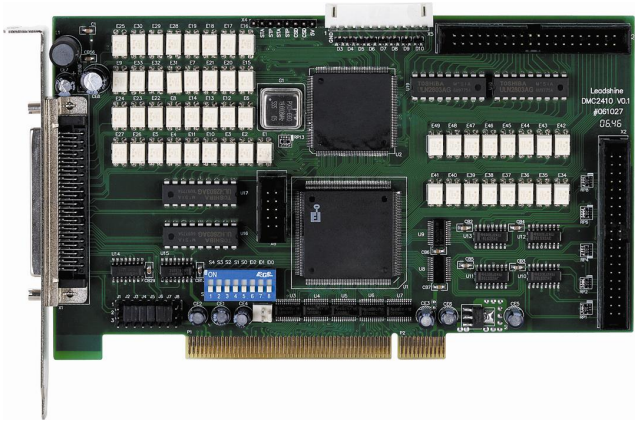
深圳市雷泰控制技术有限公司
SHENZHEN LEADTECH CONTROL TECHNOLOGY CO., LTD

DMC2410 PCI bus 4 Axes Motion Control Card

Hardware Manual

Version 1.1



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For a period of one year from the date of original purchase, LEADTECH will repair or replace without charge controls and accessories which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied.

LEADTECH shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some countries and U.S. states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, LEADTECH's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to LEADTECH with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses. Goods may be returned only with written notification including a LEADTECH Return Authorization Number and any return shipments must be prepaid.

Safety Notice

Only qualified personnel should attempt to start-up, program or troubleshoot this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

Precautions

WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that no high voltage is present at this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury.

WARNING: Be sure that you are completely familiar with the safe operation and programming of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

WARNING: The stop input to this equipment should not be used as the single means of achieving a safety critical stop. Driver disable, motor disconnect, motor brake and other means should be used as appropriate.

WARNING: Improper operation or programming may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Peak torque of several times the rated motor torque can occur during control failure.

CAUTION: The safe integration of this equipment into a machine system is the responsibility of the machine designer. Be sure to comply with the local safety requirements at the place where the machine is to be used. In Europe these are the Machinery Directive, the Electromagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is the National Electrical code and local codes.

CAUTION: Electrical components can be damaged by static electricity. Use ESD (electrostatic discharge) procedures when handling this drive.

Contents

Chapter 1 Introduction

1.1 Hardware structure

The DMC2410 is a 4 axes motion control card with PCI bus. It can generate high frequency pulses to drive stepping motors and servo motors.

Figure 1.1 shows the function block diagram of DMC2410 card. DMC2410 uses an ASIC to perform 4 axes motion control. The motion control functions include trapezoidal and S-curve velocity profile, linear interpolation between four axes, continuous motion, in positioning and home return are done by the ASIC. Since these functions needing complex computations are done internally on the ASIC, the PC's CPU is free to supervise and perform other tasks.

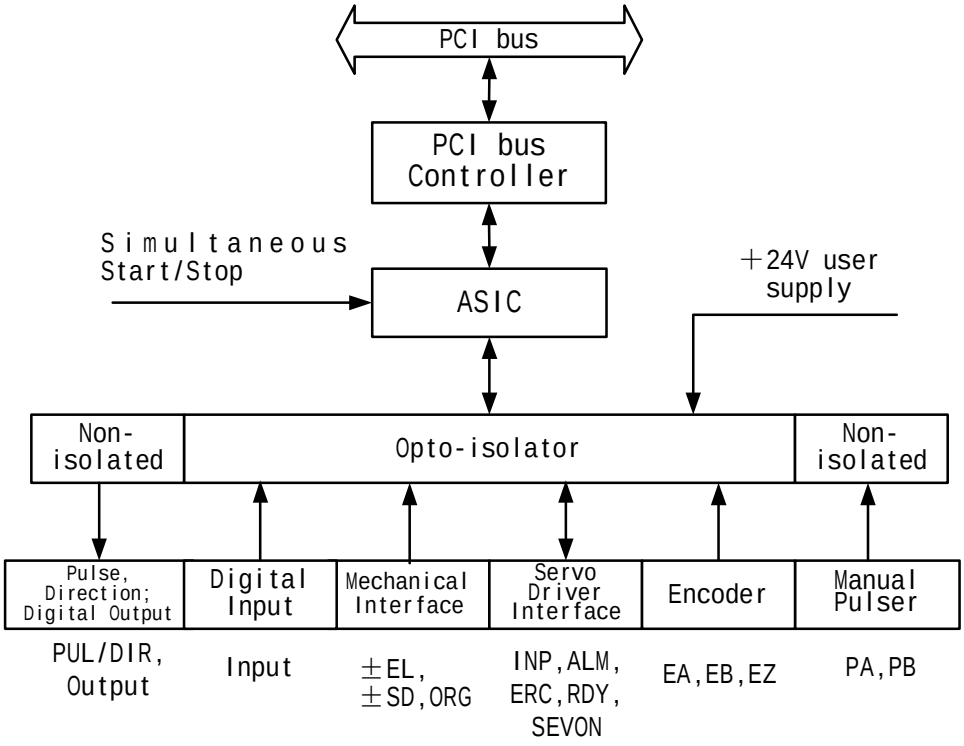

Figure 1.1 Block diagram of DMC2410

Incremental encoder interface on all four axes provide the ability to correct for positioning errors generated by inaccurate mechanical transmissions. In addition, mechanical sensor interface, servo motor interface and general purpose I/O signals are provided for system integration. Multiple DMC2410 cards can be used in one system.

1.2 Features

The following lists summarize the main features of the DMC2410 motion control card.

- Advanced RISC processor for robust real-time motion and I/O control.

- 4 axes of step and direction pulse output for controlling stepping or servo motor.
- Maximum output frequency of 5 Mpps.
- Trapezoidal and S-curve velocity profiles.
- 2-axis circular and 4-axis linear interpolation.
- 28-bit up/down counter for incremental encoder feedback.
- High speed position latch for each axis and output compare.
- Change Speed on the Fly.
- Simultaneous start/stop motion on multiple axes.
- Manual pulser input interface.
- Extensive on-board 40 general purpose digital I/O.
- Software supports maximum up to 8 DMC2410 cards (32 axes) operation.
- Compact, half size PCB.
- Comprehensive support for C/C++/C#, LabVIEW and Visual Basic programmers.
- Motion 2410, a Microsoft Windows based application testing software.
- Powerful suite of software utilities and sample programs included.

1.3 Specifications

Applicable Motors:

Stepping motors.

AC or DC servomotors with pulse/direction input servo drivers.

Performance:

Number of controllable axes: 4 axes.

Pulse output frequency: 1~5×10^6 pps

Pulse output frequency precision: ±0.1%

Position pulse setting range: －134,217,727~＋134,217,727 (28-bit).

Ramping-down point setting range: 0 ~ 16777215(24-bit).

Up / down counter counting range: –134,217,728 ~ +134,217,727 (28-bit.)

I/O Signales:

General purpose digital input: 20, opto-isolated.

General purpose digital output: 20, open-collector output

Incremental encoder signals input: EA, EB and EZ, opto-isolated.

Mechanical limit/home signal input: EL±, SD and ORG, opto-isolated.

Servomotor interface : INP, ALM and ERC, opto-isolated.

Manual Pulser signal input: PA and PB.

Simultaneous Start/Stop signal: STA and STP.

General Specifications:

Connectors: 68-pin SCSI-type connector, 37-pin D-type connector.

Operating Temperature: 0 ° C ~ 50 ° C

Storage Temperature: -20 ° C ~ 80 ° C

Humidity: 5 ~ 85%, non-condensing.

Power Consumption:

Slot power supply (input): +5V DC ±5%, 1100mA max.

External power supply (input): +24V DC ±5%, 500mA max.

External power supply (output): +5V DC ±5%, 500mA, max.

Dimension:

177.5mm (L) X 106.5mm (H)

Applications:

Semiconductor front & back end equipment.

TFT/LCD manufacturing equipment.

Electronic assembly and testing equipment.

Automatic Optical Inspection equipment.

Automatic sampling and testing equipment in Medicine, Biology.

1.4 Package contents

(1) DMC2410 motion controller card.

(2) Terminal board: a piece of ACC68.
one or two piece of ACC50, optional.

(3) Cable: one CABLE68,
one or two CABLE37, optional.
one CABLE37-1-5F, optional.

(4) Software CD for DMC2410.

Chapter 2 DMC2410 Functions

2.1 Pulse output mode

The DMC2410 uses pulse command to control the servo / stepping motors via the drivers. The pulse command consists of two output signals: OUT and DIR. The pulse command output of DMC2410 has two mode：

(1) PUL/DIR mode (single pulse output mode);

(2) CW/CCW mode (dual pulse output mode).

In PUL/DIR mode, the PUL signal indicates the motor's rotating speed, and the DIR indicates the motor's rotating direction, as the Figure 2.1:

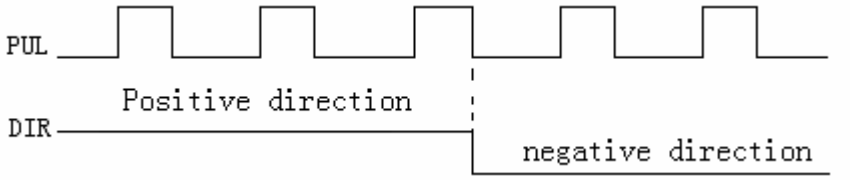

Figure 2.1 The PUL + DIR pulse output mode

In CW/CCW mode, the PUL pulse signal indicates the motor in positive direction, the DIR pulse signal indicates the motor in negative direction, and the pulse frequency relate to the motor speed as the Figure 2.2.

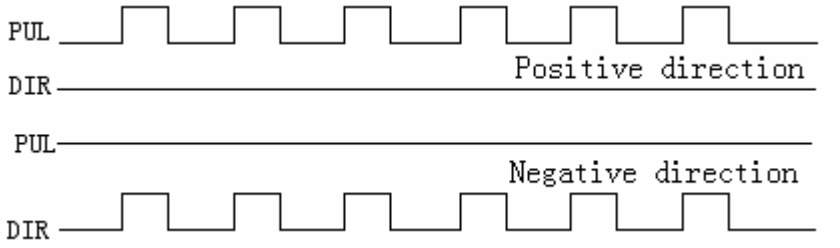

Figure 2.2 The CW/CCW pulse output mode

2.2 Motion control functions

2.2.1 Point to Point Motion

In this mode, the DMC2410 will control a motor move from currently point to another point, the distance is depending on output pulse number, and the accelerate rate, decelerate rate and speed will be configured. The DMC2410 will automatically output the pulse to control the motor. When the output pulse equal to the command pulse, the DMC2410 will stop to output pulse. The diagram of this mode is shown as Figure 2.3.

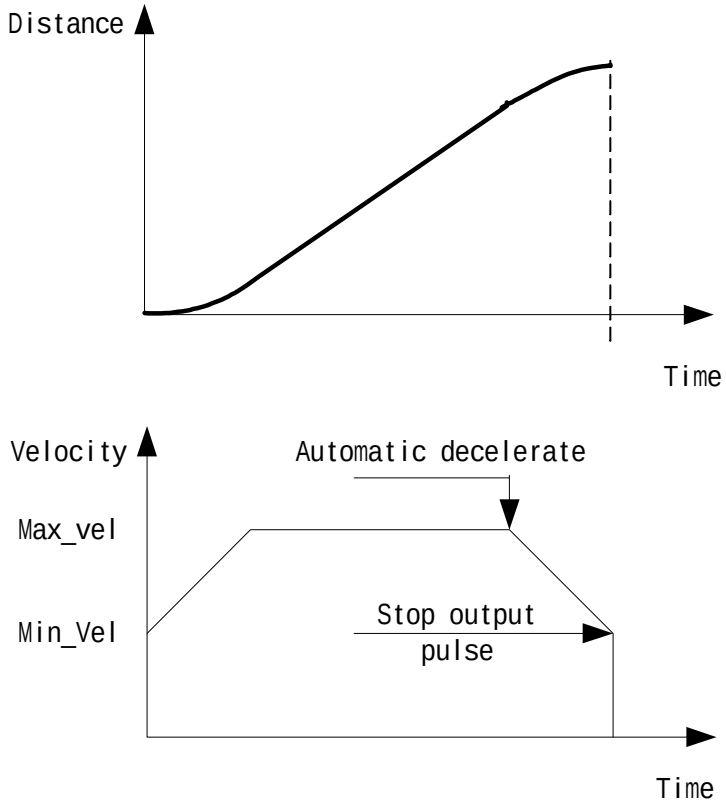

Fig.2-3. The Point to Point motion

2.2.2 Continuous motion

In this mode, the motion start on starting speed, then accelerate to maximum speed, and continuous move until accept a stop command or emergency stop command, then decelerate stop or stop at once. The diagram of this mode is shown as Figure 2.4.

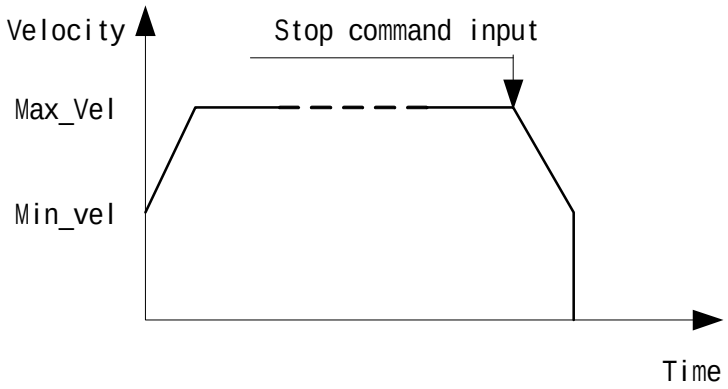

Figure 2.4 The continuous motion mode

2.2.3 Interpolation motion

DMC2410 provides a linear interpolation mode for 2 or more axes, and a circular interpolation mode for 2 axes. In these interpolation mode, motion between the axes is

coordinated to maintain the prescribed vector speed, acceleration, and deceleration along the specified path.

For example, in the Figure 2.5, DMC2410 control motors to move the axes from P0 to P1, the two axes start and stop simultaneously at a period of time Δt, the moving speed along X-axis and Y-axis will be $\Delta X/\Delta t.$, $\Delta Y/\Delta t.$ respectively.

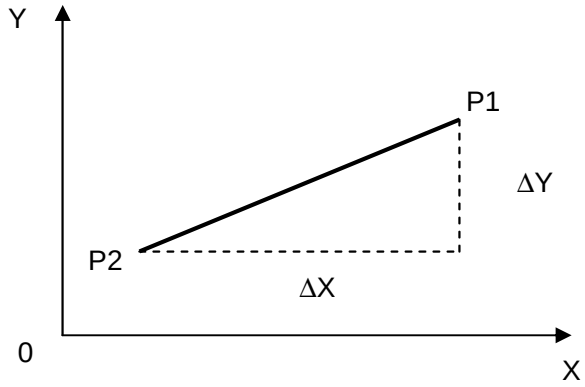

Figure 2.5 the interpolation mode

2.2.4 Homing motion

For most applications, the first thing of motion control is to homing, which is to find a mechanical reference point. There is a position sensor or a switch at the reference point, when an axis has reached this position, and activating the sensor, DMC2410 captures the origin position of the axis. (See Figure x.x)

2.2.6 Manual pulser control mode

This mode is to accept input signals of a manual pulser through X5 Port., and a motor will be controlled by the manual pulser.

2.3 Encoder input and it's functions

Each axis of DMC2410 has an up/down counter for checking the current position. The counter counts signals input from EA and EB pins. The card can accept 2 kinds of pulse input: (1) CW/CCW mode; (2) 90°phase differential signal mode.

2.3.1 CW/CCW mode

In this mode, pulse from EA causes the counter to count up; otherwise, pulse from EB causes the counter to count down.

2.3.2 90° phase differential signal mode

In this mode,

If the EA signal is 90°phase leading compare with EB signal, it will be consider as positive direction. If the EA signal is 90°phase lagging compare with EB signal, it will be consider as negative direction. The diagram of the signal is shown as Figure 2.6.

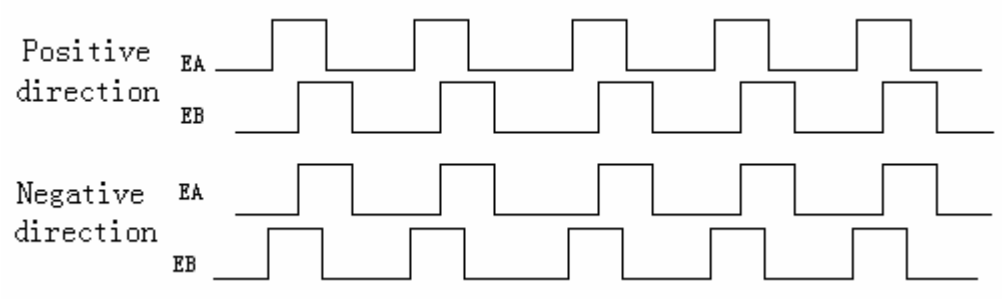

Figure 2.6 90° phase differential signal

If a rotary encoder has 2000 pulses per circle, and the multiplied factor 4x is selected, then the value read from the counter will be 8000 pulses per round or -8000 pulses per round.

2.3.3 Position capture

The DMC2410 support capturing the position of One axis's encoder triggered by LTC input. This function is widely used in atuo measure devices, the LTC signal usually come from a probe.

2.3.4 Position compare

The DMC2410 provide two positions of an axis for the position compare. When the current position of the axis is equal or less or more than the positions which setting by program, the CPM pin will output a signal to indicate that a position compare event has occurred.

2.4 AC servo Motor Interface

The DMC2410 provides RDY, INP, ALM, SEVON and ERC signals for AC servo motor driver's control interface. RDY, INP, and ALM are used for feedback the servo driver's status. The SEVON and ERC are used to control servo motor driver.

2.4.1 RDY signal

When a servo motor driver is ready to move, it will send a RDY single to its motion controller. DMC2410 can check the RDY input to decide if send pulses to the motor.

2.4.2 INP signal

Usually, servo motor driver with pulse input has a position deflection counter to detect the deflection between the input pulse command and feedback counter. The driver controls the motion of servo motor to minimize the deflection until it becomes 0. Theoretically, the servo motor operates with some time delay from command pulses. Accordingly, when the motion controller stops outputting pulses, the servo motor does not stop but keep running until the deflection counter become zero. At this moment, the servo driver sends out the in-position signal (INP) to the controller to indicate the motor stops running.

2.4.3 ALM signal

The ALM input receives the alarm signal output from the servomotor driver. The signal immediately stops DMC2410 to generate pulses or stop it after deceleration.

2.4.4 SEVON signal

DMC2410 can send a single form SEVON pin to a servomotor driver, let it into standby state.

2.4.5 ERC signal

The ERC (Deflection counter clear) signal can immediately stop the servomotor by resetting the deflection counter to zero. ERC usually is inserted in the following 4 situations:

(1) Home return is complete;

(2) The end-limit switch is active;

(3) An alarm signal stops PULSE and DIR signals;

(4) An emergency stop command is issued by software operator.

2.5 Mechanical Switch Interface

2.5.1 SD signal

SD (Slow-down) is a ramping-down signal, which is used to slow-down the control output signals (PUL/DIR) when it is active. The signals are very useful to protect the mechanism moving under high speed toward the mechanism origin or limit position.

During varied speed operation in the home return mode or continuous operation mode, the ramping-down signal in the moving direction lets the output control signals (PUL/DIR) ramp down to the pre-setting starting velocity.

2.5.2 ORG signal

When the motion controller is operated at the home return mode, the ORG signal is used to stop the control output signals (PUL/DIR).

2.5.3 EL signal

The End-Limit signals are used to stop the control output signals (PUL/DIR) when the end-limit is active. EL+ signal indicates end-limit in positive (plus) direction. EL- signal indicates end-limit in negative (minus) direction.

When the output pulse signals (PUL/DIR) are toward positive direction, the pulse will be immediately stopped when the EL+ signal is inserted, while the EL- signal is meaningless in this case, and vise versa. When the EL- is inserted and the output pulse is fully stopped, only the negative (minus) direction output pulse can be generated for moving the motor to negative (minus) direction.

2.4 Multiple DMC2410 Cards Operation

The software function library support maximum up to 8 DMC2410 cards, which means one PC can control 32 motors. Since DMC2410 has the characteristic of Plug-and-Play, users not need to care about setting the based address and the IRQ level of the card.

No. 1 of cards controls No. 0 ~ 3 of axes, No. 2 of cards controls No. 4 ~ 7 of axes, and so on. User can use MOTION2410 testing software to check the number of axes and the number

of cards.

2.5 Sensors and control signals of a motion stage

DMC2410 provides 2 limit signals EL±, 1 slow-down signal SD, 1 origin signal ORG for every axis, and these input signals have opto-isolation and filter circuit to ensure the reliability of DMC2410. Figure 2.7 shows a motion stage with sensors and control signals.

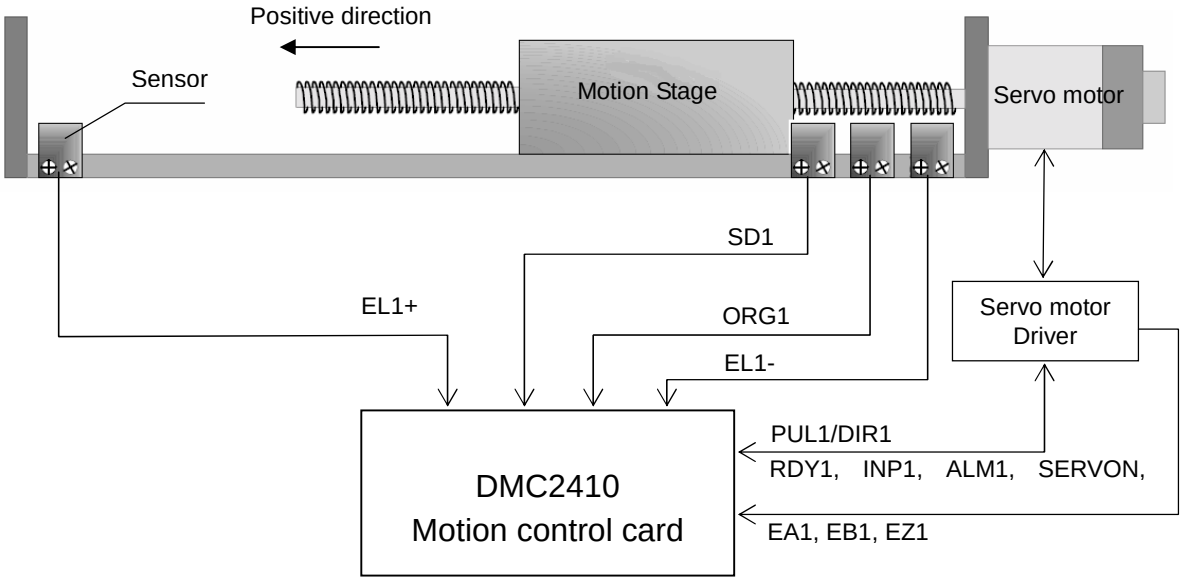

Figure 2.7 Sensors and control signals of a motion stage with DMC2410

Chapter 3 Hardware Installation

3.1 Installation Procedure

(1) Read through this manual and setup the jumper according to your application.
(2) Turn off your computer and remove the cover from your computer.
(3) Select a 32-bit PCI expansion slot.
(4) Before handling the DMC2410, discharge any static electricity buildup on your body by touching a ground wire. Hold the edge of the card and do not touch the components.
(5) Put the board into the PCI slot you have selected.
(6) Secure the card in place at the rear panel of the PC, and using a screw to fix the card.

3.2 Layout of the card

The layout of the DMC2410 motion control card is shown as figure 3.1. There are many jumpers and switches for setting the card's working mode.

The connector X1 and X2 of the card are used for the base signals. The connector X3 is for I/O signals, X5 is for the manual pulser, X4 for the signal of the simultaneous start/stop. The connector X6 is used for writing IC program, customer don't care about it.

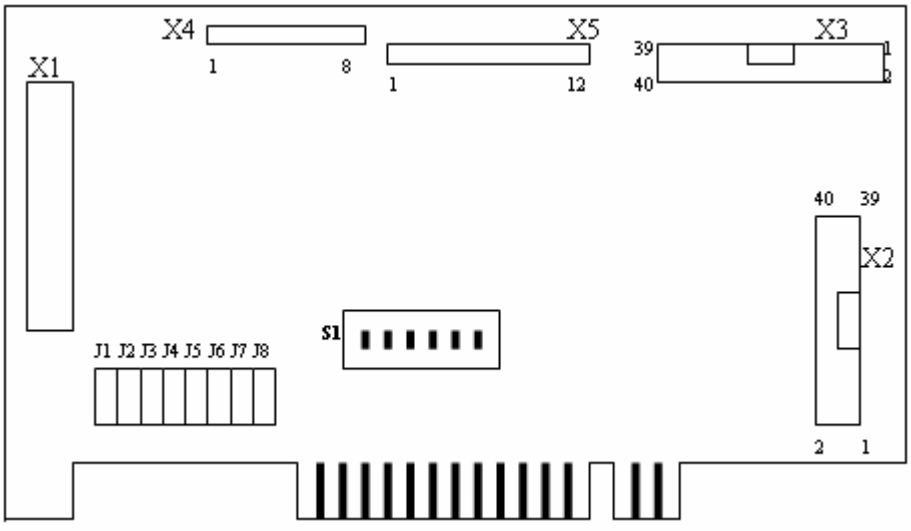

Figure 3.1 The DMC2410 layout of Connectors, jumpers and switches

3.3 Board setting

(1) Jumper J1 ~ J8 setting

The J1~J8 is used to set the signal type of the pulse output signals (PUL/DIR). The output

signal type could be differential line driver output or single-ended output. Please refer to section 5.2 for details of the jumper setting.

The default setting is the differential line driver mode, see figure 3.2. Figure 3.3 shows the single-ended output mode. The relation between signals and jumpers are shown as table 3.1.

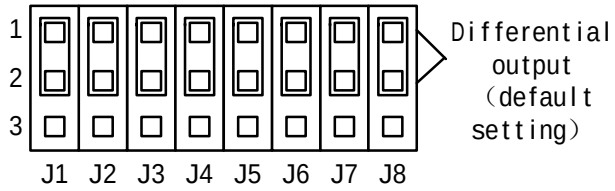

Figure 3.2 Differential output

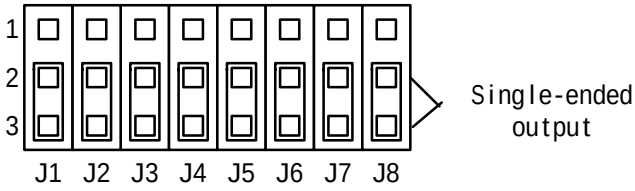

Figure 3.3 Single-ended output

Table 3.1 Relation between signals and jumpers

X1 Pin	Signal	Jumper	X1 Pin	Signal	Jumper
1	PUL1+	J1	35	PUL3+	J5
2	PUL1-		36	PUL3-	
3	DIR1+	J2	37	DIR3+	J6
4	DIR1-		38	DIR3-	
5	PUL2+	J3	39	PUL4+	J7
6	PUL2-		40	PUL4-	
7	DIR2+	J4	41	DIR4+	J8
8	DIR2-		42	DIR4-	

(2) Switch S1 setting

S1 can setup the output port logic level of OUT1～OUT12 and SEVON1～SEVON4. When S1 is selected at ”ON” position, write “0” to a output bit, the port output low level; write “1” to a output bit, the port output high level. When S1 is selected at “OFF” position, write “0” to an output bit, the port output high level; write “1” to an output bit, the port output low level.

Besides, S1 can be used to setup the initial level of OUT1~OUT12 and SEVON1~SEVON4. When “Off” is selected, the initial level of output is low, “On” is selected, and the initial level of output is high. S1 is defined as below:

Bit 1 of S1: Reserve.
Bit 2 of S1: Reserve.
Bit 3 of S1: Reserve.
Bit 4 of S1: set the initial level of OUT1~OUT4.
Bit 5 of S1: set the initial level of OUT5~OUT8.
Bit 6 of S1: set the initial level of OUT9~OUT12.
Bit 7 of S1: Reserve.
Bit 8 of S1: set the initial level of SEVON1~SEVON4.

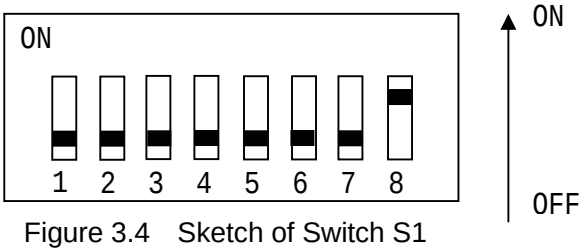

Figure 3.4 Sketch of Switch S1

The default setting of all bit of S1 are selected “On”, that are the initial level of SEVON1~ SEVON4 and OUT1~ OUT12 are high.

Note: The initial level of OUT13~ OUT20 can’t be set, their initial level are high.

Chapter 4 Connector's pin assignment

4.1 Connector X1

The connector X1 is a SCSI-Ⅱ 68 pins connector for motion control and I/O signals. Its assignment is shown as table 4.1.

Table 4.1 Connector X1 pin assignment

Pin	Name	I/O	Description	Pin	Name	I/O	Description
1	PUL1+	O	Pulse signal(+) of Axis 1	35	PUL3+	O	Pulse signal(+) of Axis 3
2	PUL1-	O	Pulse signal(-) of Axis 1	36	PUL3-	O	Pulse signal(-) of Axis 3
3	DIR1+	O	Direction signal(+) of Axis 1	37	DIR3+	O	Direction signal(+) of Axis 3
4	DIR1-	O	Direction signal(-) of Axis 1	38	DIR3-	O	Direction signal(-) of Axis 3
5	PUL2+	O	Pulse signal(+) of Axis 2	39	PUL4+	O	Pulse signal(+) of Axis 4
6	PUL2-	O	Pulse signal(-) of Axis 2	40	PUL4-	O	Pulse signal(-) of Axis 4
7	DIR2+	O	Direction signal(+) of Axis 2	41	DIR4+	O	Direction signal(+) of Axis 4
8	DIR2-	O	Direction signal(-) of Axis 2	42	DIR4-	O	Direction signal(-) of Axis 4
9	OUT1	O	General output 1	43	OUT3	O	General output 3
10	OUT2	O	General output 2	44	OUT4	O	General output 4
11	SEVON1	O*	Servo On signal of Axis 1	45	SEVON3	O*	Servo On signal of Axis 3
12	SEVON2	O*	Servo On signal of Axis 2	46	SEVON4	O*	Servo On signal of Axis 4
13	ERC1	O	Deflection counter clear signal of Axis 1	47	ERC3	O	Deflection counter clear signal of Axis 3
14	ERC2	O	Deflection counter clear signal of Axis 2	48	ERC4	O	Deflection counter clear signal of Axis 4
15	CMP1	O*	Position compare signal of Axis 1	49	CMP3	O*	Position compare signal of Axis 3
16	CMP2	O*	Position compare signal of Axis 2	50	CMP4	O*	Position compare signal of Axis4
17	INPUT1	I	General input 1	51	INPUT3	I	General input 3
18	INPUT2	I	General input 2	52	INPUT4	I	General input 4
19	ALM1	I	Servo alarm signal of Axis 1	53	ALM3	I	Servo alarm signal of Axis 3
20	INP1	I*	Servo in-position signal of Axis 1	54	INP3	I*	Servo in-position signal of Axis 3
21	RDY1	I*	Servo ready signal of Axis 1	55	RDY3	I*	Servo ready signal of Axis 3
22	EL1+	I	Positive End limit signal of Axis 1	56	EL3+	I	Positive End limit signal of Axis 3
23	EL1-	I	Negative End limit signal of Axis 1	57	EL3-	I	Negative End limit signal of Axis 3
24	SD1/PCS1	I*	Slow-down signal of Axis 1	58	SD3/PCS3	I*	Slow-down signal of Axis 3
25	ORG1	I	Origin signal of Axis 1	59	ORG3	I	Origin signal of Axis 3
26	ALM2	I	Servo alarm signal of Axis 2	60	ALM4	I	Servo alarm signal of Axis 4
27	INP2	I*	Servo in-position signal of Axis 2	61	INP4	I*	Servo in-position signal of Axis 4
28	RDY2	I*	Servo ready signal of Axis 2	62	RDY4	I*	Servo ready signal of Axis 4
29	EL2+	I	Positive End limit signal of Axis 2	63	EL4+	I	Positive End limit signal of Axis 4

30	EL2-	I	Negative End limit signal of Axis 2	64	EL4-	I	Negative End limit signal of Axis 4
31	SD2/PCS2	I*	Slow-down signal of Axis 2	65	SD4/PCS4	I*	Slow-down signal of Axis 4
32	ORG2	I	Origin signal of Axis 2	66	ORG4	I	Origin signal of Axis 4
33	VDD	I	+12V-+24V supply for user's I/O	67	GND		PC ground signal
34	EGND		user's supply ground	68	EMG	I	Emergency stop (for all axis)

Note: the pin with sign * can be used as general I/O when its function is disable.

4.2 Connector X2

The connector X2 is an IDC 40 pins connector for encoder input and other signals. Its assignment is shown as table 4.2.

Table 4.2 Connector X2 pin assignment

Pin	Name	I/O	Description	Pin	Name	I/O	Description
1	5V		PC supply 5V	20	GND		PC supply ground
2	GND	I	PC supply ground	21	EA2+	I	Encoder A-phase (+) of Axis 2
3	EA1+	I	Encoder A-phase (+) of Axis 1	22	EA2-	I	Encoder A-phase (-) of Axis 2
4	EA1-	I	Encoder A-phase (-) of Axis 1	23	EB2+	I	Encoder B-phase (+) of Axis 2
5	EB1+	I	Encoder B-phase (+) of Axis 1	24	EB2-	I	Encoder B-phase (-) of Axis 2
6	EB1-	I	Encoder B-phase (-) of Axis 1	25	EZ2+	I	Encoder Z signal (+) of Axis 2
7	EZ1+	I	Encoder Z signal (+) of Axis 1	26	EZ2-	I	Encoder Z signal (-) of Axis 2
8	EZ1-	I	Encoder Z signal (-) of Axis 1	27	LTC2+	I	Position capture (+) of Axis 2
9	LTC1-	I	Position capture (-) of Axis 1	28	LTC2-	I	Position capture (-) of Axis 2
10	5V		PC supply 5V	29	GND		PC supply ground
11	GND		PC supply ground	30	EA4+	I	Encoder A-phase (+) of Axis 4
12	EA3+	I	Encoder A-phase (+) of Axis 3	31	EA4-	I	Encoder A-phase (-) of Axis 4
13	EA3-	I	Encoder A-phase (-) of Axis 3	32	EB4+	I	Encoder B-phase (+) of Axis 4
14	EB3+	I	Encoder B-phase (+) of Axis 3	33	EB4-	I	Encoder B-phase (-) of Axis 4
15	EB3-	I	Encoder B-phase (-) of Axis 3	34	LTC1+	I	Position capture (+) of Axis 1
16	EZ3+	I	Encoder Z signal (+) of Axis 3	35	EZ4-	I	Encoder Z signal (-) of Axis 4
17	EZ3-	I	Encoder Z signal (-) of Axis 3	36	$\overline{\text{LTC1}}$	O	LTC1 invert output
18	EZ4+	I	Encoder Z signal (+) of Axis 4	37	$\overline{\text{LTC1}}$	O	LTC1 invert output
19	5V		PC supply 5V	38-40	GND		PC supply ground

4.3 Connector X3

The connector X3 is an IDC 40 pins connector for general I/O and other signals. Its assignment is shown as table 4.3.

Table 4.3 Connector X3 pin assignment

Pin	Name	I/O	Description	Pin	Name	I/O	Description
1	IN5	I	General input 5	20	LTC3-	I	Position capture (-) of Axis 3
2	IN6	I	General input 6	21	OUT5	O	General output 5
3	IN7	I	General input 7	22	OUT6	O	General output 6
4	IN8	I	General input 8	23	OUT7	O	General output 7
5	IN9	I	General input 9	24	OUT8	O	General output 8

6	IN10	I	General input 10	25	OUT9	O	General output 9
7	IN11	I	General input 11	26	OUT10	O	General output 10
8	IN12	I	General input 12	27	OUT11	O	General output 11
9	IN13	I	General input 13	28	OUT12	O	General output 12
10	IN14	I	General input 14	29	OUT13	O	General output 13
11	IN15	I	General input 15	30	OUT14	O	General output 14
12	IN16	I	General input 16	31	OUT15	O	General output 15
13	IN17	I	General input 17	32	OUT16	O	General output 16
14	IN18	I	General input 18	33	OUT17	O	General output 17/CMP1’
15	IN19	I	General input 19	34	OUT18	O	General output 18/CMP2’
16	IN20	I	General input 20	35	OUT19	O	General output 19/CMP3’
17	LTC4+	I	Position capture (+) of Axis 4	36	OUT20	O	General output 20/CMP4’
18	LTC4-	I	Position capture (-) of Axis 4	37/38	GND		PC supply ground
19	LTC3+	I	Position capture (+) of Axis 3	39/40	GND		PC supply ground

4.4 Connector X4

The connector X4 is used for simultaneous start/stop of motion on multiple axes. Its assignment is shown as table 4.4.

Table 4.4 Connector X4 pin assignment

Pin	Name	Description
1	GND	PC supply ground
2	STA	simultaneous start input/output
3	STP	simultaneous stop input/output
4	STA	simultaneous start input/output
5	STP	simultaneous stop input/output
6	CSD	simultaneous slow-down input/output
7	CSD	simultaneous slow-down input/output
8	+5V	PC supply 5V

If there are more than two cards and axes will start/stop simultaneously, the STA, STP and STA signals of connector X4 of all cards should be connect in series as Figure 4.1 shown.

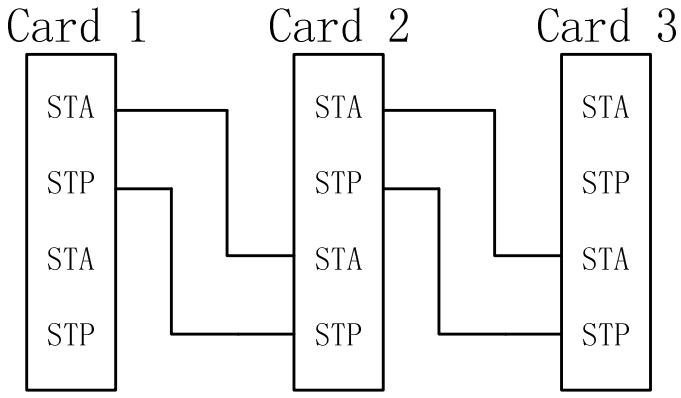

Figure 4.1 Multiple Cards X4 connect for simultaneous start/stop

4.5 Connector X5

The connector X5 is for a manual pulser input. Its assignment is shown as table 4.5.

Table 4.5 Connector X5 pin assignment

Pin	Name	Description
1	GND	PC supply ground
2	PA1	manual pulser A-phase signal of Axis 1
3	PB1	manual pulser B-phase signal of Axis 1
4	PA2	manual pulser A-phase signal of Axis 2
5	PB2	manual pulser B-phase signal of Axis 2
6	+5V	PC supply 5V
7	GND	PC supply ground
8	PA3	manual pulser A-phase signal of Axis 3
9	PB3	manual pulser B-phase signal of Axis 3
10	PA4	manual pulser A-phase signal of Axis 4
11	PB4	manual pulser B-phase signal of Axis 4
12	+5V	PC supply 5V

Chapter 5 Interface circuit

5.1 Motion control signals of PUL/DIR

PUL and DIR signals are driven by 26LS31 line drivers, providing RS-422 differential outputs. PUL/DIR output signal type could be set as differential line driver output or single-ended output by selecting J1~J8, see Figure 5.1 and 5.2. The table 5.1 shows all the motion control signals of DMC2410 on X1 connector.

Table 5.1 Motion control signals

X1 Pin	Name	Description	X1 Pin	Name	Description
1	PUL1+	Pulse signal of Axis 1	35	PUL3+	Pulse signal of Axis 3
2	PUL1-		36	PUL3-	
3	DIR1+	Direction signal of Axis 1	37	DIR3+	Direction signal of Axis 3
4	DIR1-		38	DIR3-	
5	PUL2+	Pulse signal of Axis 2	39	PUL4+	Pulse signal of Axis 4
6	PUL2-		40	PUL4-	
7	DIR2+	Direction signal of Axis 2	41	DIR4+	Direction signal of Axis 4
8	DIR2-		42	DIR4-	

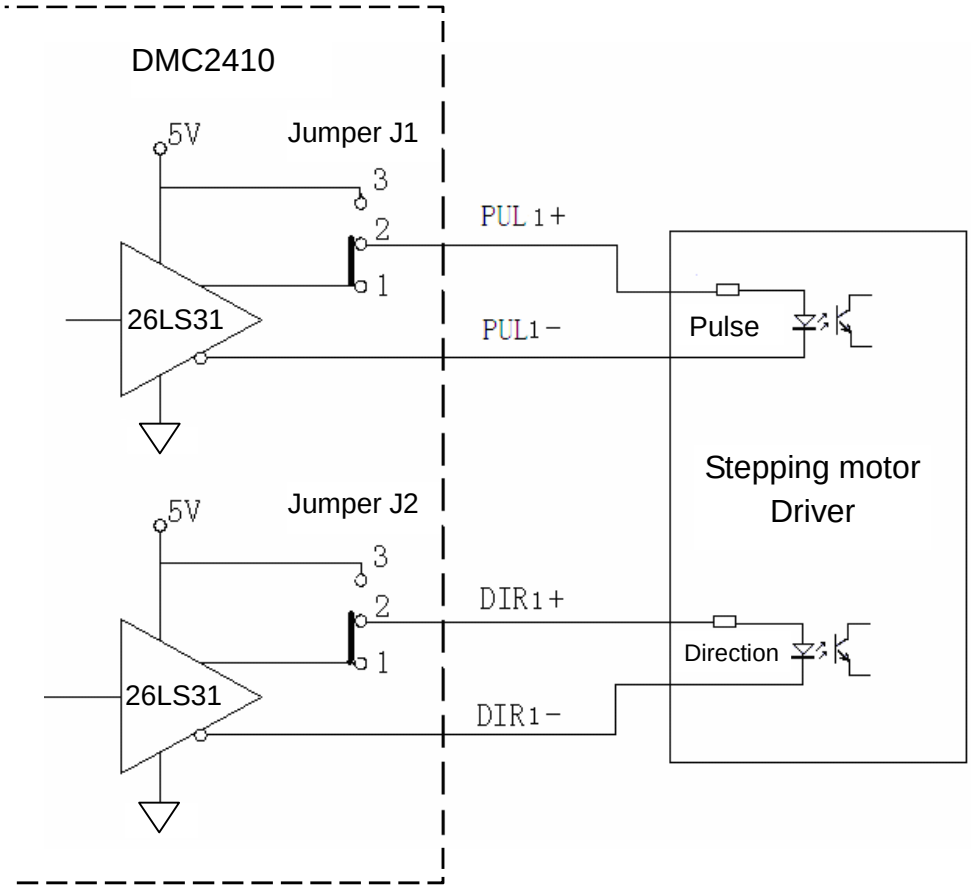

Figure 5.1 The differential line driver mode of PUL/DIR

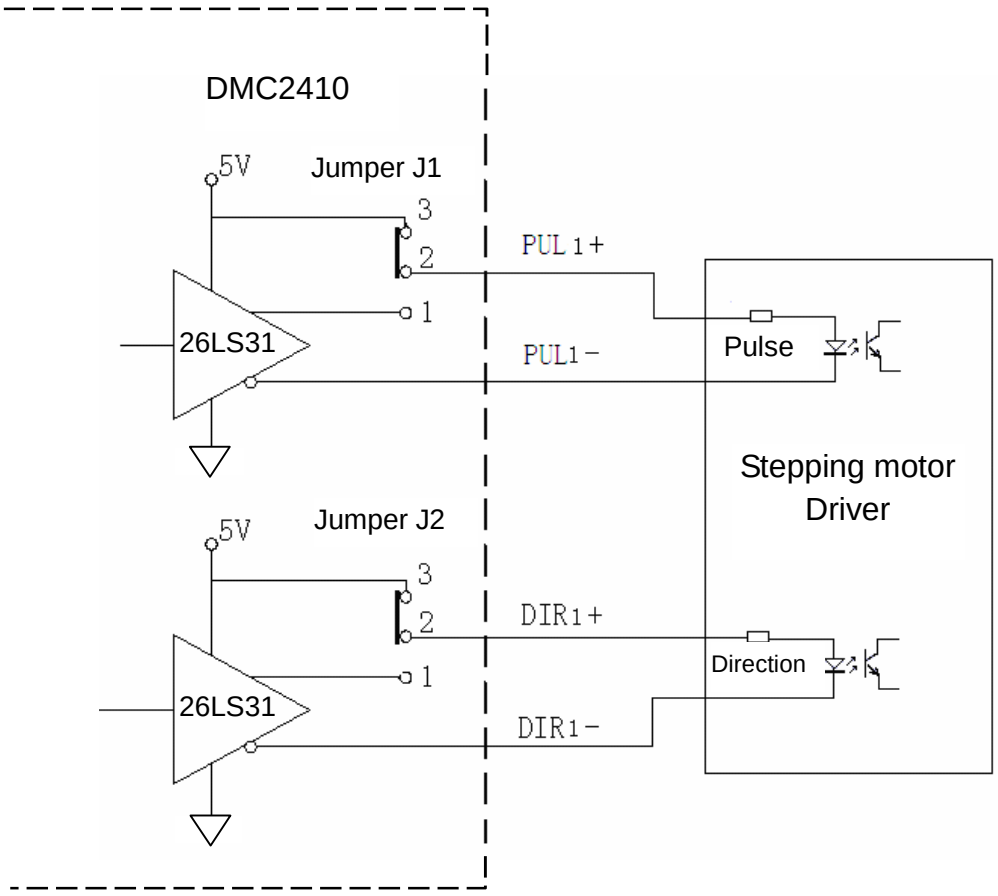

Figure 5.2 The single-ended output mode of PUL/DIR

Note: 1. Using the differential line driver mode, the card's ability of anti-interference is better, the transfer distance of signals will be farther.

2. Please take care that the current sink to OUT- and DIR- pins must not exceed 20mA.

5.2 Origin Signal ORG

There are an opto-isolation and a filter in the input circuit of the origin signal ORG, shown as Figure 5.3. The opto-isolation can isolate the interference signals in exterior power supply, and the filter can filtrate high frequency noise signals, so that the reliability of DMC2410 is better. The relative signal name, pin number and axis number are shown in the table 5.2.

Table 5.2 Origin Signal List

X1 Pin	Name	Description	X1 Pin	Name	Description
25	ORG1	Origin signal of Axis 1	59	ORG3	Origin signal of Axis 1
32	ORG2	Origin signal of Axis 2	66	ORG4	Origin signal of Axis 4

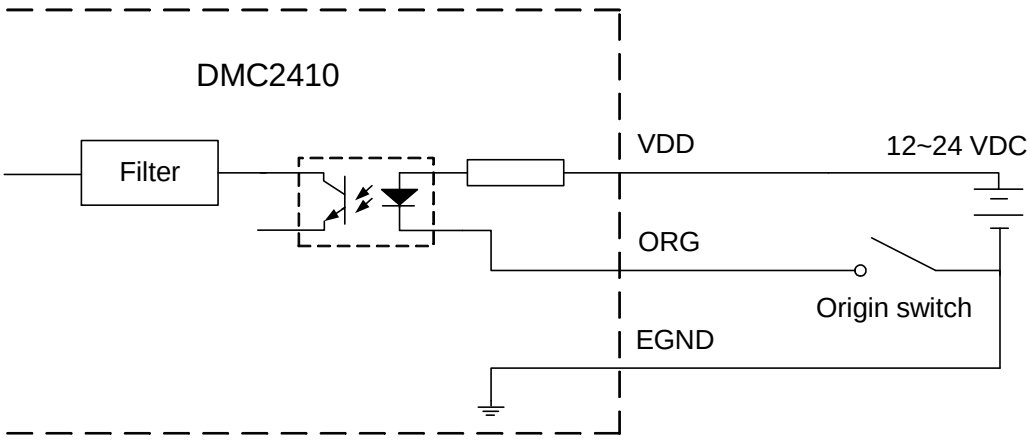

Figure 5.3 ORG signal input circuit

5.3 Slow-down signal SD

After DMC2410 get a SD (Slow-down) signal, the motor's speed of this Axis will be ramping-down. SD signal inputs to the ASIC after passed an opto-isolation and a filter, its input circuit is shown as Figure 5.4. The relative signal name, pin number and axis number are shown in the table 5.3.

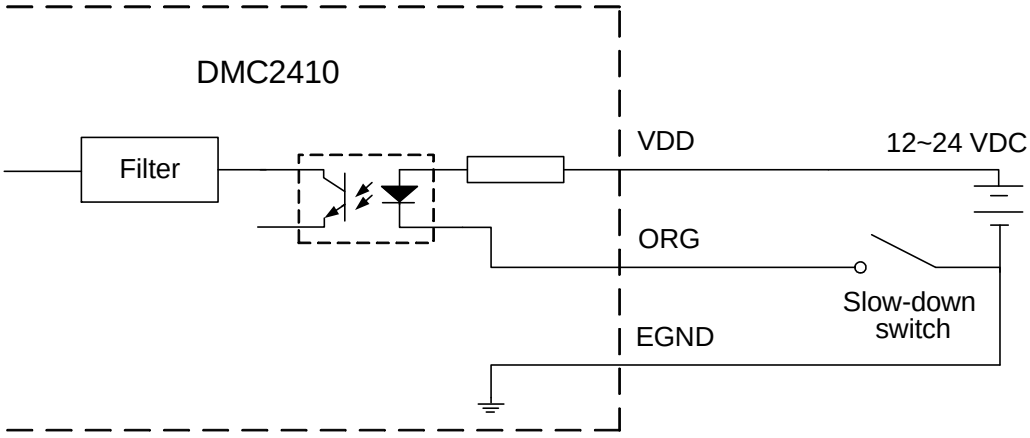

Figure 5.4 SD signal input circuit

Table 5.3 SD signals List

X1 Pin	Name	Description	X1 Pin	Name	Description
24	SD1	SD signal of Axis 1	58	SD3	SD signal of Axis 3
31	SD2	SD signal of Axis 2	65	SD4	SD signal of Axis 4

5.4 Limit signals EL±

There are two end-limit signals EL＋ and EL－ for one axis. EL＋ indicates end limit signal in plus direction and EL－ indicates end limit signal in minus direction. EL± signals input to the ASIC after passed an opto-isolation and a filter, its input circuit shown as Figure 5.5. The relative signal name, pin number and axis number are shown in the table 5.4.

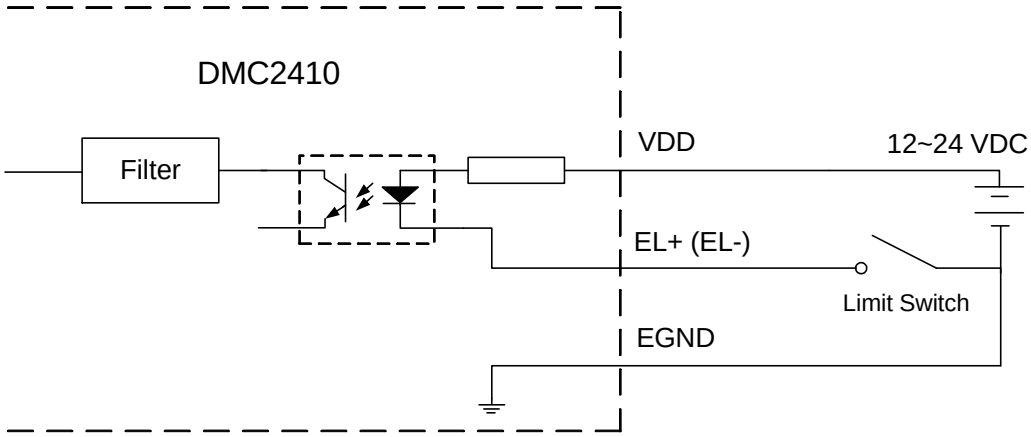

Figure 5.5 EL± signal input circuit

Table 5.4 Limit signals List

X1 Pin	Name	Description	X1 Pin	Name	Description
22	EL1+	Positive direction limit of Axis 1	56	EL3+	Positive direction limit of Axis 3
23	EL1-	Negative direction limit of Axis 1	57	EL3-	Negative direction limit of Axis 3
29	EL2+	Positive direction limit of Axis 2	63	EL4+	Positive direction limit of Axis 4
30	EL2-	Negative direction limit of Axis 2	64	EL4-	Negative direction limit of Axis 4

The effective level of EL± can be set by software. If a normally opened contact switch is used as the limit sensor, the effective level of EL± should be set low level. If a normally closed contact switch is used as the limit sensor, the effective level of EL± should be set high level.

5.5 Encoder signal EA, EB and EZ

The encoder signals include 3 pair's differential signals EA, EB and EZ, EA is phase-A signal, EB is phase-B signal, and EZ is index signal. The EA and EB are used for position counting; the EZ is used for the origin position index. After passed a 26LS32, the differential signal is converted and input to the ASIC. The input circuit of the EA (EB, EZ) signals is shown as Figure 5.6.

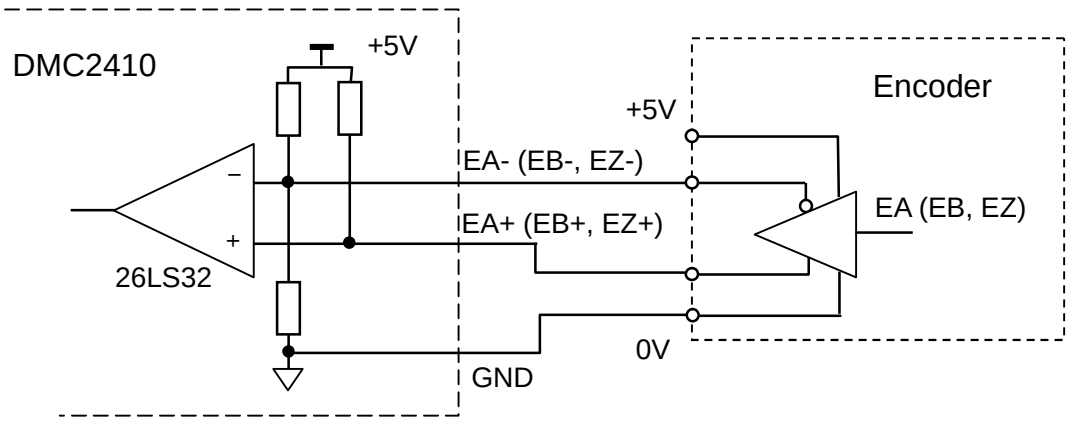

Figure 5.6 Encoder signal input circuit

If an encored which is open collector output is used, the output of the encoder should connect to EA+ (EB+, EZ+), and EA-(EB-, EZ-) not need to connect.

Note: 1. the differential signals EA±, EB± and EZ± of encoder output voltage should be higher than 3.5V and less than 5V, its current should be more than 6mA.
2. The ground of the encoder must be connected to the GND of DMC2410.

The encoder's signal names, pin numbers and the axis number are shown in the table 5.5.

Table 5.5 Encoder input signals List

X2 Pin	Name	Description	X2 Pin	Name	Description
3	EA1+	A-phase of Axis 1	12	EA3+	A-phase of Axis 3
4	EA1-		13	EA3-	
5	EB1+	B-phase of Axis 1	14	EB3+	B-phase of Axis 3
6	EB1-		15	EB3-	
7	EZ1+	Z signal of Axis 1	16	EZ3+	Z signal of Axis 3
8	EZ1-		17	EZ3-	
21	EA2+	A-phase of Axis 2	30	EA4+	A-phase of Axis 4
22	EA2-		31	EA4-	
23	EB2+	B-phase of Axis 2	32	EB4+	B-phase of Axis 4
24	EB2-		33	EB4-	
25	EZ2+	Z signal of Axis 2	18	EZ4+	Z signal of Axis 4
26	EZ2-		35	EZ4-	

5.6 Position capture signal LTC

The DMC2410 supports 4 position capture signals LTC for 4 axes. The LTC signal triggers a position Latch to capture the current motor position from the encoder or the command position register. The input circuit of the LTC signals is shown as Figure 5.7. The relative signal name, pin number and axis number are shown in the table 5.6.

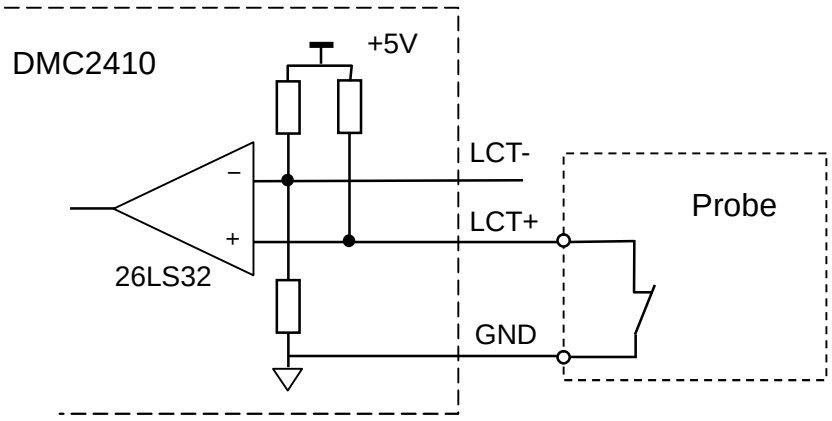

Figure 5.7 LCT signal input circuit

Table 5.6 Position capture signals List

X2 Pin	Name	Description	X3 Pin	Name	Description
34	LTC1+	Position capture of Axis 1	19	LTC3+	Position capture of Axis 3
9	LTC1-		20	LTC3-	
27	LTC2+	Position capture of Axis 2	17	LTC4+	Position capture of Axis 4
28	LTC2-		18	LTC4-	

LTC1~LTC4 can capture the position of 4 axes separately, and LTC1 signal also can capture the position of 4 axes at the same time, which function should use software to setup.

5.7 Position compare signal CMP

DMC2410 provide two positions of an axis for the position compare. When the current position of the axis, which position is read from its encoder or its command position register, is equal or less or more than the positions which setting by program, the CPM pin will output a signal to indicate that a position compare event has occurred. The output circuit of the CMP signal is shown as Figure 5.8. The relative signal name, pin number and axis number are shown in the table 5.7.

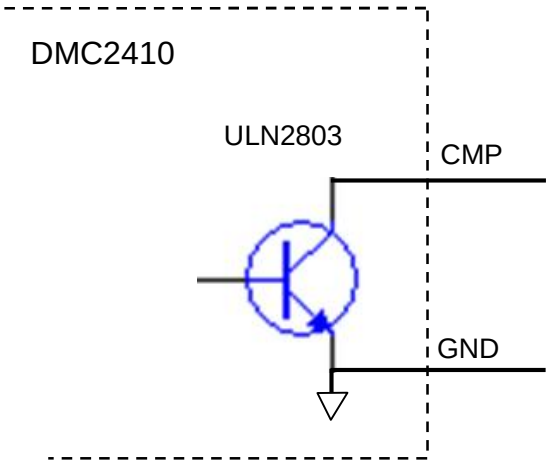

Figure 5.8 CMP signal output circuit

Table 5.7 Position compare signals List

X1 Pin	Name	Description	X3 Pin	Name	Description
15	CMP 1	1st position compare point of Axis 1	33	CMP1’	2nd position compare point of Axis 1
16	CMP 2	1st position compare point of Axis 2	34	CMP2’	2nd position compare point of Axis 2
49	CMP 3	1st position compare point of Axis 3	35	CMP3’	2nd position compare point of Axis 3
50	CMP 4	1st position compare point of Axis 4	36	CMP4’	2nd position compare point of Axis 4

5.8 Position change signal PCS

DMC2410 have 4 position change signals PCS for each axis. When a motion command is running, PCS signal can trigger the ASIC to change the object position of current command; the new object position is set by next command. The input circuit of the PCS signal is shown as Figure 5.9. The relative signal name, pin number and axis number are shown in the table 5.8.

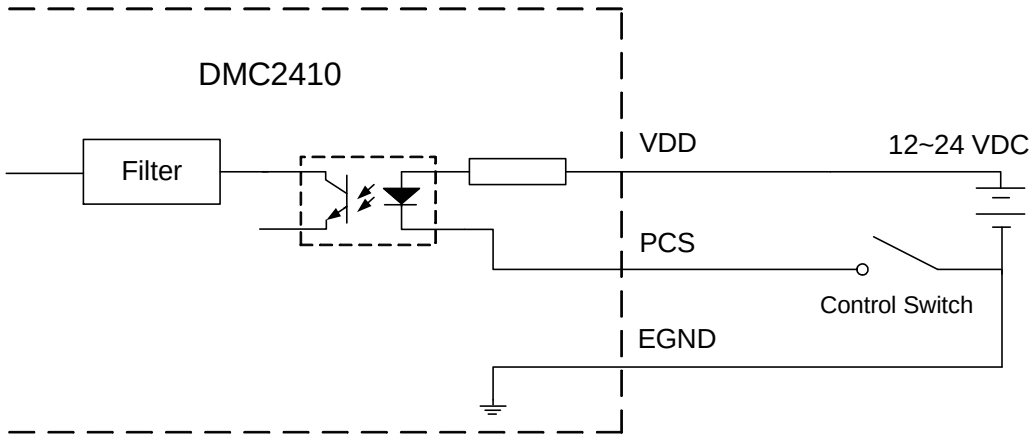

Figure 5.9 PCS signal input circuit

Table 5.8 Position change signals List

X1 Pin	Name	Description	X1 Pin	Name	Description
24	PCS1	Position change signal of Axis 1	58	PCS3	Position change signal of Axis 3
31	PCS2	Position change signal of Axis 2	65	PCS4	Position change signal of Axis 4

If the PCS function is not be used, the PCS port can be use as general digital signal input.

5.9 General digital input signal INPUT

DMC2410 provide 20 general digital input signal, which can be use to input switches, sensors, and other signals. There is an opto-isolation in the input circuit of the INPUT signal; its input circuit is shown as Figure 5.10. The relative signal name, pin number and axis number are shown in the table 5.9.

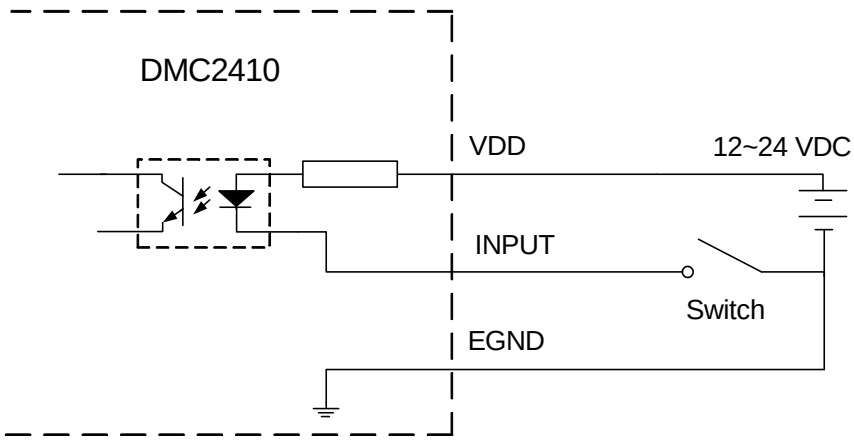

Figure 5.10 INPUT signal input circuit

Table 5.9 General digital input signals List

X1 Pin	Name	X3 Pin	Name	X3 Pin	Name
17	INPUT 1	1	INPUT 5	9	INPUT 13
18	INPUT 2	2	INPUT 6	10	INPUT 14
51	INPUT 3	3	INPUT 7	11	INPUT 15
52	INPUT 4	4	INPUT 8	12	INPUT 16
		5	INPUT 9	13	INPUT 17
		6	INPUT 10	14	INPUT 18
		7	INPUT 11	15	INPUT 19
		8	INPUT 12	16	INPUT 20

5.10 General digital output signal OUT

DMC2410 provide 20 general digital output signal, which can be use to control relay, electromagnetic valve, signal lamp and other devices. The output signals are driven by ULN2803 Chips. The outputs are designed to sink current from an external supply (typically 24 V dc), but have no overcurrent or short circuit protection. When an output is activated, it is grounded through the ULN2803, as Figure 5.11 shown.

The relative signal name, pin number and axis number are shown in the table 5.10.

Table 5.10 General digital output signals List

X1 Pin	Name	X3 Pin	Name	X3 Pin	Name
9	OUT1	21	OUT5	29	OUT13
10	OUT2	22	OUT6	30	OUT14
43	OUT3	23	OUT7	31	OUT15
44	OUT4	24	OUT8	32	OUT16
		25	OUT9	33	OUT17
		26	OUT10	34	OUT18
		27	OUT11	35	OUT19
		28	OUT12	36	OUT20

The initial level of OUT1～OUT12 can be set high or low by using the Switch S1, detail as section 3.3. The initial level of OUT13～OUT20 are high, which can not be selected.

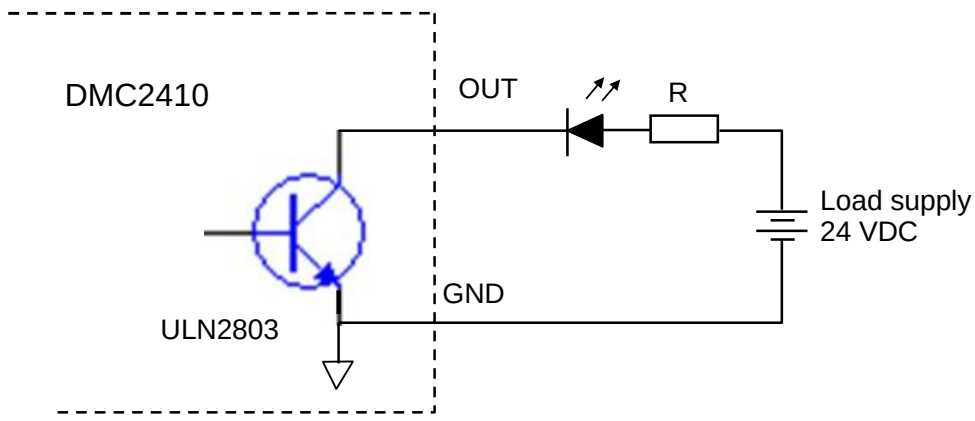

Figure 5.11 OUT signal control a LED

The general digital output signals of DMC2410 control some typical devices are shown

as following:

1. Control a LED

The current of LED should be about 10 mA, the resistor is 2 kΩ when the load supply is 24V DC. The circuit is shown as Figure 5.11.

2. Control an incandescent lamp

For enhance the life of the lamp, it is better to parallel a resistor R, as the Figure 5.12 shown. The method of selecting the resistance of R is when the output signal is low; the lamp will not be light.

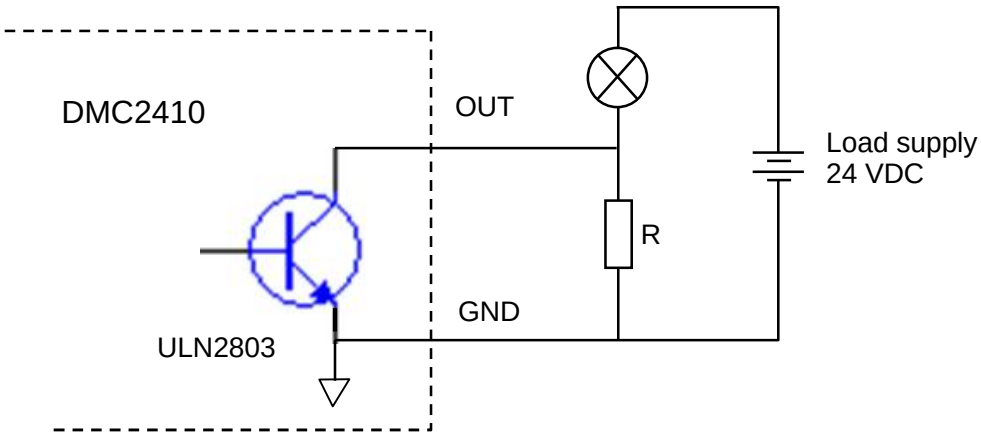

Figure 5.12 OUT signal control a LED

3. Control a relay

Relay is inductance component. For protecting ULN2803, a leak diode should be used, as the Figure 5.13 shown.

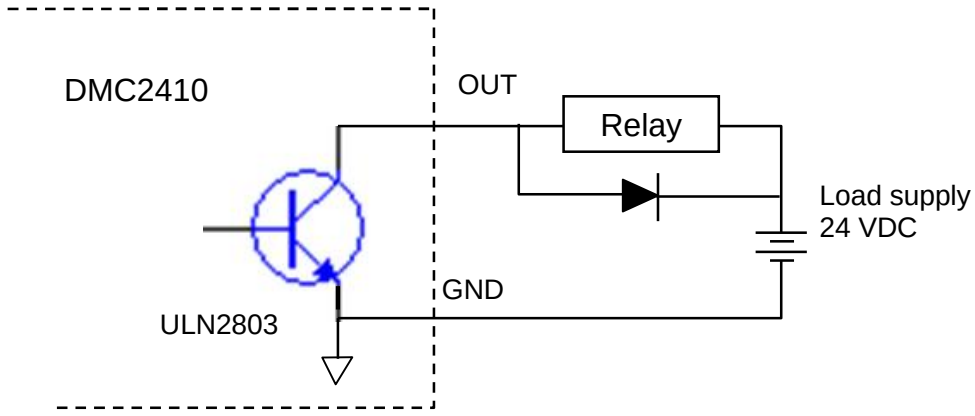

Figure 5.13 OUT signal control a relay

Warning: 1. the ground of the load supply must be connected to the GND of DMC2410.
2. The load supply can not be connected to the OUT of DMC2410 directly.

5.11 AC servo motor control signals

5.11.1 Input signals of ALM, INP, and RDY

Servo alarm ALM, servo in-position INP and servo ready RDY signals are 3 state signals of AC servo motor driver, which input to DMC2410. There is an opto-isolation in the input circuit of the INPUT signal; its input circuit is shown as Figure 5.14. The relative signal name, pin number and axis number are shown in the table 5.11, 5.12, 5.13.

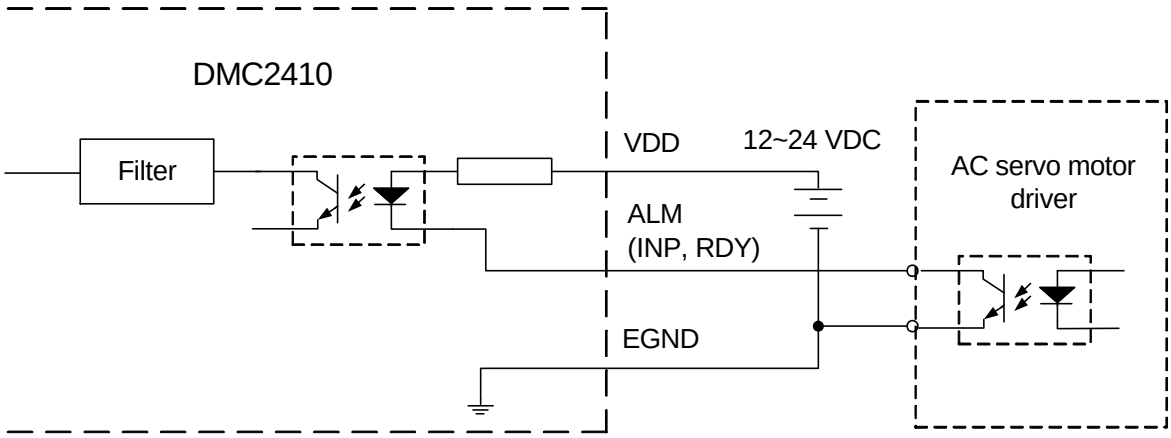

Figure 5.14 ALM, INP and RDY signals input circuit

Table 5.11 Servo alarm signal List

X1 Pin	Name	Description	X1 Pin	Name	Description
19	ALM1	Servo alarm signal of Axis 1	53	ALM3	Servo alarm signal of Axis 3
26	ALM2	Servo alarm signal of Axis 2	60	ALM4	Servo alarm signal of Axis 4

Table 5.12 Servo in-position signal List

X1 Pin	Name	Description	X1 Pin	Name	Description
20	INP1	Servo in-position signal of Axis 1	54	INP3	Servo in-position signal of Axis 3
27	INP2	Servo in-position signal of Axis 2	61	INP4	Servo in-position signal of Axis 4

Table 5.13 Servo ready signal List

X1 Pin	Name	Description	X1 Pin	Name	Description
21	RDY1	Servo ready signal of Axis 1	55	RDY3	Servo ready signal of Axis 1
28	RDY 2	Servo ready signal of Axis 2	62	RDY4	Servo ready signal of Axis 2

Note: If port INP and RDY is not be used for a servo motor, the port INP and RDY can be used as a general digital input port.

5.11.2 Output signals of SEVON、ERC

Servo on SEVON, servo deflection counter clear ERC signals are 2 control signals of

DMC2410 for AC servo motor driver, which are driven by ULN2803 as Figure 5.15, shown. The relative signal name, pin number and axis number are shown in the table 5.14, 5.15.

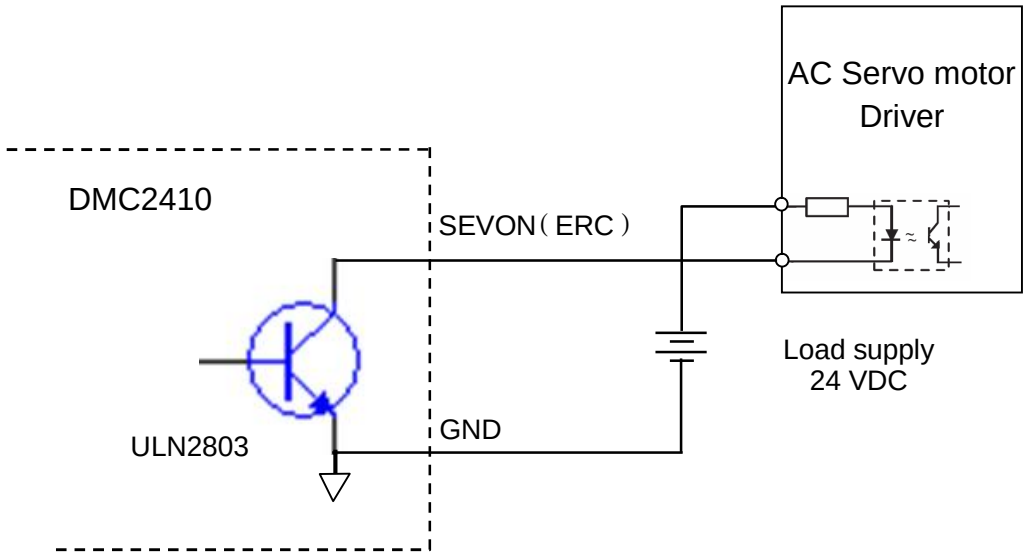

Figure 5.15 SEVON, ERC signals output circuit

Table 5.14 Servo on signal List

X1 Pin	Name	Description	X1 Pin	Name	Description
11	SEVON1	Servo on signal of Axis 1	45	SEVON3	Servo on signal of Axis 3
12	SEVON2	Servo on signal of Axis 2	46	SEVON4	Servo on signal of Axis 4

Table 5.15 Servo deflection counter clear signal List

X1 Pin	Name	Description	X1 Pin	Name	Description
13	ERC1	Servo deflection counter clear signal of Axis 1	47	ERC3	Servo deflection counter clear signal of Axis 3
14	ERC2	Servo deflection counter clear signal of Axis 1	48	ERC4	Servo deflection counter clear signal of Axis 4

Note: If port SEVON is not be used for a servo motor, the port SEVON can be used as a general digital output port.

5.12 External pulse control signals PA and PB

DMC2410 can accept external pulse signals such as a manual pulser to control motors' motion. DMC2410 control the distance and speed of motors depend on the number and frequency of the pulse, which input from connector X5. The external pulse control signals input circuit is shown as Figure 5.16. The relative signal name, pin number and axis number are shown in the table 5.16.

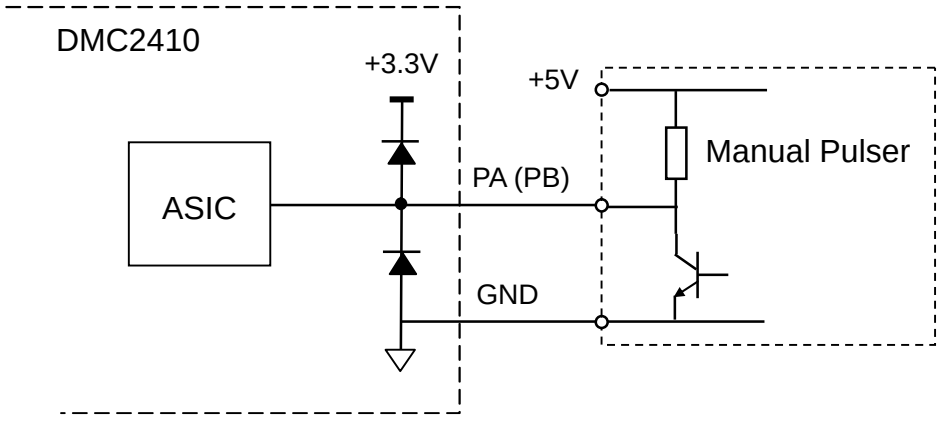

Figure 5.16 The external pulse control signals input circuit

Table 5.16 Manual pulser input signals List

X5 Pin	Name	Description	X5 Pin	Name	Description
2	PA1	manual pulser signal of Axis 1	8	PA3	manual pulser signal of Axis 3
3	PB1		9	PB3	
4	PA2	manual pulser signal of Axis 2	10	PA4	manual pulser signal of Axis 1
5	PB2		11	PB4	

5.13 Emergency Stop input signal EMG

If the Emergency Stop signal EMG of DMC2410 is active, all output pulses which control motors moving are stopped. The input circuit of the Emergency Stop signal is shown as Figure 5.17.

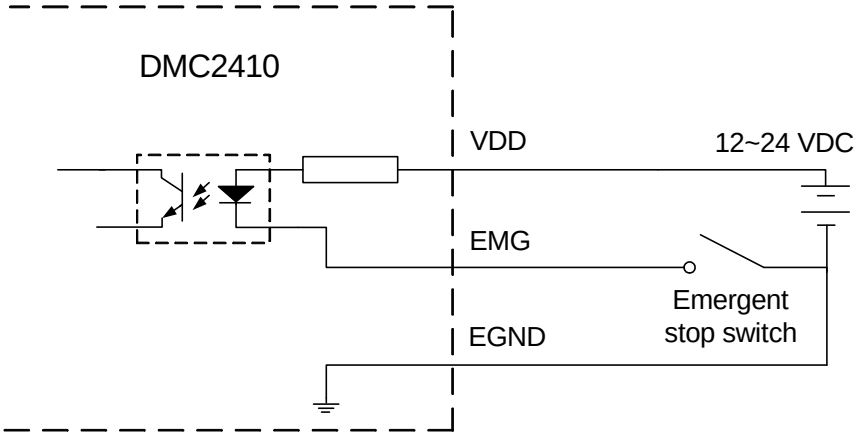

Figure 5.16 The Emergency Stop signal input circuit

Chapter 6 Applications of DMC2410

6.1 Connect to stepping motor driver

(1) DMC2410 connects to a stepping motor driver with single-ended signal input

For example, DMC2410 connects to LeadShine stepping motor driver M415B as Figure 6.1 shown.

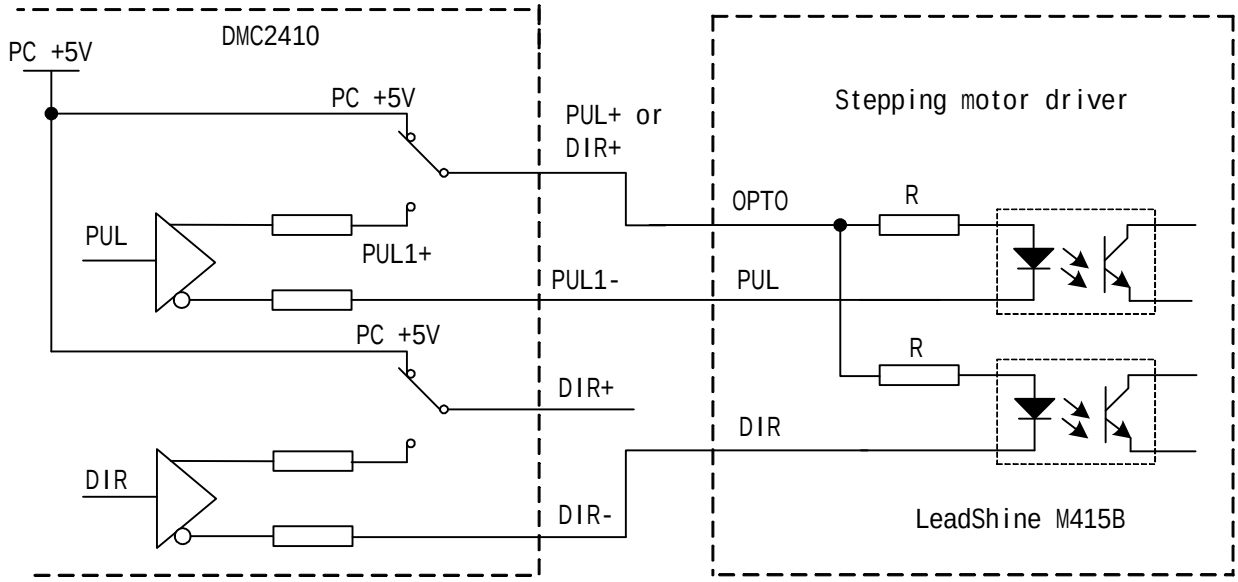

Figure 6.1 DMC2410 connects to a stepping motor driver with single-ended signal input

(2) DMC2410 connects to a stepping motor driver with differential signal input

For example, DMC2410 connects to LeadShine stepping motor driver MD556 as Figure 6.2 shown.

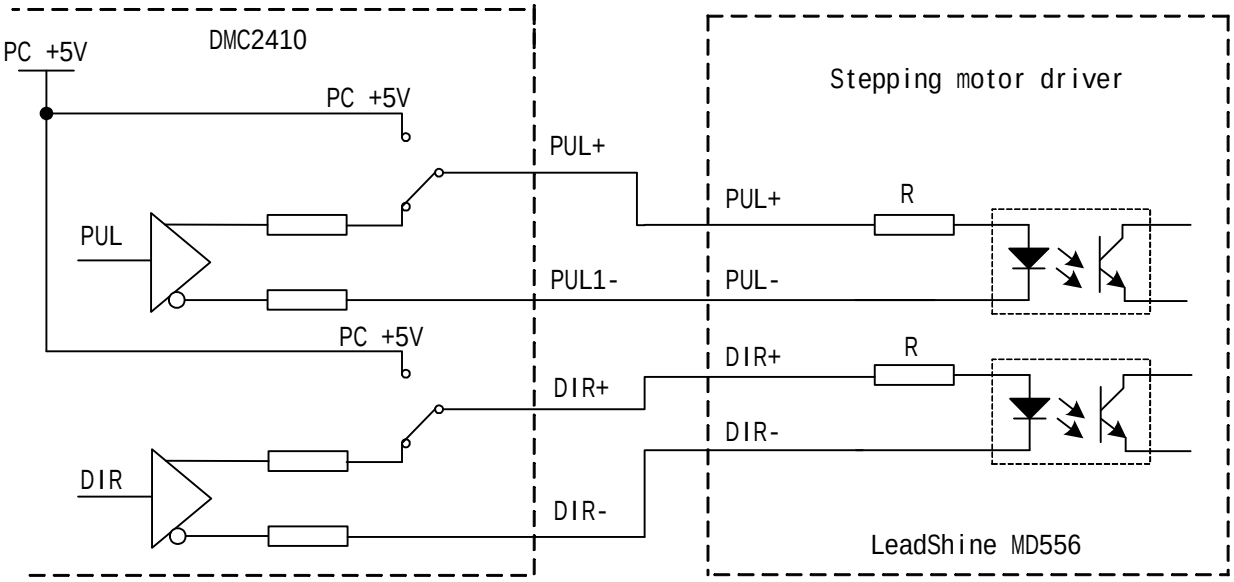

Figure 6.2 DMC2410 connects to a stepping motor driver with differential signal input

6.2 Connect to AC servo motor driver

DMC2410 connects to an AC servo motor driver as Figure 6.3 shown.

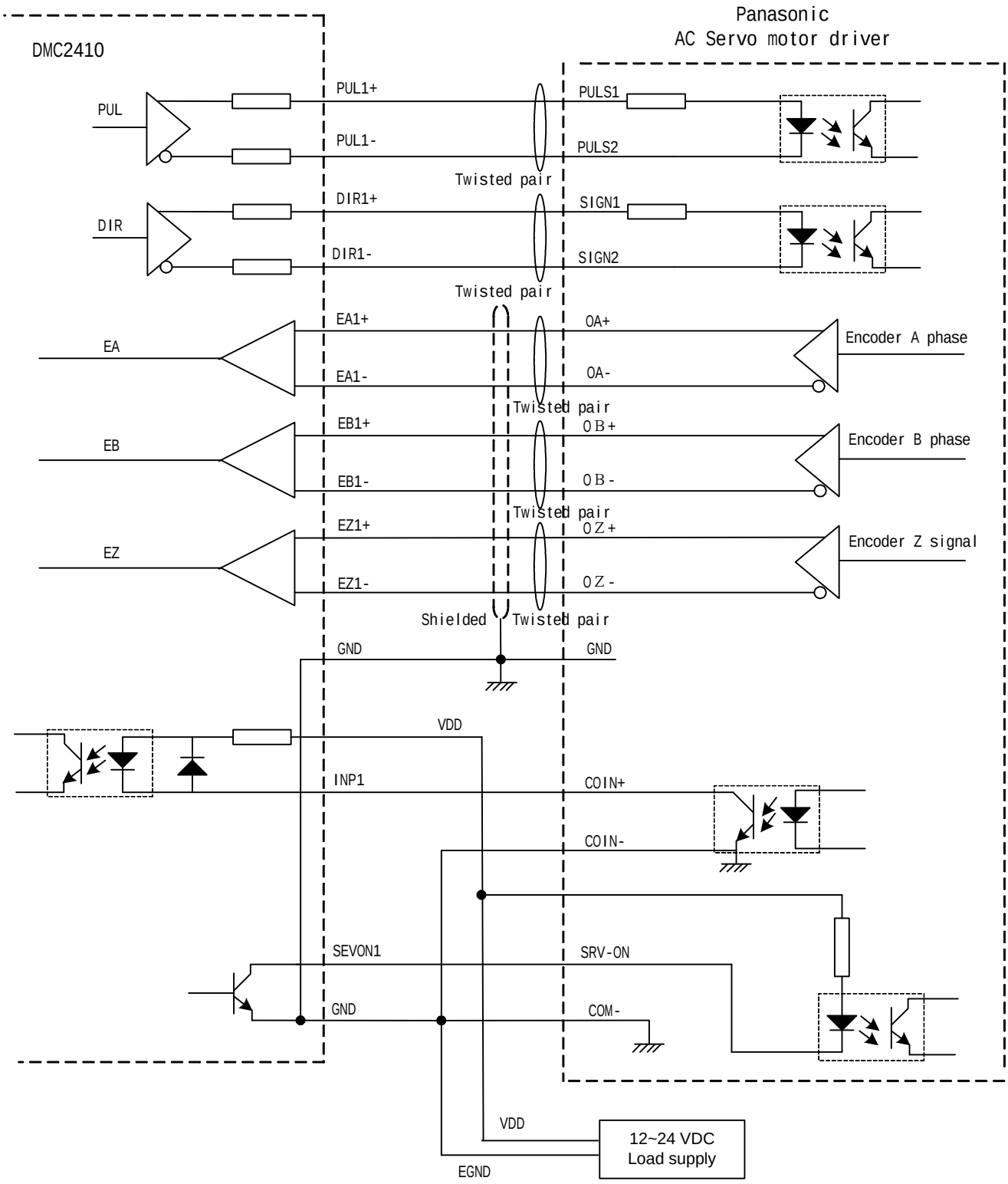

Figure 6.3 DMC2410 connects to AC servo motor driver

6.3 Connect to Approach switch

DMC2410 connects to an OMRON approach switch TL-Q5MC2 as Figure 6.4 shown.

(Approach switch TL-Q5MC2 is a NPN type, open collector output, supply is 12~24 VDC)

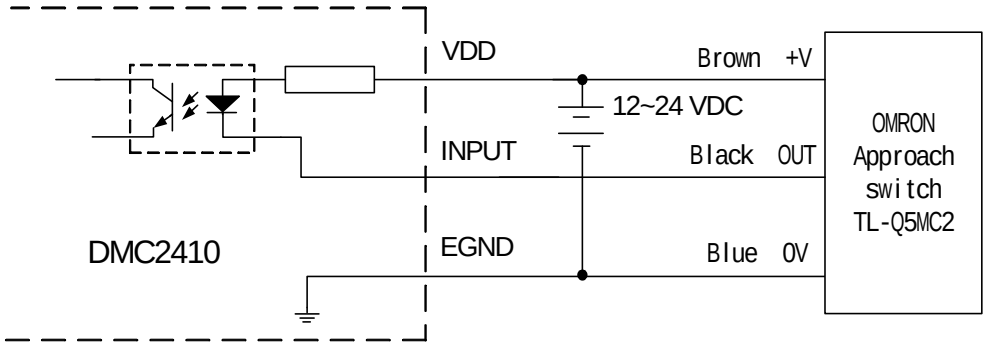

Figure 6.4 DMC2410 connects to a approach switch

6.4 Connect to photoelectric sensor

DMC2410 connects to a photoelectric sensor RG150-8 as Figure 6.5 shown.

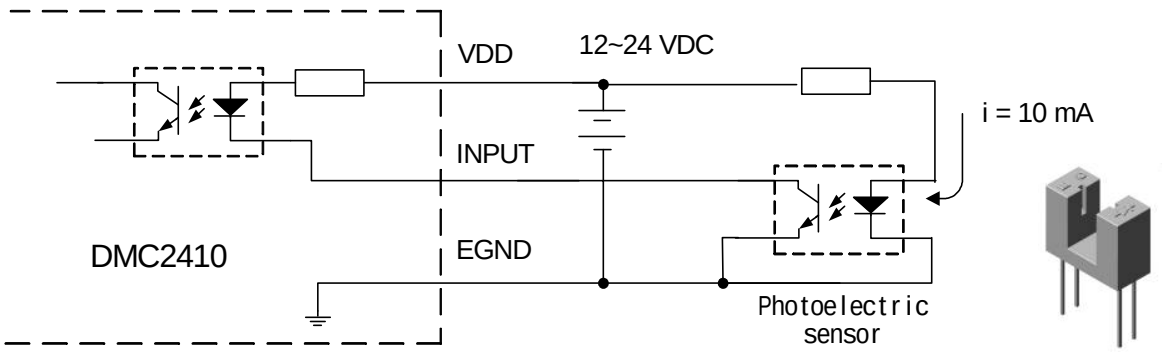

Figure 6.5 DMC2410 connects to a photoelectric sensor

6.5 Connect to relay

DMC2410 connects to OMRON relay LY1J as Figure 6.6 shown. Because relay is an inductance load, a diode must be paralleled with the coil of the relay for protecting the output driver ULN2803 of DMC2410.

(OMRON relay LY1J's coil voltage is 24 VDC, the maximum voltage of the switch is 250 VAC or 25 VDC, the maximum current of the switch is 15 A)

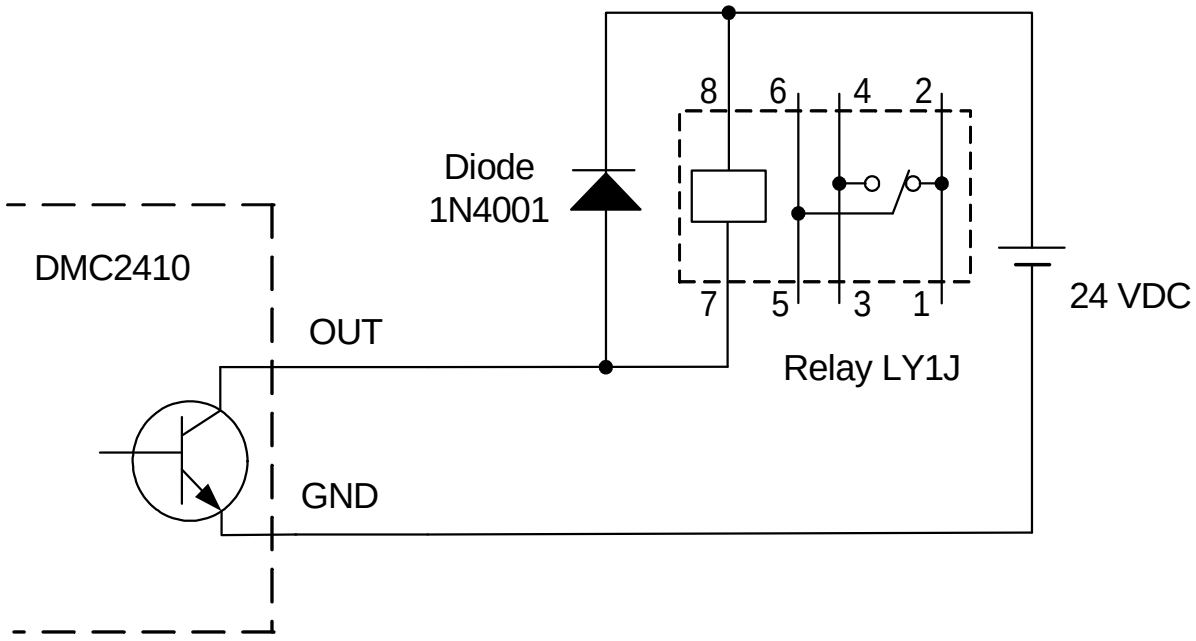

Figure 6.6 DMC2410 connects to OMRON relay LY1J

Chapter 7 Specification of DMC2410

Motor control output signals：

Description	Value
Pulse Max. output frequency	5 MHz
Pulse output type	RE422, step and direction
Pulse output Max. current	100 mA (sink)

Encoder input signals:

Description	Value
Encoder input	RS422, A/B differential , Z index
Maximum input frequency	4 MHz

External pulse control signals:

Input signals	PA, PB	
Max. input frequency	100 Hz	
Input voltage (TTL)	Low	Max. 0.8 V
	High	Min. 2.4 V

Digital input / output signals:

Input signal	Max. input frequency	4 KHz
	input current	12 mA (typical)
	Protect	2500 VDC opto-isolating, RC filter
Output signal	output voltage	5~40 VDC, open collector output
	Max. current	100 mA, sink

Connector X1 pin assignment:

Pin	Name	I/O	Description	Pin	Name	I/O	Description
1	PUL1+	O	Pulse signal(+) of Axis 1	35	PUL3+	O	Pulse signal(+) of Axis 3
2	PUL1-	O	Pulse signal(-) of Axis 1	36	PUL3-	O	Pulse signal(-) of Axis 3
3	DIR1+	O	Direction signal(+) of Axis 1	37	DIR3+	O	Direction signal(+) of Axis 3
4	DIR1-	O	Direction signal(-) of Axis 1	38	DIR3-	O	Direction signal(-) of Axis 3
5	PUL2+	O	Pulse signal(+) of Axis 2	39	PUL4+	O	Pulse signal(+) of Axis 4
6	PUL2-	O	Pulse signal(-) of Axis 2	40	PUL4-	O	Pulse signal(-) of Axis 4
7	DIR2+	O	Direction signal(+) of Axis 2	41	DIR4+	O	Direction signal(+) of Axis 4
8	DIR2-	O	Direction signal(-) of Axis 2	42	DIR4-	O	Direction signal(-) of Axis 4
9	OUT1	O	General output 1	43	OUT3	O	General output 3
10	OUT2	O	General output 2	44	OUT4	O	General output 4
11	SEVON1	O*	Servo On signal of Axis 1	45	SEVON3	O*	Servo On signal of Axis 3
12	SEVON2	O*	Servo On signal of Axis 2	46	SEVON4	O*	Servo On signal of Axis 4
13	ERC1	O	Deflection counter clear signal of Axis 1	47	ERC3	O	Deflection counter clear signal of Axis 3
14	ERC2	O	Deflection counter clear signal of Axis 2	48	ERC4	O	Deflection counter clear signal of Axis 4
15	CMP1	O*	Position compare signal of Axis 1	49	CMP3	O*	Position compare signal of Axis 3

16	CMP2	O*	Position compare signal of Axis 2	50	CMP4	O*	Position compare signal of Axis4
17	INPUT1	I	General input 1	51	INPUT3	I	General input 3
18	INPUT2	I	General input 2	52	INPUT4	I	General input 4
19	ALM1	I	Servo alarm signal of Axis 1	53	ALM3	I	Servo alarm signal of Axis 3
20	INP1	I*	Servo in-position signal of Axis 1	54	INP3	I*	Servo in-position signal of Axis 3
21	RDY1	I*	Servo ready signal of Axis 1	55	RDY3	I*	Servo ready signal of Axis 3
22	EL1+	I	Positive End limit signal of Axis 1	56	EL3+	I	Positive End limit signal of Axis 3
23	EL1-	I	Negative End limit signal of Axis 1	57	EL3-	I	Negative End limit signal of Axis 3
24	SD1/PCS1	I*	Slow-down signal of Axis 1	58	SD3/PCS3	I*	Slow-down signal of Axis 3
25	ORG1	I	Origin signal of Axis 1	59	ORG3	I	Origin signal of Axis 3
26	ALM2	I	Servo alarm signal of Axis 2	60	ALM4	I	Servo alarm signal of Axis 4
27	INP2	I*	Servo in-position signal of Axis 2	61	INP4	I*	Servo in-position signal of Axis 4
28	RDY2	I*	Servo ready signal of Axis 2	62	RDY4	I*	Servo ready signal of Axis 4
29	EL2+	I	Positive End limit signal of Axis 2	63	EL4+	I	Positive End limit signal of Axis 4
30	EL2-	I	Negative End limit signal of Axis 2	64	EL4-	I	Negative End limit signal of Axis 4
31	SD2/PCS2	I*	Slow-down signal of Axis 2	65	SD4/PCS4	I*	Slow-down signal of Axis 4
32	ORG2	I	Origin signal of Axis 2	66	ORG4	I	Origin signal of Axis 4
33	VDD	I	+12V-+24V supply for user's I/O	67	GND		PC ground signal
34	EGND		user's supply ground	68	EMG	I	Emergency stop (for all axis)

Note: the pin with sign * can be used as general I/O when its function is disable.

Connector X2 pin assignment:

Pin	Name	I/O	Description	Pin	Name	I/O	Description
1	5V		PC supply 5V	20	GND		PC supply ground
2	GND	I	PC supply ground	21	EA2+	I	Encoder A-phase (+) of Axis 2
3	EA1+	I	Encoder A-phase (+) of Axis 1	22	EA2-	I	Encoder A-phase (-) of Axis 2
4	EA1-	I	Encoder A-phase (-) of Axis 1	23	EB2+	I	Encoder B-phase (+) of Axis 2
5	EB1+	I	Encoder B-phase (+) of Axis 1	24	EB2-	I	Encoder B-phase (-) of Axis 2
6	EB1-	I	Encoder B-phase (-) of Axis 1	25	EZ2+	I	Encoder Z signal (+) of Axis 2
7	EZ1+	I	Encoder Z signal (+) of Axis 1	26	EZ2-	I	Encoder Z signal (-) of Axis 2
8	EZ1-	I	Encoder Z signal (-) of Axis 1	27	LTC2+	I	Position capture (+) of Axis 2
9	LTC1-	I	Position capture (-) of Axis 1	28	LTC2-	I	Position capture (-) of Axis 2
10	5V		PC supply 5V	29	GND		PC supply ground
11	GND		PC supply ground	30	EA4+	I	Encoder A-phase (+) of Axis 4
12	EA3+	I	Encoder A-phase (+) of Axis 3	31	EA4-	I	Encoder A-phase (-) of Axis 4
13	EA3-	I	Encoder A-phase (-) of Axis 3	32	EB4+	I	Encoder B-phase (+) of Axis 4
14	EB3+	I	Encoder B-phase (+) of Axis 3	33	EB4-	I	Encoder B-phase (-) of Axis 4
15	EB3-	I	Encoder B-phase (-) of Axis 3	34	LTC1+	I	Position capture (+) of Axis 1
16	EZ3+	I	Encoder Z signal (+) of Axis 3	35	EZ4-	I	Encoder Z signal (-) of Axis 4
17	EZ3-	I	Encoder Z signal (-) of Axis 3	36	$\overline{\text{LTC1}}$	O	LTC1 invert output

18	EZ4+	I	Encoder Z signal (+) of Axis 4	37	$\overline{\text{LTC1}}$	O	LTC1 invert output
19	5V		PC supply 5V	38-40	GND		PC supply ground

Connector X3 pin assignment:

Pin	Name	I/O	Description	Pin	Name	I/O	Description
1	IN5	I	General input 5	20	LTC3-	I	Position capture (-) of Axis 3
2	IN6	I	General input 6	21	OUT5	O	General output 5
3	IN7	I	General input 7	22	OUT6	O	General output 6
4	IN8	I	General input 8	23	OUT7	O	General output 7
5	IN9	I	General input 9	24	OUT8	O	General output 8
6	IN10	I	General input 10	25	OUT9	O	General output 9
7	IN11	I	General input 11	26	OUT10	O	General output 10
8	IN12	I	General input 12	27	OUT11	O	General output 11
9	IN13	I	General input 13	28	OUT12	O	General output 12
10	IN14	I	General input 14	29	OUT13	O	General output 13
11	IN15	I	General input 15	30	OUT14	O	General output 14
12	IN16	I	General input 16	31	OUT15	O	General output 15
13	IN17	I	General input 17	32	OUT16	O	General output 16
14	IN18	I	General input 18	33	OUT17	O	General output 17/CMP1’
15	IN19	I	General input 19	34	OUT18	O	General output 18/CMP2’
16	IN20	I	General input 20	35	OUT19	O	General output 19/CMP3’
17	LTC4+	I	Position capture (+) of Axis 4	36	OUT20	O	General output 20/CMP4’
18	LTC4-	I	Position capture (-) of Axis 4	37/38	GND		PC supply ground
19	LTC3+	I	Position capture (+) of Axis 3	39/40	GND		PC supply ground

Connector X4 pin assignment:

Pin	Name	Description
1	GND	PC supply ground
2	STA	simultaneous start input/output
3	STP	simultaneous stop input/output
4	STA	simultaneous start input/output
5	STP	simultaneous stop input/output
6	CSD	simultaneous slow-down input/output
7	CSD	simultaneous slow-down input/output
8	+5V	PC supply 5V

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