

ALS-311 Temperature Sensor Board

Background

The ALS-311 temperature sensor board is a member of the Advanced Logic System® (ALS®) platform, providing high performance temperature sensor capabilities. The ALS-311 provides eight isolated independent high-integrity temperature sensing channels, which can be individually configured to interface with the resistance temperature detector (RTD) or thermocouple sensors. The ALS-311 supports a wide range of RTDs and thermocouples to provide compatibility with the existing sensors located in the plant.

Description

The ALS-311 interfaces with both 3-wire and 4-wire Pt100 and Pt200 RTDs. The ALS-311 provides a highly accurate measurement throughout the full range of the RTD sensors, eliminating the industry notion of “wide” and “narrow” range RTDs.

The ALS-311 supports the most popular thermocouples including types J, K, E, T, N, R and S, providing a temperature measurement of up to 1,700 degrees centigrade. Automatic cold junction compensation is performed by using a single cold junction sensed on channel 8, from an external cold junction temperature supplied from the ALS core logic board, or from an externally sourced cold junction temperature.

The ALS-311 provides automatic self-test and fault detection features which, in an overlap approach, maintain the integrity of the sensor measurement through the ALS-311 board and transmission to the ALS core logic board for logical decision making. Each channel performs a self-test to provide integrity of the individual channel. Additionally, each channel provides “out-of-range” detection and automatic recovery from an overload condition. Channel status and board status are visible on the front panel indications providing a quick status assessment for the board. The status indication includes the standard ALS platform indications, as well as the following channel-specific indications:

- Input temperature signal within range and operational
- Input temperature signal outside range or integrity error
- Channel in calibration
- Channel in bypass
- Channel disabled

The ALS-311 allows for customization of each measurement channel. The configurable parameters for each channel include:

- Enable or disable of the channel
- Configure for two-wire thermocouple, 3-wire RTD or 4-wire RTD
- Linearization parameters for the particular sensing element
- Cold junction compensation source
- Out-of-range limits

The ALS-311 supports online calibration of individual sensor channels. Each channel is independently calibrated with OFFSET and SPAN. Only the channel under calibration is impacted, and therefore requires only one bypassed channel at a time. Calibration of a channel while online is achieved by utilizing the ALS service unit (ASU). Additional detailed information regarding the board configuration, diagnostics and status is also available via the ASU.

The ALS-311 is designed for autonomous operation, allowing the system level design to maintain the overall integrity of the application whether a fault occurs within the individual board or at the system level. A failure in one of the input channels does not impact the other channels.

The ALS-311 is designed by Westinghouse and is built and manufactured under Westinghouse control per an approved 10CFR50 Appendix B Quality Assurance program. The processes and procedures for the design and development have been reviewed and approved by the U.S. Nuclear Regulatory Commission for use in Class 1E systems.

The ALS-311 was subjected to a board level reliability analysis so the highest level of reliability is achieved. Additionally, the ALS-311 was subjected to a failure modes and effects analysis (FMEA) at the individual component level.

Benefits

The ALS-311 incorporates a common implementation approach with all ALS platform boards. Component reuse and circuit design reuse is a key aspect of the ALS platform, providing long-term reliability and mitigation of obsolescence issues. Additionally, the common implementation provides a common look and feel to all ALS platform boards for ease of maintainability.



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Electrical Specifications

Number of input channels	Eight galvanically isolated inputs
Maximum allowed source Impedance	1 k Ω
Constant current source	0.420 mA (split for 3-wire mode (0.210 mA))
Input impedance	20 M Ω
Isolation	500V _{RMS} inter-channel, 750V _{RMS} channel to earth 1,500V _{RMS} channel to logic

Analog Conversion

Resolution	20 bit analog conversion (17 effective bits)
Scan rate	90 Hz \pm 5Hz
Response time	Thermocouple and 3-wire RTD: 95 ms 4-Wire RTD: 105 ms
Settling time	Thermocouple and 3-wire RTD: 360 ms 4-Wire RTD: 380 ms

Measurement Error

Accuracy	\pm 0.1 Ω RTD input \pm 0.05 mV thermocouple input
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Filtering

Filter modes	1 Hz, 1.1 Hz, 1.2 Hz, 1.4 Hz, 1.9 Hz, 2.2 Hz, 2.7 Hz
Common mode rejection	>120 db at 50/60 Hz
Normal mode rejection	> 45 db at 50/60 Hz, >10 db at 10 Hz

Power Requirements

Power consumption	Less than 3 watts from ALS chassis power supply
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Environmental

Standard operating temperature range	5 C to +60 C
Storage temperature range	-20 C to +70 C
Relative humidity range	10 to 95 percent, non-condensing

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