

US082-FS2012EVZ

The US082-FS2012EVZ board enables quick prototyping for a custom system design with the [FS2012](#) mass air flow sensor module. The board provides a standard Pmod™ Type 6A (Extended I<sup>2</sup>C) connection for the on-board sensor to plug into any MCU evaluation kit with a matching connector.

The US082-FS2012EVZ features Pmod connectors on both sides of the board allowing additional Type 6/6A boards to be connected in a daisy-chained solution with multiple sensors on the same MCU Pmod connector. Because of the standard connector and software support, the US082-FS2012EVZ is the best choice to rapidly create an IoT system with the Renesas Quick-Connect IoT.

**Features**

- FS2012 sensor sample mounted:
  - Thermo-transfer (calorimetric) principle uses MEMS thermocouples to measure flow, which provide excellent signal-to-noise ratio
  - Resistant to surface contamination
  - No cavity to cause clogging
  - Resistant to vibration and pressure shock
- High-temperature flow housing
- Standardized Type 6A Pmod connector supports I<sup>2</sup>C Extended interface
- Dual connectors allow pass-through signals for daisy-chained solutions

**Board Contents**

- US082-FS2012EVZ Board



Figure 1. US082-FS2012EVZ Pmod Board

## Contents

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## 1. Functional Description

The US082-FS2012EVZ functions as a sensor building block to create a custom system solution. Use the board individually or with a combination of other sensors by using the Pmod Type 6A interface. (See the [Renesas Quick-Connect IoT](#) web page for a list of available sensor Pmod boards.)

## 2. Setup

### 2.1 Required or Recommended User Equipment

The following additional lab equipment (sold separately) is required for using the board:

- Any MCU board that supports Type 6A Pmod.
- US082-INTERPEVZ interposer board if using one of the Renesas MCU kits shown in [Table 1](#).

**Table 1. Renesas MCU Evaluation Kits<sup>[1]</sup> capable of supporting Type 6A PMODs when used with the US082-INTERPEVZ**

| RA        | RX                | Synergy |
|-----------|-------------------|---------|
| EK-RA4W1  | RX111-Starter-Kit | PK-S5D9 |
| EK-RA2A1  | RX231-Starter-Kit | DK-S3A7 |
| EK-RA4M1  | RX23W-Starter-Kit | DK-S128 |
| EK-RA6M1  | RX23T-Starter-Kit | TB-S1JA |
| EK-RA6M2  | RX24T-Starter-Kit | TB-S3A6 |
| EK-RA6M3  | RX24U-Starter-Kit | DK-S7G2 |
| EK-RA6M3G |                   |         |

1. This table is not a comprehensive list of supported MCU Kits. See the evaluation kit hardware manual to confirm Pmod pinout.

### 2.2 Kit Hardware Connections

Follow these procedures to set up the kit as shown on [Figure 2](#).

1. Ensure the MCU evaluation kit has a Pmod connector set to Type 6A (see the kit hardware manual if unsure).
  - a. If no Type 6A Pmod is available, ensure the MCU evaluation kit can use the US082-INTERPEVZ interposer board and insert the board into the MCU connector before adding any sensor boards.
2. Plug in the US082-FS2012EVZ to the Type 6A connector, being careful to align Pin 1 on the sensor board and MCU kit.
3. Connect the J4 and J5 jumpers to place 4.7k pull-up resistors on the I<sup>2</sup>C bus lines.
  - a. Only one set of pull-up resistors should be used on the I<sup>2</sup>C bus lines. If multiple sensor boards are used, only one board should have the jumpers present.
  - b. MCU kits typically do not have pull-up resistors present on the bus lines but make sure to check for them.
4. The sensor is now ready to be used in the system. Follow the MCU kit instructions for connecting and powering up the evaluation kit.

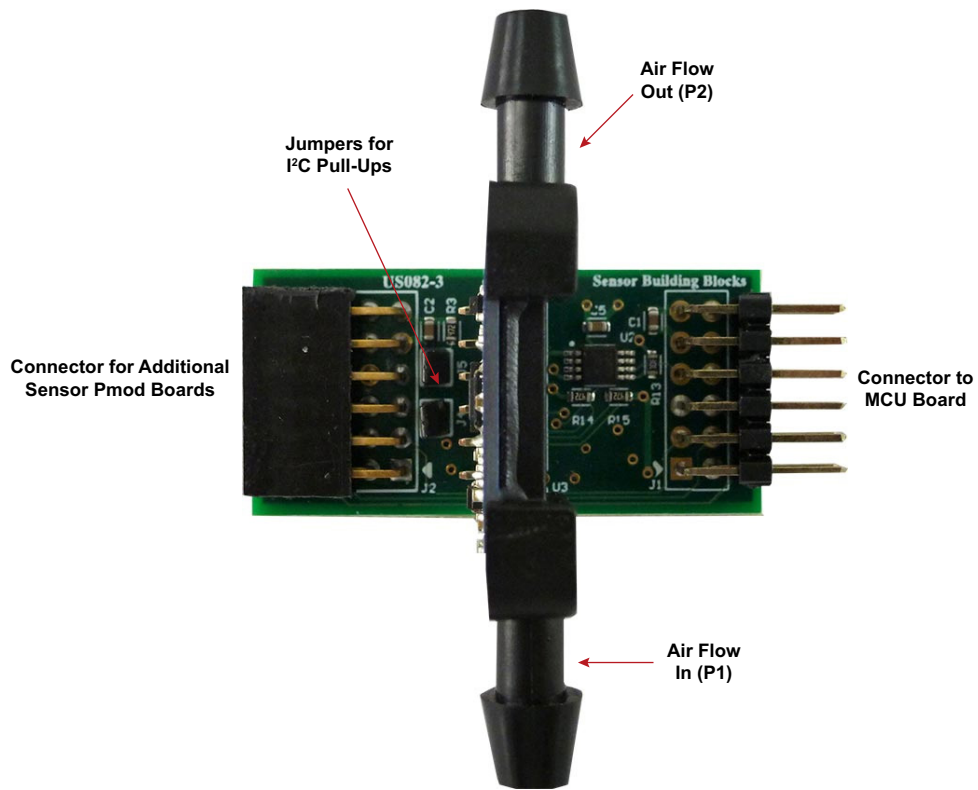
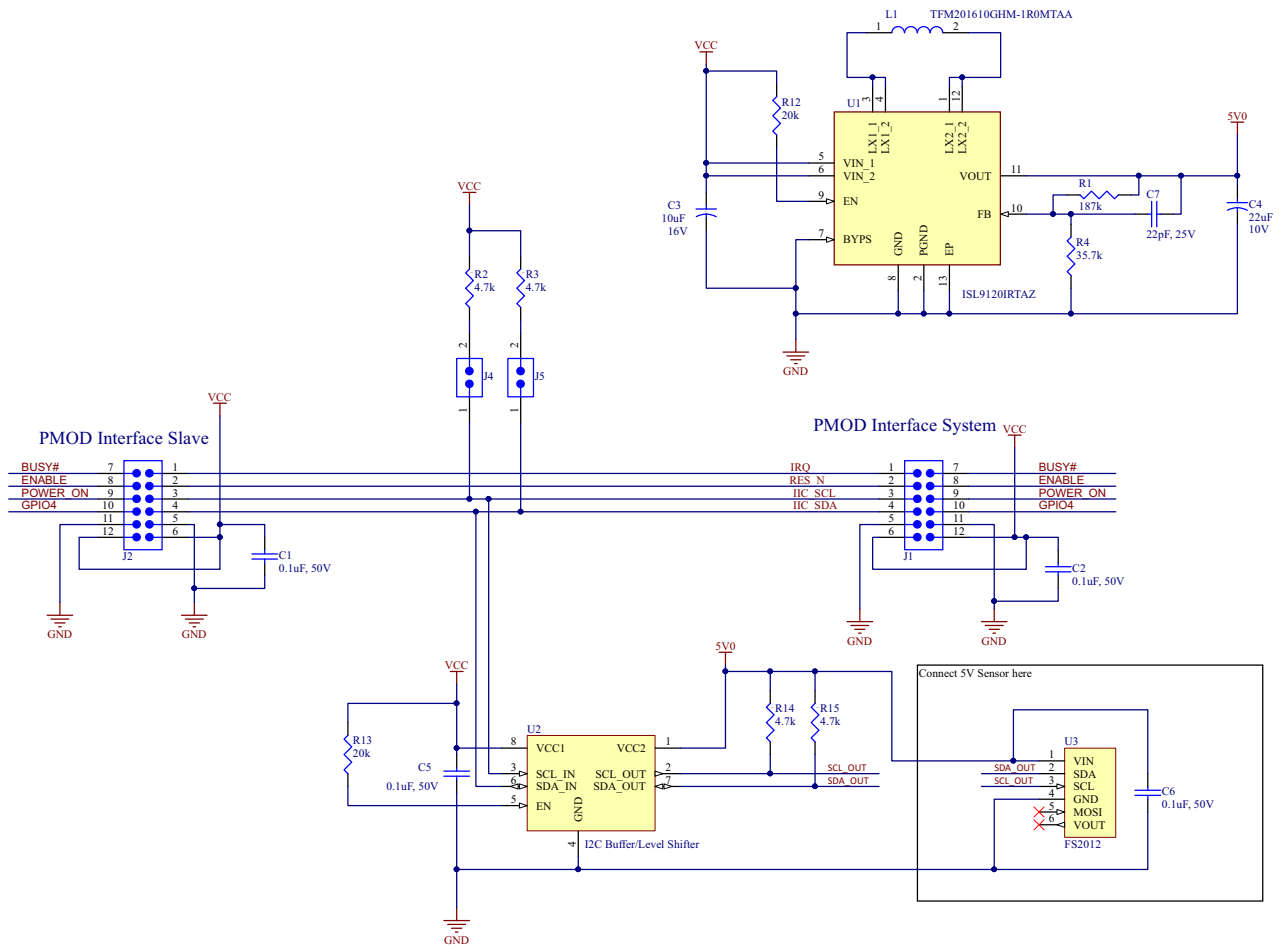


Figure 2. Evaluation Kit Connections

### 3. Board Design

#### 3.1 Schematic Drawings



**NOTES:**  
 1) Net VCC can be 3.3 or 5.0 volts DC  
 2) If 3.3V, 3.3V PMODs may be daisy chained downstream.  
 3) If 5.0V, only 5.0V PMODs may be connected downstream

Figure 3. US082-FS2012EVZ Schematic

### 3.2 Bill of Materials

| QTY | Reference        | Description                                   | Value              | PCB Footprint          | Part Number          |
|-----|------------------|---|--------------------|------------------------|----------------------|
| 4   | C1, C2, C5, C6   | Capacitor, 0.1 $\mu$ F, 50V, 0603             | 0.1 $\mu$ F        | 0603                   | C0603C104J5RACTU     |
| 1   | C3               | 10 $\mu$ F, X5R, MLCC Ceramic Capacitor       | 10 $\mu$ F         | 0805                   | CL21A106KOQNNNG      |
| 1   | C4               | 22 $\mu$ F, X5R, 10V MLCC Ceramic Capacitor   | 22 $\mu$ F         | 0603                   | 0603ZD226MAT2A       |
| 1   | C7               | 22pF, 25V, COG-NPO                            | 22pF               | 0603                   | C0603C220K3GACTU     |
| 1   | J1               | Male Header 0.1" pitch PMOD 2x6 Right Angle   | Pmod <sup>TM</sup> | PMOD-MALE-TOP          | M20-9950645          |
| 1   | J2               | Female Header 0.1" pitch PMOD 2x6 Right Angle |                    | CON-000050-01          | SSW-106-02-F-D-RA    |
| 2   | J4, J5           | CONN HEADER VERT 2POS 1.27 MM                 |                    | HDR-1X2-FTS            | FTS-102-01-L-S       |
| 1   | L1               | 1 $\mu$ H, 3A SMT Inductor                    | 1 $\mu$ H          | INDC2016X100N          | TFM201610GHM-1R0MTAA |
| 1   | R1               | 187K Resistor, 0603                           | 187k               | 0603                   | RT0603BRE0735K7L     |
| 3   | R2, R3, R14, R15 | Resistor, 4.7k, 0603                          | 4.7k               | 0603                   | RC0603JR-074K7L      |
| 1   | R4               | 35.7K Resistor, 0603                          | 35.7k              | 0603                   | RT0603BRE0735K7L     |
| 2   | R12, R13         | 20k Resistor 0603                             | 20k                | 0603                   | RC0603FR-0720KL      |
| 1   | U1               | Buck-Boost DC/DC, Adjustable Output           |                    | QFN50P300X300X75-13N-D | ISL9120IRTAZ         |
| 1   | U2               | I2C Level Shifter                             |                    | TSOP65P490X110-8N      | ISL33003IUZ          |
| 1   | U3               | Flow Sensor Module                            |                    | FS2012-6pin            | FS2012-1100-NG       |
| 2   | J4, J5           | 1.27" 1x2 Jumper with Grip, Gold              |                    |                        | NPB02SVFN-RC         |

### 3.3 Board Layout

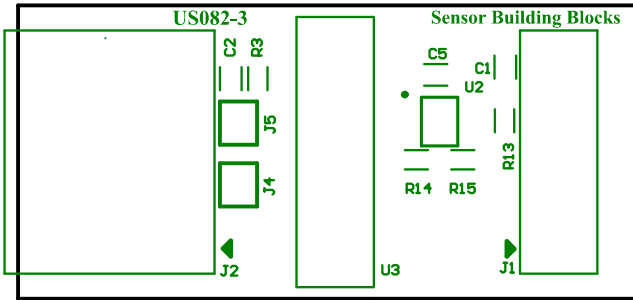


Figure 4. Silkscreen Top Layer

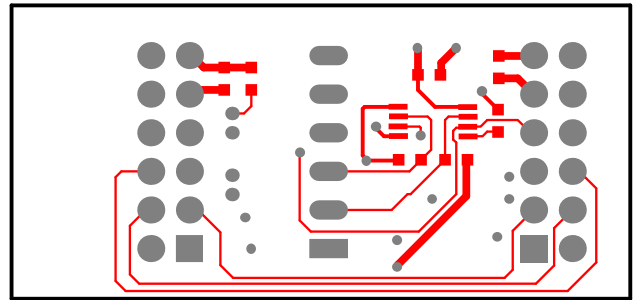


Figure 5. Top Layer

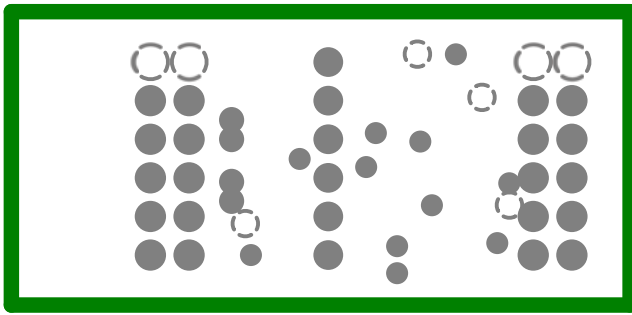


Figure 6. Layer 1

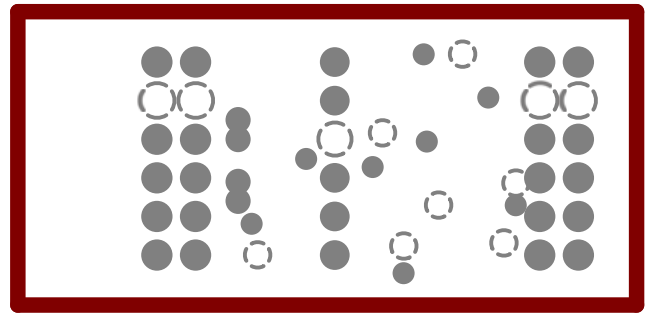


Figure 7. Layer 2

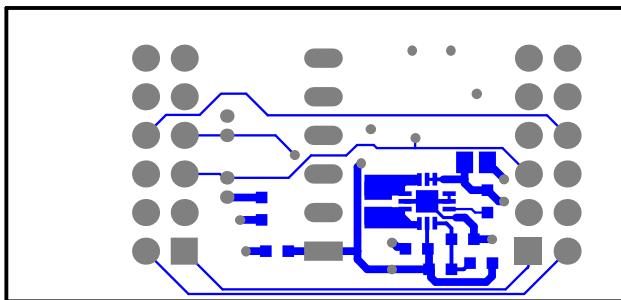


Figure 8. Bottom Layer

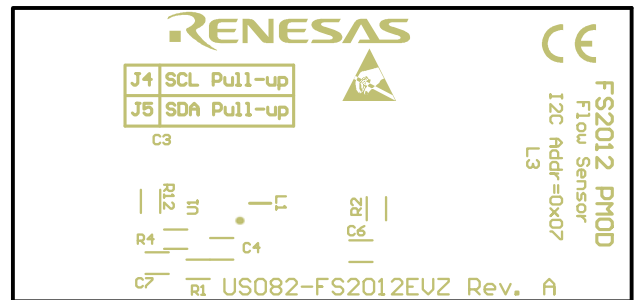


Figure 9. Silkscreen Bottom Layer

### 4. Ordering Information

| Part Number     | Description   |
|-----------------|---|
| US082-FS2012EVZ | FS2012 Pmod Board   |
| US082-INTERPEVZ | Pmod interposer board to convert Type 2A and 3A to Type 6A on older Renesas MCU kits. |

## 5. Revision History

| Revision | Date         | Description     |
|----------|--------------|-----------------|
| 1.0      | Jun 30, 2021 | Initial release |



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