Honeywell

HC900 Hybrid Controller

When you need more than just discrete control

HC900 Ethernet Connectivity via Modbus/TCP – Product Note

Ethernet Modbus/TCP Communications Overview

Ethernet TCP/IP networks, operating at 100MBits/sec, are becoming increasingly popular in an industrial production environment. This is due to their speed, versatility, and commonality with other business level networks based on the same networking standards within a plant location. Many industrial level products now offer an Ethernet interface, either direct to the equipment or through a hardware bridge. The protocols used within this Ethernet environment are an important factor in connectivity between a software package running in a PC and the field hardware.

A Modbus RTU protocol interface has been used as a defacto standard for many years in lower speed, RS-485 serial network applications Modbus/TCP combines the Modbus RTU protocol with Ethernet TCP/IP, allowing data access over an Ethernet LAN (Local Area Network) connection. Since standard Modbus addressing is used, interfacing is well known.

Honeywell's HC900 controllers, Trendview paperless recorders and UDC Controllers support the Modbus/TCP protocol *as standard* via a direct Ethernet connection.

Benefits of using Modbus/TCP protocol in Ethernet Communications

- **Customer demand** - Ethernet LAN connection to application software is becoming a requirement for many customers, most of which have business or production networks using Ethernet with IT (Information Technology) support.
- **Growing popularity of Modbus/TCP over Ethernet** – most HMI and data acquisition software packages offer a Modbus/TCP driver, it is becoming an open standard
- **Modbus familiarity** - Data access for read and write is via normal serial Modbus RTU methods using the same function code and parameter definitions, known to many users. Real-time data available in the HC900 such as control loop parameters, signal tags, variables, analog inputs, etc. can be accessed real-time via the appropriate Modbus address.
- **Speed** – Ethernet networks (now normally 100Base-T star topology) offer higher speed data access versus serial RS-485 networks. This is especially true for direct Ethernet-connected products such as the HC900. Depending on Networks will not be slowed significantly as more units are placed on the network due to Ethernet's higher "bandwidth". A 100Base-T network offers 100MBits/sec. data rates although there is possible contention for network access due to Ethernet CSMA/CD principles.
- **Ethernet Multi-Channel Support** – Many applications can operate concurrently over an Ethernet LAN between Ethernet "nodes" using separate "channels". The HC900 can support up to 10 concurrent connections to software applications. As an example, 2 separate HMI packages, HC900's Hybrid Control Designer software, a Visual BASIC and an EXCEL application at different network locations can all address the same controller concurrently. On the other hand, RS-485 supports only a single channel connection.

HC900 Network Installation considerations

The HC900 is equipped with an Ethernet port as a standard feature (two Ethernet ports on the C70 & C70R CPU). These ports can function simultaneously as slave and master communications ports. The HC900 dual Ethernet ports (C70 & C70R CPU's) can be configured for redundant operation to a host . If the host device does not have the inherent capability to recognize a network failover, the Honeywell HWIOPC Server would be used to perform this functionality.

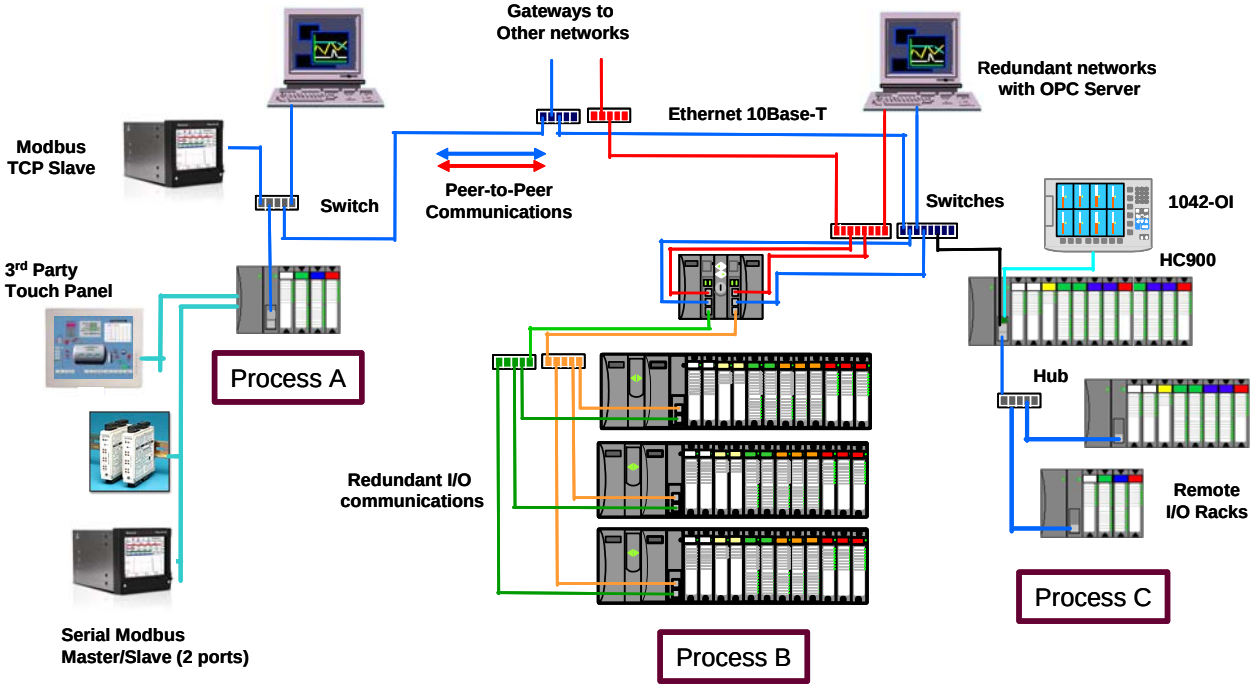
The HC900 dual Ethernet ports will not operate in a redundant configuration through a gateway to a host/server on another subnet. While both the E1 & E2 Ethernet can be configured with a default gateway address, only the E1 port will actually communicate across a gateway to another subnet. The exception is when the HC900 is unable to locate the SMTP Server (for e-mail of Alarms & Events) over the E1 port gateway. The HC900 will switch to the E2 port gateway in search of the SMTP Server.

If both E1 & E2 ports must communicate to a host/server in a redundant configuration, an OPC Server must be used to direct that communications.

In addition to the 10 host connections, the Ethernet ports on the HC900 have peer-to-peer communications capability. Any HC900 controller can communicate with up to 32 peer HC900 controllers. HC900 peer-to-peer communications is via the UDP Protocol.

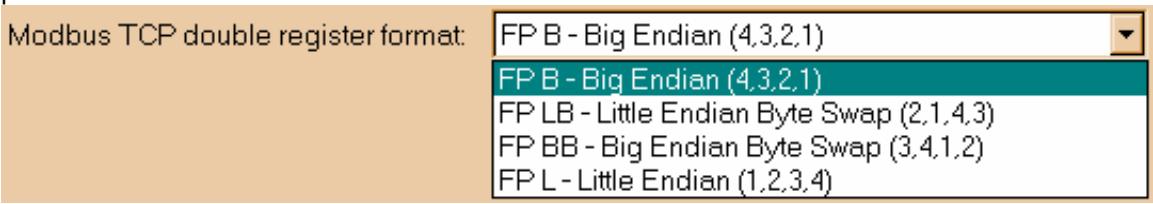
The HC900 controller can also act as a master and communicate with slave devices via the Ethernet port of the controller.

Scalable Small to Large



Network Setup in the HC900

The HC900 Ethernet network connection for Modbus/TCP is inherent once the Ethernet IP address for the controller host port is established. The HC900 predominantly uses an IEEE floating point format for communicating data to software applications supported by Modbus/TCP protocol. A floating point value is sent as (2) consecutive 16-bit registers, each register of which consists of two 8-bit bytes. Some software packages require the registers to be sent in a certain order. The HC Designer software tool allows this order to be selected. The following table lists the selections provided.



The Modbus TCP double register transmission format selection, FB LB "Little Endian Byte-Swapped", would be selected for interface to most third party software packages which use this format as standard. Our default, FB B "Big Endian" is used with SpecView32 or PlantScape software and follows the "Honeywell" default format of other control and recording products.

Fortunately, most PC software packages offer a word swap selection in their driver package anyway, so there should never be an incompatibility.

The application software Modbus/TCP driver (server) must be configured per the software vendor's documentation for dialog box entries. This usually involves setting up a communications channel based on using an installed Ethernet NIC (Network Interface Card or adapter), a TCP/IP port (default is 502), entry of the unit's IP address, use (or non-use) of zero-based register addressing, and connection timeout.

Data available from HC900 over Ethernet Modbus/TCPC

HC900 controllers provide access to an array of parameters that are categorized by function in the HC900 Ethernet Modbus/TCP Communications User's Manual, 51-52-25-111. The HC900 retains all of the Modbus addresses available for the UMC800 and expands the listing due to its greater capacity and functionality. Table 1 summarizes this parameter access, including the read/write capability, when using an Ethernet Modbus/TCP or Modbus Ethernet protocol driver (server) for the host software application. The HC Designer tool also provides the Modbus addresses for all Signal Tags and Variables plus the starting Modbus addresses for the major functions supporting a Modbus address set such as control loops, SP programmers, etc. The Tag Information and the Block Modbus Addresses reports may be viewed on-line and printed out for reference when configuring the database for the host software application. Also, the HC900 Modbus addressing can be exported and saved in CSV format for import into many Data Acquisition applications.

Entering Modbus Addresses in Third Party Software

After selecting the driver for the TCP/IP channel in a third party software package, the tag database would then be created in some cases via a Wizard. The tag definition dialog box would have entries typically for Data Type (Float, Integer, etc.) and decimal (or Hex) parameter addressing, typically decimal with a range of 1 to 65535. The Modbus function code (1, 2, 3, 4, 16, etc.) may also be a separate entry or part of the decimal address. These function codes are defined as follows:

Function Code 1: Read Digital Output Status
Function Code 2: Read Digital Input Status
Function Code 3: Read Holding Registers
Function Code 4: Read Input Registers (Analog Inputs)
Function Code 5: Force Single Digital Output
Function Code 6: Preset Single Register (Write)
Function Code 16 (10 hex): Preset Multiple Registers (Writes)
Function Code 17 (11 hex): Report HC900 ID

Floating point values take (2) consecutive 16-bit registers (32 bits) and it is normal to just address the first register. For example, Analog Input 1 on an AI card (8 inputs) in Rack 1, Slot 1 would be addressed, using function code 4, by entering 0000, Analog Input 2 would have address 0001, and so on. Integers use only (1) 16-bit register. Sometimes the driver will add a leading 4 or 40 to the address, e.g. 400065 for Loop1 PV, to represent "Holding" registers accessed using Modbus Function Code 3, or a 3 or 30 to the address (to represent "Input" registers accessed using Function Code 4). The application via the communications driver knows by data type how many registers to obtain in sequence.

For further detail on Modbus addressing, consult the HC900 Ethernet Modbus/TCP Communications User Manual (form # 51-52-25-111)

Glossary of Terms

Name/Acronym	Name/Definition	Comments
10Base-T	Ethernet network using twisted pair wiring and RJ-45 connectors, used in star topologies	Most popular Ethernet standard. In the name 10Base-T, the "10" refers to 10 Mbps transmission speed, the "Base" refers to Baseband, which means that no frequency multiplexing is applied, and the "-T" refers Twisted Pair conductors in the cable.
CSMA/CD	Carrier Sense Multiple Access with Collision Detection	All nodes on the same network are free to initiate message transmission. If two nodes transmit simultaneously, the Collision is detected, both nodes abort transmission and attempt to re-transmit after a pause.
Data Link Layer	Layer 2 of the OSI Model that is media-independent, and functions above Layer 1 (Physical Layer).	Defines protocols for data packets and how they are transmitted between networking devices. Includes two sublayers: Medium Access Control (MAC), and Logical-Link Control (LLC).
Default Gateway	A PC that controls traffic between subnets	
Ethernet	LAN protocol defined by IEEE 802.3 networking standard (physical and data link layers). Uses CSMA/CD access method at a variety of speeds and using several different media	10 or 100 Mbps, Baseband network that uses various media (twisted pair, thick coax, thin coax, or fiber optic cable). Example: 10Base-T is 10 Mbps Twisted Pair.
Ethernet/Modbus Bridge	A hardware device that serves as an interface between serial Modbus RTU devices and host applications using Modbus/TCP protocol	Most bridges support sub-addressing for multiple devices connected to its serial RS-485 port

Name/Acronym	Name/Definition	Comments
FTP	File Transfer Protocol	Use to send and receive files between a PC acting as an FTP client and a PC acting as an FTP Server.
Hub	A hardware device with multiple ports enabling one device to be connected to several others	A hub forwards all messages on one of its ports to all of its other ports with no isolation between devices.
IEEE 802.3	The basis for the Ethernet standard. It defines the physical and data link communication layers, uses the CSMA/CD access method at a variety of speeds with a variety of media such as unshielded twisted pair.	
Internet	A system of networks (local, regional, national, and international) linked by the TCP/IP protocol suite that function as single, cooperative, virtual network.	
IP Address	Internet Protocol Address	A 32 bit numeric address written as 4 "octets" (eight bits, translating to integers from 0 to 255) separated by periods, e.g., 164.142.145.065. It is a software address. Within an isolated network you can assign the addresses at random as long as each is unique, but connecting a private network to the Internet requires registered IP addresses to avoid duplication.
LAN	Local Area Network	Networked devices, logically isolated from other networks and devices.
MAC Address	MAC coded ID	A Data Link layer address also known as hardware address, physical address. Unique code is "burned-in" into the product by its manufacturer. A set (6) 2-digit hexadecimal numbers.
Modbus/TCP or Modbus TCP/IP	Variant of Modbus protocol	Modbus/TCP is a derivative of related Modbus RTU protocol used with RS232/RS-485 data acquisition and supervisory structures. Basically, Modbus/TCP encapsulates Modbus RTU frames in TCP frames for transport over an Ethernet network.
Node	An intelligent device on a network that has a hardware address such as a PC, printer, a controller or recorder	

Name/Acronym	Name/Definition	Comments
OSI 7-Layer Model	Open Systems Interconnection Reference Model	The OSI model is established by International Standards Organization (ISO) to enable computer communications using disparate media and protocols. Includes seven “Layers” refer to OSI Reference Model” for more information.
Packet	A bit sequence that is transmitted as an entity on a network.	The content of a packet varies with the protocols that are applied. It includes the data message itself and various routing and control information such as source and destination addresses. In many cases, a packet includes a set of frames for one protocol embedded (or encapsulated) in a set of frames for another protocol. (Several levels of encapsulation could be incorporated in a packet.)
Protocol	A system of rules for communicating over a network.	
Segment	A section of a network connecting 2 or more computers separated by switches, hubs or routers	Recorders, controllers, and PC’s may be in a segment
Subnet	A portion of the network that shares a common address component	
Subnet Mask	Acts as a filter when identifying IP addresses on a subnet. It is simply a screen that indicates which numbers to access. 255.255.255.0 is an example default.	A single IP network can be divided into many subnets by using some of the most significant bits of the host address portion of an IP address as a subnet.
Switch	A multi-port Ethernet device that switches traffic between two or more network segments on an address-selective basis. Also called switching hubs.	An Ethernet switch looks like a hub, but unlike a hub automatically determines and remembers where an Ethernet device is located and routes messages only through the appropriate port. This minimizes network loading and enables true deterministic communications over Ethernet by eliminating “collisions”.
TCP/IP	Transport Control Protocol/Internet Protocol	Transmission Control Protocol (TCP): - Operates at the Transport Layer of the OSI Model. - manages connections between computers. Internet Protocol (IP): - operates at the Network Layer (one step below TCP) - defines how data is addressed (source/destination)