

HIB-IP
Remote Network Interface
MCN
Monitoring and Control Network

Hardware Reference Manual
S2-61173-110



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Revision History

S2-61173-100	Initial Release
S2-61173-105	Added definitions for flashing error codes
S2-61173-106	Added reference to “NVs” for test operation of Option Switch 3 Corrected Table D2 reference to Option Switch 3
S2-61173-110	Removed references to AUI Connector on rear panel

1. INTRODUCTION

WHAT IS A HIB-IP?

The HIB-IP module is a remote network interface for an MCN (Monitoring & Control Network) system. It is used with the MCNRCD (MCN Remote Comparator Display) software in a PC. The HIB-IP connects to the MCN network on one side and to a PC via an Ethernet connection.

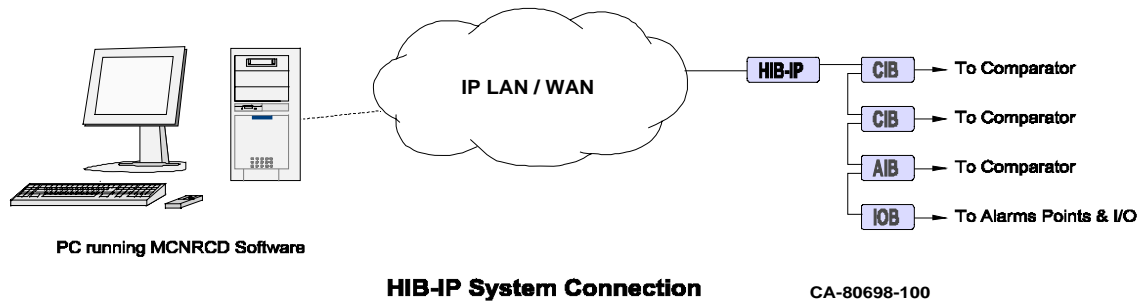


Figure 1 MCN System with HIB-IP

Software compatibility:

MCNRCD (Windows) Version 2.00 & up	Can connect to 1 HIB-IP unit
MCNRCD Server Version 2.00 & Up	Can connect to multiple HIB-IP units (Depending upon the Server license.)

Available Models

The HIB-IP module is identified by the model number found on the rear panel of the module. The table below shows the model numbers and the type of EXB it represents.

Model Number	(WAN Media)	MCN Network Transceiver
S2-61151	HIB-IP (10Base-T)	78 Kbps

HIB-IP versus EXB-IP

The HIB-IP is housed in a module similar to the EXB-IP. Although both connect to an MCN network and an Ethernet network, there are some differences:

- EXB-IP modules are used in pairs to link distant MCN networks together over IP.
HIB-IP modules are used to connect a PC to a remote MCN Network over IP.
- The PC requires an MCN Network Interface to connect to the MCN Network.
If EXBs are used, the PC still needs an MCN network interface (such as a PCLTA or HIB-232 to connect to the MCN
- Multiple PCs (each with its own MCN Network Interface) can connect to a local network served by EXBs.

Only one PC can connect to a HIB-IP unit at a time.

REFERENCE DOCUMENTS

The following additional information is available.

Part Number	Document
S2-60425	Monitoring and Control Network Comparator Display System Manual
S2-60426	CIB Comparator Interface Manual
S2-61043	MCNRCD for Windows Manual
S2-61170	MCN Server Software Manual

FRONT PANEL

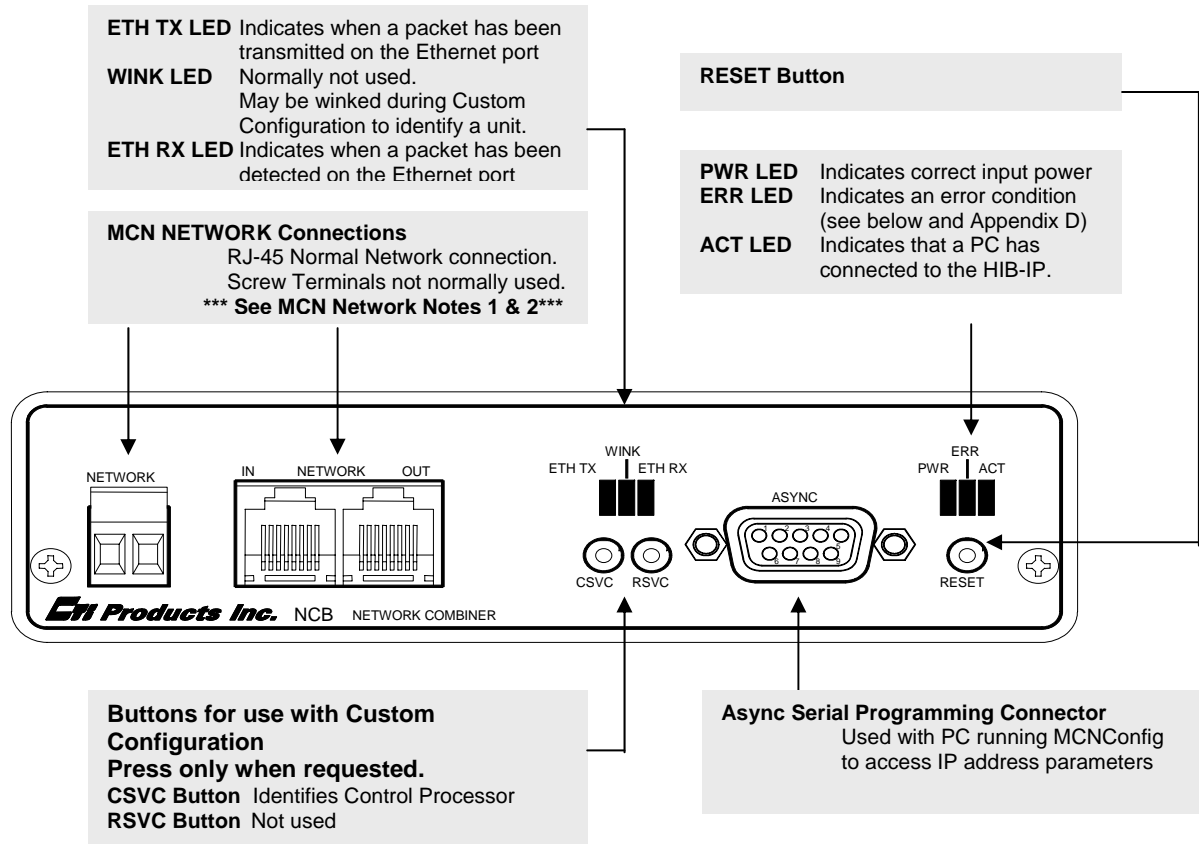


Figure 2 HIB-IP Front Panel

MCN Network Note 1

Unlike most other MCN modules, the HIB-IP does not inject power into the Network Out connector. It also does not use any DC power from the Network In connector. All 8 pins on the Network In & Out connectors are paralleled, so that any power from other modules will be passed through.

MCN Network Note 2

Although the MCN Network connectors are RJ-45s, THEY ARE NOT ETHERNET CONNECTORS. Because the MCN network connectors on the front of the units may have DC power on them from other MCN devices, DO NOT CONNECT THE NETWORK IN OR OUT CONNECTORS TO ETHERNET PORTS. THIS CAN DAMAGE THE ETHERNET DEVICE. The Ethernet cable should be connected to the 10BASE-T connector on the rear of the HIB-IP unit.

Front Panel Indicators – Additional Information

ETH RX LED (Yellow) – Indicates when a packet has been detected on the Ethernet port. NOTE: Flashing of this LED does NOT necessarily mean that a packet addressed to this EXB module has been received, just that a packet has been detected on the Ethernet network.

ERR LED (Red) – Indicates a possible error condition. See Table D2 in Appendix D for a list of Error Code definitions.

REAR PANEL

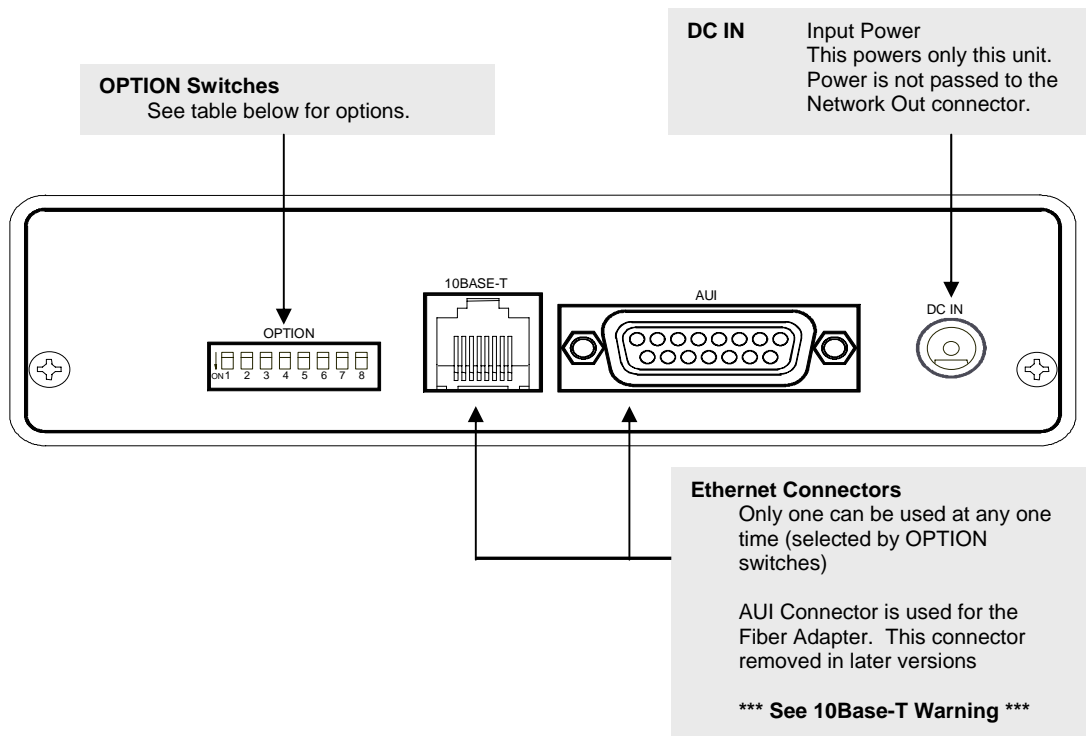


Figure 3 HIB-IP Rear Panel

10Base-T Warning
Do not connect the 10Base-T connector to an MCN Network connector. Damage could result.

Switch Settings

Function	Up	Down	Default
1. Flash Load	Operate	Flash Load	Up
2. HTTP Enable	HTTP On	HTTP Page Off	Up
3. Factory Test	Factory Test (& NVs)	Operate	Down
4. Not Used			Up
5. Not Used			Up
6. Not Used			Up
7. >			
8. > Ethernet Connector			

Mode	Switch: 7	8
10BaseT (Default)	Up	Up
AUI (Not available on later versions)	Down	Down

2. IP ADDRESS CONFIGURATION

This section describes the IP address parameters that must be set for the HIB-IP unit.

NOTE: *DO NOT connect the HIB-IP module to a live IP network until it has been reconfigured with new IP addresses. Network-wide problems could arise from connecting devices to a network without coordination of addressing information. For usage with dedicated fiber segments, see the note below.*

The IP address parameters are downloaded into the units using the MCNConfig software that comes with the MCNRCD or MCNRCD Server software through the front panel programming connector.

The MCNConfig software will keep track of all HIB-IP units for a particular system. If you are running the standard MCNRCD software, you will be able to use (1) HIB-IP. If you are running the MCNRCD Server software, you may be able to access multiple HIB-IP units, depending upon your license.

The MCNConfig program maintains a list of:

- Addressing parameters for all HIB-IP units in the system (including the MCN Group & Module)
- Authorized PC List

Each HIB-IP unit will be configured with:

- Its own HIB-IP addressing information
- Authorized PC information

Appendix F of this manual provides an overview of IP addressing concepts.

IP SETTINGS WORKSHEET

Gather the following IP information for the system. IP information must be obtained *for each HIB-IP module to be used* (from the network administrator responsible for the IP network to which the HIB-IP module will be attached):

System-Wide Parameters (for all HIB-IP Units)

Channel Name	
Global Subnet Mask	_____._____._____._____

Individual HIB-IP Parameters:

For each HIB-IP in the system, gather the following information:

<i>HIB-IP Number</i>	
<i>Name</i>	
<i>HIB-IP Address (Host IP Address)</i>	_____._____._____._____
<i>Subnet Mask</i>	_____._____._____._____ or ____ Use Global
<i>Gateway IP Address</i>	_____._____._____._____
<i>MCN Group (00-FE)</i>	
<i>MCN Module Number (00-7F)</i>	

Note: the Subnet Mask cannot be less restrictive than the following standard IP Class Subnet Masks

Class	First Octet	Standard Subnet Size	Standard Subnet Mask
A	1-127	16,777,214	255.0.0.0
B	128-191	65,543	255.255.0.0
C	192-223	253	255.255.255.0
D	224-239	Multicast – Do not use.	
E	240-255	Experimental – Do not use.	

The HIB-IP units can accept a subnet mask that is more restrictive (more 1's set in the Subnet Mask), but not less restrictive.

The Gateway address is the address of the router used to communicate with PCs in other subnets. The Gateway subnet must be the same as the HIB-IP unit's subnet. If it is set to Empty, the HIB-IP will not be able to communicate to PCs outside of its subnet.

Authorized PCs:

For each PC in the system that will connect to the HIB-IP, collect the following information:

<i>PC Name</i>	
<i>PC IP Address (Host IP Address)</i>	_____._____._____._____

See the MCNRCD Server Software manual for instructions on:

- Entering this data into the database
- Downloading the configuration data into the HIB-IP units.


The configuration is downloaded from the PC to the HIB-IP unit using a serial cable.

3. INSTALLATION

PHYSICALLY INSTALL HIB-IP UNIT ONTO THE IP NETWORK

A) Set Option Switches:

- Set up the OPTION switches for the desired operation.

	Function 1. Flash Load 2. HTTP Enable 3. Factory Test 4. Not Used 5. Not Used 6. Not Used 7. > 8. > Ethernet Connector	Up Operate HTTP On Factory Test	Down Flash Load HTTP Page Off Operate	Default Up Up Down Up Up Up												
				<table border="1"> <tr> <td>Mode</td> <td>Switch:</td> <td>7</td> <td>8</td> </tr> <tr> <td>10BaseT (Default)</td> <td></td> <td>Up</td> <td>Up</td> </tr> <tr> <td>AUI (Not available on later versions)</td> <td></td> <td>Down</td> <td>Down</td> </tr> </table>	Mode	Switch:	7	8	10BaseT (Default)		Up	Up	AUI (Not available on later versions)		Down	Down
Mode	Switch:	7	8													
10BaseT (Default)		Up	Up													
AUI (Not available on later versions)		Down	Down													

The default settings should be suitable for most applications.

Additional security:

For applications that require additional security on the IP network, set Switch 2 Down to disable the HTTP status page.

B) Mount the EXB units (See Appendix B for Mounting Option details):

Desk, Wall, or Rack Mounting

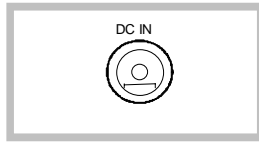
- Non-slip rubber feet are included on all EXB modules to allow them to conveniently rest on any horizontal surface. Four 6-32 threaded holes are also available on the bottom of the module to allow bolting of the module in any convenient orientation. **WARNING: Care should be taken to limit protrusion of the screw into the module to no more than 0.125 inch from the module bottom surface!**
- Mounting kits are available as options to allow wall or rack (19" EIA) mounting of the EXB modules.

C) Make electrical connections (See Appendix C for connector details):

Grounding

- When wall or rack mounting the EXB, a suitable safety and protective earth ground should be provided to the metal enclosure. The protective earth ground provides a path to ground for electrostatic discharge (ESD) energy. This connection is most conveniently made directly to the wall mount bracket or rack plate.

DC Power Connection

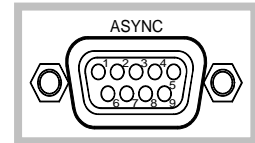


DC power must be attached to the EXB module via the **DC IN** connector. A wall plug-in style power supply designed for the EXB module is an available option.

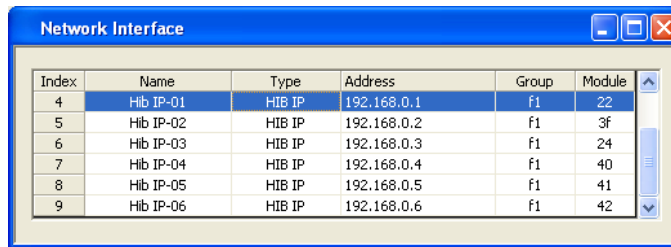
C) Program IP Parameters:

The IP parameters are downloaded from the PC to the HIB-IP unit using a serial cable.

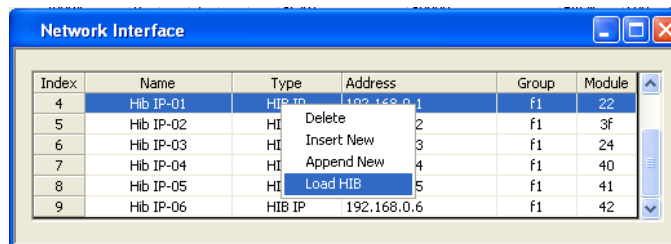
1. Be sure all the HIB-IP and Authorized PC parameters have been entered into the PC database as described in Section: 2. IP Address Configuration.
2. Connect a Null Modem cable (CTI # 89-11314) between the PC and the Async Serial Programming connector on the HIB-IP.



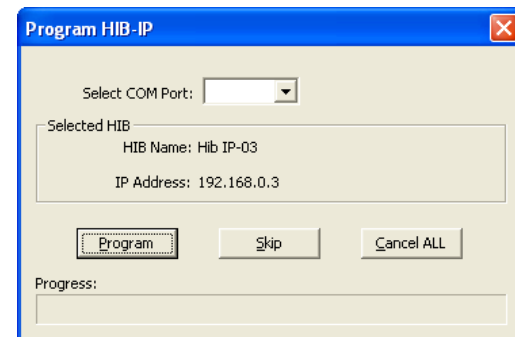
3. Load the IP parameters to the HIB-IP using the MCNConfig program:
 - a. Go to the Network Interfaces window and select the proper HIB-IP unit.



- b. Right-click on the HIB-IP unit and select "Load HIB" from the pop-up window.

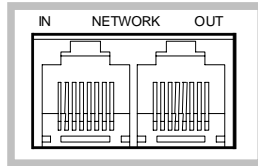


- d. Select the proper COM port and hit "Program".

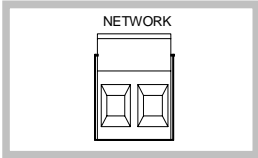


D) Connect to the MCN & IP networks:**MCN Network Connection**

- The local MCN network must be attached to the HIB-IP module via the “NETWORK” connector following standard guidelines as to cable type, cable length, and termination appropriate for the selected transceiver.



The dual RJ45 **NETWORK** connector allows a daisy-chained network connection method, as the network pins of the two RJ45 connectors are directly paralleled. The HIB-IP unit does not inject DC power on the network cable. It does not use any DC power from the cable.

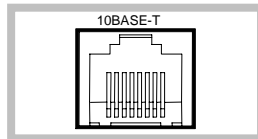


The 2 pin removable terminal strip is wired in parallel with the network connections on the dual RJ45 connector. This connector is normally not used.

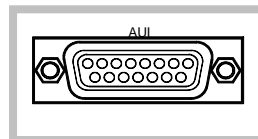
Ethernet Connection

- The Ethernet network must be attached to the HIB-IP module via one of the Ethernet connectors. Be sure to set the OPTION switch positions 7 and 8 as shown in *Step 6A* to match the type of Ethernet physical media being used.

WARNING: DO NOT connect the HIB-IP module to a live Ethernet network until it has been reconfigured with its IP parameters. Network-wide problems could arise from connecting devices to a network without coordination of addressing information.



The **10BaseT** port utilizes a standard RJ45 connector. Level 5 unshielded twisted pair cable should be used between the HIB-IP module and the hub. The length of this cable should be less than 100 meters (328 feet).



The **AUI** port accepts standard Ethernet MAUs (Media Attachment Units) for 10Base-FL (fiber). This connector has been removed on later versions.

E. Run the MCNRCD program or the MCN Server program:

The installation of the EXB units is now complete.

4. TESTING

HTTP STATUS PAGE

The HIB-IP unit contains an HTTP status page.

Connect your PC to the HIB-IP via a LAN and enter the IP address of the HIB-IP in the address window: Option Switch 2 must be Up for this page to be active.



The Status Page lists the current configuration for the HIB-IP unit. Obviously, if its own IP parameters are set wrong, you won't be able to see the Status Page.

Additional System Security

1. You can disable the Status Page by setting Option Switch 2 Down. (Remember to reset the unit after changing switch settings.)
2. The Authorized PCs restricts the use of MCNRCD or MCN Server PCs. It does not restrict Pings or the ability to access the HTTP page.
3. You can further restrict the HIB-IPs ability to talk to units outside its own subnet by setting its Gateway address to "0.0.0.0". For this case, the status page will display "EMPTY" for the Gateway address as shown above.

USING THE "PING" FUNCTION

The "Ping" function can be used as a diagnostic tool to determine if a particular IP address can be "seen" by a PC. The HIB-IP will respond to IGMP Ping messages from the IP network.

APPENDIX

APPENDIX A. FACTORY DEFAULT CONFIGURATION

Control Processor

Restoring Factory Default Communication Parameters

If the Control Processor or router module communication parameters are overwritten by a network management tool, they can be restored as follows:

- Press the “RESET” button on the front of the EXB unit
- After the “ERR” LED goes off, press the “RESET” button a second time.

The Control Processor communication parameters are now restored to factory defaults.

IP Address Parameters

The units are factory programmed as follows:

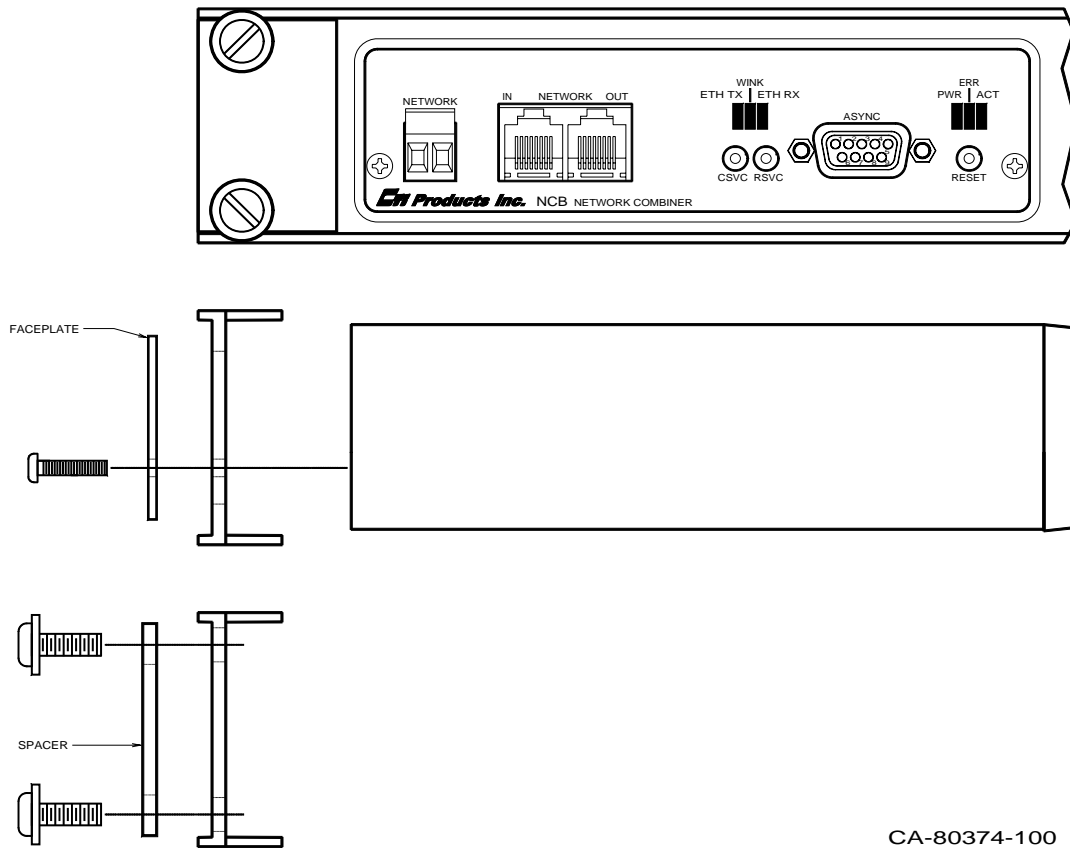
- IP Address: 192.1.1.1
- IP Address Mode: Unicast
- Subnet Mask: 255.255.255.0
- PC IIP Address 192.1.1.201

APPENDIX B. MOUNTING OPTIONS

Wall mount and EIA 19" rack mount kits are available as options for the HIB-IP units from CTI Products, Inc. The wall mount kit includes brackets to allow a single HIB-IP module to be mounted to any flat surface. The rack mount kit includes an adapter allowing up to three HIB-IP modules to be mounted in a single rack unit height.

Rack Mount Option

The rack mount option allows up to three EXB modules to be mounted in a one rack unit height (1.75 inches) of a standard 19 inch rack. The modules are mounted in the rack plate by removing its' front bezel and remounting the module into the rack plate. Figure 4 shows an exploded view of the rack mount installation. The top diagram shows the front view of the bracket with one module installed. The bottom two diagrams show a side view of the module installation into the rack adapter and rack adapter installation into the rack, respectively.



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Figure 4 HIB-IP Module Rack Mounting

To attach a module to the rack adapter, and then mount the rack adapter into the rack, follow the steps below.

WARNING

Do not allow the PC board to slide out of the housing when the front panel is removed. If it does, **DO NOT** slide the PC board back into the housing from the front of the module. Doing so may damage the unit, causing the unit to malfunction when powered on. Doing so will void the unit's warranty. Return the PC board to the housing by sliding it only from the rear. (See instructions below.)

Rack Mounting Instructions

Step	Operation
1	Remove the front panel from the module, including the bezel, by removing the two Philips head screws in the faceplate. The bezel is not used when rack mounting the module.
2	Position the module behind the rack adapter, lining up the holes in the rack adapter with the front panel screw holes on the module.
3	Position the front panel in front of the rack adapter, lining up the front panel with the module.
4	Fasten the front panel and module to the rack adapter with the Philips head screws that were previously removed.
5	Position the rack adapter into your rack, lining up the four mounting holes of the rack adapter with mounting holes in the rack frame.
6	Position the two spacers in the front of the rack adapter, aligning the cutouts in the spacers with the holes of the adapter.
7	Install mounting screws (customer provided) into the rack.

When the module's front panel is removed, do not allow the PC board to slide out of the housing. If the PC board does slide out of the housing, you must follow the steps below to replace the PC board in the housing. **DO NOT RE-INSTALL THE PC BOARD FROM THE FRONT OF THE HOUSING !**

Re-Installing a PC Board in its housing

Step	Operation
1	From the front of the module, slide the PC board out of the housing.
2	Remove the back panel of the module.
3	Attach either bezel and front panel or rack kit and front panel to the housing with two Philips head screws.
3	From the rear of the module, slide the PC board back into the housing (there are markings on the PC board to indicate which edge to insert into the rear of the housing first).
4	Attach bezel and rear panel to the housing with two Philips head screws.

Wall Mount Option

The wall mount option allows an HIB-IP module to be mounted to any flat surface. The HIB-IP module has four screw holes on the bottom. Simply attach the two mounting plates to the bottom of the module using the four flat-head screws provided with the wall mount kit. This assembly is then attached to the flat surface with user-provided fasteners. Figure 5 shows a dimensioned view of the wall mount installation.

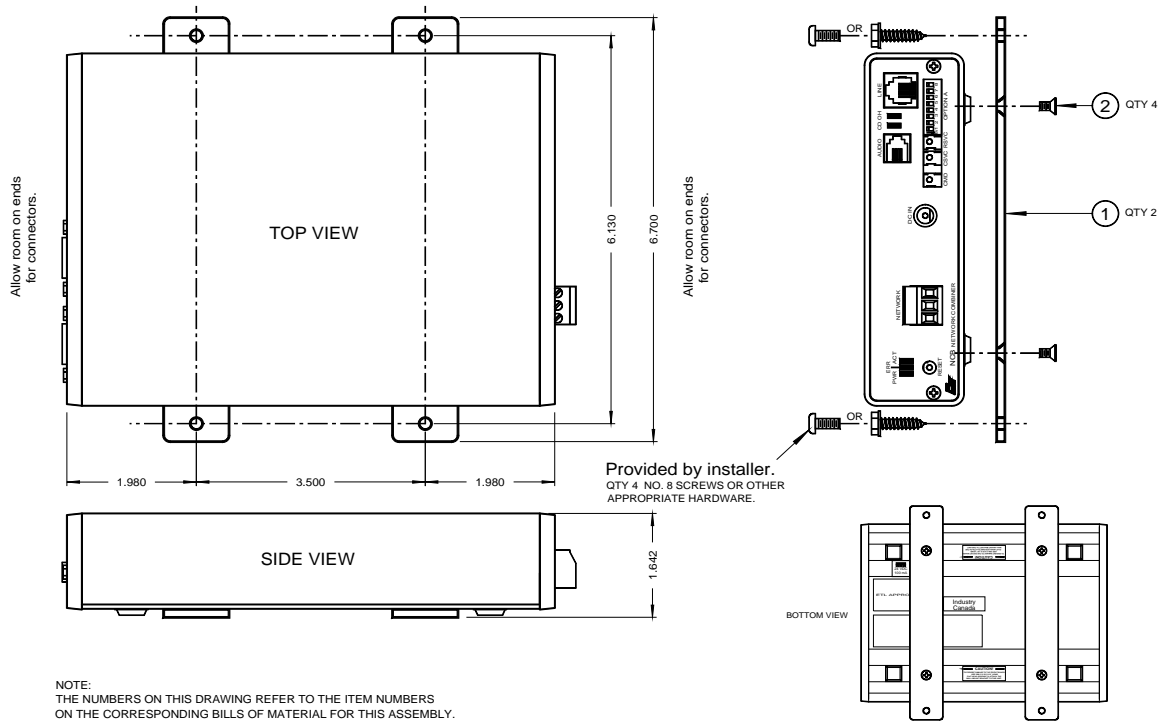


Figure 5 HIB-IP Module Wall Mounting

CAUTION

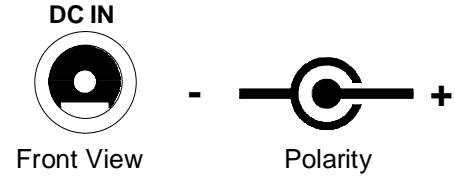
Be sure to use the flat head screws provided with the wall mount kit. If you are not using the wall mount kit from CTI Products, Inc., make sure that the screws do not protrude into the enclosure more than 0.125 inches from the bottom surface of the module.

Using a longer screw that touches the PC board inside the module may damage the module. Doing so will void the unit's warranty.

APPENDIX C. CONNECTOR DETAILS

DC IN Connector

Connector type: 2.5 x 5.5 mm coaxial
 Mating Connector: Switchcraft 760 or equivalent
 Connector pinout: CTI Products, Inc. standard power supply is wired with center pin positive, HIB-IP module can accept either pin positive, polarity routing is provided internal.

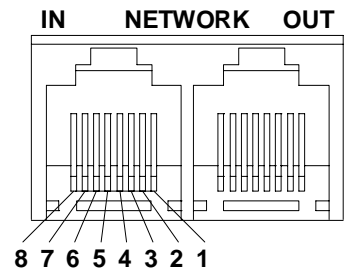


NETWORK Connectors

RJ45 Connectors:

Pins 1 and 2 of both RJ45 connectors as well as the screw-terminal connector are all wired in parallel.

Connector Type: Standard RJ45 telephone connector, 8 position 8 contact.



Pin	Function	Notes
1	Network	Network connection is NOT polarity sensitive
2	Network	Pins 1,2 of IN and OUT connectors tied parallel
3	No Connection Note 1	Pin 3 of IN and OUT connectors tied together
4	No Connection	Pin 4 of IN and OUT connectors tied together
5	No Connection	Pin 5 of IN and OUT connectors tied together
6	No Connection Note 2	Pin 6 of IN and OUT connectors tied together
7	No Connection Note 2	Pin 7 of IN and OUT connectors tied together
8	No Connection Note 1	Pin 8 of IN and OUT connectors tied together

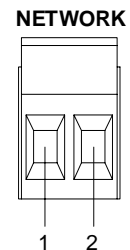
Note 1: May have + DC power on this pin from other MCN modules.

Note 2: May have - DC power on this pin from other MCN modules.

2-Position Screw-Terminal:

Mating Connector: Weidmueller 128176

Pin	Function
1	Network
2	Network



Ethernet Connectors

10BaseT Connector:

Connector type: Standard RJ45 female.

Note: in	Function
1	Ethernet TX
2	Ethernet TX
3	Ethernet RX
4	N/C
5	N/C
6	Ethernet RX
7	N/C
8	N/C

AUI Connector:

Note: This connector removed on later versions

Connector type: Standard D-Subminiature 15 pin female.

Pin	Function
1	Chassis Ground
2	Collision
3	Ethernet TX
4	Chassis Ground
5	Ethernet RX
6	Signal Ground
7	N/C
8	N/C
9	Collision
10	Ethernet TX
11	Chassis Ground
12	Ethernet RX
13	+12V
14	Chassis Ground
15	N/C

ASync Serial Programming Connector

When this port is connected to a PC's serial port, the MCNConfig program can be used to configure the IP address parameters.

Connector type: Standard D-Subminiature 9 pin male. DTE (Like IBM PC 9 pin)
Null Modem cable (CTI # 89-11314) required for connection to PC.

Pin	Function
1	Data Carrier Detect
2	RX
3	TX
4	Data Terminal Ready
5	Signal Ground
6	Data Set Ready
7	Clear to Send
8	Request to Send
9	N/C

APPENDIX D. TROUBLESHOOTING

Table D1

If the PWR LED . . .	REASON	CORRECTIVE ACTION
Steadily illuminates	Normal operation indicating that HIB-IP unit is receiving proper DC input power.	Go to next Table.
Occasionally illuminates	Loading of HIB-IB is excessive for the power supply	Check that power supply can deliver 5 watts at 10-32VDC.
Does not illuminate	EXB unit is not receiving DC input power.	Check for proper voltage at “DC IN” connector (10-32VDC).

Table D2

If the ERR LED . . .	REASON	CORRECTIVE ACTION
Does not illuminate	Normal operation indicating no error condition was detected.	Go to next Table.
Occasionally flashes on, then off.	Normal operation when “CSVC” button is pressed.	Go to next Table.
Flashes one time, & repeats	EE Read Fail	Return to CTI Products for repair
Flashes 2 times, & repeats	EE MAC Image Read Fail	Return to CTI Products for repair
Flashes 3 times, & repeats	Target not configured	Configure IP parameters in MCN Config Program, then “Load HIB” through serial port. (See Section “2. IP Address Configuration” on Page 9, and see MCNRCD Software Manual)
Flashes 4 times, & repeats	Host not configured	Configure IP parameters in MCN Config Program, then “Load HIB” through serial port. (See Section “2. IP Address Configuration” on Page 9, and see MCNRCD Software Manual)
Flashes 6 times, & repeats	One of the following is set to 0: Host IP Address Host IP Mask IP Mode	Configure IP parameters in MCN Config Program, then “Load HIB” through serial port. (See Section “2. IP Address Configuration” on Page 9, and see MCNRCD Software Manual)
Flashes 7 times, & repeats	No Authorized PC List	Configure IP parameters in MCN Config Program, then “Load HIB” through serial port. (See Section “2. IP Address Configuration” on Page 9, and see MCNRCD Software Manual)
Flashes 8 times, & repeats	Multicast IP Address Error: Multicast mode is selected, but Multicast Address = 0.0.0.0	Configure IP parameters in MCN Config Program, then “Load HIB” through serial port. (See Section “2. IP Address Configuration” on Page 9, and see MCNRCD Software Manual)
Flashes 10 times, & repeats	Factory Test Mode: Option Switch 3 is UP	Place in Operating Mode by placing Option Switch 3 DOWN, then Reset the unit.
Is steadily illuminated.	Unit not functioning.	Return to CTI Products for repair

Table D3

If the ETH TX LED . . .	REASON	CORRECTIVE ACTION
Occasionally flashes on, then off.	Normal operation indicating a message packet has been transmitted from the Ethernet port.	Go to next Table.
Never illuminates	IP messages are being transmitted from the HIP-IP	Check the integrity of the IP network and cabling.

Table D4

If the ETH RX LED . . .	REASON	CORRECTIVE ACTION
Occasionally flashes on, then off.	Normal operation indicating a message packet has been detected on the IP network.	Go to next Table.
Never illuminates	IP messages are not being received by the HIP-IP	Check the integrity of the IP network and cabling.

Table D5

If the ACT LED . . .	REASON	CORRECTIVE ACTION
Is steadily illuminated	Normal operation indicating a PC running MCNRCD or MCN Server software is connected to the HIB-IP	None.
Never illuminates	<ol style="list-style-type: none"> 1. PC not running MCNRCD or MCN Server Software 2. PC not configured to access HIB-IP 3. No IP connection between PC & HIB-IP 4. HIB-IP IP parameters wrong or PC not in Authorized PC list. 5. Ethernet port not enabled 	<ol style="list-style-type: none"> 1. Start the software 2. Use MCNConfig to Re-configure PC to access HIB-IP. Restart the MCNRCD or MCN Server software. 3. Check IP cabling. Try to Ping HIB-IP from PC Check PC's IP address Check ETH RX LED for activity Check the Status Page 4. Re-load the IP parameters & Authorized PC list in the HIB-IP 5. Check Option Switch settings: 10BaseT (Default), 7 & 8 UP AUI (Fiber), 7 & 8 DOWN (Reset unit after changing switch settings)

Table D6

Web Page not available . .	REASON	CORRECTIVE ACTION
If the Web page cannot be accessed	HTTP option is disabled	Place Option Switch 2 UP, then Reset the unit.

To request RMA for return of product to CTI Products, call Customer Support at +1-513-595-5900

APPENDIX E. SPECIFICATIONS

HIB-IP

<i>DC Power Input:</i>	10 to 32 VDC, unregulated (10BaseT) 15 to 32 VDC unregulated (AUI - Fiber) 5 watts maximum
<i>Size:</i>	7.5" D x 5.6" W x 1.6" H
<i>Operating Temperature:</i>	0 to 60 °C
<i>Humidity:</i>	10-95% non-condensing
<i>Mounting:</i>	Desktop with integral non-slip feet Wall mount or 19" rack mount with optional adapters
<i>Configuration:</i>	
<i>Ethernet IP Parameters</i>	Using MCNConfig program supplied with MCNRCD software.
<i>Transceivers Supported:</i>	
<i>MCN</i>	78K
<i>Ethernet</i>	10Base-T
<i>IP Addressing Modes:</i>	Unicast
<i>IP Transport:</i>	UDP
<i>Status Page</i>	HTTP (may be disabled)
<i>IP Ports:</i>	1100 (destination) and 1283 (source).
<i>Operating System:</i>	Proprietary (Non-Windows, Non-Linux, Non-Unix)

APPENDIX F. IP ADDRESSING

Conventions

Any node connected to an IP (Internet Protocol) network must be identified with a unique 32-bit address. These 32-bit addresses are commonly written *in dotted decimal* notation as four decimal numbers (referred to as octets because each decimal number represents 8 bits) separated by decimal points. Each octet can be a number from 1 to 255. For example, 131.9.1.2 is a valid IP address. The IP address assigned to a network device is commonly called the *Host IP Address*. By having unique addresses on a network, individual stations (also called hosts or nodes) can be identified on the network.

IP Address Classes

There are five types of IP addresses. Three are associated with networks – Class A, B, and C.

- **Class A** addresses are for networks that have a large number of hosts, up to a maximum of 16,777,214 on a single IP network. The first octet is between 1 and 126. (127 is reserved for loopback and is used for internal testing on the local machine.)
- **Class B** addresses are for medium-sized networks. The first octet is between 128 and 191.
- **Class C** addresses are for small networks, up to 255 hosts. The first octet is between 192 and 223.
- **Class D** addresses are reserved for multicasting and the first octet is between 224 and 239.
- **Class E** addresses (240 to 255) are reserved and should not be used.

An IP address consists of two parts – one part identifies the network, and one part identifies the host (or node). The NetID portion of the IP address identifies the physical network segment. The HostID portion of the IP address identifies the node within the network segment. The following table lists the capacities of each IP address and the bits used as NetID and HostID.

IP Class	Net ID (Beginning Bits)	# of Networks	Host ID (Ending Bits)	# of Hosts or Subnets	1 st byte Range
A	8	126	24	16.7 million	1-126
B	16	16,000	16	65,000	128-191
C	24	2 million	8	254	192-293

Subnetting using Subnet Masks

A portion of the host bits can be used to “subnet the network”. The subnet mask identifies the “NetID” and “HostID” portions of the IP address in a bitwise fashion. The mask is constructed by placing a “1” in any bit that is part of a subnetwork address. So subnet mask bits that are SET define the NetID, and CLEARED subnet mask bits define the HostID.

A subnet mask of 255.255.255.0 defines the NetID as the first three octets, and the HostID as the last octet. For example, for the address 192.47.73.111 and the subnet mask of 255.255.255.0, the subnetwork can be identified as 192.47.73.0.

Summary of Important Networking Details

- A specific “NetID” can exist on only ONE port of ONE IP router.
- The “NetID” portion of the Host Address and the Gateway Address **MUST BE THE SAME**.
- If a functioning unit is moved to a different location, its Host IP Address and Default Gateway IP Address **MUST BE CHANGED** to match the “NetID” at the new location.

MAC Addresses

Whereas IP uses Logical Addresses to identify a host (node), other protocols use Hardware Addresses called Media Access Control addresses, or MAC addresses. MAC addresses are set at the factory at time of manufacture and cannot be changed. (IP addresses can be changed at any time.) A MAC address consists of six octets, in hexadecimal notation, separated by colons. An example would be: 00:10:EE:00:02:34.

The first three octets in a MAC address identify the manufacturer. In the above example, 00:10:EE identifies CTI Products as the manufacturer of this device. The last three octets are sequentially assigned by the manufacturer to form a type of serial number. In this way, no two devices have the same MAC address.

Address Resolution Protocol (ARP)

Since IP uses Logical Addresses at the OSI Network Layer (Layer 3) and Ethernet uses MAC addresses at the OSI Data Link Layer (Layer 2), Address Resolution Protocol is used whenever IP is used over the Ethernet. ARP is needed to convert an IP address to a MAC address. The client then stores this resolved address for a period of time in its ARP cache. An ARP cache is a lookup table, typically in a router, that will store a quantity of resolved addresses for devices that it must communicate with.

When a message is destined for an IP address whose MAC address has not yet been resolved, an ARP REQUEST is sent from the local host as a broadcast message, asking for MAC identification. A remote host with the IP address in question generates an ARP RESPONSE. This ARP RESPONSE contains the requested MAC address. The local host receives the message, and places the IP Address and the matching MAC Address in its ARP Cache. The original message is then sent using the MAC Address found previously. Any additional messages to this remote IP address will be sent using the MAC address found in the local host's ARP cache.

Ethernet 10BaseT Cables

When connecting two IP devices together, either a straight-through cable or a crossover cable may be required.

If interconnecting similar devices, then a crossover cable is needed. Examples would be interconnecting two EXB routers, or two IP routers, or two hubs, or two computers. Generally, if the two devices are both Layer 3 devices, then a crossover cable is required. Routers operate at Layer 3. Similarly, if the two devices are Layer 1 or 2 devices, they would also require a crossover cable. Bridges, switches, and Network Interface Cards (NIC) operate at Layer 2, and hubs, repeaters, and concentrators operate at Layer 1.

If interconnecting dissimilar devices, then a straight-through cable is needed. Dissimilar devices would involve one Layer 3 device and a Layer 1 or Layer 2 device.

The following table summarizes devices in each layer.

Layer 3	Layer 2	Layer 1
IP Router	Bridge	Hub
EXB Router	Switch	Repeater
	NIC	Concentrator

The following table lists the connections for a straight-through cable.

Standard End				Standard End		
Signal Name	Wire Color	Pin		Pin	Wire Color	Signal Name
TD+	White/Orange	1	↔	1	White/Orange	TD+
TD-	Orange	2	↔	2	Orange	TD-
RD+	White/Green	3	↔	3	White/Green	RD+
Not used	Blue	4	↔	4	Blue	Not used
Not used	White/Blue	5	↔	5	White/Blue	Not used
RD-	Green	6	↔	6	Green	RD-
Not used	White/Brown	7	↔	7	White/Brown	Not used
Not used	Brown	8	↔	8	Brown	Not used

The following table lists the connections for a crossover cable.

Standard End				Crossover End		
Signal Name	Wire Color	Pin		Pin	Wire Color	Signal Name
TD+	White/Orange	1	↔	3	White/Green	RD+
TD-	Orange	2	↔	6	Green	RD-
RD+	White/Green	3	↔	1	White/Orange	TD+
Not used	Blue	4	↔	5	Blue	Not used
Not used	White/Blue	5	↔	4	White/Blue	Not used
RD-	Green	6	↔	2	Orange	TD-
Not used	White/Brown	7	↔	8	White/Brown	Not used
Not used	Brown	8	↔	7	Brown	Not used

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