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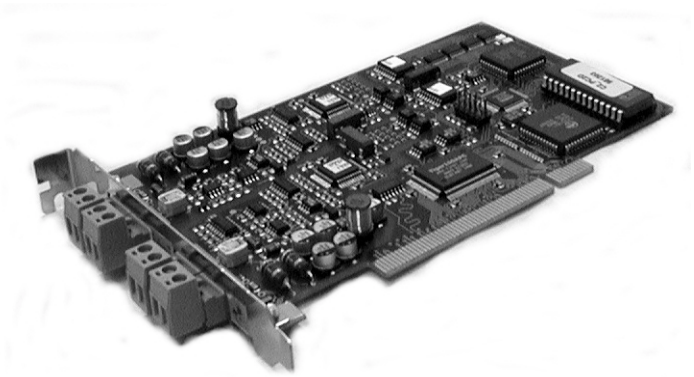

# AS-i PCI Board (Double Master)

# ASI-M22310

# User Manual

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# EC Declaration of Conformity

**In Compliance with the EC Directive on Electromagnetic Compatibility 89/336/EWG**

We hereby declare that the devices (see page 2)

**of the product family ASI-M.....**

comply with the basic requirements of the EC Directive specified under Point 1. If an item of equipment listed overleaf is modified without our approval then this declaration loses its validity for this equipment.

We employ a quality system certified by the DQS (German Quality Assurance Society), No. 462, as per ISO 9001 and have therefore observed the regulations in accordance with module H as well as the following EC directives and EN standards during development and production:

| | | | |
|---|---|---|---|
| 1. ***EC directives*** | EC EMC Directive 89/336/EEC as per 92/31/EEC, 93/68/EEC, 93/465/EEC | | |
| 2. ***Harmonized standards used*** | EN 50081-2 | Emitted interference, industry | Ed. 93-08 |
| | EN 50295 | Low-voltage switchgear and controlgear - Controller and device interface systems - Actuator Sensor interface (AS-i) | Ed. 99-03 |
| | EN 61000-6-2 | Electromagnetic compatibility Part 6-2: Immunity, industry | Ed. 99-04 |

Conformance of a type sample belonging to the above-mentioned product family with the regulations from the listed EC directives has been certified by:

Waldkirch/Br., den 30/08/01

ppa. Reglowicki
(Manager Marketing & Sales
Division Industrial Sensors)

i.V. Hertweck
(Manager Production
Division Industrial Sensors)

The declaration certifies conformance with the listed directives, but does not guarantee product characteristics. The safety instructions contained in the product documentation must be observed.

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# 1 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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# 2 Safety

## 2.1 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.*

## 2.2 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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# 3 Features of the AS-i PCI Board

The AS-i PCI Board of the SICK AG:

- ... 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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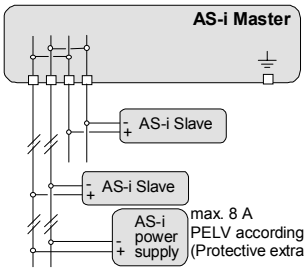
# 4 Installation of the AS-i PCI Board

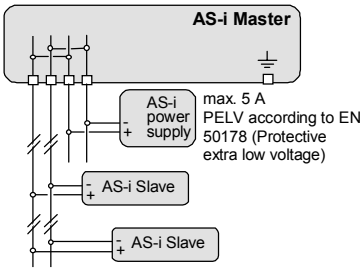
The "Plug and Play"-feature makes the installation of the AS-i PCI Board very easy:

1. Switch off the PC.
2. Then just insert the board into a free PCI slot and connect the AS-i circuit(s).
3. 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.***

4. Now switch on the PC.

**Windows 95/98:**
The needed device drivers are on the enclosed CD.

**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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# 5 Accessing the Data

## 5.1 Windows Device Drivers and DLLs

The AS-i PCI card comes with Windows device drivers for Windows 95/98/NT and 2000 (see chapter 3). In addition to that you can download the DLLs "asidrv32" and "asipci.dll" from the Internet. 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" that are also contained in the driver package "Windows drivers for AS-i Masters (32Bit DLL)".

## 5.2 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.

## 5.3 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.

### 5.3.1 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<br>6<br>7 | "AUX pin data"<br>DPRAM window selection<br>interrupt request<br>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 | |

### 5.3.2 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:

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

### 5.3.3 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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# 6 Data Exchange via the Dual Port RAM (DPRAM)

## 6.1 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/– |

**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).

## 6.2 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.

## 6.3 Working with AS-i Control Programs

While an AS-i Control program is running all output data that are written directly to the ouput data image *ODI* are overwritten instantly by the AS-i Control program.

To write output data from the PC to the card you have to write these data to the user flags. These user flags must be copied in the AS-i Control program to the outputs. You can copy the data either bit-wise or with transfer-commands byte- or word-wise to the outputs.

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## 6.4 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.

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 9 for detailed explanation of the lists and parameters of the individual commands).

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### 6.4.1 Write Permanent Parameter (*PP*)

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

### 6.4.2 Read Permanent Parameter (*PP*)

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

### 6.4.3 Write Parameter (*PI*)

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

### 6.4.4 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.

### 6.4.5 Write Permanent Configuration Data (*PCD*)

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

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### 6.4.6 Read Permanent Configuration Data (*PCD*)

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

### 6.4.7 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).

### 6.4.8 Read Configuration Data Image (*CDI*)

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

### 6.4.9 Write List of Projected Slaves (*LPS*)

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

### 6.4.10 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*.

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### 6.4.11 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):

$00_h$: 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

### 6.4.12 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

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

### 6.4.13 Read 16 Bit Input Data

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

### 6.4.14 Write 16 Bit Output Data

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

### 6.4.15 Read 16 Bit Output Data

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

### 6.4.16 Write AS-i Control Flags

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

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### 6.4.17 Get Status (AS-i Control)

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

### 6.4.18 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.

### 6.4.19 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.

### 6.4.20 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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### 6.4.21 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] |

### 6.4.22 Set LOS (Advanced AS-i Diagnostics)

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

### 6.4.23 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.

## 6.5 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.

## 6.6 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).

## 6.7 Interrupts

The AS-i card is able to release interrupts on the bus of the PC. Each interrupt source has to be enabled by setting the corresponding bit in the word (or meomory location) *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*<br>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*<br>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<br>An interrupt is released at the end of every AS-i cycle.<br>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 | |
| 9 | |
| 10 | |
| 11 | – |
| 12 | – |
| 13 | – |
| 14 | DPRAM watchdog timed out |
| 15 | Toggle bit (only in *interrupt event)*:<br>Each time an interrupt is acknowledged, this bit is toggled. |

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# 7 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" ASI-CT210 (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).

## 7.1 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.*

## 7.2 Protocol Analysis: Counters of Corrupted Data Telegrams

The AS-i master with advanced diagnostics has a counter of telegram repetitions for each AS-i slave, which is increased everytime there is a corrupted data telegram. This makes possible to judge the quality of the AS-i network, even if only a few corrupted telegrams occured 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.*

## 7.3 Off-line Phase on Configuration Errors (LOS)

The AS-i master 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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# 8 Commissioning Tools and Accessories

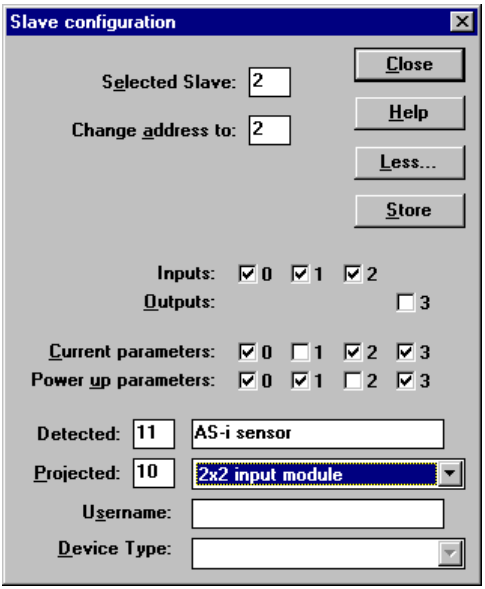
The AS-i circuit on the AS-i master can be put into operation with the comfortable Windows software "AS-i Control Tools" (ASI-CT210).

Note

The enclosed software is an unlicensed version.
The software AS-i Control Tools ASI-CT210 (art. no. 6022501) as to be ordered seperatly-

## 8.1 Windows Software AS-i Control Tools

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.
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

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"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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# 9 Appendix - Representation of Information in the User Data Bytes

## 9.1 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 | | | |

## 9.2 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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## 9.3 Execution Control Flags (ec-flags)

| | | |
|---|---|---|
| Bit 0: | config_OK | 0: configuration error<br>1: configuration O.K. |
| Bit 1: | LDS.0 | 1: slave with address 0 present |
| Bit 2: | Auto_Address_Assign | 0: automatic addressing not allowed<br>1: automatic addressing allowed |
| Bit 3: | Auto_Address_Available | 0: auto-address is not possible<br>1: auto-address is possible |
| Bit 4: | Configuration_Active | 0: AS-i Master is in protected mode<br>1: configuration mode active |
| Bit 5: | Normal_Operation_Active | 1: normal operation active |
| Bit 6: | APF | 0: AS-i power O.K.<br>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<br>1: Periphery O.K. |

## 9.4 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 |

## 9.5 Installed Software/Flags of the Host Interface

At address  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.

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| | |
|---|---|
| Byte 3 | (E/e)<br>The responding AS-i Master is featured with the optional EMC test mode. |
| Byte 4 | (D/d)<br>The responding AS-i Master is featured with the advanced diagnostics functionality |
| Byte 5 | (C/c)<br>The responding AS-i Master is featured with the function 'Offline Phase when Configuration Error' |
| Byte 6 | (./n)<br>n = number of AS-i Masters (n = 2 with a double master) |
| Byte 7 | not used |
| Byte 8 | (D/d)<br>The *data_exchange_active* host interface flag is set/erased. |
| Byte 9 | (O/o)<br>The *offline* host interface flag is set/erased. |
| Byte 10 | (A/a)<br>The *auto_address_enable* host interface flag is set/erased. |
| Byte 11 | not used |
| Byte 12 | (./A/Y)<br>The AS-i Master is according to the AS-i Specification 2.04 (.) resp. 2.1 (A, A = Advanced AS-i). A 'Y' occurs as long as loading an AS-i Control program to the board while an AS-i Control program runs. |
| Byte 13 | (S/s, T/t)<br>The AS-i Master supports 16-Bit slaves according to the analog profil 7.3 (S/s) or 7.4 (T/t). If there's a capital 'S' or 'T' the data exchange with the 16-Bit slaves is active. |
| Byte 14 | (W/w)<br>The watchdog was activated/deactivated. |
| Byte 15 | not used |

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## 9.6 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) |

## 9.7 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*) | $0000_{hex}$ |
| permanent configuration data (*PCD*) | $FF_{hex}$ |
| permanent parameter (*PP*) | $F_{hex}$ |
| AS-i control flags:<br>bit 0 (start_flag), bit 2 (ignore_config_errors),<br>bit 3 (auto_start) and bit 4 (map_counters) | all bits are erased |
| operating mode:<br>configuration mode / protected operating mode | configuration mode |

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