Doc. No. KM-012-01

DOS/V PCI Express

4-Axis Motor Control Board with Interpolation

MC8043Pe Hardware Manual

2012-01-26 Ver. 1.0

NOVA electronics

Prevent Electrostatic Discharge

ATTENTION: MC8043Pe is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle MC8043Pe:

- 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 MC8043Pe.
- Store MC8043Pe in appropriate static-safe packaging when not in use.

Safety Notice

WARNING: MC8043Pe 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 MC8043Pe in critical applications. Provide adequate design and operating safeguards in order to minimize risks associated with customer's applications when incorporating MC8043Pe in a system.

Before you begin

ATTENTION: Before using MC8043Pe, read this manual thoroughly to ensure correc usage and observe all the instructions given in this manual.

Checking the Contents

ATTENTION: When you unpack a package of MC8043Pe, check for the following accessories. If something is missing or broken, contact the place of purchase.

- MC8043Pe 1
- I/O Cable 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 MC8043Pe consists of mainly 4-axes motion control IC "MCX314As", a PCI-bus interface circuit and I/O interface circuits of each axis. Basic functions of this board all depend on MCX314As, so please refer to the user's manual of MCX314As regarding these functions. This manual describes the interface circuits of PCI bus, I/O address and I/O signals. Regarding the device drivers, see "MC8000P Device Driver Manual" describes how to the installation on Windows and how to use the library.

Environmental Conditions

ATTENTION: Use the following environmental conditions.

Operating Temperature	0～45℃ (32～113°F)
Humidity	20～90% (no condensation)
Floating dust	Not to be excessive
Corrosive gases	None
Electric supply source	DC+3.3V (±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

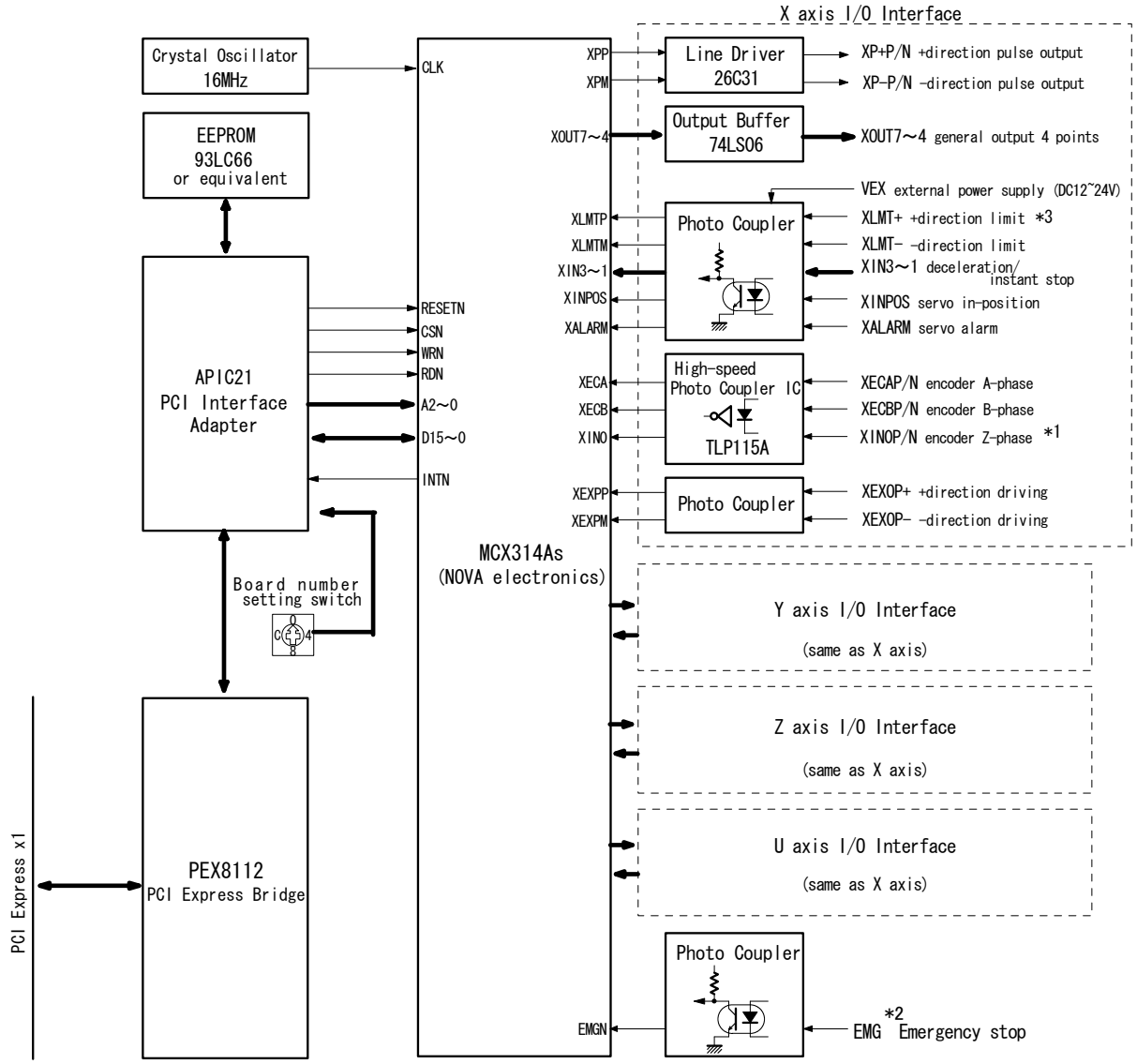
ATTENTION:

- 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

MC8043Pe is a PCI Express compliant PC/AT compatible circuit board equipped with 4-axis motion control IC with interpolation function “MCX314As”. It can independently control 4-axis of either stepper motor or pulse type servo motor for position and speed controls. In addition, this IC can perform 2/3 axes linear interpolation, CW/CCW circular interpolation and 2/3 axes bit pattern interpolation.

MC8043Pe functional block diagram is shown as follows. MC8043Pe consists of mainly 4-axis motion control IC “MCX314As”, a PCI Express 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 MCX314As, so please refer to the user’s manual of MCX314As regarding these functions.



*1 Encoder Z-phase input signal can be input to nIN2 of MCX314As by switching jumper.
*2 Emergency stop input signal can change the logic by switching jumper.
*3 All the input signals (nECA/B excluded) of I/O interface are enabled by MCX314As built-in integral filter (τ=512μsec) due to Windows device driver default setting.

MC8043Pe Circuit Block Diagram

1.1 MCX314As Functional Restriction

■ Data Length

The data has 16-bit length. The read/write access by byte is not be accepted.

■ Interrupt Signal

IRQ determined by the plug and play function (PnP function) on Windows OS is used.

■ Input Signal Filter Circuit Deletion

MC8043Pe does not support the following MCX314As input/output signals due to the board area and the number of I/O connector pins.

- BUSYN output signal
- EXPLSN input signal
- SCLK output signal
- nDRIVE/DCC output signal
- nOUT3~0 general output signal (4 points of each axis nOUT7～4 are used as output through buffer.)

1.2 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-drive output of AM26C31 line driver or equivalent.

■ General Output (nOUT7～4)

Each axis has 4 general outputs. Output buffer uses SN74LS06 or equivalent and is the open collector output. These signals can be used as a deviation counter clear, servo free and alarm reset for a servomotor.

■ 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. DC12～24V power supply is needed.

■ Decelerating Stop/Instant Stop Input (nIN3～1)

In 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. Each axis has three inputs, also can be used as general input. 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, nINOP/N)

This signal inputs A/B phase and Z-phase signals from an encoder. 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 MCX314As. nINOP/N signal is for a Z-phase signal input and stops drive pulse in deceleration or immediately. In default setting, nINOP/N signal is connected to nIN0 input of MCX314As. Short-circuiting 2 and 3 of the jumper pin JP3, this Z-phase input is connected to nIN2 of MCX314As and the user can perform automatic home search function of MCX314As. These input signals are isolated by photo coupler from internal circuit and can easily be connected to a differential output line-drive.

■ Driving by External Input(nEXOP+, nEXOP-)

This signal externally controls driving in the + or – direction. In fixed pulse driving mode, the input signal triggers (the falling edge) to output specified drive pulse. In continuous pulse 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 PnP function. The board requires serial 16 I/O address locations for PCI Express bus.
Check it not to overlap the I/O address of PC main board or other I/O expansion boards using [System Properties] – [Device Manager].

I/O port address of MCX314As is as shown in the table below. Each register is 16-bit length. Be sure to access by word, it cannot be accessed by byte. For details on each register, see chapter 4 of MCX314As user's manual.

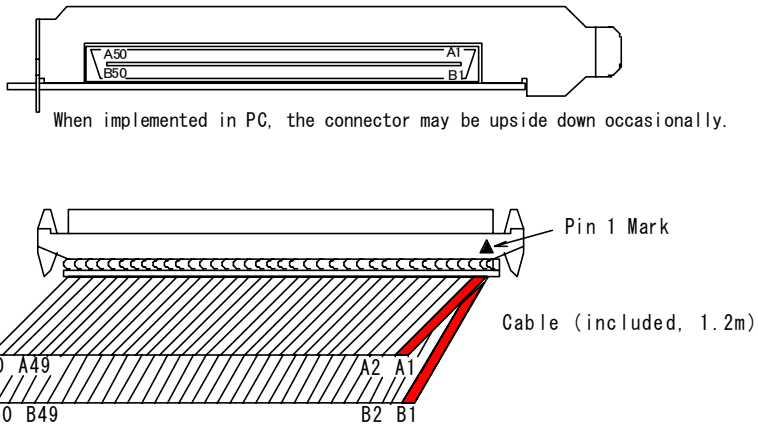
I/O Address	Write Register		Read Register	
	Sign	Register Name	Sign	Register Name
00	WR0	Command register	RR0	Main status register
01	XWR1 YWR1 ZWR1 UWR1	X axis mode register 1 Y axis mode register 1 Z axis mode register 1 U axis mode register 1	XRR1 YRR1 ZRR1 URR1	X axis status register 1 Y axis status register 1 Z axis status register 1 U axis status register 1
02	XWR2 YWR2 ZWR2 UWR2	X axis mode register 2 Y axis mode register 2 Z axis mode register 2 U axis mode register 2	XRR2 YRR2 ZRR2 URR2	X axis status register 2 Y axis status register 2 Z axis status register 2 U axis status register 2
	BP1P	BP1P register		
03	XWR3 YWR3 ZWR3 UWR3	X axis mode register 3 Y axis mode register 3 Z axis mode register 3 U axis mode register 3	XRR3 YRR3 ZRR3 URR3	X axis status register 3 Y axis status register 3 Z axis status register 3 U axis status register 3
	BP1M	BP1M register		
04	WR4	Output register	RR4	Input register 1
	BP2P	BP2P register		
05	WR5	Interpolation mode register	RR5	Input register 2
	BP2M	BP2M register		
06	WR6 BP3P	Write data register 1 BP3P register	RR6	Read data register 1
07	WR7 BP3M	Write data register 2 BP3M register	RR7	Read data register 2

3. I/O Signals

This chapter describes each I/O signal of the I/O connector. In the description, the signal name of each axis is described as n○○○○. This “n” means X, Y, Z and U.

3.1 I/O Connector

I/O 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-100P-1.27DS (Hirose), Cable side FX2B-100S-1.27R (Hirose)

Pin	Signal	I/O	Contents	Chapter
A1	VEX		External Power (DC12~24V)	3.10
A2	EMG	Input	Emergency Stop (All axes)	3.9
A3	XLMT+	Input	X axis Limit in + direction	3.4
A4	XLMT-	Input	X axis Limit in – direction	3.4
A5	XIN1	Input	X axis Decelerating Stop / Instant Stop	3.5
A6	XIN2	Input	X axis Decelerating Stop / Instant Stop	3.5
A7	XIN3	Input	X axis Decelerating Stop / Instant Stop	3.5
A8	YLMT+	Input	Y axis Limit in + direction	3.4
A9	YLMT-	Input	Y axis Limit in – direction	3.4
A10	YIN1	Input	Y axis Decelerating Stop / Instant Stop	3.5
A11	YIN2	Input	Y axis Decelerating Stop / Instant Stop	3.5
A12	YIN3	Input	Y axis Decelerating Stop / Instant Stop	3.5
A13	XINPOS	Input	X axis Servo Inposition	3.6
A14	XALARM	Input	X axis Servo Alarm	3.6
A15	XECAP	Input	X axis Encoder A-phase	3.7
A16	XECAN	Input	X axis Encoder A-phase	3.7
A17	XECBP	Input	X axis Encoder B-phase	3.7
A18	XECBN	Input	X axis Encoder B-phase	3.7
A19	XIN0P	Input	X axis Encoder Z-phase	3.7
A20	XIN0N	Input	X axis Encoder Z-phase	3.7
A21	YINPOS	Input	Y axis Servo Inposition	3.6
A22	YALARM	Input	Y axis Servo Alarm	3.6
A23	YECAP	Input	Y axis Encoder A-phase	3.7
A24	YECAN	Input	Y axis Encoder A-phase	3.7
A25	YECBP	Input	Y axis Encoder B-phase	3.7

Pin	Signal	I/O	Contents	Chapter
A26	YECBN	Input	Y axis Encoder B-phase	3.7
A27	YIN0P	Input	Y axis Encoder Z-phase	3.7
A28	YIN0N	Input	Y axis Encoder Z-phase	3.7
A29	XEXOP+	Input	X axis Driving in + direction	3.8
A30	XEXOP-	Input	X axis Driving in – direction	3.8
A31	YEXOP+	Input	Y axis Driving in + direction	3.8
A32	YEXOP-	Input	Y axis Driving in – direction	3.8
A33	GND		Internal Circuit GND	
A34	XOUT4	Output	X axis General Output	3.3
A35	XOUT5	Output	X axis General Output	3.3
A36	XOUT6	Output	X axis General Output	3.3
A37	XOUT7	Output	X axis General Output	3.3
A38	XP+P	Output	X axis Drive Pulse in + direction	3.2
A39	XP+N	Output	X axis Drive Pulse in + direction	3.2
A40	XP-P	Output	X axis Drive Pulse in – direction	3.2
A41	XP-N	Output	X axis Drive Pulse in – direction	3.2
A42	GND		Internal Circuit GND	
A43	YOUT4	Output	Y axis General Output	3.3
A44	YOUT5	Output	Y axis General Output	3.3
A45	YOUT6	Output	Y axis General Output	3.3
A46	YOUT7	Output	Y axis General Output	3.3
A47	YP+P	Output	Y axis Drive Pulse in + direction	3.2
A48	YP+N	Output	Y axis Drive Pulse in + direction	3.2
A49	YP-P	Output	Y axis Drive Pulse in – direction	3.2
A50	YP-N	Output	Y axis Drive Pulse in – direction	3.2

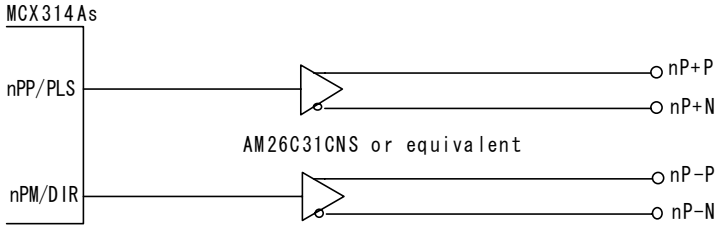
Pin	Signal	I/O	Contents	Chapter
B1	VEX		External Power (DC12~24V)	3.10
B2				
B3	ZLMT+	Input	Z axis Limit in + direction	3.4
B4	ZLMT-	Input	Z axis Limit in – direction	3.4
B5	ZIN1	Input	Z axis Decelerating Stop / Instant Stop	3.5
B6	ZIN2	Input	Z axis Decelerating Stop / Instant Stop	3.5
B7	ZIN3	Input	Z axis Decelerating Stop / Instant Stop	3.5
B8	ULMT+	Input	U axis Limit in + direction	3.4
B9	ULMT-	Input	U axis Limit in – direction	3.4
B10	UIN1	Input	U axis Decelerating Stop / Instant Stop	3.5
B11	UIN2	Input	U axis Decelerating Stop / Instant Stop	3.5
B12	UIN3	Input	U axis Decelerating Stop / Instant Stop	3.5
B13	ZINPOS	Input	Z axis Servo Inposition	3.6
B14	ZALARM	Input	Z axis Servo Alarm	3.6
B15	ZECAP	Input	Z axis Encoder A-phase	3.7
B16	ZECAN	Input	Z axis Encoder A-phase	3.7
B17	ZECBP	Input	Z axis Encoder B-phase	3.7
B18	ZECBN	Input	Z axis Encoder B-phase	3.7
B19	ZIN0P	Input	Z axis Encoder Z-phase	3.7
B20	ZIN0N	Input	Z axis Encoder Z-phase	3.7
B21	UINPOS	Input	U axis Servo Inposition	3.6
B22	UALARM	Input	U axis Servo Alarm	3.6
B23	UECAP	Input	U axis Encoder A-phase	3.7
B24	UECAN	Input	U axis Encoder A-phase	3.7
B25	UECBP	Input	U axis Encoder B-phase	3.7

Pin	Signal	I/O	Contents	Chapter
B26	UECBN	Input	U axis Encoder B-phase	3.7
B27	UIN0P	Input	U axis Encoder Z-phase	3.7
B28	UIN0N	Input	U axis Encoder Z-phase	3.7
B29	ZEXOP+	Input	Z axis Driving in + direction	3.8
B30	ZEXOP-	Input	Z axis Driving in – direction	3.8
B31	UEXOP+	Input	U axis Driving in + direction	3.8
B32	UEXOP-	Input	U axis Driving in – direction	3.8
B33	GND		Internal Circuit GND	
B34	ZOUT4	Output	Z axis General Output	3.3
B35	ZOUT5	Output	Z axis General Output	3.3
B36	ZOUT6	Output	Z axis General Output	3.3
B37	ZOUT7	Output	Z axis General Output	3.3
B38	ZP+P	Output	Z axis Drive Pulse in + direction	3.2
B39	ZP+N	Output	Z axis Drive Pulse in + direction	3.2
B40	ZP-P	Output	Z axis Drive Pulse in – direction	3.2
B41	ZP-N	Output	Z axis Drive Pulse in – direction	3.2
B42	GND		Internal Circuit GND	
B43	UOUT4	Output	U axis General Output	3.3
B44	UOUT5	Output	U axis General Output	3.3
B45	UOUT6	Output	U axis General Output	3.3
B46	UOUT7	Output	U axis General Output	3.3
B47	UP+P	Output	U axis Drive Pulse in + direction	3.2
B48	UP+N	Output	U axis Drive Pulse in + direction	3.2
B49	UP-P	Output	U axis Drive Pulse in – direction	3.2
B50	UP-N	Output	U axis Drive Pulse in – direction	3.2

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

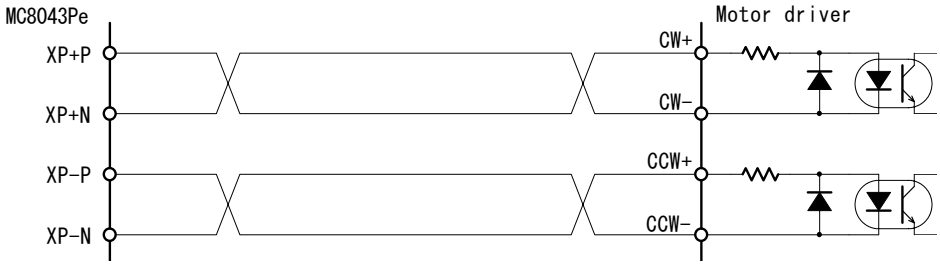
3.2 Drive Pulse Output Signal (nP+P, nP+N, nP-P, nP-N)

Drive pulse output signal outputs the drive pulse of +/– direction of MCX314As through a differential line-drive 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 2.9.2 and 4.5 of MCX314As user's manual.

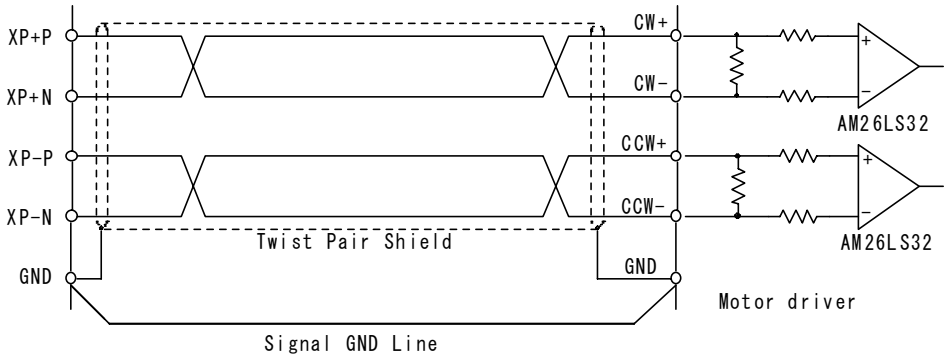


Drive Pulse Output Signal Circuit

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

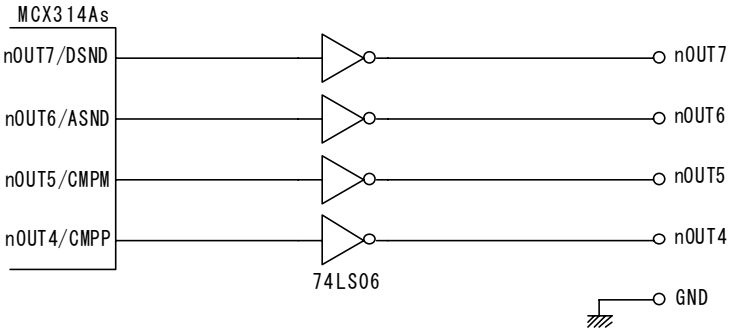


Connection example of a motor driver with a line receiver input

Note:
As shown above, when using a line receiver input circuit, connect MC8043Pe and a motor driver with Signal GND line. If there is the potential difference between MC8043Pe and motor driver, a malfunction and the destruction of the driver circuit and/or the motor driver circuit may be caused.

3.3 General Output Signal (nOUT7, nOUT6, nOUT5, nOUT4)

General output signal outputs nOUT7/DSND, nOUT6/ASND, nOUT5/CMPM and nOUT4/CMPP signals of MCX314As through buffer (74LS06).
At resetting, each output signal will be OFF.



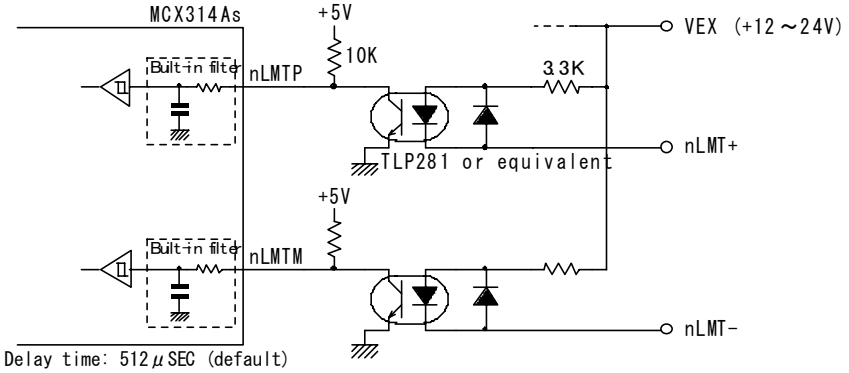
General Output Circuit

General output signals can be used as a deviation counter clear, alarm reset and excitation OFF signal of a motor driver.
In addition, these can output the accelerating/decelerating drive status and small and large status of a position counter and compare register in mode selection. For the setting of general output signals, see chapter 2.9.8 and 4.6 of MCX314As user's manual. And for the accelerating/decelerating drive output, see 2.9.7 and 4.6, and for the small and large status output of a position counter and compare register, see 2.3 and 4.6.

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

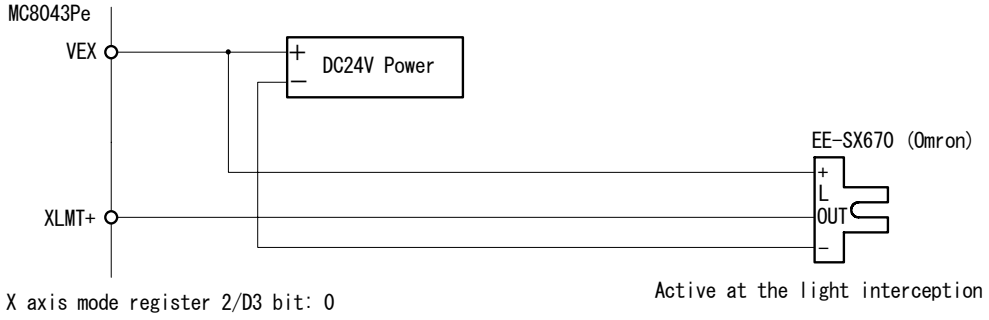
Input signal to restrain each drive pulse in the +/ – direction. This input signal is connected to the limit input of MCX314As through a photo coupler. After resetting, MCX314As becomes low active, so limit function works when current flows out from a signal pin (nLMT+, nLMT-). The logical level and decelerating/instant stop can be changed. For details on mode setting, see chapter 4.5 of MCX314As user's manual.

To enable this signal, external power supply DC12~24V is needed. When the board is powered on, the built-in integral filter of MCX314As becomes the setting of signal delay time 512 μ sec due to the default setting of Windows device driver provided by NOVA electronics. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.8 and 6.16 of MCX314As 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

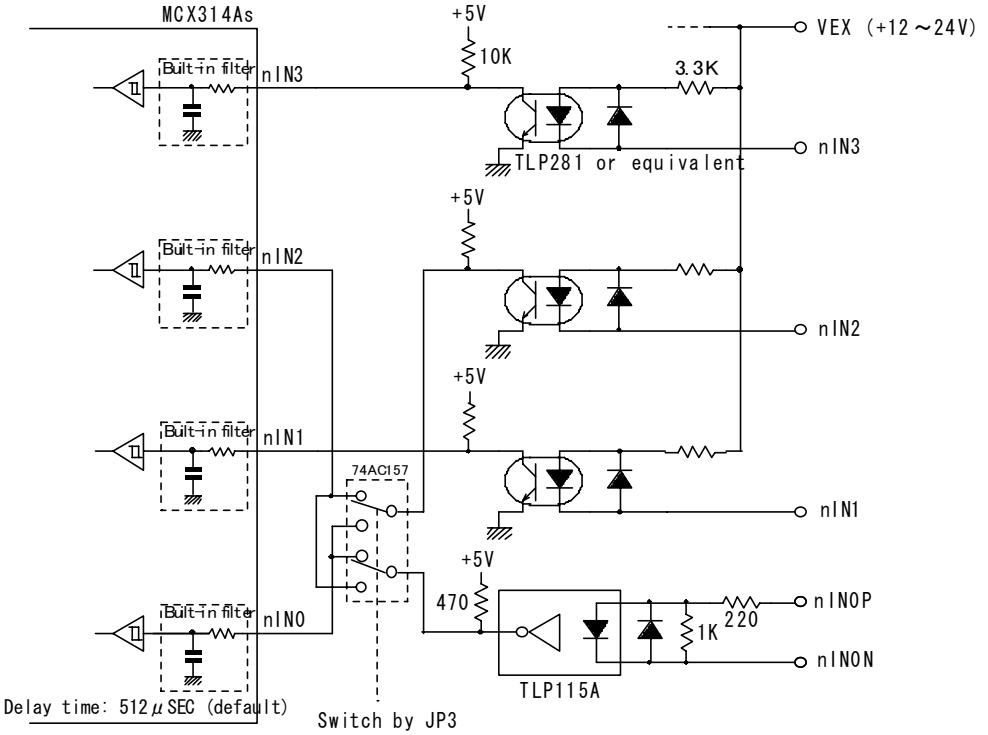
When long wiring is needed, use the shield cable.

3.5 Decelerating Stop/Instant Stop Input Signal (nIN1, nIN2, nIN3)

Three input signals to stop drive pulse output in deceleration or immediately. MCX314As has four signals, IN3～IN0 for each axis. Short-circuiting 1 and 2 of the jumper pin JP3 (default setting), the interface circuit for an encoder Z-phase (high-speed photo coupler TLP115A) is connected to nIN0 of MCX314As. nIN1, nIN2, nIN3 signals are used as home or near home input signals. If short-circuiting 2 and 3 of JP3, the interface circuit for the encoder Z-phase (high-speed photo coupler TLP115A) is connected to nIN2 of MCX314As, and automatic home search function of MCX314As can be used. For details on automatic home search, see chapter 2.5 of MCX314As user's manual.

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 stops to output. When in acceleration/deceleration driving, it stops in deceleration and when in constant driving, it stops immediately. After resetting, all the signals are disabled. For instance, in IN3 signal of X axis, when D7, D6 bit of XWR1 register is set to 1, 0 and set to low level and enable, and when current flows out from XIN3 signal pin of this board, driving stops. For details on mode setting, see chapter 4.4 of MCX314As user's manual.

To enable this signal, external power supply DC12～24V is needed. 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. When the board is powered on, the built-in integral filter of MCX314As shown below becomes the setting of signal delay time 512 μ sec due to the default setting of Windows device driver provided by NOVA electronics. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.8 and 6.16 of MCX314As user's manual.



JP3: nIN0/nIN2 switching

JP3 1-2 short circuit	Normal (Default)	The board I/O connector nIN0P/N signal is connected to nIN0 of MCX314As and the board I/O connector nIN2 signal is connected to nIN2 of MCX314As.
JP3 2-3 short circuit	Cross	The board I/O connector nIN0P/N signal is connected to nIN2 of MCX314As and the board I/O connector nIN2 signal is connected to nIN0 of MCX314As.

Decelerating Stop/Instant Stop Input Signal Circuit

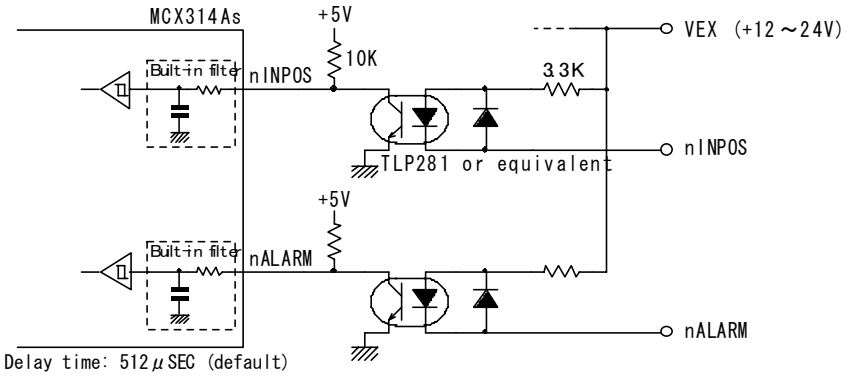
3.6 Input Signal for Servo Motor (nINPOS, nALARM)

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 MCX314As. 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 1, 0 to the D15, 14 bit of mode register 2 (nWR2) of MCX314As as low active, and the n-DRV bit of RR0 register returns to 0 after waiting to flow level current from nINPOS signal. For nALARM input signal, set 1, 0 to the D13, 12 bit of nWR2 register as low level active, and the signal becomes an alarm state when current flows out from nALARM signal pin. For more details, see chapter 2.9.5 and 4.5 of MCX314As user's manual.



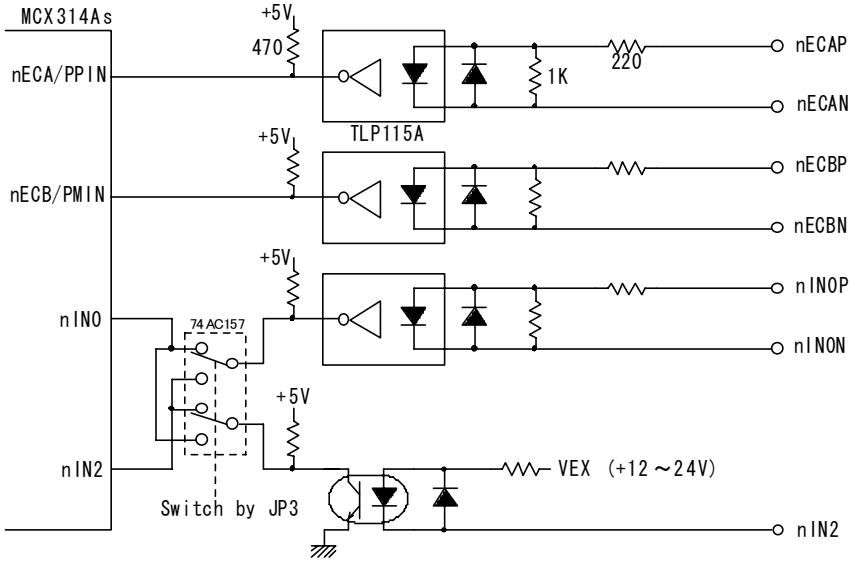
Servo Motor Input Signal Circuit

To enable this signal, external power supply DC12～24V is needed. When the board is powered on, the built-in integral filter of MCX314As shown above becomes the setting of signal delay time 512 μ sec due to the default setting of Windows device driver provided by NOVA electronics. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.8 and 6.16 of MCX314As user's manual.

3.7 Encoder Input Signal (nECAP, nECAN, nECBP, nECBN, nINOP, nINON)

nECAP/N, nECBP/N, input signals are the input to count a real position counter of MCX314As by connecting to the 2-phase output signal of an encoder or that of a servo motor driver. For more details, see chapter 2.3.1, 2.9.3 and 4.5 of MCX314As user's manual.

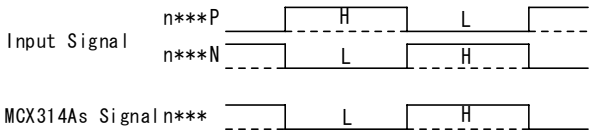
nINOP/N input signal is to stop drive pulse output by connecting to the Z-phase output signal of an encoder or that of a servo motor driver. Enable/disable and logical level can be set in mode setting. When enable is set and after this signal becomes active during driving, drive pulse stops to output. As described in chapter 3.5, if short-circuiting 2 and 3 of JP3, the interface circuit for the encoder Z-phase (high-speed photo coupler TLP115A) is connected to nIN2 of MCX314As, and automatic home search function of MCX314As can be used. For details on automatic home search, see chapter 2.5 of MCX314As user's manual.



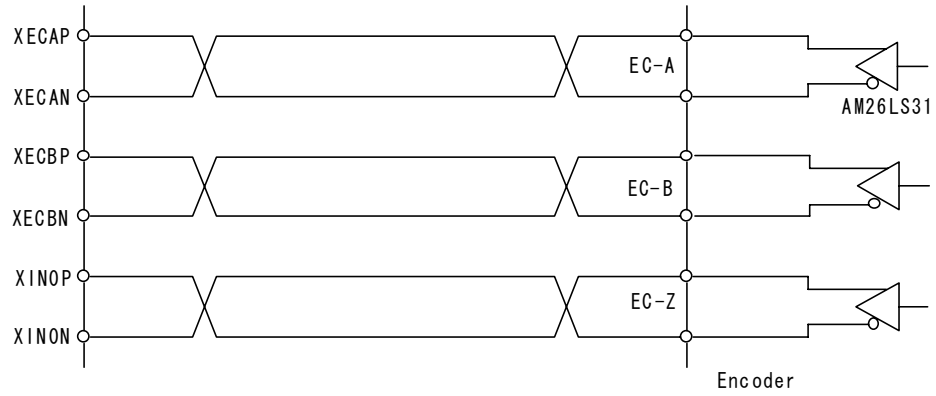
Encoder Input Signal Circuit

As shown above, encoder input signal circuit uses high-speed photo coupler IC TLP115A (Toshiba). Each input signal can be directly connected to a differential line-drive output. As the figure below, when n***P/N signal is H/L, n*** signal of MCX314As becomes Low and when is L/H, it becomes Hi. The delay time from input to the signal pin of MCX314As is under 100nSEC, so

that the signal can count up to 4MHz in the case of 2-phase pulse input.

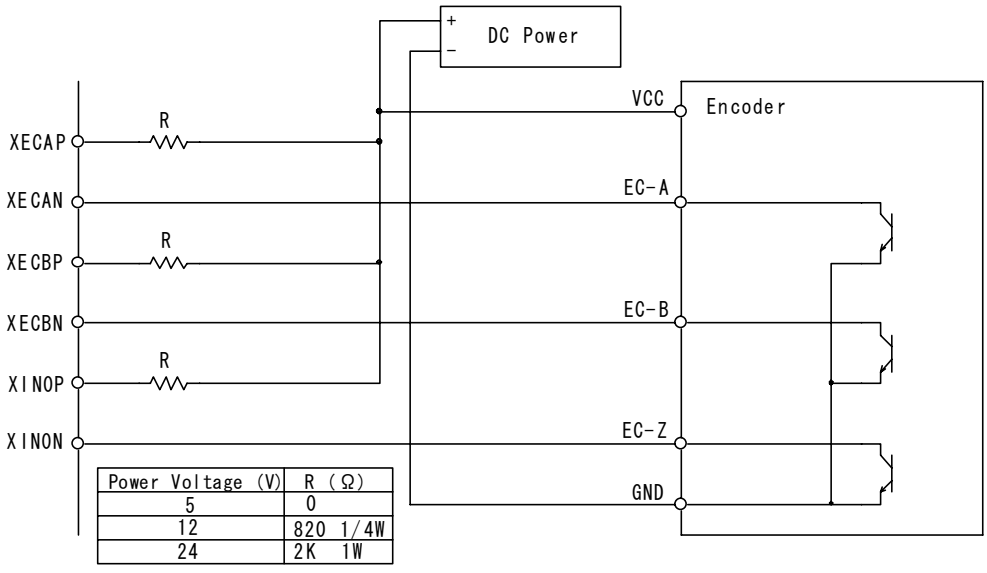


The connection example of an encoder input signal and a differential line-drive output is shown as follows:



Connection Example with Differential Line-Drive Output

The connection example of an encoder input signal and the encoder with open collector output is shown as follows:

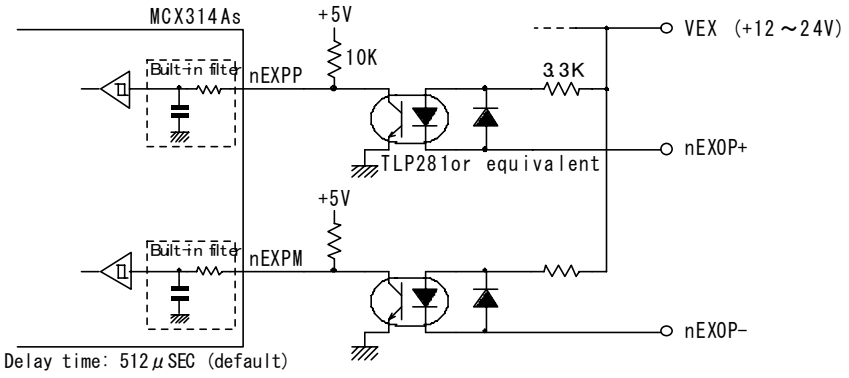


Connection Example with Open Collector Output

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

The signal externally controls driving in the + or – direction. In fixed pulse driving mode, the falling edge of these signals trigger to output specified drive pulse. In continuous pulse 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 MCX314As. For details, see chapter 2.9.1 and 4.6 of MCX314As user's manual.

To enable this signal, external power supply DC12~24V is needed. When the board is powered on, the built-in integral filter of MCX314As shown below becomes the setting of signal delay time 512 μ sec due to the default setting of Windows device driver provided by NOVA electronics. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.8 and 6.16 of MCX314As user's manual.

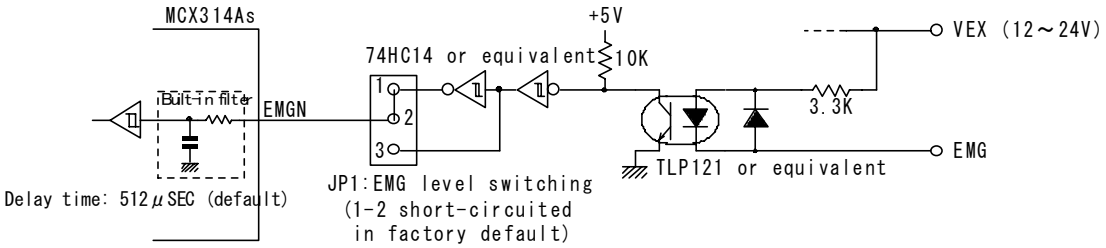


External Driving Signal Circuit

3.9 Emergency Stop Input Signal (EMG)

All the drive pulse output stops when emergency stop signal becomes active. Active level can be switched by the JP1 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 MCX314As, see chapter 2.9.6 and 4.12 of MCX314As user's manual.

JP1: 1-2 short circuit: When emergency stop signal (EMG) is short-circuited with GND of the external power, it becomes active.
JP1: 2-3 short circuit: When emergency stop signal (EMG) is open, it becomes active.
Factory default is 1-2 short-circuited.



Emergency Stop Input Signal Circuit

To enable this signal, external power supply DC12~24V is needed. When the board is powered on, the built-in integral filter of MCX314As shown above becomes the setting of signal delay time 512 μ sec due to the default setting of Windows device driver provided by NOVA electronics. This signal delay time can be changed for circumstances of system noise. For more details, see chapter 2.8 and 6.16 of MCX314As user's manual.

3.10 External Power (VEX)

The power supplied externally is used for over run limit input signal (nLMT+, nLMT–) of each axis, decelerating stop/instant stop (nIN1, nIN2, nIN3), input signal for servo motor (nINPOS, nALARM), external signal for driving (nEXOP+, nEXOP–) and emergency stop input signal (EMG). DC12~24V is needed. Consumption current is 3.3mA per 1 input signal in DC12V and 7mA per 1 input signal in DC24V.

3.11 PCI Express Connector

Pin no.	Side A		Side B	
	Symbol	Content	Symbol	Content
1	+12V	12V Power	PRSNT1#	Hot-Plug presence detect
2	+12V	12V Power	+12V	12V Power
3	RSVD	Reserved	+12V	12V Power
4	GND	Ground	GND	Ground
5	SMCLK	SMBus(System Management Bus)clock	JTAG2	TCK(Test Clock),clock input for JTAG interface
6	SMDAT	SMBus(System Management Bus)data	JTAG3	TDI(Test Data Input)
7	GND	Ground	JTAG4	TDO(Test Data Output)
8	+3.3V	3.3V Power	JTAG5	TMS(Test Mode Select)
9	JTAG1	TRST# (Test Reset) resets the JTAG interface	+3.3V	3.3V power
10	3.3Vaux	3.3V auxiliary power	+3.3V	3.3V power
11	WAKE#	Signal for Link reactivation	PERST#	Fundamental reset
12	RSVD	Reserved	GND	Ground
13	GND	Ground	REFCLK+	Reference clock(differential pair)
14	PETp0	Transmitter differential pair, Lane 0	REFCLK-	
15	PETn0		GND	Ground
16	GND	Ground	PERp0	Receiver differential pair, Lane 0
17	PRSNT2#	Hot-Plug presence detect	PERn0	
18	GND	Ground	GND	Ground

Signals with "#" mark means negative logic.

4. Interrupt

This board has an interrupt signal generated by MCX314As, which connect to the INTA# of four interrupt request signals in the PCI Express bus. The interrupt can be handled in the application on Windows.
All interrupt signals which are generated by MCX314As are output to CPU.
By reading status register 3(nRR3) of the axis from which an interrupt is generated, the interrupt signal returns to non-active level.

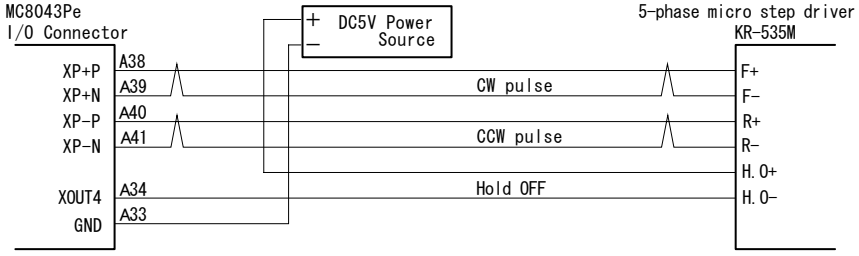
Create an application program with VC. VB program cannot handle the interrupt.

For more details on programming handling the interrupt, see chapter 3 Programming of MC8000P device driver user's manual.

5. Connection Example for Motor Driver

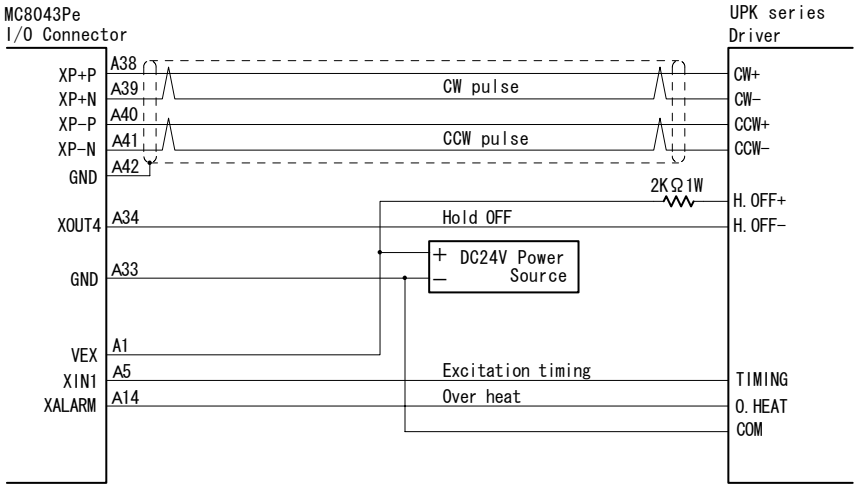
5.1 Connection Example for Stepper Motor

The figure shown below illustrates the connection example of MC8043Pe X axis and 5-phase micro step driver KR535M.



Note1: Wire hold OFF signal according to need. The hold off signal can be controlled by writing 0, 1 into the D8 bit of WR3 register of MCX314As.

The figure shown below illustrates the connection example of MC8043Pe X axis and the stepper motor driver of Oriental Motor UPK series.

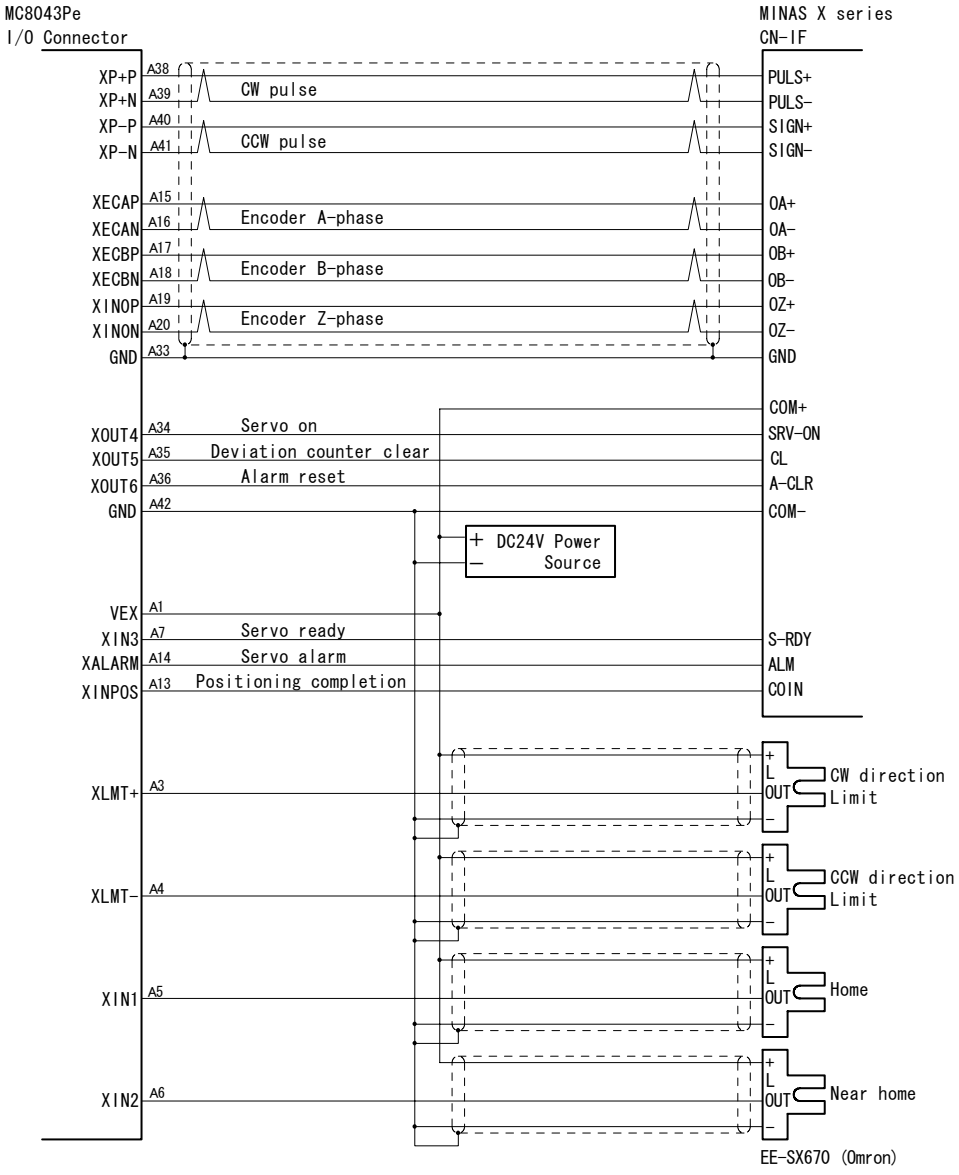


Note1: Wire hold OFF, excitation timing and over heat signals according to need. The hold off signal can be controlled by writing 0, 1 into the D8 bit of WR3 register of MCX314As. The excitation timing signal can perform a home search by the mode setting of the WR1 register D0, 1 bit. The over heat signal can perform an alarm function by the mode setting of the WR2 register D12, 13 bit. In addition, excitation timing and over heat signals can directly read out the signal level through the RR4, 5 registers.

Note2: When the circumstances are affected by strong noise or distance to the driver is long, 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 MC8043Pe X axis and the AC servo motor driver of MINAS X series.



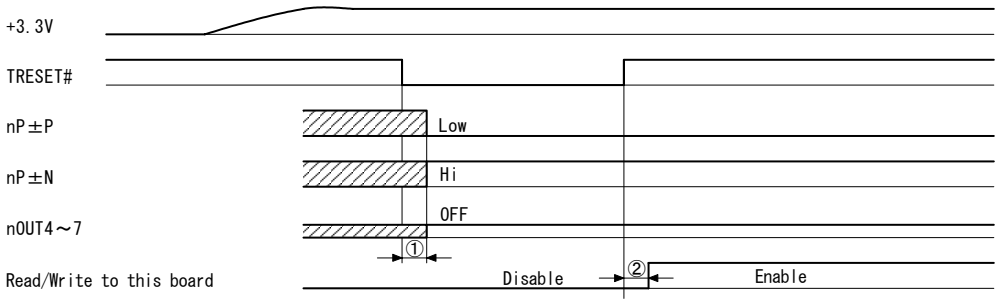
Note1: Set the mode of MINAS driver control to the position control mode and the pulse form to CW/CCW pulse mode. Do not set the command pulse form to Pulse/Sign mode because the lack of t6 time occurs.

Note2: Use encoder A/B phase signals when the user counts a real position counter in MCX314As. If the real position data is not necessary, no need to connect them. For other signals, connect them according to need.

Note3: 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

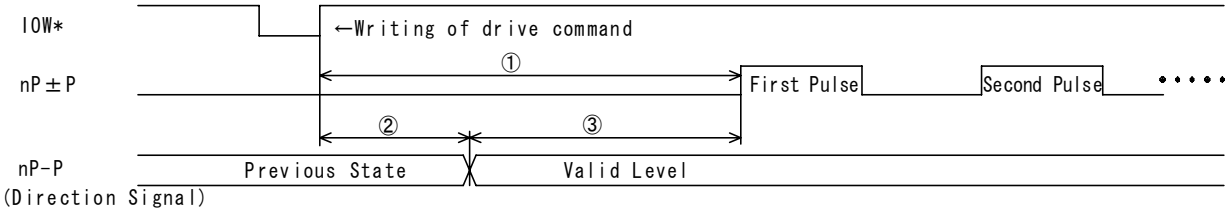


① Drive pulse output signals (nP±P, nP±N) and general output signals (nOUT4～7) are determined within a maximum of 250nSEC after from ↓ of the target reset signal (TRESET#) of APIC21 (ADTEC).

② The target reset signal(TRESET#) of APIC21 becomes ↑ 12mSEC after from ↑ of PCI Express reset signal (TRESET#) .

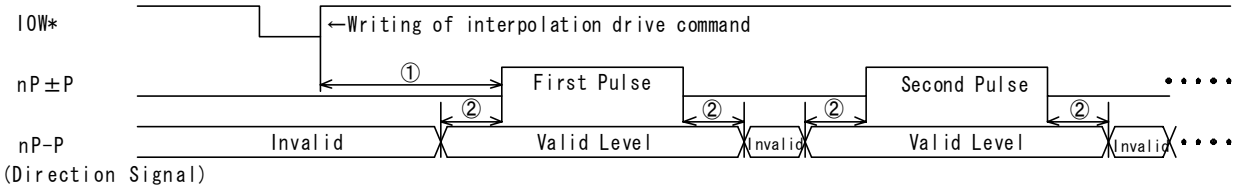
③ Writing/Reading to this board can be performed after 500nSEC from ↑ of the target reset signal (TRESET#).

6.2 Independent 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.

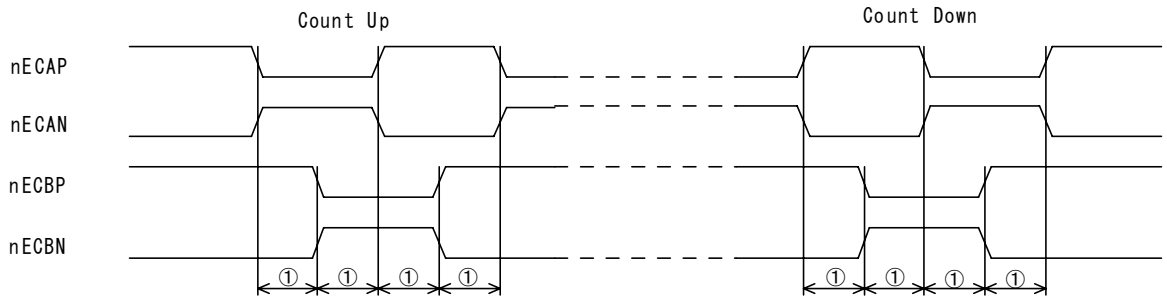
6.3 Interpolation



① During interpolation driving, first drive pulse is output within a maximum of 775nSEC after writing of interpolation drive command.
② When drive output pulse is 1-pulse type, a direction signal (nP-P) becomes valid level while each drive pulse is Hi level and between before and after the 125nSEC only. (When the drive pulse is positive logical level)

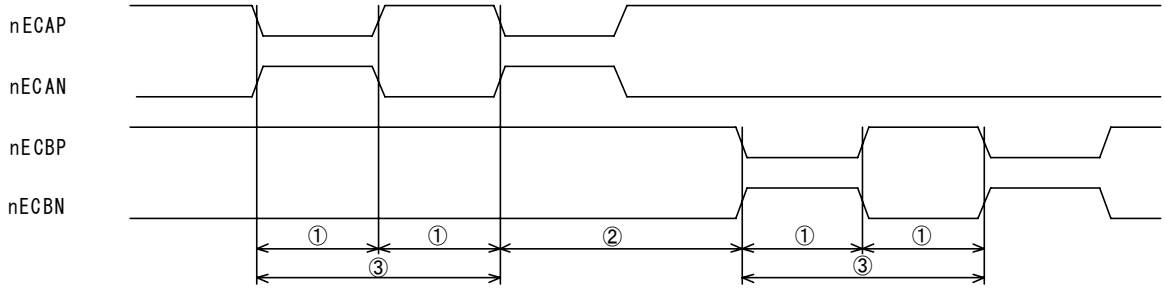
6.4 Input Pulse Timing

■ Encoder 2-phase Pulse Input



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

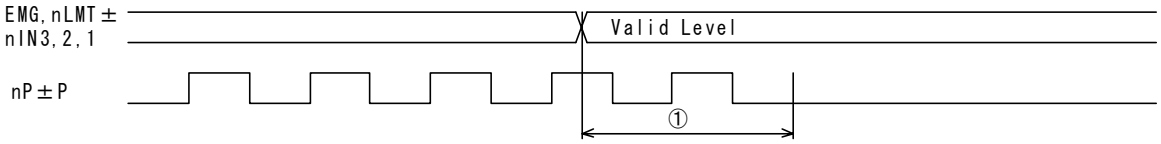
■ Up/Down Pulse Input



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

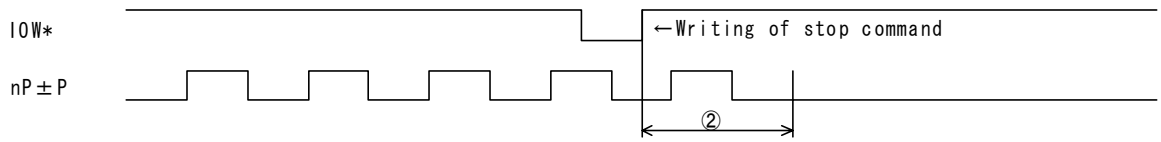
6.5 Instant Stop Timing

■ Instant Stop by External Signal



① When an instant 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.

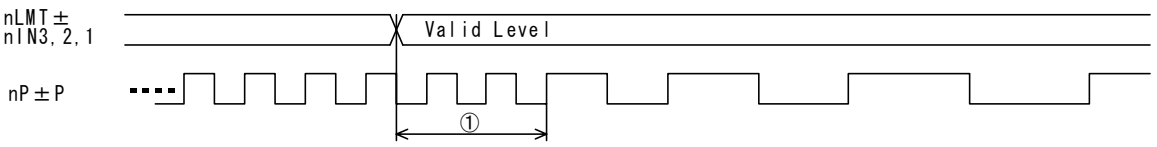
■ Instant Stop by Command



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

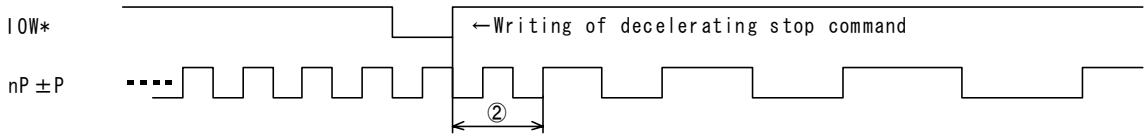
6.6 Decelerating Stop Timing

■ Decelerating Stop by External Signal



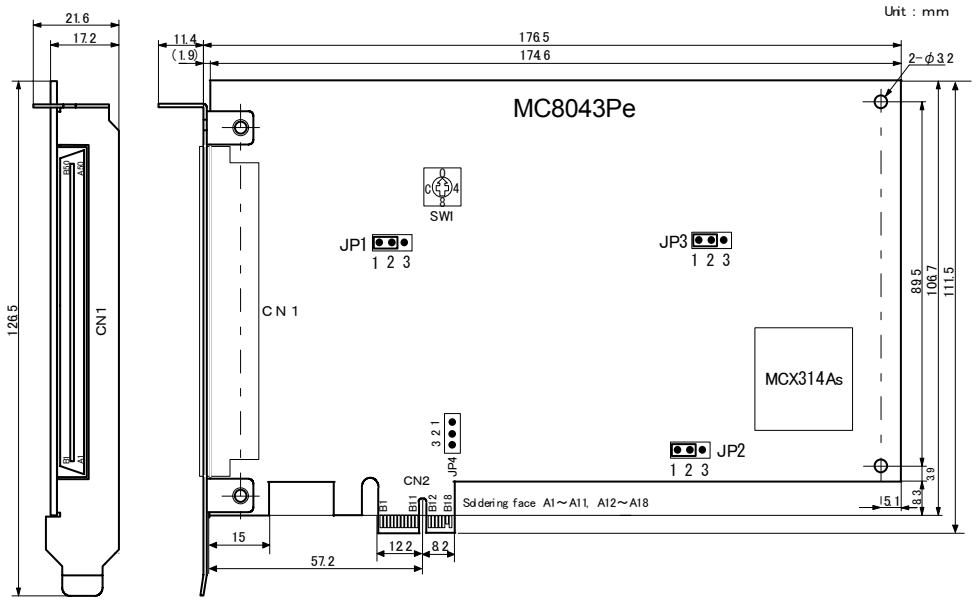
① When an external decelerating stop signal becomes valid level during driving, the driving starts deceleration after photo coupler delay time (100 μ sec max.) + the delay time of IC built-in integral filter (512 μ sec default) + 2 drive pulses.

■ 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: 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.
2-3 short circuit: When the signal is open, it becomes active.

JP2: Keep 1-2 short circuit (default setting).

JP3: Switch nIN0/nIN2 signal.
1-2 short circuit (default): The board I/O connector nIN0P/N signal is connected to nIN0 of MCX314As and the board I/O connector nIN2 signal is connected to nIN2 of MCX314As.
2-3 short circuit: The board I/O connector nIN0P/N signal is connected to nIN2 of MCX314As and the board I/O connector nIN2 signal is connected to nIN0 of MCX314As.

JP4: Keep it open (default setting).

SW1: Rotary switch to set the board number when multiple boards are used, which can be set from 0 to 9 (default setting: 0).

8. Specifications

● Control Axis 4 axes

PCI Express Bus Interface

● Data Bit Width 16 bit
● Occupied I/O Address 16 byte Address is determined by PnP.
● Interrupt IRQ Connected by PnP.

Interpolation Functions

■ **2-axis / 3-axis Linear Interpolation**
● Interpolation Range Each axis -2,147,483,646～+2,147,483,646
● Interpolation Speed 1PPS～4MPPS
● Interpolation Accuracy ±0.5LSB (Within the range of whole interpolation)

■ **Circular Interpolation**
● Interpolation Range Each axis -2,147,483,646～+2,147,483,646
● Interpolation Speed 1PPS～4MPPS
● Interpolation Accuracy ±1 LSB (Within the range of whole interpolation)

■ **2-axis / 3-axis Bit Pattern Interpolation**
● Interpolation Speed 1PPS～4MPPS (Dependent on CPU data writing time)

■ **Related functions of Interpolation**
● Can select any axis ● Constant vector speed
● Continuous interpolation
● Single step interpolation (Command)

Common Specifications of Each Axis

■ **Drive Pulses Output**
● Pulse Output Circuit Differential line-drive (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~ 62.5×10^{6}PPS/SEC^{2} (Multiple = 1)
477 x 10^{3}～31.25 x 10^{9}PPS/ SEC^{2} (Multiple =500)
● Accelerating / Decelerating Speed 125～1 x 10^{6} PPS/SEC (Multiple = 1)
62.5×10^{3}～500 x 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 0～4,294,967,295(Fixed pulse drive) or unlimited(Continuous pulse drive)
● Speed Curve Constant speed, symmetrical/non-symmetrical linear acceleration, symmetrical/non-symmetrical parabola S-curve acceleration/deceleration drive
● Fixed Pulse Drive Deceleration Mode Auto (non-symmetrical linear acceleration is also allowed) / manual
● Prevention of triangle driving profile for fixed pulse trapezoidal/S-curve acceleration
● Output-pulse numbers and drive speeds are changeable during the driving.
● Independent 2-pulse system or 1-pulse 1-direction system is selectable.
● Logical levels of drive pulse is selectable.

■ **Encoder A/B/Z Quadrature Input**
● Input Circuit High-speed photo coupler input. Connectable with differential line-driver.
● 2-phase pulse style or Up/Down pulse style is 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 feedback pulse) range −2,147,483,648～+2,147,483,647
To read / write date is always possible.

■ **Comparison Register**
● COMP + Register Position comparison range −2,147,483,648～+2,147,483,647
● COMP − Register Position comparison range −2,147,483,648～+2,147,483,647
● Status and signal outputs for the comparisons of position counters
● To work as Software limit.

■ **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 is selectable

■ **Synchronous action**

● Activation factor Transition to “position counter ≥ COMP+”, Transition to “position counter < COMP+”, Trasition to “position counter < COMP−”, Transition to “position counter ≥ COMP−”, start of driving, termination of driving, IN3 signal↑, IN3 signal↓, LP read command, activation command.

● Action Start of +/− fixed pulse drive, start of +/− continuous pulse drive, drive decelerating stop, drive instant stop, saving position counter values, setting position counter values, setting an output pulse number, setting a drive speed and interrupt

Any action of other axes can be activated from the factor of the own axis.

■ **Interrupt** (Interpolations Excluded)

● The factors of occurring interrupt:

..drive-pulse outputting
..start / finish of a constant-speed drive during the acceleration / deceleration driving
..end of the driving
..Transition to “the volume of position counter ≥ the volume of COMP−”
..Transition to ”the volume of position counter < the volume of COMP−”
..Transition to ”the volume of position counter ≥ the volume of COMP+”
..Transition to ”the volume of position counter < the volume of COMP+”
..terminating of automatic home search, synchronous action

Enable / disable for these factors is selectable.

■ **External Signal for Driving**

● EXPP and EXPM signals for +/- direction fixed pulse / continuous drive
● Input Circuit Photo coupler and IC built-in integral filter

■ **External Deceleration / Instant Stop Signal**

● IN0～3 4 points for each axis (IN0:encoder Z-phase input)
● Input Circuit Photo coupler and IC built-in integral filter (IN0: high-speed photo coupler input)

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 and IC built-in integral filter

Enable / disable and logical levels is selectable.

■ **General Output Signal**

● OUT4～7 4 points for each axis (General output/drive status output can be switched)
● Output Circuit 74LS06 output (open collector output)

■ **Driving Status Signal Output**

● ASND (speed accelerating), DSND (speed decelerating), CMPP (position ≥ COMP+), CMPM (position < COMP−)

Drive status is readable by status registers.

■ **Limit Signals Input**

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

Logical levels and decelerating / instant stop is selectable.

■ **Emergency Stop Signal Input**

● EMGN 1 point for all axes

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

● Input Circuit Photo coupler and IC built-in integral filter

Electrical Characters

● Temperature Range for Driving	0～+ 45°C (No condensation)
● Power Voltage for Driving	+3.3V ± 5 % (Consumption current 1,000mA max.)
● Consumption current	Max.1000mA (When all 4 axes drive if loaded current of drive output is15mA/axis.)
● External Supply Voltage	+12～24V
● Board Dimensions	174.6 × 106.7mm (Connectors and brackets excluded)
● I/O Connector Type	FX2B-100PA-1.27DS (Hirose)
● Accessories	FX2B-100SA-1.27R (Hirose) with 1.2m cable

Appendix A. MC8043P and MC8043Pe

In case MC8043Pe replaces MC8043P or in case MC8043Pe and MC8043P are installed in a PC, read the following matters:

1. The differences of the hardwares between MC8043P and MC8043Pe

■ Bus specifications

MC8043P is a PCI bus compliant and MC8043Pe is a PCI Express compliant.

■ I/O interface

All of signal names and pin assignments of both MC8043P and MC8043Pe are same.

2. Software

■ In case MC8043P and MC8043Pe are used in a PC

In case MC8043P and MC8043Pe are use in a PC, set the different numbers as the different boards by SW1.

■ Device driver

Device driver for MC8043Pe is same for MC8043P.

■ User's application software

User's application software for MC8043P can control MC8043Pe and vice versa.