Thermocouple Input Module (TIM)

Fully Qualified Safety-Related Digital Platform

CURTISS-WRIGHT

About

Curtiss-Wright Nuclear has partnered with Radics, LLC to supply integrated FPGA-based instrumentation and control (I&C) systems for nuclear power plants and research reactors. RadICS is a digital I&C platform that is robust, flexible, and scalable. It provides state-of-the-art functions, services, and safeguards for safety applications in the nuclear industry. The RadICS product line consists of a Logic Module, basic input/output modules, and specialty modules all housed in a seismically qualified chassis.

The Thermocouple Input Module serves as a high-density analog thermocouple sensor acquisition module. It provides 32 independent, highly reliable, and galvanically isolated inputs with built-in filtering, calibration, and analog to digital conversion for use by the Logic Module. The Thermocouple Input Module also performs robust and continuous self-diagnostics to ensure the safety and integrity of each input and module function.

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Thermocouple Input Module (TIM)

- High density 32 channel analog inputs with built-in hardware redundancy and self-diagnostics for highly reliable operation, filtering, calibration, and random hardware failure detection.
- Independent FPGA for data communication, self-diagnostics, and fail-safe functional behavior.
- Robust self-diagnostics give early fault detection for safety-focused fault management.
- Segregation of communications processing, self-diagnostics, and watchdog functions assures safety critical functionality.
- Galvanic isolation for external communication lines with robust and dedicated communication links to Logic Module for secure data transfer.
- Inherent on-board diversity features eliminate common cause failure vulnerabilities.
- FPGA technology ensures resilience to I&C obsolescence.
- Support for Type B, E, J, K, N, R, S, T thermocouples, with thermocouples being independently selectable per channel.

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Thermocouple Input Module Technical Specifications

Function	Specifications
Supported Sensor Types	Type B, E, J, K, N, R, S, T with temperature engineering unit conversion performed in TIM module Also supports raw millivolts (mV) acquisition
Cold Junction Compensation	Cold Junction Temperature is sensed at the field terminations by an RTD and applied to the measured thermocouple signal in the Logic Module prior to use by the safety function
A/D Conversion Resolution	19 bits delta-sigma analog-to-digital conversion
Response Time	150 milliseconds
Common Mode Rejection Ratio	> 86 dB
Overall Accuracy	Type B: 0.15% of full scale (@ 25 °C) Type R, S, T: 0.1% of full scale (@ 25 °C) Others - 0.04% of full scale (@ 25 °C)
Input Channel Isolation	All input channels are galvanic-isolated up to 250 V_{RMS} AC or 250 VDC field-to-chassis and channel-to-channel
Overvoltage Protection	±60 VAC/VDC continuous (using external protection elements installed in chassis)
Information Package Exchange Cycle	5 milliseconds
Diagnostic Package Exchange Cycle	5 milliseconds
LVDS Line Speed	100 megabit/second
LVDS Line Protocol	Proprietary protocol with integrity checking (CRC), galvanic-isolated Tx / Rx
Self-Diagnostic Functions	Diverse watchdog unit, checksum analysis, active diagnostics with internal fault detection, hardware error detection, functionally diverse continuous self-diagnostic tests, power supply fault detection
Power Supply / Consumption	2 independent inputs – 24 (18 – 36) VDC / 0.85 amp (± 0.15 amp)
Indications	2 status LED indicators (RUN/FAULT) 4-character dot matrix symbol-indicator for providing current operational mode, service information, and error codes
Operating Temperature	4.4 to 60 °C (40 to 140 °F)
Operating Humidity	10 to 90% relative humidity, non-condensing

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