Product Overview

Enhancing Smart Metering with TI Multiplexers and Analog Switches

Smart meters are revolutionizing the way we monitor and manage energy consumption. At the heart of these advanced systems are multiplexers, which play a crucial role in optimizing sensor data acquisition and signal routing. This overview explores key applications of multiplexers in smart meters and highlights in demand features that allow for easy integration.

Small Size Multiplexers

Size optimization is a key care about in temperature sensing as the amount of sensors and PCB area vary from design to design. Fortunately, TI offers a variety of small packages in a slew of configurations to enable flexible designs. Packages such as the DYY, VQFN, X2SON and DSBGA offer a competitive advantage on size whilst being available in various configurations and channel counts.

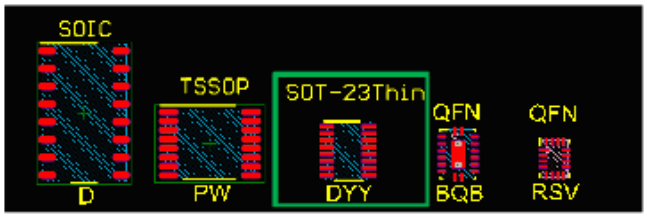

Figure 1. Packages Size Comparison - DYY Offers 57% Space Savings versus Legacy SOIC Package

Smart meters require temperature monitoring for accurate functionality. Multiplexers such as the SN74LV4051A, enable the integration of multiple temperature sensors into a single ADC channel. This setup reduces the number of required ADC channels, simplifying the design and lowering costs. In a typical application, temperature sensors such as thermocouples or RTDs (Resistance Temperature Detector) are connected to the multiplexer inputs. The mux can sequentially select each sensor signal using control logic and route the signals to the ADC. This process maintains accurate readings from multiple points within the smart meter, which is crucial for maintaining performance and reliability. Note that this design is similar for a broad range of sensors. A design can use sensors such as current and voltage monitors, but implementation remains the same.

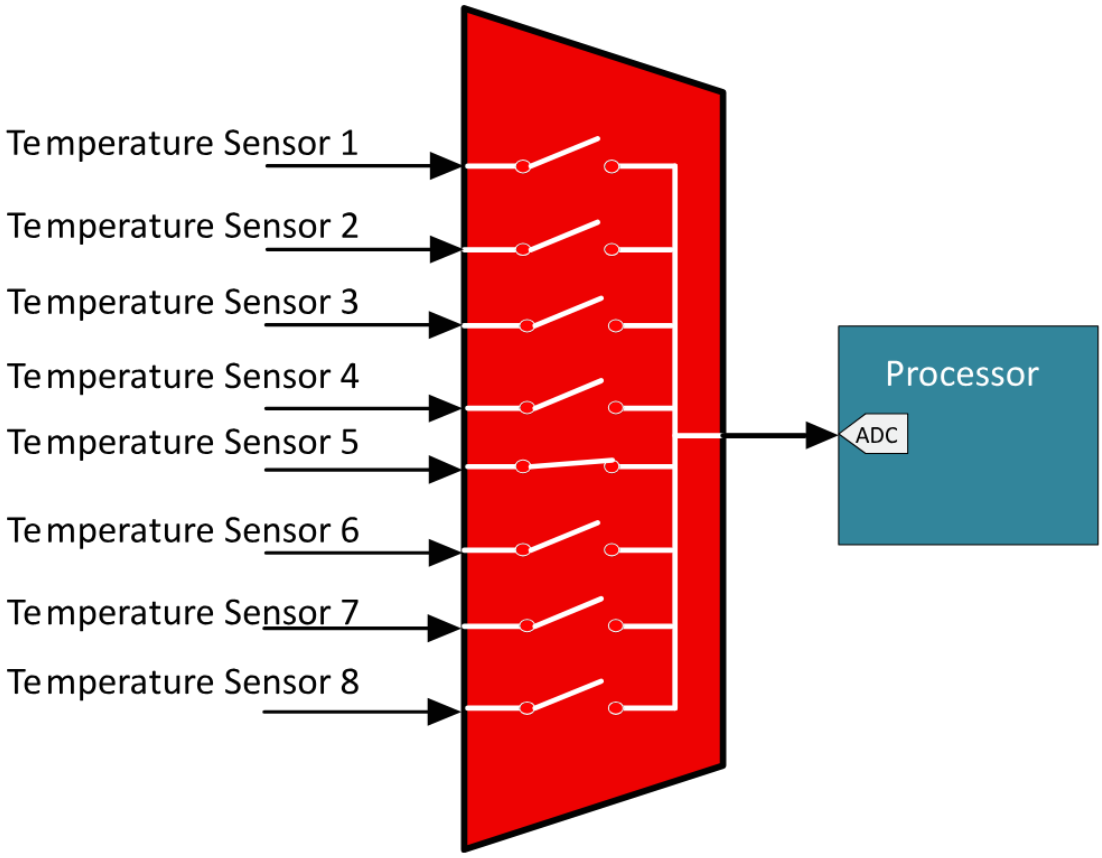

Figure 2. Typical Temperature Sensor Implementation

Design Considerations for Smart Meters

- Choose a multiplexer with an appropriate package for your PCB size and design to avoid space constraints.
- Match the input signal range less than or equal to the supply voltage of the multiplexer. Most multiplexers only support signals up to the supply voltage provided to the mux.
- Select multiplexers with enough bandwidth and the appropriate channel count to support the needs of the application.
- Choose multiplexers that meet parametric requirements over the full temperature range of your application to maintain signal integrity.
- Features such as Powered-off Protection maintain that the I/Os of the device remain in a high-Z state when powered off.

Table 1. Multiplexers With Small Package Size Options

Part Number	V_{cc} Range (V)	Channel Count	Configuration	R_{on} (Ω)	Available Packages (mm)	Features
CD405xB	3.3, 5, 12, 16, 20, +/-10, +/-2.5, +/-5	1, 2, 3	8:1, 4:1, 2:1	125	TSSOP (PW) (5.00 × 6.40) SOIC (D) (9.90 × 6.00) SOP (NS) (10.20 × 7.80) PDIP (N) (19.30 × 9.40)	Break-before-make
CD74HC4067	1.8, 2.5, 3.3, 5	1	16:1	60	SOIC (DW) (15.40 × 10.30)	Break-before-make
SN74LV405xA	1.8, 2.5, 3.3, 5	1, 2, 3	8:1, 4:1, 2:1	22	SOT-23-THN (DYY) (4.20 x 3.26) VQFN (RGY) (4.00 × 3.50) TSSOP (PW) (5.00 × 6.40) SOIC (D) (9.90 × 6.00)	Break-before-make
SN74LVC1G3157	1.8,2.5,3.3,5	1	2:1	6	X2SON (DTB) (0.80 × 1.00) SON (DSF) (1.00 × 1.00) DSBGA (YZP) (1.41 × 0.91) SON (DRY) (1.45 × 1.00) SOT (DRL) (1.60 × 1.20) SC70 (DCK) (2.00 × 1.25) SOT-23 (DBV) (2.90 × 1.60)	Break-before-make
TMUX1308	1.8, 2.5, 3.3, 5	1	8:1	59	SOT-23-THN (DYY) (4.20 × 2.00) WQFN (BQB) (3.50 × 2.50) TSSOP (PW) (5.00 × 4.40)	1.8V compatible control inputs, Break-before-make, Fail-safe logic, Injection current control, Short-to-battery protection
TMUX157x	1.2, 1.8, 2.5, 3.3, 5	4	2:1	1.7, 2	DSBGA (YCJ) (1.40 × 1.40) TSSOP (PW) (5.00 × 4.40) UQFN (RSV) (2.60 x 1.80) SOT-23-THN (DYY) (4.20 x 2.00)	1.2V compatible control inputs, 1.8V compatible control inputs, Integrated pulldown resistor on logic pin, Powered-off protection, Supports input voltage beyond supply

Low Leakage, Low On-Resistance Multiplexers

Low leakage multiplexers play a crucial role in flowmeters and ultrasonic gas meters by enabling efficient management and processing of signals from multiple transducers. In flowmeters, high voltage & low leakage multiplexers like the TMUX9832 allow simultaneous processing of signals from multiple transducer pairs, improving measurement responsiveness and precision. This is achieved by allowing more transducer elements to be added without increasing the number of signal processing components, providing a comprehensive view of flow data and better noise filtering capabilities. In this application, multiplexers facilitate switching between transmission and reception signals from the microcontroller unit to the transducer channels. This switching capability allows the same transducers to both send and receive ultrasonic pulses for accurate gas flow measurement.

For a lower voltage system, multiple TS5A9411s can be used for a similar effect. This device provides a solution with features such as low R_{on}, low leakage and low power with a break-before make feature to enable switching the transmission and reception signals from the MCU to two transceivers efficiently and without distortion. By streamlining transducer management, multiplexers enhance measurement quality and reliability in these systems. Multiplexers in flowmeters and ultrasonic gas meters offer several key benefits:

1. Improved measurement accuracy and precision by enabling simultaneous processing of multiple transducer signals.
2. Enhanced efficiency by allowing more transducers to be added without increasing signal processing components.
3. Flexibility in transducer management and signal routing.
4. Streamlined operation by allowing the same transducers to transmit and receive signals.

Multiplexers are integral to the functionality of smart meters, providing efficient data acquisition and signal routing capabilities. In temperature sensor applications, multiplexers streamline the integration of multiple sensors into a single ADC channel, while in ultrasonic gas meters, multiplexers enable precise control over transmission and reception signals. These benefits make multiplexers a key component in the advancement of smart metering technology.

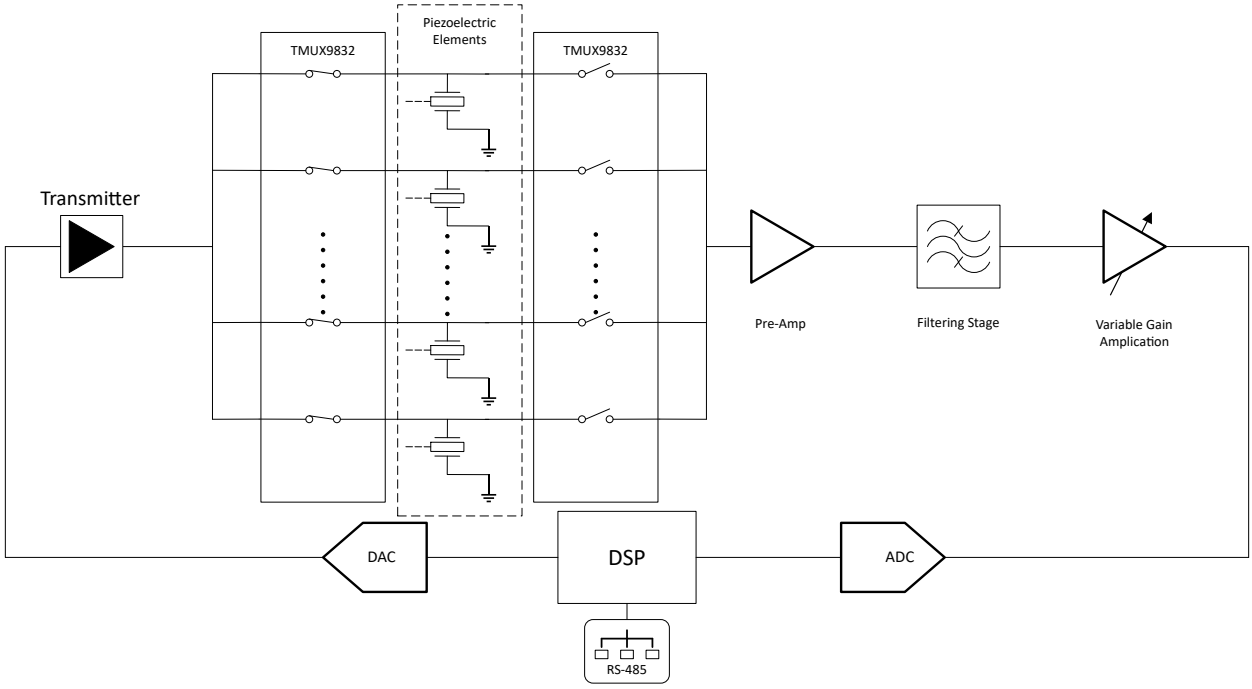

Figure 3. Typical Ultrasonic Gas Meter Implementation

Design Considerations

- Match the input signal range less than or equal to the supply voltage of the multiplexer. Most multiplexers only support signals up to the supply voltage provided to the mux.
- Select multiplexers with enough bandwidth and the appropriate channel count to support the needs of the application.
- Select relatively low on-state resistance and low leakage multiplexers to reduce errors and increase system measurement accuracy.
- Learn about multiplexer parameters with this *TI precision lab videos*
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- Explore the analog switches and multiplexers portfolio

Table 2. Low Leakage Multiplexers

Part Number	V_{cc} Range (V)	Channel Count	Configuration	Leakage (uA)	Packages Available (mm)	Features
TMUX9832	+/-110V	32	1:1	Request Info	NFBGA (ZEH) (7.50 x 7.50) VQFN (RWF) (10.00 × 10.00)	1.8V compatible control inputs, Daisy chain mode, Integrated bleed resistors on the outputs, Supports input voltage beyond supply
TS5A9411	2.5, 3.3, 5	1	2:1	0.01	SOT-SC70 (DCK) (2.00 x 1.50)	Break-before-make
TS5A23157	1.8,2.5,3.3,5	2	2:1	1	UQFN (RSE) (2.00 x 1.50) VSSOP (DGS) (3.00 x 3.00)	Break-before-make

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