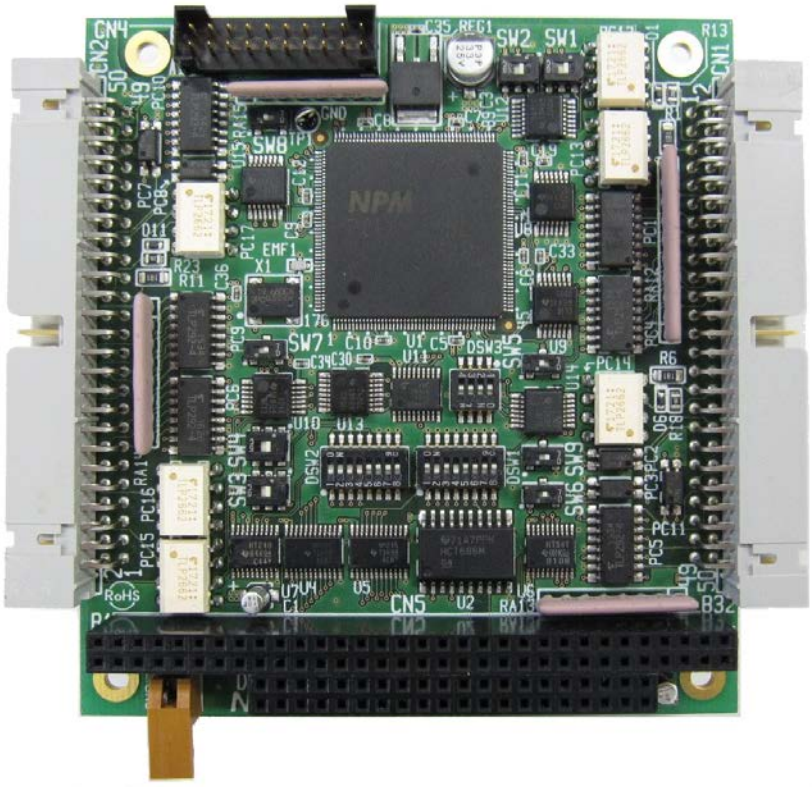
Motion Control Board

RoHS

# 4-axis control board (PC/104)

# NPMC6045A-4104C

# User's Manual



NPM Impress, not just satisfy
Nippon Pulse Motor Co., Ltd.

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## [Product Warranty]

### ●In the case of purchase from a supplier other than NPM

Regarding the product warranty in the case of purchase from a supplier other than NPM, please contact to the supplier

### ●Warranty period

The warranty period is one year from the date of the delivery to an assigned place.

### ●Warranty scope

If defects are found in the product during the warranty period under normal use following this document, NPM will repair the product without charge. However, the following cases are not covered by the warranty and free repair does not apply to the product even during the warranty period.

- The products are modified or repaired by anyone other than NPM or an authorized person by NPM.
- The defect results from falling of the product after delivery or mishandling in transit.
- -Wearing of components, natural deterioration or fatigue (motor axle bearing, gear, grease, cables, etc.)
- The defect results from any use other than original use.
- The product has been subjected to natural disaster or force majeure such as fire, earthquake, lightning strike, wind and flood, salt, and electrical surges.
- The defects or damage results from the cause other than the fault of NPM.

Note 1) The products exported to outside Japan are not covered by the warranty.
Note 2) Only if the product with defects is carried to the specific place to repair, NPM will repair the product. NPM will not provide on-site repair.
Note 3) The warranty period of the repaired product is not extended beyond the warranty period of the product before the failure. It is the same as the warranty product of the product before the repair.
Note 4) This warranty covers the product. It does not cover the detriments caused by the product's defects, etc.
Note 5) A replacement may be provided instead of a repair at the direction of NPM.

● This documents aims to describe the detail of the function of the product and it does not warrant fitness for a particular purpose of the customers.
The examples of application and circuit diagram in this manual are described for your reference. Please confirm the feature and the safety of device or equipment before use.

● Please do not use this product for the following use in principle.
If you use the product for the following use, please contact our sales department.

- Any equipment that may require high reliability or safety, such as nuclear facility, electricity or gas supply system, transportation facilities, vehicle, various safety system, medical equipment, etc.
- Any equipment that may directly affect human survival or property
- Usage under conditions or circumstances that are not specified in the brochure, manual, etc.

● When this product is used in any equipment where faults or malfunctions may directly affect human survival or property, please secure high reliability and security with redundancy design, etc..

## *1. Preface*

Thank you for purchasing a 4-axis control board (PC/104): NPMC6045A-4104C

□

The NPMC6045A-4104C is a 4-axis control board, for servomotors and stepper motors, that is equipped with an NPM PCL6045BL pulse control LSI, and it is compatible with PC/104 bus interface.
The PCL6045BL allows you to make linear interpolations between 2 to 4 axes, arc interpolations between any 2 axes, perform S-curve acceleration/deceleration, override the target position, and perform simple point-to-point positioning of motors.
This board has a 16-bit data bus. You can assign the I/O addresses on this board and set interrupts using switches.

□

The PC/104 standard is a small PC/AT IEEE P996 architecture. This standard uses a modified ISA bus design to reduce the size of PC/AT devices and to reduce current consumption.
This board can be controlled from a PC/AT (ISA) bus using a bus conversion board compatible with PC/104 devices.

This board comes with a program to check its operation. The program is written in 'C' and the program source is included, so that you can use it as a programming sample.

□

This instruction manual describes the specifications and methods for using the NPMC6045A-4104C. We want you to read this manual thoroughly and get full use of the functions offered by this board.

This instruction manual does not describe the detailed functions of the pulse control LSI: PCL6045BL.
For more details about the functions and registers of the PCL6045BL, please read NPM's "User's Manual for the Pulse control LSI PCL6045BL."

## *2. About Model Number*

The model number of this board is changed according to the following specifications after the release in 2003.

| Model number | Modification contents |
|---|---|
| NPMC6045A-4104 | New development |
| NPMC6045A-4104A | Mounted LSI is changed from PCL6045A to PCL6045B. |
| NPMC6045A-4104B | RoHS compliant |
| NPMC6045A-4104C | Mounted LSI is changed from PCL6045B to PCL6045BL. |

Each model's basic function is same and be compatible with each other.
Specifications of mounted LSIs are changed to improve functions.
Please see "Pulse control LSI PCL6045BL User's Manual" in detail.

## *3. Precautions*

### *3-1. Safety precautions*

When you operate stepper motors or servomotors, you must take the utmost care to keep people from entering the zone in which components are being moved by the motors.
In addition, provide an emergency stop mechanism to stop the motor operation instantly if a person is in danger.

### *3-2. Handling precautions*

**Inputting power**

Never connect or disconnect connectors and signal lines 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 that allow you to set addresses and input/output functions.
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.

**Connecting and disconnecting the PC/104 bus**

Forcible removal of the PC/104 bus connector may bend the connector pins and cause faulty contact. We recommend that you use a specialized tool to connect or disconnect this connector.

## 4. Feature of the PCL6045BL

This board is equipped an NPM PCL6045BL pulse control LSI.
This board can access the following functions found on this LSI.

**Acceleration/deceleration control**

Linear acceleration/deceleration and S-curve acceleration/deceleration are available.
Linear acceleration/deceleration can be inserted in the middle of an S-curve acceleration/deceleration curve.

**Interpolation operations**

Feeding while using linear interpolation between any two to four axes, and circular interpolation betweenany two axes, are both supported.

**Speed override**

The feeding speed can be changed in any of the operation mode.
(However, the feed speed cannot be changed during operation when the synthesized speed constant control for linear interpolation is ON while using S-curve deceleration.)

**Target position override**

1) The target position (feeding amount) can be changed while feeding in the positioning mode.
If the current position exceeds the newly entered position, the motor will decelerate and stop (immediately stop when already feeding at a low speed), and then feed in the reverse direction.
2) Operation starts at the same as the continuous mode. When an external signal is received, the PCL6045BL outputs specified number of pulses and the motor will stop.

**Triangle drive suppression function**

In the positioning mode, when a small number of pulses are output, this function automatically lowers the maximum speed and eliminates triangle driving.

**Pre-register function (Look-ahead function)**

Next two sets of data (feeding amount, initial speed, feeding speed, acceleration rate, deceleration rate, speed magnification rate, ramping-down point, operation mode, center of circular interpolation, S-curve range on an acceleration, S-curve range on a deceleration, number of steps for circular interpolation) can be written while executing current data. The next set of data, and other sets of data, can be written in advance of their execution for checking by the comparator.
When the current operation is complete, the system will immediately execute the next operation.
Using this function, the motor can operate continuously without stopping rotation.

**Comparators**

There are five comparator circuits for each axis. They can be used to compare target values and internal counter values.
The counter to compare can be selected from COUNTER1 (command position counter), COUNTER2 (mechanical position counter), COUNTER3 (deviation counter), and COUNTER4 (a general-purpose counter).
Comparators 1 and 2 can also be used as software limits (+SL, -SL).

**Software limit**

You can set software limits using two of the comparator's circuits.
When the mechanical position approaches the software limit range, the LSI will instruct the motors to stop immediately or to stop by deceleration. After that, it is possible to move in the direction opposite to the previous travel.

**Backlash correction/slip correction functions**

The LSI has a backlash correction function.

Each time the feed direction is changed, the LSI applies a backlash correction. The LSI uses a slip correction for each feed amount regardless of the feed direction. However, the backlash correction cannot be applied while performing a circular interpolation.

**A variety of counter circuits**

The following four counters are available separately for each axis.

| Counter | Purpose of use | Count input |
|---|---|---|
| COUNTER1 | 28-bit counter for control of the command position | Outputs pulses |
| COUNTER2 | 28-bit counter for mechanical position control (Can be used as general-purpose counter) | EA/EB input<br>Outputs pulses<br>PA/PB input |
| COUNTER3 | 16-bit counter for controlling the deviation between the command position and the machine's current position | Outputs pulses and EA/EB input<br>Outputs pulses and PA/PB input<br>EA/EB input and PA/PB input |
| COUNTER4 | 28-bit counter used to output synchronous signals (Can be used as general-purpose counter) | Outputs pulses<br>EA/EB input<br>PA/PB input<br>1/2 of reference clock |

All counters can be reset by writing a command or by providing a CLR signal.

They can also latch values by writing a command, or by providing an LTC or ORG signal. The PCL6045BL can also be set to reset automatically soon after latching these signals. The latched values can be read out from registers RLTC1 to RLTC4.

The COUNTER1, COUNTER2, and COUNTER4 counters have a ring count function that repeats counting through a specified counting range.

**Simultaneous start function**

Multiple axes controlled by the same LSI, or controlled by multiple sets of this LSI, can be started at the same time with a command or with an external signal.

**Simultaneous stop function**

Multiple axes controlled by the same LSI, or controlled by multiple sets of this LSI, can be stopped at the same time by a command, by an external signal, or by an error stop on any axis.

**Vibration restriction function**

Specify a control constant in advance and add one pulse each for reverse and forward feed just before stopping.

Using this function, vibration can be decreased while stopping.

**Manual pulsar input function**

By applying manual pulse signals, you can rotate a motor directly.

The input signals can be 90˚ phase difference signals (1x, 2x, or 4x) or up and down signals.

In addition to the magnification rates above, the PCL6045BL contains an integral pulse number magnification circuit, which multiplies by 1x to 32x, and a pulse quantity division circuit, which is divided by 1 to 2048.

Software limit settings can be used, and the PCL stops the output of pulses. It can also feed in the opposite direction.

**Out-of-step detection function**

This LSI has a deviation counter which can be used to compare command pulses and encoder signals (EA/EB).

It can be used to detect out-of-step operation and to confirm a position by using a comparator.

**Idling pulse output function**

This function outputs a preset number of pulses at the self-start frequency (FL) before a high-speed start acceleration operation.

When the initial speed is set higher during the acceleration/deceleration of a stepper motor, this function is effective in preventing out-of-step operation.

**Operation mode**

The basic operations of this LSI are: continuous operation, positioning, origin return, linear interpolation, and circular interpolation. By setting the optional operation mode bits, you can use a variety of operations.

<Examples of the operation modes>

1) Start/stop by command.
2) Continuous operation and positioning operation using PA/PB inputs (manual pulsar).
3) Operate for specified distances or in continuous operation using +DR/-DR signals (drive switch).
4) Origin return operation.
5) Positioning operation using commands.
6) Hardware start of the positioning operation using CSTA input.
7) Change the target position after turning ON the PCS. (Delay control)

**Variety of origin return sequences**

The following patterns can be used.

1) Feeds at low speed and stops when the ORG signal is turned ON
2) Feeds at low speed and stops when an EZ signal is received (after the ORG signal is turned ON).
3) Feeds at low speed, reverses when the ORG signal is turned ON, and stops when an EZ signal is received.
4) Feeds at low speed and stops when the EL signal is turned ON. (Normal stop)
5) Feeds at low speed, reverses when the EL signal is turned ON, and stops when an EZ signal is received.
6) Feeds at high speed, decelerates when the SD signal is turned ON, and stops when the ORG signal is turned ON.
7) Feeds at high speed, decelerates when the ORG signal is turned ON, and stops when an EZ signal is received.
8) Feeds at high speed, decelerates and stops after the ORG signal is turned ON. Then, it reverses feeds and stops when an EZ signal is received.
9) Feeds at high speed, decelerates and stops by memorizing the position when the ORG signal is turned ON, and stops at the memorized position.
10) Feeds at high speed, decelerates to the position stored in memory when an EZ signal is received after the ORG signal is turned ON. Then, returns to the memorized position if an overrun occurs.
11) Feeds at high speed, reverses after a deceleration stop triggered by the EL signal, and stops when an EZ signal is received.

**Mechanical input signal**

The following four signals can be input for each axis.

1) PEL (+EL)

When this signal is turned ON, while feeding in the positive (+) direction, movement on this axis stops immediately (with deceleration). When this signal is ON, no further movement occurs on the axis in the positive (+) direction. (The motor can be rotated in the negative (-) direction.)

2) MEL (-EL)

Functions the same as the +EL signal except that it works in the negative (-) direction.

3) SD

This signal can be used as a deceleration signal or a deceleration stop signal, according to the software setting. When this is used as a deceleration signal, and when this signal is turned ON during a high

speed feed operation, the motor on this axis will decelerate to the FL speed. If this signal is ON and movement on the axis is started, the motor on this axis will run at the FL low speed. When this signal is used as a deceleration stop signal, and when this signal is turned ON during a high speed feed operation, the motor on this axis will decelerate to the FL speed and then stop.

4) ORG

Input signal for an origin return operation.

For safety, make sure the PEL (+EL) and MEL (-EL) signals stay on from the EL position until the end of each stroke.

The input logic for these signals can be changed using the switches.

The input logic of the SD and ORG signals can be changed using software.

**Servomotor interface**

The following three signals can be used as an interface for each axis

1) INP

Input positioning complete signal that is output by a servomotor driver.

2) ERC

Output deviation counter clear signal to a servomotor driver.

3) ALM

Regardless of the direction of operation, when this signal is on, movement on this axis stops immediately (deceleration stop). When this signal is on, no movement can occur on this axis.

The input logic of the INP, ERC, and ALM signals can be changed using software.

The ERC signal is a pulsed output. The pulse length can be set. (12 µsec to 104 msec. A level output is also available.)

**Output pulse specifications**

Output pulses can be set to a CW/CCW method (2-pulse mode) , Direct method (common pulse) or 90° phase difference mode. The output logic can also be selected.

**Emergency stop signal (CEMG) input**

When this signal is turned ON, movement on all axes stops immediately. While this signal is ON, no movement is allowed on any axes.

**Interrupt signal output**

An INT (interrupt request) can be output for many reasons.

The INT terminal output signal can use ORed logic for lots of conditions on each axis.

[Precautions]

Please note that this board cannot use the following PCL6045BL signals. Therefore, you cannot use the simultaneous signal output function, direct input to the operation switches, and other features.

- Hardware start input using external switches (+DRx to +DRu, -DRx to -DRu)
- General-purpose I/O (P3x to P3u, P4xt o P4u, P5x to P5u, P6x to P6u, P7x to P7u)
- Counter reset input (CLRx to CLRu)
- Counter latch input (LTCx to LTCu)
- Operation signal output (BSYx to BSYu)

## *5. Specifications*

Here are the specifications for this board.

| Item | Signal name | Specifications |
|---|---|---|
| Bus line | | PC/104 bus version 2.4 compatible. 16-bit data bus |
| Number of I/O addresses | | 32 bytes<br>(Set SA5 to SA15 using switches. SA1 to SA4 are used by the PCL6045BL) |
| Interruption | IRQ | Can be set to line 3, 4, 5, 6, or 9<br>Obtain an INT interrupt signal from the PCL6045BL and set the IRQ line to use for interrupts using the switches. |
| Number of axes controlled | | 4 axes<br>(Axes "x" to "u" on the PCL6045BL correspond to axes 1 to 4 on this board) |
| Positioning control range | | -134,217,728 to +134,217,727 (28 bits) |
| Ramp down point setting range | | 0 to 16,777,215 (24 bits) |
| Number of registers for setting the speed | | 3 registers: FL, FH, and FA (corrected speed) for each axis. |
| Command output pulses | PULS*P<br>PULS*N<br>DIR*P<br>DIR*N | CW/CCW method (2-pulse mode),directional method (common pulse mode) or 90 phase difference mode.<br>[Output speed] A maximum of 6.5 Mpps and a minimum of 0.1 pps<br>[Interface] Differential output (AM26LS31C or equivalent)<br>- Positive phase output (PULS*P, DIR*P) can be switched to use an internal +5V power supply by an internal setting. |
| Acceleration / deceleration characteristics | | Acceleration and deceleration can be set independently for linear acceleration/deceleration patterns, and also for S-curve acceleration/deceleration patterns. |
| Acceleration setting range | | 1 to 65,535 (16 bits) |
| Deceleration setting range | | 1 to 65,535 (16 bits) |
| Ramp down point set automatically | | It is possible to have the ramp down point set automatically within the range of: (deceleration time) < (acceleration time x 2). |
| Automatic operating speed correction function | | When you want to feed a small distance using acceleration and deceleration, the board will reduce the maximum speed allowed automatically. |
| Counter | | COUNTER1: Command position counter (28 bits)<br>COUNTER2: Machine position counter (28 bits)<br>COUNTER3: Deviation counter (16 bits)<br>COUNTER4: General-purpose counter (28 bits) |
| Comparators | | 28 bits with 5 comparison circuits per axis |
| Interpolation function | | Linear interpolation: Between any 2 to 4 axes selected by the user.<br>Arc interpolation: Between any 2 selected axes |
| Encoder input | EA*P, EA*N<br>EB*P, EB*N<br>EZ*P, EZ*N | Encoder A, B, and Z phase input. Maximum response frequency: 3.5 MHz. Note2<br>[Interface] High-speed photo-coupler (TLP2662 or equivalent, 10 M baud type)<br>-Can be connected to a differential output or an open collector output |

Note1: Positions marked with an asterisk "*", have a digit from 1 to 4 which mean 1st through 4th axes.

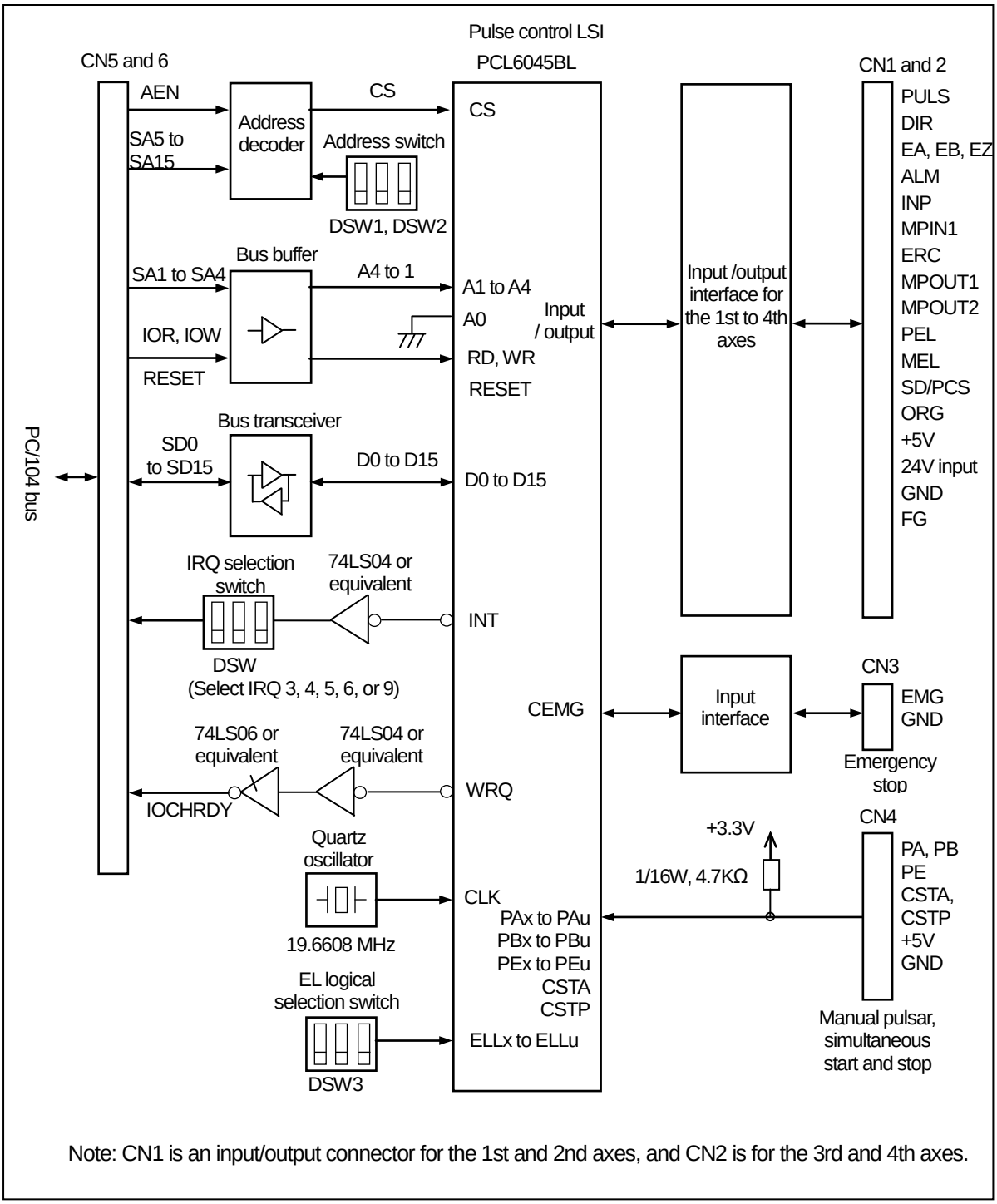
Note2: See the "8-2. Encoder Inputs" for the operating conditions of encoder input.

| Item | Signal name | Specifications |
|---|---|---|
| Driver input | ALM*<br>INP*<br>MPIN*1 | Alarm input (ALM*), positioning complete input (INP*), and general-purpose input (MPIN*1) for each axis.<br>(Connect the general-purpose input to the general-purpose input/output point P0 on the PCL6045BL. When the board is connected to a motor driver, use this output as servo ready completion input (SVRDY)) normally.<br>[Interface] Photo-coupler (TLP292 or equivalent)<br>- Uses external power supply |
| Driver output | ERC*<br>MPOUT*1<br>MPOUT*2 | Three deviation counter clear outputs (ERC*) and 2 general-purpose outputs (MPOUT*1 and MPOU*2) on each axis.<br>(Connect general-purpose outputs 1 and 2 to general-purpose input/output points P1 and P2 on the PCL6045BL. When the board is connected to a motor driver, use these outputs as servo ON output (SVON) and alarm reset output (ALMRES)).<br>[Interface] Open collector output (equivalent to 74LS07) |
| Mechanical input points | PEL*, MEL*<br>SD*/PCS*<br>ORG* | There are 4 inputs for each axis: positive end limit input (PEL*), negative end limit input (MEL*), ramp down input (SD*) or positioning start input (PCS*), and origin position input (ORG*)<br>- Use a switch to change between use as ramp down inputs or positioning start inputs.<br>[Interface] Photo-coupler (TLP292 or equivalent)<br>- Uses the external power supply |
| Emergency stop input | EMG | Emergency stop input<br>- Enable/Disable the emergency switch (use a switch).<br>[Interface] Photo-coupler (TLP292 or equivalent)<br>- Uses the external power supply |
| Simultaneous start input/output<br>Simultaneous stop input/output | CSTA<br>CSTP | Simultaneous start input/output (CSTA), simultaneous stop input/output (CSTP)<br>[Interface]<br>- Pull up to +3.3V with 4.7 k-ohm internal resistor |
| Manual pulsar input<br>Enable/disable input | PA*<br>PB*<br>PE* | Manual pulsar input (90˚phase difference input or pulse input)(PA, PB), enable/disable input (PE)<br>[Interface]<br>- Pull up to +3.3V with 4.7 k-ohm internal resistor |
| Reference clock | | PCL6045BL reference clock<br>19.6608 MHz |
| Board control power supply | +5V | 5VDC ±5%, 400mA TYP. (no load)<br>(Supplied from the PC/104 bus) |
| External power supply | P24* | Power for the input interface of each axis (each axis is independent)<br>24VDC ±5%, 250mA max.<br>(Supplied through CN1 and CN2) |
| Ambient operating temperature | | 0 to +40˚C |
| Ambient operating humidity | | 80%RH or less<br>(Non condensing under condition between +10˚ and +40˚C) |
| Vibration resistance | | Complies with JIS C60068-2-6 |
| Environmental responsiveness | | RoHS(2011/65/EU) compliant |
| Dimensions | | 90.2 W x 95.9 H (Unit: mm) |

Note: Positions marked with an asterisk "*", have a digit from 1 to 4 which mean 1st through 4th axes.

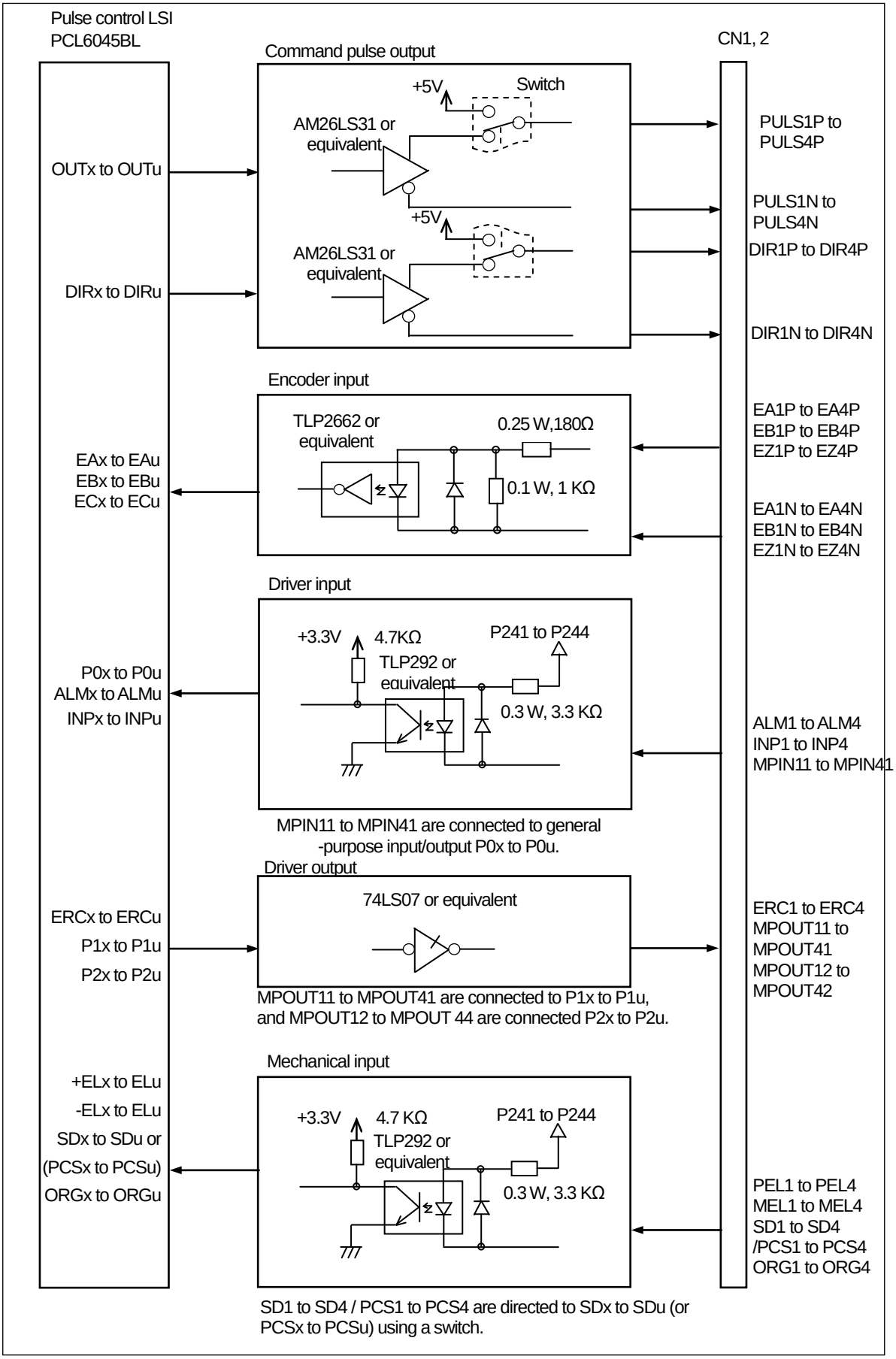
## *6. Configuration*

The block diagram for this board is shown below.

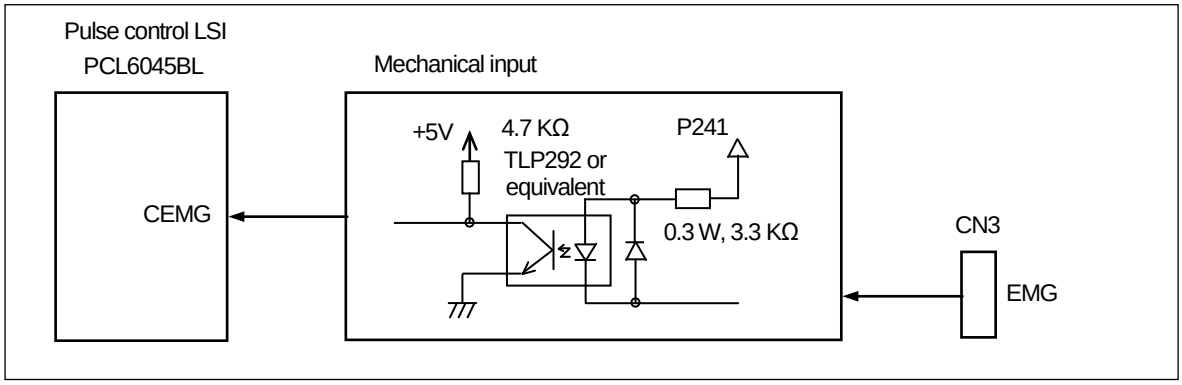



Note: CN1 is an input/output connector for the 1st and 2nd axes, and CN2 is for the 3rd and 4th axes.

A block diagram for the 1st to 4th axes input/output interfaces is shown below.



A block diagram of the emergency stop input interface is shown below.



## *7. Connector Pin Assignments*

### *7-1. CN1 connector*

The signal connection assignments for motor drivers and mechanical systems for the 1st and 2nd axes are shown below.

| | No | Signal name | Function |
|---|---|---|---|
| Command pulse output | 1 | PULS1P | 1st axis pulse signal output (+) |
| | 2 | PULS1N | 1st axis pulse signal output (-) |
| | 3 | DIR1P | 1st axis directional signal output (+) |
| | 4 | DIR1N | 1st axis directional signal output (-) |
| Encoder input | 5 | EA1P | 1st axis encoder A-phase input (+) |
| | 6 | EA1N | 1st axis encoder A-phase input (-) |
| | 7 | EB1P | 1st axis encoder B -phase input (+) |
| | 8 | EB1N | 1st axis encoder B-phase input (-) |
| | 9 | EZ1P | 1st axis encoder Z-phase input (+) |
| | 10 | EZ1N | 1st axis encoder Z-phase input (-) |
| Power supply | 11 | +5V | Board control power supply +5V |
| | 12 | GND | Board control power supply GND |
| Driver input/output | 13 | MPIN11 | 1st axis general-purpose input |
| | 14 | ALM1 | 1st axis alarm input |
| | 15 | INP1 | 1st axis positioning complete input |
| | 16 | ERC1 | 1st axis deviation counter clear output |
| | 17 | MPOUT11 | 1st axis general-purpose output 1 |
| | 18 | MPOUT12 | 1st axis general-purpose output 2 |
| Mechanical input | 19 | PEL1 | 1st axis + side end limit input |
| | 20 | MEL1 | 1st axis - side end limit input |
| | 21 | SD1/PCS1 | 1st axis ramp down<br>/1st axis positioning start input |
| | 22 | ORG1 | 1st axis origin position input |

| | No | Signal name | Function |
|---|---|---|---|
| Command pulse output | 23 | PULS2P | 2nd axis pulse signal output (+) |
| | 24 | PULS2N | 2nd axis pulse signal output (-) |
| | 25 | DIR2P | 2nd axis directional signal output (+) |
| | 26 | DIR2N | 2nd axis directional signal output (-) |
| Encoder input | 27 | EA2P | 2nd axis encoder A-phase input (+) |
| | 28 | EA2N | 2nd axis encoder A-phase input (-) |
| | 29 | EB2P | 2nd axis encoder B-phase input (+) |
| | 30 | EB2N | 2nd axis encoder B-phase input (-) |
| | 31 | EZ2P | 2nd axis encoder Z-phase input (+) |
| | 32 | EZ2N | 2nd axis encoder Z-phase input (-) |
| Power supply | 33 | +5V | Board control power supply +5V |
| | 34 | GND | Board control power supply GND |
| Driver input/output | 35 | MPIN21 | 2nd axis general-purpose input |
| | 36 | ALM2 | 2nd axis alarm input |
| | 37 | INP2 | 2nd axis positioning complete input |
| | 38 | ERC2 | 2nd axis deviation counter clear output |
| | 39 | MPOUT21 | 2nd axis general-purpose output 1 |
| | 40 | MPOUT22 | 2nd axis general-purpose output 2 |
| Mechanical input | 41 | PEL2 | 2nd axis + side end limit input |
| | 42 | MEL2 | 2nd axis - side end limit input |
| | 43 | SD2/PCS2 | 2nd axis ramp down input<br>/2nd axis positioning start input |
| | 44 | ORG2 | 2nd axis origin position input |
| Power supply | 45 | P241 | 1st axis 24VDC input for external inputs |
| | 46 | P242 | 2nd axis 24VDC input for external inputs |
| | 47 | +5V | Board control power supply +5V |
| | 48 | GND | Board control power supply GND |
| | 49 | GND | Board control power supply GND |
| | 50 | FG | Frame ground |

## *7-2. CN2 connector*

Signal connection assignment of motor drivers and mechanical systems for 3rd and 4th axes are shown below.

| | No. | Signal name | Function |
|---|---|---|---|
| Command pulse output | 1 | PULS3P | 3rd axis pulse signal output (+) |
| | 2 | PULS3N | 3rd axis pulse signal output (-) |
| | 3 | DIR3P | 3rd axis direction signal output (+) |
| | 4 | DIR3N | 3rd axis direction signal output (-) |
| Encoder input | 5 | EA3P | 3rd axis encoder A-phase input (+) |
| | 6 | EA3N | 3rd axis encoder A-phase input (-) |
| | 7 | EB3P | 3rd axis encoder B-phase input (+) |
| | 8 | EB3N | 3rd axis encoder B-phase input (-) |
| | 9 | EZ3P | 3rd axis encoder Z-phase input (+) |
| | 10 | EZ3N | 3rd axis encoder Z-phase input (-) |
| Power supply | 11 | +5V | Board control power supply +5V |
| | 12 | GND | Board control power supply GND |
| Driver input/output | 13 | MPIN31 | 3rd axis general-purpose input |
| | 14 | ALM3 | 3rd axis alarm input |
| | 15 | INP3 | 3rd axis positioning complete input |
| | 16 | ERC3 | 3rd axis deviation counter clear output |
| | 17 | MPOUT31 | 3rd axis general-purpose output 1 |
| | 18 | MPOUT32 | 3rd axis general-purpose output 2 |
| Mechanical input | 19 | PEL3 | 3rd axis + side end limit input |
| | 20 | MEL3 | 3rd axis - side end limit input |
| | 21 | SD3/PCS3 | 3rd axis ramp down input /3rd axis positioning start input |
| | 22 | ORG3 | 3rd axis origin position input |

| | No. | Signal name | Function |
|---|---|---|---|
| Command pulse output | 23 | PULS4P | 4th axis pulse signal output (+) |
| | 24 | PULS4N | 4th axis pulse signal output (-) |
| | 25 | DIR4P | 4th axis direction signal output (+) |
| | 26 | DIR4N | 4th axis direction signal output (-) |
| Encoder input | 27 | EA4P | 4th axis encoder A-phase input (+) |
| | 28 | EA4N | 4th axis encoder A-phase input (-) |
| | 29 | EB4P | 4th axis encoder B-phase input (+) |
| | 30 | EB4N | 4th axis encoder B-phase input (-) |
| | 31 | EZ4P | 4th axis encoder Z-phase input (+) |
| | 32 | EZ4N | 4th axis encoder Z-phase input (-) |
| Power supply | 33 | +5V | Board control power supply +5V |
| | 34 | GND | Board control power supply GND |
| Driver input/output | 35 | MPIN41 | 4th axis general-purpose input |
| | 36 | ALM4 | 4th axis alarm input |
| | 37 | INP4 | 4th axis positioning complete input |
| | 38 | ERC4 | 4th axis deviation counter clear output |
| | 39 | MPOUT41 | 4th axis general-purpose output 1 |
| | 40 | MPOUT42 | 4th axis general-purpose output 2 |
| Mechanical input | 41 | PEL4 | 4th axis + side end limit input |
| | 42 | MEL4 | 4th axis - side end limit input |
| | 43 | SD4/PCS4 | 4th axis ramp down input /4th axis positioning start input |
| | 44 | ORG4 | 4th axis origin position input |
| Power supply | 45 | P243 | 3rd axis 24VDC input for external inputs |
| | 46 | P244 | 4th axis 24VDC input for external inputs |
| | 47 | +5V | Board control power supply +5V |
| | 48 | GND | Board control power supply GND |
| | 49 | GND | Board control power supply GND |
| | 50 | FG | Frame ground |

### *7-3. CN3 connector*

Connect an emergency stop switch

| No. | Signal name | Function |
|---|---|---|
| 1 | EMG | Emergency stop input |
| 2 | GND | Board control power supply GND |

Note: The GND for pin number 2 will be only be effective if it is connected to the ground for P241 (CN1 pin 45). See the emergency stop input interface for details.

### *7-4. CN4 connector*

This connector is used for a manual pulsar or to perform simultaneous starts or stops using multiple boards.

| No. | Signal name | Function |
|---|---|---|
| A1 | PA1 | 1st axis pulsar A-phase input |
| B1 | PB1 | 1st axis pulsar B-phase input |
| A2 | PE1 | 1st axis pulsar enable/disable input |
| B2 | PA2 | 2nd axis pulsar A-phase input |
| A3 | PB2 | 2nd axis pulsar B-phase input |
| B3 | PE2 | 2nd axis pulsar enable/disable input |
| A4 | PA3 | 3rd axis pulsar A-phase input |
| B4 | PB3 | 3rd axis pulsar B-phase input |
| A5 | PE3 | 3rd axis pulsar enable/disable input |
| B5 | PA4 | 4th axis pulsar A-phase input |

| No. | Signal name | Function |
|---|---|---|
| A6 | PB4 | 4th axis pulsar B-phase input |
| B6 | PE4 | 4th axis pulsar enable/disable input |
| A7 | CSTA | Simultaneous start input/output |
| B7 | CSTP | Simultaneous stop input/output |
| A8 | +5V | Board control power supply +5V |
| B8 | +5V | Board control power supply +5V |
| A9 | +5V | Board control power supply +5V |
| B9 | GND | Board control power supply GND |
| A10 | GND | Board control power supply GND |
| B10 | GND | Board control power supply GND |

### *7-5. CN5 connector*

J1/P1 connector for the PC/104 bus.

| No. | Signal name | Direc-tion | Function | No. | Signal name | Direc-tion | Function |
|---|---|---|---|---|---|---|---|
| A1 | | | | B1 | GND | | Ground |
| A2 | SD7 | I/O | Data bus | B2 | RESETDRV | | Reset |
| A3 | SD6 | I/O | Data bus | B3 | +5V | | Power supply, +5VDC |
| A4 | SD5 | I/O | Data bus | B4 | IRQ9 | I | Interrupt |
| A5 | SD4 | I/O | Data bus | B5 | | | |
| A6 | SD3 | I/O | Data bus | B6 | | | |
| A7 | SD2 | I/O | Data bus | B7 | | | |
| A8 | SD1 | I/O | Data bus | B8 | | | |
| A9 | SD0 | I/O | Data bus | B9 | | | |
| A10 | IOCHRDY | I | Wait Request | B10 | | | |
| A11 | AEN | O | Decoding condition | B11 | | | |
| A12 | | | | B12 | | | |
| A13 | | | | B13 | /IOW | O | Write command strobe |
| A14 | | | | B14 | /IOR | O | Read command strobe |
| A15 | | | | B15 | | | |
| A16 | SA15 | O | Address bus | B16 | | | |
| A17 | SA14 | O | Address bus | B17 | | | |
| A18 | SA13 | O | Address bus | B18 | | | |
| A19 | SA12 | O | Address bus | B19 | | | |
| A20 | SA11 | O | Address bus | B20 | | | |
| A21 | SA10 | O | Address bus | B21 | | | |
| A22 | SA9 | O | Address bus | B22 | IRQ6 | I | Interrupt |
| A23 | SA8 | O | Address bus | B23 | IRQ5 | I | Interrupt |
| A24 | SA7 | O | Address bus | B24 | IRQ4 | I | Interrupt |
| A25 | SA6 | O | Address bus | B25 | IRQ3 | I | Interrupt |
| A26 | SA5 | O | Address bus | B26 | | | |
| A27 | SA4 | O | Address bus | B27 | | | |
| A28 | SA3 | O | Address bus | B28 | | | |
| A29 | SA2 | O | Address bus | B29 | +5V | | Power supply, +5VDC |
| A30 | SA1 | O | Address bus | B30 | | | |
| A31 | SA0 | O | Address bus | B31 | GND | | Ground |
| A32 | GND | | Ground | B32 | GND | | Ground |

Note: The directions above are correct when looking at the connector from the CPU operation's point of view. I = Input and O = Output.

Note 3: A forward slash ( / ) next to the signal name means the line uses negative logic.

Note 3: A blank row means there is no connection for that pin.

## ***7-6. CN6 connector***

J2/P2 connector for the PC/104 bus.

| No. | Signal name | Direc -tion | Function |
|---|---|---|---|
| C0 | GND | | Ground |
| C1 | | | |
| C2 | | | |
| C3 | | | |
| C4 | | | |
| C5 | | | |
| C6 | | | |
| C7 | | | |
| C8 | | | |
| C9 | | | |
| C10 | | | |
| C11 | SD8 | I/O | Data bus |
| C12 | SD9 | I/O | Data bus |
| C13 | SD10 | I/O | Data bus |
| C14 | SD11 | I/O | Data bus |
| C15 | SD12 | I/O | Data bus |
| C16 | SD13 | I/O | Data bus |
| C17 | SD14 | I/O | Data bus |
| C18 | SD15 | I/O | Data bus |
| C19 | | | |

| No. | Signal name | Direc- tion | Function |
|---|---|---|---|
| D0 | GND | | Ground |
| D1 | | | |
| D2 | /IOCS16 | I | 16-bitI/O cycle |
| D3 | | | |
| D4 | | | |
| D5 | | | |
| D6 | | | |
| D7 | | | |
| D8 | | | |
| D9 | | | |
| D10 | | | |
| D11 | | | |
| D12 | | | |
| D13 | | | |
| D14 | | | |
| D15 | | | |
| D16 | +5V | | Power supply, +5VDC |
| D17 | | | |
| D18 | GND | | Ground |
| D19 | GND | | Ground |

Note: The directions above are correct when looking at the connector from the CPU operation's point of view. I = Input and O = Output.

Note 3: A forward slash ( / ) next to the signal name means the line uses negative logic.

Note 3: A blank row means there is no connection for that pin.

## *7-7. Manufacturers' names for the connectors used*

The manufacturers' names for the connectors installed on this board are shown below.

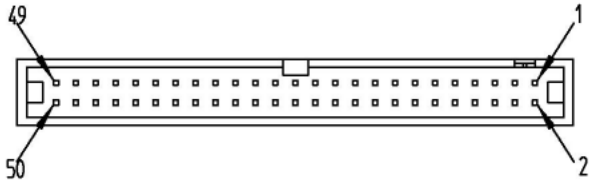
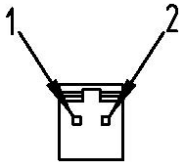
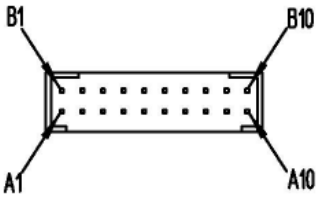
| No. | Mfg. | Model name | Remark |
|---|---|---|---|
| CN1 | 3M | 7650-5002SC | MIL standard, 50-pin box pin header |
| CN2 | 3M | 7650-5002SC | MIL standard, 50-pin box pin header |
| CN3 | JAE | IL-2P-S3FP2 | IL series connector, 2.5mm pitch connector |
| CN4 | JAE | PS-20PLB-D4T1-FL1 | 2 row type, 2.54 mm pitch connector |

Cables for this board are available as options (except for connector CN4).
Connectors for users to fabricate their own cables are not supplied with the board.
We recommend the following items when fabricating cables.

| No. | Item name | Mfg. | Model name | Remark |
|---|---|---|---|---|
| For CN1 | Connector | 3M | 7950-6500SC | 1.27 mm pitch, connector for crimping flat cable |
| For CN2 | Connector | 3M | 7950-6500SC | 1.27 mm pitch, connector for crimping flat cable |
| For CN3 | Connector | JAE | IL-2S-S3L-(N) | IL series connector, 2.5 mm pitch connector |
| | Crimped terminals | JAE | IL-C2-10000 | The model name shown on the left is for 10000 pieces / reel.<br>Compatible wire sizes: AWG#22 to #24<br>Manual crimping tool: CT150-1C-IL |
| For CN4 | Connector | JAE | PS-20SLA-D4C2 | 2 row type, 2.45 mm pitch connector |
| | Crimped terminals | JAE | PS-SLA-C2-1-100 | The model name shown on the left is for loose piece, 100 pieces. Compatible wire sizes: AWG#24 to #28<br>Manual crimping tool: CT150-2-PSSLA-B |

## *7-8. Connector pin number arrangement*

The pin number arrangements for the connectors used on this board are shown below.

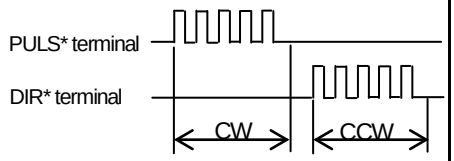
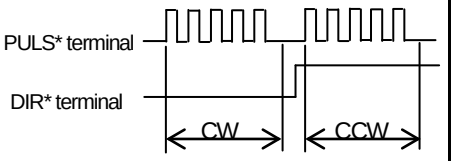
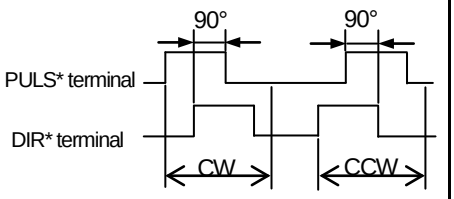
| Pin numbers locations on CN1 and CN2 | Pin numbers locations on CN3 |
|---|---|
|  |  |
| Pin numbers locations on CN4 | |
|  | |

## *8. Signal Functions*

### *8-1. Command pulse outputs (PULS*P, PULS*N, DIR*P, and DIR*N)*

**Function**

The command pulse outputs are used to send command pulses to a motor driver.
You can choose the output method for these pulses: CW/CCW (2-pulse mode) , Direction method (common pulse mode) or 90 phase difference mode, using the environment register (RENV1 register) on the PCL6045BL.

| | Description | Output example of command pulse |
|---|---|---|
| CW/CCW method (2-pulse mode) | This method outputs command pulses to a motor rotation direction lines, CW (clockwise) or CCW (counter-clockwise), independently. Using this method, the board will output CW pulse signals from the PULS terminal, and CCW pulse signals from the DIR terminal. |  |
| Direction method (common pulse mode) | This method outputs both CW and CCW command pulses through a PULS terminal, and it indicates the motor direction by sending the DIR terminal HIGH or LOW. In the example on the right, the motor will rotate CW when the DIR terminal is LOW and CCW when it is HIGH. |  |
| 90 phase difference mode | In this method, 90 phase difference pulses signals are output from PULS and DIR terminals. In the example on the right, the motor rotates CW if signals from PULS terminal are ahead of DIR terminal; it rotates CCW if signals from DIR are ahead. |  |

Fill in an axis number (1 to 4) where the asterisk * appears above.

**Output speed**

Maximum speed: 6.5535 Mpps, Minimum speed: 0.1 pps
The output speed range depends on the setting of the magnification rate. (Magnification setting values: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100)

Ex.:

| Magnification rate | Output speed range |
|---|---|
| 0.1x | 0.1 to 6,553.5 pps |
| 1x | 1 to 65,535 pps |
| 100x | 100 to 6,553,500 pps |

**Output interface**

These signals are differential outputs (AM26lS31C or equivalent).
PULS*P and DIR*P output command pulses as positive phase signals. PULS*N and DIR*N output negative phase signals.
[Output specifications]

- H level output current: IOH = -20mA, max.
- L level output current: IOL = 20mA, max.
- H level output voltage: VOH = 2.5V min. (when Vcc = 4.75V, IOH = -20mA)
- L level output voltage: VOL = 0.5V max. (when Vcc = 4.75V, IOL = 20mA)

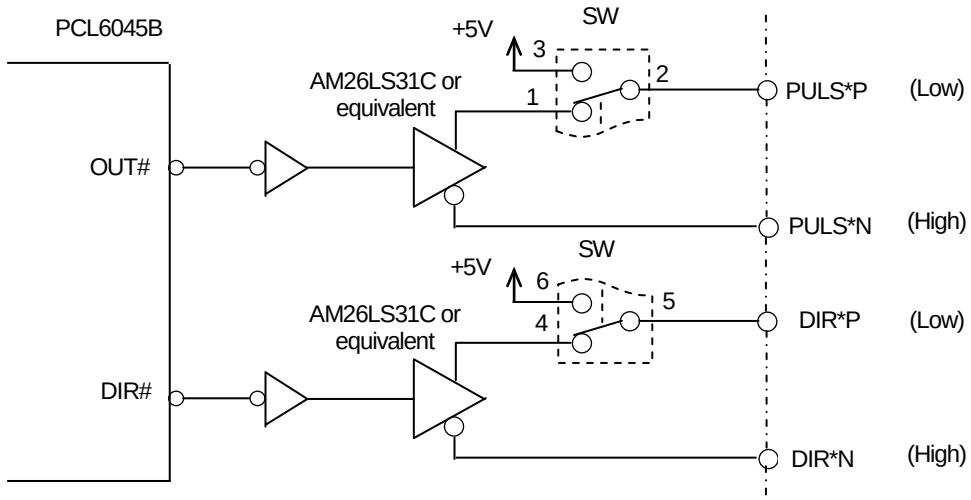
**Register settings (environment setting register 1 (RENV1))**

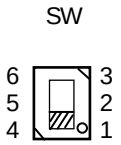
To use positive output logic (PULS*P, DIR*P as low, PULS*N, DIR*N as high), set PMD0 to PMD2 in environment setting register 1 (RENV1) as follows.

CW/CCW method (2-pulse mode): '100'
Direction method (common pulse mode): '000'
90 phase difference mode: '101'

**Positive phase output selection switches (SW1 to SW4)**

You can set the positive phase output (PULS*P, DIR*P) to use the 5V internal power supply using internal switches.
Switches SW1 to SW4 correspond to axes 1 to 4.
This switch is a double pole switch.
Positive-phase output: pins 1-2, 4-5 connected
+5V Internal power supply: pins 2-3, 5-6 connected




For the settings shown above

Descriptions in ( ) parenthesis show the output logic when the AM26LS31C (or equivalent) is LOW.

## *8-2. Encoder inputs (EA*P, N, EB*P, N, EZ*P, and N)*

**Function**

**EA*P, N, EB*P, and N**

Connect the A and B phases of the 90˚ phase difference signals as feedback signals from an encoder that is connected to servo driver or to a mechanical axis. These inputs are used to count signals indicating thee current position of the machine.

Pulse trains can be also be input.

**EZ*P, N**

Connect a Z-phase signal (this signal provides one pulse per encoder rotation), or an excitation phase origin position output from a stepper motor driver.

Use this input to detect the origin position in origin return operations.

**Input interface**

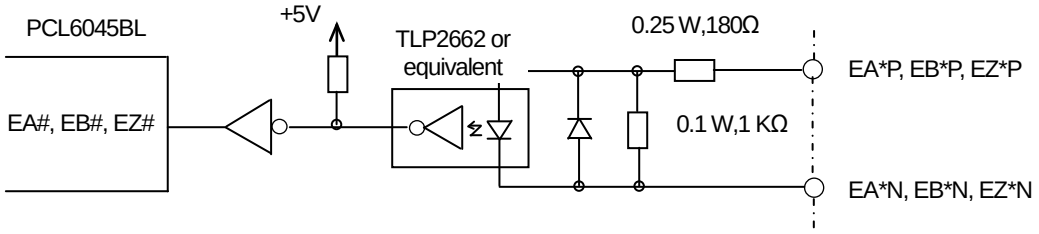
Encoder inputs are high-speed photo-couplers (TLP2662 or equivalent)

You can connect them to line driver outputs (AM26LS32AC or equivalent), open collector outputs, or the photo-coupler outputs of an encoder.

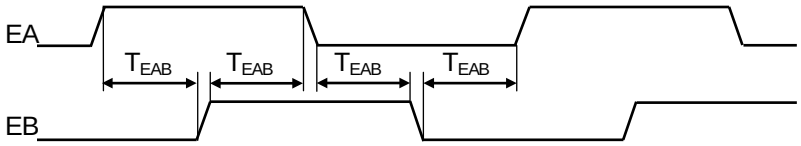
When connecting to a line-driver output, you do not need to use external limiting resistors.

[Input specifications]

- Response frequency: 3.5 MHz max. (at IF = 6.4mA, 90˚ phase difference input, without using an input filter) Note




Note: Encoder operating conditions




| Item | Symbol | Condition | Min | Max | Unit |
|---|---|---|---|---|---|
| EA,EB input signal phase (90 degree) | $T_{EAB}$ | Note2 | $T_{CLK}(3T_{CLK})$ | | ns |

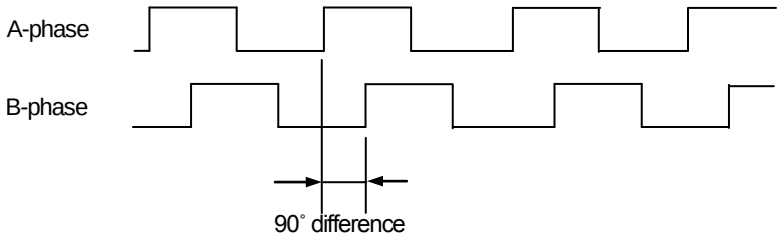
Note1. $T_{CLK}$ in the above table indicates 14 MHz (71 ns).

2. If the input filter is ON < EINF (bit18) =1 in RENV2>, the minimum time will become $3T_{CLK}$.

**Register settings (environment setting register 2 (RENV2))**

**EA*P, N, EB*P, N**

- A 90˚ phase-difference input is shown




Set the EIM 0 and 1 bit in environment setting register 2 (RENV2), to a 90˚ phase difference of 1x "00."
Set the EDIR bit in environment setting register 2 (RENV2) to "0."

- Applying an input filter

There is no physical input filter between the PCL6045B and the input connector.
If you need a filter, set the EINF bit in environment register 2 (RENV2) to "1", to enable a filter approximately 150 n sec in width.

**EZ*P, N**

- Input logic setting

To read "1" while the photo-coupler is ON, set the EZL bit in environment setting register 2 (RENV2) to "1", to detect the rising edge.

## 8-3. Driver inputs (ALM*, INP*, and MPIN*1)

**Function**

**ALM***

Connect this terminal to the alarm signal output of the motor driver. Use it to stop immediately or to decelerate and stop the motor when an alarm occurs in the motor driver.

**INP***

Connect this terminal to the positioning complete output of the servo driver. Use it to detect when the position control deviation counter on the servo driver is within the range you set and positioning is complete.

**MPIN*1**

General-purpose driver inputs. These inputs are connected to the general-purpose input/output points P0x to P0u on the PCL6045BL.

Normally, this terminal is connected to the servo ready completion output (SVRDY) on the servo driver, to check that the servo driver is ready for operation. (You may also use this terminal for other purposes.)

**Input interface**

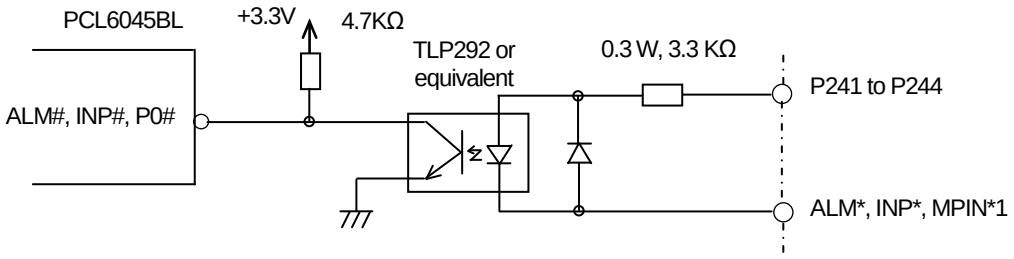
These inputs use a photo-coupler interface (TLP292 or equivalent).

The Anode side of the photo-coupler is connected internally to pins P241 to P244 on CN1 and CN2 through limiting resisters. P241 to P244 correspond to the 1st to 4th axes.

Supply 24VDC to P241 to P244.

[Input specifications]

- Input current: IF = 6.9mA TYP. (at P241 to P244 = 24V)




**Register setting (environment setting register 1,2 (RENV1,2))**

**ALM***

- Input logic setting

To read a "1" when the photo-coupler is on, set the ALML bit in environment setting register 1 (RENV1) to "0."

**INP***

- Input logic setting

To read a "1" when the photo-coupler is on, set the INPL bit in environment setting register 1 (RENV1) to "0."

**MPIN*1**

- Input logic setting

Set POM 0 and POM 1 in environment setting register 2 (RENV2) to “00”, for use as general-purpose inputs.

When the photo-coupler is on, this signal will go LOW, "0." (active LOW (negative logic))

## 8-4. Driver outputs (ERC*, MPOUT*1, and MPOUT*2)

### Function

**ERC***

Clears the position control deviation counter in the servo driver. This signal is output to stop the motor immediately at an origin return or an emergency stop. Be careful when setting the output time because some drivers keep rotating slowly while this signal is on, since only the speed control feedback signals are returned.

**MPOUT*1**

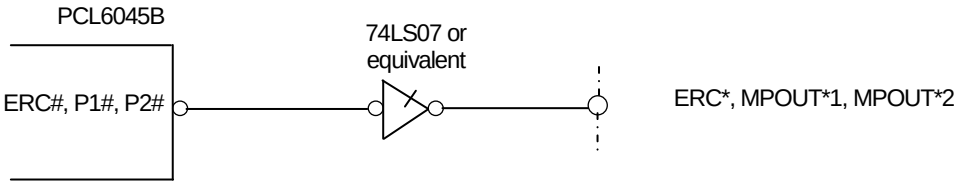
This is a general-purpose output for a driver. It is connected to P1x to P1u of the general-purpose input/output terminals on the PCL6045BL. Normally, this signal is used to turn on the servo signal (SVON), to enable motor operation by exciting the motor.
(You may use this signal for other purposes.)

**MPOUT*2**

This is a general-purpose output for a driver. It is connected to P2x to P2u of the general-purpose input/output terminals on the PCL6045BL Normally, this signal is used as alarm reset signal (ALMRES), to clear the alarm from the motor driver
(You may use this signal for the other purposes.)

### Output interface

The output interface is open collector output (equivalent to 74LS07).
[Output specifications]
- Output withstand voltage: 30V, max.
- Output current: IOL = 40mA, max.
- LOW level output voltage: VOL = 0.7V max. (Vcc = 4.75V, IOL = 40mA)




### Register setting (environment setting register 1, 2 (RENV1, 2))

**ERC***

- Output logic setting
  To turn on the output transistor with "1," set the ERCL bit in environment setting register 1 (RENV1) to negative logic "0".
- Output time setting
  You may set the output time with bits EPW0 to EPW2 in environment setting register 1(RENV1).

**MPOUT*1**

- Output setting
  Set bits P1M0 and P1M1 in environment setting register 2 (RENV2) to "01", for use as general-purpose outputs.
  "0" will turn the output transistor on (active LOW (negative logic)).

**MPOUT*2**

- Output setting
  Set P2M0 and P2M1 in environment setting register 2 (RENV2) to "01", for use as a general-purpose output. "0" will turn the output transistor on (active LOW (negative logic)).

**Note:** To use the general-purpose outputs, before setting environment setting register 2 to output, write a "1" to each respective bit. Please note that if the respective bit is left at "0," the output transistor will be on when setting the environment parameters.

## 8-5. Mechanical inputs (PEL*, MEL*, SD*/PCS*, and ORG*)

**Function**

**PEL*,MEL***

PEL* is the end limit input for movement in the plus (+) direction, and MEL* is the end limit input for movement in the minus (-) direction.

These signals are used to keep from outputting unwanted signals to the driver.

**SD*/PCS***

You may choose SD* or PCS* using an internal switch.

SD* is used to decelerate motor or to decelerate and stop motor. It is also used for origin return operations and other functions.

PCS* is used to override a target position.

**ORG***

Use this signal to confirm the origin position while in an origin return operation.

Combined use of this signal with the Z phase (EZ*) signal from the encoder will enhance repeated origin return precision.

**Input interface**

The input interface is a photo-coupler (TLP292 or equivalent).

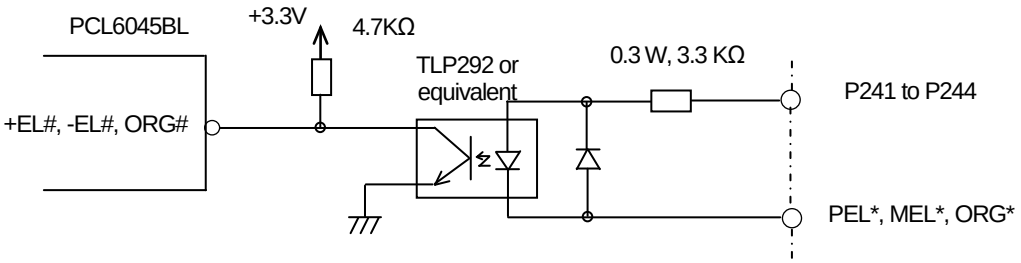
The photo-coupler anode is internally connected to P241 to P244, which come from CN1 and CN2 through limiting resistors. P241 to P244 correspond to 1st to 4th axes, respectively.

Supply 24VDC to P241 to P244.

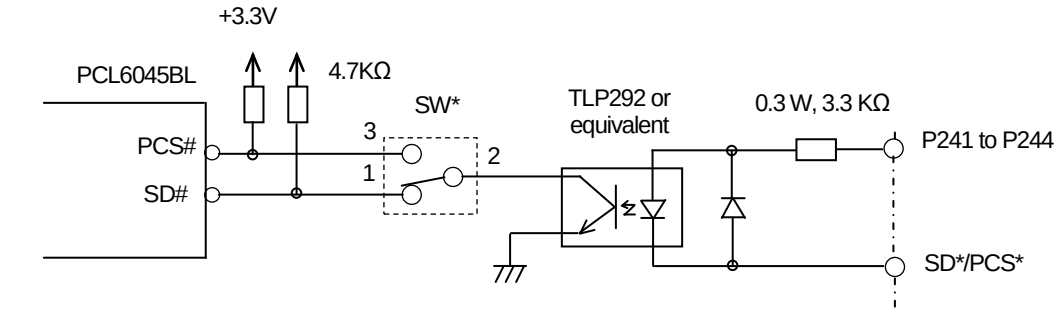
[Input specifications]

- Input current: IF = 6.9mA TYP. (P241 to P244 = 2V)

**PEL*, MEL*, ORG***




**SD*/PCS***



**Register settings (environment setting register 1 (RENV1))**

**SD***

- Input logic setting

  To see a "1" when the photo-coupler is on, set the SDL bit in environment setting register 1 (RENV1) to "0."

**PCS***

- Input logic setting

  To see a "1" when the photo-coupler is on, set the PCSL bit in environment setting register 1 (RENV1) to "0."

**ORG***

- Input logic setting

  To see a "1" when the photo-coupler is on, set the ORGL bit in environment setting register 1 (RENV1) to "0."

**PEL, MEL input logic setting switch (DSW3)**

You can change the input logic for PEL* and MEL* using switch DSW3.

Switches 1 to 4 correspond to the 1st to 4th axes, respectively.

Precautions for using the end limit switches.

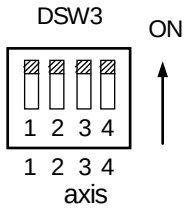
Since these signals are used for emergency stops, we recommend that you mount sensors which have a negative logic output to your machine.

These switches can be set the logic for both PEL* and MEL* at the same time.

(They cannot be set independently.)

ON: The end limit signal goes off when the photo-coupler turns on.

OFF: The end limit signal goes on when the photo-coupler turns on.

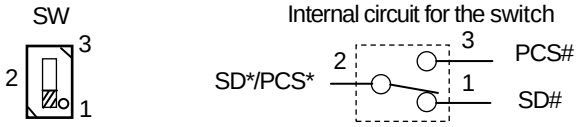



**SD/PCS select switch (SW5 to 8)**

Switches SW5 to SW8 correspond to the 1st to 4th axes, respectively.

SD#: pins 1-2 connected

PCS#: pins 2-3 connected



## 8-6. Emergency stop input (EMG)

**Function**

When this signal is received while in operation, the board immediately stops outputting command pulses

**Input interface**

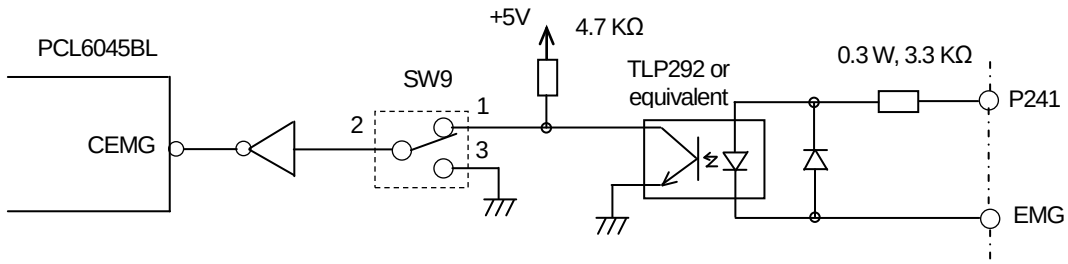
The interface for this signal is a photo-coupler input (TLP292 or equivalent).

The anode side of the photo-coupler is internally connected to P241, which is supplied from CN1 through a limiting resistor. P241 is the power supply for 1st axis input.

Supply P241 with DC24V.

[Input specifications]

-Input current: IF = 6.9mA TYP. (at P241 = 24V)




**Input logic**

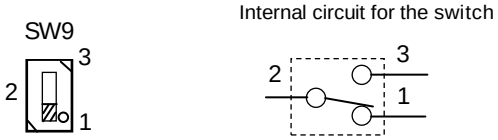
After an emergency stop has occurred, the emergency stop is released when the photo-coupler is turned on.

**Emergency stop enable/disable switch (SW9)**

Switch SW9 is used to select whether to enable or disable external emergency stop signals.

Enable: pins 1-2 connected

Disable: pins 2-3 connected




Precautions if you disable emergency stops.

Make sure you have a separate function that ensures the safety of your entire system.

## 8-7. Simultaneous start I/O (CSTA), simultaneous stop I/O (CSTP)

**Function**

**CSTA**

Multiple axes can be started simultaneously using an external signal.

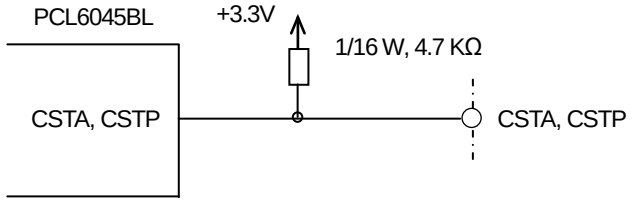
**CSTP**

Multiple axes can be stopped simultaneously using an external signal.

These are useful for simultaneously starting and stopping motors controlled by multiple boards.

**Input interface**

This signal is pulled up with a 4.7 K-ohm resistor internally.




## 8-8. Manual pulsar inputs (PA*, PB*), enable/disable pulsar input (PE*)

**Function**

**PA*, PB***

These inputs receive 90˚ phase difference signals or pulse signals from an encoder other than manual pulsar or motor. The signals are directed to an internal counter.

**PE***

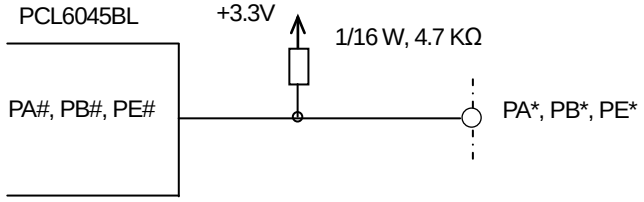
Enables or disables the PA* and PB* inputs.

By connecting this signal to GND, PA* and PB* will be enabled.

**Input interface**

This signal is pulled up internally with a 4.7 K-ohm resistor.

To input external signals, provide an external interface circuit to match the interface of the manual pulsar.




**Register settings (environment setting register 1, 2 (RENV1, 2))**

**PA*, PB***

There is no physical input filter between the PCL6045BL and the input connector.

If you need a filter, set the PINF bit in environment register 2 (RENV2) to "1", to enable a filter approximately 150 nsec in width.

**PE***

There is no physical input filter between the PCL6045BL and the input connector.

If you need a filter, set the DRF bit in environment register 1 (RENV1) to "1", to enable a filter approximately 32 msec in width.

## 8-9. Others

**Input filter**

No physical input filter is provided on the following signal lines between the PCL6045BL and the input connectors.

PEL*, MEL*, SD*, ORG*, ALM*, and INP*

If you need a filter, set the FLTR bit in environment register 1 (RENV1) to "1", to enable a filter approximately 4 µsec wide.

**Unused general-purpose input/output lines (P3 to P7)**

In addition to the general-purpose input/output lines P0 to P2 that this board uses, the PCL6045BL also has the signals from P3 to P7.

This board does not use these P3 to 7 signals and they are pulled up to +3.3V with each one of 4.7 K-ohm internal resistors. Therefore, set the bits in environment register 2 (RENV2) for these terminals to make them behave as general-purpose inputs "00."

Please note that inputs on these lines P3 to 7 are always "1."

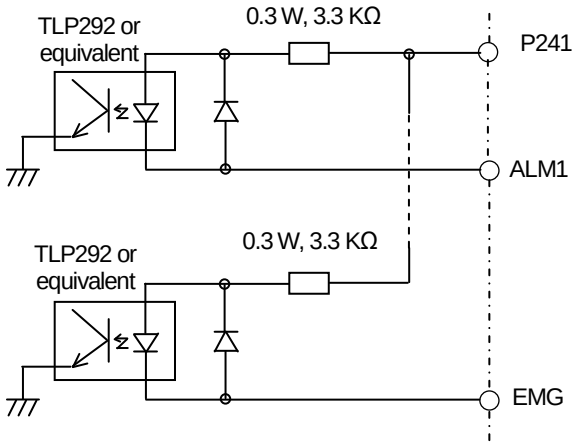
| General-purpose input/output terminal name | Bit name | Setting | | Signal logic of PCL6045BL |
|---|---|---|---|---|
| P0# (MPIN*1) | P0M0 and P0M1 | General-purpose input | 00 | Active LOW (negative logic) |
| P1# (MPOUT*1) | P1M0 and P1M01 | General-purpose output | 01 | Active LOW (negative logic) |
| P2# (MPOUT*2) | P2M0 and P2M1 | General-purpose output | 01 | Active LOW (negative logic) |
| P3# | P3M0 and P3M1 | General-purpose input | 00 | Always "1" |
| P4# | P4M0 and P4M1 | General-purpose input | 00 | Always "1" |
| P5# | P5M0 and P5M1 | General-purpose input | 00 | Always "1" |
| P6# | P6M0 and P6M1 | General-purpose input | 00 | Always "1" |
| P7# | P7M0 and P7M1 | General-purpose input | 00 | Always "1" |

**Power supply P241 to P244 for external input**

Pins for the 1st to 4th axis input/output lines on CN1 and CN2 use P241 to P244 lines for to supply power to an external input. These lines are common with the terminals supplying 24VDC power to the input for each axis.

P241 is connected to the anode of the photo-coupler on the 1st axis input (ALM1, INP1, MPIN11, PEL1, MEL1, SD1/PCS1, ORG1) and to the emergency stop input (EMG) through a limiting resistor.

P242 to P244 are connected to the anode of the photo-coupler on the 2nd to 4th axis inputs (ALM2 to ALM4, INP2 to INP4, MPIN21 to MPIN41, PEL2 to PEL4, MEL2 to MEL4, SD2 to SD4/PCS2 to PCS4, and ORG2 to ORG4) through limiting resistors.



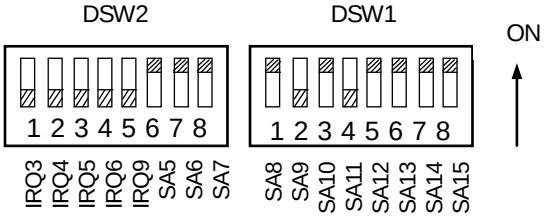
## *9. Address Setting*

### *9-1. Base address*

Set the base address (top address) for this board using switches (DSW1 and DSW2) for the top 11 lines (SA15 to 5) of the address bus.

In the address shown below, ON = "0" and OFF = "1."

This board is set to address 0x0a00 when delivered.




### *9-2. I/O address map*

**Axis allocation map**

The address range for each axis is separate and is set with address lines SA3 and SA4.

| SA4 | SA3 | Address range | Description |
|---|---|---|---|
| 0 | 0 | 00H to 07H | Address range of the 1st axis |
| 0 | 1 | 08H to 0FH | Address range of the 2nd axis |
| 1 | 0 | 10H to 17H | Address range of the 3rd axis |
| 1 | 1 | 18H to 1FH | Address range of the 4th axis |

**Map inside each axis**

The memory map for each axis is defined by the setting of SA2 and SA1.

- Write cycle

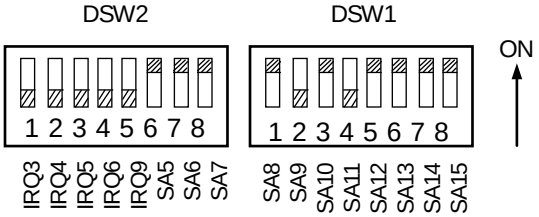
| SA2 | SA1 | Address signal | Description |
|---|---|---|---|
| 0 | 0 | COMW | Select axis and write control commands |
| 0 | 1 | OTPW | Change the status of the general -purpose output port (only affects the output bit) |
| 1 | 0 | BUFW0 | Write to the I/O buffer (bits 0 to 15) |
| 1 | 1 | BUFW1 | Write to the I/O buffer (bits 16 to 31) |

- Read cycle

| SA2 | SA1 | Address signal | Description |
|---|---|---|---|
| 0 | 0 | MSTSW | Read the main status (bits 0 to 15) |
| 0 | 1 | SSTSW | Read the sub-status of the general-purpose input port |
| 1 | 0 | BUFW0 | Read from the input/output buffer (bits 0 to 15) |
| 1 | 1 | BUFW1 | Read from the input/output buffer (bits 15 to 31) |

## ***10. Interrupts***

Interrupts sent from this board to the PC/104 bus can be set to one of 5 IRQ addresses (3, 4, 5, 6, or 9) using switches (DSW2).
By sliding a switch to the ON side, that IRQ is selected.
This board is set not to send any interrupts when delivered.



## *11. Example of Connections to a Motor Driver*

### *11-1. Command pulse output (PULS*P, PULS*N, DIR*P, and DIR*N)*

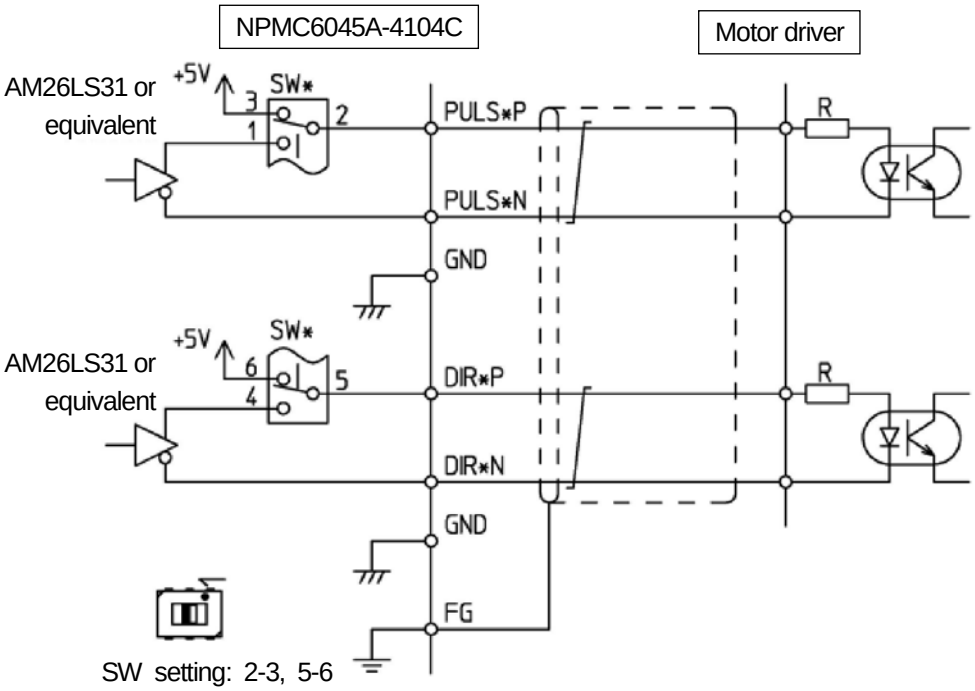
In general, there are four types of connections, depending on the interface specifications.

A. Connections with photo-couplers
B. Connections with line receivers
C. Connections with photo-couplers and a driver support the differential input.
D. Connections with TTL signals.

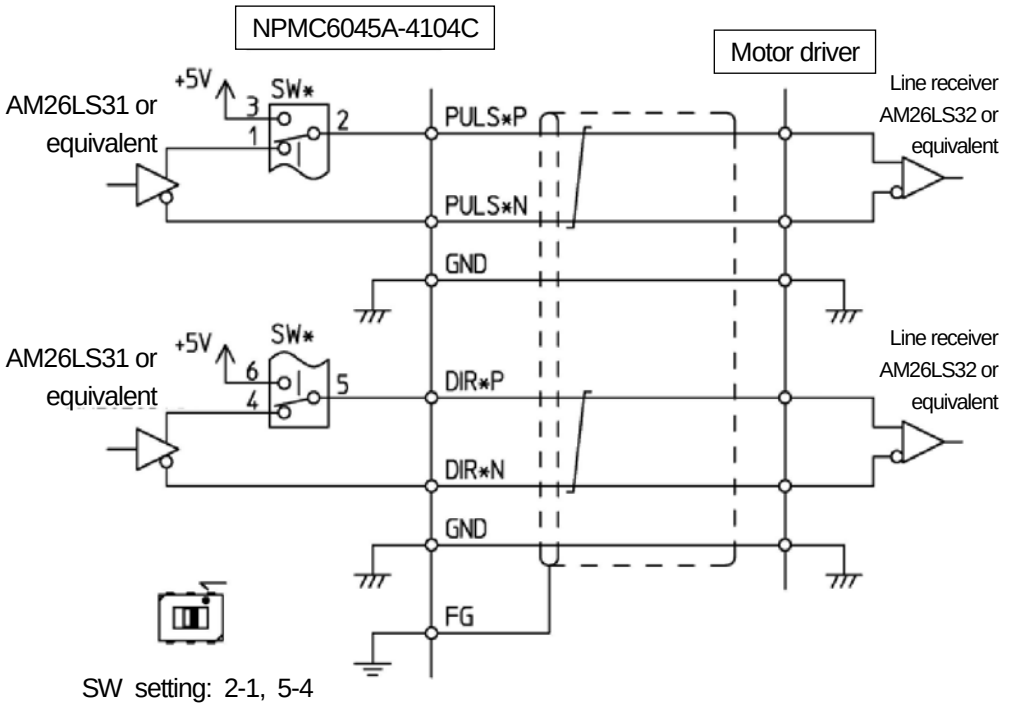
Although the connection specification varies with the driver specifications and the wiring cable size, you can use the following tables as a general guide.

| Connection method | Cable length | Command pulse frequency | Noise immunity |
|---|---|---|---|
| B or C above | 10 m or less | Up to the maximum driver frequency | Strong |
| A above | 3 m or less | 500 Kpps or less | Some |
| D above | 1 m or less | 250 Kpps or less | Not much |

A. Connections to photo-couplers (to connect to an internal 5V power supply)

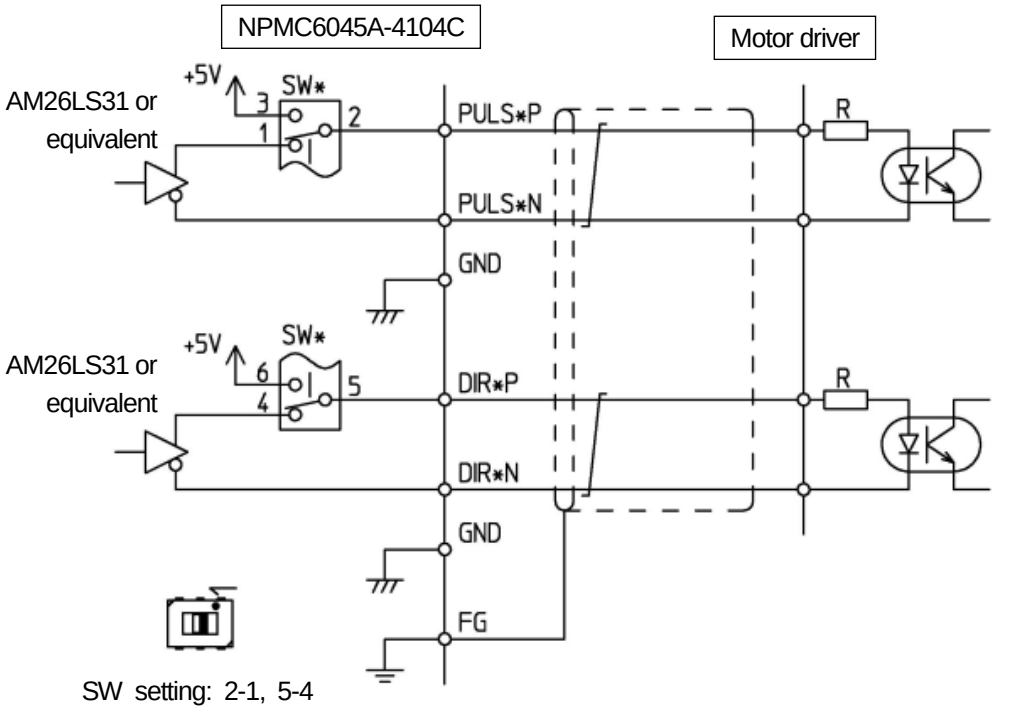


B. Connections to line receivers



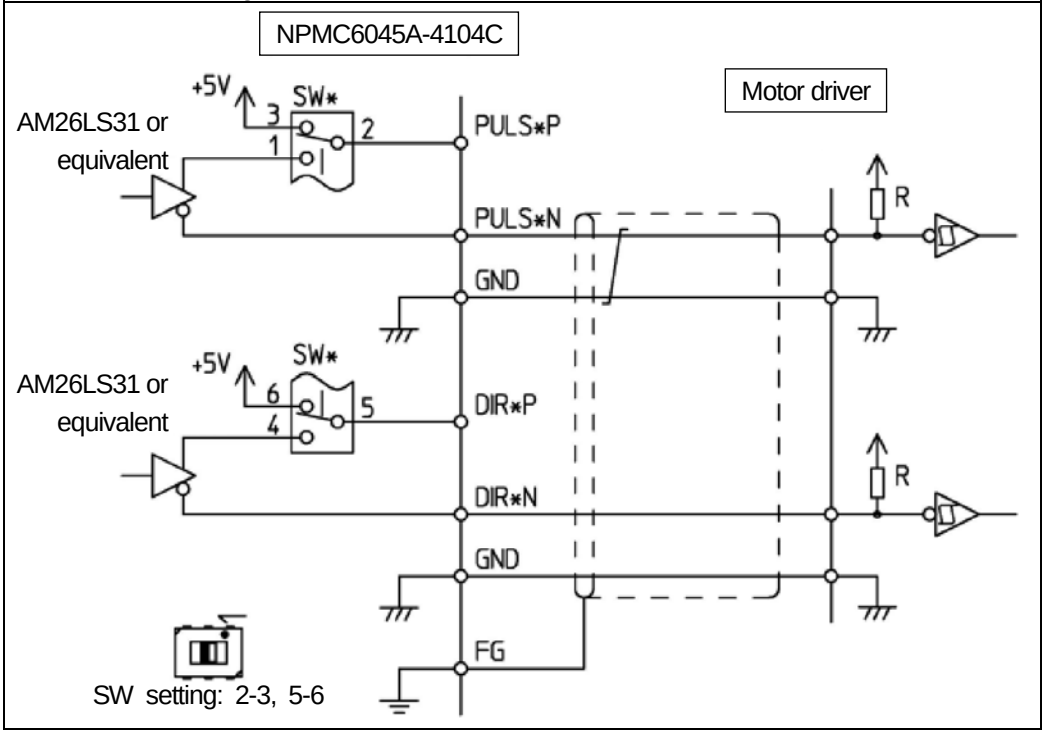

SW setting: 2-1, 5-4

C. Connections to photo-couplers and the driver supports the differential input.



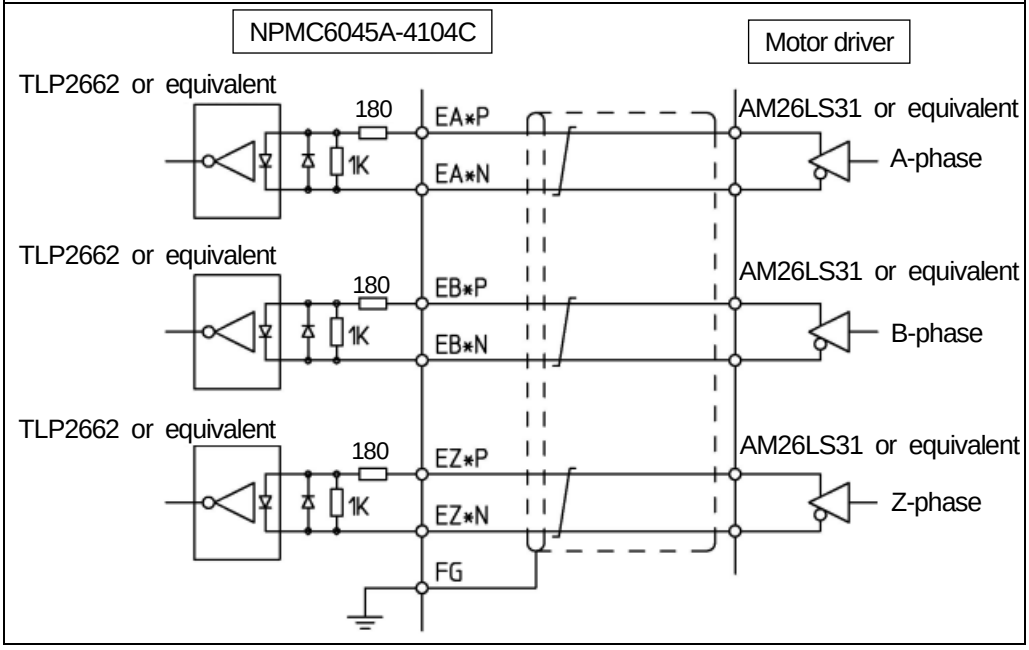

SW setting: 2-1, 5-4

D. Connections using TTL



***11-2. Encoder inputs (EA*, EB*, and EZ*)***

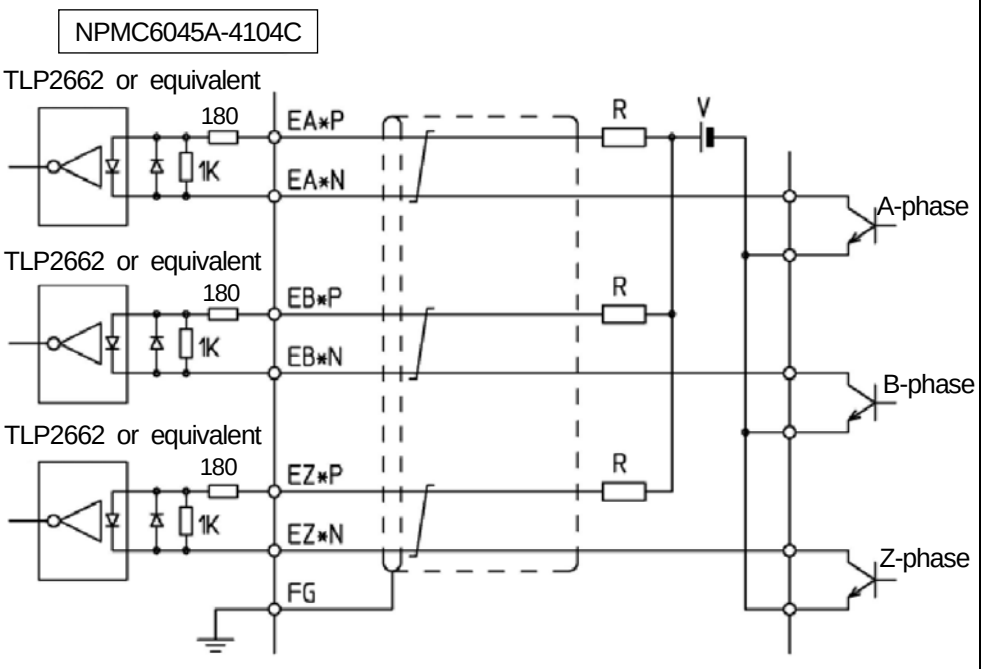
Connections to line drivers




Connections to open-collectors

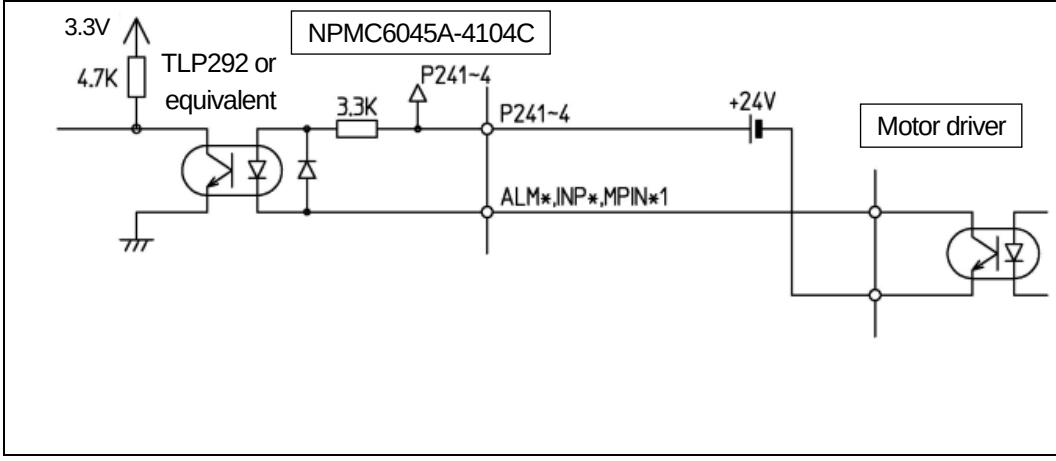
Connect external resistors (R) to match with the voltage (V) used.

| Voltage (V) | Recommended external resistor value (R) |
|---|---|
| +5V | 1/4 W, 100Ω |
| +12V | 1/4 W, 1 KΩ |
| +24V | 1/2 W, 2.2 KΩ |



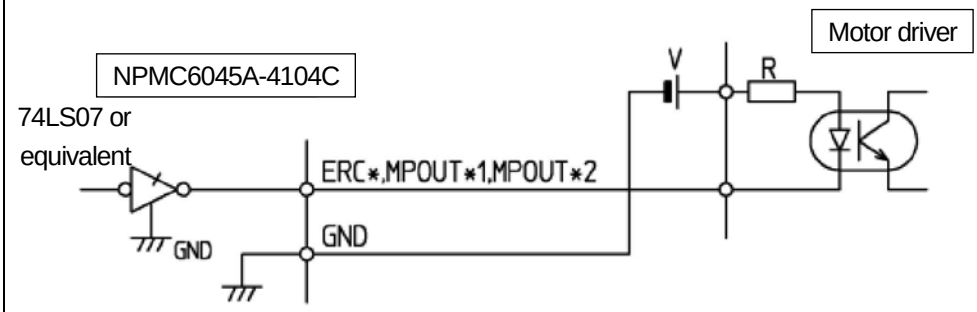
### ***11-3. Driver inputs (ALM*, INP*, and MPIN*1)***

Connections to photo-couplers




### ***11-4. Driver outputs (ERC*, MPOUT*1, and MPOUT*2)***

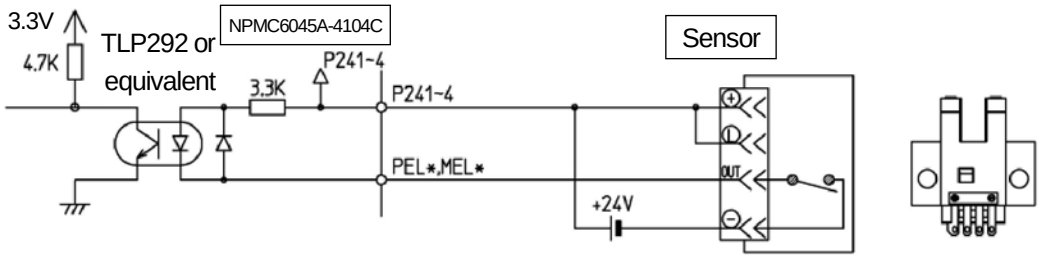
Connections to photo-couplers (+30V max.)



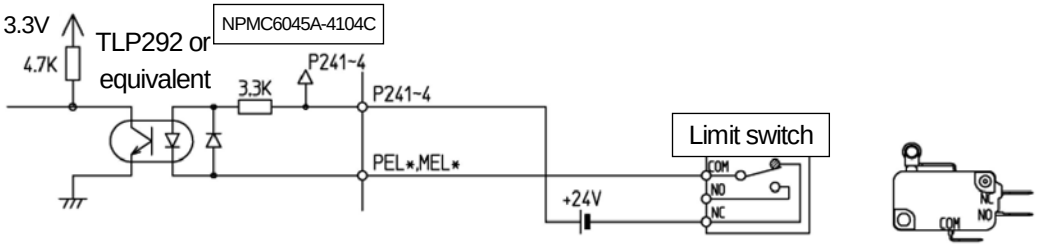
## ***11-5. Mechanical inputs (PEL*, MEL*, SD*/PCS*, and ORG*)***

1) Positive (+) and negative (-) end limit inputs (PEL*, MEL*)
We recommend connecting to a b-contact (negative logic) mechanical sensor or mechanical limit switch.

Connections to mechanical sensors

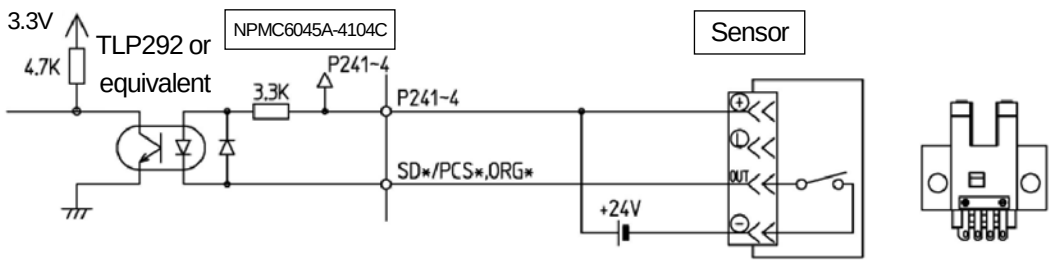



Connections to mechanical limit switches

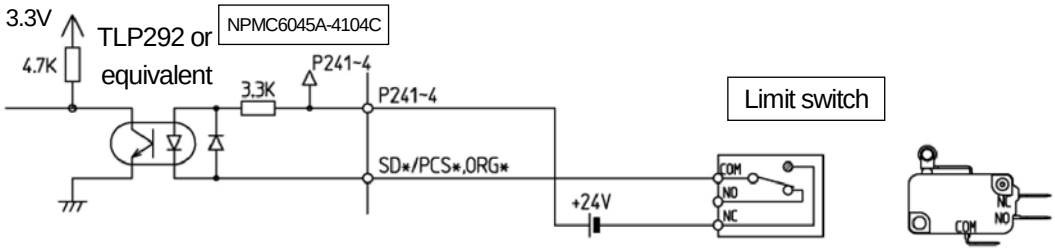


2) Ramp down/positioning start input (SD*/PCS*), origin position input (ORG*)
We recommend connecting to an a-contact (positive logic) mechanical sensor or mechanical limit switch.
Use a mechanical sensor when repeat precision is much required.

Connections to mechanical sensors

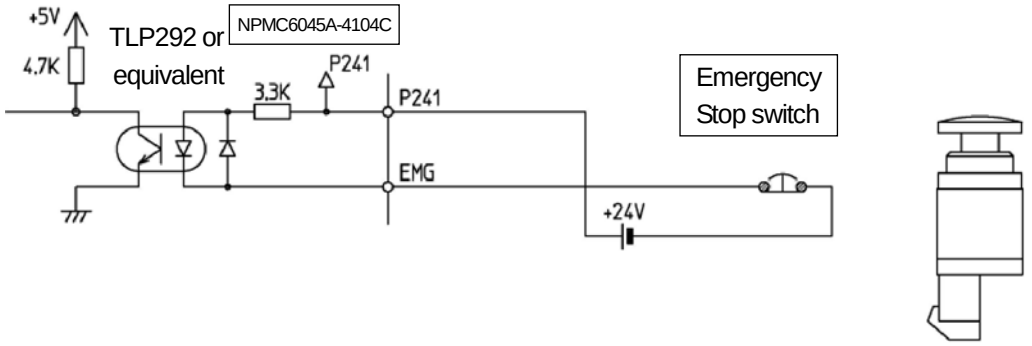



Connections to mechanical limit switches



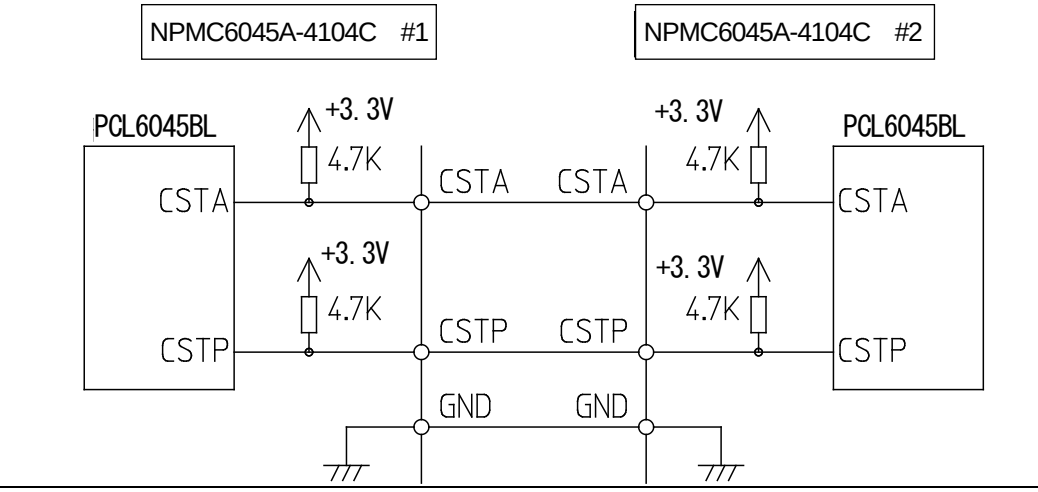
***11-6. Emergency stop input (EMG)***

Connection to an emergency stop switch



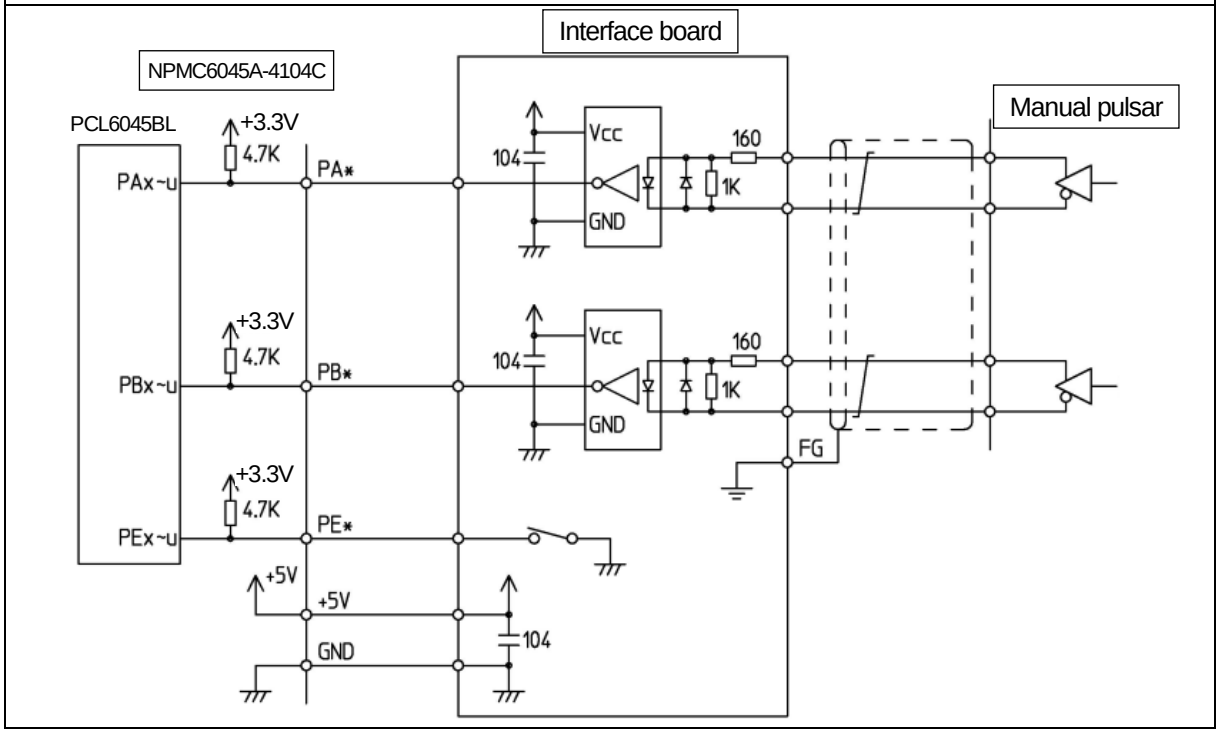

***11-7. Simultaneous start I/O terminal (CSTA), simultaneous stop I/O terminal (CSTP)***

Connecting two NPMC6045A-4104Cs



## ***11-8. Manual pulsar inputs (PA*, PB*), enable/disable pulsar input (PE*)***

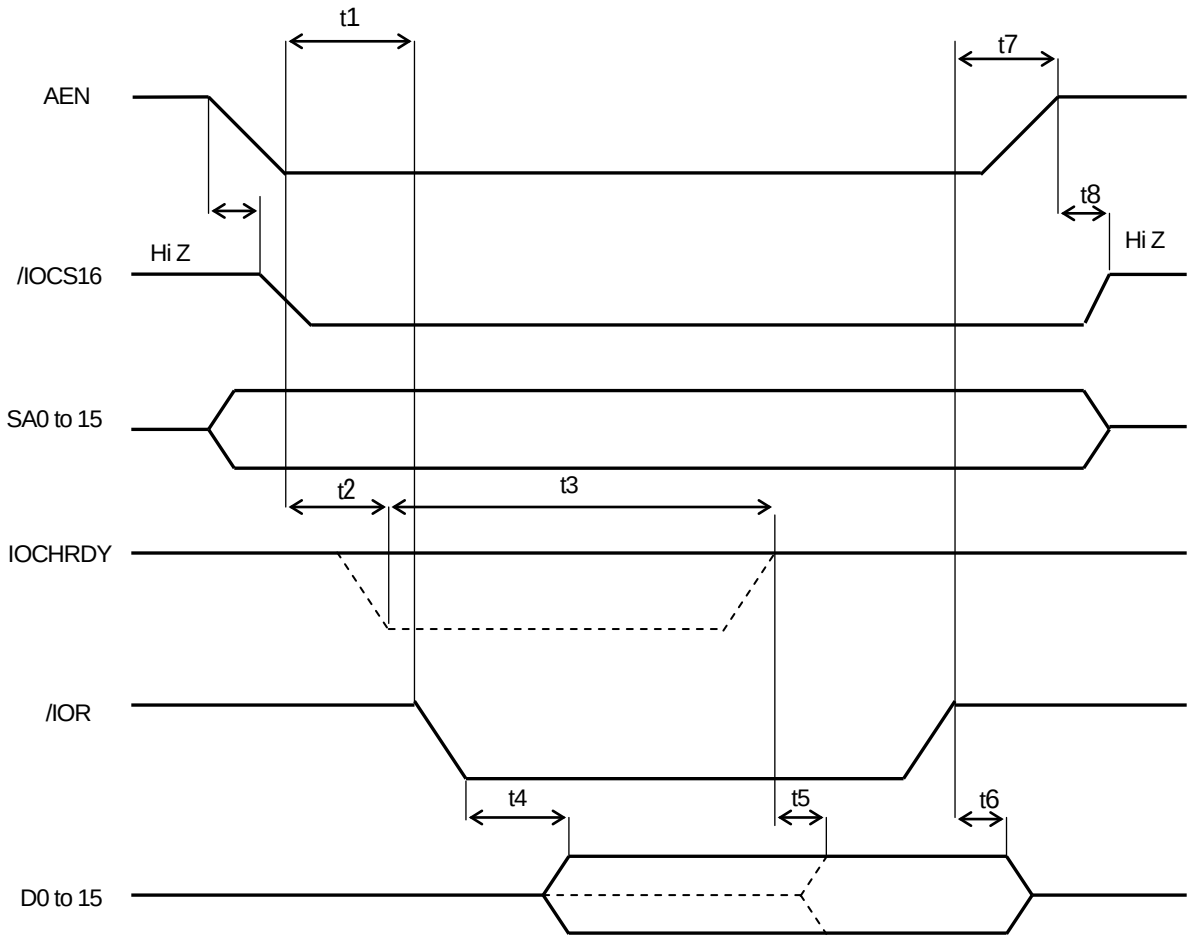
Connections to a user interface board




The circuit shown inside the user interface above is only for reference purposes.

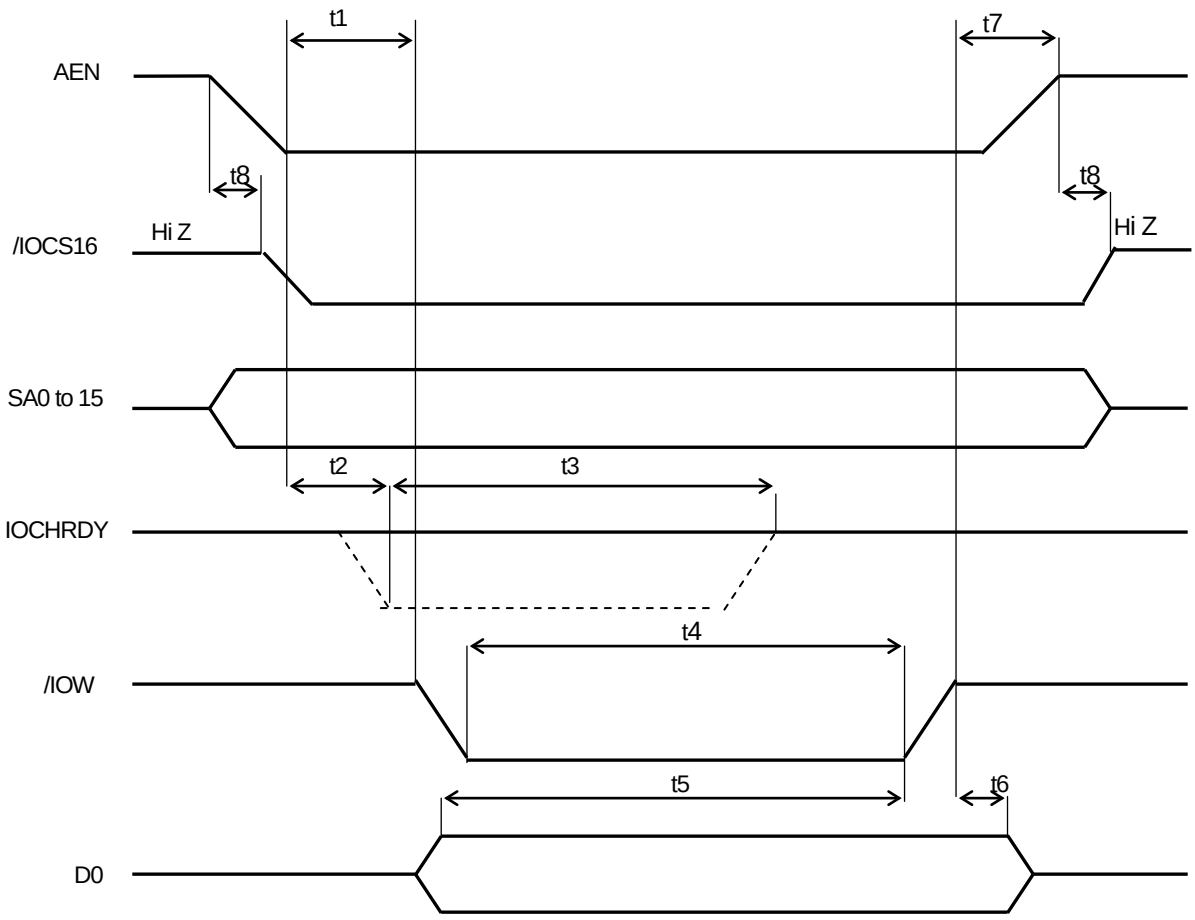
## *12. Bus timing*

### *12-1. Read timing*




| Symbol | Item | min. | max. | Unit |
|---|---|---|---|---|
| t1 | Address, AEN stabilizing time | 31 | | ns |
| t2 | IOCHRDY delay time | | 76 | ns |
| t3 | CPU wait request time | | 262 | ns |
| t4 | Data output delay time | | 35 | ns |
| t5 | Data output delay time | | 18 | ns |
| t6 | Data float delay time | | 26 | ns |
| t7 | Address, AEN latch time | 6 | | ns |
| t8 | /IOCS16 delay time | | 70 | ns |

***12-2. Write timing***

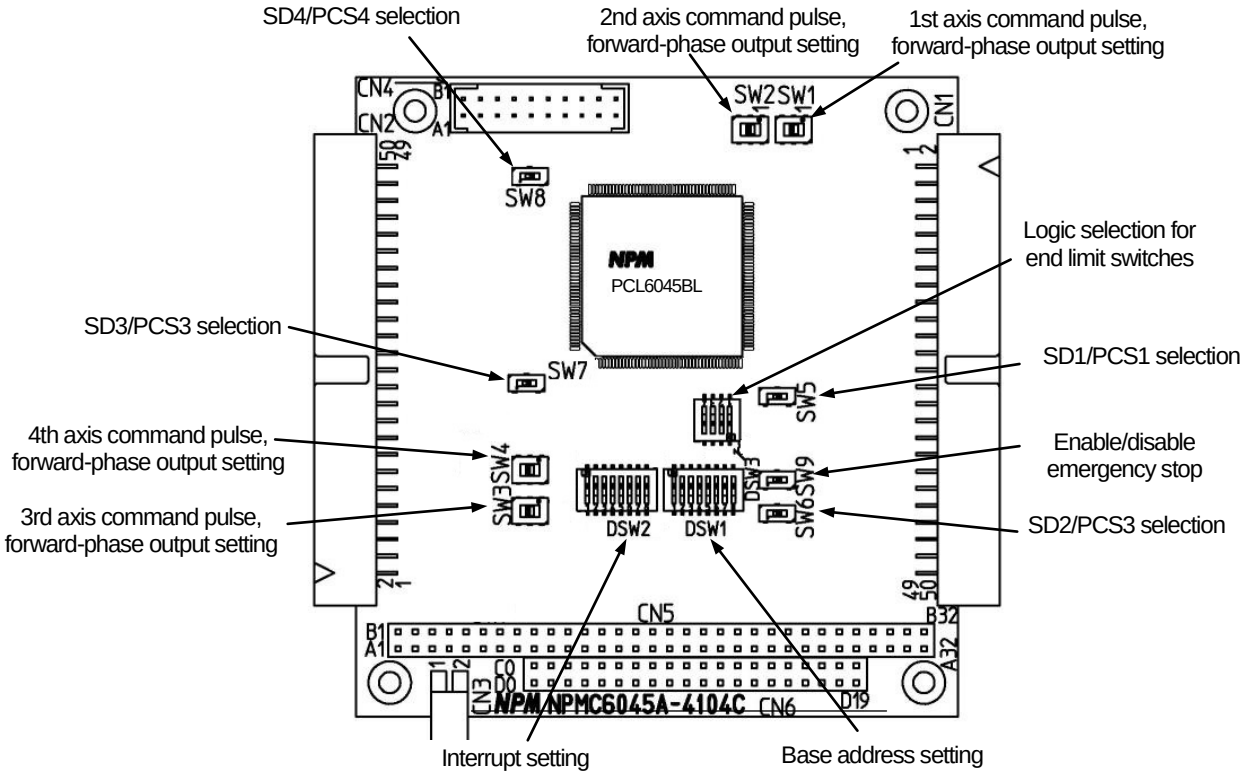


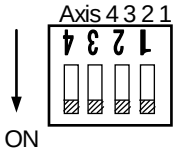
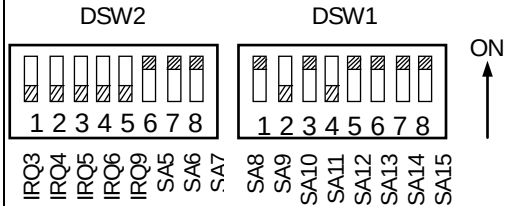

| Symbol | Item | min. | max. | Unit |
|---|---|---|---|---|
| t1 | Address, AEN stabilizing time | 31 | | ns |
| t2 | IOCHRDY delay time | | 76 | ns |
| t3 | CPU wait request time | | 262 | ns |
| t4 | /IOW signal width (note 1) | 13 | | ns |
| t5 | Data setup time | 12 | | ns |
| t6 | Data latch time | 6 | | ns |
| t7 | Address, AEN latch time | 6 | | ns |
| t8 | /IOCS16 delay time | | 70 | ns |

Note 1: When a CPU wait request is output, t4 is the amount of time after IOCHRDY goes high till /IOW goes high.

## *13. Setting Switch Layout*

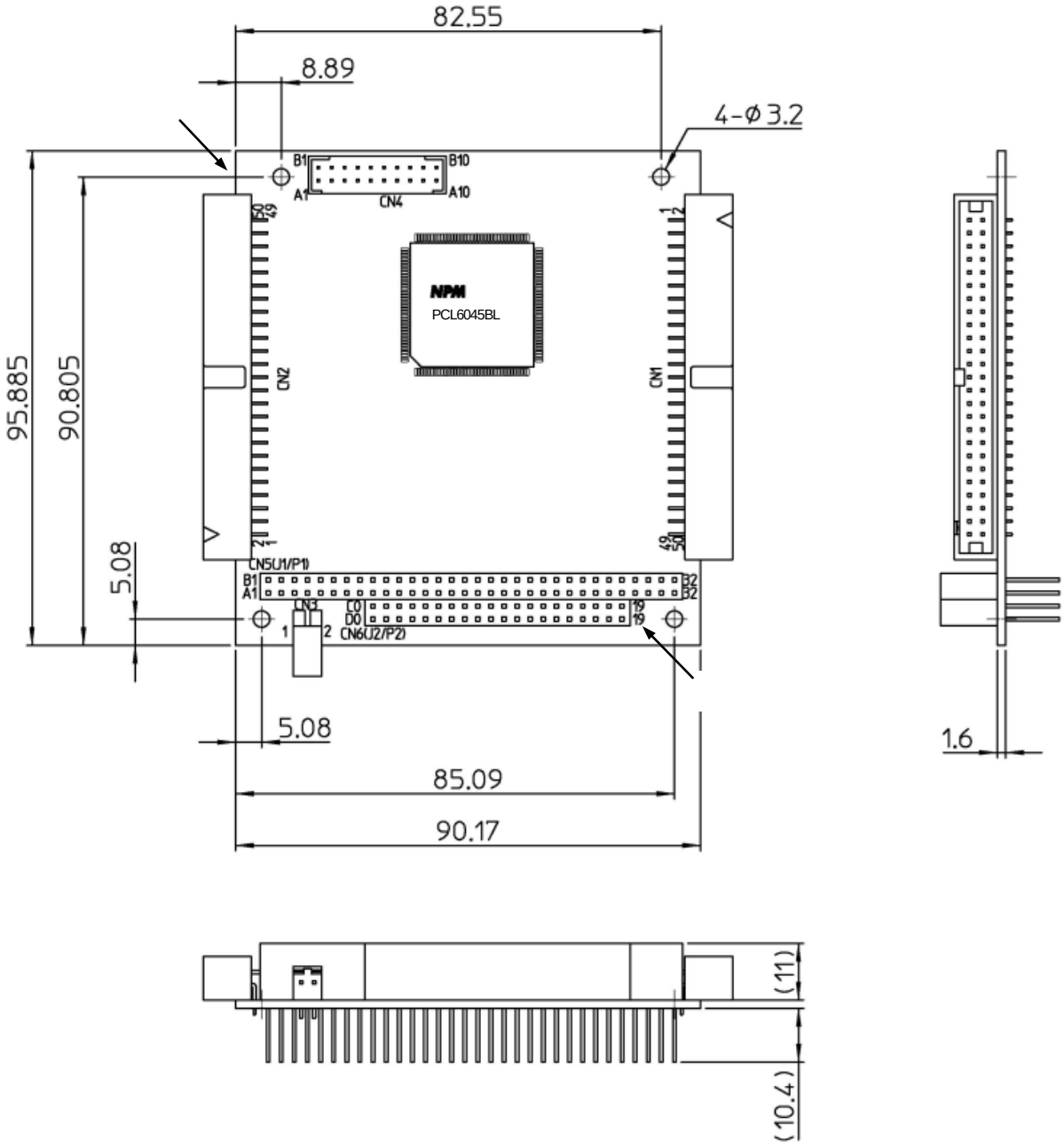
The layout of the setting switches is shown below.




| Item | Setting status | Setting item | Setting status |
|---|---|---|---|
| Command pulse forward-phase output setting (SW1 to SW4) | Forward-phase output<br>Pins 1-2, 4-5 connected<br>  <br>Internal power supply +5V (Setting when delivered)<br>Pins 2-3, 5-6 connected<br>  | Logical selection of end limit switch (DSW3) | ON (Setting when delivered)<br>Turn off the end limit signal by turning on the photo-coupler.<br>  <br>Turn on the end limit by signal by turning on the photo-coupler. |
| SD*/PCS* selection (SW5 to SW8) | SD* selection (Setting when delivered)<br>  <br>PCS* selection<br>  | Base address setting<br><br>Interrupt Setting<br><br>(DSW1 to DSW2) | Base address setting ON: "0," OFF: "1"<br>Interrupt setting. Select by turning on.<br>(Setting when delivered)<br>  |
| Enable/disable emergency stop (SW9) | Enable emergency stop (Setting when delivered)<br>  <br>Disable emergency stops<br>  | | |

## *14. External Dimensions of the Board*

The external appearance of this board is shown below.
The FGs terminals (frame grounds) on CN1 and CN2 are connected to through-holes A and B, respectively.
Connect to the through-hole by putting a stacking spacer on the frame of the control system.



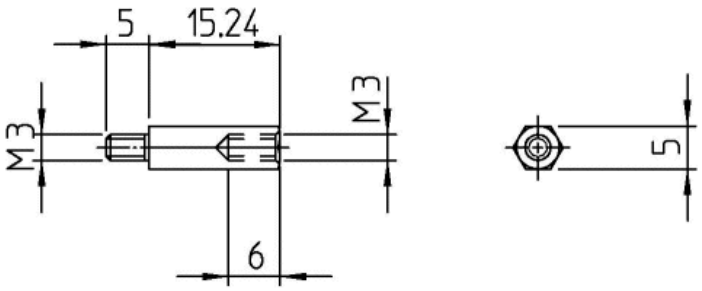

Unit: mm

## ***15. Accessories***

This board is supplied with the following items.

- Nut 4pcs
- Stacking spacer 4pcs

Material = Brass, Surface processing = Nickel plated



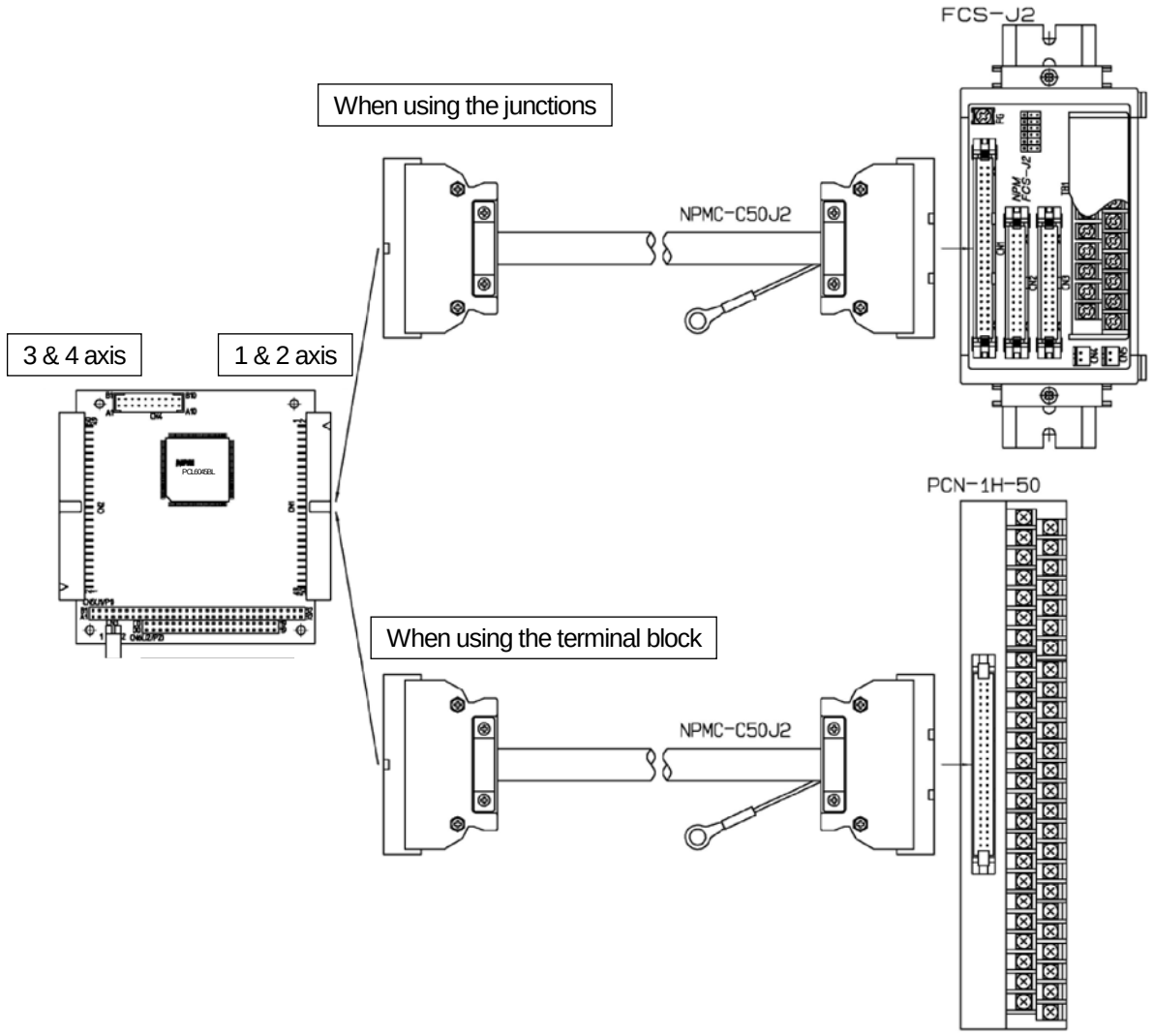

Unit: mm

## *16. Optional Items*

The following junction boards, terminal blocks, and cables are available as options.

### *16-1. Configuration of the options*

- Junction board, terminal block




Cable length

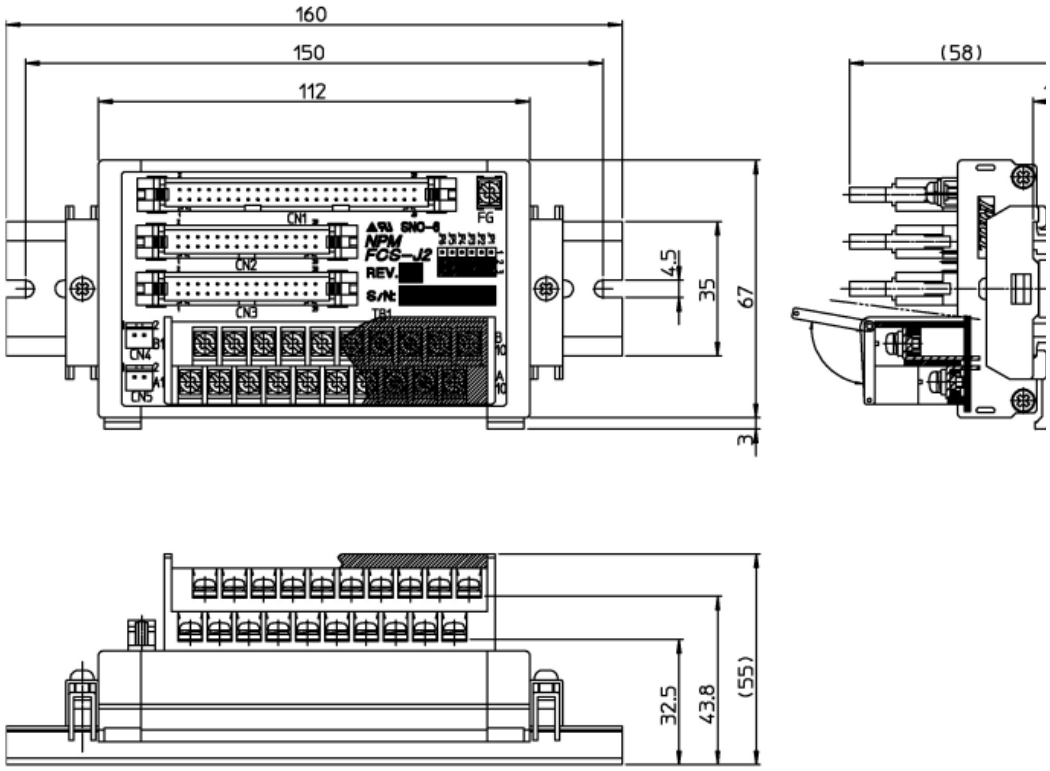
- NPMC-C50J2 1.2 m

## *16-2. Specifications of optional items*

### *16-2-1. Junction board: FCS-J2*

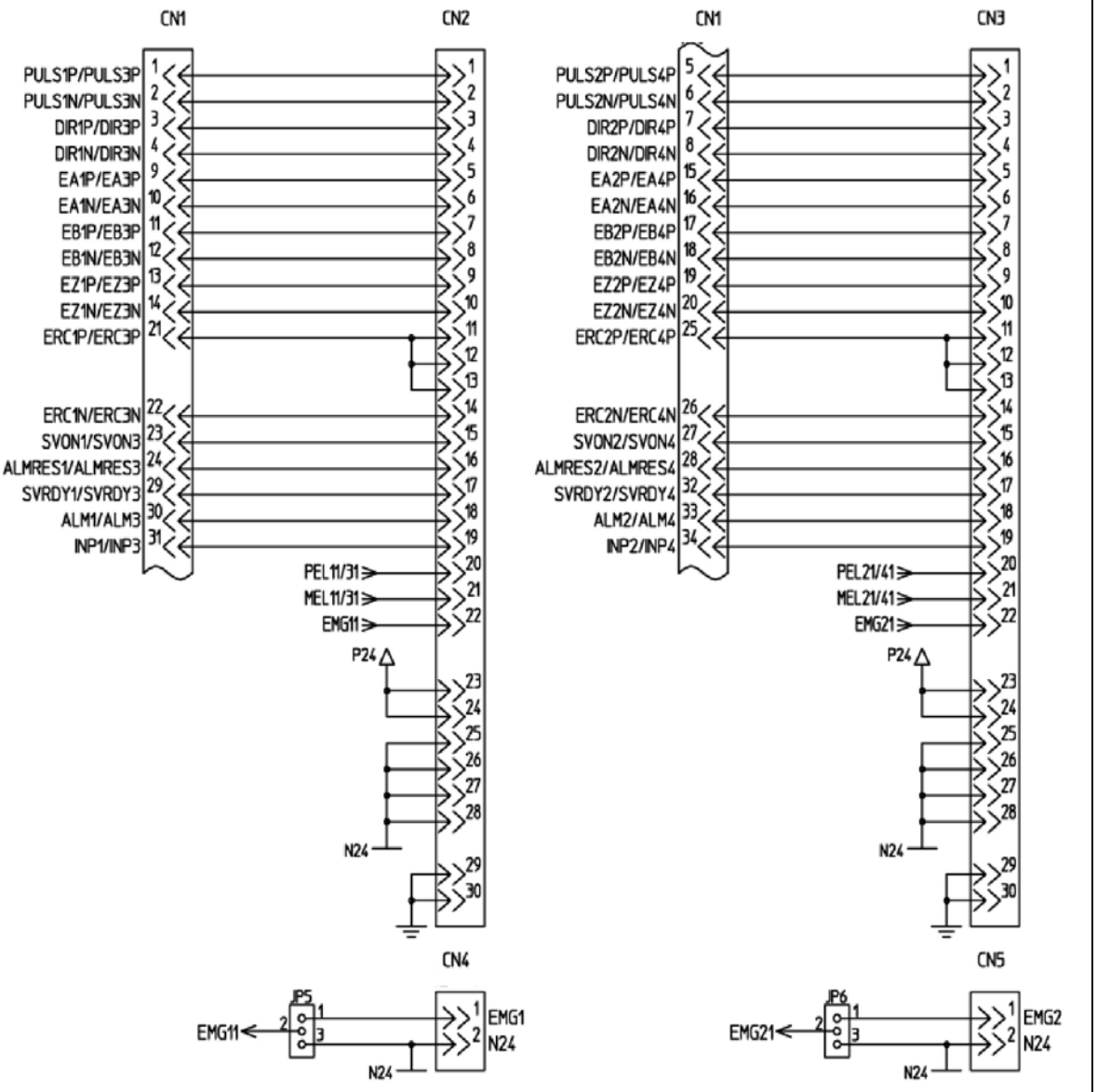
A junction board to connect each motor driver.

External drawings of the board

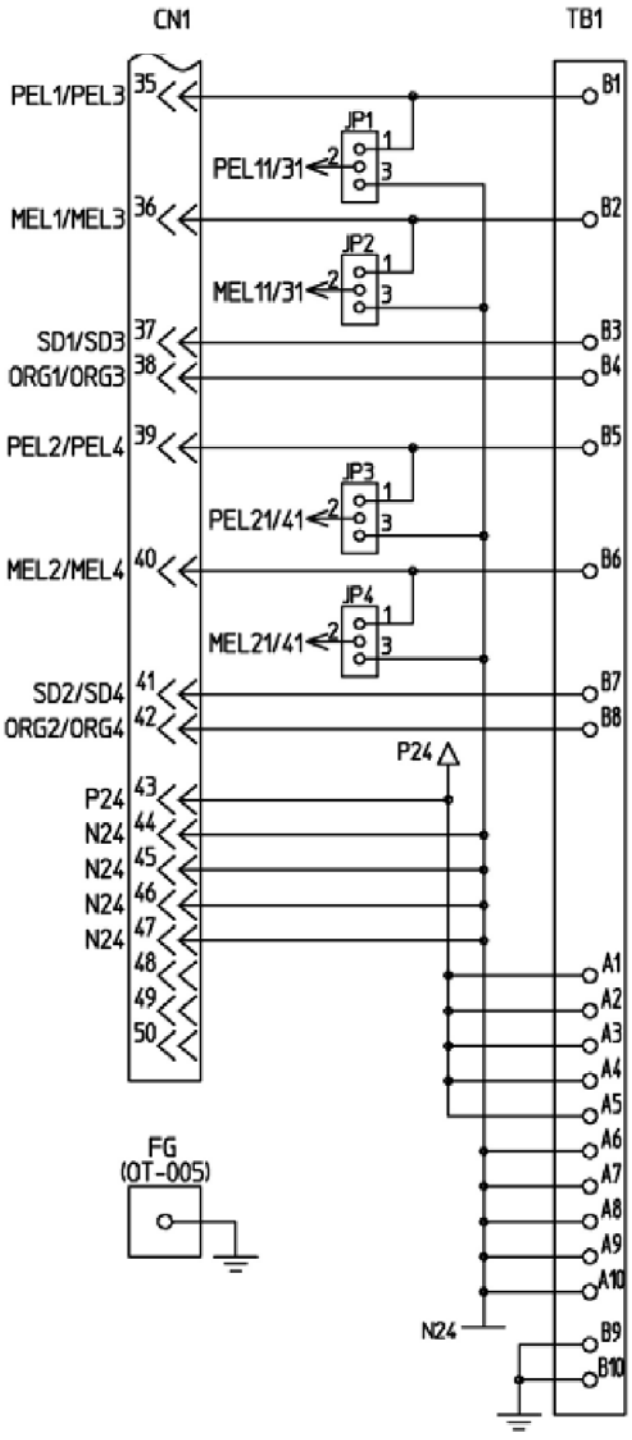



| Position | Part type | Model name - Specification | Mfg. |
|---|---|---|---|
| CN1 | Connector | MIL standard pin heater − 50-pin, with 2 guide keys, right and left | |
| CN2 | Connector | MIL standard pin heater − 30-pin<br>(1st and 3rd axes, for connecting motor drivers) | |
| CN3 | Connector | MIL standard pin heater − 30-pin<br>(2nd and 4th axes, for connecting motor drivers) | |
| CN4 | Connector | IL-2P-S3EN2<br>(1st and 3rd axes, for emergency stop inputs to the motor drivers) | JAE |
| CN5 | Connector | IL-2P-S3EN2<br>(2nd and 4th axes, for emergency stop inputs to the motor driver) | JAE |
| TB1 | Terminal block | 20 terminals (for mechanical inputs) | |
| FG | Screw terminal | For connecting the shield on the CN1 connection cable | |
| JP1 | Jumper | (1st and 3rd axes, select input to prohibit CW rotation) | |
| JP2 | Jumper | (1st and 3rd axes, input to select whether CW rotation is prohibited ) | |
| JP3 | Jumper | (2nd and 4th axes, input to select whether CCW rotation is prohibited ) | |
| JP4 | Jumper | (2nd and 4th axes, input to select whether CW rotation is prohibited ) | |
| JP5 | Jumper | (1st and 3rd axes, input to select whether CCW rotation is prohibited ) | |
| JP6 | Jumper | (2nd and 4th axes, enable/disable emergency stop input) | |

Connector Wiring Diagram 1



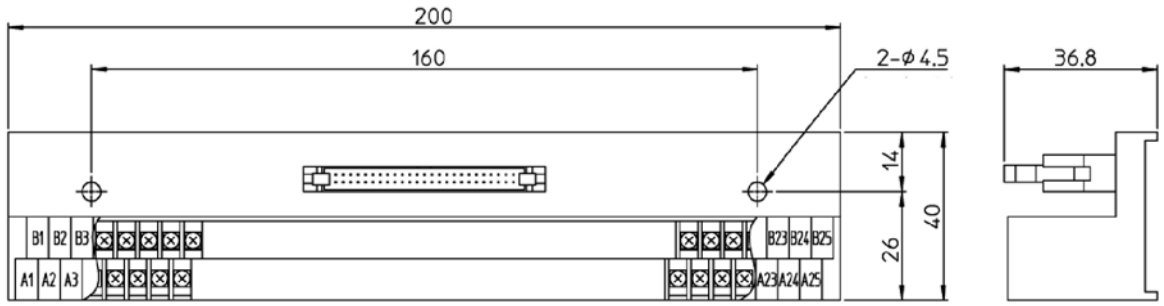
Connector Wiring Diagram 2



### ***16-2-2. Connector terminal block: PCN-1H-50***

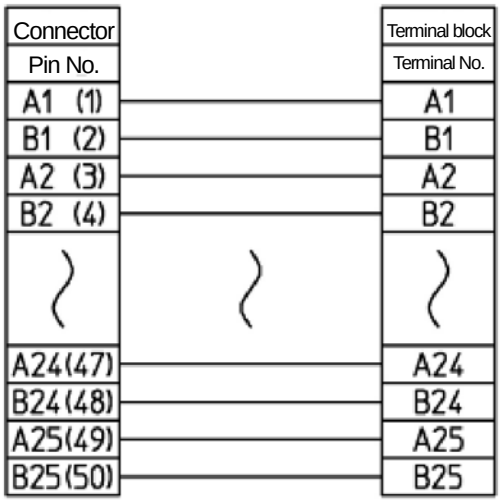
Connector terminal block for connecting each motor driver

External dimensions of the terminal block




| Position | Model name - Specification |
|---|---|
| Installed on the board | Can be installed on a DIN rail |
| | Can be secured with screws through the two ø4.5 holes<br>(We recommend M4 × 15 screws) |
| Connector | MIL standard pin header − 50-pins, with two guide keys, right and left |
| Terminal block | 50 terminals |

Wiring diagram

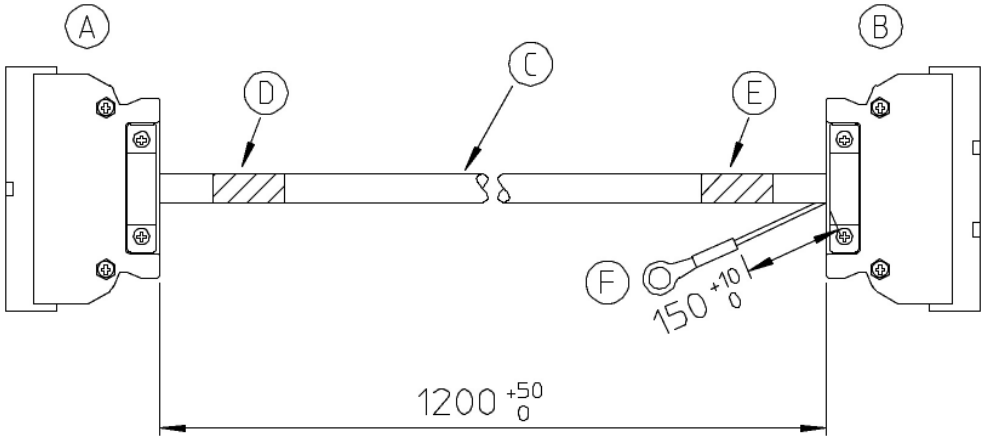



* Numbers in ( ) parenthesis are the pin numbers on the CN1 cable connector.

### ***16-2-3. Cable: NPMC-C50J2***

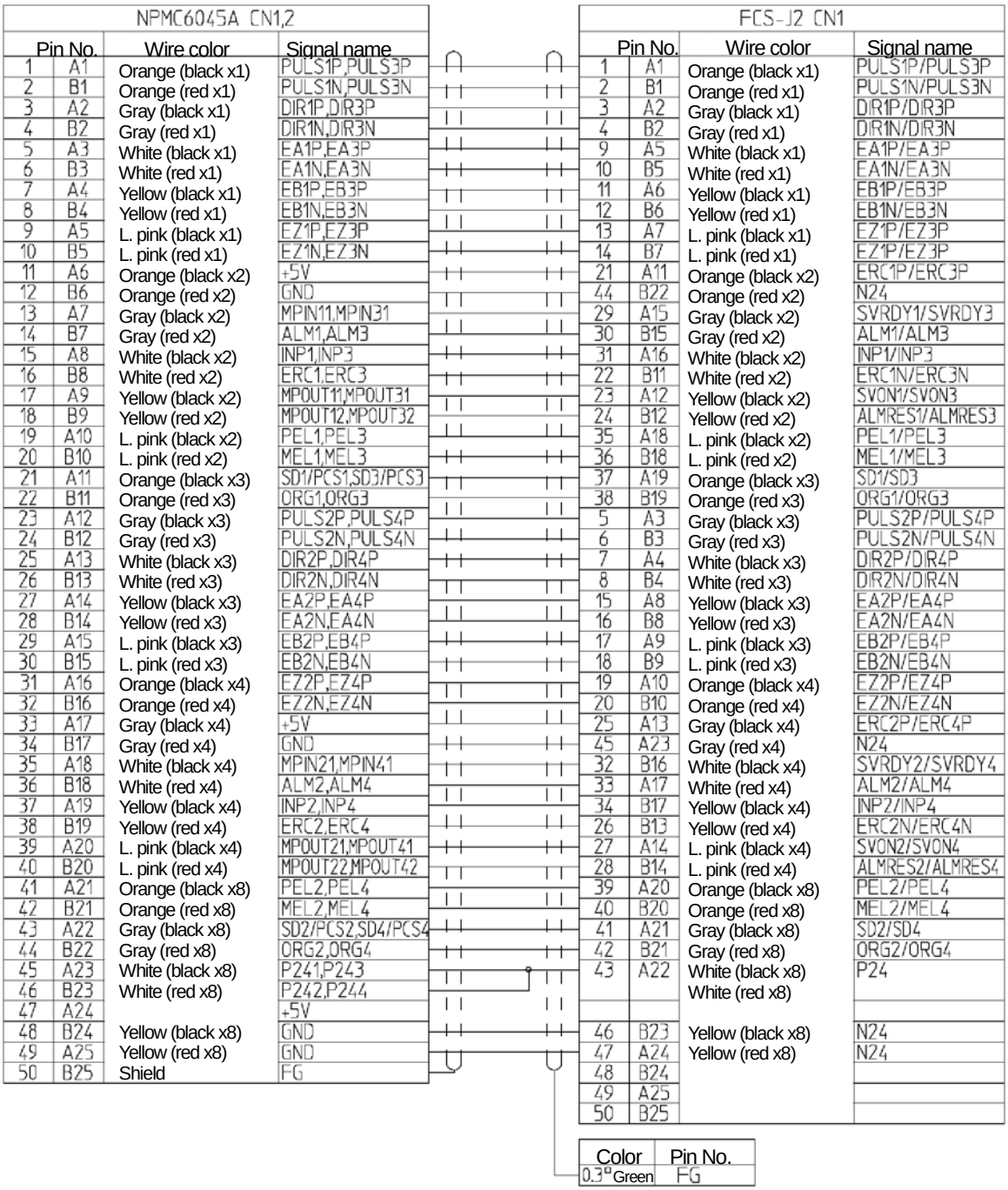
Cable used to connect this board to a junction board, or a terminal block connector.

External dimensions of the cable




| Position | Part name | Model name – Specification | Mfg. |
|---|---|---|---|
| A | Connector | PS-D4C50N | JAE |
| | Cable clamp shell | PS-HD50 | |
| | Crimped terminals | 030-51307-001 | |
| B | Connector | PS-D4C50 | JAE |
| | Cable cramp shell | PS-HD50 | |
| | Crimped terminals | 030-51307-001 | |
| C | Cable | UL20276, nominal cross-sectional area AWG28 (including the shield) | |
| D | Printing | "NPMC6045A CN1, 2" | |
| E | Printing | "FCS-J2 CN1" | |
| F | Ring terminal | 1.25-M3 | JST |
| | Wire | 0.3 $mm^2$ green 150 mm (for connecting to the shield) | |

Pin assignment table



| NPMC6045A CN1,2 | | | |
|---|---|---|---|
| Pin No. | | Wire color | Signal name |
| 1 | A1 | Orange (black x1) | PULS1P,PULS3P |
| 2 | B1 | Orange (red x1) | PULS1N,PULS3N |
| 3 | A2 | Gray (black x1) | DIR1P,DIR3P |
| 4 | B2 | Gray (red x1) | DIR1N,DIR3N |
| 5 | A3 | White (black x1) | EA1P,EA3P |
| 6 | B3 | White (red x1) | EA1N,EA3N |
| 7 | A4 | Yellow (black x1) | EB1P,EB3P |
| 8 | B4 | Yellow (red x1) | EB1N,EB3N |
| 9 | A5 | L. pink (black x1) | EZ1P,EZ3P |
| 10 | B5 | L. pink (red x1) | EZ1N,EZ3N |
| 11 | A6 | Orange (black x2) | +5V |
| 12 | B6 | Orange (red x2) | GND |
| 13 | A7 | Gray (black x2) | MPIN11,MPIN31 |
| 14 | B7 | Gray (red x2) | ALM1,ALM3 |
| 15 | A8 | White (black x2) | INP1,INP3 |
| 16 | B8 | White (red x2) | ERC1,ERC3 |
| 17 | A9 | Yellow (black x2) | MPOUT11,MPOUT31 |
| 18 | B9 | Yellow (red x2) | MPOUT12,MPOUT32 |
| 19 | A10 | L. pink (black x2) | PEL1,PEL3 |
| 20 | B10 | L. pink (red x2) | MEL1,MEL3 |
| 21 | A11 | Orange (black x3) | SD1/PCS1,SD3/PCS3 |
| 22 | B11 | Orange (red x3) | ORG1,ORG3 |
| 23 | A12 | Gray (black x3) | PULS2P,PULS4P |
| 24 | B12 | Gray (red x3) | PULS2N,PULS4N |
| 25 | A13 | White (black x3) | DIR2P,DIR4P |
| 26 | B13 | White (red x3) | DIR2N,DIR4N |
| 27 | A14 | Yellow (black x3) | EA2P,EA4P |
| 28 | B14 | Yellow (red x3) | EA2N,EA4N |
| 29 | A15 | L. pink (black x3) | EB2P,EB4P |
| 30 | B15 | L. pink (red x3) | EB2N,EB4N |
| 31 | A16 | Orange (black x4) | EZ2P,EZ4P |
| 32 | B16 | Orange (red x4) | EZ2N,EZ4N |
| 33 | A17 | Gray (black x4) | +5V |
| 34 | B17 | Gray (red x4) | GND |
| 35 | A18 | White (black x4) | MPIN21,MPIN41 |
| 36 | B18 | White (red x4) | ALM2,ALM4 |
| 37 | A19 | Yellow (black x4) | INP2,INP4 |
| 38 | B19 | Yellow (red x4) | ERC2,ERC4 |
| 39 | A20 | L. pink (black x4) | MPOUT21,MPOUT41 |
| 40 | B20 | L. pink (red x4) | MPOUT22,MPOUT42 |
| 41 | A21 | Orange (black x8) | PEL2,PEL4 |
| 42 | B21 | Orange (red x8) | MEL2,MEL4 |
| 43 | A22 | Gray (black x8) | SD2/PCS2,SD4/PCS4 |
| 44 | B22 | Gray (red x8) | ORG2,ORG4 |
| 45 | A23 | White (black x8) | P241,P243 |
| 46 | B23 | White (red x8) | P242,P244 |
| 47 | A24 | | +5V |
| 48 | B24 | Yellow (black x8) | GND |
| 49 | A25 | Yellow (red x8) | GND |
| 50 | B25 | Shield | FG |

| FCS-J2 CN1 | | | |
|---|---|---|---|
| Pin No. | | Wire color | Signal name |
| 1 | A1 | Orange (black x1) | PULS1P/PULS3P |
| 2 | B1 | Orange (red x1) | PULS1N/PULS3N |
| 3 | A2 | Gray (black x1) | DIR1P/DIR3P |
| 4 | B2 | Gray (red x1) | DIR1N/DIR3N |
| 9 | A5 | White (black x1) | EA1P/EA3P |
| 10 | B5 | White (red x1) | EA1N/EA3N |
| 11 | A6 | Yellow (black x1) | EB1P/EB3P |
| 12 | B6 | Yellow (red x1) | EB1N/EB3N |
| 13 | A7 | L. pink (black x1) | EZ1P/EZ3P |
| 14 | B7 | L. pink (red x1) | EZ1P/EZ3P |
| 21 | A11 | Orange (black x2) | ERC1P/ERC3P |
| 44 | B22 | Orange (red x2) | N24 |
| 29 | A15 | Gray (black x2) | SVRDY1/SVRDY3 |
| 30 | B15 | Gray (red x2) | ALM1/ALM3 |
| 31 | A16 | White (black x2) | INP1/INP3 |
| 22 | B11 | White (red x2) | ERC1N/ERC3N |
| 23 | A12 | Yellow (black x2) | SVON1/SVON3 |
| 24 | B12 | Yellow (red x2) | ALMRES1/ALMRES3 |
| 35 | A18 | L. pink (black x2) | PEL1/PEL3 |
| 36 | B18 | L. pink (red x2) | MEL1/MEL3 |
| 37 | A19 | Orange (black x3) | SD1/SD3 |
| 38 | B19 | Orange (red x3) | ORG1/ORG3 |
| 5 | A3 | Gray (black x3) | PULS2P/PULS4P |
| 6 | B3 | Gray (red x3) | PULS2N/PULS4N |
| 7 | A4 | White (black x3) | DIR2P/DIR4P |
| 8 | B4 | White (red x3) | DIR2N/DIR4N |
| 15 | A8 | Yellow (black x3) | EA2P/EA4P |
| 16 | B8 | Yellow (red x3) | EA2N/EA4N |
| 17 | A9 | L. pink (black x3) | EB2P/EB4P |
| 18 | B9 | L. pink (red x3) | EB2N/EB4N |
| 19 | A10 | Orange (black x4) | EZ2P/EZ4P |
| 20 | B10 | Orange (red x4) | EZ2N/EZ4N |
| 25 | A13 | Gray (black x4) | ERC2P/ERC4P |
| 45 | A23 | Gray (red x4) | N24 |
| 32 | B16 | White (black x4) | SVRDY2/SVRDY4 |
| 33 | A17 | White (red x4) | ALM2/ALM4 |
| 34 | B17 | Yellow (black x4) | INP2/INP4 |
| 26 | B13 | Yellow (red x4) | ERC2N/ERC4N |
| 27 | A14 | L. pink (black x4) | SVON2/SVON4 |
| 28 | B14 | L. pink (red x4) | ALMRES2/ALMRES4 |
| 39 | A20 | Orange (black x8) | PEL2/PEL4 |
| 40 | B20 | Orange (red x8) | MEL2/MEL4 |
| 41 | A21 | Gray (black x8) | SD2/SD4 |
| 42 | B21 | Gray (red x8) | ORG2/ORG4 |
| 43 | A22 | White (black x8) | P24 |
| | | White (red x8) | |
| | | | |
| 46 | B23 | Yellow (black x8) | N24 |
| 47 | A24 | Yellow (red x8) | N24 |
| 48 | B24 | | |
| 49 | A25 | | |
| 50 | B25 | | |

| Color | Pin No. |
|---|---|
| 0.3□ Green | FG |

## *17. Driver connection example*

See the separate pages containing the "NPMC6045A-4104 connection example"

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

Impress, not just satisfy
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