I/A Series® Software

PSS 21S-3A7 B3

Modbus Master (Serial and TCP/IP) Driver for Field Device System Integrator Modules

The Field Device System Integrator (FDSI) Modbus Master driver is designed to smoothly integrate single or dual-ported Modbus devices using several different Modbus protocols into an I/A Series® system.

FEATURES

Key features of the FDSI Modbus Master driver are:

- Integration of single and/or dual-ported Modbus devices into an I/A Series system at the fieldbus level
- Exchange of real-time data between Modbus devices and the I/A Series system
- Compliance with the globally accepted and widely used Modbus communication standard
- Simplex (FBM230 or 232) or Redundant (FBM231 or 233) operation of FDSI Fieldbus Modules
- Support for three Modbus protocols: Modbus RTU and Modbus ASCII protocols for serial devices, and Modbus/TCP for Ethernet devices
- Optionally available vendor-specific device variations of Modbus drivers
- FDSI hardware provides a barrier for network security issues
- Availability of standard I/A Series plant management functions and operator displays to Modbus devices
- System Monitor detection of Modbus device connectivity.

invensys®
FOXBORO®

OVERVIEW

The Field Device System Integrator (FDSI) Modbus Master driver enables the integration of vendor-independent single or dual-ported Modbus devices using one of several Modbus protocols into an I/A Series system.

The Modbus Master driver allows the I/A Series system to obtain real-time data from attached Modbus devices, manipulate the data using state-of-the-art control algorithms, and write output data to the devices.

The Modbus Master driver is downloaded to the appropriate single or redundant FBM, and allows the FBM to translate the data sent to the I/A Series system from the field device or vice-versa.

Figure 1 illustrates a typical configuration in which a simplex FBM230 is communicating with serial Modbus devices. Figure 2 illustrates a typical configuration in which an FBM is communicating with Ethernet Modbus devices.

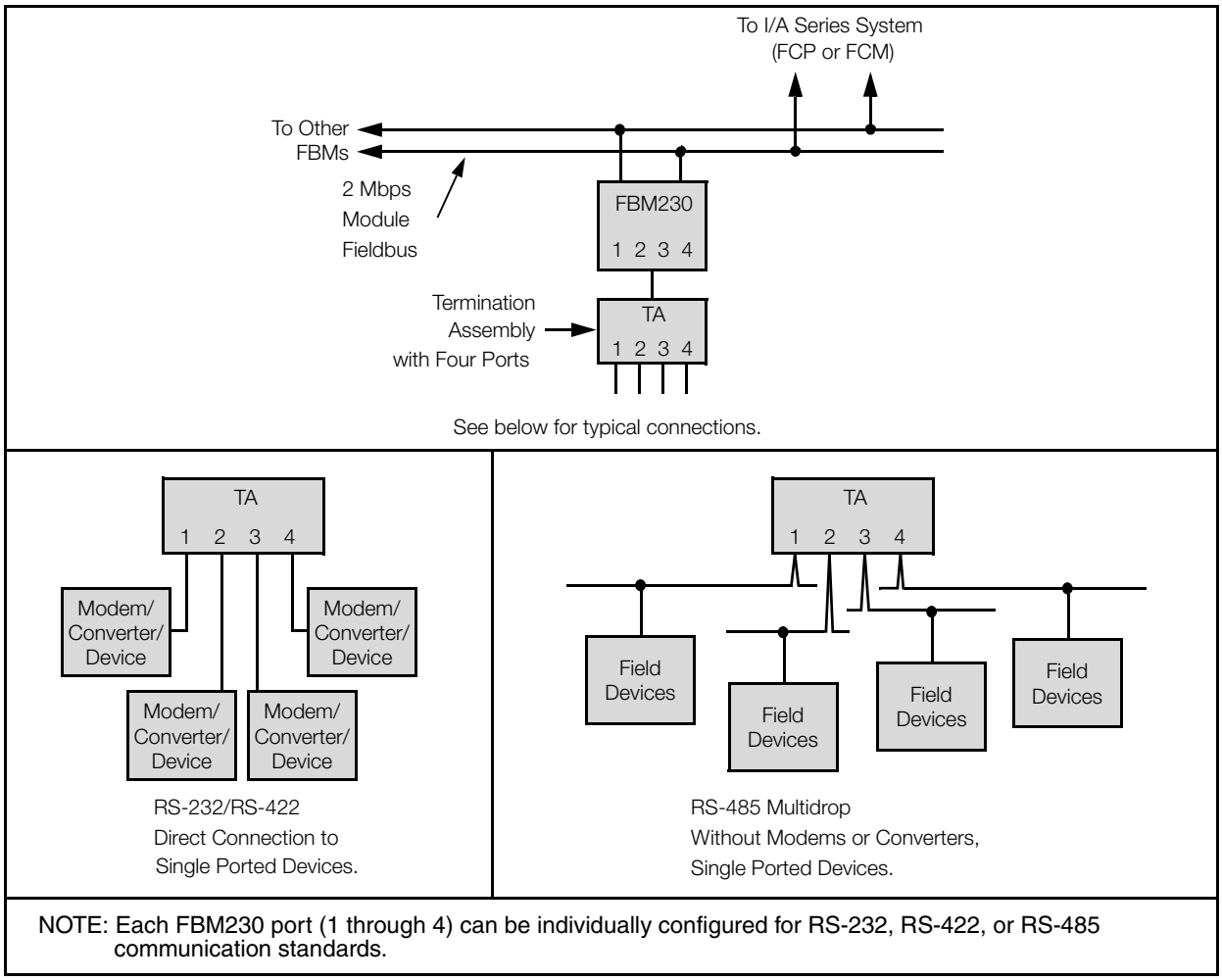

Figure 1. Simplex Serial Configuration

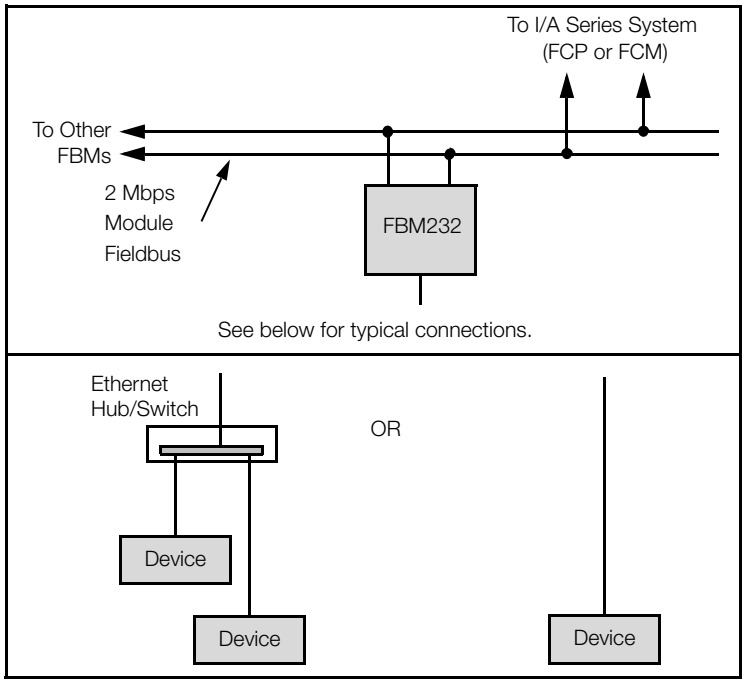

Figure 2. Simplex Ethernet Configuration

HARDWARE

Devices with which the FDSI FBMs can successfully communicate are single or dual-ported Modbus devices that support any of the three Modbus communication protocols. Depending on which Modbus devices and methods of communication you are using, as well as redundancy requirements, you need one or more of the following FDSI FBMs.

FBM230

The FBM230 is equipped with four ports, each of which can be configured to use either the RS-232, RS-422, or RS-485 physical interface standard. The FBM230 supports single-ported devices utilizing either the Modbus RTU or Modbus ASCII communication protocols, and provides a serial interface between the I/A Series system and the devices. Refer to PSS 21H-2Z30 B4.

FBM231

The FBM231 is equipped with four ports, each of which can be configured to use either the RS-232, RS-422, or RS-485 physical interface standard. Two FBM231s can be used to implement a redundant serial interface between the I/A Series system and dual-ported devices utilizing either the Modbus RTU or Modbus ASCII communication protocols. Refer to PSS 21H-2Z31 B4.

FBM232

The FBM232 supports single-ported devices utilizing the Modbus/TCP communication protocol, and provides an Ethernet interface between the I/A Series system and the devices. Refer to PSS 21H-2Z32 B4.

FBM233

Two FBM233s can be used to implement a redundant Ethernet interface between the I/A Series system and single or dual-ported devices utilizing the Modbus/TCP communication protocol. Refer to PSS 21H-2Z33 B4.

MODBUS MASTER DRIVER BENEFITS

Using the Modbus Master driver with FDSI FBMs provides the benefits described in the following subsections.

Easy Integration of Modbus Devices

The Modbus Master driver allows you to include new or existing Modbus-compliant devices in your process, regardless of device manufacturer. Incorporating an open communication standard like Modbus in your system provides a wide range of options when selecting the best field devices for your process.

I/A Series System Support

The I/A Series system supports three protocols for communication with Modbus devices: Modbus RTU, Modbus ASCII, and Modbus/TCP. For FBMs 230 and 231, either Modbus RTU or Modbus ASCII are separately configurable on each port. This support accommodates the transfer of data to and from both single and dual-ported Modbus devices, via a serial or Ethernet connection.

I/A Series software also provides standard plant management functions and operator displays for these devices, in addition to startup and communication fault detection and display using System Monitor.

Flexibility

The Modbus/TCP protocol uses Ethernet and TCP/IP technologies. The simplicity and low cost of Ethernet hardware combined with the high speeds and reliability characterized by Ethernet networks greatly improves plant efficiency and provides the flexibility required to constantly keep up with changing technology. Using an Ethernet network, you can provide remote access to process data over the network.

Redundancy

A pair of FBM231 or 233 modules combine to provide redundancy at the FBM level. In redundant configurations, one FBM serves as the Master module and the other as the Tracker module. (Both are Modbus Masters on their respective networks.) A communication link between the two modules allows each module to monitor the other's health and to share information about the health of the attached slave devices. For illustrations of typical configurations in which redundant FDSI FBMs communicate with serial and Ethernet Modbus devices, refer to PSS 21H-2Z31 B4 and PSS 21H-2Z32 B4.

Detection of communication issues between the FBM and the field are determined by the device heartbeat or scan message.

If a message is missed, up to two retries are performed. If the retries fail, the device is marked as failed in System Monitor displays.

If a device failure is detected, the Master requests an automatic role switch and generates a system alarm. Role-switching occurs without a loss of data. Alternatively, you can initiate a role switch between Master and Tracker modules manually using I/A Series System Monitor.

If any one FBM fails, the failure is indicated in System Monitor. If a role switch has occurred and you are running with a failed FBM, the new Master will continue to detect and alarm device failures.

When the System Monitor alerts you to FBM or network connection failures, you can then replace the faulty FBM or repair the network connection without upsetting field input or output signals on the functional side. When a failure occurs, it is recommended that you repair or replace the faulty component as soon as possible to prevent possible loss of data if another failure should occur.

Custom Drivers

Device-specific drivers can be created for unique process requirements. For example, a custom driver can be created to support Modbus slave devices, to perform non-standard data type conversions in systems that utilize a combination of data types, or to support non-standard Modbus protocol implementations. Contact your local Invensys Foxboro sales representative for information on specific custom drivers that may be available for your system.

Diagnostics

System Monitor watches for loss of communication between the Modbus field devices and the FDSI FBM. FBMs scan their connected devices at a user-specified time interval. If the FBM does not receive a response from the device, System Monitor displays show that the device has failed.

The driver can be configured to send heartbeat poll messages to devices that support function code 8. This enables you to monitor device connection.

OVERVIEW OF MODBUS TECHNOLOGY

The Modbus Protocol was introduced by Gould-Modicon® in 1979 as a proprietary message structure and format that allowed communication and transfer of control data between intelligent field devices via RS-232. Modbus/TCP was introduced later by Schneider Automation® to support Ethernet TCP/IP as an additional data transmission technology for the Modbus protocol.

Today, Modbus has evolved into a globally accepted and widely used standard for communication between multi-vendor field devices. The Modbus protocol specifies the master-slave/query-response message structure that controllers can recognize and use.

Messaging Operation

Query messages, sent by Modbus masters to devices, include a destination address, a task request indicated by a “function code”, and any supporting data required for the slave to carry out the assigned task. The message can be sent directly to a particular slave by including its unique address in the message.

After receiving a query message from the master, the Modbus device responds with a message. The response message specifies whether or not the requested action was successfully performed and confirms that the correct Modbus device responded to the requested action. The response message also returns any data requested by the master.

Query and response messages both contain error checking mechanisms that allow devices to confirm the integrity of the query message and allow the master to confirm the integrity of the response. If the error check is not correct, the associated query or response message is ignored and the transaction is retried.

Modbus Master Device Driver Operation

Modbus "function codes" specify the types of actions the Modbus devices must perform. The following Modbus function codes are supported by the FDSI Modbus Master Driver:

Function Code	Description
01	Read Coil Status
02	Read Input Status
03	Read Holding Registers
04	Read Input Registers
05	Force Single Coil
06	Preset Single Register
08*	Loopback Diagnostic Test
15	Force Multiple Coils
16	Preset Multiple Registers

* Data diagnostic code only.

You do not need to specifically configure Modbus transactions, which makes driver configuration very easy. By defining the necessary device register addresses in DCI blocks, the Modbus driver automatically determines the necessary transactions.

After the appropriate DCI blocks and ECBs are configured and device communication is enabled, the FDSI FBM starts sending "scan" messages to each Modbus device. The FBM waits for a response from the device, processes the data contained in the response, and stores the data in its database for incorporation into the I/A Series control system. Data can also be written out to the individual devices from the I/A Series network.

Installation and Download

Installation of the driver does not require shutting down the I/A Series software or rebooting the I/A Series workstation. Furthermore, any updated driver can be downloaded to the FBM or FBM pair without disrupting the rest of the I/A Series system.

CONFIGURATION

To configure the FDSI Modbus Master driver, you must use the FDSI Configurator software, which can be installed on a workstation running the Windows XP® operating system. The FDSI Configurator is required for configuring FBM serial and Ethernet port properties and communication settings.

Device Configuration

Device configuration for the Modbus Master driver is performed entirely in DCI blocks. There are no scan ECBs or device configuration files required or used by the driver. Once you have configured DCI blocks, the driver builds the required Modbus scan transactions to transfer data.

SPECIFICATIONS

Protocols

The Modbus Master driver offers support for the following protocols:

- Modbus RTU protocol (for serial devices)
- Modbus ASCII protocol (for serial devices)
- Modbus/TCP protocol (for Ethernet devices)

For additional information, refer to the following Modbus protocol documentation:

- *Modicon Modbus Protocol Reference Guide* (Modbus RTU and Modbus ASCII protocols) PI-MBUS–300 Rev. J, MODICON, Inc. Industrial Automation Systems, June 1996
- *Open Modbus/TCP Specification* (Modbus/TCP protocol) Release 1.0, Schneider Electric, March 1999.

Register Address Support

The Modbus Master driver supports both five digit and six digit register addresses.

Data Type and Format

The Modbus Master driver accepts data from devices in big endian or little endian format; data format is configurable.

Number of Devices

Up to 64 devices per FDSI FBM maximum. The number of actual devices is performance and configuration dependent.

Number of Devices per FBM

- RS-232: 1 device per port
- RS-422: 1 device per port
- RS-485: 16 devices per port
- Ethernet: multiple devices per FBM or FBM pair. (The number of actual devices is performance dependent.)

Number of Points

Up to 2000 I/O points can be handled in an FDSI FBM. The standard Modbus Master driver uses a default 500 millisecond scan cycle, but can be configured to other rates in 100 ms increments to as fast as 100 ms. As a result, the practical limit on the number of points that can be supported depends on the update rate you require. The throughput rate is determined by:

- Network limitations.
- Efficiency of the database (accessing scattered registers in a Modbus device requires more Modbus messages than accessing contiguous register numbers).
- Response time of the connected devices.

Control Block Support

Distributed Control Interface (DCI) blocks address and read/write data from/to the addressed slave device. The Modbus driver offers control block support for the following ECBs and standard DCI block types:

Table 1. ECBs Supported by the Modbus Master Driver

ECB200	Parent ECB, representing the FBM230 or FBM232
ECB202	Parent ECB, representing the FBM231 or FBM233
ECB201	Child ECB, representing a device

Table 2. DCI Blocks Supported by the Modbus Master Driver

BIN	Binary Input block
BINR	Redundant Binary Input block
BOUT	Binary Output block
IIN	Integer Input block
IOUT	Integer Output block
PAKIN	Packed Input block
PAKOUT	Packed Output block
PLSOUT	Pulse Output block
RIN	Real Input DCI block
RINR	Redundant Real Input DCI block
ROUT	Real Output DCI block

33 Commercial Street
Foxboro, MA 02035-2099
United States of America
www.foxboro.com
Inside U.S.: 1-866-746-6477
Outside U.S.: 1-508-549-2424
or contact your local Foxboro
representative.
Facsimile: 1-508-549-4999

MB 21A Printed in U.S.A. 1204