Maxim's MAX22530 is Ideal for Integrated Self-Powered Isolated ADC Applications

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Industrial systems with analog-to-digital converters (ADCs) contain thousands—or more—of integrated connections. The plant's overall equipment effectiveness (OEE) is dependent on these connections working in concert to flow electricity predictably. A fault in any one of the massive number of connections can cause downtime, along with substantial person-hours lost to diagnosing the current abnormality. It is critical to monitor the signal to protect against this type of failure. In addition, power and data isolation can prevent faults by separating high- and low-voltage circuits. Along with reducing or eliminating downtime, this isolation protects machine and equipment operators and the surrounding environment.

MAXSafe™ is a new system architecture that simplifies diagnostic monitoring while providing isolated power. As the **first integrated isolated micropower architecture** in the industry, MAXSafe employs a proprietary isolation approach that uses a DC-DC converter to supply power from the lower-voltage logic side to the higher-voltage field side. Implementing this approach makes the costly, large-footprint power supply that augments the power supply during low field-side power demand periods obsolete. Its small footprint ensures that MAXSafe consumes 4x less space than traditional isolated power sources and boasts a greater than 2x increase in channel density. MAXSafe by Maxim Integrated is the choice for isolated power coupled with diagnostic monitoring.

Complex System Architectures Hinder Diagnostic Monitoring

Diagnostic monitoring is essential to identify the location of a fault rapidly. Popular ADC applications are challenging to monitor because of the interdependencies of the systems. These use cases are:

- Substation automation
- Distribution automation
- Process automation
- Precision motion control

Each of these complex ADC systems presents a significant and unique opportunity for monitoring. Plant equipment, running multiple steps continuously with changeovers sometimes built into the automation, must be monitored to ensure the process runs smoothly. Rather than reacting and rapidly repairing a failure, it is much more efficient to predict and prevent an upcoming equipment fault. In doing so, you could schedule the repair during routine machine maintenance to avoid shutting down the equipment a second time to fix an unplanned repair.

The above applications are described next in more detail to illustrate the problem to solve:

Substation Automation

Substation automation provides:

- Automated and manual supervisory control
- Local and system-level alarms
- Direct fault location diagnostics
- Machine-driven interlocking
- Improved information management with automated retrieval from the substation

It also contains automatic switching sequences, and it supports third-party supervisory control and data acquisition (SCADA) technology. The combination of manual and automated tasks creates a highly complex and challenging monitoring opportunity.

Distribution Automation

Distribution automation refers to the **technology needed** to collect, automate, analyze, and optimize data to enable the power distribution system to improve its operational efficiency. These systems automatically balance the electrical loads on the distribution system to maximize machinery utilization, automate interconnected capital equipment, and shift the distribution and demand to an optimized state. Calibration and certification equipment, along with IT networks, are also part of a distribution automation system.

The variable voltages and currents and the potentially competing optimization objectives network components increase the complexity of monitoring to diagnose or predict a failure.

Process Automation

Process automation is the use of technology to automate repeatable tasks. Simple in concept, the applications best suited for process automation require high levels of consistency at each site. Repeatability is also a critical pillar in enabling process automation. The process has to have sufficiently random data trends, the data must be within specification limits, and free from errors that put the process out of control.

The high-quality nature of the data and needed process capability typically requires significant amounts of capital equipment. The

more integrated the capital, the more challenging it is to monitor the many integrated connections.

Precision Motion Control

Precision motion control automatically guides the position of the active machine's components. The machinery's ability to take digital information and translate it into physical motion **enables high-speed automation** for a given process. This type of motion control drives out inefficiency because of heat loss and power consumption, resonance, audible noise, diagnostics without sensors, and battery life.

The sensitivity and interdependence in controlling one of these systems with the others creates significant complexity, outlining the need for an improved monitoring solution to ensure the above events can be optimized for performance.

All of these ADC applications could benefit from a solution that simplifies diagnostic monitoring while providing isolated power.

Application Focus: 4-Channel MUX ADC

The complex system architectures we've described carry a challenging opportunity for system monitoring. A solution that addresses the ability to manage complex integrated ADC applications while providing isolated power is the Maxim Integrated **MAX22530 Self-Powered Isolated ADC**.

A substation automation company first commercialized a member of the MAXSafe family, 4-channel multiplexed, 12-bit ADC, the MAX22530. It contains an integrated, isolated DC-DC converter to supply power to all the field-side circuitry. This outcome ensures that the equipment can record diagnostics on the field side, even in the absence of an input signal. Engineers developed the MAX22530 to simplify the system architecture in a specialized niche market: monitoring discrete analog inputs. The features that deliver this unique performance are outlined in the following.

Enable robust detection of multichannel analog/binary inputs

Isolation is the essential design lever to protect against overvoltage and faults. It also eliminates ground loops within the network, minimizing errors and signal distortion while protecting against mismatches between voltage and ground.

The MAX22530 can withstand 3.5kVRMS isolation for 60 seconds for a shrink small outline package (SSOP) package and 5KVRMS isolation for the same timeframe for a small outline integrated circuit (SOIC) package. The product also provides 5.5mm creepage and clearance for 20- or 28-pin SSOP and 8mm creepage clearance for 16-pin wide SOIC. Providing against creepage ensures the system components do not physically interfere with each other, which de-risks the system to guard against unintended conduction paths.

Reduces BOM and board space through high integration

The most significant advantage of the MAX22530 is the field-side self-power, accomplished by an integrated DC-DC supply. This level of integration reduces the packaging footprint while significantly removing the number of interconnections. Although isolation is a powerful tool against faults, integration to minimize internal connection points can also reduce the probability of a fault by simply reducing the number of potential failure points.

The MAX22530 (**Figure 1**) contains a 12-bit, 20ksps per-channel ADC and an integrated 1.8V reference. In addition, this component offers isolation for both data and DC-DC supply, along with programmable threshold comparators for each channel to improve control for enhanced monitoring. These combined benefits are the magic behind the MAXSafe™ device's advantage.

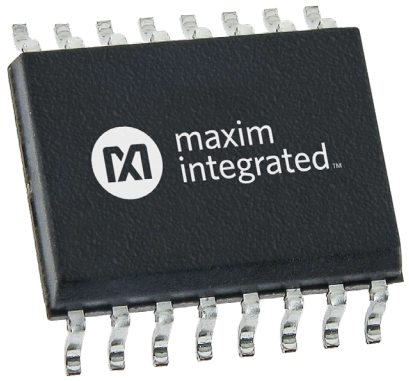

Figure 1: *MAX22530 Self-Powered Isolated ADCs*

Increase system uptime with simplified system design and maintenance

Maintaining uptime, as previously mentioned, is a primary success criterion for industrial ADC applications. The MAX22530 implements field-side ADC functionality diagnostics and continuous power monitoring. These features are fundamental to allow system operators to see and diagnose issues within the system. In addition, the component includes a self-diagnostic system for the communication system, providing vital feedback to operators without delay.

Flexible control and interface

To improve usability and ease of realizing the above features, the MAX22530's flexible control and interface moves the user closer to the action. With programmable upper and lower input thresholds, the MAX22530 enables programmable hysteresis. It includes a Serial Peripheral Interface (SPI) with optional cyclic redundancy checking (CRC) and contains precision internal reference within 1 percent nominally. The MAX22530 is constructed out of a robust material set, capable of withstanding operating temperatures between -40°C and 125°C. This wide operating range assures performance in nearly any environmental application condition.

Reception by Partner Industries

Maxim's partner industries have praised the transformative advantages of the MAX22530. The MAX22530 has found a home targeted by an impactful market niche by simplifying the system architecture while monitoring various analog inputs. Two of the partner industries are Power Monitoring and Signal Monitoring.

Power Monitoring

Implementing isolation for power monitoring is essential; protecting humans and equipment against electric shock or tangential damage is a non-negotiable safety feature. The challenge is in how to deliver that provision. The power supply must be continuous to maintain up-time, but different load conditions and voltage sources require conflicting system needs.

Given that context, operators and system engineers must know the condition of the power distribution at all times to be able to react to issues that arise. The MAX22530 enables critical monitoring while providing isolation for integrated safety. Power monitoring industries have enjoyed the dual benefits offered by this transformative component.

Signal Monitoring

Signal monitoring is another partner industry that has enjoyed the benefits from the MAX22530. The goal of isolation in this market is to prevent DC and (unwanted) AC transfer between system components while still transmitting a signal and transmitting power. The ideal solution to this challenge operates at a high magnitude of power delivery with high efficiency and low emissions. Although efficiency and emissions often go together, achieving high power delivery with efficiency is often in conflict.

The MAX22530 can overcome this conflict by the high degree of integration and wide operating range while incorporating the needed isolation. Integration reduces losses over a higher number of connection points. Each connection introduces an opportunity for loss, both at initial startup and over time because of the material degradation. Any chance to remove these losses moves the system toward a better state and can reduce system cost along with way. Furthermore, with the wide operating range, the MAX22530 reduces the occurrence probability of material degradation because of fatigue through thermal cycling or spiking outside the operating range. Environmental factors can always impact the connections' interface integrity, but appreciably reducing one such failure helps extend the expected lifetime of the materials.

Takeaway

MAXSafe is a new system architecture that simplifies diagnostic monitoring while providing isolated power. The significant product advancements of the MAX22530 leverage proprietary isolation approaches that integrate a DC-DC converter. This enhancement separates supply power between the lower-voltage logic side and the higher-voltage field-side while allowing operators visibility into the power condition. This approach eliminates the expensive, large-footprint auxiliary power supplies when the power demand in the field side is small.

Incorporating isolation is vital to protecting the safety of employees and equipment to avoid a critical fault. The disruption of a fault leads to downtime, time loss for manual diagnosis, or equipment breakage. It is essential to monitor the signal to prevent a failure of this nature. In addition, power and data isolation can prevent faults by separating high- and low-voltage circuits. Along with reducing or eliminating downtime, this isolation protects machine and equipment operators and the surrounding environment.

As the partner industries of power and signal monitoring can attest, the dual benefit of isolation with integrated monitoring capability has transformed each market. The MAX occupies a quarter of the space of traditional isolated power sources while doubling the channel density. MAXSafe by Maxim Integrated is the choice for isolated power coupled with diagnostic monitoring.