INTERBUS

User Manual

Controller Board for Siemens SIMATIC® S5-95U/100U PLCs

Type:	IBS S5 100 CB HW/SW UM E
Revision:	E
Order No.:	92 70 98 3

This manual is valid for:

IBS S5 100 CB-T	Order No.: 27 53 69 8	Hardware revision A

5074E

PHOENIX CONTACT

Please Observe the Following Notes:

In order to guarantee the safe use of your device, we recommend that you read this manual carefully. The following notes give you information on how to use this manual.

Requirements on the User Group

The use of products described in this manual is oriented exclusively to qualified application programmers and software engineers, who are familiar with automation safety concepts and applicable national standards. Phoenix Contact assumes no liability for erroneous handling or damage to products from Phoenix Contact or external products resulting from disregard of information contained in this manual.

Explanation of Symbols Used

The *attention* symbol refers to handling which could lead to damage to the hardware or software, or (in indirect connection with dangerous process peripherals) to personal injury.

Text marked like this informs you of conditions that must absolutely be observed to achieve error-free operation. The *hand* symbol also gives you tips and advice on the efficient use of hardware and on software optimization to save you extra work.

The *text* symbol refers you to detailed sources of information (manuals, data sheets, literature, etc.) on the subject matter, product, etc. This text also provides helpful information for the orientation in the manual.

We Are Interested in Your Opinion

We are constantly attempting to improve the quality of our manuals.

Should you have any suggestions or recommendations for improvement of the contents and layout of our manuals, we would appreciate it if you would send us your comments. Please use the universal fax form at the end of the manual for this.

Statement of Legal Authority

Phoenix Contact reserves the right to make any technical changes that serve the purpose of technical progress.

Phoenix Contact reserves all rights in the case of patent award or listing of a registered design. External products are always named without reference to patent rights. The existence of such rights shall not be excluded.

Table of Contents

Section 1

This section informs you about

- The INTERBUS system and its available components.
- Basic specifications of the INTERBUS systems.
- Terms specific to the INTERBUS systems.

1 System Overview

INTERBUS - The fast, universal sensor/actuator bus system.

INTERBUS shifts the input/output level from the higher-level control or computer system (host) directly to the machine or into the system. A serial bus cable connects the host with the I/O devices installed in the system. This reduces cabling to a minimum as compared with conventional parallel cabling.

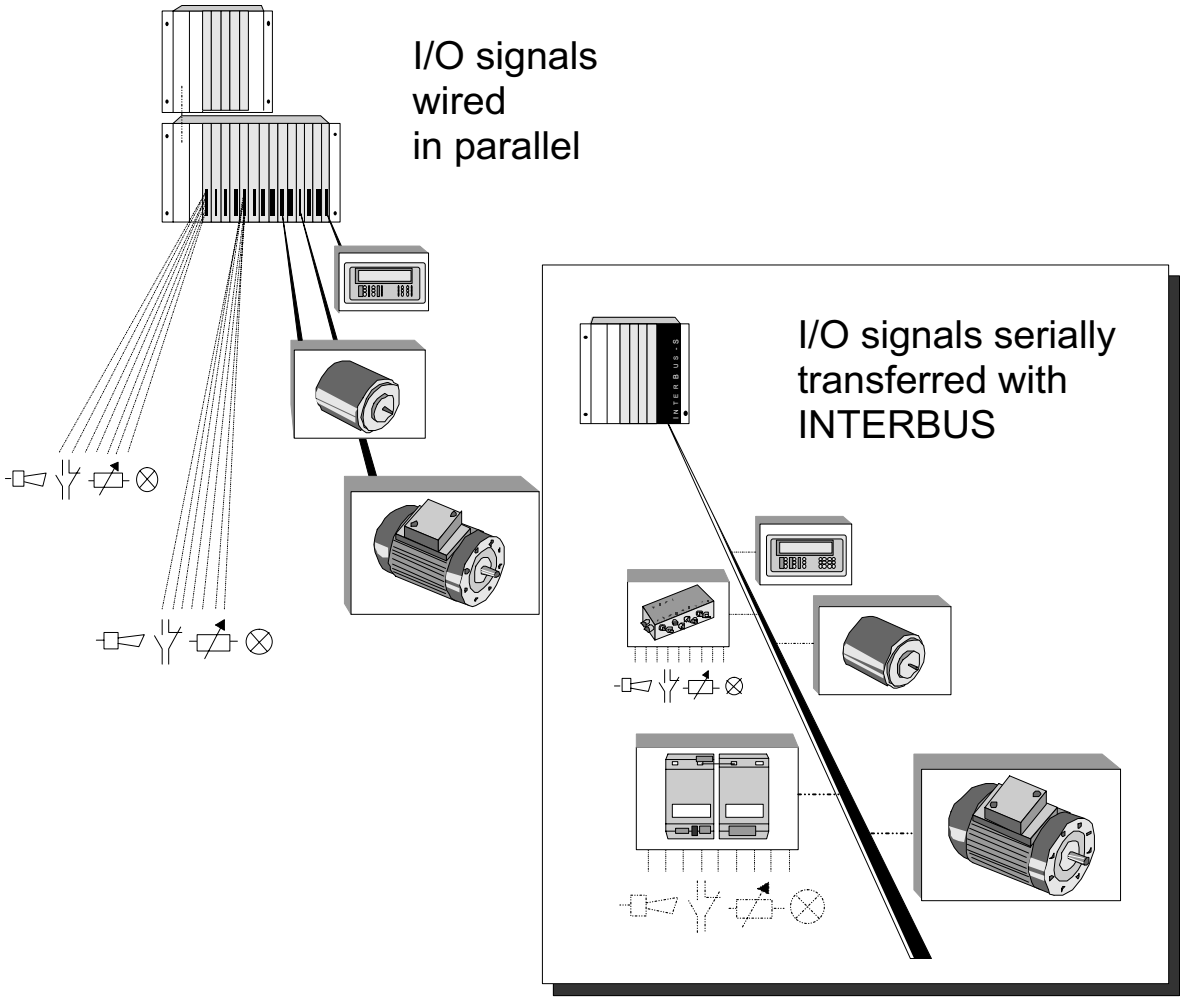


Figure 1-1: Optimizing the transmission structure with INTERBUS

1.1 Networking with INTERBUS

The constantly increasing degree of automation in general, but also the more complex demands of production and process engineering require more and more powerful sensors and actuators for specific applications. Today, already more than 200 device manufacturers support INTERBUS as an open bus system with the most various products. This enables the user to always select the most powerful and low-cost components for their specific applications.

Overview of INTERBUS-compatible devices:

- Controller boards for **p**rogrammable **l**ogic **c**ontrollers (PLCs)
- Controller boards for IBM-compatible PCs, VMEbus systems and industrial computers
- I/O units for
  - Digital inputs/outputs
  - Analog inputs/outputs
  - Degrees of protection - IP 20
    - IP 65
- High-tech modules for
  - Wrenching controllers
  - Positioning controllers
  - Robot controllers
- Drives
  - DRIVECOM standard
  - General motion control
- Valve manifolds
- Encoders
- Identification systems
- HMIs

Further devices with an INTERBUS device are in preparation!

1.2 INTERBUS Topology

INTERBUS is installed in the system as a compact, single-circuit line following one direction. Starting at the **controller board**, the bus system connects the PLC or computer system (host) with the distributed I/O devices (e.g., digital and analog I/O modules).

The main line led through the system is called **remote bus** and covers the distances between distributed substations.

Local branches are possible from the remote bus. Depending on the type, they are called installation remote bus, local bus or INTERBUS ST compact station.

The **installation remote bus** corresponds - according to its structure - to the remote bus. However, it provides the option to carry along a supply voltage for sensors in the bus cable (hybrid cable design). A bus terminal module (e.g., IBS IP CBK) is located at the beginning of the installation remote bus. The installation remote bus may be set up with CDI, CDO, DIO modules and other remote bus devices. The installation remote bus can be used to install distributed substations with direct connection of sensors and actuators. This results in an optimally short and low-cost sensor/actuator connection.

The **local bus** has been designed for the cost-effective and flexible installation of a distributed substation in switch cabinets and terminal boxes. A bus terminal module (BK module) constitutes the beginning of the local bus. The local bus cables connect the different local bus modules with the BK module, as well as the local bus modules with each other.

An **INTERBUS ST compact station** consists of INTERBUS ST devices which offer the direct connection of sensors and actuators as known from terminal technology and a pluggable and service-friendly electronics module.

A **bus terminal module** (BK module) couples a local bus or an installation remote bus to the remote bus.

An **INTERBUS ST bus terminal module** couples an INTERBUS ST compact station to the remote bus.

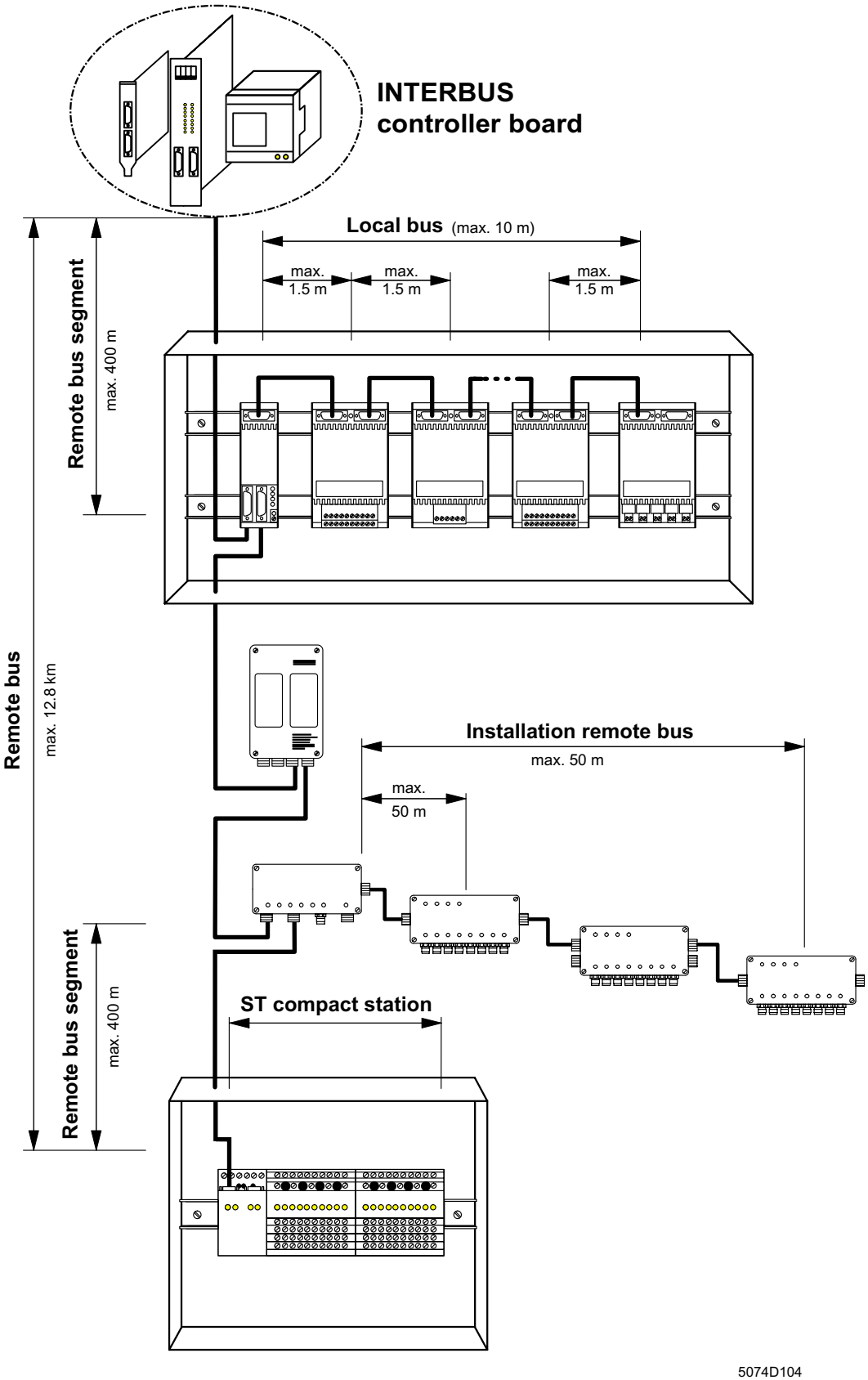


Figure 1-2: INTERBUS topology with the various bus types

Basic System Specifications

Remote Bus

Max. bus cable length between

- Controller board and first remote bus device	400 m
- Two remote bus devices	400 m
- Controller board and last remote bus device	12.8 km

Installation Remote Bus

Max. Total current consumption	4.5 A

Max. bus cable length between

- BK module and first I/O device	50 m
- Two I/O devices	50 m
- BK module and last I/O device	50 m

The number of I/O devices in the installation remote bus is limited by the current consumption of the devices and the connected initiators. The total current consumption of these components must not exceed 4.5 A. The current consumption of the actuators is not added to the calculation, as the actuators are supplied with a separate I/O voltage.

Local Bus

Number of devices on the local bus	max. 8
	(depending on the current consumption of every device and the load carrying capacity of the BK module; see data sheets for more detailed information)

Max. bus cable length between

- BK module and first I/O device	1.5 m
- Two local bus devices	1.5 m
- BK module and last I/O device	10 m

1.3 System Components

1.3.1 Controller Boards

The INTERBUS system is a sensor/actuator bus that is independent of the control or computer system. Programmable logic controllers (PLCs), IBM-compatible PCs, VMEbus systems or industrial computers may be used as control or computer systems.

The link to the INTERBUS system is achieved with a special controller board (PLCs, computer systems) which is inserted into the control or computer system.

Functions of Controller Boards

Control of the cyclic INTERBUS protocols (except for PC boards)

Transfer of input or output data to the INTERBUS devices or the control system

Monitoring of the INTERBUS system

Error detection

Determination of the error type and location

Error message to the control or computer system

Visual diagnostic indicators

- Operating indicators - Error indicators - I/O status

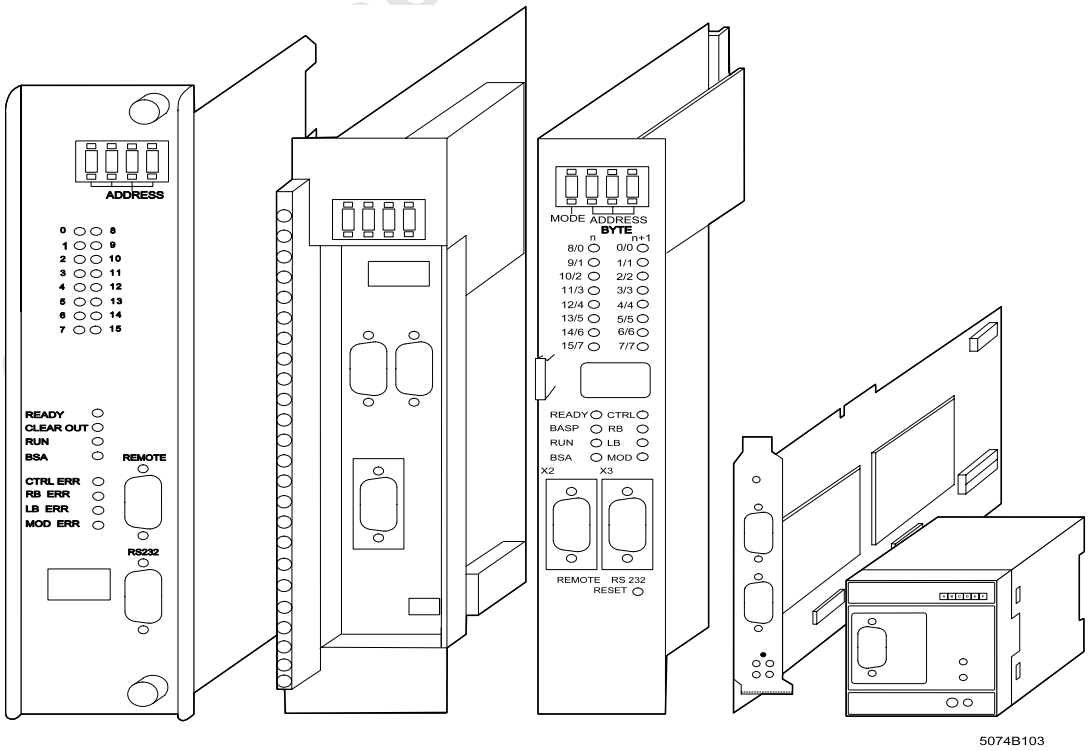


Figure 1-3: Controller boards for various control or computer systems

1.3.2 Remote Bus

The remote bus covers long distances within a system. The entire remote bus may be up to 12.8 km long (from the controller board up to the last connected remote bus device). This is achieved by dividing the entire INTERBUS system into individual bus segments.

There are two types of bus segments:

- Remote bus segment
- Local bus segment (which also includes the INTERBUS ST compact station)

Each bus segment type is numbered consecutively, starting with 0 (viewed from the controller board).

A remote bus segment consists of a BK module and the remote bus section which lies between the BK module of the segment and the next BK module leading to the controller board.

The local bus segment consists of a BK module and the local bus (or an INTERBUS ST compact station) which is connected to it.

A remote bus segment may bridge a distance of 400 m. In this way, the complete remote bus can be divided into up to 256 remote bus segments (see Figure 1-4, page 1-10).

The installation remote bus described in the next section consists of devices which are regarded as remote bus devices. Therefore, they are included in the total of remote bus segments.

The *remote bus* is often referred to by its abbreviation RB.

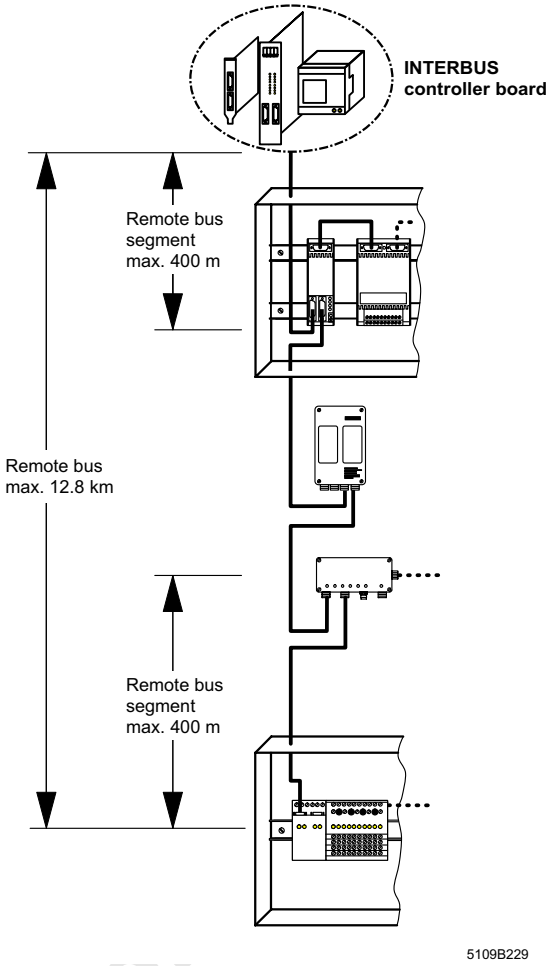


Figure 1-4: Structure and maximum dimensions of the remote bus

Basic Remote Bus Specifications

Max. number of bus segments	(DCB)	256
(including installation remote bus segments)	(DAB, CB-T,BA AT)	64
for DCB, DAB, CB controller boards	(PC CB/COP/I-T)	256
	(PC CB/I-T)	256
	(PC CB/I-T)	32

Max. length of a remote bus segment	400 m

Max. bus cable length between

Controller board and first remote bus device	400 m
Two remote bus devices	400 m
Controller board and last remote bus device	12.8 km

Transmission method	RS-485
Transmission medium	Single-shielded signal lines

Alternatively, the following transmission media may be used for the remote bus:

- Optical Fiber
- Slotted microwave guide
- Infrared transmission path
- Data slip ring

1.3.3 Installation Remote Bus

The installation remote bus branches off from the remote bus. Physically, it is a remote bus. A BK module (e.g., IBS IP CBK) couples the installation remote bus to the remote bus. Besides the actual data lines, the installation remote bus cable (hybrid cable) carries additional supply lines for the bus logic of the devices and initiators (communication voltage U_L).

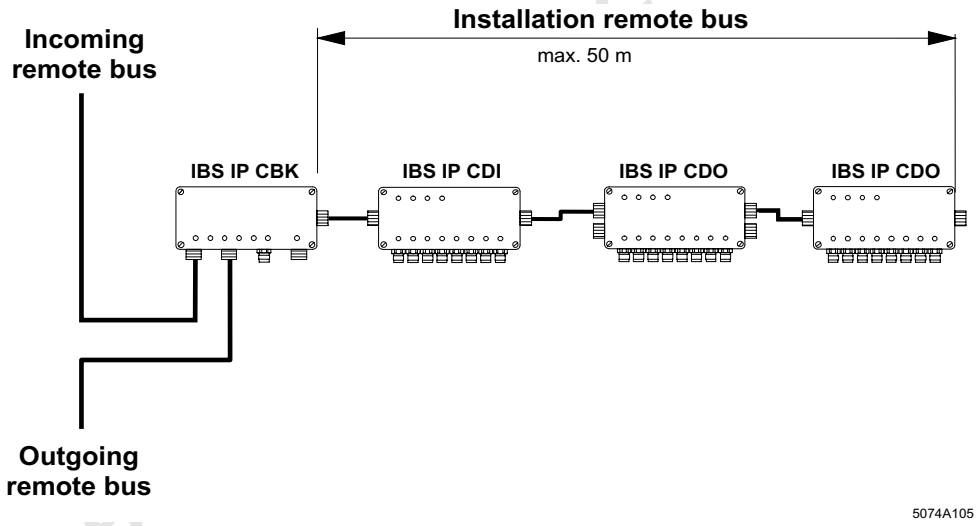


Figure 1-5: Structure and maximum dimensions of the installation remote bus

Both the remote bus and installation remote bus are often referred to by the abbreviation RB.

The installation remote bus interface is designed especially for the connection of the I/O devices IBS IP CDI and IBS IP CDO (IP 65 protection). It is also possible to integrate all remote bus devices with two-wire interfaces into the installation remote bus. It is not possible to set up another branch with a BK module.

Basic Installation Remote Bus Specifications

Max. bus cable length between

- BK module (CBK) and the first I/O device 50 m
- BK module (CBK) and the last I/O device 50 m

Max. current carrying capacity of the hybrid cable 4.5 A

The number of I/O devices in the installation remote bus is limited by the current consumption of the devices and the connected initiators. The total current consumption of these components must not exceed 4.5 A. The current consumption of the actuators is not added to the calculation, as the actuators are supplied with a separate I/O voltage.

Calculation Example for Determining the Number of Devices in the Installation Remote Bus

Let us assume that 8 CDI- and 4 CDO modules are to be used in an installation remote bus. (The information on the current consumption by the I/O devices and initiators is taken from the appropriate data sheets).

Table 1-1: Example for testing the load capacity of an installation remote bus

Current consumption by the bus logic of a CDO module:	I_{CDO} = 120 mA
Current consumption by the bus logic of a CDI module:	I_{CDO} = 195 mA
Current consumption of a typical initiator:	I_I = 25 mA
Number of CDO modules:	m = 4
Number of CDI modules:	n = 8
Number of connected initiators:	p = 27
Total current consumption:	$I = m * I_{CDO} + n * I_{CDI} + p * I_I$
In the example:	$I = 4 * 120\ mA + 8 * 195\ mA + 27 * 25\ mA$ $I = 2.715\ A$

Bus system operation is ensured in this example!

1.3.4 Bus Terminal Module (BK)

A BK module is a remote bus device. It connects the local bus (see Section 1.3.5, "Local Bus", page 1-14) or installation remote bus with the remote bus (see Section 1.3.2, "Remote Bus", page 1-9). BK modules are identified by the abbreviation *BK* (e.g., IBS 24 BK-T, IBS 24 BK I/O-T, IBS IP CBK 1/24-F, IBS 24 BK-LWL, IBS 24 BK/LC 2, IBS ST 24 BK-T). There are BK modules with an additional I/O function (*I/O* is part of the designation).

Even if one part of the system has been switched off, the supply voltage of a BK module must always be maintained to ensure that the remaining parts of the bus system can continue to operate.

If the supply voltage at a BK module fails, the controller board stops the bus and generates an error message for the corresponding bus segment.

Functions of the BK Module

- Coupling an installation remote bus or local bus to the remote bus
- Supplying I/O devices with communication voltage U_L
- Regenerating data in the remote bus
- Electrical isolation of the bus segments
- Connecting or disconnecting the local bus, installation remote bus, and outgoing remote bus
- Indicating errors through an isolated alarm output and an LED
- For IBS 24 BK/LC 2: Reconfiguration through an external pushbutton

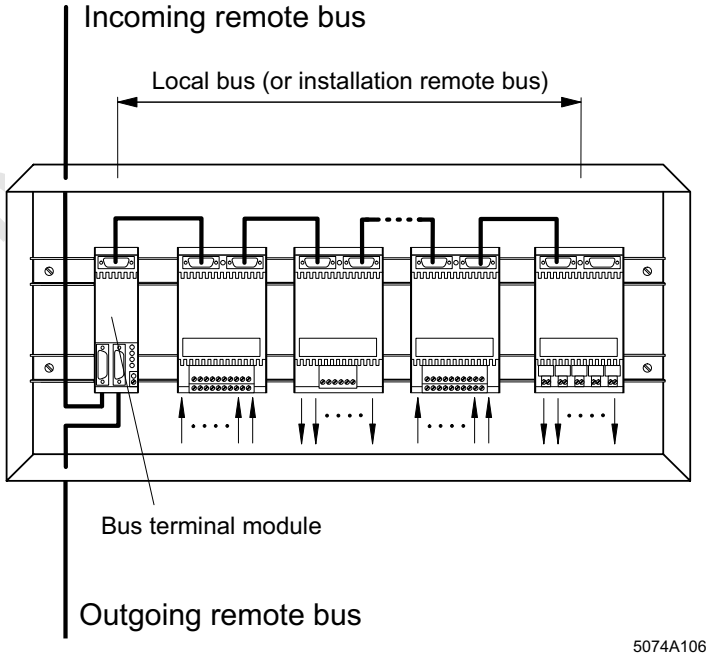


Figure 1-6: Remote bus at the interface to the local bus

1.3.5 Local Bus

The local bus is a local branch of the main remote bus. It is used inside the switch cabinet. The local bus allows the variable and low-cost installation of a distributed substation. The local bus is coupled to the remote bus using a BK module. In the local bus, different I/O devices can be combined with each other.

Local bus devices cannot be integrated into the remote bus or installation remote bus. Conversely, it is not possible to use remote bus devices on the local bus.

The *local bus* is also referred to by its abbreviation LB.

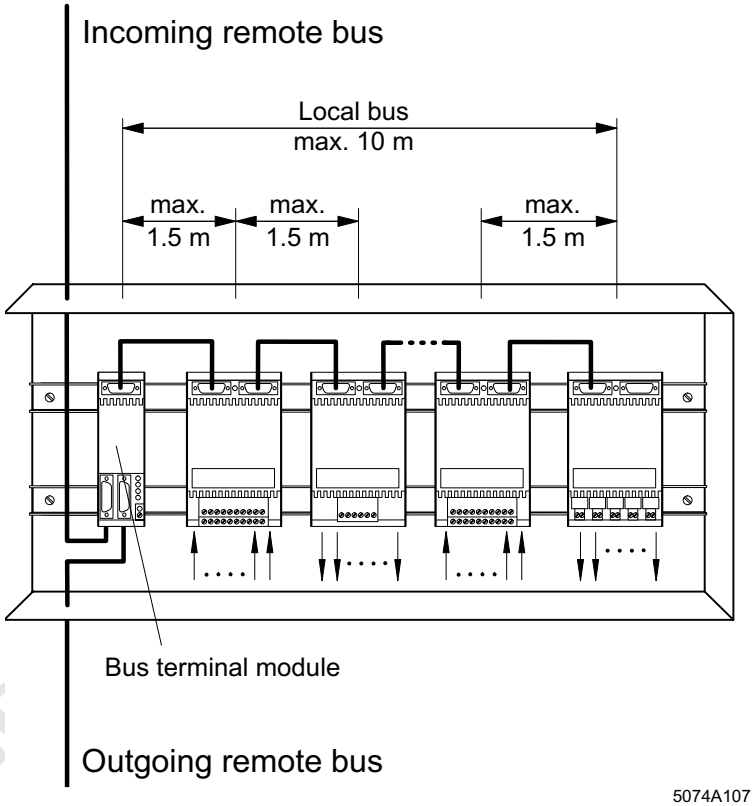


Figure 1-7: Structure and maximum dimensions of the local bus

Basic Local Bus Specifications

Max. total current consumption	0.8 A
Max. bus cable length between	
- BK module and first local bus device	1.5 m
- Two I/O devices	1.5 m
- BK module and last local bus device	10 m
Max. number of local bus devices on the local bus	8

You can order the following preassembled cables from Phoenix Contact as connecting cables:

- 10 cm (Order No.: 27 84 17 5)
- 20 cm (Order No.: 27 06 31 2)
- 50 cm (Order No.: 27 59 43 0)
- 100 cm (Order No.: 27 84 18 8)
- 150 cm (Order No.: 27 84 19 1)

1.3.6 INTERBUS I/O Devices

The I/O devices in the INTERBUS system are the link between the sensors and actuators and the bus system. Here, a distinction is to be made between I/O devices in the remote bus or installation remote bus and the I/O devices in the local bus or INTERBUS ST compact station.

1.3.6.1 Remote Bus and Installation Remote Bus Devices

To operate the INTERBUS system, the bus logic of all INTERBUS devices must be supplied with communication voltage U_L.

The voltage to supply the bus logic (communication voltage U_L) is

- directly connected for remote bus devices.
- supplied over the special installation remote bus cable for installation remote bus devices.

The installation remote bus cable is supplied with voltage through the BK module which couples the respective installation remote bus to the main line.

If the communication voltage U_L fails in a remote bus or installation remote bus device, the INTERBUS system is stopped and an error message is output for the respective bus segment.

Besides I/O devices for digital and analog signals, there are I/O devices with BK module functionality (e.g., IBS 24 BK I/O-T), as well as operator interfaces, valve manifolds, DRIVECOM devices, ENCOM devices, etc.

1.3.6.2 Local Bus Devices

Local bus devices are I/O devices for the variable and cost-effective installation of a decentralized substation in a switch cabinet. Depending on the control and monitoring task, local bus devices of any type may be combined in a local bus.

A BK module couples the local bus to the remote bus. This BK module has an integrated power supply unit. It supplies the bus logic of the BK module and, through the local bus cable, the bus logic of the connected I/O devices with communication voltage.

The voltage supplied to the respective I/O device (I/O supply voltage) supplies the peripherals side (actuators) that is electrically isolated from the bus logic.

If the power supply for the BK module fails, the INTERBUS system stops and the controller board outputs an error message for the remote bus concerned.

1.3.6.3 INTERBUS ST Compact Station

An INTERBUS ST compact station performs the same functions as a local bus.

In addition, the INTERBUS ST compact station has the following features:

- Automatic connection of the protective conductor when the module is snapped on the mounting rail.
- Outputs and initiator supply are electronically protected against short circuit.
- The INTERBUS ST modules are available in two sizes with 8, 16 and 32 I/O channels and with multi-wire terminals for the connection of two-, three- and four-wire sensors/actuators.

A BK module couples the INTERBUS ST modules to the remote bus. It supplies the bus logic of the connected INTERBUS ST modules with communication voltage.

The special advantages of an INTERBUS ST compact station are

- Space-saving installation in a terminal box
- Direct connection of the sensor/actuator signals to a terminal block
- Replaceable fieldbus electronics of every INTERBUS ST module
- Large labeling fields

1.4 INTERBUS Method of Operation

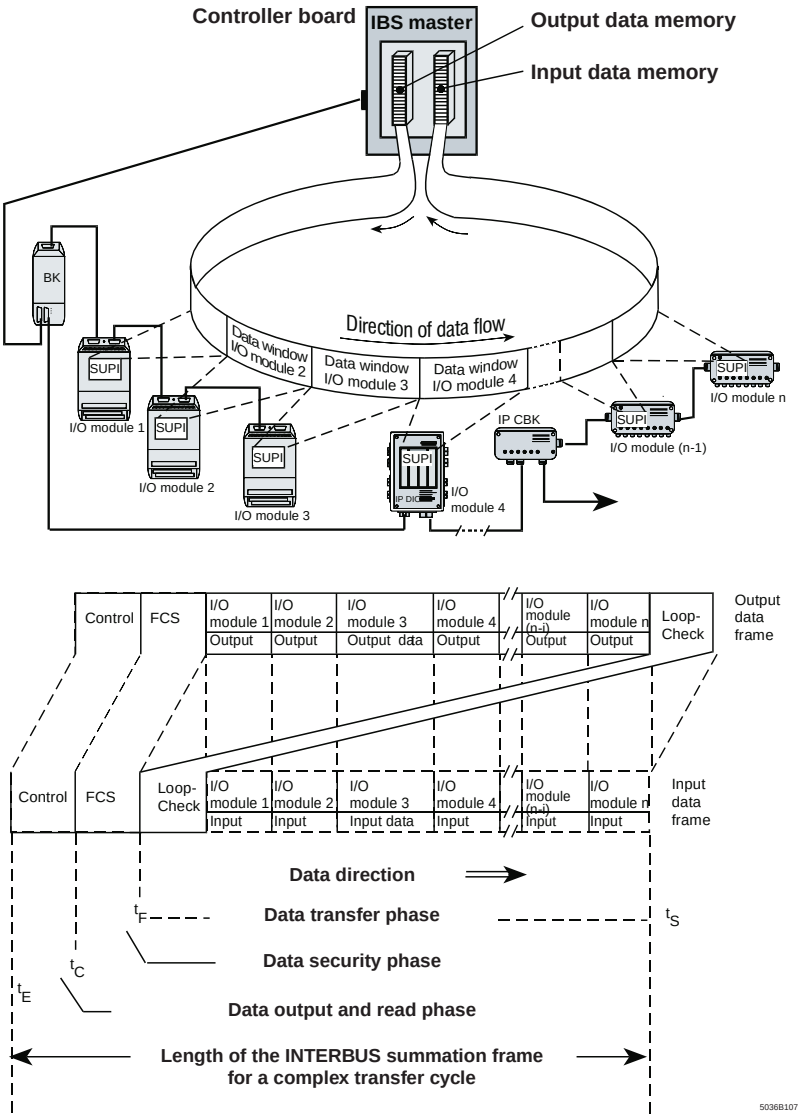


Figure 1-8: INTERBUS method of operation

1.4.1 General Method of Operation

The INTERBUS system is designed as a data ring with a central master-slave access method. It has the structure of a spatially distributed shift register. Every device with its registers is part of the shift register. The INTERBUS master on the controller board shifts the data serially through this ring. Using the ring structure in this way allows to send and receive data simultaneously (full duplex).

To simplify the system installation, the ring system is implemented in one cable line. Due to this, the system appears like a a bus system with branch lines (tree structure).

Each device in the INTERBUS system has an identification register (ID register). This register contains information on the module type, the register length, the status and error states. In addition, the I/O devices have I/O registers for the transmission of process data.

There are two types of cycles in an INTERBUS system:

- The identification cycle (ID cycle) which is run to initialize the INTERBUS system and on request. In the ID cycle, the ID registers of all devices are read out and this information is used to generate the process image on the controller board.
- The data cycle i.e., the actual operating cycle, in which data is transferred. In the data cycle, the controller board updates the I/O data of all INTERBUS devices (modules, operator interfaces, etc.) at the same time (full duplex).

The data transmission is checked for each cycle using special test methods.

- If no error occurred during data transmission, the data is accepted by the controller board and sent to the device's outputs.
- If an error is detected, the data of the erroneous cycle is rejected, since a new cycle is completed faster than the correction of corrupted data.

1.4.2 Error Protection Mechanisms

The INTERBUS system has been developed as a sensor/actuator bus for use in industrial environments. In order to ensure a safe data transmission under diverse conditions in the industrial field of application, extensive protection mechanisms have been implemented. The following precautionary measures guarantee a safe data transmission:

Differential Signal Transmission in Accordance with RS-485

A shielded twisted-pair is used for transmission in accordance with RS-485. User data is sent over both lines of a pair as differential signals. This transmission method is used on the remote bus line and on the installation remote bus, which can be strongly affected by external influences.

Remote Bus Check

The individual bus segments are checked by exchanging special status information. A broken bus cable or a connector that does not have proper contact causes a *RB ERR* remote bus error and the *RC* LED on the remote bus device to go out.

Loop Check

The controller board clocks the *loop-back word* ahead of the output data through the INTERBUS ring. Thus, the *loop-back word* passes directly between the input and output data through all devices in the INTERBUS system and follows the input data back to the controller board. The time required by the *loop-back word* to make a complete cycle is known to and monitored by the controller board. In addition, the controller board can detect errors along the transmission path or in the INTERBUS devices by means of the special bit sequence of the *loop-back word*.

Cyclic Redundancy Check (CRC)

Every transmission path between two devices in the INTERBUS system is checked by a CRC. For this, a CRC check word is calculated in each device and the controller board itself, in the input direction as well as in the output direction. At the end of each transmission cycle, it is checked whether the check words at the beginning and end of a transmission path match. If the two check values do not match, the controller board reports this to all subsequent devices and starts a new cycle with current data. With this CRC a Hamming distance = 4 is reached.

Test Routines

In order to detect hardware errors on the controller board, various test routines are executed following a *reset* or voltage recovery.

This special routines test the:

- CPU of the INTERBUS master on the controller board
- EPROM and the RAM
- Bus logics and functions of various components

After error-free execution of the test routines, the green *READY* LED of the controller board lights up.

In addition, the connected INTERBUS system is initiated and its functions are checked. The controller board activates all bus segments one after the other and checks the functioning of each.

First, the controller board enables the connection to the first BK module or the first remote bus device. When no errors occur, the local bus or installation local bus connected to the BK module is initialized. Thereafter, the connection to the next remote bus device is activated. In this way, all segments in the INTERBUS system are started up one after the other. Following this configuration phase, the controller board knows the connected INTERBUS system and can operate it.

This configuration algorithm is also used to locate the error if a malfunction occurs in the course of normal data traffic.

1.4.3 INTERBUS Protocol Sequence

- Starting with the *loop-back word*, the controller board clocks the output data into the INTERBUS system data ring. At the same time, the controller board receives input data which has previously been stored in the data ring by the INTERBUS devices.
- The *loop-back word* is transferred between the input and output data through the entire data ring formed by all INTERBUS devices. When the controller board receives the *loop-back word*, all output data is in the data ring and all input data in the controller board.
- The checksums calculated by the CRC generators are transferred to the next device where they are checked.
- When the *loop-back word* is correctly read back and the comparison of the checksums results in an error-free transfer on all bus lines, the output data becomes valid and the devices put the data on their outputs. The controller board also transfers the read input data to the control or computer system for processing.
- Thereafter, the controller board causes the devices to store all new input data in the data ring, before it clocks a new loop-back word and new output data into the data ring.
- Due to the ring topology of the INTERBUS system, input and output data is transmitted simultaneously (full duplex).

1.4.4 Calculation of the Cycle Time

The cycle time of the INTERBUS system depends on few factors and increases almost linearly with an increasing number of I/O points. However, due to high efficiency of the INTERBUS protocol, the cycle time is predominantly determined by the number of I/O points. Furthermore, the number of BK modules, the check sequence, the signal runtime, and the cable length of the bus system also influence the cycle time to a minor degree. The cycle time can be calculated as follows:

$$t_{cycle} = (1.15 * 13 * (8 + n) + 3a) * t_{BIT} + t_{SW} + t_{PH}$$

- t_{cycle} Cycle time in milliseconds
- t_{SW} Software runtime = 0.34 ms (with G3 controller boards)
- n Number of user data bytes (process data words and PCP words)
- a Total number of bus devices (including BK modules)
- t_{Bit} Bit duration = 0.002 ms at 500 kbit/s
- t_{PH} Propagation time on the transmission medium
  (For copper: t_{PH}=0.016 ms * l/km)
- l Length of the remote bus cable in kilometers

When calculating the sum of I/O points, please observe that only the simple register width is taken to calculate the total sum for devices that have inputs as well as outputs.

Example for Determining the Register Length n (in Bytes) for Two Different Configurations of 16 Inputs and 16 Outputs:

Example of a BK module with 16 inputs and 16 outputs (IBS 24 BK I/O-T).

IBS 24 BK I/O-T
2 bytes for input
2 bytes for output
Sum for n: 2 bytes

Example of a module with 16 inputs and a module with 16 outputs (IBS 24 DI and IBS 24 DO).

IBS 24 DI	**IBS 24 DO**
2 bytes for input	--
--	2 bytes for output
Sum for n: 4 bytes	

Practical Example for Calculating the Cycle Time

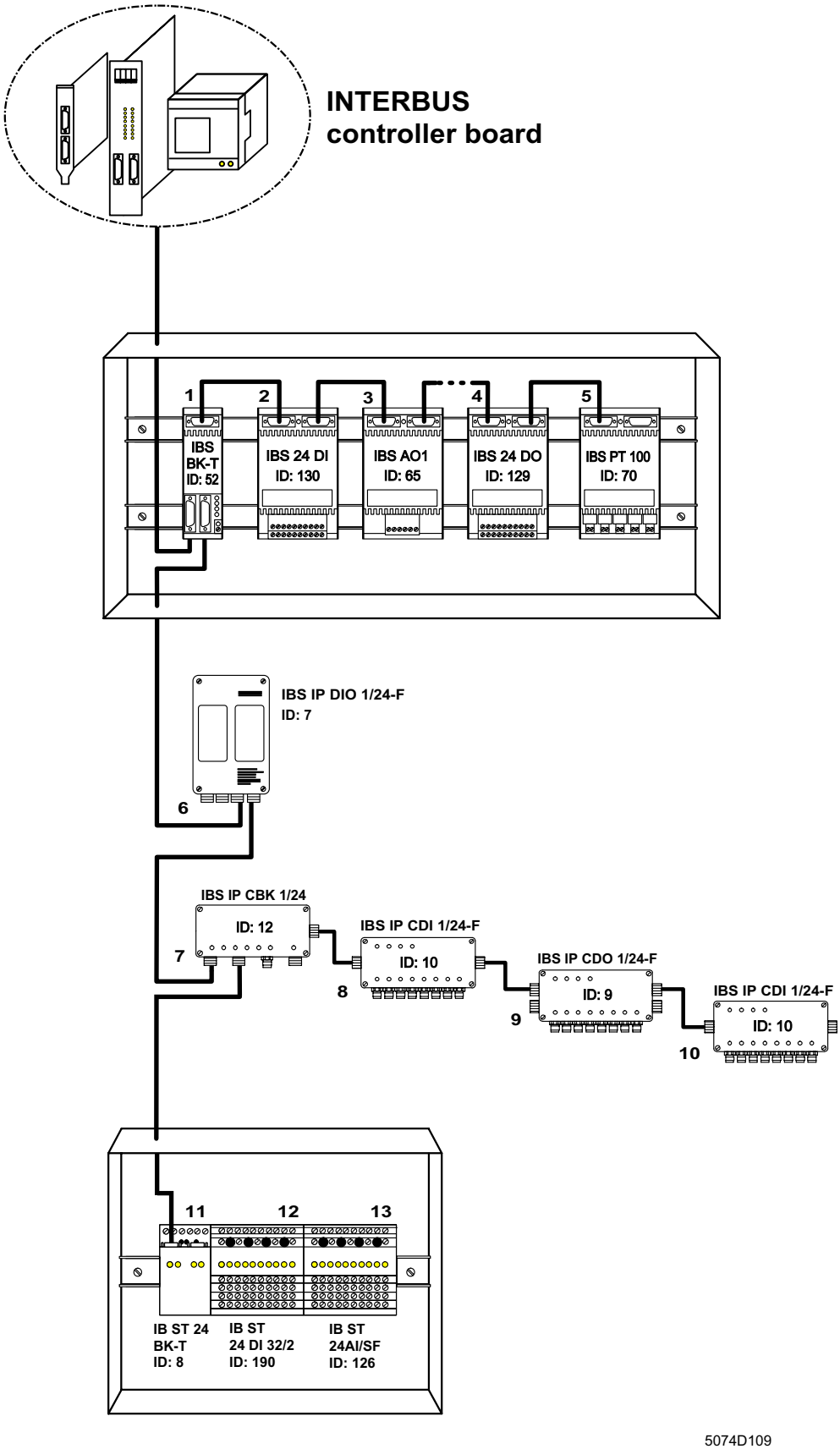


Figure 1-9: Configuration example for calculating the cycle time

Table 1-2: Input bytes, output bytes, and register length of the configuration example

Module/Device	Inputs (Bytes)	Outputs (Bytes)	Register Length (Bytes)
IBS 24 BK-T	-	-	-
IBS 24 DI	2	-	2
IBS 24 AO1	-	8	8
IBS 24 DO	-	2	2
IBS PT 100	8	-	8
IBS 24 IP DIO	2	1	2
IBS IP CBK	-	-	-
IBS 24 CDI	1	-	2
IBS 24 CDO	-	1	2
IBS 24 CDI	1	-	2
IB ST 24 BK-T	2	2	2
IB ST 24 DI 32/2	4	-	4
IB ST 24 AI/SF	8	8	8
	28	22	n = 42

Number of user data bytes = 42

Number of devices installed = 13

Cable length (copper) e.g. = 400 m

$t_{cycle} = (1.15 * 13 * (8 + n) + 3a) * t_{BIT} + t_{SW} + t_{PH}$

$t_{cycle} = (1.15 * 13 * (8 + 42) + 3 * 13) * 0.002 \text{ ms} +$
$0.34 \text{ ms} + 0.016 \text{ ms/km} * 0.4 \text{ km} =$ 1.9194 ms

Section 2

This section shows you in detail

- The indicating and operating elements of the controller board.
- How to install and connect the controller board.

2 Mounting and Connecting the IBS S5 100 CB-T Board

2.1 Unpacking the Controller Board

The controller board is supplied in an ESD bag together with a package slip which contains installation instructions.

Only qualified personnel is allowed to pack and unpack as well as to handle the controller board in compliance with respective ESD regulations.

2.1.1 ESD Regulations

In order to protect the controller board against electrostatic discharge, the operating personnel is required to electrostatically discharge itself before packing and unpacking, opening switch boxes and cabinets, and touching the board.

2.2 Design of the Controller Board

Figure 2-1 shows the connection and operating elements of the IBS S5 100 CB-T controller board. The following description of how to install and remove the controller board refers to these elements.

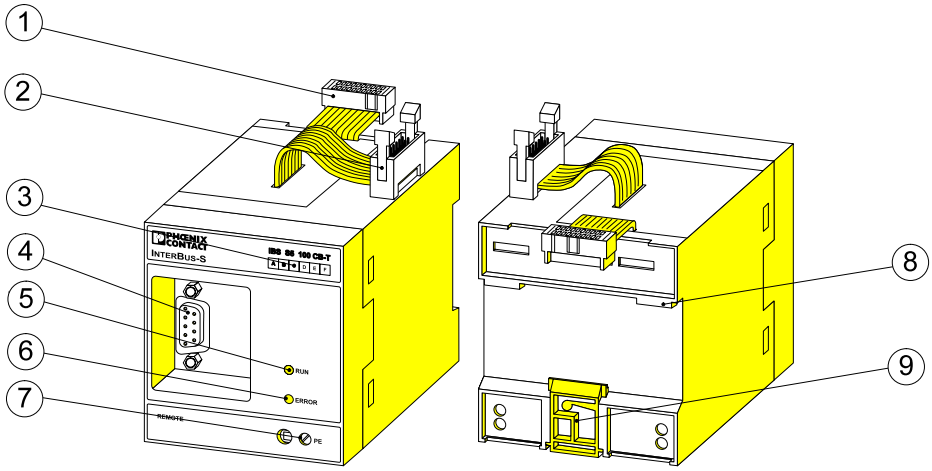


Figure 2-1: Connection and operating elements of the IBS S5 100 CB-T at the front and in the rear

1. Flat-ribbon cable in the rear
2. Outgoing pin strip on the flat-ribbon cable
3. Revision letter
4. INTERBUS remote bus connector (REMOTE)
5. RUN LED (operating indicator)
6. ERROR LED (error indicator)
7. PE terminal (protective earth)
8. Upper guide rail
9. Positive latch

Carry out all electrical connections to the PLC (S5 95U or S5 100U) and to the INTERBUS system only when the operating voltage has been switched off (see Section 2.4, "Connection", page 2-7).

When you install the module as described in the following, avoid mechanical canting and use a screwdriver!

2.3 Mounting and Removal

Installation

If you intend to install other Siemens I/O modules beside the IBS S5 100 CB-T controller board, you should install the components in the following order (Figure 2-2):

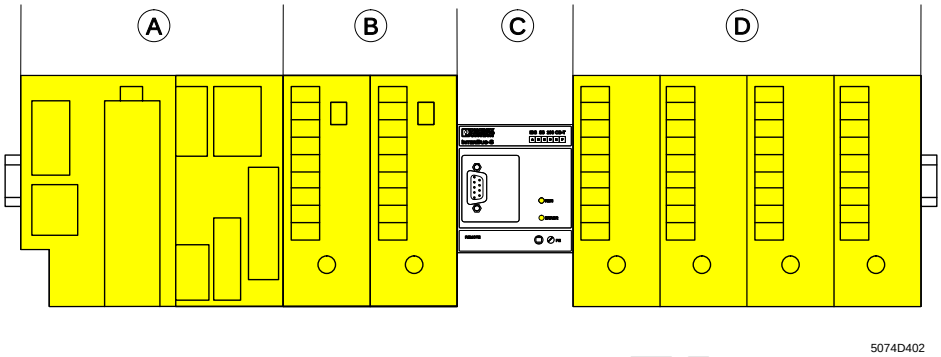


Figure 2-2: Installation order for the PLC, the INTERBUS controller board and other I/O modules from Siemens

A. S5 95U or S5 100U PLC

B. Siemens analog modules

C. IBS S5 100 CB-T controller board

The controller board must only be plugged into the slot 0, 2, 4 or 6. The slot also determines the addresses of the INTERBUS devices in the process image (see Section 4).

D. Siemens digital modules

Mounting

To mount the controller board, please proceed as shown in Figure 2-3:

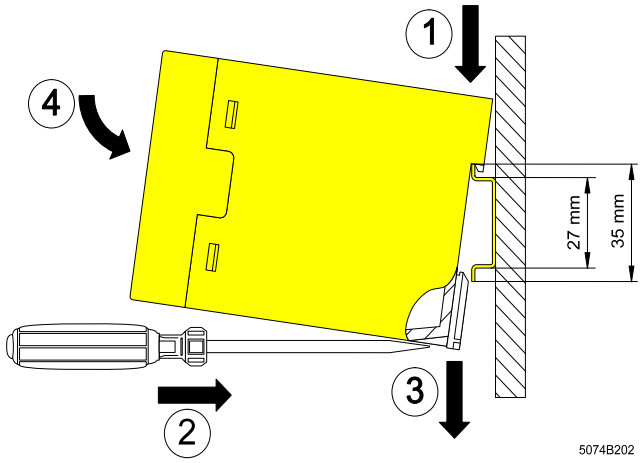


Figure 2-3: Mounting the controller board onto the standard rail

1. Hook the upper guide rail of the controller board onto the upper part of the standard rail (type: EN 50022, see figure for dimensions). The rear flat ribbon cable is facing upwards.

2. Insert the tip of the screwdriver into the cut-out of the red latch (at the bottom).
3. Pull the red latch with the screwdriver to the bottom.
4. Swivel the controller board to the lower part of the standard rail. Then pull away the screwdriver and let the latch engage.

Removal

To remove the controller board, please proceed as follows (Figure 2-4):

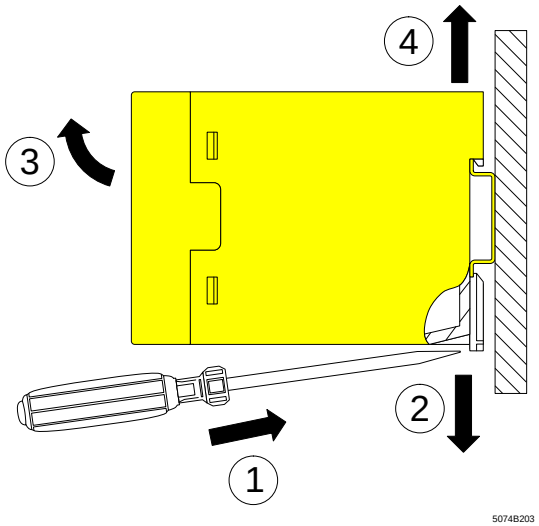


Figure 2-4: Removing the controller board

Remove all existing cable connections to the controller board.

1. Insert the tip of the screwdriver into the cut-out of the red latch.
2. Pull the red latch with the screwdriver to the bottom.
3. Swivel the controller board upwards.
4. Unhook the controller board from the upper part of the standard rail.

For detailed information on how to install the other components of the INTERBUS system (INTERBUS devices, cable connections, etc.), please refer to the IBS SYS INST UM E Installation Manual (Order No.: 27 54 80 4).

2.4 Connection

Connection to Bus Module

Plug the rear flat-ribbon cable (without lengthening or squeezing it) onto the bus module of the last analog module (if provided) (see Figure 2-5)

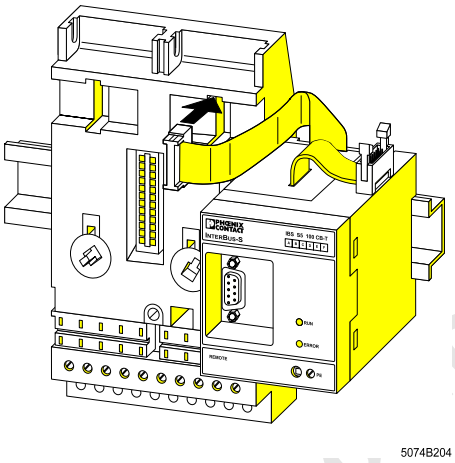


Figure 2-5: Connecting the controller board to the bus module of the last analog module

or

Connection to PLC

directly in the female connector on the side of the PLC (see Figure 2-6).

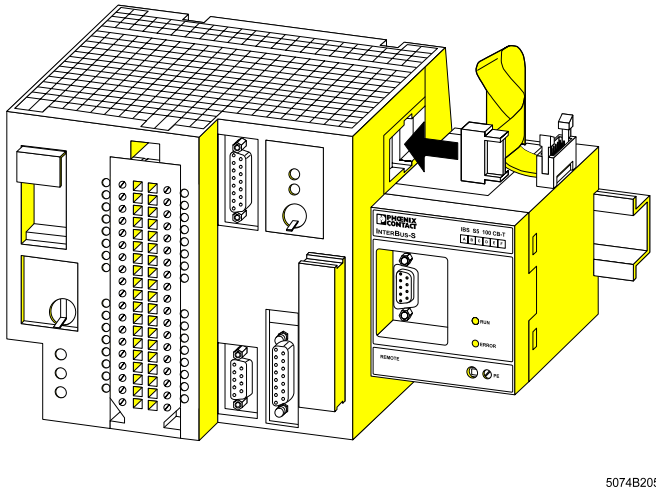
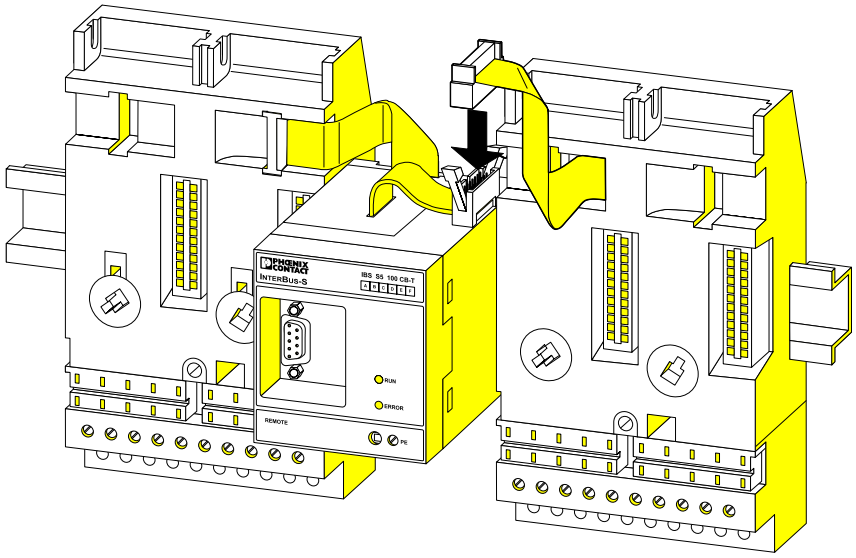


Figure 2-6: Connecting the controller board directly to the PLC

The address assignment of the process image with INTERBUS devices is described in detail in Section 4, "Addressing".

Connection Together with Other Modules

If digital modules from Siemens are to be used besides INTERBUS, plug the female connector of the module to the right into the outgoing pin strip of the controller board and lock the female connector into position using the latches.



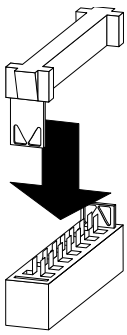
5074B206

Figure 2-7: Connecting the flat-ribbon cable of the right bus module to the controller board

If no additional I/O modules are to be installed to the right of the controller board, you should plug the IP 20 dummy plug FLK 16 (see Section A.2, "Additional Products", page A-2) onto the pin strip in order to ensure that the controller board complies with the IP 20 protection standard (information on how to install the dummy plug can be found on the next page).

Figure 2-8 shows how the IP 20 dummy plug is assembled.

Please ensure that the parts are not canted when they are put on each other. Then push the upper part uniformly and tightly onto the bottom part which should lie on an even, fixed base.



5074B210

Figure 2-8: Assembling the IP 20 dummy plug

Plug the IP 20 dummy plug without canting onto the outgoing pin strip of the controller board (Figure 2-9). The connector coding is on the left (covered in Figure 2-9). Thereafter, the connector is locked into position by means of the latches.

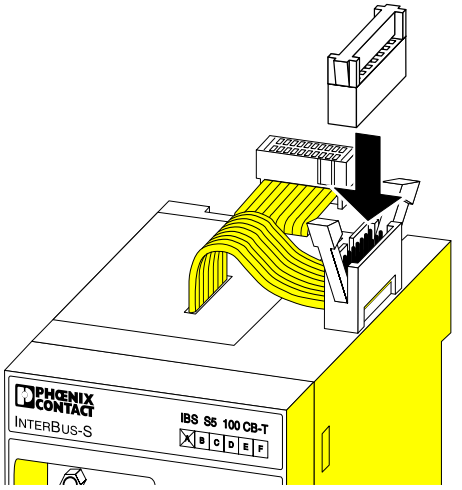


Figure 2-9: IP 20 upgrade of the controller board with the dummy plug

Connection to the INTERBUS system

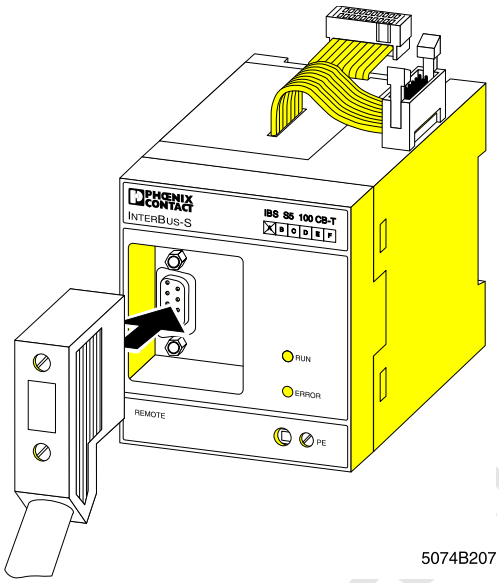


Figure 2-10: Connecting the male remote bus connector to the female REMOTE connector

If you want to assemble the remote bus connector shown in Figure 2-10 by yourself, Figure 2-11 shows you the pin assignment and information on how to assemble the connector (type: 9-pos. D-SUB):

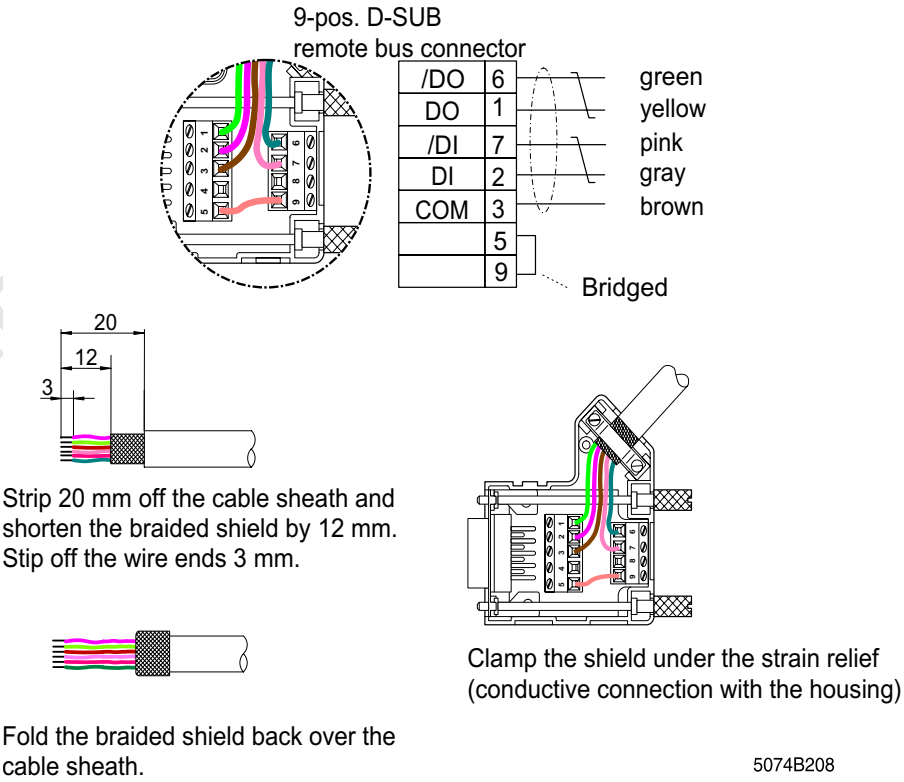


Figure 2-11: Pin assignment of the remote bus connector

It is important that you connect the PE terminal of the controller board to the central ground of the system. Please use a cable cross section with a minimum of 4 mm^2.

Section 3

This section informs you about

- How the control program is prepared for a convenient error treatment.
- How to start INTERBUS.
- The indicators on board, to enable you to recognize proper operation as well as transmission errors.
- The priority classification of the error sources and their indication.
- How the errors indicated in the INTERBUS system can be removed.

3 Starting the System and Evaluating Operating Indicators

Before you start the INTERBUS system, please make sure that the controller board has been correctly installed. In addition, the INTERBUS devices and the associated cable connections must be correctly installed.

Information on the correct mounting and connection to the controller board is given in Section 2, "Mounting and Connecting the IBS S5 100 CB-T Board". The IBS SYS INST UM E installation manual (Order No.: 27 54 80 4) describes the correct installation of the entire INTERBUS system.

The INTERBUS data transmission starts automatically when the PLC is powered up. As soon as the RUN LED is on, the current input states of the sensors are available to the control program and the outputs can be set.

3.1 Adding the FB 14 Function Block to the Control Program

The enclosed disk contains the function block FB 14.
With this function block, the control program can respond to possible errors in the INTERBUS system automatically or manually.

For a better understanding, the Appendix describes the function of FB 14 in detail. The description below gives a short overview of the functions.

FB 14 Short Description

The function block evaluates the bits MOD and RUN in the diagnostic register. If an error occurs (i.e., MOD=1 or RUN=0) the bus can be started manually with the QUIT parameter or the pending error message can be acknowledged. It is useful to connect this parameter logically with a pushbutton. When the AUTO parameter is set, the PLC can start acknowledgment automatically after a previously specified period of time has been expired.
The number of the connected input and output bytes is also monitored.

Calling FB 14

It is preferred to call FB 14 in the organization block OB 1 unconditionally at the beginning.

The organization blocks 21 and 22 initialize FB 210 and the associated data block by means of FB 210.

FB 210 is called unconditionally during PLC startup. A detailed description of FB 210 is given in the Appendix.

3.2 Starting INTERBUS

Switching On the Supply Voltage

Switch on the power supply for the PLC!

When the PLC is powered up, the configuration of the INTERBUS system is read in and addressed in a slot-oriented (physical) way.

The PLC recognizes the address space required by INTERBUS. This space is then considered in the I/O address of the entire system.

Immediately afterwards the RUN LED should be on permanently. This always indicates that data is transmitted between the PLC and the INTERBUS devices.

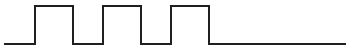
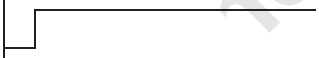
However, when the RUN LED is blinking the controller board shows that it is ready to operate. INTERBUS has not been started yet.

If the ERROR LED is blinking or is permanently on, there is an error in the data transmission. In this case, the blinking sequence or the steady light of the ERROR LED indicate the error cause. Table 3-1 shows which blinking sequence corresponds to which error cause.

You may start INTERBUS either by means of the control program or by switching the power supply of the PLC on and off again.

Indications of the ERROR LED

Table 3-1: Blinking sequences of the ERROR LED and the associated error causes and remedies

Error Cause	Indication of ERROR LED, Blinking Sequence	Error Remedy
Module error	 Blinking Pause	Check I/O voltage for failure or dips, short circuit at sensor or actuator?
Local bus error	 Blinking Pause	Check local bus cabling and/or I/O module, too many or not enough local bus devices
Remote bus error	 Blinking Pause	Check remote bus cabling and power supply of the BK modules, too many remote bus devices, therefore check the configuration (up to 64 remote bus devices)
Parameterization error	 Blinking Pause	See text below (explanations of error causes)
Hardware fault	 Steady light	Replace the controller board!

The blinking sequences are always followed by a clear pause.

Explanation of the Error Causes

Module Error

The module error (MOD) occurs when the I/O cabling is defective, when there is a blown fuse or a missing I/O voltage. The error is only indicated for modules with a bus acknowledgment. The error does not stop the bus. The diagnostic parameter register (see Section 5, "Controlling INTERBUS") contains the number of the bus segment where the indicated error occurred.

The I/O data of the reporting local bus device does not correspond to the current signal states. Do not access the INTERBUS addresses.

Local Bus Error

A defective local bus (LB) was diagnosed. The diagnostic parameter register (see Section 5, "Controlling INTERBUS") contains the number of the bus segment where the indicated error occurred.

The error stops the bus. The I/O data does not correspond to the current signal states. Do not access the INTERBUS addresses.

Remote Bus Error

A defective remote bus or a defective installation remote bus device was diagnosed (RB). The diagnostic parameter register(see Section 5, "Controlling INTERBUS") contains the number of the bus segment where the indicated error occurred.

The error stops the bus. The I/O data does not correspond to the current signal states. Do not access the INTERBUS addresses.

Apart from the bus segment number, the diagnostic parameter register can also contain the numbers E1, E2, E4 or E6. Table 3-2 describes the meanings of these errors, their causes and remedies.

Table 3-2: Remote bus error indications E1, E2, E4 and E6

Error No.	Meaning	Error Cause	Remedy
E1	After the error occurred, no error was found when the configuration was acquired and compared.	Incorrect cabling or shielding	- Check remote bus and local bus cabling. - Check voltage supply.
E2	The maximum possible configuration has been exceeded.	Number of devices or register locations is too high.	- Check configuration.
E4	The configuration could not be acquired.	Device does not respond.	Check voltage supply for dips.
E6	No error found when the configuration was acquired and compared, but no data cycle is possible.	Module error	- Inform the Technical Support of Phoenix Contact.

Parameterization Error

When this error occurs (CTRL), switch the PLC off and on again, provided that the operating state of the entire system permits this. If the error is indicated again, read out the diagnostic parameter register (see Section 5, "Controlling INTERBUS"), write down the hexadecimal value and notify Phoenix Contact for service.

The error can stop the bus. The I/O data does not correspond to the current signal states. Do not access the INTERBUS addresses.

Indication Priorities of Errors

The various types of errors have different priorities. If several errors occur, the error with the highest priority will be indicated. If several errors occur that have the same priority, the error which occurred first will be displayed. Priority 1 is of utmost importance.

Table 3-3: Priorities of error causes

Error Cause	Diagnostic Parameter	Priority
Hardware fault	Error code	1
Parameterization error	Bus segment number	2
Remote bus error	Bus segment number	2
Local bus error	Bus segment number	2
Module error	Bus segment number	3

Section 4

In this section you will get to know

- How the addresses of the INTERBUS devices are determined by the slot of the controller board relative to the other INTERBUS SIMATIC® components in the PLC memory.
- How to determine the maximum number of connectible INTERBUS I/O points depending on the slot of the controller board.
- An example which illustrates the assignment of the INTERBUS addresses in the PLC memory.

4 Addressing

To understand this section, it is required that you are familiar with and can apply the slot-oriented addressing of the Siemens S5-95U/S5-100U PLCs (see Section "Addressing" of the product documentation from Siemens).

From the automation equipment viewpoint the INTERBUS devices are to be handled like Siemens modules as far as the addressing is concerned (load or transfer operations). That means you can access the devices directly via the periphery (L PW, T PW) or indirectly via the process image (A I, S Q, L IW, T QW, ...). This allows to use the complete instruction set of the PLC.

4.1 Determining the Slot and Addresses Required

Slot of the Controller Board

When you select the slot of the controller board you automatically select the first, even start address in the analog process image for the data of the INTERBUS system. This data comprises system information (operating, error and function indicators) and digital/analog input and output words.

Figure 4-1 shows the relationship between the possible slots for the controller board and the resulting first occupied INTERBUS address in the analog process image.

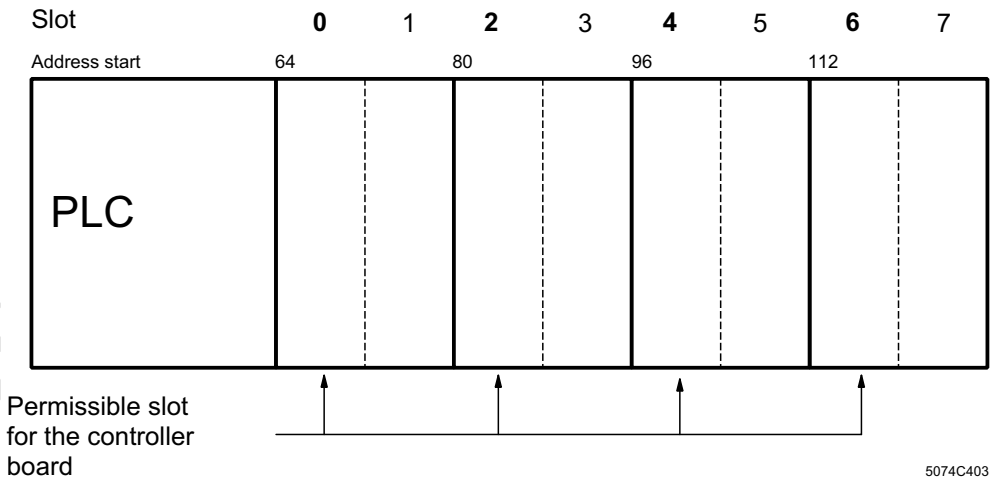


Figure 4-1: Possible slots for the controller board and the associated first INTERBUS address

The selection of the slot is determined by the number of I/O points to be connected in the INTERBUS system and, if necessary, the Siemens analog modules to be installed.

Installation Order

Figure 4-2 shows the installation order when additional Siemens analog modules are to be installed.

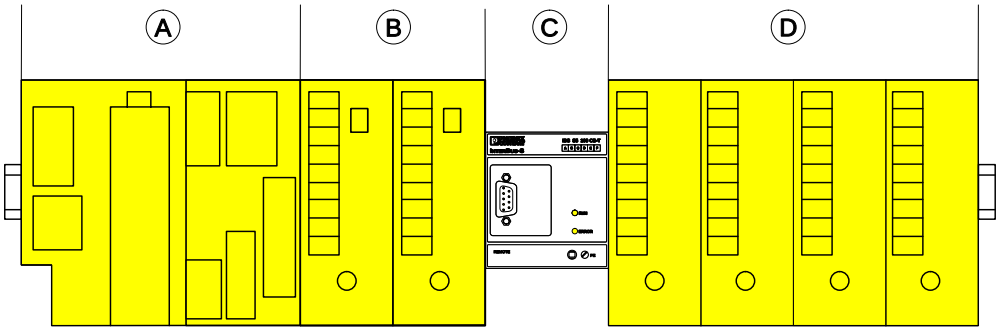


Figure 4-2: Installation order for the PLC, the INTERBUS controller board and other I/O modules from Siemens

A. S5 95U or S5 100U PLC

B. Siemens analog modules

C. IBS S5 100 CB-T controller board

The controller board must only be plugged into the slot 0, 2, 4 or 6. The slot also determines the addresses of the INTERBUS devices in the process image.

D. Siemens digital modules

Please refer to Table 4-1 in order to determine the appropriate slot for the controller board.

Table 4-1 shows the maximum number of the addressable digital/analog I/O addresses and the start address. These addresses depend on the PLC used, the CPU installed and the slot of the controller board.

Addressing examples for various CPU types can be found in the Appendix (see Section A.6, "Addressing Examples", page A-5).

Table 4-1: Start address and number of I/O points depending on the PLC used, the CPU and slot location of the controller board

Possible Slot for IBS S5 100 CB-T	INTERBUS Base Address (First INTERBUS Device Address *)		Maximum Number of I/Os, Bytes (Bits)			
			S5 95U	S5 100U		
				CPU 100	CPU 102	CPU 103
0	Inputs	64 (68)	64 (512)	16 (128)	32 (256)	64 (512)
	Outputs	64 (66)	64 (512)	16 (128)	32 (256)	64 (512)
2	Inputs	80 (84)	48 (384)	xx	16 (128)	48 (384)
	Outputs	80 (82)	48 (384)		16 (128)	48 (384)
4	Inputs	96 (100)	32 (256)	xx	xx	32 (256)
	Outputs	96 (98)	32 (256)			32 (256)
6	Inputs	112 (116)	16 (128)	xx	xx	16 (128)
	Outputs	112 (114)	16 (128)			16 (128)

* In the word-oriented address area (analog area) of the PLC, two input words and one output word are assigned to the diagnostic and function registers of the controller board.

xx The controller board cannot be placed at the specified slot.

Addressing examples for various CPU types can be found in the Appendix (see Section A.6, "Addressing Examples", page A-5).

Block-by-Block Assignment of PLC Memory

The memory space assigned to INTERBUS data is additionally determined via an automatic memory block reservation by the controller board.

If one single INTERBUS device is connected, 16 bytes of the max. assignable 64 input and output bytes (no Siemens analog module connected) will be "reserved" block by block.

As soon as the required byte number of all devices to be connected exceeds 16 bytes **but** does not exceed 32 bytes, further 16 bytes are preassigned. This is done independent of the byte number that is actually used.

If further devices are to be connected which exceed the reserved area of 32 bytes, the controller board reserves 16 further bytes. If this area (48 bytes) is exceeded as well, another 16 bytes will be added. With that the complete analog I/O memory area (64 bytes) is assigned as of address 64 to 127 (assumption: no Siemens analog modules are connected!).

The reservation of memory for the INTERBUS modules causes an offset in the slots that can be assigned to subsequent Siemens digital modules.

Table 4-2 shows how many slots are reserved in the PLC depending on the address area reserved by INTERBUS.

Table 4-2: Slots occupied in the PLC depending on the reserved INTERBUS address area.

Address Area Reserved by INTERBUS	Slots Occupied in the PLC
16 bytes	2
32 bytes	4
48 bytes	6
64 bytes	8

Even when the remote bus is not connected or the bus configuration has not been acquired does the controller board occupy two slots (viewed from the PLC).

Example with the Data from the Table:

Figure 4-2 shows the first two slots which are occupied with SIMATIC® modules. Thus, when the INTERBUS control registers are taken into consideration, the INTERBUS data area starts with address 84 in the input area or address 82 in the output area.

4.2 INTERBUSI/O Data in the Analog PLC Address Area

Figure 4-3 shows how the digital/analog input and output data is distributed as well as the INTERBUS I/O data positioned in the analog address area (bytes 64 - 127) of the S5-95U/ S5-100U PLC:

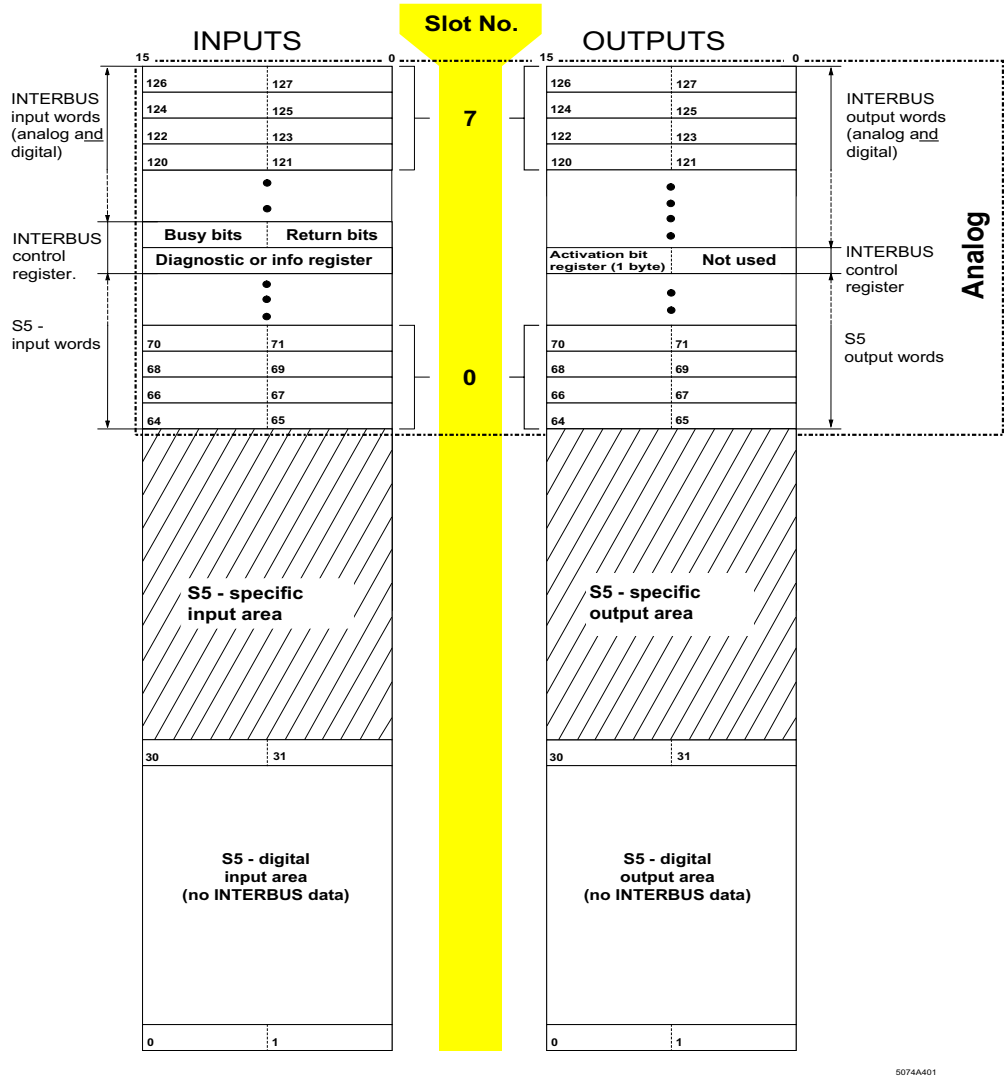


Figure 4-3: Slot-oriented address allocation to INTERBUS devices.

The registers shown in Figure 4-3 which are called "Busy bits", "Return bits", "Diagnostic or info register" in the input area or "Activation bit register" in the output area are used to control the INTERBUS system. They are explained in more detail in Section 5, "Controlling INTERBUS".
These registers are always stored at the beginning of the INTERBUS data area (input or output area). They are not important for the exchange of process data.

Number of Addressable INTERBUS Devices

The number of addressable INTERBUS devices depends on the number of the analog modules connected between the PLC and the controller board, since only the slots 0 to 7 (analog I/O address area, address 64 - 127) can be used.

Byte-by-Byte Memory Access

The I/O memory area can be accessed byte-by-byte.

Ascending Order of INTERBUS I/O Data in the PLC Memory

When arranging the analog/digital INTERBUS I/O data in the data areas, it is necessary that the data bytes or words are stored in an ascending order according to their physical order in the bus topology. The physical order of the INTERBUS devices results from the controller board viewpoint in direction of the last INTERBUS device (see the numbering of INTERBUS devices in Figure 4-4).

Owing to the limited address area, word modules are also assigned to odd addresses.

The assignment of the input address area is independent of that in the output address area and vice versa. For example, address 84 of the INTERBUS output address area can be assigned, even when address 84 in the INTERBUS input address area is also used (see Figure 4-4).

Only for analog INTERBUS data you should observe that this data always starts at an even address in the analog address area of the PLC. Thus, individual bytes in the memory may not be assigned when an analog device follows a digital device (both devices with the same data transmission direction).

To obtain information on the bytes assigned to a module in the I/O address area, please refer to the "IBS Device List" Data Sheet.

INTERBUS devices (even digital ones!) with PCP data are classified like analog devices (address assignment in the analog area of the PLC). However, the PCP data item itself is not represented in the PLC's process image.

Exemptions From the Data in the "IBS Device List" Data Sheet When Using the IBS S5 100 CB-T Controller Board:

Module Type	Short Description	Address Area	
		IN (Byte)	OUT (Byte)
IBS IP DIO 1/24..	16 inputs /8 outputs 24 V	2	2*
IBS IP DIO 2/24..	16 inputs /8 outputs 24 V	2	2*
IBS IP BDIO 1/24..	16 inputs /8 outputs 24 V	2	2*
IBS 24 IP DIO BB1/E-T	24 inputs, 8 conf. inputs/outputs	4	4*
IBS 24 IP DIO BB1-T	16 inputs, 16 conf. inputs/outputs	4	4**

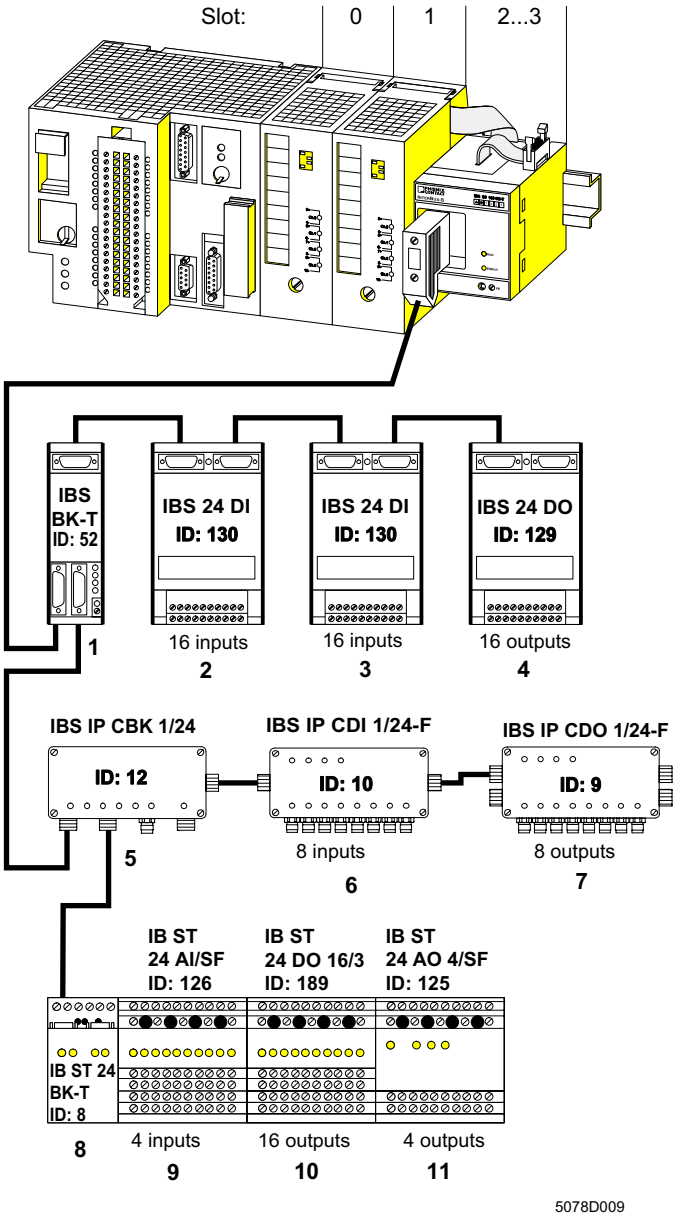
* The output data can be read in the first byte of the memory word.

** The output data can be read in the first and second byte of the two memory words.

4.3 Example of the INTERBUS Address Assignment in the Process Image

Figure 4-4 shows a bus configuration with the IBS S5 100 CB-T controller board. Table 4-3 shows the byte-serial assignment of the I/O address in the PLC. As two SIMATIC® controller boards are connected prior to the controller board, the INTERBUS I/O address area starts with address 84 (inputs) or 82 (outputs).

Table 4-3: Exemplary bus configuration



Add.	In-puts	Out-puts
80	Param.	Activat.
81	Bit	xx
82	Busy	Dev. 4
83	Return	
84	Dev. 2	Dev. 7
85		Dev. 10
86	Dev. 3	
87		xx
88	Dev. 6	Dev. 11
89	xx	
90	Dev. 9	
91		
92		
93		
94		
95		
96		xx
97		
98	xx	
111	xx	xx

Figure 4-4: Exemplary bus configuration

xx Address area which is not assigned but reserved for INTERBUS

Section 5

This section informs you about

- How to detect errors and to acknowledge them with the help of a function block (included in the scope of delivery).
- INTERBUS-specific operating and error indications (diagnostic information) which can also be called by special registers of the PLC program.
- How to control INTERBUS by means of bit-controlled system functions.
- How to obtain information about the number of INTERBUS I/O bytes.

5 Controlling INTERBUS

INTERBUS Registers

Besides the visual indication on the controller board (RUN and ERROR LEDs), you have also diagnostic information on the operating state of the INTERBUS system.

For this purpose there are three register types:

- Diagnostic register
- Info register
- Control register for system functions

The diagnostic register and the info register are assigned to the same 16-bit input word in the analog address area. This input word is located at the beginning of the INTERBUS data area.

Control Registers

The control registers are assigned to the first output word and one input word in the analog address area. You can determine whether the diagnostic or info register will be mapped using one bit of this register. In addition, you can process INTERBUS system commands.

The diagnostic register is described in the following Section 5.1, "Structure and Meaning of the Diagnostic Register".
The control registers are described in Section 5.2, "Controlling INTERBUS via System Functions".
The meaning of the info register is explained in Section 5.3, "Structure and Meaning of the Info Register".

5.1 Structure and Meaning of the Diagnostic Register

Diagnostic Register

The high-order byte of the diagnostic register contains the diagnostic bits, the location of which is shown in the following figure. This part of the register is called diagnostic bit register. The low-order byte contains supplementary information (diagnostic parameter) to indicate the diagnostic bit register.

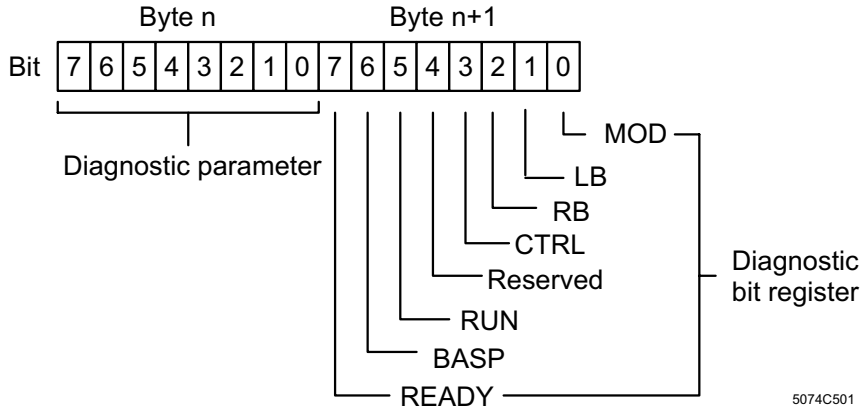


Figure 5-1: Structure of the diagnostic bit register (part of the diagnostic register)

The diagnostic bits reflect the operating and error states of the INTERBUS system and the PLC and correspond to the optical indication of the ERROR and RUN LEDs (see Section 3, "Starting the System and Evaluating Operating Indicators").

Meanings of the Diagnostic Bits

The following list explains the meanings of these bits. If a diagnostic bit is set (logic 1), the corresponding status is active.

Operating Indicators Through Diagnostic Bits

READY
The controller board ran through its selftest without errors and is ready to operate.

BASP
The PLC activated the BASP signal (command output inhibit) and is in the STOP state. In this mode, INTERBUS resets all outputs.

RUN
The RUN bit becomes active when a data cycle runs on INTERBUS.

Error Indication Through Diagnostic Bits

CTRL
The CTRL bit (**C**on**TR**o**L**ler Error) reports an error which is related to the controller board.

RB
A defective remote bus (**R**emote **B**us Error) was diagnosed.

LB
A defective local bus (**L**ocal **B**us Error) was diagnosed.

MOD
The MOD ERR (**MOD**ule Error) occurs when an INTERBUS device indicates an error (e.g., short circuit or missing voltage supply) (only possible for modules with bus acknowledgment). The bus runs properly.

Meaning of the Diagnostic Parameter Register

The low-order byte of the diagnostic register (see Figure 5-1) contains the diagnostic parameters.

If a bit (MOD, LB or RB) is set in the diagnostic bit register, the diagnostic parameter register indicates the bus segment number of the reported error type.

What Is a Bus Segment?

There are two types of bus segments:

- Remote bus segment
- Local bus segment (which also includes the INTERBUS ST stations)

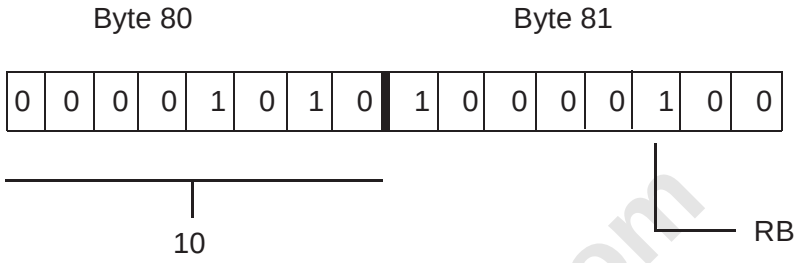
Each bus segment type is consecutively numbered - viewed from the controller board - starting with 0 (see Figure 4-4). Each remote bus segment consists of a BK module and the remote bus segment which lies between this BK module and the next BK module leading to the controller board.

The local bus segment consists of a BK module and the local bus connected to it (or an INTERBUS ST compact station).

In the event of the error type CTRL, the parameter indicates the number of the error which occurred on the controller board.

Example for Determining the Error Type and Location in the Diagnostic Register:

Let us assume that the following indication is mapped into the diagnostic register, for example, into the address bytes 80 and 81:



The evaluation shows that an error occurred in the 10th remote bus segment.

This information in the diagnostic register allows a quick error localization.

The error shown in the diagnostic register can be removed as follows:

Check the BK module concerned and the incoming remote bus cable (remote bus segment 10) for damage or voltage failure and blown fuses.

5.2 Controlling INTERBUS via System Functions

If you have detected and finally removed the error cause with the help of the information contained in the diagnostic register, you may control INTERBUS via bit-controlled system functions. For this purpose, the bits of an additional register are used which is called activation bit register. The activation bit register is located in the analog output area of PLC at the beginning of the INTERBUS data area which is determined by the slot of the controller board (see Section 4, "Addressing").
Which system functions are available and to which bits of the activation bit register are they assigned is shown in Figure 5-2 and Table 5-1.

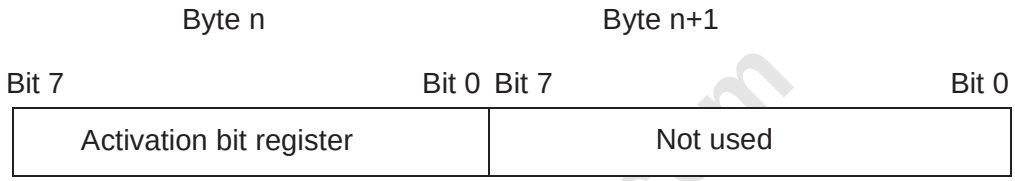


Figure 5-2: Activation bit register

Table 5-1: Allocation of the bits of the activation bit register to the system functions

Bit No. of Byte n	System Function
0	Starts the INTERBUS system
1	Reads in the bus configuration and checks the system
2	Clears the diagnostic register and the ERROR LED
3	Clears the diagnostic register, the ERROR LED, and reads in the module errors
4	Acknowledges all module errors stored on the modules
5	Stops the bus system and resets all outputs
6	Configures and re-addresses the system
7	Switches between the display of the diagnostic and the info register

Reset the set activation bit after the functions have been processed.

5.2.1 Meanings and Use of System Functions

Starting the INTERBUS Systems (Bit No. 0):

Function 0 The diagnostic display is cleared and the connected INTERBUS system started.

Use Starting the INTERBUS system after an error in a remote or local bus.

Reading In the Bus Configuration and Checking the System (Bit No. 1):

Function 1 The diagnostic display is cleared and the connected INTERBUS configuration read in. The ERROR LED and the diagnostic register indicate an error.

Use Checking the INTERBUS system in the event of an error. For the control of the INTERBUS system, the info register shows the number of input and output bytes in the system.

Clearing the Diagnostic Register and the ERROR LED (Bit No. 2):

Function 2 The diagnostic data indicated by the LEDs and the diagnostic register is cleared.

Use If a "forced error" is produced (e.g., disconnecting the outputs or I/O voltage when a protective screen is opened), the error message can be cleared.

Clearing the Diagnostic Register, the ERROR LED, and Reading In the Module Errors (Bit No. 3):

Function 3 See bit no. 2. In addition, the controller board first clears the module error indication. If there are further existing module errors (of a lower priority), they are indicated afterwards. This indication remains clear if there is no further module error.

Use Clearing of a detected and removed module error and indicating subsequent module errors. For example, after a protective screen was closed or the I/O voltage was switched on, it is checked whether the I/O side is actually supplied with power.

Acknowledging All Module Errors Stored on the Modules (Bit No. 4):

Function 4 The errors stored on the modules (storage only possible for a few modules) are acknowledged and cleared. The diagnostic display is not cleared.

Use If there is a module error on the modules concerned (e.g., a short circuit or failure of the I/O voltage), this module error must be acknowledged using this function. The diagnostic indication can be processed with the bit numbers 2 and 3.

Stopping the Bus System and Resetting the Outputs (Bit No. 5):

Function 5 The INTERBUS system is stopped (no data transmission) and the INTERBUS outputs are reset. The inputs are reset.

Use A quick stop of the entire system.

The SIMATIC® outputs are **not** affected.

Configuring and Re-Addressing the System (Bit No. 6):

Function 6

The diagnostic indication is cleared, the connected INTERBUS system is read in and re-addressed to the PLC. Thereafter, INTERBUS is started.

If, after the PLC was switched on, a bigger INTERBUS system is started up, the SIMATIC® addresses may have been shifted. The PLC can be set to the STOP state.

Use

If the info register indicates a smaller bus configuration than expected after the PLC has been switched on, bit no. 1 can be used to read in the configuration. For the control of the INTERBUS system, the info register shows the number of input and output bytes in the system.

If the configuration has the expected size (i.e., the expected address block is correct), INTERBUS is started via bit no. 0. The controller board does not form blocks again.

If the configuration does not have the expected size, INTERBUS must be re-configured using the bit no. 6. The controller board again forms blocks in the PLC memory (another address block is activated, e.g. 16 bytes).

The PLC may be put into the STOP state.

Switching Between the Indication of the Diagnostic and the Info Register (Bit No. 7):

Function 7

Alternate indication of the diagnostic register or the info register in the first data word of the INTERBUS address area.

Use

With the diagnostic register (bit no. 7 = 0) you can detect operating or error states of the INTERBUS system. The info register (bit no. 7 = 1) indicates how many input and output bytes have been detected in the INTERBUS system.

The set, seventh bit of the busy bit register (see following section) indicates that the info register is shown.

Busy/Return Bit Register to Control System Functions

If you start system functions by setting the corresponding output bit in the activation bit register, you may follow the processing sequence of the system function by means of another register, the busy/return bit register.

Both the busy bit register and the return bit register occupy one byte and are located directly above the diagnostic or info register. The low-order byte of this register contains the busy bits corresponding to the bits of the activation bit register. A set busy bit indicates that the associated function is being processed at the moment.

Only one system function must be processed at a time.

Example of How a Successfully Processed System Function Is Indicated: (Clearing the Diagnostic Register and Checking the System)

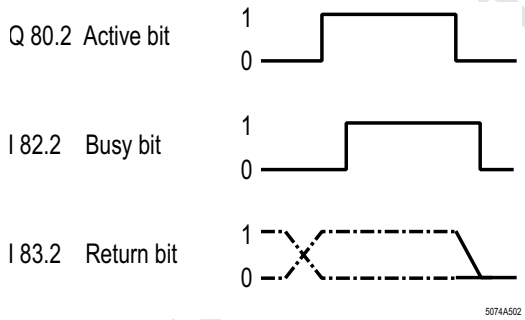


Figure 5-3: Sequence description of a successfully system function

In the example, the busy bit indicates that the diagnostic register and the LEDs have been cleared. While the system functions are being processed, the state of the return byte (low-order byte) is not defined.

As soon as the function is processed (busy bit = 0), the associated return bit indicates whether the processing was successful (return bit = 0) or unsuccessful (return bit = 1).

Reset the set activation bit after the functions have been processed.

Example of How an Incorrectly Processed System Function Is Indicated: (Clearing the Diagnostic Register and Checking the System)

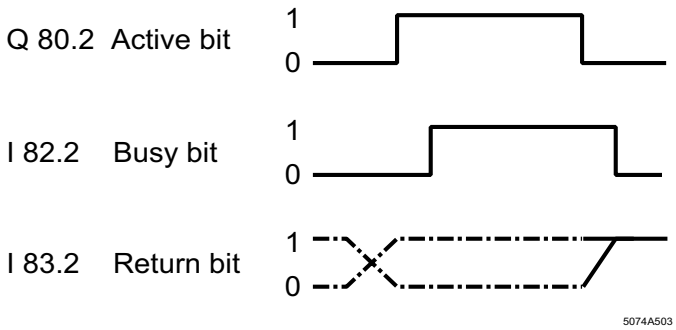


Figure 5-4: Sequence description for an incorrectly processed system function

The example shows that the diagnostic register **and/or** the LED could not be cleared. In this case (return bit = 1), please inform yourself about the error cause with the help of the diagnostic register (see Section 5.3, "Structure and Meaning of the Info Register", page 5-10).

5.3 Structure and Meaning of the Info Register

Bit 7 of the activation bit register is used to switch between the diagnostic register and the info register which both use physically the same 16-bit input word in the analog address area. When bit 7 in the activation bit register and the busy bit 7 are set, the info register is shown.

In the low-order byte, the info register shows the number of the INTERBUS output bytes. The high-order byte indicates the number of INTERBUS input bytes.

Setting or clearing the activation bit 7 causes the info or diagnostic register to be shown.

Low-order byte n		High-order byte n+1	
Bit 7	Bit 0	Bit 7	Bit 0
Number of INTERBUS output bytes		Number of INTERBUS input bytes	

Figure 5-5: Structure of the info register

5.4 Easy Error Treatment with the Function Block FB 14

Requirements

FB 14 has to be linked to the PLC program (see Section 3.1, "Adding the FB 14 Function Block to the Control Program", page 3-3) and the data has to be entered properly into the associated data block DIDB (see Section A.3, "Function Blocks FB 14 and FB 210", page A-3).
When an error occurs and you are using this function block, you do not need to activate system function individually, evaluate the info register or start the bus system.

NSTR Parameter

NSTR determines how INTERBUS can be started:

NSTR = 0: INTERBUS is started only by switching the PLC on or off.
NSTR = 1: INTERBUS is started by switching the PLC on or off or during PLC startup.

5.4.1 Manual Error Treatment

Parameters AUTO = 0, QUIT = 1

When the FB 14 parameter "QUIT" is set, an error message is acknowledged or INTERBUS is started again. The start is only successful, if all errors that occurred have been removed.

5.4.2 Automatic Error Treatment

Parameter AUTO = 1

In the time-slot pattern of the value (DW 5) stored in the data block, the function block regularly attempts to acknowledge an error message or to restart INTERBUS. The start is only successful, if all errors that occurred have been removed.

A Appendix

A.1 Technical Data

Controller Board

Type	IBS S5 100 CB-T
Hardware version	A
Order No.	27 53 69 8
Power supply	Through SIMATIC® connection
Current consumption	550 mA at +9 V
Host systems	S5 95U, S5 100U
Interrupt operation	Not possible
Degree of protection	IP 0 (default state, upgradable to IP 20 protection through optional FLK 16-pin strip)
Permissible operating temperature	From 0°C to 55°C
Permissible storage temperature	From -20°C to 70°C
Permissible humidity during operation	70%
Permissible humidity during storage	95%, no condensation
Housing dimensions (w*h*d)	67.5 mm * 75 mm * 105 mm, one mounting location on standard rail (67.5 mm)

INTERBUS Interface

Number of devices	Up to 128
Number of remote bus devices	Up to 64
Inputs/outputs	Max. 480 inputs and 496 outputs can be connected to INTERBUS
Operating mode	Controlled mode
PCP communication	Not supported
Addressing	Slot-oriented (physical) addressing
Diagnostic elements	2 diagnostic LEDs on the front plate Diagnostic registers in the input address area of the PLC

A.2 Additional Products

User Manuals

Installation Manual	IBS SYS INST UM E
Order No.	27 54 80 4

Data sheets for INTERBUS I/O modules from Phoenix Contact are available on request.

Connectors/Cables

9-pos. D-SUB male connector (remote bus)	SUBCON 9/M-SH
Order No.	27 61 50 9

and

Remote bus cable	IBS RBC METER-T
Order No.	28 06 28 6
Dummy plug for IP 20 protection	FLK 16 pin strip
Order No.	22 87 11 9

A.3 Function Blocks FB 14 and FB 210

The "CBDIAGST.S5D" file on the enclosed disk contains the source text for the function blocks FB 14 and FB 210 that are to be linked to the control program.

The function block FB 14 (name: CB DIAG) is responsible for the startup and acknowledges the error messages of the INTERBUS system.

Call and Parameters of FB 14

	JU	FB 14		
Name:	CB-DIAG			
DIDB:		DB	14	Definition of the data block DIDB
NSTR:		F	100.0	Start of INTERBUS after cold or warm start
QUIT:		I	12.0	Acknowledgment button
AUTO:		F	0.0	Automatic acknowledgment of an error message
IRUN:		F	100.1	INTERBUS in the RUN state
IMOD:		F	100.2	INTERBUS reports a module error
T:		T	2	Occupied timer

Method of Functioning of FB 14

FB 14, which is initialized through FB 210 from the startup blocks, evaluates the bits of the diagnostic bit register. In the event of an error (bits "LB", "RB", "CTRL" or "MOD"), the input parameters "NSTR", "QUIT" or "AUTO" (if they are set) determine how the error message(s) is (are) acknowledged and how the bus is started again.
The function block compares the number of the actually used I/O bytes from the info register with the number of I/O bytes specified in the data block DB 14 (DW 10). INTERBUS will only be started if both values are identical. The start can be carried out manually (AUTO = 0, QUIT = 1) or automatically (AUTO = 1 and time selection with the data word DW 5 in the data block DIDB). When the manual start is selected, the QUIT parameter can be set by means of a button, thus starting INTERBUS again.

Description of the DIDB Data Block

The data block DIDB (of the length 14) stores the working data for FB 14. You have to enter the correct values into the data words 0 - 3, 5 and 10.

DW0	**KY**	**000,081**		**Address of the diagnostic bit register**
DW1	**KY**	**000,080**		**Address of the diagnostic parameter register**
DW2	**KY**	**000,080**		**Address of the activation bit register (QW)**
DW3	**KY**	**000,082**		**Address of the activation bit register (IW)**
DW4	KF	+00000		Not used
DW5	**KT**	**500.0**		**Value of the timer used**
DW6	KM	00000000	00000000	Diagnostic bit register (last content)
DW7	KF	+00000		Last content of the diagnostic parameter register
DW8	KF	+00000		Internally used
DW9	KF	+00000		Internally used
DW10	**KY**	**013, 013**		**Preset I/O bytes for the info register**
DW11	KY	000, 000		Read I/O bytes of the info register
DW12	KF	+00000		Internally used
DW13	KF	+00000		Internally used

Technical Data of FB 14

Number:	FB14
Name:	CB-DIAG
Length:	188
Phoenix library number:	61413
Version:	1.3
Occupied flags, timers, counters:	FW 254, FY 253, time see parameters Assignment
Data block:	DW0 - DW13 of DIDB

Function Block FB 210

The function block FB 210 initializes the function block FB 14. FB 210 is called in the organization blocks OB 21 and 22. It has the following content:

```
Name   :Startup

       :AN   F    100.0    Parameter "NSTR" of
       :S    F    100.0    FB 14 is set
       :C    DB   14       Working data block for FB 14
       :L    KB   0        Reset
       :T    DW   8        Internal data words
       :T    DW   9        used by FB 14.
       :T    DW   11
       :BE
```

A.4 INTERBUS Devices from Other Manufacturers

Besides the INTERBUS devices which are listed in the data sheet "IBS Device List" and can be obtained from Phoenix Contact, the INTERBUS User Groups DRIVECOM, ENCOM and other manufacturers offer a wide variety of remote bus and local bus devices. Please contact the respective manufacturer for a description of these bus devices as well as their ID and length codes.

A.5 Changes When Compared to the First Hardware Release

You can recognize the first delivery state of IBS S5 100 CB-T controller board by the fact that none of the revision letters at the front is marked.

- The organization block OB 13 of the PLC types S5 95U und S5 100U with a CPU 103 is supported by hardware revision A.
- The pin strip on the top side for the connection of further bus modules is flexibly attached to the end of the flat-ribbon cable.
- With hardware releases lower than A, the connection is made by means of a separate extension cable.

A.6 Addressing Examples

A.6.1 Addressing Examples for Siemens CPU 95 and CPU 103

	Addresses										
Analog	64-71	72-79	80-87	88-95	96-103	104-111	112-119	120-127	--	--	--
Digital	0.0-0.7	1.0-1.7	2.0-2.7	3.0-3.7	4.0-4.7	5.0-5.7	6.0-6.7	7.0-7.7	8.0-8.7	9.0-9.7	...
CPU	IBS (16 bytes)		SiD	SiD	SiD	SiD	SiD	SiD	SiD	SiD	...
CPU	SiA	not used	IBS (16 bytes)		SiD	SiD	SiD	SiD	SiD	SiD	...
CPU	SiA	SiA	IBS S5 100 CB-T (32 bytes)				SiD	SiD	SiD	SiD	...
CPU	SiA	SiA	IBS S5 100 CB-T (48 bytes)						SiD	SiD	...
CPU	IBS S5 100 CB-T (64 bytes)								SiD	SiD	...

A.6.2 Addressing Examples for Siemens CPU 100

	Addresses										
Analog	64-71	72-79	80-87	88-95	96-103	104-111	112-119	120-127	--	--	--
Digital	0.0-0.7	1.0-1.7	2.0-2.7	3.0-3.7	4.0-4.7	5.0-5.7	6.0-6.7	7.0-7.7	8.0-8.7	9.0-9.7	...
CPU	IBS (16 bytes)		SiD	SiD	SiD	SiD	SiD	SiD	SiD	SiD	...

With the CPU 100, Siemens analog modules cannot be used!

A.6.3 Addressing Examples for Siemens CPU 102

	Addresses										
Analog	64-71	72-79	80-87	88-95	96-103	104-111	112-119	120-127	--	--	--
Digital	0.0-0.7	1.0-1.7	2.0-2.7	3.0-3.7	4.0-4.7	5.0-5.7	6.0-6.7	7.0-7.7	8.0-8.7	9.0-9.7	...
CPU	IBS (16 bytes)		SiD	SiD	SiD	SiD	SiD	SiD	SiD	SiD	...
CPU	SiA	not used	IBS (16 bytes)		SiD	SiD	SiD	SiD	SiD	SiD	...
CPU	SiA	SiA	IBS (16 bytes)		SiD	SiD	SiD	SiD	SiD	SiD	...
CPU	IBS S5 100 CB-T (32 bytes)				SiD	SiD	SiD	SiD	SiD	SiD	...

Key:

- IBS S5 100 CB-T and INTERBUS address area
- Siemens digital module (SiD)
- Siemens analog module (SiA)

Appendix B

List of Figures

Section 1

Section 2

Section 4

Section 5

Appendix B

List of Tables

Section 1

Section 3

Section 4

Section 5

Appendix B

Index

Address Area See *Input Address Area* and *Output Address Area*.

Alarm Output Additional alarm contact at a BK module which can be used, for instance, to control an alarm indicator.

BK Module A bus terminal (BK) module is used to couple an INTERBUS local bus or installation remote bus to a higher-level bus, for example the remote bus of INTERBUS. The BK module also supplies the module electronics of the connected modules (communication voltage U_L).

Bus Diagnostics The bus diagnostics provides information allowing bus errors to be analyzed. Diagnostic elements on the hardware level are LEDs on controller boards, BK modules and I/O modules. In addition, the controller board can locate the errors by means of software. A Hand-Held Monitor which can be coupled directly to the bus stations is available as a test and service device.

Bus Topology Principle structure of a bus system.

General term of any connection of INTERBUS devices provided that it complies with the rules for the setup of an INTERBUS systems (e.g., max. device number and distance between two devices).

Communication Voltage U_L The communication voltage U_L is supplied at the BK module. In the power supply unit of the BK module, it is converted to 5 V or 9 V and supplies the electronics of the local bus or installation remote bus devices as well as sensors.

Control Register Generic term for the busy/return bit register and the activation bit register, which both are used to control INTERBUS.

Controller Board The controller board connects programmable logic controllers (PLCs) to the INTERBUS sensor/actuator bus. Controller boards are available for all common PLCs.

CRC Error Data transmission error which was detected by means of a cyclic redundancy check (CRC). The error can be produced by every INTERBUS device after the CRC check word has been generated.

Cycle Time With an INTERBUS cycle the input data of all INTERBUS devices (slaves) is transmitted to the host system and the output data of the host system to all INTERBUS devices. The cycle time is the duration of an INTERBUS cycle. It depends on few factors and increases almost linearly as the number of I/O points grows.

Cyclic Redundancy Check The **C**yclic **R**edundancy **C**heck (CRC) is a test method for data save in which a data block is divided by a standardized polynomial and the rest of the division is appended as a CRC word to the user data block to be transmitted.

Diagnostic Register	Generic term for the diagnostic bit and the diagnostic parameter register. The diagnostic indicators on the front plate of the diagnostic controller board are made available to the application program.
DRIVECOM	DRIVECOM is a registered User Group which comprises drive manufacturers that joined together with the aim of enabling the drive systems of the DRIVECOM members to communicate with each other by way of an open and standardized bus concept. INTERBUS which fully meets these demands was selected as communication medium.
Electrical Isolation	Electrical isolation means that the circuits of an electrical device are galvanically separated from each other.
ENCOM	The ENCOM User Group combines leading manufacturers of encoders who decided to use INTERBUS for the networking of their devices. The goals of the ENCOM group are the definition of device profiles, standard test criteria and test equipment as well as the certification of devices.
Extended Installation Remote Bus	An installation remote bus that is capable of providing a larger current to supply the module's electronics and initiators (communication voltage U_L).
Fiber-Optic BK	BK module using fiber optics to connect system parts without equipotential bonding. In addition, it can be used in environments exposed to electromagnetic interference of a high degree. These BK modules correspond to standard BK modules (e.g., IBS 24 BK-T) except for the fact that they are provided with a direct optical fiber connection as a remote bus interface.
Function Module	Module with a certain function (e.g., counter, V24 module).
Gateway	A gateway is an INTERBUS device to couple other transmission systems to INTERBUS.
Hand-Held-Monitor	The Hand-Held Monitor (HHM) is a portable diagnostic device which is coupled to a local bus interface. The device allows a function check of the I/O modules, of a complete local bus system and the connected sensors and actuators. An implemented operator prompting allows its simple use. Possible errors are indicated on a 4-line clear text display.
ID Code	Each INTERBUS device has an identification code (ID code) which is used by the controller board to identify the device during the startup of the bus. From the ID codes of a bus configuration, the controller board generates a bus image which is used later for address assignment of the I/O data and for error detection during operation.
Information Register	The information register (info register) indicates how many input and output bytes that are connected to INTERBUS were detected by the controller board.
Input Address Area	Number of bytes which an INTERBUS device occupies in the input address area of the host system.

Input Data (IN Data)	An INTERBUS device transmits input data to the INTERBUS master.
Installation Depth	The remote bus has the installation depth 0.
Installation Remote Bus	With regard to its structure, the installation remote bus corresponds to a remote bus. However, it provides the option of carrying the supply voltage for module's electronics and sensors in one bus cable (hybrid cable). In terms of the topology it is a local remote bus branch and can be used to set up distributed substations with a direct connection of the sensors and actuators.
Installation Remote Bus, Extended	See *Extended Installation Remote Bus.*
INTERBUS Device	General term for devices with different functions and fields of application, which participate in the data exchange via INTERBUS (e.g., controller boards, interface boards, BK modules, various I/O modules, high-tech controllers, drive controllers, valve manifolds, encoders, ID systems, operator panels and display devices).
I/O Voltage U_S	The I/O voltage U_S is fed in directly at the module to supply the I/Os (sensors, actuators).
Length Code	The length code is the encoding for the number of process data of an INTERBUS device.
Local Bus	A local line that branches off from the remote bus. The local bus consists of local bus modules and is coupled to the remote bus by means of a BK module. The local bus cable connects the local bus modules to each other and to the BK module.
Local Bus Error	The INTERBUS master diagnosed an error in a local bus.
Module Error	The module error (MOD) occurs when the I/O cabling is defective, when there is a blown fuse or a missing I/O voltage. The error is only indicated for modules with bus acknowledgment. The error does not stop the bus.
Output Address Area	Number of bytes which an INTERBUS device occupies in the output address area of the host system.
Output Data (OUT Data)	The INTERBUS master (controller board) transmits the output data to the INTERBUS slaves.
Process Data	Process data is data which is transmitted in a quick, cyclic, and equidistant way through the process data channel of INTERBUS.

Process Data Channel

The process data channel allows to transmit data in an unacknowledged and equidistant way. The direction of the process data is regarded as from the host system to the bus i.e.,

- Process output data is data which the host system writes to the process data channel.
- Process input data is data which the host system reads out of the process data channel.

Reconfiguration

The INTERBUS master generates a message for reconfiguration when the reconfiguration pushbutton is pressed on the BK module.

Register Length

Number of bytes which an INTERBUS device occupies in the INTERBUS ring. This information is required to calculate the cycle time.

Remote Bus

The remote bus connects the distributed INTERBUS substations over long distances and cyclically exchanges the I/O and process data between these substations and the controller board. It must be distinguished from the installation remote bus.

Remote Bus Branch

A drop line from the remote bus which can be disconnected (e.g., installation remote bus).

Slave Board

INTERBUS device in a lower-level control or computer system. The slave board allows the communication of this slave system with the INTERBUS master.

Status Indication

LEDs on the diagnostic controller board or modules indicating the operating state.

Cycle Time

With an INTERBUS cycle the input data of all INTERBUS devices (slaves) is transmitted to the host system and the output data of the host system to all INTERBUS devices. The cycle time is the duration of an INTERBUS cycle. It depends on few factors and increases almost linearly as the number of I/O points grows.

Appendix B

Index

The figures marked in bold indicate the page on which you will find the definition or a short description of the term.

F

H

I

L

M

N

P

R

S

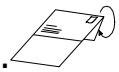
T

We Are Interested in Your Opinion!

We would like to hear your suggestions, wishes and criticisms concerning this InterBus manual. Therefore, we would appreciate your answers to the questionnaire overleaf. No matter how small your contribution, we will deal with any hint or comment.

This reply can be sent as a fax, in an envelope, or directly, after folding (1. / 2.) and sticking it together (with adhesive tape).

Thanking you for your cooperation !

1. 

Phoenix Contact GmbH & Co.
Produktmarketing InterBus/ME-DOK
Flachsmarktstraße 8 - 28
32825 Blomberg
Germany

2. 

FAX-NO.: *49-(0)5235-331199

FAX Reply
Phoenix Contact GmbH & Co.
Produktmarketing InterBus/ME-DOK

Date: .....

No. of pages: .....

Sender:

Company: ..... Contact: .....

..... Dept.: .....

Address: ..... Title: .....

City, ZIP code:..... Telephone: ..... / .....

Country: ..... Fax: ..... / .....

Manual data:

Type: ..... Revision: ..... Order No: .....

My Opinion on the Manual

Form

	Yes	In part	No
Is the Table of Contents clearly arranged?	❒	❒	❒
Are the figures/diagrams easy to understand/meaningful?	❒	❒	❒
Does the page layout make it easy to locate the required information?	❒	❒	❒
Is the chapter overview detailed enough?	❒	❒	❒
Do the corresponding explanations of the figures suffice?	❒	❒	❒
Does the quality of the figures (clear/self-explaining) meet your expectations/requirements?	❒	❒	❒
Do the index entries guide you to the relevant information?	❒	❒	❒

Contents

	Yes	In part	No
Are the technical terms easy to understand/meaningful?	❒	❒	❒
Is the wording always easy to understand/meaningful?	❒	❒	❒
Are the index entries easy to understand/meaningful?	❒	❒	❒
Which reference list (Table of Contents, Figures, Tables, Index) do you use most when you search for information ?			
Is any important information missing? If so, which?	❒	❒	❒
Are the examples practice-oriented?	❒	❒	❒
Is the manual easy to handle?	❒	❒	❒
Do you wish more space for your own notes?	❒	❒	❒

I have the following suggestion(s)/comment(s):

.....
.....
.....
.....
.....
.....

DNR 2533

5050CF17