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The RadICS Platform is robust, flexible, and scalable. It delivers state-of-the-art functions, services, and safeguards for both safety and non-safety applications in the nuclear industry. The RadICS Platform components are designed to the latest IEC standards for safety-critical service in the highest classified nuclear systems. The RadICS Platform consists of a Logic Module, basic input/output modules, communication module, and specialty modules, all housed in a seismically qualified chassis.

In 2014, the RadICS I&C Platform was certified by *exida* as SIL 3 capable in a single channel meting the requirements of the IEC 61508:2010 Certification Process.

In 2019, the U.S. Nuclear Regulatory Commission (NRC) approved RadICS I&C Platform for use at nuclear power plants in safety and safety-related systems with no additional restrictions.

RadICS Digital Instrumentation and Control Platform

➤ Equipment fully qualified to NRC requirements for use in US safety related applications

➤ Inherent on-board diverse watchdog technological and self-diagnostic functional diversity which eliminates common cause failure vulnerabilities

➤ Flexible and scalable system design architecture for any size and type of I&C system

➤ Fast and deterministic performance using advanced FPGA technology. Response time as fast as 5 milliseconds

➤ IEC 61508 SIL 3 compliant FPGA-based platform specifically designed for nuclear safety applications. SIL 3 even in a single channel configuration

➤ Comprehensive self-diagnostics ensure safety-critical functions, with fail safe design features

➤ Testing optimization and maintenance cost reductions achieved via the use of overlapping automatic and semi-automatic surveillance capabilities

➤ Quality built-in from day one through design, manufacturing, verification and testing processes

➤ Delivering high reliability required for the most demanding nuclear safety applications, such as reactor trip and engineered safety feature actuation systems

30+ Years of Proven Innovation for the Global Nuclear Industry

radICS

For more than 30 years Radiy has provided advanced instrumentation and control (I&C) solutions for nuclear power plant modernization and new build projects in the global market. Radiy's main I&C product, the RadICS I&C Platform, was developed specifically for use in nuclear power plants. It is the only FPGA-based I&C platform with a SIL 3 certification in a single channel configuration. Radiy also offers industrial control systems, electrical equipment, and reverse engineering services. Radics, a wholly owned LLC, delivers RadICS Platform based I&C systems for international markets to meet local regulatory requirements.

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Platform Equipment

Logic Module (LM)

Analog Inputs Module (AIM)

Discrete Inputs Module (DIM)

Analog Outputs Module (AOM)

Discrete Outputs Module (DOM)

Optical Communication Module (OCM)

Wide Range Analog Inputs Module (WAIM)

Thermocouple Inputs Module (TIM)

Resistance Temperature Detector Inputs Module (RIM)

Chassis

RadICS-based Safety and Safety-Related System Applications

Reactor Trip System

Engineering Safety Features Actuation System

Conventional Island I&C System

Nuclear Island I&C System

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The Logic Module serves as the brain for the entire platform. In addition to executing the application logics, the Logic Module communicates with all other modules installed in the chassis, performs and monitors self-diagnostics, and controls communications with external chassis and systems.

Logic Module (LM)

➤ Fast and deterministic performance using modern FPGA technology. Response times as low as 5 milliseconds!

➤ IEC 61508 SIL 3 certification in single and multiple channel configurations.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of application logic, self-diagnostics, and watchdog functions assures safety-critical functionality.

➤ Galvanic isolation for inputs and outputs with robust error checking for digital communications independence.

➤ Inherent on-board diversity features eliminate common cause failure vulnerabilities.

➤ FPGA technology and design strategies eliminate cyber security threat vectors common in microprocessor-based systems.

➤ FPGA technology ensures resilience to I&C obsolescence.

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Logic Module Technical Specifications

FPGA Capacity	capacity to handle > 500 application blocks
Memory	8 megabit (FPGA internal) 4*2 megabit (4 external EEPROMs) 2 megabit (external SSRAM)
Discrete Inputs	24 VDC, 10 milliamps maximum, Form A "dry" contact with galvanic isolation between inputs (2 available, 1 reserved)
Discrete Inputs Overvoltage Protection	up to 150 VDC continuous
Access Key Signal Input	discrete signal (24 VDC, 0 to 10 milliamps) receiver with optic-isolation
Discrete Outputs	"dry" contact: up to 48 V, 0.2 amp (AC/DC), galvanic-isolated by optic-relays (6 fast discrete outputs)
Discrete Outputs Overvoltage Protection	up to +60 VDC/VAC continuous
Application Logic Processing Cycle	up to 2.5 milliseconds for application logic up to 2.5 milliseconds for input/output signals/data processing
Diagnostic Data Exchange Cycle	up to 5 milliseconds
Ethernet / Protocol	100 BASE-FX IP/UDP
LVDS Line Speed	100 megabit/second
LVDS Line Protocol	proprietary protocol with integrity checking (CRC), galvanic-isolated Tx / Rx
Fiber Optical Lines Speed	100 megabit/second
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 / Maximum consumption: 0.92A (±0.15A)
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

RadICS Platform is the only FPGA-based I&C platform with a SIL 3 certification in a single channel configuration. The Platform is reviewed and approved by U.S. NRC. Radics LLC provides engineering, testing and commercial grade dedication services for nuclear power clients on international markets to meet local nuclear regulatory requirements and ensure safety and reliability at nuclear power genera on sites.

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The Analog Inputs Module (AIM) serves as a high-density analog field sensor acquisition module. It provides for 32 independent, highly reliable, and galvanically isolated inputs with built-in filtering and calibration to be used by the Logic Module. The AIM also performs robust and continuous self-diagnostics to ensure the safety and integrity of each input and module function.

Analog Inputs Module (AIM)

➤ 32 channel analog inputs with built-in hardware redundancy and self-diagnostics for highly reliable operation, filtering, calibration, and random hardware failure detection. All channels are galvanically-isolated between each other and from the rest part of the module.

➤ Independent FPGA for analog input processing, self-diagnostics, and fail-safe functional behavior.

➤ IEC 61508 SIL 3 certification in single and multiple channel configurations.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of input processing, self-diagnostics, and watchdog functions assure safety-critical functionality.

➤ Robust point-to-point communication links to Logic Module with proprietary data transmission protocol for secure data transfer.

➤ Inherent on-board diversity features eliminate common cause failure vulnerabilities.

➤ FPGA technology ensures resilience to I&C obsolescence.

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Analog Inputs Module Technical Specifications

Input Analog Signal Range	0 to +5.1 V (0 to 20 milliamps using external 250 ohm resistor installed in connection/junction box) Differential input impedance: not less than 1 megohm
A/D Conversion Resolution	18 bits / 400 kilo samples per second (kSPS)
Common Mode Rejection Ratio	> 86 dB
Overall Accuracy	0.04% of full scale for 0 to +5.1 V (at 25 °C) 0.04% of full scale for 4 to 20 milliamps using external resistor with 0.05% tolerance (25 °C)
Input Channel Isolation	all input channels are galvanic-isolated up to 500 V_{RMS} AC or 500 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 / Maximum consumption: 0.85A(±0.15A) (32 inputs used; 5V input value at each input)
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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Radiy delivers a digital I&C platform that is robust, flexible, and scalable. It provides state-of-the-art functions, services, and safeguards for both safety and safety-related 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 Analog Outputs Module (AOM) serves as a high-density output conditioning module providing for 32 independent, highly reliable, and galvanically isolated analog outputs. The Logic Module uses the AOM to drive field devices, indicators, and other functions. The AOM also performs robust and continuous self-diagnostics to ensure the safety integrity of each output and module function. In the event of critical failures, the AOM de-energizes to a safe-state.

Analog Outputs Module
(AOM)

➤ High density 32 channel analog outputs designed to detect conditioned output signals that exceed accuracy and response time diagnostic tolerances.

➤ Independent FPGA for analog output processing, self-diagnostics, and fail-safe functional behavior.

➤ IEC 61508 SIL 3 certification in single and multiple channel configurations.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of output processing, self-diagnostics, and watchdog functions assures safety-critical functionality.

➤ Galvanic isolation for signal outputs 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.

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Analog Outputs Module Technical Specifications

Output Range	0 to +5 V / 4 to 20 milliamp / ± 10 V / 0 to 5 milliamps
D/A Conversion Resolution	16 bits
Output Signal Value Accuracy	0.04% of full scale (at 25 °C)
Maximum Output Load	up to 350 ohm (kΩ) for current output Minimum of 1 kΩ for voltage output
Internal Power Supply On Each Output Channel	±15 V / ±35 milliamp
Output Analog Channel Isolation	all output channels are galvanic-isolated up to 500 V_{RMS} AC or 500 VDC field-to-Chassis and channel-to-channel
Overvoltage Protection	±60 VAC/VDC continuous (using external protection elements installed in Chassis)
Output Signal Update 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 / Maximum consumption: 1.42A(±0.15A) (32 outputs in 4-20mA mode used; 20mA at each output)
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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The Discrete Inputs Module (DIM) serves as a high-density discrete dry contact module providing for 32 independent, highly reliable, and optically isolated inputs for use by the Logic Module. The DIM also performs robust and continuous self-diagnostics to ensure the safety and integrity of each input and module function.

Discrete Inputs Module
(DIM)

➤ High density 32 channel discrete dry-contact inputs with built-in hardware redundancy and line integrity checks for hardware failure detection.

➤ Independent FPGA for discrete input processing, self-diagnostics, and fail-safe functional behavior.

➤ IEC 61508 SIL 3 certification in single and multiple channel configurations.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of input processing, self-diagnostics, and watchdog functions assures safety-critical functionality.

➤ Galvanic isolation for signal inputs 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.

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Internal Power Supply For Each Independent Discrete Input	24 VDC / 10 milliamps maximum (Form A "dry" contacts)
Input Channel Isolation	all input channels are galvanic-isolated up to 500 V_{RMS} AC or 500 VDC field-to-Chassis and channel-to-channel
Input Channel Isolation Method	optic relay
Overvoltage Protection	150 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 / Maximum consumption: 0.77A(±0.15A) (32 inputs used; all inputs closed)
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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The Discrete Outputs Module (DOM) serves as a high-density module providing for 32 independent, highly reliable, and optically isolated discrete outputs. The Logic Module uses the DOM to drive field devices, indicators, and other functions. The DOM also performs robust and continuous self-diagnostics to ensure the safety and integrity of each output and module function. In the event of critical failures, the DOM de-energizes to a safe-state.

Discrete Outputs Module
(DOM)

➤ High density 32 channel Form-A optically isolated, fuse and overvoltage protected discrete outputs.

➤ Independent FPGA for discrete output processing, self-diagnostics, and fail-safe functional behavior.

➤ IEC 61508 SIL 3 certification in single and multiple channel configurations.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of output processing, self-diagnostics, and watchdog functions assures safety-critical functionality.

➤ Galvanic isolation for signal outputs 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.

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Discrete Outputs Module Technical Specifications

Output Channel Load Voltage / Current (maximum switching voltage / current)	up to 48 VDC, 0.2 amp, Form A contact
Output Channel Isolation	all output channels are galvanic-isolated up to 500 V_{RMS} AC or 500 VDC field- to-Chassis and channel-to-channel
Output Channel Isolation Method	optical relay
Output Overvoltage Protection	up to ±60 VDC/VAC 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
Fiber Optical Lines Speed	100 megabit/second
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 / Maximum consumption: 0.63A(±0.15A) (32 outputs used; all outputs closed)
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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The Wide Range Analog Inputs Module (WAIM) will serve as a highdensity analog field sensor acquisition module. It will provide 32 independent, highly reliable, and galvanically isolated inputs with built-in filtering and calibration for use by the Logic Module. The WAIM will also perform robust and continuous self-diagnostics to ensure the safety and integrity of each input and module function.

Wide Range Analog Inputs Module (WAIM)

➤ 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 analog input processing, self-diagnostics, and fail-safe functional behavior.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of input processing, self-diagnostics, and watchdog functions assure safety-critical functionality.

➤ Galvanic isolation for signal inputs 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.

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Wide Range Analog Inputs Module
Technical Specifications

Input Analog Signal Range	±10 V (+-11.5V over-range monitoring capability) Differential input impedance: not less than 1 megaohms
A/D Conversion Resolution	18 bits / 400 kilo samples per second (kSPS)
Response Time	5 milliseconds
Common Mode Rejection Ratio	> 86 dB
Overall Accuracy	0.04% of full scale (@ 25 °C)
Input Channel Isolation	all input channels are galvanic-isolated up to 500 V_{RMS} AC or 500 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 / Maximum consumption: 1.01A(±0.15A) (32 inputs used; -10V input value at each input)
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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The Thermocouple Inputs Module (TIM) will serve as a high-density analog thermocouple sensor acquisition module. It will provide 32 independent, highly reliable, and galvanically isolated inputs with built-in filtering and calibration for use by the Logic Module. The TIM will also perform robust and continuous self-diagnostics to ensure the safety and integrity of each input and module function.

Thermocouple Inputs 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 analog input processing, self-diagnostics, and fail-safe functional behavior.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of input processing, self-diagnostics, and watchdog functions assure safety-critical functionality.

➤ Galvanic isolation for signal inputs 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.

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Supported Sensor Types	Type B, E, J, K, N, R, S, T with internal conversion mV→t °C. Also supports raw millivolts (mV) acquisition (to support any other sensor type with external conversion into temperature performed in Logic Module).
A/D Conversion Resolution	19 bits delta-sigma analog-to-digital conversion
Response Time	300 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 500 V_{RMS} AC or 500 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 / Maximum consumption: 0.4A(±0.15A) (32 inputs used in -35..+100mV mode; 100mV at each input)
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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The RTD Inputs Module (RIM) will serve as a highdensity analog RTD sensor acquisition module. It will provide 8 independent, highly reliable, and galvanically isolated inputs with built-in filtering and calibration for use by the Logic Module. The RIM will also perform robust and continuous self-diagnostics to ensure the safety and integrity of each input and module function.

Resistance Temperature Detector Inputs Module (RIM)

➤ High density 8 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 analog input processing, self-diagnostics, and fail-safe functional behavior.

➤ Robust self-diagnostics ensure higher reliability and early fault detection with safety-focused fault management.

➤ Segregation of input processing, self-diagnostics, and watchdog functions assure safety-critical functionality.

➤ Galvanic isolation for signal inputs 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.

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Resistance Temperature Detector Inputs Module Technical Specifications

Input Analog Signal Range	5-1500 Ohms (0-1600 Ohms over-range monitoring capabilities) 4 signal sub-ranges: 5-198 Ohms; 5-398 Ohms; 5-795 Ohms; 5-1500 Ohms.

Supported Sensor Types	1. 2-, 3- and 4-wire connection schemes support.
	2. Raw resistance (Ohms) measurement
	   (to support any specific sensor type with external conversion into temperature performed in Logic Module).
	3. 5 pre-defined RTD sensor types support with adjustable R0 (up to 350 Ohms) and R -> t conversion performed internally by module.
	Supported RTD types:
	   - Platinum (α=0.00385 per °C) – corresponds to IEC 751
	   - Platinum (α=0.00391 per °C)
	   - Copper (α=0.00428 per °C)
	   - Copper (α=0.00426 per °C)
	   - Nickel (α=0.00617 per °C)

A/D Conversion Resolution	18 bits / 400 kilo samples per second (kSPS)
Response Time	100 milliseconds
Common Mode Rejection Ratio	> 86 dB
Overall Accuracy	0.1% of sub-range full scale (@ 25 °C)
Input Channel Isolation	all input channels are galvanic-isolated up to 500 V_{RMS} AC or 500 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 / Maximum consumption: 0.29A(±0.15A) (8 inputs used; 1500 Ohms input value at each input)
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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The Optical Communication Module (OCM) receives and transmits data via up to five independent safety qualified point to point fiber optic interfaces that are used to extend the RadICS Platform to additional chassis (OCM to OCM or OCM to LM). The OCM also performs robust and continuous self-diagnostics to ensure the safety and integrity of data transfer and module function.

Optical Communications Module (OCM)

➤ Five independent fiber optic communication ports for full duplex communications between channels or expansion racks.

➤ Five RS-232/RS-485 interfaces for one-way communication with peripheral devices.

➤ 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.

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Optical Communications Module
Technical Specifications

|	
Fiber Optical Lines Type	optical full duplex
Fiber Optical Lines Speed	100 megabit/second
LVDS lines speed	100 megabit/second
RS-232 Interfaces Speed	up to 115,200 bauds/second
RS-485 Interfaces Speed	up to 921,600 bauds/second
RS-232/RS-485 Interfaces Protection	up to 28 V_{RMS} (line to line) up to 120 V_{RMS} (line to ground) power cross condition
Information Package Exchange Cycle	5 milliseconds
Diagnostic Package Exchange Cycle	5 milliseconds
Diagnostic Data Exchange Cycle	up to 5 milliseconds
Fiber Optical Line Protocol	proprietary protocol with integrity checking (CRC), galvanic-isolated Tx / Rx
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 / Maximum consumption: 0.5A(±0.15A) (5 optical ports used)
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

RadICS Platform is the only FPGA-based I&C platform with a SIL 3 certification in a single channel configuration. The Platform is reviewed and approved by U.S. NRC. Radics LLC provides engineering, testing and commercial grade dedication services for nuclear power clients on international markets to meet local nuclear regulatory requirements and ensure safety and reliability at nuclear power genera on sites.

![radICS logo]

Radics has developed and delivered a digital I&C platform that is robust, flexible, and scalable. It provides state-of-the-art functions, services, and safeguards for both safety and non-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 Interface Protection Modules (IOPM) are used to provide electromagnetic compatibility and other electrical hazards protection for the input and output modules of RadICS Platform.
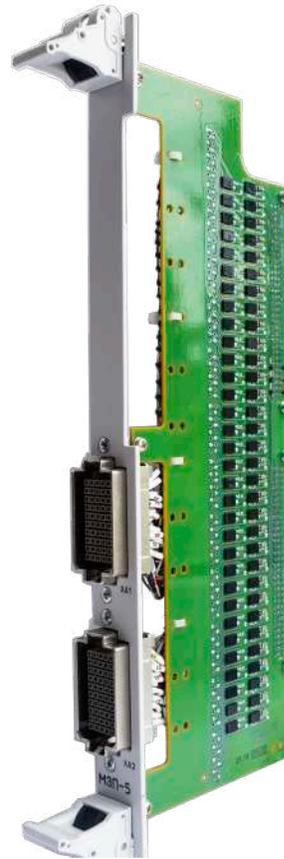
Interface Protection Module (IOPM)

➤ Provides electromagnetic compatibility, overvoltage, overcurrent, electrostatic discharge, and other electrical hazards protection for the RadICS input, output and communication modules.

➤ Passive component usage for best signal throughput

➤ Staggered connection locations (top/bottom) for maximum cable connectivity

➤ IEC 61508 SIL 3 certification

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Electrostatic Discharge Protection	15 kV air discharge 8 kV contact discharge
Input/Output channel isolation	all input and output channels are galvanic-isolated up to 500 VRMS AC or 500 VDC field-to-chassis and channel-to-channel
Overvoltage protection	Depends on module type
Operating temperature	4.4 to 60 °C (40 to 140 °F)
Operating humidity	10 to 90% relative humidity, non-condensing

radICS

Radics has developed and delivered a digital I&C platform that is robust, flexible, and scalable. It provides state-of-the-art functions, services, and safeguards for both safety and non-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 RadICS Chassis consists of 16 physical module slots, module communication and power supply backplane, and two fans (with associated control board). The RadICS Chassis (in qualified configuration) has a slot for 1 Logic Module and 14 slots for various I/O and Optical Communication (OCM) Modules. Each of the slots is equipped for proper and safe module installation and is configured with electrical protection for each module.
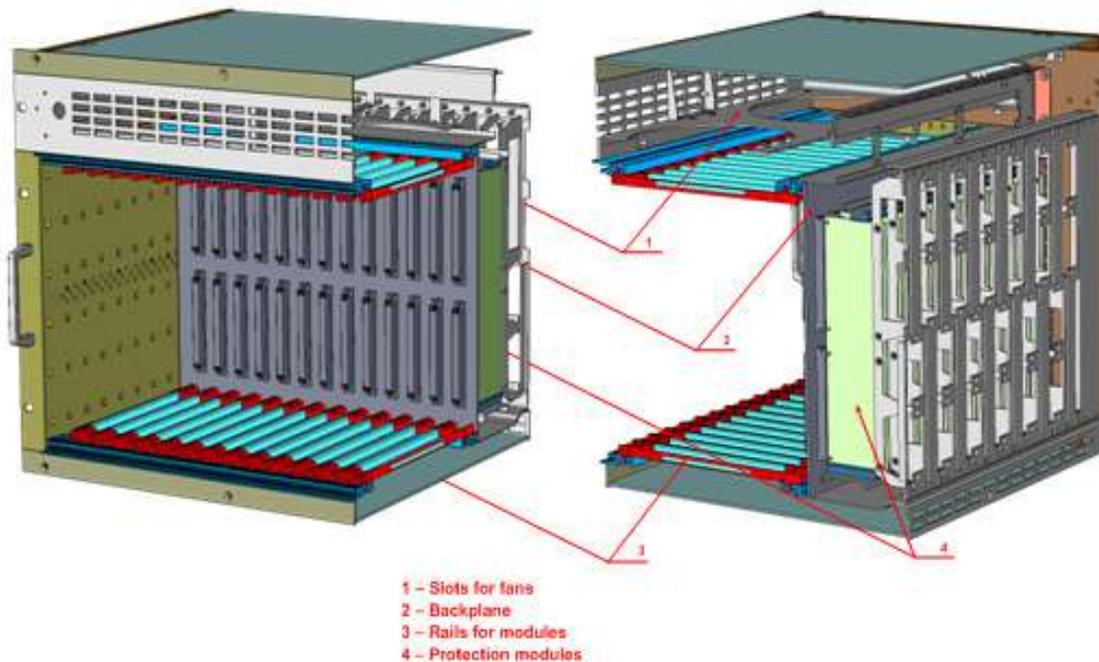
Chassis

➤ Standard 19-inch rack installation fit

➤ Two redundant 24 VDC supply inputs for distribution to each Module slot.

➤ I/O and OCM slots are configurable with rear accessible interface protection modules for module electrical protection

➤ Backplane for communication between the RadICS Modules, using direct individual lines from each I/O and OCM slot to the LM slot.

➤ Human Factor Features including:

- Labeling to identify slot allocation

- Visually verifiable tie-down clamps

- Blanks covering all unused slots

- Front mounted fiber optic connectors for LM and OCM

- Rear-connected I/O and OCM cabling

- Special coding pegs prevent I/O and OCM Modules from being inserted into the wrong slot

➤ Qualified to NRC-approved requirements for environmental, seismic, and electromagnetic compatibility.

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Chassis Technical Specifications

Chassis capacity	1 Logic Module Slots 14 Input/Output/Communication Module Slots
Backplane Communications	Galvanic-isolated point-to-point LVDS Tx / Rx
Self-diagnostic functions	Ventilation module detects fan failures
Power consumption	2 independent and redundant inputs – 24 (18 – 36) VDC / 1 amp (without modules) Distributed to all module slots
Indications	2 fan status LED indicators
Keyswitches	2 keyswitches provided for LM Tuning function
Operating temperature	4.4 to 60 °C (40 to 140 °F)
Operating humidity	10 to 90% relative humidity, non-condensing

1 – Slots for fans
2 – Backplane
3 – Rails for modules
4 – Protection modules

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Radics delivers digital I&C Platform RadICS that is robust, flexible, and scalable. The Company provides state-of-the-art functions, services, and safeguards for both safety and safety-related applications in the nuclear industry. The RadICS product line consists of a Logic Module, basic input/output modules, and specialized modules, all housed in a seismically qualified chassis.

PLM (Priority Logic Module) is designed to be used as a terminal control element from several command sources (multichannel systems and control panels) to control actuators as "Motor", "Gate Valve", and "Valve" (electromagnetic or pneumatic with electrical control) and others in I&C systems based on RadICS hardware.

PLM is made as a full-size standard RadICS Platform module which is designed for installation in a specialized RadICS chassis (with power connectors).

Priority Logic Module - PLM

➤ Control signal receive from different priority levels (most priority first): systems control signals (RPS, ESFAS or other), manual switches from Main and Emergency Control Rooms, front panel buttons

➤ All safety-critical functions are implemented using hard code on FPGA.

➤ Input line with neutral position control for eliminating wrong commands

➤ Voting logic select using hardware jumpers: "2oo4", "2oo3", "2oo2" or "1oo2"

➤ Actuating device select using hardware jumpers: motor, valve, gate valve.

➤ Independent FPGA for self-diagnostic, power control, diagnostic data transfer.

➤ BYPASS feature for providing safe testing means

  Actuator control using feedback inputs and current sensing.

➤ Digital self-diagnostic provides complete information about all internal units to operator PC via RadICS Platform tools

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Priority logic module – PLM

Actuator Control Outputs	3x 250 VAC/VDC, contact Form A, up to 3A each ("ON", "STOP", "OFF" circuits)
Linear Switchers Control Inputs	2x 250 VAC/VDC, 5 mA each. Differential input impedance: not less than 44 kOhm
Analog Outputs	3x 10 mA current outputs for external LED indication ("OPEN", "STOP", "CLOSE") (up to 24 Voltage dropout or 2.6 kOhm load)
Discrete Inputs Groups	11 isolated groups 4 circuits each (ON, STOP, OFF, NEUTRAL), 24 VDC / 7 milliamps maximum ("dry contacts")
Discrete Inputs	24 VDC, 10 milliamps maximum, Form A "dry" contact with galvanic isolation between inputs (2 reserved)
Input/Output Channel Isolation	all input and output channels are galvanic-isolated up to 500 VAC or 500 VDC channel-to-channel, channel-to-chassis
Discrete Inputs Overvoltage Protection	up to ±30 VDC/VAC continuous for input group and up to 150 VDC continuous for individual inputs (using external protection elements installed in Chassis)
Output Overvoltage Protection	250 VDC/VAC
Information Package Exchange Cycle	5 milliseconds
Diagnostic Package Exchange Cycle	5 milliseconds
LVDS Line	100 Mbit/sec
LVDS Line Protocol	proprietary protocol with integrity checking (CRC), galvanicisolated 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 / Maximum consumption: 0.77A(±0.15A) (32 inputs used; all inputs closed)
Indications	2 status LED indicators "RUN/FAULT" 3 actuator commands LED indicators "ON/STOP/OFF" 3 actuator position LED indicators "OPEN/STOP/CLOSE" 4 voting mode LED indicators "2oo4/2oo3/2oo2/1oo2" "BYPASS" indicator "MAN" for manual control indicator 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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RadICS delivers a digital I&C platform that is robust, flexible, and scalable. It provides state-of-the-art functions, services, and safeguards for both safety and safety-related applications in the nuclear power industry. The RadICS product line consists of a Logic Module, basic input/output modules, and specialty modules all housed in a seismically qualified chassis (except a standalone RVDU, which is not installed in the platform chassis).

RadICS Video Display Unit (RVDU) serves as a standalone unit providing display screen generation for commercial displays in accordance with input data from several chassis. The RVDU also provides functional data input in scope of system design using touchscreen, keyboard, mouse or trackball.

RadICS Video Display Unit (RVDU)

- ➤ FPGA-based design without any operating system for all functions.

- ➤ 8 independent fiber optic communication ports for full duplex communications between RVDU and platform chassis.

- ➤ 2 independent fiber optic Ethernet ports for functional and diagnostic data transfer to independent remote PCs.

- ➤ Master/slave mode for redundant 2-channel system design.Functional data input using touchscreen display, keyboard, mouse or trackball.

- ➤ Functional data input using touchscreen display, keyboard, mouse or trackball.

- ➤ Dedicated dry-contact input for data input confirmation.

- ➤ 4 isolated dry-contact inputs for common use.

- ➤ Dedicated dry-contact output for error alarm.

- ➤ 4 isolated dry-contact outputs for common use.

- ➤ Videoframe forming process does not influence on safety functions

- ➤ Robust self-diagnostics provides early fault detection for safety-focused fault management.

- ➤ Segregation of communications processing, self-diagnostics, watchdog functions and video frame forming assure safety-critical functionality.

- ➤ Inherent on-board diversity features eliminate common cause failure vulnerabilities.

- ➤ FPGA technology ensures resilience to I&C obsolescence.

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RadICS Video Display Unit Technical Specifications

Fiber Optical Lines	8x100 Mb/s Optical full duplex
Memory	48 megabit (FPGA internal total) 2*2 megabit (two external EEPROMs) 2048 megabytes (external DDR for logic elements) 2048 megabytes (external DDR for graphical elements)
Fiber Optical Line Protocol	Proprietary protocol with integrity checking (CRC), galvanic isolated Tx / Rx
Information Package Exchange Cycle	5 milliseconds
Ethernet Fiber Optical Lines	2x1000 BASE-FX IP/UDP
Diagnostic Data Exchange Cycle	5 milliseconds
Discrete Inputs	24 VDC, 10 milliamps maximum, Form A "dry" contact with galvanic isolation between inputs (5 available, 1 reserved)
Discrete inputs overvoltage protection	up to 150 VDC continuous
Discrete Outputs	"dry" contact: up to 48 V, 0.2 amp (AC/DC), galvanic-isolated by opticrelays (4 available 2 reserved fast discrete outputs)
Discrete outputs overvoltage protection	up to +60 VDC/VAC continuous
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
Keyboard, mouse or trackball interface	PS/2
Touchscreen interface	RS-485
Monitor Resolution Support	1280x720 px
Monitor interface Support	HDMI. Videoframes update time – 250 ms
Power Supply / Consumption	2 independent inputs– 24 (18 – 36) VDC / Maximum consumption: 0.92A(±0.15A)
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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