*Technical Article*

# *Upgrade Your Explosive Atmosphere Designs with IECEx-certified Digital Isolators*

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Explosive atmospheres or environments with the potential for the ignition of combustible sources pose an inherent challenge for the safe operation of critical machinery in industries such as oil refineries, sawmills and chemical plants. These environments produce flammable gases and dust that when combined with oxygen and an ignition source can cause an explosion.

To help reduce the risk of such an event, the International Electrotechnical Commission (IEC) has a set of standards within IEC 60079 to protect equipment used in explosive environments. The IEC system for certification of a standard relating to equipment for use in explosive atmospheres is known as IECEx, with the “Ex” label applied to any components or equipment certified and used in such environments.

Although in this article I will mostly focus on IECEx certification, there are also regional versions of the certification, such as Atmosphère Explosible (ATEX) in Europe, that are mostly identical to IEC standards. Part 0 of the international standard (IEC 60079-0, European Norm [EN] 60079-0) covers the general requirements, while Part 11 (IEC 60079-11, EN 60079-11) covers equipment protection by intrinsic safety “i.” Intrinsic safety is a type of protection where restriction of the electrical energy in a system is designed to remain under a level capable of causing an ignition through sparks or heat.

To help meet these requirements, engineers can implement features into their designs such as signal isolation. Signal isolation is an important part of many applications found in explosive environments, such as field transmitters and programmable logic controllers (Figure 1), and is used to improve communication reliability by breaking system ground loops or helping restrict the electrical energy in hazardous environments.

**Figure 1. A programmable logic controller in a factory environment**

### Implementing IECEx-certified digital isolators in explosive environments

While designers have typically turned to optocouplers, also known as optoisolators, for data isolation in explosive environments, digital isolators have emerged as a more performance-optimized approach now that devices are available that were designed to meet the stringent requirements of the IEC 60079. While in the past, most digital isolators could not meet the stringent certification requirements for IECEx and ATEX certifications, that's no longer the case.

Now that both optocouplers and digital isolators can achieve IECEx and ATEX certification, how do they compare? To provide a comparison, I will use our ISO7041 and ISO7021 digital isolators for reference. Both devices can help designers reduce the explosive potential of their systems. Learn more about key requirements of these standards when designing for explosive environments in the application report, "Intrinsic Safety Compliance of Digital Isolators in Explosive Atmospheres."

### Comparing IECEx-certified digital isolators and optocouplers

At 10 kbps, all four channels of the ISO7041 consume less than 20 µA, enabling you to redistribute the power saved (compared to an optocoupler solution) to other systems in order to improve functionality or add features. Optocouplers typically consume a minimum of 6 mA (10 mA typical) at the device input and several additional milliamps on its output. It is possible to source lower-power optocouplers that consume about 1 mA to 2 mA per channel, but these devices will increase costs. A two or four-channel digital isolator can operate at up to 4 Mbps per channel while consuming very low power for simple two-way communication. This opens up new data-transfer possibilities and capabilities compared to a typical optocoupler, which can only operate at around 100 kbps. Higher-speed optocouplers are available, but they come with the trade-offs of higher power consumption and cost.

Digital isolators also provide a more compact design and a lower package height. The ISO7041 offers four channels of data isolation across 17.5 $mm^2$ of area with a height requirement of 2.5 mm, whereas an optocoupler could consume as much as 50 $mm^2$ depending on the number of data lines.

Digital isolators like the ISO7041 and ISO7021 that use TI's capacitive isolation technology, where the high-voltage silicon dioxide capacitors provide a high level of isolation and are constructed in a well-controlled semiconductor process, offer very low device variation. In contrast, optocouplers can have significant

manufacturing variability and no TDDB (time-dependent dielectric breakdown) requirement, which is a rigorous and standardized dielectric lifetime assessment.

You can learn more about the device reliability and size advantages of digital isolators in field transmitter designs when compared to optocouplers in the application note, "How to Isolate Two-Wire Loop-Powered Field Transmitters."

If you've been designing with optocouplers and are ready to consider a digital isolator, Table 1 provides the safety or entity parameters and temperature ratings by application scenario for the ISO7041 and ISO7021, based on the ambient temperature range and maximum input power available on each side of the isolation barrier.

**Table 1. Entity parameters and temperature ratings for digital isolators**

| Device | Application (1) | Entity parameters side 1 | Entity parameters side 2 | Ambient temperature | Maximum component temperature |
|---|---|---|---|---|---|
| ISO7041 | IS to IS: case 1 | Ui = 50 V Ii = 300 mA Pi = 1.3 W Li = 0 H Ci = 4 pF | Ui = 50 V Ii = 300 mA Pi = 1.3 W Li = 0 H Ci = 4 pF | –55°C to +70°C | 194.3°C |
| ISO7041 | IS to IS: case 2 | Ui = 50 V Ii = 300 mA Pi = 1.1 W Li = 0 H Ci = 4 pF | Ui = 50 V Ii = 300 mA Pi = 1.1 W Li = 0 H Ci = 4 pF | –55°C to +85°C | 183.1°C |
| ISO7021 | IS to IS: case 1 | Ui = 50 V Ii = 300 mA Pi = 1.3 W Li = 0 H Ci = 4 pF | Ui = 50 V Ii = 300 mA Pi = 1.3 W Li = 0 H Ci = 4 pF | –55°C to +85°C | 183°C |

(1) Intrinsically safe to intrinsically safe (IS to IS)

Since the maximum component temperature of the ISO7041 and ISO7021 in each scenario above is <200°C, these digital isolators are a good fit for equipment rated to temperature classes T3, T2, or T1 within the specified ambient temperature ranges.

Because certified digital isolators enable you to reallocate the power budget for the rest of the system while providing longer lifetimes and increased reliability, they're an exciting option for complicated and design-limited applications in explosive environments. If you design systems like these and are considering using a digital isolator approach for the first time but have questions, we can help. Post your need or question in our Isolation forum, and one of our engineers will be in touch.

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