# 4/2 Channel ADC - MAX11612 - Trēo™ Module

## Module Features

- Maxim Integrated MAX11612
- RoHS Compliant
- Software Library
- NightShade Trēo™ Compatible
- Spring Terminals
- Breakout Headers

## MAX11612 Features

(from Maxim Integrated)

- 12-Bit Resolution
- 4 Single-Ended Channels or
  2 Fully Differential Channels
- Internal Voltage Reference
- 5MHz Bandwidth (-3dB)

## Applications

- Industrial Signal Input
  - Pressure Sensors
  - Flow Meters
- Power Monitoring
  - Solar Energy
  - Alternative Energy
- Battery Management Systems

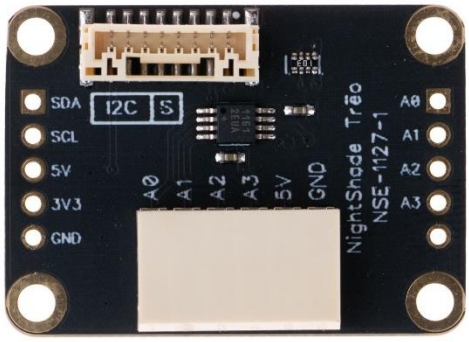
## Trēo™ Compatibility

### Electrical

| | |
|---|---|
| **Communication** | I2C |
| **Max Current, 3.3V** | 1mA |
| **Max Current, 5V** | 1mA |

### Mechanical

- 35mm x 25mm Outline
- 30mm x 20mm Hole Pattern
- M2.5 Mounting Holes




## Description

The MAX11612 Trēo™ Module is a ADC module that features Maxim Integrated's MAX11612 ADC. The module provides 4 singled-ended ADC inputs or 2 full-differential inputs. Measurements are made with bandwidths up to 5MHz and 12-bit resolution. This module is a part of the NightShade Treo system, patent pending.

## Table of Contents

# 1 Summary

The MAX11612 ADC can make measurements on 4 channels with respect to ground (single-ended) or it can measure the voltage between channel 0 and 1, or 2 and 3; providing fully differential measurements. When using the MAX11612 for single-ended measurements, all four channels are measured simultaneously with the acquireAllChannels() function and measurements are stored in a local buffer. The measurements are retrieved with the readChannel() function. The differential measurements are made with the measureDiffChXChX() function corresponding to channels 0 and 1, or 2 and 3. The measurements can be made with respect to the internal 4.096V reference (default) or to an external reference tied to the A3 pin. When using the external reference the resolution is $V_{ref}$/4096 per LSB.

# 2 What is Trēo™?

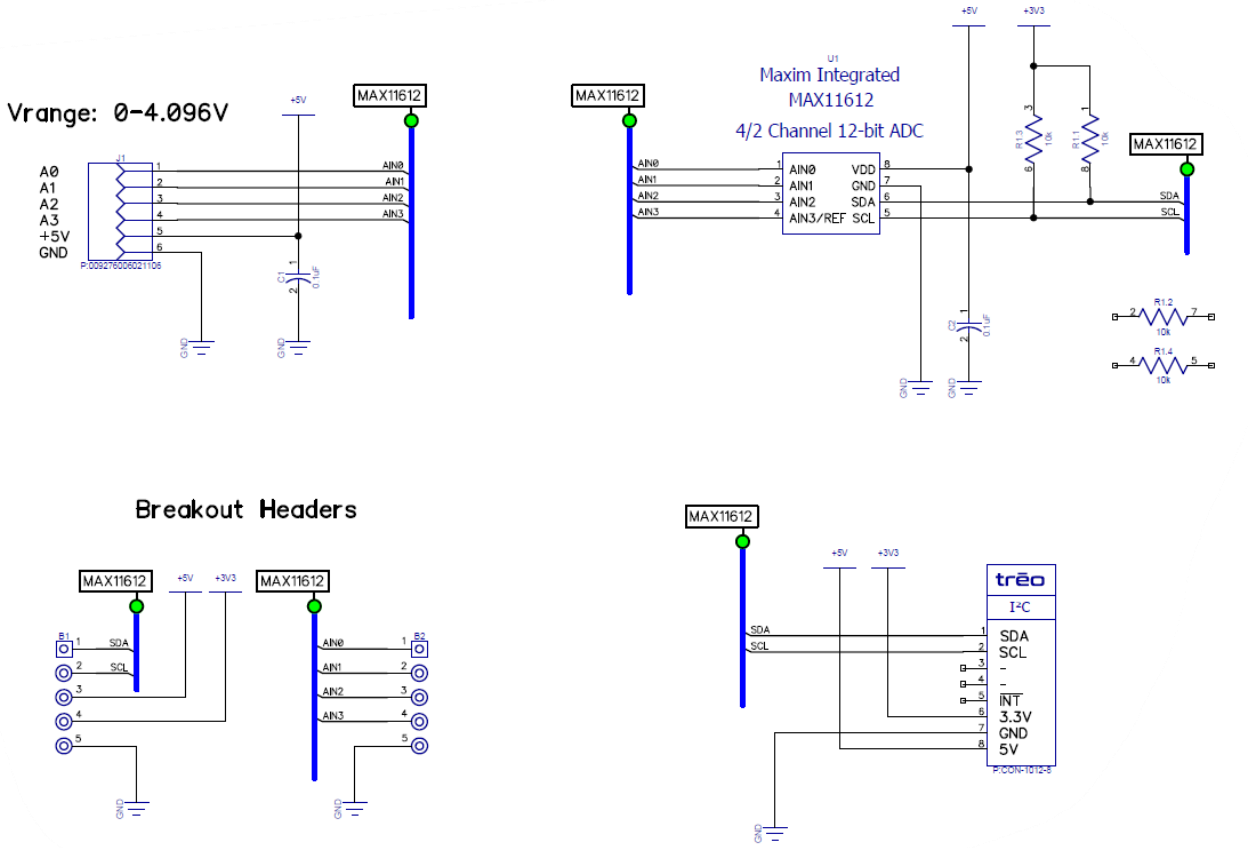
NightShade Trēo is a system of electronic modules that have standardized mechanical, electrical, and software interfaces. It provides you with a way to quickly develop electronic systems around microprocessor development boards. The grid attachment system, common connector/cabling, and extensive cross-platform software library allow you more time to focus on your application. Trēo is supported with detailed documentation and CAD models for each device.

Learn more about Trēo here.

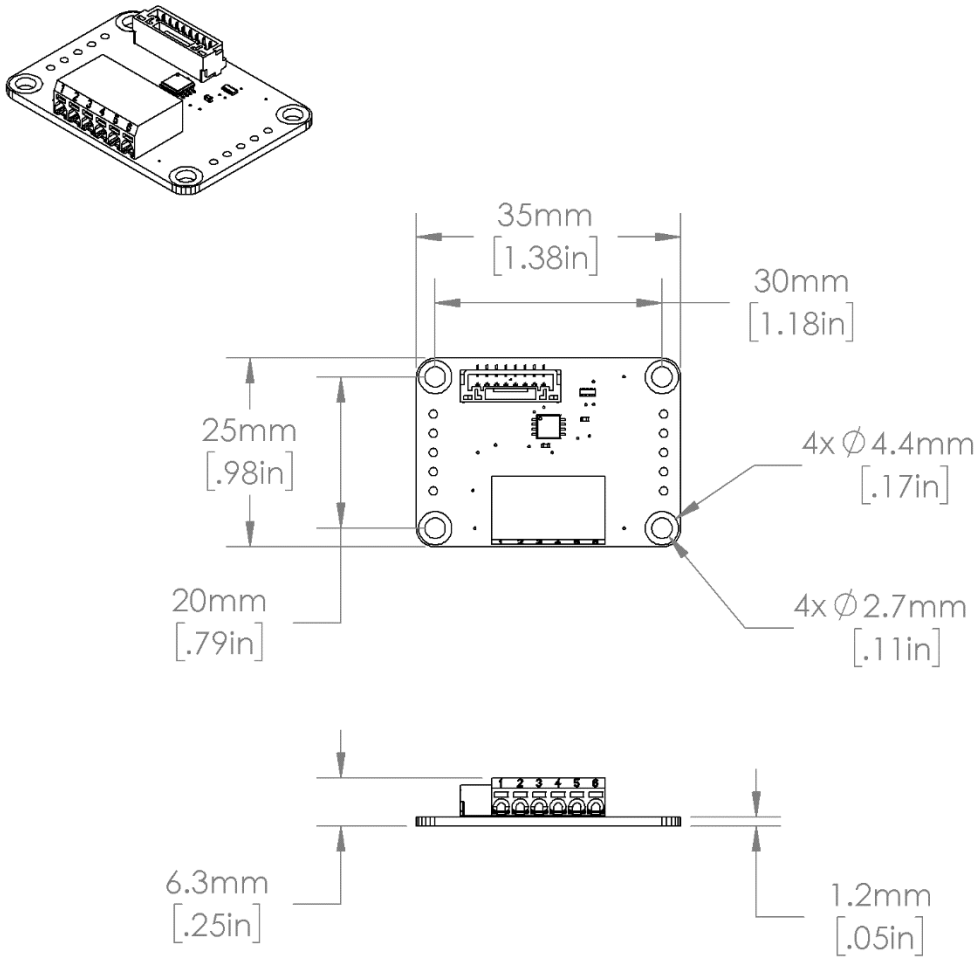
# 3 Electrical Characteristics

| | Minimum | Nominal | Maximum |
|---|---|---|---|
| **Voltages** | | | |
| $V_{i/o}$ (SDA, SCL) | -0.3V | - | 3.6V |
| $V_{3.3V}$ | 3.1V | 3.3V | 3.5V |
| $V_{5V}$ | 4.8V | 5.0V | 5.2V |
| $V_{in}$ (A0, A1, A2, A3) | -0.3V | - | $V_{5V}$ + 0.3V |
| $V_{ExtRef}$ | 0V | - | $V_{5V}$ |
| | | | |
| **Measurement** | | | |
| Bandwidth (Full Power) | - | - | 5MHz (3MHz) |
| Sample Rate (Int. Clock) | - | 51ksps | - |
| Range | 0V | - | 4.096V or $V_{ExtRef}$ |
| Precision | $V_{Ref}$/4096 | 1.0mV ($V_{ref}$ = 4.096V) | 1.2mV ($V_{ref}$ = 5V) |
| Error (25°C) | -2.2% | - | +2.2% |
| | | | |
| **I2C Slave Address** | | 0x34 | |
| | | | |
| **Operating Temperature** | -25°C | - | +85°C |

# 4 Electrical Schematic



# 5 Mechanical Outline



# 6 Example Arduino Program

```
/*********************************************************
  MAX11612_ADC - NightShade_Treo by NightShade Electronics

  This sketch demonstrates the functionality of the
  NightShade Trēo MAX11612 ADC module. (NSE-1127-1/2) It
  prints the voltage present on channel 0 to Serial at
  115200 baudrate. 10x mode can be enabled for the
  NSE-1127-2.

  Created by Aaron D. Liebold
  on February 15, 2021

  Links:
  NightShade Trēo System: https://nightshade.net/treo
  Product Page: https://nightshade.net/product/treo-4-2-channel-12-bit-adc-max11612/

  Distributed under the MIT license
  Copyright (C) 2021 NightShade Electronics
  https://opensource.org/licenses/MIT
*********************************************************/

// Include NightShade Treo Library
#include <NightShade_Treo.h>

// Declare Objects
NightShade_Treo_MAX11612 adc(1);

// Set to 1 to enable the 10x input for NSE-1127-2
#define ENABLE_10X_INPUT 0

void setup() {
  adc.begin();
  Serial.begin(115200);
}

void loop() {
  adc.acquireAllChannels();

  if (ENABLE_10X_INPUT) {
    Serial.print((long) 10 * adc.readChannel(0));
  } else {
    Serial.print(adc.readChannel(0));
  }
  Serial.println("mV");

  delay(1000);
}
```

# 7 Library Overview (C++ & Python)

**C++ Class**

NightShade_Treo_MAX11612 <classObject>();

**Python Module**

<classObject> = NightShade_Treo_MAX11612()

## 7.1 Constructors

**NightShade_Treo_MAX11612(int port, uint32_t clockSpeed)**

Creates a ValveManifoldController object.

Arguments:

| | |
|---|---|
| port | Integer of the I2C port used. (e.g. 0 = "/dev/i2c_0") |
| clockSpeed | The desired clock speed for the I2C bus. |

Returns:

nothing

**NightShade_Treo_MAX11612(int port)**

Creates a ValveManifoldController object assuming the default slave address and clock speed.

Arguments:

| | |
|---|---|
| port | Integer of the I2C port used. (e.g. 0 = "/dev/i2c_0") |

Returns:

nothing

## 7.2 Methods

**begin()**

Initializes the MAX11612 to use the internal clock and internal voltage reference of 4.096V.

Arguments:

none

Returns:

| | |
|---|---|
| error | 0 = Success |

**acquireAllChannels()**

Reads all channels (single ended) and stores the results in a local buffer. Data is read from the local buffer with the readChannel() function.

Arguments
none

Returns

| | |
|---|---|
| error | 0 = Success |

**readChannel(int channel)**

Returns channel measurement value from the local buffer. The measurement is performed with the acquireAllChannels() function. When using the internal reference, the result is 1mV/LSB.

Arguments

| | |
|---|---|
| channel | Number of the requested channel value (1-4) |

Returns

| | |
|---|---|
| value | The ADC value of the corresponding channel (int) |

**readDiffCh0Ch1()**

Reads the voltage differential between channel 0 and channel 1.

Arguments
none

Returns

| | |
|---|---|
| value | The ADC value of the voltage between the differential channels |

**readDiffCh1Ch0()**

Reads the voltage differential between channel 1 and channel 0. When using the internal reference, the result is 1mV/LSB.

Arguments
none

Returns

| | |
|---|---|
| value | The ADC value of the voltage between the differential channels |

**readDiffCh2Ch3()**

Reads the voltage differential between channel 2 and channel 3. When using the internal reference, the result is 1mV/LSB.

Arguments
none

Returns

| | |
|---|---|
| value | The ADC value of the voltage between the differential channels |

**readDiffCh3Ch2()**

Reads the voltage differential between channel 3 and channel 2. When using the internal reference, the result is 1mV/LSB.

Arguments
none

Returns

| | |
|---|---|
| value | The ADC value of the voltage between the differential channels |

**enableExternalReference(int enable)**

Enables the use of the external voltage reference connected to A3.

Arguments

| | |
|---|---|
| enable | 0: Internal Voltage Reference<br>1: External Voltage Reference |

Returns

| | |
|---|---|
| error | 0 = Success |

**enableReferenceOutput(int enable)**

Connects internal voltage reference to the reference pin, A3.

Arguments

| | |
|---|---|
| enable | 0: Reference pin can be used as a reference input<br>1: Reference pin is connected to the internal voltage reference |

Returns

| | |
|---|---|
| error | 0 = Success |