PCI1040
User's Manual

Beijing ART Technology Development Co., Ltd.

Contents

Chapter 1 Overview 3
1.1 Introduction 3
1.2 Features 3
Chapter 2 Component Layout and Pin Layout 5
2.1 Component Layout 5
2.1.1 Signal Input and Output Connectors 5
2.2.2 Status Indicator 5
2.2.3 Physical ID of DIP Switch 5
2.2 Pin Layout 7
Chapter 3 The Description of Functions 12
3.1 Pulse Output Command 12
3.1.1 Fixed Pulse Driving Output 12
3.1.2 Continuous Pulse Driving Output 14
3.2 Acceleration and Deceleration 15
3.2.1 Constant Speed Driving 15
3.2.2 S-shaped Acceleration/Deceleration Driving 15
3.3 Interpolation 16
3.4 General Purpose Input/Output Signal 17
3.5 The Output of Sensor 17
3.6 The Output of CLR 17
3.7 Synchronous Action 18
3.8 External start-up and origin search setting 18
3.8.1 Return-to-Origin Operation 18
3.8.2 External Start-up 18
3.8.3 External Drive Mode 18
Chapter 4 Interrupt Function 22
4.1 Pulse Oscillation Interrupt 22
4.2 Counter Interrupt 23
4.3 Sensor Interrupt 24
4.4 Comparator Interrupt 25
Chapter 5 Hardware Limit Signals 26
5.1 Initial Setting for Filter 26
5.2 Over Limit Signal 26
5.3 In-position Signal for Servo Motor 26
5.4 Alarm Signal 26
5.5 Deceleration Stop Signal 27
Chapter 6 Status Display 28
Chapter 7 Notes, Warranty Policy 29
7.1 Notes 29
7.2 Warranty Policy 29
Appendix PCI1040 Brief Test Method 30

Chapter 1 Overview

1.1 Introduction

PCI1040 that generates a pulse for controlling the speed and positioning of pulse train input-type servo motors and stepping motors. PCI1040 enables 8-axis control.

This unit is comprised of an S-shaped or linear acceleration/deceleration pulse generator, a line interpolation divider, an automatic deceleration point calculator based on trapezoidal or triangular driver, multi-counter and encoder inputs that can be used as the current position counter or deviation counter, a return-to-origin sensor interface, a limit sensor interface, a servo drive interface, a limit sensor interface, a servo drive interface, an 8-bit general-purpose input, and an 8-bit general-purpose output.

1.2 Features

◇ CPU interface
- Applicable microcomputers: 80 series, 68 series, etc.
- Address occupancy: 6 bits (64 bytes) for X7083
- Data bit width 8 bits

◇ Drive commands
- Index drive:
- Continuous pulse drive:
- Return-to-origin drive:
- Sensor positioning drive:

◇ Drive modes
- Acceleration/deceleration mode: S-shaped (sine, parabolic), linear
- Deceleration start point: Automatic calculation, manual setting, offset setting
- Synchronization mode: Multi-axis linear interpolation, sync start

◇ Encoder counter
- Number of counters: 2
- Bit length: 32 bits
- Count inputs: Internal pulse only, external-input pulses only, Internal pulse and external-input pulses

◇ Encoder converter inputs
- Number of channels: 1 channel
- Input format: 2-clock, 2-phase clock 90°phase error
- Multiplication: 1/2/4 multiplication

◇ Comparator
- Bit length: 24 bits
- Comparison targets: Register and counter, counter and counter

- Comparison methods: =, >

◇ I/O

- Inputs: 8
- Outputs: 8

◇ Other functions

- Independent setting functions for accelerator and decelerator
- Timer function
- Input filtering function
- Interrupt function
- I/O logic switching function
- Status functions

◇ Clock: 20.0 MHz (max), 16.384 MHz or 19.6608 MHz recommended

◇ Technology: CMOS

◇ Power source: Internal voltage: 3.3V IO voltage: 5V or 3.3V

◇ Operating temperatures: -40 to +85℃

◇ Others

- Multiplication: 1~250

Actual initial speed, drive speed, acceleration, and deceleration vary directly with multiplication.

✧ If multiplication=1, then

- ➢ Acceleration: 125~2047875
- ➢ Deceleration: 125~2047857
- ➢ Initial Speed: Linear movement: 1~16383
  S-shaped movement: 1~10000
- ➢ Drive Speed: Linear movement: 1~16383
  S-shaped movement: 1~10000

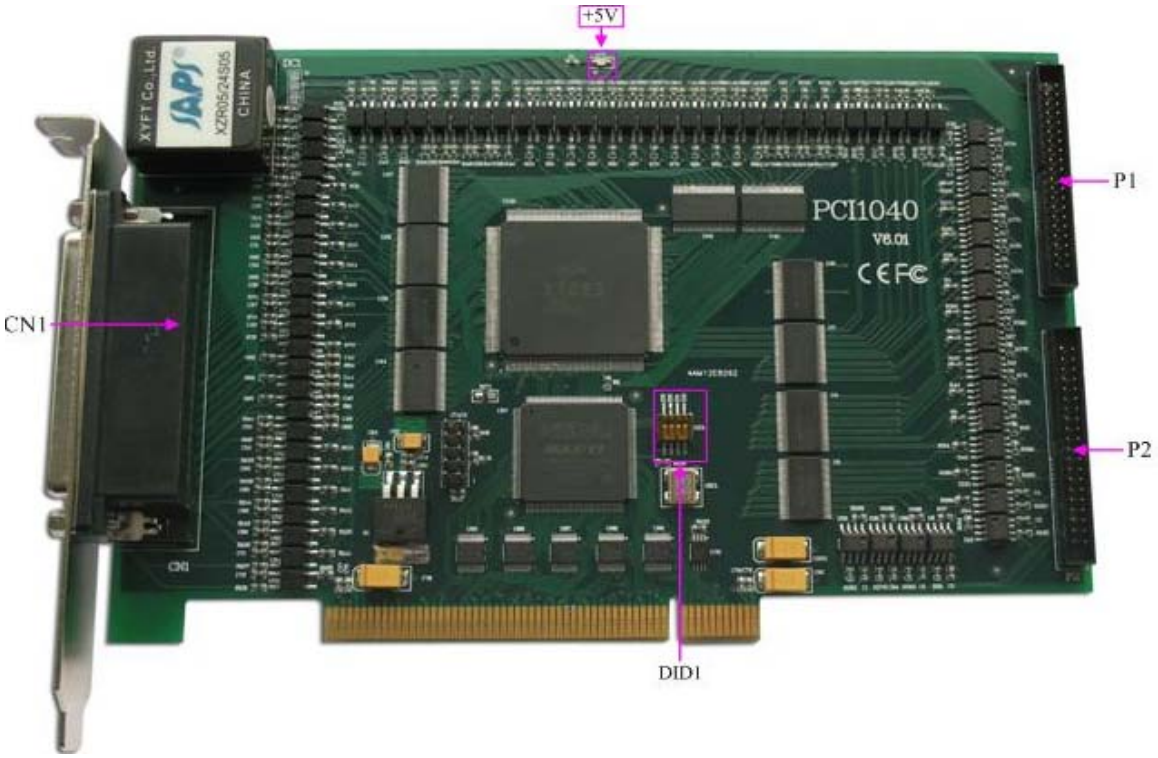
✧ If multiplication=250, then

- ➢ Acceleration: 31250~511968750
- ➢ Deceleration: 31250~511968750
- ➢ Initial Speed: Linear movement: 250~4095750
  S-shaped movement: 250~2500000
- ➢ Drive Speed: Linear movement: 250~4095750
  S-shaped movement: 250~2500000

- Pulse Output Mode: CW/CCW (2-pulse output) and Pulse/DIR(single-pulse output)

Chapter 2 Component Layout and Pin Layout

2.1 Component Layout



2.1.1 Signal Input and Output Connectors

CN1: analog signal input and output connectors

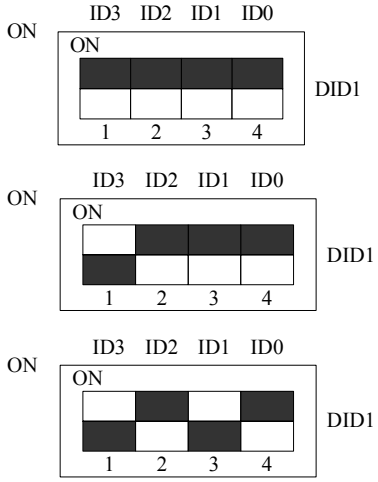
2.2.2 Status Indicator

+5V: 5V power supply indicator, on for normal

2.2.3 Physical ID of DIP Switch

DID1: Set physical ID number. When the PC is installed more than one PCI1040 , you can use the DIP switch to set a physical ID number for each board, which makes it very convenient for users to distinguish and visit each board in the progress of the hardware configuration and software programming. The following four-place numbers are expressed by the binary system: When DIP switch points to "ON", that means "1", and when it points to the other side, that means "0." As they are shown in the following diagrams: place "ID3" is the high bit."ID0" is the low bit, and the black part in the diagram represents the location of the switch. (Test software of the company often uses the logic ID management equipments and at this moment the physical ID DIP switch is

invalid. If you want to use more than one kind of the equipments in one and the same system at the same time, please use the physical ID as much as possible. As for the differences between logic ID and physical ID, please refer to the function explanations of "CreateDevice" and "CreateDeviceEx" of ***The Prototype Explanation of Device Object Management Function*** in ***PCI1040S*** software specification).



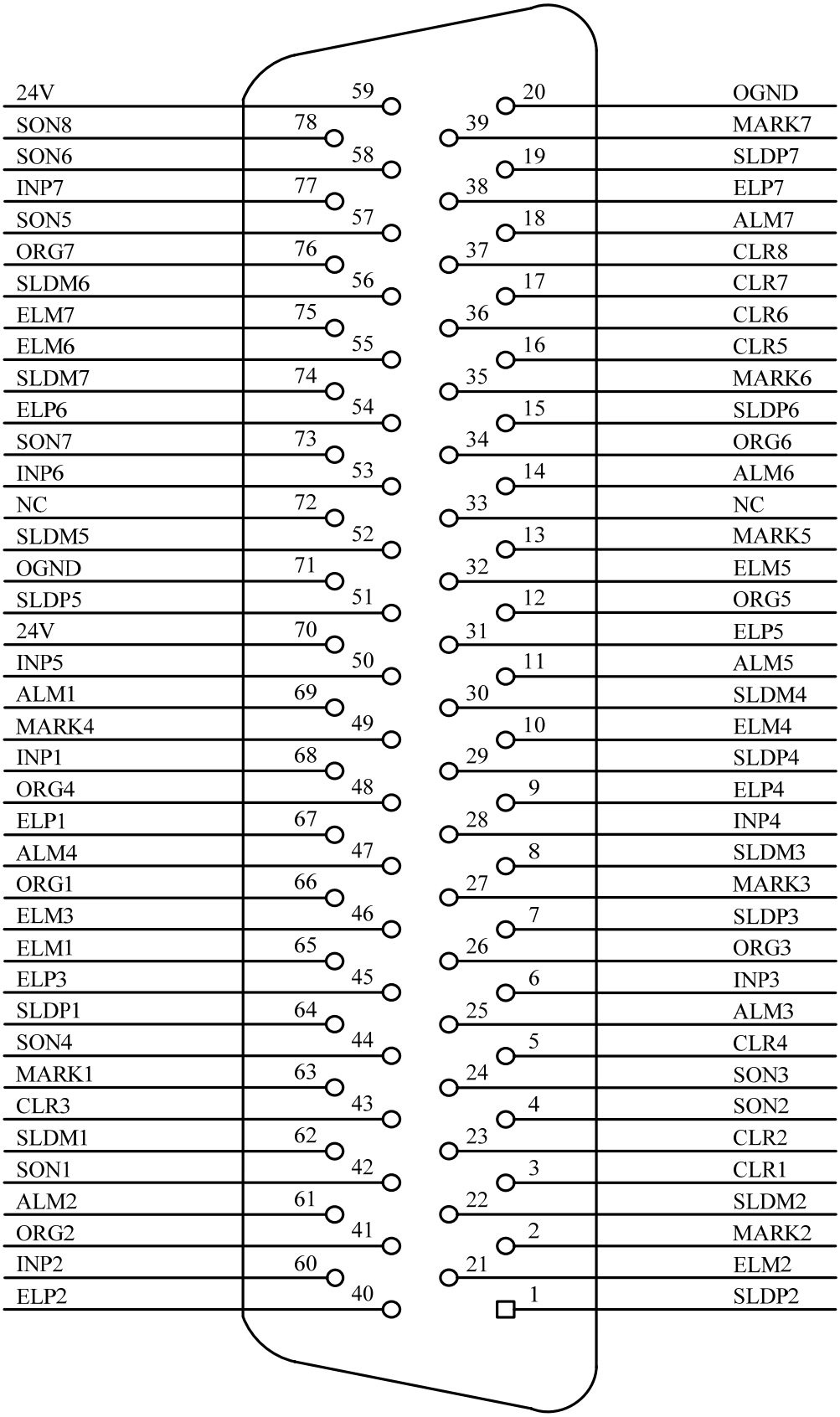
The above chart shows"1111", so it means that the physical ID is 15.

The above chart shows"0111", so it means that the physical ID is 7.

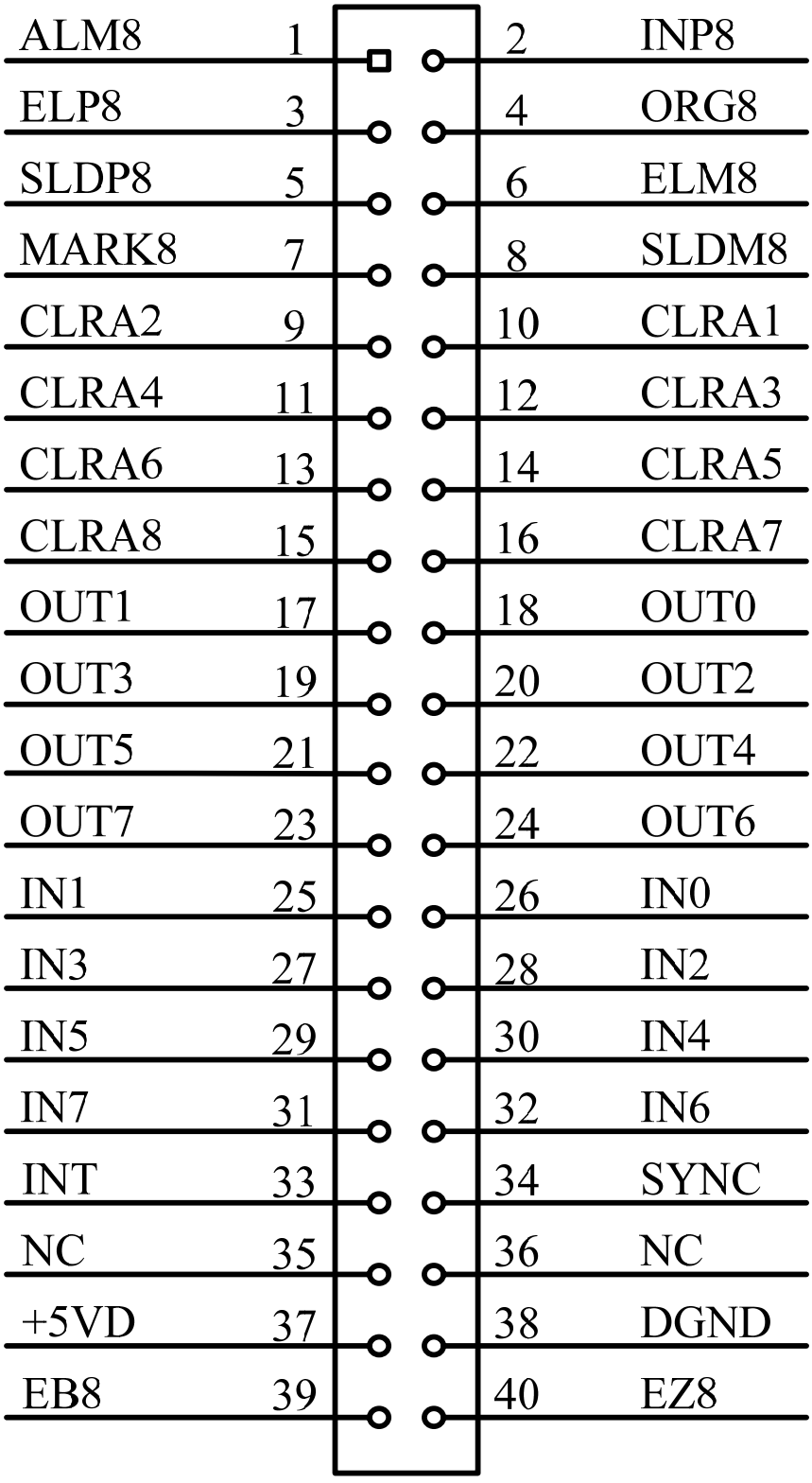
The above chart shows"0101", so it means that the physical ID is 5.

ID3	ID2	ID1	ID0	Physical ID（Hex）	Physical ID（Dec）
OFF（0）	OFF（0）	OFF（0）	OFF（0）	0	0
OFF（0）	OFF（0）	OFF（0）	ON（1）	1	1
OFF（0）	OFF（0）	ON（1）	OFF（0）	2	2
OFF（0）	OFF（0）	ON（1）	ON（1）	3	3
OFF（0）	ON（1）	OFF（0）	OFF（0）	4	4
OFF（0）	ON（1）	OFF（0）	ON（1）	5	5
OFF（0）	ON（1）	ON（1）	OFF（0）	6	6
OFF（0）	ON（1）	ON（1）	ON（1）	7	7
ON（1）	OFF（0）	OFF（0）	OFF（0）	8	8
ON（1）	OFF（0）	OFF（0）	ON（1）	9	9
ON（1）	OFF（0）	ON（1）	OFF（0）	A	10
ON（1）	OFF（0）	ON（1）	ON（1）	B	11
ON（1）	ON（1）	OFF（0）	OFF（0）	C	12
ON（1）	ON（1）	OFF（0）	ON（1）	D	13
ON（1）	ON（1）	ON（1）	OFF（0）	E	14
ON（1）	ON（1）	ON（1）	ON（1）	F	15

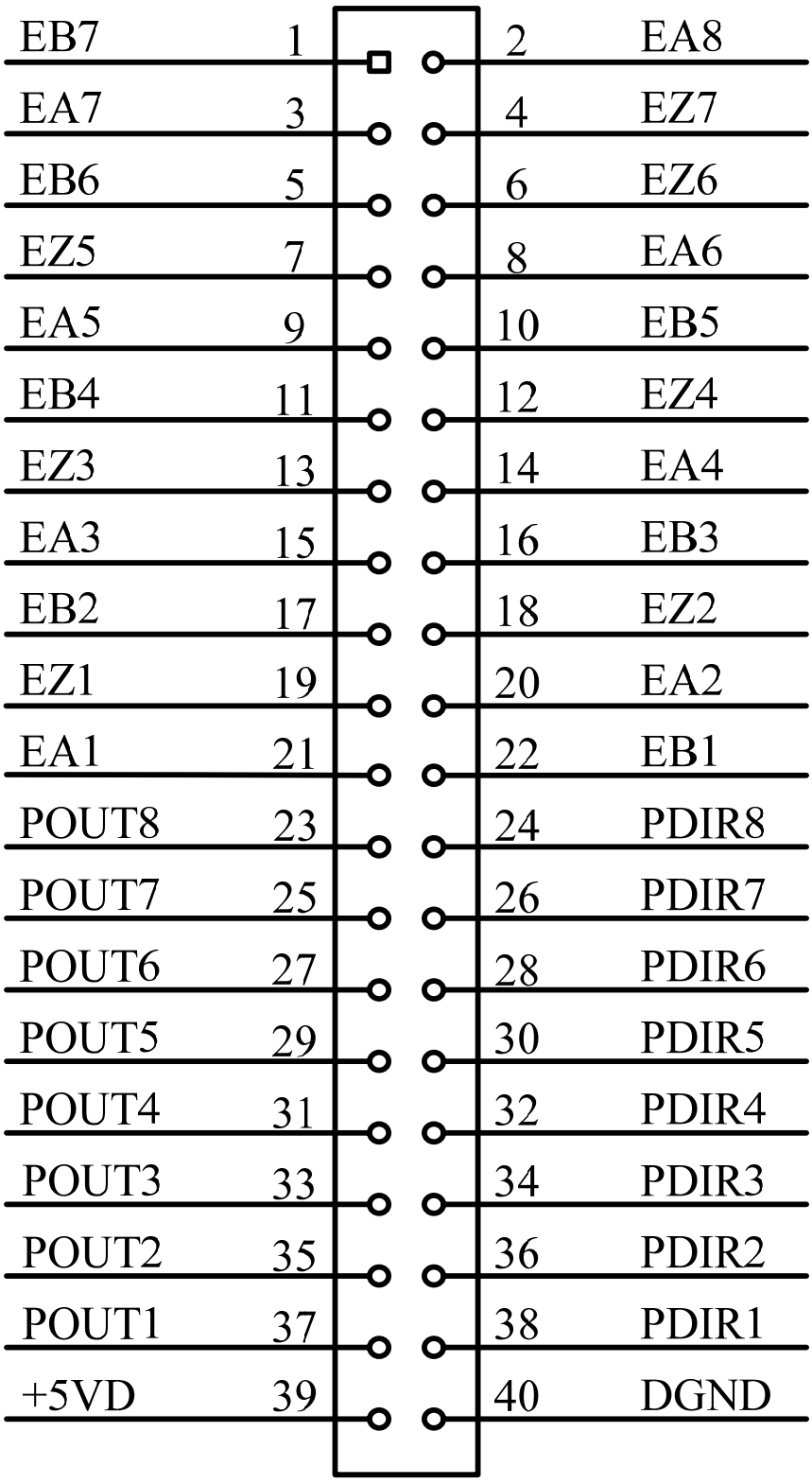
2.2 Pin Layout



P1:


ALM8 1
2 INP8
ELP8 3
4 ORG8
SLDP8 5
6 ELM8
MARK8 7
8 SLDM8
CLRA2 9
10 CLRA1
CLRA4 11
12 CLRA3
CLRA6 13
14 CLRA5
CLRA8 15
16 CLRA7
OUT1 17
18 OUT0
OUT3 19
20 OUT2
OUT5 21
22 OUT4
OUT7 23
24 OUT6
IN1 25
26 IN0
IN3 27
28 IN2
IN5 29
30 IN4
IN7 31
32 IN6
INT 33
34 SYNC
NC 35
36 NC
+5VD 37
38 DGND
EB8 39
40 EZ8

P2:


EB7 1
2 EA8
EA7 3
4 EZ7
EB6 5
6 EZ6
EZ5 7
8 EA6
EA5 9
10 EB5
EB4 11
12 EZ4
EZ3 13
14 EA4
EA3 15
16 EB3
EB2 17
18 EZ2
EZ1 19
20 EA2
EA1 21
22 EB1
POUT8 23
24 PDIR8
POUT7 25
26 PDIR7
POUT6 27
28 PDIR6
POUT5 29
30 PDIR5
POUT4 31
32 PDIR4
POUT3 33
34 PDIR3
POUT2 35
36 PDIR2
POUT1 37
38 PDIR1
+5VD 39
40 DGND

Pin name	Description
$\overline{\text{ALM1}}$ ~ $\overline{\text{ALM8}}$	Driver alarm emergency stop unit
$\overline{\text{EL P1}}$ ~ $\overline{\text{EL P8}}$	+direction immediate stop end limit input
$\overline{\text{EL M1}}$ ~ $\overline{\text{EL M8}}$	-direction immediate stop end limit input
$\overline{\text{SLD P1}}$ ~ $\overline{\text{SLD P8}}$	+ direction slow-down limit input
$\overline{\text{SLD M1}}$ ~ $\overline{\text{SLD M8}}$	- direction slow-down limit input
$\overline{\text{ORG1}}$ ~ $\overline{\text{ORG8}}$	Origin sensor input
$\overline{\text{EZ1}}$ ~ $\overline{\text{EZ8}}$	Encoder phase Z input
$\overline{\text{IN P1}}$ ~ $\overline{\text{IN P8}}$	Servo driver positioning completion input
$\overline{\text{MARK1}}$ ~ $\overline{\text{MARk8}}$	Sensor positioning start input
$\overline{\text{INO}}$ ~ $\overline{\text{IN7}}$	General-purpose input
$\overline{\text{CLRA1}}$ ~ $\overline{\text{CLRA8}}$	Clear Counter A
$\overline{\text{POUT1}}$ ~ $\overline{\text{POUT8}}$	Instruction pulse output
$\overline{\text{PDIR1}}$ ~ $\overline{\text{PDIR8}}$	Direction output or instruction pulse output
$\overline{\text{CLR1}}$ ~ $\overline{\text{CLR8}}$	1-short or general-purpose output for clearing the deviation counter of the servo driver
$\overline{\text{SON1}}$ ~ $\overline{\text{SON8}}$	Servo ON output for the servo driver
$\overline{\text{OUT0}}$ ~ $\overline{\text{OUT7}}$	General-purpose output
$\overline{\text{EA1}}$ ~ $\overline{\text{EA8}}$	Phase A input of encoder input
$\overline{\text{EB1}}$ ~ $\overline{\text{EB8}}$	Phase B input of encoder input
$\overline{\text{SYNC}}$	Sync start input
$\overline{\text{INT}}$	Interrupt request signal
24V	24V Power Supply

OGND	Ground
+5VD	5V Power Supply
DGND	Ground
NC	No Connection

Chapter 3 The Description of Functions

3.1 Pulse Output Command

There are two kinds of pulse output command: fixed pulse driving output and continuous pulse driving output.

3.1.1 Fixed Pulse Driving Output

When host CPU writes a pulse numbers into PCI1040 for fixed pulse driving and configures the performance such as acceleration/ deceleration and speed, PCI1040 will generate the pulses and output them automatically. Fixed pulse driving operation is performed at acceleration/deceleration where the acceleration and deceleration are equal. As shown in Fig.2.1, automatic deceleration starts when the number of pulses becomes less than the number of pulses that were utilized at acceleration, and driving terminates at completion of the output of the specified output pulses. For fixed pulse driving in linear acceleration, the following parameters must be set.

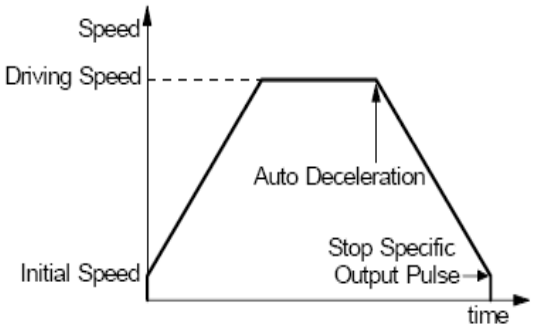


Fig.2.1 Fixed Pulse Driving

Parameter name	Comment
Acceleration/Deceleration	When acceleration and deceleration are equal, the setting of deceleration is not required.
Initial Speed	
Drive Speed	
Number of Output Pulse	

■ Changing the Number of Output Pulse in Driving

The number of output pulse can be changed in the fixed pulse driving. If the command is for increasing the output pulse, the pulse output profile is shown as Fig. 2.2 or 2.3. If the command is for decreasing the output pulses, the output pulse will be stopped immediately as shown in Fig. 2.4. Furthermore, when in the S-shaped acceleration /deceleration driving mode, the output pulse number change will occur to an incomplete deceleration S-shaped.

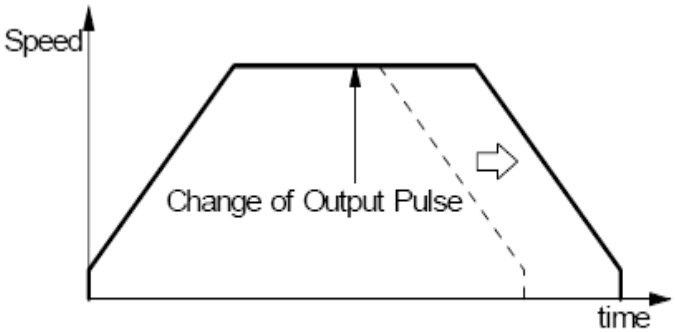


Fig.2.2 Change of Output Pulse Number in Driving

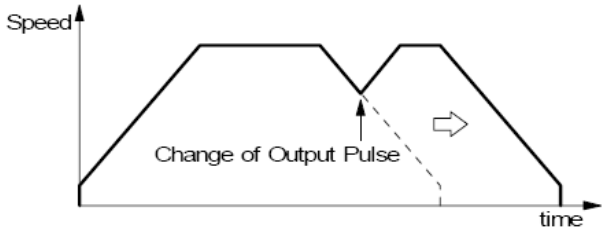


Fig. 2.3 Changing The Number of Output Pulse During Deceleration

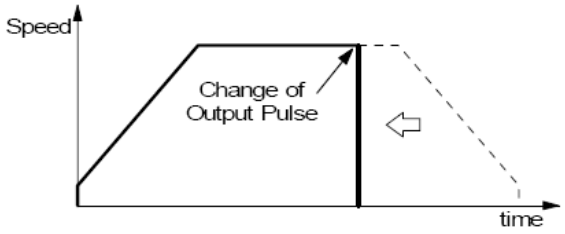


Fig. 2.4 Changing The Pulse Number Less Than Output Pulse Number

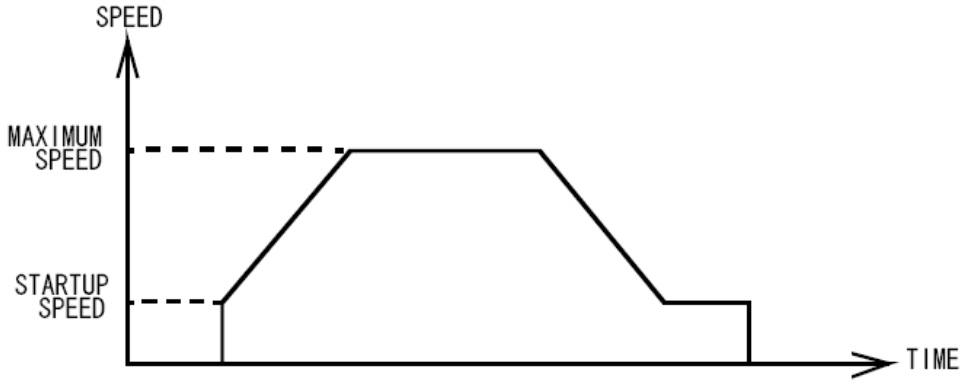
■ Automatic Setting Deceleration for Acceleration/Deceleration Driving

This mode can be used when the acceleration rate and deceleration rate are identical. Counter D is cleared to 0 at the start of drive and counting is performed during drive. When the value of remaining pulse count management counter C becomes equal to or less the value of counter D, the drive starts to decelerate. Counter D need not be preset before the startup.

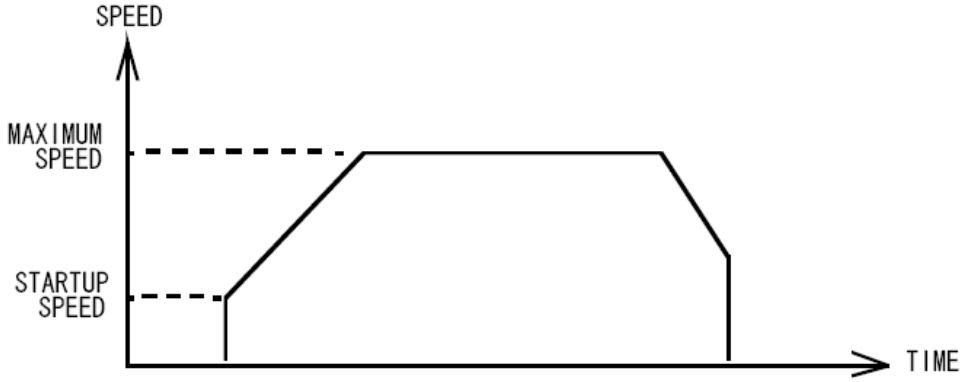
■Offset Setting Deceleration for Acceleration/Deceleration Driving

The offset function can be used for compensating the pulses when the decelerating speed does not reach the setting initial speed during the S-shaped fixed pulse driving. The method is calculating the output acceleration pulses and comparing them with the remaining pulses. When the remaining pulses are equal to or less the pulses in acceleration, it starts the deceleration. The setting value is between -8,388,608 and 8,388,607. The operations that occur are shown below.

When a positive value is preset:



When a negative value is preset:



■Manual Setting Deceleration for Acceleration/Deceleration Driving

As shown in Fig. 2.1, generally the deceleration of fixed pulse acceleration/deceleration driving is controlled automatically. However, in the following situations, it should be preset the deceleration point by the users.

● The change of speed is too often in the trapezoidal fixed pulse acceleration/deceleration driving.
● Set an acceleration, a deceleration, an jerk (acceleration increasing rate), and deceleration increasing rate individually for S-shaped deceleration fixed pulse driving.

S-shaped acceleration/deceleration
In the S-shaped acceleration/deceleration mode, two kinds of acceleration/deceleration shapes can be used. Namely, the parabolic curve and sine functional curve.

3.1.2 Continuous Pulse Driving Output

When the Continuous Pulse Driving is performed, PCI1040 will drive pulse output in a specific speed until stop command or external stop signal is happened. The main application of continuous pulse driving is: home searching, teaching or speed control. The drive speed can be changed freely during continuous pulse driving.

3.2 Acceleration and Deceleration

Basically, driving pulses of each axis are output by a fixed driving command or a continuous pulse driving command of the +direction or –direction. These types of driving can be performed with a speed curve constant speed, linear acceleration, non-symmetrical linear acceleration, S-shaped acceleration/deceleration, or non-symmetrical S-shaped acceleration/deceleration according to the mode that is set or operation parameter value.

3.2.1 Constant Speed Driving

When the drive speed set in PCI1040 is lower than the initial speed (or a speed higher than the drive speed is set as the initial speed), the acceleration/decoration will not be performed, instead, a constant speed driving starts.

If the user wants to perform the sudden stop when the home sensor or encoder Z-phase signal is active, it is better not to perform the acceleration/deceleration driving, but the low-speed constant driving from the beginning.

3.2.2 S-shaped Acceleration/Deceleration Driving

PCI1040 creates an S curve by increasing/reducing acceleration/deceleration in a primary line at acceleration and deceleration of drive speed.
Fig.2.5 shows the operation of S-shaped acceleration/deceleration driving where the acceleration and the deceleration are symmetrical. When driving starts, the acceleration increases on a straight line at the specified jerk (K). In this case, the speed data forms a secondary parabolic curve (section a). If the difference between the specified drive speed (V) and the current speed becomes less than the speed that was utilized at the increase of acceleration, the acceleration starts to decrease towards 0. The decrease ratio is the same as the increase ratio and the acceleration decreases in a linear form of the specified jerk (K). In this case, the rate curve forms a parabola of reverse direction (section b).
The speed reaches the specified drive speed (V) or the acceleration reaches 0, the speed is maintained (section c). In fixed pulse driving of S-shaped acceleration/deceleration where acceleration and deceleration are symmetrical, deceleration starts when the number of remaining output pulses becomes less than the number of pulses that were utilized. At the deceleration also, the speed forms an S curve by increasing/decreasing the deceleration in a primary linear form (section d and e). The same operation is performed in acceleration/deceleration where the drive speed is changed during continuous pulse driving.

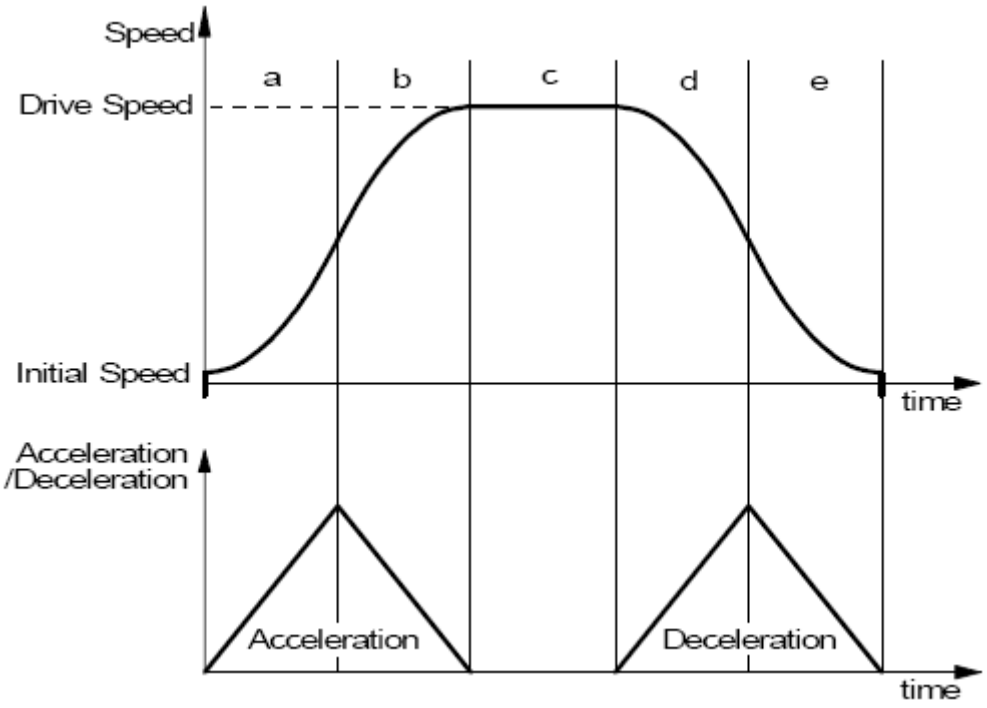


Fig.2.5 Symmetrical S-shaped Acceleration/Deceleration Driving

3.3 Interpolation

This 8-axis motion control card can perform any 2, 3, 4 axes linear interpolation. In the process of interpolation driving, all the calculations will follow the main axis (ax1). So, the user has to set the parameters such as initial speed and drive speed of the main axis before performing the interpolation. During the linear interpolation, it is not necessary to set the main axis as “long axis”.

Axes #1 to #4 of the 8 axes can be set for linear interpolation. To execute the linear interpolation, the user can, according to the present point coordinates, set the finish point coordinates. Fig.2.6 shows an example of axis interpolation where linear interpolation is performed from the current coordinates to the finish point coordinates. For individual axis control, the command pulse number is unsigned, and it is controlled by +direction command or –direction command. For interpolation control, the command pulse number is signed. The resolution of linear interpolation is within ±0.5 LSB, as shown in Fig.2.6.

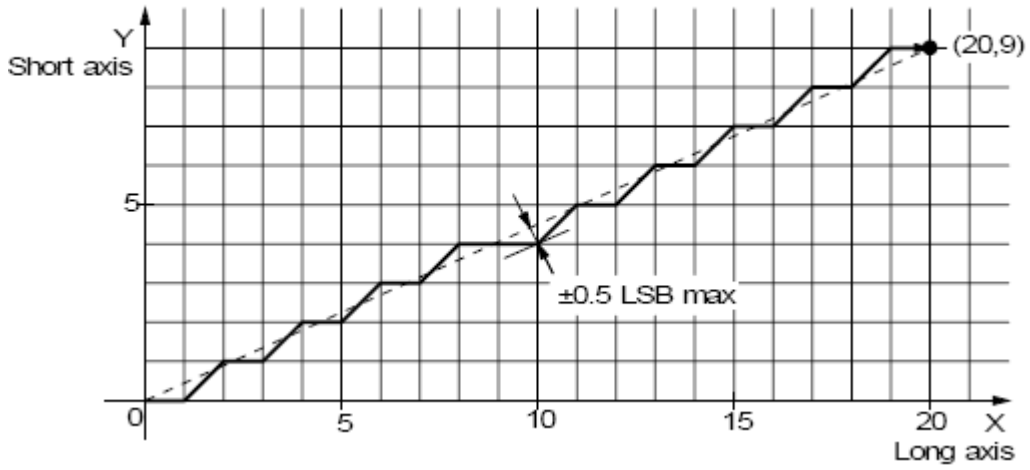


Fig.2.6 The Position Accuracy for Linear Interpolation

3.4 General Purpose Input/Output Signal

In PCI1040, there are 8 general purpose inputs and 8 general purpose outputs, OUT0~OUT7 are output pins, IN0~IN7 are input pins. $\overline{\text{IN0}}$ (LSB) to $\overline{\text{IN7}}$ (MSB) form an 8-bit parallel input. Interrupt is possible at the change of $\overline{\text{IN0}}$ from High to Low.

$\overline{\text{OUT0}}$ (LSB) to $\overline{\text{OUT7}}$ (MSB) form an 8-bit parallel, general-purpose output. The 8 bits can be rewritten simultaneously while the bit operation of each bit is possible.

3.5 The Output of Sensor

Servo ON output for the servo driver. Can be used as the general-purpose output, SON1 to SON8 are output pins.

3.6 The Output of CLR

1-shot or general-purpose output for clearing the deviation counter of the servo driver. The 1-shot and general-purpose output can be switched with the initial setting register of the output. The pulse duration of shot is 32 times the reference clock period. The output logic can be switched with the output logic register. CLR1 to CLR8 are CLR pins.

3.7 Synchronous Action

Sync start input. When the sync start mode is activated, the pulse starts to be output when $\overline{\text{SYNC}}$ changes from High to Low.

3.8 External start-up and origin search setting

3.8.1 Return-to-Origin Operation

With the return-to-coordinate-basic-origin drive, the return-to-origin operation is based on either the $\overline{\text{ORG}}$ input alone or the $\overline{\text{ORG}}$ and $\overline{\text{EZ}}$ (Encoder phase Z) inputs.

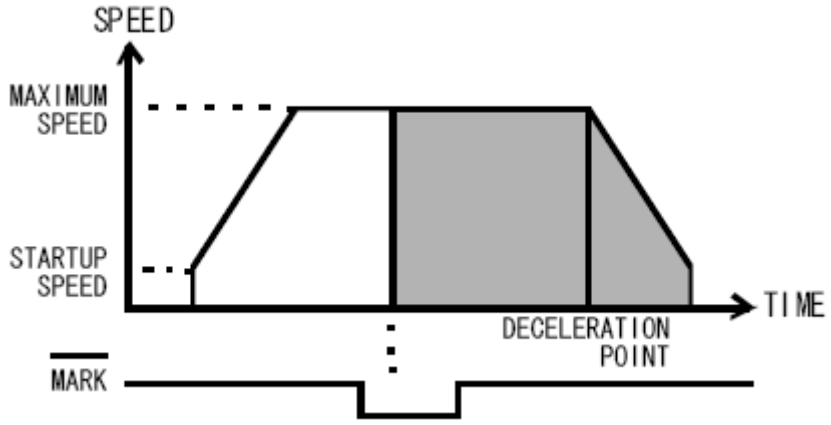
The input sensitivity is 1 or 16 times the reference clock period.

3.8.2 External Start-up

When the sensor positioning drive is used, the set number of pulses are output when the $\overline{\text{MARK}}$ input becomes active. The input sensitivity is 1 or 16 times the reference clock period.

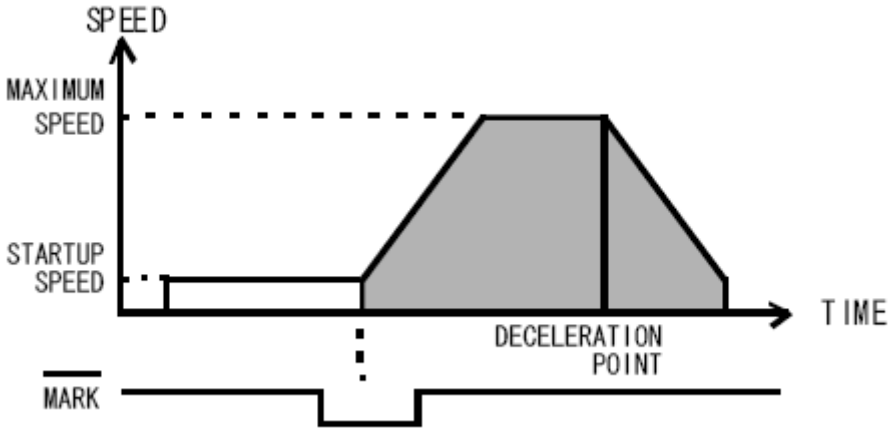
3.8.3 External Drive Mode

1. Sensor positioning drive I: Positioning drive from the position where the $\overline{\text{MARK}}$ input terminal goes active. Acceleration starts from the beginning of the drive.

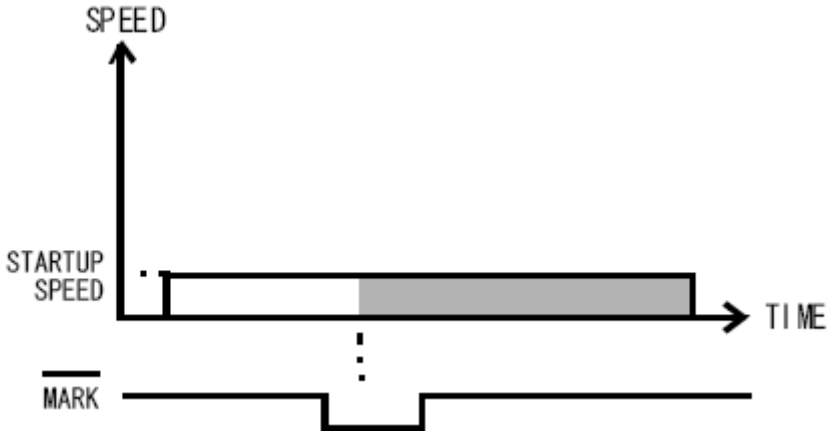


2. Sensor positioning drive Ⅱ: Positioning drive from the position where the $\overline{\text{MARK}}$ input terminal goes

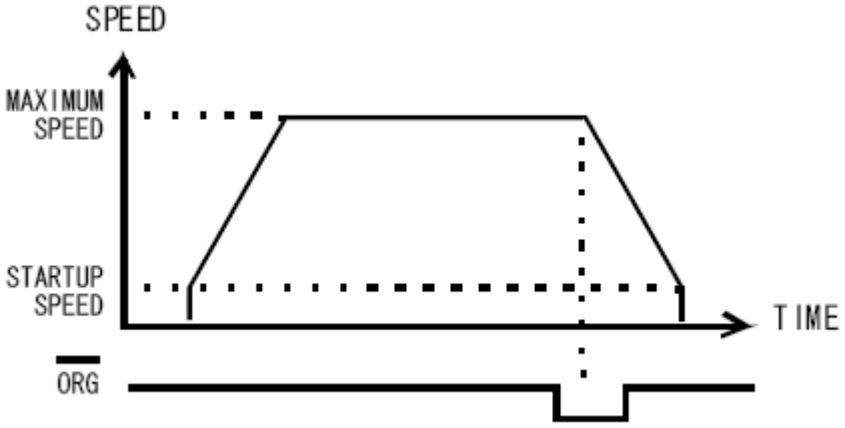
active. Acceleration starts when the $\overline{\text{MARK}}$ input goes active.



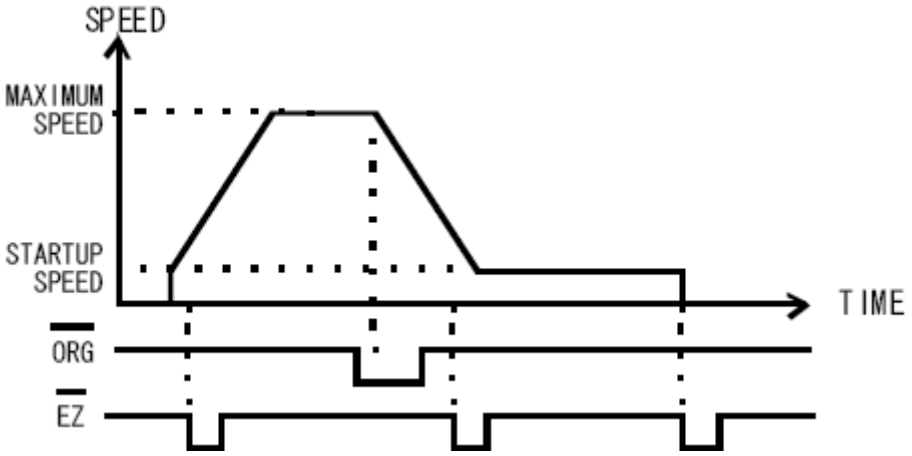
3. Sensor positioning drive Ⅲ: Positioning drive from the position where the $\overline{\text{MARK}}$ input terminal goes active. Acceleration and deceleration are not performed.



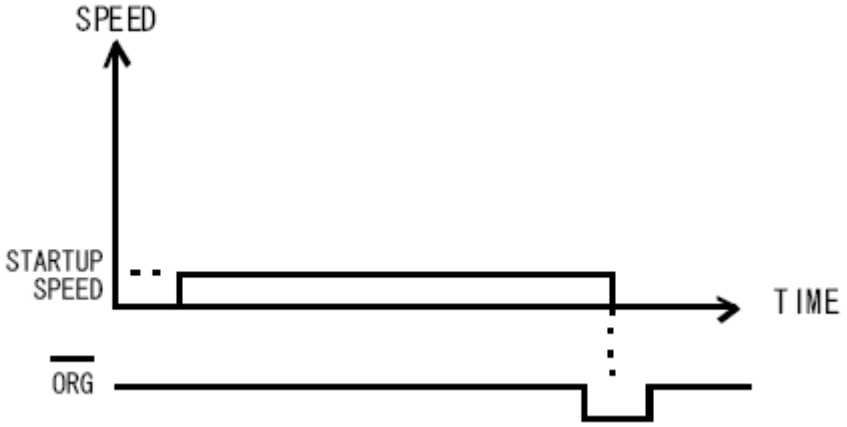
4. Return-to-origin Ⅰ: Return-to-origin accompanied with acceleration and deceleration. The drive decelerates and stops when $\overline{\text{ORG}}$ goes active.



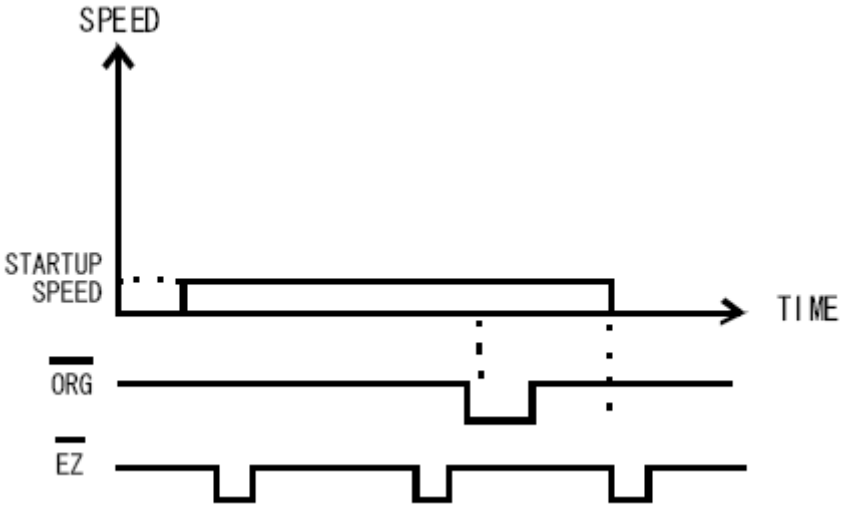
5. Return-to-origin Ⅱ: Return-to-origin accompanied with acceleration and deceleration. The drive decelerates when $\overline{\text{ORG}}$ goes active and stops when $\overline{\text{EZ}}$ goes active after reaching startup speed.



6. Return-to-origin Ⅲ: Return-to-origin at the startup speed. Immediate stop occurs when $\overline{\text{ORG}}$ goes active.



7. Return-to-origin Ⅳ: Return-to-origin at the startup speed. Immediate stop occurs when $\overline{\text{EZ}}$ goes active after $\overline{\text{ORG}}$ has been activated.


SPEED
STARTUP
SPEED
TIME
ORG
EZ

Chapter 4 Interrupt Function

The PCI1040 has an interrupt function based on the pulse output, counter and sensor factors. It is also possible to mask the interrupt due to each factor.

Interrupt signals can be generated when: (1). the start/finish of a constant speed drive during the acceleration/deceleration driving, (2).the end of driving, and (3). the compare result once higher/lower the border-lines of the position counter range. An interrupt signal can be also generated during the interpolation driving.

4.1 Pulse Oscillation Interrupt

In pulse oscillation interrupt mode, there are four modes: normal pulse output completion interrupt disabled, Error stop interrupt disabled, deceleration start point interrupt disabled and maximum acceleration rate interrupt disabled.

Table 3-1: Pulse Oscillation Interrupt Mask Register

bit	Description	
	0	1
0	Normal pulse output completion interrupt disabled	Normal pulse output completion interrupt enabled
1	Error stop interrupt disabled	Error stop interrupt enabled
2	Deceleration start point interrupt disabled	Deceleration start point interrupt enabled
3	ISO-speed interrupt disabled	ISO-speed interrupt enabled
4	Not used (permanently set to 0)	
5	Maximum acceleration rate interrupt disabled	Maximum acceleration rate interrupt enabled
6	Not used (permanently set to 0)	
7	Not used (permanently set to 0)	

Table 3-2: Pulse Oscillation Interrupt Flag

bit	Description	
	0	1
0	Pulse output completion interrupt flag is OFF	Pulse output completion interrupt flag is ON
1	Error stop interrupt flag is OFF	Error stop interrupt flag is ON
2	Deceleration start point interrupt flag is OFF	Deceleration start point interrupt flag is ON
3	ISO-speed interrupt flag is OFF	ISO-speed interrupt flag is ON
4	Undefined (permanently set to 0)	
5	Maximum acceleration rate interrupt flag is OFF	Maximum acceleration rate interrupt flag is ON
6	Not used (permanently set to 0)	
7	Not used (permanently set to 0)	

4.2 Counter Interrupt

In counter interrupt mode, there are four interrupt modes: Counter A carry interrupt disabled, Counter A borrow interrupt disabled, Counter B carry interrupt disable and Counter B borrow interrupt disabled.

Table3-3: Counter Interrupt Mask Register

bit	Description	
	0	1
0	Counter A carry interrupt disabled	Counter A carry interrupt enabled
1	Counter A borrow interrupt disabled	Counter A borrow interrupt enabled
2	Counter B carry interrupt disabled	Counter B carry interrupt enabled
3	Counter B borrow interrupt disabled	Counter B borrow interrupt enabled
4	Undefined (permanently set to 0)	
5	Counter C borrow interrupt disabled	Counter C borrow interrupt enabled
6	Undefined (permanently set to 0)	
7	Undefined (permanently set to 0)	

Table3-4: Counter Interrupt Flag

bit	Description	
	0	1
0	Counter A carry interrupt flag is OFF	Counter A carry interrupt flag is ON
1	Counter A borrow interrupt flag is OFF	Counter A borrow interrupt flag is ON
2	Counter B carry interrupt flag is OFF	Counter B carry interrupt flag is ON
3	Counter B borrow interrupt flag is OFF	Counter B borrow interrupt flag is ON
4	Undefined (permanently set to 0)	
5	Counter C borrow interrupt flag is OFF	Counter C borrow interrupt flag is ON
6	Undefined (permanently set to 0)	
7	Undefined (permanently set to 0)	

4.3 Sensor Interrupt

In sensor interrupt mode, there are four interrupt modes: $\overline{\text{ORG}}$ interrupt disabled, $\overline{\text{EZ}}$ interrupt disabled, $\overline{\text{IN0}}$ interrupt disabled and $\overline{\text{MARK}}$ interrupt disabled.

Table 3-5: Sensor Interrupt Mask Register

bit	Description	
	0	1
0	$\overline{\text{ORG}}$ interrupt disabled	$\overline{\text{ORG}}$ interrupt enabled
1	$\overline{\text{EZ}}$ interrupt disabled	$\overline{\text{EZ}}$ interrupt enabled
2	$\overline{\text{IN0}}$ interrupt disabled	$\overline{\text{IN0}}$ interrupt enabled
3	$\overline{\text{MARK}}$ interrupt disabled	$\overline{\text{MARK}}$ interrupt enabled
4	Undefined (permanently set to 0)	
5	Undefined (permanently set to 0)	
6	Undefined (permanently set to 0)	
7	Undefined (permanently set to 0)	

Table 3-6: Sensor Interrupt Flag

bit	Description	
	0	1
0	$\overline{\text{ORG}}$ interrupt flag is OFF	$\overline{\text{ORG}}$ interrupt flag is ON
1	$\overline{\text{EZ}}$ interrupt flag is OFF	$\overline{\text{EZ}}$ interrupt flag is ON
2	$\overline{\text{IN0}}$ interrupt flag is OFF	$\overline{\text{IN0}}$ interrupt flag is ON
3	$\overline{\text{MARK}}$ interrupt flag is OFF	$\overline{\text{MARK}}$ interrupt flag is ON
4	Undefined (permanently set to 0)	
5	Undefined (permanently set to 0)	
6	Undefined (permanently set to 0)	
7	Undefined (permanently set to 0)	

4.4 Comparator Interrupt

In comparator interrupt mode, there are two interrupt modes: P=Q interrupt disabled and P>Q interrupt disabled.

Table 3-7: Comparator Interrupt Mask Register

bit	Description	
	0	1
0	P = Q interrupt disabled	P = Q interrupt enabled
1	P > Q interrupt disabled	P > Q interrupt enabled
2	Undefined (permanently set to 0)	
3	Undefined (permanently set to 0)	
4	Undefined (permanently set to 0)	
5	Undefined (permanently set to 0)	
6	Undefined (permanently set to 0)	
7	Undefined (permanently set to 0)	

Table 3-8: Comparator Interrupt Flag

bit	Description	
	0	1
0	P = Q interrupt flag is OFF	P = Q interrupt flag is ON
1	P > Q interrupt flag is OFF	P > Q interrupt flag is ON
2	Undefined (permanently set to 0)	
3	Undefined (permanently set to 0)	
4	Undefined (permanently set to 0)	
5	Undefined (permanently set to 0)	
6	Undefined (permanently set to 0)	
7	Undefined (permanently set to 0)	

Chapter 5 Hardware Limit Signals

Hardware limit signals, are used for stopping the pulse output if the limit sensors of + and – direction are triggered.

5.1 Initial Setting for Filter

The setting values of the input filter decides the sensitivity of $\overline{+EL}$, $\overline{-EL}$, $\overline{ALM}$, $\overline{+SLD}$ and $\overline{-SLD}$.

The setting value range is from 1 to 256. Set 0 for 256. Sensitivity is one cycle of 16 x F x reference clock.

5.2 Over Limit Signal

Over limit +: signal of direction over limit. During the + direction drive pulse outputting, decelerating stop or sudden stop will be performed once this signal is active. When the filter function is disabled, the active pulse width must be 2CLK or more.
Over limit -: signal of – direction over limit. During the - direction drive pulse outputting, decelerating stop or sudden stop will be performed once this signal is active. The active pulse width should be more than 2CLK. Decelerating stop/sudden stop and logical levels can be set during the mode selection.

5.3 In-position Signal for Servo Motor

Positive logic: from low to high, the external in-position light becomes red and continues to maintain the original movement, it can decelerate movement or stop immediately.
Negative logic: from high to low, the external in-position light becomes red and continues to maintain the original movement, it can decelerate movement or stop immediately.

5.4 Alarm Signal

Positive logic: from low to high, the alarm status light becomes red, and it immediately stops movement.
Negative logic: from high to low, the alarm light becomes red, and it immediately stops movement.

5.5 Deceleration Stop Signal

In this case, three parameters must be set:

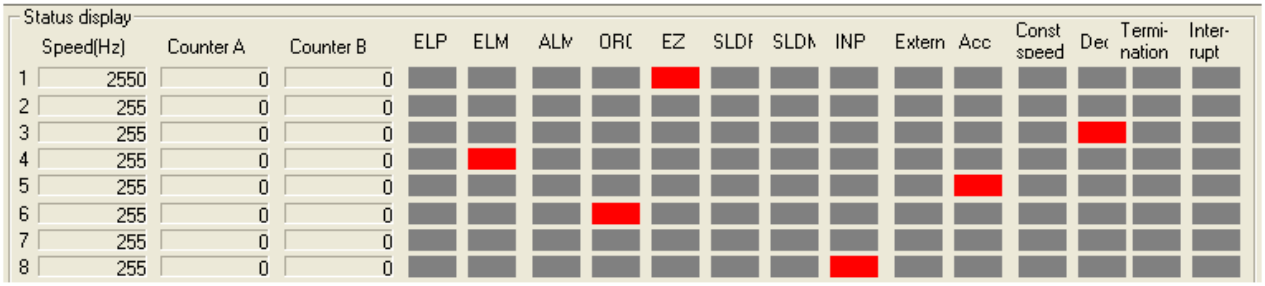
Parameter name	Description
Logical Direction	Positive logic and negative logic
Signal Mode	Level signal and edge signal
Movement Mode	Immediate stop and deceleration stop

In movement mode, immediate stop occurs when this command is written during drive. However, the pulse duration of the last pulse is assured. In interpolation mode, only one axis stops. Deceleration stop: the drive deceleration and stops when this command is written during drive. Immediate stop occurs if this command is written during constant speed drive. However, the pulse duration of the last pulse is assured. In interpolation mode, other axes also decelerate and stop.

Chapter 6 Status Display

In this department, we can see the value of speed, logic counters and real-bit counter, and the graphics of motor movement. According to the signal, we also can see the following status: hardware limit, origin flag, encoder Z, subtract bit, external in-position signal, external start, acceleration status, constant speed status, deceleration status, termination status and interrupt status. Through the indicator light changes, we can determine the movement of servo motor.

ELP: +hardware limit status
ELM: - hardware limit status
ALM: alarm status
ORG: origin flag status
EZ: encoder Z status
SLDP: +subtract bit
SLDM: -subtract bit
INP: external in-position signal
Extern: external start
Acc: acceleration status
Const speed: constant speed status
Dec: deceleration status
Termination: termination status
Interrupt: interrupt status



Chapter 7 Notes, Warranty Policy

7.1 Notes

In our products' packing, user can find a user manual, a PCI1040 module and a quality guarantee card. Users must keep quality guarantee card carefully, if the products have some problems and need repairing, please send products together with quality guarantee card to ART, we will provide good after-sale service and solve the problem as quickly as we can.

When using PCI1040, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of PCI1040 module.

7.2 Warranty Policy

Thank you for choosing ART. To understand your rights and enjoy all the after-sales services we offer, please read the following carefully.

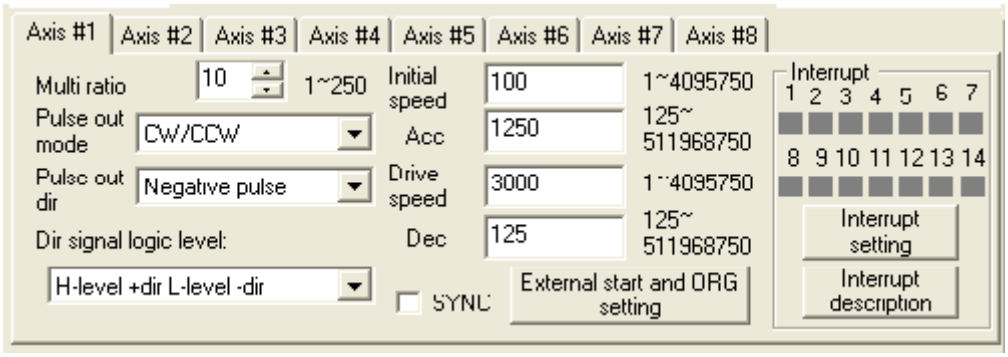
1. Before using ART's products please read the user manual and follow the instructions exactly. When sending in damaged products for repair, please attach an RMA application form which can be downloaded from: www.art-control.com.
2. All ART products come with a limited two-year warranty:
   - The warranty period starts on the day the product is shipped from ART's factory
   - For products containing storage devices (hard drives, flash cards, etc.), please back up your data before sending them for repair. ART is not responsible for any loss of data.
   - Please ensure the use of properly licensed software with our systems. ART does not condone the use of pirated software and will not service systems using such software. ART will not be held legally responsible for products shipped with unlicensed software installed by the user.
3. Our repair service is not covered by ART's guarantee in the following situations:
   - Damage caused by not following instructions in the User's Manual.
   - Damage caused by carelessness on the user's part during product transportation.
   - Damage caused by unsuitable storage environments (i.e. high temperatures, high humidity, or volatile chemicals).
   - Damage from improper repair by unauthorized ART technicians.
   - Products with altered and/or damaged serial numbers are not entitled to our service.
4. Customers are responsible for shipping costs to transport damaged products to our company or sales office.
5. To ensure the speed and quality of product repair, please download an RMA application form from our company website.

Appendix PCI1040 Brief Test Method

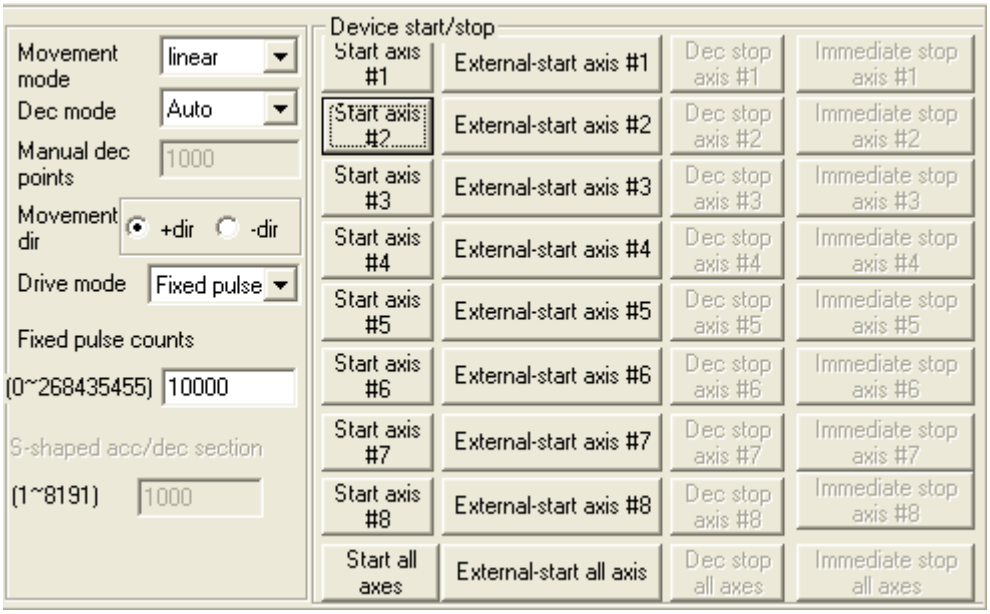
Configuration of public parameters

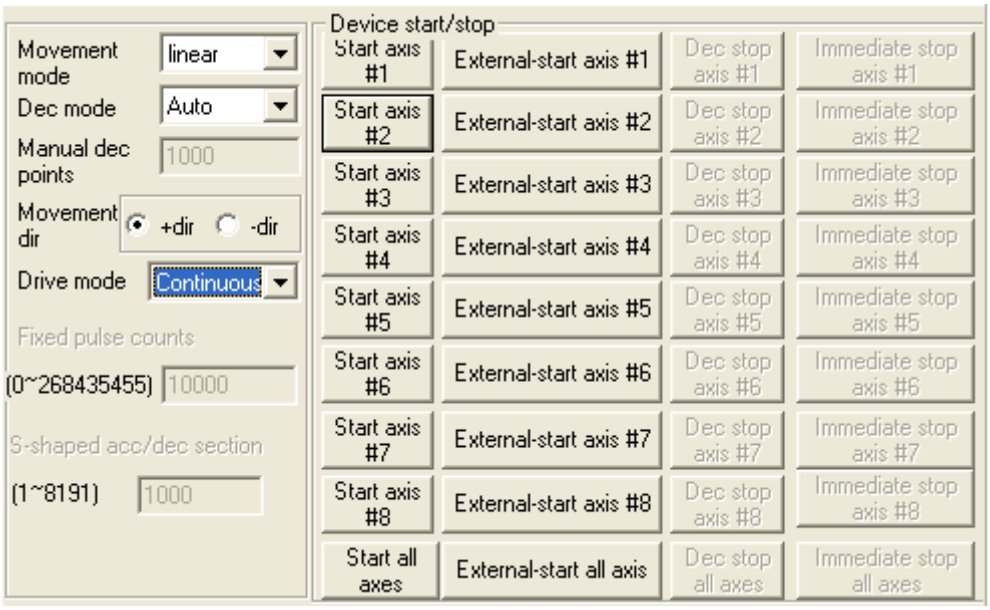
- Linear Movement

  Set the public parameters of linear movement in the upper left corner of the box, we can configure multiplication, pulse output mode, pulse out direction, logic level of direction signal, initial speed, acceleration, drive speed, deceleration. The parameters for each axis independent, not affect each other.



  In the right box, we can set movement mode, deceleration mode, manual deceleration points, movement direction, drive mode, fixed pulse, and S-shaped acceleration/deceleration segment.





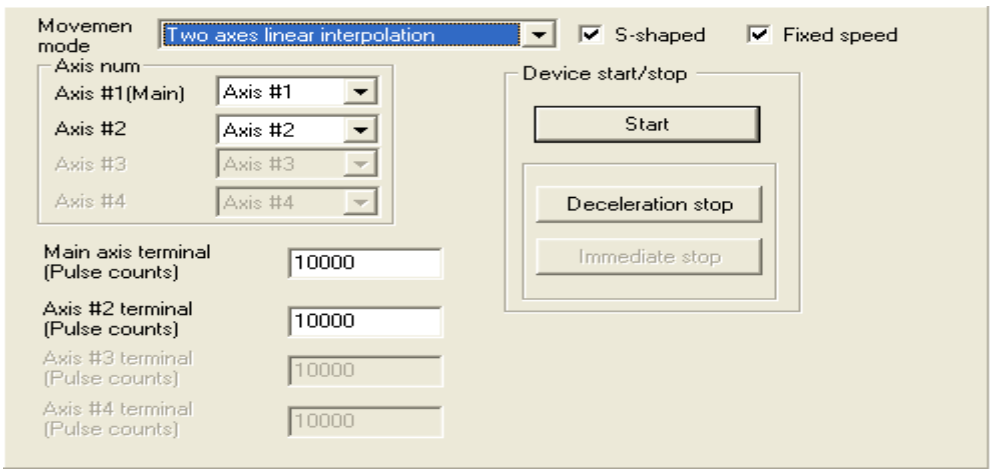
- When select linear movement, only need to select the movement direction and drive mode (it is necessary to set fixed- pulses when fixed- pulse in the choice).

- When select S-shaped movement, need to select the deceleration mode, if you want acceleration and deceleration curves are the same, select auto-deceleration. If you want acceleration and deceleration curves are different, then select Manual deceleration or offset deceleration.

Interpolation Movement

Set the public parameters of interpolation movement in the upper left corner of the box.

Axes #1 to #4 of the 8 axes can be set for linear interpolation. If choose axes #1 as main axis, we should set initial speed, drive speed, acceleration and deceleration for axes #1. To execute the linear interpolation, the user can, according to the present point coordinates, set the finish point coordinates. For example: set axes #1 finish point coordinates: 10000, speed: 1000 axes #2 finish point coordinates: 5000. If the motor drive objects in the two-dimensional coordinates, then the object's initial coordinates is the origin of coordinates (0, 0), and makes a linear motion. Object will movement 10000 steps in #1-axis, 5000 steps in #2-axis and the speed of #2 is 500, they are proportionable.



Make a brief description of the various functions

1. Pulse Output Mode: First select the CW/CCW (2-pulse mode).
2. Logic level test of direction signal: must select the Pulse/DIR (single-pulse mode) pulse output mode.

   Low level is +direction, high level is -direction. That is, when movement is +direction, PDIR(negative pulse output pins) will output low level, on the contrary, movement is -direction, PDIR will output high level.

   High level is +direction, low level is -direction. That is, when movement is +direction, PDIR will output high level, on the contrary, movement is -direction, PDIR will output low level.
3. Alarm Signal: (ALM)

   Positive logic: when it is set to valid, the signal of specified axis is from low to high, and alarm light becomes red.

   Negative logic: when it is set to valid, the signal of specified axis is from high to low, and alarm light becomes red.
4. In-position Signal for Servo Motor (INP)

   Positive logic: from low to high, the external in-position light becomes red and continues to maintain the original movement, it can decelerate movement or stop immediately.

   Negative logic: from high to low, the external in-position light becomes red and continues to maintain the original movement, it can decelerate movement or stop immediately.
5. Over Limit Signal (ELM, ELP)

   Positive Rotation

   Positive logic: direction of movement is positive rotation, starts when ELP is low level. ELP from low level to high level, the hardware limit light becomes red and stops immediately.

   Negative logic: direction of movement is positive rotation, starts when ELP is high level. ELP from high level to low level, the hardware limit light becomes red and stops immediately.

   Reverse Rotation

   Positive logic: direction of movement is reverse rotation, starts when ELM is low level. ELM from low level to high level, the hardware limit light becomes red and stops immediately.

   Negative logic: direction of movement is reverse rotation, starts when ELM is high level. ELM from high level to low level, the hardware limit light becomes red and stops immediately.
6. SYNC: Output pulse synchronously
7. Deceleration Stop

   When set to positive rotation, it should be controlled by the SLDP. When set to reverse rotation, it should be controlled by the SLDM.
8. Interrupt

   Counter A is logic pulse counter, Counter B is real-bit pulse counter.

   Counter A carry interrupt (counter range: -2147483648～+2147483647), when the logic pulse number is greater than 2147483647, generate carry interrupt.

   Counter A borrow interrupt (counter range: -2147483648～+2147483647), when the logic pulse number is greater than -2147483647, generate borrow interrupt.

Counter B is similar with the Counter A.

ORG interrupt: generate interrupt when ORG from high level to low level

EZ interrupt: generate interrupt when EZ from high level to low level

INO interrupt: generate interrupt when INO from high level to low level

MARK interrupt: generate interrupt when MARK from high level to low level

P=Q interrupt: P can choose Counter A\Counter B\Comparator register

Q can choose Counter A\Counter B\Comparator register

P and Q can not both select the same register, if you choose Comparator register, comparator values need to be set, when meet conditions, generate interrupt.

P>Q is similar with the P=Q.

9. Status Display

Through status lights, can judge the status of movement.

ELP: +hardware limit status

ELM: - hardware limit status

ALM: alarm status

ORG: origin flag status

EZ: encoder Z status

SLDP: +subtract bit

SLDM: -subtract bit

INP: external in-position signal

Extern: external start

Acc: acceleration status

Const speed: constant speed status

Dec: deceleration status

Termination: termination status

Interrupt: interrupt status