ICP DAS Release Stable and Cost-effective Data Acquisition Auto-Report System?

Download FAQ-065 Demo.

1. Introduction

Please refer to Section 2 and 3 for VC++ 6.0 demo program.
Please refer to Section 2 and 4 for VB 6.0 demo program.
Please refer to Section 6 for more information about Ethernet security.

Many applications need to monitor/collect large amount of I/O and acquisition data distributed in wide-spread location for safety and management. The usual way to implement this is to apply one or couples of central PC/Server to poll (request one by one in turn) every PAC/PLC periodically in every spread location. This generates three disadvantages.

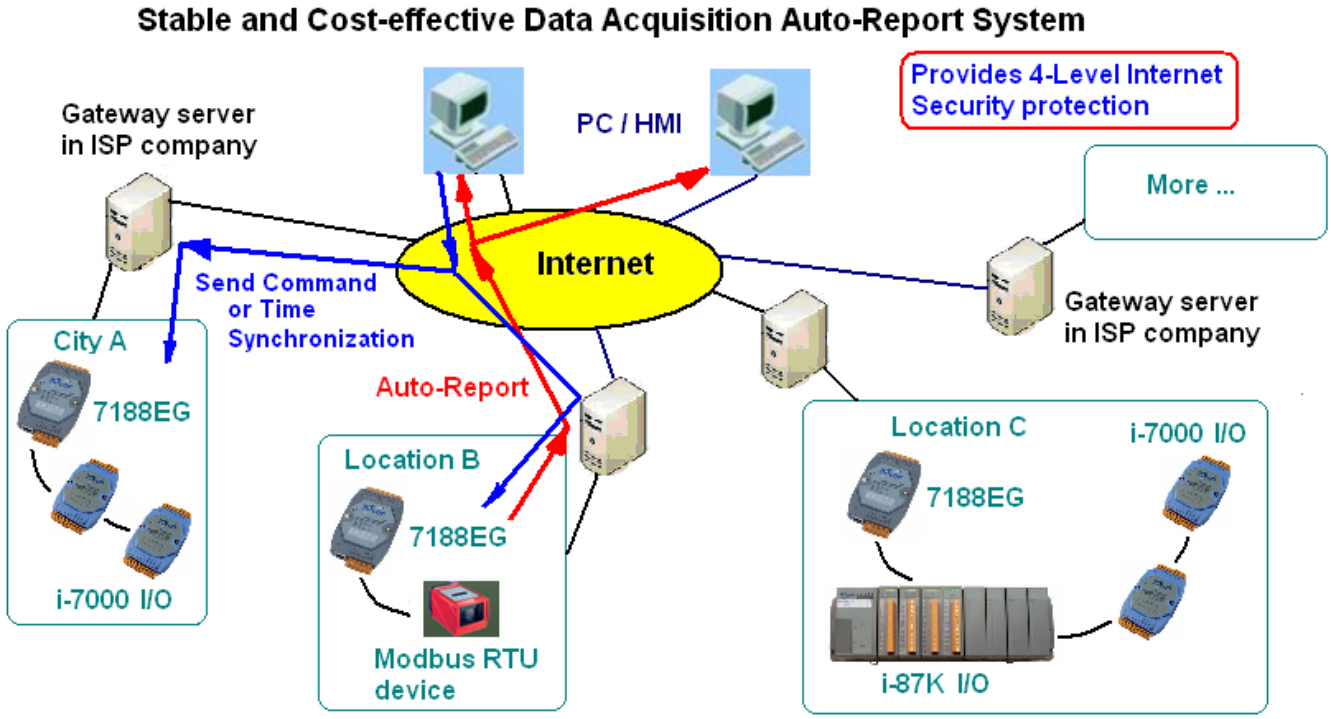
(1) The CPU loading of the central PC/Server will become too heavy. That is because it must request every distributed local PAC one by one in turn periodically. So the result is the PC/Server becoming un-effective.
(2) The second one is when the amount of local PACs is a little more or large, the PC/Server can not handle emergency events (because it request PAC in turn).
(3) Every local PAC should setup a fixed Internet IP address for the PC/Server to request them. This waste money and Internet resource a lot.

ICP DAS ISaGRAF PACs I-7188EG, I-8437-80, and I-8837-80 support Auto-report data acquisition and I/O data to the remote Internet PC/Sever via UDP/IP protocol. They can be setup to report periodically and report at any time when emergency event happens. Moreover, at any time, the PC/Server can send command to the local PAC if necessary. For example, the time synchronization. This feature is very useful in the below three applications.

Useful Applications:

1. Distributed energy monitoring/management system, like electric power, gas, oil, water dam, etc.
2. Distributed facility safety monitoring/management system, like elevator, building, stock room, etc.
3. Other possible distributed data acquisition system.

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Seven Advantages:

1. If local PAC is I-7188EG, the price is much cost-effective compared with other PLC/PAC if they have similar solution. (ICP DAS I-7188EG, I-8437-80, and I-8837-80 all support this feature)

2. The distributed local PAC doesn't need a fixed Internet IP. There is no limitation of the distance between the local PAC and the central PC/Server, 100 meters, 1 kilo-meter,… , 10000 kilo-meters are all possible.

3. Provides 4-Level Internet security protection.

   Level 1: PAC do auto-report only if it wish do. PAC can be programmed to refuse any communication data coming from Internet normally. The PAC can be designed only accept one valid command when it auto-report data to the PC/Server, after that it can refuse any data again.

   Level 2: “Security Password”. Every delivered data between local PAC and PC/Server all add a “Security Password” protection.

   Level 3: IP protection. PAC can be programmed to accept data only coming from one or couples of selected Internet IP address.

   Level 4: Programmer can design his own security protection in both PAC and the PC/Server.

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4. Local PAC will automatically report its acquisition and I/O data to remote PC/Server. It can report periodically and report when an emergency event triggered. Moreover, at any time, the PC/Server can send command to the local PAC if necessary. For example, the time synchronization command.

5. ICP DAS ISaGRAF PACs support various I/O modules, such as I-7000 series, I-87K series remote I/O. Also support Modbus RTU devices created by others, like Modbus power meters, Modbus inverters, Modbus temperature PACs ...

6. PACs support ISaGRAF with IEC61131-3 PLC standard, which provides Ladder Diagram, Structure Text, Function Block, IL , SFC and Flow Chart PLC languages. Easy to use and easy programming.

7. ICP DAS provides VC++6.0 and VB6.0 and VB.net 2005 sample program which can run in PC/Server. And also provides ISaGRAF sample program for running in I-7188EG, I-8437-80, and I-8837-80 PACs. Please visit http://www.icpdas.com/en/faq/index.php?kind=280#751 FAQ-065.

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2. Install software and hardware for demo testing

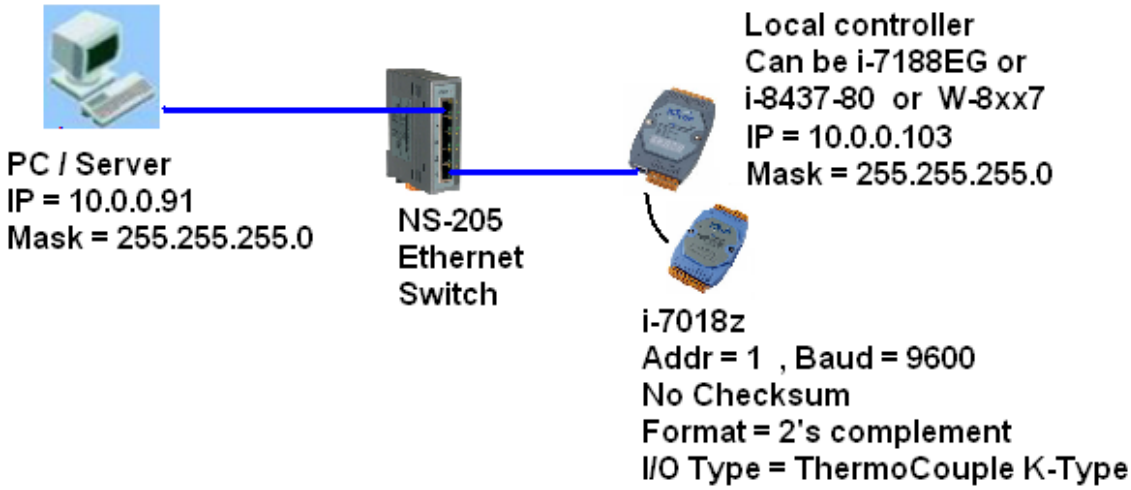
Please visit http://www.icpdas.com/en/faq/index.php?kind=280#751 FAQ-065 to download the related document and demo program. To know more about the UDP protocol for this demo, please refer to section 5.

ISaGRAF demo program

If the PAC is I-7188EG, please use "..\faq065_demo**demo_74.pia**" (7188EG since driver version of 2.18)
If the PAC is I-8437-80 or I-8837-80, please use "..\faq065_demo**wdemo_61.pia**"
(I-8x37 since driver version of 3.20)

Hardware configuration:

Note that the WinCon-8xx7 has been phased out, Visit the ISaGRAF website for more information about new PACs. https://www.icpdas.com/en/product/guide+Software+Development__Tools+ISaGRAF



Please set IP address of your testing PC to a Fixed IP = 10.0.0.91, Mask = 255.255.255.0.

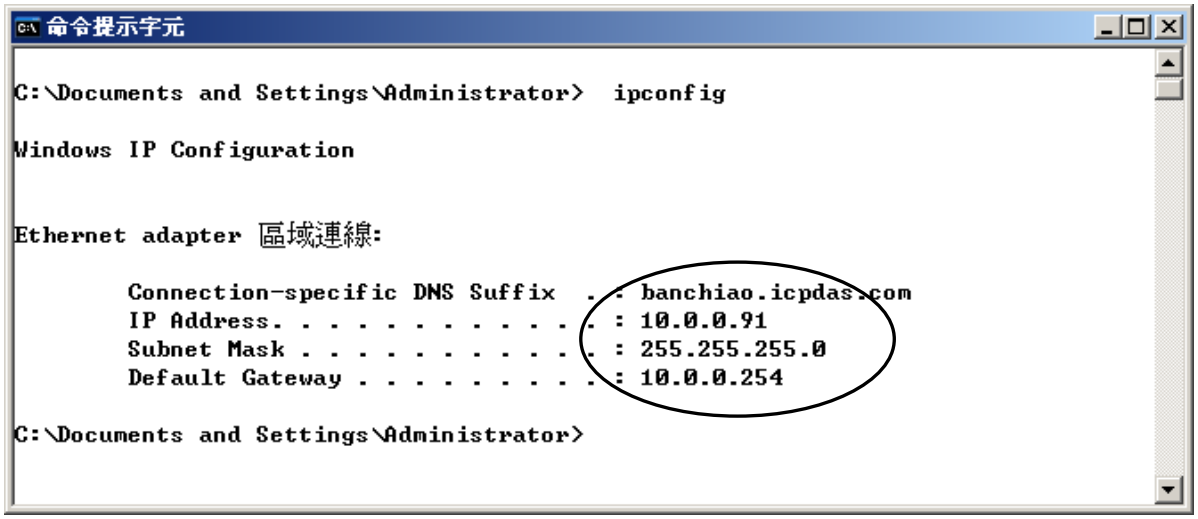
The testing PAC can be one of I-7188EG or I-8437-80 or I-8837-80. Please set its IP address as a Fixed IP = 10.0.0.103 , Mask = 255.255.255.0

Note:

Sometimes PC/Server reside at the Internet with a fixed Internet IP address. Then all the local PACs in the same application must assign its proper Gateway IP. The value of this "Gateway IP" can be found in a PC which is in the same local area with the local PAC.

First please set IP of that PC as DHCP (Obtain an IP address automatically), then open a Command Prompt, key-in "ipconfig" as below, then we got the Gateway IP setting.

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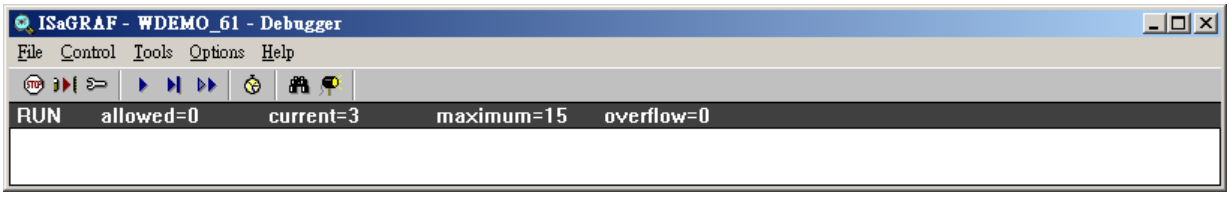


Here we use one I-7018Z I/O module in this demo. Please do initial configuration for it by using the "DCON Utility". Please set its "ADDR" as 1, "Baud rate" as 9600, "Format" as 2's complement, Checksum" as disable and set its Ch.1 through Ch.10 as "T/C K-Type".

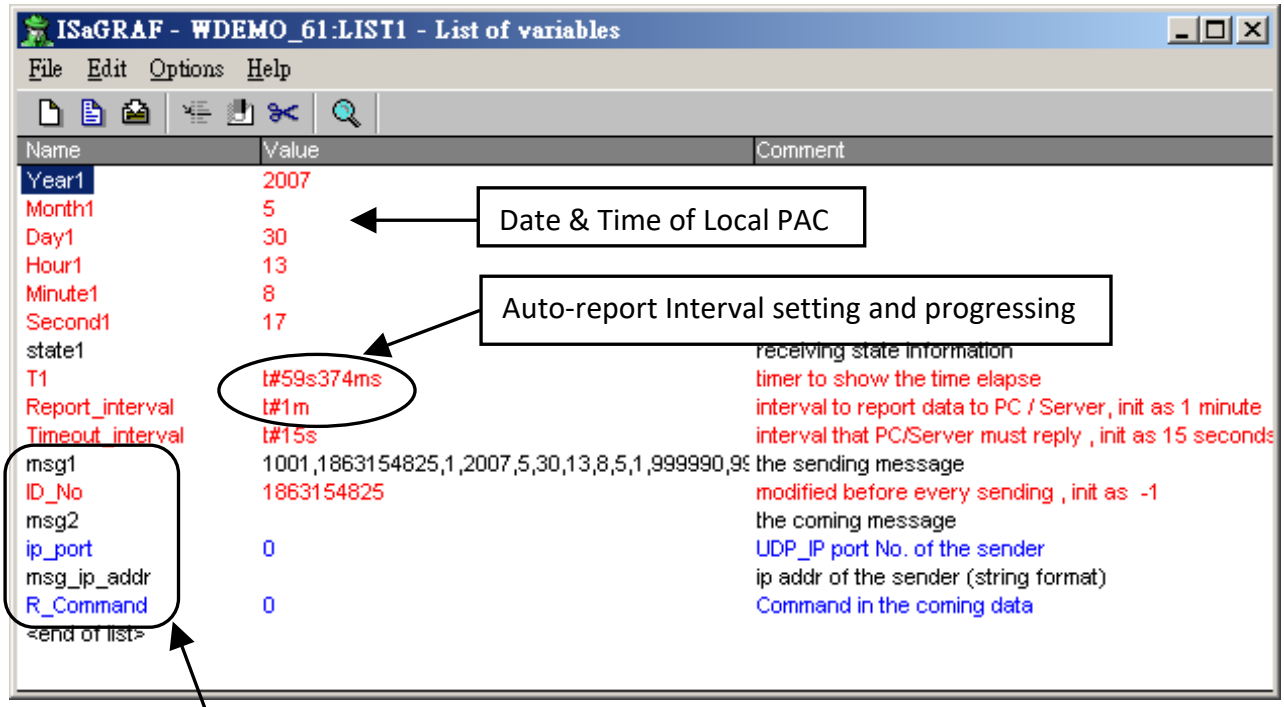
Then if the PAC is **I-7188EG**, please connect this I-7018Z module at its **COM2: RS-485**. And then wire an external resistor about 110 to 330 ohms to be between the D2+ and D2- pin of the I-7188EG's COM2: RS485 port. Then recycle the power of I-7188EG. And then download the ISaGRAF demo program "demo_74" to I-7188EG.

If the PAC is **I-8437-80 or I-8837-80**, please connect this I-7018Z module at its **COM3: RS-485**. And then wire an external resistor about 110 to 330 ohms to be between the D+ and D- pin of the PAC's COM3: RS485 port. Then recycle the power of the PAC. And then download the ISaGRAF demo program "**wdemo_61**" to the PAC.

If successfully download ISaGRAF program, the below similar window will show up.



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"**Msg1**" is the message from Local PAC sent to the PC/Server.

"**Msg2**" is the reply message from the PC/Server to Local PAC.

"**Msg_ip_addr**" and "**ip_port**"
are the source IP address and UDP port No. which sent message to the local PAC. Normally, it is the IP and port No. of the central PC/Server. If it is not, that means some other un-friendly station or PC sending UDP data to the Local PAC.

"**R_Command**"
is the <command> field in the message from the PC/Server. (Here in this demo is 2 or 4)

Then please run VC++ 6.0 **demo_01** program in your testing PC (refer to Section 3) , or run VB 6.0 **demo_7** program in your testing PC (refer to Section 4).

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3. VC++ 6.0 demo program

Please finish the steps listed in Section 2 first before doing the steps in this section.

Please set your PC's IP address to a fixed IP = 10.0.0.91, Mask = 255.255.255.0 for testing this demo. (Because the ISaGRAF demo program "demo_74" and "wdemo_61" running on the Local PAC will report message to the PC with IP = 10.0.0.91 and with UDP port No. = 12001)

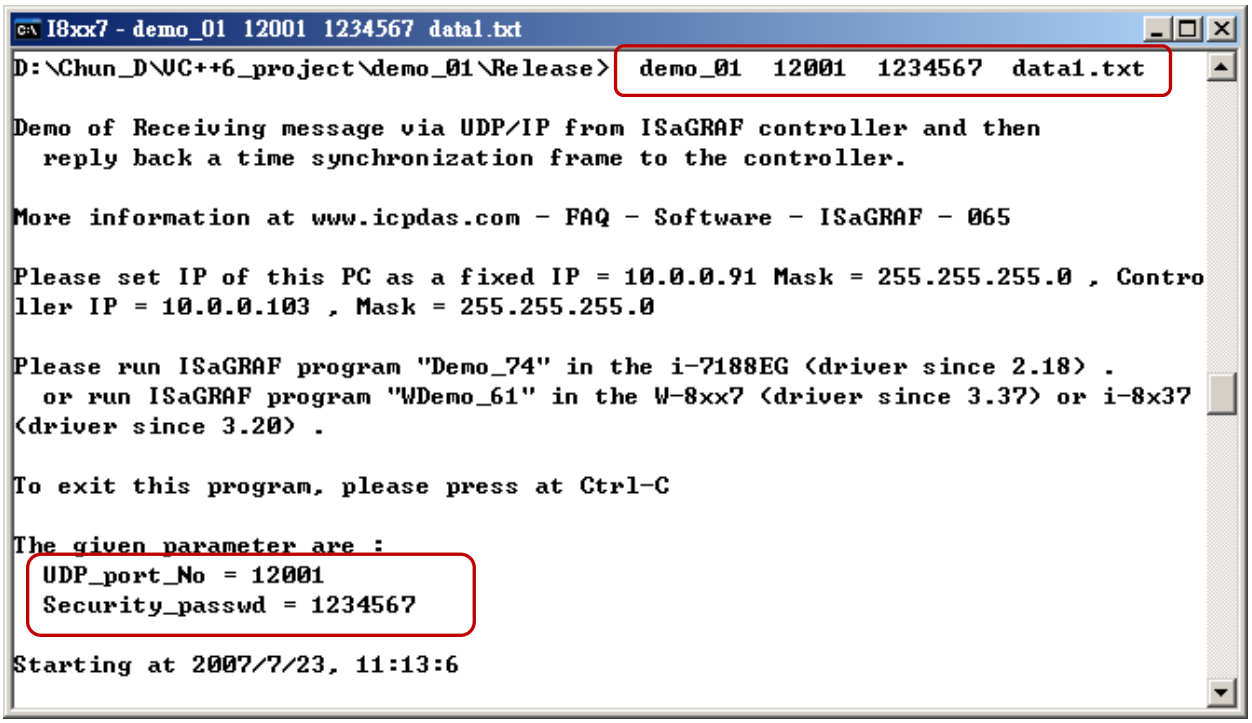
The VC++ 6.0 demo program "**demo_01.exe**" resides at "…\vc++6_demo\demo_01\release\"
(Please visit http://www.icpdas.com/en/faq/index.php?kind=280#751 FAQ-065 to download it.)
Please run MS. VC++ 6.0 development studio to open the source code of this "demo_01", the file is "…\vc++6_demo\demo_01**demo_01.dsw**"

To run "**demo_01.exe**", open a Command Prompt on the PC first. Then get into folder of "…\vc++6_demo\demo_01\release\" to click it. Then key-in the command as below to run it.

Syntax: **demo_01 UDP_port Security_passwd (file_name)**

"**UDP_port**" is the UDP port No. which this PC is going to bind it to receive message coming from local PACs (value can be 1001 to 65535). This demo uses value of 12001.
"**Security_passwd**" is the protocol security password. Value can be 0, or 1 to 2147483647, or -2147483647 to -1. This demo uses value of 1234567.
"**File_name**" is an option. You may specify it or leave it empty. If specifying a name to it, then demo_01.exe will create a new empty file to record all valid message from the local PACs.

Example 1: Demo_01 12001 1234567
Example 2: Demo_01 12001 1234567 data1.txt



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How to test?

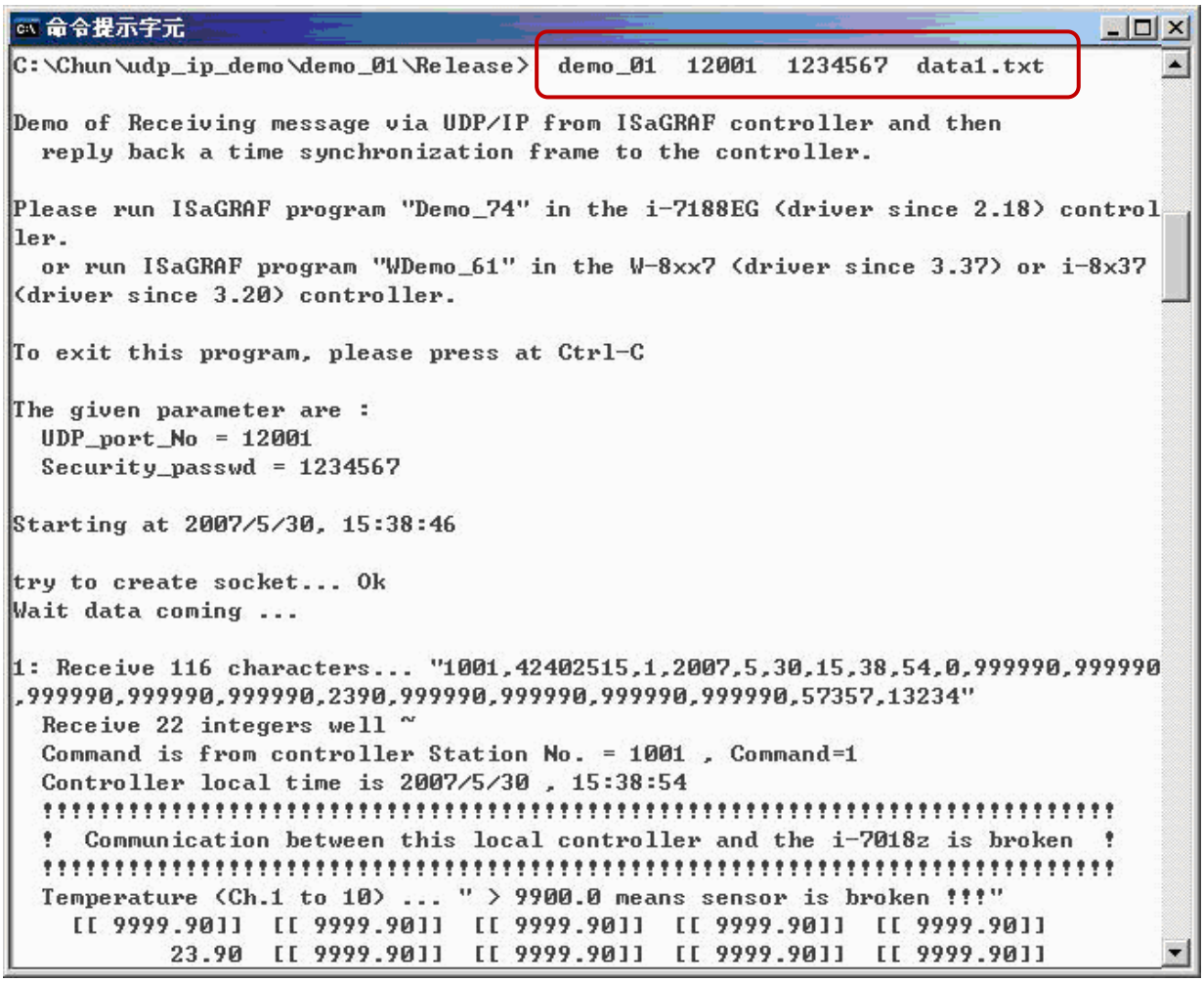
The local PAC will send message to the PC/Server when below events happen in this demo.

1. 15 seconds later after the Local PAC is power up. (This only deliver once)
2. Send once at every minute past. (Continuously and periodically)

In the following item 3 to item 8, local PAC will send once when each event happens.

3. If the RS-485 communication between the Local PAC and I-7018Z is broken.
4. If the RS-485 communication between the Local PAC and I-7018Z is back to OK again.
5. If any one of I-7018Z's Ch.1 through Ch.10's temperature sensor is damaged or broken.
6. If any one of I-7018Z's Ch.1 through Ch.10's temperature sensor is back to OK again.
7. If any one of I-7018Z's Ch.1 through Ch.10's temperature reading larger than 60 degree Celsius.
8. If any one of I-7018Z's Ch.1 through Ch.10's temperature reading is back to under 60 degree Celsius again.

A. After **demo_01.exe** is running, please disconnect the RS-485 connection between the I-7018Z and the Local PAC. It should display a coming message from the local PAC similar as below.



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B. Then please recover the RS-485 connection between the I-7018Z and the PAC. It should display a coming message.

C. Please observe if receiving a message every minute.

D. Please measure the temperature of a glass of hot water by one channel K-type sensor of the I-7188Z. If the temperature is over 60 degree Celsius, it should display a message. And then if the temperature is back to under 60 degree Celsius again, one another Message should be displayed.

E. Remove one channel K-type sensor from the I-7018Z, it should receive one message. Then recover it, another message should be received.

F. This demo provides a time synchronization feature. If the date and time sent by the local PAC differ more than 20 seconds than the time on the PC/Server, the PC will drop this message and reply back <command> = 4 to inform the local PAC to adjust its date and time and then send data to the PC/Server once again.

   (Here use so big value of 20 seconds because the application may be applied in the Internet. Sometime the Internal communication is busy. If your application is in local intranet, you may reduce this value to, for example, 5 seconds) .

User can modify the date or time on the PC/Server, then you will see the PAC ‘s date and time will be modified also when it sends next message to the PC/Server.

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4. VB 6.0 demo program

Please finish the steps listed in section 2 first before doing the steps in this section.

Please set your PC 's IP address to a fixed IP = 10.0.0.91 , Mask = 255.255.255.0 for testing this demo. (Because the ISaGRAF demo program "demo_74" and "wdemo_61" running in the Local PAC will report message to the PC with IP = 10.0.0.91 and with UDP port No. = 12001)

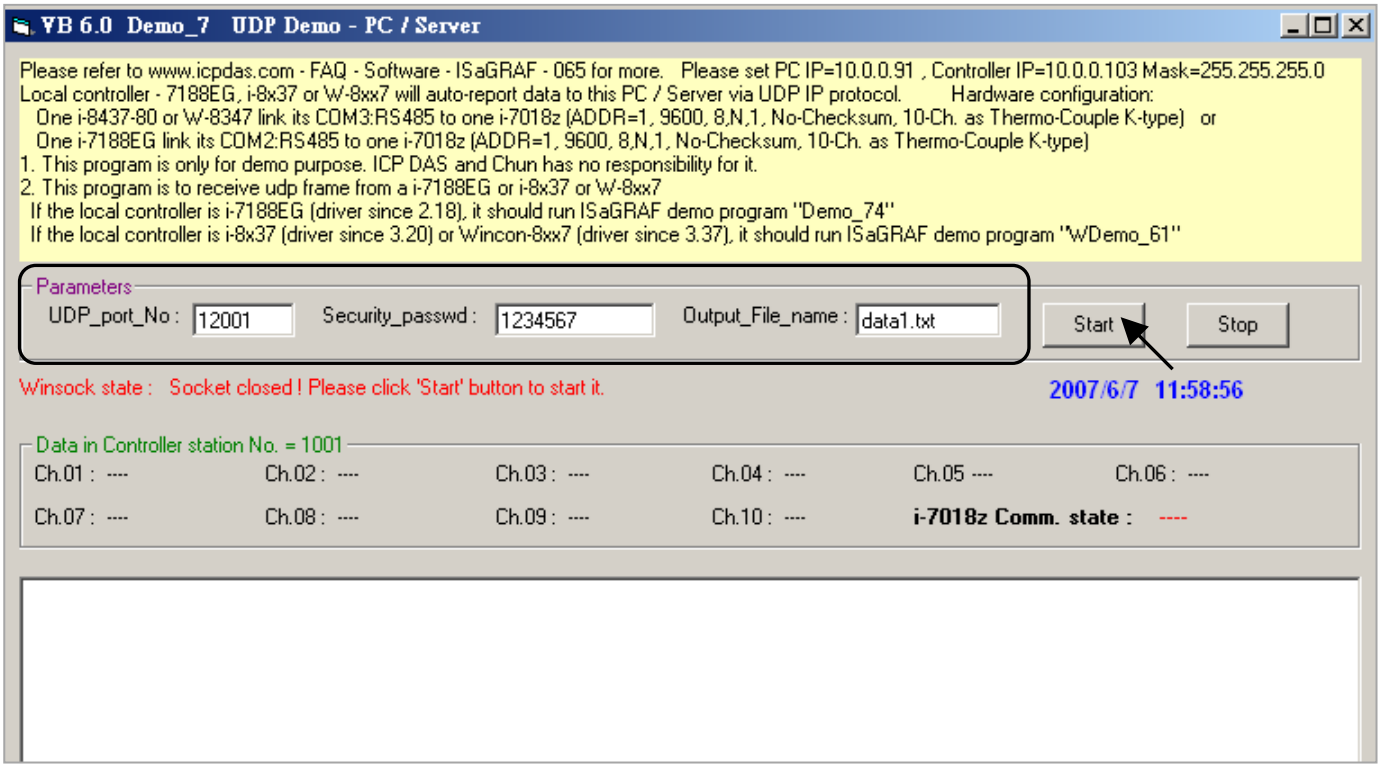
The VB 6.0 demo program "**demo_7.exe**" resides at "…\vb6_demo\demo_7\"
(Please visit http://www.icpdas.com/en/faq/index.php?kind=280#751 FAQ-065 to download it.)
Please run MS. VB 6.0 development studio to open the source code of this "demo_7" , the file is "…\vb6_demo\demo_7\demo_7.vbp"

After running this "**demo_7.exe**", a "VB 6.0 Demo_7" window will show up as below. Please enter the proper value of the following items and then click on "**Start**" to test it.

"UDP_port_No" is the UDP port No. which this PC is going to bind it to receive message coming from local PACs (value can be 1001 to 65535). This demo uses value of 12001.

"Security_passwd" is the protocol security password . Value can be 0, or 1 to 2147483647, or -2147483647 to -1. This demo uses value of 1234567.

"Output_File_name" is an option. You may specify it or leave it empty. If specifying a name to it, then demo_01.exe will create a new empty file to record all valid message from the local PACs.



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How to test?

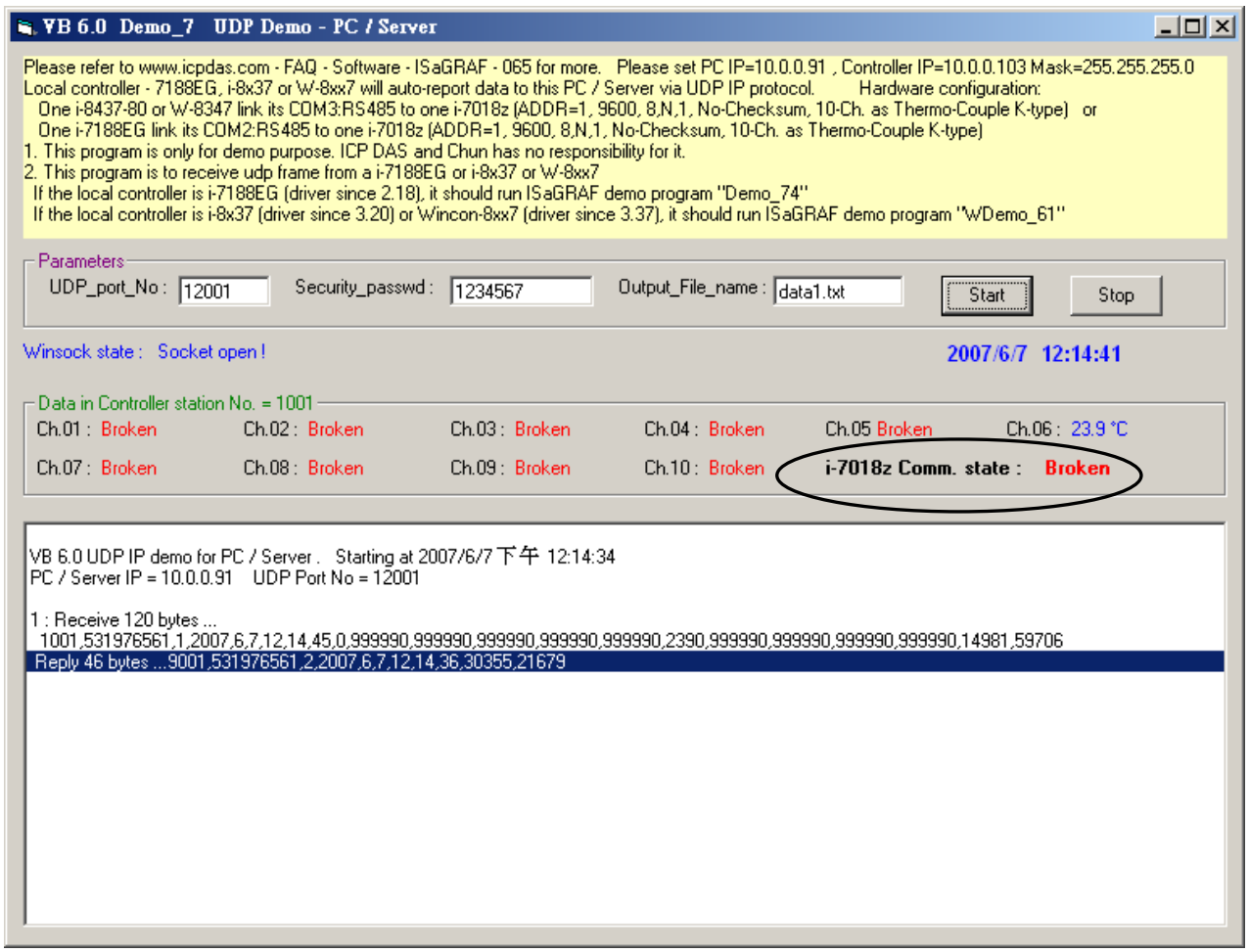
The local PAC will send message to the PC/Server when below events happen in this demo.

1. 15 seconds later after the Local PAC is power up. (This only deliver once)
2. Send once at every minute past. (Continuously and periodically)

In the following item 3 to item 8, local PAC will send once when each event happens.

3. If the RS-485 communication between the Local PAC and I-7018Z is broken.
4. If the RS-485 communication between the Local PAC and I-7018Z is back to OK again.
5. If any one of I-7018Z 's Ch.1 through Ch.10 's temperature sensor is damaged or broken.
6. If any one of I-7018Z 's Ch.1 through Ch.10 's temperature sensor is back to OK again.
7. If any one of I-7018Z 's Ch.1 through Ch.10 's temperature reading larger than 60 degree Celsius.
8. If any one of I-7018Z 's Ch.1 through Ch.10 's temperature reading is back to under 60 degree Celsius again.

A. After **demo_7.exe** is running, please disconnect the RS-485 connection between the I-7018Z and the Local PAC. It should display a coming message from the local PAC similar as below.



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B. Then please recover the RS-485 connection between the I-7018Z and the PAC. It should display a coming message.

C. Please observe if receiving a message every minute.

D. Please measure the temperature of a glass of hot water by one channel K-type sensor of the I-7188Z. If the temperature is over 60 degree Celsius, it should display a message. And then if the temperature is back to under 60 degree Celsius again, one another Message should be displayed.

E. Remove one channel K-type sensor from the I-7018Z, it should receive one message. Then recover it, another message should be received.

F. This demo provides a time synchronization feature. If the date and time sent by the local PAC differ more than 20 seconds than the time on the PC/Server, the PC will drop this message and reply back <command> = 4 to inform the local PAC to adjust its date and time and then send data to the PC/Server once again.

   (Here use so big value of 20 seconds because the application may be applied in the Internet. Sometime the Internal communication is busy. If your application is in local intranet, you may reduce this value to, for example, 5 seconds) .

User can modify the date or time on the PC/Server, then you will see the PAC date and time will be modified also when it sends next message to the PC/Server.

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5. UDP protocol definition in the demo listed in this document

This protocol definition is valid for the ISaGRAF demo program "**demo_74**" and "**Wdemo_61**" and VC++ 6.0 demo program "**demo_01**" and VB 6.0 demo program "**demo_7**".

1. Local PAC is as UDP Client , while PC/Server is as UDP Server. Only Local PAC can auto-send data (message/string) to the PC/Server.

   (The message variable - "IP_correct_PC " and integer variable - "Port_correct_PC" in the ISaGRAF demo program "demo_74" and "Wdemo_61" specify the IP address and UDP port No. of the target PC/Server. And also there is similar definition of the target PC/Server in the ISaGRAF IO connection window - "udp_ip").

2. PC/Server must reply a message with <Command> = 2 or 4 to the local PAC in 15 seconds after it receives a valid message from the local PAC. The replied message must contain the exact same <ID No.> as the <ID No.> it received from the local PAC.

   The local PAC will drop the replied message with incorrect <ID No.>. If the local PAC doesn't receive a valid replied message from the PC/Server in 15 seconds, it will send message once to the PC/Server with a different <ID No.>. Then if PC/Server still not replied it in 15 seconds, local PAC will continuously send message again until it receives a valid replied message.

   (The timer variable - "Timeout_interval" in the ISaGRAF demo program "demo_74" and "Wdemo_61" defines this Timeout value)

3. The local PAC will send message to the PC/Server when below events happen in this demo.

   (1) 15 seconds later after the Local PAC is power up. (This only deliver once)
   (2) Send once at every minute past. (Continuously and periodically)

   In the following item (3) to item (8) , local PAC will send once when each event happens.
   (3) If the RS-485 communication between the Local PAC and I-7018Z is broken.
   (4) If the RS-485 communication between the Local PAC and I-7018Z is back to OK again.
   (5) If any one of I-7018Z 's Ch.1 through Ch.10 's temperature sensor is damaged or broken.
   (6) If any one of I-7018Z 's Ch.1 through Ch.10 's temperature sensor is back to OK again.
   (7) If any one of I-7018Z 's Ch.1 through 10 's temperature reading larger than 60 degree Celsius.
   (8) If any one of I-7018Z 's Ch.1 through 10 's temperature reading is back to under 60 degree Celsius again.

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4. UDP message format of Local PAC sending to the PC/Server.

Security_passwd: Must be specified as the same value in the ISaGRAF IO connection window – "udp_ip" and in the PC VC++ and VB demo program to communicate well.

Value can be 0: means "No encoding" (it is not safe), or 1 to 2147483647, or -2147483647 to -1 (none-zero value means "with encoding", it is much safe).

If setting as a none-zero value, please refer to the "convert_to_udp_deliver_buf( )" , "convert_back_udp_deliver_buf( )" and "udp_ip_crc( )" function in the VC++ 6.0 "demo_01" or VB 6.0 "demo_7" for its encoding algorithm.

When setting "Security_passwd" as 0, every delivered message can not exceed 255 bytes.

When setting "Security_passwd" as none-zero value, every delivered message can not exceed 259 bytes. The last added 4-bytes is the <4-byte-Checksum > calculated by the "udp_ip_crc( )" function.

Local PAC will send the below format to the PC/Server

Security_passwd is 0 : (No 4-byte-Checksum at the end)

<Station_No of local PAC>,<ID No.>,<Command>,

<Year>,<Month>,<Day>,<Hour>,<Minute>,<second>,<I-7018Z Comm. state>,

<C1>,<C2>,<C3>,<C4>,<C5>,<C6>,<C7>,<C8>,<C9>,<C10>,

<User-defined CRC>

For example:

1001,850334470,1,2007,5,30,17,31,51,1,999990,999990,999990,999990,999990,2360,
999990,999990,999990,999990,46677,18632

It means,

<Station_No of local PAC> is 1001

<ID No.> is 850334470

<Command> is 1

PAC's date and time is 2007/5/30 , 17:31:51

< I-7018Z Comm. state > is 1 : RS-485 communication OK

The temperature reading value of Ch.1 through Ch.10 are,

broken, broken, broken, broken, broken, 23.60 degree, broken, broken, broken, broken

(value of 999990 means T/C Sernsor is broken)

< User-defined CRC > is 46677,18632

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Security_passwd is not 0 : (With 4-byte-Checksum at the end)

<Station_No of local PAC>,<ID No.>,<Command>,

<Year>,<Month>,<Day>,<Hour>,<Minute>,<second>,<I-7018Z Comm. state>,

<C1>,<C2>,<C3>,<C4>,<C5>,<C6>,<C7>,<C8>,<C9>,<C10>,

<User-defined CRC><4-byte-Checksum>

<Command> definition:

1 : Local PAC report data to the PC/Server

<I-7018Z Comm. state> definition:

1 : RS-485 communication is OK between local PAC and I-7018Z

0 : RS-485 communication is broken between local PAC and I-7018Z

<User-defined CRC> definition:

Can be defined as a different algorithm by the User. This demo apply the following algorithm (Please apply a different algorithm in real application for safety)

Value is fixed as 11 bytes (Character) . It contains two value of 0 to 65535 separated by a ","

For example,

value_1	**value_2**		**Fixed Length of 11 Bytes (Character)**	
0	0	:	' 0, 0'	(with 4 Space Char. before '0')
1	1	:	' 1, 1'	(with 4 Space Char. before '1')
21	21	:	' 21, 21'	(with 3 Space Char. before '2')
321	321	:	' 321, 321'	(with 2 Space Char. before '3')
4321	4321	:	' 4321, 4321'	(with 1 Space Char. before '4')
54321	65535	:	'54321,65535'	(No Space Char.)

Below steps - **(a) to (d)** is to get **value 1**, while - **(e)** is to get **value 2**

(Please apply a different algorithm in real application for safety)

(a) extract the string not including the <User-defined CRC> and <4-byte-Checksum> into byte array - user_buf[ ] (for convient, we call this byte array as "user_buf[ ]")

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(b) replace user_buf[3] as **user_buf[3] xor 100**
That is user_buf[3] = user_buf[3] ^ (unsigned char)100 ;
(user may use [2], [4], ... , and may be not using 100, ... whatever, this depends on your own decision. Please use your own algorithm for safety.)

(c) replace user_buf[7] as **user_buf[7] xor 200**
That is user_buf[7] = user_buf[7] ^ (unsigned char)200;
(user may use [5], [6], ... , and may not use 200, ... whatever, this depends on your own decision. Please use your own algorithm for safety.)

(d) Calculate <User-defined CRC> as **two byte => <CRC_Hi><CRC_Lo)**
Then <User-defined CRC> = 256*<CRC_Hi> + <CRC_Lo). It is a value between 0 and 65535.

(e) using a different algorithm to get value 2
proceed (a) , then proceed (b) by using user_buf[4] = **user_buf[4]^(unsigned char)48**
then proceed (c) by using user_buf[6] = **user_buf[6]^(unsigned char)197**
then proceed (d). Then we get value 2. It is a value between 0 and 65535.
(Please use your own algorithm for safety.)

5. UDP message format of the PC/Server replying to local PAC

Security_passwd: Using the same definition as item 4.

PC/Server will reply below format to the local PAC.

Security_passwd is 0 : (No 4-byte-Checksum at the end)

<Station_No of PC/Server>,<Same ID No. from the local PAC>,<Command>,
<Year>,<Month>,<Day>,<Hour>,<Minute>,<second>,
<User-defined CRC>

For example,
9001,519805546,2,2007,5,30,18,59,53,6830,42679

It means,

< Station_No of PC/Server > is 9001

<ID No.> is 519805546

<Command> is 2

Date and Time on PC/Server is 2007/5/30, 18:59:53

< User-defined CRC > is 6830,42679 (there is one Space Char. Before the first “6”)

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Security_passwd is not 0 : (With 4-byte-Checksum at the end)

<Station_No of PC/Server>,<Same ID No. from the local PAC>,<Command>,
<Year>,<Month>,<Day>,<Hour>,<Minute>,<second>,
<User-defined CRC><4-byte-Checksum>

<Command> definition:

2: to inform the local PAC that PC/Server receive its correct data.

4: to inform the local PAC that its date and time differ more than 20 seconds than the PC/Server, please adjust PAC's date and time and then send data to PC/Server once again.

<User-defined CRC> definition:

Using the same definition as item 4.

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6. PAC Ethernet security

Note: **WinCon-8xx7 has been phased out, the user can use ISaGRAF XPAC.** Visit the ISaGRAF website for new information.
https://www.icpdas.com/en/product/guide+Software+Development__Tools+ISaGRAF

6.1 : Modbus TCP/IP security

There are some ways user can get access to the Wincon-8xx7 via its ethernet port.

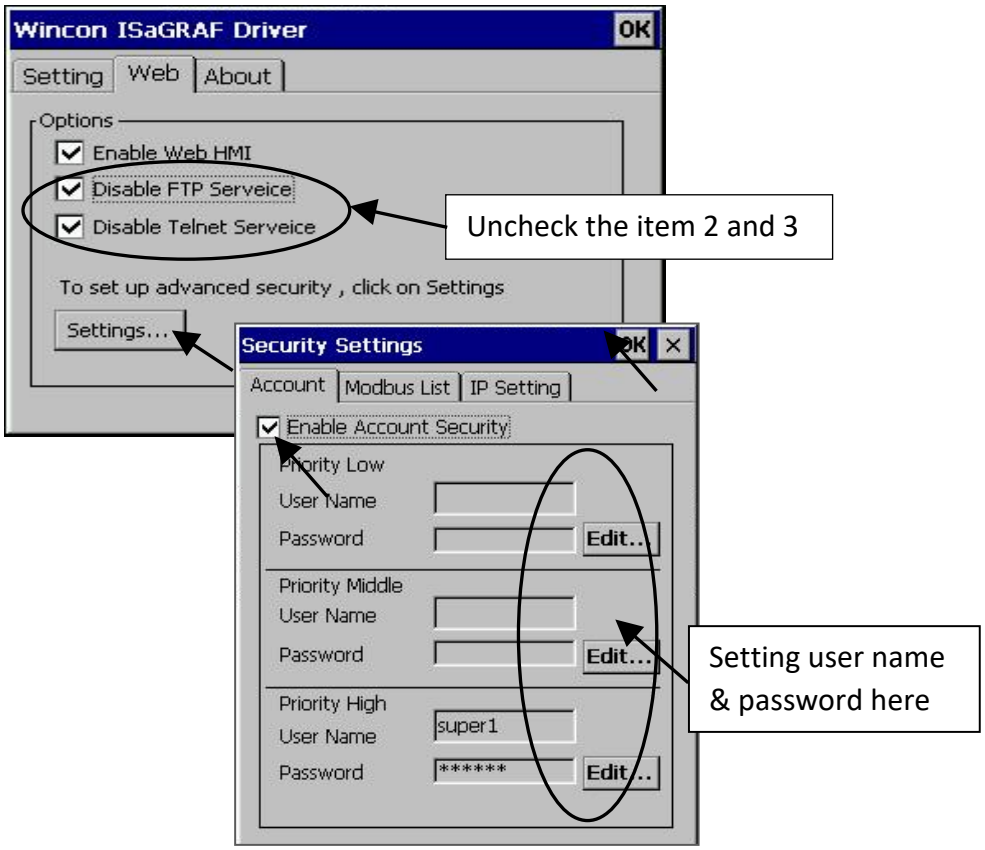
1. Using Modbus TCP protocol at port No.= 502. (ISaGRAF and other HMI can do this)
2. Using FTP (for example, keyin “ftp://10.0.0.103” on the Internet Explorer)
3. Using Telent (for example, keyin “telnet 10.0.0.103” in the “command” window)
4. Using the Web server (The Web HMI does)

Note:

1. **While for I-8437-80/8837-80, I-8437/8837 and I-7188EG, only item 1 is possible.**
2. If the PAC is W-8x47/8x46, when using “ftp”, “telnet”, “Web HMI” & “Modbus TCP/IP”, please connect your PC/HMI to W-8x47/8x46’s “LAN1” port, and please use “NS-205” or “NS-208” Ethernet switch.

For safety, recommend to disable item 2 and 3 at run time for ISaGRAF PAC. For using the Web HMI (item 4 above), checking “**Enable Web HMI**”, clicking the **Settings** button and set the proper username & password.

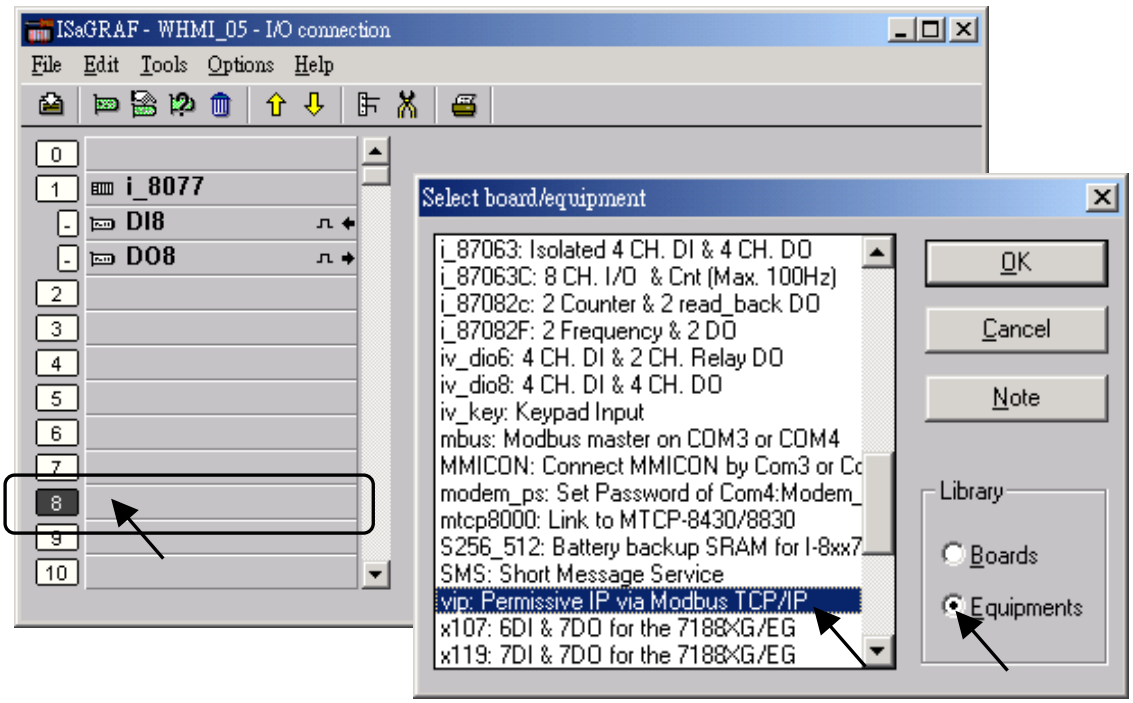
.

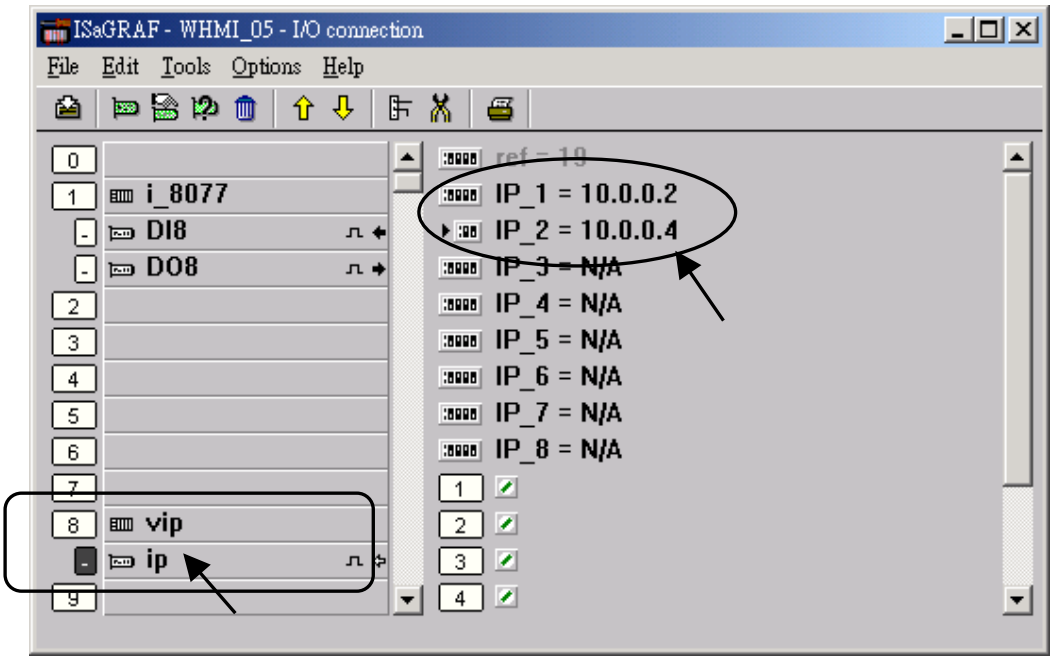


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About item 1, user may set up to 8 IP address for ISaGRAF or other HMI to get access to the I-8x37 or I-7188EG via the Modbus TCP/IP protocol as below.

On the **IO connection** window of ISaGRAF, please connect "**vip**" and entering the IP which can get access to the PAC via Modbus TCP/IP protocol. If "vip" is not connected, any remote IP can get access to your PAC via Modbus TCP/IP protocol. If "vip" is connected and No IP is entered (all assigned as "N/A"), No HMI and ISaGRAF can get access to it by Modbus TCP/IP anymore.

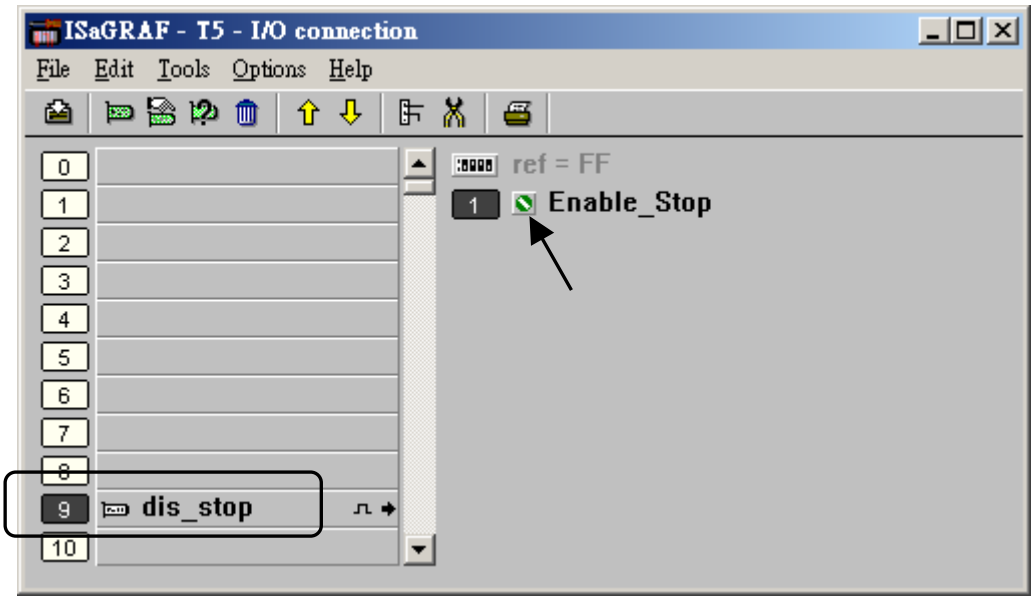




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6.2 : Using "dis_stop" to disable/enable the ISaGRAF Download function

For some reason, to prevent someone to use ISaGRAF software to stop or to download a different PAC project already running on the I-7188EG or I-8437/8837, the "Dis_stop" can be applied . Please connect "**dis_stop**" at a slot No. larger than 8 and init the channel value to become **TRUE**. Then stop/download command is not allowed in this PAC.



To disable "Dis_stop" to accept stop/download command, please run the original ISaGRAF project to link to this PAC and set the channel value to become **False**.

Click the link for more ISaGRAF FAQ:
http://www.icpdas.com/en/faq/index.php?kind=280#751

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