15 MHz, 20 MS/s, 8-Bit Digital Oscilloscopes

NI 5102 Series

Analog Input
20 MS/s per channel real-time sampling
1 GS/s random interleaved sampling
8 bits vertical resolution
50 mV to 50 V input range
15 MHz bandwidth
2 simultaneously sampled channels

Waveform Memory
663,000 samples onboard
Up to 16 million samples via PCI bus mastering to host RAM

Digital Pulse Generation
Asynchronous pulse train generation

Triggering
Analog and digital

Application Software
LabVIEW
BridgeVIEW
LabWindows/CVI
ComponentWorks
VirtualBench
IVI-compliant instrument driver

Solutions
Digital oscilloscope
Ultrasonic testing
Automotive ignition testing
Cable testing
Telephony
Disk drive testing
Nondestructive testing

Calibration certificate included

Bus	Operating Systems
PXI/CompactPCI	Windows NT/98/95
PCI, PCMCIA, and ISA	Windows NT/98/95/3.1
USB	Windows 98

Overview

The NI 5102 Series consists of dual-channel 20 MS/s digital oscilloscopes for use with PCI, PXI/CompactPCI, USB, PCMCIA, and ISA bus computers. Using the NI 5102 deep-memory digital oscilloscopes, you can build lower cost, faster performance automated test systems.

Hardware

Analog Input

The NI 5102 Series digital oscilloscopes feature two analog input channels with extensive functionality. Each channel has 15 MHz analog input bandwidth. By using selectable attenuation, an input voltage range of ±50 mV to ±5 V is achieved. Attenuating probes are used to extend the voltage range. Table 1 shows the input voltage range for the NI 5102.

Software-selectable AC or DC coupling increases the signal measurement capability. For example, if you are measuring an AC signal that has a large DC component, use AC coupling to remove the DC component and amplify only the AC component. Without AC coupling, it is difficult to view the details of a small AC signal with a large DC offset, such as when measuring the switching noise of a DC power supply.

	Input range	
Gain	1X Probe	10X Probe
1	±5 V	±50 V
5	±1 V	±10 V
20	±0.25 V	±2.5 V
100	±50 mV	±0.5 V

Table 1. CH0 and CH1 Input Ranges

Acquisition System

The NI 5102 uses a pair of 20 MS/s, 8-bit flash ADCs to digitize the input signals. The real-time sampling rate ranges from 20 MS/s down to 1 kS/s. For repetitive signals, you can use Random Interleave Sampling (RIS) to extend the effective sampling rate to 1 GS/s. RIS samples different points along a repetitive waveform for each occurrence of a trigger, and then reconstructs the waveform from the data acquired over many cycles.

Acquisition Memory

The NI 5102 has 663,000 samples of onboard acquisition memory. Data is acquired into the onboard memory before being transferred to the host PC system memory.

The PCI and PXI/CompactPCI versions of the NI 5102 can transfer acquisition samples across the PCI, PXI/CompactPCI bus system memory in real time. These versions can acquire a maximum 16 million samples if your computer has at least 16 MB free. On the NI 5102 versions for ISA, PCMCIA, and USB, data transfer takes place after the acquisition ends, for up to 663,000 samples.

Triggering

One of the biggest challenges of taking a measurement is to successfully trigger the acquisition at the point of interest. Because most high-speed digitizers actually record the signal for

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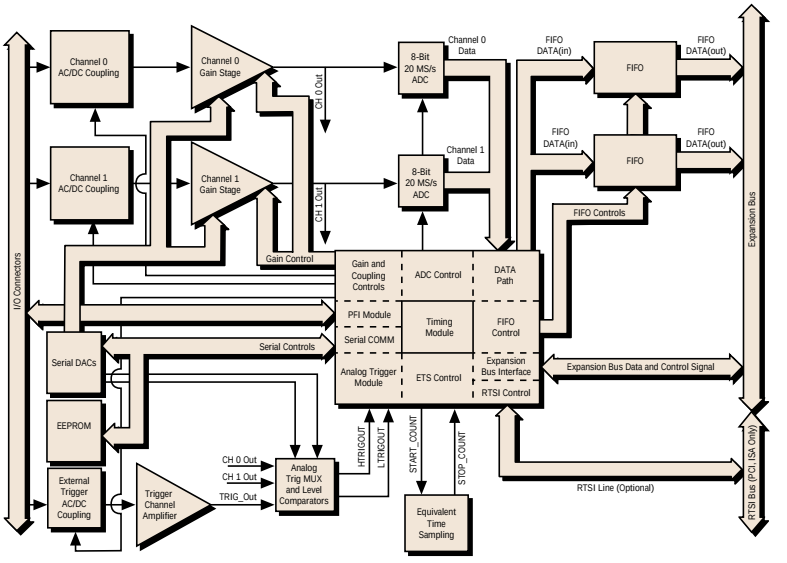

Figure 1. NI 5102 Block Diagram

a fraction of the total time, a signal anomaly is missed if the trigger point is set incorrectly. The NI 5102 DSOs are equipped with sophisticated triggering options, such as programmable trigger thresholds, hysteresis values, trigger hold-off, and bilevel triggering on input channels, as well as on a dedicated trigger channel. The NI 5102s also have two TTL/CMOS digital triggers, used to synchronize instruments.

Two trigger modes are available on the NI 5102 – pretrigger and posttrigger. Through software you specify the number of samples to acquire before and after a trigger event occurs. Refer to Table 2 for a list of the minimum and maximum number of samples the NI 5102 digital oscilloscope can acquire in pre and posttrigger modes.

Digital Triggers

All NI 5102 oscilloscopes have two multipurpose programmable function digital input/output lines that you can use for external timing and triggering or outputting various signals, such as the probe compensation signal or TTL-level pulse trains. The direction on these lines is individually selectable as input or output.

Multiple Instrument Synchronization

For the PCI, PXI/CompactPCI, and ISA versions of the NI 5102, a synchronization bus (RTSI for PCI and ISA, and PXI Trigger Bus for PXI/CompactPCI) routes timing and trigger signals between one or more NI 5102 devices and other National Instruments data acquisition and instrument products. The benefits of multiple instrument synchronization include triggering multiple measurement devices with a single trigger and timing the acquisition of multiple devices with the same sample clock.

The RTSI bus has seven bidirectional trigger lines and one bidirectional clock signal. The PXI Trigger bus has six bidirectional trigger lines and one bidirectional clock signal.

Calibration

Every NI 5102 is shipped with calibration certificates stating that they were calibrated to NIST-traceable standards. The NI 5102 can be returned to National Instruments or a qualified metrology lab for recalibration.

All NI 5102s are factory calibrated to the levels detailed in the specifications. Each channel gain and DC offset are adjustable to be within the specified tolerances.

Instrument Automation Performance

The NI 5102 Series is ideal for test, measurement, and data acquisition applications. Using them saves you valuable test time because the time to configure and transfer data is so much faster than with traditional GPIB or RS-232 controlled oscilloscopes.

I/O Connector

The NI 5102 instruments have two standard BNC female connectors for CH0 and CH1 analog input connections, one standard BNC female connector for the TRIG channel, and two standard SMB female connectors for the multipurpose digital timing and triggering signals. On the PXI/CompactPCI version, there is one SMB female and one AUX connector (9-pin DIN) for the digital triggers.

Acquisition Mode	Number of Channels	NI 5102 Version	
		PCI, PXI, CPCI	PCMCIA, USB, ISA
Posttrigger Samples Only	One	16,777,088*	663,000
	Two	16,777,088*	331,500
Pretrigger and Posttrigger Samples	One	663,000	663,000 minus the number of posttrigger samples
	Two	331,500	331,500 minus the number of posttrigger samples

* With PCI bus mastering and dependent on available system memory.

Table 2. Possible Number of Samples for Posttrigger and Pretrigger Acquisitions

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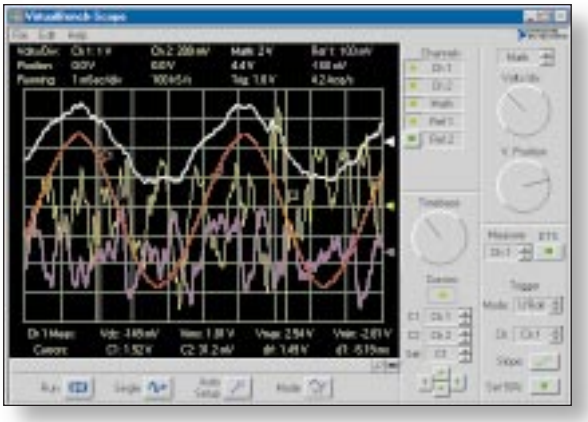

Figure 2. You get easy and intuitive hands-on operation with the VirtualBench-Scope soft front panel

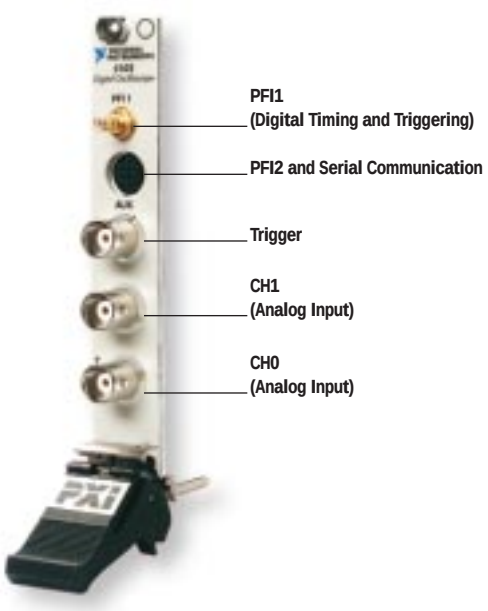

Figure 3. NI 5102 for PXI/Compact PCI front panel connector

Software

Instrument Driver

If you want to build an automated test application or to integrate an NI 5102 with your test software, use the IVI-compliant NI-Scope instrument driver. It works with

- *LabVIEW (G Code)*
- *BridgeVIEW (G Code)*
- *LabWindows/CVI*
- *Microsoft Visual C/C++*
- *Borland C++*
- *Visual Basic*

Interactive Control

VirtualBench-Scope software, shown in Figure 2, is shipped with all NI 5102 oscilloscopes. VirtualBench-Scope is a soft front panel that controls the NI 5102 with no programming required. All hardware features of the NI 5102 are accessible by the software. You use VirtualBench-Scope just as you use stand-alone instruments, but you benefit from the processing, display, and storage capabilities of computers. VirtualBench-Scope can save waveform data to disk, generate reports, and perform statistical measurements.

For cables and accessories, refer to page 585.

Ordering Information

***NI 5102** for*

PCI 777304-01
PXI/CompactPCI.....777556-01
PCMCIA 777251-01
ISA (AT)..... 777252-01
USB with power supplies for
U.S. 120 VAC.....777650-01
Universal Euro 240 VAC.....777650-04
United Kingdom 240 VAC 777650-06
Japanese 100 VAC 777650-07

Each kit includes the NI 5102 hardware, NI-Scope instrument driver, switchable 1x/10x probes, probe compensation cables, and VirtualBench-Scope.

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Specifications

Typical for 25 °C unless otherwise noted.

Acquisition System

Bandwidth	15 MHz at all input ranges
Number of channels	2 simultaneously sampled
Number of digitizers	2 independent ADCs
Max sample rate	1 GS/s repetitive, 20MS/s single shot
Sample onboard memory	663,000 samples
Max waveform buffer	Up to 16 million samples/channel (for only PCI- and PXI-5102 with PCI bus mastering, (depends on available host memory); 663,000 samples for USB, AT, PCMCIA
Vertical sensitivity (gains)	1 mV/div to 10 V/div with VirtualBench-Scope 50 mV to 50 V input ranges (with external probe attenuation)
DC accuracy	±2.5% of full scale at all gains
Resolution	8 bits
Input coupling	AC/DC software selectable
Input impedance	1 MΩ ±1% in parallel with 25 pF ±10 pF (Impedance increases with attenuating probes)
Maximum measurable input voltage	±500 V, (DC + peak AC) < 15 MHz (with 100X probe) ±50 V, (DC + peak AC) < 15 MHz (with 10X probe) ±5 V, (DC + peak AC) < 15 MHz (with 1X probe)
Input protection	±42 V (DC + peak AC < 10 kHz, without external attenuation)

Timebase System

Number of timebases	2. RTSI clock and main timebase at 20 MHz
Sample rate range	Internal: 20MS/s to 1kS/s with 20,000 intermediate rates
Clock accuracy	100 ppm over operating temperature range
Interpolator resolution (repetitive only)	1 ns
External clock	Provided through Ch0, Ch1, TRIG, RTSI TRIG <0..6> or PFI<1..2>; Frequency <= 20 MHz with a 50% duty cycle; Ch0, Ch1, TRIG can be used for ECL or other thresholds; RTSI<0..6> and PFI<1..2> are CMOS/TTL inputs only

Triggering System

Modes	Above threshold, below threshold, between thresholds, outside thresholds
Source	Ch0, Ch1, TRIG, PFI<1..2>, RTSI<0..6>
Slope	Rising/falling
Hysteresis	Full scale voltage/n, where n is between 1 and 256; Full scale voltage on TRIG is fixed to ±5 V (without external attenuation)
Coupling	AC/DC on Ch0, Ch1, TRIG
Pretrigger depth	1 sample up to 663,000 samples divided by number of channels
Posttrigger depth	1 sample up to 16 million samples (PCI-5102 and PXI-5102); 1 sample up to 663,000 minus pretrigger depth divided by number of channels (AT, USB, PCMCIA)
Holdoff by time	800 ns to 6.71 seconds
Trigger sensitivity	8 bits, 256 steps in full scale voltage range
TRIG input range	±5 V (without external attenuation)
TRIG input impedance	1 MΩ ±1% in parallel with 30 pF ±15 pF; Impedance increases with attenuating probes
TRIG input protection	±42 V [(DC + peak AC) < 10 kHz, without external attenuation]

Acquisition Modes

RIS	1 GS/s down to 40 MS/s effective sample rate, repetitive signals only, Data is interleaved in software
Single shot	20 MS/s down to 1 kS/s sample rate, for transient and repetitive signals

Power Requirement

PCI, PXI	500 mA at +5 VDC (±5%) typical
PCMCIA	260 mA at +5 VDC (±5%) active operation 60 mA power down
ISA, USB	300 mA at +5 VDC (±5%) typical

Physical

Dimensions

PCI, ISA	10.7 by 17.5 cm (4.2 by 6.87 in.)
PXI	10 by 16 cm (3.9 by 6.3 in.)
PCMCIA	Type II PC Card
USB	14.6 by 21.3 by 3.8 cm (5.8 by 8.4 by 1.5 in)

I/O Connectors

Analog inputs CH0,CH1	BNC female
Analog trigger TRIG	BNC female
Digital triggers PFI1, PFI2	SMB female, AUX for PXI-5102

Operating Environment

Ambient temperature	0 to 55 °C
Relative humidity	10% to 90%, noncondensing
Storage Environment	
Ambient temperature	-20 to 70 °C
Relative humidity	5% to 95%, noncondensing

Certifications and Compliances

CE Mark Compliance CE