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Improving Energy Efficiency in Electronics Systems Through Low Voltage Oscillators

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Technological advancements like artificial intelligence (AI), machine learning (ML), and edge computing are reshaping the future of electronics-based systems. Low voltage capabilities have become a key element in these areas, driven by the growing demand for energy efficiency and increased adoption of automation across markets and applications such as automotive, networking, medical devices, wearables, and the Internet of Things (IoT). **(Figure 1)**

FIGURE 1: Low voltage frequency control products are becoming increasingly popular amongst many applications

The popularity of low voltage (LV) frequency control products, such as oscillators, has grown significantly as manufacturers have moved to satisfy demands for more powerful products, smaller packaging, and longer battery life. To meet these evolving needs, Aker now offers production-ready crystal oscillators that operate at voltages as low as 0.9 V, delivering both energy efficiency and reliable frequency performance.

Crystal Oscillators: The Heartbeat of Modern Electronics

Quartz crystal oscillators are the 'heartbeat' for the entire microprocessor unit (MCU) found in modern electronic devices. They provide the clock frequency signal that is necessary for the MCU to execute instructions. Crystal oscillators are used frequently since they have good signal quality and stability, and do not require a complicated configuration, so they are relatively simple to connect.

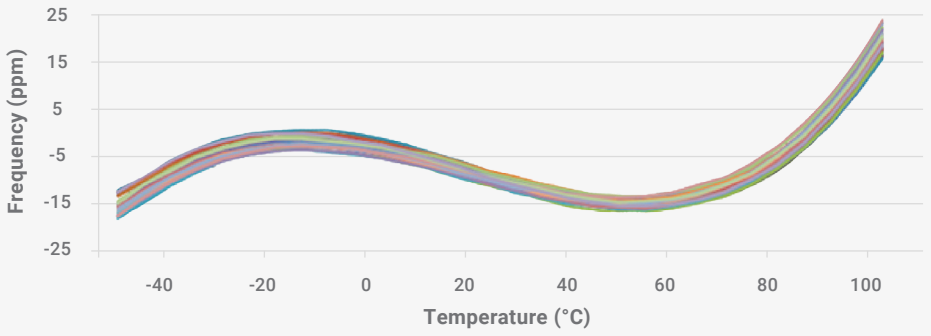
Advantages of Low Voltage Oscillators

Low voltage oscillators are versatile elements in the electronics landscape, adept to being tailored for various applications across multiple industries. The reduced energy use, space savings, frequency stability and lower noise that LV oscillators provide give designers the flexibility to use them in many applications, including wireless devices, wearable medical devices, and more.

By utilizing low voltage oscillators, the modern needs, preferences, and global trends across various markets can be met with efficiency. These key advantages include:

- **Reduced Energy Costs:** Low voltage oscillators play a crucial role in enhancing energy efficiency across various devices and applications. By operating at lower voltages, electronic systems consume less energy, benefiting the environment and resulting in significant cost savings over time. As energy costs continue to rise, the efficiency and cost-effective gains provided by low voltage oscillators become increasingly valuable for both consumers and industries.
- **Space Savings:** Low voltage oscillators provided by Aker are available in miniaturized packages as small as 2.0 x 1.6 mm, supporting the movement for reducing size and weight of electronic components, making them ideal for portable and wearable devices.
- **Extended Battery Life:** Because low-voltage oscillators consume less power, the contribute to an extended battery life and longer operational times in electrical devices.
- **Precise Frequency Stability:** Voltage variations can cause frequency drift in high-voltage oscillators, causing interference or signal degradation. A lower operating voltage means that the oscillator circuit is less affected by changes in the power supply voltage, providing more stable frequency, which is crucial for system reliability, particularly in areas requiring precise timing and synchronization. **(Figure 2)**

FIGURE 2: Low voltage oscillator stability vs. Temperature



- **Reduced Noise:** Low voltage oscillators can be designed to operate with lower noise levels. This is because power dissipation and thermal effects are minimized, which can lead to a cleaner and more stable output signal and fewer timing errors.

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Low Voltage Oscillator-enabled Applications

As modern technologies evolve, the applications for low voltage power have grown extensively. This brings into play the need for specific frequency control elements only found in low voltage oscillators.

The significantly reduced power consumption of LV oscillators is critical for battery-powered devices and applications to minimizing power draws, especially when considering the long-term battery life and energy efficiency of a circuit.

Other key parameters include the small packaging of these low power oscillators that ensure efficiency and scalability among ultra-compact electronics. Low voltage circuits can be easily upgraded or expanded without disrupting existing infrastructures, ensuring adaptability and integration, as well.

Aker meets the frequency control demands of the electronics industry with our new TXON-211Z Series, a 1.2V Temperature Compensated Crystal Oscillator (TCXO) that is the ultimate choice for next-generation low-power applications in an era of energy-efficient and high-performance electronics. The ultra-low power TXON-211Z Series ensures stable frequency output, while significantly reducing power consumption for wearable devices, IoT sensors, and mobile communications – all in an extremely small 2.0 x 1.6 mm package.

Low Voltage Dominating the Market

The commercial and automotive electronics market that drives the demand for low voltage products is vast, with numerous applications that utilize low voltage electronic components including:

Application Area	Specific Uses
Wireless Communication Devices	Bluetooth Systems, Low-Power Wireless Devices
Industrial and Environmental Monitoring Equipment	Various Monitoring Stations, Industrial Sensor Networks
Medical Devices	Mobile Medical Systems, Wireless Health Monitors
Mobile Devices	Smartphones and Tablets, Low-Power GPS Trackers
Wearable Devices	Smart Watches, Health Monitoring Systems
IoT Devices	Low-Power Sensors, Smart Home Systems

FIGURE 3: Applications for Low Voltage Oscillators

Medical. Using high-quality crystals and oscillators in the design of medical devices helps to ensure the reliability of frequency control. Many medical devices, especially those that patients wear or carry for extended periods, utilize low voltage electronics for safety and efficiency, including pacemakers and hearing aids. Low voltage oscillators consume less power, contributing to an extended battery life and longer operational times in portable medical devices. The trend towards smaller, more compact medical devices that are more convenient for patients also demands more precise frequency control.

Communications. Wireless networks such as 5G and industrial automation have completely changed the way we communicate, connecting people all around the world with just the press of a button. This new era of digital transformation is marked by high speed, low latency, and multiple connections. The high-frequency stability, low jitter and lower power consumption of low voltage oscillators make them ideal for meeting the needs of the high-speed data exchange required in today's wireless networks.

Smart Industrial and Home IoT. IoT looks to create more automated and data-driven industrial environments by seamlessly integrating physical and digital systems. As more devices within residential and industrial spaces become interconnected, the demand for low voltage power solutions that can support continuous, reliable operation increases. Low voltage oscillators are essential in smart industrial and home IoT systems because they provide precise time and frequency control that is vital for the synchronization, communication and operation of electronic systems.

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A Future Focused on Low Voltage Oscillators

Understanding the pivotal role that low voltage oscillators play in modern electronics today is essential for leveraging their benefit to improve future advancements.

With the rapid development of IoT, 5G communications, and wearable technology, low voltage oscillators like Akers' new 1.2 V TXON-211Z Series, have become the cornerstone of future technology. It is not only the ultimate choice for today's low-power, high-precision applications, but it will also drive future innovations, representing a significant breakthrough in electronic component design.

Low voltage electronics will be a key focus to keep technology advancing and Aker is positioned to meet the market demands for the next generation of low voltage solutions.

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