Precision Timing Solutions

UAVs and Drones

Precision Timing in UAVs and Drones

UAVs and drones are essential for intelligence gathering, surveillance, reconnaissance, and precision strikes. These capabilities rely on precise timing to ensure accurate navigation, stable communications, and synchronized sensor data, delivering real-time situational awareness while reducing risks to human personnel.

Key Considerations

- Low power consumption
- Best-in-class vibration: 0.004 ppb/g
- Extended time holdover
- Small, lightweight, cost-effective

UAVs must operate, navigate, and communicate reliably during takeoff, cruising, and landing, even in turbulent air and harsh conditions. To keep UAVs agile, many functions are integrated into compact spaces. Achieving stable operation, precise navigation, and dependable communication, while managing power supply noise and board layout, creates significant challenges for timing system design. SiTime's Endura™ commercial off-the-shelf (COTS) ruggedized MEMS oscillators address these challenges effectively. These ruggedized Endura solutions deliver exceptional reliability, maintaining stability and low jitter across wide temperature ranges and under intense vibrations.

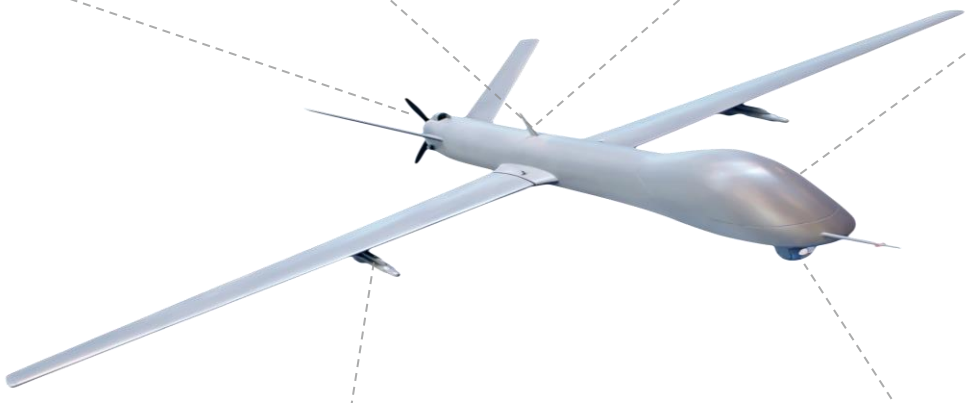
Applications and SiTime Enabling Products

Propulsion Controls
SiT7601

SATCOM, Data Links
SiT7201 | SiT7343

GPS/GNSS, A-PNT
SiT7343 | SiT7101

Flight Management
SiT7601



Landing Controls
SiT7601

Payload Controls
SiT7601

Video, LiDAR, Camera
SiT5346 | SiT7101 | SiT9356

Other Flight Sensors & Network Interfaces (IMU, Magnetometer, Baro, Pressure Sensor, Radar)
SiT9356 | SiT8944 | SiT7601

Endura Timing Solutions

Type	Product	Frequency Range, Stability Over Temperature, and Operating Range	Key Features & Value
OCXO	SiT7101	10 to 220 MHz ±1 to ±5 ppb -40°C to +95°C	• 24hr holdover < 1 µs time error* • 5x better stability (ADEV): 5E-12 from 1-1000 s • 70x lower sensitivity to vibration 0.01 ppb/*g* • 9.0 x 7.0 x 3.6 mm package
Super-TCXO	DURA-TTT**	1 to 105 MHz ±50 to ±500 ppb -55°C to +125°C	• Low power 21 mW (1.8 V), small package 5 x 3.2 mm • -150 dBc/Hz at 10 kHz offset (19.2 MHz nominal) • Best dynamic stability under airflow & thermal shock • 0.004 ppb/*g* acceleration sensitivity • >100 kg shock survivability
	SiT7201/02	1 to 220 MHz ±100 to ±250 ppb -40°C to +105°C	• RF-grade phase noise, 30x better under vibration • -159 dBc/Hz at 10 kHz offset (19.2 MHz) • Digital frequency tuning through I2C or SPI • ±100 fs phase jitter & low g-sensitivity 0.01 ppb/*g*
	SiT5146/47	1 to 220 MHz ±0.5 to ±2.5 ppm -55°C to +105°C	• Low jitter: 0.31 ps RMS • 2x better stability: 1.5e-11 ADEV at 10 s • 0.004 ppb/*g* acceleration sensitivity • 25x lower sensitivity to vibration 0.004 ppb/*g* • ±1 ppb/°C frequency slope (ΔF/ΔT) • 5.0 x 3.2 mm ceramic package • Digital frequency tuning through I2C
	SiT5346/47/48/49	1 to 220 MHz ±50 to ±250 ppb -40°C to +105°C	
Single Ended XO	SiT7601	4 to 125 MHz picklist ±25 to ±50 ppm -40°C to +125°C	• Fast startup 1 ms • Low power 4.5 mW (1.8 V) • >100,000+ *g* shock and 70 *g* RMS vibration
	SiT8944/45	1 to 137 MHz ±20 to ±50 ppm -55°C to +125°C	• ±28 ppm 20yr aging, 8x better than quartz • Configurable drive strength and rise/fall time • 100% drop-in replacement for quartz XOs
Differential XO	SiT9356/57	1 to 900 MHz ±20 to ±50 ppm -55°C to +125°C	• Low jitter: 150 fs RMS • ±300 ppb 20yr aging, 8x better than quartz • 20x lower sensitivity to vibration 0.04 ppb/*g* • Industries smallest diff. XO package 2.0 x 1.6 mm

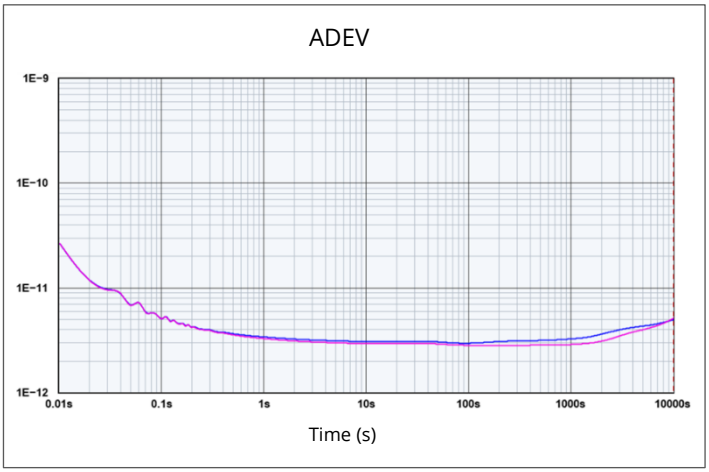
Lifetime Warranty, Lifetime Availability, 100% Production Tested

*When paired with SiTime's TimeFabric™ solution
**Contact SiTime for datasheet

Designed for Harsh Environments

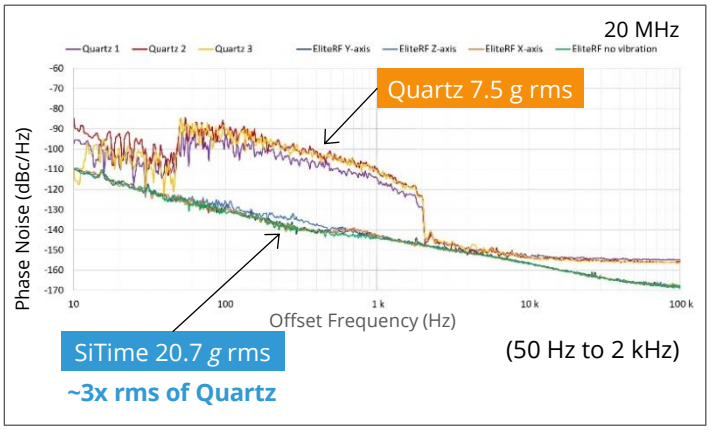
- ✓ Supporting-55°C to +125°C
- ✓ 20x better g-sensitivity (±0.004 ppb/*g*)
- ✓ 50x better vibration survivability (70 *g*)
- ✓ 65x better shock survivability (100,000+ *g*)
- ✓ 38x better df/dT (1 ppb/°C)
- ✓ Operates in >70,000 ft altitude
- ✓ No change in jitter/phase noise under vibration
- ✓ 100% screened over full temperature range

DURA-TTT : Allan Deviation at 1.8 V, 25°C



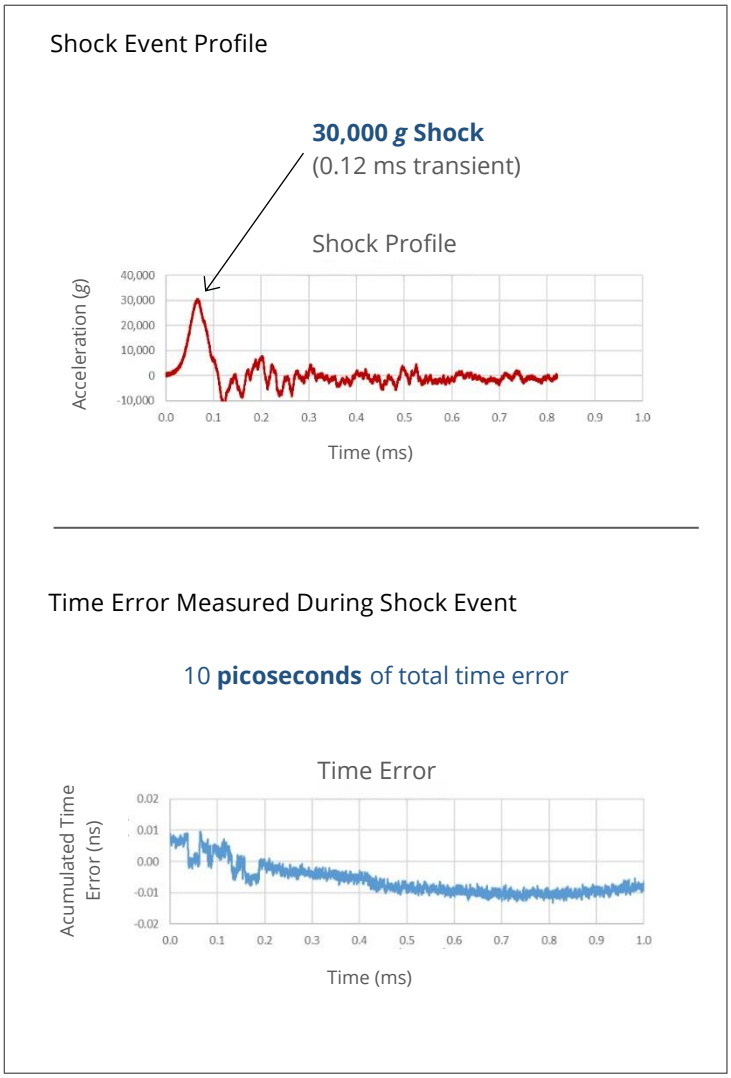
DURA-TTT offers and ADEV of 1.5E-11 from 1-1000s

SiT5346: Phase Noise under Random Vibration



SiT5346 is operating with little to no degradation in a vibration profile 3x stronger than a comparable quartz oscillator which is degraded by ~30 dBc/Hz

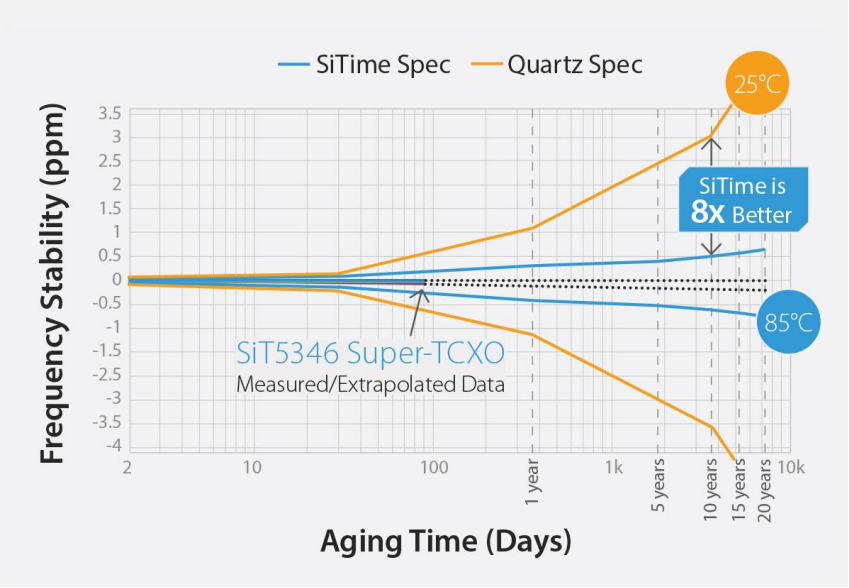
DURA-TTT: 30,000 *g* Shock Test



SiTime Super-TCXO's have been designed and qualified to survive and operate in high shock environments with no performance impact. The performance data shown above is comparable for all Endura Super-TCXOs.

Failure is not an option

- ✓ No frequency jumps
- ✓ No cold start issues
- ✓ 6-sigma process control
- ✓ <0.5 DPPM
- ✓ 2 billion hours MTBF
- ✓ 20-year aging (as low as ±150 ppb)
- ✓ 100% screened over the full temperature range with multiple power cycles



- SiTime devices are typically smaller than crystal devices and are available in plastic packages. Due to the coefficient of thermal expansion (CTE) being closer to the CTE of a PCB, plastic packages improve the solder joint reliability compared to the ceramic packages required for crystal resonators and oscillators.
- SiTime differential oscillators offer state-of-the-art jitter performance.
- SiTime Endura products eliminate the headaches of quartz oscillators. They simplify design, reduce problems discovered during verification and qualification, shorten product development and time to certification, support production ramp up and continuous supply, and ease trouble shooting through the life of the product.

Applications

SiTime Endura oscillators are the timing solution of choice in a numbers of UAV subsystems

- Automated flight control
- Flight management and health monitoring
- Network control
- Data management
- GNSS receiver
- Flight sensors, IMU and gyroscopes
- Navigation
- Camera and video sensors
- Communication
- Collision avoidance
- Weather radar
- Performance monitoring
- Engine propulsion system
- Landing system control