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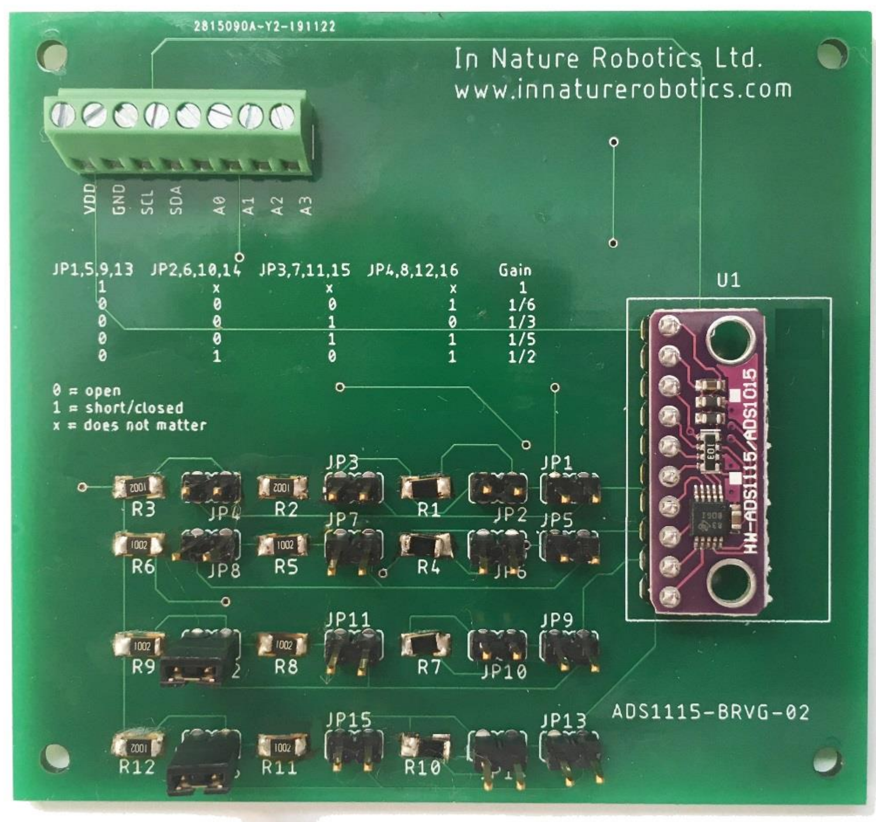
ADS1115-BRVG User Guide



Introduction

The ADS1115-BRVG is a high-precision 16-bit analog to digital converter module, with jumper-selectable and software-selectable gain settings. It uses an Inter-Integrated Circuit (I^2C) interface to enable simple communications with computer or microcontroller modules such as the Raspberry Pi™ or Arduino™.

Absolute Maximum Ratings[1]

Rating	Maximum Limit	Units
VDD to GND	-0.3 to +5.5	V
Analog input current	100, momentary	mA
Analog input current	10, continuous	mA
Analog input voltage to GND	-0.3 to VDD + 0.3	V
SDA, SCL, ADDR, ALERT/RDY voltage to GND	-0.5 to +5.5	V
Maximum junction temperature	+150	°C
Storage temperature range	-60 to +150	°C

(1) Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum conditions for extended periods may affect device reliability.

Electrical Characteristics

All specifications at -40 °C to +125 °C, VDD = 3.3V, and Full-Scale (FS) = ± 2.048V, unless otherwise noted. Typical values are at +25 °C.

Parameter	Test Conditions	Minimum	Typical	Maximum	Units
ANALOG INPUT					
Full-scale input voltage[1]	$V_{IN} = (AIN_P) - (AIN_N)$		± 4.096/PGA		V
Analog input voltage	AIN_P or AIN_N to GND	GND		VDD	
Common-mode input impedance	FS=±6.144V[1]		10		MΩ
	FS=±4.096V[1], ±2.048V		6		MΩ
	FS=±1.024V		3		MΩ
	FS=±0.512V, ±0.256V		100		MΩ
SYSTEM PERFORMANCE					
Resolution		16			Bits
Data rate (DR)			8, 16, 32, 64, 128,		Samples per

			250, 475, 860		second (SPS)
Data rate variation	All data rates	-10		10	%
Integral nonlinearity	DR = 8 SPS, FS=±2.048V, best fit[2]			1	Least significant bit (LSB)
Offset error	FS=±2.048V, differential inputs		±1	±3	LSB
	FS=±2.048V, single-ended inputs		±3		LSB
Offset drift	FS=±2.048V		0.005		LSB/°C
Offset power-supply rejection	FS=±2.048V		1		LSB/V
Gain error[3]	FS= ±2.048V at 25°C		0.01	0.15	%
Gain drift[3]	FS=±0.256V		7		ppm/°C
	FS=±2.048V		5	40	ppm/°C
	FS=±6.144V		5		ppm/°C
Gain power-supply rejection			80		ppm/V
PGA gain match(3)	Match between any two PGA gains		0.02	0.1	%
Gain match	Match between any two inputs		0.05	0.1	%
Offset match	Match between any two inputs		3		LSB
Common-mode rejection	At dc and FS=±0.256V		105		dB
	At dc and FS=±2.048V		100		dB
	At dc and FS=±6.144V[1]		90		dB
	f_{CM} = 60 Hz, DR=8SPS		105		dB
	f_{CM} = 50 Hz, DR=8SPS		105		dB
DIGITAL INPUT/OUTPUT					

Logic Level					
V_{IH}		0.7VDD		5.5	V
V_{IL}		GND - 0.5		0.3VDD	V
V_{OL}	I_{OL} = 3 mA	GND	0.15	0.4	V
Input Leakage					
I_H	V_{IH} = 5.5V			10	µA
I_L	V_{IL} = GND	10			µA
POWER SUPPLY REQUIREMENTS					
Power-supply voltage		2		5.5	V
Supply Current	Power-down current at 25 °C		0.5	2	µA
	Power-down current up to 125 °C			5	µA
	Operating current at 25 °C		150	200	µA
	Operating current up to 125 °C			300	µA
Power dissipation	VDD=5.0V		0.9		mW
	VDD=3.3V		0.5		mW
	VDD=2.0V		0.3		mW
TEMPERATURE					
Storage temperature		-60		+150	°C
Specified temperature		-40		+125	°C

(1) This parameter expresses the full-scale range of the ADC scaling. In no event should more than VDD+0.3V be applied to this device.
(2) 99% of full-scale.
(3) Includes all errors from onboard PGA and reference.

Jumper Settings For ADC Gain

The ADS1115-BRVG comes with jumpers and resistor dividers that can be used to divide the voltage seen by the analog to digital converter. This can be useful for example when monitoring a battery voltage or some other voltage that may be considerably higher than the power supply voltage (VDD) of the ADS1115 analog to digital converter. The following two tables indicate which jumpers correspond to which input channels of the ADS1115 (**Table 1**) and which jumper settings should be used to achieve a given gain at the ADS1115 (**Table 2**).

Table 1. Jumpers For A to D Channels

Channel	**Jumpers**
1	JP1, JP2, JP3, JP4
2	JP5, JP6, JP7, JP8
3	JP9, JP10, JP11, JP12
4	JP13, JP14, JP15, JP16

Table 2. Jumper Settings For A to D Input Gain

JP1, JP5, JP9, JP13	**JP2, JP6, JP10, JP14**	**JP3, JP7, JP11, JP15**	**JP4, JP8, JP12, JP16**	**Gain**
1	X	X	X	1
0	0	0	1	1/6
0	0	1	0	1/3
0	0	1	1	1/5
0	1	0	1	1/2

Phoenix Connector Screw Terminal Wiring

Electrical connections to the green Phoenix connector in the top-left corner of the board should be made as follows:

Table 3. Phoenix Connector Wiring

Terminal #	Signal
1 (leftmost terminal looking down on board)	VDD
2	GND
3	SCLK
4	SDA
5	A0
6	A1
7	A2
8 (rightmost terminal looking down on board)	A3

Sample Code

Arduino Uno Sample Code

The program below uses the default ADS1115 gain of 2/3, so that the reference voltage is ±4.096V/ (2/3) = ± 6.144V. The program samples the single-ended voltage on all 4 channels approximately once per second, and outputs the results to the serial port at 9600 bps. The program requires the Adafruit ADS1X15 library in order to run. This library is available through the Arduino development software (i.e. click the 'Tools | Manage Libraries' menu item, and search for "Adafruit ADS1X15").

```
#include <Wire.h>
#include <Adafruit_ADS1015.h>

Adafruit_ADS1115 ads(0x48);

float fVoltages[4];

void setup() {
  Serial.begin(9600);
  Wire.setClock(100000);
```

```
  ads.begin();
}

void loop() {
  int16_t adc0;
  int16_t adc1;
  int16_t adc2;
  int16_t adc3;
  adc0 = ads.readADC_SingleEnded(0);
  adc1 = ads.readADC_SingleEnded(1);
  adc2 = ads.readADC_SingleEnded(2);
  adc3 = ads.readADC_SingleEnded(3);
  fVoltages[0] = (adc0*0.1875)/1000;
  fVoltages[1] = (adc1*0.1875)/1000;
  fVoltages[2] = (adc2*0.1875)/1000;
  fVoltages[3] = (adc3*0.1875)/1000;
  Serial.print(fVoltages[0],3);
  Serial.print("\t");
  Serial.print(fVoltages[1],3);
  Serial.print("\t");
  Serial.print(fVoltages[2],3);
  Serial.print("\t");
  Serial.print(fVoltages[3],3);
  Serial.println();
  delay(1000);
}
```

Raspberry Pi Sample Code

The program below also uses the default ADS1115 gain of 2/3, so that the reference voltage is ±4.096V/ (2/3) = ± 6.144V. The program samples the single-ended voltage on all 4 channels and prints out the results. The program requires the “AToD.h” and “AToD.cpp” library files from In Nature Robotics Ltd. Links to these files are available from the ADS1115-BRVG product page at www.innaturerobotics.com.

```
#include <iostream>
#include <string>
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <memory>
#include "AToD.h"
```

```
using namespace std;

int main (void)
{
  const int NUM_READINGS = 100;
  char *i2c_filename = (char*)"/dev/i2c-1";
  const unsigned char A_TO_D_ADDRESS = 0x48;

  AToD atod(i2c_filename, A_TO_D_ADDRESS);//constructor
  for (int i=0;i<NUM_READINGS;i++)
  {
      double channel_voltages[4] = {0.0,0.0,0.0,0.0};
      for (int j=0;j<4;j++) {
        atod.GetMeasurement(j+1,0,1.0,channel_voltages[j]);
      }
      printf("Voltages: %.3f, %.3f, %.3f, %.3f\n",channel_voltages[0],channel_vol
tages[1],channel_voltages[2],channel_voltages[3]);
  }
  return 0 ;
}
```