LINK to Data Highway Plus Gateway

⚠

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.

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Chapter 1   INTRODUCTION

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

The Data Highway Plus (DHP) is a token passing local area network which uses conventional twisted pair cable for data transmission. The DHP network may operate at either 57.6 Kbaud (thousand bits per second) or 115.2 Kbaud depending on the specific hardware which resides on the DHP. The current implementation of the L5210-DHP uses the lower baud rate of 57.6 Kbaud. The DHP network is primarily used to transmit data between Allen-Bradley Programmable Logic Controllers (PLC's).

In general, a gateway provides a means to exchange information between two dissimilar communications networks. The L5210-DHP is a *LINK* module which permits the *LINK* and DHP networks to exchange data.

Chapter 2   THEORY OF OPERATION

The gateway is an embedded computer running firmware designed by Eurotherm Drives which permits the user to pass information between the DHP and *LINK* networks. The information passed between the networks is dependent upon a configuration created and installed using the *LINK* software tool Configuration Editor (ConfigEd).

HARDWARE DESCRIPTION

The L5210-DHP-02 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. Earlier versions of the L5210-DHP could only be powered by a 115 volts AC power supply. Earlier versions may be identified by a L5210-DHP-01 product code.

Both versions have three major components: the *LINK* Inteface Card, the DHP Interface Card, and the CPU Card. Together they provide the platform for running the gateway's firmware. The part number for each component is listed in Appendix A. Figure 1. shows the location of the three major components of the gateway.
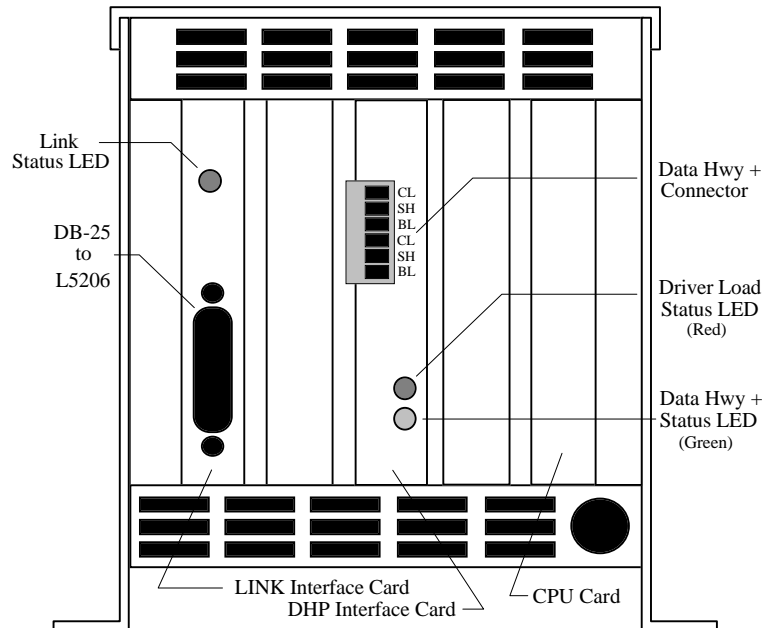
Figure 1- End View of L5210-DHP

LINK Interface Card

A cable assembly connects an L5206 Gateway Repeater module to the *LINK* Interface Card and provides access to the *LINK* network. The *LINK* network address is configurable using ConfigEd. A tricolor light emitting diode (LED) on the card indicates *LINK* network and gateway status (see Appendix B).

DHP Interface Card

This card provides the interface between the DHP network and the gateway. The DHP network address may be modified using ConfigEd and the System Control function block in the gateway. Green and red LED's are provided on the edge of the card to indicate the status of the card and the DHP network (see Appendix C).

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 code resides in EPROM while the configuration the user creates is stored in EEPROM.

FIRMWARE DESCRIPTION

The gateway is an event driven device that constantly monitors both the DHP and the *LINK* networks. When the gateway receives a message from either network, it 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 for any reason, an error will be logged per Appendix E.

The user defines the data type and message routing between the DHP and *LINK* networks when building the gateway's configuration using ConfigEd. The function block selected by the user determines the data type for a particular DHP address while connections made to the block determine the routing. For each DHP input or output address in the configuration, the user can select either a Bit, Integer Register, or Float Register type function block to indicate the type of data to be transferred. Input function blocks define data that is to be written to the *LINK* network while output function blocks define data that is to be read from the *LINK* network. The data types for each network are defined in Table 1.

LINK	Range	Format	Data Hwy+	Range	Format
Logic	False or True	Least significant bit of 16 bit word	Bit	0 or 1	Any bit of 16 bit word
Ordinal	0 to 65535	16 bit word	Integer	-32768 to 32767	16 bit word
Value	-1.0 to +1.0	16 bit signed integer	Float	1.18e-38 to 3.40e+38 [+/-]	IEEE 32 bit floating point per Appendix D

Table 1 - Gateway Data Types

Upon power-up or restart, the gateway performs initialization checks which: check the status of the *LINK* network, retrieve and expand the configuration from EEPROM, and load the driver for the DHP Interface Card.

First, the gateway checks for the presence of the *LINK* network. If not present, the gateway will remain in the *Checking Network* state per Appendix B until a valid network is established.

Second, after the network is verified, the gateway retrieves and expands the configuration from EEPROM. During expansion, the configuration is checked for validity. If the configuration is invalid, the gateway enters the *No Configuration* state per Appendix B. While in this state, the gateway will neither process messages nor install the driver for the DHP Interface Card.

Lastly, after validating the configuration, the gateway builds a routing table from the user's configuration and loads the driver for the DHP Interface Card. The routing table "maps" the relationship between the DHP and *LINK* networks while the driver enables the hardware on the DHP Interface Card. After successful driver installation, the red LED on the DHP Interface Card will be extinguished and the gateway will enter the *OK* state. In the *OK* state, the gateway continuously monitors buffers on both the *LINK* Interface and DHP Interface Cards. If either card receives a message, the gateway will behave differently based on the direction of data flow (i.e., *LINK* $\Rightarrow$ DHP, or DHP $\Rightarrow$ *LINK*).

If the gateway receives a message on the *LINK* network, it takes the data from the message and stores the value in a memory location associated with the DHP address. At this point, depending on the configuration of the output function block, either a master device on the DHP network may poll the data or the gateway initiates a DHP message to transfer the data to another device on the DHP network.

Conversely, upon receipt of a message on the DHP network, the gateway determines the action required to process the message. DHP messages may be categorized into Read-type or Write-type messages. Read-type messages poll the gateway for the current value of a register associated with a DHP address while Write-type messages route data across the *LINK* network or to other function blocks for control purposes.

For a Read-type DHP message, the gateway queries the memory location associated with the specified DHP address and responds on the DHP network. No messages across the *LINK* network are required to support a Read-type message.

For a Write-type message, the gateway either initiates a *LINK* message or transfers the data to an output function block within the gateway. The action taken is based on connections made to the input function blocks in the gateway's configuration. For connections made to remote *LINK* modules, the gateway generates a *LINK* message whenever data is received on the DHP network at the address associated with the input function block. For connections to output function blocks, the output function blocks will be updated instead of generating a *LINK* message. If internal connections exist, both a *LINK* message is generated AND the output function block is updated.

As long as both the *LINK* and DHP networks remain in their normal processing states (i.e., the *LINK* Interface Card has a solid green LED (the *OK* state) per Appendix B and the DHP Interface Card has a blinking green LED per Appendix C), message processing will continue. If a problem is encountered, refer to Chapter 6 for details in troubleshooting the gateway.

Chapter 3   INSTALLING THE GATEWAY

Installing the gateway involves connecting the DHP and *LINK* networks, and connecting the AC power.

WARNING!

Ensure that the AC supply to be used for the gateway and the 24 VDC supply to be used for the L5206 Gateway Repeater have been isolated prior to installing the gateway.

Caution

Observe static discharge precautions when handling the L5210-DHP. Do not touch the pins of the DB-25 (*LINK*) or the terminals of the green Phoenix-type connectors (Data Hwy+) of the gateway.

TYPICAL DATA HIGHWAY PLUS AND LINK NETWORKS

A typical gateway application with both *LINK* and DHP networks is shown in Figure 2.
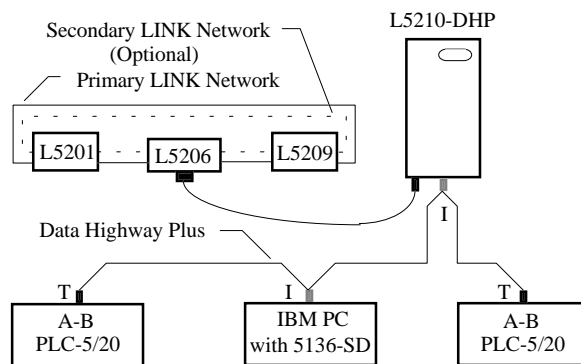
Figure 2 - Typical LINK/Data Highway Plus Networks

The "T" (for Terminator) in Figure 2 represents DHP devices which require a termination resistor while the "I" (for In-Line) devices have no terminating resistor.

CONNECTING THE DATA HIGHWAY PLUS NETWORK

In connecting the DHP network, the cable is installed in a multidrop daisy chain configuration. Allen-Bradley recommends using shielded Belden 9463 twin axial "Blue Hose" cable (A-B Catalog No. 1770-CD) for all DHP communication links. The "Blue Hose" cable has two conductors (with blue and clear insulation) enclosed in a noise reducing shield. Both the gateway and the PLC-5 do not explicitly label the appropriate terminals "Clear", "Blue", and "Shield"; however, Figure 5 shows the physical location of the terminals.
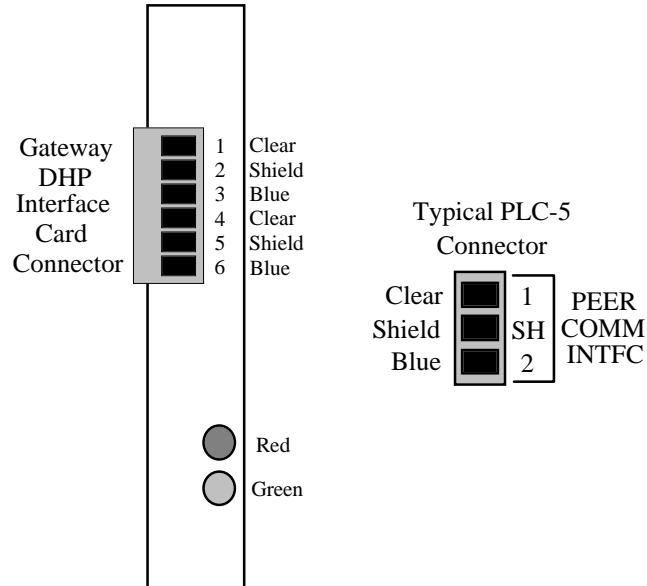
Figure 3 - Data Highway Plus Terminals

The DHP Interface Card has extra terminals to aid in installation of the daisy-chained communications cable. Terminals 1 and 4, terminals 2 and 5, and terminals 3 and 6 are common on the card only when the connector is plugged into the card. Consequently, the communications cable may be terminated to either of the appropriate terminals. Ensure during cable installation that all "Clear", "Blue", and "Shield" wires are common for the entire DHP network.

DHP devices at the physical end of the network require a terminating resistor. Some DHP devices have the ability to switch in an onboard termination resistor; however, the DHP Interface Card in the gateway has no such facility. If the gateway is at the end of the network, install a 150Ω resistor between the "Clear" and "Blue" terminals. Cabling and termination of a typical DHP network is shown in Figure 5.

Gateway   Gateway

Clear

PLC-5   PLC-5

1
SH
2

1
SH
2

150 Ohm Resistor
(Switched In)

Blue

Shield

150 Ohm Resistor
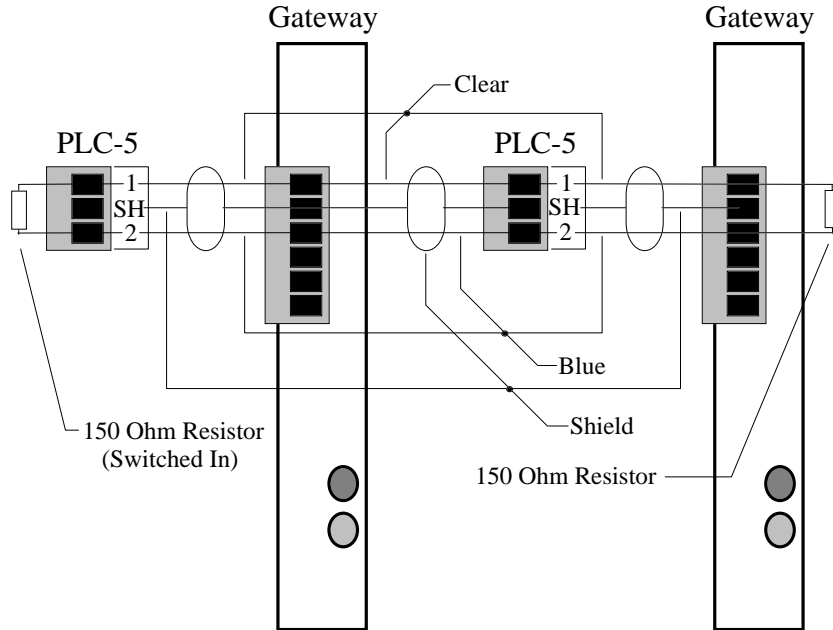
Figure 4 - Typical DHP Connections

High Noise Environments

In environments where electrical noise is prevalent, network termination may have to be changed from a single 150Ω resistor to two 75Ω resistors. In these cases, install one 75Ω resistor between the "Blue" and "Shield" terminals and install the other 75Ω resistor between the "Clear" and "Shield" terminals. Figure 5 shows DHP connections for high noise environments.
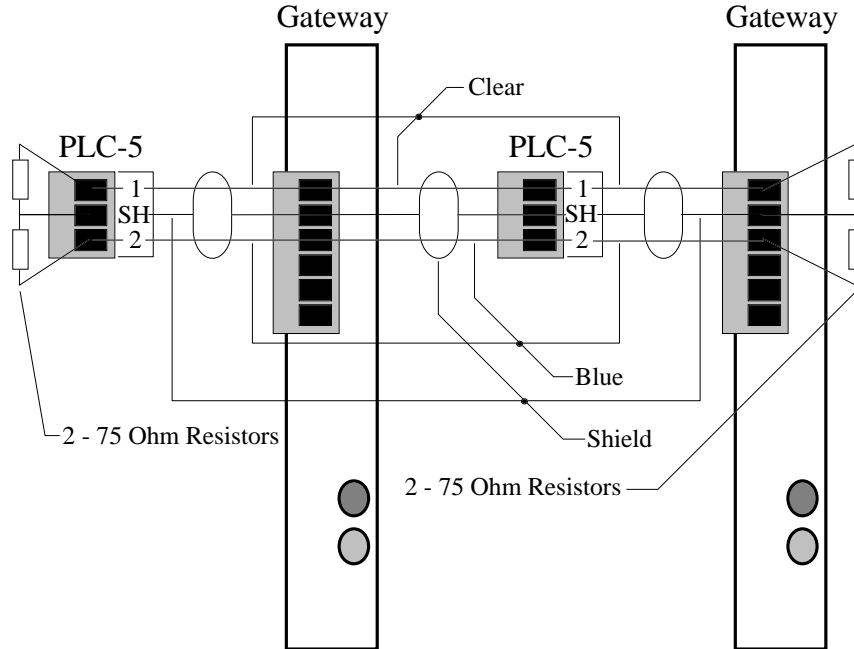
Figure 5 - DHP Connections in High Noise Enviroments

For further details on configuring and terminating a DHP network, refer to Allen-Bradley's 1785 PLC-5 Family Programmable Controllers Hardware Installation Manual listed in Appendix K. Once terminated properly, the connector may be plugged into the DHP Card of the gateway.

CONNECTING THE LINK NETWORK

To connect the gateway to the *LINK* network, install an L5206 Gateway Repeater as shown in Appendix H. Installation involves: mounting the repeater, tapping into the fiber optic network, and providing 24 VDC to the repeater. The fiber optic cable routing into the repeater varies based on the topology of the *LINK* network.

NOTE. For a Simple topology, the *LINK* network will report a *Network Failure* when the gateway is not connected to the L5206 Gateway Repeater.

While disconnected, the L5206 Gateway Repeater will act as a standard L5206 Repeater which requires different fiber optic routing for placement in the network. To bypass the gateway, the fiber optics in the L5206 Gateway Repeater may be reconnected in accordance with the standard Repeater Data Sheet.

Once installed, connect the repeater to the *LINK* Interface Card of the gateway using the CM350901 cable provided in the L5210-DHP package. The cable installation is independent of orientation (i.e., the J1 and J2 connectors may be connected to either the gateway or the L5206 Gateway Repeater as desired).

CONNECTING AC POWER

Figure 6 shows the locations of the AC power connector and the fuse holder.

Fuse holder (1 Amp AC Fuse)

AC Power Connector

G   N   L

End with Link\Data Highway Plus Connectors
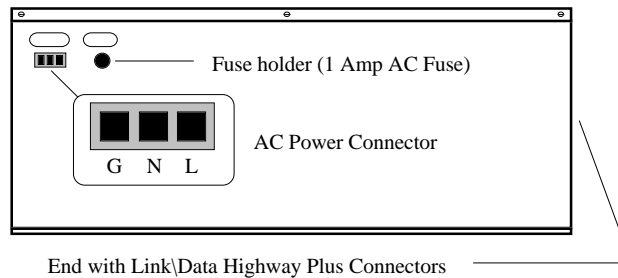
Figure 6 - Side View of L5210-DHP

As mentioned in Chapter 2, the power supply allows a supply voltage in the range from 80 to 260 volts AC. The green Phoenix-type connector has three slots with screw type lugs for terminating the main supply leads. Once terminated, the connector unplugs easily for service.

At this point, check all connections and reapply power to the system.

Chapter 4   CONFIGURING THE GATEWAY

The standard message format for obtaining data on the DHP network includes a starting address and the number of data registers to be read. Using contiguous addresses optimizes the communication performance because fewer messages are required on the DHP network to get the required data. Therefore, when configuring a gateway, the user should determine exactly which data needs to be transferred and carefully organize their addresses between the *LINK* and DHP networks.

SYSTEM CONTROL

When creating a new L5210-DHP configuration, the System Control function block (shown in Figure 7) is the only block present.
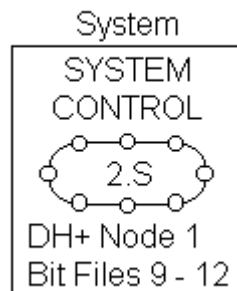
Figure 7 - System Control Function Block

The gateway uses this function block to initialize each network and to monitor network activity. The "2.S" in the figure is the address and topology for the configuration. In this case, the *LINK* network address is 2 and the topology is Simple. Addresses can vary from 1 to 3000 and topologies can be either Simple (S), Redundant (R), Tapped (T), or Auxiliary Tapped (A). As with all other *LINK* modules, the gateway can be configured to restart its firmware on: "*Network Failure*", "*Reconfiguration*", "or "*Module Failure*" in the "*Network Configuration - Link*" section of the System Control block. The default settings for all restart options in the "*Network Configuration - Link*" section of the block is "*Disabled*".

The "*Network Configuration - AB Data Highway Plus*" section of the System Control block is used to specify the station address of the gateway on the DHP network and the files which are to be Bit-type control files. In Figure 7, the "DH+ Node 1" indicates the DHP station address of the gateway is 1 and the "Bit Files 9 - 12" means the user-defined files in the range from 9 through 12 will be interpreted by the gateway as Bit-type data. The station address of the gateway on the DHP network can vary in the range from 0 to 63 decimal. Bit-type control files may be defined as any files in the range from file number 9 through 255.

NOTE. Allen-Bradley uses the octal representation for specifying addresses on the DHP network whereas the System Control function block requires this data be entered in decimal format.

The *LINK* and DHP addresses are completely independent of each other within the gateway configuration. Each may be changed at the user's discretion.

After configuring the System Control, Bit, Integer, and Float function blocks may be inserted in the gateway's configuration.

FUNCTION BLOCKS

The passing of data between the DHP and *LINK* networks depends on the type of function blocks selected and connections made to the blocks. To configure the function blocks in the gateway, the PLC-5 file structure and the DHP addressing scheme must be understood. The file structure for both PLC-5 processors and the gateway are very similar; however, there are important differences as shown in Table 2.

PLC-5 File No.	PLC-5 File Type	gateway File Type
0	Outputs	Undefined
1	Inputs	Undefined
2	Status	Undefined
3	Bit	Bit
4	Timer	Bit
5	Counter	Bit
6	Control	Bit
7	Integer	Integer or float
8	Floats	Integer or float
9	User defined	Bit
10 - 255	User defined	User defined
256 - 999	User defined	Undefined

Table 2 - File Types

As shown in table, the gateway file numbers are a subset of those available for a PLC-5 processor. File types assigned to specific PLC-5 functions (i.e., file numbers 4, 5, and 6) have been reassigned to Bit-type files since their PLC-5 functions do not exist in the gateway.

Together, the file number and the register (or bit) number define the DHP address of a function block. ConfigEd restricts the file number to the range from 3 through 255. For Integer or Float-type function blocks, ConfigEd restricts the range from 0 through

999, while for Bit-type function blocks, the range is from 0 through 15999 (i.e., 1000 16 bit registers).

Function blocks supported by the gateway are restricted to the following: Bit Input, Bit Output, Integer Input, Integer Output, Float Input, and Float Output. The technique used for inserting, configuring, and connecting the gateway's function blocks is identical to that for any other *LINK* module. When inserting function blocks, it is recommended the block type, file number, and register (or bit) number be combined to form the function block name. To make this easier, ConfigEd recommends a default prefix of BIP, BOP, IIP, IIO, FIP, or FOP for each block type. For example, the name for an Integer input at register four in File Number 7 would be IIP7:003. This naming convention makes troubleshooting using the non-graphical version of the Setup and Monitor (SAM) software simpler since windows are sorted in alphanumeric order.

Basic Rules

Due to the way messages are processed and the complete flexibility ConfigEd provides, the user must follow a few basic rules.

1. No two function blocks may have the same file number and register (or bit) addresses.
2. Each input type function block must have at least one connection to a remote *LINK* module or to an output function block(s) of the same data type (e.g., Integer Input to Integer Output).
3. Only registers of the same type (Bit, Integer, or Float) may have the same DHP Node Address and File Number.
4. Bit registers may only be assigned file numbers defined as Bit-types in Table 2 or in the range specified in the "Bit Files 9 - ?" section of the System Control function block. Conversely, Integer or Float registers may not be assigned file numbers in the Bit register region.
5. All input function blocks must have the same DHP Node Address as configured in the System Control function block.
6. Bit Input or Bit Output function blocks must be used in groups of sixteen to support the word level addressing required by the DHP network. Additionally, each group must start at 16 bit intervals (i.e., starting at 0, 16, 32, 160, etc.). For example, bit numbers 0 through 15 would be used in sixteen function blocks to access the data at word B9:0 in the gateway while to access the data associated with B9:5 the bit numbers would be 80 through 95.
7. Function blocks in the gateway may have a maximum of sixteen connections to other function blocks or remote *LINK* modules.

Bit Input/Output

Boolean data (i.e., either true or false) is best represented using the Bit Input or Bit Output function blocks. Once a Bit Input or Bit Output function block is placed in the configuration, the DHP node address, file number, and bit number of the block must be configured.

A typical Bit Input connection which routes data written to the least significant bit of word 0 in File Number 9 (B9:000) on the DHP network to slot 1 in a remote *LINK* module at address 500 is shown in Figure 8.

BIP9:000 | DH+ Node 1 | File 9 | Bit 0 |———————(500   1)
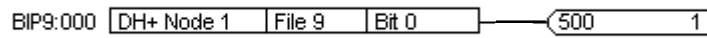
Figure 8 - Bit Input

Conversely, a typical Bit Output connection which routes data received in slot 1 of the gateway from a *LINK* module at address 499 to a memory location associated with the least significant bit of word 1 in File Number 9 (B9:016) on the DHP side is shown in Figure 9.

(499   1)———————| DH+ Node 1 | File 9 | Bit 16 | BOP9:016
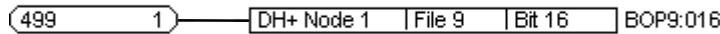
Figure 9 - Bit Output

Integer Input/Output

For data which is best represented as an integer value use the Integer Input or Integer Output function blocks. As with the Bit function blocks, the DHP node address and file number must be configured. However, the bit number is replaced by the Integer register address (IReg) and the Scaling Factor. The IReg parameter locates the appropriate word of the configured file while the Scaling Factor enables the user to scale the data to be accessed from the DHP side of the gateway in engineering units. Appendix F explains the use of the Scaling Factor.

> NOTE. A Scaling Factor of 1.0000 will have no effect on the value written to the *LINK* module.

A typical Integer Input connection which routes data written to the first word in File Number 7 (N7:000) on the DHP network to slot 2 in a remote *LINK* module at address 500 is shown in Figure 10.

IIP7:000 | DH+ Node 1 | File 7 | I Reg 0 | Scale 1.0000 |———————(500   2)
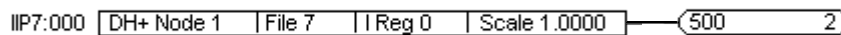
Figure 10 - Integer Input

A typical Integer Output connection which routes data received in slot 2 of the gateway from a *LINK* module with the address of 499 to a memory location associated with the eleventh word in File Number 7 (N7:010) on the DHP side is shown in Figure 11.

(499   2)———————| DH+ Node 1 | File 7 | I Reg 10 | Scale 1.0000 | IOP7:010
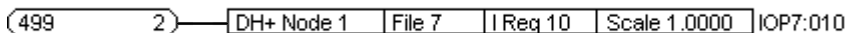
Figure 11 - Integer Output

Float Input/Output

For data which is best represented as a real value use the Float Input or Float Output function blocks. Identical to the Integer function blocks, the DHP node address, file number, and Scaling Factor must be entered when placed in the configuration. However, the IReg parameter is replaced by the Float register address (FReg) parameter which locates the appropriate words of the configured file.

A typical Float Input connection which routes data written to the first word in File Number 8 (F8:000) on the DHP network to slot 3 in a remote *LINK* module at address 500 is shown in Figure 12.

FIP8:000 | DH+ Node 1 | File 8 | F Reg 0 | Scale 0.0100 |———(500   3)
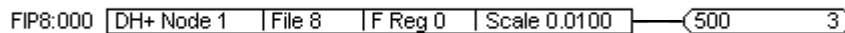
Figure 12 - Float Input

In Figure 12, the value received on the DHP network is multiplied by the Scaling Factor of 0.0100 and then sent to the remote *LINK* module.

A typical Float Output connection which routes data received in slot 3 of the gateway from a *LINK* module with the address of 499 to a memory location associated with the ninth word in File Number 8 (F8:008) on the DHP side would appear as follows:

(499   3)———| DH+ Node 1 | File 8 | F Reg 8 | Scale 0.0100 | FOP8:008
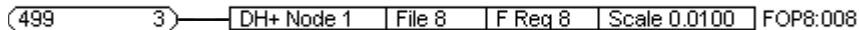
Figure 13 - Float Output Example

In Figure 13, the value received on the *LINK* network is divided by the Scaling Factor of 0.0100 and then stored at the memory location associated with address F8:008 on the DHP network.

> NOTE. Although the gateway internally stores both Integer and Float data in 32 bit floating point format, remote *LINK* connections restrict resolution to 16 bits. Normally, the rounding associated with the format conversion from 32 to 16 bits is of no concern; however, a write verification may appear to fail based on this loss of resolution.

OUTPUT FUNCTION BLOCKS AS DHP MASTERS

In the preceding examples, the gateway stores the values associated with particular DHP addresses locally in RAM. It is assumed a device (probably a PLC) on the DHP will poll the gateway for the values of the Output function blocks (i.e., the gateway acts as a slave device). This is the safest and most intuitive approach to communications on the DHP.

Caution

The gateway should not be used as a master device on DHP network. As a master, the gateway will directly alter memory locations in slave devices (PLC's in this case) which could result in unexpected operation resulting in damage to equipment or injury to personnel.

The gateway, however, may be forced into the role of a master device by changing its "DH+ Node Address" for each Output function block to the required DHP destination address. If an Output function block's DHP address differs from that of the System Control function block, the gateway generates a DHP message for each message received from the *LINK* network.

A typical Float Output connection which routes data received in slot 4 of the gateway from a *LINK* module with the address of 499 to word 0 in File Number 20 (F20:000) at address 34 decimal (42 octal) on the DHP is shown in Figure 14:

```
( 499          4 )—————| DH+ Node 34 | File 20 | F Reg 0 | Scale 0.0100 | FOP20:000
```
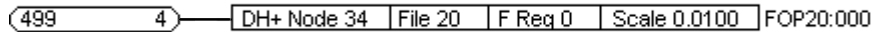
Figure 14 - gateway as DHP Master Example

Chapter 5   PROGRAMMING THE PLC

SUPPORTED REQUEST TYPES

The installed configuration determines whether the gateway is a master or a slave device on DHP. Typically, the gateway is configured as a slave device and the PLC acts as a local master, either modifying particular files in the gateway or inquiring about their status. Table 3 lists DHP command types supported by the gateway.

PLC-5 Command Type	Command Code	Function Code
Typed Read	0F	68
Typed Write	0F	67
Word Range Read	0F	01
Word Range Write	0F	00
Read-Modify-Write	0F	26

Table 3 - Data Highway Plus Command Types

Although the gateway supports all of these types, only the Typed Read and Typed Write commands are available to the user through the MSG instruction for PLC's.

MSG INSTRUCTION

The MSG instruction can generate a number of different message types on the DHP network. Although the MSG instruction supports Read/Write commands for various PLC's, only the PLC-5 Typed Read and PLC-5 Typed Write functions are described in this manual (refer to the Allen-Bradley PLC-5 Programming Software Release 4.4 Instruction Set Reference of Appendix K for further details). When inserted into the user's PLC program, the MSG instruction appears as shown in Figure 15.

```
                +MSG-------------------+
          -----¦SEND/RECEIVE MESSAGE   +-(EN)-
               ¦Control block    N20:0+-(DN)
               ¦                      +-(ER)
               +----------------------+
```

Figure 15 - MSG Instruction

The Control Block is a user assigned integer file which defines communication parameters for the MSG instruction. As seen in Figure 15, the Control Block starts at address N20:0 in PLC memory. The length of the block can vary based on its configuration but is typically nine words long (in this case, the block ends at address N20:8). Accordingly, when allocating addresses for Control Blocks, care must be taken to ensure portions of the control block are not inadvertently overwritten. If overwritten, communication failures with the gateway will occur.

MSG STATUS BITS

The status bits for the MSG instruction are used for monitoring the progress of the DHP data transfer. These bits are associated with the first word in the Control Block (for example, N20:0 for the MSG instruction of Figure 15). The MSG instruction status bits are described in Table 5.

Status	Label	Bit	Description (Set when...)
Enable	.EN	15	The instruction is enabled (and being executed). In non-continuous mode, the bit remains set until the message is completed and the rung goes false. In continuous mode, once the bit is set, it remains set regardless of the rung condition.
Start	.ST	14	The processor is executing the MSG instruction. Reset, when either the Done (.DN) or Error (.ER) bit is set.
Done	.DN	13	The last packet of the MSG instruction has been transferred. Reset the next time the associated rung goes from false to true. Inactive in continuous mode.
Error	.ER	12	The processor has detected that a message transfer failed. The bit is reset the next time the rung goes from false to true.
Continue	.CO	11	Manually set for repeated operation of the MSG block after the first scan, independent of whether the processor scans the rung. Reset the bit to return to non-continuous mode, where the rung must go true to initiate messages.
Enable-Waiting	.EW	10	The processor has detected that a message request has entered the queue.
No Response	.NR	09	The target processor (in this case the gateway) does not respond to the first MSG request. Reset when the associated rung goes from false to true.
Time Out	.TO	08	When set through ladder logic, the processor stops processing the message and sets the Error (.ER) bit (Error code 55). A message will automatically time out in 30-60 seconds.

Table 4 - MSG Control Status Bits

Theoretically, a PLC program can have an unlimited number of MSG instructions; however, in practice, overall performance of the communication scheme will suffer as additional MSG instructions are added. This degradation in performance is due to the relatively high fixed overhead associated with each MSG message transfer on the DHP network. If, as recommended in Chapter 4, the gateway is configured using

contiguous addresses, the number of MSG instructions will be minimized resulting in optimal communication performance.

> NOTE. Allen-Bradley's documentation indicates each MSG can transfer up to 120 words of data. In practice, only 90 words of data can be transferred (i.e., 1440 Bits, 90 Integers, or 45 Floats).

CONFIGURING THE CONTROL BLOCK

The configuration of the MSG instruction control block provides the PLC with the necessary information to address the gateway on the DHP network. When inserting the MSG instructions in the PLC program, the Data Entry screen of Figure 16 will appear. The data to be entered is a function of the gateway's configuration created in accordance with Chapter 4.

```
             MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:9


             Communication Command:           PLC-5 TYPED WRITE
             PLC-5 Data Table Address:        B9:0
             Size in Elements:                1
             Local/Remote:                    LOCAL
                Remote Station:               N/A
                Link ID:                      N/A
                Remote Link Type:             N/A
             Local Node Address:              01
             Destination Data Table Address:  B9:0


  BLOCK SIZE = 9 WORDS



Press a key to change a parameter or <ENTER> to accept parameters.
> _
Rem Prog   Forces:None     Edits:None                    5/15 File DHPMAN1
Command  PLC-5  Size in Local/  Remote   Link   Remote  Local/  Destin
 Type    Address Elemnts Remote  Station   ID     Link    Node   Address
  F1       F2      F3     F4      F5       F6      F7      F8      F9
```

Figure 16 - BOP Continuous Read Control Block Set-up

Details for using the Data Entry screen to edit the MSG instruction control block are provided in Table 5.

Key	Description	Function
F1	Communication Command	Select: PLC-5 Typed Write for gateway Inputs PLC-5 Typed Read for gateway Outputs
F2	PLC-5 Data Table Address	For a Typed Write, the starting address in PLC memory where the data to be transmitted is obtained. For a Typed Read, the starting address in PLC memory where the received data is to be stored.
F3	Size in Elements	Number of Bit Registers, Integer Registers, or Float Registers to be either transmitted or received. For Bits, this is the number of 16 bit words to be transferred.
F4	Local/Remote	Always set to Local mode.
F5	Remote Station	Not applicable in Local mode.
F6	Link ID	Not applicable in Local mode.
F7	Remote Link	Not applicable in Local mode.
F8	Local/Node Address	DHP address of the gateway (0-77 octal).
F9	Destination Data Table Address	For a Typed Write, the starting address in the gateway where the data is to be sent. For a Typed Read, the starting address in the gateway where data is to be polled.

Table 5 - MSG Control Block Configuration

MSG INSTRUCTIONS USING CONTINUOUS MODE

For simplicity, all of the MSG instructions in the next few sections use the continuous mode of operation where all of the data is polled/written as quickly as possible. The drawback of this mode of operation is data which does not require update will still be transferred. These unnecessary transfers ultimately result in longer update times for data which has changed state. As an alternative, ladder logic may be programmed to enable the MSG instruction only when changes occur. The Triggering MSG blocks with Logic section later in this chapter shows programming examples where data is transferred only on-change and with specified frequencies, thereby optimizing performance.

Read MSG Instructions

An MSG instruction configured to read polls the gateway's output function blocks for data. In the following Read examples, a gateway has been configured with:

1. A Data Highway Plus address of 1

2. One group of 16 Bit Outputs starting at address B9:016 (Word B9:1)

3. Ten Integer Outputs starting at address N7:010

4. Eight Float Outputs starting at address F8:008.

Three separate MSG instructions are required to read this data. The three MSG Instructions are described in the following sections.

Bit Read

To read the 16 Bit Outputs starting at address B9:016, the MSG instruction is placed in the ladder logic program as shown in Figure 17:

```
¦                                                      Read                ¦
¦                                                      BOP9:016            ¦
¦                                                      Thru                ¦
¦                                                      BOP9:031            ¦
¦                                                      From GWY            ¦
¦                                                 +MSG-------------------+  ¦
¦----------------------------------------------¦SEND/REC MESSAGE     +-(EN)-¦
¦                                              ¦Control Block     N20:0+-(DN) ¦
¦                                              ¦                      +-(ER) ¦
¦                                              +----------------------+     ¦
¦ Read       ¦Reset .EN                                           Read      ¦
¦ BOP9:016   ¦BOP9:016                                            BOP9:016  ¦
¦ Thru       ¦Thru                                                Thru      ¦
¦ BOP9:031   ¦BOP9:031                                            BOP9:031  ¦
¦ Error Bit  ¦One-Shot                                            Enable Bit¦
¦   N20:0        B3                                                 N20:0   ¦
¦----] [-------[ONS]-----------------------------------------------(U)-----¦
¦     12         0                                                    15    ¦
```

Figure 17 - BOP Read MSG

The MSG instruction control block is configured as shown in Figure 16:

```
          MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:0


          Communication Command:            PLC-5 TYPED READ
          PLC-5 Data Table Address:         B9:1
          Size in Elements:                 1
          Local/Remote:                     LOCAL
             Remote Station:                N/A
             Link ID:                       N/A
             Remote Link Type:              N/A
          Local Node Address:               01
          Destination Data Table Address:   B9:1


 BLOCK SIZE = 9 WORDS
```

Figure 18 - BOP Continuous Read Control Block Set-up

Integer Read

To read the 10 Integer Outputs starting at address N7:010, the MSG instruction is
placed in the ladder logic program as shown in Figure 19:

```
¦                                                              Read                 ¦
¦                                                              IOP7:010             ¦
¦                                                              Thru                 ¦
¦                                                              IOP7:019             ¦
¦                                                              From GWY             ¦
¦                                                  +MSG-------------------+         ¦
¦-------------------------------------------------¦SEND/REC MESSAGE     +-(EN)-¦
¦                                                  ¦Control Block    N20:18+-(DN) ¦
¦                                                  ¦                       +-(ER) ¦
¦                                                  +---------------------+         ¦
¦ Read      ¦Reset .EN                                             Read            ¦
¦ IOP7:010  ¦IOP7:010                                              IOP7:010        ¦
¦ Thru      ¦Thru                                                  Thru            ¦
¦ IOP7:019  ¦IOP7:019                                              IOP7:019        ¦
¦ Error Bit ¦One-Shot                                              Enable Bit      ¦
¦   N20:18       B3                                                  N20:18        ¦
¦----] [-------[ONS]-------------------------------------------------(U)-----¦
¦     12         2                                                   15          ¦
```
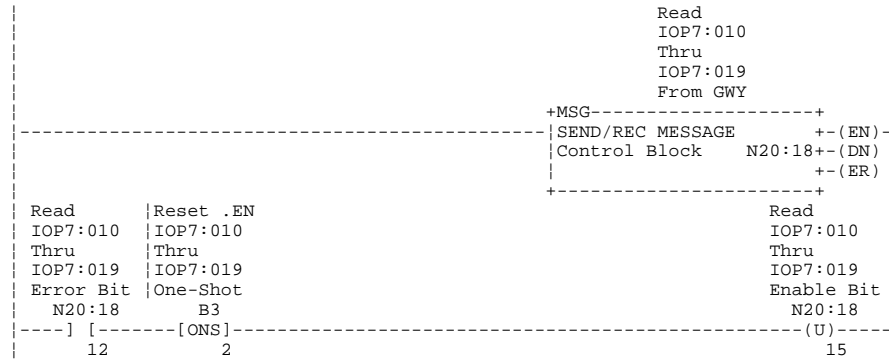
Figure 19 - IOP Read MSG

The MSG instruction control block is configured as shown in Figure 20:

```
          MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:18


          Communication Command:            PLC-5 TYPED READ
          PLC-5 Data Table Address:         N7:10
          Size in Elements:                 10
          Local/Remote:                     LOCAL
             Remote Station:                N/A
             Link ID:                       N/A
             Remote Link Type:              N/A
          Local Node Address:               01
          Destination Data Table Address:   N7:10


 BLOCK SIZE = 9 WORDS
```
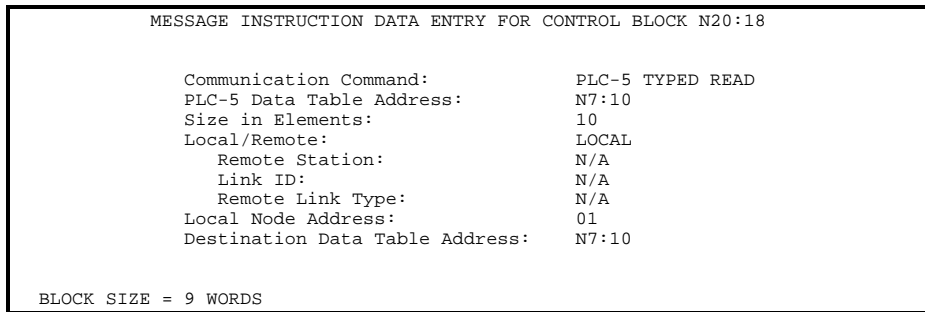
Figure 20 - IOP Continuous Read Control Block Set-up

Float Read

To read the 8 Float Outputs starting at address F8:008, the MSG instruction is placed in the ladder logic program as shown in Figure 21:

```
|                                                       Read                |
|                                                       FOP8:008             |
|                                                       Thru                |
|                                                       FOP8:015             |
|                                                       From GWY             |
|                                                  +MSG-------------------+   |
|-------------------------------------------------¦SEND/REC MESSAGE     +-(EN)-¦
|                                                  ¦Control Block   N20:36+-(DN) |
|                                                  ¦                     +-(ER) |
|                                                  +---------------------+   |
| Read      ¦Reset .EN                                              Read      |
| FOP8:008  ¦FOP8:008                                               FOP8:008  |
| Thru      ¦Thru                                                   Thru      |
| FOP8:015  ¦FOP8:015                                               FOP8:015  |
| Error Bit ¦One-Shot                                               Enable Bit |
|   N20:36      B3                                                    N20:36   |
|----] [-------[ONS]-------------------------------------------------(U)-----¦
|    12        4                                                       15    |
```
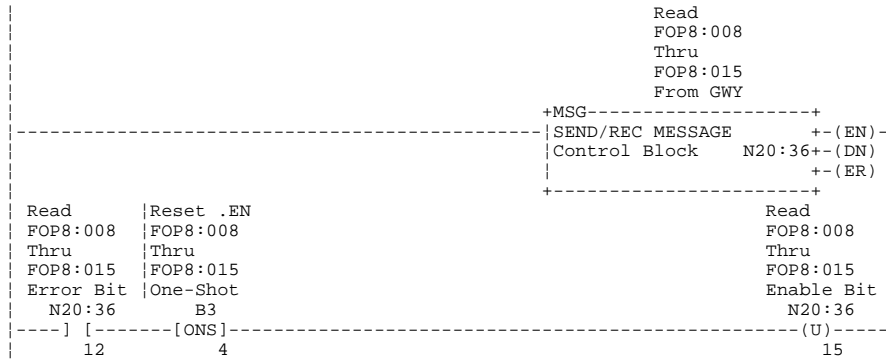
Figure 21 - FOP Read MSG

The MSG instruction control block is configured as shown in Figure 22:

```
          MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:36


          Communication Command:          PLC-5 TYPED READ
          PLC-5 Data Table Address:       F8:8
          Size in Elements:               8
          Local/Remote:                   LOCAL
             Remote Station:              N/A
             Link ID:                     N/A
             Remote Link Type:            N/A
          Local Node Address:             01
          Destination Data Table Address:  F8:8


 BLOCK SIZE = 9 WORDS
```
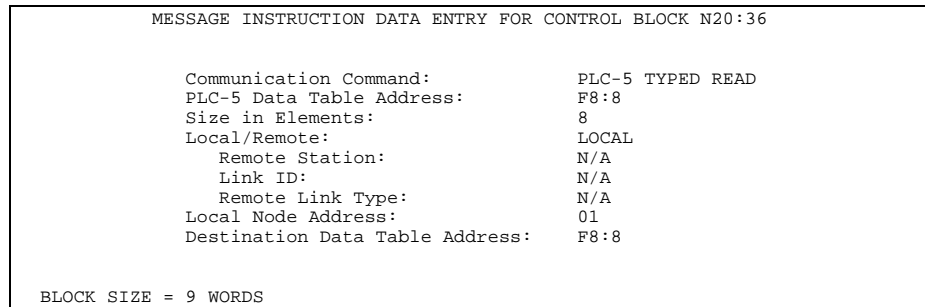
Figure 22 - FOP Continuous Read Control Block Set-up

Write MSG Instructions

An MSG instruction configured to write will transfer data to the gateway's input
function blocks. In the following Write examples, a gateway has been configured
with:

1. A Data Highway Plus address of 1
2. One group of 16 Bit Inputs starting at address B9:000 (Word B9:0)
3. Ten Integer Inputs starting at address N7:000
4. Eight Float Inputs starting at address F8:000.

Three separate MSG instructions are required to write this data. The three MSG
instructions are described in the following sections.

Bit Write

To write the 16 Bit Inputs starting at address B9:000, the MSG instruction would be
placed in the ladder logic program as shown in Figure 23:
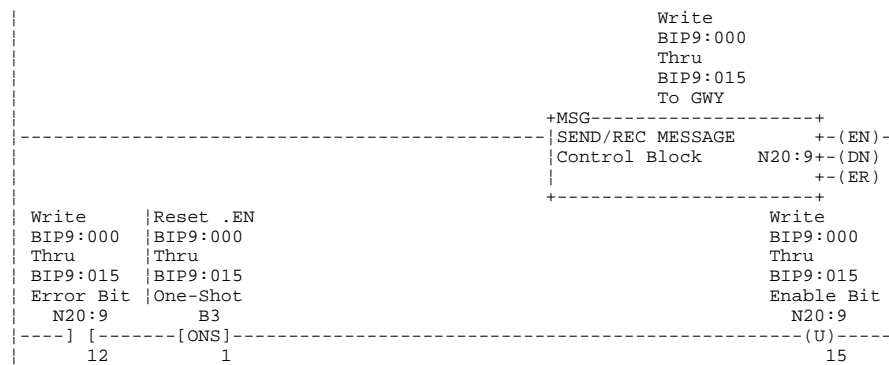
```
¦                                                              Write              ¦
¦                                                              BIP9:000           ¦
¦                                                              Thru               ¦
¦                                                              BIP9:015           ¦
¦                                                              To GWY             ¦
¦                                              +MSG-------------------+           ¦
¦---------------------------------------------¦SEND/REC MESSAGE      +-(EN)-¦     ¦
¦                                              ¦Control Block    N20:9+-(DN) ¦     ¦
¦                                              ¦                      +-(ER) ¦     ¦
¦                                              +----------------------+           ¦
¦ Write      ¦Reset .EN                                             Write         ¦
¦ BIP9:000   ¦BIP9:000                                             BIP9:000       ¦
¦ Thru       ¦Thru                                                 Thru           ¦
¦ BIP9:015   ¦BIP9:015                                             BIP9:015       ¦
¦ Error Bit  ¦One-Shot                                             Enable Bit     ¦
¦   N20:9       B3                                                   N20:9        ¦
¦----] [-------[ONS]-------------------------------------------------(U)-----¦
¦    12        1                                                     15        ¦
```
Figure 23 - BIP Continuous Write MSG

The MSG instruction control block is configured as shown in Figure 24:
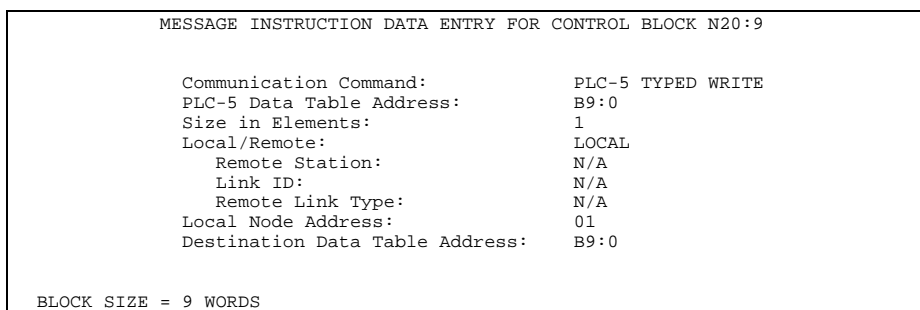
```
            MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:9


            Communication Command:            PLC-5 TYPED WRITE
            PLC-5 Data Table Address:         B9:0
            Size in Elements:                 1
            Local/Remote:                     LOCAL
               Remote Station:                N/A
               Link ID:                       N/A
               Remote Link Type:              N/A
            Local Node Address:               01
            Destination Data Table Address:   B9:0


 BLOCK SIZE = 9 WORDS
```
Figure 24 - BIP Continuous Write Control Block Set-up

Integer Write

To write the 10 Integer Inputs starting at address N7:000, the MSG instruction is
placed in the ladder logic program as shown in Figure 25:
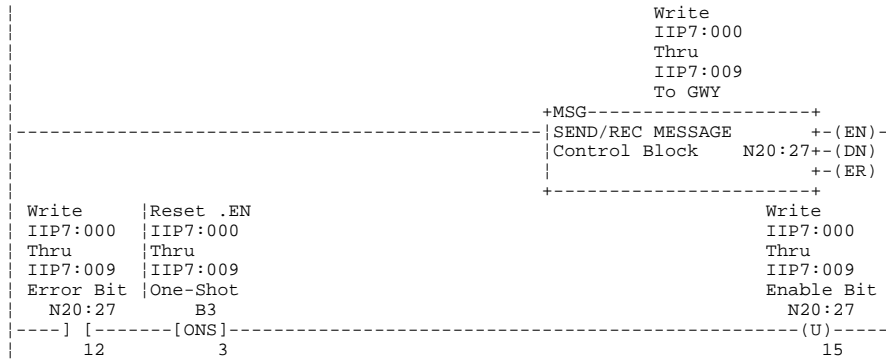
```
¦                                                      Write              ¦
¦                                                      IIP7:000           ¦
¦                                                      Thru               ¦
¦                                                      IIP7:009           ¦
¦                                                      To GWY             ¦
¦                                          +MSG-------------------+       ¦
¦-----------------------------------------¦SEND/REC MESSAGE     +-(EN)-¦
¦                                          ¦Control Block    N20:27+-(DN) ¦
¦                                          ¦                       +-(ER) ¦
¦                                          +---------------------+        ¦
¦ Write      ¦Reset .EN                                    Write          ¦
¦ IIP7:000   ¦IIP7:000                                     IIP7:000       ¦
¦ Thru       ¦Thru                                         Thru           ¦
¦ IIP7:009   ¦IIP7:009                                     IIP7:009       ¦
¦ Error Bit  ¦One-Shot                                     Enable Bit     ¦
¦   N20:27        B3                                          N20:27      ¦
¦----] [-------[ONS]-------------------------------------------------(U)-----¦
¦     12          3                                              15      ¦
```
Figure 25 - IIP Write MSG Rungs

The MSG instruction control block is configured as shown in Figure 26:
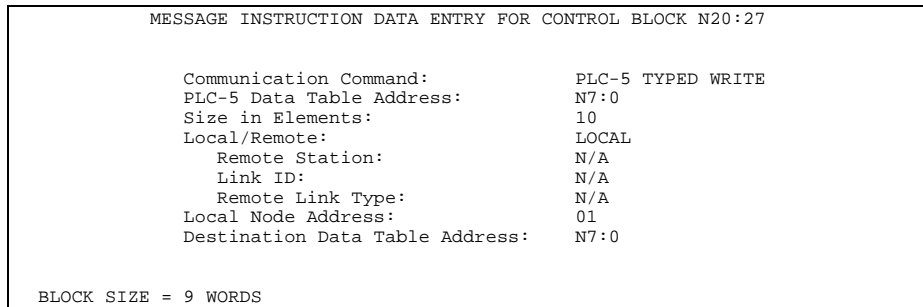
```
        MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:27


        Communication Command:          PLC-5 TYPED WRITE
        PLC-5 Data Table Address:       N7:0
        Size in Elements:               10
        Local/Remote:                   LOCAL
           Remote Station:              N/A
           Link ID:                     N/A
           Remote Link Type:            N/A
        Local Node Address:             01
        Destination Data Table Address: N7:0



 BLOCK SIZE = 9 WORDS
```
Figure 26 - IIP Continuous Write Control Block Set-up

Float Write

To write the 8 Float Inputs starting at address F8:000, the MSG instruction is placed
in the ladder logic program as shown in Figure 27:

```
¦                                                          Write              ¦
¦                                                          FIP8:000           ¦
¦                                                          Thru               ¦
¦                                                          FIP8:007           ¦
¦                                                          To GWY             ¦
¦                                              +MSG--------------------+      ¦
¦---------------------------------------------¦SEND/REC MESSAGE      +-(EN)-¦
¦                                              ¦Control Block    N20:45+-(DN) ¦
¦                                              ¦                       +-(ER) ¦
¦                                              +----------------------+      ¦
¦ Write      ¦Reset .EN                                         Write        ¦
¦ FIP8:000   ¦FIP8:000                                          FIP8:000     ¦
¦ Thru       ¦Thru                                              Thru         ¦
¦ FIP8:007   ¦FIP8:007                                          FIP8:007     ¦
¦ Error Bit  ¦One-Shot                                          Enable Bit   ¦
¦   N20:45      B3                                                N20:45      ¦
¦----] [-------[ONS]------------------------------------------------(U)-----¦
¦      12        5                                                 15        ¦
```
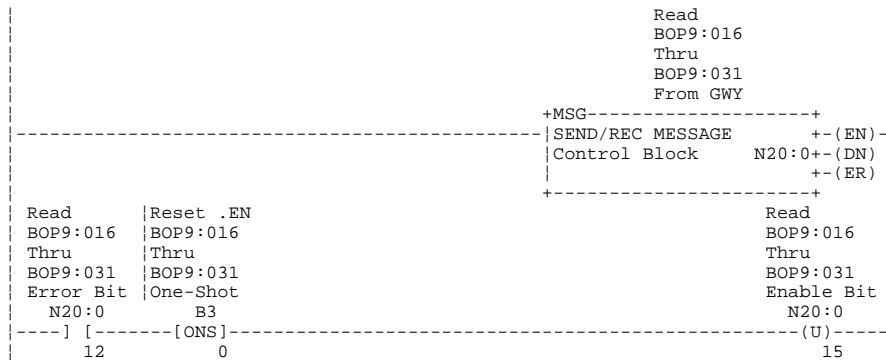
Figure 27 - FIP Continuous Write MSG Rungs

The MSG instruction control block is configured as shown in Figure 28:

```
           MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:45


        Communication Command:           PLC-5 TYPED WRITE
        PLC-5 Data Table Address:        F8:0
        Size in Elements:                8
        Local/Remote:                    LOCAL
           Remote Station:               N/A
           Link ID:                      N/A
           Remote Link Type:             N/A
        Local Node Address:              01
        Destination Data Table Address:  F8:0


 BLOCK SIZE = 9 WORDS
```

Figure 28 - FIP Continuous Write Control Block Set-up

Enabling Continuous Mode

After creating the rungs in the ladder logic as described in the previous sections, the Continue Bit (Bit 11) in each control word must be set to enable communications. The .CO bit may be set either using ladder logic or by directly manipulating the bit using the Data Monitor feature of the PLC programming software.

When using ladder logic, the Continue Bit is accessed by using bit level addressing on Bit 11 of each control word. Enabling of the communications for the preceding continuous mode examples is shown in Figure 29.

```
¦ DHP                                                               Read       ¦
¦ Network                                                           BOP9:016   ¦
¦ Comms                                                             Thru       ¦
¦ Enable                                                            BOP9:031   ¦
¦                                                                   .CO Bit    ¦
¦    B3                                                               N20:0    ¦
¦----] [--------------------------------------------------------------( )------¦
¦     6                                                             ¦    11    ¦ ¦
¦                                                                   ¦Write     ¦ ¦
¦                                                                   ¦BIP3:000  ¦ ¦
¦                                                                   ¦Thru      ¦ ¦
¦                                                                   ¦BIP3:015  ¦ ¦
¦                                                                   ¦.CO Bit   ¦ ¦
¦                                                                   ¦  N20:9   ¦ ¦
¦                                                                   +---( )----¦ ¦
¦                                                                   ¦    11    ¦ ¦
¦                                                                   ¦Read      ¦ ¦
¦                                                                   ¦IOP7:010  ¦ ¦
¦                                                                   ¦Thru      ¦ ¦
¦                                                                   ¦IOP7:019  ¦ ¦
¦                                                                   ¦.CO Bit   ¦ ¦
¦                                                                   ¦  N20:18  ¦ ¦
¦                                                                   +---( )----¦ ¦
¦                                                                   ¦    11    ¦ ¦
¦                                                                   ¦Write     ¦ ¦
¦                                                                   ¦IIP7:000  ¦ ¦
¦                                                                   ¦Thru      ¦ ¦
¦                                                                   ¦IIP7:009  ¦ ¦
¦                                                                   ¦.CO Bit   ¦ ¦
¦                                                                   ¦  N20:27  ¦ ¦
¦                                                                   +---( )----¦ ¦
¦                                                                   ¦    11    ¦ ¦
¦                                                                   ¦Read      ¦ ¦
¦                                                                   ¦FOP8:008  ¦ ¦
¦                                                                   ¦Thru      ¦ ¦
¦                                                                   ¦FOP8:015  ¦ ¦
¦                                                                   ¦.CO Bit   ¦ ¦
¦                                                                   ¦  N20:36  ¦ ¦
¦                                                                   +---( )----¦ ¦
¦                                                                   ¦    11    ¦ ¦
¦                                                                   ¦Write     ¦ ¦
¦                                                                   ¦FIP8:000  ¦ ¦
¦                                                                   ¦Thru      ¦ ¦
¦                                                                   ¦FIP8:007  ¦ ¦
¦                                                                   ¦.CO Bit   ¦ ¦
¦                                                                   ¦  N20:45  ¦ ¦
¦                                                                   +---( )----+ ¦
¦                                                                        11     ¦
```
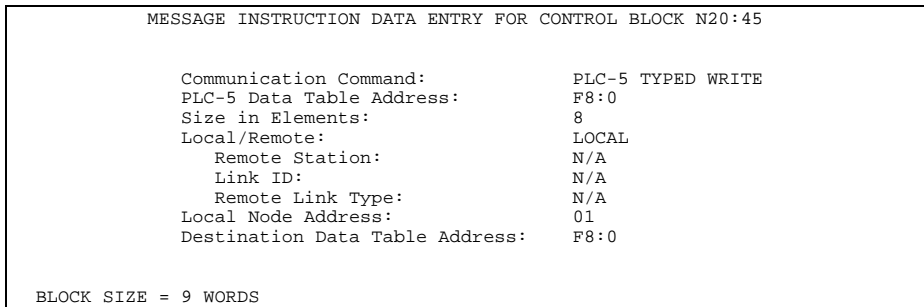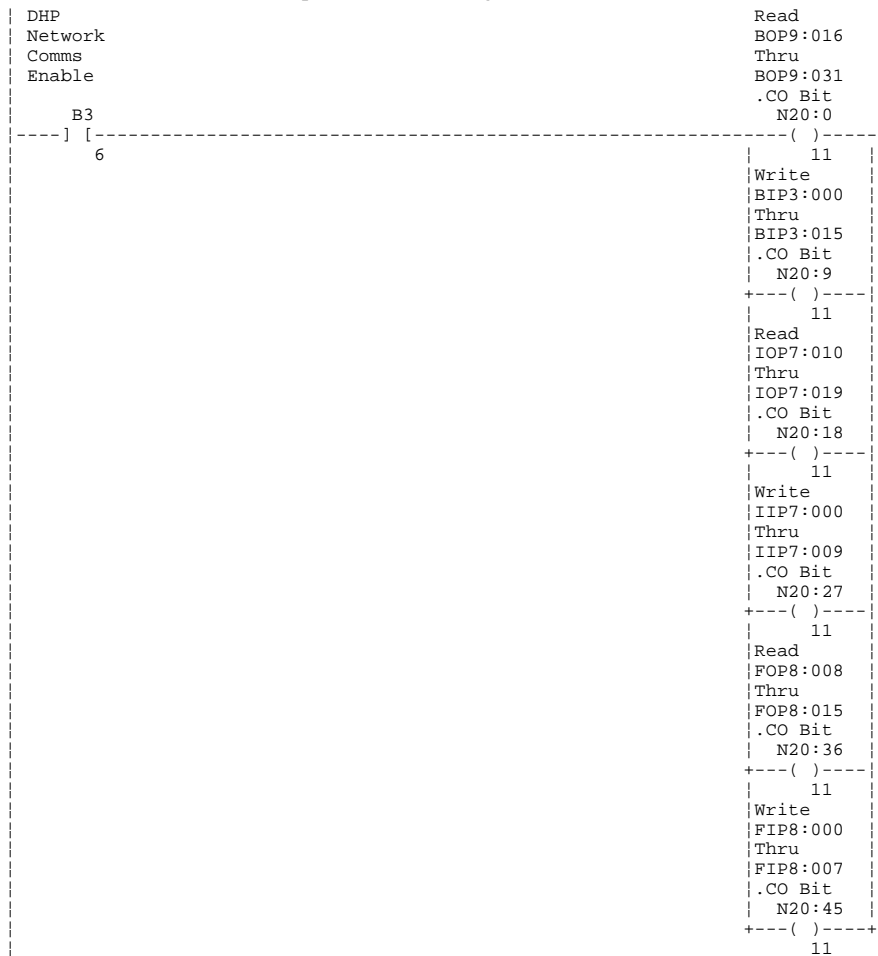
Figure 29 - Logic Enabling Continuous Bit

If using discrete logic to enable DHP network communications is not required, the Data Monitor screen of the PLC programming software is used to enable each MSG instruction. A typical Data Monitor screen (in this case, the Bit Read MSG of Figure 17) is shown in Figure 30. The arrow (←) in the figure locates the .CO bit which must be set (equal to 1) to enable communications. The bit is set by placing the cursor on the .CO bit and depressing "F9" to toggle the status.

```
          MESSAGE INSTRUCTION DATA MONITOR FOR CONTROL BLOCK N20:0


 Communication Command:          PLC-5 TYPED READ
 PLC-5 Data Table Address:       B9:1                  ignore if timed-out:  0 TO
 Size in Elements:               1                          to be retried:  0 NR
 Local/Remote:                   LOCAL                  awaiting execution:  0 EW
    Remote Station:              N/A                             continuous:  1 CO←
    Link ID:                     N/A                                 error:  0 ER
    Remote Link Type:            N/A                          message done:  0 DN
 Local Node Address:             01                   message transmitting:  1 ST
 Destination Data Table Address: B9:1                      message enabled:  1 EN


                                              control bit addr:  N20:0/8

 Error Code:      0 (DEC)

 BLOCK SIZE = 9 WORDS


Press a function key to change a value.
> _
Rem Prog   Forces:None     Data:Formatted               5/15 File DHPMAN1
               Size in                                          Toggle
               Elemnts                                            Bit
                F3                                                F9
```

Figure 30 - Data Monitor Enabling Continuous Bit

MSG INSTRUCTIONS USING LOGIC

When DHP network traffic becomes heavy, it may be necessary to use logic to trigger MSG instructions in the PLC . The following sections show schemes which perform Reads on a specified interval and Writes only upon change of data.

Read MSG Instructions

The TON timer in Figure 31 causes Reads to be initiated from the gateway at specified intervals. The Preset of the timer is used to control the frequency of Read requests (in this instance, Reads are performed at 500 millisecond intervals).

```
¦ Read From                                          Read From            ¦
¦ gateway                                            gateway              ¦
¦ Timer                                              Timer                ¦
¦ Done                                                                    ¦
¦                                                                         ¦
¦    T4:0                                      +TON--------------+        ¦
¦----]/[--------------------------------------¦TIMER ON DELAY    +-(EN)-¦ ¦
¦     DN                                       ¦Timer       T4:0¦         ¦
¦                                              ¦Time base   0.01+-(DN)   ¦
¦                                              ¦Preset        50¦         ¦
¦                                              ¦Accum         20¦         ¦
¦                                              +-----------------+        ¦
```

Figure 31 - Periodic Read Timer

Bit Read

To read the 16 Bit Outputs starting at address B9:016 every 500 ms, the rung controlling the MSG instruction is placed in the ladder logic program as shown in Figure 32.

```
¦ Read From                                          Read                 ¦
¦ gateway                                            BOP9:016             ¦
¦ Timer                                              Thru                 ¦
¦ Done                                               BOP9:031             ¦
¦                                                    From GWY             ¦
¦    T4:0                                 +MSG-------------------+        ¦
¦----] [----------------------------------¦SEND/RECEIVE MESSAGE   +-(EN)-¦
¦     DN                                  ¦Control block     N20:0+-(DN) ¦
¦                                         ¦                        +-(ER) ¦
¦                                         +----------------------+        ¦
```
Figure 32 - BOP Periodic Read MSG

The MSG instruction control block is configured as shown in Figure 33.

```
             MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:0


         Communication Command:              PLC-5 TYPED READ
         PLC-5 Data Table Address:           B9:1
         Size in Elements:                   1
         Local/Remote:                       LOCAL
            Remote Station:                  N/A
            Link ID:                         N/A
            Remote Link Type:                N/A
         Local Node Address:                 01
         Destination Data Table Address:     B9:1


 BLOCK SIZE = 9 WORDS
```
Figure 33 - BOP Periodic Read Control Block Set-up

Integer Read

To read the 10 Integer Outputs starting at address N7:010 every 500 ms, the rung
controlling the MSG instruction is placed in the ladder logic program as shown in
Figure 34.

```
¦ Read From                                              Read                   ¦
¦ gateway                                                IOP7:010               ¦
¦ Timer                                                  Thru                   ¦
¦ Done                                                   IOP7:019               ¦
¦                                                        From GWY                ¦
¦    T4:0                                        +MSG-------------------+        ¦
¦----] [--------------------------------------¦SEND/RECEIVE MESSAGE   +-(EN)-¦
¦     DN                                         ¦Control block    N20:18+-(DN) ¦
¦                                                ¦                        +-(ER) ¦
¦                                                +---------------------+        ¦
```

Figure 34 - IOP Periodic Read MSG

The MSG instruction control block is configured as shown in Figure 35.

```
          MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:18


          Communication Command:            PLC-5 TYPED READ
          PLC-5 Data Table Address:         N7:10
          Size in Elements:                 10
          Local/Remote:                     LOCAL
             Remote Station:                N/A
             Link ID:                       N/A
             Remote Link Type:              N/A
          Local Node Address:               01
          Destination Data Table Address:   N7:10


 BLOCK SIZE = 9 WORDS
```

Figure 35 - IOP Periodic Read Control Block Set-up

Float Read

To read the 8 Float Outputs starting at address F8:008 every 500 ms, the rung controlling the MSG instruction is placed in the ladder logic program as shown in Figure 36.

```
¦ Read From                                          Read               ¦
¦ gateway                                            FOP8:008           ¦
¦ Timer                                              Thru               ¦
¦ Done                                               FOP8:015           ¦
¦                                                    From GWY           ¦
¦    T4:0                                  +MSG-------------------+      ¦
¦----] [-----------------------------------¦SEND/RECEIVE MESSAGE   +-(EN)-¦
¦     DN                                   ¦Control block    N20:36+-(DN) ¦
¦                                          ¦                       +-(ER) ¦
¦                                          +----------------------+      ¦
```
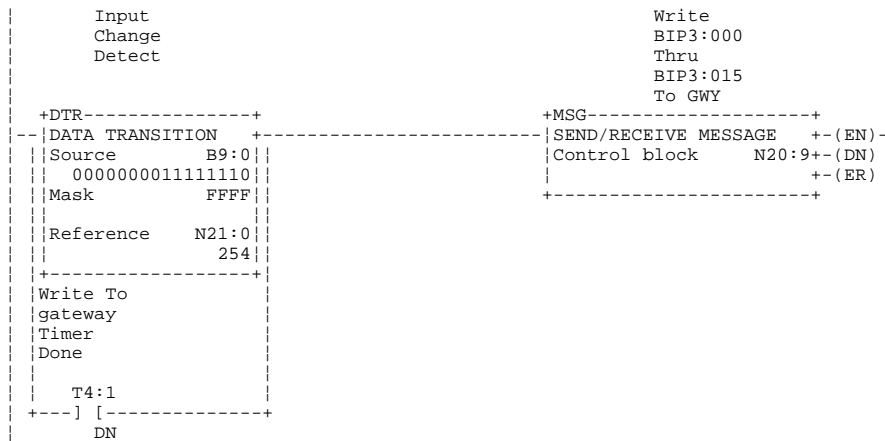
Figure 36 - FOP Periodic Read MSG

The MSG instruction control block is configured as shown in Figure 37.

```
           MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:36


        Communication Command:            PLC-5 TYPED READ
        PLC-5 Data Table Address:         F8:8
        Size in Elements:                 8
        Local/Remote:                     LOCAL
           Remote Station:                N/A
           Link ID:                       N/A
           Remote Link Type:              N/A
        Local Node Address:               01
        Destination Data Table Address:   F8:8



 BLOCK SIZE = 9 WORDS
```

Figure 37 - FOP Periodic Read Control Block Set-up

Write MSG Instructions

For Writes, additional rungs are required to determine if the data associated with Input registers in the gateway has changed. If a change is detected, the PLC generates a DHP message to update the appropriate registers in the gateway. As a precaution against communication failures, each Write MSG instruction is also enabled by the Done Bit (.DN) of a TON timer. By including the timer of Figure 38, users ensure data is valid within 2 seconds after a failure has occurred (assuming no hard failure exists).

```
¦ Write To                                              Write To             ¦
¦ gateway                                               gateway              ¦
¦ Timer                                                 Timer                ¦
¦ Done                                                                       ¦
¦                                                                            ¦
¦    T4:1                                             +TON--------------+    ¦
¦----]/[---------------------------------------------¦TIMER ON DELAY   +-(EN)-¦
¦     DN                                             ¦Timer        T4:1¦     ¦
¦                                                    ¦Time base    0.01+-(DN) ¦
¦                                                    ¦Preset        200¦     ¦
¦                                                    ¦Accum           0¦     ¦
¦                                                    +-----------------+     ¦
```

Figure 38 - Periodic Write Timer

Bit Write

In Figure 39, the Data Transition (DTR) instruction in the rung detects changes in
word B9:0 (addresses B9:000 through B9:015). If a change is detected, the MSG
instruction is enabled for one scan of the PLC and a DHP message is generated. The
DTR instruction then stores the current word at address N21:0 to be used in the next
comparison. If necessary, the DTR Mask may be used to ignore certain bits in the
word (i.e., a mask of 00FF ignores bits B3:015 through B3:008).

```
¦       Input                                             Write                  ¦
¦       Change                                            BIP3:000               ¦
¦       Detect                                            Thru                   ¦
¦                                                         BIP3:015               ¦
¦                                                         To GWY                 ¦
¦   +DTR---------------+                     +MSG-------------------+            ¦
¦--¦DATA TRANSITION   +-----------------------¦SEND/RECEIVE MESSAGE   +-(EN)-¦
¦  ¦¦Source        B9:0¦¦                      ¦Control block     N20:9+-(DN) ¦
¦  ¦¦  0000000011111110¦¦                      ¦                       +-(ER) ¦
¦  ¦¦Mask          FFFF¦¦                      +----------------------+        ¦
¦  ¦¦                  ¦¦                                                       ¦
¦  ¦¦Reference    N21:0¦¦                                                       ¦
¦  ¦¦              254¦¦                                                        ¦
¦  ¦+-----------------+¦                                                        ¦
¦  ¦Write To          ¦                                                        ¦
¦  ¦gateway           ¦                                                        ¦
¦  ¦Timer             ¦                                                        ¦
¦  ¦Done              ¦                                                        ¦
¦  ¦                  ¦                                                        ¦
¦  ¦    T4:1          ¦                                                        ¦
¦  +---] [-------------+                                                       ¦
¦       DN                                                                     ¦
```
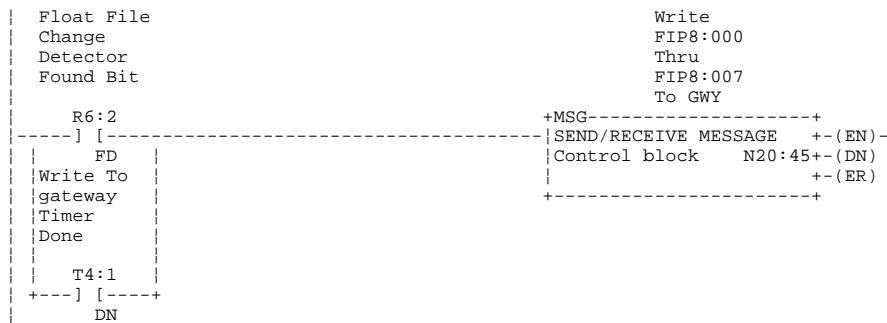
Figure 39 - BIP Detect Change and Write MSG

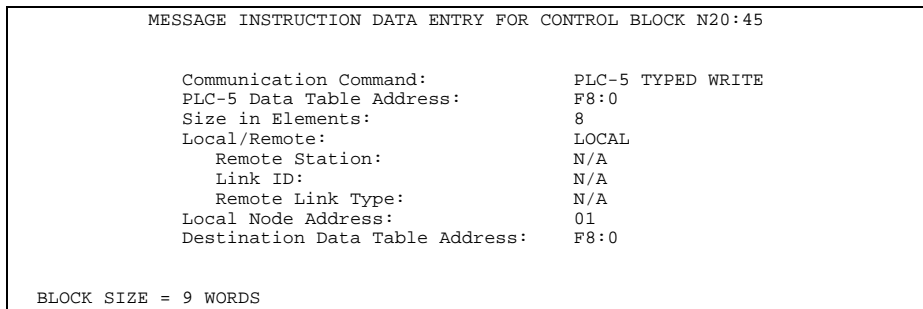The MSG instruction control block is configured as shown in Figure 40.

```
              MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:9


              Communication Command:              PLC-5 TYPED WRITE
              PLC-5 Data Table Address:           B9:0
              Size in Elements:                   1
              Local/Remote:                       LOCAL
                 Remote Station:                  N/A
                 Link ID:                         N/A
                 Remote Link Type:                N/A
              Local Node Address:                 01
              Destination Data Table Address:     B9:0


 BLOCK SIZE = 9 WORDS
```

Figure 40 - BIP Periodic/On-Change Control Block Set-up

Integer Write

In Figure 41, the Diagnostic Detect (DDT) instruction in the rung detects changes in the words associated with addresses N7:000 through N7:009. If a change is detected, the DDT sets the R6:0 control word's Found Bit (.FD) and stores the current values at addresses N22:000 through N22:009 for the next comparison.

```
¦ Integer                                             Integer              ¦
¦ File                                                File                 ¦
¦ Change                                              Change               ¦
¦ Detector                                            Detector             ¦
¦ Done Bit                                                                 ¦
¦    R6:0                                      +DDT-------------------+     ¦
¦----]/[--------------------------------------¦DIAGNOSTIC DETECT    +-(EN)-¦
¦     DN                                       ¦Source          #N7:0+-(DN) ¦
¦                                              ¦Reference      #N22:0+-(FD) ¦
¦                                              ¦Result         #N23:0+-(IN) ¦
¦                                              ¦Compare control  R6:0+-(ER) ¦
¦                                              ¦Length            160¦      ¦
¦                                              ¦Position          160¦      ¦
¦                                              ¦Result control   R6:1¦      ¦
¦                                              ¦Length             10¦      ¦
¦                                              ¦Position            0¦      ¦
¦                                              +---------------------+      ¦
```
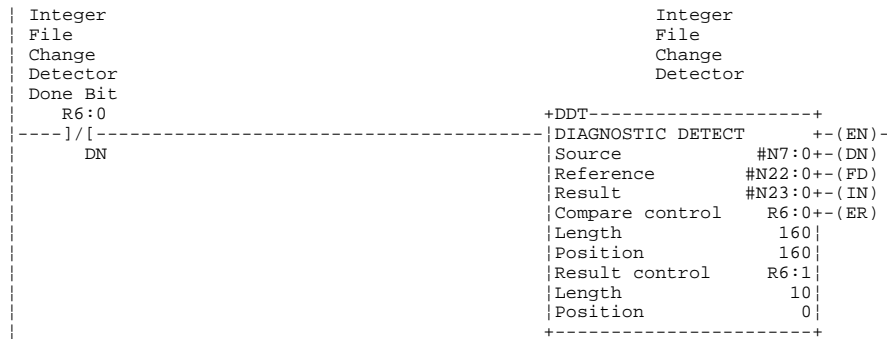
Figure 41 - IIP Detect Change

To write the 10 Integer Inputs starting at address N7:000, the rung controlling the MSG instruction is placed in the ladder logic program as shown in Figure 42.

```
¦  Integer                                              Write                ¦
¦  File                                                 IIP7:000             ¦
¦  Change                                               Thru                 ¦
¦  Detector                                             IIP7:009             ¦
¦  Found Bit                                            To GWY                ¦
¦    R6:0                                       +MSG-------------------+      ¦
¦-----] [---------------------------------------¦SEND/RECEIVE MESSAGE   +-(EN)-¦
¦ ¦     FD    ¦                                  ¦Control block    N20:27+-(DN) ¦
¦ ¦Write To   ¦                                  ¦                      +-(ER) ¦
¦ ¦gateway    ¦                                  +---------------------+      ¦
¦ ¦Timer      ¦                                                               ¦
¦ ¦Done       ¦                                                               ¦
¦ ¦           ¦                                                               ¦
¦ ¦    T4:1   ¦                                                               ¦
¦ +---] [----+                                                               ¦
¦       DN                                                                   ¦
```
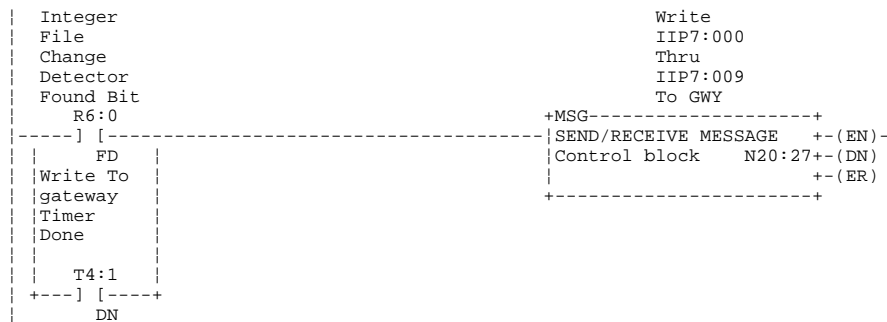
Figure 42 - IIP Periodic/On-Change Write MSG

The MSG instruction control block is configured as shown in Figure 43.

```
          MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:27


          Communication Command:           PLC-5 TYPED WRITE
          PLC-5 Data Table Address:        N7:0
          Size in Elements:                10
          Local/Remote:                    LOCAL
             Remote Station:               N/A
             Link ID:                      N/A
             Remote Link Type:             N/A
          Local Node Address:              01
          Destination Data Table Address:  N7:0



 BLOCK SIZE = 9 WORDS
```

Figure 43 - IIP Periodic/On-Change Control Block Set-up

Float Write

In Figure 44, the File Search and Compare (FSC) instruction in the rung detects changes in the words associated with addresses F8:000 through F8:007. If a change is detected, the FSC sets the R6:2 control word's Found Bit (.FD).

```
| Float File                                         Float File           |
| Change                                             Change               |
| Detector                                           Detector             |
| Done Bit                                                                |
|                                                                         |
|    R6:2                                    +FSC-------------------+      |
|----]/[-------------------------------------|FILE SEARCH/COMPARE   +-(EN)-|
|    DN                                      |Control           R6:2|      |
|                                            |Length               8+-(DN) |
|                                            |Position             0|      |
|                                            |Mode               ALL+-(ER) |
|                                            |Expression            |      |
|                                            |#F8:0 <> #F24:0       |      |
|                                            +----------------------+      |
```

Figure 44 - FIP Detect Change

After the change is detected, the rung of Figure 45 copies the eight values starting at address F8:000 to F24:000 for use in the next comparison.

```
| Float File                                         Copy              |
| Change                                             Float File        |
| Detector                                           For Next          |
| Found Bit                                          Comparison        |
|                                                                      |
|    R6:2                                    +COP--------------+ |
|----] [-------------------------------------|COPY FILE        +-|
|    FD                                      |Source       #F8:0| |
|                                            |Destination #F24:0| |
|                                            |Length           8| |
|                                            +-----------------+ |
```

Figure 45 - FIP Copy for Next Comparison

To write the 8 Float Inputs starting at address F8:000, the rung controlling the MSG instruction is placed in the ladder logic program as shown in Figure 46.

```
¦  Float File                                        Write               ¦
¦  Change                                            FIP8:000            ¦
¦  Detector                                          Thru                ¦
¦  Found Bit                                         FIP8:007            ¦
¦                                                    To GWY              ¦
¦     R6:2                              +MSG-------------------+         ¦
¦----] [-------------------------------¦SEND/RECEIVE MESSAGE   +-(EN)-¦  ¦
¦ ¦     FD   ¦                          ¦Control block    N20:45+-(DN) ¦  ¦
¦ ¦Write To  ¦                          ¦                       +-(ER) ¦  ¦
¦ ¦gateway   ¦                          +----------------------+         ¦
¦ ¦Timer     ¦                                                           ¦
¦ ¦Done      ¦                                                           ¦
¦ ¦          ¦                                                           ¦
¦ ¦   T4:1   ¦                                                           ¦
¦ +---] [----+                                                           ¦
¦      DN                                                                ¦
```

Figure 46 - FIP Periodic/On-Change Write MSG

The MSG instruction control block is configured as shown in Figure 47.

```
          MESSAGE INSTRUCTION DATA ENTRY FOR CONTROL BLOCK N20:45


          Communication Command:           PLC-5 TYPED WRITE
          PLC-5 Data Table Address:        F8:0
          Size in Elements:                8
          Local/Remote:                    LOCAL
             Remote Station:               N/A
             Link ID:                      N/A
             Remote Link Type:             N/A
          Local Node Address:              01
          Destination Data Table Address:  F8:0


 BLOCK SIZE = 9 WORDS
```

Figure 47 - FIP Periodic/On-Change Control Block Set-up

After detecting the change and completing the write to the gateway, the FSC must be prepared for the next comparison by resetting the R6:2 control word's Inhibit Bit (.IN) as shown in Figure 48.

```
¦ Write      ¦Float File                                      Float File ¦
¦ FIP8:000   ¦Change                                          Change     ¦
¦ Thru       ¦Detector                                        Detector   ¦
¦ FIP8:007   ¦Found Bit                                        Inhibit    ¦
¦ Done Bit   ¦                                                 Bit        ¦
¦   N20:45      R6:2                                            R6:2      ¦
¦----] [--------] [---------------------------------------------(U)-----¦
¦    13         FD                                             IN        ¦
```

Figure 48 - FSC Reset for Next Comparison

MONITORING THE STATUS OF MSG INSTRUCTIONS

While On-Line with PLC programming software, the Data Monitor feature may be used to check the status of each MSG instruction. If there is a communication failure, a non-zero Error Code is displayed (adjacent to the arrow ($\Leftarrow$) in Figure 50). This Error Code may then be compared to Appendix G for resolution of the communication problem.

```
    MESSAGE INSTRUCTION DATA MONITOR FOR CONTROL BLOCK N20:0

Communication Command:            PLC-5 TYPED READ
PLC-5 Data Table Address:         B9:1              ignore if timed-out:  0 TO
Size in Elements:                 1                      to be retried:  0 NR
Local/Remote:                     LOCAL             awaiting execution:  0 EW
   Remote Station:                N/A                       continuous:  1 CO
   Link ID:                       N/A                            error:  0 ER
   Remote Link Type:              N/A                     message done:  0 DN
Local Node Address:               01              message transmitting:  1 ST
Destination Data Table Address:   B9:1                 message enabled:  1 EN

                                            control bit addr:  N20:0/8

ERROR CODE :      0 (DEC) ⇐

BLOCK SIZE = 9 WORDS
```

Figure 49 - Monitoring MSG On-Line

Chapter 6   TROUBLESHOOTING THE GATEWAY

If communications between the DHP and *LINK* networks cannot be established, a systematic approach to troubleshooting will help the user to diagnose and resolve any problems. This approach involves prudent use of the hardware and software diagnostics available from both the PLC and the gateway.

HARDWARE DIAGNOSTICS

The first step in diagnosing any gateway communication problem is to check the hardware diagnostics. When communication is OK, the DHP Card's green LED will be flashing while the *LINK* Card's tri-color LED will be solid green (an *OK* state).

LED Indicators

If the DHP Card's green LED is NOT flashing, refer to Appendix C for assistance in troubleshooting on the DHP network.

If the *LINK* Card's LED is NOT solid green, refer to Appendix B for assistance in troubleshooting on the *LINK* network and decoding the gateway's blink state. Except for the *Network Warning* and sometimes *Network Failure* states, all blink states will cause the gateway to suspend message processing on both the *LINK* and DHP networks. While in this state, error codes will be displayed in all of the PLC's MSG instruction's control words.

If both LED's are off and power to the gateway is on, check the 1 amp fuse located on the side of the gateway and replace if necessary. The part number for the fuse is provided in Appendix A.

Network Warnings/Failures

Generally, messages on the *LINK* network are only lost when a *Network Warning* or *Network Failure* has occurred. A *Network Warning* is generated whenever corrupted data is received by a module. In response, the detecting module will discard the corrupt data and broadcast a warning message to all modules on the network. If the *LINK* module continues to receive corrupted data, or there is a complete loss of data on its receiver, the module will report a *Network Failure*. When a *Network Failure* occurs, all modules will either ignore the failure or restart depending on their System Control function block.

In a *Network Failure* state, communications on the *LINK* network will continue when:
1.   The source and destination modules are configured NOT to restart on *Network Failure*.
2.   A path still exists between the modules on the fiber optic ring.

Figure 50 shows a *LINK* network in a *Network Failure* state. At the time of the break in the fiber, module 2 reports the failure of the network and each module will respond according to the configuration of its System Control function block. Upon receipt of the *Network Failure* message, modules 3, 10, and 11 will restart and enter the

Initialization state until the network is restored while modules 1, 2, and 101 will ignore the failure.
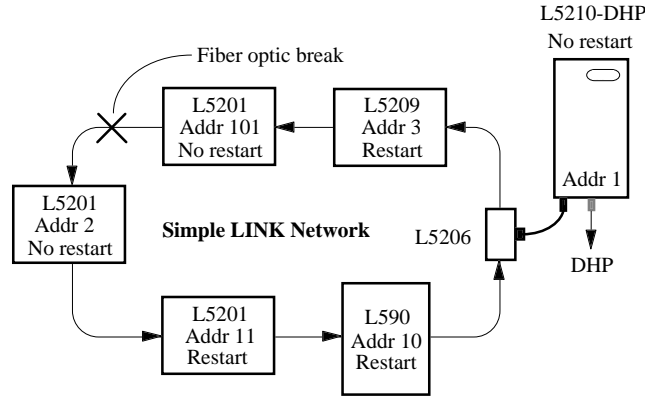
Figure 50 - Communications During Network Failure

Regardless of their processing state, *LINK* modules continue transmitting messages received on their fiber optic ring. Depending on the system's design, this property enables modules not configured to "Restart on Network Fail" to continue to operate.

Destination	Source Module					
Module	1	2	3	10	11	101
1	No	Yes	No	Reconfig	Reconfig	No
2	No	No	No	No	No	No
3	Reconfig	Reconfig	No	Reconfig	Reconfig	No
10	No	Reconfig	No	No	Reconfig	No
11	No	Reconfig	No	No	No	No
101	Yes	Yes	Reconfig	Reconfig	Reconfig	No

Table 6 - gateway Data Types

In a *Network Warning* state, the *LINK* network may lose messages for the duration of the *Network Warning*, but the DHP is unaffected and will continue processing messages. Typically, the gateway will return to the *OK* state after a *Network Warning* and message processing on both networks will continue. However, if 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 may only be lost as the physical fiber optic cable in-use is switched (within 84 msecs) to compensate for the damaged cable.

Finally, if a *Network Failure* occurs, the gateway will behave differently based on the action specified in the System Control function block per Chapter 4. If restart on *Network Failure* is enabled, the gateway will go through its initialization process as if

power were just applied to its AC terminals. After this restart, if the network remains in the failed state, the gateway will go to 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 DHP network and 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. First, the error code for each MSG instruction's control word should be checked for a non-zero value. This is accomplished by monitoring each MSG block while On-line with the PLC processor. If non-zero, the value in the error code register should be compared to Appendix G and the appropriate corrective action taken. Of primary concern are those error codes associated with a slave device (the gateway). It may become necessary to check the MSG control word set-up versus the gateway configuration for correctness during this phase of the troubleshooting.

If no problems are noted with the MSG block(s) in the PLC, troubleshooting must continue using the SAM software and the software function blocks in the gateway. The System Control function block allows the user to: "Get 2nd Net Status", "Get Logged Errors", and "Get Error Codes".

The "Get 2nd Net Status" will return either a value of "Disabled" or "Enabled" depending on whether or not the driver for the DHP Card was installed properly after initialization of the gateway. If the DHP 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. If "Enabled", the "Get Logged Errors" and "Get Error Codes" may be used to further diagnose the problem. Appendix E details 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, it may be verified that both networks are processing messages using the "Get Error Codes" for the Logged Error of "No error" .

Once the "Get Logged Errors" returns "No error" and it is verified both the *LINK* and DHP networks are processing messages, the state of the input/output function blocks can be verified using the "Get" command and the Monitor List of SAM as with any other *LINK* module. If a "Get" returns the message "Error: could not access data" during testing, it indicates no value has been received by the gateway to initialize the function block. For an input function block, this means the DHP has not yet written to the applicable address, while for an output function block, it indicates the *LINK* network has not received a message either from an input function block or a remote *LINK* module.

Appendix A SPARE PARTS LIST

The L5210-DHP-02 package contains the following items:

Qty	Part Number	Description
1	L5210-DHP	Data Highway Plus gateway assembly
1	L5206-2-01	*LINK* Gateway Repeater
1	CM350901	Cable assembly for Data Highway Plus gateway
1	HA351581	Instruction Manual

The L5210-DHP Data Highway Plus gateway assembly is manufactured from the following subassemblies and parts:

Qty	Part Number	Description
1	L5210-000-01	gateway assembly - No external network
1	AH350634	PC Bus Interface Card (L5204)
1	AH351564	CPU Card (KILA KS-6)
1	AH350897	Data Hwy+/Remote I/O card for IBM PC (5136-SD Revision 2 Direct-LinkTM Interface Card)
1	RD351581U000	Data Highway Plus gateway firmware (LOW byte)
1	RD351581U001	Data Highway Plus gateway firmware (HIGH byte)
1	CH351042	1 Amp Slow Blow Fuse (20 x 5 mm)

Appendix B GATEWAY BLINK CODES

The L5204 PC Bus Interface Card used by the gateway to communicate with the *LINK* network has a tricolor (Red, Green, Amber) LED which provides the user with a quick and easy method of determining the gateway's state without requiring the use of the 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. 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.

This fault can also be caused by fiber optic cables being connected to secondary terminals of the repeater.

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 repeater. Check the gateway cable for continuity per Appendix I.

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

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 5136-SD DIAGNOSTICS

The red and green LED's on the DHP Card in the gateway provide limited diagnostics as to the state of the DHP Card and the DHP.

Red LED

When the gateway is first powered on (or restarted), the red LED is illuminated. Once the software driver has been successfully loaded, the red LED will be extinguished. If for some reason loading fails, the red LED will remain illuminated and all attempts to communicate with the gateway on the DHP network will fail.

Green LED

After the driver for the card has been installed and the red LED has been extinguished, the green LED indicates the communication status of the gateway. The green LED turns on whenever the gateway is transmitting on the DHP network, and in its normal operating state, the green LED flickers rapidly.

Although it may appear very dim at times, the green LED should never be completely extinguished. If the green LED is completely extinguished, either all other nodes on the DHP are powered off or there is a miswire on the cabling of the network.

Appendix D 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:

$$\text{Number} = (-1)S2E-127(1.M)$$

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 x 10-38 to 3.40 x 1038.

The format at the bit level is as follows:

S	E-EXPONENT	M-MANTISSA

Bits 0 1   8 9   31
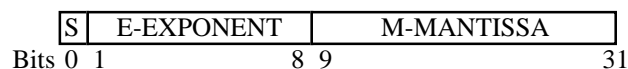
Note, there is an implied 1 in the base equation above. Also note, the mantissa is the decimal portion of the number to be represented where specific bits are set for representing portions of the value (e.g., bit 9 = 1 (0.500), bit 10 = 1 (0.250), bit 11 = 1 (0.125), ... etc.). Therefore, to represent 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 E LOGGED ERRORS

When the gateway is in the *OK* state, there is a circular queue of the last ten items which caused the gateway to record an error. The queue is accessed by opening the System Control function block and executing "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 number of LINK messages. Second error code is the number of Data Highway+ 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.
Card failed	0x1 0x1	The DHP Card for the DHP is not responding at its configured memory address.	Cycle power on the gateway. If the problem persists, replace the gateway.
Card failed	0x1 0x2 - 5	The DHP Card for the DHP has failed.	Cycle power on the gateway. If the problem persists, replace the gateway.
Card failed	0x1 0x6	An attempt to reset the DHP Card for the DHP has failed.	Cycle power on the gateway. If the problem persists, replace the gateway.
H/W buf. overflow	0x0 0x0	Transmit buffer in RTNID device on LINK Card full.	The error is ignored by the gateway. Cycle power on LINK network to empty the transmit buffer.

Logged Error	Error Codes	Description	Corrective Action Required
Unknown msg	0x0 0x1	A LINK message of unknown type was received.	The gateway ignores the message. No action required.
Unknown msg	0x0 0x2	An unknown LINK network Configuration Protocol (NCP) command was received.	The gateway ignores the command. No action required.
Unknown msg	0x1 0x1	A DHP message was received containing a non-PLC-5 command.	The PLC will report an error code 134 Dec (6000 Hex) - "Requested function is not available". Correct the PLC MSG instruction(s) so only supported PLC-5 commands are used. See Chapter 5.
Unknown msg	0x1 0x2	An unknown or unsupported PLC-5 command was received in a DHP message.	The PLC will report an error code 134 Dec (6000 Hex) - "Requested function is not available". Correct the PLC MSG instruction(s) so only supported PLC-5 commands are used. See Chapter 5.
Bad msg	0x1 0x0 or 11	An invalid address was encountered in a DHP message.	The PLC will report an error code 231 Dec (F001 Hex) - "Processor incorrectly converted the address". Correct the PLC MSG instruction(s) so only supported PLC-5 commands are used. See Chapter 5.
Bad msg	0x1 0x1 or 2	A DHP message was received which requested too many parameters in an array transfer.	The PLC will report an error code 237 Dec (F007 Hex) - "Destination file is too small for number of words requested". Modify the PLC MSG instruction(s) to read no more than 120 data words in a single message.

Logged Error	Error Codes	Description	Corrective Action Required
Bad msg	0x1 0x3 or 4	A DHP message was received which wrote too many parameters in an array transfer.	The PLC will report an error code 237 Dec (F007 Hex) - "Destination file is too small for number of words requested". Modify the PLC MSG instruction(s) to write no more than 120 data words in a single message.
Bad msg	0x1 0x10,11, or 12	An unsupported data type was received in a DHP PLC-5 Typed Read or Typed Write command.	The gateway will route the data with a value of zero. Modify the PLC MSG instruction(s) to access only Bit, Integer, or Floating Point data.
Bad x-action	0x1 0x0	An unknown transaction type was received by the DHP software from the message router.	The error is ignored. If the problem persists, cycle power on the gateway.
Bad x-action	0x1 0x10	The DHP software detected an unknown data format in a transaction from the message router.	A value of zero is returned for the queried parameter. If the problem persists, cycle power on the gateway.
Unexpected x-action	0x1 0x0	An unexpected transaction was received by the DHP software from the message router.	The error is ignored. If the problem persists, cycle power on the gateway.
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 configuration for location of the reported slot under Error Codes and correct the gateway configuration or the source node's configuration and install changes.

Logged Error	Error Codes	Description	Corrective Action Required
Missing reg.	0xRRRR 0xNNFF	A DHP message was received for an undefined register where: RRRR = Register number FF = File number NN = DHP Node number (The address is either the actual register or the next in a group of registers which failed).	The PLC will report an error code 231 Dec (F001 Hex) - "Processor incorrectly converted the address". Modify the PLC MSG instruction(s) to exclude the offending address or add a function block to the gateway configuration for the missing register.
Routing error	0x1 0x0 or 1	Either a DHP master device tried to read an input function block or an input has no connections to its function block output.	The PLC will report an error code 231 Dec (F001 Hex) - "Processor incorrectly converted the address". Check the addresses specified by the MSG instruction and ensure there are no reads of input registers. Ensure all input function blocks have output connections. Lastly, ensure there are no LINK outputs where the local gateway is the source of the value (i.e., there are no connections to itself across the LINK network).

Appendix F   SCALING FACTORS

Internally, the gateway handles both integer and float type data values in floating point format. For both Integer and Float type function blocks, the default value for the scaling factor is unity (1.0000) which results in the gateway simply passing any data through unchanged.

If processing of the value is desired after receipt or prior to transmission on the DHP side of the gateway, the scaling factor is used. The scaling factor serves as a multiplier on Input type function blocks and as 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% on the DHP network to the normalized values of +/- 1.0000 on the *LINK* network:

```
FIP8:000 | DH+ Node 1 | File 8 | F Reg 0 | Scale 0.0100 |——( 500          3 )
```
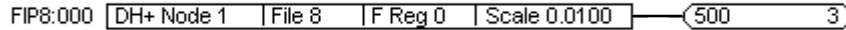
If 100.0 is written to register 0 of file number 8 in the gateway, the value is multiplied by 0.0100 to yield a value of 1.0000, or full scale for a value type on the *LINK* network.

```
( 499          3 )——| DH+ Node 1 | File 8 | F Reg 8 | Scale 0.0100 | FOP8:008
```
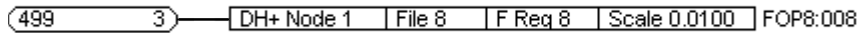
Conversely, if 1.0000 is received on the *LINK* network in slot 3 of the gateway, the value is divided by 0.0100 to yield a value of 100.00. Depending on the gateway's DH+ Node address, the value is either stored locally in the gateway or sent directly out on the DHP depending configuration.

Note, for integer type data, rounding to the nearest integer value will occur after the scaling has been applied to the data value. For example, if the integer value of 131 is written to an Integer Input with a scaling factor of 1.25, the value displayed by SAM and used on the *LINK* network would be 164. Similarly, an Integer Output with a scaling factor of 1.25 which receives an ordinal value of 164 would store a value of 131 for reading by the DHP network.

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

Appendix G MSG INSTR ERROR CODES

When an error is detected by the PLC processor, the Error Bit (.ER) of the MSG instruction is set and an error code is generated. While on-line with the PLC, the error code may be obtained by using the data monitor feature of the PLC programming software with the MSG instruction selected. These errors codes can be useful in resolving communications problems between the gateway and the PLC.

Depending on the processor type, the error codes will be displayed in decimal (Group A: PLC-5/10, 5/15, or 5/25) or hexadecimal format (Group B: PLC-5/11, 5/20, 5/30, 5/40, 5/60, 5/80). Error codes associated with the MSG instruction are listed below:

Error Codes		Description
Group A	Group B	
55	0x0037	Message timed out in local processor
129	0x1000	Illegal command from local processor
130	0x2000	Communication module not working
131	0x0083	Processor is disconnected
132	0x4000	Processor connected but faulted (hardware)
133	0x5000	Wrong station number specified
134	0x6000	Requested function is not available
135	0x7000	Processor in program mode
136	0x8000	Processor's compatibility file does not exist
137	0x0089	Processor's message buffer is full
139	0xB000	Processor is downloading so it is inaccessible
146	0x0092	No response (regardless of station type)
211	0x00D3	Control block incorrectly formatted
213	0x00D5	Incorrect address for the local data table
231	0xF001	Processor incorrectly converted the address
232	0xF002	Incomplete address
233	0xF003	Incorrect address
236	0xF006	Addressed file does not exist in target processor
237	0xF007	Destination file is too small for number of words requested

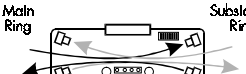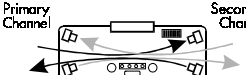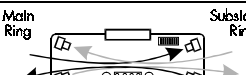| Error Codes | | Description |
Group A	Group B	
240	0xF00A	Target processor cannot put requested information in packets
241	0xF00B	Privilege error, access denied
242	0xF00C	Requested function not available
243	0xF00D	Request is redundant
247	0xF011	Data type requested does not match data available
248	0xF012	Incorrect command parameters

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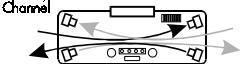
Module Model Number	L5206-2-01
Module Name	Gateway Repeater Module
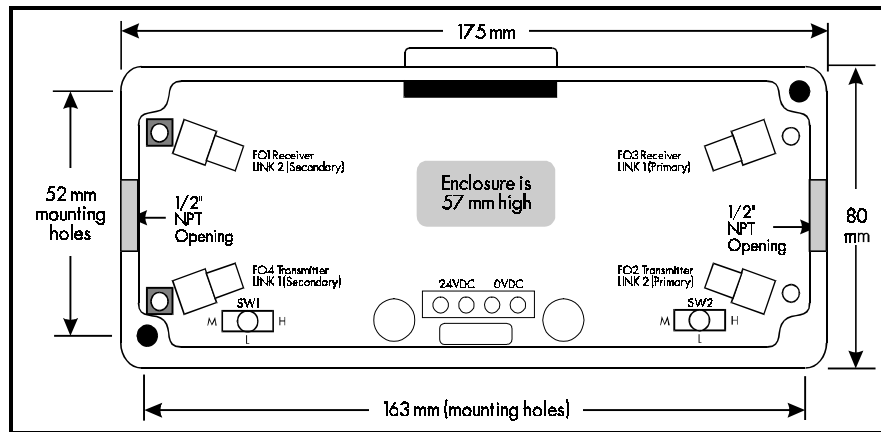
Refer to the *LINK* Overview manual (HA350678) for general information on this module.

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 LINK5204, LINK5210 or LINK5211 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-DHP gateway, the L5206-2-01 is connected to implement the desired *LINK* network topology. The connections are show 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 I   LINK GATEWAY CABLE

In 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 below:

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 *LINK* Card in the gateway and the 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.
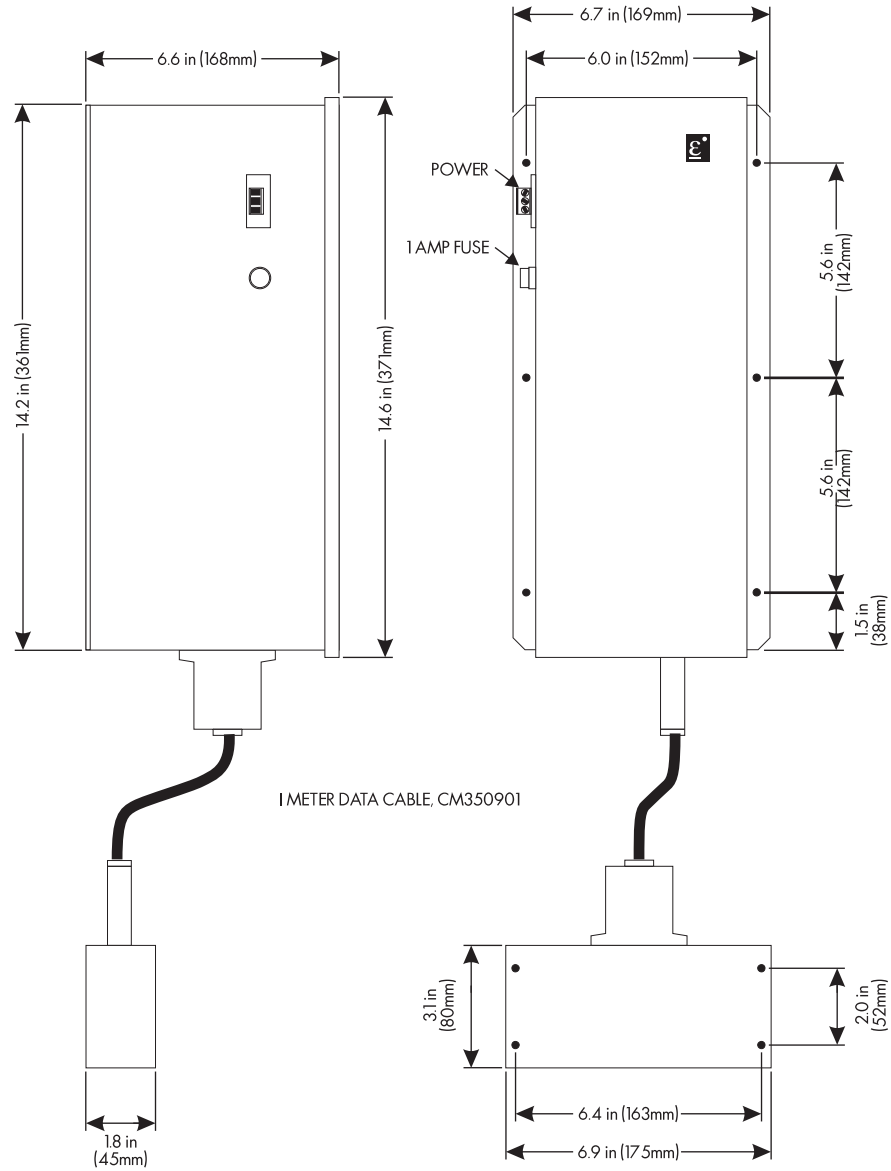

CM350901 Pinout
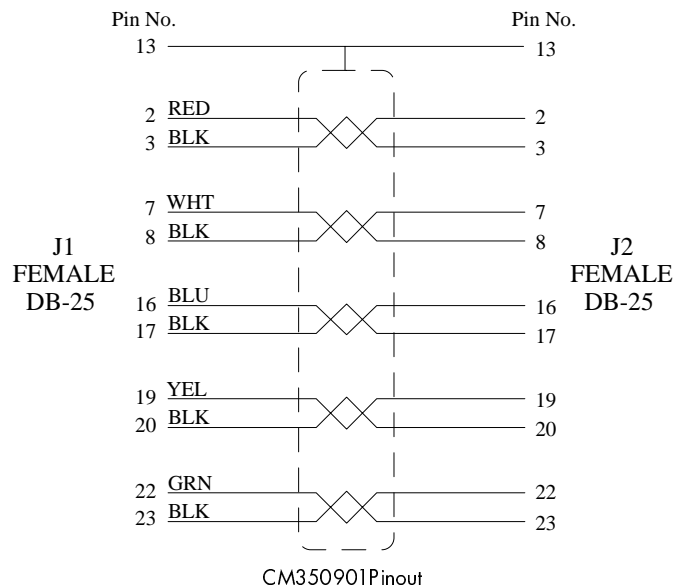
Location of the pins in the DB-25 connector are typically marked on the connector per the layout depicted below:

13 ─   ─ 1

25 ─   ─ 14
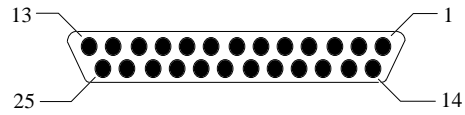
End View of DB-25 Connector

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 J DIMENSIONS

6.6 in (168mm)

14.2 in (361mm)

14.6 in (371mm)

6.7 in (169mm)

6.0 in (152mm)

POWER

1 AMP FUSE

5.6 in (142mm)

5.6 in (142mm)

1.5 in (38mm)

l METER DATA CABLE, CM350901

1.8 in (45mm)

3.1 in (80mm)

2.0 in (52mm)

6.4 in (163mm)

6.9 in (175mm)

Appendix K REFERENCES

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