B~IO

Bus Connectors for I/O Modules B~IO-M
Module Description / Project Engineering

Edition 101

BOSCH
Automation

B~IO

Bus Connectors for I/O Modules B~IO-M
Module Description / Project Engineering

1070 072 221-101 (02.01) GB

Discretionary charge 6.– €

Table of Contents

1 Safety Instructions

Read this manual before you put the bus connection modules of the module family B~IO into operation. Keep the manual in a location that is accessible to all users at all times.

1.1 Intended Use

This manual contains information concerning use in accordance with the intended purpose. The products described are used as decentralized bus connection modules for PROFIBUS-DP, InterBus-S, CANopen and DeviceNet. They are used together with the I/O modules of the B~IO module family.

The products described hereunder

- were developed, manufactured, tested and documented in accordance with the relevant safety standards. In standard operation, and provided that the specifications and safety instructions relating to the project phase, installation and correct operation of the product are followed, there should arise no risk of danger to personnel or property.
- are certified to be in full compliance with the requirements of
  - the EMC Directives (89/336/EEC, 93/68/EEC and 93/44/EEC)
  - the Low-Voltage Directive (73/23/EEC)
  - the harmonized standards EN 50081-2 and EN 50082-2
- are designed for operation in an industrial environment (Class A emissions). The following restrictions apply:
  - No direct connection to the public low-voltage power supply is permitted.
  - Connection to the medium and/or high-voltage system must be provided via transformer.

  The following applies for application within a personal residence, in business areas, on retail premises or in a small-industry setting:
  - Installation in a control cabinet or housing with high shield attenuation.
  - Cables that exit the screened area must be provided with filtering or screening measures.
  - The user will be required to obtain a single operating license issued by the appropriate national authority or approval body. In Germany, this is the Federal Institute for Posts and Telecommunications, and/or its local branch offices.

☞ **This is a Class A device. In a residential area, this device may cause radio interference. In such case, the user may be required to introduce suitable countermeasures, and to bear the cost of the same.**

Proper transport, handling and storage, placement and installation of the product are indispensable prerequisites for its subsequent flawless service and safe operation.

1.2 Qualified Personnel

This instruction manual is designed for specially trained personnel. The relevant requirements are based on the job specifications as outlined by the ZVEI and VDMA professional associations in Germany. Please refer to the following German-Language publication:
Weiterbildung in der Automatisierungstechnik
Publishers: ZVEI and VDMA Maschinenbau Verlag
Postfach 71 08 64
60498 Frankfurt/Germany

This manual is aimed at construction engineers who equip the machines and units with PLC s well as at skilled electrical technicians who install and put the machines into operation. They require special knowledge of PLC, the PROFIBUS-DP, the InterBus-S, the CANopen bus and the DeviceNet bus.

Interventions in the hardware and software of our products not described in this instruction manual may only be performed by our skilled personnel.

Unqualified interventions in the hardware or software or non-compliance with the warnings listed in this instruction manual or indicated on the product may result in serious personal injury or damage to property.

Installation and maintenance of the products described hereunder is the exclusive domain of trained electricians as per IEV 826-09-01 (modified) who are familiar with the contents of this manual.

Trained electricians are persons of whom the following is true:

- They are capable, due to their professional training, skills and expertise, and based upon their knowledge of and familiarity with applicable technical standards, of assessing the work to be carried out, and of recognizing possible dangers.
- They possess, subsequent to several years' experience in a comparable field of endeavour, a level of knowledge and skills that may be deemed commensurate with that attainable in the course of a formal professional education.

With regard to the foregoing, please read the information about our comprehensive training program. The professional staff at our training centre will be pleased to provide detailed information. You may contact the centre by telephone at (+49) 6062 78-258.

1.3 Safety Markings on Components

DANGER! High voltage!

CAUTION! Electrostatically sensitive components!

Disconnect mains power before opening!

Lug for connecting PE conductor only!

Functional earthing or low-noise earth only!

Screened conductor only!

1.4 Safety Instructions in this Manual

DANGEROUS ELECTRICAL VOLTAGE
This symbol warns of the presence of a **dangerous electrical voltage.** Insufficient of lacking compliance with this warning can result in **personal injury.**

DANGER
This symbol is used wherever insufficient or lacking observance of this instruction can result in **personal injury.**

CAUTION
This symbol is used wherever insufficient or lacking observance of instructions can result in **damage to equipment or data files.**

☞ This symbol is used to alert the user to an item of special interest.

★ This asterisk symbol indicates that the manual is describing an activity which the user will be required to perform.

1.5 Safety Instructions for the Described Product

DANGER
Fatal injury hazard through ineffective Emergency-OFF devices!
Emergency-OFF safety devices must remain effective and accessible during all operating modes of the system. The release of functional locks imposed by Emergency-OFF devices must never be allowed to cause an uncontrolled system restart! Before restoring power to the system, test the Emergency-OFF sequence!

DANGER
Danger to persons and equipment!
Test every new program before operating the system!

DANGER
Retrofits or modifications may interfere with the safety of the products described hereunder!
The consequences may be severe personal injury or damage to equipment or the environment. Therefore, any system retrofitting or modification utilizing equipment components from other manufacturers will require express approval by Bosch.

DANGEROUS ELECTRICAL VOLTAGE
Unless described otherwise, maintenance procedures must always be carried out only while the system is isolated from the power supply. During this process, the system must be blocked to prevent an unauthorized or inadvertent restart.

If measuring or testing procedures must be carried out on the active system, these must be carried out by trained electricians.

CAUTION
Only Bosch-approved spare parts may be used!

CAUTION
Danger to the module!
All ESD protection measures must be observed when using the module! Prevent electrostatic discharges!

Observe the following protective measures for electrostatically endangered modules (EEM)!

- The Employees responsible for storage, transport and handling must be trained in ESD protection.
- EEMs must be stored and transported in the protective packaging specified.
- Out of principle, EEMs may be handled only at special ESD work stations equipped for this particular purpose.
- Employees, work surfaces and all devices and tools that could come into contact with EEMs must be on the same potential (e.g. earthed).
- An approved earthing wrist strap must be worn. It must be connected to the work surface via a cable with integrated 1 MΩ resistor.
- EEMs may under no circumstances come into contact with objects susceptible to accumulating an electrostatic charge. Most items made of plastic belong to this category.
- When installing EEMs in or removing them from an electronic device, the power supply of the device must be switched OFF.

1.6 Documentation, Software Release and Trademarks

Documentation

This manual provides information on the project engineering, installation and operation of the bus connection modules of the module family B~IO.

The corresponding I/O modules are described in a separate manual, which is listed in the following table.

Overview of available manuals:

Overview of the documentation	Order numbers		
	German	English	Italian
Bus connectors for I/O Modules B~IO-M, Module Description / Project Planning	1070 072 220	1070 072 221	–
Input / output modules for CL150, B~IO, Module Description	1070 072 199	1070 072 259	1070 072 248

Trademarks

All trademarks referring to software that is installed on Bosch products when shipped from the factory represent the property of their respective owners.

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PROFIBUS® is a registered trademark of the PROFIBUS Nutzerorganisation e.V. (user organization).

INTERBUS-S® is a registered trade mark of Phoenix Contact.

DeviceNet® is a registered trade mark (TM) of ODVA (Open DeviceNet Vendor Association, Inc.).

Notes:

2 System Overview

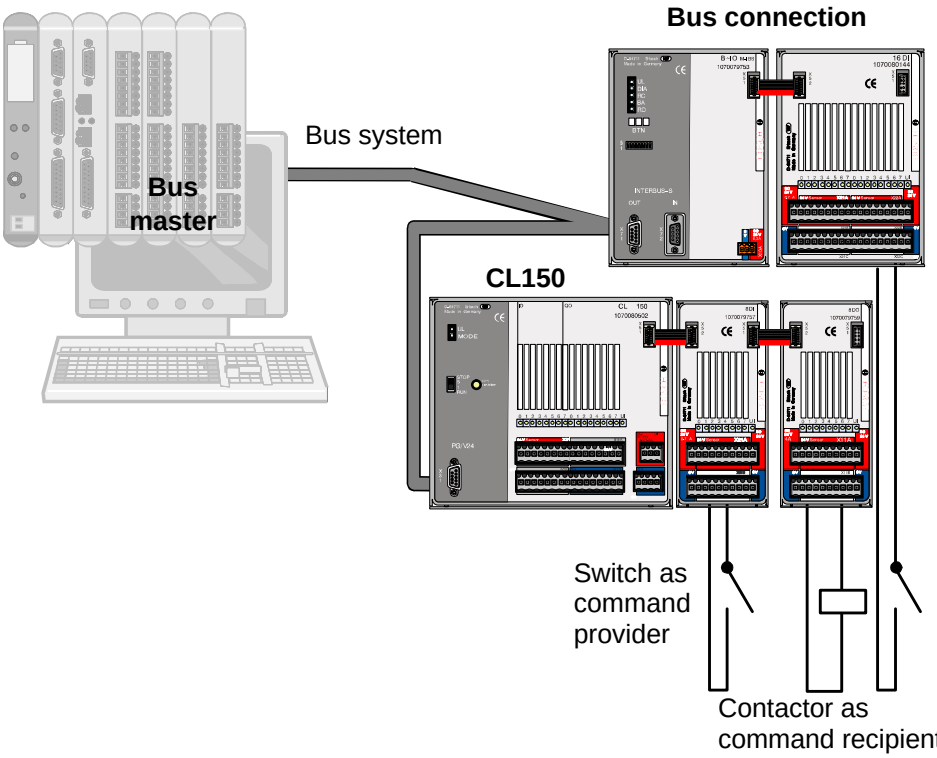
2.1 Area of Application

The decentral bus connection modules are used to connect the I/O modules of the B~IO family to the following bus systems:

- PROFIBUS-DP, B~IO M-DP Order no. 1070 079 751
- InterBus-S, B~IO M-IBS Order no. 1070 079 753
- CANopen, B~IO M-CAN Order no. 1070 079 755
- DeviceNet, B~IO M-DEV Order no. 1070 079 950

☞ **Information on the I/O modules of the B~IO-M family can be found in the appropriate manuals, cf. page 1–7.**

Sample layout



2.2 General Technical Data

Technical data	
corresponds to the general electrical engineering standards	• EN 61 131-2 • EN 50 178 • DIN VDE 0110 • EN 60 204-1 (corresponds to VDE 0113) • EMC Directive 93/68/EEC and revised legislation
Insulation testing voltage	• 350 V AC • 500 V DC • 500 V impulse 1.2/50 ms
Mechanical stress • Vibration, sinusoidal oscillations in all 3 axles EN 61 131-2 • Shock, impacts in all 3 axles EN 61 131-2	 • 10 to 57 Hz, 0.0375 mm amplitude constant, 0.075 mm amplitude occasional • 57 to 150 Hz, 0.5 g constant, 1 g occasional • 11 ms semi-sinusoidal 15 g
Degree of contamination complying with EN 61 131-2 and VDE 0470-1	2, Installation areas, at least IP 54, dust-free air
Type of protection complying with DIN VDE 0470-1	IP 20
Protection class complying with EN 50 178	1
Humidity class complying with EN 61 131-2	RH-2; 5 to 95 %, condensation not permitted
Operating temperature range	+ 5 to + 55 °C, average temperature over 24 hours maximum 50 °C, horizontal installation
Storage temperature range complying with EN 61 131-2	– 25 to + 70 °C
Air pressure complying with EN 61 131-2	Operation up to 2000 m above sea level
Transport resilience complying with EN 61 131-2	Drop height with packaging 1.0 m
Interference emission • Hard radiation • Radio interference suppression, housing complying with EN 50 081-2	 none Class A complying with EN 55 011 • Frequency 30 to 230 MHz Limit value 40 dB (mV/m) in 10 m • Frequency 230 to 1000 MHz Limit value 47 dB (mV/m) in 10 m
Interference immunity • High-frequency electromagnetic fields complying with EN 61 131-2, EN 50 082-2 and EN 61 000-4-3, Criterion A • Electrostatic discharge on accessible housing parts complying with EN 50 082-2, EN 61 131-2 and EN 61 000-4-2	 Test field strength 10 V/m; Frequency band 27 to 1000 MHz AM, 80 % with 1 kHz; Throughput speed 0.0015 dec./s • ESD resistance 4 for humidity class RH-2 • Testing voltage: air discharge 15 kV contact discharge 4 kV
Conducted interference • 24 V power supply complying with EN 61 131-2 and EN 50 082-2 • Digital inputs/outputs complying with EN 61131- and EN 50082-2	 • HF interaction unsymmetrical 10 V, 150 kHz to 80 MHz, 80 % AM, 1 kHz complying with EN 61000-4-6 • Rapid burst impulses, direct interaction 2 kV complying with EN 61000-4-4, Criterion A damped sinus 1 MHz, symmetrical 1 kV complying with EN 61000-4-12

The above data applies to all of the components described in this manual. It is supplemented by specific data of the assemblies.

Notes:

3 Installation

3.1 Installation Positions and Distances

The bus connection modules are placed directly on a 35 x 7.5 mm or 35 x 15 mm support rail complying with EN 50 022 in the switch cabinet. The support rails must be earthed, see page 8–5.

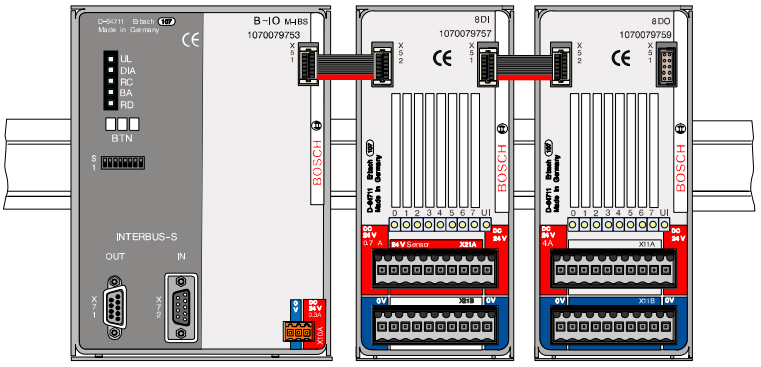
The bus connection modules normally are engaged to the left-hand side of the I/O modules on the support rail and connected by means of the module connector plugs. An exception is the use of the I/O gateway module. In this case one bus connection module is located on the left-hand side of the I/O gateway, the other is located on the right-hand side.

Permitted installation positions:

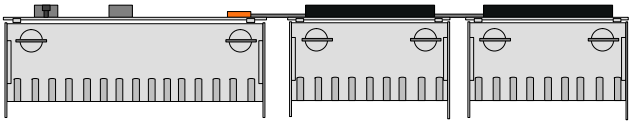
- horizontal
- lying
- vertical, above bus connection or CL150

Horizontal installation position (normal position)

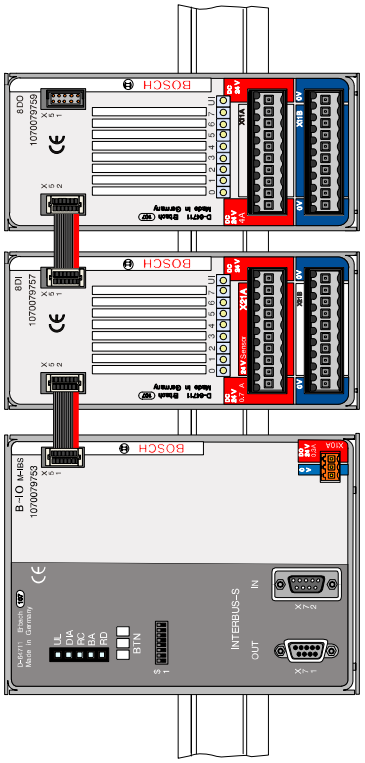
Bus connection modules to the left-hand side of the I/O modules.



Lying installation position



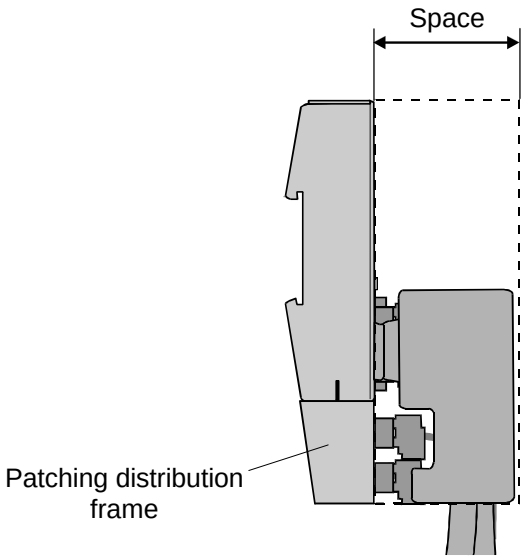
Vertical installation position



Minimum spacing

For easier installation and deinstallation, a space of 2 cm should be allowed above and below the modules. The free space at the front of the module is determined by the dimensions of the connector plugs used and the cable exits. Circulation of the surrounding air must be ensured.

Ensure that the ambient temperature is as low as possible, as high temperatures lead to more rapid ageing of components.

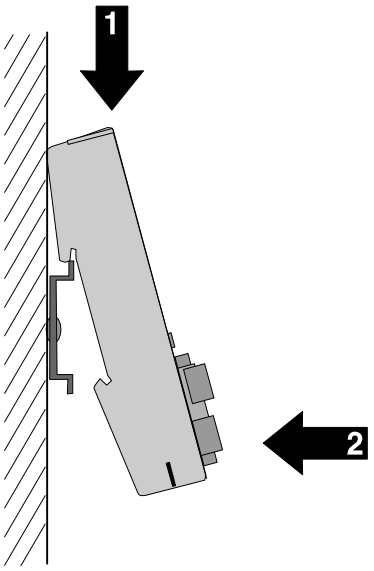


Fitting module

★ Insert module upwards in the rail.

★ Press module lightly downwards and engage.

★ Use module connector plug (ribbon cable) to attach connector X52 to connector X51 of the neighboring module on the left.



Labeling fields

Labeling fields are available for identification of the bus participant address and the inputs/outputs. These can be written in with a permanent marker.

For labeling with an inkjet or laser printer, self-adhesive labels are available as DIN A4 sheets (see 'Accessories' in the relevant chapters of the modules).

Maintenance

The modules are maintenance-free. If the housing needs to be cleaned, cleaning agents containing solvents or abrasives must not be used.

3.2 Combination of Modules

Connection

The I/O modules are connected using module connector plugs (ribbon cable) to the neighboring modules and to the bus connection module:

- Connector X52 to connector X51 of the neighboring module on the left
- Connector X51 to connector X52 the neighboring module on the right.
- If there is no neighboring module on the right, connector X51 remains open.

Arrangement

The sequence in which the I/O modules are connected to the bus connection is unimportant, with a few exceptions.

The allocation of the PLC addresses to the inputs and outputs of the I/O modules is regulated in different ways for the various bus systems.

☞ **For detailed information on the arrangement and addressing, refer to the individual chapters which describe the bus connection modules.**

Number of modules

A maximum of 16 modules can be connected to a bus connection module. If more than 16 modules are connected, a fault is displayed.

Sum current

Each bus connection module provides a maximum current of 500 mA for the logic supply of the I/O modules. This level of current must not be exceeded.

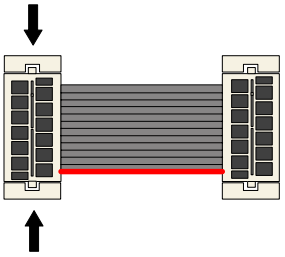
$I_{V, ges} = I_{V, module\ 1} + I_{V, module\ 2} + ... I_{V, module\ n} \leq 500$ mA

Module	Current consumption from internal bus
8DI	I_V = maximum 10 mA
16DI	I_V = maximum 20 mA
16DI-3	I_V = maximum 20 mA
8DO	I_V = maximum 15 mA
8DO/2A	I_V = maximum 10 mA
16DO	I_V = maximum 30 mA
8DO R	I_V = maximum 10 mA
8DI/DO	I_V = maximum 20 mA
4AI_UI	$I_V \leq 50$ mA
4AI_UIT	$I_V \leq 50$ mA
4AO_U	$I_V \leq 30$ mA
4AO_I	$I_V \leq 30$ mA
Gateway	I_V = maximum 10 mA

3.3 Deinstallation

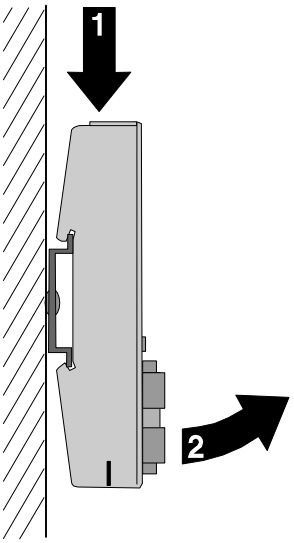
☞ **For deinstallation, ensure that the connectors are labeled. In this way, you ensure that the connector positions cannot be confused on reinstallation.**

★ Remove the module connector plugs to the left-hand and right-hand neighboring modules. To do so, unlock the connectors by pressing the engaging lugs and draw off carefully.



★ Lightly press the module downwards – against the spring force – and disengage from the bottom.

★ Disengage the module from the rail from above.



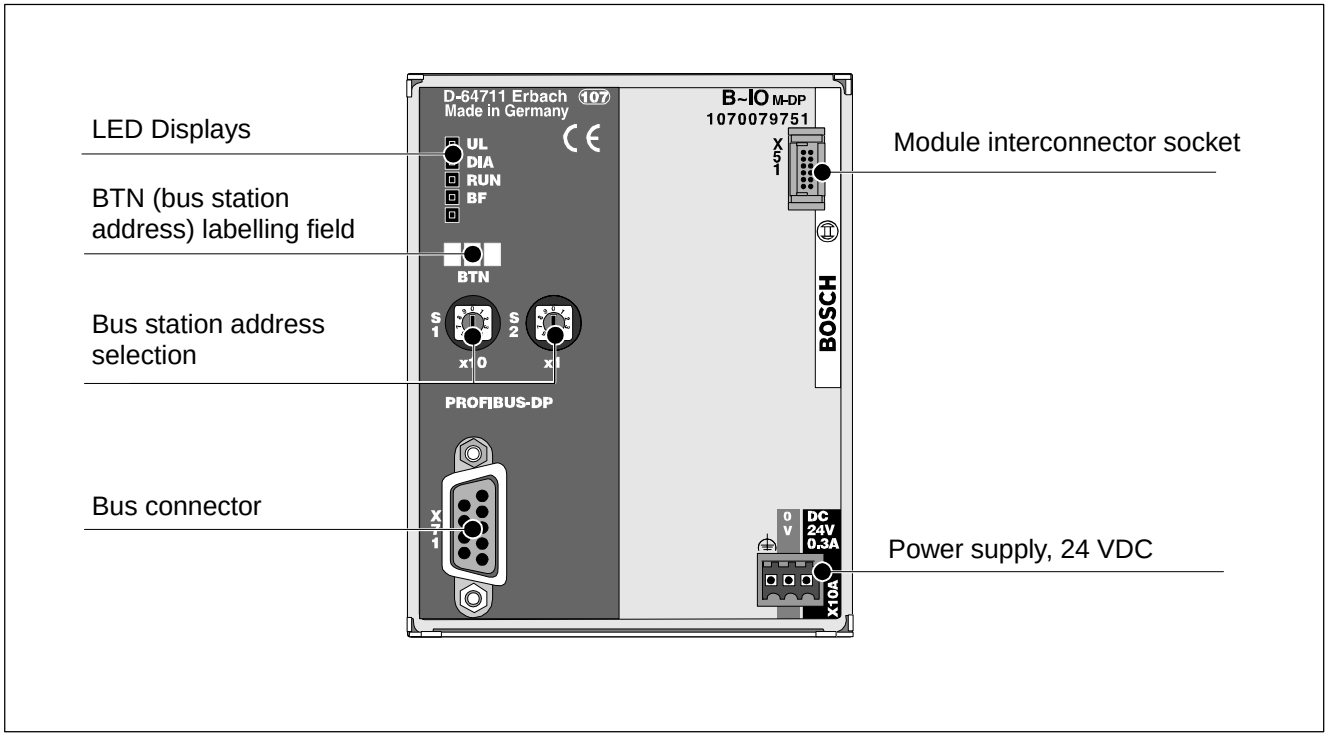
Notes:

4 PROFIBUS-DP Bus Connector

4.1 Hardware Configuration

The bus connector maintains constant contact with the governing control unit via PROFIBUS-DP.

- It receives the current switching signals at the inputs and, via the PROFIBUS-DP, directs them to the governing control unit for further processing.
- It receives the output signals of the governing control unit via the PROFIBUS-DP, and directs them to the outputs.



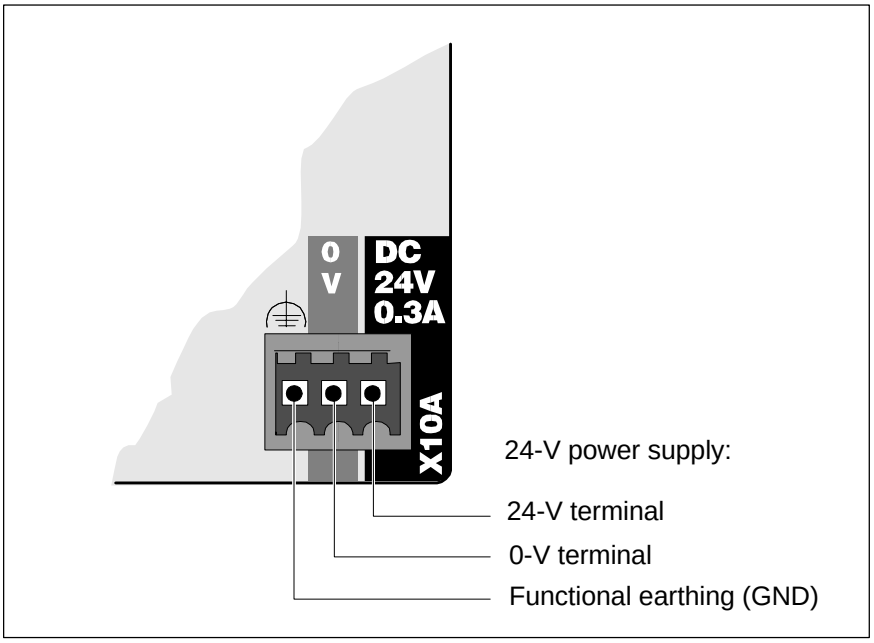
4.2 Connectors

4.2.1 24-V Power Supply (X10A)

The bus connector requires a 24-V power supply.

The 24-V power supply module provides electrically isolated power for

- PROFIBUS-DP interface, and
- Logic circuits of connected I/O modules.



4.2.2 PROFIBUS-DP (X71)

The PROFIBUS-DP comprises a field bus pursuant to EN 50170-2.

The PROFIBUS-DP connection uses a male 9-pin D-SUB (DB-9) connector that is threaded onto to the female DB-9 connector X71 of the B~IO M-DP bus connection module.

Pin Assignment

Pin no.	RS-485 ref.	Signal	Explanation
1	–	–	–
2	–	–	–
3	B/B’	RxD/TxD-P	Receive / Send data (positive)
4	–	CNTR_P	Repeater control signal
5	–	DGND	Data reference potential (M5V)
6	–	VP	Power supply (positive) (P5V)
7	–	–	–
8	A/A’	RxD/TxD-N	Receive / Send data (negative)
9	–	DGND	Data reference potential (M5V)
Housing	–	Shield	

The VP pin of the DB9 connector X71 provides a power supply for external equipment. The maximum current which can be drawn from this source is 100 mA.

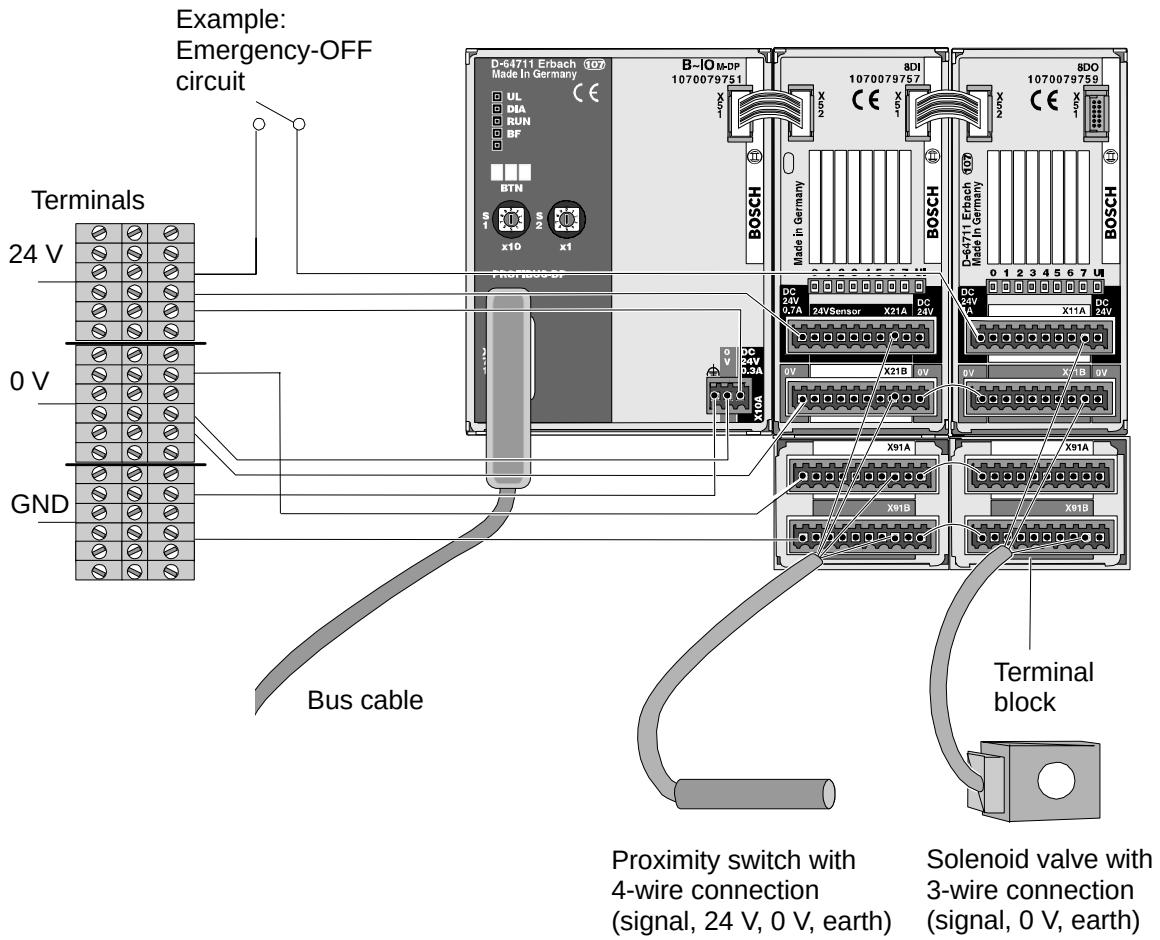
☞ **The default PROFIBUS connectors only support the lines A (green), B (red) and shield.**

Baud Rates

The B~IO M-DP bus connection module automatically recognizes the baud rate selected on the PROFIBUS-DP. Baud rates between 9.6 kbaud and 12 Mbaud are supported.

4.2.3 Connection Example

The example below illustrates the connection of the connector strips of a B~IO M-DP with module for 8 inputs and module for 8 outputs:



4.3 Operation

Power-up Sequence

At the time the governing control unit is switched on, a comparison is automatically effected between the selected values and the actual prevailing conditions. For this reason, the power supply for the B~IO M-DP should already be activated at the time the governing control unit is started.

Procedural sequence:

- Switch on power to B~IO M-DP module
- B~IO M-DP module maintains all outputs at 0 (LOW) state
- B~IO M-DP stands by and waits for data exchange with governing control unit.

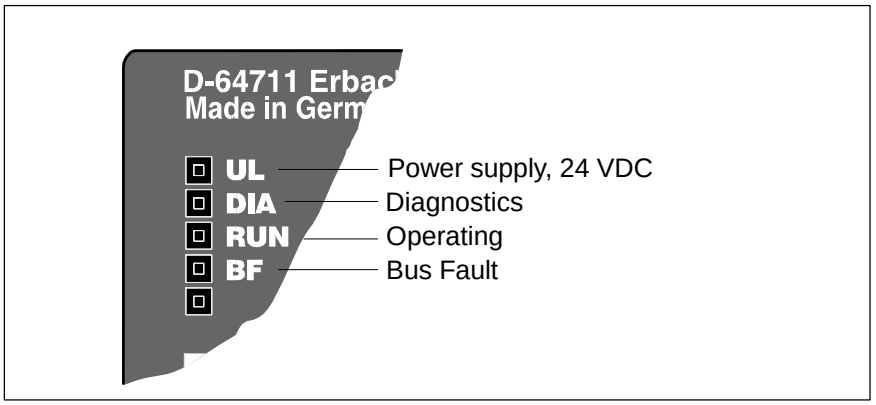
☞ **Observe the relevant information in the operating manual supplied with the governing control unit.**

Ongoing Operation

The bus connection module is operated by the governing control unit. As manual operation is not required, there are no relevant provisions.

The bus connection module is activated and working properly if

- UL LED illuminates green without interruption
- DIA LED does not illuminate red
- RUN LED RUN illuminates green without interruption
- BF LED is extinguished.



4.4 Module Placement and Addressing

The bus connection module automatically assigns a module number to each I/O module. The first I/O module beside the bus connection module is always module number 0, the next is module number 1, and so forth.

The assignment of PLC addresses to the inputs and outputs of the I/O modules is effected by a *DP Configurator* on the basis of the module numbers.

Input and Output Data

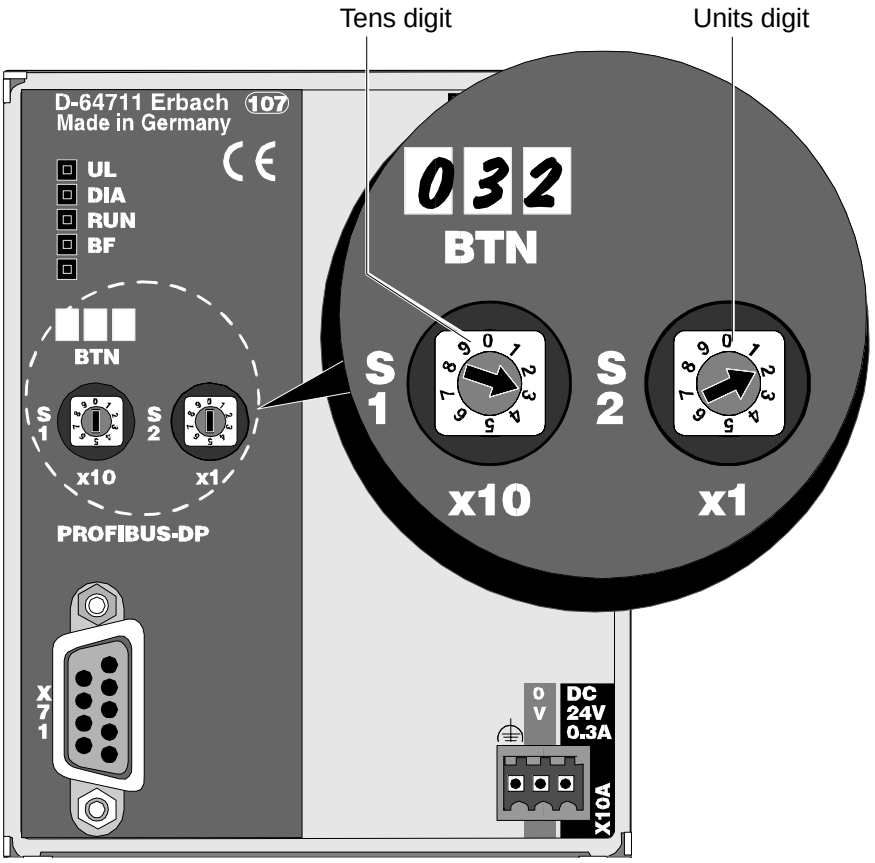
The B~IO M-DP bus connection module supports up to 64 bytes of inputs and 64 bytes of outputs.

In addition, a sum total of 64 bytes of diagnostic data and 64 bytes of parameter data are supported.

If the connected modules occupy more than 64 bytes, a fault message will be returned.

4.5 DP Configuration

4.5.1 Setting the Bus Station Address



The bus station address for the B~IO M-DP bus connection module is set in two digits with the use of two rotary switches. Addresses are available in the range between 0 and 99. For each PROFIBUS-DP, a given address may be assigned only once.

☞ **Use the BTN labelling field to record the selected address which, in the example shown, is 032.**

☞ **Please observe also the limitations and specifications of the governing control unit.**

☞ **At the time of activating the power supply, the B~IO M-DP bus connection module determines the selected address. In the event that the address setting is changed during ongoing operation, the change will come into effect only with the subsequent startup of the power supply module.**

This results in the following procedure for setting the bus station address:

- Record the current address or determine an address that is still available.
- Switch off 24 V power supply and control unit power supply.
- Select bus station address on rotary switches.
- Switch on 24 V power supply for B~IO M-DP module.
- Switch on power supply for control unit.

The applicable baud rate is selected automatically.

4.5.2 Baud Rate

The B~IO M-DP bus connection module automatically recognizes the baud rate selected on the PROFIBUS-DP. Supported baud rates are listed below:

- 9.6 kbaud
- 19.2 kbaud
- 93.75 kbaud
- 187.5 kbaud
- 500 kbaud
- 1.5 Mbaud
- 3 Mbaud
- 6 Mbaud
- 12 MBaud.

Subsequent to automatic baud rate detection, the bus station logs in on the bus master. It is then ready for operation.

In the event that no baud rate is detected, the BF LED will illuminate red. Upon detection of the correct baud rate, the BF LED will extinguish.

4.5.3 DP Configuration Program

The operation of the B~IO M-DP bus connection module requires the use of a DP configuration program (*DP Configurator*).

The functions of the *DP Configurator* program include the specification of the bus station address, and the assignment of PLC addresses to the decentralized inputs and outputs.

In addition, the *DP Configurator* is used to select the bus parameter settings, such as the baud rate, for example.

The *DP Configurator* WinDP for Windows 95 / NT) is available for Bosch controllers. To operate the B~IO series modules in conjunction with bus masters of other manufacturers, the DP configuration program of the respective manufacturer must be used.

4.5.4 Device Specification File for PROFIBUS-DP

In accordance with DIN EN 50170 part 2, the data file containing all major device specifications (GSD file) contains all information required to connect the modules to any desired DP master. The file is interpreted by the respective DP configuration program.

The Bosch proprietary device specification file (GSD file) bears the filename RBxx0133.GSD, where xx represents the version number of the GSD file.

☞ **The contents of the GSD file must not be modified.**

4.6 Cyclical Data Exchange

In cyclical operation, input and output data is exchanged via the PROFIBUS-DP between the governing PLC control unit and the B~IO M-DP bus connection module.

The PROFIBUS-DP differentiates three operating modes:

- SYNC
- FREEZE
- Fail_Save

SYNC Mode

Upon receiving a SYNC command from the DP master, the output statuses of the B~IO M-DP bus connection module are frozen. The output data that is subsequently transferred is not output until the next SYNC command is received from the DP master. This operating mode can be cancelled by sending an UNSYNC command from the DP master.

This facilitates the synchronization of the outputs of several DP slaves.

FREEZE Mode

Upon receiving a FREEZE command from the DP master, the input statuses of the B~IO series modules are frozen, and are ready for transfer to the DP master. Repeating the FREEZE control command causes the procedure to be repeated. This operating mode can be cancelled by sending an UnSYNC command from the DP master.

This facilitates the synchronization of the inputs of several DP slaves.

Fail_Save Mode

The B~IO M-DP bus connection module supports the Fail_Save-Mode as specified in DIN EN 50170, PROFIBUS-DP. As long as the DP master keeps Fail_Save mode active, all outputs of the bus connection module are set to LOW status.

4.7 Diagnostics

To the extent that the disgnostic messages are enabled, current diagnostic information is transferred to the DP master.

With diagnostics enabled, diagnostic information is supplied to the DP master or *DP Configurator*. To confirm this condition, the red DIA LED on the B~IO M-DP bus connection module illuminates.

☞ **Diagnostics must have been enabled via the required parameter settings. If this is not the case, the occurrence of a diagnostic event will cause the display of the bus connection module, red DIA LED, and the message to the DP master to be suppressed.**

Diagnostic Modes

The B~IO M-DP bus connection module supports the following enhanced diagnostic modes:

- ID-specific diagnostics
- Channel-specific diagnostics
- Status message Revision_Number

ID-specific Diagnostics

The ID-specific diagnostics provide information about whether or not a diagnostics event has occurred in the I/O modules of a bus connection module. The Diagnostics / No Diagnostics information is returned for each individual module. However, the message does not provide any information with regard to the type of diagnostics.

Channel-specific Diagnostics

The channel-specific diagnostics provide for diagnostic evaluation of individual channels of I/O modules. The diagnostic message depends upon the type of module being diagnosed.

Module type	Diagnostic message
Input	Error
Output	Short-circuit
Input / Output	Error

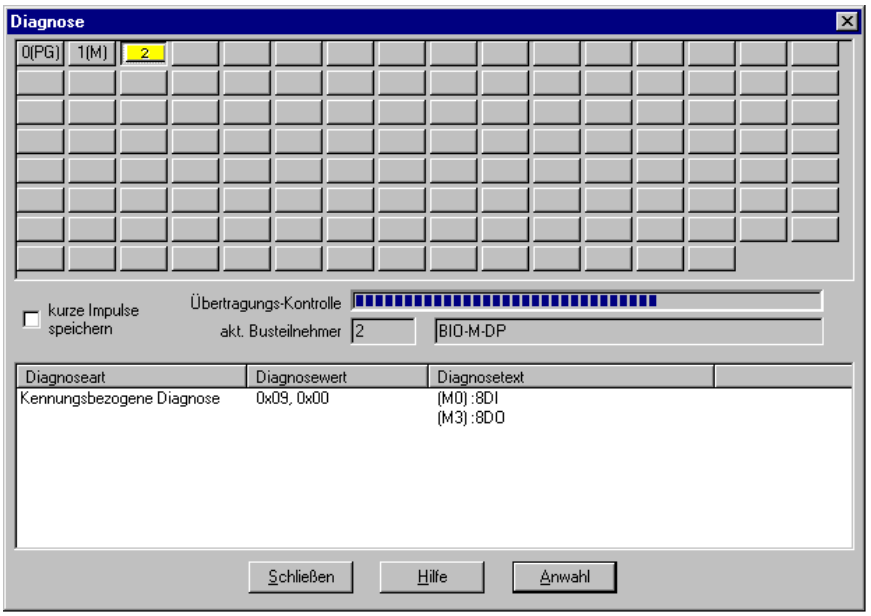
Revision_Number

The Revision_Number status message is used to monitor the consistency of firmware and GSD file versions by the *DP Configurator*. The Revision_Number of the B~IO M-DP bus connecting module can be displayed as a status message in the *DP Configurator*.

Example

Display of ID-specific diagnostics in WinDP *DP Configurator*.

A diagnostic event is being reported by the modules labelled 8DI 24 V (module number 0) and 8DO (module number 3) of the B~IO M-DP bus station identified by station address 2. Using the displayed module ID (module numbers M0 and M3), the affected modules are easily located.



4.8 Displays and Error Messages

4.8.1 Displays

4 light emitting diodes (LEDs) are used to display the operating status of the bus connection module B~IO M-DP:

Name	LED	Explanation
UL	Green	24-V power supply of X10.1 is OK
	OFF	24-V power supply is faulty
DIA	OFF	Standard operation
	Red	No processing; diagnostics or system halted
RUN	Green	Standard operation
	OFF	Error
BF	OFF	Bus is fault-free
	Red	Bus fault (baud rate, bus station address, bus cable) or initialization phase on PROFIBUS-DP

4.8.2 Error Messages

Light-emitting Diodes				Explanation
UL green	DIA red	RUN green	BF red	
●	○	●	○	Standard operation, no fault indication
○				No 24 V power available
●●				Bus connection module is arrested in initialization phase by one or more I/O modules
●●●●	○			System Halt, configuration error, check I/O configuration
	●			One or more I/O modules report diagnostics event
●	●●			System Halt, unknown I/O module
●/○	●●●●			System Halt, firmware fault
●●●●	●●●●			System Halt, hardware fault
●		○	○	The bus connection module has recognized and adopted the baud rate but is not addressed by the DP master. Possible causes: • Wrong PROFIBUS-DP bus station address • PROFIBUS-DP bus station address has been assigned on the bus more than once • Monitoring interval has expired • Fault in master parameter set (GSD file). Example: Wrong PNO ID number, wrong buffer sizes (Prm, Cfg, ...) • Faulty parameterization in User_Prm_Data[1]
		●●		Configuration fault, difference between nominal and actual assignment
			●	Bus connection module is searching for baud rate
			●●	Parameterization fault, invalid parameterization data

Explanations:

○	LED remains dark
●	LED illuminates
●●	Slow-flashing LED, e.g. 0.8 s ON / 0.2 s OFF
●●●●	Rapid-flashing LED, e.g. 0.125 s ON / 0.125 s OFF
	Display has no significance

System Halt

The System Halt status of the bus connection module is indicated by means of the UL and DIA LEDs. A system Halt condition causes outputs to be set to LOW state, and the bus transfer to the bus master is interrupted. The DP master is no longer able to address this station. The System Halt status can be cancelled only by a restart.

System Halt – Unknown I/O Module

The B~IO M-DP bus connection module has recognized an I/O module that is not supported by the firmware version of the B~IO M-DP bus connection module.

- To operate the I/O module, a firmware update will be required.
- In the event that this fault occurs with the latest version of the B~IO M-DP firmware auf, this indicates a hardware fault in the I/O module.

System Halt – Configuration Fault

The following I/O configurations will cause a System Halt:

- No I/O modules in configuration
- More than 16 I/O modules in configuration
- More than 64 input bytes configured
- More than 64 output bytes configured
- The sum of parametrization data for all modules exceeds 64 bytes
- The sum of diagnostic data for all modules exceeds 64 bytes

FW Firmware Exception Fault

During the operation of the firmware, plausibility checks are conducted on an ongoing basis. If a fault is detected, the module will enter the FW firmware exception fault condition.

HW Hardware Exception Fault

At the time the bus connection module is powered up, the hardware components are tested. Also, the I/O configuration and the quality of the signal transferred to the I/O modules is monitored. Any fault occurrence will cause the module to enter the HW hardware exception fault condition.

4.9 Operating Behaviour

4.9.1 Startup

Creating Actual Configuration List

Subsequent to power-up the B~IO M-DP bus connection module determines its own I/O module configuration, and uses this data to create an Actual Configuration List in accordance with the PROFIBUS-DP standard.

Faulty configurations, such as missing I/O modules, are indicated by means of the UL and DIA LEDs. If this is the case, the bus connection module enters the System Halt condition.

Baud Rate Detection

Once the actual configuration has been determined, the bus connection module synchronizes itself to the baud rate selected on the PROFIBUS-DP.

In the event that no valid baud rate is detected, the BF LED will illuminate red. Upon detection of the correct baud rate, the BF LED will extinguish.

The bus connection module will now wait for its parameterization by the DP master.

4.9.2 Parameterization

The parameterization message provides the B-IO M-DP bus connection module with the data required to control the diagnostic routines.

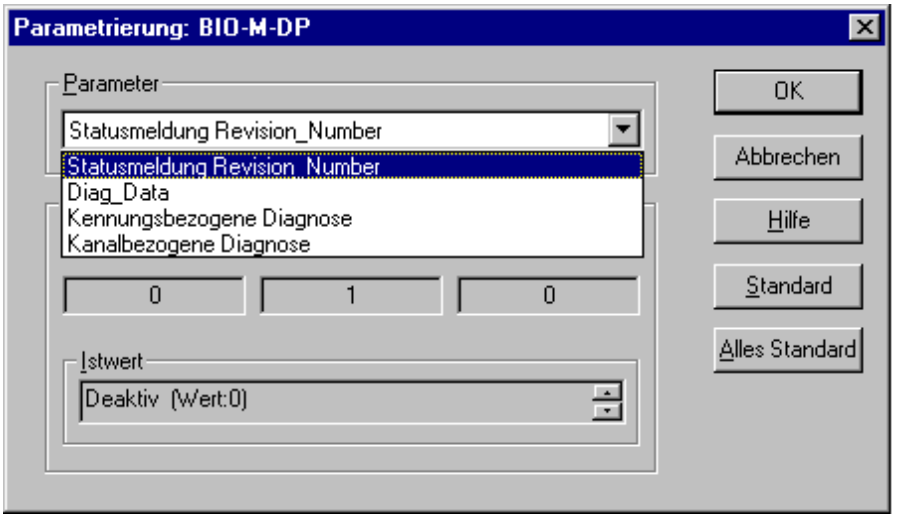
The B-IO M-DP bus connection module checks the parameterization data for plausibility. The presence of faulty parameters is indicated by slow flashing of the red BF LED.

The settings listed below can be selected by the user.

Parameter	Status	Explanation
Status message Revision_Number	0	No transfer of Revision_Number status message
	1	Transfer of Revision_Number status message
Diag_Data	0	Transfer of diagnostic data with constant length
	1	Transfer of diagnostic data with variable length
ID-specific diagnostics	0	Disables ID-specific diagnostics
	1	In the case of a diagnostic event, the ID-specific diagnostics data is transferred to the DP master, and the red DIA LED illuminates.
Channel-specific diagnostics	0	Disables channel-specific diagnostics
	1	In the case of a diagnostic event, the channel-specific diagnostics data is transferred to the DP master, and the red DIA LED illuminates.

Example

Parameterization of the B~IO M-DP bus station by means of the WinDP DP configuration program.



4.9.3 Configuration

Actual Configuration

The Actual Configuration defines the number and width of the input/output ranges, and their configuration with regard to data consistency. The Actual Configuration is determined by the bus connection module at the point of power-on.

Nominal Configuration

The Nominal Configuration is structured similarly to the Actual Configuration. It is cretaed by the user with the aid of a DP configuration program (e.g. *DP Configurator*), and transferred from the DP master to the DP slave during the startup phase.

Comparing Nominal and Actual Configuration

The bus connection module compares the Actual Configuration determined during startup with the Nominal Configuration of of the bus master.

As soon as the match between Actual and Nominal Configuration has been confirmed, the bus connection module enters the cyclical data exchange status. The green RUN LED illuminates.

In the event that a fault is detected during the compare procedure, this will be reported to the DP master. As a result, the B~IO M-DP bus connection module will wait for a new Nominal Configuration. This is indicated by slow flashing of the green RUN LED.

Address Assignment

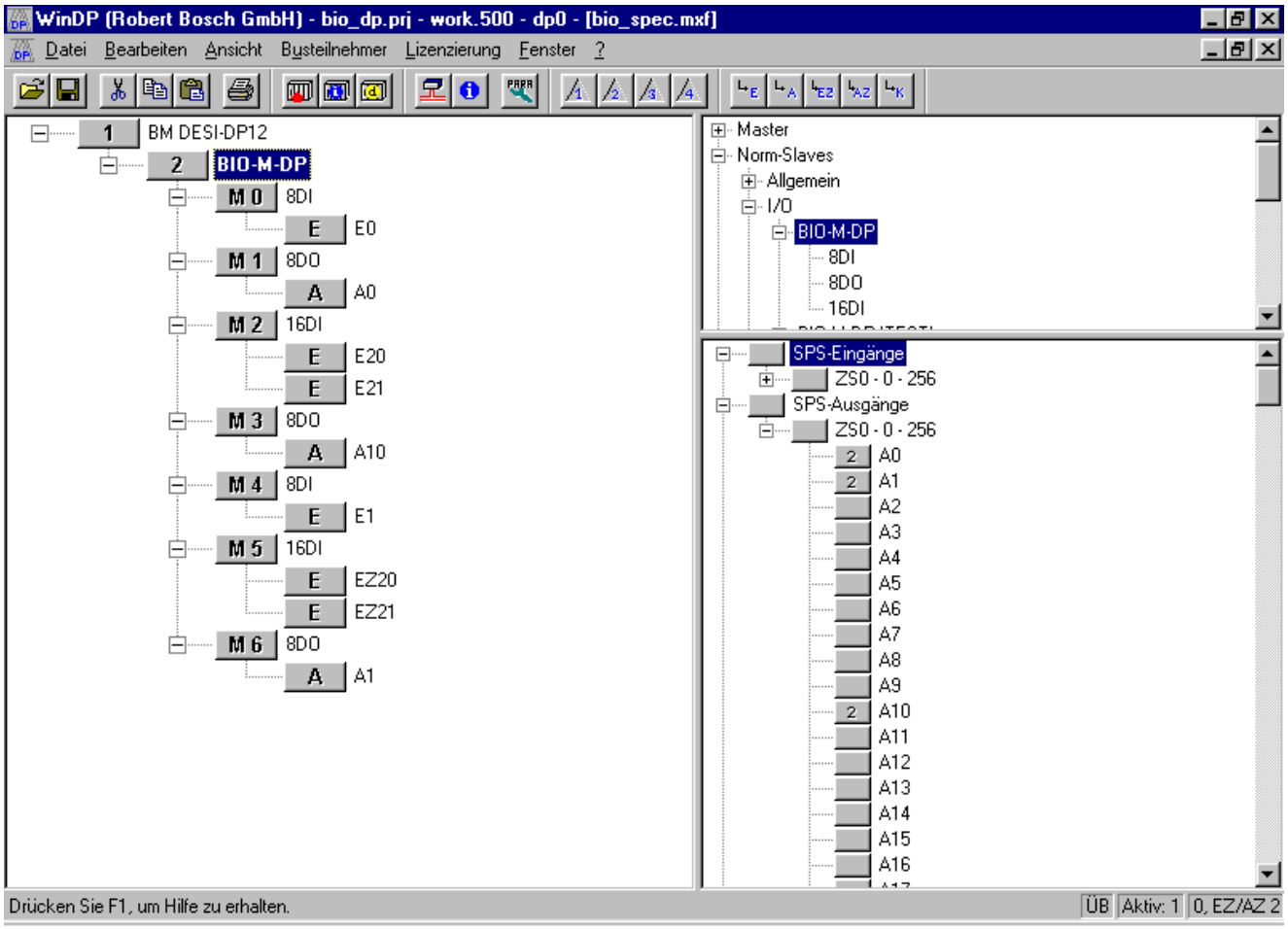
The PLC addresses are assigned to inputs and outputs of the I/O mopdules by means of the DP configuration program, e.g. WinDP.

The reference between Nominal and Actual Configuration is provided by the I/O module numbers which are automatically assigned by the B~IO M-DP bus connection module.

As an example, the following configuration shall be assumed to exist:

B~IO M-DP	8DI	8DO	16DI	8DO	8DI	16DI	8DO
	Module 0	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6

Using the WinDP DP configuration program to configure the bus station and assign the PLC addresses.



4.10 Parameterization Details

The table below lists the parameterization data for the B~IO M-DP bus connection module (pursuant to DIN EN 50170, PROFIBUS-DP). This data must be considered in the event that a third-party DP master is being used.

Byte	Designation	Explanation
1	Stations_Status	Standard parameter as per DP standard (SPC3)
2	WD_Fact_1	Standard parameter as per DP standard (SPC3)
3	WD_Fact_2	Standard parameter as per DP standard (SPC3)
4	MinTsdr	Standard parameter as per DP standard (SPC3)
5	Ident_Number	Standard parameter as per DP standard (SPC3)
6	Ident_Number	Standard parameter as per DP standard (SPC3)
7	Group_Ident	Standard parameter as per DP standard (SPC3)
8	User_Prm_Data[0]	Parameterization of SPC3 ASIC
9	User_Prm_Data[1]	Parameterization of DPS2 (DP interface)
10	User_Prm_Data[2]	Parameterization of B~IO M-DP bus connection module
11	User_Prm_Data[3]	Parameterization data of I/O modules
...	...	(Ext_User_Prm_Data)
74	User_Prm_Data[66]	

Standard Parameters

The initial 8 data bytes of the message containing parameterization data are interpreted automatically be the PROFIBUS-DP SPC3 ASIC (application-specific integrated circuit). The first 7 bytes are defined in accordance with DIN EN 50170 (PROFIBUS-DP). In the event that faults are found within the first 7 bytes, e.g. incorrect PNO ID number, the SPC3 ASIC will automatically return a parameterization error message. The user will not be able to influence the standard parameters by means of the *DP Configurator*.

☞ **Parameterization errors that are automatically recognized by the SPC3 ASIC are not indicated by the BF LED. The RUN LED will remain dark.**

Summary

The following table indicates the user-definable parameters and their significance. The defaults are defined in the device specification file (GSD file).

Parameter	Bit no.	Function	Status	Explanation	Default
User_Prm_Data [0]	0 through 7	SPC3 ASIC	00h entry in GSD file may not be modified		
User_Prm_Data [1] (DP interface)	0	Revision_Number	0	Disabled	x
			1	Enabled	
	1	Diag_Data	0	Constant length	x
			1	Variable length	
User_Prm_Data [2] (bus connection module)	0	ID-specific diagnostics	0	Disabled	x
			1	Enabled	
	1	Channel-specific diagnostics	0	Disabled	x
			1	Enabled	

☞ **Unused bits must be set to 0. Setting these bits to 1 will cause a parameterization error in the bus connection module.**

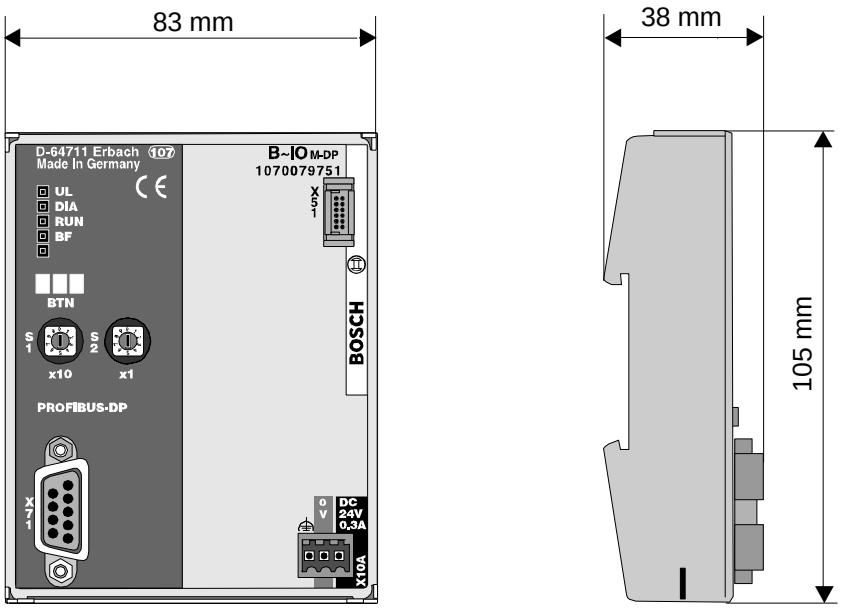
4.11 Operational Restrictions with DP Master Modules

Older DP masters, such as BOSCH BM-DP or DP masters of other manufacturers can process a maximum of 16 bytes of diagnostic data. For this reason, when operating the B~IO M-DP bus connection module with the referred masters, the channel-specific diagnostic mode must not be enabled. Accordingly, the User_Prm_Data[2] bit1 must always be set to 0 (LOW).

When operating the B~IO M-DP bus connection module in conjunction with the Bosch BM-DP master, the diagnostic data must be transferred with constant length: User_Prm_Data[1] Bit1 = 0.

DP Master	User_Prm_Data[1]		User_Prm_Data[2]	
	Diag_Data	Revision_Number	Channel-specific Diagnostics	Module Diagnostics
	Bit 1	Bit 0	Bit 1	Bit 0
BOSCH BM-DP	0	0	0	0 or 1
BOSCH BM-DP12	0 or 1	0 or 1	0 or 1	0 or 1
BOSCH ZE200-DP	0 or 1	0 or 1	0 or 1	0 or 1

4.12 Technical Data



Specifications	M-DP
Order no.	1070 079 751
Power supply, as per DIN EN 61131-2	24 V (19.2 through 30 V)
Current draw from 24 V power supply	≤ 0.3 A
Power supply • for PROFIBUS-DP interface • for internal bus	 5 V ± 5 % external 100 mA RS-485, electrically isolated max. 500 mA, electrically isolated
Max. number of connected modules	16
Max. number of addressable bytes	• 64 Inputs • 64 Outputs • 64 Parameters • 64 Diagnostics
Weight	Approx. 260 g

4.13 Spare Parts & Accessories

4.13.1 Connector Strip Assortments

The connector strip assortments comprise the connection between the machine wiring and the B~IO M-DP module. Using the connector strip extractors, they can be removed quickly and with ease. Therefore no individual wires have to be disconnected in order to exchange a B~IO M-DP module.

Two different types of connector strips are available:

- Threaded terminals
- Spring clamp terminals.

The connector strip assortments consist of several single connector strips. Connector strip assortments for compact modules contain, besides the input and output connector strips, also the connector strips for the power supply.

The following conductors, with cross-sections as listed, can be connected:

- Threaded terminals
  - ”e” single-wire H05 (07) V-U 0.5 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 28 through 16
  - Strip length 7 mm
- Spring clamp terminals
  - ”e” single-wire H05 (07) V-U 0.08 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 24 through 16
  - Strip length 7 mm

)* not permitted with plastic collar DIN 46228/4. Shape A; crimping shape of the crimping tools for AEH PZ 1.5 or PZ 6.5.

Connector strip assortment

Designation	Order no.	Connector Type
BL-SET-SA-BUSANS.-M	1070 080 344	• Threaded terminal
BL-SET-FK-BUSANS.-M	1070 080 351	• Spring clamp terminal

4.13.2 Device Specification File for PROFIBUS-DP

The device specification file conforms to DIN EN 50170-2. It contains all data required to configure the modular B~IO M-DP devices for use with any DP master.

Designation	Order no.
Device Specification Files, Floppy Disk 3 1/2”	1070 075 547

Furthermore, the device specification file is available in the Internet:

- Bosch Rexroth home page: http://www.boschrexroth.de; continue with ”Electric Drives and Controls”
- Profibus User Organization home page: http://www.profibus.com

4.13.3 Module Plug Connector

Designation	Order no.
FL line, 12-conductor	1070 079 782
Module Plug Connector, long, for dual row assembly	1070 084 071

4.13.4 Bus Connector Accessories

Bus connector, PROFIBUS-DP, threaded terminals

Designation	Order no.
IP 20 bus connector, 90 degrees	1070 918 538
IP 20 bus connector, 180 degrees	1070 920 957
IP 20 bus connector w/ female DB-9 and additional PG connector	1070 918 539

Bus connector, PROFIBUS-DP, Fast Connect

The following connectors for Fast Connect (FC) only can be used in conjunction with the corresponding FC cables. FC is a system for a fast and easy assembly of Profibus cables.

Designation	Order no.
FC bus connector, 90 degrees	1070 920 960
FC bus connector, 180 degrees	1070 920 962
FC bus connector w/ female DB-9 and additional PG connector	1070 920 961

Bus cables, PROFIBUS-DP, standard

Designation	Order no.
PROFIBUS-DP bus cable, drag link cable, permissible tensile force: 100 N	1070 917 201
PROFIBUS-DP bus cable, drag link cable, permissible tensile force: 20 N	1070 919 660
PROFIBUS-DP, bus cable, solid, flame-resistant, inspection type C	1070 917 202
PROFIBUS-DP, bus cable, solid, flame-resistant, inspection type B	1070 919 661

Bus cables, PROFIBUS-DP, Fast Connect

The following special bus cables can be used for Fast Connect as well as for threaded terminals.

Designation	Order no.
FC bus cable for PROFIBUS-DP, drag link cable, permissible tensile force: 100 N	1070 921 034
FC bus cable for PROFIBUS-DP, solid	1070 921 035

Tools for Fast Connect

The following tools are recommended for assembling the Fast Connect bus cables.

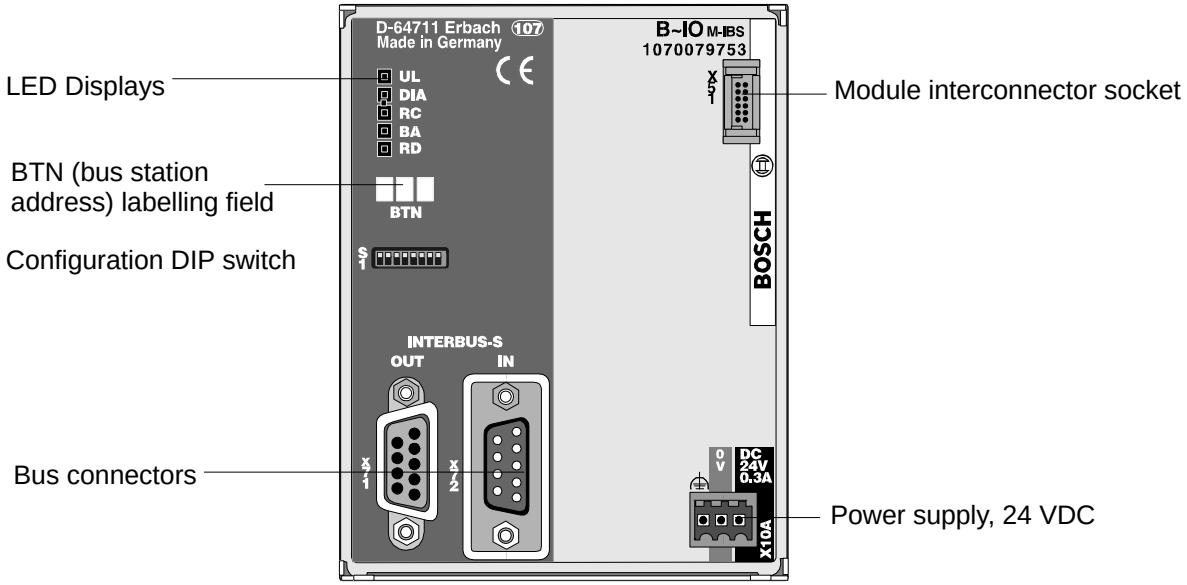
Designation	Order no.
Wire stripping tool FC	1070 920 958
Spare blade for wire stripping tool	1070 920 959

5 InterBus-S Bus Connector

5.1 Hardware Configuration

The bus connector maintains constant contact with the governing control unit via the InterBus-S long-distance bus.

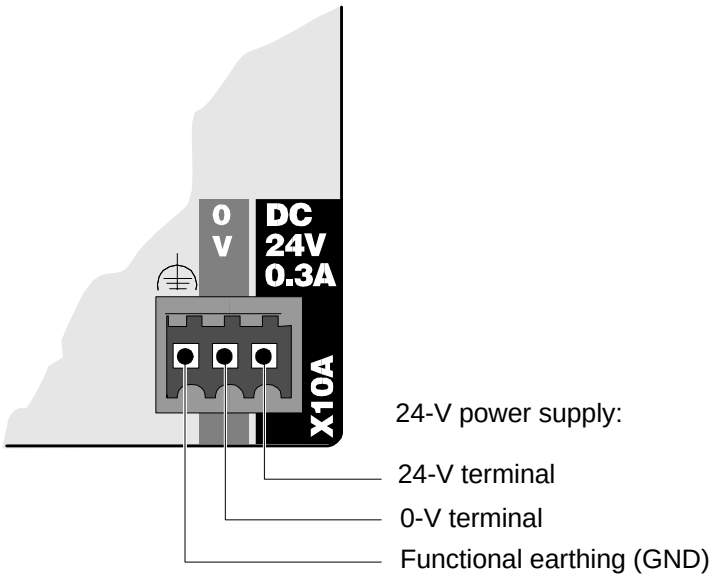
- It receives the current switching signals at the inputs and, via the InterBus-S, directs them to the governing control unit for further processing.
- It receives the output signals of the governing control unit via the InterBus-S, and directs them to the outputs.



5.2 Connectors

5.2.1 24-V power supply (X10A)

The bus connector requires a 24-V power supply.



5.2.2 InterBus-S (X71, X72)

The InterBus-S comprises a long-distance bus pursuant to EN 50 254.

The InterBus-S connection uses a male 9-pin D-SUB (DB-9) connector that is threaded onto the female DB-9 connector (IN) of the B~IO M-IBS bus connection module. The outgoing bus connection to the next bus station is accomplished by interconnecting the referred station and the DB-9 output socket (OUT) of the B~IO M-IBS bus connection module.

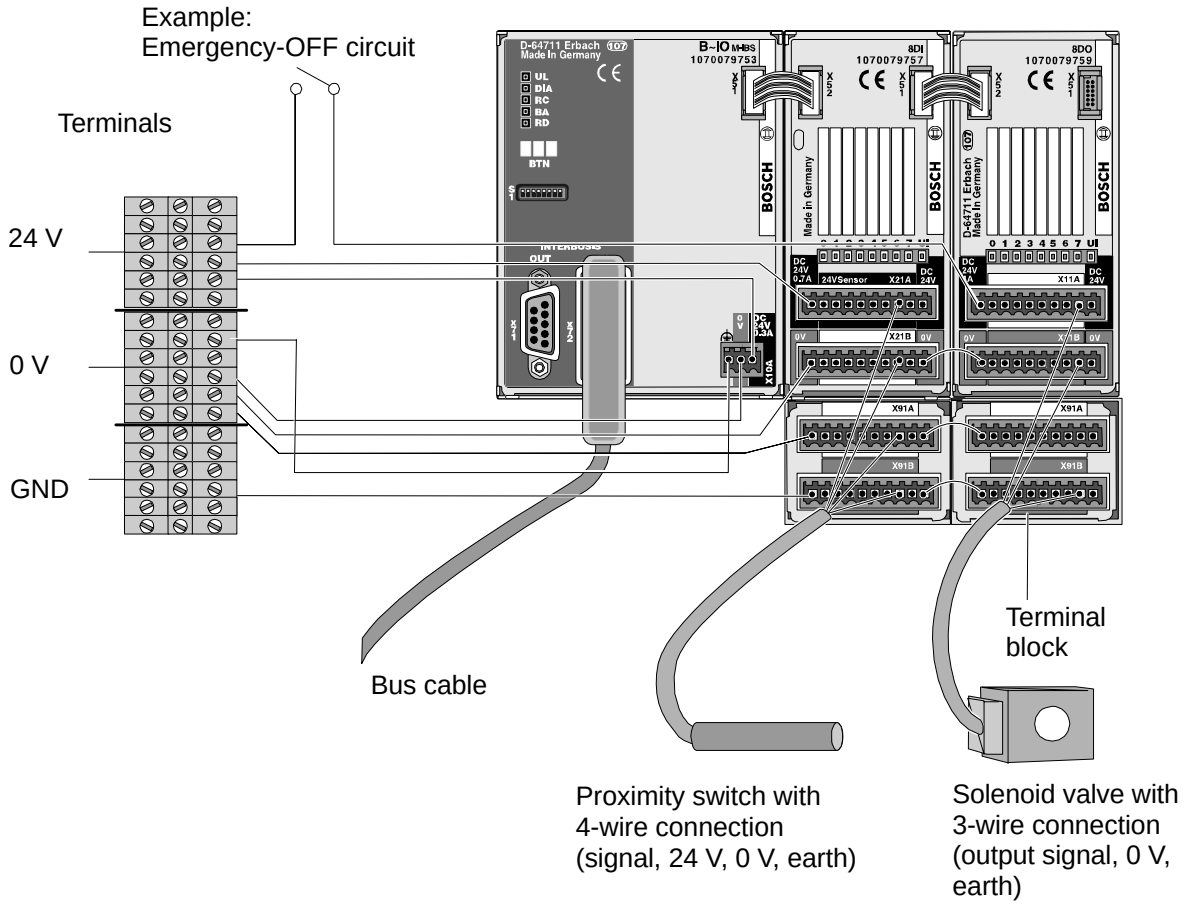
Pin Assignment

Pin no.	IN X72 plug	OUT X71 socket	Explanation
1	DO	DO	Send data
2	DI	DI	Receive data
3	COM	COM	Common GND reference
4	–	–	–
5	–	+ 5 V ISO	for RBST bridge
6	$\overline{\text{DO}}$	$\overline{\text{DO}}$	Send data
7	$\overline{\text{DI}}$	$\overline{\text{DI}}$	Receive data
8	–	–	–
9	–	RBST	Identifier, additional station connected. When making up the connecting cable, it must be ensured that the bridging between pin 5 and pin 9 is provided in the bus cable plug connector at the OUT socket.
Housing	Screen via RC circuit	Screen	

☞ **Unless otherwise specified, the InterBus-S installation guidelines and cabling recommendations provided by Phoenix-Contact shall be observed, e.g., IBS SIG Part 1 UM or the IBS SYS INST UM installation manual.**

5.2.3 Connection Example

The example below illustrates the connection of a B~IO M-IBS with a module for 8 inputs, and a module for 8 outputs being the last bus station:



5.3 Operation

Power-up Sequence

In the event that the B~IO M-IBS module is not powered at the time the governing controller is switched on, the decentralized inputs and outputs will not be available. For this reason, the power supply for the B~IO M-IBS should already be activated at the time the governing control unit is started.

Procedural sequence:

- Switch on power to B~IO M-IBS module
- B~IO M-IBS maintains all outputs at 0 (LOW) state
- B~IO M-IBS stands by and waits for data exchange with governing control unit.

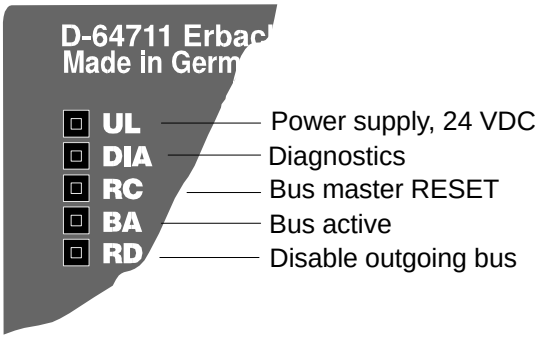
☞ **Observe the relevant information in the operating manual supplied with the governing control unit.**

Ongoing Operation

The bus connection module is operated by the governing control unit. As manual operation is not required, there are no relevant provisions.

The bus connection module is activated and working properly if –

- UL LED illuminates green without interruption
- DIA LED does not illuminate red
- RC LED illuminates green without interruption
- BA LED illuminates green.



5.4 Module Placement and Addressing

The address space assignment depends on the respective customer-specific equipping of a given B~IO M-IBS series module.

The addresses of equipped input and output modules are assigned in an ascending left-to-right progression, without leaving gaps. The bus connection module itself does not occupy an address.

In the event that input and output modules are equipped simultaneously, the assigned input and output data range of the B~IO M-IBS module will malways be of equal size. For example, if 3 words are occupying outputs, corresponding to 6 output modules, 3 words will occupy inputs, even if a lesser number of input modules is actually equipped.

The B~IO M-IBS series bus connection module supports up to 20 input bytes and 20 output bytes, or a maximum of 16 modules.

The central PLC addresses are assigned to the decentralized inputs and outputs by means of an IBS bus master and a configurator, e.g., IBS CMD G4 by Phoenix Contact.

☞ **The HIGH and LOW byte in a data word may have been reversed! This depends on the type of bus master being deployed (cf. configuration switch S1, section**

The bus station address can be noted on the three-digit labelling field on the front panel.

Example

B~IO M-IBS with 2 input words and one output word

B~IO M-IBS	8DI	8DO	16DI	8DO	8DI
Bus connection	24 V	24 V/ 0.5 A	24 V	24 V/ 0.5 A	24 V
	Module 1	Module 2	Module 3	Module 4	Module 5

Corresponding address assignment:

Module number	Input byte address	Output byte address
Module 1	n	
Module 2		n
Module 3	n+1 and n+2	
Module 4		n+1
Module 5	n+3	

In addition, output bytes n+2 and n+3 are occupied in the addressing space but not used.

Input and Output Data

The B~IO M-IBS bus connection module supports up to 20 bytes of inputs and 20 bytes of outputs.

In the event that the connected modules occupy a larger number of bytes, an error message will be returned.

☞ **If an I/O gateway module is connected to the bus connection module B~IO M-IBS and additionally further I/O modules are attached, please observe that the DIP switch S1 on the I/O gateway should be configured to a switching matrix width of 8 bytes I/O. Otherwise, the maximum I/O data length of 20 bytes will be exceeded.**

5.5 Operating Parameters

5.5.1 ID Code and Address Assignment

The B~IO M-IBS bus connection modules are equipped with the Supi3 ASIC and thus compatible with Generation 3 and 4 bus masters.

☞ **However, all integrated ASIC functions can be evaluated only if all InterBus-S system components, including the master, support Generation 4 features.**

The B~IO M-IBS feature the general identification code for digital long-distance bus stations, and occupy the corresponding address space.

Typ	ID Code
B~IO M-IBS equipped with output modules only	01
B~IO M-IBS equipped with input modules only	02
B~IO M-IBS equipped with both input and output modules	03

☞ **Depending on the bus master being used, the HIGH and LOW byte may be the opposite of the label designation.**

Unless at least one module is connected at any time, a forced System Halt will occur.

5.5.2 Baud Rate

The B~IO M-IBS bus connection module automatically synchronizes to the baud rate selected on the InterBus-S.

5.5.3 IBS Configuration

IBS configuration program

To operate the B~IO M-IBS, an IBS configuration program (”IBS configurator”) can be used. A suitable IBS configurator is the IBS CMD4 by Phoenix Contact.

5.5.4 Configuration DIP Switch S1

The B~IO M-IBS bus connection module features an 8-segment configuration DIP switch on the front panel, labelled ”S1”.

As shipped from the factory, all switch segments are set to OFF.

Switch	Status	Function
1	OFF	Unused
	ON	
2	OFF	Unused
	ON	
3	OFF	Unused
	ON	
4	OFF	Unused
	ON	
5	OFF	HIGH and LOW byte swap enabled (corresponds to Bosch-typical setting)
	ON	HIGH and LOW byte swap disabled (corresponds to Siemens-typical setting, for example)
6	OFF	Extended data length (G4 master only)
	ON	Standard data size (G3 and G4 master)
7	OFF	Diagnostic messages to bus master (module diagnostics)
	ON	No diagnostic messages to bus master
8	OFF	Unused
	ON	

Switches 1 through 4

These switches are not used.

Switch 5

Swap switch: In contrast to the Bosch bus connection module, some bus connection modules from other manufacturers (e.g., Siemens, AEG) reverse or ”swap” the LOW and HIGH byte. The switch setting to OFF corresponds to the Bosch-typical setting. However, with this setting, the 1-byte and 3-byte data bus widths cannot be used. The next higher data bus width of 1 word and/or 2 words will be used automatically.

Switch 6

Effective with the bus master connection module with a software version higher than v4.0 (G4), extended data sizes are supported, and can be selected via this switch. In the case of older software versions (G3 bus master) and an actual data bus width that is not listed in the table, the standard data bus width must be selected because otherwise the bus master will be unable to communicate with the slave module.

Switch setting	Supported data bus width
OFF (Default)	1 byte, 1 word, 3 byte, 2 words, 3 words, 4 words, 5 words, 6 words, 7 words, 8 words, 9 words, 10 words (G4 Master)
ON	1 word, 2 words, 3 words, 4 words, 5 words, 8 words, 9 words, 10 words, (G3 and G4 master)

☞ **In the Bosch-typical setting, 1 and 3-byte operation is not possible! In this case, the next higher data width of 1 word or 2 words, respectively, is chosen.**

Switch 7

This switch generally determines whether or not diagnostic messages are to be sent to the bus master.

Switch 8

This switch is not used.

☞ **It should ne noted that the configuration DIP switch settings are loaded only once, i.e., at the time the power to the logic circuits is switched on.**

5.6 Cyclical Data Exchange

In cyclical operation, input and output data is exchanged via the InterBus-S between the governing PLC control unit and the B~IO M-IBS module.

5.7 Diagnostics

With diagnostic mode enabled, an error is reported to the IBS master as a general periphal error; to indicate this condition, the red DIA (diagnostics) LED on the front panel of the respective B~IO M-IBS bus connection module illuminates.

On I/O modules that are appropriately equipped, the diagnostic messages are grouped in the form of peripheral errors.

☞ **Diagnostics must have been enabled via parameter selection with configuration DIP switch no. 7 = set to OFF. If diagnostics are not enabled, the occurrence of a diagnostic event will suppress both the response of the red DIA LED on the front panel of the bus connection module, and the message to the IBS master.**

5.8 Displays and Error Messages

5.8.1 Displays

The operating status of the B~IO M-IBS bus connection module is indicated by 5 light-emitting diodes (LEDs):

Name	LED	Explanation
UL	Green	24-V power supply for X10 A is functional
	OFF	24-V power supply is faulty
DIA	OFF	Standard operation
	Red	Diagnostics or system halted
RC	Green	Incoming bus is fault-free, diabled bus RESET on bus master
	OFF	Governing controller or bus master in RESET mode; bus fault
BA	Green	Data messages are being transferred on the bus
	OFF	No data messages are being transferred on the bus
RD	OFF	The outgoing bus is enabled
	Red	The outgoing bus is disabled

5.8.2 Error Messages

Light-emitting Diodes					Explanation
UL green	DIA red	RC green	BA green	RD red	
●	○	●	●		Standard operation, no error indication
○					24-V power supply not available
●●					The bus connection module is being held in the initialization phase by one or more I/O modules
●●●●	○				System Halt, configuration error, check and verify I/O configuration
	●				One or more I/O modules are reporting diagnostics
●	●●				System Halt, unknown I/O module
●/○	●●●●				System Halt, firmware error
●●●●	●●●●				System Halt, hardware fault
●		○			The inbound long-distance bus is either improperly connected or without x-connection, or a bus RESET of the bus master is enabled. Possible causes: • A fault has been detected in the long-distance bus cabling. • A bus RESET is active on the bus master.
●			○		The bus is not active.
●				●	The outgoing bus is disabled after this bus connection module. All subsequent bus connection modules are therefore inactive/disabled.

Legend:

○	LED remains dark
●	LED illuminates
●●	LED flashes slowly, e.g., ON for 0.8 s and OFF for 0.2 s
●●●●	LED flashes rapidly, e.g., ON for 0.125 s and OFF for 0.125 s
	Display has no significance

System Halt

The System Halt status of the bus connection module is indicated by the two LEDs labelled UL and DIA. A System Halt condition causes outputs to be reset to LOW state, and the data transfer to the bus master is interrupted. The IBS master is no longer able to address this station. The System Halt status can be cancelled only by a restart.

System Halt – Unknown I/O Module

The B~IO M-IBS bus connection module has recognized an I/O module that is not supported by its onboard firmware version.

- To operate the I/O module, a firmware update will be required.
- The occurrence of this error with the latest frimware version for the B~IO M-IBS bus connection module, this indicates a hardware fault in the I/O module.

System Halt – Configuration Fault

The following I/O configurations will cause a System Halt:

- No I/O modules in configuration
- More than 16 I/O modules in configuration
- More than 20 input bytes configured
- More than 20 output bytes configured

FW Firmware Exception Fault

During the operation of the firmware, plausibility checks are conducted on an ongoing basis. If a fault is detected, the module will enter the FW firmware exception fault condition.

HW Hardware Exception Fault

At the time the bus connection module is powered up, the hardware components are tested. Also, the I/O configuration and the quality of the signal transferred to the I/O modules is monitored. Any fault occurrence will cause the module to enter the HW hardware exception fault condition.

5.9 Operating Behaviour

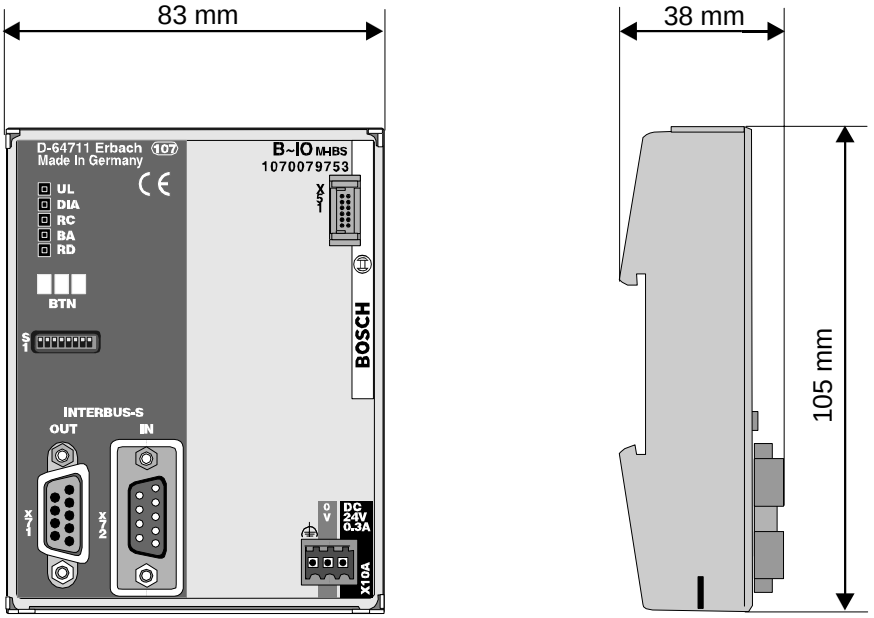
Creating Actual Configuration List

Subsequent to power-up, the B~IO M-IBS bus connection module determines its own I/O module configuration and uses this data to xcreate an Actual Configuration List.

Faulty configurations, such as missing I/O modules, are indicated by means of the LEDs labelled UL and DIA. If this is the case, the buus connection module will enter the System Halt condition.

The bus connection module then waits to be addressed by the IBS master.

5.10 Technical Data



Specifications	M-IBS
Part no.	1070 079 753
InterBus-S interface type	Long-distance bus
Power supply, as per EN 61 131-2	24 V; 19.2 through 30 V
Current draw from 24 V power supply	≤ 0.3 A
Power supply for I/O modules I_V	max. 500 mA, electrically isolated
Max. number of connected modules	16
Max. number of addressable bytes	20 bytes inputs, 20 bytes outputs
Weight	approx. 260 g
Potential separation between IN and OUT interface	yes
Potential separation between OUT interface and logic	no
Potential separation logic to inputs and outputs	yes
Potential separation 24-V power supply to logic	yes

5.11 Spare Parts & Accessories

5.11.1 Connector Strip Assortments

The connector strip assortments comprise the connection between the machine wiring and the B~IO M-IBS module. Using the connector strip extractors, they can be removed quickly and with ease. Therefore no individual wires have to be disconnected in order to exchange a B~IO M-IBS module.

Two different types of connector strips are available:

- Threaded terminals
- Spring clamp terminals.

The connector strip assortments consist of several single connector strips. Connector strip assortments for compact modules contain, besides the input and output connector strips, also the connector strips for the power supply.

The following conductors, with cross-sections as listed, can be connected:

- Threaded terminals
  - ”e” single-wire H05 (07) V-U 0.5 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 28 through 16
  - Strip length 7 mm
- Spring clamp terminals
  - ”e” single-wire H05 (07) V-U 0.08 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 24 through 16
  - Strip length 7 mm

)* not permitted with plastic collar DIN 46228/4. Shape A; crimping shape of the crimping tools for AEH PZ 1.5 or PZ 6.5.

Connector strip assortment

Designation	Order no.	Connector Type
BL-SET-SA-BUSANS.-M	1070 080 344	• Threaded terminal
BL-SET-FK-BUSANS.-M	1070 080 351	• Spring clamp terminal

5.11.2 Module Plug Connector

Designation	Order no.
FL line, 12-conductor	1070 079 782
Module Plug Connector, long, for dual row assembly	1070 084 071

Notes:

6 Bus Connector with CANopen

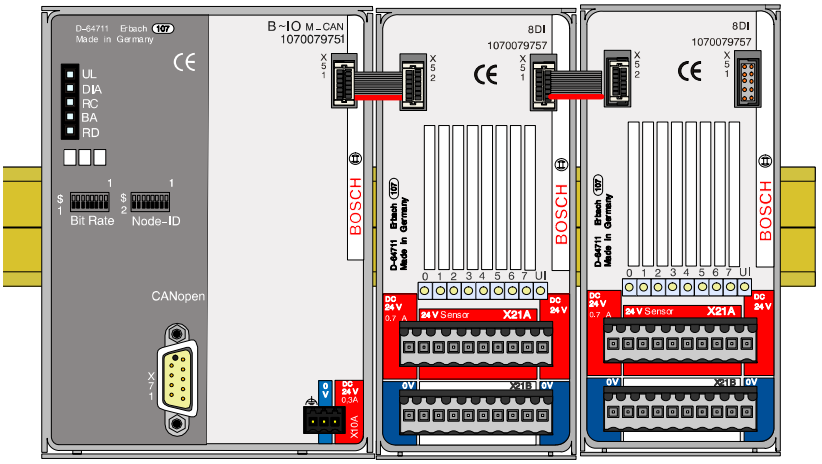
6.1 Structure

B~IO M-CAN is a field bus connector for CANopen based on specifications of the CiA (CAN in Automation e.V.). It can be extended using various I/O modules into a complete CANopen slave.

The bus connector has a permanent connection to the higher level control system via the field bus CANopen.

- It receives the current switching signals from the inputs and makes them available to the higher level control system for processing via CANopen.
- It receives the output signals from the higher level control system via CANopen and passes these on to the outputs.

The following example shows a B~IO M-CAN bus connector with two I/O modules:



6.2 Standards and References

OSI Reference Model

The CANopen communication model takes its orientation from the ISO/OSI reference model: ISO 7498, 1984, Information Processing Systems – Open System Interconnection – Basic Reference Model.

CAN

The lower layers of the reference model are based on the Controller Area Network (CAN):

- Robert Bosch GmbH, CAN Specification 2.0 Part B, September 1991
- ISO 11898, November 1993, Road Vehicles, Interchange of Digital Information – Controller Area Network (CAN) for high-speed Communication.

CANopen

All the data and guidelines regarding CANopen can be found in the CiA (CAN in Automation e.V.) specifications:

- CiA/DS 102,CAN Physical Layer for Industrial Applications
- CiA/DS 201, CAN Reference Model, February 1996
- CiA/DS 202-1, CMS Service Specification, February 1996
- CiA/DS 202-2, CMS Protocol Specification, February 1996
- CiA/DS 202-3, CMS Encoding Rules, February 1996
- CiA/DS 203-1, NMT Service Specification, February 1996
- CiA/DS 203-2, NMT Protocol Specification, February 1996
- CiA/DS 204-1, DBT Service Specification, February 1996
- CiA/DS 204-2, DBT Protocol Specification, February 1996
- CiA/DS 205-1, LMT Service Specification, February 1996
- CiA/DS 205-2, LMT Protocol Specification, February 1996
- CiA/DS 206, Application Specific Data Types, February 1996
- CiA/DS 207, Application Layer Naming Specification, Feb. 1996
- CiA/DS 301, CAL-based Communication Profile, Oct. 1996

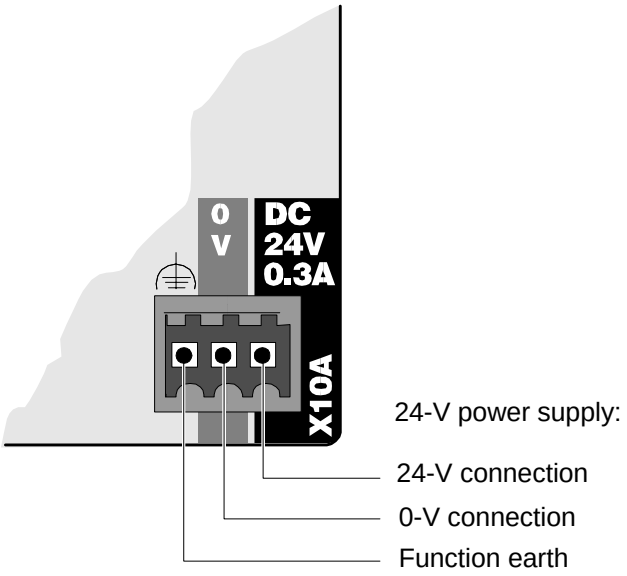
6.3 Connections

6.3.1 24-V Power Supply (X10A)

The bus connector requires a 24-V power supply.

The 24-V power supply is for the electrically separated supply of:

- CAN interface
- the logic of the connected I/O modules.



6.3.2 CAN (X71)

The connection to the CANopen bus system is made by a 9-pin D-SUB socket screwed to the D-SUB connector of the B~IO M-CAN (X71).

The connection allocation corresponds to the CANopen standards.

- CiA/DS 102, CAN Physical Layer for Industrial Applications, Feb. 1996 and
- CiA/DS 301, CAL-based Communication Profile, Oct. 1996.

Connection Allocation

Pin no.	Signal	Meaning
1	–	Reserved
2	CAN_L	Bus cable CAN_L (dominant low)
3	CAN_GND	Reference potential CAN
4	–	Reserved
5	(CAN_SHIELD)	Optional CAN Shield
6	–	Reserved
7	CAN_H	Bus cable CAN_H (dominant high)
8	–	Reserved
9	–	Reserved

6.4 CAN Configuration

6.4.1 Baud rate (switch S1)

The baud rate as well as the default operating mode are set using DIP switch S1 after the supply voltage of the B~IO M-CAN bus connector is switched on.

DIP switch S1:

SW8	**SW7**	**SW6**	SW5	SW4	**SW3**	**SW2**	**SW1**

SW = Switch

SW3..SW1 Baud rate

Baud rate	SW3	SW2	SW1	Max. cable length	Comments
1Mbit/s	on	on	on	25 m	
–	on	on	off		Reserved
500 Kbit/s	on	off	on	100 m	
250 Kbit/s	on	off	off	250 m	
125 Kbit/s	off	on	on	500 m	
50 Kbit/s	off	on	off	1 km	
20 Kbit/s	off	off	on	2.5 km	
10 Kbit/s	off	off	off	5 km	min. baud rate

SW5..SW4 Reserved

SW7..SW6 default operating mode after switching on the supply voltage (Power-On Default Mode, see below)

SW8 = off B~IO M-CAN conforms with CANopen

SW8 = on B~IO M-CAN conforms with Bosch ’rho’

☞ **Shipped state: Baud rate 1 Mbit/s, conforms with CANopen**

6.4.2 Power-On Default Mode (Switch S1)

SW6 and SW7 can be used to make default settings regarding 'transmission type' and the 'input transmit characteristics' of the B~IO M-CAN bus connector.

The settings can then be changed again via the bus according to the CANopen specifications.

Transmission Type

The default settings for the parameter 'Transmission Type' apply to all PDOs of each slave. A PDO-related setting of this parameter must be made via the bus with the corresponding CANopen service.

The DIP switch can be used to choose between two preset 'Transmission Types':

- asynchronous manufacturer-specific
- cyclical synchronous.

The remaining transmission types can be set via the bus as specified by the CiA.

Input Transmit Characteristics

This parameter can be used to set the transmit characteristics of the B~IO M-CAN if an input is changed. The following settings are possible:

- all PDOs, i.e. if one or more inputs are changed, the slave transmits all active PDOs (all inputs)
- 1 PDO, i.e. if one or more inputs are changed, the slave only transmits the PDOs in which the inputs have actually changed.

This setting is only relevant in asynchronous mode. In synchronous mode, the SYNC telegram always leads to transmission of all input PDOs.

SW7	SW6	Transmission Type, input transmit characteristics	Comments
on	on	reserved	
on	off	cyclical synchronous, all PDOs	new
off	on	asynchronous manufacturer-specific, 1 PDO	new
off	off	asynchronous manufacturer-specific, all PDOs	setting used so far

☞ **Shipped state: asynchronous manufacturer-specific, all PDOs**

6.4.3 Node ID (Switch S1)

Each bus connector on the CANopen must be allocated its own node ID.

Each node ID may only be allocated once in the entire CANopen.

Node ID 1..127 of the B~IO M-CAN bus connector is set using DIP switch S2.

DIP switch S2:

SW8	**SW7**	**SW6**	**SW5**	**SW4**	**SW3**	**SW2**	**SW1**

SW = Switch

SW7..SW1 Node ID (1..127)

SW8 Reserved

Node ID	SW7	SW6	SW5	SW4	SW3	SW2	SW1	Comments
0	off	off	off	off	off	off	off	not usable
1	off	off	off	off	off	off	on	
2	off	off	off	off	off	on	off	
3	off	off	off	off	off	on	on	
4	off	off	off	off	on	off	off	
...								
126	on	on	on	on	on	on	off	
127	on	on	on	on	on	on	on	not permitted with more than 16 inputs or more than 16 outputs

☞ **It is not permitted to set address 0 as node ID. Node ID setting 0 leads to a system halt.**

☞ **Also important here is the maximum possible data capacity of the CAN diagrams (see 'Operating Characteristics, PDO Channels', section 6.6)**

☞ **During 'power on', the set node ID is read once again after 'NMT Reset Node' and 'NMT Reset Communication' of the bus module B~IO M-CAN.**

This means that a change to the node ID during operation only takes effect after one of the above-mentioned events.

The node ID can be noted in the lettering field on the front panel.

Shipped state: Node ID = 1

6.4.4 Electronic Data Sheet (EDS)

The EDS file is an ASCII file specified by the CiA, describing the objects of a CANopen device. The EDS file can be read in certain CANopen configuration tools (e.g. Nodemaster, configuration tool from Vektor, etc.). This provides the user with a convenient project design solution.
The following EDS files for B~IO-M-CAN modules are available:

EDS file	**as of index**
RB01BM00.EDS	101
RB02BM00.EDS	104

As of index 104 (firmware version V1.2), a few OD objects have been added. These are contained in the newer EDS file version (RB02BM00.EDS).

A free download of current EDS files from the Internet is possible from http://www.boschrexroth.de. The EDS files are also available on floppy disk (order no. 1070 075 547).

6.5 Displays and Error Messages

6.5.1 Displays

The operating modes of the B~IO M-CAN bus connector are indicated by 4 light-emitting diodes (LEDs):

Name	LED	Meaning
UL	green	24-V power supply of X10.1 is OK
	off	24-V power supply is defective
DIA	off	normal operation
	red	no processing, diagnosis or system halt
RUN	green	normal operation
	off	error
BF	off	bus error-free
	red	bus error (baud rate, bus node address, bus cable) or initialisation phase at the CAN

6.5.2 Error messages

Light-emitting diodes				Meaning
UL green	DIA red	RUN green	BF red	
●	○	●	○	Normal operation, no error display
○				No 24-V power supply present
●●				The bus connector is held by one or more I/O modules in the initialisation phase
●●●●	○			System halt, incorrect configuration, check I/O configuration
	●			One or more I/O modules report diagnosis
●	●●			System halt, unknown I/O module
●/○	●●●●			System halt, firmware error
●●●●	●●●●			System halt, hardware error

●		○		Module comes to a halt in initialisation mode after power on. Possible causes:
				• Incorrect node ID (node ID = 0 or node ID > 127)
				• Partner unreachable
				  • Remaining CAN bus nodes switched off
				  • Bus cable disconnected, defective
				  • Baud rate incorrectly set

		●●		Bus connector is in the 'Preoperational' mode
				• Slave has not yet received an NMT_Start telegram
				• Guarding Failure
				• Sychronisation error (missing PDOs in the SYNC operating mode)
				• Slave has been set by the CAN master in 'Preoperational' mode by means of:
				  • NMT_RESET_NODE
				  • NMT_RESET_COM
				  • NMT_STOP
				  • NMT_DISCONNECT
				  • NMT_PREOPERATIONAL

			●	Critical bus error: BUSOFF
			●●	Invalid node ID (node ID = 0 or node ID > 127) or synchronisation error (in the SYNC mode, a SYNC telegram was received without the correct number of PDOs being transferred beforehand.
			●●●	Bus Warning Level exceeded

Explanations:

○	LED remains dark
●	LED illuminates
●●	Slow flashing of LED, e.g. 0.8 s ON / 0.2 s OFF
●●●●	Rapid flashing of LED, e.g. 0.125 s ON / 0.125 s OFF
	Display has no significance

System halt

The state ’system halt’ of the bus connector is indicated by the two light-emitting diodes **’UL’** and **’DIA’**. At system halt, the outputs are set to a safe state (’0’) and bus traffic to the CAN master is interrupted. The system halt can only be exited by means of a restart of the assembly (’power on’).

System halt, ’unknown I/O module’

The B~IO M-CAN bus connector has detected an I/O module that is not supported by the firmware version of the B~IO M-CAN bus connector.

- For the operation of the I/O module, the firmware has to be updated.
- If the error occurs with the latest version of the B~IO-M-CAN firmware, there is a hardware error on the I/O module.

System halt ’Incorrect configuration’

The following I/O configurations lead to a system halt due to an incorrect configuration:

- No I/O modules in configuration
- More than 16 I/O modules in configuration
- More than 32 bytes inputs configured
- More than 32 bytes outputs configured
- The total of the parameter data exceeds 65 bytes
- The total of the diagnostic data of all modules exceeds 33 bytes
- The configuration instructions (see section 6.6.1, ”Procedure for Configuration”) for the modules were not complied with.

Exceptional Error, Hardware (HW)

On startup (’power on’) the bus connector, the hardware components are tested. Furthermore, during the cyclical operation, the I/O configuration and interchange quality to the I/O modules is monitored. In the event of an error, the assembly is placed on system halt ’Exceptional error, HW’.

Exceptional Error, Firmware (FW)

While the firmware is running, plausibility checks are carried out continuously. If an error is detected, the assembly is placed on system halt ’Exceptional error, FW’.

6.6 Operating Characteristics

The characteristics of the B~IO M-CAN bus connector are dependent on the CANopen properties and how the I/O modules are equipped.

PDO Channels

CAN telegrams have a maximum data capacity of 8 bytes. For each CAN node, 2 channels are set up for transmission and 2 channels for reception of PDOs (Process Data Objects).

This sets the boundaries of the maximum support of process data per node (inputs 2*8 bytes, outputs 2*8 bytes).

More process data than is supported in the 2 PDOs for outputs and 2 PDOs for inputs can result if, for example, several 16DI modules are used in the B~IO M-CAN system.

If more than 16 input or 16 output data bytes are set up, the B~IO M-CAN system delivers more process data in that the node ID of the logical subsequent module is also used.

At the same time, this means that if more than 16 input or output data bytes are set up the logical subsequent node ID must not be used physically. It is then not possible to use the highest usable address 127 either.

SDO channel

There is one SDO channel (Service Data Object) available per CAN node in transmit and receive direction.

6.6.1 Startup Characteristics

Characteristics of the assembly after ’power on’

After the assembly has been switched on (24-V power supply has been applied), the hardware components are tested. If errors are detected, the B~IO M-CAN assembly is placed on system halt.

After the startup test has been successfully completed, the B~IO-M-CAN bus connector determines its own I/O module configuration and uses it to create an actual configuration list.

The CAN controller is then initialised according to the DIP switch settings.

After successful initialisation, the assembly is in the ’Preoperational’ mode. It can now be placed by the CAN master in the ’Operational’ mode by means of an ’*NMT START*’ telegram.

Only when the assembly is in the ’Operational’ mode can process data be interchanged via PDOs.

It is not permitted to disconnect or connect an I/O module during operation; this leads to a system halt.

Creating the Actual Configuration List

After 'power on', the B~IO-M-CAN bus connector determines its own I/O module configuration and uses it to create an actual configuration list.

Defective configurations (e.g. no I/O modules configured) are displayed by means of the light-emitting diodes 'UL' and 'DIA' and the bus connector is placed in system halt (see section 6.5.2.).

The actual configuration list can be read out by means of an SDO transfer.

Procedure for Configuration

When configuring the I/O modules, the following procedure must be adhered to:

★ First, configure all analog modules (the order of the analog inputs and analog outputs is not relevant here).

★ Then, all digital modules can be configured.

☞ **If the configuration instructions are not followed, inconsistent data can occur (e.g. high byte and low byte of an analog value do not match).**

☞ **Analog input modules should not be activated with EventDriven. The modules should be activated with RemoteTransmitRequest (RTR) or synchronously.**
NB: the default setting of the PDOs is EventDriven!

6.6.2 Object Dictionary (OD)

The Object Dictionary (OD) is used to, among other things, specify which communication objects are provided and in what way.

General OD Objects

For general OD objects, the CiA DS-301 specifies the following types of entries:

Entry	Type	Use
Constants	R	Information on module states, version codes, etc.
Readable entries	R	
Writable entries	W	For control and configuration of the module, deviating from the default settings. E.g. reallocating objects, changing identifiers, etc.
Readable and writable entries	RW	

☞ **All of the values in the OD changed by the user or changed by situations during runtime are lost in the event of a power failure. After a new power on, all the objects are at their default values.**

All OD objects of the B~IO M-CAN are described in the device master data (EDS files) in ASCII format. A free download of current EDS files from the Internet is possible from http://www.boschrexroth.de. The EDS files are also available on floppy disk (order no. 1070 075 547).

Manufacturer-specific OD objects

Over and above the OD objects specified by the CiA, there is an area reserved for manufacturers in which device-specific objects are entered and thus made accessible to the user:

Index (HEX)	Subindex (HEX)	Object Description	see page
1002 Read only	0	**Manufacturer Status Register (MSR**) The MSR is not located in the area reserved for manufacturers; however, the coding of this object is a matter for the manufacturer.	6–16
2000 R/W	0	**Module Control Register (MCR)** Influences the characteristics of the B~IO M-CAN.	6–16
2020 Read only	 0 1 2	**Diagnostic Information** **Number of Diagnosis Entries** (max. 33) **Diagnostic Status** Higher-level information on the set diagnosis. It is transmitted via the Emergency object. Additional details can be obtained via Subindex 2 per SDO. **Diagnostic Data** Detailed error information.	6–18
2030 Read only	 0 1	**Configuration Information** **Number of Detected Modules** (max. 16) **Configuration Data** One coding byte per module.	6–18
2040 R/W	 0 1 2	**Parameter Information** **Number of Parameter Data** **Parameter Info** Parameter data for B~IO-M and modules. **Device Parameter Data** 1 parameter byte for global settings of the B~IO-M (diagnosis settings)	6–19

Index 1002
Subindex 0

Manufacturer Status Register (MSR)

The MSR contains status information of the B~IO M-CAN.

Size: 1 byte

MSB							LSB	
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
					0	0	0	Initialisation
					0	0	1	Not used
					0	1	0	Not used
					0	1	1	Not used
					1	0	0	Not used
					1	0	1	Preoperational
					1	1	0	Operational
					1	1	1	Undefined state
								Reserved
x								Error Collection Bit

Error collection bit:
x = 0: no error
x = 1: At least one error is present

Index 2000
Subindex 0

Module Control Register (MCR)

The MCR can be used to change the characteristics of the B~IO M-CAN:

- Bit 0 to bit 3 specify the characteristics in the event of an error or after receipt of an NMT service
- Bit 8 (high byte) controls the input transmit characteristics.

Size: 2 bytes

high byte		low byte							
Bit 15 ... 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
									Module status in the event of an error
									Outputs in the event of an error
									EMCY reaction in the event of an error
									Reserved
									Reserved
									Reserved
									Reserved
									Input transmit characteristics
									Reserved

Module status in the event of an error (Bit 0)

0 ⇒ preoperational (default)

1 ⇒ Operational

Outputs in the event of an error (Bit 2, 1)

00 ⇒ CLAB: Outputs are disabled. (default)

01 ⇒ last state: outputs retain their last state.

10 ⇒ Reserved

11 ⇒ Reserved

EMCY reaction (Bit 3)

0 ⇒ In the event of an error, the Emergency object (EMCY) is sent. (default)

1 ⇒ In the event of an error, the Emergency object (EMCY) is not sent.

Input Transmit Characteristics (no relation to error!)

0 ⇒ An input change means that all input information is sent by all active PDOs. (default)

1 ⇒ An input change means that only the PDO to which the input is allocated is sent.

Characteristics in the event of an error:

Error	Module status	Outputs	EMCY reaction
BUS OFF The 'transmit error counter' of the CAN controller has exceeded the limit of 256.	according to MCR bit 0	according to MCR bit 2, 1	according to MCR bit 3
Missing PDO (SYNC mode) Missing receive PDO in synchronous cyclical mode.	according to MCR bit 0	according to MCR bit 2, 1	according to MCR bit 3
Guarding Failure Node guard monitoring period has elapsed. (Only if Node Guarding enabled by CAN master.)	according to MCR bit 0	according to MCR bit 2, 1	according to MCR bit 3

Characteristics after receipt of an NMT service:

NMT service	Module status	Outputs	EMCY reaction
NMT_RESET_NODE	Preoperational	all outputs deleted	no EMCY
NMT_RESET_COM	Preoperational	according to MCR bit 2, 1	no EMCY
NMT_STOP	Preoperational	according to MCR bit 2, 1	no EMCY
NMT_DISCONNECT	Preoperational	according to MCR bit 2, 1	no EMCY
NMT_PREOPERATIONAL	Preoperational	according to MCR bit 2, 1	no EMCY

Index 2020 **Diagnostic Information**

Diagnostic information can be read via this index. The B~IO M-CAN provides a block of max. 33 bytes of diagnostic data. Here, each item of diagnostic information consists of 3 bytes, so that a total of up to 11 diagnosis messages can be transferred.

Two types of diagnosis are supported:

- Code-related diagnosis (module diagnosis): each I/O module has one bit of diagnostic information available. The allocation by module number specifies clearly which I/O modules provide diagnosis.
- Channel-related diagnosis: provides diagnostic information for each individual I/O channel.

Index 2020
Subindex 0 **Number of Diagnosis Entries**

Length of current diagnostic data: A maximum of 33 bytes of diagnostic data can be transferred. If more than 33 bytes of diagnostic data is present, this is displayed by means of the 'Diagnostic Status' (see below).

Index 2020
Subindex 1 **Diagnostic Status**

The diagnostic status provides higher-level information on the set diagnosis. After a change in the diagnosis, the diagnostic status is transmitted via the Emergency object. Additional details can be obtained via Subindex 2 per SDO.

00 hex:	No diagnosis message present
01 hex:	Diagnosis message present
02 hex:	Diagnosis buffer overflow (more than 33 bytes of diagnostic information)

Index 2020
Subindex 2 **Diagnostic Data**

Diagnosis buffer of the B~IO M-CAN. The diagnostic data must be read by means of an '*Upload Multiplexed Domain Segment*' transfer by the CAN master.

Index 2030 **Configuration Information**

Current actual configuration detected by the B~IO M-CAN system.

Each module is described by 1 code byte.

Index 2030
Subindex 0 **Number of Detected Modules**

Number of Modules (Max. 16)

Index 2030
Subindex 1 **Configuration Data**

Actual configuration list of the B~IO M-CAN. The configuration data must be read by means of an '*Upload Multiplexed Domain Segment*' transfer by the CAN master.

Code	Module Name	Order No.
0x02	Digital input module 8DI/24V	1070 079 912
0x08	Digital output module 8DO/24V/0.5A	1070 079 913
0x10	Digital input module 3-cable connection 16DI-3/24V–	1070 081 862
0x0A	Digital output module 8DO/24V/2A	1070 080 151
0x0B	Digital output module 8DO/230V~/2A	1070 080 680
0x0F	Digital input module 16DI/24V–	1070 080 144
0x15	Digital output module 16DO/24V–/0.5A	1070 081 858
0x1C	Analog input module 4AI_UI	1070 080 524
0x1D	Analog input module 4AI_UIT	1070 080 526
0x20	Analog output module 4AO_U	1070 080 530
0x21	Analog output module 4AO_I	1070 080 528
0x24	Digital input / output module 8DI/DO	1070 080 709
0x28	I/O gateway 20 bytes I/O	1070 083 150
0x29	I/O gateway 8 bytes I/O	1070 083 159

Index 2040 Parameter Information

This index is used to set parameters for the B~IO M-CAN.

The B~IO M-CAN system supports up to 65 bytes of parameter data. These include 1 byte of device-specific and up to 64 bytes of module-related parameter data.

The parameter data can be read and written.

Byte	Meaning
Byte 0	device-specific
Byte 1	1st module parameter byte
...	...
Byte 64	64th module parameter byte

The following table shows the coding of device-specific parameter data (byte 0):

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)	User_Prm_Data[2]
...	...	...	...	...	...	...	0	Module diagnosis blocked
...	...	...	...	...	...	...	1	Module diagnosis released
...	...	...	...	...	...	0	...	Channel diagnosis blocked
...	...	...	...	...	...	1	...	Channel diagnosis released
...	...	...	...	...	0	...	...	default
...	...	...	...	...	1	...	...	not permitted
...	...	...	...	0	...	...	...	default
...	...	...	...	1	...	...	...	not permitted
...	...	...	0	...	...	...	...	default
...	...	...	1	...	...	...	...	not permitted
...	...	0	...	...	...	...	...	default
...	...	1	...	...	...	...	...	not permitted
...	0	...	...	...	...	...	...	default
...	1	...	...	...	...	...	...	not permitted
0	...	...	...	...	...	...	...	default
1	...	...	...	...	...	...	...	not permitted

The coding of the module parameter data can be found in the description of the relevant modules.

There are not yet any modules where parameters can be set.

Index 2040
Subindex 0

Number of Parameter Data

The subindex contains the number of parameter data.

Index 2040
Subindex 1

Parameter Information

The set parameters can be read or new parameter data can be loaded into the B~IO M-CAN.

The parameter data must be read by means of an '*Upload Multiplexed Domain Segment'* transfer.

With data lengths <= 4 bytes, the writing of the parameter data can be transferred either by means of an accelerated (parameter data in the '*Initiate Domain Download*' telegram) or segmented transfer.

The coding of the parameter data is module-dependent and can be found in the relevant module description.

Index 2040
Subindex 2

Device Parameter Data

Here, the first byte of the parameter data can be accessed independent of the module parameter data. It is used, among other things, to enable or disable the diagnosis.

Access is by means of an accelerated transfer.

6.6.3 Diagnosis

In a diagnosis case, the diagnostic information is provided to the CAN master and/or configurator and indicated by the light-emitting diode 'DIA = red' on the B~IO M-CAN bus connector.

☞ **The diagnosis must be enabled via the setting of parameters. If the diagnosis is not enabled, in a diagnosis case the display (light-emitting diode 'DIA = red') of the bus connector as well as the message to the CAN master are suppressed.**

Diagnosis Types

The B~IO M-CAN bus connector supports the extended diagnosis types 'code-related diagnosis' and 'channel-related diagnosis'.

Code-related Diagnosis

The code-related diagnosis (= module diagnosis) provides the information as to whether I/O modules of the bus connector are in a diagnosis case. For each I/O module, the information 'no diagnosis' / 'diagnosis' is provided. Here, no information is provided regarding the type of diagnosis on the I/O modules.

☞ **The code-related diagnosis is activated by the user by setting the parameter bit "device-specific parameter byte" bit 0 = 1.**

The code-related diagnosis occupies exactly 3 bytes of diagnostic information in the diagnosis buffer.

In the case of code-related diagnosis, each I/O module has one bit of diagnostic information available.

The allocation by module number specifies clearly which I/O modules provide diagnosis.

The following tables show the coding of the code-related diagnosis:

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)	Byte 1: header byte
		0	0	0	0	1	1	Length fixed at 3 bytes
0	1							Code, fixed at 0, 1

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)	Byte 2: diagnosis modules 0...7
...	...	...	...	...	...	...	0	Module 0 reports no diagnosis
...	...	...	...	...	...	...	1	Module 0 reports diagnosis
...	...	...	...	...	...	0	...	Module 1 reports no diagnosis
...	...	...	...	...	...	1	...	Module 1 reports diagnosis
...	...	...	...	...	0	...	...	Module 2 reports no diagnosis
...	...	...	...	...	1	...	...	Module 2 reports diagnosis
...	...	...	...	0	...	...	...	Module 3 reports no diagnosis
...	...	...	...	1	...	...	...	Module 3 reports diagnosis
...	...	...	0	...	...	...	...	Module 4 reports no diagnosis
...	...	...	1	...	...	...	...	Module 4 reports diagnosis
...	...	0	...	...	...	...	...	Module 5 reports no diagnosis
...	...	1	...	...	...	...	...	Module 5 reports diagnosis
...	0	...	...	...	...	...	...	Module 6 reports no diagnosis
...	1	...	...	...	...	...	...	Module 6 reports diagnosis
0	...	...	...	...	...	...	...	Module 7 reports no diagnosis
1	...	...	...	...	...	...	...	Module 7 reports diagnosis

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)	Byte 3: diagnosis modules 8...15
...	...	...	...	...	...	...	0	Module 8 reports no diagnosis
...	...	...	...	...	...	...	1	Module 8 reports diagnosis
...	...	...	...	...	...	0	...	Module 9 reports no diagnosis
...	...	...	...	...	...	1	...	Module 9 reports diagnosis
...	...	...	...	...	0	...	...	Module 10 reports no diagnosis
...	...	...	...	...	1	...	...	Module 10 reports diagnosis
...	...	...	...	0	...	...	...	Module 11 reports no diagnosis
...	...	...	...	1	...	...	...	Module 11 reports diagnosis
...	...	...	0	...	...	...	...	Module 12 reports no diagnosis
...	...	...	1	...	...	...	...	Module 12 reports diagnosis
...	...	0	...	...	...	...	...	Module 13 reports no diagnosis
...	...	1	...	...	...	...	...	Module 13 reports diagnosis
...	0	...	...	...	...	...	...	Module 14 reports no diagnosis
...	1	...	...	...	...	...	...	Module 14 reports diagnosis
0	...	...	...	...	...	...	...	Module 15 reports no diagnosis
1	...	...	...	...	...	...	...	Module 15 reports diagnosis

Channel-related Diagnosis

With the channel-related diagnosis (= channel diagnosis), it is possible to diagnose individual channels of I/O modules. The diagnosis message is dependent on the type of I/O module.

☞ **The channel diagnosis is activated by the user by setting the parameter bit ”device-specific parameter byte” bit 1 = 1.**

The channel diagnosis always occupies 3 bytes of diagnostic information per channel.

These 3 bytes of channel diagnosis can be multiple in the diagnosis buffer (up to 10 times), i.e. a maximum of 10 channels can be diagnosed.

If there is more diagnostic information than the diagnosis buffer can handle, the flag Ext_Diag_Overflow is set in the diagnostic status (Index 2020 Subindex 1) to inform the CAN master of the overflow of the diagnosis buffer.

The following tables show the coding of the 3 bytes of diagnostic information:

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)	Byte 1: code/module number
...	...	0	0	0	0	0	0	Module number 0
		...	...	...	...	...	...	...
		0	0	1	1	1	1	Module number 15
1	0	...	...	...	...	...	...	Code, fixed at 1, 0

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)	Byte 2: channel number/direction
...	...	0	0	0	0	0	0	Diagnosis channel 0
...	...	0	0	0	0	0	1	Diagnosis channel 1
...	...	0	0	0	0	1	0	Diagnosis channel 2
...	...	0	0	0	0	1	1	Diagnosis channel 3
...	...	0	0	0	1	0	0	Diagnosis channel 4
...	...	0	0	0	1	0	1	Diagnosis channel 5
...	...	0	0	0	1	1	0	Diagnosis channel 6
...	...	0	0	0	1	1	1	Diagnosis channel 7
...	...	...	...	...	...	...	...	...
...	...	1	1	1	1	1	1	Diagnosis channel 63
0	1	...	...	...	...	...	...	Input (I)
1	0	...	...	...	...	...	...	Output (O)
1	1	...	...	...	...	...	...	Input/Output (I/O)

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)	Byte 3: diagnosis type
...	...	...	0	1	0	0	1	I error type: ”Error”
...	...	...	0	0	0	0	1	O error type: ”Short circuit”
...	...	...	0	1	0	0	1	I/O error type ”Error”
0	0	1	...	...	...	...	...	Channel type: 1 bit

Example of External Diagnosis Messages

Without standard diagnosis, as of byte no. 6 in the diagnosis data block (Ext_Diag_Data[0]) in ascending order.

The following table shows an example of external diagnosis messages:

Byte	hex	Bit 7 MSB	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 LSB	
[0]	0xC1	1	1	0	0	0	0	0	1	Revision_Number: e.g. 1
[1]	0x43	0	1	0	0	0	0	1	1	Module Diagnosis Header
[2]	0x81	1	0	0	0	0	0	0	1	Modules 0, 7 with diagnosis
[3]	0x04	0	0	0	0	0	1	0	0	Module 10 with diagnosis
[4]	0x80	1	0	0	0	0	0	0	0	Channel diagnosis, module 0
[5]	0x80	1	0	0	0	0	0	0	0	Output channel 0
[6]	0x21	0	0	1	0	0	0	0	1	Diagnosis type ”short circuit”
[7]	0x80	1	0	0	0	0	0	0	0	Channel diagnosis, module 0
[8]	0x83	1	0	0	0	0	0	1	1	Output channel 3
[9]	0x21	0	0	1	0	0	0	0	1	Diagnosis type ”short circuit”
[10]	0x80	1	0	0	0	0	0	0	0	Channel diagnosis, module 0
[11]	0x8E	1	0	0	0	1	1	1	0	Output channel 14
[12]	0x21	0	0	1	0	0	0	0	1	Diagnosis type ”short circuit”
[13]	0x80	1	0	0	0	0	0	0	0	Channel diagnosis, module 7
[14]	0x46	0	1	0	0	0	1	1	0	Input channel 6
[15]	0x29	0	0	1	0	1	0	0	1	Diagnosis type ”Error”
[16]	0x80	1	0	0	0	0	0	0	0	Channel diagnosis, module 7
[17]	0x47	0	1	0	0	0	1	1	1	Input channel 7
[18]	0x29	0	0	1	0	1	0	0	1	Diagnosis type ”Error”

6.6.4 CAN Identifier

In the shipped state, after the power-up of the B~IO M-CAN, the identifiers are set according to the specifications of the CiA DS-301 (master/slave connection set):

- the B~IO-M-CAN system acts completely as a slave.
  An application master, DBT master or NMT master can use the node ID of the slave to calculate its identifier.
- No communication between slaves.

Via SDO, a DBT master can change the identifiers of the B~IO M-CAN in any way so that direct communication of process data becomes possible among slaves.

Standard identifier allocation (ID length 11 bits = range of 0 to 2047) according to specifications of the 'predef. Master/Slave Connection Set'.

hex	decimal	
0	0	NMT services
1 to 0x7F	1 to 127	reserved by CAL
0x80	128	SYNC message (rho mode: 0x64)
0x81 to 0xFF	129 to 255	Emergency Messages
0x100	256	Time Stamp
0x181 to 0x1FF	385 to 511	PDO1 (Transmit)
0x200	512	reserved by CAL
0x201 to 0x27F	513 to 639	PDO1 (Receive)
0x280	640	reserved by CAL
0x281 to 0x2FF	641 to 767	PDO2 (Transmit)
0x300	768	reserved by CAL
0x301 to 0x37F	769 to 895	PDO2 (Receive)
0x400 to 0x580	896 to 1408	reserved by CAL
0x581 to 0x5FF	1409 to 1535	SDO (Transmit)
0x600	1536	reserved by CAL
0x601 to 0x67F	1537 to 1663	SDO (Receive)
0x680 to 0x6E0	1664 to 1760	reserved for SDO
0x701 to 0x77F	1793 to 1919	Node Guarding
0x760 to 0x7EF	1888 to 2031	reserved for NMT
0x7F0 to 0x7FF	2032 to 2047	reserved by CAL

The standard identifier allocation sets itself automatically if the inputs or outputs do not exceed the number of 16 bytes. Using normal I/O modules, this number is not exceeded. Only special modules such as an ASI master can lead to the limit value of 16 bytes input data or 16 bytes output data being exceeded.

If the number of 16 bytes is not exceeded, the identifier allocation is according to the CANopen specifications (CiA-DS301).

The identifiers of the PDO channels as well as for the SYNC object can be redefined in any way via the Object Dictionary.

Only the number of PDO channels (and thus also the corresponding identifiers) are activated as required by the I/O fitting.

Node-ID-independent Identifier Definitions

Object	Identifier	Direction
NMT	0	Transmit/Receive
SYNC	128 (CANopen) 100 (conforms with rho)	Receive

Node-ID-dependent Identifier Definitions

Object	Identifier	Direction
Emergency	128 + node ID	Transmit
NMT Node Guarding	1792 + node ID	Transmit/Receive
SDO	1408 + node ID	Transmit
SDO	1536 + node ID	Receive
PDO1	384 + node ID	Transmit
PDO2	640 + node ID	Transmit
PDO1	512 + node ID	Receive
PDO2	768 + node ID	Receive

Example: Set node ID = 4

Object	Identifier	Direction
Emergency	132	Transmit
NMT Node Guarding	1796	Transmit/Receive
SDO	1412	Transmit
SDO	1540	Receive
PDO1	388	Transmit
PDO2	644	Transmit
PDO1	516	Receive
PDO2	772	Receive

Extended Identifier Allocation (with Special Modules)

The extended identifier allocation sets itself automatically if the inputs or outputs exceed the number of 16 bytes.

Here, too, the identifier allocation is according to the CANopen specifications (CiA-DS301). In addition, the identifiers of the logically subsequent node ID are allocated.

That means that the logically highest node ID of 127 cannot be set at the module in this case. Furthermore, the logically subsequent node ID must not be physically present on the network.

The identifiers of the PDO channels as well as for the SYNC object can be redefined in any way via the Object Dictionary.

Only the number of PDO channels (and thus also the corresponding identifiers) are activated as required by the I/O configuration.

Node-ID-independent Identifier Definitions

Object	Identifier	Direction
NMT	0	Transmit/Receive
SYNC	128 (CANopen) 100 (conforms with rho)	Receive

Node-ID-dependent Identifier Definitions

Object	Identifier	Direction
Emergency	128 + node ID	Transmit
NMT Node Guarding	1792 + node ID	Transmit/Receive
SDO	1408 + node ID	Transmit
SDO	1536 + node ID	Receive
PDO1	384 + node ID	Transmit
PDO2	640 + node ID	Transmit
PDO3	384 + node ID + 1	Transmit
PDO4	640 + node ID + 1	Transmit
PDO1	512 + node ID	Receive
PDO2	768 + node ID	Receive
PDO3	512 + node ID + 1	Receive
PDO4	768 + node ID + 1	Receive

Example: set node ID = 4, 32 bytes inputs, 32 bytes outputs

Object	Identifier	Direction
Emergency	132	Transmit
NMT Node Guarding	1796	Transmit/Receive
SDO	1412	Transmit
SDO	1540	Receive
PDO1	388	Transmit
PDO2	644	Transmit
PDO3	389 1)	Transmit
PDO4	645 1)	Transmit
PDO1	516	Receive
PDO2	772	Receive
PDO3	517 1)	Receive
PDO4	773 1)	Receive

1) Allocation of the identifiers of the logically subsequent node

6.6.5 Setting Conforming with Bosch ’rho’

DIP switch S1 can be used to set up communications characteristics that conform to Bosch ’rho’ (SW8 = On). Here, the following properties are different to those of CANopen:

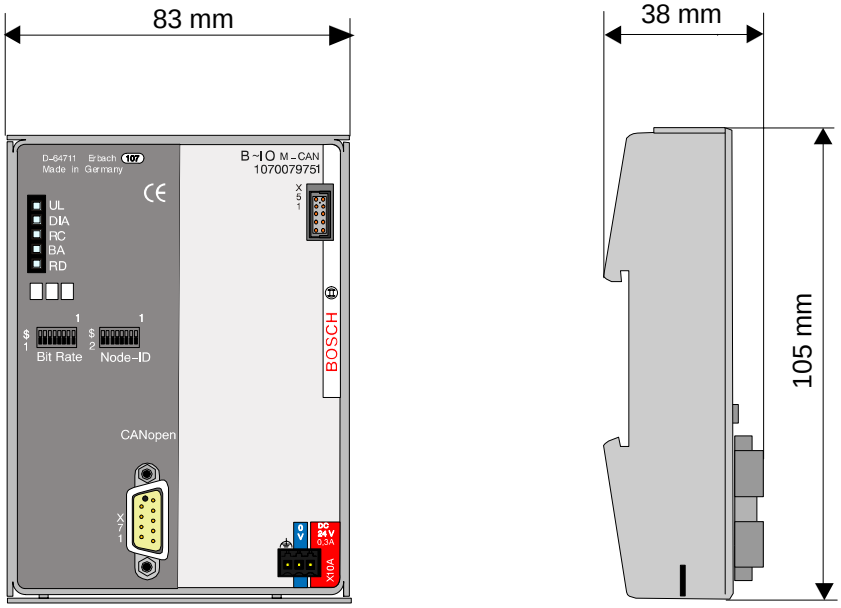
- All PDOs have been set as standard not to acyclical but to cyclical, synchronous data interchange.
- The SYNC message is not set to 128, but to 100.
- The SYNC message contains one data byte that is evaluated by the B~IO M-CAN:
  ’0’ in the first data byte —> initialisation phase
  ’1’ in the first data byte —> cyclical operation

The switch from ’Preoperational’ into ’Operational’ mode is automatic via the content of the first data byte of the SYNC message.

6.7 Range of Functions: Summary

Performance/Function	Features	Comments
Protocol-independent Functions		
Baud rates in kBaud	10, 20, 50, 125, 250, 500, 1000	
Max. input data	32 bytes	
Max. output data	32 bytes	
Channel diagnosis	yes	
Code diagnosis	yes	
Actual config. information	yes	Module-related
CANopen		
Asynchronous mode	yes	Individually configurable for each PDO
Synchronous mode	yes	Individually configurable for each PDO
Number SDO (transmit)	1	
Number SDO (receive)	1	
Number PDO (transmit)	4 (max.)	The PDOs can be configured is any way (asynchronous, synchronous, cyclical synchronous, acyclical synchronous, etc.) If more than 2 PDO channels are used, the logically subsequent module is also used for this node ID.
Number PDO (receive)	4 (max.)	The PDOs can be configured is any way (asynchronous, synchronous, cyclical synchronous, acyclical synchronous, etc.) If more than 2 PDO channels are used, the logically subsequent module is also used for this node ID.
Emergency Object	1	
Time stamp	no	not supported.
SYNC object	1	Only reception but not transmission of the SYNC object is supported.
NMT Service support	• Stop • Start • Disconnect • Enter Preoperational • Reset Node • Reset Communication	–
Default und Variables Mapping	yes	
Node Guarding	yes	
Simple Boot Up	yes	
Extended Boot Up	no	

6.8 Technical Data



Specifications	M-CAN
Order no.	1070 079 755
Power supply, as per EN 61131-2	24 V ; 19.2 to 30 V
Current draw from 24–V power supply	≤ 0.3 A
Power Supply • for CAN interface • for internal bus	 P5VISO / GNDISO 5 V ± 5 % RS485, electrically isolated Max. 500 mA, electrically isolated
Max. number of connected modules	16
Max. number of addressable bytes	• 32 Inputs • 32 Outputs • 65 Parameters • 33 Diagnostics • 16 Bytes module identifiers
Weight	Approx. 260 g

6.9 Spare Parts & Accessories

6.9.1 Connector Strip Assortments

The connector strip assortments comprise the connection between the machine wiring and the B~IO M-CAN module. Using the connector strip extractors, they can be removed quickly and with ease. This means that no individual wires have to be disconnected in order to exchange a B~IO M-CAN module.

Two different types of connector strips are available:

- Threaded terminals
- Spring clamp terminals.

The connector strip assortments consist of several single connector strips. Connector strip assortments for compact modules contain, besides the input and output connector strips, also the connector strips for the power supply.

The following conductors, with cross-sections as listed, can be connected:

- Threaded terminals
  - ”e” single-wire H05 (07) V-U 0.5 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 28 through 16
  - Strip length 7 mm
- Spring clamp terminals
  - ”e” single-wire H05 (07) V-U 0.08 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 24 through 16
  - Strip length 7 mm

)* not permitted with plastic collar DIN 46228/4. Shape A; crimping shape of the crimping tools for AEH PZ 1.5 or PZ 6.5.

Connector Strip Assortment

Designation	Order no.	Connector Type
BL-SET-SA-BUSANS.-M	1070 080 344	• Threaded terminal
BL-SET-FK-BUSANS.-M	1070 080 351	• Spring clamp terminal

6.9.2 Electronic Data Sheet (EDS)

The available EDS files for B~IO M-CAN (see section 6.4.4) are included in the following floppy disk.

Designation	Order no.
Device Specification Files, Floppy Disk 3 1/2”	1070 075 547

Furthermore, the EDS files are available on the Internet:

- Bosch Rexroth homepage: http://www.boschrexroth.de; continue with ”Electric Drives and Controls”

6.9.3 Module Plug Connector

Designation	Order no.
FL line, 12-conductor	1070 079 782
Module Plug Connector, long, for dual row assembly	1070 084 071

6.9.4 Bus Connector Accessories

Bus connector, CANopen

Designation	Order no.
Bus connector CANopen, 9-pin, black, without terminating resistor	1070 919 029
Bus connector CANopen, 9-pin, green, with terminating resistor	1070 919 030

Bus cable, CANopen

Designation	Order no.
Bus cable CANopen, for flexible use and for fixed wiring LI2YCY (TP)	1070 919 189

7 Bus Connector with DeviceNet

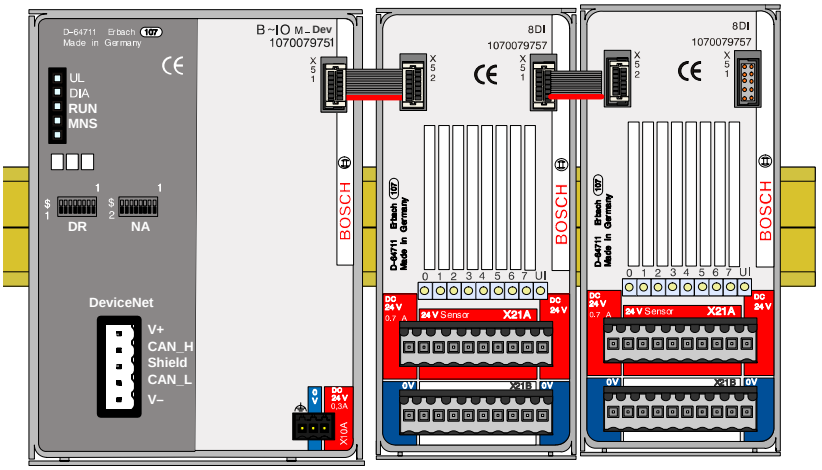
7.1 Structure

B~IO M-DEV is a field bus connector for DeviceNet based on DeviceNet specifications of the Open DeviceNet Association (ODVA). It can be extended using various I/O modules into a complete DeviceNet slave.

The bus connector has a permanent connection to the higher level control system via the field bus DeviceNet.

- It receives the current switching signals from the inputs and makes them available to the higher level control system for processing via DeviceNet.
- It receives the output signals from the higher level control system via DeviceNet and passes these on to the outputs.

The following example shows a B~IO M-DEV bus connector with two I/O modules:



7.2 Standards and References

OSI Reference Model

The DeviceNet communication model takes its orientation from the ISO/OSI reference model: ISO 7498, 1984, Information Processing Systems – Open System Interconnection – Basic Reference Model.

CAN

The lower layers of the reference model are based on the Controller Area Network (CAN):

- Robert Bosch GmbH, CAN Specification 2.0 Part B, September 1991
- ISO 11898, November 1993, Road Vehicles, Interchange of Digital Information – Controller Area Network (CAN) for high-speed Communication.

DeviceNet Specifications and Guidelines

All the data and guidelines regarding DeviceNet can be found in the Open DeviceNet Association (ODVA) specifications:

- DeviceNet Specification Volume I, Release 2.0
- DeviceNet Communication Model and Protocol
- DeviceNet Specification Volume II, Release 2.0
- DeviceNet Device Profiles and Object Library.

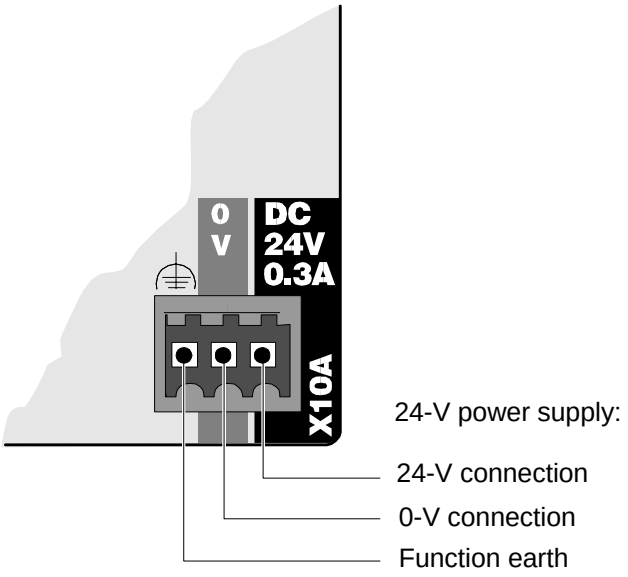
7.3 Connections

7.3.1 24-V Power Supply (X10A)

The bus connector requires a 24-V power supply.

The 24-V power supply is for the electrically separated supply of:

- DeviceNet interface,
- the logic of the connected I/O modules.



7.3.2 DeviceNet

Connection to the DeviceNet bus system is by means of a 5-pin connector in accordance with DeviceNet specification (Pluggable Open Connector).

The connection allocation corresponds to the DeviceNet standard: DeviceNet Specification Volume I, Release 2.0.

Connection Allocation

Pin no.	Signal	Meaning
1	V–	GND bus power supply
2	CAN–	Bus cable CAN_L (dominant low)
3	Shield	Shield
4	CAN+	Bus cable CAN_H (dominant high)
5	V+	Bus power supply 24 V

7.4 DeviceNet Configuration

7.4.1 Baud Rate (Switch S1)

The baud rate of the B~IO M-DEV bus connector is set using DIP switch S1.

DIP switch S1:

SW8	SW7	SW6	SW5	SW4	**SW3**	**SW2**	**SW1**

SW = Switch

SW3..SW1 Baud rate

SW8..SW4 Reserved

Baud rate	SW3	SW2	SW1	Max. cable length	Comments
1Mbit/s	on	on	on		reserved
–	on	on	off		reserved
500 Kbit/s	on	off	on	100 m	
250 Kbit/s	on	off	off	250 m	
125 Kbit/s	off	on	on	500 m	
50 Kbit/s	off	on	off		reserved
20 Kbit/s	off	off	on		reserved
10 Kbit/s	off	off	off		reserved

☞ **The set baud rate is read once again during 'power on' or after a 'Reset Node' service of the bus module B~IO M-DEV. This means that a change to the baud rate during operation only takes effect after one of these events.**

MAC-ID (Switch S2)

Each bus connector on the DeviceNet must be allocated its own MAC ID.

Each MAC ID may only be allocated once in the entire DeviceNet.

The MAC-ID 0..63 of the B~IO M-DEV bus connector is set using DIP switch S2.

DIP switch S2:

SW8	SW7	**SW6**	**SW5**	**SW4**	**SW3**	**SW2**	**SW1**

SW = Switch

SW6..SW1 MAC-ID (0..63)

SW7,SW8 Reserved

MAC-ID	SW6	SW5	SW4	SW3	SW2	SW1
0	off	off	off	off	off	off
1	off	off	off	off	off	on
2	off	off	off	off	on	off
3	off	off	off	off	on	on
4	off	off	off	on	off	off
...						
63	on	on	on	on	on	on

☞ **The set MAC ID is read once again during ’power on’ or after a ’Reset Node’ service of the bus module B~IO M-DEV. This means that a change to the MAC ID during operation only takes effect after one of these events.**

The MAC ID can be noted in the lettering field on the front panel.

7.5 Displays and Error Messages

7.5.1 Displays

The operating modes of the B~IO M-DEV bus connector are indicated by 4 light-emitting diodes (LEDs):

Name	LED	Meaning
UL	green	24-V power supply of X10.1 is OK
	off	24-V power supply is defective
DIA	off	normal operation
	red	no processing, diagnosis or system halt
RUN	green	normal operation
	off	error
MNS	green	bus error-free
	red	bus error (baud rate, bus node address, bus cable) or initialisation phase at the DeviceNet

7.5.2 Error Messages

Light-emitting Diodes					Meaning
UL green	DIA red	RUN green	MNS green	MNS red	
●	○	●	●	○	Normal operation, no error display
○					No 24-V power supply present
●●					The bus connector is held by one or more I/O modules in the initialisation phase
●●●●	○				System halt, incorrect configuration, check I/O configuration
	●				One or more I/O modules report diagnosis
●	●●				System halt, unknown I/O module
●/○	●●●●				System halt, firmware error
●●●●	●●●●				System halt, hardware error
●		○	○	○	Module comes to a halt in initialisation mode after power on. Possible cause: 24-V power supply via CAN bus missing.
			●		Module online at bus, communication links are set up
			●●●		Module online at bus; **no** communication links are set up
				●	Critical error – BUSOFF – Error 'duplicate MAC-ID' (in conjunction with RUN LED)
				●●●	Reparable error: watchdog error I/O connection
		●●●●			24-V power supply via CAN bus missing or duplicate MAC-ID error

Explanations:

○	LED remains dark
●	LED illuminates
●●	Slow flashing of LED, e.g. 0.8 s ON / 0.2 s OFF
●●●	Medium flashing of LED, e.g. 0.5 s ON / 0.5 s OFF
●●●●	Rapid flashing of LED, e.g. 0.125 s ON / 0.125 s OFF
	Display has no significance

System Halt

The state 'system halt' of the bus connector is indicated by the two light-emitting diodes **'UL'** and **'DIA'.** At system halt, the outputs are set to a safe state ('0') and bus traffic to the DeviceNet master is interrupted. The system halt can only be exited by means of a restart of the assembly ('power on').

System halt, 'unknown I/O module'

The B~IO M-DEV bus connector has detected an I/O module that is not supported by the firmware version of the B~IO M-DEV bus connector.

- For the operation of the I/O module, the firmware has to be updated.
- If the error occurs with the latest version of the B~IO-M-DEV firmware, there is a hardware error on the I/O module.

System halt 'Incorrect configuration'

The following I/O configurations lead to a system halt due to an incorrect configuration:

- No I/O modules in configuration
- More than 16 I/O modules in configuration
- More than 32 bytes inputs configured
- More than 32 bytes outputs configured
- The total of the parameter data of all modules is greater than 65 bytes
- The total of the diagnostic data of all modules is greater than 33 bytes.

Exceptional Error, Hardware (HW)

On powering up ('power on') the bus connector, the hardware components are tested. Furthermore, during the cyclical operation, the I/O configuration and interchange quality to the I/O modules is monitored. In the event of an error, the assembly is placed on system halt 'Exceptional error, HW'.

Exceptional Error, Firmware (FW)

While the firmware is running, plausibility checks are carried out continuously. If an error is detected, the assembly is placed on system halt 'Exceptional error, FW'.

7.6 Operating Characteristics

The characteristics of the B~IO M-DEV bus connector are dependent on the CAN and DeviceNet properties and from the configuration of the I/O modules.

As a *Group 2 Only Server*, the module B~IO M-DEV supports the *Predefined Master Slave Connection Set* according to *DeviceNet Specification Volume I, Release 2.0.*

7.6.1 Startup Characteristics

Characteristics of the assembly after 'Power On'

After the assembly has been switched on (24-V power supply has been applied), the hardware components are tested. If errors are detected, the assembly B~IO M-DEV is placed on system halt.

After the startup test has been successfully completed, the B~IO M-DEV bus connector determines its own I/O module configuration and uses it to create an actual configuration list.

The CAN controller is then initialised according to the DIP switch settings.

The initialisation phase is concluded by a *duplicate MAC ID check* according to DeviceNet specification. Here, a check is run as to whether a second device with the same MAC ID is on the bus.

It is not permitted to disconnect or connect an I/O module during operation; this leads to a system halt.

Creating the Actual Configuration List

After 'power on', the B~IO-M-DEV bus connector determines its own I/O module configuration and uses it to create an actual configuration list.

Defective configurations (e.g. no I/O modules in configuration) are displayed by means of the light-emitting diodes 'UL' and 'DIA' and the bus connector is placed in system halt (see chapter 7.5.2.).

The actual configuration list can be read out by means of an explicit messaging protocol.

☞ **Analog input modules should not be activated with 'Change of State' (COS). The modules should be activated with 'Poll Cyclic' or 'Bit Strobe'.**

7.6.2 DeviceNet Objects

Identity Object (Class 1)

Class and Instance Attributes:

Object Class (HEX)	Object Instance (HEX)	Object Attribute (HEX)	Object Description
1	0	1	**Revision** Revision of the identity object
1	1	1	**Vendor ID** 0xFF (hex) Robert Bosch GmbH
		2	**Product Type** 0x00 (hex) Generic Device
		3	**Product Code** 2
		4	**Revision** Revision of the B~IO M-DEV product
		5	**Status** Cumulative device status (bit coding according to DeviceNet specification)
		6	**Serial Number** In conjunction with the vendor ID a unique serial no.
		7	**Product Name** ”B~IO M-DEV DeviceNet Slave”

Supported Common Services:

Service Code	Service Name
0x05	Reset
0x0E	Get Attribute Single

☞ **Class 1, Instance 1, attributes 0 for reset service.**

The device is reset by this service.

All communication links are broken. The DIP switches (node ID and baud rate) are read in once again and the CAN controller is reinitialised accordingly.

Message Router Object (Class 2)

No attributes are supported for this object.

DeviceNet Object (Class 3)

Class and Instance Attributes:

Object Class (HEX)	Object Instance (HEX)	Object Attribute	Object Description
3	0	1	**Revision** Revision of the DeviceNet object
3	1	1	**MAC ID** MAC ID of the activated node
		2	**Baud Rate** Code of the set baud rate
		3	**BOI** Support for the Bus Off Interrupt
		4	**Bus-Off Counter** Number of Bus Off events
		5	**Allocation Information** Information on the active connections of the Predefined Master/ Slave Connection Set.

Supported Common Services:

Service Code	Service Name
0x0E	Get Attribute Single

Supported Object Specific Services:

Service Code	Service Name
0x4B	Allocate Master/Slave Connection Set
0x4C	Release Master/Slave Connection Set

Assembly Object (Class 4)

Class and Instance Attributes:

Object Class (HEX)	Object Instance (HEX)	Object Attribute (HEX)	Object Description
4	0	1	**Revision** Revision of the DeviceNet object
		2	**Max Instance** Max. number of instances for this object
4	x	3	**Assembly Object 1** Data of the objects to be transmitted
4	y	3	**Assembly Object 2** Data of the objects to be received

The following object instances result:

Number of producing data bytes	Assembly Object Instance x	Number of consuming data bytes	Assembly Object Instance y
1	4	1	34 (22 hex)
2	5	2	35 (23 hex)
4	6	4	36 (24 hex)
Other number	7	Other number	37 (25 hex)

Supported Common Services:

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

The assembly object is configured automatically depending on how the B~IO M-DEV system is equipped. The input/output bytes are mapped in the assembly object in the same order as the modules are equipped.

The diagnostic status of the B~IO M-DEV can be mapped according to the input data (see: Module Control Register). The inputs remain in the same position.

Connection Object (Class 5)

Class and Instance Attributes:

Object Class (HEX)	Object Instance	Object Attribute	Object Description
5	0	1	**Revision** Revision of the connection object
5	x	1	**State** Status of the connection
		2	**Instance Type** Type of connection (either I/O or messaging)
		3	**TransportClass_trigger** Defined the characteristics of the connection
		4	**Produced_Connection_ID** CAN identifier of the transmission connection
		5	**Consumed_Connection_ID** CAN identifier of the reception connection
		6	**Initial_Comm_Characteristics** Defines the message group(s) of this connection
		7	**Produced_Connection_Size** Maximum number of bytes that can be transmitted via this connection.
		8	**Consumed_Connection_Size** Maximum number of bytes that can be received via this connection.
		9	**Expected_Packet_Rate** Defines the times for inactivity and watchdog of this connection.
		12	**Watchdog_Timeout_action** Defines how the inactivity and watchdog events are to be treated.
		13	**Produced_Connection_Path_Length** Number of bytes in the ”Produced_Connection_Path” attributes
		14	**Produced_Connection_Path** Specifies the application object(s) whose data is transmitted across this connection.
		15	**Consumed_Connection_Path_Length** Number of bytes in the ”Consumed_Connection_Path” attributes
		16	**Consumed_Connection_Path** Specifies the application object(s) whose data is received across this connection.

In the previous table, X is defined as follows:

x	Connection Type
1	Explicit Messaging Connection
2	Poll I/O Connection
3	Bit Strobe I/O Connection
4	COS/ Cyclic I/O Connection
5	Reserved

Supported Class Services:

Service Code	Service Name
0x08	Create

Supported Common Services:

Service Code	Service Name
0x0D	Apply Attributes
0x0E	Get Attribute Single
0x10	Set Attribute Single

Discrete Input Point (Class 8)

Class and Instance Attributes:

Object Class (HEX)	Object Instance	Object Attribute	Object Description
8	0	1	**Revision** Revision of the DeviceNet object
		2	**Max Instance** Maximum number of instances of this object

The value of the attribute ”Max Instance” reflects the number of input points. This value is always a multiple of 8. When the diagnostic status is activated, in addition to the number of input points 1 byte (8 points) is to be added to the value of the attribute.

Supported services:

Service Code	Service Name
0x0E	Get Attribute Single

Discrete Output Point (Class 9)

Class and Instance Attributes:

Object Class (HEX)	Object Instance	Object Attribute	Object Description
9	0	1	**Revision** Revision of the DeviceNet object
		2	**Max Instance** Maximum number of instances of this object

The value of the attribute ”Max Instance” reflects the number of output points. This value is always a multiple of 8.

Supported services:

Service Code	Service Name
0x0E	Get Attribute Single

7.6.3 Manufacturer-specific Objects

I/O Data Object (Class 100)

Class and Instance Attributes:

Object Class (HEX)	Object Instance	Object Attribute	Object Description
100	0	1	**Revision** Revision of the I/O data object
		2	**Max. Instance** Maximum number of instances of the I/O data object
100	1	100	**Number of Inputs** Number of input bytes
		101	**Number of Outputs** Number of output bytes
		102	**Input Data** Input data as an entire stream
		103	**Output Data** Output data as an entire stream
100	2	100 + i	**Input Data (Byte)** Input data as single byte i=0 (byte 0 of input data) i=1 (byte 1 of input data) etc.
100	3	100 + i	**Output Data (Byte)** Output data as single byte i=0 (byte 0 of output data) i=1 (byte 1 of input data) etc.
100	4	100 + i	**Input Data (Word)** Input data as single word i=0 (word 0 of input data) i=1 (word 1 of input data) etc.
100	5	100 + i	**Output Data (Word)** Output data as single word i=0 (word 0 of output data) i=1 (word 1 of output data) etc.

Supported Common Services:

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Status Object (Class 101)

Class and Instance Attributes:

Object Class (HEX)	Object Instance	Object Attribute	Object Description
101	0	1	**Revision** Revision of the status and diagnostic objects
		2	**Max. Instance** Maximum number of instances of the status and diagnostic object
101	1	100	**Manufacturer Status Register** Status of the B~IO M-DEV system
		101	**Module Serial Number** Individual serial number of the module
101	2	100	**Diagnostic Data Length** Length of the diagnostic data
		101	**Diagnostic Status** Diagnostic status
		110	**Diagnostic Data** Diagnostic data (DP format) max. 33 bytes
101	3	100	**Configuration Length** Length of the configuration information in bytes (= number of detected modules)
		150	**Configuration Data** Max. 16 bytes

Supported Common Services:

Service Code	Service Name
0x0E	Get Attribute Single

Module and Diagnostic Control Object (Class 102)

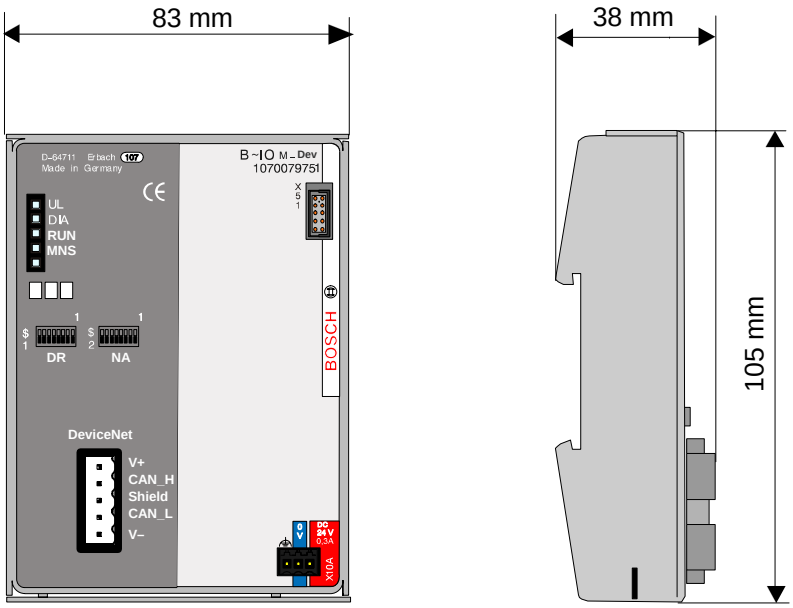
Class and Instance Attributes:

Object Class	Object Instance	Object Attribute	Object Description
102	0	1	**Revision** Revision of the modules and diagnostic control objects
		2	**Max. Instance** Maximum number of instances modules and diagnostic control objects
102	1	100	**Module Control Register** B~IO M-DEV control byte
102	2	100	**Parameter Data Length** Number of parameter data of the B~IO M-DEV.
		101	**Parameter Data** Device and module parameter data as entire stream, max. 65 bytes.
		102	**Device Parameter Data** 1 byte device parameters. This can be use to activate or deactivate the diagnosis.

Supported Common Services:

Service Code	Service Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

7.7 Technical Data



Specifications	M-DEV
Order no.	1070 079 950
Power supply, as per EN 61131-2	24 V ; 19.2 to 30 V
Current draw from 24 V power supply	≤ 0.3 A
Power supply ● for DeviceNet interface ● For internal bus	 DeviceNet interface is supplied via the bus, as per ODVA DeviceNet specification Release 2.0, Volume 1, I_V up to 50 mA. RS485, electrically isolated Max. 500 mA, electrically isolated
Max. number of connected modules	16
Max. number of addressable bytes	● 32 Inputs ● 32 Outputs ● 65 Parameters ● 33 Diagnostics ● 16 Bytes module identifiers
Weight	Approx. 260 g

7.8 Spare Parts & Accessories

7.8.1 Connector Strip Assortments

The connector strip assortments comprise the connection between the machine wiring and the B~IO M-DEV module. Using the connector strip extractors, they can be removed quickly and with ease. This means that no individual wires have to be disconnected in order to exchange a B~IO M-DEV module.

Two different types of connector strip are available:

- Threaded terminals
- Spring clamp terminals.

The connector strip assortments consist of several single connector strips. Connector strip assortments for compact modules contain, besides the input and output connector strips, also the connector strips for the power supply.

The following conductors, with cross-sections as listed, can be connected:

- Threaded terminals
  - ”e” single-wire H05 (07) V-U 0.5 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 28 through 16
  - Strip length 7 mm
- Spring clamp terminals
  - ”e” single-wire H05 (07) V-U 0.08 through 1.5 mm^2
  - ”f” filament wire H05 (07) V-K 0.5 through 1.5 mm^2
  - ”f” with wire-end ferrule, DIN 46228/1 0.5 through 1.5 mm^2)*
  - AWG conductor sizes 24 through 16
  - Strip length 7 mm

)* not permitted with plastic collar DIN 46228/4. Shape A; crimping shape of the crimping tools for AEH PZ 1.5 or PZ 6.5.

Connector strip assortment

Designation	Order no.	Connector Type
BL-SET-SA-BUSANS.-M	1070 080 344	• Threaded terminal
BL-SET-FK-BUSANS.-M	1070 080 351	• Spring clamp terminal

7.8.2 Electronic Data Sheet (EDS)

The EDS file is an ASCII file specified by the CiA, describing the objects of a CANopen device. The EDS file can be read in certain CANopen configuration tools (e.g. Nodemaster, configuration tool from Vektor, etc.). This provides the user with a convenient project design solution.
The following EDS files for B~IO-M-DEV modules are available:

EDS file	Index
RB01BM00.EDS	101
RB02BM00.EDS	104

As of index 104 (firmware version V1.2), a few OD objects have been added. These are contained in the newer EDS file version (RB02BM00.EDS).

The EDS files available for B~IO M-DEV are on the following floppy disk:

Designation	Order no.
Device Specification Files, Floppy Disk 3 1/2”	1070 075 547

Furthermore, the EDS files are available on the Internet:

- Bosch Rexroth home page: http://www.boschrexroth.de; continue with ”Electric Drives and Controls”

7.8.3 Module Plug Connector

Designation	Order no.
FL line, 12-conductor	1070 079 782
Module Plug Connector, long, for dual row assembly	1070 084 071

7.8.4 Bus Connector Accessories

Bus Connector, DeviceNet

Designation	Order no.
Bus Connector DeviceNet	1070 910 731

8 Installation Guidelines

On setting up a system in which electrical equipment such as control systems are deployed, the following regulations must always be complied with:

- DIN VDE 0100
- EN 60 204-1
- EN 50 178

DANGER

Hazard to persons and property!

- **Dangerous states of the system that can lead to personal injury or damage to property must be prevented!**
- **The regulations for the setup of EMERGENCY STOP devices in accordance with EN 60 204-1 must be observed!**
- **It must be excluded that machines start up of their own accord after reconnection of the mains voltage, e.g. following an EMERGENCY STOP!**
- **Protection against direct and indirect contact must be ensured by the prescribed measures (connection with protective earth, insulation, etc.)!**

8.1 Power Connection

The power connection must be equipped with safe isolation complying with EN 50 178, section 5.2.18.1. Transformers with safe isolation must be designed complying with EN 60 742.

The 24 V power supply is then regarded as extra-low voltage with safe isolation complying with EN 50 178, section 5.2.8.1. It can be designed either as safety extra-low voltage (SELV) without earthing of the reference lead or as protective extra-low voltage (PELV) with earthing of the reference lead.

A 3-phase power connection with simple full-bridge rectification is adequate. The superimposed AC voltage proportion must not exceed 5 %.

All cables of the 24 V power supply must

- be laid separate from cables with higher voltages or
- be specially insulated, whereby the insulation must be designed for the highest occurring voltage, see EN 60 204-1: 1997, section 14.1.3.

The isolated supply of output supplies means that these, for example in the event of EMERGENCY STOP, can be deactivated byte by byte. This means that the inputs and the outputs not assigned to the EMERGENCY STOP circuit remain functional.

☞ **All peripheral devices such as digital sensors/actuators or other bus connections connected to the interfaces of the I/O modules must also meet the criteria of safe isolation from power circuits.**

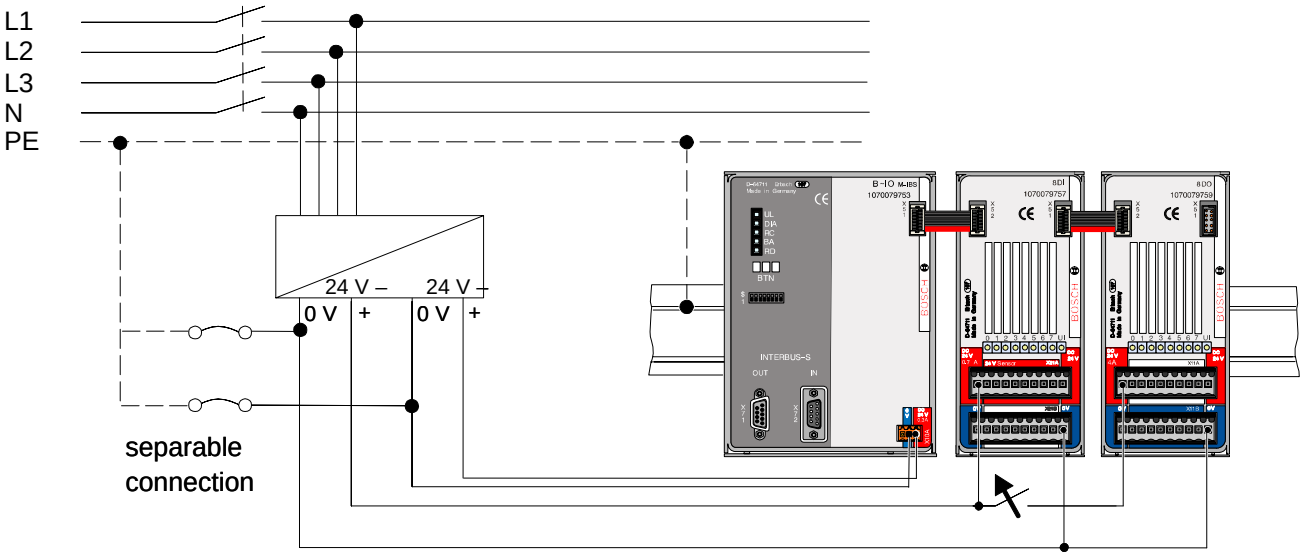
8.2 24-V Power Supply

There are two connection options for the 24-V power supply of the bus connection modules:

- Reference lead connected to the protective earth, see item 8.2.1.
- Reference lead not connected to the protective earth, see item 8.2.2.

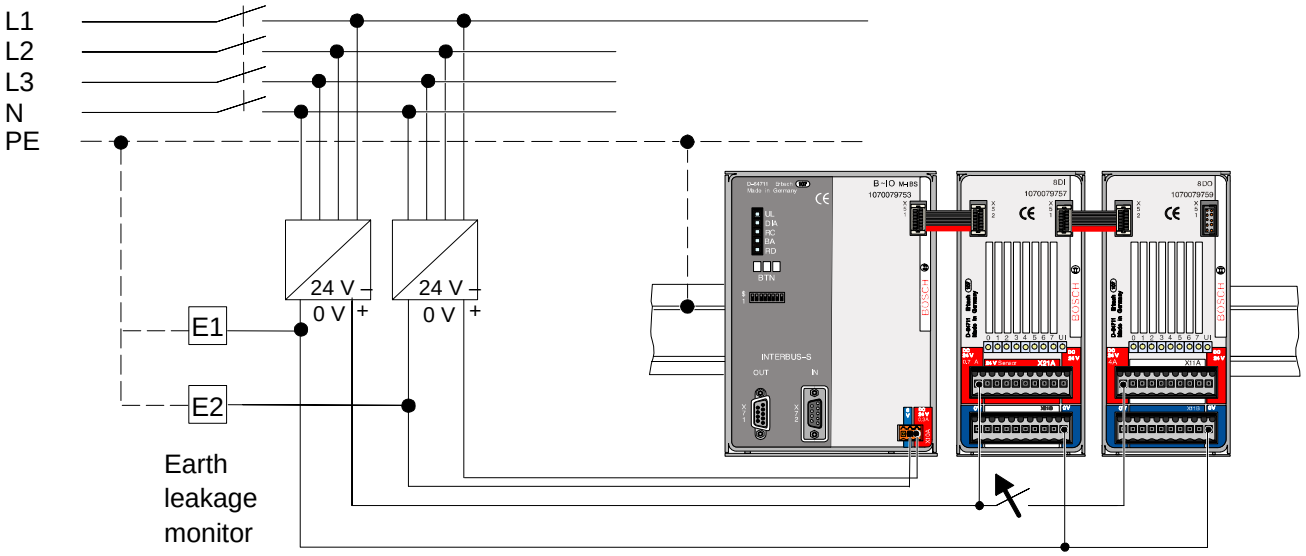
8.2.1 Reference Lead Connected to the Protective Earth

If the reference lead (N, 0 V) is connected to the protective earth system, this connection must be arranged at a central position, e.g. at the load power connection or the isolating transformer, and it must be separable for measurement of earth currents. This type of connection is to be used where possible. The supply circuit is thus a PELV circuit, see also section 8.1.



8.2.2 Reference Lead Not Connected to the Protective Earth

If the reference lead (N, 0 V) is not connected to the protective earth system, a corresponding earth fault monitoring device must be deployed to detect earth faults in order to avoid inadvertent activation in the case of insulation faults. The supply circuit is thus a SELV circuit, see also section 8.1. Please note that other connected resources can nullify the earth-free layout.



8.2.3 Capacitive Load of the Power Supply

Capacitances are installed in the bus connection modules between the supply leads and protective earth for interference suppression. This is to be taken into account if an earth fault monitoring device is deployed.

Module	Order number	Capacitance 24 V → PE	Capacitance 0 V → PE
B~IO M-DP	1070 079 751	5 nF	5 nF
B~IO M-IBS	1070 079 753	5 nF	5 nF
B~IO M-CAN	1070 079 755	5 nF	5 nF
B~IO M-DEV	1070 079 950	5 nF	5 nF

8.2.4 Dimensioning of the Power Supply

When dimensioning the power supply, the maximum currents are to be taken into account, see VDE 0100-523. Directly at the device, there must be a voltage of 24 V (+ 20 %, – 15 %).

The voltage must also be retained in the case of

- fluctuations in the mains voltage, e.g. caused by varying loads on the power supply
- different load states, e.g. short-circuit, normal load, lamp load or idling.

The maximum cable cross-section for the power supply of bus connection modules is 1.5 mm^2.

8.2.5 Master Switch

A master switch complying with VDE 0100 must be fitted for modules, sensors and actuators.

8.2.6 Fuses

Fuses and cable circuit breakers are used to protect the supply leads in a network. The cables of the power supply for bus connection modules must be secured with fuses/circuit breakers. Here, the supply of sensors and actuators should be secured separately with fuses/circuit breakers. If the supply leads for sub-distribution are shorter than 3 m, and installed so that they are secured against earth faults and short circuits, the fuses/circuit breakers for these leads can be omitted.

In choosing fuses/circuit breakers, a large number of criteria must be considered. The most important aspect is the rated current of the circuit to be protected, see also VDE 0100-430. The rated current determines the cable cross-section, see VDE 0100-523.

Other criteria regarding the selection of fuses/circuit breakers include:

- Rated voltage
- Temperature
- Internal resistance of the fuses
- Activation currents
- Cable lengths
- Pre-impedance of the power supply
- Possible defect location
- Vibrations

Other information, see:

Manual no. 32
VDE publications
Rating and protection of leads and cable complying with DIN 57 100, VDE 0100-430 and -523.

In addition, many manufacturers of fuses and circuit breakers offer appropriate information.

8.2.7 Earthing

Function earthing

The bus connection modules must be fitted on a metallic, earthed support, e.g. rear panel of switching cabinet.
Installation is on 35 x 7.5 mm support rails complying with EN 50 022. The support rail must be earthed, whereby any chrome coating or similar at the connection point must be removed.

For optimum interference immunity, function earthing is required. The function earthing must be connected across a cable that is as short as possible, or better an earthing strap.

Guide value:	Cable length	max. 1 m
	Cross-section	6 mm^2

If low interference levels are to be expected, function earthing via the earth contacts of the power supply connections is also possible.

Guide value:	Cable length	max. 0.5 m
	Cross-section	1.5 mm^2

Potential equalization

Between the system components and the power supply, potential equalization in accordance with VDE 0100 Part 540 must be ensured.

8.3 Electromagnetic Compatibility

The electromagnetic compatibility (EMC) is the capability of an electrical unit to operate satisfactorily in its electromagnetic environment without influencing this environment, to which other units belong, to more than a permitted degree (EN 61 000-4-1).

8.3.1 Interference

An important aim in automation technology is to achieve the greatest possible level of system availability. For this reason, there is a strong interest in avoiding standstill times due to interference.

Possible sources of interference for the user are:

- self-generated interference, e.g. by frequency converter, inductive loads etc.
- externally generated interference, e.g. lightning discharge, mains fluctuations etc.

These sources of interference affect the device, the interference trough, in different ways. The main interaction paths of the interference are:

- emitted interference interaction
- conducted interference interaction
- electrostatic discharges

Conducted interference can change into emitted interference and vice versa. For example, the conducted interference on a cable causes a field which emits onto a cable fitted in parallel and also causes conducted interference.

8.3.2 Signal-to-Interference Ratio

The signal-to-interference ratio is the ability of a device or component to tolerate interference up to a certain level without restriction. Electronic units such as control units have a significantly lower signal-to-interference ratio than other electrical equipment, e.g. contactors.

8.3.3 EMC Legislation and CE Identification

As a whole, the system must meet certain minimum requirements as regards interference immunity. The system manufacturer or seller of the overall machine is responsible for complying with these specifications. This is specified by the EMC legislation based on the EMC Directive of the Council of Europe.

The minimum requirements to comply with EMC legislation is specified in product (family) standards. If these standards do not exist, basic technical standards are applied. Conformity with the corresponding regulations is indicated by attachment of the CE identification.

The CE identification indicates conformity with all the relevant directives of the Council of Europe. However, it is not a seal of approval, and does not guarantee any properties; it is only intended for the monitoring authorities.

Depending on the product and area of application, a number of directives can be relevant. In addition, the manufacturer must draw up a corresponding declaration of conformity, which must be made available to the authorities on request.

Conformity is usually evidenced by standard tests, described in the so-called base standards, e.g. in EN 61 000-4-x = VDE 0847-4-x. However, to ensure interference immunity on site, the user must also adhere to the installation conditions specified by the manufacturer.

On setting up the system or machine, the EMC Directive, the Low Voltage Directive, the Machine Directive and possibly other directives relating to special types of system must be observed.

8.3.4 EMC Characteristics of Bus Connection Modules

The bus connection modules already meet the EMC requirements from the relevant standards (see descriptions of the individual assemblies or specifications).

Compliance with standards has been tested on certain system configurations. However, this fact certainly does not mean that the required electromagnetic compatibility of the system is ensured in every configuration. Responsibility for the overall system lies with the system/plant manufacturer alone.

Adequate electromagnetic compatibility can only be achieved with conscientious adherence to the installation guidelines. It is only when this condition is met that it can be assumed that an entire system composed of units – each with their own CE identification – will comply with the aims for protection in the Council of Europe directive.

A comprehensive summary of the application of the directive is provided by the publication 'Guidelines on the application of Council Directive 89/336/EEC of May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility', issued on 23 May 1997 by the European Commission. A German translation is available from the regulating authority for telecommunications and post, RegTP, and the Central Association of the Electrical and Electronics Industry, ZVEI.

Test of transient overvoltages (surge)

The appendix of the technical base standard EN 50 082-2, which is currently not part of the standard, contains a description of the surge test for direct current supplies and interfaces used for process control. This test is significant if cables exit from the building, e.g. danger of lightning, or are linked to power cables with interference.

Under the following conditions, the requirements of a system with I/O modules can be met:

- All power supplies of the control must be equipped with external varistor modules (e.g. Phoenix MODUTRAB VAR/3S-24AC) or with overvoltage protection modules.
- All digital inputs and outputs to be protected must be fitted with overvoltage protection terminals (e.g. Phoenix TERMITRAB SLKK 5/24DC, TERMITRAB UK5/24V or corresponding modules from the MODUTRAB range).

Emissions, radio interference

Bus connection modules meet the technical base standard EN 50 081-2 that specify the limit values for interference emissions. This standard only applies to use in the industrial area. In contrast to a residential area, the industrial area is characterized by the following specifications:

- no connection to the public low voltage power supply
- existence of a separate high-voltage or medium-voltage transformer
- operation in industrial environments or in the immediate vicinity of industrial supply networks

The expression 'industrial area' has nothing to do with the legal division (in part, specifically German) between industrial and residential areas.

The limit values for use in industry are higher than those for use in residential areas. For this reason, the user must implement additional measures if the system is to be used in residential areas:

- Installation of the system in a switch cabinet or a housing with high transmission loss shielding.
- An I/O system usually has a large number of peripheral interfaces. These are the major path for the emission of radio interference. To comply with the reduced emission values, all cables that exit from the shielded area must be fitted with filters and shielding.

For systems in residential areas (residential, office and commercial areas, small enterprises), specific approval must be obtained from authorities or inspection bodies. In Germany, this specific approval is given by the regulating authority for telecommunications and post, RegTP, and local bureaus.

Protection against electrostatic discharges

All modules contain components that can be destroyed by electrostatic discharges (ESD). A defective assembly will not necessarily be recognizable immediately, but can become apparent in the form of occasional or delayed failures.

The relevant measures for handling electronic components and assemblies must be observed without fail. In particular, it is not permitted to connect or disconnect plugs under voltage. Before an assembly is touched directly, the person involved must be electrostatically discharged.

8.3.5 Installation Measures to Ensure Interference Immunity

As a general principle, prevention and rectification of interference at the source have priority. In this connection, the following points must be noted:

Earthing

To draw off interference potentials that take effect between the device and the reference earth, the device housing must be connected to earth by a low-impedance connection. Especially in the case impulse interference with rise times in the nanosecond range, the very inductive lining of simple cables inhibits the distributed leakage of interference to a considerable extent. Earthing straps have considerably better high-frequency characteristics and should therefore definitely be used.

Shielding

A significant source of interference results from magnetic or electrical interaction. Interactions can be avoided by adequate shielding and spatial separation. This means that it is a requirement that potentially interfering components (e.g. power supply and motor cables, contactors, frequency converters, etc.) are installed isolated or shielded from components with low signal-to-interference ratios (e.g. signal circuitry, electronic controls).

This systematic spatial separation of potential sources of interference and interference troughs as early as the planning phase of a system is the cheapest way to maximize the interference immunity of the system.

Deployment of transformers with shielded coils is preferred, as these produce very good damping of the interference in the higher voltage level.

Twisting

Mainly in the data lines, but also in the power supply lines, the technique of twisting in pairs is used. The close intermingling of the wires means that interference voltages caused by interaction between the wires cannot occur.

It is important that the twisted cable consists of a two-way line, i.e. that the flowing currents add up to zero. This is the case with many data interchange processes, but also as a rule with power supplies.

Parallel laying of data lines and power cables with interference

A close parallel installation of data lines or input/output lines and interfering cables such as motor cables or leads to contactors with poor interference suppression must be avoided. The smaller the spacing between the parallel installed cables, the greater the interacting interference.

In cable ducts and switch cabinets, cables and data lines must be arranged at the greatest possible distance to one another, spacing of at least 10 cm and preferably in separate, shielded chambers. Data lines to be crossed by power lines at an angle of 90°.

Interference suppression of inductive loads

In general, most control outputs limit inductive deactivation peaks to a level that causes no problems by means of built-in terminal diodes. This also applies to the output modules which interact with the bus connection modules.

However, the occurrence of a cable break, pulling put a connector for inductive load, e.g. valves, lamps or contactors etc.) or the deliberate deactivation by means of a mechanical contact lead to very high interference levels which can spread in the system due to galvanic, inductive or capacitive interaction. To dampen this, a corresponding interference suppression element (free-wheeling diodes, varistors, RC elements) must be fitted directly at the inductive load.

Due to their universal application, it is recommended to use bidirectional suppressor diodes. These consist either of two opposingly poled, in-line switched suppressor diodes or one poled suppressor diode with bridge rectification. Corresponding modules are commercially available.

Also suitable are varistor modules which, for example, are offered by the manufacturers of contactors for the relevant contactors.

Filters

Normally, the interference immunity of the modules is sufficient that a function is assured even in an environment with relatively strong interference. To improve the EMC properties even further, it might be necessary to implement additional filtering measures. These measures are to be examined for each individual case. Suitable filters can be selected from the wide range available.

Voltage drops

The logic supply can bridge voltage drops of up to 10 milliseconds to ensure the continuity of your operation. This means that a disruption of bus operation by brief voltage drops is unlikely. Drops in supply at outputs are not covered here. This means that, in the event of voltage drops of this kind, contactors and other actuators can be de-energized.

Falsified input data due to voltage drops are usually prevented by filters in the input circuits. The usual activation times are approx. 3 ms. If longer interruptions in the power supply occur, suitable measures must be initiated. For example, magnetic voltage stabilizers can be used on the AC voltage side or stand-by batteries or support capacitors on the DC voltage side.

Notes:

A Appendix

A.1 Abbreviations

Abbreviation	Description
AC	Alternating current
AO	Analog output
CAN	Controller area network
Cu	Copper
DC	Direct current
Dev	DeviceNet
DI	Digital input
DO	Digital output
DP	PROFIBUS-DP
DIP	Dual inline package
EGB	Electrostatically endangered components!
EMC	Electromagnetic compatibility
ESD	Electrostatic discharge Abbreviation for all terms relating to electrostatic discharge, e.g. ESD protection, ESD hazards, etc.
GND	Ground
GSD	Device master data
I	Current
IBS	InterBus-S
LED	Light emitting diode, i.e. status indicator
LSB	Least significant bit
M	Modular
MSB	Most significant bit
PE	Protective earth
PDO	Process data object
PLC	Programmable logic control
R	Relay
RV	Patching distribution frame
S	Switch
T	Temperature
U	Voltage

A.2 Index

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