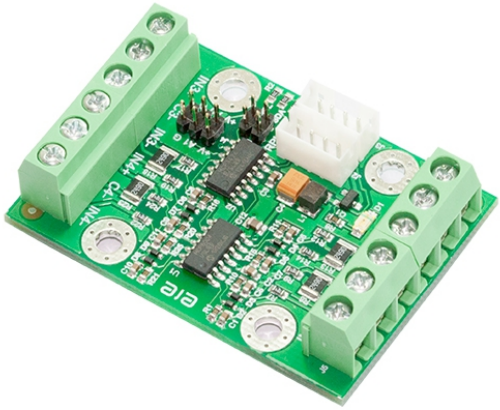
I2C-AI418S

I2C Bus Voltage and Current Analog Input Board



Features

- 4 Channels Of Analog Inputs
- MCP3424, 12,14,16 and 18-Bit
- Voltage Input: 0-5V, 0-10V
- Current Input: 0-20mA, 4-20mA, 0-40mA
- I2C Bus Interface 100Khz, 400Khz, 3.4Mhz
- Programmable Gain Amplifier(PGA)
- Pull-Up Resistors for I2C Bus
- Up To 8 Boards On Bus
- Compatible With Most Microcontrollers
- Single Supply Operating Voltage: 2.7V to 5.5V
- Inverse Polarity Protection Circuits for Supply Voltage
- Over Input Voltage Protections
- PCB Size 37x53mm

Introduction

This is an I2C bus analog to digital converter board, I2C ADC board. You can connect voltage and current sources to inputs of this board. The board converts the analog value to digital value. The digital value of this board can be processed by microcontrollers. The microcontrollers can read the digital value of this board via I2C bus. The I2C ADC board has 4 channels of inputs. Each channel accepts voltage 0-5V, 0-10V and current 0-20mA, 4-20mA, 0-40mA. Resolution of digital value of this board can be 12,14,16 and 18-bit. Which the most significant bit (MSB) is used for a sign bit. For this board, the sign bit is away zero. It represents a plus sign. The PGA can be programmed via I2C bus.

The board needs only single supply voltage from 2.7V to 5.5V. The I2C bus compatible standard 100Khz, 400Khz and 3.4Mhz mode.

The I2C bus address are selected by two jumpers. The board can be configured to one of eight addresses. It means eight boards can be connected together on the same bus. The board has two of 10K ohm pull-up resistors for I2C bus. The user can enable or disable them by jumpers. The 10K ohm resistor is suitable for 100KHz bus speed.

Diagram

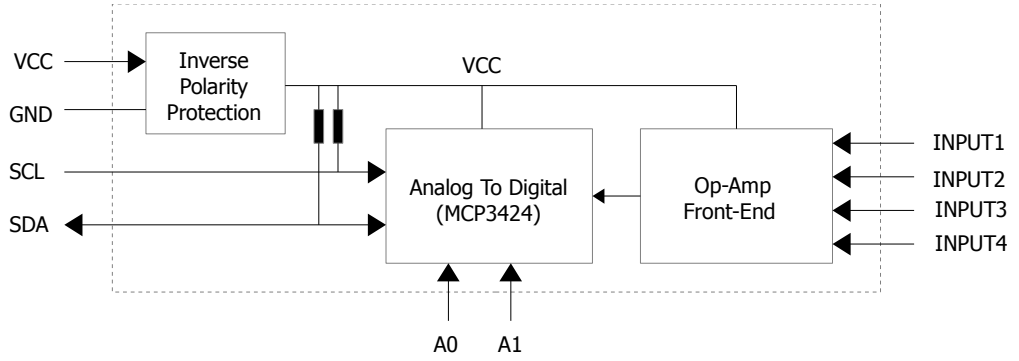


Figure 1: Block Diagram

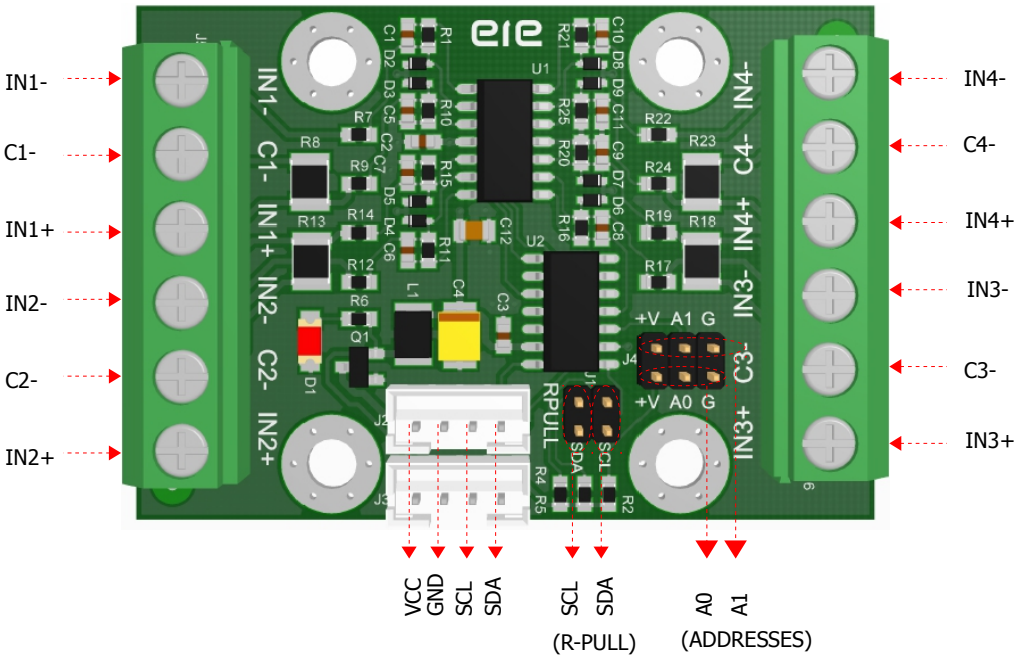


Figure 2: Board Layout

Table 1: Pin Descriptions

Symbol	Description
VCC	Power supply input voltage.
GND	Ground.
SCL	I2C bus serial clock signal.
SDA	I2C bus serial data signal.
R-PULL (SDA)	A jumper for selecting 10K pull-up resistor of SDA.
R-PULL (SCL)	A jumper for selecting 10K pull-up resistor of SCL.
A0	A jumper for selecting address of A0.
A1	A jumper for selecting address of A1.
IN1+… IN4+	Positive voltage and current for INPUT1 to INPUT4
IN1-... IN4-	Negative voltage for INPUT1 to INPUT4
C1-... C4-	Negative current for INPUT1 to INPUT4 (connect to IN1-..IN4- when input is current)

Analog Inputs

The user can connect voltage and current sources to input connectors of the board. The voltage of each channel can be 0-5V and 0-10V. Also the current of each channel can be 0-20mA, 4-20mA and 0-40mA.

Voltage and Current Connection

A figure shows a methods to connect voltage sources and current sources to input connectors of the board.

When user wants to connect voltage sources to the board. The positive wire of the voltage source has to connect to the INx+. And the negative wire of the voltage source has to connect to INx-. Leave the Cx- alone.

When user wants to connect current sources to the board. The positive wire of the current source has to connect to the INx+. And the negative wire of the current source has to connect to INx- and Cx-. It means the user has to short INx- to Cx- when current sources connect to the board.

Voltage and current outputs from any sensors are connected to the board as same as the figure.

x *means channel number 1,2,3 and 4*

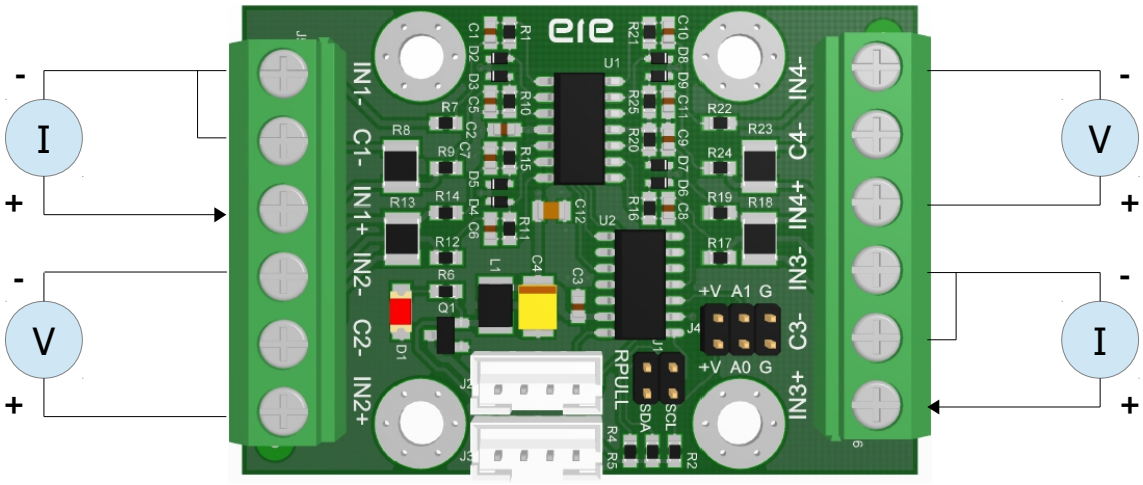


Figure 3: Input Source Connection

Table 2: Gain and Scale

Input Source	PGA	Analog Full Scale	12-bit max code	14-bit max code	16-bit max code	18-bit max code
0-5V	2	5.585V	2047	8191	32767	131071
0-10V	1	11.170V	2047	8191	32767	131071
0-20mA	2	22.431mA	2047	8191	32767	131071
4-20mA	2	22.431mA	2047	8191	32767	131071
0-40mA	1	44.863mA	2047	8191	32767	131071

MSB bit of digital code is a sign bit. For this board the sign bit(MSB) is away zero, It represents positive value.

VREF is voltage reference internal of MCP3424 chip. The value is 2.048V

PGA is a programmable gain of MCP3424. The user defines via I2C bus.

Front-End Gain(FEG) is a gain of op-amp circuit of each channel.

Front-End Gain(FEG) of this board is $\frac{33}{180}$

Analog Full Scale is a maximum value of input signal when digital code is maximum. This value can be calculated by

Analog Full Scale = $(\frac{VREF}{PGA})(\frac{1}{FEG})$

If the user wants to know input voltage from digital code that read over I2C bus. The user can use the following formula

input voltage = $(\frac{code}{max\,code})(\frac{VREF}{PGA})(\frac{1}{FEG})$

Also if input signal is current. The user can use the following formula to calculate the input current.

input current = $\frac{input\ voltage}{249}$

I2C Bus Pull-Up Registers

The I2C bus needs resistors for pulling-up SCL and SDA lines. The board has two 10K ohm resistors for this purpose. These resistors can be enabled by closing jumpers. These resistors have to be enabled if there is no any resistor on the bus.

The bus usually needs only one resistor when boards are connected together on the bus. More resistors make bus stronger. But the strong bus is needed for high frequency bus. The 10K ohm is suitable for 100KHz bus frequency.

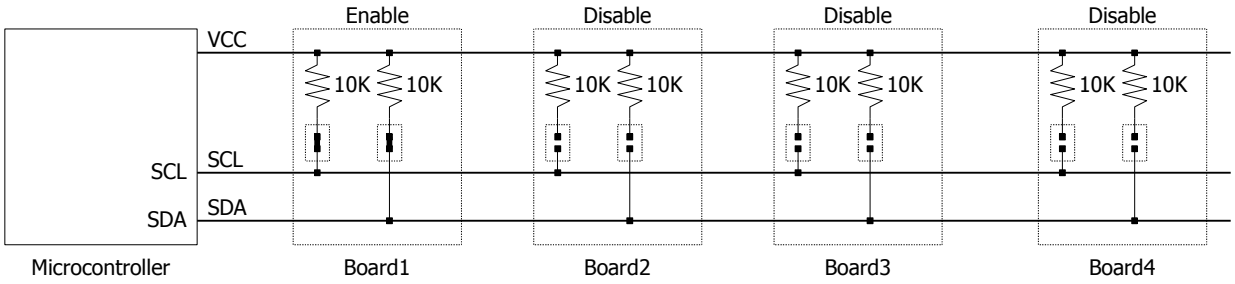


Figure 4: I2C bus resistors

Interfacing

When VCC is supplied into the board the LED turns on. The SCL and SDA pins must be connected to SCL and SDA pins of microcontroller respectively. Remember pull-up resistors must be enabled when there is no external pull-up resistor on the bus.

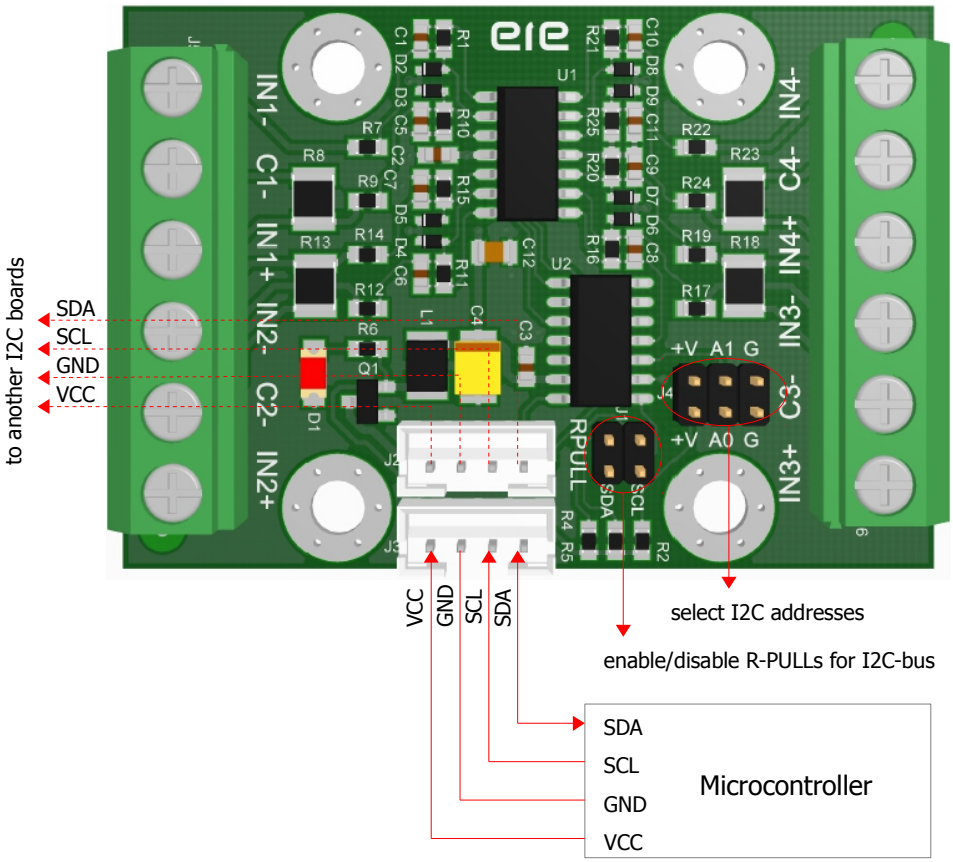


Figure 5: Interface

The boards can be connected together up to 8 boards on a single bus.

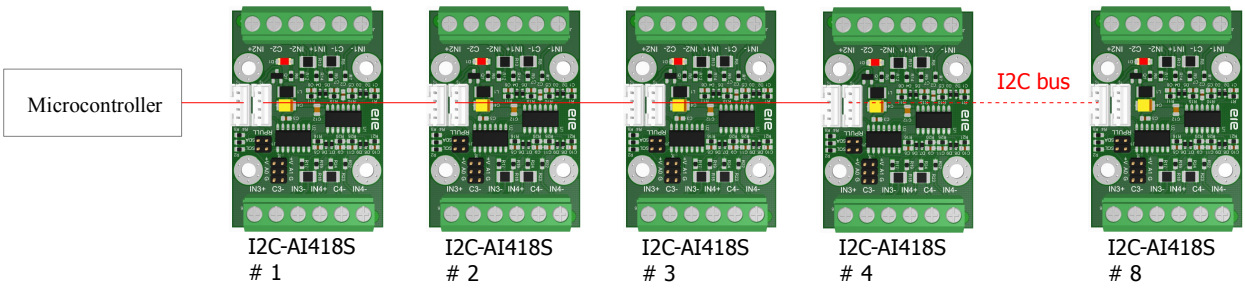


Figure 6: Multi-Boards on Bus

Address

The board is addressed by 2 jumpers to make 8 different addresses.

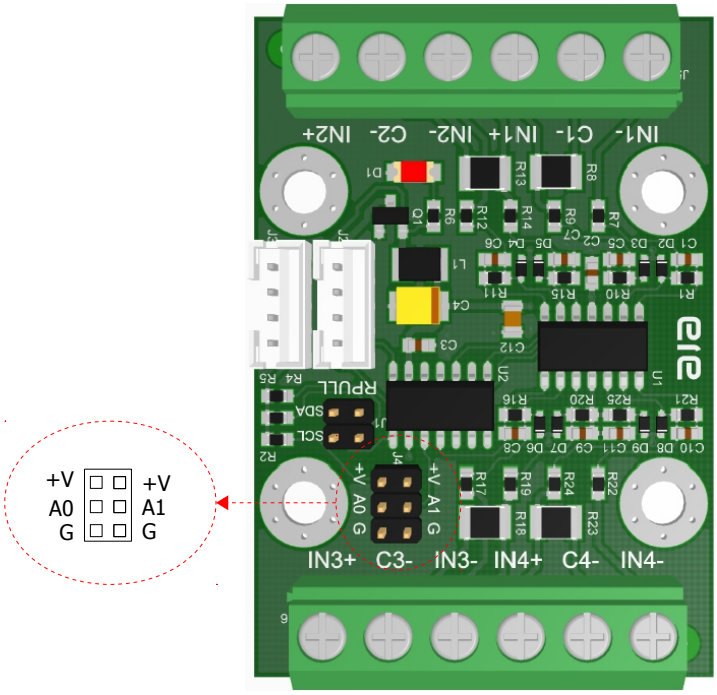


Figure 7: Address Jumpers

Table 3: Address Setting

Address Byte for Reading	Address Byte for Writing	Jumper Setting
A2 A1 A0 R/W S 1 1 0 1 0 0 0 1 A 0xD1	A2 A1 A0 R/W S 1 1 0 1 0 0 0 0 A 0xD0	+V +V A0 A1 G G +V +V A0 A1 G G

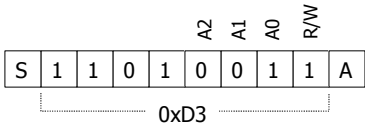
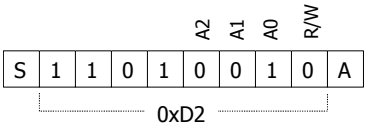
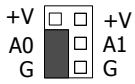
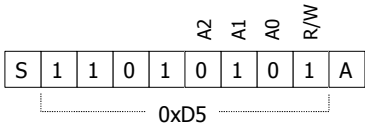
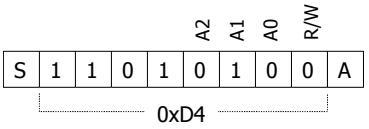
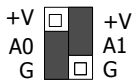
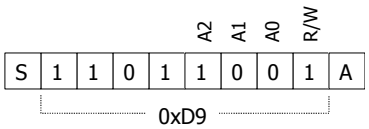
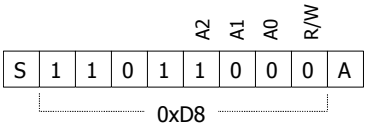
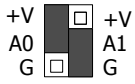
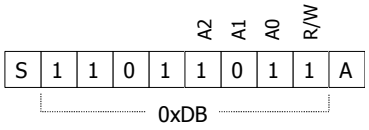
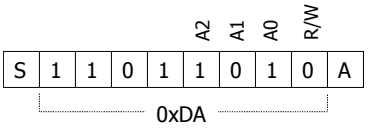
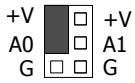
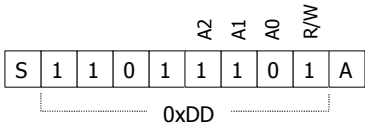
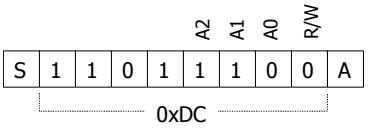
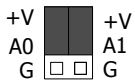
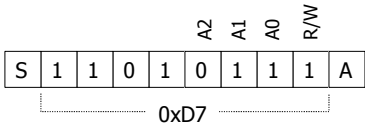
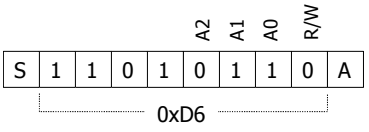
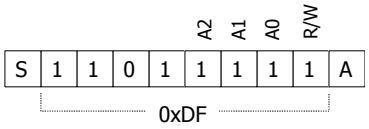
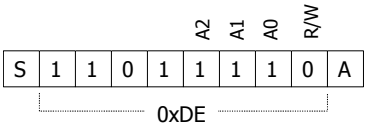
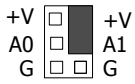
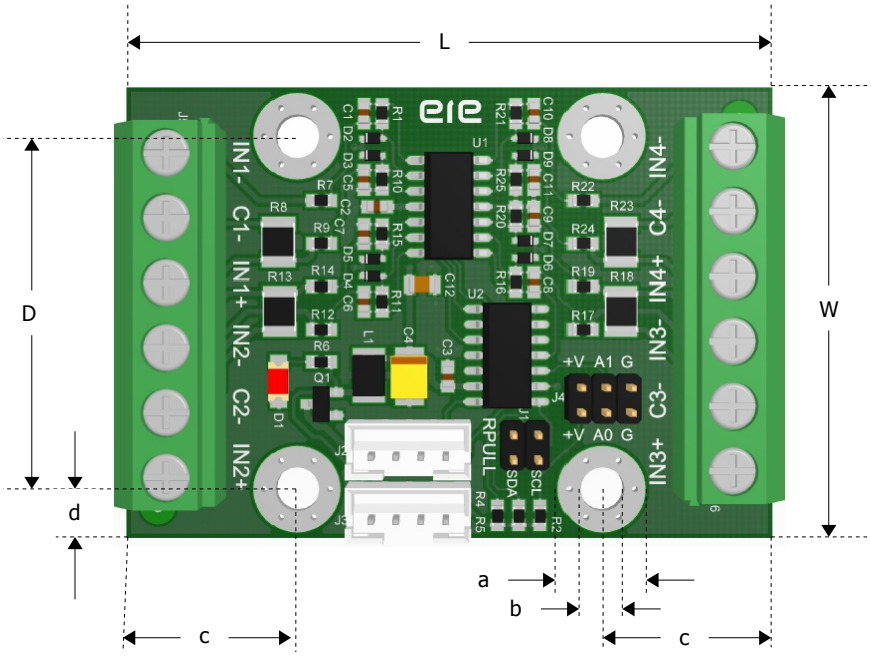
Address Byte for Reading	Address Byte for Writing	Jumper Setting
		
		
		
		
		
		
		

Table 4: Specification

Operating voltage	2.7V – 5.5V
Interface	I2C bus
Max. board on bus	8 boards
Max. bus frequency	100Khz, 400Khz, 3.4Mhz
Input channel	4 channels
Input voltage range	0-5V, 0-10V
Input current range	4-20mA, 0-20mA, 0-40mA

Dimensions



unit	inch	mm
L	2.086	53.00
W	1.456	37.00
D	1.141	29.00
a	0.279	7.10
b	0.141	3.60
c	0.551	14.00
d	0.157	4.00

Figure 8: Board Dimension