Precision Timing Solutions

Weather Balloon Radiosondes

Precision Timing in Radiosondes

A radiosonde is a battery-powered telemetry instrument carried into the atmosphere by a weather balloon. It measures various atmospheric parameters such as altitude, pressure, temperature, relative humidity, wind, cosmic rays, ozone concentration. Data are transmitted to ground stations via radio link. Hundreds of radiosondes are launched all over the world daily and are an essential source of meteorological data.

Key Considerations

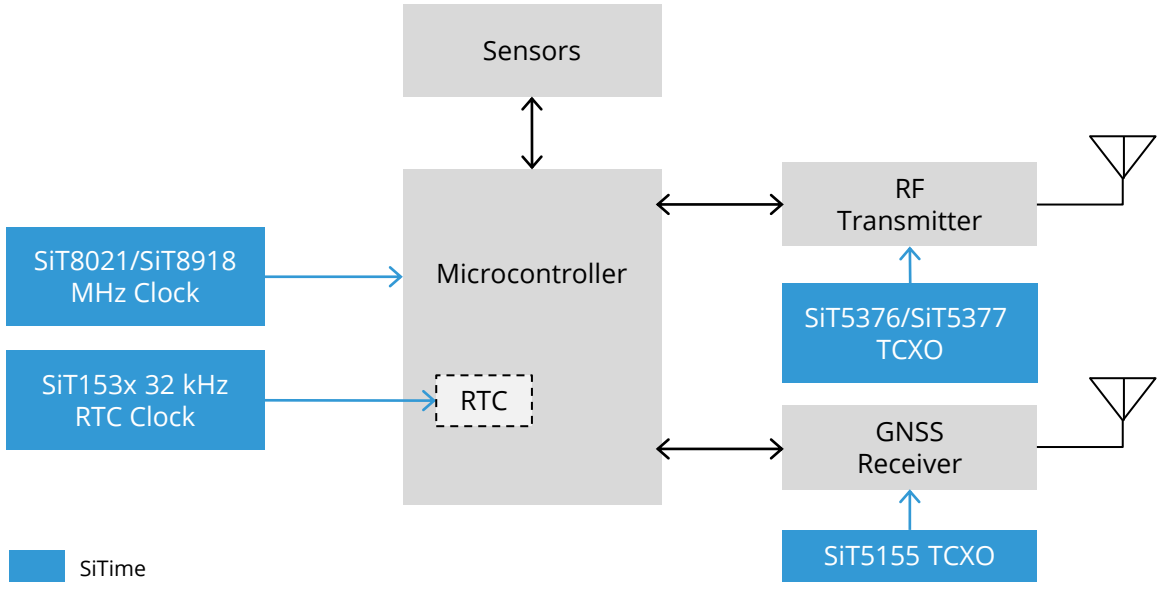
- Extended temperature range
- Low power
- Frequency stability
- Ruggedness
- Small footprint

At the heart of a radiosonde is a microcontroller. Its role is to consolidate all sensor data and transmit them via an RF transmitter to ground stations. A GNSS receiver permanently records the radiosonde's position.

Radiosondes rely on several clocks:

- **Microcontroller clock**: Usually in the 16 to 40 MHz range. Although crystal resonators can be used for this purpose, SiTime oscillators have many advantages (see page 4).
- **RTC clock**: Optional in this application, as the GPS features a time-of-day function. Some radiosondes are equipped with it.
- **GNSS receiver clock**: Provided by a TCXO.
- **RF transmitter clock**: Can be provided by a crystal resonator, an oscillator or a TCXO, depending on the transmitter chipset used.

Radiosondes Block Diagram



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Featured Products – please refer to SiTime.com or contact us for more options

Type	Product	Frequency	Key Features	Key Values
MHz Oscillator	SiT8021	1 to 26 MHz	• Ultra low power: < 270 µA at 6.144 MHz, 1.8 V, 10 pF load • 1.5 x 0.8 mm package • ±50 and ±100 ppm options • 1.62 to 3.63 V supply	• Saves power, maximizes battery life • Saves board space
	SiT8918	1 to 110 MHz	• -40°C to 125°C • ±20 to ±50 ppm freq stability • 2.0 x 1.6 mm, 2.5 x 2.0 mm, 3.2 x 2.5 mm, 5.0 x 3.2 mm, 7.0 x 5.0 mm packages	• High reliability • High temperature operation • Various standard package options • Immunity to EMI
Differential Oscillator	SiT9501	25 to 644.5 MHz (70 fs[1] IPJ)	• ±20 to ±50 ppm freq stability • LVPECL, LVDS, HCSL • 1.8 V to 3.3 V • -40°C to 105°C • 2.0 x 1.6 mm, 2.5 x 2.0 mm, 3.2 x 2.5 mm packages	• Meets demanding jitter requirements • Small PCB footprint, easier layout • Easy design due to flexibility • Better MEMS reliability
Super-TCXO	SiT5155	12 frequencies from 10 MHz to 40 MHz	• ±0.5 ppm freq stability • -40°C to 105°C • 5.0 x 3.2 mm package	• Designed for GNSS/GPS • Higher dynamic performance for faster lock to satellites in harsh environments
	SiT5376 SiT5377	1 to 220 MHz	• ±0.1 to ±0.25 ppm freq stability • -40°C to 105°C • 5.0 x 3.5 mm package	• Designed for RF systems • Low-phase-noise • Digital control, pull up to ±400 ppm
32.768 kHz XO	SiT1532 SiT1534	SiT1532: 32.768 kHz SiT1534: 1 to 32,768 Hz	• 900 nA typ. power consumption • 1.2 V to 3.63 V operation • 1.5 x 0.8 mm and 2.0 x 1.2 mm packages	• Saves power, maximizes battery life • Programmable output swing for further power savings • Small footprint saves board space • Internal VDD filtering eliminates external bypass capacitor: BOM cost reduction and further space savings
	SiT1569	1 Hz to 462.5 kHz	• 3.3 µA current consumption at 100 kHz • ±50 ppm stability • 1.5 x 0.8 mm package	
32.768 kHz TCXO	SiT1552	32.768 kHz	• ±5 to ±20 ppm freq stability • 990 nA typ consumption • 1.5 V to 3.65 V supply range • 1.5 x 0.8 mm package	

[1] 12 kHz to 20 MHz integration range

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Endura Ruggedized Featured Products

Endura products are designed for aerospace, defense, and other ruggedized applications. They can be factory-programmed to a wide combination of frequency, output and supply voltage options, eliminating the long lead times and customization costs associated with quartz products.

Type	Product	Frequency	Key Features	Key Values
Single ended oscillator	SiT8944	1 to 60 MHz	• ±10 to ±50 ppm freq stability over temp range • -55°C to 105°C • 0.1 ppb/*g* frequency stability • Low jitter < 0.5 ps RMS[1] • 1.8 V, 2.5 V, 3.3 V	• Better frequency and jitter margin enhance system stability and robustness • Easy availability of any device configuration • MEMS reliability • Minimizes EMI from the oscillator
	SiT8945	60 to 220 MHz		
Differential oscillator	SiT9356	1 to 220 MHz	• Low jitter 150 fs RMS[1] • LVPECL, LVDS, HCSL, FlexSwing • ±30 ppm freq stability over temp range • 1.8 V, 2.5 V, 3.3 V • -55°C to 125°C • 2.0 x 1.6 mm QFN package	• Meets demanding jitter requirements • Small PCB footprint, easier layout • Easy design due to flexibility • 0.04 ppb/*g* acceleration sensitivity for harsh environments • MEMS reliability • Minimizes EMI from the oscillator
	SiT9357	220 MHz to 944 MHz		
	SiT9551	14 standard frequencies from 25 MHz to 644 MHz	• Low jitter 70 fs RMS[1] • LVPECL, LVDS, HCSL, FlexSwing • ±20 and ±50 ppm freq stability • up to -55°C to 125°C • 2016, 2520 and 3225 packages	
Super-TCXO	SiT5146	1to 60 MHz	• ±0.5 to ±2.5 ppm freq stability • -55°C to 105°C • 5.0 x 3.2 mm package	• Ultra-wide operating temperature • Low 0.31 ps phase jitter (rms) • Higher dynamic performance for faster lock to satellites in harsh environments
32.768 kHz Super-TCXO	SiT7910	32.768 kHz	• ±0.1 to ±0.4 ppm freq stability • -55°C to 105°C • 5 µA current consumption • 3.5 ppm 20-year aging at 85°C • 2.5 x 2.0 mm ceramic package	• Unique combination of low power and frequency stability – only possible with MEMS! • Enables fast GNSS signal acquisition without compromising power

[1] 12 kHz to 20 MHz integration range

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Advantages of SiTime Oscillators for Radiosondes

- **Wide operating temperature range**: From ground level to the stratosphere, radiosondes are exposed to a wide temperature.
- **Guaranteed operation at -55°C**: MEMS technology is not subject to the issues plaguing crystals, in particular cold start, i.e., a crystal failure to start oscillating at cold temperatures. A solution to this limitation of quartz crystals is to increase the crystal drive current. However, besides running the risk of exceeding the maximal drive current of the crystal, it consumes higher power, which is detrimental to such battery-operated systems.
- **Resilience to shock and vibration**: Due to the smaller size and lower vibrating mass of the MEMS resonator, as well as better strength of silicon, SiTime MEMS oscillators are 100x more resilient to shock and vibration than crystal-based oscillators.
- **Low power consumption**: Because battery capacity drops with lower temperatures, low power consumption is even more important for devices operating in cold conditions.

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