

USBLMC_CUH_DIGIT_V1(2)_EN

USBLMC Client Use Handbook

Digital Board

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Safety During Installation And Operation

Please read these operating instruction completely before you proceed with installing and operating this product. If there are any questions regarding the contents of this manual, please contact BJJCZ.

1. Steps For Safe Operation

- Carefully check your application program before running it. Programming errors can cause a break down of the system. In this case neither the laser nor the scan head can be controlled.
- Protect the board from humidity, dust, corrosive vapors and mechanical stress.
- For storage and operation, avoid electromagnetic fields and static electricity. These can damage the electronics on the product. For storage, always use the antistatic bag.
- The allowed operating temperature range is $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$.
- The storage temperature should be between -20°C and $+60^{\circ}\text{C}$.

2. Laser Safety

- This product is intended for controlling a laser scan system. Therefore all relevant laser safety directives must be known and applied before installation and operation. The customer is solely responsible for ensuring the laser safety of the entire system.
- All applicable laser safety directives must be adhered to. Safety regulation may differ from country to country. It is the responsibility of the customer to comply with all local regulations.
- Please observe all laser safety instructions as described in you scan head or scan module manual, and this manual.
- **Always turn on the power of this product and the power supply for the scan head first before turning on the laser. Otherwise there is the danger of uncontrolled deflection of the laser beam.**
We recommend the use of a shutter to prevent uncontrolled emission of laser radiation.

I. Common Digital Module

1. Features

Galvo output signal is digital port.

Laser signal can be set as high-level available or lower-level available.

PWM signal provides differential drive pattern.

There are a total of 10 channels of common input signals, 7 channels of common output signals, and 1 channel of start signal. Among them, the input signals are classified to two groups, one group needing external power supply and the other not.

Outputs extend axis 1 and axis 2 step motor control signals.

Outputs two channels of analog volume to control power/frequency.

2. Definition of Output Socket

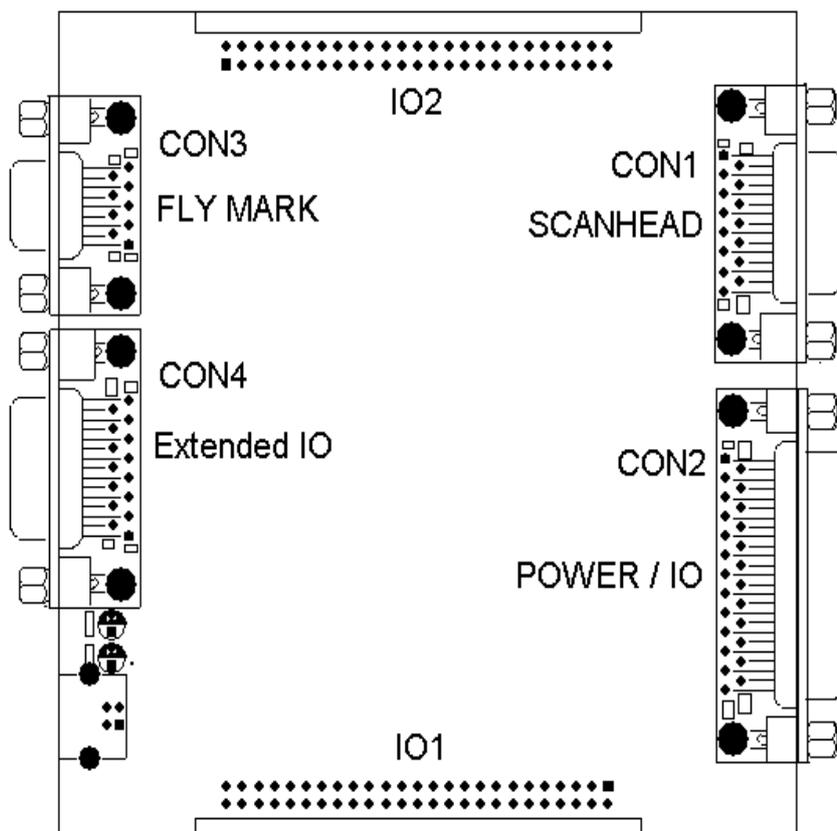


Fig. 1-1 Digital Module Illustration

3. Definition of Output Socket Pins

a. CON1:DB15 Galvo Output

Galvo signal is digital signal, which can be directly connected to digital galvo. Because the digital signal transfer protocols used in digital galvo are not exactly the same, it needs to be confirmed which type of protocols is used in digital galvo. The company also provides transfer modules transferring digital to analog. It is also feasible to be transferred to analog signals via the transfer module to output and connect analog galvo.

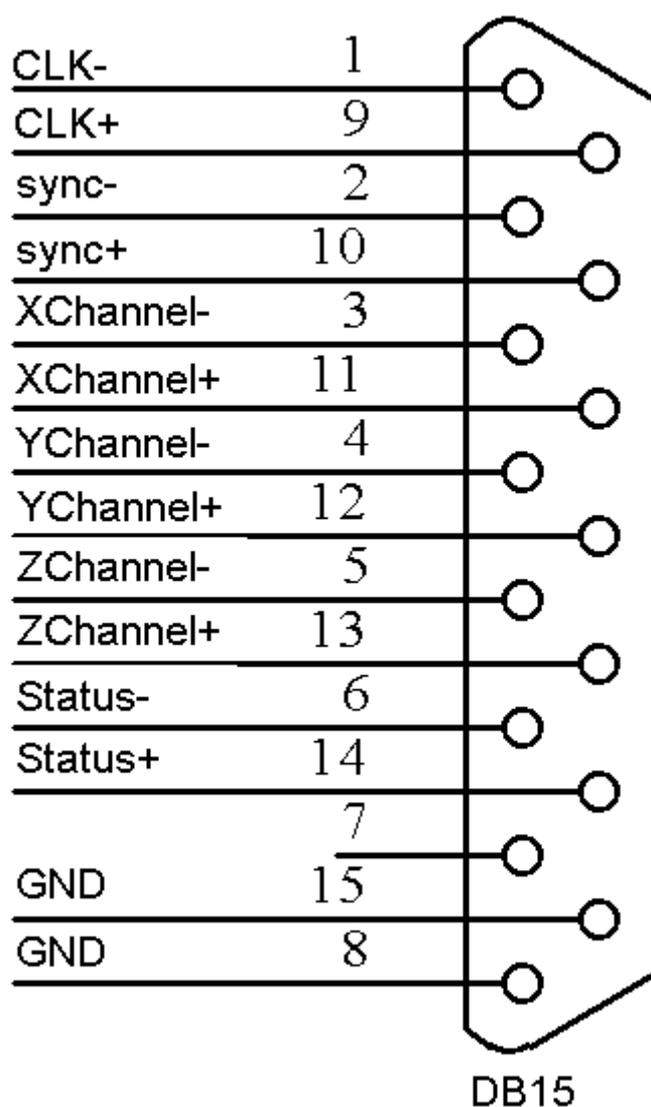


Fig. 1-2 CON1 of Digital interface board

PIN No.	Signals	Illustrations
1, 9	CLK-/CLK+	Clock signal. Differential output.

2, 10	SYNC-/ SYNC+	Synchronization signal. Differential output.
3, 11	XChannel-/ XChannel+	X-axis galvo data signal. Differential output.
4, 12	YChannel-/ YChannel+	Y-axis galvo data signal. Differential output.
5, 13	ZChannel-/ ZChannel+	Z-axis galvo data signal. Differential output.
6, 14	Status-/ Status+	Galvo status feedback signal. Differential input.
8, 15	Gnd	Control card's reference Ground.

For the commonly used 2-dimension galvo, just connect CLK (clock), SYNC (synchronization), XChannel and Ychannel signals, that is, a total of 8 signal cables for these 4 signals. For digital signals, double-twisted cables (like the commonly used internet cables) are recommended for connection.

b. CON2:DB25 Power/IO Socket

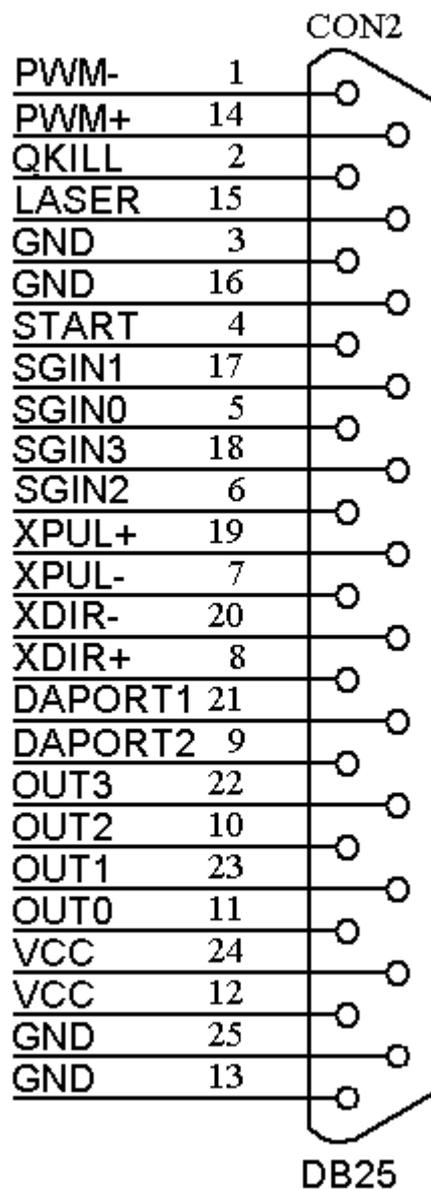


Fig. 1-3 CON2 of Digital interface board

PIN No.	Signals	Illustrations
1, 14	PWM-/PWM+	Differential output. For CO2 laser, this signal is used to set laser power and also as output of Tickle signal; for Yag laser, this signal is used for driver Q as repeat frequency signal. In addition, PWM+ along with pin25 Ground can form a high level efficiency output; PWM- along with pin25 Ground can form a low level efficiency output.
2	QKILL	First Pulse Killer signal. TTL output. Reference Ground

		signal is GND.
15	LASER	Laser switch signal. TTL output. Reference ground signal is GND. Can be set to high-level available or low-level available by jumper.
3, 13, 16, 25	GND	Control card reference Ground, also the reference Ground of control card's 5V input power. This signal is the reference Ground of all other signals of CON2 socket on digital module.
4	START	Start signal, which forms a return circuit with GND signal. To use this signal, just connect it and the GND signal respectively to either terminal of the switch. This is an input signal.
5, 17, 6, 18	SGIN0, SGIN1, SGIN2, SGIN3	Common input signals 0~3, which form a return circuit with GND signal. To use this signal, just connect it and the GND signal respectively to either terminal of the switch. This is an input signal. Please refer to "Connections of Switch Input Signals".
7, 19	XPUL-/ XPUL+	Pulse signal of extend axis X (step motor or servo motor). The output can be set either as differential output or as level output (TTL output). This is an output signal.
8, 20	XDIR+/ XDIR-	Direction signal of extend axis X (step motor or servo motor). The output can be set as differential output or level output (TTL output). This is an output signal.
9	DAPORT2	Frequency control signal / FPK signal. This signal is the analog signal of [0V~5V], maximum current being 5mA. This signal can be set in the software. Forms a return circuit with GND signal.
11, 23 10, 22	OUT0, OUT1 OUT2, OUT3	Common output signal 0~3, with GND signal as reference Ground. This is an output signal.
21	DAPORT1	Laser power control signal, and the analog signal of [0V~9.5V], maximum drive current being 5mA. Forms a return circuit with GND signal.
12, 24	VCC	Anode of 5V input power supply. This is an input signal.

c. CON3:DB9 Marking-on-fly Encoder

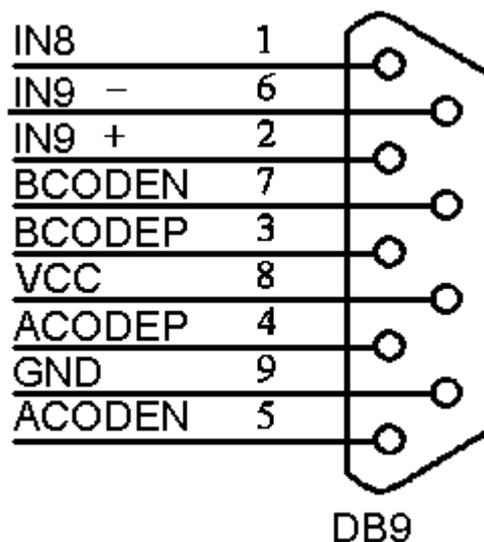


Fig. 1-4 CON3 of Digital interface board

PIN No.	Signals	Illustrations
1	IN8	Common input signal 8. Forms a return circuit with GND signal (pin9). To use this signal, just connect it and the GND signal respectively to either terminal of the switch.
2, 6	IN 9+ / IN 9-	TTL input signal with internal 1K current-limited resistor. External current-limited resistance is suggested if voltage is over 5V.
3, 7	BCODEN / BCODEP	Input signal of phrase B of encoder. Differential input.
4, 5	ACODEN / ACODEP	Input signal of phrase A of encoder. Differential input.
8	Vcc	5V power supply output of control card.
9	Gnd	Control card's reference Ground, as return circuit signal of pin8 and pin1.

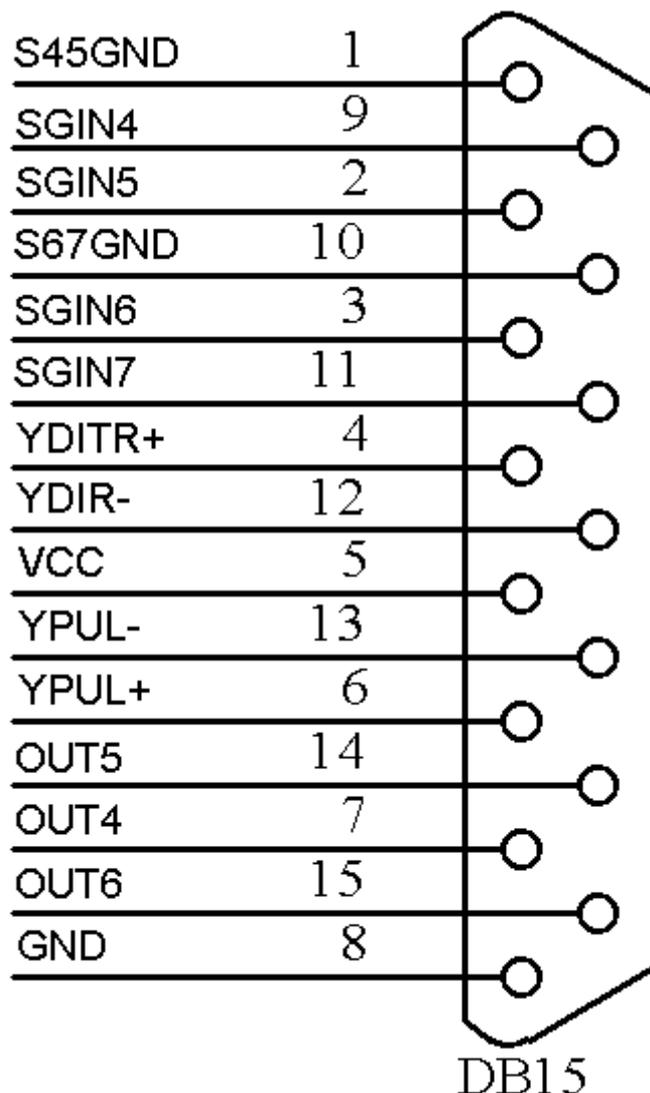
d. CON4:DB15 Extend IO Socket

Fig.1-5 CON4 of Digital interface board

PIN No.	Signals	Illustrations
1	S45GND	Cathode of common input signals 4 and 5.
2, 9	SGIN5, SGIN4	Anode of common input signals 4 and 5. With an internal current-limited resistance of 330Ω . External current-limited resistance is suggested if voltage is over 5V.
3, 11	SGIN6, SGIN7	Anode of common input signals 6 and 7. With an internal current-limited resistance of 330Ω . External current-limited resistance is suggested if voltage is over 5V. Please see "IN9 Connection Illustration".
4, 12	YDIR+/YDIR-	Direction signal of extend axis Y (step motor or servo motor). The output can be set as differential output or level output (TTL output). This is an output signal.

5	VCC	5V power supply output of control card, with GND signal (pin8) as reference Ground.
6, 13	YPUL+/YPUL-	Pulse signal of extend axis X (step motor or servo motor). The output can be set as differential output or level output (TTL output). This is an output signal.
7, 14 15	OUT4, OUT5 OUT6	Common output signals 1~3. With GND signal (pin8) as reference Ground. This is an output signal.
8	GND	Ground signal. Reference Ground of pin5, 7, 14, 15.
10	S67GND	Cathode of common input signals 6 and 7.

4. Jumper Illustration

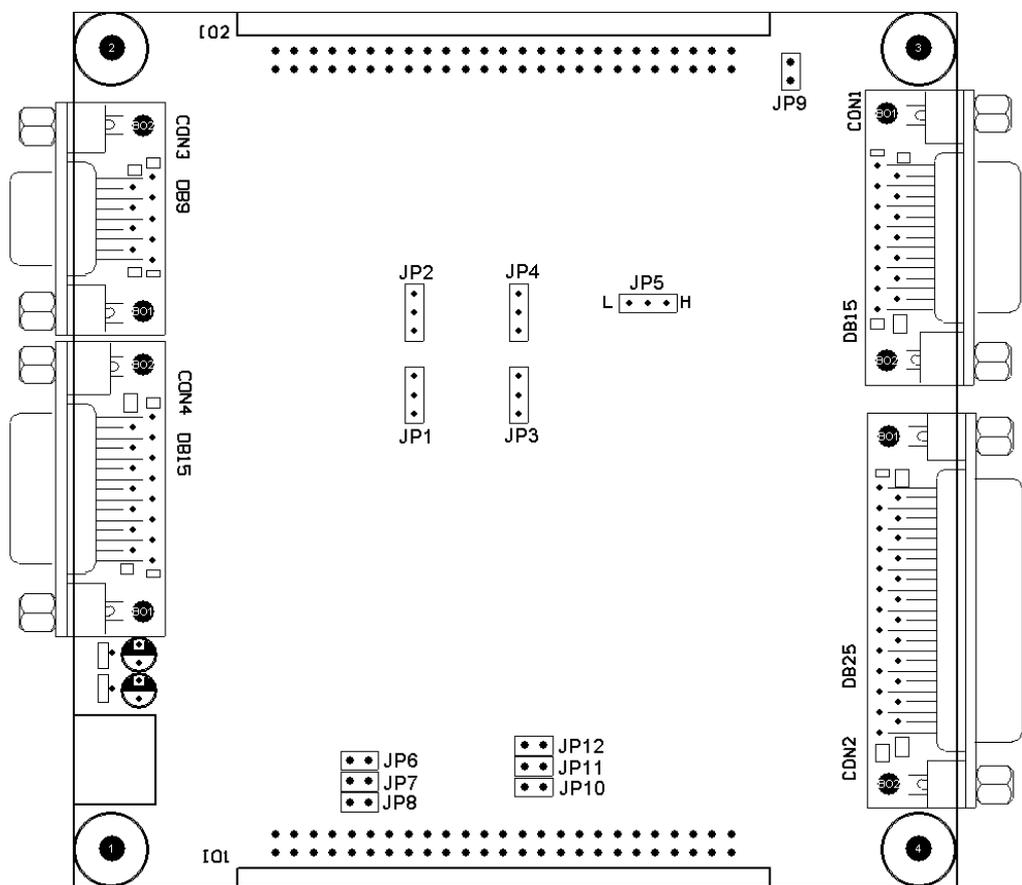


Fig.1-6 Digital Module Jumper Location Illustration

See jumper illustrations as followed:

No.	Qty of Pin	Illustrations
JP1, JP2 JP3, JP4	3	Direction/pulse signal setting of extend axes. JP1 and JP3 set direction signals; JP2 and JP4 set pulse signals. JP1 and JP2 correspond to extend axis Y; JP3 and JP 4 correspond to extend

		axis X. Short connecting JUMPER pin1&2 will make direction/pulse signals differential outputs. Respectively connect control card's DIR-, DIR+, PUL-, PUL+ to step driver's DIR-, DIR+, PUL-, PUL+; Short connecting JUMPER pin2-3 will make direction/pulse signals level outputs. In this case, respectively connect control card's VCC, DIR+, PUL+ to step driver's VCC, DIR, PUL.
JP5	3	Sets laser switch signal Laser as high-level available or low-level available. Short connecting JUMPER pin 1-2 will make low-level available; short connecting JUMPER pin 2-3 will make high-level available.
JP6, JP7, JP8	2	Index numbers 0~7. Differentiate various cards when multi-cards are used at a time. JP8 –JP7- JP6 respectively correspond to binary b2 b1 b0. Short connecting JUMPER means 0, and not short connecting it means 1.
JP9	2	Short connecting JUMPER means direct output of galvo data; not short connecting it means the digital portal protocol used contains extend codes.
JP10, JP11 JP12	2	Power pre-setting. JP10-JP11-JP12 respectively correspond to binary b2 b1 b0. Short connecting JUMPER means b0, not short connecting it means b1. CON2 socket pin21 signal DAPORT1 is the analog voltage of control card output, used to set laser power supply's power. Via JP10-12 the value of DAPORT1 can be pre-set. Specified voltage can be output when control card is powered on. See following chart for the corresponding relations between jumper and voltage.

JP10 JP11 JP12 B2 B1 B0	Output Voltage
000	0
001	1
010	1.5
011	2
100	2.5
101	3
110	3.5
111	4

Default Settings:

JP1——JP4: Short connecting pin 2-3. Level output.

JP5: Short connecting pin 2-3. Laser signal output at high-level available.

JP6——JP8: Not connected.

JP9: Short connecting.

JP10——JP12: Short connecting. Pre-set power is 0V.

JP13—JP14: Short connecting pin 2-3. Single-port output.

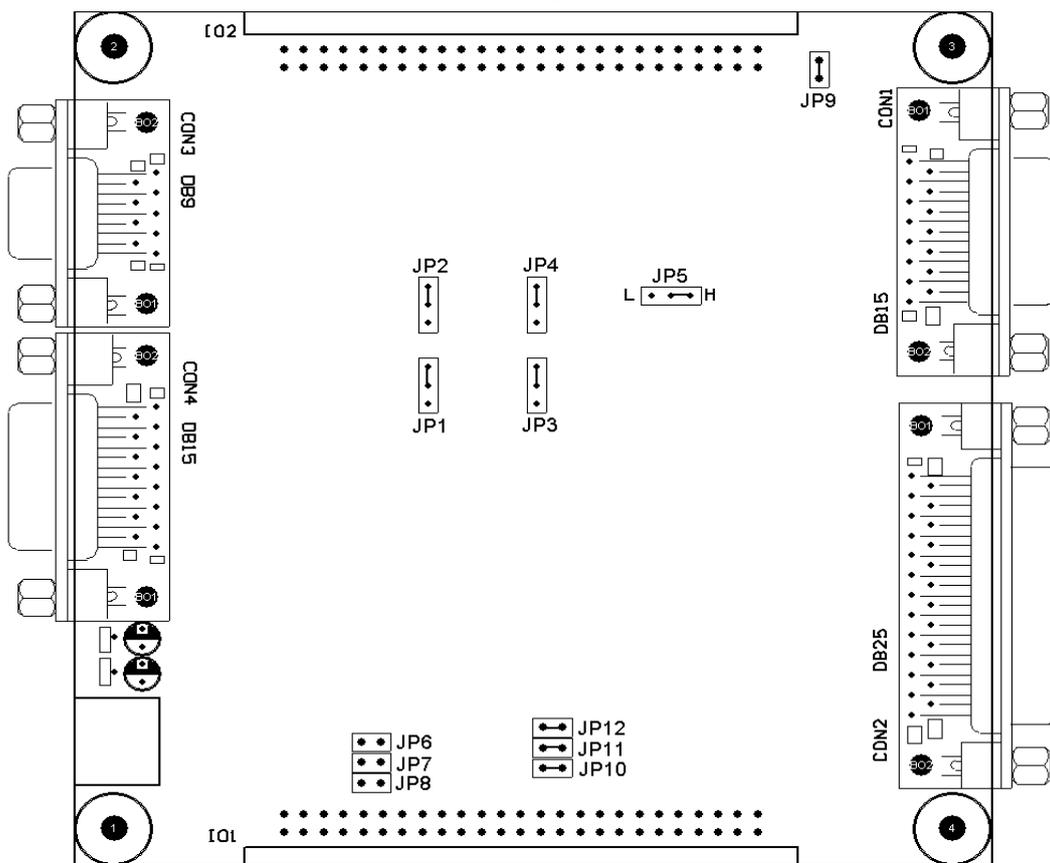


Fig.1-7 Digital Module Jumper Default Setting

5. Hardware Connection Illustration

a. IO Connection Illustration

See fig.1-8 and 1-9 for the connection circuit illustration and recommended connection of input signals IN4-IN7 and IN9.

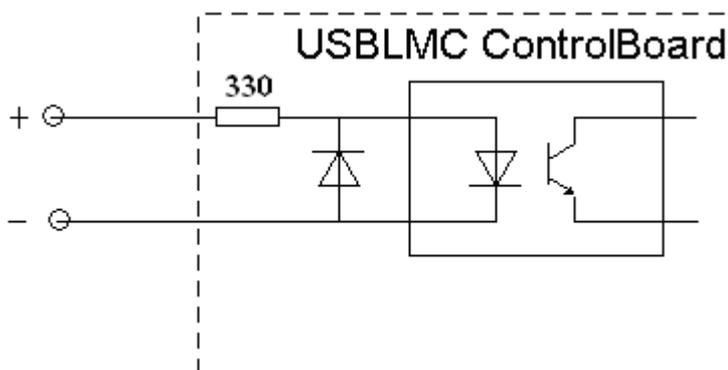


Fig.1-8 Common Input Signals IN4-IN7 and IN9 Connection Circuit

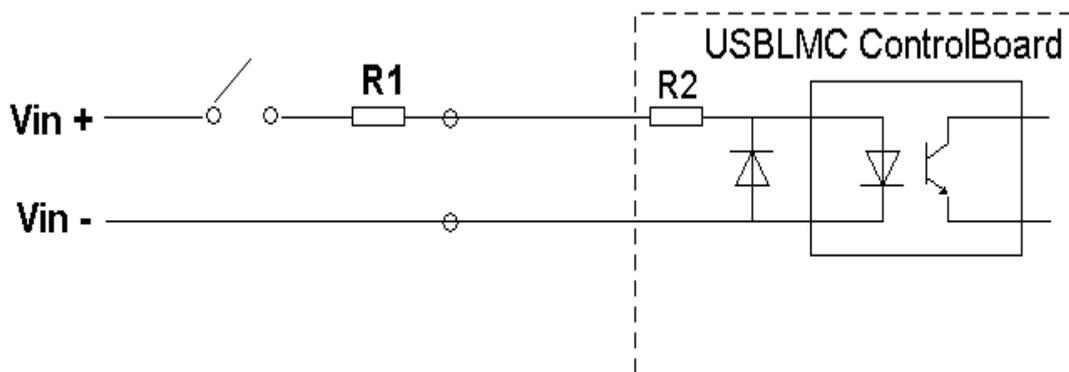


Fig.1-9 Recommended Connection of Common Input Signals IN4-IN7 and IN9

Note: $R2 = 330 \Omega$

External power supply V_{in} needs proper input voltage to make sure the input current is within 10mA~15mA. External current-limited resistance $R1$ is recommended is input voltage is over 5V. Choose input current of 12mA, and the input resistance $R1$ is calculated as per the following formula:

$$R1 = \left(\frac{V_{in}}{12} - 0.33 \right) \times 1000 \Omega$$

Refer the fig.1-10 and 1-11 for the connection circuit and recommended connection of common input signals IN0~IN3 and IN8.

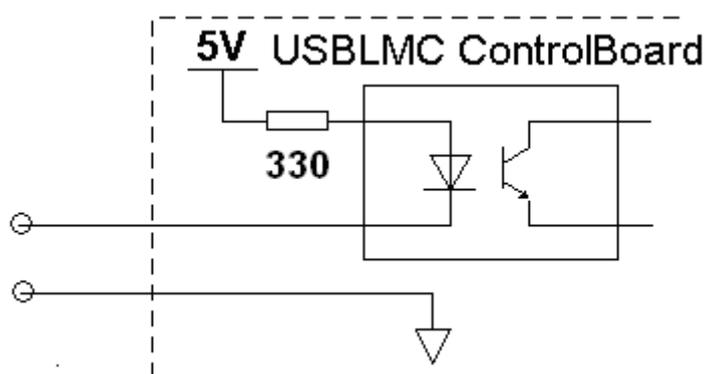


Fig.1-10 Connection Circuit Illustration of Common Input Signals

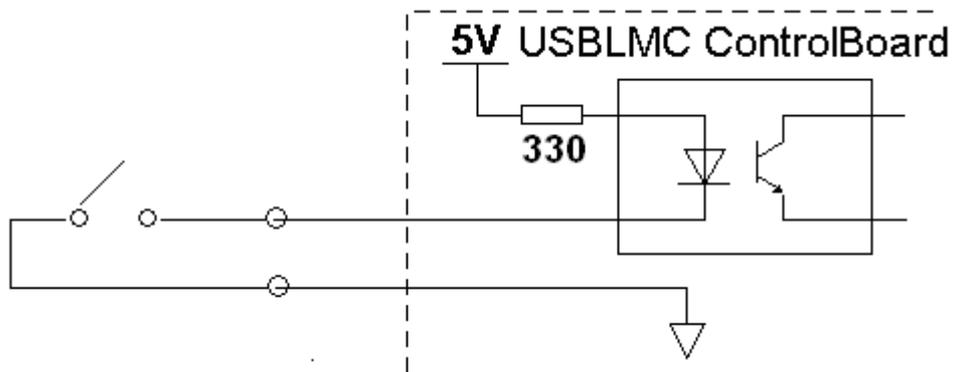


Fig.1-11 Recommended Connection of Common Input Signals

For other input signals, only an external switch is needed. The switch's contact resistance must be under 100 Ω .

b. PWM Signal Connection

As shown in fig. 1-12-1 at the right, PWM signal connection is differential output connected to PWM- / PWM+, or connected as level mode. As shown in fig. 1-12-2, the connection is high-level available output, connected to PWM+ / GND. As shown in fig 1-12-3, the connection is low-level available output, connected to PWM- / GND.

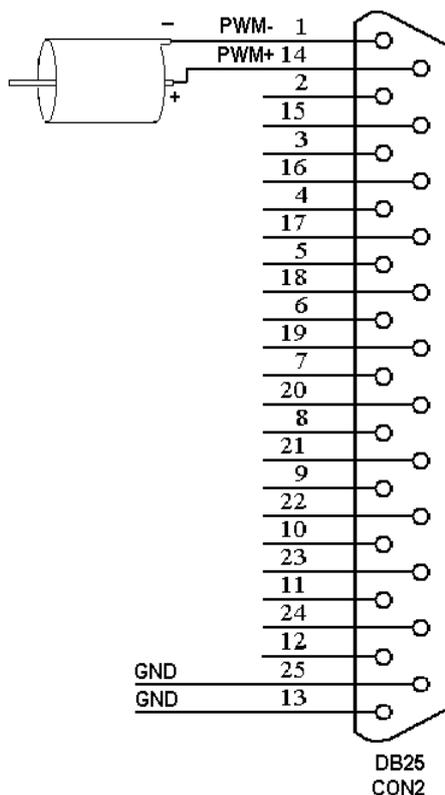


Fig.2-12-1 Differential Output: PWM+ /PWM-

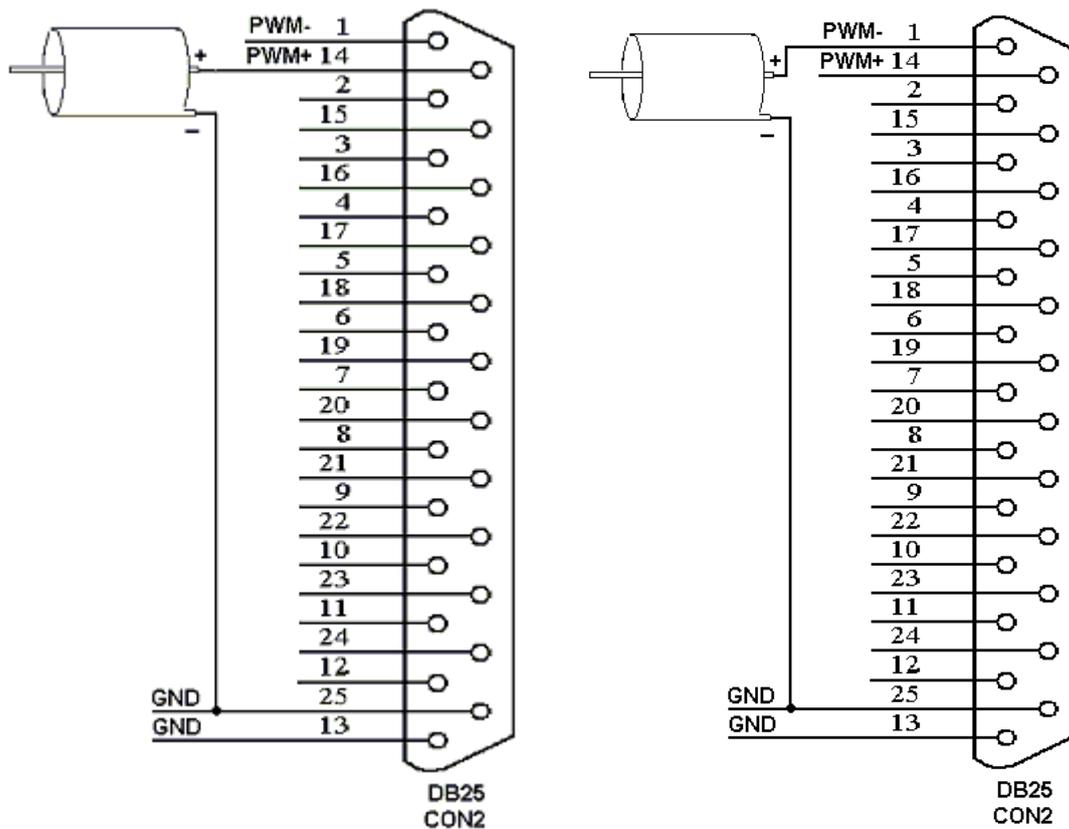


Fig. 2-12-2 High-level available output: PWM+/GND

Fig. 2-12-3 Low-level available Output: PWM-/GND

c. FPK signal

FPK Signals

USBLMC1 control card can output two types of FPK signal, one being the TTL signal and the other analog signal. TTL FPK signal is output from CON2 socket pin2 – QKILL. This signal’s chronological relation with laser switch signal and PWM signal can be set via software. Particular way of restraint can be set according to practical situations. To YAG equipments, PWM signal is the repeat frequency signal for the drive Q. See fig. 1-13 for the chronological relation.

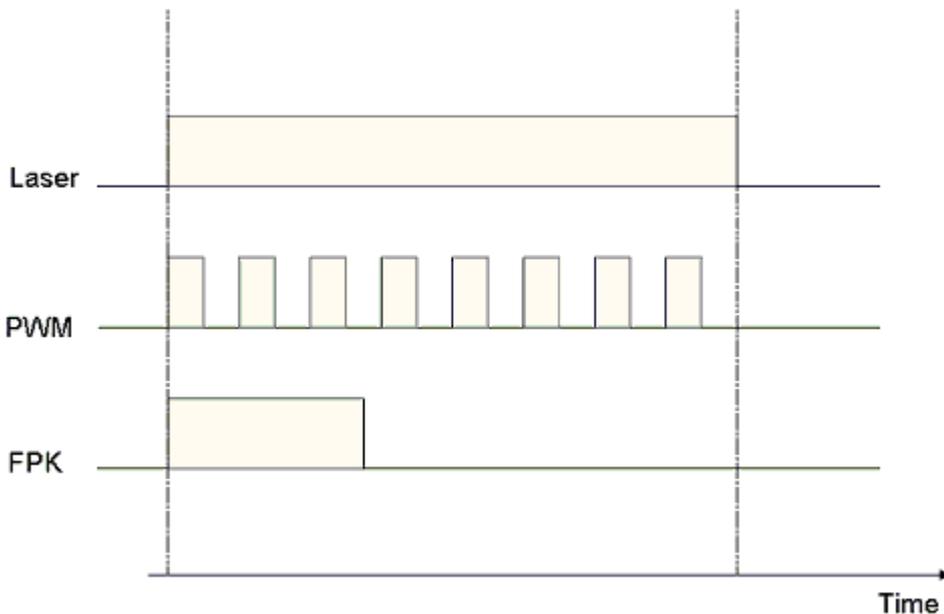


Fig.1-13-1 FPK Signals forming at the same time as PWM Signals

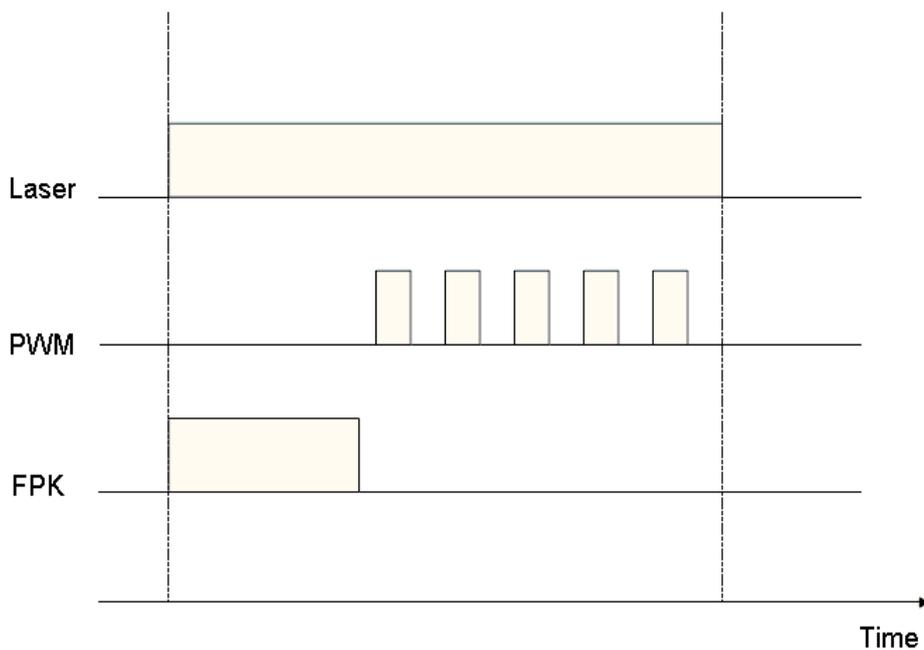


Fig.1-13-2 FPK Output PWM signal after finishing

The FPK signal as analog signal is output from CON2 socket pin9 – DA2PORT, and shares the same pin with analog (frequency) output port. This pin can be set in software as FPK signal or as repeat frequency setting signal. Analog pulse restraint signal is output as shown in the following fig. 1-13-3.

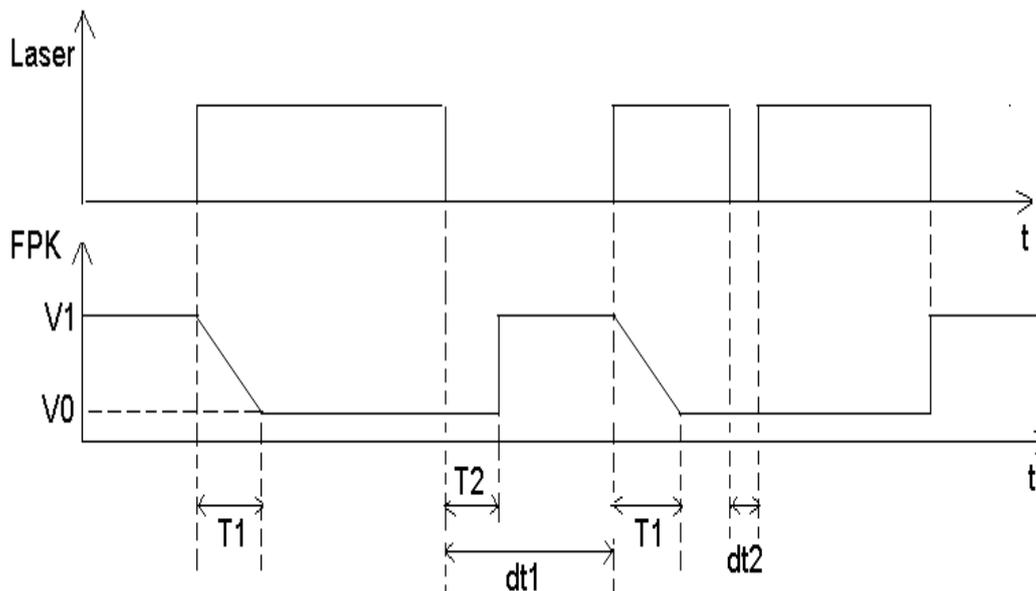


Fig.1-13-3 Analog FPK

Four parameters V1, V0, T1, and T2 must be set in the software for analog FPK. Their meanings are as followed:

V1: Maximum voltage of analog FPK signal.

V0: Minimum voltage of analog FPK.

T1: Time taken for analog FPK to change from maximum voltage to minimum voltage.

T2: Minimum intervals between analog FPK outputs.

As per fig.1-13-3, when laser cut-off time $dt1 > T2$, the next time when laser outputs, the analog FPK become effective. When the laser cut-off time $dt2 < T2$, there is no FPK.

The FPK signals in fig.1-13-3 are descending, and the signals can be set via software to be ascending.

d. Start signal connection

For the connection of start signal, only one switch (e.g. the Floor push) is needed to connect to the responding pin of control card. See fig. 1-14.

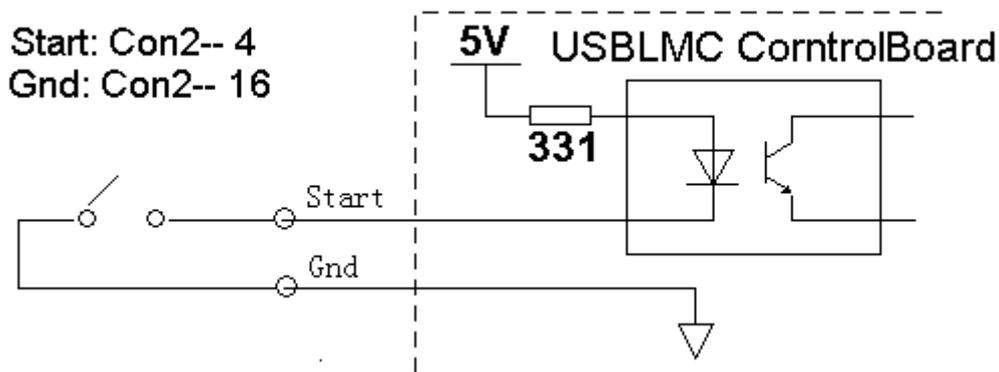


Fig.1-14 Connection of Digital Module Start Signal

e. Typical Connection of Digital Module

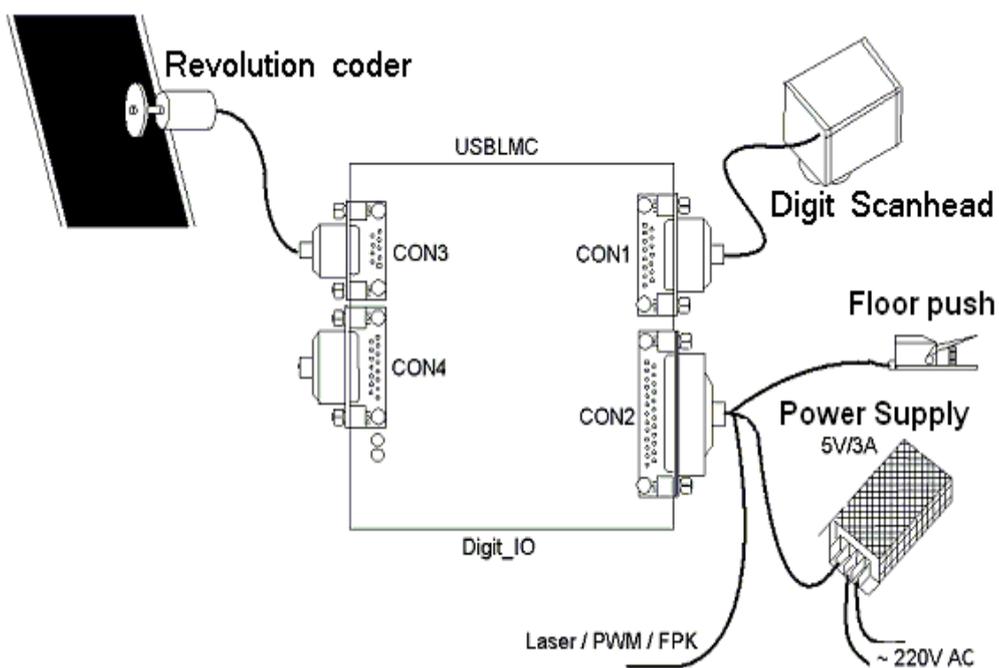


Fig. 1-15 Typical Connection of Digital Module

For the Floor push, it depends whether the rotary encoder needs connected. If the marking-on-fly function is not used, then there is no need to connect the rotary encoder.

II. Digital IO signal circuit

1. Figure of Digital input signal circuit

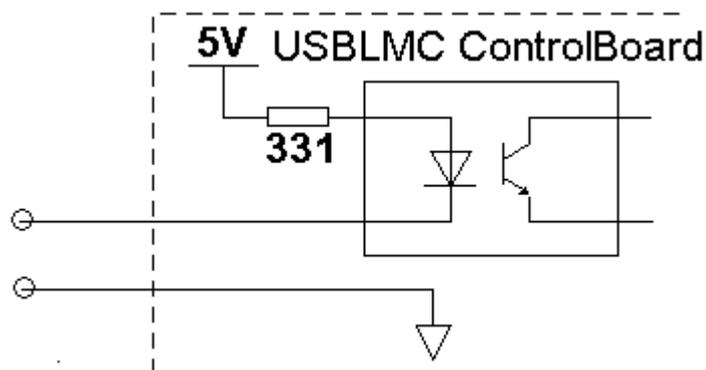


Fig. 2-1 input interface SGIN0、SGIN1、SGIN2、SGIN3、SGIN8 and START

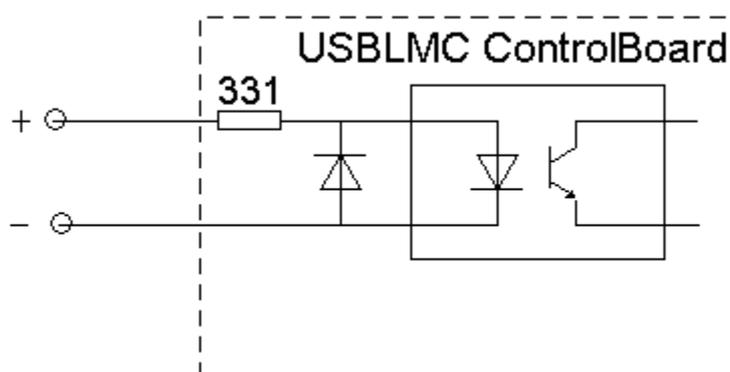


Fig. 2-2 input interface SGIN4、SGIN5、SGIN6、SGIN7

Note: Input signal is default to be +5V, when more than +5V, we need add current-limited resistance. The input current should be less than 20mA and more than 5mA. We suggest 10-15mA.

2. Digital output signal circuit figure

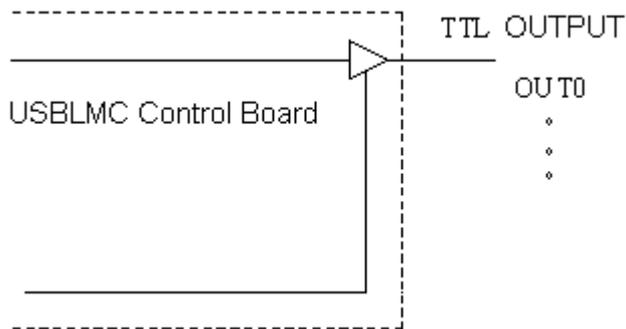


Fig.2-3 Output interface of OUT0----OUT6

Note: Output circuit Is TTL output to assure of the output current as 10mA.

III. The common connection ways.

1. The connection between User-defined digital Galvo conversion board & USBLMC control card

CON1 (Digital input signal socket): Connect User-defined digital Galvo conversion's DB15 with USBLMC control card's DB15 directly.

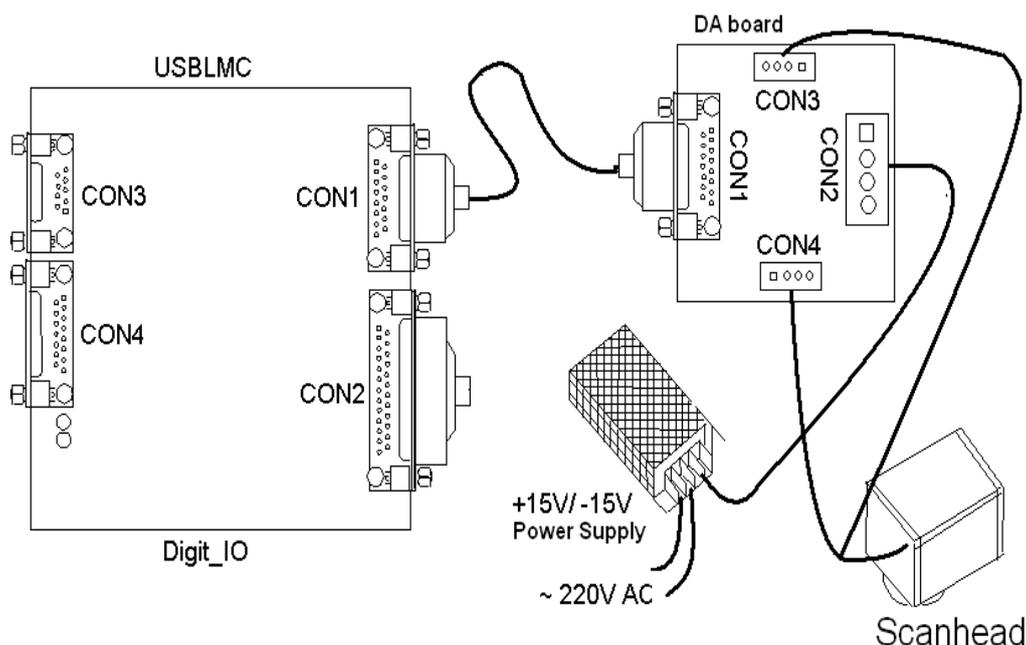


Fig. 3-1 Connection of conversion board

CON2 (Power socket): Connect the outside $\pm 15V$ power to the corresponding pin, the range of the voltage is $[\pm 12V-\pm 15V]$, as the following figure (Fig. 3-2)

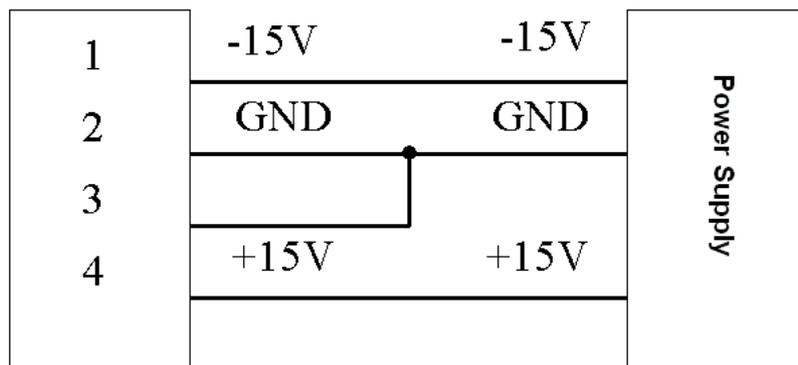


Fig. 3-2 Connection of Power supply

CON3/CON4 (Galvo control signal): It's divided into Single interface & Difference two connection ways, we should choose the most suitable connection way according to the Galvo

Note: Difference connection's output voltage is twice of single interface's. We suggest use single interface connection. And while only confirmed the Galvo interface is Difference interface, we can consider to follow the Difference output way.

The two connection ways are as following figure (Fig. 3-3 Single interface of Galvo; Fig.3-4 The difference of Galvo)

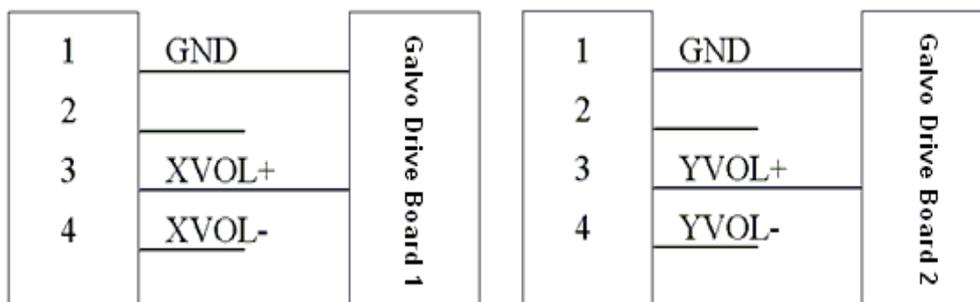


Fig. 3-3 Single interface of Galvo

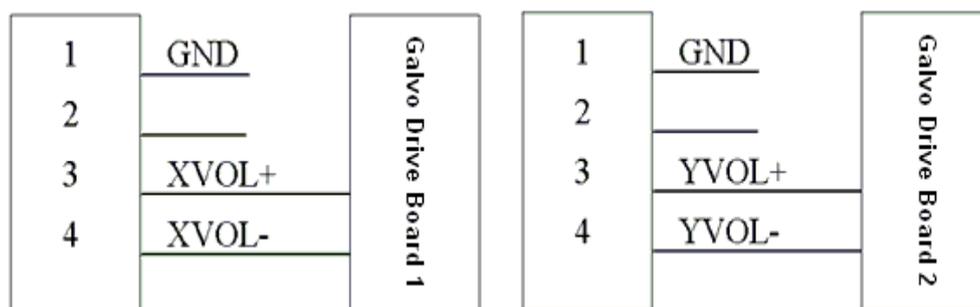


Fig. 3-4 The difference of Galvo

2 . The encoder, photoelectric switch during marking-on-fly

USBLMC control card receives differential drive signal (eg DS26LS31 type) of encoder; use CON3:DB9 encoder and photoelectric switch socket of mark-on-fly. The connection as the following figure (Fig: 3-5)

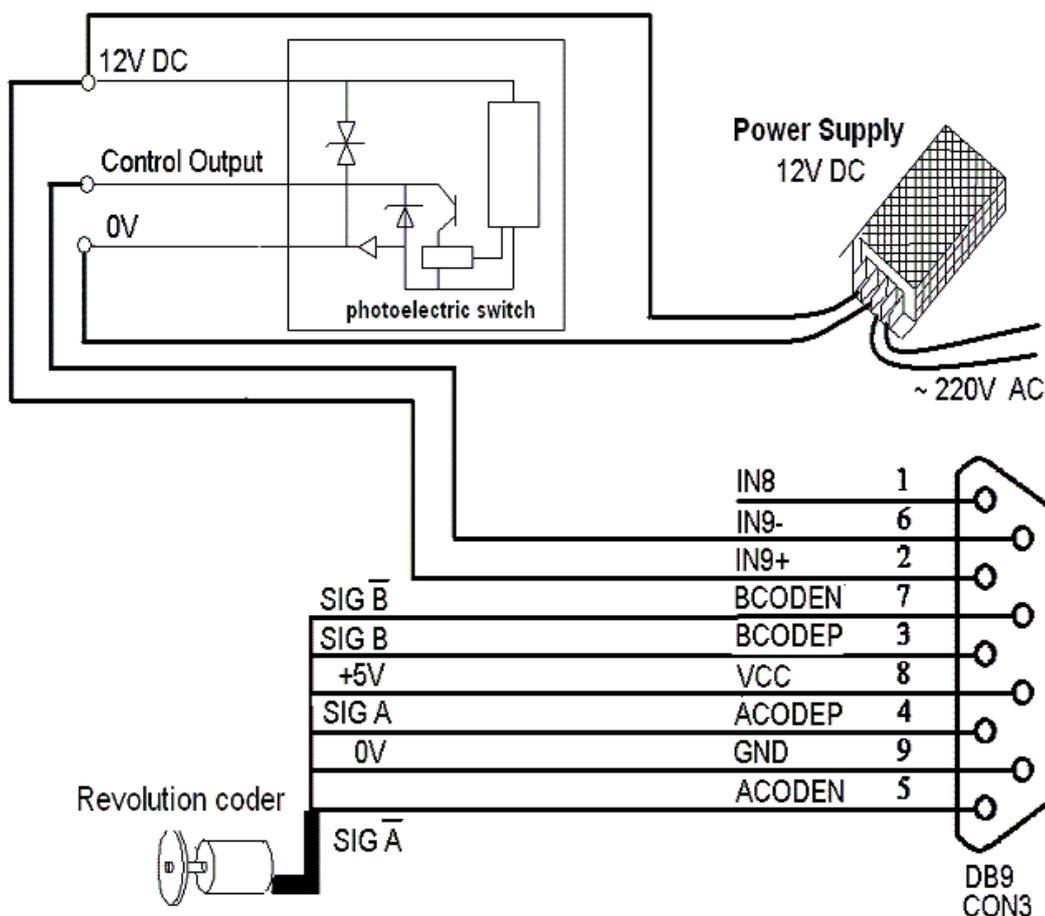


Fig. 3-5 Connection of encoder and photoelectric switch

3 . The connection of Electrical machine drive & USBLMC

The control interface of Electrical machinery driver divided into level and difference ways , it decides the connection way of the control card according to the driver interface. Fig.3-6 and 3-7, show the connection way of the common digital interface board / common analog interface board. The optic fibre interface board needs to be connected by the corresponding signal to the step motor driver.

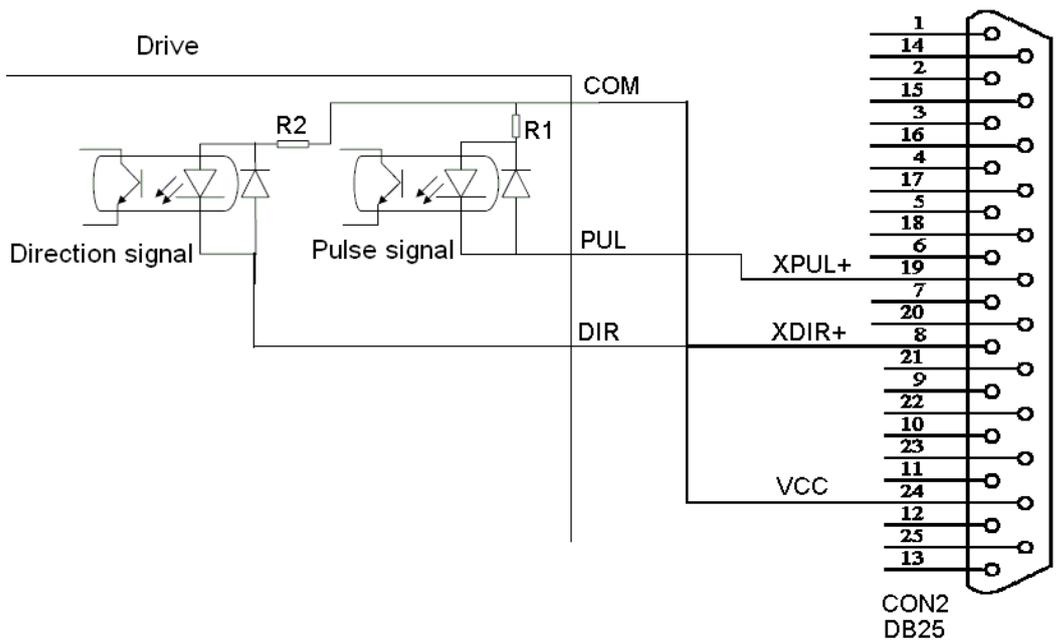


Fig. 3-6 Motor driver connection

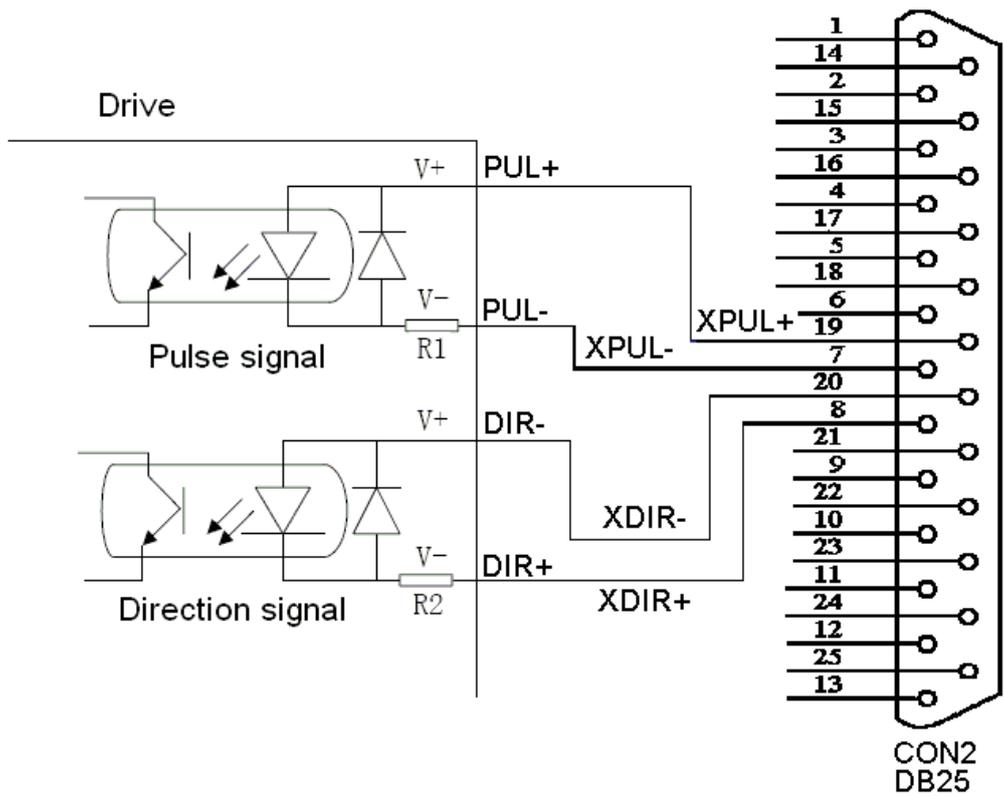


Fig. 3-7 Motor driver connection

4. Connection of Floor push and USB _ LMC1

We Use common digital interface board's CON2: DB25 power / IO socket joins the Floor push. We can choose any input interface (from SGIN0 to SGIN7) as the Floor push input. The typical connects pictures are as followed 3-8 & 3-9:

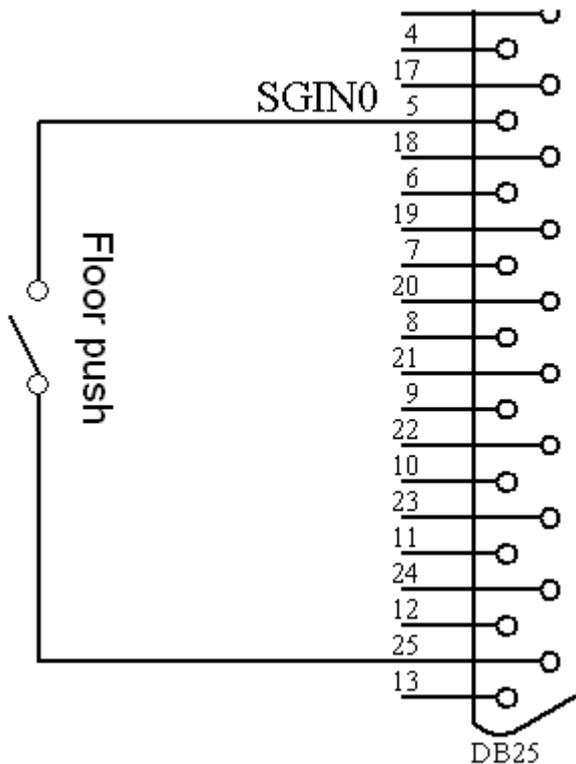


Fig. 3-8 Connection of input interface SGIN0、SGIN1、SGIN2、SGIN3

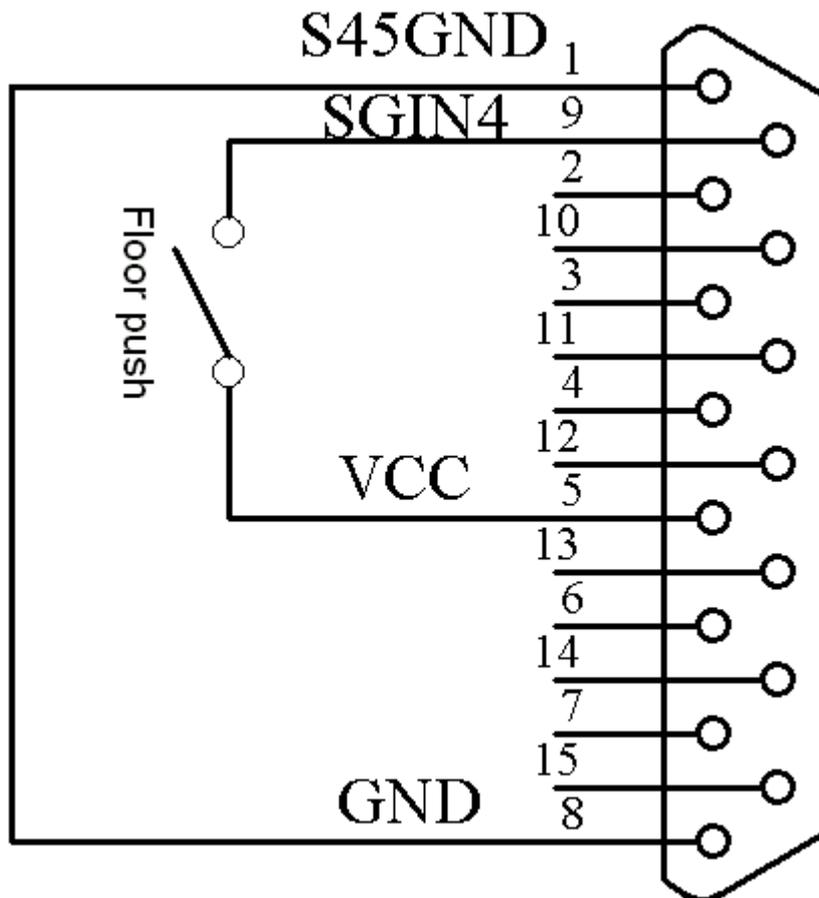


Fig. 3-9 Connection of input interface SGIN4、SGIN5、or SGIN6、SGIN7
(connect S67GND with GND)