User's Manual For SMC6400B

Stand-Alone 4-Axis Motion Controller

Version 1.0

Attention: Please read this manual carefully before using the controller!

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Chapter 1 General Information

1.1 Introduction

The SMC6400B motion controller is Leadshine's high performance, stand-alone motion controller, which based on a 32-bit RISC CPU. It offers 1 to 4 axes motion control for stepping motors or servo motors to accomplish various operations The SMC6400B supports standard ISO G-code programming. The user can edit G-code program with HMI or in a PC before download the program to the controller through RS232 serial port or USB disk.

The SMC6400B can generate pulse control signal (up to 9.8 MHz) to control servo or stepping system. The pulse output type can either be PUR/DIR or CW/CCW. 28 general purpose digital inputs and 28 general purpose digital outputs are built inside the SMC6400B. In multi-axis operation, the SMC6400B provides linear interpolation by any 2, any 3, or even all-4 axes. And any 2 axes can perform circular interpolation. It also supports trapezoidal/s-curve velocity profile and the continuous interpolation function.

There are totally 41 instructions (14 G-codes and 17 M-codes) has been carefully designed for user programming, offering motion control and program flow control including jumping, looping and subprogram calls, with or without condition. SMC6400B also support multi-task and variable declaration. Most of the instructions are coincident with standard G-codes and easily understanding.

1.2 Features

- Stand-alone Operation
- Supports G-code programming
- 32-bit CPU, 60MHz, Rev1.0
- Pulse output rate up to 9.8MHz
- 6 pulse/dir output modes: Pulse /DIR, CW/CCW etc.

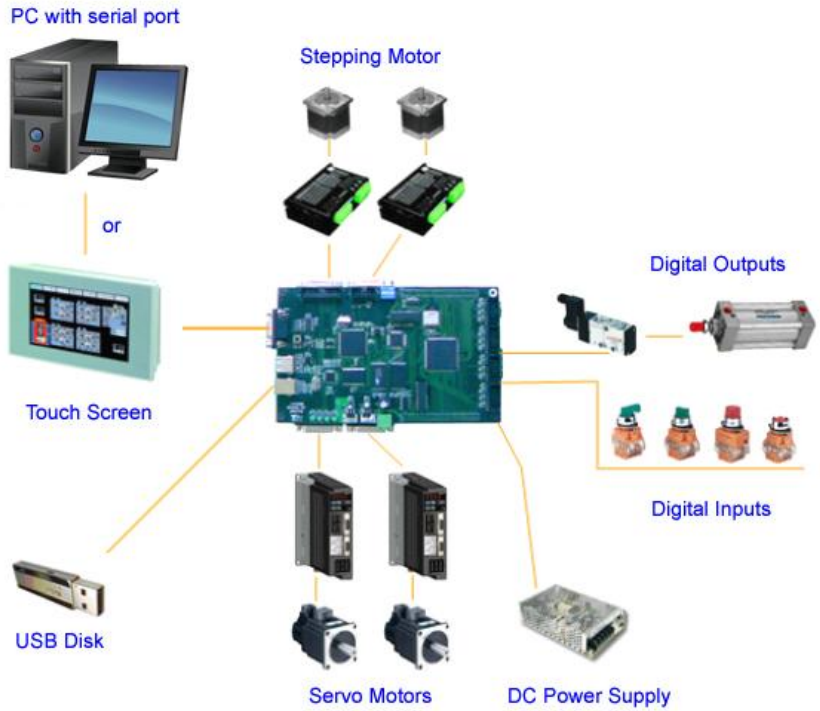


Figure 1-1 SMC6400B Control System

- 2~4 axes linear interpolation
- 2 axes circular interpolation
- Multi-axis continuous interpolation
- 2 home return modes
- Trapezoidal and S-curve velocity profiles programmable
- Multi-axis, simultaneous start/stop
- Position limit and return home signals for each axis
- Standard servo motor control signal for each axis
- 28 general digital inputs with Opto-isolated
- 28 general digital outputs with Opto-isolated
- HMI optional

1.3 Specification

1.3.1 Performance

- Number of controllable axes: 4 axes.
- Internal reference clock: 60 MHz
- Pulse output frequency: 1 pps ~ 9.8 Mpps
- Linear and circular interpolation accuracies: ±0.5 LSB
- Maximum manual pulser input frequency: 100KHz

1.3.2 I/O signals

- Number of general purpose digital input: 28 (Isolated)
- Number of general purpose digital output: 28 (Isolated)
- Command signals: PUL and DIR (Non-isolated)
- Mechanical limit/switch signal input pins: ±EL, SD and ORG (Isolated)
- Servo motor interface I/O pins: INP, ALM and ERC (Isolated)
- Pulser signal input pin: PA and PB (Non-isolated)

1.3.3 User program memory

- User program：9999 lines G-code for each G-code program

1.4 Power Supply

- 24VDC±5%

1.5 Communication Interface

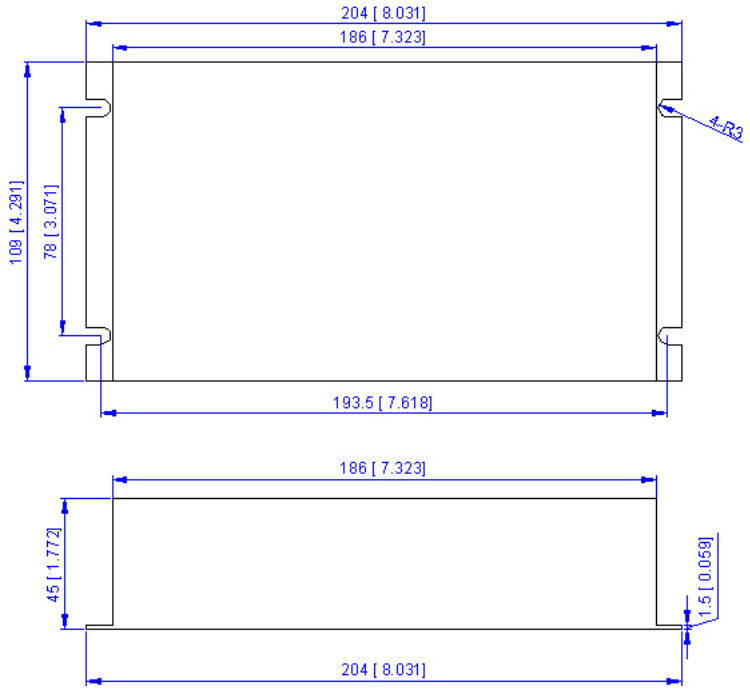
- USB disk interface: USB1.1
- Serial interface: RS-232

1.6 Environment

- Operating temperature: 0℃～50℃

- Storage temperature: -20℃～80℃
- Humidity: 5%RH ~ 85%RH

1.7 Mechanical Specification (Unit = mm[inch])



1.8 Applications

- Electronic assembly and measurement equipments
- Semiconductor and LCD manufacturing &measurement equipments
- Laser cutting/engraving/marking equipments
- Vision & measurement automation equipments
- Biotech sampling and handing devices
- Robotics
- Special CNC machines

Chapter 2 Installation

This chapter describes how to install SMC6400B

2.1 Package Connect

Besides this User's Manual (Electronic Edition), the package also includes the following items, depending to your actual order:

- SMC6400B (1 piece) - 4-Axis Stand-Alone Motion Controller
- Cable15-1.0 (4 piece) – Control signal cable for each axis
- ACC6400 (1 piece) - Terminal Board for digital I/O.
- Cable20-0.4 (2 piece) – Cable for CC6400.
- Cable10-0.4 (1 piece, Optional) – Cable for digital output 17-24
- Cable10-0.4 (1 piece, Optional) – Cable for manual pulse input
- Touch Screen (1 piece, Optional) – HMI and setting parameters
- CABLE09-1.0 (1 piece, Optional) – RS232 cable connected to HMI
- Leadshine All-in-one CD(Including the software)

If any of these items are missing or damaged, contact the dealer from whom you purchased the product or Leadshine.

2.2 Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the SMC6400B from its packaging, ground yourself to eliminate any stored static charge. The controller contains electro-static sensitive components that can be easily damaged by static electricity. Therefore, the controller should be handled on a grounded anti-static mat. Inspect the card module carton for obvious damage. Shipping and handling may cause damage to your module. Be sure there is no shipping and handling damage on the carton before continuing.

Note: Do not attempt to install a damaged controller.

2.3 Hardware Installation

Before installation, the user needs to prepare a 24VDC power supply which offers 2.0Amp output current at the least.

Installation Procedures

1. Turn off the 24VDC power supply;
2. Before handling the controller, discharge any static buildup on your body by touching the metal case of the computer.
3. Connect the two power leads to SMC6400B's **24VDC power input connector**.
4. Connect the **terminal board** and corresponding cables to SMC6400B, depending on your configuration. See the following chapters for more information.
5. If you have ordered a **HMI**, connect it to the controller's **RS232 interface** via **Calbe09-1.0.** Otherwise, you need to prepare a computer with one serial port at least. Connect the controller to computer's serial port via **Cable09-1.0**.

Chapter 3 Connectors

SMC6400B consists of a logic board and a drive board, which are interconnected by two connectors on the side of the boards. A couple of connectors are assembled on the boards for different usage. See Figure 3-1 for more details.

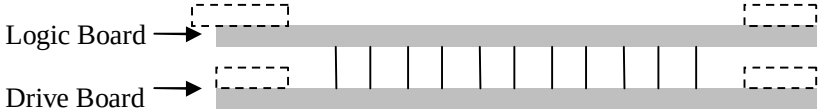


Figure 3-1 SMC6400B structure

3.1 Connectors on logic board

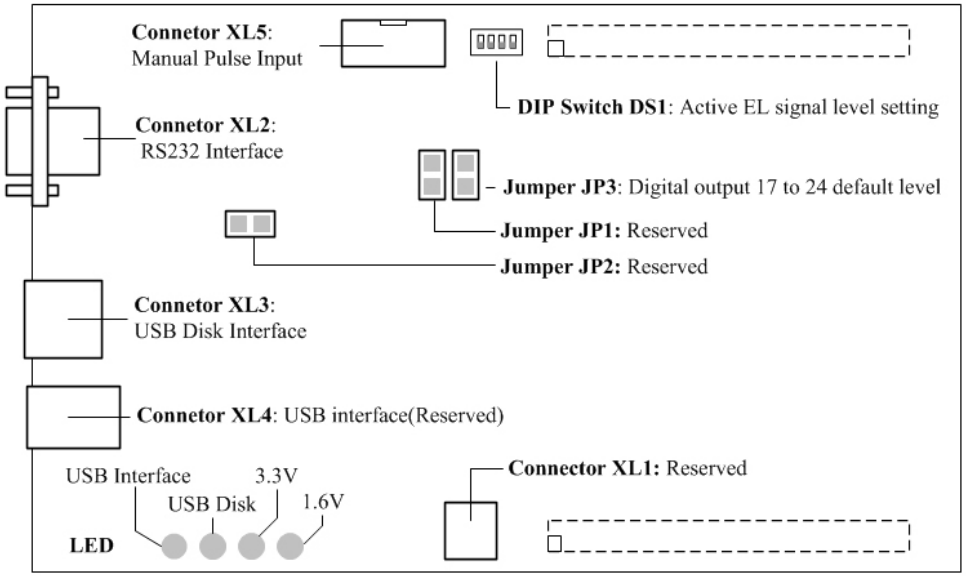


Figure 3-2 Logic board layout

Table 3-1 Connectors on logic board

Connector	Description	Connector	Description
XL1	Reserved	XL4	Reserved
XL2	RS232 serial port	XL5	Manual pulse input interface
XL3	USB disk interface		

3.1.1 Connector XL1 - Reserved

It is reserved for further development.

3.1.2 Connector XL2 – RS232 Serial port

This port is used for communication between SMC6400B and computer or HMI by a serial cable.

Table 3-2 XL2 Pin function

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
1	NC	-	Not connected	6	NC	-	Not connected
2	RX	I	RS232 receive	7	NC	-	Not connected
3	TX	O	RS232 transmit	8	NC	-	Not connected
4	NC	-	Not connected	9	NC	-	Not connected
5	GND	GND	Ground				Not connected

3.1.3 Connector XL3 - USB disk interface

If G-code programs are stored in a USB Disk, the user can load or reload them form it via this port.

3.1.4 Connector XL4 - Reserved

It is reserved for further development.

3.1.5 Connector XL5 - Manual pulse input interface

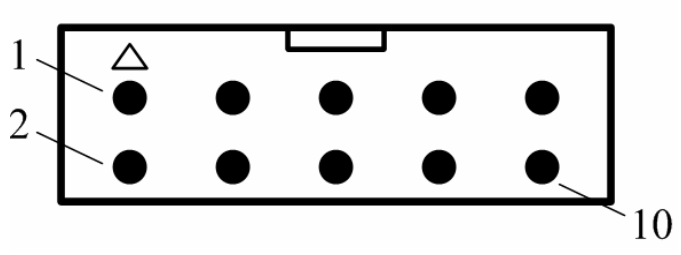


Figure 3-3 XL5 pin layout

Table 3-3 XL5 pin function

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
1	NC	-	Not connected	6	*VCC	O	5VDC
2	NC	-	Not connected	7	*GND	-	Ground
3	NC	-	Not connected	8	*GND	-	Ground
4	NC	-	Not connected	9	PA	I	Phase A of Manual pulse
5	*VCC	O	5VDC	10	PB	I	Phase B of Manual pulse

*Note: VCC is generated by internal circuit; do not connect GND to power ground EGND.

3.2 Connectors on drive board

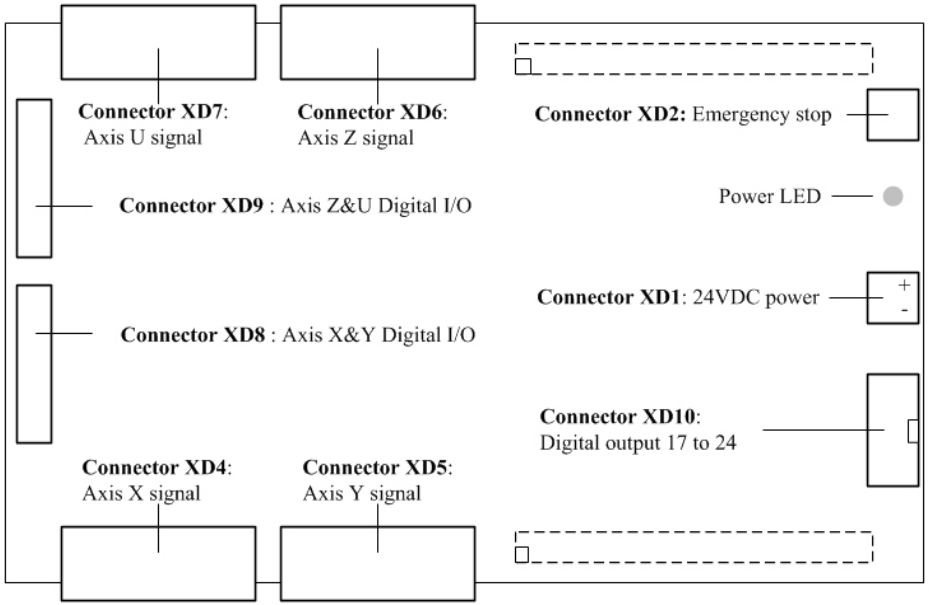


Figure 3-4 Drive board layout

Table 3-4 Connectors on drive board

Connector	Description	Connector	Description
XD1	24VDC power input	XD6	Axis Z control signal
XD2	Emergency stop input	XD7	Axis U control signal
XD3	Reserved	XD8	Axis X&Y digital I/O
XD4	Axis X control signal	XD9	Axis Z&U digital I/O
XD5	Axis Y control signal	XD10	Digital output 17 to 24

3.2.1 Connector XD1 – 24VDC power input

Table 3-5 XD1 Pin function

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
1	VDD	I	24VDC power	2	EGND	GND	Power Ground

3.2.2 Connector XD2 – Emergency stop input

Table 3-6 XD3 pin function

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
1	EMG	I	Emergency stop	2	EGND	GND	Power Ground

3.2.3 Connector XD3 – Reserved

It is reserved for further development.

3.2.4 Connector XD4 – Axis X control signal

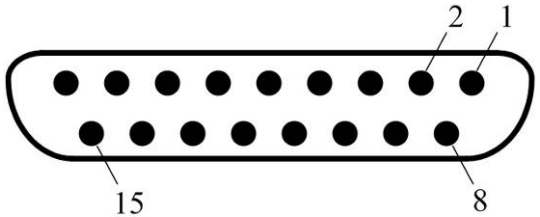


Figure 3-5 XD4 Pin layout

Table 3-7 Pin function of XD4

Pin	Signal	I/O	Description
1	VCC	O	+5VDC Power
2	PUL1-	O	Pulse signal(-),Axis X
3	DIR1-	O	Direction signal(-), Axis X
4	ERC1	O	Error clear signal, Axis X
5	INPUT17	I*	Digital input 17 or Manual pulse input function
6	ORG1	I	Origin signal, Axis X
7	EL1-	I	End limit signal(-), Axis X
8	EGND	GND	Power Ground
9	PUL1+	O	Pulse signal(+), Axis X
10	DIR1+	O	Direction signal(+), Axis X
11	OUT25	O*	Digital output 25,
12	INP1 / INPUT19	I*	Axis X in position signal or Digital input 19
13	ALM1	I	Alarm signal, Axis X
14	SD1/ INPUT18	I*	Axis X slow down signal or Digital input 18
15	EL1+	I	End limit signal, Axis X

3.2.5 Connector XD5 – Axis Y control signal

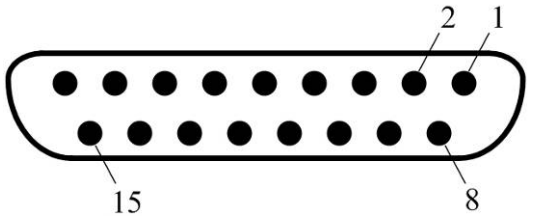


Figure 3-6 XD5 pin layout

Table 3-8 XD5 pin function

Pin	Signal	I/O	Description
1	VCC	O	+5VDC Power
2	PUL2-	O	Pulse signal(-),Axis Y

3	DIR2-	O	Direction signal(-), Axis Y
4	ERC2	O	Error clear signal, Axis Y
5	INPUT20	I*	Digital input 20 or Manual pulse input function
6	ORG2	I	Origin signal, Axis Y
7	EL2-	I	End limit signal(-), Axis Y
8	EGND	GND	Power Ground
9	PUL2+	O	Pulse signal(+), Axis Y
10	DIR2+	O	Direction signal(+), Axis Y
11	OUT26	O*	Digital output 25,
12	INP2 / INPUT22	I*	Axis Y in position signal, or Digital input 22
13	ALM2	I	Alarm signal, Axis Y
14	SD2 / INPUT22	I*	Axis Y slow down signal or Digital input 22
15	EL2+	I	End limit signal, Axis Y

3.2.6 Connector XD6 – Axis Z control signal

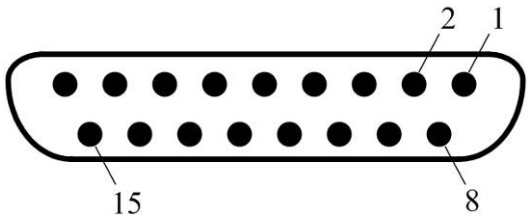


Figure 3-7 XD6 pin layout

Table 3-9 XD6 pin function

Pin	Signal	I/O	Description
1	VCC	O	+5VDC Power
2	PUL3-	O	Pulse signal(-),Axis Z
3	DIR3-	O	Direction signal(-), Axis Z
4	ERC3	O	Error clear signal, Axis Z
5	INPUT23	I*	Digital input 23 or Manual pulse input function
6	ORG3	I	Origin signal, Axis Z

7	EL3-	I	End limit signal(-), Axis Z
8	EGND	GND	Power Ground
9	PUL3+	O	Pulse signal(+), Axis Z
10	DIR3+	O	Direction signal(+), Axis Z
11	OUT27	O*	Digital output 27,
12	INP3 / INPUT25	I*	In position signal, Axis Z or Digital input 25
13	ALM3	I	Alarm signal, Axis Z
14	SD3 / INPUT24	I*	Axis Z slow down signal or Digital input 24
15	EL3+	I	End limit signal, Axis Z

3.2.7 Connector XD7 – Axis U control signal

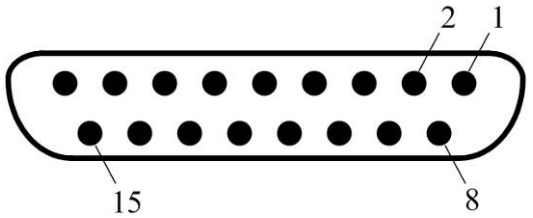


Figure 3-8 XD7 pin layout

Table 3-10 XD7 pin function

Pin	Signal	I/O	Description
1	VCC	O	+5VDC Power
2	PUL4-	O	Pulse signal(-),Axis U
3	DIR4-	O	Direction signal(-), Axis U
4	ERC4	O	Error clear signal, Axis U
5	INPUT26	I*	Digital input 26 or Manual pulse input function
6	ORG4	I	Origin signal, Axis U
7	EL4-	I	End limit signal(-), Axis U
8	EGND	GND	Power Ground
9	PUL4+	O	Pulse signal(+), Axis U
10	DIR4+	O	Direction signal(+), Axis U

11	OUT28	O*	Digital output 28,
12	INP4 / INPUT28	I*	In position signal, Axis U or Digital input 28
13	ALM4	I	Alarm signal, Axis U
14	SD4 / INPUT27	I*	Axis U slow down signal or Digital input 27
15	EL4+	I	End limit signal, Axis U

3.2.8 Connector XD8 – Axis X&Y Digital I/O

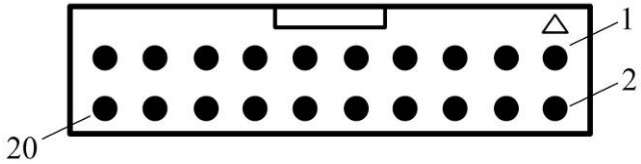


Figure 3-9 XD8 pin layout

Table 3-11 XD8 pin function

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
1	E5V	O	*+5VDC power	11	OUT1	O	Digital output 1
2	EGND	GND	Ground	12	OUT2	O	Digital output 2
3	INPUT8	I	Digital input 8	13	OUT3	O	Digital output 3
4	INPUT7	I	Digital input 7	14	OUT4	O	Digital output 4
5	INPUT6	I	Digital input 6	15	OUT5	O	Digital output 5
6	INPUT5	I	Digital input 5	16	OUT6	O	Digital output 6
7	INPUT4	I	Digital input 4	17	OUT7	O	Digital output 7
8	INPUT3	I	Digital input 3	18	OUT8	O	Digital output 8
9	INPUT2	I	Digital input 2	19	COM	O	+24VDC power
10	INPUT1	I	Digital input 1	20	EGND	GND	Ground

*Note: The +5VDC power is generated by internal circuit.

3.2.9 Connector XD9 – Axis Z&U Digital I/O

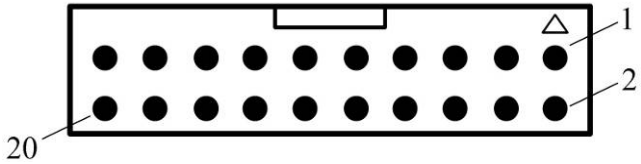


Figure 3-10 XD9 pin layout

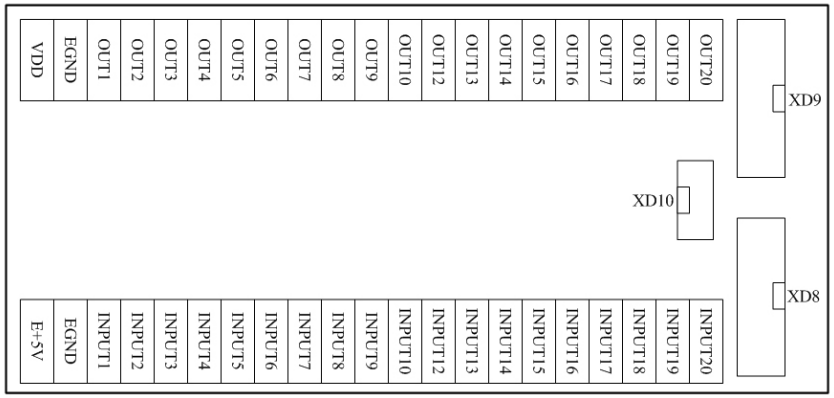


Figure 3-11 Terminal board ACC6400 pin layout

Table 3-12 XD8 pin function

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
1	E5V	O	*+5VDC power	11	OUT16	O	Digital output 16
2	EGND	GND	Ground	12	OUT15	O	Digital output 15
3	INPUT9	I	Digital input 9	13	OUT14	O	Digital output 14
4	INPUT10	I	Digital input 10	14	OUT13	O	Digital output 13
5	INPUP11	I	Digital input 11	15	OUT12	O	Digital output12
6	INPUT12	I	Digital input 12	16	OUT11	O	Digital output 11
7	INPUT13	I	Digital input 13	17	OUT10	O	Digital output 10
8	INPUT14	I	Digital input 14	18	OUT9	O	Digital output 9
9	INPUT15	I	Digital input 15	19	COM	O	+24VDC power
10	INPUT16	I	Digital input 16	20	EGND	GND	Ground

*Note: The +5VDC power is generated by internal circuit.

3.2.10 Connector XD10 – Digital Output 17 to 24

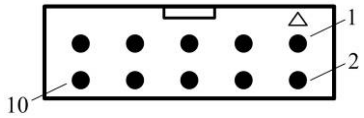


Figure 3-12 XD10 pin layout

Table 3-13 XD10 pin function

Pin	Signal	I/O	Description	Pin	Signal	I/O	Description
1	OUT24	O	Digital Output 24	6	OUT19	O	Digital Output 19
2	OUT23	O	Digital Output 23	7	OUT18	O	Digital Output 18
3	OUT22	O	Digital Output 22	8	OUT17	O	Digital Output 17
4	OUT21	O	Digital Output 21	9	EGND	O	Digital Output 16
5	OUT20	O	Digital Output 20	10	-	-	-

*Note: The +5VDC power is generated by internal module.

3.3 Special function input

Table 3-14 Special input signals

Digital input	Connector	Pin	Description
Digital input 17	XD4	5	Axis X manual pulse input selection, active low
Digital input 18	XD4	14	Axis X slow down signal / 10×manual pulse rate
Digital input 19	XD4	12	Axis X in-position signal
Digital input 20	XD5	5	Axis Y manual pulse input selection, active low
Digital input 21	XD5	14	Axis Y slow down signal / 100×manual pulse rate
Digital input 22	XD5	12	Axis Y in-position signal
Digital input 23	XD6	5	Axis Z manual pulse input selection, active low
Digital input 24	XD6	14	Axis Z slow down signal
Digital input 25	XD6	12	Axis Z in-position signal
Digital input 26	XD7	5	Axis U manual pulse input selection, active low
Digital input 27	XD7	14	Axis U slow down signal
Digital input 28	XD7	12	Axis U in-position signal

3.4 Dedicated I/O

Table 3-16 Dedicated output

Digital Output	Connector	Pin	Description
OUT1	XD8	11	It can be set by M07 & M08
OUT2	XD8	12	It can be set by M09 & M10
OUT3	XD8	13	It can be set by M11 & M12

Table 3-15 Dedicated input

Digital input	Signal	Connector	Pin	Description
INPUT1	**START**	XD8	10	Start program execution
INPUT 2	**PAUSE**	XD8	9	Pause program execution
INPUT 3	**ISTOP**	XD8	8	Immediately stop
INPUT 4	**HOME**	XD8	7	Home all the axis
INPUT 5	**X++**	XD8	6	Move axis X in + direction
INPUT 6	**X--**	XD8	5	Move axis X in - direction
INPUT 7	**Y++**	XD8	4	Move axis Y in + direction
INPUT 8	**Y--**	XD8	3	Move axis Y in - direction
INPUT9	**Z++**	XD9	3	Move axis Z in + direction
INPUT10	**Z--**	XD9	4	Move axis Z in - direction
INPUT11	**U++**	XD9	5	Move axis U in + direction
INPUT12	**U--**	XD9	6	Move axis U in - direction
INPUT13	**S-OUT1**	XD9	7	State of OUT1
INPUT14	**S-OUT2**	XD9	8	State of OUT2
INPUT15	**S-OUT3**	XD9	9	State of OUT3
INPUT16	**TEACHING**	XD9	10	Confirm teaching function(Optional)

Chapter 4 Interface Circuit

4.1 Pulse and Direction signal PUL/DIR

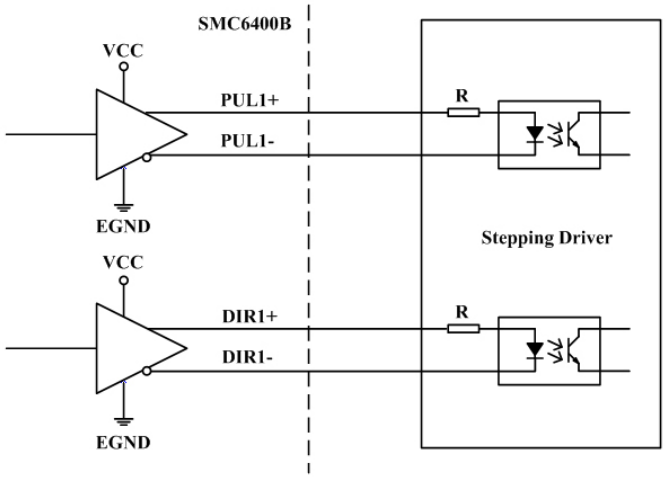


Figure 4-1 PUL/DIR differential output

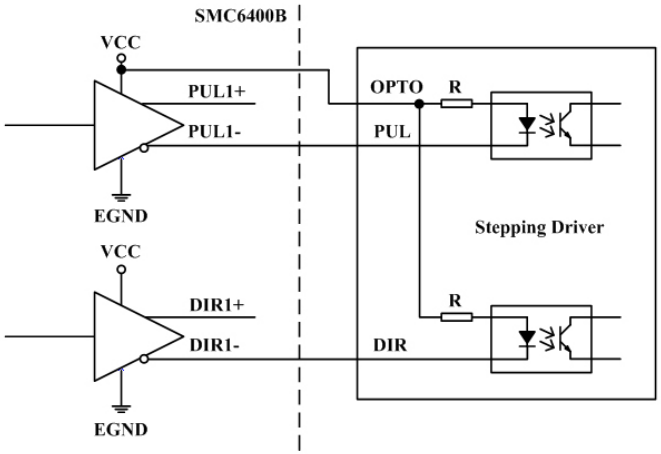


Figure4-2 PUL/DIR single-ended output

Table 4-1 VCC/PUL/DIR Pins

Connector	Pin	Signal	Description
XD4	1	VCC	+5V Power
XD4	2	PUL1-	Pulse signal(-), Axis X
XD4	9	PUL1+	Pulse signal(+), Axis X
XD4	3	DIR1-	Direction signal(-), Axis X
XD4	10	DIR1+	Direction signal(+), Axis X
XD5	1	VCC	+5V Power
XD5	2	PUL2-	Pulse signal(-), Axis Y
XD5	9	PUL2+	Pulse signal(+), Axis Y
XD5	3	DIR2-	Direction signal(-), Axis Y
XD5	10	DIR2+	Direction signal(+), Axis Y
XD6	1	VCC	+5V Power
XD6	2	PUL3-	Pulse signal(-), Axis Z
XD6	9	PUL3+	Pulse signal(+), Axis Z
XD6	3	DIR3-	Direction signal(-), Axis Z
XD6	10	DIR3+	Direction signal(+), Axis Z
XD7	1	VCC	+5V Power
XD7	2	PUL4-	Pulse signal(-), Axis U
XD7	9	PUL4+	Pulse signal(+), Axis U
XD7	3	DIR4-	Direction signal(-), Axis U
XD7	10	DIR4+	Direction signal(+), Axis U

4.2 Digital output OUT

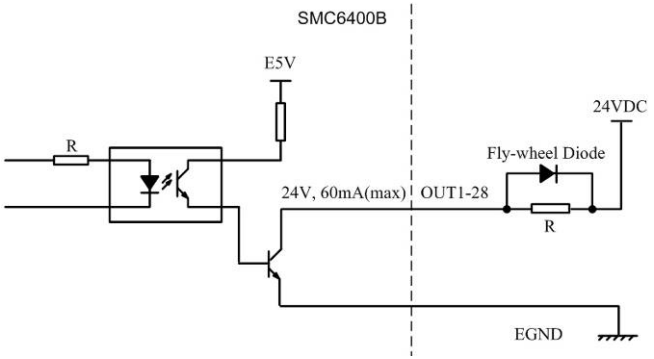


Figure 4-3 Digital output circuit

Table 4-2 Digital output pins

Connector	Pin	Signal	Description
XD8	11	OUT1	Digital output1, Axis X
XD8	12	OUT2	Digital output2, Axis X
XD8	13	OUT3	Digital output3, Axis X
XD8	14	OUT4	Digital output4, Axis X
XD8	15	OUT5	Digital output5, Axis Y
XD8	16	OUT6	Digital output6, Axis Y
XD8	17	OUT7	Digital output7, Axis Y
XD8	18	OUT8	Digital output8, Axis Y
XD9	18	OUT9	Digital output9, Axis Z
XD9	17	OUT10	Digital output10, Axis Z
XD9	16	OUT11	Digital output11, Axis Z
XD9	15	OUT12	Digital output12, Axis Z
XD9	14	OUT13	Digital output13, Axis U
XD9	13	OUT14	Digital output14, Axis U
XD9	12	OUT15	Digital output15, Axis U
XD9	11	OUT16	Digital output16, Axis U

Table 4-3 Digital output pins

Pin	Signal	Description	Logic level at power up	
			JP3 short circuit	JP3 open circuit
XD10 Pin3	OUT17	Digital output17	HIGH	LOW
XD10 Pin4	OUT18	Digital output18	HIGH	LOW
XD10 Pin5	OUT19	Digital output19	HIGH	LOW
XD10 Pin6	OUT20	Digital output20	HIGH	LOW
XD10 Pin7	OUT21	Digital output21	HIGH	LOW
XD10 Pin8	OUT22	Digital output22	HIGH	LOW
XD10 Pin9	OUT23	Digital output23	HIGH	LOW
XD10 Pin10	OUT24	Digital output24	HIGH	LOW

4.3 Digital input INPUT

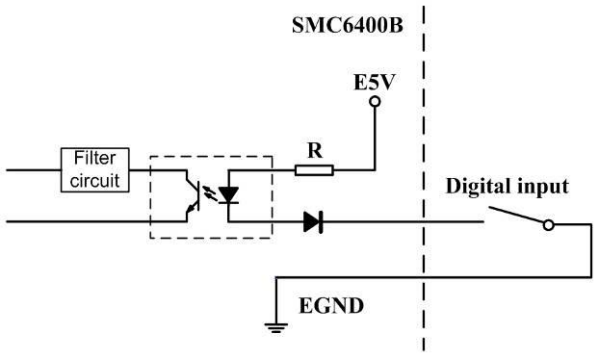


Figure 4-4 Digital input circuit

Table 4-4 Digital input pins

XD8 pin	Signal	Description	XD9 pin	Signal	Description
10	INPUT1	Digital input 1, Axis X	3	INPUT 9	Digital input9, Axis Z
9	INPUT2	Digital input 2, Axis X	4	INPUT 10	Digital input10, Axis Z
8	INPUT3	Digital input 3, Axis X	5	INPUT 11	Digital input11, Axis Z
7	INPUT4	Digital input 4, Axis X	6	INPUT 12	Digital input12, Axis Z
6	INPUT5	Digital input 5, Axis Y	7	INPUT 13	Digital input13, Axis U
5	INPUT6	Digital input 6, Axis Y	8	INPUT 14	Digital input14, Axis U
4	INPUT7	Digital input 7, Axis Y	9	INPUT 15	Digital input15, Axis U
3	INPUT8	Digital input 8, Axis Y	10	INPUT 16	Digital input16, Axis U

4.4 Origin signal ORG

Table 4-5 Origin signal pins

Connector	Pin	Signal	I/O	Description
XD4	6	ORG1	I	Origin signal, Axis X
XD5	6	ORG 2	I	Origin signal, Axis Y
XD6	6	ORG 3	I	Origin signal, Axis Z
XD7	6	ORG 4	I	Origin signal , Axis U

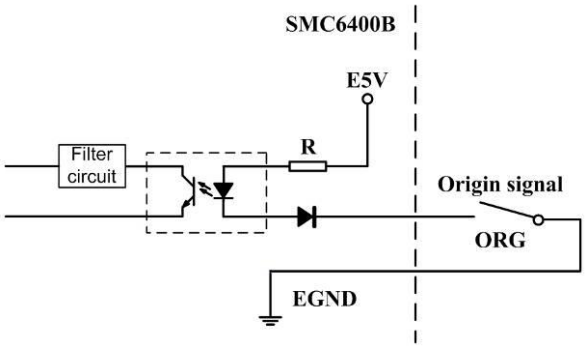


Figure 4-5 Origin signal

4.5 Slow down signal SD

Table 4-6 Slow down signal pins

Connector	Pin	Signal	I/O	Description
XD4	14	SD1	I	Slow down signal, Axis X
XD5	14	SD2	I	Slow down signal, Axis Y
XD6	14	SD3	I	Slow down signal, Axis Z
XD7	14	SD4	I	Slow down signal , Axis U

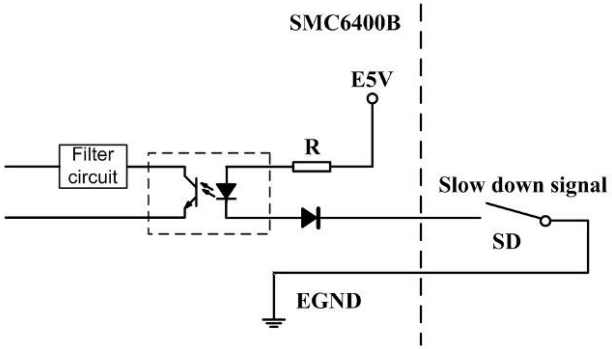


Figure 4-6 Slow down signal

4.6 In-position signal INP

Table 4-7 In-position signal pins

Connector	Pin	Signal	I/O	Description
XD4	12	INP1	I	In-position signal, Axis X
XD5	12	INP2	I	In-position signal, Axis Y
XD6	12	INP3	I	In-position signal, Axis Z
XD7	12	INP4	I	In-position signal , Axis U

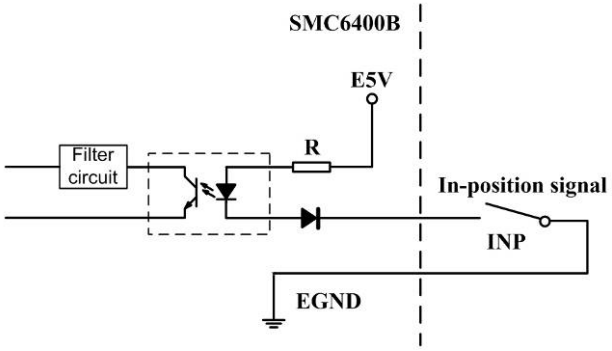


Figure 4-7 In-position signal

4.7 End limit signal EL+ & EL-

Table 4-8 End limit signal pins

Connector	Pin	Signal	I/O	Description
XD4	7	EL1-	I	End limit signal -, Axis X
XD4	15	EL1+	I	End limit signal +, Axis X
XD5	7	EL2-	I	End limit signal -, Axis Y
XD5	15	EL2+	I	End limit signal +, Axis Y
XD6	7	EL3-	I	End limit signal -, Axis Z
XD6	15	EL3+	I	End limit signal +, Axis Z
XD7	7	EL4-	I	End limit signal -, Axis U
XD7	15	EL4+	I	End limit signal +, Axis U

Table 4-9 End limit Signal setting switch DS1

Note: See ‘Connectors on logic board’ section to find DS1.

DIP	ON/OFF	End limit switch type
1	ON	EL0+/EL0- Normal Close
	OFF	EL0+/EL0- Normal Open

2	ON	EL1+/EL0- Normal Close
	OFF	EL1+/EL0- Normal Open
3	ON	EL1+/EL0- Normal Close
	OFF	EL1+/EL0- Normal Open
4	ON	EL1+/EL0- Normal Close
	OFF	EL1+/EL0- Normal Open

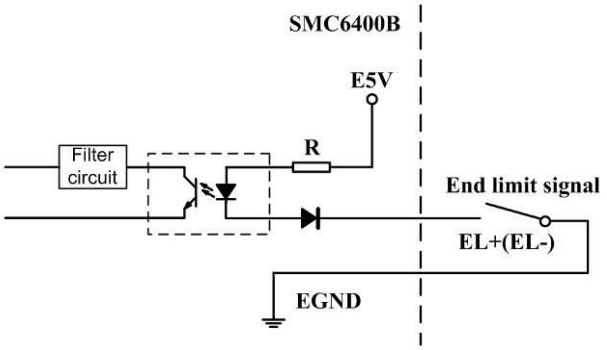


Figure 4-8 End limit signal

4.8 Alarm Signal ALM

Table 4-10 Alarm signal pins

Connector	Pin	Signal	I/O	Description
XD4	13	ALM1	I	Alarm signal, Axis X
XD5	13	ALM 2	I	Alarm signal, Axis Y
XD6	13	ALM 3	I	Alarm signal, Axis Z
XD7	13	ALM 4	I	Alarm signal, Axis U

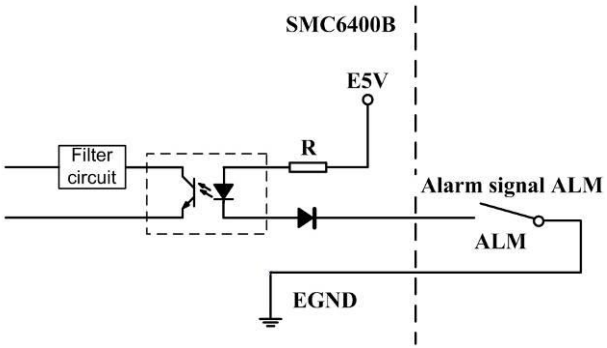


Figure 4-9 Alarm signal

4.9 Emergency stop signal EMG

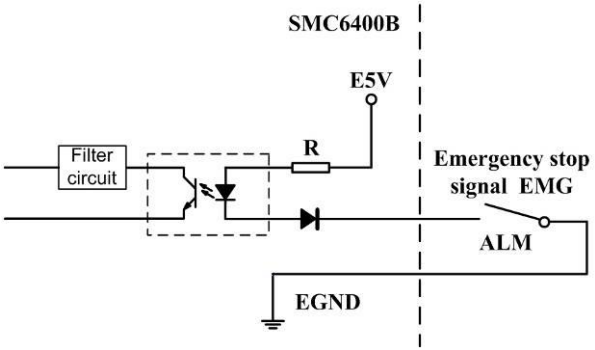


Figure 4-10 Emergency stop signal

5.0 Manual pulse input PA & PB

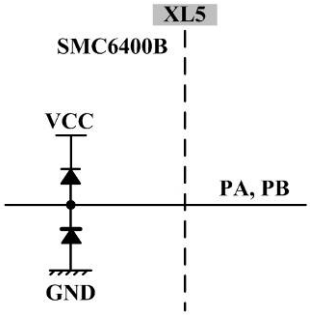


Figure 4-11 Manual input signal

Chapter 5 Connections

5.1 Connection to differential stepping driver

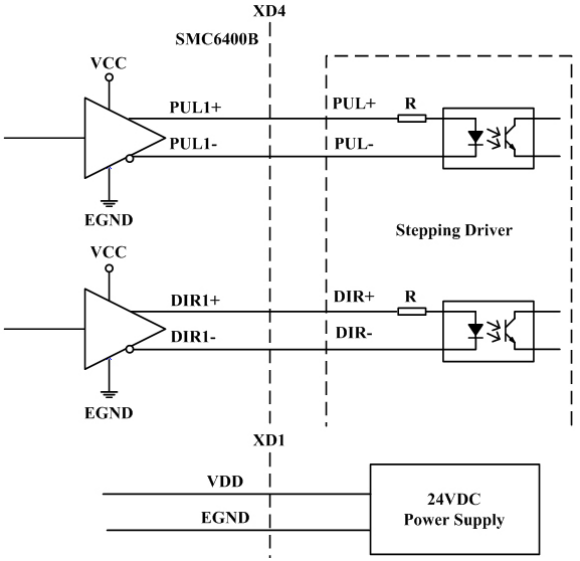


Figure 5-1 Connection to differential stepping driver

5.2 Connection to single-ended stepping driver

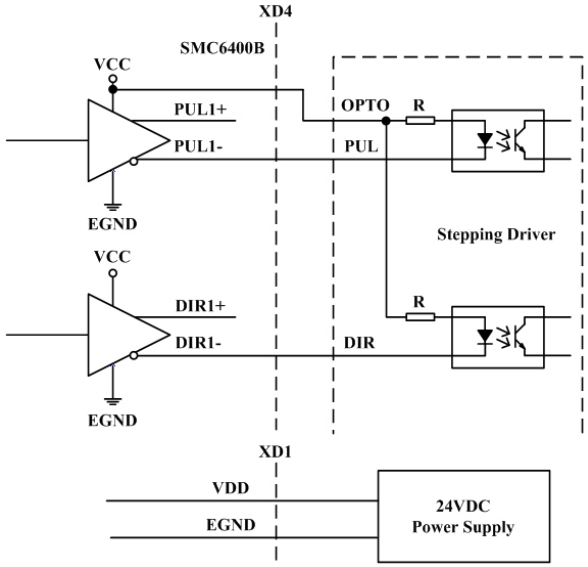


Figure 5-2 Connection to single-ended stepping driver

5.3 Connection to servo driver

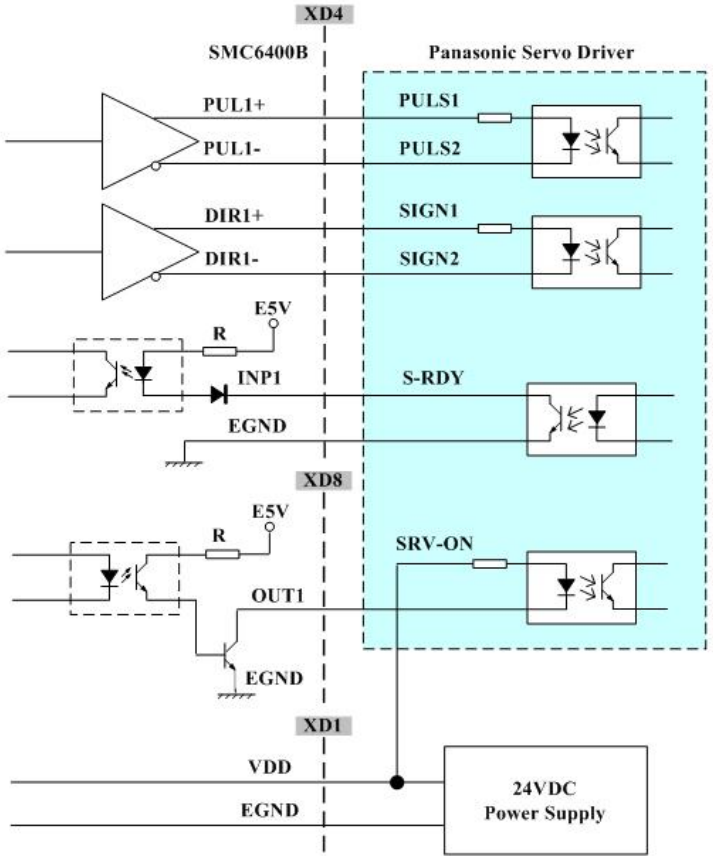


Figure 5-3 Connection to servo driver

5.4 Dedicated I/O connection

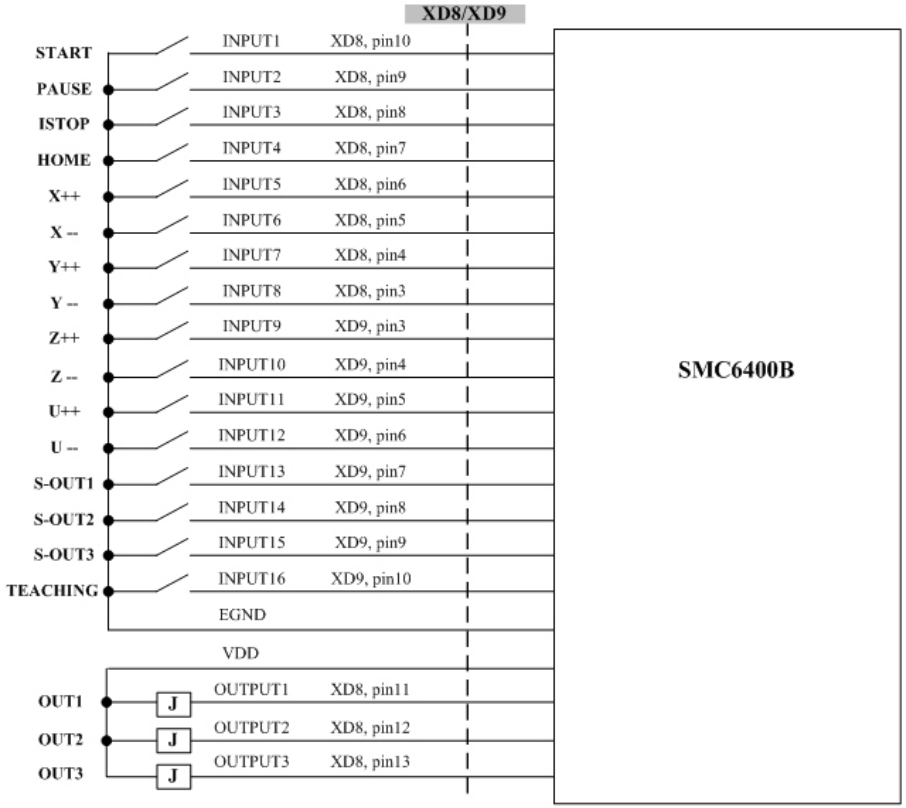
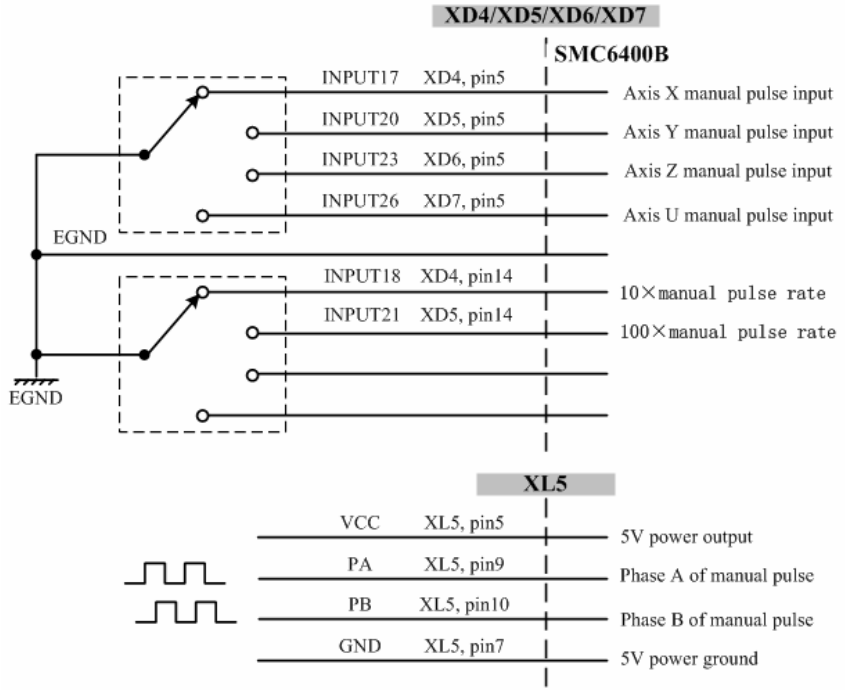


Figure 5-4 Dedicated input and output connection

5.5 Manual pulse input connection



Note: Do not connect GND to EGND

Figure 5-5 Manual pulse input connection

Chapter 6 Demo HMI for SMC6400B

6.1 Root window

Power on SMC6400B and HMI, the HMI will show the root window as Figure 6-1.

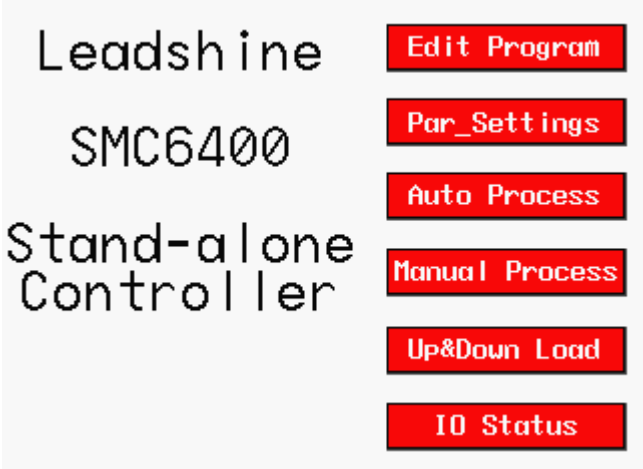


Figure 6-1 Root window

6.2 Edit G-code program

Click "Edit program" button in root window will prompt the G-code edit window as Figure 6-2. The user can edit, view and delete the G-code program in this window.

G-code Program NO input field: Click to select which G-code program to be work on. The G-code program is represented by numbers ranged from 1 to 16.

Modify: Click and enter the password (Note1), the file attribute window will prompt as Figure 6-3. In this window, you can configure the file attribute such as file name, array process, origin. See section 6.1.1 for more information.

Edit: Click and enter the password (Note1), the G-code editing window will prompt as Figure 6-4. In this window, you can edit (insert, delete and view) each line of the current G-code program. See section 6.1.2 for more information.

View: Click to view all the lines of current G-code program as Figure 6-5. See section 6.1.3 for more information.

Delete: Click and enter the password (Note1) to delete the current G-code program. Be careful! All the lines will be clear without any further notification.

Teach, playback: Click and enter the password (Note1), the teaching and playback window which helps on generating G-codes in a easy way will prompt as Figure 6-6. See section 6.1.4 for more information.

Help: Click to view the help information for all the G-code instructions, as shown in Figure 6-7. See section 6.1.5 for more information.

Menu: Click to return to the root window.

Note1: The user can set this password for editing parameters in Password Configuration Window.

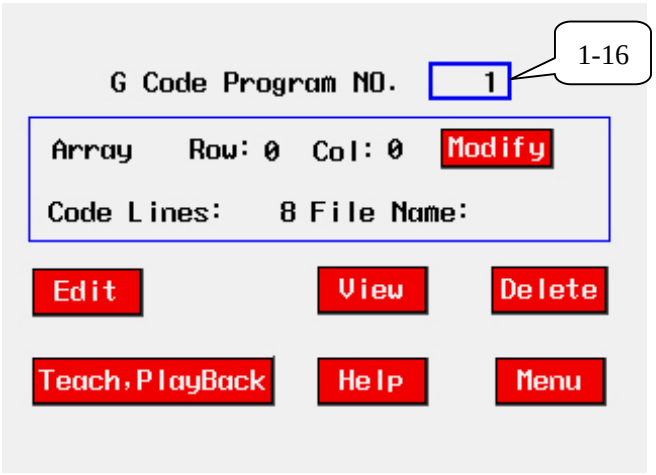


Figure 6-2 G-code Edit window

6.2.1 File attribute window

Here, "file" is different from G-code program. If we consider a G-code program as a cell which gives tool path information of a drawing, a "file" is an array which has multiple of cells. The user can configure the offset between rows and columns of these

cells. This is very helpful when there are many work pieces on the table to be processed. What's more, each file can has its own working origin which is independent from the mechanical origin. **But note that one file only has one G-code program and the file name is equivalent to the G-code program NO.** So you can take the file to be a G-code program with other features such as multiple operations, independent origin.

Click "Modify" button in the edit program window will prompt the file attribute window as Figure 6-3.

Array process: Set the number and offset of duplicating rows & columns of current file. The user can click the corresponding input field to enter the number. **Order** button decides whether row or column to be worked first.

Indep_Home: Set the working origin of the current file. The user can click the corresponding input field to enter the number. Or just click **X-**, **X+**, **Y-**, **Y+**, **U-**, **U+**, **Z-**, and **Z+** button to adjust the origin manually. Clicking **Positioning** button makes the tool move to setting origin. Toggle the "No" button to configure whether this origin is independent from the mechanical origin.

File input field: Click to enter the file name. A keyboard including number and character will prompt for input.

Save: Don't remember to click this button. Otherwise the updated parameters would be saved to current file.

Back: Return to the parent window as Figure 6-2.

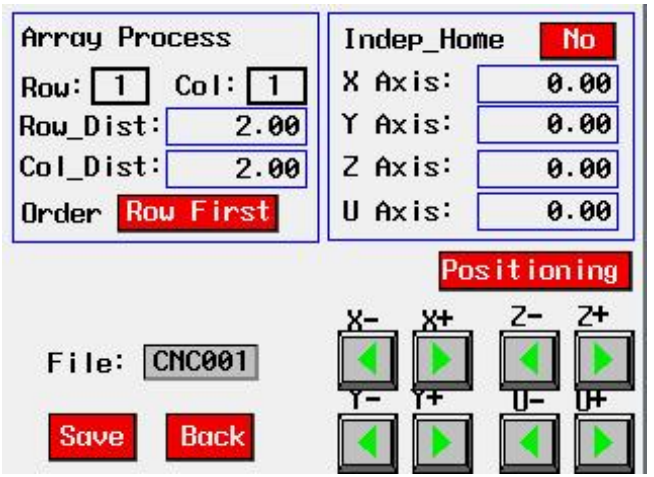


Figure 6-3 File attribute window

6.2.2 G-code edit window

Click "Edit" button in the "edit program" window will prompt the G-code edit window as Figure 6-4. The G-codes are edited line by line in this window. The line number, G-code word and corresponding parameters can be edited by clicking the input field. Coordinate of each axis can also be adjusted by the green arrow key on the button right.

Begin your first G-code program as follows:

1) Select the G-code word in "G01" field;
2) Modify the parameters;
3) Enter a line number in the "N" input field if flow control needed.
4) Save current line;
5) Click "▼" to insert a new line.

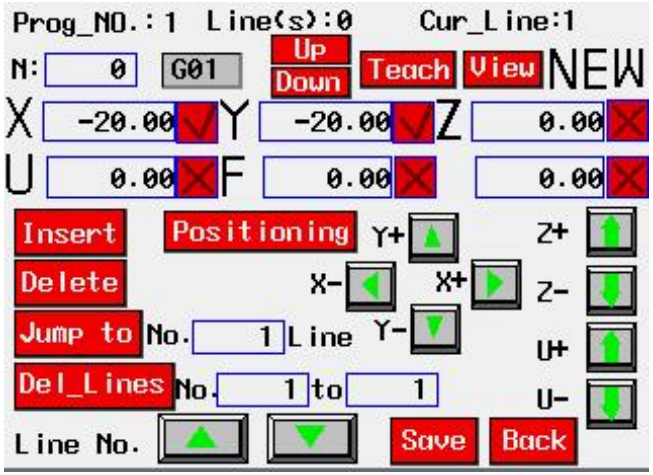


Figure 6-4 G-codes editing window

Prog_NO: G-code program number.

Line(s): Total lines of current G-code program.

Cur_Line: Current line of current G-code program.

N input field**:** Line number of G-code.

G01 input field: G-code word. See section 7.3 for more information.

Up, **Down**: Select the G-code word from a preset list.

Teach: Go to the teaching and playback window.

View: View all G-codes had been inserted.

X, **Y**, **Z**, **U**, **F** input field: G-code parameters such as coordinate, feed rate. The actual content is depending on the G-code word.

√, ×: Enable or disable parameters.

Insert: Insert a new line. A "NEW" will be displayed in the top right. The "NEW" will disappear after clicking Save button.

Delete: Delete the current line.

Jump to: Jump to the line you want to view or edit.

Del_Lines: Delete lines.

Positioning: Position the tool to the updated coordinate.

X-, **X+**, **Y-**, **Y+**, **Z+**, **Z-**, **U+**, **U-** arrow key: Manually adjust the coordinate.

Line No: The "▲"and "▼" button are used to view each G-code line had been inserted. A new line will be inserted automatically if the current line number exceeds the total lines.

Save: Save the current line parameters.

Back: Return to parent window.

6.2.3 G-code view window

Click "View" button in the "G-code edit window" will prompt the G-code view window as Figure 6-5. The complete G-code program can be view in this window. G-code program No., total lines and current line are displayed at the top.

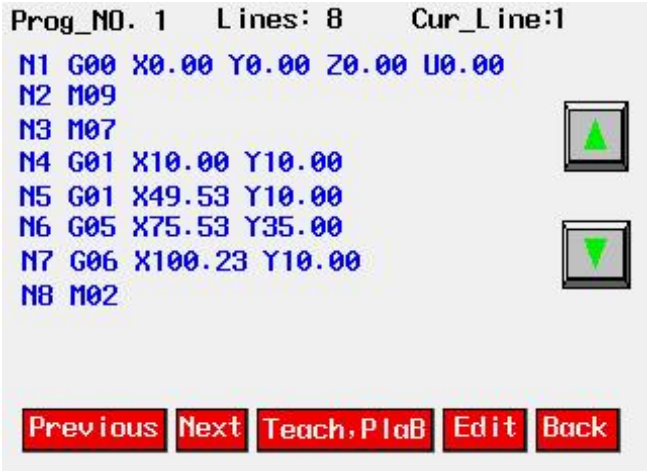


Figure 6-5 G-codes view window

Prog_NO: G-code program number.

Line(s): Total lines of current G-code program.

Cur_Line: Current line of current G-code program.

Previous: Go to previous page.

Next: Go to next page.

▲▼: Scroll page up or down by one line.

Teach, PlaB: Go to teaching and playback window.

Edit: Go to G-code program edit window.

Back: Return to parent window.

6.2.4 Teaching and playback window

Click "Teach, PlayBack" button in the "G-code edit window" will prompt the teaching and playback window as Figure 6-6. If the user does not want to enter the G-codes line by line, the teaching and playback function is a good choice. This window can generate G-codes based on points entered by the user.

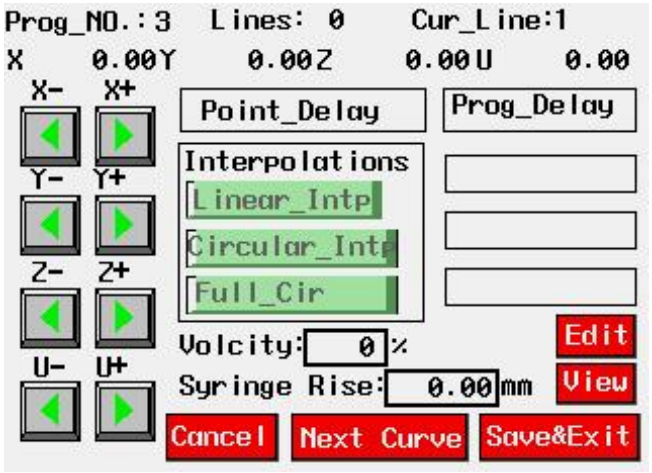


Figure 6-6 Teaching and playback window

Prog_NO: G-code program number.

Line(s): Total lines of current G-code program.

Cur_Line: Current line of current G-code program.

X-, **X+**, **Y-**, **Y+**, **Z-**, **Z+**, **U-**, **U+**: Enter coordinate manually.

Interpolations: Select interpolation mode by the Linear_Intp, Circular_Intp and Full_Cir button. Note that the current point is assumed to be the first point.

Linear_Intp: Linear interpolation mode. When click this button, a message "End of Line" will display in the first pane at the middle right of the window. It indicates the user to offer the end point of a line (It is also the second point). The user can give the end point by X-, X+, Y-, Y+, Z-, Z+, U- and U+ button. Check the coordinate by the second line of this window. After that the user need to click "End of Line". Then G01 code will be automatically inserted to make the axis interpolate from the previous point to the end point.

Circular_Intep: Circular interpolation mode. When click this button, a message "Point_on_Cir" will be display in the second pane at the middle right of the window. Enter the second point on the circular path then click the text "Point_on_Cir". After that a message "End of Cir" will be display in the third pane at the middle right of this window. It is indicate the user to provide the third point of the circular path. Please enter the third point using those arrow keys at the left of the window. The G02 or G03 code will be inserted automatically to make the axis do circular interpolation according to the points enter by the user.

Full_Cir: Full circular interpolation. The operation procedure is similar as circular Interpolation. The final path will be a full circuit instead of a arc.

Point_Delay: Delay time at a point. During this time, the axis is paused and M07 and M09 are executed to open dedicated output port 1 and 2. After the time is gone, M08 and M09 are executed to close dedicated output 1 and 2. This feature is usually in the dispensing machine.

Prog_Delay: Insert a delay time between processes.

Velocity input field: Motion velocity in percentage.

Syringe Rise input field**:** Syringe rising distance in millimeter. In dispending machine, the syringe needs to rise before moving to another point. Syringe is usually installed in axis Z in dispensing system.

Edit: Goes to G-code edit window.

View: Goes to G-code view window.

Cancel: Cancel all the operation. Note that the G-codes will be deleted without further

notification.

Next Curve: If there are two curves to be teaching and there is intermit between them, the system will use G00 to connect them together.

Save & Exit: Save all the G-codes and exit.

6.2.5 G-code help window

Click "Help" button in the "G-code edit window" will prompt the G-code view window as Figure 6-7. This window offers brief information of all the G-codes for quick reference.

Previous: Go to previous page**.**

Next: Go to next page.

Back: Return to previous window.

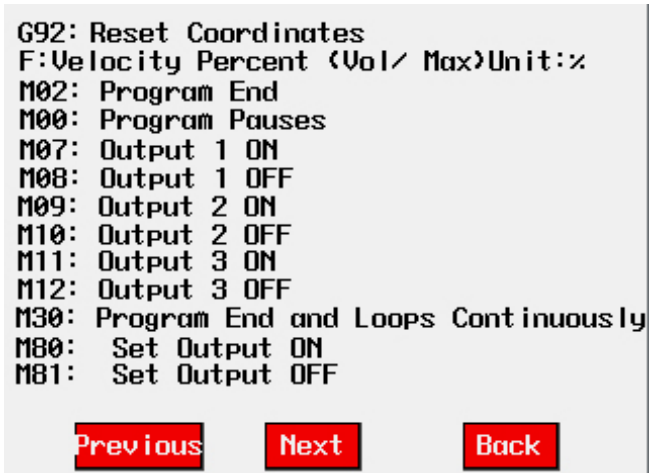


Figure 6-7 G-code help window

6.3 Parameter and option settings

Click "Par_Setting" button in the root window will prompt the parameter settings window as Figure 6-8. Motion profile, backlash compensation, software limit and other

parameters about teaching & playback, factory settings and file size can be configured in this window.

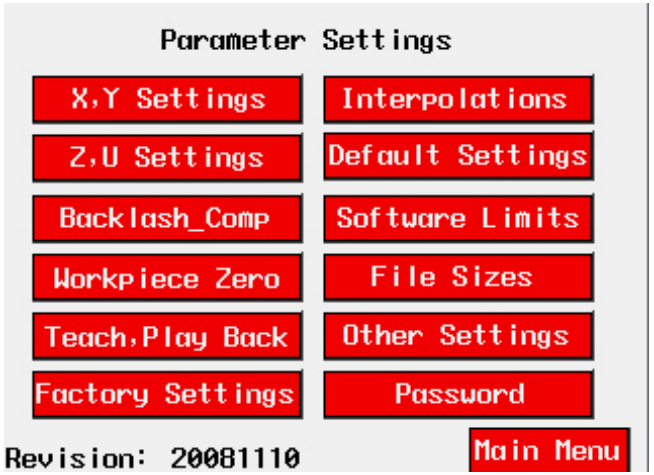


Figure 6-8 Parameter settings window

X, Y Settings: Click "X, Y Settings" button in the "Parameter settings window" will prompt the X, Y settings window as Figure 6-9.

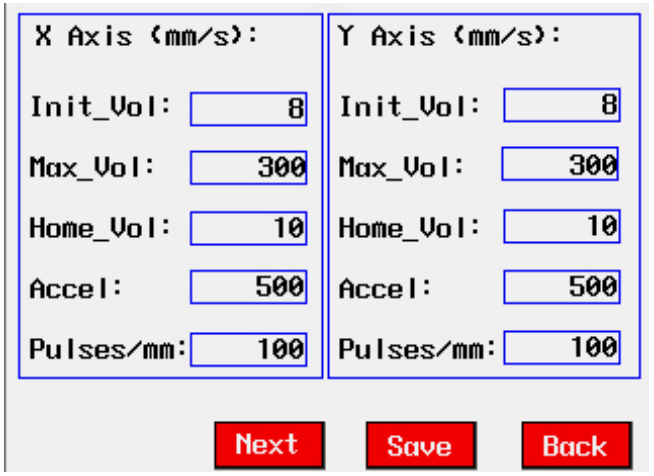


Figure 6-9 X, Y settings window

Motion profile including initial velocity, maximal velocity, home velocity, acceleration and pulses per millimeter for axis X and Y can be set in this window.

Z, U Settings: Click "Z, U Settings" button in the "Parameter settings window" will prompt the Z, U settings window as Figure 6-10.

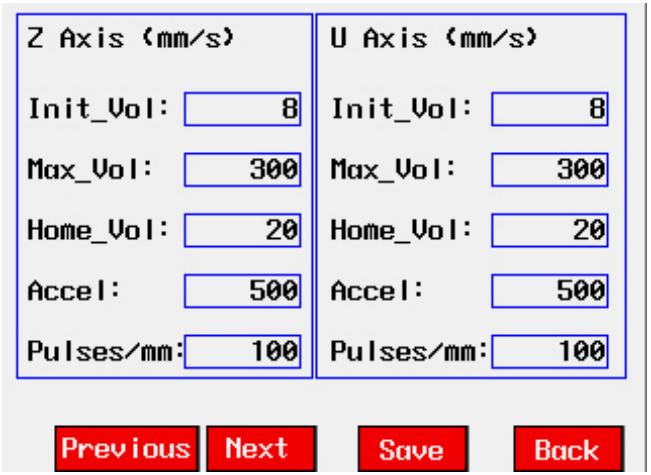


Figure 6-10 Z, U settings window

Motion profile including initial velocity, maximal velocity, home velocity, acceleration and pulses per millimeter for axis Z and U can be set in this window.

Backlash_Comp: Click "Backlash" button in the "Parameter settings window" will prompt the backlash compensation window as Figure 6-11.

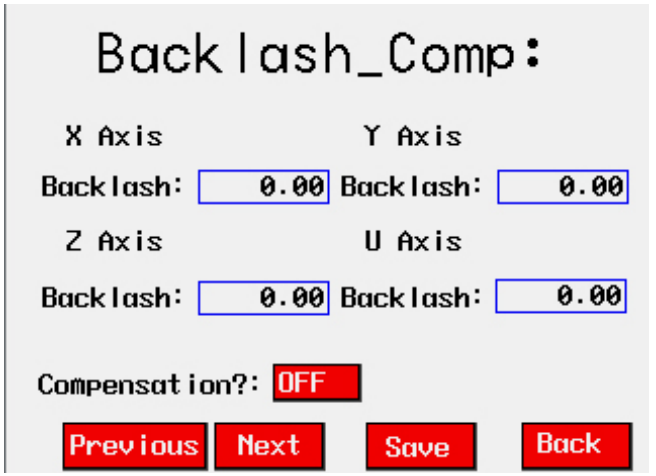


Figure 6-11 Backlash compensation window

Click the corresponding input field to enter backlash compensation for each axis. Toggle the button beside "Compensation?" to enable/disable compensation.

Workpiece Zero: Set the work piece zero point (reference or origin) for each axis. The unit is millimeter. The user can enter the zero point by clicking the input field or the arrow keys. See Figure 6-12.

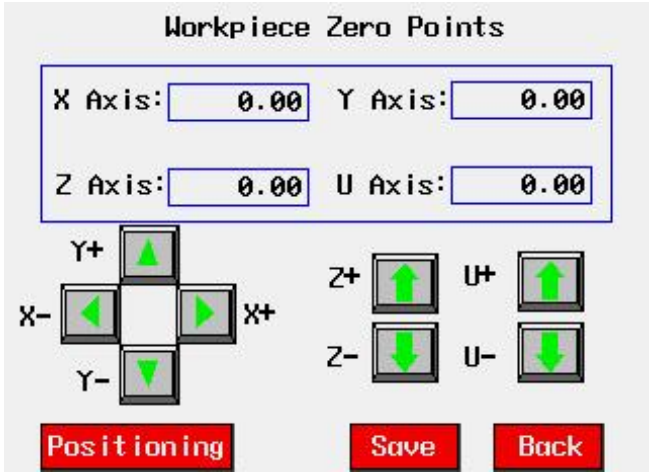


Figure 6-12 Work piece zero point setting window

Teach, play Back: Teaching and playback settings. The user can set the step length and moving velocity in playback. See Figure 6-13.

Sub-Prog Start input field: Start line number of sub-program.

End Line input field: End line number of sub-program.

Drawing Height, **Drawing_Vel**, **Syringe Positioning** input field: They represent drawing height, drawing velocity and syringe position in the dispensing system

Reverse KeyDir: Reverse the directions of those arrow keys in teaching & playback window by toggling the buttons.

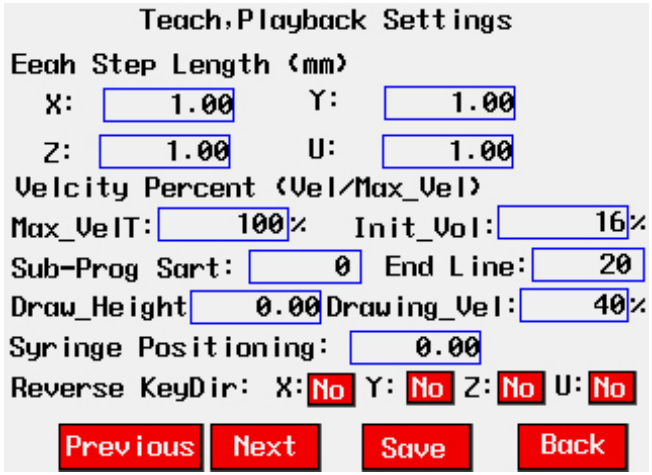


Figure 6-13 Teaching and playback settings window

Factory Settings: Factory setting for motion profile, special I/O active level, command mode, home parameters, interpolation parameters, dedicated input & output, S-curve and password. There are totally seven pages for the settings. See Figure 6-14, 6-15, 6-16, 6-17, 6-18, 6-19 and 6-20.

Factory parameters in page 1(See figure 6-14):

Init_Vol: Default initial velocity.

Max_Vol: Default. Max velocity.

Home_Vol: Default home velocity.

Accel: Default acceleration.

Pulses/mm: Pulses counts per one millimeter.

Next_P: Next page.

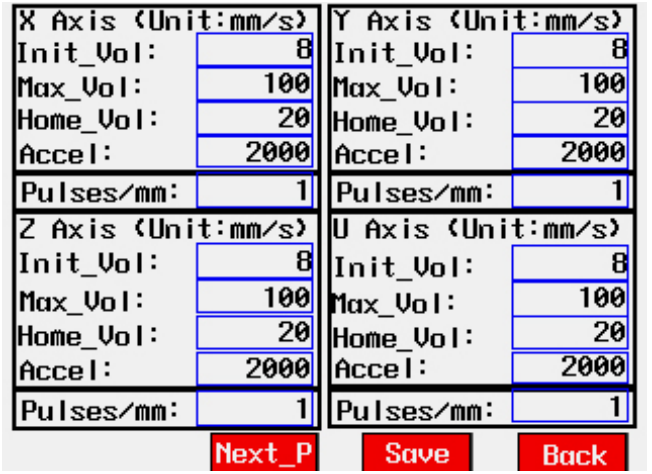


Figure 6-14 Factory Settings Page 1

Factory parameters in page 2, 3, 4 and 5(See figure 6-15, 6-16, 6-17, 6-18):

Home_ActLel: Active level of HOME signal.

ARM_ActLel: Active level of ALARM signal.

INP Setting: Enable/disable in-position signal.

INP_ActLel: Active level of in-position signal.

SD Setting: Enable/disable slow-down signal.

SD_ActLel: Active level of slow-down signal.

Command Mode:

PUL/DIR_P: Pulse and direction signal, positive polarity.

PUL/DIR_N: Pulse and direction signal, negative polarity.

AB_P: AB phase signal, positive polarity.

AB_N: AB phase signal, negative polarity.

CW/CCW_P: Clockwise and counter clock wise pulse signal, positive polarity.

CW/CCW_N: Clockwise and counter clockwise pulse signal, negative polarity.

Home_Dir: Home direction.

S_Profile: Enable or disable the s-curve.

Home Move: Set whether home or not.

Home_mode: Home mode.

Vel_Range: Set velocity Range. The velocity rate value is calculated as follows:

$$VelocityRate = \frac{VelocityRange}{2^{14}-1}$$

The SMC6400B change the velocity based on the velocity, taking it as the smallest unit.For example, the default velocity range is 1638300 pulses/second, the velocity can bethe following figures: 100, 200, 300, etc.

Intp_Vol_Range: The same as Vel_Range but for interpolation velocity.

G cont_intp: Enable/disable G code continue interpolation.

Corner_Decel: Enable/disable deceleration at corner.

Decel_Rate: Deceleration rate at corner.

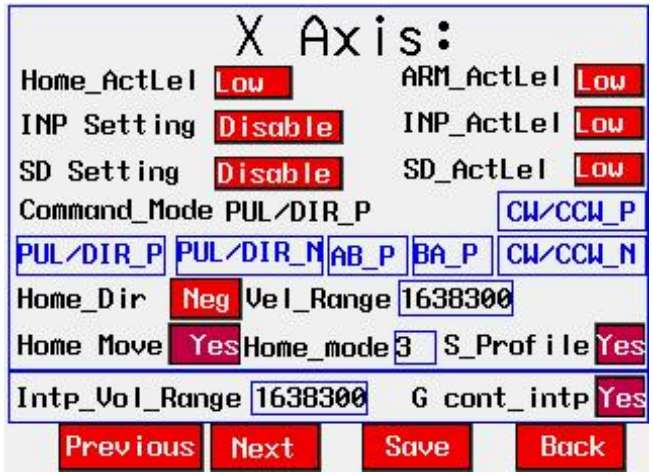


Figure 6-15 Factory Settings Page 2

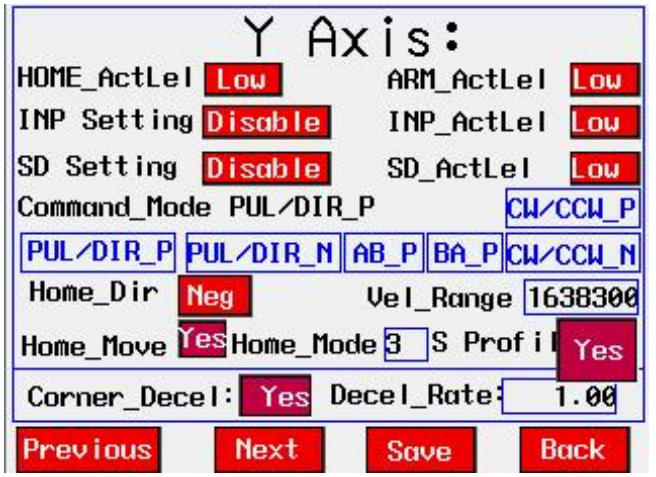


Figure 6-16 Factory Settings Page 3

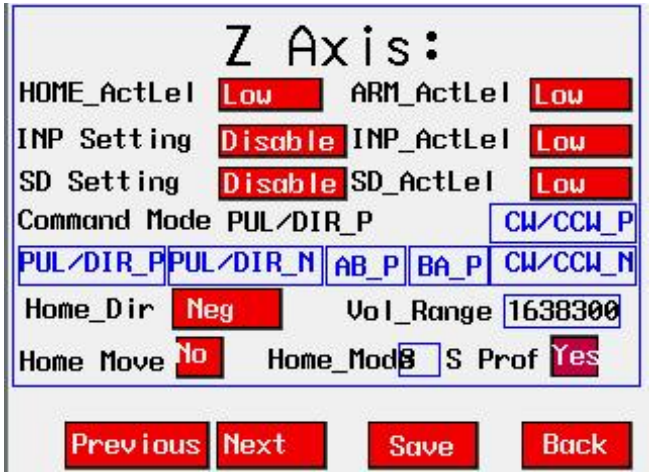


Figure 6-17 Factory Settings Page 4

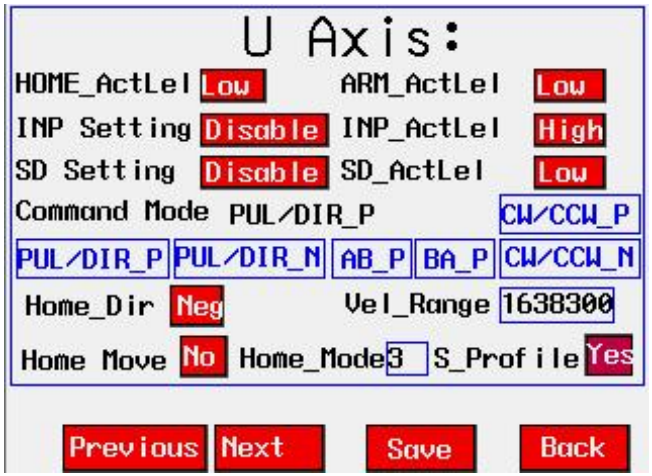


Figure 6-18 Factory Settings Page 5

Key enable/disable setting (See figure 6-19):

Teach&PlayB?: Enable/disable TEACING key(Ignore it). See figure 5-4.

M07_TriggerKey?: Enable/disable S-OUT1 key. See figure 5-4.

M09_TriggerKey?: Enable/disable S-OUT2 key. See figure 5-4.

M011_TriggerKey?: Enable/disable S-OUT3 key. See figure 5-4.

Teach_PB_Key: Enable/disable X++, X--, Y++,Y--, Z++, Z--, U++ and U--. See figure 5-4.

Manual_Pulser: Enable/disable manual pulse input for each axis.

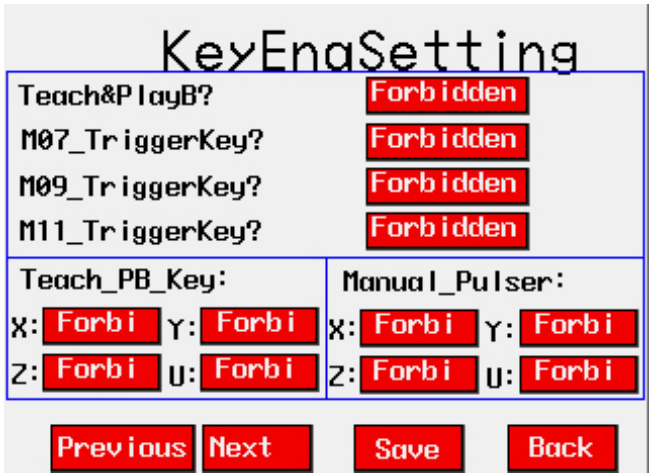


Figure 6-19 Factory Settings Page 6

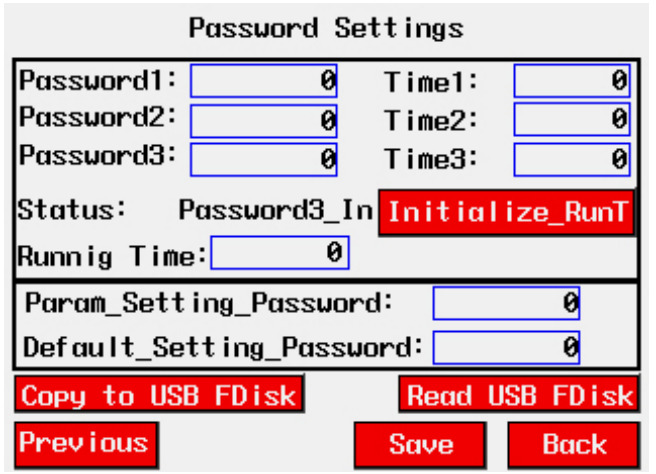


Figure 6-20 Factory Settings Page 7

Password Settings (See figure 6-20):

Password1-3: Password when time1-3 out. The HMI will require the user to input the password when time is out.

Time1-3: Allow running time 1-3. Unit : hour.

Initialize_RunT: Reset time to 0.

Param_Setting_Password: Password to enter Par_setting window.

Default_Setting_Password: Default setting password.

Copy to USB FDisk: Copy all the configuration parameters to the USB disk.

Read USB FDisk: Read all the configuration parameters from the USB disk.

Interpolations: Set the vector velocity for linear, circular interpolation. See Figure 6-21 for the prompt window.

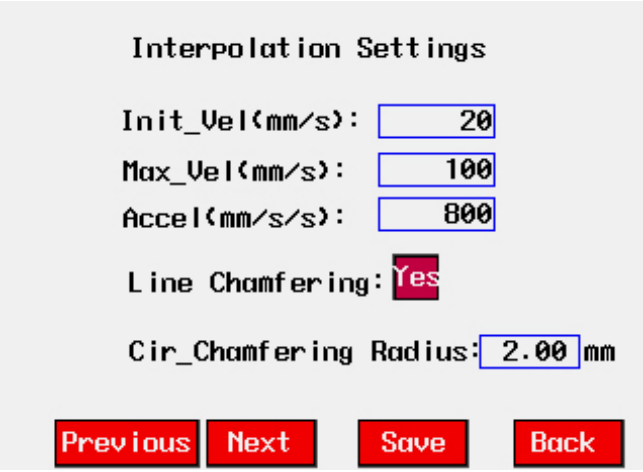


Figure 6-21 Interpolation setting window

Default Settings: Set the parameters to be factory settings. See Figure 6-22.

Figure 6-22 Apply default settings

Software Limits: Set positive and negative software limits. See Figure 6-23.

Pos_SoftLt: Positive software limit.

Neg_SoftNt: Negative software limit.

SoftLt_En: Enable/disable software limit.

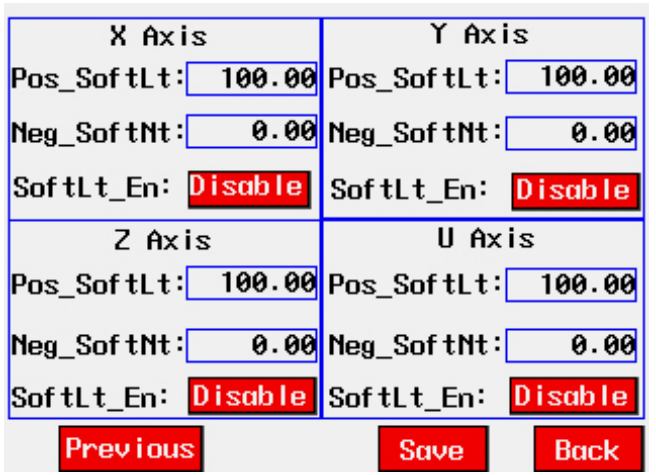


Figure 6-23 Software limit settings

File Size: Set the file size for the G-code programs. SMC6400B can sore 16 G-code programs. Click the corresponding input field to change the file size. If the file size exceeds the system's MAX system space, warning message will appear.

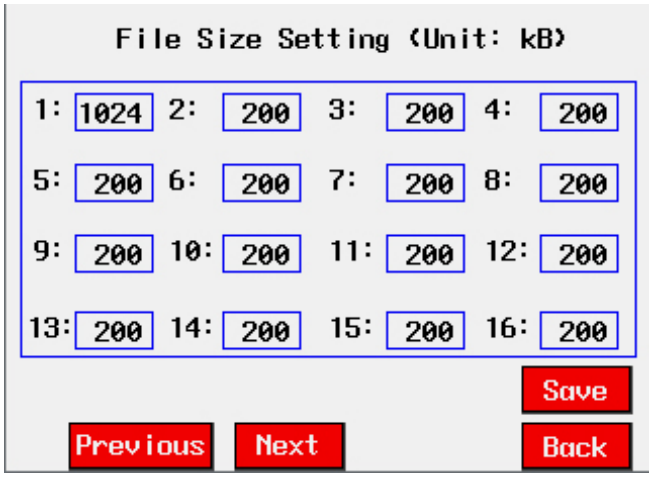


Figure 6-24 File size setting window

Other settings: Set the delay time for M07, M08, M09, M10, M11, M12 and advance time for M08, M10. Other options like read the USB disk and home all the axis automatically when power up, Enabling manual move when pause and set the default G-code program. See Figure 6-25.

AutoR_UsbFD: Read the USB disk automatically when power up.

Move when Paused: Enable: Enable/disable manual run when paused.

Auto_Home when Powered: Home all the axis when power up.

Default_Prog: Default G-code program.

Auto_Run when Powered: Run the default G-code when power up.

PauseEn of StartKeys: Extra option for the **Start** signal input (See section 3.4 & 5.4).

Pause When ReleasedKey: Pause when release the **Start** key(See section 3.4 & 5.4).

To StartPoint After Home: Go to the start point of the tool path after home.

Param_PD: Parameter setting permit password.

Edit_PD: Edit G-code program permit password.

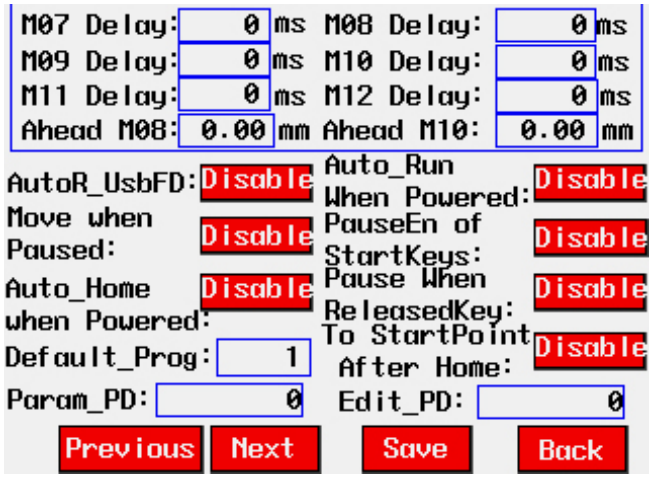


Figure 6-25 Other setting window

Password: See factory settings page 7 in Figure 20. When Time1is not zero, this button is active. The user need to input the password when time is out.

6.4 Run G-code program

Click the "Auto Process" button in the root window, the manual process window will prompt as Figure 6-27. When a G-code program file has been built, it can be executed in this window. First, enter the G-code program No. The corresponding file name will display beside the program number. Second, click the "Run" button to run the program. The user can pause or stop the process during the execution.

Cur_File No.: Current G-code file number. See section 6.2.1.

Lines: Total lines of current G-code program.

Cur_Line: Current line which is running.

Cur_Status: Process status including Standby, Running, Pause.

Num_Processed: Run count of G-code program.

Loop Counts: Loop counts of the file.

Run: Run the whole G-code file.

NT_Run: Only run the G-codes which move the axis. Those G-codes which effect the I/O will be skipped.

Pause: Pause G-code file running.

Stop: Stop G-code file running.

Home: Home all the axis.

Menu: Go to the root window.

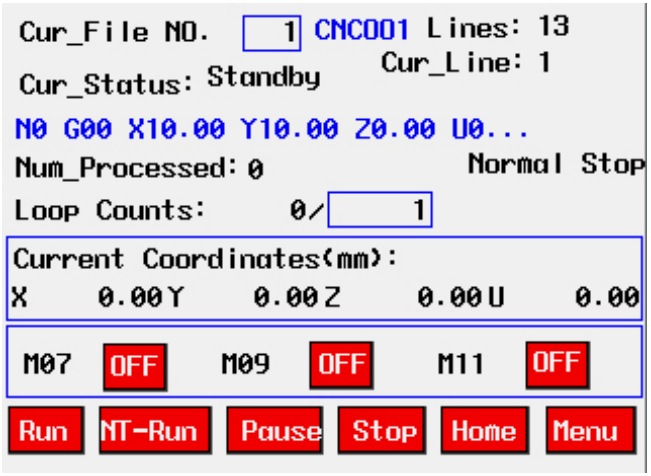


Figure 6-26 Auto process window

6.5 Manual operation

Click the "Manual Process" button in the root window, the manual process window will prompt as Figure 6-27. The mechanical and work piece coordinates are displayed at the top of this window. The user can change the coordinates by those arrow keys. Or enter the number then click "Move" button. The axis will move to the new coordinates.

Absolute: Set the coordinates to be absolute or relative.

Move: Move to the newly input coordinate immediately.

Home: Home all the axis.

Stop: Stop to move.

I/O: Go to the I/O status window.

Exit: Exit and return to root window.

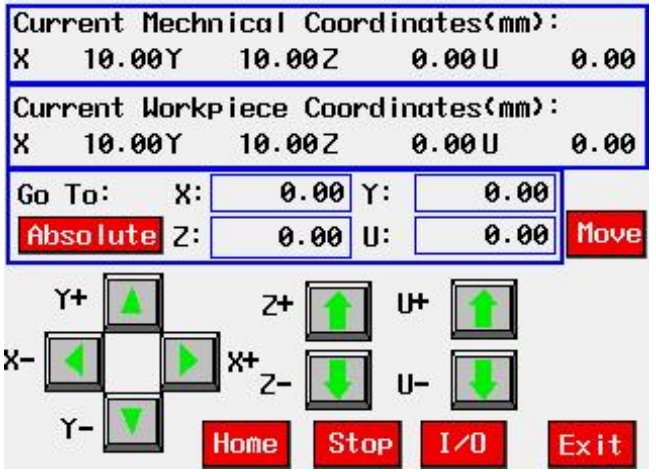


Figure 6-27 Manual process window

6.6 Upload and download G-code file

Click the "Up & Down Load" button in the root window, the G-code file upload and download window will prompt as Figure 6-28. This window has two divisions. The left part is for USB disk while the right part is for the flash ROM.

The user needs to insert the USB disk and click the "connect" button before the upload and download operation. The upload or download operations perform as follows:

1) Click "USB_FDisk File_No." and "FlashROM File_NO" field, respectively, to enter the G file number which you want to upload or download.
2) If you can not sure the whether the file number is correct or not, click the "Read" button to read the file size and total G-code lines for confirmation.
3) Click the "To FlashROM" in the left part button if download G-code file from USB disk to flash ROM inside SMC6400B.
4) Otherwise, click the "To USB_FDisk" in the right part to upload G-code file from

flash ROM to USB disk.

USB_FDisk File_No.: Range from 1 to 99， file name in the USB disk are SMCP01.DAT, SMCP02.DAT,…,SCMP99.DAT.

FlashROM File_NO.: Range from 1 to 16.

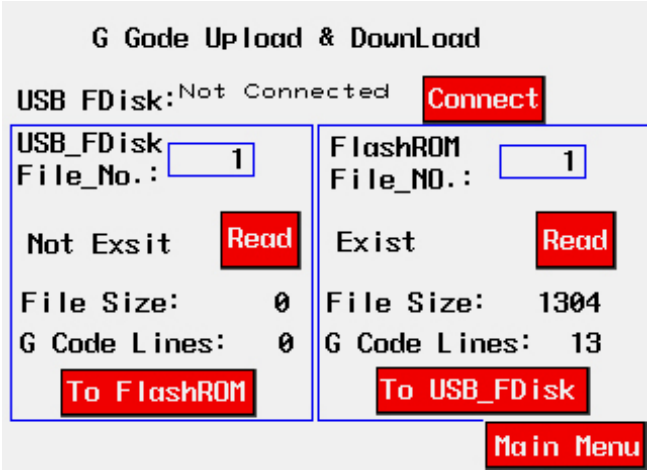


Figure 6-28 G-code upload and download window

6.7 I/O Status

Click the "Up & Down Load" button in the root window, the status window for general inputs will prompt as Figure 6-29. Page 2 and page 3 is for dedicated I/O and general outputs, respectively. The user can toggle the outputs in page 3 by click the icons. Table 6-1 gives some illustration to the effective and ineffective status.

Table 6-1 I/O status

Status	Icon	Description
Effective		The opto-coupler's emission diode is conducted. Please reference to Chapter 4: Interface Circuit.
Ineffective		The opto-coupler's emission diode is notconducted. Please reference to Chapter 4: Interface Circuit.

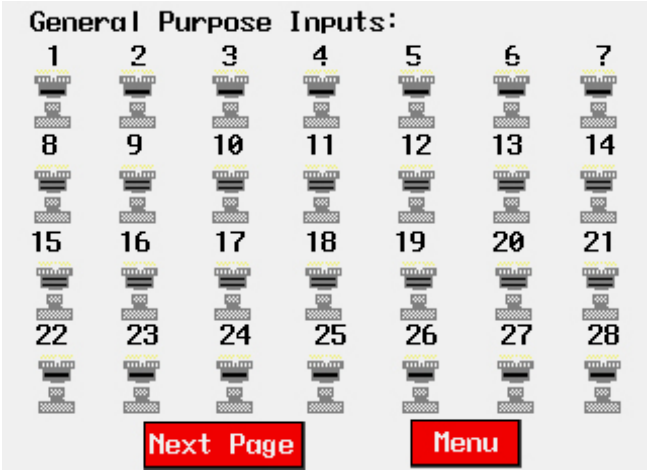


Figure 6-29 I/O status window page 1

Figure 6-30 I/O status window page 2

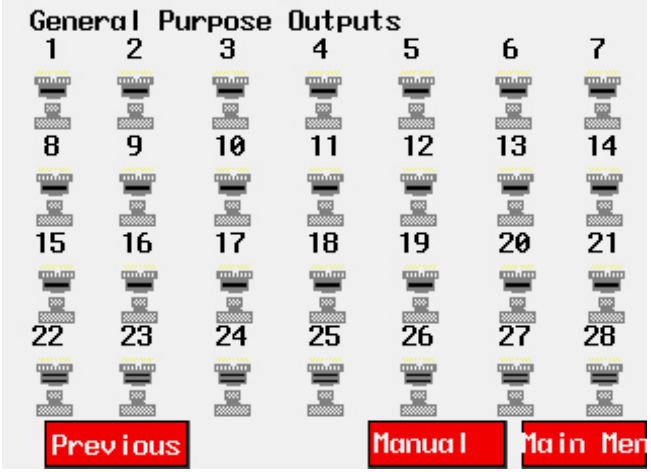


Figure 6-31 I/O status window page 3

Chapter 7 G-codes Overview

G-code are any word initialed by a letter ‘G”. They are codes or functions in numerical control programming language. As preparatory codes, G-codes do the actual work, while M-codes only manage the system. The G-codes and M-codes have many varieties in different platforms. The G-codes and M-codes used in SMC6400B coincide with ISO-1056-1975E. For convenience, the programming language in numerical control is always called G-code by people.

7.1 Coordinates system

SMC6400B adopts The Right-handed Rectangular Cartesian Coordinate system for the G-code programming. See Figure 7-1 for the illustration of right-handed Cartesian Coordinates.

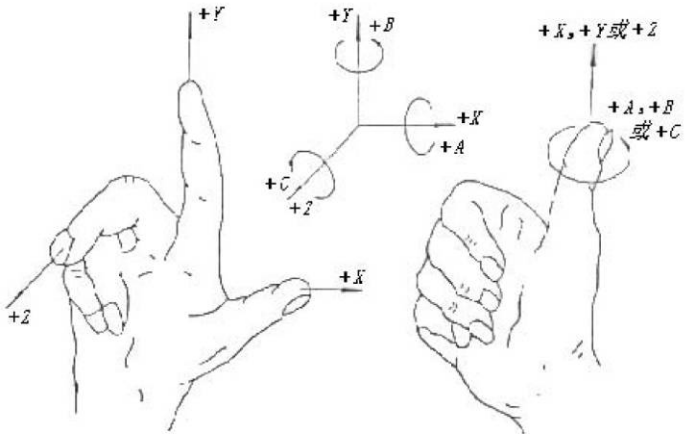


Figure 7-1 Right-handed rectangular Cartesian coordinate

7.2 Absolute and relative coordinates

The user can adopt either absolute or relative coordinates in his G-code programming for SMC6400B, using G90 or G91. All the example programs in this manual use relative coordinates.

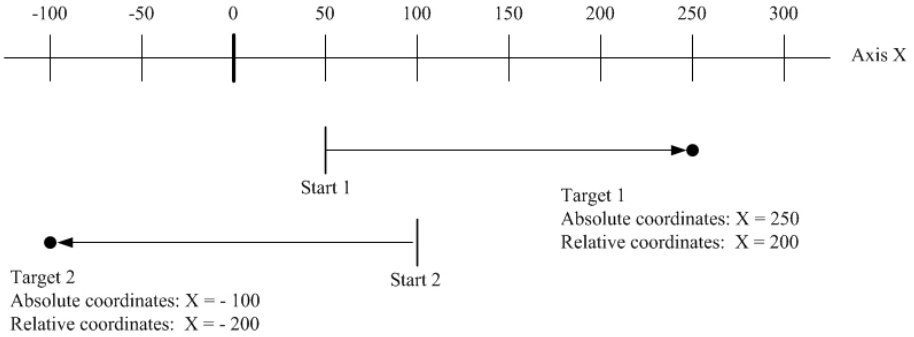


Figure 7-2 Absolute and relative coordinates

7.3 G-code function in SMC6400B

Table 7-1 G-code function

No.	G-code	Description
1	G00	Rapid Positioning
2	G01	Linear Interpolation
3	G02	Clockwise Circular Interpolation
4	G03	Counter Clockwise Circular Interpolation
5	G04	Delay(Unit: ms)
6	G05	Pass point of Circular Interpolation
7	G06	End point of Circular Interpolation
8	G26	Home Move
9	G28	Move to Workpiece Zero Point
10	G53	Change to Mechanical Coordinates
11	G54	Change to Workpiece Coordinates
12	G90	Start Absolute Coordinates
13	G91	Start Relative Coordinates
14	G92	Reposition Origin Point
15	F	Velocity Percent
16	M00	Program Pause
17	M02	Program End.
18	M07	Output 1 ON
19	M08	Output 1 OFF
20	M09	Output 2 ON
21	M10	Output 2 OFF
22	M11	Output 3 ON
23	M12	Output 3 OFF
24	M30	Program End and Loops Continuously
25	M80	Set Output On
26	M81	Set Output OFF

Table 7-1 G-code function (Continue)

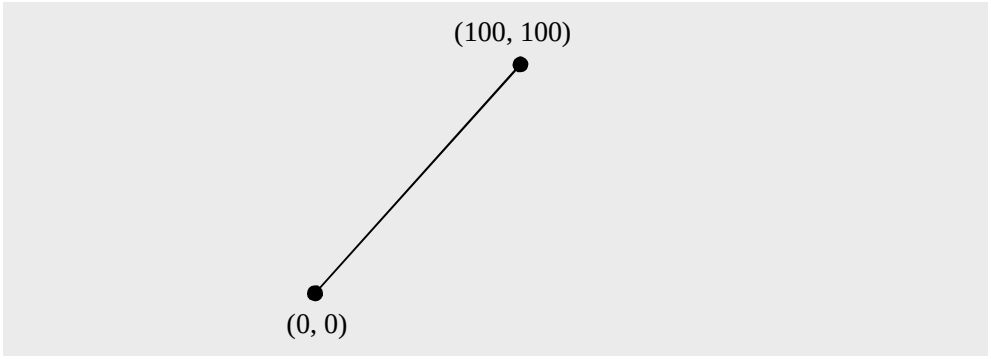
27	M82	Pauses until Input ON
28	M83	Pauses until Input OFF
29	M90	End Sub-loop
30	M91	Start sub-loop
31	M84	Start Continuous Movement
32	M85	Stop Continuous Movement
33	M98	Go to sub-program
34	M99	Return to Main Program
35	M86	Increase Variable Value
36	M87	Set variable Value
37	M89	Pause until Pass the Point
38	M94	Jump Depends on Conditional Variable
39	M95	Unconditional Jump to line No.
40	M96	Call sub-program depends on Conditional Variable
41	M97	Simultaneous Start of Multiple Tasks

Chapter 8 G-code Example

8.1 Line

The following G-code welds a work piece along a line from (0, 0) to (100, 100).

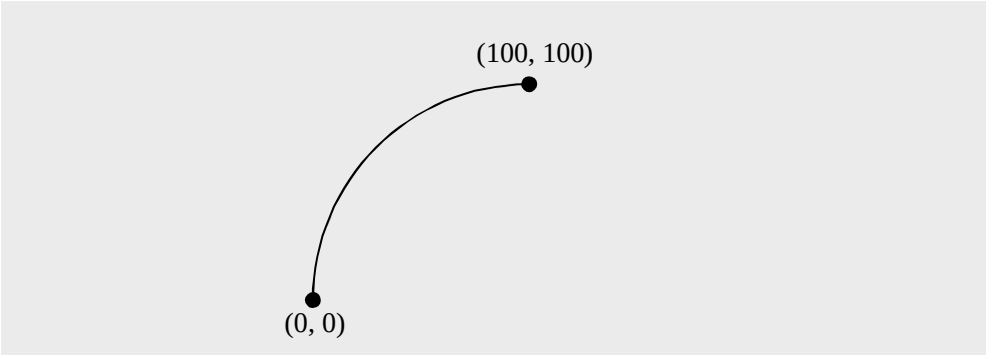
```
N00 G28 X Y                ; Home to (0, 0) of the work piece
N01 G91                    ; Use relative coordinates
N02 M07                    ; Turn on the laser（Output 1）
N03 G01 X100 Y100 F50      ; Linear interpolation at 50% feedrate
N04 M08                    ; Turn off the laser（Output 1）
N05 M02                    ; End
```



8.2 Circular interpolation

The following G-code welds a work piece along an arc from (0, 0) to (100, 100).

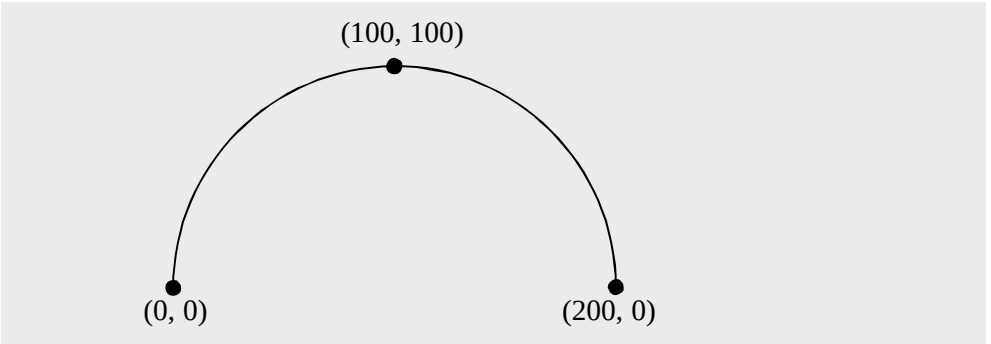
```
N00 G28 XY                 ; Home to (0, 0) of the work piece
N02 M07                    ; Turn on the laser（Output 1）
N03 G02 X100 Y100 R100     ; Clockwise circular interpolation
N04 M08                    ; Turn off the laser（Output 1）
N10 M02                    ; End
```

8.3 Another Circular interpolation

The following G-code welds a work piece along an arc from (0, 0) to (200, 0).

```
N00 G28 XY                 ; Home to (0, 0) of work piece
N02 M07                    ; Turn on the laser（Output 1）
N03 G05 X100Y100           ; Set midpoint (or point on same arc) of the arc
N04 G05 X200Y100           ; Set endpoint of the arc
N05 M08                    ; Turn off the laser（Output 1）
N10 M02                    ; End
```

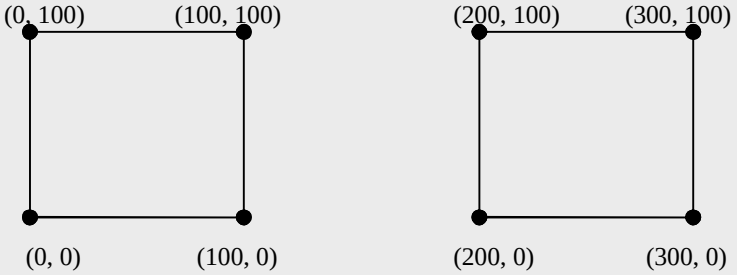


8.4 G92

8.4.1 Sub-program

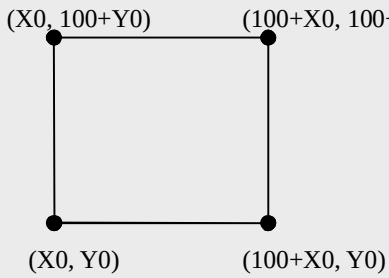
```
N01 G28 XY          ; Home to (0, 0) of work piece
N05 M98 N25         ; Call Sub-program at N25
N07 G00 X200        ; Move 200mm rightwards
N08 G92 X0Y0        ; Reset current coordinates as (0, 0)
N10 M98 N25         ; Call Sub-program at N25
N15 M02             ; End

; Draw a square of 100*100
N25 M07             ; Turn on the laser
N30 G01 X100
N31 G01 Y100
N32 G01 X0
N33 G01 Y0
N34 M08             ; Turn off the laser
N40 M99             ; Return
```

The above G-code draws two square of 100*100 by 200mm horizontal distance



8.4.2 Relative move using absolute coordinates

```
N10 G92 X0Y0        ; Reset the current coordinates as (0, 0)
N25 M07             ; Turn on the laser（Output 1）
N30 G01 X100
N31 G01 Y100
N32 G01 X0
N33 G01 Y0
N34 M08             ; Turn off the laser（Output 1）
N40 M02             ; End
```



8.5 Jump and Repeat

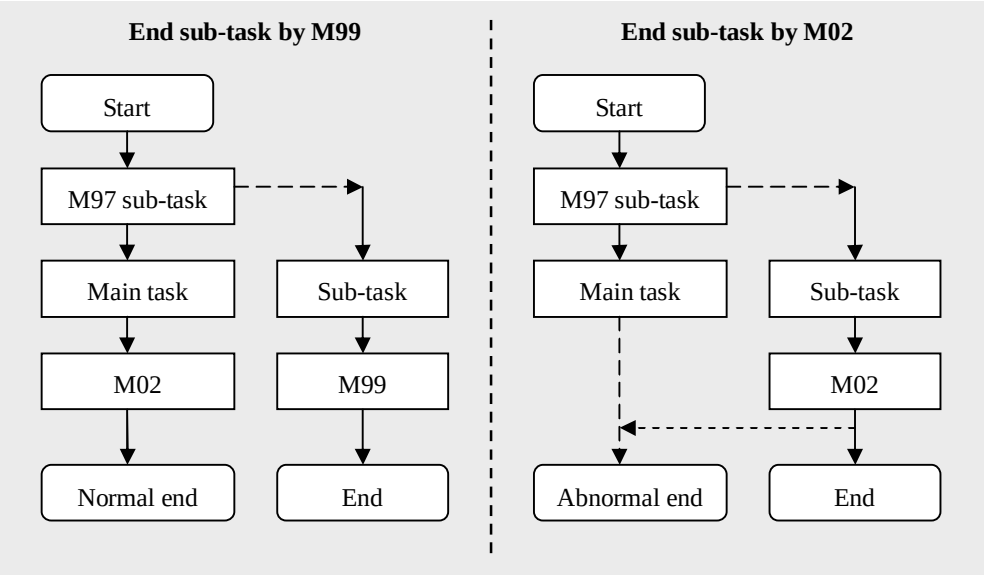
```
N01 G28 XY          ; Home to (0, 0) of the work piece
N10 M91 C100        ; Repeat 100 times
N20 M96 S10V1N100   ; Call Sub-program N100 if input10 effective,or continue
N30 G04 P2000       ; Delay 2000 millisecond
N40 M90             ; End repeat

; Sub-program that draw a square of 100*100
N100 M07            ; Turn on the laser
N110 G01 X100
N120 G01 Y100
```

```
N130 G01 X0
N140 G01 X0
N150 M08                ; Turn on the laser（Output 1）
N160 M99                ; Return
```

8.6 Multi-task

```
N01 G28 X Y             ; Home to (0, 0) of the work piece
N10 M97 N200            ; Call multi-task and start the sub-task at N200
; Draw a square of 100*100
N100 M07                ; Turn on the laser（Output 1）
N110 G01 X100
N120 G10 Y100
N130 G01 X0
N140 G01 Y0
N150 M08                ; Turn on the laser（Output 1）
N160 M02                ; End
; Check the digital input in sub-task
N200 M82 S10            ; Wait until input 10 effective
N210 M02                ; Abnormal end
```

In the above G-code, the main task and the sub-task are parallel. If the sub-task is ended by M99, the main task continues until M02. When the sub-task ended by M02, both the main task and sub-task would stop. The life time of the sub-task is show as the following figure.



8.7 M89

Note: M89 can only be used in multi-task.

The following example turns on the valve when X axis move to a specific position.

```
N01 G28 X Y             ; Home to (0, 0) of the work piece
N10 M97 N100            ; Call multi-task and start the sub-task at N100
N20 M07                 ; Turn on the laser
N30 G01 X100 Y200
N40 M08                 ; Turn on the laser
N50 M02                 ; End
N100 M89 X100           ; Wait until axis X reach to 100
N110 M09                ; Turn on the valve
N120 G04 P1000          ; Delay 1000 millisecond
N130 M10                ; Turn off the valve
N140 M99                ; End sub-program and return
```

8.8 Example of battery welding

The following G-code is a practical example of battery welding for a manufacturer of cell phone battery.

Pin assignment:

Input:

Digital input 8: Check whether the battery is in-position

Output:

Digital output 1: Control to clamp the battery in vertical direction

Digital output 2: Control to clamp the battery in horizontal direction

Digital output 4: Switch for pushing the battery

Digital output 5: Another switch for pushing the battery

Digital output 6: Switch for nitrogen

Digital output 7: Switch for laser

Axis functions (Move the head to start point before welding then reset the coordinates by G92)

Axis X: Move the battery

Axis Y: Rotate the battery.

Process:

Firstly push the battery to the camp then check whether the battery is in position. End the program if no battery is detected or clamp the battery and begin welding.

```
N010 G92 X0 Y0          ; Set current coordinates (0, 0)
N020 G80 S4             : Push the battery to camp
N030 G04 P800           ; Delay 800 millisecond
N040 M80 S5             ; Push the battery in horizontal direction
N050 G04 P500
```



```
N060 M94 S8 V0 N300     ; Jump to N300 if no battery detected
N070 M80 S2
N080 G04 P500
N090 M80 S1             ; Camp the battery
N100 M81 S5
N110 M81 S4             ; Finish pushing the battery
N120 G04 P500
N130 G00 X34            ; Fast position to the start point
N140 M80 S6             ; Turn on the nitrogen
N150 G04 P300
N160 80 S7              ; Turn on the laser
N170 G01 X-0.5 F100     ; First welding
N180 M81 S7             ; Turn off laser
N190 G01 X7 Y90 F300    ; Rotates the clamp 90 degree
N200 M80 S7
N210 G04 P80
N220 G01 X-0.5 F100     ; Second welding
N230 M81 S7             ; Turn off laser
N240 M81 S6             ; Turn off the nitrogen
N250 G01 Y135           ; Rotates the clamp 135 degree
N260 M81 S2             ; Release the battery
N270 M81 S1
N280 G04 P800
N290 G00 X0 Y0          ; Return to (0, 0) when finish welding
N300 M81 S5
N310 M81 S4
N320 M02                ; End
```