MEMS Timing Solutions

Automotive ECU

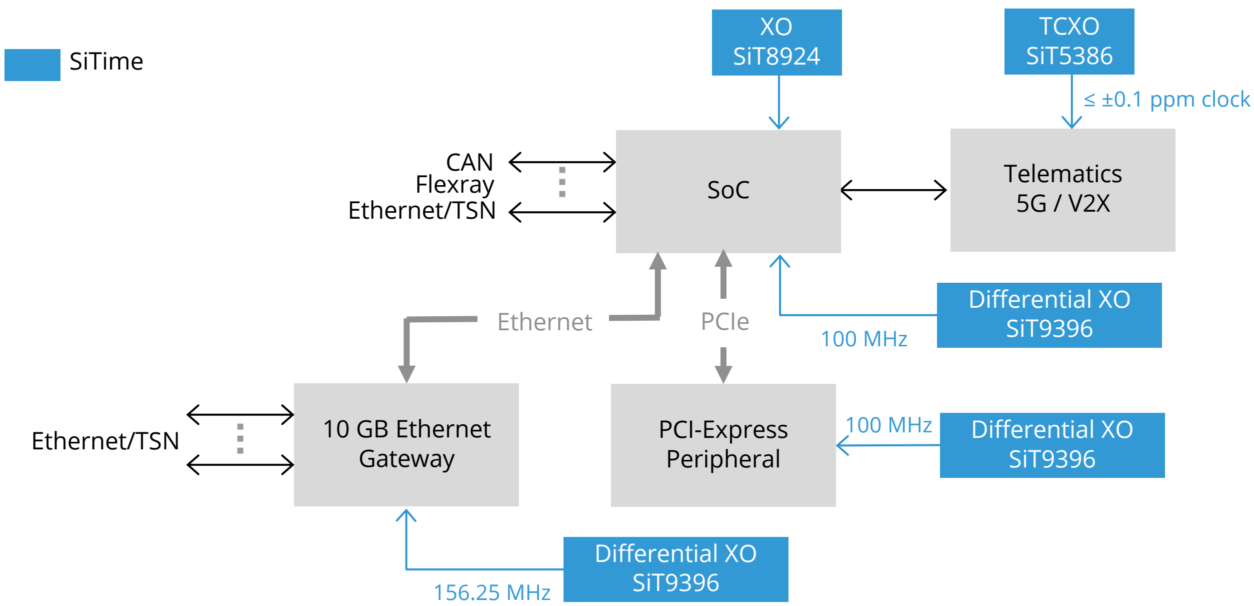
Precision Timing in Automotive ECU Systems

An electronic control system (ECU) is an embedded system that controls one or more vehicle systems. Typical ECUs include engine, drivetrain or transmission control; heating, ventilation and air conditioning (HVAC) control; infotainment; telematics; and, in more modern vehicles, all systems related to driver assistance and automated driving, from sensors to actuators.

Key Considerations

- Reliability and functional safety
- High temperature
- Low jitter
- Frequency stability and dF/dT

The transition from distributed architecture in vehicles to domain architecture has a significant impact on timing. With domain architecture, the use of higher-speed interfaces places a greater need on low jitter clocks. As ECU complexity has increased, more clocks are needed. Functional safety is an integral part of today's automotive systems. ASIL D is mandatory with most domain controllers and clocks play a significant role in supporting functional safety requirements.



SiTime Advantages

SiTime devices offer the following benefits over quartz crystals, which are particularly important in automotive.

- 50x better reliability. Apart from reducing the amount of field failures, better reliability translates into a lower FIT rate. This provides better hardware safety metrics in an FMEDA, the quantitative analysis required as part of a functional safety assessment.
- 100x better resilience to shock, vibration and electromagnetic interference, due to the smaller size (0.4 x 0.4 mm) and lower mass of MEMS resonators compared to crystals. When not causing a permanent damage to the crystal, shock and vibration can induce jitter in a crystal oscillator. As seen previously, jitter can be detrimental to the bit error rate of a high-speed link. Better resilience of SiTime oscillators ensures a low error rate regardless of operating conditions.
- Better frequency accuracy, 10x lower aging, and excellent stability over temperature – down to ±20 ppm (XO devices) over -40 to +125°C and ±0.1 ppm (TCXO devices) over -40 to +105°C.

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Featured Products – please refer to the Selector Guide for more options

Type	Product	Frequency	Key Features	Key Values
Single-ended oscillator	SiT8924	1 to 110 MHz	• Up to -55°C to +125°C • ±20 ppm stability • 2016, 2520, 3225 packages	• High reliability • Extended temperature range • EMI reduction features • Small footprint • Low power • Low jitter enables highest speed links
	SiT9025	1 to 150 MHz	• Up to -55°C to +125°C • Spread spectrum • Configurable rise / fall times • 2016, 2520, 3225 packages	
	SiT1625	44 standard frequencies	• -40°C to +125°C • ±25, ±30, ±50 ppm stability • 1612, 2016, 2520, 3225 packages • 500 fs RMS jitter[1] • 2.3 mA typ. current consumption	
Differential oscillator	SiT9396	1 to 220 MHz	• Low jitter: < 150 fs RMS[1] • ±30 ppm or ±50 ppm stability • LVPECL, LVDS, HCSL, Low-power HCSL, FlexSwing™ • -40°C to +125°C • 2016, 2520, 3225 packages	• High reliability • Low jitter • Enables interfaces with demanding jitter requirements, such as PCI-Express and 10 GB Ethernet
	SiT9397	220 to 920 MHz		
Super-TCXO DCXO/ VCXO	SiT5386	1 to 60 MHz	• 1 to 220 MHz • ±0.1, ±0.2, ±0.25 ppm stability • ±1 ppb/°C frequency slope • -40°C to 105°C • Low jitter: 0.31 ps RMS[1] • Optional voltage or digital frequency control	• High accuracy • Excellent frequency stability even with fast temperature gradients • No GNSS signal loss or V2X disconnect, as the MEMS resonator is not subject to "micro-jump" like crystal oscillators
	SiT5387	60 to 220 MHz		

[1] 12 kHz to 20 MHz integration range

Learn more about Automotive solutions from SiTime

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