ORMEC
PLC Networking Overview

Generation III motion controllers are easily integrated into a fully computerized automation environment using popular factory networks. The networks currently supported were originally developed for use with Programmable Logic Controllers in factory environments and can be divided into two types: *Factory data transfer* and *Remote* I/O networks.

Factory Data Transfer Networks

Factory data transfer networks currently supported by Generation III include Data Highway™ and Data Highway Plus™ by Allen Bradley and Modbus™ by Modicon. These networks were designed to transfer numerical data between industrial computers and Programmable Logic Controllers (PLCs) and have the following characteristics.

Determinism: Factory data transfer networks utilize either simple master-slave protocols or employ token ring technology so that the amount of time required for access to the network is deterministic. This guarantees that a message can always be sent over the network within a pre-determined time.

Error Correction: Factory data transfer networks employ error correction techniques to guarantee the validity of the information being received over the network. It should be noted, however, that since these networks use error detection and re-transmission techniques, the receipt of information over the network isn't absolutely guaranteed within a pre-determined time.

Type of Data: These networks are designed for transmitting limited amounts of data in the form of numerical parameters in a relatively timely manner, as opposed to transferring large amounts of information such as data files in a less timely manner, which is more common with personal computer office networks.

Data Transfer Applications

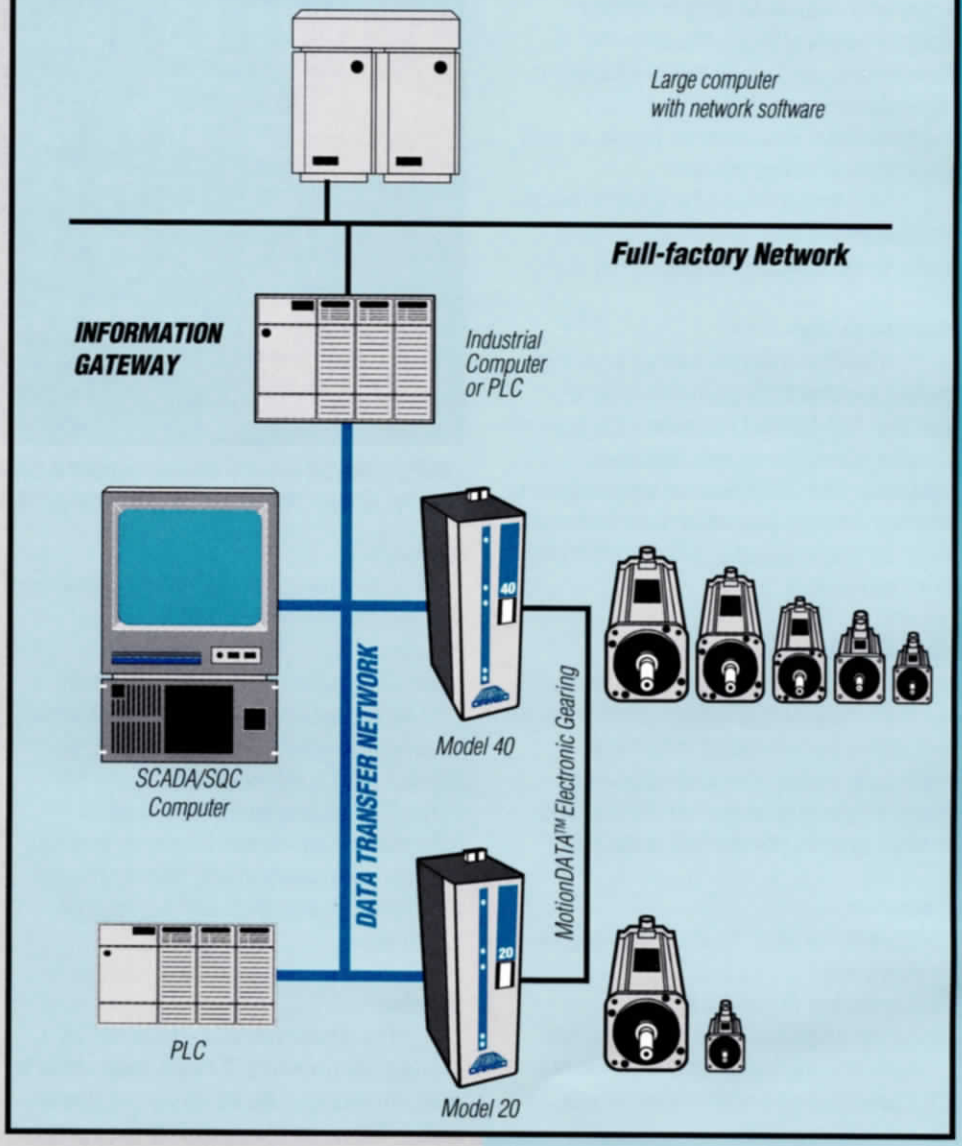
Generation III can easily provide important information for a wide variety of network data transfer applications. Typical applications include:

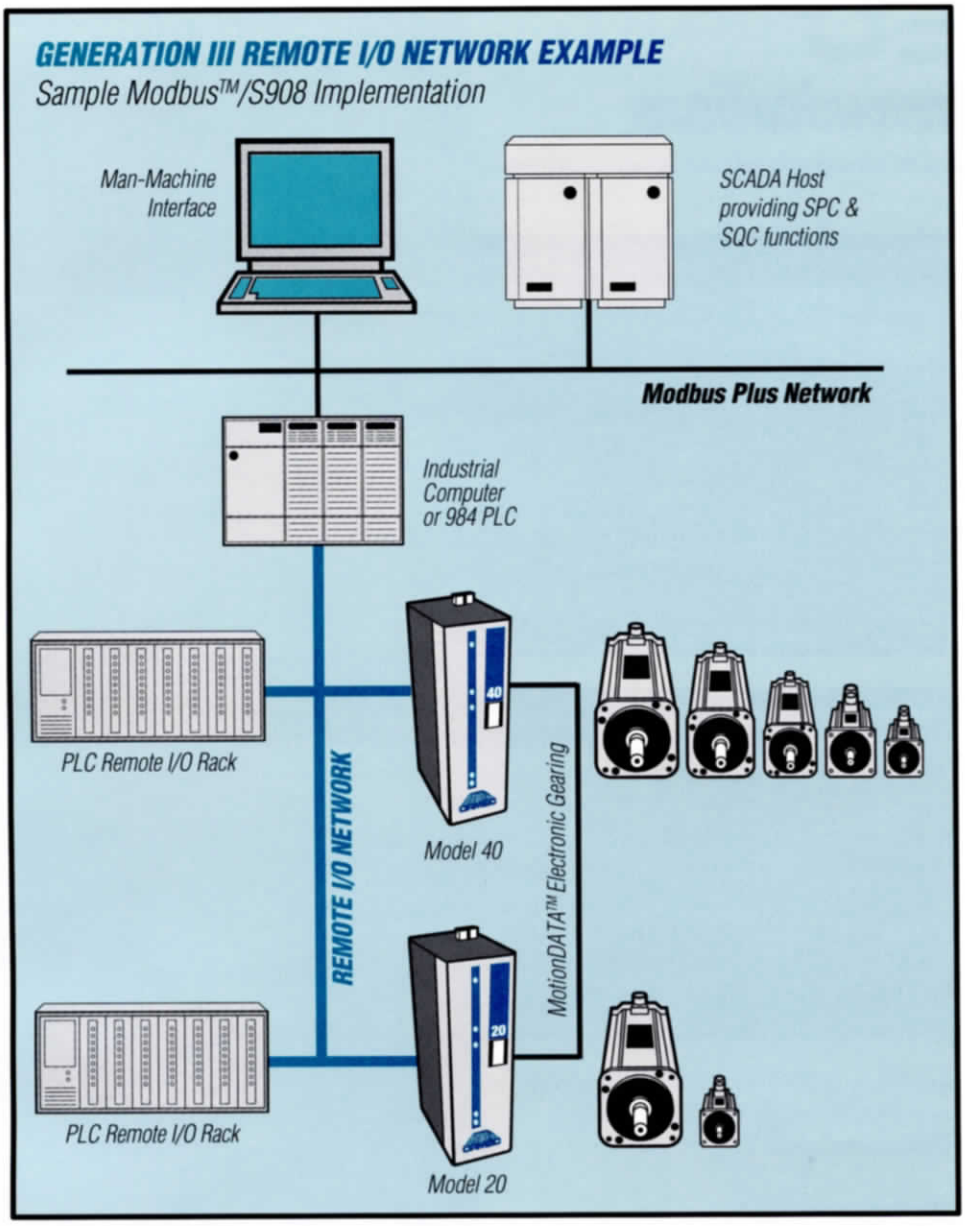
***Supervisory Control and Data Acquisition* (SCADA)**, in which an industrial computer provides both supervisory control and data acquisition functions which may include scheduling runs of different varieties of product and monitoring production output as well as product and/or process quality.

Statistical Process Control* (SPC) *or Statistical Quality Control* (SQC) *Systems, in which a supervisory computer runs specific quality-oriented software which has a real-time interface to the motion controller for the purpose of gathering data and adjusting certain parameters which affect the process/product quality.

Process monitoring & alarm annunciation, which is normally performed by an Industrial PC running a numerical or graphical package which has a real-time interface to the motion controller for the purpose of operator interface. These systems are often termed *Man-Machine Interfaces* and information presented ranges from numerical information to

GENERATION III DATA TRANSFER NETWORK EXAMPLE
Sample Modbus™ or Data Highway/Plus™ Implementation





fault diagnostic information.

Global database information collection and/or disbursement, in which one or more supervisory computers collects information from and/or disburses information to one or more motion controllers. In this case, it is more likely that the motion controller would perform some type of data reduction as part of its program and that the operation of the supervisory computer or computers is more loosely coupled to operation of the automation.

Remote I/O Networks

Remote I/O networks are designed for convenient interface of multiple digital and/or analog I/O points to a Programmable Logic Controller. Using our S908/Modbus™ network interface, a single coax cable is used to interface a Generation III motion controller to a Modicon PLC as a remote I/O rack.

The primary use of this interface is coordination of real-time control between the PLC and one or more motion controllers. A secondary benefit is the ability to use the I/O channel to simultaneously communicate numerical data and I/O information. Using this feature, the PLC "master" sends messages, formatted using the Modbus™ protocol, to set or read registers in up to 32 Generation III "slave" controllers.

An important aspect of this interface is its real-time speed, with up to 160 I/O points and 16 registers transferrable in a single PLC scan. Alternatively, a single PLC scan can accommodate the transfer of 24 registers along with 64 I/O points. This responsiveness allows real-time interaction between the PLC and the motion controller in the form of virtual I/O points as well as allowing supervisory data transfer for any of the applications above.

Factory Communications Made Simple

Using Generation III's factory communications is as simple as 1-2-3.

1) Install a plug-in MotionCARD™ which contains the required enhancements to MotionBASIC®, and a communications adapter if applicable, in the motion controller.
2) Run the menu-driven setup program provided to configure any appropriate communications setup information such as network station number, remote I/O drop number, etc.
3) "Map" register numbers which are utilized for factory network data transfer to the appropriate MotionBASIC® variables. For Remote I/O networks, map I/O numbers for the Remote I/O drop to Generation III I/O point numbers or groups of numbers.

Once a "mapping" is made between register numbers and MotionBASIC® variables (or between I/O point numbers for Remote I/O networks), all *incoming message processing* is done in the background and transparent to the operation of the Generation III motion controller. In addition, it's possible to configure the motion controller to automatically run a subroutine when certain "registers" are changed over the network by simply executing an "ON REG(#) GOSUB SUBROUTINE" statement. *Outgoing messages are initiated* by simply executing the appropriate factory communications statement from a MotionBASIC® program.

Large motion control systems

Either *Factory Data Transfer* or *Remote* I/O networks can be effectively used to implement large motion control systems, with the network choice and the overall system architecture dependent on the needs of the application. In contrast to these networks, ORMEC's proprietary MotionDATA™ network is used for close coordination of motion in systems which depend on electronic gearing. Motion initiated or terminated by a sensor, a standard feature of MotionBASIC®, can also play an important role in implementing large motion control systems.

ORMEC Modbus™ Communications

The ORMEC Modbus MotionCARD™ allows Generation III motion controllers to communicate using Modicon's Modbus™ network protocol. The Modbus factory data transfer network provides a convenient and cost-effective method for data communications between Generation III motion controllers, programmable logic controllers, man-machine interfaces, host computers and other intelligent devices which support it.

Modbus Architecture

Modicon's Modbus network is a single master, multi-drop network which supports up to 247 slave devices. A Generation III controller with a Modbus MotionCARD™ supports one Modbus port as either a network master or slave depending on the software configuration selected.

The physical layer for the Modbus network may be 3-wire RS-232 or 4-wire RS-422 asynchronous serial communications. Modicon J478 modems can be used for communication over long distances or to provide multi-drop operation using RS-232 devices.

Modbus Plus

Modicon's NM-BM85-000 BridgeMux can be used as a gateway between a Modbus Plus network and up to four Generation III motion controllers configured as Modbus masters or slaves.

Modbus Protocol Support

Generation III motion controllers with the Modbus communications option can be configured to operate as the Modbus master or as a slave in either ASCII or RTU mode. The baud rate can be set to 1200, 2400, 4800 or 9600. For a full description of the network modes and functions, refer to the Modicon publication PI-MBUS-300, Modbus Protocol Reference Guide.

MODBUS FUNCTIONS: Generation III as Master

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 Test (diagnostic code 0)
16	Preset Multiple Registers

*--Modbus master functions not listed are supported using the "Custom Command" feature

MODBUS FUNCTIONS: Generation III as Slave

Function Code	Description
01	Read Coil Status
02	Read Input Status
03	Read Holding Registers
05	Force Single Coil
06	Preset Single Register
08	Loopback Test (diagnostic codes 0,1,4,10-18)
16	Preset Multiple Registers

Hardware Interface

Generation III motion controllers can interface a Modbus network through its built-in RS-422 (MotionNET™ port) or via one of the optional RS-232 or RS-422 communications adapters.

Installation

To install Modbus communications in a Generation III motion controller:

❒ insert an optional communications adapter as appropriate; connect the physical communications link and plug the Modbus MotionCARD™ into the internal memory card slot,

❒ run the menu driven setup program provided to configure and/or test the interface, and

❒ map register numbers to any MotionBASIC® variables containing data to be communicated over the network.

Operation

Modbus is a *Factory Data Communications Network* and requires that you map register numbers to the MotionBASIC® variables containing data to be communicated over the network. Both ORMEC pre-defined variables and user variables can be mapped, and the mapping takes place only once in the initialization section of your program. After that, Modbus communications are handled in the background by the real-time operating system, totally transparent to operation of your MotionBASIC® program.

Modbus is generally used to transfer integer variables and I/O information, but Modbus communications between Generation III motion controllers supports the transfer of all

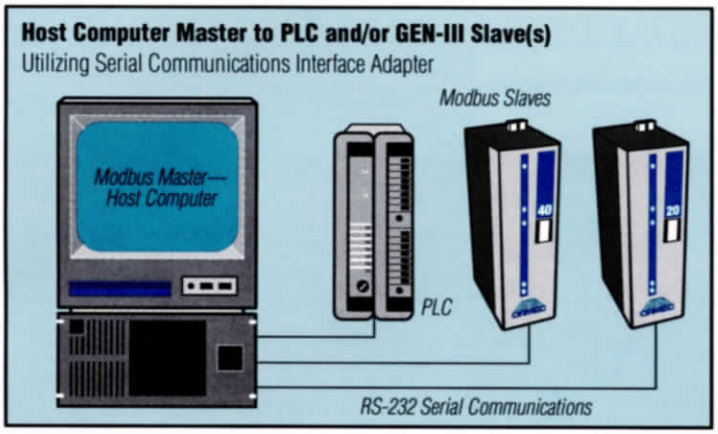
ORDERING GUIDE

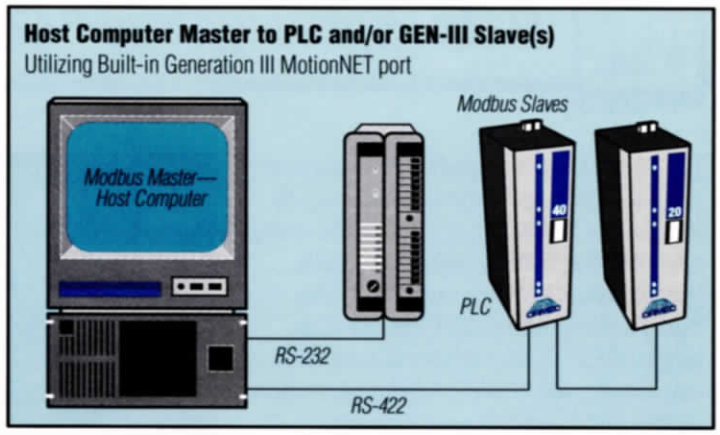
MotionCARD™ for Modbus Communications Support

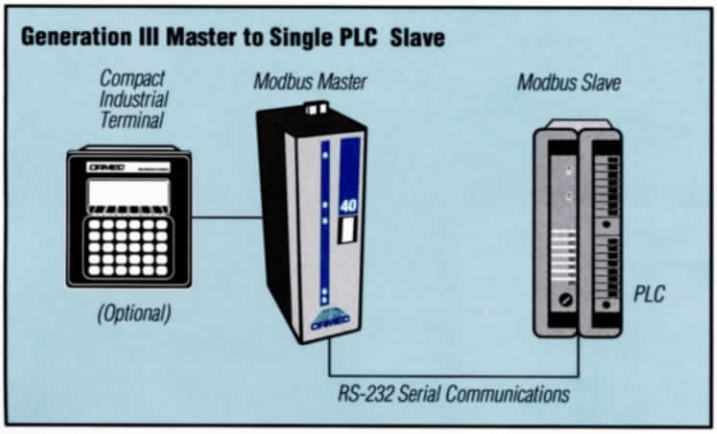
MCD-MDB/Bx.xx Modbus MotionCARD, for MotionBASIC® version x.xx
MCD-MDB/Bx.xxM Modbus MotionCARD, for MotionBASIC® version x.xx with 80187 co-processor

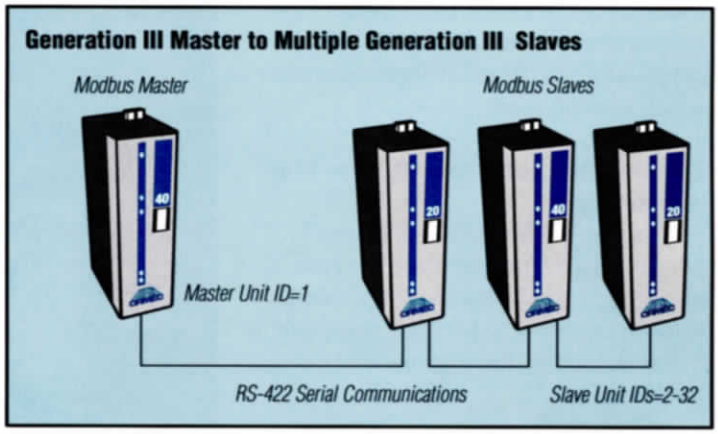
Optional serial communication adapters on page 30.

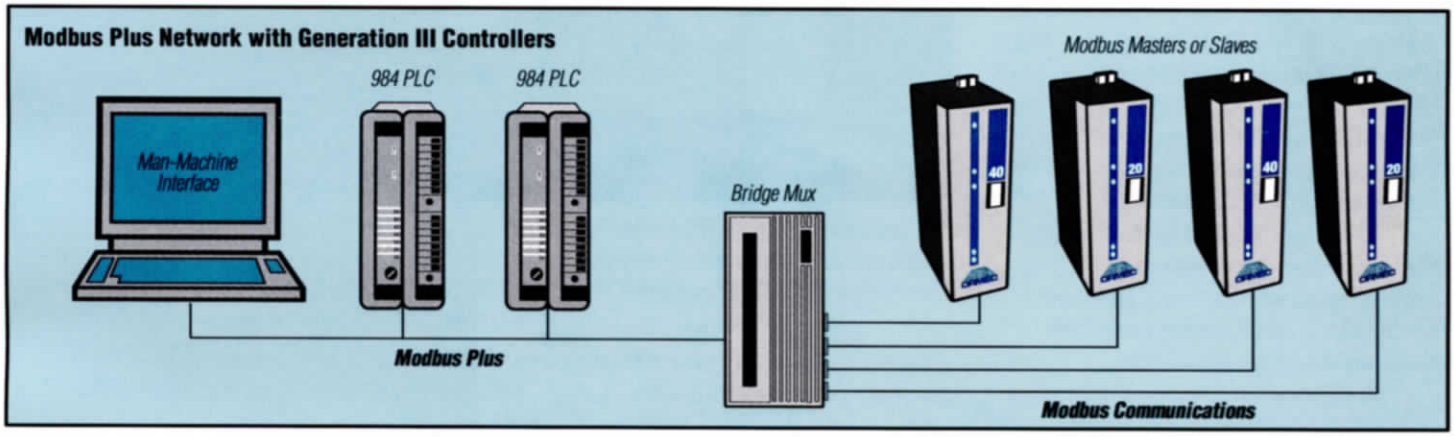
Supported Configurations











MotionBASIC® data types including integers, longs and sets as well as single and double precision floating point.

Modbus Master Support

As a Modbus master, a Generation III motion controller can initiate all Modbus command functions. Frequently used functions are implemented as individual built-in MotionBASIC® statements. All other functions, including those not listed in the chart, can be generated by your program using a powerful custom function statement.

Data sent or received by these functions is obtained from, or loaded into, registers that are mapped to MotionBASIC® program variables.

Modbus Slave Support

As a Modbus slave, a Generation III motion controller can respond to the Modbus functions shown in the chart. The *Read/Write Holding Registers* functions can transfer up to 120 registers per transaction. The *Read Coils* and *Read Inputs* functions can transfer up to 512 coils and/or inputs per transaction.

Data is transferred to, or received from Modbus functions using register numbers mapped to MotionBASIC® program variables.

All Modbus slave communications occurs in the background and is transparent to your MotionBASIC® program operation. In addition, Modbus slave communications is configurable to allow any network changes to certain registers to trigger a specified subroutine. This feature makes it easy for a Modbus master to initiate an action to be taken by any Generation III motion controller operating as a Modbus slave.

Modbus is a trademark of Modicon, Inc.