Modbus-IDA News
the architecture for distributed automation
Summer 2007 Issue

Modbus-IDA at the Debut of ISA EXPO's "Bus Station"

At this year's ISA EXPO (Houston, Texas October 2 - 4), Modbus-IDA will be showing in ISA's "Bus Station." ISA developed the concept to house and showcase the protocol support organizations and member companies that offer devices that use those protocols.

The Bus Station is a collaborative effort designed to deliver the latest information on industrial bus and field communications. Presentations and product offerings for the various networking and communication protocols will be centralized in the Bus Station where attendees can gather both technical education and product information.

This year at the Modbus exhibit (Booth 1148), you will have the opportunity to meet member companies

- **connectBlue**
- **Moxa Networking Company**
- **PCN Technologies**
- **Phoenix Contact**
- **Schneider Electric**

Also appearing in the Bus Station are member companies

- **Real Time Automation**
- **Spectrum Controls**

Pick up your bus ticket at the Modbus booth in the Bus Station. After you have visited all the Modbus-IDA members at the show, turn in your ticket for a prize drawing: Five iPod nanos will be given away during the show, with a Grand Prize drawing for a computer from among all Modbus bus ticket entrants after the show closes.

ISA EXPO 2007
2–4 October
Reliant Center, Houston, TX

ARC Advisory Group Survey on Industrial Ethernet

Headquartered in the United States with offices around the world, ARC Advisory Group is an industrial analyst and strategist in manufacturing, logistics, and supply chain solutions. **ARC is currently conducting an online survey on the topic of industrial Ethernet.** The online survey is open to all types of participants, but is targeting end users, integrators and OEMs and will evaluate the final results along these lines.

Please participate in this online survey at:

http://Survey.arcweb.com/ss2/wsb.dll/ARC/IndustrialEthernetSurvey.htm

The survey is available for completion until August 17.

Modbus in Real Time

In this article, Modbus-IDA President Fred Cohn discusses the suitability of Modbus TCP to applications requiring real-time control.

Fieldbus has been a dilemma for users trying to manage cost and choose best-in-class control products. For product developers, the proliferation of different fieldbus technologies has forced multiple, ever-changing variants of their core products, impacting the cost of development and making it difficult to offer complete solutions to a breadth of customers. By contrast, Ethernet suppliers have seen cost reductions of up to 30 percent per year due to high volumes in the office and telecom markets. But can Ethernet be applied to real-time control?

For a typical process control application, this might mean the time between when an "add ingredient signal" is triggered and the valve moves to permit the flow of material. For a typical diverter conveyor application, this would mean the time from an input signal indicating a product on the conveyor until the time an arm needs to move to divert the product to the right downstream conveyor. This differs between process and discrete control, but one can assume that most process control applications expect a process change to occur between 100ms and 1s while most discrete control applications require changes to occur between 30 and 50ms.

Meet Some of Our Members...

PCN Technology, Inc. develops and commercializes technologies and components that provide secure multi-path networks over conductive media for mission-critical embedded systems.

The company's I/O products are compatible with many different formats and protocols used for communicating data. In addition, they permit multi-path communication since each conductive medium can be used to establish multiple independent channels for transmitting and receiving data. The conductive media used may be any electrical wire commonly found in products, systems, buildings, machinery, transportation, devices, or products.

PCN's iPLC™ solutions provide iPLC™ technology for robust, reliable and secure solutions. PCN products offer flash programmable/data self programming, I2C client/server, Ethernet, RS-232, RS-485, CAN, Modbus, DeviceNet, Profibus, USB, and SPI support on module.

PCN Technology is based in Santa Clara, Calif.

(www.pcntechnology.com)

Automated Solutions offers OPC servers and ActiveX controls for HMI and SCADA development. Its products include runtime-free .NET Components for HMI/SCADA; runtime-free ActiveX Controls for HMI/SCADA; OPC data access servers; and custom software development services, including custom software applications, OPC Servers, and custom components according to the customer's specifications.

The company's Modbus offerings include the Modbus TCP Master OPC Server; Modbus Master OPC Server (for Modbus RTU and ASCII compatible devices); Modbus TCP Master ActiveX Control (Modbus TCP via Ethernet TCP/IP to Modbus TCP compatible devices); Modbus RTU & ASCII Master ActiveX Control (Modbus RTU and ASCII via PC serial port to Modbus compatible devices); Modbus RTU/ASCII/TCP Server ActiveX Control (Modbus RTU/ASCII/TCP Server protocol for connection to Modbus and Modbus TCP Master).

Automated Solutions offers fully functioning 30-day trial versions of all its software products

(www.automatedsolutions.com)

South Carolina-based **Sealevel Systems** has been a member of Modbus-IDA since 2004. Sealevel Systems has manufactured I/O products since 1986 to serve its customers serial and digital interface requirements.

The company currently offers over 200 standard products, including nine I/O modules that are Modbus-IDA certified for compliance with the Modbus protocol.

As a demonstration of the company's commitment to high reliability and customer satisfaction, Sealevel provides a Lifetime Warranty standard with all Sealevel manufactured I/O products.

Sealevel's SeaI/O data acquisition modules provide digital, analog, and serial expansion to any computer and can be connected to the host via wireless, Ethernet, USB, RS-485, or RS-232. Multiple units can be daisy chained using pass-through connectors to create a versatile distributed control and monitoring network. Multiple modules can be combined in a local stack or separated up to 4000 feet using the RS-485 Modbus RTU expansion interface. SeaI/O modules are Modbus TCP and Modbus RTU compatible and have Sealevel SeaMAX software support for Windows 2000, XP and Vista operating systems.

(www.sealevel.com)

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Become a Member

see back cover for details...

Modbus-IDA Discussion Forums

Q&A

Number of Modbus Devices on the Bus...

On Apr 12, 2007 miuritan asked:

I have a lot of Modbus devices - about 160 or 170 devices. Is it possible to read data from them if they are connected thea same bus? There will be about six or seven RS-485 repeaters placed on that bus.

Diego M. Romero replied:

From the logical point of view Modbus protocol can address 247 different nodes. If you are using a RS-485 or RS-422 electrical interface, the limit is 32 nodes or 1.000 meters per electrical segment. To overcome this limit you must use repeaters. And depending on the speed, the delays must be taken in account.

Good luck!

An anonymous poster offered:

I guess you have them in a Daisy Chain bus, right? According to the definition you can connect 247 devices.

JustSomeGuy quoted the Modbus specification:

"The address field of a message frame contains two characters (ASCII) or eight bits (RTU). Valid server device addresses are in the range of 0 – 247 decimal. The individual server devices are assigned addresses in the range of 1 –247. A client addresses a server by placing the server address in the address field of the message. When the server sends its response, it places its own address in this address field of the response to let the client know which server is responding.

Address 0 is used for the broadcast address, which all server devices recognize. When Modbus protocol is used on higher level networks, broadcasts may not be allowed or may be replaced by other methods. For example, Modbus Plus uses a shared global database that can be updated with each token rotation."

Darrin Hansen confirmed:

Nothing in the Modbus specification prohibits such a configuration. It's really more a question of whether the repeaters introduce any significant delays. If so you must ensure your client waits long enough for responses.

But the delays should be insignificant with most repeaters (compared to the overall server's response latency, etc.)

Ask your question or help out a fellow engineer on the Modbus Discussion Forum:

modbus.control.com

From the Modbus Discussion Forum...

Modbus <—> OPC Converter...

In February, Rati wrote to the forum:

I am looking for software that can bridge between OPC and Modbus. It should be able to take OPC data and convert into Modbus data and vice versa.

Eric Murphy suggested:

Is your OPC Server for Modbus being used in a plant type environment, or a telemetry/RTU field type application? Although all compliant OPC Servers for Modbus will support the OPC interfaces the same way, how they perform as Modbus Clients/Servers will differ. Particularly in telemetry type environments you should consider an OPC server that supports different time-out configurations, poll management options and comm channel redundancy.

Here's a link that describes both Plant and Telemetry type servers (the Plant edition is a free 30 day trial download) http://www.matrikonopc.com/opc-drivers/1603/index.aspx#html

Nicolas Kunzer said:

I advise you to check Pcvue scada software. It is an OPC client AND server. You can communicate in Modbus (and other protocols). Of course if needed (may be not in your case) you can display your data in mimics and use the trends, logs and alarm management.

Check our websites:

http://www.arcinfo.com or

http://www.pcvue-sea.com

Mark offered:

Check out automatedsolutions.com for Modbus OPC Servers. You can download a fully functioning 30-day trial version to test with.

http://automatedsolutions.com/products/opcmodbusrtu.asp

Michael Griffin replied:

OPC is not a protocol. It is the converter software. You need an OPC server that talks Modbus.

David offered:

Presumably you already have software that includes an OPC client? If so, you need an OPC server, which includes the Modbus driver.

A whole bunch of vendors supplying OPC servers is available at http://www.opcfoundation.org/ Specifically a search for "OPC server".

It pays to look for certification by the OPC foundation. Just because someone says OPC server doesn't mean it works like it should.

Ali:

See http://www.softwaretoolbox.com We are using it on Modbus+ with Modicon 984 series PLC as OPC server. Working well with 4000 tags and eight PLCs.

Modbus Products and Innovations

Afcon Announces P-CIM 7.70

Afcon Software and Electronics Ltd. announced the release of version 7.70 of its popular P-CIM SCADA solution. The revision includes a new reporting system, the P-CIM Supreme Report, an innovative Process Control System analysis and reporting software aimed at improving the decision-making process at all levels of the enterprise.

The P-CIM Supreme Report combines open connectivity to multiple sources such as real-time and alarms data, historical data, relational databases and files data with excellent performance, delivering easy-to-use and secure reports. P-CIM Supreme Report offers a user-friendly interface for designing report templates with company logos and built-in graphical objects.

P-CIM Supreme Report also has a library of predefined statistical and analytical objects allowing users to access information such as minimum, maximum, average, weighted average, sum, integral, counts, duration and percentage for display in text fields, charts or tables. Reports can be generated automatically or manually and distributed to web portal, e-mail, file servers or printers in secured PDF format.

P-CIM 7.70 features enhanced data and workstation security compliant with FDA requirements.

P-CIM 7.70 is dedicated to monitoring industrial control, fire, safety, security and building management systems. Read more about P-CIM 7.70 at the company's website, www.afcon-inc.com or contact marketing@afconinc.com

MiMiC Simulation Driver for Modbus TCP

MYNAH Technologies' MiMiC Simulation Driver for Open Modbus TCP allows I/O and process simulation for devices that support Modbus TCP. Simulation system setup over Industrial Ethernet networks is fast and easy using this I/O driver. MiMiC Simulation software can be used for software acceptance testing and operating training systems that use this migration simulation.

The MiMiC Simulation Workstation uses an Ethernet Network Interface Card to communicate to a controller that supports the Modbus TCP protocol.

Selection of the Modbus TCP protocol is done during initialization of the MiMiC dataset. The MiMiC Workstation reads and writes Modbus registers through an Ethernet Network Interface Card (NIC). This NIC must be configured in Windows with a static IP address.

MYNAH recommends the use of a separate NIC for simulation communications from the office or plant network interface card. One MiMiC Workstation can provide Modbus TCP I/O simulation connections for up to 32 Modbus server devices.

The final step for simulation system setup is to set the IP address of the target controller. This is done by selecting the Setup button and entering the IP address of the target controller. Then users enter the Modbus address and select Extended Addressing if the address range is in the Extended Modbus address range (XXX,XXX registers). The Setup Window is shown in the figure below.

A link to the the full application note, is on the Modbus home page, http://www.modbus.org/

Advertise Your Modbus Products on the Modbus-IDA Website

With our growing number of site visitors and the increasing popularity of our device directory, what better place to advertise your Modbus devices and software than at www.modbus.org?

All banner ads must conform to the following specifications:

- File size: 20k maximum
- Maximum dimensions: 468 pixels x 68 pixels
- File type: Graphics Interchange Format (GIF) or animated GIF
- Resolution: 72 dpi
- Color depth: 8 bit (256 colors)
- Every banner must include a working URL.

Please note that we will not post ads. with cycle rates or animation modes that are irritants to our visitors. We would be happy to help you design an effective Web ad with acceptable cycle rates and types of animation.

Contact lenore@modbus-ida.org for a rate sheet.

Modbus in Real Time

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For motion control, where multiple axes of motion are coordinated to make a smooth, angular or circular motion, throughput could require updates as fast as 250µs. To achieve these throughput levels, the device update over the network must be approximately 10 times faster than the application throughput requirement.

So, in process control, device update times of <100ms are adequate for most applications while for discrete control, device update times of <10ms are common. With more demanding discrete control applications, customers are asking for device update times approaching 1ms. When using a fieldbus for coordinated motion control, update times of less than 100µs are necessary.

Actual applications may vary from these figures, but this represents the vast majority of applications. Since the number of applications requiring coordinated motion control is relatively small, it's safe to assume that more than 90 percent of applications can be served with devices achieving device update times of 1ms.

Determinism is defined as the "guarantee" that an event will occur within a specified time period – not faster, not slower. Sometimes too fast can be as problematic as too slow; but most people are concerned with too slow.

In technical terms, Ethernet is a non-deterministic network. In certain architectures, communications can be held up due to collisions or traffic overload conditions. However, using modern Ethernet switch technology and separating control architectures from plant-wide and office networks (either physically or with network routers), determinism is virtually assured.

Using commercial off-the-shelf technology, hardware chips, RTOS, stacks, etc., device update times of 1ms are achievable making Ethernet suitable for virtually all discrete control applications.

Applying Ethernet to coordinated motion control, the determinism using pure COTS Ethernet solutions is probably inadequate, and special protocols (e.g., IEEE 1588, precision time protocol) or custom-designed stacks may be necessary. Device developers are required to buy those custom stacks from controls suppliers or must to design them in-house – an expensive proposition for all but the largest control product suppliers.

For device designers, the more critical aspect is how the Ethernet communications interface interacts with the control side of the device or controller. While COTS Ethernet hardware, RTOS, and stack potentially provide suitable performance, if the designer doesn't take care to manage the resources and hardware design, optimal performance might not be achieved. Designers must balance the needs of the communications network and the device's own requirements.

...can Ethernet be applied to meet the needs of real-time control? For most process control or discrete control applications, the answer is definitely, YES!

So, can Ethernet be applied to meet the needs of real-time control? For most process control or discrete control applications, the answer is definitely YES!

Control system designers, however, must make sure they understand a product's performance characteristics and how it will behave in a given system architecture – understanding a device's network response time, its application throughput, and the controller's reaction time through the hardware interface and control program.

The Modbus Perspective

For real-time control, Modbus-IDA believes that the Modbus Messaging protocol can be deployed to meet over 90 percent of control applications. Many people perceive Modbus as the slower serial line protocol for which it was originally designed. However, the Modbus protocol, reincarnated as Modbus TCP, uses all the performance and reliability services of Ethernet TCP/IP for addressing, connection management, and packet loss management.

Modbus TCP system performance is dependent on network speed: 100-Mbps- up to Gbps-level transfer to devices supporting the Modbus protocol. When Modbus-IDA refers to real time, we consider the applicability of the network to replace fieldbus technologies such as Profibus, DeviceNet, or proprietary I/O and device networks. Virtually all control applications can be satisfactorily served with the performance of any of these networks, and Modbus TCP can meet or exceed their performance characteristics.

The limited number of cases requiring higher network performance(typically associated with coordinated motion for X-Y tables, robot control, flexible machining centers, or advanced packaging machines) dictate specialized solutions with proprietary implementations. But these requirements are uncharacteristic of the majority market fieldbus applications.

The marketing noise level on specialized real-time Ethernet is deafening; the reality is that most applications don't require this type of performance and most customers aren't specifying this level of response time.

Modbus protocol, leveraging the Ethernet TCP/IP network solution, meets 90 percent of control applications and is cost-effective, simple to implement, ubiquitous (found in nearly every SCADA package and OPC Server), and royalty-free.

Why pay for what you don't need?

Fred Cohn is President of Modbus-IDA. An expanded article on this topic can be found in the Industrial Ethernet Book Issue 37.

Clear Skies Ahead: Afcon's Recent Flue Gas Desulfurization Project

With governments worldwide setting strict limits on emissions, electricity companies are changing their systems to treat and improve the gases emitted during the electricity creation process. Modbus-IDA member company Afcon Software and Electronics, Ltd. became involved in such as project with the Electricity Company in Israel.

AFCON SOFTWARE AND ELECTRONICS LTD.

One of the most effective processes for cleaning and diverting one targeted gas is Flue Gas Desulfurization (FGD). Gas is emitted into an absorber that cleans the sulfur from the gas, resulting in gypsum dust. This dust is then used as a main part of the gypsum production industry.

The Electricity Company selected Lurgi Lentjes Bischoff GmbH as the main contractor for its Rotenberg power plant. Afcon was selected as the subcontractor for all control systems in the plant's production line, HMI, alarms and operational control applications.

The control system in the plant features redundancy in all layers of the project. The system uses five pairs of Modicon Quantum PLCs in a hot standby configuration. In addition, there are a number of Siemens PLCs with a Modbus card and a Telemecanique PLC that came with the equipment.

Project Configuration:

- Number of I/O: 10,000
- Number of PCs: 9
- Number of PLCs: 10
- PLC Models: Modicon-Quantum, SIEMENS S7-400 and Telemecanique.
- Operating system: Windows 2000
- Protocols: Modbus TCP and MB+

The PLC Communication uses a dual MB+ network for a hot standby configuration at the PLC level. The SCADA system is Afcon's P-CIM SCADA/HMI, using two servers to

support each other in a redundancy configuration. The two servers are connected to the PLC level. They hold the database of the plant and all displays and alarms.

Seven P-CIM clients are connected to the servers. The clients are located in the local and central control rooms. Every update on the servers is automatically recorded on the client. The secondary server is automatically updated with any change on the primary server. All PCs have Windows 2000 operating systems installed. The P-CIM Network: Communication between operating stations and servers is through a dual Ethernet TCP/IP network as redundancy on the network connection.

The Modbus-IDA Newsletter

This is the newsletter of Modbus-IDA, the international nonprofit organization devoted to the evolution and support of the Modbus and IDA protocols.

For more information about membership and other services of Modbus-IDA, please refer to our website: www.modbus-ida.org

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The Modbus-IDA Mission

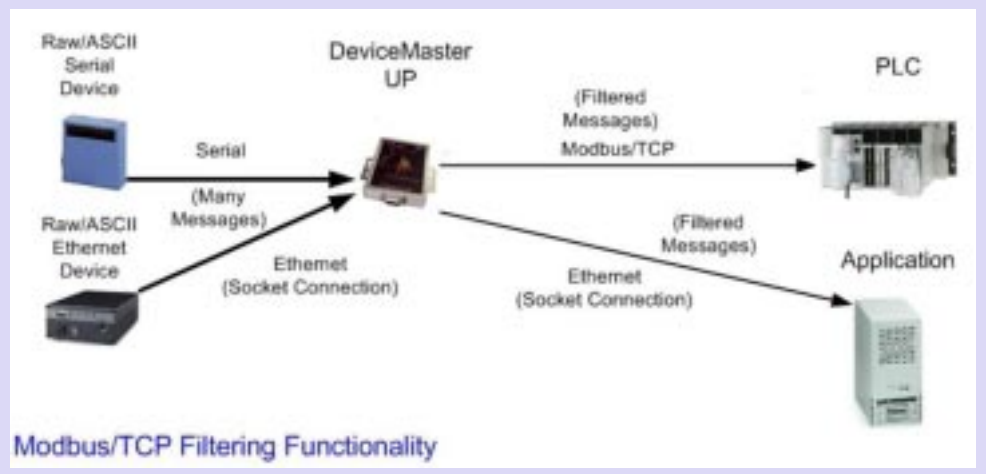
Modbus-IDA is a group of independent users and suppliers of automation devices that seeks to drive the adoption of the Modbus communication protocol suite and the evolution to address architectures for distributed automation systems across multiple market segments. Modbus-IDA will also provide the infrastructure to obtain and share information about the protocols, their application and certification to simplify implementation by users resulting in reduced costs.

Modbus Application Stories

Modbus Filtering & Data Extraction on Comtrol's DeviceMaster UP with Modbus TCP

There are many questions to answer when interfacing a device to an RFID reader; it can be overwhelming for even the most experienced PLC programmers. Like most of us, you probably have limited time and budget to finish the task.

How do you format the RFID tag data? How do you extract the company, product, and serial number parameters from the many possible bit encoded formats? How do you filter out repeated data? How do you handle data from different antennas on the same RFID reader? What if you also need to verify that RFID and barcode data match correctly? How do you possibly do it all in ladder logic?



Modbus/TCP Filtering Functionality

Comtrol provides a solution with its patent-pending Filtering and Data Extraction process. This user-friendly and highly configurable process greatly simplifies PLC programming while doing the hard work so the PLC doesn't have to.

What does this technology do?

- Extracts the company, product, and serial numbers from all 43 EPCglobal RFID tag formats.
- Extracts the company and product codes from EPC/EAN barcodes.
- Provides highly programmable filtering of string, RFID tag and barcode data. Data is aged so the PLC gets only the data it needs and when it needs it.
- Provides the RFID and Barcode parameters to the PLC in a simplified and easy-to-use format.
- With the peer-to-peer Modbus TCP functionality, polling for data is optional The gateway or proxy can write the data directly into PLC memory pace.

Patent-pending DualConnect technology allows you to send the data to both the PLC and an application so your IT department can receive the data too.

One example of the technology at work is a conveyor installation, where containers may be received with multiple devices. Each has an RFID tag and both a PLC and database require the tag data. The system allows the PLC to receive the tag parameters just once to divert the container correctly. At the same time, a database application can receive all the tags to maintain inventory control.

Both a barcode and an RFID tag must be attached to each container and they both must be correct. The parameters for both the RFID tag and barcode can be extracted and placed directly into PLC memory. The PLC program need only perform simple compares to verify the RFID and barcode data.

In this environment, a device such as a high-speed servo or encoder sends out status data continuously. The string filtering option filters out duplicate status data so the PLC only receives the status data when it changes.


DeviceMaster UP Gateway

Modbus-IDA Members:
Submit your application story for publication in the Modbus Newsletter

Join! Design! Test! Promote! Apply!

We're with you. Modbus-IDA exists to help suppliers and users of Modbus protocols succeed. Our members range from suppliers of Modbus-compliant products, to system integrators, end users, and educational institutions.

The common link? They all value the information and services provided by Modbus-IDA, and they all play a role in determining the future of the world's most broadly applied protocol.

To join Modbus-IDA, order a Toolkit, or arrange conformance testing, visit our website:

www.modbus-ida.org

Designing with Modbus

Each day, Modbus developers turn to Modbus-IDA for valued assistance with their projects:

• Start with downloading specifications and other design documents from the modbus-ida.org website.

• To really save time, purchase the Modbus TCP Toolkit CD (FREE with general membership); it contains source code and a myriad of other resources.

• Then, if you come across technical issues that have you stumped, post your question on our active developer's forum. One of the many experienced Modbus implementers who frequent this forum will likely have your answer.

Conformance Testing

When your project's done, what then? How do you know it really conforms to Modbus specifications? How do your users know?

The answer starts with running the conformance test suite included with your Modbus TCP Toolkit. This self-test helps you check your design assumptions and catch the subtle "gotchas" that might otherwise slip through your design review.

To make the definitive statement of your company's commitment to open protocols, submit your product for testing to the independent Modbus-IDA Conformance Test Lab. We'll certify your product as compliant, and post that information on the Modbus website for the world to see.

Visibility for You and Your Products

Your products, your membership in Modbus-IDA also opens the door to a powerful range of visibility options to highlight your company as a supplier of Modbus-based products.

Exposure on our website, in our newsletter, and through our various trade show appearances are all options that allow you to make the most of your Modbus-IDA membership.

If your company is truly on the cutting edge of new technology, you'll likely also value the opportunity to participate in our technical committees. There, your company's knowledge, experience and technology can help guide future enhancements, extensions and adaptations of Modbus to keep it the world's leader for decades to come.

Time to Apply

When it comes time to get your Modbus network up and running, it's comforting to know that hundreds of thousands of applications have preceded yours. But what if things don't go as planned?

The modbus-ida.org users forum is ready to answer your questions and provide guidance. Thousands of users from diverse backgrounds read the forum, giving you a powerful base of experience from which to draw.

The Future is Yours

So, whatever your role in the use of Modbus, consider joining Modbus-IDA. You'll get the support you need today, and have opportunities to help guide Modbus to a dynamic future.

The Modbus TCP Toolkit

The Modbus TCP Toolkit provides all the necessary pieces to develop a Modbus-compliant device, including documentation, diagnostic tools, sample source code, and pre-test software to prepare for Modbus-IDA conformance certification. The toolkit is available as a benefit of membership in Modbus-IDA or can be purchased separately for US$500 plus shipping and handling.

Toolkit Contents

Modbus Documentation

• Modbus Application Protocol Specification, V 1.01b

• Modbus Messaging on TCP Implementation Guide, Rev. 1.0b

Tools

• Modbus/TCP Client Diagnostic Tool

• Modbus/TCP Server Diagnostic Tool

Sample Source Code

• Modbus/TCP Sample Client Code for Visual Basic Win32

• Modbus/TCP Sample Client Code for C/C++ Win32

• Modbus/TCP Sample Server Code for C/C++ Win32

• Modbus/TCP Sample Server Code for C VxWorks

• Modbus/TCP Sample Server Code for C++ VxWorks

Conformance Testing

• Modbus/TCP Conformance Test Software