Precision Digital Presents

An Introduction to Modbus® Communications

Webinar Organizers

Joe Ryan

Product Manager

Precision Digital Corporation

Ryan Shea

Applications Specialist

Precision Digital Corporation

Bruce McDuffee

Webinar Moderator

Precision Digital Corporation

Agenda

1. What is Modbus?
2. Protocols, networks and terms
3. How does Modbus work?
4. When should I use Modbus?
5. Pros and Cons of Modbus
6. Practical cases

INTELLIGENT
MONITORING & CONTROL

Takeaways

Understand the fundamentals of the terms and difference between a network and communication protocol

Learn how Modbus works and how it's different from analog signals

Know the pros and cons of Modbus as a communication choice

Put it all together with a couple of real case scenarios

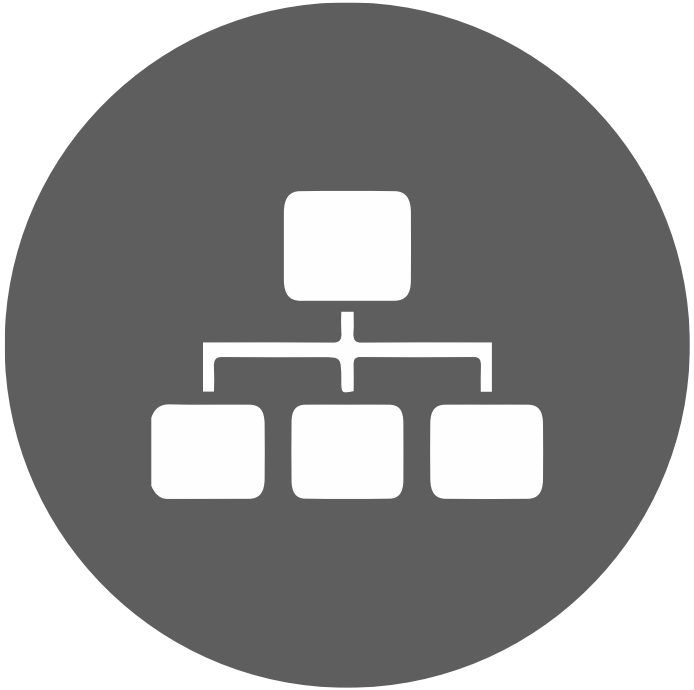
Getting to know you

- Where are you located?
- What is your industry?
- What is your experience with Modbus?

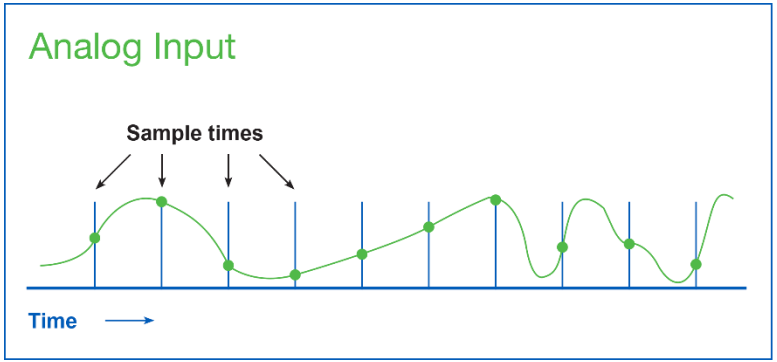
INTELLIGENT
MONITORING & CONTROL

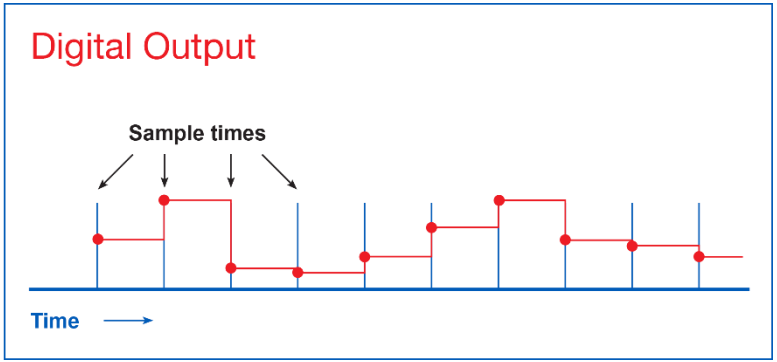
What is Modbus?

- Digital communication for 2 or more devices
- An application-layer protocol
- Open source code
- Published by Schneider Electric



Protocols, networks, and terms





Analog Signals

- Analog signals have an infinite number of possible values over time.
- Example:
  - 12.9 mA
  - 4.563 mA

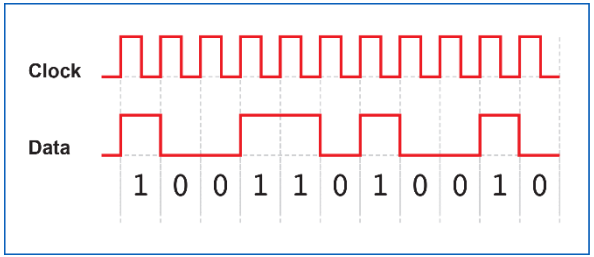
Digital Signals

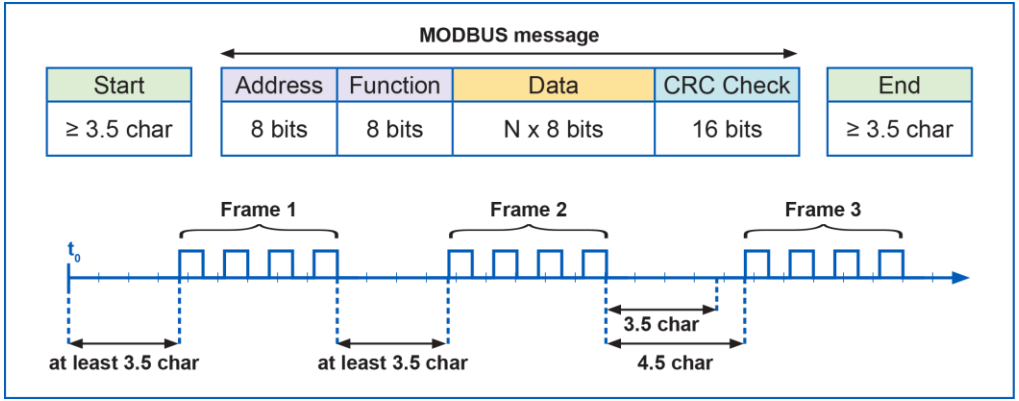
- Discrete number of values from 2 to billions determined by number of bits
- Vary with sample times

Protocols, networks, and terms

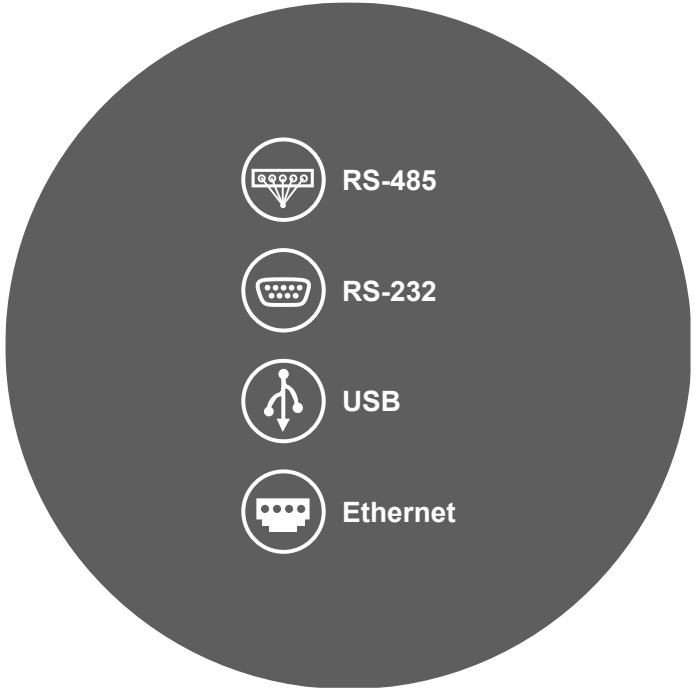
Digital Communication via Packets

- Digital signal communicated 1 and 0 values
- This code is read and interpreted by the Protocol





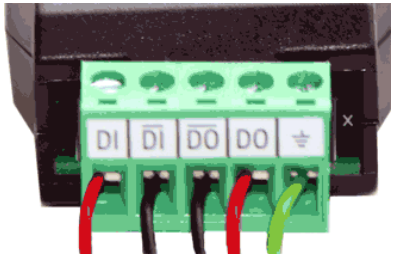
Protocols, networks, and terms



- RS232, RS485, USB, Ethernet are types of networks and used with Modbus.
  - Different transmission mediums to send the Modbus Protocol
    - Modbus is the language being spoken
    - RS232, RS485, Ethernet, etc. are the medium, such as phone, VOIP, fax, letter, etc.
    - Different methods of communicating the same core language between two devices.

Types of Networks

- RS-485
  - Full (5-wire) or half-duplex (3-wire)
  - Multi-drop
  - Up to 4,000 ft (1219 m).
  - Very common on industrial devices
  - Not common on computers
- RS-232
  - Usually 9-pin serial port
  - Usually only two devices
  - Up to 1,000 ft (305 m) are required.
  - Common on older desktop computers



Example RS-485 5-Wire Connection

Example Female RS-232 Connection

Types of Networks (cont.)

- USB (Universal Serial Bus)
  - Various standard cables and connectors
    - Type A, Type B, mini, and micro
  - Less than 16 feet 5 inches (5 meters) without additional devices
  - Very common on computers
- Ethernet
  - Devices accessed anywhere on the network
  - Often everywhere in a facility
  - Web servers, virtual coms, etc. for global reach
  - Complicated to setup
  - Power over Ethernet options available

Example USB Connectors

Questions?

- Please enter your questions in the ‘Questions’ window

Common specifications and settings

Device address /
Slave ID

Baud rate

Data format

Parity

Other

INTELLIGENT
MONITORING & CONTROL

Device Address / Slave ID

- Programmable for 1 – 247 devices
- Each device on the Modbus network must have a unique identifier.

INTELLIGENT
MONITORING & CONTROL

Baud rate

- Speed of communication in bits/second
- 300 – 19,200 bps
- Must be identical for all devices on the network

Data format

- Configures the Modbus data packet
- Start bits & Stop bits
- Must match on all devices on the network

INTELLIGENT
MONITORING & CONTROL

Parity

- Even, odd or none
- Defines the data packet
- Should match on all devices

INTELLIGENT
MONITORING & CONTROL

Other specifications

- Byte-to-byte timeout
- Transmit delays
- Other

Registers & tables

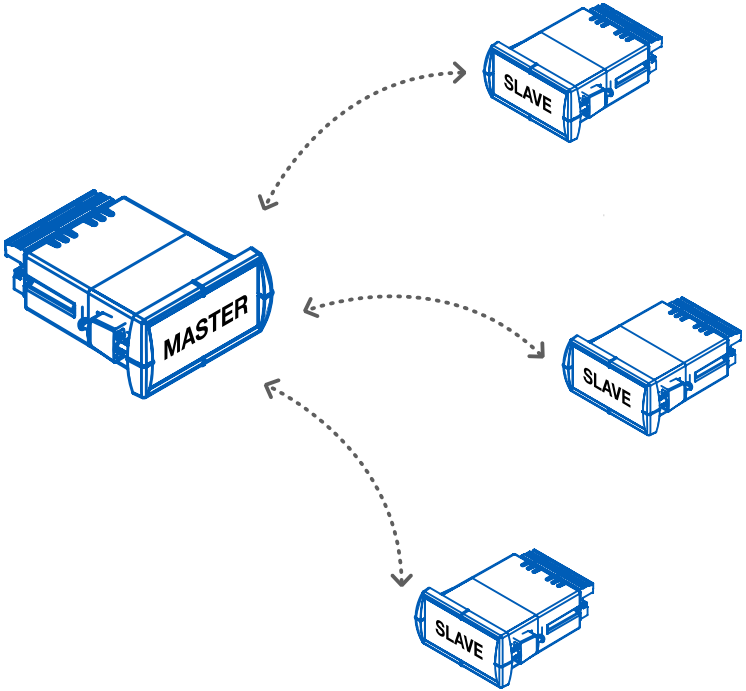
PROVU® Modbus® Scanner Series Register Tables — Serial Communication

Register [1] Number	Register [1] Address (Hex)	Name	Access	Limits or Range [2]	Units	Data Type [3]	Function Code(s)	Comments
40001 – 40002	0 – 1 (0000 – 0001)	PV1 Display value	Read Only	-99999 to 999999	User defined	Floating point	03, 04	Represents the PV1 display value including the decimal point. Under Range = -99999, Over Range = 999999, and Open = -99999
40003	2 (0002)	Alarm and Relay status	Read Only	1 = In Alarm 1 = relay energized	None	Word; Bits	03, 04	Read alarm status and energized/non-energized status of relays. Alm = Alarm. Rly = Relay. 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Alm 8 Alm 7 Alm 6 Alm 5 Alm 4 Alm 3 Alm 2 Alm 1 Rly 8 Rly 7 Rly 6 Rly 5 Rly 4 Rly 3 Rly 2 Rly 1
40004	3 (0003)	Digital Inputs and Outputs status	Read Only	1 = Input selected 1 = Output active	None	Word; Bits	03, 04	Read the state of the digital inputs and outputs. 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 DI 8 DI 7 DI 6 DI 5 DI 4 DI 3 DI 2 DI 1 DO 8 DO 7 DO 6 DO 5 DO 4 DO 3 DO 2 DO 1
40005 – 40006	4 – 5 (0004 – 0005)	Maximum Display value	Read Only	-99999 to 999999	User defined	Floating point	03, 04	Represents the Maximum display value, including the decimal point, since last power up or Max Value reset.

- Tables are a tool for programming the master device
- Tables are charts used to define the registers.
- Each register will have type and number.

INTELLIGENT
MONITORING & CONTROL

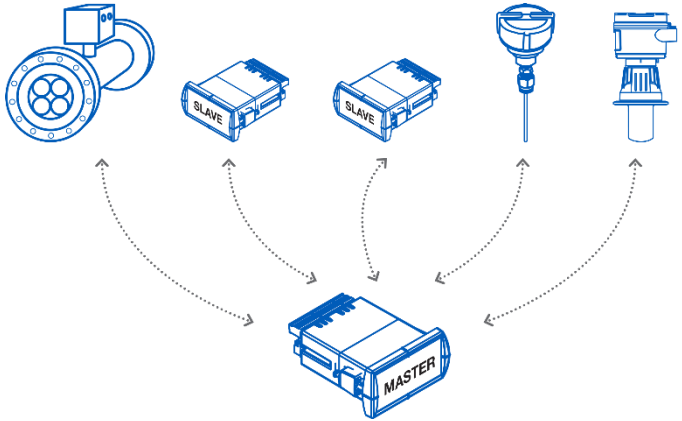
How does Modbus work?



- Master and Slave devices
  - Master polls multiple slave devices to gather information
  - Slave devices cannot transmit information without a request
  - The master keeps communication organized
- Data is sent in a series of 1s and 0s called bits in packets
  - Data content is identified in tables and registers
- Modbus Map
  - Defines the data
  - Tells the Master where the data is stored
  - Tells the Master how the data is stored

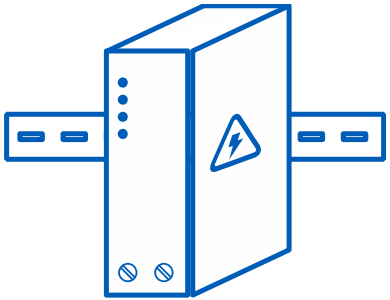
INTELLIGENT
MONITORING & CONTROL

When should I use Modbus?



When more than one piece of data is required from multiple field devices

When a single field device gathers multiple useful PVs



When adequate power is available

Pros and Cons of Modbus

Pros

- Ability to use multivariate transmitters
- Better accuracy from digital signals
- Easy to add devices
- High noise immunity
- Centralized SCADA
- Open source
- Network versatility

Cons

- More expensive than analog
- Complex to setup
- No way for slaves to report exceptions
- Limited to 247 devices
- No security of signal

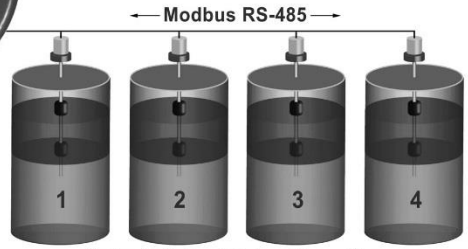
Practical Case 1: Level Monitoring of Oil & Water in Storage Tanks

Problem: Operator monitoring of top levels, oil/water interface levels, and temperature in storage tanks.

- PD6830-AX0-I-2 Modbus scanner as the Modbus master
- (4) MTS M-Series multivariable tank level gauges as *slaves*
- 3-wire half-duplex RS-485 used for the connections
  - Easy to wire
  - Long distances OK
  - Multidrop (5 devices on the network)

This solution displays product level, interface level, and temperature for each tank.

Fixed Serial Data Parameters	MTS M-Series Transmitter Data
Level Register	30001, 30002
Interface Register	30003, 30004
Ave Temp Register	30017, 30018
Data Type	Long Integer (2 registers), Binary, Signed
Byte Order	1234 (most significant digit register first)



Tanks with Multivariable Level Transmitters

The above parameters are taken from the MTS M-Series Modbus tables and used for programming the Scanner.

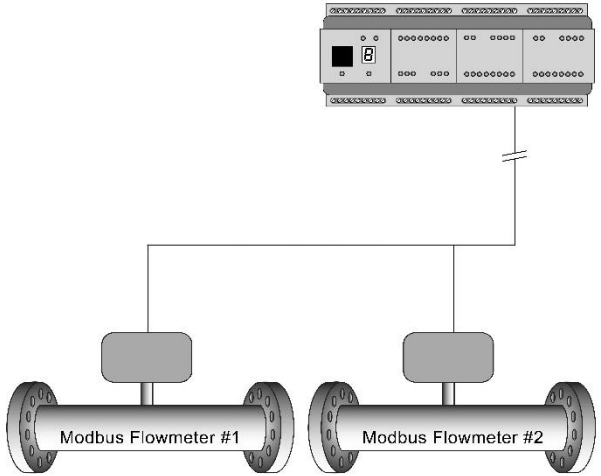
Serial Comm Parameters	Scanner	Tank 1 Transmitter	Tank 2 Transmitter	Tank 3 Transmitter	Tank 4 Transmitter
Address (Slave ID)	100	001	002	003	004
Baud Rate	4800 bps	4800 bps	4800 bps	4800 bps	4800 bps
Transmit Delay	50 ms	50 ms	50 ms	50 ms	50 ms
Parity/Stop Bits	None / 1	None / 1	None / 1	None / 1	None / 1

Practical Case 2: Using Modbus to Poll Data From the Field

Problem: How to get exact, accurate data from two flow meters mounted far from the control room.

- Modbus on PLC allows for error-free rate and total information from the flowmeters
- Ethernet used as a communication method
  - Remote location OK
  - Already present in control room
  - Easy to add devices later

Serial Comm Parameters	Flow Transmitter 1	Flow Transmitter 2	Control Room PLC
Address (Slave ID)	100	200	001
Baud Rate	9600 bps	9600 bps	9600 bps
Transmit Delay	50 ms	50 ms	50 ms
Parity	Even, 1 Stop Bit	Even, 1 Stop Bit	Even, 1 Stop Bit



Fixed Serial Data Parameters	MTS M-Series Transmitter Data
Flow Data Register	30001, 30002
Totalizer Register	30016, 30017
Data Type	Long Integer (2 registers), Binary, Un-Signed
Byte Order	1234 (most significant digit register first)

The above parameters are taken from the flowmeter Modbus tables and used for programming the PLC.

Summary

1. What is Modbus?
2. Protocols, networks and terms
3. How does Modbus work?
4. When should I use Modbus?
5. Pros and Cons of Modbus
6. Practical cases

Q & A

- Please enter your questions in the ‘Questions’ window
- Apologies if we do not get to your question today. We’ll contact you offline with a response as soon as possible.

Next Webinar – May 26th

The Fundamentals of 4-20 mA Current Loops

- This webinar is designed as an introductory class for those who have to deal with 4-20 mA process signals but are not electrical engineers. This webinar will answer questions including:
  - What is a 4-20 mA current loop?
  - Why is this signal so popular?
  - How do I wire a 4-20 mA loop?
- Back by popular demand!

Precision Digital

Helping you become more proficient with process signals connections and communications.

INTELLIGENT
MONITORING & CONTROL

Your source for:

- Digital Panel Meters
- Explosion-Proof Instruments
- Loop-Powered Meters
- Large Display Meters
- Pulse Input Meters and Controllers
- And more

Webinar info
www.predig.com/webinars

For more information

1-800-343-1001

sales@predig.com

www.predig.com

thank you