S3KM111

Smart mmWave Sensor Series

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S3KM111
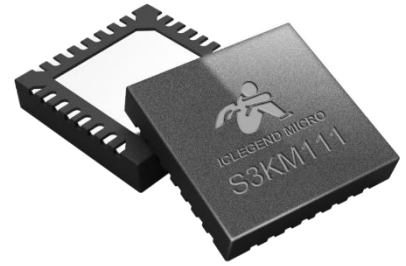
1 Device Overview

1.1 Main Features

- 24 GHz K-band highly integrated FMCW radar sensor SoC

- Up to 250MHz bandwidth FM tuning range

- Integrated one transmitter channel and one receiver channel

- Integrated FM signal generator and low phase noise PLL

- On-chip 16bits ADCs in the receiver baseband

- On-chip hardware accelerator for digital signal processing

- TX maximum output power: 12dBm

- RX noise figure: 10.5 dB

- PLL phase noise: -97dBc @ 1MHz offset

- Command IIC/SPI/UART for chip configuration

- Data SPI/UART for serialized data output

- Single power supply voltage 3.3 V

- 4 x 4 mm^2 QFN32 package

1.2 Applications

Motion detection

Range and velocity measurement

Simple gesture recognition

Vital signs monitoring

Figure 1. smart mmWave sensor's application

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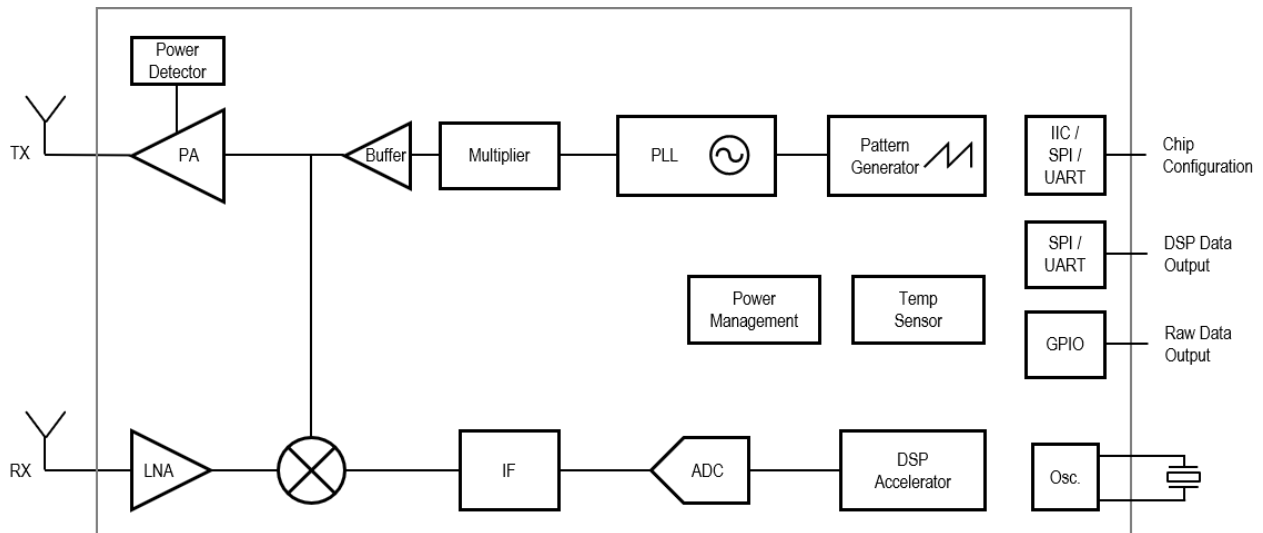
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1.3 General Description

Figure 2. S3KM111 Diagram

The S3KM111 is a highly integrated SoC mmWave sensor which is used to provide a compact solution for radar sensor system. Based on FMCW radar technology, it is capable of operation at 24GHz K-band with up to 250MHz continuous chirp.

The device includes a fully on-chip K-band RF transceiver, driven by on-chip pattern generator and PLL. The pattern generator can support several frequency sweep modes that generate various waveforms in the frequency domain, for example, saw-tooth and triangular waveforms. The generator and PLL support fast chirp mode.

The RF and Analog subsystem contain one transmitter (TX) and one receiver (RX). Gain controls are applied to both transmitter and receiver to adjust the whole link budget to work in different scenarios. In the receiver, it integrates IQ basebands including inter-mediate frequency (IF) amplifiers, filters and ADCs. DSP accelerators are followed by the ADCs, which run data processing such as the FFT of the IQ ADCs' outputs. The processed data can be output in serialized manner through flex output pins via SPI or UART.

The S3KM111 requires minimum external components i.e. the external crystal oscillator and stabilization capacitors as the high level of integration. It can be operated with a single power supply at 3.3V thanks to the internal power management engine, and the device is fully configurable via IIC/SPI/UART.

2 Main Performance

Table 1. Main Parameters

Parameter	Description	Min	Typ	Max	Units	Condition
Vcc	Supply voltage	3.0	3.3	3.6	V	
Icc	Current Consumption		64		mA	all the circuits work at default setting mode and all the circuits are on, with 50% duty cycle chirp
F_Out	TX output frequency range	24		24.25	GHz	24GHz ISM Band
P_{max}_Out	TX maximum output power		12		dBm	
F_In	RX input frequency range	24		24.25	GHz	24GHz ISM Band
NF	RX noise figure		10.5		dB	including RF, analog and ADC
G_RX_RF	gain of LNA + Mixer in RX	15		31	dB	
BW_Chirp	FMCW chirp bandwidth			0.25	GHz	
PN	Phase noise of PLL		-97		dBc	@ 1MHz offset frequency
Res_ADC	ADC resolution		16		bits	
Fs	ADC sampling frequency		2.5		MHz	

3 Revision History

Table 2. Document Revision History

Date	Revision	Author	Changes
2019/10/10	V1.0	Marketing Department	Initial Release
2020/3/3	V1.1	Marketing Department	Update F_in、F_out、NF、PN performance、Add R_RX_RF、Fs performance
2020/3/31	V1.2	Marketing Department	Update block diagram, description, and F_in、F_out performance
2020/4/13	V1.3	Marketing Department	Update Icc and G_RX_RF