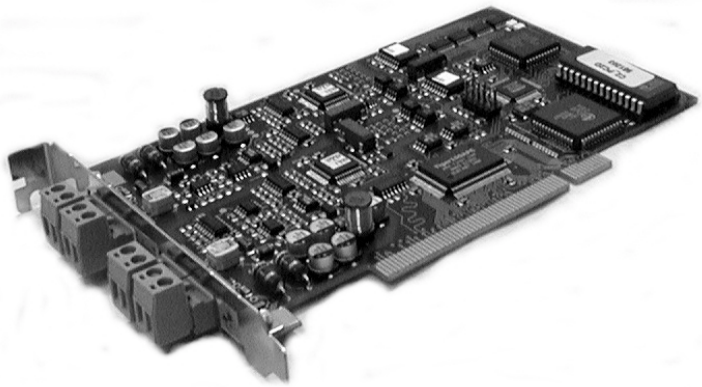
FACTORY AUTOMATION

Manual

VBM-CTR-PCI-DM

AS-Interface/PCI Board



CE

PEPPERL+FUCHS

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1 Declaration of Conformity

The AS-i/PCI master VBM-CTR-PCI-DM has been developed and produced in accordance with the applicable European standards and directives.

The corresponding of conformity can be requested from the manufacturer.

Note

The manufacturer of the product, Pepperl+Fuchs Group in D-68301 Mannheim, possesses a certified quality assurance system in accordance with ISO 9001.

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ISO9001

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2 The Used Symbols

Warning

This symbol warns the user of possible danger. Failure to heed this warning can lead to personal injury or death and/or damage to equipment.

Attention

This symbol warns the user of a possible failure. Failure to heed this warning can lead to total failure of the equipment or any other connected equipment.

Note

This symbol gives the user important hints.

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3 Safety

3.1 Intended Use

Warning

The protection of operating personnel and the system against possible danger is not guaranteed if the control interface unit is not operated in accordance with its intended use.
The device may only be operated by appropriately qualified personnel in accordance with this operating manual.

3.2 General Safety Information

Warning

Safety and correct functioning of the device cannot be guaranteed if any operation other than that described in this operation manual is performed.
The connecting of the equipment and any maintenance work to be carried out with voltage applied to the equipment must only be performed by appropriately qualified electrotechnical personnel.
In the case that a failure cannot be repaired, the device must be taken out of operation and kept from inadvertently put back into operation.
Repair work is to be carried out by the manufacturer only. Additions or modifications to the equipment are not allowed and void the warranty.

Note

The operator is responsible for the observance of local safety standards.

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4 Features of the AS-i PCI Board

- contains two complete AS-i Masters with AS-i Control option (PLC), built as a board for the PCI-bus.
- easy installation with "Plug and Play"
- is able to execute a control program. It operates without taking an affect to the performance of your PC. The other way round the control program runs with a constant cycle time independent from the PC capacity required by other applications.
- exchanges data with the PC via Dual Port RAM (DPRAM).
- An event mechanism can notify the PC application about changes of the data on the board.
- Up to 4 AS-i PCI boards can operate in one PC system.
- is capable to generate an interrupt on the PCI-bus, for example if the AS-i data changes.
- is able to detect a breakdown of the PC, if the built-in watchdog is activated (The AS-i masters will change to the Off-line phase if the watchdog is not triggered by a PC program).
- Advanced Diagnostics: to detect occasionally occuring configuration errors and to judge the quality of the AS-i communication.
- The included driver makes it possible to use the AS-i PCI board with several applications simultaneously.

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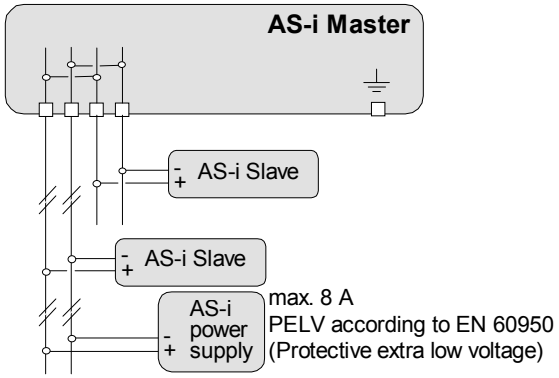
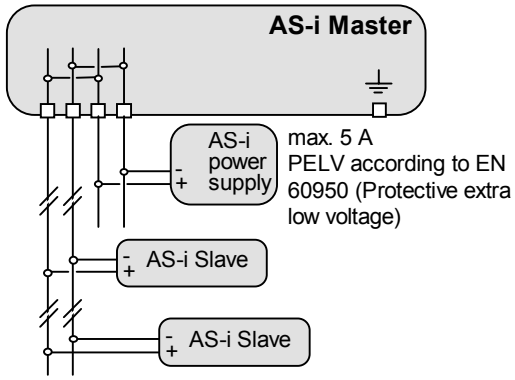
5 Installation of the AS-i PCI Board

The "Plug and Play"-feature makes the installation of the AS-i PCI Board very easy:
Switch off the PC.
Then just insert the board into a free PCI slot and connect the AS-i circuit(s).
The following pictures shows the possibilities to connect an AS-i circuit.

Warning

Connection samples for the AS-i power supply:





Attention

In the wiring schemes above the current through the AS-i master must not exceed 5 A.

Now switch on the PC.

Windows 95/98:
If you have Windows 95 or Windows 98 you will be asked to insert the driver disk for the AS-i PCI Board ("Windows 95/98 driver install disk for AS-i PCI Board"; this is the disk 1 of the software AS-i Control Tools).
Then install the AS-i Control Tools (setup.exe on disk 1) and follow the given instructions.

Windows NT:
If you have Windows NT, make sure that are you logged in as administrator, then just install the AS-i Control Tools (setup.exe on disk 1) and follow the given instructions.

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6 Accessing the Data

6.1 Windows Device Drivers and DLLs

The AS-i PCI card comes with Windows device drivers for 95/98 and NT. In addition to that there are the DLLs "asidrv32.dll" and "asipci.dll". These DLLs enable the user to write its own Windows application. The use of these DLLs is described in the files "readme.txt" and "aasidrv.h".

6.2 OPC-Server

Another possibility of data access is the use of the OPC-Server. The OPC-Server is an easy possibility to use a wide variety of SCADA-systems together with the AS-i PCI card.

6.3 Using the AS-i PCI card without the Windows Device Driver

The DPRAM of the AS-i PCI board is accessible both memory mapped and I/O mapped. The PCI host system should provide ways (such as the PCI BIOS in case of an IBM AT) to determine the I/O and/or memory base address and interrupt number.

6.3.1 Register Map

Offset	Bits	Description	Value
00_h		subsystem reset	FF_h: asserted, FE_h: released
02_h		"AUX pin control"	set to BF_h
03_h	0..5 6 7	"AUX pin data" DPRAM window selection interrupt request interrupt acknowledge	initialize with 80_h
04_h			set to 00_h
05_h		"Interrupt mask"	set to 40_h to enable interrupts, else set to 00_h
07_h		"AUX pin status"	
$C0_h$... FC_h		DPRAM window	

6.3.2 DPRAM Access

The AS-i PCI board uses a 1 kByte, byte-wide DPRAM. The access to this DPRAM is done through a 16 byte window starting at offset $C0_h$.

To select the window for a certain DPRAM_address, set the register "AUX pin data" at offset 03_h according to the following formula:

"AUX pin data" = DPRAM_address/16 + 128

In other words, bits 2^0 to 2^5 of "AUX pin data" determine the bits 2^4 to 2^9 of the DPRAM address. "AUX pin data", bit 2^7 should be set.

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To access a certain cell of the DPRAM within the DPRAM window, read or write at the following offset:

$$\text{offset} = C0_h + \text{DPRAM\_address mod } 16 * 4$$

6.3.3 Interrupt Handling

Besides installing an interrupt handler on the PCI host and selecting an interrupt source in the DPRAM, you have to set the "Interrupt mask" register at offset 05_h to 40_h in order to enable interrupt generation of the AS-i PCI board.

If the AS-i PCI asserts an interrupt, bit 2^6 of "AUX pin status" is set to zero. To acknowledge the interrupt, set bit 2^7 of "AUX pin data" to zero and wait for bit 2^6 of "AUX pin status" until it becomes ’1’. Afterwards, read the "Interrupt Event" DPRAM cell to determine the interrupt source that caused the interrupt.

(If this is done within a interrupt handler, you should save and restore the contents of the "AUX pin data" register in order to avoid switching the DPRAM window during DPRAM access of an other task.)

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7 Data Exchange via the Dual Port RAM (DPRAM)

7.1 Detailed DPRAM Address Map

AS-i Circuit 1:

address	size	data	access
000_h	8	list of active slaves *LAS*	r/–
008_h	8	list of detected slaves *LDS*	r/–
010_h	8	list of projected slaves *LPS*	r/–
018_h	8	list of peripheral faults *LPF*	r/–
020_h	32	parameter image PI	r/w
040_h	32	permanent parameter PP	r/–
060_h	32	output data image *ODI* (inverted!)	r/w
080_h	32	input data image *IDI*	r/–
$0A0_h$	2	execution control flags *ec-flags*	r/–
$0A2_h$	1	host interface flags *hi-flags*	r/w
$0A8_h$	8	list of ‘offline slaves’ *LOS*	r/–

AS-i Circuit 2:

address	size	data	access
100_h	8	list of active slaves *LAS*	r/–
108_h	8	list of detected slaves *LDS*	r/–
110_h	8	list of projected slaves *LPS*	r/–
118_h	8	list of peripheral faults *LPF*	r/–
120_h	32	parameter image PI	r/w
140_h	32	permanent parameter PP	r/–
160_h	32	output data image *ODI* (inverted!)	r/w
180_h	32	input data image *IDI*	r/–
$1A0_h$	2	execution control flags *ec-flags*	r/–
$1A2_h$	1	host interface flags *hi-flags*	r/w
$1A8_h$	8	list of ‘offline slaves’ *LOS*	r/–

Device, Part 1:

address	size	data	access
$0C8_h$	8	Date Code	r/–
$0D0_h$	16	Features	r/–
$0E0_h$	32	Master Name	r/–

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Device, Part 2:

address	size	data	access
$1B9_h$	1	Config_ok Delay	r/w
$1BA_h$	1	Watchdog Enable	r/w
$1BB_h$	1	Watchdog Counter	r/w
$1BC_h$	2	Interrupt Enable	r/w
$1BE_h$	2	Interrupt Event	r/–
$1C0_h$	16	Mailbox A	r/w
$1D0_h$	16	Mailbox B	r/w
$1E0_h$	16	Mailbox C	r/w
$1F0_h$	16	Mailbox D	r/w
200_h	128	Buffer A	r/w
280_h	128	Buffer B	r/w
300_h	128	Buffer C	r/w
380_h	128	Buffer D	r/w

If an AS-i Control program runs, buffers C and D are occupied by the AS-i Control user memory (flags).

7.2 AS-i Master *Execution Control Lists*

All data of the AS-i master may be read at any time out of the DPRAM (addresses 000_h to $0AF_h$ resp. 100_h to $1AF_h$).

The only lists, that are read cyclically by the AS-i master are the output data image *ODI*, the host interface flags (*hi-flags*) and the parameter image *PI*. All other lists can only be written by using the mailbox commands.

The AS-i master writes cyclically the input data image *IDI*, the execution control flags (*ec-flags)*, the list of active slaves *LAS*, the list of detected slaves *LDS* and the configuration data image *CDI*.

Additionally, the *installed software* string is updated.

Due to the internal processing of the output data image *ODI*, the user has to store it *inverted* to the DPRAM.

While a control program is running, it generates the new *ODI*, so the AS-i master writes it to the DPRAM image. If an *ODI* was written by the PC, it will be overwritten then.

7.3 Mailbox Commands

To read and write the execution control lists that are not directly accessibly in the DPRAM the AS-i PC card has four mailboxes. These mailboxes have to be used as well if commands like "Change Slaveaddress" or "Store Configuration" shall be executed.

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Each mailbox consists of 16 bytes:

	byte 0	byte 1	byte 2...15
in	command	AS-i circuit (0: AS-i circuit 1, 1: AS-i circuit 2)	parameter in
out	result	error message	parameter out

In addition to that there is a 128 byte buffer assigned to each mailbox.

The command is initiated by writing a valid command value to the first byte of the mailbox. After command execution, the master overwrites the command with one of the following values:

00_h: ACK
successful command execution

FF_h: NAK
an error occured during command exectution

Before the AS-i Master overwrites the first byte of the mailbox with NAK, it writes an error message to the second byte of the mailbox:

00_h: OK
no error occured

01_h: NOK
error occured, no more precise diagnosis available

10_h: Request
invalid command value was written to the first byte of the mailbox

12_h: CtrlBuff
command is not allowed in this mailbox because buffers C and D are occupied by the AS-i Control user memory.

13_h: NotImplemented
command is valid but not implemented yet

The following mailbox commands are available:

(See chapter 10 for detailed explanation of the lists and parameters of the individual commands).

7.3.1 Write Permanent Parameter (*PP*)

command	3hex/3dec
parameter in	–
parameter out	–
buffer in	PP[32]
buffer out	–

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7.3.2 Read Permanent Parameter (*PP*)

command	4hex/4dec
parameter in	–
parameter out	–
buffer in	–
buffer out	PP[32]

7.3.3 Write Parameter (*PI*)

command	5hex/5dec
parameter in	[slave address][PI]
parameter out	[slave address][PI][slave response]
buffer in	–
buffer out	–

7.3.4 Store Actual Parameter (*PI*)

command	7hex/7dec
parameter in	–
parameter out	–
buffer in	–
buffer out	–

Stores the actual parameters of the AS-i slaves as permanent parameters.

7.3.5 Write Permanent Configuration Data (*PCD*)

command	8hex/8dec
parameter in	–
parameter out	–
buffer in	PCD[128]
buffer out	–

7.3.6 Read Permanent Configuration Data (*PCD*)

command	9hex/9dec
parameter in	–
parameter out	–
buffer in	–
buffer out	PCD[128]

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7.3.7 Store Actual Configuration

command	Ahex/10dec
parameter in	–
parameter out	–
buffer in	–
buffer out	–

Stores the actual configuration as permanent configuration, i. e. the list of detected slaves (LDS) is stored as list of projected slaves (LPS) and the configuration data image (CDI) is stored as permanent configuration data (PCD).

7.3.8 Read Configuration Data Image (*CDI*)

command	Bhex/11dec
parameter in	–
parameter out	–
buffer in	–
buffer out	CDI[128]

7.3.9 Write List of Projected Slaves (*LPS*)

command	Chex/12dec
parameter in	LPS[8]
parameter out	–
buffer in	–
buffer out	–

7.3.10 Set Operation Mode

command	11hex/17dec
parameter in	[0: protected mode, not 0: configuration mode]
parameter out	–
buffer in	–
buffer out	–

If the value of the first byte of *parameter in* is not equal to zero, the AS-i master changes to the *configuration mode*. Else, the AS-i master tries to change to *protected mode*.

7.3.11 Change Slave Address

command	14hex/20dec
parameter in	[old slave address][new slave address]
parameter out	–
buffer in	–
buffer out	–

In case of an error this command returns a special *error message* (second byte of the mailbox):

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00_h: OK
no error occured

02_h: SND
slave with *old address* not detected

03_h: SD0
slave with address zero detected

04_h: SD2
slave with *new address* detected

05_h: DE
error with deletion of old address

06_h: SE
error with setting of new address

07_h: AT
new address could only be stored temporarily

09_h: RE
error with reading the extended ID-code 1

7.3.12 Write Extended ID-code 1 of slave 0

command	18hex/24dec
parameter in	[extended ID-code 1]
parameter out	–
buffer in	–
buffer out	–

In case of an error this command returns a special *error message* (second byte of the mailbox):

00_h: OK
no error occured

02_h: SND
slave with address zero not detected

06_h: SE
error with setting of extended ID-code 1

08_h: ET
extended ID-code 1 could only be stored temporarily

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7.3.13 Read 16Bit Input Data

command	20hex/32dec
parameter in	[slave address]
parameter out	[slave address] [channel 0 low byte][channel 0 high byte] [channel 1 low byte][channel 1 high byte] [channel 2 low byte][channel 2 high byte] [channel 3 low byte][channel 3 high byte]
buffer in	–
buffer out	–

7.3.14 Write 16Bit Output Data

command	21hex/33dec
parameter in	[AS-i slave address] [channel 0 low byte][channel 0 high byte] [channel 1 low byte][channel 1 high byte] [channel 2 low byte][channel 2 high byte] [channel 3 low byte][channel 3 high byte]
parameter out	–
buffer in	–
buffer out	–

7.3.15 Read 16Bit Output Data

command	22hex/34dec
parameter in	[slave address]
parameter out	[slave address] [channel 0 low byte][channel 0 high byte] [channel 1 low byte][channel 1 high byte] [channel 2 low byte][channel 2 high byte] [channel 3 low byte][channel 3 high byte]
buffer in	–
buffer out	–

7.3.16 Write AS-i Control Flags

command	32hex/50dec
parameter in	[AS-i Control flags]
parameter out	–
buffer in	–
buffer out	–

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7.3.17 Get Status (AS-i Control)

command	33hex/51dec
parameter in	–
parameter out	[AS-i Control flags] [last cycle time low byte] [last cycle time high byte] [maximum cycle time low byte] [maximum cycle time high byte] (cycle time in ms)
buffer in	–
buffer out	–

7.3.18 Write User Memory (AS-i Control)

command	36hex/54dec
parameter in	[start address][0][length]
parameter out	–
buffer in	data[length]
buffer out	–

Writes up to 128 bytes of user memory (flags). There are 256 bytes of user memory available, therefore the start address may range from 0 to 255.

7.3.19 Read User Memory (AS-i Control)

command	38hex/56dec
parameter in	[start address][0][length]
parameter out	–
buffer in	–
buffer out	data[length]

Reads up to 128 bytes of user memory (flags). There are 256 bytes of user memory available, therefore the start address may range from 0 to 255.

7.3.20 Read and Clear LCS (Advanced AS-i Diagnostics)

command	46hex/70dec
parameter in	–
parameter out	LCS[8]
buffer in	–
buffer out	–

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7.3.21 Read and Clear Transmission Error Counters (Advanced AS-i Diagnostics)

command	47hex/71dec
parameter in	–
parameter out	–
buffer in	–
buffer out	transmission error counters[64]

7.3.22 Set LOS (Advanced AS-i Diagnostics)

command	48hex/72dec
parameter in	LOS[8]
parameter out	–
buffer in	–
buffer out	–

7.3.23 Update DPRAM

command	80hex/128dec
parameter in	–
parameter out	–
buffer in	–
buffer out	–

The whole DPRAM (except watchdog and output data image) is rewritten by the AS-i master in order to eliminate inconsistencies.

7.4 Watchdog

If the contents of the byte *watchdog enable* is not equal to zero, the watchdog is enabled and the user has to write cyclically a value different to zero to the byte *watchdog counter*. The AS-i master decrements the watchdog counter every 10 ms. If Zero is reached, it changes to the off-line phase.

This way, the maximum watchdog time is written in units of 10 ms. That allows supervising times from 10 ms up to 2.55 seconds.

To disable the watchdog, the user has to write 00h to the byte *watchdog enable*.

Timing out may be recognized by *watchdog enable* $\neq 0$ and *watchdog counter* = 0.

7.5 Config_ok Delay

It is recommended to read the execution control flags every time the input data image *IDI* is read. Only if the *Config_ok* flag is set, the user can be sure that all input data is valid.

The PC needs a certain time to read the input data image and the execution control flags out of the DPRAM (in addition, the PC may be interrupted by other tasks while reading), and the AS-i master is able to alter the DPRAM at any time.

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To guarantee the input data read by the PC is valid when it reads ‘configuration O.K.’, the 0-to-1 transition of the *Config_ok* flag is delayed. The user has to read both, input data and execution control flags before this delay runs out.

The DPRAM byte *Config_ok delay* holds the maximum time for this delay in units of 10ms. If the user is sure reading of *IDI* and flags does not take more than 10ms, he does not need to change the default value of 2 (20 ms).

7.6 Interrupts

The AS-i PCI card is able to release interrupts on the PCI bus of the PC. Each interrupt source has to be enabled by setting the corresponding bit in the byte *interrupt enable*. It is possible to activate several interrupt sources at one time.

The register *interrupt event* holds the source(s) of the pending interrupt and should be cleared by the users interrupt routine.

The interrupt sources are as follows:

Bit	Interrupt Source
0	AS-i circuit 1, changes on *Config_OK* Both, 0-to-1 and 1-to-0 transition of the execution control flag *Config_ok* release an interrupt.
1	AS-i circuit 1, changes on the Input Data Image *IDI* If this bit is set, the input data image is tested cyclically for changes by the PC card. As soon as a change is detected, an interrupt is released.
2	AS-i circuit 1, end of AS-i cycle An interrupt is released at the end of every AS-i cycle. The AS-i Cycle time for the AS-i masters is between 300µs (one AS-i slave only) and about 5ms (31 AS-i slaves).
3	–
4	Command in mailbox A is executed.
5	Command in mailbox B is executed.
6	Command in mailbox C is executed.
7	Command in mailbox D is executed.
8	AS-i circuit 2, changes on *Config_OK*
9	AS-i circuit 2, changes on the Input Data Image *IDI*
10	AS-i circuit 2, end of AS-i cycle
11	–
12	–
13	–
14	DPRAM watchdog timed out
15	Toggle bit (only in *interrupt event)*: Each time an interrupt is acknowledged, this bit is toggled.

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8 Advanced Diagnostics for AS-i Masters

The advanced AS-i diagnostics serve to locate occasionally occurring errors and to judge the quality of data transmission on AS-i without additional diagnostics tools.

The AS-i Control Tools (software for the comfortable commissioning of the AS-Interface and the programming of AS-i Control) support the operation of the advanced diagnostics (LCS, error counters and LOS) from version 3.0 on.

8.1 List of Corrupted AS-i Slaves (*LCS*)

To locate occasionally occurring short-time configuration errors the AS-i masters with advanced diagnostics manage beside the list of projected slaves (*LPS*), the list of detected slaves (*LDS*) and the list of activated slaves (*LAS*) a forth list, the **list of corrupted slaves (*LCS*)**. This list contains entries of all AS-i slaves which were responsible for at least one configuration error since powering up the AS-i master or reading the list. Short-time AS-i power failures are represented in the *LCS* at the position of AS-i slave with address 0.

Note

With every read access the LCS will be deleted.

8.2 Error Counters: Counters of corrupted data telegrams

The AS-i master with advanced diagnostics has an error counter for each AS-i slave, which is increased every time there is a corrupted AS-i telegram. This makes it possible to judge the quality of the AS-i network, even if only a few corrupted telegrams occurred and the AS-i slave did not cause any configuration errors.

Note

The counter values can be read via the host interface and will be deleted with every read access. The counter value is limited to 254. 255 means counter overflow.

8.3 Off-line Phase on Configuration Errors (LOS)

The AS-i masters with advanced diagnostics offer the possibility to put themselves into the off-line Phase when a configuration error on the AS-Interface occurs. In this way the security of the application can be ensured. The reaction to a configuration error is very fast and the host can be relieved from this task. If there are any problems on the AS-i network, the AS-interface can be switched to a secure state.

There are two different ways to parameterize the AS-i master for this feature:

- Every configuration error during normal operation in protected mode releases the off-line phase.
- For each slave address can be chosen whether a configuration error on this address will release the off-line phase or not. This information is stored in the List of Off-line Slaves (*LOS*).

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The user himself can decide how the system reacts to a configuration error on the AS-Interface. The AS-i master can release the off-line phase in critical situations, i.e. only with certain slave addresses, while in less critical situations (if one of the other AS-i slaves have a configuration error) only the error message configuration error is sent to the host, but AS-i is still running.

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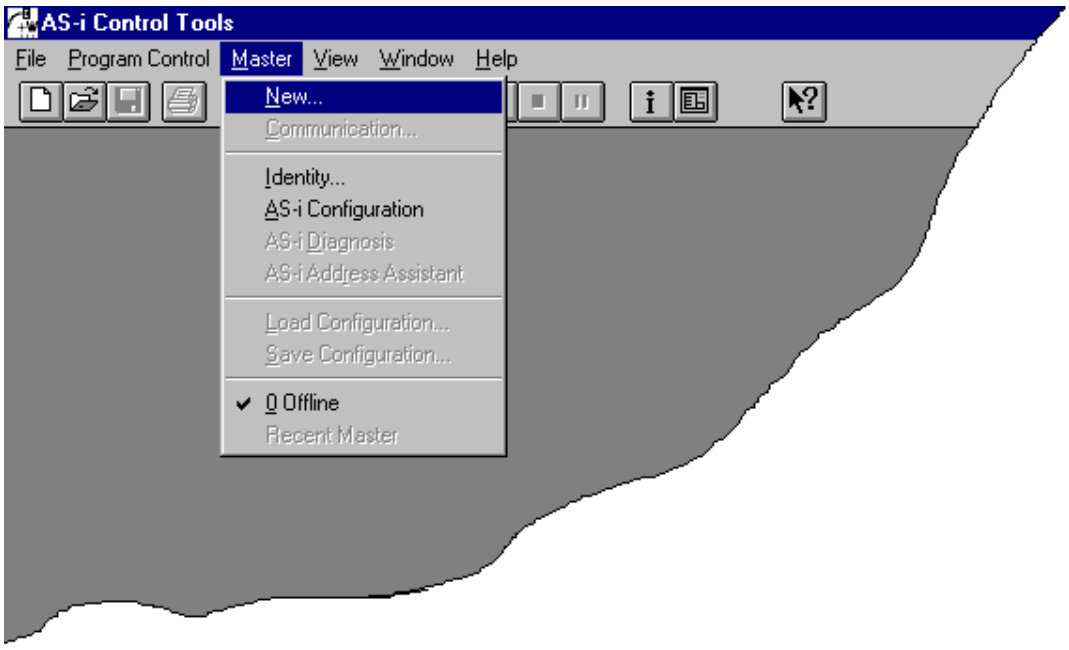
9 Accessories for putting AS-i into Operation and Test Tools

The AS-i circuit on the AS-i Master can be put into operation with the comfortable Windows software AS-i Control Tools.

9.1 Windows Software AS-i Control Tools

The Windows software AS-i Control Tools enables you to configure the AS-i circuit in a very comfortable manner.

1. Start the AS-i Control Tools.
2. Call the command Master | New.



3. Choose AS-i PCI as protocol.
4. Do the appropriate settings.
5. Call the command Master | AS-i configuration.
   The AS-i configuration editor will be started. All detected and projected AS-i slaves are displayed in this window.

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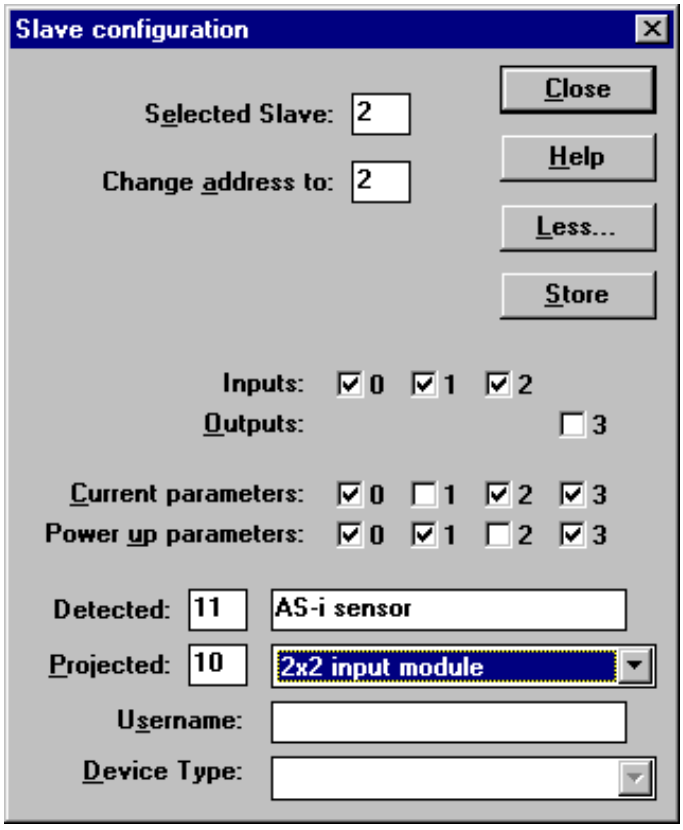
6. Click on a slave entry to open the dialogbox slave configuration.



This dialog box is for changing a slave address, setting AS-i parameters or AS-i configuration data. Additionally you can test inputs and outputs.

A very easy approach to configure the AS-i circuit is connecting each AS-i slave to the line and setting the AS-i slave address one after the other. After that press the button “Store configuration” to adopt the detected AS-i circuit to the AS-i master as projected data.

Moreover you can use the **AS-i Address Assistant**. This tool changes automatically the address of an AS-i slave to the desired address after plugging the slave to the AS-i line. The desired AS-i configuration can be created off-line before and stored to a file. When you build up the plant you only have to plug the AS-i slaves to the AS-i line one after the other.

Further descriptions to all features of the software can be obtained from the integrated help.

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10 Appendix - Representation of Information in the User Data Bytes

10.1 Input and Output Data

For each slave, a four-digit binary number can be entered as input and output data. Input and output data can therefore range between 0 and 15.

Byte 0, bits 0 through 3 (lower nibble) contains the input data of the slave with operating address zero; the bits 4 through 7 (upper nibble) of the user data byte 15 contain the data of slave 31 or 31A. The bytes 16 through 31 hold the data of the slaves with B-addresses.

byte	0								1							
bit	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
slave	0				1/1A				2/2A				3/3A			

...

byte	14								15							
bit	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
slave	28/28A				29/29A				30/30A				31/31A			

...

byte	30								31							
bit	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
slave	28B				29B				30B				31B			

10.2 AS-i Slave Lists

The AS-i Slave lists LPS, LDS, LAS, LCS, LOS and LPF list are built up as follows:

byte	0								1							
bit	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
slave	0	1/ 1A	2/ 2A	3/ 3A	4/ 4A	5/ 5A	6/ 6A	7/ 7A	8/ 8A	9/ 9A	10/ 10A	11/ 11A	12/ 12A	13/ 13A	14/ 14A	15/ 15A

byte	2								3							
bit	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
slave	16/ 16A	17/ 17A	18/ 18A	19/ 19A	20/ 20A	21/ 21A	22/ 22A	23/ 23A	24/ 24A	25/ 25A	26/ 26A	27/ 27A	28/ 28A	29/ 29A	30/ 30A	31/ 31A

byte	4								5							
bit	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
slave	-	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B

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byte	6								7							
bit	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
slave	16B	17B	18B	19B	20B	21B	22B	23B	24B	25B	26B	27B	28B	29B	30B	31B

Meaning of the Lists:

LPS List of Projected Slaves

LDS List of Detected Slaves

LAS List of Activated Slaves

LCS List of Corrupted Slaves
List of those slaves, that have caused a short-time configuration error.

LOS List of Off-line Slaves
List of those slaves, with that in case of configuration error the AS-i Master shall switch to the Off-line phase.

LPF List of Peripheral Faults
List of those slaves, that indicate a peripheral fault.

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10.3 Execution Control Flags (ec-flags)

Bit 0:	config_OK	0: configuration error 1: configuration O.K.
Bit 1:	LDS.0	1: slave with address 0 present
Bit 2:	Auto_Address_Assign	0: automatic addressing not allowed 1: automatic addressing allowed
Bit 3:	Auto_Address_Available	0: auto-address is not possible 1: auto-address is possible
Bit 4:	Configuration_Active	0: AS-i Master is in protected mode 1: configuration mode active
Bit 5:	Normal_Operation_Active	1: normal operation active
Bit 6:	APF	0: AS-i power O.K. 1: AS-i power failure
Bit 7:	Offline_Ready	1: AS-i Master is in off-line phase
Bit 8:	Periphery_OK	0: peripheral fault 1: Periphery O.K.

10.4 Host Interface Flags (hi-flags)

Bit 0:	data_exchange_active	1: activates the data transmission between AS-i Master and slaves
Bit 1:	Offline	1: sets the AS-i Master to the off-line phase
Bit 2:	Auto_Address_Enable	1: enables the automatic addressing

10.5 Installed Software/Flags of the Host Interface

At address $0D0_h$ at the DPRAM a 16 bytes long character string is stored. This string contains the host interface states and the AS-i Master's capabilities as upper- and lower-case letters.

The letters have the following explanations:

Byte 0 `(C/c,D/d)`
The responding AS-i Master is an AS-i Control. The capital 'C' means that a control program is currently being executed. A lower-case 'c' means that either the start flag has not been set or that the AS-i Master's status does not permit the execution.
Is D/d displayed instead of C/c, the new software of AS-i Control is installed.

Byte 1 `(B/b)`
Bus-capable AS-i Master. The responding Master has a bus-capability (true for all PC boards).

Byte 2 `(F/f)`
The responding AS-i Master is featured with the optional AS-i error counter.

Byte 3 `(E/e)`

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	The responding AS-i Master is featured with the optional EMC test mode.
Byte 4	(D/d) The responding AS-i Master is featured with the advanced diagnostics functionality
Byte 5	(C/c) The responding AS-i Master is featured with the function ‘Offline Phase when Configuration Error’
Byte 6-7	not used
Byte 8	(D/d) The *data_exchange_active* host interface flag is set/erased.
Byte 9	(O/o) The *offline* host interface flag is set/erased.
Byte 10	(A/a) The *auto_address_enable* host interface flag is set/erased.
Byte 11	not used
Byte 12	(A/.) The AS-i Master supports/does not support the Advanced AS-i (according to AS-i specification 2.1)
Byte 13	not used
Byte 14	(W/w) The watchdog was activated/deactivated.
Byte 15	not used

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10.6 AS-i Control Flags, Start/Stop Code

Bit 0:	start_flag	When bit 0 is set, the control program is executed as soon as the AS-i Master's status permits the execution. (This flag is stored non-volatile)
Bit 1:	reset_bit	The control program is read from the EEPROM prior to the start. In addition, the user memory (flag bytes) is erased. (Necessary after each download, not returned as AS-i Control flag)
Bit 2:	*ignore_config_errors*	When bit 2 is erased, the control program is stopped as soon as an AS-i configuration error occurs. (This flag is stored non-volatile)
Bit 3:	auto_start	When bit 3 is set, AS-i Control waits for a push on the "set" button before it restarts the control programm. (This flag is stored non-volatile)
Bit 4:	*map_counters*	When bit 4 is set, the counter registers of the 15 counters can be accessed by F 96.0 to F 125.7. (This flag is stored non-volatile)

10.7 Non-volatile stored Data

Following datas and states are stored non-volatile in the AS-i Master.

Non-volatile stored data	**state of delivery**
bit 2 (Auto_Address_Enable) of the host interface flags	set
list of the projected slaves (*LPS*)	00000000_{hex}
permanent configuration data (*PCD*)	$FFFF_{hex}$
permanent parameter (*PP*)	F_{hex}
AS-i control flags: bit 0 (start_flag), bit 2 (ignore_config_errors), bit 3 (auto_start) and bit 4 (map_counters)	all bits are erased
operating mode: configuration mode / protected operating mode	configuration mode

issue date 31.1.2001

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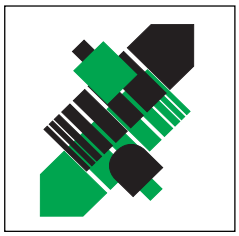
One Company, Two Divisions.



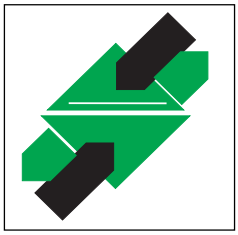
Factory Automation Division

Product Range

- Digital and analogue sensors
- in different technologies
  - Inductive and capacitive sensors
  - Magnetic sensors
  - Ultrasonic sensors
  - Photoelectric sensors
- Incremental and absolute rotary encoders
- Counters and control equipment
- Identification Systems
- AS-Interface

Areas of Application

- Machine engineering
- Conveyor or transport
- Packaging and bottling
- Automotive industry



Process Automation Division

Product Range

- Signal conditioners
- Intrinsically safe interface modules
- Remote Process Interface (RPI)
- Intrinsically safe field bus solutions
- Level control sensors
- Process measuring and control systems engineering at the interface level
- Intrinsic safety training

Areas of Application

- Chemical industry
- Industrial and community sewage
- Oil, gas and petrochemical industry
- PLC and process control systems
- Engineering companies for process systems

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