

Overview

SEN-39003 is a Qwiic-compatible breakout board for the AMS / Franklin AS3935 Digital Lightning (that's right, *lightning*, not "lighting") sensor IC. This low-cost sensor "listens" to the EM spectrum in the 500 kHz range to identify lightning strikes up to 40 km away. This is about 4 times farther away than a typical human can discern lightning proximity using the "30-30 rule", in which lightning is within 10 km if thunder is heard within 30 seconds of a visible lightning flash. With lots of settings and calibrations, the sensor can be tuned for a wide variety of applications and locations.

These settings and readings are accessed by either SPI (using the breakout header) or I2C, either with the header or Qwiic-compatible cable. Unlike other suppliers, Playing With Fusion calibrates and provides this cal value (in pF) for each sensor's antenna frequency. We also store the value in case you happen to lose it.

Features

- AS3935 Sensor IC with all necessary support components
- 4-wire SPI or Qwiic-compatible I2C interfacing with no modifications
- Lightning strike distance estimated from 1 km to 40 km in 15 steps
- Both cloud-to-ground and cloud-to-cloud lightning detected
- 2.4V - 5.5V power and digital interface
- Fully calibrated, cal values stored in case the value is lost

Includes

- SEN-39003: AS3935 Sensor Breakout



Typical Applications

- Weather stations
- Sports electronic equipment
- Cell phones and towers
- Smart watches
- Golf, bike, and sports equipment
- Sensitive equipment protection
- Pool safety

Application & Guide

AS3935 is a configurable lightning sensor IC that detects the presence of potentially hazardous lightning activity. This includes both cloud-to-ground and cloud-to-cloud flashes, which enables risk to be evaluated for approaching storms.

Not only can AS3935 detect lightning flashes, but it turns measured strike EMI magnitude into an estimated range. Range is output from 1km to 40 km in 15 steps, in ~3 km increments. Sensor distance approximation is based on a statistical approach, and as a result, the values output by the device are not absolute. As such, an application should balance signal confidence with a risk analysis. For example, personal safety should typically be set for the most conservative alert, whereas equipment protection applications can

balance confidence, signal strength, and battery life.

The digital interface provides access to both configurations and sensor readings. To begin, several calibrations need to be selected based on the final application. These include Analog Front-End (AFE) settings, Noise Floor settings, and antenna tuning.

AFE Gain is typically set to one of two values, as developed and optimized by AMS. Either Indoor (default) or Outdoor mode is selected. It is important to set this value correctly, as the gain is critical when using the final measured values to estimate lightning strike distance.

“Watchdog” and Spike Rejection thresholds are subsequently used to filter out “disturbers”. In electrically noisy environments, it may be necessary to increase these thresholds to eliminate excessive reports of disturber events, but this will negatively impact lightning detection efficiency and effective detection range. Set the Watchdog and Spike Rejection thresholds as low as practical. Note, the Watchdog is used on the analog front-end, whereas spike rejection is part of signal validation.

Ambient noise is important to device performance. As such, AS3935 is designed to filter man-made sources of EMI, including fluorescent lighting, microwave ovens, and other “disturbers,”, but it is possible for environmental noise to overwhelm the sensing capability. Noise Floor Level is monitored continuously, and a notification is set wherever the noise exceeds the limit set in the register. This

threshold can be set dependent on the user application.

Some typical noise sources should be avoided when designing for the application. These include inductor-based DC-DC converters, smart phone and watch displays, as well as operating switching signals (SPI interface, for example) at 500 kHz.

Antenna tuning is also critical to AS3935 operation. A loop antenna based on a parallel LC resonator is implemented, which needs to be tuned to $\pm 3.5\%$ of 500kHz for optimal performance. This is accomplished via external components, plus internal tuning capacitors to dial-in the final setting. Each SEN-39003 is calibrated prior to shipment to achieve this goal, and the cal value is provided on the device package. It is also stored in the PwF customer database and can be retrieved upon request.

Getting Started

SEN-39003 is designed for rapid setup and integration. Zero soldering. Qwiic-compatible I2C interface. Just about as easy as you can get. Of course, you can opt to use the 2MHz-capable SPI interface in a breakout form, as well - we offer code examples for both! See the PwFusion Github page for [I2C example code](#) and [SPI example code](#).

QuickStart

Start by plugging SEN-39003 into a Qwiic-compatible port on either your Qwiic-enabled microcontroller board or something like a [Qwiic Mux Breakout](#). Alternatively, use the SPI header on a breadboard. Next, download the desired application code ([I2C code](#) and [SPI code](#)),

flash the board, and start detecting! Please note: if you're using Arduino code examples, be sure to set your serial monitor baud rate to match the Serial.begin() statement in the setup() routine.

Of course, a lightning sensor doesn't do much if there is no lightning present, and as a result, it can be hard to tell if everything is set up and running correctly without a thunderstorm overhead. We have a solution to that! [SEN-39002](#) is a lightning "emulator" designed to work with your AS3935 module to verify proper system configuration and operation. It is an Arduino shield with a 500 kHz broadcast antenna that can emulate near, far, and other types of strikes. See the [user guide](#) for many more details.

Advanced User

AS3935 is a smart sensor, and with those smarts comes LOTS of configurability. It is highly recommended to spend time with the AS3935 datasheet and appnotes once you are up and running to ensure optimal performance in your application.

Common Issues

- A thunderstorm went by and no lightning was detected
 - Setup and wiring issues
 - Consider using [SEN-39002](#) to verify your setup
- Far-away lightning seems to trigger shorter range readings
 - See Figure 17 of the AS3935 datasheet for details on sensor functionality
 - This is designed into the sensor as part of the strategy to monitor a storm's approach. The distance output does not represent distance to a single

strike, but that of the storm proximity to the installation

- The sensor will eventually clear this as time thresholds expire
- It is possible to "reconfigure" the sensor to reset the estimation routines

Ordering Options & Related Parts

[SEN-39003](#): Qwiic-compatible AS3935 Lightning Sensor Breakout

[SEN-39001](#): PwFusion Original AS3935 sensor breakout

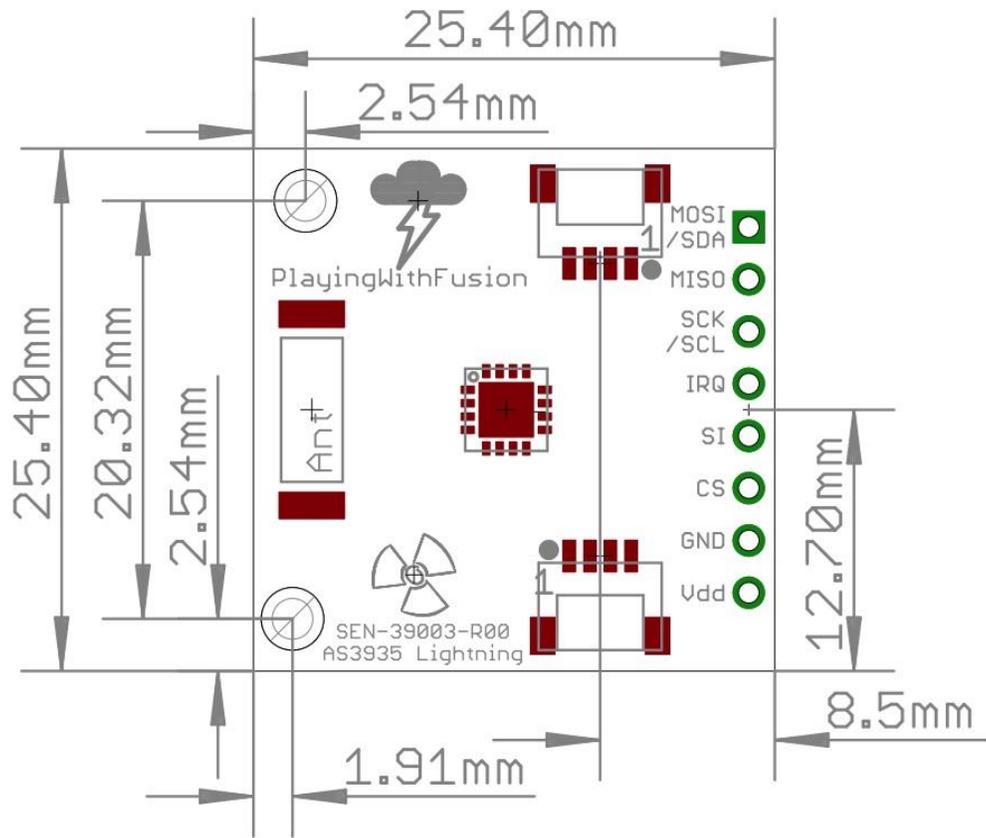
[SEN-39002](#): "Emulator" for verifying functionality and simulating storms

[IFB-10011](#): Qwiic-compatible I2C MUX based on TCA9548A

[WIR-10001](#): 10cm Qwiic-compatible interconnect cable

SEN-37003: SHT31-F, extremely high accuracy and precision temperature and humidity sensor

Appendix 1: SEN-39003 Mech Drawing



Appendix 2a: SEN-39003 Front View



Appendix 2b: SEN-39003 Back View



Revision History

Date	Author	Notes
03/29/2021	J. Steinlage	First revision published