ADT-8960

6-axis Motion Control Card

User’s Reference Manual

Adtech (Shenzhen) CNC Technology Co.,Ltd.
Add：5th floor,Tianxia IC Industrial Park,MaJiaLong,Yiyuan Road, Nanshan District, Shenzhen City, China
Post Code: 518052
Tel：0755-26099116　　Fax: 0755-26722718
email：export@machine-controller.com
http://www.machine-controller.com

Version Upgrading Record

Version	Revised in	Descriptions
V7.0	2010/01/04	The seventh version

Remark: The three digits in the version number respectively mean:

☐	☐	☐
Hardware version number	Major version number	Minor version number

Contents

Chapter 1 General information

☞ INTRODUCTION

ADT8940A1 Card is a kind of high-performance 4-axis servo/ stepping control card based on PCI bus and supporting Plug & Play, while one system can support up to 16 control cards and control up to 64 lines of servo/ stepping motors.

Pulse output method may be single pulse (pulse + direction) or double pulse (pulse+pulse), with the maximum pulse frequency of 2MHz. Advanced technologies are applied to ensure the frequency tolerance is less than 0.1% despite of high output frequency.

It supports 2-4 axis of linear interpolation, with the maximum interpolation speed of 1MHz.

Position management is realized through two up/ down counters, one used to manage logical positions of internally driven pulse output, and the other used to receive external input, with encoder or grating ruler inputted through A/ B phase as the input signal.

Counters are up to 32 digits, specially, the range is 2,147,483,648~+2,147,483,647.
The system also provides DOS/WINDOWS95/98/NT/2000/XP/WINCE development libraries and enable software development in VC++, VB, BC++, LabVIEW, Delphi, and C++Builder.

☞ MAIN FEATURES

- 32-digit PCI bus, enabling Plug & Play
- All the input and output are under photoelectric coupler isolation, with strong resistance to disturbance.
- 6-axis servo/ stepping motor control, with every axis able to move independently without mutual effects.
- Frequency tolerance for pulse output is less than 0.1%.
- The maximum pulse output frequency is 2MHz.
- Pulse output may be single (pulse+ direction) or double(pulse+ pulse)
- All the 6 axes have position feedback input in 32-digit counting, giving the maximum counting range of -2,147,483,648~ +2,147,483,647.
- Trapezoidal acceleration/ deceleration
- 2-6 axis linear interpolation.
- Maximum interpolation speed: 1MHz.
- Handwheel and external signal operation, position lock, large-capacity of hardware caching.

- Real-time reading of logical, real and driving speeds during movement
- 32 channels digital input/32 channels digital output with optical coupling isolation, including two positive/negative limiting signals of each axis Read the logical position, actual position, driving speed, acceleration and driving state in real time during motion Two limit input for each axis may be set as Nil and work as general input
- Up to 16 control cards supported within one system.
- DOS/WINDOWS95/98/NT/2000/XP/WIN CE supported.

☞ APPLICATIONS

- Multi-axis engraving system
- Robot system
- Coordinate measurement system
- PC-based CNC system

Chapter 2 Hardware installation

☞ PARTS

1. ADT-8960 User Manual (this manual)
2. ADT-8960 6-axis PCI bus high-performance motion control card
3. ADT-8960 user CD
4. ADT-D62GG 2 pcs
5. ADT-9162 connecting plate 2 pcs
6. DB64 64pin cable 1 pc
7. ADT-9164 connecting plate 1 pc

☞ INSTALLATION

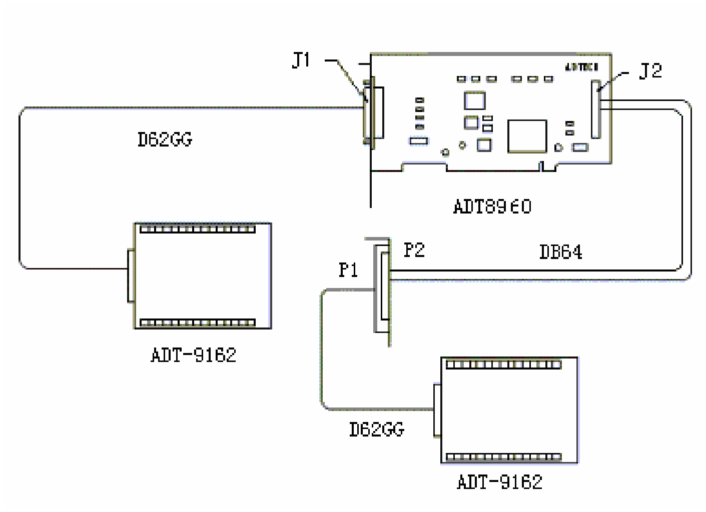
1. Switch off the computer power supply (for ATX supply case, switch off the overall power)
2. Open the back cover of the computer case
3. Insert ADT-8960 into an available PCI slot
4. Ensure the golden finger of ADT-8960 has been fully inserted the slot and then fasten card with screws
5. Connect one end of the D62GG cable to J1 interface of motion card and the other end to terminal block ADT_9162.
6. Check whether it is necessary to install J2 interface cable. To install J2 if necessary:

(1) Connect one end of ADT-DB64 to J2 of motion card and the other end to P2 of ADT-DB64;

(2) Fix the ADT-DB64 on the rear side of the enclosure;

(3) Connect ADT-D62GG to P2 of the transition board and ADT-D62GG.

Chapter 3 Electrical connection

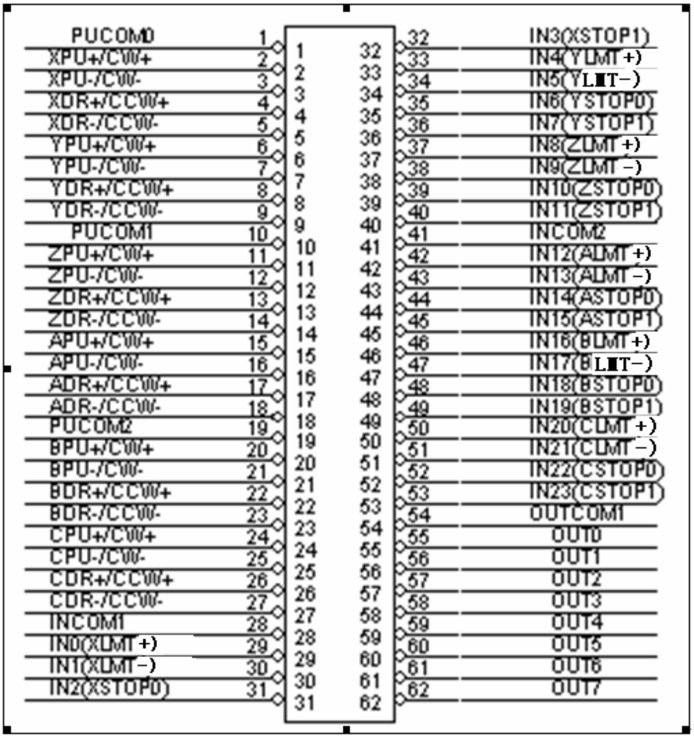


There are two input/ output interfaces inside an ADT8960 card, whereby J1 is for 62-pin socket and J2 is for 62-pin.

J1 is the signal cable for pulse output of X, Y, Z and A, B, C axis, switch amount input and switch amount output (OUT0-OUT7); **J2** is the signal cable for encoder input and switch amount input of X, Y, Z and A, B, C axis; switch amount input and switch amount output (OUT8-OUT15).

Signals are defined as follows:

☞ J1 line



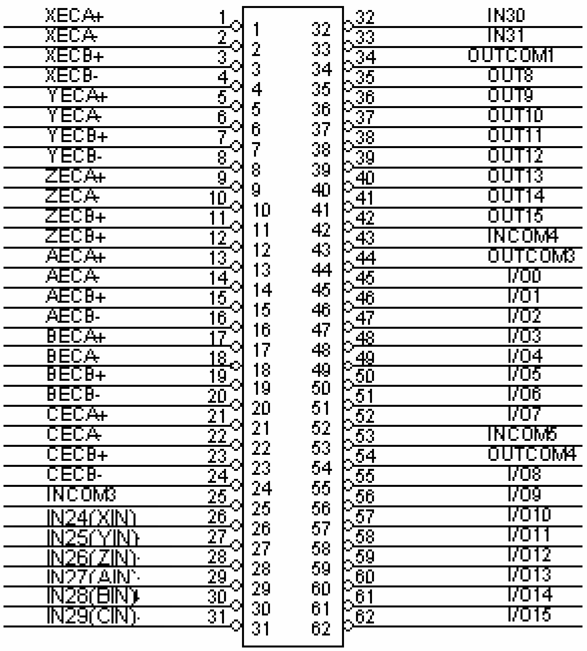
Line number	Signal	Introduction
1	PUCOM0	Used for single-port input, not available for external power supply
2	XPU+/CW+	X pulse signal +
3	XPU-/CW-	X pulse signal -
4	XDR+/CCW+	X direction signal +
5	XDR-/CCW-	X direction signal -
6	YPU+/CW+	Y pulse signal +
7	YPU-/CW-	Y pulse signal -
8	YDR+/CCW+	Y direction signal +
9	YDR-/CCW-	Y direction signal -

10	PUCOM1	Used for single-port input, not available for external power supply
11	ZPU+/CW+	Z pulse signal +
12	ZPU-/CW-	Z pulse signal -
13	ZDR+/CCW+	Z direction signal +
14	ZDR-/CCW-	Z direction signal -
15	APU+/CW+	A pulse signal +
16	APU-/CW-	A pulse signal -
17	ADR+/CCW+	A direction signal +
18	ADR-/CCW-	A direction signal -
19	PUCOM2	Used for single-port input, not available for external power supply
20	BPU+/CW+	B pulse signal +
21	BPU-/CW-	B pulse signal -
22	BDR+/CCW+	B direction signal +
23	BDR-/CCW-	B direction signal -
24	CPU+/CW+	C pulse signal +
25	CPU-/CW-	C pulse signal -
26	CDR+/CCW+	C direction signal +
27	CDR-/CCW-	C direction signal -
28	INCOM1	IN0-11, able to work as general input signal
29	IN0(XLMT+)	Positive direction of the Limit Signal for X,able to work as general input signal
30	IN1(XLMT-)	Negative direction of the Limit Signal for X able to work as general input signal

31	IN2(XSTOP0)	Origin signal 0 for X, Manually decelerate, able to work as general input signal
32	IN3(XSTOP1)	STOP1- signal for X,able to work as general input signal
33	IN4(YLMT+)	Positive direction of the Limit Signal for Y,able to work as general input signal
34	IN5(YMT-)	Negative direction of the Limit Signal for Y able to work as general input signal
35	IN6(YSTOP0)	Origin signal 0 for Y, Manually decelerate, able to work as general input signal
36	IN7(YSTOP1)	STOP1- signal for Y,able to work as general input signal
37	IN8(ZLMT+)	Positive direction of the Limit Signal for Z,able to work as general input signal
38	IN9(ZLMT-)	Negative direction of the Limit Signal for Z able to work as general input signal
39	IN10(ZSTOP0)	Origin signal 0 for Z, Manually decelerate, able to work as general input signal
40	IN11(ZSTOP1)	STOP1- signal for Z,able to work as general input signal
41	INCOM2	IN12-23 Input general port
42	IN12(ALMT+)	Positive direction of the Limit Signal for A,able to work as general input signal
43	IN13(ALMT-)	Negative direction of the Limit Signal for A able to work as general input signal
44	IN14(ASTOP0)	Origin signal 0 for A, Manually decelerate, able to work as general input signal
45	IN15(ASTOP1)	STOP1- signal for A,able to work as general input signal

46	IN16(BLMT+)	Positive direction of the Limit Signal for B,able to work as general input signal
47	IN17(BLMT-)	Negative direction of the Limit Signal for B able to work as general input signal
48	IN18(BSTOP0)	Origin signal 0 for B, Manually decelerate, able to work as general input signal
49	IN19(BSTOP1)	STOP1- signal for B,able to work as general input signal
50	IN20(CLMT+)	Positive direction of the Limit Signal for C,able to work as general input signal
51	IN21(CLMT-)	Negative direction of the Limit Signal for C able to work as general input signal
52	IN22(CSTOP0)	Origin signal 0 for C, Manually decelerate, able to work as general input signal
53	IN23(CSTOP1)	STOP1- signal for C,able to work as general input signal
54	OUTCOM1	OUT0-OUT7 general port
55	OUT0	Digital Output.
56	OUT1	
57	OUT2	
58	OUT3	
59	OUT4	
60	OUT5	
61	OUT6	
62	OUT7	

☞ **J2 line**



Line number	Signal	Introduction
1	XECA+	X-axis encoder A-phase input+
2	XECA-	X-axis encoder A-phase input -
3	XECB+	X-axis encoder B-phase input +
4	XECB-	X-axis encoder B-phase input -,
5	YECA+	Y-axis encoder A-phase input+
6	YECA-	Y-axis encoder A-phase input -
7	YECB+	Y-axis encoder B-phase input +
8	YECB-	Y-axis encoder B-phase input -,
9	ZECA+	Z-axis encoder A-phase input+
10	ZECA-	Z-axis encoder A-phase input -
11	ZECB+	Z-axis encoder B-phase input +
12	ZECB-	Z-axis encoder B-phase input -,

13	AECA+	A-axis encoder A-phase input+
14	AECA-	A-axis encoder A-phase input -
15	AECB+	A-axis encoder B-phase input +
16	AECB-	A-axis encoder B-phase input -,
17	BECA+	B-axis encoder A-phase input+
18	BECA-	B-axis encoder A-phase input -
19	BECB+	B-axis encoder B-phase input +
20	BECB-	B-axis encoder B-phase input -,
21	CECA+	C-axis encoder A-phase input+
22	CECA-	C-axis encoder A-phase input -
23	CECB+	C-axis encoder B-phase input +
24	CECB-	C-axis encoder B-phase input -,
25	INCOM3	IN24-IN31 General port
26	IN24(XIN)	Input points for switch amount(X-axis position lock)
27	IN25(YIN)	Input points for switch amount(Y-axis position lock)
28	IN26(ZIN)	Input points for switch amount(Z-axis position lock)
29	IN27(AIN)	Input points for switch amount(A-axis position lock)
30	IN28(BIN)	Input points for switch amount(B-axis position lock)
31	IN29(CIN)	Input points for switch amount(C-axis position lock)
32	IN30	Input points for switch amount
33	IN31	Input points for switch amount(All axis stop)
34	OUTCOM2	OUT8-OUT15 General port
35	OUT8	Output points for switch amount
36	OUT9	Output points for switch amount
37	OUT10	Output points for switch amount
38	OUT11	Output points for switch amount
39	OUT12	Output points for switch amount
40	OUT13	Output points for switch amount
41	OUT14	Output points for switch amount
42	OUT15	Output points for switch amount

43	INCOM4	I/O0-I/O7 as Input public port
44	OUTCOM3	I/O0-I/O7 as output public port
45	I/O0	Input/output(X axis manually CW)
46	I/O1	Input/output(X axis manually CCW)
47	I/O2	Input/output(Y axis manually CW)
48	I/O3	Input/output(Y axis manually CCW)
49	I/O4	Input/output(Z axis manually CW)
50	I/O5	Input/output(Z axis manually CCW)
51	I/O6	Input/output(A axis manually CW)
52	I/O7	Input/output(A axis manually CCW)
53	INCOM5	I/O8-I/O15 as Input public port
54	OUTCOM4	I/O8-I/O15 as output public port
55	I/O8	Input/output(B axis manually CW)
56	I/O9	Input/output(B axis manually CCW)
57	I/O10	Input/output(C axis manually CW)
58	I/O11	Input/output(C axis manually CCW)
59	I/O12	Input/output
60	I/O13	Input/output
61	I/O14	Input/output
62	I/O15	Input/output

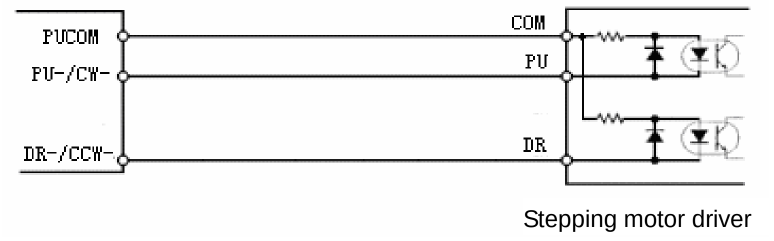
Remark: In case an encoder is used for general input signals, XECA+、XECB+、YECA+、YECB+、ZECA+、ZECB+、AECA+、AECB+、BECA+、BECB+、CECA+、CECB+ will be respectively used as public ports of corresponding input signals. Voltage at the public ports can only be +5V; in case of using an external+12V power supply, users must serially connect a 1K resistance. Please refer to the following digital input connection part for wiring method.

☞CONNECTION FOR PULSE/ DIRECTION INPUT SIGNAL

Pulse output is in differential output.

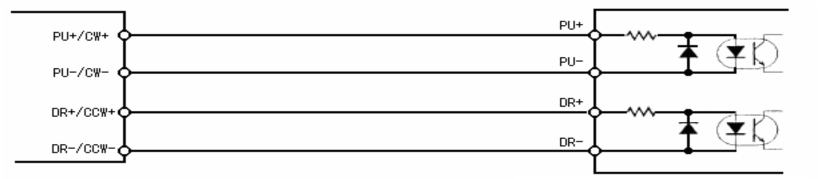
May be conveniently connected with a stepping/ servo driver

The following figure shows open-collector connection between pulse and direction.

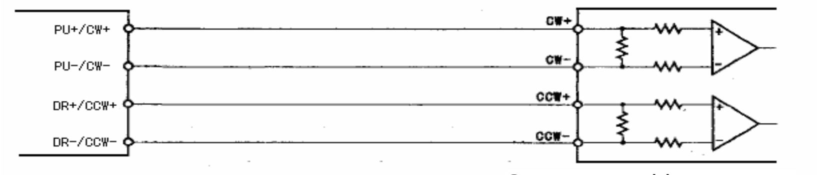


Stepping motor driver

The following figure shows differential-output connection between pulse and direction signals; this method is recommended as it is differential connection with strong resistance to disturbance.



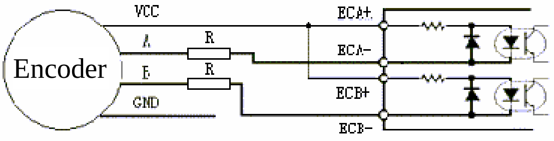
Stepping motor driver



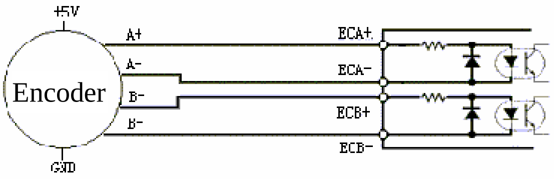
Servo motor driver

Remark: Refer to Appendix A for wiring maps of stepping motor drivers, normal servo motor driver and terminal panel.

☞ CONNECTION FOR ENCODER INPUT SIGNAL

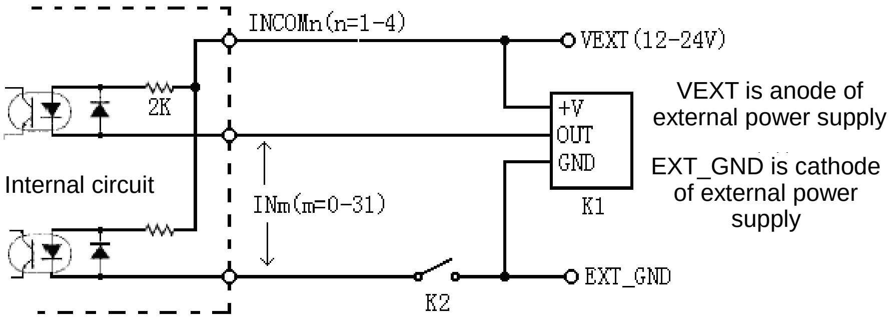


Wiring map for an open-collect output-type encoder. For +5V power supply, R is not required; for +12V power supply, R= 1KΩ; and for +24V power supply, R= 2KΩ



Wiring map for a differential-driver output-type encoder

☞ CONNECTION FOR DIGITAL INPUT


INCOMn(n=1-4)
VEXT(12-24V)
2K
+V
OUT
GND
K1
Internal circuit
INm(m=0-31)
EXT_GND
K2
VEXT is anode of external power supply
EXT_GND is cathode of external power supply

K1 is for approach switch or photoelectric switch, and K2 is for normal mechanical switch

Remark:

(1) Public terminal for IN0-IN11: INCOM1

Public terminal for IN12-IN23: INCOM2

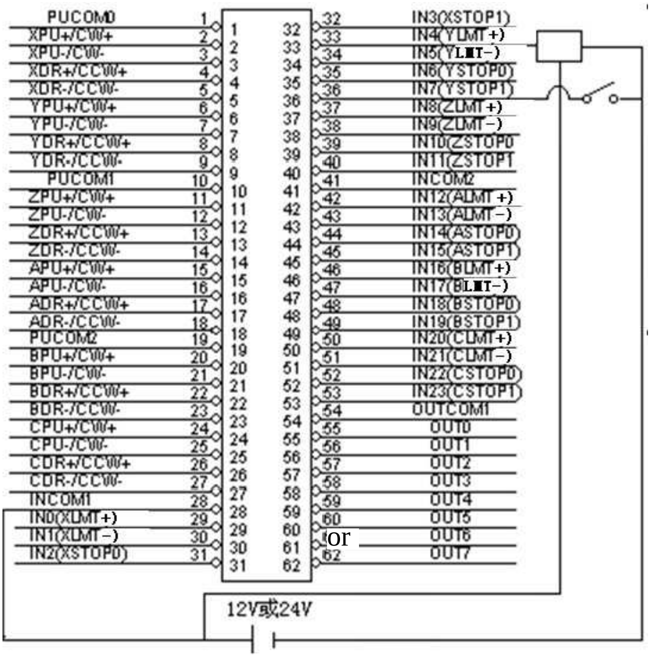
Public terminal for IN24-IN31: INCOM3

Public terminal for I/O0-I/O7: INCOM4

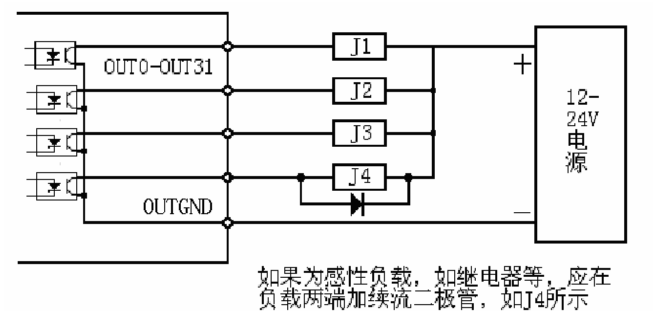
Public terminal for I/O8-I/O15: INCOM5

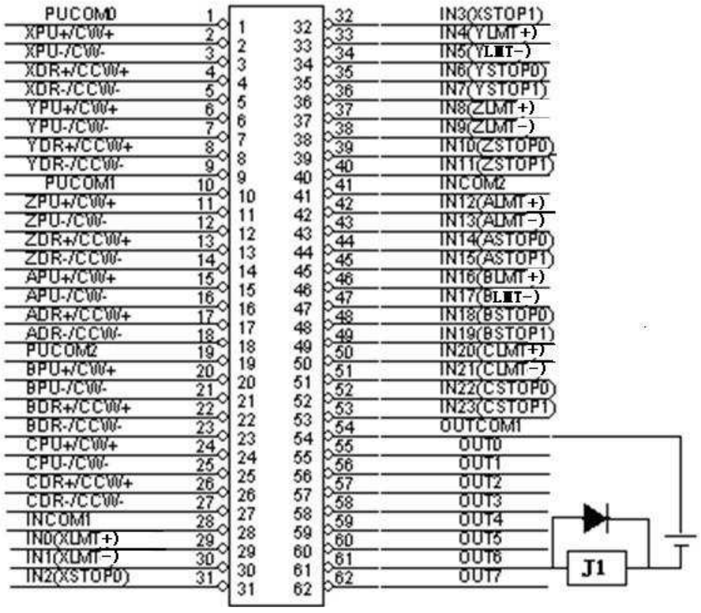
(2) To make input signals effective, users shall make sure: firstly, the photoelectric coupling public ports for corresponding input signals (INCOM1, INCOM2, INCOM3，INCOM4 or INCOM5) have been connected with anodes of 12V/ 24V power supply; secondly, one port of the normal switch or earthing cable of the approach switch has been connected with the cathode (earthing cable); and lastly, the other port of the normal switch or the control of the approach switch has been connected with the input port corresponding by the terminal panel.

(3) The following is the actual wiring map of power supply from normal switch and approach switch to photoelectric coupling public ports, through external power supply.　　（take J1 as example）



☞ Connection of digital output.





Chapter 4 Software installation

ADT8960 card must be used with drive installed under Win95/ Win98/ NT/ Win2000/ WinXP, but in case of DOS, no drive is required to be installed.

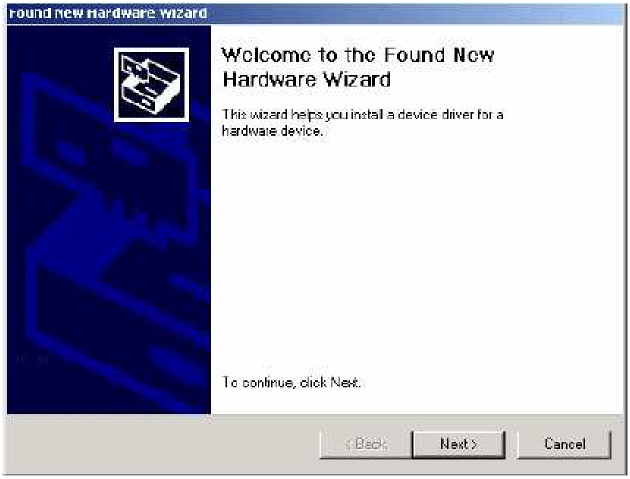
The following part takes Win98 and WinXP for example, and users may refer to other operating systems.

Drive for the control card is located in the Drive/ ControlCardDrive folder within the CD, and the drive file is named as ADT8960.INF.

☞ DRIVE INSTALLATION IN WIN98

The following part takes Win98 Professional Version as example to indicate installation of the drive; other versions of Win98 are similar.

After attaching the ADT8960 card to the PCI slot of a computer, a user shall log in as administrator to the computer; upon display of the initial interface, the computer shall notify “Found new hardware” as follows:



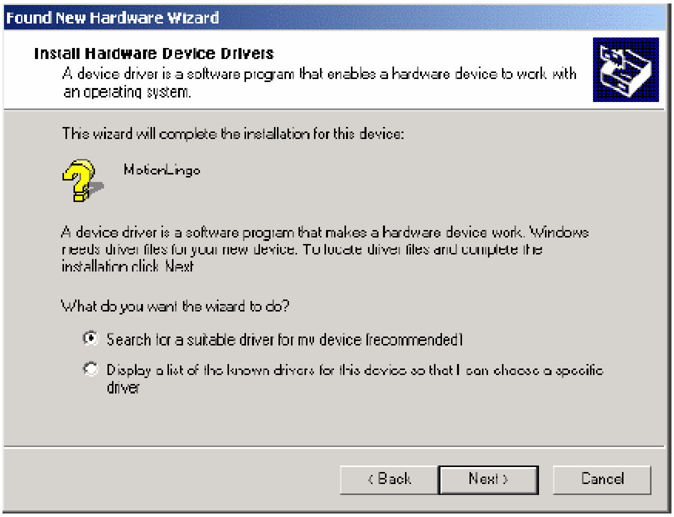
Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

This wizard helps you install a device driver for a hardware device.

To continue, click Next.

Just click “Next” to display the following picture:



Found New Hardware Wizard

Install Hardware Device Drivers

A device driver is a software program that enables a hardware device to work with an operating system.

This wizard will complete the installation for this device:

MotionLingo

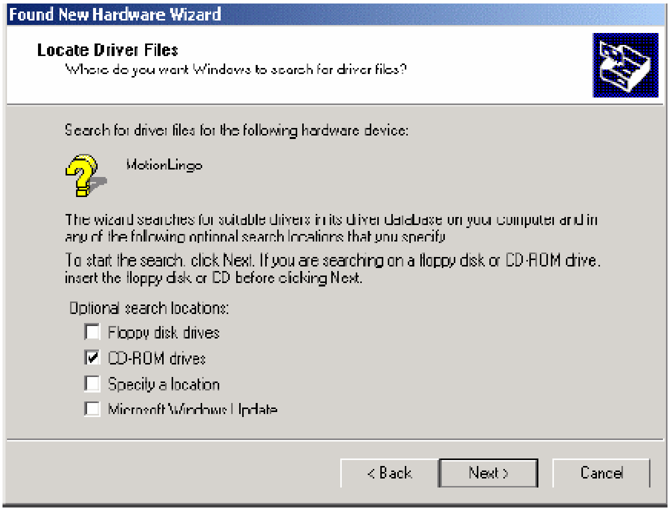
A device driver is a software program that makes a hardware device work. Windows needs driver files for your new device. To locate driver files and complete the installation click Next.

What do you want the wizard to do?

[✓ Search for a suitable driver for my device (recommended)]

Display a list of the known drivers for this device so that I can choose a specific driver

Click again "Next" to display the following picture:



Found New Hardware Wizard

Locate Driver Files

Where do you want Windows to search for driver files?

Search for driver files for the following hardware device:

MotionLingo

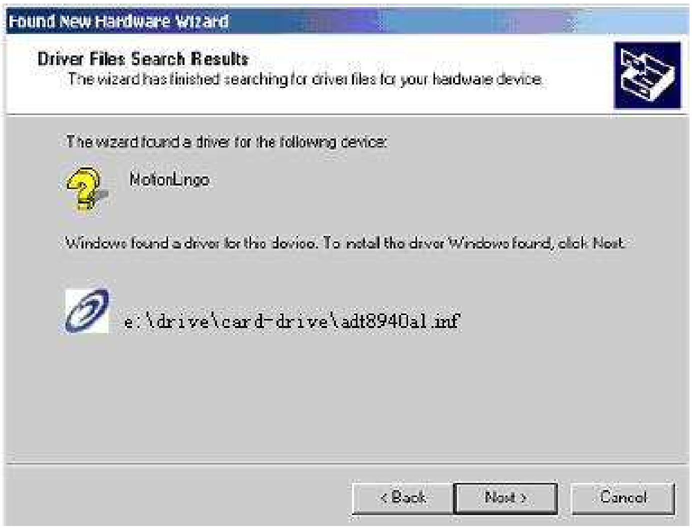
The wizard searches for suitable drivers in its driver database on your computer and in any of the following optional search locations that you specify.

To start the search, click Next. If you are searching on a floppy disk or CD-ROM drive, insert the floppy disk or CD before clicking Next.

Optional search locations:

- [ ] Floppy disk drives
- [x] CD-ROM drives
- [ ] Specify a location
- [ ] Microsoft Windows Update

Then select "Specify a location" and Click again "Next" and Click "Browse" button to select DevelopmentPackage/ Drive/ CardDrive and find the ADT8960.INF file, then click "OK" to display the following interface:


Found New Hardware Wizard

Driver Files Search Results

The wizard has finished searching for driver files for your hardware device.

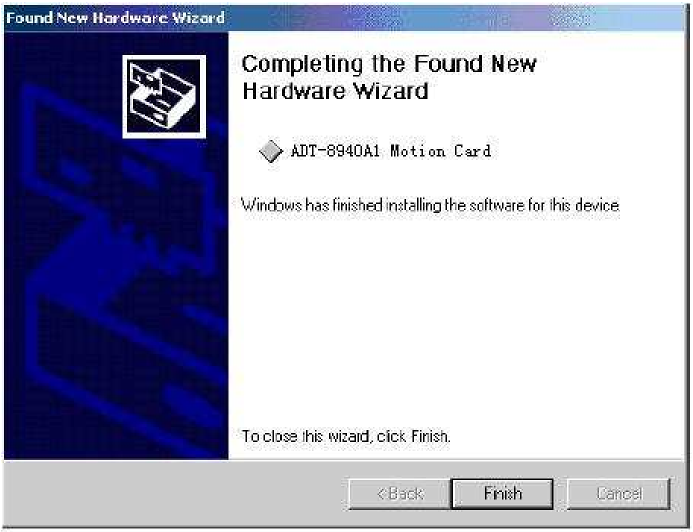
The wizard found a driver for the following device:

MotionLingo

Windows found a driver for this device. To install the driver Windows found, click Next.

e:\drive\card-drive\adt8940a1.inf

Click “Next” to display the following picture:


Found New Hardware Wizard

Completing the Found New Hardware Wizard

ADT-8940A1 Motion Card

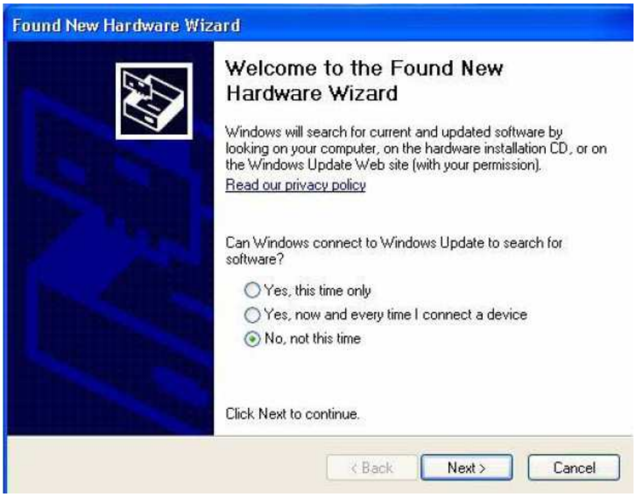
Windows has finished installing the software for this device.

To close this wizard, click Finish.

Finally click “Finish” to complete installation.

☞ **DRIVE INSTALLATION UNDER WINXP**

Installation under WinXP is similar to that under Win98, specifically:



Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

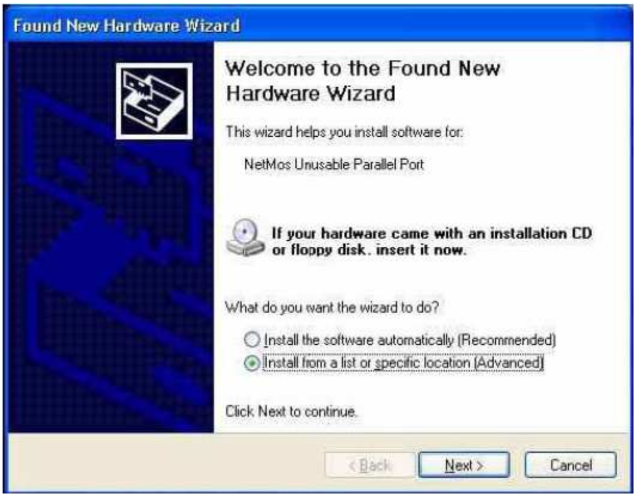
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).

Read our privacy policy

Can Windows connect to Windows Update to search for software?

- Yes, this time only
- Yes, now and every time I connect a device
- [✓ No, not this time]

Click Next to continue.



Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

This wizard helps you install software for:

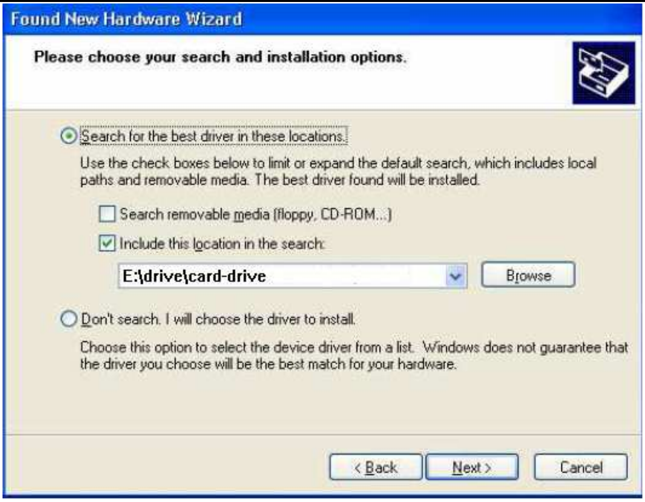
NetMos Unusable Parallel Port

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

- Install the software automatically (Recommended)
- [✓ Install from a list or specific location (Advanced)]

Click Next to continue.



Found New Hardware Wizard

Please choose your search and installation options.

[✓ Search for the best driver in these locations.]

Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.

☐ Search removable media (floppy, CD-ROM...)

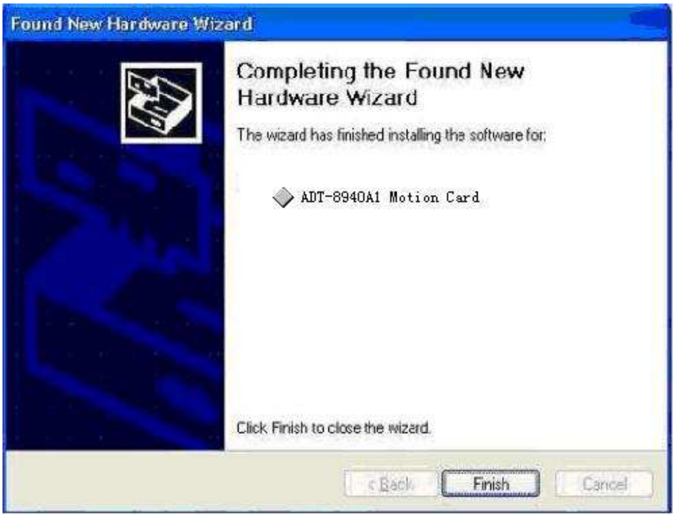
☑ Include this location in the search:

E:\drive\card-drive

Don't search. I will choose the driver to install.

Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.

Click “Browse” button to select Drive/ CardDrive and find the ADT8960.INF file, then click “Next” to display the following interface:



Found New Hardware Wizard

Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

ADT-8940A1 Motion Card

Click Finish to close the wizard.

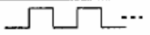
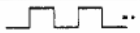
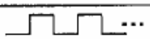
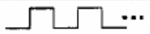
Then click “Finish” to complete installation.

Chapter 5 Functions

☞ Pulse output method

Pulse output may be realized through either independent 2-pulse or 1-pulse. In case of independent 2-pulse, the positive direction drive has PU/CW outputting drive pulses, and the negative direction drive has DR/CCW outputting drive pulses. In case of 1-pulse, PU/CW outputs drive pulse and DR/CCW outputs direction signals.

Pulse/ direction is set on the positive logical level

Puls	Drive direction	Output signal waveform	
		PU/CW signal	DR/CCW signal
Independent 2-puls	+Direction		Low level
	-Direction	Low level	
1-pulse 1-direction	+Direction		Low level
	-Direction		Hi level

☞ Hardware limit signal

Hardware limit signals LMT+ and LMT- are respectively to limit the input signals outputted by drive pulse along positive and negative directions, which can be set as “effective”, “ineffective” with high/low levels. Actually “effective” or “ineffective” can be set for positive limit and negative limit individually. In case “ineffective” is selected, they may work as ordinary input points.

Hard limit signals STOP0 and STOP1 are input signals that may realize hardware termination for all axis drive and may be set as “effective”, “ineffective” as well as termination method for high/low levels. In case “ineffective” is selected, they may work as general input points. Besides, they, when working as drive for interpolation, are effective for the minimum interpolation axis only.

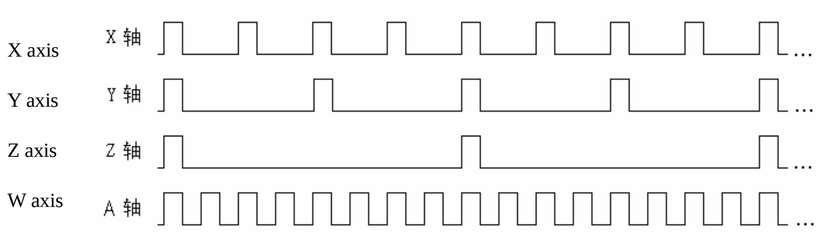
☞ Linear interpolation

This card may work for 2~6 axes linear interpolation under the modified method of point-by-point comparison, which can ensure uniform pulse along the long axis, giving the precision within one pulse.

Firstly, take the axis outputting the maximum pulses among the axes joining interpolation as the long axis, and proportionally distribute for the rest axes. Speed control applies only to speed of the long axis.

For example, (1-X axis, 2-Y axis, 3-Z axis, and 4-W axis).

Take four axes for linear interpolation, while Axis 1 outputs 1000 pulses, Axis 2 outputs 500, Axis 3 outputs 250 and Axis outputs 2000.



From the above figure, A axis shall be the long axis, and the rest axes proportionally share the pulses.

Setting of interpolation speed takes the minimum speed of an axis among the joined axes as the benchmark, for example, if Axis 2 and Axis 3 join linear interpolation, the interpolation speed will be determined by speed of Axis 2. moreover, speed of interpolation is only half of the single axis.

For example, Axis 2 and Axis 3 work for two-axis linear interpolation, with Axis 2 outputs 10000 pulses along positive direction and Axis 3 outputs 5000 pulses along negative direction, which means Axis 2 is the long axis.

```
set_startv(0,2,1000);
set_speed(0,2,1000);
inp_move2(0,2,3,10000,-5000);
```

After execution of the above program, Axis 2 will send 10000 pulses in the frequency of 1000/2=500Hz, while frequency of Axis 3 shall be

500*5000/10000=250Hz.

If speed of Axis 2 realizes trapezoidal acceleration/deceleration, interpolation will also follow such trapezoidal acceleration/deceleration.

☞ **Quantitative velocity**

The velocity may change during motion, so as to control the speed and track more flexibly and effectively. Refer to the settings of relative functions, set_atartv, set_speed, set_acc and so on for change of velocity.

☞ **External signal driving**

External signal driving is the motion controlled by external signals (handwheel or switch). It is mainly used in the manual debugging of machines and teaching system. When the external signal driving is enabled, use the handwheel or mechanical switch to control the pulse and thus the motion. When the external signal function is not to be used, disable the external signal driving.

☞ **Position lock**

Realize hardware position lock function with the designated IN signal on each axis. With one lock signal, the current position, either logical or actual, of all axes can be locked. The position lock is useful in measuring system.

☞ **Manual deceleration**

Realize manual deceleration function with the designated IN signal on each axis. The manual deceleration point can be set on each axis separately. When reaching the point, it will decelerate to the designated speed automatically. The origin can be searched at the designated speed, while the origin signal should be triggered externally.

☞ **Hardware Cache**

With the large capacity hardware cache function, interpolation data can be saved in the buffer area before motion to be processed in advance, ensuring continuous output of pulse and enabling smooth and consecutive motion. Therefore, the processing precision can be effectively promoted. The memory space for FIFO is as high as 2MB.

Chapter 6 List of ADT8960 basic library functions

List of library functions

Function type	Function name	Function description	Page
Basic parameters	adt8960_initial	Initialize card	29
	set_pulse_mode	Set pulse mode	29
	set_limit_mode	Set limit mode	30
	set_stop0_mode	Set stop mode	30
	set_stop1_mode	Set stop mode	31
	set_delay_time	Delay status	31
	set_suddenstop_mode	Hardware stop	31
	set_ad_mode	Acceleration/deceleration mode	32
Check for drive status	get_status	Get status of single axis drive	32
	get_inp_status	Get status of interpolation	32
	get_delay_status	Delay status	33

	get_hardware_ver	Hardware version	33
Movement parameter setting	set_acc	Set acceleration	33
	set_acac	Set acceleration change rate	34
	set_startv	Set starting speed	34
	set_speed	Set drive speed	34
	set_command_pos	Set logical position counter	34
	set_actual_pos	Set real position counter	35
	set_symmetry_speed	Set symmetry speed	35
	set_io_mode	General IN/OUT point position	36
Check for motion para	get_command_pos	Get logical position	36
	get_actual_pos	Get real position	36
	get_speed	Get drive speed	37
	get_out	Get output point	37
	get_ad	Get acceleration	37
Drive	pmove	Single-axis quantitative drive	38

	continue_move	Continue moving	38
	dec_stop	Deceleration stop	38
	sudden_stop	Sudden stop	39
	inp_move2	2-axis linear interpolation	39
	inp_move3	3-axis linear interpolation	39
	inp_move4	4-axis linear interpolation	40
	inp_move5	5-axis linear interpolation	40
	inp_move6	6-axis linear interpolation	41
Switch I/O category	read_bit	Read single input point	41
	write_bit	Single output point	41
Composite driving	symmetry_relative_move	Symmetric relative movement of single axis	42
	symmetry_absolute_move	Symmetric absolute movement of single axis	42
	symmetry_relative_line2	Relative movement of 2-axis symmetric linear interpolation	43

	symmetry_absolute_line2	Absolute movement of 2-axis symmetric linear interpolation	43
	symmetry_relative_line3	Relative movement of 3-axis symmetric linear interpolation	44
	symmetry_absolute_line3	Absolute movement of 3-axis symmetric linear interpolation	44
	symmetry_relative_line4	Relative movement of 4-axis symmetric linear interpolation	45
	symmetry_absolute_line4	Absolute movement of 4-axis symmetric linear interpolation	45
	symmetry_relative_line5	Relative movement of 5-axis symmetric linear interpolation	46
	symmetry_absolute_line5	Absolute movement of 5-axis symmetric linear interpolation	46
	symmetry_relative_line6	Relative movement of 6-axis symmetric linear interpolation	47
	symmetry_absolute_line6	Absolute movement of 6-axis symmetric linear interpolation	47
External puls	manual_pmove	Quantitative drive function of external signal	48

	manual_continue	Continuous drive function of external signal	48
	manual_disable	Disable external signal drive	48
Position lock	set_lock_position	Set position lock mode	49
	get_lock_status	Get lock status	49
	get_lock_position	Get lock position	49
	clr_lock_status	Clear lock position	50
Hardware cache	fifo_inp_move1	1-axis FIFO	50
	fifo_inp_move2	2-axis FIFO	50
	fifo_inp_move3	3-axis FIFO	51
	fifo_inp_move4	4-axis FIFO	51
	fifo_inp_move5	5-axis FIFO	52
	fifo_inp_move6	6-axis FIFO	52
	reset_fifo	Reset FIFO	53
	read_fifo_count	Read FIFO	53

	read_fifo_empty	Read FIFO	53
	read_fifo_full	Read FIFO	53
Manual deceleration	set_dec_mode	Set manual deceleration mode	55
	set_dec_pos1	Set manual deceleration point	55
	set_dec_pos2	Rest position after arriving at deceleration point	55
	clr_dec_status	Clear manual deceleration status	56
	get_dec_status	Get manual deceleration status	56
	set_end_speed	Set the ending speed	56

Chapter 7 Details of ADT8960 basic library functions

☞ Category of basic parameter setting

1.1 Initialize card

int adt8960_initial(void)

Function:

To initialize the card

Return:

(1)>0, indicating the amount of installed ADT8960 cards; In case the Return is 3, the available card numbers shall be 0, 1, and 2;

(2) =0, indicating no installation of ADT8960 card;

(3)<0, indicating no installation of service if the value is -1 or PCI bus failure if the value is -2.

Note: Initialization functions are preliminary conditions to call other functions thus must be called firstly so as to verify available cards and initialize some parameters.

1.2 Get output pulse mode

int set_pulse_mode(int cardno, int axis, int value,int logic,int dir_logic)

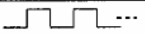
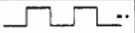
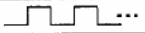
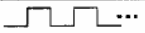
Function:

To set the output pulse mode

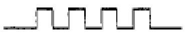
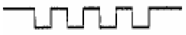
Parameters:

cardno	Card number
axis	Axis number (1-6)
Value	0: Pulse+Pulse method 1: Pulse+direction method

Pulse/ direction are both of positive logic setting

Pulse output method	Drive direction	Output signal waveform	
		PU/CW signal	DR/CCW signal
Independent 2-pulse method	Positive drive output		Low level
	Negative drive output	Low level	
1-pulse method	Positive drive output		Low level
	Negative drive output		Hi level

logic 0: Positive logic pulse 1: Negative logic pulse

Positive logic pulse:  Negative logic pulse: 

dir-logic 0: Positive logic direction of output signal 1:

Negative logic direction of output signal

Dir_logic	Output to positive direction	Output to negative direction
0	Low	Hi
1	Hi	Low

Return: 0: Correct 1: Wrong

Default mode: Pulse + direction, with positive logic pulse and positive logic direction input signal

1.3 Set mode of nLMT signal input along positive/negative direction

int set_limit_mode(int cardno, int axis, int v1,int v2,int logic)

Function:

To set mode of nLMT signal input along positive/negative direction

Parameters:

cardno	Card number	
axis	Axis number (1-6)	
v1	0: Positive limit is effective	1: Positive limit is ineffective
v2	0: Negative limit is effective	1: Negative limit is ineffective
logic	0: Low level is effective	1: High level is effective

Return: 0: Correct 1: Wrong

Default mode: positive and negative limits with low level are effective

1.4 Set mode of stop0 input signal

int set_stop0_mode(int cardno, int axis, int v,int logic)

Function:

To set mode of stop0 input signal

Parameters:

cardno Card number

axis Axis number (1-6)

v 0: stop0 is ineffective 1: stop0 is effective

logic 0: Low level is effective 1: High level is effective

Return: 0: Correct 1: Wrong

Default mode: Stop 0 is ineffective

1.5 Set mode of stop1 input signal

int set_stop1_mode(int cardno, int axis, int v,int logic)

Function:

To set mode of stop1 input signal

Parameters:

cardno Card number

axis Axis number (1-6)

v 0: stop0 is ineffective 1: stop0 is effective

logic 0: Low level is effective 1: High level is effective

Return: 0: Correct 1: Wrong

Default mode: stop1 is ineffective

1.6 Delay time

int set_delay_time(int cardno,long time)

Function:

To delay the time

Parameters:

cardno Card number

time Delay time

Return: 0: Correct 1: Wrong

Note: The time unit is 1/8us, with the maximum integer value as its maximum.

1.7 Set stop using the hardware

int set_suddenstop_mode(int cardno,int v,int logical)

Function:

To set stop sing the hardware

Parameters:

cardno	Card number	
v	0: ineffective	1: effective
logical	0: low level effective	1: high level effective

Return: 0: Correct 1: Wrong

Note: Hardware stop signals are assigned to use the 33 pin at the P2 terminal panel (IN31)

1.8 Set acceleration/deceleration mode

int set_ad_mode(int cardno,int axis,int mode)

Function: To select the acceleration/deceleration mode, trapezoid or S-type

Parameters:

cardno	Card number	
axis	Axis number (1-6)	
mode	0: linear acceleration/deceleration	1: S-type acceleration/deceleration

Return: 0: Correct 1: Wrong

Default mode: Linear acceleration/deceleration

☞ **Category of drive status check**

2.1 Get status of single-axis drive

int get_status(int cardno,int axis,int *value)

Function:

To get status of single-axis drive

Parameters:

cardno	Card number
axis	Axis number (1-6)

value Indicator of drive status

0: Drive completed Non-0: Drive in process

Return: 0: Correct 1: Wrong

2.2 Get status of interpolation

int get_inp_status(int cardno,int *value)

Function:

To get status of interpolation

Parameters:

cardno	Card number
value	Indicator of interpolation 0: Interpolation completed 1: Interpolation in process

Return: 0: Correct 1: Wrong

2.3 Get status of Delay

int get_delay_status(int cardno)

Function:

To get status of Delay

Parameters:

cardno Card number

Return: 0: Delay completed 1: Delay in process

2.4 Get hardware version

float get_hardware_ver(int cardno)

Function:

To get hardware version

Parameters:

cardno Card number

Return: 1.1: Version 1.1 1.2: Version 1.2

Note: The return value is default. Version 1.1 or 1.2 indicates the temporary version. The current version is 1.3.

☞ **Category of movement parameter setting**

Note: The following parameters are not determined after

initialization, and thus must set before use.

3.1 Set acceleration

int set_acc(int cardno,int axis,long value)

Function:

To set acceleration

Parameters:

cardno	Card number
axis	Axis number
value	Acceleration (0-32000)

Return: 0: Correct 1: Wrong

3.2 Set acceleration change rate

int set_acac(int cardno,int axis,long value)

Function: To set the acceleration/deceleration change rate

Parameters:

cardno	Card number
axis	Axis number
value	K value (1-65535)

Return: 0: Correct 1: Wrong

3.3 Set starting speed

int set_startv(int cardno,int axis,long value)

Function:

To set starting speed

Parameters:

cardno	Card number
axis	Axis number
value	Starting speed (1-2M)

Return: 0: Correct 1: Wrong

3.4 Set drive speed

int set_speed(int cardno,int axis,long value)

Function:

To set drive speed

Parameters:

cardno	Card number
axis	Axis number
Speed (1-2M)	

Return: 0: Correct 1: Wrong

3.5 Set logical position counter

int set_command_pos(int cardno,int axis,long value)

Function:

To set values for the logical position counter

Parameters:

cardno	Card number
axis	Axis number
value	Range (-2147483648~+2147483647)

Return: 0: Correct 1: Wrong

A logical position counter can read and write at any time.

3.6 Set real position counter

int set_actual_pos(int cardno,int axis,long value)

Function:

To set values for the real position counter

Parameters:

cardno	Card number
axis	Axis number
value	Range (-2147483648~+2147483647)

Return: 0: Correct 1: Wrong

A real position counter can read and write at any time.

3.7 Set the symmetry speed

int set_symmetry_speed(int cardno,int axis,long lspd,long hspd,double tacc)

Function:

To set values for the symmetry speed

Parameters:

cardno	Card number
axis	Axis number (1-6)
lpsd	start speed
hspd	running speed
tacc	acceleration time

Return: 0: Correct 1: Wrong

3.8 Set IN/OUT point

int set_io_mode(int cardno,int v1,int v2);

Function:

To set IN/OUT point

Parameters:

v1 0: Set the earlier 8 points as Input 1: Set the earlier 8 points as Output

v2 0: Set the later 8 points as Input 1: Set the later 8 points as Output

Return: 0: Correct 1: Wrong

Note: When the IO point is set as output, the IN status can be read at the same time.

☞ **Category of motion parameter check**

The following functions can be called at any time

4.1 Get logic position of each axis

int get_command_pos(int cardno,int axis,long *pos)

Function:

To get logic position of each axis

Parameters:

cardno	Card number
axis	Axis number
pos	Indicator of logic position value

Return: 0: Correct 1: Wrong

This function can get the logic position of the corresponding axis at any time, and in case of no out-step by motor, pos values just indicate the current position of the axis.

4.2 Get real position of each axis (i.e., encoder feedback input)

int get_actual_pos(int cardno,int axis,long *pos)

Function:

To get real position of each axis

Parameters:

cardno	Card number
axis	Axis number
pos	Indicator of real position value

Return: 0: Correct 1: Wrong

This function can get the real position of the corresponding axis at any time, and even though in case of out-step by motor, pos values still indicate the real position of the axis.

4.3 Get current drive speed of each axis

int get_speed(int cardno,int axis,long *speed)

Function:

To get motion speed

Parameters:

cardno	Card number
axis	Axis number
speed	Indicator of current drive speed

Return: 0: Correct 1: Wrong

Its data unit is same as that for drive speed setting value V.

This function can get the axis drive speed at any time.

4.4 Get status of output

int get_out(int cardno, int number)

Function:

To get status of output

Parameters:

cardno	Card number
number	Port number

Return: Current output point status, -1: Wrong

4.5 Get current acceleration of each axis

```
int   get_ad(int cardno,int axis,long *ad);
```

Function: To get current acceleration of each axis

Parameters:

cardno	Card number
axis	Axis number
ad	Indicator of current acceleration

Return: 0: Correct 1: Wrong

Note: The unit of the data is the same as the drive acceleration setting value, A.

☞ **Category of drive**

5.1 Quantitative drive

```
int   pmove(int cardno,int axis,long pulse)
```

Function:

To set quantitative drive

Parameters:

cardno	Card number
axis	Axis number
pulse	Outputted pulses
	>0: move along positive direction
	<0: move along negative direction
	Range (-268435455~+268435455)

Return: 0: Correct 1: Wrong

Note: Users must correctly set the parameters required by speed curve before making drive commands.

5.2 Continue moving

```
int   continue_move(int cardno,int axis,int dir)
```

Function:

To continue moving

Parameters:

cardno	Card number
axis	Axis number
dir	Direction 0: Positive 1: Negative

Return: 0: Correct 1: Wrong

5.3 Deceleration stop

int dec_stop(int cardno,int axis)

Function:

To set deceleration stop

Parameters:

cardno	Card number
axis	Axis number

Return: 0: Correct 1: Wrong

During drive pulse output, this command will make deceleration stop. Users may use this command to stop when the drive speed is lower than the starting speed.

Note: During linear interpolation, if requiring deceleration stop, users shall make command only for the earliest interpolation axis, otherwise it may fail to achieve expected results.

5.4 Sudden stop

int sudden_stop(int cardno,int axis)

Function:

To set sudden stop

Parameters:

cardno	Card number
axis	Axis number

Return: 0: Correct 1: Wrong

This command will suddenly stop the pulse output in process, even though it is in acceleration/deceleration drive.

Note: During linear interpolation, if requiring sudden stop, users shall make command only for the earliest interpolation axis, otherwise it may fail to achieve expected results.

5.5 2-axis interpolation

int inp_move2(int cardno,int axis1,int axis2,long pulse1,long pulse2)

Function:

To set 2-axis interpolation

Parameters:

cardno Card number

axis1 , axis 2 Axis number joining interpolation

pulse1,pulse2 Relative distance of movement Range (-8388608~+8388607)

Return: 0: Correct 1: Wrong

5.6 3-axis interpolation

int inp_move3(int cardno,int axis1,int axis2,int axis3,long pulse1,long pulse2,long pulse3)

Function:

To set 3-axis interpolation

Parameters:

cardno Card number

axis1 , axis 2, axis 3 Axis number joining interpolation

pulse1,pulse2,pulse3 Relative distance of motion along specified axis (axis 1/2/3)

Range (-8388608~+8388607)

Return: 0: Correct 1: Wrong

5.7 4-axis interpolation

int inp_move4(int cardno, int axis1,int axis2,int axis3,int axis4,long pulse1,long pulse2,long pulse3,long pulse4)

Function:

To set 4-axis interpolation

Parameters:

cardno Card number

axis1 , axis 2, axis 3, axis 4 Axis number joining interpolation

pulse1,pulse2,pulse3,pulse4 Relative distance of movement along axis 1/2/3/4

Range (-8388608~+8388607)

Return: 0: Correct 1: Wrong

5.8 5-axis interpolation

int inp_move5(int cardno,int axis1,int axis2,int axis3,int axis4, int axis5,long pulse1,long pulse2,long pulse3,long pulse4,long pulse5)

Function:

To set 5-axis interpolation

Parameters:

cardno Card number

axis1 , axis 2, axis 3, axis 4, axis 5 Axis number joining interpolation

pulse1,pulse2,pulse3,pulse4 ,pulse5 Relative distance of movement along axis 1/2/3/4/5

Range (-8388608~+8388607)

Return: 0: Correct 1: Wrong

5.9 6-axis interpolation

int inp_move6(int cardno,long pulse1,long pulse2,long pulse3,long pulse4,long pulse5,long pulse6)

Function:

To set 6-axis interpolation

Parameters:

cardno Card number

pulse1,pulse2,pulse3,pulse4 ,pulse5,pulse6 Relative distance of movement along axis 1/2/3/4/5/6

Range (-8388608~+8388607)

Return: 0: Correct 1: Wrong

☞ **Category of INPUT/OUTPUT**

6.1 Read single input point

int read_bit(int cardno,int number)

Function:

To read single input point

Parameters:

cardno	Card number
number	Input point (0-31)

Return: 0: low level 1: high level effective

-1: Wrong

6.2 Output single output point

int write_bit(int cardno,int number,int value)

Function:

To set sing output point

Parameters:

cardno	Card number	
number	Output point (0-15)	
value	0: Low	1: High

Return: 0: Correct 1: Wrong

A number corresponds to the output number.

☞ **Category of composite driving**

To provide convenience for the customers, we encapsulated composite driving functions in the basic library functions. There functions mainly integrate speed mode setting, speed parameter setting and motion functions, while absolute motion and relative motion are also considered.

7.1 Single axis symmetric relative moving

int symmetry_relative_move(int cardno, int axis, long pulse, long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

~~Refer to the current position to perform quantative movement at~~

acceleration

Parameters:

cardno	Card number
axis	Axis number
pulse	Pulse of axis
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.2 Single axis symmetric absolute moving

int symmetry_absolute_move(int cardno, int axis, long pulse, long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the Origin to perform quantative movement at acceleration

Parameters:

cardno	Card number
axis	Axis number
pulse	Pulse of axis
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.3 Relative moving of 2-axis symmetric linear interpolation

int symmetry_relative_line2(int cardno, int axis1, int axis2, long pulse1, long pulse2, long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the current position to perform linear interpolation at acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
pulse1	Pulse 1
pulse1	Pulse 2
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.4 Absolute moving of 2-axis symmetric linear interpolation

int symmetry_absolute_line2(int cardno, int axis1, int axis2, long pulse1, long pulse2, long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the origin to perform linear interpolation at acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
pulse1	Pulse 1
pulse1	Pulse 2
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.5 Relative moving of 3-axis symmetric linear interpolation

int symmetry_relative_line3(int cardno, int axis1, int axis2, int axis3, long pulse1, long pulse2, long pulse3, long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the current position to perform linear interpolation at acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
axis1	Axis 3
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.6 Absolute moving of 3-axis symmetric linear interpolation

int symmetry_absolute_line3(int cardno, int axis1, int axis2, int axis3, long pulse1, long pulse2, long pulse3, long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the origin to perform linear interpolation at

acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
axis1	Axis 3
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.7 Relative moving of 4-axis symmetric linear interpolation

int symmetry_relative_line4(int cardno,int axis1, int axis2, int axis3,int axis4,long pulse1, long pulse2, long pulse3, long pulse4,long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the current position to perform linear interpolation at acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
axis1	Axis 3
axis1	Axis 4
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
pulse1	Pulse 4
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7. 8 Absolute moving of 4-axis symmetric linear interpolation

int symmetry_absolute_line4(int cardno, int axis1, int axis2, int axis3,int axis4,long pulse1, long pulse2, long pulse3, long pulse4,long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the origin to perform linear interpolation at acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
axis1	Axis 3
axis1	Axis 4
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
pulse1	Pulse 4
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.9 Relative moving of 5-axis symmetric linear interpolation

int symmetry_relative_line5(int cardno,int axis1, int axis2, int axis3,int axis4,int axis5,long pulse1, long pulse2, long pulse3, long pulse4,long pulse5,long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the current position to perform linear interpolation at acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
axis1	Axis 3
axis1	Axis 4
axis1	Axis 5
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
pulse1	Pulse 4
pulse1	Pulse 5
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.10 Absolute moving of 5-axis symmetric linear interpolation

int symmetry_absolute_line5(int cardno, int axis1, int axis2, int axis3,int axis4,int axis5,long pulse1, long pulse2, long pulse3, long pulse4,long pulse5,long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the origin to perform linear interpolation at acceleration

Parameters:

cardno	Card number
axis1	Axis 1
axis1	Axis 2
axis1	Axis 3
axis1	Axis 4
axis1	Axis 5
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
pulse1	Pulse 4
pulse1	Pulse 5
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.11 Relative moving of 6-axis symmetric linear interpolation

int symmetry_relative_line6(int cardno,long pulse1, long pulse2, long pulse3, long pulse4,long pulse5, long pulse6,long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the current position to perform linear interpolation at acceleration

Parameters:

cardno	Card number
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
pulse1	Pulse 4
pulse1	Pulse 5
pulse1	Pulse 6
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

7.12 Absolute moving of 6-axis symmetric linear interpolation

int symmetry_absolute_line6(int cardno,long pulse1, long pulse2, long pulse3, long pulse4,long pulse5, long pulse6,long lspd ,long hspd, double tacc, long vacc, int mode)

Function:

Refer to the origin to perform linear interpolation at

acceleration

Parameters:

cardno	Card number
pulse1	Pulse 1
pulse1	Pulse 2
pulse1	Pulse 3
pulse1	Pulse 4
pulse1	Pulse 5
pulse1	Pulse 6
lspd	Low speed
hspd	High speed
tacc	Time of acceleration (Unit: sec)
vacc	Acceleration change rate
mode	Mode (0: trapezoid 1: S curve)

Return: 0: Correct 1: Wrong

☞ Category of external signal driving

8.1 Quantitative drive function of external signal

int manual_pmove(int cardno, int axis, long pos)

Function: To set quantitative drive function of external signal

Parameters:

cardno	Card number
axis	Axis number

Return: 0: Correct 1: Wrong

Note: (1) Send out quantitative pulse, but the drive does not start immediately until the external signal level changes.

(2) Ordinary button and handwheel are acceptable.

8.2 Continuous drive function of external signal

int manual_continue(int cardno, int axis)

Function: To set continuous drive function of external signal

Parameters:

cardno	Card number
axis	Axis number

Return: 0: Correct 1: Wrong

Note: (1) Send out continuous quantitative pulse, but the drive does not start immediately until the external signal level changes.

(2) Ordinary button and handwheel are acceptable.

8.3 Disable the external signal drive

int manual_disable (int cardno, int axis)

Function: To disable the external signal drive

Parameters:

cardno	Card number
axis	Axis number (1-6)

Return: 0: Correct 1: Wrong

Note: When using external signal to send out pulses, the function will not stop the pulse by the function. To stop the pulse, use Stop command.

☞ **Category of position lock**

9.1 Lock the logical position and real position for all axes

int set_lock_position(int cardno, int axis,int mode,int regi,int logical)

Function: To lock the logical position and real position for all axes with signal function

Parameters:

axis	Reference axis		
mode	Set lock mode	0: Ineffective	1: Effective
regi	Register mode	0: Logical position	1: Real position
logical	Level signal	0: From low to high	1: From high to low

Return: 0: Correct 1: Wrong

Note: Use the IN signal of specified axis to trigger.

9.2 Get lock status

int get_lock_status(int cardno, int axis, int *v)

Function: To get the status of position lock

Parameters:

cardno	Card number	
axis	Axis number (1-6)	
v	0: Unlocked	1: Locked

Return: 0: Correct 1: Wrong

Note: The function is applicable to capture the lock status.

9.3 Get lock position

int get_lock_position(int cardno,int axis,long *pos)

Function: To get lock position

Parameters:

cardno	Card number
axis	Axis number (1-6)
pos	Lock position

Return: 0: Correct 1: Wrong

9.4 Clear lock status

int _stdcall clr_lock_status(int cardno, int axis)

Function: To clear lock status

Parameters:

cardno	Card number
axis	Axis number (1-6)

Return: 0: Correct 1: Wrong

☞ **Category of hardware cache**

10.1 1-axis FIFO

int fifo_inp_move1(int cardno,int axis1,long pulse1,long speed)

Function: To set single axis FIFO

Parameters:

cardno	Card number
axis1	Axis number (1-6)
pulse1	Pulses in FIFO buffer
speed	FIFO speed

Return: 0: Correct 1: Wrong

Note: The buffer size is 2048 bytes. Every 1-axis cache command occupies 3 bytes, i.e., 682 commands can be saved.

10.2 2-axis FIFO

int fifo_inp_move2(int cardno,int axis1,int axis2,long pulse1,long pulse2,long speed)

Function: To set 2-axis FIFO

Parameters:

cardno	Card number
axis1	Axis number (1-6)
axis2	Axis number (1-6)

pulse1	Pulses in FIFO buffer
pulse2	Pulses in FIFO buffer
speed	FIFO speed

Return: 0: Correct 1: Wrong

Note: The buffer size is 2048 bytes. Every 2- axis cache command occupies 4 bytes, i.e., 512 commands can be saved.

10.3 3-axis FIFO

int fifo_inp_move3(int cardno,int axis1,int axis2,int axis3,long pulse1,long pulse2,long pulse3,long speed)

Function: To set 3-axis FIFO

Parameters:

cardno	Card number
axis1	Axis number (1-6)
axis2	Axis number (1-6)
axis3	Axis number (1-6)
pulse1	Pulses in FIFO buffer
pulse2	Pulses in FIFO buffer
pulse3	Pulses in FIFO buffer
speed	FIFO speed

Return: 0: Correct 1: Wrong

Note: The buffer size is 2048 bytes. Every 3- axis cache command occupies 5 bytes, i.e., 409 commands can be saved.

10.4 4-axis FIFO

int fifo_inp_move4(int cardno,int axis1,int axis2,int axis3,int axis4,long pulse1,long pulse2,long pulse3,long pulse4,long speed)

Function: To set 4-axis FIFO

Parameters:

cardno	Card number
axis1	Axis number (1-6)
axis2	Axis number (1-6)
axis3	Axis number (1-6)
axis4	Axis number (1-6)

pulse1	Pulses in FIFO buffer
pulse2	Pulses in FIFO buffer
pulse3	Pulses in FIFO buffer
pulse4	Pulses in FIFO buffer
speed	FIFO speed

Return: 0: Correct 1: Wrong

Note: The buffer size is 2048 bytes. Every 4-axis cache command occupies 6 bytes, i.e., 341 commands can be saved.

10.5 5-axis FIFO

int fifo_inp_move5(int cardno,int axis1,int axis2,int axis3,int axis4,int axis5,long pulse1,long pulse2,long pulse3,long pulse4,long pulse5,long speed)

Function: To set 5-axis FIFO

Parameters:

cardno	Card number
axis1	Axis number (1-6)
axis2	Axis number (1-6)
axis3	Axis number (1-6)
axis4	Axis number (1-6)
axis5	Axis number (1-6)
pulse1	Pulses in FIFO buffer
pulse2	Pulses in FIFO buffer
pulse3	Pulses in FIFO buffer
pulse4	Pulses in FIFO buffer
pulse5	Pulses in FIFO buffer
speed	FIFO speed

Return: 0: Correct 1: Wrong

Note: The buffer size is 2048 bytes. Every 5- axis cache command occupies 7 bytes, i.e., 292 commands can be saved.

10.6 6-axis FIFO

int fifo_inp_move6(int cardno,long pulse1,long pulse2,long pulse3,long pulse4,long pulse5,long pulse6,long speed)

Function: To set 6-axis FIFO

Parameters:

cardno	Card number
pulse1	Pulses in FIFO buffer
pulse2	Pulses in FIFO buffer
pulse3	Pulses in FIFO buffer
pulse4	Pulses in FIFO buffer
pulse5	Pulses in FIFO buffer
pulse6	Pulses in FIFO buffer
speed	FIFO speed

Return: 0: Correct 1: Wrong

Note: The buffer size is 2048 bytes. Every 6- axis cache command occupies 8 bytes, i.e., 256 commands can be saved.

10.7 Reset FIFO cache

int reset_fifo(int cardno)

Function: To reset FIFO cache

Parameters:

cardno	Card number

Return: 0: Correct 1: Wrong

10.8 Read FIFO cache

int _stdcall read_fifo_count(int cardno,int *value)

Function: To read FIFO cache to determine the number of FIFO commands that haven't been implemented

Parameters:

cardno	Card number
value	space (bytes) of commands that haven't been implemented

Return: 0: Correct 1: Wrong

10.9 Read FIFO status to determine whether it is empty

int read_fifo_empty(int cardno)

Function: To read whether the FIFO status is empty

Parameters:

cardno Card number

Return 0: Non-empty 1: Empty

10.10 Read FIFO status to determine whether it is full

int read_fifo_full(int cardno)

Function: To read whether the FIFO cache is full. If so, no more data can be saved.

Parameters:

cardno	Card number

Return 0: Non-full 1: Full

☞ Manual deceleration function

First, set the manual deceleration mode; when the mode is valid, set manual deceleration point pos1, the origin offset pos2, and the ending speed (low speed) after manual deceleration point, endspeed.

During manual deceleration process: when arriving at pos1, it will decelerate to and operate at endspeed automatically. Search the origin signal at endspeed, while the origin signal needs to be triggered with external signal (low level triggerment of stop0). After triggerment, it stops immediately after arriving at the origin offset (pos2). If no origin signal is searched, it will keep moving at endspeed.

11.1 Set manual deceleration mode

int set_dec_mode(int cardno,int axis,int mode)

Function: To set manual deceleration mode

Parameters:

cardno	Card number
axis	Axis number (1-6)
mode	Manual deceleration mode 0 ineffective 1 effective

Return: 0: Correct 1: Wrong

11.2 Set manual deceleration point

int set_dec_pos1(int cardno, int axis,long pos)

Function: To set manual deceleration point

Parameters:

cardno	Card number
axis	Axis number (1-6)
pos	Deceleration point

Return: 0: Correct 1: Wrong

Note: Upon reaching the deceleration point, it will decelerate to the specified low speed motion automatically to search signal to trigger origin. If no such signal is found, it keeps moving at the speed until the motion completes.

11.3 Set manual deceleration offset

int set_dec_pos2(int cardno, int axis,long pos)

Function: To set the offset of origin

Parameters:

cardno	Card number
axis	Axis number (1-6)
pos	Residual position

Return: 0: Correct 1: Wrong

Note: The motion of such offset requires external signal (low level of stop0) for triggerment.

11.4 Clear manual deceleration

int clr_dec_status(int cardno, int axis)

Function: To clear manual deceleration status

Parameters:

cardno	Card number
axis	Axis number (1-6)

Return: 0: Correct 1: Wrong

11.5 Get manual deceleration status

int get_dec_status(int cardno,int axis,int *sta)

Function: To get manual deceleration status

Parameters:

cardno	Card number
axis	Axis number (1-6)

sta Deceleration status

0: Searching

1: Search completed

2: Motion stopped. No deceleration point is found

3: Fail to reach the actual offset

4: Servo is turned off while searching for deceleration point

5: Deceleration point is found, which fails to get in place when moving towards offset (it might be limit triggerment)

Return: 0: Correct 1: Wrong

11.6 Set end speed

int set_end_speed(int cardno,int axis,long value);

Function: To set the endspeed to search for origin signal after manual deceleration point

Parameters:

cardno	Card number
axis	Axis number (1-6)
value	Range (1-2M)

Return: 0: Correct 1: Wrong

Note: If no signal for triggerment (deceleration origin signal) is found after reaching the manual deceleration point (pos1), it will keep moving at such speed.

Chapter 8 Guide to motion control function library

1. Introduction to ADT8960 function library

ADT8960 function library is actually the interface for users to operate the motion control card; users can control the motion control card to execute corresponding functions simply by calling interface functions.

The motion control card provides movement function library under DOS and dynamic link library under Windows; the following part will introduce the library calling method under DOS and Windows.

2. Calling dynamic link library under Windows

The dynamic link library adt8960.dll under Windows is programmed in VC, saved in the DevelopmentPackage/Drive/Dynamic Link Library, and applicable for general programming tools under Windows, including VB, VC, C++Builder, VB.NET, VC.NET, Delphi and group software LabVIEW.

2.1 Calling under VC

(1) Create a new project;

(2) Copy adt8960.lib and adt8960.h files from DevelopmentPackage/VC in the CD to the routing of the newly created item;

(3) Under File View of the Work Area of the new item, right click mouse to select “Add Files to Project” and then in the pop-up file dialogue select the file type to be "Library Files (.lib)”, then search for “adt8960.lib” and select it, finally click OK to finish loading of the static library;

(4) Add #include “adt8960.h” in the declaim part of the source file, header, or overall header “StdAfx.h”;

After the above four steps, users can call functions in the dynamic link library.

Note: The calling method under VC.NET is similar.

2.2 Calling under VB

(1) Create a new project;

(2) Copy adt8960.bas file from DevelopmentPackage/VB in the CD to the routing of the newly created item;

(3) Select the menu command Engineering/Add module and subsequently Save Current in the dialogue to search out the adt8960.bas module file, finally click the Open button;

After the above four steps, users can call functions in the dynamic link library.

Note: The calling method under VB.NET is similar.

2.3 Calling under C++Builder

(1) Create a new project;

(2) Copy adt8960.lib and adt8960.h files from DevelopmentPackage/C++Builder in the CD to the routing of the newly created item;

(3) Select the menu command “Project/Add to Project”, and in the pop-up dialogue select the file type to be “Library files(*.lib)”, then search out the “adt8960.lib” file and click Open button;

(4) Add #include “adt8960.h” in the declaim part of the program file;

After the above four steps, users can call functions in the dynamic link library.

2.4 Calling under LabVIEW8

(1) Create a new VI;

(2) Copy the adt8960.dll file from DevelopmentPackage/Drive/Control Card Drive in the CD to the routing of the newly created item;

(3) Select “Call Library Function Node” under “Connectivity\Libraries & Executables” in the function module in the window of flow diagram where the function should be called and add it to the target place;

(4) Double click the node, first select adt8960.dll dynamic link library in the pop-up dialogue “Call Library Function”, subsequently select the required library function, and finally configure the return and

parameter attribute of the function;

After the above four steps, users can call functions in the dynamic link library.

3. Calling library functions under DOS

Function libraries under DOS are edited in Borland C3.1 and saved in the DevelopmentPackage/C++(or C). Library functions may be categorized into large and huge modes, applicable for standard C and Borland C3.1 or above versions.

The method of calling function library with Borland C is as follows:

(1) Under the development environment of Borland C, select the “Project\Open Project” command to create a new project;

(2) Copy adt8960H.LIB/adt8960L.LIB and adt8960.H files from DevelopmentPackage/C(or C++) in the CD to the routing of the newly created item;

(3) Select the “Project\Add Item” command and further in the dialogue select “adt8960H.LIB” or “adt8960L.LIB”, finally click the Add button;

(4) Add #include “adt8960.h” statement in the user program file;

After the above four steps, users can call library functions in the program.

4. Returns of library functions and their meanings

To ensure that users will correctly know the execution of library functions, each library function in the function library after completion of execution will return to execution results of the library functions. Users, based on such Returns, can conveniently judge whether function calling has succeeded.

Except “int adt8960_initial(void)” and “int read_bit(int cardno, int number)” have special Returns, other functions have only “0” and “1” as the Returns, where “0” means success and “1” means failure.

The following list introduced meanings of function Returns.

Function name	Return	Meaning
adt8960_initial –	-1	No installation of service
	-2	PCI slot failure
	0	No installation of control card
	>0	Amount of control card
Read_bit	0	Low level
	1	High level
	-1	Card number or input point out of limit
Other functions	0	Correct
	1	Wrong

Note: Return 1 means calling error, and the normal cause is wrong cardno (Card Number) or axis (Axis Number) passed during the process of calling library functions. Card number have their values starting as 0, 1, 2, thus in case there is only one card, the card number must be 0; similarly values of axis number can only be 1, 2, 3, 4, 5, 6, other values are all wrong.

Chapter 9 Briefing on motion control development

Some problems may be encountered during programming, but most problems are caused by misunderstanding of the principle of this control card. The following part will give explanations on some usual and easy-to-misunderstood situations.

☞ **Card initialization**

At the beginning, users shall call adt8960_initial() function and ensure the ADT8960 card has been correctly installed, and then set pulse output mode and limit switch mode. The above parameters shall be set for individual machine, and normally only one setting is required during program initialization instead of any later setting.

Generally, the R value should be determined by the highest frequency under use, and shall not be changed during application unless the lowest frequency fails to meet the service requirement.

Note: The library function "adt8960_initial" is the door to ADT8960 card, thus calling other functions are meaningful only after successful card initialization with calling to this function.

☞ **Speed setting**

2.1 Constant speed motion

Parameter setting is so simple that users just need to set the drive speed equal to the starting speed; other parameters need no setting.

Relevant functions:

set_startv

set_speed

2.2 S-type acceleration/deceleration

To achieve better acceleration for several modes with higher load, S curve is recommended. For this purpose, the value of plus the acceleration should be set, while the calculation of plus the acceleration has a great effect on the shape of S curve. Refer to the above-mentioned example.

Relevant functions:

set_startv

set_speed

set_acc

set_acac

set_ad_mode (Set as S curve acceleration/deceleration mode)

2.3 Interpolation speed

ADT8960 card can take any 2/3/4/5/6 axes for linear interpolation.

For speed of interpolation, speed parameter for the earliest axis will apply as speed of the long axis, for example,

inp_move2 (0,3,1,100,200)

Is to apply the speed parameters of the first axis, i.e., X axis, independent of parameter sequence.

inp_move3 (0,3,4,2,100,200,500)

Is to apply the speed parameters of the second axis, i.e., Y axis, independent of parameter sequence.

Note: Speed multiple rate during interpolation is half of that during single-axis movement, which means under the same parameters speed of interpolation is only half of that of single-axis movement.

Chapter 10 Programming samples in motion control development

All movement control functions return immediately; once a drive command is made, the movement process will be controlled by the motion control card until completion; then the host computer software of users can real-time monitor the whole movement process or force to stop the process.

Note: Axis during motion are not allowed to send new drive commands to motion axis, otherwise the previous drive will be given up so as to execute the new drive.

Although programming languages vary in types, they can still be concluded as Three Structures and One spirit. Three Structures refer to sequential structure, cycling structure and branch structure emphasized by all the programming languages, and One Spirit refer to calculation and module division involved in order to complete design assignments, which is also the key and hard point in whole programming design.

To ensure that a program is popular, standard, expandable and easy for maintenance, all the later samples will be divided into the following modules in terms of project design: motion control module (to further seal library functions provided by the control card), function realization module (to cooperate code phase of specific techniques), monitoring module and stop processing module.

Now let’s brief application of ADT8960 card function library in VB and VC. Users using other programming languages may take reference.

☞ VB programming samples

1.1 PREPARATION

(1) Create a new item and save as “test.vbp”;

(2) Add the adt8960.bas module in the item following the above-mentioned method;

1.2 Motion control module

(1) Add a new module in the project and save as “ctrlcard.bas”;

(2) At first, within the motion control module self-define initialization functions of the motion control card and initialize library functions to be sealed into initialization functions;

(3) Further self-define relevant motion control functions, such as speed setting function, single-axis motion function, and interpolation motion function;

(4) Source code of ctrcard.bas is:

```
Public Result As Integer              'Return
Const MAXAXIS = 6                     'Maximum axis number
'******************Initialize the function***********************
‘ The function includes the common library functions for card
initialization, which is the base to call other functions, so it must be first
called in the example. ‘Return<=0 means initialization failure; Return >0
means initialization success
'*************************************************
Public Function Init_Card() As Integer
      Result = adt8960_initial               'Initialize card
      If Result <= 0 Then
          Init_Card = Result
          Exit Function
      End If
      For i = 1 To MAXAXIS
            set_command_pos 0, i, 0          'Clear logical position
counter
          set_command_pos 0, i, 0          'Clear real position counter
          set_startv 0, i, 1000            'Set starting speed
          set_startv 0, i, 2000            'Set drive speed
```

```
            set_startv 0, i, 625                'Set acceleration
        Next i
        Init_Card = Result
End Function
'*******************Get version information***********************
        The function is used to get the version of function library
        Parameters:      libver-library version
**********************************************************
Public Function Get_Version(libver As Double) As Integer
        Dim ver As Integer
ver = get_hardware_ver(0)
       libver = (ver / 256)
End Function
********************* Set speed module *********************
     Based on the value of the parameter, judge it's uniform or deceleration
       Set the initial velocity, drive speed and acceleration
       Parameter:   axis – axis No.
                    StartV - initial velocity
                    Speed - drive speed
                    Add - acceleration
       Return value=0 right，Return value =1 wrong
'******************************************************
Public Function Setup_Speed(ByVal axis As Integer, ByVal startv As Long, ByVal
speed As Long, ByVal add As Long) As Integer
            If (startv - speed >= 0) Then
                  Result = set_startv(0, axis, startv)
                  set_speed 0, axis, startv
            Else
                  Result = set_startv(0, axis, startv)
                  set_speed 0, axis, speed
                  set_acc 0, axis, add / 250
            End If
        End Function
        '********************single axis drive function*********************
                'Used for driving sing motion axis
                'Parameter：axis       pulse
                'Return value=0 right，Return value =1 wrong
        '****************************************************
        Public Function Axis_Pmove(ByVal axis As Integer, ByVal pulse As Long) As
        Integer
                Result = pmove(0, axis, pulse)
                Axis_Pmove = Result
        End Function
        '********************** single axis continuous drive function *********************
                'Used for driving sing motion axis
                'Parameter：axis       pulse
                'Return value=0 right，Return value =1 wrong
        '*******************************************************/
        Public Function Axis_ConMove(ByVal axis As Integer, ByVal dir As Long) As
        Integer
                Result = continue_move(0, axis, dir)
                Axis_ConMove = Result
        End Function
        ****************** random 2 axis interpolation function *******************
                Used for random 2 axis interpolation
                Parameter: axis1 , axis2
                                pulse1,pulse2
                Return value=0 right，Return value =1 wrong
        ***************************************************
        Public Function Interp_Move2(ByVal axis1 As Integer, ByVal axis2 As Integer,
        ByVal pulse1 As Long, ByVal pulse2 As Long) As Integer
                Result = inp_move2(0, axis1, axis2, pulse1, pulse2)
        Interp_Move2 = Result
End Function
******************* random 3 axis interpolation function *******************
        Used for random 3 axis interpolation
        Parameter: axis1 , axis2, axis3
                        pulse1,pulse2, pulse3
        Return value=0 right，Return value =1 wrong
'*******************************************************

Public Function Interp_Move3(ByVal axis1 As Integer, ByVal axis2 As Integer,
ByVal axis3 As Integer, ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal pulse3
As Long) As Integer
        Result = inp_move3(0, axis1, axis2, axis3, pulse1, pulse2, pulse3)
        Interp_Move3 = Result
End Function
******************* random 4 axis interpolation function *******************
        Used for random 4 axis interpolation
        Parameter: axis1 , axis2, axis3, axis4
                        pulse1,pulse2, pulse3, pulse4
        Return value=0 right，Return value =1 wrong
*******************************************************
Public Function Interp_Move4(ByVal axis1 As Integer, ByVal axis2 As Integer,
ByVal axis3 As Integer, ByVal axis4 As Integer, ByVal pulse1 As Long, ByVal pulse2
As Long, ByVal pulse3 As Long, ByVal pulse4 As Long) As Integer
        Result = inp_move4(0, axis1, axis2, axis3, axis4, pulse1, pulse2, pulse3,
pulse4)
        Interp_Move4 = Result
End Function
******************* random 5 axis interpolation function *******************
        Used for random 5 axis interpolation
        Parameter: axis1 , axis2, axis3, axis4, axis5
```

```
                    pulse1,pulse2, pulse3, pulse4, pulse5
        Return value=0 right，Return value =1 wrong
    ******************************************************
    Public Function Interp_Move5(ByVal axis1 As Integer, ByVal axis2 As Integer,
    ByVal axis3 As Integer, ByVal axis4 As Integer, ByVal axis5 As Integer, ByVal
    pulse1 As Long, ByVal pulse2 As Long, ByVal pulse3 As Long, ByVal pulse4 As
    Long, ByVal pulse5 As Long) As Integer
        Result = inp_move5(0, axis1, axis2, axis3, axis4, axis5, pulse1, pulse2, pulse3,
    pulse4, pulse5)
        Interp_Move5 = Result
    End Function
    ******************* random 6 axis interpolation function ********************
        Used for random 6 axis interpolation
        Parameter: axis1 , axis2, axis3, axis4, axis5, axis6
                    pulse1,pulse2, pulse3, pulse4, pulse5, pulse6
        Return value=0 right，Return value =1 wrong
    '******************************************************
    Public Function Interp_Move6(ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal
    pulse3 As Long, ByVal pulse4 As Long, ByVal pulse5 As Long, ByVal pulse6 As
    Long) As Integer
      Result = inp_move6(0, pulse1, pulse2, pulse3, pulse4, pulse5, pulse6)
      Interp_Move6 = Result
  End Function
  '*******************Stop driving function ********************
      'Used for stop driving, Divided into stop immediately and slow to stop
      'parameter: axis，mode: 0- stop immediately，1- slow to stop
      ' Return value=0 right，Return value =1 wrong
  '******************************************************
  Public Function StopRun(ByVal axis As Integer, ByVal mode As Integer) As Integer
      If mode = 0 Then
          Result = sudden_stop(0, axis)
      Else
          Result = dec_stop(0, axis)
      End If
  End Function
  ******************Set position function*******************
      Used for set logical position and actual position
      Parameter: axis                  pos-position setting
                   mode
                 0 – set logical position        1 – set actual position
      ' Return value=0 right，Return value =1 wrong
  '*****************************************************
  Public Function Setup_Pos(ByVal axis As Integer, ByVal pos As Long, ByVal mode As
  Integer) As Integer
      If mode = 0 Then
          Result = set_command_pos(0, axis, pos)
      Else
          Result = set_actual_pos(0, axis, pos)
      End If
  End Function
  '******************get motion info function*******************
      'Used for get logical position、actual position and running speed
      'Parameter:   axis           logps- logical position
      '                  actpos- actual position，speed- running speed
      ' Return value=0 right，Return value =1 wrong
  '*****************************************************
  Public Function Get_CurrentInf(ByVal axis As Integer, LogPos As Long, actpos As
  Long, speed As Long) As Integer
      Result = get_command_pos(0, axis, LogPos)
      get_actual_pos 0, axis, actpos
      get_speed 0, axis, speed
      Get_CurrentInf = Result
```

```
End Function
'******************get motion state function*******************
     'Used for get axis drive state and interpolation drive state
     'Parameter: axis        value-stste(0-drive finish，not 0-drive running)
     '           mode 0-get axis drive state, not 0-get interpolation drive state
     ' Return value=0 right，Return value =1 wrong
'*****************************************************
Public Function Get_MoveStatus(ByVal axis As Integer, value As Long, ByVal mode
As Integer) As Integer
     If mode = 0 Then
          GetMove_Status = get_status(0, axis, value)
     Else
          GetMove_Status = get_inp_status(0, value)
     End If
End Function
**********************Read input port******************************'
      Used for read input port '
      Parameter：number-input point(0 ~ 31)'
      Return value：0 — low level，1 —high level，-1 — wrong'
**************************************************************
Public Function Read_Input(ByVal number As Integer) As Integer
     Read_Input = read_bit(0, number)
End Function
********************Output axis function*****************************
     Used for output point signal
     Parameter：  number-output point(0 ~ 15)
               value 0-low level          1—high level
     Return value=0 right，Return value =1 wrong
'**************************************************************
Public Function Write_Output(ByVal number As Integer, ByVal value As Integer) As
Integer
```

```
        Write_Output = write_bit(0, number, value)
End Function
*******************Set pulse output mode*********************
        Used for set pulse working mode
        Parameter：axis    value-pulse mode: 0—pulse+pulse 1—pulse+direction'
'       Return value=0 right，Return value =1 wrong '
        Default pulse mode: pulse+direction '
        Adopt default positive logic pulse+direction output signal '
'*******************************************************
Public Function Setup_PulseMode(ByVal axis As Integer, ByVal value As Integer) As
Integer
        Setup_PulseMode = set_pulse_mode(0, axis, value, 0, 0)
End Function
'*******************set limit signal*********************'
      Used for set +/- direction limit input nLMT mode
      Parameter:   axis
                    value1     0—+ limit effective    1—+ limit invalid
                    value2     0—- limit effective    1—- limit invalid
                    logic      0—low level effective 1—high level effective
      Default mode: + limit effective, - limit effective, low level effective
      Return value=0 right，Return value =1 wrong
   *******************************************************
Public Function Setup_LimitMode(ByVal axis As Integer, ByVal value1 As Integer,
ByVal value2 As Integer, ByVal logic As Integer) As Integer
        Setup_LimitMode = set_limit_mode(0, axis, value1, value2, logic)
End Function
'*******************set stop0 signal mode*********************'
'      Used for set stop0 signal mode '
'      Parameter:   axis
'                     value     0—invalid             1—effective
'                     logic     0—low level effective    1—high level effective '
```

```
  Default mode:       invalid '
'     Return value=0 right，Return value =1 wrong
'    *******************************************************
Public Function Setup_Stop0Mode(ByVal axis As Integer, ByVal value As Integer,
ByVal logic As Integer) As Integer
      Setup_Stop0Mode = set_stop0_mode(0, axis, value, logic)
End Function
*******************set stop1 signal mode*********************'
     Used for set stop1 signal mode '
     Parameter: axis
                    value     0—invalid           1—effective
                    logic     0—low level effective    1—high level effective
     Default mode:       invalid '
     Return value=0 right，Return value =1 wrong
   *******************************************************
Public Function Setup_Stop1Mode(ByVal axis As Integer, ByVal value As Integer,
ByVal logic As Integer) As Integer
      Setup_Stop1Mode = set_stop1_mode(0, axis, value, logic)
End Function
*******************set hardware stop*************************
     Used for set hardware stop
     Parameter: value     0—invalid            1—effective
                    logic     0—low level effective    1—high level effective
     Default mode:       invalid
     Return value=0 right，Return value =1 wrong
     Hardware stop signal fixed on P3 connection board 34pin (IN31)
   *******************************************************
    Public Function Setup_HardStop(ByVal value As Integer, ByVal logic As Integer) As
    Integer
          Setup_HardStop = set_suddenstop_mode(0, value, logic)
    End Function
```

```
*******************set delayed*************************
    Used for set delayed '
    Parameter:        time – delay time（us）'
    Return value=0 right，Return value =1 wrong
*******************************************************


Public Function Setup_Delay(ByVal time As Long) As Integer
     Setup_Delay = set_delay_time(0, time * 8)
End Function
*********************get delay state*********************
      Used for get delay state
    Return value      0 – delay finish      1 - delay
'******************************************************
Public Function Get_DelayStatus() As Integer
      Get_DelayStatus = get_delay_status(0)
End Function
'*******************set general input/output*********************
'     Used for set general input/output
'Parameter:
'           v1 -0: the front 8 point as input 1: the front 8 point as output
'           v2 -0: the back 8 point as input 1: the back 8 point as output
    Return value=0 right，Return value =1 wrong
Remark: when take IO as output, can read input state as well
*******************************************************/
Public Function Set_IoMode(ByVal v1 As Integer, ByVal v2 As Integer) As Integer
   Set_IoMode = set_io_mode(0, v1, v2)
End Function
'/***********************Single axis relative motion********************
'*Function: Refer to the current position to accelerate quantitatively movement
'*Parameter:
'         cardno –card No.
'           axis ---axis No.
'           pulse --pulse
'           lspd ---low speed
'           hspd ---high speed
'           tacc--- acceleration time (s)
'          Return value=0 right，Return value =1 wrong
'*****************************************************/
Public Function Sym_RelativeMove(ByVal axis As Integer, ByVal pulse As Long,
ByVal lspd As Long, ByVal hspd As Long, ByVal tacc As Double) As Integer
       Sym_RelativeMove = symmetry_relative_move(0, axis, pulse, lspd, hspd,
tacc)
End Function
'/*********************single axis absolute motion***********************
'*Function: Refer to the orignal position to accelerate quantitatively movement
'*Parameter:
'           cardno –card No.
'           axis ---axis No.
'           pulse --pulse
'           lspd ---low speed
'           hspd ---high speed
'           tacc--- acceleration time (s)
'          Return value=0 right，Return value =1 wrong
'*******************************************************/
Public Function Sym_AbsoluteMove(ByVal axis As Integer, ByVal pulse As
Long, ByVal lspd As Long, ByVal hspd As Long, ByVal tacc As Double) As
Integer
       Sym_AbsoluteMove = symmetry_absolute_move(0, axis, pulse, lspd, hspd,
tacc)
End Function
'/****************2 axis linear interpolation relative movement*******************
'*function: Refer to the current position to accelerate quantitatively movement
```

```
'*Parameter:
'        cardno –card No.
'        axis1 ---axis1
'        axis2 ---axis2
'        pulse1 –pulse1
'        pulse2 –pulse2
'        lspd ---low speed
'        hspd ---high speed
'        tacc--- acceleration time (s)
'   Return value=0 right，Return value =1 wrong
'*******************************************************/
Public Function Sym_RelativeLine2(ByVal axis1 As Integer, ByVal axis2 As
Integer, ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal lspd As Long,
ByVal hspd As Long, ByVal tacc As Double) As Integer
      Sym_RelativeLine2 = symmetry_relative_line2(0, axis1, axis2, pulse1,
pulse2, lspd, hspd, tacc)
End Function
'/****************2 axis linear interpolation absolute movement*******************
'*function: Refer to the original position to accelerate quantitatively movement
'*Parameter:
'        cardno –card No.
'        axis1 ---axis1
'        axis2 ---axis2
'        pulse1 –pulse1
'        pulse2 –pulse2
'        lspd ---low speed
'        hspd ---high speed
'        tacc--- acceleration time (s)
'   Return value=0 right，Return value =1 wrong
'******************************************************/
Public Function Sym_AbsoluteLine2(ByVal axis1 As Integer, ByVal axis2 As
Integer, ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal lspd As Long,
ByVal hspd As Long, ByVal tacc As Double) As Integer
      Sym_AbsoluteLine2 = symmetry_absolute_line2(0, axis1, axis2, pulse1,
pulse2, lspd, hspd, tacc)
End Function

'/****************3 axis linear interpolation relative movement*******************
'*function: Refer to the current position to accelerate quantitatively movement
'*Parameter:
'          cardno –card No.
'          axis1 ---axis1
'          axis2 ---axis2
'          axis3 ---axis3
'          pulse1 --pulse1
'          pulse2 --pulse2
'          pulse3 --pulse3
'          lspd ---low speed
'          hspd ---high speed
'          tacc--- acceleration time (s)
'   Return value=0 right，Return value =1 wrong
'*****************************************************************/
Public Function Sym_RelativeLine3(ByVal axis1 As Integer, ByVal axis2 As
Integer, ByVal axis3 As Integer, ByVal pulse1 As Long, ByVal pulse2 As Long,
ByVal pulse3 As Long, ByVal lspd As Long, ByVal hspd As Long, ByVal tacc As
Double) As Integer
      Sym_RelativeLine3 = symmetry_relative_line3(0, axis1, axis2, axis3,
pulse1, pulse2, pulse3, lspd, hspd, tacc)
End Function
'/****************3 axis linear interpolation absolute movement*******************
'*function: Refer to the original position to accelerate quantitatively movement
'*Parameter:
```

```
'        cardno –card No.
'        axis1 ---axis1
'        axis2 ---axis2
'        axis3 ---axis3
'        pulse1 --pulse1
'        pulse2 --pulse2
'        pulse3 --pulse3
'        lspd ---low speed
'        hspd ---high speed
'        tacc--- acceleration time (s)
'   Return value=0 right，Return value =1 wrong
'*********************************************************/
Public Function Sym_AbsoluteLine3(ByVal axis1 As Integer, ByVal axis2 As Integer, ByVal axis3 As Integer, ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal pulse3 As Long, ByVal lspd As Long, ByVal hspd As Long, ByVal tacc As Double) As Integer
    Sym_AbsoluteLine3 = symmetry_absolute_line3(0, axis1, axis2, axis3, pulse1, pulse2, pulse3, lspd, hspd, tacc)
End Function
'/****************4 axis linear interpolation relative movement*******************
'*function: Refer to the current position to accelerate quantitatively movement
'*Parameter:
'        cardno –card No.
'        axis1 ---axis1
'        axis2 ---axis2
'        axis3 ---axis3
          Axis4---axis4
'        pulse1 --pulse1
'        pulse2 --pulse2
'        pulse3 --pulse3
          Pulse4---pulse4
```

```
'          lspd ---low speed
'          hspd ---high speed
'          tacc--- acceleration time (s)
'   Return value=0 right，Return value =1 wrong
'*****************************************************/
Public Function Sym_RelativeLine4(ByVal axis1 As Integer, ByVal axis2 As Integer, ByVal axis3 As Integer, ByVal axis4 As Integer, ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal pulse3 As Long, ByVal pulse4 As Long, ByVal lspd As Long, ByVal hspd As Long, ByVal tacc As Double) As Integer
       Sym_RelativeLine4 = symmetry_relative_line4(0, axis1, axis2, axis3, axis4, pulse1, pulse2, pulse3, pulse4, lspd, hspd, tacc)
End Function

'/*****************4 axis linear interpolation absolute movement************
'*function: Refer to the originalposition to accelerate quantitatively movement
'*Parameter:
'          cardno –card No.
'          axis1 ---axis1
'          axis2 ---axis2
'          axis3 ---axis3
            Axis4---axis4
'          pulse1 --pulse1
'          pulse2 --pulse2
'          pulse3 --pulse3
            Pulse4---pulse4
'          lspd ---low speed
'          hspd ---high speed
'          tacc--- acceleration time (s)
'   Return value=0 right，Return value =1 wrong
'*****************************************************/
Public Function Sym_AbsoluteLine4(ByVal axis1 As Integer, ByVal axis2 As
Integer, ByVal axis3 As Integer, ByVal axis4 As Integer, ByVal pulse1 As Long,
ByVal pulse2 As Long, ByVal pulse3 As Long, ByVal pulse4 As Long, ByVal
lspd As Long, ByVal hspd As Long, ByVal tacc As Double) As Integer
    Sym_AbsoluteLine4 = symmetry_absolute_line4(0, axis1, axis2, axis3,
axis4, pulse1, pulse2, pulse3, pulse4, lspd, hspd, tacc)
End Function
'/*****************5 axis linear interpolation relative movement*******************
'*function: Refer to the current position to accelerate quantitatively movement
'*Parameter:
'         cardno –card No.
'         axis1 ---axis1
'         axis2 ---axis2
'         axis3 ---axis3
'         axis4 ---axis4
'         axis5 ---axis5
'         pulse1 --pulse1
'         pulse2 --pulse2
'         pulse3 --pulse3
'         pulse4 –pulse4
'         pulse5 –pulse5
'         lspd ---low speed
'         hspd ---high speed
'         tacc--- acceleration time (s)
'*****************************************************/
Public Function Sym_RelativeLine5(ByVal axis1 As Integer, ByVal axis2 As
Integer, ByVal axis3 As Integer, ByVal axis4 As Integer, ByVal axis5 As Integer,
ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal pulse3 As Long, ByVal
pulse4 As Long, ByVal pulse5 As Long, ByVal lspd As Long, ByVal hspd As
Long, ByVal tacc As Double) As Integer
    Sym_RelativeLine5 = symmetry_relative_line5(0, axis1, axis2, axis3, axis4,
axis5, pulse1, pulse2, pulse3, pulse4, pulse5, lspd, hspd, tacc)
```

```
End Function
'/****************5 axis linear interpolation absolute movement*******************
'*function: Refer to the original position to accelerate quantitatively movement
'*Parameter:
'         cardno –card No.
'         axis1 ---axis1
'         axis2 ---axis2
'         axis3 ---axis3
'         axis4 ---axis4
'         axis5 ---axis5
'         pulse1 --pulse1
'         pulse2 --pulse2
'         pulse3 --pulse3
'         pulse4 –pulse4
'         pulse5 –pulse5
'         lspd ---low speed
'         hspd ---high speed
'         tacc--- acceleration time (s)
'****************************************************/
Public Function Sym_AbsoluteLine5(ByVal axis1 As Integer, ByVal axis2 As
Integer, ByVal axis3 As Integer, ByVal axis4 As Integer, ByVal axis5 As Integer,
ByVal pulse1 As Long, ByVal pulse2 As Long, ByVal pulse3 As Long, ByVal
pulse4 As Long, ByVal pulse5 As Long, ByVal lspd As Long, ByVal hspd As
Long, ByVal tacc As Double) As Integer
      Sym_AbsoluteLine5 = symmetry_absolute_line5(0, axis1, axis2, axis3,
axis4, axis5, pulse1, pulse2, pulse3, pulse4, pulse5, lspd, hspd, tacc)
End Function

'/****************6 axis linear interpolation relative movement*******************
'*function: Refer to the current position to accelerate quantitatively movement
'*Parameter:
```

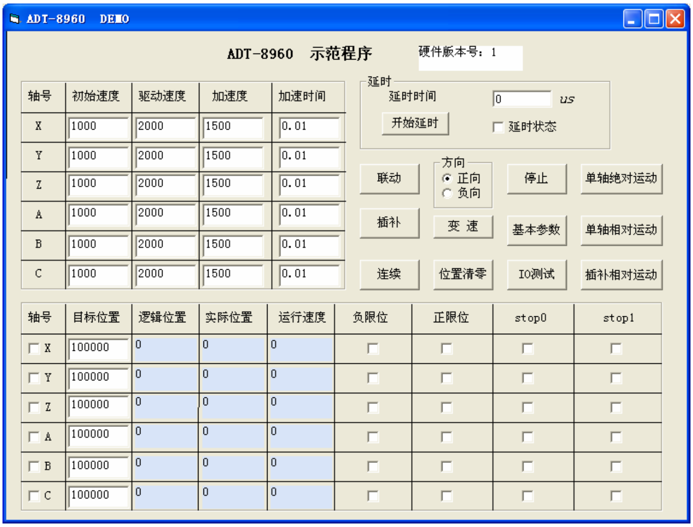
```
'          cardno –card No.
'          axis1 ---axis1
'          axis2 ---axis2
'          axis3 ---axis3
'          axis4 ---axis4
'          axis5 ---axis5
'          axis6 ---axis6
'          pulse1 --pulse1
'          pulse2 --pulse2
'          pulse3 --pulse3
'          pulse4 –pulse4
'          pulse5 –pulse5
'          pulse6 –pulse6
'          lspd ---low speed
'          hspd ---high speed
'          tacc--- acceleration time (s)
'****************************************************/
Public Function Sym_RelativeLine6(ByVal pulse1 As Long, ByVal pulse2 As
Long, ByVal pulse3 As Long, ByVal pulse4 As Long, ByVal pulse5 As Long,
ByVal pulse6 As Long, ByVal lspd As Long, ByVal hspd As Long, ByVal tacc As
Double) As Integer
          Result = symmetry_relative_line6(0, pulse1, pulse2, pulse3, pulse4,
pulse5, pulse6, lspd, hspd, tacc)
        Sym_RelativeLine6 = Result
End Function
'/****************6 axis linear interpolation absolute movement*******************
'*function: Refer to the original position to accelerate quantitatively movement
'*Parameter:
'          cardno –card No.
'          axis1 ---axis1
'          axis2 ---axis2
'          axis3 ---axis3
'          axis4 ---axis4
'          axis5 ---axis5
'          axis6 ---axis6
'          pulse1 --pulse1
'          pulse2 --pulse2
'          pulse3 --pulse3
'          pulse4 –pulse4
'          pulse5 –pulse5
'          pulse6 –pulse6
'          lspd ---low speed
'          hspd ---high speed
'          tacc--- acceleration time (s)
'*****************************************************/
Public Function Sym_AbsoluteLine6(ByVal pulse1 As Long, ByVal pulse2 As
Long, ByVal pulse3 As Long, ByVal pulse4 As Long, ByVal pulse5 As Long,
ByVal pulse6 As Long, ByVal lspd As Long, ByVal hspd As Long, ByVal tacc As
Double) As Integer
          Result = symmetry_absolute_line6(0, pulse1, pulse2, pulse3, pulse4,
pulse5, pulse6, lspd, hspd, tacc)
            Sym_AbsoluteLine6 = Result
End Function
'/****************************************************
'function: get output point
'parameter:
'      cardno
'      number output point
'return value     the current state of the designated port,-1 means wrong
'****************************************************/
Public Function Get_OutNum(ByVal number As Integer) As Integer
      Result = get_out(0, number)
```

Get_OutNum = Result

End Function

Function moudle

1.31 Interface design



ADT-8960 示范程序

硬件版本号：1

轴号	初始速度	驱动速度	加速度	加速时间
X	1000	2000	1500	0.01
Y	1000	2000	1500	0.01
Z	1000	2000	1500	0.01
A	1000	2000	1500	0.01
B	1000	2000	1500	0.01
C	1000	2000	1500	0.01

延时

延时时间 0 us

☐ 延时状态

方向

[✓ 正向] 负向

轴号	目标位置	逻辑位置	实际位置	运行速度	负限位	正限位	stop0	stop1
☐ X	100000	0	0	0	☐	☐	☐	☐
☐ Y	100000	0	0	0	☐	☐	☐	☐
☐ Z	100000	0	0	0	☐	☐	☐	☐
☐ A	100000	0	0	0	☐	☐	☐	☐
☐ B	100000	0	0	0	☐	☐	☐	☐
☐ C	100000	0	0	0	☐	☐	☐	☐

1.3.2 The initialization code in the form loads incident, code as below：

```
Private Sub Init_Board()
    Dim count As Integer
    count = Init_Card
    If count < 1 Then MsgBox "adt8960 Card not installed correctly "
    Get_Version g_nLibVer
    CardVer.Caption = " Hardware version number： " + CStr(g_nLibVer)

End Sub
```

1.3.3 linkage code located in AxisPmove_Click，send drive order from different target, 6 target: X、Y、Z、A、B、C，code as below：

```
        Private Sub AxisPmove_Click()
    '****************speed setting***********************
    '   Initial velocity and drive speed Setting range (1～2M)'
```

```
'   The acceleration setting range(1×250～32000×250)'
'****************************************************
    For i = 1 To 6
            Setup_Speed i, m_nStartV(i - 1).Text, m_nSpeed(i - 1).Text, m_nAdd(i -
1).Text
        Next i
        If m_bX.value = vbChecked Then
            Axis_Pmove 1, m_nPulse(0).Text
        End If
        If m_bY.value = vbChecked Then
            Axis_Pmove 2, m_nPulse(1).Text
        End If
        If m_bZ.value = vbChecked Then
            Axis_Pmove 3, m_nPulse(2).Text
        End If
        If m_bA.value = vbChecked Then
            Axis_Pmove 4, m_nPulse(3).Text
        End If
        If m_bB.value = vbChecked Then
            Axis_Pmove 5, m_nPulse(4).Text
        End If
        If m_bC.value = vbChecked Then
            Axis_Pmove 6, m_nPulse(5).Text
        End If
    End Sub
```

1.3.4 Interpolation code located in InterpMove_Click，send drive order from different target, 6 target: X、Y、Z、A、B、C，code as below:

```
Private Sub InterpMove_Click()
'****************Speed setting**********************
'   Initial velocity and drive speed Setting range (1～2M)
'   The acceleration setting range (1×250～32000×250)
```

```
'****************************************************
    For i = 1 To 6
            Setup_Speed i, m_nStartV(i - 1).Text, m_nSpeed(i - 1).Text, m_nAdd(i - 1).Text
     Next i
'**************************** Interpolation ***************************
'ADT-8960 can random 2 axis Interpolation, random 3 axis Interpolation, random 4 axis Interpolation, random 5 axis Interpolation and 6 axis Interpolation.
'**************************************************************


'*****************************6 axis Interpolation *************************
     If m_bX.value = vbChecked And m_bY.value = vbChecked And m_bZ.value = vbChecked And m_bA.value = vbChecked And m_bB.value = vbChecked And m_bC.value = vbChecked Then
          Interp_Move6 m_nPulse(0).Text, m_nPulse(1).Text, m_nPulse(2).Text, m_nPulse(3).Text, m_nPulse(4).Text, m_nPulse(5).Text
'**************************** random 5 axis Interpolation ***************************
     ElseIf m_bX.value = vbChecked And m_bY.value = vbChecked And m_bZ.value = vbChecked And m_bA.value = vbChecked And m_bB.value = vbChecked Then
          Interp_Move5 1, 2, 3, 4, 5, m_nPulse(0).Text, m_nPulse(1).Text, m_nPulse(2).Text, m_nPulse(3).Text, m_nPulse(4).Text



'************************ random 4 axis Interpolation *************************
     ElseIf m_bX.value = vbChecked And m_bY.value = vbChecked And m_bZ.value = vbChecked And m_bA.value = vbChecked Then
          Interp_Move4 1, 2, 3, 4, m_nPulse(0).Text, m_nPulse(1).Text, m_nPulse(2).Text, m_nPulse(3).Text
'************************ random 3 axis Interpolation *************************
'**********************XYZ 3 axis Interpolation ***************************
     ElseIf m_bX.value = vbChecked And m_bY.value = vbChecked And m_bZ.value = vbChecked Then
```

```
          Interp_Move3 1, 2, 3, m_nPulse(0).Text, m_nPulse(1).Text, m_nPulse(2).Text
'************************XYA 3 axis Interpolation ************************ ElseIf m_bX.value = vbChecked And m_bY.value = vbChecked And m_bA.value = vbChecked Then
          Interp_Move3 1, 2, 4, m_nPulse(0).Text, m_nPulse(1).Text, m_nPulse(3).Text
'***********************XZA 3 axis Interpolation *************************
     ElseIf m_bX.value = vbChecked And m_bZ.value = vbChecked And m_bA.value = vbChecked Then
          Interp_Move3 1, 3, 4, m_nPulse(0).Text, m_nPulse(2).Text, m_nPulse(3).Text
 '*************************YZA 3 axis Interpolation *************************
     ElseIf m_bY.value = vbChecked And m_bZ.value = vbChecked And m_bA.value = vbChecked Then
          Interp_Move3 2, 3, 4, m_nPulse(1).Text, m_nPulse(2).Text, m_nPulse(3).Text
 '*************************2 axis Interpolation *************************
 '*********************XY 2 axis Interpolation *************************
     ElseIf m_bX.value = vbChecked And m_bY.value = vbChecked Then
          Interp_Move2 1, 2, m_nPulse(0).Text, m_nPulse(1).Text
'***********************XZ 2 axis Interpolation ***********************
     ElseIf m_bX.value = vbChecked And m_bZ.value = vbChecked Then
          Interp_Move2 1, 3, m_nPulse(0).Text, m_nPulse(2).Text
'**********************XA 2 axis Interpolation *************************
     ElseIf m_bX.value = vbChecked And m_bA.value = vbChecked Then
          Interp_Move2 1, 4, m_nPulse(0).Text, m_nPulse(3).Text
 '***************************YZ 2 axis Interpolation ***********************
     ElseIf m_bY.value = vbChecked And m_bZ.value = vbChecked Then
          Interp_Move2 2, 3, m_nPulse(1).Text, m_nPulse(2).Text
'************************YA 2 axis Interpolation ***************************
     ElseIf m_bY.value = vbChecked And m_bA.value = vbChecked Then
          Interp_Move2 2, 4, m_nPulse(1).Text, m_nPulse(3).Text
*************************ZA 2 axis Interpolation *************************
     ElseIf m_bZ.value = vbChecked And m_bA.value = vbChecked Then
```

```
        Interp_Move2 3, 4, m_nPulse(2).Text, m_nPulse(3).Text
    Else
        MsgBox "Please select interpolation axis",, "tip"
    End If
End Sub
```

1.4 Monitoring module

Monitoring module for real-time obtain all axis drive information, displaying moving information, and control the drive not send new instructions in processing. Monitoring module completed by timer events , code as follows:

```
      Private Sub Timer1_Timer()
       Dim nLogPos As Long                        'logic position
        Dim nActPos As Long                       'real position
        Dim nSpeed As Long                        'running speed
        Dim nStatus(6) As Long                    'driving state
        For i = 1 To 6
            Get_CurrentInf i, nLogPos, nActPos, nSpeed
            m_nLogPos(i - 1).Caption = nLogPos
            m_nActPos(i - 1).Caption = nActPos
            m_nRunSpeed(i - 1).Caption = nSpeed
            Get_MoveStatus i, nStatus(i - 1), 0
     ' detect limit、stop0, stop1 signal
      'detect + limit(XLMT+: 0,YLMT+ :4,ZLMT+:8,ALMT+ :12,BLMT+:16,CLMT+ :20)
            If Read_Input((i - 1) * 4) = 0 Then
                m_bPLimit(i - 1).value = 1
            Else
                m_bPLimit(i - 1).value = 0
            End If
    detect - limit (XLMT- : 1,YLMT- :5,ZLMT- :9,ALMT- :13,BLMT- :17,CLMT- :21)
            If Read_Input((i - 1) * 4 + 1) = 0 Then
                m_bNLimit(i - 1).value = 1
            Else
```

```
                    m_bNLimit(i - 1).value = 0
                End If
        'detect stop0(XSTOP0 :
2,YSTOP0 :6,ZSTOP0 :10,ASTOP0 :14,BSTOP0 :18,CSTOP0 :22)
                If Read_Input((i - 1) * 4 + 2) = 0 Then
                    m_bStop0(i - 1).value = 1
                Else
                    m_bStop0(i - 1).value = 0
                End If
        'detect stop1(XSTOP1 :
3,YSTOP1 :7,ZSTOP1 :11,ASTOP1 :15,ZSTOP1 :19,ASTOP1 :23)
                If Read_Input((i - 1) * 4 + 3) = 0 Then
                    m_bStop1(i - 1).value = 1
                Else
                    m_bStop1(i - 1).value = 0
                End If
            Next i
            If nStatus(0) = 0 And nStatus(1) = 0 And nStatus(2) = 0 And nStatus(3) = 0 Then
            'driving
                AxisPmove.Enabled = True
                InterpMove.Enabled = True
                BaseparaSet.Enabled = True
                ClearPos.Enabled = True
                ComeMove.Enabled = True
                LineInpMove.Enabled = True
                IOTest.Enabled = True
            Else
            'driving finish
                AxisPmove.Enabled = False
                InterpMove.Enabled = False
                BaseparaSet.Enabled = False
                ClearPos.Enabled = False
                ComeMove.Enabled = False
                LineInpMove.Enabled = False
                IOTest.Enabled = False
            End If
        End Sub
```

1.5 Stop module

Stop module mainly used to control the incidents that need immediate termination all axes in the processing. Stop module code is located in CmdStop button, code as follows:

```
   Private Sub Stop_Click()
        For i = 1 To 4
            StopRun i, 0
        Next i
    End Sub
```

☞ VC programming samples

2.1 Preparation

(1) Create a new item and save as “VCExample.dsw”;

(2) Add the “adt8960.lib” as module in the item following the above-mentioned method

2.2 Motion control module

(1) Add a new module in the project, header file save as “CtrlCard.h”, Original file save as “CtrlCard.cpp”;

(2) within the motion control module self-define initialization functions of the motion control card and initialize library functions to be sealed into initialization functions;

(3) Further self-define relevant motion control functions, such as speed setting function, single-axis motion function, and interpolation motion function;

(4) Header file “CtrlCard.h” code as follow:

```
# ifndef __ADT8960__CARD__
# define __ADT8960__CARD__
/********************** motion control module *******************
*****************************************************/
#define   MAXAXIS   6      //max axis
class CCtrlCard
{
public:
        int Get_DelayStatus();
        int Setup_Delay(long time);
        int Setup_HardStop(int value, int logic);
        int Setup_Stop1Mode(int axis, int value, int logic);
        int Setup_Stop0Mode(int axis, int value, int logic);
        int Setup_LimitMode(int axis, int value1, int value2, int logic);
        int Setup_PulseMode(int axis, int value);
        void Get_Version(float &LibVer);
        int Setup_Pos(int axis, long pos, int mode);
        int Write_Output(int number, int value);
        int Read_Input(int number);
        int Get_CurrentInf(int axis, long &LogPos, long &ActPos, long &Speed);
        int Get_Status(int axis, int &value, int mode);
        int StopRun(int axis, int mode);
        int Interp_Move6(long pulse1,long pulse2,long pulse3,long pulse4,long
pulse5,long pulse6);
        int Interp_Move5(int axis1,int axis2,int axis3,int axis4,int axis5,long
pulse1,long pulse2,long pulse3,long pulse4,long pulse5);
       int Interp_Move4(int axis1,int axis2,int axis3,int axis4,long value1, long value2,
long value3, long value4);
        int Interp_Move3(int axis1, int axis2, int axis3, long value1, long value2, long
value3);
```

```
        int Interp_Move2(int axis1, int axis2, long value1, long value2);
        int Axis_Pmove(int axis ,long value);
        int Axis_ConMove(int axis, long value);
        int Setup_Speed(int axis ,long startv ,long speed ,long   add );
        int Init_Board();
        int Set_IoMode(int v1,int v2);
        CCtrlCard();
        int Result;              //return value
}; # endif
```

(5) original file “CtrlCard.cpp”code as follow：

```
#include "stdafx.h"
#include "DEMO.h"
#include "CtrlCard.h"
#include "adt8960.h"
CCtrlCard::CCtrlCard()
{
}
/****************** Initialization function **********************
This function contains the control card initialization common library,must be based
on the example program
The return value < = 0 means initialization failed, the return value is > 0 means
initialization success
***************************************************/
int CCtrlCard::Init_Board()
{
        Result =adt8960_initial() ;                    //card Initialization function
        if (Result <= 0) return Result;
        for (int i = 1; i<=MAXAXIS; i++){
            set_limit_mode (0, i, 0, 0, 0);                 //set limit mode
            set_command_pos (0, i, 0);                      // Clear logical counter
            set_actual_pos (0, i, 0);                       // Clear real counter
```

```
          set_startv (0, i, 1000);                      //设定起始速度
          set_speed (0, i, 1000);                       //设定驱动速度
          set_acc(0, i, 625);                           //设定加速度
        }
        return 1;
}

/*********************Speed setting module**********************
      From the value of the parameter, judge it is uniform or deceleration
      Return value=0 right, return value=1 wrong
*******************************************************/
int CCtrlCard::Setup_Speed(int axis, long startv, long speed, long add ,long
ratio ,double tacc)
{
            if (startv - speed >= 0)        // uniform speed
            {
                  Result = set_startv(0, axis, startv/ratio);
                  set_speed (0, axis, startv/ratio);
            }
            else                            // acceleration /deceleration
            {
                  Result = set_startv(0, axis, startv/ratio);
                  set_speed (0, axis, speed/ratio);
                  set_acc (0, axis, add/250/ratio);
            }
      return Result;
}
/********************single axis drive function*********************
      Used for drive single motion axis
      Return value=0 right, return value=1 wrong
*****************************************************/
```

```
int CCtrlCard::Axis_Pmove(int axis, long value)
{
        Result = pmove(0, axis, value);
        return Result;
}
/*********************** single axis continuous drive function **********************
      Used for drive single motion axis
      Parameter：  axis，value-pulse direction
      Return value=0 right, return value=1 wrong
*********************************************************/
int CCtrlCard::Axis_ConMove(int axis, long dir)
{
        Result = continue_move(0, axis, dir);
        return Result;
}
/*****************Random 2 axis Interpolation function *******************
      Used for Random 2 axis Interpolation movement
      Return value=0 right, return value=1 wrong
****************************************************/
int CCtrlCard::Interp_Move2(int axis1, int axis2, long value1, long value2)
{
        Result = inp_move2(0, axis1, axis2, value1, value2);
        return Result;
}

/***************** Random 3 axis Interpolation function **********************
      Used for Random 3 axis Interpolation movement
      Return value=0 right, return value=1 wrong
******************************************************/
int CCtrlCard::Interp_Move3(int axis1, int axis2, int axis3, long value1, long value2,
long value3)
```

```
{
        Result = inp_move3(0, axis1, axis2, axis3, value1, value2, value3);
        return Result;
}

/****************** Random 4 axis Interpolation function **********************
       Used for Random 4 axis Interpolation movement
       Return value=0 right, return value=1 wrong
*******************************************************/
int CCtrlCard::Interp_Move4(int axis1,int axis2,int axis3,int axis4, long value1, long
value2, long value3, long value4)
{
        Result = inp_move4(0, axis1, axis2, axis3, axis4, value1, value2, value3,
value4);
        return Result;
}
/******************** Random 5 axis Interpolation function **********************
       Used for Random 5 axis Interpolation movement
        Parameter：axis1,axis2,axis3,axis4,axis5
                 pulse1,pulse2,pulse3,pulse4,pulse5-output pulse
       Return value=0 right, return value=1 wrong
*******************************************************/
int CCtrlCard::Interp_Move5(int axis1,int axis2,int axis3,int axis4,int axis5,long
pulse1,long pulse2,long pulse3,long pulse4,long pulse5)
{
        Result = inp_move5(0, axis1, axis2, axis3, axis4, axis5, pulse1, pulse2,
pulse3, pulse4, pulse5);

        return Result;
}
```

```
/******************** Random 6 axis Interpolation function **********************
      Used for Random 6 axis Interpolation movement
       Parameter：axis1,axis2,axis3,axis4,axis5,axis6
                pulse1,pulse2,pulse3,pulse4,pulse5,pulse6-output pulse
      Return value=0 right, return value=1 wrong
*********************************************************/
int CCtrlCard::Interp_Move6(long pulse1,long pulse2,long pulse3,long pulse4,long
pulse5,long pulse6)
{
       Result = inp_move6(0, pulse1, pulse2, pulse3, pulse4, pulse5, pulse6);
       return Result;
}

/*******************Obtain hardware version infomation**********************
       Used for obtain version infomation
       Parameter：LibVer－hardware version No.
*******************************************************/
void CCtrlCard::Get_Version(float &LibVer)
{
       int   Ver;
       Ver = get_hardware_ver(0);
       LibVer = float(Ver/256);
}
/****************Obtain motion infomation****************************
      Used for feedback logic position, real position and running speed.
      Return value=0 right, return value=1 wrong
*********************************************************/
int CCtrlCard::Get_CurrentInf(int axis, long &LogPos, long &ActPos, long &Speed)
{
       Result = get_command_pos(0, axis, &LogPos);
        get_actual_pos (0, axis, &ActPos);
```

```
          get_speed (0, axis, &Speed);
          return Result;
    }

    /*****************Stop axis driving*****************************
          Used for stop driving immediately or slow down.
                Return value=0 right, return value=1 wrong
    **********************************************************/
    int CCtrlCard::StopRun(int axis, int mode)
    {
          if (mode == 0)
                Result = sudden_stop(0, axis);           //stop
          else
                Result = dec_stop(0, axis);              //slow down
          return Result;
    }

    /*****************get driving state *************************
          Used for get driving state and interpolation state
                Return value=0 right, return value=1 wrong
    **********************************************************/
    int CCtrlCard::Get_Status(int axis, int &value, int mode)
    {
          if (mode==0)                              //get sing axis driving state
                Result=get_status(0,axis,&value);
          Else                                      //get interpolation driving state
                Result=get_inp_status(0,&value);
          return Result;
    }
/*************** set hardware stop *********************
      Used for set hardware stop
```

```
        Parameter: value     0—invalid            1—effective
                     logic     0—low level effective    1—high level effective
        Default mode:       invalid
        Return value=0 right，Return value =1 wrong
        Hardware stop signal fixed on P3 connection board 34pin (IN31)
  ******************************************************/
int CCtrlCard::Setup_HardStop(int value, int logic)
{
       Result = set_suddenstop_mode(0, value, logic);
       return Result;
}
/******************* set delayed *********************
            Used for set delayed '
            Parameter:        time – delay time（us）'
            Return value=0 right，Return value =1 wrong
  ******************************************************/
int CCtrlCard::Setup_Delay(long time)
{
       Result = set_delay_time(0, time*8);
       return Result;
}
       *********************get delay state*********************
              Used for get delay state
            Return value      0 – delay finish       1 - delay
******************************************************/
int CCtrlCard::Get_DelayStatus()
{
       Result = get_delay_status(0);
       return Result;
}
/*******************function：set delay time*****************
```

```
function：set delay time
cardno          card No.
time             delay time
return value          0：right              1：wrong
unit of time 1/8us
****************************************************/
int CCtrlCard::Set_Delay(long time)
{
       Result = set_delay_time(0,time);
       return Result;
}
       '******************set general input/output*******************
       '    Used for set general input/output
       'Parameter:
       '           v1 -0: the front 8 point as input 1: the front 8 point as output
       '           v2 -0: the back 8 point as input 1: the back 8 point as output
           Return value=0 right，Return value =1 wrong
Remark: when take IO as output, can read input state as well
*****************************************************/
int CCtrlCard::Set_IoMode(int v1,int v2)
{
       Result= set_io_mode(0,v1,v2);
       return Result;
}
       '/**********************Single axis relative motion*******************
       '*Function: Refer to the current position to accelerate quantitatively movement
       '*Parameter:
       '          cardno –card No.
       '          axis ---axis No.
       '          pulse --pulse
       '          lspd ---low speed
```

```
      '         hspd ---high speed
      '         tacc--- acceleration time (s)
      '         Return value=0 right，Return value =1 wrong
*****************************************************************/
int CCtrlCard::Sym_RelativeMove(int axis, long pulse, long lspd ,long hspd, double tacc)
{
      Result= symmetry_relative_move(0,axis, pulse, lspd ,hspd, tacc);
     return Result;
}

      '/*********************single axis absolute motion***********************
      '*Function: Refer to the orignal position to accelerate quantitatively movement
      '*Parameter:
      '         cardno –card No.
      '         axis ---axis No.
      '         pulse --pulse
      '         lspd ---low speed
      '         hspd ---high speed
      '         tacc--- acceleration time (s)
      '         Return value=0 right，Return value =1 wrong
*****************************************************************/
int CCtrlCard::Sym_AbsoluteMove(int axis, long pulse, long lspd ,long hspd, double tacc)
{
      Result= symmetry_absolute_move(0,axis, pulse, lspd ,hspd, tacc);
     return Result;
}
      '/****************2 axis linear interpolation relative movement*******************
      '*function: Refer to the current position to accelerate quantitatively movement
      '*Parameter:
      '         cardno –card No.
      '         axis1 ---axis1
```

```
        '        axis2 ---axis2
        '        pulse1 –pulse1
        '        pulse2 –pulse2
        '        lspd ---low speed
        '        hspd ---high speed
        '        tacc--- acceleration time (s)
'        Return value=0 right , Return value =1 wrong
****************************************************************/
int CCtrlCard::Sym_RelativeLine2(int axis1, int axis2, long pulse1, long pulse2, long
lspd ,long hspd, double tacc)
{
        Result= symmetry_relative_line2(0, axis1, axis2, pulse1,pulse2, lspd ,hspd,tacc);
      return Result;
}
        '/****************2 axis linear interpolation absolute movement*******************
        '*function: Refer to the original position to accelerate quantitatively movement
        '*Parameter:
        '        cardno –card No.
        '        axis1 ---axis1
        '        axis2 ---axis2
        '        pulse1 –pulse1
        '        pulse2 –pulse2
        '        lspd ---low speed
        '        hspd ---high speed
        '        tacc--- acceleration time (s)
'        Return value=0 right , Return value =1 wrong
****************************************************************/
int CCtrlCard::Sym_AbsoluteLine2(int axis1, int axis2, long pulse1, long pulse2, long
lspd ,long hspd, double tacc)
{
        Result= symmetry_absolute_line2(0, axis1, axis2, pulse1, pulse2, lspd ,hspd, tacc);
```

```
    return Result;}

     '/****************3 axis linear interpolation relative movement*******************
     '*function: Refer to the current position to accelerate quantitatively movement
     '*Parameter:
     '          cardno –card No.
     '          axis1 ---axis1
     '          axis2 ---axis2
     '          axis3 ---axis3
     '          pulse1 --pulse1
     '          pulse2 --pulse2
     '          pulse3 --pulse3
     '          lspd ---low speed
     '          hspd ---high speed
     '          tacc--- acceleration time (s)
'      Return value=0 right , Return value =1 wrong
****************************************************************/
int CCtrlCard::Sym_RelativeLine3(int axis1, int axis2, int axis3, long pulse1, long pulse2,
long pulse3, long lspd ,long hspd, double tacc)
{
     Result= symmetry_relative_line3(0,axis1, axis2, axis3, pulse1, pulse2, pulse3,
lspd ,hspd, tacc);
    return Result;
}
     '/****************3 axis linear interpolation absolute movement*******************
     '*function: Refer to the original position to accelerate quantitatively movement
     '*Parameter:
     '          cardno –card No.
     '          axis1 ---axis1
     '          axis2 ---axis2
     '          axis3 ---axis3
```

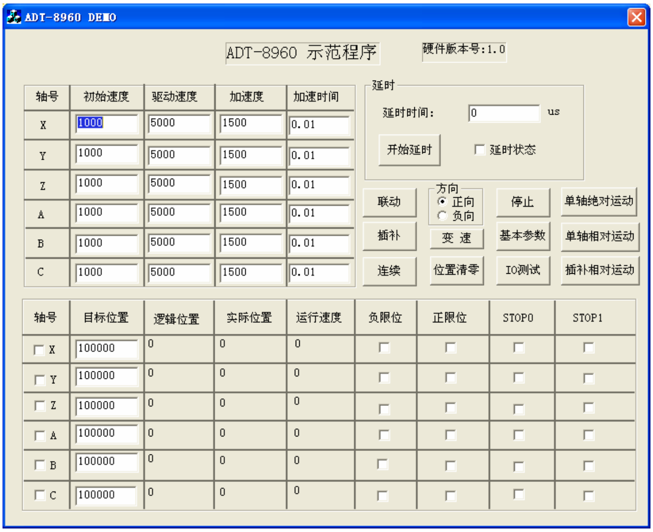
```
        '         pulse1 --pulse1
        '         pulse2 --pulse2
        '         pulse3 --pulse3
        '         lspd ---low speed
        '         hspd ---high speed
        '         tacc--- acceleration time (s)
'         Return    value=0    right  ,   Return   value   =1    wrong
*****************************************************************/
int CCtrlCard::Sym_AbsoluteLine3(int axis1, int axis2, int axis3, long pulse1, long pulse2,
long pulse3, long lspd ,long hspd, double tacc)
{
        Result= symmetry_absolute_line3(0, axis1, axis2,axis3,pulse1, pulse2,  pulse3,
lspd , hspd,  tacc);
      return Result;
}
        '/*****************4 axis linear interpolation relative movement*******************
        '*function: Refer to the current position to accelerate quantitatively movement
        '*Parameter:
        '         cardno –card No.
        '         axis1 ---axis1
        '         axis2 ---axis2
        '         axis3 ---axis3
                   Axis4---axis4
        '         pulse1 --pulse1
        '         pulse2 --pulse2
        '         pulse3 --pulse3
                   Pulse4---pulse4
        '         lspd ---low speed
        '         hspd ---high speed
        '         tacc--- acceleration time (s)
        '   Return value=0 right，Return value =1 wrong
```

```
*****************************************************/
int CCtrlCard:: Sym_RelativeLine4(int axis1,int axis2,int axis3,int axis4,long pulse1, long
pulse2, long pulse3,   long pulse4,long lspd ,long hspd, double tacc)
{
      Result=symmetry_relative_line4(  0,  axis1,axis2,axis3,axis4,pulse1,    pulse2,
pulse3, pulse4,lspd ,hspd, tacc);
      return Result;
}
      '/****************4 axis linear interpolation absolute movement************
      '*function: Refer to the originalposition to accelerate quantitatively movement
      '*Parameter:
      '         cardno –card No.
      '         axis1 ---axis1
      '         axis2 ---axis2
      '         axis3 ---axis3
                 Axis4---axis4
      '         pulse1 --pulse1
      '         pulse2 --pulse2
      '         pulse3 --pulse3
                 Pulse4---pulse4
      '         lspd ---low speed
      '         hspd ---high speed
      '         tacc--- acceleration time (s)
'         Return    value=0    right    ,    Return    value    =1    wrong
*****************************************************/
int CCtrlCard::Sym_AbsoluteLine4(int axis1,int axis2,int axis3,int axis4,long pulse1, long
pulse2, long pulse3, long pulse4,long lspd ,long hspd, double tacc)
{
      Result= symmetry_absolute_line4(0, axis1,axis2,axis3,axis4, pulse1,   pulse2,
pulse3,  pulse4, lspd , hspd,  tacc);
      return Result;
}
      '/****************5 axis linear interpolation relative movement*******************
      '*function: Refer to the current position to accelerate quantitatively movement
      '*Parameter:
      '           cardno –card No.
      '           axis1 ---axis1
      '           axis2 ---axis2
      '           axis3 ---axis3
      '           axis4 ---axis4
      '           axis5 ---axis5
      '           pulse1 --pulse1
      '           pulse2 --pulse2
      '           pulse3 --pulse3
      '           pulse4 –pulse4
      '           pulse5 –pulse5
      '           lspd ---low speed
      '           hspd ---high speed
      '           tacc--- acceleration time (s)
****************************************************/
int CCtrlCard:: Sym_RelativeLine5(int axis1,int axis2,int axis3,int axis4,int axis5,long
pulse1, long pulse2, long pulse3,   long pulse4,long pulse5,long lspd ,long hspd, double
tacc)
{
      Result=symmetry_relative_line5( 0, axis1,axis2,axis3,axis4,axis5,pulse1,   pulse2,
pulse3, pulse4,pulse5,lspd ,hspd, tacc);
      return Result;
}
      '/****************5 axis linear interpolation absolute movement*******************
      '*function: Refer to the original position to accelerate quantitatively movement
      '*Parameter:
      '           cardno –card No.
      '         axis1 ---axis1
      '         axis2 ---axis2
      '         axis3 ---axis3
      '         axis4 ---axis4
      '         axis5 ---axis5
      '         pulse1 --pulse1
      '         pulse2 --pulse2
      '         pulse3 --pulse3
      '         pulse4 –pulse4
      '         pulse5 –pulse5
      '         lspd ---low speed
      '         hspd ---high speed
      '         tacc--- acceleration time (s)
****************************************************/
int CCtrlCard::Sym_AbsoluteLine5(int axis1,int axis2,int axis3,int axis4,int axis5,long
pulse1, long pulse2, long pulse3, long pulse4,long pulse5,long lspd ,long hspd, double
tacc)
{
      Result= symmetry_absolute_line5(0, axis1,axis2,axis3,axis4,axis5,pulse1,
pulse2, pulse3, pulse4, pulse5, lspd , hspd, tacc);
      return Result;
}
      '/****************6 axis linear interpolation relative movement*******************
      '*function: Refer to the current position to accelerate quantitatively movement
      '*Parameter:
      '         cardno –card No.
      '         axis1 ---axis1
      '         axis2 ---axis2
      '         axis3 ---axis3
      '         axis4 ---axis4
      '         axis5 ---axis5
      '          axis6 ---axis6
      '          pulse1 --pulse1
      '          pulse2 --pulse2
      '          pulse3 --pulse3
      '          pulse4 –pulse4
      '          pulse5 –pulse5
      '          pulse6 –pulse6
      '          lspd ---low speed
      '          hspd ---high speed
      '          tacc--- acceleration time (s)
*****************************************************/
int CCtrlCard:: Sym_RelativeLine6(long pulse1, long pulse2, long pulse3, long
pulse4,long pulse5,  long pulse6,long lspd ,long hspd, double tacc)
{
      Result=symmetry_relative_line6( 0, pulse1,  pulse2, pulse3, pulse4,pulse5,
pulse6,lspd ,hspd, tacc);
      return Result;
}
      '/****************6 axis linear interpolation absolute movement*******************
      '*function: Refer to the original position to accelerate quantitatively movement
      '*Parameter:
      '          cardno –card No.
      '          axis1 ---axis1
      '          axis2 ---axis2
      '          axis3 ---axis3
      '          axis4 ---axis4
      '          axis5 ---axis5
      '          axis6 ---axis6
      '          pulse1 --pulse1
      '          pulse2 --pulse2
      '          pulse3 --pulse3
```

```
        '       pulse4 –pulse4
        '       pulse5 –pulse5
        '       pulse6 –pulse6
        '       lspd ---low speed
        '       hspd ---high speed
        '       tacc--- acceleration time (s)
****************************************************/
int CCtrlCard::Sym_AbsoluteLine6(long pulse1, long pulse2, long pulse3, long
pulse4,long pulse5,  long pulse6,long lspd ,long hspd, double tacc)
{
        Result= symmetry_absolute_line6(0, pulse1, pulse2, pulse3, pulse4,pulse5,
pulse6, lspd , hspd,  tacc);
        return Result;
}
/****************************************************
        'function: get output point
        'parameter:
        '     cardno
        '     number output point
        'return value    the current state of the designated port,-1 means wrong
****************************************************/
int CCtrlCard::Get_OutNum(int number)
{
        Result=get_out(0,number);
        return Result;
}
```

2.3 Function moudle

2.3.1 Interface design


ADT-8960 DEMO

ADT-8960 示范程序

硬件版本号:1.0

轴号	初始速度	驱动速度	加速度	加速时间
X	1000	5000	1500	0.01
Y	1000	5000	1500	0.01
Z	1000	5000	1500	0.01
A	1000	5000	1500	0.01
B	1000	5000	1500	0.01
C	1000	5000	1500	0.01

延时

延时时间: 0 us

开始延时 ☐ 延时状态

方向: [✓ 正向] 负向

轴号	目标位置	逻辑位置	实际位置	运行速度	负限位	正限位	STOP0	STOP1
☐ X	100000	0	0	0	☐	☐	☐	☐
☐ Y	100000	0	0	0	☐	☐	☐	☐
☐ Z	100000	0	0	0	☐	☐	☐	☐
☐ A	100000	0	0	0	☐	☐	☐	☐
☐ B	100000	0	0	0	☐	☐	☐	☐
☐ C	100000	0	0	0	☐	☐	☐	☐

2.3.2 The initialization code in the form loads incident, code as below：

```
      if (g_CtrlCard.Init_Board() <= 0)
      {

            MessageBox( "Initialization failed!");
      }
      else

           MessageBox ("card can used!");
      float LibVer;                //version No.
      g_CtrlCard.Get_Version(LibVer);
      CStatic *lbl;
      CString str;
      lbl=(CStatic*)GetDlgItem(IDC_INFO_VER);
      str.Format("hardware version No:%1.1f\n",LibVer);
      lbl->SetWindowText(str);
//******* set default speed 1000 *********
      m_nStartvX = 1000;
```

```
        m_nStartvY = 1000;
        m_nStartvZ = 1000;
        m_nStartvA = 1000;
//*********set default drive speed to 2000********
        m_nSpeedX   = 2000;
        m_nSpeedY   = 2000;
        m_nSpeedZ   = 2000;
        m_nSpeedA   = 2000;
//********* set default acceleration speed to 1500**********
        m_nAddX     = 1500;
        m_nAddY     = 1500;
        m_nAddZ     = 1500;
        m_nAddA     = 1500;
//********set default target position to100000******
        m_nPulseX   = 100000;
        m_nPulseY   = 100000;
        m_nPulseZ   = 100000;
        m_nPulseA   = 100000;
//***********set acceleration time***************
        m_dTaccX = 0.1;
        m_dTaccY = 0.1;
        m_dTaccZ = 0.1;
        m_dTaccA = 0.1;
//*********set delay time to 0************
        m_nDelayTime = 0;
        UpdateData(FALSE);
        SetTimer(1001,100,NULL);                    //start timer
```

2.3.3 linkage code located in button Click，send drive order from different target, code as below

```
        void CDEMODlg::OnButtonPmove()
```

```
	{
	UpdateData(TRUE);
	longStartv[]={m_nStartvX,m_nStartvY,m_nStartvZ,m_nStartvA,m_nStartvB,m_nStar
tvC};
	longSpeed[]={m_nSpeedX,m_nSpeedY,m_nSpeedZ,m_nSpeedA,m_nSpeedB,m_n
SpeedC};
	long Add[]={m_nAddX,m_nAddY,m_nAddZ,m_nAddA,m_nAddB,m_nAddC};
	for(int i=1;i<MAXAXIS+1;i++)
	{
		g_CtrlCard.Setup_Speed(i, Startv[i-1], Speed[i-1], Add[i-1]);
	}
	if(m_bX)
	{
		g_CtrlCard.Axis_Pmove(1, m_nPulseX);
	}

	if(m_bY )
	{
		g_CtrlCard.Axis_Pmove(2, m_nPulseY);
	}
	if(m_bZ )
	{
		g_CtrlCard.Axis_Pmove(3, m_nPulseZ);
	}
	if(m_bA )
	{
		g_CtrlCard.Axis_Pmove(4, m_nPulseA);
	}
	if(m_bB )
	{
		g_CtrlCard.Axis_Pmove(5, m_nPulseB);
	}
	if(m_bC )
	{
	       g_CtrlCard.Axis_Pmove(6, m_nPulseC);
	}
	}
```

2.3.4 Interpolation code located in button Click，send drive order from different target, code as below：

```
void CDEMODlg::OnButtonInpmove()
{
UpdateData();
longStartv[]={m_nStartvX,m_nStartvY,m_nStartvZ,m_nStartvA,m_nStartvB,m_nStartvC};
longSpeed[]={m_nSpeedX,m_nSpeedY,m_nSpeedZ,m_nSpeedA,m_nSpeedB,m_nSpee
dC};
long                              Add[]
```

```
={m_nAddX,m_nAddY,m_nAddZ,m_nAddA,m_nAddB,m_nAddC};                    //
加速度
longPulse[]={m_nPulseX,m_nPulseY,m_nPulseZ,m_nPulseA,m_nPulseB,m_nPulseC};
for(int i=1;i<MAXAXIS+1;i++)
{
        g_CtrlCard.Setup_Speed(i, Startv[i-1], Speed[i-1], Add[i-1]);
}
if(m_bX && m_bY && !m_bZ && !m_bA && !m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(1, 2, Pulse[0], Pulse[1]);
}
else if(m_bX && !m_bY && m_bZ && !m_bA && !m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(1, 3, Pulse[0], Pulse[2]);
}
else if(m_bX && !m_bY && !m_bZ && m_bA && !m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(1, 4, Pulse[0], Pulse[3]);
}
else if(m_bX && !m_bY && !m_bZ && !m_bA && m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(1, 5, Pulse[0], Pulse[4]);
}
else if(m_bX && !m_bY && !m_bZ && !m_bA && !m_bB && m_bC)
{
        g_CtrlCard.Interp_Move2(1, 6, Pulse[0], Pulse[5]);
}
else if(!m_bX && m_bY && m_bZ && !m_bA && !m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(2, 3, Pulse[1], Pulse[2]);
}
else if(!m_bX && m_bY && !m_bZ && m_bA && !m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(2, 4, Pulse[1], Pulse[3]);
}
else if(!m_bX && m_bY && !m_bZ && !m_bA && m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(2, 5, Pulse[1], Pulse[4]);
}
else if(!m_bX && m_bY && !m_bZ && !m_bA && !m_bB && m_bC)
{
        g_CtrlCard.Interp_Move2(2, 6, Pulse[1], Pulse[5]);
}
else if(!m_bX && !m_bY && m_bZ && m_bA && !m_bB && !m_bC)
{
      g_CtrlCard.Interp_Move2(3, 4, Pulse[2], Pulse[3]);
```

```
}
else if(!m_bX && !m_bY && m_bZ && !m_bA && m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(3, 5, Pulse[2], Pulse[4]);
}
else if(!m_bX && !m_bY && m_bZ && !m_bA && !m_bB && m_bC)
{
        g_CtrlCard.Interp_Move2(3, 6, Pulse[2], Pulse[5]);
}
else if(!m_bX && !m_bY && !m_bZ && m_bA && m_bB && !m_bC)
{
        g_CtrlCard.Interp_Move2(4, 5, Pulse[3], Pulse[4]);
}
else if(!m_bX && !m_bY && !m_bZ && m_bA && !m_bB && m_bC)
{
        g_CtrlCard.Interp_Move2(4, 6, Pulse[3], Pulse[5]);
}
else if(!m_bX && !m_bY && !m_bZ && !m_bA && m_bB && m_bC)
{
        g_CtrlCard.Interp_Move2(5, 6, Pulse[4], Pulse[5]);
}
else if(m_bX && m_bY && m_bZ && !m_bA && !m_bB && !m_bC)
{
         g_CtrlCard.Interp_Move3(1, 2, 3, Pulse[0], Pulse[1], Pulse[2]);
}
else if(m_bX && m_bY && !m_bZ && m_bA && !m_bB && !m_bC)
{
         g_CtrlCard.Interp_Move3(1, 2, 4, Pulse[0], Pulse[1], Pulse[3]);
}
else if(m_bX && m_bY && !m_bZ && !m_bA && m_bB && !m_bC)
{
         g_CtrlCard.Interp_Move3(1, 2, 5, Pulse[0], Pulse[1], Pulse[4]);
}
else if(m_bX && m_bY && !m_bZ && !m_bA && !m_bB && m_bC)
{
         g_CtrlCard.Interp_Move3(1, 2, 6, Pulse[0], Pulse[1], Pulse[5]);
}
else if(m_bX && !m_bY && m_bZ && m_bA && !m_bB && !m_bC)
  {
         g_CtrlCard.Interp_Move3(1, 3, 4, Pulse[0], Pulse[2], Pulse[3]);
}
else if(m_bX && !m_bY && m_bZ && !m_bA && m_bB && !m_bC)
{
         g_CtrlCard.Interp_Move3(1, 3, 5, Pulse[0], Pulse[2], Pulse[4]);
}
else if(m_bX && !m_bY && m_bZ && !m_bA && !m_bB && m_bC)
{
        g_CtrlCard.Interp_Move3(1, 3, 6, Pulse[0], Pulse[2], Pulse[5]);
}
else if(!m_bX && m_bY && m_bZ && m_bA && !m_bB && !m_bC)
{
         g_CtrlCard.Interp_Move3(2, 3, 4, Pulse[1], Pulse[2], Pulse[3]);
}
else if(!m_bX && m_bY && m_bZ && !m_bA && m_bB && !m_bC)
{
         g_CtrlCard.Interp_Move3(2, 3, 5, Pulse[1], Pulse[2], Pulse[4]);
}
else if(!m_bX && m_bY && m_bZ && !m_bA && !m_bB && m_bC)
 {
        g_CtrlCard.Interp_Move3(2, 3, 6, Pulse[1], Pulse[2], Pulse[5]);
}
else if(!m_bX && !m_bY && m_bZ && m_bA && m_bB && !m_bC) {
         g_CtrlCard.Interp_Move3(3, 4, 5, Pulse[2], Pulse[3], Pulse[4]);
}
else if(!m_bX && !m_bY && m_bZ && m_bA && !m_bB && m_bC) {
          g_CtrlCard.Interp_Move3(3, 4, 6, Pulse[2], Pulse[3], Pulse[5]);
}
else if(!m_bX && !m_bY && !m_bZ && m_bA && m_bB && m_bC) {
          g_CtrlCard.Interp_Move3(4, 5, 6, Pulse[3], Pulse[4], Pulse[5]);
}

else if(m_bX && m_bY && m_bZ && m_bA && !m_bB && !m_bC)            //XYZA 4
axis interpolation
{
        g_CtrlCard.Interp_Move4(1,2,3,4,Pulse[0], Pulse[1], Pulse[2], Pulse[3]);
}
else if(m_bX && m_bY && m_bZ && m_bA && m_bB && !m_bC)            //XYZAB 5
axis interpolation

{
         g_CtrlCard.Interp_Move5(1,2,3,4,5,Pulse[0],   Pulse[1],   Pulse[2],   Pulse[3],
Pulse[4]);
}
else if(m_bX && m_bY && m_bZ && m_bA && m_bB && m_bC)            //XYZABC
6 axis interpolation

{
        g_CtrlCard.Interp_Move6(Pulse[0],   Pulse[1],   Pulse[2],   Pulse[3],   Pulse[4],
Pulse[5]);
}
else
{
MessageBox
}
```

}

2.4 Monitoring module

Monitoring module for real-time obtain all axis drive information, displaying moving information, and control the drive not send new instructions in processing. Monitoring module completed by timer events , code as follows:

```
void CDEMODlg::OnTimer(UINT nIDEvent)
{
long log=0,act=0,spd=0;
UINTnID1[]={IDC_POS_LOGX,IDC_POS_LOGY,IDC_POS_LOGZ,IDC_POS_LOGA,ID
C_POS_LOGB,IDC_POS_LOGC};
UINTnID2[]={IDC_POS_ACTX,IDC_POS_ACTY,IDC_POS_ACTZ,IDC_POS_ACTA,IDC
_POS_ACTB,IDC_POS_ACTC};
UINTnID3[]={IDC_RUNSPEED_X,IDC_RUNSPEED_Y,IDC_RUNSPEED_Z,IDC_RUNS
PEED_A,IDC_RUNSPEED_B,IDC_RUNSPEED_C};
CStatic *lbl;
CString str;
int status[6];
for (int i=1; i<MAXAXIS+1; i++)
{
g_CtrlCard.Get_CurrentInf(i,log,act,spd);    //read logic position, real position and running
                                                speed
lbl=(CStatic*)GetDlgItem(nID1[i-1]);
str.Format("%ld",log);
lbl->SetWindowText(str);
lbl=(CStatic*)GetDlgItem(nID2[i-1]);
str.Format("%ld",act);
lbl->SetWindowText(str);
lbl=(CStatic*)GetDlgItem(nID3[i-1]);
str.Format("%ld",spd);
lbl->SetWindowText(str);
g_CtrlCard.Get_Status(i,status[i-1],0);
}
UINT nIDIN[]={ IDC_LIMIT_X,IDC_LIMIT_X2,    //X axis +/- limit
IDC_STOP0_X, IDC_STOP1_X ,
IDC_LIMIT_Y, IDC_LIMIT_Y2,                  //Y axis +/- limit
IDC_STOP0_Y,IDC_STOP1_X2,
IDC_LIMIT_Z,IDC_LIMIT_Z2,                   //Z axis +/- limit
IDC_STOP0_Z,IDC_STOP1_Z,
IDC_LIMIT_A,IDC_LIMIT_A2,                   //A axis +/- limit
IDC_STOP0_A,IDC_STOP1_A,
IDC_LIMIT_B,IDC_LIMIT_B2,                   //B axis +/- limit
IDC_STOP0_B,IDC_STOP1_B,
IDC_LIMIT_C,IDC_LIMIT_C2,                   //C axis +/- limit
IDC_STOP0_C,IDC_STOP1_C,
};
int io[]={0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23};
CButton *btn;
int value;
for (i=0; i<24; i++)
{
value=g_CtrlCard.Read_Input(io[i]);                          //read signal

btn=(CButton*)GetDlgItem(nIDIN[i]);

btn->SetCheck(value==0?1:0);
}
if(status[0]==0 && status[1]==0 && status[2]==0 && status[3]==0)
{
btn=(CButton*)GetDlgItem(IDC_BUTTON_PMOVE);
btn->EnableWindow(TRUE);
btn=(CButton*)GetDlgItem(IDC_BUTTON_INPMOVE);
btn->EnableWindow(TRUE);
btn=(CButton*)GetDlgItem(IDC_BUTTON_CLEARPOS);
btn->EnableWindow(TRUE);
btn=(CButton*)GetDlgItem(IDC_BUTTON_BASEPARA);
btn->EnableWindow(TRUE);
}
else
{
//**********driving**********
btn=(CButton*)GetDlgItem(IDC_BUTTON_PMOVE);
btn->EnableWindow(FALSE);
btn=(CButton*)GetDlgItem(IDC_BUTTON_INPMOVE);
btn->EnableWindow(FALSE);
btn=(CButton*)GetDlgItem(IDC_BUTTON_CLEARPOS);
btn->EnableWindow(FALSE);
btn=(CButton*)GetDlgItem(IDC_BUTTON_BASEPARA);
btn->EnableWindow(FALSE);}
CDialog::OnTimer(nIDEvent);
}
```

2.5 Stop module

Stop module mainly used to control the incidents that need immediate termination all axes in the processing. Stop module code is located in CmdStop button, code as follows:

```
    void CDEMODlg::OnButtonStop()
    {
        for (int i = 1; i<=MAXAXIS; i++)
        {
                g_CtrlCard.StopRun(i,1);
            }
        }
```

Chapter 11 Normal failures and solutions

☞ Motion control card detection failure

During use of control card, if encountering failure to detect the control card, users may follow the following items to check:

(1) Check whether the drive program for the control card has been installed step by step following installation guide and whether there is dynamic library file for the control card under the system menu (system 32 or System);
(2) Check the contact between the motion control card and the slot. Users may test it by re-inserting or changing the slot, alternatively, use a rubber to clean dirt on the golden finger of the control card and re-insert;
(3) Under the system equipment manager, check whether there is conflict between the control card and other hardware. In case of use of PCI card, users may remove other cards or boards first, such as found card and network card; in case of PC104 card, users may adjust the dialing switch and reset the base address, while the base address used during card initialization must be the same as the actual base address;
(4) Check whether there are any problems with the operating system; users may test it through re-installing other versions of operating systems;
(5) If failing to find the control card after the above steps, users may change the control card for further detection so as to discover whether there is damage with the control card.

☞ Motor service failure

In case the motor breakdowns while the motion control card works normally, users may follow the following points for troubleshooting.

(1) Motor makes no reaction when the control card outputs pulses
- ➢ Check the cable between the control card and the terminal panel;
- ➢ Check whether the pulse and direction signal wire of the motor driver has been correctly connected to the terminal panel;
- ➢ Check the connection of the external power supply for the servo driver;
- ➢ Check whether there is alarming status in the servo/stepping motor driver; in case of any alarm, follow codes corresponding to alarms to check the reason;

- Check connection to the servo SON and whether there is excitation status in the servo motor;
- In case of servo motor, check control method of the driver, the control card of our company supports the Position Control Method;
- Damage to motor/driver

(2) Stepping motor makes abnormal noise during service and motor makes obvious out-steps.

- Calculate motor speed and make sure the stepping motor is under 10-15 rounds per second instead of faster speed;
- Check internal obstruction in the mechanical part or resistance to the machine;
- Change to large-moment motors if the current motor is not sufficient;
- Check current and voltage of the driver; current shall be set as 1.2 of the nominated current and supply voltage shall be within the nominated range;
- Check the starting speed of the controller; normally, it shall be 0.5-1 and the acceleration/deceleration time shall be over 0.1 second.

(3) Servo/stepping motor makes obvious vibration or noises during processing

- Reduce the position ring gain and speed ring gain of the driver while allowed by the positioning precision, if the cause is such ring gains are too big;
- Adjust machine structure if the cause is poor machine rigidity;
- Change to large-moment stepping motors if the current motor is not sufficient;
- Avoid the co-vibration area of the motor or increase partitions so as not to have the speed of stepping motor within the co-vibration area of the motor.

(4) Motor positions inaccurately

- Check whether the mechanic screw pitch and pulses per round comply with the parameters set in the actual application system, i.e., pulse equivalent;
- Enlarge position ring gain and speed ring gain in case of servo motor;
- Check screw gap of the machine in the way of measuring the backward gap of a screw through a micrometer and adjust the screw if there is any gap;
- In case of inaccurate positioning out of regular time or position, check external disturbance signals;
- Check whether it is due to non-powerful motor that there is shaking or out-step.

(5) Motor makes no direction

- Check DR+/DR- cable for connection error or loose connection;
- Make sure the pulse mode applied in the control card comply with the actual driver mode; this control card support either “pulse+direction” or “pulse+pulse” mode;

- ➢ Check broken cables or loose connection along the motor cable, in case of stepping motor.

☞ Abnormal switch input

In case some input signals give unusual detection results during system adjusting and running, users may check in accordance with the following methods.

(1) No signal input

- ➢ Check whether the wiring is correct according to the above-mentioned wiring maps for normal switch and approach switch and ensure the public port for photoelectric coupling of input signals have been connected with anode of internal or external power supply (+12V or 24V);
- ➢ Check switch model and wiring mode; the input switch for I/O points of our company is of NPN model;
- ➢ Check whether there is damage with the photoelectric coupler. In case of normal wiring, input status will not change no matter the input point is broken or closed; users may use multi-use meter to check whether the photoelectric coupler has been broken, and if so, replace with a new one;
- ➢ Check the 12V or 24V power supply to the switch;
- ➢ Check whether there is damage to the switch.

(2) Non-continuous signals

- ➢ Check whether there is disturbance by detecting signal status in the I/O test interface; in case of disturbance, increase with Model 104 multiple layer capacitor or apply blocking cables;
- ➢ If the machine vibrates obviously or stops abnormally during normal service, check whether there is disturbance to the limit switch signals or the limit switch work reliably;
- ➢ Check connection of external cables.

(3) Inaccurate reset

- ➢ Too high speed decreases reset speed;
- ➢ Check disturbance source if the problem is there is external disturbance to signals;
- ➢ Wrong resetting direction;
- ➢ Improper installation position of the reset switch or loose switch.

(4) Limit out of use

- ➢ Check whether the limit switch still works under the I/O test;
- ➢ Too high speed during manual or automatic processing;
- ➢ Check disturbance source if the problem is there is external disturbance to signals;
- ➢ Wrong manual direction;
- ➢ Improper installation position of the limit switch or loose switch.

☞ Abnormal switch output

Abnormal switch output may be checked in the following methods.

(1) Abnormal output

- ➢ Check whether the wiring is correct following the above-mentioned wiring for output points and ensure the output public port (earthing line) has been connected with the earthing line of the used power supply;
- ➢ Check whether there is any damage to the output components;
- ➢ Check whether there is damage with the photoelectric coupler. Users may use multi-use meter to check whether the photoelectric coupler has been broken, and if so, replace with a new one;
- ➢ Safety issue. Continuous dioxide (model: IN4007 or In4001) must be serial connected in case of output with sensitive loading.

(2) Judgment method for improper output

Break the external cable at the output point and connect at the output point a pull up resistor of around 10K to the power supply, while earthing line of the output must be connected with GND of the power supply; then users use the red pen of a multi-use meter to touch the 12V anode, and black pen to touch the signal output port, at the same time of using hand to touch the button on the test interface to see whether there is voltage output. If case of any voltage output, check the external circuit, otherwise check connection to the public port of boards/cards and internal photoelectric couplers.

☞ Abnormal encoder performance

Abnormal encoder performance may be checked in the following methods.

(1) Check encoder cables and make sure they comply with the above-mentioned differential or collecting electrode wiring method;

(2) Check encoder voltage. The motion control card normally accepts +5V signals. In case a +12V or +24V encoder is selected, users must serial connect a 1K (+12V) resistor between the Phase A/B of the encoder and Phase A/B of the terminal panel;

(3) Inaccurate encoder counting. External cables to the encoder must be blocking double-twittered cables, and shall be tied free from those cables with strong disturbance such as strong electricity, specially, they shall be separated for over 30-50 MM.