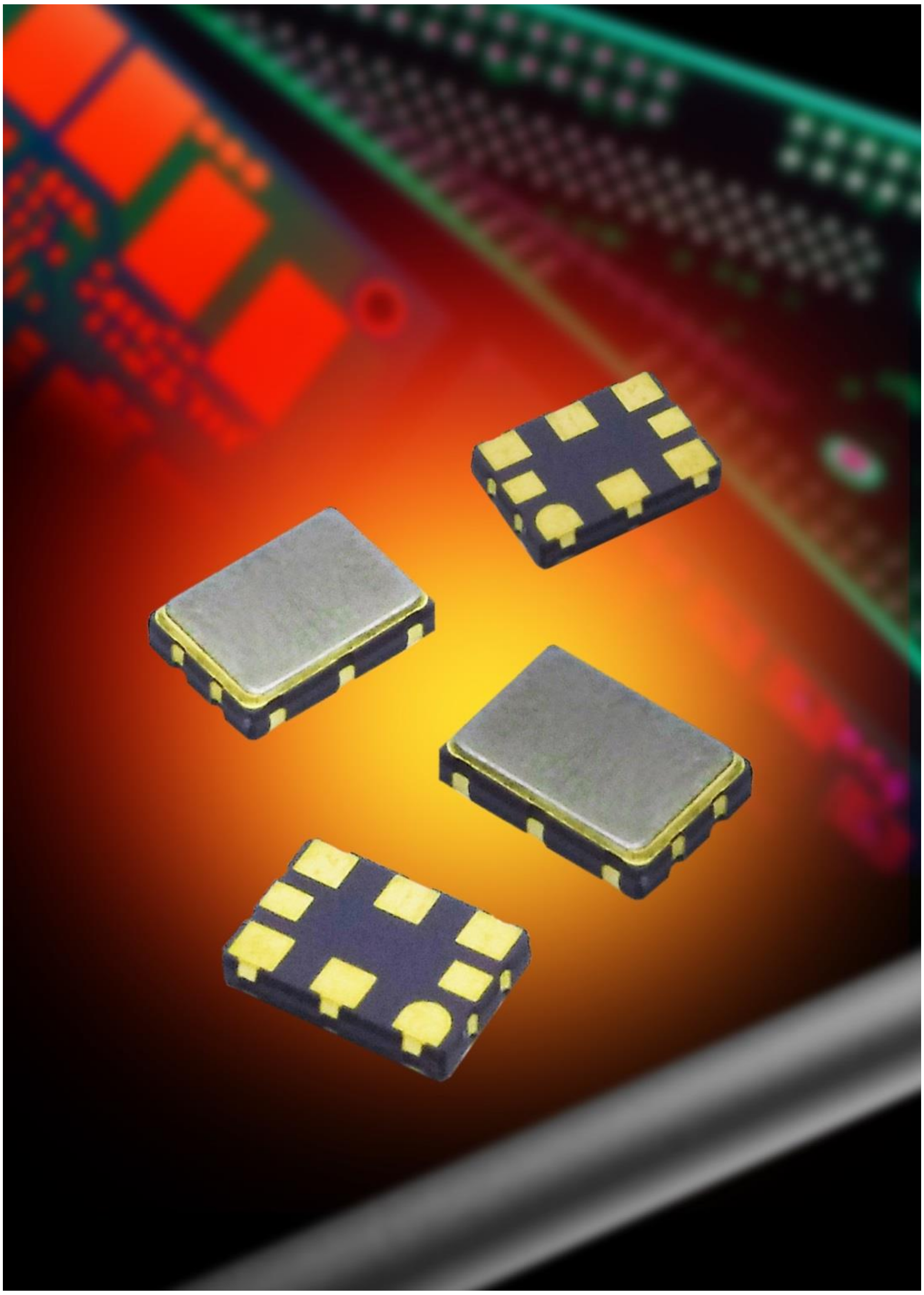
Trends in Oscillator Design Technology

EUROQUARTZ

Many modern applications require lower phase noise characteristics such as higher frequencies and lower operating voltages and this is pushing the boundaries of oscillator design forward.
The semiconductor houses are working hard to develop new chipsets with an increasing amount of complexity.



If we consider the discrete quartz crystal market, based on the gathered data, there is likely to be a reduction in requirement for individual crystal elements in favour of packaged oscillators, with approximately 70% of total production output being allocated to packaged oscillators of one kind or another.

In recent years the industry has moved away from TTL to CMOS oscillator outputs and the trend will be continue to move towards new techniques such as HCSL and CML logic.
The processing of increased amounts of data requires systems to run at much faster data transfer speeds and this requires higher frequencies and faster transition times.

High Speed Current Steering Logic (**HCSL**) offers a constant current characteristic which offers a less “noisy” solution compared with a static logic solution. This is a major benefit for mixed low voltage signal processing such as can be seen in optical communication, PCI systems etc.

Current Mode Logic offers a similar performance to LVPECL, however does not require external biasing, the downside is that they do require ac-coupling due to the fact that they are unable to provide sufficient current to bias other devices. The advantage is that **CML** offers lower output voltage swings compared to standard CMOS devices. This makes them ideal for low power applications and fast data speeds from 321.5 Mbits /sec to 3.125 Gbit/Sec. and are used for such things as serial data transceivers, frequency synthesizers, etc

Combined with higher speed, the requirement for better phase noise and jitter performance is going to be an increasing requirement. Data integrity is vital in all modern data transmission systems as this can

be seriously affected by phase noise and jitter.
Traditionally the best way to improve this performance characteristic was to use higher frequency fundamental crystals, but there is a limit to the frequencies that are available and the performance that they can offer.
Oscillator designers are somewhat limited by the semiconductors that are currently available, but they are working hard with the semiconductor houses to develop new products continuously.
There has been an increase in the number of oscillators that offer better performance in this area leading the design of faster and improved data transmission systems.

Another area of oscillator development that has taken off over the last few years is the area of **High Temperature operation** and whereas most oscillator manufacturers were able to offer product that would function at 150°C, the notion of 200°C was unthinkable. However there are now oscillators that have been developed for downhole drilling applications that operate up to 260°C and it is expected that the operation temperature will increase further.
Recent work on jet engine development has thrown up a requirement for this type of oscillator.
In order to achieve a high temperature performance the problems do not lie with the quartz crystal, but with the substrates, packaging and mounting systems which have to accommodate large coefficients of expansion.
As the oil industry drills ever deeper, the temperatures of the drill bits and associated electronics increase, which is a major driving factor in this area of design.

In the area of temperature compensated oscillators (**TCXO's**) much progress has been made and the stabilities being obtained are matching those of lower end oven-controlled oscillators (**OCXO's)** which in turn offers a lower cost solution.
Aging and phase noise characteristics are critical and in recent projects Euroquartz have been able to offer solutions for aging performances of ≤6ppm over 30 years.
For high vibration applications special compensation systems are employed to cancel out vibrational effects on the quartz crystal which is essential in many military applications.

It is only fair to mention Micro-Electro-Mechanical Systems (MEM's) oscillators at this point, the companies producing these devices have been through a difficult time recently with the Discera brand product changing hands twice and is now owned by Microchip Technology Inc.
These are being promoted as programmed units, but the problem still remains, that unlike quartz products there are only two manufacturers of the product.
However, they are becoming more widely available through distribution as a result of the new marketing approach adopted by Microchip.
MEM's oscillators do offer mechanical resilience advantages over quartz devices, but there are aging characteristics that need to be taken into consideration. It is predicted by manufacturers that the usage of MEM's technology will continue to grow but is unlikely to replace the current quartz crystal technology in the near future.
There is a lack of long term performance data for MEM's product compared with that of quartz and this can only be gathered over time. Initial results suggest that the performance falls a long way short of that of quartz and in accelerometer applications concerns regarding acoustic noise interference have been raised recently.
In conclusion future oscillator designs will become more complex, with better phase noise performance, additional functionality, higher frequency and better temperature stabilities in order to keep pace with the increase in complexity of customer requirements.

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