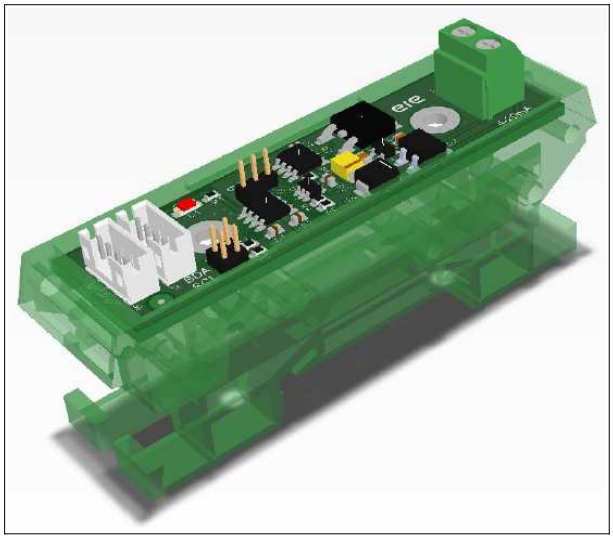
I2C-AO112DIx

I2C-Bus 4-20mA Analog Output Boards Din-Rail supports



Features

- Single Channel Analog Output 2-wire Current Loop 4-20 mA
- 12 Bits Digital to Analog Converter MCP4725
- I2C-Bus Interfacing 100Khz, 400Khz
- I2C-Bus Operating Voltage 3-5VDC
- On-Board Pull-Up Resistors for I2C-Bus
- Selectable I2C-bus addresses
- Up to 8 boards on a Single Bus
- Compatible with Most Microcontrollers
- Accept 9-36VDC for Analog Output Loop Voltage
- Inverse Polarity Protection Circuits
- Transient Voltage Protections
- Din-rail supports

1. Introduction

When a sensor such as temperature sensor, humidity sensor, and pressure sensor sends an analog signal on a long cable in a disturbed environment to a processing units such as a computer, a PLC ,and a microcontroller. A current loop is always chosen because it's robust for sending an analog signal.

The I2C-AO112DIx is a brand new current loop board. It receives digital data from a sensor and a microcontroller, and it sends the data out as an analog signal, 4-20mA current loop. An I2C-Bus is used to interface the sensor and the microcontroller to this board. Also the board is designed for supporting a Din-rail PCB Holder. Thus it's easy to be installed on industrial plants. The I2C-AO112DIx family composes of four models, I2C-AO112DI0, I2C-AO112DI1, I2C-AO112DI2, and I2C-AO112DI3 that they can be connected together up to eight boards on a single bus.

2. Diagrams

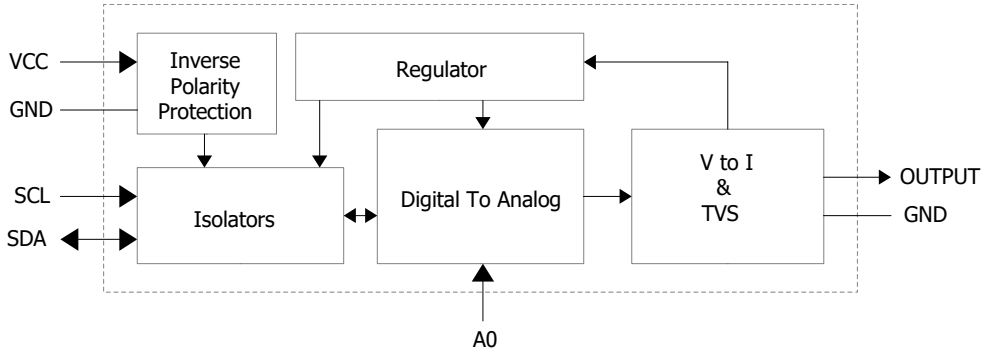


Figure 1: Block Diagram

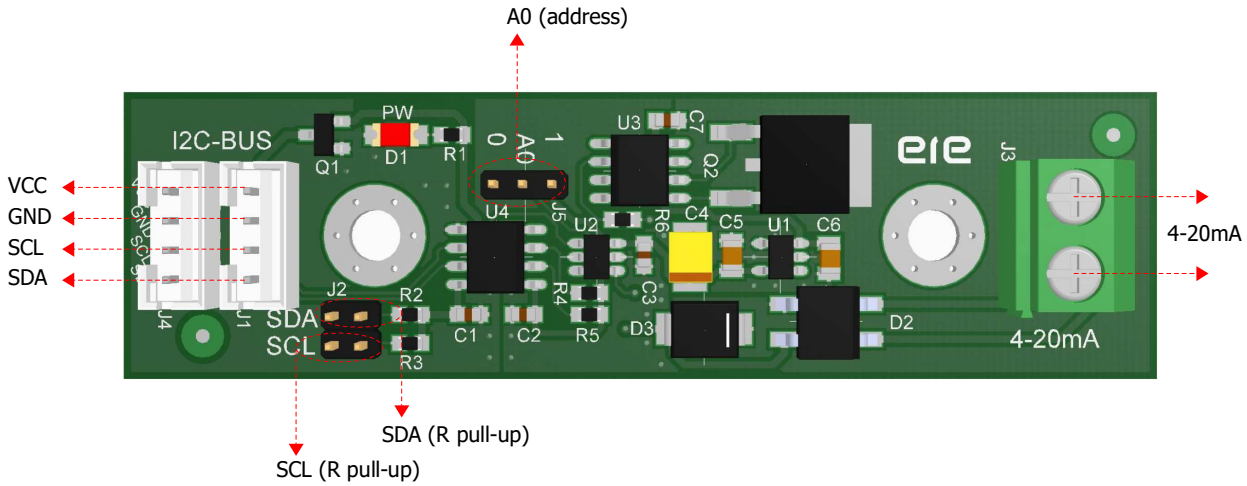


Figure 2: Board Diagram

Table 1: Pin Descriptions

Symbols	Descriptions
VCC	Power supply for I2C-Bus
GND	Ground for I2C-bus.
SCL	I2C-bus serial clock signal.
SDA	I2C-bus serial data signal.
R-PULL (SDA)	A jumper for enable/disable a pull-up resistor of SDA line.
R-PULL (SCL)	A jumper for enable/disable a pull-up resistor of SCL line.
A0	A jumper for selecting address of A0.
4-20mA	4-20mA analog output current loop.

3. Analog Output Current Loop

The analog output is a single channel current loop, 2-wire 4-20mA. It can be connected to an input of a receiver and a resistor called RL. A power supply for the analog current loop is 9-36VDC. The board has an output bridge circuit. So users do not worry about polarity of power supply. Also the output circuit has a transient voltage suppressor to limit external voltage spikes.

An analog output must be connected to 9-36VDC when the DAC (MCP4725) is interfacing to I2C bus. Because the DAC draws current from the current loop power supply. It doesn't draw current from I2C-Bus.

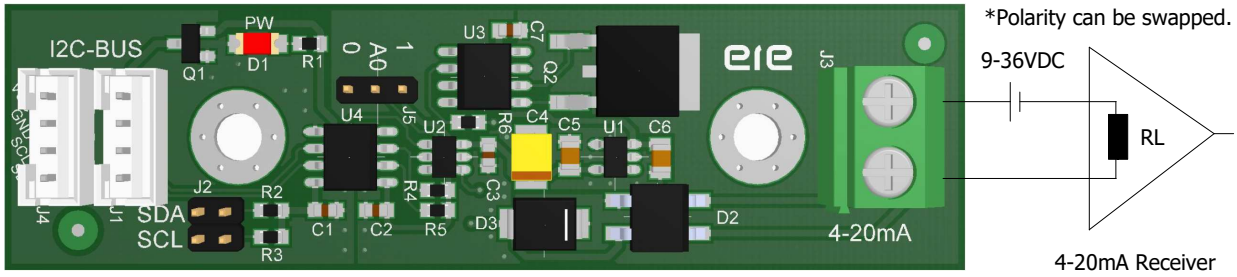


Figure 3: Analog Output Current Loop

4. I2C-Bus Pull-Up Resistors

I2C-Bus devices use open-drain circuits. So an I2C-Bus needs pull-up resistors at the ends of SCL and SDA lines. Most of a master (microcontroller) board has prepared these pull-up resistors. But sometimes the resistors have to be connected on the lines externally. However, this board has a pair of 10K ohm resistors for this purpose. They can be enabled by closing the jumpers. These resistors have to be enabled if there is no any pull-up resistors on the bus.

The I2C-Bus usually uses a pair of resistors when the boards are connected together on a single bus. More parallel pull-up resistors make the bus stronger, but the strong bus is needed for very high speed data transfering. The a pair of 10K ohm resistors are suitable for 100KHz bus frequency.

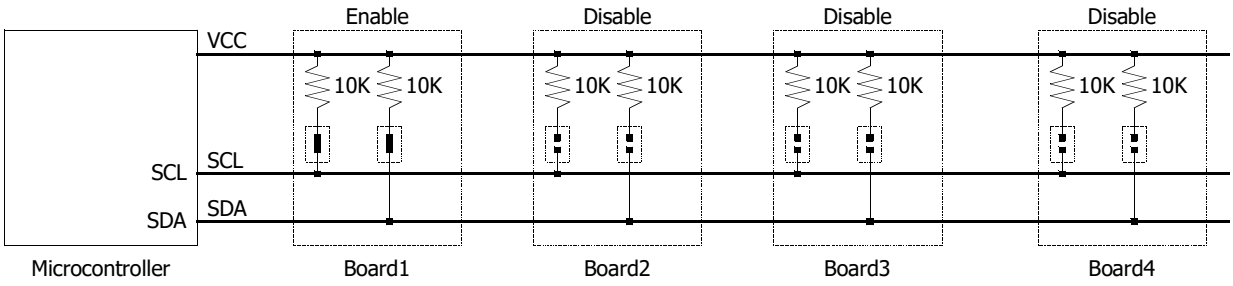


Figure 4: I2C-Bus pull-up resistors

5. I2C-bus Interfacing

An I2C-Bus is used to interface to a digital part on this board. The VCC, GND, SCL, and SDA lines must be connected to I2C-Bus master correctly. The VCC can be connected to VCC of the master. The SCL and SDA pins must be connected to the SCL and SDA pins of the master respectively. Remember the board must enable the pull-up resistors if there are no any external pull-up resistors. When the VCC is applied into the board, an LED turns on.

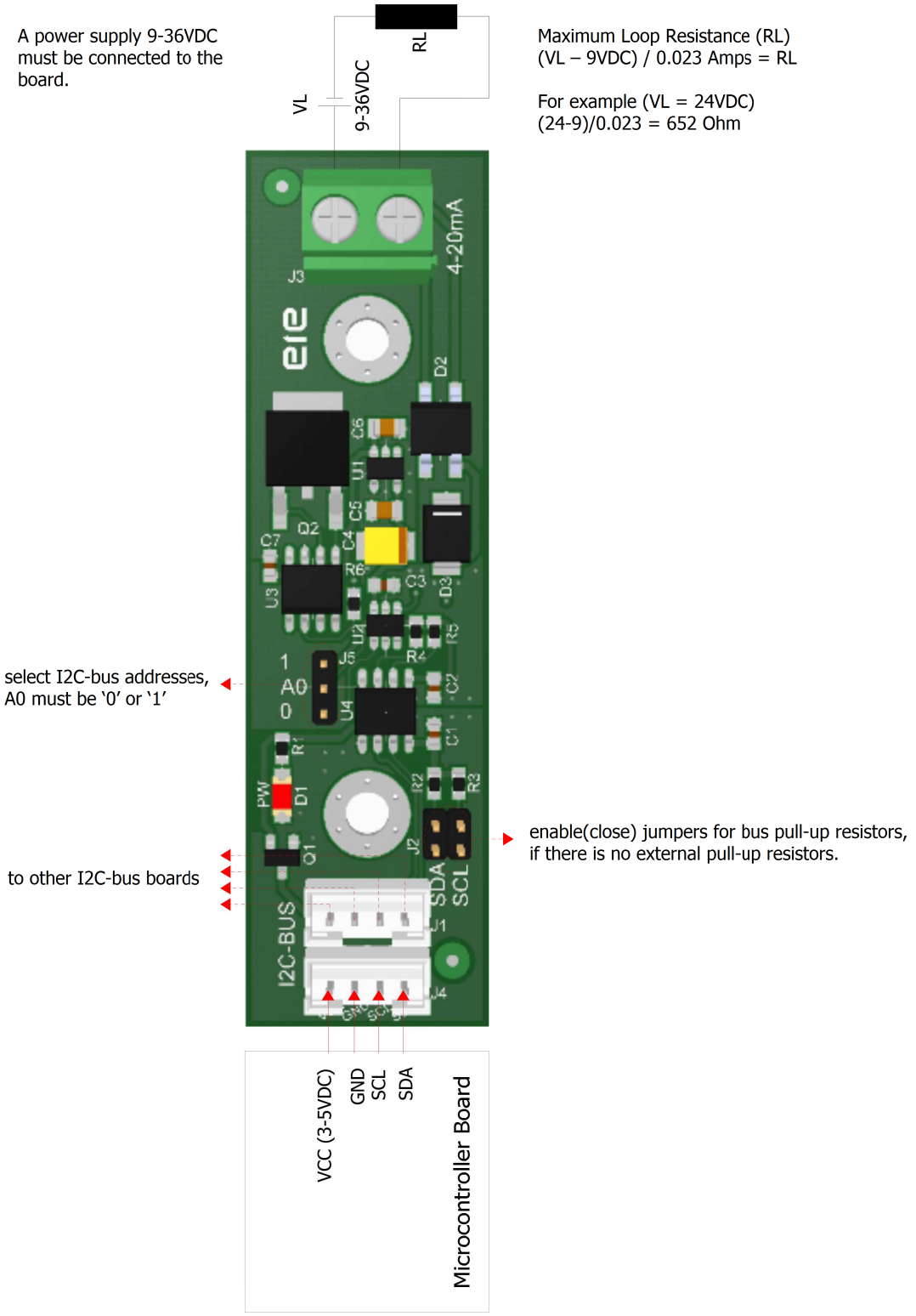


Figure 5: I2C-Bus Interfacing

A pair of the same model boards can be connected on a single bus because the board has only one address pin, it is A0. The address jumper of each board must be either set as "0" or "1". The same model of a board cannot be connected more than two boards on a single bus.

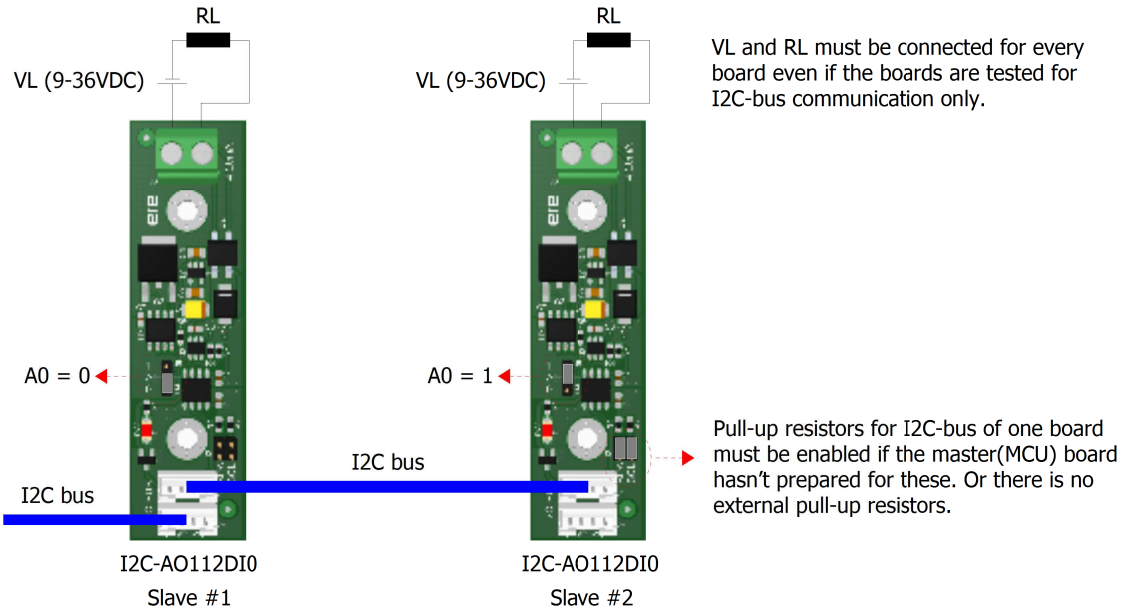


Figure 6: Two Boards Same Model Connection

However, 8 boards of 4 models can be connected together on a single bus. By using two boards of each model.

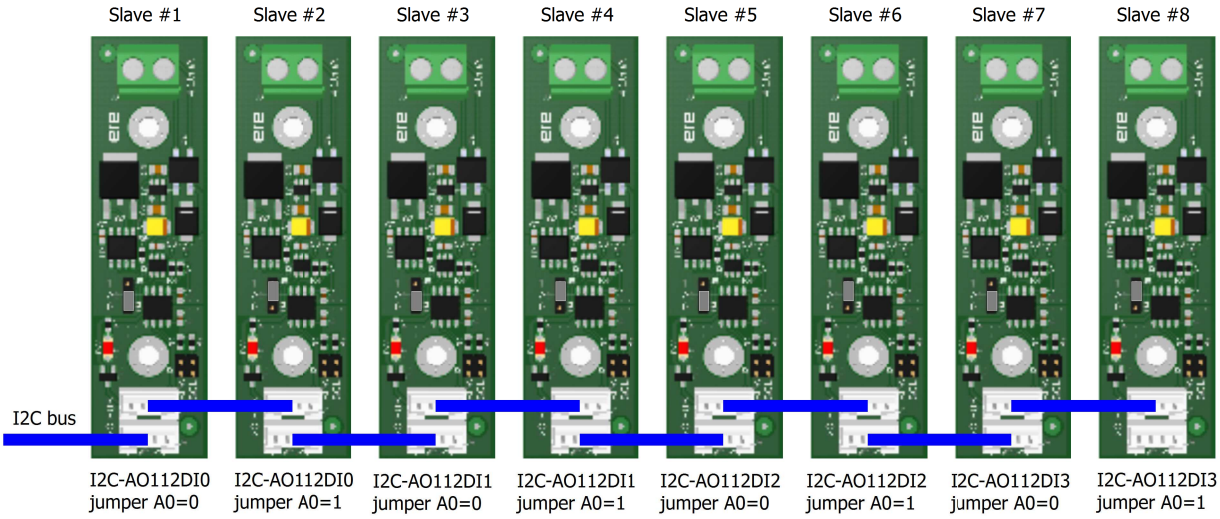


Figure 7: Eight Boards Different Model Connection

6. I2C-Bus Addressing

Every board can be addressed by a jumper to make two different addresses.

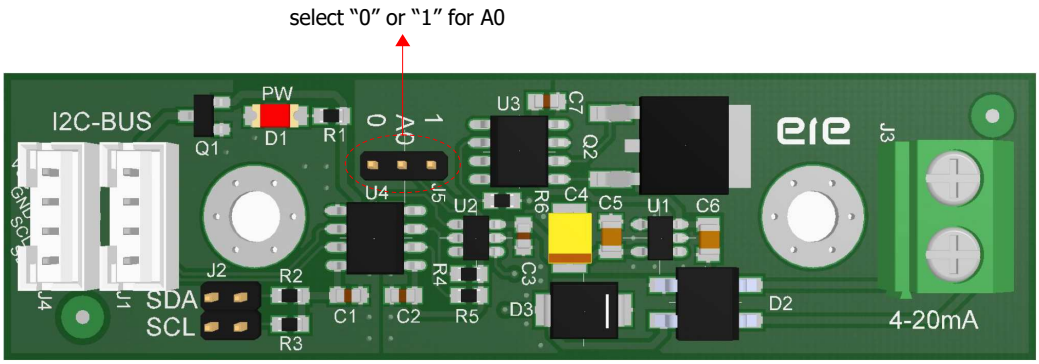


Figure 8: A Jumper for Addressing

Table 2: Address Setting for I2C-AO112DI0

Address Byte for Reading	Address Byte for Writing	Jumper Setting (A0)
S 1 1 0 0 0 0 0 1 A (A2 A1 A0 R/W) 0xC1	S 1 1 0 0 0 0 0 0 A (A2 A1 A0 R/W) 0xC0	A0 = 0
S 1 1 0 1 0 0 1 1 A (A2 A1 A0 R/W) 0xD3	S 1 1 0 1 0 0 1 0 A (A2 A1 A0 R/W) 0xD2	A0 = 1

Table 3: Address Setting for I2C-AO112DI1

Address Byte for Reading	Address Byte for Writing	Jumper Setting (A0)
S 1 1 0 0 0 1 0 1 A (A2 A1 A0 R/W) 0xC5	S 1 1 0 0 0 1 0 0 A (A2 A1 A0 R/W) 0xC4	A0 = 0
S 1 1 0 0 0 1 1 1 A (A2 A1 A0 R/W) 0xC7	S 1 1 0 0 0 1 1 0 A (A2 A1 A0 R/W) 0xC6	A0 = 1

Table 4: Address Setting for I2C-AO112DI2

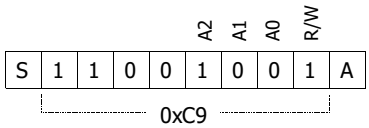
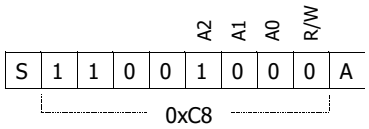
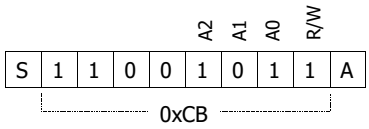
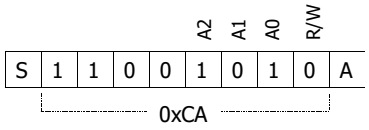
Address Byte for Reading	Address Byte for Writing	Jumper Setting (A0)
		A0 = 0
		A0 = 1

Table 5: Address Setting for I2C-AO112DI3

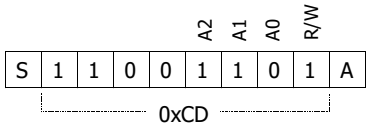
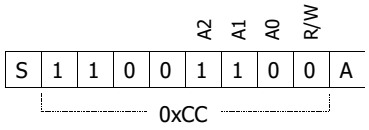
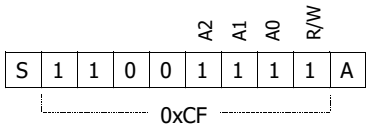
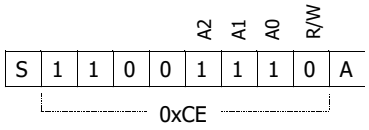
Address Setting for Reading	Address Setting for Writing	Jumper Setting (A0)
		A0 = 0
		A0 = 1

Table 6: Specifications

Power supply voltage for I2C bus	3.00-5.00 VDC
Power supply voltage for analog output	9.00-36.00 VDC
Interface	I2C-Bus
Max. board on bus	2 Boards (*up to 8 Boards)
Max. I2C-bus frequency	100Khz, 400Khz
Output channel	1 Channel
Output current range	2.xx – 23.xx mA**

*Up to 8 boards when using different models, I2C-AO112DI0, I2C-AO112DI1, I2C-AO112DI2, and I2C-AO112DI3
**.xx means .00 -.99

7. Board Model Codes

The I2C-AI112DIx has four different models. Every model looks the same, so it's difficult to distinguish them. However each model uses a particular DAC chip, so a code on top of the chip have to be observed for separating the board models.

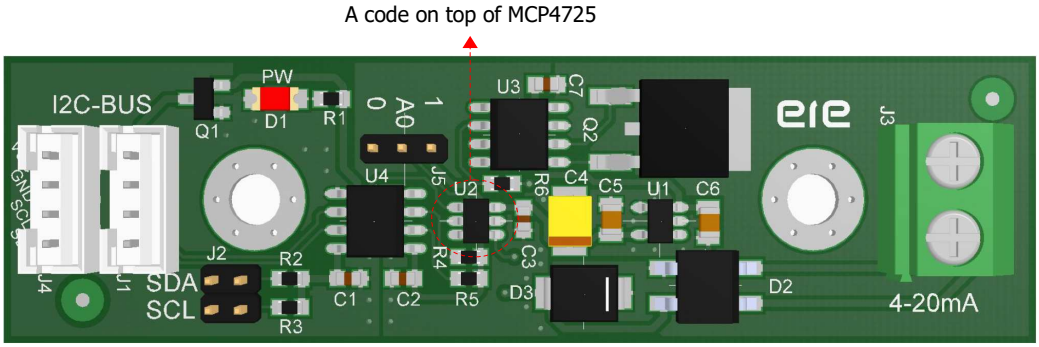
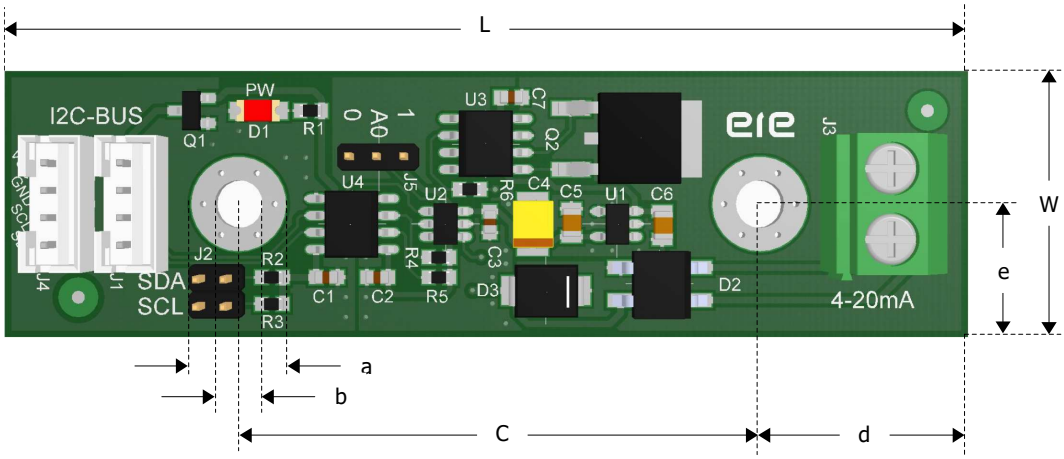


Figure 9: Board Model Codes

Table 7: Board Model Codes

Board Models	DAC Chips	Codes
I2C-AO112DI0	MCP4725A0	AJ
I2C-AO112DI1	MCP4725A1	AP
I2C-AO112DI2	MCP4725A2	AQ
I2C-AO112DI3	MCP4725A3	AR

8. Board Dimensions



unit	inch	mm
L	2.834	72.00
W	0.787	20.00
C	1.535	39.00
e	0.393	10.00
a	0.279	7.10
b	0.141	3.60
d	0.610	15.50

Figure 10: Board Dimensions