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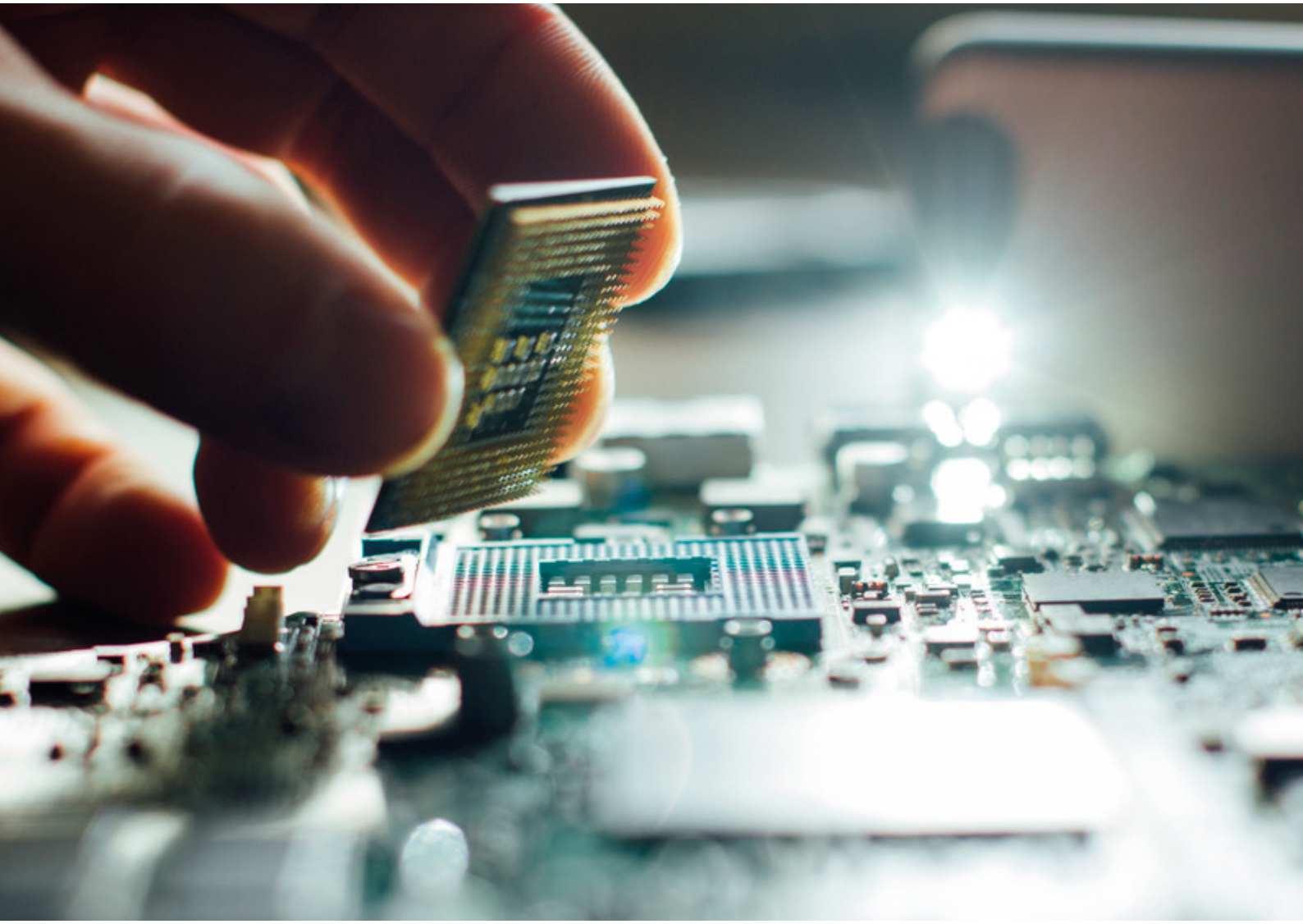
A digital designer's guide to analog products for IoT



In IoT, analog is everywhere

Although the general perception among design engineers may be that the majority of new products being developed to support the Internet of Things (IoT) are in the digital domain, it remains the case that analog will have a key role to play in the IoT for many years to come.

Analog is fundamental to the successful implementation and operation of the IoT, which means that while the complex devices that form its core rely heavily on digital technology, they rely just as much on analog for the acquisition and conditioning of raw data.

While the quality of the analog components you use is critical to the IoT, design engineers shouldn't be intimidated by how they go about getting the absolute best out of those analog components. For those who are currently unsure, this easy-to-understand guide should prove invaluable.

Well-known examples of where IoT technology is making ground include the safety and security sector, thermal management and power management. Managing the power of a building or even a city, for instance, demands efficiency, reliability, speed and adaptability. At the user end, the data needs to be presented, shared and managed digitally but behind the scenes are devices that require a significant amount of analog design. For example, most microcontroller-based systems need a fixed regulated voltage in order to operate.

Looking closer at power management, there are many analog products that are applicable to power supply applications. These include linear regulators, switching regulators, charge pumps, voltage detectors, robust power MOFSET drivers and battery chargers. The vast majority of these products are available in high-efficiency low-power devices with a small footprint which are both robust and reliable.

In safety and security applications, analog design is found in such products as piezoelectric horn drivers or smoke detectors while thermal management requires analog-based temperature sensors, fan speed controllers and fan fault detectors.

The importance of analog

While digital IoT edge devices might be capable of handling many tasks simultaneously, analog sensors are often limited to one signal-enhancement function. However, it is the accuracy of analog that cements its importance in the IoT, which is why today's designers have to be capable of working in an integrated analog and digital environment.

Typically, analog IoT signals relate to infinitely changing parameters such as temperature, light, pressure, proximity, speed and touch, as well as phenomena such as fluids and liquids including smoke, gases and more.

To design IoT devices that interact with analog signals, designers need to consider signal-to-noise ratio (SNR), data conversion and filters in the knowledge that successful operation of the IoT depends heavily on devices such as analog to digital converters (ADCs), digital to analog converters (DACs), voltage amplifiers and various types of filters.

When collecting data on such factors as pressure, temperature, vibration and light, it is important to ensure signal accuracy before the data is moved into the digital domain. As mentioned above, to achieve the best SNR, it is essential to design a low-noise analog front-end and an ADC capable of capturing sensor signals with a high level of accuracy. Meanwhile, the best circuit performance relies on the choice of all parts, from operational amplifiers to voltage references.

Six major groups of the IoT portfolio

Strong analog technology portfolios aims to solve common and complex problems while also helping to reduce design time, with low-power, high-voltage and space-saving solutions offering smart integration capabilities. Built to be straightforward for digital designers to use, the products are ideal for such end-use applications as home automation, utility metering, automotive, computing, aerospace and defense, medical equipment and appliances—even at low power and low voltage.

Deciding on the right products is obviously an important step, but there are also various support services available throughout the product development cycle that aim to ensure developers not only choose the most appropriate and up-to-date products but also that they get the correct types of services that enable them to bring competitive solutions to market within shorter timeframes. There are six major groups in which these fall:

THERMAL MANAGEMENT

POWER MANAGEMENT

MIXED SIGNAL DEVICES

LINEAR PRODUCTS

SAFETY AND SECURITY DEVICES

INTERFACE PRODUCTS

THERMAL MANAGEMENT

With smaller form factors and higher performance every day, thermal management is becoming an increasingly important topic at the board level. For maximum integration, technology companies like Microchip offer motor drivers with integrated LAN receiver, comparator, voltage regulators and op amps, as well as digitally enhanced power analog (DEPA) products. Microchip's ADCs and temperature sensors are available in small packages, like SOT-23 Advanced architectures ensure maximum accuracy. For example, the blend of low-power, small packages, cost effectiveness and high accuracy for AEC-Q100-qualified temperature sensors can make them strong contenders for connected automotive applications.

POWER MANAGEMENT

Power management is vital in a world driven by smaller devices reliant upon batteries that require efficient power consumption and precision. For designers, strong power management solutions must offer built-in intelligence, highly efficient power conversion, low drop-out linear voltage regulators and high efficiency switching voltage regulators. Voltage supervisor and voltage reference products monitor system voltages to eliminate problems during operation. On power-down, the supervisor monitors the power supply voltage and resets the system if the voltage falls below a predetermined level. On power-up, the supervisor holds the system in reset until the voltage has stabilized. Several families of series and shunt voltage references are available, with options for high-accuracy, low-noise and general purpose use. These devices provide a stable reference for a variety of data conversion and signal conditioning applications.

MIXED SIGNAL DEVICES

Designing mixed signal and analog presents many more complications versus some digital designs. Rather than mixed signal designers pitching things over the wall to a digital team, having access to signal chain solutions with complete packages for sensor signal conditioning and data acquisition applications allows for a much more collaborative, and quicker, time to design. Like many products in the portfolio, they combine space-saving with low power, precision and low system cost as well as ease of integration through reduced component count. Other features include a low cost to performance ratio, the lowest supply current op amps for a given gain-bandwidth product, and highly accurate delta-sigma ADCs and high-speed pipelined ADCs.

LINEAR PRODUCTS

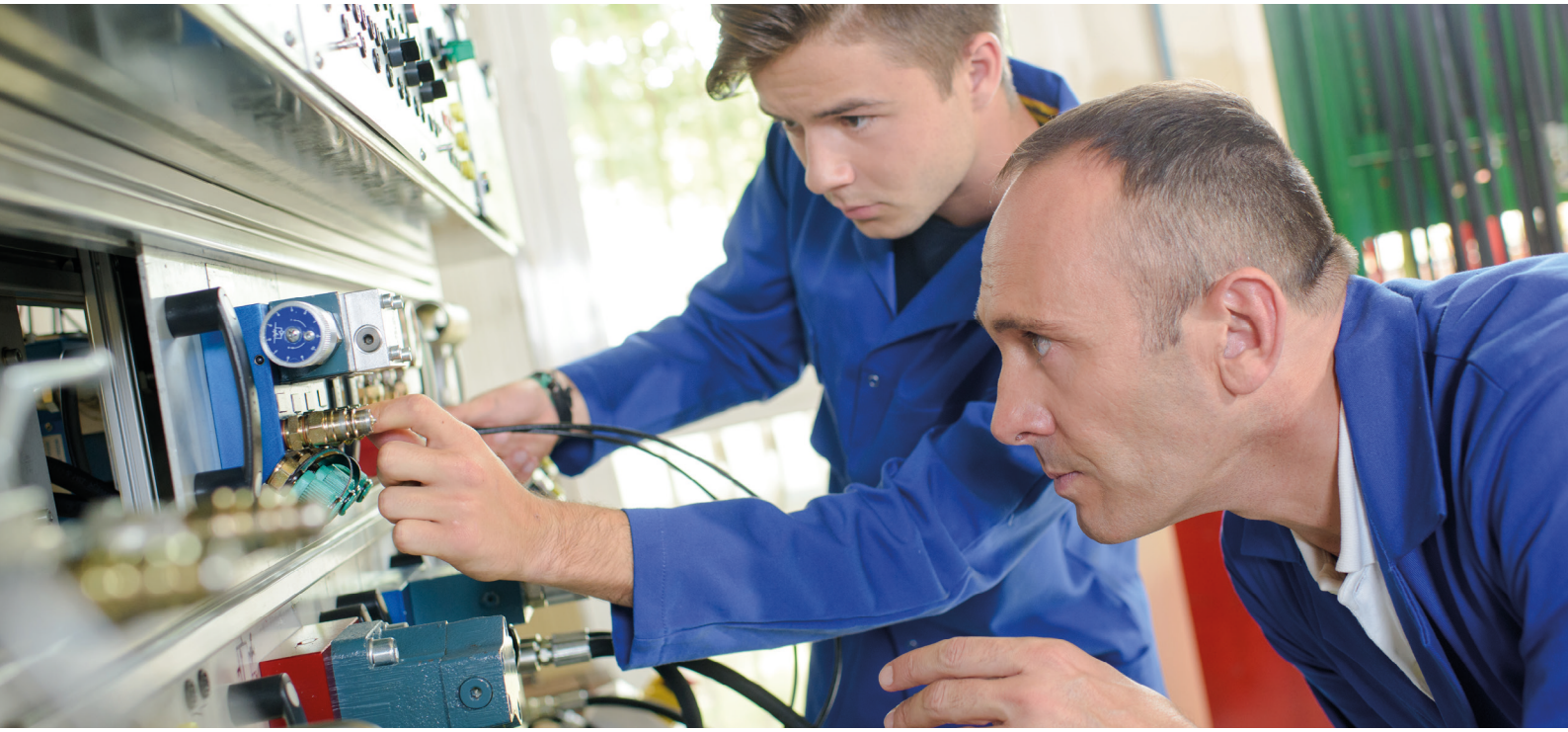
For space-saving, Microchip's ADCs, op amps, comparators and LDO linear voltage regulators are available in SC70 format. Microchip's LDO regulators feature ultra-low quiescent current, ultra-low dropout voltage, ultra-high ripple rejection, very accurate output, fast transient response, a wide selection of packages and a wide input voltage range. The MIC5306, for example, provides ultra-fast transient response while offering 16µA operating current, output accuracy of ±1%, 45mV dropout at 100mA and Input voltage ranging from 2.25V to 5.5V.

SAFETY & SECURITY DEVICES

Smart buildings and cities rely on IoT-backed safety and security solutions to help provide connection while still protecting many non-connected things. Take CO_2 or smoke detection—these applications can benefit widely from ionization smoke detector ICs, ionization smoke detector front ends and even photoelectric smoke detector ICs as well. Strong portfolios in these areas like Microchip's provide low battery and reverse battery protection as well as low power operation for smoke detection and even power management systems, boost regulators and bidirectional interconnect for CO_2 detection.

INTERFACE PRODUCTS

Interface products vary widely, from CAN, CAN FD, LIN transceivers and system basis chips as well as Ethernet and RF peripherals, USB bridge devices and GPIO expanders. In the IoT, RF front-end solutions from the company are ideal for a range of communication applications, covering Wi-Fi operating at 2.4GHz and 5GHz as well as Bluetooth and ZigBee at 2.4GHz. Benefits of using the Wi-Fi devices include high power for longer distances, lower DC power consumption, low external component count and highly integrated front-end modules.



Take the next step on your path to analog

Although the emphasis tends to focus on digital design for the IoT, there is still and always will be a portion of design that has to interface with the analog or real world. That's why as designers go through the iterative process of developing and tweaking their designs, they should always maintain a strong focus on the analog 'backbone' of the IoT and devote a large percentage of their time to understand how to enhance the analog features in new and existing products and systems.

Whatever the level of expertise, engineers should not be intimidated when it comes to selecting the correct analog part for a particular application. To support this, the Microchip Treelink tool provides an encompassing overview of all Microchip Technology's analog and interface products, enabling designers to create complete systems while streamlining the design process and lowering design risk.

The products and development tools available from Microchip and Avnet have been created to enable customers to create optimal designs which reduce risk while lowering total system cost and time to market. When it comes to very edge of IoT, trust Microchip and Avnet as your path to analog.

LEARN MORE ABOUT AVNET & MICROCHIP'S ANALOG SOLUTIONS AT AVNET.COM/ANALOG

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