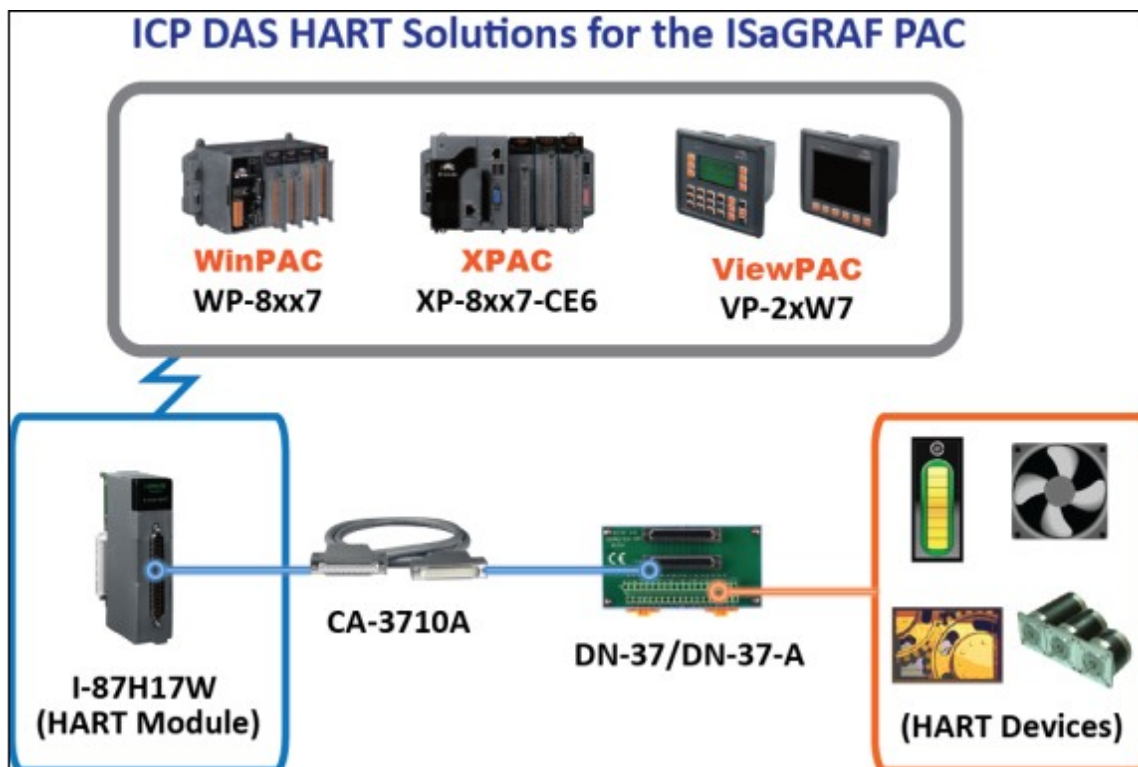


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## HART Solution : ISaGRAF PAC plus I-87H17W

The ICP DAS XP-8347-CE6 / XP-8747-CE6, WP-8447 / WP-8847 / WP-8437 / WP-8837 and VP-25W7 / VP-23W7 ISaGRAF PAC support the I-87H17W HART Master module since the below driver version.

XP-8xx7-CE6 : driver Ver.1.15 , WP-8xx7 : driver Ver.1.35 , VP-2xW7 : driver Ver.1.27



If the ISaGRAF driver of User's ISaGRAF PAC is older than the above listed version, please visit the following web site to download it and update it to user's PAC.

ISaGRAF driver : <http://www.icpdas.com/products/PAC/i-8000/isagraf-link.htm>

ISaGRAF PAC : <http://www.icpdas.com/products/PAC/i-8000/isagraf.htm>

Data Sheet : <http://www.icpdas.com/products/PAC/i-8000/data%20sheet/data%20sheet.htm>

I-87H17W : [http://www.icpdas.com/products/Remote\\_IO/can\\_bus/i-87h17w.htm](http://www.icpdas.com/products/Remote_IO/can_bus/i-87h17w.htm)

This paper is the ISaGRAF FAQ-136. User can visit the following web site to download it and demo programs. <http://www.icpdas.com/faq/isagraf.htm> > 136 .

The XP-8xx7-CE6 PAC supports I-87H17W in its slot No. 1 to 7 (Its leftmost slot No. is 1).

The WP-8xx7 PAC supports I-87H17W in its slot No. 0 to 7 (Its leftmost slot No. is 0).

The VP-2xW7 supports I-87H17W in its slot No. 0 to 2 (Its leftmost slot No. is 0).

ICP DAS ISaGRAF PAC don't support the I-87H17W which is plugged in the RS-485 remote expansion base (like the I-87K8, RU-87P8).

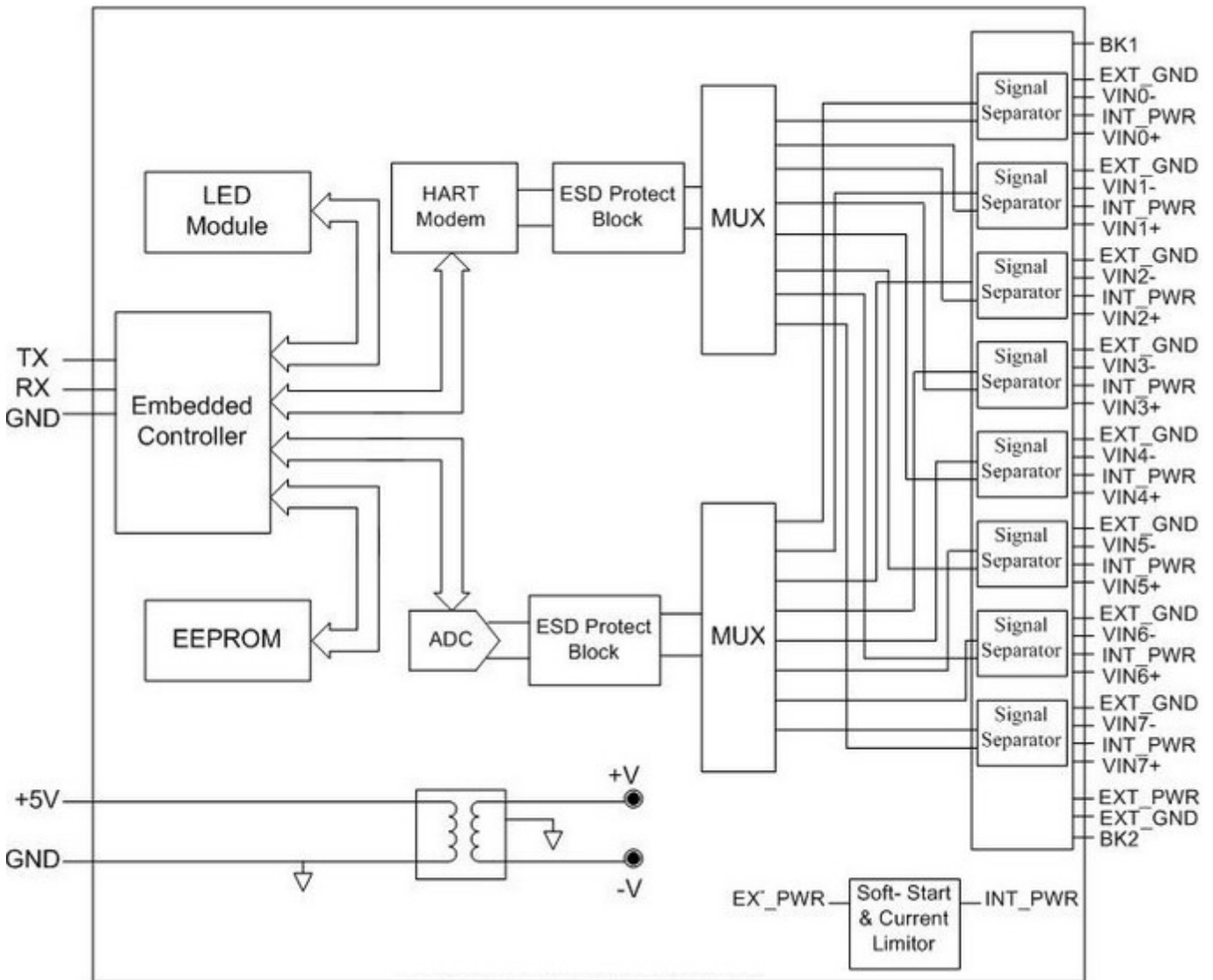
The I-87H17W has 8 Analog input channels. They can measure current inputs (4 to 20 mA) and also they can be used as HART communication channels. Recommend to link only one HART device in each channel.

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### 1.1 : I-87H17W hardware

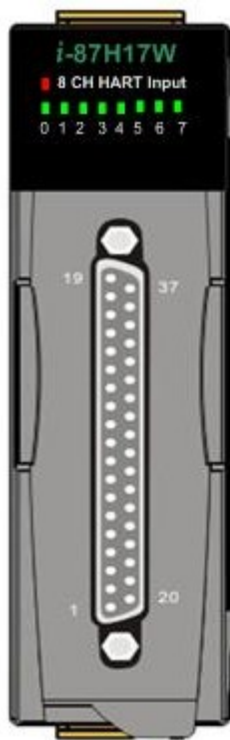
Please visit [http://www.icpdas.com/products/Remote\\_IO/can\\_bus/i-87h17w.htm](http://www.icpdas.com/products/Remote_IO/can_bus/i-87h17w.htm) for more information about the I-87H17W hardware. This section lists only “Internal I/O structure” and “Pin assignments” and “Wire connection”.

Internal I/O structure of the I-87H17W :



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Pin assignments of the I-87H17W :

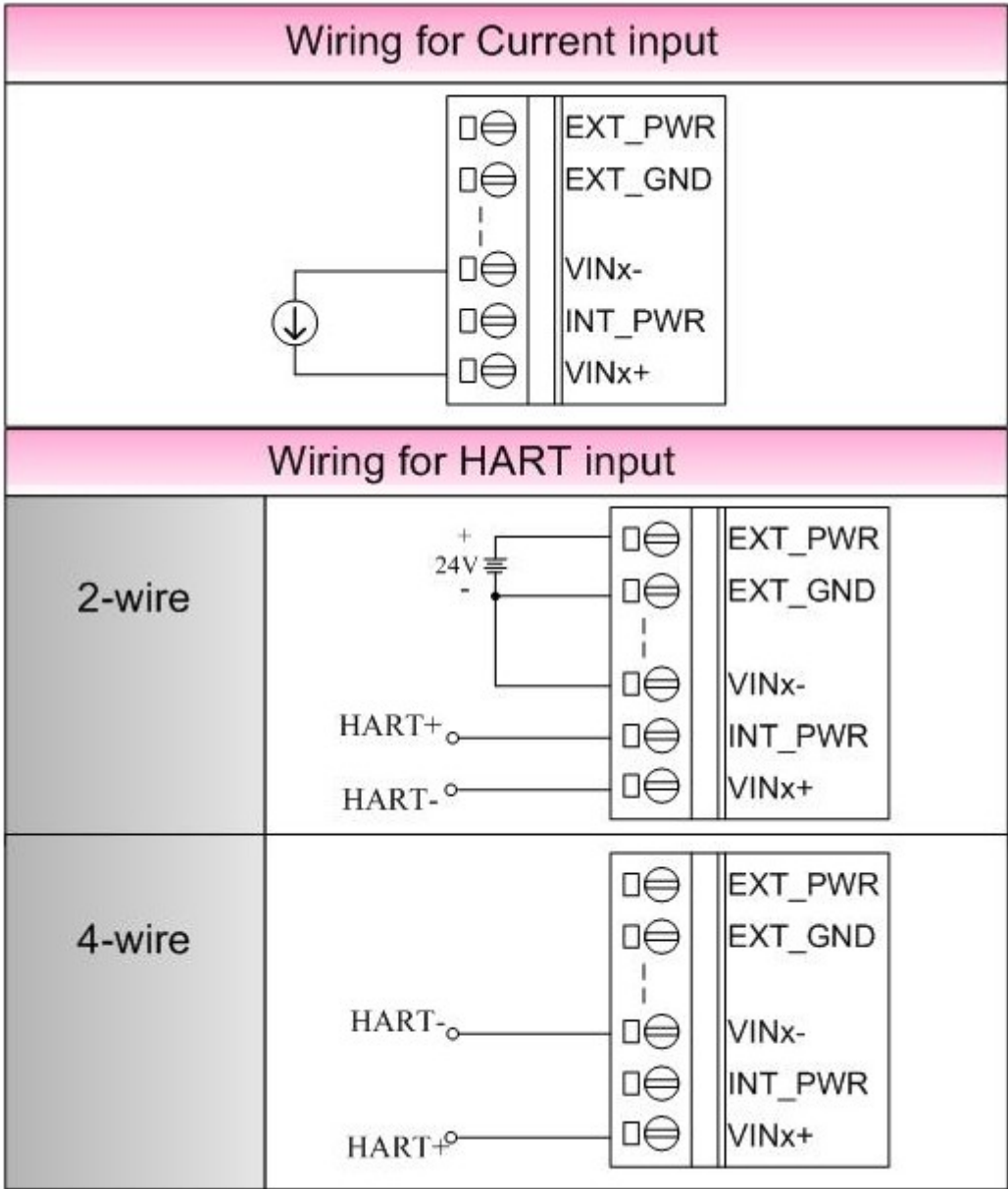


Pin Assignment Name	Terminal No.	Pin Assignment Name
X	19	37
EXT_PWR	18	36
VIN7-	17	35
VIN7+	16	34
VIN6-	15	33
VIN6+	14	32
VIN5-	13	31
VIN5+	12	30
VIN4-	11	29
VIN4+	10	28
VIN3-	09	27
VIN3+	08	26
VIN2-	07	25
VIN2+	06	24
VIN1-	05	23
VIN1+	04	22
VIN0-	03	21
VIN0+	02	20
BK1	01	

37-pin male D-Sub Connector

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Wire connection of the I-87H17W :



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## 1.2 : Restore the I/O library and ISaGRAF example programs

User may visit <http://www.icpdas.com/faq/isagraf.htm> > 136 to download the “faq\_136.zip” which includes the PDF paper and example projects( “faq136\_1.pia” to “faq136\_4.pia” ). Please restore them to your PC / ISaGRAF.

faq136_1	Send HART frame manually from Ch.1 of Slot 2, and then receive the ans frame.
faq136_2	Similar as “faq136_1” but convert the received answer frame to 4 REAL value.
faq136_3	Send HART frame and then receive answer frame automatically from Ch.1 of Slot 2 first. Then switch to handle Ch.2 of Slot 2. And then switch to handle Ch.3 of Slot 2. Then after switch back to handle the Ch.1 of Slot 2, ...
faq136_4	Similar as “faq136_3” but using three I-87H17W cards which are plugged in Slot No. 1 , 2 and 3 respectively. Each I-87H17W can process only one channel to communicate with HART device at a time. It must process channels one by one in turn. That is because all the 8 channels in one I-87H17W are sharing the same HART chip . However more than one I-87H17W in different slot No. can process one of their own channels at the same time.

To program the ISaGRAF PAC plus I-87H17W cards, first enable the function of “Variable Array” of your PC / ISaGRAF. Refer to the <http://www.icpdas.com/faq/isagraf.htm> > 039 to setup it.

The method is to add two rows on the top position of the file “ISA.ini” in the “C:\ISAWIN\EXE\” path where your ISaGRAF software installed. After inserting these two rows, save the “ISA.ini” and then run the PC / ISaGRAF software again.

### [DEBUG]

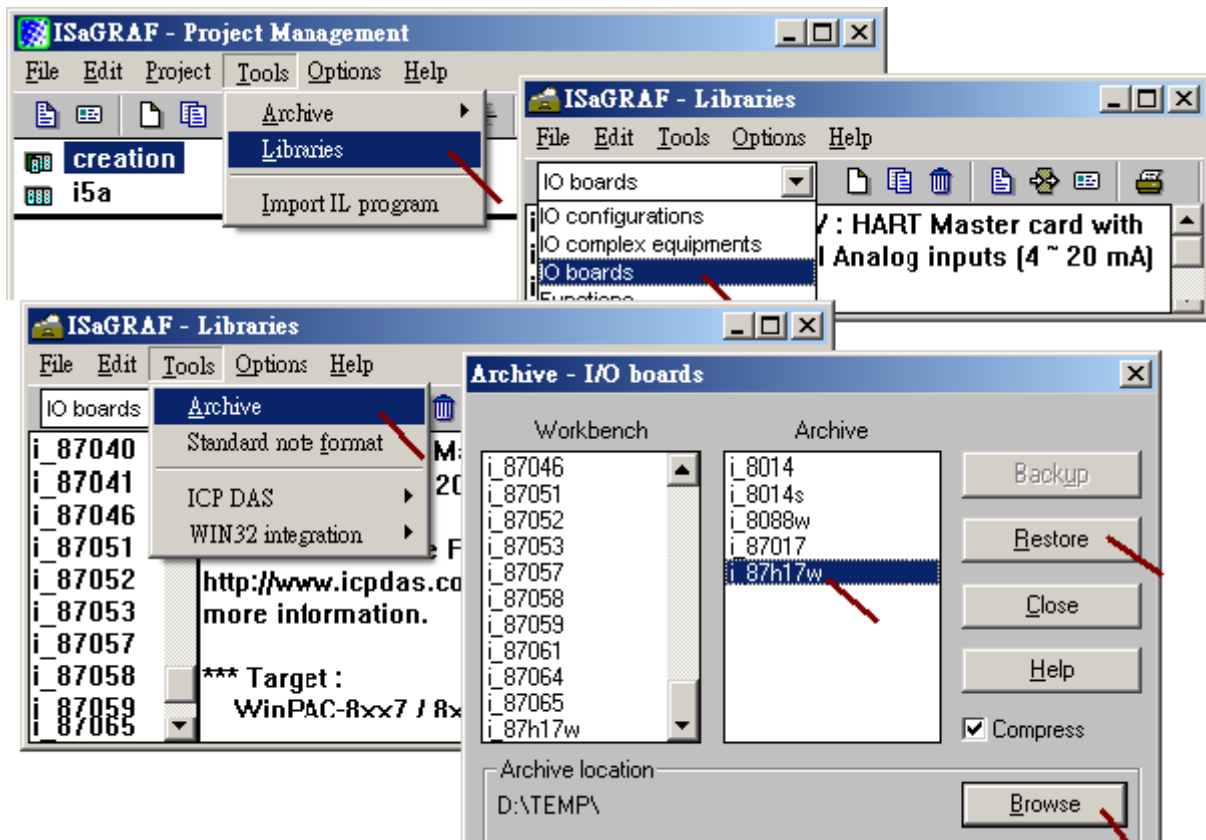
**arrays=1**

User may refer to the section 1.1 and 1.2 and chapter 2 of the “ISaGRAF User's manual” if he is not familiar with the ISaGRAF programming. The PDF manual is the “user\_manual\_i\_8xx7.pdf” and “user\_manual\_i\_8xx7\_appendix.pdf” which can be found in the CD-ROM of the ISaGRAF PAC 's product box. Or visit the below web site to download it. The size is about 21MB.

[http://www.icpdas.com/products/PAC/i-8000/getting\\_started\\_manual.htm](http://www.icpdas.com/products/PAC/i-8000/getting_started_manual.htm)

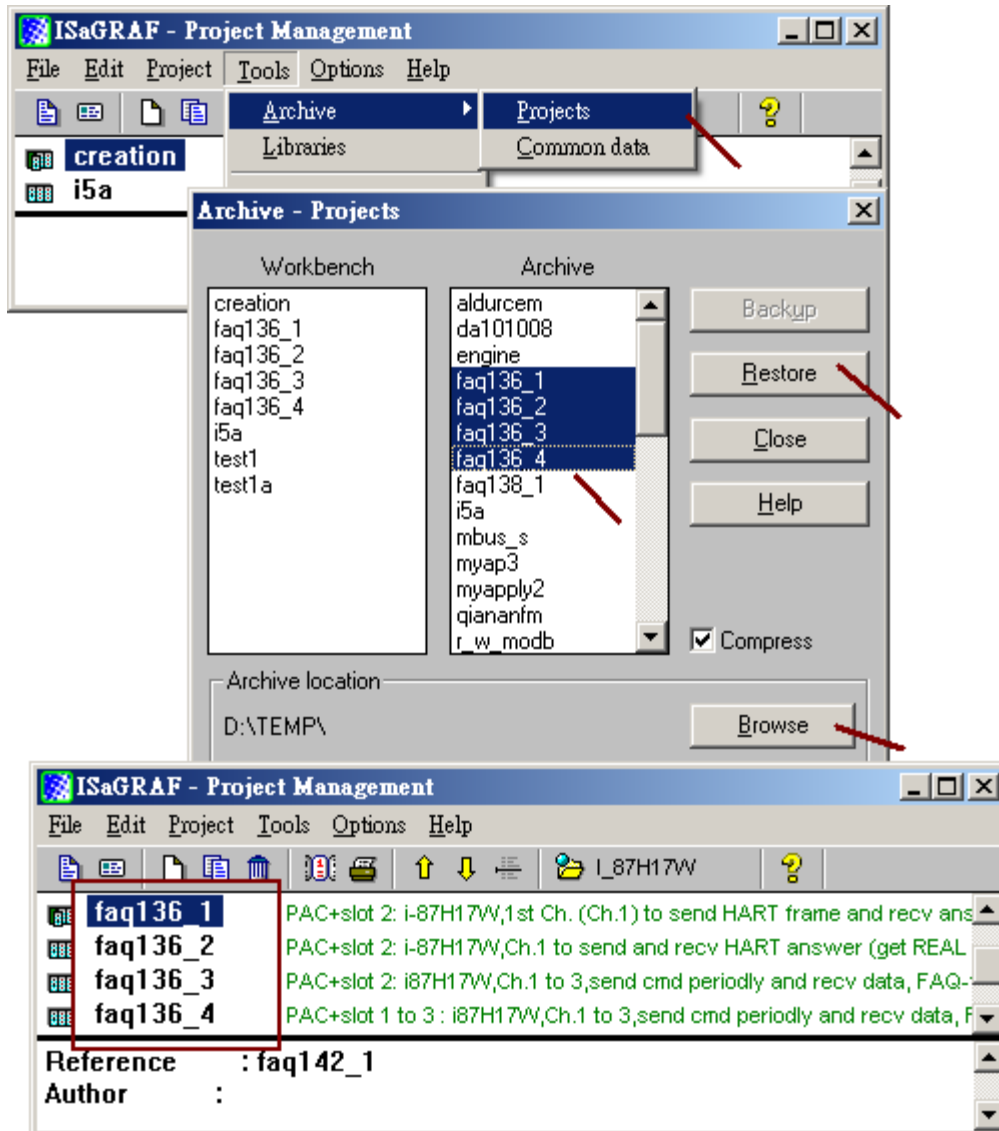
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Restore the “i\_87h17w” :



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Restore the ISaGRAF projects - faq136\_1.pia, faq136\_2.pia, faq136\_3.pia and faq136\_4.pia :



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### 1.3 : Format of the HART protocol

Note:

A. This section only introduce the basic format of the HART protocol. It may not fit all the HART devices in the current market all over the world. Please must refer to the document of the respective HART devices and follow their format to work the ISaGRAF PAC with them.

B. DO NOT use the below "Check-byte" in the ISaGRAF program. The I-87H17W card will automatically calculate the "Check-byte" and add it into the HART frame to be sent. When receive a correct HART answer frame from a device, the I-87H17W will remove the "Check-byte" automatically and then pass the answer frame without "Check-byte" to the ISaGRAF program.

C. HART physical layer is using 1200 bps, 1 start-bit, Odd parity, 8 character-size, 1 stop-bit .

I-87H17W send :

Byte-count is the byte amount of the "Data" . Its value is 0 to 255.

Preamble	Delimiter	Address	Command	Byte Count	Data	Check byte
5 ~ 20 byte	1 byte	1 byte (short) 5 byte (long)	1 byte	1 byte	0 ~ 255 byte	1 byte

HART device answer :

Byte-count is the byte amount of the "Data" plus "Response code" . Its value is 0 to 255.

Preamble	Delimiter	Address	Command	Byte Count	Response code	Data	Check byte
5 ~ 20 byte	1 byte	1 byte (short) 5 byte (long)	1 byte	1 byte	2 byte	0 ~ 253 byte	1 byte

Preamble : 5 ~ 20 byte

value of each byte is 255 (16#FF, Hex)

Delimter : 1 byte

- 01 : Short frame, Burst Frame
- 02 : Short frame, Master to Slave
- 06 : Short frame, Slave to Master
- 129 (16#81) : Long frame, Burst Frame
- 130 (16#82) : Long frame, Master to Slave
- 134 (16#86) : Long frame, Slave to Master

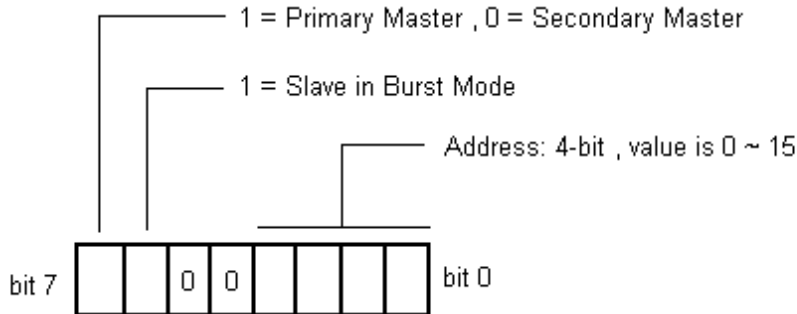
(More in the next page)



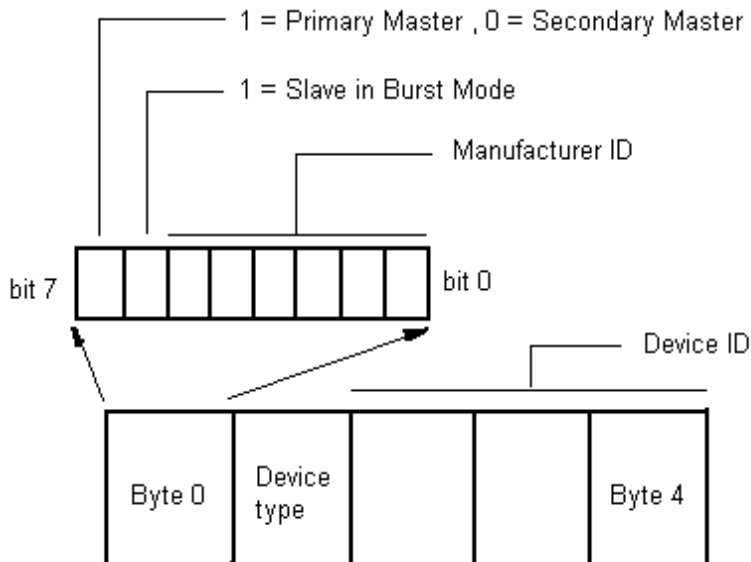
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Address : 1 byte (Short frame) or 5 bytes (Long frame)

Short frame (1 byte) :



Long frame (5 bytes) :



Command : 1 byte , refer to the manual of the HART device for its definition.

Byte-count : 1 byte

I-87H17W send: Byte-count is the byte amount of the "Data" . value is 0 to 255.

Device answer: Byte-count is the byte amount of "Data" + "Response code". value is 0 to 255.

Response code : 2 byte , refer to the manual of the HART device for its definition.

Data : refer to the manual of the HART device for its definition.

Check-byte : 1 byte

DO NOT use the "Check-byte" in the ISaGRAF program. The I-87H17W card will automatically calculate the "Check-byte" and add it into the HART frame to be sent. When receive a correct HART answer frame from a device, the I-87H17W will remove the "Check-byte" automatically and then pass the answer frame without "Check-byte" to the ISaGRAF program.

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#### 1.4 : Basic concept of the program of the ISaGRAF PAC plus the I-87H17W

For detail ISaGRAF program, please refer to the example project - "faq136\_1" to "faq136\_4". User may also refer to section 1.5 of this paper to test the example projects.

faq136_1	Send HART frame manually from Ch.1 of Slot 2, and then receive the ans frame.
faq136_2	Similar as "faq136_1" but convert the received answer frame to 4 REAL value.
faq136_3	Send HART frame and then receive answer frame automatically from Ch.1 of Slot 2 first. Then switch to handle Ch.2 of Slot 2. And then switch to handle Ch.3 of Slot 2. Then after switch back to handle the Ch.1 of Slot 2, ...
faq136_4	Similar as "faq136_3" but using three I-87H17W cards which are plugged in Slot No. 1 , 2 and 3 respectively. Each I-87H17W can process only one channel to communicate with HART device at a time. It must process channels one by one in turn. That is because all the 8 channels in one I-87H17W are sharing the same HART chip . However more than one I-87H17W in different slot No. can process one of their own channels at the same time.

Please make sure your ISaGRAF driver of the XP-8347-CE6 / XP-8747-CE6, WP-8447 / WP-8847 / WP-8437 / WP-8837 and VP-25W7 / VP-23W7 PAC does fit the version requirement listed in the page one of this paper.

To program the ISaGRAF PAC plus I-87H17W cards, first enable the function of "Variable Array" of your PC / ISaGRAF. Refer to the <http://www.icpdas.com/faq/isagraf.htm> > 039 to setup it.

The method is to add two rows on the top position of the file "ISA.ini" in the "C:\ISAWIN\EXE\" path where your ISaGRAF software installed. After inserting these two rows, save the "ISA.ini" and then run the PC / ISaGRAF software again.

**[DEBUG]**  
**arrays=1**

User may refer to the section 1.1 and 1.2 and chapter 2 of the "ISaGRAF User's manual" if he is not familiar with the ISaGRAF programming. The PDF manual is the "user\_manual\_i\_8xx7.pdf" and "user\_manual\_i\_8xx7\_appendix.pdf" which can be found in the CD-ROM of the ISaGRAF PAC 's product box. Or visit the below web site to download it. The size is about 21MB.

[http://www.icpdas.com/products/PAC/i-8000/getting\\_started\\_manual.htm](http://www.icpdas.com/products/PAC/i-8000/getting_started_manual.htm)

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To enable the I-87H17W in the ISaGRAF PAC, connect the “i\_87h17w” in the ISaGRAF I/O connection window. The below figure shows the example project - “faq136\_1” has enabled one I-87H17W in the slot No. 2, while the “faq136\_4” has enabled three I-87H17W in slot No.1 to 3.

**Note:**

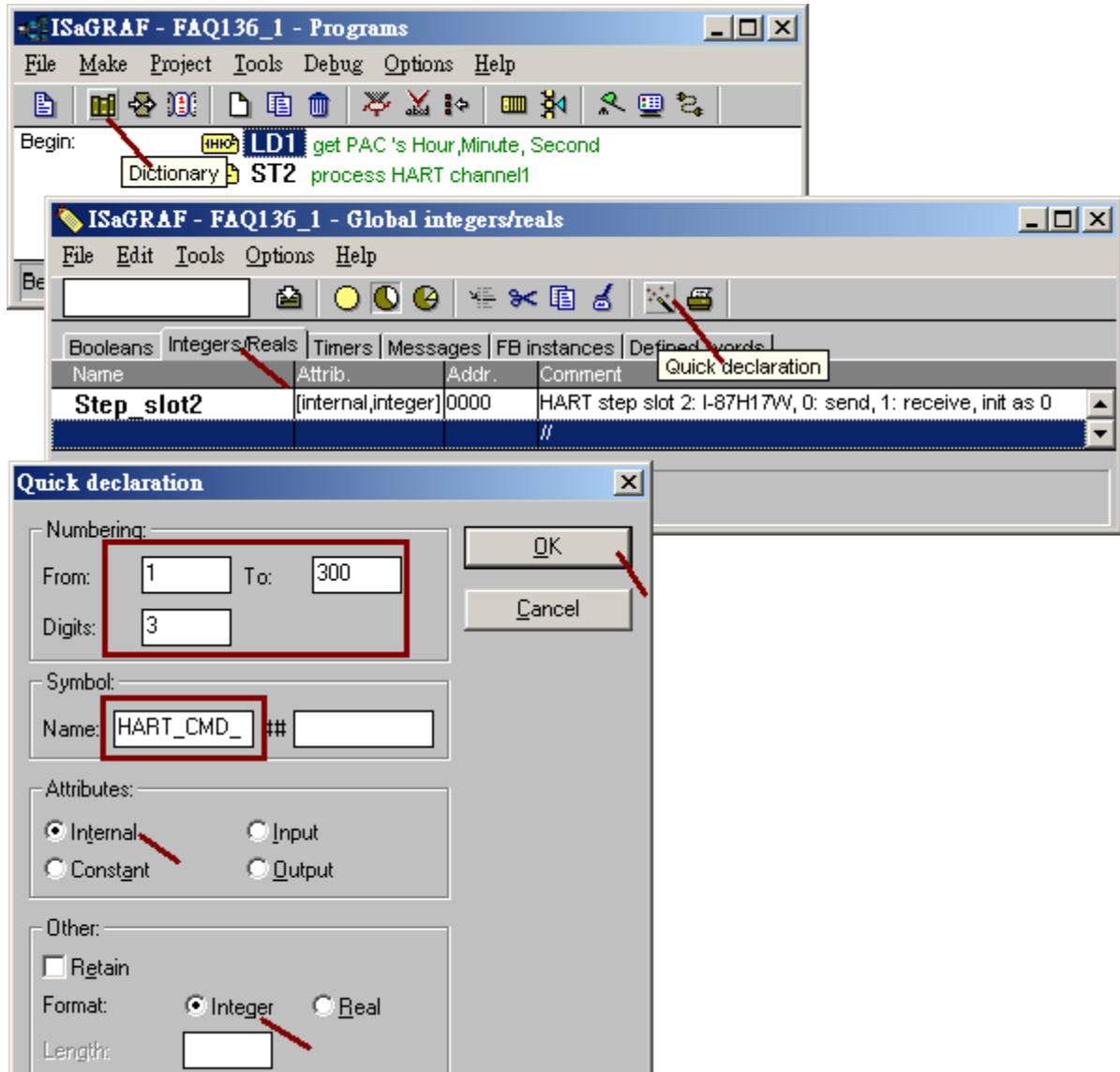
- A. The leftmost I/O slot No. of the XP-8xx7-CE6 is 1 .
- B. The leftmost I/O slot No. of the WP-8xx7 and VP-2xW7 is 0 .
- C. The channel value of the I-87H17W is a value ranging from 0 to 32767 to represent current input of 4 to 20 mA. For example,if value is 12288, it means the current input is 10 mA.If the value is a negative value “-32768” , it means “sensor broken-line” or “current input less than 4 mA” .

Channel value (0 to 32767) means ( 4 to 20 mA).  
For example, value 12288 means 10 mA.

Value -32768 means under-range or broken-line  
(For ex., input only 1 mA will get value -32768)

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Please declare 300 integer variables named “HART\_CMD\_001” to “HART\_CMD\_300” to store the HART frame to be sent to the HART device. And must assign 300 continuous network-address number (3001 to 3300) to them.



(More in the next page)

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Assign continuous "Network address" as 3001 to 3300 (more in the next page):

**Change to "Decimal"**

**1**

**2**

**5**

**3** Select the 3001 number

**4** Using Shift and Mouse to select all HART\_CMD\_001 , HART\_CMD\_002 , ... to HART\_CMD\_300

**Here always displayed as Hex. number**

Name	Attrib.	Addr.	Comment
HART_CMD_001	[internal, integer]	0BB9	HART frame send to other HART devices, addr= 3001 to 3300
HART_CMD_002	[internal, integer]	0BBA	
HART_CMD_003	[internal, integer]	0BBB	
HART_CMD_004	[internal, integer]	0BBC	
HART_CMD_005	[internal, integer]	0BBD	
HART_CMD_006	[internal, integer]	0BBE	

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Follow the similar steps to declare 300 integer variables named “HART\_ANS\_001” to “HART\_ANS\_300” to store the HART answer frame received from the HART device. And must assign 300 continuous network-addresss number (3301 to 3600) to them.

**Quick declaration**

Numbering:

From: 1 To: 300

Digits: 3

Symbol:

Name: HART\_ANS\_ ##

Attributes:

Internal  Input

Constant  Output

Other:

Retain

Format:  Integer  Real

**ISaGRAF - FAQ136\_1 - Global integers/reals**

File Edit Tools Options Help

Booleans Integers/Reals Timers Messages FB instances Defined words

Name	Attrib.	Addr.	Comment
HART_CMD_297	[internal, integer]	OCE1	
HART_CMD_298	[internal, integer]	OCE2	
HART_CMD_299	[internal, integer]	OCE3	
HART_CMD_300	[internal, integer]	OCE4	
			//
HART_ANS_001	[internal, integer]	OCE5	HART frame received from other device, addr= 3301 to 3600
HART_ANS_002	[internal, integer]	OCE6	
HART_ANS_003	[internal, integer]	OCE7	
HART_ANS_004	[internal, integer]	OCE8	
HART_ANS_005	[internal, integer]	OCE9	
HART_ANS_006	[internal, integer]	OCEA	
HART_ANS_007	[internal, integer]	OCEB	
HART_ANS_008	[internal, integer]	OCEC	
HART_ANS_009	[internal, integer]	OCED	

Here always displayed as Hex. number

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The I-87H17W is a 8-channel HART master module. All the 8 channels in the same I-87H17W are sharing the same HART chip. The ISaGRAF program must handle the HART communication one channel by one channel. DO NOT send frame or receive frame for two or more channels in the same I-87H017W at the same time . First handle the sending and receiving of channel 1. When the answer frame is received or the result is established (for example, timeout or error), then switch to handle channel 2, ...

Before sending a HART frame, first use the "COMReady( )" function to check if the I-87H17W is ready for sending frame. If it returns "True", then use the "COMARY\_W( )" function to send a HART frame. Then after, the program should use the "COMReady( )" to check if the answer frame is well received. If it returns "True", use the "COMARY\_R( )" to receive the answer frame.

### COMReady

Usage : TMP\_Boo := COMReady( Channel\_ID ) ;

Parameters :

Channel\_ID : integer,10S0C , "S" is slot No. of the I-87H17W (0 ~ 7), "C" is channel No (1 ~ 8).  
for example, 10203 means Slot 2, Channel 3.

Returns : boolean

True : The I-87H17W is ready for sending HART frame, or  
the HART answer frame is well received or the result is established (timeout, error, ..)

False : The I-87H17W is busy or invalid parameters.

### COMARY\_W

Usage : TMP\_Boo := COMARY\_W( Channel\_ID , Network\_addr , Count ) ;

Parameters :

Channel\_ID : integer,10S0C , "S" is slot No. of the I-87H17W (0 ~ 7), "C" is channel No (1 ~ 8).  
for example, 10203 means Slot 2, Channel 3.

Network\_addr : integer, 1 ~ 7801 , the network address of the first integer variable which  
restoring the HART frame to be sent to the HART device.

Count : integer, the byte amount of the HART frame to be sent.

DO NOT include the "Check-byte" (refer to section 1.3).

Returns : boolean

True : calling COMARY\_W( ) ok.

False : calling COMARY\_W( ) fail. May be invalid parameters, or the I-87H17W is busy,  
or the network address of integer variables which restoring the HART sending frame  
are not declared as integer or not assigned with continuous network addr. (refer 1.4).

(More in the next page)

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## COMARY\_R

Usage : TMP\_Int := COMARY\_R( Channel\_ID , Network\_addr ) ;

Parameters :

Channel\_ID : integer, 10S0C , "S" is slot No. of the I-87H17W (0 ~ 7), "C" is channel No (1 ~ 8).  
for example, 10203 means Slot 2, Channel 3.

Network\_addr : integer, 1 ~ 7801 , the network address of the first integer variable which is used for storing the received HART frame which is coming from HART device.

Note : the "Check\_byte" is removed by the I-87H17W after the answer frame is well received.  
(Please refer to the section 1.3)

Returns : integer

- 0 : invalid parameter, or network address error, or variables are not declared well (refer 1.4), or the I-87H17W is busy.
- > 0 : receive answer frame well. The value is the byte amount (no including the "check-byte" ) (please refer to section 1.3)
- < 0 : The result is established but error happens (listed as the following).
  - 1 : Timeout
  - 2 : Read\_data\_too\_short error
  - 3 : Delimiter error
  - 4 : addr\_master error
  - 5 : addr\_burst error
  - 6 : recv\_command error
  - 7 : checksum error
  - 8 : response error
  - 98 : para\_mismatch error
  - 99 : impossible error
  - 102 : I-87H17W timeout
  - 104 : invalid frame to send
  - 105 : invalid frame to send
  - 117 : can not communicate with the I-87H17W card
  - 118 : the "i\_87h17w" is not connected in the ISaGRAF IO connection window
  - 198 : answer frame size larger than 283 bytes
  - 199 : HART\_ANS\_xxx are not internal integers or not assigned with correct network address



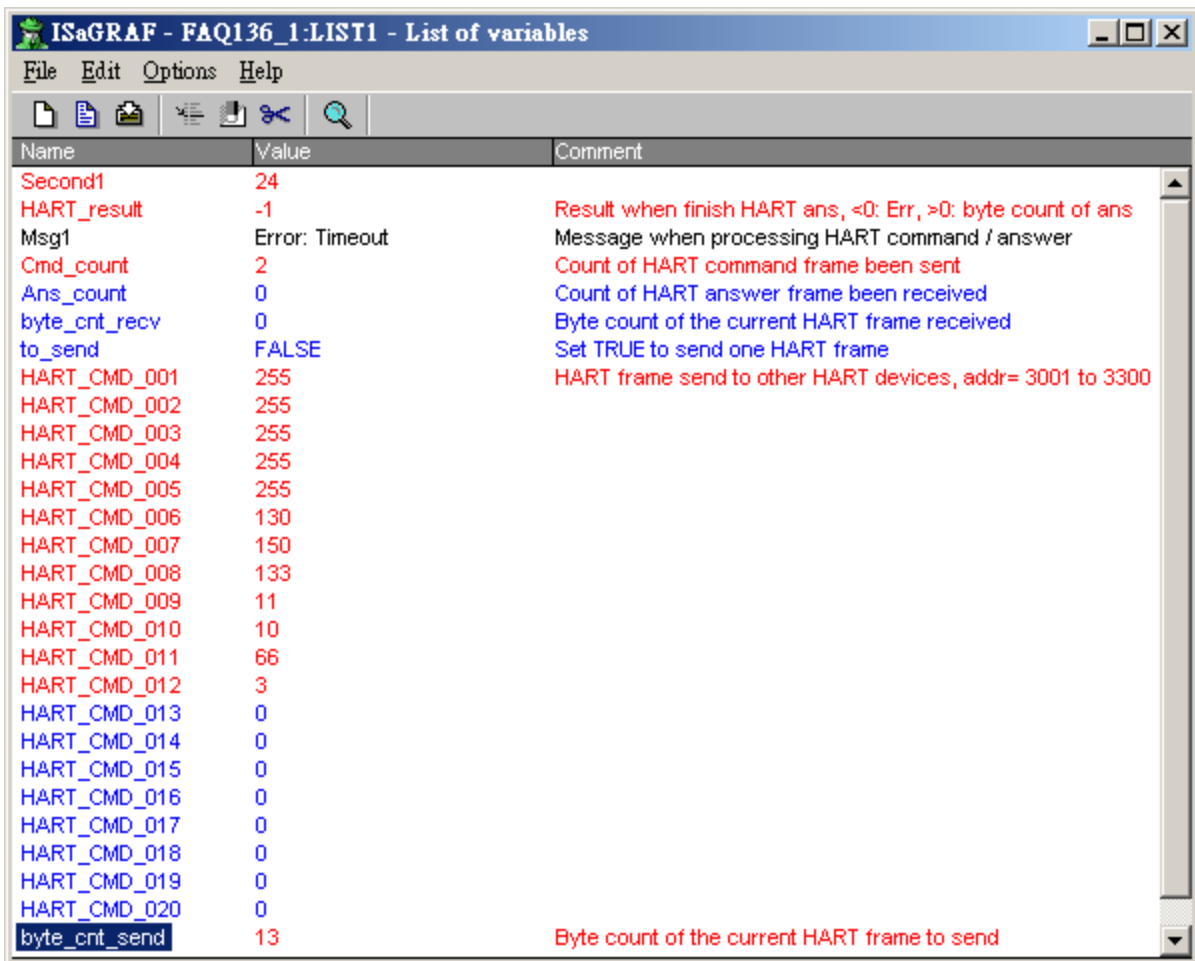
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### 1.5 : Test the example projects

faq136_1	Send HART frame manually from Ch.1 of Slot 2, and then receive the ans frame.
faq136_2	Similar as “faq136_1” but convert the received answer frame to 4 REAL value.
faq136_3	Send HART frame and then receive answer frame automatically from Ch.1 of Slot 2 first. Then switch to handle Ch.2 of Slot 2. And then switch to handle Ch.3 of Slot 2. Then after switch back to handle the Ch.1 of Slot 2, ...
faq136_4	Similar as “faq136_3” but using three I-87H17W cards which are plugged in Slot No. 1 , 2 and 3 respectively. Each I-87H17W can process only one channel to communicate with HART device at a time. It must process channels one by one in turn. That is because all the 8 channels in one I-87H17W are sharing the same HART chip . However more than one I-87H17W in different slot No. can process one of their own channels at the same time.

#### 1.5.1 : Test the project “faq136\_1” and “faq136\_2”

To well test the “faq136\_1” project, please must plug one I-87H17W in PAC 's Slot 2 and connect its 1st channel (Ch.1) to the HART device (refer to section 1.1). Then power up the PAC, download the “faq136\_1” project to it, then PC / ISaGRAF will show up the below window.



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Before sending a HART frame, first enter the HART frame data to the variables (“HART\_CMD\_001” to ...). Then remember to enter the correct value to the “byte\_cnt\_send”. Then set “to\_send” as True to send a HART frame to the HART device. The following figure shows the sending frame has 13 bytes (“HART\_CMD\_001” to “HART\_CMD\_013”)

The screenshot displays the ISaGRAF software interface with several windows and dialog boxes. Red arrows and numbers 1 through 7 highlight specific elements:

- 1:** Points to the 'LD1' ladder logic step in the 'Debug programs' window.
- 2:** Points to the 'Integers/Reals' tab in the 'Global integers/reals' window.
- 3:** Points to the 'Step\_slot2' configuration box at the bottom.
- 4:** Points to the 'byte\_cnt\_send' variable in the 'List of variables' window.
- 5:** Points to the '13' value entered in the 'Write integer/real variable' dialog box.
- 6:** Points to the 'to\_send' variable in the 'List of variables' window.
- 7:** Points to the 'TRUE' button in the 'Write boolean variable' dialog box.

Name	Attrib	Addr	Value
HART_CMD_001	[internal,integer]	0BB9	255
HART_CMD_002	[internal,integer]	0BBA	255
HART_CMD_003	[internal,integer]	0BBB	255
HART_CMD_004	[internal,integer]	0BBC	255
HART_CMD_005	[internal,integer]	0BBD	255
HART_CMD_006	[internal,integer]	0BBE	130
HART_CMD_007	[internal,integer]	0BBF	150
HART_CMD_008	[internal,integer]	0BC0	133
HART_CMD_009	[internal,integer]	0BC1	11
HART_CMD_010	[internal,integer]	0BC2	10
HART_CMD_011	[internal,integer]	0BC3	66
HART_CMD_012	[internal,integer]	0BC4	3
HART_CMD_013	[internal,integer]	0BC5	0
HART_CMD_014	[internal,integer]	0BC6	0

Name	Value
HART_CMD_017	0
HART_CMD_018	0
HART_CMD_019	0
HART_CMD_020	0
byte_cnt_send	13
<end of list>	
Second1	41
HART_result	-1
Msg1	Error: Timeout
Cmd_count	2
Ans_count	0
byte_cnt_recv	0
to_send	6
HART_CMD_001	255
HART_CMD_002	255

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Then view the value of the “HART\_result” and “Msg1” to see the result of the answer frame. If the value of “HART\_result” is larger than 0, for example the below figure shows 34, it means the received answer frame is correct and has 34 bytes (HART\_ANS\_001 to HART\_ANS\_034). However If the value of “HART\_result” is less than 0, error happens.

The screenshot shows two windows from the ISaGRAF software. The top window, titled 'ISaGRAF - FAQ136\_1:LIST1 - List of variables', displays a list of variables and their current values. The 'HART\_result' variable is highlighted with a blue selection bar and has a value of 34. A red arrow points to this value. A red line also points to the 'Msg1' variable, which contains the text 'OK: Got one HART answer fra Message when processing HART command / answer'. A red note next to the 'HART\_result' value reads: 'Result when finish HART ans, <0: Err, >0: byte count of ans'. The bottom window, titled 'ISaGRAF - FAQ136\_1 - Global integers/real', shows a table of global integer variables. A red box highlights the first 22 rows of this table, which correspond to the HART answer frames mentioned in the text.

Name	Unit	Address	Value	Comment
HART_ANS_001	[internal, integer]	OCE5	255	HAR
HART_ANS_002	[internal, integer]	OCE6	255	
HART_ANS_003	[internal, integer]	OCE7	255	
HART_ANS_004	[internal, integer]	OCE8	255	
HART_ANS_005	[internal, integer]	OCE9	255	
HART_ANS_006	[internal, integer]	OCEA	134	
HART_ANS_007	[internal, integer]	OCEB	150	
HART_ANS_008	[internal, integer]	OCEC	133	
HART_ANS_009	[internal, integer]	OCED	11	
HART_ANS_010	[internal, integer]	OCEE	10	
HART_ANS_011	[internal, integer]	OCEF	66	
HART_ANS_012	[internal, integer]	OCF0	3	
HART_ANS_013	[internal, integer]	OCF1	21	
HART_ANS_014	[internal, integer]	OCF2	0	
HART_ANS_015	[internal, integer]	OCF3	0	
HART_ANS_016	[internal, integer]	OCF4	65	
HART_ANS_017	[internal, integer]	OCF5	160	
HART_ANS_018	[internal, integer]	OCF6	255	
HART_ANS_019	[internal, integer]	OCF7	62	
HART_ANS_020	[internal, integer]	OCF8	12	
HART_ANS_021	[internal, integer]	OCF9	62	
HART_ANS_022	[internal, integer]	OCFA	197	

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To test the “faq136\_2” project is similar as the “faq136\_1”. However the “faq136\_2” will convert the answer frame 's “Data” (refer to the section 1.3) to become 4 REAL value.

Note:

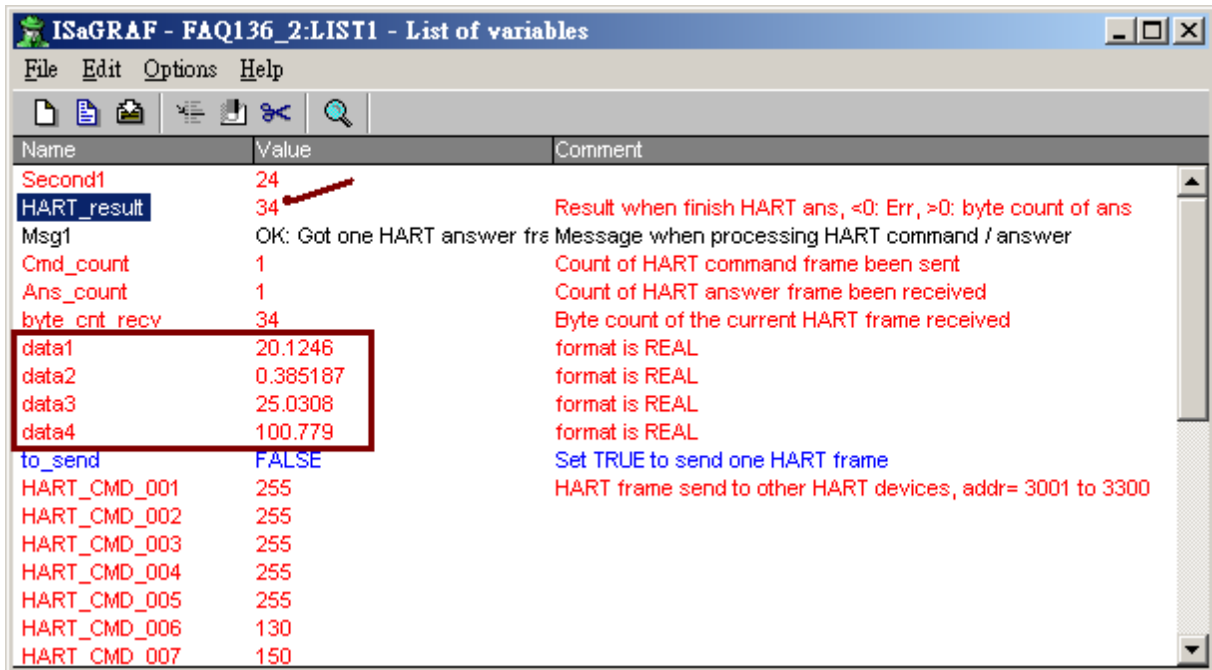
1. The value of the below frame is displayed as Hex. format.
2. The below frame is only for illustration. It may not fit the “Data” definition of your HART device. Please follow the “Data” definition of your HART device to modify the program of “faq136\_2”,

I-87H17W send : FF FF FF FF FF 82 96 85 0B 0A 42 03 00 (13 bytes)

Device answer : FF FF FF FF FF 86 96 85 0B 0A 42 03 15 00 00 41 A0 FF 3E 0C 3E C5 37 48 20 41 C8 3F 22 39 42 C9 8E D1 (34 bytes)

Then the result is as the following.

data1 = 20.1246 ( 41 A0 FF 3E )  
data2 = 0.385187 ( 3E C5 37 48 )  
data3 = 25.0308 ( 41 C8 3F 22 )  
data4 = 100.779 ( 42 C9 8E D1 )



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### 1.5.2 : Test the project “faq136\_3”

If you haven't test the “faq136\_1” yet, recommend to play it once (refer to section 1.5.1)

To well test the “faq136\_3” project, please must plug one I-87H17W in PAC 's Slot 2 and connect its Ch.1, Ch.2 and Ch.3 to HART devices (refer to section 1.1). Then power up the PAC, download the “faq136\_3” to the PAC, then the PC / ISaGRAF will show up the following window.

If you just want to test the first channel (Ch.1) only, set the value of the “Max\_Ch[2]” to 1 (it means only process slot 2 's channel 1) .

This “faq136\_3” will automatically send frame and then receive answer from Ch.1 to Ch.3 one by one.

There is a setting called “silence period” which means the time to wait before sending the next HART frame after a channel 's answer frame is received. The variable “HART\_Interval[0]” to “HART\_Interval[7]” in the “faq136\_3” project defines the “silence period” of the Slot No. 0 to 7. Its unit is ms. Recommend to set it as 100 to 2000 ms. The “faq136\_3” set it as 200 ms .

(More about the “Variable Array” , please visit <http://www.icpdas.com/faq/isagraf.htm> > 039)

The screenshot displays two windows from the ISaGRAF software. The top window, titled "ISaGRAF - FAQ136\_3:LIST1 - List of variables", shows a table of variables:

Name	Value	Comment
Second1	15	
Max_Ch[2]	3	
HART_Slot2_ID[1]	10201	
HART_Slot2_ID[2]	10202	
HART_Slot2_ID[3]	10203	
HART_Step[2]	1	

The bottom window, titled "ISaGRAF - FAQ136\_3:ST2 - ST program", shows the following code with comments:

```

(* Current processing Channel number *)
(* HART_Now_Ch[0] means the current processing channle No. of slot 0: i-87H17W, ...
   HART_Now_Ch[7] means the current processing channle No. of slot 7: i-87H17W *)
HART_Now_Ch[TMP_Slot] := 1 ; (* starting from Channel 1 *)

(* Command interval, time gap between two <command/answer> *)
(* HART_Interval[0] means the command interval of slot 0: i-87H17W, ...
   HART_Interval[7] means the command interval of slot 7: i-87H17W *)
HART_Interval[TMP_Slot] := 200 ; (* init as 200 ms *)

end_if ;

```

A red box highlights the line: `HART_Interval[TMP_Slot] := 200 ; (* init as 200 ms *)`

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### 1.5.3 : Test the project “faq136\_4”

If you haven't test the “faq136\_1” yet, recommend to play it once (refer to section 1.5.1)

To well test the “faq136\_4” project, please must plug three I-87H17W in PAC 's Slot 1 , 2 and 3. Then connect their Ch.1, Ch.2 and Ch.3 to HART devices (refer to section 1.1). Then power up the PAC, download the “faq136\_4” to the PAC, then the PC / ISaGRAF will show up the following window.

If you just want to test the first channle (Ch.1) only, set the value of “Max\_Ch[1]” , “Max\_Ch[2]” and “Max\_Ch[3]” to 1 (it means only process their channel 1 in slot 1 , 2 and 3 ) .

This “faq136\_4” will automatically send frame and then receive answer from Ch.1 to Ch.3 one by one.

There is a setting called “silence period” which means the time to wait before sending the next HART frame after a channel 's answer frame is received. The variable “HART\_Interval[0]” to “HART\_Interval[7]” in the “faq136\_4” project defines the “silence period” of the Slot No. 0 to 7. Its unit is ms. Recommend to set it as 100 to 2000 ms. The “faq136\_4” set it as 200 ms .

( More about the “Variable Array” , please visit <http://www.icpdas.com/faq/isagraf.htm> > 039 )

The screenshot shows two windows from the ISaGRAF software. The top window, titled "ISaGRAF - FAQ136\_4:LIST1 - List of variables", displays a table of variables and their values. The bottom window, titled "ISaGRAF - FAQ136\_4:ST1 - ST program", shows the ST program code with a red box highlighting a specific line.

Name	Value	Comment
Second1	30	
Max_Ch[2]	3	
HART_Slot1_ID[1]	10101	
HART_Slot2_ID[1]	10201	
HART_Slot3_ID[1]	10301	
HART_Step[1]	0	
HART_Step[2]	1	
HART_Step[3]	0	
HART_now_Ch[2]	3	
slot1_result[1]	-117	
slot2_result[1]	-1	
slot3_result[1]	-117	
data_slot1_1[1]	0	
data_slot1_2[1]	0	
data_slot1_3[1]	0	
data_slot1_4[1]	0	
data_slot2_1[1]	0	
data_slot2_2[1]	0	
data_slot2_3[1]	0	
data_slot2_4[1]	0	
data_slot3_1[1]	0	
data_slot3_2[1]	0	

```

ISaGRAF - FAQ136_4:ST1 - ST program
File Edit Options Help
[* Current processing Channel *]
[* HART_Now_Ch[0] means the current processing chann]
   HART_Now_Ch[?] means the current processing chann]
HART_Now_Ch[TMP_Slot] := 1 ; [* starting from Channe]

[* Command interval, time gap between two <command/an]
[* HART_Interval[0] means the command interval of slo]
   HART_Interval[?] means the command interval of slo]
HART_Interval[TMP_Slot] := 200 ; [* init as 200 ms *]

end_if ;

```