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IBS ISA SC/RI-LK

Controller Board for PC Systems

Data Sheet 5312A 03/2001

Product Description

INTERBUS system coupler (bus master and slave) for IBM-compatible PCs with integrated 16-bit ISA bus.

Features

- INTERBUS protocol (IEC 61158)
- All INTERBUS interfaces with optical fibers
- Remote bus interface to the higher-level system with independent 24 V supply
- Variable register set of 1 to 10 words
- Support of process data and parameter channel
- Complete Generation 4 functionality

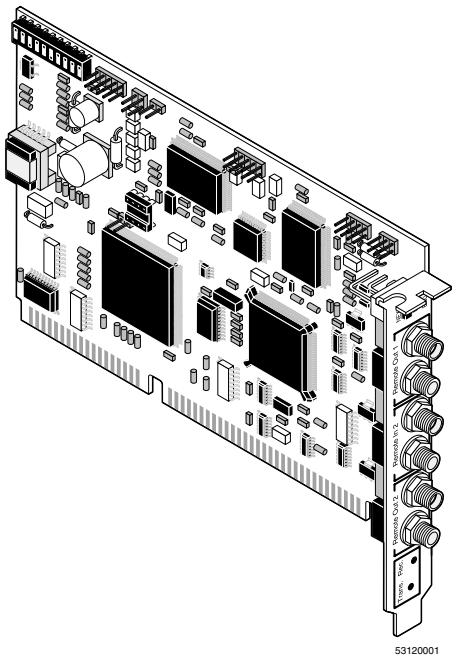


Figure 1 IBS ISA SC/RI-LK

Applications

Connection to a higher-level and a lower-level INTERBUS system and connection of these two systems to a network.

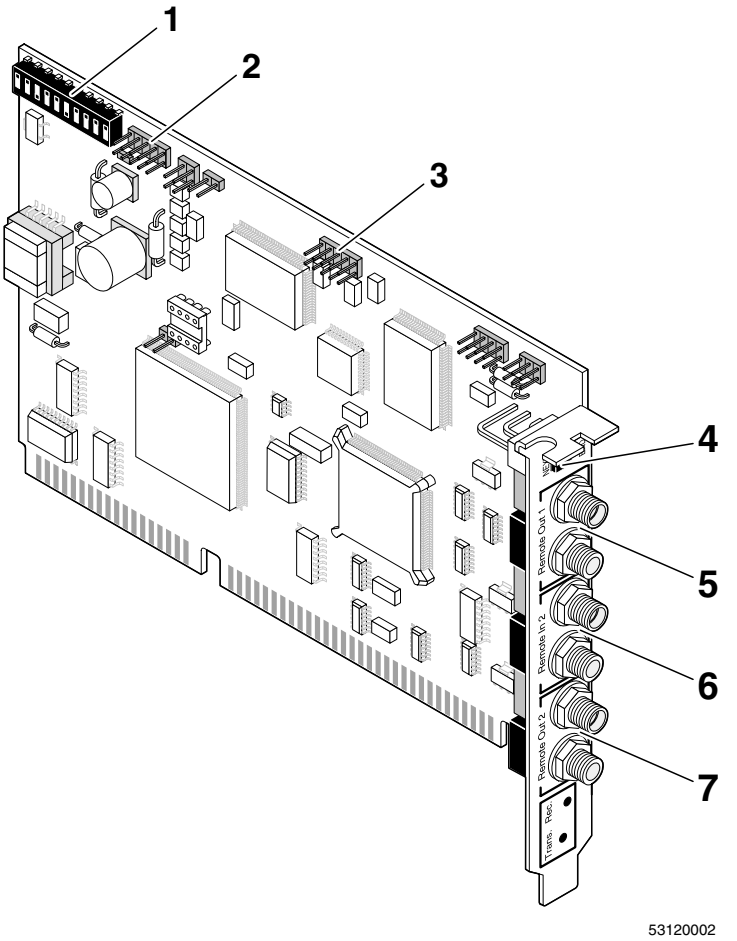


Figure 2 Structure of the IBS ISA SC/RI-LK controller board

The controller board has the following components:

1. DIP switches to set the board address and the startup operating mode
2. External 24 V supply voltage (optional)
3. Diagnostic interface (optional)
4. Switch to connect and disconnect the outgoing slave interface
5. Master interface
   (Remote Out 1, outgoing remote bus)
6. Slave interface
   (Remote In 2, incoming remote bus)
7. Slave interface
   (Remote Out 2, outgoing remote bus)

Functional Units of the Controller Board

DIP Switches

The DIP switches for setting the board address and the startup operating mode for the slave device are on the upper edge of the board and are positioned so that they can be set when the board has been inserted.

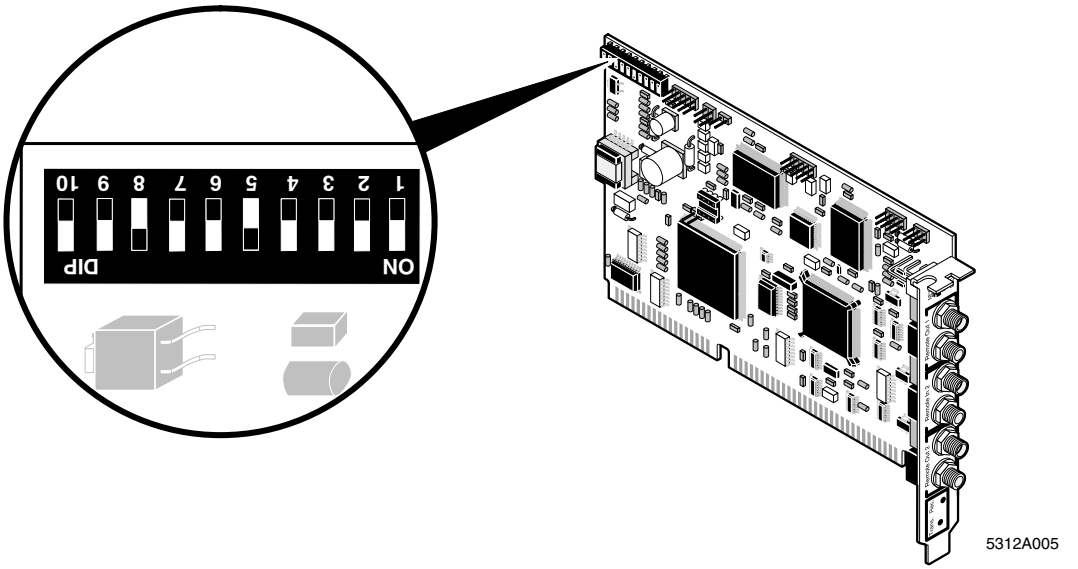


Figure 3 Default setting of the DIP switches (I/O address 120_{hex}, ID code 38_{hex})

Setting the DIP Switches

The startup operating mode for the SμPI3 protocol chip in the slave circuit is set according to the following table using DIP switches 1 and 2:

Table 1: Setting the startup operating mode

DIP Switches	1	2	
Startup operating mode			
ID code 38_{hex} (Not Ready ID, default for Firmware 4.X)	OFF	OFF	Default
ID code 3, 4 data bytes μP interface	ON	OFF	
ID code 3, 6 data bytes μP interface	OFF	ON	
ID code 3, 8 data bytes μP interface	ON	ON	

Because the slave and master core can be supplied with voltage independently from each other, it is possible that the slave part may be ready to operate before the master. As a result, a "NOT READY" ID is provided in the SµPI3, which indicates to the higher-level master that the IBS device has a SµPI3, operating in µP mode, which has not yet been initialized. After startup, the SµPI3 has this special ID code (38_{hex}) and 0 words in the INTERBUS ring and the ring can therefore be started up.
To achieve compatibility with a higher-level Generation 3 bus master, the startup behavior of the SµPI3 can be modified using DIP switches 1 and 2. This step must be carried out because Firmware 3.X does not support the "Not Ready" ID code.

The board address can be set to any value divisible by 8 in the range between 100_{hex} and $3F8_{hex}$ using DIP switches 4 to 10. Eight consecutive addresses in the I/O channel are used.

Table 2: Setting the board address

DIP Switches	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Value	200_{hex}	100_{hex}	80_{hex}	40_{hex}	20_{hex}	10_{hex}	8_{hex}	
I/O address								
100	OFF	ON	OFF	OFF	OFF	OFF	OFF	
108	OFF	ON	OFF	OFF	OFF	OFF	ON	
110	OFF	ON	OFF	OFF	OFF	ON	OFF	
118	OFF	ON	OFF	OFF	OFF	ON	ON	
120	OFF	ON	OFF	OFF	ON	OFF	OFF	Default
128	OFF	ON	OFF	OFF	ON	OFF	ON	
...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	
3F8	ON	ON	ON	ON	ON	ON	ON	

DIP switch 3 (test mode) is not used for setting addresses. It is used to activate the test mode. When the controller board is restarted with test mode switched on, it starts the INTERBUS system with automatic addressing, and initializes it. During test mode the controller board does not respond to instructions from the host system (PC). Any parameterization stored on the controller board is not read in. The controller board initializes and starts up the INTERBUS system independently. Outputs are not set.

The test mode is not intended for normal operation of the controller board. To deactivate test mode, set switch 3 to OFF.

Diagnostic Interface (Optional)

The serial diagnostic interface on the controller board has been designed as a 10-pos. DIL male connector. A flat-ribbon cable is inserted into this male connector so that it can be converted into a standard 9-pos. D-SUB male connector. The D-SUB male connector can be inserted either in an additional mounting cover or in a free mounting slot on the housing.

Table 3: Diagnostic interface pin assignment

D-SUB	DIL	Signal
2	2	TxD
3	3	RxD
5	5	GND
6	6	Connector keying
7	7	RTS
8	8	CTS
1, 4, 9	1, 4, 9, 10	Not used

Bus Connection Using Optical Fibers

The optical fiber cables of the remote bus must be fitted with the appropriate F-SMA connectors. HCS fiber cables and polymer fiber cables can be used as optical fiber cables (see Table 4).

Plug the connectors into the sockets provided and secure the connections with the cap nuts. "Remote In 2" indicates the connection for the incoming remote bus, while "Remote Out 2" indicates the connection for the outgoing remote bus of the slave interface.
"Remote Out 1" indicates the master interface. The terms "Trans." and "Rec." indicate which connector receives (Rec.) or transmits (Trans.) data.

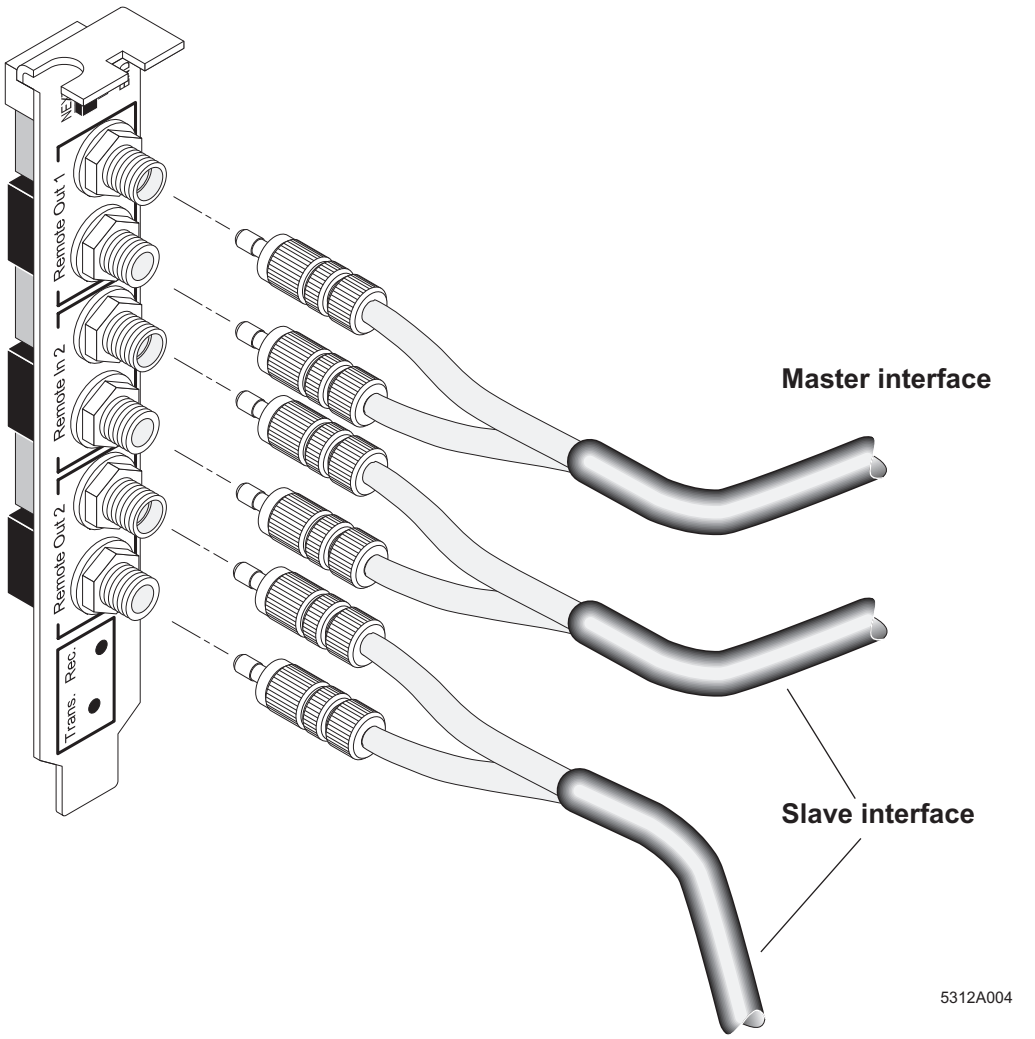


Figure 4 Connecting optical fibers

The NEXT/END switch must be set to "NEXT" if an outgoing bus segment is connected to the "Remote Out 2" connections. The switch must be set to "END" if an outgoing bus segment is not connected to the "Remote Out 2" connections or if, for test purposes, this segment is not to be connected.

Table 4: Comparison of polymer and HCS fibers

	Polymer Fiber	HCS Fiber
Wavelength	665 nm, typical	665 nm, typical
Optical output power	-8.9 dBm (129 µW), minimum	-22.2 dBm (6.0 µW)
Optical responsivity	-26.4 dBm (2.3 µW), minimum	-28.4 dBm (1.4 µW)
Optical overrange	-2.75 dBm (530 µW), maximum	> -8 dBm (158 µW)
Power reduction through wavelength drift	1 dB, typical (50 m [164.04 ft.] cable length)	Negligible
System reserve	> 3 dB	> 3 dB
Transmission length -20°C to +55°C (-4°F to 131°F)	1 m (3.28 ft.), minimum, to 50 m (164.04 ft.) (fiber attenuation 260 dB/km, LED source with 672 nm) 1 m (3.28 ft.) to 60 m (196.85 ft.), typical (fiber attenuation 230 dB/km)	1 m (3.28 ft.), minimum, to 300 m (984.25 ft.) (fiber attenuation 10 dB/km, LED source with 665 nm) 1 m (3.28 ft.) to 400 m (1312.34 ft.), typical (fiber attenuation 8 dB/km)
Bit error rate	10^{-9}	10^{-9}
Core diameter	980 µm	200 µm
Cladding diameter	1000 µm	230 µm
Numerical aperture	0.47	> 0.36
Attenuation for 660 nm measured with LED source	< 220 dB/km	< 10 dB/km
Connector type	FSMA (type 905) according to IEC 874-2 (St.6/89) DIN 47258 (St. E 11/89)	FSMA (type 905) according to IEC 874-2 (St.6/89) DIN 47258 (St. E 11/89)



Phoenix Contact offers pre-assembled bus cables to minimize assembly times. The cables are available in various lengths.

INTERBUS Slave

Up to 10 data words are available when the SμPI3 protocol chip is used with a serial register expansion.

The external supply of the slave interface with a 24 V voltage can be provided to ensure that the slave is ready to operate even if the host PC is disconnected. The slave interface is automatically supplied with voltage when the PC is switched on and thus an external supply is not required. The external supply is electrically isolated from the PC voltage using a DC/DC converter.

No measures for the filtering of high-frequency interference voltage are provided so please ensure that only undisturbed voltages are fed to the PC or a filter (IBS ISA SC/RI-LK FIL, Order No. 27 22 72 6) is placed directly in the housing slot.

EMC Filter for External Voltage Supply (Optional)

The filter is used to feed a 24 V current supply from the industrial sector with ambient class 4 (harsh industrial environment) into a device, typically a PC, which requires ambient class 1 (well protected environment). It is designed for a current of up to 1 A and contains protection against polarity reversal. The external connection is made using a 3-pos. POWER-SUBCON connector. The filter is installed in a slot inside the housing, which is normally used for installing 9-pos. D-SUB connectors. The housing is connected using the usual printed circuit board connections for flat-ribbon cable with connectors attached. The threaded joints of the POWER-SUBCON connector make a good conductive connection to the grounded housing (if the inside of the housing is not coated).

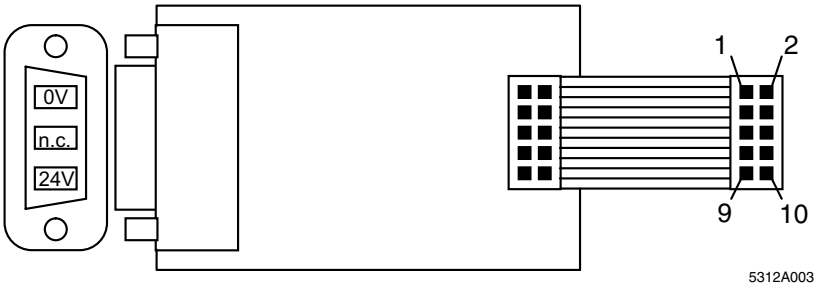


Figure 5 EMC filter (diagram)

The 24 V supply voltage is connected using a Phoenix Contact POWER-SUBCON connector PSC1,5/3-F. The filtered voltage is supplied through a 40 cm (15.75 in.), 10-pos. flat-ribbon cable, that ends with an attached socket strip for double-row pin strips with contact spacing 2.54 mm (0.100 in.)

Table 5: Socket strip assignment

Contact	Assignment
1 - 4	0 V (filtered)

Table 5: Socket strip assignment

5 - 6	Not used
7 - 10	24 V (filtered)

Address Area Assignment of PC I/O Ports

The controller board uses eight bytes in the I/O address area, of which five are used by registers. Only drivers use these registers.

Table 6: I/O address assignment

Offset	Designation	Function
0	WIN_ADR_PC	Window address and enabling (host PC side)
1	WIN_ADR_MPM	Window address and MPM side
2	IRQ_Control	IRQ selection and enabling
3	WDT_Control	Watchdog timer status, enabling, and retriggering
4	MA_Reset_Control	Enabling reset button and software reset for master kernel
5	—	Reserved
6	—	Reserved
7	—	Reserved

Multi-Port Memory (MPM)

The 64-kbyte MPM has been designed as a static RAM (SRAM) and exchanges data between the host PC and the controller board. The MPM is displayed in the address area of the host (between 640 kbytes and 1 Mbyte). The space available is limited and therefore only memory windows with 4-kbytes are used. The device driver shifts the window automatically to the required address area of the MPM. During shifting, the window address in the memory area of the host remains constant.

The window address can be set by the software to any address divisible by 4096 ranging from 80000_{hex} to $FF000_{hex}$. After the PC has been reset the window is switched off. The window must be enabled by the driver software.

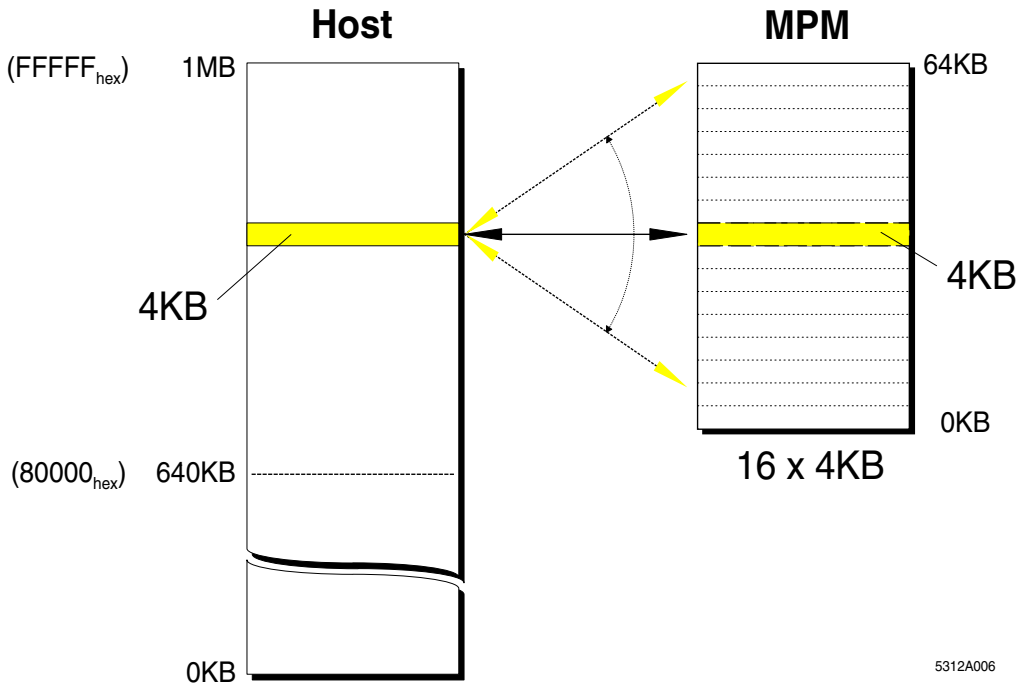


Figure 6 Shifting the MPM window using the device driver

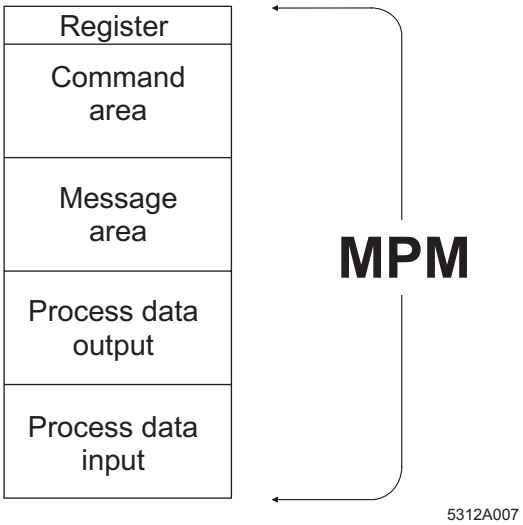


Figure 7 MPM structure

The MPM includes (see Figure 7):

– The Mailbox Interface for exchanging commands and messages (message area)
– The Data Interface for exchanging process data (process data area)
– Register for exchanging status and handshake information
– The Signal Interface for executing predefined commands (command area).

Write and read access to the MPM can be gained using the corresponding drivers. Application programs can access input and output process data to execute logical operations. Command and message buffers are used for sending and receiving commands from the controller board and PCP commands. When the application program is running, mainly process data is transmitted. The application program reads the input process data, carries out logical operations, and then writes in the output process data area of the MPM. Process data is addressed according to the physical location of the I/O modules in the network. The appropriate amount and type of process data is specified in the data sheet of the corresponding I/O module.

Watchdog

An integrated watchdog timer on the controller board can be used to monitor the running of the application program on the PC. The watchdog timer is switched off after a system reset and must be enabled by the driver software.
The watchdog timer is triggered by write or read access to an I/O register of the board. If the monitoring time is exceeded, the watchdog timer forces a bus reset and resets all INTERBUS module outputs via the INTERBUS master.

Programming

Individual applications are created with the support of the corresponding drivers. These drivers are available for commonly used operating systems and programming languages.

The drivers execute write and read operations on the MPM and the I/O addresses.

Table 7: Driver software

Operating System	Driver	Installation
DOS	TSR program	Linking the driver with the *autoexec.bat* and protecting the MPM window from access by a memory manager through a corresponding entry in the *config.sys*.
Windows® 95/98	Virtual Device Driver (VxD)	Creating key words and entry of the board parameters in the register database.
Windows® NT	Kernel Mode Driver	

The operating system-specific installation program checks the system settings of the PC (free address area, etc.) and sets up the board for operation.



For additional information on the driver software, please refer to the *Readme* file on the driver disk.

A detailed description of the register and MPM can be found in the *Device Driver Development Kit* for programming your own driver software.

Technical Data

Up-to-date information can be found on the Internet at www.phoenixcontact.com.

General Data	
Order Designation	IBS ISA SC/RI-LK
Dimensions	162.56 mm x 106.71 mm (6.400 in. x 4.201 in.)
Height	23 mm (0.906 in.), approximately
Control system	ISA-PC-AT according to IEEE P996
Number of devices	512 (256 remote bus devices/bus segments)
Number of process data words	256 words (4096 binary inputs/outputs)
Number of PCP devices	62

Voltage Supply	
$V_{S,\ controller}$ (PC supply)	5 V DC ±5%
$V_{S,\ slave}$	20 V to 30 V, 24 V DC, typical (ambient class 1)
Residual ripple	$V_{pp\ =}$ 0.5 V
Power consumption	Approximately 3.5 W, typical (with slave)
Insulation resistance	0.5 kV

Master Interface	
Connection method	Optical fiber, 2 F-SMA connectors according to IEC 874-2
Control system	SA-PC-AT according to IEEE P996

Slave Interface	
Remote IN	Optical fiber, 2 F-SMA connectors according to IEC 874-2
Remote OUT	Optical fiber, 2 F-SMA connectors according to IEC 874-2

Diagnostic Interface	
Connection method	10-pos. DIL male connector, connection cable to 9-pos D-SUB male connector optional

Address Areas	
Memory	4 kbytes, can be selected between 80000_{hex} and $FF000_{hex}$
I/O	8 bytes, can be selected between 100_{hex} and $3F8_{hex}$
Data width	8 bits for I/O access, 8 or 16 bits for memory access Can be selected from IRQ 3, 5, 7, 9(2), 10, 11, 12, and 15

Ambient Conditions	
Permissible operating temperature	0° to 70°C (32°F to 158°F) (free air operating temperature)
Permissible storage temperature	25° to 75°C (77°F to 167°F)
Humidity (according to EN 60204-1)	During operation, storage, and transport: 75%, on average, 85%, occasionally (DIN 40040); no condensation
Air pressure	Operation: 860 hPa to 1080 hPa (up to 1500 m [4921 ft.] above sea level) Storage and transport: 660 hPa to 1080 hPa (up to 3500 m [11483 ft.] above sea level)

Ordering Data

Description	Order Designation	Order No.
Controller board	IBS ISA SC/RI-LK	27 21 65 9
EMC filter	IBS ISA SC/RI-LK-FIL	27 22 72 6
RS-232 adapter cable, from 10-pos. plug-type connector to 9-pos. D-SUB male connector	IBS PC COP RS232 CAB	27 51 65 8
"Configuring and Installing INTERBUS" User Manual	IBS SYS PRO INST UM E	27 43 80 2
CMD operating software	IBS CMD SWT G4 E	27 21 44 2
Programming cable	IBS PRG CAB	28 06 86 2

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