Precision Timing Solutions

Downhole Instrumentation

Precision Timing in Downhole Instrumentation

The downhole/drilling environment is one of the harshest on Earth, with high temperatures and high pressure.

SiTime Endura™ ruggedized oscillators are built for aerospace, defense, and industrial automation applications that demand ultra-high resiliency to a wide range of harsh environmental conditions.

Key Considerations

- High-temperature operation beyond classic military range
- High mechanical shock and vibration survival
- Hermetic packaging
- High reliability

The silicon MEMS-based Endura oscillators deliver the lowest acceleration sensitivity, best shock and vibration resistance, high-reliability, and superior dynamic performance under airflow, thermal gradients, pressure, and power supply noise.

Endura products can be factory-programmed to any combination of frequency, stability, and voltage within a wide range of parameters, eliminating the long lead times and customization costs associated with quartz products. Endura oscillators are tested in accordance with MIL-PRF-55310 and MIL-STD-883 specifications. Standard or custom up-screening flows are available.

Why MEMS-based Oscillators

Compared to quartz crystal oscillators, MEMS-based oscillators are more resistant to shock and vibration, highly immune to electromagnetic energy and power supply noise, and are programmable.

More robust in harsh environments:

- 4x better vibration resistance — 0.1 ppb/g typical
- 20x 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

Programmability for flexible design

- Any frequency, any stability, any voltage within a wide range
- Qualify once for multiple parts

Higher quality and reliability

- Up to 50x better reliability — 2.2 billion-hour MTBF
- Lifetime warranty

Unique features

- EMI reduction — Up to 30 dB lower
- Low power for longer battery life
- Smaller size — down to 1.2 mm x 1.1 mm packages

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Downhole instrumentation collects critical, real-time data. Key applications include monitoring while drilling (MWD) and logging while drilling (LWD). These are similar devices but employ different types of sensors.

MWD records instantaneous on-drill parameters which can be used to supply contextual information for in-situ, down hole conditions, such as changes in geology, the presence of pre-existing fractures or voids and dynamic alterations.

Monitor While Drilling (MWD) Sensors

- Weight-on-bit
- Torque
- Annular Pressure
- Tubing Pressure
- Inclination
- Temperature
- Vibration

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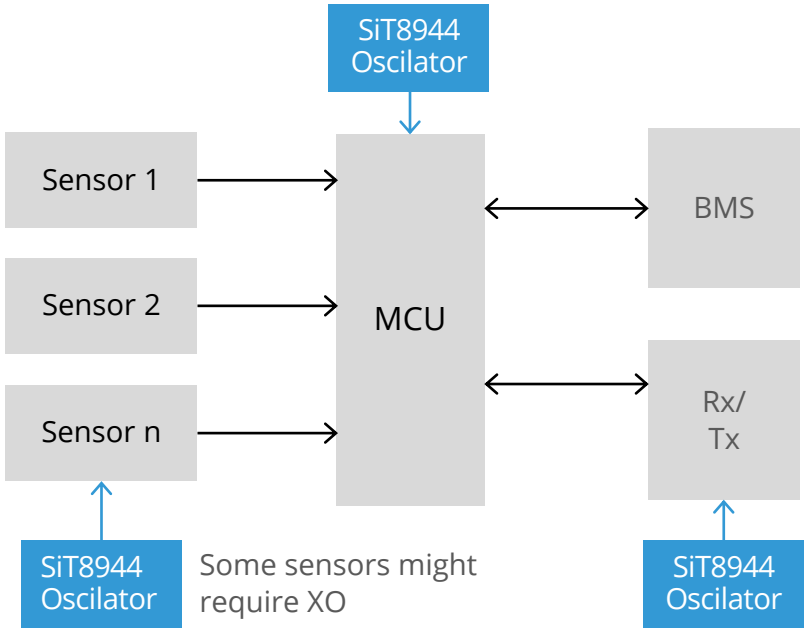

LWD is a more modern version of the much older wireline tools. LWD tools collect down-hole data while drilling without needing to remove drill pipe from the well. LWD offers similar functionality as wireline logging with differences in data quality, resolution, and/or coverage.

Logging While Drilling (LWD) Sensors

- Resistivity
- Porosity
- Pressure
- Temperature
- Vibration

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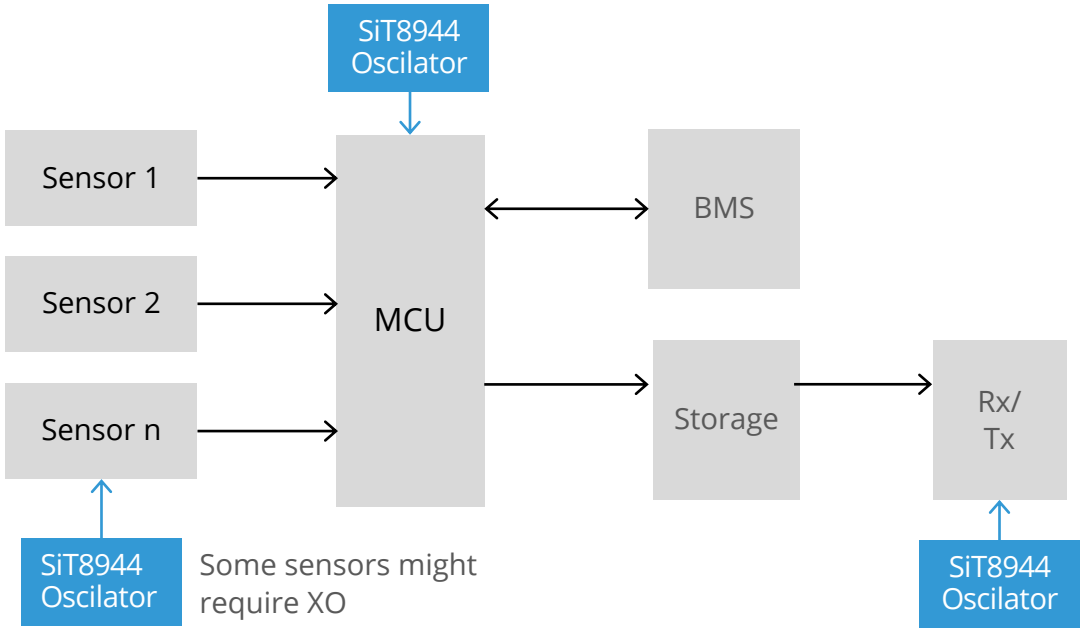

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Downhole Instrumentation

Endura™ Timing Solutions

Type	Product	Frequency	Key Features	Key Values
Single-ended oscillator	SiT8944	1 to 60 MHz	• ±10 ppm to ±50 ppm frequency stability over -55°C to 125°C • 0.1 ppb/g acceleration sensitivity • 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 • Minimizes EMI from the oscillator
	SiT8945	60 to 220 MHz		
Differential oscillator	SiT9346	1 to 220 MHz	• Low jitter 0.23 ps RMS[1] • LVPECL, LVDS, HCSL • 2.5 to 3.3 V • -40°C to 105°C • 3.2 x 2.5 mm package	• Meets demanding jitter requirements • Small PCB footprint, easier layout • Easy design due to flexibility • MEMS reliability
	SiT9347	220 to 725 MHz		
DCXO	SiT3541	1 to 220 MHz	• Digital frequency control I2C/SPI • ±3200 ppm pull range • 5 ppt resolution • ±10 ppm to ±50 ppm frequency stability over temp range	• Eliminates need for external DAC to control a VCXO • Better accuracy, lower noise due to digital control
	SiT3542	220 to 725 MHz		
Super-TCXO	SiT5146	1 to 60 MHz	• ±0.5 to ±2.5 ppm stability over 55°C to 105°C • ±15 ppb/°C • 0.009 ppb/g acceleration sensitivity	• Extremely stable under shock and vibration • No change in phase noise under vibrations • Minimizes link drops due to shock, vibration, or temperature change • I2C/SPI digital control available to speed design
	SiT5147	1 to 60 MHz		
	SiT5346	1 to 60 MHz	• ±0.1 to ±0.25 ppm stability over -40°C to 105°C • ±1 ppb/°C • 0.009 ppb/g acceleration sensitivity	
	SiT5347	60 to 220 MHz		
	SiT5348	1 to 60 MHz	• ±50 ppb stability over -40°C to 105°C • ±1 ppb/°C • 0.009 ppb/g acceleration sensitivity	
	SiT5349	60 to 220 MHz		

[1] 12 kHz to 20 MHz integration range

Learn more about Industrial solutions from SiTime

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