ACCESSNET®-T IP
DIB-R5 flexibleTx

Digital Integrated Base Station
Operation Manual

90DIBR5flexibleTxOM02 - 1.2

Hytera Mobilfunk GmbH
Fritz-Hahne-Straße 7
31848 Bad Münder
Germany
Telephone: +49 (0)5042 / 998-0
Fax: +49 (0)5042 / 998-105
E-mail: info@hytera.de
Internet: www.hytera-mobilfunk.com

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 danger
- Source of danger
- Measures to be taken to avert the specified danger

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 danger 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 dangerous 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 danger 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 History of changes

The following table identifies the changes made to a document. The following reasons for changes are distinguished:

- Content-related changes (e.g. functional expansions or new functions)
- Editorial changes (e.g. changes to the layout)
- Fault corrections (document-specific corrections)

History of changes

Version	Date	Reason for changes	Implemented changes	refer to
1.1	2016-01-25	Content-related changes	Expansion of safety regulations (FCC/IC)	*Chapter 2 “Safety regulations” on page 15*
			Product description updated	*Chapter 3 “Product description” on page 25*
1.2	2016-02-02	Content-related changes	"Model Name" updated	*Table “Certified frequency ranges (FCC/IC)” on page 16*

1.7 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 flexibleTx Technical Data
  describe the technical properties of the product.
- DIB-R5 flexibleTx Site Requirements
  describe the requirements for the site where the product is used.
- DIB-R5 flexibleTx Installation Manual
  describes the proper setup and electrical connection of the product at site.
- DIB-R5 flexibleTx Configuration Manual
  describes the configuration of the product.
- DIB-R5 flexibleTx Service 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 NMCs and support trouble-shooting.
  The user manuals for the following NMCs 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, e.g. component versions of software components or document versions.
- project-specific documents e.g. the "Base Design" document, where applicable, describe 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.

1.8 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.

Hytera Mobilfunk GmbH

Fritz-Hahne-Straße 7

31848 Bad Münder

Germany

Telephone: +49 (0)5042 / 998-0

Fax: +49 (0)5042 / 998-105

E-mail: info@hytera.de

Internet: *www.hytera-mobilfunk.com*

2 Safety regulations

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

2.1 Safety instructions and declaration of conformity

The operation of the product is subject to the statutory provisions of the respective country, in which the product is used. For the operation, the required operating licenses must be requested from the responsible local authorities. Particularly the frequency range used must be reserved for the respective purpose in the country, in which the product is used. The product user is responsible for complying with the statutory provisions and the intended use.

2.1.1 Safety instructions and declaration of conformity for North America

The product complies with the requirements of the Federal Communications Commission (FCC).

This device complies with part 15 and 90 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The product complies with the requirements of ICES-003 Issue 5 and RSS-119 of Industry Canada (IC).

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- l'appareil ne doit pas produire de brouillage, et
- l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- This device may not cause interference, and
- this device must accept any interference, including interference that may cause undesired operation of the device.

Operation of the product in North America

The product is certified for operation on the territory of the United Sates of America and of Canada by the Federal Communications Commission (FCC) as well as by Industry Canada (IC). It may only be operated in the certified frequency ranges and at the frequencies approved at the sites concerned.

The FCC and IC has approved the DIB-R5 for the USA and/or Canada for the frequency ranges listed in the table below.

Certified frequency ranges (FCC/IC)

Authority	Model Name	FCC Identifier/Certification Number	Frequency range (MHz)
Federal Communications Commission (FCC)	DIF-R5400	ZW4DIF5400	450,0 to 470,0
	DIF-R5800	ZW4DIF5800	854,0 to 869,0
Industry Canada (IC)	DIF-R5400	4431B-DIF5400	■ 406,1 to 430,0 ■ 450,0 to 470,0
	DIF-R5800	4431B-DIF5800	851,0 to 869,0

Further information on the certifications is available on the websites of the FCC and the IC:

- FCC: *http://www.fcc.gov/*
- IC: *http://www.ic.gc.ca/*

The product meets the requirements of FCC and IC for the United States and Canada, respectively, only if the external antenna coupling system meets all requirements at all times, refer to ↳ *Table “Requirements for external antenna coupling systems” on page 15*.

Responsibility for the installation, commissioning and maintenance of the external antenna coupling system

The network operator is responsible for the proper installation, commissioning and maintenance of external antenna coupling systems unless this is an integral part of the contract with the Hytera Mobilfunk GmbH. An installer who may have been entrusted with the installation/commissioning and/or maintenance of the antenna coupling system is responsible for complying with all the applicable requirements and for the metrological tests required afterwards.

The network operator is responsible for ensuring that:

– all of the requirements listed in the following are met at any time.
– equipment for overload protection and lightning protection has been provided at the installation site.

The following table describes the requirements for external antenna coupling systems.

Requirements for external antenna coupling systems

Component	Property/demand		Value/value range
Transmitter coupling system	Return loss	at all Tx inputs	≥ 19 dB
	Isolation	between Tx inputs	≥ 50 dB
		between output and Tx inputs	≥ 50 dB
	Impedance	at all Tx inputs	50 Ω
	Input power per Tx input (mean value)		according to the adjusted transceiver power
	Input power (total, mean value)		according to the total of the adjusted transceiver power
	Input power (total, peak value)		($\log_2$ (number of transceivers) +1) x 3 dB + output per transceiver [dB]
	Intermodulation products of 3rd order (IM 3) between Tx inputs	2 x 49 dBm @ 250 kHz	> 85 dB
	Intermodulation products of 3rd order (IM 3) per Tx input	2 x 47 dBm @ 10 kHz	> 65 dB
Duplex filter (with common Tx/Rx antenna)	Isolation between Tx and Rx input	common Tx/Rx antenna: 0 dB antenna decoupling	≥ 80 dB
	Intermodulation products of 3rd order (IM 3)	2 x 46 dBm @ 250 kHz	≤ -150 dBc
	Input power (total, peak value)		according to the total output from the transmitter coupling system
	Suppression of 2nd harmonic of all transmitters		> 30 dB
Transmitting filter	Attenuation in Rx band	Separate Tx/Rx antennas, assumed antenna decoupling 25 dB	≥ 55 dB
	Intermodulation products of 3rd order (IM 3)	2 x 46 dBm @ 250 kHz	≤ -150 dBc
	Input power (total, peak value)		according to the total output from the transmitter coupling system

Component	Property/demand		Value/value range
Receiving filter	Attenuation in Tx band	Separate Tx/Rx antennas, assumed antenna decoupling 25 dB	≥ 55 dB
	Attenuation		≤ 1.2 dB to achieve the sensitivity according to the Technical Data

2.2 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 terminals 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 network 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.

The network operator is responsible for ensuring that:

- the product is used exclusively within the scope of the intended use,
- work on the electrical installation is performed only by experts that have been trained accordingly,
- special legal requirements that govern the operation of the product are complied with,
- product modifications or expansions:
  - are performed only after having consulted Hytera Mobilfunk GmbH,
  - are only performed in compliance with the state of the art and scientific knowledge,
  - are performed taking into consideration the applicable national and international provisions,
  - are performed exclusively by trained experts who have been authorized accordingly.
- damage to the product and product defects are immediately remedied by experts that have been trained and authorized accordingly,

- appropriate measures are taken against radio interference,
- any defects in the operation room that come up later on are eliminated immediately,
- for subsequent modifications of the operation room, the requirements described in the present document are always taken into consideration,
- appropriate fire precautions are taken as required (e.g. the use of appropriate fire extinguishers),
- special legal requirements that control the operation and handling of batteries and battery systems, if used, are complied with and that appropriate security devices and measures are provided and taken as required.

Country-specific laws and provisions

All the stipulated laws and provisions of the respective country of use shall always apply. The network operator is responsible for the adherence to these laws and provisions.

2.3 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 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.

2.3.1 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. This aspect includes ensuring that access to the site is safeguarded and instruction has been provided on all precautionary measures to be taken.

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: Persons who
  - operate the product,
  - monitor, interrupt, terminate and restore operation of the product.
- Service personnel: Persons who
  - set up the product,
  - prepare and restore the operational state,
  - adjust and/or parameterize the product,
  - monitor, interrupt, terminate and restore operation of the product,
  - maintain, care for, and repair the product.

2.3.2 Electromagnetic compatibility

For function-related reasons, increased electromagnetic radiation may occur with specific products, e.g. RF 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 network operator is obliged to assess workplaces with a considerable risk of exposure to radiation and to avert any hazards.

2.3.2.1 Electromagnetic compatibility for North America

For compliance with the electromagnetic radiation and the limit values with regard to the security of the general population in high-frequency fields, the document "RF Exposure" must always be observed. For the proper operation of the product, the limit values specified in the document "RF Exposure" must always be complied with. For this purpose, site-specific calculations by the network operator may be required.

The document "RF Exposure Info" is available at the following URL as a PDF file: *https://apps.fcc.gov/oetcf/eas/reports/GenericSearch.cfm*.

For this purpose, the first three digits of the FCC Identifier must be entered on the form as "Grantee Code" (ZW4) and the remaining digits as "Product Code", refer to *Table “Certified frequency ranges (FCC/IC)” on page 14*.

2.3.3 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.

2.3.4 Hazardous substances

The following chapters contain information on hazardous substances.

2.3.4.1 Hazardous substances outside Europe

All the stipulated laws and provisions of the respective country of use shall always apply. The network operator is responsible for the adherence to these laws and provisions.

2.3.5 Product disposal

The following chapters contain information on product disposal.

2.3.5.1 Product disposal outside Europe

All the stipulated laws and provisions of the respective country of use shall always apply. The operator is responsible for the adherence to these laws and provisions.

2.4 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.

2.5 Safety markings

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

2.5.1 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]).

2.5.2 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.

2.5.2.1 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.

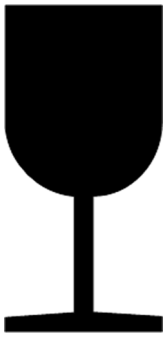

Figure 1: Safety marking "Fragile"

2.5.2.2 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.

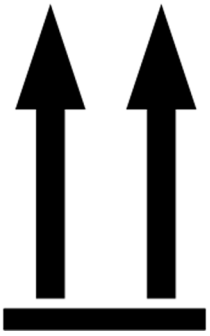

Figure 2: Safety marking "Transport Upright"

2.5.2.3 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. Pioneering TETRA Release 2 support, particularly the TEDS technology (TETRA Enhanced Data Service), render the DIB-R5 extremely attractive for all scenarios in which a high degree of availability as well as high-speed data are absolutely necessary. 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 base station family DIB-R5 meet 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 and consists of one or two equipment racks depending on the number of carriers.
- DIB-R5 compact
  The DIB-R5 compact offers up to four TETRA carriers with hybrid combiner and consists of one or two compact racks depending on the number of carriers.
  DIB-R5 compact is suitable for space-saving installation in existing 19" equipment racks.
- DIB-R5 flexibleTx
  The DIB-R5 flexibleTx provides up to four TETRA carriers in a compact rack and is operated project-specific with external antenna coupling systems. DIB-R5 flexibleTx 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.

Properties of the DIB-R5 flexibleTx

In each compact rack DIB-R5 flexibleTx offers space for four TETRA Channel Units (CHU), which are each providing one TETRA carrier. Thus offers DIB-R5 flexibleTx a maximum of 16 radio channels to the radio subscribers that can be used simultaneously. To increase the availability, DIB-R5 flexibleTx can be equipped with different redundancy options to avoid "Single Points of Failure". On the hardware side, the transceivers, control unit and power supply can be designed redundantly. Furthermore, additional software-based redundancy options are available that further increase the reliability of features.

DIB-R5 flexibleTx is used project-specific with external antenna coupling systems. In addition, DIB-R5 flexibleTx supports optimal reception of triple diversity with highest sensitivity. 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 flexibleTx 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.

Due to the compact dimensions and the low weight, the DIB-R5 flexibleTx can be optimally integrated into existing communication systems, e.g. into standard 19" equipment racks. The compact design also eases transport, which can be undertaken using the integrated carrying handles if necessary.

For time synchronization, the DIB-R5 flexibleTx can be operated with satellite-based synchronization, e.g. GPS, Galileo and Glonass (Global Navigation Satellite System, GNSS). As an alternative, the synchronization via the IP transport network can be carried out with the help of the Precision Time Protocol (PTP). For this purpose, the base stations DIB-R5 are supplied with the time synchronization from a central point.

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 flexibleTx with four TETRA Channel Units (CHU) and V_{AC} power supply. The following table describes the components in greater detail.

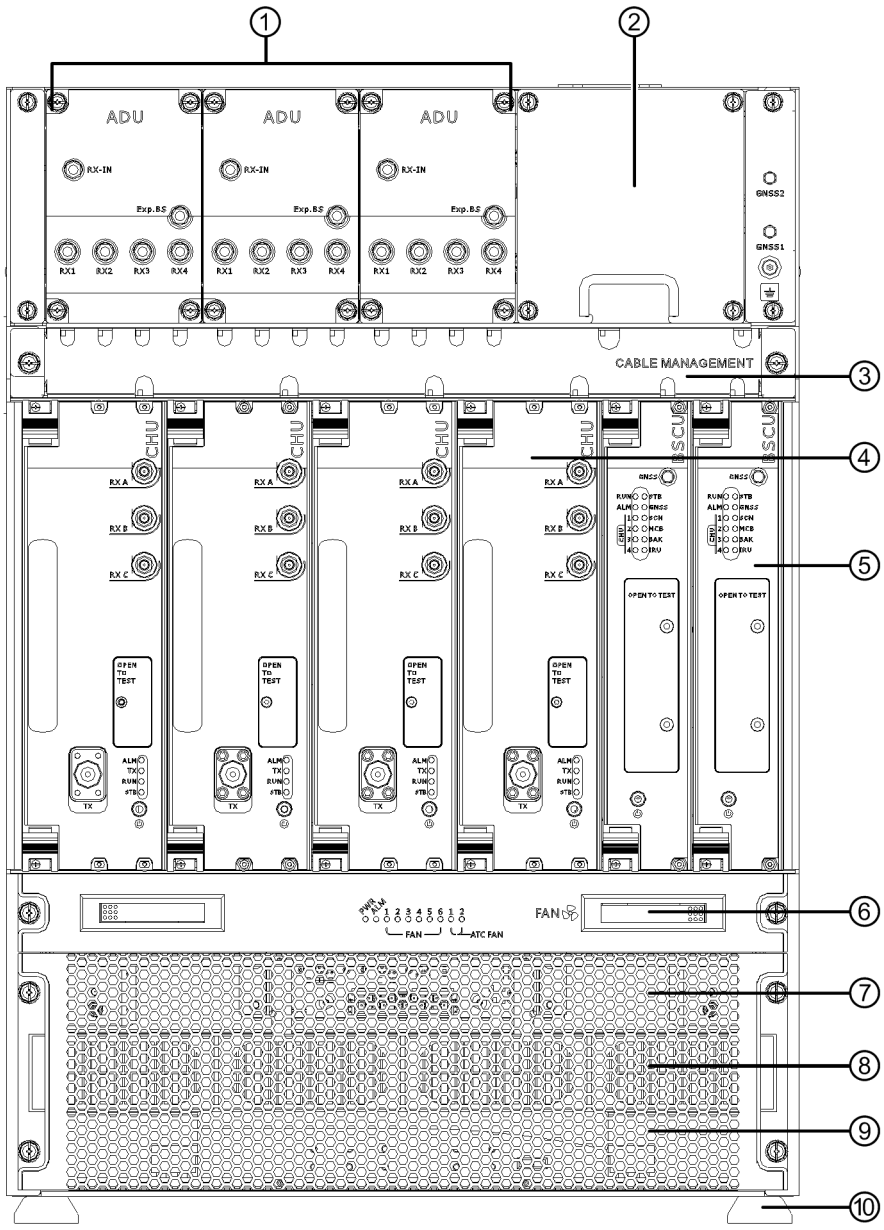

Figure 5: DIB-R5 flexibleTx (front view)

Legend: DIB-R5 flexibleTx (front view)

No.	Component	Number	Described in
1	ADU	1 to 3	*Chapter 3.2.4.1 “Active Divider Unit (ADU)” on page 45*
2	Cable routing for Tx cable	1	---
3	Cable routing for Rx and GNSS cable (Global Navigation Satellite System, GNSS)	1	---

No.	Component	Number	Described in
4	TETRA Channel Unit (CHU)	1 to 4	*Chapter 3.2.5 “TETRA Channel Unit (CHU)” on page 46*
5	Base Station Controller Unit (BSCU)	1 to 2	*Chapter 3.2.6 “Base Station Controller Unit (BSCU)” on page 49*
6	Fan unit	1	*Chapter 3.2.7 “Fan unit” on page 53*
7	Air entry for fan unit	1	---
8	■ V_{AC} power supply: Power Supply Unit (PSU) including Power Supply Module (PSM) ■ V_{DC} power supply: Dummy plate	■ 1 to 2 ■ 0	*Chapter 3.2.2.2 “Power Supply Unit (PSU) including Power Supply Module (PSM)” on page 40*
9	Dummy plate	1	---
10	Support feet	4	---

The following figure shows the top view of the DIB-R5 flexibleTx with V_{AC} power supply. The following table describes the components in greater detail.

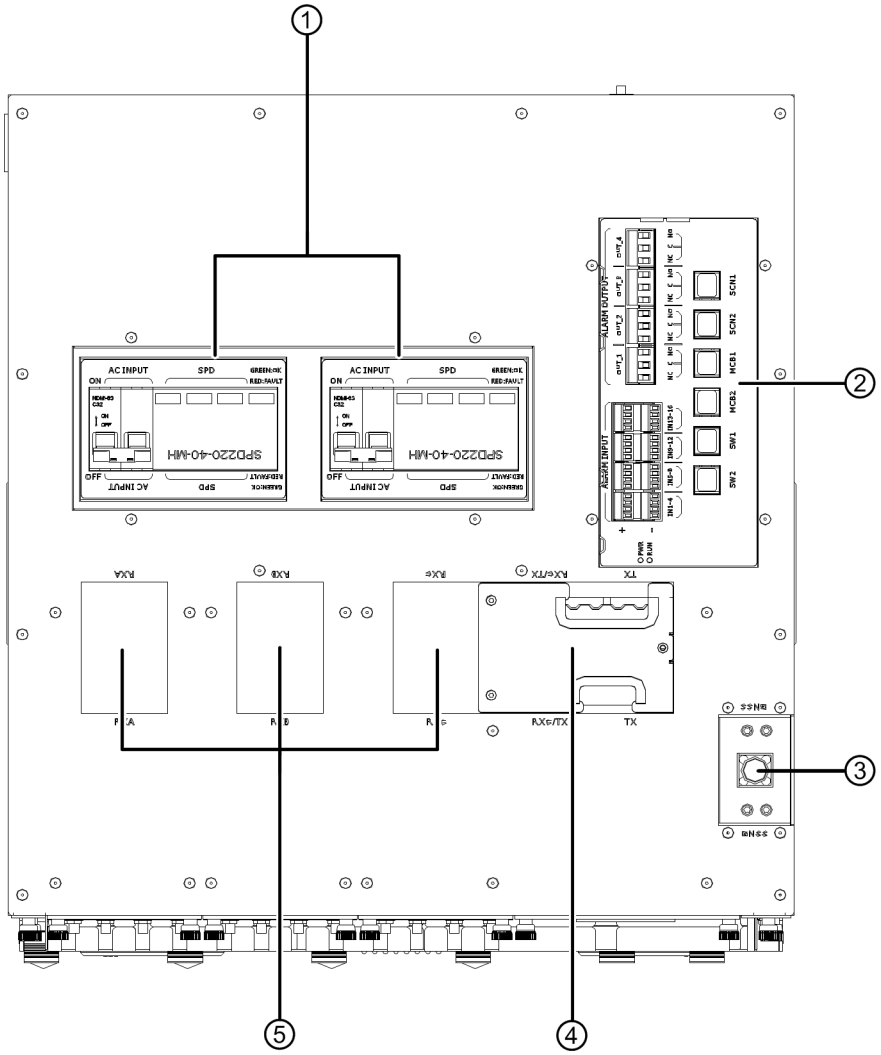

Figure 6: DIB-R5 flexibleTx (top view)

Legend: DIB-R5 flexibleTx (top view)

No.	Component	Number	Described in
1	■ V_{AC} power supply: AC Power Distribution Module (APDM) ■ V_{DC} power supply: DC Power Distribution Module (DPDM)	1 to 2	■ *Chapter 3.2.2 “V_{AC} power supply” on page 38* ■ *Chapter 3.2.3 “V_{DC} power supply” on page 42*
2	Connection panel	1	*Chapter 3.2.1.2 “Connection panel” on page 36*
3	GNSS splitter	1	*Chapter 3.2.1.3 “GNSS splitter” on page 38*

No.	Component	Number	Described in
4	Grommet	1	---
5	Dummy plate	3	---

The following figure shows the rear view of the DIB-R5 flexibleTx with V_{AC} power supply and opened cover. The following table describes the components in greater detail.

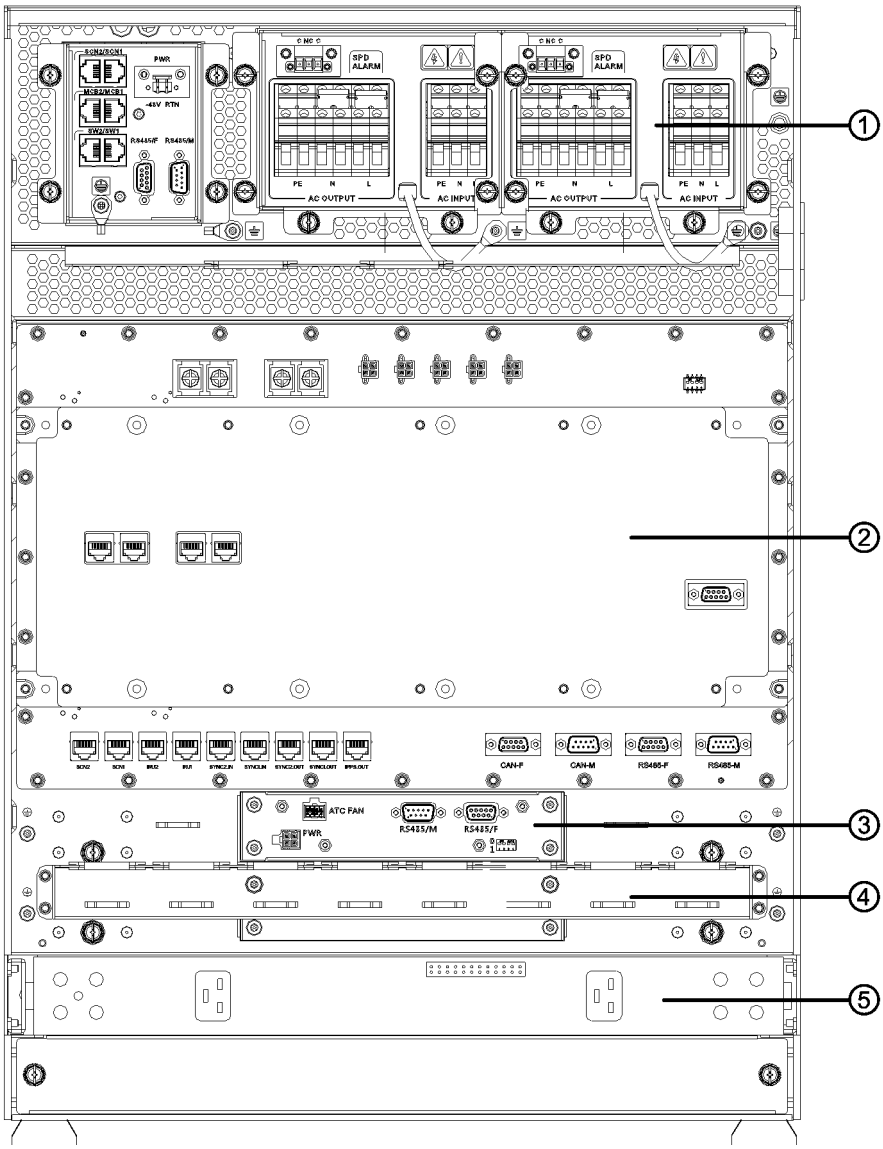

Figure 7: DIB-R5 flexibleTx with opened cover (rear view)

Legend: DIB-R5 flexibleTx with opened cover (rear view)

No.	Component	Number	Described in
1	■ V_{AC} power supply: AC Power Distribution Module (APDM) ■ V_{DC} power supply: DC Power Distribution Module (DPDM)	1 to 2	■ *Chapter 3.2.2 "V_{AC} power supply" on page 38* ■ *Chapter 3.2.3 "V_{DC} power supply" on page 42*
2	Backplane	1	*Chapter 3.2.8 "Backplane" on page 55*
3	Fan unit	1	*Chapter 3.2.7 "Fan unit" on page 53*
4	Cable routing	1	---
5	■ V_{AC} power supply: Power Supply Unit (PSU) including Power Supply Module (PSM) ■ V_{DC} power supply: Not available	■ 1 to 4 ■ ---	*Chapter 3.2.2.2 "Power Supply Unit (PSU) including Power Supply Module (PSM)" on page 40* ---

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 power supply, frequencies and redundancy options. Depending on the characteristic, different components can be installed.

The following table provides an overview of the properties.

Properties of the DIB-R5

Property	DIB-R5 advanced	DIB-R5 compact	DIB-R5 flexibleTx
Max. number of CHUs	■ 4 per equipment rack ■ 2 equipment racks possible	■ 2 per compact rack ■ 2 compact racks possible	■ 4 per compact rack ■ 1 compact rack possible
Max. number of carriers/channels	■ 8 carriers ■ 32 channels	■ 4 carrier ■ 16 channels	■ 4 carrier ■ 16 channels
Redundancy for CHUs	✓	✓	✓
Redundancy for control unit (BSCU)	✓	✓	✓
Power supply	V_{AC} or V_{DC}		

Property	DIB-R5 advanced	DIB-R5 compact	DIB-R5 flexibleTx
	Redundancy with V_{AC} power supply by means of following, optional additions: ■ Redundant rectifier modules (Power Supply Module, PSM) ■ Redundant power supply lines		
Triple diversity reception	✓	✓	✓
Antenna coupling system	Cavity combiner (motor tuned)	Hybrid combiner	External antenna coupling system at the site
	One of the following transmitting filters: ■ DUPLEXER for a common transmitting/receiving antenna (Tx/Rx antenna). Can be combined with up to two receiving antennas (Rx antennas). ■ TX FILTER for separate transmitting and receiving antennas (Tx and Rx antennas). Must be combined with up to three receiving antennas (Rx antennas).		

3.2 Components

The following table lists the components of the DIB-R5 flexibleTx for each compact rack.

Components of the DIB-R5 flexibleTx

Component		Described in
Connection and control panel	*On/off switch*	*Chapter 3.2.1.1 "On/off switch" on page 36*
	Connection panel	*Chapter 3.2.1.2 "Connection panel" on page 36*
	GNSS splitter	*Chapter 3.2.1.3 "GNSS splitter" on page 38*
V_{AC} power supply		*Chapter 3.2.2 "V_{AC} power supply" on page 38*
V_{DC} power supply		*Chapter 3.2.3 "V_{DC} power supply" on page 42*
Divider Unit (DIU)	*Active Divider Unit (ADU)*	*Chapter 3.2.4.1 "Active Divider Unit (ADU)" on page 45*

Component	Described in
TETRA Channel Unit (CHU)	*Chapter 3.2.5 “TETRA Channel Unit (CHU)” on page 46*
Base Station Controller Unit (BSCU)	*Chapter 3.2.6 “Base Station Controller Unit (BSCU)” on page 49*
Fan unit	*Chapter 3.2.7 “Fan unit” on page 53*
Backplane	*Chapter 3.2.8 “Backplane” on page 55*

3.2.1 Connection and control panel

DIB-R5 flexibleTx features a connection and control panel at the top to which the antenna and power supply cables can conveniently be connected. In addition, the connection and control panel provides access to all the elements that are required for additional connections and operation.

The following figures show the connection and control panel for V_{AC} and V_{DC} power supply in the top view. The following table describes it in detail.

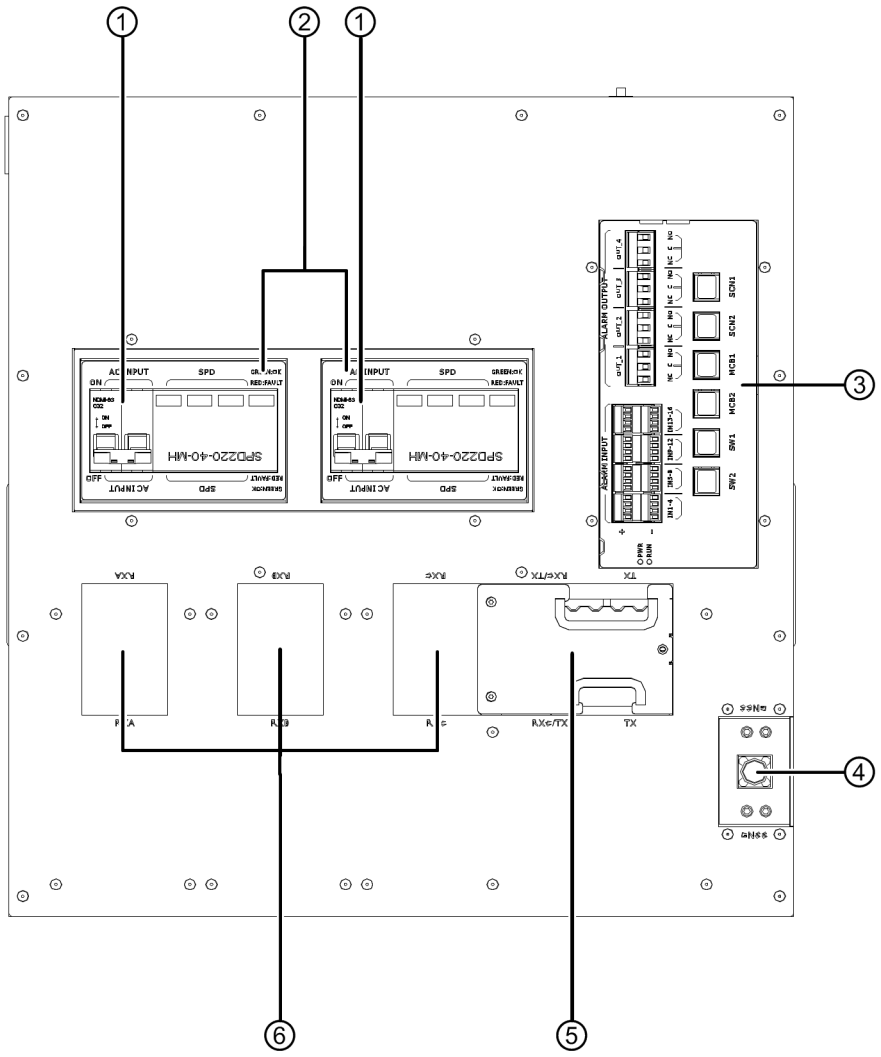

Figure 8: Connection and control panel for V_{AC} power supply (top view)

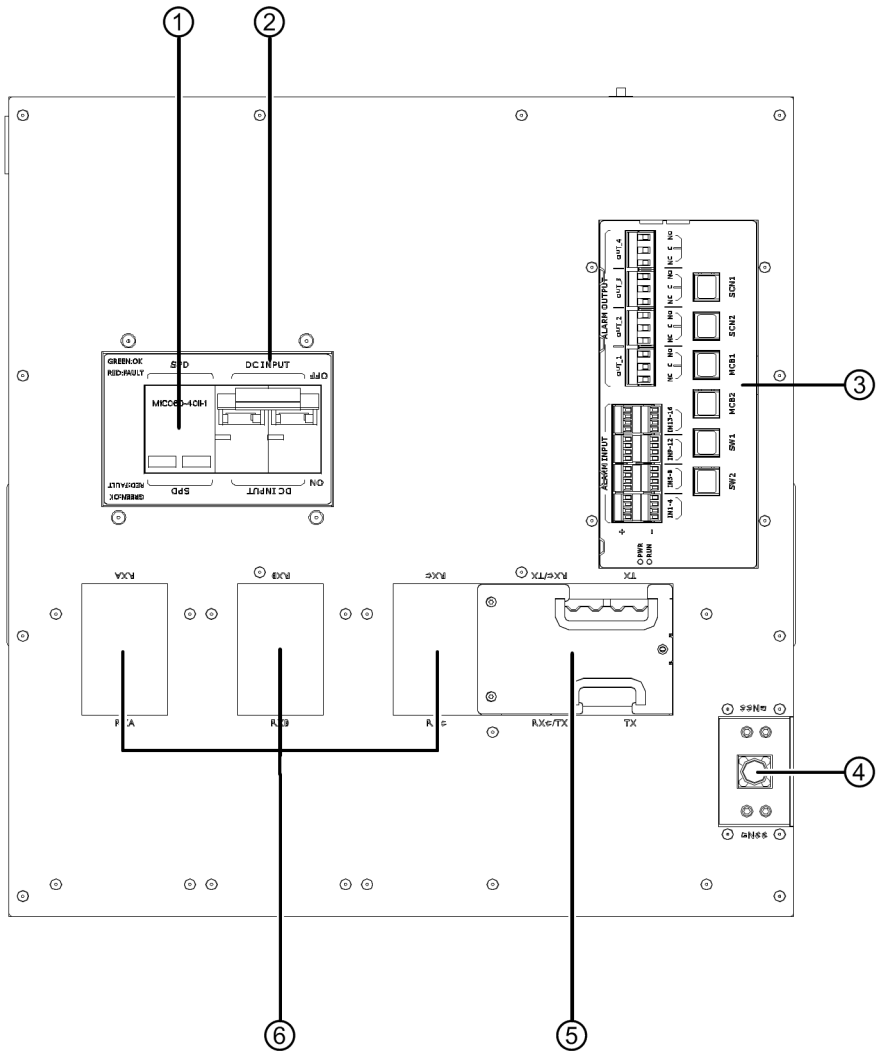

Figure 9: Connection and control panel for V_{DC} power supply (top view)

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 36*
2	■ V_{AC} power supply: AC Power Distribution Module (APDM) ■ V_{DC} power supply: DC Power Distribution Module (DPDM)	■ refer to ↳ *Chapter 3.2.2 "V_{AC} power supply" on page 38* ■ refer to ↳ *Chapter 3.2.3 "V_{DC} power supply" on page 42*
3	Connection panel	refer to ↳ *Chapter 3.2.1.2 "Connection panel" on page 36*

No.	Component	Description
4	GNSS splitter	refer to *Chapter 3.2.1.3 "GNSS splitter" on page 38*
5	Grommet	---
6	Dummy plate	---

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 power supply and is used for connecting the power supply and the power distribution to the hardware components of the DIB-R5 flexibleTx.

- With the V_{AC} power supply, the on/off switch is available via the AC Power Distribution Module (APDM), refer to *Chapter 3.2.2 "V_{AC} power supply" on page 38*.
- With the V_{DC} power supply, the on/off switch is available via the DC Power Distribution Module (DPDM), refer to *Chapter 3.2.3 "V_{DC} power supply" on page 42*.

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 flexibleTx 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.

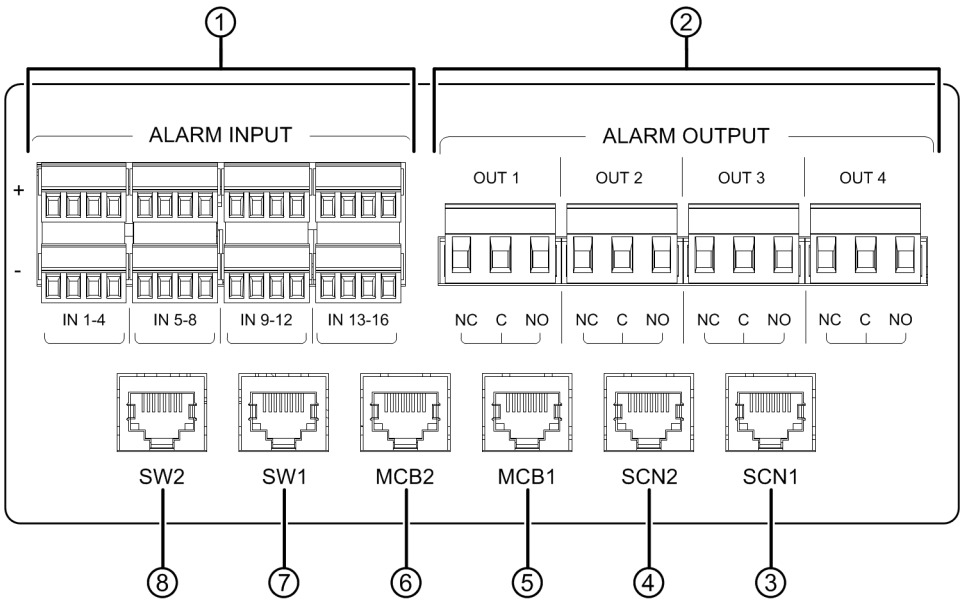

Figure 10: Connection panel (top view)

Legend: Connection panel (top view)

No.	Component	Description	Connection type
1	ALARM INPUT	Alarm inputs/outputs for wiring alarm contacts	Connector with screw terminal
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		
7	SW1	Connection of the service computer (local)	RJ45
8	SW2	Connection of service computer (local) – optional for controller redundancy This connection is used only if software downloads should be performed purposefully only 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 allocation and distribution of the received GNSS signal (e.g. GPS, Galileo or Glonass) to up to two BSCUs. The GNSS splitter is installed in the connection and control panel.

3.2.2 V_{AC} power supply

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

The V_{AC} power 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 power supply and the power distribution to the backplane and the installed hardware components. The APDM is used for the V_{AC} power 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 power supply line, two APDMs are installed (optional). The redundancy options of the power supply are described in *Chapter 3.5.6 “Redundant V_{AC} power supply” on page 62*.

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

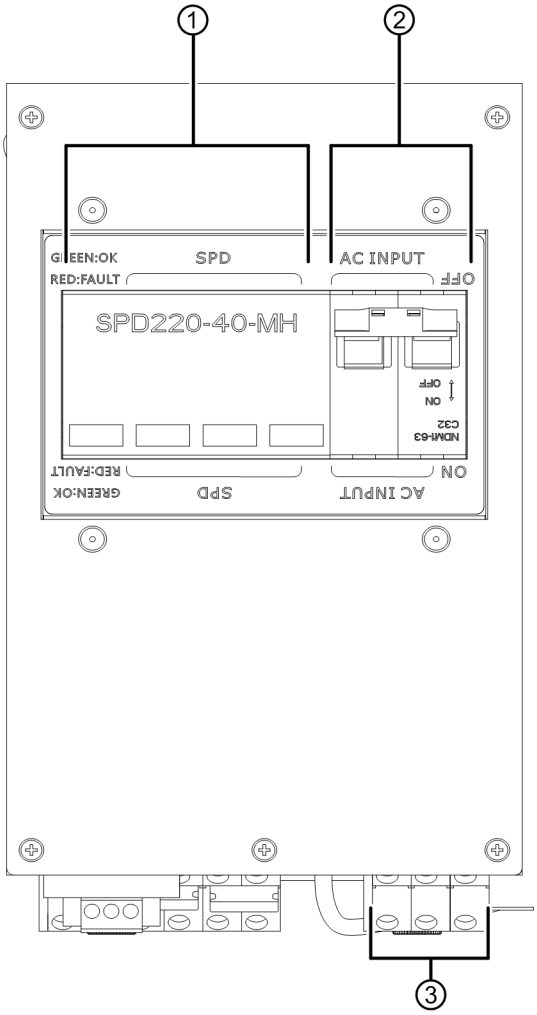

Figure 11: APDM (top view)

Legend: APDM (top view)

No.	Component	Description
1	Surge protection	Surge Protection Device (SPD) of the DIB-R5 flexibleTx
2	On/off switch	On/off switch of the DIB-R5 flexibleTx
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.

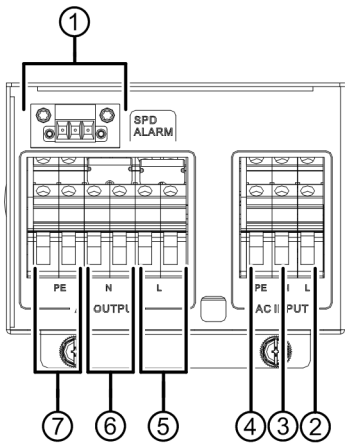

Figure 12: APDM (front view)

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		Protective conductor connection for V_{AC} input voltage
5	L	Output	Phase conductor connection for the V_{AC} output voltage – already connected with the PSU at time of delivery
6	N		Neutral conductor connection for the V_{AC} output voltage – already connected with the PSU at time of delivery
7	PE		Protective conductor connection for the V_{AC} output voltage – already connected with the PSU at time of delivery

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

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

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

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

The Power Supply Module (PSM) is a rectifier module and is used with V_{AC} power 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 power supply and the number of installed CHUs per equipment or compact rack. The number is higher if redundant PSMs are used (maximum 4 per equipment or compact rack).

Recommended number of PSMs (per equipment or compact rack)

Power supply	Number of CHUs	Number of PSMs
90 V_{AC} - 185 V_{AC} (nominal)	1 to 2	2
	3 to 4	4
185 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.

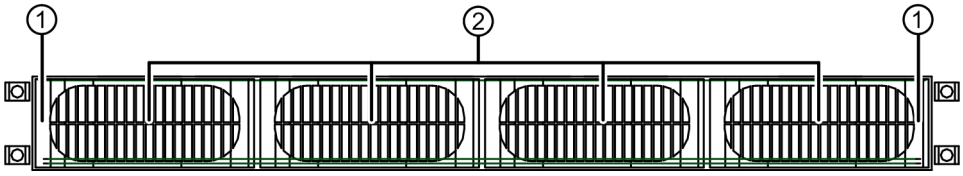

Figure 13: PSU (front view)

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 site and the number of installed CHUs, refer to *Table “Recommended number of PSMs (per equipment or compact rack)” on page 39*

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

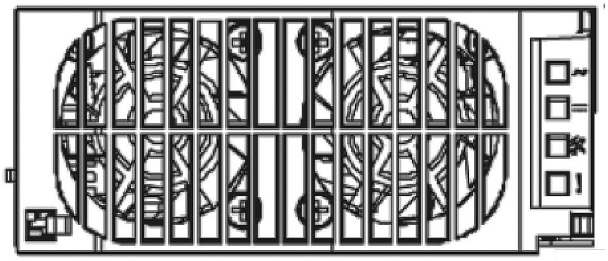

Figure 14: PSM (front view)

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} power supply

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

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

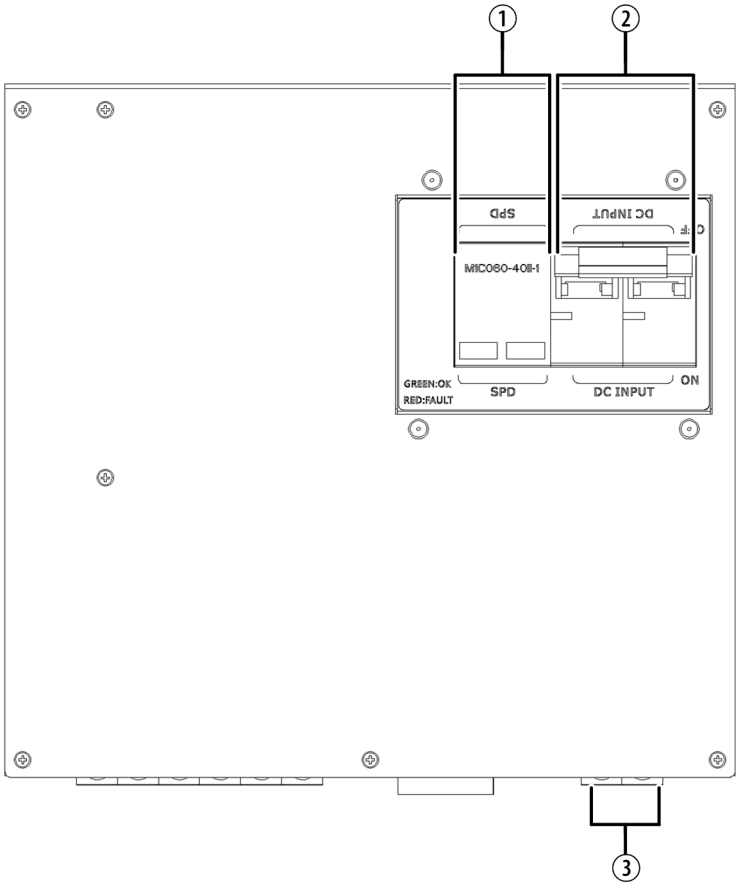

Figure 15: DPDM (top view)

Legend: DPDM (top view)

No.	Component	Description
1	Surge protection	Surge Protection Device (SPD) of the DIB-R5 flexibleTx
2	On/off switch	On/off switch of the DIB-R5 flexibleTx
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.

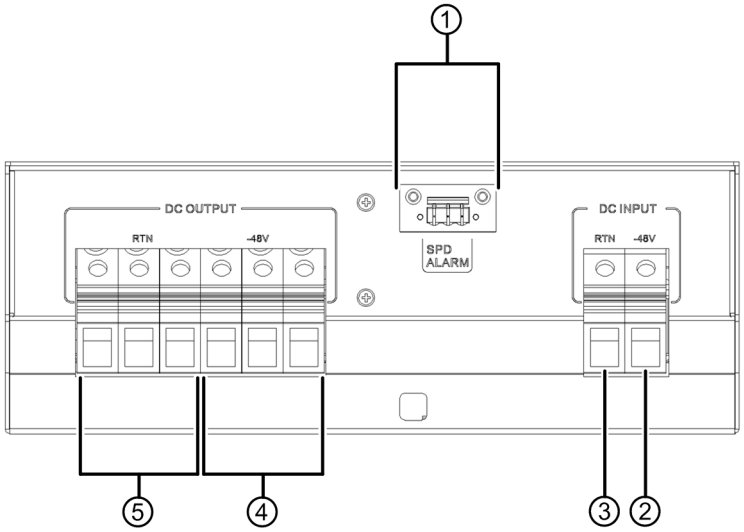

Figure 16: DPDM (front view)

Legend: DPDM (front view)

No.	Component		Description
1	SPD ALARM		Connection for monitoring the Surge Protection Device (SPD)
2	DC INPUT	-48 V	Connection for the negative voltage line (input voltage)
3		RTN	Connection for the positive voltage line (input voltage)
4	DC OUTPUT	-48 V	Connection for the negative voltage line (output voltage) – already connected with the backplane at the time of delivery
5		RTN	Connection for the positive voltage line (output voltage) – already connected with the backplane at the time of delivery

3.2.4 Divider Unit (DIU)

The Divider Unit (DIU) is a component of the antenna coupling system and used for distributing a reception signal received by the antennas to the installed CHUs.

Different DIUs are used in the DIB-R5 flexibleTx:

- *Active Divider Unit (ADU)*

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

3.2.4.1 Active Divider Unit (ADU)

The Active Divider Unit (ADU) is used for amplifying the received Rx signals. The Rx signals are distributed by the ADU and forwarded to the respective Channel Units (CHU).

The number of ADUs depends on the number of receiving antennas (Rx antennas). One ADU is required for every Rx antenna.

This component features an antenna connection at the front side with which an external antenna coupling system can be connected, refer to *Chapter 3.2.1 “Connection and control panel” on page 31*.

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

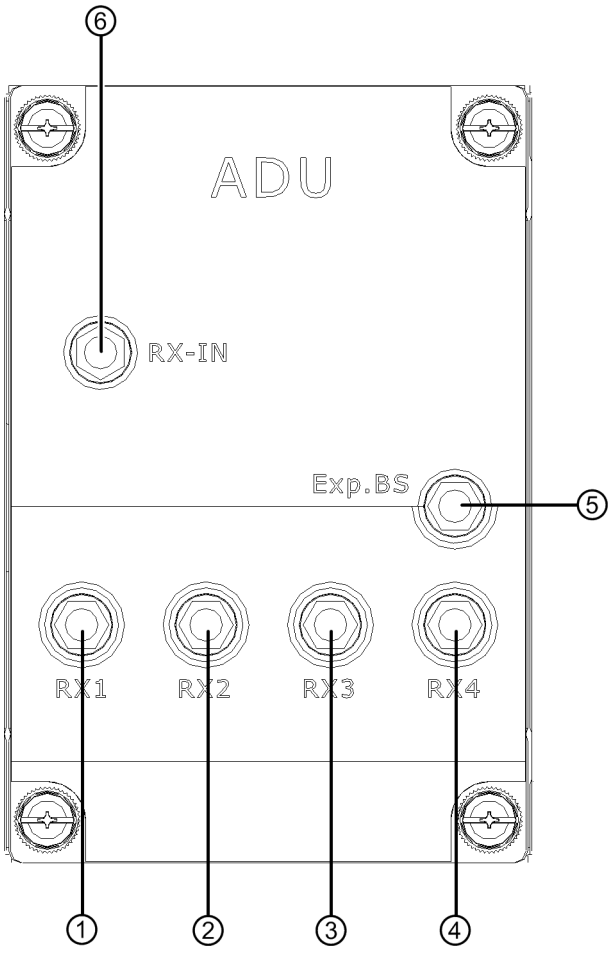

Figure 17: ADU (front view)

Legend: ADU (front view)

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

No.	Component	Description
3	RX3	Connector for the connection with CHU 3
4	RX4	Connector for the connection with CHU 4
5	Exp. BS	Not used for the time being
6	RX-IN	Connector for the connection with an external antenna coupling system

3.2.5 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 (downlink and uplink) 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 terminals 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 following figure shows the front view of the CHU. The following table describes it in detail.

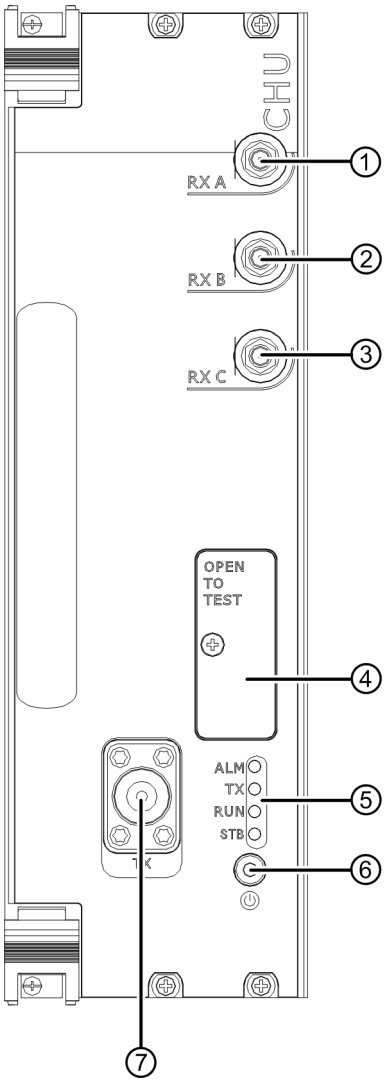

Figure 18: CHU (front view)

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 48*
5	Indicators (LEDs)	Status display of the CHU, refer to *Table “Legend: Indicators (LEDs) of the CHU” on page 48*

No.	Component	Description
6	Power button	Power button for shutting down and restarting the hardware component For shutdown and restart, the power button must be pressed for at least 5 seconds.
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.

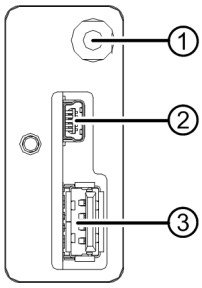

Figure 19: Connectors for test and service purposes (OPEN TO TEST) of the CHU

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

No.	Component	Description	Connection 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.

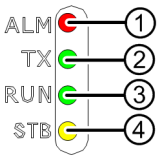

Figure 20: Indicators (LEDs) of the CHU

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

No.	LED	Color	Description
3	RUN	green	Lights if the CHU is in operation
4	STB	yellow	Lights if the CHU is in standby operation

3.2.6 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 flexibleTx as well as to external network constituents such as system controller nodes.

In addition, the BSCU receives and distributes the clock and time signals for the synchronization of the base stations that are acquired via the integrated GNSS component (Global Navigation Satellite System) with a 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 ACCESSNET-T IP and, as such, secures the connection to other network constituents, such as system controller nodes, the network management system (NMS) or applications.

The BSCU is a modular subrack for the DIB-R5 flexibleTx and is installed in the basic rack. To increase availability, up to two BSCUs can be installed. If the first BSCU fails, the redundant BSCU automatically assumes operation in order to quickly resume the radio coverage. The failed BSCU can now be replaced during running operation.

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

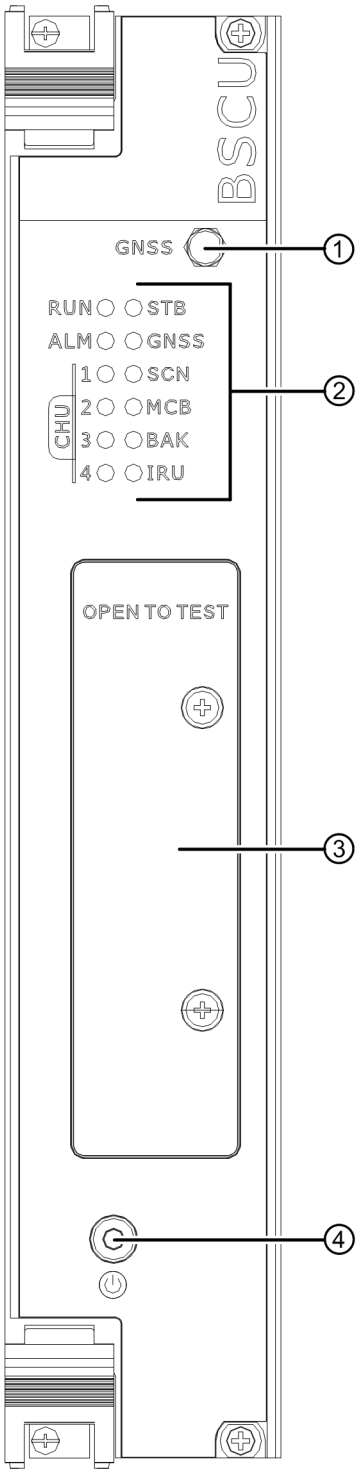

Figure 21: BSCU (front view)

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 51*
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 52*
4	Power button	Power button for shutting down and restarting the hardware component For shutdown and restart, the power button must be pressed for at least 5 seconds.

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

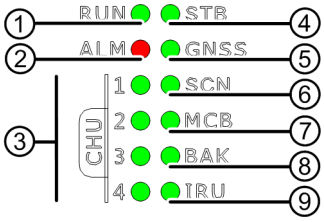

Figure 22: Indicators (LEDs) of the BSCU

Legend: Indicators (LEDs) of the BSCU

No.	LED	Color	Description
1	RUN	green	■ Flashes slowly (1 s) if the BSCU is in operation ■ Flashes quickly (250 ms) if the BSCU – starts up – has been shut down ■ Lights if the power button is pressed briefly ■ Off (6 s) if the power button is pressed and held for more than 5 seconds
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 the internal clock system of the base station is synchronous according to its configuration ■ Flashes if the internal clock system attempts to reach a synchronization ■ Off if the internal clock system is faulty

No.	LED	Color	Description
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
8	BAK	green	■ Lights if a connection exists between redundant BSCUs ■ Flashes if data are being transferred
9	IRU	green	■ Lights if a connection to an Interconnection Relay Unit (IRU) exists – with expansion rack only ■ 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.

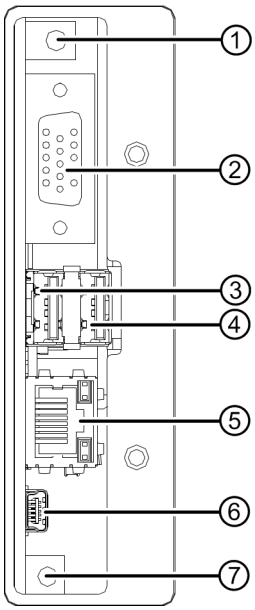

Figure 23: Connectors for test and service purposes (OPEN TO TEST) of the BSCU

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

No.	Component	Description	Connection 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

No.	Component	Description	Connection type
4	USB2		USB A
5	LAN	Ethernet port for the service computer	RJ45
6	Mini-USB	USB port for service purposes	Mini-USB
7	Reset button	Reset button for restarting the Main Processing Unit (MPU) integrated component on the BSCU main board	---

3.2.7 Fan unit

The fan unit is used for cooling the installed components within the DIB-R5 flexibleTx. The air filter pad is affixed to the inside of the front 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 flexibleTx and contains six fans. For every fan, the state is signaled via an LED so that the status is visible from the outside. The ambient temperature is continuously being monitored and the fan speed is adjusted accordingly. In addition, the fans of the cavity combiner are being monitored.

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

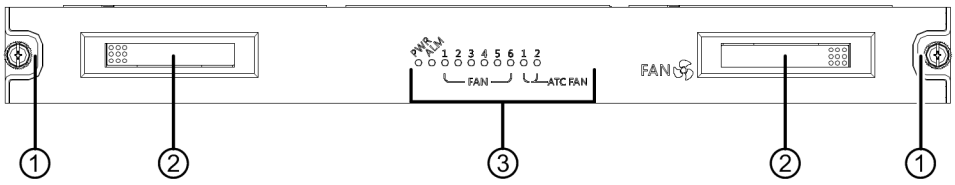

Figure 24: Fan unit (front view)

Legend: Fan unit (front view)

No.	Component	Description
1	Mounting screw	Screw for fastening in the compact 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 54*

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

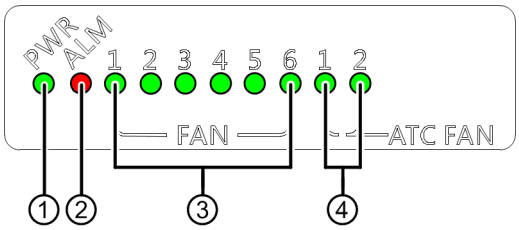

Figure 25: Indicators (LEDs) of the fan unit

Legend: Indicators (LEDs) of the fan unit

No.	LED	Color	Description
1	PWR	green	Lights if the power 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
			Off if the fan is not OK
4	ATC FAN 1 to 2	green	Lights if the fans of the cavity combiner are OK
			Flashes if the fan speed is not OK

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

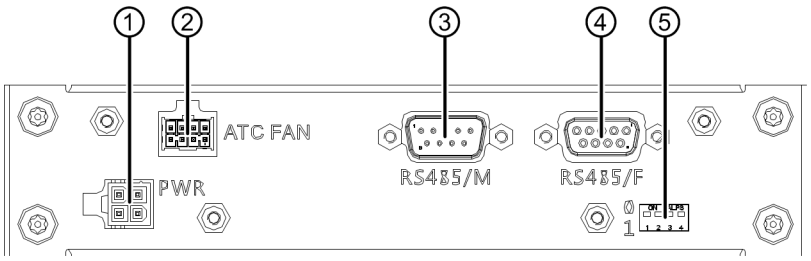

Figure 26: Fan unit (rear view)

Legend: Fan unit (rear view)

No.	Component	Description
1	PWR	Power supply
2	ATC FAN	Connection for the fans of the cavity combiner
3	RS485/M	Interface to the cavity combiner

No.	Component	Description
4	RS485/F	Interface to the backplane
5	DIP switches	Switches for monitoring the fans of the cavity combiner Switch positions: ■ DIP switch (1) – DIB-R5 advanced: top – DIB-R5 compact: bottom – DIB-R5 flexibleTx: bottom ■ DIP switch (2 to 4): top

3.2.8 Backplane

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

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

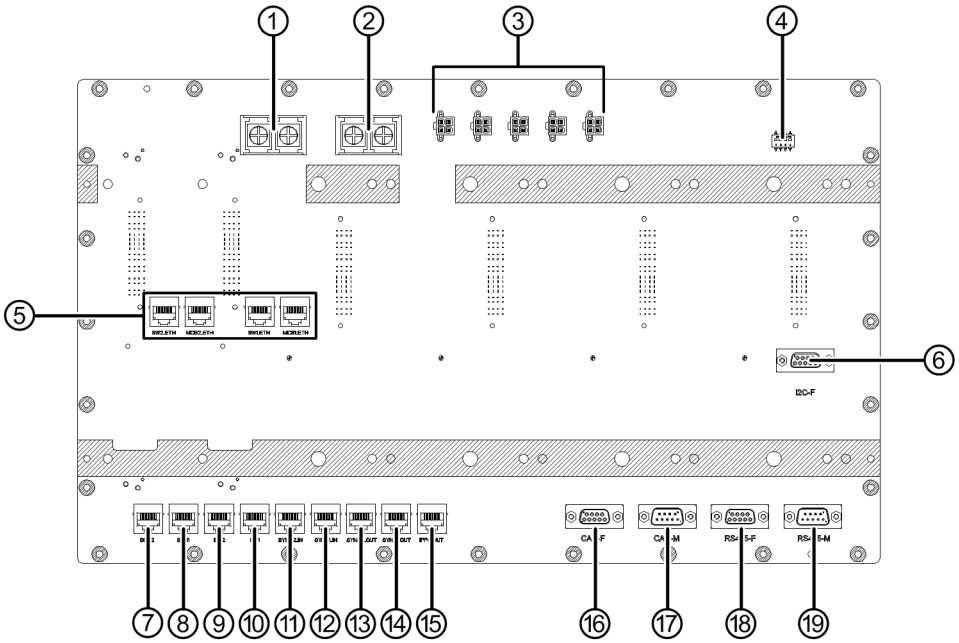

Figure 27: Backplane (rear view)

Legend: Backplane (rear view)

No.	Component	Description
1	RTN	Connection for the positive voltage line (input voltage)
2	DC -48 V	Connection for the negative voltage line (input voltage)
3	PWR_OUT	Power supply connectors for the installed components
4	DIP switches	Switches for the setting as basic rack or expansion rack Switch positions: ■ DIP switch (1) – Basic rack: top – Expansion rack: bottom ■ DIP switch (2 to 4): top
5	SW2	Connectors of the connection panel, refer to *Chapter 3.2.1.2 "Connection panel" on page 34*
	SW1	
	MCB2	
	MCB1	
6	I2C_M	Connector of the PSU – only for V_{AC} power supply
7	SCN2	Connector of the connection panel, refer to *Chapter 3.2.1.2 "Connection panel" on page 34*
8	SCN1	Connector of the connection panel, refer to *Chapter 3.2.1.2 "Connection panel" on page 34*
9	IRU2	Connector for connecting an expansion rack
10	IRU1	Connector for connecting an expansion rack
11	SYNC2_IN	Synchronization connector (input) of the expansion rack
12	SYNC1_IN	Synchronization connector (input) of the expansion rack
13	SYNC2_OUT	Synchronization connector (output) of the basic rack
14	SYNC1_OUT	Synchronization connector (output) of the basic rack
15	1PPS_OUT	Synchronization connector (output) via a 1PPS signal (pulse per second) for base stations, such as DIB-500 R4.1
16	CAN_F	Not used for the time being
17	CAN_M	
18	RS485_F	Connector for the alarm/connection box
19	RS485_M	Connector for the fan unit

3.3 Interfaces

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

Interfaces (per equipment or compact rack)

External antenna coupling system	Tx transmitter output	Number	1 to 4
		Connection	N female
	Rx receiver inputs	Number	1 to 3
		Connection	SMA female
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 flexibleTx 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 power supply connector and the connector to the existing grounding 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 external antenna coupling system*	*Chapter 3.4.1.1 “Internal wiring with four CHUs and external antenna coupling system” on page 58*
Antenna configurations	*Antenna configuration with four CHUs and external antenna coupling system*	*Chapter 3.4.2.1 “Antenna configuration with four CHUs and external antenna coupling system” 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 external antenna coupling system	*Chapter 3.4.1.1 “Internal wiring with four CHUs and external antenna coupling system” on page 58*

3.4.1.1 Internal wiring with four CHUs and external antenna coupling system

The following figure shows the internal wiring with four CHUs and external antenna coupling system.

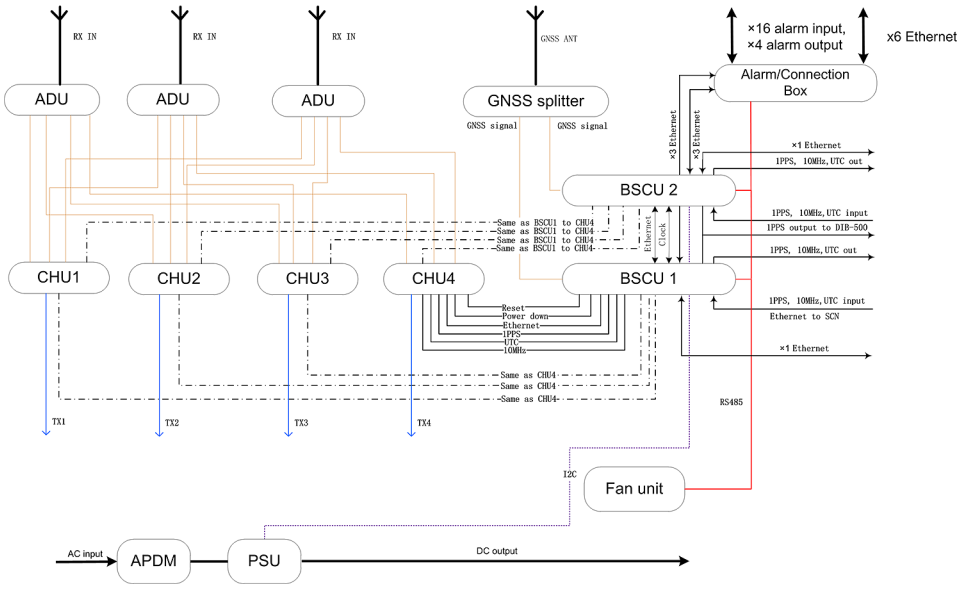

Figure 28: Internal wiring with four CHUs and external antenna coupling system

3.4.2 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 external antenna coupling system	*Chapter 3.4.2.1 “Antenna configuration with four CHUs and external antenna coupling system” on page 59*

3.4.2.1 Antenna configuration with four CHUs and external antenna coupling system

The following figure shows the antenna configuration with four CHUs and external antenna coupling system.

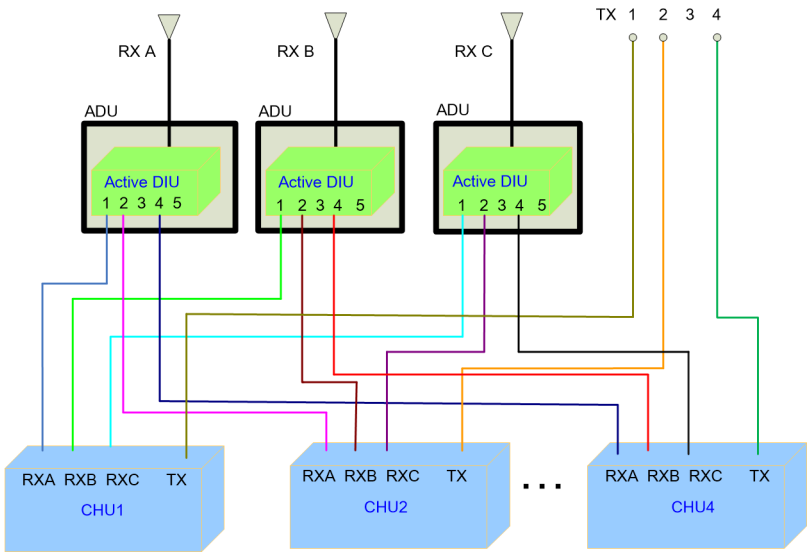

Figure 29: Antenna configuration with four CHUs and external antenna coupling system

3.5 Redundancy options

The 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 site reliability and system reliability. Site and system reliability refers to the capability of the network to perpetuate the operation of the overall system, even if one site 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 flexibleTx 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 flexibleTx enables a fully functional fallback operation and full redundancy for the important components transceiver (CHU), control unit (BSCU) and power supply.

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

- *Redundant main control channel (MCCH)*
- *Carrier redundancy*
- *Controller redundancy*
- *Fallback operation*
- *Stand-alone operation*
- *Redundant V_{AC} power 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 transfer is made as often as the number of carriers that are available on 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 such that the MCCH does not suffer further interference after the frequency change.

Irrespective of the number of carriers, each radio cell has only one MCCH, via which the terminals 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 Carrier redundancy

To increase the reliability of carriers or to ensure the Base Station Function (BSF), redundant carriers can be used within a base station. These spare carrier ensure the radio coverage on the frequency of the failed carrier if a carrier drops out. Carrier 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 of redundant design. For this purpose two BSCUs (Base Station Controller Units, BSCU) are used, where one BSCU is in operation and the other is on standby. In the case of a failure of the active BSCU, the standby BSCU is automatically activated and takes on its function. In this way, the operation of the base station is always ensured.

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 unavailability of network-wide services is signaled to the terminals and taken into account by them during 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 unavailability of network-wide services is signaled to the terminals and taken into account by them during the cell selection. Depending on the project requirements, the signaling can be switched off upon demand.

3.5.6 Redundant V_{AC} power supply

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

- *Redundant rectifier modules (Power Supply Module, PSM)*
- *Redundant power supply lines*

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

3.5.6.1 Redundant rectifier modules (Power Supply Module, PSM)

The power 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 power supply lines", two PSMs each are supplied by one power supply line.

3.5.6.2 Redundant power supply lines

The power supply continues to be ensured by a redundant power supply line on site and secures the operation of the DIB-R5, even if a supply line should fail or the required voltage range is underrun. This is particularly meaningful in difficult environments in which, for example, the infrastructure on site is unreliable. With this redundancy option, one power supply line supplies one AC Power Distribution Module (APDM) in each case.

If this redundancy option is selected, a second power supply line must be taken into account in the site 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

DIB-R5 flexibleTx is delivered in a compact rack. The scope of delivery varies depending on the variant.

The variants and characteristics of the DIB-R5 flexibleTx are derived from the following properties:

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

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

Designation		Part number	Number
DIB-R5 flexibleTx		5503.xxxx.xx	1
Connection and control panel	Alarm/connection box (connection panel)	5502.0640.02	1
	GNSS splitter	5502.0962.00	1
V_{AC} power supply	AC Power Distribution Module (APDM)	5502.0579.02	1 to 2
	Power Supply Unit (PSU)	5502.1020.00	1
	Power Supply Module (PSM)	5502.0910.00	1 to 4
V_{DC} power supply	DC Power Distribution Module (DPDM)	5502.0585.02	1
Divider Unit (DIU)	ADU	5502.0880.xx	1 to 3
Transmitting filter (one of the two)	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)		5502.0704.04	1 to 2
Fan unit		5502.0604.03	1
Backplane		5502.0656.02	1
Dummy modules/plates	RX FILTER dummy module	5502.1000.00	0 to 2
	CHU dummy module	5502.0985.00	0 to 3
	BSCU dummy module	5502.0991.00	0 to 1
	APDM dummy module	5502.0981.00	0 to 1
	PSM dummy plate	5502.0991.00	0 to 3

- **xx is variant-specific and, for example, dependent on the frequency range or power supply**
- *** with expansion rack only**

4 Operation

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

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 flexibleTx		*Chapter 4.2 “Switching on the DIB-R5 flexibleTx” on page 66*
Function tests and operational monitoring	*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 GNSS operational monitoring	*Chapter 4.3.6 “Function tests and GNSS operational monitoring” 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 flexibleTx Site Requirements".
- The product must have been set up/installed and connected according to the "DIB-R5 flexibleTx Installation Manual" document.
- The product must have been configured according to the document "DIB-R5 flexibleTx Configuration Manual".
- The DIB-R5 flexibleTx may be set up and commissioned only if the required environmental conditions are met at all times, refer to *Table “Environmental conditions” on page 66*.
- The safety regulations must be considered at all times, refer to *Chapter 2 “Safety regulations” on page 13*.
- Observe all other activity-based security measures and prerequisites in the work steps in this chapter.
- The front and rear side of the compact rack must be accessible, refer to the "DIB-R5 flexibleTx Site Requirements" document.

Environmental conditions

Operation	Temperature range (normal)	+5 °C to +45 °C (+41 °F to +113 °F)
	Temperature range (extreme, as per EN 300 394-1)	-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. altitude of site)	max. 3000 m (9842 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 flexibleTx

The product is switched on via an on/off switch on the connection and control panel. After switching on the DIB-R5 flexibleTx, 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 power source at the installation site must have been switched on already. The procedure for switching on the power source depends on the circumstances at the respective installation site.

Several on/off switches with redundant power supply lines

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

Switching on the DIB-R5 flexibleTx

Preparation:

- The DIB-R5 flexibleTx must be connected with the grounding system of the power 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 power source via the corresponding equipment at the installation site.
   ⇨ The integrated hardware components start up.

➔ **You have successfully switched on the DIB-R5 flexibleTx.**

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 operational monitoring” on page 67*.

4.3 Function tests and operational monitoring

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 operational monitoring)

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 NMC-511 FaultManager)	*Chapter 4.3.3.3 “Checking operating states (via 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 GNSS operational monitoring	*Chapter 4.3.6 “Function tests and GNSS operational monitoring” on page 74*
Function tests and PTP operational monitoring (optional)	*Chapter 4.3.7 “Function tests and PTP operational monitoring (optional)” on page 76*
Checking external antenna coupling systems	*Chapter 4.3.8 “Checking external antenna coupling systems” on page 77*

4.3.1 Work equipment for function tests

The following table provides an overview of the work equipment for function tests and operational monitoring.

Overview of work equipment (function tests and operational monitoring)

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
Checking standby carriers	NMC-511 FaultManager
Function tests and GNSS operational monitoring	■ configured NMC computer ■ NMC-511 FaultManager ■ GNSS antenna(s) ■ GNSS antenna cable
Function tests and PTP operational monitoring	■ configured NMC or service computer ■ Network tool (e.g. Wireshark)

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 flexibleTx.

Connecting the service computer

Preparation:

- The work equipment must be available, refer to *Chapter 4.3.1 "Work equipment for function tests" on page 66*.
- The service computer must have been started.
- The DIB-R5 flexibleTx must be switched on.

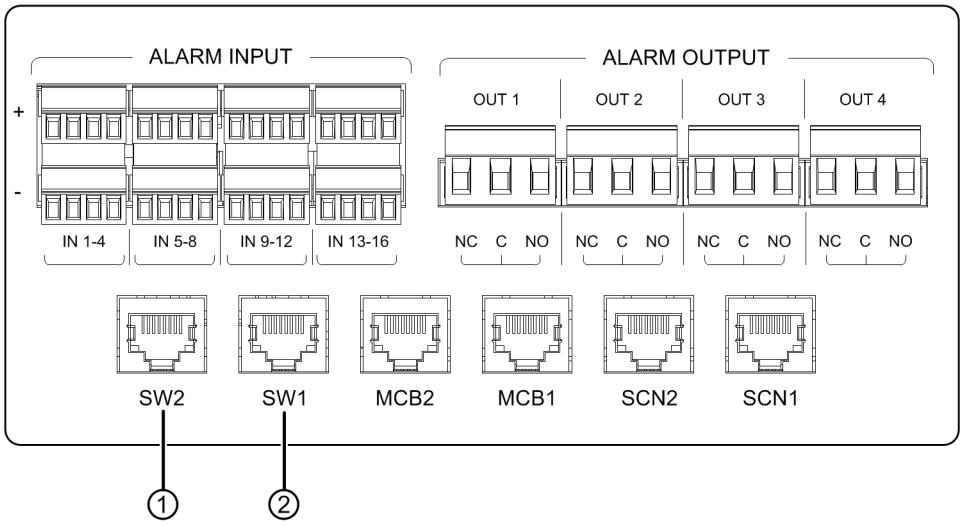

Figure 30: Connections of the service computer (local)

→ Connect the ethernet cable to the connector on the DIB-R5 flexibleTx (refer to Figure 30) 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 flexibleTx.

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 NMC-511 FaultManager)*	↳ *Chapter 4.3.3.3 “Checking operating states (via 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 46*
Base Station Controller Unit (BSCU)	↳ *Table “Legend: Indicators (LEDs) of the BSCU” on page 49*
Fan unit	↳ *Table “Legend: Indicators (LEDs) of the fan unit” on page 52*
Power Supply Module (PSM) – with V_{AC} power supply	↳ *Table “Legend: PSM (front view)” on page 40*

4.3.3.2 Checking operating states (audible check)

Upon switching on the DIB-R5 flexibleTx, 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 flexibleTx must be switched on.
- The front 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.

➔ You have successfully completed the function test.

4.3.3.3 Checking operating states (via 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 operating statuses via the NMC-511 FaultManager requires an NMC computer that is configured accordingly and 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 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.

➔ You have successfully checked the operating states.

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 state 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 flexibleTx.

   ⇨ 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

DIB-R5 flexibleTx optionally provides the redundancy option "Carrier redundancy" with which failed carriers can be replaced.

As a preventive maintenance task, it is recommended to check the function of the standby carriers at regular intervals, refer to *Chapter 7.2 “Periodical visual inspections” on page 84*. This is done via the NMC-511 FaultManager.

Checking standby carriers

Preparation:

- The respective DIB-R5 flexibleTx 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 lock* maintenance function.
   ⇨ The corresponding carriers are excluded from functional operation and identified in the *Equipment* view with the "Person" icon (operationally locked 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. Wait at least 5 minutes before releasing locked operational carriers via the *System unlock* maintenance function.
   ⇨ The system locking 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 GNSS operational monitoring

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

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 flexibleTx 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.

Alarm objects always have an alarm status, alarm status changes are notified via events and visualized in the NMC-511 FaultManager.

GNSS module – Possible messages

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

4.3.7 Function tests and PTP operational monitoring (optional)

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

4.3.7.1 PTP operational monitoring (via NMC-511 FaultManager)

The function of the PTP receiver is monitored between the DIB-R5 flexibleTx and the grandmaster clock based on the status of the Precision Time Protocol (PTP).

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.

Alarm objects always have an alarm status, alarm status changes are notified via events and visualized in the NMC-511 FaultManager.

PTP module – Possible messages

No.	Alarm object (NMC-511 FaultManager)	Meaning
1	*PTP connection*	Connection status to grandmaster clock
2	*PTP synchronization*	Status of PTP synchronization with grandmaster clock

4.3.8 Checking external antenna coupling systems

The operator alone is responsible for checking external antenna coupling systems, insofar as this is not a contractual component of the Hytera Mobilfunk GmbH. An appointed installer of the antenna coupling system is responsible for conducting all the necessary measures and for compliance with the corresponding specifications.

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 compact rack
- End of operation
- Malfunction
- 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 flexibleTx.

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 (controller redundancy), the BSCU in standby mode 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 49*.
2	BSCU (operational)

Shutting down the CHU

All installed CHUs are automatically shut down at the same time when shutting down the BSCUs without standby BSCU (controller redundancy). The CHUs do not have to be shut down individually except for service and maintenance purposes.

Shutting down hardware components

→ Press and hold down the power button at the hardware component for more than 5 seconds to shut it down.

⇨ The software components are being shut down. This may take approx. 5 to 20 seconds.

BSCU: The hardware component is properly shut down if the "RUN" LED flashes quickly.

CHU: 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 flexibleTx

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

Several on/off switches with redundant power supply lines

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

Switching off the DIB-R5 flexibleTx

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 power source at the site. 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 flexibleTx.

6 Recommissioning

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

Recommissioning

For the recommissioning of the DIB-R5 flexibleTx, proceed as described in *Chapter 4.2 “Switching on the DIB-R5 flexibleTx” on page 64* .

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.

Possible restrictions

Depending on the maintenance tasks and redundancy options, not all functions and features may be available for the duration of the maintenance tasks.

The current state of the hardware components can be monitored via an NMC-511 FaultManager. For additional information about the NMC-511 FaultManager, refer to the corresponding product documentation.

7.1 Maintenance tasks

The required activities for maintaining the product are listed below. The maintenance tasks must be performed in the intervals specified to ensure the proper operation of the product. Contaminations can, for example, impede the air supply and heat dissipation and negatively impact operation.

Maintenance tasks

Task/s	Interval/s
Replacing the fan	after 30 000 operating hours
Replacing the air filter mat	depends on the environmental conditions
Replacing the BSCU battery	every 10 years

Early fan replacement

Dependent on the environmental conditions 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 site that may result in improper operation.

The specified intervals refer to the operation within the defined environmental conditions, refer to *Table "Environmental conditions" on page 64*.

Shorter intervals may be required

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

We recommend logging the results of the test.

Tasks and intervals for visual inspections

Task/s	Interval/s
Site inspection based on the document "Site Requirements DIB-R5 flexibleTx", e.g. the inspection of the: ■ Grounding equipment ■ Power 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 flexibleTx – with expansion rack only	■ Upon site changes ■ Once every year
Check the condition of the product with respect to: ■ Operational readiness (checking operating states) ■ Dirt and dust accumulations on and in the compact 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 mat as required	Once every year
Checking function of external alarms – if wired	Once every year
Checking standby carriers – if available	Once every year
Checking external antenna coupling systems	The use of external antenna coupling systems is project specific. The network operator alone is responsible for properly checking external antenna coupling systems.

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 sites 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"
	Power supply at site not operational	Check fuse
		Check distribution box or mains socket
		Check power 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} power 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
	License for use not available	Check status in the NMC-511 FaultManager
	Subscriber unknown	Check subscriber configuration in the NMC-512 SubscriberManager
	No authorization for call services	
	Terminal incorrectly configured	Check configuration of terminal
	Terminal defective	Check terminal
No GNSS signal	GNSS antenna defective	Check antenna
	No unobstructed visibility of the sky	Checking the installation site of the GNSS antenna
	Cable connection defective	Check antenna cable and plug connections
BSCU/CHU not ready for operation	Module not correctly inserted	Check seating of the module (completely inserted and flush with the other modules)
		Check locking mechanism of clips and engage correctly as necessary
		Check mounting screws and tighten as necessary
	Electrical connection to backplane defective	Insert module correctly
	PSU/PSM defective – with V_{AC} power supply	Check PSU/PSM

Problem	Possible cause	Troubleshooting
	"ALM" LED is on	Checking operating state in the NMC-511 FaultManager
		Restarting the base station (duration approx. three to five minutes)
BSCU, CHU defective	Electrical connection to back-plane defective	Check connection to backplane
	Power supply missing	Check power supply
Fan unit not (completely) operational	Electrical connection to back-plane defective	Check connection to backplane
	PSU/PSM defective – with V_{AC} power supply	Check PSU/PSM
	"ALM" LED is on	Checking operating state in the NMC-511 FaultManager
		Check DIP switches at the rear side of the fan unit
	"FAN 1-6" LED flashes	Checking operating state in the NMC-511 FaultManager
		Check fan

9 Index