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.
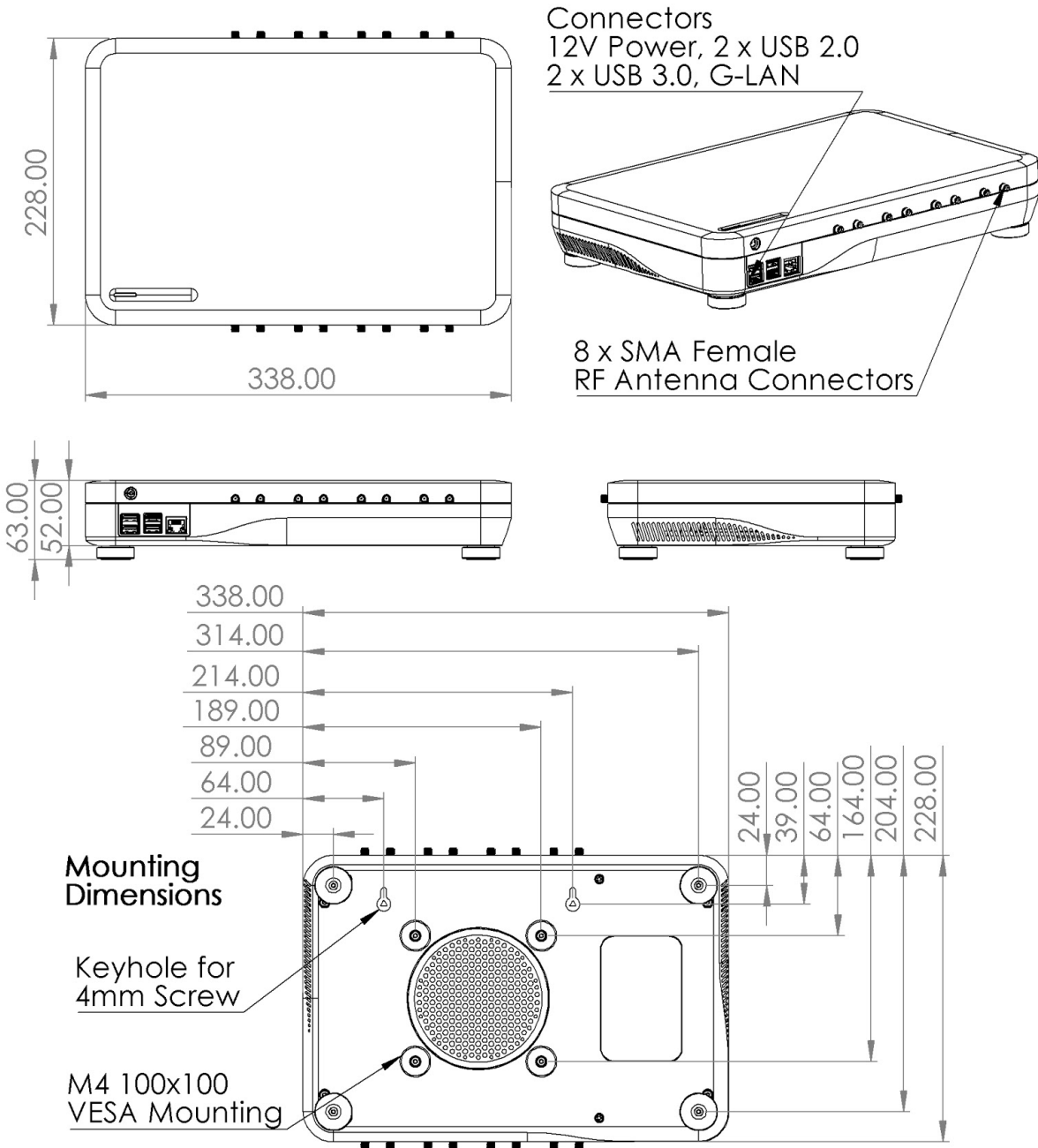
Technical Specifications

16CH Gateway, TURIN-1		

Wireless Power Transmission	Centre Frequency	860MHz ~ 940MHz [software configurable]
	Bandwidth	500KHz
	Beam angle	360-degree coverage, with real-time active beamforming over 16 channels
	Effective Range	up to 25 meters
	Antenna	16 Channel External
Connectivity	2x USB 2.0 ports	supporting peripherals such as BLE, 5G & WIFI dongles
	2x USB 3.0 ports	supporting peripherals such as BLE, 5G & WIFI dongles
	1x Gigabit Ethernet	supporting LAN connections & output protocols (MODBUS/Web Services etc.)
Input Power	DC Source	6~12VDC, 10A
Dimension	Main Body	388mm x 228mm x 52mm (3kgs)

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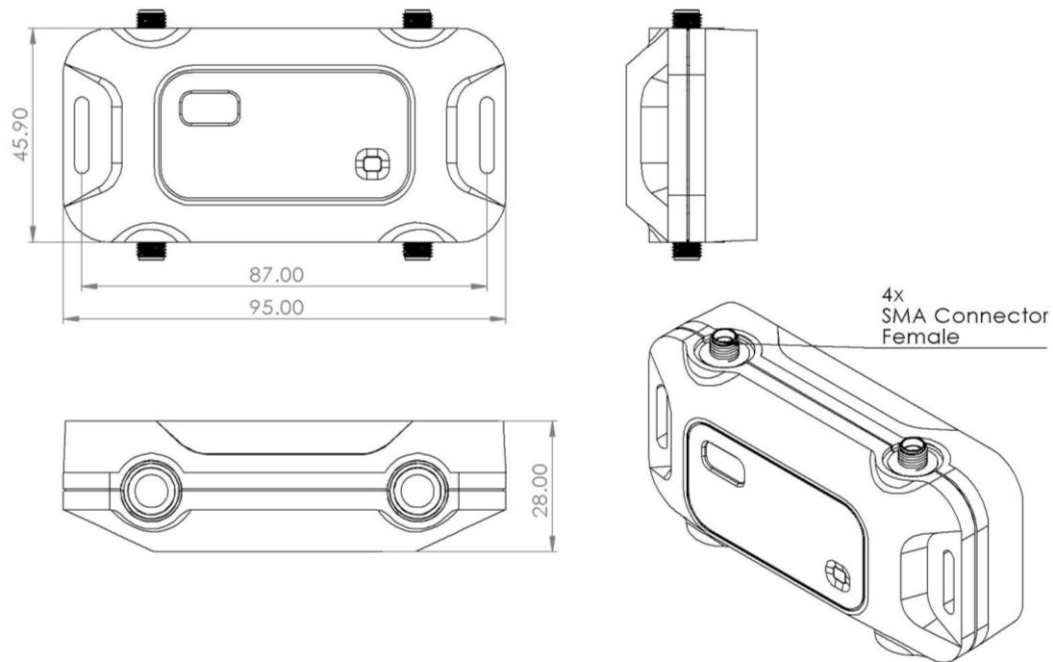
MECHANICAL SPECIFICATIONS

Gateway Dimensions
All dimensions in mm

Connectors
12V Power, 2 x USB 2.0
2 x USB 3.0, G-LAN

8 x SMA Female
RF Antenna Connectors

Mounting Dimensions

Keyhole for
4mm Screw

M4 100x100
VESA Mounting

Sense, TURIN-1		

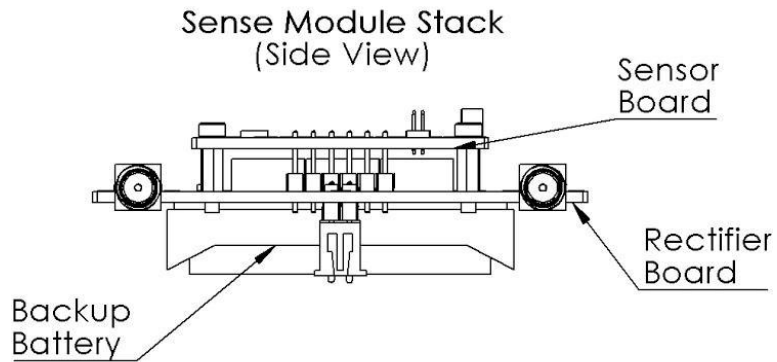|		
Power Performance	RF Harvesting	860MHz ~ 940MHz [optimized], 4 external antennas
	Output Voltage	2.1V DC [customizable over 1.8-5V]
	Energy Storage	Capacitor [alternative option of rechargeable battery]
	Backup Storage	2 x AAAA Battery (1.5V) *Optional
Built-in Sensors	3-axis Accelerometer LISDH12	*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.
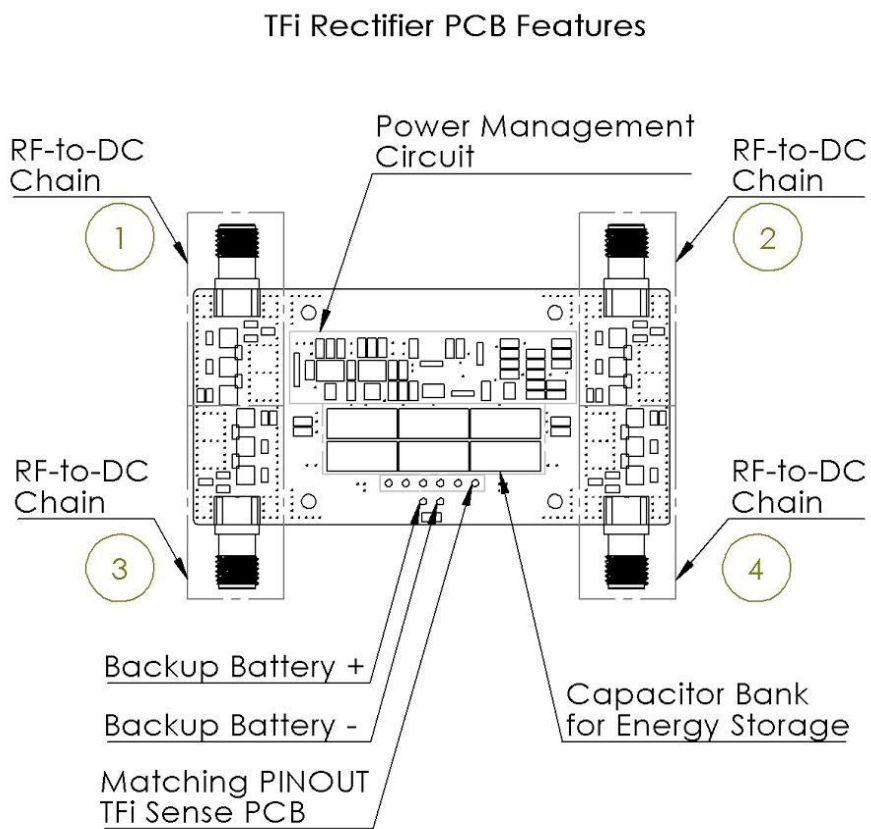
Antenna Considerations: The Sense module is compatible with most 915 Mhz antenna designs, with higher gain antennas, more range can be realized.
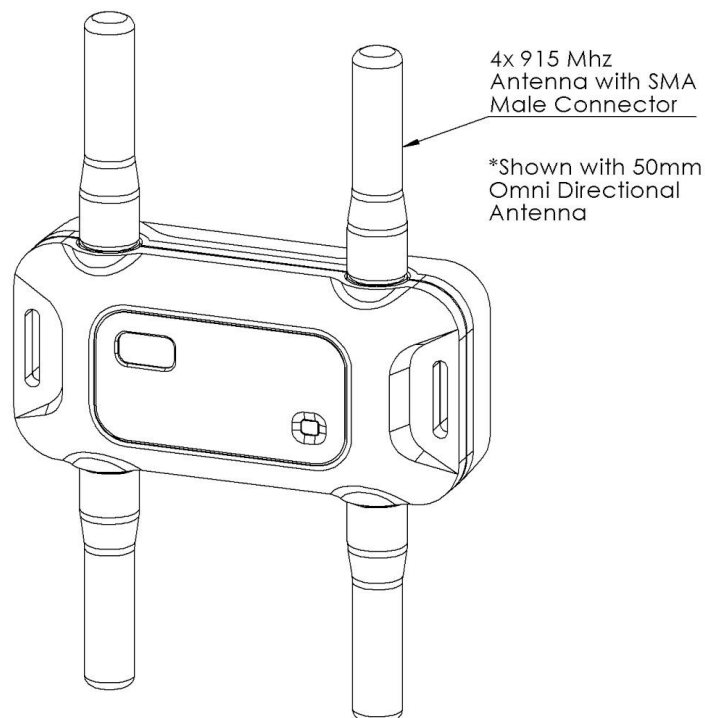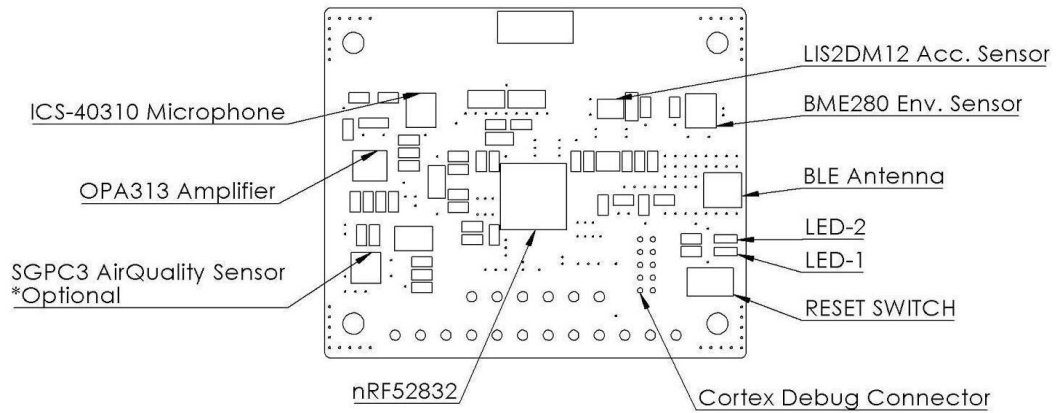

SENSE MODULE STACK DIAGRAM

Sense Module Stack
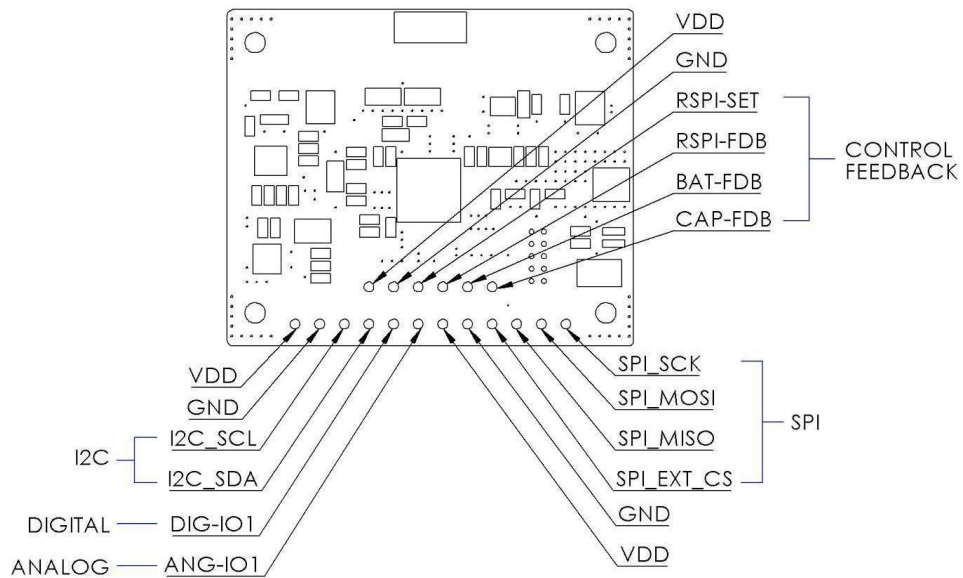(Side View)

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
DIG-IO1
DIGITAL
ANG-IO1
ANALOG

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.
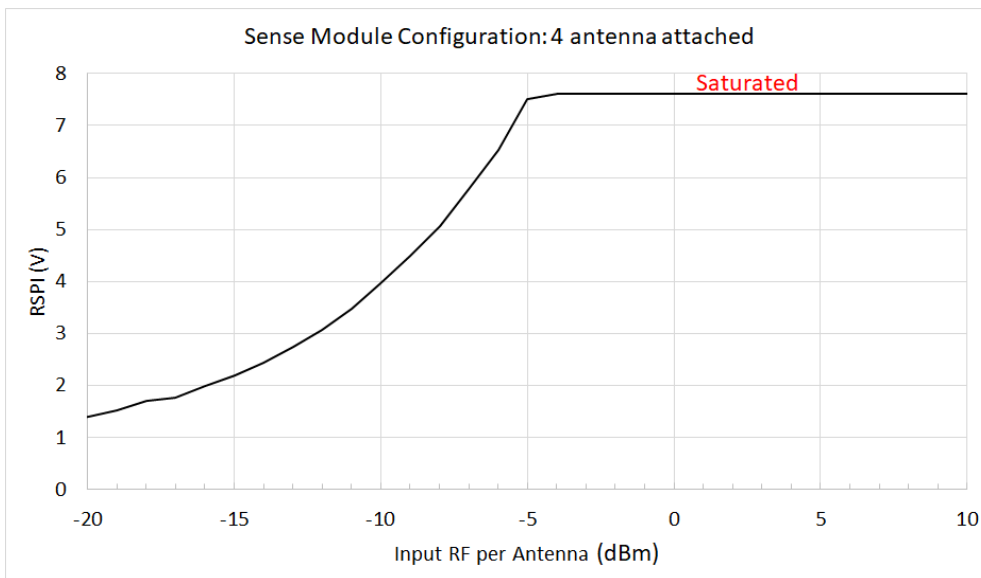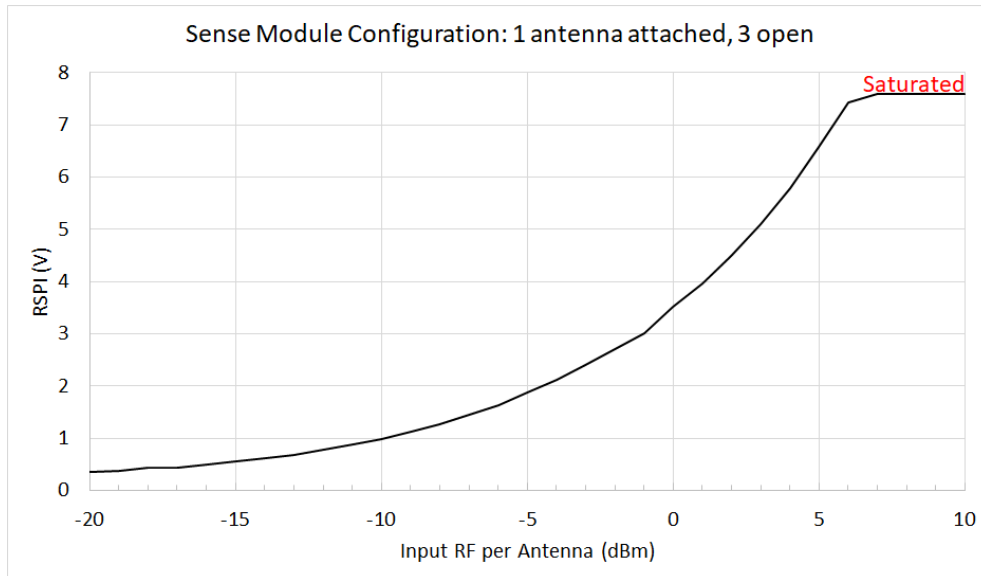
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RF-TO-DC CONVERSION EFFICIENCY

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].