

## A 1 V ISM-band RF SoC with integrated DSP for ultra-low power portable applications

Icycom is an RF system-on-chip (SoC) integrating a 863-928 MHz ultra-low power RF transceiver, a 16/32-bit 120  $\mu\text{A}/\text{MHz}$  dual-MAC DSP RISC core with 96 kbytes of SRAM.

The SoC is powered between 1.0 and 3.6 V, consuming less than 3 mA at 3.0 V in RF mode, down to 1  $\mu\text{A}$  in hibernation with RTC running. Additional peripherals such as DC-DC, ADC, SPI, I2C, UART, I2S and timers are all included on-chip, resulting in a compact system solution.

Icycom targets portable 863-928 MHz applications needing long battery life and/or signal processing, such as AMR, WSN and medical.

### Applications

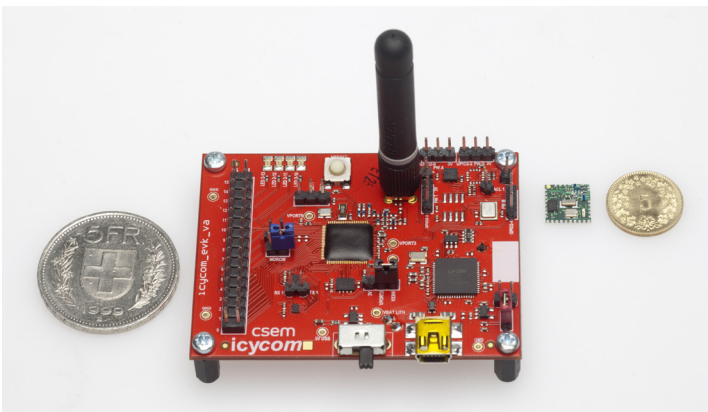
- Automatic Meter Reading (AMR)
- Wireless Sensor Networks (WSN)
- Medical and Body Area Networks (BAN)
- Home automation

### Availability

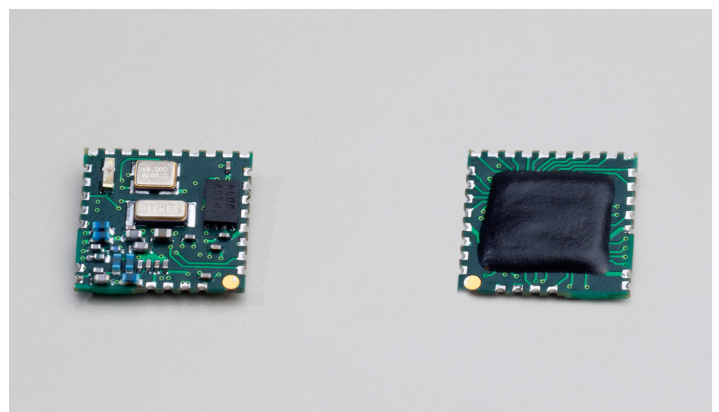
- Samples and evaluation kits are available from CSEM
- Packaging options: bare die or QFN
- Derivatives of the icycom platform are configurable to customer-specific requirements

### Features

- Ultra-low power 863-928 MHz transceiver
- Voltage operation from 3.6 V down to 1.0 V
- Minimum current standby mode with RTC based on 32 kHz crystal oscillator: 1  $\mu\text{A}$  at 25°C/1 V
- Low continuous Rx/Tx current: 3.0 mA (3 V)
- RF data rate up to 400 kb/s
- Rx sensitivity -110 dBm at 25 kb/s in FSK modulation, -115 dBm at 2 kb/s in OOK modulation
- Digital RSSI: 3 dB/step from noise level up to -30 dBm
- Flexible modulation: FSK, OOK, 2-FSK, 4-FSK, QPSK
- 16/32-bit **icyflex1** DSP/CPU, 120  $\mu\text{A}/\text{MHz}$ , dual MAC
- Software development kit: gcc, gdb, ISS, Eclipse
- 96 kiB low leakage SRAM (program and data)
- Integrated ADC (10 kS/s), power management, LED current sources
- Standard digital interfaces: SPI, UART, I2C, I2S and GPIO
- ETSI EN300-220 V2.2.2 and FCC part 15.247 and 15.249 compliant



Hardware development kit (red) and icycom\_mini module (green)



1 cm<sup>2</sup> icycom\_mini module (front and back)

## Specifications

Parameter	Comments	Min.	Typ.	Max.	Unit
Low supply voltage, $V_{bat}$	e.g. alkaline cell. See step-ups	1.0		1.8	V
Higher supply voltage	e.g. lithium cell using voltage divider	2.0		3.6	V
Temperature		-25		75	°C
Standby currents (1 V)	Running 32 kHz RTC for a re-boot		1.0		μA
	Running 32 kHz RTC for a fast wake-up		2.7		μA
16/32-bit processor	At 1 V, battery voltage independant		120		μW/MHz
Memory	Internal low-power RAM (program + data)		96		kiB
Transceiver	Some external passive components may be different for the two ISM bands	902		928	MHz
		863		870	MHz
Receiver	Continuous reception, $1.0 V < V_{bat} < 1.8 V$			3.5	mA
	Per channel power sampling, $1.0 V < V_{bat} < 1.8 V$			1	mA·ms
	200 kbit/s FSK			-105	dBm
Transmitter	Continuous transmission, full power (10 dBm)			40	mW
	Continuous transmission, low power (-5 dBm)			6	mW
10-bit ADC	Energy per conversion			$5 \cdot V_{bat}$	nJ
	Max. sampling frequency			10	kHz
High-current Step-up	>95% current efficiency $V_{out} > 2.0 V$ $V_{out} > 2.7 V$	0.1		13	mA
		0.1		4	mA
Low-current Step-up	>50% current efficiency and $V_{out} > 2.5 V$	1		10	μA

## Block diagram

