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Configuring a Mitsubishi PLC CC-Link Network

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Introduction

AcraDyne Gen IV Controllers are available with CC-Link (Version 1 and 2) communication capability. As such, they can be implemented as Remote Device Stations on a CC-Link network and supervised by a Master Station for error proofing and data collection. This document is intended to explain the steps involved in configuring a Mitsubishi Melsec Q-Series PLC for communication with an AcraDyne Gen IV Controller via CC-Link network.

Equipment/Software

- CC-Link capable controller from AIMCO.
  - AcraDyne Gen IV Controller ().
  - Anybus CC-Link Slave Module (AB6211).
- Mitsubishi Melsec Q-Series PLC (Base Unit, Power Supply, CPU)
- Mitsubishi QJ61BT11N CC-Link Master Module.
- GX Developer, Version 8
- USB to RS-232 mini-DIN 6 cable (USB-QC30R2 Programming Cable)
- CC-Link Data Cable

Initial Setup

- Connect the PC to the PLC's RS-232 port via the Programming Cable.

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- Connect the CC-Link Master Module to the Anybus CC-Link Module in the Gen IV Controller
- Power-on the PLC and the Gen IV Controller

Configuring the Gen IV Controller

The CC-Link connection parameters for the Gen IV Controller depend on the assigned ANYBUS Inputs and Outputs. **Therefore, the ANYBUS Inputs and Outputs should be configured prior to configuring the connection parameters.**

From the Home screen on the Gen IV Controller, navigate to the ANYBUS Configuration screen. [Controller] -> [Communication Interface] -> [ANYBUS]

Set the station number, baud rate, and CC-Link version. Then click the green check mark to save the settings.

Wait approximately 20 seconds for the Gen IV Controller's CC-Link module to reboot, then navigate to the ANYBUS Configuration screen again and take note of the number of occupied stations and extension cycles. (For CC-Link version 1, the number of extension cycles is always one.) You will need these values to configure the station information in GX Developer. The tables on the next page show how many stations and extension cycles the Gen IV Controller will occupy based on number of ANYBUS Input/Output words.

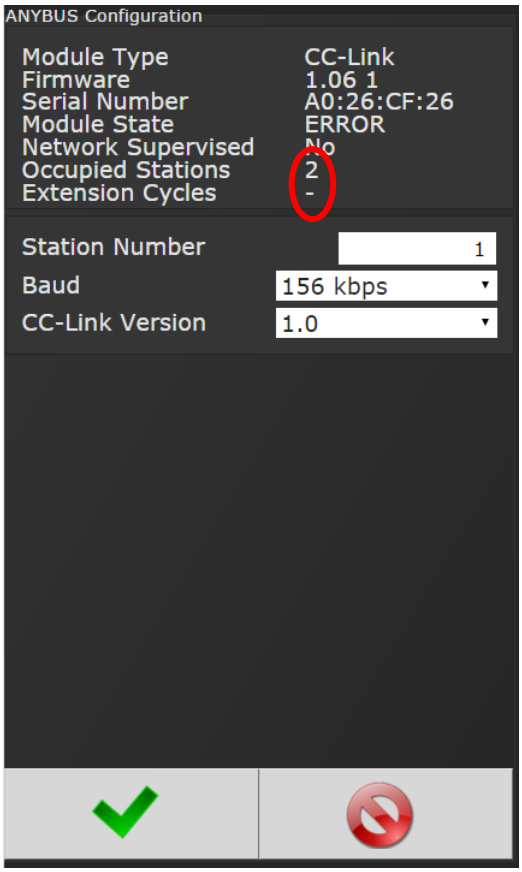

Figure 1. CC-Link ANYBUS Configuration Screen

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Table 1 – Stations Required by Gen IV Controller with CC-Link Version 1.

CC-Link Version 1		Input Words(16-bit)				
		0-4	5-8	9-12	13-16	17-20
Output Words (16-bit)	0-3	1 station	2 stations	3 stations	4 stations	5 stations
	4-7	2 stations	2 stations	3 stations	4 stations	5 stations
	8-11	3 stations	3 stations	3 stations	4 stations	5 stations
	12-15	4 stations	4 stations	4 stations	4 stations	5 stations
	16-19	5 stations	5 stations	5 stations	5 stations	5 stations

Table 2 – Stations and Expansion Cycles Required by Gen IV Controller with CC-Link Version 2.

CC-Link Version 2		Input Words (16-bit)						
		0-4	5-8	9-16	17-32	33-64	65-96	97-128
Output Words (16-bit)	0-3	1 station 1 cycle	1 station 2 cycles	1 station 4 cycles	1 station 8 cycles	2 station 8 cycles	3 stations 8 cycles	4 stations 8 cycles
	4-7	1 station 2 cycles	1 station 2 cycles	1 station 4 cycles	1 station 8 cycles	2 stations 8 cycles	3 stations 8 cycles	4 stations 8 cycles
	8-15	1 station 4 cycles	1 station 4 cycles	1 station 4 cycles	1 station 8 cycles	2 stations 8 cycles	3 stations 8 cycles	4 stations 8 cycles
	16-31	1 station 8 cycles	1 station 8 cycles	1 station 8 cycles	1 station 8 cycles	2 stations 8 cycles	3 stations 8 cycles	4 stations 8 cycles
	32-63	2 stations 8 cycles	2 stations 8 cycles	2 stations 8 cycles	2 stations 8 cycles	2 stations 8 cycles	3 stations 8 cycles	4 stations 8 cycles
	64-95	3 stations 8 cycles	3 stations 8 cycles	3 stations 8 cycles	3 stations 8 cycles	3 stations 8 cycles	3 stations 8 cycles	4 stations 8 cycles
	96-127	4 stations 8 cycles	4 stations 8 cycles	4 stations 8 cycles	4 stations 8 cycles	4 stations 8 cycles	4 stations 8 cycles	4 stations 8 cycles

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Configuring the PLC

Open the GX Developer software and start a New Project. *[Project] -> [New project…]*

In the New Project dialogue window, select the appropriate PLC series and type as shown in Figure 2. For this example, we are using a Q00JCPU PLC. You can also name the project at this point by checking the "Setup project name" box and choosing a name and title for the project.

Click 'OK' when finished. You may receive a message stating the project does not exist and asking if you would like to create it. Click "Yes".

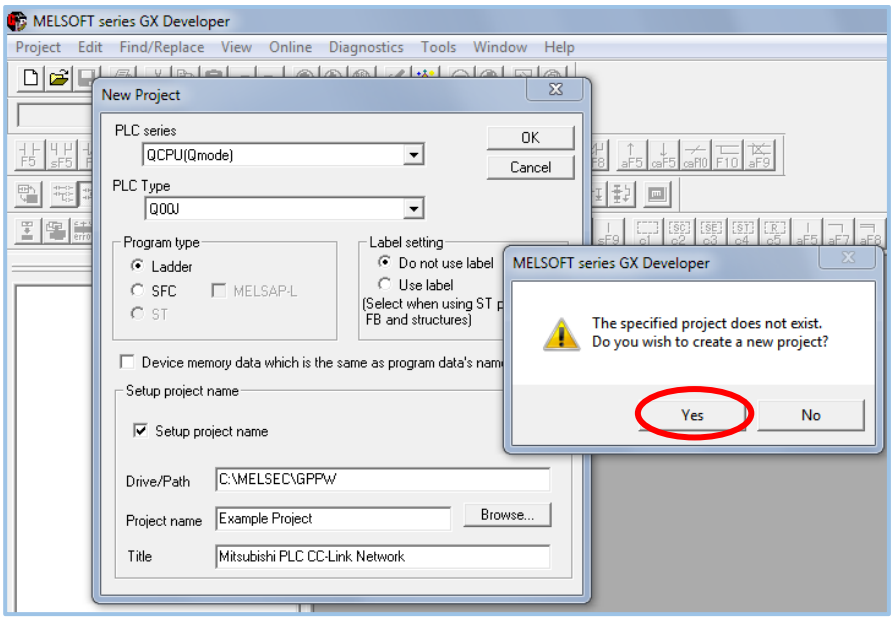

Figure 2. Configure PLC series and type.

Next, expand the "Parameter" item in the Project Data List on the left side of the screen and double-click "Network param." Then click the "CC-Link" button shown in Figure 3.

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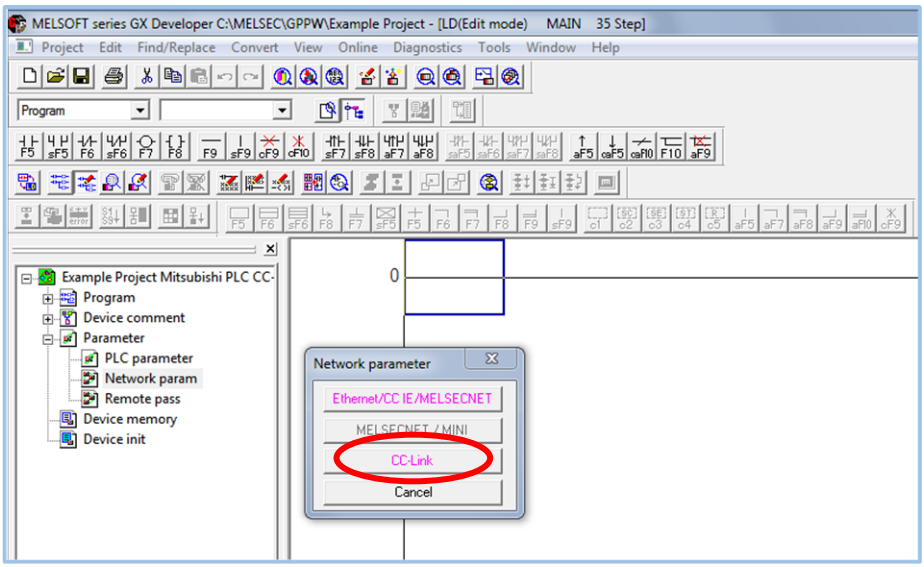

Figure 3. Navigate to CC-Link configuration screen.

On the CC-Link Network Parameters screen shown below in Figure 4, specify the network parameters. Be sure to select the “No. of board in module”

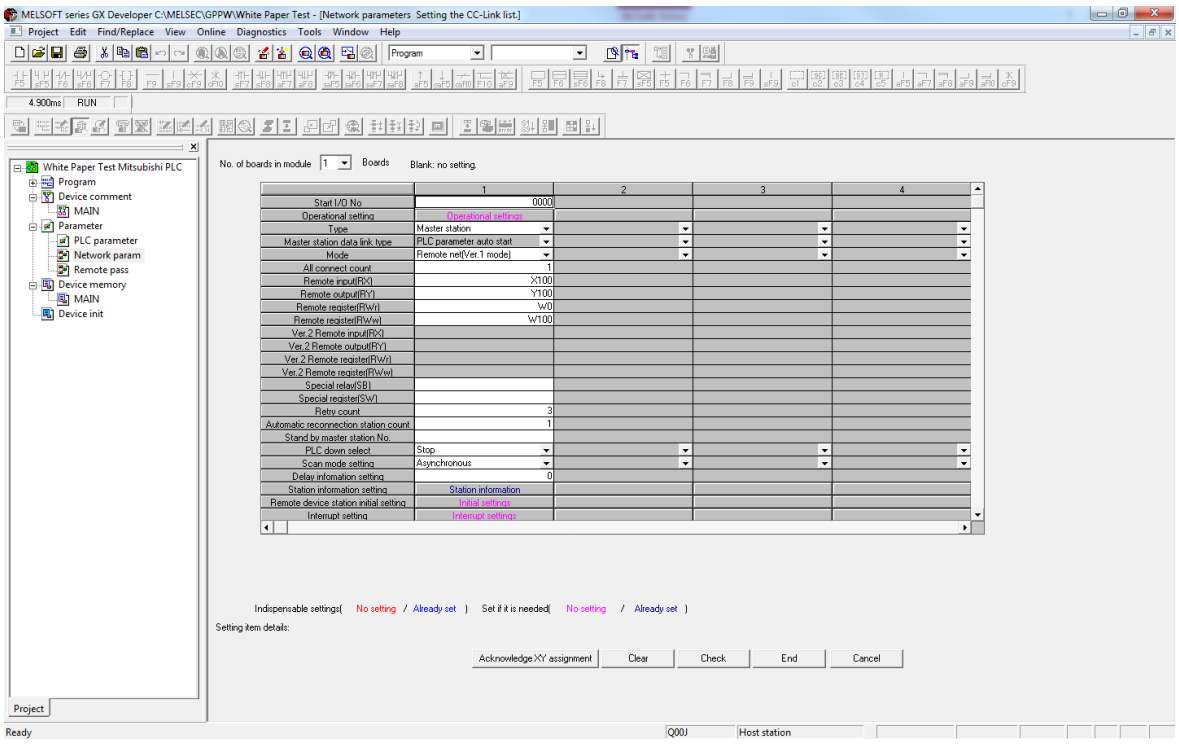

Figure 4. Configure CC-Link network parameters.

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No. of boards in module refers to the number of Master/Local modules on base unit – in this example we have one Master module.

Start I/O No is the first I/O point of the CC-Link Master module. The Master is in slot 0 in this case, and has 32 I/O points, so it occupies I/O points 0 – 1F (hex). If the Master module were in a different slot, the default start I/O number would be different.

Type determines the function of the module on the network (Master, Local, Standby Master) and must set to *Master station*.

Mode must be set to the appropriate version for your CC-Link network – *Remote net(Ver. 1 mode)* or *Remote net(Ver. 2 mode)*. AcraDyne Gen IV Controllers are compatible with CC-Link versions 1 and 2.

All connect count is the total number of Remote Devices connected to this Master Station. The network in this example consists of the Master and 1 Remote Device.

Remote input(RX) is the offset for the CC-Link Remote Input data (Slave -> Master, bit data). The Gen IV Controller does not utilize Remote I/O data other than for handshaking. Set this parameter to a value that does not conflict with any other I/O devices on the CC-Link network. For this example we will set it to X100.

Remote output(RY) is the offset for the CC-Link Remote Output data (Master -> Slave, bit data). The Gen IV Controller does not utilize Remote I/O data other than for handshaking. Set this parameter to a value that does not conflict with any other I/O devices on the CC-Link network. For this example we will set it to Y100.

Remote register(RWr) is the offset for the CC-Link Remote Read register (Slave -> Master, word data). For this example we will set it to W0.

Remote register(RWw) is the offset for the CC-Link Remote Write register (Master -> Slave, word data). For this example we will set it to W100.

Station information setting is where the parameters for each slave station are configured. Click on *Station information* as shown in Figure 5 below.

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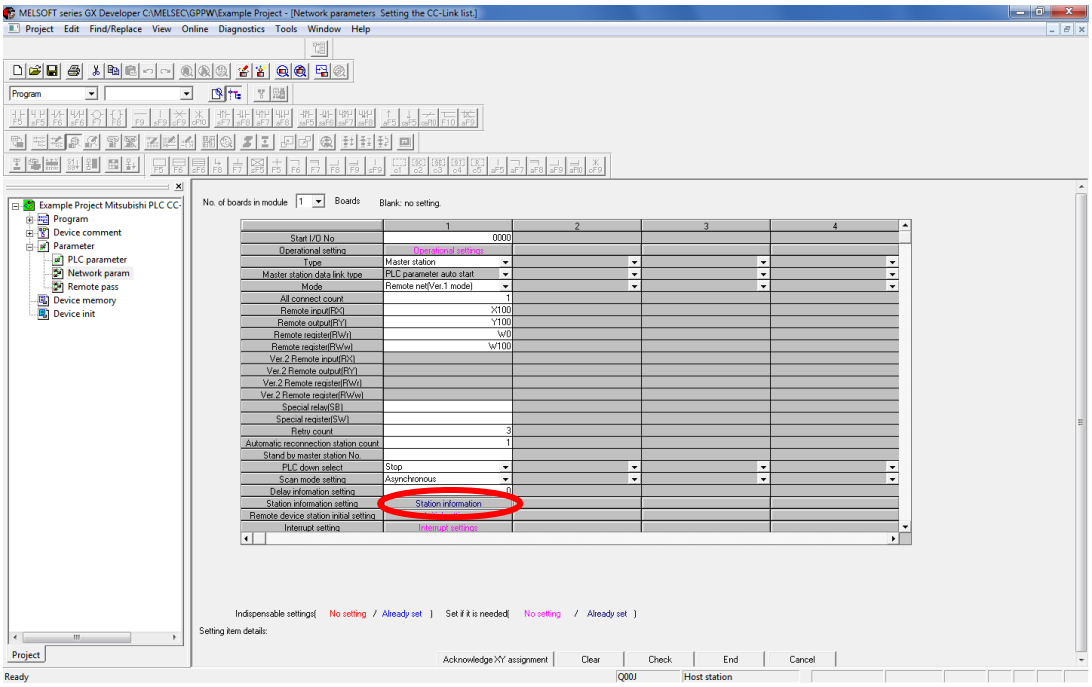

Figure 5

This will bring up the Station Information window as shown below in Figure 6.

The **Station type** for a Gen IV on a CC-Link network is Remote device station.

The next two parameters, **Expanded cyclic setting** and **Exclusive station count**, must be set to the values determined when configuring the Gen IV Controller. For CC-Link version 1, the **Expanded cyclic setting** will always be single.

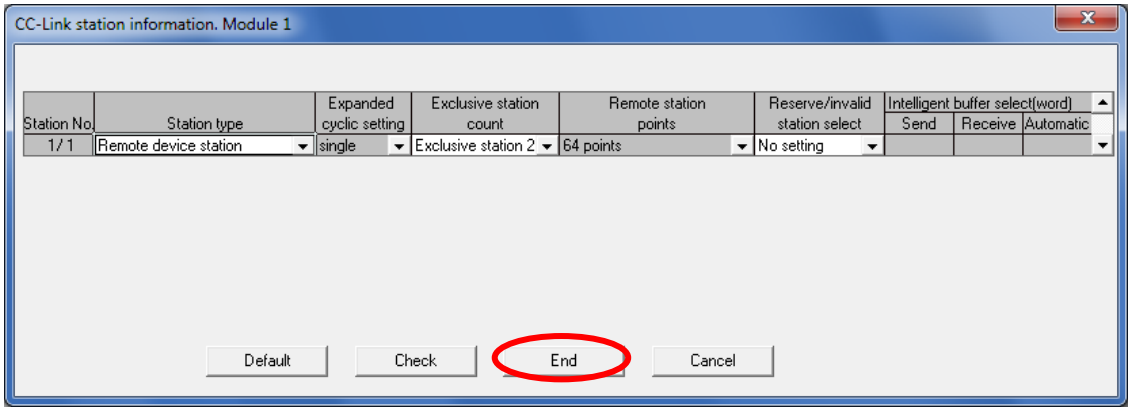

Figure 6. Configure station information.

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Click end on the Station Information window to save the settings. Click end again on the CC-Link Configuration screen. You may have to scroll down to see the button.

PLC Handshaking

The Gen IV Controller requires handshaking with the PLC over CC-Link network. There are differences in how the handshaking must be carried out between CC-Link version 1 and version 2. This process is described below for each CC-Link version.

CC-Link Version 1

The handshaking area is offset in memory according to the following formula:

(Formula 1)

$$HAO = Remote\ input(RX) + ((m+n)*10\ \text{Hex})$$

Where *HAO* is the Handshake Area Offset, *Remote input(RX)* is the value set on the Network Parameters screen (100 Hex in this example), and *m* and *n* are determined as follows:

$$m = (station\ number - 1) * 2$$

$$n = (\#\ of\ occupied\ stations * 2) - 1$$

In this example, the *station number* is 1 and the *# of occupied stations* is 2, so *m* and *n* are 0 and 3, respectively. When these values are plugged back into Formula 1, we get a Handshaking Area Offset of 130 Hex.

The handshaking area is structured as shown in Table 3 for CC-Link Version 1.

Table 3 – Handshaking area: CC-Link Version 1.

Bit	Slave -> Master (RX)	Master -> Slave (RY)
0 – 7	Reserved	Reserved
8	Initial data processing request flag	Initial data processing complete flag
9	Initial data setting complete flag	Initial data setting request flag
A	Error status flag	Error reset request flag
B	Remote READY	Reserved
C – F	Reserved	Reserved

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With this knowledge, we can write a short PLC program to handle the handshaking process. An example program is shown in Figure 7. Be sure that GX Developer is in "Write mode".

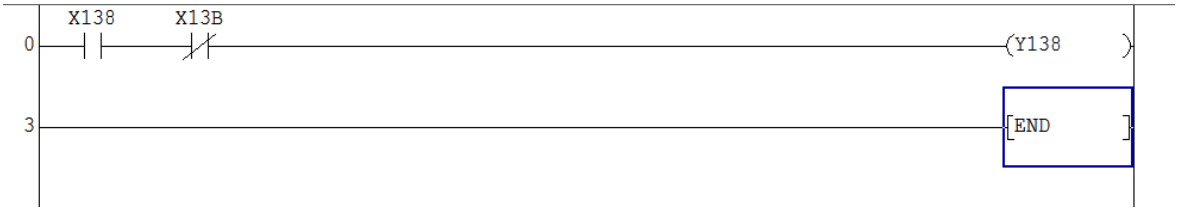

Figure 7. Example PLC program to handle handshaking process. (CC-Link ver. 1)

If the 'initial data processing request flag' is set and the 'Remote READY' flag is cleared, the PLC will set the 'initial data processing complete flag'. The 'Remote READY' flag will then be set by the slave module and handshaking is complete.

CC-Link Version 2

The handshaking area is offset in memory according to the following formulae:

If the number of extension cycles is 1:

(Formula 2)

HAO = Remote input(RX) + (*# of occupied stations* * 20 Hex) - 10 Hex

If the number of extension cycles is 2 or greater:

(Formula 3)

HAO = Remote input(RX)

+ (((*# of occupied stations* * 20 Hex) - 10 Hex) * *# of extension cycles)* - 10 Hex

For example, if the # of occupied stations is 1 and the # of extension cycles is 2, using Formula 3 we would find that Handshaking Area Offset is equal to 110 Hex.

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The handshaking area is structured as shown in Table 4 for CC-Link Version 2.

Table 4 – Handshaking area: CC-Link Version 2.

Bit	Slave -> Master (RX)	Master -> Slave (RY)	
0 – 7	Reserved	Reserved	
8	Initial data processing request flag	Initial data processing complete flag	
9	Initial data setting complete flag	Initial data setting request flag	
A	Error status flag	Error reset request flag	
B	Remote READY	Reserved	
C – F	Reserved	Reserved	

With this knowledge, we can write a short PLC program to handle the handshaking process. An example program is shown in Figure 8.

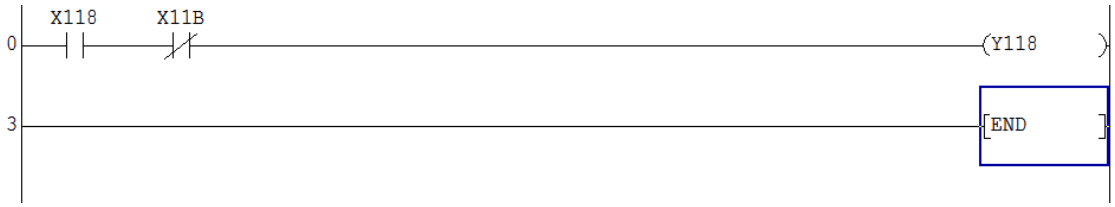
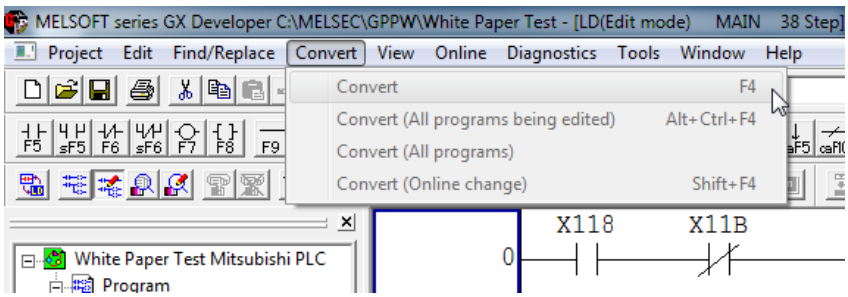


Figure 8. Example PLC program to handle handshaking process. (CC-Link ver. 2)

If the 'initial data processing request flag' is set and the 'Remote READY' flag is cleared, the PLC will set the 'initial data processing complete flag'. The 'Remote READY' flag will then be set by the slave module and handshaking is complete.

When finished, select "Convert" and click "Convert".



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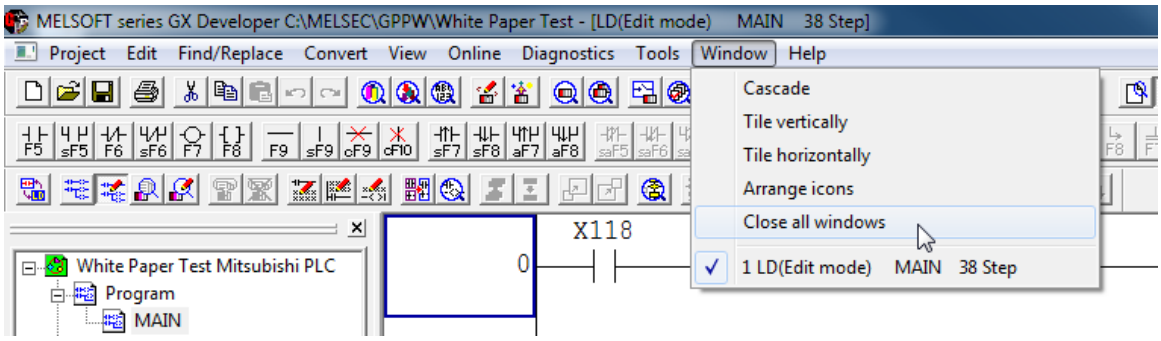
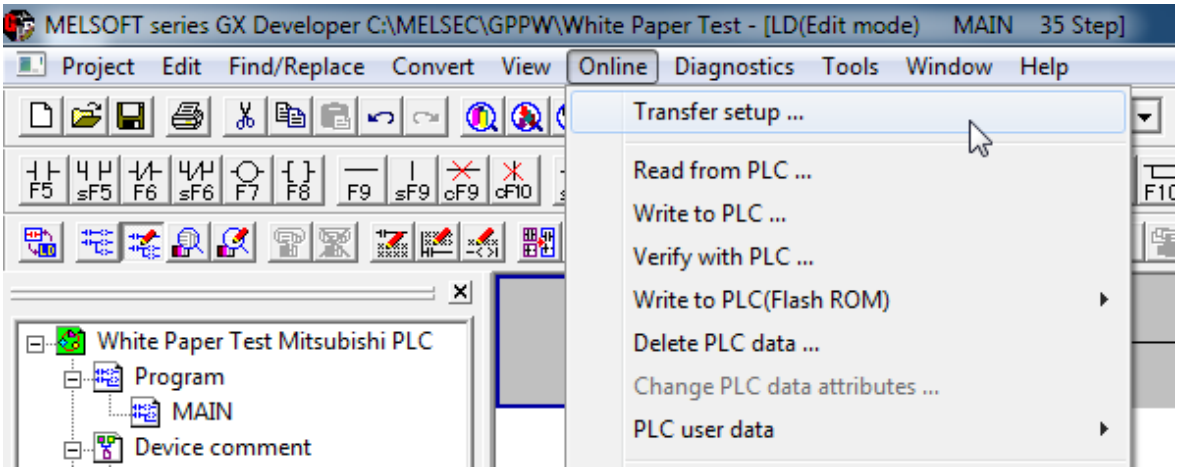
PLC Programming

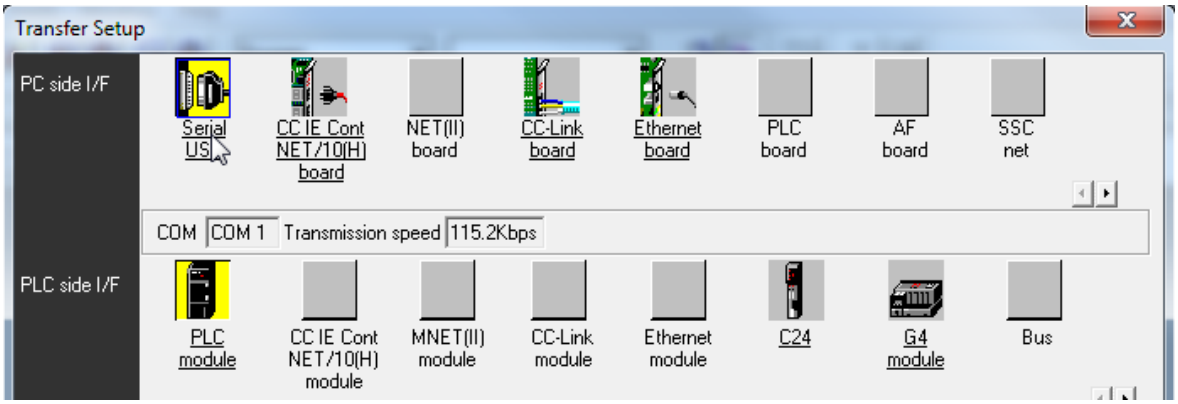
Close all Windows before proceeding to the next steps. This is done under the “Windows” option.



Select the proper COM port for the PLC. To do this, select “Online”→”Transfer Setup …”



Double click on “Serial USB” to configure the COM port and Transmission speed



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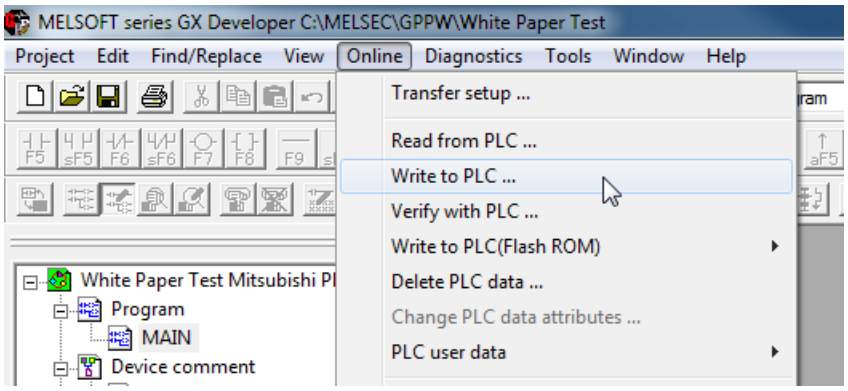
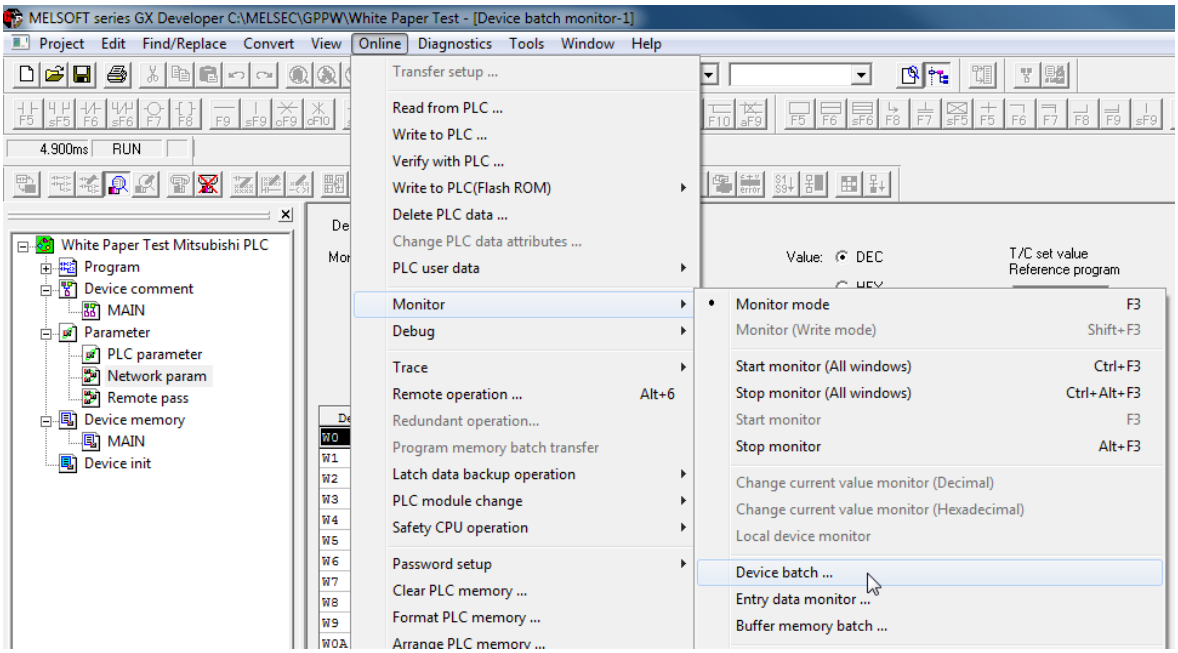
To write a program to the PLC, select “Online”→”Write to PLC …”



Once the program has been written to the PLC, the user can monitor the traffic between the master and slave modules. To do so, navigate to “Online”→”Monitor”→”Device Batch …”



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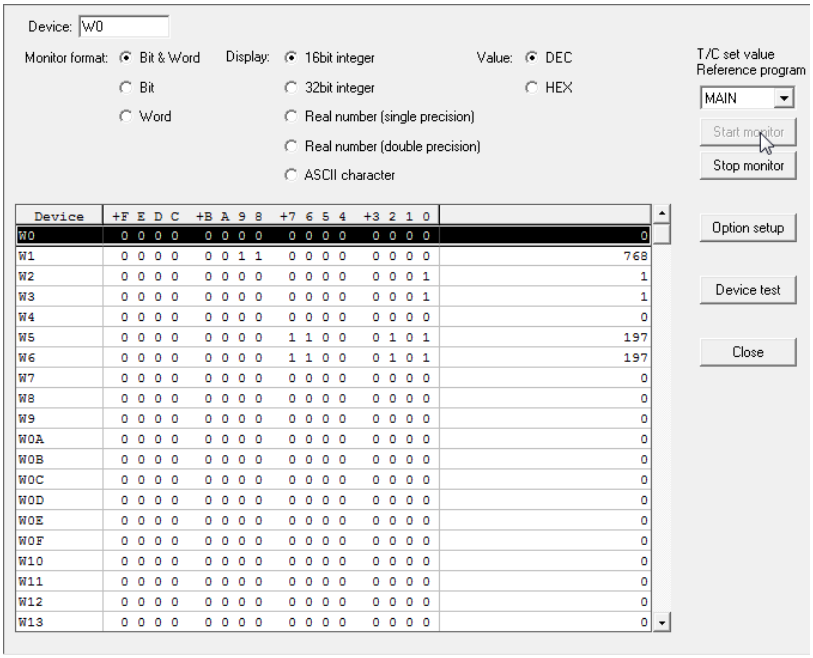
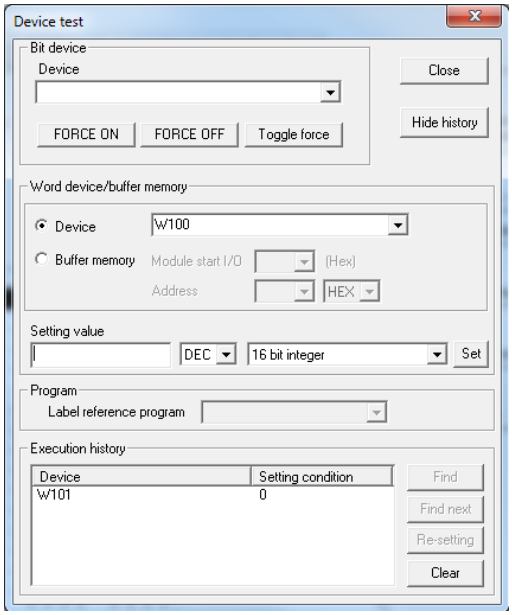
Enter “W0” into the “Device” field to view the controller’s transmitted data (slave to master). Click the “Start monitor” button to see live data. In this example we see the default I/O settings.



To view the controller’s received data (master to slave), simply enter “W100” into the “Device” field and click the “Start monitor” button. In this example, we will manually transfer data to the controller. Double click on the first device and the following menu will appear.



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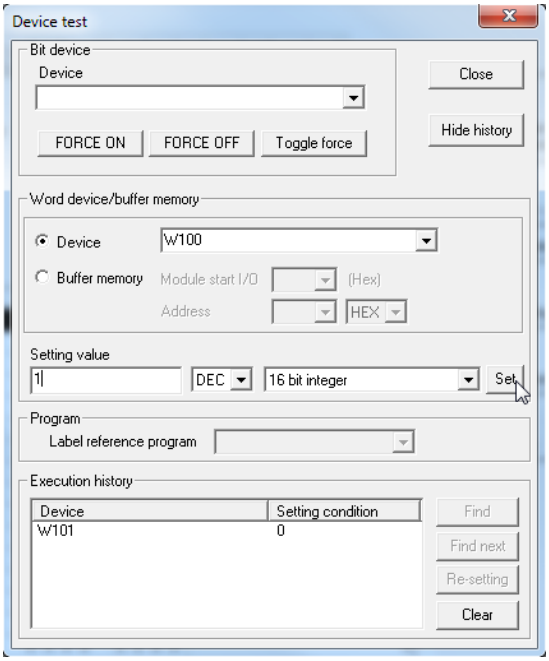
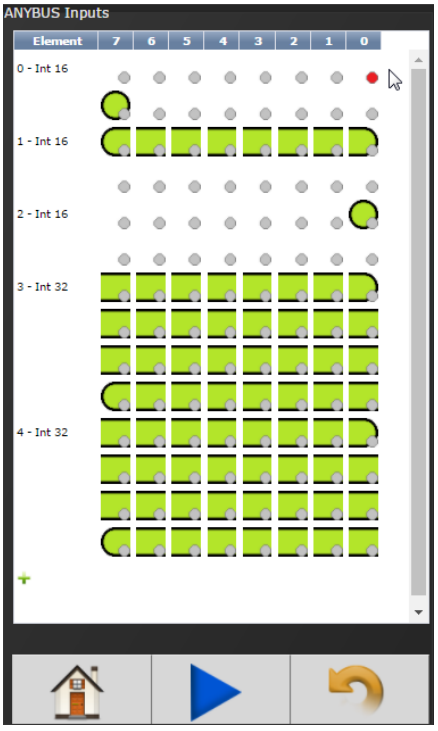
Change the “Setting value” to any decimal value (this example will use 1) and click “Set”



The first bit should appear red on the “ANYBUS Inputs” web screen



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ANYBUS Default Inputs							
Element	**Bit**						
	7	**6**	**5**	**4**	**3**	**2**	**1**
0 - Int 16							
	Stop						
1 - Int 16	Select Job						
2 - Int 16							Reset Job
3 - Int 32	Set ID						
4 - Int 32	Set Date/Time						

ANYBUS Default Outputs							
Element	**Bit**						
	7	**6**	**5**	**4**	**3**	**2**	**1**
0 - Int 16				Angle High	Angle Low	Torque High	Torque Low
1 - Int 16							
						Error (N.C)	Tool Enabled
2 - Int 16		External Controlled		Job Complete		NOK	OK
3 - Int 16							OK
4 - Int 16	Torque (x10)						
5 - Int 16	Angle						
6 - Int 16	Angle						