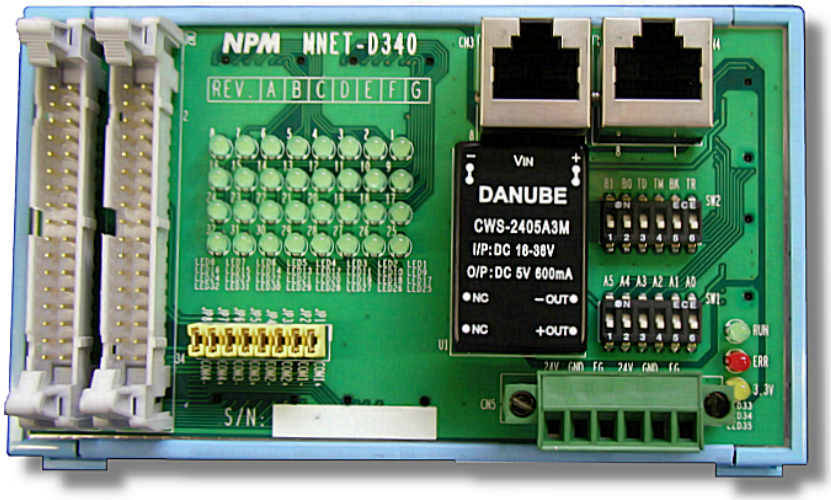
Motionnet
Remotel/O & RemoteMotion

Local Input Board

MNET-D340

Instruction Manual



NPM
Nippon Pulse Motor Co., Ltd.

Table of Contents

1. Preface

Thank you for purchasing our input board, a local board from our Motionnet ultra-high speed serial communication system series.

□

The MNET-D340 board you have purchased is a 32-point parallel input board which contains a G9002 IO device for ultra-high speed serial communication.
This board is controlled by a center board, which is equipped with a G9001A Motionnet Center device. Use the center board together with this board.

□

Motionnet

Motionnet is an ultra-high-speed serial communication system created by NPM (Nippon Pulse Motor). Using our four specially developed devices (G9001A, G9002, G9003, and G9004) as core chips, this serial communication system is a complete system for reducing wiring while affording remote operation by emulating a CPU and handling CPU message communications, as well as controlling input and output, at transfer speeds of 20 Mbps.

Device

G9001A: Center device

This is a central controller that manages local devices. This device has 256 bytes of RAM for I/O control, and 512 bytes for data communication. This device can be operated from a remote CPU just like accessing a memory. It can be connected to a maximum of 64 local devices (G9002, G9003, and G9004).

G9002: IO device

This is a local I/O control device that can control 32 separate I/O signals.

G9003: PCL device

This is a local device containing a pulse control LSI that has been developed and polished by NMP for use in motion control over many years. It also has a serial communication function. It can control single-axis pulse input type stepper motors and servomotors.

G9004: CPU emulation device

This is the most sophisticated local device in the Motionnet series, and it can remotely control other LSIs that need a connection to a CPU (for example a PCL6045B made by NPM). By connecting a CPU to its local side, it can also communicate messages between CPUs.

RemoteI/O

If a Motionnet line is only used for input and output control, it can send and receive signals for 2048 points on 64 local devices in 0.97 msec (using a 20 Mbps data transfer speed). (If a smaller number of devices are connected, the data transfer time will be proportionally shorter.)

RemoteMotion

If a Motionnet line is only used to control motors, it can control up to 64 axes. With this type of control, individual devices can control pulse-input type stepper motors and servomotors. They can execute continuous operations at constant speed, linear acceleration/deceleration, and S-curve acceleration/deceleration, as well as carry out preset positioning operations, and zero return operations.

A system combining these two motor types is also possible.
Although it depends on the number of devices connected and the data transfer speed selected, the cable length can be extended up to 100 m using an ordinary CAT5 LAN cable.
The serial communication uses a receive-respond type protocol. This protocol adds a CRC number to the communication frame to detect errors, thus offering higher reliability. You can use it without worrying about the accuracy of the communication.

□

This instruction manual describes the specifications and methods for using the MNET-D340. We want you to read this manual thoroughly and get full use of the functions offered by this board.

This manual does not describe the detailed functions of the G9001A and G9002 LSIs for ultra-high-speed serial communication systems.
For the details about the functions and registers of these LSIs, please read NPM's "User's Manual for the G9001A/G9002, LSIs for the Motionnet ultra-high speed serial communication system."

2. Features

Data transfer speed

20 Mbps, maximum

Data transfer cycle

A maximum of 0.97ms, when using 64 I/O boards.
(At a transfer speed of 20 Mbps, and using our recommended 50 m cable.)

Number of devices that can be connected

Maximum 64 I/O boards/line, with 2048 points connected.

Connection method

Multi-drop connections using LAN cables.

Serial communication types

Three types of communication are available.

1) System communication
   By polling the Motionnet line, the number of local devices that are connected, the device numbers, device types, and I/O port allocation status can all be checked.
2) Cyclic communication
   The system starts communication with the local device that has the lowest device number. When the communication cycle reaches the device with the highest device number, the system starts over again, communicating with the device that has the lowest device number. The process of communicating with all active devices, from the lowest to the highest device, is one cycle. The system always repeats this communication cycle, automatically.
   Input and output are controlled using cyclic communication.
3) Data communication
   This type of communication is used to read and write data between a PCL device and a CPU emulation device.
   Data is written into a FIFO buffer in the center device, and then a send command is issued. These communications are sent and received automatically, during the interrupt driven cyclic communications.

Communication error detection

Errors can be detected by adding CRC numbers to the serial communication frames.

Input

- Number of input points: 32 points
- Isolation method: Photocouplers

Common input specifications

8 input points are configured as one group. This group is independent from all other groups. Each group has one common line. Using jumpers, they can be connected to the power supply that is also supplying power to the power connector.

3. Handling Precautions

Inputting power

Do not connect or disconnect connectors while this board or peripheral circuits are supplied with power.

Static electricity

This board uses a CMOS device. Therefore this board must be stored in a package in which it was shipped until you actually use it, in order to prevent damage from static electricity.

Switch settings

This board is equipped with switches to set device number and details for serial communications. Be sure to shut off the power supply to the board before changing these switches.

Connections to electrically noisy devices

Interference from excessively noisy devices or from power surges on the power and I/O circuits may cause the board to malfunction. To connect to a device, which may generate electrical noise, we recommend taking countermeasures, such as attaching a protective circuit to the input/output circuits. However, it is best not to share the same power supply with noise generating sources.

Heat generation of circuit elements

Input resistors, output transistor arrays, and other elements may generate heat and thus become hot, depending on the operating conditions. If this happens, take steps such as using forced cooling.

4. Warranty Period and Coverage

Warranty period

12 months after being shipped from our factory.

Warranty coverage

During the warranty period, we will repair without charge any problems on the board that occurred while it was being used appropriately, and where the cause of the problem is due to us.
However, the following cases will be not be covered by the warranty, even if the warranty period has not expired.

- Problems caused by inappropriate handling or use.
- Problems caused by using parts not made or approved by us.
- Problems caused by modifications made to the board that were not authorized by NPM.
- Problems caused by disasters, accidents, or fires.

We warranty only the product as delivered, and we do not accept responsibility for any loss caused by a fault in our product. We will repair the board when the user sends it to our plant.

5. Specifications

Specifications of this board are shown below.

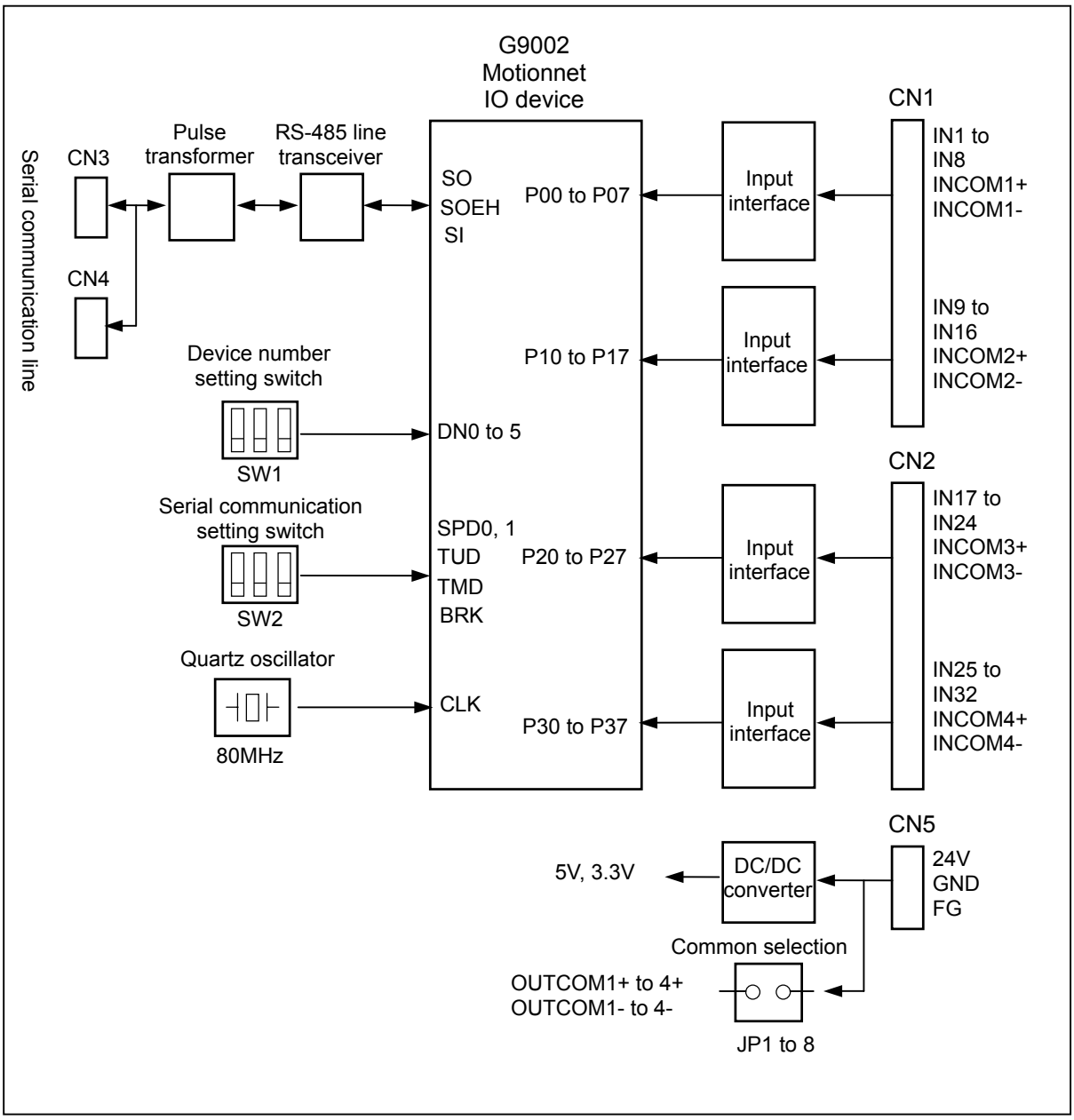
Item	Signal name	Specifications
Cyclic communication times and data transfer cycles		Maximum of 0.12 msec, when using 8 devices. #1 Maximum of 0.24 msec, when using 16 devices. #1 Maximum of 0.49 msec, when using 32 devices. #1 Maximum of 0.97 msec, when using 64 devices. #2 (Data transfer speed: 20 Mbps, when using our recommended cable #1:100m, #2: 50m)
Total serial communication line length		Maximum of 100 m (At a data transfer speed of 20 Mbps with 32 devices connected) Maximum of 50 m (At a data transfer speed of 20 Mbps with 64 devices connected) Maximum of 100 m (At a data transfer speed of 10 Mbps with 64 devices connected) (Using our recommended cables)
Serial communication interface		Pulse transformer and RS-485 specification line transceiver
Serial communication protocol		Our proprietary protocol
Serial communication coding method		NRZ signed
Serial communication method		Half-duplex communication
Connection method		Multi-drop connection using a LAN cable or our proprietary cable.
Serial communication device number	SW1- A0 to A5	Assignable device numbers, 0 to 63. Set using switches.
Serial communication transfer speed	SW2- B0, B1	20 Mbps/10 Mbps/5 Mbps/2.5 Mbps Set using switches.
Output status setting when a communication error occurs	SW2-TD	Maintain current status / Reset Select one using a switch (The selected output is used when the watchdog timer times out during communication)
Watchdog timer setting	SW2-TM	When 20 Mbps is selected: 20 msec. / 5 msec. When 10 Mbps is selected: 40 msec. / 10 msec. When 5 Mbps is selected: 80 msec. / 20 msec. When 2.5 Mbps is selected: 160 msec. / 40 msec. Select one of the above using a switch. (This is the data sending interval allowed by the center device.)
Break frame request	SW2-BK	Send a break frame. Set using a switch.
Termination resistance setting	SW2-TR	Enable termination resistance on the last device on a serial line. Set using a switch.
Display serial communication status	RUN ERR	RUN: While receiving serial communications normally, the green LED is lit. ERR: When a serial communication error occurs continuously, the red LED is lit.
Input/output status display		Input: The green LED goes on when the input photocoupler turns on. Output: The red LED goes on when the output transistor turns on.
Selection of a common line	JP1 to 8	Connection between the input/output circuit commons and CN5, the input power terminal. Set using a jumper connector.
G9002 reference clock		80 MHz

Item	Signal name	Specifications
Input		- Number of points: 32 (one common line for each 8 points) - Photocoupler input (sink type output) - Input signal voltage: 24 VDC - Input signal current: 4.2 mA/point (Typ.) - Response time: 55 msec (Typ.)
Power requirements	CN5-24 V, GND	24 VDC±10%, 55 mA (Typ.) (The current value given above is true when 24 VDC is input and there is no connection with the input/output circuit common.)
Power indicator	3.3 V	Yellow LED Indicates that 3.3 VDC internal control power is being output.
Operating temperature range *1		0 to +40˚C
Operating ambient humidity		80%RH or less (Non condensing through the +10˚C to +40˚C range)
Vibration proof		Complies with JIS C0040
Installation method		Using DIN rail. (DIN rails are not supplied as accessory.)
Dimensions		W124x D72.5 x H50 (Unit: mm)

*1: The input current resistors have a loss of 0.12 W per point. Consider the heat generated by these transistors in use.

6. Configuration

A block diagram is shown below.



7. Connector Pin Assignment

7-1. CN1 (input signal connector 1)

Connect 16 points of input signals.

No.	Signal name	Function	No.	Signal name	Function
1	IN1	Input signal 1	2	INCOM1+	Input signal common 1+
3	IN2	Input signal 2	4	INCOM1+	Input signal common 1-
5	IN3	Input signal 3	6	INCOM1+	Input signal common 1+
7	IN4	Input signal 4	8	INCOM1+	Input signal common 1-
9	IN5	Input signal 5	10	INCOM1+	Input signal common 1+
11	IN6	Input signal 6	12	INCOM1+	Input signal common 1-
13	IN7	Input signal 7	14	INCOM1+	Input signal common 1+
15	IN8	Input signal 8	16	INCOM1-	Input signal common 1-
17	IN9	Input signal 9	18	INCOM2+	Input signal common 2+
19	IN10	Input signal 10	20	INCOM2+	Input signal common 2-
21	IN11	Input signal 11	22	INCOM2+	Input signal common 2+
23	IN12	Input signal 12	24	INCOM2+	Input signal common 2-+
25	IN13	Input signal 13	26	INCOM2+	Input signal common 2+
27	IN14	Input signal 14	28	INCOM2-	Input signal common 2-
29	IN15	Input signal 15	30	INCOM2+	Input signal common 2+
31	IN16	Input signal 16	32	INCOM2-	Input signal common 2-
33	INCOM2+	Input signal common 2+	34	INCOM2-	Input signal common 2-

7-2. CN2 (input signal connector 2)

Connect 16 points of input signals.

No.	Signal name	Function	No.	Signal name	Function
1	IN17	Input signal 17	2	INCOM3+	Input signal common 3+
3	IN18	Input signal 18	4	INCOM3-	Input signal common 3-
5	IN19	Input signal 19	6	INCOM3+	Input signal common 3+
7	IN20	Input signal 20	8	INCOM3-	Input signal common 3-
9	IN21	Input signal 21	10	INCOM3+	Input signal common 3+
11	IN22	Input signal 22	12	INCOM3-	Input signal common 3-
13	IN23	Input signal 23	14	INCOM3+	Input signal common 3+
15	IN24	Input signal 24	16	INCOM3-	Input signal common 3-
17	IN25	Input signal 25	18	INCOM4+	Input signal common 4+
19	IN26	Input signal 26	20	INCOM4-	Input signal common 4-
21	IN27	Input signal 27	22	INCOM4+	Input signal common 4+
23	IN28	Input signal 28	24	INCOM4-	Input signal common 4-
25	IN29	Input signal 29	26	INCOM4+	Input signal common 4+
27	IN30	Input signal 30	28	INCOM4-	Input signal common 4-
29	IN31	Input signal 31	30	INCOM4+	Input signal common 4+
30	IN32	Input signal 32	32	INCOM4-	Input signal common 4-
31	INCOM4+	Input signal common 4+	34	INCOM4-	Input signal common 4-

7-3. CN3, 4 (serial communication connector)

Connect the Motionnet serial signal. The corresponding pins of CN3 and CN2 are internally connected.

No.	Signal name	Function	No.	Signal name	Function
1	N.C.	-	2	N.C.	-
3	RS485+	Serial communication data+	4	N.C.	-
5	N.C.	-	6	RS485-	Serial communication data-
7	N.C.	-	8	N.C.	-

Note 1: N.C. means Not Connected.

Note 2: The connector frames are connected to the FG terminal on the power connector.

7-4.CN5 (power connector)

Power connections

No.	Signal name	Function	No.	Signal name	Function
1	24V	Power, 24 VDC	2	GND	Ground
3	FG	Frame ground	4	24V	Power, 24 VDC
5	GND	Ground	6	FG	Frame ground

7-5. Connectors used

The manufacturer model names of the connectors used on this board are shown below.

Nbr.	Mfg.	Model name	Remarks
CN1	3M	3431-6002LCSC or equivalent	MIL standard, 34-pin box pin header
CN2	〃	〃	〃
CN3	Hirose Electric	TM11R-3C-88 or equivalent	8-pin modular jack connector
CN4	〃	〃	〃
CN5	Omron	Board side: XW4A-06B1-V1 or equivalent Cable side: XW4B-06B1-H1 or equivalent	Connector terminal block 3.81 mm pitch

This board does not come with connectors for other devices owned by the user.

To choose these connectors, we recommend the following items.

Nbr.	Item name	Mfg.	Model name	Remarks
For CN1	Connector	3M	7934-6500SC 3448-7934	Crimp connector, 1.27 mm pitch for flat cable, with a strain relief
For CN2	〃	〃	〃	〃
For CN3	Modular plug	Hirose electric	TM11P-88P	Modular plug, with a shield
For CN4	〃	〃	〃	〃

8. Signals and Functions

8-1. Input signal (IN, INCOM*+, INCOM*-)*

Function

These are input signals for general use.

Input signal interface

1) Number of input signal points

This board has 32 parallel input signal points, and a + common and a - common for each group of 8 points. The commons can be connected to the power that is supplied to the power connector using jumper lines JP1 to JP8.

2) The input signal terminals are assigned to the following terminals on the G9002.

IN1 to 8: P00 to P07, IN 9 to 16: P10 to P17

IN17 to 24: P20 to P27, IN 25 to 32: P30 to P37

3) The open collector input signals are isolated from the internal power supply using photocouplers (TLP280 or equivalent)

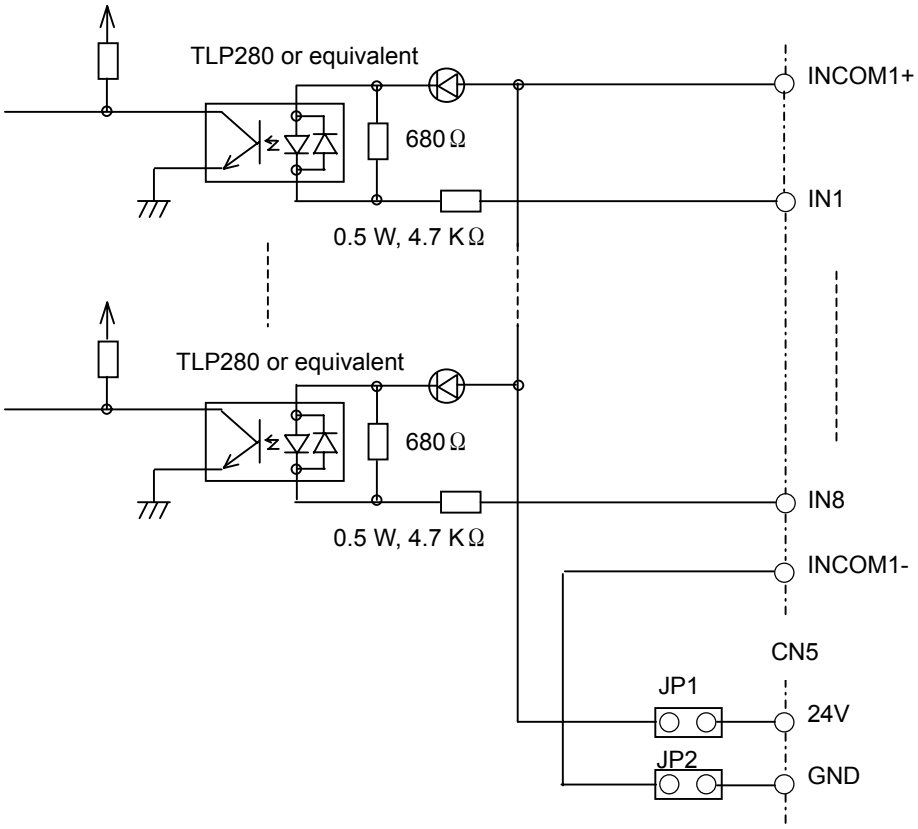
4) Logic

Photo couplers are turned on when 'active-high'. (Positive logic)

(By turning on a photocoupler, the respective input bit will become "1.")

[Input signal specifications]

- Input signal voltage: 24 VDC
- Input signal current: 4.2 mA (Typ.)
- Response time: 55 µsec. (Typ.)



5) Common signal lines and jumpers

Common	JP	Common	JP
INCOM1+	JP1	INCOM1-	JP2
INCOM2+	JP3	INCOM2-	JP4
INCOM3+	JP5	INCOM3-	JP6
INCOM4+	JP7	INCOM4-	JP8

8-2. Serial communication (RS485+, RS485-)

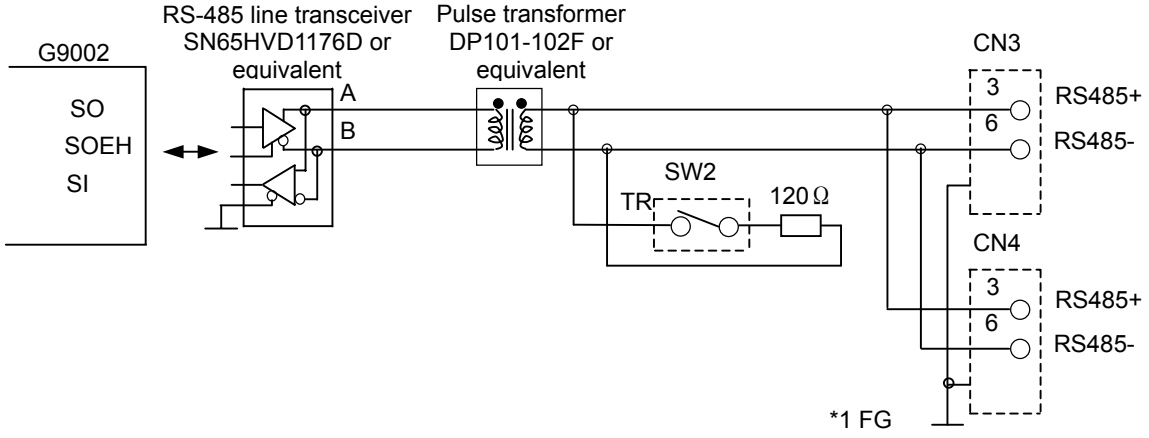
Function

These are the Motionnet serial signals.

Interface

1) Serial communication signals are isolated by using a pulse transformer. They are input and output by a line transceiver (SN65HVD1176D or equivalent) that meets the RS-485 specifications.
The board inputs/outputs the forward phase of the line transceiver through the RS485 plus side and the reverse phase through the RS485 minus side terminals.

2) Termination resistance
In order to prevent reflection of the serial communication line signals, termination resistors must be present at the start and end points of the line.
The serial communication setting witch (SW2) is used to enable/disable the termination resistance. By turning on this switch, the termination resistance of 120 ohm is enabled on the board. Be sure to turn this switch on if the board is the last one on the serial communication line.



*1: The connector frame is connected to the FG terminal of power connector.

8-3. Power requirements (24V, GND, FG)

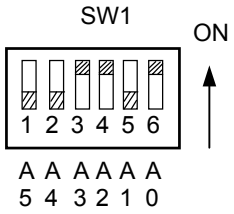
Function

These are terminals used to supply control power to the board. The 5 V and 3.3 V internal control voltages are created from these lines using an isolated DC/DC converter.
The power terminals can be connected to the common lines of the input/output signal circuits using jumpers.
The frame ground (FG) is connected to the serial communication connector case. Be sure to ground the FG to the ground.

9. Settings

9-1. Setting the serial communication device number (SW1)

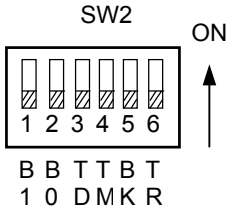
Set the device number for Motionnet serial communication using switch SW1.
Set a device number that is not being used by any other device on the same serial communication line.
You do not need to set the device numbers sequentially. Pick any number between 0 and 63.
Switches A0 to A5 correspond to the values 1, 2, 4, 8, 16, and 32, respectively. The device number will be the sum of the numbers for the switches that are turned on.
When delivered, the device number is set to 0.



The example on the left means “13d” in decimal or “Dh” in hexadecimal.

9-2. Setting the serial communication parameters (SW2)

Set the parameters for Motionnet serial communications using switch SW2.
When delivered, all these switches are off.



9-2-1. Setting the data transfer speed (B0, B1)

Specify a data transfer speed. Use switches B0 and B1 to choose from four speeds.

B1 (SW2-1)	B0 (SW2-2)	Transfer speed
OFF	OFF	20 Mbps
OFF	ON	10 Mbps
ON	OFF	5 Mbps
ON	ON	2.5 Mbps

9-2-2. Setting the output signal status to use when a communication error occurs (TD)

Select the output signal state to use when the communication status watchdog timer times out. Choose from the desired setting below using the TD switch.

TD (SW2-3)	Output signal status
OFF	Maintains the current status of the output signal
ON	Turns off the output signal transistor (reset status)

The signal inputs will not be affected by this setting.

9-2-3. Setting the watchdog timer (TM)

Set the time for the watchdog timer that is used to monitor the communication status. When the interval between data communications from a center board, on which the G9001 is mounted, exceeds the time set here, the watchdog timer will time out.
Possible causes of a time out are an abnormality on the serial communication line, and that the center board communication has stopped.
This interval time varies with the data transfer time selected.

TM (SW2-4)	Watchdog timer time out interval			
	At 20 Mbps	At 10 Mbps	At 5 Mbps	At 2.5 Mbps
OFF	5 ms	10 ms	20 ms	40 ms
ON	20 ms	40 ms	80 ms	160 ms

9-2-4. Break frame request (BK)

This function is used to add to the number of local boards, or to restore a specific local board that has previously been excluded from cyclic communication due to a communication error.
The center board on which the G9001 is mounted sends regular break frame sending request data (approximately every 250 ms at 20 Mbps) to local devices. A local device, which has sent a break frame request, will respond this communication from the center device.
When the center board confirms the response, the corresponding status bit “BRKF” will be changed to “1” and an interrupt will occur.
With this sequence, the center board realizes that a local board has been added to the communication line.

BK (SW2-5)	Break frame
OFF	-
ON	Break frame request

9-2-5. Setting the termination resistance (TR)

Set the termination resistance on a serial communication line. Turn the switch on to enable the termination resistance.

TR (SW2-6)	Termination resistance
OFF	-
ON	Enable the termination resistance

10. Status Display

10-1. Communication status display LED (RUN)

When the G9002 in the local board receives serial communications data successfully, the MSEL LED will be lit green.
If there are a lot of local boards connected to the serial communication line, the LED may be somewhat dimmed. This LED is green.

10-2. Communication status display LED (ERR)

When an error occurs, such as a CRC error in the serial communication data, the G9002 MRER LED is lit red.

10-3. Power indicator LED (3.3 V)

Shows that 3.3 VDC is available internally. Lights yellow.

10-4. Input/Output signal display LED

When any of the input/output signals goes on, this LED goes on.
It lights green when inputs signals are detected and it lights red when output signals are sent.

11. Serial Communication Connection Cable

This system guarantees enhanced quality for high-speed communication, and is designed to be connected with LAN cables suitable for 100BASE and 1000BASE.
These are standard cables, easy to find and cheap. Therefore, we do not include these cables with our products.

To select cables you need to connect, make sure they meet the following specifications.

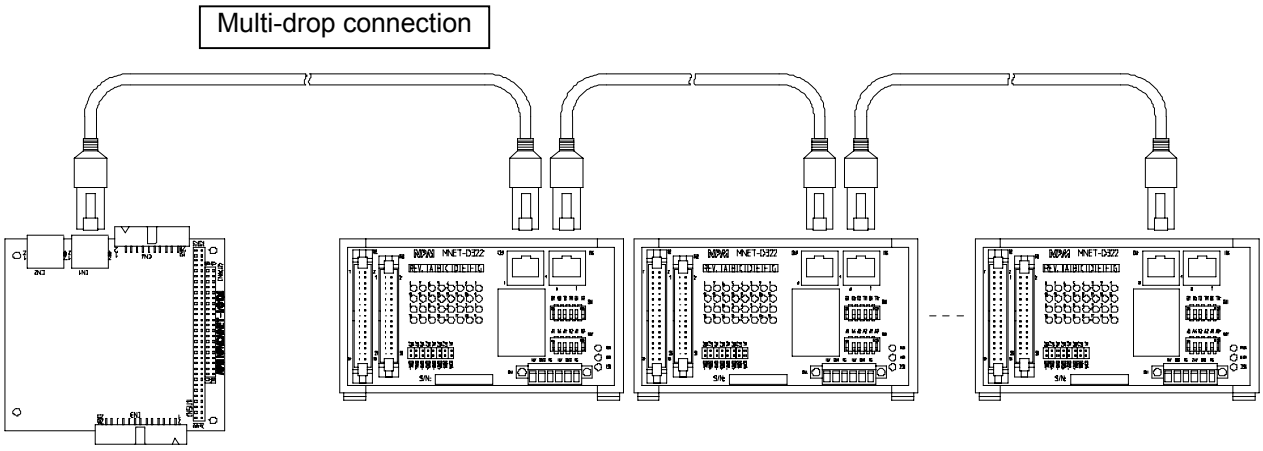
Wiring standard: TIA/EIA-568-B
- Category 5 (CAT5)
- Enhanced category 5 (CAT5e)
- Category 6 (CAT6)

UTP (UnShieldedTwistedPair) cables or STP (ShieldedTwistedPair) cables that meet the specifications above.

The higher the standard the cables meet, the more the communication quality will be improved. To use the board in an area with excessive electrical noise, use shielded cables (STP).

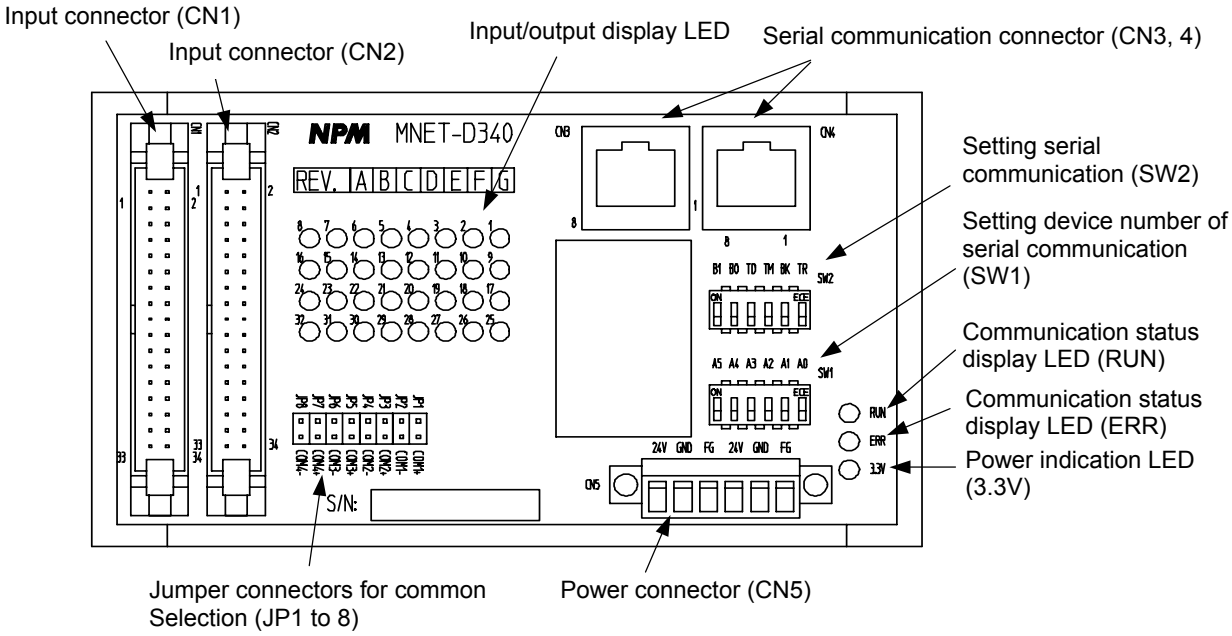
Observe the following when connecting your system.

1) Total serial line length
   This system employs a multi-drop connection method. The maximum total extension distance of the line varies, depending on the data transfer speed and the number of local boards that are connected.
   - Max. 100 m (Transfer speed; 20 Mbps with 32 local boards connected)
   - Max. 50 m (Transfer speed; 20 Mbps with 64 local boards connected)
   - Max. 100 m (Transfer speed; 10 Mbps with connecting 64 local boards connected)
2) Minimum cable length
   The shortest cable must be at least 60 cm long.
3) Do not mix cables of different types and model in the same serial line.
4) Keep the total serial line length as short as possible.
5) If you are 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.



12. Allocation of Switches and Connectors

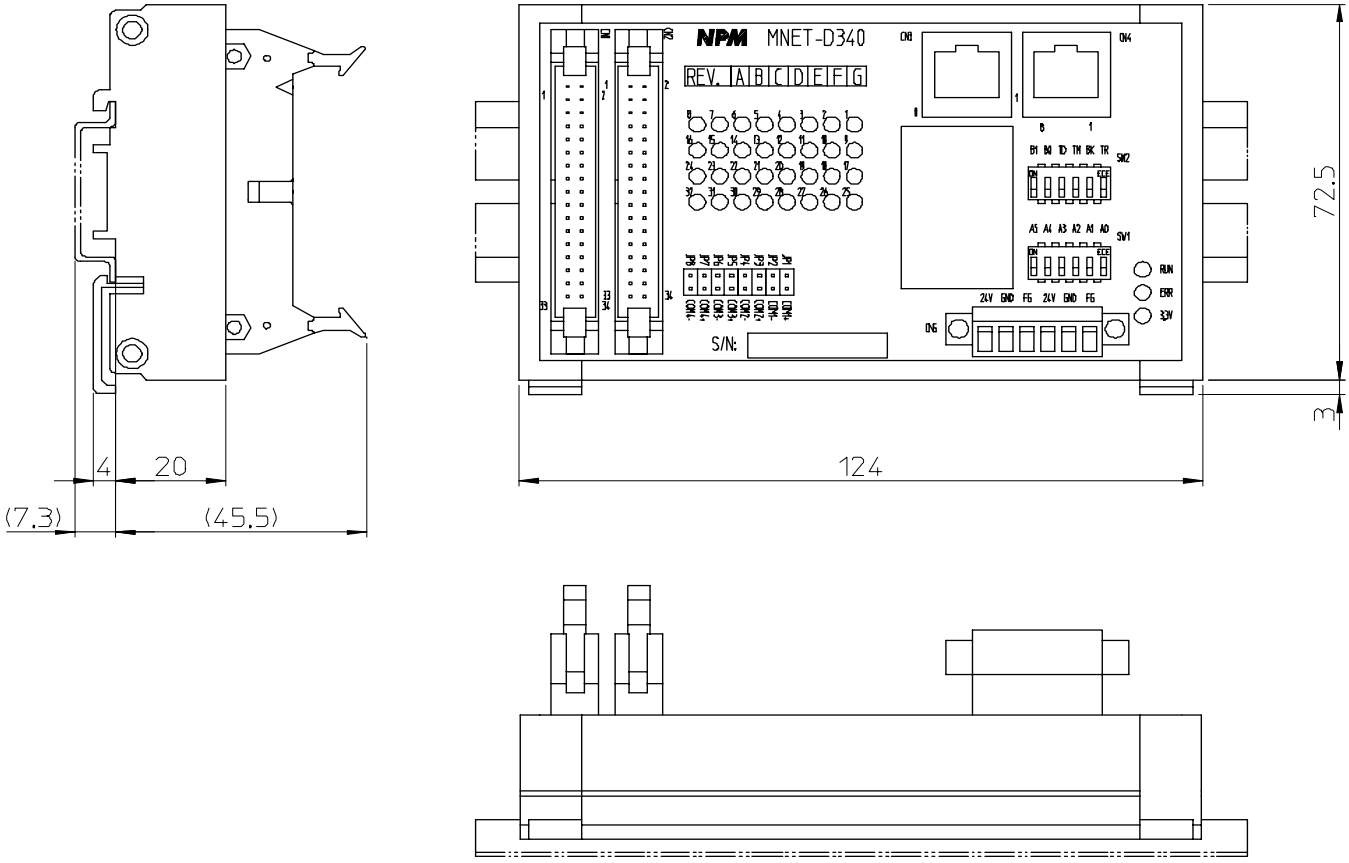
Shown below is the layout of the connectors and switches.



Item	Setting details	Item	Setting details
Serial communication device number assignment (SW1)	Assign a device number for serial communication. ON: 1, OFF: 0. The example below sets “13d” as the device number. (Default setting: “0d”) SW1 ON 1 2 3 4 5 6 A A A A A A 5 4 3 2 1 0	Serial communication assignment (SW2)	- Set transfer speed (B0, B1) B0 / B1 / Transfer speed: OFF/OFF 20 Mbps; ON/OFF 10 Mbps; OFF/ON 5 Mbps; ON/ON 2.5 Mbps - Set the output signal status to use when a communication error occurs (TD) TD: OFF – Maintain the current output status; ON – Turn off the output signal transistor (reset status) - Set the watchdog timer time (TM) TM: OFF – 20Mbps 5ms, 10Mbps 10ms, 5Mbps 20ms, 2.5Mbps 40ms; ON – 20Mbps 20ms, 10Mbps 40ms, 5Mbps 80ms, 2.5Mbps 160ms - Break frame request (BK) ON: Request a break frame - Set termination resistance (TR) ON: Use termination resistance (Default setting: All off) SW2 ON 1 2 3 4 5 6 B B T T B T 1 0 D M K R
Common selection connector (JP1to 8)	JP1 INCOM1+ / JP2 INCOM1- JP3 INCOM2+ / JP4 INCOM2- JP5 INCOM3+ / JP6 INCOM3- JP7 INCOM4+ / JP8 INCOM4- (Default setting: All open)		

13. External Dimensions

The external dimensions of this board are shown below. (DIN rails are not supplied as accessory for this board).



Unit: mm

CAUTION	The descriptions in this manual may be changed without prior notice to improve performance or quality.

NPM Nippon Pulse Motor Co., Ltd.

Tokyo business site: 6-1, Sakaecho, Tachikawa City, Tokyo, 190-0003, Japan
TEL: 81-42-534-7701 FAX: 81-42-534-0017
Osaka sales office: 1-2-1-2504, Benten, Minato Ward, Osaka city, 552-0007
TEL: 81-6-6576-8330 FAX. 81-6-6576-8335
E-mail: control@npm.co.jp URL: //http://www.pulsemotor.com/

Issued in March 2008