Sensor iD ST25RU3993 Development Boards Instruction Manual

Contents

ST25RU3993 Development Boards

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Product Information

The product is a RFID (Radio Frequency Identification) device manufactured by SENSOR ID SRL in Campochiaro, Italy. It operates in the 860-960 MHz UHF band and is configured at the factory to operate within the specific band of each region. In North America, the RFID UHF bandwidth ranges from 902.5 to 927.5 MHz.

The RFID board of the device is based on the integrated reader ST25RU3993 and is controlled by BGM13S32A. It includes an antenna for UHF RFID reading. The device requires a 5V DC power supply and the RFID board is integrated on the product PCB.

The carrier frequency of the device is modulated by either ASK or PR-ASK shaped modulation signal. The ST25RU3993 differential output is connected to a 2:1 balun that transforms the transmit signal from a 100Ω differential to a 50Ω single-ended signal. To limit cross-channel interference, a SAW (Surface Acoustic Wave) filter is placed on the TX-path of the reader, specifically the B3717 model manufactured by TDK.

To maintain the sensitivity of the reader, the self-jamming signal reaching the receiving inputs of ST25RU3993 needs to be minimized. This self-jamming signal consists of reflections from the antenna and leakage across the main directional coupler. To minimize this signal, a carrier cancellation circuit is connected to the coupled port of the main directional coupler.

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Product Usage Instructions

1. Connect the RFID device to a 5V DC power supply.

2. Ensure that the device is configured to operate within the

specific UHF band of your region.

3. Place the RFID device within range of the RFID tags you want to read.

4. The device will automatically detect and read the RFID tags within its range.

5. To maintain optimal sensitivity, ensure that there are no obstructions or interference between the device and the RFID tags.

6. If you experience any issues with reading RFID tags, check the antenna matching and ensure that the self-jamming signal is minimized by using the carrier cancellation circuit.

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RFID OPERATIONAL DESCRIPTION MANUAL		
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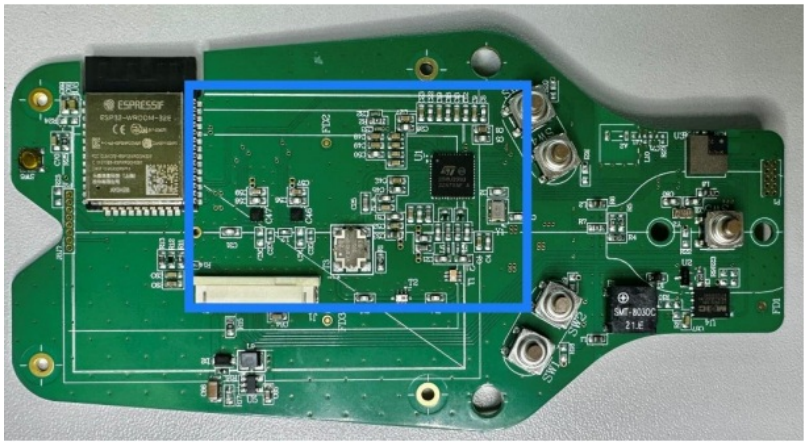
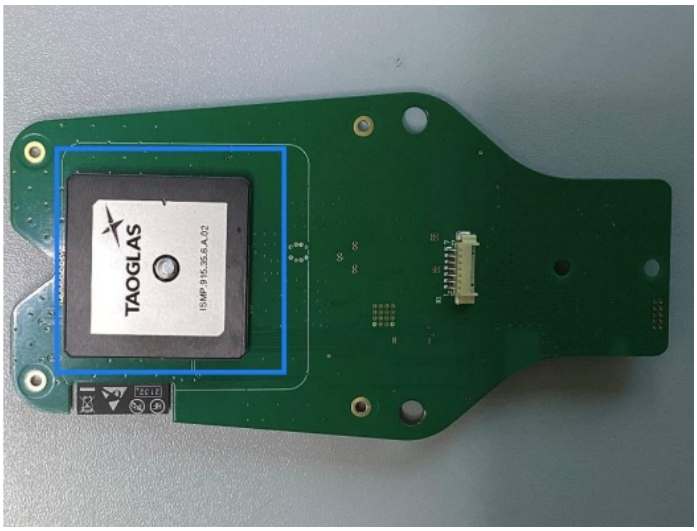
I. Product description

The RFID technology operates in the 860-960 MHz UHF band, so the reader is configured at the factory to operate within the specific band of each region.
RFID UHF bandwidth in North America ranges from 902.5 to 927.5 MHz.

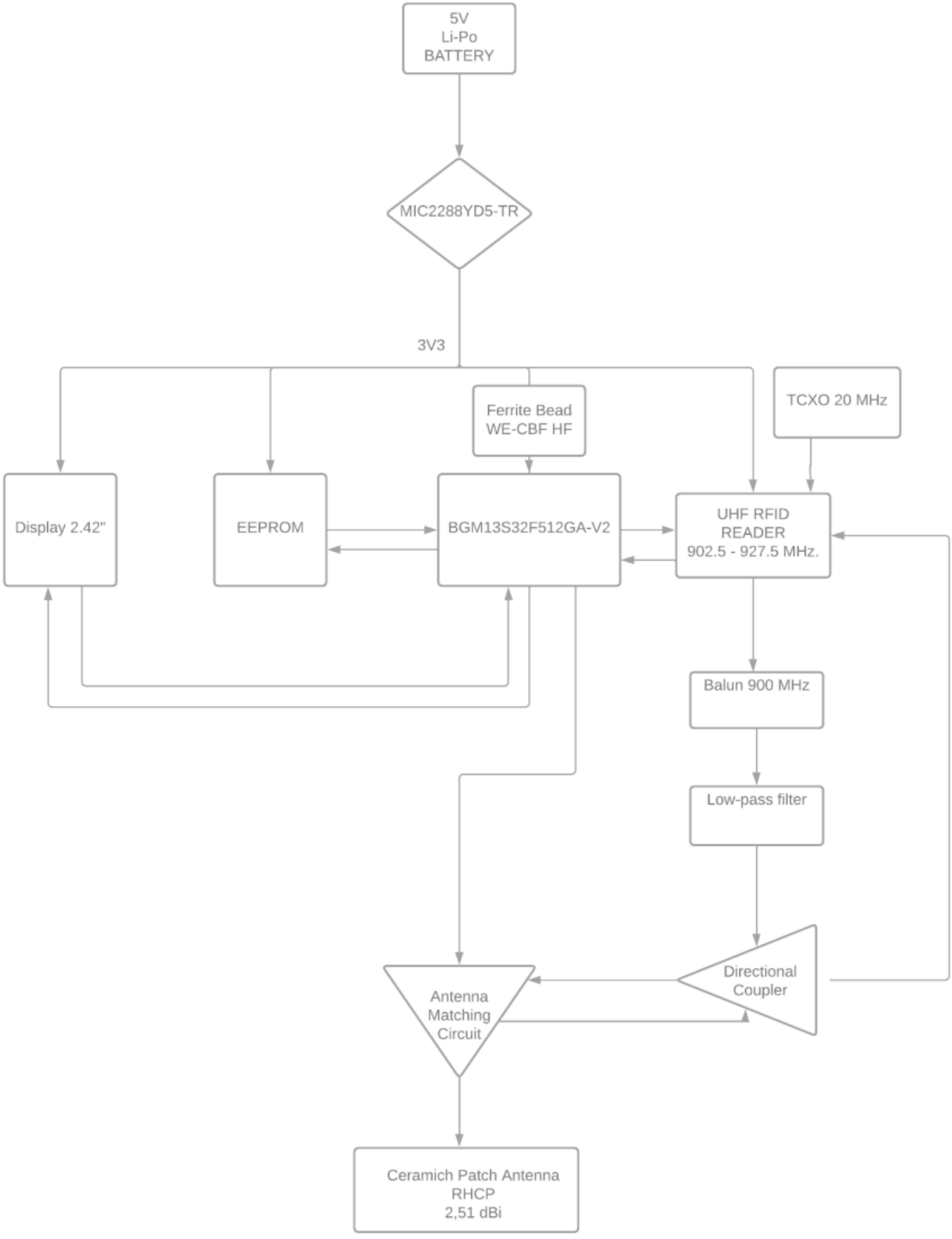
- RFID BOARD: RF circuit based on the integrated reader ST25RU3993 device, controlled by BGM13S32A and an antenna UHF RFID Reader
- 5V DC POWER SUPPLY

RFID BOARD INTEGRATED ON THE PRODUCT PCB





RFID OPERATIONAL DESCRIPTION USING A FLOWCHART



2 RF circuit

The core component of the RF circuit is the ST25RU3993 chip. It receives digital base-ban transmit data and commands from the MCU via the SPI interface. ST25RU3993 frames the transmitted data accordingly, and automatically encodes it into PIE symbols. Based on the PIE encoded symbols ST25RU3993 creates a sinusoidal shaped modulation signal. The modulation signal can either be ASK or PR-ASK. ST25RU3993 synthesizes an RF carrier frequency with a VCO / integer-n phase locked loop (PLL). The frequency reference for the PLL is a

temperature compensated crystal oscillator (TCXO).

The carrier frequency is modulated by the ASK or PR-ASK shaped modulation signal. The ST25RU3993 differential output is connected to a 2:1 balun where the transmit signal is transformed from a 100 Ω differential to a 50 Ω single-ended signal. In order to limit cross channel a SAW filter must be placed on the TX-path of the reader, the selected SAW filter is B3717 which is manufactured by TDK.

The signal then proceeds to the external power amplifier to generate a high-power output signal with approximately 30 dBm in the default configuration of the board. The output of external power amplifier is connected to a low-pass filter, which attenuates the second and third harmonic of the carrier frequency.
The filtered transmit signal to directional coupler, which has a coupling factor of 10 dB. The purpose of this device is to isolate the transmit signal from the receiving inputs of ST25RU3993 and has a major influence on the sensitivity of the reader. The isolated port of the main directional coupler is connected to a 2:1 balun to transform the incoming tag response signal to a 100 Ω differential signal that is connected to the receiving pins of ST25RU3993

3 Antenna matching

To maintain the sensitivity of the reader the self-jamming signal reaching the receiving inputs of ST25RU3993 needs to be minimized. The self-jamming signal comprises reflections from the antenna and the leakage across the main directional coupler. To minimize the self-jamming signal a carrier cancellation circuit is connected to the coupled port of the main directional coupler.

The antenna matching circuit can change its impedance and hence to reflect a certain amount of the coupled power back into the directional coupler. This reflected signal is combined with the self- jamming signal at the isolated port of the main directional coupler.

To find the impedance setting of the antenna matching circuit resulting from a self-jamming signal cancellation the power of the self-jamming signal needs to be measured. Such a measurement capability is provided by ST25RU3993 and is referred to as reflected power measurement. An optimal impedance setting of the antenna matching circuit results in low reflected power. The main components of the antenna matching circuit are two digital tunable capacitors, which are controlled by the microcontroller via the SPI interface. The fixed lumped components of the antenna matching circuit help to center its impedance to 50 Ω and define the impedance step created by one change of a digital tunable capacitor.

4 Antenna specifications

Electrical	
Frequency	915 MHz
Return Loss	-10dB max.
Efficiency	77.1 %

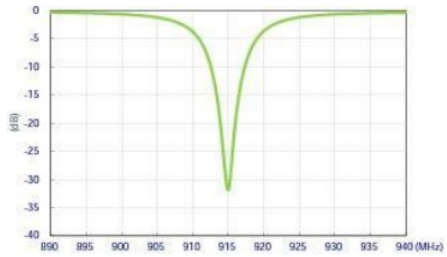
Average Gain	-1.13 dB
Peak Gain	2.51 dBi typ.
Axial Ratio	3.0 max (d) Zenith
Polarization	RHCP
Impedance	50
Mechanical	
Dimensions	35 x 35 x 6 mm
Material	Ceramic
Pin Diameter	0.9 mm
Pin Length	2.4 mm
Weight	34.3 g
Environmental	
Operation Temperature	-40°C to 85°C
Storage Temperature	-40°C to 105°C

Humidity	Non-condensing 65°C 95% RH

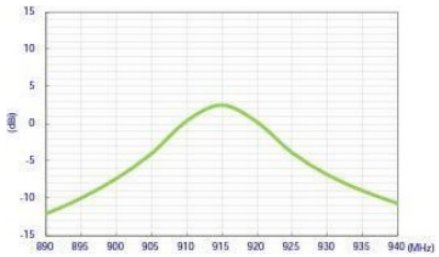
* Antenna properties were measured with the antenna mounted on 70*70mm Ground Plane

Antenna Characteristics

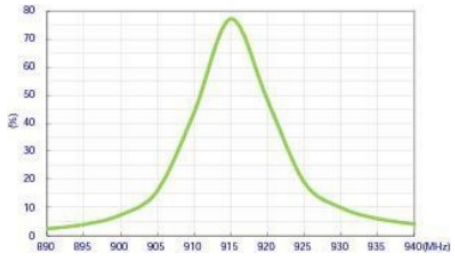
Return Loss



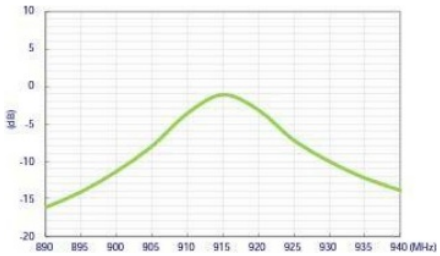
Peak Gain



Efficiency

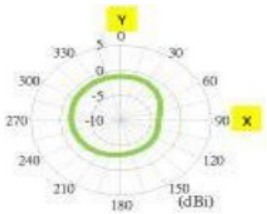


Average Gain

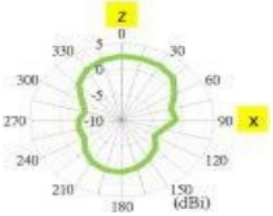


RADIATION PATTERN

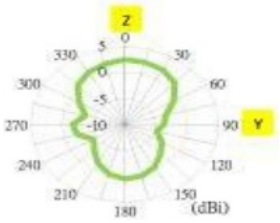
4.2 X-Y Plane



X-Z Plane



Y-Z Plane



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Registro AEE N. IT 2203000013700 Azienda certificata **ISO 13485:2016**
Reg. Pile ed Accumulatori N. IT 20010P00005962 Azienda Certificata **ISO 9001:2015**

Documents / Resources

	Sensor iD ST25RU3993 Development Boards [pdf] Instruction Manual U27BTW11, 2AVDNU27BTW11, 2AVDNU27BTW11, ST25RU3993 Development Boards, Development Boards, Boards

References

- Welcome Sensor ID - Proximity Wireless Technologies Made in Italy