PCIe-7856

Master-Slave Distributed Motion
and I/O Master Controller

User's Manual

Manual Rev.: 1.0

Revision Date: February 27, 2020

Part No: 50-15113-1000

Leading **EDGE COMPUTING**

Revision History

Revision	Release Date	Description of Change(s)
1.0	2020-02-27	Initial release

Preface

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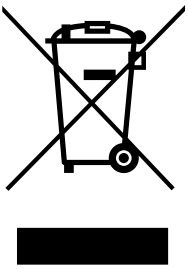

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WARNING: This product can expose you to chemicals including acrylamide, arsenic, benzene, cadmium, Tris(1,3-dichloro-2-propyl)phosphate (TDCPP), 1,4-Dioxane, formaldehyde, lead, DEHP, styrene, DINP, BBP, PVC, and vinyl materials, which are known to the State of California to cause cancer, and acrylamide, benzene, cadmium, lead, mercury, phthalates, toluene, DEHP, DIDP, DnHP, DBP, BBP, PVC, and vinyl materials, which are known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov**.**

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Conventions

Take note of the following conventions used throughout this manual to make sure that users perform certain tasks and instructions properly.

NOTE: Additional information, aids, and tips that help users perform tasks.

CAUTION: Information to prevent ***minor*** physical injury, component damage, data loss, and/or program corruption when trying to complete a task.

WARNING: Information to prevent ***serious*** physical injury, component damage, data loss, and/or program corruption when trying to complete a specific task.

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1 Introduction

As industrial machine automation continues to advance, designers require not only centralized control systems but also distributed solutions to develop more complex machine applications. Distributed solutions provide many benefits such as lower maintenance, reduced wiring, and easy integration of vast numbers of modules. Motionnet (MNET) and High Speed Link (HSL) are innovative distributed motion and I/O technologies that enable time-deterministic scanning of thousands of I/O points within milliseconds using the master-slave architecture. The MNET bus further improves distributed motion control capability by providing control of up to 256 axes plus minimal command execution time for single-axis control.

The PCIe-7856 is a PCI Express interface card with two ports for MNET and HSL systems for distributed motion and I/O modules for a wide variety of machine automation applications.

HSL technology allows thousands of I/O points to be scanned at the millisecond level in real time by means of the master-slave architecture. Commercial Ethernet cables with RJ45 connectors are used for simplified setup of HSL slave modules as close as possible to sensor devices, resulting in dramatic wiring reduction. System integrators can greatly benefit from an HSL network because it integrates discrete I/O and analog I/O modules. This local network features rapid-response, real-time scanning.

An MNET system is a distributed motion solution for machine systems. MNET is an innovative distributed motion technology which provides distributed motion axis control of up to 256 axes for any servo/stepper motor controlled using mater-slave architecture. This not only facilitates general purpose 4-axis motion control, but also allows up to 64 specific single-axis motion control modules to be scanned at the millisecond level in real time.

MNET and HSL features:

- Flexible, comprehensive, extendable distributed motion and I/O solution based on PC architecture or embedded platform.
- Convenient wiring for remote distributed motion and I/O modules, inc. multiple-axis motion control modules, single-axis motion control modules, discrete I/Os, and analog I/Os.
- Saves space, reduces wiring, and lowers costs due to ease of maintenance.
- Fast, time-deterministic scanning with hundreds of discrete I/O points (up to 2,016 points).
- Rapid, real-time scanning to support high-speed and high-response motion control of up to 256 axes.

The PCIe-7856 block diagram is as follows.

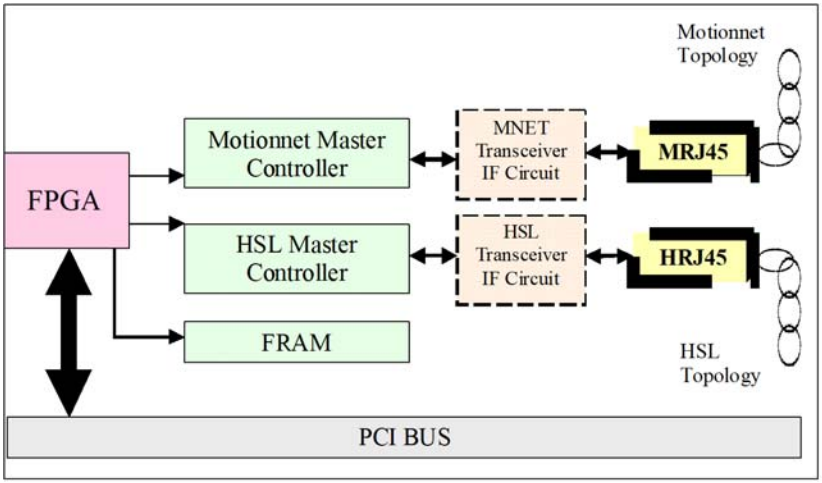


Figure 1-1: PCIe-7856 Block Diagram

1.1 Specifications

PCIe Bus

- PCI Express, Plug and Play

Master Controller

- Dedicated Motion Controller
  - MNET ASIC master control (80 MHz external clock)
- Dedicated I/O Controller
  - HSL ASIC master control (48 MHz external clock)

Interface

- MNET
  - RS-485 with transformer isolation
  - Half-duplex communication
  - 2.5/5/10/20 Mbps transmission rate can be set by software (20 Mbps default)
- HSL
  - RS-485 with transformer isolation
  - Full-duplex communication
  - 3/6/12 Mbps transmission rate can be set by software (6 Mbps default)

Connector

- RJ45 connector x4 (MRJ45 for MNET, HRJ45 for HSL)

Interrupt

- Status read back (functions with slave)
- Timer

LED Indicator

- Link status (red for MNET status, green for HSL status)

Dimensions

- 119.5 mm × 100.2 mm (L × W) (4.66” × 3.9”)

Operating Temperature

- 0°C to 60°C

Storage Temperature

- -20°C to 80°C

Power Consumption

- +3.3 V @ 1.2 A (typical)
- +5 V @ 1.5 A (typical)

Certification

- FCC Part 15 B
- EN 55032 / 55035

1.2 Supported Software

Program Library

ADLINK provides Windows WDM drivers and DLL function libraries for the PCIe-7856. These function libraries are shipped with the board and they support Windows 7/8/10 (32/64-bit).

2 Installation

This chapter describes how to install and set up the PCIe-7856. Please follow these steps:

- Check the product for any sign of defect or damage (use Figure 2-1 on page 6 as a reference).
- Install software drivers (Section 2.3, page 7).
- Understand the I/O signal connections and how to use them (Section 2.4 on page 7).

2.1 Package Contents

In addition to this User's Guide, the package also includes the following item:

- PCIe-7856: Distributed Motion and I/O Master Board x1

If any part of the item is missing or damaged, contact the dealer from whom you purchased the product. Save the shipping materials and carton to ship or store the product in the future.

Signal connections of all I/O's are described later in this chapter. Refer to the contents of this chapter before wiring any cables between the PCIe-7856 and any slave module.

2.2 PCIe-7856 Mechanical Drawing

Dimensions: mm

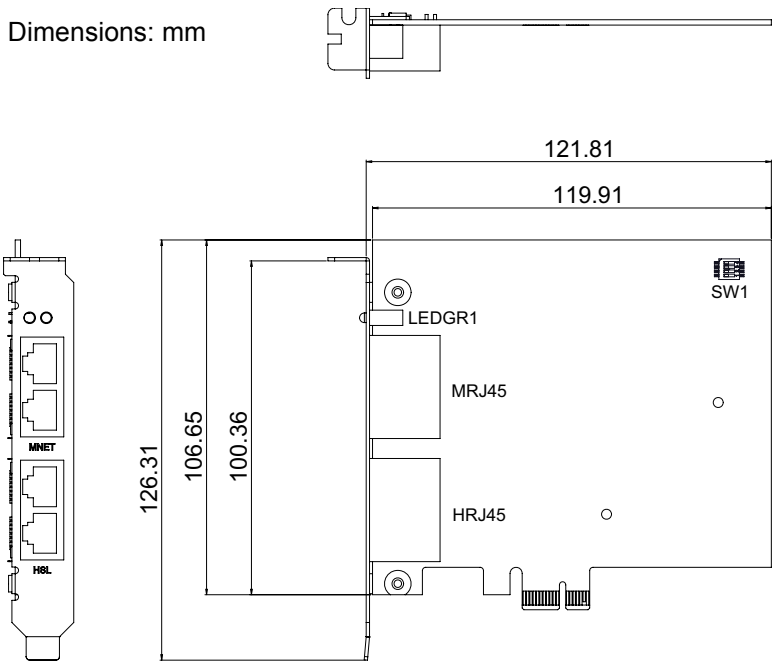


Figure 2-1: PCIe-7856 Mechanical Drawing

- **MRJ45:** MNET connection port
- **HRJ45:** HSL connection port
- **SW1:** Card identification switch
- **LEDGR1:** HSL/Motionnet Scan LEDs

2.3 Driver Installation

Click “Driver” on the product web page to see available drivers: https://www.adlinktech.com/Products/Industrial_Fieldbus/Motionnet/PCI-7856. After downloading an appropriate ZIP file, extract and double-click the enclosed executable to run the installer. Follow the installation steps and, after installation is complete, restart the PC.

2.3.1 Troubleshooting

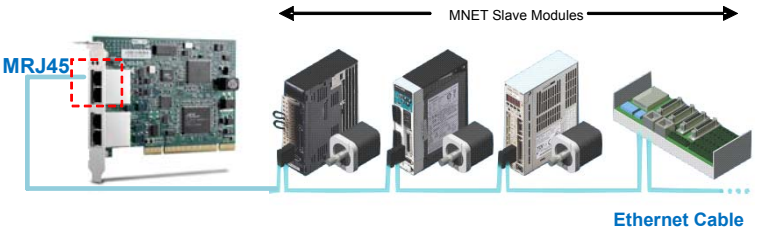
If the system doesn’t boot or if the PCIe board exhibits any erratic behavior, it is most likely caused by an interrupt conflict. After confirming the issue wasn’t caused by a simple oversight, the solution can be found by consulting the BIOS documentation that comes with your system. Check the Windows control panel on the connected PC to see if the card is listed by the system. If not, check the PCIe settings in the BIOS or use another PCIe slot.

2.4 Signal Connections

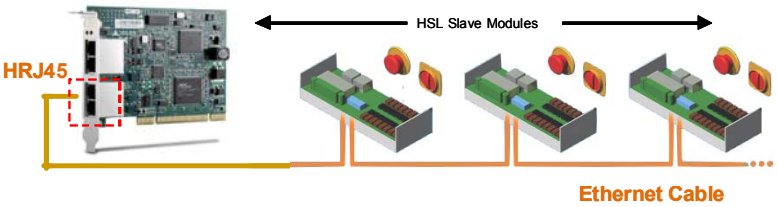
Signal connections of all I/O’s are described in the following two sub-sections. Please review this information before wiring any cables between the PCIe-7856 and slave modules.

2.4.1 Connecting HSL/MNET Slave Modules

Wiring for MNET Motion Slave Modules



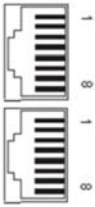
Wiring for HSL I/O Slave Modules



Ethernet Cable (CAT5e Recommended)

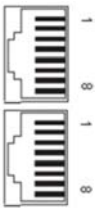
2.4.2 RJ45 Pin Assignments

The Motionnet (MNET) master is the key component in charge of communicating with slave motion modules. The master sends commands to slave motion controllers and obtains motion status from them. The PCIe-7856 provides two MNET master connection ports for greater wiring flexibility. The pin assignments of the MRJ45 connector on the PCIe-7856 are as listed below:



Pin No.	Pinout
1	NC
2	NC
3	NC
4	Data-
5	Data+
6	NC
7	NC
8	NC

The HSL master is the key component in charge of communicating with slave I/O modules. The master sends output values to, and gathers input information from, the slaves. PCIe-7856 provides two ports for HSL master connections for greater wiring flexibility. The pin assignments of the HRJ45 connector on the PCIe-7856 are as follows:



Pin No.	Pinout
1	NC
2	NC
3	RX+
4	TX-
5	TX+
6	RX-
7	NC
8	NC

2.4.3 HSL and Motionnet LED Indicators

The two LEDs on the PCIe-7856 provide communication status information. The red LED indicates MNET status and the green LED indicates HSL status. Before initialization of the PCIe-7856, both LEDs will be off. After initialization, the LEDs will begin blinking at a 1 Hz frequency.

When the PCIe-7856 connects to an HSL slave module, the green LED will turn on and remain constantly on during the scanning process, after which the green LED will continue blinking at 1 Hz.

When the PCIe-7856 connects to an MNET slave module, the red LED will turn on and remain constantly on until the scanning process stops or a communication error occurs, after which the red LED will continue blinking at 1 Hz.

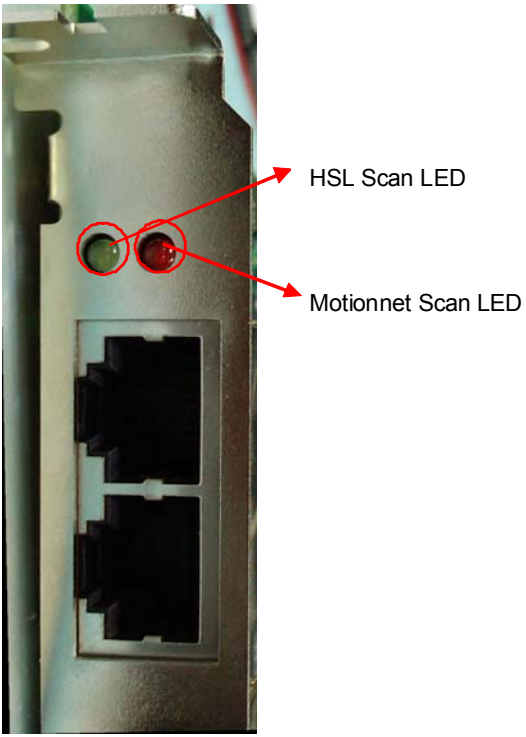
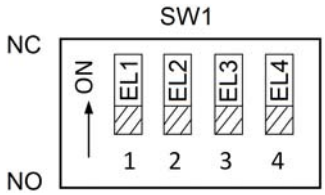


Figure 2-2: LED Indicators on the PCIe-7856

2.5 SW1 Card ID Switch Settings

The card ID can be set via the SW1 DIP switch as follows.



ON = 1
0000 Card ID 0
0001 Card ID 1
0010 Card ID 2
… …
1110 Card ID 14
1111 Card ID 15
OFF = 0

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3 MNET Master-Slave Motion System

Motionnet (MNET) is an ultra-high-speed serial communication system proposed by Nippon Pulse Motor (NPM). It features strong performance with a maximum transfer speed of up to 20Mbps. The PCIe-7856 is equipped with one MNET port offering control of up to 256 axes via serial connections. ADLINK MNET solutions include not only single-axis controllers suitable for multiple PTP (point-to-point) movement applications, but also 4-axis motion controllers with support for linear and circular interpolation functions. Individual devices can control Mitsubishi J3, Panasonic A4, and Yaskawa Sigma series servo drivers. The controller can be used for executing continuous operations at constant speeds, performing linear as well as S-curve acceleration and deceleration, carrying out preset positioning operations, executing zero return operations, and so forth. As for connection distance, the cable length can be extended by up to 100 meters using an ordinary CAT5e LAN cable while connecting 64 axes at 20Mbps. All function library designs are compatible with ADLINK's PCIe motion controllers and MNET bus motion controllers.

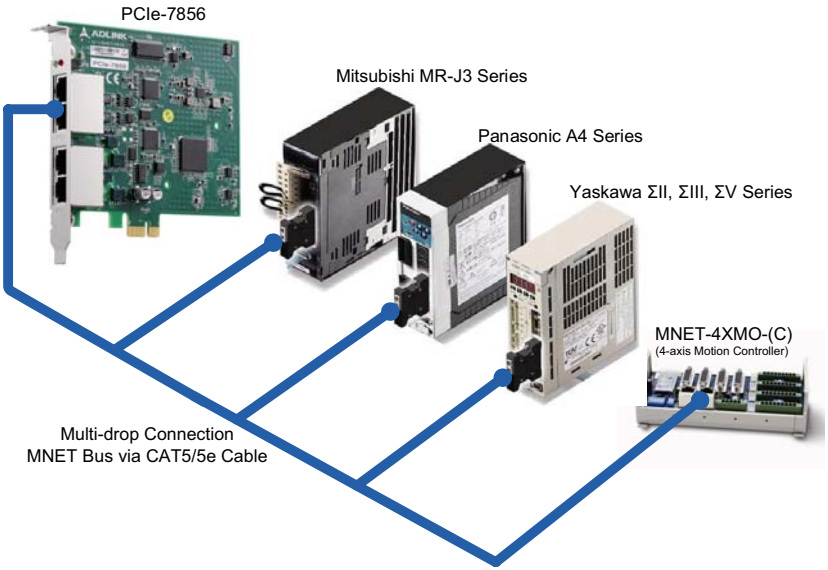


Figure 3-1: MNET Distributed Motion Control System

3.1 MNET System Specifications

The two major functions of a Motionnet (MNET) system are serial communication and motion control.

Item	Specifications
Total serial communication line length (using recommended cables)	▶ Maximum of 100m (at a data transfer speed of 20 Mbps with 32 devices connected) ▶ Maximum of 50m (at a data transfer speed of 20 Mbps with 64 devices connected) ▶ Maximum of 100m (at a data transfer speed of 10 Mbps with 64 devices connected)
Serial communication interface	Pulse transformer and RS-485 specification line transceiver
Serial communication protocol	ADLINK proprietary protocol
Serial communication	NRZ signed
Serial communication method	Half-duplex communication
Connection method	Multi-drop connection using a LAN cable (CAT5/ CAT5e STP/S-STP)
Serial data transfer speed	20 Mbps/10 Mbps/5 Mbps/2.5 Mbps programmable speed setting
Maximum number of MNET modules	64 (the total number of axes will be 64 if all single-axis modules are connected or 256 if all modules belong to MNET-4XMO)

Table 3-1: MNET System Specifications

3.1.1 Wiring Cables

The PCIe-7856 system guarantees enhanced quality for high-speed communication and is designed to be connected with user-provided LAN cables suitable for 100BASE-T and 1000BASE-T. Because these cables have well-known specifications and are cheap and easy to obtain, we do not provide them and do not include them in our product lines. When selecting cables, make sure they meet one of the following standards.

Wiring Standards

- TIA/EIA-568-B
- Category 5 (CAT5)
- Enhanced Category 5 (CAT5e)
- Category 6 (CAT6)

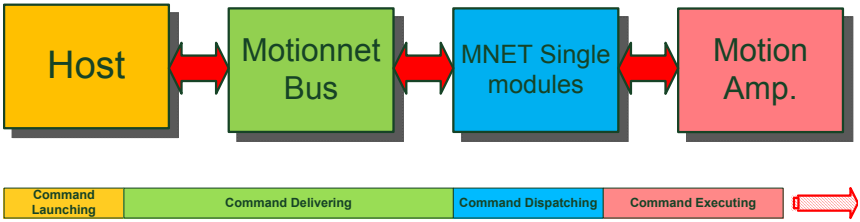
Choose UTP (Unshielded Twisted Pair) or STP (Shielded Twisted Pair) cables that meet one of the standards above. For an environment with excessive electromagnetic noise, use a shielded cable (STP).

Observe the following when connecting your system.

1. Keep the total serial line length as short as possible.
2. Maximum total serial line length will vary based on the data transfer speed and the number of local boards that are connected (this system employs a multi-drop connection method).
   - 20 Mbps with 32 modules connected: Max. 100 m
   - 20 Mbps with 64 modules connected: Max. 50 m
   - 10 Mbps with 64 modules connected: Max. 100 m
3. The shortest cable must be at least 60 cm long.
4. Do not mix cables of different types or models in the same serial line.
5. If using shielded cables, do not connect the shield on both ends to the FG terminals. Connecting only one end of the shield on each cable will improve noise immunity.

3.1.2 MNET System Communication

The following is a communication block diagram for a Missionnet (MNET) system.



Command Launching

Within the MNET system, remote modules communicate with each other using MNET network packets, but users do not need to understand the contents of these packets. Several API functions are provided for controlling modules and these functions are easy to understand and use.

API functions can analyze parameters from user commands and pack them as MNET network packets. The packets are then passed to remote modules. The remote modules will interpret the packets and execute the commands. Before launching a packet, all commands issued by the user are written into RAM and transferred on the MNET network.

RAM, therefore, is a bridge between the MNET master controller and the host PC. The RAM access time for one packet is about 600 ns and should be quite fast on the host PC. The delivery time for one command on the network will depend on the number of modules and the operating clock rate. In addition to using RAM, users can also write data into a FIFO queue in the central device and then issue a “send” command. This communication will be sent and received automatically by interrupting the cyclic communication. Complete command delivery time will depend on the number of MNET packets. One packet command can be delivered in one MNET scan (cycle) time.

Command Delivery

For commands delivered as part of the *cyclic communication* process, the time allowed for communication by a single module is fixed. However, in a direct *data communication* the communication time will vary based on how the communication is controlled by the user's program and the time needed to access the PCIe-7856.

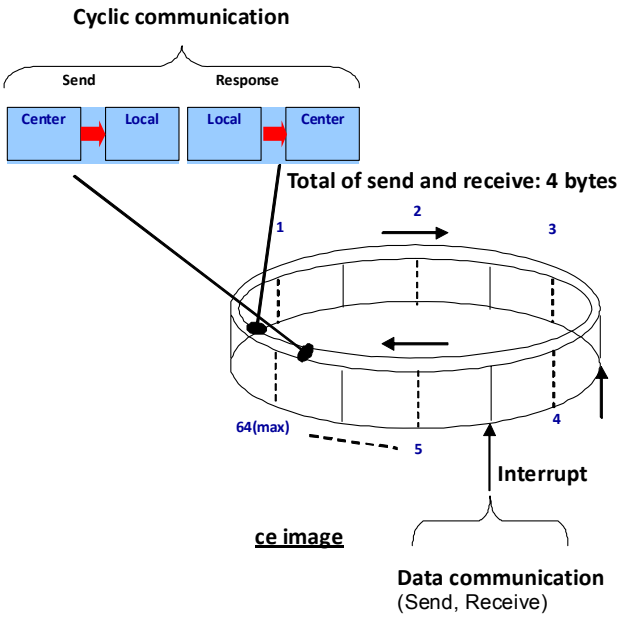


Figure 3-2: MNET System Communication Sequence

3.2 MNET Motion Modules

Motionnet (MNET) motion slave modules are wire-saving solutions. ADLINK provides two types of general purpose 4-axis modules: MNET-4XMO and MNET-4XMO-C. Both offer crucial motion functions such as point-to-point, zero-position searching, programmable acceleration/deceleration, T/S curve speed profile, etc. In addition, the MNET-4XMO-C also supports high-speed position comparison, a trigger output function, and a point table for continuous contouring applications. For additional details, please refer to the MNET-4XMO Series User's Manual available for download at: https://www.adlinktech.com/Products/Industrial_Fieldbus/Motionnet/MNET-4XMO-(C).

ADLINK has also provided three types of single-axis motion modules with specific drivers for connecting to (1) Panasonic A4 servos, (2) Mitsubishi J3 servos, and (3) Yaskawa ΣII, ΣIII, and ΣV servos. These single-axis modules have reached "end of life," however, and the 4-axis modules are recommended as they can be conveniently plugged into any of those servos.

Regardless of the module and servo types involved, the servos themselves can be connected serially by the recommended cable type, greatly reducing wiring requirements.

Series	Model	Servo Driver	Axes	Mechanical I/O
MNET Single-axis Motion Modules	MNET-MIA (EOL)	Panasonic A4	1	PEL, MEL, ORG, SD, EMG
	MNET-J3 (EOL)	Mitsubishi MR-J3	1	PEL, MEL, ORG, SD, EMG
	MNET-S23 (EOL)	Yaskawa ΣII, ΣIII, ΣV	1	PEL, MEL, ORG, SD, EMG
MNET 4-axis Motion Modules	MNET-4XMO	General Purpose	4	PEL, MEL, ORG, SD, EMG
	MNET-4XMO-C	General Purpose	4	PEL, MEL, ORG, SD, EMG, TRG

Table 3-2: MNET Motion Module Series

The MNET-J3 can control a servomotor when I/O signals from a Mitsubishi MR-J3 series servo driver CN1 are routed directly to this connector: CN4.

The MNET-MIA can control a servomotor when I/O signals from a Panasonic (Matsushita) servo amplifier MINAS A4 series (pulse command supporting type) servo amplifier CNI/F or CNX5 are routed directly to this connector: CN4.

The MNET-M341-S23 controls Yasukawa ΣII, ΣIII and ΣV series servo packs (pulse train supporting types) by docking all command and feedback signals to the CN1 connector of the servo driver.

These single-axis modules can control continuous operations of a servomotor with a variety of speed patterns (constant speed, linear acceleration/deceleration, S-curve acceleration/deceleration, preset positioning, and zero return) using serial communications.

Since these modules can connect directly to the mechanical I/O signals of a servo driver, they do not need the special servo driver cable required of conventional motion control modules, thus saving time and providing the following advantages: simplified wiring, shortened wiring runs, and reduction of problems caused by faulty wiring. They also offer high noise immunity, take full advantage of high-speed signal lines to handle command pulses, and are highly compact, especially since they conserve wiring space.

Again, ADLINK also offers general purpose 4-axis motion control modules which are highly recommended, especially if using servos or stepper motors that are not described above or if more advanced motion functionality is required (such as linear/circular interpolation). By using specific or general purpose D-Sub cables, these 4-axis modules can directly connect to servo drivers, including Mitsubishi J2S, Panasonic MINAS A4, Yaskawa ΣII/ΣIII/ΣV, and Delta ASDA A2.

3.2.1 Motion Module Mechanical Drawings

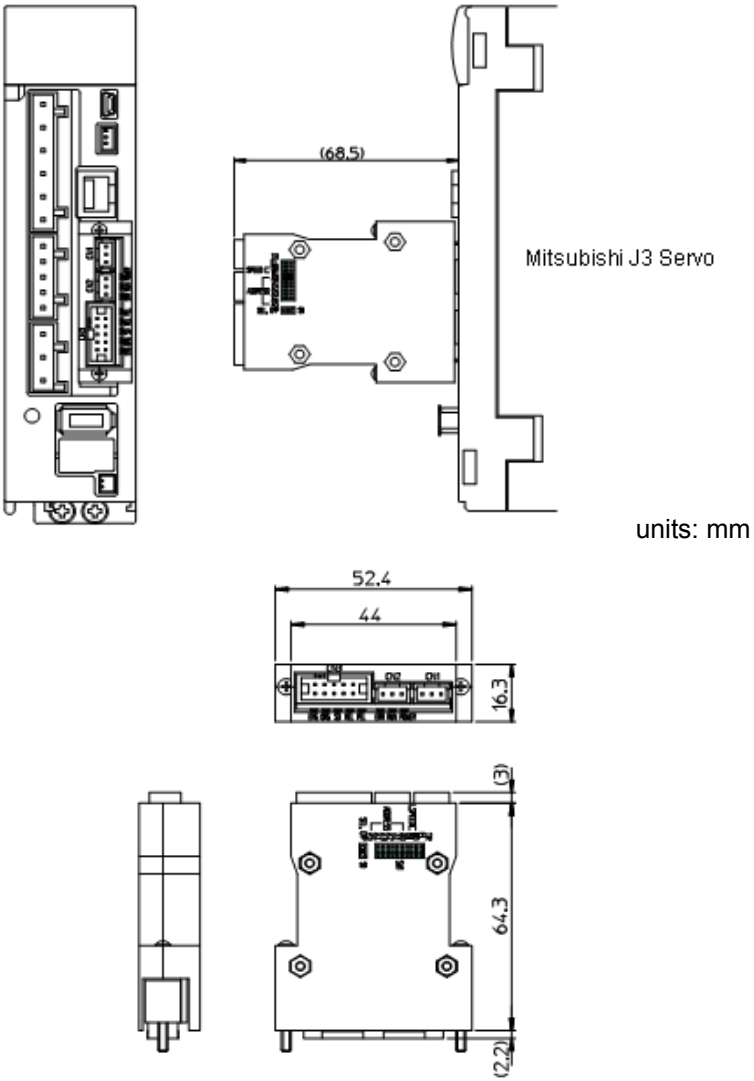
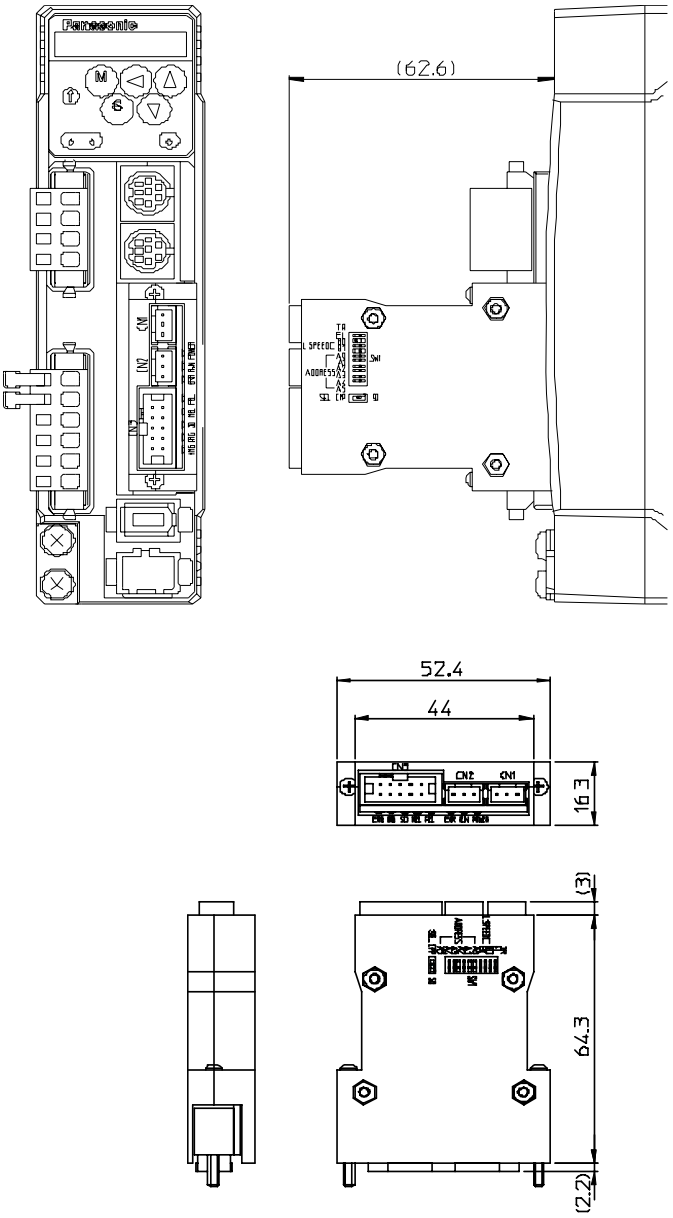


Figure 3-3: MNET-J3 with MR-J3 Servo Driver



units: mm

Figure 3-4: MNET-MIA with MINAS A4 Servo Driver

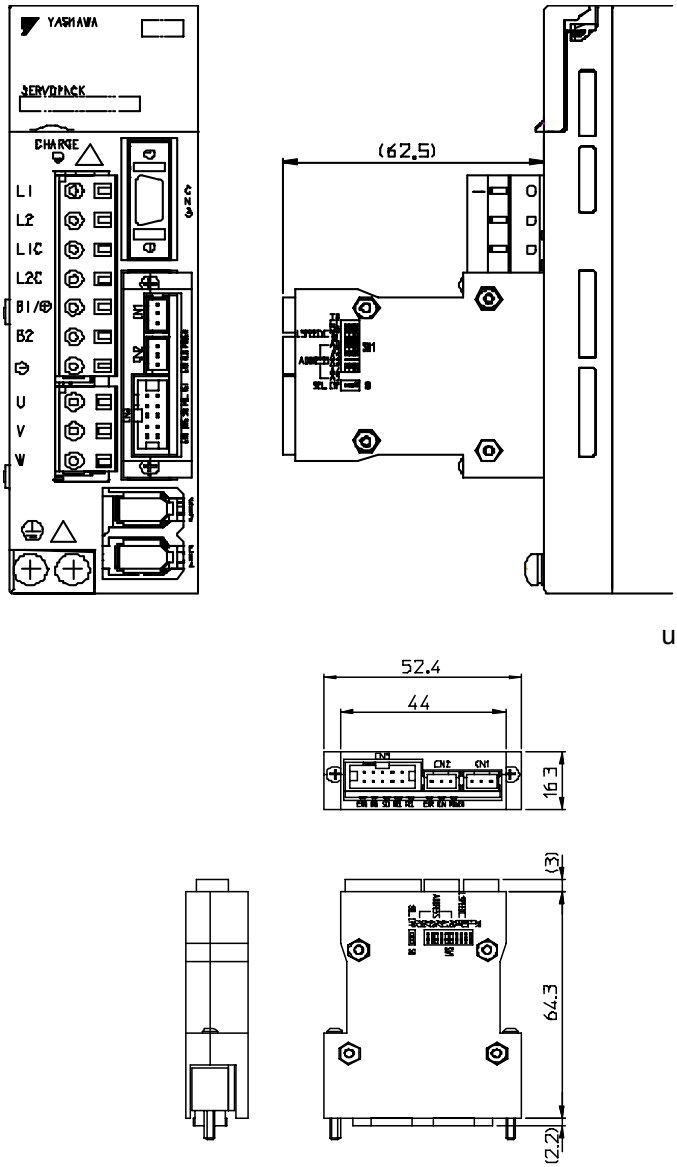
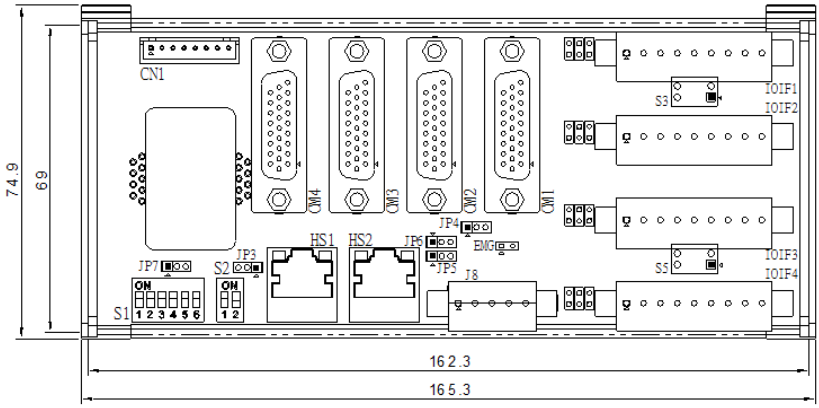


Figure 3-5: MNET-S23 with ΣII, ΣIII, and ΣV Servo Drivers



units: mm

Figure 3-6: MNET-4XMO-(C) Mechanical Diagram

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4 HSL Slave Modules

High Speed Link (HSL) is a master-slave network system featuring an innovative distributed architecture that modularizes communication, I/O functionality, and signal termination. ADLINK provides slave I/O modules and terminal bases to meet your particular application requirements, including discrete I/O, analog I/O, and motion control. For complete details about the modules, please refer to the HSL-4XMO User's Manual, available here:
https://www.adlinktech.com/Products/Industrial_Fieldbus/HighSpeedLink(HSL)/HSL-4XMO

Slave I/O Modules: There are three groups of slave I/O modules with different dimensions. Slave I/O modules give terminal bases additional I/O capability. To identify each slave I/O module in a HSL network, a module type electronic data sheet is stored in the module itself. Slave I/O modules can also be located by address ID, set by a 6-bit DIP-switch. Depending on the I/O type, each slave I/O module may consume 1 or 2 address IDs. Since the greatest ID number in a HSL master is 63 (the highest value for a 6-bit unsigned integer), and since '0' is reserved for the master, there are at most 63 slave I/O modules for each HSL master.

Terminal Bases: The function of a terminal base (TB) slave module is to facilitate convenient wiring. Both power and signal wiring go from the TB into the slave I/O modules. TBs can also facilitate RJ-45 connections between masters and slave I/O modules. With the help of a TB, slave I/O modules can be hot-swapped without interfering with other modules on the same HSL network.

U-series Modules: U-series slave modules provide direct I/O signal wiring on top of the device. They are more compact than TBs and offer several I/O interface types to facilitate signal linking.

HUB/Repeaters: HSL-HUB/Repeaters provide more sub-system flexibility and thus enable a greater variety of topologies.

Wiring Cables: The communication wiring cables between an HSL master and its I/O modules are standard 100 Base/TX with RJ-45 connectors, the same as commercial Ethernet cables.

4.1 HSL Slave I/O Modules

4.1.1 Discrete I/O Modules

ADLINK provides three discrete I/O module series: DB, M, and U.

- **DB:** Daughter board form factor
- **M:** Daughter board form factor with aluminum cover
- **U:** Low-profile design

Series	Model	Discrete Inputs	Discrete Outputs	Relay Outputs	Slave Index Occupation
DB	HSL-DI32-DB-N; HSL-DI32-DB-P (EOL)	32			2 (consecutive from odd number)
	HSL-DO32-DB-N; HSL-DO32-DB-P (EOL)		32		2 (consecutive from odd number)
	HSL-DI16DO16-DB-N/P (EOL)	16	16		1
M	HSL-DI32-M-N/P	32			2 (consecutive from odd number)
	HSL-DO32-M-N/P		32		2 (consecutive from odd number)
	HSL-DI16DO16-M-NN/NP/PN/PP	16	16		1
	HSL-R8DI16-M-N/P (EOL)	16		8	1
U	HSL-DI16DO16-US/UJ-NN/NP/PN/PP	16	16		1
	HSL-DI16-UL	16			1

Table 4-1: HSL Discrete I/O Module Series

The selection guide is as follows:

HSL -	Discrete I/O Type	-	Series	-	Signal Type
	▶ **DI16DO16:** 16 discrete inputs and 16 discrete outputs ▶ **DI32:** 32 discrete inputs ▶ **DO32:** 32 discrete outputs ▶ **R8DI16:** 8 relay outputs and 16 discrete inputs		▶ **DB:** Daughter board form factor ▶ **M:** Daughter board with aluminum cover ▶ **U:** Low-profile design		▶ **X:** Input Signal Type: NPN sinking or PNP sourcing support ▶ **Y:** Output Signal Type: NPN sinking or PNP sourcing support

Table 4-2: HSL Discrete I/O Module Selection Guide

4.1.2 Analog I/O Modules

ADLINK provides M and U analog I/O modules, as shown below.

Series	Model	Analog Input	Analog Output	Slave Index Occupation
M	HSL-AI16AO2-M-VV	16	2	2 (leap number)
	HSL-AI16AO2-M-AV	16	2	2 (leap number)
U	HSL-AO4		4	2

Table 4-3: HSL Analog I/O Module Series

The selection guide is as follows.

HSL -	Discrete I/O Type	-	Series	-	Signal Type
	▶ **AI16AO2:** 16 analog inputs and 2 analog outputs		▶ **M:** Daughter board with aluminum cover		▶ **X:** Input signal type, V for voltage and A for current ▶ **Y:** Output signal type, V means voltage

Table 4-4: HSL Analog I/O Module Selection Guide

4.2 General Specifications

4.2.1 Digital I/O Modules

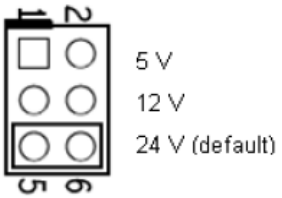
Discrete Input	Photo Couple Isolation	2500 VRMS	
	Input Impedance	4.7 kΩ	
	Input Voltage	+24 V(6)	
	Input Current	For NPN(1)	-10 mA
		For PNP(2)	+10 mA
	Operation Voltage (@ 24 V_{DC} Power Supply)	For NPN(1)	ON: 11.4 V_{DC} (max.) OFF: 14.3 V_{DC} (min.)
		For PNP(2)	ON: 12.6 V_{DC} (min.) OFF: 9.8 V_{DC} (max.)
	Response Time	ON: 8.8 µs (typical) OFF: 42 µs (typical)	
Discrete Output	Switch Capacity	For NPN(3)	All channels: -50 mA/ch at 24 V_{DC}
		For PNP(4)	All channels: +50 mA/ch at 24 V_{DC}
	Response Time	ON to OFF: 68 µs	
		OFF to ON: 1.1 µs	
Relay	Relay Type	SPST, normally open, non-latching	
	Rating	30 V_{DC}/2 A, 250 V_{AC}/2 A	
	Switching Frequency	20 times/minute at rating load	
	Response Time	ON to OFF: 3 µs (max.)	
		OFF to ON: 6 µs (max.)	

Table 4-5: Digital I/O Module

NOTE:

(1) NPN sinking type sensor input modules.
(2) PNP sourcing type sensor input modules.
(3) NPN sinking type sensor output modules.
(4) PNP sourcing type sensor output modules.
(5) U-series single channels: -90 mA at 24 VDC.
(6) The HSL-DI16-UL supports 5 V, 12 V and 24 V, selected by jumper for each channel (see Section 4.2.2).

4.2.2 JD10-JD15 Input Voltage Setting



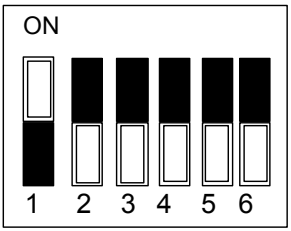
4.2.3 Analog I/O Modules

Analog Input	A/D Resolution	16-bit (14-bit guaranteed)
	Input Range	For VV type: ±10 V, ±5, ±2.5, ±1.25 V
		For AV type: 20 mA, 10 mA, 5 mA
	A/D Conversion	10 µs
	Signal Type	16-ch Single Ended; 8-ch Differential
Analog Output	D/A Resolution	16-bit
	D/A Settling Time	10 µs

Table 4-6: Analog I/O Modules

4.2.4 HSL Module DIP Switch

Figure 4-1: HSL Module DIP Switch Location



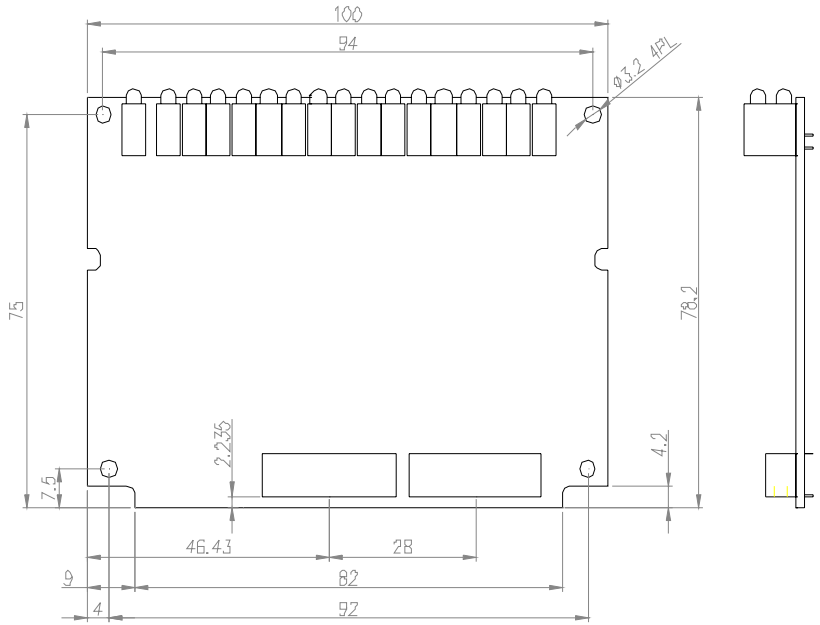
ON = 1
100000 address 1
010000 address 2
… …
011111 address 62
111111 address 63
OFF = 0

NOTE:

1. The address (or index) '0' is reserved for the master.
2. HSL-DI32-M, HSL-DO32-M, HSL-DI32-DB, and HSL-DO32-DB need two consecutive addresses starting from an odd number. For example, if the DIP switch is set to 3, it will occupy indexes 3 and 4.
3. HSL-AI16AO2-M-VV/AV needs two leap addresses in full-duplex mode. For example, if the DIP switch is set to 2, this module will occupy indexes 2 and 4.

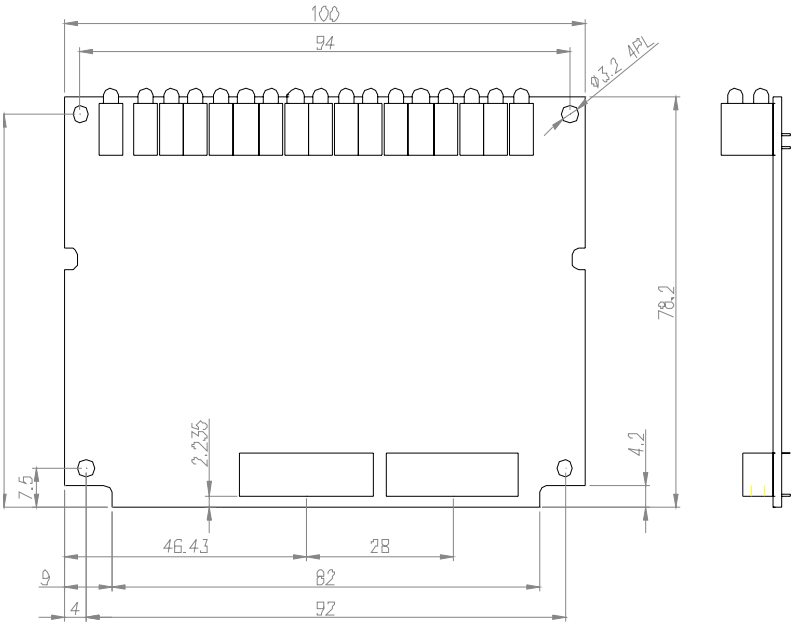
4.2.5 Daughter Board/Module Dimensions

DB: Daughter board form factor (100 mm × 78.2 mm)



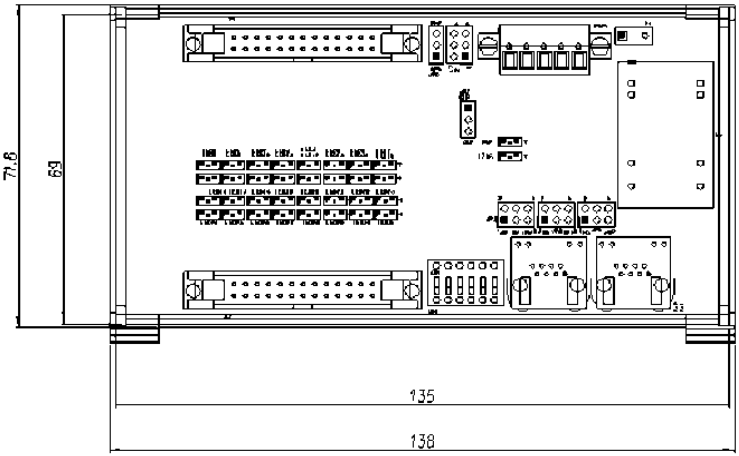
units: mm

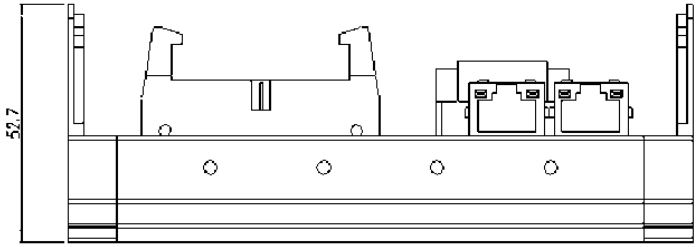
M: Daughter board with aluminum cover (125 mm × 80 mm)



units: mm

U: Low-profile I/O module (71.8 mm × 138 mm)

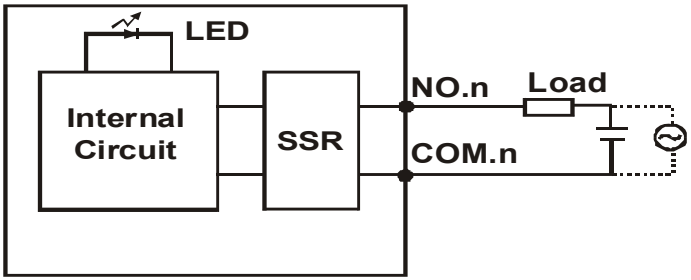




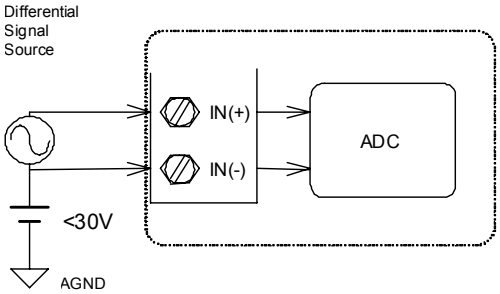
units: mm

4.2.6 Wiring Diagrams

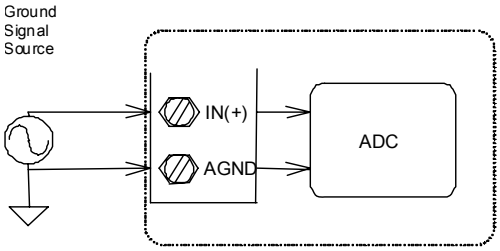
R (Relay Output):



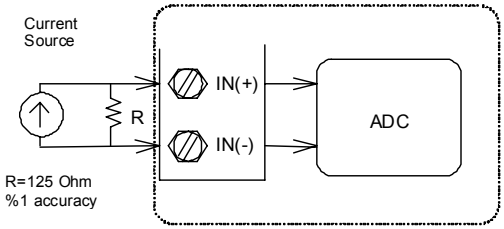
Analog Input (Differential Voltage Input):



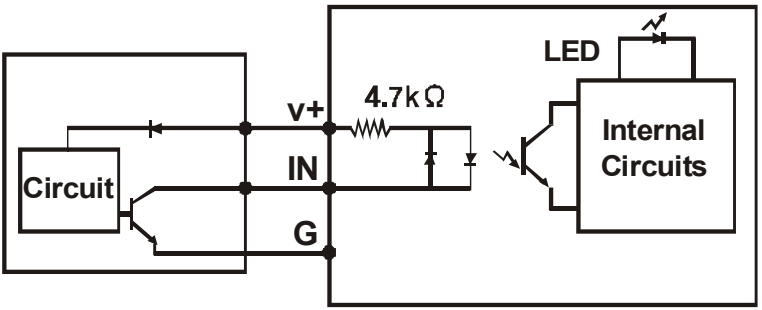
Analog Input (Single-Ended Voltage Input):



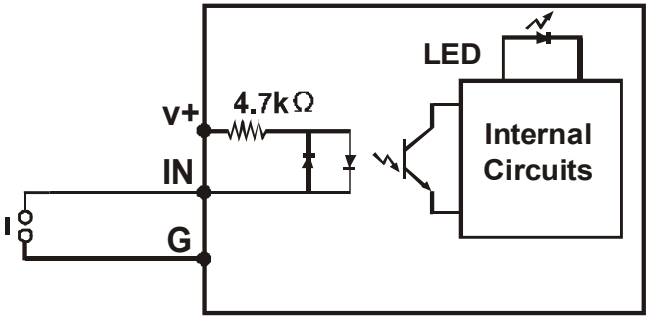
Analog Input (Current Measure):



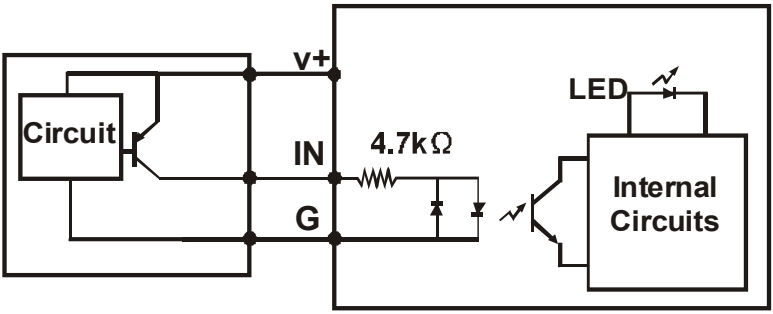
N (NPN Sinking-type Sensor Input):



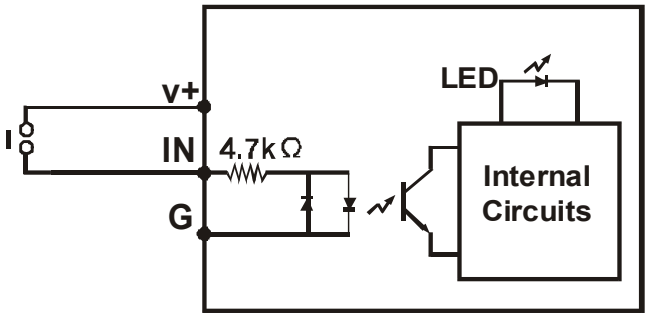
N (Dry Contact Input):



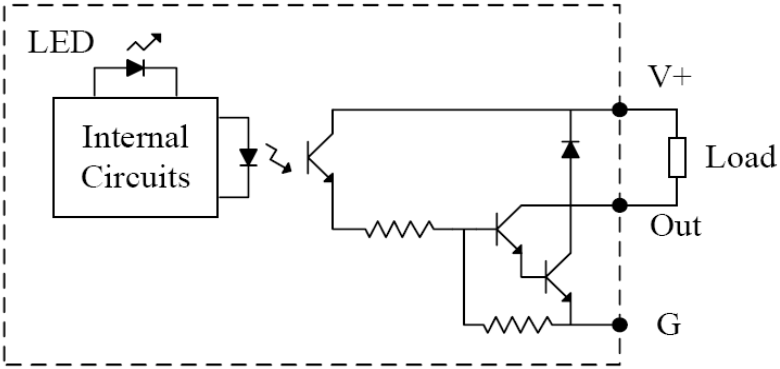
P (PNP Sourcing-type Sensor Input):



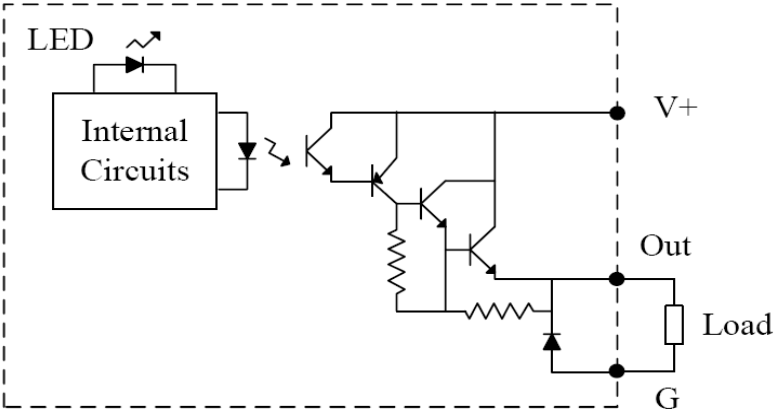
P (Wet Contact Input):



N (NPN Sinking Output):



P (PNP Sourcing Output):



4.2.7 Terminal Base Motion Control Modules

The terminal bases (TBs) include:

- HSL-TB32-U-DIN
- HSL-TB64-DIN
- HSL-TB32-M-DIN
- HSL-TB32-MD

Features

- Field I/O wiring connection for HSL I/O modules
- Screw or spring terminal for easy field wiring
- Power and ground included for each signal channel
- Interlocking design for rugged installation
- Power LED indicator
- DIN rail mount
- Onboard terminator resistor

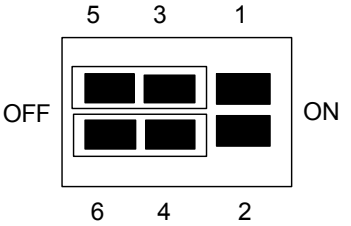
General Descriptions

Series	Model	Description	Module Support
DB	HSL-TB32-U	(1) 32-channel direct connection terminal base (2) One DB slot	All HSL DB-series modules
	HSL-TB64	(1) 64-channel direct connection terminal base (2) Two DB slots	All HSL DB-series modules
M	HSL-TB32-M	32-channel direct connection terminal base for HSL M-series modules	All HSL M-series modules
	HSL-TB32-MD		

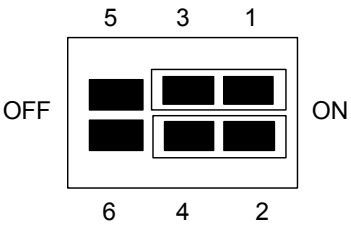
Jumper Settings

Since HSL is a serial transmission system, a terminator should be set at the end of the cable. Each TB has a jumper-selectable terminator on board. Only the last module needs to have the terminator enabled.

Not the last module (Default)

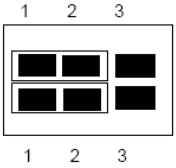


The last module



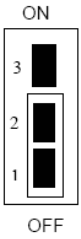
HSL-TB32-MD Jumper Settings

JP1,2 (External Power Option)



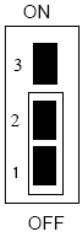
1, 2 short: Different Power (Default)
2, 3 short: Common Power

JP3 (Tx Terminal Resistor)



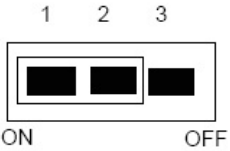
OFF is default setting

JP4 (Rx Terminal Resistor)



OFF is default setting

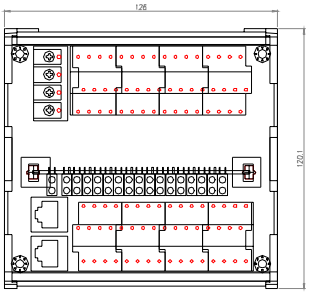
JP5 (Fuse Option)



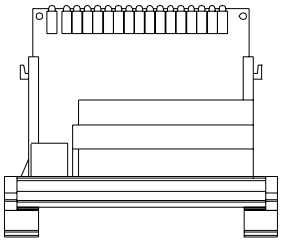
1, 2 short: With Fuse
2, 3 short: Without Fuse (Default)

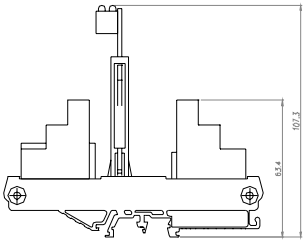
Dimensions

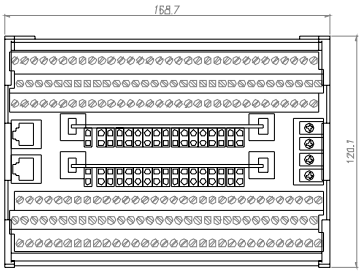
DB with HSL-TB32-U-DIN (126 × 120.1 × 107.3) mm

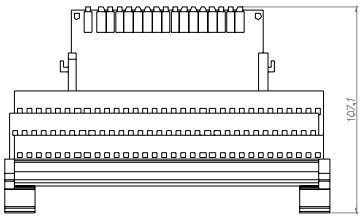


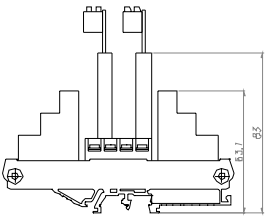
units: mm



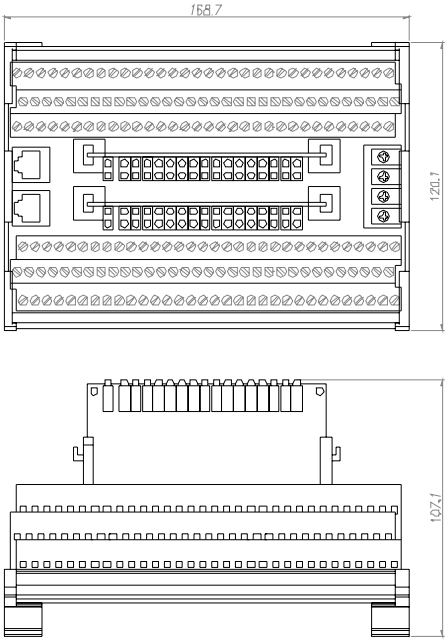






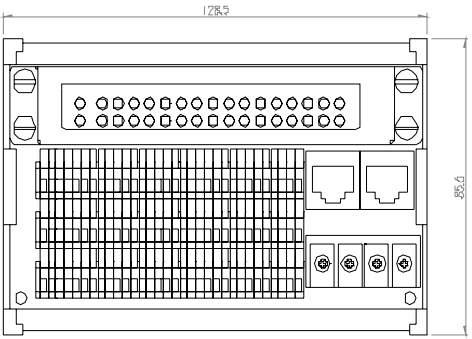


DB with HSL-TB64-DIN (168.7 × 120.1 × 107.3) mm

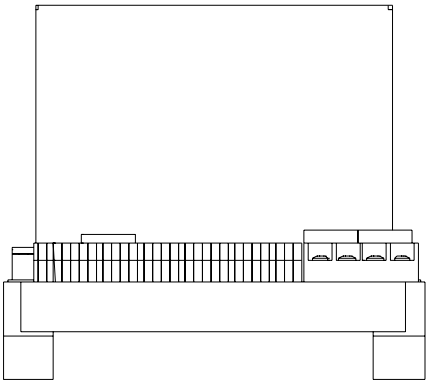


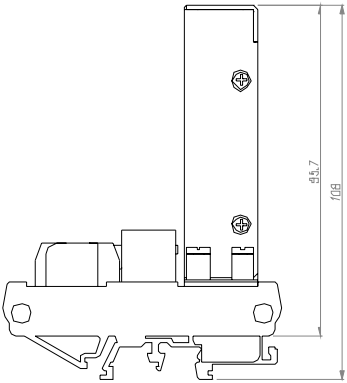
units: mm

M module with HSL-TB32-M-DIN (128.5 × 85.5 × 108) mm



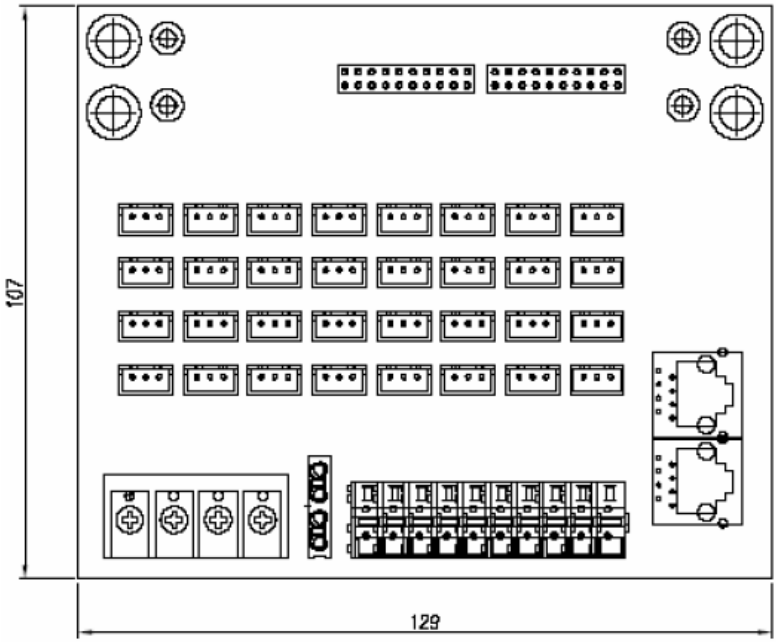
units: mm





HSL-TB32-MD (129 × 107) mm

units: mm



4.2.8 HSL-HUB/Repeaters

Each HSL-HUB/Repeater consists of the following:

- HSL-HUB
- HSL-Repeater

Features

- Three linking styles: Master to HUB, HUB to HUB, and HUB to Slave.
- Supports T bracing connection and star connection (subsystem concept).
- Supports max. 2.4 km by 7 HSL-HUB/Repeater modules.
- One input port with 3 output segment ports.
- Jumper-selectable transmission speeds: 3/6/12 Mbps.
- Jumper-selectable full- and half-duplex transmission modes.
- RJ45 phone jack for easy installation.
- 24 VDC input.

General Configuration

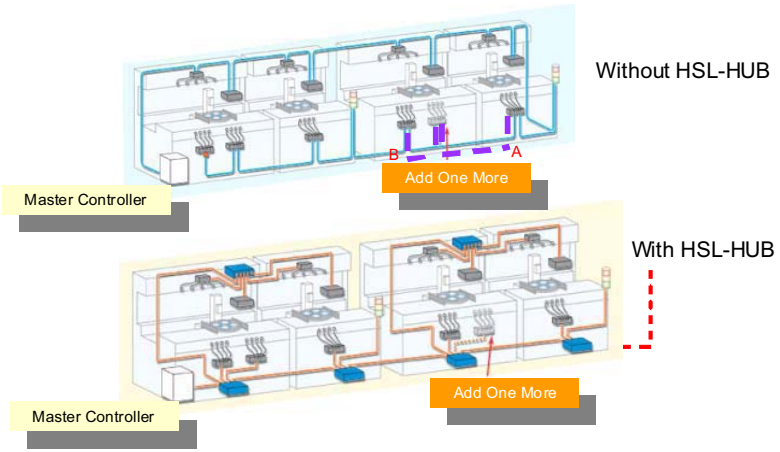
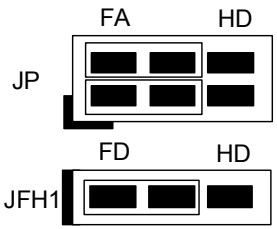


Figure 4-2: HSL System Configuration

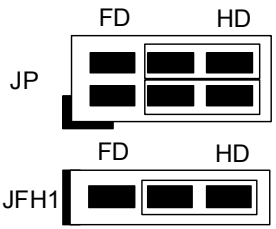
Jumper Settings

FD / HD setting: JP*(0-3), JFH1

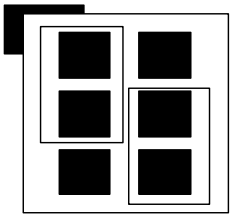
Full Duplex (default)



Half Duplex



3 M / 6 M / 12 M setting JBPS1

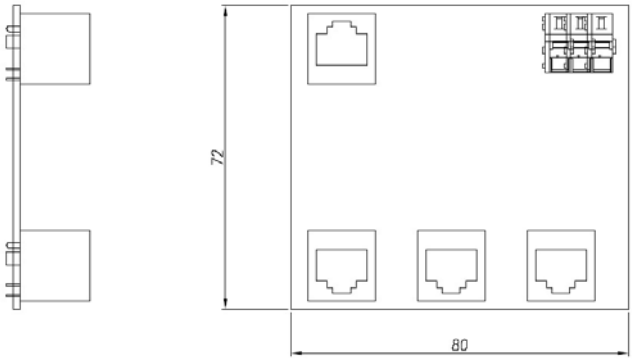


6 M (default)

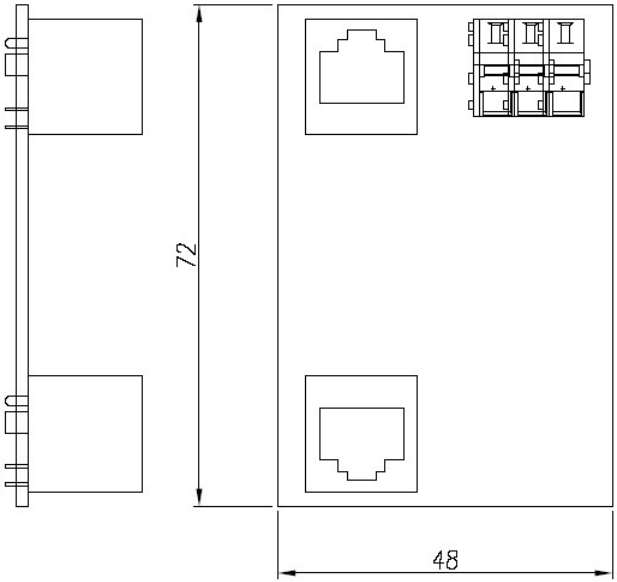
1 – 3 & 2 – 4	12 M
1 – 3 & 4 – 6	6 M (default)
3 – 5 & 2 – 4	3 M
3 – 5 & 4 – 6	EXC

Dimensions (mm)

HSL-HUB



HSL-Repeater



4.2.9 Managing Slave Indexes in an HSL Network

Before Proceeding

Before powering on the slave modules, ensure the DIP switch is properly set. Refer to Section 4.2.4 on page 30 and take special note of the following:

1. One master controller can connect to a maximum of 63 slave modules.
2. The more compact the slave addresses, the more efficiently the HSL system can work.
3. Discrete I/O and relay module rules:

Module	Slave Index Occupation	Transmission Mode	Transmission Speed
HSL-DI16DO16-M-NN/NP/PN/PP	1 (any address)	Full-duplex (fixed)	6 Mbps (fixed)
HSL-DI16DO16-DB-NN/NP/PN/PP			
HSL-R8DI16-M-N/P			
HSL-DI32-M-N/P	2 (consecutive from odd number)		
HSL-DI32-DB-N/P			
HSL-DO32-M-N/P			
HSL-DO32-DB-N/P			

4. Analog I/O and thermocoupling module rules:

Module	Slave Index Occupation	Transmission Mode	Transmission Speed
HSL-AI16AO2-M-VV	2 (leap number)	Full-duplex (fixed)	3/6/12 Mbps (selectable)
HSL-AI16AO2-M-AV			
HSL-AO4-U			

5. Special rule: If installing only one HSL-AI16AO2-M-VV or HSL-AI16AO2-M-AV and the DIP switch is set to 1 (the HSL-AI16AO2-M-VV/AV only supports full-duplex mode), the occupied indexes will be 1 and 3. You must assign a value of 4 to the parameter “MOD_No” of “APS_set_field_bus_slave_param()” to ensure correct communication.

Examples

The following examples are provided for user reference. All the modules involved are assumed to be in full-duplex mode.

Example 1

HSL-DI16DO16-UD×2, HSL-DI32-MN×2, and HSL-AI16AO2-VV×1 are installed (with all slave modules in full-duplex mode) under two different conditions:

Condition 1: HSL-AI16AO2-VV operating at 6 Mbps.

ADLINK suggests the following slave index configuration:

Item	DIP Switch	Index Occupation in HSL
HSL-DI32-M-N #1	1	1, 2
HSL-DI32-M-N #2	3	3, 4
HSL-AI16AO2-VV	5	5, 7
HSL-DI16DO16-UD #1	6	6
HSL-DI16DO16-UD #2	8	8

This is an example of a compact composition. The scan time will be 30.33 µs × 8 at 6 Mbps, full-duplex mode. Users can connect the modules with one master controller.

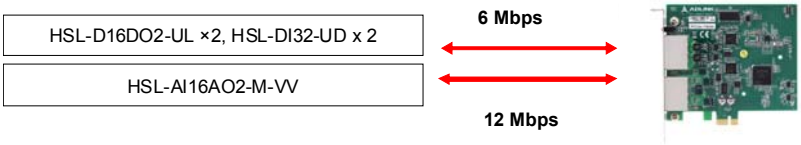
Condition 2: HSL-AI16AO2-VV×1 operating at 12 Mbps.

ADLINK recommends the following slave index configuration.

Item	DIP Switch	Index Occupation in HSL
HSL-DI32-M-N #1	1	1, 2
HSL-DI32-M-N #2	3	3, 4
HSL-DI16DO16-UD #1	5	5
HSL-DI16DO16-UD #2	6	6

This is another example of a compact composition. The scan time required is 30.33 µs × 6 at 6 Mbps, full-duplex mode. Users may connect these modules with one master controller.

The HSL-AI16AO2-M-VV module will connect to another master controller. The DIP switch of HSL-AI6AO2-M-VV will be assigned a value of 1.



Consequently, the cycle time of the first master controller is 30.33 µs × 6 and the cycle time of the second master controller is 45.5 µs at 12 Mbps, full-duplex mode.

Example 2

Two HSL-DI16DO16-UJ's, one HSLDI16DO16-M-NN, two HSL-DO32-M-N's and one HSL-AI16AO2-VV are installed (with all slave modules in full-duplex mode) under two different conditions:

Condition 1: HSL-AI16AO2-VV module operating at 6 Mbps.

ADLINK recommends the following slave index configuration:

Item	DIP Switch	Index Occupation in HSL
HSL-DO32-M-N #1	1	1, 2
HSL-DO32-M-N #2	3	3, 4
HSL-AI16AO2M-VV	5	5, 6
HSL-DI16DO16-UJ #1	7	7
HSL-DI16DO16-UJ #2	8	8
HSL-DI16DO16-M-NN	9	9

The scan time will be 30.33 µ ×17 at 6 Mbps, full-duplex mode. These modules can be connected with one master controller.

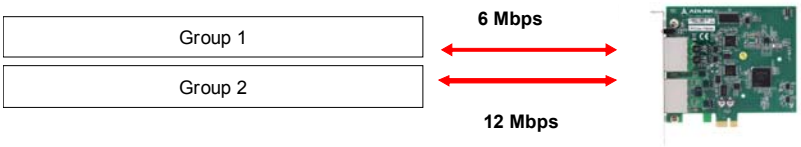
Condition 2: HSL-AI16AO2-VV module operating at 12 Mbps.

ADLINK recommends the following slave index configuration:

Group 1	DIP Switch	Index Occupation in HSL
HSL-DO32-M-N #1	1	1, 2
HSL-DO32-M-N #2	3	3, 4
HSL-DI16-UJ #1	5	5
HSL-DI16-UJ #2	6	6
HSL-DI16DO16-M-NN	7	7

The scan time required is 30.33 µs × 7. These modules may be connected with one master controller. The HSL-AI16AO2-M-VV module will connect to another master controller. The management table and illustration below are provided for reference.

Group 2	DIP Switch	Index Occupation in HSL
HSL-AI16AO2-M-VV	1	1, 2



The cycle time of the first master controller will be 30.33 µs × 7 while the cycle time of the second master controller will be 15.17 µs × 11 at 12 Mbps, full-duplex mode.

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5 MotionCreatorPro 2 (MCP2)

After installing the hardware, it is necessary to correctly configure all cards and double-check the system before running. This chapter provides guidelines for establishing a control system and manually testing the PCIe-7856 to verify correct operation. The MCP2 software provides a simple yet powerful means to set up, configure, test, and debug a motion control system that uses PCIe-7856.

5.1 About MCP2

Before running MCP2, please note the following.

1. MCP2 was developed using BCB 6.0 and is available only for Windows systems with a screen resolution of 1024x768 or higher. It cannot be run under DOS.
2. The following files are required by the program:
   - ▷ MCP2.mdb, which stores parameters and graphics.
   - ▷ MCPro2.ini, which stores initialization settings.
3. MCP2 is a highly integrated program that supports many ADLINK motion control cards. Multiple cards can be used in one system.

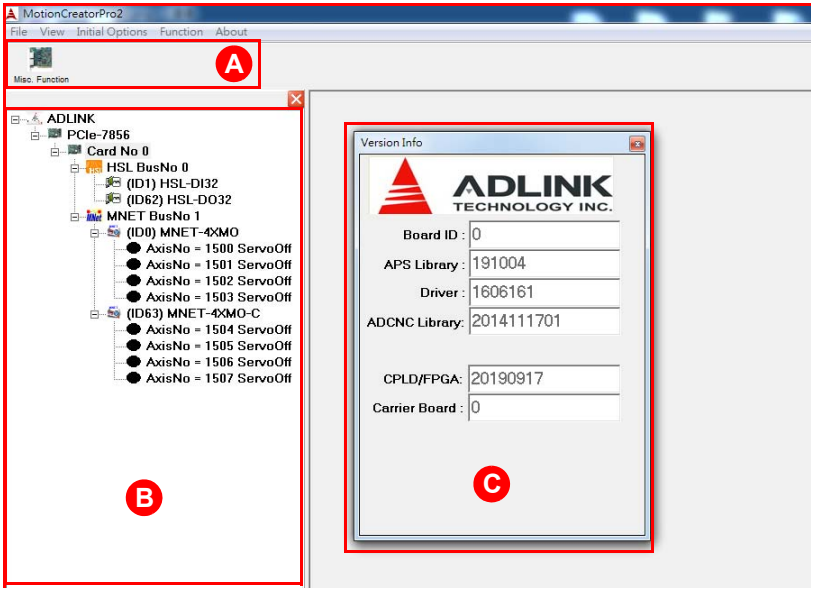
5.2 How to Run MCP2

After installing the software drivers for PCIe-7856, the MCP2 program will be located at “<chosen path>\MCP2.exe”. Double click the executable file to run the program.

5.3 MCP2 Features

5.3.1 Main Menu

Launching MCP2.exe will present the user with the main menu. Refer to the following images and descriptions for details on all the available features. To exit the program at any time, select “Exit” from the “File” menu.



A. Icons for operation modes. Some will be active when a bus/motion item in the tree view is selected and some will be active when an axis item is selected.

▶ **Function Buttons**

▷ **Configuration**

Button	Function	Description
	Axis/Board Configuration	Set axis/board parameters.

▷ Movement

Button	Function	Description
	Single Movement	Single-axis movement (PTP), including absolute and relative functions.
	Home Return Movement	Home return movement.
	Interpolation	Interpolation function.
	Sampling	Sampling function. Select this to set the source and draw its profile.
	2D Movement	Execute 2D motion.

▷ Field Bus

Button	Function	Description
	Field Bus Connect	Connect an MNET/HSL module. Select baud rate (to the right of the button) and connect.
	Field Bus Disconnect	Disconnect an MNET/HSL module.
	Field Bus Module Test	If properly connected, a module can be selected here for a module test.

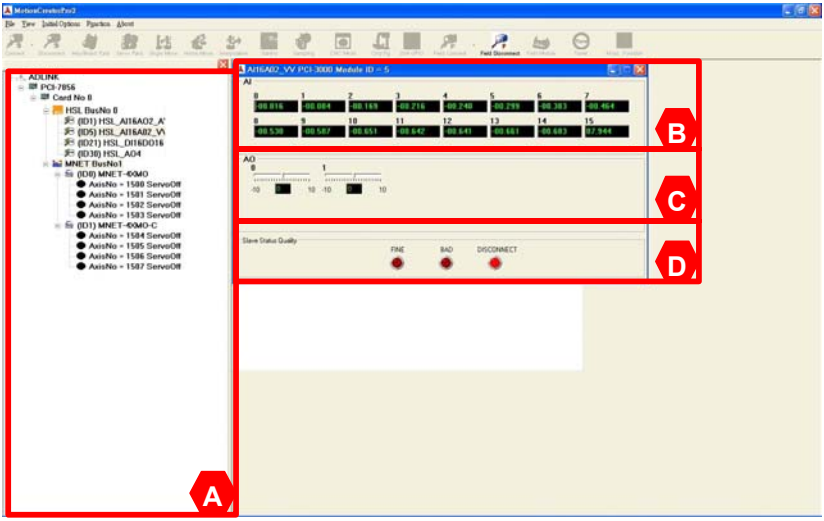
B. All automation products found by MCP2. The tree view will display motion axes as well as field bus I/O.

ICON	Function	Description
(Yellow)	Warning	Servo warning.
(Red)	Alarm	Servo alarm.
(Black)	Normal (Servo OFF)	No error and servo is off.
(Green)	Normal (Servo ON)	No error and servo is on.

C. Board information, including software, firmware, and hardware version numbers.

5.3.2 HSL Distributed I/O Manager

This page can be used to test the HSL system and slave modules. After executing the I/O management page, the main operation window shown below will appear. You can select the module for testing in the tree list of left window. The corresponding ID will also appear with each module. For example, the following figure shows the management pane for the HSL-AI16AO2-VV module. Analog input information is presented in this window and you can use the sliding bar to control the analog output.



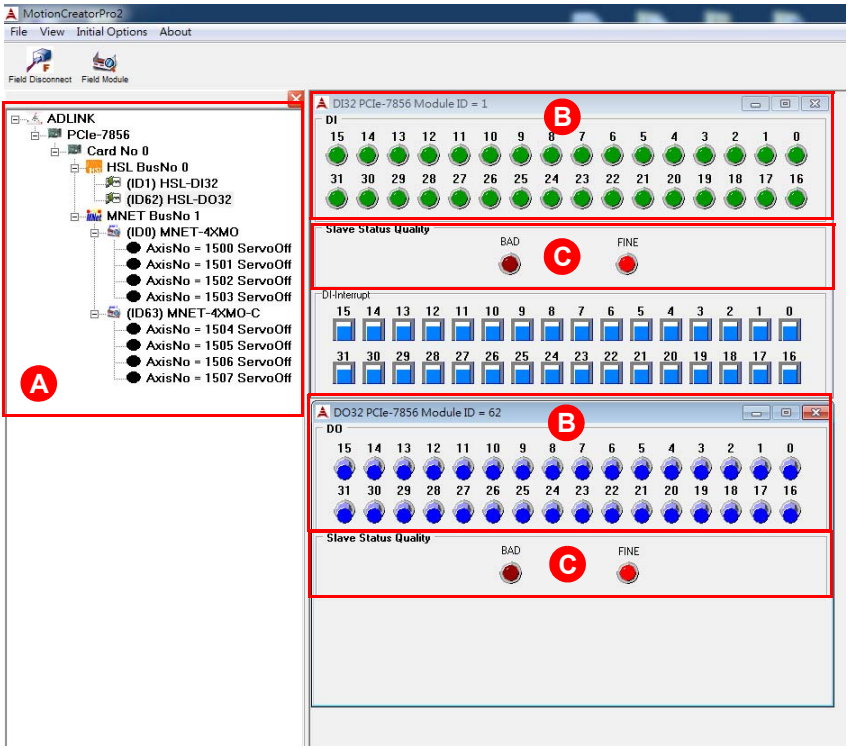
Operation Instructions

A. Tree view of all HSL and MNET modules.

B. Analog input presentation.

C. Analog output control panel.

D. Check the communication status of each module.



Operation Instructions

A. Tree view of all HSL and MNET modules.

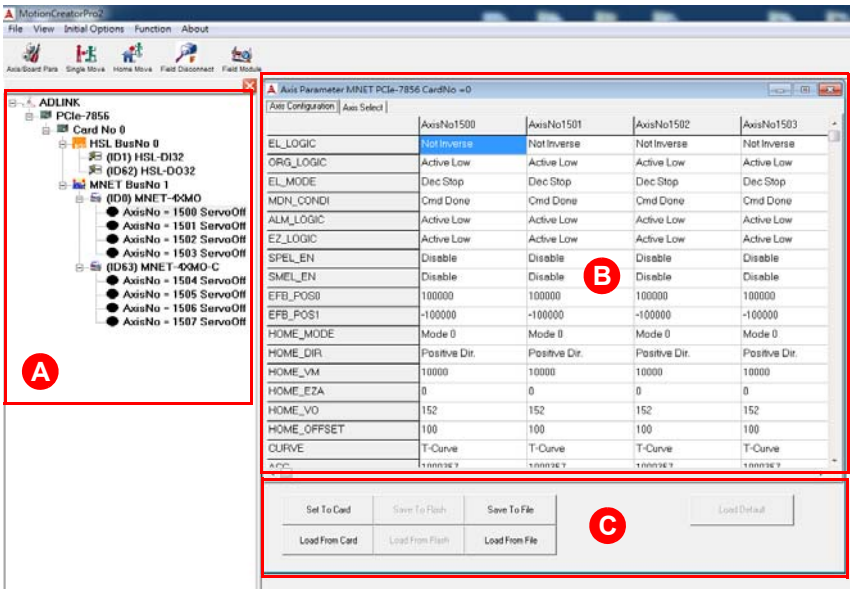
B. Digital input representation or digital output control.

C. Check the communication status of each module.

5.3.3 MNET Distributed Motion Manager

The Motionnet (MNET) manager offers several motion operations, including single-axis movement, home return, axis parameter setting, etc.

Parameter Management

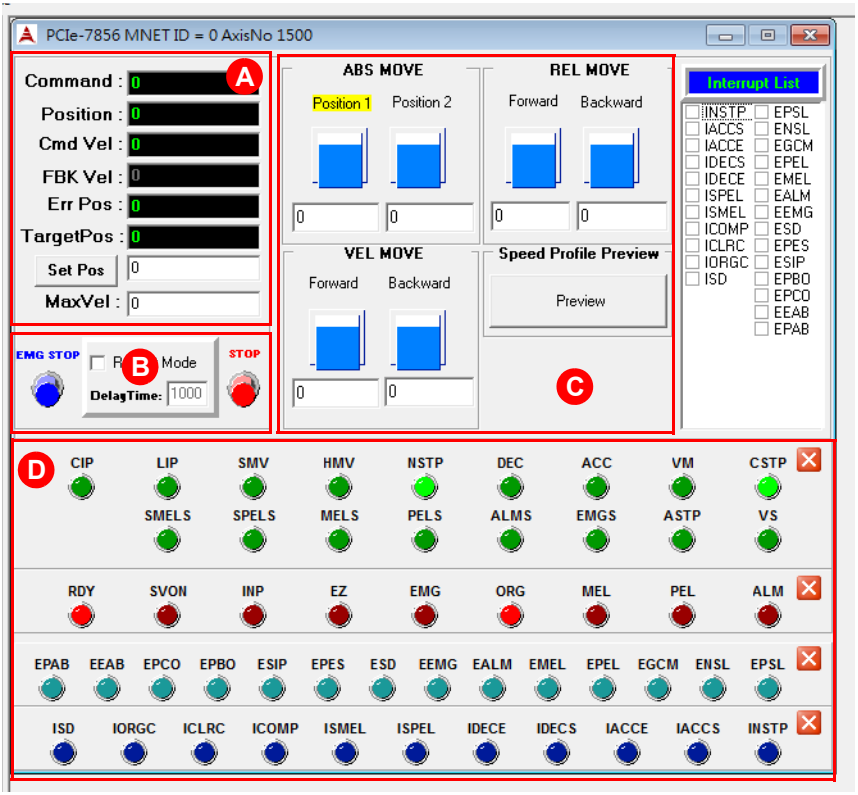


Operation Instructions

- **A.** Tree view of all HSL and MNET modules.
- **B.** Parameter values of each axis.
- **C.** Parameter management buttons for saving/loading parameters in various ways. “Set To Card” must be clicked to activate any changes made to this table.

Tip: *Right-click on a parameter to apply it to all other axes*.

Single-axis Movement



Operation Instructions:

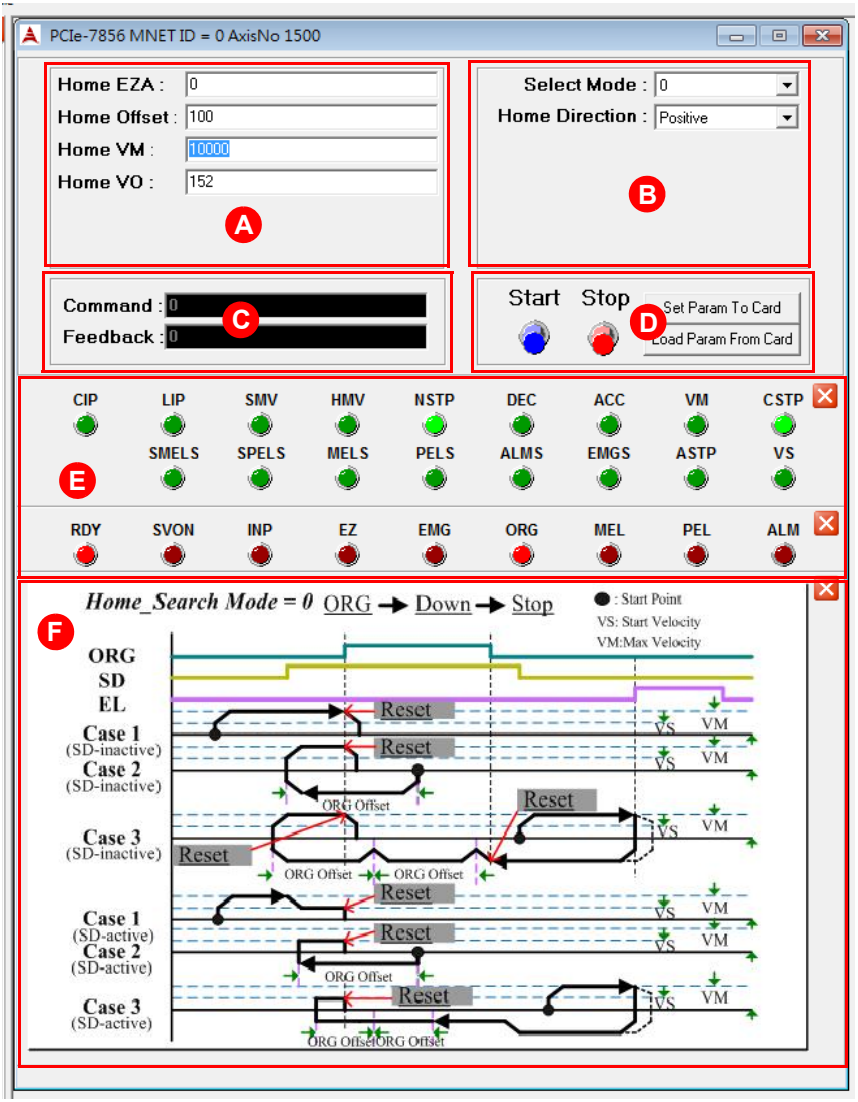
A. Command, feedback, error, and target position information. Command and feedback speed information. The minimum speed value may be limited by speed calculation cycle time for low speed display.

B. Optional operation settings and buttons. Repeat Mode can be used in both Relative and Absolute mode. The axes will move between two positions or forward/backward distance cyclically. You can set the delay time (in milliseconds) between each move. The minimum value is 1 ms. The stop button is for relative, absolute, and velocity modes.

C. Operation buttons and settings for 3 modes. You can switch operation between relative, absolute, and velocity modes. Before operation, mode parameters must be set, such as positions 1 and 2, forward/backward distance, and forward/backward velocity. Set “MaxVel” before executing relative or absolute mode. While using jog mode, the other three modes will be disabled.

D. Motion status, I/O status, and interrupt status display area.

Home Return


PCIe-7856 MNET ID = 0 AxisNo 1500
Home EZA : 0
Home Offset : 100
Home VM : 10000
Home VO : 152
A
Select Mode : 0
Home Direction : Positive
B
Command : 0
Feedback : 0
C
Start
Stop
Set Param To Card
Load Param From Card
D
CIP LIP SMV HMV NSTP DEC ACC VM CSTP
SMELS SPELS MELS PELS ALMS EMGS ASTP VS
E
RDY SVON INP EZ EMG ORG MEL PEL ALM
F
Home_Search Mode = 0 ORG → Down → Stop
: Start Point
VS: Start Velocity
VM:Max Velocity
ORG
SD
EL
Case 1 (SD-inactive)
Case 2 (SD-inactive)
Case 3 (SD-inactive)
Case 1 (SD-active)
Case 2 (SD-active)
Case 3 (SD-active)
Reset
ORG Offset
VS
VM

Operation Instructions

A. Speed parameter of the homing profile. Refer to area F.

B. Mode setting for the homing function, selectable via pull-down menu.

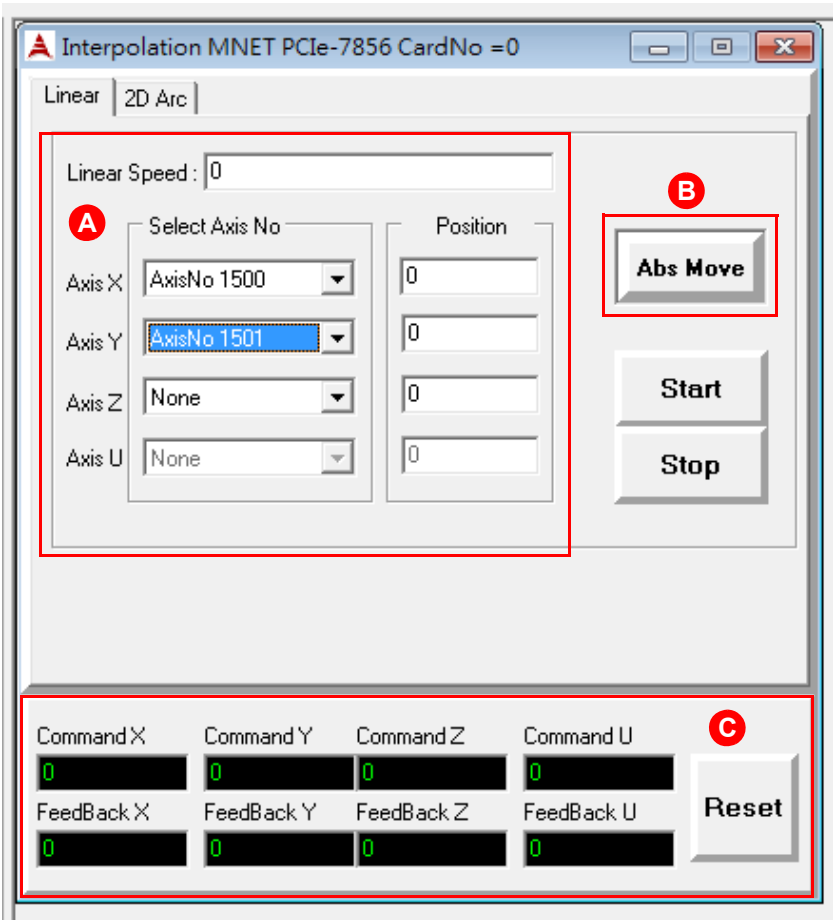
C. Command and position information while homing. After homing is complete, command will reset to zero.

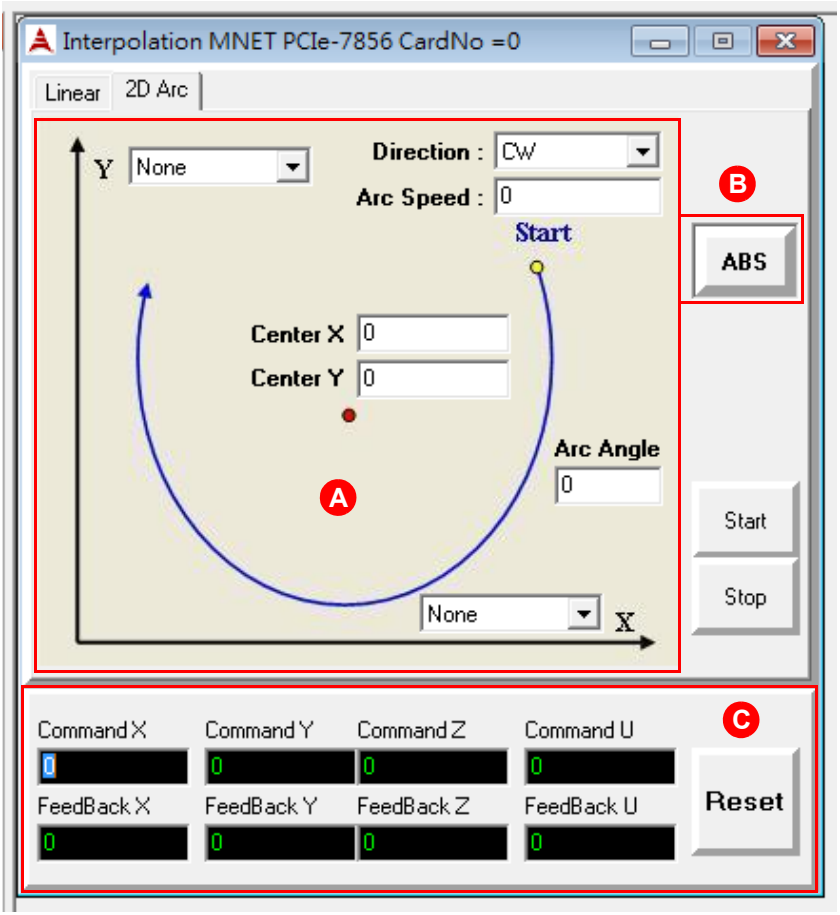
D. Buttons for “starting” and “stopping/aborting” the homing function.

E. Motion and I/O status while homing.

F. Timing chart for the homing function.

Interpolation




Interpolation MNET PCIe-7856 CardNo =0
Linear
2D Arc
Y
None
Direction :
CW
Arc Speed :
0
Start
ABS
Center X
0
Center Y
0
Arc Angle
0
A
B
Start
Stop
None
X
C
Command X
Command Y
Command Z
Command U
0
FeedBack X
FeedBack Y
FeedBack Z
FeedBack U
Reset

Operation Instructions

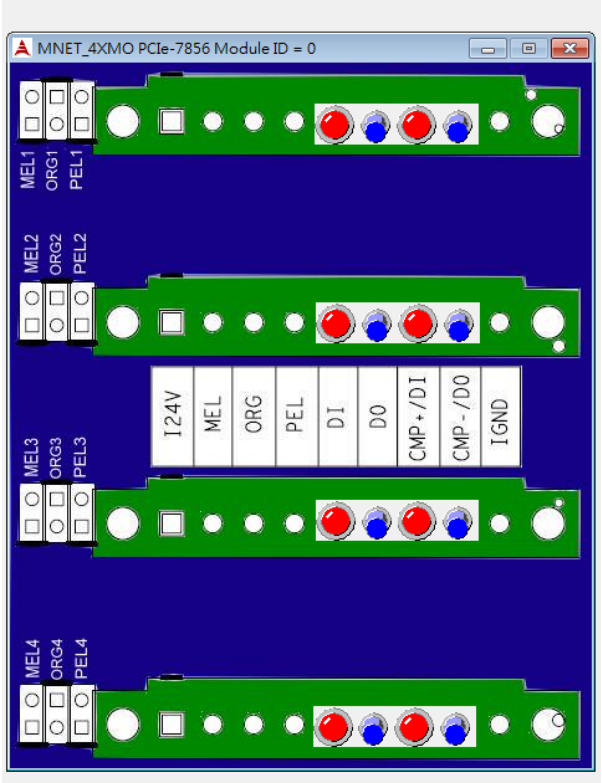
A. Interpolation axis selection and operation parameters, including center position in Arc mode or target position in Linear mode. The arc angle can be larger than 360.

B. Absolute or relative interpolation mode selection. In Arc mode, it relates to the center position. In Linear mode, it relates to the target position.

C. Command and position information. In Arc mode, only two will be active.

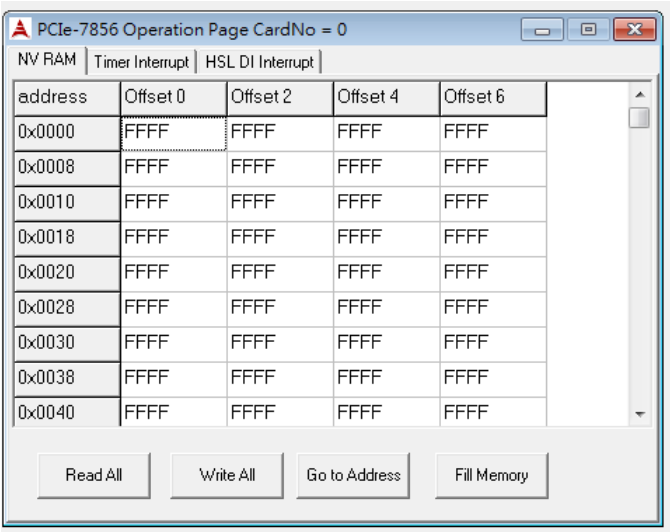
Dedicated Motion I/O status

Conveniently monitor and configure motion I/O channels.



NVRAM Read/Write Window

The PCIe-7856 is equipped with 32 kB of NVRAM. The read/write window provides direct access to this non-volatile memory.



5.4 MCP2 Error Codes

The meaning of error codes that may be returned by the MCP2 program are as follows:

- (-1) Operation system type mismatch
- (-2) Open device driver failed; driver interface creation failed
- (-3) Insufficient memory
- (-4) Cards not initialized
- (-5) Cards not found (no card in your system)
- (-6) Duplicate card IDs
- (-7) Cards have been initialized, check if different software has been enabled on same hardware device
- (-8) Card interrupt events not enabled or not initialized
- (-9) Function timed out
- (-10) Invalid function input parameters
- (-11) Set data to EEPROM failed
- (-12) Get data from EEPROM failed
- (-13) Function unavailable in this step; function unsupported by device; internal process failed
- (-14) Firmware error: please reboot the system
- (-15) Previous command is in process
- (-16) Duplicate axis ID
- (-17) Slave module not found
- (-18) Number of modules insufficient
- (-51) Set data to SRAM failed
- (-52) Get data from SRAM failed
- (-1000) Invalid INT value or WIN32_API error: please contact ADLINK support staff

6 Scan Time Table

6.1 Full-duplex Mode

Minimum scan times in full-duplex mode at different transmission speeds are as shown below.

Slave Index Number	Cycle Time at 2.5 Mbps	Cycle Time at 5.0 Mbps	Cycle Time at 10 Mbps	Cycle Time at 20 Mbps
Base Unit	60.67 µs	30.33 µs	15.17 µs	15.17 µs
< 3	182.00 µs	91.00 µs	45.50 µs	45.50 µs
5	303.33 µs	151.67 µs	75.83 µs	75.83 µs
10	606.67 µs	303.33 µs	151.67 µs	151.67 µs
20	1.213 ms	606.67 µs	303.33 µs	303.33 µs
30	1.820 ms	910.00 µs	455.00 µs	455.00 µs
40	2.427 ms	1.213 ms	606.67 µs	606.67 µs
50	3.033 ms	1.516 ms	758.33 µs	758.33 µs
60	3.640 ms	1.820 ms	910.00 µs	910.00 µs
63	3.822 ms	1.911 ms	955.50 µs	955.50 µs

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7 HSL-HUB/Repeater Information

7.1 Transfer Rates

Transfer rates at recommended total extension distances according to the number of inserted hubs/repeaters are as follows.

Transmission Rate	Number of Inserted Hubs/Repeaters							
	Basic Configuration (0)	1	2	3	4	5	6	7
3 Mbps	300 m	600 m	900 m	1.2 km	1.5 km	1.8 km	2.1 km	2.4 km
6 Mbps	200 m	400 m	600 m	800 m	1 km	1.2 km	1.4 km	1.6 km
12 Mbps	100 m	200 m	300 m	400 m	500 m	600 m	700 m	800 m

7.2 Scan Times

Full-duplex at 12 Mbps

Number of Inserted Hubs/ Repeaters	Slave Index Number		
	3 (Min.)	30	63 (Max.)
Basic Configuration (0)	45.50 µs	455.00 µs	955.50 µs
1	82.00 µs	820.00 µs	1722.00 µs
2	118.00 µs	1180.00 µs	2478.00 µs
3	154.00 µs	1540.00 µs	3234.00 µs
4	190.00 µs	1900.00 µs	3990.00 µs
5	226.00 µs	2260.00 µs	4746.00 µs
6	262.00 µs	2620.00 µs	5502.00 µs
7	298.00 µs	2980.00 µs	6258.00 µs

Full-duplex at 6 Mbps

Number of Inserted Hubs/ Repeaters	Slave Index Number		
	3 (Min.)	30	63 (Max.)
Basic Configuration (0)	91.00 µs	910.00 µs	1911.00 µs
1	164.00 µs	1640.00 µs	3444.00 µs
2	236.00 µs	2360.00 µs	4956.00 µs
3	308.00 µs	3080.00 µs	6468.00 µs
4	380.00 µs	3800.00 µs	7980.00 µs
5	452.00 µs	4520.00 µs	9492.00 µs
6	524.00 µs	5240.00 µs	11004.00 µs
7	596.00 µs	5960.00 µs	12516.00 µs

Full-duplex at 3 Mbps

Number of Inserted Hubs/ Repeaters	Slave Index Number		
	3 (Min.)	30	63(Max.)
Basic Configuration (0)	182.00 µs	1820.00 µs	3822.00 µs
1	328.00 µs	3280.00 µs	6888.00 µs
2	472.00 µs	4720.00 µs	9912.00 µs
3	616.00 µs	6160.00 µs	12936.00 µs
4	760.00 µs	7600.00 µs	15960.00 µs
5	904.00 µs	9040.00 µs	18984.00 µs
6	1048.00 µs	10480.00 µs	22008.00 µs
7	1192.00 µs	11920.00 µs	25032.00 µs

Important Safety Instructions

For user safety, please read and follow all instructions, Warnings, Cautions, and Notes marked in this manual and on the associated device before handling/operating the device, to avoid injury or damage.

S'il vous plaît prêter attention stricte à tous les avertissements et mises en garde figurant sur l'appareil , pour éviter des blessures ou des dommages.

- Read these safety instructions carefully.
- Keep the User's Manual for future reference.
- Read the Specifications section of this manual for detailed information on the recommended operating environment.
- The device can be operated at an ambient temperature of 55ºC.
- When installing/mounting or uninstalling/removing device, or when removal of a chassis cover is required for user servicing:
  - Turn off power and unplug any power cords/cables.
  - Reinstall all chassis covers before restoring power.
- To avoid electrical shock and/or damage to device:
  - Keep device away from water or liquid sources.
  - Keep device away from high heat or humidity.
  - Keep device properly ventilated (do not block or cover ventilation openings).
  - Always use recommended voltage and power source settings.
  - Always install and operate device near an easily accessible electrical outlet.
  - Secure the power cord (do not place any object on/over the power cord).
  - Only install/attach and operate device on stable surfaces and/or recommended mountings.
- If the device will not be used for long periods of time, turn off and unplug it from its power source
- Never attempt to repair the device, which should only be serviced by qualified technical personnel using suitable tools

- A Lithium-type battery may be provided for uninterrupted backup or emergency power.

Risk of explosion if battery is replaced with one of an incorrect type; please dispose of used batteries appropriately.
Risque d'explosion si la pile est remplacée par une autre de type incorrect. Veuillez jeter les piles usagées de façon appropriée.

- The device must be serviced by authorized technicians when:
  - The power cord or plug is damaged.
  - Liquid has entered the device interior.
  - The device has been exposed to high humidity and/or moisture.
  - The device is not functioning or does not function according to the User's Manual.
  - The device has been dropped and/or damaged and/or shows obvious signs of breakage.
- Disconnect the power supply cord before loosening the thumbscrews and always fasten the thumbscrews with a screwdriver before starting the system up.
- It is recommended that the device be installed only in a server room or computer room where access is:
  - Restricted to qualified service personnel or users familiar with restrictions applied to the location, reasons therefor, and any precautions required.
  - Only afforded by the use of a tool or lock and key, or other means of security, and controlled by the authority responsible for the location.

BURN HAZARD
Touching this surface could result in bodily injury. To reduce risk, allow the surface to cool before touching.
RISQUE DE BRÛLURES
Ne touchez pas cette surface, cela pourrait entraîner des blessures.
Pour éviter tout danger, laissez la surface refroidir avant de la toucher.

Getting Service

Ask an Expert: http://askanexpert.adlinktech.com

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