

Alpha Pi Eng

The Alpha Pi Eng is an integrated digital front end board for the evaluation and use of Alphasense 4 way AFEs on the Raspberry Pi allowing the measurement of environmental gasses in the PPB range. Additionally it allows use of an OPC for measuring particulates and a temperature and humidity sensor. It is provided with full access to evaluation software written in Python, with a custom Raspian Image available for quick evaluation.

Circuit elements

The circuit uses 0.2Hz analog active filters placed between the AFE outputs and ADS1115 16 bit I2C analog to digital converters.

A MCP9808 ADC provides circuit board temperature.

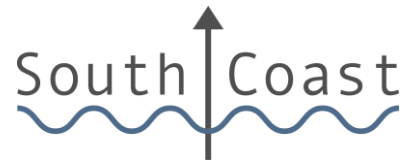
A MCP3425 ADC allows the PT1000 on the AFE, if fitted, to be read.

A battery holder and switch over circuit to allow the electro-chemical sensors on the AFE to remain biased when the parent platform is powered down, this reduces the settling time following power up.

A CAT24C32 EEPROM provides compatibility with the Raspberry Pi HAT specification.

An optional breakout board with a SHT31 temperature and humidity sensor.

Pico-clasp sockets to allow connection of two SPI devices, typically an OPC and another connector for an additional device.



Supported Gasses

The Alphasense AFEs available and supported by the Alpha Pi Eng are

Gasses and VOCs

NO₂, O₃, (CO, SO₂ or H₂S) and VOC

NO₂, O₃, NO and VOC

NO₂, CO, (SO₂ or H₂S) and VOC

NO₂, (CO, SO₂ or H₂S) NO and VOC

CO, SO₂, H₂S and VOC

Gasses

NO₂, O₃, (CO, SO₂ or H₂S) and (CO,SO₂ or H₂S)

NO₂, O₃, NO and (CO, SO₂ or H₂S)

NO₂, CO, (SO₂ or H₂S) and (SO₂ or H₂S)

NO₂, (CO,SO₂ or H₂S), NO and (CO,SO₂ or H₂S)

CO, SO₂, NO and H₂S

Supported OPC

Alphasense N2 or N3 OPC capable of measuring particulate sizes of PM₁₀, PM_{2.5} and PM₁.

Software

Software is provided in two ways a custom Raspian disk image or through a GIT repository.

Disk Image

TBA. Currently by request to South Coast Science.

Repository

<https://github.com/south-coast-science>

https://github.com/south-coast-science/scs_dfe_eng

Pinouts

Raspberry Pi Header signal usage

The Raspberry Pi header is a 2.54mm pitch double row 40 pin header.

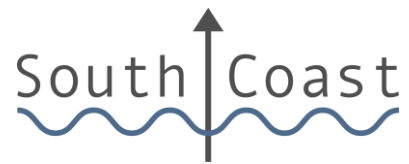
| Function | Pin | Pin | Function |
|----------|-----|-----|---------------|
| 3V3 | 1 | 2 | 5V |
| I2C SDA | 3 | 4 | 5V |
| I2C SCL | 5 | 6 | GND |
| NC | 7 | 8 | NC |
| GND | 9 | 10 | NC |
| NC | 11 | 12 | NC |
| NC | 13 | 14 | GND |
| NC | 15 | 16 | NC |
| NC | 17 | 18 | NC |
| SPI MOSI | 19 | 20 | GND |
| SPI MISO | 21 | 22 | NC |
| SPI CLK | 23 | 24 | SPI SC0 (OPC) |
| GND | 25 | 26 | SPI SC1 (AUX) |
| ID SD | 27 | 28 | NC |
| NC | 29 | 30 | GND |
| NC | 31 | 32 | NC |
| NC | 33 | 34 | GND |
| NC | 35 | 36 | NC |
| NC | 37 | 38 | NC |
| GND | 39 | 40 | NC |

Signals marked NC are unused by the Alpha Pi Eng and may be used without interfering with the board.

SPI Connectors

The SPI connectors are 6 pin Molex Pico-Clasp connectors.

| Pin | Function |
|-----|-----------------|
| 1 | 5V |
| 2 | SPI CLK |
| 3 | SPI MISO |
| 4 | SPI MOSI |
| 5 | SPI Chip Select |
| 6 | GND |



Temperature and humidity connector

The temperature and humidity connector is a 4 pin 1.27mm TE MicroMatch connector .

| Pin | Function |
|-----|----------|
| 1 | 3V3 |
| 2 | SCL |
| 3 | SDA |
| 4 | GND |

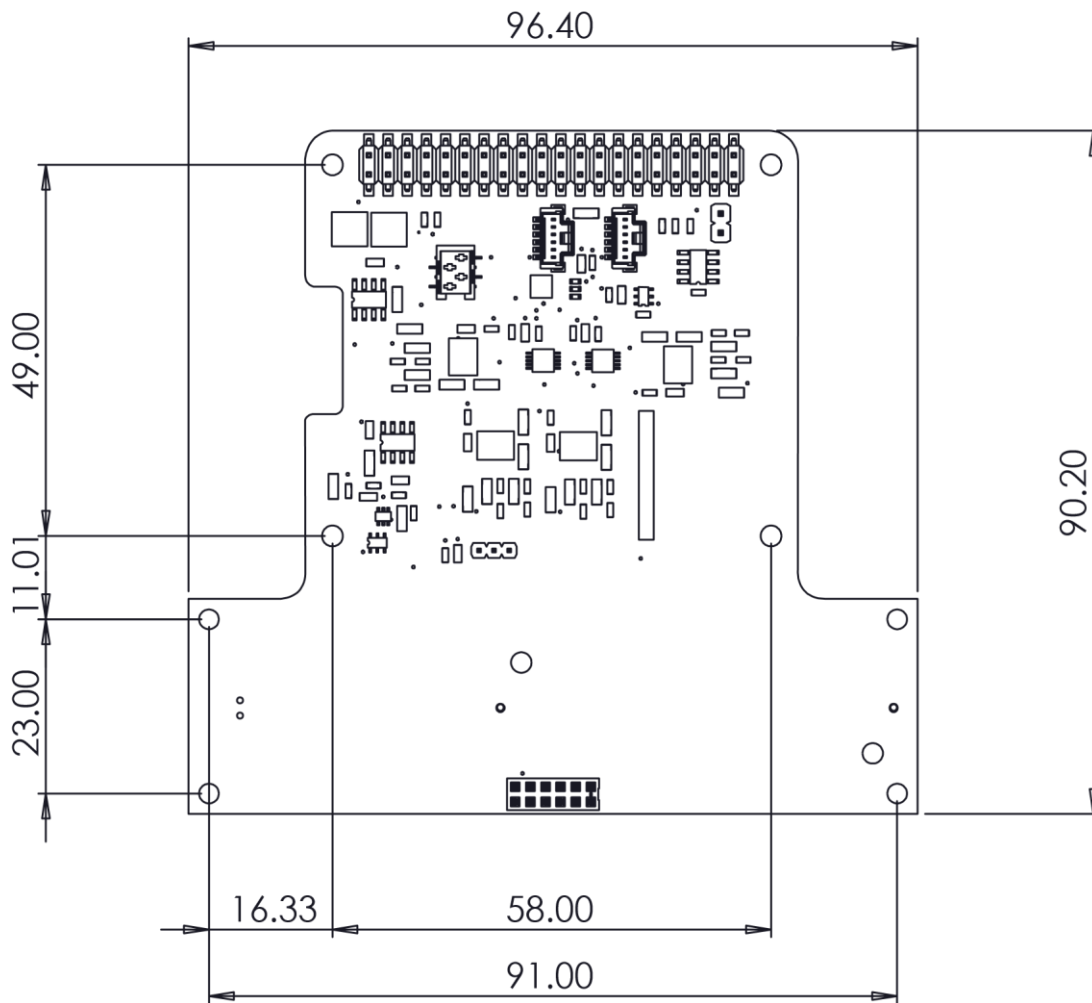
Jumpers

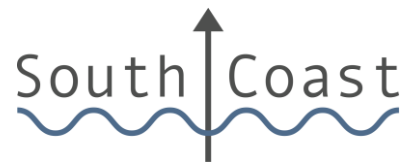
There are two jumper headers on the board.

A two pin 2.54mm header which when closed allows the EEPROM to be written to.

A three pin 2mm header which controls the selection between a PID for enabling measurement of VOCs and selection of the fourth channel for the measurement of gasses using an electro chemical sensor.

Dimensions





Specification

General

| | |
|------------------------------|---------|
| AFE ADC resolution | 16 bit |
| PT1000 ADC resolution | 16 bit |
| Board temperature resolution | 16 bit |
| AFE filter cut-off frequency | 0.2Hz |
| AFE supply voltage | 4.3V |
| PID supply voltage | 5V |
| Current draw | 200mA |
| Peak current draw | 1A |
| Typical AFE reading noise | +/-3PPB |

I2C addresses

| IC | Function | Address |
|---------|--------------------------|--------------|
| ADS1115 | Work ADC | 0x49 |
| ADS1115 | Aux ADC | 0x48 |
| MCP9808 | Board temperature ADC | 0x1F |
| MCP3425 | PT1000 ADC | 0x68 |
| SHT31 | Temperature and humidity | 0x44 or 0x45 |