PCI Bus

2/4-Axis Motor Control Board

MC8022P/MC8042P

Hardware Manual

2013-04-17 Ver. 1.0

NOVA electronics

Prevent Electrostatic Discharge

ATTENTION: MC8022P/MC8042P is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle MC8022P/MC8042P:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wrist strap.
- Hold both ends of the board between your fingers or hold a mounting bracket.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components on MC8022P/MC8042P.
- Store MC8022P/MC8042P in appropriate static-safe packaging when not in use.

Safety Notice

WARNING: MC8022P/ MC8042P is not designed or intended to be fail-safe, or for use in any application requiring fail-safe performance, such as in life-support or safety devices or systems that could lead to death, personal injury or severe property or environmental damage (individually and collectively, "critical applications"). Customer must be fully responsible for the use of MC8022P/MC8042P in critical applications. Provide adequate design and operating safeguards in order to minimize risks associated with customer's applications when incorporating MC8022P/MC8042P in a system.

Before you begin

ATTENTION: Before using MC8022P/MC8042P, read this manual thoroughly to ensure correct usage and observe all the instructions given in this manual.

Checking the Contents

ATTENTION: When you unpack a package of MC8022P/MC8042P, check for the following accessories. If something is missing or broken, contact the place of purchase.

- MC8042P or MC80222P 1
- I/O Cable (CN2) 1

The user's manual and software are not with the package for resource-saving. If you need additional manuals or software, contact the place of purchase or contact us to the following email address as "novaelec_info@novaelec.co.jp".

Consulting Other Manuals

ATTENTION: The circuit of MC8022P/MC8042P consists of mainly 4-axis motion control IC “MCX304”, a PCI-bus interface circuit and I/O interface circuits of each axis. Basic functions of this board all depend on MCX304, so please refer to the user’s manual of MCX304 regarding these functions. This manual describes about Electric Specification of each axis I/O signal. Regarding the installation on Windows, API function for board control and sample program files for this board, see “MC8000P Device Driver Manual.”

Environmental Conditions

ATTENTION: Use the following environmental conditions.

Operating Temperature	0～45°C(32～113°F)
Humidity	20～90% (no condensation)
Floating dust	Not to be excessive
Corrosive gases	None
Electric supply source	DC+5V (±5%), external source: DC+24V

Inspection and Maintenance

ATTENTION: Perform inspection and maintenance periodically for correct use.

Cable connection	The connector of the board and a cable should properly be connected.
Card-edge	No dust and no corrosion.
Connector terminal area	No dust and no corrosion.
On the IC and board	No excessive dust and no foreign substance.

Handling Precautions

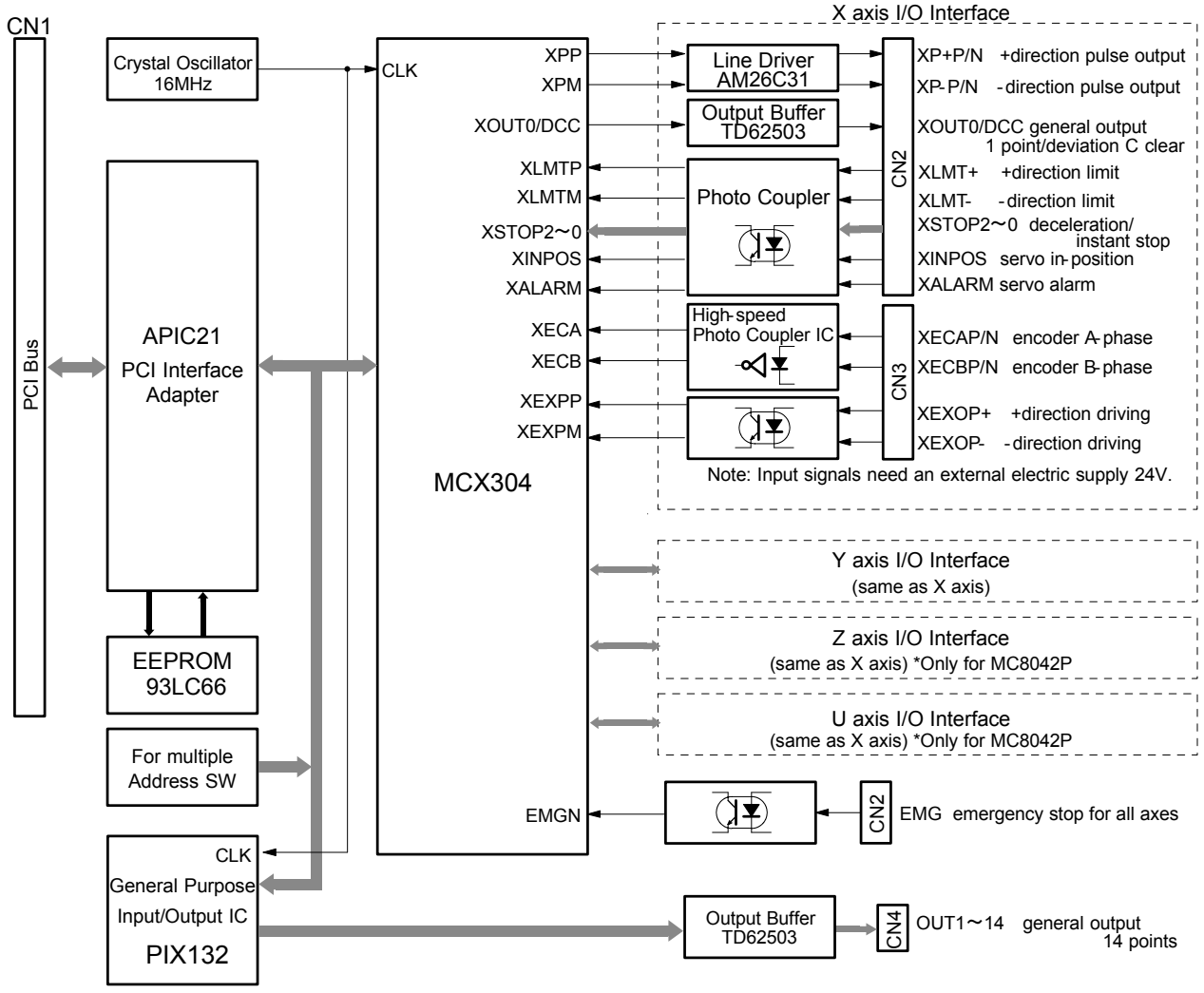
ATTENTION:

- Do not use in any location subject to shock, vibration, magnetism and electricity. Otherwise, the equipment may be damaged or malfunctioned.
- Do not disassemble, repair or modify the equipment.
- Do not connect or disconnect the board or cables while power is applied. Otherwise, breakdown or operation error may result.

1. Outline

MC8022P/MC8042P is a PCI-bus compliant circuit board equipped with 4-axis motion control IC “MCX304”. It can independently control 2/4-axis of either stepper motor or pulse type servo drives for position and speed controls.

MC8022P/MC8042P functional block diagram is shown as follows. MC8022P/MC8042P consists of mainly 4-axis motion control IC “MCX304”, a PCI-bus interface circuit and I/O interface circuits of each axis: X, Y, Z and U. Therefore, basic functions of this board all depend on MCX304, so please refer to the user’s manual of MCX304 regarding these functions.



CN1: PCI card edge connector
CN2: PC rear connector
CN3, 4: Connectors on the board

MC8022P/MC8042P Circuit Block Diagram

1.1 MCX304 Functional Restriction

MC8022P/MC8042P does not support the following MCX304 general output signals. However, it is equipped with PIX132(NOVA Electronics) on the board, so that it has fourteen general output signals and nOUT general output signals of MCX304.

■ MCX304-nOUT1 output signal
nSTOP2/OUT1 pin of MCX304 is used as STOP2 input, so it cannot be used as general output nOUT1.
■ MCX304-nOUT2, 3 output signals
D15~D8 are used due to 16-bit data bus performance. Therefore, it cannot be used as nOUT2, 3 signals.

1.2 PCI Bus Interface

■ Occupied I/O Address
The board requires 24 I/O address locations for PCI bus. I/O addressing is determined by “plug and play” function of Windows.

■ Data Length
Data length is 16-bit. Read/Write access cannot be performed per byte.

■ Interrupt Signal
When using an interrupt to PCI bus, the board uses IRQ determined by “plug and play” function of Windows.

1.3 Each Axis I/O Interface

■ Drive Pulse Output (nP+P/N, nP-P/N)
Drive pulses in the +/- direction for motor driving are output a 50% duty cycle of from 1PPS to 4MPPS.
Drive pulse output signals of each direction are the differential line-driver output of AM26C31 line driver or equivalent.

■ General Output (OUT1~14, nOUT0)
General output signals (14points) from PIX132, output buffer uses TD62503 (Toshiba) and is the open collector output with sustaining voltage 35V. These signals are placed in the connector CN4 on the board. nOUT0 signal for each axis can be used as a deviation counter clear signal (DCC) for a servomotor in automatic home search executing. nOUT0 signal is placed in the rear connector CN2.

■ Over Run Limit Input (nLMT+, nLMT-)
Input signal to disable output pulse for + and – direction respectively. Decelerating stop and instant stop for active can be selected in mode setting. These input signals are isolated by photo coupler from internal circuit. external 24V power supply is needed.

■ Decelerating Stop/Instant Stop Input (nSTOP2~0)
In automatic home search, this input signal is to stop drive pulse in deceleration or immediately from outside. Enable/Disable and active logical level can be selected in mode setting and each axis has three inputs. For encoder Z-phase signal, input to nSTOP2. The user can connect to the driver whose type of output circuit is open collector or differential line-driver. These input signals are isolated by photo coupler from internal circuit.

■ Servo Motor Input (nINPOS, nALARM)
INPOS (in-position) signal and ALARM signal for servo motor drivers can be input, which can also be used as general input signals. These input signals are isolated by photo coupler from internal circuit.

■ Encoder Input (nECAP/N, nECBP/N)
This signal inputs A/B phase signal from an encoder, which is placed in the connector CN3 on the board. nECAP/N, nECBP/N signals are for an encoder A/B phase signal input and count up or down 32-bit real position counter inside MCX304. These input signals are isolated by photo coupler from internal circuit and can easily be connected to a differential output line-driver.

■ Driving by External Input(nEXOP+, nEXOP-)
This signal externally controls driving in the + or – direction, which is placed in the connector CN3 on the board. In fixed driving mode, the input signal triggers (the falling edge) to output specified drive pulse. In continuous driving mode, drive pulse is output continuously while the input signal is low. This function can reduce the load of the host CPU, so the user can perform jog feed of each axis speedy. These input signals are isolated by photo coupler from internal circuit.

■ Emergency Stop Input (EMG)

This signal is to perform the emergency stop for all axes. Active logical level can be set by selecting a jumper on the board. This input signal is isolated by photo coupler from internal circuit.

2. I/O Address Setting and Register

I/O port address of the board is automatically determined by the plug and play function (PnP function) of the PCI bus. Read/Write registers of MCX304 on the board and ports of PIX132 can be accessed by API function which MC8000P device driver provides. Each register and I/O port address are as shown in the table below.
For more details on each register, see chapter 4 of MCX304 user's manual.

I/O Address	IC	Write Register	Read Register
00	MCX304	WR0 command register	RR0 main status register
01		XWR1 X axis mode register 1 YWR1 Y axis mode register 1 ZWR1 Z axis mode register 1 UWR1 U axis mode register 1	XRR1 X axis status register 1 YRR1 Y axis status register 1 ZRR1 Z axis status register 1 URR1 U axis status register 1
02		XWR2 X axis mode register 2 YWR2 Y axis mode register 2 ZWR2 Z axis mode register 2 UWR2 U axis mode register 2	XRR2 X axis status register 2 YRR2 Y axis status register 2 ZRR2 Z axis status register 2 URR2 U axis status register 2
03		XWR3 X axis mode register 3 YWR3 Y axis mode register 3 ZWR3 Z axis mode register 3 UWR3 U axis mode register 3	XRR3 X axis status register 3 YRR3 Y axis status register 3 ZRR3 Z axis status register 3 URR3 U axis status register 3
04		WR4 output register 1	RR4 input register 1
05		WR5 output register 2	RR5 input register 2
06		WR6 write data register 1	RR6 read data register 1
07		WR7 write data register 2	RR7 read data register 2
10	PIX132	write prohibit	invalid
11		write prohibit	invalid
12		write prohibit	invalid
13		write prohibit	invalid
14		Port A output data (Set to D7~D0)	Port A output data reading (D7~D0)
15		Port B output data (Set to D7~D0)	Port B output data reading (D7~D0)
16		Port C output data (Set to D7~D0)	Port C output data reading (D7~D0)
17		invalid	invalid

3. I/O Signals

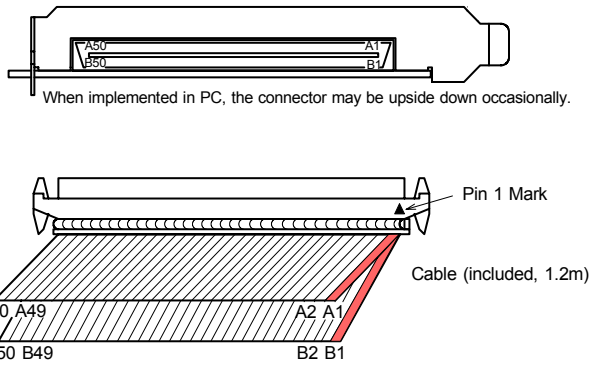
This chapter describes each I/O signals of the I/O connector. In the description, the signal name of each axis is described as n○○○○.

3.1 CN2 Connector (Rear connector)

CN2 connector is equipped with external power (+24VDC) input, and inputs/outputs signals of each axis as shown below.

Connector	Signal Type	Signal Name
CN2	Drive pulse output signal in the +/– direction	nP+P/N, nP-P/N
	Over run limit input signal in the +/– direction	nLMT+, nLMT-
	Decelerating stop/Instant stop input signal 3 points	nSTOP0, nSTOP1, nSTOP2
	In-position and alarm input signal for servo motor	nINPOS, nALARM
	Deviation counter clear output signal for servo motor (shared with general output 1 point)	nOUT0/DCC
	Emergency stop input signal for all axis	EMG

CN2 Connector Pin Assignments



The cable (included) is A1, A2, … A49, A50 from the right (red) of the upper cable to the left, and B1, B2, … B49, B50 from the right (red) of the lower cable to the left when Pin 1 mark (▲) of the connector is placed in the upper right.

Connector type: Board side FX2B-100PA-1.27DS (Hirose), Cable side FX2B-100SA-1.27R (Hirose)

CN2 Connector

Pin	Signal	I/O	Content	Chapter *Note2	Pin	Signal	I/O	Content	Chapter
A1	VEX		External Power (+24V)	3.12	B1	EMG	Input	Emergency Stop (All axes)	3.11
A2	XLMT+	Input	X axis Limit in + direction	3.5					
A3	XLMT-	Input	X axis Limit in – direction	3.5					
A4	XSTOP0	Input	X axis Decelerating Stop / Instant Stop	3.6					
A5	XSTOP1	Input	X axis Decelerating Stop / Instant Stop	3.6					
A6	YLMT+	Input	Y axis Limit in + direction	3.5					
A7	YLMT-	Input	Y axis Limit in – direction	3.5					
A8	YSTOP0	Input	Y axis Decelerating Stop / Instant Stop	3.6					
A9	YSTOP1	Input	Y axis Decelerating Stop / Instant Stop	3.6					
A10	ZLMT+	Input	Z axis Limit in + direction	3.5 MC8042P					
A11	ZLMT-	Input	Z axis Limit in – direction	3.5 MC8042P					
A12	ZSTOP0	Input	Z axis Decelerating Stop / Instant Stop	3.6 MC8042P					
A13	ZSTOP1	Input	Z axis Decelerating Stop / Instant Stop	3.6 MC8042P					
A14	ULMT+	Input	U axis Limit in + direction	3.5 MC8042P					
A15	ULMT-	Input	U axis Limit in – direction	3.5 MC8042P					
A16	USTOP0	Input	U axis Decelerating Stop / Instant Stop	3.6 MC8042P					
A17	USTOP1	Input	U axis Decelerating Stop / Instant Stop	3.6 MC8042P					
A18	XSTOP2	Input	X axis Encoder Z-phase	3.7					
A19	XINPOS	Input	X axis Inposition	3.8					
A20	XALARM	Input	X axis Alarm	3.8					
A21	YSTOP2	Input	Y axis Encoder Z-phase	3.7					
A22	YINPOS	Input	Y axis Inposition	3.8					
A23	YALARM	Input	Y axis Alarm	3.8					
A24	ZSTOP2	Input	Z axis Encoder Z-phase	3.7 MC8042P					
A25	ZINPOS	Input	Z axis Inposition	3.8 MC8042P					
A26	ZALARM	Input	Z axis Alarm	3.8 MC8042P					
A27	USTOP2	Input	U axis Encoder Z-phase	3.7 MC8042P					
A28	UINPOS	Input	U axis Inposition	3.8 MC8042P					
A29	UALARM	Input	U axis Alarm	3.8 MC8042P					
A30	GND		Internal Circuit GND						
A31	XOUT0/DCC	Output	X axis General Output/DCC *Note1	3.4					
A32	YOUT0/DCC	Output	Y axis General Output/DCC	3.4					
A33	ZOUT0/DCC	Output	Z axis General Output/DCC	3.4 MC8042P					
A34	UOUT0/DCC	Output	U axis General Output/DCC	3.4 MC8042P					
A35	XP+P	Output	X axis Drive Pulse in + direction	3.3					
A36	XP+N	Output	X axis Drive Pulse in + direction	3.3					
A37	XP-P	Output	X axis Drive Pulse in – direction	3.3					
A38	XP-N	Output	X axis Drive Pulse in – direction	3.3					
A39	YP+P	Output	Y axis Drive Pulse in + direction	3.3					
A40	YP+N	Output	Y axis Drive Pulse in + direction	3.3					
A41	YP-P	Output	Y axis Drive Pulse in – direction	3.3					
A42	YP-N	Output	Y axis Drive Pulse in – direction	3.3					
A43	ZP+P	Output	Z axis Drive Pulse in + direction	3.3 MC8042P					
A44	ZP+N	Output	Z axis Drive Pulse in + direction	3.3 MC8042P					

A45	ZP-P	Output	Z axis Drive Pulse in – direction	3.3 MC8042P					
A46	ZP-N	Output	Z axis Drive Pulse in – direction	3.3 MC8042P					
A47	UP+P	Output	U axis Drive Pulse in + direction	3.3 MC8042P					
A48	UP+N	Output	U axis Drive Pulse in + direction	3.3 MC8042P					
A49	UP-P	Output	U axis Drive Pulse in – direction	3.3 MC8042P					
A50	UP-N	Output	U axis Drive Pulse in – direction	3.3 MC8042P					

*Note1: DCC (Deviation Counter Clear): Output to clear the deviation counter of a servo motor driver.
*Note2: MC8042P: The signals which only MC8042P has. MC8022P doesn't.

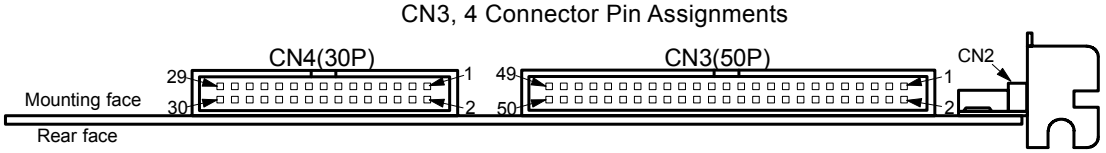
Note: When connecting or disconnecting the cable into the CN2 connector, turn OFF PC first and turn OFF external power (DC+24V), then connect or disconnect the cable. Otherwise, the destruction of the internal circuit may be caused. Be careful about the connector direction and not to reverse it.

3.2 CN3, 4 Connector (Connector on the board)

CN3, 4 connectors on the board input/output signals of each axis as shown below.

Connector	Signal Type	Signal Name
CN3	Driving by external input signal in the +/– direction (can be used as general input) Encoder A/B phase input signal	nEXOP+, nEXOP– nECAP/N, nECBP/N
CN4	General output signal	OUT1~14

CN3, 4 Connector Pin Assignments



Connector: HIF3FC-30PA-2.54DS (Hirose)
Socket (included): HIF3BA-30D-2.54R
(Optional accessor

Connector: HIF3FC-50PA-2.54DS (Hirose)
Socket (included): HIF3BB-50D-2.54R
(Optional accessory)

CN3 Connector

Pin	Signal	I/O	Content	Chapter	Pin	Signal	I/O	Content	Chapter
1	VEX		External Power（+24V）	3.12	2	VEX		External Power（+24V）	3.12
3	XEXOP+	Input	X axis Driving by External Signal in + direction	3.10	4	XEXOP-	Input	X axis Driving by External Signal in - direction	3.10
5	YEXOP+	Input	Y axis Driving by External Signal in + direction	3.10	6	YEXOP-	Input	Y axis Driving by External Signal in - direction	3.10
7	ZEXOP+	Input	Z axis Driving by External Signal in + direction	3.10 *Note2	8	ZEXOP-	Input	Z axis Driving by External Signal in - direction	3.10 *Note2
9	UEXOP+	Input	U axis Driving by External Signal in + direction	3.10 *Note2	10	UEXOP-	Input	U axis Driving by External Signal in - direction	3.10 *Note2
11					12				
13					14				
15					16				
17					18				
19	XECAP	Input	X axis Encoder A phase (+)	3.9	20	XECAN	Input	X axis Encoder A phase (–)	3.9
21	XECBP	Input	X axis Encoder B phase (+)	3.9	22	XECBN	Input	X axis Encoder B phase (–)	3.9
23	YECAP	Input	Y axis Encoder A phase (+)	3.9	24	YECAN	Input	Y axis Encoder A phase (–)	3.9
25	YECBP	Input	Y axis Encoder B phase (+)	3.9	26	YECBN	Input	Y axis Encoder B phase (–)	3.9
27	ZECAP	Input	Z axis Encoder A phase (+)	3.9 *Note2	28	ZECAN	Input	Z axis Encoder A phase (–)	3.9 *Note2
29	ZECBP	Input	Z axis Encoder B phase (+)	3.9 *Note2	30	ZECBN	Input	Z axis Encoder B phase (–)	3.9 *Note2
31	UECAP	Input	U axis Encoder A phase (+)	3.9 *Note2	32	UECAN	Input	U axis Encoder A phase (–)	3.9 *Note2
33	UECBP	Input	U axis Encoder B phase (+)	3.9 *Note2	34	UECBN	Input	U axis Encoder B phase (–)	3.9 *Note2
35					36				
37					38				
39					40				
41					42				
43					44				
45					46				
47					48				
49					50				

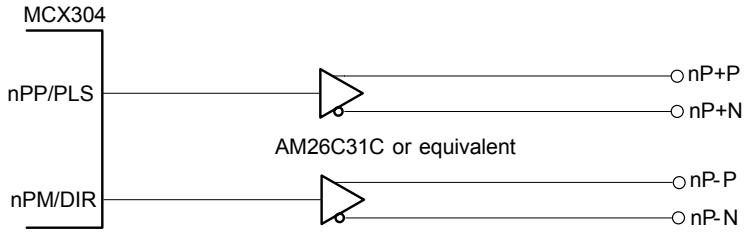
*Note2: MC8042P: The signals which only MC8042P has. MC8022P doesn't.

CN4 Connector

Pin	Signal	I/O	Content	Chapter	Pin	Signal	I/O	Content	Chapter
1	VEX		External Power（+24V）	3.12	2	VEX		External Power（+24V）	3.12
3					4				
5					6				
7					8				
9	OUT1/PA6	Output	General Output1	3.4	10	OUT2/PA7	Output	General Output2	3.4
11	OUT3/PB0	Output	General Output3	3.4	12	OUT4/PB1	Output	General Output4	3.4
13	OUT5/PB2	Output	General Output5	3.4	14	OUT6/PB3	Output	General Output6	3.4
15	OUT7/PB4	Output	General Output7	3.4	16	OUT8/PB5	Output	General Output8	3.4
17	OUT9/PB6	Output	General Output9	3.4	18	OUT10/PB7	Output	General Output10	3.4
19	OUT11/PC0	Output	General Output11	3.4	20	OUT12/PC1	Output	General Output12	3.4
21	OUT13/PC2	Output	General Output13	3.4	22	OUT14/PC3	Output	General Output14	3.4
23					24				
25					26				
27	GND		Internal Circuit GND		28	GND		Internal Circuit GND	
29	GND		Internal Circuit GND		30	GND		Internal Circuit GND	

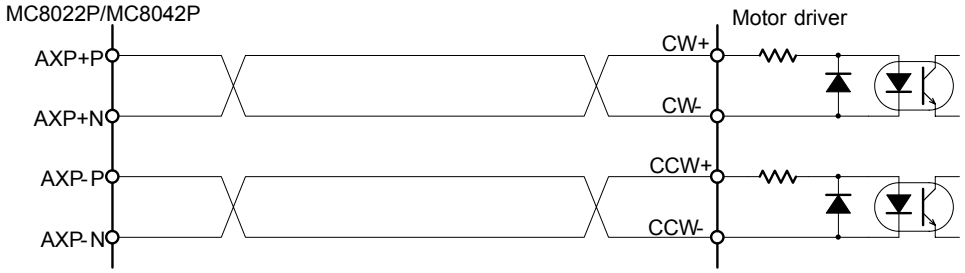
3.3 Drive Pulse Output Signal (nP+P, nP+N, nP-P, nP-N)

Drive pulse output signal outputs the drive pulse of +/– direction of MCX304 through a differential line-driver output (AM26C31 or equivalent). nP+N is the reverse output of nP+P and nP-N is the reverse output of nP-P. At resetting, positive output (nP+P, nP-P) becomes low level and reverse output (nP+N, nP-N) becomes hi level. Drive pulse output is set to independent 2-pulse type after resetting; however, the user can change to 1-pulse 1-direction type in mode setting. See chapter 2.6.2 and 4.5 of MCX304 user's manual.

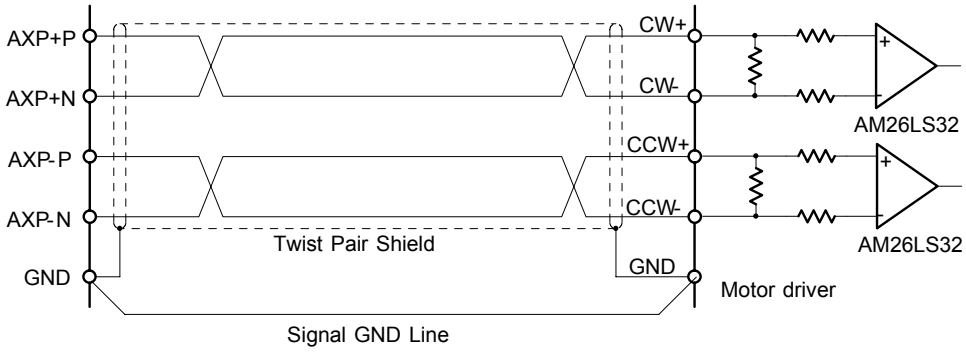


Drive Pulse Output Signal Circuit

The following is the connection example of a motor driver with a photo coupler input and line receiver input.



Connection example of a motor driver with a photo coupler input



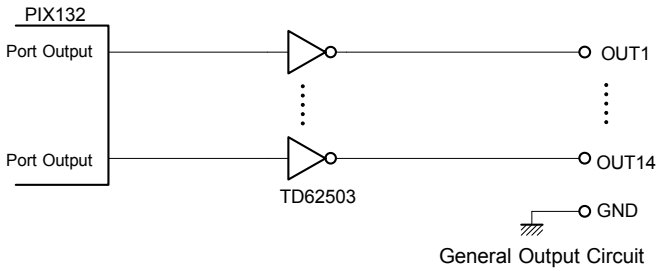
Connection example of a motor driver with a line receiver input

Note1: As shown above, when using a line receiver input circuit, connect MC8022P/MC8042P and a motor driver with GND line. If there is the potential difference between MC8022P/MC8042P and motor driver, the malfunction and destruction of a driver circuit and/or a motor driver circuit may be caused.

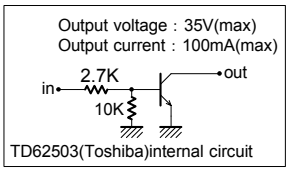
3.4 General Output Signal and Deviation Counter Clear Output Signal (OUT1~14, nOUT0/DCC)

General output signal outputs 14 points from PIX132 and one nOUT0/DCC output signal in MCX304 through buffer (TD62503). nOUT0 signal is shared with deviation counter clear output (DCC) and is output from CN2 connector. Also other general output signals: OUT1~14 are output from CN4 connector. At resetting, all the output signals (open collector output) will be OFF.

■ OUT1~14 Output



General Output Circuit



OUT1~14 general output signals are output from CN4. ON/OFF of this signal can be controlled by writing to each port of PIX132 (NOVA electronics). Each port is set to output and becomes OFF when the PC system is started.

General Output Signal(CN4pin),Register Bit Table

CN4		PIX132	
Pin #	Output signal	Port address	Bit position
9	OUT1	0x14	6
10	OUT2	0x14	7
11	OUT3	0x15	0
12	OUT4	0x15	1
13	OUT5	0x15	2
14	OUT6	0x15	3
15	OUT7	0x15	4
16	OUT8	0x15	5
17	OUT9	0x15	6
18	OUT10	0x15	7
19	OUT11	0x16	0
20	OUT12	0x16	1
21	OUT13	0x16	2
22	OUT14	0x16	3

ON/OFF of OUT1~14 output signals can be controlled by the following steps (1)~(4) on the program.

(1) Read current output data.
・Check the port address of the signal which the user wants to output and bit position according to the table above.
・Read the current output of the port.

Function: Nmc_InPort Current output data: mcb0pa
mcb0pa = Nmc_InPort(Board number, Port address);
Port address → 0x14, 0x15, 0x16
Board number → 0x0~0xF

Example) Read the output data of the port which includes OUT1 output signal. mcb0pa = Nmc_InPort(0x0, 0x14);

(2) When turning ON the output.
・Set 1 to the bit corresponding to the signal which the user wants to turn ON.
・Example) When turning ON OUT1 output signal

```
mcb0pa = mcb0pa | 0x40;      (OUT1 is bit position 6, OR bit pattern is 0x40.)
```

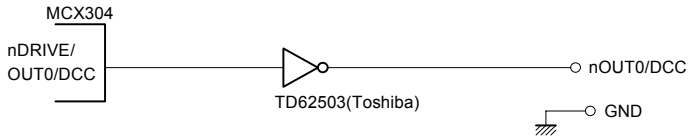
(3) When turning OFF the output.
・Set 0 to the bit corresponding to the signal which the user wants to turn OFF.
・Example) When turning OFF OUT1 output signal.

```
mcb0pa = mcb0pa & 0xbf;      (OUT1 is bit position 6, AND bit pattern is 0xbf.)
```

(4) Set the output data.
・Write the output data which is calculated by (2) or (3) to the port.
Function: Nmc_OutPort(Board number, Port address, Output data);
Example) Write the output data to the port Nmc_OutPort(0x0, 0x14, mcb0pa);

Examples of ON/OFF control of general output signals are described in sample program, so refer to it.

■ nOUT0/DCC Output



nOUT0/DCC output is shared with general output signal (nOUT0) and deviation counter clear output (DCC), and is output to CN2. At resetting, it will be OFF. Control of this signal is different from other general output, it can be performed by writing to the register of MCX304.

When used as general output.

(1) To enable nOUT0 output, set the nOT0E bit of MCX304/WR5 to 1.

(2) Turn ON: Set the nOUT0 bit of MCX304/WR4 to 1. Turn OFF: Set the nOUT0 bit of MCX304/WR4 to 0.

When used as deviation counter clear output.

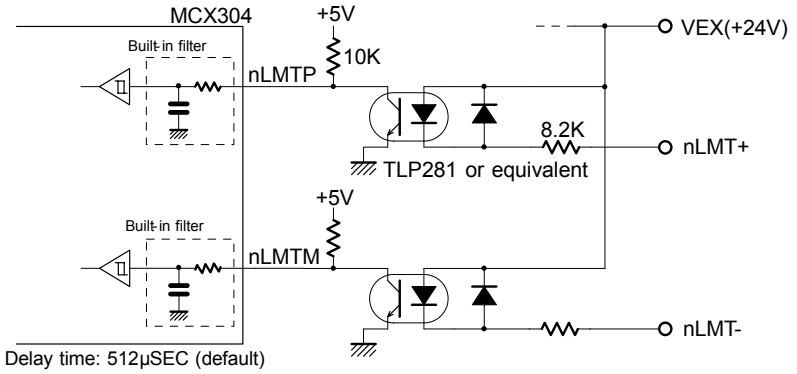
Deviation counter clear output is the output to clear a deviation counter in a servo motor driver. MCX304 has the function to output this deviation counter clear signal during automatic home search.

For setting of a deviation counter clear enable, a logical level and pulse width, see chapter 2.4.3 of MCX304 user's manual. And for automatic home search details, see chapter 2.4. As shown in the figure above, TD62503 is used as buffer on the board, so that the board output (open collector) turns ON when MCX304 output is active Hi.

3.5 Over Run Limit Input Signal (nLMT+, nLMT-)

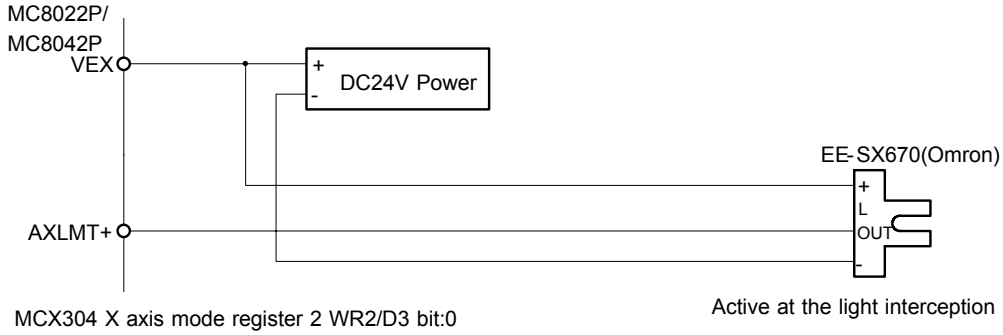
It is the input signal to stop each drive pulse in the +/ – direction. This input signal is connected to the limit input of MCX304 through a photo coupler. After resetting, MCX304 becomes low active, so limit function works when electric current flows from a signal pin (nLMT+, nLMT-). For more details on mode setting, see chapter 4.5 of MCX304 user's manual.

To enable this signal, external power supply DC24V is needed. When the board is powered on, a built-in filter of this signal becomes the setting of signal delay time 512 μ sec as default. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.6.9 and 4.6 of MCX304 user's manual.



Over Run Limit Input Signal Circuit

The connection example of an over run limit input signal and a photo microsensor is shown below. When D3 bit of X axis mode register 2 (XWR2) is set to 0 (the mode at reset), limit function becomes active at the light interception.



Connection Example of Over Run Limit Input Signal and Photo Microsensor

When long wiring is needed, use the shield cable.

3.6 Decelerating Stop / Instant Stop (nSTOP0, nSTOP1)

Input signal to stop drive pulse output in deceleration or immediately. Generally, nSTOP0 signal is used as a near home signal and nSTOP1 signal is used as a home signal. MCX304 has three signals, STOP2~STOP0 for each axis as a home search input signal; however, STOP2 is equipped with an interface circuit for encoder Z-phase. STOP1 signal is used as an input signal for home and STOP0 is for near home.

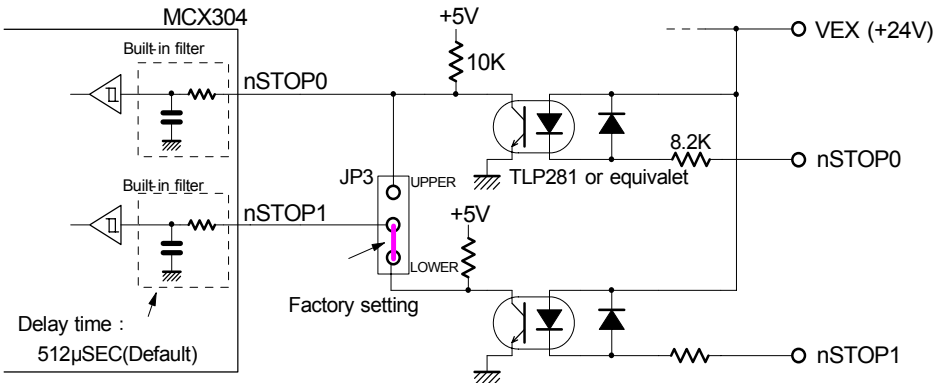
[Enable/Disable and Logical setting]

Each input signal can be set enable/disable and logical level in mode setting. When enable is set in mode setting, and when this signal becomes active during driving, drive pulse output stops. When during acceleration/deceleration driving, it stops in deceleration and when during constant driving, it stops immediately. After resetting, all the signals are disabled. For instant, when D1, D0 bit of XWR1 register is set to 1, 0 and set to low level and enable, and when current flows out from XSTOP0 signal pin (CN2-A4) of this board, driving stops. For more details on mode setting, see chapter 4.4 of MCX304 user's manual.

[Automatic Home Search]

MCX304 has automatic home search function. See chapter 2.4 of MCX304 user's manual.

To perform high-speed home search → low-speed home search by only one signal, use nSTOP0 signal and switch JP3 jumper to UPPER side as follows:



Decelerating Stop/ Instant Stop Input Signal Circuit

To enable this signal, external power supply DC24V is needed. When the board is powered on, a built-in filter in this signal becomes the setting of signal delay time 512 μ sec as default. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.6.9 and 4.6 of MCX304 user's manual.

This signal can read out the signal status by input register 1, 2 (RR4, 5) at any time, so it can be used as general input.

3.7 Encoder Z-phase Input Signal (nSTOP2)

nSTOP2 input signal is to stop drive pulse output during driving by connecting to the Z-phase output signal of an encoder or a servo motor driver.

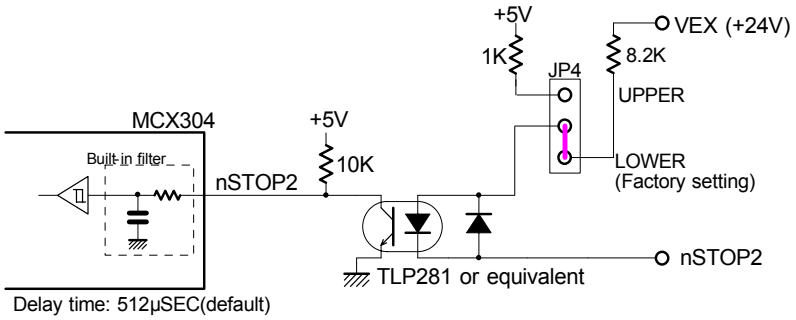
To enable this signal, external power supply DC24V is needed. When the board is powered on, a built-in filter in this signal becomes the setting of signal delay time 512 μ sec as default. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.6.9 and 4.6 of MCX304 user's manual.

[Enable/Disable and Logical setting]

nSTOP2 signal can be set enable/disable and logical level in mode setting as well as nSTOP1, 0 signal. For instant, when D5, D4 bit of WR1 register is set to 1, 0 and set to low and enable, and when current flows out from nSTOP2 signal pin of this board, driving stops. For more details on mode setting, see chapter 4.4 of MCX304 user's manual.

[Jumper setting]

This input signal can be adapted to either open collector output or line-driver output of the other output side by switching JP4 jumper. When the other side is open collector output, set JP4 to LOWER side (factory setting) and when is line-driver output, set JP4 to UPPER side and connect nSTOP2 signal to one side of line-driver output.



Encoder Z-phase Input Signal Circuit

[Notes on Z-phase search]

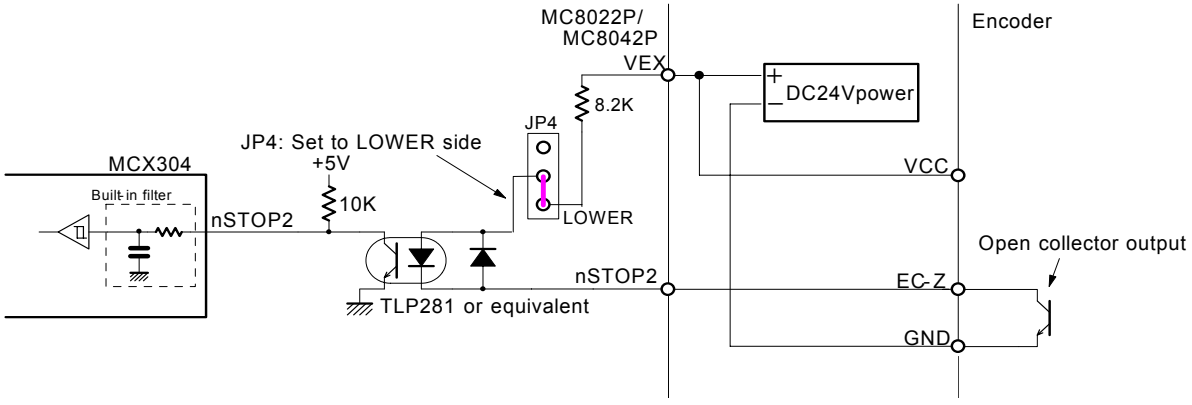
■ Drive speed of Z-phase search

When this board is powered on, a built-in filter of nSTOP2 signal becomes the setting of signal delay time 512 μ sec as default. In addition, TLP281 photo coupler (Toshiba) has approximately 100 μ sec delay time, so that the drive speed to search Z-phase must be set for Z-phase signal to be active more than 1msec at least. When noise circumstances are good, search operation can be performed at the higher speed by disabling the built-in filter of STOP2 signal.

■ Starting position for Z-phase search

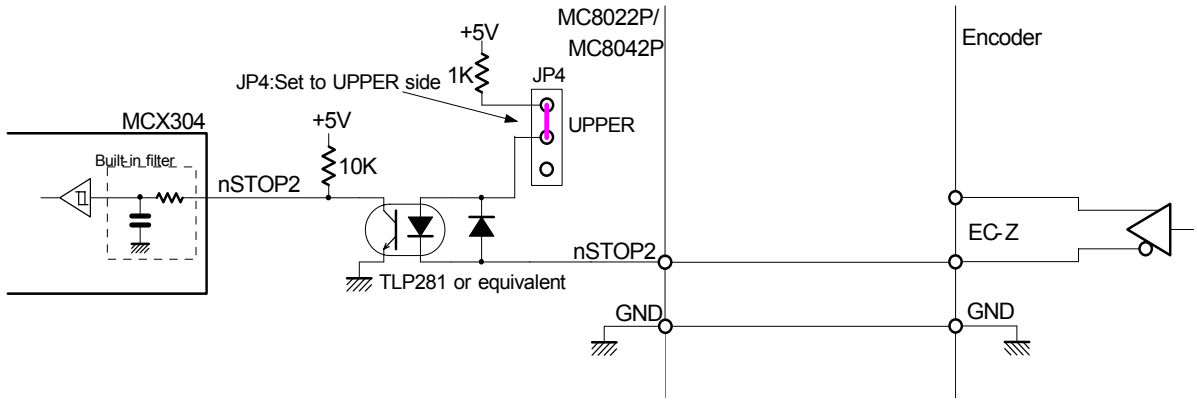
In automatic home search of MCX304, the function stops search driving when the Z-phase signal (nSTOP2) changes from inactive to active. Therefore, the starting position for Z-phase search must be completely away from this change point. Normally, adjust mechanically so that this starting position becomes the 180° opposite side to the encoder Z-phase position.

The connection example of nSTOP2 input signal and open collector output of an encoder is shown below. When open collector output is ON at Z-phase detected, set the D4 bit (SP2-L) of WR1 register to 0 (state of reset) for logical setting of MCX304.



Connection Example with Z-phase Output of open collector

The following is the connection example of nSTOP2 input signal and one pin of line-driver output of an encoder. When output is low level at Z-phase detected, set the D4 bit (SP2-L) of WR1 register to 0 (state of reset) for logical setting of MCX304.



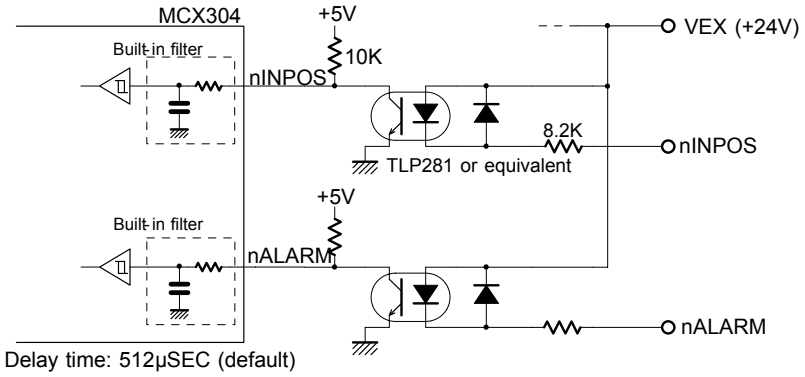
Connection Example with Z-phase Output of line-driver

3.8 Input Signals for Servo Motor (nINPOS, nALARM)

nINPOS input signal is applied to the in-position output of a servo motor driver. Enable/disable and logical level can be set in mode setting of MCX304. When enable is set and after completion of the driving, nDRV bit of main status register (RR0) returns to 0 after this signal becomes active.

nALARM input signal is applied to the alarm output from a servo motor driver. Enable/disable and logical level can be set in mode setting. When enable is set, nALARM input signal is monitored, and when nALARM is active, the ALARM bit of status register 2 (nRR2) is set to 1. When the signal becomes active during driving, driving will stop immediately.

After resetting, both signals are disabled. For nINPOS input signal, set the D15, 14 bit of mode register 2 (nWR2) of MCX304 to 1,0 as low level active, and the n-DRV bit of RR0 register returns to 0 after waiting to flow current from nINPOS signal. For nALARM input signal, set the D13, 12 bit of nWR2 register to 1,0 as low level active, and the signal becomes an alarm state when current flows from nALARM signal pin. For more details, see chapter 2.6.5 and 4.5 of MCX304 user's manual.



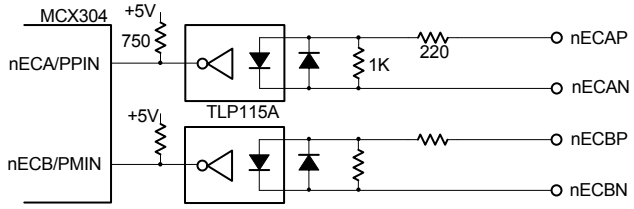
Input Signal Circuit for Servo Motor

To enable this signal, external power supply DC24V is needed. When the board is powered on, a built-in filter in this signal becomes the setting of signal delay time 512 μ sec as default. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.6.9 and 4.6 of MCX304 user's manual.

In addition, the input signal for a servo motor can read out the signal status by input register 1, 2 (RR4, 5) at any time, so it can be used as general input.

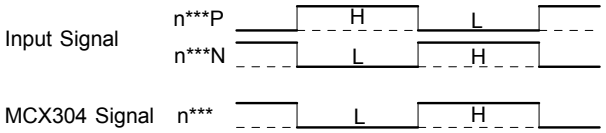
3.9 Encoder A/B phase Input Signal (nECAP, nECAN, nECBP, nECBN)

nECAP/N, nECBP/N, input signals are the input to count a real position counter of MCX304 by connecting to the 2-phase output signal of an encoder or a servo motor driver. For more details, see chapter 2.3.1, 2.6.3 and 4.5 of MCX304 user's manual.

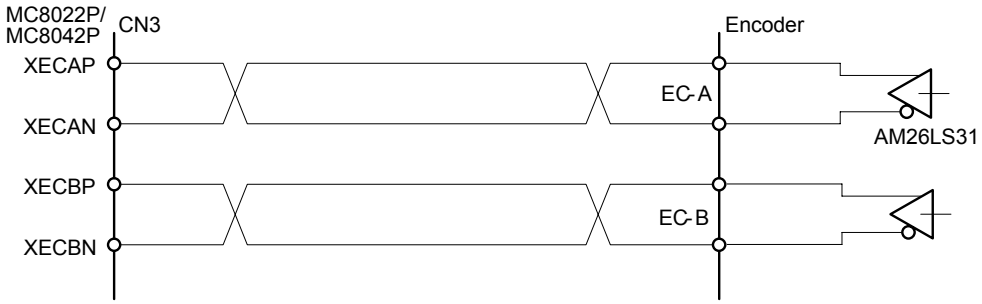


Encoder A/B phase Input Signal Circuit

As shown above, encoder A/B phase input signal circuit uses high-speed photo coupler IC TLP115A (Toshiba). Each input signal can be directly connected to a differential line-driver output. As the figure below, when n***P/N signal is H/L, n*** signal of MCX304 becomes Low and when is L/H, it becomes Hi. The delay time from input to the signal pin of MCX304 is under 100nSEC, so that the signal can count up to 4MHz in the case of 2-phase pulse input.

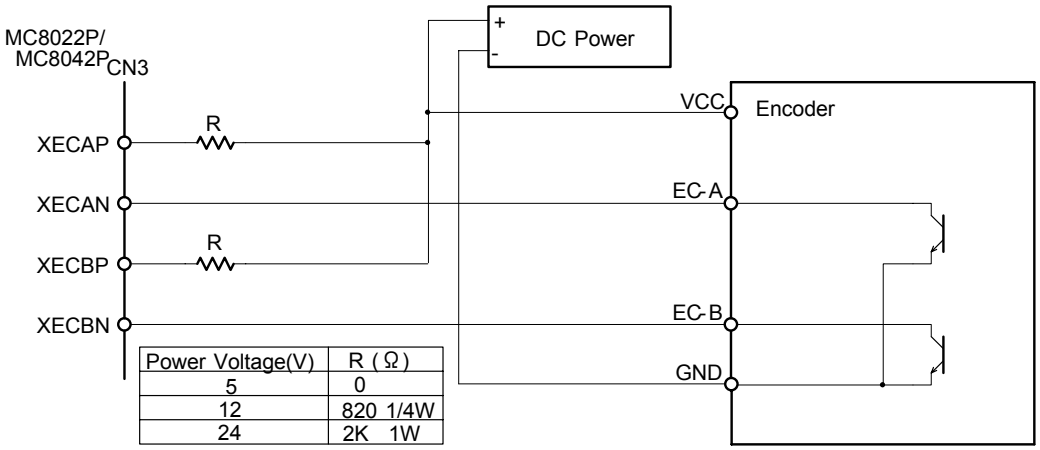


The connection example of an encoder A/B phase input signal and a differential line-driver output is shown as follows:



Connection Example with Differential line-driver Output

The connection example of an encoder A/B phase input signal and an encoder with open collector output is shown as follows:

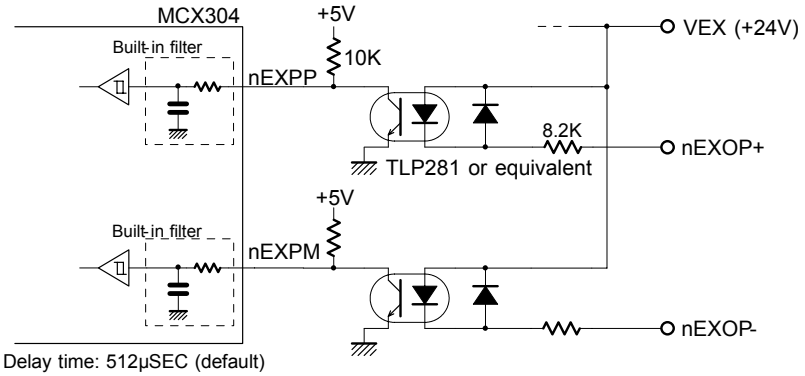


Power Voltage(V)	R (Ω)
5	0
12	820 1/4W
24	2K 1W

Connection Example with Open Collector Output

3.10 Driving by External Signal (nEXOP+, nEXOP-)

The signal externally controls driving in the + or – direction. In fixed driving mode, the falling edge of these signals trigger outputs specified drive pulse. In continuous driving mode, drive pulse is output continuously while the input signals are low. This function can reduce the load of the host CPU, so the user can perform jog feed of each axis speedy. External signal for driving can be set in mode setting of MCX304. For more details, see chapter 2.6.1 and 4.6 of MCX304 user's manual.

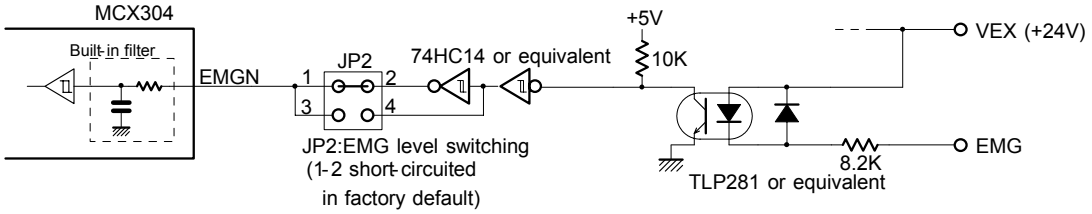


External Driving Signal(nEXOP+/-) Circuit

To enable this signal, external power supply DC24V is needed. When the board is powered on, a built-in filter in this signal becomes the setting of signal delay time 512 μ sec as default. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.6.9 and 4.6 of MCX304 user's manual.

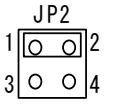
3.11 Emergency Stop Input Signal (EMG)

All the drive pulse output stops when emergency stop signal becomes active. Active level can be switched by the JP2 jumper pin on the board. When emergency stop signal becomes active during driving, driving for all axes stops instantly and 1 is set to the error bit of all axes of main status register. For emergency stop of MCX304, see chapter 2.6.6 and 4.1.2 of MCX304 user's manual.



Emergency Stop Input Signal Circuit

To enable this signal, external power supply DC24V is needed. When the board is powered on, a built-in filter in this signal becomes the setting of signal delay time 512 μ sec as default. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.6.9 and 4.6 of MCX304 user's manual.



Pin assignments of the JP2 jumper is shown on the left.
1-2 short circuit: When emergency stop signal (EMG) is short-circuited with GND of the external power, it becomes active.
3-4 short circuit: When emergency stop signal (EMG) is open, it becomes active.
Factory default is 1-2 short-circuited.

3.12 External Power (VEX)

The power supplied externally is used for over run limit input signal (nLMT+, nLMT–) of each axis, decelerating stop/instant stop (nSTOP0, nSTOP1, nSTOP2) input signal, input signal for servo motor (nINPOS, nALARM), external signal for driving (nEXOP+, nEXOP–) and emergency stop input signal (EMG). DC24V is needed. Consumption current is 2.8mA per 1 input signal.

4. Interrupt

This board has an interrupt signal generated by MCX304, which connect to the INTA# of four interrupt request signals in the PCI bus. When an interrupt occurs in MCX304, the interrupt request signal of this board changes from Hi to Low. By reading out the status register 3 (nRR3) of the axis generated the interrupt, the interrupt request signal returns from Low to Hi.

For the interrupt function of MCX304, please refer to the following.

Article	Reference manual
Function of the interrupt	Chapter 2.5 of MCX304 user's manual
Setting of the interrupt enable / disable	Chapter 4.4 of MCX304 user's manual
Interrupt notion to the application	MC8000P User's manual of device driver When handling the interrupt by VC in Chapter 3.4.3
Reading out of the interrupt generation	Chapter 4.13 of MCX304 user's manual
	MC8000P User's manual of device driver When handling the interrupt by VC in Chapter 3.4.3

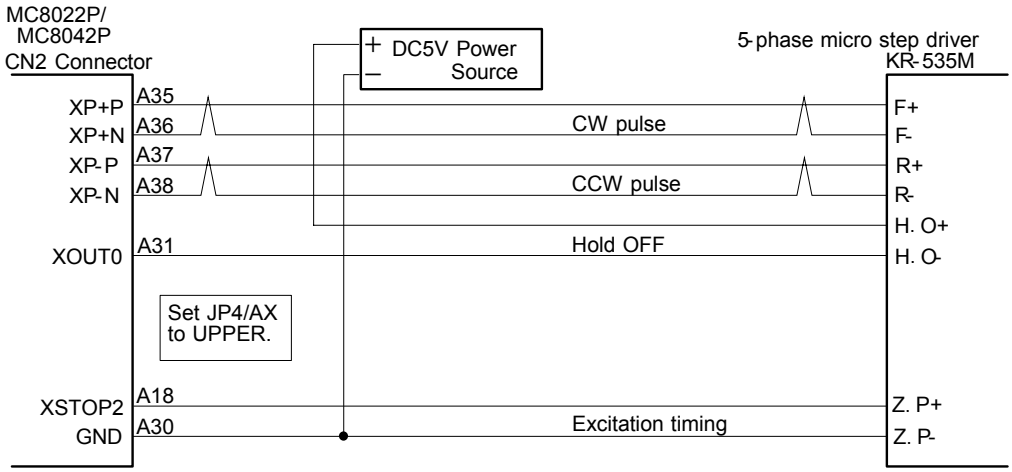
[Notes for using interrupt]

IRQ number for the interrupt signal of this board is determined depending on PnP function.
In addition, it shares the same interrupt request signal with other devices by PnP function and Windows, competition is not occurred because Windows generally controls it.

5. Connection Example for Motor Driver

5.1 Connection Example for Stepper Motor Driver

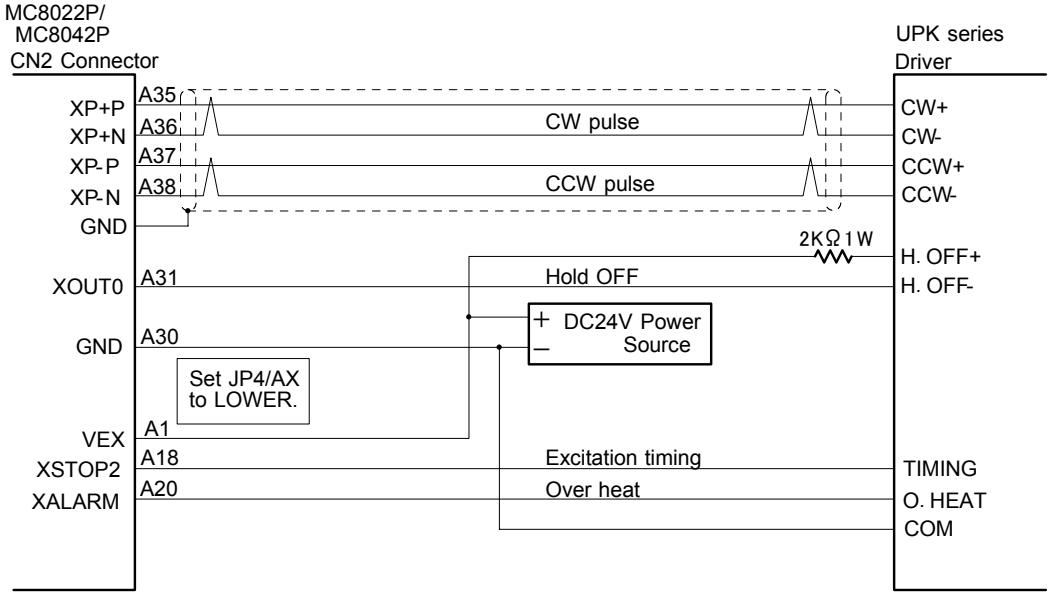
The figure shown below illustrates the connection example of MC8022P/MC8042P X axis and the 5-phase micro step driver of TECHNO DRIVE KR535M.



Note1: Wire hold OFF and excitation timing signals according to need. The hold off signal can be controlled by writing 0, 1 into the D0 bit of MCX304 WR4 register after the D0 bit of WR5 register is 1 for enabling XOUT0 signal. The excitation timing signal can perform a home search by the mode setting of WR1 register D4, 5 bit. In addition, the excitation timing signal can directly read out the signal level through the RR4 register.

Note2: When the circumstances are affected by strong noise or there is long distance to the driver, the twist pair shield cable shown above is recommended.

The figure shown below illustrates the connection example of MC8022P/MC8042P X axis and the stepper motor driver of Oriental Motor UPK series.

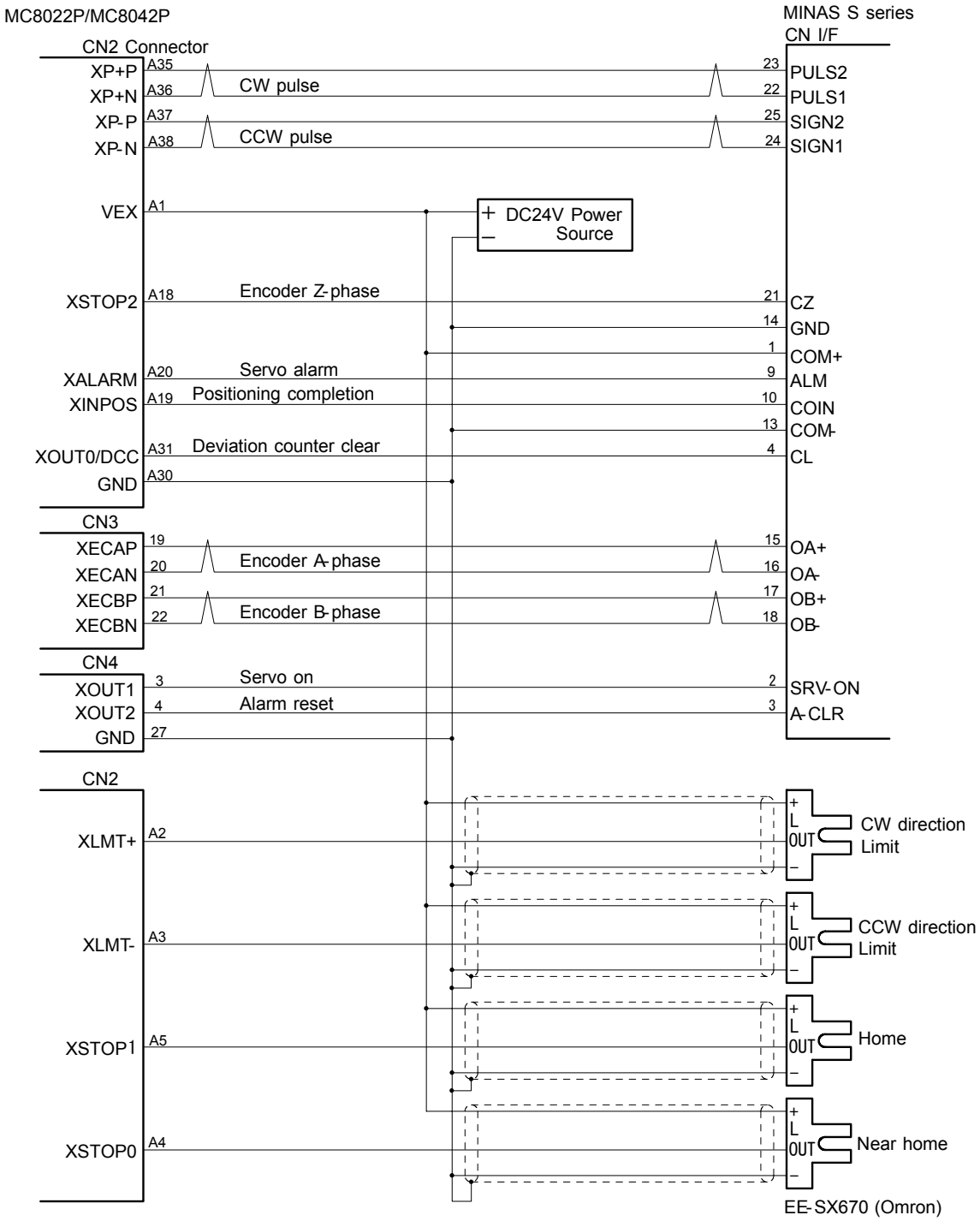


Note1: Wire hold OFF, excitation timing and over heat signals according to need. The hold off signal can be controlled by writing 0, 1 into the D0 bit of MCX304 WR4 register after the D0 bit of WR5 register is 1 for enabling XOUT0 signal. The excitation timing signal can perform a home search by the mode setting of the WR1 register D4, 5 bit. The over heat signal can perform an alarm function by the mode setting of the WR2 register D12, 13 bit. In addition, the excitation timing and over heat signals can directly read out the signal level through the RR4 register.

Note2: When the circumstances are affected by strong noise or there is long distance to the driver, the twist pair shield cable shown above is recommended.

5.2 Connection Example for AC servo motor driver

The figure shown below illustrates the connection example of MC8022P/MC8042P X axis and the AC servo motor driver of MINAS S series.



Note1: Set the mode of MINAS driver control to the position control mode and the pulse form to CW/CCW pulse mode. Do not set the pulse form to Pulse/Sign mode because the lack of t6 time occurs.

Note2: Use encoder A/B phase signals when the user counts a real position counter in MCX304. If the real position data is not necessary, no need to connect them. For other signals, connect them according to need.

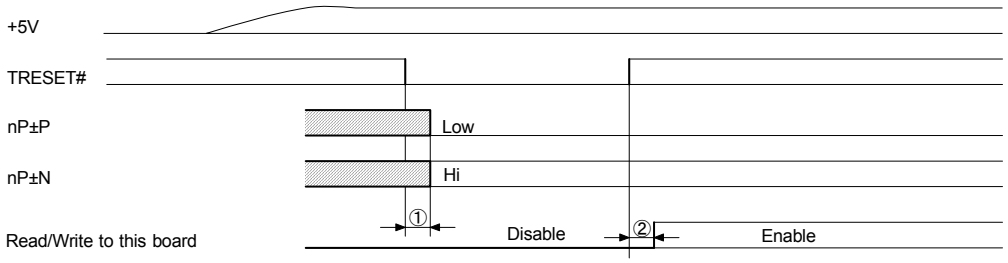
Note3: In this example, encoder Z-phase uses the open collector output of driver side, so set JP4 to Lower side (default).

Note4: In this example, a near home signal and home signal are each connected for the home signal, so set JP3 to LOWER side (default).

Note5: When the circumstances are affected by strong noise or the distance to the driver is long, the twist pair shield cable shown above is recommended.

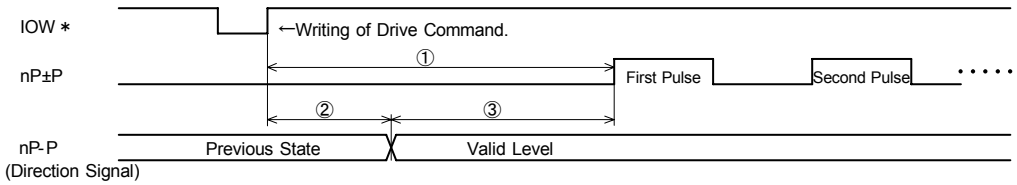
6. Input/Output Signals Timing

6.1 Reset



① Drive pulse output signals (nP±P, nP±N) are determined within a maximum of 250nSEC from ↓ of the target reset signal (TRESET#) of APIC21 (ADTEC).
② Writing/Reading to this board can be performed after 500nSEC from ↑ of the target reset signal (TRESET#).

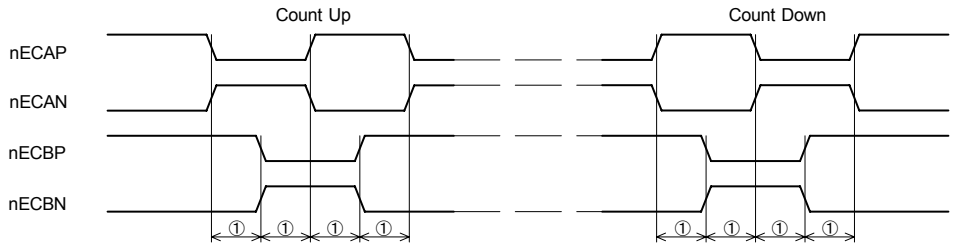
6.2 Beginning of Driving



① First drive pulse is output within a maximum of 650nSEC after writing of drive command.
②③ When drive output pulse is 1-pulse type, a direction signal (nP-P) becomes valid level within a maximum of 275nSEC after writing of drive command. And first drive pulse is output after 375nSEC when the direction signal becomes valid level.

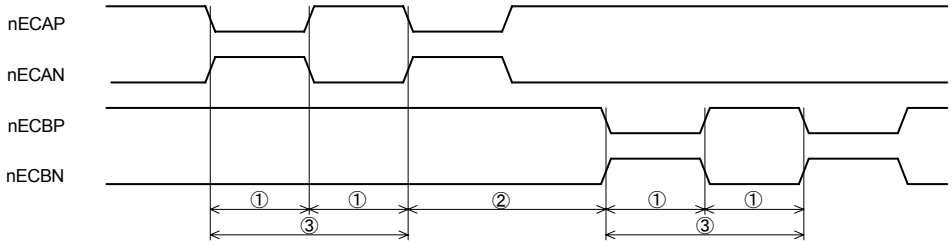
6.3 Input Pulse Timing

■ Encoder 2-phase Pulse Input



① EC-A,EC-B phase difference time : 200nSEC min.

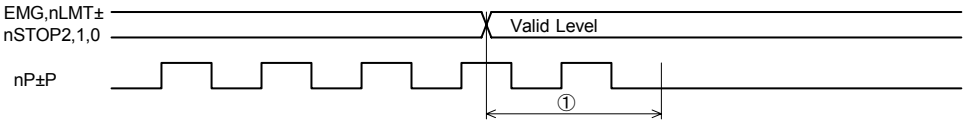
■ Up/Down Pulse Input



① UP/DOWN pulse width : 130nSEC min.
② UP⇔DOWN between the pulses : 260nSEC min.
③ UP/DOWN pulse cycle : 260nSEC min.

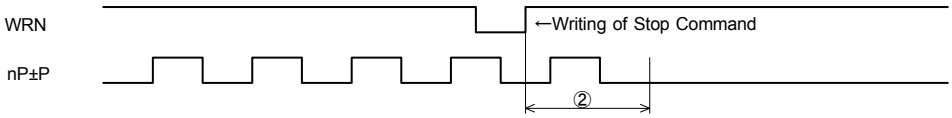
6.4 Instant Stop Timing

■ Instant Stop by External Signal



① When an external stop signal becomes valid level during driving, the driving stops after photo coupler delay time (100 μ sec max.) + the delay time of IC built-in integral filter (512 μ sec default) + 1 drive pulse.

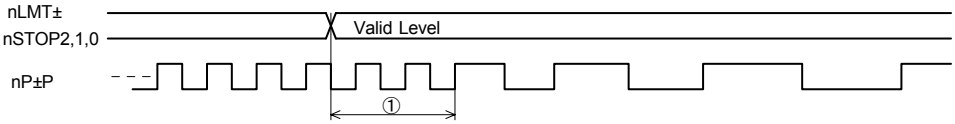
■ Instant Stop by Command



② When stop command is written during driving, the driving stops after a maximum of 1 drive pulse.

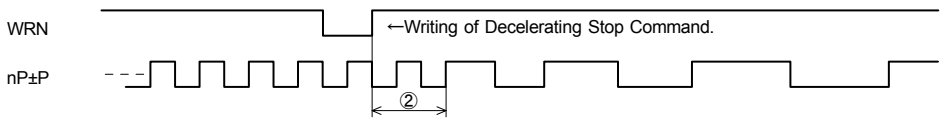
6.5 Decelerating Stop Timing

■ Decelerating Stop by External Signal



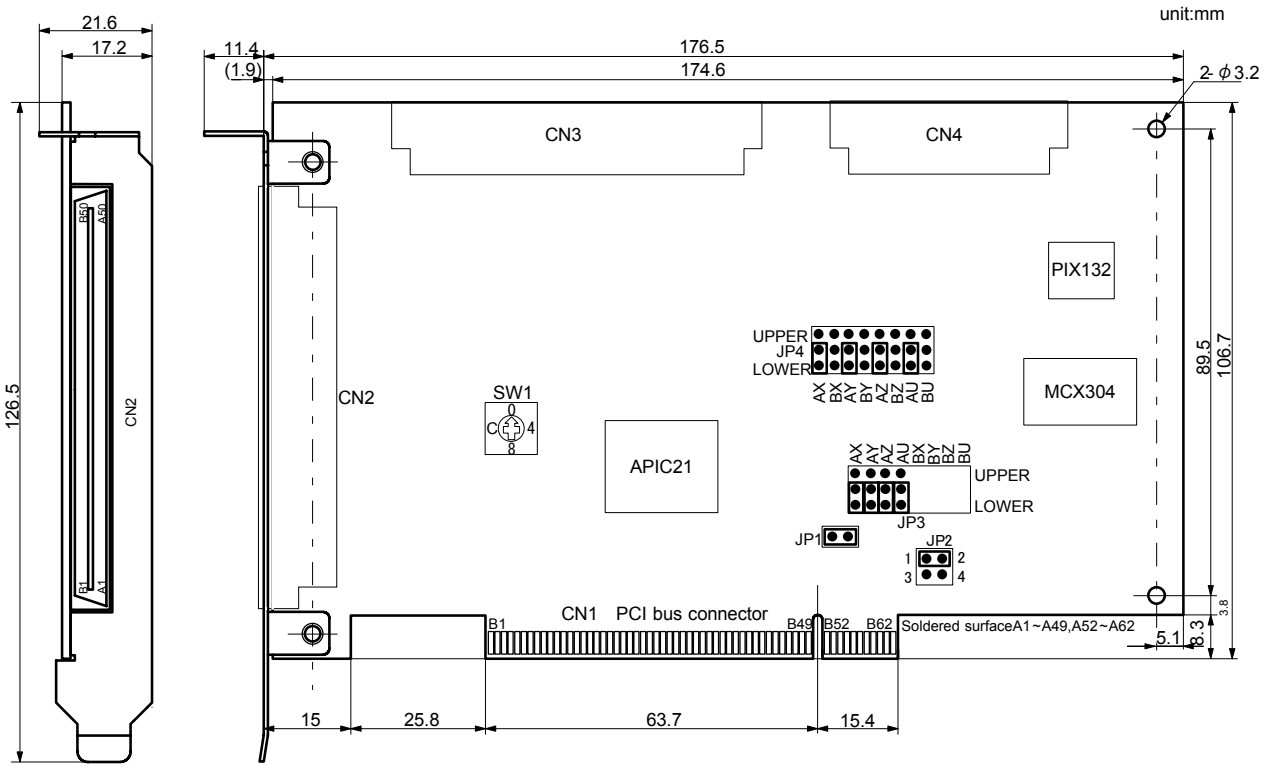
① When an external decelerating stop signal becomes valid level during driving, the driving starts deceleration after photo coupler delay time (100 μ sec max.) + the delay time of IC built-in integral filter (512 μ sec default) + 2 drive pulses.

■ Decelerating Stop by Command



② When decelerating stop command is written during driving, the driving starts deceleration after a maximum of 2 drive pulses.

7. Board Dimensions



JP1: Keep 1-2 short circuit (default).

JP2: Select active logical level for emergency stop signal (EMG).
1-2 short circuit (default): When the signal is short-circuited with GND, it becomes active.
3-4 short circuit: When the signal is open, it becomes active.

JP3: Select a home search signal. See chapter 3.6.
LOWER (default): Use STOP0 as a near home signal and STOP1 as a home signal.
UPPER: Use only STOP0 to perform high-speed home search → low-speed search.
*Axis assignment of MC8022P is executed by AX and AY, of MC8042P is executed by AX, AY, AZ and AU.

JP4: Select STOP2 (Encoder Z-phase) input circuit. See chapter 3.7.
LOWER (default): For the open collector output.
UPPER: For the line-driver output.
*Axis assignment of MC8022P is executed by AX and AY, of MC8042P is executed by AX, AY, AZ and AU.

SW1: Rotary switch to set the board number when multiple boards are used, which can be set from 0 to F (default setting: 0).

8. Specifications

- Control Axis: MC8022P: 2 axes (Independent, Simultaneous Control)
  MC8042P: 4 axes (Independent, Simultaneous Control)

PCI Bus Interface

- Data Bit Width: 16 bit
- Occupied I/O Address: 64 Determined by PnP.
- Interrupt: IRQ Determined by PnP.

Common Specifications of Each Axis

■ Drive Pulses Output

- Pulse Output Circuit: Differential line-driver (AM26C31) output
- Pulse Output Speed: 1PPS ~ 4MPPS
- Pulse Output Speed Accuracy: ± 0.1% (according to the setting speed)
- Speed Multiplier: 1 ~ 500
- S-curve Jerk: $954 \sim 62.5 \times 10^6$ PPS/SEC^2 (Multiple = 1)
  $477 \times 10^3 \sim 31.25 \times 10^9$PPS/ SEC^2 (Multiple =500)
- Accelerating / Decelerating Speed: $125 \sim 1 \times 10^6$ PPS/SEC (Multiple = 1)
  $62.5 \times 10^3 \sim 500 \times 10^6$ PPS/ SEC (Multiple = 500)
- Initial Speed: 1 ~ 8,000PPS (Multiple = 1)
  500PPS ~ 4×10^6 PPS (Multiple = 500)
- Drive Speed: 1 ~ 8,000PPS (Multiple = 1)
  500PPS ~ 4×10^6 PPS (Multiple = 500)
- Output-pulse Number: 0 ~ 268,435,455 (fixed drive)
- Speed Curve: Constant speed, linear acceleration/deceleration, parabola S-curve acceleration/deceleration drive
- Fixed Drive Deceleration Mode: Auto (non-symmetrical trapezoidal acceleration is also allowed) / manual

- Output-pulse numbers and drive speeds changeable during the driving
- Independent 2-pulse system or 1-pulse 1-direction system selectable
- Logical levels of drive pulse selectable

■ Encoder A/B phase Input

- Input Circuit High-speed photo coupler input. Connectable with differential line-driverr.
- A/B phase pulse style or Up/Down pulse style selectable
- Pulse of each single, double and quad count edge evaluation is selectable (2-phase pulse style).

■ Position Counter

- Logic Position Counter (for output pulse) range −2,147,483,648 ~ +2,147,483,647
- Real Position Counter (for input pulse) range −2,147,483,648 ~ +2,147,483,647

To read / write data is always possible.

■ Comparison Register

- COMP + Register Position comparison range −1,073,741,824 ~ +1,073,741,823
- COMP − Register Position comparison range −1,073,741,824 ~ +1,073,741,823
- Software limit functioned

■ Automatic home search

- Automatic execution of Step 1 (high-speed near home search) → Step 2 (low-speed home search) → Step 3 (low-speed encoder Z-phase search) → Step 4 (high-speed offset drive).
  Enable/Disable of each step and search direction selectable
- Deviation counter clear output : Clear pulse width within the range of 10 μ ~20msec and logical level selectable

■ Interrupt

- The factors of occurring interrupt:
  ..start / finish of a constant-speed drive
  ..end of the driving
  ..transition to “position counter ≥ COMP−”
  ..transition to “position counter < COMP−”
  ..transition to “position counter ≥ COMP+”
  ..transition to “position counter < COMP+”

Enable / disable for these factors selectable

■ External Signal for Driving

- EXOP+ and EXOP- signals for fixed / continuous drive
- Input Circuit Photo coupler + IC built-in integral filter

■ **External Deceleration / Instant Stop Signal**

- STOP0 ~ 2 3 points for each axis (STOP0:near home, STOP1:home, STOP2:encoder Z-phase input)
- Input Circuit Photo coupler + IC built-in integral filter

Enable / disable and logical levels selectable and can be used as general input.

■ **Servo Motor Input Signal**

- ALARM (Alarm), INPOS (In Position Check)
- Input Circuit Photo coupler + IC built-in integral filter

Enable / disable and logical levels selectable

■ **Servo Motor Output Signal**

- DCC (Pin shared between deviation counter clear output and OUT0)
- Output Circuit TD62503 output (open collector output)

■ **General Output Signal**

- OUT1 ~ 14 14 points
- Output Circuit TD62503 output (open collector output)

■ **Limit Signals Input**

- 1 point for each + and − direction
- Input Circuit Photo coupler + IC built-in integral filter

Logical levels and decelerating / instant stop selectable

■ **Emergency Stop Signal Input**

- EMG 1 point for all axes

Stop the drive pulse immediately for all axes and logical levels selectable by jumper on the board.

- Input Circuit Photo coupler + IC built-in integral filter

Electrical Characters

● Temperature Range for Driving	0 ~ + 45°C (No condensation)
● Power Voltage for Driving	+5V ± 5 %
● Consumption current	MC8022P: 300mA max / MC8042P: 400mA max
● External Supply Voltage	+24V
● Board Dimensions	174.6 × 106.7mm (Connectors and brackets excluded)
● I/O Connector Type	CN2: FX2B-100PA-1.27DS (Hirose) CN3: HIF3FC-50PA-2.54DS (Hirose) CN4: HIF3FC-30PA-2.54DS (Hirose)
● Accessories	CN2: FX2B-100SA-1.27R (Hirose) with 1.2m cable
● Optional accessories	CN3: HIF3BB-50D-2.54R (Hirose) connector only CN4: HIF3BA-30D-2.54R (Hirose) connector only AB80411: Round cable with a shield for CN2 (3.5m) AC80801: Extension board for CN3, CN4