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***PXI-1000***

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## 2.66 GHz Dual-Core Real-Time Embedded Controller for PXI

### NI PXI-8109 RT



- Intel Core i7-620M dual-core processor (2.66 GHz (base), 3.33 (single-core turbo))
- 2 GB (1 x 2 GB DIMM) dual-channel 1066 MHz DDR3 standard, 4 GB (2 x 2 GB DIMM) maximum
- Execution target for NI LabWindows/CVI Real-Time 2010 or later applications
- Execution target for NI LabVIEW Real-Time 2010 or later applications
- 161 kHz single PID loop rate, maximum
- Reliable and deterministic operation and Ethernet control of PXI
- Two 10/100/1000BASE-TX Ethernet ports and four Hi-Speed USB ports
- Other peripherals (ExpressCard/34 slot, DVI-I video connector, IEEE 1284 ECP/EPP parallel port, GPIB (IEEE 488) controller, and RS232 serial port)
- Complete PXI system configuration at [ni.com/pxiadvisor](http://ni.com/pxiadvisor)

### Overview

National Instruments RT Series PXI embedded controllers deliver a flexible, rugged platform for your deterministic, real-time measurement and control applications. The NI PXI-8109 RT controller with 2.66 GHz base frequency, a 3.33 GHz (single-core turbo) dual-core processor, dual-channel 1066 MHz DDR3 memory, and high-performance 7200 rpm hard drive offers a high-performance platform ideal for demanding real-time test and control applications. You can develop your LabVIEW application with the LabVIEW Real-Time Module on Windows and download the program to your NI PXI-8109 RT controller via Ethernet. The embedded code executes on a real-time OS. Thus, you use the powerful and flexible development tools of LabVIEW to build reliable, real-time solutions.

LabVIEW Real-Time applications running on PXI systems achieve millisecond loop rates with only 3 to 4  $\mu$ s of system jitter. These real-time measurement and control systems capitalize on the latest processors combined with the advanced timing, triggering, and I/O synchronization benefits of PXI. Furthermore, NI measurement services software extends the timing capabilities of PXI to deliver tight integration with LabVIEW Real-Time applications through operations such as hardware-timed software loops.

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### Requirements and Compatibility

#### OS Information

- Real-Time OS

#### Software Compatibility

- LabVIEW
- LabVIEW Real-Time Module

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### Application and Technology

#### NI PXI-8109 RT Features

CPU	Intel Core i7-620M, 2.66 GHz (base), 3.33 GHz (single-core turbo mode), 3.06 GHz (dual-core turbo mode) <sup>1</sup>
Dual-channel 1066 MHz DDR3 RAM, standard	2 GB (1 x 2 GB)
Dual-channel 1066 MHz DDR3 RAM, maximum	4 GB (2 x 2 GB)
Hard drive (standard option), minimum	120 GB SATA (7200 rpm)

Hard drive (extended temperature and 24/7 option), minimum	80 GB SATA (5400 rpm)
10/100/1000BASE-TX (Gigabit) Ethernet ports	2
Hi-Speed USB ports	4
GPIO (IEEE 488) controller	
Serial port (RS232)	
Parallel port	
ExpressCard/34 slot	
Watchdog/trigger SMB	

<sup>1</sup> Processor should not throttle CPU frequency under reasonable, worst-case processor workloads in high operating temperature.

Table 1. NI PXI-8109 RT Features

### Run Parallel Tasks on Separate Processor Cores

The LabVIEW Real-Time Module takes advantage of the available dual cores on the Intel processor to increase performance and determinism for large real-time test and control applications. You can either explicitly assign certain tasks to run on specific cores of the processor or let the real-time operating system manage this assignment for you.

The NI PXI-8109 RT features Intel Turbo Boost technology which provides performance benefits for all types of applications without requiring the application to be optimized for multicore processors. The NI PXI-8109 RT has a 2.66 GHz base clock frequency, and, with Intel Turbo Boost technology, the frequency automatically increases based on the application type. For example, when running applications that generate only a single processing thread, the CPU places the unused cores into an idle state and increases the active core's clock frequency from 2.66 to 3.33 GHz.<sup>1</sup> For applications that are processing two threads, the active core's clock frequency increases from 2.66 to 3.06 GHz.<sup>1</sup> Turbo Boost provides performance increases for all types of applications and can significantly reduce test times for applications that are processor-intensive.

**Note:** Intel Turbo Boost technology can increase application jitter, so care should be taken when enabling this setting on real-time systems.

<sup>1</sup>Processor should not throttle CPU frequency under reasonable, worst case processor workloads in high operating temperatures.

### Connect to Any I/O

The modularity of PXI and open development environment of LabVIEW make it easy to integrate a variety of I/O within your application. Create a custom real-time embedded solution using a PXI-8109 RT with any number and combination of PXI/CompactPCI plug-in modules. With built-in LabVIEW libraries, you can create applications with data acquisition, dynamic signal acquisition, motion control, image acquisition, reconfigurable I/O, and instrumentation. Communicate with peripheral devices through CAN, GPIO, Ethernet, or serial protocols. And use NI-VISA to integrate third-party PXI/CompactPCI modules into your application.

In addition, the NI PXI-8109 RT controller includes an external SMB connection for use as a trigger input, output, or watchdog timer. Use the external SMB to pass trigger and timing signals into and out of the PXI trigger bus in your system.

### Create Reliable Stand-Alone Systems

To ensure reliable operation, embedded LabVIEW Real-Time applications continue to run even if the host PC is interrupted or rebooted. Because the PXI-8109 RT embedded controller runs in a separate chassis with a dedicated power supply, the operator can shut down the host computer entirely without disrupting the real-time program.

For stand-alone operation, you can embed code in the system so that it starts automatically when the system boots, requiring no human interaction. Use the LabVIEW Professional Development System and LabVIEW Real-Time Module to compile your LabVIEW application into an executable and download it to your PXI-8109 RT controller.

### Dual-Boot Option

You can configure NI PXI embedded controllers to boot into Windows or the real-time OS. NI Measurement & Automation Explorer (MAX) includes features for installing and configuring PXI embedded controllers as LabVIEW Real-Time targets. The controllers use a hardware switch or BIOS setting to boot into the desired OS.

The result is a PXI embedded controller that can run embedded LabVIEW Real-Time or Windows applications. When the controller is in real-time mode, you need another Windows computer to develop and debug the LabVIEW Real-Time code for the PXI controller. To enable a Windows PXI embedded controller to dual-boot with the real-time OS, you must purchase the LabVIEW Real-Time embedded deployment software for the controller.

### Extended Temperature and 24/7 Operation Option

You can choose from two versions of the PXI-8109 RT embedded controller to address different environmental and usage conditions. The primary difference between the versions is that the version for extended temperature and 24/7 operation uses a different hard drive that is designed for both reliability in low- and high-temperature extremes and 24/7 operation. The standard version of the controllers has an operating temperature of 5 to 50 °C and a storage temperature of -40 to 65 °C. The extended temperature and 24/7 operation version has an operating temperature of 0 to 55 °C and a storage temperature of -40 to 70 °C.

You can also use the extended temperature and 24/7 operation version for applications that require continuous operation for up to 24 hours/day, seven days/week because the hard drive is rated for 24/7 operation. The hard drive in the standard version of the controllers is designed to be powered on for eight hours/day, five days/week. Additionally, 24/7 operation applications may subject the hard drive to a high-duty cycle (the percentage of the maximum sustained throughput of the hard drive). The hard drive in the extended temperature and 24/7 operation version has a capacity of 80 GB (minimum). See specifications for further details.

### Real-Time Performance Benchmarks

Table 2 contains the PID loop rate benchmark numbers for the PXI-8109 RT. For a direct comparison, the benchmarks for the PXI-8109 RT embedded controller were artificially restricted to exercise only the first CPU cores on the Intel i7-620M dual-core processor. The PXI-8109 RT had Intel Turbo Boost technology enabled. This can increase application jitter, so be careful when enabling this setting on real-time systems.

Benchmark	Processing	Channels	DAQ I/O Mode	Loop Rate (kHz)	
				PXI-8110 RT	PXI-8109 RT
Analog I/O	PID	1	Polling	161	161
Analog I/O	PID	1	Interrupt	29	40
Analog I/O	PID	4	Polling	93	94
Analog I/O	PID	4	Interrupt	27	36
Analog I/O	PID	16	Polling	33	33
Analog I/O	PID	16	Interrupt	21	28

Table 2. Maximum loop rates for LabVIEW Real-Time PXI systems are shown. All benchmarks use the LabVIEW Real-Time Module 2010 with NI-DAQmx 9.1.5. Benchmarks were revised to adhere to the architecture recommended by NI for symmetric multiprocessing-enabled systems. Benchmarks that do not test network performance run on a headless target without a direct Ethernet connection for maximum performance. Benchmarks that do test network performance use interrupt-mode Ethernet via a direct connection between the host PC and real-time target with a crossover cable. Visit [ni.com](http://ni.com) or contact National Instruments for additional benchmarks.

### In-ROM Memory and Hard-Drive Diagnostics

To improve the serviceability of the NI PXI-8109 RT, In-ROM diagnostics for the hard drive and memory can be quickly accessed without requiring external third-party tools. By running these diagnostics, the results of analysis can determine if replacement of the hard drive or memory is required. The design of the controller allows for quick field replacement of critical components such as the hard drive and the memory without affecting the warranty. To ease the process of buying spare components, you can purchase hard drive and memory upgrades with the NI PXI-8109 RT. The combination of this and the In-ROM diagnostics significantly improves NI PXI-8109 RT serviceability.

### Memory

The PXI-8109 RT uses dual-channel 1066 MHz DDR3 SDRAM, which makes the controller ideal for data-intensive applications requiring significant analysis. It has two SO-DIMM sockets for the DDR3 SDRAM. 2 GB (1 x 2 GB DIMM) of RAM is standard with upgrade options to 4 GB.

Memory Options	Configuration	Part Number	
		Included in Kit	Additional P/N Required
Standard - 2 GB	1 x 2 GB DIMM	1 x 2 GB DIMM	N/A
4 GB	2 x 2 GB DIMM	1 x 2 GB DIMM	Add 1 x 781508-2048

Table 3. Memory Upgrade Options

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## Ordering Information

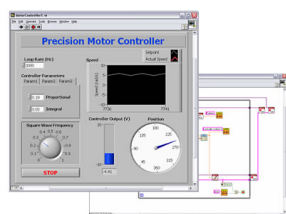
For a complete list of accessories, visit the product page on [ni.com](http://ni.com).

Products	Part Number	Recommended Accessories	Part Number
<b>Hard-Drive Spare/Replacement and Upgrades</b>			
500 GB 2.5 in SATA Hard Drive Upgrade	781946-01	No accessories required.	
120 GB (or greater) 2.5 in. SATA Blank HDD Spare/Replacement	780970-01	No accessories required.	
250 GB 2.5 in MLC SATA Solid-State Drive Upgrade	781945-01	No accessories required.	
80 GB (or greater) 2.5 in. SATA Ext Temp, 24/7 Blank HDD Spare/Replacement	779175-07	No accessories required.	
32 GB 2.5 in SATA Solid-State Drive Upgrade	779175-08	No accessories required.	
<b>Other Accessories</b>			
USB English keyboard and optical mouse	779660-01	No accessories required.	
USB-to-dual-PS/2 keyboard/mouse adapter cable	778713-02	No accessories required.	
Micro-GPIB to GPIB cable (2 m)	183285-02	No accessories required.	
ExpressCard strain-relief accessory for embedded controllers	192524-01	No accessories required.	
Micro-GPIB to GPIB cable (1 m)	183285-01	No accessories required.	
External USB floppy drive	778492-02	No accessories required.	
<b>NI PXI-8109 RT</b>			
NI PXI-8109 Real-Time Embedded SW Extended Temp	781454-33	No accessories required.	
NI PXI-8109 Real-Time Embedded SW	781453-33	No accessories required.	

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## Software Recommendations

### 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
- Includes real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

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## Support and Services

### System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at [ni.com/advisor](http://ni.com/advisor) to find a system assurance program to meet your needs.

### Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit [ni.com/support](http://ni.com/support) to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit [forums.ni.com](http://forums.ni.com) for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit [community.ni.com](http://community.ni.com) to find, contribute, or collaborate on customer-contributed technical content with users like you.

### Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit [ni.com/repair](http://ni.com/repair).

### Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

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Visit [ni.com/training](http://ni.com/training) for more information.

### Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit [ni.com/warranty](http://ni.com/warranty).

### OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit [ni.com/oem](http://ni.com/oem).

### Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit [ni.com/alliance](http://ni.com/alliance).

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## Detailed Specifications

This appendix lists the electrical, mechanical, and environmental specifications of the NI PXI-8109 embedded computer.

### Features

NI PXI-8109	
CPU	Intel Core i7-620 M
CPU Frequency	2.66 GHz (base), 3.33 GHz (single-core Turbo mode)
On-die L2 cache	256 KB x2 (256 KB per core)
On-die L3 cache	4 MB shared between cores
Dual-Channel DDR3 RAM, PC3 8500	2 GB Standard, 8 GB Maximum
Hard Drive	120 GB or larger Serial ATA <sup>1</sup>
Ethernet	10/100/1000 BaseTX, 2 ports
GPIO (IEEE 488 Controller)	Yes
Serial Ports (RS-232)	Yes (1)
Parallel Port	Yes (1)

NI PXI-8109	
Hi-Speed USB (2.0) Ports	Yes (4)
ExpressCard/34 Slot	Yes
PS/2 Keyboard/Mouse Connector	No
PXI Trigger Bus Input/Output	Yes
Installed Operating System	Windows 7 Professional, Windows XP Professional SP3 for Embedded Systems

## Electrical

Voltage (V)	Current (A)	
	Typical	Maximum
+3.3	2 A	3 A
+5 (+5 V <sub>DC</sub> and +5 V <sub>IO</sub> ) <sup>2</sup>	8 A	9.5 A
+12	.050 A	.150 A
−12	0 A	0 A

## Physical

Board dimensions	PXI 3U-size module, 8.1 cm × 13 cm × 21.6 cm (3.2 in. × 5.1 in. × 8.5 in.)
Slot requirements	One system slot plus three controller expansion slots
Compatibility	Fully compatible with PXI specification
Weight	1.30 kg (2.87 lb) typical

## Environment

Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
Pollution Degree	2
Indoor use only.	

## Operating Environment

Ambient temperature <sup>3 4</sup>	
Base	5 to 50 °C <sup>5</sup> (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2)
Extended temperature	0 to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2)
Relative humidity	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)



**Caution** Clean the NI PXI-8109 with a soft nonmetallic brush. Make sure that the device is completely dry and free from contaminants before powering-on the controller again.

## Storage Environment

Ambient temperature	
Base	−40 to 65 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Extended temperature	−40 to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Relative humidity	5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

## Shock and Vibration

Operational shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)
Random vibration	
Operating	5 to 500 Hz, 0.3 g <sub>rms</sub> (with solid-state hard drive)
Nonoperating	5 to 500 Hz, 2.4 g <sub>rms</sub> (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)



**Note** Specifications are subject to change without notice.

## Safety Standards

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

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1



**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 electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic 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** For EMC declarations and certifications, refer to the *Online Product Certification* section.



**Note** For EMC compliance, operate this device with shielded cables and accessories.

## CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

## Online Product Certification

To obtain product certifications and the DoC for this product, visit [ni.com/certification](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## 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 not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at [ni.com/environment](http://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 products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit [ni.com/environment/weee.htm](http://ni.com/environment/weee.htm).

### Battery Replacement and Disposal



**Battery Directive** This device contains a long-life coin cell battery. If you need to replace it, use the Return Material Authorization (RMA) process or contact an authorized National Instruments service representative. For more information about compliance with the EU Battery Directive 2006/66/EC about Batteries and Accumulators and Waste Batteries and Accumulators, visit [ni.com/environment/batterydirective](http://ni.com/environment/batterydirective).

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(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china).)

<sup>1</sup> Extended-temperature 24/7 option provides 80 GB minimum hard drive.

<sup>2</sup> Does not include any attached USB devices or ExpressCard.

<sup>3</sup> For chassis that are not available in the online catalog at [ni.com](http://ni.com), contact National Instruments for supported operating temperatures.

<sup>4</sup> Processor should not throttle CPU frequency under reasonable, worst case processor work loads in high operating temperatures.

<sup>5</sup> 5 to 40 °C for the PXI-1000B DC.

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