PRODUCT FLYER

C Series Functional Safety Module

CONTENTS

C Series Functional Safety Module

NI-9350

- Measurements, control, and safety integrated into a single system

- Powerful and easy-to-use Functional Safety Editor software

- I/O—analog input, digital input, and digital output

- Safety Integrity Level (SIL) 3 capable

- Functional safety certifications—IEC 61508, IEC 62061, and IEC 61511

- Built-in diagnostics

Measurements, Control, and Safety Converge

C Series Functional Safety Modules provide IEC 61508 SIL 3 level safety functions to a CompactRIO-based measurement or control system. The safety logic solver resides inside the module, and you can program it with the included Functional Safety Editor software. The module contains built-in diagnostics that can monitor the status of the hardware as well as the integrity of the connections. You can use these modules to control critical safety functions in manufacturing assembly and test cells, large physical systems tests, condition monitoring applications, and process monitoring and control.

Table 1. C Series Functional Safety Module Specifications

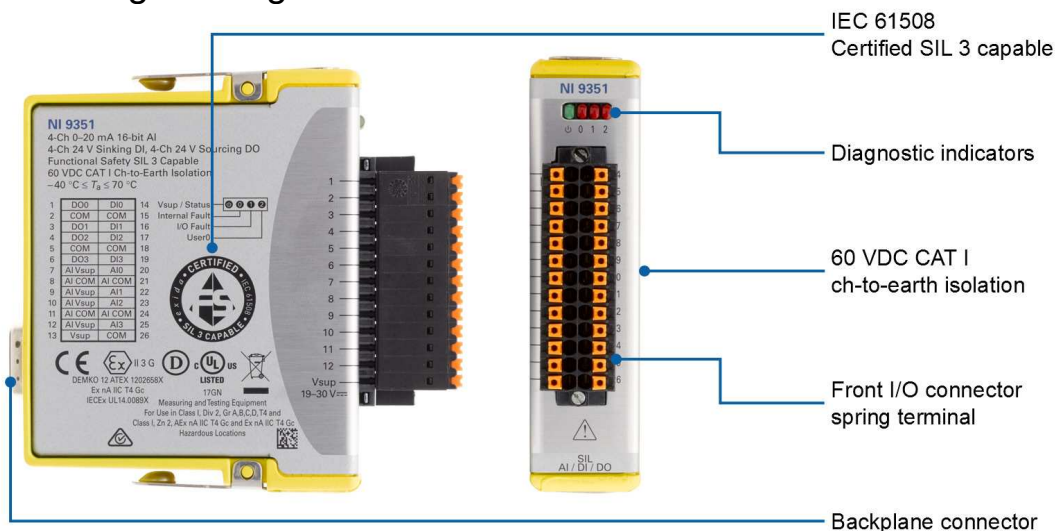|	NI 9350	NI 9351
Number of Channels	8 DI, 8 DO	4 AI, 4 DI, 4 DO
Type of Digital Input/Output	Sinking DI, Sourcing DO	
Type of Analog Input	--	0-20 mA, 16 bit
Rated Digital Input/Output Voltage	24V DC	
Input Voltage Range, "1" Input Current, "1"	11-30V 1.1 mA @ 24 V	
Input Voltage Range, "0" Input Current, "0"	0-6V	
Output Current	250 mA max	
Safety Response Time	250 µs max	2.1 ms max
SIL Level	Certified SIL 3 Capable	
Certification	IEC 61508, IEC 62061	
Connectivity	Spring Terminal	
Protection	Inputs: ±30 V; Outputs: short circuit protection from COM to Vsup	Digital Inputs: ±30 V; Analog Inputs: 20 V single channel up to 55°C Outputs: short circuit protection from COM to Vsup
Diagnostics	• Open loop & over current detection • Configurable test pulse outputs • Redundant DI with discrepancy timers	• Open loop & over current detection • Configurable test pulse outputs • Redundant DI with discrepancy timers • Overcurrent AI detection • Internal AI redundancy
Isolation	60VDC (bank)	
Operating Temperature	-40ºC to 70ºC	

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Detailed Views of the Functional Safety C-Series Modules

NI-9350 Digital I/O

IEC 61508
Certified SIL 3 capable

Diagnostic indicators

60 VDC CAT I
ch-to-earth isolation

Front I/O connector
spring terminal

Backplane connector
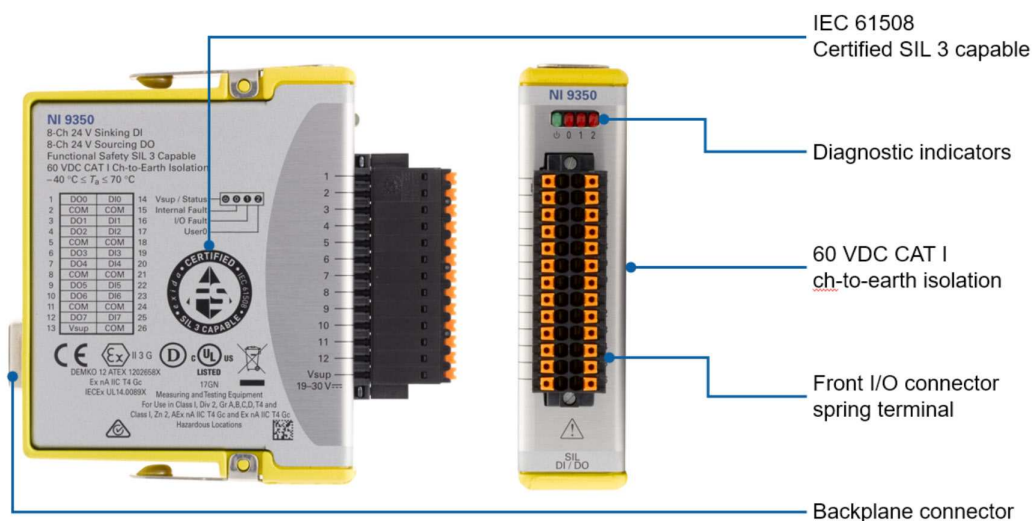
NI-9351 Analog and Digital I/O

IEC 61508
Certified SIL 3 capable

Diagnostic indicators

60 VDC CAT I
ch-to-earth isolation

Front I/O connector
spring terminal

Backplane connector

Key Features

Measurements, Control, and Safety in a Single System

The CompactRIO platform improves the way you design and deploy advanced control and monitoring systems with its endless capabilities and unrivaled performance. From controlling complex machines to monitoring critical assets, the CompactRIO platform offers unsurpassed advantages in any application. Connect to sensors, displays, cameras, motors, databases, and the enterprise directly from CompactRIO controllers to create a powerful, reliable system that you can customize and reconfigure through software—even after deployment in rugged environments.

In addition to conditioned measurements and control, you can integrate functionally safe I/O into a

CompactRIO system with the C Series Functional Safety Module. When you use the same platform for safety and control, you get the advantages of a single integrated development environment. You no longer need redundant sensors for both your control and safety systems because you can share the input values of the safety modules with the CompactRIO host without compromising the safety of your system. You also can place the modules into a pass-through mode where the output values can be controlled via the host. This is often valuable when automating tasks that don't need to be functionally safe such as proof testing. Finally, by integrating functional safety into your measurement or control system, you save significantly on total system and integration costs. This is especially true when deploying to hazardous environments where equipment such as explosion-proof enclosures are required. Eliminating the need for this extra equipment can significantly reduce the overall cost of your system.

SIL 3 Capable

C Series Functional Safety Modules are certified by exida to be SIL 3 capable with a hardware fault tolerance (HFT) of 0 under IEC 61508, IEC 62061, and IEC 61511.

Figure 1. C Series Functional Safety Modules are certified by exida to be SIL 3 capable with a HFT = 0.

Their logic solvers feature a unique design. The logic solver is self-contained within the module and uses an FPGA. This approach yields some of the fastest safety response times available on the market and provides an architecture that can be used alongside safety PLCs and relays when a unique and diverse backup solution is required.

Easy-to-Use Functional Safety Editor

The logic solver in C Series Functional Safety Modules is programmed with a stand-alone software package called the Functional Safety Editor. This software allows you to easily develop safety logic via state machines and create the necessary file to download to the module's logic solver. Using a graphical programming technique, you can create complex safety logic in an easy-to-use way. The graphical design flow lets you design safety logic like the safety diagrams in your safety instrumented system (SIS) manual were created.
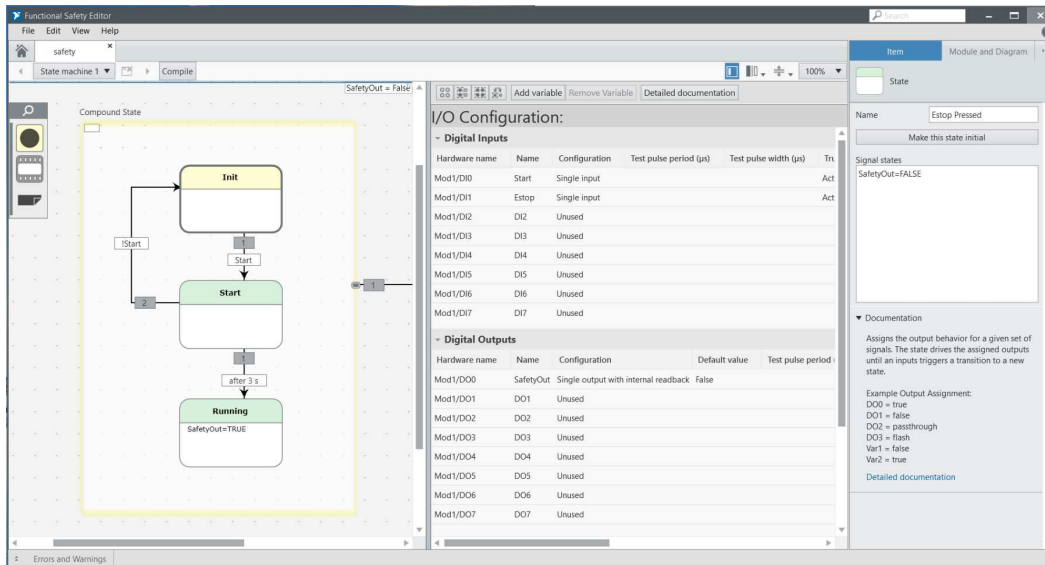
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Figure 2. The Functional Safety Editor allows you to easily develop safety logic.

What Is C Series?

Connect to Any Sensor or Any Bus

Digital systems interface with the physical world through sensors, and in the hyper-connected world of the Industrial Internet of Things (IIoT), these connections are growing rapidly. Take advantage of decades of NI leadership and innovation in acquiring high quality signals from any sensor or bus and high speed control with C Series I/O modules that feature measurement-specific signal conditioning and options for bank and channel-to-channel isolation.

With more than 150 NI and third-party C Series modules for measurement, control, and communication to choose from, you can connect C Series I/O to any sensor, signal, or bus. C Series I/O modules can be inserted into any CompactDAQ or CompactRIO chassis or controller to create a mix of channel counts and measurement types within one system. In addition to built-in signal conditioning, these hot-swappable modules feature numerous options for direct sensor connectivity and are designed to operate in the harshest of environments – with extended operating temperature ranges of -40 °C to 70 °C (-40 °F to 158 °F), 50 g shock rating, and a variety of international safety, electromagnetic compatibility (EMC), and environmental certifications and ratings.

Table 2. Connect to any sensor on any bus with C Series I/O modules.

Signal Type	Channels	Measurement Types	Max Rate	Special Features
Analog Input*				
Voltage	4, 8, 16, 32	±200 mV, ±1 V, ±5 V, ±10 V, ±60 V, 300 V_{rms}, 400 V_{rms}, 800 V_{rms}	1 MS/s/ch	Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters
Current	4, 8, 16	±20 mA, 5 A_{rms}	200 kS/s	Anti-aliasing filters, ch-ch isolation, built-in shunt resistors
Universal	2, 4	V, mA, TC, RTD, strain, Ω, IEPE	51.2 kS/s/ch	Excitation, bridge completion, anti-aliasing filters, ch-ch isolation, built-in shunt resistors, amplification
Thermocouple	4, 16	J, K, T, E, N, B, R, and S types	75 S/s/ch	CJC, bank isolation, amplification, filtering
RTD	4	100 Ω	400 S/s	50/60 Hz filtering
Strain/Bridge Based	4, 8	1/4, 1/2, full bridge (120 or 350 Ω)	50 kS/s/ch	Excitation, bridge completion, anti-aliasing filters
Acceleration and Sound	3, 4	±5 V, ±30 V	102.4 kS/s/ch	IEPE, anti-aliasing filters

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Analog Output**				
Voltage	4, 16	±10 V	100 kS/s/ch	Ch-ch isolation, bank isolation
Current	4	0 mA - 20mA	100 kS/s/ch	Open-loop detection
Digital I/O				
Input	4, 8, 16, 32	LVTTL, 5 VTTL, 12 V, 24 V, 30 V, 250 VDC/VAC	55 ns	Ch-ch isolation, bank isolation, sinking and sourcing
Output	4, 8, 16, 32	LVTTL, 5 VTTL, 12 V, 24 V, 60 V, 0 V - 50 V programmable	55 ns	Ch-ch isolation, bank isolation, sinking and sourcing
Input/Output	4, 8, 16, 32	LVTTL, 5 VTTL, 12 V, 24 V	55 ns	Ch-ch isolation, bank isolation
Relays	4, 8	30 VDC, 60 VDC, 250 VAC, SPST and SS	1 op/sec	Ch-ch isolation, bank isolation
Specialty				
Motion	1, 1	step/dir, CW/CCW, analog PWM	-	Stepper and servo drive signals, incremental encoder feedback
Synchronization	1, 3	Cabled, GPS	-	Pulse per second (PPS) accuracy of ±100 ns for multi-chassis synchronization

*Up to 24-bit resolution
**Up to 16-bit resolution

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Platform-Based Approach to Advanced Control and Monitoring

What Is the CompactRIO Platform?

The CompactRIO platform is built on three foundations: productive software, reconfigurable hardware, and an expansive ecosystem. Every CompactRIO product is built upon these pillars, resulting in a hardware platform that allows your business to standardize, customize, and accelerate productivity.

The integrated run-time software, development environments, IP libraries, drivers, middleware, and enterprise & systems management tools, along with high quality hardware and global services and support, provide the capabilities to support your business needs.

Software
Take advantage of NI Linux Real-Time using LabVIEW and C/C++, while abstracting the complexities of FPGA programming using LabVIEW FPGA for faster development

Modules
Over 200+ IO types supported by the CompactRIO family of products. Analog: Voltage, Current, Universal, Thermocouple, RTD, Strain, Bridge Based, Acceleration, Sound; Digital: Input, Output, Relays; Specialty: Motion, Synchronization, Industrial Communications

Form Factor
Choose between packaged and board-level controllers depending on your application requirements while feeling confident each product has been tested for maximum ruggedness and durability

Integration
Supports expansion I/O, vision, motion, industrial communication protocols, and HMI's to enable the creation of complex cohesive systems in one product

Monetize Your Efforts

Focus on the core expertise of your business while leaving the foundational elements of your embedded design to us. Spend time delivering innovation, competitive differentiation, and value-add features to your customers by customizing a pre-built, pre-validated embedded system from NI. Get your equipment or machines shipping faster, with less engineering expense and risk, and more features.

DETERMINISTIC CONTROL

USER PROGRAMMABLE FPGA

ANY SENSOR, ANY BUS

RUGGED ENVIRONMENTS
up to
50g shock
5g vibration

Hardware Services

All NI hardware includes a one-year warranty for basic repair coverage, and calibration in adherence to NI specifications prior to shipment. CompactRIO systems also include basic assembly and a functional test. NI offers additional entitlements to improve uptime and lower maintenance costs with service programs for hardware. Learn more at ni.com/services/hardware.

	Standard	Premium	Description
Program Duration	3 or 5 years	3 or 5 years	Length of service program
Extended Repair Coverage	●	●	NI restores your device's functionality and includes firmware updates and factory calibration.
System Configuration, Assembly, and Test[1]	●	●	NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment.
Advanced Replacement[2]		●	NI stocks replacement hardware that can be shipped immediately if a repair is needed.
System Return Material Authorization (RMA)[1]		●	NI accepts the delivery of fully assembled systems when performing repair services.
Calibration Plan (Optional)	Standard	Expedited[3]	NI performs the requested level of calibration at the specified calibration interval for the duration of the service program.

[1]This option is only available for PXI, CompactRIO, and CompactDAQ systems.
[2]This option is not available for all products in all countries. Contact your local NI sales engineer to confirm availability.
[3]Expedited calibration only includes traceable levels.

PremiumPlus Service Program
NI can customize the offerings listed above, or offer additional entitlements such as on-site calibration, custom sparing, and life-cycle services through a PremiumPlus Service Program. Contact your NI sales representative to learn more.

Technical Support
Every NI system includes a 30-day trial for phone and e-mail support from NI engineers, which can be extended through a Software Service Program (SSP) membership. NI has more than 400 support engineers available around the globe to provide local support in more than 30 languages. Additionally, take advantage of NI's award winning online resources and communities.

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