KHD2-MTI-AB4

Allen-Bradley Remote I/O Node Adapter for
IDENT-I System P

User Manual

2001

PEPPERL+FUCHS

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Overview

The AB Remote I/O Node Adapter KHD2-MTI-AB4 enables a Pepperl+Fuchs inductive identification system Communicator for Ident-I System P (IPT-PF with base U-P4-Rx) to be treated as a remote rock. For the purpose of this manual, the combination of KHD2-MTI-AB4 and Communicator is referred to as the *ID System.* Communications between the PLC and *ID System* is accomplished via Discrete I/O (DIO).

KHD2-MTI-AB4

IPT-FT with U-P4-Rx

Revisions

July 2001 Reading of Pre-Configured IPC03-xx tags has been implemented. Reading pre-configured tags is only possible when the node adapter is set for IPC03 type tags and if the Rack Size has been set to ¼ or ½ Rack (see section *DIP Switches on the KHD2-MTI-AB4*).

2001 The previously manufactures bases U-P3-Rx and U-P3-R4 have been replaced by U-P4-Rx and U-P4-R4. The following changes occurred:

	U-P3-Rx	**U-P3-R4**	**U-P4-Rx**	**U-P4-R4**
Interface	RS-232 (Compatible with KHD2-MTI-AB4)	RS-485	RS-232 (Compatible with KHD2-MTI-AB4)	RS-485
Threading	PG 13.5	PG 13.5	½" NPT	½" NPT

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Protocol – Using the PLC Input and Output Image Tables

Communication between the PLC and the *ID System* is accomplished by means of Discrete I/O (DIO) only. At any given time during the operation the system can be in one of three operational states:

(1) While scanning for tags and not updating the PLC Input image table
(2) While updating the PLC input image table and not scanning for tags
(3) While writing data to a tag

The PLC instructs the ***ID System* via 8 *Communication-Bits***, mapped into the lower half of Word 0 of the output image table. Status information from the ID System is transmitted to the PLC via 8 ***Status-Bits*** located in the lower half of Word 0 of the PLC input image table The following defines the names of special *Communication-Bits* and also outlines the PLC input and output image structure.

16 bit Words

PLC Output Image table	**Word 0**	Nibble 4	Nibble 3	**4 Bit Block selection**	**Clear**	**Op**	**Done**	**Start**
	Word 1	Nibble 4	Nibble 3	Nibble 2	Nibble 1			
	Word 2	Nibble 4	Nibble 3	Nibble 2	Nibble 1			
	Word 3	Nibble 4	Nibble 3	Nibble 2	Nibble 1			
	Word 4	Nibble 4	Nibble 3	Nibble 2	Nibble 1			
	Word 5	Nibble 4	Nibble 3	Nibble 2	Nibble 1			
	Word 6	Nibble 4	Nibble 3	Nibble 2	Nibble 1			
	Word 7	Nibble 4	Nibble 3	Nibble 2	Nibble 1			

START: Start transferring data from *ID System* (when reading) or to *ID Sy*stem (when writing)
DONE: Indicates that the PLC user program has processed the data and is ready to receive more data (reading only)
OP: Operation OFF for reading tags, ON for writing tags
CLEAR: Instructs the *ID system* to clear all data from its internal buffers (reading only)
4-BIT BLOCK SELECTION: Used to select read and write location on read/write tags. Also used instruct reading a read only FIXCODE (reading only)

PLC Input Image table	**Word 0**	Nibble 4	Nibble 3	**Error**	**Empty**	0	**OPA**	**Clear ACK**	**BAT**	**NT**	**Data OK**
	Word 1	Nibble 4	Nibble 3	Nibble 2				Nibble 1			
	Word 2	Nibble 4	Nibble 3	Nibble 2				Nibble 1			
	Word 3	Nibble 4	Nibble 3	Nibble 2				Nibble 1			
	Word 4	Nibble 4	Nibble 3	Nibble 2				Nibble 1			
	Word 5	Nibble 4	Nibble 3	Nibble 2				Nibble 1			
	Word 6	Nibble 4	Nibble 3	Nibble 2				Nibble 1			
	Word 7	Nibble 4	Nibble 3	Nibble 2				Nibble 1			

DATA OK: Indicates PLC input image equal the output image (reading only)
NT, ERROR, BAT: No Tag (writing only), Error and battery low indication
CLEAR ACK: Internal buffers have been cleared
OPA: Operation Acknowledge. PLC has received a Write Request (Writing only)
EMPTY: No additional data available from *ID System*

The number of words in the input and output image table used by the *ID System* depends on the **selected rack size** (selected via DIP-Switches on the HKD2-MTI-AB4). Note that data mapping depends on the selected *Start Quarter*, selected via DIP-Switches on the KHD2-MTI-AB4.
The protocol on the node adapter has been designed to completely shield the user from the specifics of the ID Communicators. Because Ident-I System P utilizes a command subset of the "P+F Talk" protocol, PLC code written for Ident-I System P can typically be used for other ID system offering "P+F Talk".

Power-Up

When powering-up the HKD2-MTI-AB4 sends the necessary configuration data to the Communicator. Depending on the position of DIP-Switch SW1,1 on the KHD2-MTI-AB4 The system is configured to work with IPC02 (R/O code on tags only) or IPC03 (R/O code and tags plus R/W memory) type tags:

Ident-I System P

SW1,1 = Off	ci003,19200<chk><etx>	Configure for 19200 baud and 300ms serial timeout.
	ct02<chk><etx>	Select to work with IPC02(*) Type R/O code carriers
	rs<chk><etc>	Rest to activate the "ci" settings
SW1,1 = On	ci003,19200<chk><etx>	Configure for 19200 baud and 300ms serial timeout.
	ct03<chk><etx>	Select to work with IPC03 Type R/W data carriers
	rs<chk><etc>	Rest to activate the "ci" settings

The entire configuration and startup phase takes under 1 second. The *ID System* will only go online with the RIO Scanner once a Communicator has been found and was properly configured. Once online the green RIO-LED on the KHD2-MTI-AB4 is on solid. See section ***Trouble Shooting*** for additional information.

In order for the HKD2-MTI-AB4 to perform this configuration, the Communicator must be set to an RS232 baud rate of 9600 baud or 19200 baud. This can be accomplished by one of the following methods:

Issue the command ci003,9600#<Enter> using a terminal program at the correct current baud rate of the Communicator. Then power-down and power-up the unit. The default baud rate of Communicators shipped from stock is 9600 baud.

(*) This mode also enables reading on IPC10 that have been written using the X-Command. For additional information see P+F Documentation ***IPT with Base U-P4-Rx*** or ***IPT with Base U-P4-R4***.

Reading Tag Data

Scanning for Tags

(Initial state: START=Off, DONE=Off, OP=Off, Clear=Off)

The *ID System* scans for tags as long as the "**START**" bit is OFF.

IDENT-I System P

Scanning takes under 500ms worst case and depends on the selected rack size and the amount of electromagnetic noise in the operating environment.

When reading tags the "**4 Bit Block selection**" is used to specify which memory locations are read. The amount of data read depends on the selected rack size on the HKD2-MTI-AB4:

Rack Size	Number of Bytes read
Quarter	03
Half	07
Three Quarter	11
Full	15

Quarter Rack In this case a data block of 3 bytes is read from the tag. The following table relates the byte location on the tag with the value of the "4 Bit Block selection"

Block Selection	Tag Data Bytes (in decimal)
0000	01 through 03
0001	04 through 06
0010	07 through 09
0011	10 through 12
0100	13 through 15
0101	16 through 18
0110	19 through 21
0111	22 through 24
1000	25 through 27
1001	28 through 30
1010	31 through 33
1011	34 through 36
1100	37 through 39
1101	40 through 42
1110	43 through 45
1111	Fixcode

The general relation between the "**4 Bit Block selection**" and the data byte range on the tag is as follows:

Start of Range = 1 + Block Selection (in Decimal) * 3

End of range = 3 + Block Selection (in Decimal) * 3

Using IPC03 tags, all "**4 Bit Block selection**" patterns are allowed.

Half Rack In this case a data block of 7 bytes is read from the tag. The following table relates the byte location on the tag with the value of the "**4 Bit Block selection**"

Block Selection	Tag Data Bytes (in decimal)
0000	01 through 07
0001	08 through 14
0010	15 through 21
1110	99 through 105
1111	Fixcode

The general relation between the "**4 Bit Block selection**" and the data byte range on the tag is as follows:
Start of Range = 1 + Block Selection (in Decimal) * 7
End of range = 7 + Block Selection (in Decimal) * 7

Using IPC03 tags, all "**4 Bit Block selection**" patterns are allowed.

Three Quarter Rack In this case a data block of 11 bytes is read from the tag. The following table relates the byte location on the tag with the value of the "4 Bit Block selection"

Block Selection	Tag Data Bytes (in decimal)
0000	01 through 11
0001	12 through 22
0010	23 through 33
•	•
•	•
1001	100 through 110 (last accessible block on IPC03)
•	•
•	•
1110	155 through 165
1111	Fixcode

The general relation between the "**4 Bit Block selection**" and data byte range on the tag is as follows:
Start of Range = 1 + Block Selection (in Decimal) * 11
End of range = 11 + Block Selection (in Decimal) * 11

Using IPC03 tags, the highest "**4 Bit Block selection**" patterns allowed is 1001. When selecting a higher "**4 Bit Block selection**" the Communicator is instructed to access tags memory that does not exist.

Full Rack In this case a data block of 15 bytes is read from the tag. The following table relates the byte location on the tag with the value of the “4 Bit Block selection”

Block Selection	Tag Data Bytes (in decimal)
0000	01 through 15
0001	16 through 30
0010	31 through 45
•	•
•	•
0110	91 through 105 (last accessible block on IPC03)
•	•
•	•
1110	211 through 225
1111	Fixcode

The general relation between Block Selection and data byte range on the tag is as follows:

Start of Range = 1 + Block Selection (in Decimal) * 15

End of range = 15 + Block Selection (in Decimal) * 15

Using IPC03 tags, the highest “**4 Bit Block selection**” patterns allowed is 0110. When selecting a higher “**4 Bit Block selection**” the Communicator is instructed to access tags memory that does not exist.

Special case: Reading “Fixcodes”

The “**4 Bit Block selection**” pattern 1111 has a special meaning. It causes the node adapter to issue a R/O command. The length of the reply sting depends on the ID system type and tags type as follows

ID System Type	**Tag Type**	**data reply length**
IDENT-I System P	IPC02 (Bit 1, Switch 1 OFF	40 bits of data
	IPC03 (Bit 1, Switch 1 ON)	32 bits of data
	IPC10 in IPC02 mode (Bit 1, Switch 1 OFF)	40 bits of data

When using ¼ Rack the most significant two bytes of an IPC02 are lost
When using ¼ Rack the most significant two bytes of an IPC10 in IPC02 Mode are lost
When using ¼ Rack the most significant byte of an IPC03 is lost

Mapping into PLC Input Image:

(Initial state: START=Off, DONE=Off, OP=Off, Clear=Off)

When the user program in the PLC sets the "**START**" bit ON (indicating start data transfer to PLC) the *ID System* places data into the PLC input image.

Mapping of the tag data bytes into the Input image table is as follows

<table>
<tr><th>PLC Input Word</th><th></th><th></th><th colspan="4">Remark: Rack Size to # of Tag Bytes relation</th></tr>
<tr><td>Word-0</td><td>Byte 1</td><td>Communication</td><td rowspan="2">Quarter Rack</td><td rowspan="4">Half Rack</td><td rowspan="6">Three Quarter Rack</td><td rowspan="8">Full Rack</td></tr>
<tr><td>Word-1</td><td>Byte 3</td><td>Byte 2</td></tr>
<tr><td>Word-2</td><td>Byte 5</td><td>Byte 4</td><td></td></tr>
<tr><td>Word-3</td><td>Byte 7</td><td>Byte 6</td><td></td></tr>
<tr><td>Word-4</td><td>Byte 9</td><td>Byte 8</td><td></td><td></td></tr>
<tr><td>Word-5</td><td>Byte 11</td><td>Byte 10</td><td></td><td></td></tr>
<tr><td>Word-6</td><td>Byte 13</td><td>Byte 12</td><td></td><td></td><td></td></tr>
<tr><td>Word-7</td><td>Byte 15</td><td>Byte 14</td><td></td><td></td><td></td></tr>
</table>

Status Bits (from *ID System*)

The Status Bits are used to inform the PLC about the status of the ID System. This includes the status of the battery. The status messages from the ID system are mapped as follows

ID System Status	"NT"-bit	"Error"-bit	"BAT"-bit
0 (operation successful)	OFF	OFF	OFF
2, 5	ON	OFF	OFF
1 (Low bat indication)	OFF	OFF	ON
Com-Loss	OFF	ON	OFF
4 (invalid parameters)	ON	ON	OFF

Changing the "4 Bit Block selection"

Once the *ID System* is scanning for tags a new "4 Bit Block selection" takes effect only if the "**Start**" bit is switched from **ON** ➔ **OFF**. Then the *ID System* clears its internal buffers and sets the "**Empty**" bit = **ON**. It is the PLC's responsibility to retrieve all needed data from the *ID System* before changing the Block Selection.

Retrieving Data from the *ID System*

Once the *ID System* has placed the data into the PLC input image table it will start scanning the PLC output image table. The user program on the PLC will now take the received data (Input Image) and copy it into the PLC output image. When the *ID System* determines that the two images (PLC input image generated by the *ID System* and PLC output image generated by user program on the PLC) are the same the "**DATA OK**" bit is turned ON in the PLC Input image. This will tell the PLC user program that the data has been transmitted correctly. The comparison by the *ID System* takes the selected rack size into consideration and compares only the necessary number of data words. When the *ID System* sets the "**DATA OK**" bit it stops comparing input and output images and starts checking the values of the "**DONE**" bit in the PLC output image table.

As soon as the PLC user program sees the "**DATA OK**" bit it can copy the data (i.e. the data it received from the *ID System*) into any other data storage location for later usage. Once the PLC user program has copied the data, the PLC will set the "**DONE**" bit in the PLC output image table. This is indication for the *ID System* that the data has been processed by the user program. The *ID System* resets the "**Data OK**" bit to OFF. Now two situations may occur.

No additional data available from ID System
Since no additional data is available the *ID System* will set the "**EMPTY"** bit in the PLC input image table. This completes one cycle and the PLC must then reset "**START**" bit, "**DONE**" bit and "**CLEAR**" bit to OFF.

Once the *ID System* receives the "**START**" OFF it starts scanning for tags again. The *ID System* will also send zeros to the PLC input image table (with the exception of the "**EMPTY**" bit, which remains ON.

Additional data available from ID System
When the *ID System* has additional data it will now place it in the PLC Input Image. Then the above process is repeated:

PLC user program copies data to output image,
ID System compares and sets "**DATA OK**" bit,
PLC user program copies data to storage location, and
PLC user program set "Done" bit in output image.

This is repeated until no more data is available.

It is also possible to clear the data buffer on the *ID system* without requesting all stored data (see next section).

Clearing the Data Buffer on the ID System

The PLC user program can clear the data buffer on the *ID system* any time by setting the "**CLEAR**" bit in the PLC output image table. The *ID System* confirms this by setting the "**CLEAR ACK**" bit in the PLC input image table.
Again, two possible scenarios must be considered:

"START" bit OFF

The *ID System* is currently scanning for tags (i.e. "**START**" bit OFF). In this case the ID System deletes all data entries in its internal buffers.

The PLC user program now sets the "**CLEAR**": bit to Off, resuming scanning for tags

"START" bit ON

The *ID System* does not scan for tags (i.e. "**START**" bit ON). As soon as the *ID System* receives the "**Clear**" bit is clears the internal buffers, clears the data fields in the PLC input image table and sets the "**EMPTY**" bit in the PLC input image.

The PLC user program now sets the "**CLEAR**" bit to Off. This would enable scanning for tags as soon as the "**START**" bit is set to Off.

Writing Data to a Tag

(Initial state: START=On, DONE=Off, OP=On, Clear=Off)

The "**OP"** bit determines if the *ID System* is currently reading or writing. When the PLC user program sets the "**OP"** bit = ON (writing) while the "**START"** bit is ON (and "**Done**" = Off, "**Clear**" = Off) the following happens:

The *ID System* acknowledges receiving a request to perform a write via the "**OPA**" bit. The "**OPA**" bit is tuned ON when the Node Adapter received the write request. No write takes place at that time.

"**ERROR**", "**CLEAR ACK**" and "**DATA OK**" bits in the PLC input image table are all set OFF by the *ID System.* Also, the *ID System* takes the data in the PLC output image that will be written to the tag an copies it back to the PLC input image. The number of words used for this copy operation depends on the selected Rack Size. The PLC user program must compare the data in its output image with the received data in the input image table (excluding the Control bits). If they are the same AND the *ID System* has sets the "**OPA**" bit = ON the node adapter has received a full data set and is ready to write. To confirm that the data has been verified by the PLC, the PLC user program now toggles the "**START**" bit from **ON ➔ OFF**. The *ID System* then performs the write and also sets the "**OPA**" bit = OFF.

While the *ID System* is writing to the tag the PLC user program must evaluate the *Status Bits* to determine if the write operation was successful. The following table shows how internal status messages are mapped into the PLC input image table.

ID System Status	"DATA OK" bit	"NT" bit	"Error" bit	"BAT"-bit
0 (operation successful)	ON	OFF	OFF	OFF
1 (Bat low)	ON	OFF	OFF	ON
5 (No tag present)	OFF	ON	OFF	OFF
4 (invalid parameters)	OFF	ON	ON	OFF
Com-Loss	OFF	OFF	ON	OFF
B (Multiple tags in field during write)	OFF	OFF	ON	OFF

To initiate another write operation the PLC user program must toggles the "Start" bit OFF ➔ ON. The *ID System* replies with "Data OK" = OFF, "NT" = OFF, "Error" = OFF and "OPA" = ON. Now the entire process can be repeated.

Reading Pre-Configured IPC03-xx Data Carriers

Using IPC03 tag that have been pre-configured offer significantly faster reads. To activate this feature the following must be done:

(1) On the IPC03-xx data carrier pre-configured read must be activated for transmission of one double word. Configuring any other data size will result in an error.

(2) The DIP switches on the KHD2-MTI-AB4 must be set for

Tag Type → IPC03

RIO Rack Size → Quarter or Half

(3) Additionally, SWITCH 2 DIP-Switch 2 must be set to ON. This switch is usually used to set RIO Rack Addresses but is redefined in this particular case. Thus, the RIO Rack Address is now limited to $(0\ 0)_{Octal}$ to $(3\ 7)_{Octal}$.

When reading tags the **Four-Bit Block selection** in the PLC Output Image Table is ignored. Writing is still possible and takes the **Four-Bit Block Selection** into account.

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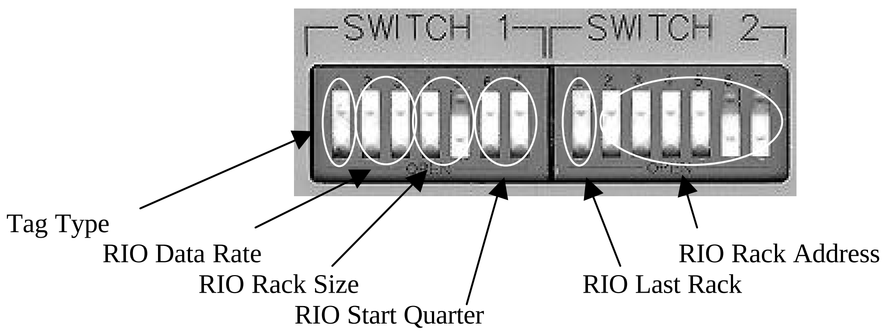
DIP Switches on the KHD2-MTI-AB4

Two sets of DIP-Switches on the KHD2-MTI-AB4 are used to define operational parameters. The settings are as follows. Please note that the Switch 1-1 has two functions depending on the type of Communicator used.

Ident-M System T: Used to select the ScanTime
Ident-I System P: Used to select the IPC02 or IPC03 type tags



SWITCH 1

	Function	ON (Close)	OFF (OPEN)
DIP-Switch 1	Tag Type	ON.	IPC03
		OFF.	IPC02 (IPC10)
DIP-Switch 2,3	RIO Data Rate	OFF, OFF	57.6 kbps
		OFF, ON	115.2 kbps
		ON, OFF	230.4 kbps
		ON, ON	Reserved
DIP-Switch 4,5	RIO Rack Size	OFF, OFF	Quarter
		OFF, ON	Half
		ON, OFF	Three Quarter
		ON, ON	Full
DIP-Switch 6,7	RIO Start Quarter	OFF, OFF	First
		OFF, ON	Second
		ON, OFF	Third
		ON, ON	Fourth

SWITCH 2

	Function	ON (Close)	OFF (OPEN)
DIP-Switch 1	RIO Last Rack	OFF	No
		ON	Yes
DIP-Switch 2(*) to 7	RIO Rack Address	Binary coded Address	

(*) Note: DIP-Switch 2 is used to activate the faster Pre-Configured reads possible with IPC03 type data carriers. Refer to pages 2 (Revisions) and 13 (Reading Pre-Configured IPC03-xx Data Carriers) for more information.

Trouble Shooting

The RIO-LED on the KHD2-MTI-AB4 and the main LED on the Communicator can be used for trouble shooting. The RIO-LED indicates the status of the connection between the PLC and the KHD2-MTI-AB4.

KHD2-MTI-AB4 online: RIO-LED on solid green
PLC in Program Mode: RIO-LED blinks green
RIO connection lost: RIO-LED off

The Main-LED on Communicator indicates the following operation states.

Communicator powered: Green Power LED ON
KHD2-MTI-AB4 offline: LED blinks red, green power LED remains ON

Once the KHD2-MTI-AB4 is online the "**Error**" bit in the PLC input image table can be used to check for connection between the KHD2-MTI-AB4 and Communicator. If the Communicator fails to reply to commands sent by the KHD2-MTI-AB4 the "**Error**" bit is turned on. As soon as the connection is reestablished the "**Error**" bit is turned off.

Notes: