TFi Wireless Power Network (WPN) System

The TFi Wireless Power Network (WPN) is used to power Industrial IoT (IIoT) sensors, enabling non-invasive sensor deployments by reducing the complexity of wiring infrastructure. This translates to 50% cost saving on cabling and installation and 80% less time for deployment. It is retrofittable to a variety of existing sensors in the market.

Technical Specifications

Sense, TURIN-1		

Power Performance	RF Harvesting	860MHz ~ 940MHz [optimized], 4 external antennas
	Output Voltage	2.1V DC [customizable over 1.8-5V]
	Energy Storage	Capacitor [alternative option of rechargeable battery]
	Backup Storage	2 x AAAA Battery (1.5V) *Optional
Built-in Sensors	3-axis Accelerometer LISDH12	*Max Sensor Sampling Rate Support:* 1.34KHz *Resolution Options:* 8-bit, 10-bit, 12-bit *Output Options:* Acceleration/Velocity RMS, Standard Deviation, FFT Spectrum
	Noise Level Detection ICS-40310	*Max Audio Sampling Rate Support:* 40KHz *Resolution Options:* 12-bit, 14-bit *Output Options:* Average, Standard Deviation, Peak-to-Peak, FFT Spectrum
	Environmental sensing BME280	*Max Sensor Sampling Rate Support:* 10Hz *Output Options:* Average, Maximum, Minimum
	TVOC* SGPC3	*Optional *Maximum Sensor Sampling Rate Support:* 0.1Hz
External Expansion	Interface	Analog I/O, digital I/O, I²C, and SPI
Connectivity	Frequency	2.4GHz ISM, with built-in high gain antenna
	Protocol	BLE 4/5
	Transmission Rate	Up to 5Hz

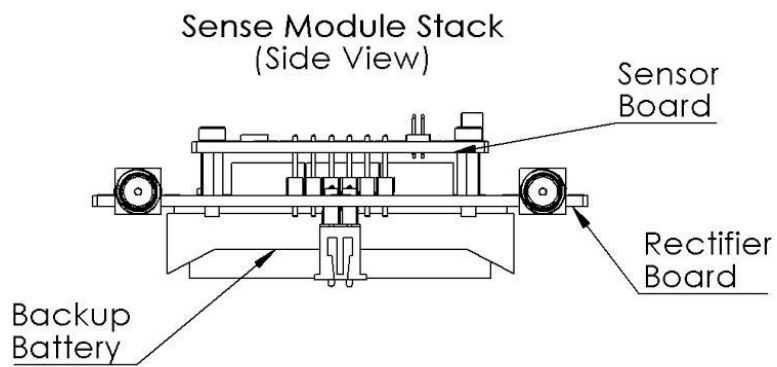|	Encryption	Proprietary + AES 128
Edge Computation	MCU	ARM Cortex-M4, 512KB Flash, and 64KB RAM
Dimension	Main Body	95 x 46 x 28mm
	Antenna	5 to 20cm 4x external antenna
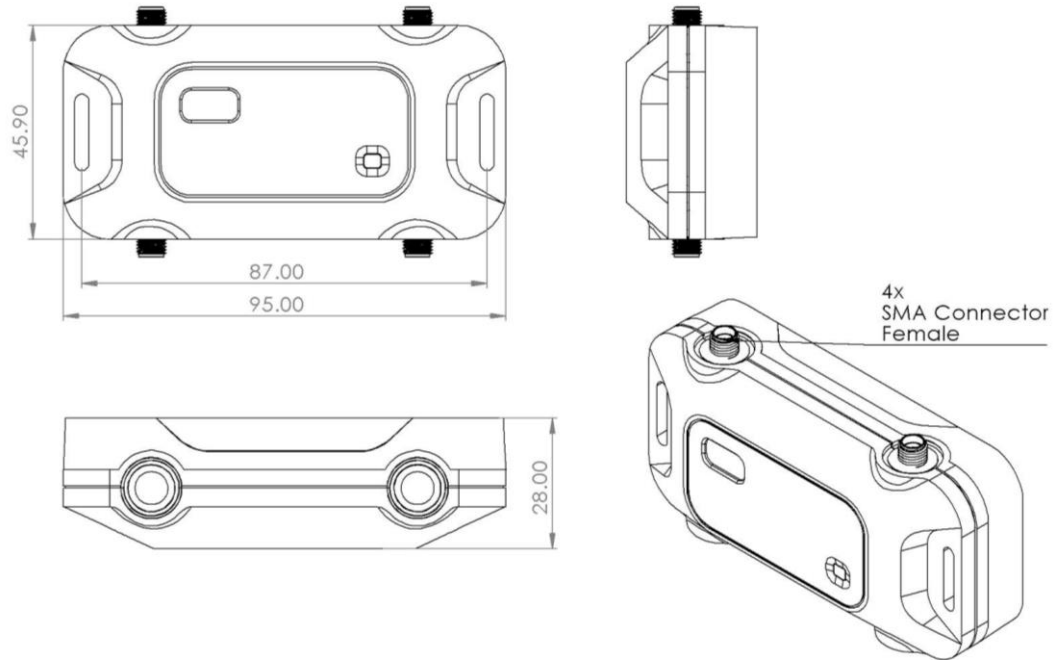
Mounting Considerations: Depending on the mounting surface, the sensor can be mounted using double sided adhesive tapes, zip ties or M3 bolts & screws (87mm pitch as shown in diagram above) Mounting brackets can be provided depending on the application.

Antenna Considerations: The Sense module is compatible with most 915 Mhz antenna designs, with higher gain antennas, more range can be realized.
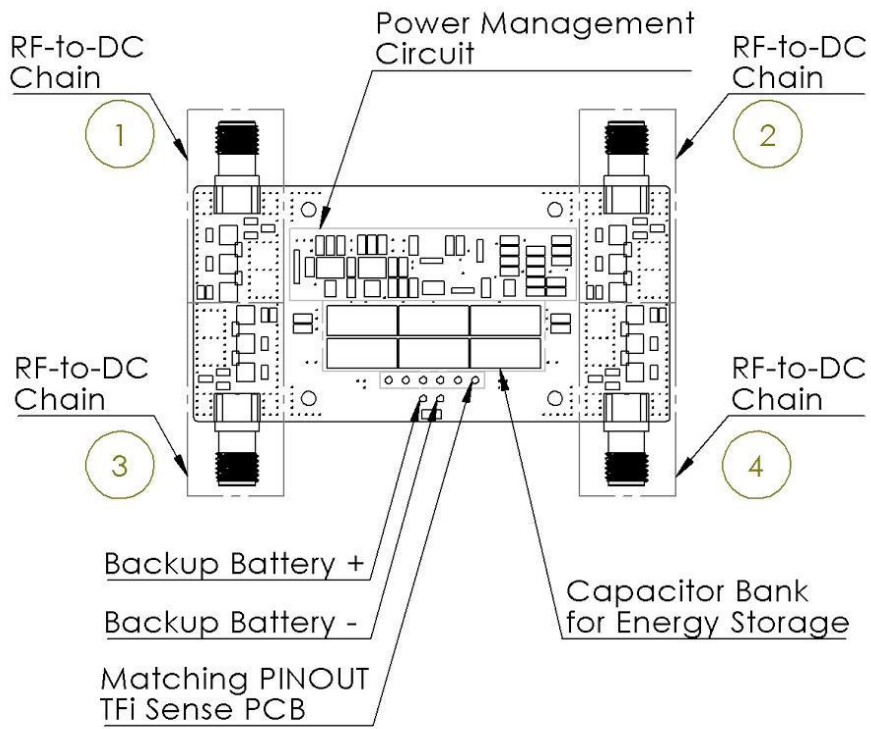
4x 915 Mhz
Antenna with SMA
Male Connector

*Shown with 50mm
Omni Directional
Antenna
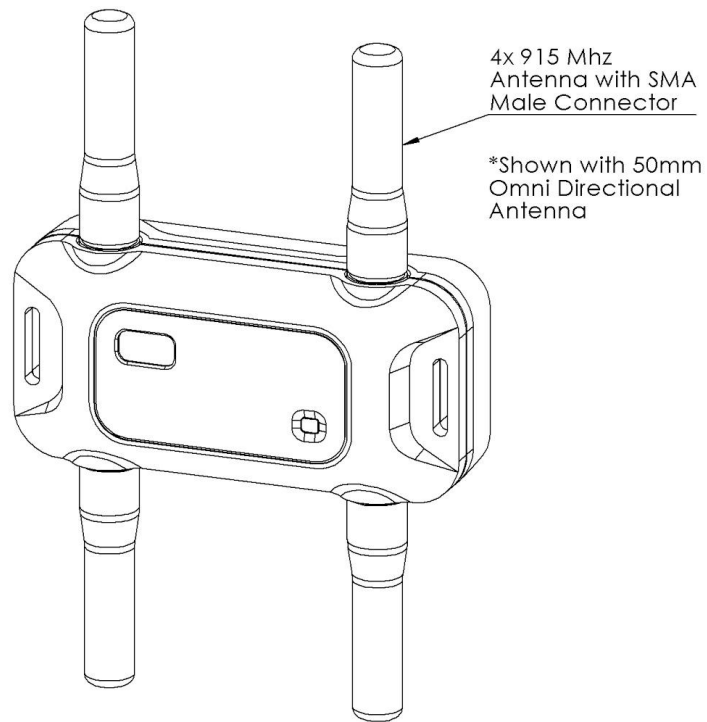
SENSE MODULE STACK DIAGRAM

Sense Module Stack
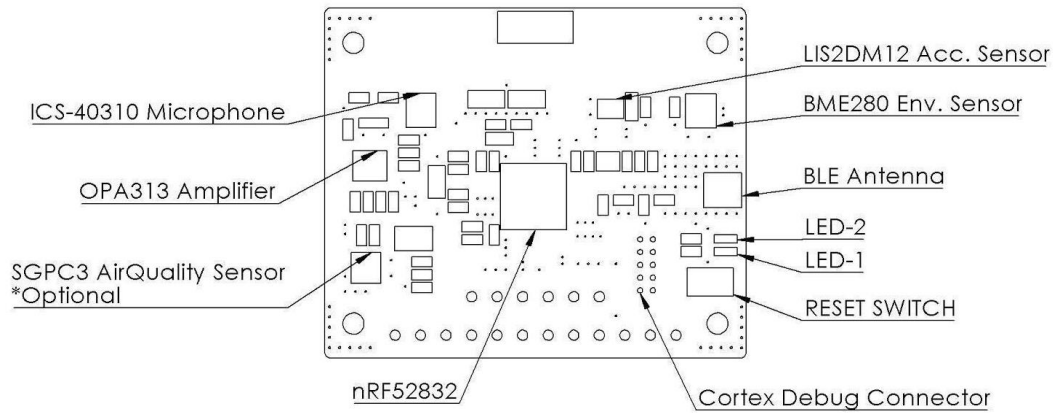(Side View)

Sensor
Board

Rectifier
Board

Backup
Battery

RECTIFIER BOARD DIAGRAM

TFi Rectifier PCB Features

SENSOR BOARD DIAGRAMS
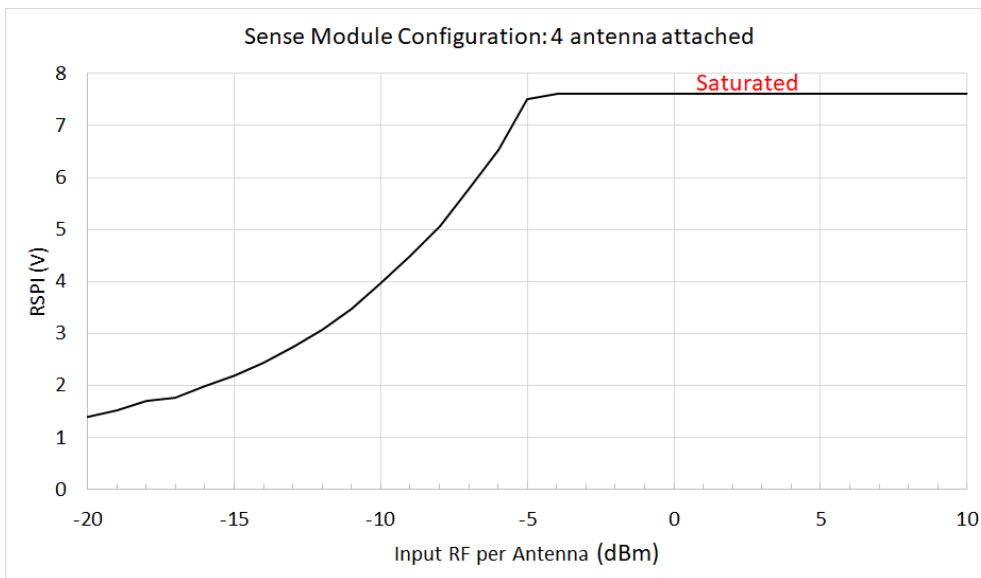
SENSOR & COMPONENT LOCATIONS
TFi Sense PCB Top View

ICS-40310 Microphone

OPA313 Amplifier

SGPC3 AirQuality Sensor
*Optional

nRF52832

LIS2DM12 Acc. Sensor

BME280 Env. Sensor

BLE Antenna

LED-2

LED-1

RESET SWITCH

Cortex Debug Connector

PINOUT DIAGRAM
TFi Sense PCB Top View

VDD

GND

RSPI-SET

RSPI-FDB

BAT-FDB

CAP-FDB

CONTROL
FEEDBACK

VDD

GND

I2C_SCL

I2C_SDA

I2C

DIGITAL — DIG-IO1

ANALOG — ANG-IO1

SPI_SCK

SPI_MOSI

SPI_MISO

SPI_EXT_CS

SPI
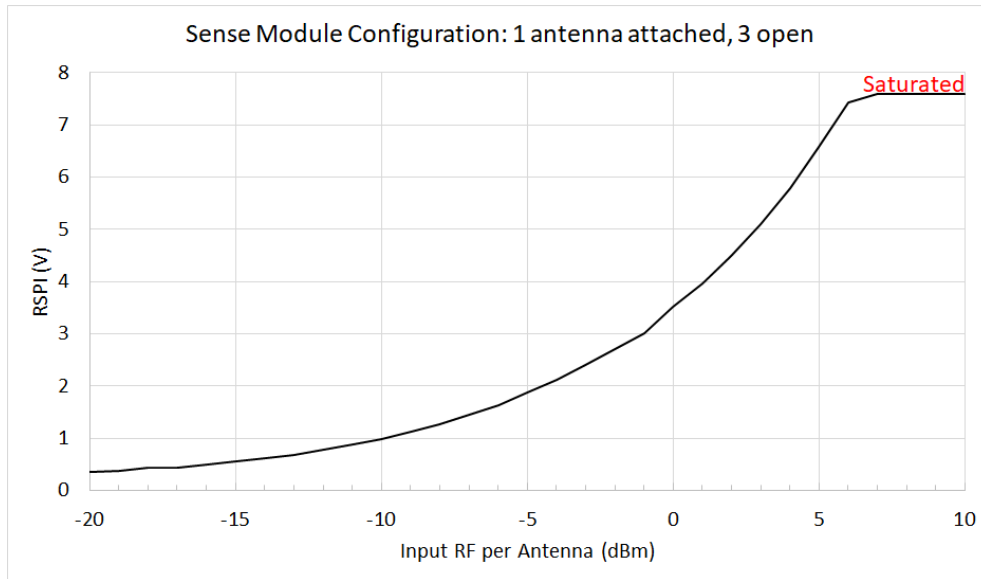
GND

VDD
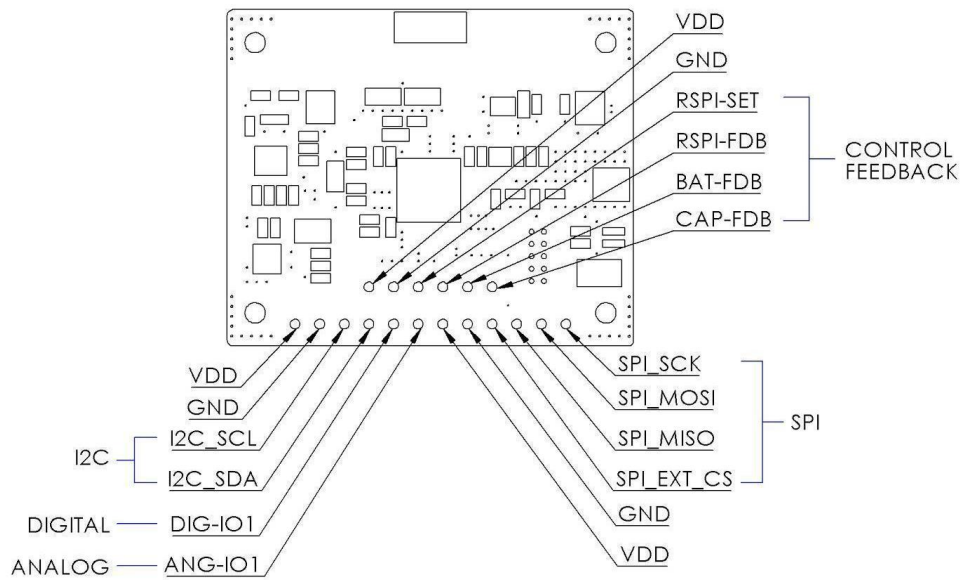
RECEIVED SIGNAL POWER INDICATOR (RSPI)

Using the RSPI value reported by the Sense module, one can calculate the amount of RF power descent at each RF-to-DC chain. The RSPI (V) versus input RF power (dBm) curves for the one-antenna and four-antenna [all identical] configurations are shown below.

Sense Module Configuration: 1 antenna attached, 3 open

Saturated

RSPI (V) vs *Input RF per Antenna (dBm)*

Sense Module Configuration: 4 antenna attached

Saturated

RSPI (V) vs *Input RF per Antenna (dBm)*

Data is not guaranteed, and is provided for reference purposes only.

RF-TO-DC CONVERSION EFFICIENCY

TFi rectifier, Turin-1, offers a superior ***end-to-end RF-to-DC conversion efficiency*** [which is defined as the energy stored in the rectifier's capacitor bank divided by the energy descend at the rectifier's antenna(s) within a given time interval, and thus includes the losses of matching circuitry, power management system, and ohmic resistance of traces]. The efficiency is over 30% for a wide range of RF input. The peak efficiency of 42% is obtained at 5dBm input for the single-antenna configuration [or -1dBm input to each antenna for the four-antenna configuration].

SENSOR BOARD POWER CONSUMPTION

The power consumption of the TFi sensor board depends on its firmware configuration including the sampling rate of each sensor, BLE advisement rate, etc. For the ***default firmware*** [i.e., 25Hz 3-axis acceleration with standard deviation output, 1Hz environmental sensing with average output, 0.1Hz noise level detection with Max-Min output, and 1Hz BLE advisement @ 0dbm], the power consumption is 240μW [120μA @ 2V].