SPECIFICATIONS

NI sbRIO-9637

Single-Board RIO OEM Devices

This document lists the specifications for the NI sbRIO-9637. The following specifications are typical for the -40 °C to +85 °C operating temperature range unless otherwise noted.

Caution Do not operate the sbRIO-9637 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.

Processor

Type	Xilinx Zynq-7000, XC7Z020 All Programmable SoC
Architecture	ARM Cortex-A9
Speed	667 MHz
Cores	2
Operating system	NI Linux Real-Time (32 bit)
Nonvolatile memory[1]	512 MB
Volatile memory (DRAM)	512 MB
Real-time clock, accuracy	5 ppm
Flash reboot endurance[2]	100,000 cycles

Note For information about the life span of the nonvolatile memory and about best practices for using nonvolatile memory, visit *ni.com/info* and enter the Info Code `SSDBP`.

[1] Formatted nonvolatile memory may be slightly less than this value.

[2] You can increase the flash reboot endurance value by performing field maintenance on the device. If you expect that your application may exceed the maximum cycle count listed in this document, contact NI support for information about how to increase the reboot endurance value.

NATIONAL INSTRUMENTS

Operating System

Note For minimum software support information, visit *ni.com/info* and enter the Info Code `swsupport`.

Supported operating system	NI Linux Real-Time (32-bit)
Minimum software requirements	
Application software	
LabVIEW	LabVIEW 2015, LabVIEW 2015 Real-Time Module, LabVIEW 2015 FPGA Module
C/C++ Development Tools for NI Linux Real-Time[3]	Eclipse Edition 2014
Driver software	NI CompactRIO Device Drivers August 2015

Reconfigurable FPGA

Type	Xilinx Zynq-7000, XC7Z020 All Programmable SoC
Number of logic cells	85,000
Number of flip-flops	106,400
Number of 6-input LUTs	53,200
Number of DSP slices (18 x 25 multipliers)	220
Available block RAM	560 KB
Number of DMA channels	16
Number of logical interrupts	32

Network/Ethernet Port

Number of interfaces	
Front Panel Ethernet	1 (Eth0)

[3] C/C++ Development Tools for NI Linux Real-Time is an optional interface for C/C++ programming of the sbRIO-9637 processor. Visit *ni.com/info* and enter Info Code `RIOCdev` for more information about the C/C++ Development Tools for NI Linux Real-Time.

Network interface	10Base-T, 100Base-TX, and 1000Base-T Ethernet[4]
Compatibility	IEEE 802.3
Communication rates	10 Mbps, 100 Mbps, 1000 Mbps auto-negotiated, half-/full-duplex
Maximum cabling distance	100 m/segment

RS-232 (DTE) Serial Port

Number of interfaces	
Onboard RS-232	2 (Serial1, Serial2)
Baud rate support	Arbitrary
Maximum baud rate	230,400 bps
Data bits	5, 6, 7, 8
Stop bits	1, 2
Parity	Odd, Even, Mark, Space
Flow control	RTS/CTS, XON/XOFF, DTR/DSR, None

RS-485 Serial Port

Number of interfaces	
Onboard RS-485	1 (Serial3)
Maximum baud rate	460,800 bps
Data bits	5, 6, 7, 8
Stop bits	1, 1.5, 2
Parity	Odd, Even, Mark, Space
Flow control	XON/XOFF
Wire mode	4-wire, 2-wire, 2-wire auto
Isolation voltage, port to earth ground	None

[4] For revision D and earlier, 1000Base-T Ethernet link and communication is not guaranteed for the Ethernet port below -20 °C. If you expect ambient temperatures below -20 °C, NI recommends using a 10/100 network infrastructure or assigning 10/100Mbps communication speeds to the Ethernet Adapter in NI Measurement & Automation Explorer (MAX).

Embedded CAN

Number of interfaces	
Onboard CAN	1 (CAN0)
Onboard CAN transceiver	NXP PCA82C251T
Maximum baud rate	1 Mbps
Minimum baud rate	10 kbps

USB Port

Number of interfaces	
Front Panel USB Host	1 (USB0)
Compatibility	USB 2.0, Hi-Speed
Maximum data rate	480 Mb/s
Maximum front panel USB current	900 mA

SD Card Slot

Number of interfaces	
Front Panel SD	1 (SDIO0)
Supported Standards	SD, SDHC[5]
Front Panel SD Throughput	
Read	12.0 MB/s maximum
Write	9.0 MB/s maximum

3.3 V Digital I/O on 50-Pin IDC Connector

Number of DIO channels	28
Maximum tested current per channel	±3 mA
Input logic levels	
Input low voltage, V_{IL}	-0.3 V minimum; 0.8 V maximum
Input high voltage, V_{IH}	2.0 V minimum; 5.25 V maximum

[5] Both standard SD and microSD interfaces are supported.

Output logic levels

Output high voltage, V_{OH} when sourcing 3 mA	2.4 V minimum; 3.45 V maximum
Output low voltage, V_{OL} when sinking 3 mA	0.0 V minimum; 0.4 V maximum

Analog Input Characteristics

Number of channels	16 single-ended or 8 differential
ADC resolution	16 bits
Maximum aggregate sampling rate	200 kS/s
Input range	±10 V, ±5 V, ±2 V, ±1 V
Maximum working voltage (signal + common mode)	
10 V range	±11 V
5 V range	±10.5 V
2 V range	±9 V
1 V range	±8.5 V
Input impedance	
Powered on	> 1 GΩ in parallel with 100 pF
Powered off/overload	2.3 kΩ minimum
Overvoltage protection	
Powered on	±25 V, for up to 2 AI pins
Powered off	±15V

AI accuracy

Measurement Conditions	Range	Percent of Reading (Gain Error)	Percent of Range (Offset Error)
Typical (25 °C, ±5 °C)	1 V	0.042%	0.007%
	2 V		0.007%
	5 V		0.007%
	10 V		0.008%

Measurement Conditions	Range	Percent of Reading (Gain Error)	Percent of Range (Offset Error)
Max (-40 to 85 °C)	1 V	0.380%	0.179%
	2 V	0.360%	0.138%
	5 V	0.348%	0.113%
	10 V	0.344%	0.105%

Gain drift	12 ppm of reading/°C
Offset drift	4 ppm of range/°C
AI noise	
10 V range	200 µVrms
5 V range	105 µVrms
2 V range	45 µVrms
1 V range	30 µVrms
INL	±64 ppm of range, maximum
DNL	No missing codes guaranteed
CMRR, DC to 60 Hz	-80 dB
Input bandwidth (-3 dB)	540 kHz, typical
Settling error (multichannel scanning)	±60 ppm step size, typical
Crosstalk (10 kHz)	-70 dB

Typical performance

Figure 1. Common Mode Rejection Ratio versus Frequency

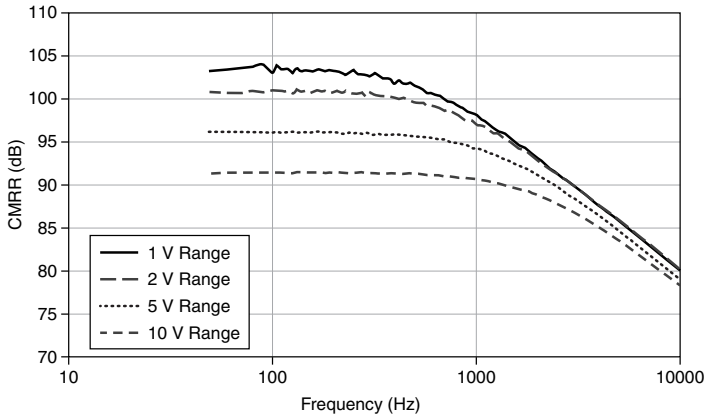


Figure 2. Normalized Signal Amplitude versus Frequency

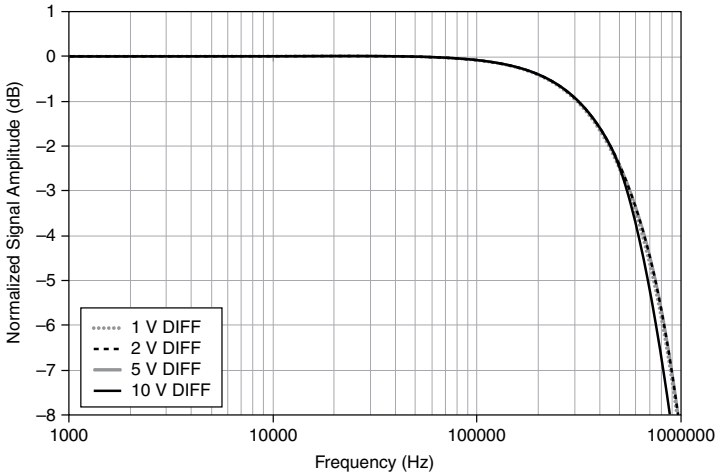
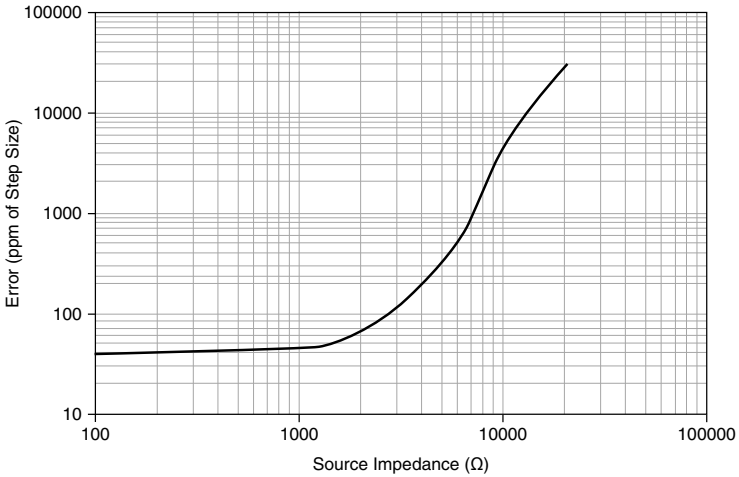


Figure 3. Settling Error versus Source Impedance



Analog Output Characteristics

Number of channels	4
DAC resolution	16 bits

Maximum update rate[6]	336 kS/s
Range	±10 V
Overrange operating voltage	
Minimum	10.3 V
Typical	10.6 V
Maximum	10.9 V
Output impedance	0.4 Ω typical
Current drive	±3 mA/channel maximum
Protection	Short-circuit to ground
Power-on state[7]	0 V

AO accuracy

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range (Offset Error)[8]
Typical (25 °C, ±5 °C)	0.09%	0.02%
Maximum (-40 to 85 °C)	0.50%	0.20%

Gain drift	23 ppm of reading/°C
Offset drift	5.4 ppm of range/°C
INL	±194 ppm of range, maximum
DNL	±16 ppm of range, maximum
Capacitive drive	1.5 nF, typical
Slew rate	3.7 V / µsec, typical
Settling time (100 pF load to 320 µV)	
FS step	50 µs
2 V step	12 µs
0.2 V step	9 µs

[6] This is the maximum update rate when running one AO channel in a loop with the FPGA top-level clock set to 40 MHz.

[7] When the analog output initializes, a voltage glitch occurs for about 20 µs, peaking at 1.3 V, typical.

[8] Range is 5 V.

CMOS Battery

Note The battery is user-replaceable. The NI sbRIO device ships with a BR1225 coin cell battery from RAYOVAC, which is industrial-rated. Ensure that power remains connected to the NI sbRIO device while you replace the battery so that time-keeping is not disrupted. Refer to the *Battery Replacement and Disposal* section for information about replacing the battery.

Typical battery life with power applied to power connector	10 years
Typical battery life in storage at 55 °C	2.5 years[9]

Power Outputs on 50-Pin IDC Connector

Caution This output is protected by a fuse. Exceeding the power limits may cause this fuse to open.

+5 V power output	
Output voltage	5 V ±5%
Maximum current	1.5 A
Maximum ripple and noise	50 mV

Power Requirements

The NI sbRIO device requires a power supply connected to the power connector. Refer to the *Powering On the NI sbRIO Device* section in the *NI sbRIO-9637 Getting Started Guide* on *ni.com/manuals* for information about connecting the power supply.

Caution Exceeding the power limits may cause unpredictable device behavior.

Recommended power supply	55 W, 30 VDC maximum
Power supply voltage range	9 VDC to 30 VDC
Reversed-voltage protection	30 VDC
Power consumption	26 W maximum

[9] Battery life may drop dramatically in extreme temperatures.

Environmental

Caution Clean the sbRIO-9637 with a soft, nonmetallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

Local ambient operating temperature near device (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 85 °C[10]
Maximum reported onboard sensor temperature	
CPU/FPGA temperature	98 °C
Primary System temperature	85 °C
Secondary System temperature	85 °C

Table 1. Component Maximum Case Temperature

Component	Manufacturer	Maximum Case Temperature
CPU/FPGA	Xilinx	NA[11]
DDR memory	Micron	95 °C
NAND flash	Micron	89 °C
CPLD	Lattice	94 °C
USB PHY	Microchip	120 °C
ENET PHY	Micrel	120 °C

The sbRIO-9637 includes three onboard temperature monitoring sensors to simplify validation of a thermal solution by indicating thermal performance during validation and deployment. The sensors measure the CPU/FPGA junction temperature and printed circuit board temperatures that can be used to approximate the primary and secondary side local ambient temperatures. This approach is called digital validation. Alternatively, the traditional analog approach using thermocouples can be used to validate thermal performance. The digital approach is more accurate for determining the performance of the CPU/FPGA but is more conservative for determining the local ambient temperatures. NI recommends using digital validation.

For digital validation, ensure that the reported CPU/FPGA, reported Primary System, and reported Secondary System temperatures do not exceed any of the maximum temperatures listed in this document. Thermal validation is complete if the reported temperatures are within

[10] If you expect ambient temperatures below -20 °C, NI recommends using a 10/100 network infrastructure or assigning 10/100Mbps communication speeds to the Ethernet Adapter in NI MAX. Refer to the *Network/Ethernet Port* section of this document for more information.

[11] Use digital approach to ensure the on-chip temperature reading is below 98°C.

specifications. For more information about how to access the onboard sensors, visit *ni.com/info* and enter the Info Code `sbriosensors`. If the reported Primary System temperature or reported Secondary System temperature exceed the maximum temperatures listed in this document then analog validation may be used for further verification.

For analog validation, measure the local ambient temperature by placing thermocouples on both sides of the PCB, 5 mm (0.2 in.) from the board surface. Avoid placing thermocouples next to hot components such as the CPU/FPGA or near board edges, which can cause inaccurate temperature measurements. In addition to the local ambient temperature, the case temperature of the components should not exceed the recommended maximum case temperature.

Note Some systems may require a heat sink or air flow to remain within the maximum allowed temperature ranges. You can mount the Thermal Kit for NI sbRIO-9607/9627/9637 (153901-02) heat spreader on the NI sbRIO device.

Note The NI sbRIO device thermal performance is greatly influenced by several factors, including resource utilization, mounting, and adjacent power dissipation. These factors can substantially affect the achievable external ambient temperature at which the maximum local and reported temperatures are reached. NI recommends additional thermal design to remain within the maximum allowed temperature ranges. For information about and examples of environmental and design factors that can affect the thermal performance of NI sbRIO systems, visit *ni.com/info* and enter the Info Code `sbriocooling`. For device-specific guidelines about enabling proper thermal design, refer to the *NI sbRIO-9637 User Manual* on *ni.com/manuals*.

Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 85 °C
Operating humidity (IEC 60068-2-78)	10% RH to 90% RH, noncondensing
Storage humidity (IEC 60068-2-78)	5% RH to 95% RH, noncondensing
Maximum altitude	5,000 m
Pollution Degree (IEC 60664)	2

The NI sbRIO device is intended for indoor use only.

Physical Characteristics

Weight	128.7 g (4.540 oz)

Safety Voltages

Connect only voltages that are below these limits.

V terminal to C terminal	30 VDC maximum, Measurement Category I

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as *MAINS* voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Caution Do not connect the sbRIO-9637 to signals or use for measurements within Measurement Categories II, III, or IV.

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*.

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*.

电子信息产品污染控制管理办法（中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

Worldwide Support and Services

The NI website is your complete resource for technical support. At *ni.com/support*, you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

Visit *ni.com/services* for information about the services NI offers.

Visit *ni.com/register* to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

NI corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. NI also has offices located around the world. For support in the United States, create your service request at *ni.com/support* or dial 1 866 ASK MYNI (275 6964). For support outside the United States, visit the *Worldwide Offices* section of *ni.com/niglobal* to access the branch office websites, which provide up-to-date contact information.

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