ABRACON

SPXOs for Low-Power Applications

Abracon MHz Continuous Voltage Oscillators

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Introduction

Battery storage is one of the most integral forms of energy storage to date. It essentially allows the world to be mobile. Industry movements from the likes of 5G, mobile AI and IoT are particularly dependent on the use of batteries as a primary energy source. The exponential growth in battery dependency will force many new designs to accommodate a fluctuating supply voltage.

Abracon has confronted this challenge by introducing the Continuous Voltage SMD Oscillator family, which includes MHz SPXO, kHz SPXO and TCXO types. This paper will focus on the recently launched ASADV, ASDDV and ASEDV MHz simple packaged crystal oscillator (SPXO) devices that are designed for simplicity and optimized for low-power consumption while eliminating the need for a set bias voltage (V_{DD}).

The Challenge of Source Variability and Volatility

Battery-dependent electronics have the challenge of dealing with a variable voltage source. The graph in Fig. 1 illustrates how the voltage of batteries diminishes under a constant current draw and how a fluctuating current draw can affect the supply voltage [1].

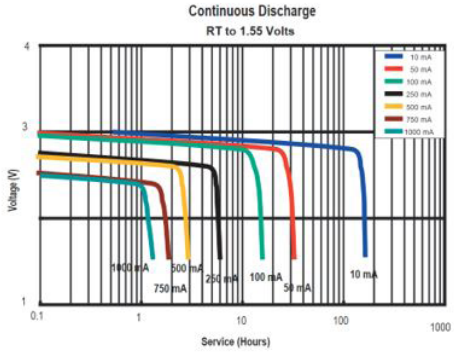

Fig. 1. Duracell Li/MnO2 2/3A voltage over time

As the device is used over time, the voltage will slope downward at various rates, depending on the battery technology. The operations that the processor carries out will also have an impact on the supply voltage as some operations draw more current than others.

With this challenge becoming more prevalent in the industry, Abracon has introduced a Continuous Voltage oscillator product line to address the challenge. Table 1 overviews the current Abracon MHz series offerings.

Table 1

SERIES	PACKAGE SIZE (MM)	FREQUENCY (MHZ)	SUPPLY VOLTAGE (V)	TYP. SUPPLY CURRENT (MA)	FREQUENCY STABILITY OPTIONS (+/- PPM)
ASADV	2.0 x 1.6 x 0.8	1 to 100	1.6 to 3.63	5	20 / 25 / 30 / 50 / 100
ASDDV	2.5 x 2.0 x 0.95	1 to 160	1.6 to 3.63	5	20 / 25 / 30 / 50 / 100
ASEDV	3.2 x 2.5 x 1.2	1 to 160	1.6 to 3.63	5	20 / 25 / 30 / 50 / 100

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IC Topologies

The CMOS integrated circuits within the Continuous Voltage oscillators have a voltage regulator that not only isolates the bias voltage dependency but also significantly reduces current consumption and crystal drive. This ensures a much more stable operation under varying source conditions.

There are two types of IC topologies that are used in the Continuous Voltage oscillators.

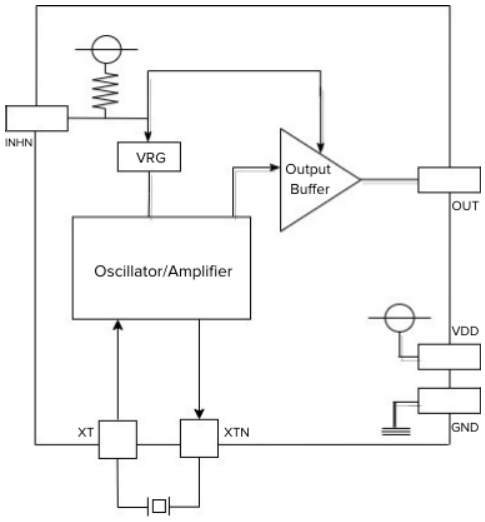

Fig. 2. IC Topology

The combination of a fundamental mode IC topology, a 3rd overtone IC topology and an internal divider chain allows for the Continuous Voltage oscillator family to reach a broad frequency range of 1 to 160MHz.

Another note to consider with respect to the Continuous Voltage ICs is that the disable current is kept to a minimum thanks to the family's tri-state functionality. When the tri-state pin is pulled low, the oscillator and CMOS output buffer cease operation. As seen in the IC topologies (Fig. 2), the output buffer is pulled up to VDD. The disable current is dictated by the internal pull-up resistor, which allows no more than 10µA draw from the source over the specified supply range.

Continuous Voltage Oscillator Performance Characteristics

The voltage regulator inside the oscillator IC ensures a tight frequency stability over the specified voltage range, as seen in Fig. 3.

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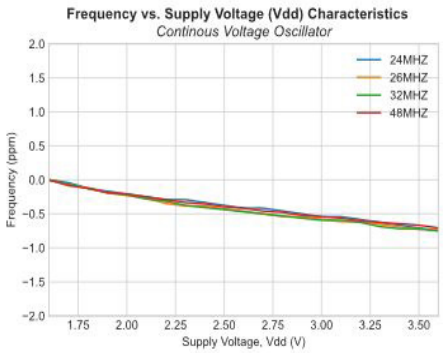

Fig. 3. Continuous Voltage Oscillator frequency deviation across a supply range

The typical frequency deviation is well within ±1ppm across the offered frequency range, which satisfies the requirements of most battery-powered applications. Keeping the current consumption to a minimum is also a priority across the Continuous Voltage oscillator family.

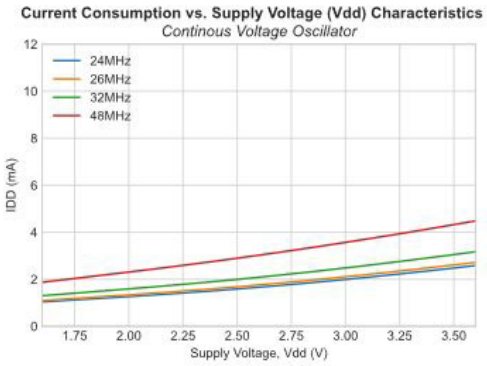

Fig. 4. Current consumption over the specified supply range

Key aspects of a robust design include maintaining a long battery life and meeting a low power system budget. The Abracon Continuous Voltage oscillators address these aspects using a low current draw oscillator IC, as demonstrated in Fig. 4. This figure shows device current draw as a function of device output frequency and V_{DD}.

The stability over temperature is also a priority metric given the automotive, aerospace, transportation, and alternative variable temperature environments that this oscillator family is expected to encounter.

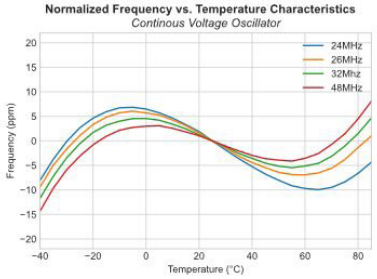

Fig. 5. Normalized frequency over temperature

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The maximum frequency deviation over temperature is specified to be at most ±25ppm, and the stability typically stays within a ±10ppm over an industrial temperature range (-40°C to +85°C), as shown in Fig. 5.

Conclusion

The ASADV, ASDDV, and ASEDV Continuous Voltage oscillator series are designed to confront the challenges of battery-powered applications. A battery is essentially a variable energy source with a depleting voltage as a function of load and usage. The CMOS integrated circuits within Abracon's Continuous Voltage oscillator family remove the bias dependency by integrating a wide-range voltage regulator. The current consumption is also kept to a minimum with tight system power budgets in mind.

The Continuous Voltage oscillators are well-suited for general MCU, USB, Ethernet, Wi-Fi, and Bluetooth IC's for computer and peripheral, local area networking (LAN), medical, test and measurement, industrial control and automation, consumer electronic, and WANS designs. They make ideal clock sources for IoT and security applications such as network cameras, DVRs, access control systems, and portable and wearable devices.

These three oscillator series are available with industry-standard package sizes, stability options and supply voltages. The ASADV, ASDDV and ASEDV series are in stock and available through Abracon's global distribution network. Contact your local sales representative for more information, and visit our website to learn more about Abracon's Continuous Voltage oscillator family: https://abracon.com/continuous-voltage-oscillators.

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References

[1] Duracell, "Lithium/Manganese Dioxide Battery," DL123A datasheet, Sept. 2018. Accessed: Dec. 2021. [Online]. Available: https://www.duracell.com/wp-content/uploads/2018/09/2018-September-DL123_0918-002.pdf

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