italtec

Technical Training Systems

WIRELESS COMMUNICATION

Wireless Communication

IT.TEL701GSM Trainer

Description
The GSM trainer IT-701 allows the student a closer look at the core of modern day mobile equipment and its working as a GSM modem. This trainer allows the control using standard AT commands and provides the study of AT commands to use the SIM card features using PC. An extensive PC based software is provided to explore the features of GSM module.

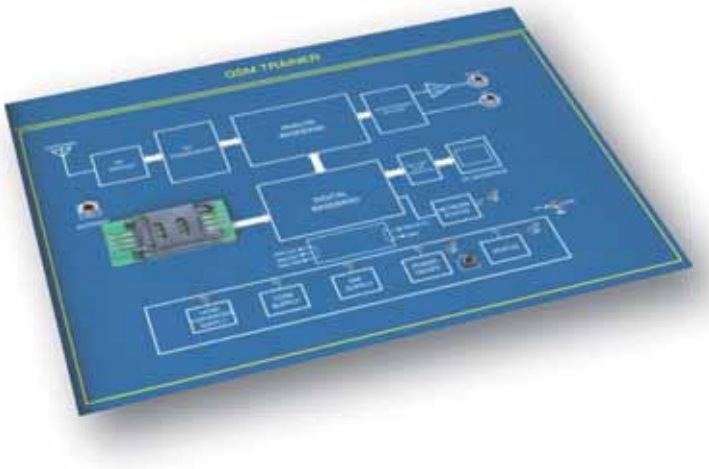
Features:

- Power Supply Included
- Required Circuits Tested
- Each Section Clearly Marked for Input and Output
- Built-in Amplifier
- Built-in Protection Circuit
- Each Section Clearly Marked for Easy Understanding

Experiments included:

- Introduction to Sections of GSM Trainer
- Introduction to GSM Trainer Software
- Exploring Call Options using AT Commands
- Exploring Call Log Options using AT Commands
- Exploring SMS Options using AT Commands
- Exploring Volume Control Options using AT Commands
- Exploring Phone Book Options using AT Commands
- Exploring Network and Clock Options using AT Commands
- DTMF Tone generating using AT Commands
- Software Application using GSM Trainer

Technical Features:



GSM capability: GSM 900 / 1800, E – GSM
SIM Interface
EGSM Sensitivity: < -104 dBm
DCS Sensitivity: < -102 dBm
Selectivity: >+9 dBc @ 200 KHz
Selectivity: >+41 dBc @ 400 KHz
Dynamic range: 63 dB
Inter modulation: >-43 dBm
Maximum output power: 33 dBm ± 2 dB (EGSM)
Maximum output power: 30 dBm ± 2 dB (DCS)
Minimum output power: 5 dBm ± 5 dB (EGSM)
Minimum output power: 0 dBm ± 5 dB (DCS 1800)
Noise in 925 – 935 MHz: < -67 dBm
Noise in 935 – 960 MHz: < -79 dBm
Noise in 1805 – 1880 MHz: < -71 dBm
Phase error at peak power: < 5° RMS
Frequency error: ± 0,1ppm max
Interconnections: 2mm gold plated pins

Accessories: USB cable, GSM Antenna with SMA connector, Hands free kit, Power Cord, Software CD and Experiment Manual

IT.TEL702 GSM Phone Application Trainer

Description

The trainer provides the full understanding of mobile phone hardware. This trainer is a working model of a mobile phone. The software provided with this trainer allows the student to study and control IT.TEL702 mobile phone trainer. This trainer allows student to understand the working of different sections of a mobile phone. Custom software provided with the train helps the student to control the features of mobile phone through PC.

Features:

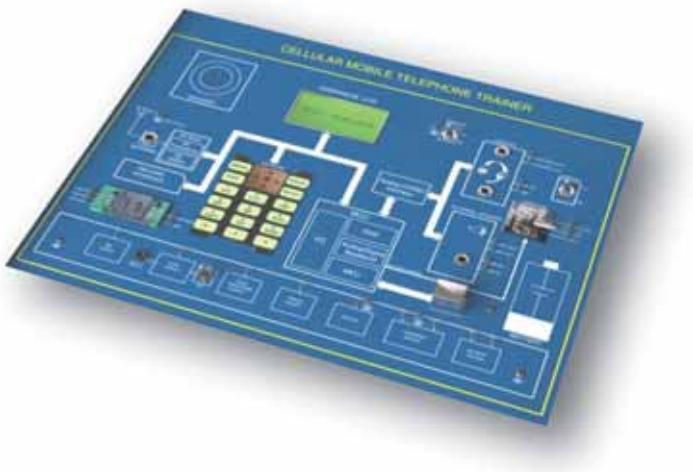
- Power Supply Included
- Required Circuits Tested
- Each Section Clearly Marked for Input and Output
- Built-in Amplifier
- Built-in Protection Circuit
- Built-in SIM Interface
- Built-In Speaker with Amplifier
- Each Section Clearly Marked for Easy Understanding

Experiments included:

- Introduction to Trainer Sections
- Introduction to Menu Driven Software
- Study of Power Supply Section
- Study of SIM Card Interface Section
- Study of Microphone & Speaker Section
- Study of Vibrator Section
- Study of Charging Section
- Study of Frequency Signals during Call Process
- Introduction to PC Software
- Exploring SMS Options of Trainer using PC Software
- Exploring Phone Book Options of Trainer using PC Software
- Exploring Special Features of Trainer using PC Software

Technical Features:

- Cellular System: EGSM/GSM 800/1800/1900 Auto Selected
- Keypad: 4X4 Matrix Keypad with 5-Way Joy Stick and Decoder
- Output Power: 25dBm ±5dB
- Channel spacing: 200 KHz
- Antenna: Omni directional with Magnetic Base
- Display: 128 × 64 pixels Graphical LCD
- SIM Interface: Supports 3V & 1.8V SIM Cards
- Battery: 1200mAH Li-on
- PC Interface: USB – UART @ 57600 Baud
- Vibrator: 1Hz Pulse with Driver
- Speaker: 8 Ohm @ 0.5W
- Audio Amplifier: 3.1W Fully Differential
- Charging: On-Board Charging interface
- Software: Menu Driven



Accessories:

Power cord, Experiment Manual, Mono Head Phone with Microphone, GSM Antenna, Software CD, 2mm patch Cord, USB Cable

IT.TEL703 Radar Communication Trainer

Description

Radar communication Trainer IT.TEL703 demonstrates the basic concept of satellite communication. The trainer is based on three parts namely Uplink Transmitter (IT.TEL703A), Transponder (IT.TEL703B) and Downlink Receiver (IT.TEL703C). This trainer is capable of transmitting two Audio channels and one Video channel simultaneously. All parts of the trainer are self contained providing the student with microphone interface tone generator and data generator etc. PC software is also available for PC – PC data transmission using satellite link.

Features:

- Power Supply Included
- Required Circuits Tested
- Each Section Clearly Marked for Input and Output
- Built-in Amplifier
- Built-in Data Generator
- Built-in Audio Generator
- Built-in Speaker with Amplifier
- Built-in Protection Circuit
- Each Section Clearly Marked for Easy Understanding

Experiments included:

- Understanding concepts of Satellite Communication
- To set up direct link using Uplink and Downlink
- To set up Active Satellite link
- Study of Satellite transponder
- To set up Satellite communication link using transponder
- Study Audio-Video transmission through Satellite link
- Study of Voice transmission in Satellite link
- To transmit and receive function generator waveforms through Satellite link
- To transmit Tone through Satellite link
- To establish PC – PC Communication using Satellite Communication link

Accessories:

USB cable, Software CD, Audio/Video RCA connectors, Experiment Manual
Antennas, Power Cord and Microphone

Technical Features:

Uplink Transmitter

Frequency: 2400 / 2427 / 2454 / 2481 MHz Selectable
RISC processor based PLL
Audio Signal: 1Vp-p
Video Signal: 1Vp-p
Audio Generator: Adjustable amplitude and Frequency
Microphone Interface: for Voice applications
PC interface: USB – UART interface
Clock Generator: 1KHZ, 2KHZ and 4KHZ
Data Generator: 8-bit DIP selectable
Antenna: Detachable with Stand
Output Power: 25 mW(approx.)
PC Interface: USB – UART interface

Transponder:

Downlink Frequency: 2400 / 2427 / 2454 / 2481 MHz Selectable
Uplink Frequency: 2400 / 2427 / 2454 / 2481 MHz Selectable
Antenna: Detachable with Stand
Low Pass Filter: 5th Order Butterworth with 3.4KHz cut off
Output Power: 25 mW(approx.)
Speaker: For Audio with Amplifier

Downlink Receiver:

Frequency: 2400 / 2427 / 2454 / 2481 MHz Selectable
RISC processor based PLL
Antenna: Detachable with Stand
Sensitivity: -80dBm
Low Pass Filter: 5th Order Butterworth with 3.4KHz cut off
AC Amplifier: with variable gain
Comparator: used as Data Squarer
Audio Amplifier: Monolithic Amplifier with Speaker
PC interface: USB – UART interface
Interconnections: 2mm gold plated pins

IT.TEL704 RFID-Trainer

Description
RFID Trainer The trainer has a reader for the popular RFID Tags. The software supplied covers all the features of these RFID tags, including anti-collision, so that it can detect multiple cards in the reader field. Individual memory blocks can be read. This trainer uses the popular 13.56MHz RFID tags. These are used in a variety of applications from door entry to stock control.

Features:

- Power Supply Included
- Required Circuits Tested
- Each Section Clearly Marked for Input and Output
- Built-in RF-ID Antenna
- Built-in Protection Circuit
- Each Section Clearly Marked for Easy Understanding

Experiments included:

- Study of RFID Technology
- Study of Trainer Components
- Study of RFID Tag Protocols
- Study of RFID Tag Data
- Software Examples to Utilize RFID Data

Technical Features:

- Frequency: 13.56 MHz
- Modulation: ASK
- Range: Less than 10 cm.
- Supported Protocols:
  ISO 14443A
  ISO 14443B
  ISO 15693
- Core Supply: 3.3V
- Display: Character LCD
- Antenna: Inductively coupled coil type
- Buzzer: To indicate card detection
- PC Interface: USB – UART
- Interconnections: 2mm gold plated pins

Application Software:
This program helps the students to understand working application of RFID technology

Accessories: USB cable, Software CD, Experiment Manual and Power Cord

IT.RFID13,56 RFID-Trainer

Description
Helps to comprehend configuration and process of the RFID system and enables hardware manufacturing and programming experiment.

- Student can learn RFID system design skill more effectively, since RFID hardware operation can be observed through experiment.
- Not firmware but PC based programming trainer.
- Air Protocol can be programmed by using C, C++.
- Air Protocol analysis is possible.
- Student can experiment and comprehend transmission protocols such as Anticollision and ISO15693, EPC global.

Features:

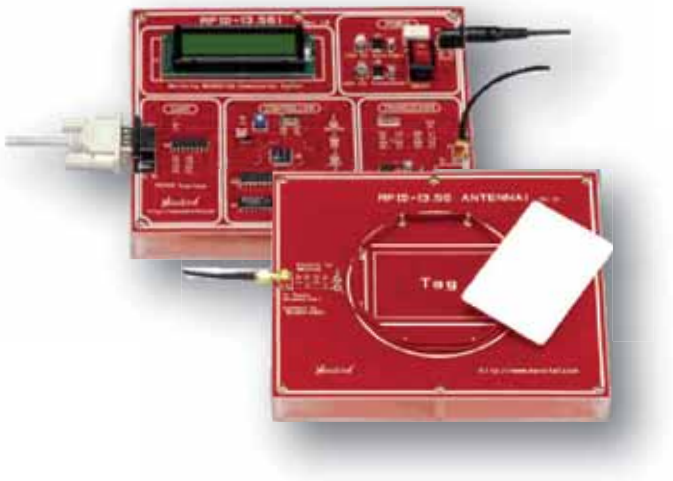
- Comprehension of basic principle of RFID
- Comprehension of RFID system design skill
- Comprehension of ISO 15693 protocol
- Comprehension of Anticollision
- Comprehension of reader configuration
- Comprehension of RFID application programming Read / Write experiment
- Comprehension of EPC Global protocol Air Protocol Programming S/W programming by using API
- Comprehension of 128bit encryption which was applied to RFID system

Technical Features:

- Frequency : 13.56 MHz, 915MHz
- Protocol: ISO 15693(13.56 MHz only)
- Transpond Type: Vicinity Card(13.56 MHz), Module(915 MHz)
- Field Range: 3Cm(13.56 MHz), 2m(915 MHz)
- PC Interface: RS-232C

Experiments included:

1) RFID Theory
2) Hardware Setup and Operation
3) Hardware Configuration and Exercise
4) Packet Structure
5) Anticollision
6) CRC Algorithm
7) Demo Program Operation Exercise
8) RFID Command Operation Exercise
9) RFID Command Programming Exercise
10) RFID Packet Monitoring Programming Exercise
11) RFID Packet Emulation Programming Exercise
12) Understanding of API
13) Example Programming Exercise
14) API Application Programming Exercise
15) RFID application practice Demo
16) Demo program for RFID application practice
17) RFID application demo programming



Accessories: Cable, Software CD, Experiment Manual and Power Cord

IT.TEL705 Bluetooth Transceiver Trainer

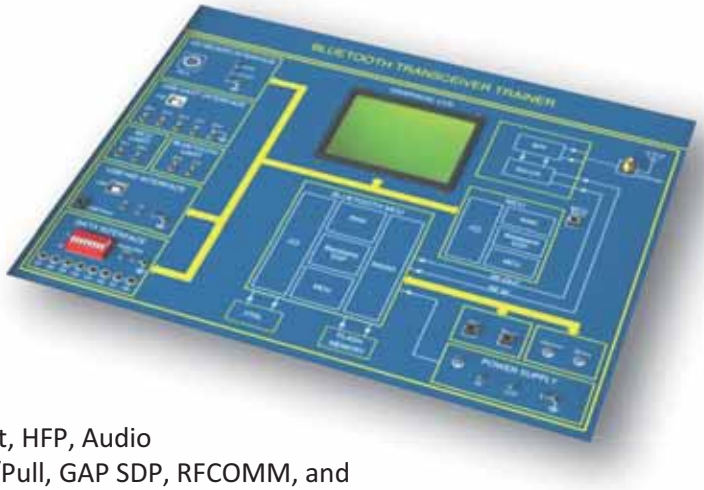
Description
Bluetooth Transceiver Trainer is designed for students and researchers in the field of RF and IT engineering to understand the basic concepts of Bluetooth Technology. This trainer is based on Class 2 Bluetooth System having range up to 10 meters and is fully compliant for Data Communication. It consists of two identical modules and any one of these can be selected as a Master or Slave for Communication. This Training System can be connected to PC for operation and execution of Bluetooth AT Commands. Bluetooth standard AT commands can be run on the graphical LCD display also with the help of keyboard.

Features:

- Power Supply Included
- Required Circuits Tested
- Each Section Clearly Marked for Input and Output
- Built-in Bluetooth Module
- Built-in Data Generator
- Built-in Protection Circuit
- Each Section Clearly Marked for Easy Understanding

Experiments included:

- Study the functioning of Bluetooth Trainer
- Pairing of Slave unit with Master unit using software
- Study of AT commands
- Data Communication using USB – UART
- Data Communication using USB HID Interface
- Study of Communication using on-board data generator
- Study of RF signals

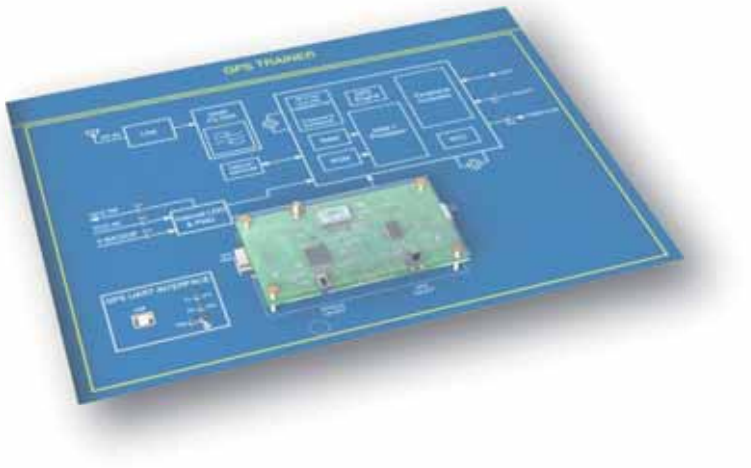


Technical Features:

- Carrier Frequency: 2.40 GHz to 2.48 GHz
- Bandwidth: 80 MHz
- Modulation FHSS/GFSK
- Channels: 79
- Channel Intervals: 1 MHZ
- Transmission Power: +4dBm max (2.5mW)
- Transmission Range: 10 meter approximate
- Transmission rate (over the air): 721kbps
- Receive sensitivity: -83dBm typ.
- Stack Profiles Included: SPP, DUN, LAN, Headset, HFP, Audio Gateway, FTP Client/Server, OBEX, OPP – Push/Pull, GAP SDP, RFCOMM, and L2CAP protocols
- Output Interface: USB – UART and USB
- Operating temperature range: -40~+70ºC
- Antenna: Monopole Antenna
- Display: 128X64 Graphical LCD

Accessories: Power cord, Experiment Manual, Software CD, 2mm patch Cords, USB Cables, PS/2 Keyboards

IT.TEL706 GPS Trainer



Description
Navigation played a very important role in our lives since we started travelling. Global Positioning System (GPS), now a days it is becoming very important part of our life as the technology has made it available to every person. This technology is enabling ordinary people, with no knowledge of navigation, to find their way around the Earth. This technology is used for many purposes, like for fun, for saving lives, to find a way around lost path etc. This Trainer explores the theory and practical related to GPS technology.

Features:

- Power Supply Included
- Required Circuits Tested
- Each Section Clearly Marked for Input and Output
- Built-in GPS Receiver
- External Antenna for GPS
- Built-in Protection Circuit
- Each Section Clearly Marked for Easy Understanding

Experiments included:

- Study of GPS Theory
- Study of GPS Hardware
- Study of NMEA Protocol
- Study of GPS Software
- Study of Different NMEA output codes
- Study of Satellite Signal Strength
- Study of UTC Date & Time

Technical Features:

- Carrier Frequency: L1 Band (1575.42MHz)
- Channel: 48
- Horizontal Accuracy: <2.5m
- Velocity Accuracy: <0.01m/s
- Acceleration Accuracy: 0.1m/s2
- Time to Fist Fix: <35s
- Sensitivity: -148dBm
- Maximum Altitude: <18288m
- Maximum Velocity: <514m/s
- PC Interface: USB – UART
- Protocol: NMEA
- Antenna: External with SMA Connector

Accessories: USB cable, Software CD, Experiment Manual and Power Cord

italtec
Technical Training Systems

Company with Quality Management System
Certified by DNV = ISO 9001/2008 =

BANCO DI LAVORO PER ELETTRONICA

IT.0100B
IT.0705T

Banco biposto per allievo dotato di sistemi per la prova e la verifica di strumenti elettronici con possibilità di connessioni che simulano le reali condizioni imposte dalla moderna tecnologia sia in sistemi produttivi intelligenti che in impianti ingegnerizzati su misura. Sistema modulare per realizzare numerose prove ed esperimenti di laboratorio attraverso l'impiego di connettori con riconoscimento del colore e delle funzioni. Possibilità di collegamento di prese e connessioni per l'utilizzo di strumenti di test e verifica quali voltmetri, amperometri, misuratori di frequenza.

CE

IT.0100B
BANCO -Dim.(cm):200x100x80h
La struttura, il telaio portante sono in profilato d'acciaio 80x20x2mm e le gambe sono cilindriche, dia. 80mm con spessore 2mm.
Il piano di lavoro è realizzato in legno multistrato bilaminato.
Questa struttura sopporta un carico di 850 kg senza subire deformazioni.
Il piano accuratamente bordato con angoli raggiati senza spigoli vivi.
Tutte le parti metalliche del banco sono accuratamente trattate con fondo antiruggine e verniciate a polvere epossidica a forno senza solventi.

IT.0705T
PULPITO CON ALIMENTAZIONE CA-CC
Dotato di uscite trifase-monofase alternata e corrente continua.
Con variazione di tensione da 0 a 30Vcc con strumenti di misura voltmetro e amperometro su entrambe le uscite.

- Servizi generali, con comando principale di tipo elettromagnetico, interruttore generale a chiave, protezione con interruttore automatico differenziale ad alta sensibilità, pulsante di arresto/emergenza con ritenuta meccanica, lampada di segnalazione, 2 prese monofasi a 230 V protette con interruttore automatico magnetotermico da 16A.
- Linea trifase 380V/16A con protezione magnetotermica, lampada spia e morsetti di sicurezza.
- Linea bassa tensione regolabile 0-30Vcc con provacircuiti protezione fusibili sezionabili, indicatore digitale di tensione e corrente, morsetti di sicurezza.
- Linea bassa tensione 24Vcc & 24Vca uscita su morsetti di sicurezza.
- Alimentazione trifase 380V+N+T

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Rev 03/05/2019

Strumentazione Elettrica

OFEL ENGINEERING

MULTIMETRO DIGITALE DMM180

CE

SPECIFICHE GENERALI:

- **Selezione delle gamme:** automatica / manuale
- **Prestazioni particolari:** protezione contro sovraccarico e controllo dello stato di carica della batteria
- **Dimensioni** (H x L x P)**:** 200 x 100 x 40 mm
- **Peso:** 600gr

Strumento elettronico di misura, portatile, conforme alla norma CEI EN 61010-1 con le seguenti caratteristiche:

• visualizzatore digitale a cristalli liquidi con 5 5/6 cifre 5000 counts con barra grafica analogica;
• retroilluminazione del visualizzatore con funzione di memorizzazione del valore misurato;
• precisione base: ± 0,03% del valore letto;
• misura del vero valore efficace (TRMS): la banda passante è di (>20k Hz);
• portate automatiche:
tensione in c.c.: (50 mV ÷ 1000V)
tensione in c.a.: (50 mV ÷ 1000V)
corrente in c.c.: (500 µA ÷ 10A)
corrente in c.a.: (500 µA ÷ 10A)
resistenza: (500 Ω ÷ 50 MΩ)
• prova diodi;
• prova di continuità con segnalatore acustico;
• alimentazione con batteria incorporata, con autonomia > a 150 ore;
• segnalazione di batteria scarica;
• sicurezza: secondo norma CEI EN 61010-1, categoria di misura IV a 600V – III a 1000V, doppio isolamento, grado di inquinamento 2
• fusibili di protezione con alto potere d'interruzione (≥ 200kA per portare fino a 2A, ≥ 20kA per portate fino a 10A) su tutti i circuiti amperometrici, contro errati ingressi di tensione;
• protezione contro gli urti mediante guscio in gomma che avvolge lo strumento.

MARCATURE:

• Sono riportate le marcature previste dalla norma CEI EN 61010-1 ed in particolare quanto segue: - 1000 V cat. III e simbolo (doppio isolamento)
• Marchio **"CE"** indicante il rispetto della direttiva 89/336/CEE sulla "compatibilità elettromagnetica" e delle direttive 73/23/CEE e 93/68/CEE "bassa tensione".

CONFEZIONE:

Lo strumento è fornito completo di:
• custodia per il trasporto, predisposta con vano per l'alloggiamento dello strumento, dei cavi di collegamento, degli accessori in dotazione e del manuale;
• n° 2 cavetti di collegamento flessibili lunghi ≅ 1 m, realizzati in doppio strato per mantenere il doppio isolamento, muniti di puntali (non separati dal cavo) conformi alle Norme di sicurezza per i puntali CEI EN 61010-031 (per categoria di installazione III a 1000V, doppio isolamento, grado di inquinamento 2).

GENERALI:

Questo strumento è in grado di soddisfare le esigenze degli operatori professionisti anche più esigenti.
Le gamme di misura disponibili permettono di effettuare un'ampia gamma di rilevamenti di tensione, corrente, frequenza, capacità etc. Settori di impiego: adatto per un utilizzo professionale nel campo della manutenzione di macchine elettriche ed elettroniche.
Appositamente studiato per potere operare senza problemi in ambienti industriali anche grazie all'ampio display retroilluminato ed alla notevole robustezza costruttiva.

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CARATTERISTICHE TECNICHE

Tensione AC

Gamma	Risoluzione	Precisione		
		40Hz – 1KHz	1KHz – 10KHz	10KHz – 20KHz
50mV	0.001mV	± (0.5% + 40)	± (1% + 40)	± (2.5% + 40)
500mV	0.01mV			
5V	0.1mV			
50V	1mV			
500V	10mV			---
1000V	0.1V		---	

Tensione DC

Gamma	Risoluzione	Precisione
50mV	0.001mV	± (0.03% + 10)
500mV	0.01mV	± (0.03% + 6)
5V	0.1mV	
50V	1mV	
500V	10mV	
1000V	0.1V	

Corrente AC

Gamma	Risoluzione	Precisione			Carico
		40Hz~1KHz	1KHz~10KHz	10KHz~20KHz	
500μA	0.01μA	± (0.75%+20)	± (1%+20)	± (2%+20)	102μV/μA
5000μA	0.1μA	± (0.75%+10)	± (1%+10)	± (2%+10)	
50mA	1μA	± (0.75%+20)	± (1%+20)	± (2%+20)	1.5mV/mA
500mA	10μA	± (0.75%+10)	± (1%+10)	± (2%+10)	
5A	0.1mA	± (0.75%+20)	± (1.5%+20)	± (5%+20)	30mV/A
10A	1mA	± (1%+10)	± (1.5%+10)	---	

Corrente DC

Gamma	Risoluzione	Precisione	Carico
500μA	0.01μA	± (0.15%+15)	102μV/μA
5000μA	0.1μA	± (0.15%+10)	
50mA	1μA		1.5mV/mA
500mA	10μA		
5A	0.1mA	± (0.5%+10)	30mV/A
10A	1mA		

Resistenza		
Gamma	Risoluzione	Precisione
500ohm	0.01ohm	± (0.01% + 10)
5Kohm	0.1ohm	± (0.1% + 5)
50Kohm	1ohm	
500Kohm	10ohm	
5Mohm	100ohm	± (0.1% + 10)
50Mohm	1Kohm	± (0.5% + 10)

Capacità		
Gamma	Risoluzione	Precisione
50nF	0.01nF	± (1% + 5)
500nF	0.1nF	
5μF	1nF	
50μF	10nF	
500μF	0.1μF	± (2% + 5)
5000μF	1μF	

Diodo		
Gamma	Risoluzione	Precisione
2.5V	0.1mV	± (1% + 5)

Frequenza logica		
Gamma	Sensibilità	Precisione
5Hz ~ 2MHz	Vp 2 ~ 5V onda quadra	± (0.006% + 4)

Frequenza lineare			
Gamma	Gamma tensione/corrente	Sensibilità	Precisione
5Hz ~ 200KHz Onda sinusoidale	500mV	100mV	± (0.006% + 4)
	5V	0.5V	
	50V	4V	
	500V	40V	
	1000V	400V	
	5000μA	1mA	
	500mA	100mA	

SDG1000X Series

Function/Arbitrary Waveform Generator

SIGLENT®

DataSheet-2016.12

SIGLENT TECHNOLOGIES CO.,LTD

SDG1062X
SDG1032X

Overview

SIGLENT's SDG1000X is a series of dual-channel function/arbitrary waveform generators with specifications that include up to 60 MHz maximum bandwidth, 150 MSa/s sampling rate and 14-bit vertical resolution. The proprietary EasyPulse technique helps to solve the weaknesses inherent in traditional DDS generators when generating pulse waveforms, and the special square generator is capable of generating square waveforms up to 60 MHz in frequency with low jitter. With these advantages, the SDG1000X can provide users with a variety of high fidelity / low jitter signals while meeting the growing requirements of a wide range of complex and varied applications.

Key Features

- Dual-channel, with bandwidth up to 60 MHz, and amplitude up to 20 Vpp
- 150 MSa/s sampling rate, 14-bit vertical resolution, and 16 kpts waveform length
- Innovative EasyPulse technology, capable of generating lower-jitter Pulse waveforms, brings a wide range and extremely high precision in pulse width and rise/fall times adjustment
- Special circuit for Square wave function, can generate Square waves up to 60 MHz with jitter less than 300 ps+0.05 ppm of period
- Plenty of analog and digital modulation types: AM, DSB-AM, FM, PM, FSK, ASK, PSK and PWM
- Sweep and Burst functions
- Harmonics Generator function
- Waveform Combining function
- High precision Frequency Counter
- Standard interfaces: USB Host, USB Device (USBTMC), LAN (VXI-11)
- 4.3" TFT-LCD display

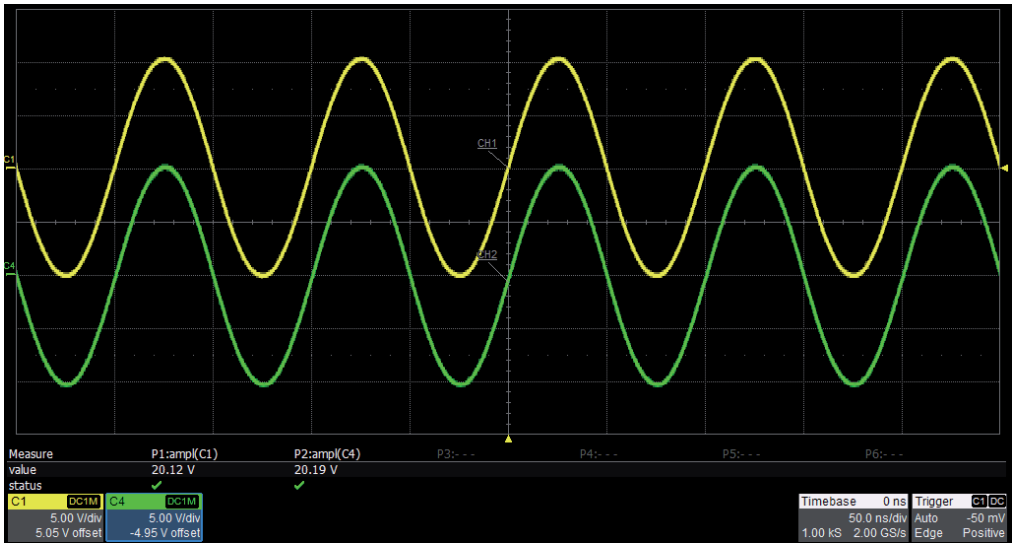
Models and Key Specifications

Product Model	SDG1062X	SDG1032X
Bandwidth	60 MHz	30 MHz
Sampling rate	150 MSa/s	
Vertical resolution	14-bit	
Waveform Length	16 kpts	
Num. of channels	2	
Max. amplitude	±10 V	
Display	4.3" display, 480 x 272 x RGB	
Interface	Standard: USB Host, USB Device, LAN	

Characteristics

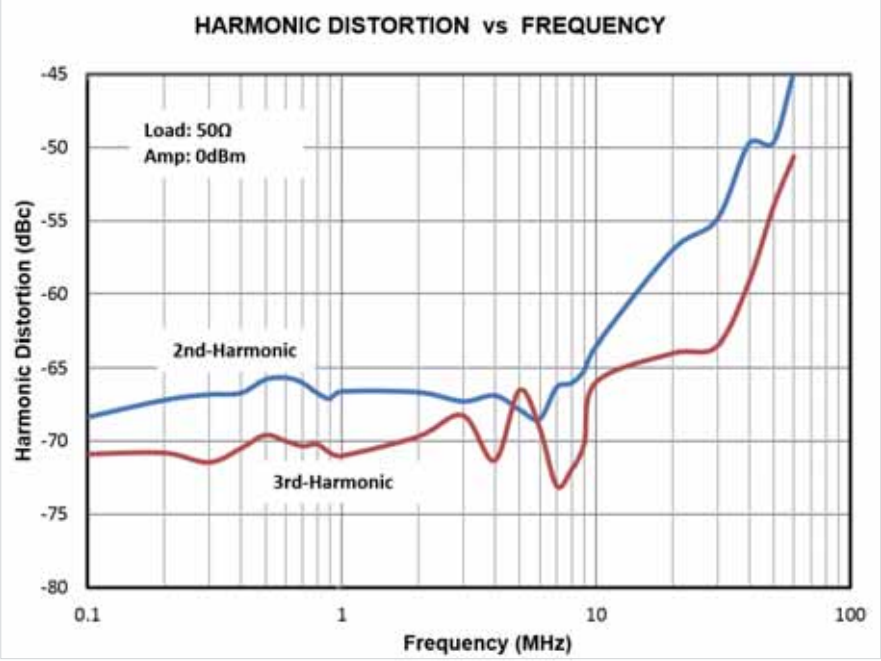
Identical dual output-channels with high performance

Capable of outputting large signals at high frequencies. dual-channels, 20 Vpp amplitude can be guaranteed at up to 10 MHz.

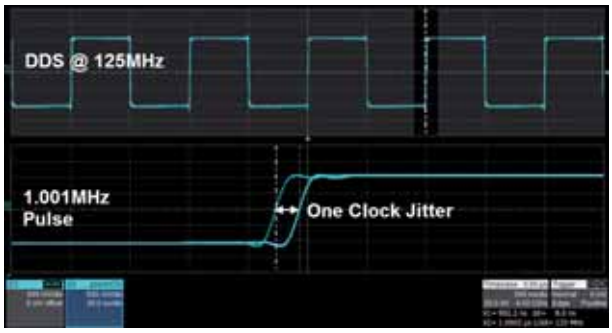


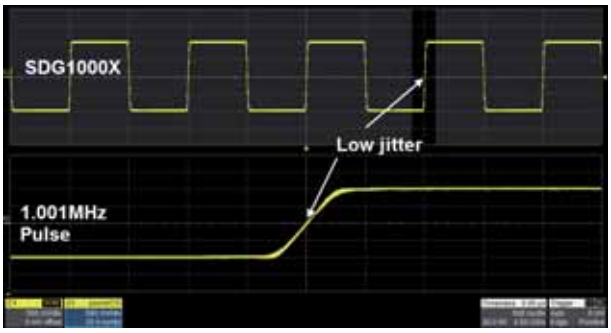
Low Distortion Output

With 0 dBm output, the THD (Total Harmonic Distortion) is less than 0.075%. Harmonics and spurs are less than -40 dBc throughout the entire bandwidth.

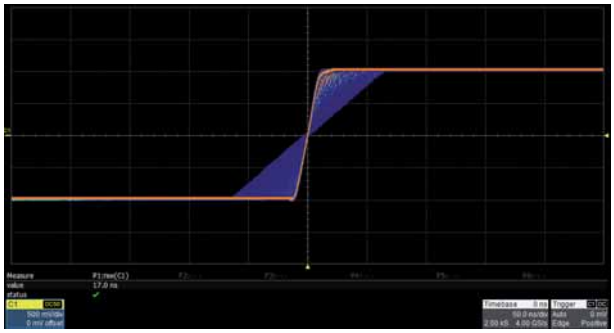


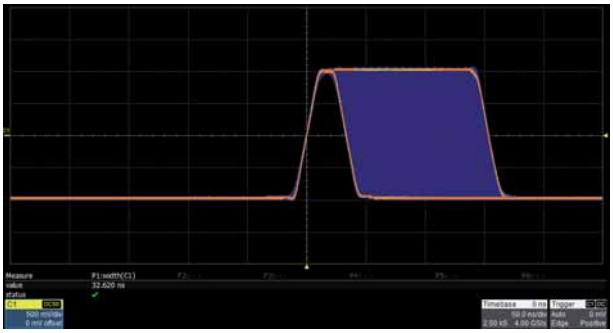
Innovative EasyPulse Technology





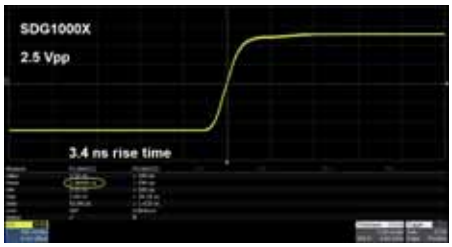
When a Pulse waveform is generated by a common DDS generator, there will be a one-clock-jitter if the sampling rate is not an integer-related multiple of the output frequency. SDG1000X EasyPulse technology successfully overcomes this weakness in DDS designs and helps to produce low jitter Pulse waveforms.





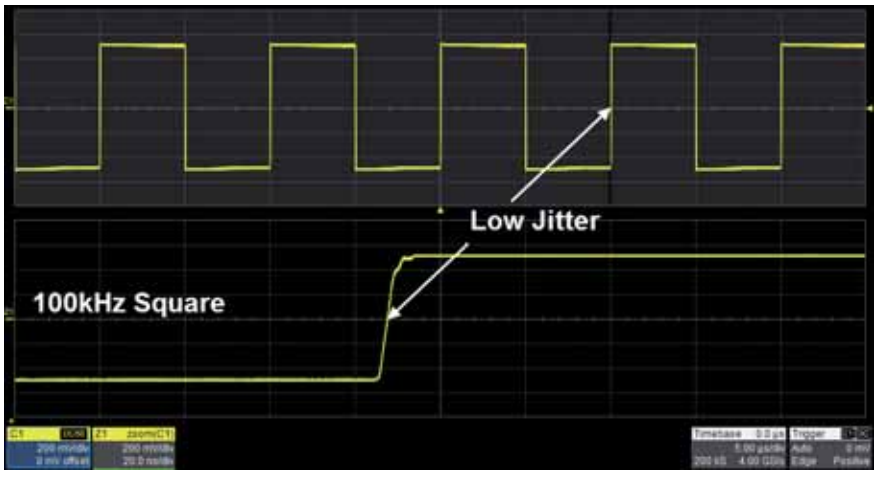
The rise/fall times can be set independently to the minimum of 16.8 ns at any frequency and to the maximum of 22.4 s. The adjustment step is as small as 100 ps. The Pulse width can be fine-tuned to the minimum of 32.6 ns with the adjustment step as small as 100ps.

High performance Square Waves



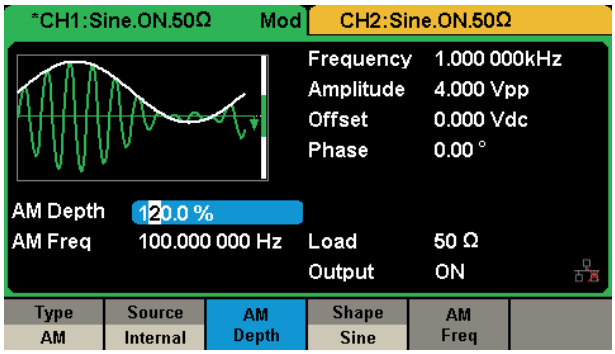
Benefitting from a special square-wave generating circuitry, the Square from the SDG1000X breaks the 60 MHz bandwidth barrier, reaching rise/fall times of less than 4.2 ns, and frequencies up to 60 MHz.

The Square wave exhibits the same excellent jitter performance as the Pulse waveform.



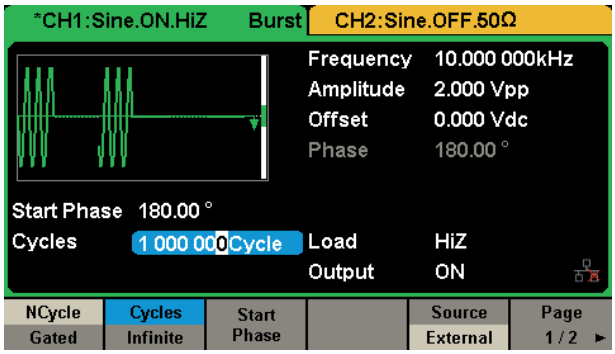
Characteristics

Modulation



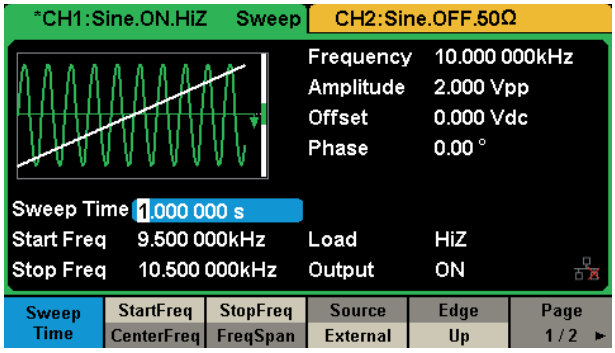
Multiple modulation types: AM, DSB-AM, FM, PM, FSK, ASK, PSK and PWM. The modulation source can be configured as "Internal" or "External".

Burst



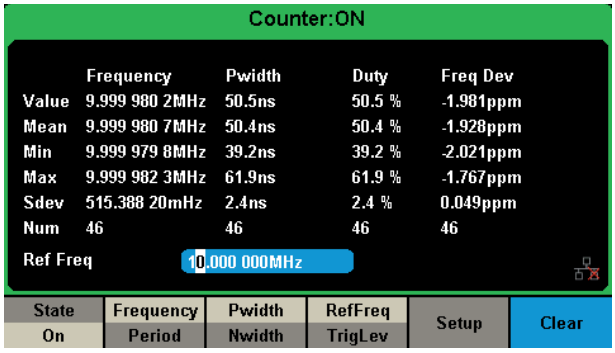
Two Burst modes, "N cycle" and "Gated". The Burst source can be configured as "Internal", "External" or "Manual".

Sweep



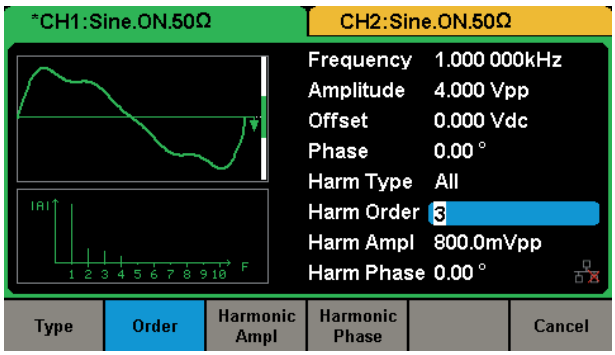
Two Sweep modes, "Linear" and "Log". Two Sweep directions, "Up" and "Down" and three Sweep sources, "Internal", "External" and "Manual".

Frequency Counter



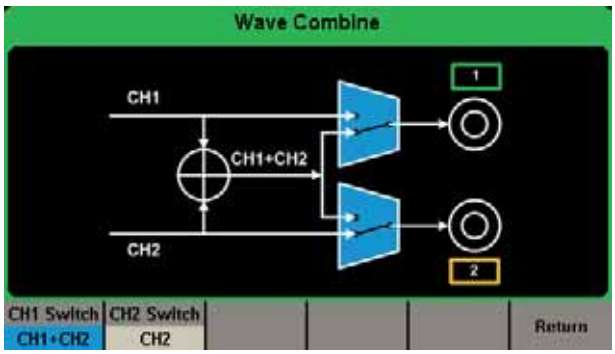
High precision Frequency Counter with an input frequency range of 0.1 Hz~200 MHz.

Harmonics Function



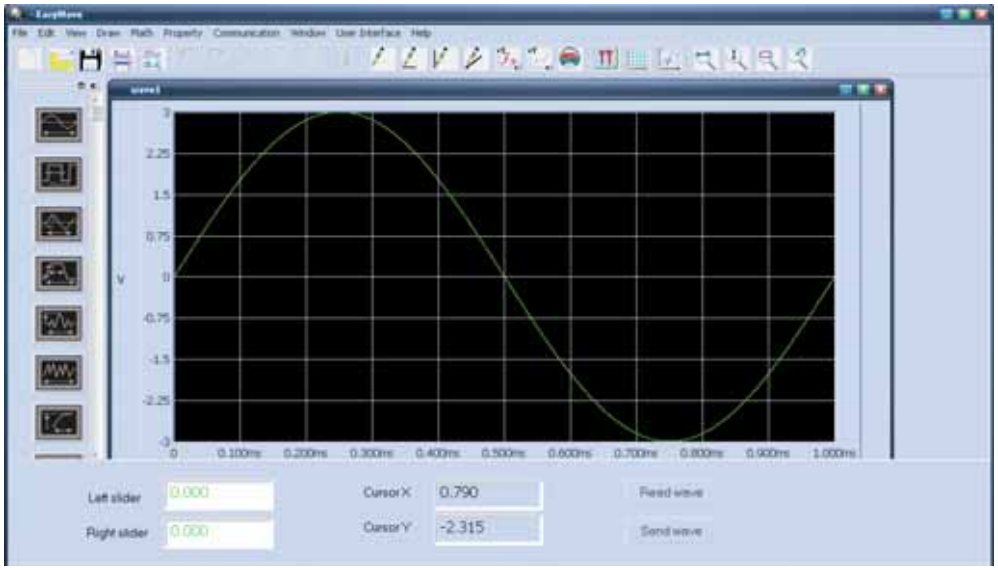
Up to 10 harmonics may be generated. Amplitude and phase of each harmonic can be set independently

Waveform Combining



Capable of combining the waveforms of 2 channels from internal, providing more flexible tools to generate complex waveforms.

Arbitrary Waveform Software EasyWave



EasyWave is a powerful arbitrary waveform editing software program that supports several ways to generate arbitrary waveform such as manual drawing, line-drawing, equation-drawing, coordinate-drawing, etc. It is quite convenient for users to edit their own arbitrary waveforms through EasyWave.

Specifications

All specifications apply to both channels. Unless otherwise stated, all specifications are not guaranteed unless the following conditions are met:

- The generator is within calibration period of validity
- The generator has been working continuously for at least 30 minutes at a specified temperature (18℃ ~ 28℃).

Frequency Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Resolution			1μ	Hz	
Initial accuracy	-25		+25	ppm	1st year, 0~40℃

Sine Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		60 M	Hz	SDG1062X
			30 M		SDG1032X
Harmonic distortion			-60	dBc	0 dBm, 0~10 MHz (included)
			-50	dBc	0 dBm, 10~30 MHz (included)
			-40	dBc	0 dBm, 30~60 MHz
Total Harmonic Distortion			0.075		0 dBm, 10 Hz ~ 20 kHz
Non-harmonic spurious			-65	dBc	0 dBm, 0~10 MHz (included)
			-55	dBc	0 dBm, 10~30 MHz (included)
			-40	dBc	0 dBm, 30~60 MHz

Square Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		60 M	Hz	SDG1062X
			30 M		SDG1032X
Rise/fall times			4.2	ns	10% ~ 90%, 1 Vpp, 50 Ω load
			3.8	ns	10% ~ 90%, 2.5 Vpp, 50 Ω load
Overshoot			3	%	100 kHz, 1 Vpp, 50 Ω load
Duty cycle	0.001		99.999	%	Limited by frequency setting
Jitter (rms), Cycle to cycle			300 ps + 0.05 ppm of period		1 Vpp, 50 Ω load

Pulse Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		12.5 M	Hz	
Pulse width	32.6			ns	
Pulse width accuracy			±(0.01%+1 ns)		
Rise/fall times	16.8 n		22.4	s	10% ~ 90%, 1 Vpp, 50 Ω load , Subject to pulse width limits
Overshoot			3	%	100 kHz, 1 Vpp
Duty cycle	0.001		99.999	%	Limited by frequency setting
Duty cycle resolution	0.001			%	
Jitter (rms) cycle to cycle			300 ps + 0.05 ppm of period	ps	1 Vpp, 50 Ω load

Noise Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
-3 dB bandwidth	60			MHz	

Ramp Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		500 k	Hz	
Symmetry	0		100	%	
Linearity			1	%	Percentage of peak-peak output, 1 kHz, 1 Vpp, 100%

Arbitrary Wave characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		6 M	Hz	
Waveform length	16 k			pts	
Sampling rate	150 M			Sa/s	
Vertical solution	14			bit	
Jitter (pk-pk)		6.7		ns	
Types of built-in Arb	196				

DC Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Range	-10		10	V	HiZ load
	-5		5	V	50 Ω load
Accuracy	±(1%+3 mV)				HiZ load

Harmonic Output Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Order			10		
Type	Even, Odd, All				

Output Characterisics

Parameter	Min.	Typ.	Max.	Unit	Condition
Range (Note 1)	4 m		20	Vpp	≤ 10 MHz, HiZ load
	4 m		10	Vpp	>10 MHz, HiZ load
Accuracy	±(1%+1 mVpp)				10 kHz sine, 0 V offset
Amplitude flatness	-0.3		+0.3	dB	50 Ω load , 2.5 Vpp, compare to 10 kHz sine,
Output impedance	49.5	50	50.5	Ω	10 kHz sine
Output current	-200		200	mA	
Crosstalk (CH1 - CH2 / CH2 - CH1)			-60	dBc	CH1= CH2= 0 dBm, Sine, 50 Ω load

Note 1: The specification will be divided by 2 when applied to a 50 Ω load.

Modulation Characteristics

AM					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Sine, Square, Ramp, Noise, Arb				
Modulation depth	0		120	%	
Modulation frequency	1 m		20 k	Hz	While modulation source is "Internal"
FM					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Sine, Square, Ramp, Noise, Arb				
Frequency deviation	0		0.5*BW		BW is the max. output frequency limited by frequency setting
Modulation frequency	1 m		20 k	Hz	While modulation source is "Internal"

Modulation Characteristics

PM					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Sine, Square, Ramp, Noise, Arb				
Phase deviation	0		360	°	
Modulation frequency	1 m		20 k	Hz	While modulation source is "Internal"
ASK					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Square with 50% duty cycle				
Keying frequency	1 m		50 k	Hz	Limited by frequency setting while modulation source is "Internal"
FSK					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Square with 50% duty cycle				
Modulation frequency	1 m		50 k	Hz	While modulation source is "Internal"
PWM					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Pulse				
Modulation Source	Internal/External				
Modulating wave	Sine, Square, Ramp, Noise, Arb				
Modulation frequency	1 m		1 M	Hz	While modulation source is "Internal"
Pulse width deviation resolution	6.67			ns	

Burst Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Pulse, Noise, Arb				
Type	Count(1-1000000cycles), Infinite, Gated				
Carrier frequency	2 m		BW	Hz	BW is the max. output frequency
Start/Stop phase	0		360	°	
Internal period	1 μ		1000	s	
Trigger source	Internal, External, Manual				
Gated source	Internal/External				
Trigger delay			100	s	

Sweep Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Type	Linear, Log				
Direction	Up, Down				
Carrier frequency	1 μ		BW	Hz	BW is the max. output frequency
Sweep time	1 m		500	s	
Trigger source	Internal, External, Manual				

Frequency Counter Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Function	Frequency, Period, Positive/Negative pulse width, Duty cycle				
Coupling mode	AC, DC, HF REJ				
Frequency range	100m		200 M	Hz	DC coupling
	10		200 M	Hz	AC coupling
Input amplitude	100 mVrms		±2.5 V		DC coupling, < 100 MHz
	200 mVrms		±2.5 V		DC coupling, 100 MHz ~ 200 MHz
	100 mVrms		5 Vpp		AC coupling, < 100 MHz
	200 mVrms		5 Vpp		AC coupling, 100 MHz ~ 200 MHz
Input impedance		1 M		Ω	

Reference Clock Input/Output

Reference Clock Input

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency		10 M		Hz	
Amplitude	1.4			Vpp	
Input impedance	5			kΩ	AC coupling

Reference Clock Output

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency		10 M		Hz	Synchronized to internal reference clock
Amplitude	2	3.3		Vpp	HiZ load
Output impedance		50		Ω	

Auxiliary In/Out Characteristics

Trigger Input

Parameter	Min.	Typ.	Max.	Unit	Condition
V_{IH}	2		5.5	V	
V_{IL}	-0.5		0.8	V	
Input impedance	100			kΩ	
Pulse width	100			ns	
Response time			100	ns	Sweep
			600	ns	Burst

Trigger Output

Parameter	Min.	Typ.	Max.	Unit	Condition
V_{OH}	3.8			V	I_{OH} = −8 mA
V_{OL}			0.44	V	I_{OL} = 8 mA
Output impedance		100		Ω	
Frequency			1	MHz	

Sync Output

Parameter	Min.	Typ.	Max.	Unit	Condition
V_{OH}	3.8			V	I_{OH} = −8 mA
V_{OL}			0.44	V	I_{OL} = 8 mA
Output impedance		100		Ω	
Pulse width		500		ns	
Frequency			1	MHz	

Auxiliary In/Out Characteristics

Modulation Input

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	0		50	kHz	
Input impedance	10			kΩ	
Amplitude@ 100% Modulation depth	11	12	13	Vpp	

General Characteristics

Power

Parameter	Min.	Typ.	Max.	Unit	Condition
Voltage	100 - 240 Vrms (± 10%), 50 / 60 Hz 100 - 120 Vrms (± 10%), 400 Hz				
Power consumption		21	50	W	Dual channels, Sine, 1kHz, 10Vpp, 50Ω load

Display

Parameter	Min.	Typ.	Max.	Unit	Condition
Color depth		24		bit	
Contrast ratio		350:1			
Luminance		300		cd/m^2	

Environment

Parameter	Min.	Typ.	Max.	Unit	Condition
Operating temperature	0		40	℃	
Storage temperature	-20		60	℃	
Operating humidity	5		90	%	≤ 30 ℃
	5		50	%	40 ℃
Non-operating humidity	5		95	%	
Operating altitude			3048	m	≤ 30 ℃
Non-operating altitude			15000	m	

Calibration

Parameter	Min.	Typ.	Max.	Unit	Condition
Calibration interval		1		year	

Mechanical

Parameter	Min.	Typ.	Max.	Unit	Condition
Dimensions	W×H×D = 260.3 mm×107.2 mm×295.7 mm				
Net weight		3.43		kg	
Gross weight		4.35		kg	

Compliance

LVD	IEC 61010-1:2010
EMC	EN61326-1:2013

Ordering Information

Product Description	
60 MHz, 2 CH, 150 MSa/s, 14 bit	SDG1062X
30 MHz, 2 CH, 150 MSa/s, 14 bit	SDG1032X
Standard Configurations	
Quick Start -1	
Power Cord-1	
Calibration Certificate -1	
USB Cable -1	
CD (Includes Quick Start guide, data sheet, and Application Software Package) -1	
Optional Configurations	
BNC Coaxial Cable	SDG-BNC
20 dB Attenuator	ATT-20dB
10W Power Amplifier	SPA1010

SDS2000X-E Series

Super Phosphor Oscilloscope

SIGLENT®

DataSheet-2018.12

SIGLENT TECHNOLOGIES CO.,LTD

SDS2202X-E
SDS2352X-E

Product overview

SIGLENT's new SDS2000X-E Series Super Phosphor Oscilloscopes are available in two bandwidths; 200 MHz and 350 MHz. They each have a maximum sampling rate of 2 GSa/s and a standard record length of 28 Mpts. The most commonly used functions can be accessed with its user-friendly one-button design.

The SDS2000X-E series employs a new generation of SPO technology. With its excellent signal fidelity, background noise is lower than similar products in the industry. It has a minimum vertical input range of 500 uV/div, an innovative digital trigger system with high sensitivity and low jitter, and a waveform capture rate of 400,000 frames/sec (sequence mode). It also employs a 256-level intensity grading display function and a color temperature display mode not found in other models in this class. Siglent's newest oscilloscope offering supports multiple powerful triggering modes including serial bus triggering and decoding. History waveform recording and sequential triggering allow for extended waveform records to be captured, stored, and analyzed. Also included is the deep memory FFT. This math function uses up-to 1 M samples for the FFT calculation, providing the SDS2000X-E with very high frequency resolution. The hardware co-processor executes true fast measurement and math to all of 28M sample points so that there is minimal distortion on analysis. It also supports searching and navigating, on-screen Bode plot, 16 channel digital /MSO (optional), an external USB powered 25 MHz AWG function generator module (option), a USB WIFI adapter for wireless control and monitoring (option), and an embedded application that allows remote control via web browser. The features and high-performance of the SDS2000X-E oscilloscopes cannot be matched else anywhere at this price.

Key Features

- 200MHz, 350MHz bandwidth models
- Real-time sampling rate up to 2 GSa/s (1 GSa/s per channel, if both channels active)
- The newest generation of SPO technology
  - Waveform capture rate up to 110,000 wfm/s (normal mode), and 400,000 wfm/s (sequence mode)
  - Supports 256-level intensity grading and color display modes
  - Record length up to 28 Mpts
  - Digital trigger system
- Intelligent trigger: Edge, Slope, Pulse Width, Window, Runt, Interval, Time out (Dropout), Pattern
- Serial bus triggering and decoding (standard), supports protocols IIC, SPI, UART, CAN, LIN
- Video trigger, supports HDTV
- Low background noise with voltage scales from 500μV/div to 10V/div
- 10 types of one-button shortcuts, supports Auto Setup, Default, Cursors, Measure, Roll, History, Display/Persist, Clear Sweep, Zoom and Print
- Segmented acquisition (Sequence) mode, divides the maximum record length into multiple segments (up to 80,000), according to trigger conditions set by the user, with a very small dead time segment to capture qualifying events
- History waveform record (history) function (maximum recorded waveform length is 80,000 frames)
- Automatic measurement function for 38 parameters as well as Measurement Statistics, Zoom, Gating, Math, History and Reference functions
- 1 Mpt FFT
- Math and measurement functions use all sampled data points in memory (up to 28 Mpts)
- Math functions (FFT, addition, subtraction, multiplication, division, integration, differential, square root)
- Preset key can be customized for user settings or factory "defaults"
- Security Erase mode
- High Speed hardware based Pass/ Fail function
- 16 Digital channels (MSO) (option)
- Bode plot
- Search and navigate
- USB AWG module(option)
- USB WIFI adapter(option)
- Web Browser based control
- Large 7 inch TFT -LCD display with 800 * 480 resolution
- Multiple interface types: USB Host, USB Device (USB -TMC), LAN, Pass / Fail, Trigger Out
- Supports SCPI remote control commands
- VXI-11+SCPI, Telnet (port 5024) +SCPI and Socket (port 5025) +SCPI programming over LAN
- Supports web control and virtual instrument control panel for both PC and mobile terminals
- Web control update rate of up-to 10 times/s provides nearly real-time update rate
- Supports Multi-language display and embedded online help

Models and key Specification

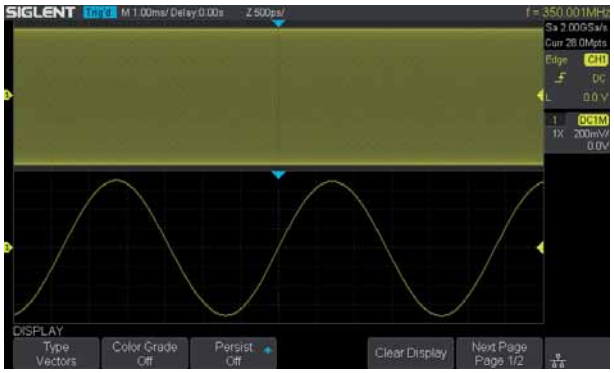
Model	SDS2202X-E	SDS2352X-E
Bandwidth	200 MHz	350 MHz
Sampling Rate (Max.)	2 GSa/s	
Channels	2+EXT	
Memory Depth (Max.)	14 Mpts/CH (not interleave mode) 28 Mpts/CH (interleave mode)	
Waveform Capture Rate (Max.)	110,000 wfm/s (normal mode), 400,000 wfm/s (sequence mode)	
Trigger Type	Edge, Slope, Pulse Width, Window, Runt, Interval, Dropout, Pattern, Video	
Serial Trigger and decoder (Standard)	IIC, SPI, UART, CAN, LIN	
16 Digital Channels (option)	Maximum waveform capture rate up to 1GSa/s, Record length up to 14 Mpts/CH	
USB AWG module (option)	One channel, 25 MHz, sample rate of 125 MHz, 16 kpts waveform memory sample size	
Bode plot	Minimum start frequency of 10 Hz, minimum scan bandwidth of 500 Hz, maximum scan bandwidth of 120 MHz (dependent on Oscilloscope and AWG bandwidth), 500 maximum scan frequency points	
USB WIFI adapter (option)	802.11b/g/n, WPA-PSK NOTE: To ensure compatibility, we recommend using only SIGLENT WiFi accessories	
I/O	USB Host, USB Device, LAN, Pass/Fail, Trigger Out, Sbus (Siglent MSO)	
Probe (Std)	2 pcs passive probe PP215	2 pcs passive probe SP2035
Display	7 inch TFT–LCD (800 x 480 pixels)	
Weight	Without package 2.6 Kg; With package 3.8 Kg	

Function & Characteristics

7-inch TFT-LCD display and 10 one-button menus

- 7-inch TFT-LCD display with 800 * 480 resolution
- Most commonly used functions are accessible using 10 different one-button operation keys: Auto Setup, Default, Cursor, Measure, Roll, History, Persist, Clear Sweep, Zoom, Print.

Maximum sample rate of 2 GSa/s, record Length of up to 28 Mpts

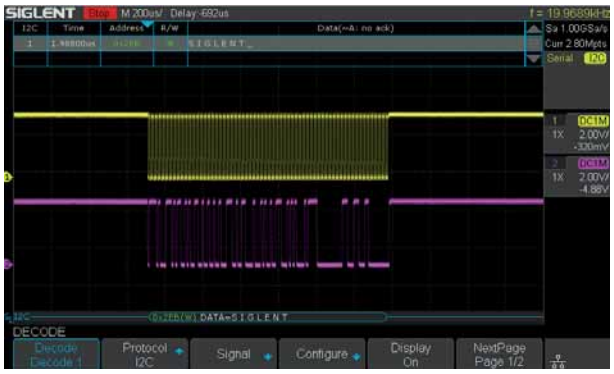


Using hardware-based Zoom technologies and max record length of up to 28 Mpts, users are able to oversample to capture for longer time periods at higher resolution and use the zoom feature to see more details within each signal.

Waveform Capture Rate up to 400,000 wfm/s

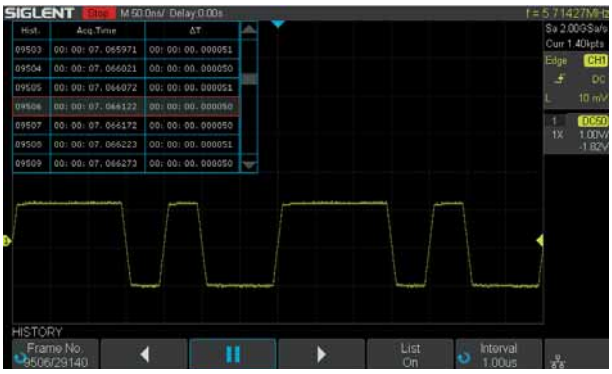
With a waveform capture rate of up to 400,000 wfm/s (sequence mode), the oscilloscope can easily capture the unusual or low-probability events.

Serial Bus Decoding Function (Standard)



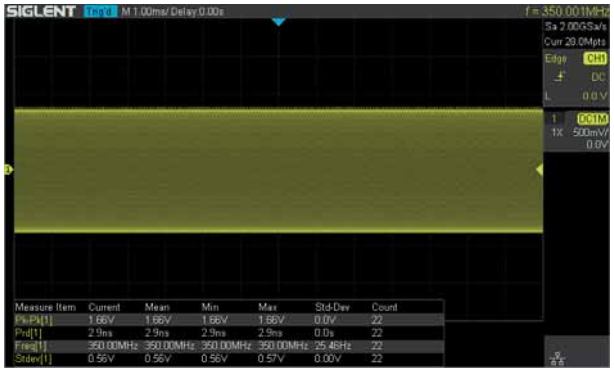
SDS2000X-E displays the decoding through the events list. Bus protocol information can be quickly and intuitively displayed in a tabular format.

History Waveforms (History) Mode and Segmented Acquisition (Sequence)



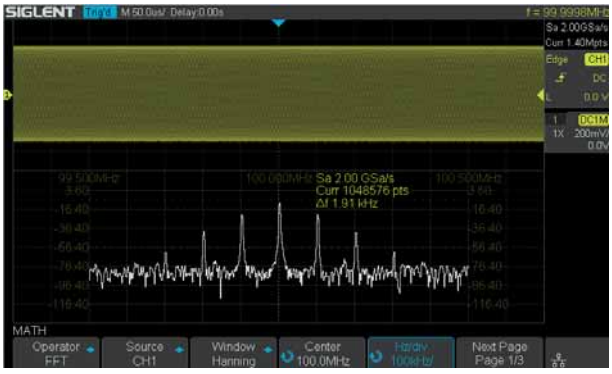
Playback the latest triggered events using the history function. Segmented memory collection will store trigger events into multiple (Up to 80,000) memory segments, each segment will store triggered waveforms and timestamp of each frame.

True measurement to 28 M points



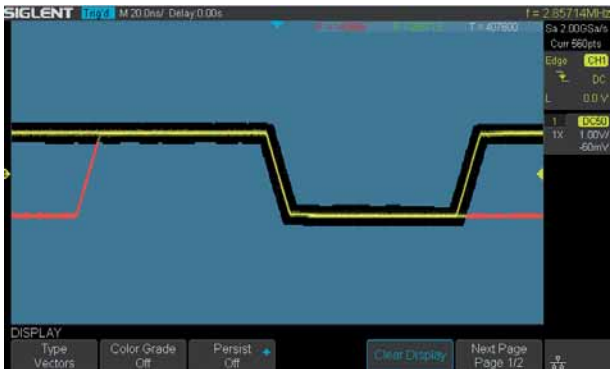
SDS2000X-E can apply automatic measurements on all sampled data points up to 28 Mpts. This ensures the accuracy of measurements while the math co-processor decreases measurement time and increases ease-of-use.

1 Mpoint FFT



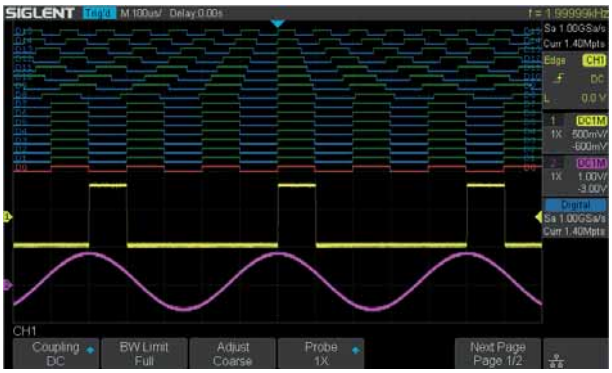
The new math co-processor enables FFT analysis of incoming signals using up to 1 million samples per waveform. This provides high frequency resolution with a fast refresh rate. The FFT function also supports a variety of window functions so that it can adapt to different spectrum measurement needs.

Hardware-Based High Speed Pass/Fail function



The SDS2000X-E utilizes a hardware-based Pass/Fail function, performing up to 40,000 Pass / Fail decisions each second. Easily generate user defined test templates provide trace mask comparison making it suitable for long-term signal monitoring or automated production line testing.

16 Digital Channels/MSO (option)

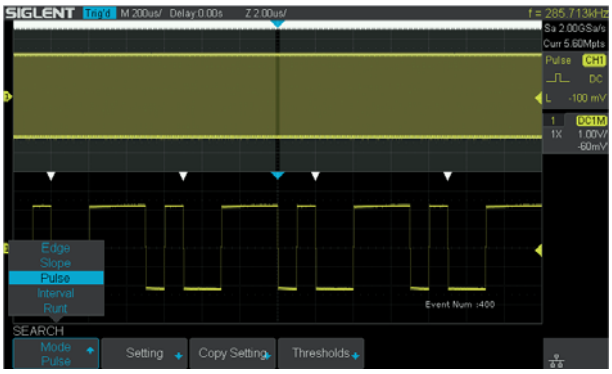


16 digital channels enables users to acquire and trigger on digital input channels and view both digital and analog waveforms simultaneously with one instrument.

USB 25 MHz AWG Module (option)

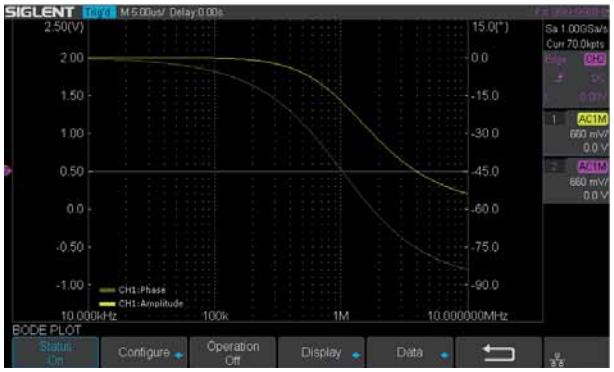
The optional 25 MHz function/arbitrary waveform generator is operated from the USB host connection. Functions include Sine, Square, Ramp, Pulse, Noise, DC and 45 additional built-in waveforms. The arbitrary waveforms can be accessed and edited by the SIGLENT EasyWave PC software.

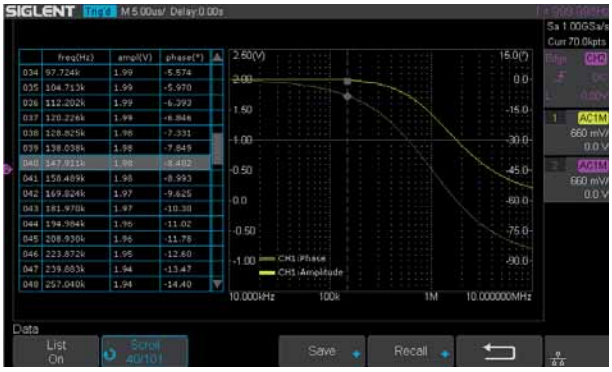
Search and Navigate



The SDS2000X-E can search events specified by the user in a frame. It can also navigate by time (delay position) and historical frames.

Bode Plot



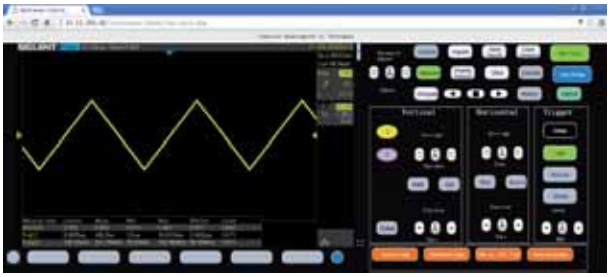


SDS2000X-E can control the USB AWG module or an independent SIGLENT SDG instrument, scan a circuits amplitude and phase frequency response, and display the data as a Bode Plot. It can also show the result lists, and export the data to a USB disk.

USB WIFI Adapter (option)

WiFi control of instrumentation can provide a convenient and safe method of configuring and collecting data. This new feature works with a SIGLENT approved WiFi adapter to provide wireless control and communications with SIGLENT SDS2000X-E scopes.

Web control



With the new embedded web server, users can control the SDS2000X-E from a simple web page. This provides wonderful remote troubleshooting and monitoring capabilities. The web page has PC and mobile styles that include an embedded virtual control panel.

Real-time update screen in web page

With 100 Mbps LAN, the internal web page can update at a rate of up to 10 times/s, providing a nearly-real time update of waveform data and measurements. When viewed on a PC, the screen can be displayed in full screen mode. With this feature and a PC VGA interface, you can easily use a projector or other video display device to deliver the screen information to a larger audience.

Complete Connectivity

SDS2000X -E supports USB Host, USB Device (USB -TMC), LAN, Pass/Fail and Trigger Out.

Specifications

Acquire System	
Sampling Rate	2 GSa/s (single channel), 1 GSa/s (two channels)
Memory Depth	Max 28 Mpts/Ch (single channel), 14 Mpts/Ch(two channels)
Peak Detect	1 nsec
Average	Averages: 4, 16, 32, 64, 128, 256, 512, 1024
Eres	Enhance bits: 0.5, 1.5, 2, 2.5, 3
Waveform interpolation	Sin(x)/x, Linear

Input	
Channels	2+EXT
Coupling	DC, AC, GND
Impedance	DC 1 MΩ: (1 MΩ ± 2%) || (18 pF ± 2 pF) DC 50 Ω: 50 Ω ± 2%
Max. Input voltage	1 MΩ: ≤ 400 Vpk (DC + Peak AC <= 10 kHz) 50 Ω: ≤ 5V rms
CH to CH Isolation	DC-Max BW :> 40 dB
Probe attenuation	0.1X, 0.2X, 0.5X, 1X, 2X, 5X, 10X……1000X, 2000X, 5000X, 10000X, Custom

Vertical System	
Bandwidth (-3 dB)	350 MHz (SDS2352X-E) 200 MHz (SDS2202X-E)
Vertical Resolution	8-bit
Vertical Scale (Probe 1 X)	500 μV/div - 10 V/div (1-2-5 sequence)
Offset Range (Probe 1 X)	500 μV - 100 mV: ± 2 V
	102 mV- 1 V: ± 20 V
	1.02 V - 10 V: ± 200 V
Bandwidth Limit	20 MHz ± 40%
Channel Flatness (Inner 50 Ω)	DC - 60% (BW): ± 1 dB
	60% - 100% (BW): + 1 dB/-3 dB
Low Frequency Response (AC -3 dB)	≤ 2 Hz (at input BNC)
Noise	ST-DEV ≤ 0.5 division (< 1 mV/div)
	ST-DEV ≤ 0.2 division (< 2 mV/div)
	ST-DEV ≤ 0.1 division (≥ 2 mV/div)
SFDR including harmonics	≥35 dB
DC Gain Accuracy	≤ ± 3.0%: 5 mV/div-10 V/div
	≤ ± 4.0%: ≤ 2 mV/div
Offset Accuracy	± (1% * Offset + 1.5% * 8 * div + 2 mV): ≥2 mV/div
	± (1% * Offset + 1.5% * 8 * div + 500 uV): ≤1 mv/div
Risetime	Typical 1.0 ns (SDS2352X-E)
	Typical 1.8 ns (SDS2202X-E)

Horizontal System	
Timebase Scale	500 ps/div-100 s/div
Channel Skew	<100 ps
Waveform Capture Rate	Up to 110,000 wfm/s (normal mode), 400,000 wfm/s (sequence mode)
Intensity Grading	256 Levels
Display Format	Y-T, X-Y, Roll
Timebase Accuracy	±25 ppm
Roll Mode	50 ms/div-100 s/div (1-2-5 step)

Trigger System	
Trigger Mode	Auto, Normal, Single
Trigger Level	Internal: ±4.5 div from the center of the screen
	EXT: ±0.6 V
	EXT/5: ±3 V
Holdoff Range	80 ns - 1.5 s
Trigger Coupling	AC DC LFRJ HFRJ Noise RJ
Coupling Frequency Response	DC: Passes all components of the signal
	AC: Blocks DC components and attenuates signals below 8 Hz
	LFRJ: Blocks the DC component and attenuates the low-frequency components below 2 MHz
	HFRJ: Attenuates the high-frequency components above 1.2 MHz
Coupling Frequency Response (EXT)	DC: Passes all components of the signal
	AC: Blocks DC components and attenuates signals below 10 Hz
	LFRJ: Blocks the DC components and attenuates low-frequency components below 6 KHz
	HFRJ: Attenuates high-frequency components above 200 KHz
Trigger Accuracy (typical)	Internal: ±0.2 div
	EXT: ±0.4 div
Trigger Sensitivity	DC - Max BW 0.6 div
	EXT: 200 mVpp DC – 10 MHz
	300 mVpp 10 MHz - BW frequency (External 50 Ω)
	EXT/5: 1 Vpp DC – 10 MHz
	1.5 Vpp 10 MHz -BW frequency (External 50 Ω)
Trigger Jitter	< 100 ps
Trigger Displacement	Pre-Trigger: 0 - 100% Memory
	Delay Trigger: 0 to 10,000 div
Edge Trigger	
Slope	Rising, Falling, Rising&Falling
Source	All channels / EXT / (EXT/5) / AC Line
Slope Trigger	
Slope	Rising, Falling
LimitRange	<, >, <>, ><
Source	All channels
TimeRange	2 ns - 4.2 s
Resolution	1 ns

Pulse Trigger	
Polarity	+wid , -wid
Limit Range	<, >, <>, ><
Source	All channels
Pulse Range	2 ns - 4.2 s
Resolution	1 ns
Video Trigger	
Signal Standard	NTSC, PAL, 720p/50, 720p/60, 1080p/50, 1080p/60, 1080i/50, 1080i/60, Custom
Source	All channels
Sync	Any, Select
Trigger condition	Line, Field
Window Trigger	
Window Type	Absolute, Relative
Source	All channels
Interval Trigger	
Slope	Rising, Falling
Limit Range	<, >, <>, ><
Source	All channels
Time Range	2 ns - 4.2 s
Resolution	1 ns
Dropout Trigger	
Timeout Type	Edge, State
Source	All channels
Slope	Rising, Falling
Time Range	2 ns - 4.2 s
Resolution	1 ns
Runt Trigger	
Polarity	+wid , -wid
Limit Range	<, >, <>, ><
Source	All channels
Time Range	2 ns - 4.2 s
Resolution	1 ns
Pattern Trigger	
Pattern Setting	Invalid, Low, High
Logic	AND, OR, NAND, NOR
Source	All channels
Limit Range	<, >, <>, ><
Time Range	2 ns - 4.2 s
Resolution	1 ns

Search	
Event	Edge, Slope, Pulse, Interval, Runt
Event Number	Y-T: 700 ROLL: No limitation Stop After ROLL: 700

Serial Trigger	
I2C Trigger	
Condition	Start, Stop, Restart, No Ack, EEPROM, 7 bits Address & Data, 10 bits Address & Data, Data Length
Source (SDA/SCL)	All channels
Data Format	Hex
Limit Range	EEPROM: =, >, <
Data Length	EEPROM: 1 byte Addr & Data: 1-2 byte Data Length: 1-12 byte
R/W bit	Addr & Data: Read, Write, Do not care
SPI Trigger	
Condition	Data
Source (CS/CL/Data)	All channels
Data Format	Binary
Data Length	4-96-bit
Bit Value	0, 1, X
Bit Order	LSB, MSB
UART Trigger	
Condition	Start, Stop, Data, Parity Error
Source (RX/TX)	All channels
Data Format	Hex
Limit Range	=, >, <
Data Length	1 byte
Data Width	5, 6, 7, 8-bits
Parity Check	None, Odd, Even
Stop Bit	1, 1.5, 2-bits
Idle Level	High, Low
Baud Rate (Selectable)	600/1200/2400/4800/960019200/38400/57600/115200 bit/s
Baud Rate (Custom)	300-5000000 bit/s
CAN Trigger	
Condition	Start Remote, ID, ID + Data, Error
Source	All channels
ID	STD (11 bit), EXT (29 bit)
Data Format	Hex
Data Length	1-2 byte
Baud Rate	5 k/ 10 k/ 20 k/ 50k/ 100 k/ 125 k/ 250 k/ 500 k/ 800 k/ 1 M bit/s
LIN Trigger	
Condition	Break, Frame ID, ID+Data, Error
Source	All channels
ID	1 byte
Data Format	Hex
Data Length	1-2 byte
Baud Rate (Selectable)	600/1200/2400/4800/9600/19200 bit/s
Baud Rate (Custom)	300 bit/s - 20 kbit/s

Serial Decoder	
Number of Decoders	2
I2C Decoder	
Signal	SCL, SDA
Address	7, 10 bits
Threshold	-4.5 - 4.5 div
List	1 - 7 lines
SPI Decoder	
Signal	SCL, MISO, MOSI, CS (2 channel scopes can only use 2 signal identifiers)
Edge Select	Rising, Falling
Idle Level	Low, High
Bit Order	MSB, LSB
Threshold	-4.5 - 4.5 div
List	1 - 7 lines
UART Decoder	
Signal	RX, TX
Data Width	5, 6, 7, 8-bits
Parity Check	None, Odd, Even
Stop Bit	1, 1.5, 2-bits
Idle Level	Low, High
Threshold	-4.5 - 4.5 div
List	1 - 7 lines
CAN Decoder	
Signal	CAN_H, CAN_L
Source	CAN_H, CAN_L, CAN_H - CAN_L
Threshold	-4.5 - 4.5 div
List	1 - 7 lines
LIN Decoder	
LIN Specification Package Revision	Ver 1.3, Ver 2.0
Threshold	-4.5 - 4.5 div
List	1 - 7 lines

Measurement		
Source	All channels, All channels in Zoom, Math, All References, History	
Number of Measurements	Display 4 measurements at the same time. 5 measurements displayed in statistics table	
Measurement Range	Screen or Gate region	
Measurement Parameters (38 Types)		
Vertical (Voltage)	Max	Highest value in input waveform
	Min	Lowest value in input waveform
	Pk - Pk	Difference between maximum and minimum data values
	Ampl	Difference between top and base in a bimodal signal, or between max and min in a singal mode signal
	Top	Value of most probable higher state in a bimodal waveform
	Base	Value of most probable lower state in a bimodal waveform
	Mean	Average of all data values
	Cmean	Average of data values in the first cycle
	Stdev	Standard deviation of all data values
	Cstd	Standard deviation of all data values in the first cycle
	VRMS	Root mean square of all data values
	Crms	Root mean square of all data values in the first cycle
	FOV	Overshoot after a falling edge; (base -min)/Amplitude
	FPRE	Overshoot before a falling edge; (max -top)/Amplitude
	ROV	Overshoot after a rising edge; (max -top)/Amplitude
	RPRE	Overshoot before a rising edge; (base -min)/Amplitude
	Level@X	The voltage value of the trigger point
Horizontal (Time)	Period	Time between the middle threshold points of two consecutive, like-polarity edges
	Freq	Reciprocal of period
	+Wid	Width measured at 50% level and positive slope
	-Wid	Width measured at 50% level and negative slope
	Rise Time	Duration of rising edge from 10-90%
	Fall Time	Duration of falling edge from 90-10%
	Bwid	Time from the first rising edge to the last falling edge, or the first falling edge to the last rising edge at the 50% crossing
	+Dut	Time difference between the 50% threshold of a rising edge to the 50% threshold of the next falling edge of the pulse
	-Dut	Time difference between the 50% threshold of a falling edge to the 50% threshold of the next rising edge of the pulse
	Delay	Time from the trigger to the first transition at the 50% crossing
	Time@Level	Time from the trigger to each rising edge at the 50% crossing. When Statistics is Off, it shows the time from the trigger to the last rising edge at the 50% crossing. When Statistics is On, it shows the Current, Mean, Min, Max, Standard Deviation of time from the trigger to each rising edge at the 50% crossing in multiple frames (number = Count).
Delay	Phase	Phase difference between two edges
	FRR	Time from the first rising edge of channel A to the following first rising edge of channel B
	FRF	Time from the first rising edge of channel A to the following first falling edge of channel B
	FFR	Time from the first falling edge of channel A to the following first rising edge of channel B
	FFF	Time from the first falling edge of channel A to the following first falling edge of channel B
	LRR	Time from the first rising edge of channel A to the last rising edge of channel B
	LRF	Time from the first rising edge of channel A to the last falling edge of channel B
	LFR	Time from the first falling edge of channel A to the last rising edge of channel B
	LFF	Time from the first falling edge of channel A to the last falling edge of channel B
	Skew	Time of source A edge minus time of nearest source B edge

Measurement	
Cursors	Manual : Time X1, X2, (X1 -X2), (1/ΔT) Voltage Y1, Y2, (Y1 -Y2) Track: Time X1, X2, (X1 -X2)
Statistics	Current, Mean, Min, Max, Stdev, Count
Counter	Hardware 6-digit counter (channels are selectable)

Math Function	
Operation	+ , - , * , / , FFT, d/dt, ∫dt, √
FFT window	Rectangular, Blackman, Hanning, Hamming, Flattop
FFT display	Full Screen, Split, Exclusive

USB AWG Module (option)	
Channel	1
Max. Output Frequency	25 MHz
Sampling Rate	125 MSa/s
Frequency Resolution	1 μHz
Frequency Accuracy	±50 ppm
Vertical Resolution	14-bit
Amplitude Range	-1.5 ~ +1.5 V (50 Ω load)
	-3 ~ +3 V (High-Z load)
Waveform Type	Sine, Square, Ramp, Pulse, Noise, DC and 45 built-in waveforms
Output impedance	50 Ω ± 2%
Protection	Over-Voltage Protection, Current-Limiting Protection
Sine	
Frequency	1 μHz ~ 25 MHz
Offset Accuracy (10 kHz)	± (1%*Offset Setting Value +3 mVpp)
Amplitude flatness (10 kHz, 5 Vpp)	±0.3 dB
SFDR	DC ~ 1 MHz -60 dBc
	1 MHz ~ 5 MHz -55 dBc
	5 MHz ~ 25 MHz -50 dBc
HD	DC ~ 5 MHz -50 dBc
	5 MHz ~ 25 MHz -45 dBc
Square/Pulse	
Frequency	1 μHz ~ 10 MHz
Duty Cycle	1% ~ 99%
Rise/Fall Time	< 24 ns (10% ~ 90%)
Overshoot (1 kHz, 1 Vpp, Typical)	< 3% (typical 1 kHz, 1 Vpp)
Pulse Width	> 50 ns
Jitter	< 500 ps + 10 ppm
Ramp	
Frequency	1 μHz ~ 300 kHz
Linearity (Typical)	< 0.1% of Pk-Pk (Typical, 1 kHz, 1 Vpp, 50% Symmetry)
Symmetry	0% ~ 100%

DC	
Offset range	±1.5 V (50 Ω load)
	±3 V (High-Z load)
Accuracy	± (|offset|* 1% + 3 mV)
Noise	
Bandwidth	> 25 MHz (-3 dB)
Arbitrary Wave	
Frequency	1 μHz ~ 5 MHz
Wave Length	16 kpts
Sampling Rate	125 MSa/s
Lead In	EasyWave and U-Disk

Digital Channels (option)	
No. of Channels	16
Max. Sampling Rate	1 GSa/s
Memory Depth	14 Mpts/CH
Min. Detectable Pulse Width	4 ns
Level Group	D0 ~ D7, D8 ~ D15
Level Range	-8 V ~ 8 V
Logic Type	TTL, CMOS, LVCMOS3.3, LVCMOS2.5, custom
Skew[2]	D0 ~ D15: ±1 sampling interval Digital to Analog: ± (1 sampling interval +1 ns)

I/O	
Standard	USB Host*2, USB Device, LAN, Pass/Fail, Trigger Out
Pass/Fail	3.3 V TTL Output

Display (Screen)	
Display Type	7-inch TFT LCD
Display Resolution	800 × 480 pixels
Display Color	24-bit
Contrast (Typical)	500:1
Backlight	300 nits
Range	8 x 14 divisions

Display (Waveform)	
Display Mode	Dot, Vector
Persist Time	Off, 1 Sec, 5 Sec, 10 Sec, 30 Sec, Infinite
Color Display	Normal, Color
Screen Saver	1 min, 5 min, 10 min, 30 min, 1 hour, Off
Language	Simplified Chinese, Traditional Chinese, English, French, Japanese, Korean, German, Russian, Italian, Portuguese

Environments	
Temperature	Operating: 10℃ ~ +40℃
	Non-operating: -20℃ ~ +60℃
Humidity	Operating: 85% RH, 40℃ , 24 hours
	Non-operating: 85% RH, 65℃ , 24 hours
Height	Operating: ≤3000 m
	Non-operating: ≤15,266 m
Compliance	LVD IEC 61010-1:2010
	EMC EN6 1326-1:2013

Power Supply	
Input Voltage	100 - 240 Vrms (± 10%), 50 / 60 Hz 100 - 120 Vrms (± 10%), 400 Hz
Power	50W Max

Mechanical	
Dimensions	Length: 312 mm
	Width: 132.6 mm
	Height: 151 mm
Weight	N.W: 2.6 kg; G.W: 3.8 kg

Strumentazione Elettronica

PS5305DS

POWER SUPPLY

- **Due uscite variabili 0-30V e 0-5A**
- **2 display per tensione e 2 display corrente**
- **Uscita fissa 5V / 3A**
- **Tracking : serie e parallelo**
- **Alta stabilità**

CE

Specifiche tecniche:

	Funzioni	Caratteristiche
	Power voltage	220Vac / 50Hz
Uscita variabile	Uscita in tensione	0 to 30V (completamente regolabile)
	Uscita in corrente	0 to 5A (completamente regolabile)
	Regolazione CV	≤ 1 x 10^{-4} + 0,5mV
	Regolazione CC	≤ 2 x 10^{-3} + 1mA
	Regolazione a carico CV	≤ 1 x 10^{-4} + 2mV
	Regolazione a carico CC	≤ 2 x 10^{-3} + 2mA
	Tempo di salita CV	≤ 0,5mVrms (5Hz-1MHz)
	Tempo di salita CC	≤ 2mArms
	Protezione	Limitatore di corrente
	Display	3 digits display per tensione e corrente
	Precisione display tensione	±1%±2 digits
	Precisione display corrente	±2%±2 digits
Uscita fissa	Uscita in tensione	5V±3%
	Uscita in corrente	3A
	Regolazione	≤ 1 x 10^{-4} + 1mV
	Regolazione a carico	≤ 1 x 10^{-3}
	Tempo di salita	≤ 1mVrms (5Hz-1MHz)
	Protezione	Limitatore di corrente e cortocircuito
Generale	Temperatura di lavoro	da 0 a 40°C
	Umidita di lavoro	< 90%
	Lavoro continuo	8 h
	Dimensione	266 x 160 x 310 mm
	Peso	Circa. 4kg

GENERALI

Due uscite variabili, la tensione è variabile da 0 a 30 volt e la corrente è variabile da 0 a 5 ampere. Il gruppo di 4 display digitali LED per misurare il reale valore di tensione e di corrente con un massimo di 2% di errore.

Una terza uscita che è fissa a 5V e 3A.

Applicazione

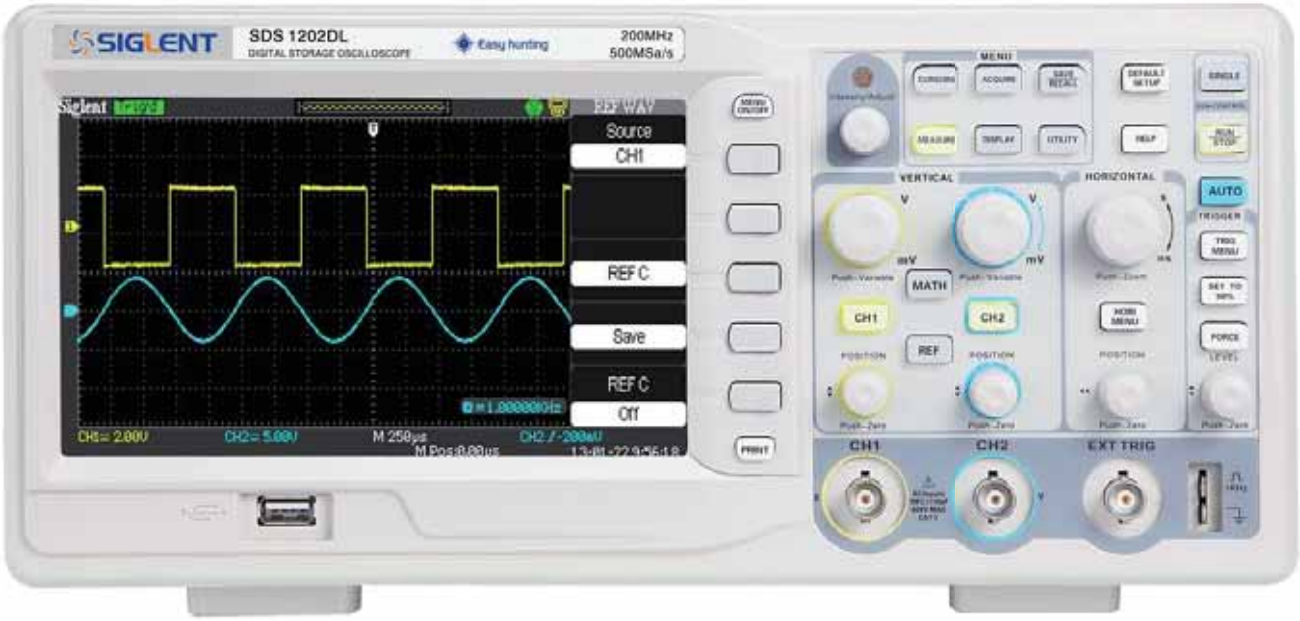
- *Didattica*
- *Laboratori ricerca e sviluppo*
- *Produzione e Testing*

Accessori

- *Manuale di istruzioni*
- *Cavo di alimentazione*

DataSheet

SDS1000DL
Series Digital Oscilloscope



CHARACTERISTIC:

- The highest Single real-time sampling rate can be up to 500MHzsa/s; Equivalent sampling rate is up to 50GSa/s.
- Memory Depth: 32Kpts
- Trigger types: Edge, Pulse Width, Video, Slope, Alternative
- Unique Digital Filter function and Waveform recorder function
- Support Pass/Fail function.
- Thirty two parameters Auto measure function.
- Save/recall types: Setups, Waveforms, CSV file, Picture.
- Support Multilingual On-line help system
- Waveform Intensity and Grid Brightness can be adjusted.
- Support twelve types Language
- Standard Configuration Port:
  USB Host: Support USB flash driver save/recall function and update firmware;
  USB Device: Support PictBridge compatible printer and support PC remote control;
  RS232;
  Pass/Fail Output.

Specifications

All specification applies to 10X probe and All the SDS1000DL Series Digital Storage Oscilloscopes.

To verify that the oscilloscope meets specifications, the oscilloscope must first meet the following conditions:

- The oscilloscope must have been operating continuously for thirty minutes within the specified operating temperature.
- You must perform the Do Self Cal operation, accessible through the Utility menu, if the operating temperature changes by more than 5° C.
- The oscilloscope must be within the factory calibration interval

All specifications are guaranteed unless noted “typical.”

Inputs	
Input Coupling	AC, DC, GND
Input Impedance	1MΩ±2% || 16Pf±3Pf,
Maximum Input voltage	400V （DC+AC PK-PK，1MΩ input impedance，X10），CAT I
Ch to Ch Isolation (Both channels in same V/div setting)	>100:1 at 100MHz: (SDS1202DL) >100:1 at 50MHz:(SDS1102DL) >100:1 at 25MHz (SDS1052DL) >100:1 at 10MHz (SDS1022DL)
Probe Attenuator	1X,10X
Probe Attenuator Factors Set	1X,5X,10X,50X,100X, 500X,1000X

Vertical System	
Vertical Sensitivity	2mV/div -10V/div(1-2-5 order)
Channel Voltage Offset Range	2mV –200mV: ±1.6V 206mV - 10V: ±40V
Vertical Resolution	8 bit
Channels	2
Analog	200MHz(SDS1202DL)

Bandwidth	100MHz(SDS1102DL) 50MHz(SDS1052DL) 25MHz(SDS1022DL)
Single-shot Bandwidth	200MHz(SDS1202DL) 100MHz(SDS1102DL) 50MHz(SDS1052DL) 25MHz(SDS1022DL)
BW Flatness at BNC input	DC -10% of rated BW: +/- 1dB 10% - 50% of rated BW: +/- 2dB 50% - 100% of rated BW: + 2dB/-3dB
Lower frequency limit (AC -3dB)	≤10Hz(at input BNC)
Noise: Pk-Pk for 3K record	≤0.6 Div for average of 10 Pk-Pk readings, Fixed gain settings ≤0.7 Div for average of 10 Pk-Pk readings, Variable gain settings
SFDR including harmonics (measured with FFT)	>=35dB
DC Gain Accuracy	＜±3.0%: 5mv/div to 10V/div in Fixed Gain Ranges ＜±4.0%: 2mv/div Variable Gain Ranges
DC Measurement Accuracy: All Gain settings ≤ 100mv/div	± [3%* （ |reading|+|offset| ） +1% *of |offset| +0.2div+2mv]
DC Measurement Accuracy: All Gain settings ＞ 100mv/div	± [3%* （ |reading|+|offset| ） +1%* of |offset| +0.2div+100mv]
Rise time	<1.8ns (SDS1202DL) <3.5ns(SDS1102DL) <7.0ns (SDS1052DL) <14ns (SDS1022DL)
Overshoot, Typical (using 500ps pulse)	<10% with probe or BNC input w/ 50 Ohm feed thru
Ch to Ch Skew (both channels in same V/div setting)	<1ns: SDS1202DL SDS1102DL <4ns: SDS1052DL <10ns: SDS1022DL (Equivalent to 2 minor divisions in smallest t/div)
Math operation	+, -, *, /, FFT

FFT	Window mode: Hanning, Hamming, Blackman, Rectangular
	Sampling points: 1024
Bandwidth limited	20MHz ± 40% (Note: BW limited below 20MHz when using probe in x1)

Horizontal System	
Real Time Sampling Rate	Single Channel:500MSa/s,Double Channel: 250MSa/s(When timebase faster than 250ns/div)
Equivalent Sampling Rate	50GSa/s (SDS1022DL:10GSa/s)
Measure Display Modes	MAIN, WINDOW, WINDOW ZOOM, ROLL, X-Y
Timebase Accuracy	±100ppm measured over 1ms interval
Horizontal Scan Range	1/2.5/5/25nS/DIV - 50S/DIV (According to the Bandwidth)
	Scan: 100mS/DIV ～50S/DIV (1-2.5-5 sequence)

Trigger System	
Trigger Types	Edge, Pulse Width, Video, Slope, Alternative
Trigger Source	CH1,CH2,EXT,EXT/5,AC Line
Trigger Modes	Auto, Normal, Single
Trigger Coupling	AC, DC, LF rej, HF rej
Trigger Level Range	CH1,CH2: ±6divisions from center of screen
	EXT: ±1.2V
	EXT/5: ±6V
Trigger Displacement	Pre-trigger：（Memory depth/（2*sampling））, Delay Trigger: 271.04DIV
Trigger Level Accuracy (typical) applicable for the signal of rising and falling time ≥20ns	Internal： ±(0.2 div×V/div)(within±4 divisions from center of screen) EXT： ±(6% of setting + 40 mV) EXT/5： ±(6% of setting + 200 mV)
Trigger Sensitivity	For fixed gain ranges 1 Divisions: DC-10MHz 1.5 Divisions: 10MHz - Max BW
	EXT: 200mVpp DC-10MHz, 300mVpp 10MHz - Max BW
	EXT/5: 1Vpp DC-10MHz, 1.5Vpp 10MHz - Max BW
Pulse Width Trigger	Trigger Modes: (＞,＜, ＝)positive Pulse Width, (＞, ＜, ＝)Negative Pulse Width
	Pulse Width Range: 20ns – 10s

Video Trigger	Support signal Formats: PAL/SECAM, NTSC
	Trigger condition : odd field, even field, all lines, line Num
Slope Trigger	(>,<, =) Positive slope, (>,<, =) Negative slope
	Time: 20ns-10s
Alternative Trigger	CH1 trigger type: Edge, Pulse, Video, Slope
	CH2 trigger type: Edge, Pulse, Video, Slope

X-Y Mode	
X-pole Input / Y-Pole Input	Channel 1 (CH1) / Channel 2 (CH2)
Sample Frequency	XY mode has a breakthrough that trad oscilloscopes restrict sampling rate at 1MSa/s. Support 25Ksa/s～250Msa/s adjusted.

Hard Ware Frequency Counter	
Reading resolution	1Hz
Accuracy	±0.01%
Range	DC Couple, 10Hz to MAX Bandwidth
Signal Types	Satisfying all Trigger signals(Except Pulse width trigger and Video Trigger)

Control Panel Function	
Auto Set	Auto adjusting the Vertical, Horizontal system and Trigger Position
Save/Recall	Support 2 Group referenced Waveforms, 20 Group setups, 20 Group captured Waveforms internal Storage/Recall function and USB flash driver storage function.

Measure System	
Auto Measure (32 Types)	Vpp, Vmax, Vmin, Vamp, Vtop, Vbase, Vavg, Mean,Crms, Vrms, ROVShoot, FOVShoot, RPREShoot, FPREShoot, Rise time, Fall time, Freq, Period,+ Wid,－Wid, ＋Dut, －Dut, BWid, Phase, FRR, FRF, FFR, FFF, LRR, LRF, LFR, LFF
Cursor Measure	Manual mode, Track mode and Auto mode

Generic Specification

Display System	
Display Mode	Color TFT 7.0in.(177.8mm)diagonal Liquid Crystal Display
Resolution	480 horizontal by 234 vertical pixels
Display Color	24bit
Display Contrast （Typical state）	150:1
Backlight Intensity（Typical state）	300nit
Wave display range	8 x 18 div
Wave Display Mode	Dots, Vector
Persist	Off, 1 sec, 2 sec, 5 sec, Infinite
Menu Display	2 sec, 5 sec, 10 sec, 20 sec, Infinite
Screen-Saver	Off,1min,2min,5min,10min,15min,30min,1hour,2hour,5hour
Skin	Classical, Modern, Tradition, Succinct
waveform interpolation	Sin(x)/x，Linear
Color model	Normal , Invert
Language	Simplified Chinese, Traditional Chinese, English, Arabic, French, German, Russian, Portuguese Spanish, Japanese, Korean, Italian

Environments	
Temperature	Operating:10℃ to +40℃ Not operating: -20℃ to +60℃
Cooling	The fan forces it cold.
Humidity	Operating: 85%RH, 40℃, 24 hours Not operating: 85%RH, 65℃, 24 hours
Height	Operating: 3000m Not operating: 15,266m

Power Supply	
Input Voltage	100-240 VAC, CAT II, Auto selection
Frequency Scope	45Hz to 440Hz
Power	50VA Max

Mechanical		
Dimension	length	323.1mm
	Width	135.6mm
	Height	157mm
weight	2.5kg	

Type Selections:

NAME:

SDS1000DL series Digital Oscilloscope

TYPE:

SDS1022DL 25MHz

SDS1052DL 50MHz

SDS1102DL 100MHz

SDS1202DL 200MHZ

Standard Accessories:

- 1:1/10:1 probe (2 PCS)
- Power Cable that fits the standard of destination country
- Qualified Certification.
- Guaranty Card
- CD (including EasyScope computer software system)
- User Manual
- USB Cable

Electronic Instruments

FG205 FUNCTION GENERATOR

- **DC Offset function**
- **Digital display for frequency**
- **Adjustable symmetry and amplitude**
- **5 waveforms: sinus, square, triangular, pulse and ramp**
- **Frequency range from 0,2Hz to 5MHz in 8 steps.**

Technical specifications:

	Function	FG205 specifications
Main output	Frequency range	0,2 Hz to 5 MHz in 8 steps
	Waveforms	Sine, triangle, square, positive or negative pulse wave, positive or negative ramp.
	Amplitude	Not smaller than 20Vp-p(open)
	Output impedance	50ohm; ±10%
	DC Offset	0 ~ ± 10V continuous adjustable
	Symmetry	80:10 ~ 10:80
	Sweep mode	Linear, logarithmic
	Distortion	<1%, 10Hz to 100KHz
	Rise and fall time	<50nsec
	Frequency measurement	1Hz-20MHz
	Measuring error	Not larger than 0.003% ± 1digit
Other	Power	220V/110V ±10%50Hz/60Hz
	Dimensions & weight	280(W) x 100(H) x 255(D); 3Kg
	Display	5 digits + 3 digits

GENERAL

The FG205 is a 5MHz function generator with digital display, able to produce 5 different waveforms. It can produce: Sine, Square, Triangle, Pulse, Ramp. With integrated frequency display measurement of external signals. This function generator is very simple to use and intuitive.

ACCESSORIES INCLUDED

- *Power cord*
- *BNC-crocodile clip*
- *User manual*

italtec
Technical Training Systems

Company with Quality Management System
Certified by DNV = ISO 9001/2008 =

KIT DIDATTICO COMPOSTO DA N. 2 ALIMENTATORI

MOD.3000AC + MOD.3000DC

Set di alimentatori che asservono agli esperimenti di laboratorio idonei ad essere utilizzati con la maggior parte degli strumenti di analisi, test e verifica. Grado di protezione IP67

CE

MOD.3000AC

Alimentatore CA per misure elettriche e macchine elettriche Utilizzato per alimentare tutte macchine in CA monofase e trifase.
Alimentazione richiesta: 380/415V, trifase + N + PE;
- Protezione generale con interruttore magnetotermico differenziale ad alta sensibilità 0,03A.
- Pulsante di emergenza a fungo;
- Tutte le uscite sono protette da proprio interruttore magnetotermico automatico.

USCITE:
Trifase/Monofase regolabile: 0-380V/220V 1A; L1, L2, L3, N, PE
- protetta con magnetotermico automatico.
- con 1 x voltmetro 0 - 500V C.A.
- con 3 x amperometri 0-3A C.A. inseriti su ogni fase;

- Presa di servizio universale, Italiana bipasso, Tedesca Schuko, Americana lamellare 10/16A di sicurezza.;

MOD.3000DC

Alimentatore CC per misure elettriche e macchine elettriche Utilizzato per alimentare le macchine In CC del laboratorio EMMS, freni e accessori.
Alimentazione richiesta: 230V monofase+ PE;
- Protezione generale con interruttore magnetotermico differenziale ad alta sensibilità 0,03A.
- Pulsante di emergenza a fungo;
- Tutte le uscite sono protette da proprio interruttore magnetotermico automatico.

USCITE:
C.C. regolabile 0-220V, 1,2A per le eccitazioni;
- protetta con magnetotermico automatico per C.C.
- con 1 x voltmetro 0-300V f.s. C.C. ;
- con 1 x amperometro 0-5A f.s. C.C. ;

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Rev 03/05/2019

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Technical Training Systems

Company with Quality Management System
Certified by DNV = ISO 9001/2008 =

BANCO PROVA MOTORI E TRASFORMATORI

IT.0100B
MOD.3090, MOD.3040
MOD.3160, MOD.3240
MOD.3190, MOD.3195
RST150, DT26

Banco biposto per allievo dotato di sistemi per la prova e la verifica dei parametri elettrici fondamentali di funzionamento di macchine elettriche trasformatori, comprensivo di motore elettrico AC asincrono mono e trifase, motore elettrico DC, inverter per motore AC e trasformatore mono e trifase. Possibilità di connessione di motori e trasformatori sia in AC che DC, sistema di fissaggio dotato di basetta regolabile connettori a puntale con riconoscimento del colore e delle funzioni. Possibilità di collegamento di prese e connessioni per l'utilizzo di strumenti di test e verifica quali voltmetri, amperometri, misuratori di frequenza. Alimentazione AC 380V. Possibilità di test su verso di rotazione di macchine elettriche e misurazione della velocità angolare.

CE

IT.0100B
BANCO - Dimensioni.(cm):200x100x80h
La struttura, il telaio portante sono in profilato d'acciaio 80x20x2mm e le gambe sono cilindriche, dia. 80mm con spessore 2mm. Il piano di lavoro è realizzato in legno multistrato bilaminato. Questa struttura sopporta un carico di 850 kg senza subire deformazioni. Il piano accuratamente bordato con angoli raggiati senza spigoli vivi. Tutte le parti metalliche del banco sono accuratamente trattate con fondo antiruggine e verniciate a polvere epossidica a forno senza solventi.

Comprensivo di:

MOD.3040 Motore asincrono a gabbia di scoiattolo completo di basamento, morsettiera ripatitiva, singola sporgenza d'albero. Tensione: 220/380V; triangolo / stella / 50Hz; Corrente 1,76 / 1A; Velocità : 2820giri/'; Potenza : 0,37kW;	**MOD.3090** Motore monofase con condensatore permanente completo di basamento e morsettiera ripetitiva. Tensione: 220V c.a.; Potenza: 0,3kW; Velocità: 2800giri/	**MOD.3160** Macchina completa di basamento, con possibilità di ispezione delle spazzole e del collettore. Doppia sporgenza d'albero. Funzionamento: motore e generatore eccitazione composta; Tensione: 220V; Tensione eccit.:200V; Velocità 3000giri/'; Potenza:0,25kW
MOD.3240 Regolatore di velocità motori C.A. modulo di regolazione di velocità per motori trifase fino a 750W. Permette allo studente di sperimentare su anello aperto e chiuso la regolazione di motori c.a. utilizzati in automazione, robotica, ecc. Il modulo dispone di tutte le funzioni programmabili degli inverter industriali come limitatore di corrente, guadagno regolabile e tempo di partenza variabile.	**MOD.3190** Trasformatore Monofase Primario e secondario sono divisi in varie sezioni per consentire tutte le possibilità di collegamento. Tensione: 220/110V prim./sec. Primario: 2x110V; Secondario 2x55V; Potenza: 300VA; Frequenza: 50-60Hz;	**MOD.3195** Trasformatore Trifase in versione didattica. Ogni fase degli avvolgimenti primario e secondario sono divisi in due parti per consentire vari collegamenti incluso lo zig-zag. Primario: 400V stella (3x2x115V); Secondario: 230V stella (3x2x66,5V); Potenza: 300VA; Frequenza 50/60Hz;

Test di verifica verso di rotazione di macchine elettriche

Test di misurazione della velocità angolare

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Rev 03/05/2019

DEVICE SPECIFICATIONS

NI VB-8012

NI VirtualBench™ All-In-One Instrument

These specifications are for the National Instruments VirtualBench VB-8012 only. These specifications are valid following 30 minutes of warmup and are typical at 25 °C, unless otherwise noted. For feature differences between the VirtualBench application for Windows and iPad, go to *ni.com/info* and enter `vbfeatures`.

Mixed Signal Oscilloscope

Analog Channels

Vertical System

Number of channels	2 single-ended, non-isolated
Bandwidth (-3 dB)[1]	100 MHz
Resolution	8 bits
Accuracy[2]	±2% of input ±1% full scale (V_{pk-pk})
Input coupling	DC, AC
Vertical sensitivity (range)	10 mV/div (100 mV_{pk-pk}) 20 mV/div (200 mV_{pk-pk}) 50 mV/div (400 mV_{pk-pk}) 100 mV/div (1 V_{pk-pk}) 200 mV/div (2 V_{pk-pk}) 500 mV/div (4 V_{pk-pk}) 1 V/div (10 V_{pk-pk}) 2 V/div (20 V_{pk-pk}) 5 V/div (40 V_{pk-pk})
Input impedance	1 MΩ || 20 pF

[1] Bandwidth using the accessory oscilloscope probe in 10X mode.

[2] Indicates warranted specifications valid at T_{cal} ±5 °C. Temperature coefficients are calculated using the temperature change from last external calibration.

NATIONAL INSTRUMENTS™

Table 1. DC Offset Range

Range	Programmable Offset Range
10 mV/div, 20 mV/div, 50 mV/div	±5 V
100 mV/div, 200 mV/div, 500 mV/div, 1 V/div, 2 V/div, 5 V/div	±20 V

Acquisition modes	Sample, peak detect, averaging

Horizontal System

Maximum sample rate	1 GS/s single channel, 500 MS/s/channel, dual channel
Maximum record length	1 MS/channel

Digital Channels/Logic Analyzer

Vertical System

Number of channels	34
Maximum input frequency	100 MHz
Input voltage	0 V to 5 V
Input current	≤50 µA

Note Mixed signal oscilloscope digital channels are designed to withstand accidental overvoltage from signals on the VB-8012 or similar devices. They are not recommended for use with signals likely to exceed 0 V to 5 V in normal operation.

Input threshold	Programmable, 0 V to 2.0 V
Threshold accuracy	350 mV
Input impedance	100 kΩ || 7.5 pF pulled to -2.0 V to +6.5 V, varies with the input threshold setting
Additional/internal channels	Digital I/O lines, function generator start, external trigger (TRIG), power line frequency

Horizontal System

Timing mode sample rate[3]	1 GS/s (down to ~15 kS/s)
Maximum external sample clock rate	100 MHz
Record length	
Typical	1 MS
Minimum[4]	4 kS
Decimation	External Sample Clock, 1:1, 2:1, and n*4:1 where n is an integer
Maximum sample compression	2^{15} to 1

Triggering

Trigger modes	Normal, Auto, Force, Single[5]
Trigger sources	Oscilloscope analog channels, oscilloscope digital channels, function generator start, digital I/O lines, external trigger (TRIG), power line frequency
Trigger types	
Analog	Edge with hysteresis
Digital	Edge, pattern, glitch, level[6]
Trigger resolution	
Analog/oscilloscope	667 ps
Digital/logic analyzer	1 ns
Trigger export	Available through external trigger (TRIG)

[3] Indicates warranted specifications valid at T_{cal} ±5 °C. Temperature coefficients are calculated using the temperature change from last external calibration.

[4] Under most conditions, the logic analyzer can acquire 1 MS of data. Under some conditions with very high sustained activity on multiple inputs, the logic analyzer may only capture 4 kS of data.

[5] Single trigger mode is only available in the VirtualBench application.

[6] Glitch and level triggers are only available with the NI VirtualBench driver.

Waveform Measurements

Oscilloscope time[7]	Period, frequency, positive duty cycle, negative duty cycle, positive pulse width, negative pulse width, rise time, fall time, rise rate, fall rate
Oscilloscope voltage[7]	High, low, amplitude, maximum, minimum, peak-to-peak, overshoot, undershoot, RMS, mean, cycle RMS, cycle mean
Logic analyzer time[7]	Period, frequency, positive duty cycle, negative duty cycle, positive pulse width, negative pulse width

Waveform Math

Operations[8]	A + B, A - B, A * B, A/B, FFT

Function Generator (FGEN)

Waveforms	Sine, square, ramp/triangle, DC, arbitrary[9]
Update rate	125 MS/s
Resolution	14 bits
Number of channels	1
Output impedance	50 Ω
Switchable filter[10]	36 MHz lowpass, 7-pole, elliptical
Sine	
Maximum frequency	20 MHz
Total Harmonic Distortion (THD)	
1 MHz	-55 dBc
10 MHz	-50 dBc
Spurious Free Dynamic Range (SFDR)	-70 dB at 1 MHz (non-harmonic)
Phase noise (1 MHz)	-115 dBc/Hz at 10 kHz offset

[7] Waveform measurements are only available in the VirtualBench application.
[8] Waveform math is only available in the VirtualBench application.
[9] Arbitrary waveforms are only available with the NI VirtualBench driver.
[10] Switchable filters are only available with the NI VirtualBench driver. The VirtualBench application automatically enables the lowpass filter in sine mode.

Square	
Maximum frequency	5 MHz
Rise/fall time	<20 ns (10% to 90%)
Overshoot	<5%
Jitter	8 ns cycle-to-cycle
Ramp/triangle maximum frequency	1 MHz
Accuracy (with >10 kΩ load)	
Amplitude (1 kHz sine)	±(1% of output value ± 5 mV)
DC	±(1% of output value ± 5 mV)
Output range	
50 Ω	±6 V
Hi-Z (>10 kΩ)	±12 V
DC offset	
50 Ω	±6 V
Hi-Z (>10 kΩ)	±12 V

Note The combination of signal amplitude and DC offset cannot exceed the output range specifications. The impedances listed are the loads applied by the user to the FGEN output.

Frequency	
Accuracy	≤100 ppm
Resolution	1 μHz
Arbitrary waveform	
Points	1 MS
Sample rate	125 MS/s
Flatness	±0.3 dB to 20 MHz
Protection	Short-circuit protected

Triggering

Trigger types	Start of buffer[11]
Trigger resolution	8 ns
Trigger export	Available through external trigger (TRIG)

[11] The function generator can only produce a trigger.

Digital I/O

Number of channels	8
Direction control	Input or output, software-selectable
Logic level	5 V compatible TTL input, 3.3 V LVTTL output
Drive strength	4 mA
Input voltage	0 V to 5 V

Note Digital I/O lines are designed to withstand accidental overvoltage from signals on the VB-8012 or similar devices. They are not recommended for use with signals likely to exceed 0 V to 5 V in normal operation.

DIO channel pull resistors	10 kΩ, pull-down on dig/<0..7>, 10 kΩ, configurable pull-up to 3.3 V on dig/<6,7>

External Power

3.3 V output	
Voltage	3.3 V ±10%
Current	20 mA

Digital Multimeter

Functions	DC voltage, AC voltage, DC current, AC current, resistance, diode, continuity[12]
Resolution	5½ digits
Sample rate	5 S/s

Caution Do not use this device for connection to signals or for measurements within Measurement Categories III or IV. For more information about Measurement Categories, refer to the *Safety Voltages* section.

Input protection	
Resistance, diode	Up to 300 V DC
DC and AC voltage	Up to 300 V DC or 265 V AC_{rms}, 400 V AC peak

[12] Continuity is only available in the VirtualBench application.

DC and AC current

DMM A current connector fuse	Internal ceramic fuse, 10 A 250 V, time-delay, 5 × 20 mm, T 10A H 250V (Bussmann part number S505H-10-R at `www.cooperindustries.com`)
DMM mA current connector fuse	Internal ceramic fuse, 1.25 A 250 V, time-delay, 5 × 20 mm, T 1.25A H 250V (Bussmann part number S505H-1.25-R at `www.cooperindustries.com`)

Caution Fuses are located on bottom of device underneath door. Use Phillips #1 screwdriver for removal. Ensure all hazardous voltages are disconnected from the device prior to removal of door.

Fuse When this fuse symbol is marked on a device, take proper precautions.

Maximum common-mode voltage	300 V DC or AC_{rms}

DC

Table 2. DC Voltage Accuracy

Range	Input Impedance	1-Year Accuracy[13] ± (% of Reading + % of Range)	Temperature Coefficient[13] ± (% of Reading + % of Range)/°C
100 mV*	>10 GΩ, 10 MΩ	0.015 + 0.005	0.001 + 0.0005
1 V	>10 GΩ, 10 MΩ	0.015 + 0.005	0.001 + 0.0005
10 V	>10 GΩ, 10 MΩ	0.015 + 0.005	0.001 + 0.0005
100 V	10 MΩ	0.035 + 0.005	0.005 + 0.0005
300 V	10 MΩ	0.035 + 0.005	0.005 + 0.0005
* Add 15 µV if not immediately following offset null.			

[13] Indicates warranted specifications valid at T_{cal} ±5 °C. Temperature coefficients are calculated using the temperature change from last external calibration.

Table 3. DC Current Accuracy

Range	Burden Voltage	1-Year Accuracy[13] ± (% of Reading + % of Range)	Temperature Coefficient[13] ± (% of Reading + % of Range)/°C
10 mA	<0.03 V	0.070 + 0.020	0.0035 + 0.0010
100 mA	<0.3 V	0.070 + 0.003	0.0020 + 0.0010
1 A	<0.03 V	0.130 + 0.025	0.0065 + 0.0010
10 A*	<0.3 V	0.130 + 0.004	0.0045 + 0.0010
* 30 seconds on, 30 seconds off. Add 300 ppm/A for currents >2.2 A. After measuring >5 A, wait two minutes to get full accuracy in the 1 A range.			

Table 4. DC Resistance Accuracy (2-Wire)*, 1 V Open Circuit Voltage

Range	Short-Circuit Current	1-Year Accuracy[13] ± (% of Reading + % of Range)	Temperature Coefficient[13] ± (% of Reading + % of Range)/°C
100 Ω	170 µA	0.018 + 0.050	0.0010 + 0.0005
1 kΩ	170 µA	0.018 + 0.005	0.0010 + 0.0005
10 kΩ	70 µA	0.018 + 0.005	0.0010 + 0.0005
100 kΩ	10 µA	0.018 + 0.005	0.0010 + 0.0005
1 MΩ	1.1 µA	0.035 + 0.005	0.0040 + 0.0005
10 MΩ	1.1 µA	0.150 + 0.005	0.0100 + 0.0005
100 MΩ	1.1 µA	1.3 + 0.005	0.1000 + 0.0005
* Perform offset nulling.			

Caution The input terminals of the DMM are not protected for electromagnetic interference. As a result, the DMM may experience reduced measurement accuracy or other temporary performance degradation when connected to unshielded test leads in an environment with radiated or conducted radio frequency electromagnetic interference.

DC continuity accuracy range[14]	100 Ω
DC diode test range	2 V

[14] DC continuity is only available in the VirtualBench application.

Effective Common-Mode Rejection Ratio (CMRR), 1 kΩ resistance in LO lead	>100 dB
Normal-Mode Rejection Ratio (NMRR), 50/60 Hz ±0.1%	>100 dB
Overrange	105% of range except 300 V

AC

Table 5. AC Voltage Accuracy

Range (rms)	Peak Voltage	Frequency	1-Year Accuracy[15] ± (% of Reading + % of Range)	Temperature Coefficient[15] ± (% of Reading + % of Range)/°C
100 mV, 1 V, 10 V, 100 V, 265 V	±210 mV, ±2.1 V, ±21 V, ±210 V, ±400 V	20 Hz to 45 Hz	0.91 + 0.10	0.01 + 0.005
		45 Hz to 65 Hz	0.30 + 0.05	0.01 + 0.005
		65 Hz to 1 kHz	0.21 + 0.05	0.01 + 0.005
		1 kHz to 5 kHz	0.12 + 0.05	0.01 + 0.005
		5 kHz to 20 kHz	0.35 + 0.05	0.01 + 0.005

Table 6. AC Current Accuracy

Range (rms)	Peak Current	Burden Voltage (rms)	Frequency	1-Year Accuracy[15] ± (% of Reading + % of Range)	Temperature Coefficient[15] ± (% of Reading + % of Range)/°C
5 mA	±10.5 mA	<0.02 V	20 Hz to 1 kHz	0.20 + 0.01	0.01 + 0.005
			1 kHz to 5 kHz	0.60 + 0.01	
50 mA	±105 mA	<0.2 V	20 Hz to 1 kHz	0.20 + 0.01	0.01 + 0.005
			1 kHz to 5 kHz	0.50 + 0.01	
500 mA	±1.05 A	<0.02 V	20 Hz to 1 kHz	0.15 + 0.01	0.01 + 0.005
			1 kHz to 5 kHz	0.50 + 0.01	

[15] Indicates warranted specifications valid at T_{cal} ±5 °C. Temperature coefficients are calculated using the temperature change from last external calibration.

Table 6. AC Current Accuracy (Continued)

Range (rms)	Peak Current	Burden Voltage (rms)	Frequency	1-Year Accuracy[15] ± (% of Reading + % of Range)	Temperature Coefficient[15] ± (% of Reading + % of Range)/°C
5 A	±10.5 A	<0.2 V	20 Hz to 1 kHz	0.25 + 0.03	0.01 + 0.005
			1 kHz to 5 kHz	0.60 + 0.03	

Caution The input terminals of the DMM are not protected for electromagnetic interference. As a result, the DMM may experience reduced measurement accuracy or other temporary performance degradation when connected to unshielded test leads in an environment with radiated or conducted radio frequency electromagnetic interference.

Input impedance	10 MΩ || 200 pF
CMRR, 1 kΩ resistance in LO lead	>70 dB (DC to 60 Hz)

DC Power Supply

Outputs	0 V to +6 V/0 A to 1 A, 0 V to +25 V/0 mA to 500 mA (isolated), 0 V to -25 V/0 mA to 500 mA (isolated)

Note The +25 V and -25 V channels are bank isolated from ground but not from each other.

Table 7. DC Accuracy/Resolution

Output	Type	+6 V	+25 V	-25 V
DC output[16]	Voltage	0 V to +6 V	0 V to +25 V	0 V to -25 V
	Current[17]	1 A	500 mA	500 mA
Programming accuracy[16,17] ± (% of reading + offset)	Voltage	0.1% + 5 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.2% + 10 mA	0.15% + 4 mA	0.15% + 4 mA

[16] Indicates warranted specifications valid at T_{cal} ±5 °C. Temperature coefficients are calculated using the temperature change from last external calibration.

[17] Minimum programmable current limit is 1% of range.

Table 7. DC Accuracy/Resolution (Continued)

Output	Type	+6 V	+25 V	-25 V
Readback accuracy[16,18] ± (% of reading + offset)	Voltage	0.1% + 5 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.2% + 10 mA	0.15% + 4 mA	0.15% + 4 mA
Programming resolution	Voltage	1.7 mV	6.5 mV	6.5 mV
	Current	0.30 mA	0.15 mA	0.15 mA
Readback resolution	Voltage	0.41 mV	1.7 mV	1.7 mV
	Current	70 µA	35 µA	35 µA
Load regulation[19] ± (% of reading + offset)	Voltage	0.01% + 25 mV	0.03% + 5 mV	0.03% + 5 mV

Overvoltage protection	30 V (25 V channels) and 10 V (6 V channel)
Reverse voltage protection	Reverse clamp diode, protected by self-resetting fuse

External Trigger (TRIG)

Direction control	Input or output, software-selectable
Logic level	5 V compatible TTL input, 3.3 V LVTTL output
Drive strength	4 mA
Input voltage	0 V to 5 V

Note The external trigger line is designed to withstand accidental overvoltage from signals on the VB-8012 or similar devices. It is not recommended for use with signals likely to exceed 0 V to 5 V in normal operation.

Connectivity

Wired USB Interface

USB specification	USB 2.0 Hi-Speed

[18] Programming and readback accuracy specified at no load.
[19] Change in output voltage for any load within range.

Wireless Interface

Table 8. Network Protocols and Ports Used

Port	Protocol	Function
Port 80/TCP	HTTP	Device configuration (web, MAX)
Port 443/TCP	HTTP	Device configuration (web, MAX)
Port 3580/TCP	Service locator	Device configuration (web, MAX)
Port 9090/TCP	Configuration only	VirtualBench instrument protocol
Port 5353/UDP	Multicast DNS	Device discovery

Network IP configuration	IPv4, DHCP Client/Server
Radio mode	IEEE 802.11 b,g,n
Wireless modes	AP mode (default), client mode
Frequency band	2.4 GHz ISM
Channel width	20 MHz
Channels	USA 1-11, International 1-13 (12 and 13 client mode only)
TX power	+10 dBm maximum (10 mW)
Security	Open, WPA, WPA2, WPA2-Enterprise
Enterprise security EAP types	EAP-TLS, EAP-TTLS/MS-CHAPv2, PEAPv0/MS-CHAPv2
Antenna	External RP-SMA omnidirectional dipole

Power Requirements

Caution The protection provided by the VirtualBench hardware can be impaired if it is used in a manner not described in the *NI VB-8012 Safety, Environmental, and Regulatory Information* document.

Voltage input range	100 VAC to 240 VAC, 50/60 Hz
Power consumption	100 W maximum

Power input connector	IEC C13 power connector
Power disconnect	The AC power cable provides main power disconnect. Do not position the equipment so that it is difficult to disconnect the power cable. Depressing the front panel power button does not inhibit the internal power supply.

Calibration

Calibration cycle (digital multimeter, mixed signal oscilloscope, function generator, DC power supply)	1 year
Specified temperature	T_{cal} ± 5 °C
Warmup time	30 minutes

Physical Characteristics

Dimensions	
Enclosure	25.40 cm × 19.05 cm × 7.77 cm (10.00 in. × 7.50 in. × 3.06 in.)
Enclosure with connectors and antenna	25.40 cm × 23.37 cm × 14.40 cm (10.00 in. × 9.20 in. × 5.67 in.)

Note Use the VirtualBench instrument in a horizontal orientation. Allow at least 10.16 cm (4.0 in.) of clearance in front and behind the VirtualBench instrument for USB, power, and common connector cabling.

Weight	2.05 kg (4 lb 8.3 oz)
Connectivity	
Mixed signal oscilloscope	BNC
Logic analyzer	2x20 shrouded IDC header
External trigger	BNC
Function generator	BNC

Digital I/O	
Type	Pluggable screw terminal, 3.5 mm (14 position)
Screw terminal wiring	0.1 to 2.0 mm^2 (30 to 14 AWG)
Torque	0.25 N · m (2.2 lb · in.)
Digital multimeter	4 mm banana jacks
DC power supply	
Type	Pluggable screw terminal, 3.81 mm (6 position)
Screw terminal wiring	0.1 to 2.0 mm^2 (30 to 14 AWG)
Torque	0.25 N · m (2.2 lb · in.)
Security cable slot	1, complies with Kensington security slot dimensions

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

Safety Voltages

Connect only voltages that are within these limits.

DMM Isolation Voltages

Hazardous Voltage This icon denotes a warning advising you to take precautions to avoid electrical shock.

Channel-to-earth ground	
Continuous	300 V, Measurement Category II
Withstand	3,000 V_{RMS}, verified by a 5 s dielectric withstand test

Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example, 115 V for U.S. or 230 V for Europe.

Caution Do not connect the VirtualBench hardware to signals or use for measurements within Measurement Categories III or IV.

DC Power Supply Isolation Voltages

+25 V and -25 V-to-earth ground, continuous	60 VDC, Measurement Category I

Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Environmental

Operating temperature	0 °C to 40 °C
Storage temperature	-20 °C to 70 °C
Operating humidity	10% to 90% RH, noncondensing DMM full accuracy at 10% to 80%
Storage humidity	5% to 95% RH, noncondensing
Cooling	Forced air circulation (positive pressurization) through a fan. Fan speed automatically adjusts according to operating conditions. Intake and exhaust locations are on rear of device. Ensure that the intake and exhaust locations are not obstructed.
Pollution Degree	2
Maximum altitude	2,000 m

Indoor use only.

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 Hz to 500 Hz, 0.3 g_{rms}
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

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

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; for radio equipment; and for telecommunication terminal equipment:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: 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 CE

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)
- 2014/53/EU; Radio Equipment Directive (RED)

SPECIFICATIONS

cRIO-9054

1.33 GHz Dual-Core CPU, 2 GB DRAM, 4 GB Storage, Artix-7 A100T FPGA, 4-Slot CompactRIO Controller

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- *Typical* specifications describe the performance met by a majority of models.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are *Typical* unless otherwise noted.

Conditions

Specifications are valid for -20 °C to 55 °C unless otherwise noted.

Processor

CPU	Intel Atom E3805
Number of cores	2
CPU frequency	1.33 GHz
On-die L2 cache	1 MB (shared)

Software

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

Supported operating system	NI Linux Real-Time (64-bit)
Supported C Series module programming modes	Real-Time (NI-DAQmx) mode Real-Time Scan (I/O Variables) LabVIEW FPGA
Application software	
LabVIEW[1]	LabVIEW 2018 or later, LabVIEW Real-Time Module 2018 or later, LabVIEW FPGA Module 2018 or later,
C/C++ Development Tools for NI Linux Real-Time[2]	Eclipse Edition 2014 or later
Driver software	NI CompactRIO Device Drivers 18.1 or later

Network/Ethernet Port

Number of ports	2
Network interface	10Base-T, 100Base-TX, and 1000Base-T Ethernet
Compatibility	IEEE 802.3
Communication rates	10 Mb/s, 100 Mb/s, 1000 Mb/s auto-negotiated
Maximum cabling distance	100 m/segment

[1] LabVIEW FPGA Module is not required when using Real-Time Scan (I/O Variables) mode or Real-Time (NI-DAQmx) mode. To program the user-accessible FPGA on the cRIO-9054, the LabVIEW FPGA Module is required.

[2] C/C++ Development Tools for NI Linux Real-Time is an optional interface for C/C++ programming of the cRIO-9054 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 Timing and Synchronization

Protocol	IEEE 802.1AS-2011 IEEE 1588-2008 (default end-to-end profile)
Supported ethernet ports	Port 0, port 1
Network synchronization accuracy[3]	<1 µs

Note The cRIO-9054 employs time-aware transmission support. For more information about time-aware transmission support, visit *ni.com/info* and enter Info Code `timeaware`.

USB Ports

Port 1:	
Type	USB Type-C, device port with Console Out
USB interface	USB 2.0, Hi-Speed
Maximum data rate	480 Mb/s
Maximum current (from host)	250 mA
Console Out	
Baud rate	115,200 b/s
Data bits	8
Stop bits	1
Parity	None
Flow control	None
Port 2:	
Type	USB Type-C, host port
USB interface	USB 3.1 Gen1, SuperSpeed
Maximum data rate	5 Gb/s
Maximum current	900 mA

[3] Network synchronization is system-dependent. For information about network synchronization accuracy, visit *ni.com/info* and enter Info Code `criosync`.

SD Association MicroSD Card Slot

MicroSD card support	MicroSD and MicroSDHC standards
Supported interface speeds	Full speed, high speed, UHS-I SDR50, and DDR50

Memory

Nonvolatile memory (SSD)	4 GB
Nonvolatile memory (SSD) type	Planar SLC NAND

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

Volatile memory (DRAM)	
Density	2 GB
Type	DDR3L
Maximum theoretical data rate	8.533 GB/s

Reconfigurable FPGA

FPGA type	Xilinx Artix-7 A100T
Number of flip-flops	126,800
Number of 6-input LUTs	63,400
Number of DSP slices (18 × 25 multipliers)	240
Available block RAM	4,860 kbits
Number of DMA channels	16
Number of logical interrupts	32

Internal Real-Time Clock

Accuracy	200 ppm; 40 ppm at 25 °C

Controller PFI 0

Maximum input or output frequency	1 MHz
Cable length	3 m (10 ft)
Cable impedance	50 Ω
PFI 0 connector	SMB
Power-on state	High impedance
I/O standard compatibility	5 V TTL
I/O voltage protection	±30 V
Maximum operating conditions	
I_{OL} output low current	8 mA maximum
I_{OH} output high current	-8 mA maximum

Table 1. DC Input Characteristics

Voltage	Minimum	Maximum
Positive going threshold	1.43 V	2.28 V
Negative going threshold	0.86 V	1.53 V
Hysteresis	0.48 V	0.87 V

Table 2. DC Output Characteristics

Voltage	Conditions	Minimum	Maximum
High	—	—	5.25 V
	Sourcing 100 µA	4.65 V	—
	Sourcing 2 mA	3.60 V	—
	Sourcing 3.5 mA	3.44 V	—
Low	Sinking 100 µA	—	0.10 V
	Sinking 2 mA	—	0.64 V
	Sinking 3.5 mA	—	0.80 V

Real-Time Streaming Performance

Data throughput is dependent on the application, system, and performance of the removable storage media. For information about optimizing data throughput on the cRIO-9054 visit *ni.com/info* and enter Info Code `optdata`.

Data throughput from system memory to target	
MicroSD card	40 MB/s
USB Type-C	100 MB/s

Real-Time (NI-DAQmx) Mode

The following specifications are applicable for modules and slots programmed in Real-Time (NI-DAQmx) mode. For more information about using modules in LabVIEW FPGA mode or Real-Time Scan (I/O Variables) mode, visit *ni.com/info* and enter Info Code `swsupport`.

Analog Input

Input FIFO size	253 samples per slot
Maximum sample rate[4]	Determined by the C Series module or modules
Timing accuracy[5]	50 ppm of sample rate
Timing resolution	12.5 ns
Number of channels supported	Determined by the C Series module or modules
Number of hardware-timed tasks	8

Analog Output

Hardware-timed tasks	
Number of hardware-timed tasks	8
Number of channels supported	
Onboard regeneration	16
Non-regeneration	Determined by the C Series module or modules
Non-hardware-timed tasks	
Number of non-hardware-timed tasks	Determined by the C Series module or modules
Number of channels supported	Determined by the C Series module or modules

[4] Performance dependent on type of installed C Series module and number of channels in the task.
[5] Does not include group delay. For more information, refer to the documentation for each C Series module.

Maximum update rate	1.6 MS/s

Note Streaming applications are limited by system-dependent factors and the capability of C Series modules.

Timing accuracy	50 ppm of sample rate
Timing resolution	12.5 ns
Waveform onboard regeneration FIFO	8,191 samples shared among channels used
Waveform streaming FIFO	253 samples per slot

Digital Waveform

Waveform acquisition (DI) FIFO	
Parallel modules	255 samples per slot
Serial modules	127 samples per slot
Waveform onboard regeneration (DO) FIFO	
Parallel modules	2,047 samples shared among slots used
Waveform streaming (DO) FIFO	
Parallel modules	255 samples per slot
Serial modules	127 samples per slot
Sample clock frequency	
Digital input	0 MHz to 10 MHz
Digital output	
ot0:6 timing engine	0 MHz to 3.5 MHz
ot7 timing engine	0 MHz to 10 MHz

Note Streaming applications are limited by system-dependent factors and the capability of C Series modules.

Timing accuracy	50 ppm
Number of digital input hardware-timed tasks	8
Number of digital output hardware-timed tasks	8

General-Purpose Counters/Timers

Number of counters/timers	4
Resolution	32 bits

Counter measurements	Edge counting, pulse, semi-period, period, two-edge separation, pulse width
Position measurements	X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding
Output applications	Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling
Internal base clocks	80 MHz, 20 MHz, 13.1072 MHz, 12.8 MHz, 10 MHz, 100 kHz
External base clock frequency	0 MHz to 20 MHz
Base clock accuracy	50 ppm
Output frequency	0 MHz to 20 MHz
Inputs	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down
Routing options for inputs	Any module PFI, controller PFI, analog trigger, many internal signals
FIFO	Dedicated 127-sample FIFO

Frequency Generator

Number of channels	1
Base clocks	20 MHz, 10 MHz, 100 kHz
Divisors	1 to 16 (integers)
Base clock accuracy	50 ppm
Output	Any controller PFI or module PFI terminal

Module PFI

Functionality	Static digital input, static digital output, timing input, and timing output
Timing output sources[6]	Many analog input, analog output, counter, digital input, and digital output timing signals
Timing input frequency	0 MHz to 20 MHz
Timing output frequency	0 MHz to 20 MHz

[6] Actual available signals are dependent on type of installed C Series module.

Digital Triggers

Source	Any controller PFI or module PFI terminal
Polarity	Software-selectable for most signals
Analog input function	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Analog output function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Counter/timer function	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down

Module I/O States

At power-on	Module-dependent. Refer to the documentation for each C Series module.

Time-Based Triggers and Timestamps

Number of time-based triggers	5
Number of timestamps	6
Analog input	
Time-based triggers	Start Trigger, Sync Pulse
Timestamps	Start Trigger, Reference Trigger, First Sample
Analog output	
Time-based triggers	Start Trigger, Sync Pulse
Timestamps	Start Trigger, First Sample
Digital input	
Time-based triggers	Start Trigger
Timestamps	Start Trigger, Reference Trigger, First Sample
Digital output	
Time-based triggers	Start Trigger
Timestamps	Start Trigger, First Sample
Counter/timer input	
Time-based triggers	Arm Start Trigger
Timestamps	Arm Start Trigger

Counter/timer output	
Time-based triggers	Start Trigger, Arm Start Trigger
Timestamps	Start Trigger, Arm Start Trigger

CMOS Battery

Typical battery life with power applied to power connector	10 years
Typical battery life when stored at temperatures up to 25 °C	3.66 years
Typical battery life when stored at temperatures up to 85 °C	3.20 years

Power Requirements

Note Some C Series modules have additional power requirements. For more information about C Series module power requirements, refer to the C Series module(s) documentation.

Note Sleep mode for C Series modules is not supported in Real-Time (DAQmx) Mode.

Voltage input range (measured at the cRIO-9054 power connector)	9 V DC to 30 V DC
Maximum power consumption	30 W

Note The C terminal of the power connector is functionally isolated from chassis ground to prevent ground loops, but does not meet IEC 61010-1 for safety isolation

Note The maximum power consumption specification is based on a fully populated system running a high-stress application at elevated ambient temperature and with all C Series modules and USB devices consuming the maximum allowed power.

Typical standby power consumption	3.4 W at 24 V DC input
Recommended power supply	60 W, 24 V DC

Notice Include a switch or circuit breaker in the installation to disconnect the system from DC Mains. The switch or circuit breaker must be suitably rated, accessible, and marked as the disconnecting device for the system.

EMC ratings for voltage input as described in IEC 61000	Short lines, long lines, and DC distributed networks
Power input connector	2-position, 3.5 mm pitch, pluggable screw terminal with screw locks, Sauro CTF02BV8-AN000A

Physical Characteristics

Weight (unloaded)	1154 g (2 lbs, 9 oz)
Dimensions (unloaded)	221.4 mm × 82.5 mm × 189.6 mm (8.72 in. × 3.25 in. × 3.53 in.)
Power connector wiring	
Gauge	0.5 mm^2 to 2.1 mm^2 (20 AWG to 14 AWG) copper conductor wire
Wire strip length	6 mm (0.24 in.) of insulation stripped from the end
Temperature rating	85 °C
Torque for screw terminals	0.20 N · m to 0.25 N · m (1.8 lb · in. to 2.2 lb · in.)
Wires per screw terminal	One wire per screw terminal
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.20 N · m to 0.25 N · m (1.8 lb · in. to 2.2 lb · in.)
Insulation rating	300 V, maximum

Safety Voltages

Connect only voltages that are below these limits.

V terminal to C terminal	30 V, maximum
Chassis ground to C terminal	30 V, maximum

Environmental Guidelines

Notice This model is intended for use in indoor applications only.

Notice Mount the system directly on a flat, rigid surface, using the rear mounting holes, as described in the user manual, affix ferrules to the ends of the terminal wires, and use retention accessories for the USB type-C ports (NI locking USB cables, 143556-xx; NI USB Extender Cable, 143555-xx).

Notice All cabling should be strain-relieved near input connectors. Take care to not directionally bias cable connectors within input connectors when applying strain relief.

Environmental Characteristics

Temperature and Humidity

Temperature	
Operating	-20 °C to 55 °C
Storage	-40 °C to 85 °C
Humidity	
Operating	10% RH to 90% RH, noncondensing
Storage	5% RH to 95% RH, noncondensing
Ingress protection	IP40
Pollution Degree	2
Maximum altitude	5,000 m

Shock and Vibration

Operating vibration	
Random	5 g RMS, 10 Hz to 500 Hz
Sinusoidal	5 g, 10 Hz to 500 Hz
Operating shock	30 g, 11 ms half sine; 50 g, 3 ms half sine; 18 shocks at 6 orientations

Hazardous Locations

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

Safety Compliance 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 C22.2 No. 61010-1
- EN 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4
- UL 60079-0; Ed 6, UL 60079-15; Ed 4
- CSA C22.2 No. 60079-0, CSA C22.2 No. 60079-15

Note For UL and other safety certifications, refer to the product label or the *Product Certifications and Declarations* section.

Environmental Standards

This product meets the requirements of the following environmental standards for electrical equipment.

- IEC 60068-2-1 Cold
- IEC 60068-2-2 Dry heat
- IEC 60068-2-30 Damp heat cyclic (12 + 12h cycle)
- IEC 60068-2-64 Random operating vibration
- IEC 60068-2-6 Sinusoidal operating vibration
- IEC 60068-2-27 Operating shock

Note To verify marine approval certification for a product, refer to the product label or visit *ni.com/certification* and search for the certificate.

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; 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.

Notice For EMC declarations and certifications, and additional information, refer to the *Product Certifications and Declarations* section.

CE Compliance CE

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)
- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit *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 to the environment and to NI customers.

DATASHEET

NI 9219

4 AI, 100 S/s/ch Simultaneous, Universal Measurements

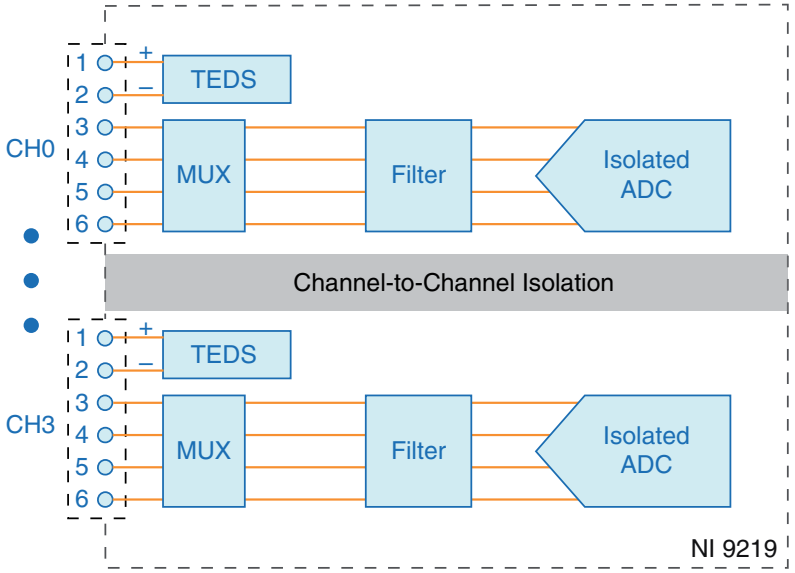
- Spring-terminal connectivity
- Support for Thermocouple (50 S/s/ch), RTD, Resistance, Full-Bridge, Half-Bridge, Quarter-Bridge, Voltage, and Current Measurements
- Voltage and current excitation
- 250 VAC, CAT II, channel-to-channel isolation

The NI 9219 is a universal C Series module designed for multipurpose testing in any NI CompactDAQ or CompactRIO chassis. With the NI 9219, you can measure several signals from sensors such as strain gages, RTDs, thermocouples, load cells, and other powered sensors. The channels are individually selectable, so you can perform a different measurement type on each of the four channels. Measurement ranges differ for each type of measurement and include up to ±60 V for voltage and ±25 mA for current.

Kit Contents	• NI 9219 • NI 9219 Getting Started Guide • Spring-Terminal Tool
Accessories	• NI 9972 Backshell Connector Kit

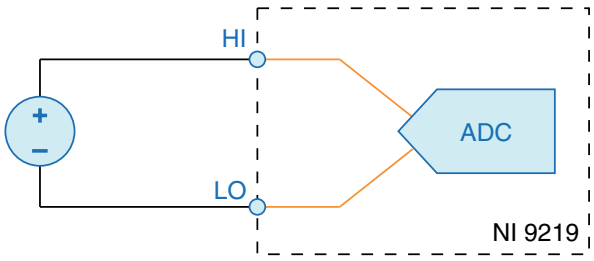
NATIONAL INSTRUMENTS™

NI 9219 Circuitry



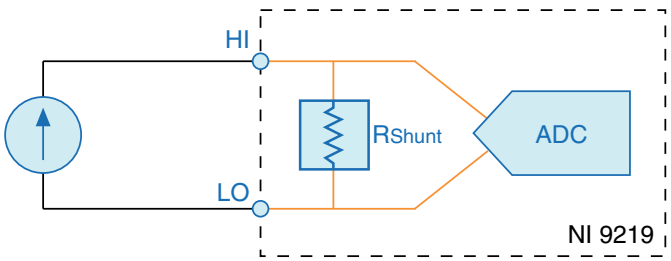
- The NI 9219 is channel-to-channel isolated.
- Four 24-bit analog-to-digital converters (ADCs) simultaneously sample all four analog input channels.
- The NI 9219 enables an excitation circuit for all input modes that require excitation.
- The NI 9219 reconfigures the signal conditioning for each measurement type.

Voltage Circuitry



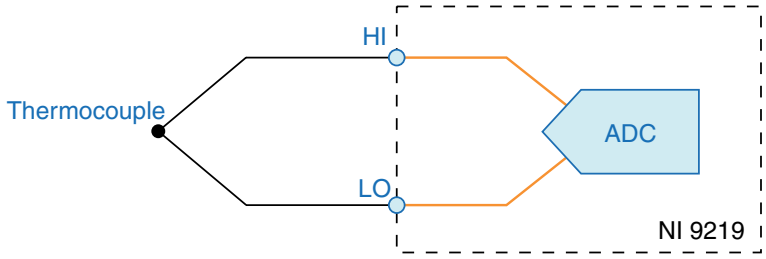
- The ADC measures voltage across the HI and LO terminals.
- The NI 9219 has ±60 V, ±15 V, ±4 V, ±1 V, and ±125 mV voltage ranges.

Current Circuitry



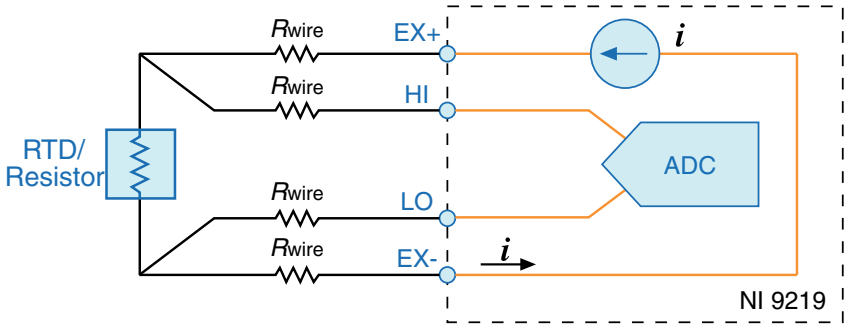
The NI 9219 computes current from the voltage that the ADC measures across an internal shunt resistor.

Thermocouple Circuitry



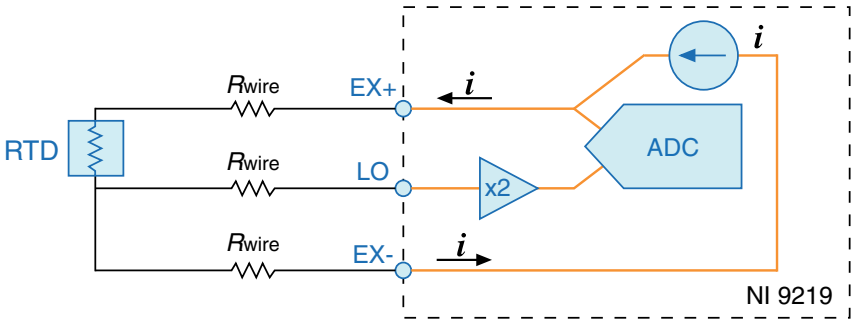
- The NI 9219 uses the ±125 mV range of the ADC to return a voltage reading.
- Each channel has a built-in thermistor for cold-junction compensation (CJC) calculations.

4-Wire Resistance and 4-Wire RTD Circuitry



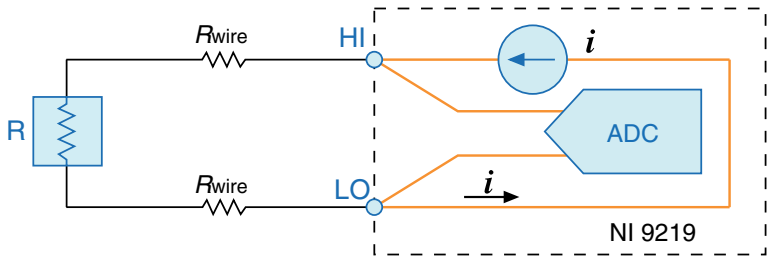
- The NI 9219 sources a current, which varies based on the resistance of the load, between the EX+ and EX- terminals. The NI 9219 computes measured resistance from the resulting voltage reading.
- Lead wire resistance does not affect these measurement types because a negligible amount of current flows across the HI and LO terminals due to the high input impedance of the ADC.

3-Wire RTD Circuitry



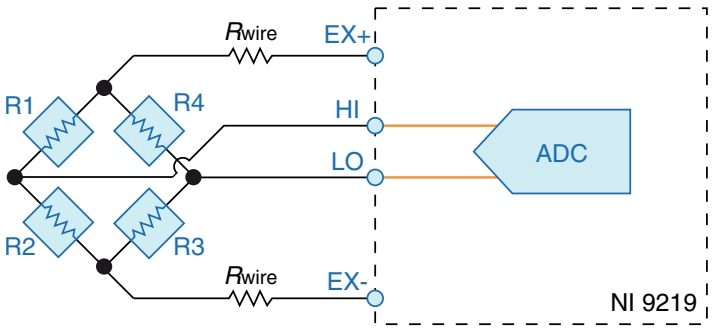
- The NI 9219 sources a current, which varies based on the resistance of the load, between the EX+ and EX- terminals.
- The NI 9219 compensates for lead wire resistance in hardware if all the lead wires have the same resistance.
- The NI 9219 applies a gain of 2x to the voltage across the negative lead wire and the ADC uses this voltage as the negative reference to cancel the resistance error across the positive lead wire.

2-Wire Resistance and Quarter-Bridge Circuitry



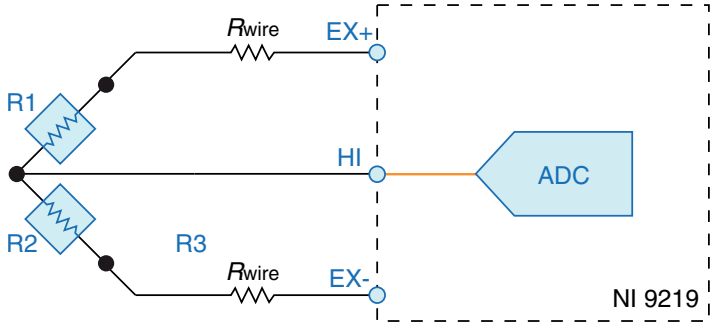
- The NI 9219 sources a current, which varies based on the resistance of the load, between the HI and LO terminals.
- The NI 9219 computes measured resistance from the resulting voltage reading.
- 2-Wire Resistance and Quarter-Bridge measurement types do not compensate for lead wire resistance.

Full-Bridge Circuitry



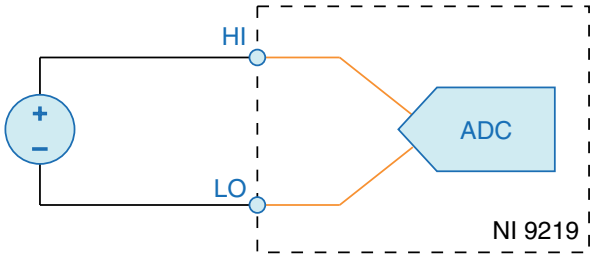
- The ADC reads the HI and LO inputs differentially.
- The internal voltage excitation sets the input range of the ADC and returns voltage readings that are proportional to the excitation level. The internal excitation voltage varies based on the resistance of the sensor.

Half-Bridge Circuitry



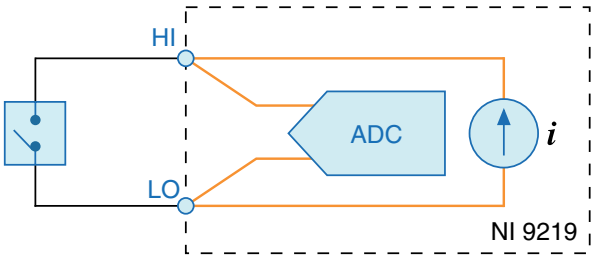
- The HI input is referenced to EX-.
- The internal voltage excitation sets the input range of the ADC and returns voltage readings that are proportional to the excitation level. The internal excitation voltage varies based on the resistance of the sensor.

Digital In Circuitry



- The NI 9219 has a 60 V unipolar threshold that you can set in software.
- The digital in measurement type is only supported in CompactRIO systems.

Open Contact Circuitry



- The NI 9219 sources a current between the HI and LO terminals and determines if the two terminals are open or closed based on the measured current through the terminals.
- When the circuit is open, make sure no more than ±60 V is sourced across the switch.
- The open contact measurement type is only supported in CompactRIO systems.

Timing Modes

The NI 9219 supports high-resolution, best 50 Hz rejection, best 60 Hz rejection, and high-speed timing modes. High-resolution timing mode optimizes maximum overall noise rejection and provides rejection of 50 Hz and 60 Hz noise . Best 50 Hz rejection optimizes 50 Hz noise rejection. Best 60 Hz rejection optimizes 60 Hz noise rejection. High-speed timing mode optimizes sample rate.

NI 9219 Specifications

The following specifications are typical for the range -40 °C to 70 °C unless otherwise noted.

Caution Do not operate the NI 9219 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.

Input Characteristics

Number of channels	4 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-sigma (with analog prefiltering)
Sampling mode	Simultaneous
Type of TEDS supported	IEEE 1451.4 TEDS Class 2 (Interface)

Table 1. Input Ranges

Measurement Type	Nominal Range(s)	Actual Range(s)
Voltage	±60 V, ±15 V, ±4 V, ±1 V, ±125 mV	±60 V, ±15 V, ±4 V, ±1 V, ±125 mV
Current	±25 mA	±25 mA
Thermocouple	±125 mV	±125 mV
4-Wire and 2-Wire Resistance	10 kΩ, 1 kΩ	10.5 kΩ, 1.05 kΩ
4-Wire and 3-Wire RTD	Pt 1000, Pt 100	5.05 kΩ, 505 Ω
Quarter-Bridge	350 Ω, 120 Ω	390 Ω, 150 Ω
Half-Bridge	±500 mV/V	±500 mV/V
Full-Bridge	±62.5 mV/V, ±7.8 mV/V	±62.5 mV/V, ±7.8125 mV/V

Table 1. Input Ranges (Continued)

Measurement Type	Nominal Range(s)	Actual Range(s)
Digital In	—	0 V to 60 V
Open Contact	—	1.05 kΩ

Conversion time, all channels	
No channels configured as a thermocouple	
High speed	10 ms
Best 60 Hz rejection	110 ms
Best 50 Hz rejection	130 ms
High resolution	500 ms
One or more channels configured as a thermocouple	
High speed	20 ms
Best 60 Hz rejection	120 ms
Best 50 Hz rejection	140 ms
High resolution	510 ms
Overvoltage protection	
Terminals 1 and 2	±30 V
Terminals 3 through 6, across any combination	±60 V
Input impedance	
Voltage and Digital In (±60 V, ±15 V, ±4 V)	1 MΩ
Current	< 40 Ω
All other measurement types	>1 GΩ

Table 2. Accuracy

Measurement Type	Range	Gain Error (Percent of Reading)	Offset Error (ppm of Range)
		Typical (25 °C ±5 °C), Maximum (-40 °C to 70 °C)	
Voltage	±60 V	±0.3, ±0.4	±20, ±50
	±15 V	±0.3, ±0.4	±60, ±180
	±4 V	±0.3, ±0.4	±240, ±720
	±1 V	±0.1, ±0.18	±15, ±45
Voltage/Thermocouple	±125 mV	±0.1, ±0.18	±120, ±360
Current	±25 mA	±0.1, ±0.6	±30, ±100
4-Wire and 2-Wire[1] Resistance	10 kΩ	±0.1, ±0.5	±120, ±320
	1 kΩ	±0.1, ±0.5	±1200, ±3200
4-Wire and 3-Wire RTD	Pt 1000	±0.1, ±0.5	±240, ±640
	Pt 100	±0.1, ±0.5	±2400, ±6400
Quarter-Bridge	350 Ω	±0.1, ±0.5	±2400, ±6400
	120 Ω	±0.1, ±0.5	±2400, ±6400
Half-Bridge	±500 mV/V	±0.03, ±0.07	±300, ±450
Full-Bridge	±62.5 mV/V	±0.03, ±0.08	±300, ±1000
	±7.8 mV/V	±0.03, ±0.08	±2200, ±8000

Cold-junction compensation sensor accuracy	±1 °C typical

[1] 2-wire resistance accuracy assumes 0 Ω of lead wire resistance. 2-wire resistance accuracy depends on the lead wire resistance.

Table 3. Stability

Measurement Type	Range	Gain Drift (ppm of Reading/°C)	Offset Drift (ppm of Range/°C)
Voltage	±60 V	±20	±0.2
	±15 V	±20	±0.8
	±4 V	±20	±3.2
	±1 V	±10	±0.2
Voltage/Thermocouple	±125 mV	±10	±1.6
Current	±25 mA	±15	±0.4
4-Wire and 2-Wire Resistance	10 kΩ	±15	±3
	1 kΩ	±15	±30
4-Wire and 3-Wire RTD	Pt 1000	±15	±6
	Pt 100	±15	±60
Quarter-Bridge	350 Ω	±15	±120
	120 Ω	±15	±240
Half-Bridge	±500 mV/V	±3	±20
Full-Bridge	±62.5 mV/V	±3	±20
	±7.8 mV/V	±3	±20

Table 4. Input Noise in ppm of $Range_{rms}$

Measurement Type	Range	Timing Mode			
		High Speed	Best 60 Hz Rejection	Best 50 Hz Rejection	High Resolution
Voltage	±60 V	7.6	1.3	1.3	0.5
	±15 V	10.8	1.9	1.9	0.7
	±4 V	10.8	2.7	2.7	1.3
	±1 V	7.6	1.3	1.3	0.5
Voltage/ Thermocouple	±125 mV	10.8	1.9	1.9	1.0

Table 4. Input Noise in ppm of $Range_{rms}$ (Continued)

Measurement Type	Range	Timing Mode			
		High Speed	Best 60 Hz Rejection	Best 50 Hz Rejection	High Resolution
Current	±25 mA	10.8	1.9	1.9	1.0
4-Wire and 2-Wire Resistance	10 kΩ	4.1	1.3	0.8	0.3
	1 kΩ	7.1	1.8	1.2	0.7
4-Wire and 3-Wire RTD	Pt 1000	7.6	1.7	1.1	0.4
	Pt 100	10.8	1.9	1.9	0.9
Quarter-Bridge	350 Ω	5.4	1.0	1.0	0.7
	120 Ω	5.4	1.0	1.0	0.7
Half-Bridge	±500 mV/V	3.8	0.5	0.5	0.2
Full-Bridge	±62.5 mV/V	5.4	1.0	1.0	0.8
	±7.8 mV/V	30	4.7	4.7	2.3

Input bias current	<1 nA
INL	±15 ppm
CMRR (f_{in} = 60 Hz)	>100 dB
NMRR	
Best 60 Hz rejection	90 dB at 60 Hz
Best 50 Hz rejection	80 dB at 50 Hz
High resolution	65 dB at 50 Hz and 60 Hz

Table 5. Half-Bridge, Full-Bridge, Quarter-Bridge, Resistance, and RTD Excitation Level

Measurement Type	Load Resistance (Ω)	Characteristic Excitation Level[2]
Half-Bridge	700	2.5 V
	240	2.0 V

[2] Excitation level is a characteristic and is not software-selectable.

Table 5. Half-Bridge, Full-Bridge, Quarter-Bridge, Resistance, and RTD Excitation Level (Continued)

Measurement Type	Load Resistance (Ω)	Characteristic Excitation Level[2]
Full-Bridge	350	2.7 V
	120	2.2 V
Resistance, RTD, and Quarter-Bridge	120	50 mV
	350	150 mV
	1,000	430 mV
	10,000	2200 mV

MTBF	384,716 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method

Power Requirements

Power consumption from chassis	
Active mode	750 mW maximum
Sleep mode	25 µW maximum
Thermal dissipation (at 70 °C)	
Active mode	625 mW maximum
Sleep mode	25 µW 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.

Spring-terminal wiring	
Gauge	0.08 mm^2 to 1.0 mm^2 (28 AWG to 18 AWG) copper conductor wire
Wire strip length	7 mm (0.28 in.) of insulation stripped from the end

[2] Excitation level is a characteristic and is not software-selectable.

Temperature rating	90 °C minimum
Wires per spring terminal	One wire per spring terminal
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.80 lb · in.)
Weight	156 g (5.5 oz)

Safety Voltages

Connect only voltages that are within the following limits.

Channel-to-channel	
Continuous	250 VAC, Measurement Category II
Withstand	1,390 VAC, verified by a 5 s dielectric withstand test
Channel-to-earth ground	
Continuous	250 VAC, Measurement Category II
Withstand	2,300 VAC, verified by a 5 s dielectric withstand test
Zone 2 hazardous locations applications in Europe	
Channel-to-channel and channel-to-earth ground	60 VDC, 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 If using in Division 2 or Zone 2 hazardous locations applications, do not connect the NI 9219 to signals or use for measurements within Measurement Categories II, III, or IV.

Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example, 115 V for U.S. or 230 V for Europe.

Caution Do not connect the NI 9219 to signals or use for measurements within Measurement Categories III or IV.

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 (IEC 61326): 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 For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

CE Compliance CE

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

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	2,000 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.

DATASHEET

NI 9263

4 AO, ±10 V, 16 Bit, 100 kS/s/ch Simultaneous

- Screw-terminal or spring-terminal connectivity
- 250 Vrms, CAT II, channel-to-earth isolation

The NI 9263 is an analog output module for any CompactDAQ and CompactRIO systems. It also features ±30 V overvoltage protection, short-circuit protection, low crosstalk, fast slew rate, high relative accuracy, and NIST-traceable calibration. The NI 9263 module includes a channel-to-earth ground double isolation barrier for safety and noise immunity.

Kit Contents	• NI 9263 • NI 9263 Getting Started Guide
Accessories	• NI 9927 backshell connector kit (screw terminal) • NI 9981 backshell connector kit (spring terminal)

NATIONAL INSTRUMENTS™

C SERIES ANALOG OUTPUT MODULE COMPARISON							
Product Name	Module Type	Signal Ranges	Channels	Sample Rate	Simultaneous	Resolution	Connectivity
NI 9260	Voltage Output	3 Vrms	2	51.2 kS/s/ch	Yes	24-Bit	BNC, mini XLR
NI 9263	Voltage Output	±10 V	4	100 kS/s/ch	Yes	16-Bit	Screw-Terminal, Spring-Terminal
NI 9264	Voltage Output	±10 V	16	25 kS/s/ch	Yes	16-Bit	Spring-Terminal, 37-Pin DSUB
NI 9265	Current Output	0 mA to 20 mA	4	100 kS/s/ch	Yes	16-Bit	Screw-Terminal
NI 9269	Voltage Output	±10 V	4	100 kS/s/ch	Yes	16-Bit	Screw-Terminal

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.

CompactDAQ

CompactDAQ is a portable, rugged data acquisition platform that integrates connectivity, data acquisition, and signal conditioning into modular I/O for directly interfacing to any sensor or signal. Using CompactDAQ with LabVIEW, you can easily customize how you acquire, analyze, visualize, and manage your measurement data.

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

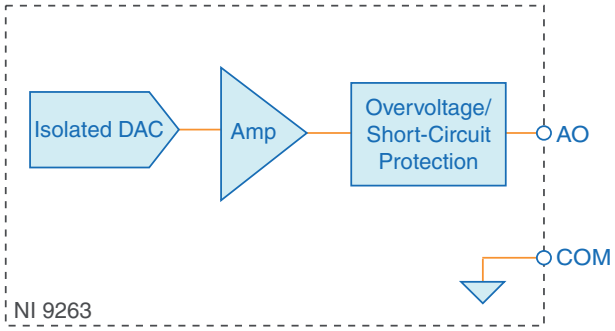
NI LabVIEW Real-Time Module

- 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

Each channel has a digital-to-analog converter (DAC) that produces a voltage signal. Each channel also has overvoltage and short-circuit protection.

Figure 1. Output Circuitry for One Channel of the NI 9263



NI 9263 Specifications

The following specifications are typical for the range -40 °C to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

Caution Do not operate the NI 9263 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.

Output Characteristics

Number of channels	4 analog output channels
DAC resolution	16 bits

Type of DAC	String
Power-on output state	Channels off
Startup voltage[1]	0 V
Power-down voltage[2]	0 V
Output voltage range	
Nominal	±10 V
Minimum	±10.4 V
Typical	±10.7 V
Maximum	±11 V
Current drive	±1 mA per channel maximum
Output impedance	2 Ω

Table 1. Accuracy

Measurement Conditions		Percent of Reading (Gain Error)	Percent of Range[3] (Offset Error)
Calibrated	Maximum (-40 °C to 70 °C)	0.35%	0.75%
	Typical (25 °C, ±5 °C)	0.03%	0.1%
Uncalibrated[4]	Maximum (-40 °C to 70 °C)	2.2%	1.7%
	Typical (25 °C, ±5 °C)	0.3%	0.25%

Stability	
Gain drift	11 ppm/°C
Offset drift	110 µV/°C
Protection	
Overvoltage	±30 V
Short-circuit	Indefinitely

1 When the module powers on, a glitch occurs for 20 µs peaking at -1.5 V.

2 The power-down voltage peaks at 1.8 V before exponentially discharging to 0 V in 100 µs. You can add a 10 kΩ load to reduce the peak voltage.

3 Range equals ±10.7 V

4 Uncalibrated accuracy refers to the accuracy achieved when acquiring in raw or unscaled modes where the calibration constants stored in the module are not applied to the data.

Table 2. Update Time

Number of Channels	Update Time for All Other Chassis	Update Time for NI cRIO-9151 R Series Expansion Chassis
1	3 µs min	3.5 µs min
2	5 µs min	6.5 µs min
3	7.5 µs min	9 µs min
4	9.5 µs min	12 µs min

Noise	
Updating at 100 kS/s	600 µVrms
Not updating	260 µVrms
Slew rate	4 V/µs
Crosstalk	76 dB
Settling time (100 pF load, to 1 LSB)	
Full-scale step	20 µs
1 V step	13 µs
0.1 V step	10 µs
Capacitive drive	1,500 pF minimum
Monotonicity	16 bits
DNL	±1 LSB maximum
INL (endpoint)	±12 LSB maximum
MTBF	1,732,619 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method

Power Requirements

Power consumption from chassis	
Active mode (at -40 °C)	500 mW maximum
Sleep mode	25 µW maximum
Thermal dissipation (at 70 °C)	
Active mode	750 mW maximum
Sleep mode	25 µW 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.

Screw-terminal wiring	
Gauge	0.2 mm^2 to 2.5 mm^2 (26 AWG to 14 AWG) copper conductor wire
Wire strip length	13 mm (0.51 in.) of insulation stripped from the end
Temperature rating	90 °C minimum
Torque for screw terminals	0.5 N · m to 0.6 N · m (4.4 lb · in. to 5.3 lb · in.)
Wires per screw terminal	One wire per screw terminal; two wires per screw terminal using a 2-wire ferrule
Ferrules	0.25 mm^2 to 2.5 mm^2
Spring-terminal wiring	
Gauge	0.2 mm^2 to 2.5 mm^2 (30 AWG to 12 AWG) copper conductor wire
Wire strip length	10 mm (0.39 in.) of insulation stripped from the end
Temperature rating	90 °C minimum
Wires per spring terminal	One wire per spring terminal; two wires per spring terminal using a 2-wire ferrule
Ferrules	0.25 mm^2 to 2.5 mm^2
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.80 lb · in.)
Weight	
NI 9263 with screw terminal	150 g (5.3 oz)
NI 9263 with spring terminal	139 g (4.9 oz)

Safety Voltages

Connect only voltages that are within the following limits:

Channel-to-channel	None
Channel-to-earth ground	
Continuous	250 Vrms, Measurement Category II
Withstand	2,300 Vrms, verified by a 5 s dielectric withstand test
Division 2 and Zone 2 hazardous locations applications (Channel-to-earth ground)	60 VDC, 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 NI 9263 to signals or use for measurements within Measurement Categories II, III, or IV.

Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example, 115 V for U.S. or 230 V for Europe.

Caution Do not connect the NI 9263 to signals or use for measurements within Measurement Categories III or IV.

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 (IEC 61326): 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 CE

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

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	2,000 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.

SPECIFICATIONS

NI myDAQ

Français Deutsch 日本語 한국어 简体中文

ni.com/manuals

Analog Input

Number of channels ..... 2 differential or 1 stereo audio input

ADC resolution ..... 16 bits

Maximum sampling rate ..... 200 kS/s

Timing accuracy ..... 100 ppm of sample rate

Timing resolution ..... 10 ns

Range

- Analog input ..... ±10 V, ±2 V, DC-coupled
- Audio input ..... ±2 V, AC-coupled

Passband (-3 dB)

- Analog input ..... DC to 400 kHz
- Audio input ..... 1.5 Hz to 400 kHz

Connector type

- Analog input ..... Screw terminals
- Audio input ..... 3.5 mm stereo jack

Input type (audio input) ..... Line-in or microphone

Microphone excitation (audio input) ..... 5.25 V through 10 kΩ

Absolute accuracy

Nominal Range		Typical at 23 °C (mV)	Maximum (18 to 28 °C) (mV)
Positive Full Scale	Negative Full Scale		
10	-10	22.8	38.9
2	-2	4.9	8.6

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Figure 1. Settling Time (10 V Range) versus Different Source Impedance

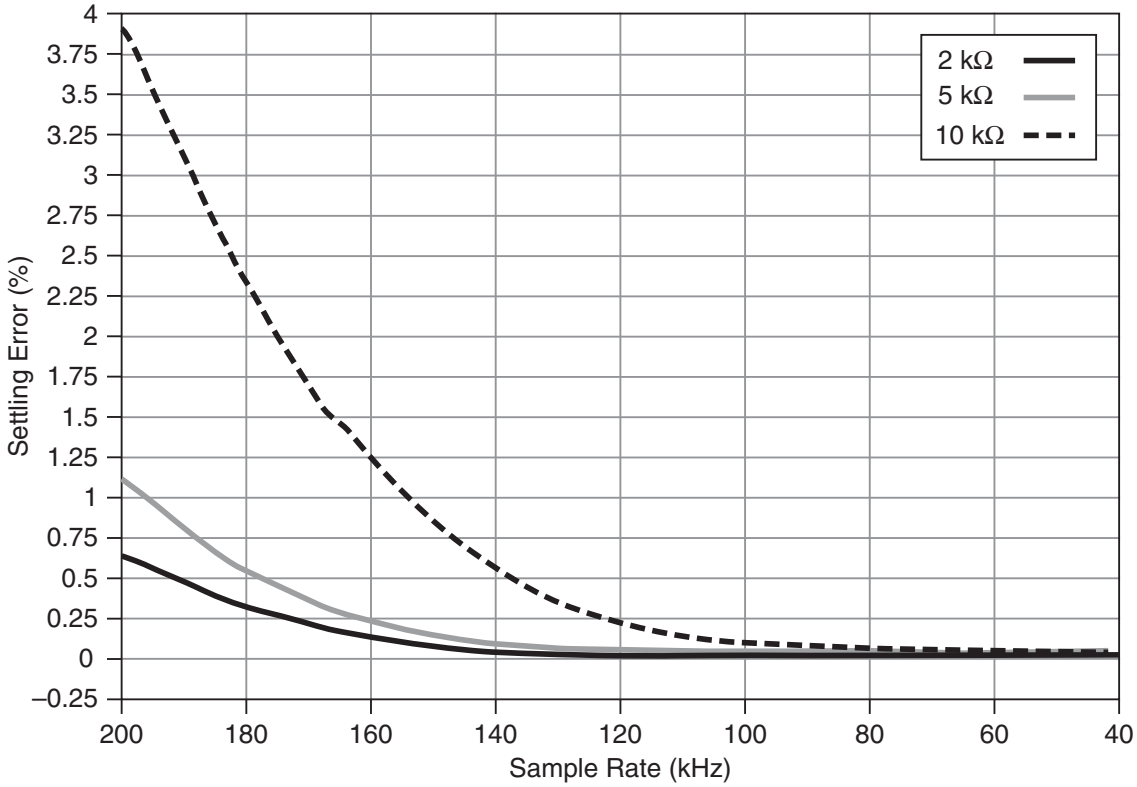
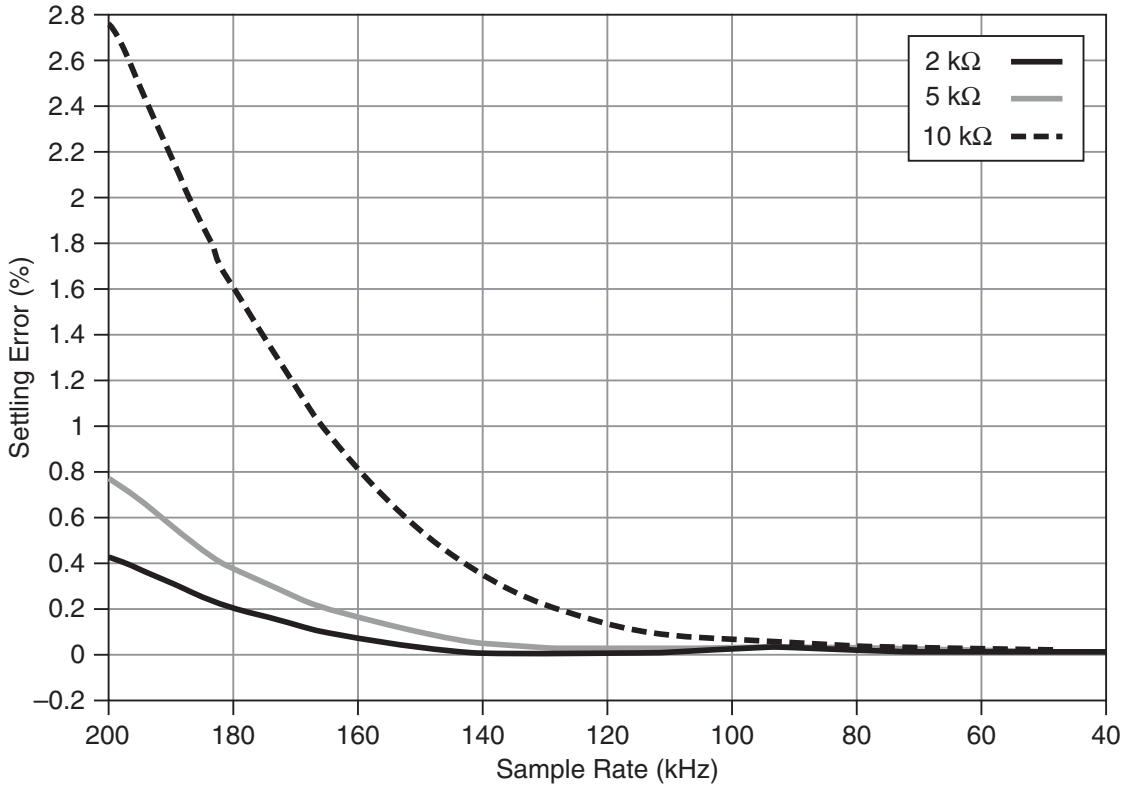


Figure 2. Settling Time (2 V Range) versus Different Source Impedance



Input FIFO size ..... 4,095 samples, shared among channels used

Maximum working voltage for analog inputs (signal + common mode) ..... ±10.5 V to AGND

Common-mode rejection ratio (CMRR) (DC to 60 Hz)..... 70 dB

Input impedance

- Device on
  - AI+ or AI- to AGND ..... >10 GΩ || 100 pF
  - AI+ to AI- ..... >10 GΩ || 100 pF
- Device off
  - AI+ or AI- to AGND ..... 5 kΩ
  - AI+ to AI- ..... 10 kΩ

Anti-aliasing filter..... None

Overvoltage protection AI+ or AI - to AGND ..... ±16 V

Overvoltage protection (audio input left and right)..... None

Analog Output

Number of channels..... 2 ground-referenced or 1 stereo audio output

DAC resolution..... 16 bits

Maximum update rate..... 200 kS/s

Range

- Analog output ..... ±10 V, ±2 V, DC-coupled
- Audio output ..... ±2 V, AC-coupled

Maximum output current (analog output)[1] ..... 2 mA

Output impedance

- Analog output ..... 1 Ω
- Audio output ..... 120 Ω

Minimum load impedance (audio output) ..... 8 Ω

[1] The total power available for the power supplies, analog outputs, and digital outputs is limited to 500 mW (typical)/100 mW (minimum). Refer to the *Calculating Power Consumption* section for information on calculating the total power consumption of the components of your system.

Connector type

Analog output ..... Screw terminals

Audio output ..... 3.5 mm stereo jack

AC-coupling high-pass frequency
(audio output with 32 Ω load)..... 48 Hz

Absolute accuracy

Nominal Range		Typical at 23 °C (mV)	Maximum (18 to 28 °C) (mV)
Positive Full Scale	Negative Full Scale		
10	-10	19.6	42.8
2	-2	5.4	8.8

Slew rate ..... 4 V/µs

Timing accuracy..... 100 ppm of sample rate

Timing resolution..... 10 ns

Overdrive protection ..... ±16 V to AGND

Maximum power-on voltage[1] ..... ±110 mV

Output FIFO size ..... 8,191 samples, shared among channels used

Digital I/O

Number of lines ..... 8; DIO <0..7>

Direction control ..... Each line individually programmable as input or output

Update mode ..... Software-timed

Pull-down resistor ..... 75 kΩ

Logic level ..... 5 V compatible LVTTL input; 3.3 V LVTTL output

V_{IH} min ..... 2.0 V

V_{IL} max ..... 0.8 V

Maximum output current per line[2]..... 4 mA

[1] When powered on, the analog output signal is not defined until after USB configuration is complete.

[2] The total power available for the power supplies, analog outputs, and digital outputs is limited to 500 mW (typical)/100 mW (minimum). Refer to the *Calculating Power Consumption* section for information on calculating the total power consumption of the components of your system.

General Purpose Counter/Timer

Number of counter/timers 1

Resolution ..... 32 bits

Internal base clocks ..... 100 MHz

Base clock accuracy ..... 100 ppm

Maximum counting and pulse generation update rate ..... 1 MS/s

Default routing

- CTR 0 SOURCE ..... PFI 0 routed through DIO 0
- CTR 0 GATE ..... PFI 1 routed through DIO 1
- CTR 0 AUX ..... PFI 2 routed through DIO 2
- CTR 0 OUT ..... PFI 3 routed through DIO 3
- FREQ OUT ..... PFI 4 routed through DIO 4

Data transfers ..... Programmed I/O

Update mode ..... Software-timed

Digital Multimeter

Functions[1] ..... DC voltage, AC voltage, DC current, AC current, resistance, diode, continuity

Isolation level ..... 60 VDC/20 V_{rms}, Measurement Category I

Caution Do *not* use this device for connection to signals or for measurements within Measurement Categories II, III, or IV. For more information on Measurement Categories, refer to the *Safety Voltages* section.

Connectivity ..... Banana jacks

Resolution ..... 3.5 digits

Input coupling ..... DC (DC Voltage, DC Current, Resistance, Diode, Continuity);
AC (AC Voltage, AC Current)

Voltage Measurement

DC ranges ..... 200 mV, 2 V, 20 V, 60 V

AC ranges ..... 200 mV_{rms}, 2 V_{rms}, 20 V_{rms}

[1] All AC specifications are based on sine wave RMS.

Note All AC voltage accuracy specifications apply to signal amplitudes greater than 5% of range.

Accuracy

Function	Range	Resolution	Accuracy	
			± ([% of Reading] + Offset)	
DC Volts	200.0 mV	0.1 mV	0.5% + 0.2 mV	
	2.000 V	0.001 V	0.5% + 2 mV	
	20.00 V	0.01 V	0.5% + 20 mV	
	60.0 V	0.1 V	0.5% + 200 mV	
			40 to 400 Hz	**400 to 2,000 Hz**
AC Volts	200.0 mV	0.1 mV	1.4% + 0.6 mV*	—
	2.000 V	0.001 V	1.4% + 0.005 V	5.4% + 0.005 V
	20.00 V	0.01 V	1.5% + 0.05 V	5.5% + 0.05 V

* The accuracy for AC Volts 200.0 mV range is in the frequency range of 40 Hz to 100 Hz. For example, for a 10 V using the DC Volts function in the 20.00 V range, calculate the accuracy using the following equation:

$$10\ V \times 0.5\% + 20\ mV = 0.07\ V$$

Input impedance.....10 MΩ

Current Measurement

DC ranges .....20 mA, 200 mA, 1 A

AC ranges .....20 mA_{rms}, 200 mA_{rms}, 1 A_{rms}

Note All AC accuracy specifications within 20 mA and 200 mA ranges apply to signal amplitudes greater than 5% of range. All AC accuracy specifications within the 1 A range apply to signal amplitudes greater than 10% of range.

Accuracy

Function	Range	Resolution	Accuracy	
			± ([% of Reading] + Offset)	
DC Amps	20.00 mA	0.01 mA	0.5% + 0.03 mA	
	200.0 mA	0.1 mA	0.5% + 0.3 mA	
	1.000 A	0.001 A	0.5% + 3 mA	
			40 to 400 Hz	**400 to 2,000 Hz**
AC Amps	20.00 mA	0.01 mA	1.4% + 0.06 mA	5% + 0.06 mA
	200.0 mA	0.1 mA	1.5% + 0.8 mA	5% + 0.8 mA
	1.000 A	0.001 A	1.6% + 6 mA	5% + 6 mA

Input protection..... Internal ceramic fuse, 1.25 A 250 V, fast-acting, 5 × 20 mm, F 1.25A H 250V (Littelfuse part number 02161.25)

Resistance Measurement

Ranges ..... 200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, 20 MΩ

Accuracy

Function	Range	Resolution	Accuracy
			± ([% of Reading] + Offset)
Ω	200.0 Ω	0.1 Ω	0.8% + 0.3 Ω*
	2.000 kΩ	0.001 kΩ	0.8% + 3 Ω
	20.00 kΩ	0.01 kΩ	0.8% + 30 Ω
	200.0 kΩ	0.1 kΩ	0.8% + 300 Ω
	2.000 MΩ	0.001 MΩ	0.8% + 3 kΩ
	20.00 MΩ	0.01 MΩ	1.5% + 50 kΩ

* Exclusive of lead wire resistance

Diode Measurement

Range ..... 2 V

Power Supplies

Caution Do *not* mix power from NI myDAQ with power from external power sources. When using external power, remove any connections to the power supply terminals on NI myDAQ.

+15V Supply

Output voltage

- Typical (no load) ..... 15.0 V
- Maximum voltage with no load ..... 15.3 V
- Minimum voltage with full load ..... 14.0 V

Maximum output current[1] ..... 32 mA

Maximum load capacitance ..... 470 µF

-15V Supply

Output voltage

- Typical (no load) ..... -15.0 V
- Maximum voltage with no load ..... -15.3 V
- Minimum voltage with full load ..... -14.0 V

Maximum output current[1] ..... 32 mA

Maximum load capacitance ..... 470 µF

+5V Supply

Output voltage

- Typical (no load) ..... 4.9 V
- Maximum voltage with no load ..... 5.2 V
- Minimum voltage with full load ..... 4.0 V

Maximum output current[1] ..... 100 mA

Maximum load capacitance ..... 33 µF

Calculating Power Consumption

The total power available for the power supplies, analog outputs, and digital outputs is limited to 500 mW (typical)/100 mW (minimum). To calculate the total power consumption of the power supplies, multiply the output voltage by the load current for each voltage rail and sum them together. For digital output power consumption, multiply 3.3 V by the load current. For

[1] The total power available for the power supplies, analog outputs, and digital outputs is limited to 500 mW (typical)/100 mW (minimum). Refer to the *Calculating Power Consumption* section for information on calculating the total power consumption of the components of your system.

analog output power consumption, multiply 15 V by the load current. Using audio output subtracts 100 mW from the total power budget.

For example, if you use 50 mA on +5 V, 2 mA on +15 V, 1 mA on -15 V, use four DIO lines to drive LEDs at 3 mA each, and have a 1 mA load on each AO channel, the total output power consumption is:

5 V × 50 mA = 250 mW

|+15 V| × 2 mA = 30 mW

|-15 V| × 1 mA = 15 mW

3.3 V × 3 mA × 4 = 39.6 mW

15 V × 1 mA × 2 = 30 mW

Total output power consumption = 250 mW + 30 mW + 15 mW + 39.6 mW + 30 mW = 364.6 mW

Communication

Bus interface ..... USB 2.0 Hi-Speed

Physical Characteristics

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

Dimensions (without screw terminal connector)

NI myDAQ device part number
195509D-01L and earlier..... 14.6 cm × 8.7 cm × 2.2 cm
(5.75 in. × 3.43 in. × 0.87 in.)

NI myDAQ device part number
195509E-01L and later ..... 13.6 cm × 8.8 cm × 2.4 cm
(5.36 in. × 3.48 in. × 0.95 in.)

Weight

NI myDAQ device part number
195509D-01L and earlier..... 175.0 g (6.1 oz)

NI myDAQ device part number
195509E-01L and later ..... 164.0 g (5.8 oz)

Note NI myDAQ device part number (*P/N: 195509*x-*01L*) is located on the product label on the bottom of the device.

Screw-terminal wiring ..... 16 to 26 AWG

Torque for screw terminals ..... 0.22 - 0.25 N · m (2.0 - 2.2 lb · in.)

Environmental

Operating temperature
(IEC 60068-2-1 and IEC 60068-2-2).....0 to 45 °C

Storage temperature
(IEC 60068-2-1 and IEC 60068-2-2).....-20 to 70 °C

Operating humidity
(IEC 60068-2-56).....10 to 90% RH, noncondensing

Storage humidity
(IEC 60068-2-56).....10 to 90% RH, noncondensing

Maximum altitude.....2,000 m (at 25 °C ambient temperature)

Pollution Degree (IEC 60664) 2

Indoor use only.

Safety

Safety Voltages

Measurement Category I[1] 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 use this module for connection to signals or for measurements within Measurement Categories II, III, or IV.

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.

Caution Using the NI myDAQ in a manner not described in this document may impair the protection the NI myDAQ provides.

[1] Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Hazardous Locations

The NI myDAQ device is not certified for use in hazardous locations.

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 B emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class B emissions
- EN 55022 (CISPR 22): Class B emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class B emissions
- AS/NZS CISPR 22: Class B emissions
- FCC 47 CFR Part 15B: Class B emissions
- ICES-001: Class B emissions

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, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives 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 Declaration of Conformity (DoC) for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

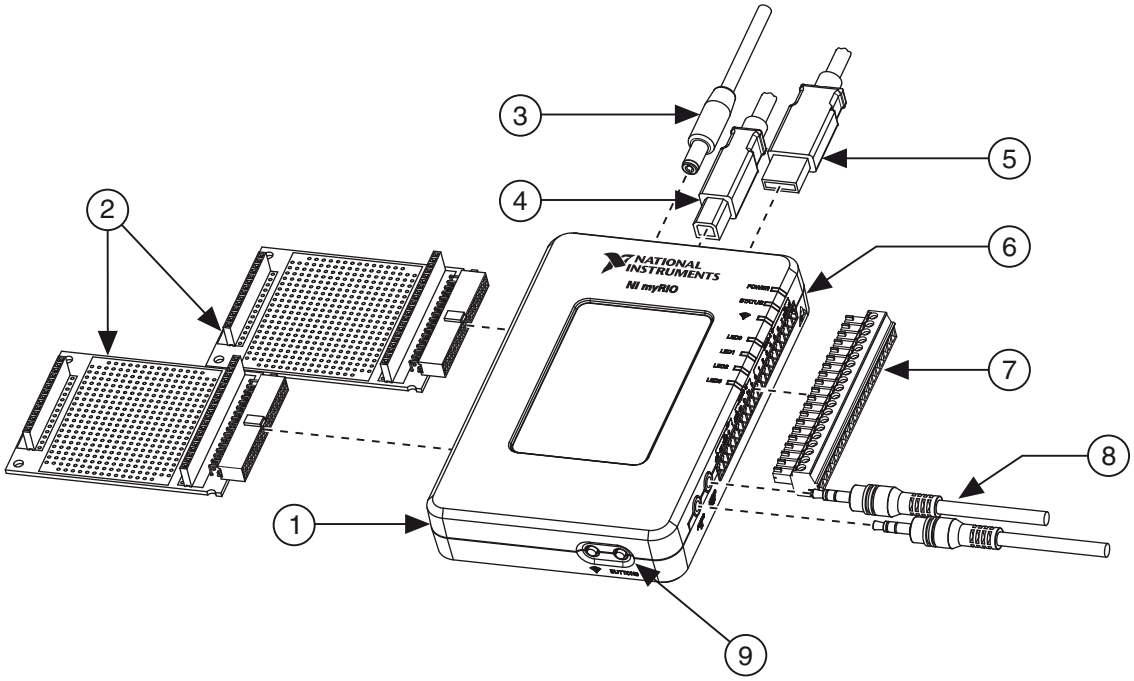
NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

USER GUIDE AND SPECIFICATIONS

NI myRIO-1900

The National Instruments myRIO-1900 is a portable reconfigurable I/O (RIO) device that students can use to design control, robotics, and mechatronics systems. This document contains pinouts, connectivity information, dimensions, mounting instructions, and specifications for the NI myRIO-1900.

Figure 1. NI myRIO-1900



1	NI myRIO-1900	6	LEDs
2	myRIO Expansion Port (MXP) Breakouts (One Included in Kit)	7	Mini System Port (MSP) Screw-Terminal Connector
3	Power Input Cable	8	Audio In/Out Cables (One Included in Kit)
4	USB Device Cable	9	Button0
5	USB Host Cable (Not Included in Kit)		

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Safety Information

Caution Do not operate the hardware in a manner not specified in this document and in the user documentation. Misuse of the hardware can result in a hazard. You can compromise the safety protection if the hardware is damaged in any way. If the hardware is damaged, return it to National Instruments for repair.

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

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and limits provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment.

This product is intended for use in commercial locations. There is no guarantee that harmful interference will not occur in a particular installation or when the product is connected to a test object. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

Caution This product was tested for EMC compliance using myRIO application software. The maximum length for USB cables is 2.0 m (6.6 ft), and the maximum length for signal wires is 30.0 cm (11.8 in.).

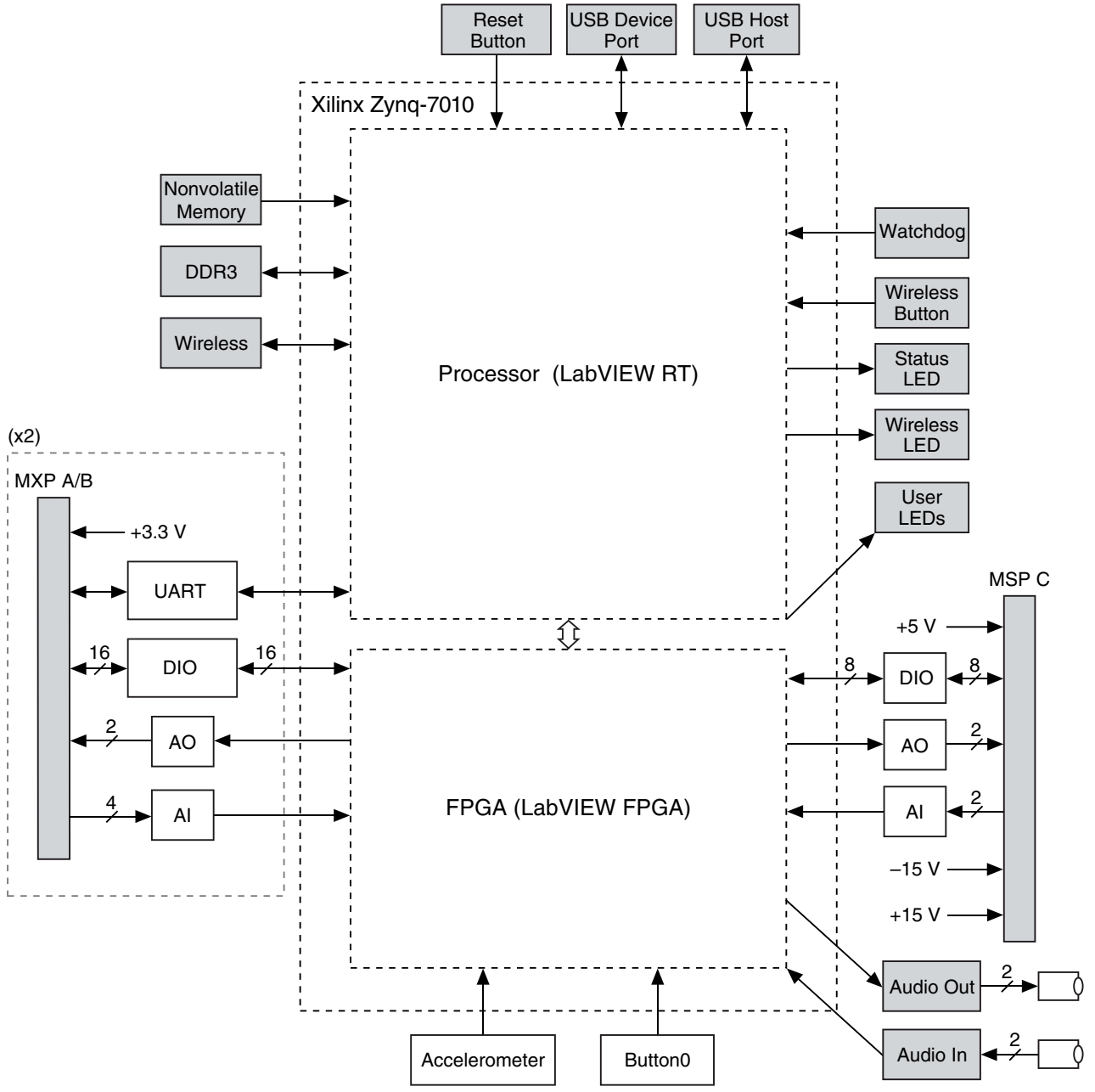
Caution The mounting keyholes on the back of the NI myRIO-1900 are sensitive to electrostatic discharge (ESD). When handling the device, be careful not to touch inside the keyholes.

Hardware Overview

The NI myRIO-1900 provides analog input (AI), analog output (AO), digital input and output (DIO), audio, and power output in a compact embedded device. The NI myRIO-1900 connects to a host computer over USB and wireless 802.11b,g,n.

The following figure shows the arrangement and functions of NI myRIO-1900 components.

Figure 2. NI myRIO-1900 Hardware Block Diagram



Connector Pinouts

NI myRIO-1900 Expansion Port (MXP) connectors A and B carry identical sets of signals. The signals are distinguished in software by the connector name, as in `ConnectorA/DIO1` and `ConnectorB/DIO1`. Refer to the software documentation for information about configuring and using signals. The following figure and table show the signals on MXP connectors A and B. Note that some pins carry secondary functions as well as primary functions.

Figure 3. Primary/Secondary Signals on MXP Connectors A and B

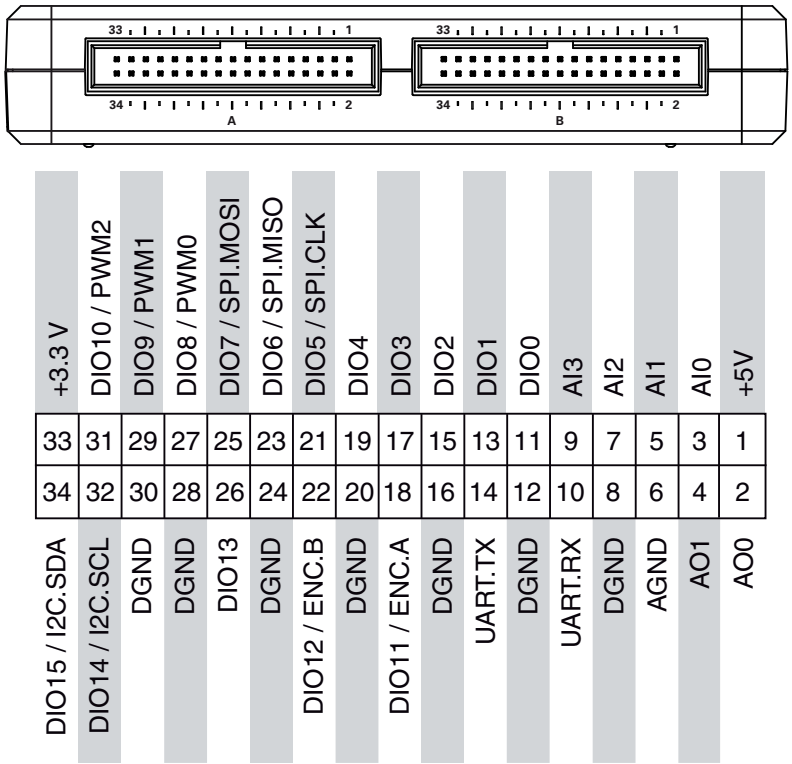


Table 1. Descriptions of Signals on MXP Connectors A and B

Signal Name	Reference	Direction	Description
+5V	DGND	Output	+5 V power output.
AI <0..3>	AGND	Input	0-5 V, referenced, single-ended analog input channels. Refer to the *Analog Input Channels* section for more information.
AO <0..1>	AGND	Output	0-5 V referenced, single-ended analog output. Refer to the *Analog Output Channels* section for more information.
AGND	N/A	N/A	Reference for analog input and output.
+3.3V	DGND	Output	+3.3 V power output.
DIO <0..15>	DGND	Input or Output	General-purpose digital lines with 3.3 V output, 3.3 V/5 V-compatible input. Refer to the *DIO Lines* section for more information.
UART.RX	DGND	Input	UART receive input. UART lines are electrically identical to DIO lines.
UART.TX	DGND	Output	UART transmit output. UART lines are electrically identical to DIO lines.
DGND	N/A	N/A	Reference for digital signals, +5 V, and +3.3 V.

The following figure and table show the signals on Mini System Port (MSP) connector C. Note that some pins carry secondary functions as well as primary functions.

Figure 4. Primary/Secondary Signals on MSP Connector C

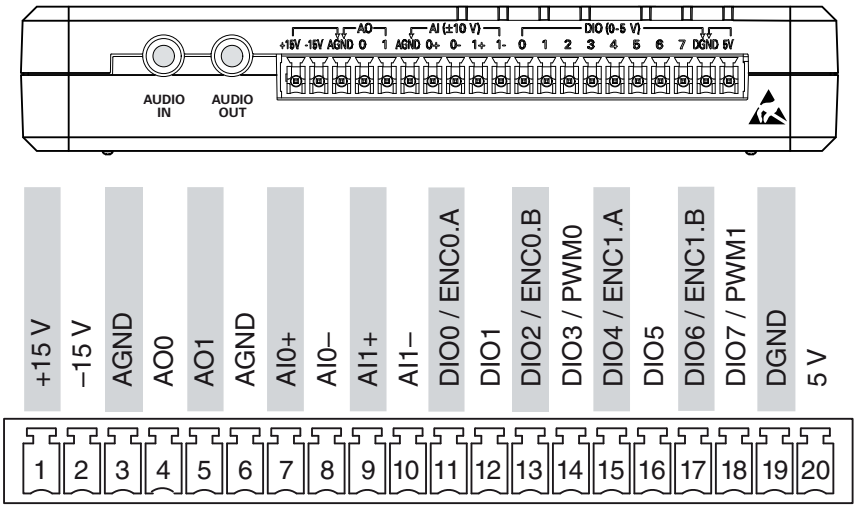


Table 2. Descriptions of Signals on MSP Connector C

Signal Name	Reference	Direction	Description
+15V/-15V	AGND	Output	+15 V/-15 V power output.
AI0+/AI0-; AI1+/AI1-	AGND	Input	±10 V, differential analog input channels. Refer to the *Analog Input Channels* section for more information.
AO <0..1>	AGND	Output	±10 V referenced, single-ended analog output channels. Refer to the *Analog Output Channels* section for more information.
AGND	N/A	N/A	Reference for analog input and output and +15 V/-15 V power output.
+5V	DGND	Output	+5 V power output.
DIO <0..7>	DGND	Input or Output	General-purpose digital lines with 3.3 V output, 3.3 V/5 V-compatible input. Refer to the *DIO Lines* section for more information.
DGND	N/A	N/A	Reference for digital lines and +5 V power output.

Table 3. Descriptions of Signals on Audio Connectors

Signal Name	Reference	Direction	Description
AUDIO IN	N/A	Input	Left and right audio inputs on stereo connector.
AUDIO OUT	N/A	Output	Left and right audio outputs on stereo connector.

Analog Input Channels

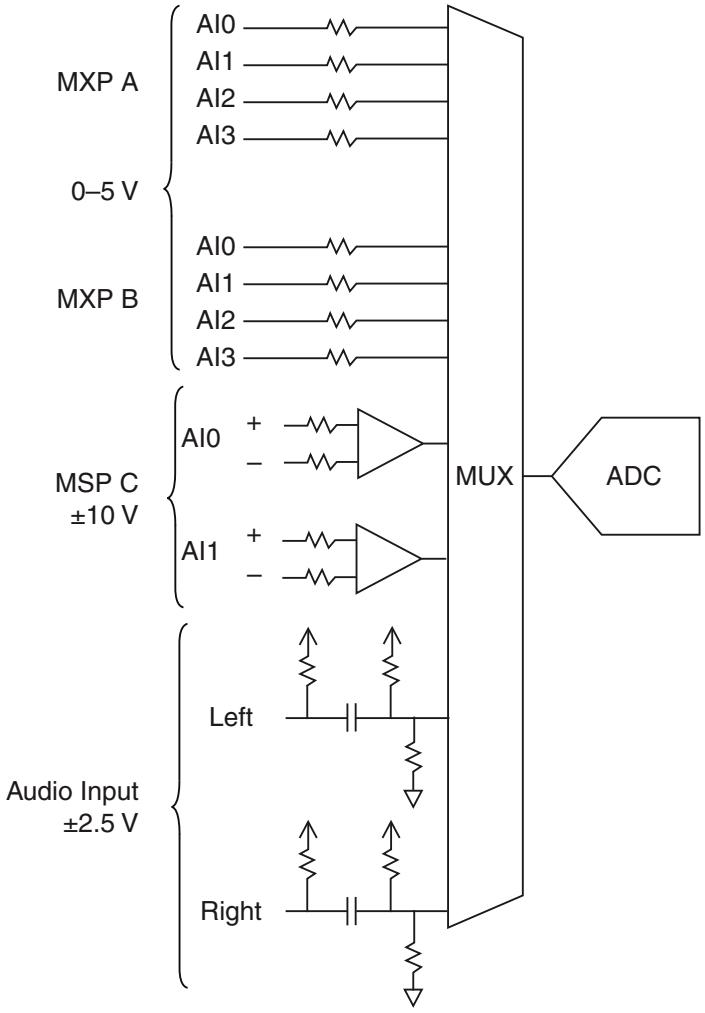
The NI myRIO-1900 has analog input channels on myRIO Expansion Port (MXP) connectors A and B, Mini System Port (MSP) connector C, and a stereo audio input connector. The analog inputs are multiplexed to a single analog-to-digital converter (ADC) that samples all channels.

MXP connectors A and B have four single-ended analog input channels per connector, AI0-AI3, which you can use to measure 0-5 V signals. MSP connector C has two high-impedance, differential analog input channels, AI0 and AI1, which you can use to measure signals up to ±10 V. The audio inputs are left and right stereo line-level inputs with a ±2.5 V full-scale range.

Note For important information about improving measurement accuracy by reducing noise, go to `ni.com/info` and enter the Info Code `analogwiring`.

Figure 5 shows the analog input topology of the NI myRIO-1900.

Figure 5. NI myRIO-1900 Analog Input Circuitry



Analog Output Channels

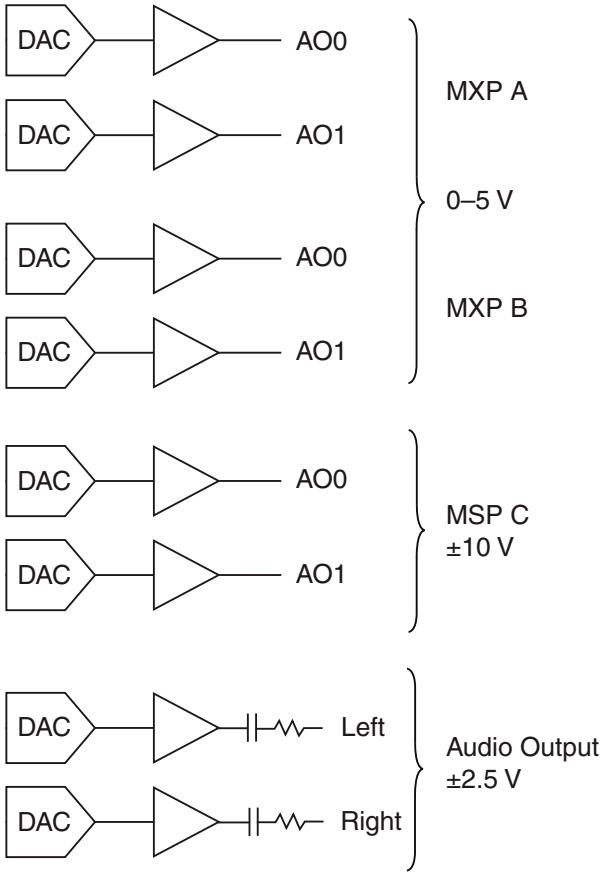
The NI myRIO-1900 has analog output channels on myRIO Expansion Port (MXP) connectors A and B, Mini System Port (MSP) connector C, and a stereo audio output connector. Each analog output channel has a dedicated digital-to-analog converter (DAC), so they can all update simultaneously. The DACs for the analog output channels are controlled by two serial communication buses from the FPGA. MXP connectors A and B share one bus, and MSP connector C and the audio outputs share a second bus. Therefore, the maximum update rate is specified as an aggregate figure in the *Analog Output* section of the *Specifications*.

MXP connectors A and B have two analog output channels per connector, AO0 and AO1, which you can use to generate 0-5 V signals. MSP connector C has two analog output channels, AO0 and AO1, which you can use to generate signals up to ±10 V. The audio outputs are left and right stereo line-level outputs capable of driving headphones.

Caution Before using headphones to listen to the audio output of the NI myRIO-1900, ensure that the audio output is at a safe level. Listening to audio signals at a high volume may result in permanent hearing loss.

Figure 6 shows the analog output topology of the NI myRIO-1900.

Figure 6. NI myRIO-1900 Analog Output Circuitry



Accelerometer

The NI myRIO-1900 contains a three-axis accelerometer. The accelerometer samples each axis continuously and updates a readable register with the result. Refer to the *Accelerometer* section of the *Specifications* for the accelerometer sample rates.

Converting Raw Data Values to Voltage

You can use the following equations to convert raw data values to volts:

$$V = Raw\ Data\ Value * LSB\ Weight$$

$$LSB\ Weight = Nominal\ Range \div 2^{ADC\ Resolution}$$

where *Raw Data Value* is the value returned by the FPGA I/O Node,

LSB Weight is the value in volts of the increment between data values,

Nominal Range is the absolute value in volts of the full, peak-to-peak nominal range of the channel,

and *ADC Resolution* is the resolution of the ADC in bits. (*ADC Resolution* = 12)

- For AI and AO channels on the MXP connectors,

$$LSB\ Weight = 5\ V \div 2^{12} = 1.221\ mV$$

$$Maximum\ reading = 4095 * 1.221\ mV = 4.999\ V$$

- For AI and AO channels on the MSP connectors,

$$LSB\ Weight = 20\ V \div 2^{12} = 4.883\ mV$$

$$Maximum\ Positive\ Reading = +2047 * 4.883\ mV = 9.995\ V$$

$$Maximum\ Negative\ Reading = -2048 * 4.883\ mV = -10.000\ V$$

- For Audio In/Out,

$$LSB\ Weight = 5\ V \div 2^{12} = 1.221\ mV$$

$$Maximum\ Positive\ Reading = +2047 * 1.221\ mV = 2.499\ V$$

$$Maximum\ Negative\ Reading = -2048 * 1.221\ mV = -2.500\ V$$

- For the accelerometer,

$$LSB\ Weight = 16\ g \div 2^{12} = 3.906\ mg$$

$$Maximum\ Positive\ Reading = +2047 * 3.906\ mg = +7.996\ g$$

$$Maximum\ Negative\ Reading = -2048 * 3.906\ mg = -8.000\ g$$

DIO Lines

The NI myRIO-1900 has 3.3 V general-purpose DIO lines on the MXP and MSP connectors. MXP connectors A and B have 16 DIO lines per connector. On the MXP connectors, each DIO line from 0 to 13 has a 40 kΩ pullup resistor to 3.3 V, and DIO lines 14 and 15 have 2.1 kΩ pullup resistors to 3.3 V. MSP connector C has eight DIO lines. Each MSP DIO line has a 40 kΩ pulldown resistor to ground. DGND is the reference for all the DIO lines. You can program all the lines individually as inputs or outputs. Secondary digital functions include Serial Peripheral

Interface Bus (SPI), I2C, pulse-width modulation (PWM), and quadrature encoder input. Refer to the NI myRIO software documentation for information about configuring the DIO lines.

Figure 7. DIO Lines <13..0> on MXP Connector A or B

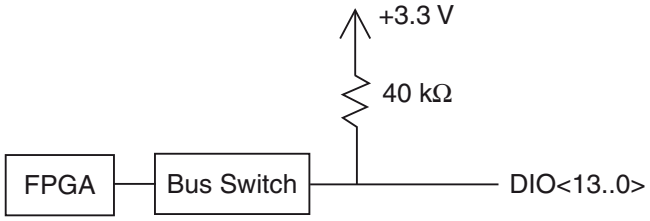


Figure 8. DIO Lines <15..14> on MXP Connector A or B

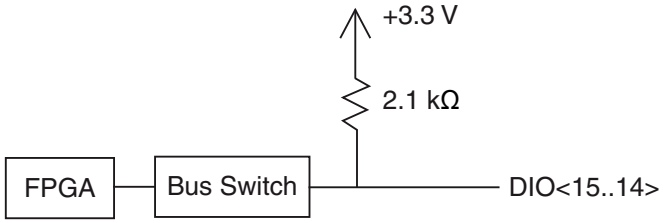
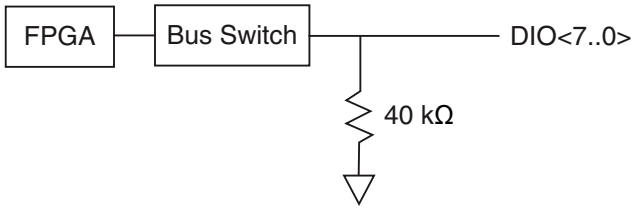


Figure 9. DIO Lines <7..0> on MSP Connector C



When a DIO line is floating, it floats in the direction of the pull resistor. A DIO line may be floating in any of the following conditions:

- when the myRIO device is starting up
- when the line is configured as an input
- when the myRIO device is powering down

You can add a stronger resistor to a DIO line to cause it to float in the opposite direction.

UART Lines

The NI myRIO-1900 has one UART receive input line and one UART transmit ouput line on each MXP connector. The UART lines are electrically identical to DIO lines 0 to 13 on the MXP connectors. Like those lines, UART.RX and UART.TX have 40 kΩ pullup resistors to 3.3 V. Use LabVIEW Real-Time to read and write over the UART lines.

Using the Reset Button

Pressing and releasing the Reset button restarts the processor and the FPGA.

Pressing and holding the Reset button for 5 seconds, then releasing it, restarts the processor and the FPGA and forces the NI myRIO-1900 into safe mode. In safe mode, the NI myRIO-1900 launches only the services necessary for updating configuration and installing software.

When the NI myRIO-1900 is in safe mode, you can communicate with it by using the UART lines on MXP connector A. You need the following items to communicate with the myRIO device over UART:

- USB-to-TTL serial UART converter cable (for example, part number TTL-232RG-VSW3V3-WE from FTD Chip)
- Serial-port terminal program configured with the following settings:
  - 115,200 bits per second
  - Eight data bits
  - No parity
  - One stop bit
  - No flow control

Using the Wireless Button and LED

For information about using the Wireless button, go to `ni.com/info` and enter the Info Code `myriowirelessbutton`.

For information about using the Wireless LED, go to `ni.com/info` and enter the Info Code `myriowirelessled`.

Using Button0

Button0 produces a logic TRUE when depressed and a logic FALSE when not depressed. Button0 is not debounced.

Understanding LED Indications

Power LED

The Power LED is lit while the NI myRIO-1900 is powered on. This LED indicates that the power supply connected to the device is adequate.

Status LED

The Status LED is off during normal operation. The NI myRIO-1900 runs a power-on self test (POST) when you apply power to the device. During the POST, the Power and Status LEDs turn on. When the Status LED turns off, the POST is complete. The NI myRIO-1900 indicates specific error conditions by flashing the Status LED a certain number of times every few seconds, as shown in Table 4.

Table 4. Status LED Indications

Number of Flashes Every Few Seconds	Indication
2	The device has detected an error in its software. This usually occurs when an attempt to upgrade the software is interrupted. Reinstall software on the device.
3	The device is in safe mode.
4	The software has crashed twice without rebooting or cycling power between crashes. This usually occurs when the device runs out of memory. Review your RT VI and check the memory usage. Modify the VI as necessary to solve the memory usage issue.
Continuously flashing or solid	The device has detected an unrecoverable error. Contact National Instruments.

LEDs 0 to 3

You can use LEDs 0 to 3 to help debug your application or easily retrieve application status. Logic TRUE turns an LED on and logic FALSE turns an LED off.

Using the USB Host Port

The NI myRIO-1900 USB host port supports Web cameras that conform to the USB Video Device Class (UVC) protocol as well as machine vision cameras that conform to the USB3 Vision standard and are USB 2.0 backward compatible. The NI myRIO-1900 USB host port also supports Basler ace USB3 cameras.

The NI myRIO-1900 USB host port also supports USB Flash drives and USB-to-IDE adapters formatted with FAT16 and FAT32 file systems. LabVIEW usually maps USB devices to the `/U`, `/V`, `/W`, or `/X` drive, starting with the `/U` drive if it is available.

NI myRIO-1900 Physical Dimensions

Figure 10. NI myRIO-1900 Dimensions, Front

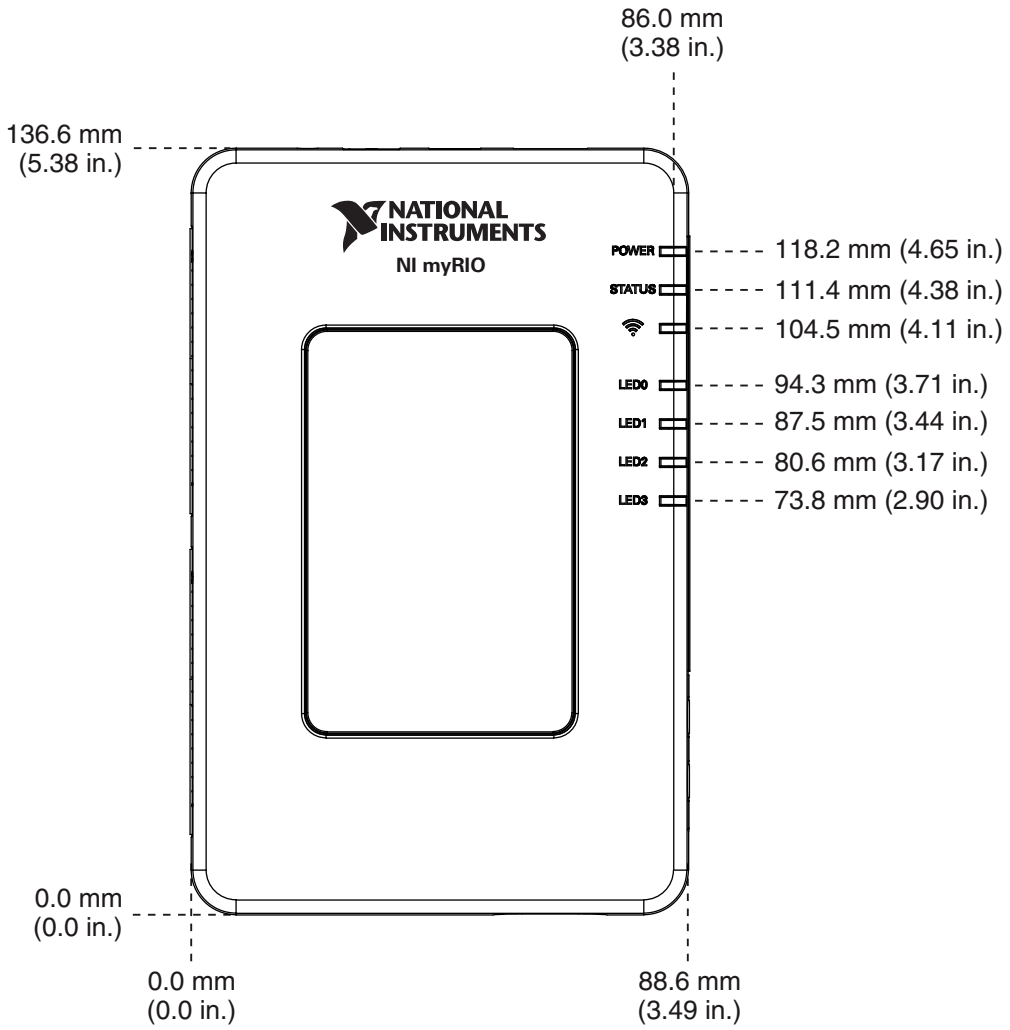


Figure 11. NI myRIO-1900 Dimensions, Back

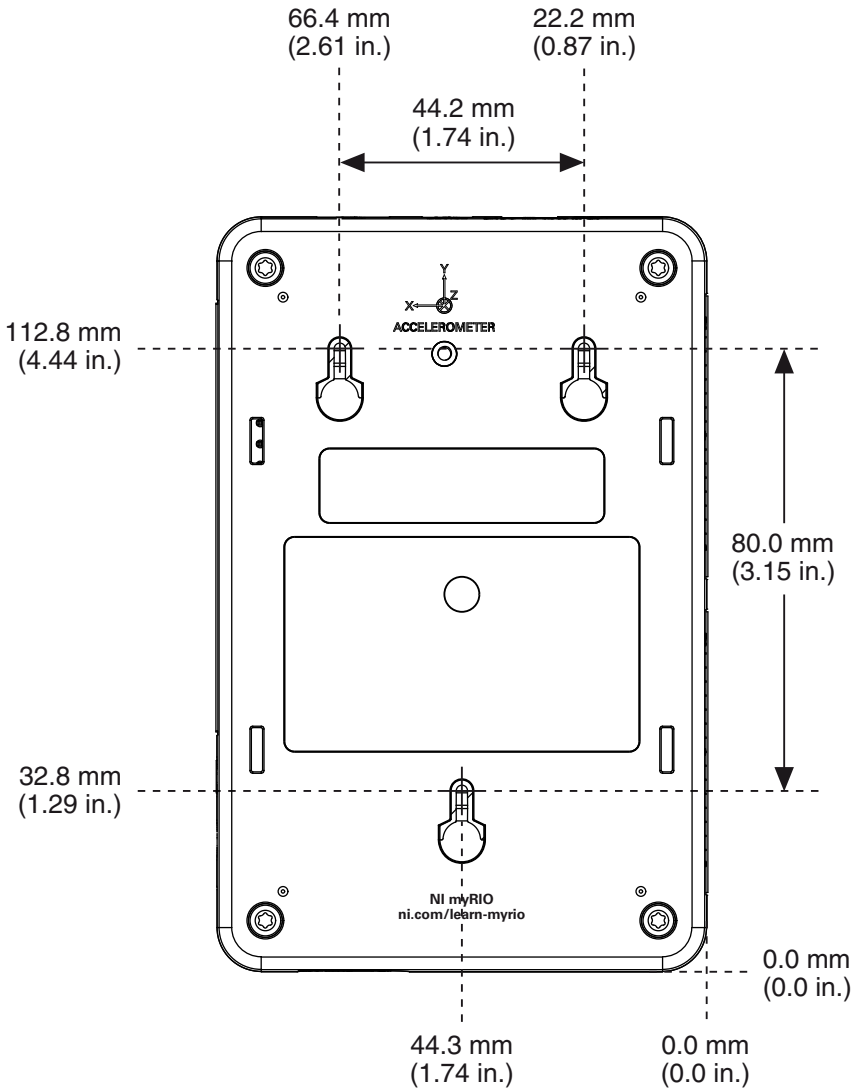
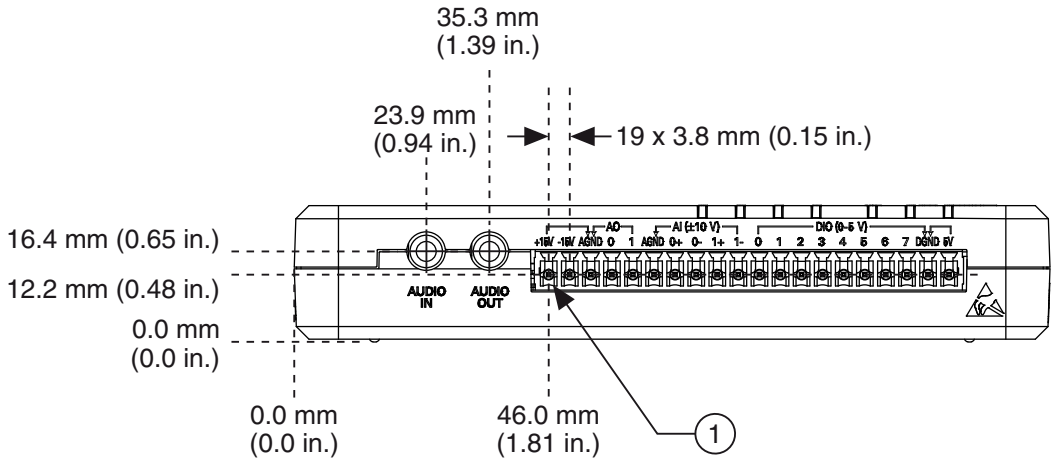
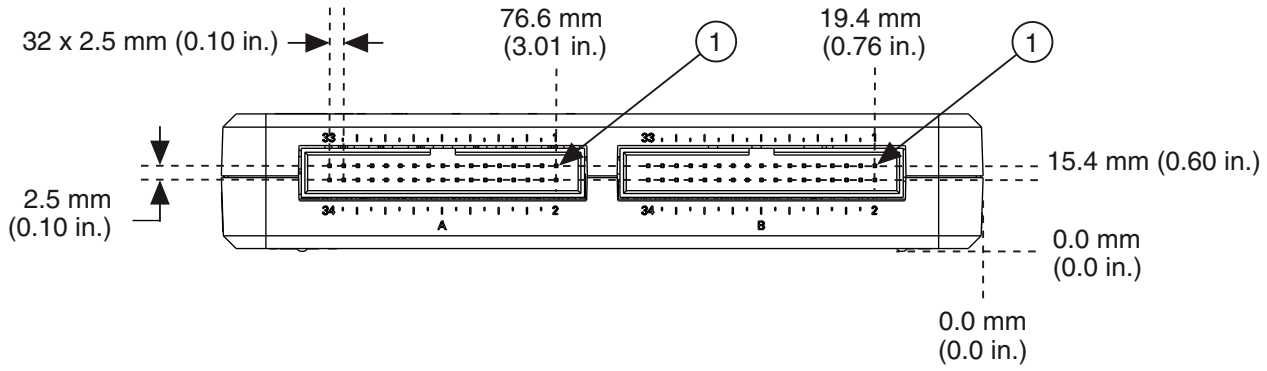


Figure 12. NI myRIO-1900 Dimensions, MSP Side



1 Pin 1

Figure 13. NI myRIO-1900 Dimensions, MXP Side



1 Pin 1

Figure 14. NI myRIO-1900 Dimensions, I/O End

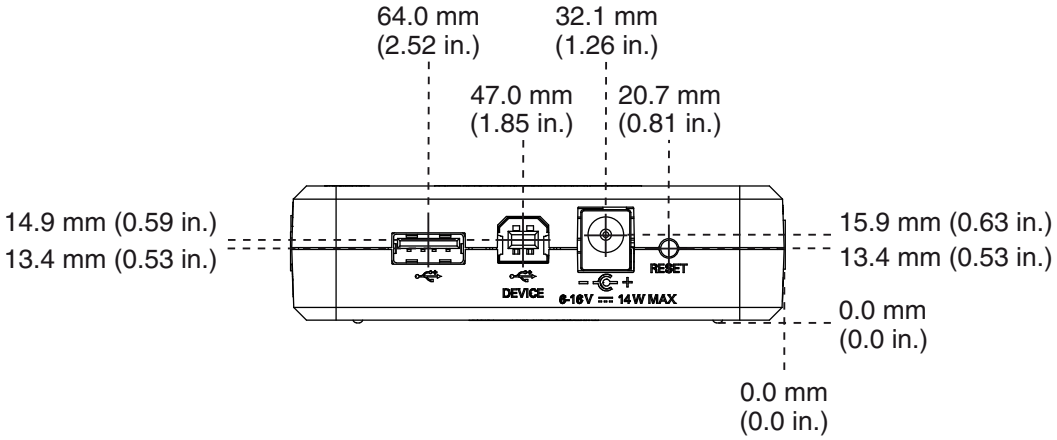
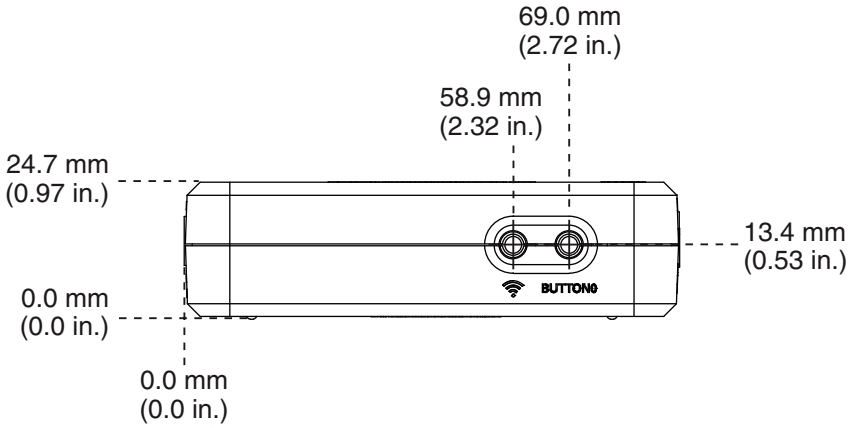


Figure 15. NI myRIO-1900 Dimensions, User End

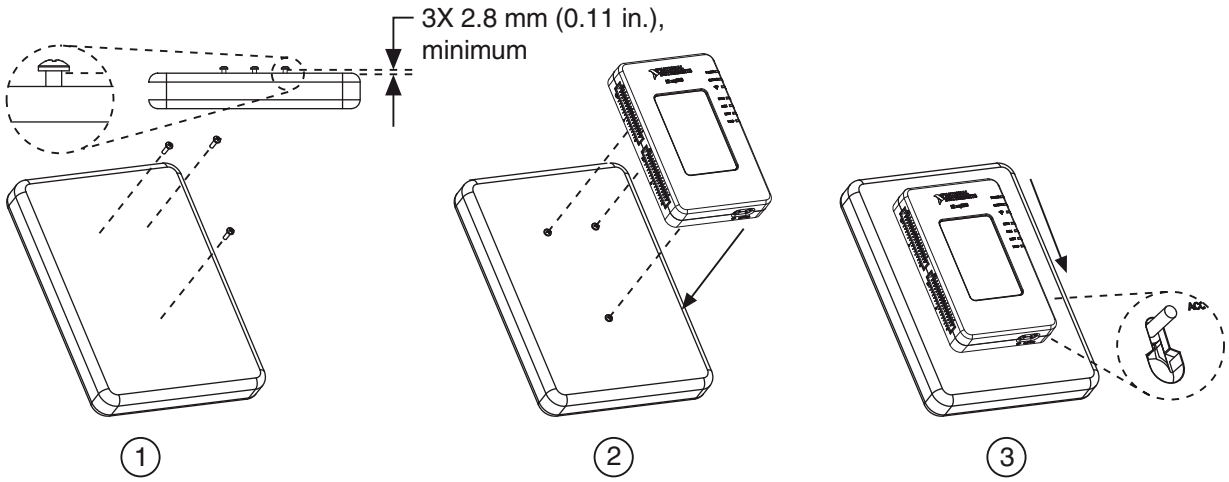


Mounting the NI myRIO-1900

Mounting the NI myRIO-1900 Using the Key Holes

You can use the provided key holes on NI myRIO-1900 to mount the device on a flat surface. Install the NI myRIO-1900 as shown in Figure 16. Use Unified #4 or ISO M3 screws to mount the NI myRIO-1900 using the key holes. Panhead screws are suitable for use with the NI myRIO-1900 key holes.

Figure 16. Mounting the NI myRIO-1900 Using the Key Holes

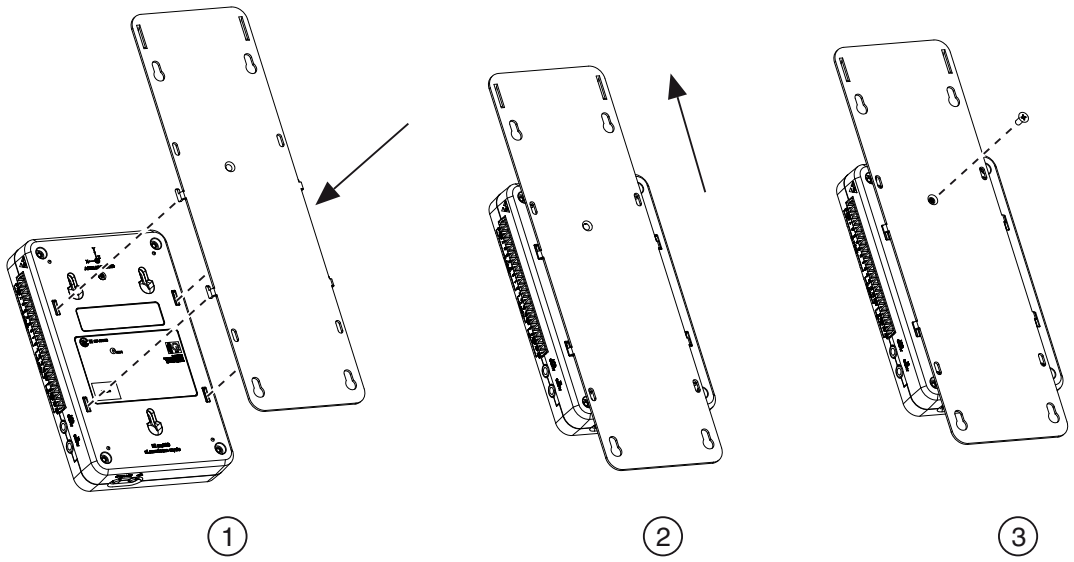


1 Install three Unified #4 or M3 screws in the flat surface using the key hole dimensions of the NI myRIO-1900 as a guide. Refer to Figure 11 for NI myRIO-1900 key hole dimensions. Leave a minimum spacing of 2.8 mm (0.11 in.) between the flat surface and the screw heads.
2 Place the NI myRIO-1900 on the screw heads.
3 Slide the NI myRIO-1900 down to secure the key holes on the screw heads.

Mounting the NI myRIO-1900 Using the Panel Mounting Kit

You can use the Panel Mounting Kit for NI myRIO-1900 to mount the device on a flat surface such as a panel or wall. Install the panel mounting kit on the NI myRIO-1900 as shown in Figure 17.

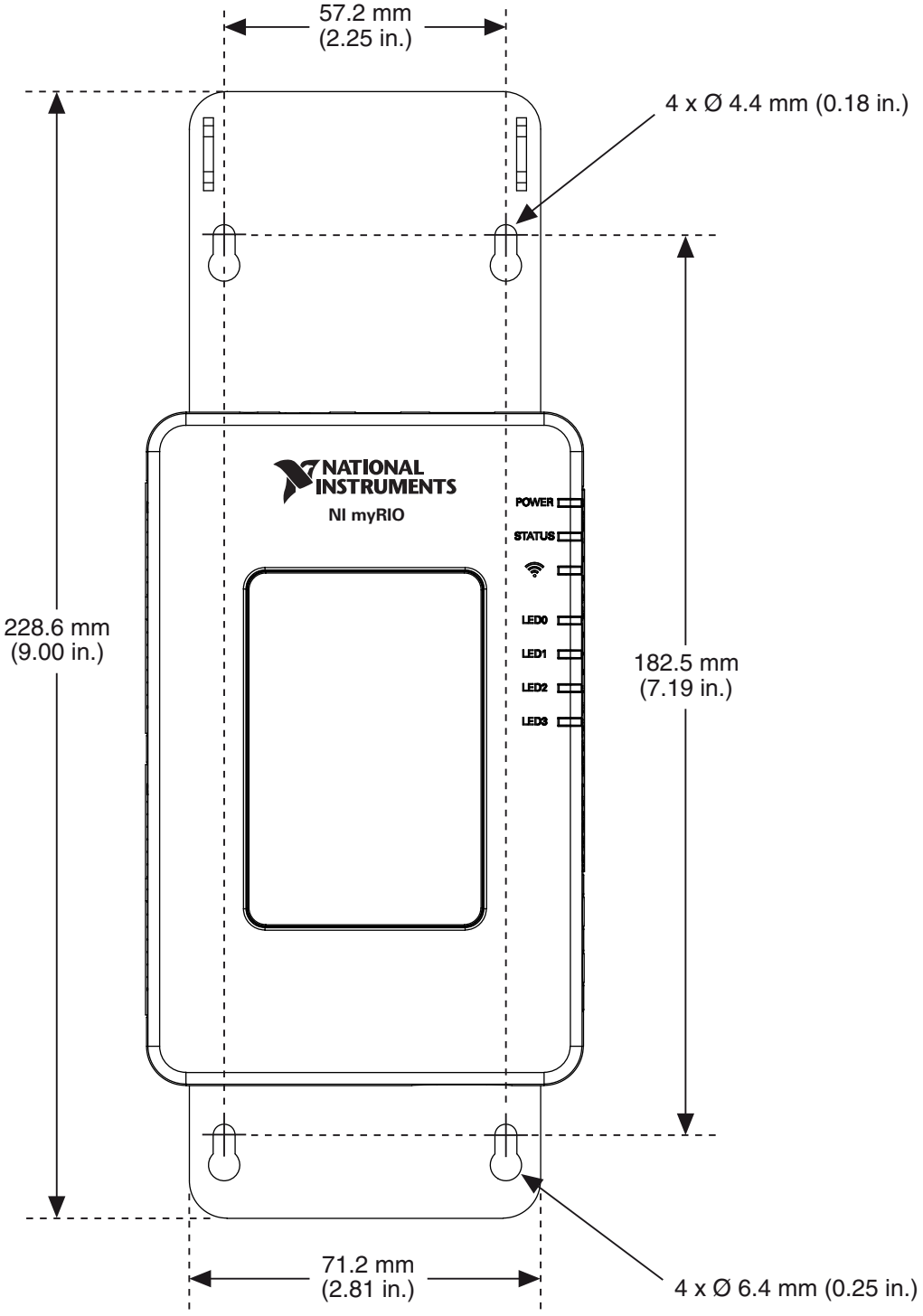
Figure 17. Installing the Panel Mounting Kit on the NI myRIO-1900



1 Place the panel on the back of the NI myRIO-1900
2 Slide the panel up to line up the screw holes on the panel and the NI myRIO-1900.
3 Secure the panel to the NI myRIO-1900. You must use the included 4-40 × 1/4 in. screw to attach the panel mounting kit to the NI myRIO-1900. Tighten the screw to 0.76 N · m (6.7 lb · in.) of torque. Do not exceed 0.87 N · m (7.7 lb · in.) of torque.

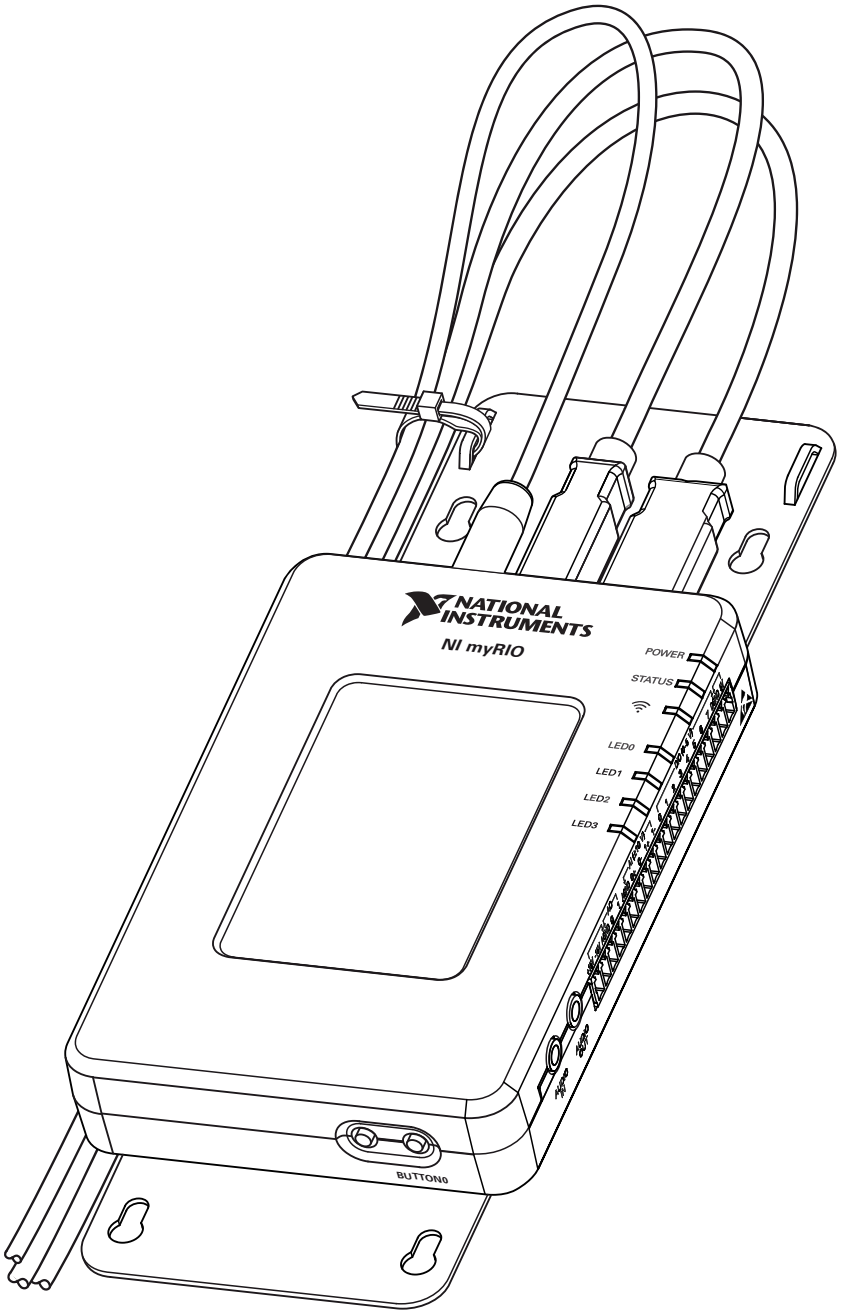
Fasten the panel mounting kit to the panel or wall using screws appropriate for the surface. The following figure shows the dimensions of the NI myRIO-1900 with the panel mounting kit installed.

Figure 18. Dimensions of NI myRIO-1900 with Panel Mounting Kit



Use a cable tie to secure the power and USB cables to the panel mounting kit as shown in Figure 19.

Figure 19. Securing the Power and USB Cables to the Panel Mounting Kit



Cables and Accessories

Table 5. Accessories Available from NI

Accessory	Description	NI Part Number
Power supply	Power supply for NI myRIO-1900	723403-01
MXP breakouts	Set of five MXP breakout boards for NI myRIO-1900	782696-01
MSP connector	MSP replacement connector plug for NI myRIO-1900	765788-01
Panel mounting kit	Panel mounting kit for NI myRIO-1900	783091-01

Specifications

The following specifications are typical for the 0 to 40 °C operating tempreature range unless otherwise noted.

Processor

Processor type ..... Xilinx Z-7010

Processor speed ..... 667 MHz

Processor cores 2

Memory

Nonvolatile memory ..... 512 MB

DDR3 memory ..... 256 MB

- DDR3 clock frequency ..... 533 MHz
- DDR3 data bus width ..... 16 bits

For information about the lifespan of the nonvolatile memory and about best practices for using nonvolatile memory, go to `ni.com/info` and enter the Info Code `SSDBP`.

FPGA

FPGA type ..... Xilinx Z-7010

Wireless Characteristics

Radio mode ..... IEEE 802.11 b,g,n

Frequency band ..... ISM 2.4 GHz

Channel width ..... 20 MHz

Channels ..... USA 1 to 11, International 1 to 13

TX power ..... +10 dBm max (10 mW)

Outdoor range ..... Up to 150 m (line of sight)

Antenna directivity ..... Omnidirectional

Security ..... WPA, WPA2, WPA2-Enterprise

USB Ports

USB host port ..... USB 2.0 Hi-Speed

USB device port ..... USB 2.0 Hi-Speed

Analog Input

Aggregate sample rate ..... 500 kS/s

Resolution ..... 12 bits

Overvoltage protection ..... ±16 V

MXP connectors

- Configuration ..... Four single-ended channels per connector
- Input impedance ..... >500 kΩ acquiring at 500 kS/s
1 MΩ powered on and idle
4.7 kΩ powered off
- Recommended source impedance ..... 3 kΩ or less
- Nominal range ..... 0 V to +5 V
- Absolute accuracy ..... ±50 mV
- Bandwidth ..... >300 kHz

MSP connector

- Configuration ..... Two differential channels
- Input impedance ..... Up to 100 nA leakage powered on;
4.7 kΩ powered off
- Nominal range ..... ±10 V
- Working voltage
(signal + common mode) ..... ±10 V of AGND
- Absolute accuracy ..... ±200 mV
- Bandwidth ..... 20 kHz minimum, >50 kHz typical

Audio input

- Configuration ..... One stereo input consisting of two AC-coupled, single-ended channels
- Input impedance ..... 10 kΩ at DC
- Nominal range ..... ±2.5 V
- Bandwidth ..... 2 Hz to >20 kHz

Analog Output

Aggregate maximum update rates

- All AO channels on MXP connectors ..... 345 kS/s
- All AO channels on MSP connector and audio output channels ..... 345 kS/s

Resolution ..... 12 bits

Overload protection ..... ±16 V

Startup voltage ..... 0 V after FPGA initialization

MXP connectors

- Configuration ..... Two single-ended channels per connector
- Range ..... 0 V to +5 V
- Absolute accuracy ..... 50 mV
- Current drive ..... 3 mA
- Slew rate ..... 0.3 V/µs

MSP connector

- Configuration ..... Two single-ended channels
- Range ..... ±10 V
- Absolute accuracy ..... ±200 mV
- Current drive ..... 2 mA
- Slew rate ..... 2 V/µs

Audio output

- Configuration ..... One stereo output consisting of two AC-coupled, single-ended channels
- Output impedance ..... 100 Ω in series with 22 µF
- Bandwidth ..... 70 Hz to >50 kHz into 32 Ω load; 2 Hz to >50 kHz into high-impedance load

Digital I/O

Number of lines

- MXP connectors ..... 2 ports of 16 DIO lines (one port per connector); one UART.RX and one UART.TX line per connector
- MSP connector ..... 1 port of 8 DIO lines

Direction control ..... Each DIO line individually programmable as input or output

Logic level ..... 5 V compatible LVTTL input; 3.3 V LVTTL output

Input logic levels

Input low voltage, V_{IL} ..... 0 V min; 0.8 V max

Input high voltage, V_{IH} ..... 2.0 V min; 5.25 V max

Output logic levels

Output high voltage, V_{OH}
sourcing 4 mA ..... 2.4 V min; 3.465 V max

Output low voltage, V_{OL}
sinking 4 mA ..... 0 V min; 0.4 V max

Minimum pulse width..... 20 ns

Maximum frequencies for secondary digital functions

SPI ..... 4 MHz

PWM..... 100 kHz

Quadrature encoder input ..... 100 kHz

I^2C..... 400 kHz

UART lines

Maximum baud rate..... 230,400 bps

Data bits..... 5, 6, 7, 8

Stop bits 1, 2

Parity..... Odd, Even, Mark, Space

Flow control..... XON/XOFF

Accelerometer

Number of axes..... 3

Range ..... ±8 g

Resolution..... 12 bits

Sample rate ..... 800 S/s

Noise..... 3.9 mg_{rms} typical at 25 °C

Power Output

+5 V power output

Output voltage ..... 4.75 V to 5.25 V

Maximum current on each connector ..... 100 mA

+3.3 V power output

Output voltage ..... 3.0 V to 3.6 V

Maximum current on each connector ..... 150 mA

+15 power output

Output voltage.....+15 V to +16 V

Maximum current .....32 mA (16 mA during startup)

-15 V power output

Output voltage.....-15 V to -16 V

Maximum current .....32 mA (16 mA during startup)

Maximum combined power from +15 V and -15 V power output .....500 mW

Power Requirements

NI myRIO-1900 requires a power supply connected to the power connector.

Power supply voltage range.....6 to 16 VDC

Maximum power consumption .....14 W

Typical idle power consumption.....2.6 W

Environmental

To meet these specifications, you must operate the NI myRIO-1900 with the window facing away from the mounting surface and ensure that there is at least 1 in. of clearance in front of the window during use.

Ambient temperature near device (IEC 60068-2-1, IEC 600682-2).....0 to 40 °C

Storage temperature (IEC 60068-2-1, IEC 600682-2).....-20 to 70 °C

Operating humidity (IEC 60068-2-56) .....10 to 90% RH, noncondensing

Storage humidity (IEC 60068-2-56) .....10 to 90% RH, noncondensing

Maximum altitude.....2,000 m

Pollution Degree (IEC 60664) 2

Indoor use only.

Physical Characteristics

Weight.....193 g (6.8 oz)

Safety

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.

Caution Using the NI myRIO-1900 in a manner not described in this document may impair the protection the NI myRIO-1900 provides.

Hazardous Locations

The NI myRIO-1900 is not certified for use in hazardous locations.

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 55022 (CISPR 22): Group 1, Class A emissions
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: 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.

CE Compliance CE

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)
- 1999/5/EC; Radio and Telecommunications Terminal Equipment Directive (R&TTE)

Online Product Certification

To obtain product certifications and the Declaration of Conformity (DoC) for this product, visit `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 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

Multifunzione LED a colori wireless 4 in 1

MFC-L3750CDW

STAMPA COPIA SCANSIONE FAX WIRELESS

http://www.brother.it/

Multifunzione LED a colori wireless 4 in 1

Il modello MFC-L3750CDW è ricco di funzionalità e offre stampe a colori alla massima velocità di stampa della categoria (fino a 24 pagine al minuto). Con connettività sia cablata che wireless e la possibilità di stampare direttamente da dispositivi mobile, questo multifunzione può essere utilizzato efficacemente in ambienti professionali. È possibile utilizzare il touchscreen a colori da 9,3 cm per accedere rapidamente e facilmente alle funzionalità preferite.

MFC-L3750CDW

Caratteristiche principali:

- **Elevata velocità di stampa fino a 24 pagine al minuto (ppm)**
- **Elevata capacità carta di 250 fogli**
- **Stampa fronte/retro in automatico**
- **Alimentatore automatico (ADF) da 50 fogli**
- **Intuitivo display touchscreen a colori da 9,3 cm**
- **Connettività cablata e wireless**
- **Consente di stampare da / eseguire scansioni verso una chiavetta USB**
- **Toner in dotazione con capacità fino a 1.000 pagine***

Progettate per ridurre al massimo il livello di rumorosità

All'interno di un ambiente professionale, è indispensabile che nessun rumore possa contribuire a distrarre gli utenti dallo svolgimento del proprio lavoro. Il modello MFC-L3750CDW stampa fino a 24 pagine al minuto a colori a meno di 45 dB, livello di rumorosità classificato come più silenzioso della tipica conversazione quotidiana in ufficio. Queste specifiche all'avanguardia rendono la stampante multifunzione a colori MFC-L3750CDW ideale per l'utilizzo in ufficio.

Progettate per incrementare l'efficienza in ufficio

Questo dispositivo desktop è semplice da usare e da configurare. Grazie ai toner in dotazione ad alta capacità che consentono di stampare immediatamente fino a 1.000 pagine*, la vostra nuova multifunzione è subito pronta per l'uso. Grazie alla stampa fronte/retro in automatico e le opzioni di stampa rapida sia da smartphone che tablet, questo apparecchio vi offre tutta la tranquillità necessaria per gestire la stampa a colori in ufficio.

Aggiungete un po' di colore alla vostra attività

Create documenti di grande impatto con un tocco di colore. Il modello MFC-L3750CDW offre una qualità di stampa fino a 2.400 dpi e utilizza la tecnologia LED per produrre stampe professionali a colori di alta qualità. Il colore non si limita alle stampe, questo apparecchio è dotato di un touchscreen a colori da 9,3 cm per un accesso rapido e semplice alle funzionalità.

Risparmio elevato di tempo e denaro

Questi apparecchi desktop sono veloci, affidabili e di grande valore. La possibilità di gestire una capacità carta fino a 250 fogli consente di stampare più a lungo senza dover rifornire il cassetto carta. Grazie ai consumabili ad alta capacità, non sarà più necessario perdere tempo per sostituire i toner frequentemente, ottenendo inoltre un costo per pagina competitivo sia a colori sia in monocromatico. Maggiore produttività e diminuzione del tempo di inattività, renderanno il vostro ufficio più efficiente.

brother
at your side

* Capacità approssimativa dichiarata in conformità con lo standard ISO/IEC 19798.

Caratteristiche generali

Tecnologia
LED elettrofotografica

Processore
Cortex A9 800 MHz
ARM946 133MHz

Interfaccia di rete cablata
Ethernet 10Base-T/100Base-TX

Interfaccia di rete wireless
IEEE 802.11b/g/n

Pannello di controllo
Display touchscreen da 9,3 cm a colori

Memoria
512 MB

Interfaccia locale
USB 2.0 ad alta velocità

Stampa da dispositivi mobile
Consente di stampare sulla stampante Brother dai dispositivi mobile

Stampa

Velocità di stampa (A4)
Fino a 24 ppm (pagine al minuto) a colori e in monocromatico

Velocità di stampa (A4)
Fino a 8 lati al minuto a colori e in monocromatico
Stampa automaticamente su entrambe le facciate di un foglio

Risoluzione
2.400 dpi (600 x 2400)

Modalità silenziosa
Una modalità che consente di ridurre la rumorosità durante la stampa riducendo la velocità di stampa a 12 ppm

FPOT (Tempo di uscita della prima stampa)
Meno di 14 secondi dalla modalità pronto

Tempo di riscaldamento
Meno di 24 secondi dalla modalità di riposo

Linguaggi di stampa
PCL6, BR-Script3
PDF versione 1.7,
XPS versione 1.0

Font residenti (PCL)
73 font scalabili,
12 font bitmap

Font residenti (Postscript)
66 font scalabili

Codici a barre (PCL)
*Code39, Interleaved 2 di 5, FIM (US-PostNet), Post Net (US-PostNet), EAN-8, EAN-13, UPC-A, UPC-E, Codabar, ISBN (EAN), ISBN (UPC-E), Code128 (set A, set B, set C), EAN128 (set A, set B, set C) Code93 GS1Databar MSI

Funzionalità di stampa

Stampa "N in 1"[3]
Consente di ridurre 2, 4, 9, 16 o 25 pagine A4 in 1 unica pagina A4
(Mac fino a 2, 4, 6, 9 o 16)

Stampa Poster[4]
Pagina A4 ingrandita in formato poster utilizzando 4, 9, 16 o 25 pagine A4

Stampa di filigrane[4]
Inserisce testi predefiniti o messaggi personalizzati nei propri documenti

Stampa ID[4]
Consente di identificare i propri documenti stampati (stampando data e ora, un breve messaggio personalizzato o il nome utente del PC)

Stampa fronte-retro manuale[4]
Stampa fronte-retro manuale (consigliata per supporti di stampa non idonei alla stampa fronte/retro automatica)

Stampa opuscoli[4]
Consente di stampare opuscoli in formato booklet A5 utilizzando la stampa fronte-retro automatica o manuale

Profili di stampa[3]
È possibile salvare le proprie impostazioni di stampa preferite in dei profili facilmente richiamabili

Stampa di testo in nero[4]
Converte in nero tutto il testo dei documenti stampati

Stampa da USB
Stampa direttamente da un'unità flash USB (PDFv1.7, JPEG, TIFF)

Scorciatoie di scelta rapida configurabili
È possibile creare fino a 18 scorciatoie di scelta rapida personalizzate per richiamare in modo semplice e rapido le funzionalità di stampa, copia, scansione e fax utilizzate abitualmente

1 Capacità approssimativa dichiarata in conformità con lo standard ISO/IEC 19798.
2 Calcolato con carta da 80 g/m².
3 Solo Windows® e Mac®.
4 Solo Windows®.
5 Download opzionale.
6 Numero massimo di pagine stampabili al mese, utilizzabile per confrontare il ciclo di vita del dispositivo con quello di prodotti simili.
7 Richiede l'utilizzo del software Brother.
8 Necessaria connessione web.

Driver stampante

Windows®
Windows® 10
(Versione a 32 e 64 bit)
Windows® 8
(Versione a 32 e 64 bit)
Windows® 7
(Versione a 32 e 64 bit)
Windows® Server 2016
(Versione a 32 e 64 bit)*
Windows® Server 2012,
2012R2 e 2008R2*
Windows® Server 2008
(Versione a 32 e 64 bit)*

Macintosh[5]
macOS v10.11.6, 10.12.x,
10.13.x

Linux[5]
CUPS, LPD/LPRng
(Versione a 32 e 64 bit)

Driver di stampa universale PostScript[5]
Driver per Windows® che consente di stampare su qualsiasi stampante laser Brother connessa in rete o in locale con supporto Postscript

Driver PCL[5]
Driver PCL XL generico

* Windows® Server supporta solo la stampa in rete

Gestione carta

Carta in ingresso
Cassetto standard: 250 fogli
Alimentatore automatico (ADF): 50 fogli
Slot inserimento manuale: 1 foglio

Uscita carta
150 fogli faccia in giù (80 g/m^2)
1 foglio faccia in su (percorso carta lineare)

Tipi e grammatura carta - Cassetto standard
Carta normale e carta riciclata (60 - 163 g/m^2)

Formati carta Cassetto standard
A4, Lettera, A5, A5 (lato lungo), A6, Executive

Tipi di carta e peso ADF
Carta normale e carta riciclata (60 - 105 g/m^2)

Formati carta ADF
Larghezza da 105 a 218 mm,
Lunghezza da 148 a 357,6 mm

Tipi e grammatura carta -Slot di inserimento manuale
Carta normale, carta riciclata, carta fine, etichette, buste (60 - 163 g/m^2)

Formati carta - Slot di inserimento manuale
Larghezza da 76,2 a 216 mm,
Lunghezza da 116 a 355,6 mm
Buste; COM-10, DL, C5, Monarch

Stampa buste/etichette Sì, dallo slot di inserimento manuale: 1 busta/foglio

Connettività con dispositivi mobile e Web

App Brother iPrint&Scan (Android)
Consente di effettuare stampe da/scansioni verso un dispositivo Android, con possibilità di invio fax, anteprima dei fax e anteprima delle copie e verifica dello stato dell'apparecchio

App Brother iPrint&Scan (iPad / iPhone / iPod)
Consente di effettuare stampe da/scansioni verso un dispositivo iPad / iPhone / iPod Touch, con possibilità di invio fax, anteprima dei fax e anteprima delle copie e verifica dello stato dell'apparecchio

App Brother iPrint&Scan (Windows® Phone)
Consente di effettuare stampe da/scansioni verso smartphone con sistema operativo Windows® Phone

Brother Print&Scan (Windows® 8,10 & RT)
Consente di effettuare stampe da / scansioni verso tablet con sistema operativo Windows® 8,10 o Windows RT

Google Cloud Print 2.0
Consente di stampare i più diffusi tipi di file da qualsiasi applicazione con funzionalità Google Cloud Print

Apple AirPrint
Consente di stampare e scansionare i più diffusi tipi di file da qualsiasi applicazione con supporto di AirPrint

Plug-in servizi di stampa Brother
Consente di stampare da dispositivi Android senza un'app dedicata

Mopria
Consente di stampare i più diffusi tipi di file da dispositivi Android con supporto di Mopria

App Brother[8]
Print creative center, scansione verso dispositivi mobili, scansione con creazione di PDF ricercabili, ingrandimento del testo copiato, inoltro fax su cloud/e-mail, scansione verso PowerPoint, scansione verso Excel, scansione verso Word, scansione semplificata verso e-mail

Connettività web[8]
Consente di effettuare, senza utilizzare un PC, la stampa da/la scansione verso i servizi Box, Dropbox, Evernote, OneDrive, Google Drive™ OneNote

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Copia

Velocità di stampa (A4)
Fino a 24 cpm (copie al minuto) a colori e in monocromatico

FCOT (Tempo di uscita della prima copia)
Meno di 15 secondi dalla modalità pronto a colori e in monocromatico

Risoluzione
Fino a 600 x 600 dpi

Multicopia/Impilamento/ Fascicolazione
Impila o fascicola fino a 99 copie di ogni pagina

Percentuale di ingrandimento/riduzione
Riduce e ingrandisce dal 25% al 400% con incrementi dell'1%

Copia N in 1
Consente di adattare 2 o 4 pagine in un singolo foglio A4

Copia ID 2 in 1
Consente di copiare entrambe le facciate di un documento d'identità in un singolo foglio A4

Scala di grigi
256 tonalità di grigio (8 bit)

Copia di ricevute
Consente di ottenere copie più chiare delle ricevute

Ingrandimento del testo copiato[8]
Rende più facile la lettura dei documenti copiati se il testo presente sul documento originale è di piccole dimensioni

Scansione

Tipo di scanner
CIS (Contact Image Sensor)

Scansione a colori e in monocromatico
Sì

Velocità scansione in monocromatico
27 ipm (immagini al minuto)

Velocità scansione a colori
21 ipm (immagini al minuto)

Risoluzione di scansione da piano fisso
Fino a 1.200 x 2.400 dpi

Risoluzione di scansione interpolata
Fino a 19.200 x 19.200 dpi

Risoluzione di scansione da ADF
Fino a 600 x 600 dpi

Profondità del colore
Elaborazione colori a 48 bit (Input) Elaborazione colori a 24 bit (Output)

Scala di grigi
Elaborazione colori a 16 bit (Input) Elaborazione colori a 8 bit (Output)

Funzionalità di scansione

Scan to E-mail
Consente di effettuare la scansione e la condivisione dei documenti tramite server e-mail

Scan to OCR
È possibile eseguire la scansione diretta dei documenti all'interno dell'applicazione di word processing utilizzata per effettuare modifiche immediate

Scan to Image
È possibile eseguire la scansione diretta dei documenti all'interno del software di elaborazione immagini preferito

Scan to File
È possibile eseguire la scansione diretta dei documenti verso un file del computer in uso

Scansione verso USB
Consente di effettuare la scansione dei documenti direttamente verso unità di memoria flash USB

Scansione verso una cartella di rete Consente di effettuare la scansione dei documenti su una cartella specificata nella rete in uso senza utilizzare un PC con sistema operativo Windows

Scan to FTP
Consente di effettuare la scansione dei documenti inviandoli direttamente a un server FTP

Profili di scansione[3]
È possibile creare fino a 25 profili predefiniti di rete o FTP per memorizzare facilmente varie impostazioni di scansione

Scan to SharePoint[4&7] Scansione documenti direttamente in SharePoint

Scansione verso PDF ricercabile
Scansione documenti con creazione di file PDF ricercabili

Allineamento automatico
Sì

Rimozione colore base
Sì

Scansione ID
Sì

Scansione 1 in 2
Sì

Driver scanner

Windows®
TWAIN e WIA
Windows® 10
(Versione a 32 e 64 bit)
Windows® 8
(Versione a 32 e 64 bit)
Windows® 7
(Versione a 32 e 64 bit)

Macintosh[5]
TWAIN
macOS v10.11.6, 10.12.x, 10.13.x

Linux[5]
SANE (versione a 32 e 64 bit)

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Fax

Modem fax
33.600 bps (Super G3)

PC Fax - Invio[3&8] e Ricezione[4&8]
Invio e ricezione dei fax direttamente dal PC in uso

Ricezione fax fronte-retro
Sì

Memoria pagine
Fino a 500 pagine (ITU-T Test Chart, risoluzione standard, JBIG)

Ricezione con carta esaurita Fino a 500 pagine (ITU-T Test Chart, risoluzione standard, JBIG)

ECM (Metodo di correzione errore)
Quando entrambi gli apparecchi supportano il sistema ECM è possibile rilevare errori durante la trasmissione del fax e in questo caso le pagine del documento per le quali si è verificato l'errore vengono nuovamente inviate

Riduzione automatica
Quando si riceve un solo documento di una singola pagina lunga più di 297 mm (A4), il fax riduce automaticamente il messaggio in modo da adattarlo a un singolo foglio formato A4

Broadcasting
Invia il medesimo messaggio fax fino a 250 utenti differenti

Scala di grigi
256 tonalità (8 bit) di grigio disponibili per i fax

Strumenti di gestione periferiche di stampa

Programma di installazione automatica[4]
Possibilità di distribuire in modo centralizzato e personalizzare i nostri driver e software

Programma di installazione MSI[4]
Programmi di installazione modulari che possono essere distribuiti tramite Active Directory®

BRAdmin Light[4&5]
Software di gestione stampanti su rete LAN/WAN

Server web integrato
Software di gestione basato sulla pagina web integrata del dispositivo

Procedura guidata per l'installazione dei driver[4 &5]
Consente di distribuire e installare facilmente e rapidamente driver di stampa in rete

Software

Brother iPrint&Scan (Windows e Mac)[5]
Consente di effettuare stampe da / scansioni verso un PC con sistema operativo Windows o macOS, con possibilità di invio fax, anteprima dei fax e anteprima delle copie e verifica dello stato dell'apparecchio

Nuance® PaperPort 14 SE[5]
Programma per la gestione e la condivisione dei documenti

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2 Calcolato con carta da 80 g/m².
3 Solo Windows® e Mac® .
4 Solo Windows®.
5 Download opzionale.
6 Numero massimo di pagine stampabili al mese, utilizzabile per confrontare il ciclo di vita del dispositivo con quello di prodotti simili.
7 Richiede l'utilizzo del software Brother.
8 Necessaria connessione web.

Rete e sicurezza

Interfaccia di rete cablata
Ethernet 10Base-T/100Base-TX

Sicurezza di rete cablata
APOP, POP prima di SMTP, SMTP-AUTH, SSL/TLS (IPPS, HTTPS, SMTP, POP), SNMP v3 802.1x (EAP-MD5, EAP-FAST, PEAP, EAP-TLS, EAP-TTLS), Kerberos

Rete wireless
IEEE 802.11b/g/n (Modalità infrastructure)
IEEE 802.11g/n (Wi-Fi Direct)

Sicurezza rete wireless
WEP 64/128 bit, WPA-PSK (TKIP/AES), WPA2-PSK (AES)
*Wi-Fi Direct supporta solo WPA2-PSK (AES), APOP, POP prima di SMTP, SMTP-AUTH, SSL/TLS (IPPS, HTTPS, SMTP, POP), SNMP v3 802.1x (LEAP, EAP-FAST, PEAP, EAP-TLS, EAP-TTLS), Kerberos

Supporto configurazione della connettività wireless
Wi-Fi Protected Setup (WPS)

Applicazioni wireless
Vertical Pairing

Wi-Fi Direct™
Stampa in modalità wireless senza la necessità di accedere ad un access point wireless (sia in automatico sia manualmente)

IPv4
ARP, RARP, BOOTP, DHCP, APIPA (Auto IP), risoluzione nomi WINS/NetBIOS, DNS Resolver, mDNS, risponditore LLMNR, LPR/LPD, Custom Raw Port/Port 9100, client SMTP, IPP/IPPS, client e server FTP, client CIFS, server TELNET, SNMP v1/v2c/v3, server HTTP/HTTPS, client e server TFTP, ICMP, servizi Web (stampa/scansione), client SNTP

IPv6
NDP, RA, DNS resolver, mDNS, risponditore LLMNR, LPR/LPD, Custom Raw Port/Port9100, IPP/IPPS, client SMTP, server e client FTP, Client CIFS, server TELNET, SNMPv1/v2c/v3, server HTTP/HTTPS, client e server TFTP, ICMPv6, client SNTP, servizi web (stampa/scansione)

Filtro IP
Limitazione dell'accesso al dispositivo in rete per specifici utenti (solo IPv4)

Stampa sicura
Protegge i processi di stampa con un codice di sblocco a 4 cifre che deve essere inserito nell'apparecchio per effettuare la stampa

Funzione Lock
Limitazione di accesso al pannello di controllo dei dispositivi tramite blocco

Secure Function Lock 3.0
Consente di limitare l'accesso di singoli utenti o gruppi di utenti in una rete. Può essere utilizzata con l'identificativo di login dell'utente PC (fino a 100 utenti)

Notifiche via e-mail
Consente l'invio automatico di avvisi tramite e-mail dal dispositivo quando è richiesta attenzione, per esempio quando il toner è insufficiente o è necessario sostituirlo

Report via e-mail
È possibile ricevere regolarmente via e-mail report relativi all'utilizzo

Consumabili e accessori

Toner in dotazione
1000 pagine C/M/Y/BK

Toner a capacità standard
1000 pagine C/M/Y/BK (TN-243)

Toner ad alta capacità
3.000 pagine BK
2.300 pagine C/M/Y (TN-247)

Unità tamburo (DR-243CL)
18.000 pagine
(1 pagina/lavoro)

Unità cinghia (BU-223CL)
Circa 50.000 pagine
(2 pagine/lavoro)

Vaschetta recupero toner (WT-223CL)
Circa 50.000 pagine
(5 pagine/lavoro)

Dimensioni e peso

Senza imballo (L x P x A)
410 x 475 x 414 mm / 23,4 kg

Con imballo (L x P x A)
589 x 523 x 568 mm / 27,6 kg

Volumi di stampa

Volume di stampa mensile consigliato
Da 300 a 1.500 pagine al mese

Volume mensile massimo[6]
Fino a 30.000 pagine stampate al mese

Consumi e rumorosità

Consumo energetico
In fase di stampa: 430 W
In modalità pronto: 75 W
In modalità silenziosa: 260 W
In modalità di riposo: 10,1 W
In modalità di riposo Deep Sleep: 1,2 W
In modalità Off: 0,04 W

Valore TEC
1,3 kWh/settimana

Livello di pressione acustica
In fase di stampa: 47 dB(A)
In modalità pronto: 33 dB(A)
In modalità silenziosa: 43 dB(A)

Potenza acustica
In fase di stampa: 6,11 B(A) in monocromatico / 6,16 B(A) a colori
In modalità pronto: 4,67 B(A)
In modalità silenziosa: 5,71 B(A) in monocromatico / 5,73 B(A) a colori In modalità di riposo Deep Sleep: impercettibile

Risparmio energetico
Consente un consumo ridotto quando la stampante non è in uso

Risparmio toner
Riduce i consumi di toner e contribuisce a diminuire i costi totali di gestione della stampante

Energy Star
Sì

Blue Angel
Sì

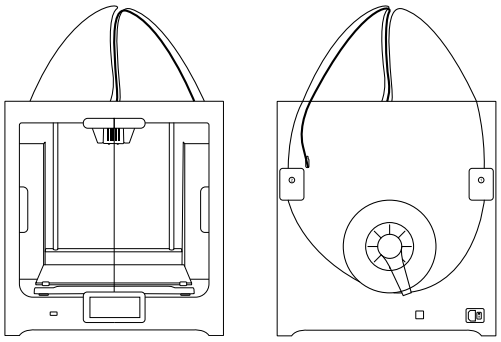
Nordic Swan
Sì

Certificazione GS mark
Sì

Eco Mode
Sì

Ultimaker S5

Specification sheet



The Ultimaker S5 is built to run continuously and maximize uptime. It not only delivers best-in-class technical specifications for a desktop 3D printer, but gives you the performance and peace of mind that comes with using the complete 3D printing solution – one trusted by hundreds of thousands of professionals worldwide.

Reliable dual extrusion on a bigger scale
Print large, intricate designs with new confidence, using the Ultimaker S5's reliable dual extrusion technology and enhanced active leveling. Our wide range of engineering and support materials provide complete design freedom – with minimal post-processing.

Open and connected system
The Ultimaker S5's connectivity means connecting multiple printers together over Wi-Fi is easy, while NFC technology automatically recognizes the loaded material. An open system enables the use third-party materials and the seamless integration of Ultimaker Cura with your existing software.

Market-leading software
Trusted by over 2 million users, Ultimaker Cura software prepares your 3D model for printing. Free to download, it features the optimal preconfigured settings for Ultimaker printers and materials, so that you get the best results instantly.

Optimized materials for high-end applications
Ultimaker S5 leverages our full material portfolio. These materials are formulated and tested by our engineers to create industrial-grade prints. And with print core CC Red, you can also print using the world's most advanced composite filaments.

Here to help you succeed
The Ultimaker S5 comes with a one-year warranty and lifetime support from our trained and certified global network of partners. And if you have a question, our online resources and community are there for you 24/7.

Version 1.03

Ultimaker

Ultimaker S5 specifications

Printer and printing properties	Technology	Fused filament fabrication (FFF)
	Print head	Dual extrusion print head with a unique auto-nozzle lifting system and swappable print cores
	Build volume	XYZ: 330 x 240 x 300 mm (left or right nozzle, or dual extrusion)
	Filament diameter	2.85 mm
	Layer resolution	0.25 mm nozzle: 150 - 60 micron 0.4 mm nozzle: 200 - 20 micron 0.6 mm nozzle: 300 - 20 micron 0.8 mm nozzle: 600 - 20 micron
	XYZ resolution	6.9, 6.9, 2.5 micron
	Build speed	< 24 mm^3/s
	Build plate	Heated glass build plate
	Build plate temperature	20 - 140 °C
	Build plate leveling	Active leveling
	Build plate heat up time	< 4 min (from 20 to 60 °C)
	Supported materials	Optimized for PLA, Tough PLA, ABS, Nylon, CPE, CPE+, PC, PP, TPU 95A, PVA, Breakaway (Also supports third-party materials) In the box: Ultimaker Tough PLA Black 750 g, Ultimaker PVA 750 g
	Feeder type	Dual-geared, abrasion-resistant (ready for composite materials)
	Nozzle diameter	0.25 mm, 0.4 mm, 0.6 mm, 0.8 mm
	Nozzle temperature	180 - 280 °C
	Nozzle heat up time	< 2 min
	Operating sound	< 50 dBA
	Maximum power output	500 W
	Material recognition	Auto-recognition with NFC scanner
	Connectivity	Wi-Fi, LAN, USB port
	Display	4.7-inch (11.9 cm) color touchscreen
	Language support	English, Dutch, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, Simplified Chinese
	Monitoring	Live camera (view from desktop or Ultimaker app)
Physical dimensions	Dimensions	495 x 457 x 520 mm 495 x 585 x 780 mm (with Bowden tubes and spool holder)
	Net weight	20.6 kg
	Shipping weight	29 kg
	Shipping box dimensions	650 x 600 x 700 mm
Ambient conditions	Operating ambient temperature	15 - 32 °C, 10 - 90% RH non-condensing
	Non-operating temperature	0 - 32 °C
Software	Supplied software	Ultimaker Cura, our free print preparation software Cura Connect, our free printer management solution
	Supported OS	MacOS, Windows, and Linux
	Plugin integration	SolidWorks, Siemens NX, Autodesk Inventor
	File types	Ultimaker Cura: STL, OBJ, X3D, 3MF, BMP, GIF, JPG, PNG Printable formats: G, GCODE, GCODE.gz, UFP
Warranty and service	Warranty period	12 months
	Technical support	Lifetime support from Ultimaker's global network of certified service partners

italtec
Technical Training Systems

Company with Quality Management System
Certified by DNV = ISO 9001/2008 =

SISTEMA INTEGRATO PER ACQUISIZIONE 3D

EPSON EB-695Wi interattivo con Finger Touch e penna

Soluzione innovativa per l'insegnamento con penna interattiva e ampio schermo scalabile fino a 100 pollici, progettata per migliorare l'apprendimento collaborativo. L'ottica ultra-corta, insieme alla resa luminosa di 3.500 lumen e alla risoluzione WXGA HD Ready consentono a EB-695Wi di proiettare immagini di grandi dimensioni da una distanza ravvicinata, riducendo al minimo le ombre e i riflessi. Questo videoproiettore offre la massima interattività coniugando la funzione Finger Touch con due penne interattive. Grazie a un rapporto di contrasto di 14.000: 1 e all'ingresso HDMI, le immagini proiettate risulteranno nitide e ben definite agli occhi degli studenti.

CE

Interazione e miglioramento dell'apprendimento

Il software Multi PC Projection consente agli insegnanti e agli studenti di condividere contemporaneamente i contenuti. Il controllo rimane tuttavia nelle mani degli insegnanti, che possono scegliere quali contenuti visualizzare grazie alla funzione Moderatore. È possibile utilizzare due videoproiettori per creare un ampio schermo interattivo. La funzionalità Split Screen consente agli insegnanti di visualizzare due tipi di contenuti contemporaneamente, ad esempio il programma delle lezioni da un PC e un'immagine fissa o un videoclip da una document camera.

Elevata luminosità e qualità delle immagini

La tecnologia Epson 3LCD assicura immagini di alta qualità con una resa luminosa dei colori pari a quella del bianco, per proiezioni vivaci e brillanti anche in pieno giorno e colori tre volte più luminosi rispetto ai principali videoproiettori della concorrenza1. Con uno schermo di dimensioni scalabili fino a 100 pollici, è possibile visualizzare due tipi di contenuti tramite la funzione Split Screen senza compromettere la qualità.

Finger Touch e due penne interattive

Con il semplice tocco delle dita è possibile scrivere note direttamente sullo schermo. In alternativa, è possibile utilizzare le penne interattive Epson, ora ancora più facili da usare e con tempi di risposta rapidissimi. Con le due nuove penne, un insegnante e uno studente oppure due studenti possono lavorare contemporaneamente sull'immagine aggiungendo contenuti diversi.

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Rev 07/05/2019

SISTEMA INTEGRATO PER ACQUISIZIONE 3D

SPECIFICHE PRODOTTO

- Tecnologia: 3 LCD da 0,59 pollici con D9
- Luminosità: 3.500 lumen- 2.900 lumen (in modalità Risparmio energetico)
- Risoluzione: WXGA, 1280 x 800, 16:10 HD Ready
- Aspetto nativo: 16:10
- Rapporto di contrasto: 14.000:1
- Tipo Lampada: 250 W, 5.000 h Durata, 10.000 h Durata (in modalità Risparmio energetico), 9.000 h Durata (in modalità Risparmio energetico)
- Correzione trapezioidale: Manuale verticale: ± 3 °, Manuale orizzontale ± 3 °
- Elaborazione video: 10 bit
- Riproduzione colori: Fino a 1,07 Miliardi di colori

OTTICA

- Rapporto di proiezione: 0,28:1
- Zoom: Digitale con fattore 1 - 1,35
- Lenti: Ottico
- Dimensioni immagine: 60’ – 100’
- Distanza focale: 3,76mm
- Messa a fuoco: Manuale
- Offset: 6:1

CARATTERISTICHE GENERALI

- Consumo energetico: 56 Watt, 312 Watt (in modalità Risparmio energetico), 0,39 Watt (in standby)
- Dimensioni: 367 x 400 x 149 mm (LxPxA)
- Peso: 5,8 kg
- Livello di rumore: Mod. Normale: 35 dB (A) - Mod. Economy: 28 dB (A)
- Altoparlante: 16 Watt

CONNETTIVITA'

Funzione USB Display 3-in-1: Video / Telecomando / Audio

Connessioni: USB 2.0 tipo A, USB 2.0 tipo B, RS-232C, interfaccia Ethernet (100Base-TX / 10Base-T), LAN wireless IEEE 802.11b/g/n (opzionale), Ingresso VGA (2x), Uscita VGA, Ingresso HDMI (3x), Ingresso Composite, Ingresso RGB (2x), Uscita RGB, MHL, Uscita audio mini jack stereo, Ingresso audio mini jack stereo (3x), ingresso microfono, Sync. In, Sync. Out

FUNZIONALITA' AVANZATE

Sicurezza: Kensington Lock, Protezione tramite password, Padlock, Foro cavo di sicurezza, Blocco unità LAN wireless, Sicurezza LAN wireless

Interattività Sì - Penna e Finger Touch

Modalità colore Lavagna scura, Dinamico, Presentazione, Sport, sRGB, Teatro, Lavagna chiara

Contenuto della confezione

Manuale su CD, Unità Finger Touch, Penne interattive, Vassoio porta penna, Cavo di alimentazione, Guida rapida, Telecomando incl. batterie, SMART Notebook software entitlement booklet, Cavo USB, Manuale utente (CD-ROM), Supporto per montaggio a parete, Warranty card

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SISTEMA DI POSIZIONAMENTO GPS

IT.GPS/EDU stazione GPS

Sistema professionale utilizzabile nella didattica per il training sul posizionamento satellitare, utilizza un posizionamento di tipo differenziale attraverso i segnali elaborati da 2 ricevitori ed un software di elaborazione in grado di estrapolare con precisione la posizione del punto di riferimento. Connettività modulare e possibilità di trasferimento dati secondo le esigenze dell'allievo

IT.GPS/INT4 workstation (interfaccia GPS 4 postazioni)

Workstation integrata attraverso sistema di elaborazione dati e periferiche interconnesse in grado di gestire simultaneamente fino a 4 utenze per analisi dati GPS, acquisizione, elaborazione, immagazzinamento dati e visualizzazione.

Introduzione

Il sistema di posizionamento GNSS (Global Navigation Satellite System) è un sistema di navigazione basato sulla ricezione di segnali radio emessi da una costellazione di satelliti artificiali in orbita attorno alla Terra. Inizialmente sviluppato come sistema ad uso militare, è stato rapidamente reso disponibile agli utenti civili.

Al 2015 il GPS (Global Positioning System), sviluppato e mantenuto dal Dipartimento di Difesa degli Stati Uniti, è il sistema GNSS maggiormente diffuso e pienamente operativo. Si ricorda che le costellazioni di satelliti in orbita sono, oltre al sistema statunitense GPS, anche quella russa GLONASS, europea GALILEO e cinese COMPASS/BEIDOU. Il rapido sviluppo dell'industria della navigazione satellitare è sorta intorno al sistema GPS; per questa ragione il termine "GPS" e "Navigazione Satellitare" sono spesso usati come sinonimi.

I ricevitori per la navigazione satellitare sono utilizzati per svariate applicazioni come il posizionamento, la navigazione ed il monitoraggio.

Utilizzare il sistema di posizionamento GPS consente la determinazione dei seguenti valori:

- stima della coordinata (latitudine, longitudine, altezza ellissoidica) con accuratezze da 20 metri ad 1 millimetro;
- ora esatta (Universal Time Coordinate, UTC) da 60 ns a circa 5 ns.

Struttura del sistema GPS

Il sistema GPS, come qualsiasi altro sistema GNSS, è costituito da 3 segmenti:

- segmento spaziale: la costellazione satellitare;
- segmento di controllo: le stazioni a terra che gestiscono il sistema;
- segmento di utilizzo: utenti del sistema.

Segmento spaziale

Il segmento spaziale del sistema GPS consiste attualmente in 31 satelliti orbitanti attorno alla Terra in 6 differenti piani orbitali. Le orbite sono ad una altezza di circa 20180 km dalla superficie della Terra e sono inclinate di 55° rispetto l'equatore. Ogni satellite completa la sua orbita in circa 12 ore siderali.

È grazie a questo schema di distribuzione e alle alte altitudini delle orbite che la comunicazione con almeno 4 satelliti è assicurata a tutte le ore in qualsiasi parte del mondo.

L'elevazione di un satellite rispetto ad un ricevitore è definita come l'angolo fra il piano orizzontale nel punto del ricevitore e la direzione del satellite; eccettuate applicazioni particolari, si utilizzano solo segnali provenienti da satelliti con elevazione superiore a 10°, al di sotto della quale vi è un significativo effetto dei disturbi atmosferici. Tipicamente ciascun satellite rimane sopra i 10° di elevazione per 1-6 ore.

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Le funzioni principali dei satelliti sono sintetizzabili in:
• trasmettere un segnale complesso agli utilizzatori mediante trasmissione su almeno 2 frequenze;
• mantenere un riferimento di tempo accurato;
• ricevere e memorizzare informazioni dal segmento di controllo.

Figura 1 - Elevazione dei satelliti in 24 ore.

Segmento di controllo

Il segmento di controllo del sistema GPS è costituito da:
• una Master Control Station (MCS);
• una Alternate Master Control Station;
• quattro antenne di Terra dedicate;
• una serie di stazioni di controllo, sparse su tutto il globo.

Le stazioni di controllo tracciano passivamente i satelliti in vista accumulando dati di pseudo-distanza. Questi sono elaborati dalla MCS per determinare le orbite dei satelliti ed aggiornare i messaggi navigazionali; la MCS inoltre svolge diverse altre attività come aggiustare le orbite dei satelliti se necessario o controllare gli orologi dei satelliti. Le informazioni aggiornate sono trasmesse ai satelliti dalle antenne a Terra.

Segmento dell'utenza

È costituito da tutte le categorie di fruitori dei servizi: queste sono eterogenee sia per tipo di applicazione, dalla navigazione al controllo di deformazioni, sia per requisiti di sistema, dal tempo reale al post-processamento, sia per richieste di accuratezza che vanno dall'ordine metrico fino a quello centimetrico.

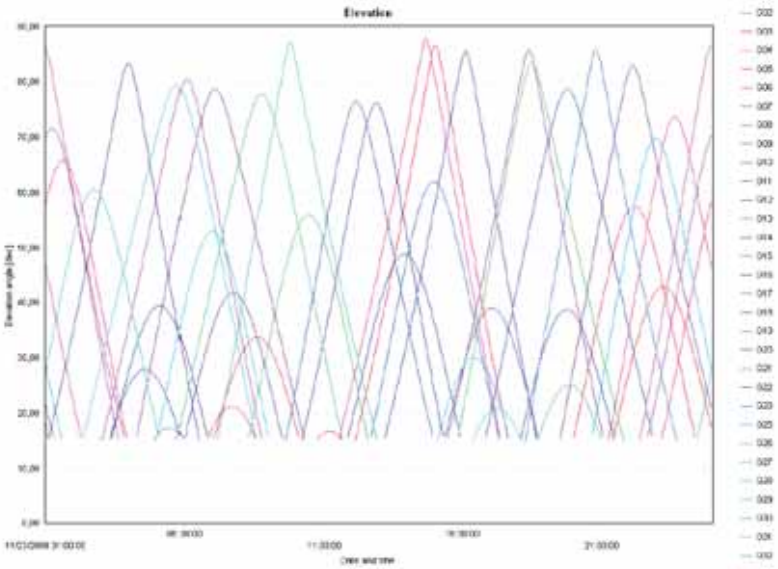

Figura 1 - Elevazione dei satelliti in 24 ore.

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SISTEMA DI POSIZIONAMENTO GPS

Struttura del segnale GPS
Gli orologi dei satelliti producono una frequenza fondamentale in banda L pari a 10.23 MHz: da questa frequenza si originano tre parti fondamentali del segnale.

Componente portante
Costituita da due onde sinusoidali L1 e L2 le cui corrispondenti lunghezze d'onda sono circa 19 e 24 centimetri circa. La disponibilità delle due onde portanti permette tra le altre cose anche la correzione della maggior sorgente di errore che affligge le misure GPS, ovvero il ritardo ionosferico.
Componente impulsiva
La misura della distanza ricevitore-satellite è misurata a partire da codici che modulano le portanti secondo un algoritmo che si ripete periodicamente nel tempo (PRN – Pseudo-Random Number).
I satelliti GPS tradizionali trasmettono due codici conosciuti come Coarse/Acquisition (codice C/A) e Precision (codice P). Il codice C/A modula solo la portante L1, mentre il codice P modula entrambe le portanti L1 e L2.
Ad ogni satellite è assegnato un codice C/A che consente ai ricevitori GPS di identificare quale satellite sta trasmettendo il segnale che in quell'istante sta tracciando il ricevitore.
Componente messaggio
Il messaggio navigazionale D è un flusso dati che viene aggiunto ai codici C/A e P, e modulato sulle portanti L1 e L2. Il messaggio navigazionale contiene le coordinate dei satelliti GPS in funzione del tempo (effemeridi broadcast), i parametri di correzioni dell'orologio del satellite, lo stato di
salute dei satelliti, i dati orbitali approssimati per tutti i satelliti (almanacco) e altro.

Principi di Posizionamento
Il posizionamento GPS può essere eseguito in varie modalità, in particolare:
• posizionamento assoluto: coordinate determinate in un sistema di riferimento globale.
• posizionamento relativo: vengono determinate le componenti del vettore baseline che unisce due vertici.
• posizionamento differenziale: simile al posizionamento assoluto ma eseguito correggendo le distanze satellite-ricevitore con una correzione differenziale calcolata da una stazione "base".

Il problema del posizionamento è la determinazione della distanza tra il ricevitore a terra e i satelliti GPS: conoscendo la distanza e le posizioni (effemeridi) di almeno 4 satelliti si può determinare la posizione del rover.
Due possono essere le modalità di misura:
• misure di codice sulla componente impulsiva del segnale.
• misure di fase sulla portante del segnale.

Il primo tipo di misura è utilizzato nel posizionamento in tempo reale DGPS per utenti con palmari GIS che cercano una precisione sub metrica. Il secondo tipo di misura è anch'esso utilizzato nel posizionamento in tempo reale e prende il nome di RTK (Real Time Kinematic); questo tipo di posizionamento arriva a precisioni centimetriche

Posizionamento assoluto con misure di codice
Nel posizionamento satellitare, per ottenere la stima delle coordinate (latitudine, longitudine, altezza ellissoidica) è fondamentale, come detto prima, conoscere la distanza ricevitore-satellite (range).

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La procedura per la determinazione del range può essere così sintetizzata. Assumendo che gli orologi a bordo di satellite e ricevitore siano sincronizzati perfettamente, quando il codice PRN è generato e trasmesso dal satellite il ricevitore genera una replica esatta del codice; dopo un breve intervallo di tempo, equivalente al tempo di volo del segnale nello spazio, il codice trasmesso arriva al ricevitore. Comparando il codice trasmesso e la sua replica, il ricevitore può calcolare il tempo di volo che, moltiplicato per la velocità della luce, fornisce la distanza satellite-ricevitore. La distanza misurata in questo modo non è che una "pseudodistanza", poiché esiste un asincronismo tra l'orologio del ricevitore e quello della costellazione, idealmente sincrona.

$PSR=\Delta tmisurata \cdot c=(\Delta t+\Delta t0)\cdot c$

$PSR=R+\Delta t0c$

La distanza R in un sistema cartesiano può essere espressa come:

$R=\sqrt{}(Xsat-Xrover)2+(Ysat-Yrover)2+(Zsat-Zrover)2$

che sostituita nell'equazione precedente fornisce:

$PSR=\sqrt{}(Xsat-Xrover)2+(Ysat-Yrover)2+(Zsat-Zrover)2+\Delta t0c$

L'equazione ha quatto incognite; servono perciò per la soluzione istantanea della posizione il tracciamento di almeno quattro satelliti.

Per la risoluzione dell'equazione precedente è necessario il tracciamento simultaneo di almeno 4 satelliti.

Posizionamento assoluto con misure di fase

La distanza ricevitore-satellite può anche essere ottenuta con misure di fase sulle portanti L1 e L2. La distanza sarà la somma del numero intero di cicli della portante più la frazione di ciclo non intero al livello del ricevitore e del satellite, moltiplicato per la lunghezza d'onda. La distanza determinata con misure di fase è più accurata che quella ottenuta con i codici poiché la lunghezza d'onda (o risoluzione) dell'onda sinusoidale, 19 centimetri nel caso della frequenza L1, è molto inferiore a quella dei codici.

La misura di fase aggiunge tuttavia un'incognita. Infatti all'accensione del ricevitore non si può determinare il numero totale di cicli tra il satellite e il ricevitore (ambiguità di fase). La determinazione dell'ambiguità di fase può essere risolta osservando un satellite per più epoche con precise modalità di calcolo. Il presupposto è che l'ambiguità di fase rimanga la stessa ovvero che sia mantenuto il contatto tra satellite e ricevitore tra le varie epoche. La perdita del contatto con i satelliti è detta cycle slip e provoca l'introduzione di una nuova ambiguità di fase incognita ad ogni interruzione.

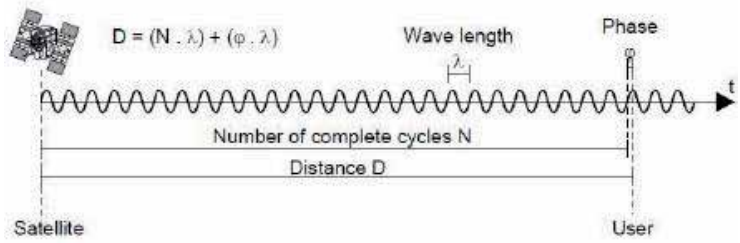

Figura 2 - Misura della fase.

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Errori nelle misure GPS

Le misure GPS sono affette da diversi tipi di errori accidentali ed errori sistematici (in inglese, bias). Questi errori possono essere classificati come originati al satellite, originati al ricevitore, e dovuti alla propagazione del segnale nell'atmosfera.
Gli errori originati al satellite includono errori delle effemeridi (note con precisione di qualche metro) e errori di orologio del satellite. Gli errori originati al ricevitore includono errori di orologio del ricevitore, errori di multipath, rumore e variazione del centro di fase dell'antenna. Gli errori di propagazione del segnale includono il ritardo del segnale GPS nel passaggio negli strati atmosferici (principalmente la ionosfera e la troposfera).
Come già accennato precedentemente alcuni di questi errori possono essere eliminati nel posizionamento differenziale.

Tecniche di posizionamento

Il GPS è stato inizialmente concepito per applicazioni di posizionamento di singoli punti in tempo reale conseguibili tutt'oggi con precisioni dell'ordine del metro in singola epoca e dell'ordine del decimetro per stazionamenti prolungati. Tuttavia la vera rivoluzione, che ha come conseguenza ultima la realizzazione delle reti di stazioni permanenti, come quella della rete S.P.IN. GNSS, è stato l'approccio interferometrico nell'elaborazione dei dati acquisiti da almeno due ricevitori, operanti contemporaneamente in punti diversi; tale approccio porta alla stima della base fra i due punti con elevata precisione. Si analizzerà quindi nel seguito le modalità di posizionamento relativo, differenziale arrivando poi alla definizione delle reti di stazioni permanenti.

Metodo di posizionamento relativo

Nel posizionamento relativo si utilizzano due o più ricevitori GPS che tracciano simultaneamente lo stesso satellite per determinare le loro coordinate relative. Il posizionamento relativo può essere fatto sulle misure di codice o sulle misure di fase. Supponendo che i due ricevitori "A" e "B" vedano contemporaneamente gli stessi satelliti "j" e "k", possono essere costruite combinazioni lineari chiamate differenze dette "singole", "doppie", "triple". L'equazione delle misure di codice e di fase nel posizionamento assoluto per un ricevitore "A" che vede un satellite "j" scritta per gli errori principali e per la portante L1 sono riportate alla pagina seguente.

$PAj=\rho Aj-EAj+c\Delta tj+\Delta TA+IAj+TAj\Phi Aj=\rho Aj-EAj+cdtj+dTA+IAj+TAj+\lambda Nj$

dove:

PAj distanza misurata dal ricevitore tra satellite "j" e ricevitore "A"
ρAj distanza geometrica tra i centri di fase del satellite "j" e del ricevitore "A"
EAj errore di effemeride, relativo alla posizione del satellite "j" nota dal ricevitore "A"
Δtj errore di orologio del satellite (asincronismo rispetto a tempo GPS)
ΔTA errore di orologio del ricevitore (asincronismo rispetto a tempo GPS)
IAj ritardo indotto sul segnale dall'attraversamento della ionosfera
TAj ritardo indotto sul segnale dall'attraversamento della troposfera
Nj ambiguità di fase intera. Questo intero è riferito alla prima epoca di osservazione del satellite, e rimane costante durante il periodo di osservazione (a meno di cycle-slip)
λ lunghezza d'onda della frequenza (es. 19 cm su L1).

Considerando due ricevitori, posti sui punti "A" e "B" e che osservano lo stesso satellite "j", si possono scrivere due equazioni relative alle misure di codice: $PAj=\rho Aj-EAj+c\Delta tj+\Delta TA+IAj+TAjPBj=\rho Bj-EBj+c\Delta tj+\Delta TB+IBj+TBj$

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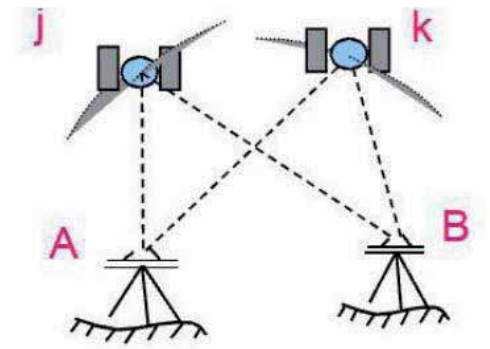

Figura 3 - Schema posizionamento relativo.

Differenziando tra loro le due equazioni si ottiene:

$$PABj=\rho ABj-c\Delta TAB+IABj+TABj$$

E per quanto riguarda le equazioni delle fasi:

$$\Phi ABj=\rho ABj-c\Delta TAB+IABj+TABj+\lambda NABj$$

Dove, per semplicità, si è adottata la seguente notazione per ogni simbolo:

$$\blacksquare ABj=\blacksquare Aj-\blacksquare Bj$$

Nelle equazioni sopra si osserva che sono spariti gli errori di orologio del satellite e quello di effemeride, mentre sono diminuiti gli errori dovuti a ionosfera e troposfera, in quanto per distanze tra i due ricevitori di pochi chilometri il ritardo per il ricevitore "A" è molto simile al ricevitore "B". Si noti inoltre che, trattandosi di differenze tra numeri interi, l'ambiguità di fase rimane ancora un numero intero.

Se i due ricevitori osservano due satelliti "j" e "k", possono essere scritte quattro equazioni alle osservazioni grezze, ed una equazione alle differenze doppie, ottenuta differenziando tra loro due equazioni alle differenze prime.

$$PABjk=\rho ABjk+IABjk+TABjk$$

$$\Phi ABjk=\rho ABjk+IABjk+TABjk+\lambda NABjk$$

Dove, in analogia con le equazioni sopra, si è adottata la seguente notazione per ogni simbolo:

$$\blacksquare ABjk=\blacksquare ABj-\blacksquare ABk$$

Si noti come si elidono i termini di errore legati agli orologi dei ricevitori, in quanto comuni nelle due equazioni alle differenze singole. Permangono ancora i termini incogniti delle ambiguità di fase mentre i ritardi ionosferici e troposferici possono essere tolti se si lavora su piccole distanze (minori di 15 km). L'eliminazione degli errori degli orologi dei ricevitori è la ragione per la quale questa è l'osservazione di base di tutti i principali programmi di trattamento dati GPS.

Metodo di posizionamento differenziale DGPS

Il posizionamento differenziale DGPS è una tecnica di posizionamento che utilizza due o più ricevitori (detti base e rover) che simultaneamente tracciano lo stesso satellite. È utilizzato quando è richiesta accuratezza nelle misure sub-metriche in tempo reale. Il ricevitore base rimane stazionario su un punto di coordinate note. Si utilizzano le coordinate precise della base e le coordinate dei satelliti, derivate dal messaggio navigazionale, per calcolare la distanza da ogni satellite. Il software prende la differenza tra la distanza calcolata e lo pseudorange misurato e ottiene la correzione differenziale PRC (pseudorange correction). Queste correzioni sono trasmesse in uno standard internazionale chiamato RTCM al rover.

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Il rover applica la correzione DGPS per correggere lo pseudorange misurato. Infine, lo pseudorange corretto è utilizzato per calcolare le coordinate del rover.
Nel dettaglio il range di codice all'epoca $t0$ può essere modellato nella stazione base secondo l'equazione:
$PAj(t0)=\rho Aj(t0)-EAj(t0)+c\Delta tj(t0)++\Delta TA(t0)+IAj(t0)+TAj(t0)$
Si calcola la correzione differenziale per ogni satellite all'epoca $t0$:
$PRCj(t0)=-PAj(t0)+\rho Aj(t0)=EAj(t0)-c\Delta tj(t0)+\Delta TA(t0)-IAj(t0)-TAj(t0)$
La correzione differenziale PRC viene applicata nel rover al tempo t e va aggiornata per sopperire alla latenza del segnale $(t-t0)$ con la
$PRCj(t)=PRCj(t0)+RRC(t-t0)$
Applicando quindi la correzione al giusto tempo allo pseudorange del rover si ottiene:
$PBj(t)correct=PBj(t)+PRC(t)=\rho Bj(t)-EAj(t0)+c\Delta tj(t)+\Delta TA(t)+IAj(t)+TAj(t)$
Viene quindi eliminato l'errore d'orologio del satellite e ridotti quelli ionosferici, troposferici e di orbita. La posizione del punto "B" è calcolata con gli pseudorange di codice corretti.

Metodo di posizionamento differenziale RTK
La stessa procedura precedentemente vista per le misure di codice può essere fatta per le misure di fase, ma in questo caso la precisione ottenibile è centimetrica:
$\Phi Bj(t)correct=\Phi Bj(t)+CPC(t)=\rho Bj(t)-EAj(t0)+c\Delta tj(t)+\Delta TA(t)+IAj(t)+TAj(t)+\lambda NABj$
Oltre alla posizione e all'errore d'orologio dei ricevitori nell'equazione compare come incognita l'ambiguità di fase "combinata" relativa al satellite j e ai ricevitori A e B. L'equazione è equivalente ad una differenza prima. Si fa poi un'ulteriore differenza rispetto ad un altro satellite k, realizzando un posizionamento analogo a quello a differenze doppie.
La misura e la stima di una base pongono tuttavia alcune problematiche essenziali: vi è la necessità di due ricevitori (uno da utilizzare come base e uno come rover) e due persone che lavorino in campagna; si devono conoscere precisamente le coordinate della stazione base. Inoltre è necessario che la distanza rover-base sia al massimo di 10-15 chilometri.

Errori nelle misure GPS
Questi problemi vengono superati grazie alle reti di stazioni permanenti GNSS che forniscono correzioni in tempo reale di area, aumentando l'applicabilità del posizionamento differenziale di precisione RTK oltre al limite dei 10-15 chilometri; questo è possibile per l'approccio delle reti alla modellazione spaziale degli errori ionosferici e troposferici. Inoltre la rete porta un risparmio economico notevole verso l'utenza in quanto permette l'uso del solo ricevitore rover.
Vediamo ora come funzionano le reti di stazioni permanenti GNSS.
Una rete di stazioni permanenti si compone di:
• un insieme di stazioni permanenti distribuite sul territorio;
• un centro di controllo che gestisce le stazioni permanenti, acquisisce i dati di queste, monitora la qualità ed elabora i dati, distribuisce dati e prodotti all'utenza.

Le reti di stazioni permanenti hanno lo scopo di favorire l'utilizzo dei metodi GNSS per le applicazioni di rilevamento, controllo del territorio e posizionamento in generale; per far ciò devono permettere agli utenti l'utilizzo del GNSS nella modalità del posizionamento relativo con alte accuratezze e riducendo gli svantaggi, ovvero costo e complessità.
Una rete di stazioni permanenti è costituita da diverse stazioni di riferimento, che altro non sono che antenne e ricevitori GNSS monumentati stabilmente.

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Infrastruttura di comunicazione dati

Per la distribuzione dei prodotti in tempo reale agli utenti del servizio di posizionamento la soluzione ottimale, che è anche quella utilizzata nella rete S.P.IN. GNSS, prevede la predisposizione di un indirizzo IP pubblico e statico tramite il protocollo NTRIP (vedi approfondimento Dati RTK e Internet) mentre per la distribuzione dei file in formato RINEX e RINEX virtuali per la post elaborazione si utilizza un server ftp.

Il Centro di Calcolo

Il cuore di una rete di stazioni permanenti è il software di rete installato su un server, di cui nel seguito si elencano le principali funzioni.

Le stazioni permanenti acquisiscono in modo continuo le osservazioni ed in tempo reale le inviano al Centro di Calcolo presso cui è installato il software di rete. Il Centro di Calcolo considera note le coordinate delle stazioni, le vincola ed elabora le loro osservazioni per:

- stimare gli errori e i disturbi sulle singole stazioni;
- modellare gli errori e i disturbi nel tempo e nello spazio;
- distribuire all'utenza in tempo reale, cioè con latenza inferiore al secondo, i dati e i modelli, in modo che questa possa correggere i propri dati.

Inoltre il software di rete esegue diverse funzioni accessorie come l'archiviazione e la pubblicazione dei dati RINEX delle stazioni permanenti per utilizzi di post-processamento e il monitoraggio delle stazioni permanenti.

Prodotti per il tempo reale

Come detto lo scopo principale per il tempo reale di una rete di stazioni di riferimento è fornire all'utenza una correzione differenziale da applicare al rover per raggiungere così, una volta fissata l'ambiguità, precisioni centimetriche.

La metodologia più semplice di correzione differenziale è quella descritta precedentemente in cui la correzione da applicare al rover è derivata dalle osservazioni della sola stazione di riferimento più vicina; questo tuttavia pone il problema della distanza massima rover-stazione di riferimento di circa 15 km.

Le stazioni permanenti organizzate in reti sfruttano tutto il loro potenziale quando per fornire la correzione al rover utilizzano diverse stazioni di riferimento (correzioni di area).

In sintesi i metodi di correzioni di area, che devono essere eseguiti in tempo reale, cioè in tempi minori di 1 secondo, seguono la seguente procedura:

- Determinazione delle ambiguità di fase o delle differenze prime o seconde delle ambiguità di fase di tutte le stazioni permanenti della rete.
- Determinazione dei valori dei bias in corrispondenza delle stazioni permanenti.
- Interpolazione dei bias sulla posizione del rover.
- Trasmissione delle stime interpolate come correzioni alle misure del rover.

Le metodologie MAX, VRS o i-MAX (spiegate nel dettaglio in Approfondimento sui prodotti di rete in tempo reale) si basano sui principi enunciati poc'anzi per generare modelli di correzioni regionali sul codice e sulla fase; questi metodi consentono l'utilizzo ottimale di correzioni anche per utenti a distanze superiori dei 30 chilometri dalla stazione permanente più vicina.

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DISPOSITIVO E SOFTWARE PER LA FRUIZIONE ALUNNI BES/PAI

C-Pen Exam Reader

- *Exam-Reader è la penna con OCR e sintesi vocale che rende autonomi gli studenti con difficoltà di lettura come la dislessia durante gli esami e nei test.*
- *Basta passare la penna sul foglio di carta come un evidenziatore e la sintesi vocale di alta qualità legge i testi negli auricolari, riga per riga, in 5 lingue.*

CE

Exam-Reader è la penna con OCR e sintesi vocale che rende autonomi agli esami e nei test. È indicata per tutti gli studenti con difficoltà di lettura come la dislessia.

Come funziona?
La penna si usa passandola sul foglio di carta come un evidenziatore e la sintesi vocale di alta qualità legge i testi, riga per riga, negli auricolari, in 5 lingue.

Perché è utile?
Con Exam-reader gli studenti con difficoltà di lettura diventano completamente autonomi nelle verifiche, esami e test, anche INVALSI. Non servono più persone come lettori di supporto, né fare la prova in altre aule con il conseguente senso di emarginazione che può emergere.
Exam-Reader è utile anche per:

- ✓ studenti con Italiano Lingua Seconda (IL2)
- ✓ studenti con ipovisione di grado moderato
- ✓ studenti mancini

Se lo studente riesce a usare correttamente l'evidenziatore su un testo cartaceo, è molto probabile che possa usare anche C-Pen.

Caratteristiche
Exam-Reader pesa solo 50 grammi, è ergonomica, ha batterie ricaricabili con un normale cavo USB. Non si connette a Internet né al PC, quindi non può essere considerata uno strumento che offre indebiti vantaggi. Il JCQ (Joint Council for Qualifications), organismo nazionale inglese per il controllo e monitoraggio della valutazioni d'esame, ha stabilito che:

Exam-Reader risponde a tutti questi criteri.

Inoltre, C-pen dispone di:

- Display OLED su tre righe 256*64
- OCR Incorporato con scansione dei font con dimensione da 6,5 a 22 pt.
- Sintesi vocale di alta qualità in 5 lingue: Italiano, Inglese, Spagnolo, Francese e Tedesco
- Altoparlante incorporato con presa cuffia standard 3.5mm e auricolari in dotazione
- Batteria 1,200mAh
- Porta Micro USB con cavo di ricarica in dotazione
- Dimensioni: 135*33*19mm
- Peso: 50g
- Certificazioni CE RoHS FCC

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ePico

Perché usare ePico!

ePico! raccoglie i frutti di molti anni di ricerca sui programmi compensativi e sulle modalità di apprendimento:

- supporta chi ha difficoltà di lettura, scrittura, calcolo e di organizzazione dello studio
- favorisce l'apprendimento e l'esecuzione dei compiti scolastici in autonomia di tutti gli studenti.
- serve a organizzare le informazioni in forma di testo, audio e immagini e quindi a trovare un metodo di studio efficace e personale.

5 programmi per gestire e organizzare le informazioni

Il cuore di ePico! è il suo Centro Attività che contiene :

1. Editor
   L'Editor funziona come un normale editor di testi e in più è dotato di funzioni compensative che potenziano l'elaborazione e la comprensione dei testi: gli Stili di lettura, l'Autocorrezione, i Lessici di lettura, un ambiente Studio nel quale creare anche file audio .mp3

2. Lettore
   Il Lettore stimola la lettura "attiva" con la sintesi vocale (canale uditivo) e con l'effetto karaoke (canale visivo) che evidenzia il testo in lettura. Funziona anche con i testi selezionati in qualsiasi programma del PC e con i testi sul web, per raccogliere materiale utile per lo studio. È ottimizzato anche per gli schermi touch screen

3. Ambiente Domande
   L'Ambiente Domande è un "catalogatore" di informazioni. Potenzia le abilità di problem solving grazie allo schema di tipo "Domande e Risposte" che facilita la comprensione del testo e lo studio, e così favorisce la creazione di un metodo di studio personale. Nella risposta si possono inserire testo, immagini e collegamenti multimediali

4. Ambiente PDF
   L'Ambiente PDF è dedicato ai libri digitali. Ha tutti gli strumenti classici che permettono di prendere appunti e personalizzare il libro digitale come se fosse un libro cartaceo: evidenziatori, riquadri, sottolineature, scrittura di testo e note, e si possono inserire o estrarre pagine dai documenti PDF. Il "Riassunto in lettura" permette di rielaborare il testo direttamente sul libro digitale, formattazione inclusa

5. Calcolatrice
   La calcolatrice "parlante" con sintesi vocale evita gli errori di trascrizione dei numeri e fa ascoltare le cifre digitate per un maggiore controllo della correttezza dei dati inseriti. È utile per superare le difficoltà come la discalculia che nascono dai disturbi specifici dell'apprendimento.

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SuperMappe EVO

A cosa servono le mappe multimediali? Sono utili per studiare con più facilità e in autonomia. SuperMappe EVO aiuta ogni studente, in particolare con Disturbi dell'apprendimento o altri Bisogni educativi speciali, a:

- Costruire le mappe in maniera rapida ed efficace
- Visualizzare concetti e relazioni
- Imparare a selezionare e organizzare informazioni
- Memorizzare gli argomenti
- Prendere rapidamente appunti e costruisci schemi
- Migliorare il tuo metodo di studio

Lo sviluppo di SuperMappe Evo

Supermappe Evo nasce da un'esperienza pluriennale maturata sul campo dal 2006 con Supermappe Classic. Nel corso degli anni lo abbiamo migliorato e sperimentato nei Campus Dislessia, nei doposcuola specializzati, nelle scuole di tutta Italia e in altri progetti. Dalla sperimentazione sul campo è cresciuta la necessità di sviluppare SuperMappe Evo che oggi offre strumenti evoluti per:

- elaborare i contenuti in modo rapido ed efficace, partendo da documenti digitali diversi come i libri e file PDF*, pagine web, testi, immagini, video, documenti, e trasformarli in approfondimenti, immagini e concetti
- creare mappe più organizzate e più gradevoli con minor fatica e tempo di applicazione
- lavorare e creare le tue mappe in una finestra unica, con pochi clic del mouse, tap sul touchscreen o sulla lavagna LIM

La possibilità di usare la Sintesi Vocale e di presentare su carta o schermo facilitano l'esposizione orale dei contenuti elaborati con la mappa e fanno di SuperMappe Evo uno Strumento Compensativo per DSA e BES potente e flessibile (Legge Dislessia 170/2010).

***Supermappe Evo si integra con i nostri prodotti ePico!**

Alcune funzioni utili di SuperMappe EVO

1. **Supporto Touch**
   Usa le tue mappe in modo semplice sulle LIM e sugli schermi touch del PC o Tablet con Windows 8 e 8.1.
2. **Presenta le tue mappe**
   Crea presentazioni in modalità visuale: clicca sugli oggetti uno dopo l'altro per creare un percorso di presentazione delle informazioni.
3. **Usa i Modelli preimpostati**
   I modelli di mappa sono mappe "da riempire" utilissime quando alcune strutture o fasi si ripetono nello studio, per esempio l'analisi di un evento storico, di un libro letto o il procedimento di un esperimento di scienze.
4. **Personalizza le tue mappe**
   Gli strumenti di personalizzazione consentono di creare mappe più belle e ordinate.
5. **SuperMappe Evo lavora anche con ePico!**
   L'integrazione con ePico! permette uno scambio rapido di appunti e mappe: i due programmi insieme creano un "sistema per l'apprendimento" potente e completo che facilita lo studio.
6. **Salva e condividi online le tue mappe con Google Drive™**
   Supermappe EVO apre e salva i documenti conservati su Google Drive™ per visualizzare e condividere il lavoro.

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