

ADS125P08: High-Channel-Count, Low-Latency Data Acquisition Across Four Key Applications



Summary

The ADS125P08 integrates a 16-channel analog multiplexer, hardware channel auto-sequencer, 1-MSPS scan rate, and low-latency digital filter in a 5mm × 5mm package, enabling simplified multi-parameter measurement across power supply monitoring, thermistor sensing, system monitoring, and pressure measurement.

Introduction

Precision data acquisition systems increasingly demand higher channel counts, faster scan rates, and lower measurement latency — often within severe size and power constraints. The ADS125P08 addresses these demands through four integrated capabilities that work together across a broad range of sensing applications:

- *16-channel input capacity* — up to 8 fully differential or 16 single-ended inputs in a single 36-pin VQFN, replacing external multiplexers and reducing BOM.
- *Channel auto-sequencer with FIFO* — autonomously scans a user-configured channel list; the 512-sample FIFO buffers results and decouples ADC scan rate from MCU read rate, reducing MCU overhead.
- *1-MSPS ADC data rate* — four power-scalable speed modes from 50 kSPS to 1.067 MSPS enable optimization across throughput, noise, and power.
- *Low-latency digital filter* — a sinc3 low-latency filter mode minimizes group delay for time-critical control loops, with simultaneous 50/60 Hz rejection available at ≤25 SPS for power line noise immunity.

Application 1: Power Supply Monitoring

System overview: Multi-rail power supply monitoring requires continuous scanning of multiple voltage rails (1.2V, 1.8V, 2.5V, 3.3V, 5V, 12V, and auxiliary supplies) with fast fault detection. A typical server or industrial controller monitors 8 to 16 rails simultaneously, using resistive dividers to bring each rail within the ADS125P08 input range.

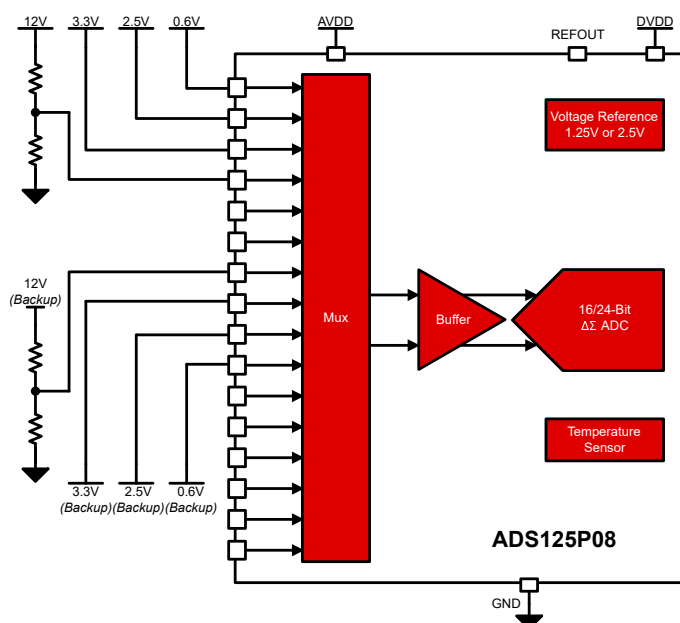


Figure 1. Power Supply Monitoring

How the ADS125P08 Key Features Apply:

- **High channel count:** All 16 single-ended rails connect directly to the ADS125P08 inputs, eliminating the external analog mux ICs and associated settling-time uncertainty that characterize discrete architectures. The integrated rail-to-rail input buffer prevents loading of the resistive divider networks.
- **Fast scan rate:** At 1 MSPS aggregate with 16 active channels, the effective per-channel rate is 62.5kSPS — sufficient to detect fast transients ($\leq 16\mu\text{s}$ per channel) on switching supplies, enabling sub-millisecond fault detection across the full rail set.
- **Sequencer:** The hardware sequencer cycles through all 16 rails autonomously. The MCU retrieves a complete 16-channel snapshot from the FIFO in a single SPI burst, freeing processor cycles for power management algorithms and communication tasks.
- **Low latency:** Low-latency filter mode minimizes group delay so that rail faults propagate to the MCU with minimal measurement lag, enabling fast protective shutdown or load-shedding responses without the multi-conversion settling delay of higher-order sinc or FIR filter modes.

Key result: A 16-rail power supply monitor requires no external mux ICs, one ADC device, and a single burst SPI read per monitoring interval — reducing BOM, PCB area, and firmware complexity simultaneously.

Application 2: Thermistor Temperature Measurement

System overview: Multi-zone thermal management systems — in battery packs, industrial enclosures, motor drives, or medical equipment — monitor NTC or PTC thermistors distributed across multiple measurement points. Accurate temperature readings require stable excitation, rejection of power-line noise, and per-channel calibration.

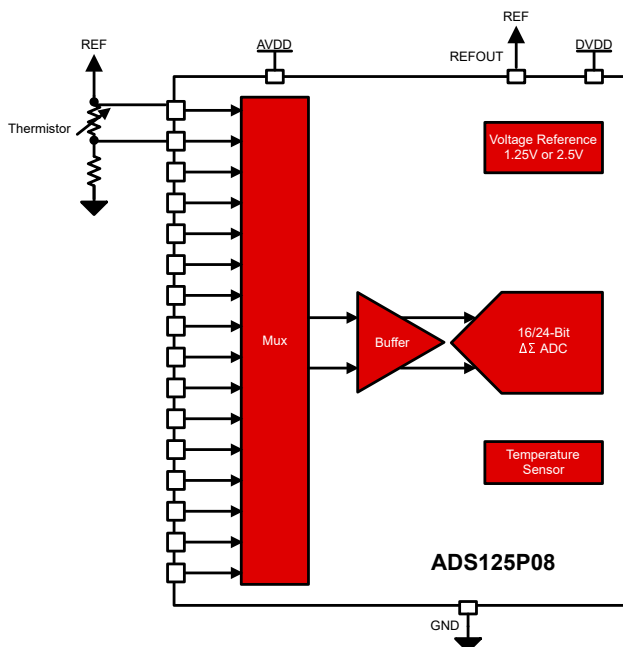


Figure 2. Thermistor Temperature Measurement

How the ADS125P08 key features apply:

- **High channel count:** Up to 16 thermistor inputs (single-ended against a common reference) connect directly, supporting dense thermal monitoring — for example, 14 cell-temperature sensors in a battery pack plus 2 ambient reference sensors. The integrated 2.5V or 4.096V reference provides a stable excitation voltage for thermistor divider networks.
- **Fast scan rate:** At mid-speed mode (200kSPS aggregate), the 12.5kSPS per-channel rate far exceeds thermistor thermal time constants, enabling oversampling and digital averaging to reduce measurement noise without dedicated hardware filters.
- **Sequencer:** The auto-sequencer steps through all thermistor channels and stores results in the FIFO. A temperature conversion algorithm runs on the MCU only after the FIFO threshold interrupt triggers — decoupling thermistor acquisition from temperature computation and enabling the MCU to sleep between burst reads.
- **Low latency:** At low data rates (≤ 25 SPS), simultaneous 50Hz and 60Hz rejection eliminates power-line interference from thermistor signal chains in industrial environments — a single configuration that covers both 50Hz and 60Hz installations globally, requiring no filter tuning between regions.

Key result: A 14-zone battery thermal management system achieves per-cell thermistor monitoring with a single ADS125P08, using the internal reference for divider excitation and the sequencer to deliver synchronized temperature snapshots at programmable update rates.

Application 3: System Monitoring

System overview: Industrial system monitoring consolidates diverse slow-to-medium-speed analog parameters — flow rates, strain gauges, analog outputs from MCUs or PLCs, current monitors, and analog GPIO levels — onto a single acquisition path. These parameters have varied update rates and accuracy requirements, and must be acquired concurrently with minimal host intervention.

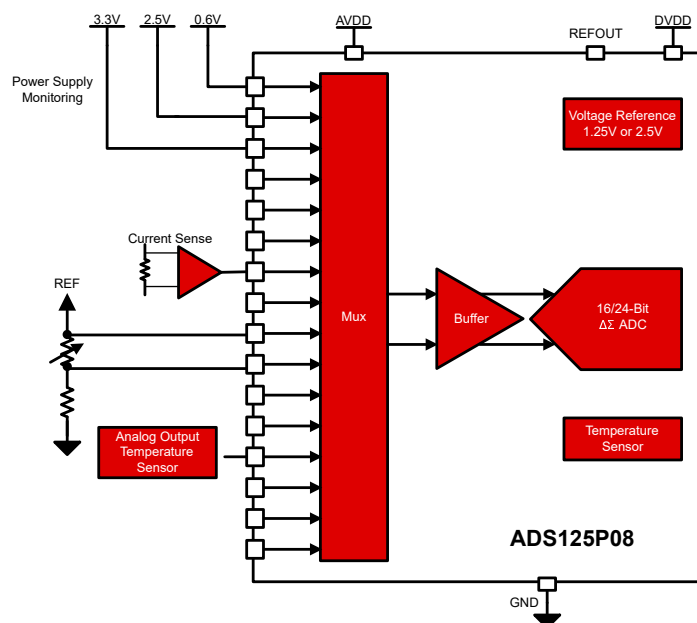


Figure 3. System Monitoring

How the ADS125P08 key features apply:

- **High channel count:** Up to 8 differential channels accommodate bridge sensors, current shunts, and analog outputs simultaneously. Single-ended inputs accommodate 0–5 V process signals. The on-chip GPIO provides additional digital I/O for sensor fault flags or enable signals, consolidating system monitoring onto one device.
- **Fast scan rate:** The power-scalable architecture allows different effective scan rates per application tier: high-speed mode (400 kSPS aggregate) for dynamic signals such as vibration proxies or fast flow transients, and low-speed mode (50 kSPS aggregate) for slow environmental parameters — all from a single device configuration.
- **Sequencer:** The auto-sequencer includes the on-die temperature sensor and AVDD monitor as additional sequenced inputs, providing housekeeping measurements at no additional external hardware cost. The channel auto-sequencer tag embedded in each FIFO result identifies which channel produced each sample (via the STEP_INDICATOR), eliminating host-side demultiplexing logic.
- **Low latency:** For time-stamped event detection (for example, detecting a process alarm signal within a defined latency window), low-latency filter mode ensures that the ADC output reflects the current input with minimal filter group delay — enabling deterministic latency budgets for system-level safety.

Key result: A distributed system monitor consolidates 8 differential process sensors or 16 single-ended analog signals, on-die temperature, and supply voltage into a single ADS125P08 scan list — eliminating multiple discrete ADCs and mux ICs from the signal chain.

Application 4: Pressure Measurement

System overview: Multi-point pressure monitoring systems — in hydraulic manifolds, HVAC distribution networks, or process pipelines — combine Wheatstone bridge pressure sensors with reference channels, common-mode monitors, and temperature compensation inputs. Bridge outputs are small differential signals requiring high resolution and noise rejection, often in electrically noisy environments.

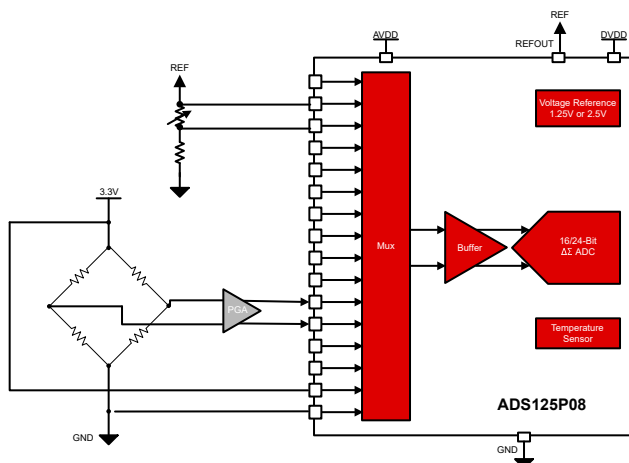


Figure 4. Pressure Measurement

How the ADS125P08 key features apply:

- **High channel count:** Up to 8 differential channels directly interface to Wheatstone bridge pressure sensors. Remaining single-ended inputs accommodate reference channels, bridge supply monitors, and temperature compensation sensors — allowing a complete multi-point pressure acquisition system without additional analog front-end ICs.
- **Fast scan rate:** At high-speed mode, the 400kSPS aggregate enables dynamic pressure measurement at 50kSPS per channel (with 8 active channels) — capturing pressure transients in hydraulic systems where bandwidth up to 10kHz per sensor is required.
- **Sequencer:** The sequencer cycles through pressure channels and temperature compensation inputs in a single programmed list, ensuring that the temperature correction factor is always acquired in the same scan cycle as the pressure reading. This eliminates time skew between pressure and temperature samples that would otherwise introduce compensation error in varying thermal environments.
- **Low latency:** For closed-loop pressure control, low-latency filter mode provides measurement results within a defined, repeatable time window after channel selection — enabling the control loop to execute with deterministic sampling intervals. The fault detection circuits within the ADS125P08 also provide over-range and under-range alerts without additional comparator ICs.

Key result: An 8-channel hydraulic pressure monitor with temperature compensation acquires synchronized pressure and temperature data in a single sequencer pass, with the FIFO delivering a complete, tagged dataset to the MCU at the end of each scan cycle.

Table 1. Feature-to-Application Summary

Key Feature	Power Supply Monitoring	Thermistor	System Monitoring	Pressure
16-ch input capacity	16 rails, no external mux	14 sensors + 2 reference	8 diff or 16 SE + GPIO	8 bridge + compensation inputs
1-MSPS scan rate	62.5kSPS/ch, <16μs fault detect	Oversampling + averaging	Per-tier rate optimization	50kSPS/ch, 10kHz BW
Auto-sequencer + FIFO	16-ch burst read, reduced MCU load	Sleep between reads	Tagged output, no demux	Synchronized P + T samples
Low-latency filter	Fast fault propagation	50/60Hz rejection at low ODR	Deterministic latency budget	Deterministic control loop timing

Conclusion

The ADS125P08 delivers a single-chip path to high-density, low-latency multi-channel data acquisition across power supply monitoring, thermistor sensing, system monitoring, and pressure measurement. The hardware channel auto-sequencer eliminates MCU sequencing overhead, the 1-MSPS aggregate scan rate enables fast fault detection and dynamic signal capture, the 16-channel input capacity replaces external multiplexers, and the low-latency filter mode provides deterministic measurement timing for closed-loop control. Together, these features reduce BOM cost, PCB area, and firmware complexity versus discrete multi-channel architectures while meeting the throughput and accuracy requirements of each application.

References

- Texas Instruments, [ADS125P08 8/16-Channel, 1MSPS, 24-Bit, Delta-Sigma ADC Datasheet](#), datasheet
- Texas Instruments, [Calculating Conversion Latency and System Cycle Time for Delta-Sigma ADCs](#), application note
- Texas Instruments, [Digital Filter Types in Delta-Sigma ADCs](#), application note

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