LINK to Modbus Plus Gateway

Instruction Manual

⚠ WARNING!

Only qualified personnel who thoroughly understand the operation of this equipment and any associated machinery should install, start-up, or attempt maintenance of this equipment. Non-compliance with this warning may result in serious personal injury and/or equipment damage.

⚠ WARNING!

Never work on any control equipment or motors without first removing all power supplies from the equipment.

⚠ Caution

This equipment contains ESD (Electrostatic Discharge) sensitive parts. Observe static control precautions when handling, installing, and servicing this device.

⚠ Caution

This equipment was tested before it left our factory. However, before installation and start up, inspect all equipment for transit damage, loose parts, packing materials, etc.

⚠ Caution

Ruptured semiconductor devices may release toxic materials. Contact Eurotherm Drives or the semiconductor manufacturer for proper disposal procedures for semiconductors or other material.

NOTE. The installation of this equipment must comply with the National Electric Code and any applicable local codes.

CONTENTS

Chapter 1   INTRODUCTION

The *LINK* network is a high speed (2.7 Mbaud - million bits per second) distributed control system that uses fiber optic technology to implement a true peer-to-peer communications network. The *LINK* network is used with industrial motor controllers designed and manufactured by Eurotherm Drives.

The Modicon® Modbus Plus™ is a relatively high speed (1 Mbaud) token passing local area network that uses conventional twisted pair cable for data transmission. The Modbus Plus network is used to transmit data between Modicon programmable logic controllers (PLC's).

A gateway provides a means to exchange information between two dissimilar communications networks. The L5210-MBP is a *LINK* module that permits the *LINK* and Modbus Plus networks to exchange data. Details on dimensions for the L5210-MBP gateway are included in Appendix K.

Chapter 2   THEORY OF OPERATION

The gateway is an embedded computer that runs firmware designed by Eurotherm Drives. It enables the user to pass information between the Modbus Plus and *LINK* networks. The information passed between the networks is determined by the configuration created and installed using the *LINK* software tool ConfigEd.

HARDWARE DESCRIPTION

The L5210-MBP gateway consists of a panel mount, passive back plane with a switched mode power supply. The power supply allows a supply voltage in the range from 80 to 260 volts AC and has a 1 amp AC fuse for protection. There are three major internal components in the gateway, the L5204 PC Bus interface card, the SA85 Modbus Plus network adapter card, and the CPU card. The two external components are the interconnecting cable and the L5206 Gateway Repeater module. The part numbers for these components are provided in Appendix A.

L5204 PC Bus Interface Card

A cable assembly connects the L5204 interface card to a L5206 Gateway Repeater Module which provides the interface to the *LINK* network. The *LINK* network address is software configurable using ConfigEd. A tricolor light emitting diode (LED) indicates the *LINK* network and gateway status (see Appendix B).

SA85 Modbus Plus Network Adapter Card

The SA85 network adapter card provides the interface to the Modbus Plus network for the gateway. The Modbus Plus network address is configurable using the eight externally accessible switches on the SA85 card (see Appendix C). A green LED indicates the Modbus Plus network status (see Appendix D).

CPU Card

The CPU card has a microprocessor, random access memory (RAM), electrically erasable programmable read only memory (EEPROM), and erasable programmable read only memory (EPROM). The firmware for the gateway resides in EPROM and the user's configuration is stored in EEPROM.

Figure 1 shows the location of these three cards in the gateway.

LINK Status LED

L5204 PC Bus
Interface Card

DB-25 to L5206

Modbus
Plus

Active

Modicon
SA85

Modbus Plus
Status LED

DB-9 Modbus
Plus Connector

CPU Card

SA85 Modbus Plus Network Adapter Card
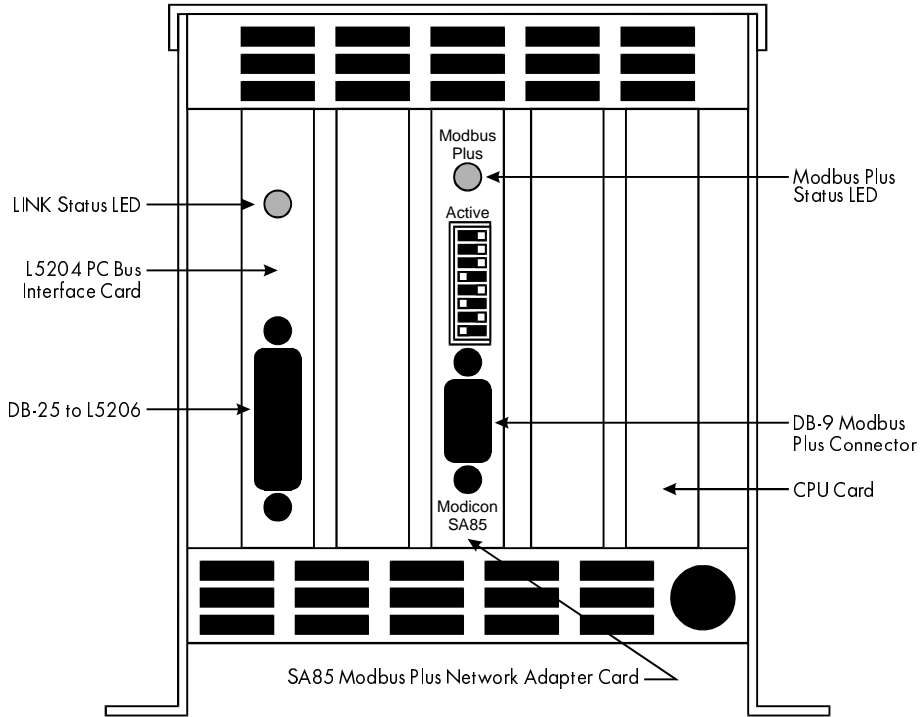
Figure 1 - End View of L5210-MBP

FIRMWARE DESCRIPTION

The gateway is an event driven device that constantly monitors both the Modbus Plus and the *LINK* networks. Upon receiving a message from either network, the gateway attempts to process the message. If the message can be routed to the other network, the gateway will do so as soon as possible based on each network's message delivery protocol and network loading. If the message cannot be routed, an error will be logged.

The data type is determined by the function block the user selects and the message routing is defined by *LINK* connections made to those blocks. Input function blocks define data that is to be written to the *LINK* network. Output function blocks define data that is to be read from the *LINK* network. The data types for each network are defined in Figure 2.

LINK	Range	Format	Modbus Plus	Range	Format
Logic	False or True	Least significant bit of 16 bit word	Coil	0x00 or 0xFF	Least significant byte of 16 bit word
Ordinal	0 to 65535	16 bit word	Holding Register	0 to 65535	16 bit word
Value	-1.0 to +1.0	16 bit signed integer	Float Holding Register	1.18e-38 to 3.40e+38 [+/-]	IEEE 32 bit floating point per Appendix E

Figure 2 - Gateway Data Types

For each input/output point in the configuration, the user can select either a Coil, Holding Register, or Float Holding Register type function block to indicate the type of data to be transferred.

On power-up or restart, the gateway executes an initialization process. First, it loads the SA85 card driver. After loading the driver, the gateway can use the hardware on the card to communicate on the Modbus Plus network. Next, the configuration is expanded from EEPROM. During expansion, the configuration is checked for validity. If the configuration is invalid, the gateway enters the *No Configuration* state (see Appendix B) and will not process any messages. If the configuration is valid, the gateway builds a routing table from the user's configuration that "maps" the relationship between the two networks.

Once the routing table has been built, the gateway is ready to process messages and enters the *OK* state. In this state, the gateway continuously monitors buffers on both the L5204 and SA85 cards. If a message is received on the *LINK* network, the gateway takes the data from the message and stores the value at the memory address specified by the user in the output function block. At this point, the data is available to a master device on the Modbus Plus network.

If a message is received on the Modbus Plus network, the type of message along with the gateway's configuration determines processing. For a write-type message, the gateway initiates a *LINK* message based on the output connections of the input function block. When the input function block is connected only to output function block(s), the output function block(s) are updated without generating a *LINK* message. If the input function block connects to both an output function block and some other *LINK* node, the gateway generates a *LINK* message and updates the output function block upon receipt of the Modbus Plus write message. For a read-type Modbus Plus message, the gateway queries the register at the specified memory location and responds with the data to the Modbus Plus network.

As long as both the networks remain in their normal processing states (that is, the *OK* state per Appendix B and the six blink state per Appendix D), message processing continues. If a problem is encountered, begin troubleshooting the gateway as directed in Chapter 6.

Chapter 3   INSTALLING THE GATEWAY

Installing the gateway involves: setting the address of the Modbus Plus network, connecting the Modbus Plus and *LINK* networks, and connecting the AC power.

WARNING!

Ensure that the gateway's AC supply and the L5206 Gateway Repeater's 24 VDC supply have been isolated prior to installing the gateway.

Caution

Observe static discharge precautions when handling the L5210-MBP. Do not touch the pins of the DB-25 (*LINK*) and DB-9 (Modbus Plus) connectors on the gateway.

TYPICAL MODBUS PLUS AND *LINK* NETWORKS

Although the possible configurations of both the *LINK* and Modbus Plus networks is virtually infinite, the rules used to implement the networks are rigorous. A typical gateway application is shown in Figure 3.
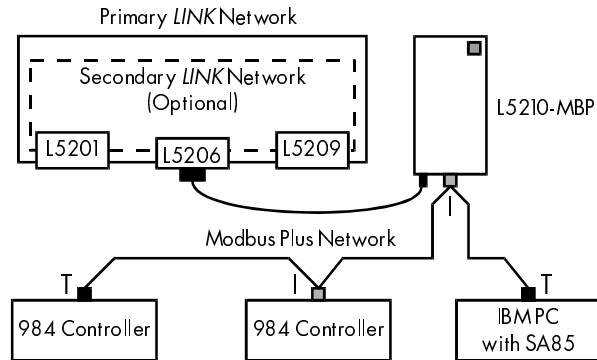
Figure 3 - Typical *LINK*/Modbus Plus Networks

SETTING THE MODBUS PLUS NETWORK ADDRESS

The gateway's Modbus Plus address is selected by setting the switches on the SA85 card to the appropriate position per Appendix C. Before an address change will take effect, the AC power must be cycled OFF and then ON.

CONNECTING THE MODBUS PLUS NETWORK

The Modbus Plus network cable is installed in a multidrop, daisy chain configuration (see Figure 3). The connectors used to terminate the cable vary depending on whether the node is inline or at the physical end of the network. For inline nodes (indicated by an "I"), use a Modicon AS-MBKT-085 Inline connector (dark gray). An endpoint

node (indicated by a "T") must use a Modicon AS-MBKT-185 Terminating connector (light gray). These connectors are illustrated in Figure 4.
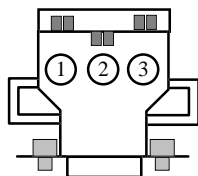
Figure 4 - Modicon Connectors AS-MBKT-#85

Each connector has three groups with two insertion points labeled 1, 2, and 3. Ensure that the 1's, 2's, and 3's are common throughout the network and no wires in any group are cross connected to wires of another group. Refer to the *Modicon IBM Host Based Devices User's Guide* for details on configuring and terminating a Modbus Plus network. Once terminated properly, insert the connector into the SA85 card of the gateway and tighten the mounting screws.

CONNECTING THE *LINK* NETWORK

A L5206 Gateway Repeater is required to connect the gateway to the *LINK* network. Installation involves tapping into the fiber optic network and supplying 24 VDC to the repeater. The fiber optic cable routing in the repeater varies based on the topology of the *LINK* network (see Appendix I).

> NOTE. A *Network Failure* will occur on a *LINK* network with a simple topology whenever the gateway is disconnected from the gateway repeater.

Once the repeater is installed, a CM350901 cable connects the repeater to the L5204 PC Bus interface card. The cable is supplied in the L5210-MBP package.

CONNECTING AC POWER

Figure 5 shows the locations of the AC power connector and the fuse. The power supply voltage can range from 80 to 260 volts AC. The removable, green connector has three slots with compression lugs for terminating the main supply leads.

Check all wiring connections and then apply the system power.

Figure 5 - Side View of L5210-MBP

Chapter 4   CONFIGURING THE GATEWAY

The message format for obtaining data on the Modbus Plus network includes a starting address and the number of data registers/coils to be read. The user should determine exactly what data needs to be transferred and strategically organize the addresses that are to be mapped between the *LINK* and Modbus Plus networks before configuring a gateway. Using contiguous addresses will optimize the communication scheme's performance by reducing the number of Modbus Plus network messages required to transfer the data.

SYSTEM CONTROL

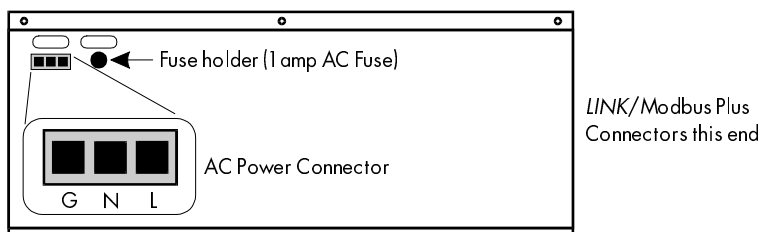The System Control (shown below) is the only function block present in the configuration when a new L5210-MBP configuration is created.
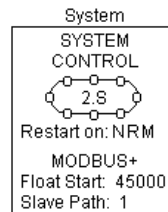
Figure 6 - System Control Function Block

The gateway uses this function block to initialize the network and to monitor network activity. The "2.S" displayed in the center of the ring is the configured address and network topology. In this case, the *LINK* network address is 2 and the network topology is Simple. Addresses can vary from 1 to 3000. Network topologies can be either Simple (S), Redundant (R), Tapped (T), or Auxiliary Tapped (A).

In the "Network Configuration - LINK" section, the gateway can be configured to restart its software on a Network failure (N), Reconfiguration (R), or Module failure (M). In the above System Control, the line "Restart on: NRM" shows that the gateway will restart on all of these *LINK* network conditions. When a letter is missing, that restart action has been DISABLED. The default setting on all of these items is DISABLED.

The "Network Configuration - Modicon Modbus Plus" section is used to specify the starting address of Float Holding Registers in the gateway configuration and the Data Slave Path for routing on the SA85 card. "Float Starting Address" defaults to 45000 and can vary from 40001 through 49999.

The gateway uses the float starting address to determine if the request for data on the Modbus Plus network coincides with the user's configuration for Float Holding Registers and Holding Registers. A Holding Register is defined as 2 bytes of data (16 bits) and a Float Holding Register is defined as 4 bytes of data (32 bits). If the gateway receives a message for a Float Holding Register address with only 2 bytes of data, it can detect it and report the error.

The Data Slave Path is Modbus Plus routing information that must be supplied to the SA85 card upon driver initialization. In most instances, the default value of 1 for the Data Slave Path is adequate. The Data Slave Path value can vary from 1 through 8.

FUNCTION BLOCKS

Once System Control has been configured, function blocks can be inserted in the configuration. The user implicitly specifies the routing path between the networks and the type of data to be transferred by selecting function blocks. Inserting and connecting function blocks in the gateway is identical to those operations in any other *LINK* module. The gateway, however, is restricted to the following six function blocks: Coil Input, Coil Output, Holding Register Input, Holding Register Output, Float Holding Register Input, and Float Holding Register Output.

When inserting function blocks of any type, it is recommended that the function block's name use the prefix suggested by ConfigEd (CI, CO, HI, HO, FI, or FO) followed by the data address. For example, choose the name HI40001 for a Holding Register Input with an address of 40001.

Basic Rules

Due to the way messages are processed and ConfigEd's complete flexibility, the user must follow two basic rules.

First, no two input function blocks may have the same address and no two output function blocks may have the same address. However, it is acceptable for pairs of input and output registers to have the same address if they are of the same data type (Coil, Holding Register, or Float Holding Register).

Second, all input type function blocks must be either connected across the *LINK* network or to an output function block(s) of the same data type. For example, connecting a Holding Register Input to a Holding Register Output.

Coil Input/Output

Boolean information, data represented by TRUE or FALSE, is best represented using the Coil Input or Output function block. Once placed in the configuration, only the block's address must be assigned. Coil addresses can range from 1 through 9999.

For example, a Coil Input connection that routes data written to address 1 on the Modbus Plus side of the gateway to slot 1 in a remote *LINK* module at address 501 would appear as:
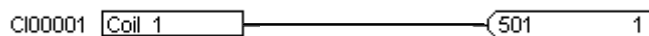
Conversely, a Coil Output connection that routes data received in slot 1 of the gateway from a *LINK* module with the address 499 to the Modbus Plus address of 1 would appear as:
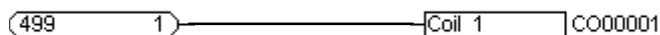
Holding Register Input/Output

For integer data, the Holding Register Input or Holding Register Output function blocks should be used. As with the Coil function blocks, the address of the function block must be entered when placed in the configuration. The address can vary from 40001 through 49999. Unlike the Coil function blocks, Holding Register function blocks have an additional parameter called the Scaling Factor. The Scaling Factor allows the user to scale the data to be accessed from the Modbus Plus side of the gateway in engineering units. Read Appendix G for details using the scaling factor.

For example, a Holding Register Input connection that routes data written to address 40001 on the Modbus Plus side of the gateway to slot 2 in a remote *LINK* module at address 500 would appear as:

```
HI40001  | HReg  40001 | Scale 1.0000 |————————( 500          2 )
```

> NOTE. The Scaling Factor of 1.0000 has no effect on the value written to the *LINK* module.

A Holding Register Output connection that routes data received in slot 2 of the gateway from a *LINK* module with the address of 499 to the Modbus Plus address of 40001 would appear as:

```
( 499          2 )————————| HReg  40001 | Scale 1.0000 | HO40001
```
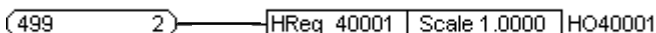
Float Holding Register Input/Output

For real value data, the Float Holding Register Input or Float Holding Register Output function blocks should be used. Identical to the Holding Register function blocks, the address and Scaling Factor must be entered when placing a Float Holding Register function block in the configuration. The address may vary from 40001 through 49999; however, the lowest address must equal or exceed the Float Starting Address specified in the System Control function block.

For example, a Float Holding Register Input connection that routes data written to address 45000 on the Modbus Plus side of the gateway to slot 3 in a remote *LINK* module at address 500 would appear as:

```
FI45000  | Float  45000 | Scale 0.0100 |————————( 500          3 )
```
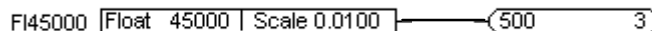
The product of the value received on the Modbus Plus network and the Scaling Factor of 0.0100 is sent to the remote *LINK* module. In this example, when 100.00 is written to the Modbus Plus address, a value of 1.0000 (100%) will be sent across the *LINK* network.

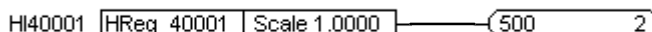A Float Holding Register Output connection that routes data received in slot 3 of the gateway from a *LINK* module with the address of 499 to the Modbus Plus address of 45000 would appear as:
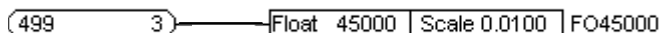

The value received on the *LINK* network is divided by the Scaling Factor of 0.0100 and stored at the Modbus Plus address of 45000. In this example, when 1.0000 (100%) is written to the Modbus Plus address, a value of 100.00 will be stored at the associated register.

NOTE. The resolution of the Holding Register and Float Holding Register function blocks varies depending on whether or not connections are made across the *LINK* network. The gateway stores both Holding Registers and Float Holding Registers internally as 32 bit floating point numbers.

If ANY *LINK* connection is made to a remote *LINK* module, the value associated with that address is rounded to 16 bit precision. That value is rounded because the resolution on the *LINK* network is restricted to 16 bits on all messages. Normally, this rounding is of no concern; however, some supervisory packages verify the data after a write to a gateway address and the verification will appear to fail.

Chapter 5   PROGRAMMING THE PLC

The gateway can only operate as a slave device on the Modbus Plus network. A PLC will typically act as a local master and either modify particular registers/coils in the gateway or inquire as to their status.

SUPPORTED REQUEST TYPES

The gateway supports the following request types as defined for the SA85 card.

Request Type	Function Code
Read Coil Status	01
Read Registers	03
Force Single Coil	05
Preset Single Register	06
Force Multiple Coils	15
Preset Multiple Registers	16

Figure 7 - Modbus Plus Message Types

Although the gateway supports all of these request types, in practice, only function codes 03 (Read Registers) and 16 (Preset Multiple Registers) are available to the user through the MSTR instruction for PLC's. Also note, since floating point numbers are not directly supported by Modicon, the only method of manipulating *LINK* value-type numbers is by writing (reading) two 16 bit registers for each Float Holding Register Input (Output) in the gateway.

MSTR INSTRUCTION

The MSTR instruction is a PLC instruction that can initiate message transactions (that is, serve as a master) on the Modbus Plus network. The instruction supports several Modbus Plus network functions; however, only the Write Data and Read Data functions will be described in this document. Refer to the appropriate Modicon PLC programming manual for further details. Although the MSTR instruction supports "broadcast" type messages with the Read/Write Global Database manipulation, the gateway does not support these global message types.
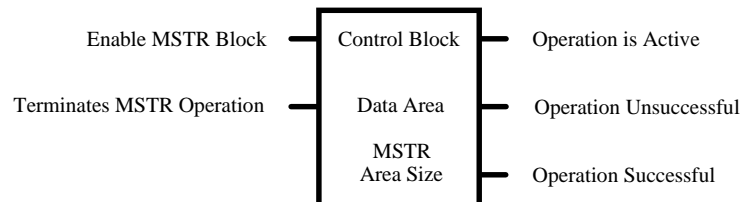
Figure 8 - MSTR Instruction

Chapter 5   PROGRAMMING THE PLC

The top address, the control block, must be a 4#### register. The address is the first of nine consecutive holding registers that form the MSTR Control Block.

The middle address, the data area, also must be a 4#### register. The address defines the first register of the data area. For Write operations, this address is the source of the data; that is, where to obtain the data in PLC memory. For Read operations, this address is the destination for the data; that is, where to put the data in PLC memory.

The bottom value, the area size, allocates the maximum number of registers associated with the data area. The area size is a constant value ranging from 1 to 100.

MSTR CONTROL BLOCK

The control block for the MSTR function is used to define the Modbus Plus message parameters. The format of the MSTR control block is shown in Figure 9.

Address	Parameter
4####	MSTR Operation (1=Write; 2=Read)
4####+1	Error Status (Hexadecimal) see Appendix H
4####+2	Message length
4####+3	Write - Gateway input register(s) starting address Read - Gateway output register(s) starting address Note: An offset of 40000 is implied (i.e.,1 = 40001, 49 = 40049)
4####+4	Gateway's Modbus Plus address (Switch settings per Appendix C)
4####+5	Gateway's Data Slave Path per System Control Block
4####+6	Routing 3 register(Unused - set to zero)
4####+7	Routing 4 register(Unused - set to zero)
4####+8	Routing 5 register(Unused - set to zero)
Note:	#### is a number between 0 and 9991

Figure 9 - MSTR Control Block

Up to four MSTR instructions may be simultaneously active in your PLC program. If more than four are required, the programmer must manipulate the enable inputs to the instructions so only four instructions are active at any time. If the gateway was configured using contiguous addresses, four instructions should be adequate in almost all cases where a PLC and a gateway are the only nodes communicating on the Modbus Plus network.

Read MSTR Instruction

A MSTR instruction configured to read will poll the gateway's output function blocks for data.

> NOTE. In the following read examples, a gateway has been configured with:
>
> 1.   A Modbus Plus address of 22
> 2.   A Data Slave Path of 1
> 3.   Sixteen Holding Register Outputs starting at address 40001
> 4.   Sixteen Float Holding Register Outputs starting at address 45000.

Two MSTR instructions would be required to read this data. In this example, the Holding Registers are stored locally in the PLC starting at address 40100 and the Float Holding Registers are stored starting at address 40200. The two MSTR instructions would be configured as follows.

HReg Read MSTR

In order to read the 16 Holding Register Outputs starting at address 40001, the MSTR instruction would be placed in the ladder logic program with the control word address set to 40300, the data area set to 40100, and the area size set to #0016.


```
40300

40100

MSTR
#0016
```
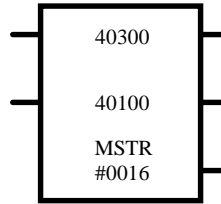
Figure 10 - MSTR Instruction
Holding Register Read

The control word starting at address 40300 would be configured per Figure 11.

Address	Value		Address	Value
40300	2 (Dec)		40305	1 (Dec)
40301	see App. H		40306	0 (Dec)
40302	16 (Dec)		40307	0 (Dec)
40303	1 (Dec)		40308	0 (Dec)
40304	22 (Dec)			

Figure 11 - Holding Register Read
Float HReg Read MSTR

To read the 16 Float Holding Register Outputs starting at address 45000, the MSTR instruction would be placed in the ladder logic program with the control word address set to 40309, the data area set to 40200, and the area size set to #0032.

```
┌─────────┐
│  40309  │
│         │
│  40200  │
│         │
│  MSTR   │
│  #0032  │
└─────────┘
```
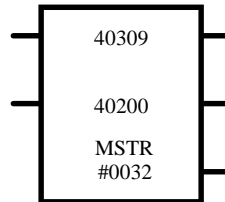
Figure 12 - Float Holding Register Read
MSTR Instruction

The control word starting at address 40309 would be configured per Figure 13.

Address	Value	Address	Value
40309	2 (Dec)	40314	1 (Dec)
40310	see App. H	40315	0 (Dec)
40311	32 (Dec)	40316	0 (Dec)
40312	5000 (Dec)	40317	0 (Dec)
40313	22 (Dec)		

Figure 13 - Float Holding Register Read
MSTR Control Word

Write MSTR Instruction

A MSTR instruction configured to write will transfer data to the gateway's input function blocks.

> NOTE. In the following write examples, a Gateway has been configured with:
>
> 1. A Modbus Plus address of 22
> 2. A Data Slave Path of 1
> 3. Sixteen Holding Register Inputs starting at address 40017
> 4. Sixteen Float Holding Register Inputs starting at address 45016.

Two MSTR instructions would be required to write this data. In this example, the Holding Registers to be written are retrieved locally in the PLC starting at address 40116. The Float Holding Registers are retrieved starting at address 40216. The two MSTR instructions would be configured as follows.

HReg Write MSTR

To write the 16 Holding Register Inputs starting at address 40017, the MSTR instruction would be placed in the ladder logic program with the control word address set to 40318, the data area set to 40116, and the area size set to #0016.

```
┌─────────────┐
│    40318    │
│             │
│    40116    │
│             │
│    MSTR     │
│    #0016    │
└─────────────┘
```
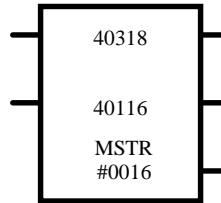
Figure 14 - Holding Register Write
MSTR Instruction

The control word starting at address 40318 would be configured per Figure 15.

Address	Value		Address	Value
40318	1 (Dec)		40323	1 (Dec)
40319	see App. H		40324	0 (Dec)
40320	16 (Dec)		40325	0 (Dec)
40321	17 (Dec)		40326	0 (Dec)
40322	22 (Dec)			

Figure 15 - Holding Register Write
MSTR Control Word

Float HReg Write MSTR

To write the 16 Float Holding Register Inputs starting at address 45016, the MSTR instruction would be placed in the ladder logic program with the control word address set to 40327, the data area set to 40216, and the area size set to #0032.

```
┌─────────────┐
│    40327    │
│             │
│    40216    │
│             │
│    MSTR     │
│    #0032    │
└─────────────┘
```
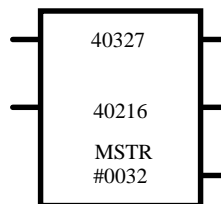
Figure 16 - Float Holding Register Write
MSTR Instruction

The control word starting at address 40327 would be configured per Figure 17.

Address	Value		Address	Value
40327	1 (Dec)		40332	1 (Dec)
40328	see App H		40333	0 (Dec)
40329	32 (Dec)		40334	0 (Dec)
40330	5016 (Dec)		40335	0 (Dec)
40331	22 (Dec)			

Figure 17 - Float Holding Register Write
MSTR Control Word

Although this section has dealt with PLC's, other devices on the Modbus Plus network that support these request types (that is, function codes 01, 03, 05, 06, 15, and 16 for the SA85 card) will communicate with the L5210-MBP.

CHAPTER 6   TROUBLESHOOTING

If communications cannot be established between the Modbus Plus and *LINK* networks, the user can follow a systematic approach to diagnose and resolve any problem. This approach uses the hardware diagnostics available on the SA85 card and the L5204 PC Bus interface card and the software diagnostics available from both the PLC's MSTR instruction control word and the gateway's System Control function block.

HARDWARE DIAGNOSTICS

Hardware diagnostics control the status LEDs on the SA85 card and the L5204 card. The first step in diagnosing any gateway communication problem is to check the hardware diagnostics.

Check Communications

Check the LED on the SA85 card and the L5204 card. When communications are *OK*, the green LED on the SA85 card in the gateway flashes six times per second and the tri-color LED on the L5204 card in the gateway will be solid green (an *OK* state).

If the SA85 card is NOT in a six flash state, go to Appendix D to troubleshoot the Modbus Plus network.

If the L5204 Card is NOT solid green, the problem is on the *LINK* network. Go to Appendix B to troubleshoot the blink state.   All states in Appendix B will cause the gateway to suspend message processing on both the *LINK* and Modbus Plus networks except the *Network Warning* and *Network Failure* states.

If both LED's are off and power has been applied to the AC power terminals on the gateway, check the fuse located on the side of the gateway and replace as necessary.

Network Warning or Failure

Generally, messages being transmitted on the *LINK* network are lost only when a *Network Warning* or *Failure* has occurred. Whether a specific message is lost or processed normally depends on the source and destination of the message and the location of the module reporting the *Network Warning* or *Failure*. If the reporting module is in the path between the source and destination modules, there is a chance the message lost caused the *Network Warning* or *Failure*. In this case, the offending message is discarded by the reporting module and the data will not be used by the destination module.

Network Warning

Messages may be lost on the *LINK* network while in a *Network Warning* state; however, the Modbus Plus will continue processing messages. Typically, the gateway returns to the *OK* state after a *Network Warning* and message processing on both networks will resume. If the *LINK* network is configured in a Redundant topology and the fiber optic ring is broken, the gateway will enter and remain in the *Network Warning* state. In this case, *LINK* messages will only be lost while the *LINK* modules

switch the physical fiber optic cable (within 84 μsecs) to compensate for the damaged cable.

Network Failure

If a *Network Failure* occurs, the gateway behaves as specified in the System Control function block described in Chapter 4. If restart on *Network Failure* is ENABLED, the gateway will perform its initialization process (as if power were just applied to its AC terminals). If the network remains in the failed state after this restart, the gateway will enter a *Checking Network* state until the *LINK* network is restored. If restart on *Network Failure* is DISABLED, the gateway will continue to process messages on the Modbus Plus network. It may still be able to receive/send messages on the *LINK* network depending on whether the source/destination module is also configured not to restart on *Network Failure* and if the transmission path on the fiber optic cable is still present.

SOFTWARE DIAGNOSTICS

If the hardware diagnostics indicate an *OK* status and communications still cannot be established (or the gateway is not functioning as expected), diagnosis of the problem must move to the software level.

Check the MSTR Control Word

Check the error code field in each MSTR instruction's control word (the second register) for a non-zero value. This is accomplished by monitoring the control word of each MSTR block while on-line with the PLC processor. If non-zero, compare the value in the error code register to Appendix H and take the appropriate corrective action. Of primary concern are those error codes associated with a slave device (the gateway). It may become necessary to check the MSTR block control word information versus the gateway configuration for correctness during this phase of the troubleshooting.

Use SAM Software

If no problems are noted with the MSTR block(s) in the PLC, use the SAM software to troubleshoot the software function blocks in the gateway. The System Control function block allows the user to: "Get Modbus+ Status", "Get Logged Errors", and "Get Error Codes".

Get Modbus Plus Status

The "Get Modbus+ Status" returns either a value of DISABLED or ENABLED depending on whether the driver for the SA85 card was installed properly during initialization of the gateway. If the Modbus Plus status using this command is DISABLED, restart the gateway. If after restart the status is still DISABLED, a hardware error has occurred and the gateway must be replaced.

Get Logged Errors and Error Codes

If ENABLED, the "Get Logged Errors" and "Get Error Codes" can be used to further diagnose the problem. Appendix F describes the use of the "Get Logged Errors" and "Get Error Codes" commands, possible error codes, and the appropriate corrective action. Once all errors have been corrected, use the "Get Error Codes" to verify that both networks are processing messages. The Logged Error should return "No error".

Check Configuration

Once the "Get Logged Errors" returns "No error" and both the *LINK* and Modbus Plus networks are processing messages, verify the state of the input/output function blocks using the "Get" command and the Monitor List in SAM as with any other *LINK* module. If a "Get" returns the message "Error: could not access data" during testing, it indicates the gateway did not receive a value to initialize the function block. For an input function block, this means the Modbus Plus has not written to the applicable address. For an output function block, it indicates the *LINK* network has not received a message from either an input function block or a remote *LINK* module depending on the user's configuration.

Appendix A SPARE PARTS LIST

The L5210-MBP-00 package contains the following items:

Qty	Part Number	Description
1	L5210-MBP	Modbus Plus Gateway assembly
1	L5206-2-01	*LINK* Gateway repeater
1	CM350901	Cable assembly for Modbus Plus Gateway
1	HA351192	Instruction Manual

The L5210-MBP Modbus Plus Gateway assembly is manufactured from the following subassemblies and parts:

Qty	Part Number	Description
1	AH350634	PC Bus Interface Card (L5204)
1	AH351564	CPU Card (KILA KS-6)
1	AH352295	SA85 Modbus Plus Network Adapter (Modicon Part Number AM-SA85-000)
1	RD352192U000	Modbus Plus Gateway firmware (LOW addresses)
1	RD352192U001	Modbus Plus Gateway firmware (HIGH addresses)
1	CM351042	1 Amp Slow Blow Fuse (20 x 5 mm)

Appendix B GATEWAY BLINK CODES

The tricolor (Red, Green, Amber) LED on the L5204 PC Bus interface card provides the user with an easy method of determining the gateway's state without using SAM software. The blink codes for the gateway are described below.

INITIALIZATION :

AMBER

While in initialization, the gateway prepares itself to run. It first performs a self-test, and then executes its initialization tasks (including reading configuration data out of EEPROM, setting up data structures, etc.). If the gateway stays in this state for an extended period, a hardware failure is suspected and the gateway should be replaced.

HALTED :

RED	1	RED	1	RED	1	RED	1	RED	1	RED	1	RED	1	RED

Indicates that the gateway has stopped as the result of a SAM or ConfigEd request. This typically occurs during reconfiguration of the gateway. The gateway may be restarted using SAM or ConfigEd and message processing will continue.

NO CONFIGURATION :

RED	1	R	2	RED	1	R	2	RED	1	R	2	RED	1	R	2	RED	1	

Indicates that the gateway is unable to run because it has no configuration or the configuration has been corrupted. Install or restore a valid configuration with SAM or ConfigEd.

L ERROR :

RED	1	R	2	R	3	RED	1	R	2	R	3	RED	1	R	2	R	3	RED	1

Indicates that the gateway has stopped due to a low-level internal error. Check for *LINK* connections to slots receiving messages at very high data rates, temporarily stop sending the data from the source node, and restart the gateway. This also could indicate a hardware failure. If the problem persists, contact Customer Service.

H ERROR :

RED	1	R	2	R	3	R	4	RED	1	R	2	R	3	R	4	RED	1	R	2	R

Indicates that the gateway has stopped due to a high-level internal error. Restart the gateway. If the problem persists, contact Customer Service.

SELF TEST FAILURE :

RED	1	R	2	R	3	R	4	R	5	RED	1	R	2	R	3	R	4	R	5	RED

Indicates that the gateway has stopped due to a hardware error. Replace the gateway.

SHUTDOWN :

RED

Indicates that the gateway is in the process of shutting itself down. If the gateway stays in this state for an extended period, a hardware failure is suspected and the gateway should be replaced.

OK :

GREEN

Indicates that the gateway is running and no fatal errors exist.

NETWORK WARNING :

GREEN	AMBER	GREEN	AMBER	GREEN	AMBER	GREEN	A

For non-redundant systems, indicates the *LINK* ring was broken for less than 1 second. For redundant systems, either the primary or secondary *LINK* ring is broken. If problem persists, inspect the integrity of the fiber optic ring.

NETWORK FAILURE :

RED	GREEN	RED	GREEN	RED	GREEN	RED	G

For non-redundant systems, the *LINK* ring has been broken for greater than 1 second. For redundant systems, both the primary and secondary *LINK* rings have been broken. The gateway will take the appropriate action based on selections made in the System Control function block.

CHECKING NETWORK :

G	G	G	G	G	G		G	G	G	G	G	G		G	

Indicates that the gateway is ready to start but is unable to send a message to itself around the ring to verify that the ring is complete. Check for disconnected modules, loose connections, and un-powered modules. Check the power to the gateway repeater. Check the gateway cable for continuity per Appendix J.

PEER HALTED :

G	G	G	G	G	G	GREEN	G	G	G	G	G	G	GREEN

Indicates that the gateway is ready to start but is waiting for other modules on the network to become ready to start. Check for modules that are halted or in an error state. The system will not run until all the modules are ready.

DUPLICATE ADDRESS :

R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

Indicates that the gateway has discovered a duplicate address on the network and has removed itself from the network and stopped. If a system has two or more modules with the same address, it cannot run. Correct the problem by reconfiguring or restoring one of the offending modules using SAM or ConfigEd.

Appendix C   MODBUS PLUS ADDRESS

The Modbus Plus address for the gateway is determined by setting the 8 DIP switches located on the SA85 card. The switches are located below the green Modbus Plus network indicator on the card. The Modbus Plus node address is determined by switches 1 through 6 on the card (switches 7 and 8 are not used). An end view of the switch and the appropriate positions for specific addresses are shown in the figure below.
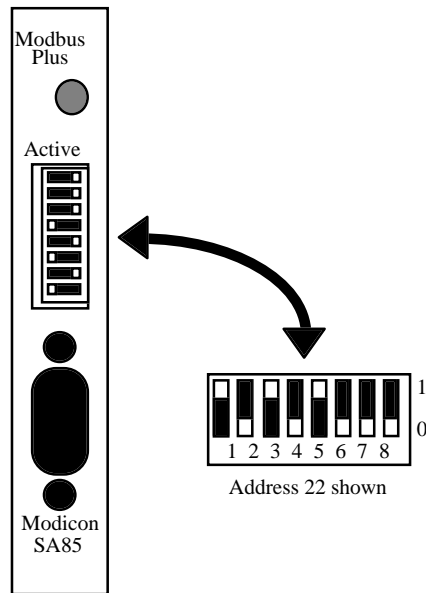
Figure 18 - SA85 Card Address Switch Location

Addr	Switch Position							Addr	Switch Position					
	1	2	3	4	5	6			1	2	3	4	5	6
1	0	0	0	0	0	0		6	1	0	1	0	0	0
2	1	0	0	0	0	0		7	0	1	1	0	0	0
3	0	1	0	0	0	0		8	1	1	1	0	0	0
4	1	1	0	0	0	0		9	0	0	0	1	0	0
5	0	0	1	0	0	0		10	1	0	0	1	0	0

Addr	Switch Position						Addr	Switch Position					
	1	2	3	4	5	6		1	2	3	4	5	6
11	0	1	0	1	0	0	38	1	0	1	0	0	1
12	1	1	0	1	0	0	39	0	1	1	0	0	1
13	0	0	1	1	0	0	40	1	1	1	0	0	1
14	1	0	1	1	0	0	41	0	0	0	1	0	1
15	0	1	1	1	0	0	42	1	0	0	1	0	1
16	1	1	1	1	0	0	43	0	1	0	1	0	1
17	0	0	0	0	1	0	44	1	1	0	1	0	1
18	1	0	0	0	1	0	45	0	0	1	1	0	1
19	0	1	0	0	1	0	46	1	0	1	1	0	1
20	1	1	0	0	1	0	47	0	1	1	1	0	1
21	0	0	1	0	1	0	48	1	1	1	1	0	1
22	1	0	1	0	1	0	49	0	0	0	0	1	1
23	0	1	1	0	1	0	50	1	0	0	0	1	1
24	1	1	1	0	1	0	51	0	1	0	0	1	1
25	0	0	0	1	1	0	52	1	1	0	0	1	1
26	1	0	0	1	1	0	53	0	0	1	0	1	1
27	0	1	0	1	1	0	54	1	0	1	0	1	1
28	1	1	0	1	1	0	55	0	1	1	0	1	1
29	0	0	1	1	1	0	56	1	1	1	0	1	1
30	1	0	1	1	1	0	57	0	0	0	1	1	1
31	0	1	1	1	1	0	58	1	0	0	1	1	1
32	1	1	1	1	1	0	59	0	1	0	1	1	1
33	0	0	0	0	0	1	60	1	1	0	1	1	1
34	1	0	0	0	0	1	61	0	0	1	1	1	1
35	0	1	0	0	0	1	62	1	0	1	1	1	1
36	1	1	0	0	0	1	63	0	1	1	1	1	1
37	0	0	1	0	0	1	64	1	1	1	1	1	1

Modicon recommends that address 1 be avoided to prevent possible confusion when using the local default address at a controller's programming panel. Also, they recommend address 64 be reserved for future network maintenance.

Appendix D SA85 DIAGNOSTICS

The SA85 Modbus Plus network adapter (P/N AM-SA85-000) used in the gateway has a single green indicator that shows the status of the Modbus Plus communication network. As with the *LINK* L5204 card, the SA85 has blink codes associated with specific network states as follows.

Six flashes per second:

| G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | |

The SA85's normal operating state. The SA85 is successfully receiving and passing the token on the Modbus Plus network. All other nodes on the Modbus Plus should also be flashing this pattern.

One flash per second:

| GREEN | | GREEN | | GREEN | |

The SA85 is off-line after just being powered up, or after exiting the four flashes per second mode. In this state, the SA85 monitors the network and builds a table of active nodes and token-holding nodes. It remains in this state for five seconds, then attempts to go to its normal operating state.

Two flashes, then OFF for 2.0 seconds:

| G | G | 2 SECONDS | G | G | |

The SA85 is hearing the token being passed among other nodes, but is never receiving the token. Check the network for an open circuit or defective termination.

Three flashes, then OFF for 1.7 seconds:

| G | G | G | 1.7 SECONDS | G | G | G | |

The SA85 is not hearing any other nodes. It is periodically claiming the token, but it finds no other node to which it may pass the token. Check the network for an open circuit or defective termination.

Four flashes, then OFF for 1.4 seconds:

| G | G | G | G | 1.4 SECONDS | G | G | G | G | |

The SA85 has heard a valid message from another node that is using the same address as the SA85. The node remains in this state as long as it continues to hear the duplicate address. If the duplicate address is not heard for five seconds, the node then changes to the pattern of one flash per second.

Appendix E   IEEE FLOATING POINT

The Institute of Electrical and Electronics Engineers (IEEE) developed the 754 standard for representing floating point numbers. This standard can represent real numbers given by the formula:
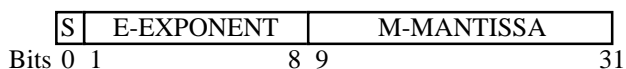
$$\text{Number} = (-1)^S 2^{E-127}(1.M)$$

where   S is the sign of the number (S = 0 is positive, S = 1 is negative)

E is exponent (0 < E < 255)

M is mantissa (significant digits)

In this form, non zero floating-point numbers may range in value from 1.18×10^{-38} to 3.40×10^{38}.

The format at the bit level is as follows:

S	E-EXPONENT	M-MANTISSA
Bits 0 1	8 9	31

Note, there is an implied 1 in the base equation above. Also note, the mantissa is the decimal portion of the number to be represented where specific bits are set for representing portions of the value (e.g., bit 9 = 1 (0.500); bit 10 = 1 (0.250); bit 11 = 1 (0.125); ... etc.). Therefore, to represent 0.625 only bits 9 and 11 would be set in the mantissa.

As an example, the number -1.5 will be represented in this format by the following bit pattern:

1011.1111.1100.0000.0000.0000.0000.0000

Appendix F LOGGED ERRORS

When the gateway is in the *OK* state, there is a circular queue of the last ten items that caused the gateway to record an error. The queue is accessed by opening the System Control function block and executing a "Get Logged Errors". When executed, a text description of the error is displayed in the SAM Scratchpad and two error codes are temporarily latched into memory. Next, execute two consecutive "Get Error Codes". These error codes provide additional information about the Logged Error to assist in diagnosing the problem.

As long as errors continue to occur and there is room in the queue, the errors will be recorded. If the problem associated with the error has been corrected, subsequent "Get Logged Errors" will empty the queue. The queue is empty when a "Get Logged Errors" results in "No errors" being displayed in the SAM Scratchpad.

The following table describes in detail the types of Logged Errors and the action required to correct same.

Logged Error	Error Codes	Description	Corrective Action Required
No Errors	0x# 0x#	First error code is the number of *LINK* messages. Second error code is the number of Modbus Plus messages. Both numbers are hexadecimal values.	None. Diagnostic to provide the user with the amount of traffic on both networks since last "Get Logged Errors" was performed.
LINK H/W buffer	0x0 0x0	Transmit buffer in RTNID device on L5204 card full.	Cycle power on *LINK* network to eliminate possible recirculating message packets.
Missing slot	0xNSSS 0xUUNN	A *LINK* message was received for an undefined slot where: SSS = Slot number NNN = Source node UU = Unused	Examine the gateway config. for location of the reported slot under Error Codes and correct the gateway configuration or the source node's configuration and install changes.
Routing error	0x1 0x0 or 0x1	Either a Modbus Plus master device tried to read an input register or a coil/register input has no connections to its function block output.	Check the addresses specified by the master device and make sure there are no reads of input registers. Ensure all input function blocks have connections to the outputs of their function blocks.

Logged Error	Error Codes	Description	Corrective Action Required
MB+ output fail	0x1 0x38	Zero elements to be processed for multiple coil outputs.	Increase the Modbus Plus message length to the correct non-zero number.
MB+ output fail	0x1 0x39	Transaction lost for multiple coil outputs.	Communications will continue. A single transaction was lost. If condition persists, contact Customer Service.
MB+ output fail	0x1 0x3A	Transmit failed on Modbus Plus network for multiple coil outputs.	Check the status of the Modbus Plus network in the System Control function block using SAM. Check electrical connections on the Modbus Plus network and status of master device.
MB+ output fail	0x1 0x3B	Routing failed for a coil in multiple coil outputs.	Check the routing in the master device to ensure it corresponds to the Data Slave Path.
MB+ output fail	0x1 0x3C	Address validation failed for a coil in multiple coil outputs.	An address was undefined. Check the addressing in the master device versus the function blocks in the gateway.
MB+ output fail	0x1 0x3E	More than 2000 coil outputs requested.	Check the length of the read request from the Modbus Plus master.
MB+ output fail	0x1 0x45	Configured data type for coil output does not match requested data type.	Check type of function blocks in gateway to ensure coil output types used throughout the address range.
MB+ output fail	0x3 0x38	Zero elements to be processed for multiple register outputs.	Increase the Modbus Plus message length to the correct non-zero number.
MB+ output fail	0x3 0x39	Transaction lost for multiple register outputs.	Communications will continue. A single transaction was lost. If condition persists, contact Customer Service.

Logged Error	Error Codes	Description	Corrective Action Required
MB+ output fail	0x3 0x3A	Transmit failed on Modbus Plus network for multiple register outputs.	Check the status of the Modbus Plus network in the System Control function block using SAM. Check electrical connections on the Modbus Plus network and status of master device.
MB+ output fail	0x3 0x3B	Routing failed for a register in multiple register outputs.	Check the routing in the master device to ensure it corresponds to the Data Slave Path.
MB+ output fail	0x3 0x3C	Address validation failed for a register in multiple register outputs.	An address was undefined. Check the addressing in the master device versus the function blocks in the gateway.
MB+ output fail	0x3 0x3D	Holding register output crosses over into float register address space.	Check the Holding Register Output function blocks versus the Float Starting Address. Check master device message to ensure Holding Register Outputs do not cross over into float region.
MB+ output fail	0x3 0x3F	More than 100 holding register outputs requested.	Check the length of the read request from the Modbus Plus master.
MB+ output fail	0x3 0x40	More than 50 float register outputs requested.	Check the length of the read request from the Modbus Plus master. (NOTE: 50 32-bit Float Holding Registers = 100 16-bit Holding Registers)
MB+ output fail	0x3 0x45	Configured data type for register output does not match the requested data type.	Check type of function blocks in gateway to ensure register output types used throughout the address range.

Logged Error	Error Codes	Description	Corrective Action Required
MB+ input fail	0x5 0x38	Zero elements to be processed for coil input.	Increase the Modbus Plus message length to the correct non-zero number.
MB+ input fail	0x5 0x39	Transaction lost for coil input.	Communications will continue. A single transaction was lost. If condition persists, contact Customer Service.
MB+ input fail	0x5 0x3A	Transmit failed on Modbus Plus network for coil input.	Check the status of the Modbus Plus network in the System Control function block using SAM. Check electrical connections on the Modbus Plus network and status of master device.
MB+ input fail	0x5 0x3B	Routing failed for coil input.	Check the routing in the MSTR block to ensure it corresponds to the Data Slave Path.
MB+ input fail	0x5 0x3C	Address validation failed for coil input.	An address was undefined. Check the addressing of the MSTR block versus the function blocks in the gateway.
MB+ input fail	0x5 0x45	Configured data type for coil input does not match requested data type.	Check type of function blocks in gateway to ensure coil input types used throughout the address range.
MB+ input fail	0x5 0x46	Illegal data in coil input.	Check the source of the data in the master device.
MB+ input fail	0x6 0x38	Zero elements to be processed for register input.	Increase the Modbus Plus message length to the correct non-zero number.

Logged Error	Error Codes	Description	Corrective Action Required
MB+ input fail	0x6 0x39	Transaction lost for register input.	Communications will continue. A single transaction was lost. If condition persists, contact Customer Service.
MB+ input fail	0x6 0x3A	Transmit failed on Modbus Plus network for register input.	Check the status of the Modbus Plus network in the System Control function block using SAM. Check electrical connections on the Modbus Plus network and status of master device.
MB+ input fail	0x6 0x3B	Routing failed for register input.	Check the routing in the master device to ensure it corresponds to the Data Slave Path.
MB+ input fail	0x6 0x3C	Address validation failed for register input.	An address was undefined. Check the addressing in the master device versus the function blocks in the gateway.
MB+ input fail	0x6 0x45	Configured data type for register input does not match the requested data type.	Check type of function blocks in gateway to ensure register input types used throughout the address range.
MB+ input fail	0xF 0x38	Zero elements to be processed for multiple coil inputs.	Increase the Modbus Plus message length to the correct non-zero number.
MB+ input fail	0xF 0x39	Transaction lost for multiple coil inputs.	Communications will continue. A single transaction was lost. If condition persists, contact Customer Service.
MB+ input fail	0xF 0x3A	Transmit failed on Modbus Plus network for multiple coil inputs.	Check the status of the Modbus Plus network in the System Control function block using SAM. Check electrical connections on the Modbus Plus network and status of master device.

| Logged Error	Error Codes	Description	Corrective Action Required
MB+ input fail	0xF 0x3B	Routing failed for a coil in multiple coil inputs.	Check the routing in the master device to ensure it corresponds to the Data Slave Path.
MB+ input fail	0xF 0x3C	Address validation failed for a coil in multiple coil inputs.	An address was undefined. Check the addressing in the master device versus the function blocks in the gateway.
MB+ input fail	0xF 0x41	More than 800 coil inputs requested.	Check the length of the write request from the Modbus Plus master.
MB+ input fail	0xF 0x44	Received message for coil inputs corrupted.	Communications will continue. A single transaction was corrupted. If condition persists, contact Customer Service.
MB+ input fail	0xF 0x45	Configured data type for a coil in multiple coil inputs does not match requested data type.	Check type of function blocks in gateway to ensure coil input types used throughout the address range.
MB+ input fail	0x10 0x38	Zero elements to be processed for multiple register inputs.	Increase the Modbus Plus message length to the correct non-zero number.
MB+ input fail	0x10 0x39	Transaction lost for multiple register inputs.	Communications will continue. A single transaction was lost. If condition persists, contact Customer Service.
MB+ input fail	0x10 0x3A	Transmit failed on Modbus Plus network for multiple register inputs.	Check the status of the Modbus Plus network in the System Control function block using SAM. Check electrical connections on the Modbus Plus network and status of master device.

Logged Error	Error Codes	Description	Corrective Action Required
MB+ input fail	0x10 0x3B	Routing failed for a register in multiple register inputs.	Check the routing in the master device to ensure it corresponds to the Data Slave Path.
MB+ input fail	0x10 0x3C	Address validation failed for a register in multiple register inputs.	An address was undefined. Check the addressing in the master device versus the function blocks in the gateway.
MB+ input fail	0x10 0x3D	Holding register input crosses over into float register address space.	Check the Holding Register Input function blocks versus the Float Starting Address. Check master device message to ensure Holding Register Inputs do not cross over into float region.
MB+ input fail	0x10 0x42	More than 100 holding register inputs requested.	Check the length of the write request from the Modbus Plus master.
MB+ input fail	0x10 0x43	More than 50 float register inputs requested.	Check the length of the write request from the Modbus Plus master. NOTE: 50 32-bit Float Holding Registers = 100 16-bit Holding Registers.
MB+ input fail	0x10 0x44	Received message for register inputs corrupted.	Communications will continue. A single transaction was corrupted. If condition persists, contact Customer Service.
MB+ input fail	0x10 0x45	Configured data type for a register in multiple register inputs does not match requested data type.	Check type of function blocks in gateway to ensure input types used throughout the address range.
Illegal MB+ function	0x0 0x0	Illegal Modbus Plus function requested.	Check the MSTR function blocks communicating with the gateway and ensure only supported functions are being initiated on the Modbus Plus network.

| Logged Error	Error Codes	Description	Corrective Action Required
MB+ H/W failed	0x5 0x0	SA85 card reset failed.	Restart the gateway using SAM. If unsuccessful, replace the SA85 card.
MB+ H/W failed	0x7 0xnn	SA85 card slave path 'nn' could not be opened.	Restart the gateway using SAM. If unsuccessful, replace the SA85 card.
MB+ H/W failed	0x8 0x0	SA85 card driver could not be turned off.	Restart the gateway using SAM. If unsuccessful, replace the SA85 card.
Config not present	0x9 0x0	Configuration data not present.	Install a valid Modbus Plus gateway configuration.

Appendix G SCALING FACTORS

The gateway internally handles both integer and float type data values in floating point format. For both Holding Register and Float Holding Register type function blocks, the scaling factor is used to process the register value after receipt or prior to storage on the Modbus Plus side of the gateway. The default value for the scaling factor is unity (1.0000) which results in the gateway passing any data through unchanged.

The scaling factor serves as a multiplier on Input type function blocks and a divisor on Output type function blocks. The example below illustrates the use of the scaling factor to allow the reading and writing of value ranging from ±100.00 on the Modbus Plus network to the range of ±1.0000 required by the *LINK* network.

FI45000 | Float 45000 | Scale 0.0100 |————(500   3)
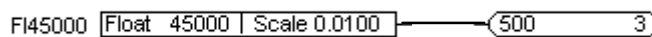
If 100.00 is written to address 45000, the value is multiplied by 0.0100 to yield a value of 1.0000, or full scale (100%) for a value type, on the *LINK* network.

(499   3)————| Float 45000 | Scale 0.0100 | FO45000
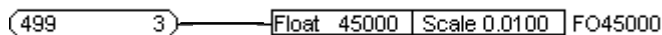
Conversely, if 1.0000 is received on the *LINK* network in slot 3 of the gateway, it is divided by 0.0100 to yield a value of 100.00 and stored at Modbus Plus address 45000.

For integer-type data, rounding (to the nearest integer value) occurs after the scaling has been applied to the data value. For example, if the integer value of 131 is written to a Holding Register Input with a scaling factor of 1.25, the value displayed by SAM and used on the *LINK* network would be 164. Similarly, a Holding Register Output with a scaling factor of 1.25 that receives an ordinal value of 164 would store a value of 131 for reading by the Modbus Plus network.

Scaling factors can vary in the range of IEEE 32-bit floating point numbers (see Appendix E); however, it is suggested the user restrict the scaling factors in the range 0.0001 through 100 for display purposes.
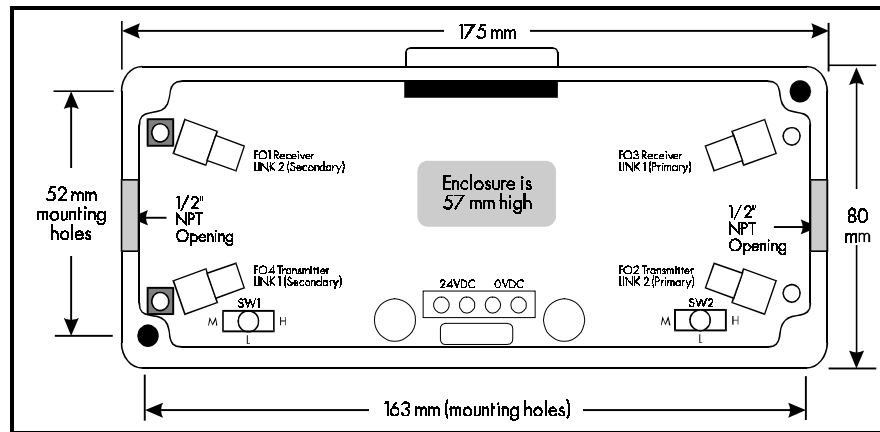
Appendix H MSTR BLOCK ERROR CODES

Error codes reported by the MSTR block are recorded in the second register of the control word. These errors can be used in resolving communication problems between the gateway and the PLC. Error codes (in hexadecimal format) associated with the MSTR block are listed below.

Error Code	Description
1001	User initiated abort
2001	Invalid operation type
2002	User parameter changed
2003	Invalid length
2004	Invalid offset
2005	Invalid length and offset
2006	Invalid slave device data area
2007	Invalid slave device network area
2008	Invalid slave device network routing
2009	Route equal to your own address
200A	Attempting to obtain more global data words than available
3001	Slave device does not support the requested operation
3002	Nonexistent slave device registers requested
3003	Invalid data value requested
3004	Unassigned error code
3005	Slave has accepted a long-duration program command
3006	Function cannot be performed now - a long duration command in effect
3008-30FF	Unassigned error codes
4001	Inconsistent Modbus slave response
5001	Inconsistent network response
6#nn	Where # is an index into the routing information where the error occurred (e.g., 0 indicates the local node, 2 is the second device on the route, etc.) and nn refers to the following codes in the table.
6#01	No response received
6#02	Program access denied
6#03	Node off-line and unable to communicate

Error Code	Description
6#04	Exception response received
6#05	Router node data paths busy
6#06	Slave device down
6#07	Bad destination address
6#08	Invalid node type in routing path
6#10	Slave has rejected the command
6#20	Initiated transaction forgotten by slave device
6#40	Unexpected master output path received
6#80	Unexpected response received
0007	Slave rejected long-duration program command

Appendix I   L5206 DATA SHEET

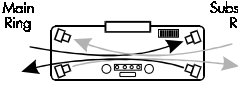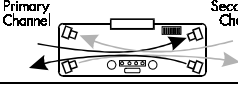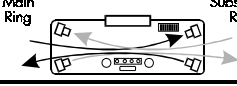| Module Model Number	L5206-2-01
Module Name	Gateway Repeater Module
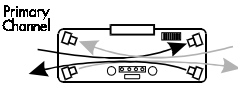
Refer to the *LINK* Overview manual (HA350678) for general information on this module.

Module Description	The L5206-2-01 *LINK* Gateway Repeater receives and retransmits network data between the *LINK* network and a gateway. It can be used with any *LINK* 5204, *LINK* 5210 or *LINK* 5211 model gateway. The gateway is connected to the LINK network via a shielded cable (part number CM350901) to the Gateway Repeater's DB-25 connector. The L5206-2-01 behaves identically to the L5206-2-00 *LINK* Repeater in the absence of a gateway. However, when a gateway is connected, network data is re-routed to include it in the *LINK* network ring.
Transmission Distance	The L5206-2-01 transmission distance is selected by the toggle switches inside the enclosure. SW1 controls the FO4 transmitter and SW2 controls the FO2 transmitter. The LOW setting (center) is used for distances between 0 and 20 meters; the MED setting (left) is used for distances between 20 and 40 meters; and the HIGH setting (right) is used for distances between 40 and 60 meters.

In the presence of an L5210-MBP gateway, the L5206-2-01 is connected to implement the desired *LINK* network topology. The connections are shown in the table below for each type of topology. Note that the arrow denotes the direction of

transmission in the fiber; that is, from the fiber optic transmitter towards the fiber optic receiver.

Fiber Optic Connections	Network Topology	Effect when L5204 is disconnected
Primary Channel	Simple	Network ring is broken.
Main Ring ... Subsidiary Ring	Tapped	**Network ring is preserved.
Primary Channel ... Secondary Channel	Redundant	Network ring is preserved.
Main Ring ... Subsidiary Ring	Aux. Tapped	**Network ring is preserved.

** A fiber optic signal failure at either receiver breaks both rings.

TECHNICAL DETAILS

Environmental	
Temperature	0 - 50 °C
Storage Temp.	-10°C to +70°C
Humidity	85% relative humidity in a dry, non-condensing environment
Enclosure	NEMA 4 (IP66) with appropriate waterproof 1/2" NPT fittings
Power Supply	
Voltage	20 - 28 VDC (24 VDC nominal)
Current	55 mA maximum
Power Dissipation	1.5 Watts maximum
Power Terminals	14 - 22 gauge (0.5 - 1.5 mm2) wire size, 8A maximum when daisy-chained module-to-module
Physical	
Weight	1.35 lbs. (0.61 Kg)
Height	6.9 in. (175 mm)
Width	3.2 in. (80mm)
Depth	2.3 in. (59mm)

Contact your Eurotherm Drives Sales Engineer, local representative, or the factory for more information on this product.

Appendix J   *LINK* GATEWAY CABLE

When troubleshooting the gateway, it may become necessary to check the continuity of the cable assembly. The pinout of the *LINK* Gateway Cable Assembly (CM350901) is shown in Figure 19.

WARNING!

Ensure that all power supplies have been removed prior to disconnecting the gateway Cable Assembly from the gateway. Disconnect the gateway cable from both the L5204 Card in the gateway and the gateway repeater prior to performing any electrical checks.

Caution

Ensure the probe does not exceed the diameter of the male pins which are normally inserted into the connector. Permanent damage may result.
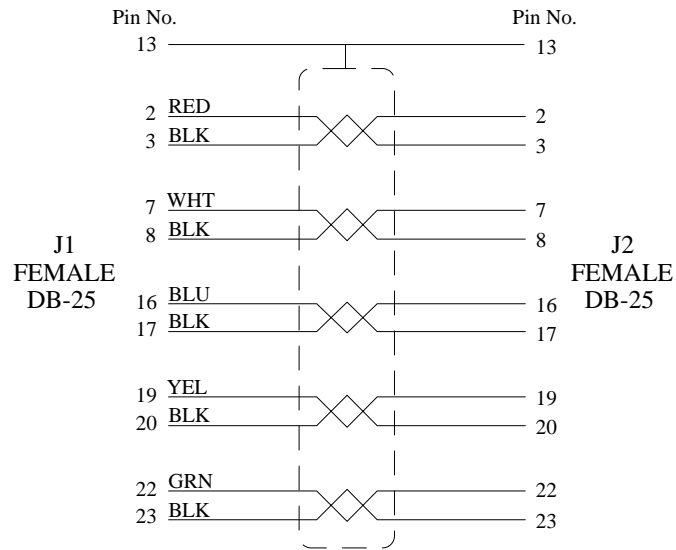

Figure 19 - CM350901 Pinout

Location of the pins in the DB-25 connector are typically marked on the connector per the layout depicted in Figure 20.
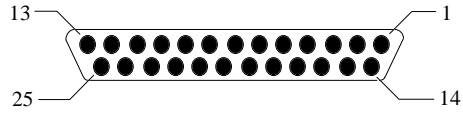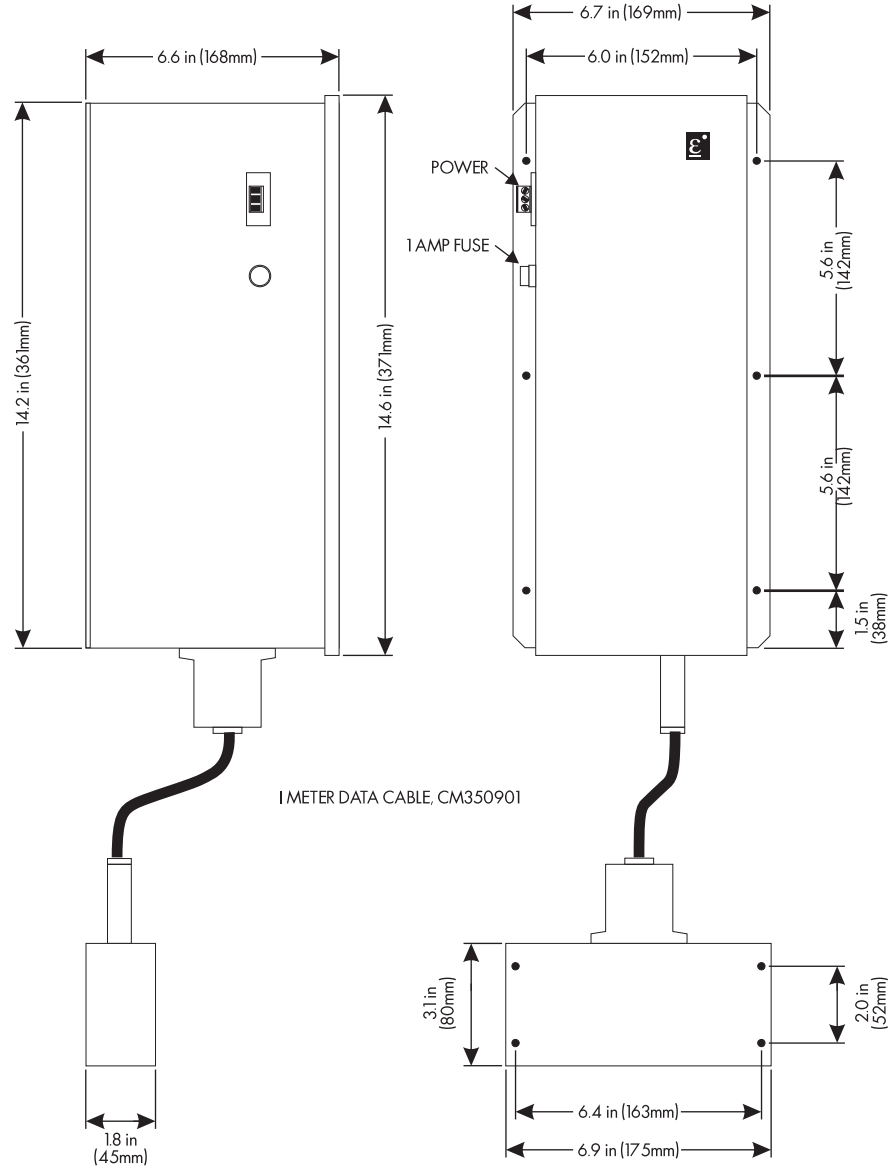
Figure 20 - End View of DB-25 Connector

NOTE. This cable is NEVER to exceed 36 inches in length from the strain relief of the J1 connector to the strain relief of the J2 connector.

Appendix K DIMENSIONS

6.7 in (169mm)

6.6 in (168mm)

6.0 in (152mm)

POWER

1 AMP FUSE

14.2 in (361mm)

14.6 in (371mm)

5.6 in (142mm)

5.6 in (142mm)

1.5 in (38mm)

I METER DATA CABLE, CM350901

3.1 in (80mm)

2.0 in (52mm)

6.4 in (163mm)

6.9 in (175mm)

1.8 in (45mm)

Appendix L   REFERENCES

Hayes, John P.; *Computer Architecture and Organization*, Second Edition, McGraw-Hill Book Company, New York, NY, 1988.

Modicon, Inc.; *Modicon IBM Host Based Devices User's Guide (GM-HBDS-001)*, Revision E, Modicon, Inc., 1992.

Modicon, Inc.; *Modicon 984 Programmable Controller Systems Manual (GM-0984-SYS)*, Revision A, Modicon, Inc., 1990.

Modicon, Inc.; *Modicon Modbus Plus Network Planning and Installation Guide (GM-MBPL-001)*, Revision D, Modicon, Inc., 1993.