

The heartbeat of electronics

MEMS devices are increasingly providing the pulse for electronics systems. By Chris Shaw

The electronics market is evolving continuously and, with it, demand grows for improved timing solutions, greater performance, more integration and faster response times. So it's no surprise that electronics manufacturers are starting to target MEMS oscillators.

MEMS oscillators offer a range of benefits and this is why an increasing number of manufacturers are embracing the technology. Discera's cto Wan-Thai Hsu explained: "Cost and integration are two major reasons why MEMS oscillators are now becoming 'direct replacement' parts for conventional quartz crystal oscillators. In the future, MEMS oscillators will play the role of 'direct replacement' on top of systems chips for optimisation of clock sources for electronic systems."

Although quartz based products have dominated the frequency control market, Paul Fear, managing director with IQD Frequency Products, believes this new technology can successfully better the price and performance. "There have been minor successes in limited ranges such as ceramic resonators," he said, "but nothing that has really challenged the dominance of quartz – until now."

To adopt such a system can be an expensive undertaking, so manufacturers are following different paths. Piyush Sevalia, vp of marketing at SiTime, revealed: "SiTime has developed fundamental MEMS oscillator technology

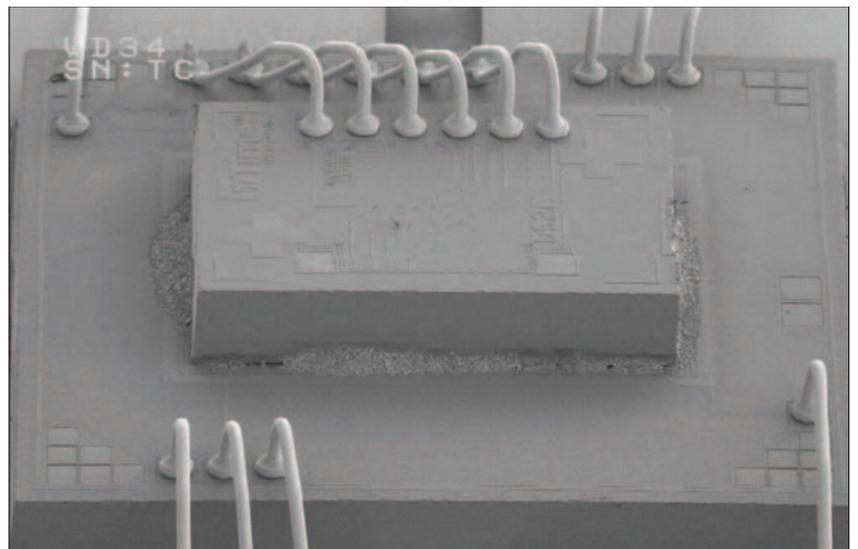
that uses standard, mature manufacturing processes and packaging. Our 'MEMS-First' process enables us to deliver cost effective, highly robust MEMS oscillators to the market place with shorter lead times, allowing customers to get to revenue faster. The fact that we are already engaged with hundreds of customers in nine different market segments is a testament to that fact."

IQD has chosen to work with technology partners. "There is still significant investment required," said Fear, "but as part of the fundraising earlier this year to return the company to private ownership, we raised enough

funds with our investment partners to support moving into this field."

With the range of MEMS oscillators growing, diverse approaches are being adopted to penetrate the developing market. SiTime's MEMS oscillators are programmable devices with a performance it says is on par with those of fixed frequency quartz oscillators. Sevalia said: "The traditional quartz market is comprised of fixed frequency and programmable quartz oscillators. System designers demand the high performance and low cost of the fixed frequency quartz oscillators for their applications but also deal with the long

Bonded resonator from SiTime





lead time and the associated inventory overhead." While shorter lead time is possible with programmable quartz oscillators at higher unit cost, the devices don't meet performance requirements in most applications.

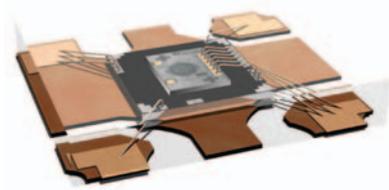
Discera has also focused on a programmable, low power oscillator and, as Hsu pointed out, the company isn't just targeting general consumer electronics applications, but also military applications that require high stock and vibration resistance.

Whilst some manufacturers have focused on replacing quartz technology on existing designs, IQD considers this unrealistic, due to the short development timescales and lifecycles of modern electronic products. Fear clarified: "Instead, IQD is focused on working with engineering teams to design MEMS based products into next generation electronic products. Fundamentally to an engineer, the products are still oscillators that must provide appropriate performance in their circuit at a size to suit the design and a cost to suit the target price point. The fact that they happen to use a new technology based on MEMS is almost beside the point. It is their primary strengths, appropriate to the product design, that are critical."

Silicon or quartz?

Initially developed for the automotive market, where high shock levels are common place, it was obvious that there were significant opportunities in other areas of the electronics industry. Fear asserted: "The consumer field was particularly strong in fields such as set top boxes and miniature camcorders, where their lack of susceptibility to shock make them virtually indestructible. Simple product design enables the devices to be qualified 'once' in any particular application." Because the approach is based upon existing CMOS technology, he considers there has been little need to develop new techniques for existing manufacturing lines.

Silicon substrates offer a number of benefits over their quartz crystal



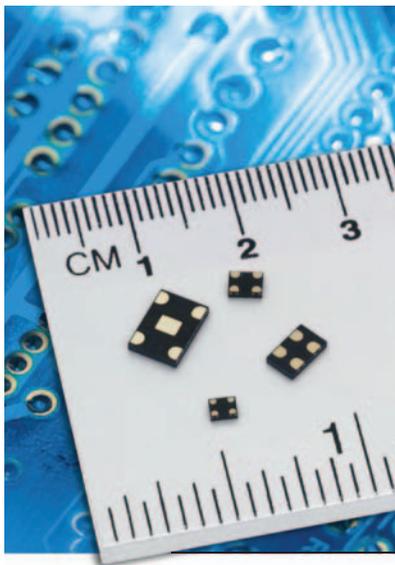
MEMS devices can be fully integrated with CMOS

counterparts. Sevalia noted: "Compared to quartz oscillators, MEMS oscillators can offer temperature controlled crystal oscillator quality frequency stability (± 10 ppm), but more cost effectively. This enables improved timing margins in customers' applications. As it is four times thinner, it is suitable for height constrained portable applications."

While the demand for MEMS oscillators grows, so profiles are becoming increasingly thinner. "The thin profile enables a number of new applications, such as the next generation SIM cards," Sevalia noted. "A thin profile also allows MEMS oscillators to be integrated directly into ASIC/ASP packages, thus eliminating all external clocks and associated components from a system."

Silicon substrates can be easily processed with mainstream IC production tools, while micromachining quartz substrate requires more specialised processes. "More importantly," noted

MEMS packages from IQD Frequency Products



Hsu, "while the size of the resonator becomes small – for example, 50 to 100 μ m – both silicon and quartz are facing the same process variation that causes frequency variations."

Because of the lack of knowledge of frequency products, SiTime has embarked on a system to educate its channel and customers on the maturity of MEMS technology. Sevalia explained: "It came as a great surprise to many people that a total of 2.7 billion units of MEMS components were shipped in 2007 in applications ranging from automotive to mobile phones. And, with increased sales and marketing effort, we are expecting great adoption of MEMS oscillators in place of quartz."

The electronics industry is well aware of the benefits of MEMS oscillators. Discera, for example, considers performance and reliability as its key selling point. "We play very conservatively in the market," Hsu said, "and make sure our customers are satisfied. At the same time, we work closely with our key customers to fit their future needs." Sevalia agreed that customer satisfaction was crucial and was achievable. "We have maintained zero field returns from quality failures out of millions of units shipped." He asserted. "We were able to resolve customer clocking issues at customer premise by programming our parts with a specific frequency oscillator."

However, Fear felt the market was still too immature and, while he believed IQD's product range to be as competitive as the best in the emerging market, he noted that early uptake can be relatively slow in all aspects of new technology. "The technology can't yet compete with all quartz based products where higher performance is required in certain areas of the specification." Fear warned. "However, the many strengths of our MEMS oscillator range suggest that, once the market becomes comfortable with the new technology, growth could be extremely rapid."

Ongoing development continues to expand the range of oscillators and their capabilities, with a result that many new market opportunities could soon emerge.