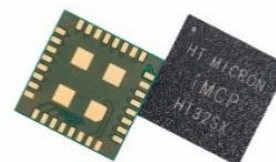


# Sigfox® Monarch RF Transceiver System in Package

## Overview

iMCP – HT32SX is a Multicomponent Integrated Circuit (MCO) designed to provide a ready-to-use connectivity solution for Internet of Things (IoT) applications. It provides both uplink (transmit) and downlink (receive) communications, and it is the first HT Micron product in a new family of non-memory component. Its small dimensions, high performance and low power consumption targets the best experience for IoT developers. The system combines an ARM Cortex M0+ 32bit (STM32L052x8) and the ST Microelectronics S2-LP low power transceiver combining all the advantages, integration and convenience of advanced semiconductor packaging technology into a single chip.



## Features

- Key features
  - Enables operations in the SIGFOX™
  - Multizone worldwide operation – MONARCH feature
  - Integrated 50 MHz crystal
  - 32-bit ARM Cortex M0+
  - 64 KB flash - Other options will be available on demand
  - 8 KB RAM
  - TX output power up to +22 dBm
  - RX sensitivity: - 128 dBm
- Power consumption
  - 17.7 mA RX
  - 166.5 mA TX @ 20 dBm, 902.2MHz
- RF
  - S2-LP Transceiver
  - STMicroelectronics
  - SKY66420-11 Front-End Module
  - Frequency bands:
    - 413-479 MHz
    - 452-527 MHz
    - 826-958 MHz
    - 904-1055 MHz
  - Modulation schemes:
    - DBPSK, 2(G)FSK, OOK, ASK
  - Data Rate:
    - Up to region: 100bps or 600bps
- Interface
  - Up 21 General-Purpose Input/Output (GPIO) pins, with configurable pull-up/pull-down resistors
  - 12-bit ADC
  - 12-bit 1 channel DAC
  - 2 USART, LPUART, USB 2.0, I<sup>2</sup>C
- Single power supply: 2.7 V to 3.6 V
- Operating temperature range: -20°C to +75°C
- External antenna
- 13x13x1.35mm LGA – 32 pads package
- Part number: HT32SX

## Applications

- Smart home
- Wireless alarm systems
- Manufacturing
- Agriculture
- Building automation
- Smart metering
- Smart lighting systems



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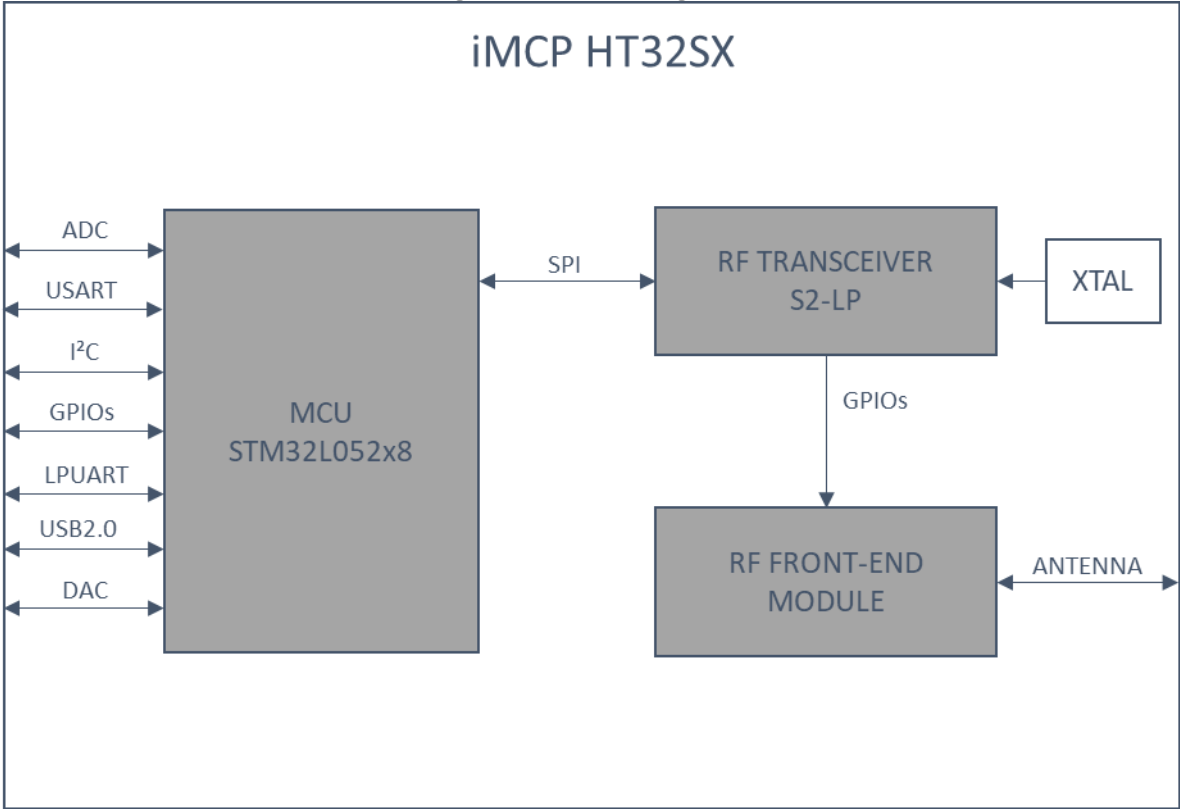
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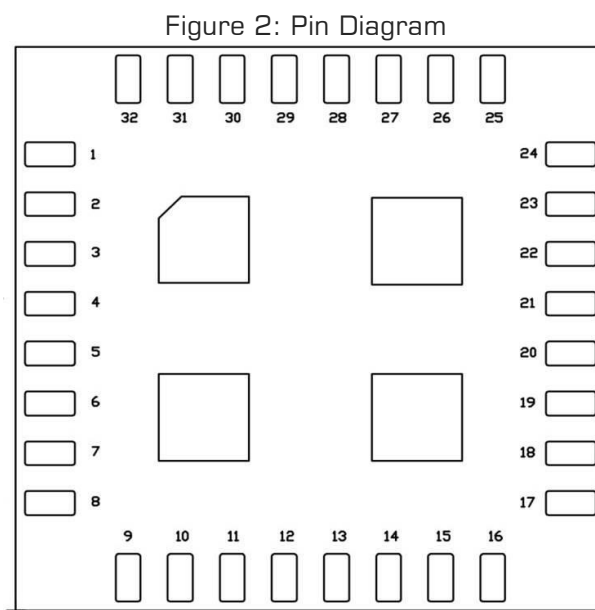
1 BLOCK DIAGRAM

Figure 1: Block Diagram



## 2 PINNING INFORMATION

### 2.1 Pin Diagram



### 2.2 Pin description

Table 1: Pin Description

Number	Symbol	Pin name	Pin Type	Description
1	GND	GND	Ground	Exposed pad connected to the ground of the application board
2	VDD_3.3V	VDD_3.3V	Power	3.3 V power supply
3	GND	GND	Ground	Exposed pad connected to the ground of the application board
4	MCU-PA2	USART2_TX	Digital I/O	USART interface
		ADC_IN2	Analog I	ADC external input 2
		TIM21_CH3	Digital I/O	General-purpose timer
		TIM22_CH3	Digital I/O	General-purpose timer
5	MCU-PB0	ADC_IN0	Analog I	ADC external input 2
		VREF_OUT	Analog I/O	Output reference voltage
6	MCU-PB5	I2C1_SMBA	Digital I/O	I2C interface
		LPTIM1_IN1	Digital I/O	Low-power timer
		TIM22_CH2	Digital I/O	General-purpose timer
7	MCU-PB6	USART1_TX	Digital I/O	USART interface
		I2C1_SCL	Digital I/O	I2C interface
		LPTIM1_ETR	Digital I/O	Low-power timer
8	MCU-PB7	USART1_RX	Digital I/O	USART interface
		I2C1_SDA	Digital I/O	I2C interface
		LPTIM1_IN2	Digital I/O	Low-power timer
9	OSC32OUT	OSC32OUT		External clock source pins
10	OSC32IN	OSC32IN		

## Datasheet

11	GND	GND	Ground	Exposed pad connected to the ground of the application board
12	NRESET	NRESET	I/O	Bidirectional reset pin with embedded weak pull-up resistor
13	MCU-PA14	SWCLK	Digital O	Serial wire clock output
		USART2_TX	Digital I/O	USART interface
14	MCU-PA13	SWDIO	Digital I/O	Serial wire
		USB_NOE	Digital I/O	USB
15	MCU-PA9	USART1_RX	Digital I/O	Serial wire
16	MCU-PA10	USART1_TX	Digital I/O	
17	MCU-PA12	USART1_RTS_DE	Digital I/O	USART interface
		USB_DP	Digital I/O	USB
		EVENT_OUT	Digital I/O	
18	MCU-PB1	LPUART1_RTS_DE	Digital I/O	Low-power USART interface
		ADC_IN9	Analog I	ADC external input 9
		VREF_OUT	Analog O	1.2 V VCO-LDO band-gap reference voltage decoupling
19	GND	GND	Ground	Exposed pad connected to the ground of the application board
20	MCU-PA11	USART1_CTS	Digital I/O	USART interface
		USB_DM	Digital I/O	USB
		COMP1_OUT	Analog O	Comparator output
		EVENT_OUT	Digital I/O	
21	MCU-PB11	LPUART1_RX	Digital I/O	Low-power USART interface
		TIM2_CH4	Digital I/O	General-purpose timer
		EVENTOUT	Digital I/O	
22	MCU-PA8	USART1_CK	Digital I/O	USART interface
		USB_CSR_SYNC	Digital I/O	
		EVENT_OUT	Digital I/O	
23	MCU-PB10	LPUART1_TX	Digital I/O	USART interface
		TIM2_CH3	Digital I/O	General-purpose timer
24	GND	GND	Ground	Exposed pad connected to the ground of the application board
25	ANTENNA	ANTENNA	RF I/O	RF input and output signal
26	GND	GND	Ground	Exposed pad connected to the ground of the application board
27	MCU-PB2	LPTM1_OUT	Digital I/O	Low-power timer
28	MCU-PA6	LPUART1_CTS	Digital I/O	USART interface
		ADC_IN6	Analog I	ADC external input 6
		TIM22_CH1	Digital I/O	General-purpose timer
		COMP1_OUT	Analog O	Comparator output
		EVENT_OUT	Digital I/O	
29	MCU-PA4	USART2_CK	Digital I/O	USART interface
		ADC_IN4	Analog I	ADC external input 4
		DAC_OUT	Analog O	DAC analog output
		TIM22_ETR	Digital I/O	General-purpose timer
		COMP1_INM4	Analog I	Comparator input
30	MCU-PA5	ADC_IN5	Analog I	ADC external input 5
		ADC_IN3	Analog I	ADC external input 3
		TIM2_CH1	Digital I/O	General-purpose timer

## Datasheet

		TIM2_ETR	Digital I/O	General-purpose timer
<b>31</b>	MCU-PA3	USART2_RX	Digital I/O	USART interface
		ADC_IN3	Analog I	ADC external input 3
		TIM2_CH4	Digital I/O	General-purpose timer
		TIM21_CH2	Digital I/O	General-purpose timer
<b>32</b>	MCU-PA1	USART2_RTS_DE	Digital I/O	USART interface
		ADC_IN1	Analog I	ADC external input 1
		COMP1_IMP	Analog I	Comparator input
		TIM21_ETR	Digital I/O	General-purpose timer
		EVENT_OUT	Digital I/O	
<b>Central pins</b>	GND	GND	Ground	Exposed pad connected to the ground of the application board

### 3 STATIC CHARACTERISTICS

#### 3.1 General operating range

Table 2: General Operating Range

Parameter	Conditions	Min	Typ.	Max	Unit
<b>Internal XTAL frequency</b>	-	-	-	50	MHz
<b>Supply voltage</b>	-	2.6	3.3	3.6	V
<b>Operating temperature</b>	-	-20	-	75	°C
<b>Storage temperature</b>	-	-	25	-	°C

#### 3.2 Power consumption

Characteristics measured over recommended operating conditions unless otherwise specified. Typical values are referred to 25 °C temperature, VDD = 3.3 V.

Table 3: Static characteristics: Low-power state power consumption TA = 25 °C, VDD = 3.3 V, 50 MHz crystal oscillator.

Parameter	Conditions	Min	Typ.	Max	Unit
<b>Supply current</b>	Shutdown	-	-	-	nA
	Standby	-	57.6	-	mA
	Sleep	-	43.1	-	uA
	Deep sleep	-	-	8	uA

## Datasheet

Table 4: Static characteristics: Power consumption in reception TA = 25 °C, VDD = 3.3 V, fc = 905 MHz

Parameter	Conditions	Min	Typ.	Max	Unit
<b>Supply current</b>	RX @ -102 sensitivity level	-	17.7	-	mA

Table 5: Static characteristics: Power consumption in transmission TA = 25 °C, VDD = 3.3 V, fc = 902.2 MHz

Parameter	Conditions	Min	Typ.	Max	Unit
<b>Supply current</b>	TX CW @ 22 dBm	-	175.1	-	mA
	TX CW @ 10 dBm	-	75.5	-	

Table 6: Static characteristics: Power consumption in transmission TA = 25 °C, VDD = 3.3 V, fc = 865.2MHz

Parameter	Conditions	Min	Typ.	Max	Unit
<b>Supply current</b>	TX CW @ 16 dBm	-	104.8	-	mA
	TX CW @ 8 dBm	-	71	-	

## 3.3 Clock source

Table 7: 50 MHz Internal XTAL clock source characteristics

Parameter	Conditions	Min	Typ.	Max	Unit
<b>Nominal frequency</b>	-	-	50	-	MHz
<b>Frequency tolerance</b>	-20°C to 75 °C	-10	-	+10	ppm
<b>Load capacitance</b>	-	-	6	-	pF
<b>Motional resistance (ESR)</b>	-	-	-	60	Ω

## 4 RF CHARACTERISTICS

Table 8: Transceiver and Receiver characteristics. TA = 25°C based on characterization; not tested in production. VDD = 3.3V; All RX measurements made at the antenna connector, to a bit error rate (BER) limit of 1%.

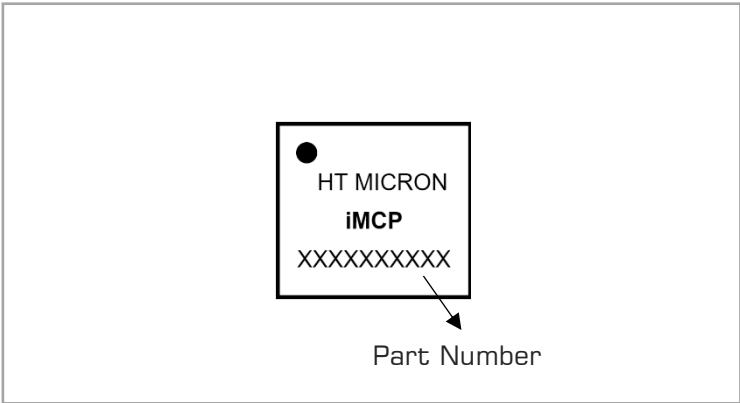
Parameter		Min	Typ.	Max	Unit
<b>RF Characteristics</b>					
<b>RF Frequency</b>	TX	865	-	924	MHz
	RX	869	-	923	MHz
<b>Tx max. output power</b>		22	-	-	dBm
<b>Tx power variation vs. temperature</b>	-40°C to +85°C	-	-	-	dB
<b>Emission 2<sup>nd</sup> Harmonics (conducted)</b>		-	-33	-	dBc
<b>Emission 3<sup>rd</sup> Harmonics (conducted)</b>		-	-41	-	
<b>Emission 4<sup>th</sup> harmonic</b>		-	-58	-	
<b>Data Rate</b> (for Sigfox Regions)	TX (RC1, RC3, RC5, RC6)	-	100	-	bps
	TX (RC2, RC4)	-	600	-	bps
	RX (All RCZ)	-	600	-	bps
<b>Antenna Load Impedance</b>			50		Ohm
<b>Rx Sensitivity (@600bps, GFSK)</b>			-128		dBm
<b>Rx Spurious Emission (30MHZ~12.75GHZ)</b>		-	-	-	dBm
<b>Rx Blocking at 10MHz offset</b>		-	-	-	dB
<b>RSSI Resolution</b>		-	1	-	dB





6 MARKING

Figure 4: Package Marking Example





7 ORDERING INFORMATION

Table 9: Ordering information

Package			
Type number	Name	Description	Version
	iMCP HT32SX	SIP module in LGA package; body 13mm x 13mm	

## ABBREVIATIONS

Table 10: Abbreviations

Acronym	Description
<b>ADC</b>	Analog to Digital Converter
<b>AES</b>	Advanced Encryption Standard
<b>API</b>	Application Program Interface
<b>CLK</b>	Clock
<b>EEPROM</b>	Electrically-Erasable Programmable Read Only Memory
<b>FIFO</b>	First In First Out
<b>GPIO</b>	General Purpose Input Output
<b>ID</b>	Identification
<b>IF</b>	Intermediate frequency
<b>IO</b>	Input Output
<b>MSL</b>	Moisture sensitivity level
<b>PCB</b>	Printed-Circuit Board
<b>PHY</b>	Physical
<b>SPI-bus</b>	Serial Peripheral Interface -bus
<b>PWM</b>	Pulse Width Modulation
<b>RAM</b>	Random Access Memory
<b>RC</b>	Remote Control
<b>RF</b>	Radio Frequency
<b>RoHS</b>	Restriction of Hazardous Substances
<b>RSSI</b>	Receive Signal Strength Indication
<b>RX</b>	Receiver
<b>SCL</b>	Serial Clock
<b>SDA</b>	Serial Data
<b>TX</b>	Transmitter



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REVISION HISTORY

Version	Changes	Date
00	Initial release	19/Nov/2019