



**Smart Building** and **Smart Home** are contemporary terms used to describe built structures that employ automated control systems to manage their environmental, lighting, security and other facilities. By extension, the term **Smart City** is used to describe a larger metropolitan area comprising multiple smart buildings and homes which may also use elements of these automated systems for larger scale facilities management (traffic flow, electricity, water treatment etc.) Commonly referred to as Building Automation and Control Systems (BACS), their goal is to improve operational efficiency by reducing building energy consumption, while also enhancing the safety and comfort of its occupants. BACS, which are typically controlled using digital controllers that closely resemble the Programmable Logic Controllers (PLC) units found in Industrial systems, are made possible through the recent convergence of smart sensors and actuators, networking protocols, and software configurability.

Maxim provide the key enabling technologies to build a complete BACS. These include:

- Digital and Analog Inputs to monitor a wide array of sensors (temperature, humidity, and pressure etc.)
- Digital and Analog Outputs to drive a variety of actuators (damper controllers, solenoids and valves)
- Communications Interfaces (RS-485, CAN, Home Bus) for data and control signaling
- Isolators for safety and also to protect low voltage electronics from high field-side voltages

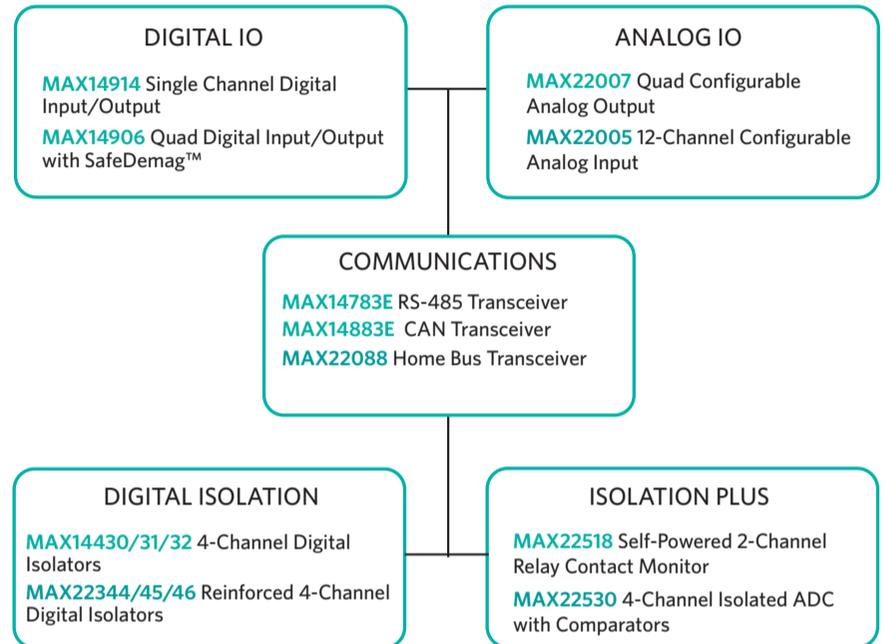


Figure 1. BACS Key Enabling Technologies

## ANALOG IO

In BACS, Analog Input and Output ICs are used to monitor and precisely control the state of continuously varying environmental variables for example temperature, humidity, lighting and gas levels.

### Analog Output

The **MAX22007** (Figure 2) is a 4-channel Analog Output in which each channel can be independently configured using software to operate in either current or voltage mode. With factory calibrated output with total unadjusted error of <1% from -40C to 85°C, this IC provides better accuracy in a smaller footprint than discrete solutions.

**Key Benefits:**

- 0 to 10.5V analog voltage or 0 to 21mA analog current output
- Integrated comparator to determine load impedance
- Robust:  $\pm 42V_{pp}$  protection on all output ports and  $\pm 1kV$  surge protection on input ports with  $5k\Omega$  resistor
- Integrated diagnostics including thermal monitoring and shutdown protection

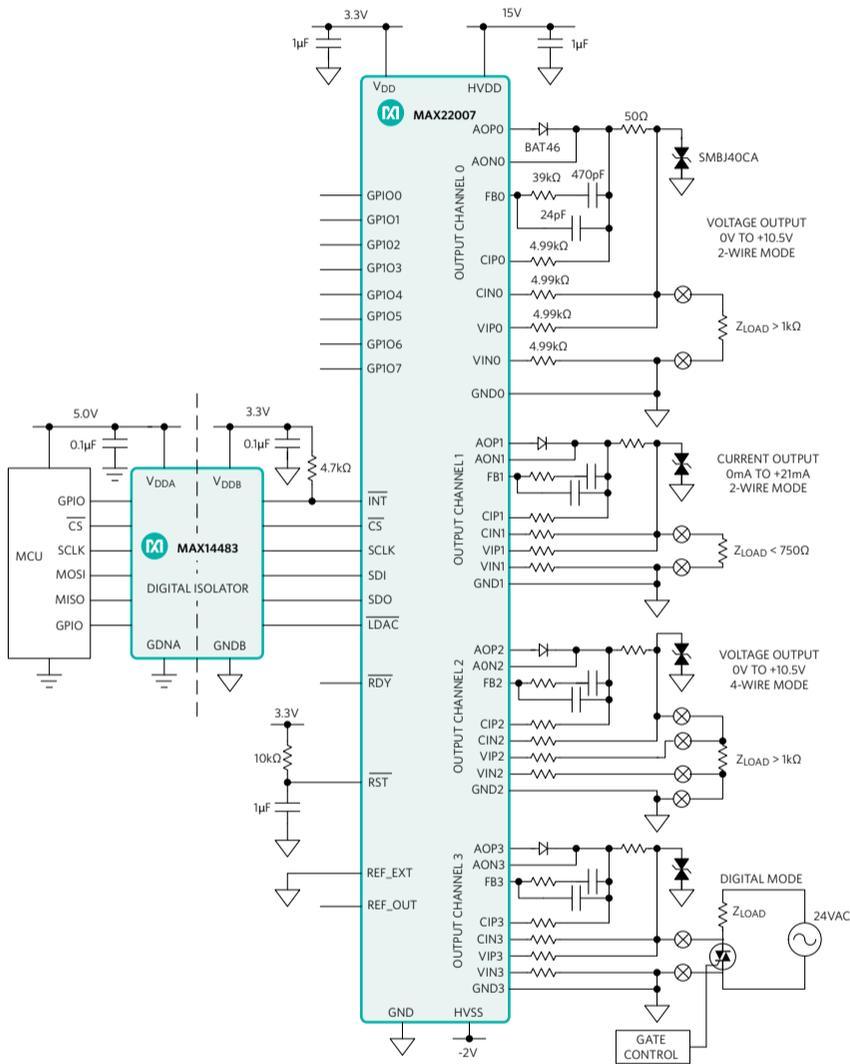


Figure 2. MAX22007 Configurable Analog Output demonstrating multi-mode application

**Analog Input**

The **MAX22005** 12-channel industrial-grade analog-input IC (Figure 3) can operate in both voltage and current mode. It provides 12 single-ended, 6 differential, 4 configurable inputs or any combination thereof.

**Key Benefits:**

- Software configurable channels function as  $\pm 12.5V$  voltage or  $\pm 25mA$  current mode analog inputs
- Choice of internal or external voltage reference
- Robust  $\pm 36V$  protection on all ports

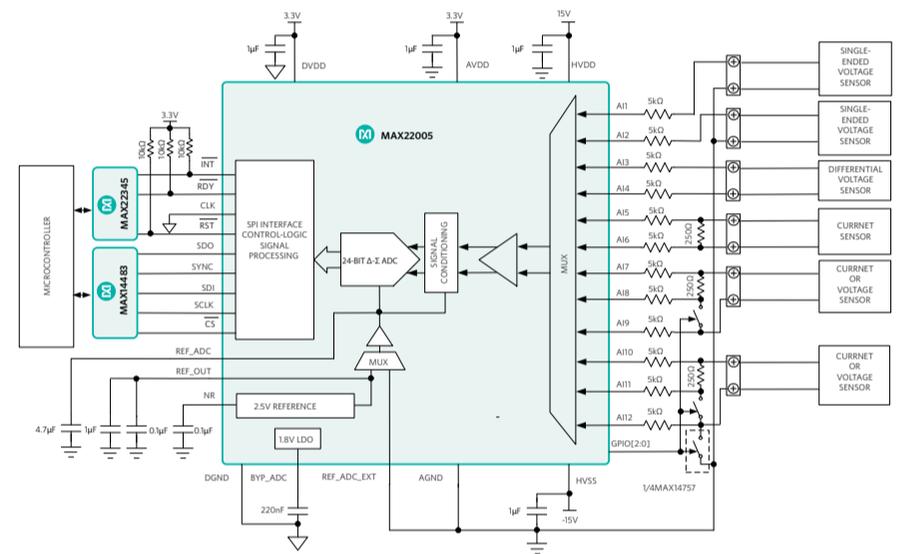


Figure 3. MAX22005 12-Channel Configurable Analog Input Application Circuit

**DIGITAL IO**

Digital Inputs and Outputs can be used at multiple locations within a BACS e.g. in a security sub-system monitoring building entrances/exits or as part of fire detection and sprinkler activation system.

### Configurable Digital IO

The single channel **MAX14914** and quad channel **MAX14906** (Figure 4) can be configured to operate either as a digital input or as a digital output (high-side or push-pull). Both devices provide space and power savings while offering robust protection against ESD and surges. These ICs integrate several diagnostic features that enhance overall end system reliability.

Key Benefits:

- Flexibility to configure each channel independently as a digital input or digital output
- Open-wire/open-load detection and supply monitoring
- Thermal shutdown protection
- SafeDemag™ enables controlled discharge of any size inductive load

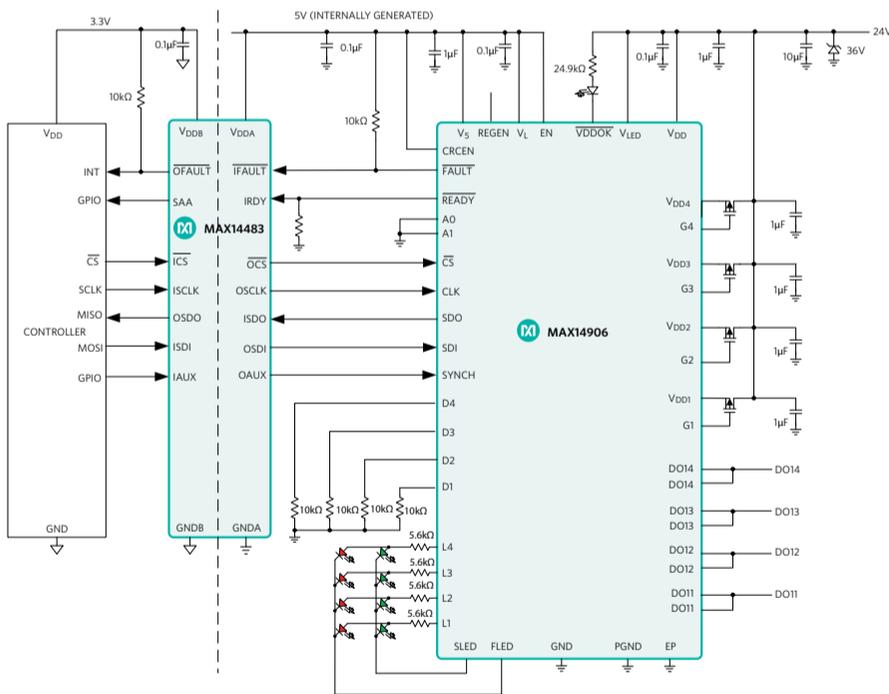


Figure 4. MAX14906 Quad-Channel Industrial Digital Output/Digital Input

### ISOLATION

For safety reasons, double isolation is a regulatory requirement in systems that require direct human contact. Reinforced isolators have the same protective effect as double isolation, making them suitable for use in BACS.

#### Galvanic Isolator

**MAX22344**, **MAX22345**, and **MAX22346** (Figure 5) are 4-channel, 3.75kV<sub>RMS</sub> reinforced, low-power digital galvanic isolators which use Maxim's proprietary process technology to provide data transfer rates up to 200Mbps. Two independent voltage supplies operate between 1.71V and 5.5V, providing logic translation in addition to the required galvanic isolation for safety.

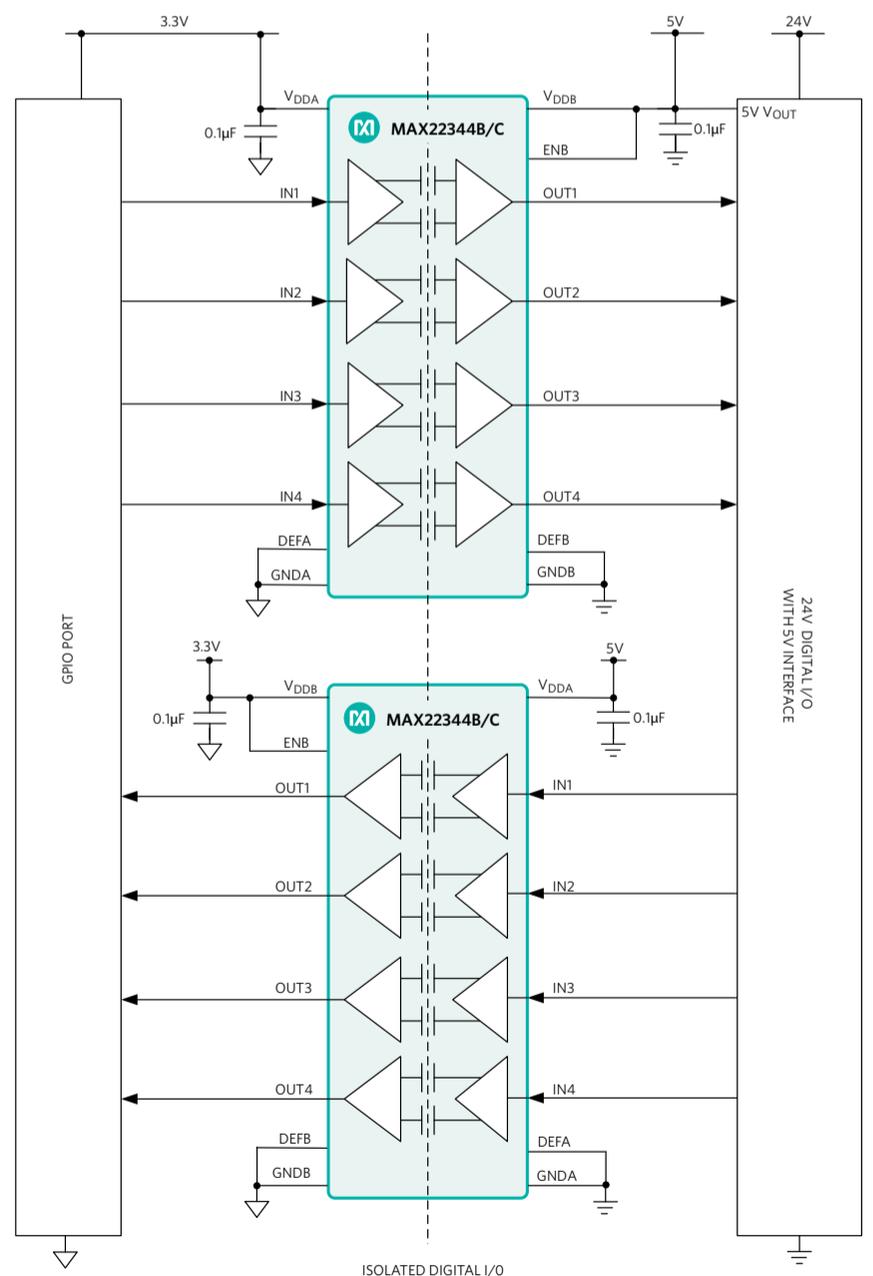


Figure 5. Reinforced Digital Isolators in Digital IO Application

## RELAYS

### Dry Contact/Relay Monitor

The **MAX22518** (Figure 6) is a dual-channel isolator with an integrated DC-DC converter. Requiring only a single 3.0-5.5V logic-side supply, it eliminates the need for a bulky and expensive field-side power supply.

Key Benefits:

- Simplifies design with no requirement for field-side supply
- Field-side operates up to 24VAC with external resistor making it ideal for monitoring low-voltage AC or DC (including relay contacts)
- Basic isolation rating of 3.5kV<sub>RMS</sub>

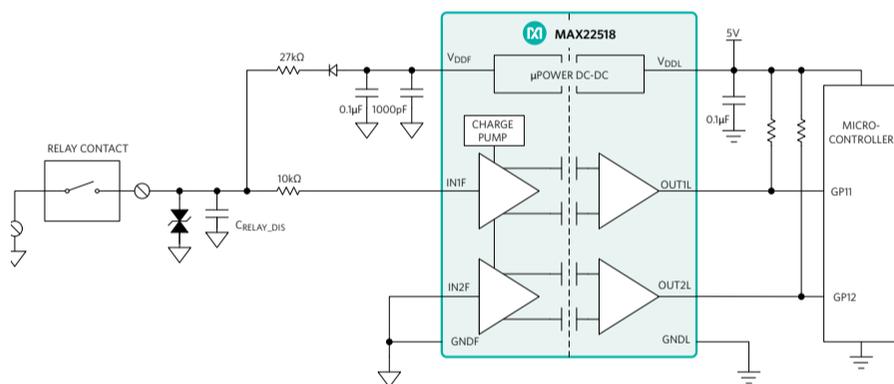


Figure 6. Single-Channel Relay Contact Monitoring with MAX22518

### 8-Channel Relay/Load Driver

The **MAX4896** (Figure 7) is an 8-channel relay and load driver designed for medium voltage applications up to 50V, which can drive either latching/non-latching or dual-coil relays. It provides open-load and short-circuit fault detection and also protects against inductive kickback and overcurrent conditions. Each independent open-drain output features a 3Ω (typical) on-resistance and is guaranteed to sink 200mA of load current ( $V_S \geq 4.5V$ ) when all channels are active or 410mA for each individual channel.

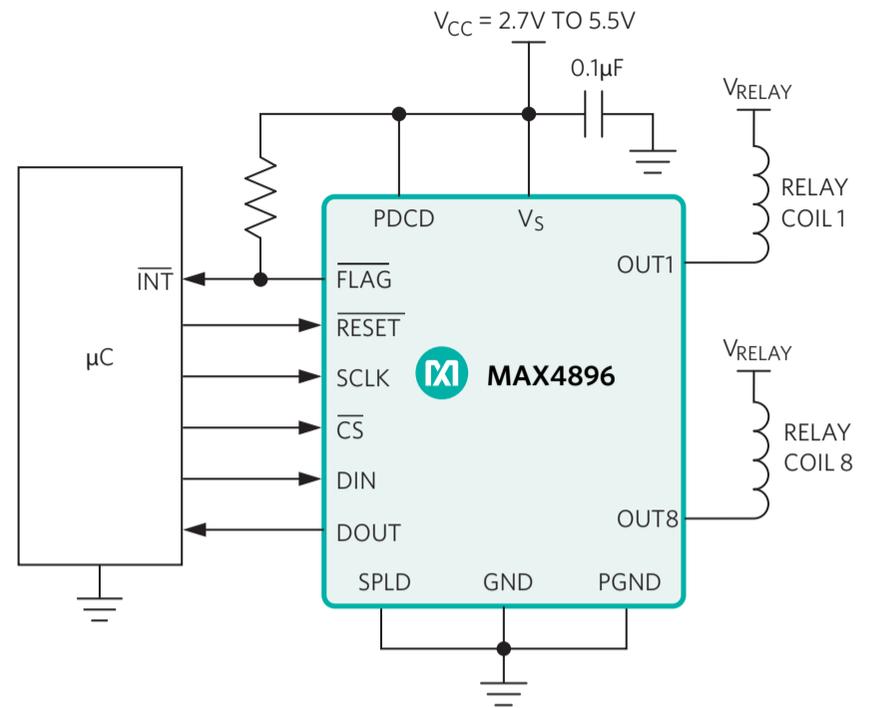


Figure 7. MAX4896 Relay Driver

### High DC Voltage Monitoring

The **MAX22530** family (Figure 8) are galvanically isolated, 4-channel, multiplexed, 12-bit analog-to-digital converters (ADC) from the MAXSafe™ family product line. An integrated, isolated, DC-DC converter powers all field-side circuitry enabling field-side diagnostics even in the absence of an input signal.

Key Benefits:

- Robust detection of multi-channel inputs with integrated data and power isolation
- High integration eliminates requirement for field-side supply, reducing board space and BOM
- Flexible control and interface with programmable comparator thresholds

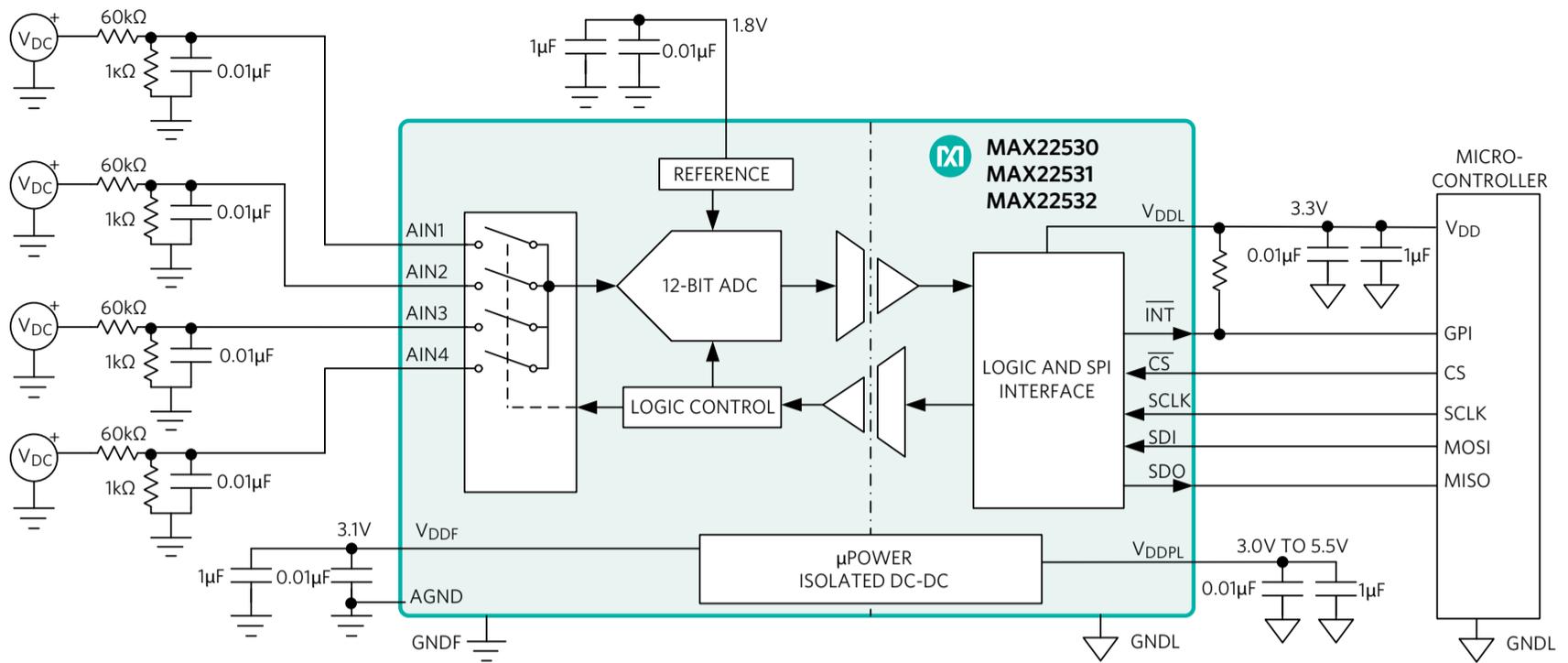


Figure 8. High DC Voltage Monitoring using MAX22530 Isolated ADC

### Quad-Channel Low-Side Switch

The **MAX14919** (Figure 9) is an industrial quad-channel low-side switch with 140mΩ (typical) on-resistance per channel and with integrated ±1kV/42Ω surge protection. It has resistor-settable current limiting that provides operating currents in the range of 100mA to 800mA. The outputs can be connected in parallel for higher load currents. The four switches are pin controlled to allow for simple and fast switching of up to 200kHz. Reverse-current detection prevents damage against load-supply miswiring faults, while the switches are short circuit and overload protected. Inductive loads can be rapidly discharged using the internal high-voltage clamps.

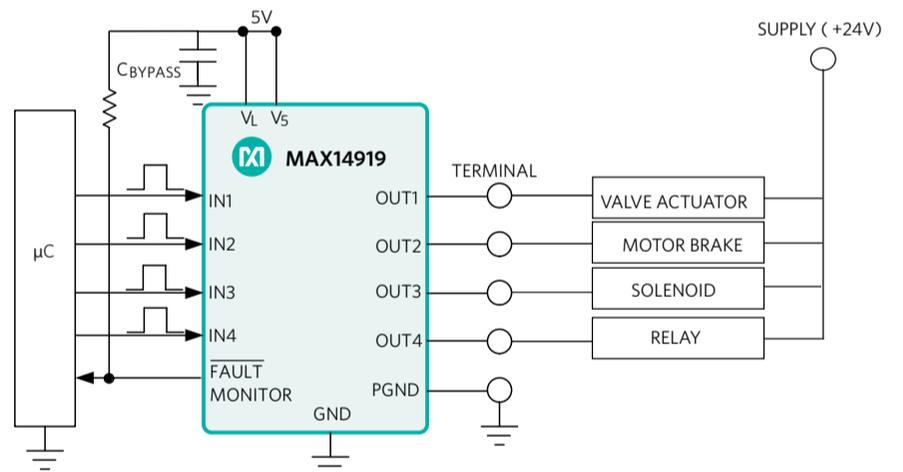


Figure 9. MAX14919 Quad Low-Side Switch

## ROBUST COMMUNICATIONS

BACnet, Profibus, Modbus, and Home Bus are networking protocols commonly used in BACS. Maxim provides a comprehensive portfolio of transceivers to provide robust and reliable data protocol signaling at the physical layer.

### RS-485

Maxim's range of **RS-485** products include half duplex, full duplex, isolated-data, and fully integrated modules like the **MAXM22511** (Figure 10) that provide full data and power isolation in a single package. All transceivers integrate high levels of ESD protection to help reduce board space while maintaining robust performance.

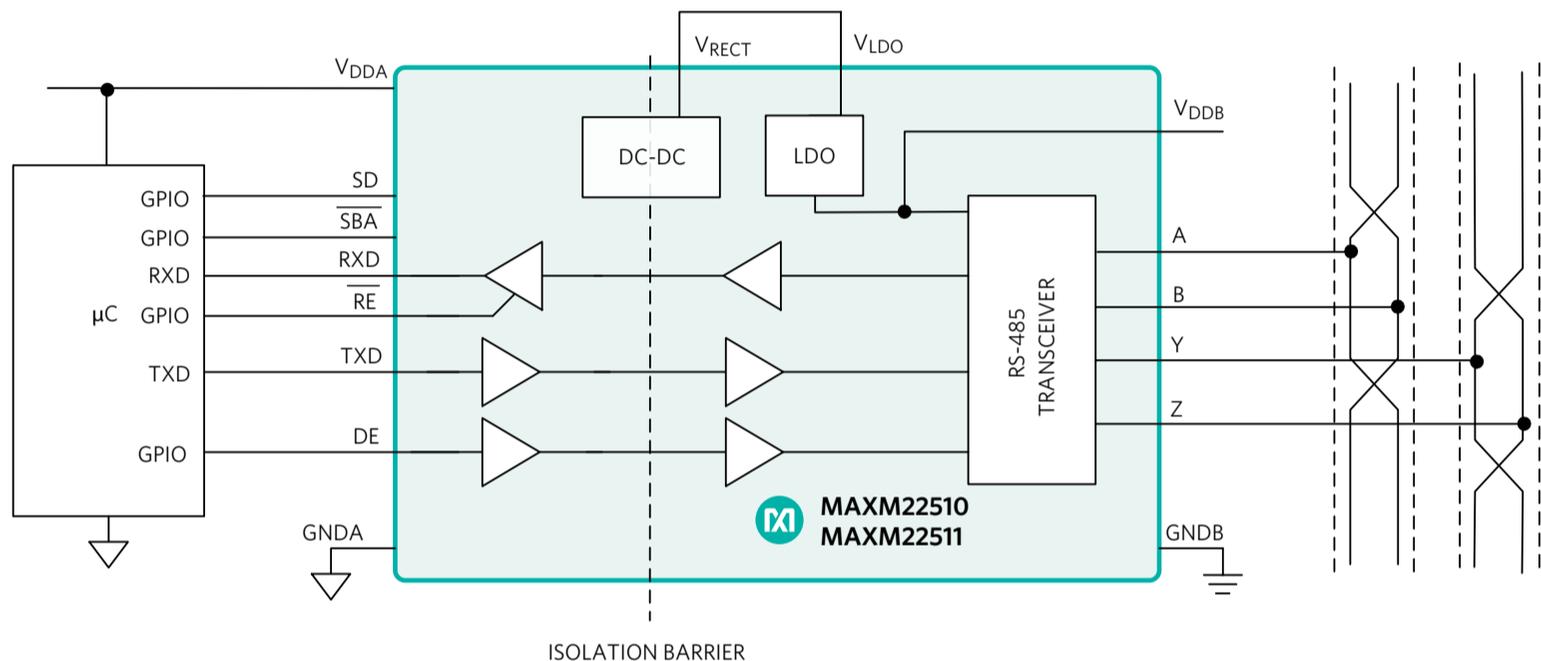


Figure 10. MAXM22511 Isolated RS-485 in Full-Duplex Configuration

### CAN

A controller area network (CAN) is a two-wire, half-duplex, high-speed serial network, typically used to provide communications between network nodes which can operate independently of the main system microcontroller. CAN transceivers act as the interface between a controller and the physical wires of the CAN bus. Maxim's portfolio of **CAN transceivers**, which includes the **MAX14883E** (Figure 11), provide high ESD and fault protection, in addition to polarity selection to reduce down-time caused by installation errors. The **MAX14878** includes integrated isolation for enhanced robustness.

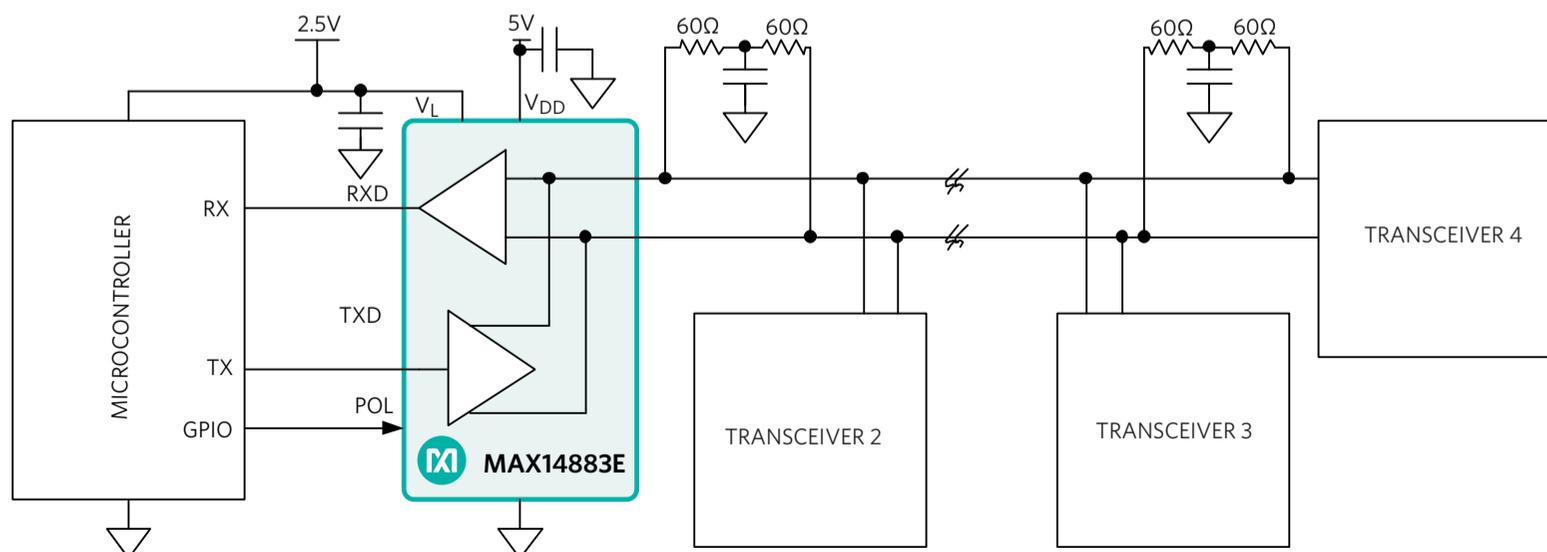


Figure 11. MAX14883E CAN Transceiver with Polarity Select

## HOME BUS

The **MAX22088** (Figure 12) is a Home Bus System (HBS) compatible transceiver which uses a single pair of wires for data and power. This IC eliminates the need for the bulky external AC-blocking inductor typically required in bus powered applications. It also improves signal quality, enabling longer cables runs.

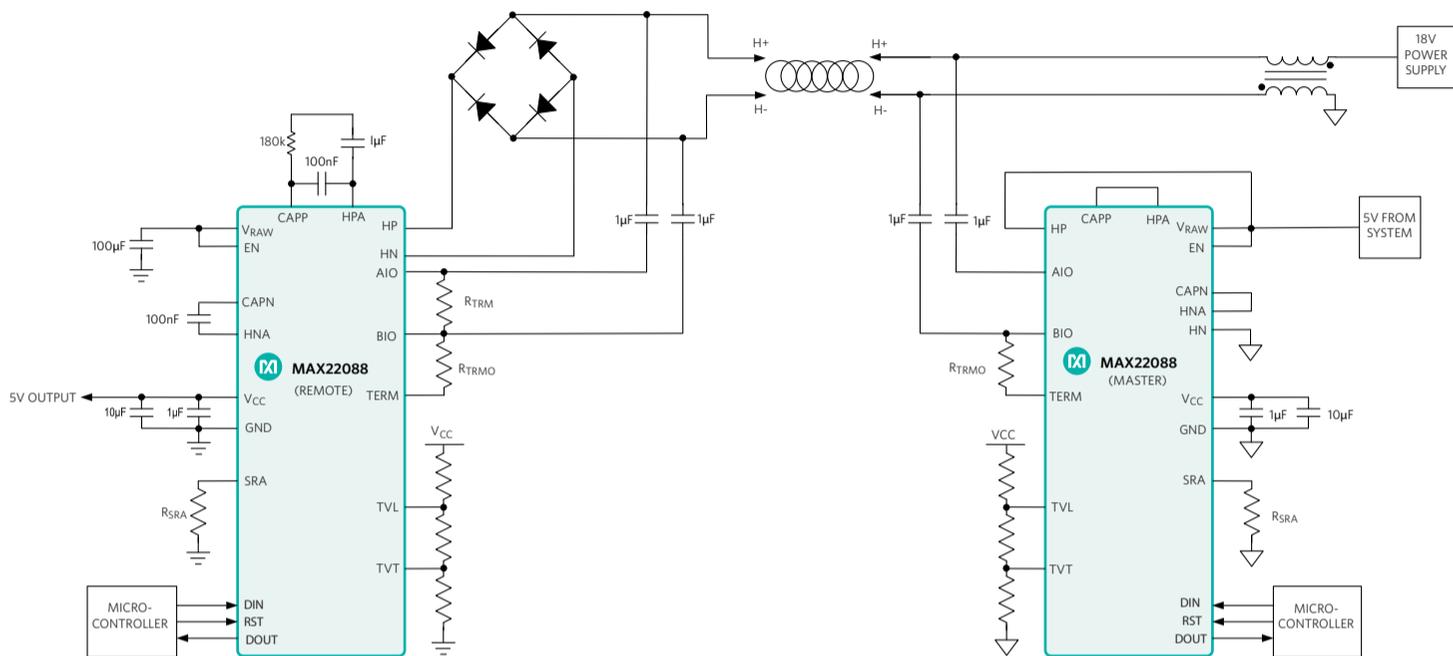


Figure 12. Complete Home Bus System using MAX22088

### Transceiver Product Selector for Building Automation

Interface	Device	Device Description	Evaluation Kit
RS-485	<a href="#">MAX14783E</a>	High-Speed 3.3V/5V, $\pm 35\text{kV}$ HBM ESD Protection	-
RS-485	<a href="#">MAX14775E</a>	$\pm 65\text{V}$ Fault Protected 500Kbps/20Mbps Half-Duplex Transceiver	<a href="#">MAX14775EEVKIT</a>
Isolated RS-485	<a href="#">MAXM22511</a>	$2.5\text{kV}_{\text{RMS}}$ Complete Isolated Transceiver Module with Integrated Isolated Power	<a href="#">MAXM22511EVKIT</a>
Isolated RS-485	<a href="#">MAX22025F</a>	Compact, Isolated, Half-Duplex Transceivers with Auto Direction Control	<a href="#">MAX2202XEVKIT</a>
CAN	<a href="#">MAX14883E</a>	CAN Transceiver with $\pm 60\text{V}$ Fault Protection and Selectable Polarity	<a href="#">MAX14883EEVKIT</a>
Isolated CAN	<a href="#">MAX14878</a>	$2.75\text{kV}$ , $3.5\text{kV}$ , and $5\text{kV}_{\text{RMS}}$ Isolated CAN Transceivers	<a href="#">MAX14878EVKIT</a>
Home Bus	<a href="#">MAX22088</a>	Home Bus Compliant Transceiver with Integrated Linear Regulator	<a href="#">MAX22088EVKIT</a>

## ANALOG SWITCHES/MULTIPLEXERS

### Quad Beyond-the-Rails® (BTR) Switch

The **MAX14777** quad SPST switch supports analog signals above and below the rails with a single 3.0V to 5.5V supply. It has a selectable -15V/+35V or -15V/+15V analog signal range for all switches. Each independent switch is controlled separately, making the device an alternative to opto-relays in applications that do not need galvanic isolation. Alternatively, the MAX14777 can be quickly configured as a single-supply analog input module that supports both  $\pm 15\text{V}$  voltages and 4mA-20mA current measurements. In this scheme (Figure 13), a switched 250 $\Omega$  resistor, translates the loop current to a voltage for analog measurement.

Each switch has 10 $\Omega$  (max) on-resistance and can carry up to 60mA of continuous current in either direction.

## CONCLUSION

Maxim's industrial communication products provide building automation engineers with a broad range of Analog IO, Digital IO, Isolation, and communication interfaces that combine low power, robust performance, and improved diagnostics in the smallest possible form factors

## LEARN MORE

- **MAX22005** Configurable Analog Input
- **MAX22007** Configurable Analog Output
- **MAX14914** Configurable Digital I/O
- **MAX14906** Quad Configurable Digital I/O
- **MAX22345** Reinforced Digital Isolator
- **MAX22518** Isolator with Integrated DC-DC
- **MAX22530** Isolated ADC
- **MAX14783E** RS-485 Transceiver
- **MAXM22511** Isolated RS-485 Module
- **MAX14883E** CAN Transceiver
- **MAX14878** Isolated CAN Transceiver
- **MAX22088** Home Bus Transceiver
- **MAX14777** Quad BTR Analog Switch
- **MAX14919** Quad Low Side Switch
- **MAX4896** 8-Channel Relay Driver

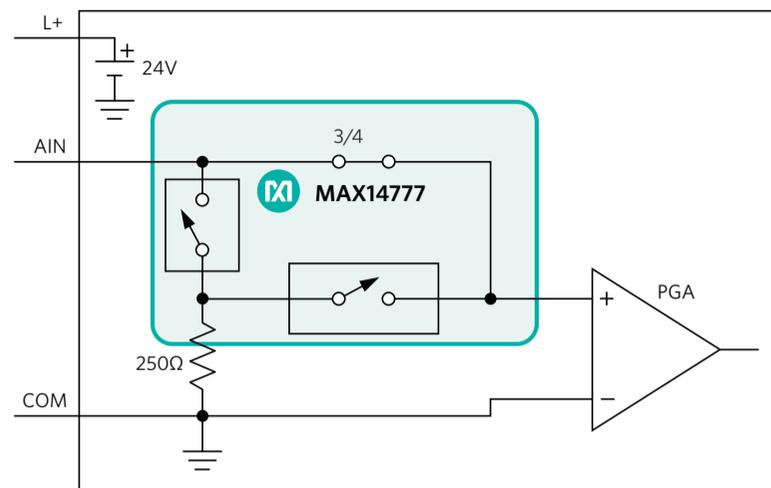


Figure 13. MAX14777 Quad BTR Switch Application Circuit

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