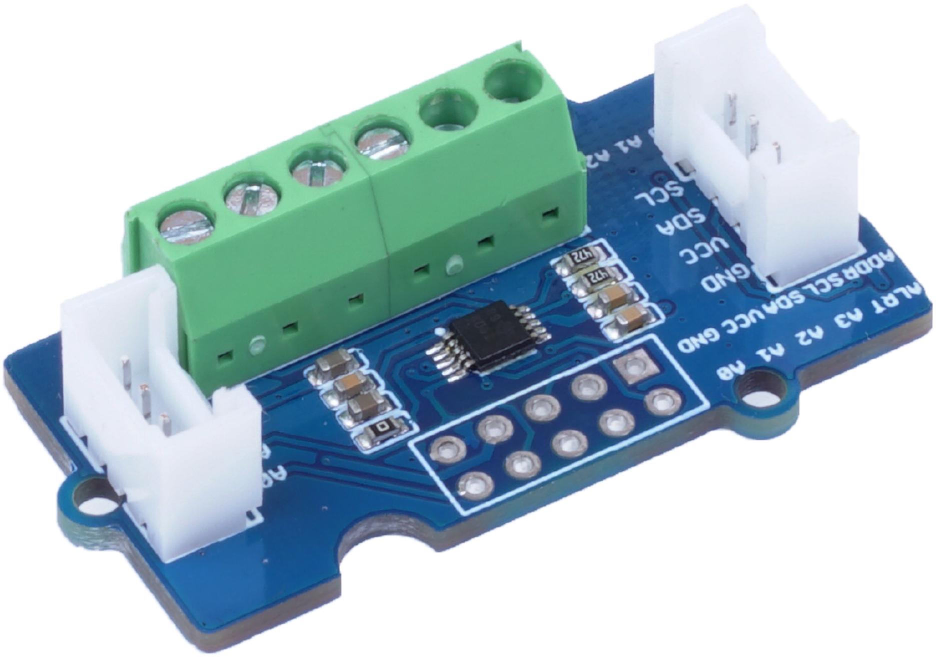
Grove - 4 Channel 16-bit ADC(ADS1115)



For microcontrollers without an analog-to-digital converter, or when you need a more accurate ADC. We provide Grove - 4-channel 16-bit ADC(ADS1115), a 4-channel ADC based on Texas Instrument ADS1115, which is a high-precision, low-power, 16-bit ADC chip. It supports 4 single ended inputs or 2 differential inputs. What’s more, it has a programmable data rate range from 8 SPS to 860 SPS with an internal programmable gain (up to x16) for small signals.

The module also contains a Grove port that is internally connected to its channel 0 and channel 1, of which makes it easier to use with Grove Ecosystem.

Get One Now

[https://www.seeedstudio.com/Grove-Speaker-Plus-p-4592.html]

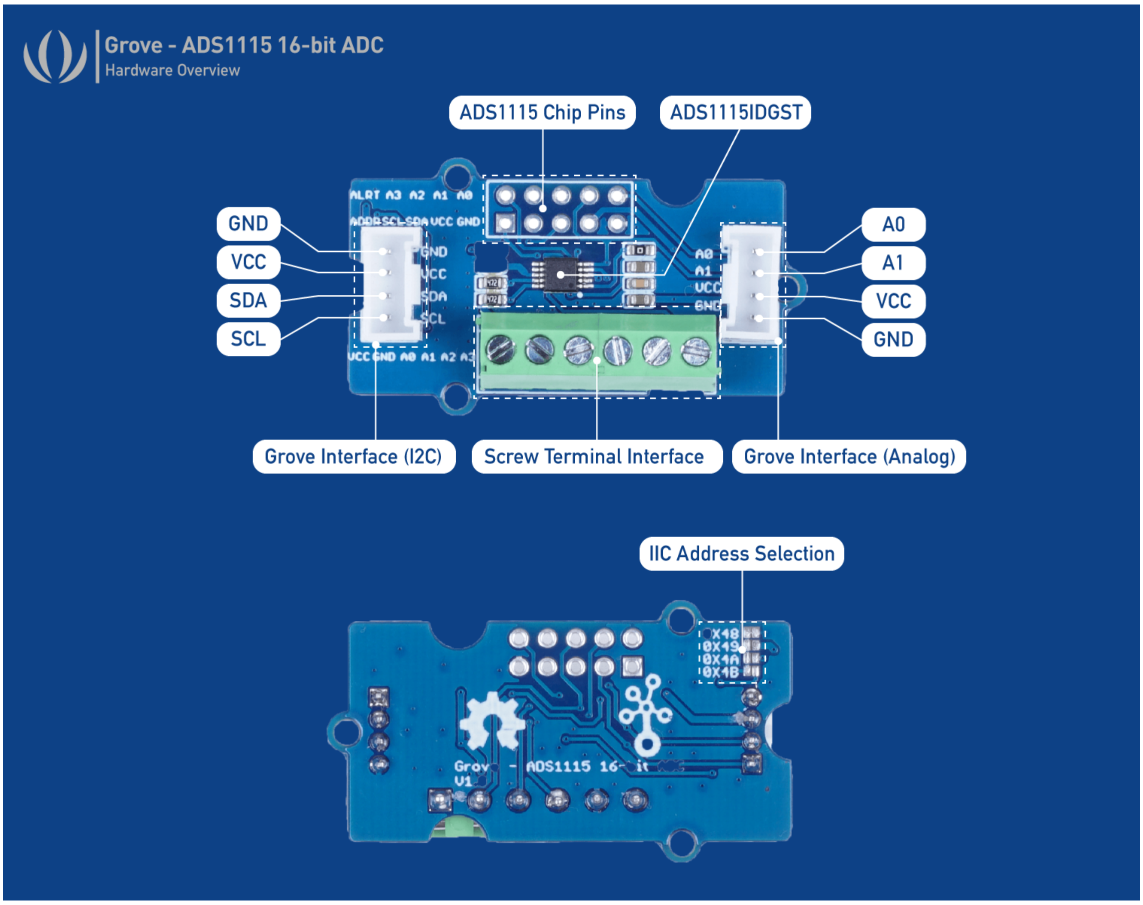
Feature

- Wide supply range: 2.0V ~ 5.5V, support 3.3 or 5V system
- 16-bit high resolution ADC
- Programmable Data Rate: 8 SPS to 860 SPS
- Internal Programmable Gain: x16 with Internal low-drift voltage reference and oscillator
- The built-in PGA is gain-adjustable and can be controlled by software
- 4 Single-Ended Inputs or 2 Differential Inputs

Specification

Parameter	Value
Input voltage	3.3V / 5V
ADC Resolution	16 Bit
Programmable Data Rate	8SPS - 860 SPS
Channels	4-channel single-ended input or 2-channel differential input
Interface	I2C, Default Address: 0x48

Hardware Overview



Platforms Supported

Arduino	Raspberry	ArduPy
		ARDUPY

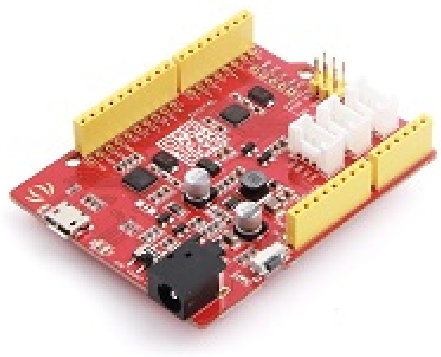
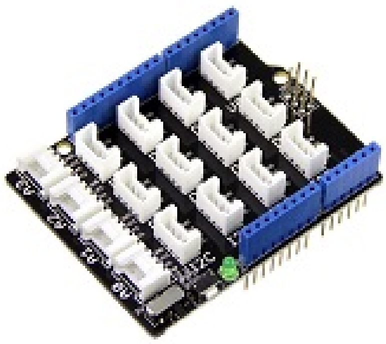
Caution
The platforms mentioned above as supported is/are an indication of the module's software or theoritical compatibility. We only provide software

library or code examples for Arduino platform in most cases. It is not possible to provide software library / demo code for all possible MCU platforms. Hence, users have to write their own software library.

Getting Started

Play With Arduino

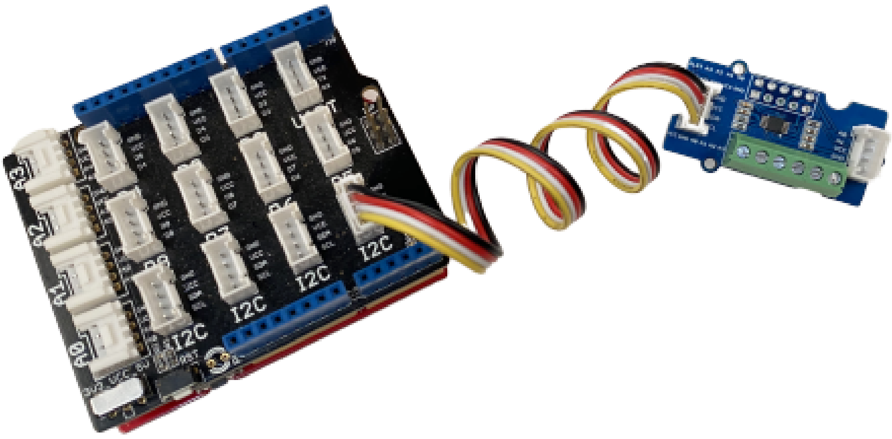
Materials required

Seeeduino V4.2	Base Shield
	
Get ONE Now [https://www.seeedstudio.com/Seeeduino-V4.2-p-2517.html]	Get ONE Now [https://www.seeedstudio.com/Base Shield-V2-p-1378.html]

> In addition, you can consider our new Seeeduino Lotus M0+ [https://www.seeedstudio.com/Seeeduino-Lotus-Cortex-M0-p-2896.html], which is equivalent to the combination of Seeeduino V4.2 and Baseshield.

Hardware Connection

- **Step 1.** Plug Grove - 16 Bit ADC(ADS1115) to the **I2C** port of Grove - Base Shield.
- **Step 2.** Plug Grove - Base Shield into Seeeduino.
- **Step 3.** Connect Seeeduino to a PC via a USB cable.



Software

Attention

If this is the first time you work with Arduino, we strongly recommend you to see Getting Started with Arduino [http://wiki.seeedstudio.com/Getting_Started_with_Arduino/] before the start.

- **Step 1.** Download the Seeed Arduino ADS1115 [https://github.com/Seeed-Studio/Seeed_Arduino_ADS1115] Library from Github.

Note

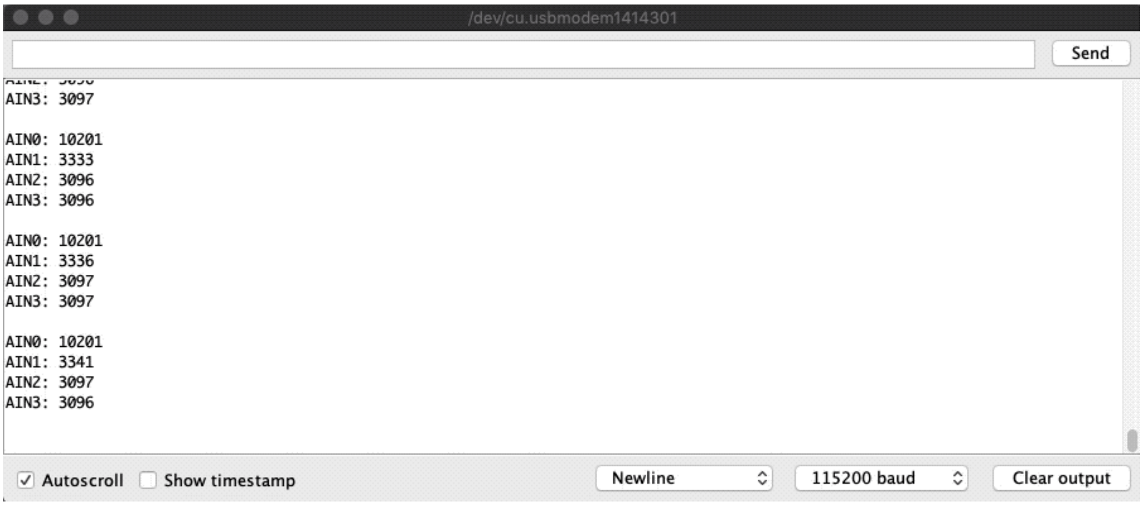
Refer How to install library to install library [http://wiki.seeedstudio.com/How_to_install_Arduino_Library/] for Arduino.

- **Step 2.** Restart the Arduino IDE. Open **Seeed_Arduino_ADS1115** example via the path: **File** → **Examples** → **Grove - ADS1115** → **single_ended**.

The `single_ended` Example code is as follow:

```
#include "ADS1115.h"

#ifdef SOFTWAREWIRE
    #include <SoftwareWire.h>
    SoftwareWire myWire(3, 2);
    ADS1115<SoftwareWire> ads(myWire);//IIC
#else
    #include <Wire.h>
    ADS1115<TwoWire> ads(Wire);//IIC
#endif

void setup(void)
{
    Serial.begin(115200);
    while(!ads.begin(0x48)){
        Serial.print("ads1115 init failed!!!");
        delay(1000);
    }
    //ads.begin(0x49)
    //ads.begin(0x4A)
    //ads.begin(0x4B)

    ads.setOperateMode(ADS1115_OS_SINGLE);
    ads.setOperateStaus(ADS1115_MODE_SINGLE);

   ads.setPGAGain(ADS1115_PGA_6_144);    // 2/3x gain +/-
    // ads.setPGAGain(ADS1115_PGA_4_096); // 1x gain   +
    // ads.setPGAGain(ADS1115_PGA_2_048); // 2x gain   +
    // ads.setPGAGain(ADS1115_PGA_1_024); // 4x gain   +
    // ads.setPGAGain(ADS1115_PGA_0_512); // 8x gain   +
    // ads.setPGAGain(ADS1115_PGA_0_256); // 16x gain  +

    ads.setSampleRate(ADS1115_DR_8); //8 SPS
    // ads.setSampleRate(ADS1115_DR_16); //16 SPS
    // ads.setSampleRate(ADS1115_DR_32); //32 SPS
    // ads.setSampleRate(ADS1115_DR_64); //64 SPS
    // ads.setSampleRate(ADS1115_DR_128); //128 SPS
    // ads.setSampleRate(ADS1115_DR_250); //250 SPS
    // ads.setSampleRate(ADS1115_DR_475); //475 SPS
    // ads.setSampleRate(ADS1115_DR_860); //860 SPS
}
void loop(void)
{
    int16_t adc0,adc1,adc2,adc3;
    adc0 = ads.getConversionResults(channel0); //P = AIN
    adc1 = ads.getConversionResults(channel1); //P = AIN
    adc2 = ads.getConversionResults(channel2); //P = AIN
    adc3 = ads.getConversionResults(channel3); //P = AIN
    Serial.print("AIN0: "); Serial.println(adc0);
    Serial.print("AIN1: "); Serial.println(adc1);
    Serial.print("AIN2: "); Serial.println(adc2);
    Serial.print("AIN3: "); Serial.println(adc3);
    Serial.println(" ");
    delay(1000);
}
```

- **Step 3.** Upload the demo. If you do not know how to upload the code, please check How to upload code [http://wiki.seeedstudio.com/Upload_Code/].
- **Step 4.** Open the **Serial Monitor** of Arduino IDE by click **Tool-> Serial Monitor**. Or tap the `Ctrl` + `Shift` + `M` key at the same time. Set the baud rate to **115200**.
- **Step 5.** The result should be like this for 4 channels:



```
AIN3: 3097

AIN0: 10201
AIN1: 3333
AIN2: 3096
AIN3: 3096

AIN0: 10201
AIN1: 3336
AIN2: 3097
AIN3: 3097

AIN0: 10201
AIN1: 3341
AIN2: 3097
AIN3: 3096
```

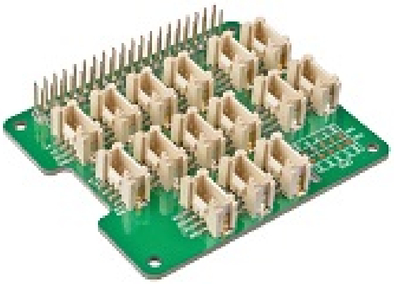
☑ Autoscroll □ Show timestamp Newline 115200 baud

Note

In this example, ⅔x gain is set so need to multiply value by 0.1875mV. For example, 10201 x 0.1875mV = 1.91V.

Play With Raspberry Pi

Hardware

Raspberry Pi	Grove Base Hat for RasPi
	
Get ONE Now [https://www.seeedstudio.com/Raspberry-Pi-3-Model-B-p-2625.html]	Get ONE Now [https://www.seeedstudio.com/Grove Base-Hat-for-Raspberry-Pi.html]

Software

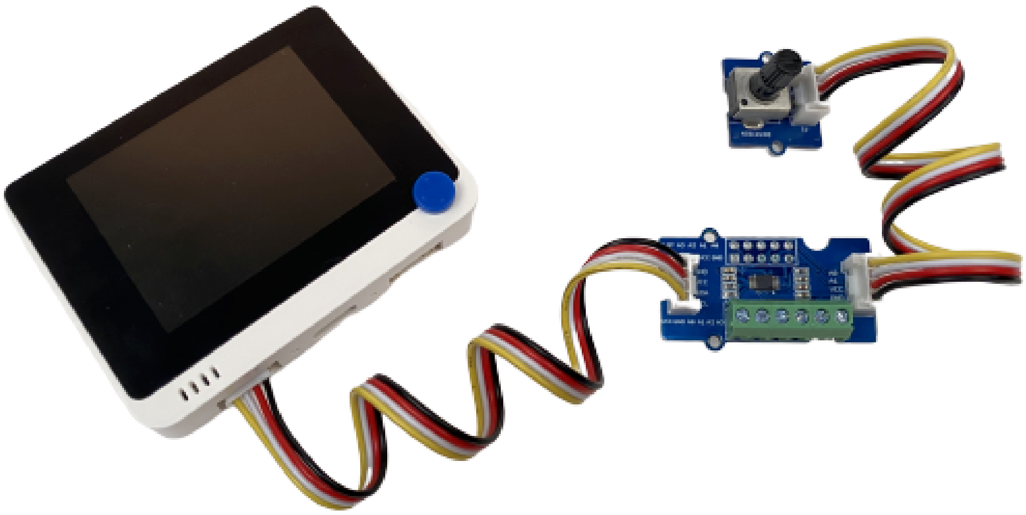
The Grove - 16-bit ADC(ADS1115) have the same usage as 4-Channel 16-Bit ADC for Raspberry Pi (ADS1115) and so please follow tutorials **here** [https://wiki.seeedstudio.com/4-Channel_16-Bit_ADC_for_Raspberry_Pi-ADS1115/#getting-started].

Play with Wio Terminal

Materials required

Wio Terminal	Grove - 16Bit ADC (ADS1115)	Grove - Rotary Angle Sens
Get ONE Now [https://www.seeedstudio.com/Wio-Terminal-p-4509.html]	Get ONE Now []	Get ONE Now [https://www.seeedstudic Rotary-Angle-Sensor--p-1:

- **Step 1.** Plug Grove - 16 Bit ADC(ADS1115) to the **I2C** port of Wio Terminal.
- **Step 2.** Connect Wio Terminal to a PC via a USB cable.

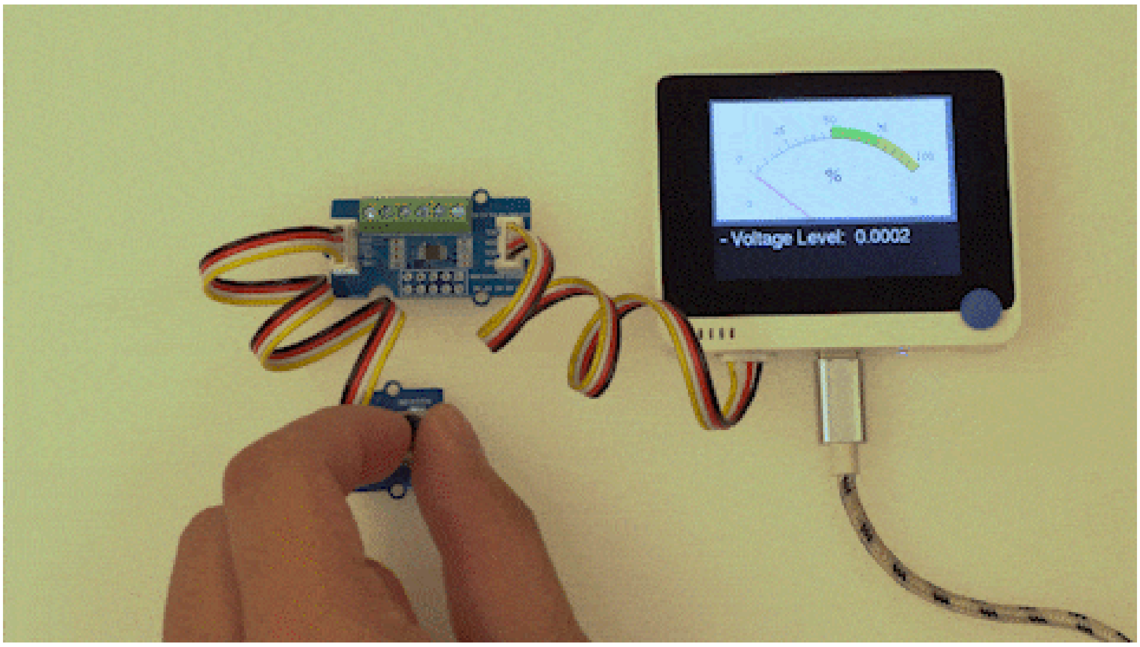


Software

- **Step 1.** Download the Seeed Arduino ADS1115 [https://github.com/Seeed-Studio/Seeed_Arduino_ADS1115] Library from Github.

> **Note**
> Follow Wio Terminal's get started [https://wiki.seeedstudio.com/Wio-Terminal-Getting-Started/] before the following steps.

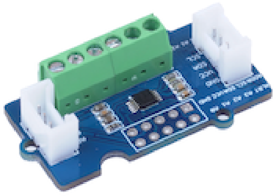
- **Step 2.** Download the **example code** [https://github.com/Seeed-Studio/Seeed_Arduino_Sketchbook/tree/master/examples/WioTerminal-ADS1115] here.
- **Step 3.** Upload the demo. If you do not know how to upload the code, please check How to upload code [http://wiki.seeedstudio.com/Upload_Code/].
- **Step 4.** Adjust the rotary sensor and you will see the corresponding voltage on Wio Terminal's LCD screen:



Play With Wio Terminal (ArduPy)

Hardware

- **Step 1.** Prepare the below stuffs:

Wio Terminal	Grove - 16 Bit ADC(ADS1115)
	
Get One Now [https://www.seeedstudio.com/Wio-Terminal-p-4509.html]	Get One Now []

- **Step 2.** Connect Grove - 16 Bit ADC(ADS1115) to **I2C** port of Wio Terminal.
- **Step 3.** Connect the Wio Terminal to PC through USB Type-C cable.

Software

- **Step 1.** Follow **ArduPy Getting Started** [https://wiki.seeedstudio.com/ArduPy/] to configure the ArduPy development environment on Wio Terminal.

- **Step 2.** Make sure that the ArduPy firmware with ADS1115 library is flashed into Wio Terminal. For more information, please follow **here** [https://wiki.seeedstudio.com/ArduPy/#ardupy-aip-cli-getting-started].

```
aip install Seeed-Studio/seeed-ardupy-ads1115
aip build
aip flash
```

- **Step 3.** Copy the following code and save it as `ArduPy-ads1115.py`:

Note: For more API, please check here [https://github.com/Seeed-Studio/seeed-ardupy-ads1115].

```python
from arduino import grove_ads1115
import time

ads = grove_ads1115()
ads.setPGAGain(0x0000)

while True:
    print ("The channel0 value is :", ads.channel0)
    print ("The channel1 value is :", ads.channel1)
    print ("The channel2 value is :", ads.channel2)
    print ("The channel3 value is :", ads.channel3)
    time.sleep(1)
```

- **Step 4.** Save the `ArduPy-ads1115.py` in a location that you know. Run the following command and **replace** `<YourPythonFilePath>` with your `ArduPy-ads1115.py` location.

```
aip shell -n -c "runfile <YourPythonFilePath>"
# Example:
# aip shell -n -c "runfile /Users/ansonhe/Desktop/ArduPy-
```

- **Step 5.** We will see the ADC value display on terminal as below:

```
ansonhe@Ansons-Macbook-Pro ~:aip shell -n -c "runfile /U
Positional argument (/dev/cu.usbmodem1413101) takes prec
Connected to ardupy
The channel0 value is : 17487.0
The channel1 value is : 3790.0
The channel2 value is : 3170.0
The channel3 value is : 3122.0
The channel0 value is : 17486.0
The channel1 value is : 3272.0
The channel2 value is : 3064.0
The channel3 value is : 3063.0
The channel0 value is : 17486.0
The channel1 value is : 3482.0
The channel2 value is : 3201.0
The channel3 value is : 3185.0
The channel0 value is : 17487.0
The channel1 value is : 17261.0
The channel2 value is : 5055.0
The channel3 value is : 4480.0
The channel0 value is : 11839.0
The channel1 value is : 3540.0
The channel2 value is : 1690.0
The channel3 value is : 1562.0
```

Precautions

Warning

When using multi-channel on **A0** and **A1** on screw terminal， please remember to not connect anything on the Grove Interface as they are also

> using A0 and A1. THIS MAY BE DANGEROUS WHEN DEALING WITH BATTERIES。

1. When in use, the maximum voltage must **not exceed 5.5V**.
2. When using the multi-channel acquisition, the sampling frequency must be set above 250SPS, otherwise the sampling frequency is too slow, and there is a possibility that the previous channel is not converted, the next channel is started, resulting in the failure to work

Schematic Online Viewer

Resources

- **[ZIP]** Grove - 16 Bit ADC(ADS1115 Schematics Files) [https://files.seeedstudio.com/wiki/Grove-16bit-ADC-ADS1115/Grove-ADS1115.zip]
- **[PDF]** Texas Instruments ADS1115 Datasheet [https://files.seeedstudio.com/wiki/Grove-16bit-ADC-ADS1115/ADS1115.pdf]

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