

## MEMS Timing Solutions Are Ideal for Digital Camera Applications

The market for digital still cameras (DSCs) and image capture devices has experienced strong growth over the past decade and is expected to continue growing over the coming years. New MEMS timing technology allows designers to differentiate their products and enhance the performance and features of digital cameras. Leveraging the performance and supply chain benefits of new timing technology enables consumer device companies to capitalize on the growth and anticipated trends in this market.

### New MEMS Timing Technology Supports Camera Market Trends

Timing devices such as oscillators are used in cameras to clock the image sensor as well as the main processor. These timing devices must support new features and performance requirements. As image resolution increases and camera features improve, the need for accurate timing devices has grown. As the size of DSCs and image capture devices becomes smaller, a clock source that takes less space on the board is increasingly more important. Additionally, as long battery life is an essential requirement in portable devices, cameras need timing components with low power consumption.

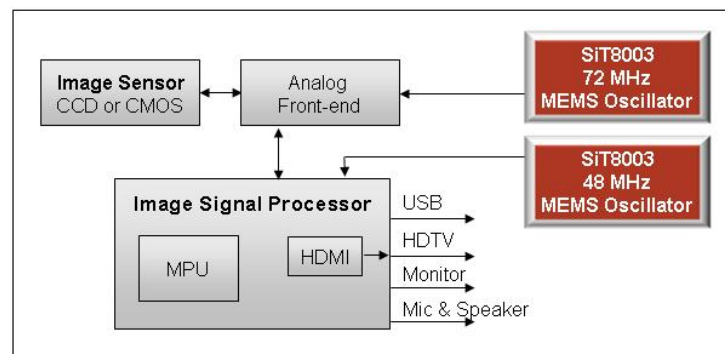


Figure 1: DSC Block diagram

The latest innovative timing devices use micro-electro mechanical systems (MEMS) technology that brings significant performance and feature improvements to oscillators. Camera makers no longer need to depend on inflexible quartz devices to provide the timing reference in their products. MEMS timing devices excel at providing the following key requirements for DSC applications.

- High performance ([low jitter](#) and [excellent frequency stability](#)) for better images
- [Small size](#) to fit in extremely small and thin systems
- Low power for long battery life
- [Shock and vibration resistance](#) for long life in spite of drops and vibration

### Benefits of SiTime MEMS-based Timing Solutions

SiTime, the leader in MEMS-based timing solutions, offers a complete portfolio that is targeted at DSCs. SiTime MEMS oscillators provide clocking for every functional block in a camera, while providing the high performance and flexible features listed below.

- Low power consumption at 2.5  $\mu$ A in standby and 3.5 mA in active mode
- Small size with 2.5 x 2.0 mm QFN plastic packages and package heights as thin as 0.25mm
- Supply current options at 1.8, 2.5, 2.8 or 3.3V (Contact SiTime for 3.0V)
- Frequency stability as low as  $\pm 20$  PPM
- Wide frequency range up to 110 MHz (Contact SiTime for frequencies up to 800 MHz)
- Short lead times from 2 to 3 weeks
- Extremely robust with 50,000 g shock and 70 g vibration ratings
- Highly flexible with custom frequencies, rise/fall time control and other programmable features

### MEMS Solutions for DSC Applications

Application	SiTime Oscillator	Frequency (MHz)	Frequency Stability (PPM)	Supply Voltage (V)	Package Size (mm)	Other Features
Image Sensor	SiT8003AI-12-18S-72.00000	72	$\pm 25$	1.8	2.5 x 2.0	2.5 $\mu$ A Standby Current
Main Processor	SiT8003AI-12-33E-48.00000 & SiT8003AI-12-33E-60.00000	48 & 60	$\pm 25$	3.3	2.5 x 2.0	Output Enable
HDMI	SiT8003AC-11-33E-74.17600	74.176	$\pm 20$	3.3	2.5 x 2.0	Output Enable

### Silicon MEMS Oscillators Provide High Reliability for Digital Cameras

With the omnipresence of digital cameras, these products are used in a wide range of environments and are subject to various conditions such as temperature fluctuations and high levels of shock and vibration. Cameras need to be rugged and designed with highly robust components. A reference oscillator must conform to its specifications under these conditions. Unlike fragile quartz crystals, SiTime's MEMS timing products have excellent performance and reliability in harsh and varied environments.

Accurate timing signals are dependent on frequency stability. With SiTime's MEMS oscillators the frequency is stable across the entire temperature range providing excellent timing margin. With quartz-based oscillators, the typical frequency stability curve is much wider providing less timing margin at the far ends of the temperature range.

In addition to exposure in temperature changes, portable consumer devices can be dropped or exposed to vibration. Silicon MEMS oscillators are 10 to 30 times more robust than quartz oscillators. SiTime's MEMS oscillators have the capability to withstand high amounts of shock and vibration, and they continue to perform reliably within specifications. Typical quartz devices are rated for 5,000 g shock, while SiTime's devices are rated for 50,000 g shock.

Figure 2 shows that SiTime's MEMS oscillators exhibit the best performance in the presence of very heavy vibration at 100 Hz vibration noise. SiTime has tested its MEMS oscillators up to 70 g of vibration with minimal impact on phase noise and jitter performance.

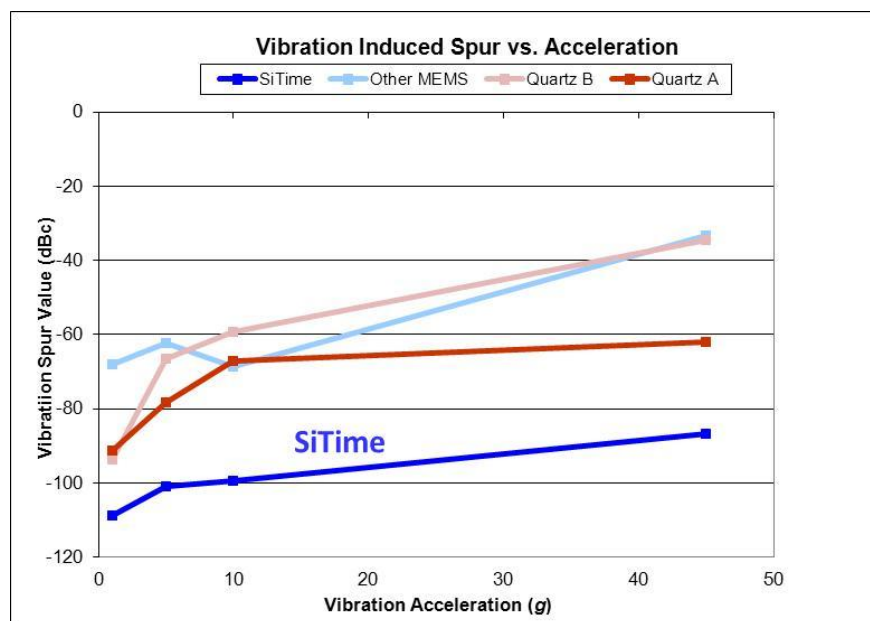


Figure 2: Performance comparison of various oscillators under conditions of vibration.

### DSC Manufacturers Benefit from Flexible MEMS Timing in Today's Market

As the camera market evolves, the flexibility of MEMS timing devices is well suited to respond to market swings and new market trends. The programmable architecture of SiTime products combined with the MEMS manufacturing model allows SiTime to support the needs of this dynamic market.

The digital camera market has experienced strong overall growth and the market is expected to continue growing for a number of years especially in Asia and Latin America. Growth will be driven by added functionality, higher performance and new camera technologies. High-end cameras such as digital still lens reflex (DSLR) cameras will become more attractive to consumers, especially as price points lower. Consumers will adopt new technology such as hybrid high-definition (HD) cameras that integrate HD video. In the future, 3D cameras will also add to growth at the high end of the camera sector.

As digital cameras integrate more features such as GPS and WiFi, SiTime's customizable timing products can support new functionality and interface standards. Many DSC improvements will be supported by enhanced processing capabilities. With accurate frequencies that can be quickly and easily programmed to the sixth decimal place, SiTime's oscillators can provide a clock signal for any application processor.

SiTime's products allow fast time to market. In addition to the programmable architecture that enables quick customization, SiTime silicon MEMS products benefit from the vast semiconductor industry infrastructure. Unlike quartz products that are manufactured in specialized factories, SiTime's silicon MEMS timing products leverage a semiconductor supply chain and production flow. The silicon-manufacturing model used to fabricate MEMS-based oscillators provides cost advantages and ensures that SiTime devices are available with very short lead times. Volumes can quickly ramp up as required. This is especially important for consumer electronics manufacturers that experience fluctuations in market demand. Supply chain managers no longer need to worry about the inventory of quartz-based products that have much longer lead times.

### **Summary**

SiTime is a leading timing supplier for tier-one DSC manufactures with tens of millions of units shipped to date. With flexibility that is not available from quartz suppliers, SiTime is poised to support the future timing requirements for image capture applications in consumer devices. The reliability, features and flexibility of SiTime MEMS solutions provide an optimal timing device with the performance, cost and responsiveness needed for the fast growing consumer market.