Hytera
Respond & Achieve

ACCESSNET®-T IP
DIB-R5 advanced

Digital Integrated Base Station
Operation Manual

90DIBR5advancedOM02 - 1.0

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Read the instructions thoroughly prior to performing any tasks!

Keep these instructions for reference.

Subject to change without notice. Data without tolerance limits is not binding.

Table of contents

1 Notes on the document

This chapter provides information on using the document. In addition, it specifies requirements that are absolutely necessary when working with the product.

1.1 Objectives of the document

The present document from Hytera Mobilfunk GmbH describes the procedures that are required for the activities on and with the product:

- Operation
- Service interruption
- Recommissioning
- Maintenance

In this context, it describes the relevant safety regulations as well as the components and operation of the product that is used in the ACCESSNET-T IP mobile radio system.

1.2 Intended audience of the document

The present document reverts to all the persons, who:

- operate an ACCESSNET-T IP TETRA mobile radio system
- commission and decommission the product
- maintain the product

Each person commissioned with performing the tasks mentioned above with or on the system must have read and understood the present document and the associated accompanying documentation.

1.3 Qualification of the personnel

Only experts are permitted to perform the tasks described in the present document. The experts must be authorized to perform these tasks.

Experts are persons, who:

- are trained and experienced in the corresponding field.
- are familiar with the applicable standards, regulations and provisions associated with the corresponding task.

1.4 Reading and navigation aids in the document

As reading and navigation aids, overview tables have been provided at the beginning of the respective chapters in the present document. These are to provide the reader with an overview of the tasks to be performed. In addition, they indicate the order in which the tasks are to be performed. When you have completed a work step, always navigate to the next work step via the overview table to ensure that the tasks are performed in the correct order. The overview tables are useful for readers of the printed document (indication of the corresponding chapters) as well as for readers of a PDF document at the PC (via active cross-references to the corresponding chapters).

1.5 Figures and special notations used

Figures and symbols are used in the present document. They are used to illustrate the product and to emphasize particular pieces of information.

1.5.1 Figures used

The figures used in this document show the product, if necessary in a simplified form for clarity (e.g. technical drawings). They refer to different product designs. If not described otherwise, the respective figure relates to the standard product design.

1.5.2 Special notations

The special forms of notation described below are intended to make it easier to understand the information. They emphasize specific pieces of information, help you to recognize this information fast and take corresponding measures.

1.5.2.1 Operating procedures

The present document describes the tasks that have to be performed in the form of operating procedures. Standard operating procedures guide you step by step through a sequence of actions until you have reached the desired goal.

Example of a sequence of actions:

Goal of the actions

Preparation:

- List of the prerequisite(s) for an action
- ...

1. Description of the first of several work steps.
   ⇨ A possible result of the work step just performed.
2. Description of the second work step.

➔ Confirmation: Results of the entire sequence of actions.

1.5.2.2 Safety instructions used

Safety instructions in this document point to a hazard that may put persons or the product/system at risk.

Within a safety instruction, the following items are brought to your attention:

- Type of hazard
- Source of hazard
- Measures to be taken to avert the specified hazard

Shown below are four security advice symbols which indicate the severity of the danger by means of different keywords (danger, warning, caution, attention). The symbols shown may vary depending on the nature and source of the danger.

⚠ DANGER

This symbol identifies security instructions

You are warned of an imminent danger for the life or health of persons.

➔ The arrow identifies a precautionary measure designed to avert this danger.

⚠ WARNING

This symbol identifies security instructions

You are warned of a potential hazard for the life or health of persons.

➔ The arrow identifies a precautionary measure designed to avert this danger.

⚠ CAUTION

This symbol identifies security instructions

You are warned of a potentially hazardous situation for the life or health of persons.

➔ The arrow identifies a precautionary measure designed to avert this danger.

NOTICE

This symbol identifies security instructions.

You are warned of a hazard for the product.

➔ The arrow identifies a precautionary measure designed to avert this danger.

1.5.2.3 General instructions used

General instructions provide supplementary and useful information.

Important Information

This symbol identifies information that may assist in handling and using the product. This includes references to further information.

1.5.2.4 Text formatting used

The following table provides an overview of the text formats used and describes the significance of these formats.

Text formatting used

Text formatting	Description	Example
Example	Identifies components of the user interface of software components such as network management clients (NMC).	Buttons, dialogs etc.
Example	Identifies required inputs.	Passwords, IP addresses etc.
`Example`	Identifies outputs.	Panel outputs etc.

1.6 Further applicable documents

Apart from the present documentation, the scope of delivery of the product includes additional documents. In addition to the contents of the present documentation, all the other documents associated with the product must always be taken into consideration. They are mandatory for the use of the product. If required, revert to Hytera Mobilfunk GmbH to request the other applicable documents.

These are:

- DIB-R5 advanced Technical Data,
  describe the technical properties of the product.
- DIB-R5 advancedSite Requirements,
  describe the requirements for the site where the product is used.
- DIB-R5 advanced Installation Manual
  describes the proper setup and electric connection of the product at the site.
- DIB-R5 advanced Configuration Manual,
  describes the configuration of the product.
- DIB-R5 advancedService and Maintenance manual,
  describes the maintenance and care of the product and the replacement of the components installed in the product
- Requirement Manual IP/VoIP
  describes the requirements for securing the IP communication within ACCESSNET-T IP mobile radio networks as well as outside, e.g. via VoIP telephone systems (Voice-over-IP, VoIP).
- ACCESSNET-T IP Service Computer Configuration Manual
  describes the configuration of the service computer that is used for the installation and commissioning of network constituents of the ACCESSNET-T IP as well as for service and maintenance purposes.
- User manuals of network management clients
  provides information required for proper operation of the product and support troubleshooting.
  The user manuals for the following products must be observed:
  - NMC-511 FaultManager
  - NMC-515 ConfigurationManager
- Open Source Acknowledgement
  contains information on the respective Open Source software the product comprises, including the information on the license(s) used and the related license agreements.
- ACCESSNET-T IP Versions
  contains information about all versions that are valid for the present PV, such as component versions of software components or document versions.
- project-specific documents such as the "Base Design" document, where applicable,
  describes the implemented network and the associated properties and requirements.

Further applicable documents

Please also heed the documentation of the third-party devices connected to the product to prevent negative effects or problems with product.

1.7 Support information

If you have any questions or proposals with regard to the products of Hytera Mobilfunk GmbH, please revert to your local service partner or directly to Hytera Mobilfunk GmbH.

For a fast and cost-effective solution of any technical problems that come up during the operation of your ACCESSNET-T IP mobile radio system, Hytera Mobilfunk GmbH offers support contracts upon request. For information on this topic, please also revert to your local service partner or directly to Hytera Mobilfunk GmbH.

Product training courses assist you in making use of the full scope of features and capabilities of your ACCESSNET-T IP mobile radio system. For information on the training program of Hytera Mobilfunk GmbH, please revert to our responsible service partner, to your local Hytera branch office or directly to Hytera Mobilfunk GmbH.

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2 Safety regulations

This chapter describes the safety regulations relevant for using the product DIB-R5 advanced.

2.1 Intended use

The product is exclusively designed for being used as a professional TETRA base station. In this application it is used for the wireless communication between subscribers equipped with the corresponding mobile stations as well as for switching calls and transferring data between subscribers within a TETRA (Terrestrial Trunked Radio) network.

Intended use also includes that:

- all the security instructions set forth in the product documents are always heeded,
- all the maintenance tasks described are performed in the interval specified,
- the general, national and in-house safety regulations are heeded.

Any other use is impermissible.

The product is not used as intended, for example, if:

- the requirements described in the product documents haven't been met and instructions are disregarded,
- the product is modified structurally or technically without the approval of Hytera Mobilfunk GmbH,
- replacement parts are used that differ from the components installed by default.

The operator of the product is responsible for damage to the product or damage caused by the product if the product was used beyond the intended application range and/or was not used as intended.

2.2 Safety measures

All the regulations specified in the following must be adhered to without fail:

- If extension cables or multiple socket outlets are used, make sure that they are inspected for proper condition periodically.
- After any security-related parts have been replaced (e.g. power switch or circuit breakers) a security check must be performed (visual inspection, protective grounding conductor load, leakage resistance, leakage current measurement, function test).
- Observe other task-related security measures and requirements in the standard operating procedures.

Heed the security labeling!

In addition to the safety notices described within the product documentation, all safety labels attached in and on the product must be observed. They point out potential hazardous areas and must neither be removed nor changed.

2.2.1 Authorized personnel

The product may only transported, set up/installed, connected, commissioned, operated and maintained by experts who know and follow the respective valid safety and installation regulations.

The experts must be authorized to perform the required tasks by the person responsible for the security in the enterprise of the network operator.

Experts are persons who:

- are trained and experienced in the corresponding field,
- are familiar with the relevant standards, regulations, provisions and security codes,
- have been instructed in the mode of operation and the operating conditions of the equipment components,
- can identify and avert dangers.

Depending on the tasks to be performed, the following user groups are distinguished:

- operators who
  - operate the product,
  - monitor, interrupt, terminate and restore operation of the product.
- Service personnel: persons who perform the following in addition to the tasks of the operator:
  - set up the product,
  - prepare and restore the operational state,
  - adjust and/or parameterize the product,
  - maintain, care for, and repair the product.

2.2.2 Electromagnetic compatibility

For function-related reasons, increased electromagnetic radiation may occur with specific products, e.g. HF radio systems. Taking into consideration that unborn life is increasingly worthy of being protected, pregnant women should be protected through appropriate measures. People with personal medical devices such as cardiac pacemakers and hearing aids can also be endangered by electromagnetic radiation. The operator is obliged to assess workplaces with a considerable risk of exposure to radiation and to avert any hazards.

2.2.3 Notes on the electrical system

The product may be operated only in the operational states specified by the manufacturer without impairment of the ventilation.

Make sure that all the security measures on the equipment, on the connecting cables and on the load have been taken. Electrical connections may be made/disconnected only when neither voltage nor current is applied to the equipment. Voltage may still be present on the outputs of the equipment after the device has been switched off.

Only perform those tasks described in the documents included in the scope of delivery of the product.

2.3 Safety and responsibility

The following chapter lists all relevant security notices for the safe handling of the product. The listed security notices must be followed for all operations on the product.

Observing the product documentation

The product documentation is part of the product and an important component in the security concept. Its non-observance can result in serious injuries or even death.

➔ Read the product documentation and always follow all described procedures and warning notices.

➔ Always keep the product documentation next to the product.

➔ Pass on the product documentation to all subsequent users.

2.4 Safety markings

The following chapters describe security markings on the product and its packaging.

2.4.1 Safety markings on the product

The product is equipped with security markings. They serve as an indication to possible hazards and may not be deleted or modified (if necessary, marking in accordance with DIN 4844 BGV A8 [VBG 125]).

2.4.2 Safety markings on transport boxes

To protect against improper handling of the product during a transport, the transport boxes and the product itself are fitted with corresponding security markings to call attention to proper handling.

Transport inspection using impact indicators

To check whether a product was properly transported, the transport boxes are fitted with impact indicators. The impact indicator shows heavy impacts or vibrations that were caused by an improper transport.

The following chapters describe the used security markings and indicate that the corresponding instructions must be followed.

2.4.2.1 Safety marking "Fragile"

The security marking "Fragile" points to the necessary protection of the product against shock. Transport boxes with this marking must absolutely be protected against shock.

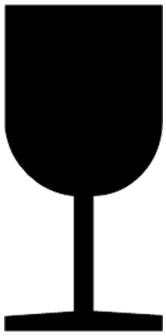

Figure 1: Safety marking "Fragile"

2.4.2.2 Safety marking "Transport Upright"

The security marking "Transport Upright" points to the cover of the transport box. Transport boxes with this marking must always be transported with the cover at the top.

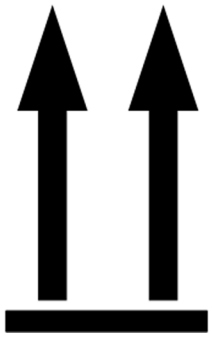

Figure 2: Safety marking "Transport Upright"

2.4.2.3 Safety marking "Keep dry"

The security marking "Keep dry" points to the necessary protection of the product against wetness (e.g. rain, high humidity during the transport in closed vehicles/containers and/or formation of condensate when covered with a tarpaulin). Transport boxes with this marking must absolutely be protected against any wet influences.

Figure 3: Safety marking "Keep dry"

Safety markings > Safety markings on transport boxes

3 Product description

The DIB-R5 base station family is a constituent of the TETRA mobile radio system ACCESSNET-T IP and ensures the powerful and reliable mobile radio coverage of a specific area. Trendsetting TETRA Release 2 and TETRA Enhanced Data Service (TEDS) support make the DIB-R5 extremely attractive for all scenarios in which a high degree of availability as well as high speed data are a must. The TEDS data transmission allows transferring up to 150 kbit/s (gross bit rate) securely and reliably via the air interface.

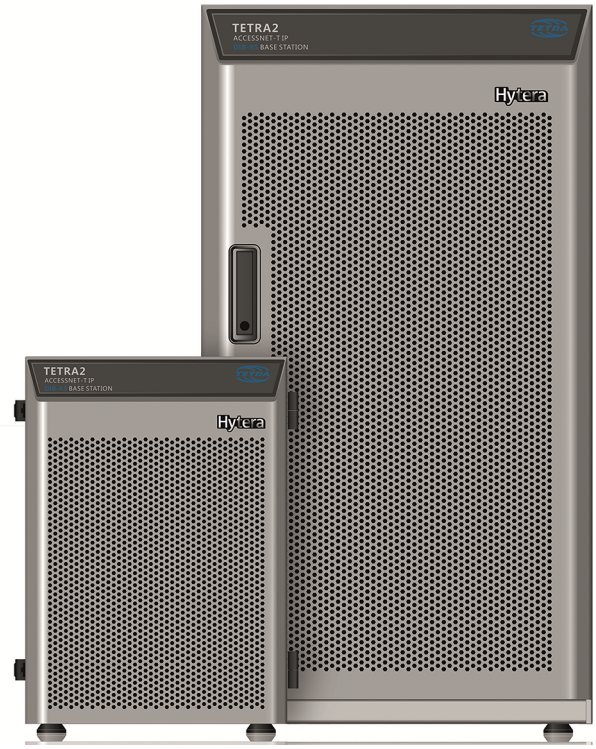

Figure 4: DIB-R5 family

The different variants of the DIB-R5 base station family meet the customer and network requirements in a perfect way. The following variants of the DIB-R5 are available:

- DIB-R5 advanced
  The DIB-R5 advanced offers up to eight TETRA carriers with cavity combiner. DIB-R5 advanced consists of one or two equipment racks depending on the number of carriers.
- DIB-R5 compact
  The DIB-R5 compact offers up to two TETRA carriers with hybrid combiner. DIB-R5 compact is suitable for space-saving installation in existing 19" equipment racks.

The hardware design of DIB-R5 features a modular layout. This allows hardware components to be replaced or added during ongoing operation.

In each equipment rack DIB-R5 advanced offers space for four TETRA Channel Units (CHU), which are each providing one TETRA carrier. By using a second equipment rack, up to eight carriers are supported. Thus offers DIB-R5 advanced a maximum of 32 radio channels to the radio subscribers that can be used simultaneously. To increase the availability, DIB-R5 advanced can be equipped with different redundancy options to avoid "Single Points of Failure". On the hardware side, the transceivers, control unit and voltage supply can be designed redundantly. Furthermore, additional software-based redundancy options are available that further increase the reliability of features.

DIB-R5 advanced supports different system configurations of the antenna coupling system, including motor-tuned cavity combiner. This enables individual and fast remote frequency change. In addition, DIB-R5 advanced supports for optimal reception triple diversity. This optimizes the radio characteristic of the base stations and reduces the number of base stations that are required for covering a certain area.

DIB-R5 advanced can be configured depending on customer requests and network requirements and expanded e.g. through additional carriers. This allows the mobile radio network to be adapted accordingly to meet new requirements and protect the current investment.

For time synchronization, the DIB-R5 advanced compact can be operated optionally with satellite-based synchronization, e.g. GPS, Galileo and Glonass (Global Navigation Satellite System, GNSS).The continuous operation is also supported without satellite-based synchronization sources. This allows a reliable operation even in underground areas or within buildings without the need of using an antenna for the reception of a satellite signal.

The following figure shows the front view of the DIB-R5 advanced with four TETRA Channel Units (CHU) and DUPLEXER. The following table describes the components in greater detail.

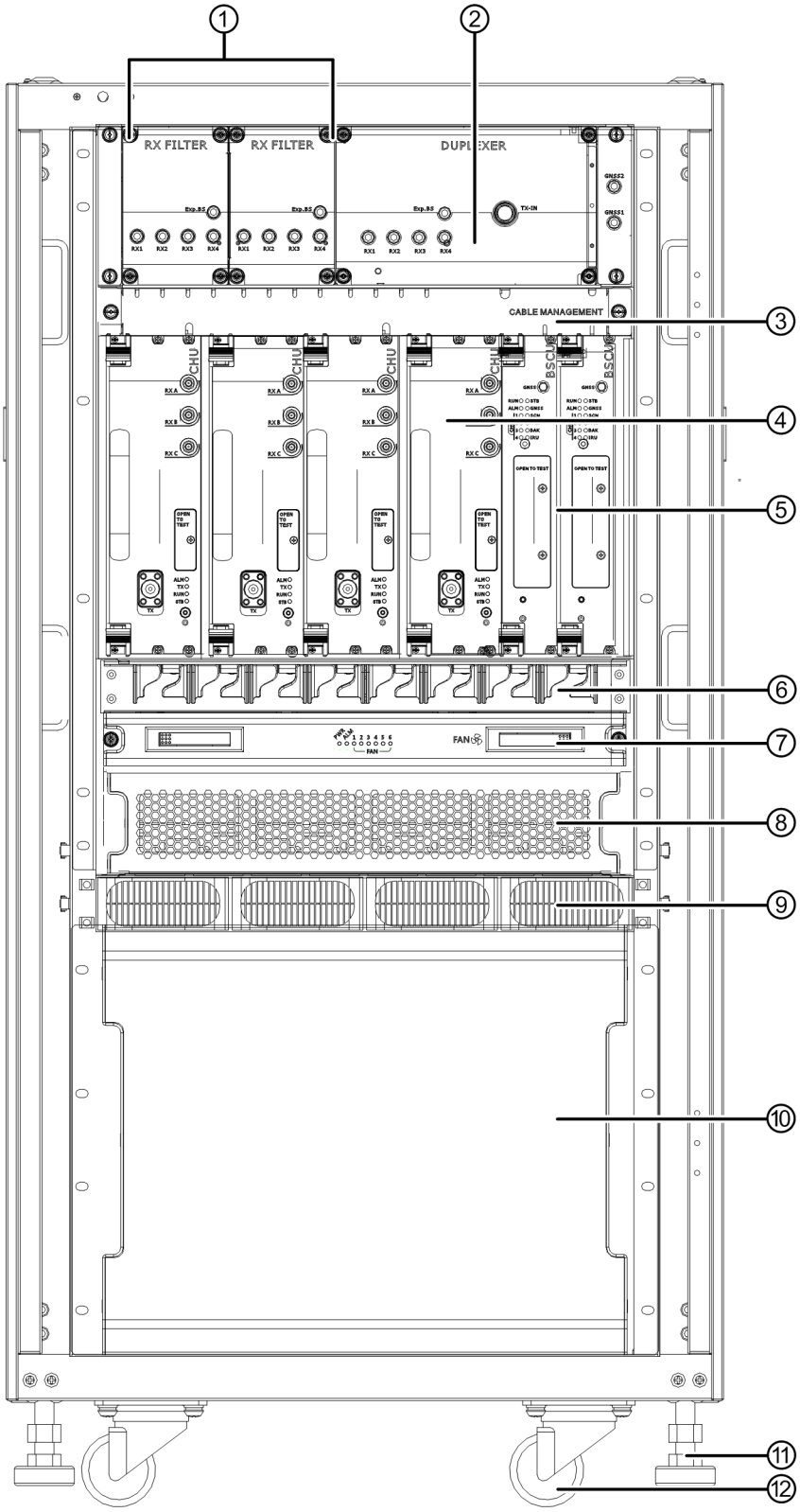

Figure 5: DIB-R5 advanced (front view)

Legend: DIB-R5 advanced (front view)

No.	Component	Number	Described in
1	RX FILTER	1 to 3	*Chapter 3.2.4.1 “RX FILTER” on page 38*
2	DUPLEXER	1	*Chapter 3.2.5.1 “DUPLEXER” on page 40*
3	Cable routing for Rx and GNSS cable (Global Navigation Satellite System, GNSS)	1	---
4	TETRA Channel Unit (CHU)	1 to 4	*Chapter 3.2.6 “TETRA Channel Unit (CHU)” on page 42*
5	Base Station Controller Unit (BSCU)	1 to 2	*Chapter 3.2.7 “Base Station Controller Unit (BSCU)” on page 44*
6	Cable routing for Tx cable	1	---
7	Fan unit	1	*Chapter 3.2.9 “Fan unit” on page 50*
8	Air entry for fan unit	1	---
9	Power Supply Unit (PSU) including Power Supply Module (PSM) Dummy plate for V_{DC} voltage supply	1 to 4	*Chapter 3.2.2.2 “Power Supply Unit (PSU) including Power Supply Module (PSM)” on page 33*
10	Cavity combiner	1	*Chapter 3.2.10 “Cavity combiner” on page 51*
11	Levelling feet	4	---
12	Transport rollers	4	---

The following figure shows the top view of the DIB-R5 advanced. The following table describes the components in greater detail.

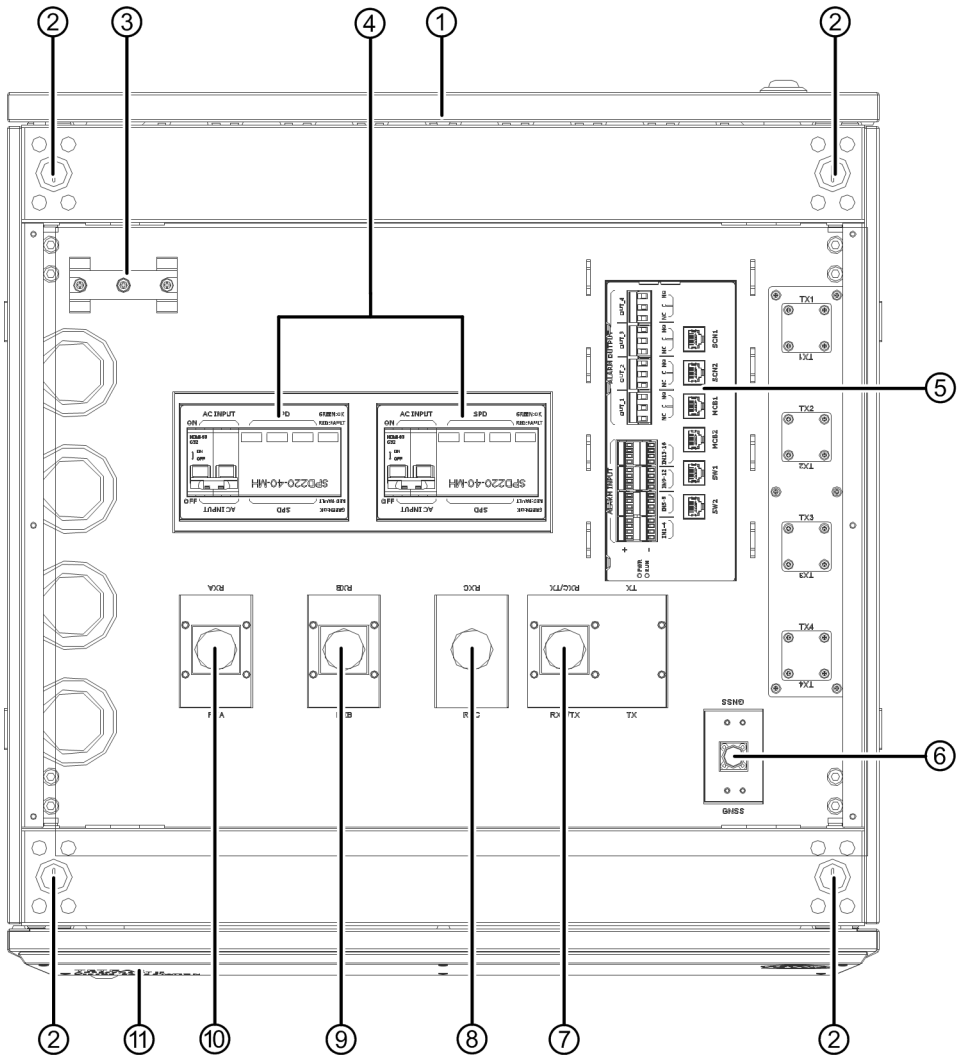

Figure 6: DIB-R5 advanced (top view)

Legend: DIB-R5 advanced (top view)

No.	Component	Number	Described in
1	Rear equipment rack door	1	---
2	Lifting rings	4	---
3	Cable fastening for voltage supply cable	1	---
4	■ AC Power Distribution Module (APDM) ■ DC Power Distribution Module (DPDM)	1 to 2	■ *Chapter 3.2.2 “V_{AC} voltage supply” on page 31* ■ *Chapter 3.2.3 “V_{DC} voltage supply” on page 35*

No.	Component	Number	Described in
5	Connection panel	1	*Chapter 3.2.1.2 “Connection panel” on page 29*
6	GNSS splitter	1	*Chapter 3.2.1.3 “GNSS splitter” on page 31*
7	TX/RXC	1	---
8	RXC – optional	1	---
9	RXB	1	---
10	RXA	1	---
11	Front equipment rack door	1	---

The following figure shows the rear view of the DIB-R5 advanced with opened equipment rack door. The following table describes the components in greater detail.

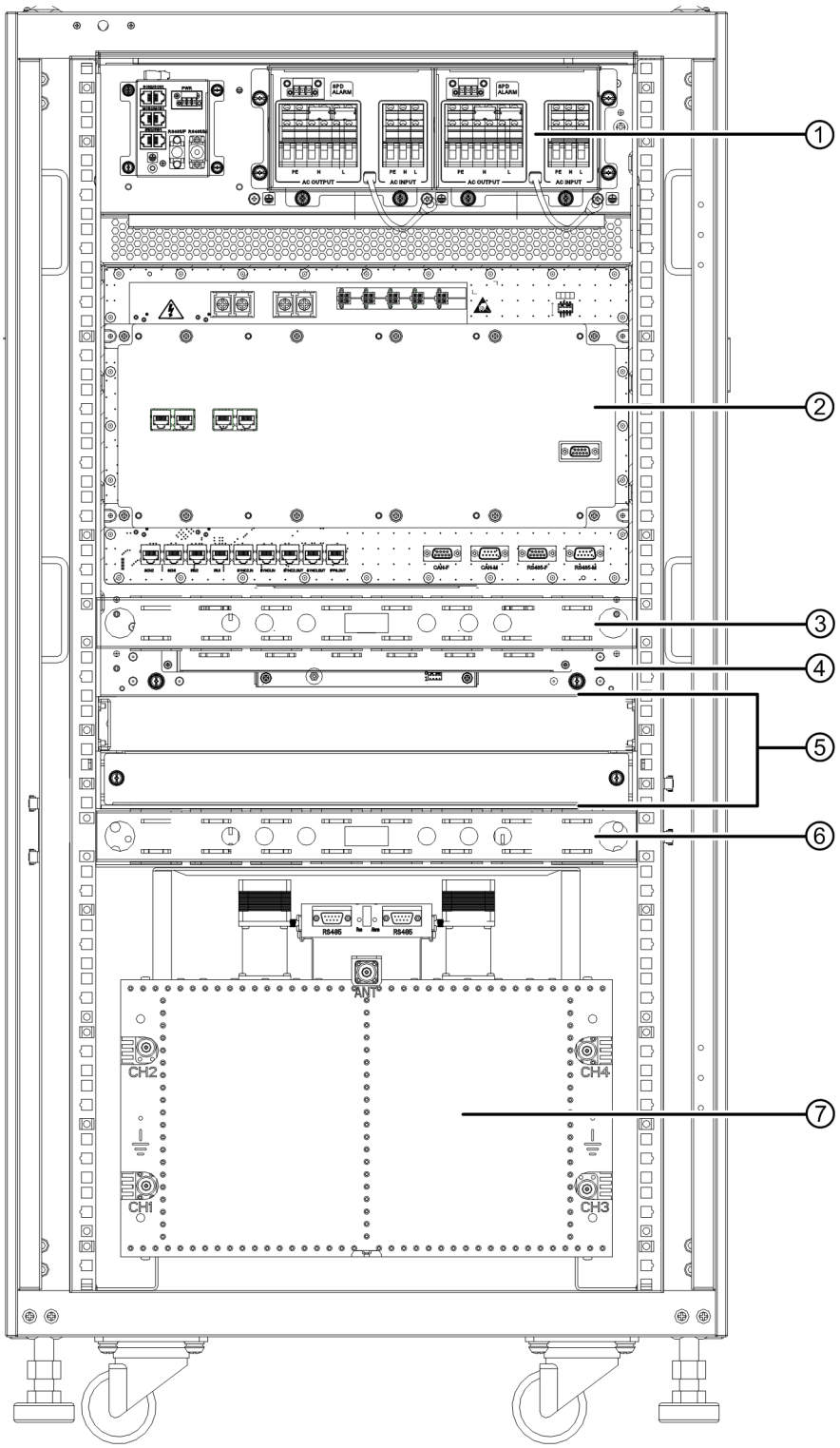

Figure 7: DIB-R5 advanced with opened equipment rack door (rear view)

Legend: DIB-R5 advanced with opened equipment rack door (rear view)

No.	Component	Number	Described in
1	■ AC Power Distribution Module (APDM) ■ DC Power Distribution Module (DPDM)	1 to 2	■ *Chapter 3.2.2 "V_{AC} voltage supply" on page 31* ■ *Chapter 3.2.3 "V_{DC} voltage supply" on page 35*
2	Backplane	1	*Chapter 3.2.11 "Backplane" on page 52*
3	Cable routing	2	---
4	Fan unit	1	*Chapter 3.2.9 "Fan unit" on page 50*
5	Rear side of air inlet for fan unit	1	---
6	Cable routing	1	---
7	Cavity combiner	1	*Chapter 3.2.10 "Cavity combiner" on page 51*

3.1 Characteristics of the DIB-R5

The DIB-R5 offers a high degree of flexibility and allows demand-oriented characteristics, e.g. with respect to voltage supply, frequencies and redundancy options. Depending on the characteristic, different components can be installed.

The following table describes the characteristics of the DIB-R5.

Characteristics of the DIB-R5

Component	Characteristic
Voltage supply	■ V_{AC} voltage supply – Redundant rectifier modules (Power Supply Module, PSM) – Redundant voltage supply feeds ■ V_{DC} voltage supply
Antenna coupling system	■ DUPLEXER for a common transmitting/receiving antenna (Tx/Rx antenna) ■ TX FILTER for separate transmitting and receiving antennas (Tx and Rx antennas)

3.2 Components

The following table lists the components of the DIB-R5 advanced.

Components of the DIB-R5 advanced

Component		Described in
Connection and control panel	*On/off switch*	*Chapter 3.2.1.1 "On/off switch" on page 29*
	Connection panel	*Chapter 3.2.1.2 "Connection panel" on page 29*
	GNSS splitter	*Chapter 3.2.1.3 "GNSS splitter" on page 31*
V_{AC} voltage supply		*Chapter 3.2.2 "V_{AC} voltage supply" on page 31*
V_{DC} voltage supply		*Chapter 3.2.3 "V_{DC} voltage supply" on page 35*
Divider Unit (DIU)	*RX FILTER*	*Chapter 3.2.4.1 "RX FILTER" on page 38*
	Passive Divider Unit (PDU) – only in case of a CHU expansion	*Chapter 3.2.4.2 "Passive Divider Unit (PDU) – only in case of a CHU expansion" on page 39*
Transmitting filter	*DUPLEXER*	*Chapter 3.2.5.1 "DUPLEXER" on page 40*
	TX FILTER	*Chapter 3.2.5.2 "TX FILTER" on page 41*
TETRA Channel Unit (CHU)		*Chapter 3.2.6 "TETRA Channel Unit (CHU)" on page 42*
Base Station Controller Unit (BSCU)		*Chapter 3.2.7 "Base Station Controller Unit (BSCU)" on page 44*
Interconnection Relay Unit (IRU) – only in the case of a CHU expansion		*Chapter 3.2.8 "Interconnection Relay Unit (IRU) – only in the case of a CHU expansion" on page 48*
Fan unit		*Chapter 3.2.9 "Fan unit" on page 50*

Component	Described in
Cavity combiner	*Chapter 3.2.10 “Cavity combiner” on page 51*
Backplane	*Chapter 3.2.11 “Backplane” on page 52*

3.2.1 Connection and control panel

The DIB-R5 advanced features a connection and control panel at the top side to which the antenna and voltage supply cable can be connected conveniently from the top. Furthermore, the connection and control panel provides access to all the elements that are required for additional connections and operation.

The following figure shows the top view of the connection and control panel. The following table describes it in detail.

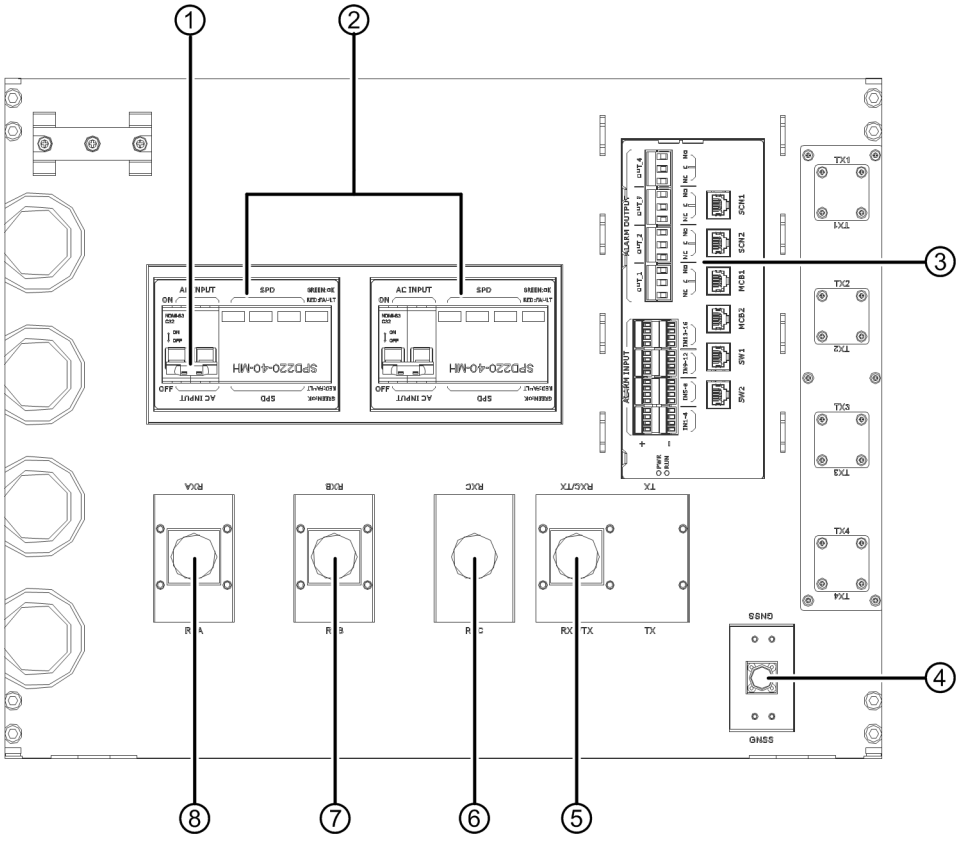

Figure 8: Connection and control panel (top view)

Legend: Connection and control panel (top view)

No.	Component	Description
1	On/off switch	refer to *Chapter 3.2.1.1 "On/off switch" on page 29*
2	■ V_{AC} voltage supply AC Power Distribution Module (APDM) ■ V_{DC} voltage supply DC Power Distribution Module (DPDM)	■ *Chapter 3.2.2 "V_{AC} voltage supply" on page 31* ■ *Chapter 3.2.3 "V_{DC} voltage supply" on page 35*
3	Connection panel	refer to *Chapter 3.2.1.2 "Connection panel" on page 29*
4	GNSS splitter	refer to *Chapter 3.2.1.3 "GNSS splitter" on page 31*
5	TX/RXC	Antenna connection for transmitting/ receiving antenna C
6	RXC – optional	Antenna connection for receiving antenna C
7	RXB	Antenna connection for receiving antenna B
8	RXA	Antenna connection for receiving antenna A

3.2.1.1 On/off switch

The on/off switch is accessible via the Power Distribution Module (PDM) in the connection and control panel. The PDM is the main component of the voltage supply and is used for connecting the voltage supply and the voltage distribution to the hardware components of the DIB-R5 advanced.

With the V_{AC} voltage supply, the on/off switch is available via the AC Power Distribution Module (APDM), refer to *Chapter 3.2.2 "V_{AC} voltage supply" on page 31*.

With the V_{DC} voltage supply, the on/off switch is available via the DC Power Distribution Module (APDM), refer to *Chapter 3.2.3 "V_{DC} voltage supply" on page 35*.

3.2.1.2 Connection panel

The connection panel combines all the essential connections, centrally and easily accessible at the top side, e.g. for connection to the transport network. Isolated alarm contacts provide digital alarm inputs and alarm outputs. The alarm inputs can be monitored via the network management system (NMS). This allows, for example, to monitor the status of the surge protection device (SPD) of the DIB-R5 advanced in the NMC-511 FaultManager. Alarms with the corresponding critical state can be signaled externally via the alarm outputs, e.g. with a connected light or ringing.

The connection panel is implemented by the alarm/connection box.

The following figure shows the top view of the connection panel. The following table describes it in detail.

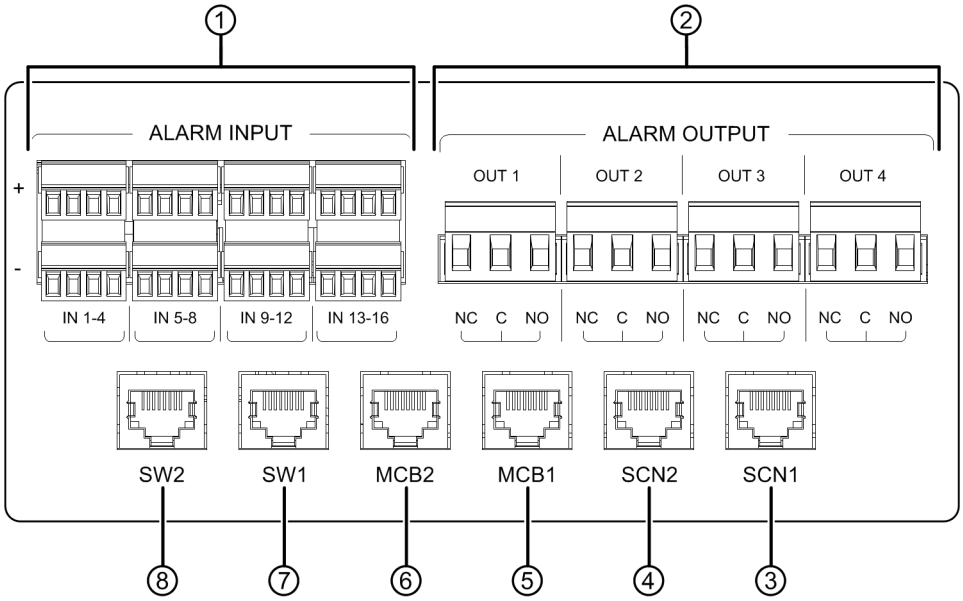

Figure 9: Connection panel (top view)

Legend: Connection panel (top view)

No.	Component	Description	Connector type
1	ALARM INPUT	Alarm inputs/outputs for wiring alarm contacts	Plug
2	ALARM OUTPUT		
3	SCN1	Connection to an IP transport network or for connecting a switching controller node (SCN). With controller redundancy (optional), both connections must be connected to design the ethernet connections of the BSCUs redundantly.	RJ45
4	SCN2		
5	MCB1	Connection for applications	RJ45
6	MCB2		

No.	Component	Description	Connector type
7	SW1	Connection of the service computer (local)	RJ45
8	SW2	Connection of service computer (local) – optional for controller redundancy This connection is required only if software downloads should be performed specifically for the redundant BSCU.	RJ45

3.2.1.3 GNSS splitter

The GNSS splitter (Global Navigation Satellite System) is used for connecting the GNSS antenna and the splitting and distribution of the received GNSS signal (e.g. GPS, Galileo or Glonass) to two BSCUs. The GNSS splitter is always installed in the connection and control panel, even if only one BSCU is used.

3.2.2 V_{AC} voltage supply

The DIB-R5 advanced can be operated with an input voltage of 90 V_{AC} to 250 V_{AC}.

The V_{AC} voltage supply consists of the following components:

- *AC Power Distribution Module (APDM)*
- *Power Supply Unit (PSU) including Power Supply Module (PSM)*

3.2.2.1 AC Power Distribution Module (APDM)

The AC Power Distribution Module (APDM) is used for connecting the voltage supply and the voltage distribution to the backplane and the installed hardware components. The APDM is used for the V_{AC} voltage supply. The V_{AC} input voltage is fed via the Power Supply Unit (PSU), converted to the required operating voltage, and subsequently distributed to the backplane and the installed hardware components.

With redundant voltage supply feed, two APDMs are installed (optional). The redundancy options of the voltage supply are described in *Chapter 3.5.6 “Redundant V_{AC} voltage supply” on page 62*.

The following figure shows the top view of the APDM. The following table describes it in detail.

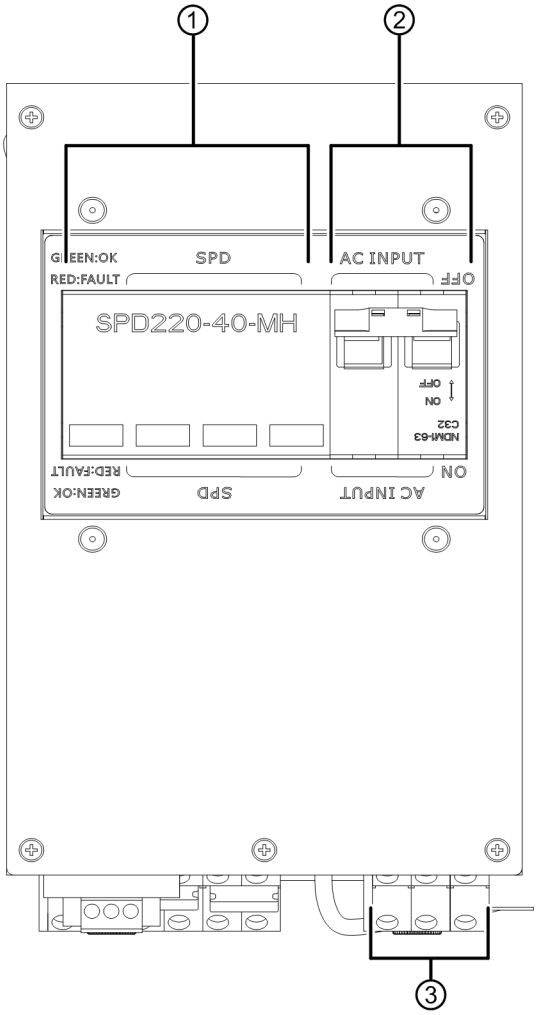

Figure 10: APDM (top view)

Legend: APDM (top view)

No.	Component	Description
1	Surge protection	Surge Protection Device (SPD) of the DIB-R5 advanced
2	On/off switch	On/off switch of the DIB-R5 advanced
3	Terminals	Terminals for V_{AC} input voltage

The following figure shows the front view of the APDM. The following table describes it in detail.

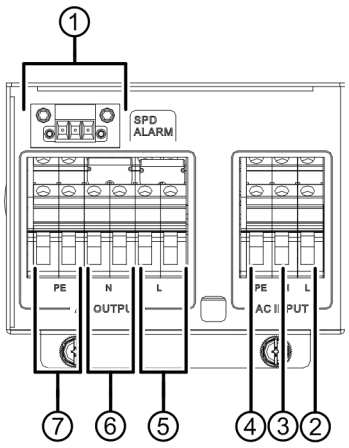

Figure 11: APDM (front view)

Legend: APDM (front view)

No.	Component	Description	
1	SPD ALARM	Connection for monitoring the Surge Protection Device (SPD)	
2	L	Input	Phase conductor connection for V_{AC} input voltage
3	N		Neutral conductor connection for V_{AC} input voltage
4	PE		Earthing conductor connection for V_{AC} input voltage
5	L	Output	Phase conductor connection for V_{AC} output voltage
6	N		Neutral conductor connection for V_{AC} output voltage
7	PE		Earthing conductor connection for V_{AC} output voltage

3.2.2.2 Power Supply Unit (PSU) including Power Supply Module (PSM)

The Power Supply Unit (PSU) is a component of the voltage supply and is used for the V_{AC} voltage supply.

Depending on the voltage supply, the number of installed CHUs and, if applicable, a redundantly implemented voltage supply, up to four Power Supply Modules (PSM) are installed.

The Power Supply Module (PSM) is a rectifier module and is used with V_{AC} voltage supply. The PSM is used for converting AC voltage (V_{AC}) into DC voltage (V_{DC}).

The following table describes the recommended number of PSMs depending on the voltage supply and the number of installed CHUs per equipment or compact rack.

Recommended number of PSMs

Voltage supply	Number of CHUs	Number of PSMs
90 V_{AC} - 170 V_{AC} (nominal)	1 to 2	2
	3 to 4	4
170 V_{AC} - 250 V_{AC} (nominal)	1 to 2	1
	3 to 4	2

The following figure shows the front view of the PSU. The following table describes it in detail.

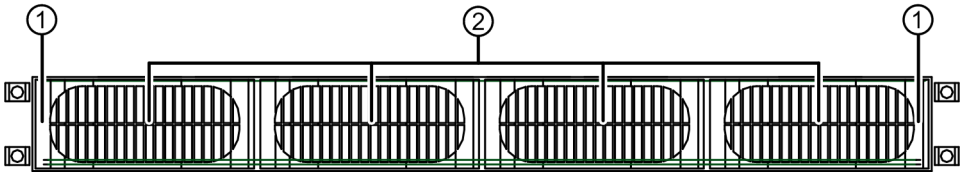

Figure 12: PSU (front view)

Legend: PSU (front view)

No.	Component	Description
1	Mounting frame	The mounting frame is used for accommodating the Power Supply Modules (PSM)
2	Power Supply Module (PSM)	Number depending on the V_{AC} voltage at the location and the number of installed CHUs, refer to *Table "Recommended number of PSMs" on page 34*

The following figure shows the front view of a PSM. The following table describes it in detail.

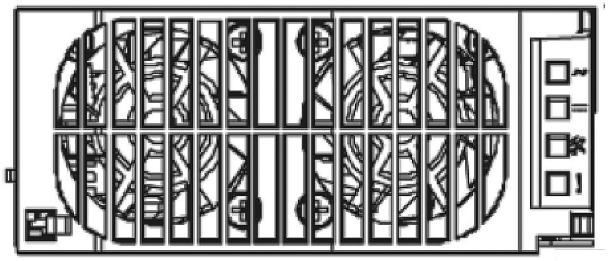

Figure 13: PSM (front view)

Legend: PSM (front view)

No.	Component	Color	Description
1		green	Lights if the V_{AC} input voltage is OK
			Flashes if the V_{AC} input voltage is outside the permissible voltage range
2		green	Lights if the V_{DC} output voltage is OK
			Flashes if the V_{DC} output voltage is overloaded
3		yellow	Lights if the temperature warning threshold is exceeded
			Flashes in case of service
4		red	Lights in case of an error

3.2.3 V_{DC} voltage supply

The DIB-R5 advanced can be operated with an input voltage of 48 V_{DC}.

The DC Power Distribution Module (DPDM) is used for connecting the voltage supply and the voltage distribution to the backplane and the installed hardware components. The DPDM is used for the V_{DC} voltage supply. The V_{DC} input voltage is distributed directly to the backplane and the installed hardware components.

The following figure shows the top view of the DPDM. The following table describes it in detail.

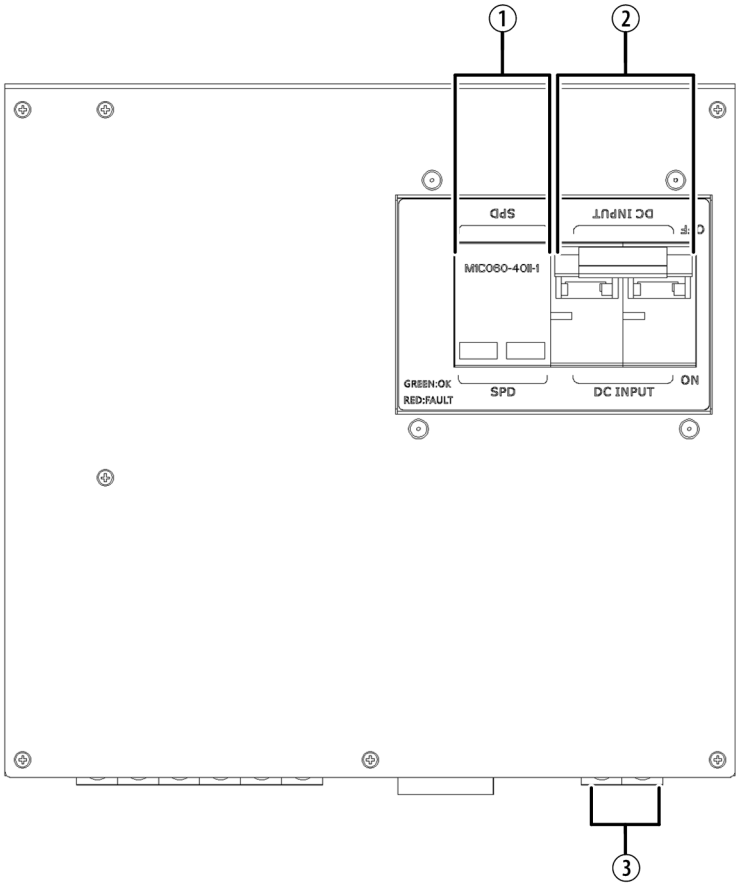

Figure 14: DPDM (top view)

Legend: DPDM (top view)

No.	Component	Description
1	Surge protection	Surge Protection Device (SPD) of the DIB-R5 advanced
2	On/off switch	On/off switch of the DIB-R5 advanced
3	Terminals	Terminals for V_{DC} input voltage

The following figure shows the front view of the DPDM. The following table describes it in detail.

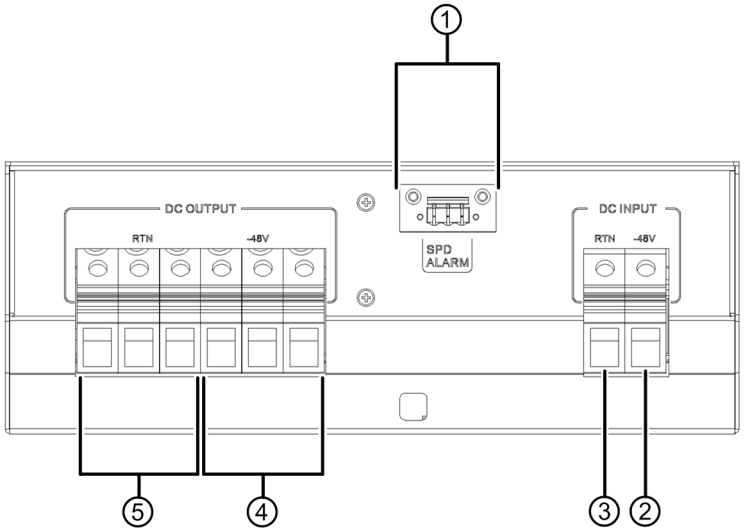

Figure 15: DPDM (front view)

Legend: DPDM (front view)

No.	Component		Description
1	SPD ALARM		Connection for monitoring the Surge Protection Device (SPD)
2	DC INPUT	-48V	Connection for the negative voltage line (input voltage)
3		RTN	Connection for the positive voltage line (input voltage)
4	DC OUTPUT	-48V	Connection for the negative voltage line (output voltage)
5		RTN	Connection for the positive voltage line (output voltage)

3.2.4 Divider Unit (DIU)

The Divider Unit (DIU) is a component of the antenna coupling system and is used for the distribution of the signals received by all antennas onto the installed CHUs.

Different DIUs are used in the DIB-R5 advanced:

- *RX FILTER*
- *Passive Divider Unit (PDU) – only in case of a CHU expansion*

The type used and the number of DIUs depends on the number of antennas and carriers.

3.2.4.1 RX FILTER

The RX FILTER is used for receiving and repeating the received Rx signals. The Rx signals are distributed by the RX FILTER and passed on to the respective Channel Units (CHU).

The number of RX FILTER depends on the number of receiving antennas (Rx antennas). One RX FILTER is required for each Rx antenna.

The following figure shows the front view of the RX FILTER. The following table describes it in detail.

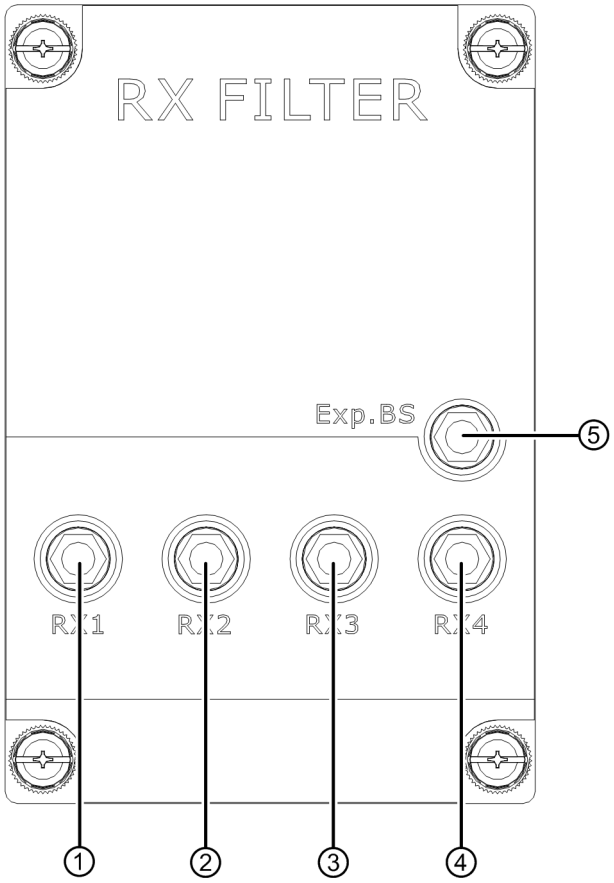

Figure 16: RX FILTER (front view)

Legend: RX FILTER (front view)

No.	Component	Description
1	RX1	Connector for the connection with CHU 1
2	RX2	Connector for the connection with CHU 2
3	RX3	Connector for the connection with CHU 3

No.	Component	Description
4	RX4	Connector for the connection with CHU 4
5	Exp. BS	Connector for the connection with a Passive Divider Unit (PDU) in a second equipment rack – only in case of more than four CHUs

3.2.4.2 Passive Divider Unit (PDU) – only in case of a CHU expansion

The Passive Divider Unit (PDU) is used for receiving and distributing the Rx signal received by an RX FILTER. The Rx signals are passed on to the respective TETRA Channel Units (CHU) by the PDU. The number of PDUs depends on the number of receiving antennas (Rx antennas). One PDU is required for every Rx antenna.

PDUs are used only in base stations with more than four CHUs.

The following figure shows the front view of the PDU. The following table describes it in detail.

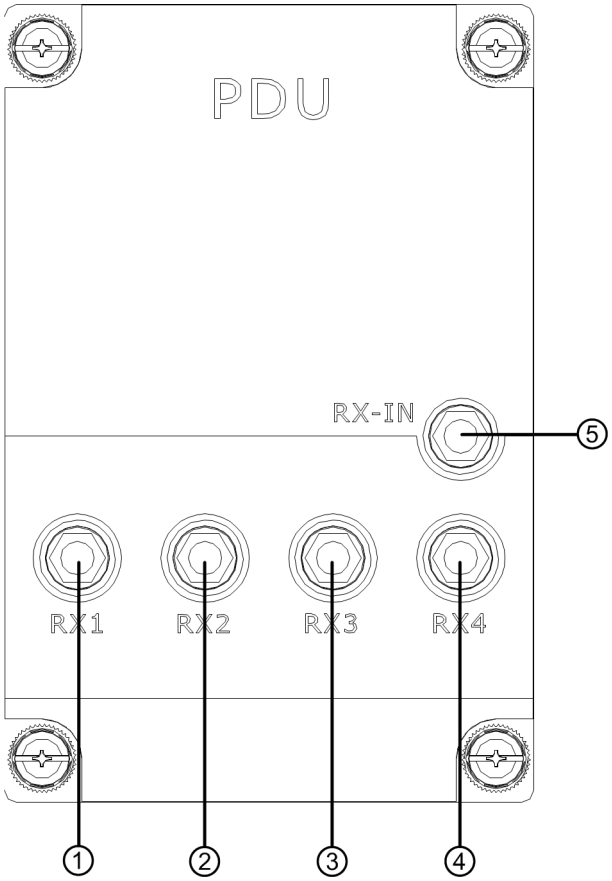

Figure 17: PDU (front view)

Legend: PDU (front view)

No.	Component	Description
1	RX1	Connector for the connection with CHU 1
2	RX2	Connector for the connection with CHU 2
3	RX3	Connector for the connection with CHU 3
4	RX4	Connector for the connection with CHU 4
5	RX-IN	Connector for the connection with an RX FILTER in a second equipment rack – only in case of more than four CHUs

3.2.5 Transmitting filter

The DIB-R5 advanced offers a high degree of flexibility and enables demand-oriented variants with respect to antenna configurations.

Depending on the antenna configuration, different transmitting filters are used that are required for transmitting and receiving. Only one of the two transmitting filters is used in the process.

One of the following transmitting filters is used in the DIB-R5 advanced:

- *DUPLEXER*
- *TX FILTER*

3.2.5.1 DUPLEXER

The DUPLEXER is used for separating the receiving and transmitting paths and is used if a common transmitting/receiving antenna (Tx/Rx antenna) is used.

The following figure shows the front view of the DUPLEXER. The following table describes it in detail.

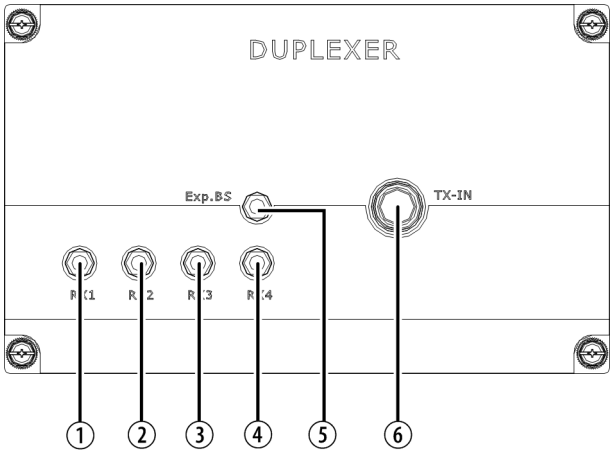

Figure 18: DUPLEXER (front view)

Legend: DUPLEXER (front view)

No.	Component	Description
1	RX1	Connector for the connection with CHU 1
2	RX2	Connector for the connection with CHU 2
3	RX3	Connector for the connection with CHU 3
4	RX4	Connector for the connection with CHU 4
5	Exp. BS	Connector for the connection with a PDU in a second equipment rack – only in case of more than four CHUs
6	TX-IN	Tx connector

3.2.5.2 TX FILTER

The TX FILTER is used for filtering the transmitting signal in the tuning range and is applied if a separate transmitting antenna (Tx antenna) is used.

The following figure shows the front view of the TX FILTER. The following table describes it in detail.

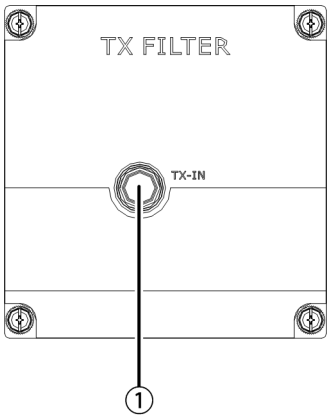

Figure 19: TX FILTER (front view)

Legend: TX FILTER (front view)

No.	Component	Description
1	TX-IN	Tx connector

3.2.6 TETRA Channel Unit (CHU)

The TETRA Channel Unit (CHU) is the transceiver module of the DIB-R5 and provides four radio channels for the voice and data transmission in transmitting and receiving direction (uplink and downlink) via one carrier signal. A transceiver consists of transmitter, receiver and transceiver software for the TETRA protocol and generates a modulated RF signal (carrier) with which signaling data and payload between the base station and the mobile stations are exchanged. In addition to providing the carrier signal, the CHU provides monitoring and control functions, with which the fan speed can be controlled dynamically, for example.

The CHU is a modular subrack for the DIB-R5 advanced and provides one carrier. The DIB-R5 advanced can be expanded in a flexible way by additional CHUs, up to four CHUs can be installed in one equipment rack. A CHU can be replaced during ongoing operation in case of malfunctions to quickly re-establish radio coverage.

The following figure shows the front view of the CHU. The following table describes it in detail.

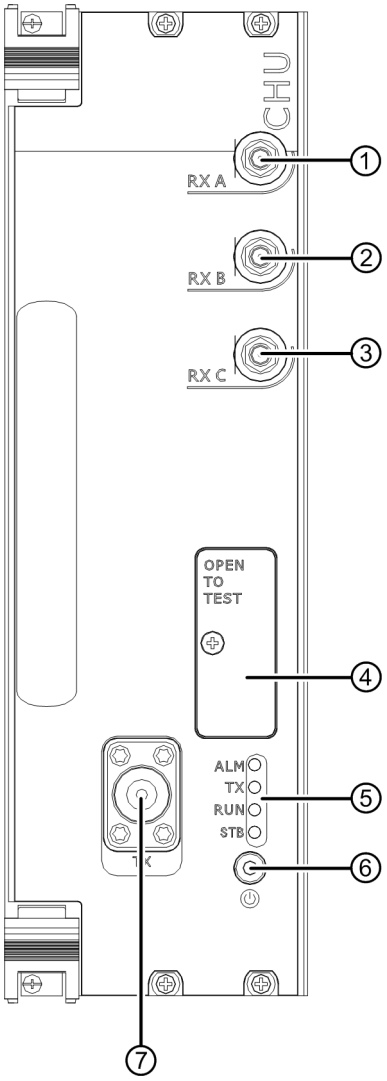

Figure 20: CHU (front view)

Legend: CHU (front view)

No.	Component	Description
1	RX A	Rx receiver input A
2	RX B	Rx receiver input B
3	RX C	Rx receiver input C
4	OPEN TO TEST	Connectors for test and service purposes, refer to *Table "Legend: Connectors for test and service purposes (OPEN TO TEST) of the CHU" on page 43*
5	Indicators (LEDs)	Status display of the CHU, refer to *Table "Legend: Indicators (LEDs) of the CHU" on page 44*
6	Power button	Power button for shutting down and restarting the hardware component
7	TX	Tx transmitter output

The following figure shows the connectors for test and service purposes (OPEN TO TEST) of the CHU. The following table describes it in detail.

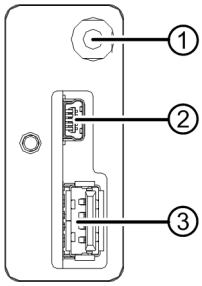

Figure 21: Connectors for test and service purposes (OPEN TO TEST) of the CHU

Legend: Connectors for test and service purposes (OPEN TO TEST) of the CHU

No.	Component	Description	Connector type
1	Multi-frame	Connector for test and approval measurements of the receiving quality	SMB (male)
2	Mini-USB	USB port for the serial connection to the console of the operating system	Mini-USB
3	USB-A	USB port, e.g. for data exchange	USB A

The following figure shows the indicators (LEDs) of the CHU. The following table describes it in detail.

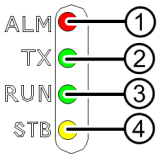

Figure 22: Indicators (LEDs) of the CHU

Legend: Indicators (LEDs) of the CHU

No.	LED	Color	Description
1	ALM	red	Lights in case of an error
2	TX	green	Lights green if the transmitter of the CHU is switched on
3	RUN	green	Flashes if the CHU is in operation
4	STB	yellow	Lights if the CHU is in standby operation

3.2.7 Base Station Controller Unit (BSCU)

The Base Station Controller Unit (BSCU) is the control unit of the base station and secures the connections inside of the DIB-R5 advanced as well as to external network constituents such as system controller nodes.

Furthermore, the BSCU receives and distributes satellite-based clock and timing signals for the synchronization of the base stations, which are acquired via the integrated GNSS component (Global Navigation Satellite System) with connected antenna. GNSS includes all the common systems, such as GPS, Galileo and Glonass. As an option, time is obtained via the Precision Time Protocol (PTP) from a so-called reference time source (Grandmaster Clock).

In addition, the BSCU is the interface to the ACCESSNET-T IP, with which network constituents such as switching nodes, the network management system (NMS) or applications are connected.

The BSCU is a modular subrack for the DIB-R5 advanced. To increase availability, up to two BSCUs can be installed. A BSCU can be replaced during ongoing operation in case of malfunctions to quickly re-establish radio coverage, if a second BSCU is in operation.

The following figure shows the front view of the BSCU. The following table describes it in detail.

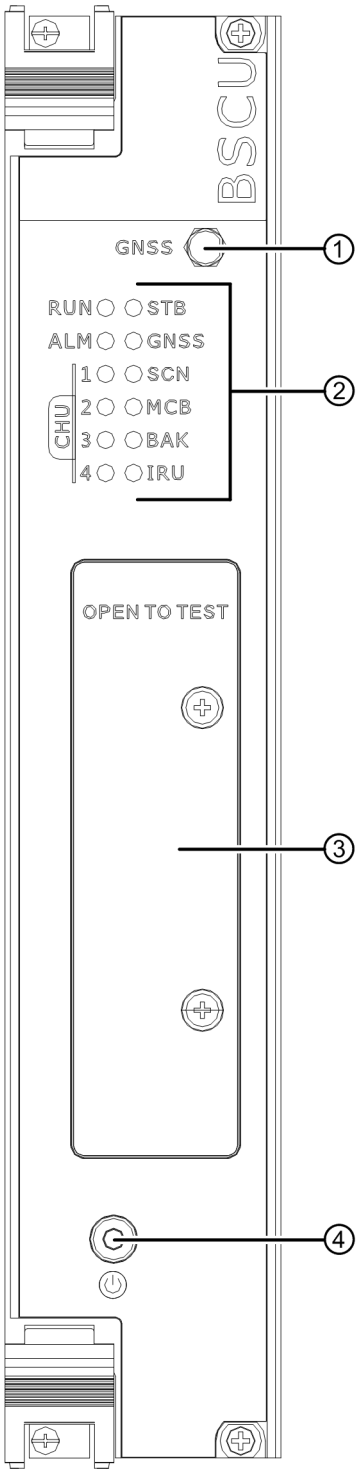

Figure 23: BSCU (front view)

Legend: BSCU (front view)

No.	Component	Description
1	GNSS	GNSS antenna connector (SMA)
2	Indicators (LEDs)	Status display of the BSCU, refer to *Table "Legend: Indicators (LEDs) of the BSCU" on page 46*
3	OPEN TO TEST	Connectors for test and service purposes, refer to *Table "Legend: Connectors for test and service purposes (OPEN TO TEST) of the BSCU" on page 47*
4	Power button	Power button for shutting down and restarting the hardware component

The following figure shows the indicators (LEDs) of the BSCU. The following table describes it in detail.

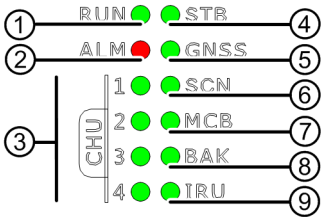

Figure 24: Indicators (LEDs) of the BSCU

Legend: Indicators (LEDs) of the BSCU

No.	LED	Color	Description
1	RUN	green	Flashes if the BSCU is in operation
2	ALM	red	Lights in case of an error
3	CHU 1 to 4	green	■ Lights if connections to CHUs exist ■ Flashes if data are being transferred
4	STB	green	Lights if the BSCU is in standby operation
5	GNSS	green	■ Lights if a GNSS signal (e.g. GPS) is available ■ Flashes if no GNSS signal is available ■ Off if no connection exists to the GNSS module
6	SCN	green	■ Lights if an ethernet connection exists for connecting a system controller node ■ Flashes if data are being transferred
7	MCB	green	■ Lights if a connection exists between the integrated components ethernet switch and BSCU mainboard (MCB) ■ Flashes if data are being transferred

No.	LED	Color	Description
8	BAK	green	■ Lights if a connection exists between redundant BSCUs ■ Flashes if data are being transferred
9	IRU	green	■ Lights if a connection exists to an Interconnection Relay Unit (IRU) – only in the case of two equipment racks ■ Flashes if data are being transferred

The following figure shows the connectors for test and service purposes (OPEN TO TEST) of the BSCU. The following table describes it in detail.

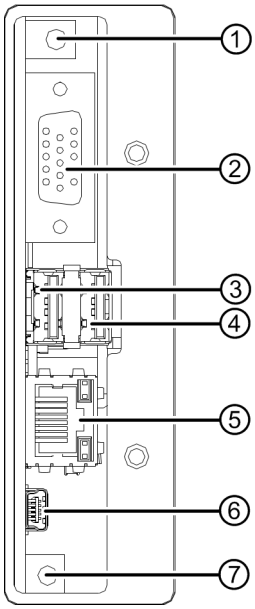

Figure 25: Connectors for test and service purposes (OPEN TO TEST) of the BSCU

Legend: Connectors for test and service purposes (OPEN TO TEST) of the BSCU

No.	Component	Description	Connector type
1	10 MHz out	Connector for measuring instruments	SMB (male)
2	VGA	Monitor port	VGA
3	USB1	USB port, e.g. for connecting a keyboard or a USB stick for software updates	USB A
4	USB2		USB A
5	LAN	Ethernet port for the service computer	RJ45

No.	Component	Description	Connector type
6	Mini-USB	USB port for service purposes	Mini-USB
7	Reset button	Reset button for restarting the integrated BSCU Mainboard (MCB) component	---

3.2.8 Interconnection Relay Unit (IRU) – only in the case of a CHU expansion

The Interconnection Relay Unit (IRU) is the receiving and distribution unit of the base station in a second equipment or compact rack and establishes the connection to a BSCU in the first equipment or compact rack. All the control information as well as clock and time signals are distributed by the IRU to the CHUs in the second equipment or compact rack and kept synchronous.

The IRU is a modular subrack for the DIB-R5 advanced, up to two IRUs can be installed. An IRU can be replaced during ongoing operation in case of malfunctions to quickly re-establish radio coverage.

The following figure shows the front view of the IRU. The following table describes it in detail.

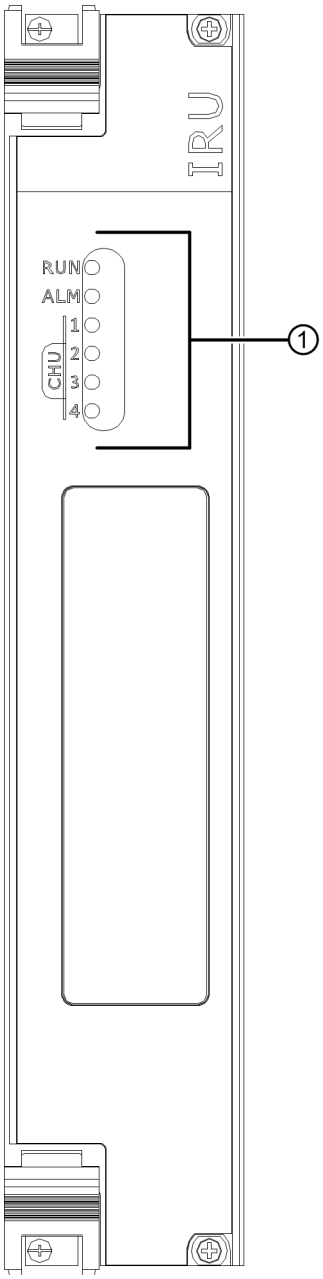

Figure 26: IRU (front view)

Legend: IRU (front view)

No.	Component	Description
1	Indicators (LEDs)	Status display of the IRU, refer to ↳ *Table "Legend: Indicators (LEDs) of the IRU" on page 50*

The following figure shows the indicators (LEDs) of the IRU. The following table describes it in detail.

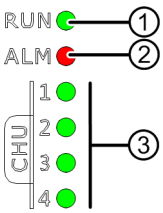

Figure 27: Indicators (LEDs) of the IRU

Legend: Indicators (LEDs) of the IRU

No.	LED	Color	Description
1	RUN	green	Flashes if the IRU is in operation
2	ALM	red	Lights in case of an error
3	CHU 1 to 4	green	■ Lights if connections to CHUs exist ■ Flashes if data are being transferred

3.2.9 Fan unit

The fan unit is used for cooling the installed components within the DIB-R5 advanced. The air filter pad is affixed to the inside of the front equipment rack door and filters the dirt and dust particles from the air.

The fan unit is implemented in the form of a fan subrack for the DIB-R5 advanced and contains six fans. Each fan features an LED, so that the status is visible from the outside. The temperatures of the hardware components CHU and BSCU are monitored at all times and the fan speed is controlled dynamically.

The following figure shows the front view of the fan unit. The following table describes it in detail.

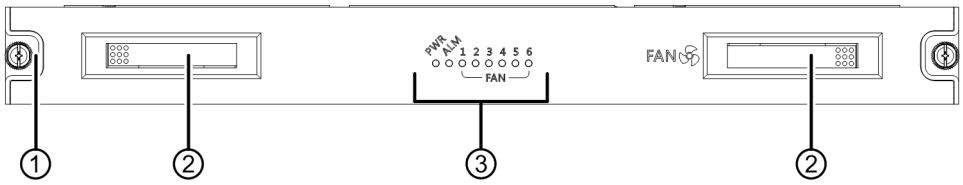

Figure 28: Fan unit (front view)

Legend: Fan unit (front view)

No.	Component	Description
1	Mounting screw	Screw for fastening in the equipment rack
2	Handle	Recessed handle for pulling out the fan unit
3	Indicators (LEDs)	Status display of the fan unit, refer to ↳ *Table "Legend: Indicators (LEDs) of the fan unit" on page 51*

The following figure shows the indicators (LEDs) of the fan unit. The following table describes it in detail.

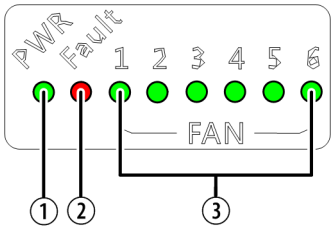

Figure 29: Indicators (LEDs) of the fan unit

Legend: Indicators (LEDs) of the fan unit

No.	LED	Color	Description
1	PWR	green	Lights if the voltage supply of the fan unit is OK
2	ALM	red	Lights in case of an error
3	FAN 1 to 6	green	Lights if the fan is OK
			Flashes if the fan speed is not OK

3.2.10 Cavity combiner

Combiners are used for combining several transmitting signals to a common transmitting antenna. The transmitters are decoupled from each other so that no mutual interference can occur.

The cavity combiner is used in DIB-R5 advanced for loss-free coupling of up to four carrier signals at one transmitting antenna. The cavity combiner is motor-tuned and allows remote frequence changes.

The following figure shows the rear view of the cavity combiner. The following table describes it in detail.

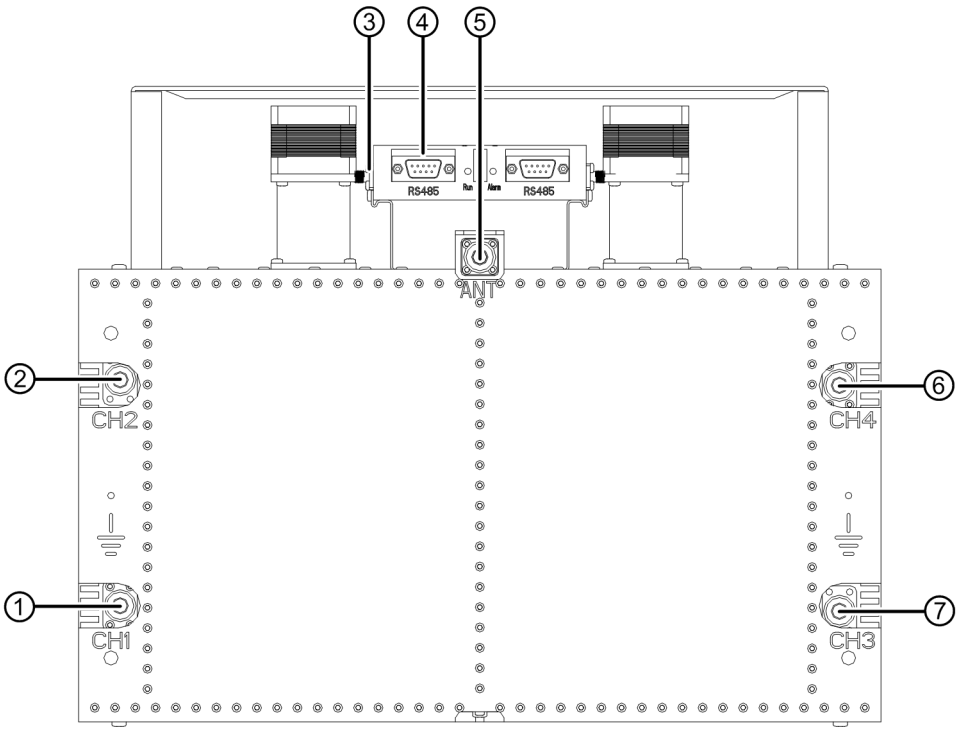

Figure 30: Cavity combiner (rear view)

Legend: Cavity combiner (rear view)

No.	Component	Description
1	CH1	Connector for the connection with CHU 1
2	CH2	Connector for the connection with CHU 2
3	+12 V	Voltage supply
4	RS-485	Interface to backplane
5	ANT	Tx transmitter output
6	CH3	Connector for the connection with CHU 3
7	CH4	Connector for the connection with CHU 4

3.2.11 Backplane

Within the DIB-R5 advanced, the backplane serves as central communication and supply element. The backplane provides the synchronization signals (clock and time) and the ethernet connections between the BSCUs and the CHUs and supplies the components with operating voltage.

Then following figure shows the backplane from the rear view of the DIB-R5 advanced. The following table describes it in detail.

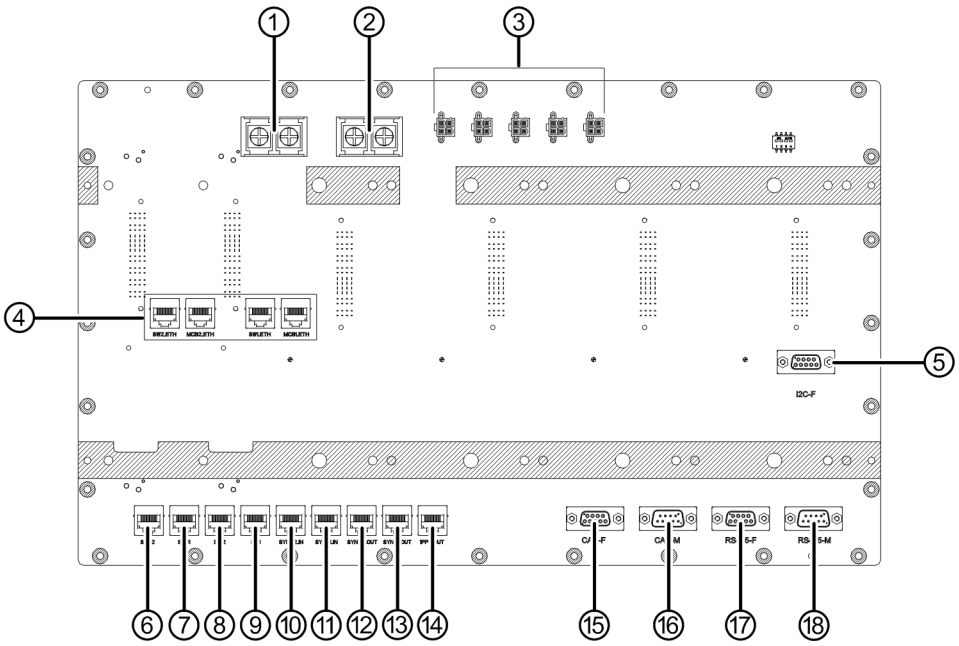

Figure 31: Backplane (rear view)

Legend: Backplane (rear view)

No.	Component	Description
1	RTN	Connection for the positive voltage line (input voltage)
2	DC -48V	Connection for the negative voltage line (input voltage)
3	RTN	Voltage supply connectors for the installed components
4	SW2	Connectors of the connection panel, refer to ↳ *Chapter 3.2.1.2 “Connection panel” on page 29*
	SW1	
	MCB2	
	MCB1	
5	I2C_M	Connector of the PSU – only for V_{AC} voltage supply
6	SCN2	Connector of the connection panel, refer to ↳ *Chapter 3.2.1.2 “Connection panel” on page 29*
7	SCN1	Connector of the connection panel, refer to ↳ *Chapter 3.2.1.2 “Connection panel” on page 29*
8	IRU2	Connector for connecting a second equipment rack – only in case of more than four CHUs
9	IRU1	Connector for connecting a second equipment rack – only in case of more than four CHUs
10	SYNC2_IN	Synchronization connector (input) for the second equipment rack – only in case of more than four CHUs

No.	Component	Description
11	SYNC1_IN	Synchronization connector (input) for the second equipment rack – only in case of more than four CHUs
12	SYNC2_OUT	Synchronization connector (output) of the first equipment rack – only in case of more than four CHUs
13	SYNC1_OUT	Synchronization connector (output) of the first equipment rack – only in case of more than four CHUs
14	1PPS_OUT	Synchronization connector (output) via a 1PPS signal (pulse per second) for base stations, such as DIB-500 R4.1
15	CAN_F	Not used for the time being
16	CAN_M	
17	RS485_F	Connector for alarm/connection box
18	RS485_M	Connector for fan unit and cavity combiner

3.3 Interfaces

The following table provides an overview of the interfaces of DIB-R5 advanced. The use of the interfaces is described in the corresponding chapters about the components of DIB-R5 advanced.

Interfaces

Antenna configuration with DUPLEXER	Combined Rx receiver input/Tx transmitter output	Number	1
		Connection	7/16 socket
	Rx receiver inputs	Number	1 to 2
		Connection	7/16 socket
Antenna configuration without DUPLEXER	Tx transmitter output	Number	1
		Connection	7/16 socket
	Rx receiver inputs	Number	1 to 3
		Connection	7/16 socket
Ethernet interfaces		Number	■ 3 with one BSCU ■ 6 with two BSCUs
		Specification	Ethernet, 10/100BaseT
		Connection	RJ45
GNSS antenna connection		Number	1
		Connection	N socket
Digital external alarm inputs		Structure	Optocoupler

	State (configurable)	■ "active-open" ■ "active-close"
	Number	16
	Connection	Plug for cable cross sections (wire or stranded wire) from 0.5 to 1.5 mm^2 (28 to 14 AWG)
Digital external alarm outputs	Structure	Relay
	State (configurable)	■ "active-open" ■ "active-close"
	Number	4
	Connection	Plug for cable cross sections (wire or stranded wire) from 0.5 to 1.5 mm^2 (28 to 12 AWG)

3.4 Wiring diagrams

The internal wiring is already in place in the condition as supplied to the customer and prepared for commissioning. All connecting cables inside of the DIB-R5 advanced feature the corresponding part numbers and the respective connection designation of the corresponding hardware component, e.g. for port 1 = P1.

The cables that still need to be connected for commissioning the product, such as for the voltage supply connector and the connector to the existing earthing system on site, must be connected during the installation of the product.

The following table provides an overview of the wiring diagrams that are described in the following chapters.

Wiring diagrams

Wiring diagram		Described in
Internal wiring	*Internal wiring with four CHUs and DUPLEXER*	*Chapter 3.4.1.1 "Internal wiring with four CHUs and DUPLEXER" on page 56*
	Antenna configurations	*Chapter 3.4.1.2 "Internal wiring with four CHUs and TX FILTER" on page 57*
Wiring of two equipment racks – only in the case of a CHU expansion		*Chapter 3.4.2 "Wiring of two equipment racks – only in the case of a CHU expansion" on page 58*

Wiring diagram		Described in
Antenna configurations	*Antenna configuration with four CHUs and DUPLEXER*	*Antenna configuration with four CHUs and DUPLEXER*
	Antenna configuration with four CHUs and TX FILTER	*Chapter 3.4.3.2 “Antenna configuration with four CHUs and TX FILTER” on page 59*

3.4.1 Internal wiring

The following table provides an overview of the internal wiring diagrams that are described in the following chapters.

Overview of internal wiring diagrams

Wiring diagram	Described in
Internal wiring with four CHUs and DUPLEXER	*Chapter 3.4.1.1 “Internal wiring with four CHUs and DUPLEXER” on page 56*
Internal wiring with four CHUs and TX FILTER	*Chapter 3.4.1.2 “Internal wiring with four CHUs and TX FILTER” on page 57*

3.4.1.1 Internal wiring with four CHUs and DUPLEXER

The following figure shows the internal wiring with four CHUs and DUPLEXER.

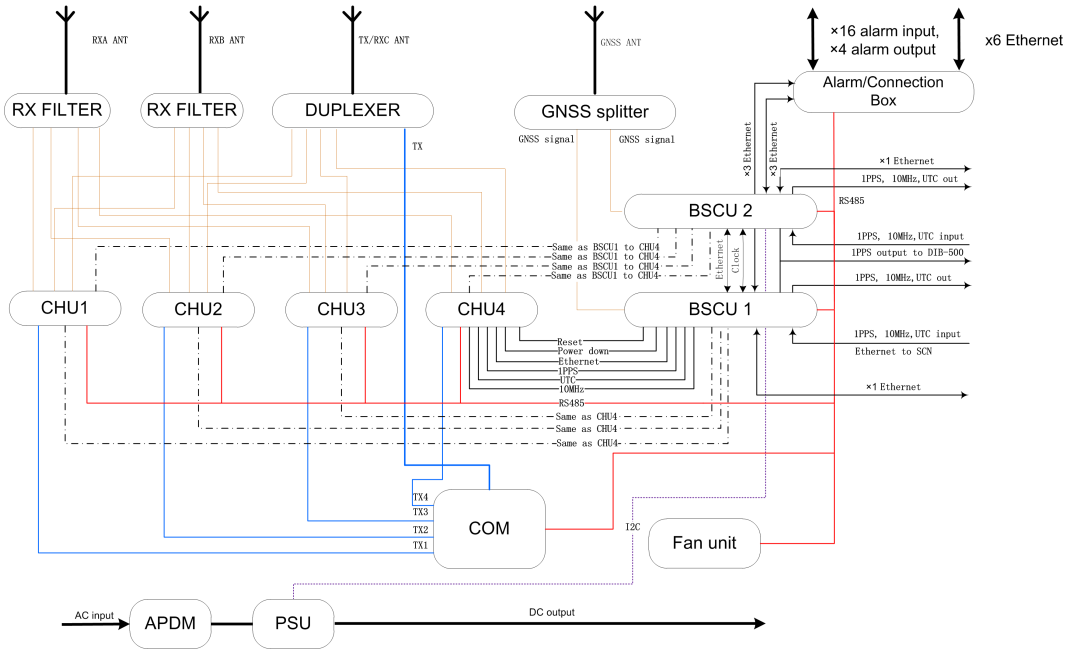

Figure 32: Internal wiring with four CHUs and DUPLEXER

3.4.1.2 Internal wiring with four CHUs and TX FILTER

The following figure shows the internal wiring with four CHUs and TX FILTER.

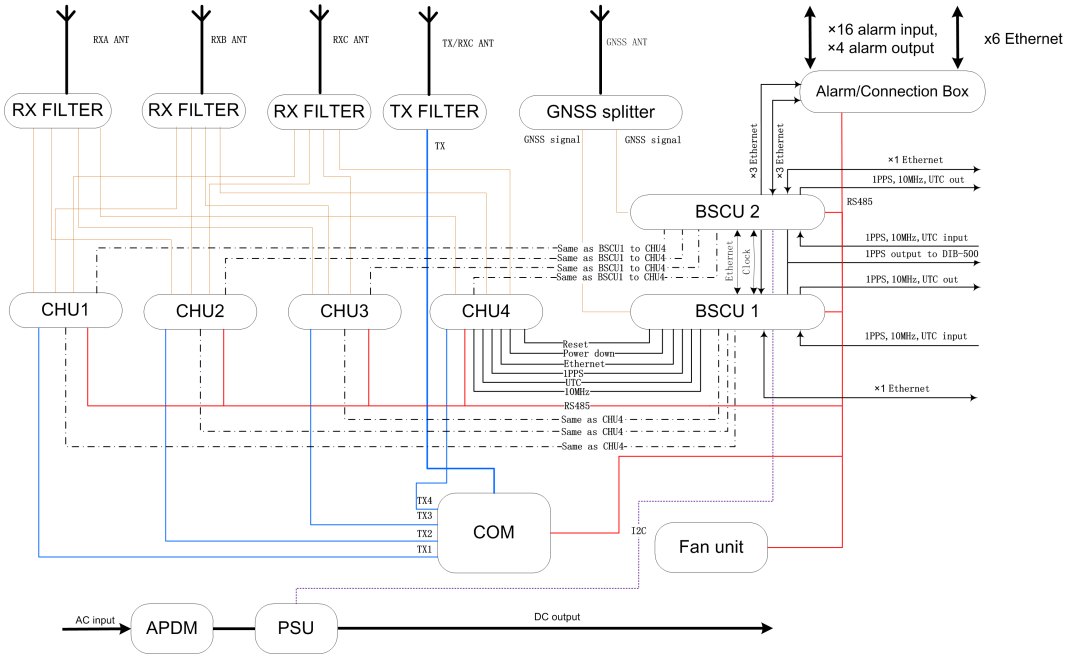

Figure 33: Internal wiring with four CHUs and TX FILTER

3.4.2 Wiring of two equipment racks – only in the case of a CHU expansion

In case of a CHU expansion of the DIB-R5 advanced, two equipment racks positioned next to each other are used. The internal wiring inside an equipment rack remains unchanged, refer to *Chapter 3.4.1 “Internal wiring” on page 56*.

Cable labeling for the connection in case of a CHU expansion

For variants with CHU expansion, the corresponding connecting cables are included in the delivery. They are identified according to their intended purpose.

The following figure shows the connection between the equipment racks of the DIB-R5 advanced.

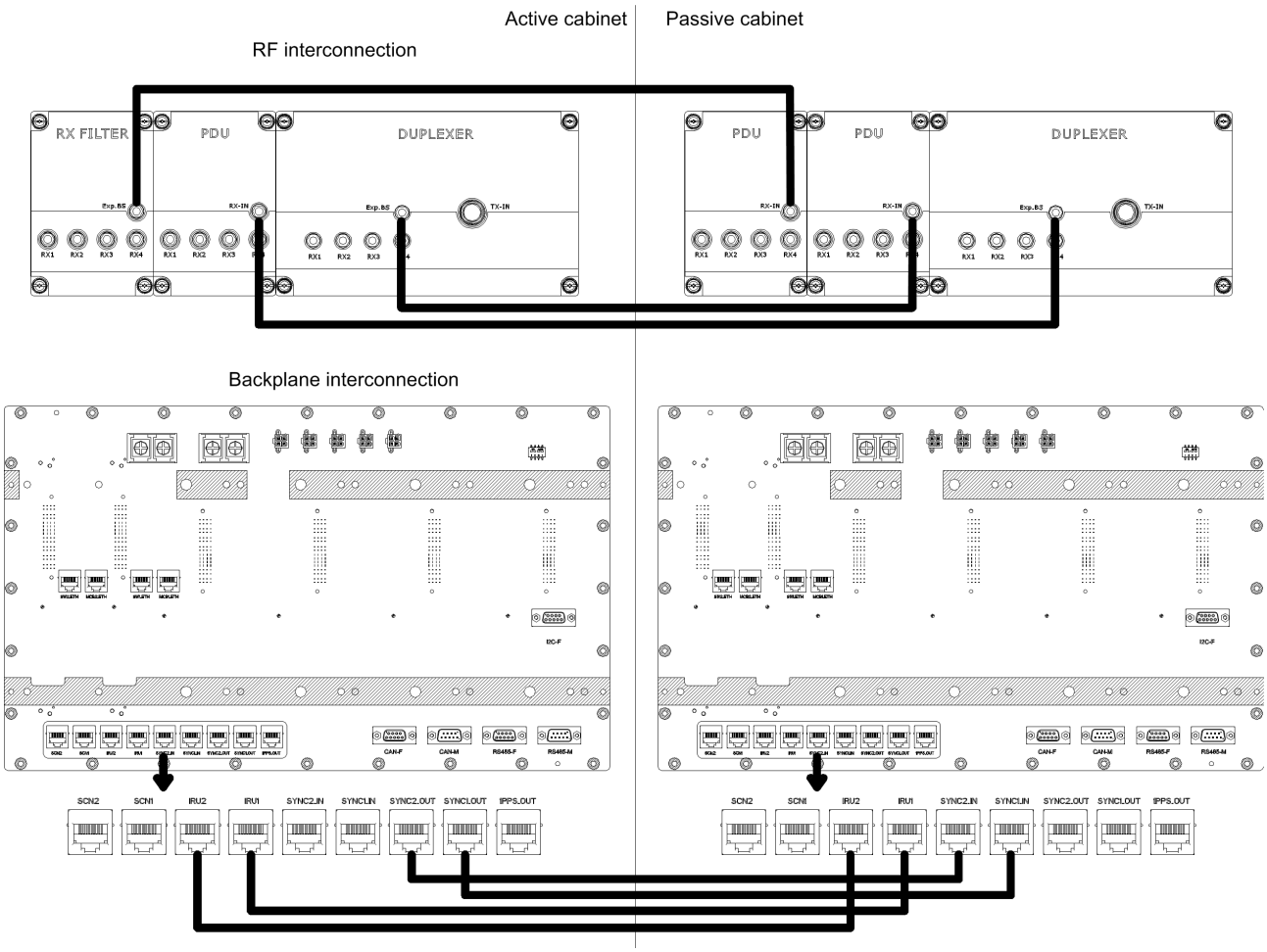

Figure 34: Wiring of two equipment racks – only in the case of a CHU expansion

3.4.3 Antenna configurations

The following table provides an overview of the antenna configurations that are described in the following chapters.

Overview of antenna configurations

Antenna configuration	Described in
Antenna configuration with four CHUs and DUPLEXER	*Antenna configuration with four CHUs and DUPLEXER*
Antenna configuration with four CHUs and TX FILTER	*Chapter 3.4.3.2 “Antenna configuration with four CHUs and TX FILTER” on page 59*

3.4.3.1 Antenna configuration with four CHUs and DUPLEXER

The following figure shows the antenna configuration with four CHUs and DUPLEXER.

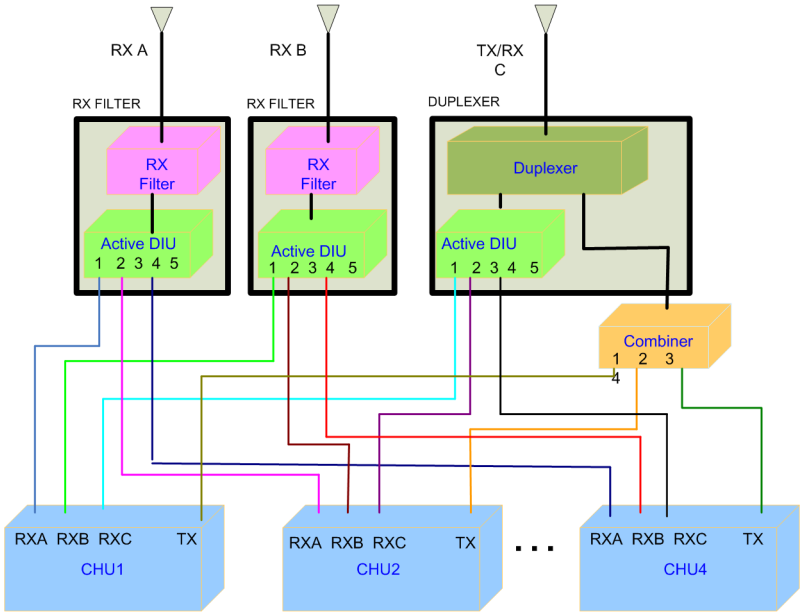

Figure 35: Antenna configuration with four CHUs and DUPLEXER

3.4.3.2 Antenna configuration with four CHUs and TX FILTER

The following figure shows the antenna configuration with four CHUs and TX FILTER.

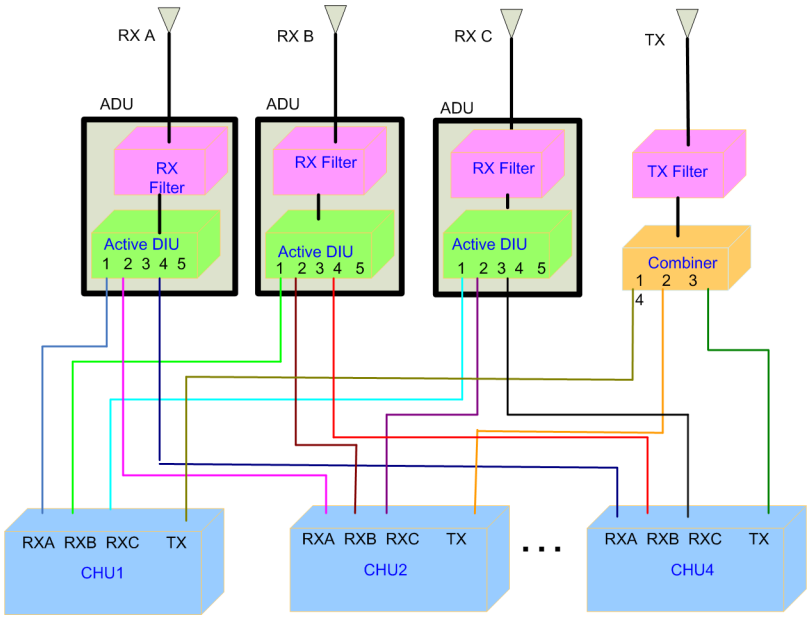

Figure 36: Antenna configuration with four CHUs and TX FILTER

3.5 Redundancy options

ACCESSNET-T IP provides numerous redundancy concepts to ensure the availability of services and features reliably even in exceptional situations. The concept of designing system functions, function blocks, network elements and connection routes redundantly, may be required to ensure location reliability and system reliability. Location and system reliability refers to the capability of the network to perpetuate the operation of the overall system, even if one location or route drops out completely or partially (due to technical failure, natural phenomena, acts of terrorism etc.).

The system technology allows flexible network structures and scalable redundancy solutions that account for the different requirements for availability and capacity within an complete network.

If the DIB-R5 advanced should be isolated from the rest of the network, it still provides most of its features in local fallback operation. Especially security-related features like authentication and air interface encryption are supported. Hence, DIB-R5 advanced enables a fully functional fallback operation and full redundancy for the important components transceiver (CHU), control unit (BSCU) and voltage supply.

The following chapters describe the available redundancy options in conjunction with DIB-R5 advanced:

- *Redundant main control channel (MCCH)*
- *Transceiver redundancy*
- *Controller redundancy*
- *Fallback operation*
- *Stand-alone operation*
- *Redundant V_{AC} voltage supply*
- *Redundant connection to the transport network*
- *Redundant synchronization (GNSS, PTP)*

The redundancy options can be combined with each other.

3.5.1 Redundant main control channel (MCCH)

By redundant main control channels (MCCH) the operation of a base station is guaranteed even if the carrier with the MCCH drops out or should be disturbed.

If the carrier that provided the main control channel last drops out, an alternative carrier will take on this task. The MCCH is thus transferred. This will maximally be repeated as often as the number of carriers that are available at the base station. In this case, the replacement carriers for the MCCH keep on sending on their original frequency, not on the frequency of the failed carrier. This frequency change is useful especially when interfering carriers affect the MCCH frequency that was being used up to that point.

Irrespective of the number of carriers, each radio cell has only one MCCH, via which the mobile stations receive information, e.g. on adjacent radio cells. As a rule, the first channel of the first carrier of a base station is used as the MCCH, the three remaining channels of that carrier and all the channels of all the other carriers are used as voice channels or the Packet Data service. Redundant MCCH are enabled by default and apply to all the base stations with more than one carrier.

3.5.2 Transceiver redundancy

To increase the system stability of carriers or to ensure the Base Station Function (BSF), as many as two redundant transceivers can be used in one base station. If one transceiver fails, these spare transceivers ensure the radio coverage with the frequency of the failed transceiver. Transceiver redundancy is mostly used in cases, in which only a few frequencies are available.

3.5.3 Controller redundancy

The controller required for operating a base station can be designed redundantly. In this case, two BSCUs (Base Station Controller Units) are used, whereby one BSCU is in operation and the other is kept ready for operation (standby). In case of a failure of the active BSCU or its ethernet connection, the standby BSCU is automatically switched to active and takes over its function. This ensures continued operation of the base station.

3.5.4 Fallback operation

The radio coverage of base stations is also ensured if the base station loses the connection to an IP Node (IPN) with Switching Controller Function (SCF). In this case, the base station changes to fallback operation. In fallback operation, the base station in its radio cell still maintains the Base Station Function (BSF). Even in fallback operation, authentication and authorization validation are ensured since the corresponding subscriber data are stored in the base station.

The connection to other network constituents is not possible in fallback operation, the following services and features, however, are available locally:

- Group calls
- Individual calls (semi-duplex and duplex calls)
- Transmission of SDS and status messages
- Class 2 and class 3 air interface encryption (encrypted voice and data communication)
- Authentication (with respect to the base station)
- Priority calls, emergency calls, pre-emptive priority calls
- Queue, depending on the priority level of the call
- Rejection of a call from/to an unknown subscriber
- Rejection with the reason "busy" if the subscriber is already making a call or the priority of the incoming call is minor
- Configurable call time limit
- Inactivity timer (ending semi-duplex calls after the configured inactivity time has expired)

Fallback operation is the emergency operating mode of base stations in networks with centralized switching architecture. The operating mode is signaled to the mobile stations and taken into account by them for the cell selection.

3.5.5 Stand-alone operation

The radio coverage of base stations with Switching Controller Function (SCF) in networks with distributed switching architecture continues to be ensured if they lose the connection to all other network constituents with SCF. In this case the base station switches to stand-alone operation.

In stand-alone operation, the base station in its radio cell will perpetuate the Base Station Function (BSF) as well as all the other local services and gateways (Application Gateway (AGW) and/or Packet Data Gateway (PGW)). As opposed to fallback operation, in stand-alone operation Call Detail Records (CDR) will still be generated.

Stand-alone operation is the emergency operating mode of base stations in networks with distributed switching architecture. The operating mode is signaled to the mobile stations and taken into account by them for the cell selection.Depending on the project requirements, the signaling can be switched off upon demand.

3.5.6 Redundant V_{AC} voltage supply

For the reliable voltage supply, DIB-R5 provides two redundancy options for V_{AC} voltage supply to ensure operation of the base station at all times:

- *Redundant rectifier modules (Power Supply Module, PSM)*
- *Redundant voltage supply feeds*

Both redundancy options can be combined for the highest possible reliability.

3.5.6.1 Redundant rectifier modules (Power Supply Module, PSM)

The voltage supply continues to be ensured through redundant rectifier modules (Power Supply Module, PSM) and ensures the operation of DIB-R5 if one PSM should fail. The active and the redundant PSMs are all in operation in this case and divide the load among them. In case of a failure, the load on the remaining PSMs is increased accordingly.

In the combination with redundancy option "Redundant voltage supply feeds", two PSMs each are supplied by one voltage supply feed.

3.5.6.2 Redundant voltage supply feeds

The voltage supply continues to be ensured on site by the redundant voltage supply feeds and secures the operation of DIB-R5 even if a feed should fail or fall below the required voltage range. This is particularly meaningful in difficult environments in which, for example, the infrastructure on site is unreliable. With this redundancy option, one Power Distribution Module (PDM), two in case of redundancy, is always supplied by a voltage supply feed.

If this redundancy option is selected, a second voltage supply feed must be taken into account in the location planning.

3.5.7 Redundant connection to the transport network

With the redundant connection to the transport network, the connection to all network components continues to be ensured in case of a failure of the IT infrastructure (e.g. router).

3.5.8 Redundant synchronization (GNSS, PTP)

The clock and time signals required for the synchronization of base stations are being obtained in parallel via a connected GNSS antenna and as an alternative via the Precision Time Protocol (PTP). If the satellite signal should no longer be available due to external influences, a switch is automatically made to the network time.

3.6 Scope of delivery

The DIB-R5 advanced is delivered in a 19" equipment rack, in case of more than four CHUs in two 19" equipment racks. The scope of delivery varies depending on the variant.

The variants of DIB-R5 advanced are the result of the following properties:

- Voltage supply
- Combiner
- Number of transceivers
- Frequency range
- Redundancy options

Scope of delivery DIB-R5 advanced (per equipment or compact rack)

Designation	Part number	Number
DIB-R5 advanced	5503.xxxx.xx	1
RX FILTER	5502.0856.xx	1 to 3
Passive Divider Unit (PDU)	5502.0840.02	1 to 2*
DUPLEXER	5502.0862.xx	1
TX FILTER	5502.0879.xx	1
TETRA Channel Unit (CHU)	5502.0104.xx	1 to 4
Base Station Controller Unit (BSCU)	5502.0704.02	1 to 2
Interconnection Relay Unit (IRU) – only in the case of two equipment or compact racks	5502.0404.02	1*
Fan unit	5502.0604.02	1
Power Supply Unit (PSU) – with V_{AC} voltage supply	5502.1020.00	1
Power Supply Module (PSM) – with V_{AC} voltage supply	5502.0910.00	1 to 4
Cavity combiner	5502.0940.00	1
Backplane	5502.0656.02	1
AC Power Distribution Module (APDM) – with V_{AC} voltage supply	5502.0579.xx	1 to 2
DC Power Distribution Module (DPDM) – with V_{DC} voltage supply	5502.0585.xx	1
Alarm/connection box (connection panel)	5502.0640.02	1
GNSS splitter	5505.0962.00	1

- **xx is variant-specific and, for example, dependent on the frequency range or voltage supply**
- *** used only in the case of two equipment or compact racks**

4 Operation

This chapter describes the procedure for the proper operation of the product at its location.

The work steps listed in the following table must be performed for the operation of the product.

Overview of work steps to be performed (operation)

Work steps		Described in
Switching on the DIB-R5 advanced		*Chapter 4.2 “Switching on the DIB-R5 advanced” on page 66*
Function tests and operating surveillance	*Checking operating states*	*Chapter 4.3.3 “Checking operating states” on page 70*
	Checking the availability	*Chapter 4.3.4 “Checking the availability” on page 72*
	Function tests and operating surveillance GNSS	*Chapter 4.3.6 “Function tests and operating surveillance GNSS” on page 74*

4.1 Safety measures and prerequisites

The following security measures and prerequisites must be observed for all activities:

- The site must be prepared in compliance with the document "DIB-R5 advanced Site Requirements".
- The product must have been set up and connected according to the document "DIB-R5 advanced Installation Manual".
- The product must have been configured according to the document "DIB-R5 advanced Configuration Manual".
- The DIB-R5 advanced may be set up and commissioned only of the required ambient conditions are met at all times, refer to *Table “Ambient data” on page 66*.
- The safety regulations must be considered at all times, refer to chapter *Chapter 2 “Safety regulations” on page 13*.
- Observe all other activity-based security measures and prerequisites in the work steps in this chapter.

Ambient data

Operation	Temperature range (normal)	+5 °C to +45 °C (+41 °F to +113 °F)
	Temperature range (extreme, as per EN 300 394)	-30 °C to +55 °C (-22 °F to +131 °F)

	Relative humidity	5 % to 85 % (non-condensing)
	Degree of protection	IP20
	Altitude for operation	max. 4000 m (13 123 ft)
Transport (in original packaging)	Temperature range	-40 °C to +70 °C (-40 °F to +158 °F)
Storage (in original packaging)	Temperature range	-40 °C to +70 °C (-40 °F to +158 °F)

4.2 Switching on the DIB-R5 advanced

The product is switched on via an on/off switch on the connection and control panel. After switching on the DIB-R5 advanced, the integrated hardware components will automatically start up. Connections will be enabled. All the components are started up after approx. three to five minutes.

To switch on the product, the connections must have been made properly and the voltage source at the installation site must have been switched on already. The procedure for switching on the voltage source depends on the circumstances at the respective installation site.

Several on/off switches with redundant voltage supply feeds

With redundant voltage supply feeds (optional), the DIB-R5 advanced features two on/off switches and two separate voltage sources, if necessary. Each of them has to be switched on for commissioning the product.

Switching on the DIB-R5 advanced

Preparation:

- The DIB-R5 advanced must be connected with the earthing system of the voltage source at the installation site.
- All required connecting cables as well as antennas must be connected.
- The alarm contacts must be wired.

1. Switch on the voltage source via the corresponding equipment at the installation site.
2. Set the on/off switch to the switch position "ON", refer to Figure 8.
   ⇨ The integrated hardware components start up.

➔ You have successfully switched on the DIB-R5 advanced.

Performing function tests

Following the execution of the work steps, it is recommended to perform function tests in order to ensure the proper mode of operation of the product.

The function tests are described in ↳ *Chapter 4.3 “Function tests and operating surveillance” on page 67*.

4.3 Function tests and operating surveillance

After all the tasks have been performed on the product that have effects on the product and/or its components, the proper operation of all the integrated network and hardware components should be tested. We recommend logging the results of the test.

In addition, it is recommended to perform the tasks described in the following sections in regular intervals during the operation.

The following table provides an overview of work steps for testing the function and for operational monitoring.

Overview of work steps (function tests and operating surveillance)

Work steps		Described in
↳ *Connecting the service computer*		↳ *Chapter 4.3.2 “Connecting the service computer” on page 69*
↳ *Checking operating states*	↳ *Checking operating states (via LEDs)*	↳ *Chapter 4.3.3.1 “Checking operating states (via LEDs)” on page 70*
	↳ *Checking operating states (audible check)*	↳ *Chapter 4.3.3.2 “Checking operating states (audible check)” on page 70*
	↳ *Checking operating states (via the NMC-511 FaultManager)*	↳ *Chapter 4.3.3.3 “Checking operating states (via the NMC-511 FaultManager)” on page 71*
↳ *Checking the availability*		↳ *Chapter 4.3.4 “Checking the availability” on page 72*

Work steps	Described in
↳ *Checking standby carriers – optional*	↳ *Chapter 4.3.5 “Checking standby carriers – optional” on page 73*
↳ *Function tests and operating surveillance GNSS*	↳ *Chapter 4.3.6 “Function tests and operating surveillance GNSS” on page 74*

4.3.1 Work equipment for function tests

The following table provides an overview of the work equipment for function tests and operating surveillance.

Overview of work equipment (function tests and operating surveillance)

Work step	Work equipment
Checking operating states via the NMC-511 FaultManager	■ configured NMC computer ■ straight through ethernet cable ■ NMC-511 FaultManager
Checking the reachability of network elements	■ configured NMC or service computer ■ straight through ethernet cable
Function tests and operating surveillance GNSS	■ configured NMC computer ■ NMC-511 FaultManager ■ GNSS antenna(s) ■ GNSS antenna cable
Checking standby carriers	NMC-511 FaultManager

4.3.2 Connecting the service computer

The service computer may be any computer that meets the system requirements.

The system requirements for the service computer are described in the related product documents, refer to the following table.

Required product documents

Product	Document type	Described in
Service computer	Configuration Manual	Chapter 2

The service computer is connected via the connection panel. The ethernet interface "SW1" is used by default for this purpose; with controller redundancy, the ethernet interface "SW2" is additionally used for the connection to the second BSCU. During the connection, the service computer is automatically assigned a local service IP address for the respective DIB-R5 advanced.

Connecting the service computer

Preparation:

- The working appliances must be available, refer to *Chapter 4.3.1 "Work equipment for function tests" on page 68*.
- The service computer must have been started.
- The DIB-R5 advanced must be switched on.

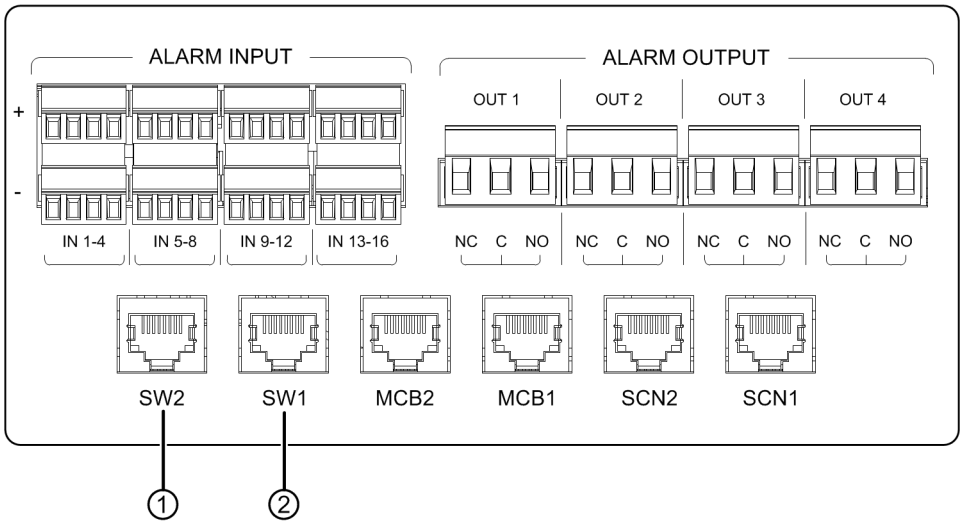

Figure 37: Connections of the service computer (local)

→ Connect the ethernet cable to the connector on the DIB-R5 advanced (refer to Figure 37) and to the ethernet port of the service computer.

➔ You have successfully connected the service computer.

4.3.3 Checking operating states

You can check manually whether the product and the hardware components installed operate properly on the respective hardware component, if indicators are available, or via a connected NMC-511 FaultManager network management client.

The following table provides an overview of the procedures for checking operating states of the DIB-R5 advanced.

Overview of the procedures for checking operating states

Work step	Described in
Checking operating states (via LEDs)	*Chapter 4.3.3.1 “Checking operating states (via LEDs)” on page 70*
Checking operating states (audible check)	*Chapter 4.3.3.2 “Checking operating states (audible check)” on page 70*
Checking operating states (via the NMC-511 FaultManager)	*Chapter 4.3.3.3 “Checking operating states (via the NMC-511 FaultManager)” on page 71*

4.3.3.1 Checking operating states (via LEDs)

The following table provides an overview of hardware components whose LEDs can be checked.

Checking operating states (via LEDs)

Hardware component	Described in
TETRA Channel Unit (CHU)	*Table “Legend: Indicators (LEDs) of the CHU” on page 44*
Base Station Controller Unit (BSCU)	*Table “Legend: Indicators (LEDs) of the BSCU” on page 46*
Fan unit	*Table “Legend: Indicators (LEDs) of the fan unit” on page 51*
Power Supply Module (PSM) – with V_{AC} voltage supply	*Table “Legend: PSM (front view)” on page 35*

4.3.3.2 Checking operating states (audible check)

Upon switching on the DIB-R5 advanced, the fans briefly rotate at high speed and are then adjusted according to the room temperature. No grinding or rattling noise should be present at this time.

Checking operating states (audible check)

Preparation:

- The DIB-R5 advanced must be switched on.
- The front equipment rack door must be open.

→ Check whether grinding or rattling noise can be heard.

⇨ If the corresponding noises can be heard, you must perform a fault analysis.

➔ The function test has been completed.

4.3.3.3 Checking operating states (via the NMC-511 FaultManager)

Using the NMC-511 FaultManager network management client, faults occurring in an ACCESSNET-T IP network can be detected and localized rapidly. This facilitates prompt fault elimination.

All network constituents and connections of an ACCESSNET-T IP are monitored via the NMC-511 FaultManager. Operating states and faults are detected by the network management system and visualized via the connected workstations, on which the NMC-511 FaultManager is installed and enabled.

The NMC-511 FaultManager displays the operating states and faults of the network constituents in the respective network in an alarm status list. This makes permanent network monitoring possible.

Checking the operating statuses via the NMC-511 FaultManager requires an NMC computer that is configured accordingly, with installed NMC-511 FaultManager that is connected with the ACCESSNET-T IP.

Besides checking the respective hardware and software components, the application connections between the network elements should also be checked to ensure the correct connection.

Checking the operating state (via the NMC-511 FaultManager)

Preparation:

- The NMC-511 FaultManager must have been started.

1. Use the *Equipment* view of the NMC-511 FaultManager to navigate to the corresponding network constituent (hardware or software component).
2. Ensure that the corresponding network constituent is shown in green in the *Equipment* view of the NMC-511 FaultManager.

   ⇨ If the respective network constituent is shown in red, you must perform a fault analysis, refer to NMC-511 FaultManager User Manual.
3. Check whether a predecessor alarm status is displayed for the respective network constituent which displays a fault that may already have existed.

   ⇨ If the predecessor alarm status is shown in red, it is recommended to generate a report via the *Analysis* perspective.
4. Navigate to the *Service* perspective and check whether corresponding services are shown in green.

   ⇨ If services are shown in red, you must perform a fault analysis, refer to NMC-511 FaultManager User Manual.
5. In the *Equipment* view, check whether all application connections are displayed in green.

   ⇨ If application connections are shown in red, you must perform a fault analysis, refer to NMC-511 FaultManager User Manual.

➔ The function test has been completed.

4.3.4 Checking the availability

After network elements have been connected with an existing switch or router at the site, it must be checked whether the respective network element can be reached via the IP address of the BSCU. The NMC-511 FaultManager is used to check whether the IP address can be reached. If this should not be possible, the **ping** command should be used to check whether it can be reached.

IP addresses of installed components

The configured IP addresses can be displayed via the NMC-511 FaultManager in the *Properties* view and are also documented in the project-specific documentation.

Checking the availability

Preparation:

- The NMC or service computer must have been connected with the transport network.
- The NMC-511 FaultManager must have been started.

1. Check the status of the connections in the *Visualization* view of the NMC-511 FaultManager.

Optional work step

The work steps described below are required only if the NMC-511 FaultManager cannot check whether the network element can be reached or if no connection exists.

2. Use the *Equipment* view of the NMC-511 FaultManager to navigate to the corresponding network constituent (hardware or software component).
3. Change to the *Properties* view and record the required IP address.
4. Click on *"Windows Start menu ➔ Programs ➔ Accessories ➔ Command prompt"*.
   ⇨ The command prompt is displayed.

5. Enter the following command to check the reachability of the network element:

   ping <xxx>

   <xxx> corresponds to the IP address of the respective component within the DIB-R5 advanced.

   ⇨ The following output is displayed (example):

```
C:\Users\User>ping <xxx>

Ping is executed for <xxx> with 32 bytes of data:

Response from <xxx>: Bytes=32 Time<1 ms TTL=63

Response from <xxx>: Bytes=32 Time<1 ms TTL=63

Response from <xxx>: Bytes=32 Time<1 ms TTL=63

Ping statistic for <xxx>:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approx. time information in milliseconds: Minimum = 0 ms,
maximum = 0 ms, average = 0 ms
```

➔ You have successfully checked the availability.

4.3.5 Checking standby carriers – optional

The DIB-R5 advanced optionally provides the redundancy option "Transceiver redundancy" with up to two standby carriers that can replace two carriers that have dropped out.

As a preventive maintenance measure, it is recommended to check the function of the standby carriers at regular intervals, refer to *Chapter 7.2 “Periodical visual inspections” on page 83*. This is done via the NMC-511 FaultManager.

Required product documents

Product	Document type	Described in
NMC-511 FaultManager	User Manual	Chapter 4

Checking standby carriers

Preparation:

- The respective DIB-R5 advanced must be in operation.
- The NMC-511 FaultManager must have been started.

1. Select the corresponding operational carrier in the *Equipment* or *Visualization* view of the NMC-511 FaultManager.
2. Right-click on the selected carriers to display the context menu.
   ⇨ The context menu will be displayed.

Availability of maintenance functions

Not all the maintenance functions can be used for all the network constituents. Maintenance functions that cannot be performed for the time being will be displayed in grey and cannot be selected.

3. In the context menu, click on the *System blocking* maintenance function.
   ⇨ The corresponding carriers are excluded from functional operation and identified in the *Equipment* view with the "Person" icon (operationally blocked by the user).

   Existing standby carriers are enabled.
4. In the NMC-511 FaultManager, check in the *Equipment* view of the *Equipment* perspective whether the standby carriers become active and do not report alarm.
5. Unblock any blocked operational carriers after at least 5 minutes with the *System release* maintenance function.
   ⇨ The system blocking of operational carriers has been revoked.

   Standby carriers are switched back to their original status.

➔ You have successfully checked the standby carriers.

4.3.6 Function tests and operating surveillance GNSS

The following chapters describe procedures for function tests and the operational monitoring concerning the GNSS functionality of the DIB-R5 advanced.

4.3.6.1 Checking the installation site of the GNSS antenna

To prevent damage, e.g. caused by insufficient guarding and/or fastening, the installation site of the GNSS antenna should be checked following the installation of the GNSS antenna.

Checking the installation site of the GNSS antenna

Preparation:

- The installation and connection of the GNSS antenna must have been completed.

1. Check the installation site of the GNSS antenna for proper condition, such as the
   - fastening of the antenna mast,
   - fastening of the GNSS antenna,
   - cable routing.

Circumferential range of vision (angle of unobstructed visibility of the sky) of the GNSS antenna.

A good circumferential range of vision (angle of unobstructed visibility of the sky according to the recommendations of the manufacturer) must be maintained to ensure proper reception of the GNSS antenna. The angle of the GNSS antenna supplied is 90°. When using a third-party GNSS antenna, heed the corresponding documentation supplied with the GPS antenna.

2. Check the circumferential range of vision of the GNSS antenna.

➔ The visual inspection has thus been completed.

4.3.6.2 GNSS operational monitoring (via NMC-511 FaultManager)

The function of the GNSS receiver and the detectable GNSS satellites are monitored by the DIB-R5 advanced based on the GNSS data received.

Using the NMC-511 FaultManager network management client, faults occurring in an ACCESSNET-T IP network can be detected and localized rapidly. This facilitates prompt fault elimination.

All network constituents and connections of an ACCESSNET-T IP are monitored via the NMC-511 FaultManager. Operating states and faults are detected by the network management system and visualized via the connected workstations, on which the NMC-511 FaultManager is installed and enabled.

The NMC-511 FaultManager displays the operating states and faults of the network constituents in the respective network in an alarm status list. This makes permanent network monitoring possible.

The procedures for this purpose are described in corresponding documents, refer to the following table.

Required product documents

Product	Document type
NMC-511 FaultManager	User Manual

In the NMC-511 FaultManager the operating conditions and errors on network constituents are represented by so-called alarm objects.

Alarm objects provide alarms/statuses for properties of hardware and software components. In addition, alarm objects contain information that aids in the context of fault management in the evaluation, localization and removal of errors.

GNSS module – Possible messages

No.	Alarm object (NMC-511 FaultManager)	Description
1	*GNSS antenna status*	Status of the GNSS antenna connection
2	*Communication (GNSS)*	Status of communication with the GNSS module

5 Service interruption

This chapter describes the procedure for the service interruption of the product.

A service interruption may be required in the following cases:

- Work on an open equipment rack
- End of operation
- Malfunction
- The integration of further components,

Possible restrictions for the operation

If a product is taken out of service, the operation of other parts in the radio network may be impaired as well. Discuss this problem with your service partner to obtain detailed information on risks and on recommended procedures.

5.1 Shutting down hardware components

The installed hardware components CHU and BSCU operate with different software components that should be shut down properly. For this reason, these hardware components must be shut down before switching off the DIB-R5 advanced.

The following table provides an overview of the order in which the hardware components should be shut down.

Shutting down hardware components (order)

Order	Hardware component
1	BSCU (standby) – optional With redundant BSCUs, the BSCU in standby operation must be shut down first to prevent a switchover of the BSCUs. The operating status of the BSCU is indicated via LEDs, refer to *Table "Legend: Indicators (LEDs) of the BSCU" on page 46*.
2	BSCU (operational)

Shutting down the CHU

When shutting down the BSCUs, all installed CHUs are also shut down automatically. The CHUs do not have to be shut down individually except for service and maintenance purposes.

Shutting down hardware components

Press the Power button on the hardware component to shut it down.

⇨ The software components are being shut down.

The indicators (LEDs) go out after approx. 5 to 20 seconds.

The hardware component is properly shut down if the "RUN" LED is off.

➔ You have successfully shut down the hardware components.

5.2 Switching off the DIB-R5 advanced

The procedure for switching off the DIB-R5 advanced is described below.

Several on/off switches with redundant voltage supply feeds

With redundant voltage supply feeds (optional), the DIB-R5 advanced features two on/off switches and two separate voltage sources, if necessary. Each of them has to be switched off for the service interruption of the product.

Switching off the DIB-R5 advanced

Preparation:

- The installed hardware components must have been shut down, refer to ↬ *Chapter 5.1 “Shutting down hardware components” on page 77*.

1. Set the on/off switch to the switch position "OFF", refer to Figure 8.

   ⇨ The integrated hardware components are switched off.

2. Switch off the voltage source at the location. Alternatively you can switch off the fuse of the sub-distribution.

   Risk of electric shock

   Ensure by means of switch interlock that a source of electrical power cannot be switched on unintentionally by an unauthorized third person.

3. Check whether all LED displays are inactive.

➔ You have successfully switched off the DIB-R5 advanced.

Recommissioning

The required recommissioning will be pointed out in the corresponding chapters.

Switching off the DIB-R5 advanced

6 Recommissioning

To recommission the product, you either have to connect the equipment rack to the voltage source or switch it on, depending on the connection variant.

Recommissioning

For a new commissioning of DIB-R5 advanced, proceed as described in *Chapter 4.2 “Switching on the DIB-R5 advanced” on page 66*.

7 Maintenance

To ensure the proper operation of products, maintenance tasks and periodical visual inspections are required.

The products have been designed for permanent and unsupervised operation. Nevertheless you have to perform checks every now and then. When doing so, you can detect and remove dirt in the vicinity of or within equipment racks, so the air supply and heat dissipation of the products is always ensured.

The current status of the hardware components can be monitored via a connected NMC-511 FaultManager. For more information on the NMC-511 FaultManager, please refer to the product documentation of the NMC-511 FaultManager.

7.1 Maintenance tasks

Soiling may impair the air supply and the heat dissipation and thus affect the operation. For this reason, the activities listed below should be performed in the interval specified.

Maintenance tasks

Task/s	Interval/s
Replace the fan	after 30,000 operating hours
Replace the air filter pad	Depends on the environmental conditions

Early fan replacement

Independent of the ambient data at the installation site, the fan may have to be replaced earlier. For this reason, please comply with the following recommended visual inspections and intervals.

7.2 Periodical visual inspections

The table below lists the recommended tasks for maintaining the products. The visual inspections should be performed in the intervals specified to be able to respond in due time, e.g. in the case of changes at the location that may result in improper operation.

We recommend logging the results of the test.

Activities and intervals for visual inspections

Task/s	Interval/s
Site inspection based on the document "DIB-R5 advanced Site Requirements", such as inspecting the: ■ Grounding equipment ■ Voltage supply connector ■ TETRA antennas ■ Installation location of the GNSS antenna ■ Condition and fit of all supply lines, renew if necessary ■ Connections between two DIB-R5 advanced – only in the case of a CHU expansion	■ Upon location changes ■ Once every year
Check the condition of the product with respect to: ■ Readiness for operation ■ Dirt and dust accumulations on and in the equipment rack, remove if necessary ■ Degree of contamination of contact pins, remove dirt if necessary ■ Check the fan unit for proper operation: Replace the air filter pad as required	Once every year
Check function of external alarms – if wired	Once every year
Checking standby carriers – if available	Once every year

Shorter intervals may be required

Depending on the respective environmental conditions at the site of the product, shorter intervals may be required.

8 Troubleshooting

Troubleshooting via the network management system (NMS)

The NMC-511 FaultManager can be used to detect faults within the ACCESSNET-T IP. This is done via a NMC computer that has been configured accordingly.

The troubleshooting via the NMC-511 FaultManager should be performed prior to the troubleshooting on site (e.g. at locations of network elements. It can provide information whether a site must actually be visited.

The following table lists possible problems, causes and troubleshooting measures.

Troubleshooting

Problem	Possible cause	Troubleshooting
Base station cannot be reached/switched on	On/off switch in switch position "OFF"	Set on/off switch to switch position "ON"
	Voltage supply at location not operational	Check fuse
		Check distribution box or mains socket
		Check voltage supply cable
	Cable connection defective	Check internal wiring
		Check cables
	APDM/DPDM defective	Check fuse
		Check wiring
		Carry out the visual inspection
		Check operating state via NMC-511 FaultManager
	PSU/PSM defective – with V_{AC} voltage supply	Check operating states via LEDs
		Check operating state via NMC-511 FaultManager
	Ethernet connection defective	Check operating state via NMC-511 FaultManager
		Check reachability with ping
Connection to transport network defective (stand-alone or fallback operation)	Cable connection defective	Check operating state via LEDs on switch/router
		Check internal wiring
		Check ethernet cable

Problem	Possible cause	Troubleshooting
	Switch/router defective	Check operating state via LEDs on switch/router
Call setup/registration not possible	Transmitting/receiving antenna defective	Check antenna
	Cable connection defective	Check wiring of antenna(s) incl. antenna cable
		Check internal wiring
	Carrier disabled	Check status of carrier in the NMC-511 FaultManager
	Carrier incorrectly configured	Check configuration in the NMC-515 ConfigurationManager
	Carrier defective	Check status of carrier in the NMC-511 FaultManager and replace as required
	No subscriber data available on the base station	Check status in the NMC-511 FaultManager and, if necessary, in the NMC-515 ConfigurationManager
	Subscriber unknown	Check subscriber configuration in the NMC-512 SubscriberManager
	No authorization for call services	
	Mobile station incorrectly configured	Check configuration of mobile station
	Mobile station defective	Check mobile station
No GNSS signal	GNSS antenna defective	Check antenna
	No unobstructed visibility of the sky	Check installation location of the GNSS antenna
	Cable connection defective	Check plug connections and antenna cable
BSCU/CHU/HCU not ready for operation	Electrical connection to backplane defective	Install insert correctly
	PSU/PSM defective – with V_{AC} voltage supply	Check PSU/PSM
	"ALM" LED is on	Checking operating state in the NMC-511 FaultManager
Insert defective, e.g. BSCU, CHU, HCU	Electrical connection to backplane defective	Check connection to backplane
	Voltage supply missing	Check voltage supply
Fan unit not (completely) operational	Electrical connection to backplane defective	Check connection to backplane
	PSU/PSM defective – with V_{AC} voltage supply	Check PSU/PSM

Problem	Possible cause	Troubleshooting
	"ALM" LED is on	Checking operating state in the NMC-511 FaultManager
	"FAN 1-6" LED flashes	Checking operating state in the NMC-511 FaultManager
		Check fan