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NI-9770

DATASHEET

NI 9770



30 kHz to 100 MHz, 50 Ω , AC Coupled RF Receiver Module



- 1-channel, 320 kS/s
- Support for RF emissions measurements from 30 kHz to 100 MHz
- Software-selectable bandwidth from 3.2 kHz to 256 kHz
- 104 dB dynamic range
- Provides hardware detection of total power in the frequency range and time domain analysis
- -40° C to 70° C operating temperature range, 5 g vibration, 50 g shock
- SMA connectors

The NI 9770 is a single-channel C Series module designed to bring more advanced sensor measurements to CompactRIO systems used within machine condition monitoring. The NI 9770 measures RF emissions in the frequency range of 30 kHz to 100 MHz using a narrow configurable bandwidth to help detect electrical anomalies, which can be a leading indicator of machine failure. The SMA connectors on the NI 9770 provide antenna connectivity and allow the CompactRIO system to be installed for maximum uptime. Subject matter experts can monitor signals over time using the swept frequency representation to perform Electromagnetic Signature Analysis (EMSA). The NI 9770 detects the following electrical phenomena:

- Partial discharge
- Corona discharge
- Arcing
- Any other phenomena that result in RF emissions

	Kit Contents	<ul style="list-style-type: none"> • NI 9770 • NI 9770 Getting Started Guide
	Recommended Accessories	<ul style="list-style-type: none"> • 781611-01 Precision Coaxial Cable, 1.0 m, K-Type, Male-Male • 780487-01 Torque Screwdriver, Preset (100 NCM)

NI C Series Overview



NI provides more than 100 C Series modules for measurement, control, and communication applications. C Series modules can connect to any sensor or bus and allow for high-accuracy measurements that meet the demands of advanced data acquisition and control applications.

- Measurement-specific signal conditioning that connects to an array of sensors and signals
- Isolation options such as bank-to-bank, channel-to-channel, and channel-to-earth ground
- -40 °C to 70 °C temperature range to meet a variety of application and environmental needs
- Hot-swappable

The majority of C Series modules are supported in both CompactRIO and CompactDAQ platforms and you can move modules from one platform to the other with no modification.

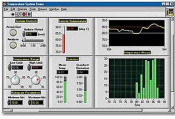
CompactRIO



CompactRIO combines an open-embedded architecture with small size, extreme ruggedness, and C Series modules in a platform powered by the NI LabVIEW reconfigurable I/O (RIO) architecture. Each system contains an FPGA for custom timing, triggering, and processing with a wide array of available modular I/O to meet any embedded application requirement.

Software

LabVIEW Professional Development System for Windows



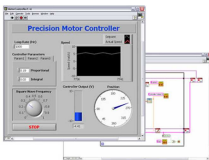
- Use advanced software tools for large project development
- Generate code automatically using DAQ Assistant and Instrument I/O Assistant
- Use advanced measurement analysis and digital signal processing
- Take advantage of open connectivity with DLLs, ActiveX, and .NET objects
- Build DLLs, executables, and MSI installers

NI LabVIEW FPGA Module



- Design FPGA applications for NI RIO hardware
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms
- Incorporate existing HDL code and third-party IP including Xilinx IP generator functions
- Purchase as part of the LabVIEW Embedded Control and Monitoring Suite

NI LabVIEW Real-Time Module

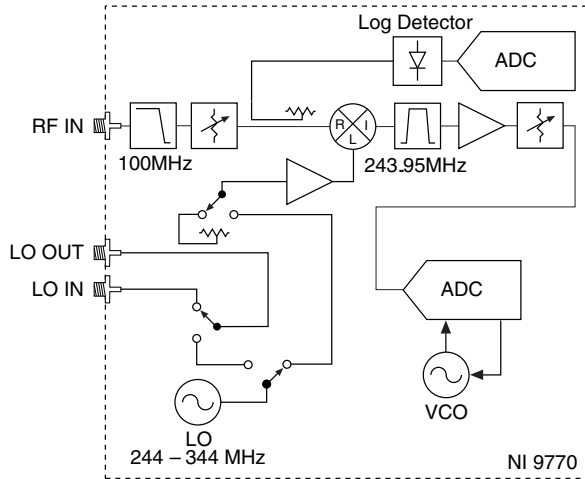


- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of multicore CPUs or set processor affinity manually
- Take advantage of real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

Circuitry

The RF IN signal of the NI 9770 is filtered, mixed, and then sampled by a 16-bit IF digitizer. The LO IN and LO OUT connectors provide local oscillator signal sharing between modules to enable phase coherency.

Figure 1. NI 9770 Input Circuitry



NI 9770 Specifications

The following specifications are typical for the range $-40\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$ unless otherwise noted.



Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.



Caution Do not operate the NI 9770 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

Typical values describe useful performance beyond specifications that are not covered by warranty and do not include guardbands for measurement uncertainty of drift. Typical values may not be verified on all units shipped from the factory. Typical values cover the expected performance of units with a 90% percentile and 90% confidence level based on measurements taken during either development or production. Nominal values (or supplemental information) describe additional information about the product that may be useful, including expected performance not covered by other specifications.

Input Characteristics

Number of channels	1 RF input
Local oscillator	1 LO input

ADC Resolution

IF digitizer	16 bits
Log detector	16 bits

Type of ADC

IF digitizer	Delta-Sigma
Log detector	Successive Approximation Register (SAR)

Sample rate

IF digitizer	320 kS/s
Log detector	190.512 kS/s

Input power

Maximum RF IN power	+10 dBm
Maximum LO IN power	+15 dBm

Absolute Maximum Input

RF IN	+10 dBm
LO IN	+15 dBm

Input impedance

RF IN	50 Ω (nominal)
LO IN	50 Ω (nominal)

Amplitude accuracy ¹ at 30 kHz to 100 MHz	± 4.0 dB
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Input coupling	AC
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Average noise floor at 1 MHz to 100 MHz ²	-155 dBm/Hz
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Instantaneous bandwidth	3.2 kHz to 256 kHz
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Phase noise at 10 MHz center frequency

10 kHz offset	< -88 dBc/Hz (nominal)
100 kHz offset	< -104 dBc/Hz (nominal)

Third-order intermodulation at maximum gain	2 dBm
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Gain compression	-2 dBm (nominal)
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Dynamic range ³	104 dB (nominal)
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¹ Amplitude accuracy is based on -10 dBm to -50 dBm reference level. The value is measured at the center frequency.

² Average noise floor is measured at maximum gain state. Extreme temperatures can affect average noise floor since the amplitude accuracy changes based on ambient temperature.

³ Dynamic range is defined as $2/3 * (\text{third order intermodulation} - \text{average noise floor})$.

Residual spurs⁴

> 0.5 MHz to 2 MHz	-100 dBm
> 2 MHz to 100 MHz	-105 dBm
IF frequency	243.9168 MHz with a bandwidth of 256 kHz

Table 1. Image and IF Rejection

Specification	1 MHz to 100 MHz
Image rejection	-64 dBc
IF rejection	-64 dBc
IF/2 rejection	-64 dBc

Output Characteristics

Number of channels	1 LO output
Output coupling	AC
Frequency range ⁵	244 MHz to 344 MHz
Output impedance	50 Ω (nominal)
Maximum LO OUT power ⁶	+15 dBm
Sample rate	320 kHz

Power Requirements

Power consumption from chassis	
Thermal Dissipation	1 W maximum
Sleep mode	25 μ W maximum

Physical Characteristics

If you need to clean the module, wipe it with a dry towel.



Tip For two-dimensional drawings and three-dimensional models of the C Series module and connectors, visit ni.com/dimensions and search by module number.

Weight	159 g (5.6 oz)
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⁴ For frequencies < 0.5 MHz, the Local Oscillator signal feeds through to the first mixer and affects residual spurs.

⁵ The frequency output is dependant on the value of the Center Frequency (Hz) control in the Configure RF block when the internal LO is used, and the frequency input to the LO In port when the External LO is used.

⁶ The internal LO has sufficient power to drive two additional slave modules.

Absolute Maximum Input

RF IN	+10 dBm
LO IN	+15 dBm

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4
Europe (ATEX) and International (IECEX)	Ex nA IIC T4 Gc

Safety and Hazardous Locations Standards

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1
- EN 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4
- UL 60079-0; Ed 5, UL 60079-15; Ed 3
- CSA 60079-0:2011, CSA 60079-15:2012



Note For UL and other safety certifications, refer to the product label or the [Online Product Certification](#) section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for sensitive electrical equipment for measurement, control, and laboratory use:

- EN 61326-2-1 (IEC 61326-2-1): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe,

Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



Note For EMC declarations and certifications, and additional information, refer to the [Online Product Certification](#) section.

CE Compliance

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 94/9/EC; Potentially Explosive Atmospheres (ATEX)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Shock and Vibration

To meet these specifications, you must panel mount the system.

Operating vibration

Random (IEC 60068-2-64)	5 g _{rms} , 10 Hz to 500 Hz
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Sinusoidal (IEC 60068-2-6)	5 g, 10 Hz to 500 Hz
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Operating shock (IEC 60068-2-27)	30 g, 11 ms half sine; 50 g, 3 ms half sine; 18 shocks at 6 orientations
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Environmental

Refer to the manual for the chassis you are using for more information about meeting these specifications.

Operating temperature (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 70 °C
Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 85 °C
Ingress protection	IP40
Operating humidity (IEC 60068-2-78)	10% RH to 90% RH, noncondensing
Storage humidity (IEC 60068-2-78)	5% RH to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	5,000 m

Indoor use only.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit ni.com/environment/weee.

电子信息产品污染控制管理办法（中国 RoHS）



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