



AS-i PC104 Board
according to AS-i spec. 2.1
User Manual

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Declaration of Conformity

according to 89/336/EEC and 73/23/EEC

Bihl+Wiedemann GmbH, Mannheim, hereby declares under its sole responsibility that the products mentioned below are according to the listed harmonized standards or normative documents and (where necessary) a component body has been released.

Specification: AS-i PC104 Board

Article-no.: 1065,1229

Applied harmonized Standards:

EN 50081-2

EN 61000-6-2

Applied national standards or normative documents:

AS-i Complete Specification (EN50295)

Prüfungsordnung für AS-i Master

Manufacturer: Bihl+Wiedemann GmbH

Date: 16.03.1998

Bernhard Wiedemann

1 The Symbols Used



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.

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

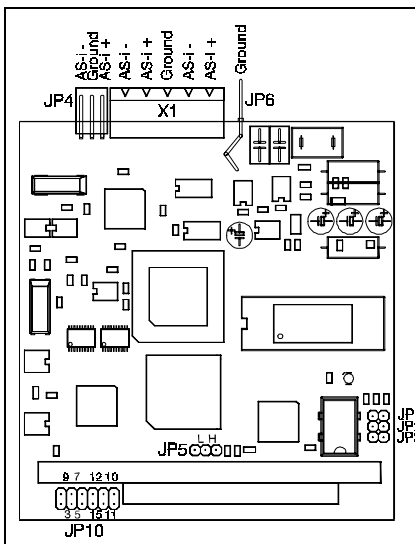
The operator is responsible for the observance of local safety standards.

3 Features of the AS-i PC104 Board

The Bihl + Wiedemann AS-i PC104 board ...

- is a single AS-i Master with AS-i Control option (PLC), build as a board for the PC104 ISA bus.
- 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).
- uses only 3 I/O addresses of the PC104 ISA bus for data exchange.
- ensures an easy way to program drivers in any programming language and for any operating system. Adapting existing PC software is also possible.
- does not need interrupts for standard operation.
- allows simultaneous operation of up to 8 AS-i PC104 boards in one PC system.
- is capable to generate an interrupt on the ISA bus, for example if a change in the AS-i data occurs.
- can share an interrupt with other AS-i PC104 boards.
- is able to detect a breakdown of the PC if the build in watchdog is activated (The AS-i master will change to the Off-line phase if the watchdog is not triggered by a PC program).
- includes the 'Advanced Diagnostics'.

4 Installation of the AS-i PC104 Board



Connections:

JP4 AMP printed circuit board connector HE14

X1 Combicon plug, grid 5.08mm

JP6 socket for crimpable flat plug, 6.3 x 0.8mm

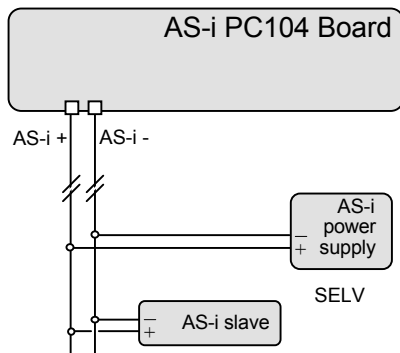
The terms of the connections mean:

AS-i + "AS-i +", Actuator Sensor Interface, positive terminal

AS-i - "AS-i -", Actuator Sensor Interface, negative terminal

Ground

AS-i power supply on the AS-i cable in the field:



The maximum current through the AS-i master is 2A.

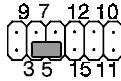
Jumper:

Interrupts:

The AS-i PC104 Board can share an interrupt with other PC104 boards. However, every board sharing an interrupt must have the same interrupt polarity and must drive the interrupt line by open collector (not push-pull!).

JP5 Jumper to set the polarity of the interrupts.
Choose active **High** if in the state of rest the CPU board pulls the interrupt line to +5V with a pull-up resistor and choose active **Low** if the CPU board pulls the interrupt line to 0V with a pull-down resistor.

JP10 Jumper for interrupt selection.
The number of the interrupt is written between the two pins that have to be connected by the jumper.
example:



Interrupt 5 selected

Base address:

JP1 - JP3 Jumper for selecting the I/O address:

I/O base address	JP1	JP2	JP3
300 _h	closed	closed	closed
304 _h	open	closed	closed
308 _h	closed	open	closed
30C _h	open	open	closed
320 _h	closed	closed	open
324 _h	open	closed	open
328 _h	closed	open	open
32C _h	open	open	open

5 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).

5.1 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.



With every read access the LCS will be deleted.

Note



The last short-time configuration error can also be displayed on the AS-i Master:

Pressing the "set" button of the AS-i master shows the AS-i slave which was responsible for the last short-time configuration error. If there was a short-time AS-i power failure the display shows "39" after pressing the "set" button.

This function is only available if device is in the normal operation mode of the protected mode (display empty) or in the off-line-phase.

Note

5.2 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 occurred and the AS-i slave did not cause any configuration errors.



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.

Note

The protocolanalysis is included in the command master | AS-i Diagnostics of "AS-i Control Tools".

5.3 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).

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.

The parameterization of off-line phase on configuration error is also supported by the "AS-i Control Tools" (command Master | Identity | Offline on configuration error).

6 Data Exchange via the Dual Port RAM (DPRAM)

6.1 Principle

The AS-i (Control) data is stored in a DPRAM which can be accessed by burst-memory-accesses. That means that the device driver is very simple and can easily be written in any language and for any operating system.

6.2 DPRAM Access

The board uses 3 addresses for data exchange, the I/O base address and the two following bytes with offset 1 and 2:

offset	reading	writing
0	data register	data register
1	—	INDEX-register
2	—	PAGE-register (Bits 0,1) reset (Bit 4) (min. 200 ms)

Reading and writing at address with offset 0 accesses the memory location, which is determined by the PAGE and INDEX register ($0x100 \cdot \text{PAGE} + \text{INDEX}$). Every access at offset 0 increments the INDEX register so 256 consecutive bytes can be written or read with one writing of the PAGE and INDEX Register.

Reading beyond the border of the page is not possible. On overflow of the index register (after reading the 256th byte of the page) both the index register and the page register are cleared, i. e. the access continues on page 0 (byte 0).

After a reset of the PC board, the DPRAM is completely new written.

Example (assume the I/O base address is 300_h):

If you want to read the AS-i information which is represented in 17 consecutive bytes (DPRAM-addresses $102_h - 111_h$), you first have to initialize the INDEX and the PAGE-Register. Since the information starts at DPRAM-address 101_h the INDEX-Register (I/O port 301_h) must be set to 2 and the PAGE-Register (I/O port 302_h) to 1. After that the data can be read at I/O port 300_h consecutively without further initialization. The write access works the same way.

6.3 Detailed DPRAM Address Map

AS-i Circuit 1:

address	size	data	access
000 _h	8	list of active slaves <i>LAS</i>	r/-
008 _h	8	list of detected slaves <i>LDS</i>	r/-
010 _h	8	list of projected slaves <i>LPS</i>	r/-
018 _h	8	list of peripheral faults <i>LPF</i>	r/-
020 _h	32	parameter image <i>PI</i>	r/w
040 _h	32	permanent parameter <i>PP</i>	r/-
060 _h	32	output data image <i>ODI</i> (inverted!)	r/w
080 _h	32	input data image <i>IDI</i>	r/-
0A0 _h	2	execution control flags <i>ec-flags</i>	r/-
0A2 _h	1	host interface flags <i>hi-flags</i>	r/w
0A8 _h	8	list of 'offline slaves' <i>LOS</i>	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/-

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 or AS-i Control user memory flag 0.0 ... 127.7	r/w
380 _h	128	Buffer D or AS-i Control user memory flag 128.0 ... 255.7	r/w

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

6.4 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.

6.5 Working with AS-i Control Programs

While an AS-i Control program is running all output data that are written directly to the output 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 out-

puts. You can copy the data either bit-wise or with transfer-commands byte- or word-wise to the outputs.

6.6 Mailbox Commands

To read and write the execution control lists that are not directly accessible 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 occurred during command execution

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 occurred

01_h: NOK
error occurred, 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 8 for detailed explanation of the lists and parameters of the individual commands).

6.6.1 Write Permanent Parameter (PP)

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

6.6.2 Read Permanent Parameter (PP)

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

6.6.3 Write Parameter (PI)

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

6.6.4 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.

6.6.5 Write Permanent Configuration Data (PCD)

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

6.6.6 Read Permanent Configuration Data (PCD)

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

6.6.7 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).

6.6.8 Read Configuration Data Image (CDI)

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

6.6.9 Write List of Projected Slaves (LPS)

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

6.6.10 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*.

6.6.11 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 occurred
- 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

6.6.12 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 occurred
- 02_h: SND
slave with address zero not detected
- 06_h: SE
error with setting of extended ID-code 1

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

6.6.13 Read 16 Bit 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	–

6.6.14 Write 16 Bit 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	–

6.6.15 Read 16 Bit 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	–

6.6.16 Write AS-i Control Flags

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

6.6.17 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	–

6.6.18 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.

6.6.19 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.

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

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

6.6.21 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]

6.6.22 Set LOS (Advanced AS-i Diagnostics)

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

6.6.23 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.

6.7 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.

6.8 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.

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 10 ms. If the user is sure reading of *IDI* and flags does not take more than 10 ms, he does not need to change the default value of 2 (20 ms).

6.9 Interrupts

The AS-i PC104 card is able to release interrupts on the ISA bus of the PC. Each interrupt source has to be enabled by setting the corresponding bit in the word (or memory 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 <i>Config_OK</i> Both, 0-to-1 and 1-to-0 transition of the execution control flag <i>Config_ok</i> release an interrupt.
1	AS-i circuit 1, changes on the Input Data Image <i>IDI</i> 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	–
9	–
10	–
11	–
12	–
13	–
14	DPRAM watchdog timed out
15	Toggle bit (only in <i>interrupt event</i>): Each time an interrupt is acknowledged, this bit is toggled.

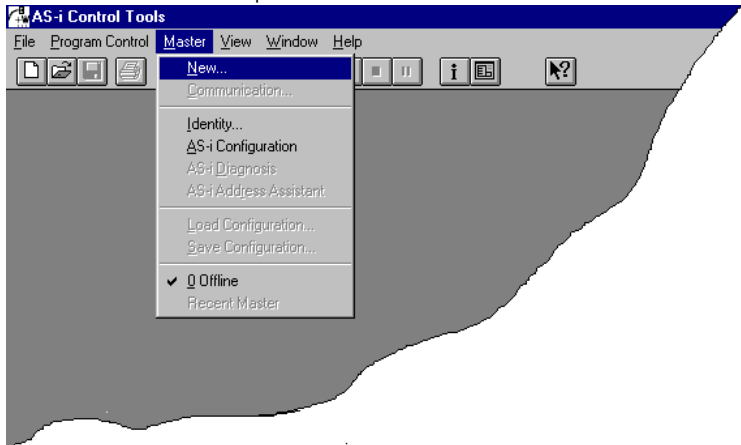
7 Commissioning Tools and Accessories

The AS-i circuit on the AS-i master can be put into operation with the comfortable Windows software "AS-i Control Tools" (art. no. 1203).

7.1 Windows Software AS-i Control Tools

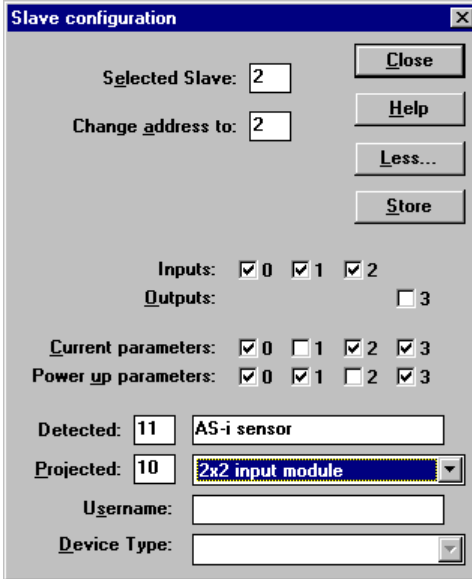
The Windows software AS-i Control Tools enables you to configure the AS-i circuit in a very comfortable manner.

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



3. Choose AS-i PC2 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.



The image shows a 'Slave configuration' dialog box with the following fields and controls:

- Selected Slave:** Input field containing '2'.
- Change address to:** Input field containing '2'.
- Buttons:** Close, Help, Less..., Store.
- Inputs:** Checkboxes for 0, 1, and 2, all checked.
- Outputs:** Checkboxes for 0, 1, 2, and 3. Only 0 is checked.
- Current parameters:** Checkboxes for 0, 1, 2, and 3. 0, 2, and 3 are checked.
- Power up parameters:** Checkboxes for 0, 1, 2, and 3. 0, 1, and 3 are checked.
- Detected:** Input field '11' and a text box 'AS-i sensor'.
- Projected:** Input field '10' and a dropdown menu showing '2x2 input module'.
- Username:** Empty text input field.
- Device Type:** Empty dropdown menu.

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.

8 Appendix - Representation of Information in the User Data Bytes

8.1 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			

8.2 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

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.

8.3 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.

8.4 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

8.5 Installed Software/Flags of the Host Interface ("Characteristics")

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) 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	(. /n) n = number of AS-i Masters (n = 2 with a double master)
Byte 7	not used
Byte 8	(D/d) The <i>data_exchange_active</i> host interface flag is set/erased.
Byte 9	(O/o) The <i>offline</i> host interface flag is set/erased.
Byte 10	(A/a) The <i>auto_address_enable</i> host interface flag is set/erased.
Byte 11	not used
Byte 12	(. /A/Y) 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) 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) The watchdog was activated/deactivated.
Byte 15	not used

8.6 AS-i Control Flags, Start/Stop Code

Bit 0: <code>start_flag</code>	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: <code>reset_bit</code>	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: <code>ignore_config_errors</code>	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: <code>auto_start</code>	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: <code>map_counters</code>	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)

8.7 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 (<i>LPS</i>)	0000 _{hex}
permanent configuration data (<i>PCD</i>)	FF _{hex}
permanent parameter (<i>PP</i>)	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

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