PLC COMMUNICATIONS

In This Chapter...

Introduction

This chapter explains the communications ability of the CLICK PLC system for exchanging data between the CPU and other connected serial devices. It covers:

- the electrical connections used for communications
- the networking routing between the CPU and other devices,
- setting the port communication parameters,
- selecting the protocols and the available data addressing types to use,
- the ladder logic program instructions that make it all work together.

The CLICK CPUs have two built-in RS-232 ports. Both ports are physically 6-pin RJ12 phone type jacks. Port 1's communication parameters are fixed and it is used primarily as the programming port. Port 1 can also be used as a Modbus RTU protocol slave device. Port 2 is a general purpose port with its communication parameters being user configurable from the CLICK Programming Software, C0-PGMSW. Port 2 can be used as a Modbus RTU master or slave protocol device, or handle ASCII data In or Out.

Some CPU versions also have a 3-pin RS-485 port, Port 3. Like Port 2, Port 3 is a general purpose port with its communication parameters being user configurable from the programming software. Port 3 can be used as a Modbus RTU master or slave protocol device, or handle ASCII data In or Out.

For details on the Modbus protocol, visit www.modbus.org.

ASCII stands for American Standard Code for Information Interchange and defines a character encoding method for text that is used in computers and other communication devices. Details can be found by doing a search for ASCII on the internet.

The CLICK PLC can be networked to other CLICK PLCs, data input devices (barcode readers, weight scales, etc.), and/or data output devices (serial printers, serial text displays, etc.). It is also possible to network the CLICK PLC to other 3rd party PLCs and devices that have the ability to communicate using the Modbus RTU protocol.

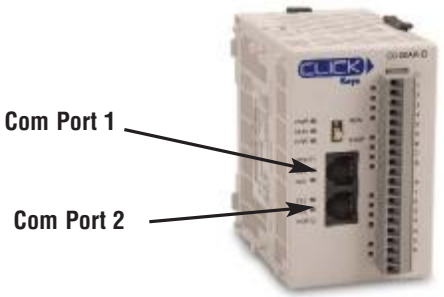
The final part of the PLC Communications chapter contains explanations and examples of the various ways the Send and Receive programming instructions can be used to perform Modbus RTU protocol and ASCII data communications between devices.

There are three different data addressing types that can be selected when using the Modbus RTU protocol from the Send and Receive instructions. They are, CLICK addressing, Modbus 984 addressing, or Modbus HEX addressing. The CLICK addressing makes it convenient to exchange data between CLICK PLCs. The other addressing choices are selected based on the Modbus protocol addressing the networked devices are using.

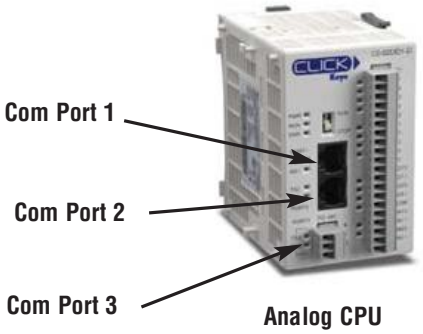
NOTE: The Modbus RTU Master is identified as the device that controls the exchange of data between itself and any connected slave device. There can only be one master on the network. When the CLICK CPU is the master, it is easily identified. It will be the PLC in the network with the Send and/or Receive instructions using the Modbus protocol in its ladder logic program.

CPU Communication Ports Specifications

The CLICK CPU modules have two or three built-in communications ports.



Basic CPU

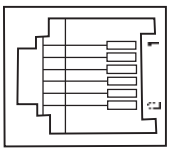


Analog CPU

Com Port 1 Specifications
Use: Programming Port
Physical: 6 pin, RJ12, RS-232
Communication speed (baud): 38400 (fixed)
Parity: Odd
Station Address: 1
Data length: 8 bits
Stop bit: 1
Protocol: Modbus RTU (slave only)

Port 1

6 pin RJ12 Phone Type Jack – Port 1

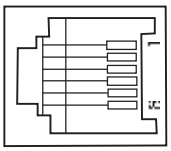


Port 1 Pin Descriptions		
1	0V	Power (-) connection (GND)
2	5V	Power (+) connection
3	RXD	Receive data (RS-232)
4	TXD	Transmit data (RS-232)
5	NC	No connection
6	0V	Power (-) connection (GND)

Com Port 2 Specifications
Use: Serial Communication
Physical: 6 pin, RJ12, RS-232
Communication speed (baud): 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity: odd, even, none
Station Address: 1 to 247
Data length: 8 bits (Modbus RTU) or 7, 8 bits (ASCII)
Stop bit: 1,2
Protocol: Modbus RTU (master/slave) or ASCII in/out

Port 2

6 pin RJ12 Phone Type Jack – Port 2

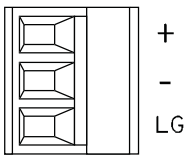


Port 2 Pin Descriptions		
1	0V	Power (-) connection (GND)
2	5V	Power (+) connection
3	RXD	Receive data (RS-232)
4	TXD	Transmit data (RS-232)
5	RTS	Request to send
6	0V	Power (-) connection (GND)

Com Port 3 Specifications
Use: Serial Communication
Physical: 3 pin, RS-485
Communication speed (baud): 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity: odd, even, none
Station Address: 1 to 247
Data length: 8 bits (Modbus RTU) or 7, 8 bits (ASCII)
Stop bit: 1,2
Protocol: Modbus RTU (master/slave) or ASCII in/out

Port 3

RS-485

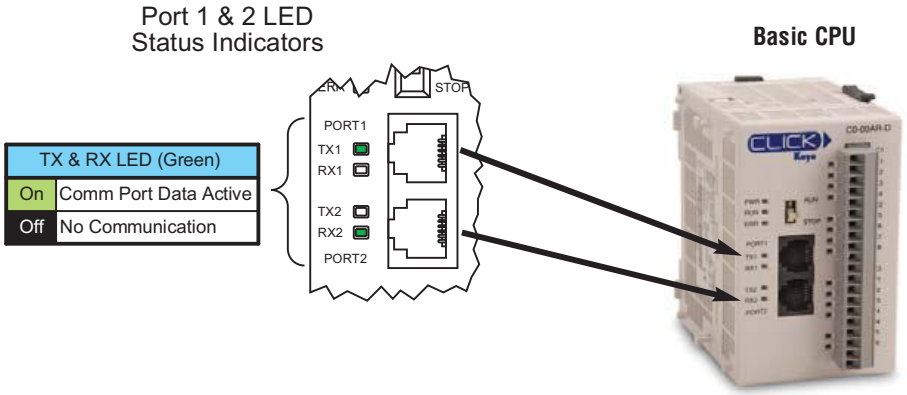


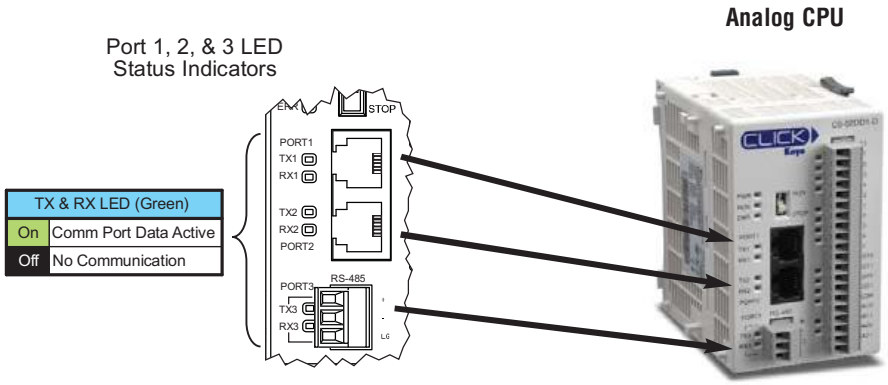
Port 3 Pin Descriptions		
1	+ (plus)	Signal A (RS-485)
2	- (minus)	Signal B (RS-485)
3	LG	Logic Ground(0 V)

LED Status Indicators

LED Status Indicators

There are LED status indicators located to the left of each communication port to indicate port activity or communications.





DirectLogic Devices That Do Not Work With CLICK PLCs

The CLICK PLC does not support K-sequence protocol, so the following DirectLogic devices do not work with the CLICK PLC:

D2-HPP

D4-HPP-1

DV-1000

3 Steps to Using the CLICK PLC Communications

We offer an easy 3-steps method to use the communications features of the CLICK PLC.

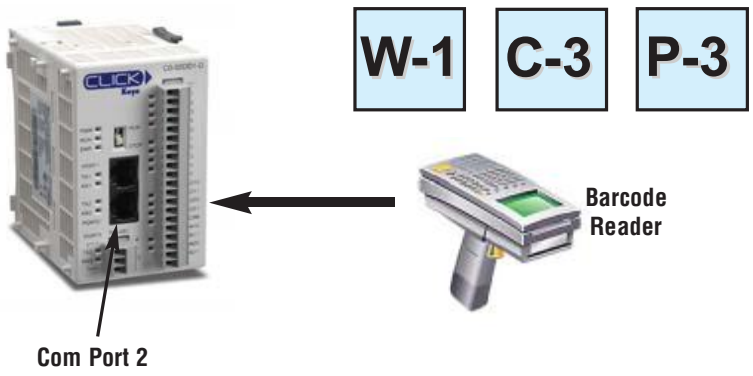
The following pages show what devices you can connect to the CLICK CPU Com ports. Use the table below to help find information on communications for your particular application. As you can see in the table, each step has subcategories. For each step, find the subcategory description that best describes your application. Use the subcategory references (W-2, C-2, etc.) to find more information on these topics in this chapter. See the example below.

CLICK PLC Communications			
Step	Subcategory Reference	Subcategory Description	Page
1	W-1	Com port 1 & 2 wiring	4-9
	W-2	Com port 3 wiring	4-12
2	C-1	Com port 1 setup	4-13
	C-2	Com port 2 setup (Modbus)	4-14
	C-3	Com port 2 setup (ASCII)	4-15
	C-4	Com port 3 setup (Modbus)	4-16
	C-5	Com port 3 setup (ASCII)	4-17
3	P-1	Modbus Slave programming	4-18
	P-2	Modbus Master programming	4-21
	P-3	ASCII Receive programming	4-24
	P-4	ASCII Send programming	4-27

Example:

Let's say you want to connect a barcode reader, which sends ASCII data, to Com Port 2.

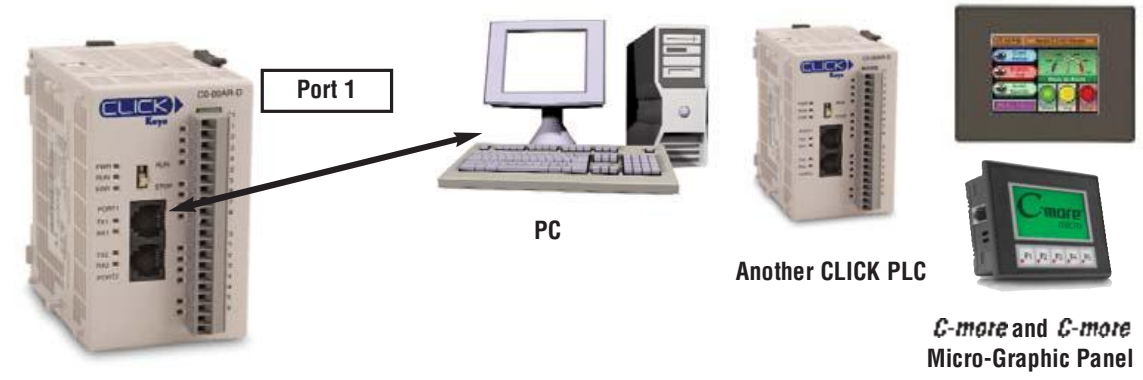
To set up the communications properly for this example, refer to these three references on the following pages.



Typical Serial Communication Applications

The diagrams on these three pages illustrate the typical uses for the CLICK CPU's communication ports. Typical serial communication applications are continued on the next two pages.

Port 1 (RS-232) – Modbus RTU Slave Mode (only)

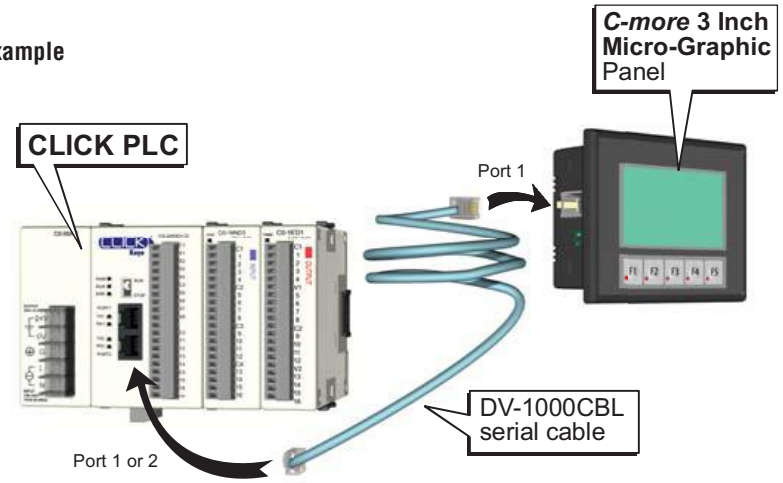


To set up the Port 1 communications properly, refer to these three references on the following pages.

Other Devices Supporting Modbus RTU Master Mode

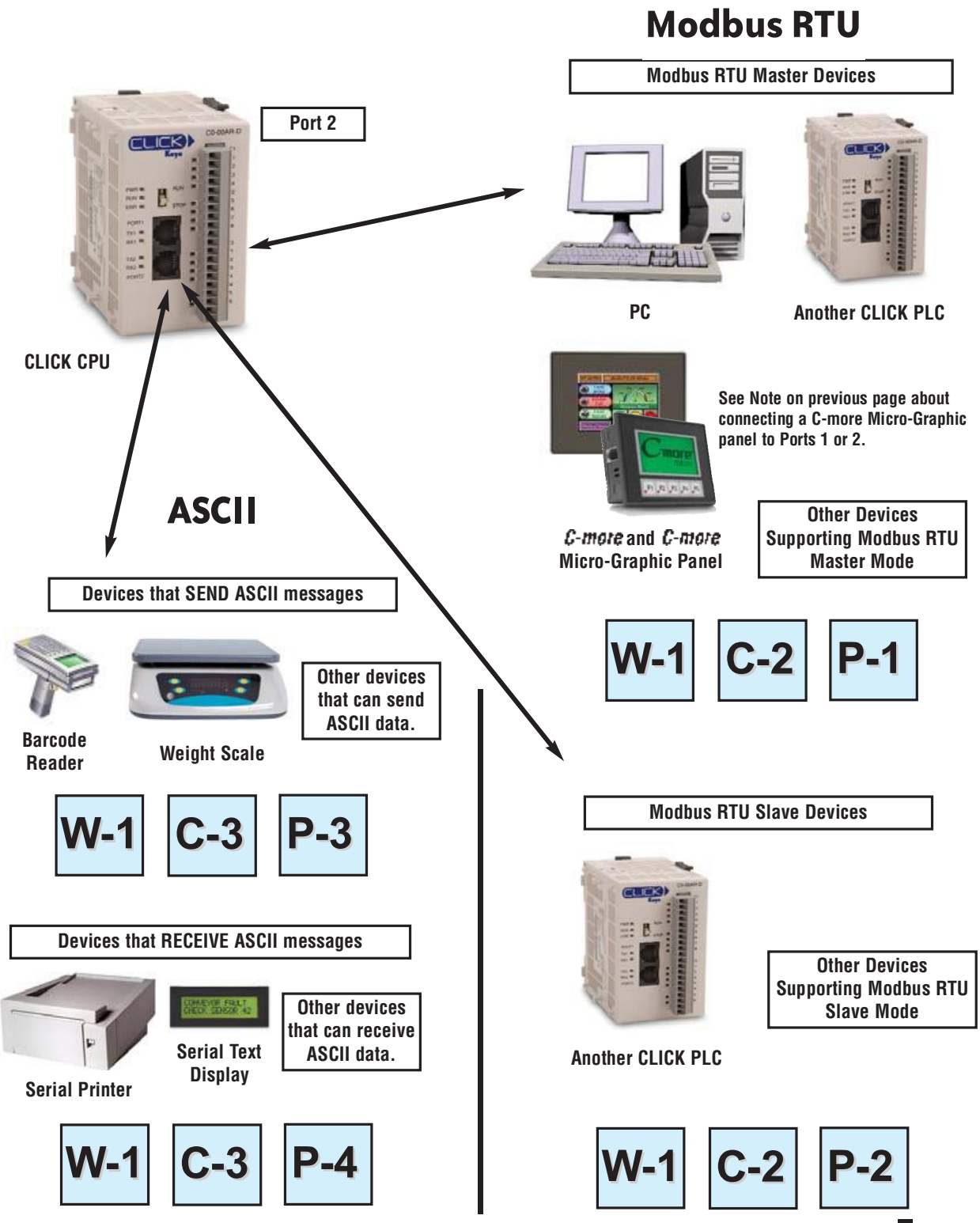
W-1 C-1 P-1

Example

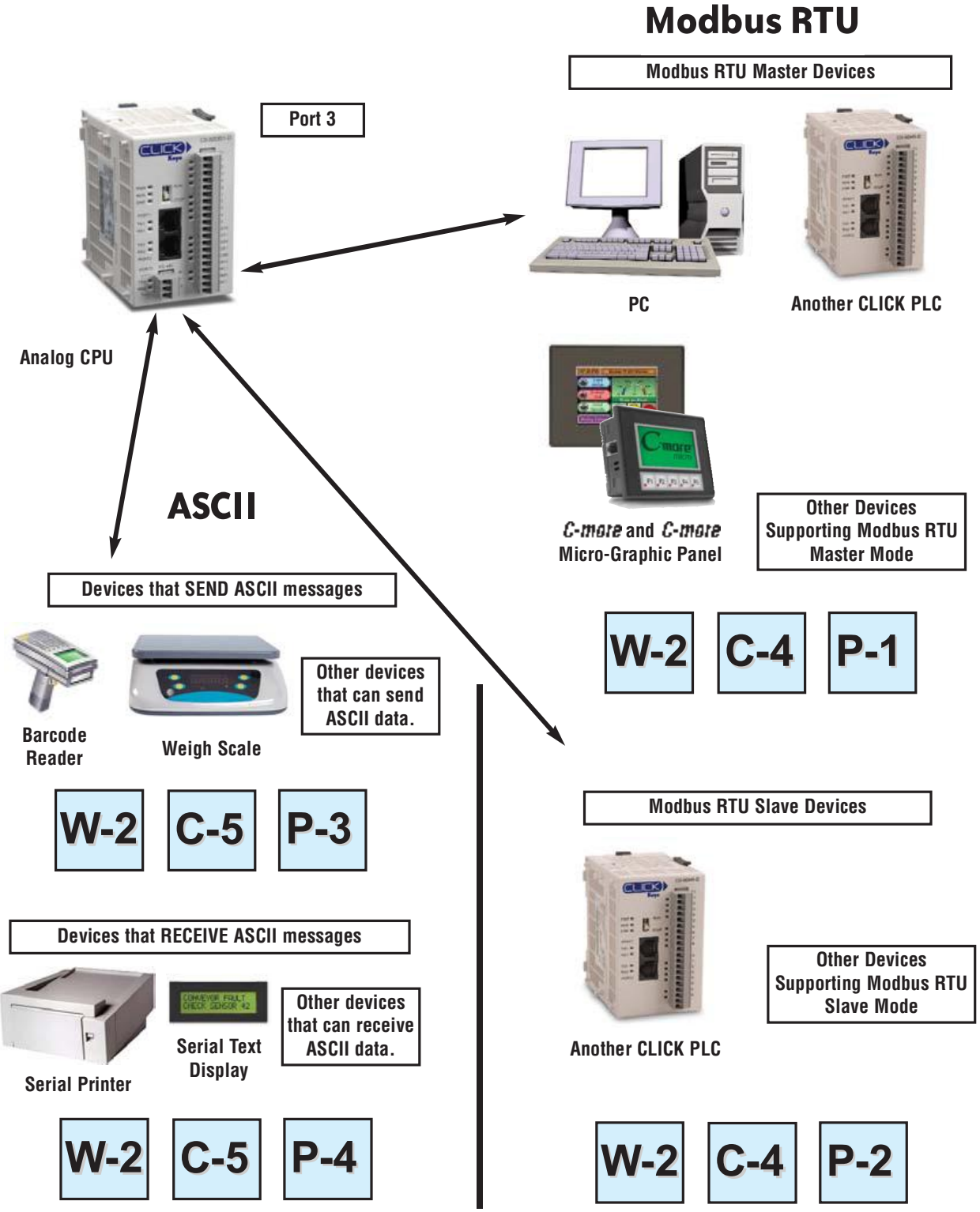


NOTE: A C-more Micro-Graphic panel can be connected to CLICK's Port 1 and/or Port 2. Either port can provide 5 VDC to power the panel, but not at the same time. If a C-more Micro-Graphic panel is connected to both ports, then at least one of the panels must be powered by a C-more DC power adapter, EA-MG-P1 or EA-MG-SP1, or another 24 VDC power source.

Port 2 (RS-232) – Modbus RTU or ASCII



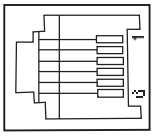
Port 3 (RS-485; Analog CPUs Only) – Modbus RTU or ASCII



W-1: Com Port 1 & 2 Wiring

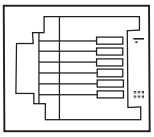
Com Port 1 and Com Port 2 have very similar pin layouts; the only difference is that Port 2 has a RTS signal output, which Port 1 does not have.

6 pin RJ12 Phone Type Jack – Port 1



Port 1 Pin Descriptions		
1	0V	Power (-) connection (GND)
2	5V	Power (+) connection
3	RXD	Receive data (RS-232)
4	TXD	Transmit data (RS-232)
5	NC	No connection
6	0V	Power (-) connection (GND)

6 pin RJ12 Phone Type Jack – Port 2



Port 2 Pin Descriptions		
1	0V	Power (-) connection (GND)
2	5V	Power (+) connection
3	RXD	Receive data (RS-232)
4	TXD	Transmit data (RS-232)
5	RTS	Request to send
6	0V	Power (-) connection (GND)

Note: Both Com ports can provide 5 VDC; however, the 5 VDC power can be used only for the C-more Micro-Graphic panel. AutomationDirect does not guarantee that the CLICK PLC will work correctly when any other device uses 5 VDC from these Com ports. Please also remember these Com ports can provide enough power only for one C-more Micro-Graphic panel. If you are going to connect a C-more Micro-Graphic panel to each Com port (2 panels in total), you must obtain power from another 24 VDC power source for the second C-more Micro-Graphic panel.

Wiring Strategy

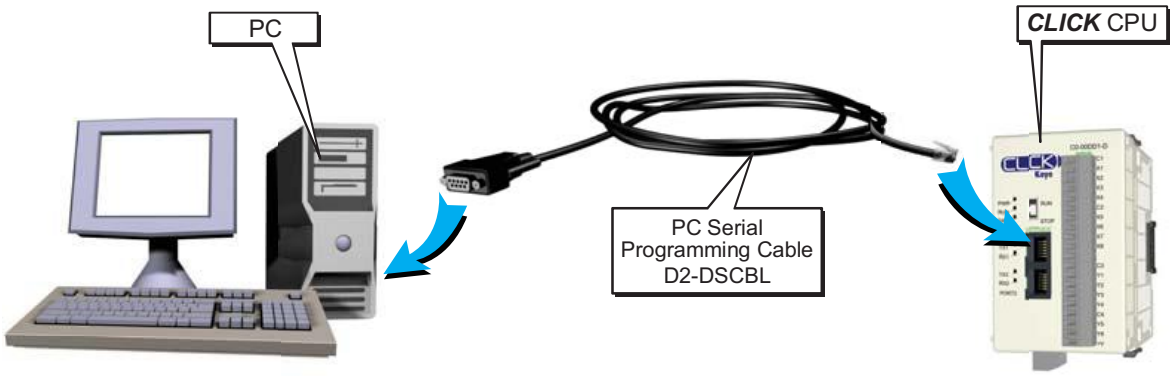
The following section covers these five case scenarios for connecting com ports 1 or 2 to:

- Case 1: PC
- Case 2: Another CLICK PLC
- Case 3: C-more or C-more Micro-Graphic panel
- Case 4: RS-232 port on another device
- Case 5: RS-422 or RS485 port on another device(s).

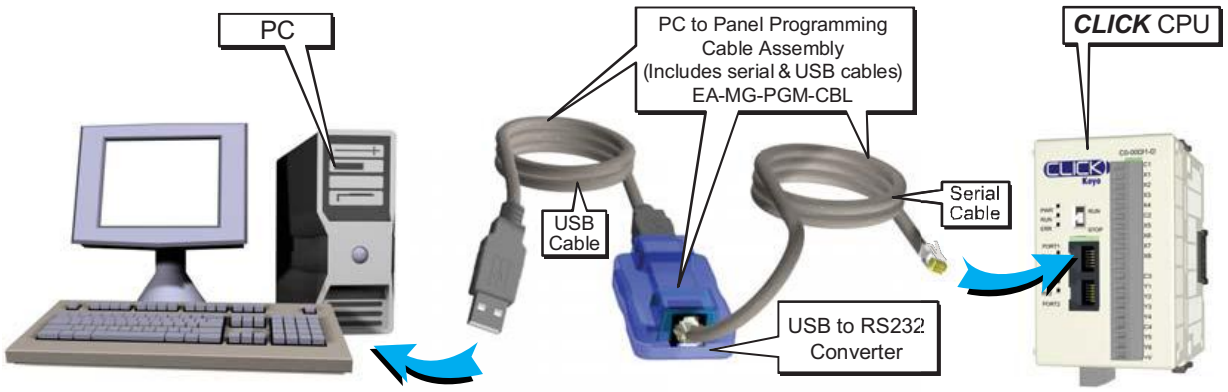
Case 1: Connect Com Port 1 or 2 to a PC

You can connect Com Port 1 or 2 to a serial com port or USB port on the PC.

1. Connect to a serial port

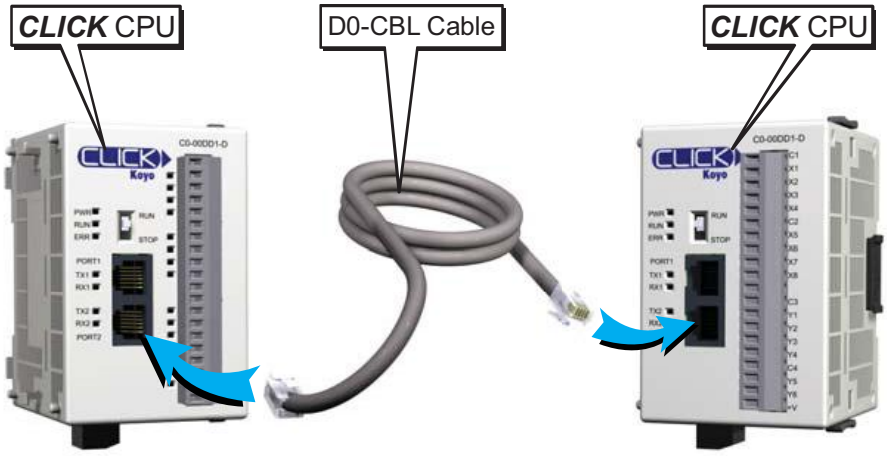


2. Connect to a USB port



Case 2: Connect Com Port 1 or 2 to another CLICK PLC

You can use the cable D0-CBL.



In this configuration, one of the CLICK CPU module needs to be the network master and the other is the network slave. Connect the D0-CBL on Com Port 2 on the master CPU module side.

Note: The ZL-RJ12-CBL-2 cable cannot be used for this purpose.

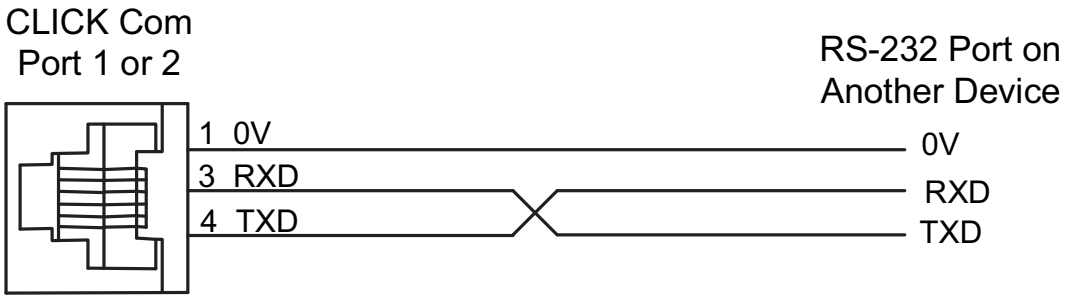
Case 3: Connect Com Port 1 or 2 to a C-more or C-more Micro-Graphic panel

Please use the following cables to make your connections.

C-more / C-more Micro-Graphic Panel	Cable Part Number
C-more Touch panels	EA-2CBL-1 (3m) or OP-2CBL-1 (2m)
C-more Micro-Graphic Panels	DV-1000CBL if the panel receives 5 VDC power from the CLICK PLC com port.
	EA-2CBL-1 (3m) or OP-2CBL-1 (2m) if the panel receives 24 VDC power from other source.

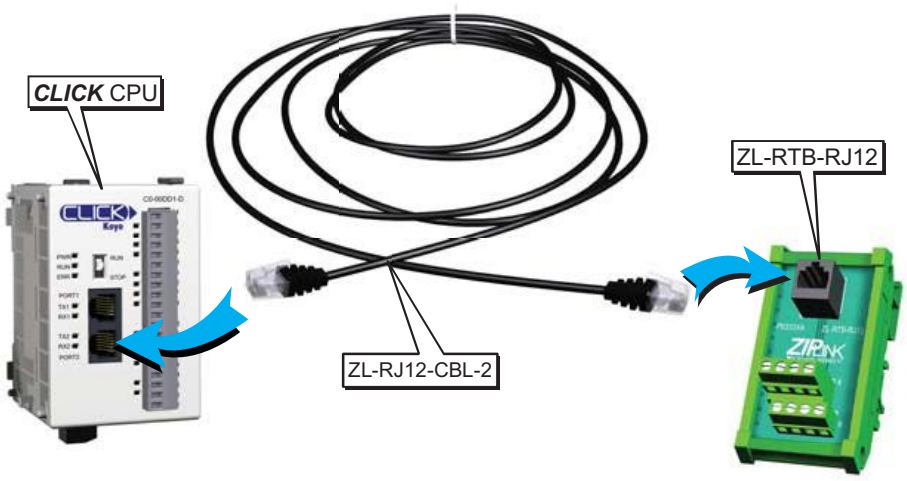
Case 4: Connect Com Port 1 or 2 to an RS-232 port on another device.

You need to cross the RTD and TXD signal lines and connect 0V on both com ports.

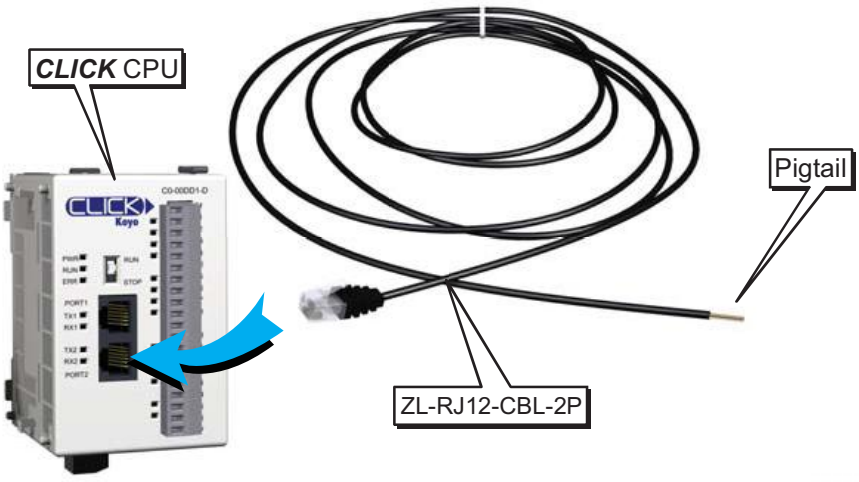


You can make your own cable. We offer two products that make your wiring much easier:

1. ZIPLink feed-through module and cable



2. ZIPLink pig-tail cable



Case 5: Connect Com Port 1 or 2 to an RS-422 or RS485 port on another device(s).

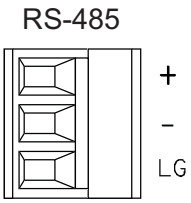
You need a RS-232 to RS-422/485 converter in this case. We recommend our FA-ISOCON as the converter.

The recommended cables to connect the FA-ISOCON to other devices:

- Belden 8103 for the RS-422
- Belden 9842 for 2-wire RS-485
- Belden 9843 for 4-wire RS-485

W-2 W-2: Com Port 3 Wiring

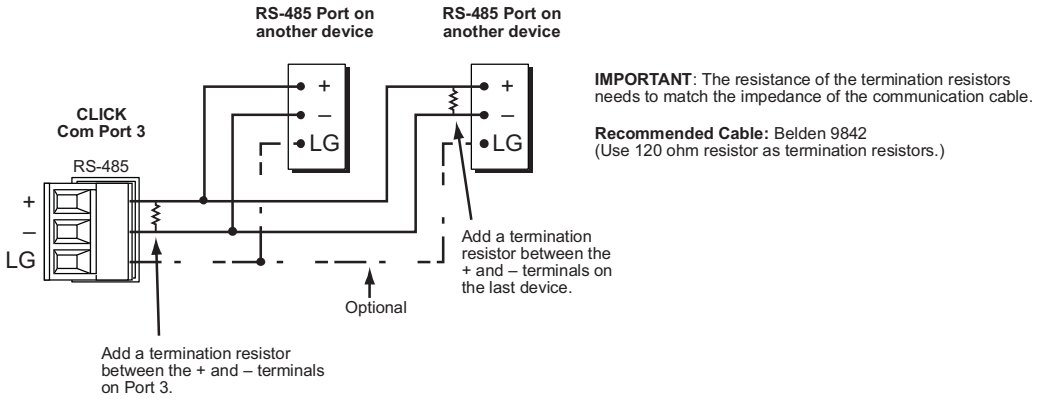
Com Port 3 supports 2-wire RS-485.



Port 3 Pin Descriptions		
1	+ (plus)	Signal A (RS-485)
2	- (minus)	Signal B (RS-485)
3	LG	Logic Ground (0 V)

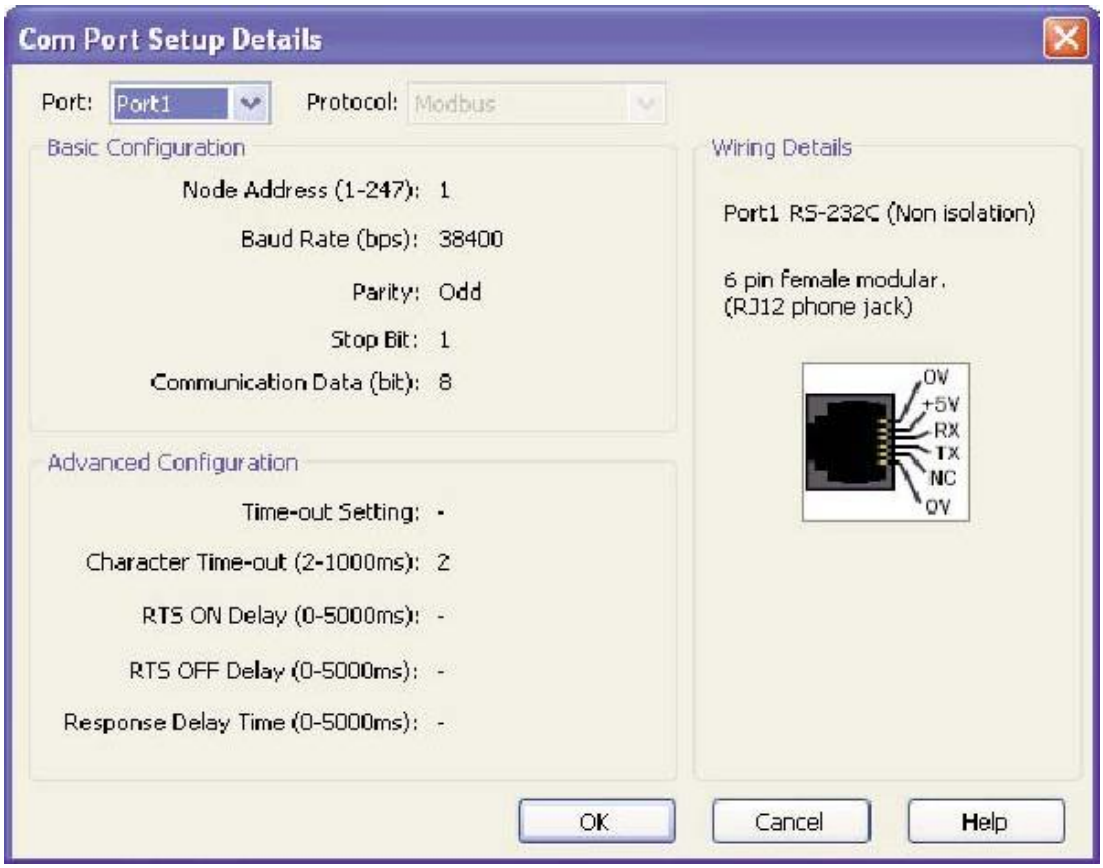
Wiring Strategy

You need to connect all + signal terminals in the network together. You also need to connect all – signal terminals together. It is optional to connect the logic ground.



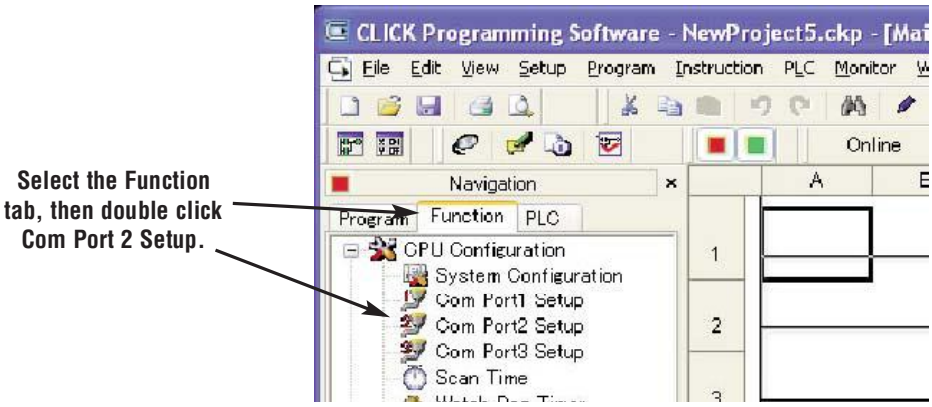
C-1 C-1: Com Port 1 Setup

Com Port 1 has a fixed setup as shown below. This com port works as a Modbus slave only. If you want to connect an external device to this com port, please make sure the external device can be a Modbus master and that the com port setup matches the following setup.

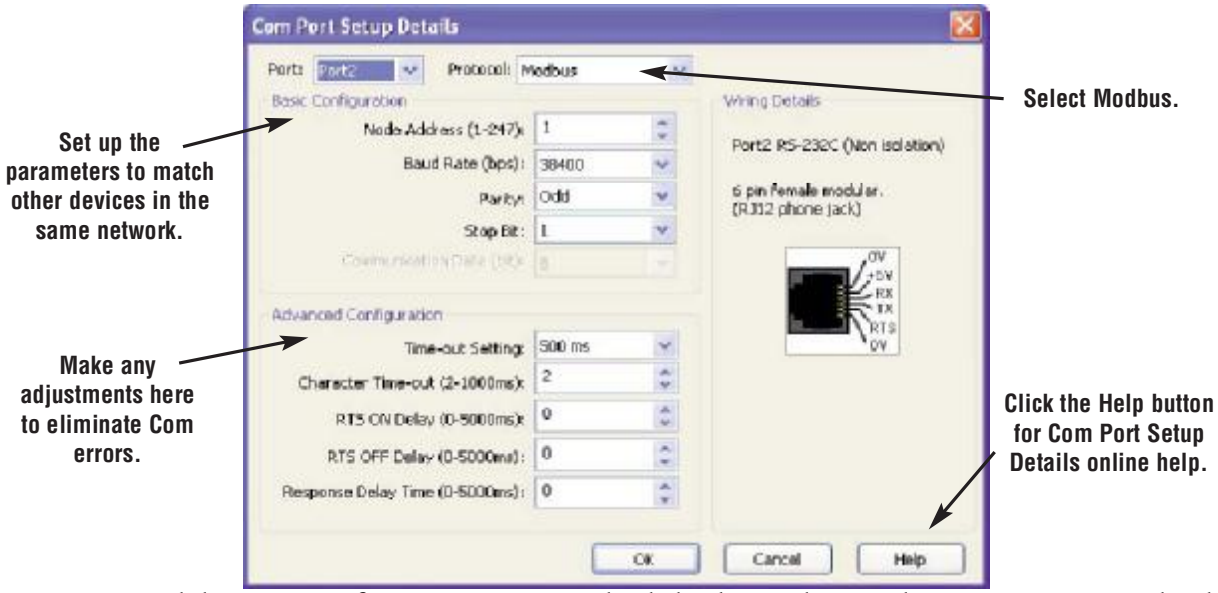


C-2: Com Port 2 Setup (Modbus)

Before you set up the communication ports you must connect the PC with the CLICK programming software to the CLICK PLC Port 1 using a D2-DSCBL or EA-MG-PGM-CBL programming cable. Refer to Chapter 1: Getting Started for step-by-step instructions for this connection. Once the PC and programming software are online with the CLICK PLC, click the Function tab located in the Navigation window and double click Com Port 2 Setup as shown below.



The Com Port Setup Details dialog box will come into view as shown below.

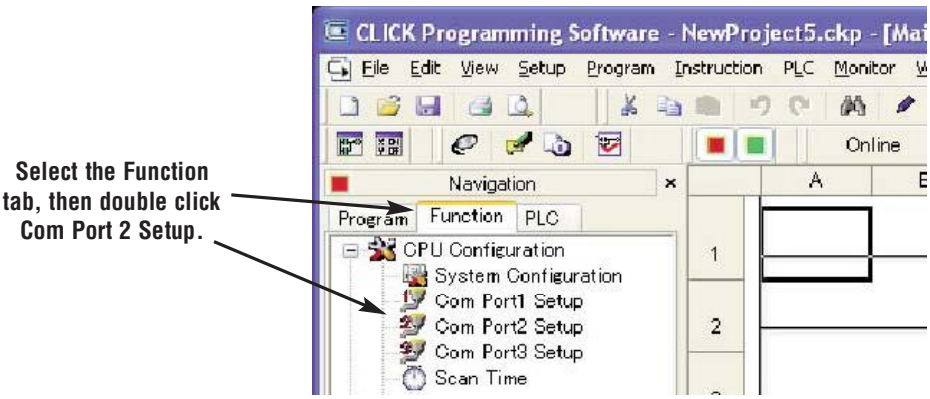


Find the Basic Configuration section in the dialog box and set up the parameters to match other devices in the same network. The dialog box also has a section named Advanced Configuration. You may need to make adjustments to these parameters to overcome communication errors which may occur.

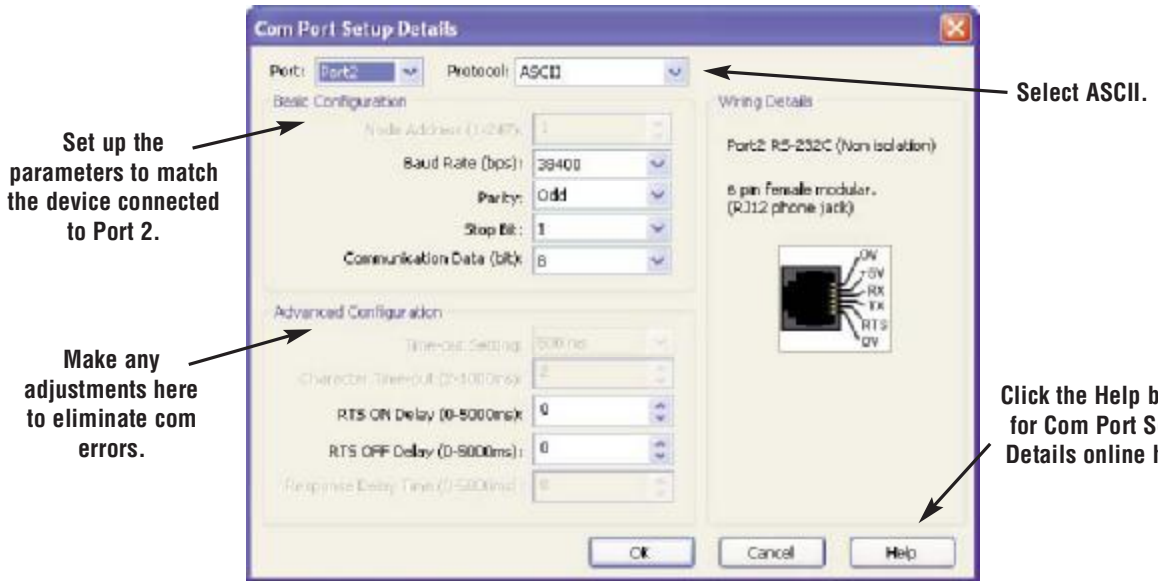
IMPORTANT: The communication port settings are saved in the project file. The project must be transferred to the CLICK PLC in order for any port setting changes to take effect.

C-3 C-3: Com Port 2 Setup (ASCII)

Before you set up the communication ports you must connect the PC with the CLICK programming software to the CLICK PLC Port 1 using a D2-DSCBL or EA-MG-PGM-CBL programming cable. Refer to Chapter 1: Getting Started for step-by-step instructions for this connection. Once the PC and programming software are online with the CLICK PLC, click the Function tab located in the Navigation window and double click Com Port 2 Setup as shown below.



The Com Port Setup Details dialog box will come into view as shown below.

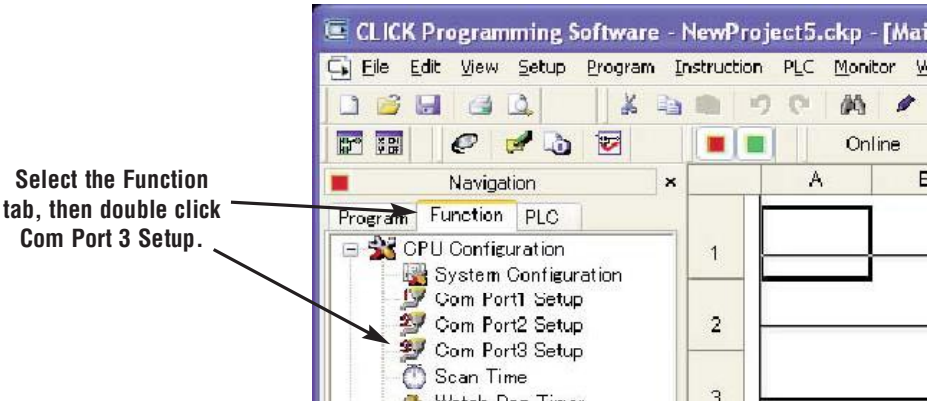


Find the Basic Configuration section in the dialog box and set up the parameters to match the device connected to Port 2. The dialog box also has a section named Advanced Configuration. You may need to make adjustments to these parameters to overcome communication errors which may occur.

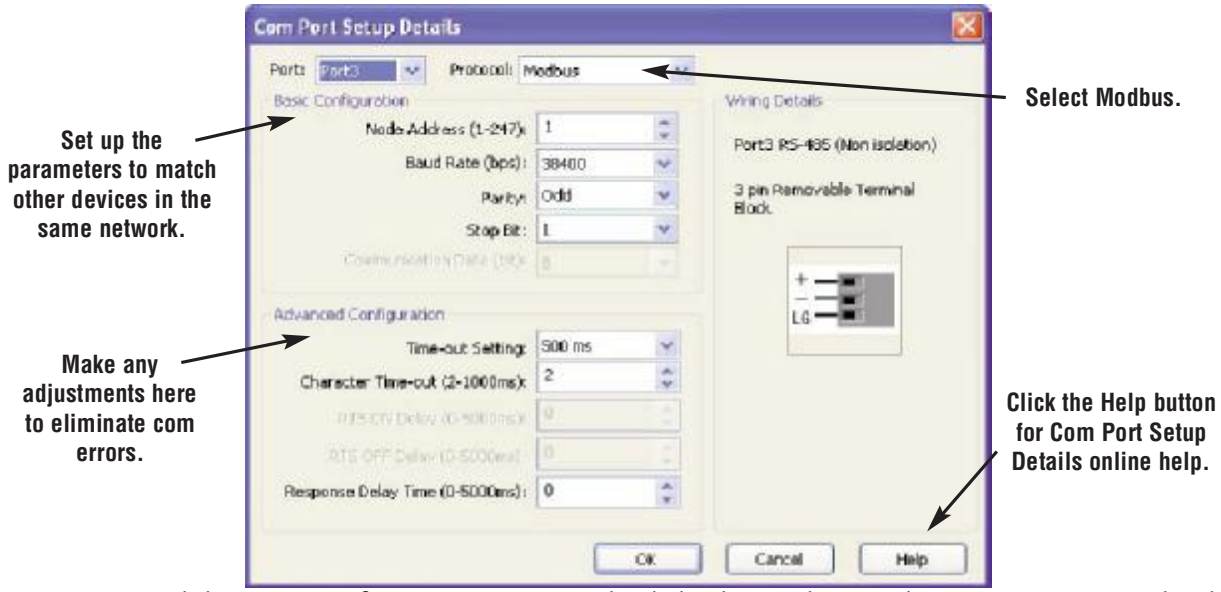
IMPORTANT: The communication port settings are saved in the project file. The project must be transferred to the CLICK PLC in order for any port setting changes to take effect.

C-4 C-4: Com Port 3 Setup (Modbus)

Before you set up the communication ports you must connect the PC with the CLICK programming software to the CLICK PLC Port 1 using a D2-DSCBL or EA-MG-PGM-CBL programming cable. Refer to Chapter 1: Getting Started for step-by-step instructions for this connection. Once the PC and programming software are online with the CLICK PLC, click the Function tab located in the Navigation window and double click Com Port 3 Setup as shown below.



The Com Port Setup Details dialog box will come into view as shown below.

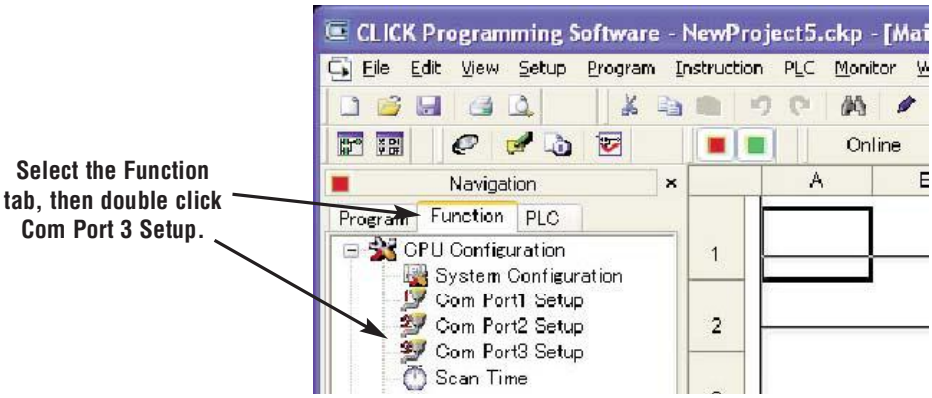


Find the Basic Configuration section in the dialog box and set up the parameters to match other devices in the same network. The dialog box also has a section named Advanced Configuration. You may need to make adjustments to these parameters to overcome communication errors which may occur.

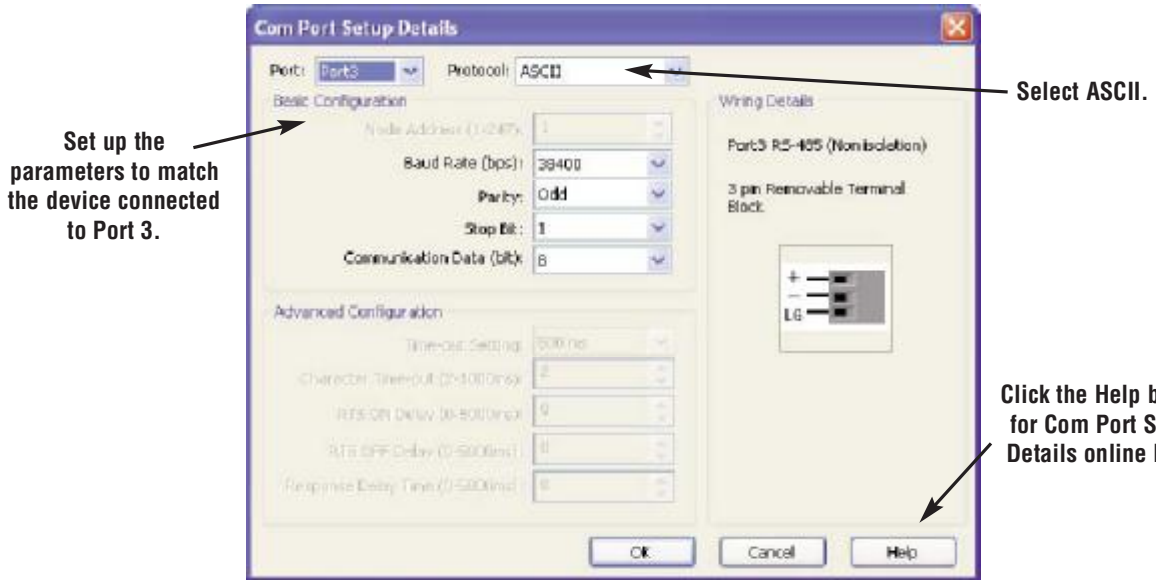
IMPORTANT: The communication port settings are saved in the project file. The project must be transferred to the CLICK PLC in order for any port setting changes to take effect.

C-5 C-5: Com Port 3 Setup (ASCII)

Before you set up the communication ports you must connect the PC with the CLICK programming software to the CLICK PLC Port 1 using a D2-DSCBL or EA-MG-PGM-CBL programming cable. Refer to Chapter 1: Getting Started for step-by-step instructions for this connection. Once the PC and programming software are online with the CLICK PLC, click the Function tab located in the Navigation window and double click Com Port 3 Setup as shown below.



The Com Port Setup Details dialog box will come into view as shown below.



Find the Basic Configuration section in the dialog box and set up the parameters to match the device connected to Port 3.

IMPORTANT: The communication port settings are saved in the project file. The project must be transferred to the CLICK PLC in order for any port setting changes to take effect.

P-1 P-1: Modbus Slave Programming

Ladder Program

To use a CLICK PLC as a Modbus slave, you don't need any special ladder program. You just need an End instruction in the ladder program to put the PLC in Run mode.

However, you can add any additional ladder program to let the slave CLICK PLC control something by itself. For instance, you may want to shut down the outputs on the slave CLICK PLC when it lost communication with the Modbus master.

Note: The Modbus master can communicate with the Modbus slave CLICK PLC without any ladder program. However, output points on the Modbus slave CLICK PLC cannot be turned on if the CPU is not in the Run mode. Because of this, we recommend having at least one End instruction and to put the CPU in Run mode.

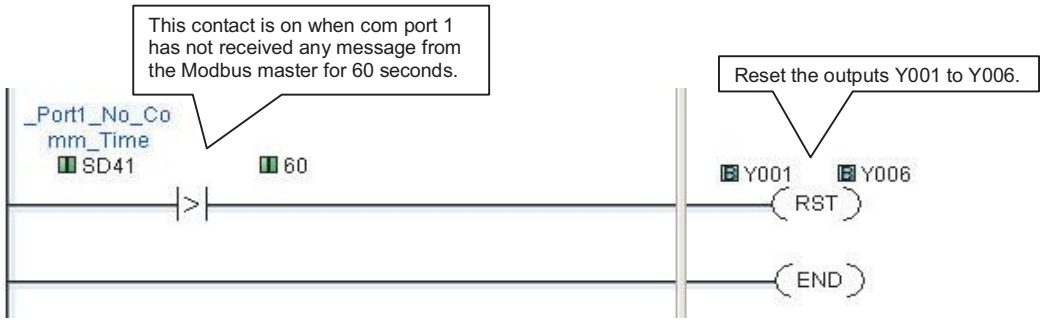
Lost Communication Situation

You may want to detect if there is something happening at the Modbus master side that stops communication with the Modbus slaves. Or, the communication cable might have been disconnected. In the situation, you may want the Modbus slaves to take an action. For instance, you may want to shut down the outputs on the slave CLICK PLC when the communication with the Modbus master is lost. We offer an easy method to accomplish this.

The CLICK keeps counting how long it has been since each com port received a message from the Modbus master, and enters the time duration in the following system data registers.

System Data Registers		
System Data Register	**Nickname**	**Range**
SD41	_Port1_No_Comm_Time	0 - 32767 (sec)
SD51	_Port2_No_Comm_Time	0 - 32767 (sec)
SD61	_Port3_No_Comm_Time	0 - 32767 (sec)

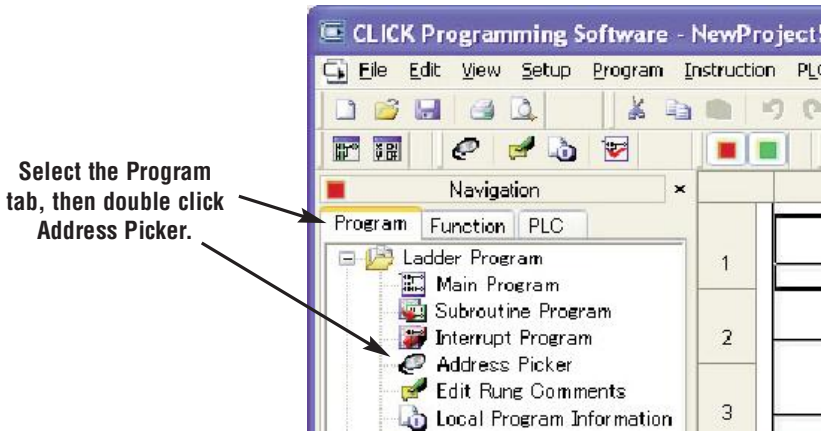
Each register is reset to zero automatically when the com port receives a message from the Modbus master. Then, its value keeps increasing by 1 per second until the com port receives another message from the Modbus master. If one of these registers has 60 as its value, it means the com port has not received any message from the Modbus master for 60 seconds. You can use this info to shut down the outputs on the slave CLICK PLC. Here is an example program.



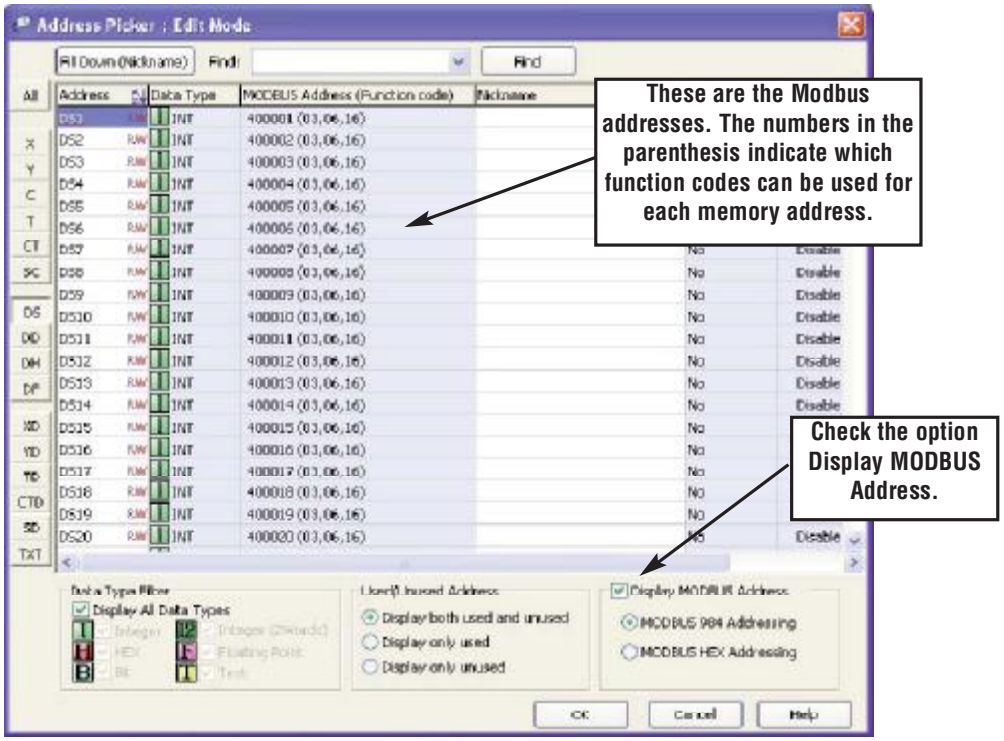
Modbus Addressing

Each of the memory addresses in the CLICK (X1, DS1, etc.) has a unique Modbus address. This means the network master in the Modbus network can access any memory address in the slave CLICK PLC. The best way to check what Modbus address is assigned to a particular CLICK memory address is to use the CLICK programming software.

Click the Program tab located in the Navigation window and double click Address Picker as shown below.



After the Address Picker window opens, check the option Display MODBUS Address on the right bottom.



Exception Response (Exception Code)

When the slave CLICK PLC receives a request from the Modbus master that it cannot respond to, the slave CLICK PLC sends an exception response to the Modbus master. The CLICK PLC supports the following Exception Responses.

Exception Response (Exception Code)		
Code	**Name**	**Details of Exception Response**
01	Illegal Function	The CLICK PLC does not support the function code received from the MODBUS master.
02	Illegal Data Address	The MODBUS master tried to access to an invalid address.
03	Illegal Data Value	The data length is zero or exceeds the maximum size.
		The data for Write Single Coil is not FF00h (ON) or 0000h (OFF).
		The PLC mode change request from the MODBUS master is not valid.
04	Slave Device Failure	Password is locked.
		When the PLC mode switch is in STOP position, the MODBUS master requested to switch to RUN mode.
		When the PLC mode switch is in RUN position, the MODBUS master requested to switch to the Firmware Update mode.

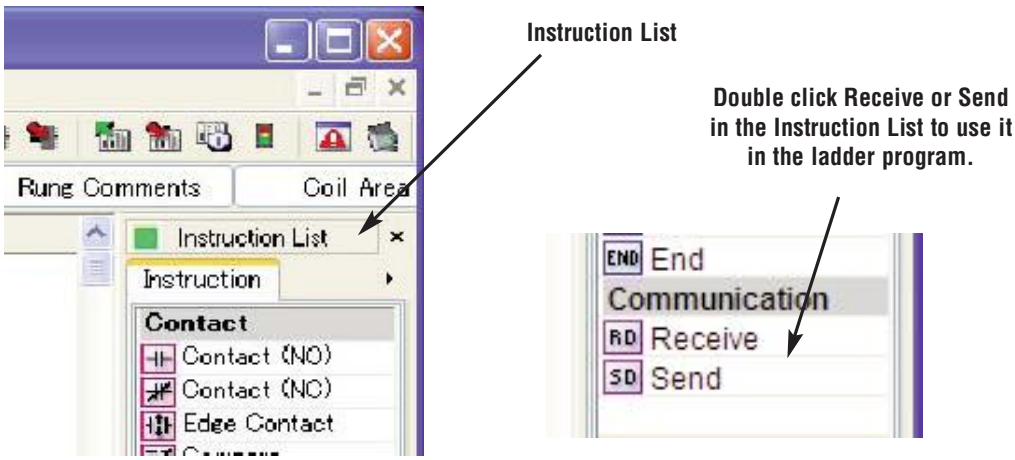
P-2 P-2: Modbus Master Programming

Instructions

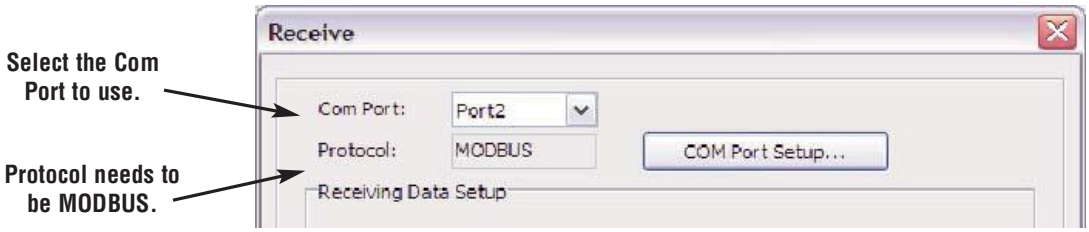
The CLICK PLC has two instructions to exchange data with external Modbus devices through the com ports; the Receive and Send instructions.

- **Receive** instruction: Read data from an external Modbus device.
- **Send** instruction: Write data to external Modbus device(s).

To use these instructions, double click Receive or Send in the Instruction List window as shown below.

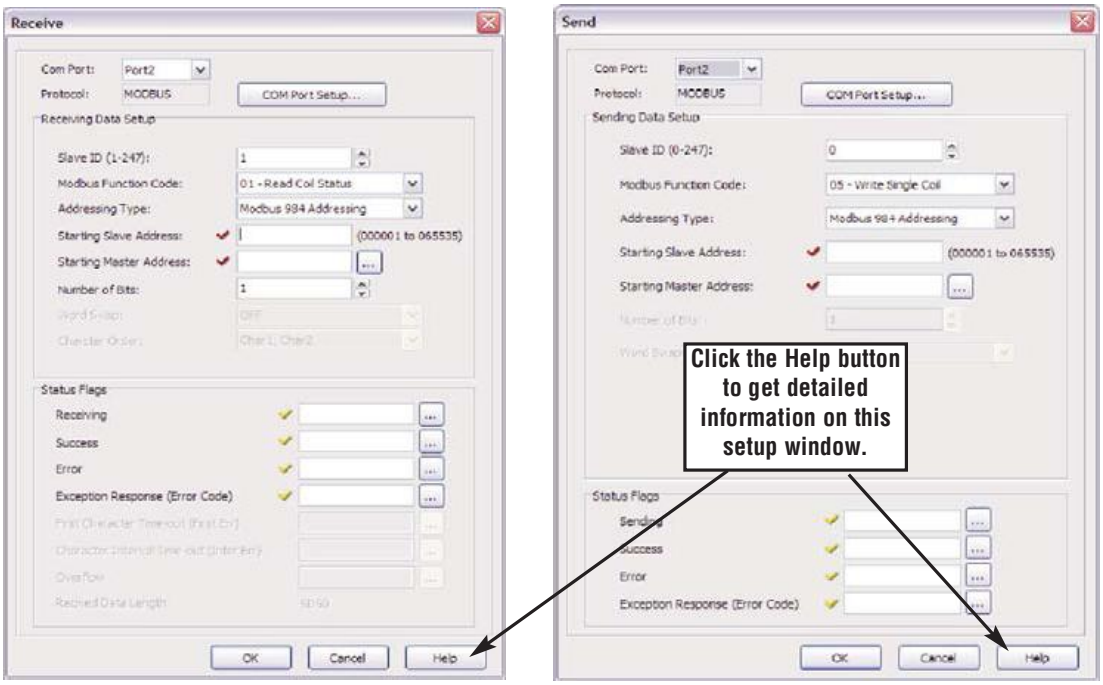


Select the Com Port that you are going to use and confirm the Protocol is MODBUS.



If the Protocol is not MODBUS, click the Com Port Setup button to open the Com Port Setup Details window and change the Protocol to MODBUS. If the Protocol selection is grayed out as shown below, it means the Com Port is used by another Receive and/or Send instruction in the ladder program. You cannot change the Protocol setup until you delete those instructions.

When you open the Receive or Send instruction in the Modbus mode, their windows should look like this. For the explanation of each setup parameter, please click the Help button on the bottom right.



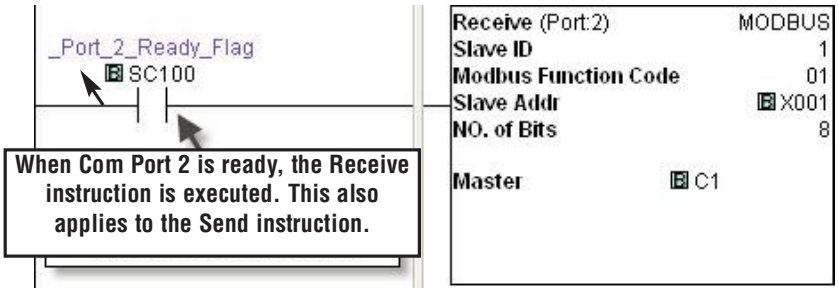
Com Port Status Indicators

The CLICK PLC has the following System Control Relays to indicate the status of the Com Ports.

System Control Relays		
Address	**Nickname**	**Description**
SC100	_Port_2_Ready_Flag	On when Port 2 is ready.
SC101	_Port_2_Error_Flag	On when Port 2 has a communication error.
SC102	_Port_3_Ready_Flag	On when Port 3 is ready.
SC103	_Port_3_Error_Flag	On when Port 3 has a communication error.

Example Program

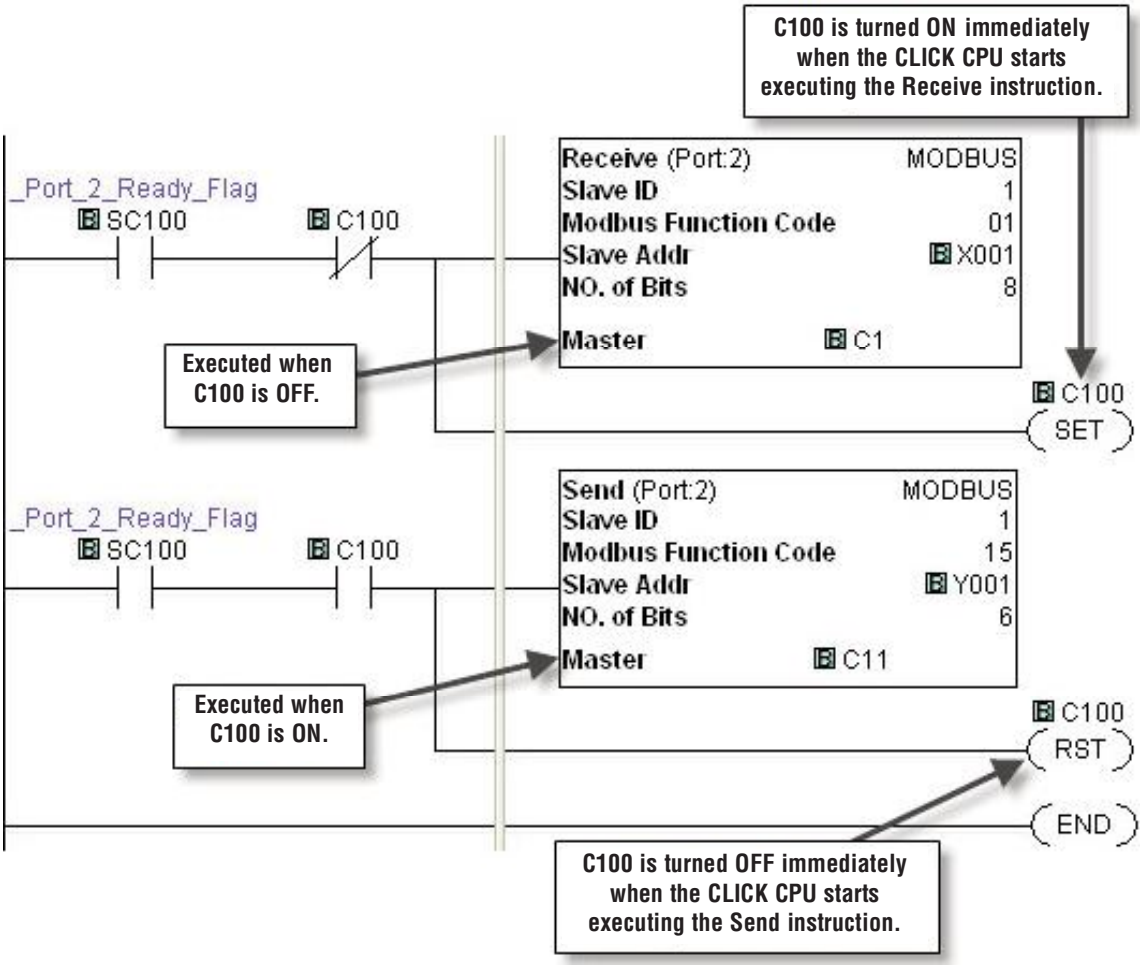
The ladder program to use these Receive and Send instructions are easy. You just need one NO (Normally Open) contact instruction to check if the com port is ready to receive or send data.



Interlocking

These instructions keeps receiving or sending data when the enable input is on. If you want to use more than one Receive and/or Send instruction, you need to be sure only one of the instructions is enabled at any point during the operation. The technique to execute more than one Receive and/or Send instruction in order is called 'Interlocking'. Here is an example of interlocking.

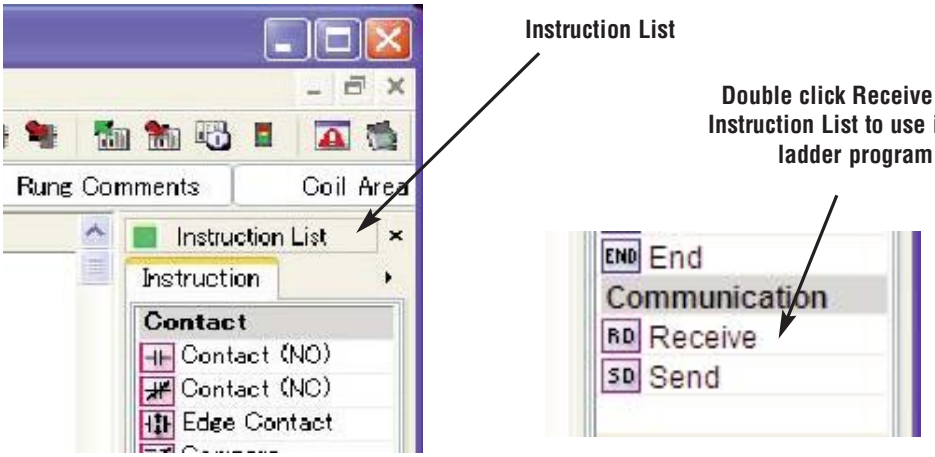
When this sample program is executed, the Receive and Send instructions are executed alternatively.



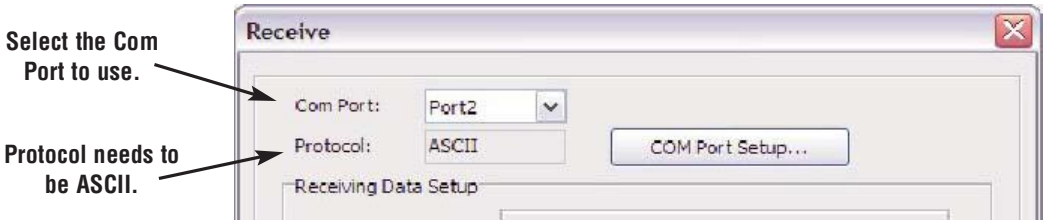
P-3 P-3: ASCII Receive Programming

Instruction

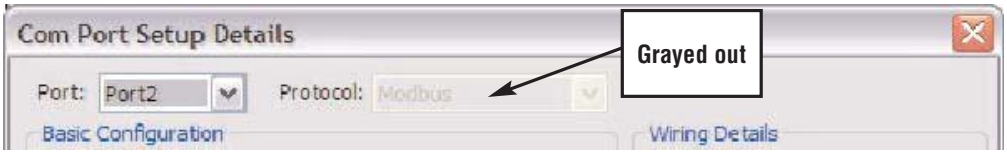
The Receive instruction allows the CLICK PLC to read ASCII message from an external device. To use this instruction, double click Receive in the Instruction List window as shown below.



Select the Com Port that you are going to use and confirm the Protocol is ASCII.



If the Protocol is not ASCII, click the Com Port Setup button to open the Com Port Setup Details window and change the Protocol to ASCII. If the Protocol selection is grayed out as shown below, it means the Com Port is used by another Receive and/or Send instruction in the ladder program. You cannot change the Protocol setup until you delete those instructions.

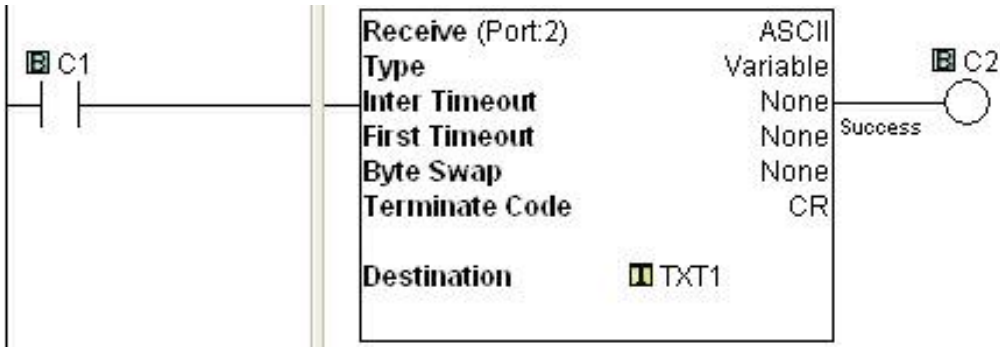


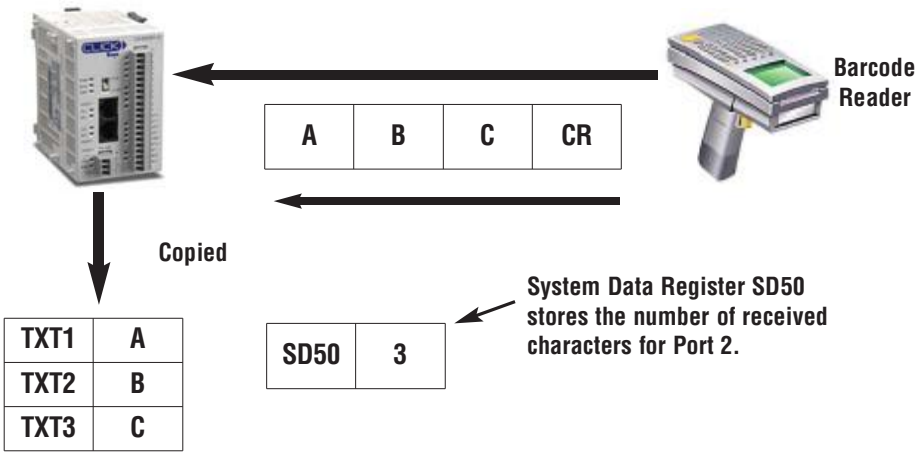
When you open the Receive instruction in the ASCII mode, the window should look like this. For the explanation of each setup parameter, please click the Help button on the bottom right

Click the Help button to get the detailed information of this setup window.

Example 1: Read ASCII message from a barcode reader.

With the following example program, when C1 is ON, the Receive instruction is activated and Com Port 2 waits for an ASCII message from the barcode reader. When Com Port 2 receives an ASCII message and it includes the termination character (CR = Carriage Return in this example), C2 is turned on and the received ASCII message is copied to TXT1 address.

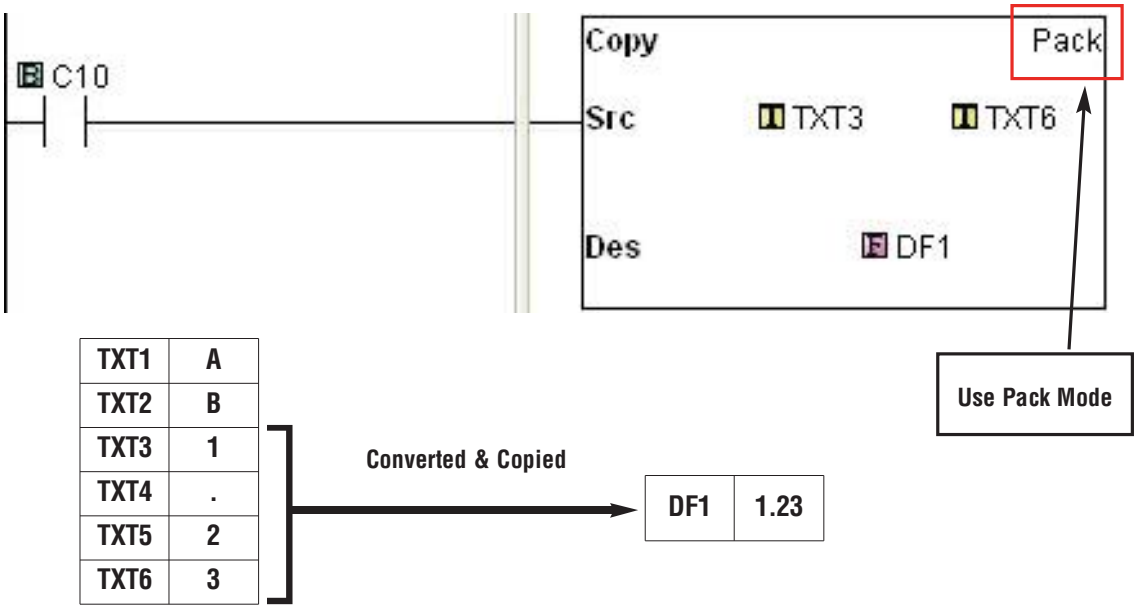




Example 2: Retrieve numerical data from the received ASCII message.

When numerical data is included in the received ASCII message, you may want to retrieve the numerical data and copy into a data register. The Copy instruction can be used for this purpose.

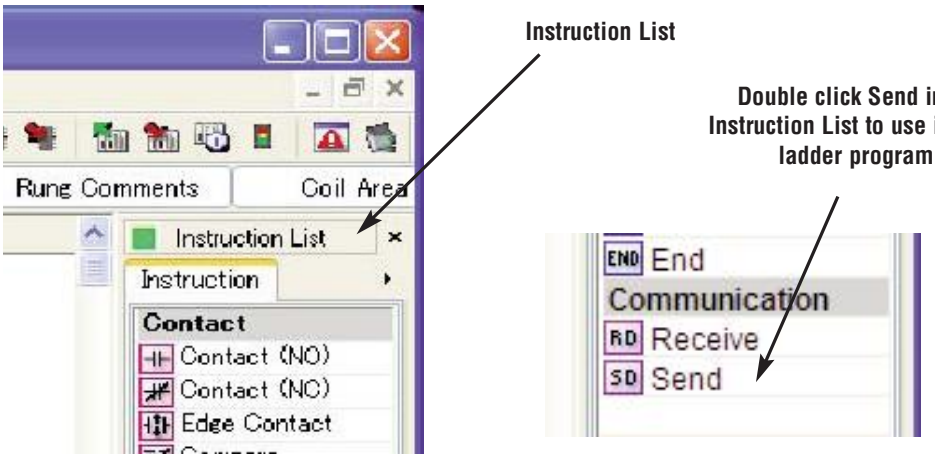
In this example, received ASCII message is stored in TXT1 to TXT6. This ASCII message includes a numerical data '1.23' as ASCII characters from TXT3 to TXT6. The Copy instruction converts those ASCII characters into the equivalent numerical data and copies into data register DF1.



P-4 P-4: ASCII Send Programming

Instruction

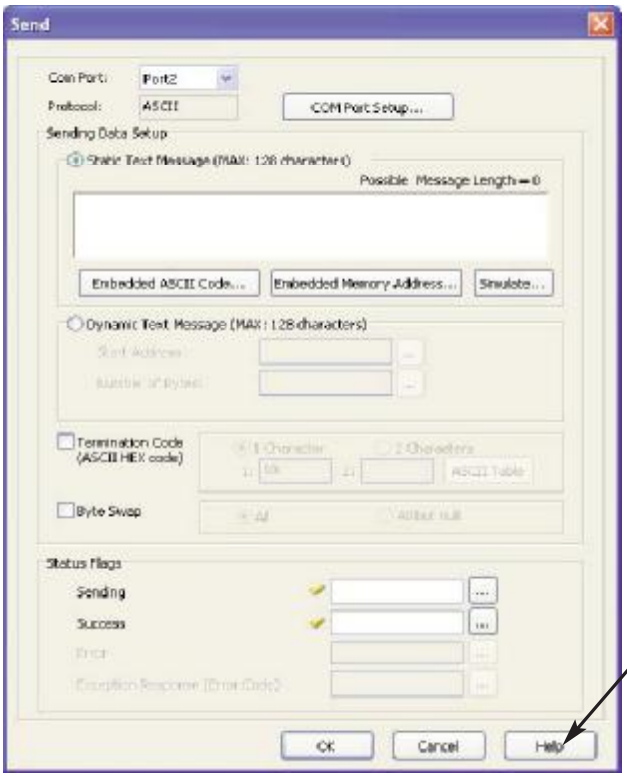
The Send instruction allows the CLICK PLC to send ASCII messages to an external device. To use this instruction, double click Send in the Instruction List window as shown below.



Select the Com Port that you are going to use and confirm the Protocol is ASCII.

If the Protocol is not ASCII, click the Com Port Setup button to open the Com Port Setup Details window and change the Protocol to ASCII. If the Protocol selection is grayed out as shown below, it means the Com Port is used by another Receive and/or Send instruction the ladder program. You cannot change the Protocol setup until you delete those instructions.

When you open the Send instruction in the ASCII mode, the window should look like this. For the explanation of each setup parameter, please click the Help button on the bottom right.



Click the Help button to get detailed information on this setup window.

Example: Send ASCII message to a serial printer.

With the following example program, when status of C1 changes from OFF to ON, the Send instruction sends ASCII message 'ABC' and the termination character (CR = Carriage Return in this example). C2 is turned on when sending the ASCII message is completed.