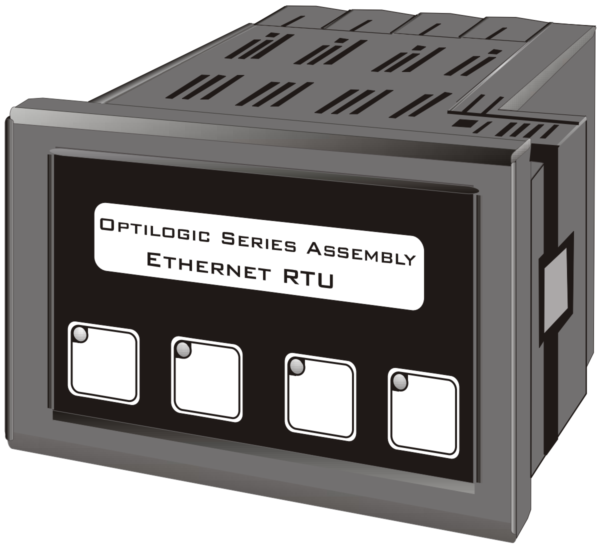
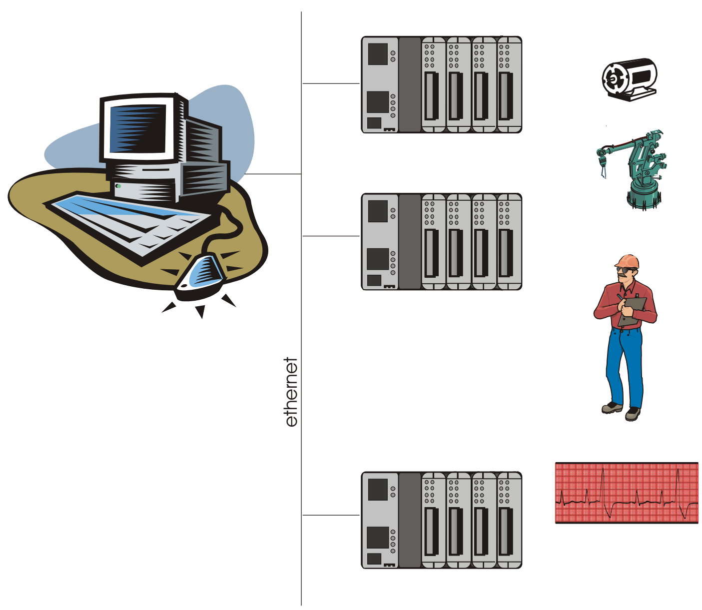


OptiLogic
Remote Terminal Units



Optimation, Inc.

(256)883-3050

www.optimate.com

Optimal Automation for Industry

WARNING

Thank you for purchasing industrial control products from Optimation, Inc. We want your new system to operate safely. Anyone who installs or uses this equipment should read this manual (and any other relevant publication) before installing or operating the system.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your system. These include the National Fire Code, National Electric Code, and other codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or governmental offices that can help determine which codes and standards apply to your situation. It is your responsibility to determine which codes and should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes. If you have any questions concerning the installation and operation of Optimation products, please call us at (256)883-3050.

Programmable control devices, such as OptiLogic I/O must not be used as stand-alone protection in any application. Unless proper safegaurds are used, unwarranted start-ups could result in equipment damage or personal injury. The operator must be made aware of this hazard and appropriate precautions must be taken.

In addition, consideration must be given to the use on an emergency stop function that is independent of the software based control system.

All Optimation products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. Warranty applies to unmodified product under normal and proper use and service. Optimation's sole obligation under this warranty shall be limited to either, at Optimation's option, repairing or replacing defective product. The cost of freight to and from Optimation will be borne by the customer. No other warranty is given or implied.

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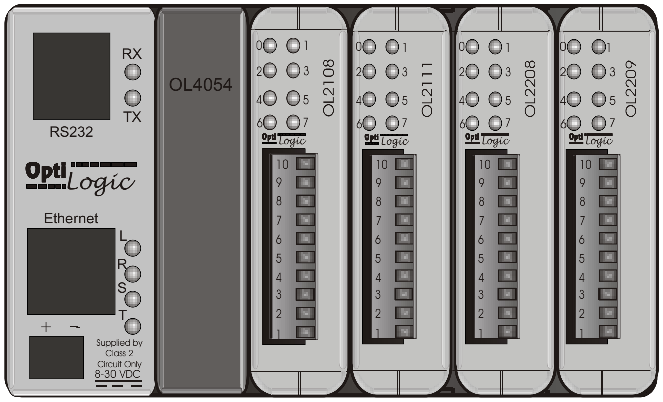

RX
TX
RS232
OptiLogic
Ethernet
L
R
S
T
+
Supplied by Class 2 Circuit Only
8-30 VDC
OL4054
OL2108
OL2111
OL2208
OL2209

1.0 OptiLogic Remote Terminal Unit

1.1 Introduction

Optimation's OptiLogic™ remote terminal units provide point of use I/O and operator panel capabilities with a high speed link to host controllers, such as the Pointe Controller, PC-based control, certain Ethernet enabled PLCs. They are designed to be a flexible, high performance, low cost I/O subsystem for distributed control applications.

OptiLogic Ethernet remote terminal units (RTUs) are modular in design. They allow you to plug together any combination of analog and digital inputs and outputs that will fit in the available slots. The card cage base snaps onto a standard DIN rail for back panel mounting. If an operator panel is required, the base snaps onto any of a variety of available OptiLogic operator panels which can, in turn, be panel mounted. The Ethernet connection provides a 10BaseT (10 MBPS) connection to the network.

A system built with OptiLogic RTUs allows you to monitor and control equipment and systems locally or spread throughout a building. A Pointe Controller, a PC or a PLC with a standard Ethernet connection can serve as the central controller. Input data, output control and operator panel operation are only a millisecond response away.

OptiLogic RTUs are designed to handle high speed ditributed I/O functions. They are part of the larger OptiLogic family that includes the Pointe Controller. If you need local control, master control, web server, java functionality, etc., please look at the Pointe Controller

The following is a list of some of the system architectures that are well suited to OptiLogic I/O.

- **Pointe Controller remote I/O**
- **Pointe Controller local expansion I/O**
- **Distributed I/O for PC-based control systems**
- **Remote or expansion I/O for ethernet enabled PLCs**

The following pages provide the basic information necessary to get your OptiLogic system up and running. More detailed information on each of the available I/O modules and operator panels is available in separate documentation.

2.0 System Overview

Before we get into the details, lets take a look at the basic system architecture. The figures on the right illustrates typical systems.

OptiLogic RTUs can be placed at the point of interface, anywhere within a building. They will communicate over an Ethernet connection back to a host PC. A system can easily incorporate from one to 255 RTUs. More than 255 RTUs can be handled with some extra configuration.

The top figure shows a Pointe Controller, as the main system controller, with OptiLogic RTUs serving as distributed or expansion I/O. This configuration represents low cost/high performance distributed control. This architecture is commonly extended to multiple Pointe Controllers, supervised by a SCADA system. Each Pointe Controller could have its own OptiLogic RTUs for I/O.

A typical PLC application would be configured identical to the Pointe Controller illustration. This architecture is available to any PLC that will communicate as a Modbus TCP/IP master - using the OL4228 RTUs.

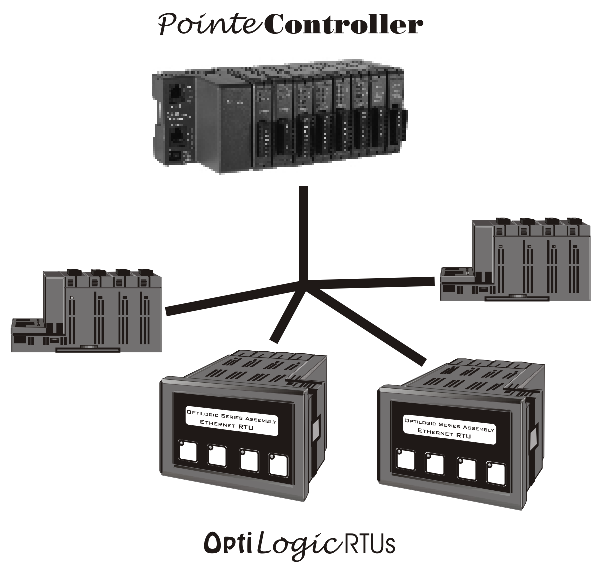
The picture on the lower right illustrates OptiLogic RTUs being used directly in a PC-based control application.

Of course, all kinds of application combinations and variations are possible.

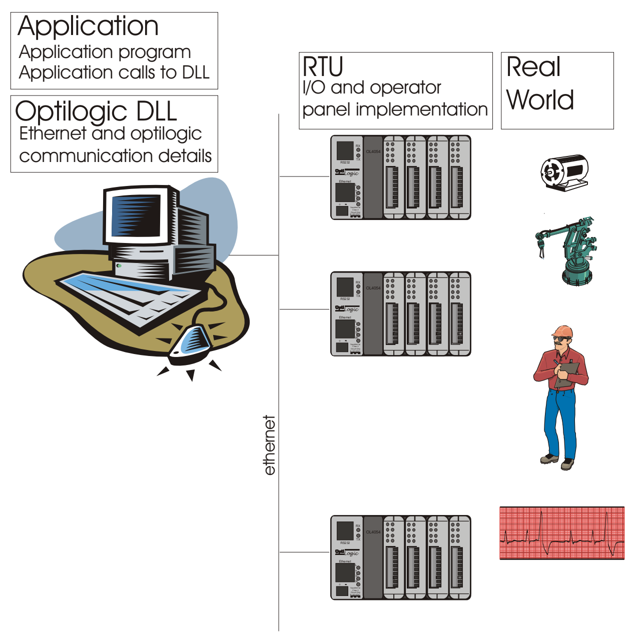
The host PC or Pointe Controller will communicate with each RTU over an Ethernet communications link. The link operates a data rate of 10MBPS (10,000,000 bits per second). At that rate, even a large system transfers all of the necessary data from host to RTU, and from RTU to host in a matter of milliseconds. With this type of communications, you can monitor and control a large system over hundreds of feet from a central controller in real time.

For deterministic Ethernet communications we recommend an **isolated** network for connecting OptiLogic RTUs to your PC based controller. For systems that are less time critical, other devices may be attached.

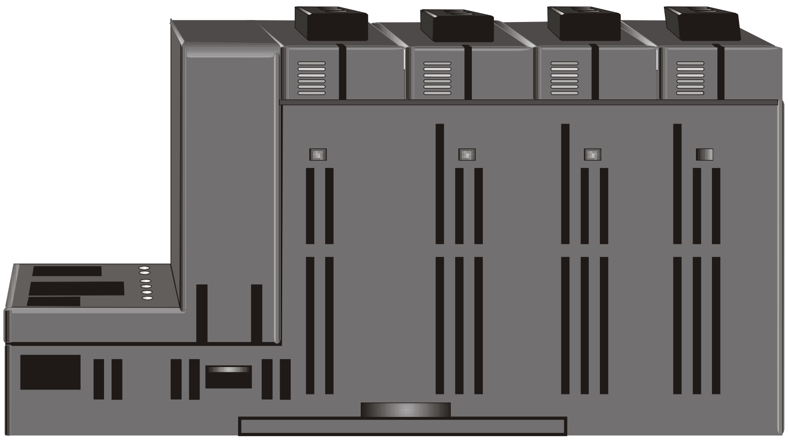
Distributed Pointe Control Application



PC-based Control Application



3.0 OptiLogic Base Description

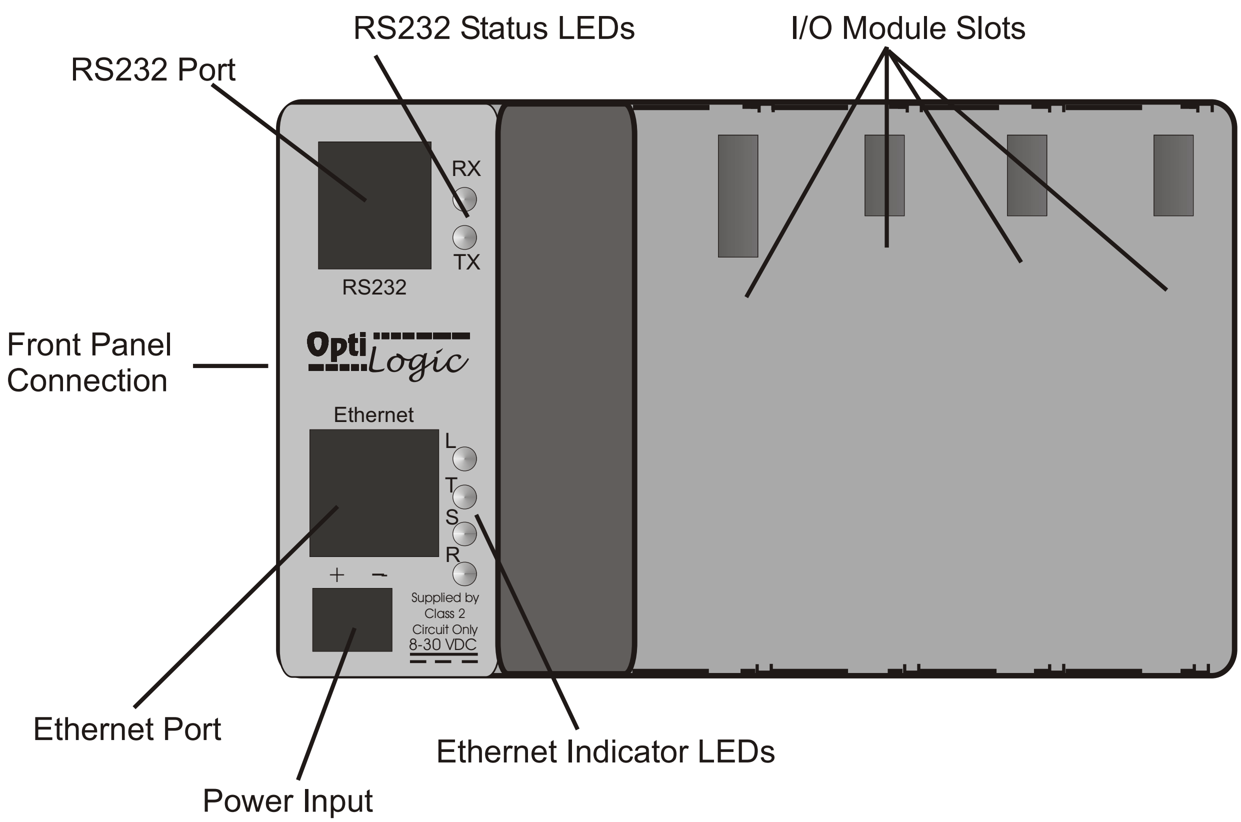


OptiLogic RTU Base

An OptiLogic Ethernet RTU base consists of a card cage containing an OptiLogic motherboard. The base unit has a built in Ethernet port, as well as an RS232 port. The Ethernet port is the interface to the larger system. The RS232 port is provided for general purpose communications (as defined by your application program). It is also designed to allow you to load future program upgrades (to incorporate the ability to interface future I/O boards and operator panels) into the base.

The figure below shows an OptiLogic Ethernet RTU base. The particular base shown is a 4 slot base. Bases with different numbers of slots are available and have the same basic features.

The communications ports both have status indicator LEDs which provide you with visible indications of each port's operation. The RS232 port indicates when transmit (TX) andreceive (RX) are active. The Ethernet port provides indications for good Ethernet link connection (L) and Ethernet port access by the

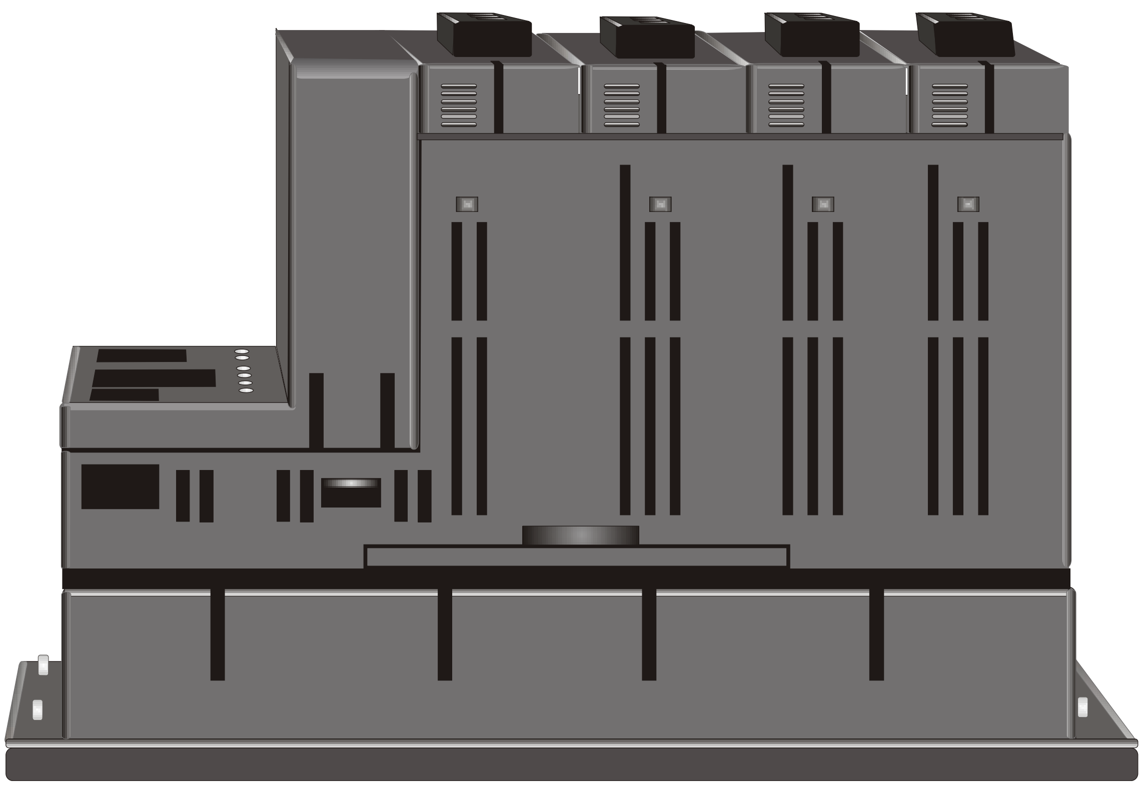


base processor (S) as well as transmit (T) and receive (R) indicators.

Power must be provided to the unit by an external DC power supply. Any DC voltage within the range of 8-30VDC is acceptable.

Input and output modules can be plugged into the slots in the base. Most modules can plug into any base slot (including slot 0). Slot 0, has some extra features for a couple of specialty modules. Those modules are documented as slot 0 specific. They are also obvious, in that they have 12 pin connectors rather than 8.

The OptiLogic base can snap onto a standard DIN rail. It also can snap onto the DIN rail built into OptiLogic operator panels. When incorporating an OptiLogic operator panel, the cable connection on the side of the RTU base is used.



Base with Attached Operator Panel

4.0 Frequently Asked Questions

Q. What is Ethernet?

A. Ethernet is the most common communication standard for use by local area networks in existence today. It is a communication standard which defines cable type and signaling methods to use in a local-area-network (LAN). An Ethernet network transmits packets of information between connected devices at speeds of 10 to 100 million bits per second (Mbps). Twisted pair 10BaseT ethernet is the most widely used ethernet technology due to its low cost, high reliability and 10 Mbps speed. Products manufactured by multiple vendors can communicate using common software protocols.

Q. What does the OptiLogic RTU do?

A. The OptiLogic RTU is designed to allow automatic communication of I/O and operator panel data with a Pointe Controller or properly configured PC-based control software. Special application interface routines (available from Optimation) are used by the PC-based master to request I/O data using Ethernet. This manual will provide details for properly installing the OptiLogic RTU in preparation for communications to a master control system.

Q. What is a protocol ?

A. A protocol is a definition of message formats that allows computers to connect with one another, transmitting messages which are understandable to both the sender and the receiver. There are "layers" of protocols. A high level layer, such as IPX or TCP/IP, transports packets of information from one point to another. A lower level protocol, such as Optimation's OptiLogic protocol or industry standard Modbus protocol contains the specific information and commands that allow the system to work.

Q. Which high level protocols are supported by the OptiLogic RTU ?

OptiLogic RTUs support both the most common high level protocols - IPX, TCP/IP and UDP/IP. IPX is a protocol developed by the long time LAN market leader Novel. TCP/IP and UDP/IP are the transport protocols used on the internet. The OL4054 and OL4058 bases support UDP/IP and IPX with the OptiLogic protocol. The OL4228 supports Modbus TCP/IP and OptiLogic UDP/IP.

Q. What are the particular strengths and limitations of IPX ?

IPX is easier to set up than TCP/IP or UDP/IP. Since it is also a somewhat simpler protocol, it normally requires less CPU time in the host CPU - yielding slightly better message turn around. If the system uses a private local network, IPX is recommended. The limitation of IPX is that it cannot be transmitted though a network router. If your network is a large routed network, use TCP/IP or UDP/IP.

Q. What are the particular strengths and limitations of UDP/IP?

UDP/IP is compatible with TCP/IP. It is routable anywhere. It is therefore recommended for any large network which contains network routers. It is a little more complicated to set up. It provides no real advantages for a smaller, local network - therefore IPX is recommended for smaller, local networks.

Q. What are the particular strength and limitations of TCP/IP?

In technical terms, within a control system, TCP has no advantages over UDP. TCP is a protocol that will handle multiple packet messages and ensure that received messages are re-assembled in the order in which they are transmitted. The reason that this really provides no technical benefit for RTU communications is that RTU messages are single packet messages anyway. The non-technical reason for implementing TCP for Modbus is that TCP was defined as the industry standard for Modbus communication (Modbus TCP/IP).

Q. What software must be present on my PC to allow it to communicate with OptiLogic RTUs using OptiLogic protocol?

A. Optimation provides link software (a DLL or dynamically linked library) that handles the communications between your application software and the RTUs. This DLL is incorporated in the graphical programming packages designed to interface OptiLogic. This makes it totally transparent to you, the user. Alternatively, you can create custom software using our Software Development Kit (SDK) for PC-based systems. See our Internet Web site at (http://www.optimate.com.)

Q. What is required to set up the Pointe Controller to communicate with OptiLogic RTUs?

There are only two requirements that must be met. Each OptiLogic RTU must be assigned an IP address within the same subnet address range as the Pointe Controller. Secondly, each RTU that a given Pointe Controller must communicate with must be given a unique unit number (rotary switch address). The procedure for setting this address is covered in this manual.

Q. Which Ethernet packets are recognized by the OptiLogicRTU slave?

A. OptiLogic RTUs support IEEE 802.2, IEEE 802.3, Ethernet 2, and SNAP Ethernet packets. The module will respond to IPX, TCP/IP and UDP/IP messages which are initiated using proprietary application interface software (Optimate DLL) or industry standard Modbus TCP/IP. Use of the Optimate DLL eliminates the need to know any of the ethernet details.

Q. What are standards and should I be concerned about them?

A. Standards are developed to provide guidelines for physical and logical network topologies. Below is a short list of most commonly used Ethernet cabling standards and their key characteristics.

10Base-2-Thin coaxial cable , which supports a maximum of 30 stations per unrepeated network and is limited to 185 meters (607ft.) per cable segment.

10Base-5 - Thick coaxial cable, which supports a maximum of 100 stations and is limited to 500 meters (1,640ft.) per unrepeated segment.

10Base-F - Plastic or Glass Fiber Optic maximum of 1024 stations and distances depend on signaling technology and medium used but can commonly support up to 2 Kilometers.

10Base-T - Unshielded Twisted Pair, which supports a maximum of 1024 stations with a segment of 100 meters, but distance is truly based on signal loss in decibels (less than 11.5dB loss source to destination).

More Ethernet standards information may be found by searching the following Internet Web site: http://standards.ieee.org

Q. Which Ethernet specifications are required to install an OptiLogicRTU system?

A. None. Detailed Ethernet specifications are not necessary for implementing the OptiLogic RTU system.

Q. Can an Ethernet System be Determinsitic ?

A. YES. Determinism means that you can count on a consistent, reasonable time from when a message is transmitted from the host until a response is received from the RTU. For OptiLogic systems with a small number of bases (5 or less), determinism is inherent with no special handling. For large systems, the simple employment of store and forward switches will eliminate the collision domains and ensure determinism.

5.0 Configuring Your RTU

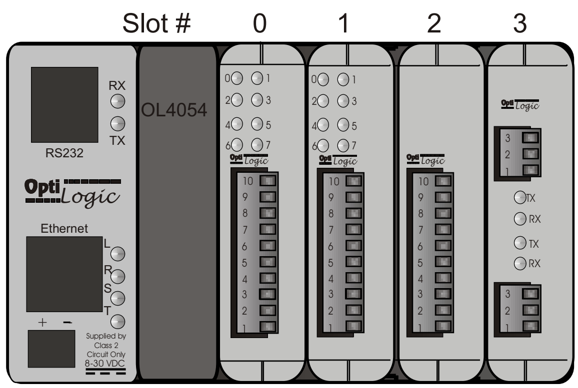
Each OptiLogic application will differ in the number and type of I/O, the operator panels used (if any) and how the devices must be distributed. The modular design of the OptiLogic system allows you to mix and match to meet your exact system requirements.

System configuration entails an early process of defining exactly what type and quantity of I/O you need at each location. If operator interaction, alarm annunciation, or status display are required at the various points, the appropriate operator panel should be chosen. Once that is done, you can custom tailor your RTUs by selecting and installing standard I/O modules in your OptiLogic base units and snapping the appropriate operator panel onto each.

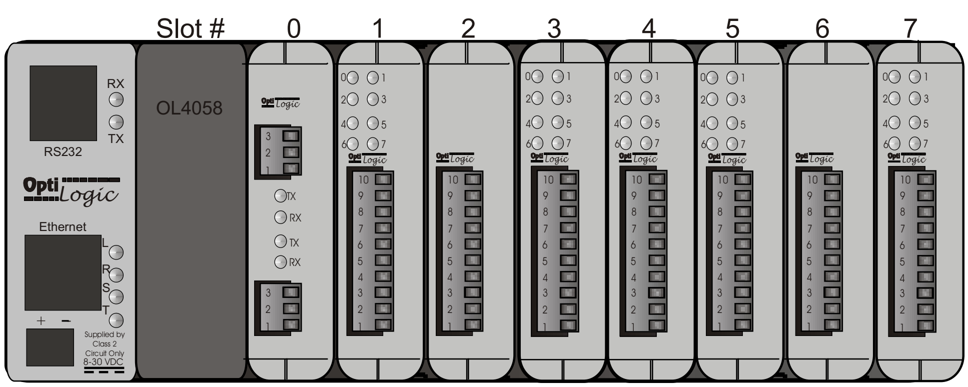
5.1 Slot Numbering

Each module will occupy one slot in the RTU base. Each slot position is numbered as shown below. The slot number will provide a reference to your application program for selecting the appropriate module for each particular operation.

Slot numbering is simply left to right, starting with slot number '0'.



OL4054 4 Slot Base



OL4058 or OL4228 8 Slot Base

5.2 Available Modules

The following is a list of I/O and operator panel modules available at the time of this printing. Many more modules will be available in the near future. To get a current list of available modules, visit our web site at http://www.optimate.com

5.2.1 Available I/O Modules

The following I/O modules are currently available (generally off the shelf).

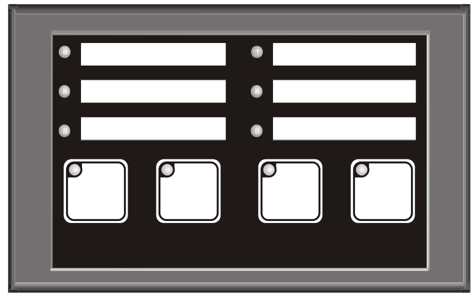
Digital Input	
OL2201	8 Digital input simulator (toggle switch input)
OL2205	4 AC/DC (10-30V) In -- Each input has a separate common
OL2208	8 DC (10-30VDC) In
OL2211	8 AC (80-132VAC) In
OL2252	2 high speed counters (up to 20KHz) inputs. 6 additional inputs configurable as general purpose DC inputs or control signals.
OL2258	High speed counter input for pulse encoder type devices. Up/Down count, Pulse & Direction or Quatdrature inputs accepted. Pulse counting to 80KHz (160KHz for quadrature). Two high speed transistor outputs.
Digital Outputs	
OL2104	4 Relay (2A resistive @ 24VDC, 1A @120VAC)
OL2108	8 Relay (2A resistive @ 24VDC, 1A @120VAC)
OL2109	8 Transistor (500mA sink)
OL2111	8 AC Solid State Relay (1A)

Analog Inputs/Outputs	
OL2304	4 channel voltage output, 0-5V, 0-10V, +/-5V, +/-10V
OL2408	8 channel 0-5VDC or 0-10VDC in
OL2418	8 channel 4-20mA in
Communications	
OL2602	2 Port RS232

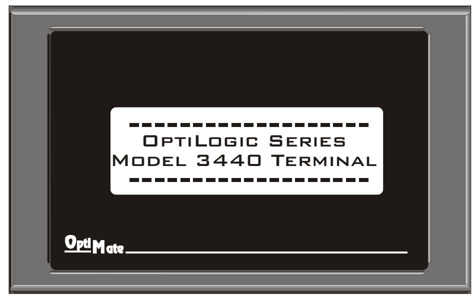
5.2.2 Available Operator Panels

The following is a list of currently available OptiLogic Operator Panels.

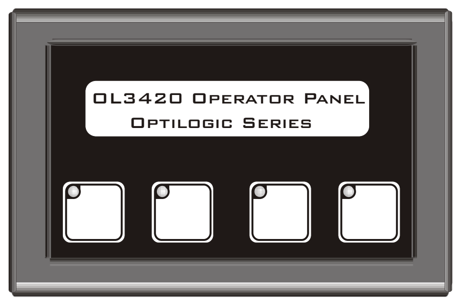
Pushbutton/ Indicator Panels	
OL3406	6 Indicator/4 Pushbutton
Alphanumeric Display	
OL3440	4 Line x 20 Character backlit LCD alphanumeric display
Terminal Panels	
OL3420	2 Line x 20 character backlit LCD display, 4 pushbuttons
OL3850	2 line x 20 character backlit LCD display, 5 user definable pushbuttons, numeric keypad, 3 indicator light bars



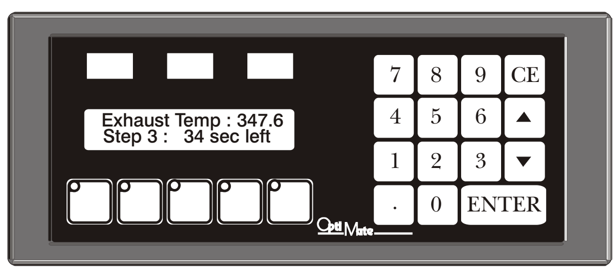
OL3406 Pushbutton/Indicator Panel



OL3440 Alphanumeric Display



OL3420 Alphanumeric Terminal



OL3850 Operator Terminal

5.3 Addressing the RTU

Each device on an Ethernet network must have a unique 48-bit IEEE assigned Ethernet address. We've taken care of that. Each RTU is assigned an address at the time of manufacture. You never have to see it or deal with it.

If you are implementing an IPX protocol system, or are implementing a TCP/IP system with a DHCP server, the only address you need to be concerned with is the OptiLogic RTU address, covered in the next section. If you are implementing a TCP/IP system and need or want to set a fixed IP address, a utility program is available to download that address.

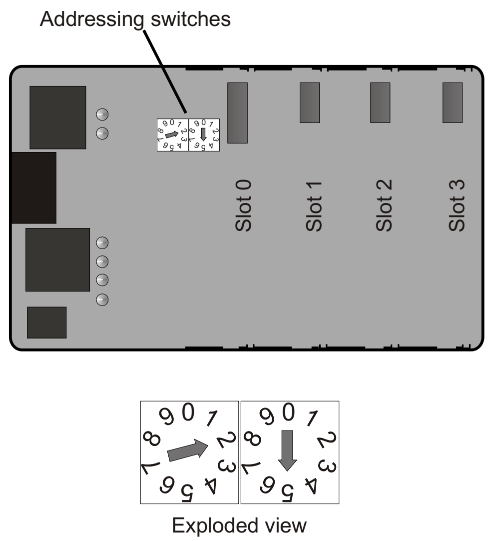
5.3.1 Setting the OptiLogic RTU Address

The addressing that you, the system designer, must set is the address set via rotary address switches in the RTU base. Each OptiLogic RTU in your system must have its own unique address. This address, a value between 1 and 99, is how the software in the master PC identifies each RTU.

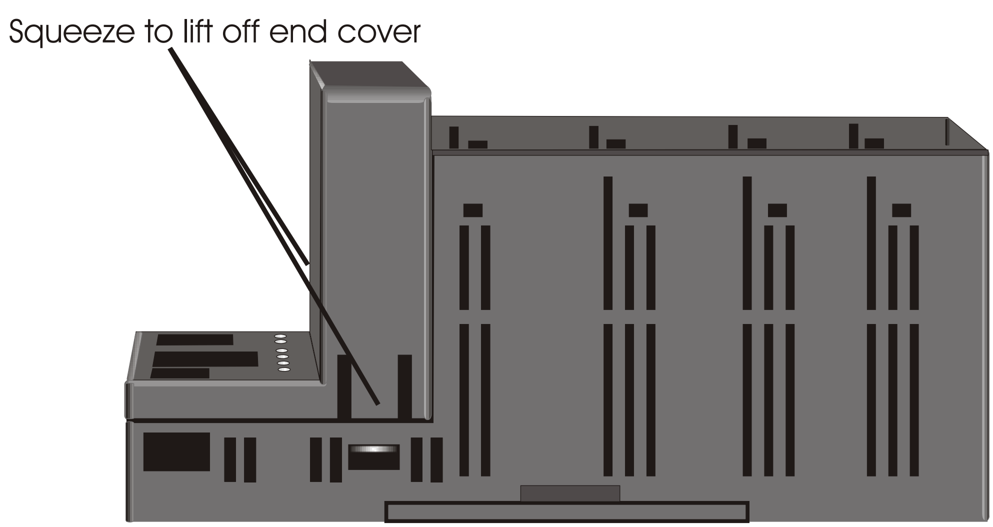
To get to the address switches, you must first remove the end cover from the base unit. To do this, simply squeeze the latching tabs, shown in the figure below, and lift the cover off.

Removing the end cover will expose the RTU base mother board. The address switches will be found near the connector for slot 0.

To set the RTU address simply rotate the rotary switches to the desired value. The switch on the left is the "tens" digit. The switch on the right is the "ones" digit. A small flat blade screw driver is the only tool you need. The address shown on the figure below is "25".



Remember that each RTU in your system must have its own unique address, which is set prior to applying power to the RTU. Duplicate addresses will cause system communications to fail.



5.3.2 Setting the IP Address

If you are implementing an ethernet system using TCP/IP, each RTU must have an IP address. This IP address can either be downloaded to each RTU as a "fixed" address, or it can be allocated dynamically in a system that has a DHCP server. ***We recommend using a fixed address.***

DHCP servers are generally found in existing systems that are used as a general data network, passing files, email, etc. throughout an office environment. If you are connecting into such a network, the OptiLogic RTUs are designed to automatically accept and use a dynamically allocated IP address provided by the DHCP server. The only requirement is that the RTU must not have a fixed IP address already assigned. The address allocation and use is totally transparent.

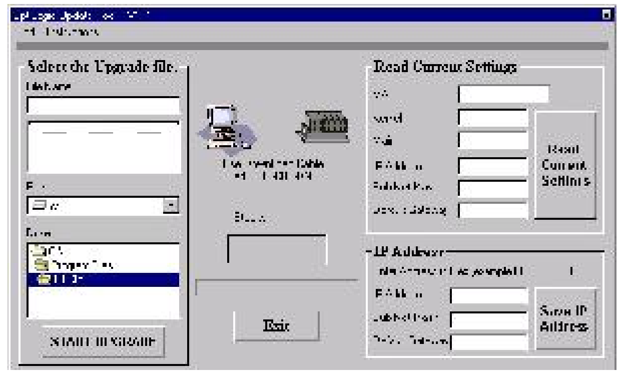
If an RTU already has a fixed IP address, and you want to change its operation to accept its address from a DHCP server, that can be accomplished. The OptiLogic Update Tool can be used to clear the fixed IP address

Optimation provides the OptiLogic Update Tool to allow you to update and upgrade your RTUs at any time. The OptiLogic Update Tool is a software utility that can be used to load new code into the RTU base, check existing software version information, and set the IP address. It can be downloaded from the Optimation web site, www.optimate.com, and runs on any PC compatible that runs Windows 95, NT or higher. You will also need a download cable, Optimation part # - OL-CBL-DNL.

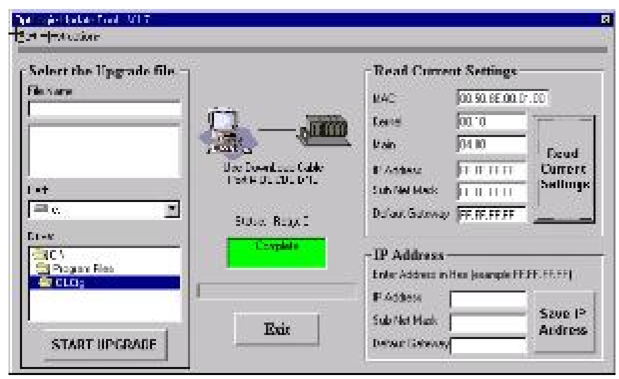
This manual will simply touch on the highlights for setting, clearing or changing an IP address.

To get the OptiLogic Update Tool, simply go to www.optimate.com. Go to the Software Downloads page. Download and install the software on your computer.

When you start the OptiLogic Update Tool, the following screen will appear. Notice that in the upper left hand corner, there are two pull downs for port selection and instructions. Select the PC's comm port that you will use, then follow th instructions.



If you read back the RTU's current settings, you will get a display similar to the one shown below. Note that if the IP address is all F's, as shown, there is no IP address set. To set the address, follow the instructions. To clear the IP address, follow the instructions & enter all F's as the address.



5.4 Calculating Your Power Budget

Each I/O module and operator panel that you attach to your RTU requires a certain maximum amount of power to operate. Each RTU base has a limit on the total amount of power available to power I/O modules and operator panels.

Always ensure that the total maximum power required by the I/O modules and operator panel does not exceed the power supplied by the RTU base. To determine your total power requirements, simply add the maximum power required by each module and operator panel.

Power Supplied	
RTU Base Type	***5V current available***
OL4054	2.7A
OL4058	2.7A
OL4228	3.6A

Power Required (Operator Panels)		
Panel Type	***Description***	***5V current required***
OL3406	PB/Indicator	50 mA
OL3420	Terminal	115 mA
OL3440	A/N Display	150 mA
OL3850	Terminal	525 mA

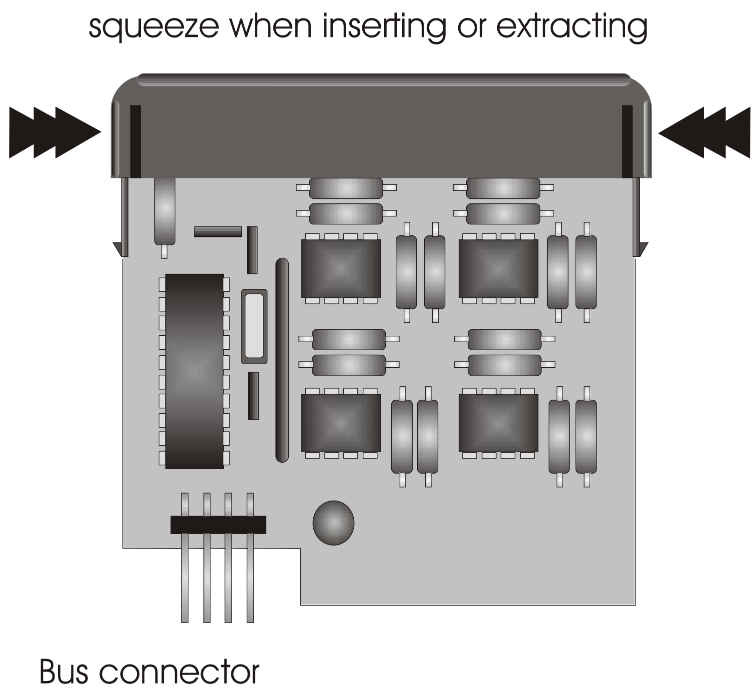
Power Required (I/O Modules)		
Module Type	***Description***	***5V current required***
OL2104	Relay Out	250mA
OL2108	Relay Out	375mA
OL2109	DC Out	140mA
OL2111	SS Relay Out	120mA
OL2201	Input Simulator	60mA
OL2205	AC/DC In	100mA
OL2208	DC In	60mA
OL2211	AC In	100mA
OL2252	Dual counter	100mA
OL2258	HS Counter	400mA
OL2304	4 chan D->A	700mA
OL2408	8 chan A->D	700mA
OL2418	8 chan A->D	700mA
OL2602	RS232	110mA

5.5 Installing I/O Modules

Each RTU bas has a number of slots available for installing I/O modules. The number varies according to the base.

Each slot has card guides along each side and a connector on the motherboard. To install an I/O module, place the module's PC board in the top and bottom card guides (note that the board will not be tightly retained until it is approximately ¾ inch into the card guide).

As you push the module into its mating connector, squeeze the ends together. This will allow the board latches to travel inside the card cage. When you have pushed the board into its mating connector and released, the latches should hook the card cage and keep the module in place.



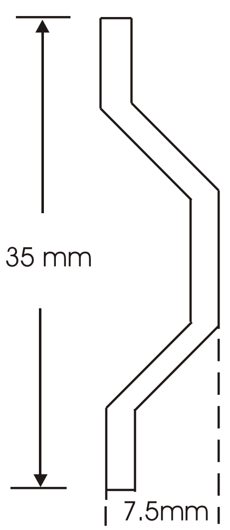
5.6 Mounting Guidelines

OptiLogic RTUs are intended to be mounted on a standard DIN rail. That DIN rail can be a commercial DIN rail attached to any flat surface. It can also be the DIN rail built into OptiLogic operator panels.

5.6.1 Mounting the Base

A DIN rail is simply a standard "U" shaped channel which is designed to be mounted horizontally on any flat surface. DIN rail can be purchased at nearly any electrical supply outlet, as well as through the PLC Direct catalog.

There are a few standard DIN rail sizes available. Pictured below is a cross sectional view of the standard 35 mm DIN rail the RTU base is designed to clamp on. The key dimensions are the 35mm overall width and a minimum 7.5mm height. The precise channel shape is not important.



DIN Rail Dimensions

Take a look at the bottom side of the RTU base. It will appear as shown in the figure below.

As shown in the figure, there is a DIN rail channel that runs lengthwise across the middle of the RTU base's bottom side. At the top of that channel are three overhanging hooks. At the bottom of the channel there is a sliding retaining clip.

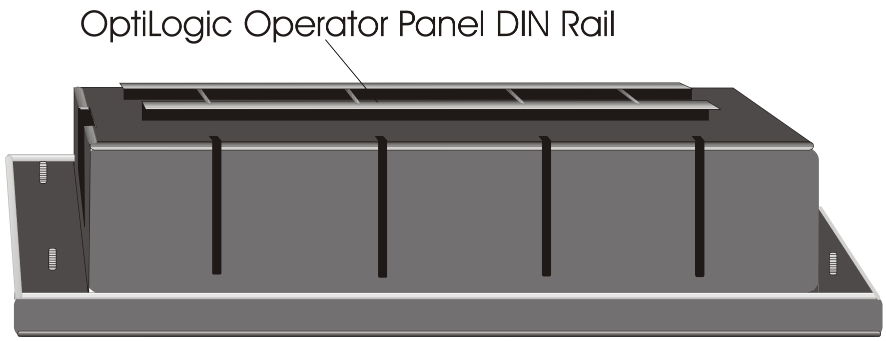
The process of installing a base on a DIN rail is as follows.

- **Pull the retaining clip back from the center of the base. It should pull back about 1/8 inch. The retaining clip on an uninstalled unit can be pulled back with your fingers.**
- **Place the RTU base on the *horizontal* DIN rail with the three overhanging hooks over the top of the rail. Mounting must be horizontal to allow convection air flow for cooling.**
- **Rock the RTU base down flat against the bottom of the DIN rail.**
- **Push the retaining clip closed to hook the bottom rib of the DIN rail.**

5.6.2 Mounting the RTU Base to an Operator Panel

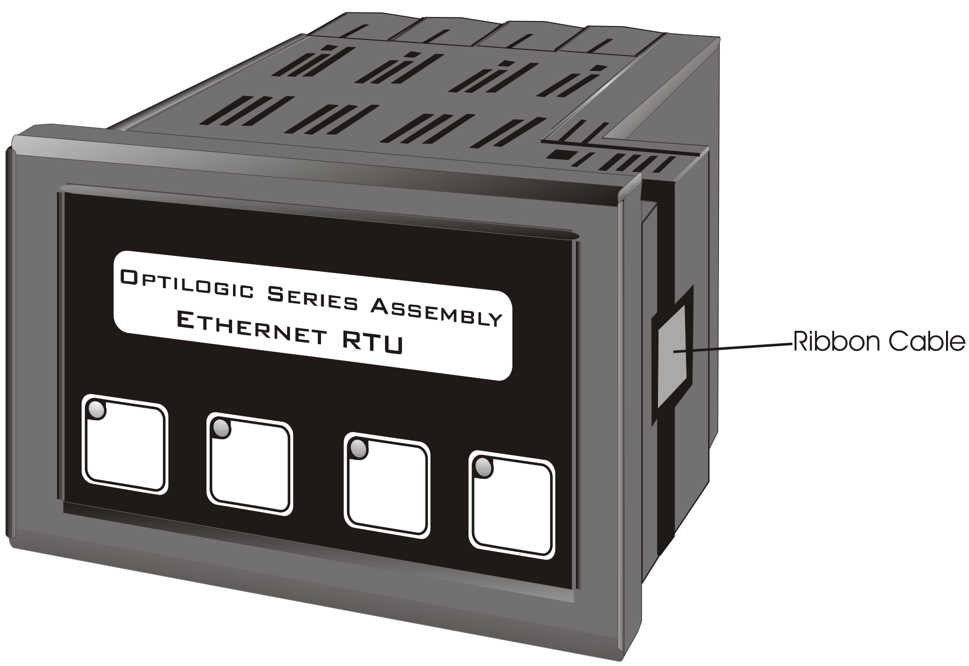
The OptiLogic RTU base can also be mounted to any OptiLogic operator panel. As shown in the figure below, OptiLogic operator panels have a built in DIN rail for mounting the base.

The mounting process is exactly the same as described for mounting to a DIN rail. Be sure that your orien-



tation is right so the connectors on the base and the front panel line up. An OptiLogic RTU base attached to an OptiLogic operator panel should look like the figure below.

The short ribbon cable, which comes with the operator panel should be used to provide the connection between the RTU base and the operator panel.



6.0 Network Configuration

A network is simply a system for interconnecting devices that talk to each other. In an Ethernet network, one transmitter connects to one receiver.

What makes Ethernet a multidrop network are devices called "hubs" and "switches", which connect to multiple Ethernet devices. On a hub or switch, each connection has a separate transmitter and receiver. A hub or switch contains several such transceivers, all interconnected in the internal electronics of the hub or switch.

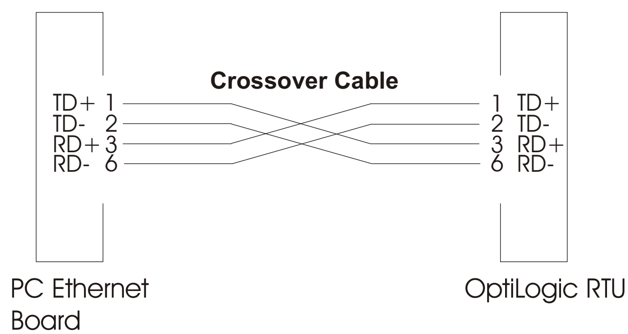
The following sections discuss interconnection using the term hub. Any of the configurations apply equally well to a switch. The differences between a hub and a switch and where to use each is covered in section 6.3

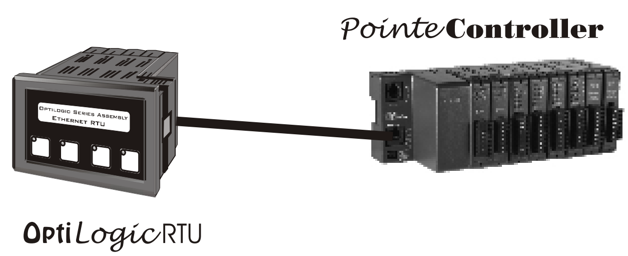
In an OptiLogic RTU system, there should be a single ***master***, the host PC, Pointe Controller or PLC. All physical media interconnections should be made to commercial building wiring standards EIA/TIA-568 and the specification for Unshielded Twisted Pair cable defined in the TIA/EIA TSB40-A specifications. For best case 10Base-T wiring, we recommend using all category 5 type cabling for connecting your OptiLogic RTU network.

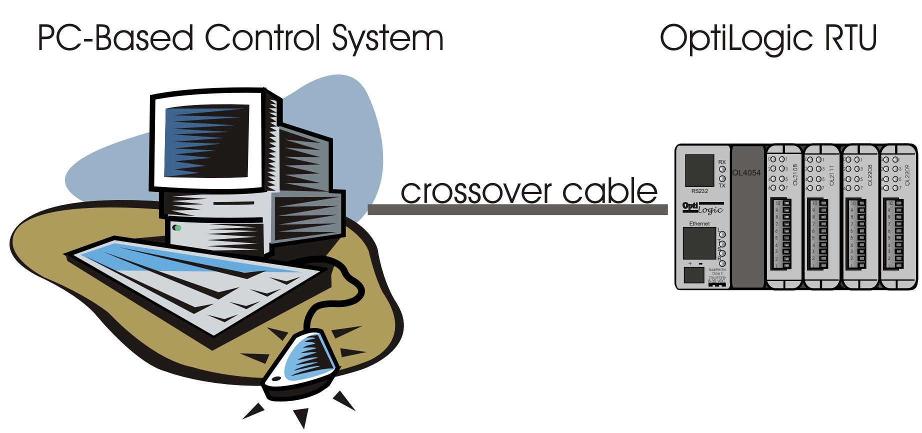
6.1.1 Point to Point Connection

The simplest system is a point to point connection. Point to point connections, as illustrated below for both the Pointe Controller to RTU & PC to RTU, require only a ***crossover*** type patch cable.

An Ethernet crossover cable, shown below, connects the transmitter on one side, with the receiver on the other. This is a category 5 type UTP crossover patch cable. Cable length is limited to less than 100 meters.



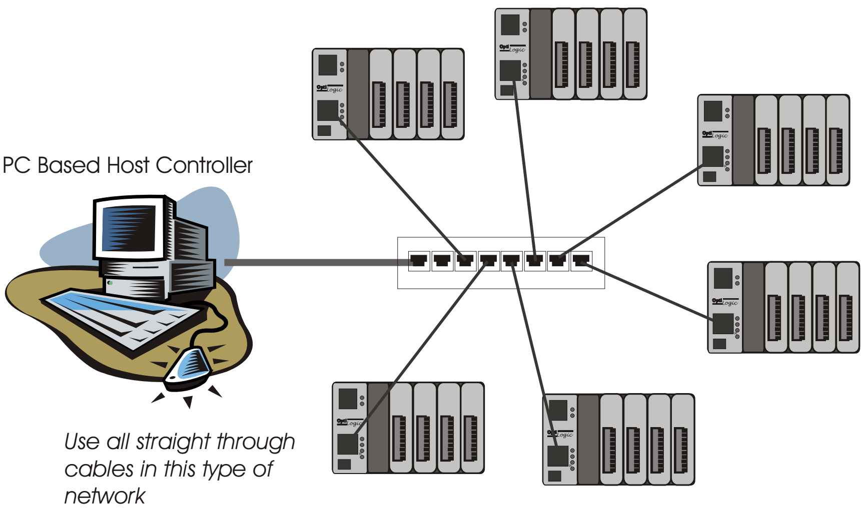




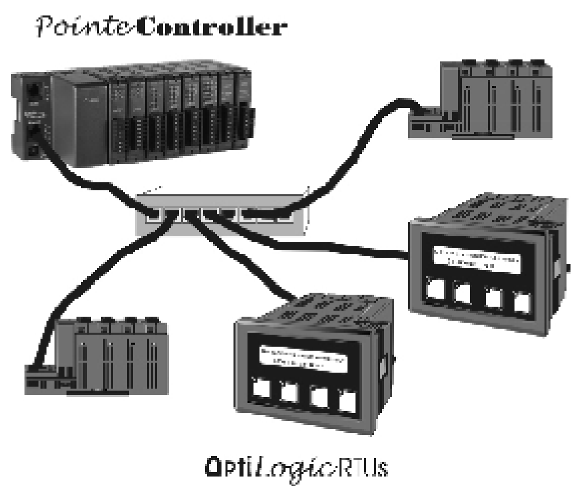
6.1.2 Single Hub Connections

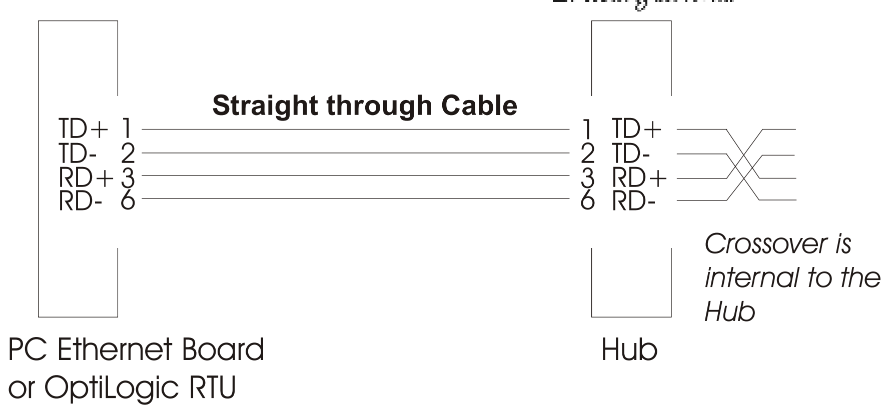
The next level of complexity is a single hub (or switch) system. Hubs are commonly available with anywhere from 4 to 24 connections.

The multiple Ethernet ports on a hub allow physical star type network wiring. The hub is typically placed in the center of the system. Individual cables are run between the hub and each RTU.



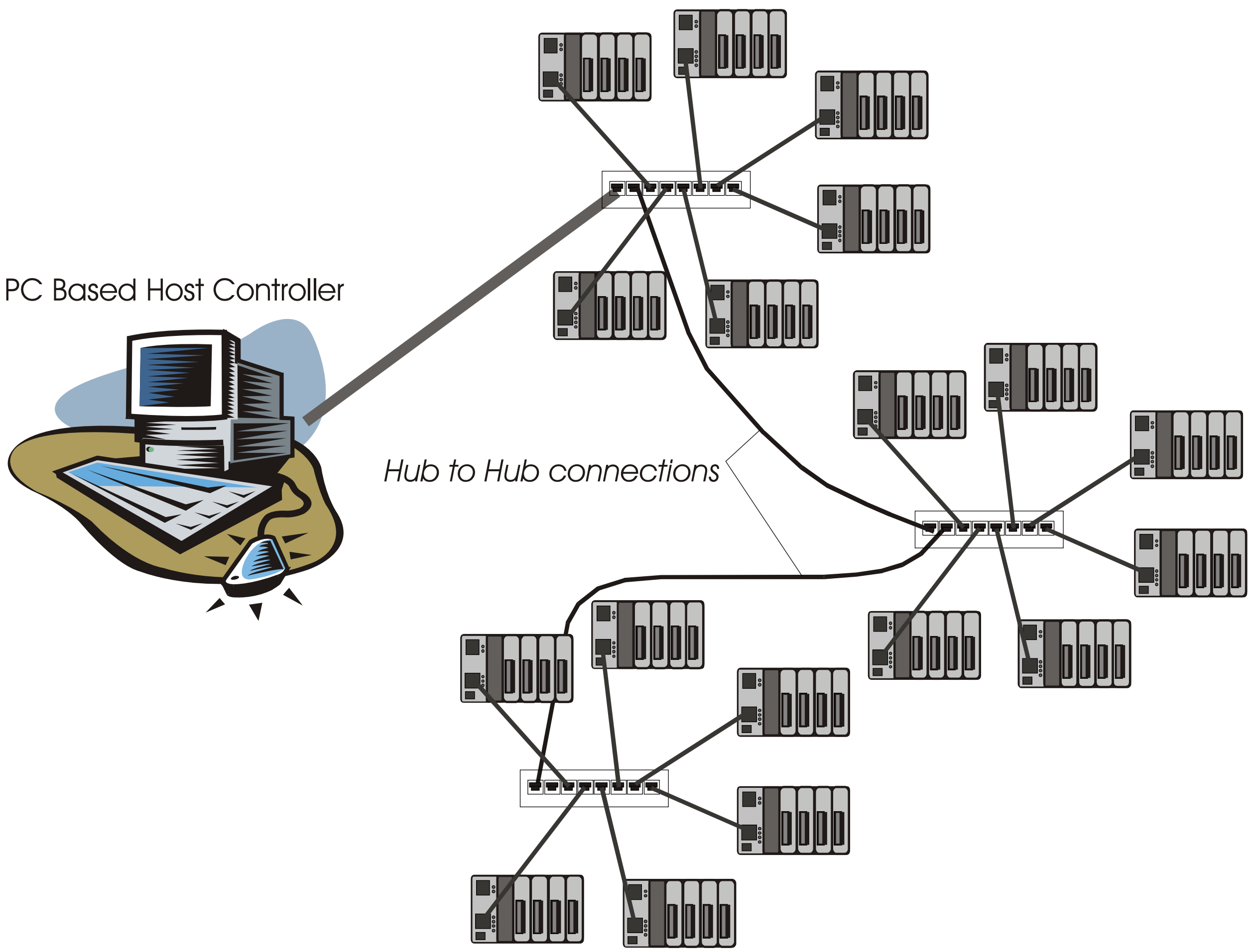
Crossovers are made internal to the hub. Therefore, in a single hub system, all connections are straight-through. Remember that for 10Base-T, each cable connection is limited to 100 meters in length.





6.1.3 Multi-Hub Networks

A maximum of five repeater, or switching, hubs may be connected in a single LAN network. These hubs provide a means for connecting multiple segments together. Each hub is commonly placed centrally to the group of RTUs that is serves. This is a cost effective solution to large distributed systems.



Multi-HubS ystem

In a multi-hub system, all connections between the PC and a hub, or an RTU and a hub are straight-through. All connections between hubs are crossover.

6.2 Ethernet Connection Guide

Ethernet 10Base-T is a flexible, low cost method of cabling local area networks. **Opti***Logic*RTUs must be connected using 10Base-T compatible products. All Ethernet 10Base-T implementation details are defined by the EIA/TIA standard 568A. This standard specifies UTP, an acronym for Unshielded Twisted Pair cable, to be between all nodes on a given 10Base-T network. UTP cables are rated according to their data-carrying ability (bandwidth) and rated by "category" number. The standard specifies category 3, 4, or 5 cable may be used with Ethernet 10Base-T applications. IEEE Ethernet standards limit cable length between nodes to 100 meters (328 feet). The distance limitation is based on the maximum cable signal loss of 11.5 decibels between the source and destination. Due to emerging high speed standards and product capabilities, many sites now install UTP category 5 type cables exclusively. We recommend category 5 cable for all OptiLogic connections.

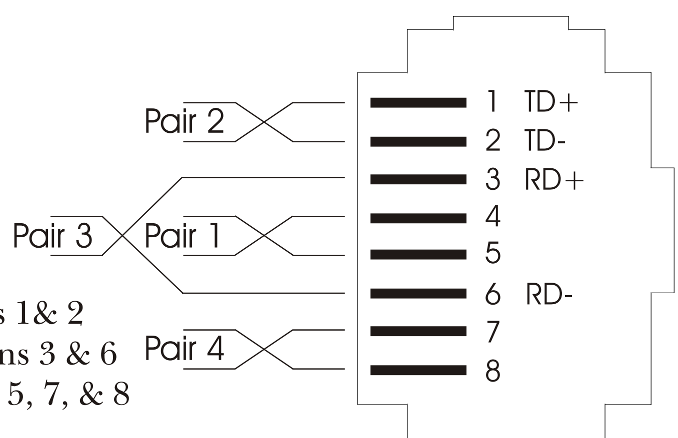
6.2.1 UTP Cable Characteristics

Cabling is the foundation of any network; if it's incorrect or unstable all other communications characteristics will be unreliable. The most critical aspect of UTP cabling is the maintaining of correct conductor pairing throughout the network. Commonly four-pair (8 wire) 24 AWG thermoplastic insulated solid conductor wire with a 100 ohm impedance and total diameter of less than 6.35mm (0.25 inch) should be used with Ethernet 10Base-T networks. To ensure correct pairing, network vendors offer patch cables (straight-through and crossover) which are assembled with connectors.

6.2.2 Cable Connectors

Opti*Logic*RTUs interface the network via the standard 8-pin extension port compatible with RJ45 type connectors. RJ45 type connectors are designed to accommodate rounded PVC outer jacket UTP cable. The strain relief for the cable is provided by the part of the RJ45 connector that acts as a wedge against the outer jacket. The wedge is pressed and locked tightly against the cable jacket when the connector is crimped into place.

A 10Base-T RJ45 connection is shown below.



10Base-T uses pins 1& 2 to transmit and pins 3 & 6 to receive. Pins 4, 5, 7, & 8 are not used

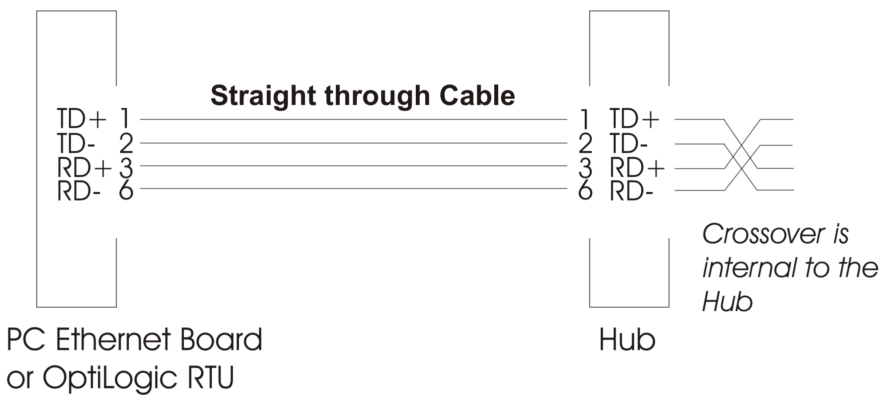
Warning: **Do not attempt to save money by using two pair or flat type cable with RJ45 connectors. The RJ45 connectors will not securely fasten onto the cable jacket.**

6.2.3 10Base-T Connections

Most hardware ports on Ethernet 10Base-T equipment are wired MDI-X (meaning medium dependent interface crossover) so you can use straight-through cable for interconnecting the network devices. This allows for proper alignment of transmitter and receiver circuits according to 10Base-T networking standards. For hub-to-hub connections, a crossover type cable is commonly required. The figures below illustrate pin assignment and signal names for straight-through and crossover type Ethernet patch cables.

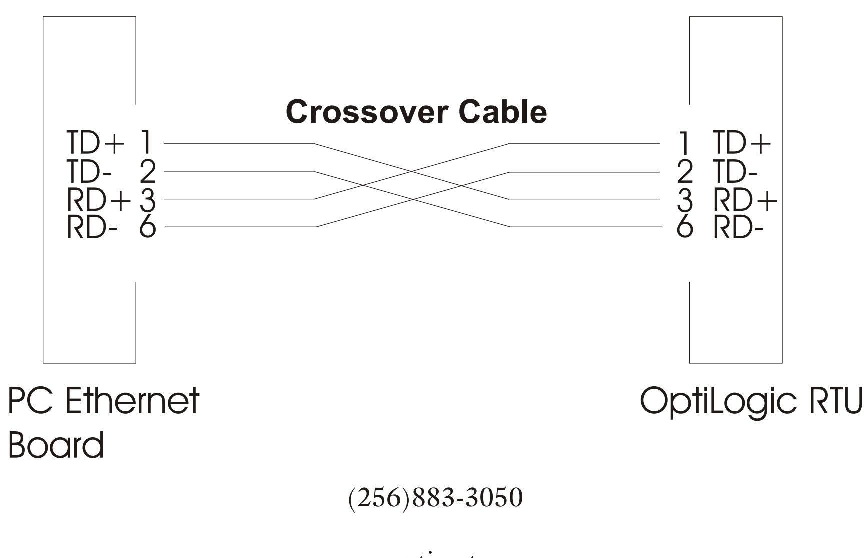
6.2.4 Straight-through Patch Cable

A straight-through cable is commonly used to connect Ethernet 10Base-T devices to a hub. Pre-assembled patch cables are available from various network product vendors. RJ45 connectors are attached at both ends of an assembled patch cable. We recommend using a category 5, UTP cable type for all **Opti**_Logic_ network connections.



6.2.5 Crossover Patch Cable

Crossover type patch cables are used to connect between hubs or switches. This type of patch cable must also be used for all point to point connections, such as a PC-based controller and OptiLogic RTU. Therefore, it is also called a point-to-point cable.



6.3 Collision Avoidance

It is important to understand the basic nature of ethernet in order to maximize performance. With an understanding of the basics and application of the appropriate network architecture, an ethernet system can be fast and deterministic.

Ethernet in a collision/backoff type network technology. When a device needs to talk on the line, it and it senses that the line is not active, it begins transmission. Collisions occur when two or more devices begin transmission at approximately the same time. Each device monitors for this situation and if a collision is sensed, each device will stop transmission and go into a “backoff”.

Ethernet backoff operates in a random, exponential manner. The first time a collision occurs, each device will back off for a random time within a range of very short time periods (microseconds). If the next time the device tries to talk another collision occurs there is another collision, the random time will be within a larger time range. Each successive collision/backoff will be within a larger range, up to a limit in the 100 millisecond range. When the backoff time gets large, it can affect system determinism.

Don’t worry. This can all be handled easily and inexpensively.

In a small network, collisions are rare & multiple collisions are extremely rare. As a general rule, systems with 5 or fewer RTUs don’t require any special handling and operate perfectly well using hubs discussed in the previous sections.

In larger systems, the use of store and forward switches can eliminate the potential collision problems.

6.3.1 The Difference between a “Store and Forward” Switch and a Hub

While switches and hubs look very similar, there are differences that can affect network operation.

A hub is a device that, when it receives a message its input side will pass it along to all legs of its output side. This results in most messages on a given leg being for devices not attached to that leg. The other important characteristic of a hub is that collisions occur in hubs & result in the backoffs just described.

A store and forward switch is more intelligent than a hub. A store and forward switch will only pass along messages, on a given leg, to devices that are attached to that leg. This results in a reduction in network traffic. A store and forward switch also buffers received messages and retransmits them when the line is free. In doing so it eliminates collisions, maximizes throughput and eliminates the possibility of long backoffs.

Store and forward switches are more expensive than hubs. However, the cost difference is very small in relation to the total cost of a large system.

This topic is handled in more detail in application notes available from Optimation.

7.0 Installation

7.1 Become Familiar with Your Application and Equipment

The first step in installing your system, is to become familiar with system requirements and all equipment involved. A major part of this task can be accomplished by reading this manual, as well as manuals on I/O modules, operator panels, and controller software to be used in the application. Other information can be gleaned from your application specifications - whether detailed written specs or simply an understanding of the application requirements.

From this information you should be able to define exactly what equipment will be required, including quantities and required physical locations of each.

7.2 Organize and Prepare Your Equipment

Ensure that you have all of the required RTUs, I/O boards, operator panels, cabling, hubs and PC equipment required for your application. The PC-based control system used must have the proper Ethernet hardware and software configuration to communicate with the OptiLogic RTUs.

The minimum parts needed are as follows:

- **OptiLogic RTU base(s)**
- **OptiLogic I/O and operator panel modules**
- **10Base-T patch cables for connecting the entire network**
- **Power supplies for powering the RTUs**
- **Hook up wire for I/O sensors and actuators**
- **PC with Ethernet board installed (for running PC-based control software) or Pointe Controller**
- **Mounting hardware, such as DIN rail**
- **Assembly tools, such as screwdrivers, wire strippers, etc.**

7.3 Network Operating System (PC-based Control Systems)

If you are using a PC as the host controller, check the following requirements when choosing your PC configuration. These are minimums. System performance will increase with high speed processor, larger memories, etc.

- **Windows NT, Windows 95 or Windows 98 compatible Pentium 133 (or higher).**
- **16MB RAM**
- **CD-ROM drive**
- **Ethernet network card**

7.4 Install the Ethernet Network Card (PC-based control systems)

Proper installation of the I/O network card is very important. The OptiLogic DLL software will use it to communicate with the RTUs. Installation will vary slightly, depending on the particular brand of Ethernet card used. However, typical installation will follow this basic sequence.

1) Remove power to your PC by unplugging the power cord.

2) Remove the cover of the PC housing to allow access to the PC motherboard and adapter cards.

3) Locate an empty slot of the type that matches your Ethernet card (either ISA or PCI slot).

4) Most network cards are software configurable. However, there are cards that require hardware configuration. If your card is hardware configurable, with jumpers or DIP switches, set it up for a)interrupt level = 10, b) I/O address = 0300h c)plug & play off

5) Remove the slot cover and install the I/O network in the slot. Secure it with the screw.

6) Replace the cover on the PC housing.

7) Apply power to the PC. If there are any interrupt or address conflicts which you can detect, it is best to resolve them before going any further.

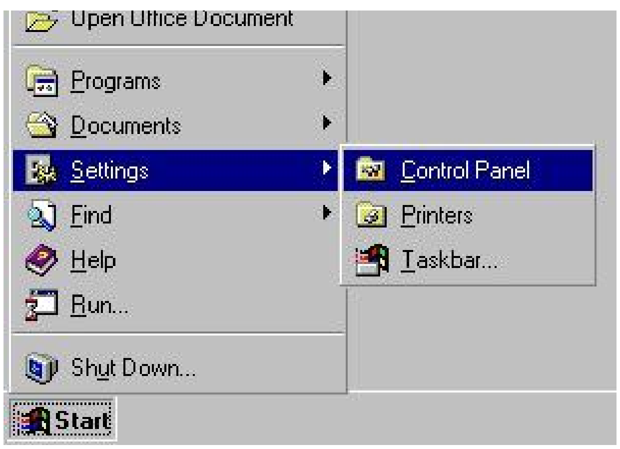
7.5 Network Adapter Card Configuration (for PC-based Control Applications)

To configure a network adapter card, first do the following:

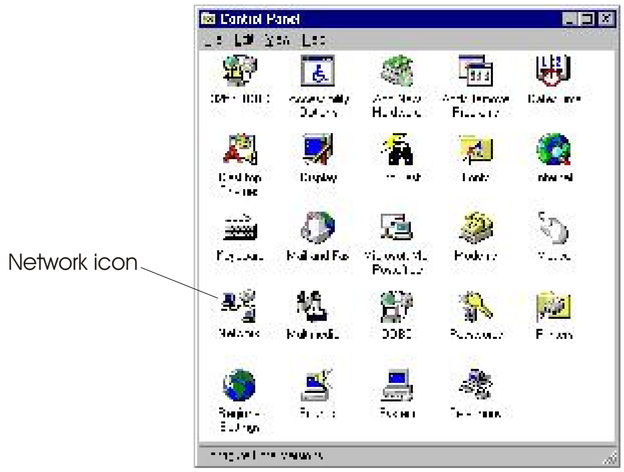
1) Locate the manufacturer's installation disk that came with your network adapter. The disk contains drivers which you will need to install.

2) If you need to install two network cards, ensure that they are configured to have unique I/O addresses and unique interrupts. The best way to verify these settings is to power up the PC using a DOS or Windows 95/98 boot disk and then running the network card's setup utility that was shipped with the card. Write down the configuration for each card so you can use the information during NT setup (if using NT). If you have to configure cards, we suggest setting one card to I/O address 300h and interrupt 10, and the other to I/O address 304h and interrupt 11, unless there are other devices using these settings.

Using the ***Start*** Menu select ***Settings***.., then ***Control Panel***.

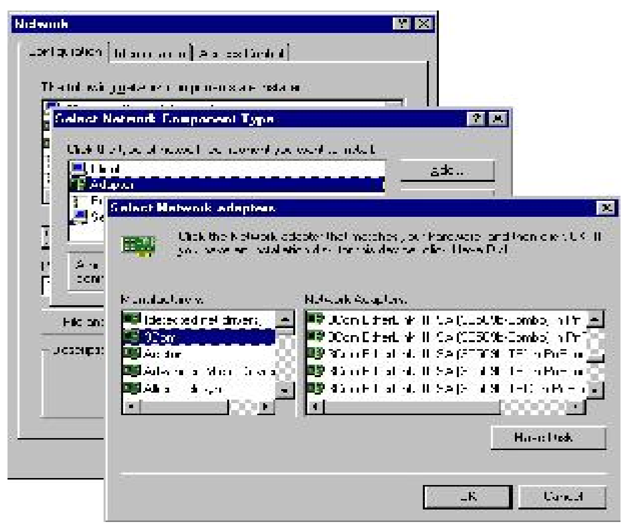


From the Control Panel, double click the Network icon. This will enable you to add a network card to the Windows configuration for your system.



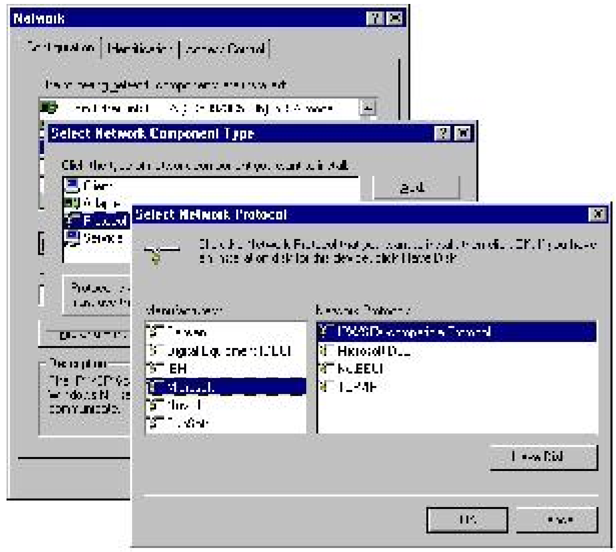
In the ***Network*** dialog box, select the ***Adapters*** tab, then Add ..., to access the list of adapter cards.

- **If you see the name of your network adapter card on the list, select it and click OK.**



- **If you do not see the name of your network adapter card, then insert the manufacturer's disk in drive A and select *Have Disk* to continue. This will load the driver from the disk to the Windows configuration.**

After adding a new adapter card, you will need to reboot your computer. This will load the driver and make the network card active and available. Be sure you restart your computer at this time.

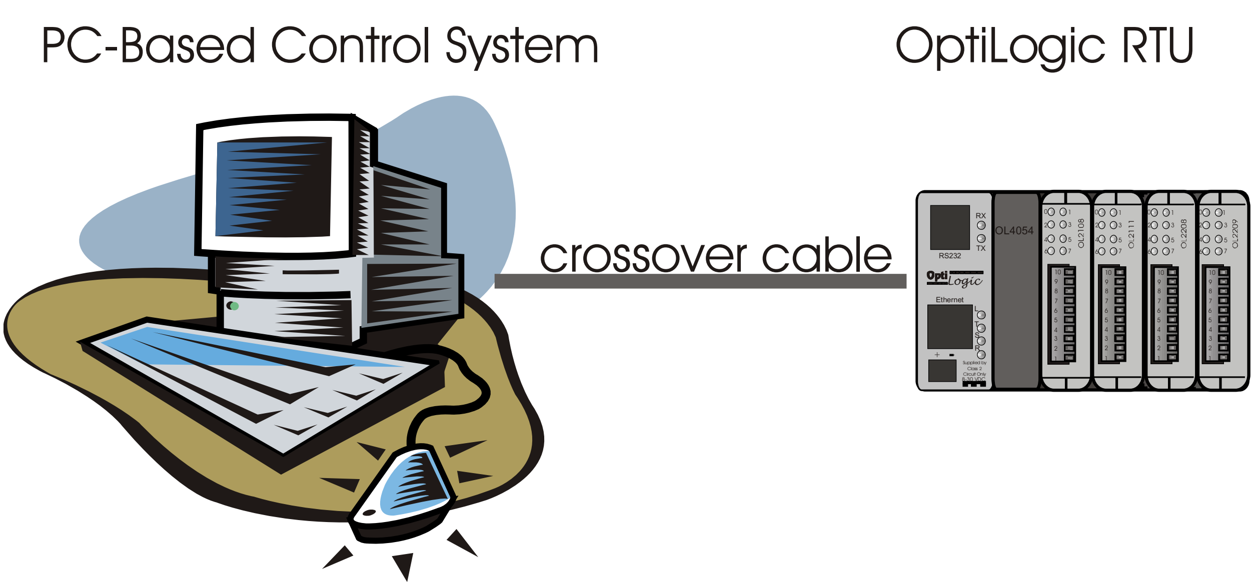


7.6 Initial PC Checkout

At this point we recommend that you set up a small, single RTU system to check out your PC configurations. This can be done in either of two ways depending on what cables and equipment you have on hand.

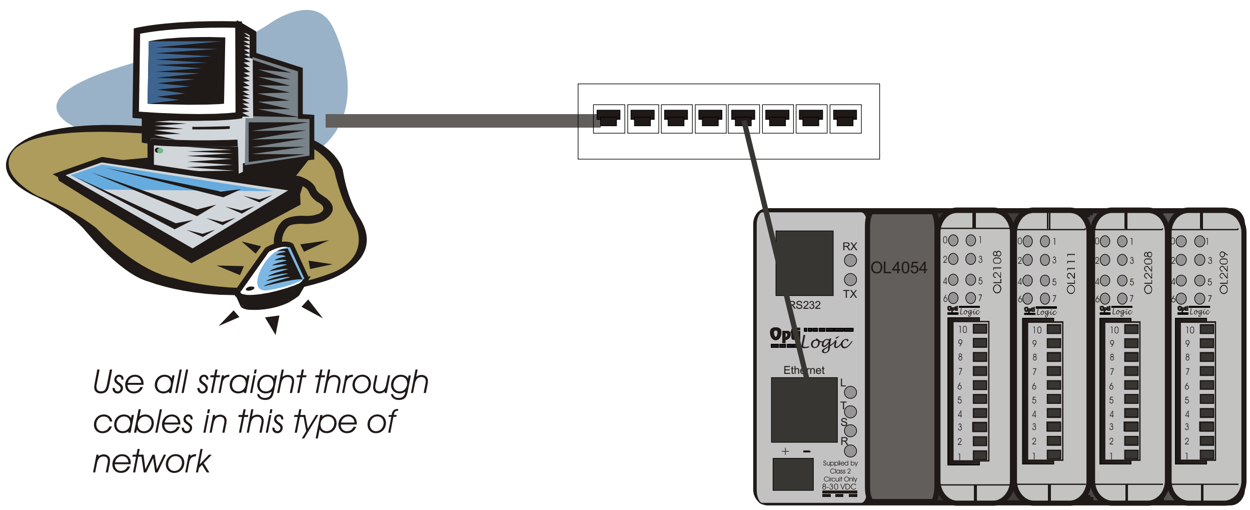
If you have a crossover cable (discussed on previous pages), simply connect the PC ethernet port to a single OptiLogic RTU, via the crossover cable. Connect DC power (12 or 24VDC supply) to the OptiLogic power input. This configuration is shown below.

If you do not have a crossover cable, set up the same basic arrangement through a hub as shown below. Apply power to the hub and RTU.



In either configuration, the first thing to check is if "Link" lights appear on the RTU. If you are connecting through a hub, link lights should appear on both the RTU connection and the PC connection. If the link

PC Based Host Controller

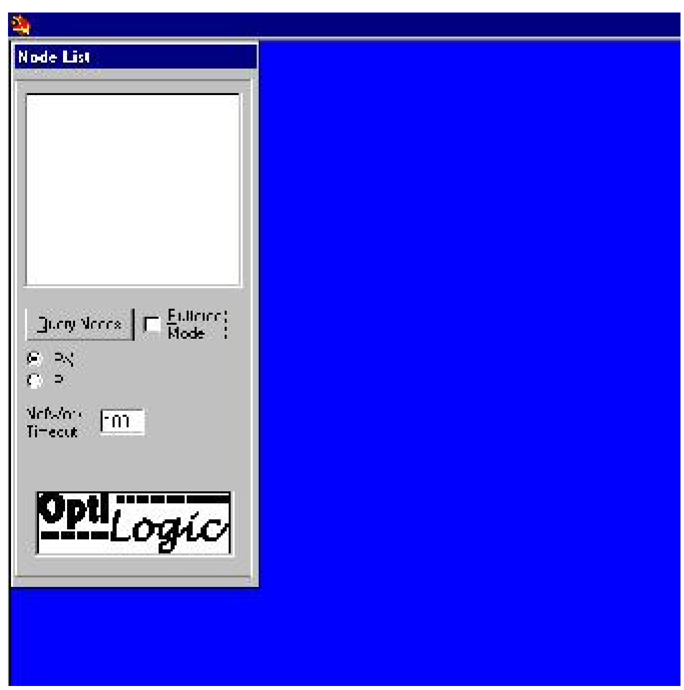


lights do not appear you probably have a bad connection.

The next step is to run the program "OL_QuickStart". This program is found on the "OptiLogic Tools CD". Install the program from the CD, then run it from your Start Menu

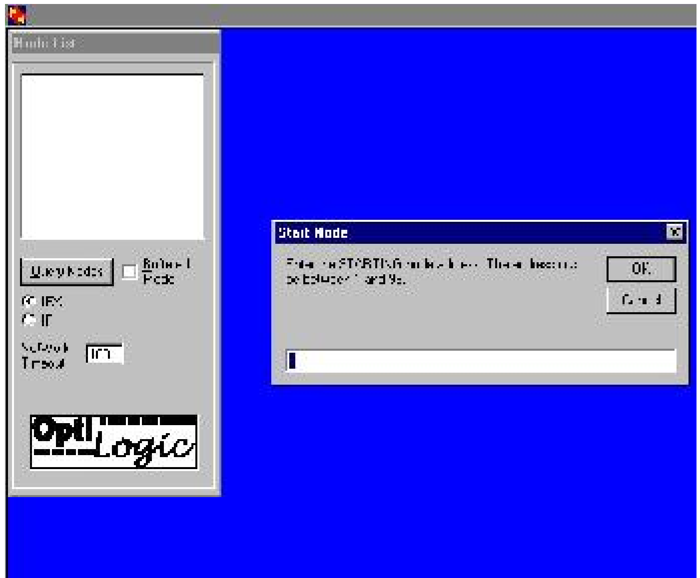
7.6.1 QuickStart Verification of PC Ethernet Board

Quickstart is more fully documented later in this manual under "System Startup". This description is simply intended to allow you to perform enough QuickStart operations to verify that your PC's ethernet board is properly installed and set up.

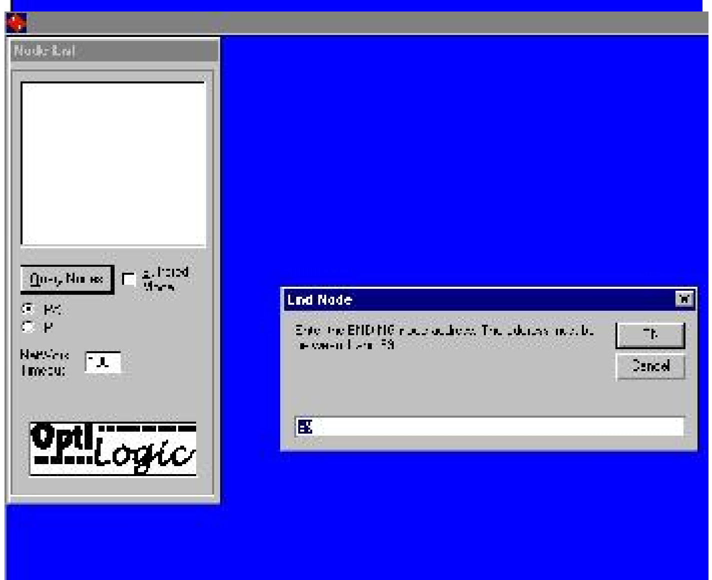


When you click on the OL_QuickStart icon, a screen like the one shown on the right should come up. When it does, use your mouse to select the protocol you want to use (IPX or IP), then select "Query Nodes".

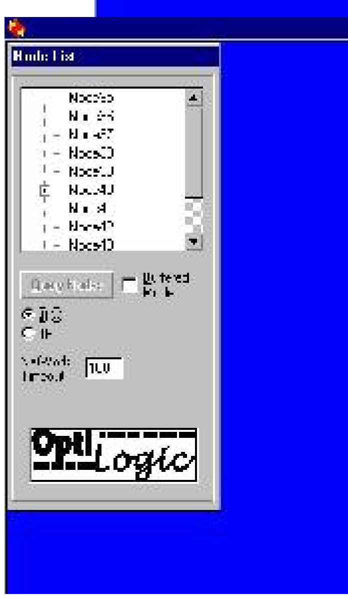
The QuickStart program first must find the attached RTU's or network nodes. It will ask you to enter the range of node numbers to search for RTUs. The node number is the address that you dial in on the RTU's rotary address switches.



Enter a node range that includes the attached RTU. Once a range is entered, the QuickStart program will begin querying all addresses in the range. The larger the range, the longer it will take to check all addresses. Once it finds the RTU(s), a "+" sign will be placed beside the node address on the node list.



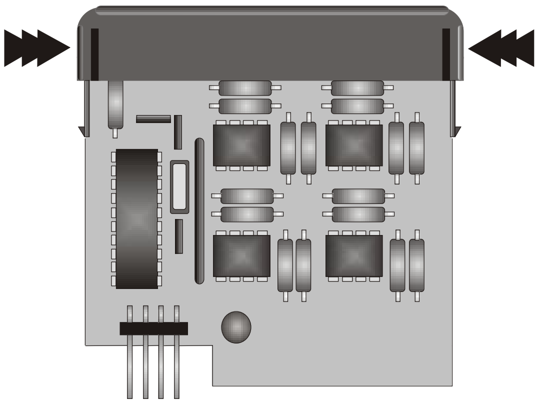
Simply finding the attached node verifies the network card installation and setup. If you would like to experiment with the node, see the more detailed OL_QuickStart instructions in the Start Up section of this manual.



7.7 Installing the I/O Modules

Insert the I/O modules into the base. The procedure is covered in detail in the preceding pages. Line up the module with the card slots, squeeze the cover to

squeeze when inserting or extracting



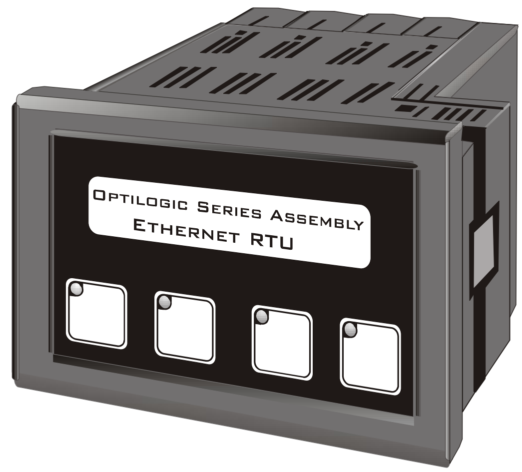
Bus connector

allow the latches to travel inside the cage, insert the board into the card cage slot (it will not be held firmly in place until it is approximately ¾ inch into the card cage. Press the card down until the connector is inserted fully into its mating motherboard connector and the latches snap to hook the module in place.

To extract a module, squeeze the ends together and pull the module out.

7.8 Install Operator Panels (if required)

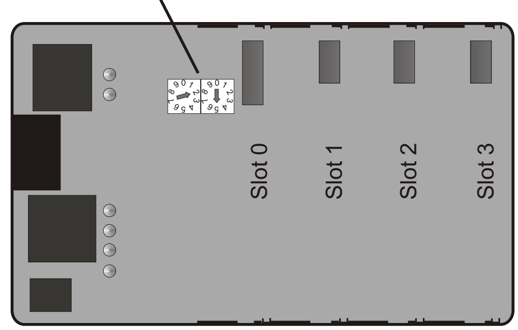
Mount the RTU base to the associated operator panel. The process is detailed in preceding pages. Remember to line up the base connector with the operator panel connector.

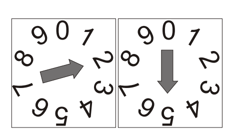


7.9 Address Each RTU Base

Each RTU base must have its own unique address. Set the address by dialing it in on the rotary switches (refer to details on preceding pages).

Addressing switches





Exploded view

7.10 Install OptiLogicRTUs at Points of Application

Each RTU is normally installed at a different physical location. Mounting of I/O only RTUs is on DIN rail.

RTUs with operator panels are panel mounted through a panel cutout. See specifications for cutout sizes. When properly installed, the operator panel will seal against the panel.

7.11 Provide Power to each RTU

Each RTU must be powered by a DC power supply which supplies power within the 8-30VDC range. Typically, a standard 12 or 24VDC power supply is used.

7.12 Cabling and Connections

All OptiLogic Cabling must comply with Ethernet 10Base-T commercial installation standards (EIA/TIA 568A). These standards are available from the American National Standards Institute (ANSI) (phone #(212)642-4900). Cabling has been covered in more detail in preceding pages. Remember the following cabling requirements.

For this connection	Use this type cable
Hub to Switch	Crossover
Hub to Hub	Crossover
PC Workstation to OptiLogic RTU	Crossover
PC Workstation to Hub	Straight-through
Hub to OptiLogic RTU	Straight-through

7.13 Ethernet Networking Rules

When designing a 10Base-T network, use the following general rules to the EIA/IEEE Ethernet standards.

For large systems use the **5-4-3-2-1** general rule when connecting various 10Base-T network components. The general rules are as follows:

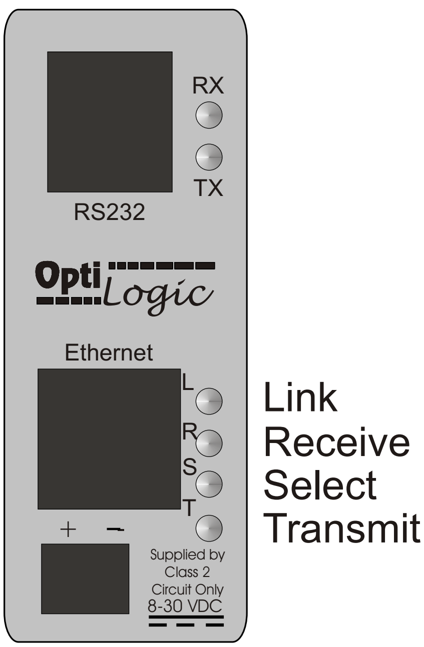
- ***Five* hubs are allowed**
- ***Four* segments per given Ethernet LAN**
- ***Three* hubs can have nodes attached**
- ***Two* hubs can't be populated and are extensions only**
- **All of this makes *one* collision domain within the logical topology**

8.0 System Start Up

The following pages cover general hardware start-up. The specific system startup operation is dependent upon system software. That operation must be covered in separate software documentation.

8.1 Diagnostic LEDs

The first thing to look at when the RTU is installed, connected to a hub or PC and everything is powered up, is the diagnostic LEDs.



The first thing that happens when the RTU is powered up is that is checks its operating program. This process takes a couple of seconds. If the operating program does not check out, the RS232 TX (transmit) LED will flash at a rate of about 1 flash per second. If this should happen, the base must be loaded with operating software.

After the startup program check (as long a programming cable is not plugged into the RS232 port), the base will enter its main program. At this point, the Select LED should be on indicating the program is interfacing the ethernet electronics.

The next thing to look at is the Link (L) LED. If it is on, there is a good ethernet link. Ethernet devices send a periodic "link pulse". The ethernet receiver on the other side looks for this link signal. If it is received, the link LED will light. Link LEDs should be on, both on the RTU and the hub.

If the link LEDs do not come on, one of the following problems probably exists.

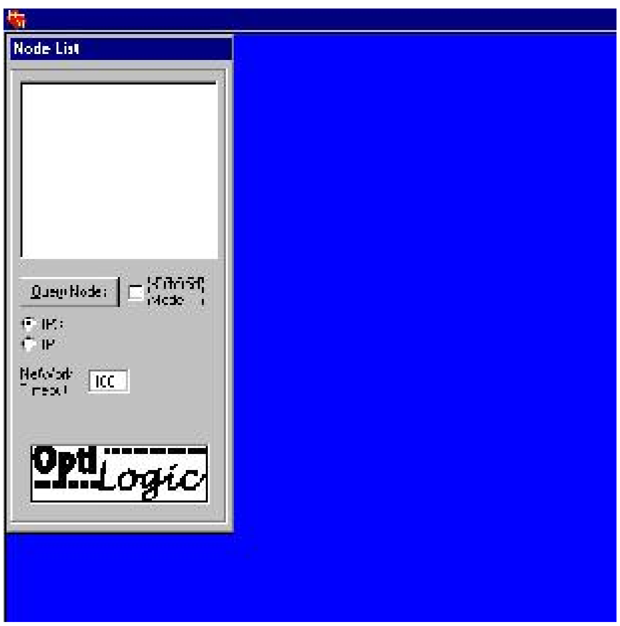
- **The cable between the hub and the RTU is defective (improper connections, bad connections, etc.)**
- **The hub or the RTU is not turned on.**

8.2 System QuickStart Software

The OptiLogic System Builder CD (purchased separately) contains a program called OL_QuickStart. This program can be used to communicate with and exercise all of the I/O, operator panel and communications functions. It will allow you to check out all of the hardware in your system.

Install the QuickStart program on your computer. To do so simply click on your Windows Start button (normally in the upper left or lower left corner of your screen). Next, select "Run", then browse your CD drive and select "SetupOLS" and "OK". The installation process will prompt you as necessary.

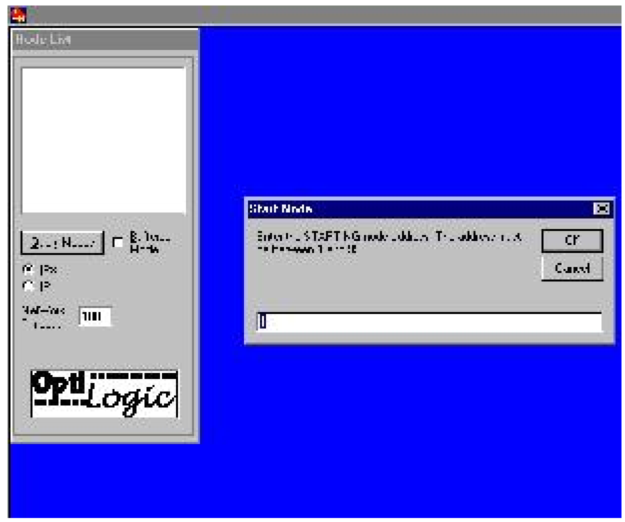
Once you have installed the software, click on the QuickStart icon to start it up. A screen like the one shown below will come up.

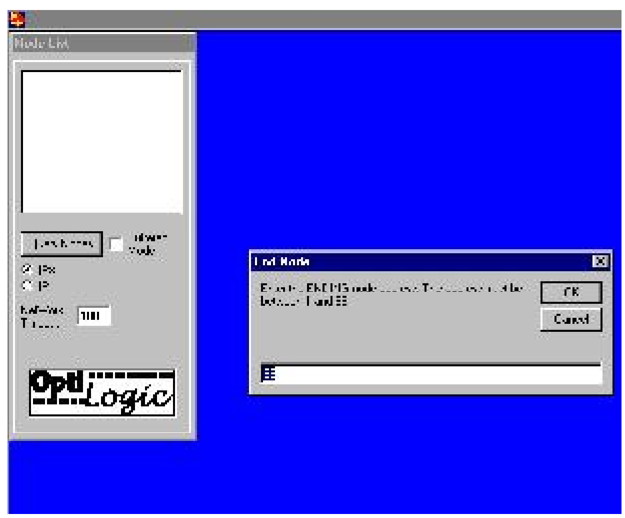


8.2.1 Finding the Attached RTUs

The first step is finding the RTUs that are attached to your network. By this point, you should have installed your RTUs and given each a unique rotary switch address. Select "Query Nodes".

Enter a node range that includes the attached RTU(s). Once a range is entered, the QuickStart program will begin querying all addresses in the range.





The larger the range, the longer it will take to check all addresses. Once it finds the RTU(s), a "+" sign will be placed beside the node address on the node list.

Look through the list of RTUs found and verify that all attached RTUs show up. If RTUs are missing from the list, begin with checking the following.

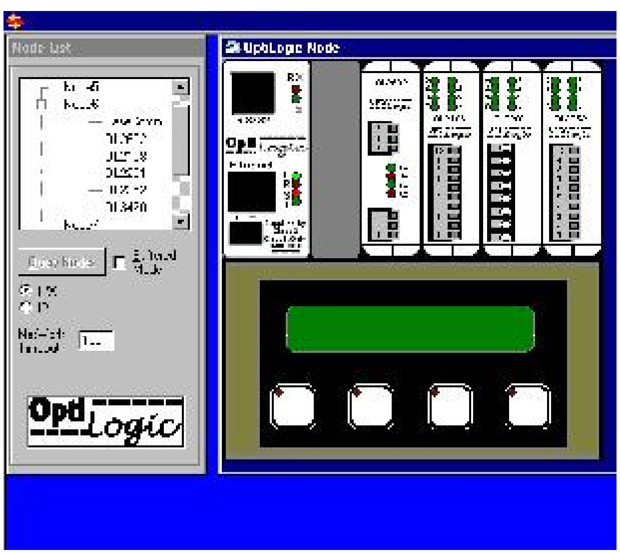
- **Verify that each RTU has a unique address, is powered on and is cabled to a system hub.**

Verify the link light is on both the RTU and the connected hub.

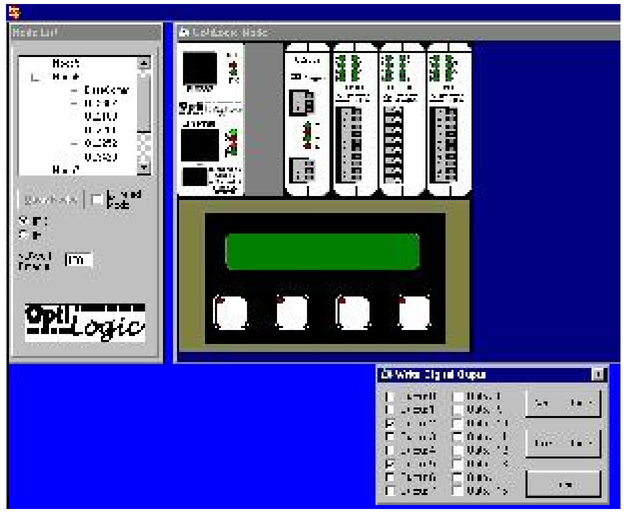
- **Check communications, hub by hub from the host computer. There may be a bad cable or bad connection along the line.**
- **The process of finding network problems on initial start up can be tedious. However, once you've sorted through any problems and brought the system up, you are ready to deal with the system on an operational level.**

8.2.2 Exercising an RTU

To exercise a particular RTU, click on its node address in the node list. A display of the RTU and all attached modules will come up as shown below. Click on the "+" sign next to the node number and the expansion list of modules, also shown below, will come up.



Click on a particular module, and its associated function screen will pop up. The figure below shows the function screen for the OL2108 relay output module, located in slot 0.

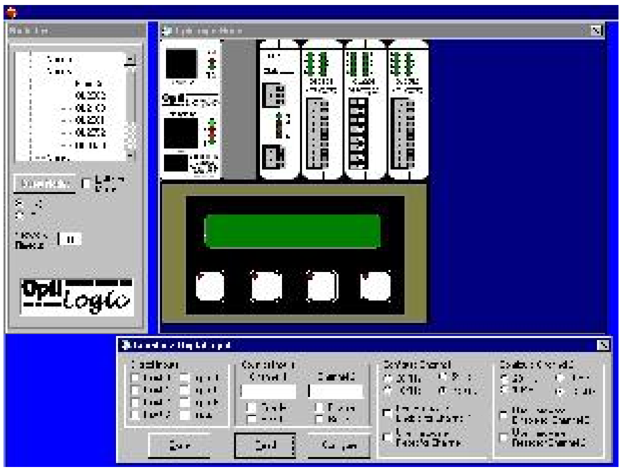


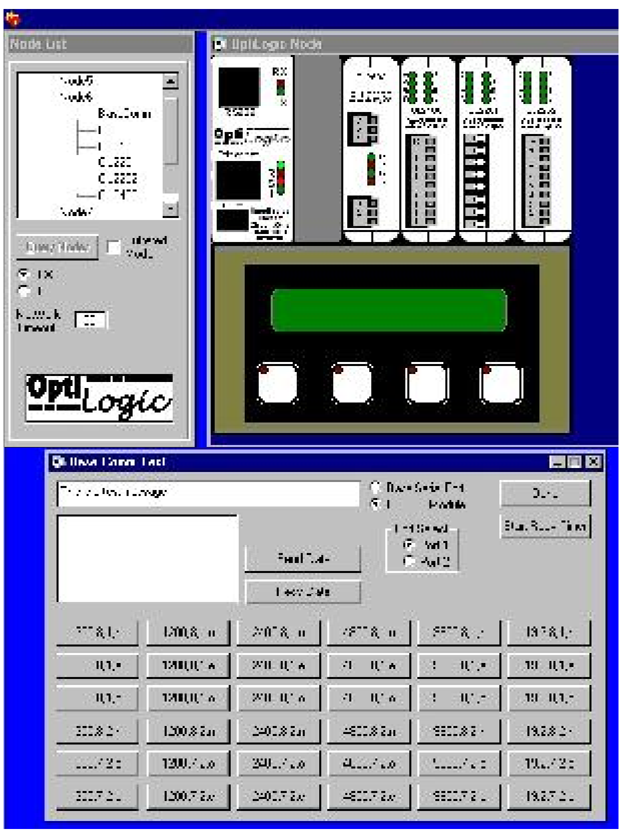
As an example of operation, select a couple of relay points and click "Write Outputs". The relays selected will turn on.

Note : Be careful when selecting the "Cycle Outputs" on a relay module. Don't leave it running long term. Relays are electro-mechanical and will wear.

When you are ready to exercise a different module, first close the function screen of the current module. After this has been done, click on the next module in the Node List. It's pop up function screen will come up.

The figures below show a couple more function screens for the OL2252 Pulse counter and the OL2602 RS232 modules. Operation of the function software is very intuitive. More detail is given in the OL_QuickStart manual.





9.0 System Development

At this point, you should have all of your system hardware configured, connected and operational. The next step is development and application of system hardware.

There are a number of options for software development. These include Pointe Controller, PC-based control, custom software and PLC applicaitons.

Implementation with a Pointe Controller is very easy. Refer to the Pointe Controller manual and related application notes. A quick app note to start with might be AN-PTCA000, The Car Wash.

For software professionals who regularly write programs in Visual Basic or Visual C, that option is available. Optimation supplies a DLL that can be used with your program to handle all of the details of communicating your requests and commands to the RTUs. The Software Interface Definition manual (available as a download on our web site), details the required interface.

An easier PC based solution for most applications, is the use of a software package. There are a number of such application software packages available, including Nematron's OpenControl, Entivity's Think & Do and Steeplechase packages. Each of these offers interactive, graphical, flow chart programming package designed specifically for real time control applications, such as those using OptiLogic RTUs. They already has all of the hooks to the OptiLogic system integrated and fully debugged. They provide the ability to develop highly complex applications quickly and easily, with a minimum level of debugging required.

OptiLogic RTUs that support Modbus TCP/IP are compatible with any controller, PLC or software package that supports Modbus TCP/IP. That includes most of the Ethernet capable devices on the market.

10.0 Specifications

10.1 OL4054 RTU Base

10.1.1 Physical (RTU Base)

- **DIN rail mount to 35mm DIN rail**
- **Overall dimensions (OL4054) 4.95"L x 3.25"H x 3.00" D**
- **Color : Dark gray**
- **Material : Polycarbonate plastic**
- **# I/O slots : 4**

10.1.2 Environmental

- **Storage Temperature : -20 to 70 C**
- **Ambient Operating Temperature : 0 to 55C**
- **Humudity : 0 - 95% non-condensing**

10.1.3 Electrical

- **Power : 8 - 30 VDC input power**
- **Minimum load current (no I/O boards or operator panel attached)**
  75mA @ 24VDC
  150mA @ 12VDC
- **Maximum load current (actual depends on the particular modules attached)**
  700 mA @ 24VDC
  1.4A @ 12VDC
- **Power available to I/O modules : 2.8A @ 5VDC**
- **Power Connection : Terminal block, 2 terminal**

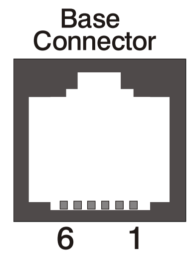
10.1.4 Communications

Ethernet

- **Type : 10Base-T ethernet**
- **Data Rate : 10 Mbps**
- **Connection : RJ45**
- **Ethernet Protocols :**
  - **OptiLogic IPX**
  - **OptiLogic UDP/IP**

RS232 Port

- **Baud rates : 300, 1200, 2400, 4800, 9600, 19.2K (selectable)**
- **Data bits : 7 or 8 (selectable)**
- **Parity : odd, even, or none (selectable)**
- **Stop bits : 1 or 2 (selectable)**
- **Connection : RJ12**



Pin #	Description	Pin #	Description
1	GND	4	Transmit data
2	Reserved (do not connect)	5	5V Power out
3	Receive data	6	GND

10.2 OL4058 RTU Base

10.2.1 Physical (RTU Base)

- DIN rail mount to 35mm DIN rail
- Overall dimensions (OL4058)
  8.4"L x 3.25"H x 3.00" D
- Color : Dark gray
- Material : Polycarbonate plastic
- # I/O slots : 8

10.2.2 Environmental

- Storage Temperature : -20 to 70 C
- Ambient Operating Temperature : 0 to 55C
- Humudity : 0 - 95% non-condensing

10.2.3 Electrical

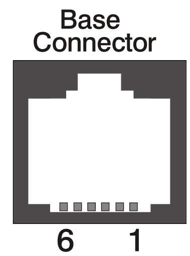
- Power : 8 - 30 VDC input power
- Minimum load current (no I/O boards or operator panel attached)
  75mA @ 24VDC
  150mA @ 12VDC
- Maximum load current (actual depends on the particular modules attached)
  700 mA @ 24VDC
  1.4A @ 12VDC
- Power available to I/O modules : 2.8A @ 5VDC
- Power Connection : Terminal block, 2 terminal

10.2.4 Communications

Ethernet

- Type : 10Base-T ethernet
- Data Rate : 10 Mbps
- Connection : RJ45
- Ethernet Protocols :
  - OptiLogic IPX
  - OptiLogic UDP/IP

RS232 Port



- Baud rates : 300, 1200, 2400, 4800, 9600, 19.2K (selectable)
- Data bits : 7 or 8 (selectable)
- Parity : odd, even, or none (selectable)
- Stop bits : 1 or 2 (selectable)
- Connection : RJ12

Pin #	Description	Pin #	Description
1	GND	4	Transmit data
2	Reserved (do not connect)	5	5V Power out
3	Receive data	6	GND

10.3 OL4228 RTU Base

10.2.1 Physical (RTU Base)

- DIN rail mount to 35mm DIN rail
- Overall dimensions (OL4228)
  8.4"L x 3.25"H x 3.00" D
- Color : Dark gray
- Material : Polycarbonate plastic
- # I/O slots : 8

10.2.2 Environmental

- Storage Temperature : -20 to 70 C
- Ambient Operating Temperature : 0 to 55C
- Humudity : 0 - 95% non-condensing

10.2.3 Electrical

- Power : 8 - 30 VDC input power
- Minimum load current (no I/O boards or operator panel attached)
  75mA @ 24VDC
  150mA @ 12VDC
- Maximum load current (actual depends on the particular modules attached)
  1A @ 24VDC
  2A @ 12VDC
- Power available to I/O modules : 3.7A @ 5VDC
- Power Connection : Terminal block, 2 terminal

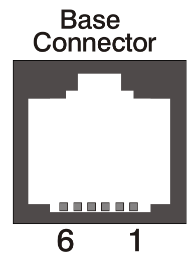
10.2.4 Communications

Ethernet

- Type : 10Base-T ethernet
- Data Rate : 10 Mbps
- Connection : RJ45
- Ethernet Protocols :
  - OptiLogic UDP/IP
  - Modbus TCP/IP

RS232 Port

- Baud rates : 300, 1200, 2400, 4800, 9600, 19.2K (selectable)
- Data bits : 7 or 8 (selectable)
- Parity : odd, even, or none (selectable)
- Stop bits : 1 or 2 (selectable)
- Connection : RJ12



Pin #	Description	Pin #	Description
1	GND	4	Transmit data
2	Reserved (do not connect)	5	5V Power out
3	Receive data	6	GND

Appendix A : Using Modbus TCP/IP

Some of the OptiLogic RTUs (the OL4228, for now) offer the option of communicating via Modbus TCP/IP. Modbus TCP/IP is an industry standard protocol, supported by a large number of vendors.

The detailed definition of the Modbus TCP/IP protocol and each of its messages can be found on the internet at such sites as Group Schneider's. Group Schneider and its subsidiary are the originators of Modbus and Modbus TCP/IP.

To use OptiLogic Modbus RTUs in a system that is designed to support Modbus TCP/IP communications, you really only need to know two types of information - the protocol message types that OptiLogic RTUs support and the specific mapping of Modbus addresses to I/O module data.

Supported Modbus Messages

OptiLogic RTUs support all of the required Modbus TCP/IP messages for data communications. Specifically, these are all of the class 0, 1 and 2 message types. They are listed in the table at the top of the next column.

Ftn Code	Function
01	Read Output Table
02	Read Input Table
03	Read Holding registers
04	Read Input registers
05	Force Single Registers
06	Preset Single Registers
07	Read Exception Status
15	Force Multiple Outputs
16	Preset Multiple Registers
20	Read general reference
21	Write general reference
22	Mask write register
23	Read write registers
24	Read FIFO queue

The next few pages detail the Modbus addressing that is applicable to each OptiLogic module.

OL2104 4 Relay Output Module

Coils :

- **Out0 - 3 : Output state for each output point (0 or 1 for OFF or ON, respectively)**
- **F/S off : If set for output, should the RTU lose communications for F/S timeout millisecond, the particular output will be automaticaally turned OFF,**
- **F/S off : If set for output, should the RTU lose communications for F/S timeout millisecond, the particular output will be automaticaally turned ON,**

F/S on adn F/S off are mutually exclusive. When the Modbus message that sets F/S off is received, F/S on is automatically cleared. When the Modbus message that sets F/S on is receive, F/S off is automatically cleared. Therefore, if both F/S on and off are sent, the last message received will take precedence.
If neither F/S on or F/S off is set, the output will retain last state.

Registers

- **F/S timeout : Failsafe timeout. If the RTU does not receive communications from its host within "F/S timeout" milliseconds, the failsafe condition, defined by the F/S coils, discussed above, will occur.**

slot>>	0	1	2	3	4	5	6	7
function								
Out0	00001	00017	00033	00049	00065	00081	00097	00113
Out1	00002	00018	00034	00050	00066	00082	00098	00114
Out2	00003	00019	00035	00051	00067	00083	00099	00115
Out3	00004	00020	00036	00052	00068	00084	00100	00116
F/S off 0	00129	00641	01153	01665	02177	02689	03201	03713
F/S on 0	00130	00642	01154	01666	02178	02690	03202	03714
F/S off 1	00131	00643	01155	01667	02179	02691	03203	03715
F/S on 1	00132	00644	01156	01668	02180	02692	03204	03716
F/S off 2	00133	00645	01157	01669	02181	02693	03205	03717
F/S on 2	00134	00646	01158	01670	02182	02694	03206	03718
F/S off 3	00135	00647	01159	01671	02183	02695	03207	03719
F/S on 3	00136	00648	01160	01672	02184	02696	03208	03720
F/S timeout	40001	40017	40033	40049	40065	40081	40097	40113

OL2108, OL2109 and OL2111 8 Output Modules

Coils :

- **Out0 - 7 : Output state for each output point (0 or 1 for OFF or ON, respectively)**
- **F/S off : If set for output, should the RTU lose communications for F/S timeout millisecond, the particular output will be automaticaally turned OFF,**
- **F/S off : If set for output, should the RTU lose communications for F/S timeout millisecond, the particular output will be automaticaally turned ON,**

F/S on and F/S off are mutually exclusive. When the Modbus message that sets F/S off is received, F/S on is automatically cleared. When the Modbus message that sets F/S on is receive, F/S off is automatically cleared. Therefore, if both F/S on and off are sent, the last message received will take precedence.
If neither F/S on or F/S off is set, the output will retain last state.

Registers

- **F/S timeout : Failsafe timeout. If the RTU does not receive communications from its host within "F/S timeout" milliseconds, the failsafe condition, defined by the F/S coils, discussed above, will occur.**

slot>>	0	1	2	3	4	5	6	7
function								
Out0	00001	00017	00033	00049	00065	00081	00097	00113
Out1	00002	00018	00034	00050	00066	00082	00098	00114
Out2	00003	00019	00035	00051	00067	00083	00099	00115
Out3	00004	00020	00036	00052	00068	00084	00100	00116
Out4	00005	00021	00037	00053	00069	00085	00101	00117
Out5	00006	00022	00038	00054	00070	00086	00102	00118
Out6	00007	00023	00039	00055	00071	00087	00103	00119
Out7	00008	00024	00040	00056	00072	00088	00104	00120
F/S off 0	00129	00641	01153	01665	02177	02689	03201	03713
F/S on 0	00130	00642	01154	01666	02178	02690	03202	03714
F/S off 1	00131	00643	01155	01667	02179	02691	03203	03715
F/S on 1	00132	00644	01156	01668	02180	02692	03204	03716
F/S off 2	00133	00645	01157	01669	02181	02693	03205	03717
F/S on 2	00134	00646	01158	01670	02182	02694	03206	03718
F/S off 3	00135	00647	01159	01671	02183	02695	03207	03719
F/S on 3	00136	00648	01160	01672	02184	02696	03208	03720
F/S off 4	00137	00649	01161	01673	02185	02697	03209	03721
F/S on 4	00138	00650	01162	01674	02186	02698	03210	03722
F/S off 5	00139	00651	01163	01675	02187	02699	03211	03723
F/S on 5	00140	00652	01164	01676	02188	02700	03212	03724
F/S off 6	00141	00653	01165	01677	02189	02701	03213	03725
F/S on 6	00142	00654	01166	01678	02190	02702	03214	03726
F/S off 7	00143	00655	01167	01679	02191	02703	03215	03727
F/S on 7	00144	00656	01168	01680	02192	02704	03216	03728
F/S timeout	40001	40017	40033	40049	40065	40081	40097	40113

OL2132 32 Output Module

Coils :

- **Out0 - 31 : Output state for each output point (0 or 1 for OFF or ON, respectively)**

slot>>	0	1	2	3	4	5	6	7
function								
Out0	00385	00897	01409	01921	02433	02945	03457	03969
Out1	00386	00898	01410	01922	02434	02946	03458	03970
Out2	00387	00899	01411	01923	02435	02947	03459	03971
Out3	00388	00900	01412	01924	02436	02948	03460	03972
Out4	00389	00901	01413	01925	02437	02949	03461	03973
Out5	00390	00902	01414	01926	02438	02950	03462	03974
Out6	00391	00903	01415	01927	02439	02951	03463	03975
Out7	00392	00904	01416	01928	02440	02952	03464	03976
Out8	00393	00905	01417	01929	02441	02953	03465	03977
Out9	00394	00906	01418	01930	02442	02954	03466	03978
Out10	00395	00907	01419	01931	02443	02955	03467	03979
Out11	00396	00908	01420	01932	02444	02956	03468	03980
Out12	00397	00909	01421	01933	02445	02957	03469	03981
Out13	00398	00910	01422	01934	02446	02958	03470	03982
Out14	00399	00911	01423	01935	02447	02959	03471	03983
Out15	00400	00912	01424	01936	02448	02960	03472	03984
Out16	00401	00913	01425	01937	02449	02961	03473	03985
Out17	00402	00914	01426	01938	02450	02962	03474	03986
Out18	00403	00915	01427	01939	02451	02963	03475	03987
Out19	00404	00916	01428	01940	02452	02964	03476	03988
Out20	00405	00917	01429	01941	02453	02965	03477	03989
Out21	00406	00918	01430	01942	02454	02966	03478	03990
Out22	00407	00919	01431	01943	02455	02967	03479	03991
Out23	00408	00920	01432	01944	02456	02968	03480	03992
Out24	00409	00921	01433	01945	02457	02969	03481	03993
Out25	00410	00922	01434	01946	02458	02970	03482	03994
Out26	00411	00923	01435	01947	02459	02971	03483	03995
Out27	00412	00924	01436	01948	02460	02972	03484	03996
Out28	00413	00925	01437	01949	02461	02973	03485	03997
Out29	00414	00926	01438	01950	02462	02974	03486	03998
Out30	00415	00927	01439	01951	02463	02975	03487	03999
Out31	00416	00928	01440	01952	02464	02976	03488	04000

OL2132 32 Output Module continued

Coils

- **F/S off : If set for output, should the RTU lose communications for F/S timeout millisecond, the particular output will be automaticaally turned OFF,**
- **F/S off : If set for output, should the RTU lose communications for F/S timeout millisecond, the particular output will be automaticaally turned ON,**

F/S on adn F/S off are mutually exclusive. When the Modbus message that sets F/S off is received, F/S on is automatically cleared. When the Modbus message that sets F/S on is receive, F/S off is automatically cleared. Therefore, if both F/S on and off are sent, the last message received will take precedence.
If neither F/S on or F/S off is set, the output will retain last state.

slot>>	0	1	2	3	4	5	6	7
function								
F/S off 0	00129	00641	01153	01665	02177	02689	03201	03713
F/S on 0	00130	00642	01154	01666	02178	02690	03202	03714
F/S off 1	00131	00643	01155	01667	02179	02691	03203	03715
F/S on 1	00132	00644	01156	01668	02180	02692	03204	03716
F/S off 2	00133	00645	01157	01669	02181	02693	03205	03717
F/S on 2	00134	00646	01158	01670	02182	02694	03206	03718
F/S off 3	00135	00647	01159	01671	02183	02695	03207	03719
F/S on 3	00136	00648	01160	01672	02184	02696	03208	03720
F/S off 4	00137	00649	01161	01673	02185	02697	03209	03721
F/S on 4	00138	00650	01162	01674	02186	02698	03210	03722
F/S off 5	00139	00651	01163	01675	02187	02699	03211	03723
F/S on 5	00140	00652	01164	01676	02188	02700	03212	03724
F/S off 6	00141	00653	01165	01677	02189	02701	03213	03725
F/S on 6	00142	00654	01166	01678	02190	02702	03214	03726
F/S off 7	00143	00655	01167	01679	02191	02703	03215	03727
F/S on 7	00144	00656	01168	01680	02192	02704	03216	03728
F/S off 8	00145	00657	01169	01681	02193	02705	03217	03729
F/S on 8	00146	00658	01170	01682	02194	02706	03218	03730
F/S off 9	00147	00659	01171	01683	02195	02707	03219	03731
F/S on 9	00148	00660	01172	01684	02196	02708	03220	03732
F/S off 10	00149	00661	01173	01685	02197	02709	03221	03733
F/S on 10	00150	00662	01174	01686	02198	02710	03222	03734
F/S off 11	00151	00663	01175	01687	02199	02711	03223	03735
F/S on 11	00152	00664	01176	01688	02200	02712	03224	03736
F/S off 12	00153	00665	01177	01689	02201	02713	03225	03737
F/S on 12	00154	00666	01178	01690	02202	02714	03226	03738
F/S off 13	00155	00667	01179	01691	02203	02715	03227	03739
F/S on 13	00156	00668	01180	01692	02204	02716	03228	03740
F/S off 14	00157	00669	01181	01693	02205	02717	03229	03741
F/S on 14	00158	00670	01182	01694	02206	02718	03230	03742
F/S off 15	00159	00671	01183	01695	02207	02719	03231	03743
F/S on 15	00160	00672	01184	01696	02208	02720	03232	03744

OL2132 32 Output Module continued

Registers

- **F/S timeout : Failsafe timeout. If the RTU does not receive communications from its host within "F/S timeout" milliseconds, the failsafe condition, defined by the F/S coils, discussed above, will occur.**

slot>>	0	1	2	3	4	5	6	7
function								
F/S off 16	00161	00673	01185	01697	02209	02721	03233	03745
F/S on 16	00162	00674	01186	01698	02210	02722	03234	03746
F/S off 17	00163	00675	01187	01699	02211	02723	03235	03747
F/S on 17	00164	00676	01188	01700	02212	02724	03236	03748
F/S off 18	00165	00677	01189	01701	02213	02725	03237	03749
F/S on 18	00166	00678	01190	01702	02214	02726	03238	03750
F/S off 19	00167	00679	01191	01703	02215	02727	03239	03751
F/S on 19	00168	00680	01192	01704	02216	02728	03240	03752
F/S off 20	00169	00681	01193	01705	02217	02729	03241	03753
F/S on 20	00170	00682	01194	01706	02218	02730	03242	03754
F/S off 21	00171	00683	01195	01707	02219	02731	03243	03755
F/S on2 1	00172	00684	01196	01708	02220	02732	03244	03756
F/S off 22	00173	00685	01197	01709	02221	02733	03245	03757
F/S on 22	00174	00686	01198	01710	02222	02734	03246	03758
F/S off 23	00175	00687	01199	01711	02223	02735	03247	03759
F/S on 23	00176	00688	01200	01712	02224	02736	03248	03760
F/S off 24	00177	00689	01201	01713	02225	02737	03249	03761
F/S on 24	00178	00690	01202	01714	02226	02738	03250	03762
F/S off 25	00179	00691	01203	01715	02227	02739	03251	03763
F/S on 25	00180	00692	01204	01716	02228	02740	03252	03764
F/S off 26	00181	00693	01205	01717	02229	02741	03253	03765
F/S on 26	00182	00694	01206	01718	02230	02742	03254	03766
F/S off 27	00183	00695	01207	01719	02231	02743	03255	03767
F/S on 27	00184	00696	01208	01720	02232	02744	03256	03768
F/S off 28	00185	00697	01209	01721	02233	02745	03257	03769
F/S on 28	00186	00698	01210	01722	02234	02746	03258	03770
F/S off 29	00187	00699	01211	01723	02235	02747	03259	03771
F/S on 29	00188	00700	01212	01724	02236	02748	03260	03772
F/S off 30	00189	00701	01213	01725	02237	02749	03261	03773
F/S on 30	00190	00702	01214	01726	02238	02750	03262	03774
F/S off 31	00191	00703	01215	01727	02239	02751	03263	03775
F/S on 31	00192	00704	01216	01728	02240	02752	03264	03776
F/S timeout	40001	40017	40033	40049	40065	40081	40097	40113

OL2204 4 Input Module

Discretes

- **In0 - 3 : Current input state**
- **Latch0 - 3 : Set if input was active at any time since the last Modbus read**

slot>>	0	1	2	3	4	5	6	7
function								
In0	10001	10017	10033	10049	10065	10081	10097	10113
In1	10002	10018	10034	10050	10066	10082	10098	10114
In2	10003	10019	10035	10051	10067	10083	10099	10115
In3	10004	10020	10036	10052	10068	10084	10100	10116
Latch0	10129	10641	11153	11665	12177	12689	13201	13713
Latch1	10130	10642	11154	11666	12178	12690	13202	13714
Latch2	10131	10643	11155	11667	12179	12691	13203	13715
Latch3	10132	10644	11156	11668	12180	12692	13204	13716

OL2201, OL2208 and OL2211 8 Input Modules

Discretes

- **In0 - 7 : Current input state**
- **Latch0 - 7 : Set if input was active at any time since the last Modbus read**

slot>>	0	1	2	3	4	5	6	7
function								
In0	10001	10017	10033	10049	10065	10081	10097	10113
In1	10002	10018	10034	10050	10066	10082	10098	10114
In2	10003	10019	10035	10051	10067	10083	10099	10115
In3	10004	10020	10036	10052	10068	10084	10100	10116
In4	10005	10021	10037	10053	10069	10085	10101	10117
In5	10006	10022	10038	10054	10070	10086	10102	10118
In6	10007	10023	10039	10055	10071	10087	10103	10119
In7	10008	10024	10040	10056	10072	00088	10104	10120
Latch0	10129	10641	11153	11665	12177	12689	13201	13713
Latch1	10130	10642	11154	11666	12178	12690	13202	13714
Latch2	10131	10643	11155	11667	12179	12691	13203	13715
Latch3	10132	10644	11156	11668	12180	12692	13204	13716
Latch4	10133	10645	11157	11669	12181	12693	13205	13717
Latch5	10134	10646	11158	11670	12182	12694	13206	13718
Latch6	10135	10647	11159	11671	12183	12695	13207	13719
Latch7	10136	10648	11160	11672	12184	12696	13208	13720

OL2232 32 Input Module

Discretes

- **In0 - 31 : Current input state**
- **Latch0 - 31 : Set if input was active at any time since the last Modbus read**

slot>>	0	1	2	3	4	5	6	7
function								
In0	10001	10017	10033	10049	10065	10081	10097	10113
In1	10002	10018	10034	10050	10066	10082	10098	10114
In2	10003	10019	10035	10051	10067	10083	10099	10115
In3	10004	10020	10036	10052	10068	10084	10100	10116
In4	10005	10021	10037	10053	10069	10085	10101	10117
In5	10006	10022	10038	10054	10070	10086	10102	10118
In6	10007	10023	10039	10055	10071	10087	10103	10119
In7	10008	10024	10040	10056	10072	10088	10104	10120
In8	10009	10025	10041	10057	10073	10089	10105	10121
In9	10010	10026	10042	10058	10074	10090	10106	10122
In10	10011	10027	10043	10059	10075	10091	10107	10123
In11	10012	10028	10044	10060	10076	10092	10108	10124
In12	10013	10029	10045	10061	10077	10093	10109	10125
In13	10014	10030	10046	10062	10078	10094	10110	10126
In14	10015	10031	10047	10063	10079	10095	10111	10127
In15	10016	10032	10048	10064	10080	10096	10112	10128
In16	10017	10033	10049	10065	10081	10097	10113	10129
In17	10018	10034	10050	10066	10082	10098	10114	10130
In18	10019	10035	10051	10067	10083	10099	10115	10131
In19	10020	10036	10052	10068	10084	10100	10116	10132
In20	10021	10037	10053	10069	10085	10101	10117	10133
In21	10022	10038	10054	10070	10086	10102	10118	10134
In22	10023	10039	10055	10071	10087	10103	10119	10135
In23	10024	10040	10056	10072	10088	10104	10120	10136
In24	10025	10041	10057	10073	10089	10105	10121	10137
In25	10026	10042	10058	10074	10090	10106	10122	10138
In26	10027	10043	10059	10075	10091	10107	10123	10139
In27	10028	10044	10060	10076	10092	10108	10124	10140
In28	10029	10045	10061	10077	10093	10109	10125	10141
In29	10030	10046	10062	10078	10094	10110	10126	10142
In30	10031	10047	10063	10079	10095	10111	10127	10143
In31	10032	10048	10064	10080	10096	10112	10128	10144

OL2232 32 Input Module continued

slot>>	0	1	2	3	4	5	6	7
function								
Latch0	10129	10641	11153	11665	12177	12689	13201	13713
Latch1	10130	10642	11154	11666	12178	12690	13202	13714
Latch2	10131	10643	11155	11667	12179	12691	13203	13715
Latch3	10132	10644	11156	11668	12180	12692	13204	13716
Latch4	10133	10645	11157	11669	12181	12693	13205	13717
Latch5	10134	10646	11158	11670	12182	12694	13206	13718
Latch6	10135	10647	11159	11671	12183	12695	13207	13719
Latch7	10136	10648	11160	11672	12184	12696	13208	13720
Latch8	10137	10649	11161	11673	12185	12697	13209	13721
Latch9	10138	10650	11162	11674	12186	12698	13210	13722
Latch10	10139	10651	11163	11675	12187	12699	13211	13723
Latch11	10140	10652	11164	11676	12188	12700	13212	13724
Latch12	10141	10653	11165	11677	12189	12701	13213	13725
Latch13	10142	10654	11166	11678	12190	12702	13214	13726
Latch14	10143	10655	11167	11679	12191	12703	13215	13727
Latch15	10144	10656	11168	11680	12192	12704	13216	13728
Latch16	10145	10657	11169	11681	12193	12705	13217	13729
Latch17	10146	10658	11170	11682	12194	12706	13218	13730
Latch18	10147	10659	11171	11683	12195	12707	13219	13731
Latch19	10148	10660	11172	11684	12196	12708	13220	13732
Latch20	10149	10661	11173	11685	12197	12709	13221	13733
Latch21	10150	10662	11174	11686	12198	12710	13222	13734
Latch22	10151	10663	11175	11687	12199	12711	13223	13735
Latch23	10152	10664	11176	11688	12200	12712	13224	13736
Latch24	10153	10665	11177	11689	12201	12713	13225	13737
Latch25	10154	10666	11178	11690	12202	12714	13226	13738
Latch26	10155	10667	11179	11691	12203	12715	13227	13739
Latch27	10156	10668	11180	11692	12204	12716	13228	13740
Latch28	10157	10669	11181	11693	12205	12717	13229	13741
latch29	10158	10670	11182	11694	12206	12718	13230	13742
Latch30	10159	10671	11183	11695	12207	12719	13231	13743
Latch31	10160	10672	11184	11696	12208	12720	13232	13744

OL2252 2 High Speed Pulse Counter Module

Coils

- **H/W Enable : Use Hardware enable input**
- **H/W Reset : Use Hardware reset input**
- **Enable : Enable Count (software enable; if H/W enable is set, H/W enable is also required)**
- **Reset : Reset count**

Discretes

- **In0-7 : Raw I/O state at time of read**
- **Latch0-7 : Latched status. Set if ever active since last read.**

Analogs

- **Count LSW, MSW : 32 bit count value, least & most signinficant bits**

Registers

- **Debounce : Debounce setting for count frequency range (2 = 20KHz, 4 = 10KHz, 8 = 5 KHz, 16 = 2.5KHz, 40 = 1KHz, 64 = 600Hz)**

slot>>	0	1	2	3	4	5	6	7
function								
H/W Enable 1	00001	00017	00033	00049	00065	00081	00097	00113
H/W Reset 1	00002	00018	00034	00050	00066	00082	00098	00114
H/W Enable 2	00003	00019	00035	00051	00067	00083	00099	00115
H/W Reset 2	00004	00020	00036	00052	00068	00084	00100	00116
Enable 1	00009	00025	00041	00057	00073	00089	00105	00121
Enable 2	00010	00026	00042	00058	00074	00090	00106	00122
Reset 1	00013	00029	00045	00061	00077	00093	00109	00125
Reset 2	00014	00030	00046	00062	00078	00094	00110	00126
In0(Pulse)	10001	10017	10033	10049	10065	10081	10097	10013
In1 (Pulse)	10002	10018	10034	10050	10066	10082	10098	10014
In2 (Reset)	10003	10019	10035	10051	10067	10083	10099	10015
In3 (Reset)	10004	10020	10036	10052	10068	10084	10100	10016
In4 (Enable)	10005	10021	10037	10053	10069	10085	10101	10017
In5 (Enable)	10006	10022	10038	10054	10070	10086	10102	10018
In6	10007	10023	10039	10055	10071	10087	10103	10019
In7	10008	10024	10040	10056	10072	10088	10104	10020
Latch0	10129	10641	11153	11665	12177	12689	13201	13713
Latch1	10130	10642	11154	11666	12178	12690	13202	13714
Latch2	10131	10643	11155	11667	12179	12691	13203	13715
Latch3	10132	10644	11156	11668	12180	12692	13204	13716
Latch4	10133	10645	11157	11669	12181	12693	13205	13717
Latch5	10134	10646	11158	11670	12182	12694	13206	13718
Latch6	10135	10647	11159	11671	12183	12695	13207	13719
Latch7	10136	10648	11160	11672	12184	12696	13208	13720
Count1 LSW	30001	30017	30033	30049	30065	30081	30097	30113
Count1 MSW	30002	30018	30034	30050	30066	30082	30098	30114
Count2 LSW	30003	30019	30035	30051	30067	30083	30099	30115
Dount2 MSW	30004	30020	30036	30052	30068	30084	30100	30116
Debounce 1	40001	40017	40033	40049	40065	40081	40097	40113
Debounce 2	40002	40018	40034	40050	40066	40082	40098	40114

OL2258 High Speed Pulse Counter Module

Coils

- **200 ms Freq : Set frequency count for # of counts received in the last 200msec. If not set, frequency count will be over the last 1 second.**
- **Z Preset : Use of Z input for preset enabled**
- **LS Preset : Use of LS input for preset enabled**
- **Range : Output control based on count range enabled**
- **Force Preset : Force the count to the preset value**
- **Hold : Hold count at current value**

Discretes

- **Inx : Raw input states**
- **Outx : State of output**

Analogs

- **Frequency : Count over most recent 200ms or 1 second period**
- **Count LSW, MSW : 32 bit count. Least & most significant 16 bits**

Registers

- **Type : Count type (?? = Pulse & direction, ?? = Up/Down count, ?? = quardrature)**
- **Preset LSW, MSW : 32 bit preset value**
- **Min, Max LSW, MSW : If Output range control is enabled, output will be turned on when within thisw range**

slot>>	0	1	2	3	4	5	6	7
function								
200 ms Freq	00001	00017	00033	00049	00065	00081	00097	00113
Z Preset	00002	00018	00034	00050	00066	00082	00098	00114
LS Preset	00003	00019	00035	00051	00067	00083	00099	00115
Range 1	00004	00020	00036	00052	00068	00084	00100	00116
Range 2	00005	00021	00037	00053	00069	00085	00101	00117
Force Preset	00009	00025	00041	00057	00073	00089	00105	00121
Hold	00010	00026	00042	00058	00074	00090	00106	00122
In A	10001	10017	10033	10049	10065	10081	10097	10113
In B	10002	10018	10034	10050	10066	10082	10098	10114
In Z	10003	10019	10035	10051	10067	10083	10099	10115
In LS	10004	10020	10036	10052	10068	10084	10100	10116
Out 1	10005	10021	10037	10053	10069	10085	10101	10117
Out 2	10006	10022	10038	10054	10070	10086	10102	10118
Frequency	30001	30017	30033	30049	30065	30081	30097	30113
Count LSW	30002	30018	30034	30050	30066	30082	30098	30114
Count MSW	30003	30019	30035	30051	30067	30083	30099	30115
Type	40001	40017	40033	40049	40065	40081	40097	40113
Preset LSW	40002	40018	40034	40050	40066	40082	40098	40114
Preset MSW	40003	40019	40035	40051	40067	40083	40099	40115
Min 1 LSW	40004	40020	40036	40052	40068	40084	40100	40116
Min 1 MSW	40005	40021	40037	40053	40069	40085	40101	40117
Max 1 LSW	40006	40022	40038	40054	40070	40086	40102	40118
Max 1 MSW	40007	40023	40039	40055	40071	40087	40103	40119
Min 2 LSW	40008	40024	40040	40056	40072	40088	40104	40120
Min 2 MSW	40009	40025	40041	40057	40073	40089	40105	40121
Max 2 LSW	40010	40026	40042	40058	40074	40090	40106	40122
Max 2 MSW	40011	40027	40043	40059	40075	40091	40107	40123

OL2304 4 Analog Output Module

Registers

- **Range : Range setting for output (?? = 0-5V, ?? = 0-10V, ?? = +/-5V, ?? = +/-10V)**
- **Out : Output value**

slot>>	0	1	2	3	4	5	6	7
function								
Range 0	40001	40017	40033	40049	40065	40081	40097	40113
Range 1	40002	40018	40034	40050	40066	40082	40098	40114
Range 2	40003	40019	40035	40051	40067	40083	40099	40115
Range 3	40004	40020	40036	40052	40068	40084	40100	40116
Out 0	40009	40025	40041	40057	40073	40089	40105	40121
Out 1	40010	40026	40042	40058	40074	40090	40106	40122
Out 2	40011	40027	40043	40059	40075	40091	40107	40123
Out 3	40012	40028	40044	40060	40076	40092	40108	40124

OL2408 and OL2418 8 Channel Output Modules

Analogs

- **In0-8 : 12 bit raw analog data (0 = 0V or 4 mA, 4095 = full scale)**

slot>>	0	1	2	3	4	5	6	7
function								
In0	30001	30017	30033	30049	30065	30081	30097	30113
In1	30002	30018	30034	30050	30066	30082	30098	30114
In2	30003	30019	30035	30051	30067	30083	30099	30115
In3	30004	30020	30036	30052	30068	30084	30100	30116
In4	30005	30021	30037	30053	30069	30085	30101	30117
In5	30006	30022	30038	30054	30070	30086	30102	30118
In6	30007	30023	30039	30055	30071	30087	30103	30119
In7	30008	30024	30040	30056	30072	30088	30104	30120

OL2602 Dual RS232 Module

Coils

- **Enable :**
- **Odd, Even Parity : Mutually exclusive port configuration to set Odd, Even or No parity**
- **1, 2 stop bits : Mutually exclusive port configuration for 1 or 2 stop bits**
- **7 data bits : Configuration for 7 dat bits (if not set, defaults to 8)**

"Analogs"

- **RX Length : # of characters in receive buffer**
- **RX buffer(0-95) : Received character buffer**

Registers

- **Baud : Port baud rate configuration (2=1200, 3=2400, 4=4800, 5=9600, 6=19,200)**
- **TX Length : # of characters to transmit**
- **TX buffer(0-95) : Transmit character buffer**

slot>>	0	1	2	3	4	5	6	7
function								
Enable (1)	00001	00017	00033	00049	00065	00081	00097	00113
Odd Parity (1)	00002	00018	00034	00050	00066	00082	00098	00114
Even Parity (1)	00003	00019	00035	00051	00067	00083	00099	00115
1 Stop Bit (1)	00004	00020	00036	00052	00068	00084	00100	00116
2 Stop Bits (1)	00005	00021	00037	00053	00069	00085	00101	00117
7 Data Bits (1)	00006	00022	00038	00054	00070	00086	00102	00118
Enable (2)	00007	00023	00039	00055	00071	00087	00103	00119
Odd Parity (2)	00008	00024	00040	00056	00072	00088	00104	00120
Even Parity (2)	00009	00025	00041	00057	00073	00089	00105	00121
1 Stop Bit (2)	00010	00026	00042	00058	00074	00090	00106	00122
2 Stop Bits (2)	00011	00027	00043	00059	00075	00091	00107	00123
7 data Bits (2)	00012	00028	00044	00060	00076	00092	00108	00124
Error Flags (1)	30001	30017	30033	30049	30065	30081	30097	30113
Error Flags (2)	30002	30018	30034	30050	30066	30082	30098	30114
TX Space (1)	30009	30025	30041	30057	30073	30089	30105	30121
TX Space (2)	30010	30026	30042	30058	30074	30090	30106	30122
RX Length (1)	30129	30641	31153	31665	32177	32689	33201	33713
RX Buffer(1) [0]	30130	30642	31154	31666	32178	32690	33202	33714
...	-	-	-	-	-	-	-	-
RX Buffer (1) [95]	30225	30737	31249	31761	32273	32785	33297	33809
RX Length (2)	30226	30738	31250	31762	32274	32786	33298	33810
RX Buffer (2) [0]	30227	30739	31251	31763	32275	32787	33299	33811
...	-	-	-	-	-	-	-	-
RX Buffer (2) [95]	30322	30834	31346	31858	32370	32882	33394	33906
Baud (1)	40001	40017	40033	40049	40065	40081	40097	40113
Baud (2)	40002	40018	40034	40050	40066	40082	40098	40114
TX Length (1)	40129	40641	41153	41665	42177	42689	43201	43713
TX Buffer (1) [0]	40130	40642	41154	41666	42178	42690	43202	43714
...								
TX Buffer (1) [95]	40225	40737	41249	41761	42273	42785	43297	43809
TX Length (2)	40226	40738	41250	41762	42274	42786	43298	43810
TX Buffer (2) [0]	40227	40739	41251	41763	42275	42787	43299	43811
...								
TX buffer (2) [95]	40322	40834	41346	41858	42370	42882	43394	43906

Appendix A : Using Modbus with OptiLogic RTUs