

## iMCP HT32SX V2.2 – SiP Sigfox

Sigfox® Monarch RF Transceiver System-in-Package

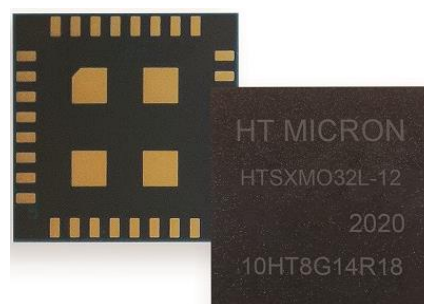
This document is a property of HT Micron and cannot be reproduced without its consent.

HT Micron does not assume any responsibility for use of what is described.

This document is subject to change without notice.

## OVERVIEW

The 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 components. Its small dimensions, high performance and low power consumption targets the best experience for IoT developers. It features an ARM Cortex M0+ 32bit (STM32L052x8) and the S2-LP low power transceiver from ST Microelectronics combined with the SKY66420 from Skyworks Solutions which provide all the performance advantages, integration, and convenience of advanced semiconductor packaging technology into a single chip.



### FEATURES

- Key features
  - Enables operations in the SIGFOX™ network
  - Multizone worldwide operation – MONARCH feature
  - ARM Cortex M0+ 32bit STM32L052x8 MCU
  - Integrated 50 MHz crystal
  - 64 KB flash - Other options will be available on demand
  - 8 KB RAM
  - TX output power up to +24 dBm
  - RX sensitivity: -128 dBm
- Power consumption
  - 18 mA RX
  - Max. of 210 mA TX peak current @22 dBm on Sigfox message transmission
  - Max. of 26 dBm TX peak output power on Sigfox message transmission
- 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

### INTERFACES

- 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, I2C
- Single power supply: 2.7 V to 3.6 V
- Operating temperature range: -40°C to +85°C
- External antenna
- 13x13x1.1mm LGA – 32 pads package
- Part number: HTSXMO32L-22

### APPLICATIONS

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

## SUMMARY

|   |    |
|---|----|
| OVERVIEW.....                                 | 2  |
| SUMMARY .....                                 | 3  |
| DOCUMENT INFO.....                            | 3  |
| 1 BLOCK DIAGRAM.....                          | 4  |
| 2 PINOUT INFORMATION.....                     | 5  |
| 2.1 PIN DIAGRAM.....                          | 5  |
| 2.2 PIN DESCRIPTION.....                      | 5  |
| 3 ELECTRICAL CHARACTERISTICS .....            | 7  |
| 3.1 GENERAL OPERATING RANGE.....              | 7  |
| 3.2 MCU I/O PORT CHARACTERISTICS .....        | 7  |
| 3.3 POWER CONSUMPTION.....                    | 8  |
| 3.4 INTERNAL CRYSTAL OSCILLATOR .....         | 9  |
| 3.5 EXTERNAL CLOCK RESONATOR.....             | 9  |
| 4 RF CHARACTERISTICS.....                     | 10 |
| 4.1 EXTERNAL IMPEDANCE MATCHING NETWORK ..... | 10 |
| 5 PACKAGE OUTLINE.....                        | 11 |
| 6 RECOMMENDED PCB FOOTPRINT.....              | 12 |
| 7 PART NUMBER.....                            | 12 |
| 8 PACKING AND ORDERING INFORMATION.....       | 13 |
| 9 STORAGE AND HANDLING.....                   | 14 |
| 10 SOLDERING INFORMATION.....                 | 14 |
| DISCLAIMER.....                               | 15 |
| ABBREVIATIONS.....                            | 16 |
| LIST OF FIGURES .....                         | 17 |
| LIST OF TABLES.....                           | 17 |
| REVISION HISTORY.....                         | 18 |
| CONTACT .....                                 | 18 |
| DOCUMENT INFORMATION .....                    | 18 |

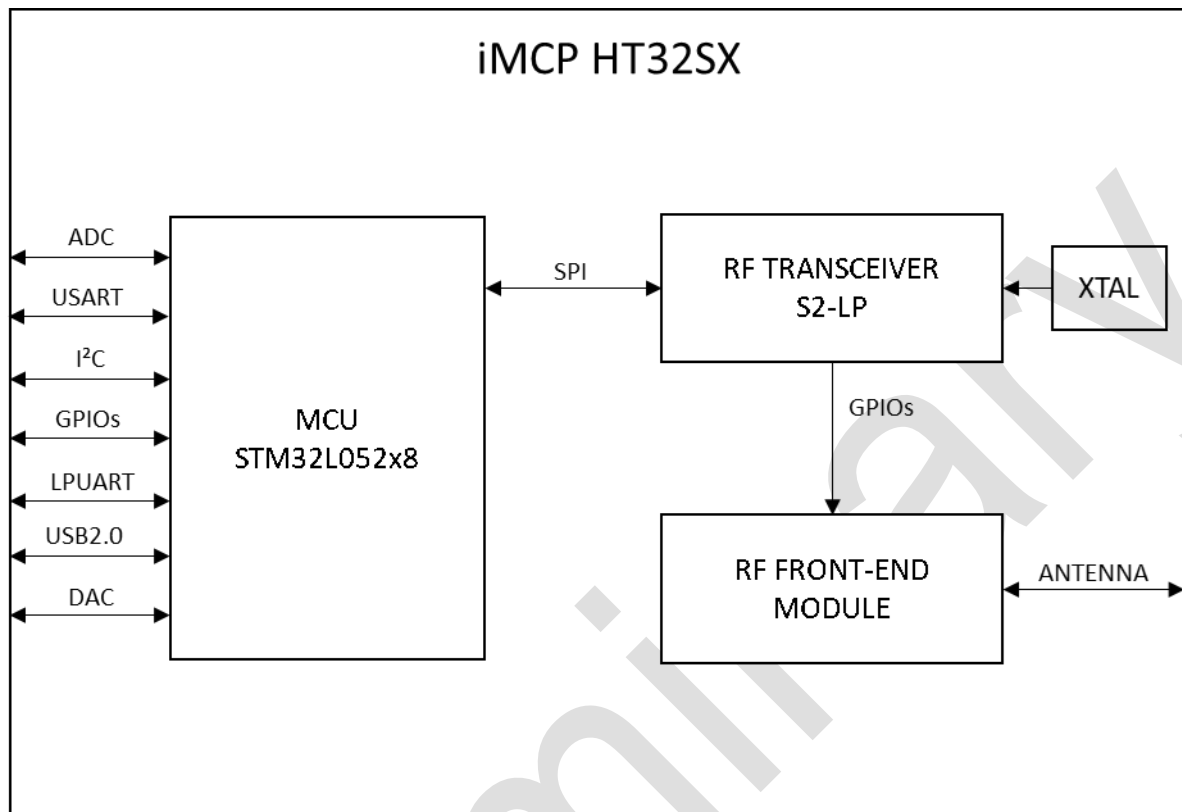
## DOCUMENT INFO

This document provides information about iMCP HT32SX – Sigfox® Monarch RF Transceiver System-in-Package.

## 1 BLOCK DIAGRAM

Functional description.

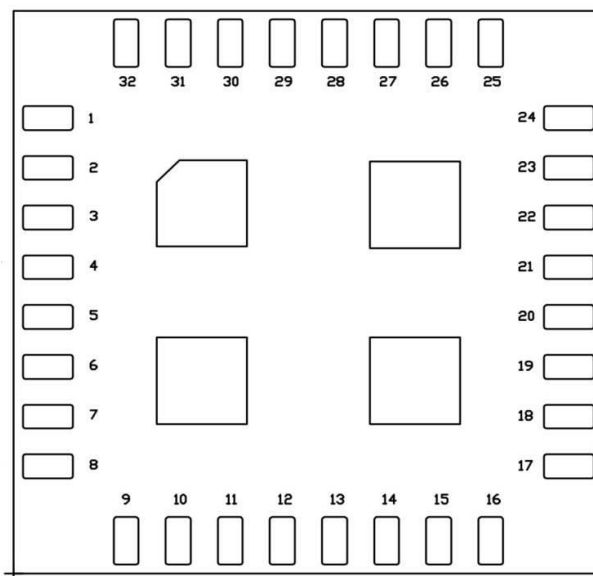
FIGURE 1: BLOCK DIAGRAM



## PINOUT INFORMATION

### 2.1 Pin Diagram

FIGURE 2: PIN DIAGRAM



### 2.2 Pin description

TABLE 1: LEGEND/ABBREVIATIONS USED IN PIN DESCRIPTION TABLE

| Name          | Abbreviation | Definition  |
|---------------|--------------|---|
| I/O Structure | FT           | 5V tolerant I/O   |
|               | FTf          | 5V tolerant I/O, FM+ capable                                |
|               | TC           | Standard 3.3V I/O   |
|               | B            | Dedicated BOOT0 pin   |
|               | RST          | Bidirectional reset pin with embedded weak pull-up resistor |

TABLE 2: PIN DESCRIPTION

| Number | Symbol   | Pin name   | Pin Type    | I/O Structure | Description  |
|--------|----------|------------|-------------|---------------|--|
| 1      | ANTENNA  | ANTENNA    | RF I/O      | -             | RF input and output signal                                   |
| 2      | GND      | GND        | Ground      | -             | Exposed pad connected to the ground of the application board |
| 3      | MCU-PA11 | USART1_CTS | Digital I/O | FT            | USART interface  |
|        |          | USB_DM     | Digital I/O |               | USB  |
|        |          | COMP1_OUT  | Analog O    |               | Comparator output  |
|        |          | EVENT_OUT  | Digital I/O |               |  |
| 4      | MCU-PA9  | USART1_TX  | Digital I/O | FT            | Serial wire  |
| 5      | MCU-PA10 | USART1_RX  | Digital I/O | FT            |  |
| 6      | MCU-PB11 | LPUART1_RX | Digital I/O | FT            | Low-power USART interface                                    |
|        |          | TIM2_CH4   | Digital I/O |               | General-purpose timer  |
|        |          | EVENTOUT   | Digital I/O |               |  |
| 7      | MCU-PB0  | ADC_IN8    | Analog I    | FT            | ADC external input 8   |
|        |          | VREF_OUT   | Analog I/O  |               | Output reference voltage                                     |

|    |           |               |             |     |  |
|----|-----------|---------------|-------------|-----|--|
| 8  | VDD_3.3V  | VDD_3.3V      | Power       | -   | 3.3 V power supply   |
| 9  | MCU-PA8   | USART1_CK     | Digital I/O | FT  | USART interface  |
|    |           | USB_CSR_SYNC  | Digital I/O |     | USB  |
|    |           | EVENT_OUT     | Digital I/O |     |  |
| 10 | MCU-PA5   | ADC_IN5       | Analog I    | TC  | ADC external input 5   |
|    |           | TIM2_CH1      | Digital I/O |     | General-purpose timer  |
|    |           | TIM2_ETR      | Digital I/O |     | General-purpose timer  |
|    |           | COMP1_INM5    | Analog I    |     | Comparator input   |
| 11 | MCU-PA3   | USART2_RX     | Digital I/O | FT  | 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  |
| 12 | MCU-PA1   | USART2_RTS_DE | Digital I/O | FT  | USART interface  |
|    |           | ADC_IN1       | Analog I    |     | ADC external input 1   |
|    |           | COMP1_INP     | Analog I    |     | Comparator input   |
|    |           | TIM21_ETR     | Digital I/O |     | General-purpose timer  |
|    |           | EVENT_OUT     | Digital I/O |     |  |
| 13 | MCU-PB10  | LPUART1_TX    | Digital I/O | FT  | USART interface  |
|    |           | TIM2_CH3      | Digital I/O |     | General-purpose timer  |
| 14 | MCU-PA6   | LPUART1_CTS   | Digital I/O | FT  | 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 |     |  |
| 15 | MCU-PA4   | USART2_CK     | Digital I/O | TC  | 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   |
| 16 | GND       | GND           | Ground      | -   | Exposed pad connected to the ground of the application board |
| 17 | MCU-PA2   | USART2_TX     | Digital I/O | FT  | USART interface  |
|    |           | ADC_IN2       | Analog I    |     | ADC external input 2   |
|    |           | TIM21_CH1     | Digital I/O |     | General-purpose timer  |
|    |           | TIM2_CH3      | Digital I/O |     | General-purpose timer  |
| 18 | MCU-PA0   | WKUP1         | Digital I   | TC  | MCU external wakeup input                                    |
|    |           | ADC_IN0       | Analog I    |     | ADC external input 0   |
|    |           | USART2_CTS    | Digital I/O |     | USART interface  |
|    |           | TIM2_CH1      | Digital I/O |     | General-purpose timer  |
| 19 | MCU-BOOT0 | BOOT0         | Digital I   | B   | Boot selection   |
| 20 | MCU-PB5   | I2C1_SMBA     | Digital I/O | FT  | I2C interface  |
|    |           | LPTIM1_IN1    | Digital I/O |     | Low-power timer  |
|    |           | TIM22_CH2     | Digital I/O |     | General-purpose timer  |
| 21 | GND       | GND           | Ground      | -   | Exposed pad connected to the ground of the application board |
| 22 | NRESET    | NRESET        | I/O         | RST | Bidirectional reset pin with embedded weak pull-up resistor  |
| 23 | MCU-PA14  | SWCLK         | Digital O   | FT  | Serial wire clock output                                     |
|    |           | USART2_TX     | Digital I/O |     | USART interface  |
| 24 | MCU-PA13  | SWDIO         | Digital I/O | FT  | Serial wire  |
|    |           | USB_NOE       | Digital I/O |     | USB  |

|    |          |                |             |     |  |
|----|----------|----------------|-------------|-----|--|
| 25 | MCU-PC15 | OSC32OUT       | Ext. clock  | TC  | External clock source pins                                   |
|    |          | GPIO           | Digital I/O |     | General purpose I/O  |
| 26 | MCU-PC14 | OSC32IN        | Ext. clock  | FT  | External clock source pins                                   |
|    |          | GPIO           | Digital I/O |     | General purpose I/O  |
| 27 | GND      | GND            | Ground      | -   | Exposed pad connected to the ground of the application board |
| 28 | MCU-PB1  | LPUART1_RTS_DE | Digital I/O | FT  | 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          |
| 29 | MCU-PB7  | USART1_RX      | Digital I/O | FTf | USART interface  |
|    |          | I2C1_SDA       | Digital I/O |     | I2C interface  |
|    |          | LPTIM1_IN2     | Digital I/O |     | Low-power timer  |
| 30 | MCU-PB6  | USART1_TX      | Digital I/O | FTf | USART interface  |
|    |          | I2C1_SCL       | Digital I/O |     | I2C interface  |
|    |          | LPTIM1_ETR     | Digital I/O |     | Low-power timer  |
| 31 | MCU-PA12 | USART1_RTS_DE  | Digital I/O | FT  | USART interface  |
|    |          | USB_DP         | Digital I/O |     | USB  |
|    |          | EVENT_OUT      | Digital I/O |     |  |
| 32 | GND      | GND            | Ground      | -   | Exposed pad connected to the ground of the application board |

### 3 ELECTRICAL CHARACTERISTICS

#### 3.1 General operating range

TABLE 3: GENERAL OPERATING RANGE

| Parameter             | Conditions         | Min | Typ. | Max | Unit |
|-----------------------|--------------------|-----|------|-----|------|
| Supply voltage        | -                  | 2.7 | 3.3  | 3.6 | V    |
| Operating temperature | -                  | -40 | 25   | 85  | °C   |
| Storage temperature   | Refer to section 9 |     |      |     |      |

#### 3.2 MCU I/O port characteristics

TABLE 4: MCU I/O PORT CHARACTERISTICS

| Symbol    | Parameter                              | Conditions   | Min         | Typ.          | Max          | Unit |
|-----------|--|--|-------------|---------------|--------------|------|
| $V_{IL}$  | Input low level voltage                | TCFT, FTf, RST I/Os  | -           | -             | $0.3V_{DD}$  | V    |
|           |  | BOOT0 pin  | -           | -             | $0.14V_{DD}$ |      |
| $V_{IH}$  | Input high level voltage               | All I/Os   | $0.7V_{DD}$ | -             | -            |      |
| $V_{hys}$ | I/O Schmitt trigger voltage hysteresis | Standard I/Os  | -           | $10\% V_{DD}$ | -            |      |
|           |  | BOOT0 pin  | -           | 0.01          | -            |      |
| $I_{lkg}$ | Input leakage current                  | $V_{SS} < V_{IN} < V_{DD}$ All I/Os except PA11, PA12, BOOT0, FTf I/Os | -           | -             | +50          | nA   |
|           |  | $V_{SS} < V_{IN} < V_{DD}$ PA11 and PA12 I/Os                          | -           | -             | -50/+250     |      |

|          |                                       |   |    |    |      |            |
|----------|---------------------------------------|---|----|----|------|------------|
|          |                                       | $V_{SS} < V_{IN} < V_{DD}$<br>FTf I/Os                                    | -  | -  | +100 |            |
|          |                                       | $V_{VDD} < V_{IN} < 5V$<br>All I/Os except PA11, PA12,<br>BOOT0, FTf I/Os | -  | -  | 200  |            |
|          |                                       | $V_{SS} < V_{IN} < 5V$<br>FTf I/Os  | -  | -  | 500  |            |
|          |                                       | $V_{SS} < V_{IN} < 5V$<br>PA11, PA12, BOOT0                               | -  | -  | 10   |            |
| $R_{PU}$ | Weak pull-up<br>equivalent resistor   | $V_{IN} = V_{SS}$   | 25 | 45 | 65   | k $\Omega$ |
| $R_{PD}$ | Weak pull-down<br>equivalent resistor | $V_{IN} = V_{DD}$   | 25 | 45 | 65   | k $\Omega$ |
| $C_{IO}$ | I/O pin capacitance                   | -   | -  | 5  | -    | pF         |

TABLE 5: OUTPUT VOLTAGE CHARACTERISTICS

| Symbol      | Parameter   | Conditions   | Min           | Max  | Unit |
|-------------|---|--|---------------|------|------|
| $V_{OL}$    | Output low level<br>voltage for an I/O pin                    | CMOS port<br>$I_{IO}=+8mA$<br>$2.7V < V_{DD} < 3.6V$ | -             | 0.4  | V    |
| $V_{OH}$    | Output high level<br>voltage for an I/O pin                   |  | $V_{DD}-0.4$  | -    |      |
| $V_{OL}$    | Output low level<br>voltage for an I/O pin                    | TTL port<br>$I_{IO}=+8mA$<br>$2.7V < V_{DD} < 3.6V$  | -             | 0.4  |      |
| $V_{OH}$    | Output high level<br>voltage for an I/O pin                   | TTL port<br>$I_{IO}= -6mA$<br>$2.7V < V_{DD} < 3.6V$ | 2.4           | -    |      |
| $V_{OL}$    | Output low level<br>voltage for an I/O pin                    | $I_{IO}=+15mA$<br>$2.7V < V_{DD} < 3.6V$             | -             | 1.3  |      |
| $V_{OH}$    | Output high level<br>voltage for an I/O pin                   | $I_{IO}= -15mA$<br>$2.7V < V_{DD} < 3.6V$            | $V_{DD}-1.3$  | -    |      |
| $V_{OL}$    | Output low level<br>voltage for an I/O pin                    | $I_{IO}=+4mA$<br>$2.7V < V_{DD} < 3.6V$              | -             | 0.45 |      |
| $V_{OH}$    | Output high level<br>voltage for an I/O pin                   | $I_{IO}= -4mA$<br>$2.7V < V_{DD} < 3.6V$             | $V_{DD}-0.45$ | -    |      |
| $V_{OLFM+}$ | Output low level<br>voltage for an FTf I/O<br>pin in FM+ mode | $I_{IO}=+20mA$<br>$2.7V < V_{DD} < 3.6V$             | -             | 0.4  |      |
|             |   | $I_{IO}= 10mA$<br>$2.7V < V_{DD} < 3.6V$             | -             | 0.4  |      |

### 3.3 Power consumption

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

TABLE 6: LOW-POWER STATE POWER CONSUMPTION TA = 25 °C, VDD = 3.3 V.

| Parameter      | Conditions | Min  | Typ. | Max | Unit |
|----------------|------------|------|------|-----|------|
| Supply current | Shutdown   | -    | -    | -   | nA   |
|                | Standby    | 1.3  | 1.33 | 1.4 | mA   |
|                | Sleep      | 2.67 | 5.5  | 9.2 | uA   |
|                | Deep sleep | 2.5  | 3.5  | 8.4 | uA   |



TABLE 7: POWER CONSUMPTION IN RECEPTION TA = 25 °C, VDD = 3.3 V, FC = 905 MHZ

| Parameter      | Conditions  | Min | Typ. | Max | Unit |
|----------------|---|-----|------|-----|------|
| Supply current | RX @ -128 dBm<br>sensitivity level for a<br>Sigfox signal | -   | 18   | -   | mA   |

TABLE 8: POWER CONSUMPTION IN TRANSMISSION TA = 25 °C, VDD = 3.3 V, FC = 902.2 MHZ

| Parameter  | Conditions | PA  | Min  | Typ. | Max  | Unit |
|--|------------|-----|------|------|------|------|
| Average supply current of a single Sigfox frame                | TX @22 dBm | ON  | 148  | 170  | 190  | mA   |
|  | TX @12 dBm | OFF | 19.2 | 25   | 27   |      |
| Average supply current of a Sigfox message (total of 3 frames) | TX @26 dBm | ON  | -    | 160  | -    |      |
|  | TX @22 dBm | ON  | -    | 110  | -    |      |
|  | TX @12 dBm | OFF | -    | 21.5 | -    |      |
| Peak supply current on Sigfox message transmission             | TX @26 dBm | ON  | -    | -    | 313  |      |
|  | TX @22 dBm | ON  | -    | -    | 110  |      |
|  | TX @12 dBm | OFF | -    | -    | 28.5 |      |

### 3.4 Internal crystal oscillator

The integrated crystal oscillator is used as the frequency reference for the RF transceiver and its choice was based on the Sigfox requirements.

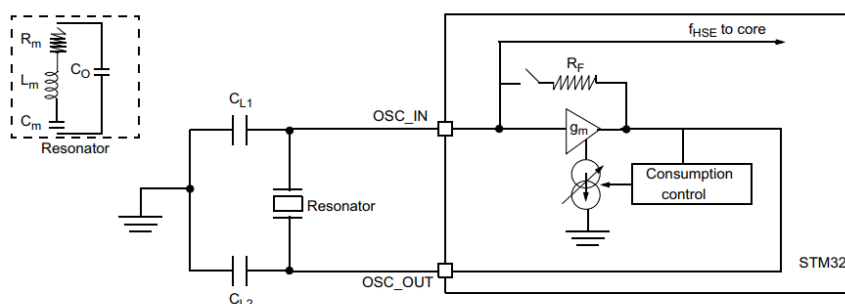
TABLE 9: 50 MHZ INTERNAL XTAL CLOCK SOURCE CHARACTERISTICS

| Parameter           | Conditions     | Min | Typ. | Max | Unit |
|---------------------|----------------|-----|------|-----|------|
| Nominal frequency   | -              | -   | 50   | -   | MHz  |
| Frequency tolerance | -20°C to 75 °C | -10 | -    | +10 | ppm  |

### 3.5 External clock resonator

The external clock resonator can be of high speed (1-25MHz) or low speed (32.768kHz), which can be connected to pins 25 and 26 of the iMCP HT32SX V2.2. The connection diagram is shown below. For CL1 and CL2, it is recommended to use high quality ceramic capacitors in the 5pF to 25 pF range (typ.), designed for high frequency applications, and selected to match the requirements of the crystal or resonator. These capacitors are usually of equal value with a rough estimate of 10 pF each. CL1 and CL2 includes PCB and the MCU pin capacitances.

FIGURE 3: EXTERNAL OSCILLATOR CIRCUIT DIAGRAM.



## 4 RF CHARACTERISTICS

TABLE 10: 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 |
|--|------------------------------|-------|-------|-------|------|
| RF Frequency   | TX                           | 865   | -     | 924   | MHz  |
|  | RX                           | 869   | -     | 923   | MHz  |
| Tx max. output power for the Sigfox signal               |                              | -     | 24    | -     | dBm  |
| Tx power variation vs. temperature                       | -40°C to +85°C               | -     | -     | -     | dB   |
| Emission 2 <sup>nd</sup> Harmonic (conducted) @max power |                              | -40.4 | -47.3 | -39.9 | dBc  |
| Emission 3 <sup>rd</sup> Harmonic (conducted) @max power |                              | -50.5 | -76.2 | -55.0 |      |
| Emission 4 <sup>th</sup> harmonic (conducted) @max power |                              | -78.9 | -78.6 | -70.0 |      |
| Data Rate<br>(for Sigfox Regions)                        | TX (RC1, RC3, RC5, RC6, RC7) | -     | 100   | -     | bps  |
|  | TX (RC2, RC4)                | -     | 600   | -     | bps  |
|  | RX (All RCs)                 | -     | 600   | -     | bps  |
| Antenna Load Impedance                                   |                              |       | 50    |       | Ohm  |
| Rx Sensitivity (@600bps, GFSK)                           |                              |       | -128  |       | dBm  |
| Rx Spurious Emission (30MHZ~12.75GHZ)                    |                              | -     | -     | -     | dBm  |
| Rx Blocking at 10MHz offset                              |                              | -     | -     | -     | dB   |
| RSSI Resolution  |                              | -     | -     | -     | dB   |

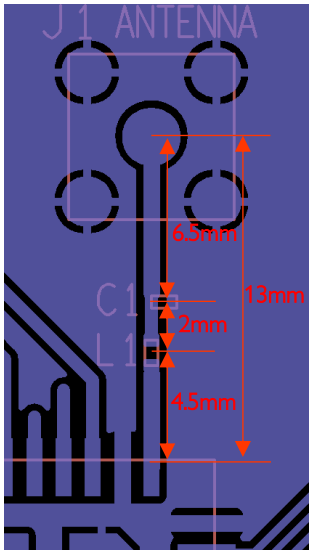
### 4.1 External impedance matching network

An external LC matching network is recommended to improve the output power level of the output signal in pin 1 (series inductor and shunt capacitor). The reference specifications for a reference FR4 1.6 mm 1 Oz copper printed circuit board (PCB) are shown below.

- SMD ceramic inductor: 5.6 nH, +-5% tolerance, 0402 size, PN L-07C5N6SV6, Johanson Technologies
- SMD ceramic capacitor: 4.7 pF, +-0.1pF tolerance, 0201 size, PN 250R05L4R7BV4S, Johanson Technologies

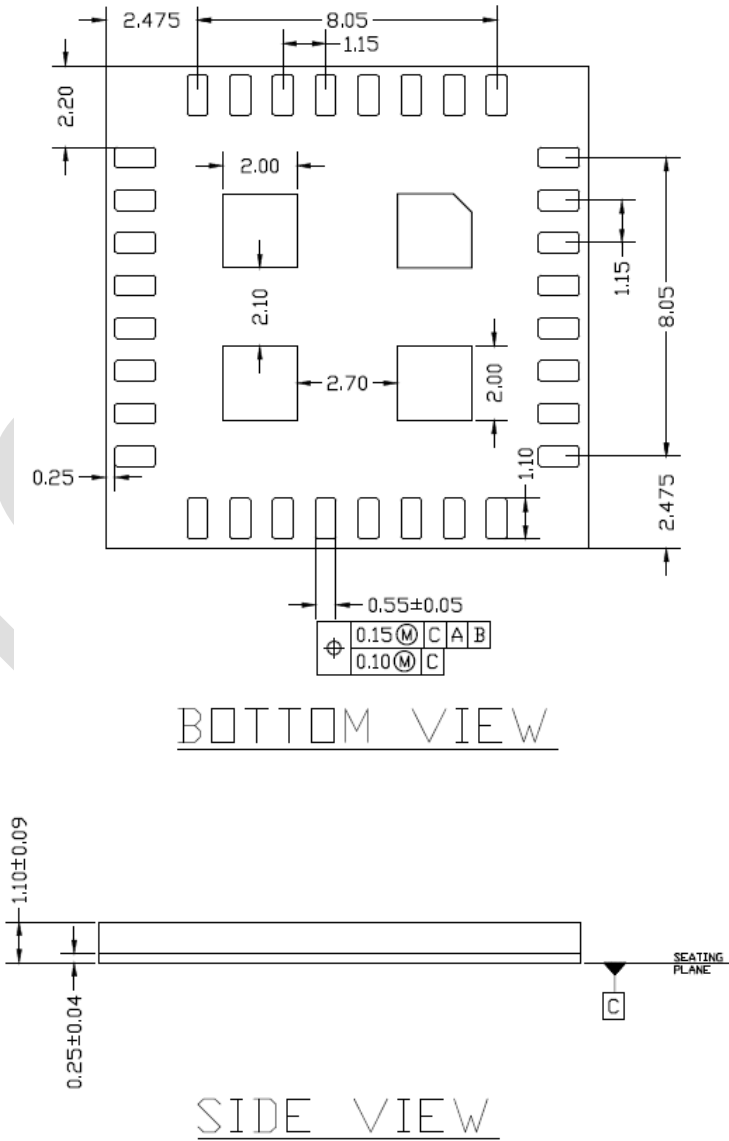
The reference PCB traces are shown in Figure 4 for an example of an output using an SMA connector. The trace width are the same as the pad width in the recommended footprint in section 6.

FIGURE 4: RECOMMENDED EXTERNAL LC MATCHING NETWORK LAYOUT.



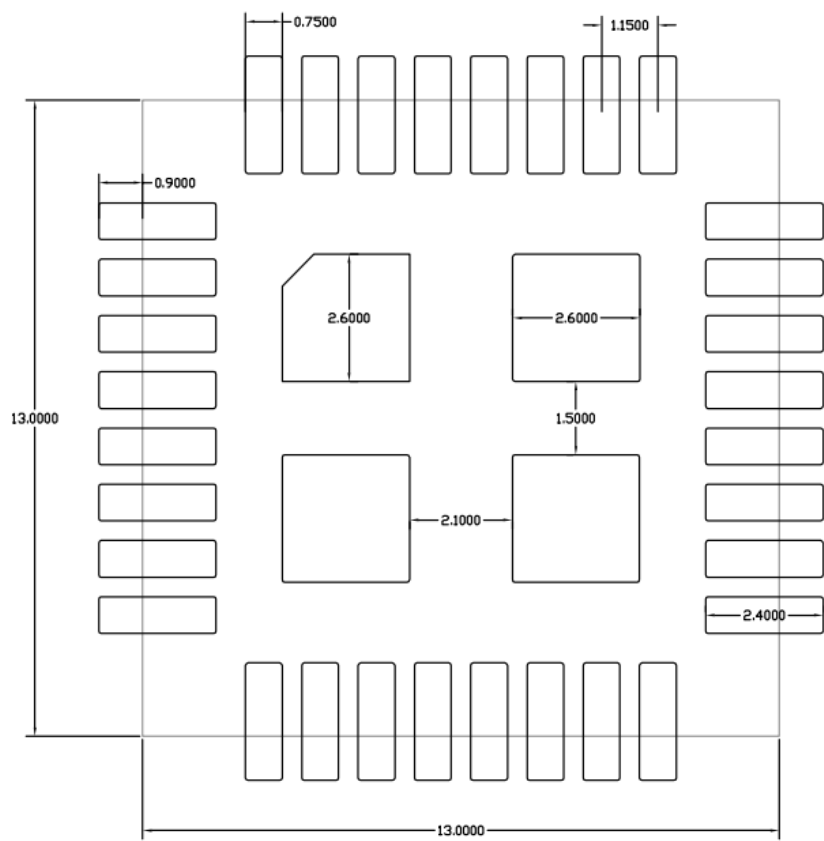
5 PACKAGE OUTLINE

FIGURE 5: PACKAGE OUTLINE



6 RECOMMENDED PCB FOOTPRINT

FIGURE 6: RECOMMENDED PCB FOOTPRINT



7 PART NUMBER

HT SX MO 32 L - 22

|             |              |
|-------------|--------------|
| HT Micron   | Version      |
| Family      | 22: Ver. 2.2 |
| SX: Sigfox  | Package      |
| Technology  | L: LGA       |
| MO: Monarch | Lead Count   |
|             | 32           |

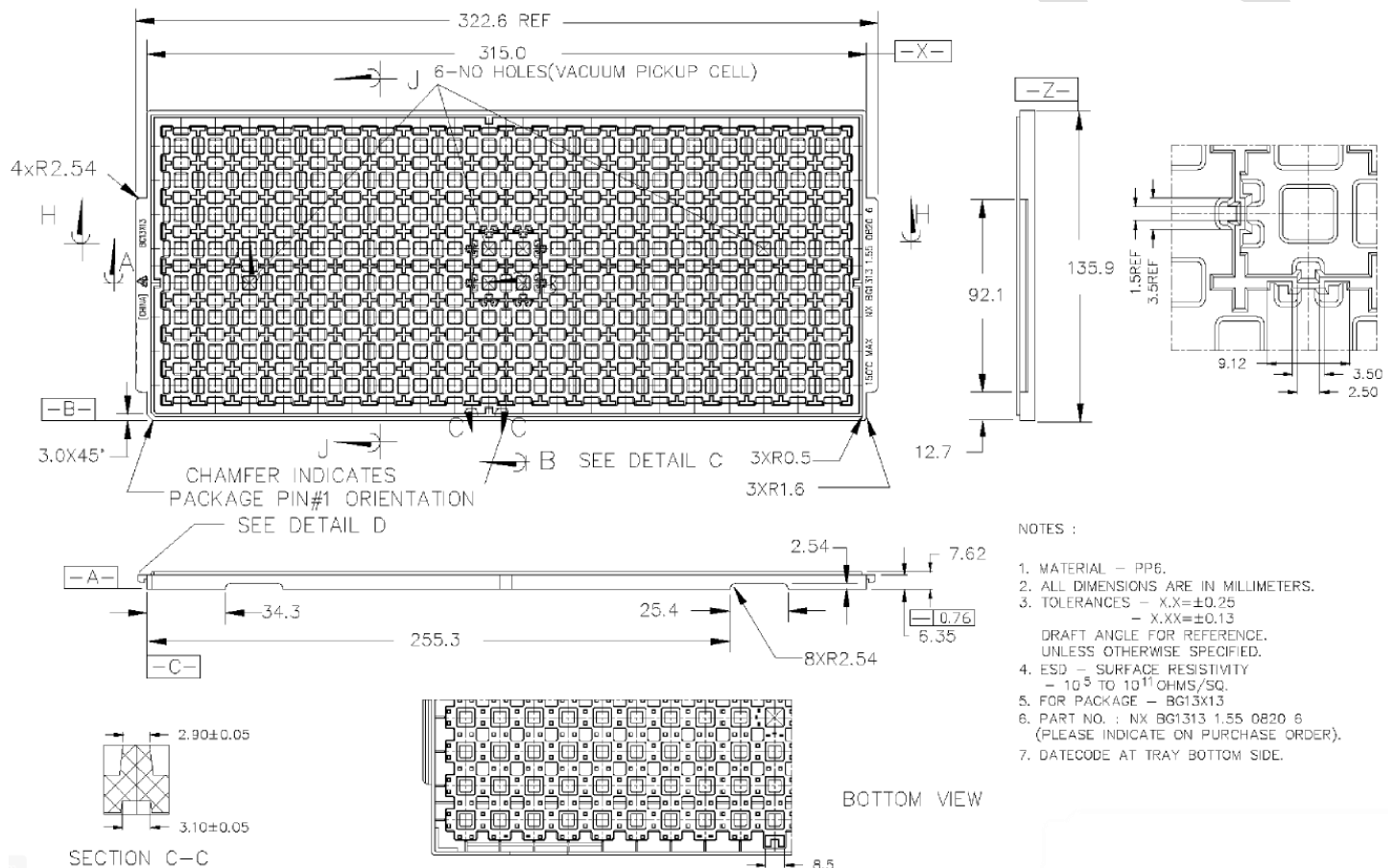
## 8 PACKING AND ORDERING INFORMATION

TABLE 11: ORDERING INFORMATION

| Part number         | Package     |   |         |
|---------------------|-------------|---|---------|
|                     | Name        | Description                                 | Version |
| <b>HTSXMO32L-22</b> | iMCP HT32SX | SiP module in LGA package; body 13mm x 13mm | 2.2     |

Products sold directly by HT Micron will be delivered in bagged trays, sealed in moisture resistant bags with desiccant pack and humidity cards. Trays are suitable for baking temperatures. Samples provided by HT Micron may be delivered in other packing methods. Please, refer to section 9 for storage, handling and moisture sensitivity information.

FIGURE 7: TRAY SIZES



## 9 STORAGE AND HANDLING



### CAUTION

ELECTROSTATIC and MOISTURE  
SENSITIVE DEVICE



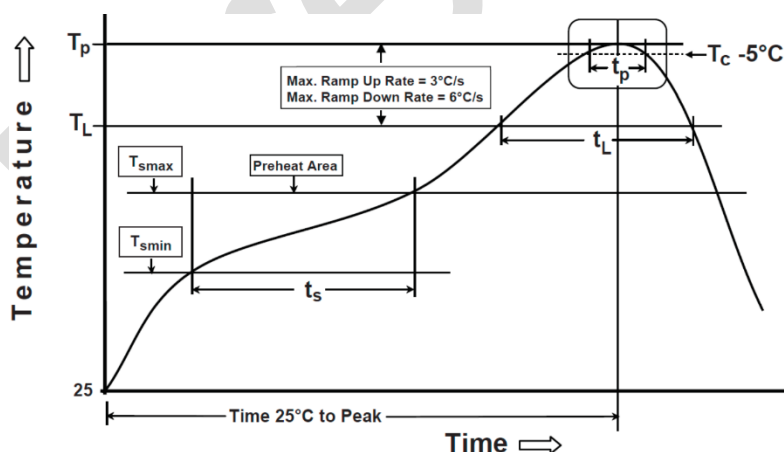
LEVEL 3

- Take proper precautions to avoid high-energy electrostatic discharge (ESD) as permanent damage may occur.
- For handling methods refer to the latest ESD Association standard ANSI/ESD S20.20.
- Do not expose the device to corrosive gasses, extreme humidity, extensive direct sunlight.
- The device is susceptible to delamination or crack damage induced by absorbed moisture and high temperature.
- Shelf life in sealed bagged tray: 12 months at  $\leq 40^{\circ}\text{C}$  and  $\leq 90\%$  relative humidity (RH).
- This device is rated MSL 3.
- For bagged tray lots: after the bag is opened, the humidity card must read  $\leq 20\%$  (at  $23 \pm 5^{\circ}\text{C}$ ), and the devices must be mounted within 168 hours at environmental conditions of  $\leq 30^{\circ}\text{C}$ ,  $\leq 60\%$  RH.
- If the above condition is not met, baking for 24 hours at  $125 \pm 5^{\circ}\text{C}$  is mandatory prior to mounting.
- For moisture sensitivity devices precaution methods refer to the latest standard IPC/JEDEC-J-STD-033.
- For any other packing method: baking is required for 192 hours at  $40^{\circ}\text{C}$  prior to mounting.
- This device is composed of all RoHS compliant materials. Refer to the Figure 8 for typical Pb-Free reflow conditions.
- Hand soldering is not recommended for this device.
- For moisture sensitivity classification and soldering methods, refer to the latest standard IPC/JEDEC-J-STD-020.
- Do not drop, shock or apply mechanical stress.

## 10 SOLDERING INFORMATION

Soldering conditions depend greatly on the solder paste that is used and as such are application specific. The picture below depicts typical Pb-free soldering conditions as seen in IPC/JEDEC-J-STD-020 standard, which are commonly used in the industry. However, ultimately we recommend that the instructions of the solder supplier are followed.

FIGURE 8: TYPICAL PB-FREE REFLOW CONDITIONS (IPC/JEDEC-J-STD-020)



- Min preheat temperature ( $T_{smin}$ ):  $150^{\circ}\text{C}$
- Max preheat temperature ( $T_{smax}$ ):  $200^{\circ}\text{C}$
- Preheat (soaking) time ( $T_s$ ): 60 to 120 s
- Liquidous temperature ( $T_L$ ):  $217^{\circ}\text{C}$
- Peak temperature ( $T_p$ ):  $260^{\circ}\text{C}$
- Max ramp-up rate ( $T_L$  to  $T_p$ ):  $3^{\circ}\text{C/s}$
- Time above  $T_L$  ( $t_L$ ): 60 to 150 s
- Classification temperature ( $T_c$ ):  $260^{\circ}\text{C}$
- Time above  $T_c - 5^{\circ}\text{C}$  ( $t_p$ ): 30 s
- Max ramp-down rate ( $T_p$  to  $T_L$ ):  $6^{\circ}\text{C/s}$
- Max time  $25^{\circ}\text{C}$  to  $T_p$ : 8 minutes

## DISCLAIMER

This document is a property of HT Micron and cannot be reproduced without its consent. Information herein contained are for informational purposes only and HT Micron assumes no responsibility for errors or omissions in this document. HT Micron documents, products, product specifications and descriptions may change without notice, at any time. Purchasers should obtain the latest relevant information on HT Micron products before placing orders.

HT Micron assumes no liability for customer product applications, design or damage to any equipment resulting from the use of HT Micron products outside of specifications and parameters.

No license of any patent, copyright or any other intellectual property right is granted by this document, whether by implication, estoppel or otherwise. HT Micron assumes no liability for any materials, products or information provided in this document except as may be provided in Terms and Conditions of Sale for customers purchasing directly from HT Micron.

Products, specifications and information are provided on an “as is” basis for reference purposes only and without warranties of any kind. HT Micron does not warrant the accuracy or completeness of information contained in this document.

HT Micron products are not intended for use in life support, medical care, safety equipment, or any other application in which product failure could lead to loss of life, personal injury, physical or environmental damage.

## ABBREVIATIONS

TABLE 12: ABBREVIATIONS

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



## LIST OF FIGURES

|  |    |
|--|----|
| Figure 1: Block Diagram .....  | 4  |
| Figure 2: Pin Diagram .....  | 5  |
| Figure 3: External oscillator circuit diagram.....                     | 9  |
| Figure 4: recommended external LC matching network layout.....         | 11 |
| Figure 5: Package Outline.....   | 11 |
| Figure 6: Recommended PCB Footprint.....                               | 12 |
| Figure 7: Tray sizes.....  | 13 |
| Figure 8: Typical Pb-Free reflow conditions (IPC/JEDEC-J-STD-020)..... | 14 |

## LIST OF TABLES

|  |    |
|--|----|
| Table 1: Legend/abbreviations used in pin description table.....   | 5  |
| Table 2: Pin description.....  | 5  |
| Table 3: General Operating Range.....  | 7  |
| Table 4: MCU I/O port characteristics .....  | 7  |
| Table 5: Output voltage characteristics.....   | 8  |
| Table 6: Low-power state power consumption $T_A = 25\text{ }^{\circ}\text{C}$ , $V_{DD} = 3.3\text{ V}$ .....  | 8  |
| Table 7: Power consumption in reception $T_A = 25\text{ }^{\circ}\text{C}$ , $V_{DD} = 3.3\text{ V}$ , $f_c = 905\text{ MHz}$ .....  | 9  |
| Table 8: Power consumption in transmission $T_A = 25\text{ }^{\circ}\text{C}$ , $V_{DD} = 3.3\text{ V}$ , $f_c = 902.2\text{ MHz}$ .....   | 9  |
| Table 9: 50 MHz Internal XTAL clock source characteristics.....  | 9  |
| Table 10: Transceiver and Receiver characteristics. $T_A = 25\text{ }^{\circ}\text{C}$ based on characterization; not tested in production. $V_{DD} = 3.3\text{V}$ ; All RX measurements made at the antenna connector, to a bit error rate (BER) limit of 1%..... | 10 |
| Table 11: Ordering information .....   | 13 |
| Table 12: Abbreviations .....  | 16 |

## REVISION HISTORY

| Date       | Version | Changes  | Remark |
|------------|---------|--|--------|
| 13/04/2020 | 00      | - Initial draft  |        |
| 05/08/2020 | 01      | - Preliminary  |        |
| 20/11/2020 | 02      | - Preliminary - fixed power consumption information                    |        |
| 25/01/2021 | 03      | - Fixed ADC_IN8 (PB0) on PIN7, operating temperature range update      |        |
| 19/02/2021 | 04      | - Package height; packing; storage, handling and soldering; disclaimer |        |
| 24/03/2021 | 05      | - Current supply updates.  |        |

## CONTACT

HT MICRON SEMICONDUTORES S.A.  
Av. Unisinos, 1550 | 93022-750 | São Leopoldo | RS | Brasil  
[www.htmicron.com.br](http://www.htmicron.com.br)

## DOCUMENT INFORMATION

Document Title: iMCP HT32SX V2.2 – SiP Sigfox  
Document Subtitle: Sigfox® Monarch RF Transceiver System-in-Package  
Classification: Preliminary  
Doc. Type: DATASHEET  
Revision: Rev. 04  
Date: 19/02/2021  
Code: DS001  
Internal Doc Reference: FO440 - rev.01 Data: 12/08/2020 Doc. Ref.: PR001