7I29 MANUAL

Rev 1.6

CAUTION!

THE 7I29 USES VOLTAGE AND POWER LEVELS THAT REPRESENT A HAZARD TO LIFE AND LIMB.

THE 7I29 IS INTENDED FOR USE BY OEMS THAT WILL INTEGRATE IT INTO A SYSTEM WITH INTERLOCKS AND OTHER SAFETY FEATURES TO PREVENT USERS FROM CONTACTING HAZARDOUS POTENTIALS OR BEING INJURED BY MECHANISMS POWERED BY THE 7I29.

WHEN TESTING THE 7I29 ON THE BENCH IT IS SUGGESTED TO AT THE **MINIMUM:**

1. **CONNECT THE 7I29'S FRAME GROUND CONNECTION TO A SECURE BUILDING GROUND**.

2. **USE A ISOLATED MOTOR POWER SUPPLY**

3. **TEST FIRST WITH A LOW VOLTAGE MOTOR POWER SUPPLY**

4. **TAKE EXTREME CARE WITH SERVO SYSTEMS, *EXPECT* THEM TO RUN_AWAY WHEN FIRST TESTED.**

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GENERAL

DESCRIPTION

The 7I29 is a dual 22.5A 165V Hbridge intended for motion control applications when used with the MESA 4I27, 4I34M, 4I65, 4I68, 5I20, 5I22, 5I23, or 7I60 motion control cards. The 7I29 uses a 50 pin flat cable interface to the motion control card. The 7I29 is a 2 Axis card but can connect to 4 axis/cable FPGA controllers, allowing 2 7I29s to share a single flat cable from the controller.

Motor power and motor connection are made with screw terminals. 10 pin encoder connectors allow TTL or differential encoders to be connected to the motion control system through the 7I29 card

The 7I29 has overcurrent protection to prevent damage to the Hbridge from stalled or shorted motors. Each channel has two user selectable current limit values, full (22.5A) and low (11.25A)

The 7I29s control circuitry is galvanically isolated from motor power and has 2500V RMS isolation for safety.

HARDWARE CONFIGURATION

CURRENT LIMIT

Each 7I29 PWM channel has a selectable current limit, Either 22.5A or 11.25A. Jumpers W5 and W6 determine the current limit. Jumper W5 sets the current limit for channel 0 and W6 sets the current limit for channel 1. When W5 or W6 are on the left hand position, the 22.5A current limit is selected. When W5 or W6 are in the right hand position, the 11.25A current limit is selected. W5 And W6 are normally set at the factory to 22.5A. Both jumpers are located under the 7I29's heatsink, and require removal of the heatsink to change.

TTL/DIFFERENTIAL ENCODER MODE

Each 7I29 channel has input signal conditioning circuitry for one encoder. These encoder inputs may be single ended (TTL) or differential (RS-422). Jumpers W1 and W4 select the encoder mode. W1 select the encoder mode for encoder 0 and W4 selects the encoder mode for encoder 1. When either W1 or W4 are in the up position, differential encoder mode is selected. When either W1 or W4 are in the down position, TTL encoder mode is selected.

AXIS SELECTION

The 7I29 can be used with controllers that support 4 Axis per control cable. This mean that two 7I29s can share a single 50 conductor flat cable from the controller. When two 7I29s share a controller cable, the 7I29s must be jumpered so that one is connected to signals for axis 0 and 1 and the other is connected to signals for axis 2 and 3. W3 selects which cable signals the 7I29 uses. When W3 is in the down position, the 7I29 connects to cable signals for axis 0 and 1. When W3 is in the up position, the 7I29 connects to cable signals for axis 2 and 3. When two 7I29s share a cable, on must be jumpered with W3 in the up position and one must be jumpered with W3 in the down position. ***Please check AXIS selection jumpering carefully before using two 7I29s on one cable. If two 7I29 cards on the same flat cable are set for the same set of axis, this will cause a conflict between the encoder signals that could possible damage one or both 7I29s.***

LED DISPLAY OPTION

Four monitor LEDs on the 7I29 (CR1,CR2,CR3,CR4) can either display PWM and DIR for both channels or the A and B encoder signals for each channel. Jumper W2 select the LED display function. When W2 is in the down position, the PWM and DIR signals are displayed. When W2 is on the up position, the encoder signals are displayed.

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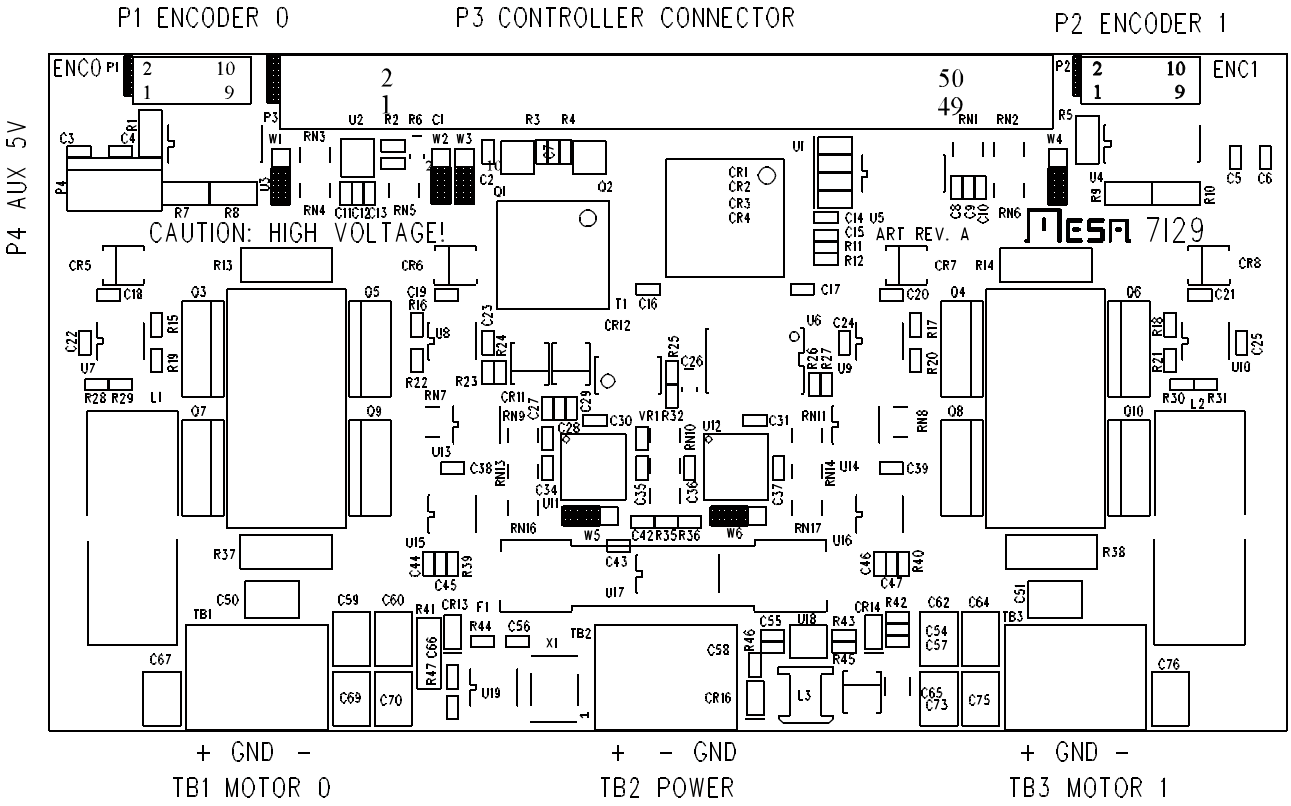
CONNECTORS

CONNECTORS, LEDS, AND DEFAULT JUMPING



CONNECTORS

POWER CONNECTOR

The power connector TB2 is the center of the three screw terminal blocks on the 7I29. TB2 pinout is as follows:

PIN	FUNCTION
1 (LEFT)	MOTOR POWER +
2 (CENTER)	MOTOR POWER -
3 (RIGHT)	FRAME GROUND

MOTOR CONNECTORS

Motor connections are made to screw terminals TB1 and TB3. TB1 and TB3 pinouts are as follows:

PIN	FUNCTION
1 (LEFT)	POSITIVE MOTOR LEAD (OFTEN RED)
2 (CENTER)	FRAME GROUND = MOTOR CASE
3 (RIGHT)	NEGATIVE MOTOR LEAD (OFTEN BLACK)

CONNECTORS

ENCODER CONNECTORS

P1 and P2 are encoder connectors P1 is for encoder 0 and P2 is for encoder 1. P1 and P2 pinouts are as follows::

PIN	FUNCTION	PIN	FUNCTION
1	5V	6	5V
2	/A	7	A
3	/B	8	B
4	/IDX	9	IDX
5	GND	10	GND

AUX 5V POWER CONNECTOR

The 7I29 normally gets its operating power from the 50 conductor flat cable that connects to the controller. If this cable is too long (> 2 feet) the 7I29 may require a local 5V source of power. P4 supplies this local 5V power. 7I29 versions B and later have a 2 pin 3.5 mm pluggable terminal block for AUX 5V power. Versions previous to revision B have a 4 pin inline header:

INLINE HEADER		TERMINAL BLOCK	
PIN	FUNCTION	PIN	FUNCTION
1	+5V	1	+5V (SQUARE PAD)
2	GND	2	GND
3	GND		
4	+5V		

CONNECTORS

CONTROLLER CONNECTOR

P5 is the motion controller connector P5 is a 50 pin latching header that mates with standard female IDC headers.

PIN	FUNCTION	PIN	FUNCTION
1	MOTOR1 ENCB	3	MOTOR1 ENCA
5	MOTOR0 ENCB	7	MOTOR0 ENCA
9	INDEX1	11	INDEX0
13	MOTOR1 PWM	15	MOTOR0 PWM
17	MOTOR1 DIR	19	MOTOR0 DIR
21	/MOTOR1 ENA	23	/MOTOR0 ENA
25	MOTOR3 ENCB	27	MOTOR3 ENCA
29	MOTOR2 ENCB	31	MOTOR2 ENCA
33	INDEX3	35	INDEX2
37	MOTOR3 PWM	39	MOTOR2 PWM
41	MOTOR3 DIR	43	MOTOR2 DIR
45	/MOTOR3 ENA	47	/MOTOR2 ENA
49	+5 POWER FROM CONTROLLER		

ALL EVEN PINS ARE CONNECTED TO GROUND

Note that odd pins 1 through 23 are used when the AXIS 0,1 option is selected (W3 down) and the odd pins 25 through 47 are used when the AXIS 2,3 option is selected (W3 up). The unused pins are floated so they do not interfere with operation of the other 7I29 on the cable.

OPERATION

5V POWER

The 7I29 requires 5V power for its logic and MOSFET gate drive. This power can be supplied from the controller connector or from the aux 5V connector P4 .Voltages less than 4.5V will cause the 7I29 to be forced into a reset state.

If the controller cable is longer than 2 feet it is suggested the 7I29 5V power be supplied from the aux 5V connector P4. This is because of the voltage drop on the controller cable. If power is supplied to the aux 5V connector, this power must come from the PC that has the controller card installed.

MOTOR POWER

Motor power is supplied to the 7I29 on pins 1 and 2 of TB2. Motor power can range from 0 to 165V VDC with an absolute maximum value of 180V. Since gate power is not derived from motor power, operation from low motor voltages will not harm the 7I29. The 7I29 does not have any braking or load dump capability, so if the 7I29 is operated near the maximum power supply voltage, either sufficient external capacitance or and external voltage sensing brake circuit may be required to prevent excessive voltage surges on the motor power supply when decelerating large motors. *In addition, there must always be enough output filter capacitance to absorb the inductive energy stored in the motor windings without increasing the motor supply voltage above the 7I29s maximum limit*.

For example at a motor armature inductance of 15 mH and 22.5A maximum current, maximum inductive stored energy is ½ LI^2 or about 3.8 Joules per motor. This requires an output capacitor in the 5000 uF range for 2 motors when the 7I29 is operated at a nominal 165V (roughly rectified 120V line voltage).

PWM RATE

Suggested PWM rates for the 7I29 are from 20 KHz to 30 KHz. Higher PWM rates are possible but voltage and full scale current must be reduced due to higher switching losses. Blanking time is 300 nS. Direction and PWM inputs have identical timing so both PWM / DIR mode and locked anti-phase mode are acceptable.

PWM rate selection is a compromise between motor ripple current (which decreases at high PWM rates) and switching losses (which increase at high PWM rates). Ripple current increases hysteresis losses in the motor. Ripple current will be worse when operated in locked anti-phase mode at 50% duty cycle (Idle). In this case peak to peak ripple current can be calculated as VMOTOR*TON/LMOTOR.

OPERATION

HIGH SIDE GATE DRIVER REFRESH

The gate drivers on the 7I29 use a bootstrap power supply arrangement to drive the high side gate MOSFET gate. This results in simple circuitry but requires the drive PWM never be fully on. The PWM signal should always have a low time of 0.8 uSec minimum. This represents a 98.4% maximum duty cycle at 20 KHz PWM frequency,

HIGH TEMPERATURE CURRENT DERATING

The 7I29 monitors its heatsink temperature and reduces the maximum output current depending on this temperature. The maximum output current is reduced to 20A at a 75 degree C heatsink temperature. From this point, maximum output current is derated to 0 at 125C heatsink temperature.

OVERTEMPERATURE SHUTDOWN

At a heatsink temperature of 125C, the Over-temperature shutdown will operate. When in over-temperature shutdown mode, the 7I29 will disable the Overheated Hbridge until its heatsink temperature has been below 125C for 1 minute.

COOLING

The 7I29 is designed for Servo duty, meaning it is not expected to operate at full current (22.5A) for extended periods. Operating near full current for long periods will result in overheating and current limiting if only convection cooling is used. If you wish to operate the 7I29 continuously near its current limits, Either a larger heatsink or forced air cooling must be provided.

INDICATORS

In addition to the monitor LEDs there are 3 status LEDs on the HV side of the Hbridge. CR13 and CR14 are red LEDs on either side of the motor power connectors. These LEDs indicate an overcurrent condition in channel 0 (CR12) or 1 (CR13). In addition there is a green LED on the HV side (CR16) that indicates that the high voltage side gate power supply is operating correctly.

FUSE

The 7I29 has a 30A fuse provided for the motor supply. Note that supply current is normally much lower than motor current. The 7I29's heatsink must be removed to gain access to this fuse.

7I29 OPERATION

FRAME GROUND

The frame ground connection on the 7I29 should always be connected to a secure earth ground. This ground connection connects to the 7I29s heatsink, the motor shield connections and the front mounting holes (near TB1 and TB3). *The 7I29s heatsink may be at a hazardous voltage level if the frame ground is not returned to earth ground.*

MOTOR/ENCODER WIRING

The Hbridge motor drive lines can radiate large amounts of noise if not shielded. This noise can easily interfere with the encoder signals and cause errors in position sensing. The following are suggestions to mitigate this potential problem:

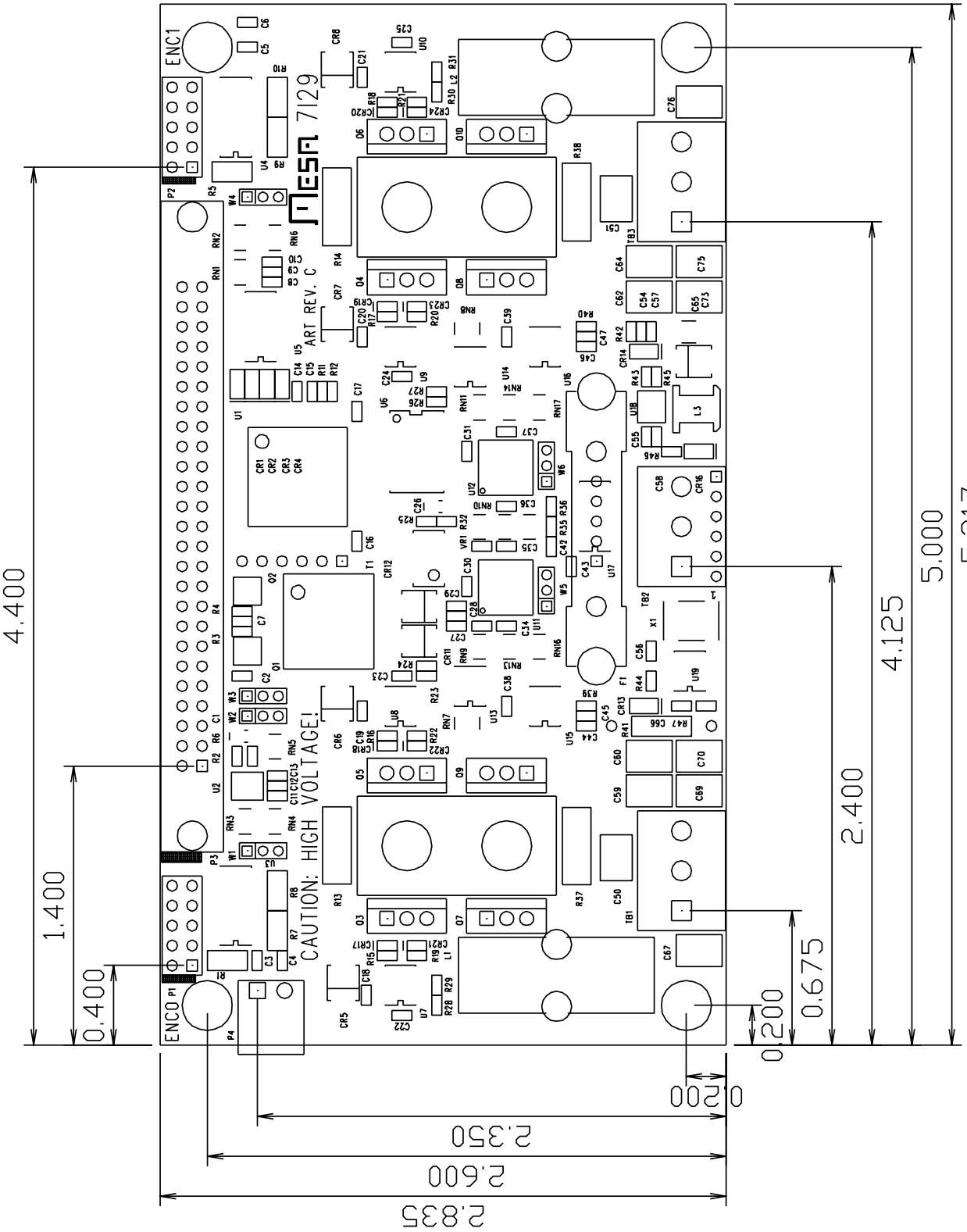
1. Twist motor leads
2. Make sure motor frame is grounded securely
3. Shield motor leads - This is the purpose of the GND pin on the motor connectors
4. Shield encoder leads
5. Use differential encoders
6. Route encoder leads away from the motor leads

FIRST TIME STARTUP

The 7I29 Hbridge will operate from very low motor supply voltages. This allows a safe way to verify proper servo operation before applying full motor power. A good way to verify proper feedback is to use 5V or 12V for motor power. This way, in a runaway motor situation, the runaway motor wont runaway very fast.

SPECIFICATIONS

	MIN	MAX	
5V POWER SUPPLY	4.5V	5.5V	
5V CURRENT	----	250 mA	
MOTOR POWER	0V	165V	ABS MAX 180VDC
PER MOTOR CURRENT	0	22.5A	
CURRENT LIMIT	11.25A	22.5A	
OPERATING TEMP.	0°C	+70°C	
OPERATING TEMP. (-I version)	-40°C	+85°C	
OPERATION HUMIDITY	0	95%	NON-CONDENSING


ENC1
ENCO
P1
P2
P3
P4
MESA 7I29
ART REV. C
CAUTION: HIGH VOLTAGE!
4.400
1.400
0.400
2.835
2.600
2.350
0.200
0.200
2.400
4.125
5.000
5.217
0.675