

24 GHz Radar Sensor Module for Vital Signs Monitoring

Description

TES Vital Radar Sensor is a continuous wave radar sensor operating in the 24 GHz ISM-Band designed to detect micro-movements and to monitor the vital signs of life e.g. the rate of respiration, heart-rate, and body movements. The TES Vital Radar Sensor module features a planar microstrip patch antenna attached to a homodyne RF receiver frontend, a microcontroller to acquire and process the IF baseband data, and a multitude of common interfaces e.g. WiFi, USB, Bluetooth, Ethernet, CAN, and UART to allow easy and flexible interface at the user end. A proprietary Graphical User Interface (GUI) is also available for the control of the firmware and for display and manipulation of the received radar data. The small form-factor and low power dissipation allows easy installation and adaptability for vital signs monitoring applications.

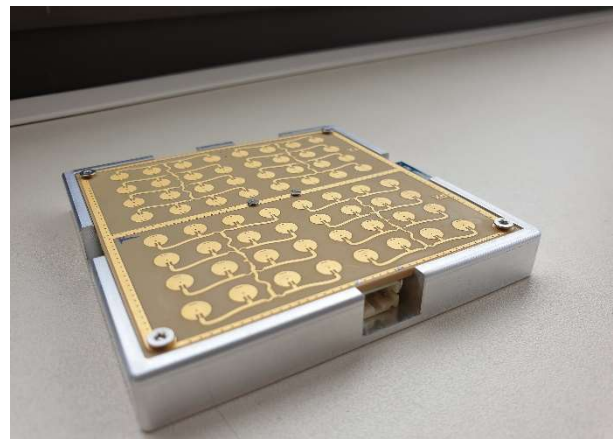
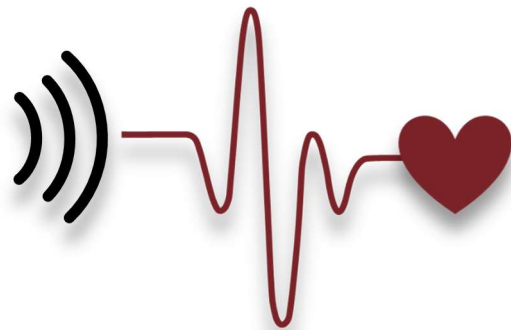


Fig. 1 The top layer view of the PCB of the TES Vital Radar Sensor (left). The bottom layer view of the TES Vital Radar Sensor PCB showing the patch antenna with the PCB mounted on an Aluminum casing (right).

Features

- Continuous Wave (CW) radar operating in the 24 GHz – ISM band for monitoring of vital signs of life i.e. rate of respiration, heart-rate, and body movement in humans and animals.
- Planar microstrip patch antenna allows a small form-factor of the overall module i.e. 70 mm × 74 mm × 7 mm.
- Arctangent demodulation of the In-phase (I) and Quadrature-phase (Q) components of the sampled baseband signal for accurate micro-motion detection.
- 32 bit ARM Cortex-M7 microcontroller unit for data acquisition and signal processing algorithms.
- Multiple interface options: WiFi, UART, USB, Bluetooth Low Energy (BLE), Ethernet, and Controller Area Network (CAN).
- Graphical user interface (GUI) to control the firmware and to observe and manipulate the received radar data.
- Overall Power Consumption in continuous operation: 1920 mW (Typical).

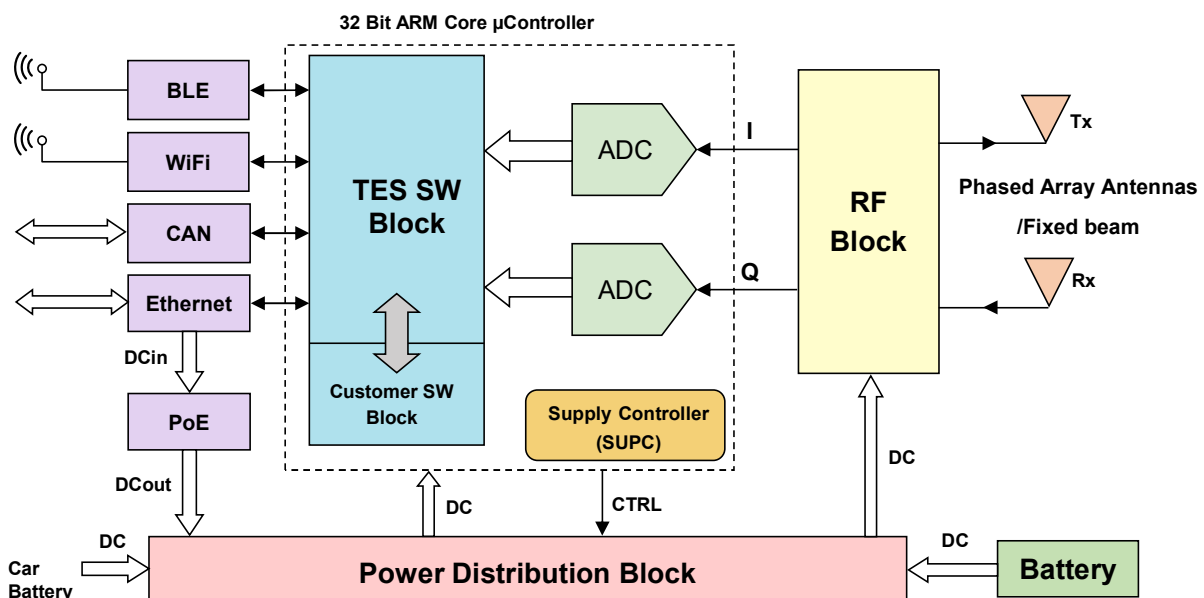


Fig. 2 Block diagram of the TES Vital Radar Sensor.

Software

- Firmware for the control of the microcontroller allowing multiple user interfaces e.g. WiFi, CAN, USB, Bluetooth, Ethernet, and UART.
- Graphical user interface allowing flexible and convenient interface for the end-user.

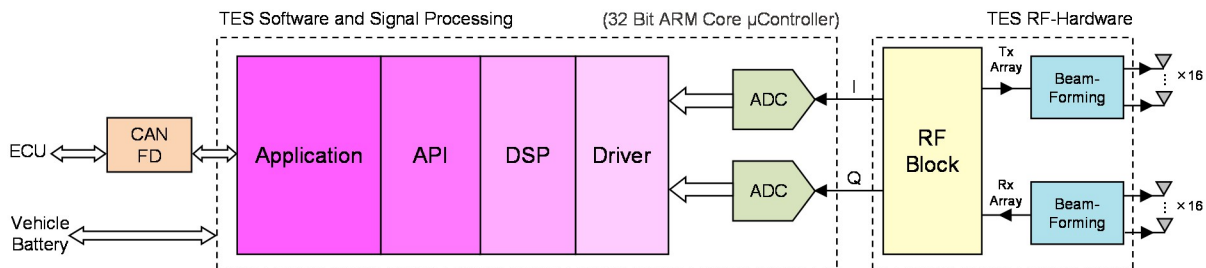
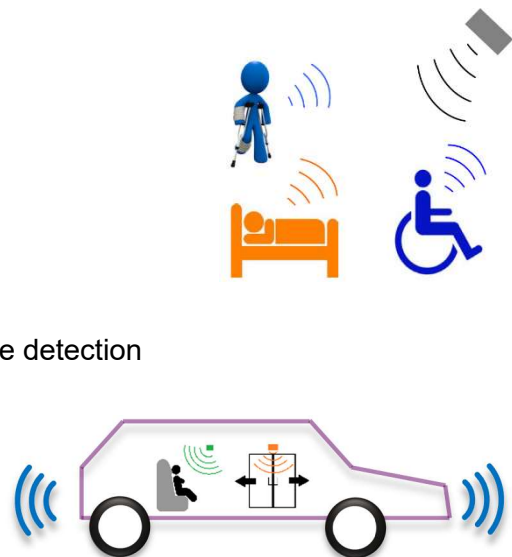


Fig. 3 Block diagram of the TES Vital Radar Sensor with the software interface to a CAN bus for automotive application.

Applications

- Medical surveillance:
 - Vital function monitoring
 - Cardiac arrhythmia or cardiac arrest alert
- Automotive applications:
 - Micro motion and occupancy detection
 - Automatic door, car hood opening system
 - Seat occupancy recognition or child presence detection
- Security applications:
 - Detection of intruders
- Rescue applications:
 - Detection of alive humans and animals underneath the debris following an earthquake/ building collapse, or avalanche.



Specifications

Parameter	Test Conditions/ Comments	Min.	Typ.	Max.	Units
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RF Characteristics

Radar transmit frequency (f_{cw})	SHF (1.2 cm) ISM-Band	24	24.125	24.25	GHz
Effective isotropically radiated power (EIRP)		-3		25	dBm
Antenna gain (G)				16.65	dBi
Noise figure (NF)	Total noise figure of the system		1.414		dB
IF bandwidth	-3 dB bandwidth		9.05		Hz
Noise power ($P_{n,rms,dBm}$)			-162.54		dBm
IF amplifier gain		28	30	33	dB
Radar range	Distance to target object	50	75	100	cm
Phase noise	@ 1 kHz offset (SSB)		-80		dBc/ Hz
	@ 10 kHz offset (SSB)		-80		dBc/ Hz
	@ 100 kHz offset (SSB)		-85		dBc/ Hz
	@ 1 MHz offset (SSB)		-105		dBc/ Hz

Power Supply

Supply Voltage		4		5	V
Supply Current			480		mA
Power dissipation			1920		mW

Environment

Operating temperature			TBD		°C
Storage temperature			TBD		°C

Mechanical Outline

Radar sensor with housing	PCB with Aluminum housing		70 × 74 × 10		mm ³
Radar sensor without housing	Only PCB without housing		70 × 74 × 7		mm ³

Antenna Specifications

Parameter	Elevation Angle	Azimuth Angle	Units
-3 dB beamwidth	20°	10°	Degrees
-10 dB beamwidth	34°	17°	Degrees

Antenna Pattern Polar Plot

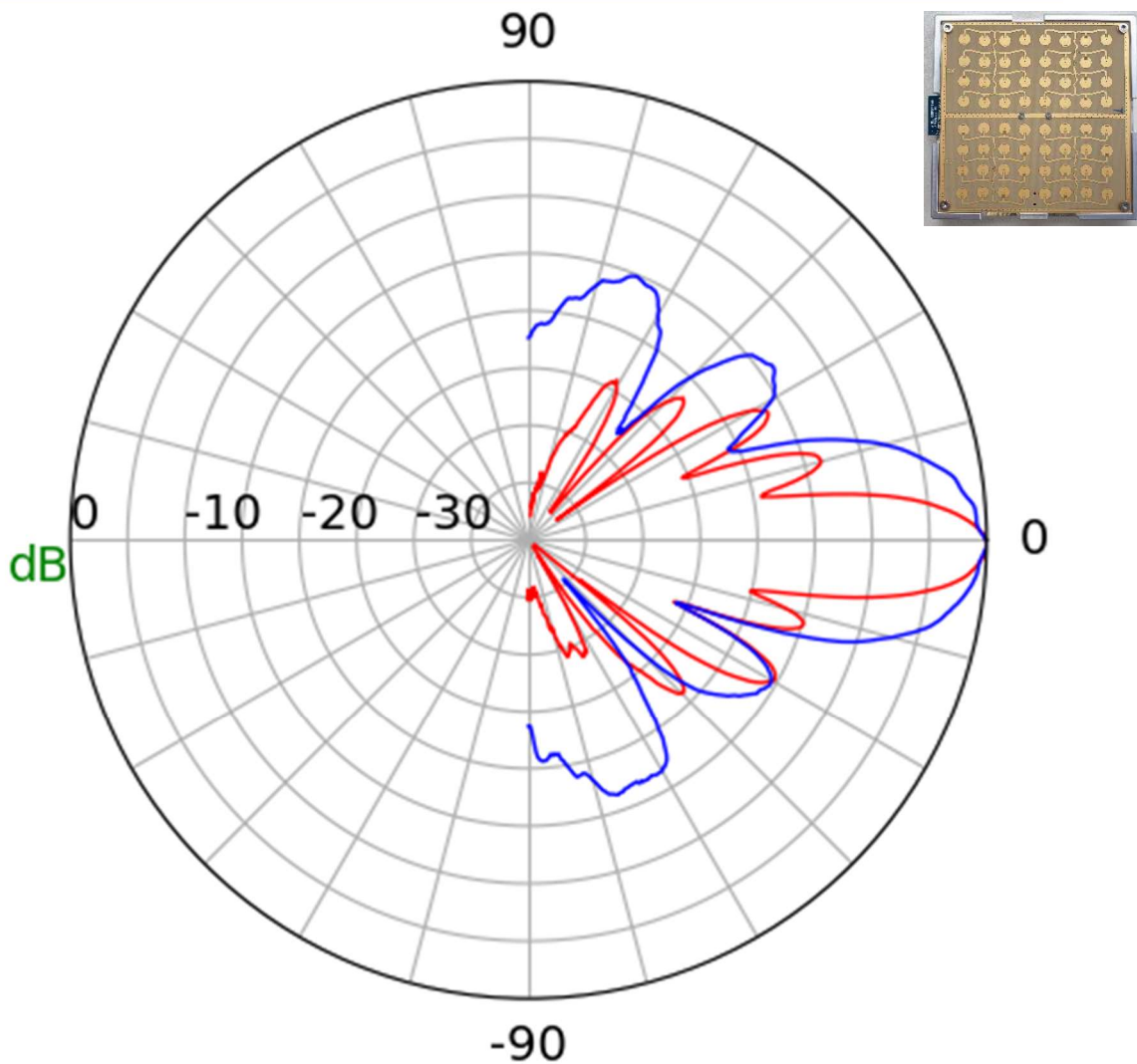


Fig. 4 Measured result of the antenna pattern plotted as a polar plot. The blue plot corresponds to the Elevation pattern whereas the red plot corresponds to the Azimuth pattern of the antenna. The antenna can be seen in the inset on top right.

Gain vs. Frequency Plot

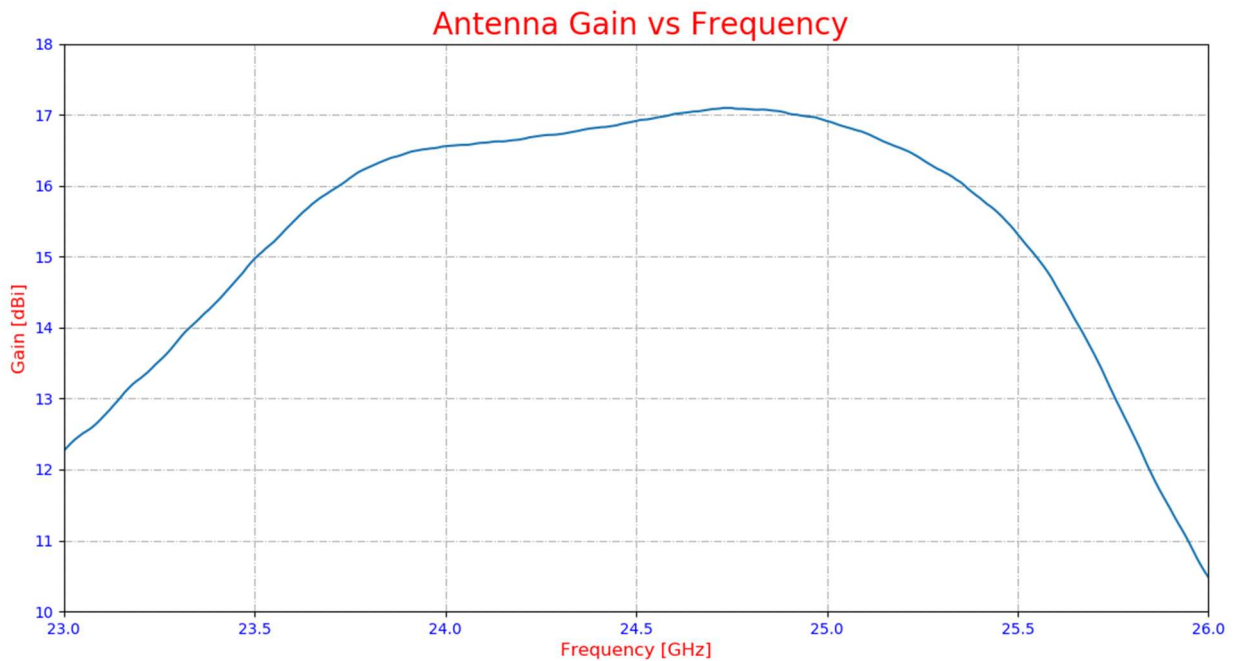


Fig. 5 Measured result of the antenna gain vs. frequency.

RoHS – Compliance

The TES Vital Radar Sensor complies with the European Union directive 2011/65/EU for the restriction of hazardous materials in the manufacture of electronic and electrical equipment.

Disclaimer

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