among other information, a product identifier in the following format: **US : AB6XDNANBTS18000**

If requested, the following information must be provided to the telephone company:

- ACTA Registered Number: AB6.

- Facility Interface Code (FIC): 04DU9.BN, 04DU9.DN, 04DU9.1KN, and 04DU9.1SN.

- Service Order Code (SOC): 6.0F.

A FCC part 68 and ACTA compliant cable is provided with the BTS equipment, with no connector at network interface side. The BTS equipment operates with a 1.544 Mbps digital channel. See Installation Instructions for details.

If the BTS18000 equipment causes harm to the phone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice is not practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes to its facilities, equipment, operations or procedures that could affect the operation of the equipment. If this happens the telephone company will provide advance notice so you can make the necessary modifications to maintain uninterrupted services.

If trouble is experienced with BTS18000 equipment, for repair or warranty information, please contact:

Toy-Brent Lorance Nortel Networks
2370D Performance Dr.
Richardson, TX 75082
Phone: 972-685-2270
Fax: 972-684-7601

If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

All repairs should be handled by authorized Nortel Networks Service Personnel.

- BTS18000 data equipment

The following table shows which jacks are associated with which modes of operation.

Operation mode	USOC Jack
Programmable & Test	RJ45S

- BTS18000 systems

Facility Interface Codes (FIC), Services Order Codes (SOC), USOC Jack Codes, and Ringer Equivalence Number (REN) are shown in the table below for each port where applicable.

Port	FIC	SOC	USOC Jack	REN
ICM T1 board	04DU9.BN	6.0F	N/A	N/A
ICM T1 board	04DU9.DN	6.0F	N/A	N/A
ICM T1 board	04DU9.1KN	6.0F	N/A	N/A
ICM T1 board	04DU9.1SN	6.0F	N/A	N/A

- BTS18000 RF health protection

Compliance with the North American requirements is demonstrated through calculation according to FCC OET bulletin 65.

Compliances for other regions/countries

For countries outside Europe and the Americas, the requirements of European countries usually apply.

It is not possible to list all the applicable approvals/compliances as they will be dependent on the markets and products considered.

Note: Please contact your local Nortel Networks representative for more information.

Operational conditions

The aforementioned standards compliance of the products are based on the following operating conditions (called normal operation):

■   doors shall be closed and (or) covers shall be in place.

■   external cables shall be of the same type as specified by Nortel Networks.

■   no modification of any mechanical or electrical characteristics of the product shall be made.

Any change or modification made to the product without written approval from Nortel Networks releases Nortel Networks from subsequent responsibility regarding the standards compliance.

Cable specifications

The compliance to the aforementioned standards has been verified using cables as specified by Nortel Networks. The continuing compliance of the product relies upon use of the correct cabling scheme as well as use of identical type cables as specified by Nortel Networks. Refer to the installation guides for details on cable specifications.

Product labeling

The label may be located inside or outside the product, provided that the operation and/or maintenance personnel have the information when working on the product.

- BTS labeling for American Countries
To indicate compliance with the CSA and UL Safety requirements, the Nortel Networks BTS18000 bears the following mark in a conspicuous location.

On the regulatory label, compliance to 47 CFR Part 15, 24 and 68 is stated along with:

- FCC ID, FCC Registration Number.

- Manufacturers name.

- Equipment designation.

- Nominal voltage operating range and maximum rated current.

- BTS labeling for European Countries
To indicate compliance with the European RTTE Directive, the Nortel Networks BTS18000 bears the following information in a conspicuous location:

- Manufacturers name.

- Equipment designation.

- Nominal voltage operating range and maximum rated current.

- Labeling for other regions / countries
Labeling for other regions and countries is performed as appropriate and required by the local regulatory framework.

1   BTS18000 OFFER

1.1   BTS18000 versions

The BTS18000 is proposed in standard in two main versions:

- BTS18000 indoor, named BTS18010,

- BTS18000 outdoor, named BTS18020.

Both can provide up to 18 TRXs per cabinet.

In addition to the two standard BTS18010 and BTS18020 versions, the BTS18000 is proposed in two variants:

- Combo GSM/UMTS dual mode variant, proposed in BTS18010 and BTS18020 version,

- MCPA variant, with increased number of TRXs per cabinet used in conjunction with MCPA cabinet, proposed in BTS18020 version.

1.2   BTS18000 possible uses

The BTS18000, which is meant for various operating environments:

- replaces the S8000 or S12000 BTSs in Nortel Networks portfolio for greenfield site deployments.

- provides continuity to the S8000 and S12000 BTSs by its ability to be operated in a synchronized co-location mode, to increase the capacity of existing S8000 or S12000 sites.

1.3 BTS18000 frequency bands supported for GSM

Table 1-1 shows the GSM frequency bands supported.

Name	Uplink (mobile transmit, base receive)	Downlink (base transmit, mobile receive)
GSM900 E-GSM900 P-GSM900	880 - 905 MHz 890 - 915 MHz	925 - 950 MHz 935 - 960 MHz
GSM1800	1710 - 1785 MHz	1805 - 1880 MHz
GSM1900	1850 - 1910 MHz	1930 - 1990 MHz

Table 1-1   Frequency bands supported for GSM

where:

P-GSM900 = Primary or Standard GSM900 band.

E-GSM900 = Extended GSM900 band (includes part of the Standard GSM900 band)

Note: The GSM900 band (35MHz) is covered by two 25MHz RF combiner part band variants.

2   BTS18000 FUNCTIONALITY

2.1   GSM-UMTS dual technology proposal

The BTS18000 is designed to integrate, within the same cabinet, both GSM/GPRS/EDGE and UMTS technologies.

This configuration is available on all GSM frequency variants (900, 1800, and 1900 MHz) and on both 1900 and 2100 MHz frequency variants for UMTS. The maximum one-cabinet configuration is GSM S333 + UMTS STSR-2.

2.2   GSM features

The BTS18000 offers a set of features enhancing the Quality of Service and the spectrum efficiency of the network such as:

- Full support of GPRS data services.

- Full support of EDGE 8PSK modulation.

- Guaranteed -110 dBm dynamic single-branch receive sensitivity (GMSK modulation) at the BTS antenna, without any tower-mounted Low Noise Amplifier (LNA).

- Improved receiver diversity gain using a Nortel Networks specific algorithm, providing 5 dB or more diversity gain in most situations, when spatial diversity and de-correlated antennas are used.

- High output power with a 30W or 40W standard Power Amplifier (PA), and an optional 60W High Power Amplifier:

  - 30W/30W (GSM1800, GSM1900),

  - 40W/40W for standard RM (GSM900),

  - 60W/45W for GSM900 HPRM (GMSK/EDGE power).

The BTS18020 cabinet can also be used as a very high density BTS in conjunction with an optional cabinet housing Multi Carrier Power Amplifiers (MCPA) and TX/RX antenna combiners.

The MCPA feature (available only in GSM1900) allows high radio capacities using fewer RF feeders (8-Carriers per feeder at 43 dBm typical between the MCPA cabinet and the antenna) and antennas:

  - without the coverage penalties of hybrid combiner solutions,

  - without the frequency hopping limitations of cavity combiner solutions.

The MCPA feature leads to a S16.16.16 configuration in two BTS cabinets and one MCPA cabinet. The BTS18020 cabinet then contains up to 27 TRX without power amplification. This BTS configuration is ideal for urban deployment with severe space limitations and high capacity demands without compromising radio coverage. One of its major benefits is the antenna number limitation (two per sector).

- Dual-band GSM configurations with single-BCCH, built in a single or in multiple BTS18000 cabinets.

- Enhanced voice quality due to an innovative algorithm of interference cancellation significantly reducing the end-user's perception of errors generated in the radio transmission.

- Full RF power control range (static and dynamic).

- Spectrum efficiency optimization with the support of the undisputed Nortel Networks capacity features that provide high quality voice and data services to a dense subscriber population, in a limited spectrum and at competitive cost.

   These solutions include Fractional Frequency Reuse, Automated Cell Tiering and Adaptive Multi Rate (AMR) support.

- Best-in-class radio performance thanks to high sensitivity receivers, unique interference cancellation and improved spatial diversity algorithms along with high output power, providing optimum coverage and link quality for both data and voice services.

- High integration of advanced technology.

   This in turn contributes to a significant reduction in required floor space, size and equipment operating costs. This concept is adapted to stringent environmental constraints and is leading to the best economic trade-off between initial and final capacity.

   In addition, the BTS18000 supports asymmetrical radio configurations such as S963 in one cabinet.

- Compatibility with the S8000 and S12000 BTSs:
   - through existing site synchronized co-location,
   - through the possibility to re-use existing site equipment (such as an S8000/S12000 outdoor plinth).

- Industry leading transmission solution including high signaling concentration on the Abis interface and drop-and-insert capability.

   As an example, a single timeslot is only required for carrying the signaling of a S333 BTS.

   Only two PCM timeslots over the Abis interface are required for each 8-radio timeslot TRX.

   For signaling:
   - only one PCM timeslot is required, with configurations up to S333,
   - only three PCM timeslots are required, with configurations up to S999,
   - only six PCM timeslots are required, with configurations up to S18.18.18.

   The BTS18000 can support eight E1/T1 PCM links, with a granularity of four E1/T1 per IFM board.

The drop-and-insert capability is used to reduce the number of PCM links needed to connect the BTSs to their BSC. This can be implemented through chain connection or loop connection, depending on the level of reliability required. The BTS18000 supports the drop-and-insert function exactly the same way as the S8000 and S12000 BTSs do. Therefore, it is possible to have the S8000, S12000 and BTS18000 BTSs on the same chain or loop.

- GSM/GPRS/EDGE and UMTS dual technology capabilities for operator evolution to 3G data services.

2.3 GSM functions

The BTS18000 provides:

- the radio interface with the mobile handsets,
- the associated signal processing and the transmission interface with the Base Station Controller (BSC).

The BTS18000 ensures the following main functions:

- RF functions:
  - Antenna coupling and duplexing,
  - Power amplification,
  - Reception, including RF 2-way receive diversity,
  - Gaussian Minimum Shift Keying (GMSK) modulation/demodulation,
  - 8-Phase Shift Keying (8-PSK) EDGE modulation/demodulation,
  - Synthesized frequency hopping in all hybrid coupling types.
- Radio channel management:
  - BTS and mobile handset power control,
  - Discontinuous Transmission and Voice Activity Detection (DTX/VAD), on both uplink and downlink paths,
  - Radio channel filling,
  - Call setup and release,
  - Mobile timing advance processing,
  - Support of Enhanced Full-Rate (EFR), Full-Rate (FR), AMR Full-Rate and AMR Half-Rate speech coding,
- Signal processing:
  - Channel encoding and decoding,
  - Encryption (A5/2 and A5/1),

- Equalization,

- Cancellation of interference,

- Processing of radio measurements, including handover algorithms,

■ Interface with the BSC:

- Communication with the BSC,

- Concentration of signaling on the Abis interface (a single PCM timeslot can concentrate signaling for up to nine transceivers),

- Multiplexing of four traffic channels on one PCM slot (each TRX needs two PCM slots for traffic).

■ Switching:

- Connection between the PCM links and the traffic/signaling channels,

- Management of drop-and-insert connections,

- Management of the TRX and PCM link redundancy.

■ Operation and Maintenance:

- High level of availability through optional duplication of switching, synchronization and control unit (working in active/stand-by mode) and optional N+1 redundancy for rectifiers and RM,

- Monitoring of internal and external alarms, through internal bus and alarm loops,

- Remote configuration management from the BSC (site, sector, Abis, TRX),

- Remote software downloading.

3   BTS18000 CABINETS DESCRIPTION

This chapter presents the BTS18000 cabinet layout for both BTS18020 and BTS18010 versions.

For the BTS18020 as well as for the BTS18010, the cabinet includes two shelves (see *Figure 5‑3* of *Chapter 5* for a functional view of these two shelves). Each shelf contains:

- one combiner rack,

- one digital rack.

3.1 BTS18020 cabinet layout

The BTS18020 can be housed in one or several cabinets depending on the required capacity:

- One base cabinet can provide up to 18 TRX (in GSM-only mode) or 9 TRX (in GSM-UMTS dual mode).

- Up to two additional extension cabinets can be added. Each extension cabinet can support up to 18 TRX.

The BTS18020 cabinet includes the following elements:

- outdoor enclosure including AC Distribution Unit (ADU),

- AC/DC power supply: Univity Compact Power System (UCPS),

- optional internal batteries,

- Environmental Control Unit (ECU),

- User Rack space and its associated User ICO,

- back-planes: Interface Back-Plane (IBP) and Digital Back-plane (DBP), not visible on *Figure 3-1*,

- one Radio InterCOnnect board (RICO),

- up to two Interface Modules (IFM),

- one Interface Control Module (ICM) or two ICMs (in a redundant configuration),

- up to two Alarm and Bridge Modules (ABM),

- up to two optional ALarm secondary PROtection (ALPRO2) boxes,

- up to six Radio Modules (RM) or High Power Radio Modules (HPRM),

- up to six Dual Duplexer Modules (DDM) or DDM with optional H2 coupling (DDM H2), with optional Voltage Standing Wave Ratio (VSWR) meter.

   At the same location, optional Transmit Filters (TXF) or TXF with optional H2 coupling (TXF H2), with optional VSWR meter, can be provided.

Note: The DDM modules are physically grouped into the two combiner racks. Each digital rack consists of the association of IFM, ICM, ABM and RM modules.

Note: IFM and ICM modules are not required in a BTS18000 extension cabinet.

Figure 3-1 presents the BTS18020 cabinet layout and situates the modules in a fully equipped cabinet.

1	Batteries	5	IFM + ICM	9	ECU Control board	13	ABM	17 ALPRO2
2	ALPRO2	6	RM (0,1,2)	10	USER ICO	14	RM (3,4,5)	18 DDU
3	DDM (0,1,2)	7	ABM	11	USER RACK (4U)	15	DDM (3,4,5)	19 CCU
4	RICO	8	ECU Air filter	12	IFM + ICM	16	ADU	20 UCPS rectifiers
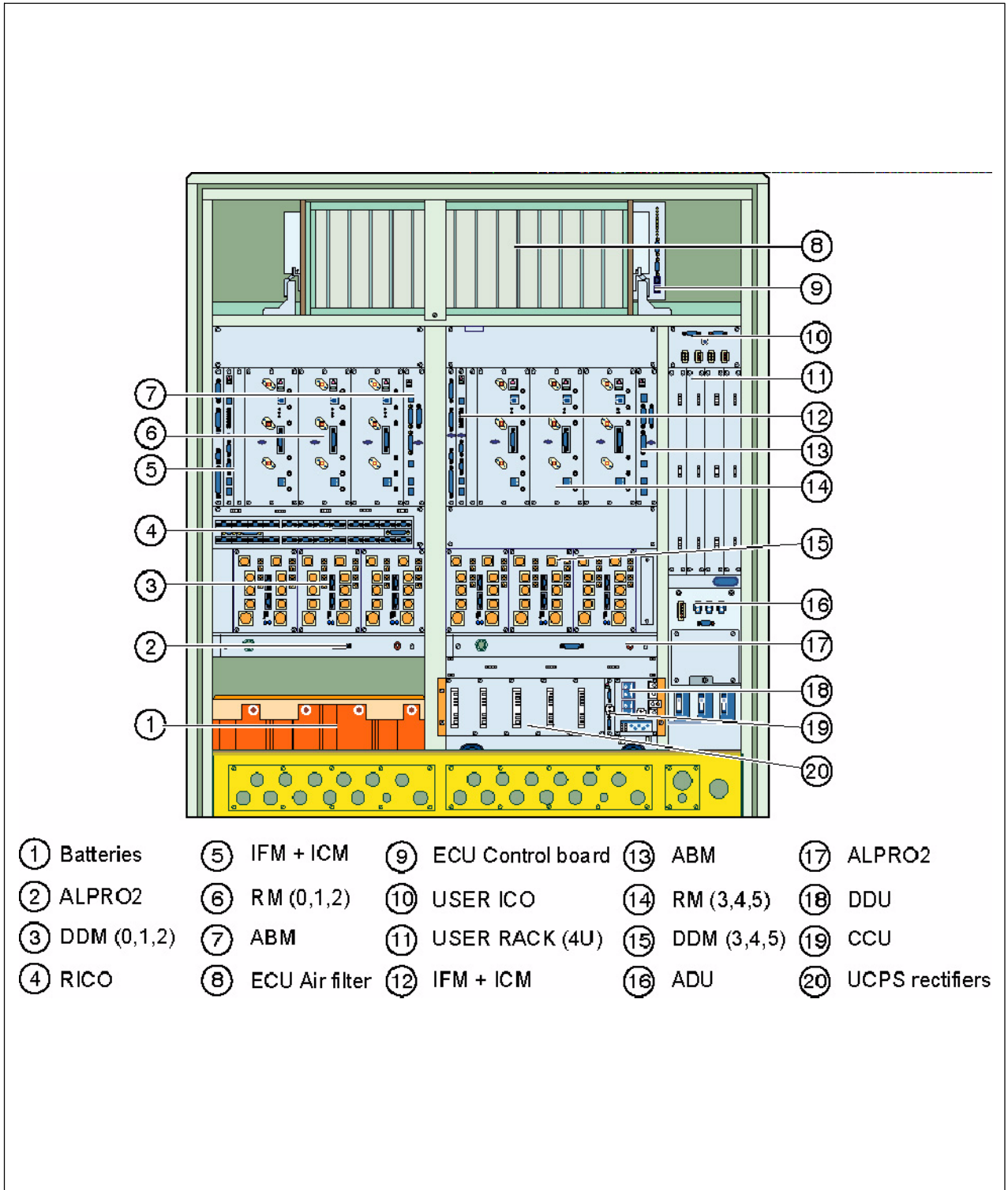
Figure 3-1   BTS18020 equipped cabinet with door opened (front view)

3.2   BTS18010 cabinet layout

The BTS18010 cabinet includes the following elements:

- indoor enclosure,
- DC breaker panel,
- BTS18000 Integrated Cooling System (SICS),
- back-planes: Interface Back-Plane (IBP) and Digital Back-plane (DBP), not visible on *Figure 3-2*,
- one Radio InterCOnnect board (RICO),
- up to two Interface Modules (IFM),
- one Interface Control Module (ICM) or two ICMs (in a redundant configuration),
- up to two Alarm and Bridge Modules (ABM),
- up to six Radio Modules (RM),
- up to six Dual Duplexer Modules (DDM) or DDM with optional H2 coupling (DDM H2), with optional VSWR meter.

    At the same location, optional Transmit Filters (TXF) or TXF with optional H2 coupling (TXF H2), with optional VSWR meter, can be provided.

Figure 3-2 presents the BTS18010 cabinet layout and situates the modules in a fully equipped cabinet.
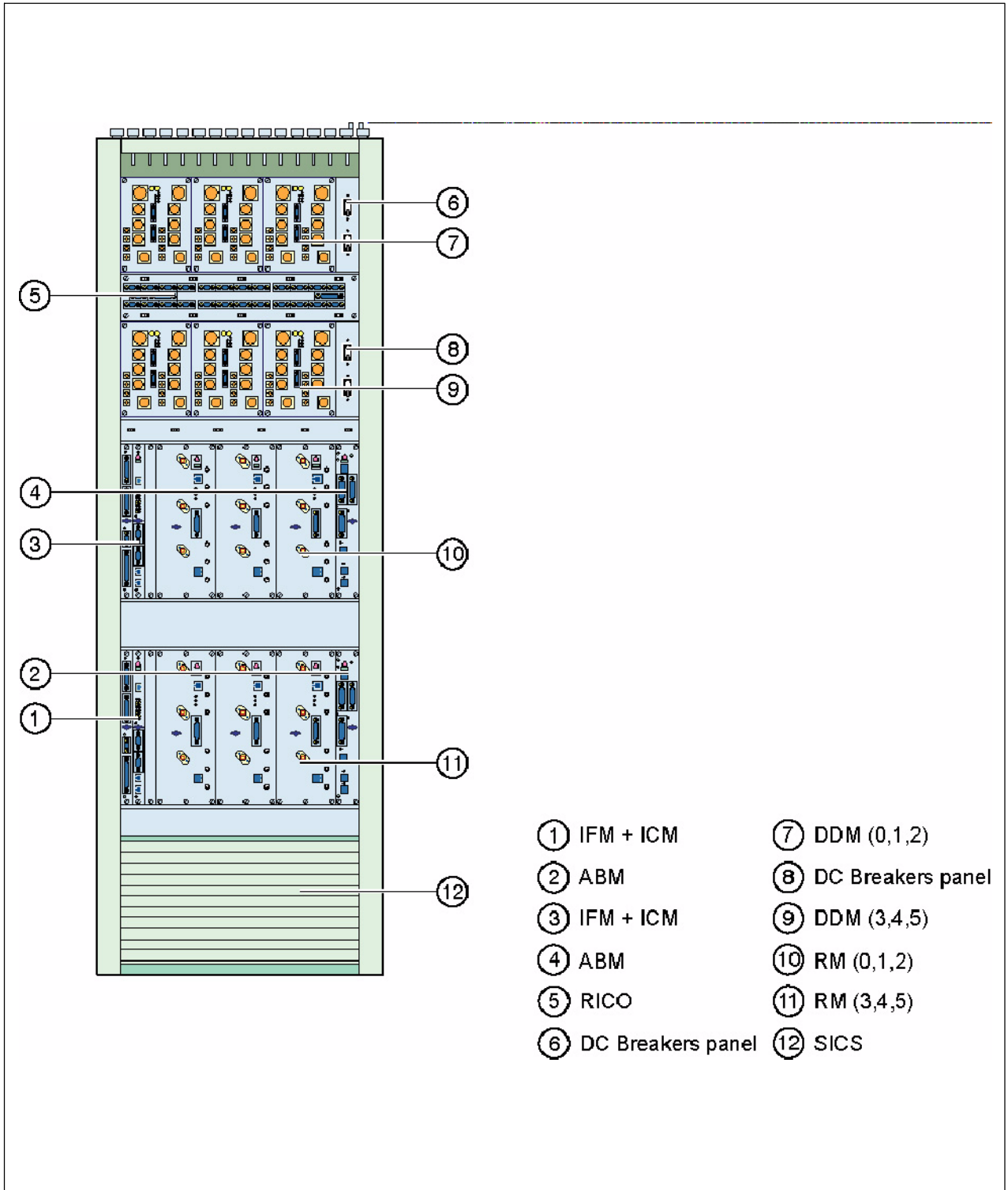
Figure 3-2   BTS18010 equipped cabinet with door opened (front view)

3.3   Power supply

3.3.1   BTS18020 cabinet

The outdoor cabinet provides an AC input. The AC Distribution Unit (ADU) performs AC protection, filtering and distribution.

The UCPS power supply system delivers −48V DC voltage from the AC input. The UCPS also manages optional internal or external batteries.

For detailed information, refer to *Chapter 4*.

3.3.2   BTS18010 cabinet

There are two variants of pre−cabled cabinet, −48V and +24V, according to the DC input.

3.4   Cooling system

There are two cooling systems, depending on the BTS18000 cabinet version:

- The BTS18000 Indoor Cooling System (SICS), for BTS18010 cabinet.

  See *Section 4.11* for detailed information.

- The Environmental Control Unit (ECU), for BTS18020 cabinet.

  See *Section 4.12* for detailed information.

3.5   Physical characteristics and environmental requirements

3.5.1   BTS18020 cabinet

As shown in *Table 3-1*, the weights and dimensions of the BTS18020 cabled cabinet allows for installations using generally available installation tools and methods. Key construction features are:

- Cabled cabinet design integrating all mechanical sub-racks and mechanical support systems required for the installation, transport and operation of the GSM wireless equipment.

- Centralized single Environmental Control Unit (ECU), supplying standardized cooling performance regardless of BTS configuration.

- AC Distribution Unit (ADU).

- Standardized AC/DC distribution system, allowing BTS minimum to maximum configuration expansion: Univity Compact Power System (UCPS).

- Standardized Radio InterCOnnection module (RICO), allowing minimum to maximum BTS configuration expansion.

- Standardized digital back-plane assembly (DBP), allowing minimum to maximum BTS configuration expansion.

BTS18020 cabinet	Height mm	Width mm	Depth mm	Weight Kg
BTS18020 pre-cabled cabinet	1500	1350	735	180
BTS18020 fully equipped cabinet	1500	1350	735	450

Table 3-1   BTS18020 dimensions and weights

The BTS18020 cabinet is designed to support an external temperature range of -40°C to +50°C with an absolute humidity between 1 g/m3 and 36 g/m3.

The BTS18020 enclosure is designed for an outdoor environment.

Combo GSM-UMTS and MCPA variants of BTS18020 cabinet support the same environmental conditions.

3.5.2 BTS18010 cabinet

As shown in the *Table 3-2*, the weight and dimensions of the BTS18010 cabled cabinet allows for installations using generally available installation tools and methods. Key construction features are:

- Cabled cabinet design integrating all mechanical sub-racks and mechanical support systems required for the installation, transport and operation of the GSM wireless equipment.

- Centralized single low acoustic noise BTS18000 Indoor Cooling System (SICS), supplying standardized cooling performance regardless of BTS configuration.

- Standardized DC distribution system, allowing BTS minimum to maximum configuration expansion.

- Standardized Radio InterCOnnection module (RICO), allowing minimum to maximum BTS configuration expansion.

- Standardized digital back-plane assembly (DBP), allowing minimum to maximum BTS configuration expansion.

BTS18010 cabinet	Height mm	Width mm	Depth mm	Weight Kg
BTS18010 pre-cabled cabinet	1750	600	600	120
BTS18010 fully equipped cabinet	1750	600	600	300

Table 3-2   BTS18010 dimensions and weight

The BTS18010 cabinet is designed to support an external temperature range of $-5°C$ to $+45°C$ with an absolute humidity between 1 g/m3 and 29 g/m3.

The BTS18010 enclosure is designed for a standard indoor environment.

Combo GSM-UMTS variant of BTS18010 cabinet supports the same environmental conditions.

4   BTS18000 MODULES DESCRIPTION

This chapter describes the BTS18000 modules, shared between the following subsystems:

■ BTS18000 Common Function Modules:

  • IBP and DBP,

  • IFM,

  • ICM,

  • ABM.

■ BTS18000 Radio Modules:

  • RM,

  • HPRM,

  • TX and RX RF Coupling Modules:

    – DDM, DDM H2, DDM with VSWR meter, or DDM H2 with VSWR meter,

    – TXF, TXF H2, TXF with VSWR meter, or TXF H2 with VSWR meter.

  • RICO.

■ BTS18000 Cabinet Modules:

  • for BTS18010 cabinet, SICS.

  • for BTS18020 cabinet:

    – ECU,

    – UCPS,

    – ADU,

    – Internal batteries,

    – User rack and User ICO.

■ BTS18000 Ancillaries Modules:

  • ALPRO,

  • ALPRO2,

  • PRIPRO,

  • PRIPRO2.

4.1   Interface BackPlane (IBP) and Digital BackPlane (DBP)

The IBP and DBP backplanes span across the whole rack and are common to BTS18010 and BTS18020 cabinets. They are field replaceable.

All modules and some cables carrying external signals are plugged into connectors mounted on the backplanes printed-circuit board.

4.1.1   Main functions

The IBP and the DBP provide the electrical interfaces that support DC power distribution and communication between all digital and radio modules.

The IBP and DBP functions are split as follows:

- the IBP routes low power and dense digital signals for ICM and IFM.
- the DBP routes RM high power, digital boards low power and a few digital signals for ABM and RMs.

Figure 4-1 illustrates the interconnection architecture of BTS18000 backplanes.
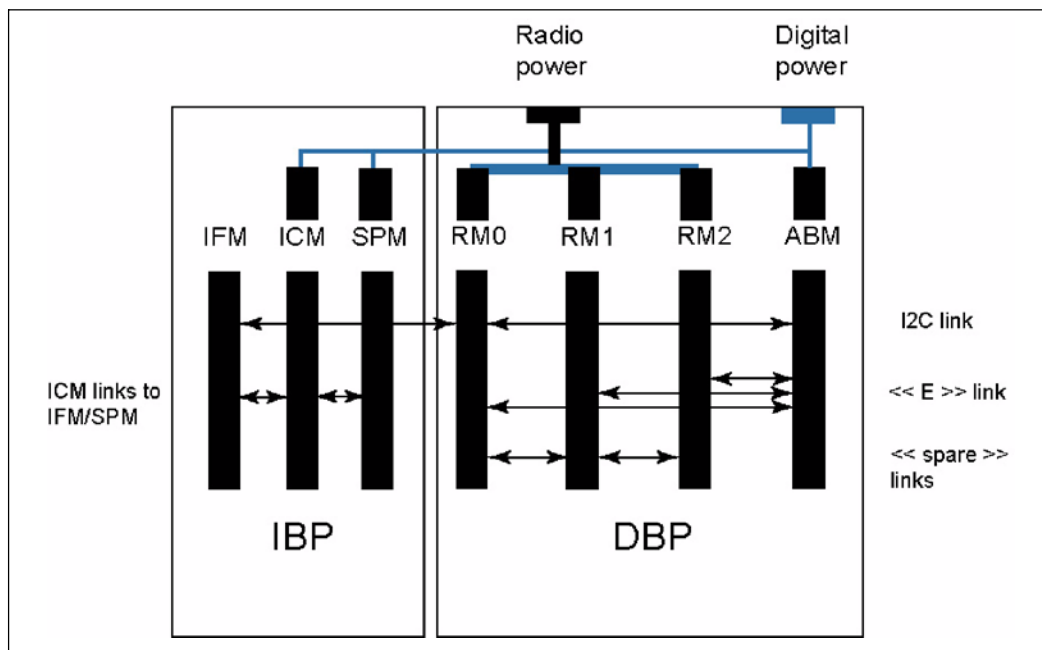
Figure 4-1   IBP and DBP interconnection architecture

4.1.2   Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth of the associated shelf (mm)	Weight (Kg)
IBP	290	75	415	< 1

Table 4–1   IBP dimensions and weight

Maximum number per cabinet: 2.

No power dissipation.

Maximum voltage: 60 V.

Warning: The IBP distributes 48V power.

Module name	Height (mm)	Width (mm)	Depth of the associated shelf (mm)	Weight (Kg)
DBP	120	311	415	< 1

Table 4–2   DBP dimensions and weight

Maximum number per cabinet: 2 (3 for MCPA BTS18020 cabinet).

No power dissipation.

Maximum voltage: 60 V.

Warning: The DBP distributes 48V power.

4.1.3   Interfaces between modules

The IBP and DBP interface with IFM, ICM, ABM and RMs using multiple high–density connectors, for digital signal path, and power connectors. The RM connectors are placed in order to optimize the DC power distribution distance on the backplane. The RM power traces, on the backplane and ground plane, can handle a current of up to 45A.

The interface between IBP and DBP is performed via a digital and power cable.

4.1.4   IBP connectors

Figure 4-2 locates all the connectors on the IBP module. They are front panel connectors, except for J8, which is located on the right side of IBP.

Figure 4-2   IBP connectors location

Table 4-3 indicates the type and the use of the IBP connectors.

IBP connectors	Use	Type
J0	Connection between IBP and IFM	HM1 210 pins male
J1	Connection between IBP and ICM	
J2	Connection between IBP and ICM	HM1 120 pins male
J3	–	
J4	Connection between IBP and ICM (ICM power)	HM1 30 pins male
J5	–	
J6	Connection between two IBPs	DUBOX 6 pins female
J7		
J8 (on IBP right side)	Connection between IBP and DBP (I2C link, detect, 48V power)	DUBOX 26 pins female

Table 4–3   IBP connectors type and use

4.1.5   DBP connectors

Figure 4-3 locates all the connectors on the DBP module. They are front panel connectors, except for J5 and J6, which are located on the rear panel of DBP.
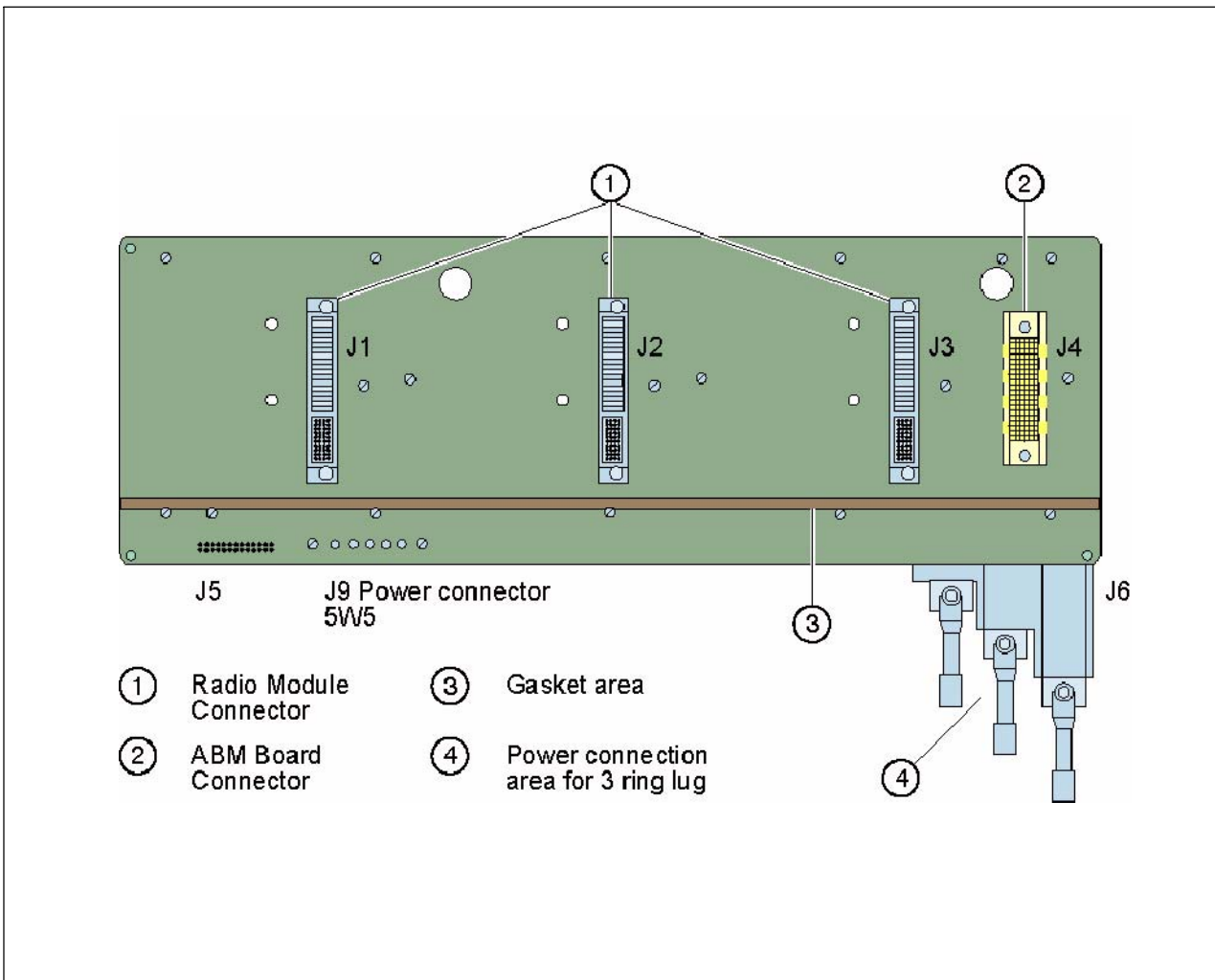
Figure 4-3   DBP connectors location

Table 4-4 indicates the type and the use of the DBP connectors.

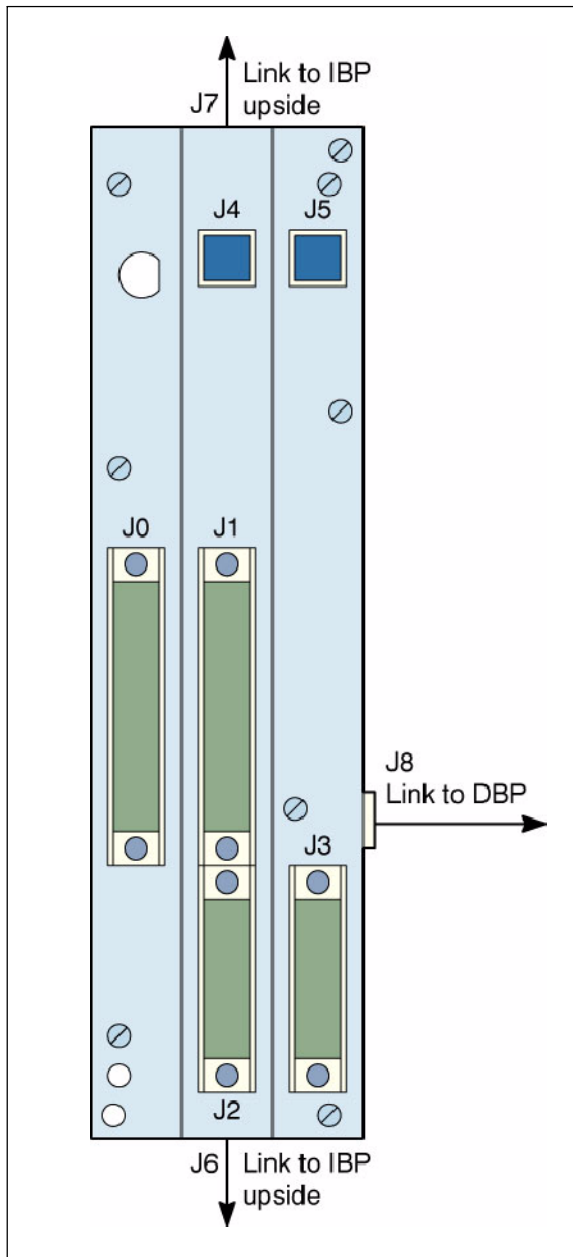| DBP connectors	Use	Type
J1	Connection to RM0	FCI Power Blade connector:
J2	Connection to RM1	4x10 pins array (1A to 10D) +
J3	Connection to RM2	6 power contacts (P1 to P6)
J4	Connection to ABM	HM1 120 pins male
J5 (rear panel)	Connection to IBP	2x13 pins array male
J6 (rear panel)	Power	SUBD 5W5 male

Table 4-4   DBP connectors type and use

4.1.6   Digital signals

The modules are inter-connected through the IBP and the DBP via controlled impedance Printed Circuit Board (PCB) traces. Signals routed through the backplane between the modules include:

- E1/T1 links between IFM and ICM operating at up to 4.096 MHz,

- Local, point-to-point LVDS links between ABM and RMs, and between RMs, operating at up to 100 MHz,

- I2C clock and data using Low-Voltage Transistor-Transistor Logic (LVTTL) operating at 100 Kbps,

- Static LVTTL signals (rack and slot Id, presence detection, status and reset signals, remote power supplies...),

- ICM redundancy,

- External synchro,

- Inter IBP signals.

4.1.7   Power signals

A three-wire DC power bus carries the -48V or +24V DC power and ground from the radio DC breaker module to the RMs. Another three-wire DC power bus, on the DBP, carries the -48V or +24V DC power from the digital breaker module to the ABM, and to the IFM and ICM via the IBP.

The ABM remotely powers the inventory memories of the other digital modules with a low drive 3.3V signal routed through the IBP and the DBP.

4.2   Interface Module (IFM)

The IFM is only used in the BTS18000 base cabinet. It is not present in the extension cabinets. The IFM is composed of a single passive board with connections on the IBP and on the front panel.

4.2.1   Main functions

The IFM provides connectivity and secondary protection (the level of protection depends on the type of board, see *Section 4.2.2 "Types of IFM board"*) on the PCM links. It provides:

- E1 (120 ohms) or T1 (100 ohms) links from the Abis (front panel) with secondary protection to the local ICM (back panel) and the redundant ICM (cross-connect connector on front panel).

- additional E1/T1 links from the other IFM (cross-connect connector on front panel) to the local ICM (back panel).

  The IFM also provides detection for this additional Abis link to the ICM.

- external synchronization link from external source (CMCF phase 2 or GPS antenna, on the front panel) to the local ICM (back panel) and the remote ICM (cross-connect connector on front panel).

  The active ICM provides an RS422 receive link to the GPS antenna, and retrieves PPS synchro input from the antenna. The IFM provides antenna detection to both ICMs.

- cross-connect link between the remote ICM (cross-connect connector on front panel) and the local one (back panel). This link conveys detection, active/passive, synchro and signaling signals between both ICMs.

- the ICM with several status signals (GPS antenna presence, redundancy status).

- the ABM with a board presence detection signal and an I2C Electrically-Erasable Programmable Read-Only Memory (EEPROM) for inventory. This memory contains factory data and is remotely powered by the ABM.

Note: The IFM does not provide the ICM with the link type (E1 or T1) detection. The selection of E1 or T1 mode must be performed via commissioning switches inside ICM (see *Section 4.3.9.1*).

4.2.2   Types of IFM board

There are two types of IFM board:

- IFM
- IFM1

Each board has a different PEC/CPC code (for these codes, see the replacement procedure in NTP < 162 >).

4.2.2.1   IFM board

The IFM board provides a level of secondary protection greater than or equal to that provided by a CSU (Channel Service Unit). Consequently, IFM is the appropriate board to use if a CSU is not being used to provide protection. The name on this board is IFM.

4.2.2.2   IFM1 board

The IFM1 board provides a lower level of secondary protection than that provided by the IFM board. If a CSU (Channel Service Unit) is being used to provide protection, then the IFM1 board can be used instead of the IFM board. The name on this board is IFM1.

4.2.2.3   Terms used in this NTP

Except for the level of secondary protection and the names that appear on the boards, the two types of IFM board are identical. Throughout this NTP, the term "IFM" is used in text and graphics. You should interpret this as a generic term that covers both types of IFM board. If it is necessary to distinguish between the two types of IFM board, then this is stated explicitly in the text.

4.2.2.4   Location in cabinet

The BTS18000 cabinet includes:

- one mandatory even IFM (IFM-even), located:
  - in the upper shelf, for BTS18010 cabinet,
  - in the left shelf, for BTS18020 cabinet.
- one optional odd IFM (IFM-odd), located:
  - in the bottom shelf, for BTS18010 cabinet,
  - in the right shelf, for BTS18020 cabinet.

4.2.3   Front panel

Figure 4-4 presents the IFM front panel. Except for the name IFM1, the IFM1 board is identical to the IFM board shown in *Figure 4-4*.
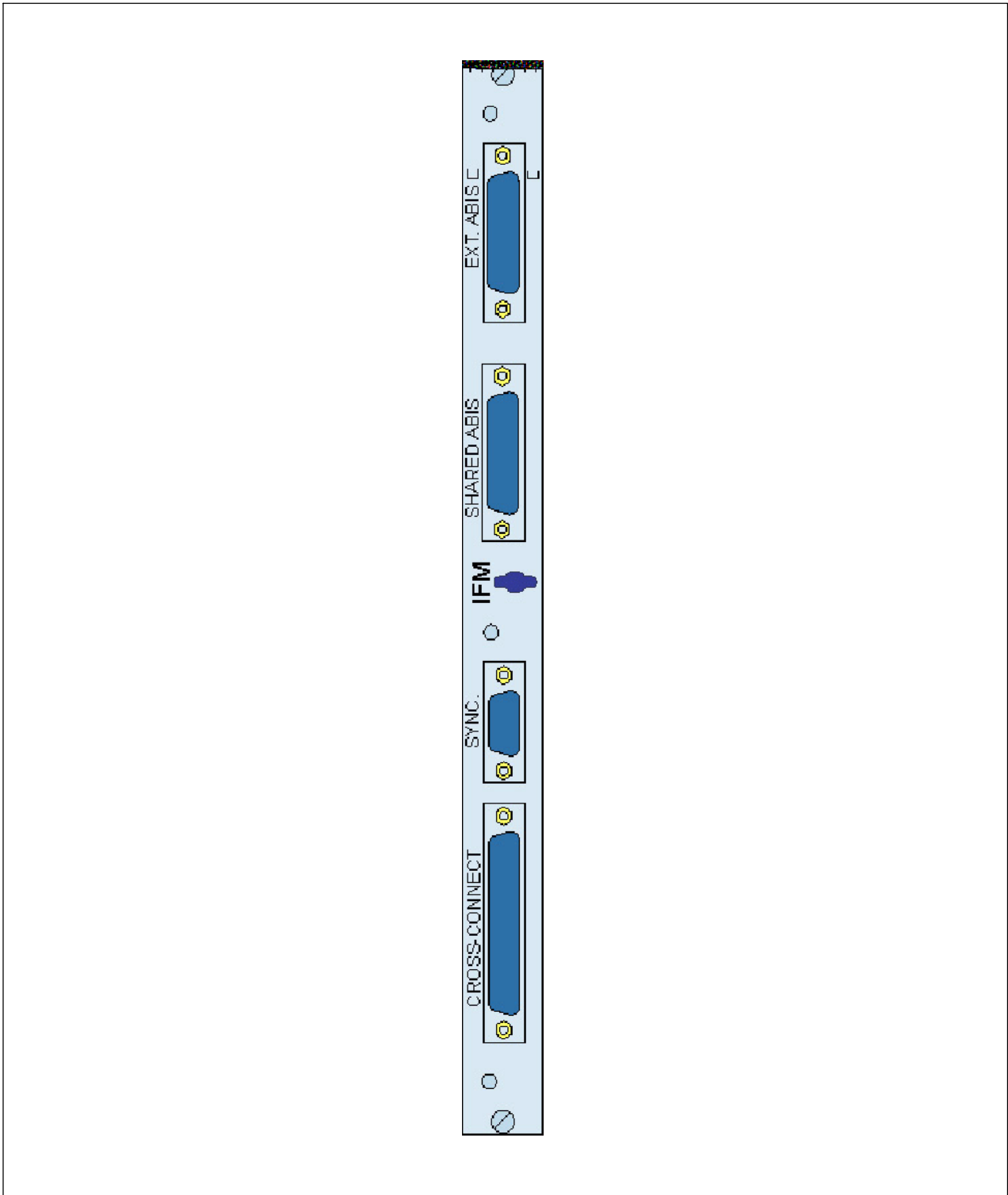
Figure 4-4   IFM front panel

4.2.4   Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth (mm)	Weight (Kg)
IFM	335	25	410	< 1

Table 4-5   IFM dimensions and weight

Maximum number per cabinet: 2, in the base cabinet only.

Maximum power consumption: 0 W.

Associated breaker:

- Digital breaker (BTS18010),
- CB3 digital breaker (BTS18020).

4.2.5   Interface description

4.2.5.1   Connectors

Table 4-6 indicates the type and the use of the IFM connectors. They are front panel connectors, except for J4, which is a back panel connector.

Abis connectors	Use	Type
J0	E1/T1 links to Abis network – EXT ABIS	SUBD 25 pins male
J1	E1/T1 links to ICM – SHARED ABIS	SUBD HD 44 pins female
External synchro connector	**Use**	**Type**
J3	External synchro: GPS clock, detect, Gnd, synchro RS422 – SYNC	SUBD 9 pins female
Cross-connect connector	**Use**	**Type**
J2	Cross link: synchro, activity detection, signaling between ICMs – CROSS-CONNECT	SUBD HD 62 pins female
Signal connector (back panel)	**Use**	**Type**
J4	Signals from Abis and Cross-connect connectors, I2C to ABM	HM1 210 pins female

Table 4-6   IFM connectors type and use

The Abis front panel connector provide the following signals:

- four E1/T1 main bidirectional links.

The External Synchro front panel connector provides the following signals:

- cable detection,

- signaling bidirectional link to GPS antenna or CBCF link,

- PPS clock from GPS antenna or 8kHz synchro from CBCF.

The Shared Abis front panel connector provide the following signals:

- four E1/T1 bidirectional links from secondary protection cell to other IFM,

- four E1/T1 bidirectional links from other cell to local ICM.

The Cross-connect front panel connector provides the following signals:

- cable detection,

- active/passive signals,

- signaling bidirectional link between ICMs,

- synchro signals from active to passive,

- external synchro signals share between IFMs.

The back panel connector provides the following signals:

- all signals from Abis front panel connectors (secondary protected),

- all signals from Cross-connect front panel connectors (except the protected four E1/T1 to remote IFM),

- board presence, I2C bus and address, EEPROM power supply.

4.2.6   LEDs behavior

There is no LED on the IFM.

4.3   Interface Control Module (ICM)

The ICM is only used in the BTS18000 base cabinet. It is not present in the extension cabinets. It is designed to manage the whole BTS18000 site in simplex or redundant mode.

The ICM is composed of a single board with connections on the IBP and on the front panel.

4.3.1   Main functions

The ICM in simplex mode covers the functions related to a complete site including:

- support of drop-and-insert facilities for the PCM links with the BSC,

- reference clock for the air interface, synchronized on the Abis PCM interface, a synchronizing BTS or a GPS antenna,

- GSM_TIME calculations with possible network synchronization,

- switching of PCM slots,

- conversion of electrical signals, from external to internal PCM data formats,

- concentration of the data flow of the BTS,

- configuration and supervision of all the modules.

Redundancy can optionally be introduced using two ICMs in the cabinet: one even ICM (ICM0) and one odd ICM (ICM1). In such a mode, called duplex, there is one active ICM and one passive ICM.

The even ICM (ICM0) shall be equipped in simplex mode and is the default active ICM at start up.

In duplex mode:

- the active ICM is the currently operational one, as opposed to the passive one,

- the passive ICM is the currently non operational one, as opposed to the active one.

The redundancy is static. If the passive ICM traps, the swap from passive to active occurs, but the traffic is lost and the newly active ICM can accept new traffic.

Note: ICM chain switching may disturb punctually the Abis lines, as line transceivers of both boards share the same signals. This disturbance may last several microseconds to several milliseconds, depending on the hardware implementation. These characteristics are also met on the BSC interface boards.

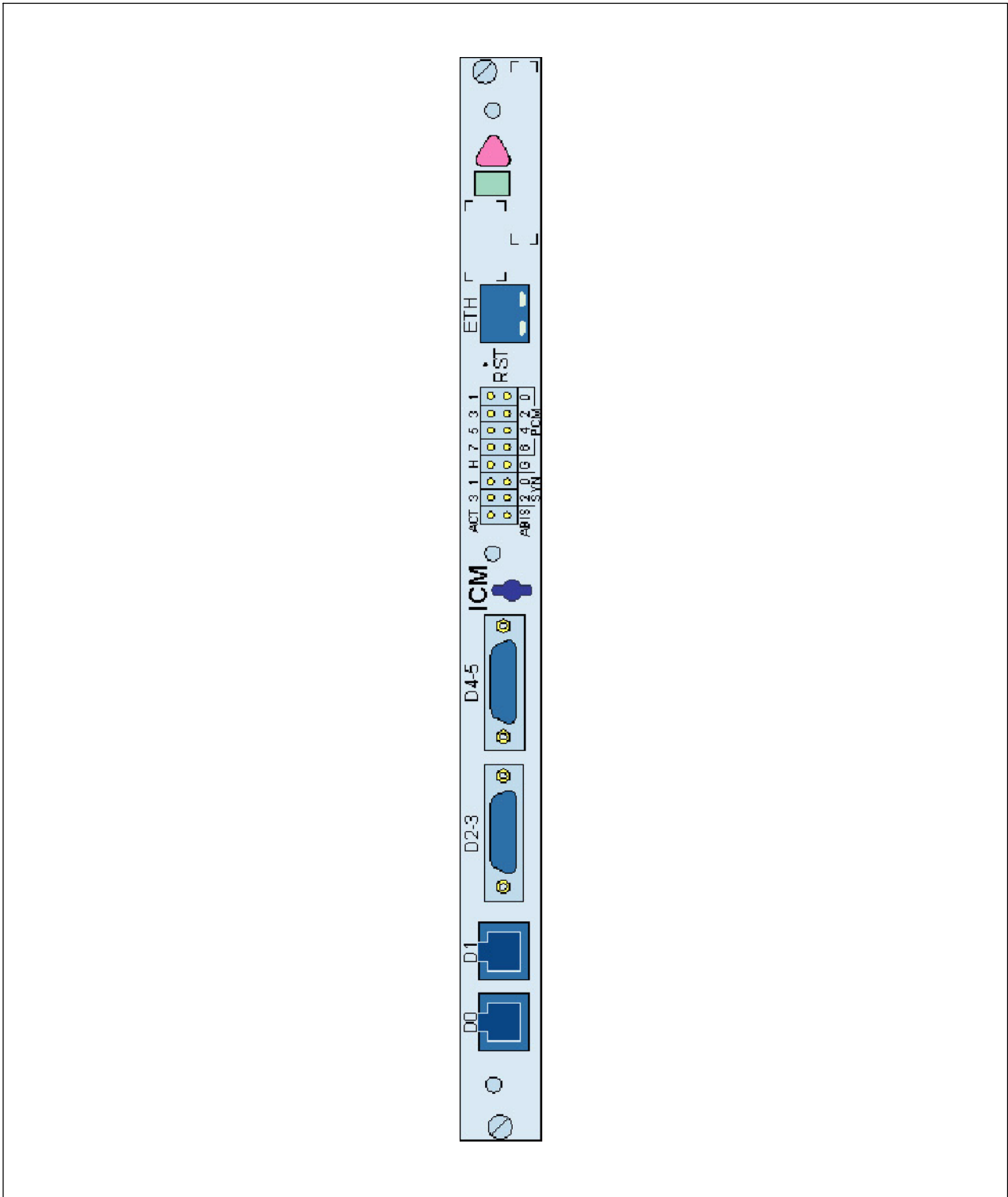### 4.3.2 Front panel

Figure 4-5 presents the ICM front panel.

Figure 4-5   ICM front panel

4.3.3　Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth (mm)	Weight (Kg)
ICM	335	25	410	< 1

Table 4–7　ICM dimensions and weight

Maximum number per cabinet: 2, in the base cabinet only.

Maximum power consumption: 30 W.

Input voltage range: 20 V – 60 V.

Associated breaker:

- Digital breaker (BTS18010),
- CB3 digital/RICO/user breaker (BTS18020).

4.3.4　Interface description

4.3.4.1　Connectors

Table 4–8 indicates the type and the use of the ICM connectors. They are front panel connectors, except for J10, J11 and J12, which are back panel connectors.

Debug connector	Use	Type
J2	Ethernet / RS232 debug – ETH	8 pins RJ45 female
Signal connectors (front panel)	**Use**	**Type**
J0	D link in the base cabinet (ABM) – D0	10 pins RJ45 female
J1	D link in the base cabinet (ABM) – D1	
J23	D link for one extension cabinet – D2–3	SUBD HD 26 pins female
J45	D link for one extension cabinet – D4–5	
Signal connectors (back panel)	**Use**	**Type**
J10	Power	HM1 30 pins female
J12	Spare links	HM1 120 pins female
J11	E1/T1 links, GPS or external synchro	HM1 210 pins female

Table 4–8　ICM connectors type and use

The front panel Debug connector provides the following signals:

- Reset push button,

- debug access (RS232 monitor + 10/100bT).

The six D link front panel connectors provide the following LVDS signals:

- clock, synchro and full duplex bi-directional data at 16.384Mbsp. Those signals are hot pluggable.

The back panel power connector provides:

- 24/48V wide input range floating supply.

The Signal back panel connectors provide:

- eight E1/T1 main bi-directional links with IFM,

- all ICM GPS signals (cable detection, power to the antenna, signaling bi-directional link to antenna, PPS clock from antenna), or external synchronization signals (SY and MICR from CBCF),

- all cross connect signals with IFM (cable detection, active/passive signals, signaling bi-directional link between ICMs, synchro signals from active to passive),

- board presence, I2C bus, address and power.

4.3.5   ICM Corporate LEDs behavior

As shown on *Figure 4‑6*, an upper triangle‑shaped red LED and a lower rectangle‑shaped green LED are used to indicate the status for some BTS18000 modules. See *Figure 4‑7* for the ICM detailed status information.
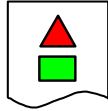
Figure 4‑6   Corporate LEDs

Green LED	Red LED	ICM status
switched off	switched off	Sleep, un‑powered or not inserted (default hardware value)
🟩	🔺	starting, BISTs in progress
🟩	switched off	normal operation – no faults
🟩	blinking	module is possibly partially faulty – ICM installation problem
switched off	🔺	alarm status: abnormal operation – must be removed and replaced
blinking	🔺 or switched off	wait for ICM connection – used on passive ICM
blinking	blinking	internal downloading – used on passive ICM

Figure 4‑7   ICM Corporate LEDs behavior

4.3.6   ICM specific LEDs behavior

Table 4-9 gives detailed information on ICM specific LEDs behavior. All these LEDs are OFF when the ICM is un-powered. All these LEDs are amber during BISTs.

LED name	Color	Meaning
PCMx (x = 0 to 7)	🟢 🔴 🟠	8 PCM status LEDs (one per PCM): – Green: the PCM is OK – Red: the PCM is in fault – Amber: the PCM is in test
G (GPS)	🟢 🔴 🟠	1 GPS or external synchro status LED: – OFF: no external synchronization – Green: GPS synchronization – Red: bad external synchronization signal – Amber: master BTS synchronization
SYN (synchro)	🟢	Four LEDs for synchronizing source: one out of the 8 PCMs or external synchronization (in that case the 4 LEDs are ON) – see *Table 4-10* –
H (holdover)	🔴	One LED for synchro locked status: – ON on active ICM: un-locked or holdover indication – ON on passive ICM: un-locked indication – OFF: synchro is locked on external source
ACT (activity)	🟢 🔴	One LED for ICM Passive or Active Status: – Green: the ICM is active – OFF: the ICM is passive – Red on both ICMs: the simplex or duplex configuration cannot be determined, both ICMs are in faulty passive state
ABIS	🟢	Level-2 status with BSC: – ON: level-2 is OK – Blinking: downloading in progress – OFF: no Level-2 with the BSC

Table 4-9   ICM specific LEDs behavior

4.3.6.1   ICM SYN LEDs behavior

The behavior of the four LEDs for synchronization source is described in *Table 4-10*.

SYNCHRO SOURCE	0	1	2	3
PCM 0	●	switched off	switched off	switched off
PCM 1	switched off	●	switched off	switched off
PCM 2	●	●	switched off	switched off
PCM 3	switched off	switched off	●	switched off
PCM 4	●	switched off	●	switched off
PCM 5	switched off	●	●	switched off
PCM 6	●	●	●	switched off
PCM 7	switched off	switched off	switched off	●
external source (GPS, master BTS)	●	●	●	●
holdover (*)	● / switched off (*)	● / switched off (*)	● / switched off (*)	● / switched off (*)
(*) In Holdover, the SYN LED indicates the clock source (PCM number) that the syn tries to use for synchronization. In that case, the holdover LED (H) is ON on the active ICM.				

Table 4-10   ICM SYN LEDs behavior

4.3.7   LEDs behavior at active ICM starting up

The specific LEDs behavior, when the active ICM starts up, is as follows:

1   When the BTS18000 is turned on, H (holdover) and ACT (active) LEDs switch ON.

2   After the Built-in Self Test (BIST) sequence, the ICM searches for synchronizing with the PCM0 link.

3   When the clock source is found, H LED switches OFF and synchro source LEDs (SYN) switch ON (see *Table 4-10*).

Table 4-11 summarizes the behavior of corporate and specific LEDs when active ICM starts up.

	ICM boot sequence	ICM BISTs	Abis connection	ICM downloading	Nominal operation
triangle corporate	🔺	🔺			
rectangle corporate	🟩	🟩	🟩	🟩	🟩
ACT		🟠	🟢	🟢	🟢
SYN		🟠	🟢	🟢	🟢
G		🟠			
Abis		🟠	🟢	🟢 blinking	🟢
PCMx		🟠	🟢	🟢	🟢
H	🔴	🟠			

Table 4-11 LEDs behavior at active ICM starting up

4.3.8 LEDs behavior at passive ICM starting up

The passive ICM can be differentiated from the active one thanks to the ACT LED switched off. The behavior of the SYN and PCM LEDs is the same as for the active ICM.

Table 4-12 summarizes the behavior of corporate and specific LEDs when passive ICM starts up.

	ICM boot sequence	ICM BISTs	Active ICM connection	Passive ICM downloading	Nominal operation
triangle corporate	🔺	🔺	🔺 or switched off	🔺 blinking	
rectangle corporate	🟩	🟩	🟩 blinking	🟩 blinking	🟩
ACT		🟠			
SYN		🟠	🟢	🟢	🟢
G		🟠			
Abis		🟠			
PCMx		🟠	🟢	🟢	🟢
H	🔴	🟠			

Table 4-12 LEDs behavior at passive ICM starting up

4.3.9 Configuration of the ICM switches for commissioning

4.3.9.1   SW10 switch

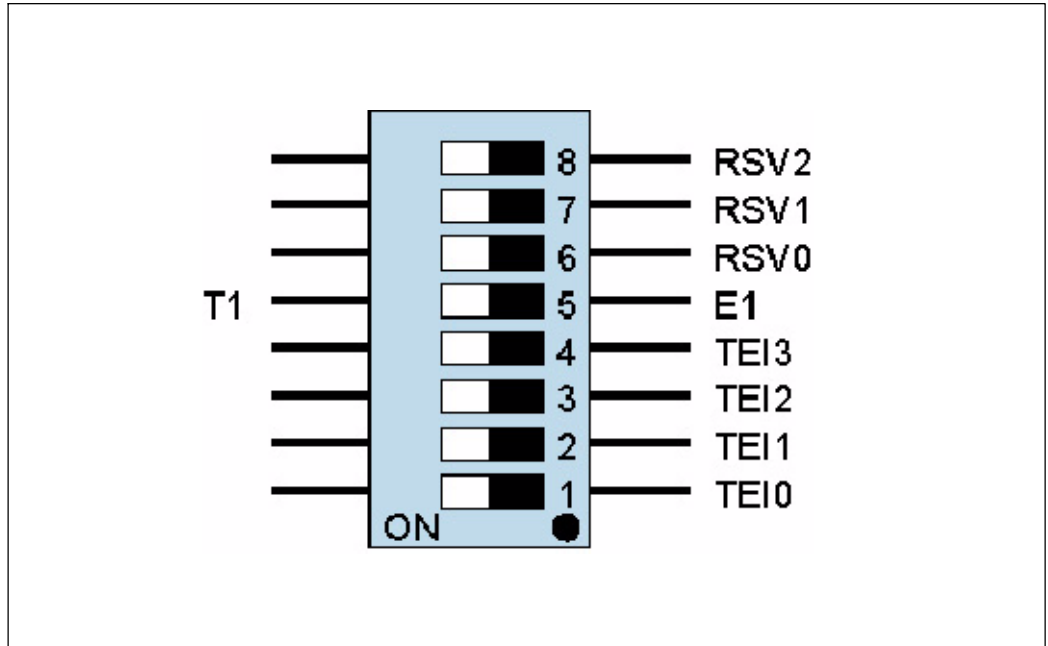**Figure 4-8   ICM SW10 switch**

E1/T1	RSV0	Frame Format
OFF	OFF	E1 mode (120 ohms)
OFF	ON	E1 mode with 75 ohms adapter
ON	–	T1 mode (100 ohms)

TEI(3)	TEI(2)	TEI(1)	TEI(0)	Site TEI coding
OFF	OFF	OFF	OFF	0
OFF	OFF	OFF	ON	1
OFF	OFF	ON	OFF	2
OFF	OFF	ON	ON	3
OFF	ON	OFF	OFF	4
OFF	ON	OFF	ON	5
OFF	ON	ON	OFF	6
OFF	ON	ON	ON	7
ON	OFF	OFF	OFF	8
ON	OFF	OFF	ON	9

Table 4-13   ICM SW10 switch configuration

An ICM board cannot start if its TEI value is out of the range given in *Table 4-13*. Factory setting is TEI equal to zero. RSV(0-2) are unused (default value is OFF).
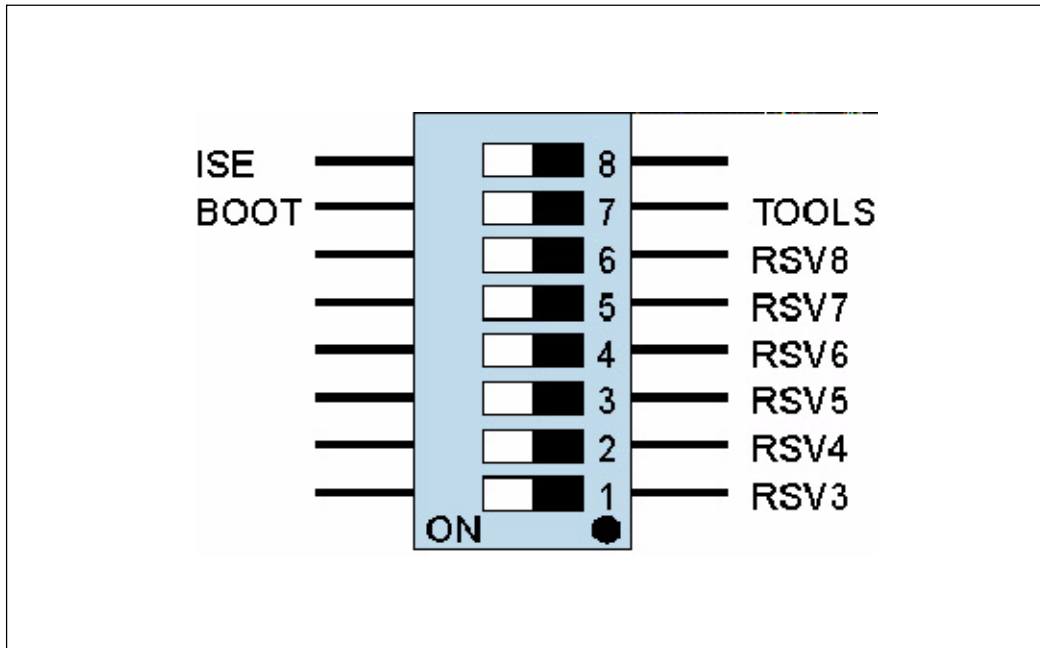
4.3.9.2 SW11 switch

Figure 4-9 **ICM SW11 switch**

ISE	ICM for New-SEB mode
OFF	ICM in nominal mode
ON	ICM in New-SEB mode if confirmation bit is set in FPGA

BOOT/TOOLS	Processor booting mode
OFF	Require emulator probe connected
ON	Booting in Flash memory (nominal mode)

Table 4-14 **ICM SW11 switch configuration**

RSV(3-8) are unused (default value is OFF). Passive and active ICM must have the same switches configuration. Otherwise, both ICM are in the "passive partially faulty" state: the corporate green LED is ON and the red one is blinking.

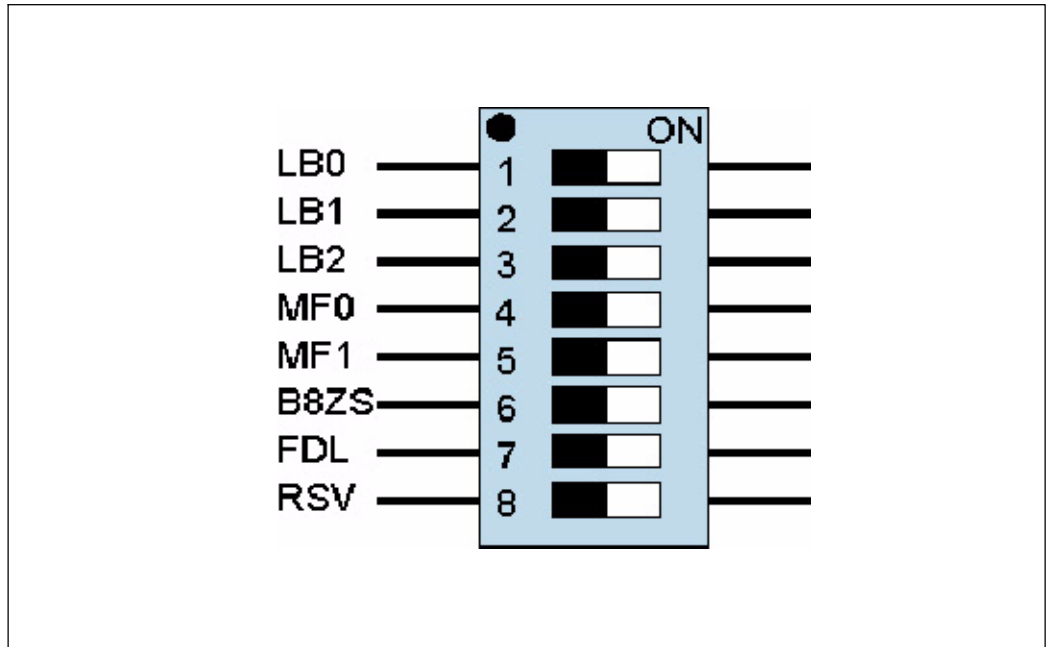4.3.9.3   SW0–SW7 switches: one per Abis line

Figure 4-10   ICM Abis switch

The E1 or T1 mode selection is performed thanks to switch SW10 (see *Table 4-13*). Refer to *Table 4-15* and *Table 4-16* for detailed information on E1/T1 configurations of the ICM Abis switches.

MF1	MF0	Frame Format
OFF	OFF	12–frame multi–frame (Super–Frame)
OFF	ON	Extended Super–frame (ESF) with CRC6 check/generation
ON	OFF	Extended Super–frame (ESF) without CRC6 check/generation
ON	ON	Not used

LB2	LB1	LB0	Line Build–Out
OFF	OFF	OFF	length = 000..133ft (0.6dB – DSX–1) / 0.0dB (DS1)
OFF	OFF	ON	length = 133..266ft (1.2dB – DSX–1)
OFF	ON	OFF	length = 266..399ft (1.8dB – DSX–1)
OFF	ON	ON	length = 399..533ft (2.4dB – DSX–1)
ON	OFF	OFF	length = 533..655ft (3.0dB – DSX–1)
ON	OFF	ON	-7.5dB (DS1)
ON	ON	OFF	-15.0dB (DS1)
ON	ON	ON	-22.5dB (DS1)

B8ZS	Line code
OFF ON	AMI coding B8ZS coding

Table 4-15   ICM Abis switch - T1 configuration

FDL (Facility Data-Link) and RSV are not used. Their default value is OFF.

MF1	MF0	Frame Format
OFF	OFF	Single frame
OFF	ON	Multi-frame with CRC4 decoding
ON	OFF	Multi-frame without any CRC4 decoding
ON	ON	Automatic multi-frame with CRC4 decoding

LB2	LB1	LB0	Line Build-Out is NOT used
OFF	OFF	OFF	Default value

B8ZS	Line code
OFF	HDB3 coding
ON	AMI coding (provision)

Table 4-16   ICM Abis switch - E1 configuration

FDL (Facility Data-Link) and RSV are not used. Their default value is OFF.

4.4   Alarms and Bridge Module (ABM)

One ABM is used in each BTS18000 digital rack. Therefore, a BTS18000 cabinet contains two ABMs (even and odd).

The ABM is composed of a single board with connections on the DBP and on the front panel.

4.4.1   Main functions

4.4.1.1   Alarm collector function

The ABM alarm collector function performs the following operations under the ICM control:

- Detection of cabinet alarms:
  - door status,
  - BTS18020 cabinet User Rack and ADU.
- Presence detection of the digital rack, combiner rack and other cabinet modules:
  - digital rack modules: IFM, ICM and the three RMs,
  - RF combiners: DDM, TX filter (TXF), DDM (H2) and TXF (H2),
  - cabinet modules: BTS18010 SICS, BTS18020 ECU and UCPS.
- Inventory of the digital rack, combiner rack and other cabinet modules:
  - IFM, ICM, and the three RMs, via the I2C bus,
  - DDM, TXF, DDM (H2) and TXF (H2), via the pseudo I2C over RS422,
  - BTS18010 SICS and BTS18020 ECU, via the pseudo I2C over RS422,
  - UCPS modules, through a dedicated protocol over RS422.
- Alarm polling of the radio coupling modules, through the pseudo I2C bus over RS422:
  - Low Noise Amplifier (LNA) over-current detection in the DDMs,
  - VSWR alarms and associated setting of thresholds in the DDMs and TX filters with the VSWR option.
- Alarm polling of the cooling system modules, through the pseudo I2C bus over RS422:
  - BTS18010 SICS blowers, filter, power and control board status,
  - BTS18020 ECU blowers, filter, damper, heater, power and control board status.

- Alarm polling of the BTS18020 cabinet UCPS:
  - AC monitoring,
  - DC monitoring,
  - breakers status,
  - battery status.
- Optional external alarm detection (up to eight customer alarms per ABM).
- Remote control drive (up to two remote controls per ABM).

4.4.1.2 Bridge function

The ABM assures bridge functions between several interfaces:

- On one side, it manages interface with ICM (one front panel D link or two in case of ICM redundancy),
- On the other side, the bridge manages one internal E link for ABM alarm function and three E links to the RM modules.

The traffic management between all interfaces is automatic and does not need specific configuration. It is kept available whatever the module software status, as long as power is on.

4.4.2 Front panel

Figure 4-11 presents the ABM front panel.
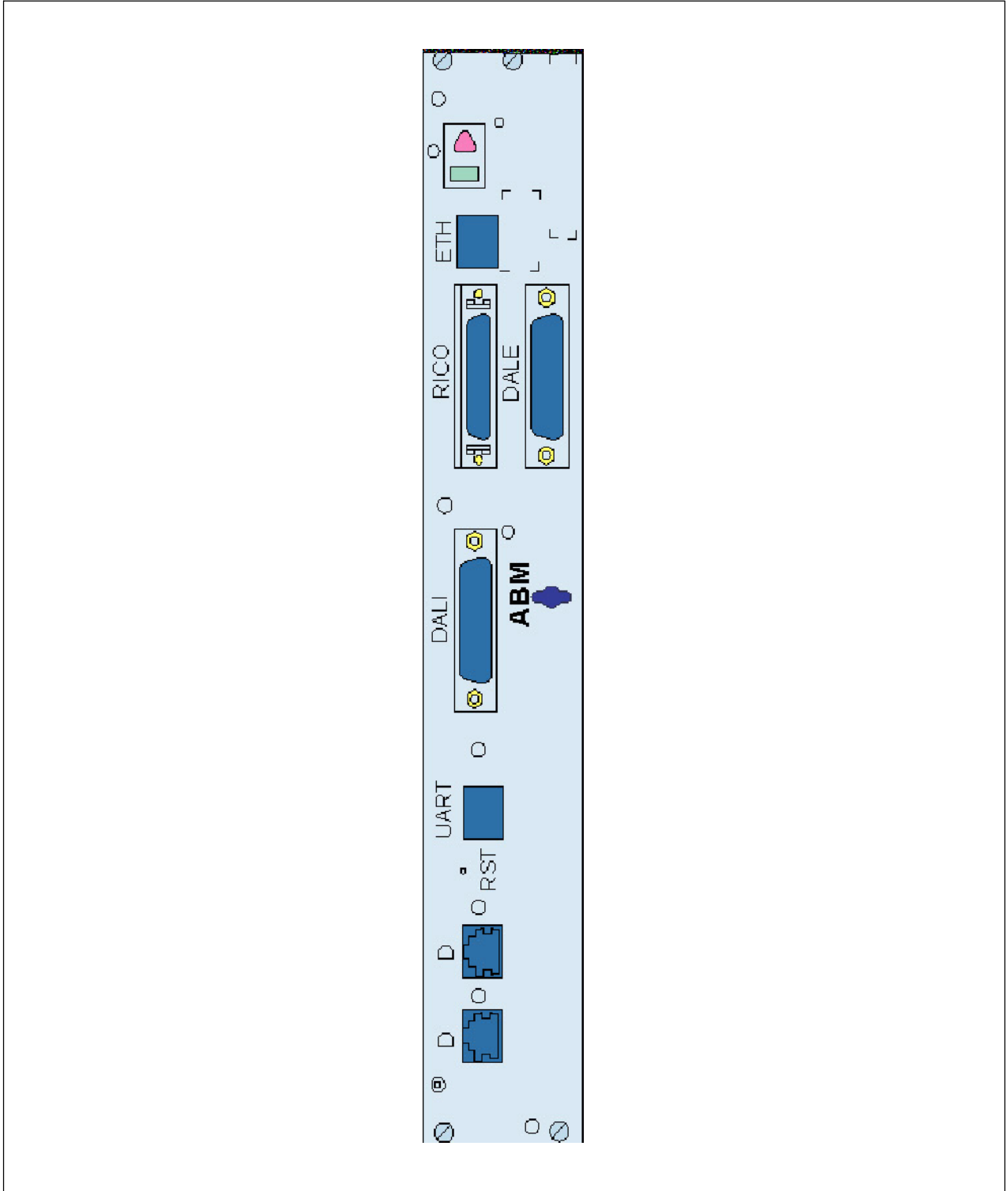
Figure 4-11   ABM front panel

4.4.3   Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth (mm)	Weight (Kg)
ABM	335	50	410	< 1

Table 4–17   ABM dimensions and weight

Maximum number per cabinet:

- 2, in standard BTS18000 cabinet,
- 3, in MCPA BTS18020 cabinet.

Maximum power consumption: 15 W.

Associated breaker: digital breaker.

4.4.4   Interface description

4.4.4.1   Connectors

Table 4–18 indicates the type and the use of the ABM connectors. They are front panel connectors, except for J10, which is a back panel connector.

Debug connector	Use	Type
J6	Ethernet / RS232 debug – ETH	8 pins RJ45 female
Cabinet interface connector	**Use**	**Type**
J21	I2C data / clock, combiner detection, cabinet detection – RICO	SCSI 50 pins female
External alarm connector	**Use**	**Type**
J21	External alarm, remote control – DALE	SUBD 25 pins female
Internal alarm connector	**Use**	**Type**
J20	Internal alarm – DALI	SUBD 25 pins male
UART connector	**Use**	**Type**
J22	UART link – UART	6 pins RJ11 female
Signal connectors (front panel)	**Use**	**Type**
J14	D link (0 or 1) – D	10 pins RJ45 female
J15	D link (0 or 1) – D	
Signal connector (back panel)	**Use**	**Type**
J10	Three E links, detection, inventory	HM1 120 pins female

Table 4–18   ABM connectors type and use

The front panel Debug connector provides the following signals:

- Reset push button,

- debug access (RS232 monitor + 10/100bT).

The Signal front panel connectors provide:

- one D link connectivity from ICM, in case of simplex mode, or two D links connectivity from ICM, in case of redundant mode,

- one spare link over RS422 for future use.

The Internal alarm front panel connector provides:

- even or odd position detection from Radio InterCO panel,

- detection, inventory and alarm of the radio combiners and cabinet modules through booleans, I2C and UART busses,

- collection of cabinet Boolean alarms.

The External, user alarms front panel connector provides:

- collection of external protected Boolean alarms and remote control.

The back panel power connector provides:

- 24/48V wide input range floating supply.

The Signal back panel connector provides:

- three point-to-point E links to the RMs,

- board presence detection, remote power I2C inventory to all digital modules (including ABM itself).

4.4.5   ABM corporate LEDs behavior

Table 4-19 gives ABM detailed status information.

Green LED	Red LED	ABM status
switched off	switched off	un-powered or not inserted (default hardware value)
🟩	🔺	starting, BISTs in progress
🟩	switched off	normal operation – no faults
switched off	🔺	alarm status: abnormal operation – must be removed and replaced
blinking	🔺 or switched off	wait for ICM connection
blinking	blinking	internal downloading

Table 4-19   ABM corporate LEDs behavior

4.4.6   ABM specific LEDs behavior

Table 4-20 gives detailed information on ABM specific LEDs behavior.

LED Name	Color	Meaning
D	🟢	2 LEDs for D activity ON: when the connection to active ICM through the D link related to the LED is correctly established Only one of the 2 D LEDs can be ON
UART	🟢	ON: UART activity (reserved for future use)

Table 4-20   ABM specific LEDs behavior

4.4.7   LEDs behavior at ABM starting up

Table 4-21 gives the behavior of corporate and specific LEDs when ABM starts up.

	ABM boot sequence	ABM BIST	Active ICM connection	ABM downloading	Nominal operation
triangle corporate	🔺	🔺	🔺 or switched off	🔺 blinking	
rectangle corporate	🟩	🟩	🟩 blinking	🟩 blinking	🟩
D			🟢	🟢	🟢

Table 4-21   LEDs behavior at ABM starting up

Note: External alarms do not impact the ABM corporate LEDs management (these LEDs only indicate ABM board alarms).

4.5 Radio Module (RM)

4.5.1 Main functions

The RM is a complete GSM/GPRS/EDGE transmitter/receiver. The RM is in charge of all processing related to the GSM TDMAs. It is designed to support three TDMA (GSM or EDGE). It is logically equivalent to three TRXs (0, 1 and 2).

The RM may operate:

- on a one-sector basis (three carriers per sector, O3 mode),

- on a three-sector basis (one carrier per sector, S111 mode).

Maximum configurations for BTS18000 mono-cabinet with RM are S666, O18 and S99.

4.5.1.1 RX splitter function

The RM integrates a RX splitter function. It is inserted between the DDM and RM RX paths (main and diversity). It allows splitting DDM RX outputs in order to reach maximum configurations (one input to three outputs split for main and diversity paths).

In order to fit both RM configurations (S111 and O3), this function is configurable by RF switches. The commands of switches are provided by the DDM (DC command multiplexed on RF signals on DDM RX outputs and automatic RX splitter configuration by RF connection).

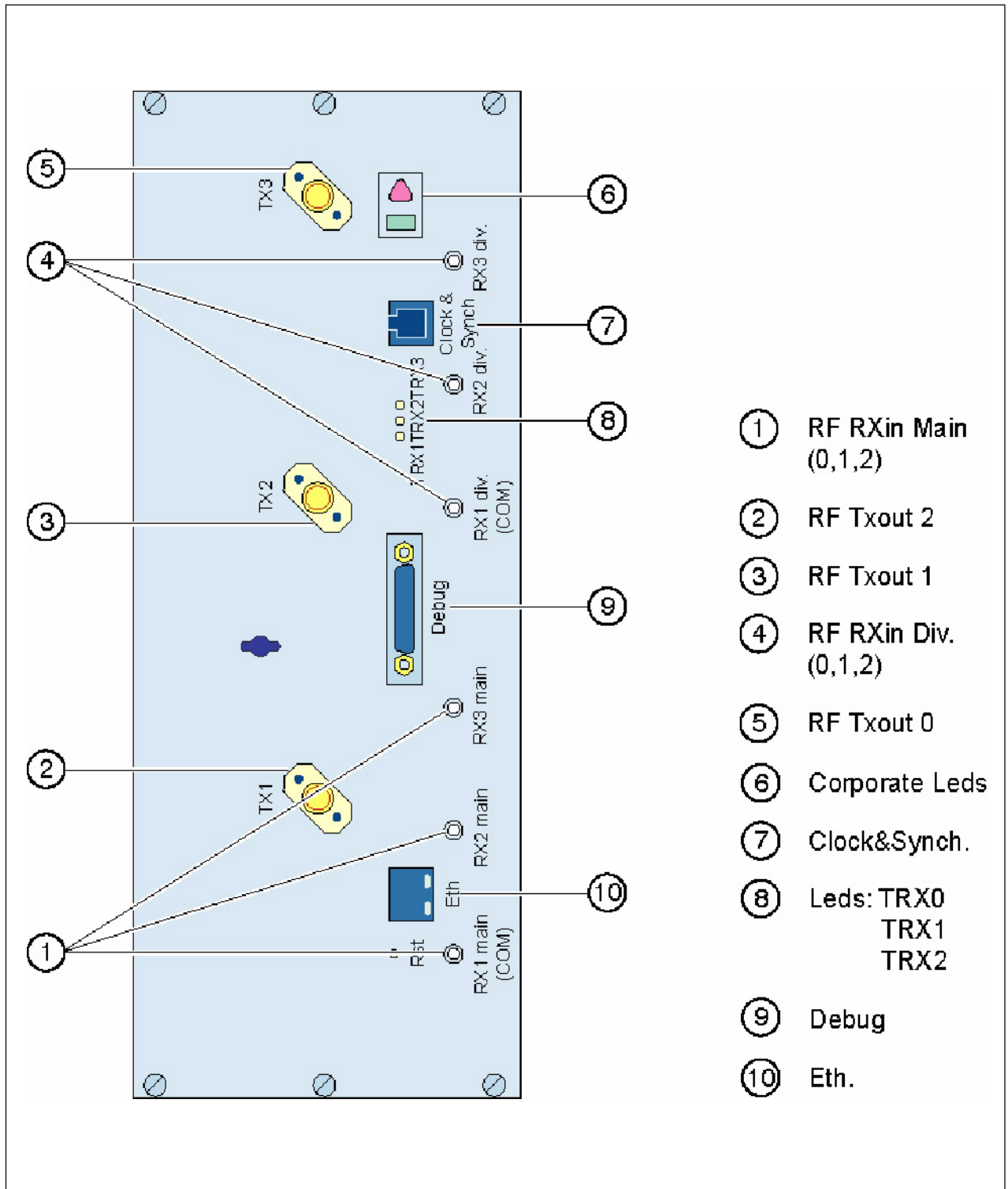### 4.5.2 Front panel

Figure 4-12 presents the RM front panel.

Figure 4-12   RM front panel

4.5.3   Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth (mm)	Weight (Kg)
RM	335	125	410	19

Table 4-22   RM dimensions and weight

Maximum number per cabinet: 6.

Maximum power consumption: 765 W.

Output power:

The RM output power may vary according to the frequency band. The frequency variant of the RM is managed by software thanks to RF board frequency variants detection. *Table 4-23* gives the RM output power for all frequency bands.

RM output power	GSM900	GSM1800	GSM1900
Typical output power (dBm)	46	44.8	44.8
Typical output power (W)	40	30	30
Variation (dB)	+/−0.5	+/−0.5	+/−0.5

Table 4-23   RM output power per frequency band

Associated breaker (one for each group of three RMs):

■ RF0 and RF1 breakers, for BTS18010 cabinet:

    • RM0, RM1 and RM2 on RF0,

    • RM3, RM4 and RM5 on RF1.

■ CB1 RF0 and CB2 RF1 breakers, for BTS18020 cabinet:

    • RM0, RM1 and RM2 on RF0,

    • RM3, RM4 and RM5 on RF1.

4.5.4 Interface description

The RM provides the following interfaces:

- radio interface:
  - three PA outputs, QN type 50 ohms connectors,
  - six RX inputs (three main, three diversity), QMA type 50 ohms connectors,
- digital/power interface on the DBP:
  - 24/48V wide range input power feeder,
  - a point-to-point E link to the ABM,
  - board presence detection and inventory I2C link to the ABM,
  - a point-to-point spare link to each of the two other RMs,
- debug interface:
  - Reset push button,
  - CPU debug access (RS232 monitor + BDM + 10/100bT),
  - DSP debug access,
  - trace access.

4.5.5 RM corporate LEDs behavior

Table 4-24 gives RM detailed status information.

Green LED	Red LED	RM status
switched off	switched off	un-powered or not inserted (default hardware value)
🟩	🔺	starting, BISTs in progress
🟩	switched off	normal operation – no faults
🟩	blinking	module is possibly partially faulty – TRX(s) in fault
switched off	🔺	alarm status: abnormal operation – RM is in fault – must be removed and replaced
blinking	🔺 or switched off	wait for ICM connection

Table 4-24   RM corporate LEDs behavior

4.5.6   RM specific LEDs behavior

4.5.6.1   Ethernet LEDs behavior

The TX (green) and LI (amber) Ethernet LEDs are on the Ethernet connector.

These LEDs are switched off in nominal mode of operation. They are only used for debug purposes.

4.5.6.2   TRX LEDs behavior

Table 4–25 gives detailed information on RM TRX LEDs behavior.

LED Name	Color	Meaning
TRX 0–1–2	🟠	– flashes during SPU cluster download – blinks until BSC connection, including Abis downloading – switched off when TRX is operational – switched on when TRX is in fault

Table 4–25   RM TRX 0–1–2 LEDs behavior

4.5.7   LEDs behavior at RM starting up

Table 4–26 gives the behavior of corporate and specific LEDs when RM starts up.

	RM power up	RM start up	RM BISTs	RM soft start	RM soft init (1/2)	SPU load & start	RM soft init (2/2)	Connection to BCF/Abis downloading	Nominal operation
triangle corporate	🔺	🔺	🔺	🔺					
rectangle corporate	🟩	🟩	🟩	🟩	🟩 blinking	🟩 blinking	🟩 blinking	🟩	🟩
TRX 0–1–2	🟠		🟠			🟠 blinking		🟠 blinking	

Table 4–26   LEDs behavior at RM starting up

4.6 High Power Radio Module (HPRM)

4.6.1 Main functions

The HPRM is a variant of the RM with only a two-TDMA capacity, but with an increased output power. It is logically equivalent to two TRXs (0 and 1).

The BTS18000 with HPRM is only available in GSM900 frequency band, as a first step.

The HPRM can operate on:

- one-sector basis (two carriers per sector, O2 mode),
- two-sector basis (one carrier per sector, S11 mode).

Maximum configurations for BTS18000 mono-cabinet with HPRM are S444, O12 and S66.

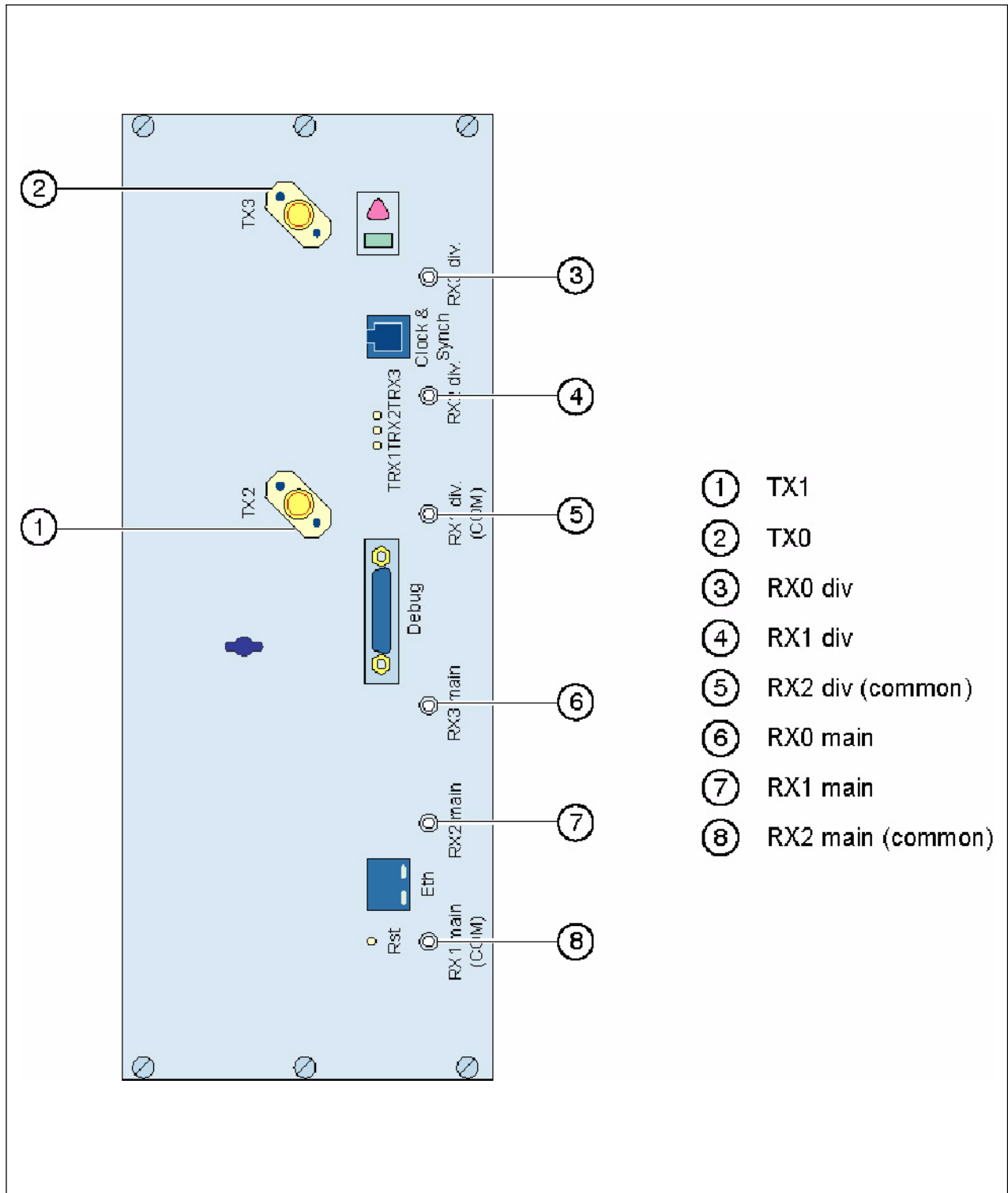### 4.6.2 Front panel

Figure 4-13 presents the HPRM front panel.

BTS18000 Reference Manual

Figure 4-13   HPRM front panel

4.6.3   Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth (mm)	Weight (Kg)
HPRM	335	125	410	19

Table 4–27   HPRM dimensions and weight

Maximum number per cabinet: 6.

Maximum power consumption: 540 W.

Output power: 60W/45W (GMSK/8–PSK) +/– 0.5 dB.

Associated breaker (one for each group of three HPRMs):

■ RF0 and RF1 breakers, for BTS18010 cabinet,

■ CB1 RF0 and CB2 RF1 breakers, for BTS18020 cabinet.

4.6.4   Interface description

The HPRM provides the following interfaces:

■ radio interface:

• two PA outputs, QN type 50 ohms connectors,

• six RX inputs (three main, three diversity), QMA type 50 ohms connectors,

■ digital/power interface on the DBP (the same as for RM),

■ debug interface (the same as for RM).

4.6.5   HPRM LEDs behavior

The HPRM LEDs behavior is identical to the RM LEDs behavior. The TRX2 LED of a HPRM remains always OFF. It is only tested during BISTs.

4.7 Dual Duplexer Module (DDM)

The operator can use different types of couplers to couple the PAs to the antennas and to combine the RX and TX paths:

- duplexers,
- transmit filters,
- hybrid combiners.

These couplers can be found in the following BTS18000 modules:

- DDM or DDM with optional H2 coupling, both including an optional VSWR meter,
- TXF or TXF with optional H2 coupling, both including an optional VSWR meter.

4.7.1 Main functions

The DDM allows to share TX and RX signals on a same antenna. The DDM is aimed at providing:

- TX filtering (noise suppression),
- RX filtering (noise suppression),
- TX to RX isolation,
- front end low noise amplification for the receive chain.

The DDM provides two separate RX paths with four outputs per chain. It also provides two transmit inputs (two transmit carrier's capacity). The DDM is used in a sector basis with one duplexer for main receive path and the other one for diversity receive path.

4.7.1.1 H2 coupling option

In addition, in order to increase the transmit capacity of the DDM, integrated 2-way hybrid combiners (H2 coupling) are proposed as an option for the DDM. These combiners can be by-passed. A front panel switch allows informing the system of the current DDM H2 configurations (2-way hybrid by-passed or not).

4.7.1.2 VSWR meter option

As an option, the DDM integrates a VSWR meter on both antenna accesses. This VSWR meter provides three levels of alarms. The corresponding thresholds of alarms are settable on site, through DDM front panel switches.

The DDM provides a presence detection signal to the ABM. The DDM is also connected to the ABM through a I2C bus. This bus allows ABM to collect alarms, inventory information, and to read VSWR thresholds settings.

The DDM operates on 24V/-48V main power supply through the RICO board. In addition, the DDM provides the RICO board with:

■ a DC signal of 3.3V, in order to power supply the inventory circuitry of the associated SICS (BTS18010) or ECU (BTS18020),

■ a DC signal of 5V, in order to power supply the associated TXF (VSWR meter and inventory circuitry).
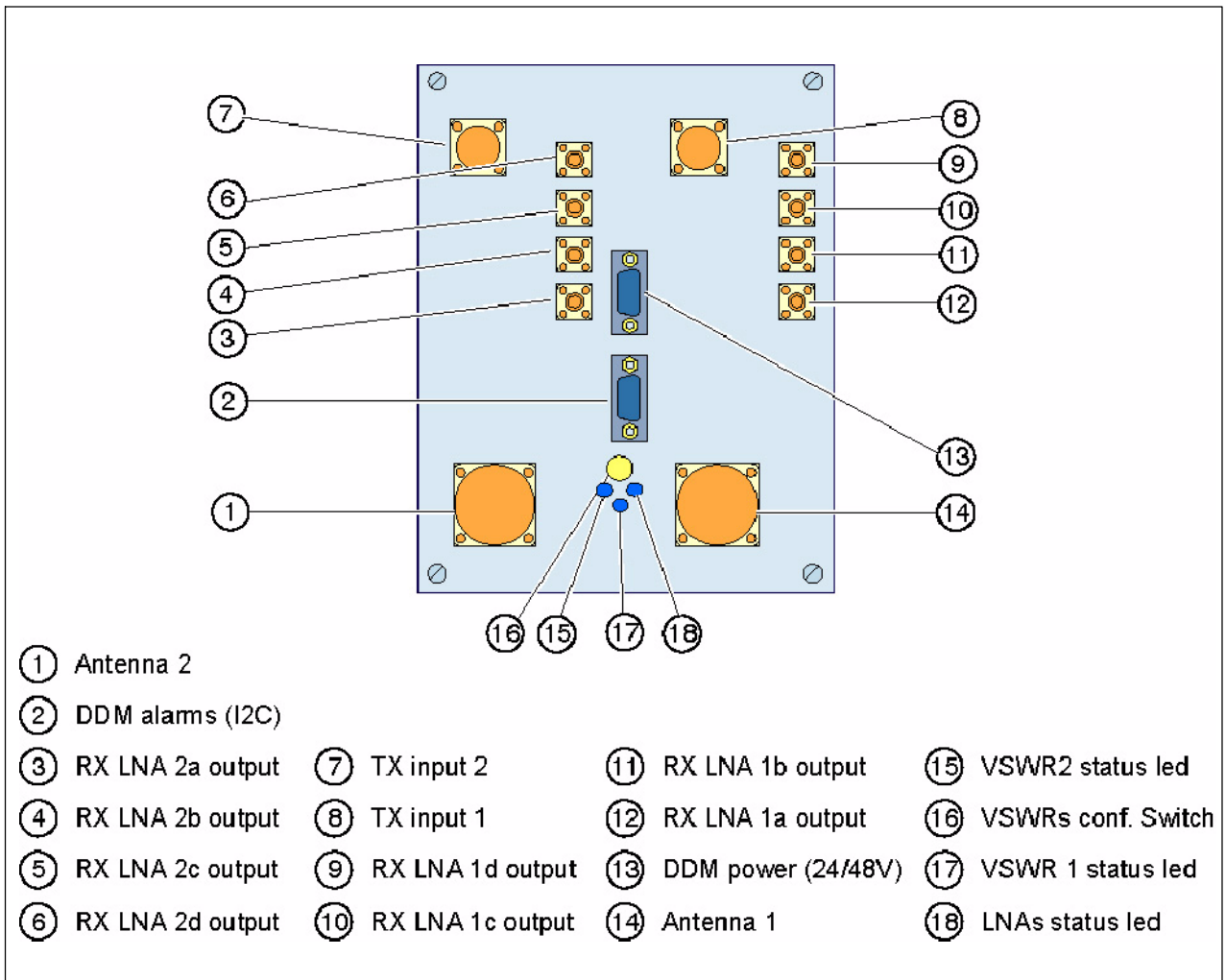
4.7.2   Front panel

4.7.2.1   DDM

① Antenna 2			
② DDM alarms (I2C)			
③ RX LNA 2a output	⑦ TX input 2	⑪ RX LNA 1b output	⑮ VSWR2 status led
④ RX LNA 2b output	⑧ TX input 1	⑫ RX LNA 1a output	⑯ VSWRs conf. Switch
⑤ RX LNA 2c output	⑨ RX LNA 1d output	⑬ DDM power (24/48V)	⑰ VSWR 1 status led
⑥ RX LNA 2d output	⑩ RX LNA 1c output	⑭ Antenna 1	⑱ LNAs status led

Figure 4–14   DDM front panel
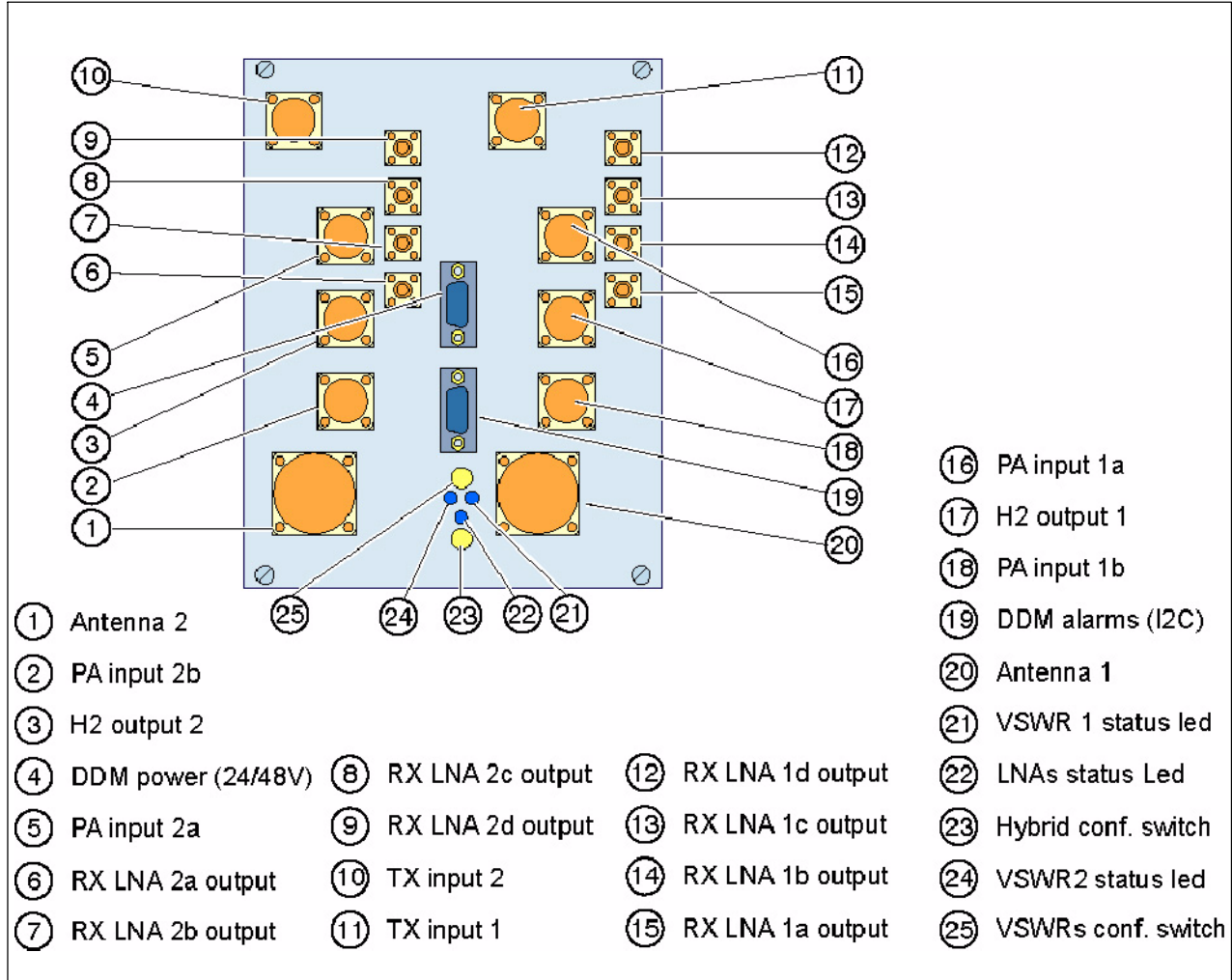
4.7.2.2   DDM H2

Figure 4-15   **DDM H2 front panel**

4.7.3   Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth (mm)	Weight (Kg)
DDM / DDM H2	190.7	149.7	400	11

Table 4-28   DDM / DDM H2 dimensions and weight

Maximum number per cabinet: 6.

Maximum total power consumption:

- 21 W, for GSM1800 and GSM1900,

- 35 W, for others.

Input voltage range: 20 V - 60 V.

Associated breaker:

- Digital breaker (BTS18010),

- CB3 digital/RICO/user breaker (BTS18020).

4.7.4   Interface description

The DDM provides the following interfaces:

- radio interface:

  - antenna ports: two 7/16 coaxial 50 ohms connectors,

  - TX input ports: two QN type 50 ohms connectors,

  - RX outputs: eight QMA type 50 ohms connectors,

- digital/power interface:

  - 24/48V wide range input power feeder,

  - board presence detection and inventory I2C link to the ABM.

4.7.5   DDM specific LEDs behavior

Three LEDs are located on the DDM font panel in order to monitor DDM internal alarm:

- one LED is dedicated to LNAs,
- two LEDs are dedicated to VSWR meter:
  - one for antenna 1 port,
  - one for antenna 2 port.

Table 4-29 describes the DDM specific LEDs behavior.

LED Name	Color	Meaning
LNA	🟢	ON when DDM is powered on
VSWR1	🔴 🟠	Red: Port 1 VSWR alarm level 3 Amber: Port 1 VSWR alarm level 2 OFF: no alarm or level 1
VSWR2	🔴 🟠	Red: Port 2 VSWR alarm level 3 Amber: Port 2 VSWR alarm level 2 OFF: no alarm or level 1

Table 4-29   DDM specific LEDs behavior

4.7.6   Configuration of the DDM switches for commissioning

Two four-position rotate switches are located on the DDM front panel (see *Figure 4-15*).

These switches must be positioned on site:

- The hybrid configuration switch (only present on DDM H2) is used to inform the system about the use of the two 2-way hybrid (by-passed or not).

Table 4-30 gives the switch position meaning.

Hybrid configuration switch	Switch position
DDM with two hybrids	0
DDM with hybrid 1 connected	1
DDM with hybrid 2 connected	2
DDM without hybrid	3

Table 4-30   DDM switches configuration

- The VSWR switch (only on DDMs with VSWR option) allows modifying, on site, the VSWR meter thresholds on both antenna ports. The three first positions (positions 0, 1 and 2) are used to offset VSWR thresholds of respectively 0, 2 or 4 dB.

  The fourth position (test position) checks that the three LEDs operate correctly.

4.8   Transmit Filter (TXF)

4.8.1   Main functions

The TXF is used, as a complement of the DDM, each time extra transmit capacity is required without need of receive capacity. It allows direct connection from the RM PA output to the antenna.

The TXF only filters the signal transmitted from the PA to the antenna and does not provide the reception path.

The TXF accommodates the same options as the DDM:
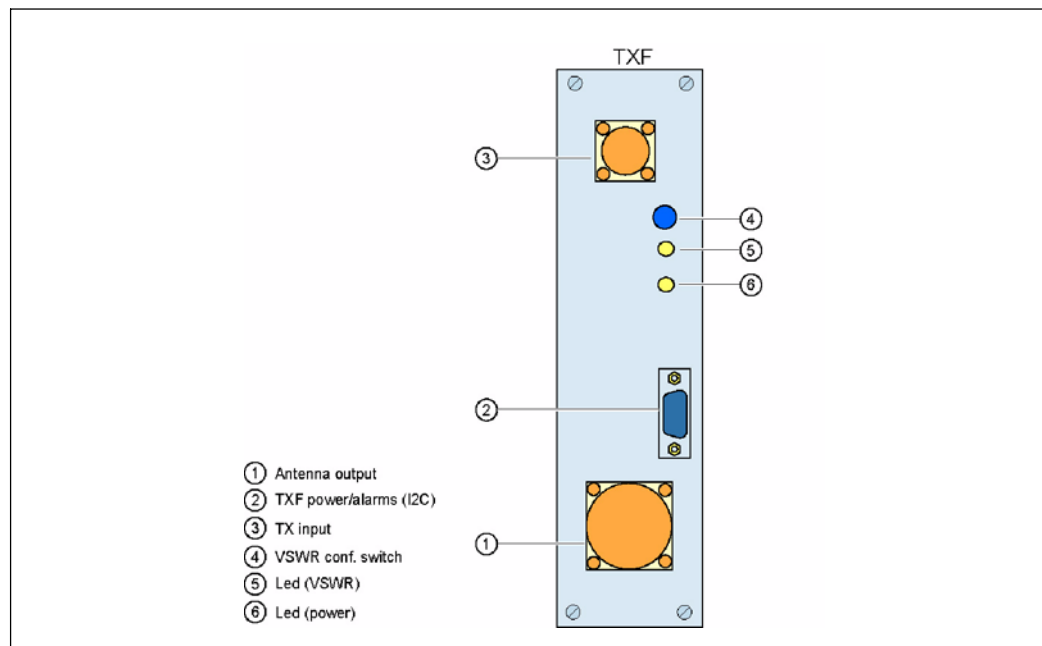
■ H2 coupling,

■ VSWR meter.

4.8.2   Front panel

4.8.2.1   TXF

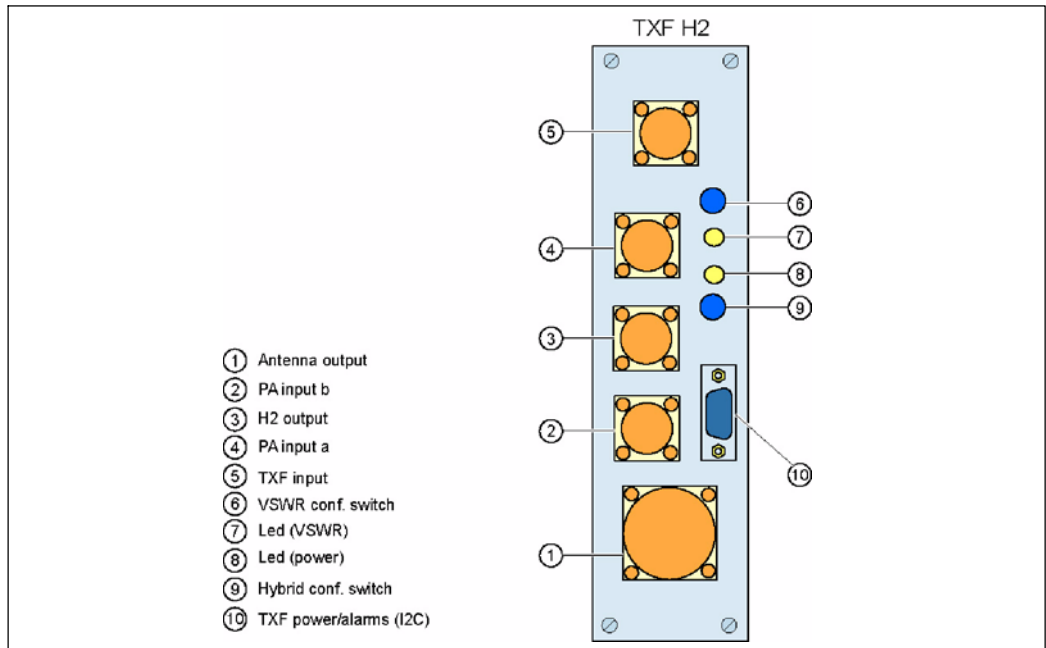**Figure 4-16   TXF front panel**

4.8.2.2 TXF H2

Figure 4-17   TXF H2 front panel

4.8.3   Physical and electrical characteristics

Module name	Height (mm)	Width (mm)	Depth (mm)	Weight (Kg)
TXF / TXF H2	190.7	49.7	400	< 5

Table 4-31   TXF / TXF H2 dimensions and weight

Maximum number per cabinet: 18.

Maximum power consumption:

- 0.6 W, on RF voltage (5 V). This power is supplied by the DDM.

Input voltage range:

- 4.7 V - 5.5 V.

Associated breaker: digital breaker.

4.8.4 Interface description

The TXF provides the following interfaces:

- radio interface:
  - antenna port: one 7/16 coaxial 50 ohms connector,
  - TX input port: one QN type 50 ohms connector,
- digital/power interface:
  - board presence detection and inventory I2C link to the ABM.

4.8.5 TXF specific LEDs behavior

Two LEDs are located on the TXF font panel in order to monitor TXF alarm:

- one LED is dedicated to DC power status,
- one LED is dedicated to VSWR meter.

Table 4-32 describes the TXF specific LEDs behavior.

LED Name	Color	Meaning
Power	🟢	ON when TXF is powered on
VSWR	🔴 🟠	Red: VSWR alarm level 3 Amber: VSWR alarm level 2 OFF: no alarm or level 1

Table 4-32 TXF specific LEDs behavior

4.8.6 Configuration of the TXF switches for commissioning

Two switches are located on the TXF front panel (see *Figure 4-17*). These switches must be positioned on site:

- The hybrid configuration two-position switch (only present on TXF H2) is used to inform the system about the use of the hybrid (by-passed or not).

Table 4-33 gives the switch position meaning.

Hybrid configuration switch	Switch position
TXF with hybrid	0
TXF without hybrid	1

Table 4-33 TXF switches configuration

- The VSWR four-position switch allows modifying, on site, the VSWR meter thresholds on both antenna ports. The three first positions (positions 0, 1 and 2) are used to offset VSWR thresholds of respectively 0, 2 or 4 dB.

  The fourth position (test position) checks that the two LEDs operate correctly.

10   DIMENSIONING AND CONFIGURATION RULES

For information on dimensioning and configuration, refer to the following engineering document: GSM/GPRS/EDGE BSS Engineering Rules (PE/DCL/DD/0138).

Wireless Service Provider Solutions
BTS18000 Reference Manual

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