Precision Timing Solutions

Seismic Sensors

Precision Timing for Seismic Sensors

Broadly speaking, seismic sensors simply measure vibration and shockwaves in the Earth's crust or at the surface, using velocity sensors or accelerometers. Depending upon the application, these sensors need to accurately measure frequencies in the range of 0.001 to 100 Hz.

Key Considerations

- Frequency accuracy
- Wide temperature range
- Long battery life
- Environmental robustness

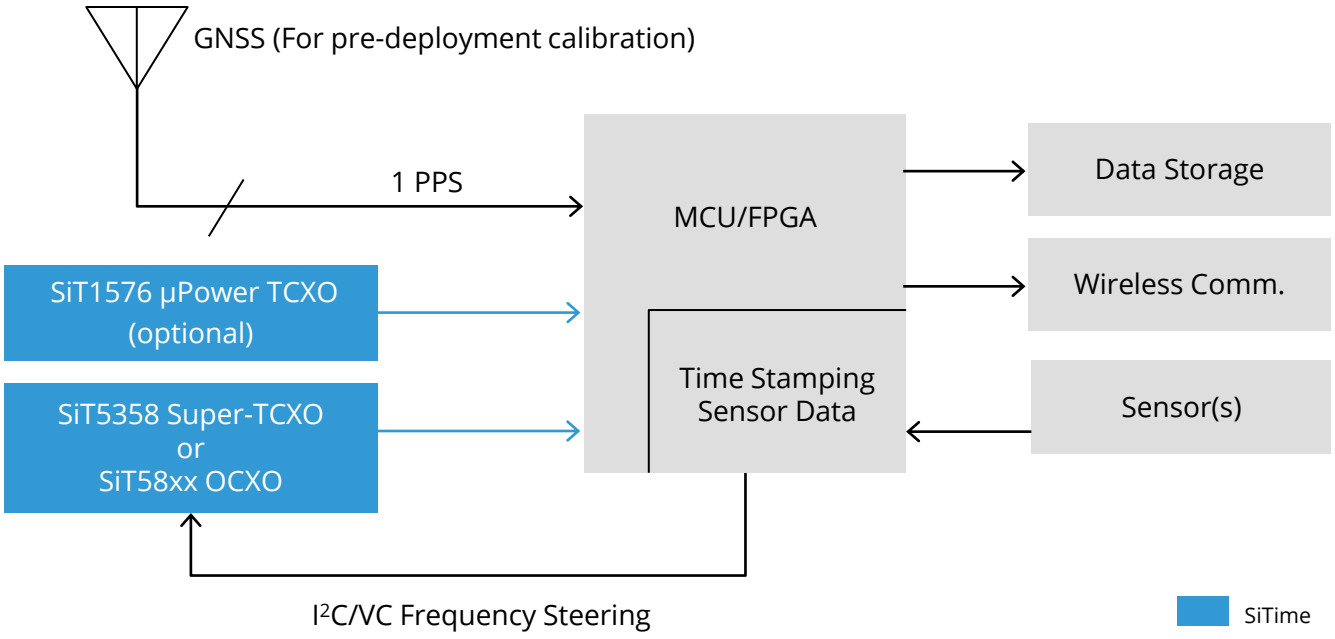
Seismic sensors are used in a range of applications:

- Earthquake monitoring
- Natural resource exploration (e.g., oil exploration)
- Ocean bottom observation
- Nuclear weapons test monitoring
- Governmental and military personal and vehicle monitoring (e.g., unattended ground sensor (UGS))

In all applications, the sensors need to operate remotely in harsh environments and are often battery powered. Therefore, the timing devices used in these sensors need to provide the following:

- Frequency stability over time and temperature range
- Wide temperature operating range
- Low power for longer battery life
- Environmental robustness (e.g., shock and vibration)

Seismic Sensor Block Diagram



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The Role of Accurate Timing in Seismic Exploration

An essential function of a seismic sensor is the time stamping of data. This time stamping is essential as data is collected from an array of sensors and needs correct correlation in time to be usable for later analysis. With the growth in non-wireline sensor arrays, precise local time keeping is essential. Local time keeping is needed because the sensors that rely on GNSS for timing may not be able to update timing data if there is interference or an obstruction to the GNSS source. Other sensor types may not be able to receive any external timing signal due to environmental conditions (buried, under water, etc.).

A Range of Solutions

SiTime offers a range of timing solutions that match the requirements of the applications, from TXCOs targeting commercial applications to the more robust Endura™ ruggedized product line targeting high-reliability applications.

SiTime Super-TCXOs are precision timing solutions with exceptional dynamic performance and rich features.

The Epoch Platform MEMS oven-controlled oscillator (OCXO family is designed to solve the long-standing problems of quartz OCXOs which are inherently unreliable and prone to performance degradation in the presence of environmental stressors. Epoch Platform OCXOs are resilient to thermal shock, airflow, and vibration, making them ideal for the rugged environment of seismic applications.

Why SiTime Timing Solutions

More robust in harsh environments:

- 4× better vibration resistance — 0.1 ppb/g typical
- 20× better shock survivability

Better stability over a wide temperature range

- Up to -55 to +125°C operation
- Airflow and thermal shock resistant — 1 ppb/°C

High reliability

- 50× better quality and reliability
- Lifetime warranty

Programmability for flexible design

- Any frequency, any stability, any voltage within a wide operating range

Unique features

- Low power for longer battery life — 6 µA at 32.768 kHz (SiT7910)
- Smaller size — down to 1.5 mm × 0.8 mm packages

Devices	Type	Function	Key Features
SiT58xx	OCXO	Time Stamping and Reference	10 to 220 Mhz, ±1 to ±5 ppb, ±10 to ±20 ppt/°C frequency slope, 420 to 460 mW power consumption
SiT535x	Super-TCXO	Time Stamping and Reference	1 to 220 MHz, ±50 to ±250 ppb , ±1 ppb/°C, ±80 ppb 20-year aging, 70g vibration survivability 110 mW power consumption
SiT1576	µPower TCXO	Low-Power Reference	1 Hz to 2.5 MHz, ±5 ppm total stability, 6 µA current consumption
SiT5541	Ruggedized Super-TCXO	Time Stamping and Reference	1 to 60 MHz, ±10 to ±20 ppb, ±0.5 ppb/°C, 0.01 ppb/g vibration sensitivity, 110mW power consumption
SiT7910	Super-TCXO	Pulse-per-Second (pps) Timekeeping	32.768 kHz, best-in-class ±0.1 to 0.4 ppm stability, 6 µA current consumption

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