Chapter 6: Linking RS-485 I-7000 & I-87K I/O Modules

Note:

1. The I-87017**R** and I-87017**RC** is better than I-87017 and I-87017C in industrial application.

2. The I-87018**Z** is better than I-87018R and I-87018 in industrial application.
   (I-87018Z has 10-channels. The precision is better than I-87018R and I-87018. And each channel can configure to be different Input type and range. For example, using Ch.1 to 4 to measure 4 to 20 mA , using Ch.5 to 8 as Thermo-Couple K-Type, using Ch.9 to measure +/- 2.5 V, and using Ch.10 as Thermo-Couple R-Type.)

3. The I-7018Z is better than I-7018R and I-7018. (The reason is the same as I-87018Z)

I-7018Z: http://www.icpdas.com/en/product/I-7018Z-G_S
I-87018Z: http://www.icpdas.com/en/product/I-87018ZW-G_S

For more description about using I-87018Z and I-7018Z, please refer to section 11.3.9 of the ISaGRAF user manual or http://www.icpdas.com/en/faq/index.php?kind=280#751 – FAQ-055.

Please refer to Section 1.5 of the I-8xx7 Getting Started for connection instructions between the I-8xx7 PAC system to the I-7000 and I-87K I/O modules.

Very Important:
Please wire an terminal resistor around 110 to 330 ohms at I-7188EG/XG, I-8xx7 or W-8xx7 PAC's RS-485 port , between the D+ and the D- pin (or beween the RS-485+ and RS-485- pin).

This will ensure the host watchdog of I-7000 and I-87K output modules to work correctly when the communication between the PAC and the I-7000/I-87K output modules is broken. (You can try 110 ohms first, then try 220 ohms, then others)

For example, if you don't wire any terminal resistor and enable the host watchdog function at "bus7000b" (Section 6.2 of the ISaGRAF user manual, the "host_watchdog" parameter set as 1), when you just un-plug the I-7000's "DATA+" pin (keep "Data-" pin connected with the PAC), you will see the watchdog doesn't work in this I-7000. If you wire a resistor about 110 ohms between the PAC's RS-485 D+ and D- pin, if you un-plug anyone of I-7000's "Data+" or "Data-" pin, the watchdog will work correctly.

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6.1: Configuring The I-7000 & I-87K Modules

Note:

A. If RS-485 remote I-7000 and I-87K I/O module's type is Analog Input, please configure the format as "2's complement" by DCON Utility. Like : I-7005, I-7013,I-7015, I-7016, I-7017, I-7017R, I-7017RC, I-7018, I-7018R, I-7018Z, I-7019, I-7019R, I-7033, I-87013, I-87015, I-87016, I-87017, I-87017R, I-87017RC, I-87018, I-87018R, I-87018Z and I-87019R.

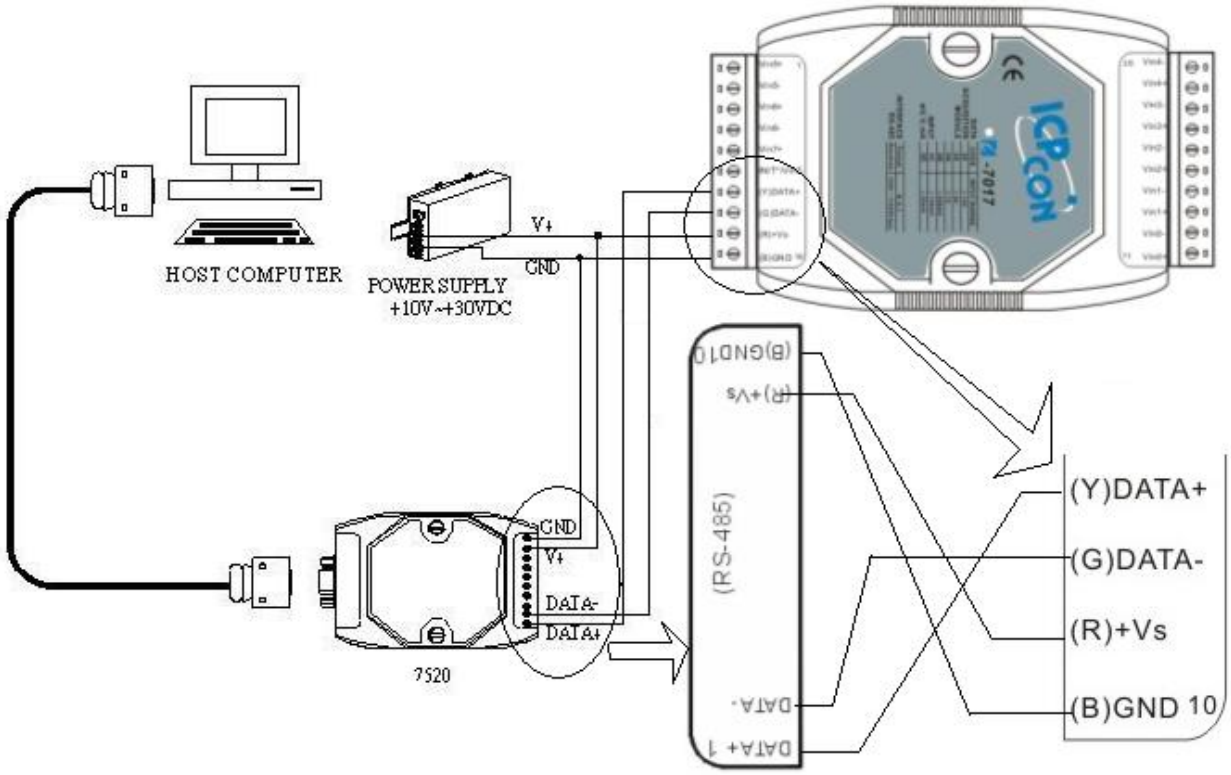
B. If RS-485 remote I-7000 and I-87K I/O module's type is Analog Output, please configure the format as "Engineer Unit" by DCON Utility. Like : I-7021, I-7022, I-7024, I-87022, I-87024 and I-87026.

To begin configuration of the I-7000 and I-87K series modules to the PAC system, use the "DCON Utility" program to set up the I-7000 and I-87K modules. Please use DCON Utility of version 4.4.3 or later version at http://www.icpdas.com/en/product/guide+Software+Utility_Driver+DCON__Utility__Pro

Notes: 1. Make sure the hardware connection is correct.
2. Search and configure the modules one by one.
3. Connect the module's INIT* to GND and Power on the module.

Step1: Hardware connection

A. The power supply must be DC power between +10V to +30V.
B. Wiring diagram for connecting to I-7000: (one module for each time)



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Note: For configuring I-7000 and I-87K I/O module, you have to prepare an I-7520R converter. Refer to "DCON Utility User's Manual" for other wiring diagram. Visit the website for more converters. http://www.icpdas.com/en/product/guide+Industrial__Communication+Serial__Communication+Converter

Step2: Set I/O module to initial state

If the module is a new one, factory have set a default settings for user's convenient. If you don't know the configuration of the module, please set the I/O module to initial state.

*** To set I-7000 module to initial state is to wire connect the INIT* to GND and Power on the module. Then the module will become initial state. (**Some new designed I-7000 modules have a Dip-switch at its back. Please switch it to the "INIT" position, then power up the module**)

*** I-87K module's initial state is set by I-87K4/5/8/9's dip switch. For example, setting dip-2 to "ON", and then re-cycle the power, it means the second slot is in initial state. If using **I-87K5** and **I-87K9**, please **DO NOT** plug I-87K board in its left-most slot for initial configuration. Please plug at **2nd to 9th slot** for initial configuration. The dip-1 is for 2nd slot of **I-87K5** and **I-87K9**, …, dip-4 is for 5th slot, Dip-8 is for 9th slot of I-87K9).

Some new designed I-87K I/O modules have dip-switch built-in. Their "INIT/Normal" state is controlled by its own dip-switch not by the dip-switch of I-87K4/5/8/9.

The default state from factory:

I/O Module	I-7000	M-7000	87K series
Address	1	1	1
Baud rate	9600	9600	115200
Checksum	Disabled	Not defined	Disabled
Protocol	DCON Protocol	Modbus Protocol	DCON Protocol

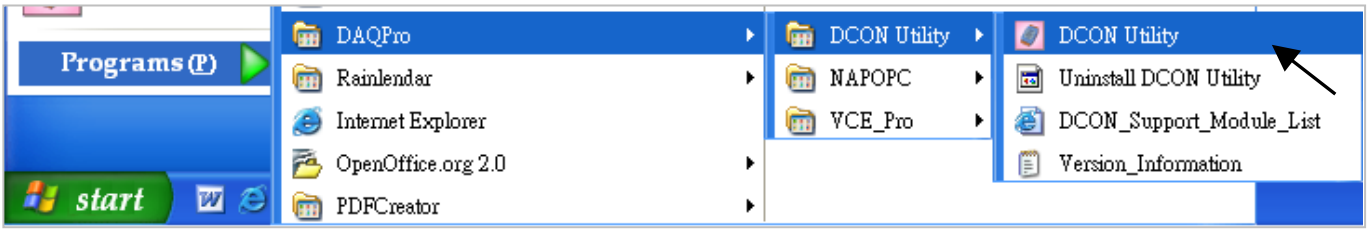
The initial state after initiation:

I/O Module	7000 series (I-7000 and M-7000)	87K series
Address	0	0
Baud rate	9600	115200
Checksum	Disabled	Disabled
Protocol	DCON Protocol	DCON Protocol

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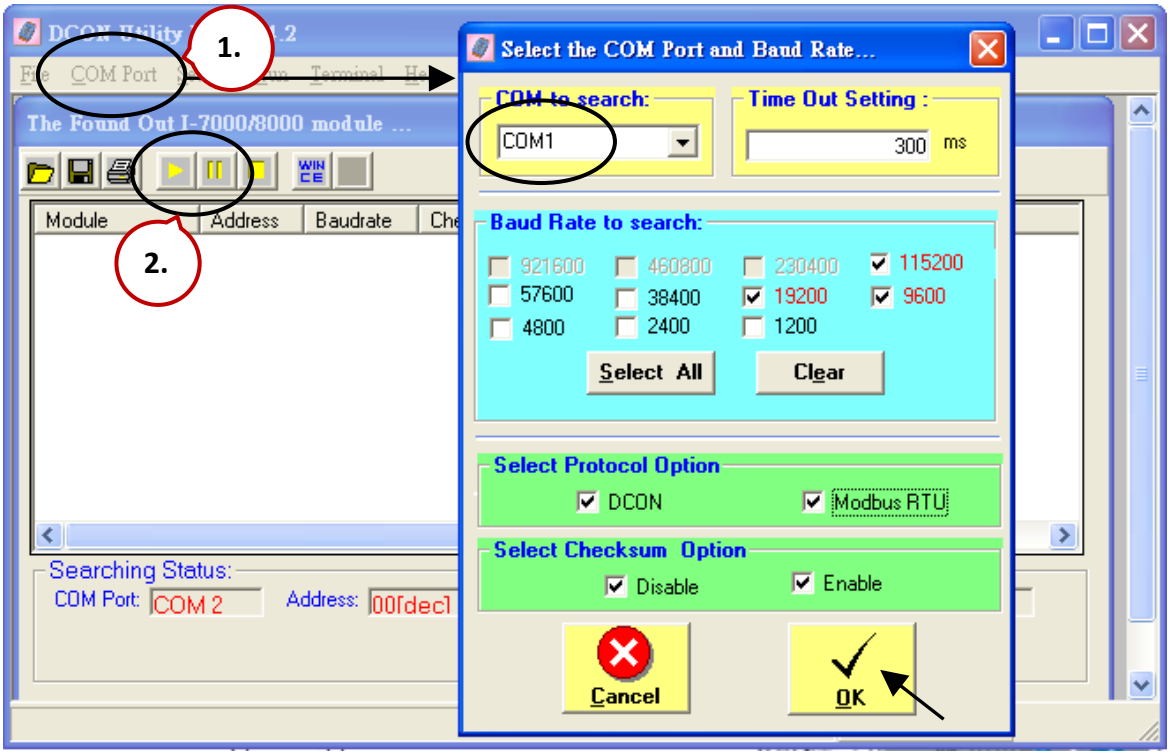
Step3: Select COM port and baud rate to search

Execute the DCON Utility from "Start/programs/DAQPro/DCON Utility/".



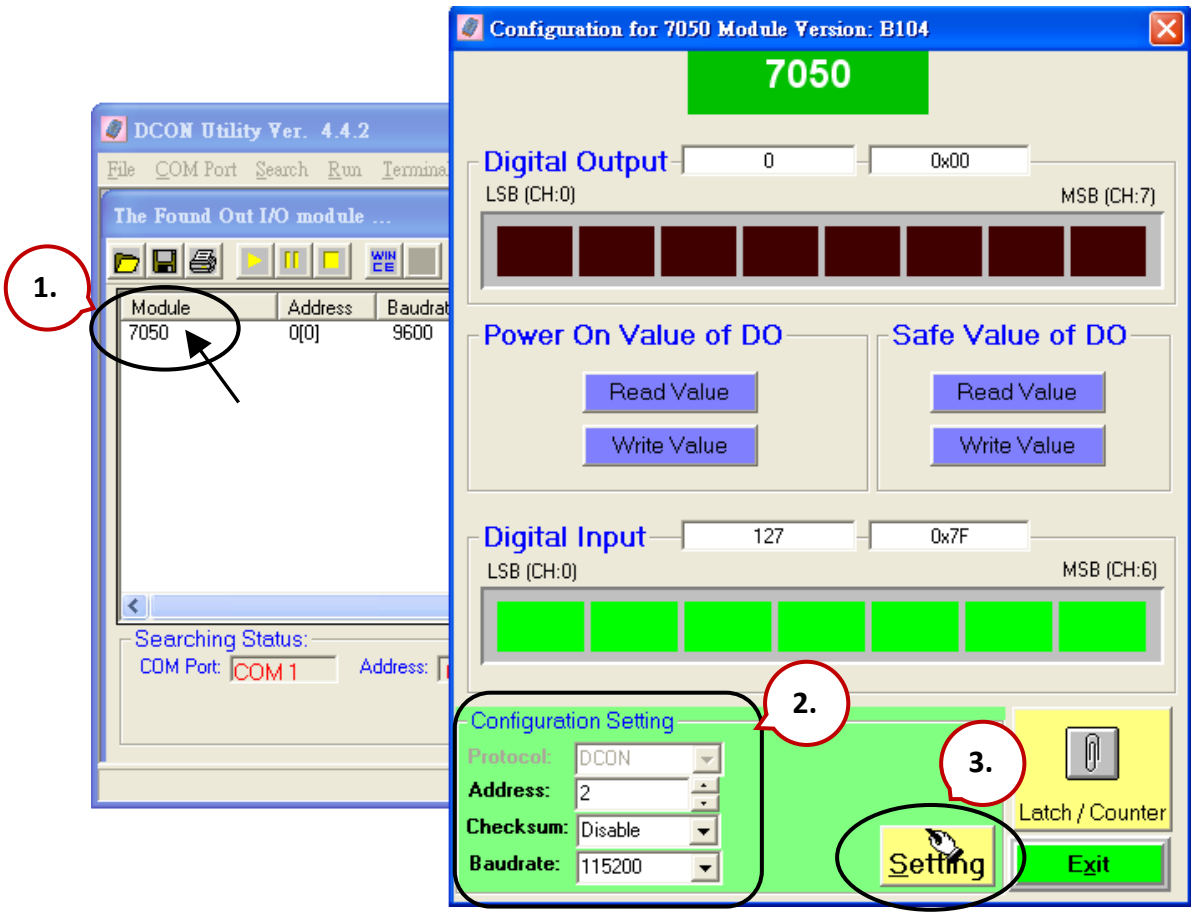
1. Click "COM Port" menu to select the COM port and baud rate to search. You can select multi-baud rate, protocol or checksum conditions if you do not know the module's setting, but it will spend more time to scan the network. After selection, click "OK".

2. Click  "Start Search" icon to begin search module. Click  when it is found.



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Step 4: Click Searched module ID and give the new configuration



Then follow the steps to check the new setting.



Note: **Remember to remove the connection of I-7000's INIT* and GND after the setting is well configured. Then recycle its power.** For I-87K I/O, remember to switch the related Dip to "OFF", then recycle its power.

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IMPORTANT NOTES Regarding remote I-7000 & I-87K Modules:

One I-8xx7, I-7188EG/XG PAC system can link up to a maximum of **64** pcs. of I-7000 and I-87K modules (**However 255 pcs for W-8xx7**). It is recommended though that you do not link more than **24** modules to a single I-8xx7 and 7188EG/XG, while 64 modules for a W-8xx7 PAC system.

Each I-7000 and I-87K module MUST have it's own unique address to properly link to an ISaGRAF PAC system. The default "Checksum" setting is disabled (If set as enabled, please connect "bus7000b" listed in section 6.2 and set "checksum" parameter to 1**), and make sure that all of the I-7000 and I-87K modules are set to the same baud rate and same checksum setting as the PAC system** (9600 baud by default).

When you receive any of the I-7000 series modules or I-87K modules you will receive documentation called "Getting Started With I-7000 Series Modules" that provides instructions on how to properly configure these modules. If you need assistance on changing the baud rate or checksum, please refer to the "Change Baud Rate & Checksum" section in the "Getting Started With I-7000 Series Modules". You can find all of the documentation on the wesite provided with your I-7000 series module from ICP DAS in a file titled "getstart.pdf".

If RS-485 remote I-7000 and I-87K I/O module's type is Analog Input, please configure the format as "2's complement" by DCON Utility. Like : I-7005, I-7013,I-7015, I-7016, I-7017, I-7017R, I-7017RC, I-7018, I-7018R,I-7018Z, I-7019, I-7019R, I-7033, I-87013, I-87015, I-87016, I-87017, I-87017R, I-87017RC, I-87018,I-87018R, I-87018Z and I-87019R.

If RS-485 remote I-7000 and I-87K I/O module's type is Analog Output, please configure the format as "Engineer Unit" by DCON Utility. Like : I-7021, I-7022, I-7024, I-87022, I-87024 and I-87026 .

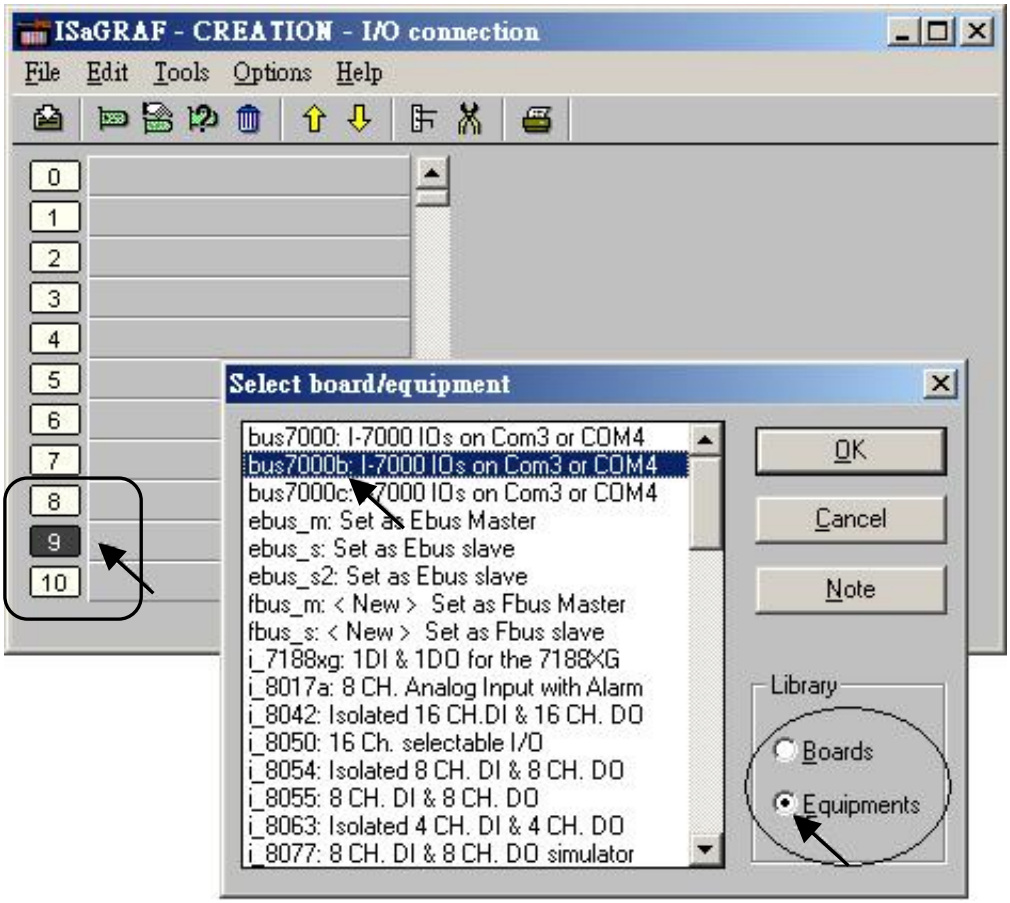
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6.2: Opening the "Bus7000b" Function

To create a link between the I-8xx7, I-7188EG/XG & W-8xx7 PAC system and an I-7000 and I-87K module, you need to connect the "Bus7000b" function through the "ISaGRAF I/O Connection" window.

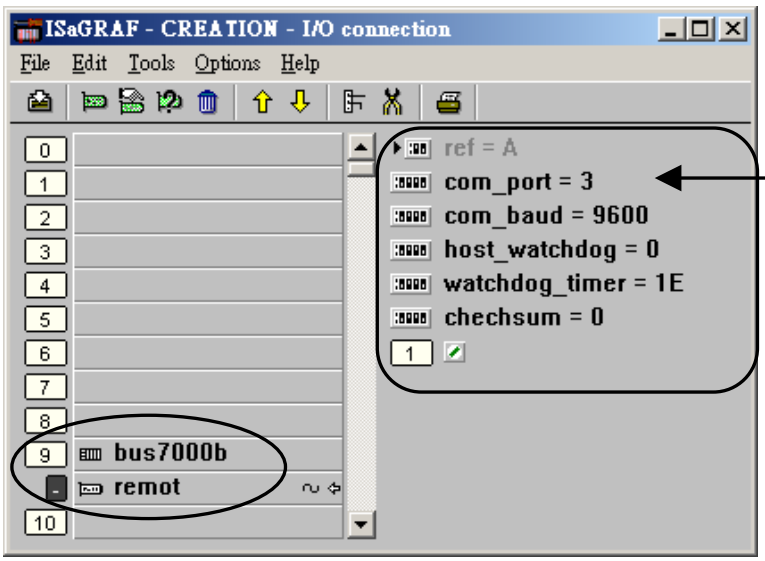
The "Bus7000b" function is considered a "virtual board", and must be selected from the "Equipments" section of the "Select Board/Equipment" window.

The "Bus7000b" MUST be connected to slot number **8 or higher** on the "ISaGRAF I/O Connection" window (since slot 0 through 7 are used to connect to real I-8000 boards). **Only one "Bus7000b"** can be linked to one PAC system! If you attempt to connect more than one "Bus7000b" to an ISaGRAF PAC, it will not work.



In the example provided, set the slot below number 9 to "Bus7000b: Remote".

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The "**com_port**" parameter can have a value of 3 (for COM3) or 4 (for COM4) for the I-8xx7 PAC, while 2 (COM2) or 3 (COM3) for the I-7188EG/XG, and 3 (COM3) for the W-8xx7. This parameter defines which COM port ID the PAC system will communicate with the I-7000/I-87K module. The default value for the "com_port" parameter is 3.

The "**com_baud**" parameter defines the baud rate that the ISaGRAF PAC will communicate with the I-7000/I-87K module. The possible values are 2400, 4800, 9600, 19200, 38400, 57600, and 115200. Make sure that the PAC and the I-7000/I-87K modules are all set to the same "com_baud" value.

The "**host_watchdog**" parameter enables or disables the watchdog function for the I-7000 and I-87K module. Setting the "host_watchdog" parameter to a non-zero value will enable the "host_watchdog" feature.

The "**watchdog_timer**" parameter defines the amount of time before a "host_watchdog" will occur. The value for the "watchdog_timer" is defined in a **hexadecimal** value with the units defined in 0.1-second increments. For example, if the "watchdog_timer" is set to a value of 1E, the "watchdog_timer" is set for 3 seconds. If the "watchdog_timer" value is set to 2A, the "watchdog_timer" is set for 4.2 seconds.

The "**checksum**" parameter defines the remote IO is using "0: No checksum" or "1: with checksum". (The old "bus7000" not supporting "checksum" options. **Bus700b** does support it)

If the host watchdog feature is activated and the watchdog timeout occurs on PAC that means the connection between the PAC and I/O modules is break, and then the value of I-7000/I-87K modules will be set to a "safe" value that configured by using DCON Utility. Normally for Digital Output channel, the "safe" state is D/O=OFF or D/O=False.

There is an analog input channel available on the "Bus7000b: Remote" virtual board. This analog input channel will return a value equal to the currently set baud rate.

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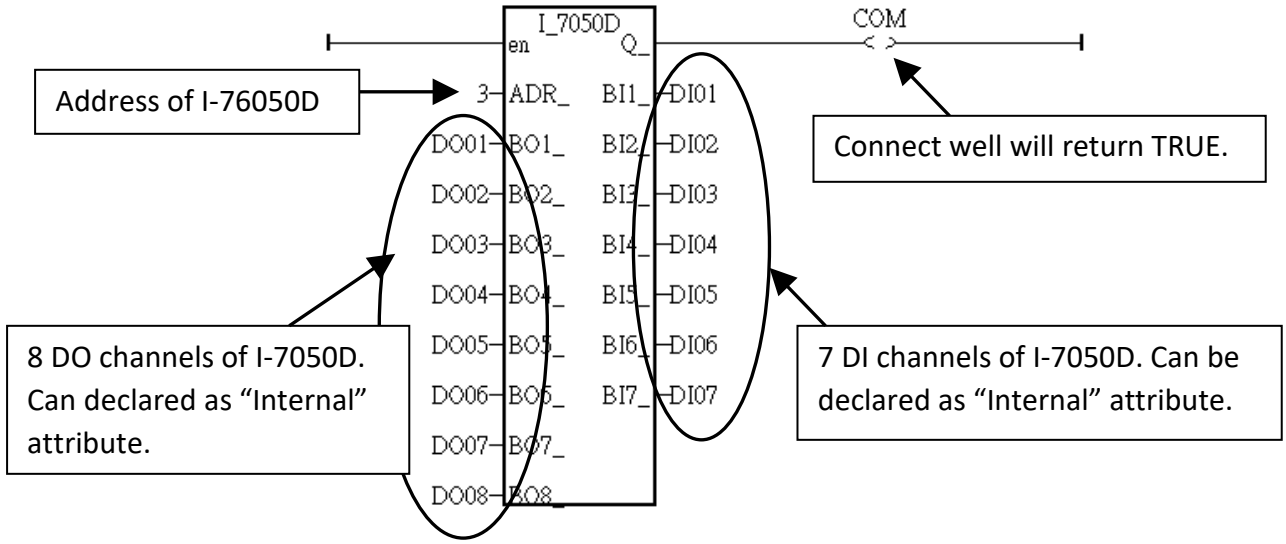
6.3: Programming an I-7000 & I-87K Module

6.3.1: Program I_7xxx or I_87xxx remote IO function blocks

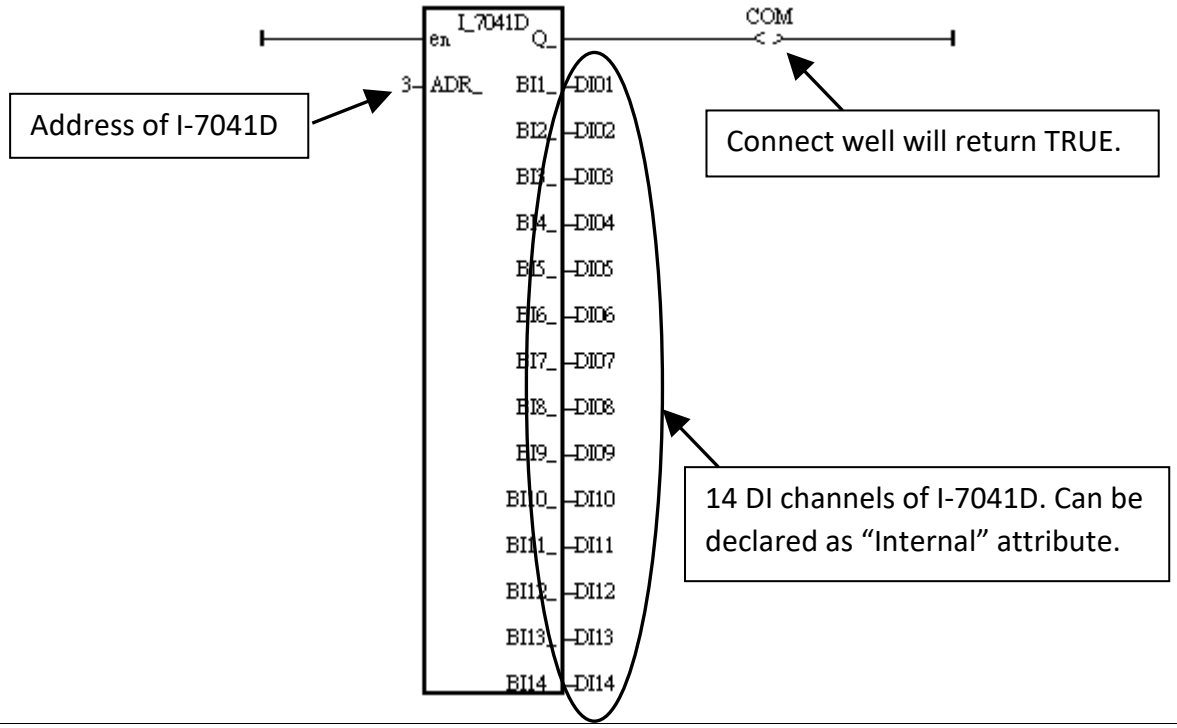
To link any I-7000 and I-87K module to the I-8xx7, I-7188EG/XG & W-8xx7 PAC system, the "Bus7000b" module MUST be opened first. Once the "Bus7000b" is opened, the "I_7xxx" / "I-87K" function block can now be programmed and you can access all of the I/O channels available from that function block, and that data can now be used in a LD program.

NOTE: Please declare all variables which connect to the I-7000/I-87K block as "**Internal**" attribution.

Example 1: Programming an I-7050D Module



Example 2: Programming An I-7041D Module



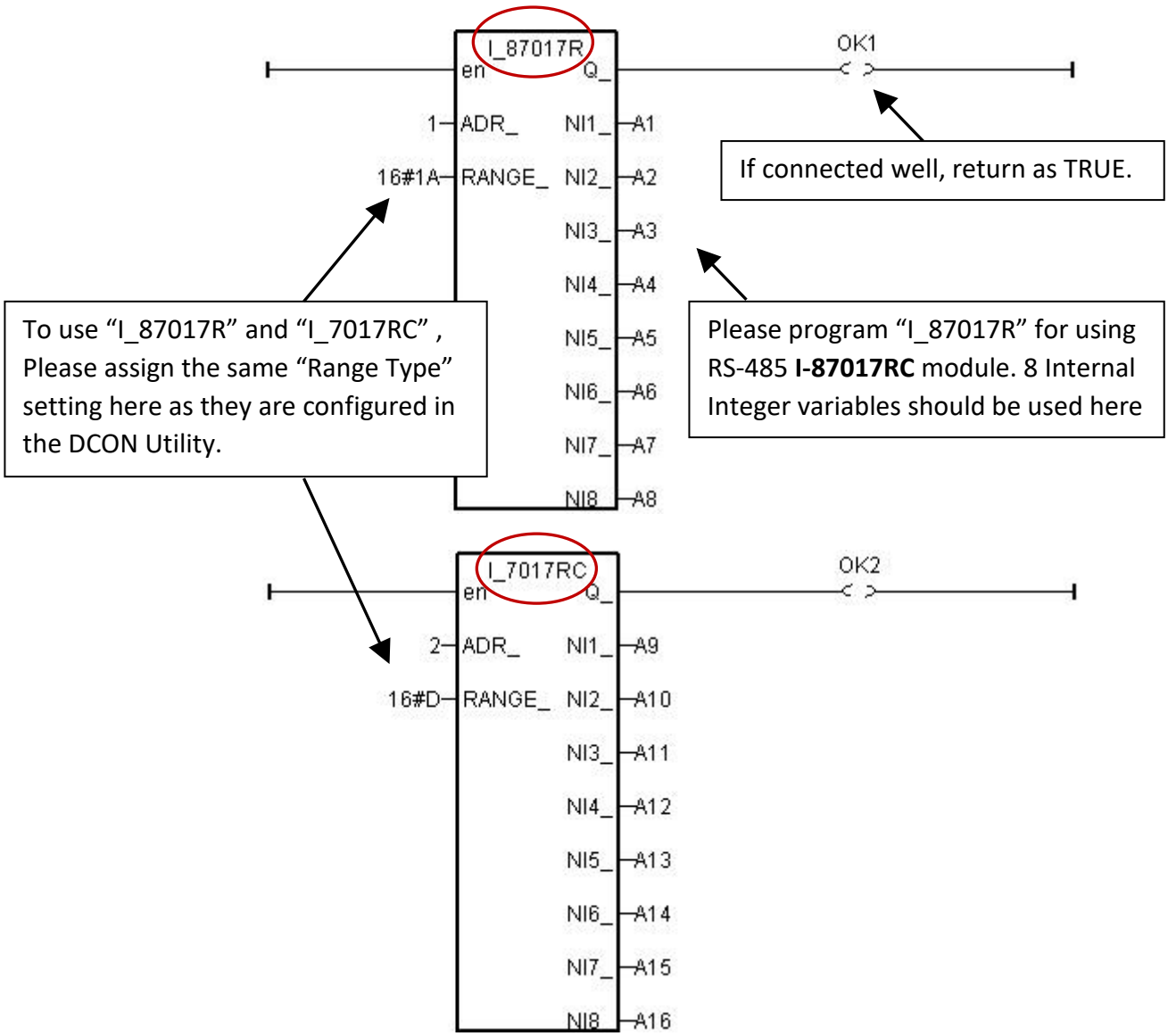
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Example 3: Programming a I-87017R or I-7017RC function block

(The hardware should be I-**87017RC** and **I-7017RC**, current input measurement)

I-87017RC and I-7017RC can measure current input of ± 20 mA , 0 ~ 20mA and 4 ~ 20mA. Unlike I-87017, I-87017R and I-7017, no external 125 ohm resistor required . Please configure their format as "2's complement" by DCON Utility. (The "A4_20_to" function can be used to convert the analog input value to user's engineering value, please refer to ISaGRAF Appendix A.4)

Range type (by "DCON Utility")	**Physical value**	**I-7017RC /87017RC Analog Input value**		
		- 32768	0	+32767
7	4 ~ 20 mA		4 mA	20 mA
D	± 20 mA	- 20 mA	0 mA	20 mA
1A	0 ~ 20 mA		0 mA	20 mA



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Note:
If the current input sensor is 4 to 20 mA, user may better set I-7017RC or I-87017RC ' range type to "[D] : +/- 20 mA", or "[1A] : 0 ~ 20 mA". (set as " [7] : 4 to 20 mA" is not good)

The reason is :
If setting RS-485 I-7017RC or I-87017RC 's range type as "**[7] : 4 to 20 mA**", analog input value of 0 or close to 0 could mean the Sensor input is 4 mA , and also possible the Sensor is broken-line. So it is not easy to distinguish these two situation by software.

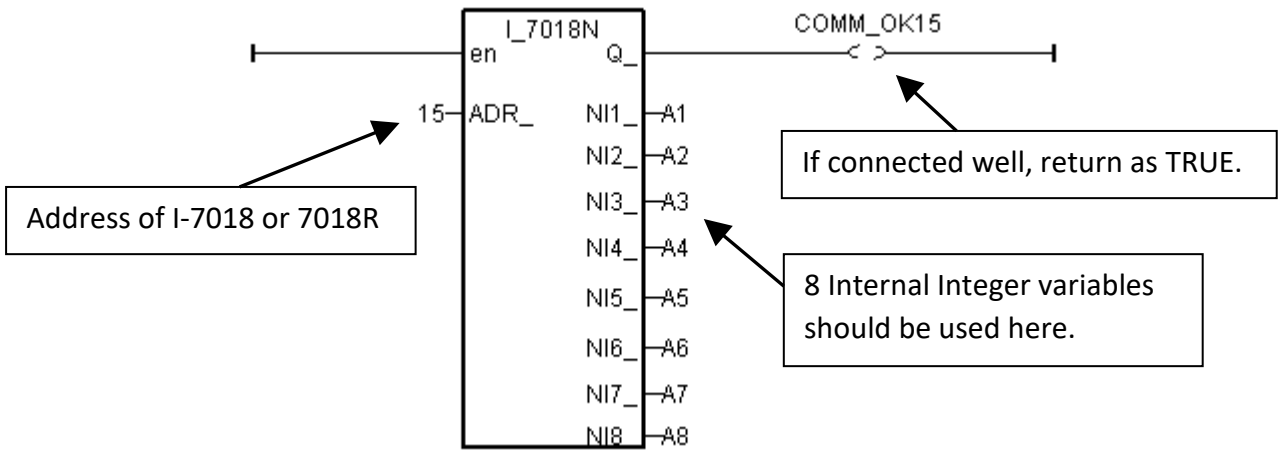
Howevr, if setting I-7017RC or I-87017RC 's range type as "**[D] : +/- 20 mA**" or "**[1A] : 0 ~ 20 mA**", analog input value of 0 or close to 0 only means the Sensor is broken-line . If the Sensor input is 4 to 20mA , the analog value should be 6553 to 32767, not close to 0.

(Of course, the communication state of the RS-485 I-7017RC and I-87017RC should be Ok. The "Ok1" and "OK2" variable in the above example 3 can indicate the communication is Ok or not. If the communication is False, it means the PAC can not link to the RS-485 I/O well. You need to handle this situation in your ISaGRAF program).

Example 4: Program I-7018 block for I-7018R and I-7018 (Please use new "i_7018n" block)

(**I-7018Z is a better hardware than I-7018 and I-7018R.** Please refer to Section 11.3.9 of ISaGRAF user manual or http://www.icpdas.com/en/faq/index.php?kind=280#751 FAQ-055 for demo example)

Please configure I-7018 and I-7018R's format as "2's complement" by DCON Utility. Then please program a "I_7018**n**" block (The "I_7018**n**" block request all 8-channels by one single command, however the "I_7018" block need to send 8 commands for 8-channels)



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The other RS-485 I-7000 and I-87K I/O all use the similar way.

Note:
If RS-485 remote I-7000 and I-87K I/O module's type is **Analog Input, please configure the format as "2's complement" by DCON Utility.** Like : I-7005, I-7013, I-7015, I-7016, I-7017, I-7017R, I-7018, I-7018R, I-7018Z, I-7019, I-7019R, I-7033, I-87013, I-87015, I-87016, I-87017, I-87017R, I-87018, I-87018R, I-87018Z and I-87019R.

If RS-485 remote I-7000 and I-87K I/O module's type is **Analog Output, please configure the format as "Engineer Unit" by DCON Utility.** Like : I-7021, I-7022, I-7024, I-87022, I-87024 and I-87026 .

Below table is for the **I-7017, 7017R, 87017, 87017R**.
(These modules need external 125 ohm resistor if using "**D: ± 20mA**")

Range tyep (by DCON Utility)	**Physical value**	**I-7017 / 87017 Analog Input value**		
		-32768	0	+32767
8	± 10V	- 10V	0V	+ 10V
9	± 5V	- 5V	0V	+ 5V
A	± 1V	- 1V	0V	+ 1V
B	± 500mV	- 500mV	0mV	+ 500mV
C	± 150mV	- 150mV	0mV	+ 150mV
D	± 20mA	- 20mA	0mA	+ 20mA

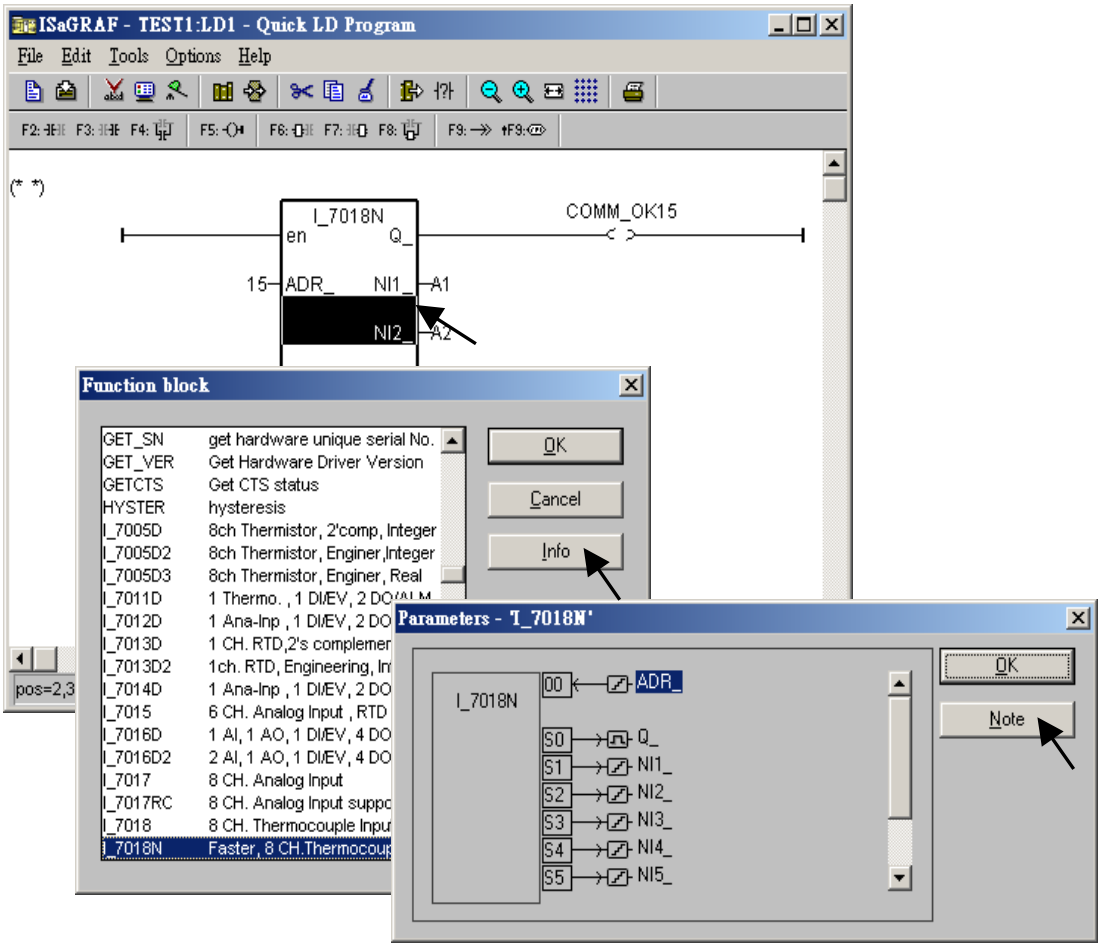
Below table is for the **I-7017RC and I-87017RC** (no external 125 ohm resistor required)

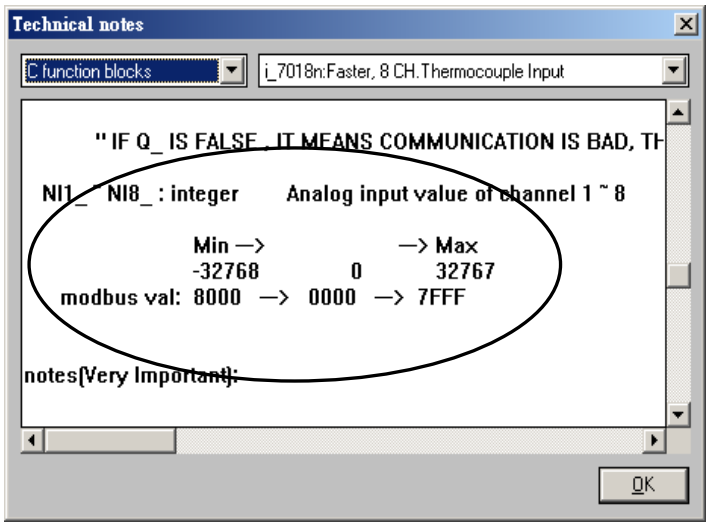
Range tyep (by DCON Utility)	**Physical value**	**I-7017 / 87017 Analog Input value**		
		-32768	0	+32767
7	4 ~ 20mA		4mA	20mA
D	± 20mA	- 20mA	0mA	20mA
1A	0 ~ 20mA		0mA	20mA

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Please refer to the on-line help for each I/O module's table or refer to the ISaGRAF Appendix D.

Double-click on the function block and click the **Info** button and then click the **Note** button.





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6.3.2: Setting a special "ADR_" parameter of remote temperature input module to get clear "Degree Celsius" or "Degree Fahrenheit" input value

ICPDAS provides many temperature input modules as below.

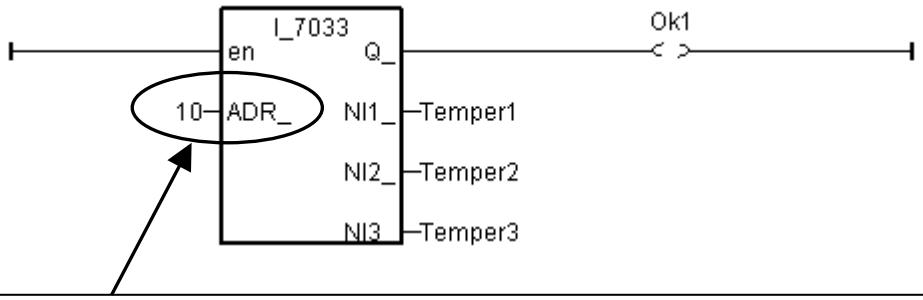
With "broken-line detection" or called "wire opening detection"

Thermocouple type: I-87018Z, I-87018R, 87019R, 7018Z, 7018R, 7018BL, 7019, 7019R
RTD type: I-87013, 87015, 7013, 7015, 7033
Thermister type: I-87005, 7005

Without "broken-line detection"

Thermocouple type: I-87018, 7018, 7018P

The "ADR_" parameter of temperature IO function block can be "standard setting" or "special setting". For example setting "ARD_" of the "I_7033" function block to 1 to 255 (Dec. value) means "standard setting", the value of 1 to 255 indicates the address of the remote I-7033. The temperature input value is normally –32768 to + 32767 in the case. It depends on the IO module's "Type code" setting (Set by DCON Utility). (Normally, value of –32768 & +32767 means wire "broken-line")



ADR_ = **10** (TT=00, RR=00, AA=**0A**, Hex.) means "standard setting", address=10, the temperature input value is normally –32768 to + 32767

If ADR_= 16#**10201A** (TT=10, RR=20, AA=1A, Hex) means "special setting", "Degree Celsius", "type code=20 of this I-7033 module set by DCON Utility", address=26, the temperature input value is a clear "Degree Celsius" value, for example, value of 4556 mans "45.56" degree. "-500" means "-5.00" degree.

If user want to get a clear temperature input value, for example, value of 2312 means "23.12" Degree Celsius. Then please set "ADR_" to a special value defined as below.

Important: Special "ADR_" setting is supported since driver version of

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I-8xx7: 3.11, I-7188EG: 2.09, I-7188XG: 2.07, W-8xx7: 3.24

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Format: **TTRRAA** (Hex.)

TT=10 (Convert to "Degree Celsius")

TT=20 (Convert to "Degree Fahrenheit")

TT=00 (standard setting, -32768 to +32767. RR should be set as 00 if TT=00)

RR: "type code" setting of the related temperature input module

AA: address of the related temperature input module

For example, setting "ADR_" as

A. 16#102011: (TT=10, RR=20, AA=11, Hex) the input value will be "Degree Celsius", unit is 0.01 degree, range= "20 : Platinum 100, a=0.00385, degree Celsius", address=17(Dec.). That results input value of "2356" = 23.56 Degree Celsius, "-489" = -4.89 Degree Celsius, "999990" = sensor broken-line.

B. 16#202A03: (TT=20, RR=2A, AA=03, Hex)) the input value will be "Degree Fahrenheit", unit is 0.01 degree, range= "2A : Platinum 1000, a=0.00385, degree Celsius", address=3(Dec.). That results input value of "4512" = 45.12 Degree Fahrenheit, "500" = 5.00 Degree Fahrenheit, "999990" = sensor broken line.

C. 16#01: (TT=00, RR=00, AA=1) standard setting, the input value will be , -32768 to +32767, address=1

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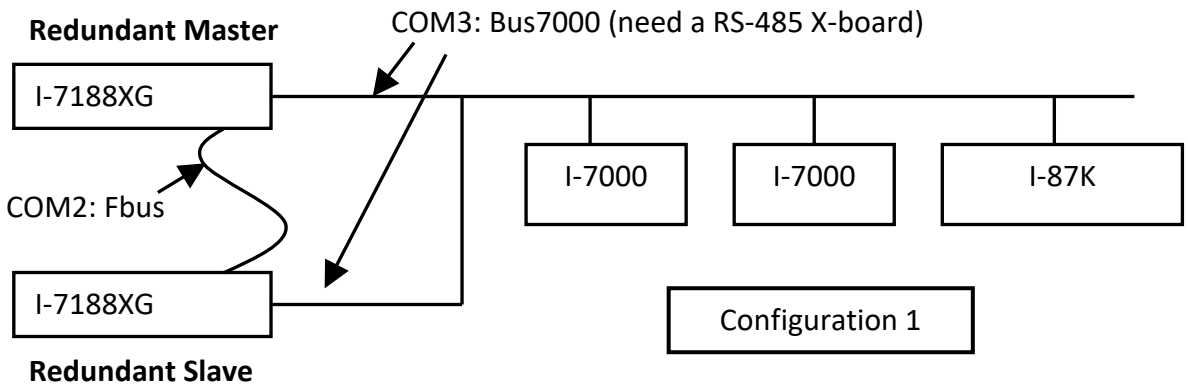
6.4: Redundant Bus7000

W-8x37 and W-8x47 have been phased out, visit the ISaGRAF wesite http://www.icpdas.com/en/product/guide+Software+Development__Tools+ISaGRAF for new products. Also, refer to Chapter 20 of ISaGRAF user manual for more information about redundancy solutions.

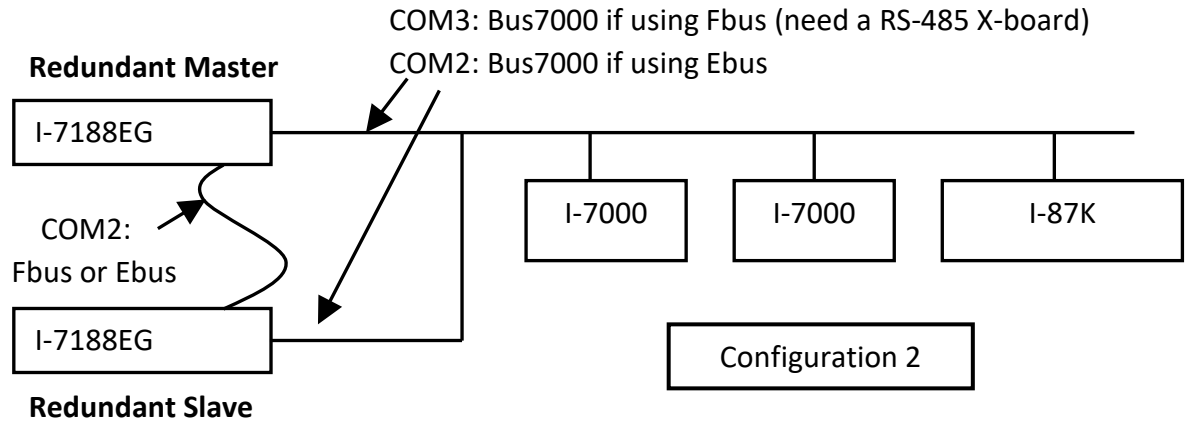
uPAC-7188EG (Rev.1.19 or above), I-7188XG (Rev.1.17 or above) & I-8417/8817/8437/8837 (Rev.2.27 or above) support Redundant Bus7000. These configurations are listed as the following.

The Fbus/Ebus are for exchanging data between the “Redundant Master” & “Redundant Slave”, and the **Fbus/Ebus cable** must be always working (break is not allowed).

I-7188XG:

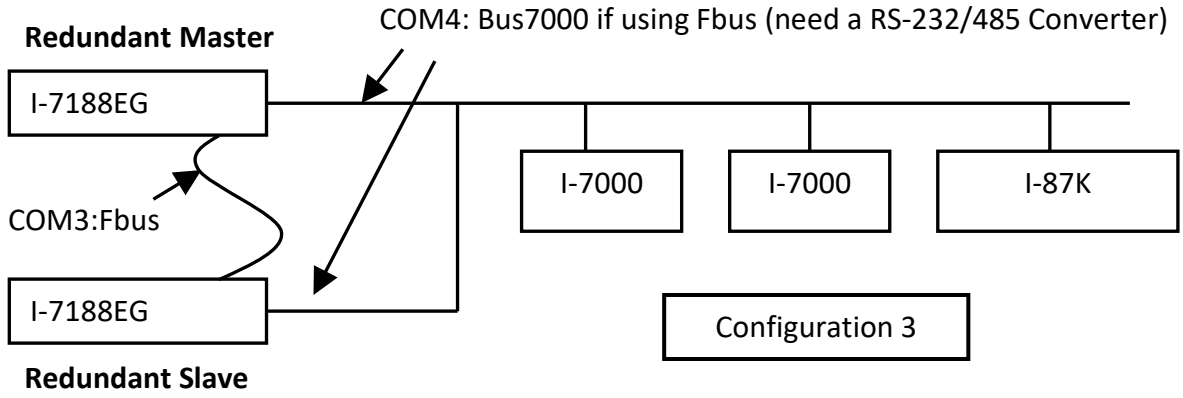


I-7188EG:

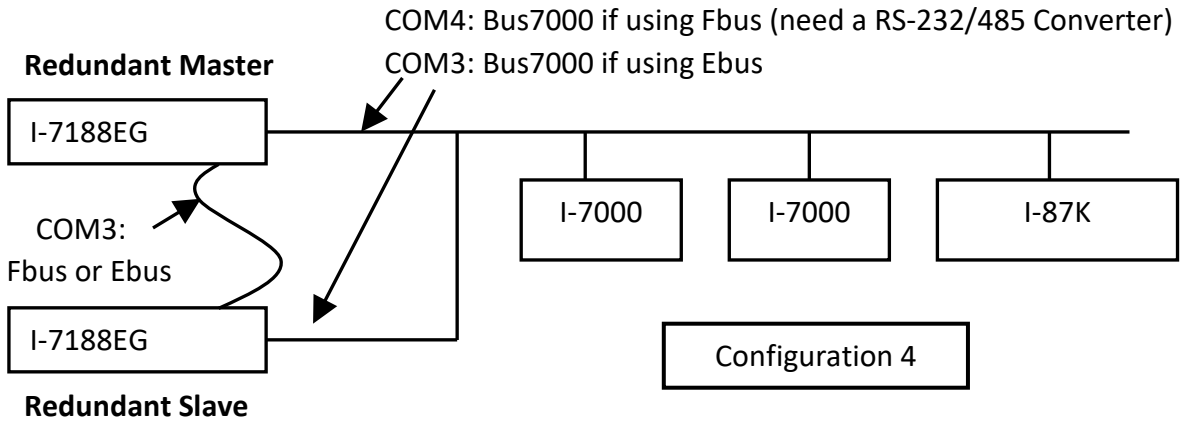


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I-8417/8817:



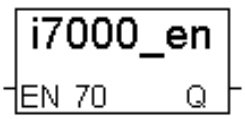
I-8437/8837:



Operations Principle:

When the system is powered up, the control right of Bus7000 belong to “Redundant Master”.
If “Redundant Master” is dead (Power off), “Redundant Slave” takes over the control right of Bus7000.
If “Redundant Master” is alive from dead (power up again), it takes over the control of Bus7000 again.
User’s control data is exchanging via Fbus or Ebus.

The “i7000_en” can be used to Enable/Disable the control right of Bus7000. The system’s default status is ‘Enable’.



Parameter:

EN_7000_	integer	True: Enable, False: Disable

Return:

Q_	Boolean	Always return True.

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Visit to ISaGRAF Download Center to download these demo programs.
http://www.icpdas.com/en/download/show.php?num=1005&nation=US&kind1=6&kind2=&model=&kw=ISAGRAF

Demo example for I-7188XG:
The demo project uses “Configuration 1” and located at demo_48a & demo_48b.

Demo example for I-7188EG:
The demo project uses “Configuration 2” with Ebus and located at demo_51a & demo_51b.

Demo example for I-8437/8837:
The demo project uses “Configuration 4” with Ebus and located at demo_49a & demo_49b.

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

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