－RoHS compliant－

PCI Bus High Function

8-Axis Motion Control Board with Interpolation

MC8541P Hardware Manual

2018-01-29 Ver. 1.0

NOVA electronics, Inc.

1. Prevent Electrostatic Discharge

ATTENTION: MC8541P is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle MC8541P:
・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 MC8541P.
・Store MC8541P in appropriate static-safe packaging when not in use.

2. Safety Notice

WARNING: MC8541P 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 MC8541P in critical applications. Provide adequate design and operating safeguards in order to minimize risks associated with customer's applications when incorporating MC8541P in a system.

3. Before you begin

ATTENTION: Before using MC8541P, read this manual thoroughly to ensure correct usage and observe all the instructions given in this manual.

4. Checking the Contents

ATTENTION: When you unpack a package of MC8541P, check for the following accessories. If something is missing or broken, contact the place of purchase.

- MC8541P 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".

5. Consulting Other Manuals

ATTENTION: The circuit of MC8541P consists of mainly 4-axis motion control IC "MCX514", a PCI-bus interface circuit and I/O interface circuits of each axis. Basic functions of this board all depend on MCX514, so please refer to the User's Manual of MCX514 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.

6. 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+12～24V

7. 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.

8. Handling Precautions

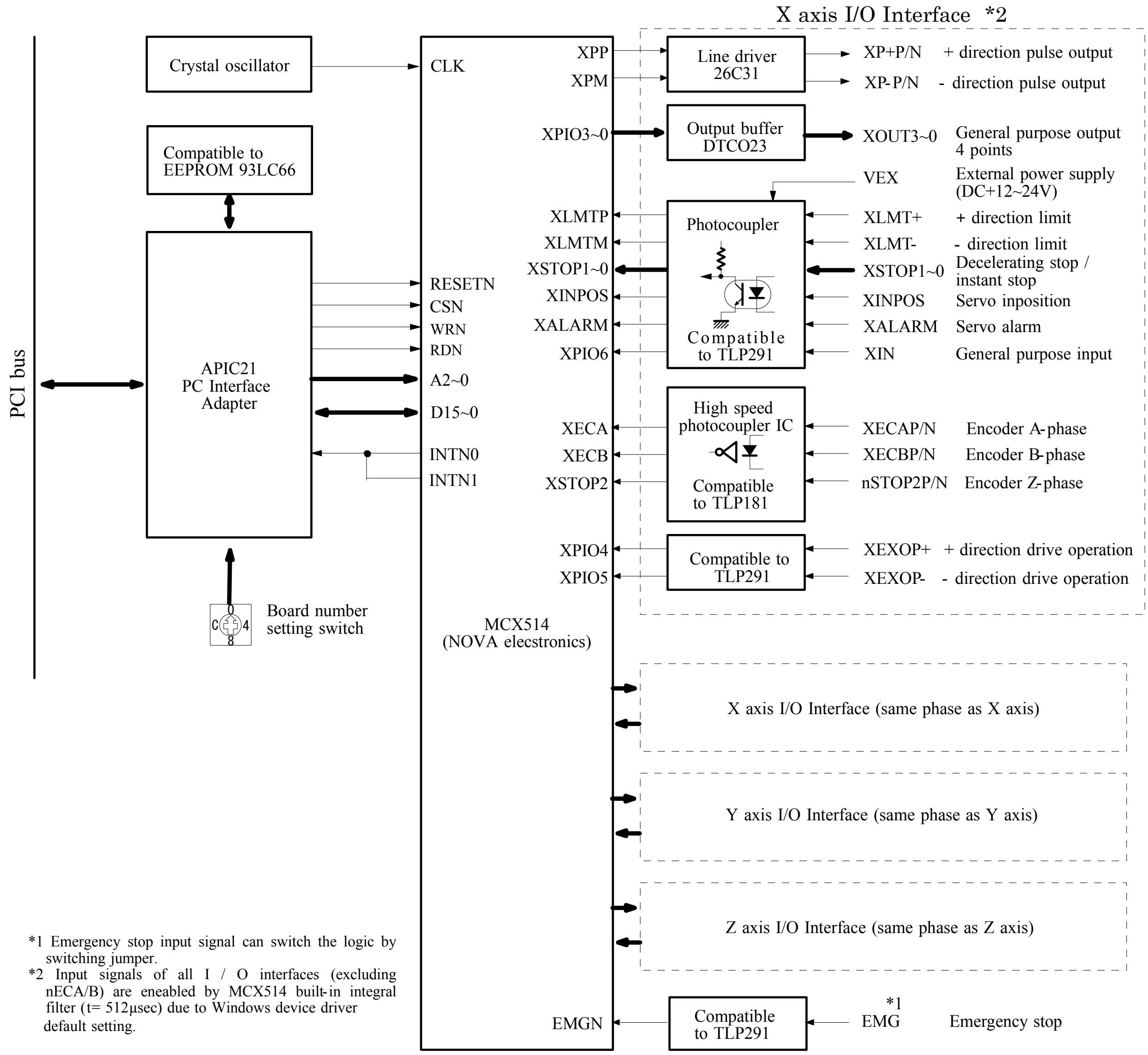
ATTENTION:

- 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

MC8541P is a PCI Bus circuit board equipped with high-function 4-axis motor control IC, MCX514. It can independently control 4 axes of either stepper motor or pulse type servo motor for position and speed control. For interpolation function, it is possible to perform 2 to 4 axes linear interpolation, circular interpolation, 2 to 4 axis bit pattern interpolation, and helical interpolation.

The figure below shows the functional block diagram of MC8541P. MC8541P consists of the PCI Bus interface and I / O interface circuits of the X, Y, Z and U axes, mainly with MCX514. Since all the basic functions of this circuit board are dependent on MCX514, please see MCX514 User's Manual for details of these function operations.



MC8541P circuit block diagram

1.1 Functional restrictions of MCX514

■ Data length
The data length is 16 bits. Read / write access in byte units cannot be accepted.

■ Interrupt signal
Use the IRQ determined by the Plug and Play function installed on Windows.

■ Input / output signal
In this board, the following input / output signals of MCX514 are not supported due to board surface size and the limitation of terminals of CN1 connector.

- I/O signal nPIO7
- Input signal EXPLSN
- Output signal nDCC
- Output signal nSPLTP
- PIN7~0 signal

Also, please note that the input / output signals, nPIO6 ~ nPIO0 are subjects to the following restrictions due to the circuit state of this board.

- Using nPIO3~nPIO0 as output signals.
- Using nPIO6~nPIO4 as input signals.

1.2 I/O interface of each axis

■ Drive pulse output (nP+P/N, nP-P/N)
Drive pulses in + / - direction for motor driving are output a duty of 50% from 1 PPS to 8 MPPS. Drive pulse output signals of each direction are the differential line-drive output of AM26C31 or equivalent.

■ General output (nOUT3~0)
Each axis has 4 points of general-purpose output. Output buffer uses DTC023YEB or equivalent and is open collector output. These signals can be used as a deviation counter clear, servo free and alarm reset for a servomotor.

■ General input (nIN)
Each axis has one general input signal. This signal is isolated from the internal circuit by a photocoupler.

■ Overrun limit input (nLMT +, nLMT-)
This is an input signal that prohibits output pulses in + /- direction. Instant stop / decelerating stop can be selected when active in mode setting. These input signals are isolated from the internal circuit by a photocoupler.

■ Decelerating stop / instant stop input (nSTOP2~0)
In home search, this input signal is to stop drive pulse in deceleration or immediately from outside. Enable / disable, active logical level can be selected in mode setting. Each axis has three input signals, also can be used as a general purpose input signal. This input signal is isolated from the internal circuit by a photocoupler.

■ Servo motor input (nINPOS, nALARM)
INPOS (in-position) signal and ALARM signal of servo motor driver. It can also be used as a general purpose input signal. This input signal is isolated from the internal circuit by a photocoupler.

■ Encoder input (nECAP/N, nECBP/N, nSTOP2P/N)
These signals input A/B-phase signal and Z-phase signal from an encoder. nECAP/N and nECBP/N signals are input signal for A/B phase signal of the encoder and count up / down 32-bit real position counter inside MCX514.
nSTOP2P/N is input signal for Z-phase to decelerating/ instant stop drive pulse. Theses input signals are isolated from the internal circuit by a high-speed photocoupler IC. It is easy to connect with the differential output line driver.

■ Driving by external input (nEXOP+, nEXOP-)

This signal externally controls driving in + /- direction. In fixed pulse driving mode, the specified drive pulse is output at the input signal triggers (the falling edge). In continuous pulse driving mode, drive pulses are 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 from the internal circuit by a photocoupler.

■ Emergency stop input (EMG)

This signal is an input signal for emergently stopping the drive of all axes. The active logical level can be set by jumper selection on the board. This input signal is isolated by the photocoupler from the internal circuit

1.3 Difference from MC8043P board

Although the pin assignment of MC8043P board and this board are the same, some functions are different.
In addition, MC8043P board carries motion control IC MCX314As, and this board has MCX514.
So the function settings are different, but the functions are improved.

■ Bus specification

Bus specification is the same such as "PCI Bus compliant".

■ Signal name:

[MC8043P]		[MC8541P]
● nIN0P input signal	→	nSTOP2P input signal
● nIN0N input signal	→	nSTOP2N input signal
● nIN1 input signal	→	nSTOP1 input signal
● nIN2 input signal	→	nSTOP0 input signal
● nIN3 input signal	→	nIN input signal

■ Difference in function

[MC8043P]		[MC8541P]
● Encoder Z-phase input signal can input to MCX314As/IN0 or IN2 switched by JP3.	→	Encoder Z-phase input signal is input to MCX514/nSTOP2. (Fixed.)
● nIN3 input signal can be used as general input signal and stop signal.	→	nIN input signal can be used as general input signal.
● Sink current of general output signal is 40mA.	→	Sink current of general output signal is 60mA
●Function details conform to MCX314As.	→	Function details conform to MCX514.

2. I / O address setting and Read / Write register

I/O port address of the board is determined by Windows Plug and Play function (PnP function) of PCI bus. The board requires serial 16 I/O address locations for PCI bus.
The table below shows the I/O address of Read/Write register in MCX514. Each register is 16-bit length. Please make sure to access by word. Access by byte is not possible. For details of each register, see MCX514 User's Manual, Chapter 6.

I/O Address	Write register		Read register	
	Symbol	Register name	Symbol	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
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
04	WR4	Output register 1	RR4	PIO read register 1
05	WR5	Output register 2	RR5	PIO read register 2
06	WR6	Write data register 1	RR6	Read data register 1
07	WR7	Write data register 2	RR7	Read data register 2

3. I / O signal

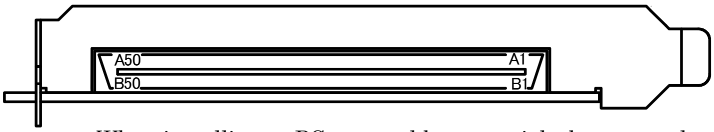
This chapter describes each input / output signal of CN1 connector.
In the explanation of the signal and the interface circuit, the signal name of each axis is described as n ○ ○ ○ ○, but "n" represents X, Y, Z, and U.

3.1 CN1 connector

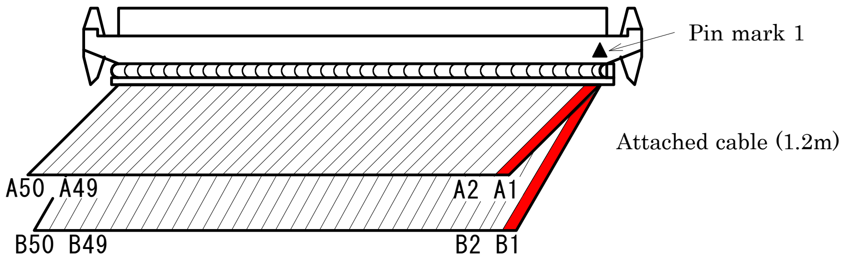
CN1 connector inputs the external power supply (DC+12 to 24 V) input and inputs / outputs the signals of each axis shown in the table below

Connector	Signal type	Signal name
CN1	Drive pulse direction output signal +/- Overrun limit direction input signal +/ - Decelerating stop / instant stop input signal 3 points In-position and alarm input signal for servo motor General input General output All axis emergency stop input signal Encoder input signal External drive operation signal	nP+P/N, nP-P/N nLMT+, nLMT- nSTOP0,nSTOP1,nSTOP2 nINPOS, nALARM nIN nOUT0～nOUT3 EMG nECAP/N,nECBP/N nEXOP+,nEXOP-

Pin assignment of CN1 connector



When installing to PC, top and bottom might be reversed



Sequence of signal is as pin mark 1 in the right upper side (triangle mark) of attachment cable, connector.

- Upper cable: From right (red line) to left: A1, A2, ... A49, A50
- Lower cable: From right (red line) to left: B1, B2, ... B 49, B50

Model of CN1 connector: Board side: FX2B-100PA-1.27DS (Hirose), Cable side: FX2B-100SA-1.27R (Hirose)

CAUTION: To prevent function failure or malfunction

□ Before inserting or removing a cable into / from the CN1 connector, please turn off the power supply of the cable(DC+12～24V)

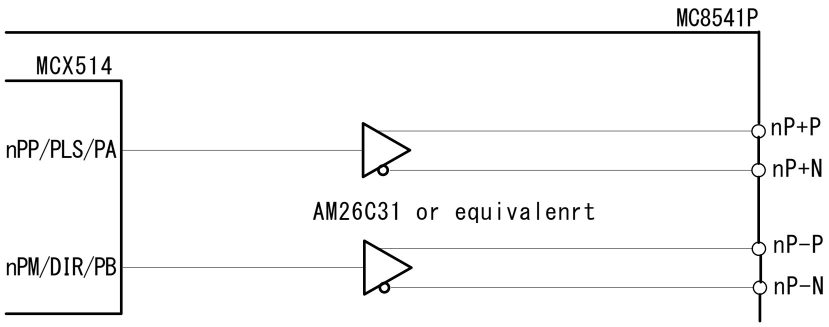
□ When inserting the cable, pay attention to the orientation of the connector and do not reverse it. If the power of personal computer or external supply is ON while connected, the internal circuit etc. of the board might be damaged.

□ CN1 connector

Pin	Signal name	I/O	Content	Description	Pin	Signal name	I/O	Content	Description
A1	VEX		External power supply (DC + 12 ~ 24 V)	3.10	B1	VEX		External power supply (DC + 12 ~ 24 V)	3.10
A2	EMG	Input	Emergency stop (common to all axis)	3.9	B2				
A3	XLMT+	Input	X axis + direction limit	3.4	B3	ZLMT+	Input	Z axis + direction limit	3.4
A4	XLMT-	Input	X axis - direction limit	3.4	B4	ZLMT-	Input	Z axis - direction limit	3.4
A5	XSTOP1	Input	X axis Decelerating stop /instant stop	3.5	B5	ZSTOP1	Input	Z axis Decelerating stop /instant stop	3.5
A6	XSTOP0	Input	X axis Decelerating stop /instant stop	3.5	B6	ZSTOP0	Input	Z axis Decelerating stop /instant stop	3.5
A7	XIN	Input	X axis general input	3.5	B7	ZIN	Input	Z axis general input	3.5
A8	YLMT+	Input	Y axis + direction limit	3.4	B8	ULMT+	Input	U axis + direction limit	3.4
A9	YLMT-	Input	Y axis - direction limit	3.4	B9	ULMT-	Input	U axis - direction limit	3.4
A10	YSTOP1	Input	Y axis Decelerating stop /instant stop	3.5	B10	USTOP1	Input	U axis Decelerating stop /instant stop	3.5
A11	YSTOP0	Input	Y axis Decelerating stop /instant stop	3.5	B11	USTOP0	Input	U axis Decelerating stop /instant stop	3.5
A12	YIN	Input	Y axis general input	3.5	B12	UIN	Input	U axis general input	3.5
A13	XINPOS	Input	X axis Servo in-position	3.6	B13	ZINPOS	Input	Z axis Servo in-position	3.6
A14	XALARM	Input	X axis servo alarm	3.6	B14	ZALARM	Input	Z axis servo alarm	3.6
A15	XECAP	Input	X axis encoder A phase	3.7	B15	ZECAP	Input	Z axis encoder A phase	3.7
A16	XECAN	Input	X axis encoder A phase	3.7	B16	ZECAN	Input	Z axis encoder A phase	3.7
A17	XECBP	Input	X axis encoder B phase	3.7	B17	ZECBP	Input	Z axis encoder B phase	3.7
A18	XECBN	Input	X axis encoder B phase	3.7	B18	ZECBN	Input	Z axis encoder B phase	3.7
A19	XSTOP2P	Input	X axis encoder Z phase	3.7	B19	ZSTOP2P	Input	Z axis encoder Z phase	3.7
A20	XSTOP2N	Input	X axis encoder Z phase	3.7	B20	ZSTOP2N	Input	Z axis encoder Z phase	3.7
A21	YINPOS	Input	Y axis Servo in-position	3.6	B21	UINPOS	Input	U axis Servo in-position	3.6
A22	YALARM	Input	Y axis servo alarm	3.6	B22	UALARM	Input	U axis servo alarm	3.6
A23	YECAP	Input	Y axis encoder A phase	3.7	B23	UECAP	Input	U axis encoder A phase	3.7
A24	YECAN	Input	Y axis encoder A phase	3.7	B24	UECAN	Input	U axis encoder A phase	3.7
A25	YECBP	Input	Y axis encoder B phase	3.7	B25	UECBP	Input	U axis encoder B phase	3.7
A26	YECBN	Input	Y axis encoder B phase	3.7	B26	UECBN	Input	U axis encoder B phase	3.7
A27	YSTOP2P	Input	Y axis encoder Z phase	3.7	B27	USTOP2P	Input	U axis encoder Z phase	3.7
A28	YSTOP2N	Input	Y axis encoder Z phase	3.7	B28	USTOP2N	Input	U axis encoder Z phase	3.7
A29	XEXOP+	Input	X axis + direction operation	3.8	B29	ZEXOP+	Input	Z axis + direction operation	3.8
A30	XEXOP-	Input	X axis - direction operation	3.8	B30	ZEXOP-	Input	Z axis - direction operation	3.8
A31	YEXOP+	Input	Y axis + direction operation	3.8	B31	UEXOP+	Input	U axis + direction operation	3.8
A32	YEXOP-	Input	Y axis - direction operation	3.8	B32	UEXOP-	Input	U axis - direction operation	3.8
A33	GND		Internal circuit GND		B33	GND		Internal circuit GND	
A34	XOUT0	Output	X axis general purpose output	3.3	B34	ZOUT0	Output	Z axis general purpose output	3.3
A35	XOUT1	Output	X axis general purpose output	3.3	B35	ZOUT1	Output	Z axis general purpose output	3.3
A36	XOUT2	Output	X axis general purpose output	3.3	B36	ZOUT2	Output	Z axis general purpose output	3.3
A37	XOUT3	Output	X axis general purpose output	3.3	B37	ZOUT3	Output	Z axis general purpose output	3.3
A38	XP+P	Output	X axis + direction drive pulse	3.2	B38	ZP+P	Output	Z axis + direction drive pulse	3.2
A39	XP+N	Output	X axis + direction drive pulse	3.2	B39	ZP+N	Output	Z axis + direction drive pulse	3.2
A40	XP-P	Output	X axis - direction drive pulse	3.2	B40	ZP-P	Output	Z axis - direction drive pulse	3.2
A41	XP-N	Output	X axis - direction drive pulse	3.2	B41	ZP-N	Output	Z axis - direction drive pulse	3.2
A42	GND	Output	Internal circuit GND		B42	GND		Internal circuit GND	
A43	YOUT0	Output	Y axis general purpose output	3.3	B43	UOUT0	Output	U axis general purpose output	3.3
A44	YOUT1	Output	Y axis general purpose output	3.3	B44	UOUT1	Output	U axis general purpose output	3.3
A45	YOUT2	Output	Y axis general purpose output	3.3	B45	UOUT2	Output	U axis general purpose output	3.3
A46	YOUT3	Output	Y axis general purpose output	3.3	B46	UOUT3	Output	U axis general purpose output	3.3
A47	YP+P	Output	Y axis + direction drive pulse	3.2	B47	UP+P	Output	U axis + direction drive pulse	3.2
A48	YP+N	Output	Y axis + direction drive pulse	3.2	B48	UP+N	Output	U axis + direction drive pulse	3.2
A49	YP-P	Output	Y axis - direction drive pulse	3.2	B49	UP-P	Output	U axis - direction drive pulse	3.2
A50	YP-N	Output	Y axis - direction drive pulse	3.2	B50	UP-N	Output	U axis - direction drive pulse	3.2

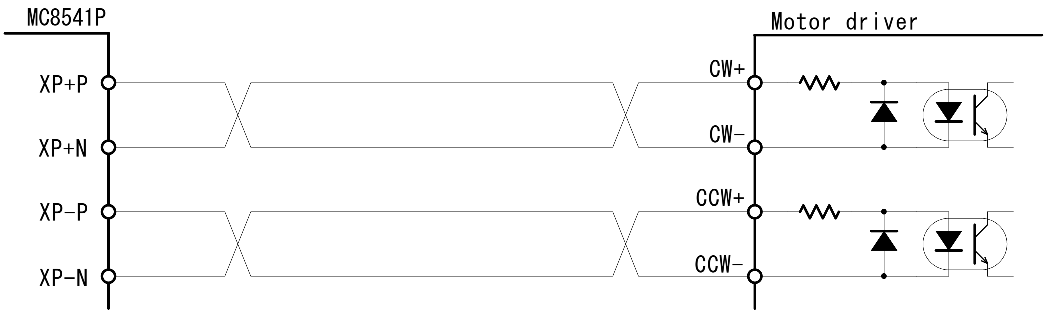
3.2 Drive pulse output signals (nP+P, nP+N, nP-P, nP-N)

Drive pulse output signal outputs the drive pulse of +/- direction of MCX514 via differential output line driver (equivalent to AM26C31). nP+N is the reverse output of nP+P, and nP-N is the reverse output of nP-P. At reset, the positive outputs (nP+P, nP-P) become low and the reverse outputs (nP+N, nP-N) become Hi.
Immediately after resetting, the drive pulse output is set to independent 2-pulse type, but it can also be changed to 1-pulse 1-direction type in mode setting. See chapters 2.12.2 and 6.7 of MCX514 User's Manual

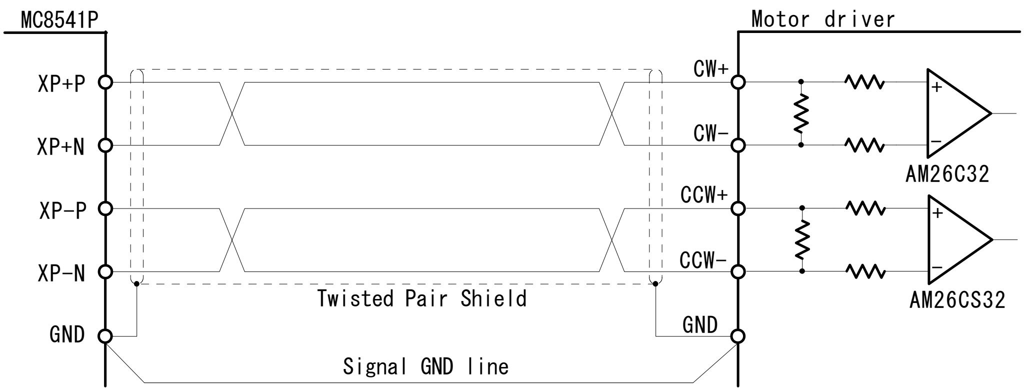


Drive pulse output circuit

The figure below shows an example of connection with a motor driver equipped with a photocoupler input circuit and a line receiver input circuit.



Connection example with motor driver of photo coupler input circuit



Connection example with motor driver of line receiver input circuit

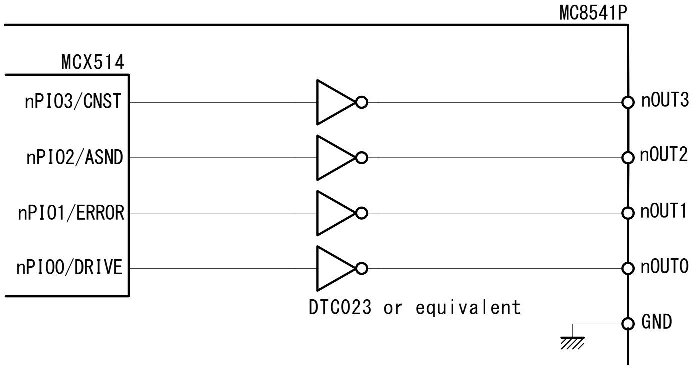
Cautions: When using line receiver input circuit

When using the line receiver input circuit, connect the line driver side and the motor driver side with signal GND line. If there is a potential difference between signals GND between the devices, the malfunction might happened and/or the driver circuit and the motor driver circuit might be damaged. Please use separate signal GND as shown above.

3.3 General-purpose output signal (nOUT3, nOUT2, nOUT1, nOUT0)

The general-purpose output signal is output from nPIO3, nPIO2, nPIO1 and nPIO0 of MCX514 via buffer (equivalent to DTC023YEB).

At reset, each output signal is OFF.



General purpose output signal circuit

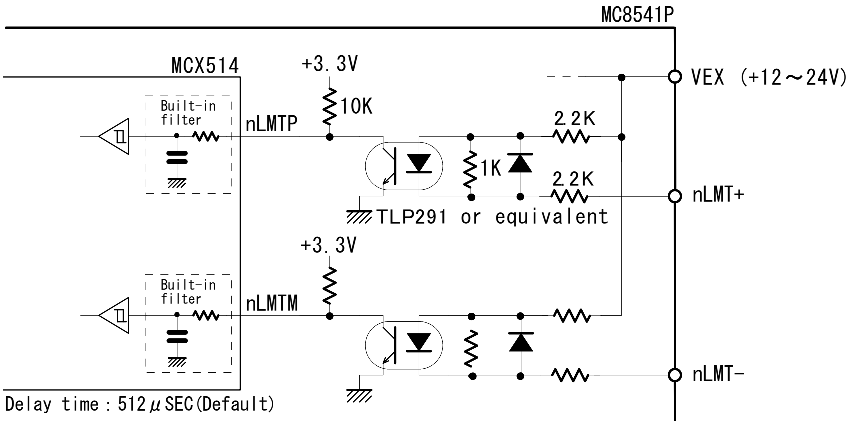
The general purpose output signal can be used for the motor driver's deviation counter clear, alarm reset, excitation OFF signal, etc.
Also, setting the "drive status output" function outputs the drive status (during driving / error occurrence / acceleration / constant speed drive).
For the setting of the general output signal, see chapters 2.8.1 and 7.3.2 of MCX514 User's Manual.

3.4 Overrun limit input signal (nLMT +, nLMT-)

This is an input signal to restrain each drive pulse in +/- direction. This input signal is connected to the limit input of MCX514 through a photocoupler. Immediately after resetting, the signal terminals (nLMT +, nLMT-) of MCX514 become active at low level, so the limit function is activated when current flows out from the terminal.
Enable / disable, logical level and instant stop / decelerating stop can be changed. For details of mode setting, see chapters 2.12.4, 6.6, and 6.7 of MCX514 User's Manual.

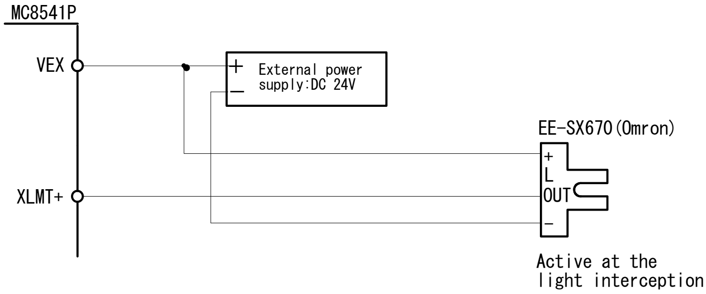
In order to operate this signal, it is necessary to supply DC + 12 to 24 V DC from the outside. Also, the integral filter built in MCX514 is set to the delay time of 512 μSEC. in the initial setting at the time of startup of Windows device driver supplied from NOVA electronics.
Depending on the noise environment of the system, this signal delay time can be changed. For details, refer to section 2.11 of MCX514 User's Manual.

In order to operate this signal, it is necessary to supply DC + 12 to 24 V DC from the outside. Also, the integral filter built in MCX514 is set to the delay time of 512 μSEC in the initial setting at the time of startup of Windows device driver supplied from NOVA electronics.
Depending on the noise environment of the system, this signal delay time can be changed. For details, see chapter 2.11 of MCX514 User's Manual.



Overrun limit input signal circuit

An example of connecting the overrun limit input signal to photomicrosensor is shown on the right. When 0 (reset mode) is set to D10 bit of X axis mode register2 (XWR2), 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.

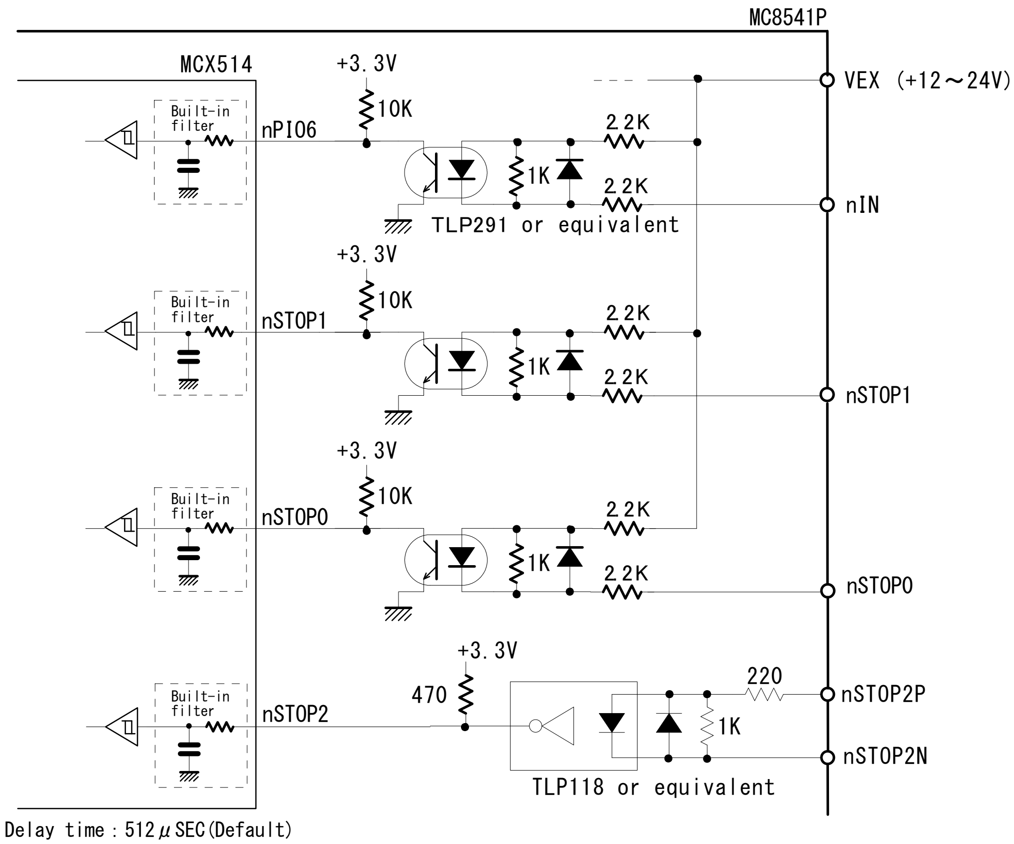
3.5 Stop input signal, home signal, general input signal (nSTOP2, nSTOP1, nSTOP0, nIN)

nSTOP2, nSTOP1 and nSTOP0 signals are input signal to stop drive pulse output in deceleration or immediately during driving. 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. For the details of the drive stop input signal, see chapter 6.6 of MCX514 User's Manual.

nSTOP2, nSTOP1 and nSTOP0 signals can be used as input signals such as encoder Z-phase, home and near home signal. For the details of automatic home search, see chapter 2.5 of MCX514 User's Manual.

nIN is general purpose input signal. For the details, see chapter 2.8.1 of MCX514 User's Manual.

In order to operate this signal, it is necessary to use supply DC+12~24V DC from the outside. In addition, the integration filter built in MCX514 is set to delay 512 μSEC in the initial setting when startup of Windows device driver supplied from NOVA electronics. Depending on the noise environment of the system, this signal delay time can be changed. For details, see chapter 2.11 of MCX514 User's Manual.



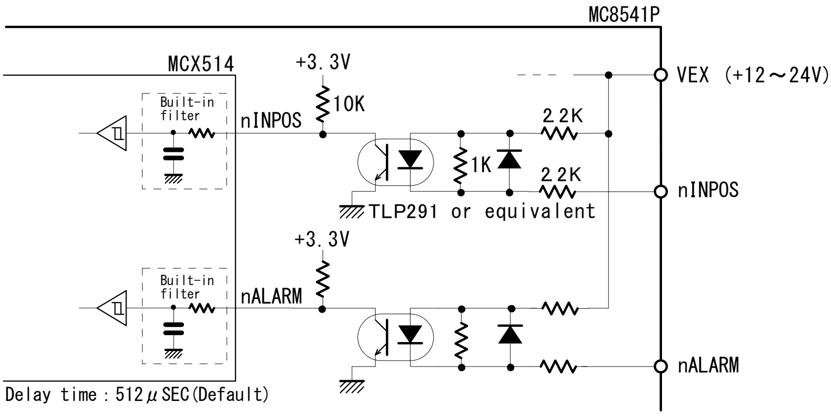
Stop input signal and origin input signal circuit

3.6 Input signal for servomotor (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 MCX514. 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 activated, driving stops immediately.

Immediately after resetting, both signals are disabled.
For more details, see chapter 2.12.5 and 6.6 of MCX514 user's manual.



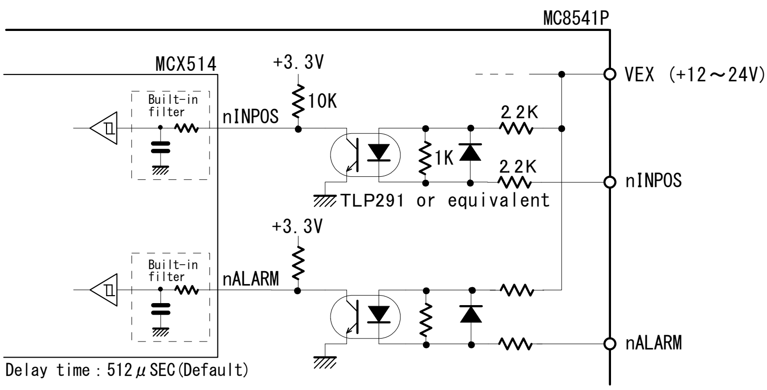
Servo Motor Input Signal Circuit

In order to operate this signal, it is necessary to use supply DC+12~24V DC from the outside. In addition, the integration filter built in MCX514 is set to delay 512 μSEC in the initial setting when startup of Windows device driver supplied from NOVA electronics. Depending on the noise environment of the system, this signal delay time can be changed. For details, see chapter 2.11 of MCX514 User's Manual.
Also, since the input signal for the servo motor can always read the signal state with the input register, it can also be used as a general purpose input.

3.7 Encoder input signal (nECAP,nECAN,nECBP,nECBN,nSTOP2P,nSTOP2N)

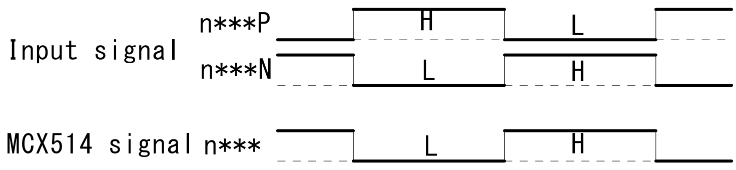
nECAP/N and nECBP/N are input signals to count a real position counter of MCX514 by connecting to the 2-phase output signal of an encoder or that of a servo motor driver. For more details, see chapters 2.3.1, 2.12.5 and 6.7 of MCX514 user's manual.

nSTOP2P/N is input signal to stop drive pulse output by connecting to 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. And, the interface circuit for the encoder Z-phase (high-speed photo coupler TLP118) is connected and automatic home search function of MCX514 can be used.
For more details of automatic home search, see chapter 2.5 of MCX514 user's manual.

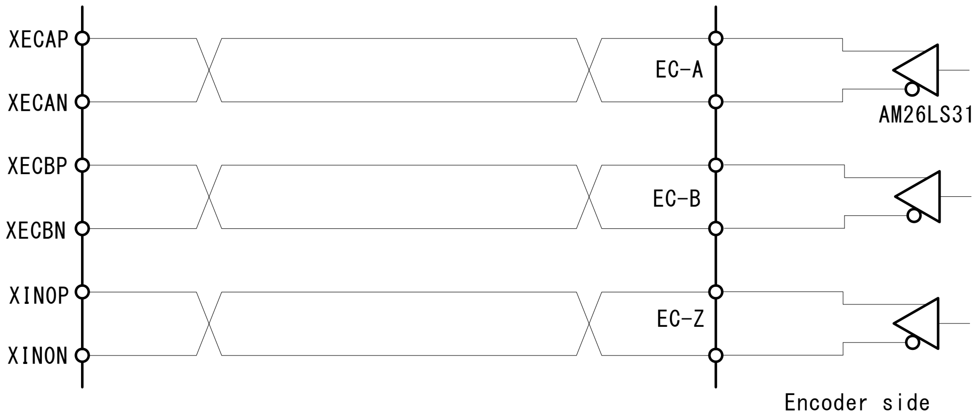


Encoder input signal circuit

As shown in the last figure, the encoder input signal circuit uses the high-speed photocoupler IC TLP118 (Toshiba). Each input signal can be directly connected with a line driver with differential output. As shown in the figure below, when the n *** P/N signal is H/L, the n *** signal of MCX514 becomes low, and when the signal is L/H, it becomes Hi. Since the delay time from the input to MCX514 signal terminal is 100 nSEC. or less, it can count up to 8 MHz maximum for 2 phase pulse input with quad count edge evaluation.

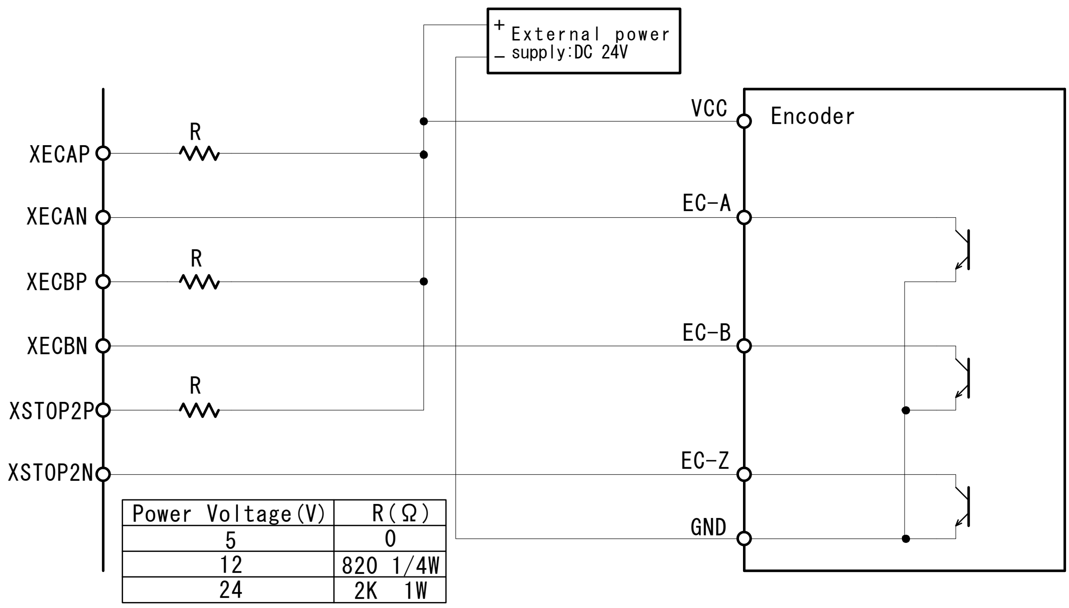


The figure below shows an example of connection between the encoder input signal and the differential output line driver.



Connection example with line driver of differential output

The figure below shows an example of connecting the encoder input signal and the open collector output encoder.



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

Connection example with open collector output

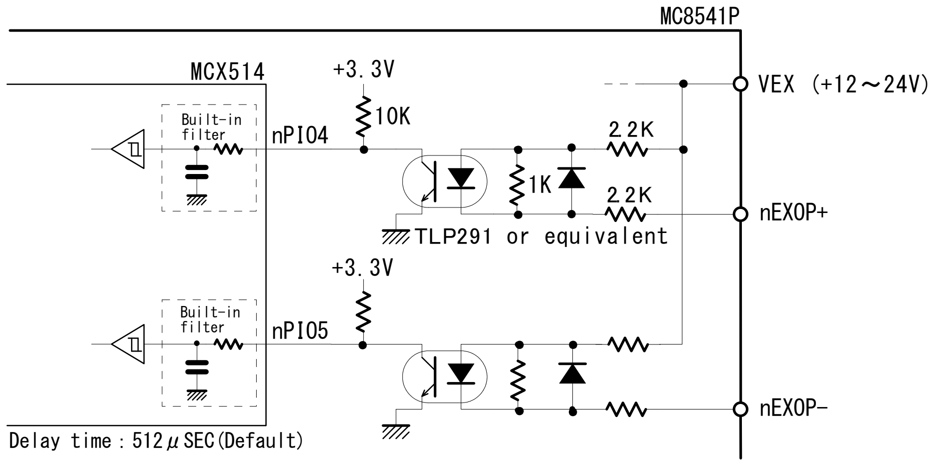
[Note for Z-phase search]
■Drive speed for Z-phase search.
512μsec is set to the delay time of built-in filter of nSTOP2 signal as default setting at power on.
In addition to this, there is the delay time of photocoupler, it needs to set drive speed to search Z-phase so that Z-phase signal becomes active for 1mSEC. or more.
It also can search by the higher speed by disabling the built-in filter of nSTOP2 signal when noise environment is better.

■Z-phase search start position
In automatic home search of MCX514, the function stops search driving when Z-phase signal (nSTOP2) changes from inactive to active. Therefore, Z-phase search starting position must be stable and different from this change point. Normally, adjust mechanically so that the starting position becomes 180° opposite side to encoder Z-phase position.

3.8 Driving by external signal (nEXOP+, nEXOP-)

This is input signal to activate + / - direction drive from the outside.
In fixed pulse drive mode, the specified drive pulse is output at the trigger (falling edge) of the input signal.
In continuous pulse drive mode, drive pulses are continuously output while the input signal is low level. For manual jog feed etc. of each axis, axis feed operation is possible without CPU intervention. In order to enable the external drive signal, MCX514 mode setting is required. For details, see chapters 2.12.1, 7.3.2, and 7.3.3 of MCX514 User's Manual.

In order to operate this signal, it is necessary to use supply DC+12~24V DC from the outside. In addition, the integration filter built in MCX514 is set to delay 512 μSEC. in initial setting when startup of Windows device driver supplied from NOVA electronics. Depending on the noise environment of the system, this signal delay time can be changed. For details, see chapter 2.11 of MCX514 User's Manual.



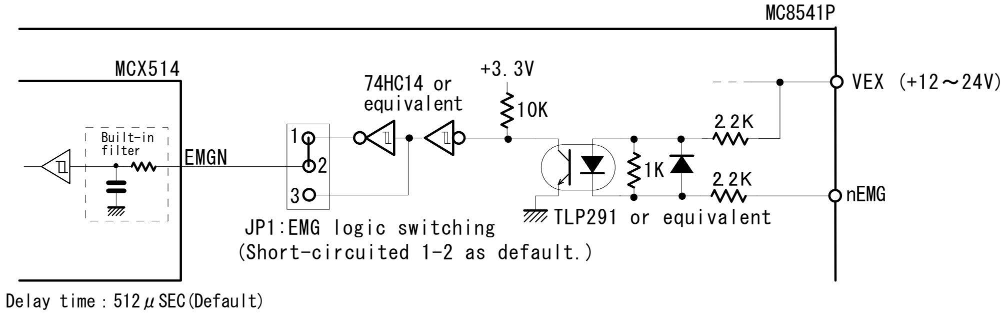
External drive operation signal circuit

3.9 Emergency stop input signal (EMG)

Drive pulse output of all axes stops when the emergency stop signal becomes active level. The active level can be switched with JP2 jumper terminal on the board. When the emergency stop signal becomes active during drive, the drive of all axes stops immediately, and 1 is set in the error bit of all axes of the main status register. For the emergency stop of MCX514, see chapter 2.12.6 of MCX514 User's Manual.

JP2:1-2 Short-circuit: Emergency stop signal (EMG) active when it is short-circuited with GND of the external power supply.
JP2:2-3 Short-circuit: Emergency stop signal (EMG) active when it becomes open state.

JP2:1-2 Short-circuit is factory setting.



Emergency stop input signal circuit

In order to operate this signal, it is necessary to use supply DC+12~24V DC from the outside. In addition, the integration filter built in MCX514 is set to delay 512 μSEC. in initial setting when startup of Windows device driver supplied from NOVA electronics. Depending on the noise environment of the system, this signal delay time can be changed. For details, see chapter 2.11 of MCX514 User's Manual.

3.10 External power supply (VEX)

The external power supply activates overrun limit input signals (nLMT+, nLMT-) for each axis, decelerating stop / instant stop input signals (nSTOP0, nSTOP1, nSTOP2), input signals for servo motors (nINPOS, nALARM), external drive operation signals (nEXOP + , NEXOP-), general input and emergency stop input signal (EMG). Current consumption per one input signal is about 2mA for DC+12V and about 5mA for DC+24V.

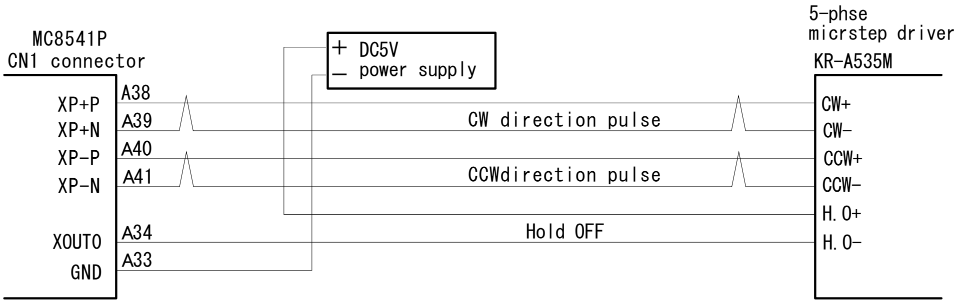
4. Interrupt

On this board, the interrupt signals (INTN 0, INTN 1) generated from MCX514 are collectively output (OR condition) to the host CPU.
The interrupt signal is canceled by reading MCX514 status register RR1 of the axis where the interrupt occurred.
For details, see chapter 2.10 of MCX514 User's Manual.
Application programs that use interrupts should be created with VC. Please note that interrupt signal cannot be created by VB program.

5. Motor driver connection example

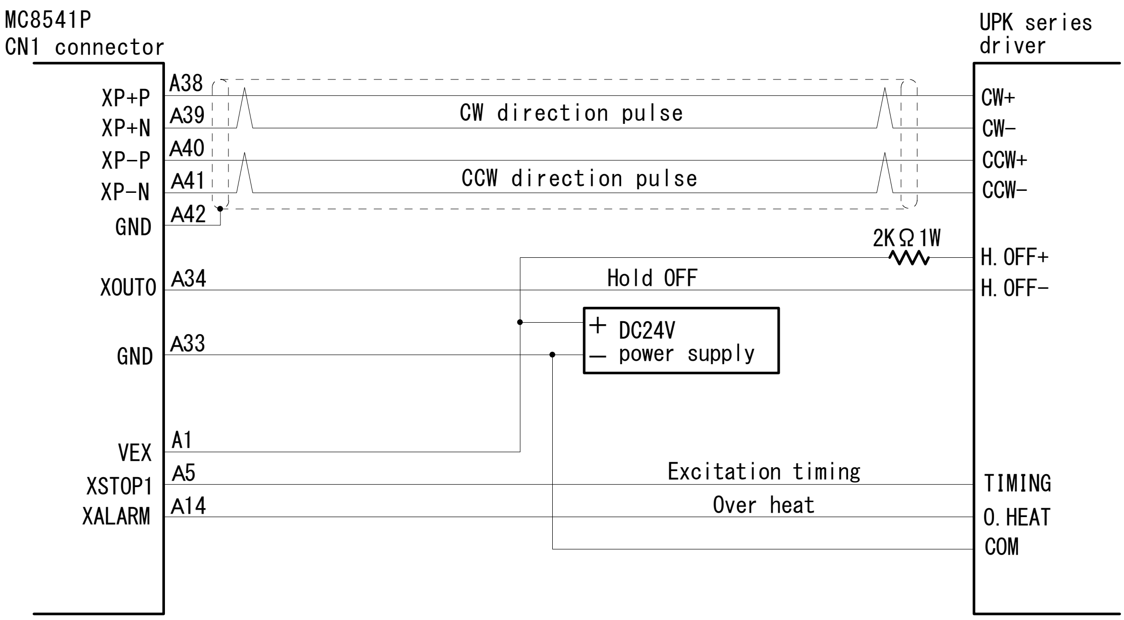
5.1 Connection example with stepping motor driver

The figure below shows an example connection between X axis of MC8541P and 5-phase microstep driver KR-A535M made by Techno Drive.



Note 1: Using hold OFF signal if necessary. When using XOUT0 output signal as hold OFF, it can be controlled writing 0, 1 into D0 bit of WR4 register of MCX514.

The figure below shows a connection example between X axis of MC8541P and stepping motor driver of UPK series made by Oriental Motor.

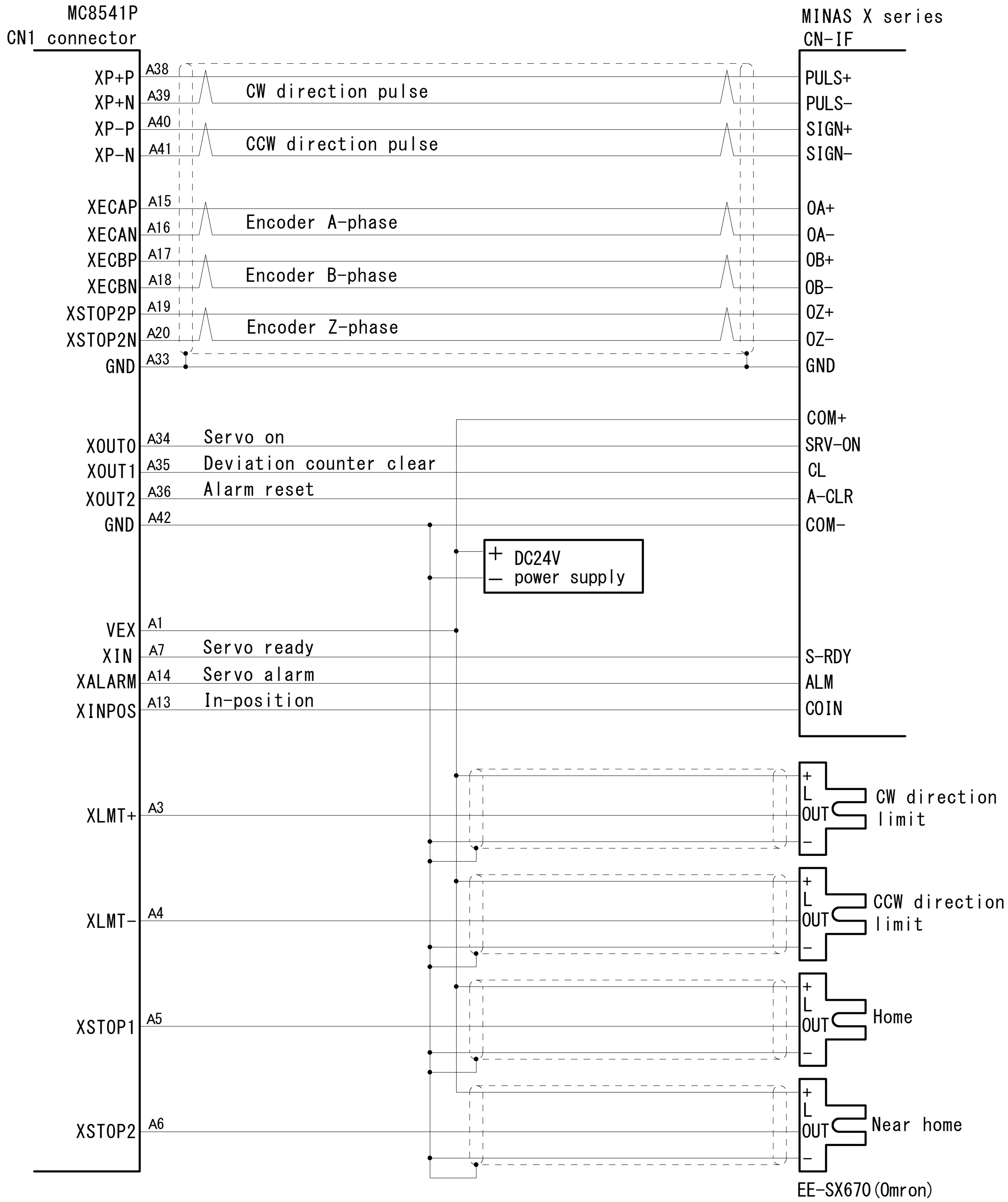


Note 1: Wiring hold OFF, excitation timing, overheat signal if necessary. When using XOUT0 output signal as hold OFF, it can be controlled writing 0, 1 into D0 bit of WR4 register of MCX514.
Excitation timing signal can execute home search by setting D0, 1 bit of WR1 register.
Over heat signal can activate alarm function by setting D9, 8 bit of WR2 register.
For the excitation timing and overheat signal, the signal level can be directly read through RR3 register.

Note 2: When under strong noise environment or the distance to the driver is long, twisted pair shielded wire is recommended as shown above.

5.2 Connection example with AC servo motor driver

The figure below shows an example of connection between X axis of MC8541P and the MINAS X series AC servomotor driver.



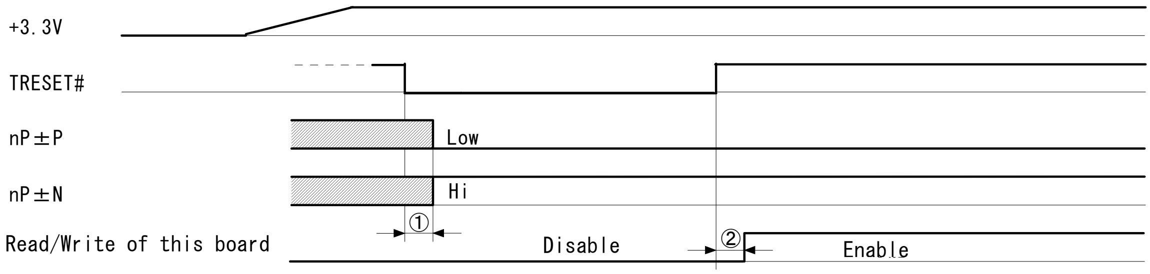
Note 1: Set the driver control mode to position control mode and the command pulse mode to CW/CCW pulse mode. If the command pulse form is set to pulse/code mode, it will not be suitable as it will run short of t6 time.

Note 2: Encoder A/B-phase signal is connected when counting the real position counter inside MCX514. If the real position data on the CPU side isn't needed, you don't need to connect. Connect other signals as necessary.

Note 3: When under strong noise environment or the distance to the driver is long, twisted pair shielded wire is recommended as shown above.

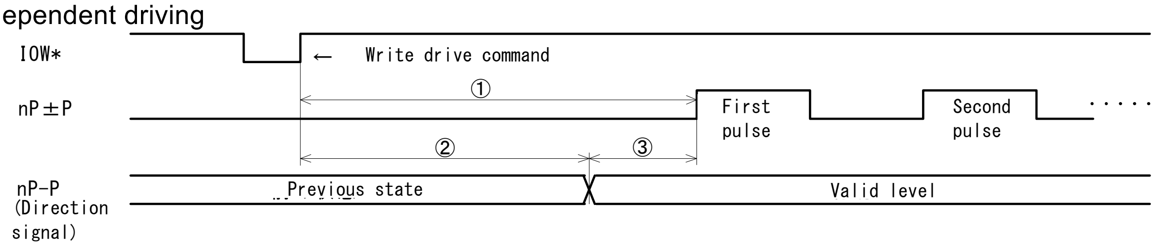
6. I / O signal timing

6.1 Reset



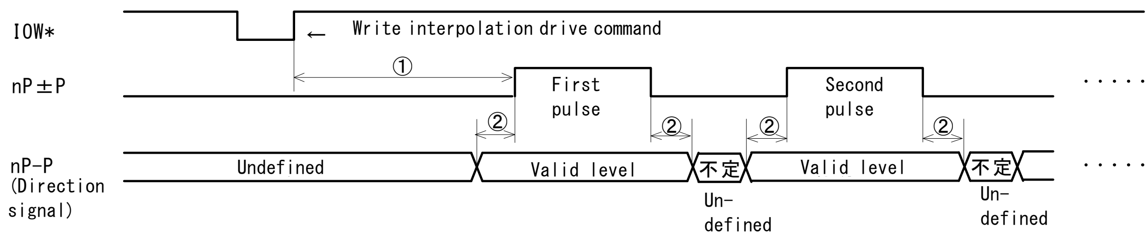
① The drive pulse output signal (nP± P, nP±N) is determined within 375nSEC maximum from ↓ of the target reset signal (TRESET #) of APIC21
② Writing / reading to / from this board is enabled after 250nSEC from ↑ of target reset signal (TRESET #).

6.2 Independent driving



① The first drive pulse is output within 250nSEC maximum after the drive command is written.
② When the drive output pulse type is set to 1 pulse type, the direction signal (nP-P) becomes valid level within 187.5nSEC maximum after writing the drive command and another 62.5nSEC later, the first drive pulse is output.

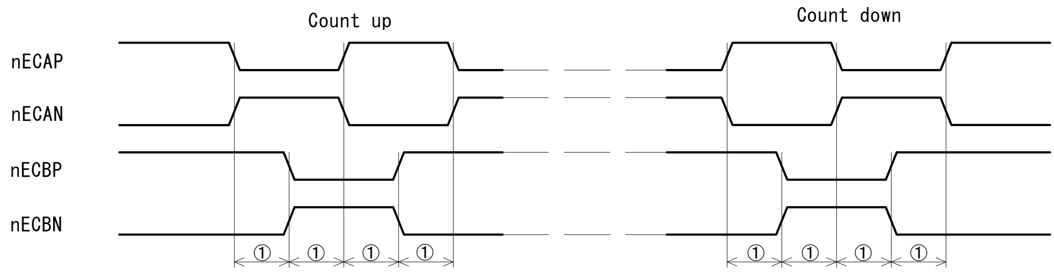
6.3 Interpolation



①The first drive pulse is output within 250nSEC maximum after the interpolation drive command is written
②When the drive output pulse type is set to 1 pulse type, the direction signal (nP-P) becomes valid level while drive pulse is Hi level and 62.5nSEC before and after Hi level. (When the drive pulse is positive logic level)

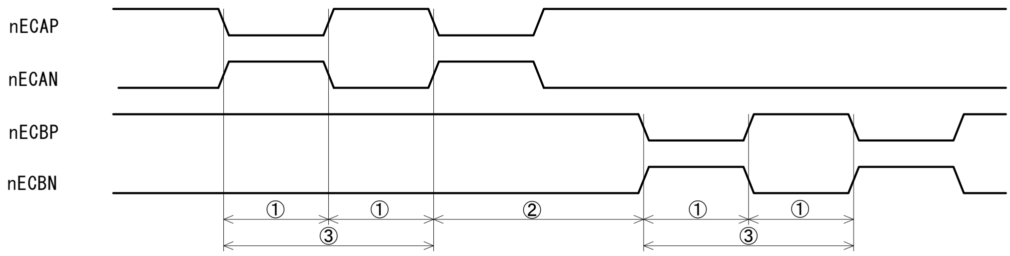
6.4 Input pulse timing

■ Encoder 2-phase pulse input



① (phase differential time between EC-A, EC-B) : 100nSEC minimum

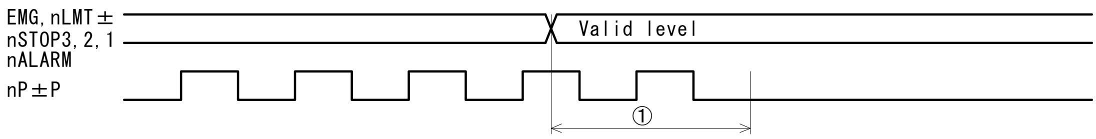
■ Up/down pulse input



① (UP/DOWN pulse width) : 100nSEC minimum ② (Between UP⇔DOWN pulse) : 200nSEC minimum
③ (UP/DOWN pulse cycle) : 200nSEC minimum

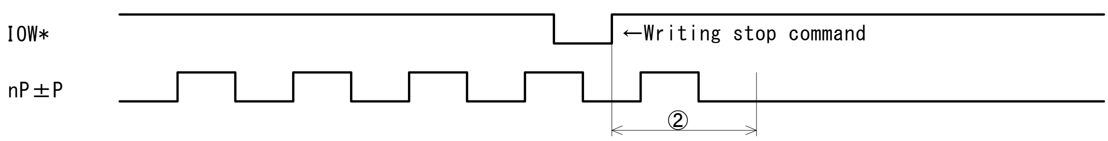
6.5 Instant stop timing

■ Instant stop by external signal



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

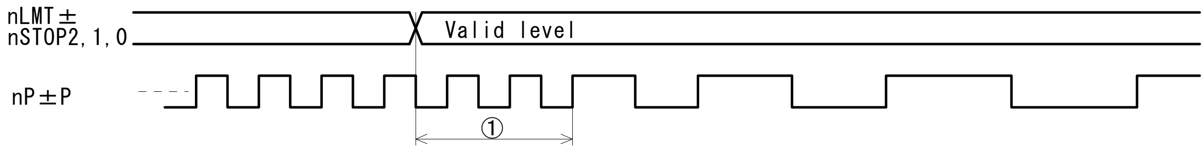
■ Instant stop by command



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

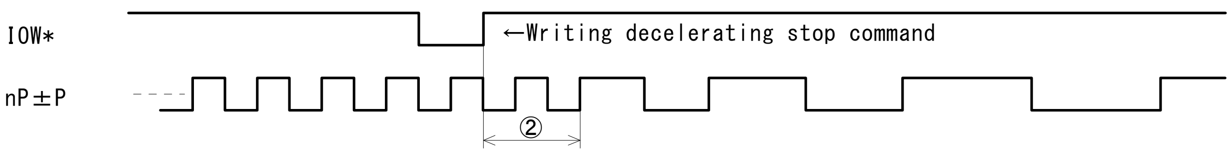
6.6 Decelerating stop timing

■ Decelerating stop by external signal



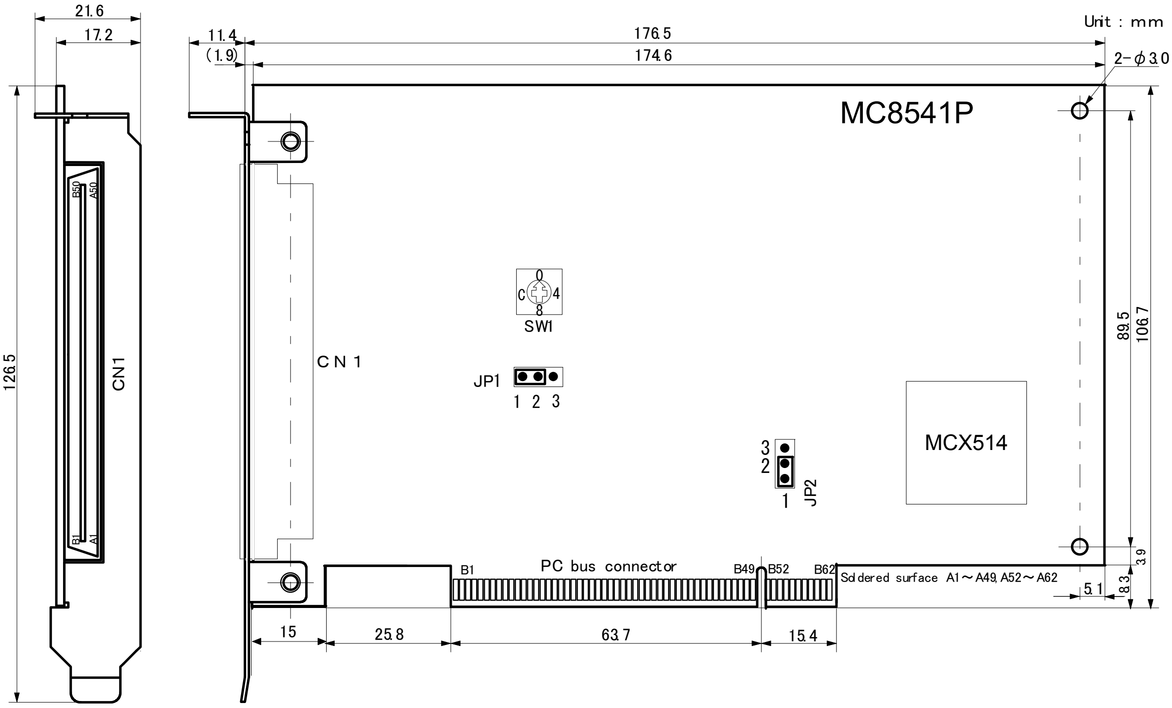
① When an external decelerating stop signal becomes valid level during driving, deceleration driving starts after photocoupler delay time (100µsec max.) + the delay time of IC built-in integral filter (512µsec default) + 2 drive pulses.

■ Decelerating stop by command



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

7. Board dimensions



JP1: Emergency stop signal (EMG) active logic is selected
Short circuit 1-2 (factory setting): Short the signal to GND and it becomes active
Short circuit 2-3: It becomes active with signal open

JP2: Keep short circuit 1-2 the same as factory setting

SW1: It is a rotary switch that sets the board number when using multiple boards.
You can set the value of 0-F (factory setting: 0)

8. Setting method of the input / output signal

In order to use the function of each input / output signal, it is necessary to set it in MCX514, motion control IC. The table below describes the setting items and main contents. For more details, see MCX514 User's Manual.

Signal name	Setting overview In ( ) is initial setting	MCX514 User Manual
Drive pulse Output signal	WR3 / D4, D3 drive pulse output type (00: independent 2 pulses) D5: Logical level (0: Positive logic) D6: 1 pulse · direction type Logical level of direction output signal (0) D7: Switching drive pulse output terminals (0)	· 2.12.2 Pulse Output Type Selection · 6.7 Mode Register3: WR3
General purpose output signal	· Function setting command: PIO signal setting1 command (21h) · WR6 / D1, D0 n PIO0 setting (01: general purpose output) D3, D2 nPIO1 setting (01: general output) D5, D4 nPIO2 setting (01: general output) D7, D6 nPIO3 setting (01: general output) ·Also available as drive status output, sync pulse, MRm compare output. · Since it is a general purpose output circuit, do not set it for "general purpose input".	· 2.8.1 nPIOm signal · 7.3.1 Multi-purpose register mode Setting · 7.3.2 PIO signal setting1 · 7.3.3 PIO signal setting2
Overrun limit input signal	· WR2/D10 nLMTP, nLMTM logical level (0: Low active) D11 nLMTP, nLMTM Disabled / Enabled (1: Enabled) D12 Drive stop type (0: instant stop) · Switching WR3/D12 input terminals (0)	· 2.12.4 Hardware Limit Signals · 6.6 Mode Register2: WR2 · 6.7 Mode Register3: WR3
Stop input signal	· WR2/D0 n STOP 0 logical level (0: Low active) D1 When using nSTOP0 = enabled (0: Disabled) D2 nSTOP1 Logical level (0: Low active) D3 When using nSTOP1 = enabled (0: Disabled) D4 nSTOP2 Logical level (0: Low active) D5 When using nSTOP2 = Enable (0: Disabled)	·6.6 Mode Register2: WR2
Home signal	· WR2/D0 n STOP0 logical level (0: Low active) D1 When using nSTOP0 = disabled (0: Disabled) D2 nSTOP1 Logical level (0: Low active) D3 When using nSTOP1 = disabled (0: Disabled) D4 nSTOP2 Logical level (0: Low active) D5 When using nSTOP2 = disabled (0: Disabled) · Function setting command: 05h STEP1, STEP4 Drive speed setting 14h STEP2, STEP3 Drive speed setting 23h Automatic home search mode setting1 24h Automatic home search mode setting2	·6.6 Mode Register2: WR2 · 2.5 Automatic home search · 7.2.6 Drive speed setting · 7.2.21 Home Search Speed Setting · 7.3.4 Automatic Home Search Mode Setting 1 · 7.3.5 Automatic Home Search Mode Setting 2
General purpose input signal	· Function setting command: PIO signal setting 1 command(21h) · WR6/ D13, D12 nPIO6 setting (00:General purpose input) · Since it is a general purpose input circuit, do not set it for "general purpose output".	·2.8.1 nPIOm Signal ·7.3.2 PIO Signal Setting 1
Input signal for servo motors	·WR2/D6 nINPOS logical level (0: Low active) D7 nINPOS disabled / enabled (0: disabled) D8 nALARM Logical level (0: Low active) D9 nALARM disabled / enabled (0: disabled)	· 6.6 Mode Register2: WR2
Encoder input signal	· WR3/D9, D8 nECA, nECB pulse type (00:2-phase pulse input ,4 quad count edge evaluation) D10 nECA, nECB positive logic / negative logic (0:	· 2.12.3 Encoder Pulse Input Type Selection

	positive logic) D11 Switching input terminal (0)	
External drive operation signal	· Function setting command: PIO signal setting 1 command (21h) · WR6/D9, D8 nPIO4 setting (00: general purpose input) D11, D10 nPIO5 setting (00: general purpose input) · Since it is an input circuit, do not set it for "general purpose output" · Function setting command: PIO signal setting 2 command (22h) · WR6/ D9, D8 External drive operation mode setting (00)	· 2.12.1 Driving by external pulses · 7.3.2 PIO signal setting 1 · 7.3.3 PIO signal setting 2
Emergency stop input signal	· EMG logical level (JP1/1-2 short circuit) JP1/1-2 short-circuit on the board: Short the signal to GND and activate it JP1/2-3 short circuit on board: activate with signal open	· 2.12.6 Emergency stop

9. Specifications

Control specifications

- Control Axis 4 axes (Independent/simultaneous)
- Interface PCI bus
- Data bit width 16 Bit (data bus of MCX514)
- Occupied I/O Address is determined by PnP
- Interrupt Connected by PnP.
- Number of control units 16 (Rotary switch determines board number (0 to F))

Interpolation Functions

- Interpolation type 2 to 4-axis linear interpolation, CW/CCW circular interpolation, 2 to 4-axis bit pattern interpolation, CW/CCW helical interpolation
- Interpolation range Each axis -2, 147, 483, 646 to +2, 147, 483, 646 drive pulse
- Interpolation speed 1 PPS to 8 MPPS (*1)
- Interpolation position accuracy ± 0.5 LSB or less (linear interpolation), ± 1 LSB or less (circular interpolation)
- Functions related to interpolation arbitrary axis selectable, short axis pulse equalization, constant vector speed, continuous interpolation

XYZU common specification for each axis

■ **Drive pulse output**

- Output circuit: differential line driver (AM26C31) output
- Output Speed Range: 1 PPS to 8 MPPS
- Initial speed range: 1 PPS to 8 MPPS
- Output Speed Accuracy: ± 0.1% or less (compared to set value)
- Acceleration / Deceleration Range: 1 PPS/SEC ~ 536, 870, 911 PPS/SEC
- Acceleration / Deceleration Increase/decrease Rate: 1 PPS/SEC 2 to 1,073, 741, 823 PPS/SEC 2 (* 2)
- Output pulse range: -2, 147, 483, 646 to +2, 147, 483, 646 drive pulse (relative position / absolute position drive)
- Acceleration / deceleration curve: Constant speed, symmetrical / non-symmetrical linear acceleration / deceleration, symmetrical / non-symmetric S-curve acceleration / deceleration
- Position drive decelerating stop mode: Automatic Decelerating stop / Manual Decelerating stop
- Override: The number of output pulses and the drive speed during drive can be changed
- Type of drive command: relative position, absolute position, + direction continuous, - direction continuous
- Triangle prevention function: Available for both linear acceleration / deceleration and S-curve acceleration / deceleration
- Drive pulse output type: Independent 2-pulse, 1-pulse·1-direction, 2-phase quad-edge evaluation, 2- phase double-edge evaluation selectable
- Drive pulse output logic: Positive logic / negative logic output selectable
- Drive pulse output terminal: Capable of exchanging terminals

■ **Encoder A phase / B phase input**

- Input circuit: High speed photocoupler input. Connectable with differential line driver.
- Input pulse input type: 2-phase quad-edge evaluation, 2-phase double-edge evaluation, 2-phase single-edge evaluation, up/down pulse type selectable
- Input pulse terminal: Capable of exchanging terminals

■ **Automatic home search**

- Sequence: STEP1 High-speed home search → STEP2 Low speed home search→ STEP3 Encoder Z phase search → STEP 4 Offset drive
- Setting: Enable / disable of each step, selectable search direction.
- Timer between steps: Select from 1 msec to 1,000 msec

■ Position counter

- Logical position counter: Count range: -2, 147, 483, 648 to +2, 147, 483, 647 drive pulse (for output pulse)
- Real position counter: Count range: -2, 147, 483, 648 to +2, 147, 483, 647 pulse (for input pulse)
- Variable ring: The maximum count value of each counter can be set.

■ Software limit

- Setting range: -2, 147, 483, 647 to +2, 147, 483, 647 pulse
- Stop mode: Decelerating stop / Instant stop selectable

■ Multi-purpose register

- Bit length · Number: Each axis 32 bits length · 4 pieces
- Usage: Compare or save position, speed and timer value, load position and speed.

■ Timer

- Number of functions: 1 per axis
- Setting range: 1 to 2, 147, 483, 647 μSEC

■ Synchronous action

- Number of sets: 4 sets per axis
- Activation Factor:
  - When multipurpose register comparison change
  - Comparison object: logical / real position counter value, current speed value, current timer value
  - Comparison condition: ≧,>, =, <
  - When timer is up
  - When starting / ending the drive, when starting / ending the constant speed area in acceleration / deceleration drive, synchronous action activate command
  - Split pulse output (* 3)

- Action:
  - Load value (MRm → set value):
    Drive speed, moving pulse number (finish point), logical position counter value, real position counter value, initial speed, acceleration
  - Save value (MRm ← current value):
    Logical position counter value, real position counter value, current timer value, current drive speed, current acceleration / deceleration
  - Relative / absolute position drive start, +/- direction continuous drive start
  - Relative / absolute position drive activation with position data set to MRm
  - Drive Decelerating stop / instant stop, speed increase / decrease, timer start / stop
  - Synchronous pulse output to external
- Activate other SYNC sets: Activation setting of other three sets of own axis can be set
- Activate SYNC 0 of other axes: Activation setting of SYNC 0 of the other axis can be set.
- Repeat: Once / repeat setting of synchronous operation can be set.

■ Interrupt function

- Number of Signal: 1 (Including Interruption of Each Axis and Continuous Interpolation Drive Interrupt)
- Enable / Disable: Enable / disable of each interrupt factor selectable.
- Interrupt factors:
  - When multi-purpose register comparison change
  - Comparative object: logical / real position counter value, current speed value, current timer value
  - Comparison condition: ≧,>, =, <
  - When starting / ending the drive, when starting / stopping the constant speed area in acceleration / deceleration drive
  - When automatic home search is completed, when a timer is up.
  - Synchronous action 0/1/2/3 is activated.

■External signal for driving

- Signal type: Relative position / continuous driving can be executed with EXOP +, EXOP- signal.
- Manual pulsar function: Encoder input: 2-phase single-edge evaluation

● Input Circuit: Photocoupler + IC Built-in Integral Filter Circuit

■ **External stop signal**
● Number of Signal: 3 points per axis (STOP 0 ~ 2)
● Enable / Disable: Enable / disable of stop signal function selectable. It can also be used as a general purpose input.
● Logical level: Low active / Hi active selectable
● Stop mode: Drive deceleration stops in active. (Instant stop at the initial speed or less)
● Input Circuit: Photocoupler + integrated integral filter circuit with IC.

■ **Input signal for servomotor**
● Signal type: ALARM (alarm), INPOS (in-position)
● Enable / Disable: enable / disable of stop signal function selectable.
● Logic level: Low active / Hi active selectable.
● Input Circuit: Photocoupler + IC Built-in Integral Filter Circuit

■ **General purpose output signal**
● Number of Signal: 4 points per axis (OUT0 ~ 3)
● Output circuit: open collector output, output voltage: 30V max, sink current: 60mA max

■ **General purpose input signal**
● Number of Signal: 1 point per axis (IN)
● Input Circuit: Photocoupler + IC Built-in Integral Filter Circuit

■ **Overrun limit signal input**
● Number of Signal: 2 points per axis (+ direction, - direction one point each)
● Enable / disable: Enable / disable of limit function selectable
● Logical level: Low active / Hi active selectable
● Stop mode: Instant stop / Decelerating stop selectable in active.
● Input pulse terminals: Can be replaced
● Input Circuit: Photocoupler + IC Built-in Integral Filter Circuit

■ **Emergency stop signal input**
● Number of signal: EMGN 1 point for all axes. Immediately stops all axes drive pulse.
● Logical level: Logical level selectable by jumper on a board
● Input Circuit: Photocoupler + IC Built-in integral filter circuit

■ **Built-in integral filter**
● Input Signal Filter: Equipped with an integral filter in the input column of each input signal
● Time constant: Selectable from 16 types (500 nSEC to 16 msec)
● Enable / Disable: Enable / disable of integral filter function selectable.

Others
● Operating temperature: 0 ° C to + 45 ° C (noncondensing)
● Power voltage: + 5V ± 5%
● Consumption current: Max 700 mA (with drive current of 15 mA / axis for all 4 axes drive)
● External power supply voltage: + 12 to 24 V
● External dimensions of board: 174.6 × 106.7 mm (excluding connectors and metal parts)
● I/O connector : FX2B-100PA-1.27DS (Hirose)
● Accessory: FX2B-100SA-1.27R (Hirose) with 1.2m cable

* 1: Bit pattern interpolation up to 4 MPPS, helical interpolation up to 250KPPS, continuous interpolation up to 4 MPPS.
* 2: This parameter is used for S-curve acceleration / deceleration drive.
* 3: Although there is no split pulse output terminal on this board, general purpose output signal (signal equivalent to split pulse) synchronized with split pulse can be outputted by using synchronous action.