

Modbus

Overview and analysis

Modbus, developed by Schneider/Modicon, has been the defacto standard for interfacing remote I/O and PLCs into the process DCS system for the past 15 years. Because of this strong history, most legacy control systems interface conveniently with the Modbus standard. Numerous actuator and instrument manufacturers support the protocol, therefore, it is used extensively as a “fieldbus” network as well. The following discussion focuses primarily on the protocol use for field networking purposes.

Modbus features

- Interfaces conveniently into most existing plant control architectures.
- Networks up to 32 devices on a 4-wire network (2-wires for signal and 2-wires for power).
- Trunk network may extend up to 4,000 feet (1220 meters) per segment.
- Dramatically cut wiring costs and commissioning over conventional applications.
- Protocol has been proven in thousands of “mission critical” process applications over the last 20 years.
- Capable of supporting both simple discrete devices as well as sophisticated analog applications.
- May be supported without additional training since most plants are already using the protocol extensively.
- Popular among instrument manufacturers for a wide variety of applications.

Optimal Modbus applications

Modbus is ideally suited for process applications where up to 32 devices (31 field devices and 1 master) may be connected over a 4,000 foot span into an existing control system. The RS485 version is used for multi-drop field applications with other versions, RS232 and RS422, relegated to point-to-point installations.

Modbus RS485 field devices must be separately powered since the signal wire pair does not transmit sufficient power. Signal wires may be shielded twisted pair. An additional 16 gauge pair is recommended for power transmission and may be run in the same tray or conduit with the shielded twisted signal pair.

Both discrete and analog applications are supported by the StoneL Modbus modules. So in addition to directly connecting valve communication terminals into the bus, conventional 4-20mA analog devices may be interfaced as well.

Modbus economic analysis

Since many PLCs and DCSs integrate a Modbus master with Modbus drivers there is minimal cost for plugging in the Modbus line and mapping I/O to the application software. A conventional 24VDC power supply may be used for powering the field devices. (Power for the master is typically incorporated into the PLC or DCS rack.)

Modbus provides significant savings in upfront wiring cost. It is recommended for long cable runs between field devices.

With the exceptional distance capabilities of the Modbus RS485 protocol there are dramatic wiring savings as noted above. Analog input capabilities further improve the economic benefits.

Modbus modules from StoneL have a 4 to 20 mA input which digitizes the signal with a resolution to 0.1%. Power for the circuit is available from the bus power pair wired to the module. Process flow, temperature, pressure, and any other 4-20mA input signal, may be input directly into the bus, eliminating wiring and input modules at the controller!

Installation cost comparison		
	Conventional	Modbus
Valve monitor; VCT with solenoid	\$510	\$730
Conduit and wiring (\$8/ft)*	\$600	\$250
I/O cards; Modbus master	\$4,000	\$100
Power supply	\$10	\$960
Protection drop connectors	\$0	\$80
Total installed cost	\$4,550	\$1,890
Net installation savings		
\$2,660		
* Wiring 10 field devices that are located an average of 500 ft from the controller in a Class 1 Division 2 environment.		

Modbus specifications			
Physical layer options	RS232, RS422 RS485 (RS485 recommended for field devices)		
	<u>RS232</u>	<u>RS422</u>	<u>RS485</u>
Max drivers	1	1	32
Max receivers	1	10	32
Max cable length	50 ft	4000 ft	4000 ft
Topology (RS485)	Trunk with drops		
Cabling (RS485)	(1) shielded twisted pair for signal and (1) pair for 24 VDC supply		
Bus power	Must have auxiliary 24 VDC supply		
Transmission rate	1.2 K to 115 K bits/second		
Data access	Broadcast by master (no response by slave) or master/slave query with slave response (cyclic polling is typically used)		
Data transfer size	Variable size in 1 byte increments		
Transmission modes	RTU or ASCII (StoneL uses RTU)		
Addresses	From 1 to 255		
Approximate cycle time	74 msec for 32 field devices @ 32.4 kbits/second		
Error detection	CRC (Cyclic Redundancy Check)		
Support organization	Modbus organization www.modbus.org		