How to connect an ISaGRAF PAC to M-7000 remote I/O?

Download FAQ-050 Demo.

ISaGRAF PACs support M-7000 remote I/O since below driver version.

PAC	Driver version
I-8417 / 8817 / 8437 / 8837	3.16 or later
I-7188EG / 7188EGD	2.14 or later
I-7188XG / 7188XGD	2.12 or later
W-8037 / 8337 / 8737 / 8036 / 8336 / 8736 (EOL)	3.32B or later
W-8047 / 8347 / 8747 / 8046 / 8346 / 8746 (EOL)	3.32B or later

Click the link to download the driver and follow instructions listed in a 'upgrade_model-driver.pdf' inside the zip file to update them if the version is older.
http://www.icpdas.com/en/download/show.php?num=368&nation=US&kind1=&model=&kw=isagraf

The M-7000 series modules are RS-485 remote I/O modules which support Modbus RTU slave protocol. Visit to the webpage for more information.

User can write ISaGRAF program to support Modbus RTU Master protocol to connect to M-7000 I/O or other Modbus RTU slave devices. Please refer to Chapter 8 of the "ISaGRAF user's Manual".
http://www.icpdas.com/en/download/show.php?num=333&nation=US&kind1=&model=&kw=isagraf

There are some frequently asked question about the Modbus RTU Master. Please visit https://www.icpdas.com/en/faq/index.php?kind=280#751 for FAQ–046, 047, 049 & 050.

One Modbus RTU Master port can connect up to **32** pcs. of M-7000 modules. I-8417/8817/8437/8837 & I-7188EG & I-7188XG can setup max. **2** Modbus RTU Master ports, while W-8xx7/8xx6 can setup max. **10** Modbus RTU Master ports.

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These programs all use COM3 port to connect to M-7000 I/O. You may change the "port_no" setting of the "mbus" to fit your PAC. Download FAQ-050 Demo.

Wdemo_41	COM3 connecting 1: M-7053D (16-Ch. D/I) + 2: M-7045D (16-Ch. D/O)
Wdemo_42	COM3 connecting 1: M-7053D to get D/I counter value (16-bit, 0-65535)
Wdemo_43	COM3 connecting 1: M-7017R (8-Ch. A/I) + 2: M-7024 (4-Ch. A/O)
Wdemo_44	COM3 connecting 1: M-7017RC (8-Ch. Current Analog Input)
Wdemo_45	COM3 connecting 1: M-7019R (8-Ch. Universal A/I, thermocouple or voltage input or current input) to get temperature value
Wdemo_46	COM3 connecting 1: M-7080 (2-Ch counter or frequency)

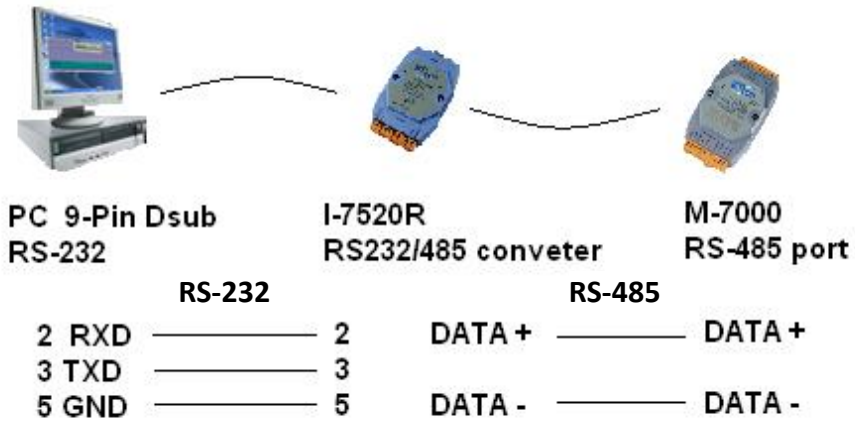
Before we starting at programming Modbus Master port, please run "DCON utility" to well configure M-7000's "Slave No" (or called Address), "Baudrate" for every D/I/O & A/I/O module and channel range or type setting for Analog input & output module. The "Procotol" setting should be "Modbus".

You may download and install "DCON Utility" at
http://www.icpdas.com/en/product/guide+Software+Utility_Driver+DCON__Utility__Pro

Steps to configure each M-7000 module

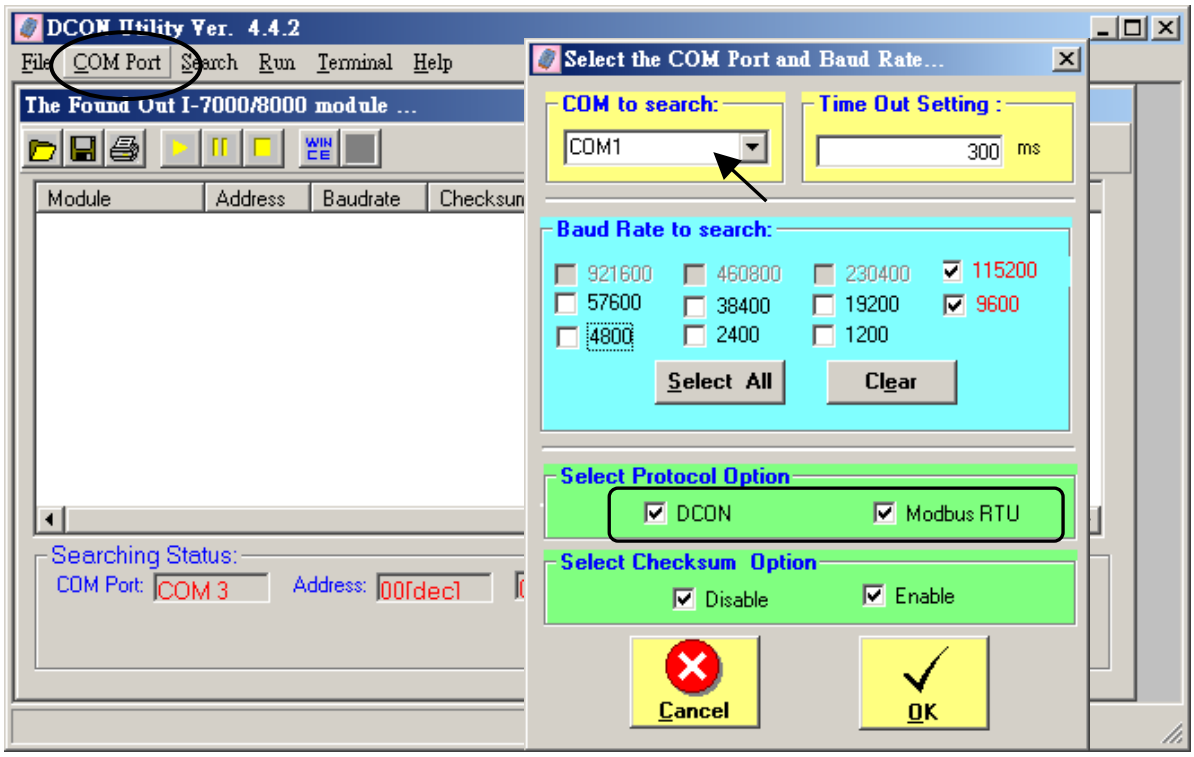
Step 1: Power off M-7000. Connect one RS232 cable from PC's COM1 (or other COM port) to one RS232/485 converter, for example I-7520R at http://www.icpdas.com/en/product/guide+Industrial__Communication+Serial__Communication+Converter , then connect this converter to the M-7000 module.

Please short "INIT*" to "GND". This means to make the M-7000 to be in initial state (Address will be 0, baudrate=9600). Some M-7000 module provide a "Init – Normal" dip switch on its back to replace the "INIT*" pin.

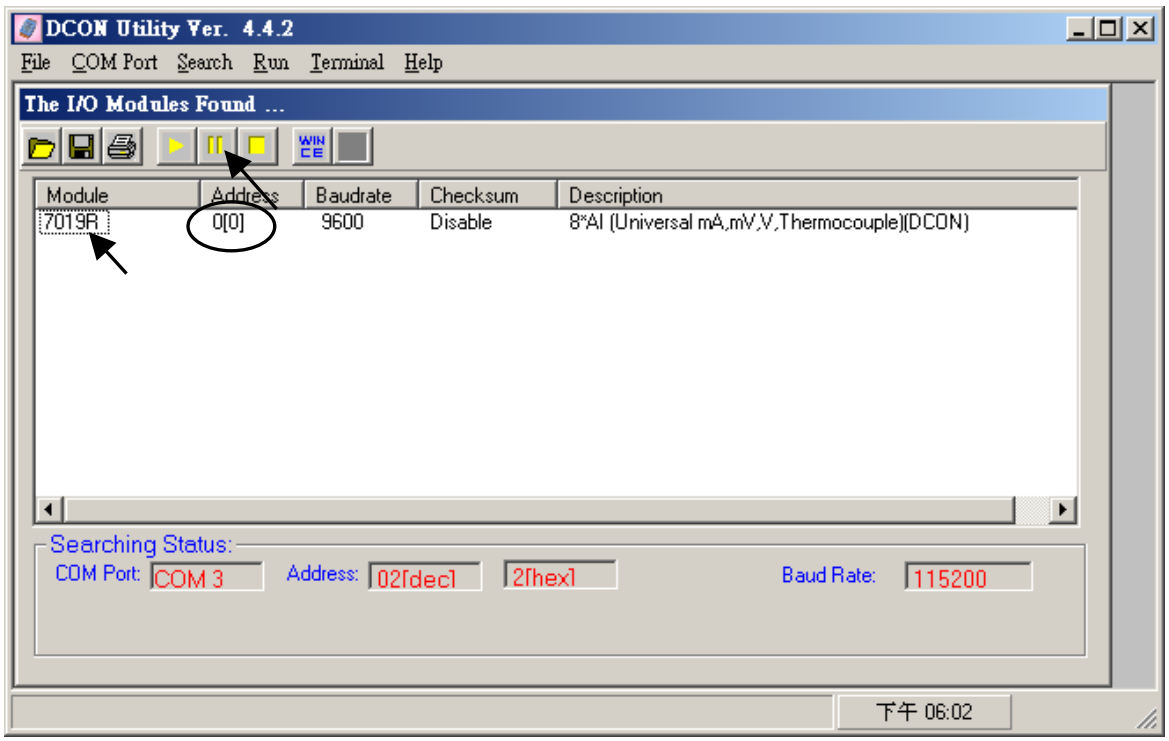


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Step 2: Power on M-7000. Run “DCON Utility”, click on “COM Port” menu to select proper COM port, baudrate to search, check on “DCON” & “Modbus RTU”.Then click on “start Search” to search M-7000.

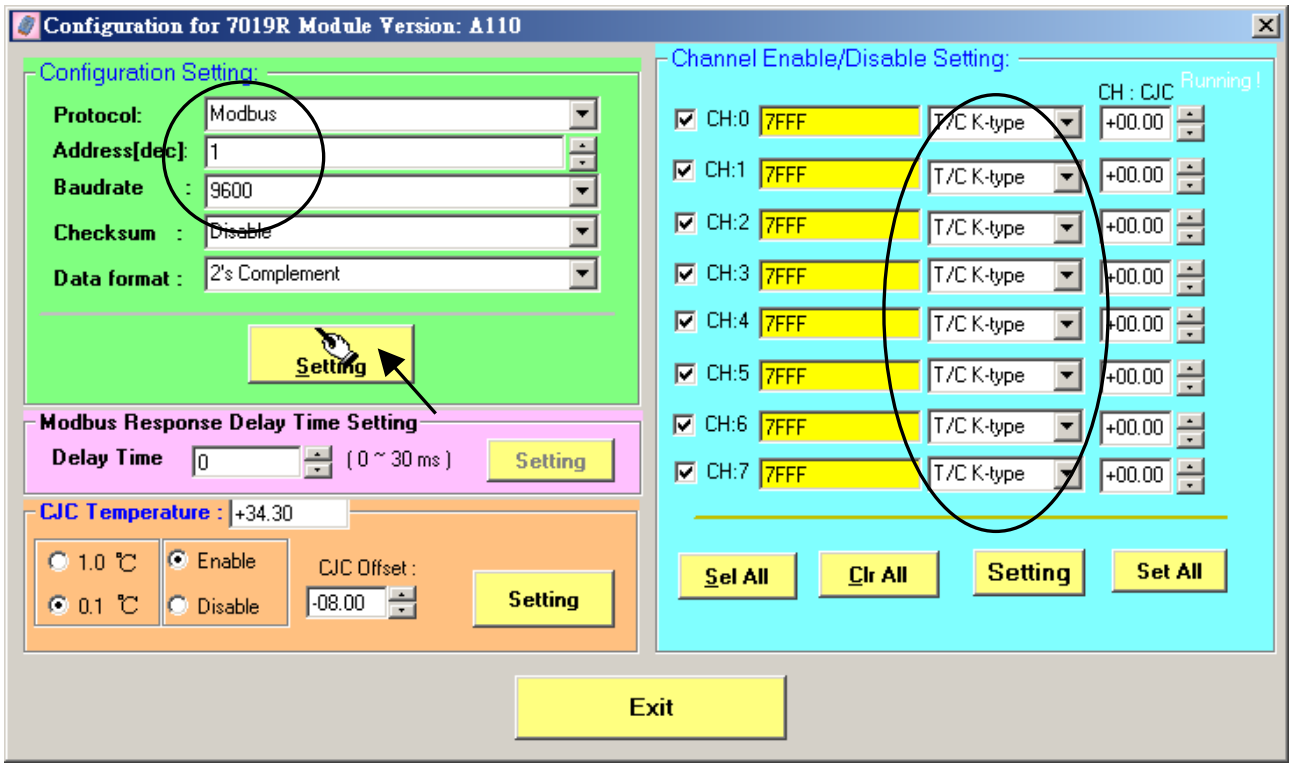


Step 3: The only one connected M-7000 should be found at Address=0 (because it is in initial state), Click “Stop” to stop searching when found it.



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Please set protocol as “Modbus”, proper “Address” (Slave no) , “Baudrate”. And if the M-7000 is Analog I/O, please set proper type & range, then click on “Setting”



Step 4: Power off M-7000. Remove connection between “INIT*” and “GND”. **Then power it ON again. Run DCON Utility to search & then check if the setting is correct or not**. If the setting is not correct, modify them and click on “setting” again.

If this M-7000 Module is M-7041 or M-7044 or M-7050 or M-7053 or M-7060 or M-7063 or M-7065 (or M-7041D or M-7044D or M-7050D or M-7053D or M-7060D or M-7063D or M-7065D), please go to step 5. If the module is not in the above item numbers, then this M-7000 is well configured.

Note:

1. Every M-7000 must be configured to **a unique “Address number” (1 to 247) and the same “Baudrate”** and other proper setting before using it.
2. User may refer to the attatched manual in the product box, or visit http://www.icpdas.com/en/download/index.php?nation=US&kind1=&model=&kw=m-7000 to get each M-7000 Module's Manual to find their “Analog Input Type and Data Formate Table” (Type code setting).

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Important Step5:

After the initial configuration is completed (Step 1 to 4), please give below Modbus command to below M-7000 modules 's Digital input channels to invert them.

01 46 29 01 (4-byte command, each byte is 2 Hex-number)

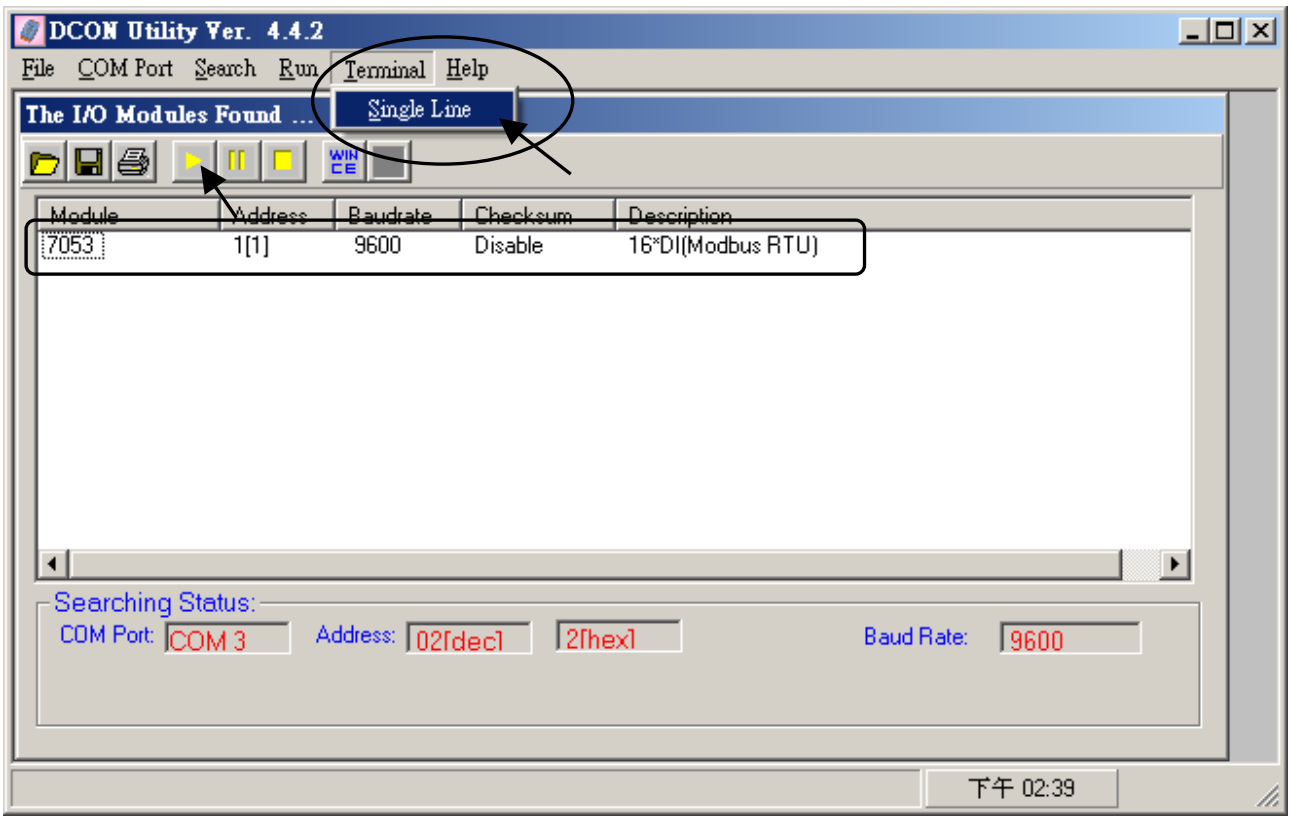
The first byte is the M-7000 Address number been set by DCON Utility, it may be 01, 02, 03, ..., 0F, ... to F7 depends on your setting of the related M-7000. The other 3 bytes “46 29 01” should be always same.

M-7000 Modules should be inverted						
M-7041,	M-7044,	M-7050,	M-7053,	M-7060,	M-7063,	M-7065
M-7041D,	M-7044D,	M-7050D,	M-7053D,	M-7060D,	M-7063D,	M-7065D

Please Do Not give the upper command to other M-7000 modules which are not in the above lists.

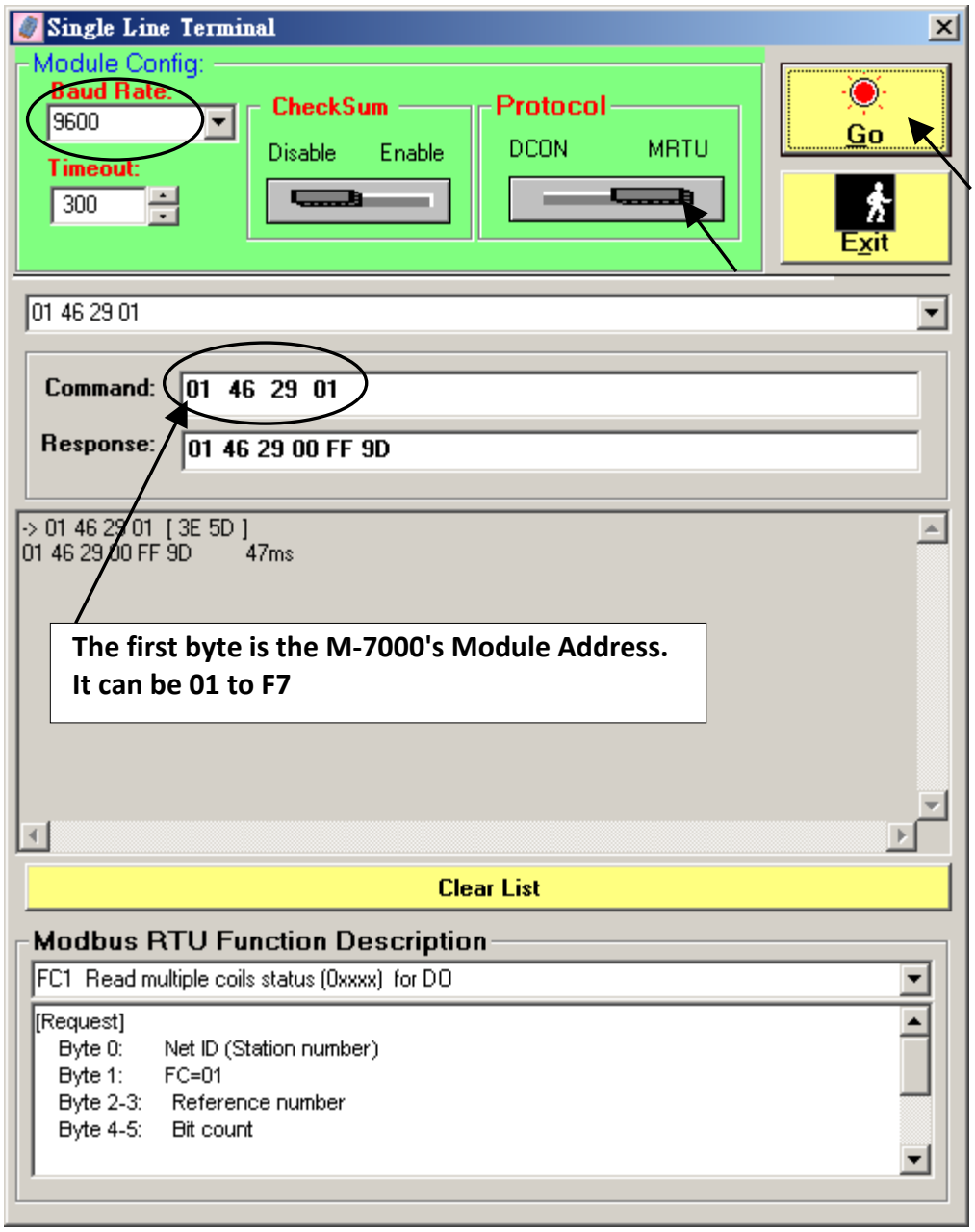
Steps to invert the digital input channels:

After Step 4 is finished, power on M-7041 or M-7044 or M-7050 or M-7053 or M-7060 or M-7063 or M-7065 again. Run DCON Utility to search the module first. If the module is found. Stop search. Make sure the Module name is one of M-7041 or M-7044 or M-7050 or M-7053 or M-7060 or M-7063 or M-7065. Then goto “Terminal” - “Single Line”



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Select the correct baudrate, Protocol should be set to “MRTU”. Then type the inverted command as below, the first byte should be the Module's Address number. It can be 01 to F7. And then click “Go”. If the response is “01 46 29 ...”, it means command succeed. Power off this M-7000 modules. And it is well configured.

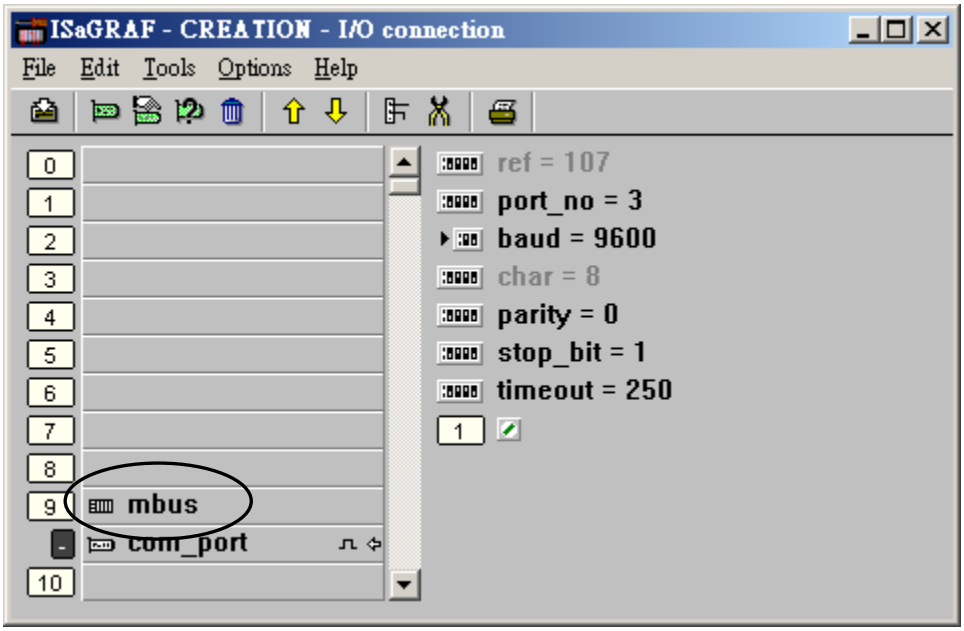


Important :

If your M-7000 is **M-7041** or **M-7044** or **M-7050** or **M-7053** or **M-7060** or **M-7063** or **M-7065** (or **M-7041D** or **M-7044D** or **M-7050D** or **M-7053D** or **M-7060D** or **M-7063D** or **M-7065D**), please follow the former Step5 to invert their digital input channels.

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To program Modbus RTU Master, please connect “mbus” in the ISaGRAF IO connection windows as below. Please set proper “port_no” , “baud” & “timeout”. “timeout” setting default is 500 ms, you can specify 250 ms if connecting only M-7000 I/O modules.



Then please create an Ladder program or function block program to access to each M-7000 I/O channels. ICP DAS ISaGRAF PACs can access to M-7000 modules by using “Mbus_r” , “Mbus_r1” , “Mbus_b_w” , “Mbus_wb” & “Mbus_n_w” .

Mbus_R	A. Read max. 12 word-value (-32768 ~ +32767) using Modbus function call **4** to read M-7000 **Analog input** channels or read D/I counter value. B. Read max. 192 bit-value using Modbus function call **2** to read M-7000 **Digital input** channels.
Mbus_R1	Same as Mbus_R but with one extra setting – Period. Read words or bits with a specified period time (unit is second)
MBUS_N_W	Write max. 4 word-value (-32768 ~ +32767) using Modbus function code **6** or **16** to witre M-7000 **Analog output** channels. (write 1 word using code **6**, write 2 ~ 4 words using code **16**)
MBUS_B_W	Write max. 4 bit-value using Modbus function code **5** or **15** to witre M-7000 **Digital output** channels. (write 1 bit using code **5,** write 2 ~ 4 bits using code **15)**
MBUS_WB	Write max. 16 bit-value using Modbus function code **15** to witre M-7000 **Digital output** channels.

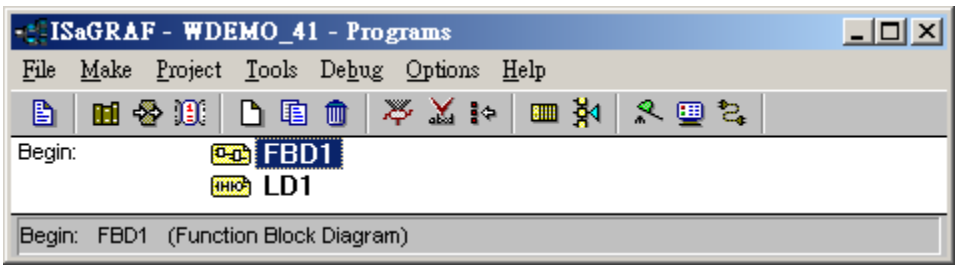
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Example 1: Connecting 1: M-7053D (16-Ch. D/I) + 2: M-07045D (16-Ch. D/O). This example is "Wdemo_41". Please follow former step 5 to invert M-7053's D/I channel's signal.

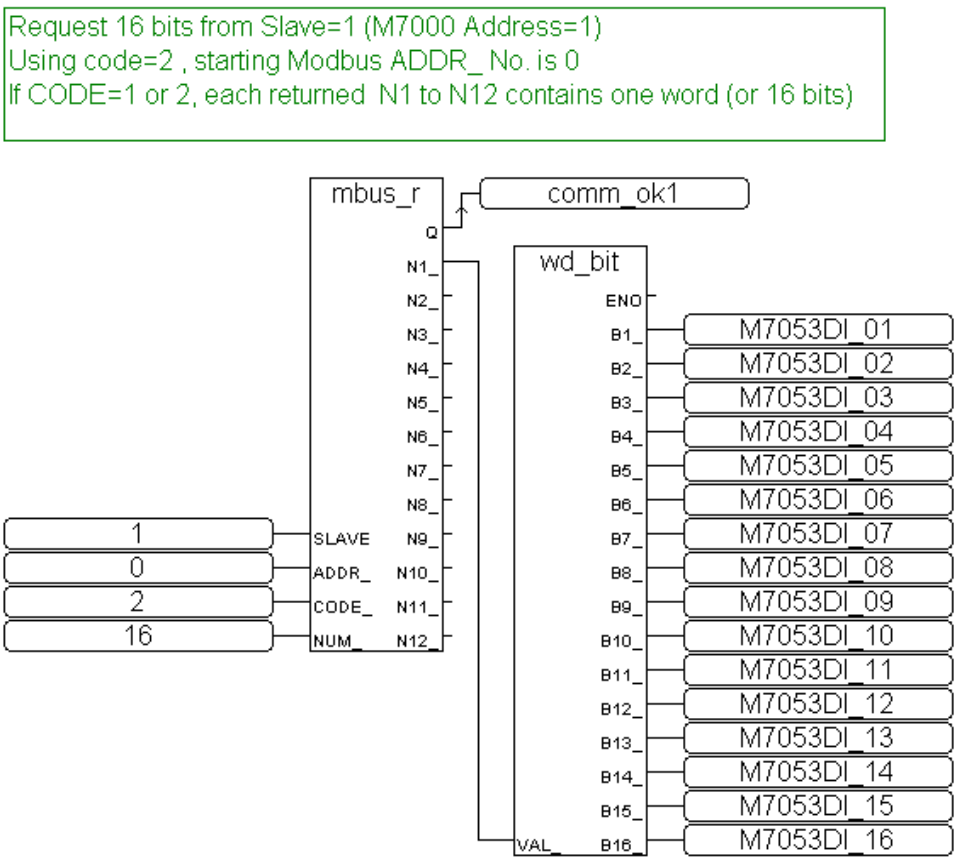
Variables:

Name	Type	Attribute	Description
comm_ok1	Bool	Internal	Communication state of the related M-7053D
comm_ok2	Bool	Internal	Communication state of the related M-7045D
M7053DI_01 to M7053DI_16	Bool	Internal	Total 16 boolean internal variables D/I Ch. 1 to 16 of M-7053D
M7045DO_01 to M7045DO_16	Bool	Internal	Total 16 boolean internal variables D/O Ch. 1 to 16 of M-7045D

Project: One function block program + one Ladder program

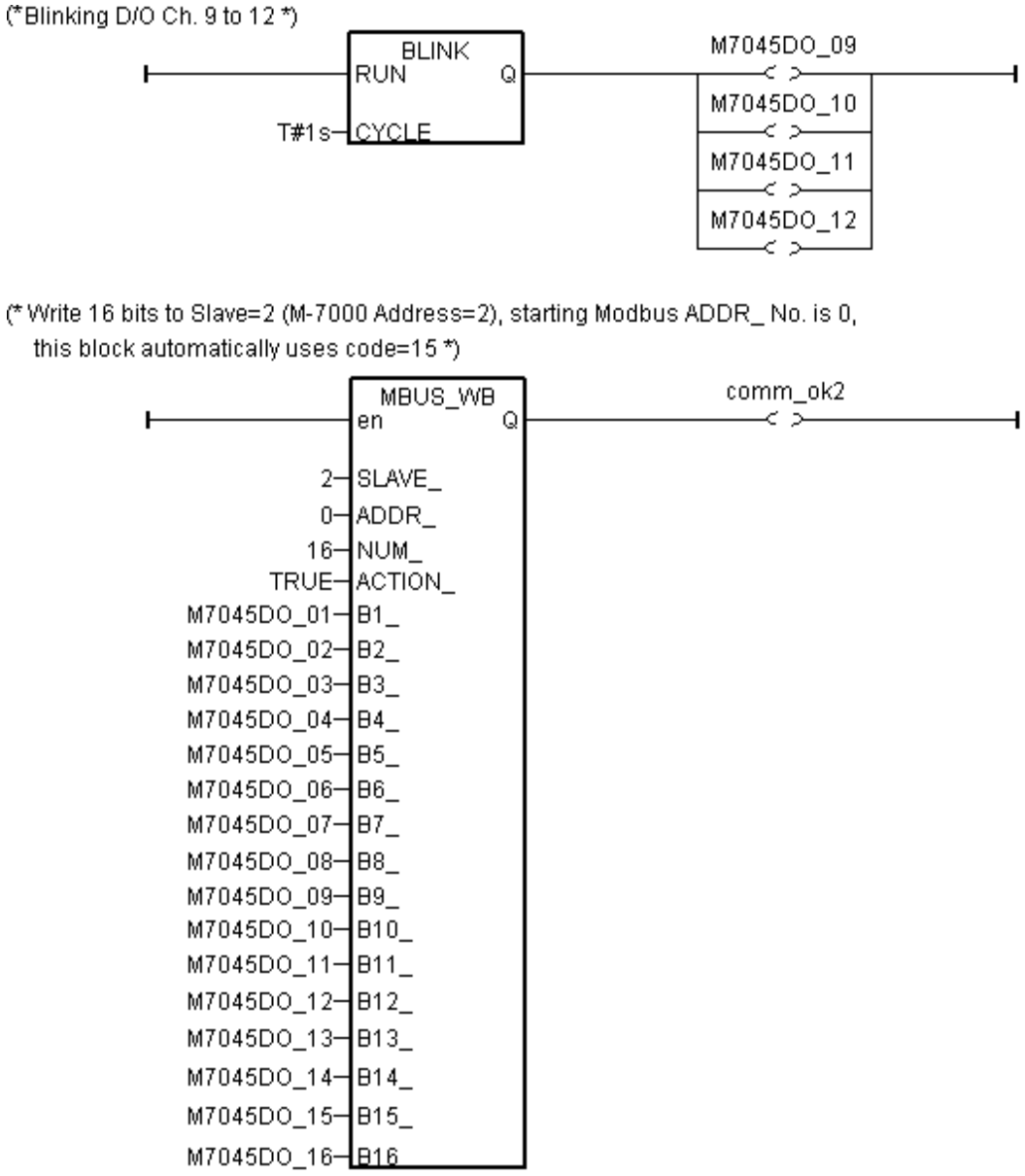


Function block program:

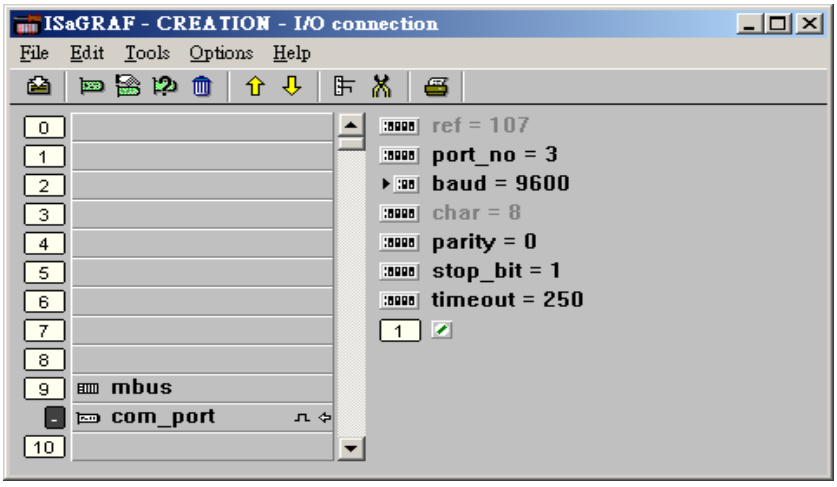


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Ladder Program:



I/O connection:



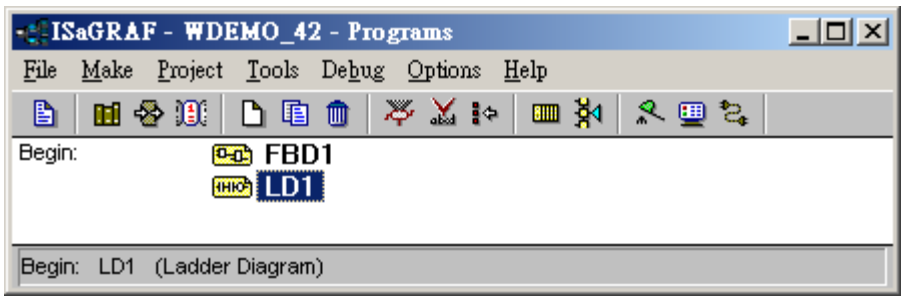
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Example 2: Connecting 1: M-7053D to get D/I counter value. (This example is “Wdemo_42”)

Variables:

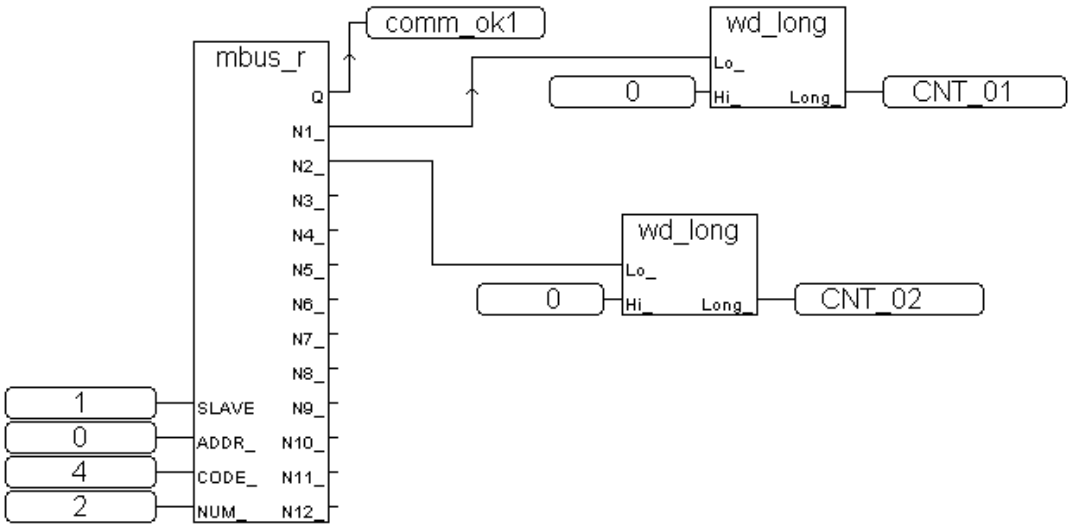
Name	Type	Attribute	Description
comm_ok1	Bool	Internal	Communication state of the related M-7053D
RS1	Bool	Internal	Set as True to reset Ch1. D/I counter value to 0
RS2	Bool	Internal	Set as True to reset Ch2. D/I counter value to 0
CNT_01	Integer	Internal	Ch1 D/I counter value
CNT_02	Integer	Internal	Ch2 D/I counter value

Project: One Function block program + one Ladder program



Function block program:

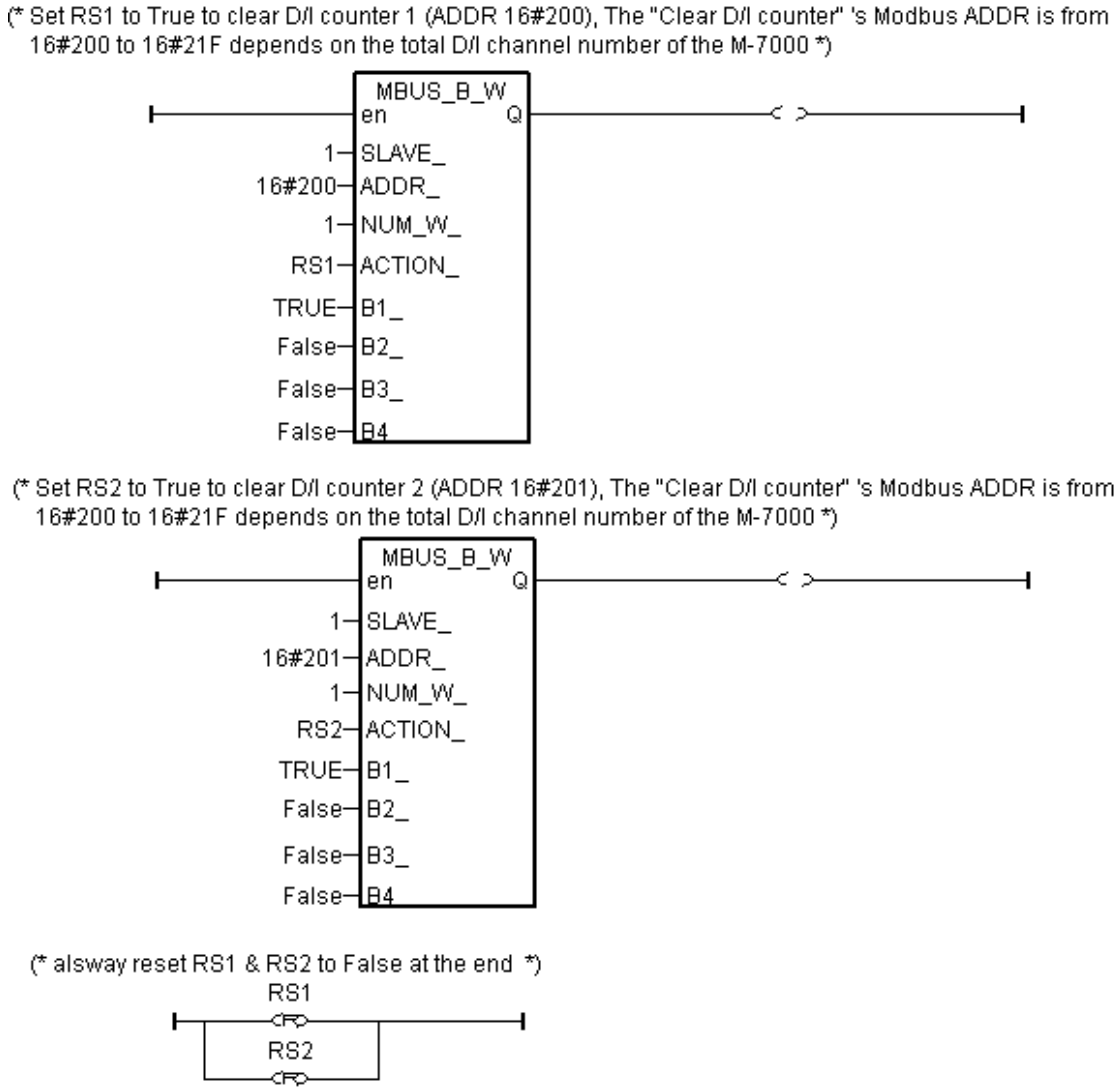
Using Code=4 to request M-7000 D/I counter value, Starting from Modbus ADDR No=0
NUM can be 1 to 12 depends on how many D/I counter channel in the M-7000 to be read
The M-7000 D/I counter value is from 0 ~ 65535 contained in one word.
Since Mbus_r & Mbus_r1 can only return word value as -32768 to +32767, so please use "wd_long" to convert this word to become a long integer value. Then the converted counter value will be 0 to 65535



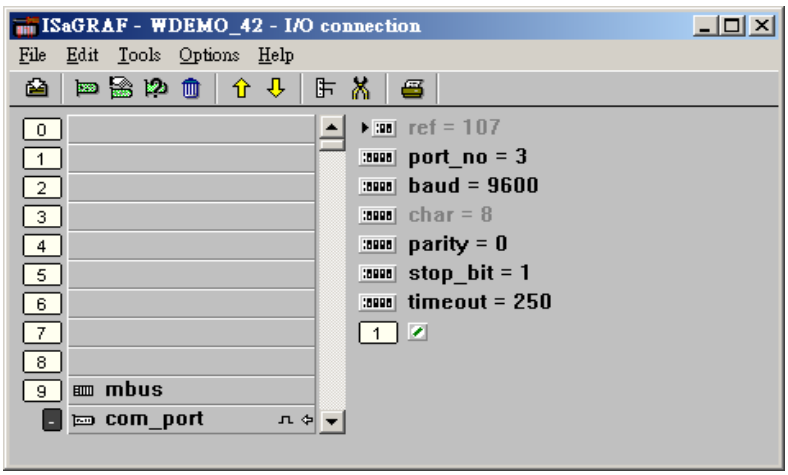
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To reset M-7000's D/I counter value to 0, please write bit value 1 (TRUE) to coil Modbus No. 16#200 to 16#21F. Reset Ch1. is to write to No. 16#200, Ch2 is 16#201, ..., Ch.32 is 16#21F.

Ladder Program:



I/O connection:



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Example 3: Connecting 1: M-7017R & 2: M-7024 (This example is “Wdemo_43”)

Please set M-7017R's Input range & Type to +/- 10V
M-7024 Output range & Type to +/- 10V

User may refer to the attatched manual in the product box, or visit http://www.icpdas.com/en/download/index.php?nation=US&kind1=&model=&kw=m-7000 to get each M-7000 Module's Manual to find their Analog I/O Value mapping to physical I/O (Type code setting).

Please refer to FAQ039 for using variable array.

Variables:

Name	Type	Attribute	Description
comm_ok1	Bool	Internal	Communication state of the related M-7053D
comm_ok2	Bool	Internal	Communication state of the related M-7045D
M_7017R[0..7]	Integer	Internal	**Variable Array** M-7017R's Analog Input value (-32768 to +32767) means (-10 to +10) V
M_7024[0..3]	Integer	Internal	**Variable Array** M-7024's Analog Output value (-16384 to +16383) means (-10 to +10) V
In_Val[0..7]	Integer	Internal	**Variable Array** Engineering value converted from M_7017R[0..7] (-32768 to +32767) converter to (-10000 to +10000)
Out_Val[0..3]	Integer	Internal	**Variable Array** Engineering value to be converted to M_7024[0..3] (-1000 to +1000) converter to (-16384 to +16383)
ii	Integer	Internal	index

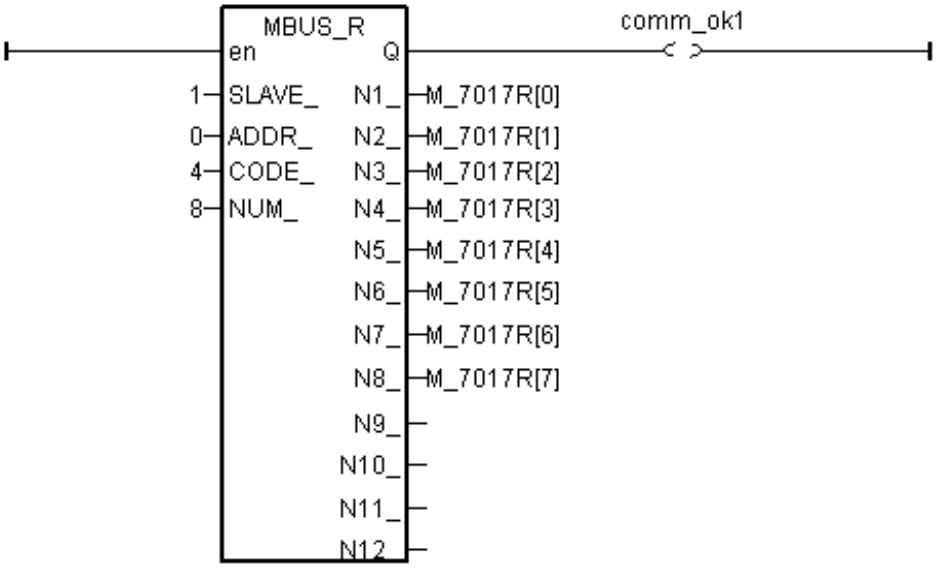
Project: One Ladder program + one ST program



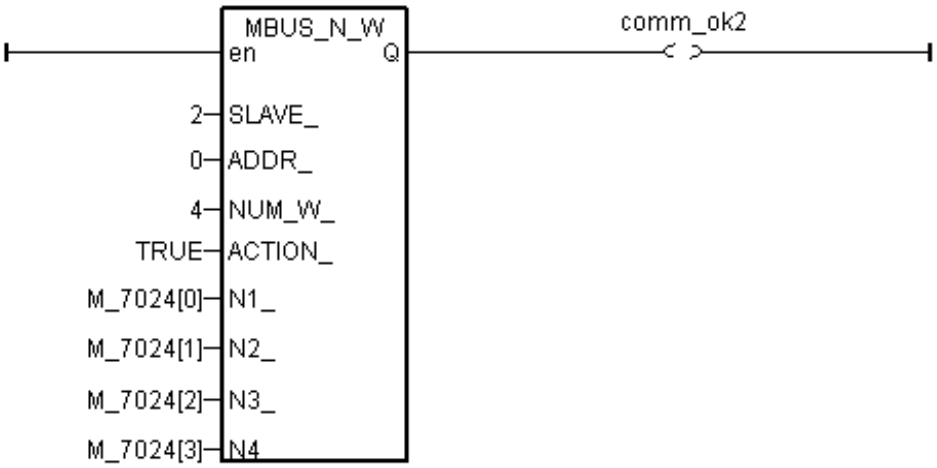
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Ladder program:

(* Read 8 words from Slave=1 (M-7000 Address=1) using code=4. starting Modbus ADDR No. is 0
Please set M-7017R's range to +/-10V by DCON utility (type code=8) *)



(* Write 4 words to Slave=2 (M-7000 Address=2) , starting Modbus ADDR No. is 0
Please set M-70124's range to +/-10V by DCON utility (type code=33) *)



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ST program:

```
(* Please configure this M-7017R as +/- 10V range (type code=8) *)
(* convert M-7017R's A/I value (-32768 to +32767) to become engineering value of (-10000 to
+10000) *)

for  ii  :=  0  to  7  do
  IN_Val[ii]  :=  Bin2Eng( M_7017R[ii] , 32767 , -32768 , 10000 , -10000 ) ;
end_for  ;

(* Please configure this M-7024 as +/- 10V range (type code=33) *)
(* convert   OUT_Val of (-1000 to +1000) to become M-7024's A/O value of (-16384 to +16383) *)

for  ii  :=  0  to  3  do
  if  OUT_Val[ii]  >  1000  then
    M_7024[ii]  :=  16383 ;

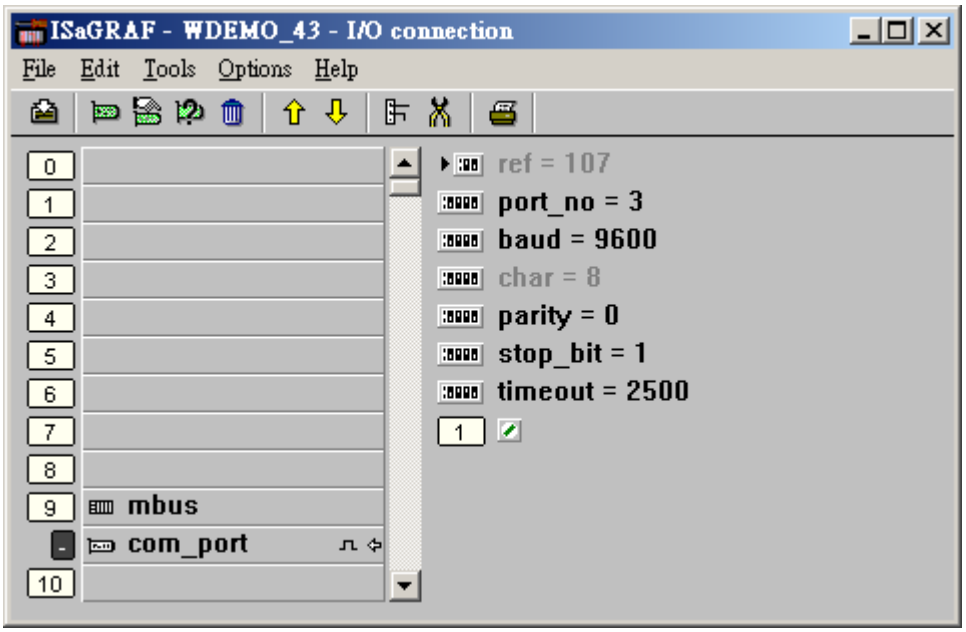
  elsif  OUT_Val[ii]  <  -1000  then
    M_7024[ii]  :=  -16384 ;

  elsif  OUT_Val[ii]  >=  0  then
    M_7024[ii]  :=  (OUT_Val[ii] * 16383) / 1000 ;

  elsif  OUT_Val[ii]  <  0  then
    M_7024[ii]  :=  (OUT_Val[ii] * -16384) / 1000 ;

  end_if ;
```

I/O connection:



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Example 4: Connecting 1: M-7017RC (This example is “Wdemo_44”)

Please set M-7017RC 's Input range & Type to +/- 20 mA

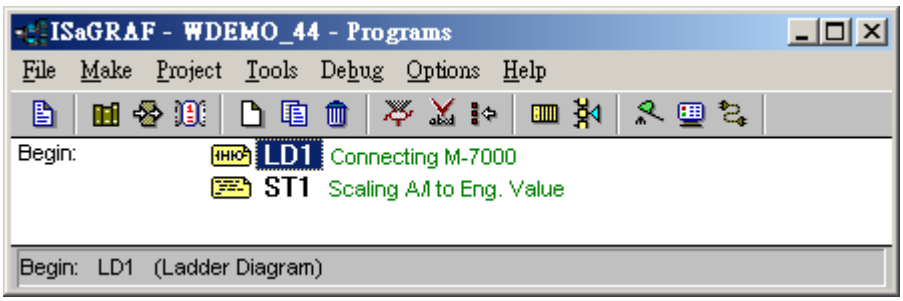
User may refer to the attatched manual in the product box, or visit http://www.icpdas.com/en/download/index.php?nation=US&kind1=&model=&kw=m-7000 to get each M-7000 Module's Manual to find their Analog I/O Value mapping to physical I/O (Type code setting).

Please refer to FAQ039 for using variable array.

Variables:

Name	Type	Attribute	Description
comm_ok1	Bool	Internal	Communication state of the related M-7053D
M7017RC[0..7]	Integer	Internal	**Variable Array** M-7017RC 's Analog Input value (-32768 to +32767) means (-20 to +20) mA if setting Input range & Type to +/- 20 mA
In_Val[0..7]	**REAL**	Internal	**Variable Array** (REAL format) Engineering value converted from M7017RC[0..7] 4 to 20 mA converting to (0.0 to 1000.0) psi
VAL[0..7]	Integer	Internal	**Variable Array** (Integer format) Engineering value converted from M7017RC[0..7] 4 to 20 mA converting to (0 to 10000), unit is 0.1 psi
ii	Integer	Internal	index

Project: One Ladder program + one ST program



Analog input Table of M-7017RC:

+/- 20 mA type (type code=16#D) : -32768 to +32767
4 to 20 mA type (type code=16#7) : 0 to +32767

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If the input sensor type is **4 to 20 mA**, it is better to set M-7017RC as **+/- 20 mA** type.
(It is not good to set M-7017RC as "4 to 20 mA" type.)

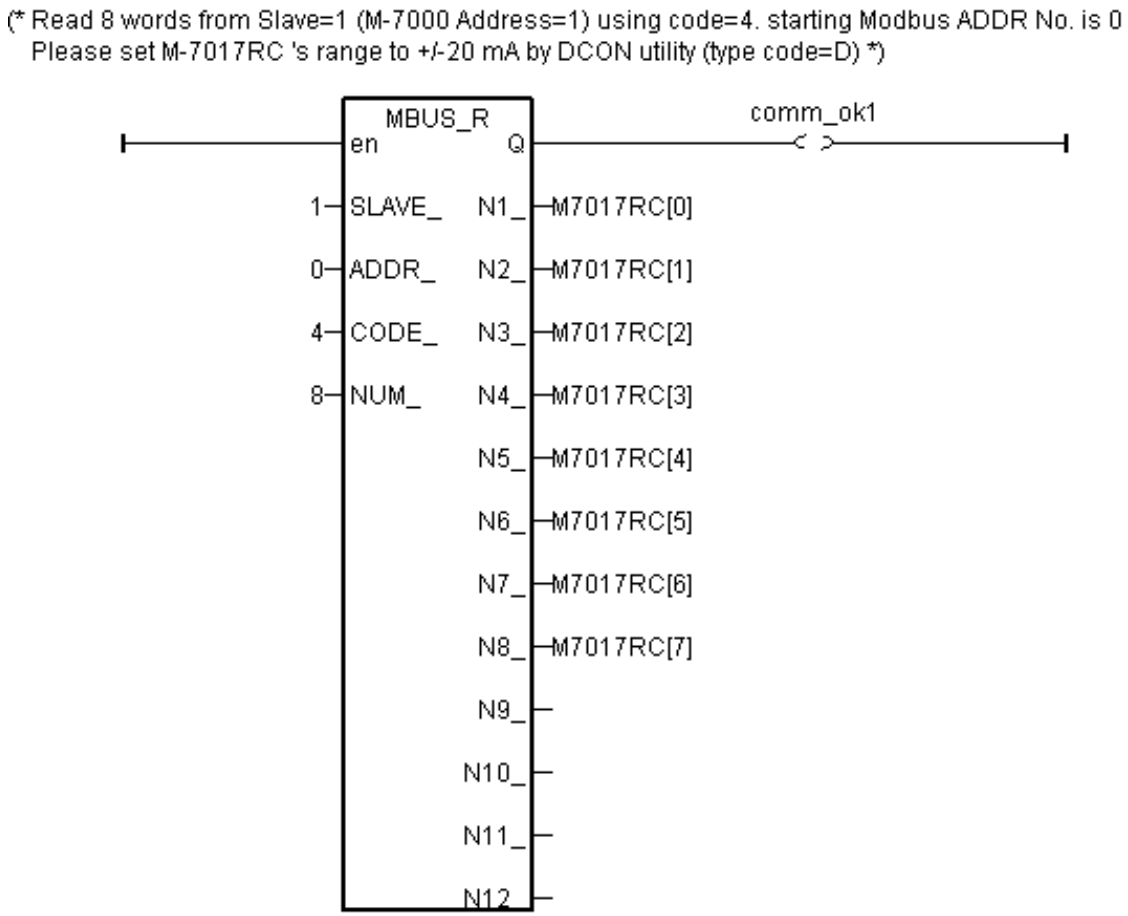
The reason is, when the sensor is broken, the analog input of M7017RC[0..7] will be near to 0.
If setting M-7017RC 's range type as 4 to 20 mA type, the value near 0 can mean 4 mA, and also can mean sensor broken. So no way to distinguish them.

However if setting M-7017RC as +/- 20 mA type, the value near 0 only means sensor broken if the communication of M-7017RC is well.

Because if sensor is well, the input is 4 to 20 mA, value should be (6553 to 32767).
Value near 0 means sensor broken if the communication of M-7017RC is well.

For safe reason, please set M-7017RC as +/- 20 mA type.
So you can say if the value of M7017RC[0..7] < 5000 "or < 4000" , then it means sensor broken.

One Ladder program:



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One ST program:

```
(* Please configure this M-7017RC as +/- 20 mA range (type code=D) *)
(* We will convert (4 , 20 mA) to become (0.0 , 1000.0 Psi), Real format    *)
for   ii   :=   0   to   7   do
   IN_Val[ii]   :=   A4_20_To( M7017RC[ii] , 16#D , 1000.0 , 0.0 );
end_for   ;

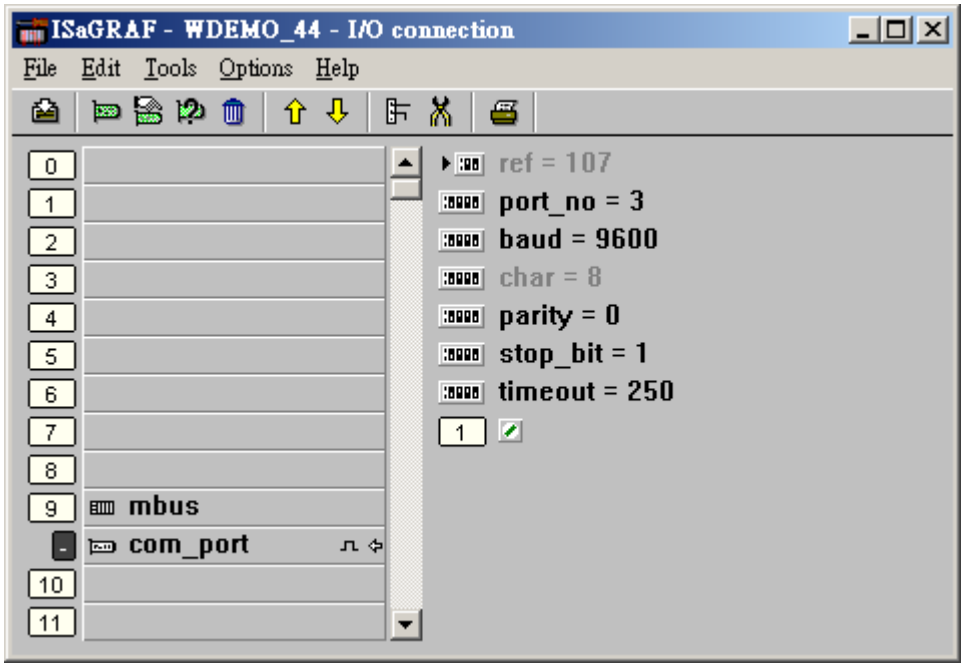
(* or you may use Bin2Eng( ) to convert (4 to 20mA) to become (0 to 10000), unit is 0.1 psi *)
(* Please declare Val[0..7] as Integer format *)
for   ii   :=   0   to   7   do
   Val[ii]   :=   Bin2Eng( M7017RC[ii] , 32767, 6553, 10000 , 0 ) ;
end_for   ;

(* You can do something if the sensor is broken or communication is break *)
if   comm_ok1 and ( M7017RC[ii] < 5000 ) then

   (* You may do someting if 4-20 mA sensor is broken *)
elsif   comm_ok1=False   then

   (* You may do someting if communication between PAC & M-7017RC is break *)
end_if ;
```

I/O connection:



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Example 5: Connecting 1: M-7019R to get temperature val (This example is “Wdemo_45”)

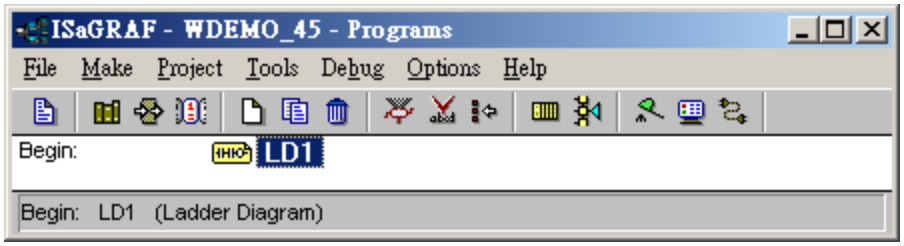
Please use DCON Utility to configure M-7019R's range & type to Thermocouple, K-Type (Type code=0F)

User may refer to the attatched manual in the product box, or visit http://www.icpdas.com/en/download/index.php?nation=US&kind1=&model=&kw=m-7000 to get each M-7000 Module's Manual to find their Analog I/O Value mapping to physical I/O (Type code setting).

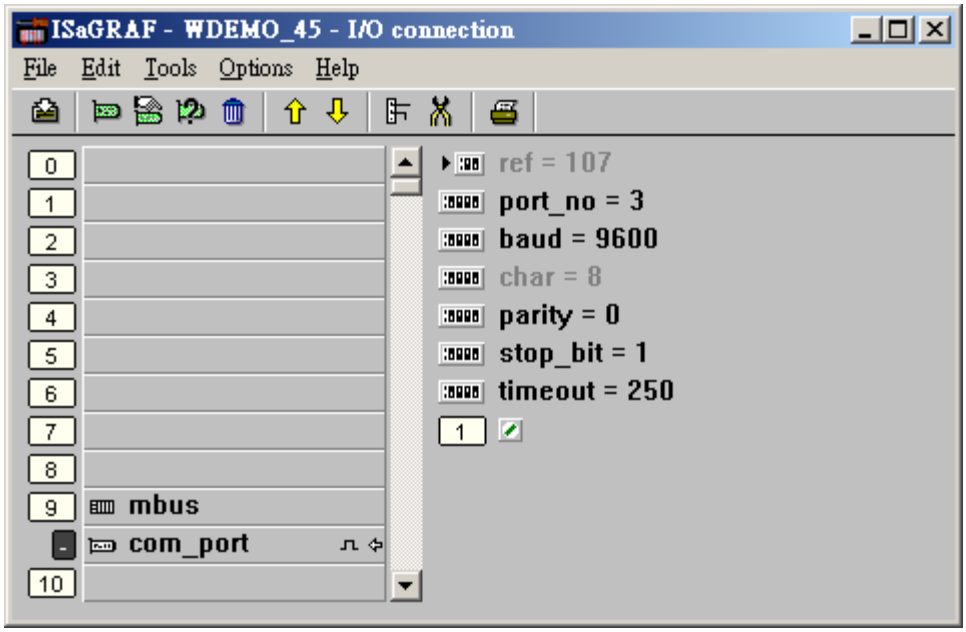
Variables:

Name	Type	Attribute	Description
comm_ok1	Bool	Internal	Communication state of the related M-7000
Temper_1 to Temper_8	Integer	Internal	Temperature input value of Ch1. To 8 of M-7019R

Project: One Ladder program

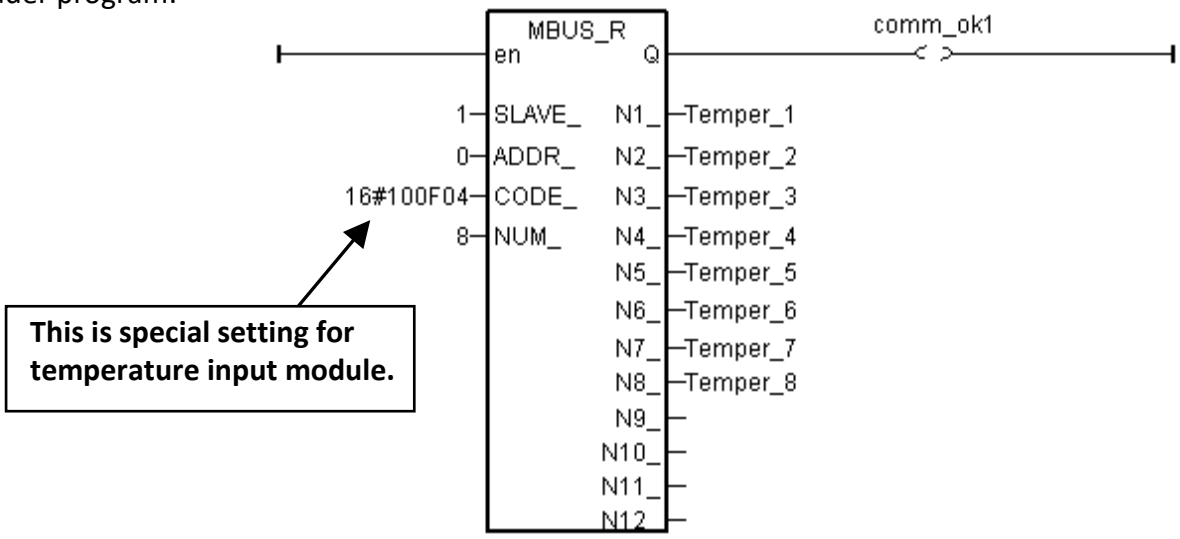


I/O connection:



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Ladder program:



The "CODE_" parameter of "MBUS_R" & "MBUS_R1" can be “standard” or “special” setting.

In the **“standard”** setting case,

Setting "CODE_" as 1 or 2 , each returned “N1_” to “N12_” contains 16-bits data (or 16 boolean)
Setting "CODE_" as 3 or 4 , each returned “N1_” to “N12_” is normally from –32768 to +32767.

The **“special”** setting case is for M-7000 temperature input modules like M-7015, M-7018R & M-7019R, Please set "CODE_" to a special value defined as below.

Format : **TTRRCC (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
CC : Modbus function code 1 to 4 of the related Modbus device

The temperature input value unit is 0.01 degree. For ex, if returned “3012”, it means 30.12 degree.
If returned 999990, it means “sensor broken line”. For example, setting "CODE_" as below to read the temperature value of M-7019:

A. 16#100F04 : (TT=10, RR=0F CC=04, Hex) the input value will be "Degree Celsius", unit is 0.01 degree, range= "0F: Thermocouple K Type, -270 ~1372 degree Celsius", code=04(Dec.). That results input value of "2356" = 23.56 Degree Celsius, "-489" = -4.89 Degree Celsius, "999990" = sensor broken-line.

B. 16#200F04 : (TT=20, RR=0F, CC=04, Hex)) the input value will be "Degree Fahrenheit ", unit is 0.01 degree, range= "0F :Thermocouple K Type, -270 ~1372 degree Celsius", code=04(Dec.). That results input value of "4512" = 45.12 Degree Fahrenheit,"500" = 5.00 Degree Fahrenheit, "999990" = sensor broken line.

C. 16#04 : (TT=00, RR=00, CC=04) standard setting, the input value will be , -32768 to +32767, code=4.

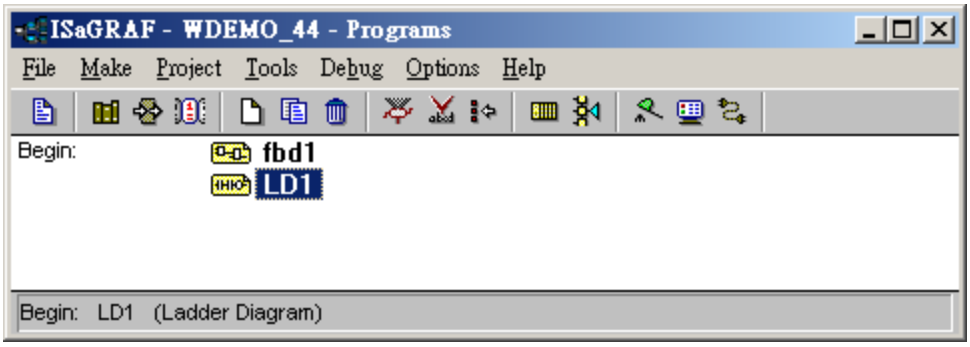
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Example 6: Connecting 1: M-7080-D to get counter value (This example is “Wdemo_46”)

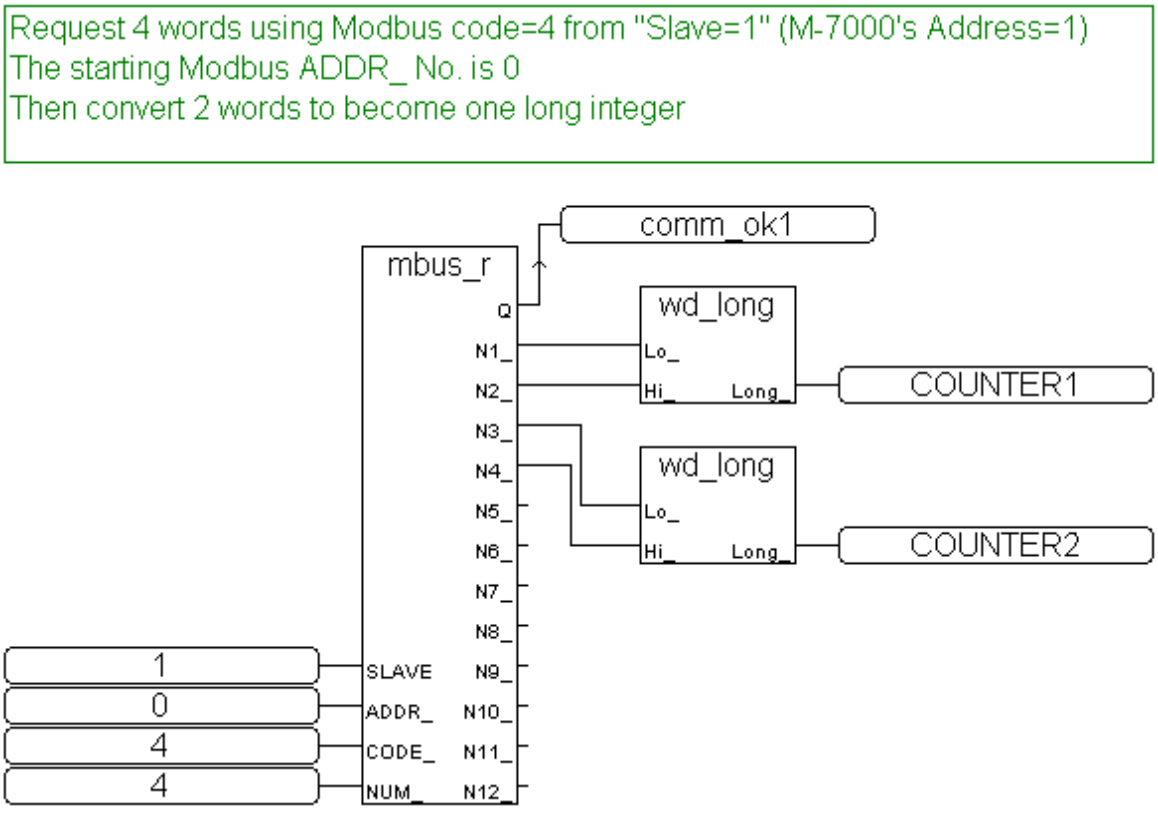
Variables:

Name	Type	Attribute	Description
comm_ok1	Bool	Internal	Communication state of the related M-7000
RS1	Bool	Internal	set as True to reset counter 1 as 0
RS2	Bool	Internal	set as True to reset counter 2 as 0
COUNTER1	Integer	Internal	1st Counter or frequency value of M-7080D
COUNTER2	Integer	Internal	1st Counter or frequency value of M-7080D

Project: One function block program + one Ladder program

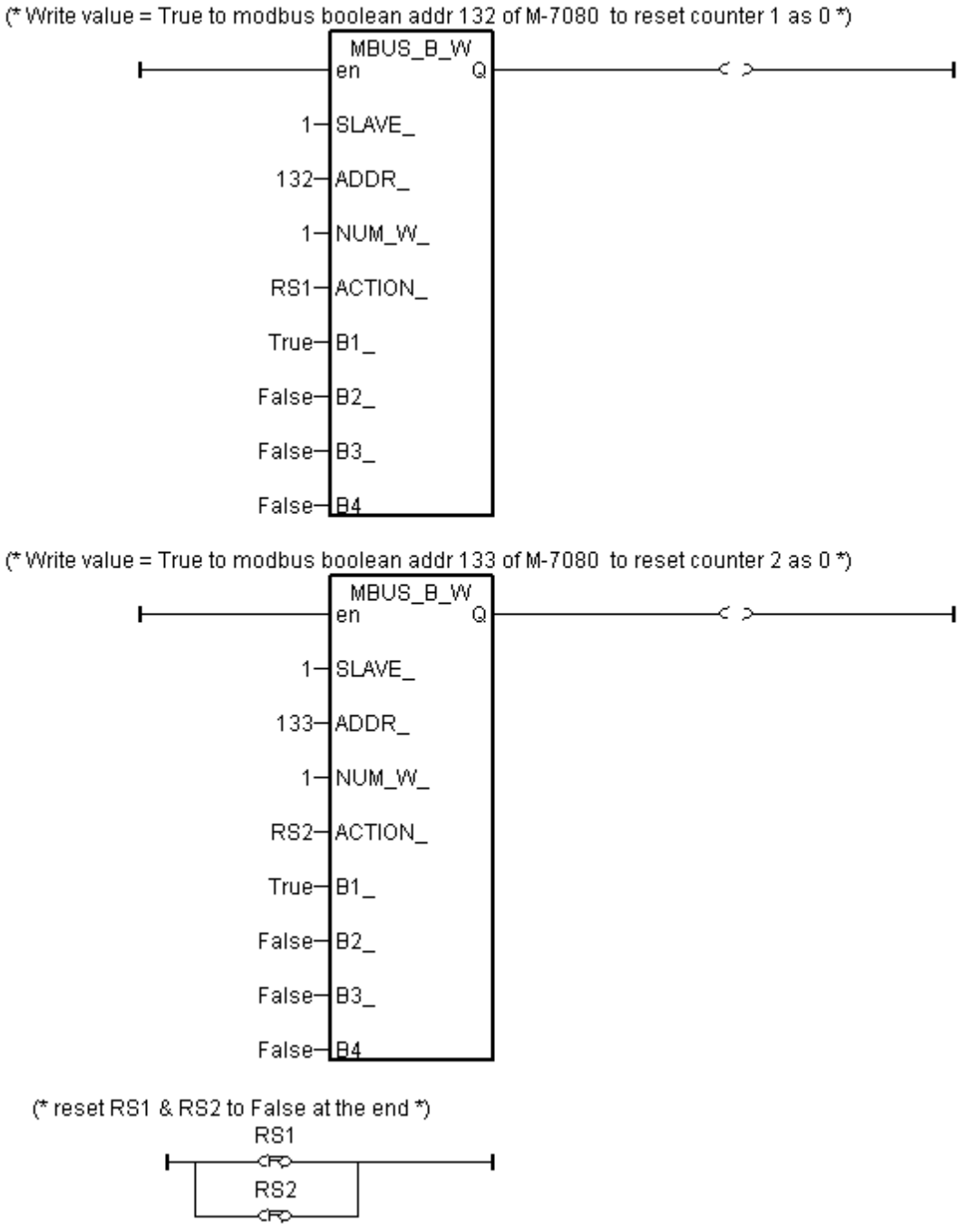


Function block program:



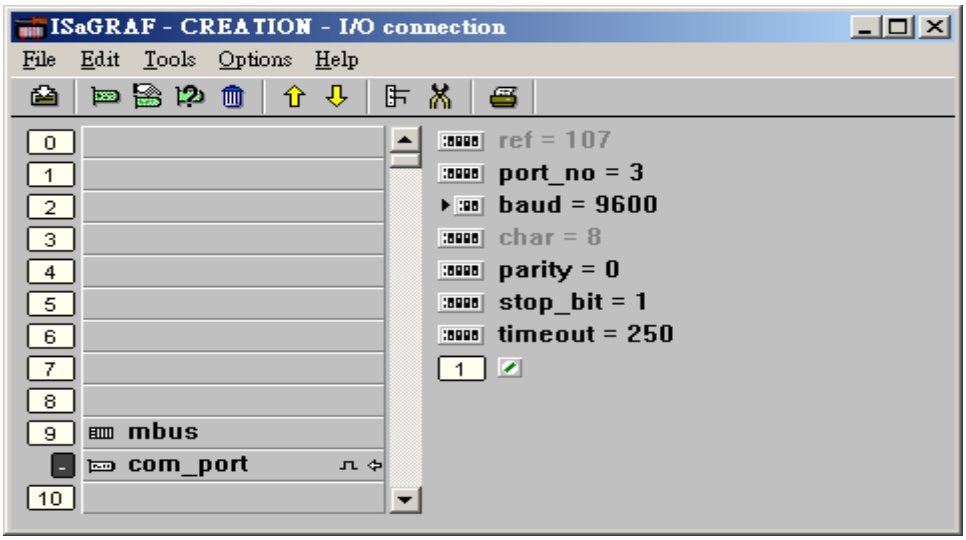
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Ladder program:



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I/O connection:



Download FAQ-050 Demo

Wdemo_41	COM3 connecting 1: M-7053D (16-Ch. D/I) + 2: M-7045D (16-Ch. D/O)
Wdemo_42	COM3 connecting 1: M-7053D to get D/I counter value (16-bit, 0- 65535)
Wdemo_43	COM3 connecting 1: M-7017R (8-Ch. A/I) + 2: M-7024 (4-Ch. A/O)
Wdemo_44	COM3 connecting 1: M-7017RC (8-Ch. Current Analog Input)
Wdemo_45	COM3 connecting 1: M-7019R (8-Ch. Universal A/I, thermocouple or voltage input or current input) to get temperature value
Wdemo_46	COM3 connecting 1: M-7080 (2-Ch counter or frequency)

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

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