

ALS-102 Core Logic Board

Background

Westinghouse has developed the Advanced Logic System® (ALS®) platform as a new approach to safety-critical control systems. The ALS-102 is a member of the ALS platform, providing the fundamental control and logic for a specific application. The ALS-102 is a versatile, highly integrated and highly reliable design that is referred to in the ALS platform as the core logic board (CLB). The CLB is customizable, based upon the requirements of a given application, and can contain any type of digital building blocks that can be generated from a NAND2 device, such as AND/OR/XOR-gates and flip-flops (D, JK, SR). These building blocks can then be combined into more complex logic circuits, such as counters, timers, multiplexers, comparators, lead/lag functions or finite state machines (FSMs).

Description

The CLB controls all sequencing and I/O states within the ALS platform. It can be customized for each application to perform the desired safety function, which may be a sequencer function, coincidence logic voter function, process protection function, or whatever function is required by the customer's system requirements.

The ALS-102 provides six contact input channels that are intended to be used for system-related inputs such as an input toggle switch to



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acknowledge and/or clear alarms or to detect the state of a maintenance key switch, a door open alarm, a power supply health, etc.

The ALS-102 provides four independent single-pole solid state relay output channels intended to support de-energize-to-actuate outputs that are typically used for alarm, trouble and status indication. Internal dedicated and independent alarm circuits control and generate these signals based on operability and integrity of the system. These output channels can drive external alarms and plant indicators, and include adequate isolation to also interface with non-safety systems. The two types of alarm actuations are the “application-related failures” such as a pressure point exceeding its alarm value, or the “system failures” related to internal ALS platform

operation such as the detection of a device failure or a communication failure.

The ALS-102 can continuously transmit a unidirectional data stream to the ALS service unit (ASU) via one of the EIA-422 communication links. This continuous data stream includes information such as contact (input/output) states, analog (input/output) states, internal state (including counter values, analog computed values, etc.), board and system integrity, and application-specific data. In the same application, the second EIA-422 communication link can continuously transmit a unidirectional data stream to a qualified display system mounted on the main control board, or to non-safety systems as required by the application.

The ALS-102 has a dedicated non-volatile memory device to store application-specific configuration information that is used for comparator set points, tuning constants, gain, offset, etc. The ALS-102 does not require calibration; however, it does support adjustments of set points and trip-values utilizing the ASU.

The ALS-102 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, output or communication channels does not impact the other channels.

Benefits

The ALS platform provides a common solution for all Class 1E safety-system applications in the nuclear power plant. The ALS platform is a hardware-based architecture that uses a minimal set of hardware to implement a system with high integrity and reliability. The platform is modular so that common individual boards can be mixed and matched to achieve an overall solution for a given application. The ALS platform is scalable so that replacements can be performed on a system-by-system basis.

Logic Specifications

System logic	Application specific
System frame rate	10 Hz – 100 Hz

Input Specifications

Number of channels	6 channels
Type of channels	Contact sense
Wetting supply voltage	48 VDC (nominal)
Contact wetting current	4 mA (nominal)
Contact (OPEN)	>20 K Ω
Contact (CLOSED)	<2.5 K Ω
Response time	20 ms, 75 ms, 150 ms, 500 ms

Output Specifications

Number of channels	4 channels
Type of channels	288 VAC (RMS) or 300 VDC
Contact switching	100 mA (continuous)
Output contact leakage	<50 μ A @ 300 VDC (open)
Response time	<80 ms
Isolation	1,000 VAC (RMS) and 1,000 VDC Inter channel

Communication Specifications

Number of channels	2 channels
Interface	EIA-422 unidirectional (transmit only, no handshake)
Baud Rate	Configurable (4,800 to 921.6k)
Isolation	1,000 VAC (RMS) and 1,000 VDC Inter channel

General Specifications

Isolation	1,500 VRMS and 1,500 VDC channel/logic
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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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