

USER GUIDE

Single-Ended Digital Flying Lead Cable

Accessory for Single-Ended NI Digital Waveform Generator/Analyzers

The NI SHC68-H1X38 cable is a single-ended cable that breaks out each NI digital waveform generator/analyzer signal into two 0.1 inch header receptacles, one receptacle each for the signal and ground. The NI SHC68-H1X38 cable provides an easy way to connect NI single-ended high-speed digital waveform generator/analyzer devices to various types of devices and circuits for interfacing, testing, or analysis.

This cable offers connectivity similar to that found on a typical logic analyzer, so you can use it in logic analyzer-type applications. Unlike a typical logic analyzer, however, this cable also allows for simultaneous pattern generation and acquisition so that you can use it in stimulus/response applications as well.

This guide explains how to set up and use the NI SHC68-H1X38 cable with single-ended NI digital waveform generator/analyzer modules.

What You Need to Get Started

To set up and use the NI SHC68-H1X38 cable, you need the following items:

- Compatible NI digital waveform generator/analyzer, installed in a PXI chassis, compactPCI chassis, or PCI slot
- The documentation included with the digital waveform generator/analyzer and driver software

You may also need the following optional items, which are included as part of the NI 654x and NI 655x logic analyzer product bundles.

- Attenuators to create attenuated inputs (NI part number 194097-01)



Note Attenuators are only included with the NI 6551/6552 Logic Analyzer bundles.

- IC clips for easy connectivity to common IC packages (NI part number 194096-01)
- NI Digital Waveform Editor



Related Documentation

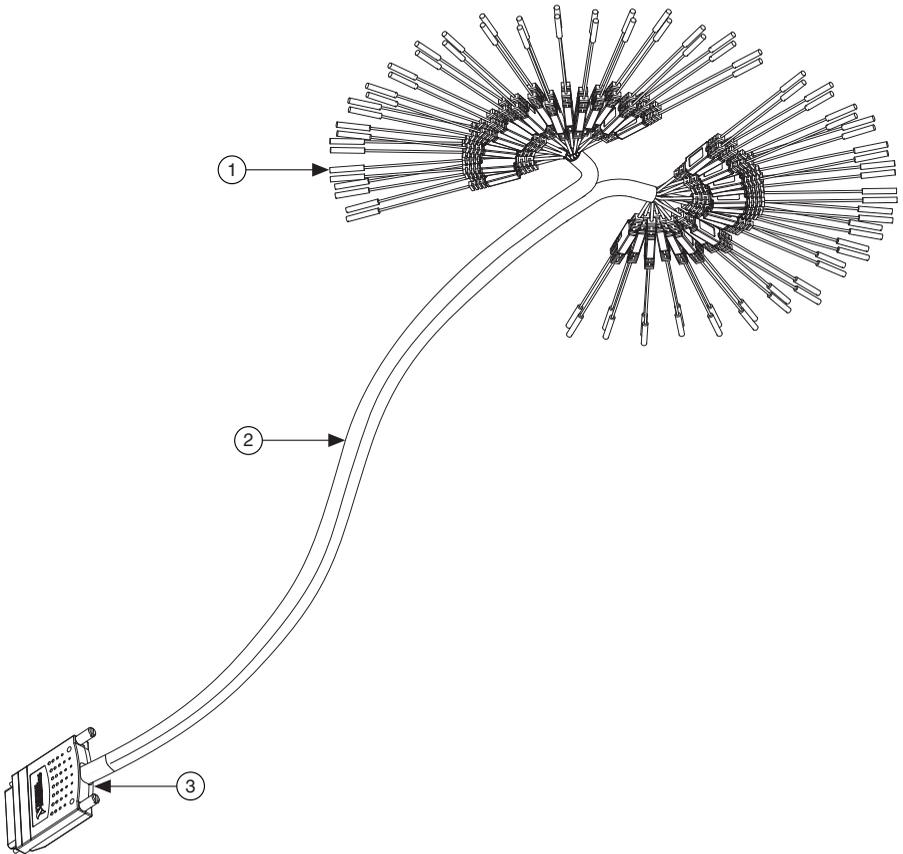
The NI digital waveform generator/analyzer ships with several documents designed to familiarize you with different aspects of the module. The documentation set includes the following pieces:

- *NI Digital Waveform Generator/Analyzer Getting Started Guide*—Read this printed document to set up the digital waveform generator/analyzer and configure it to complete your first acquisition or generation.
- *NI Digital Waveform Generator/Analyzer Help*—This online document provides more in-depth information about the hardware capabilities of the module, theory of operation, programming flow, and software reference.
- NI digital waveform generator/analyzer specifications—These printed documents provide specifications for your device.

Parts Locator

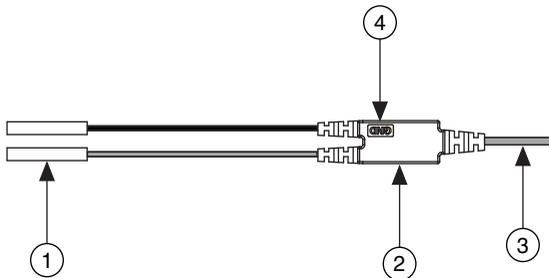
Refer to Figure 1 to locate connectors and components on the NI SHC68-H1X38 cable. The lead pairs are shown in more detail in Figure 2.

Figure 1. Parts Locator Diagram



- | | | | | | |
|---|------------|---|--------------------|---|------------------------|
| 1 | Lead Pairs | 2 | Removable Sleeving | 3 | 68-Pin VHDCI Connector |
|---|------------|---|--------------------|---|------------------------|

Figure 2. Detailed Parts Locator Diagram for the Lead Pairs



- | | | | |
|---|--|---|--------------------|
| 1 | 0.25 in. Diameter 0.1 in. Pitch Compatible Receptacles | 3 | Micro-coaxial Wire |
| 2 | Strain-Relief and Label | 4 | Ground |

Connecting Signals

Each DIO, PFI, and clock channel of the NI digital waveform generator/analyzer connects to a corresponding pair of leads on the NI SHC68-H1X38 cable.

The NI SHC68-H1X38 cable is separated into two bundles of 19 channels, and each channel is split into a pair of leads for connecting the signal and its associated ground. Table 1 describes the channels and shows how they are grouped by bundle.

Table 1. NI Digital Waveform Generator/Analyzer Signal Descriptions

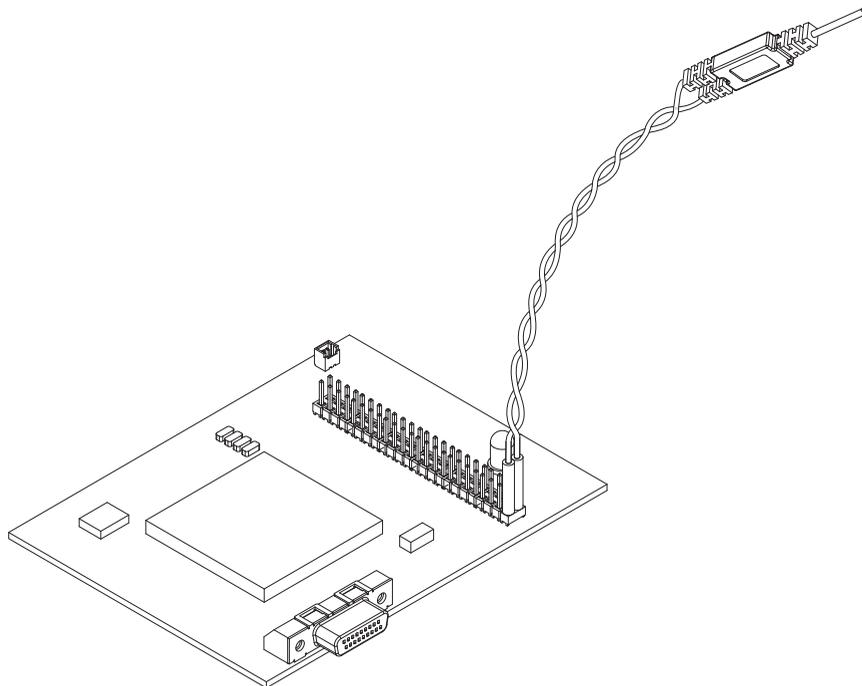
Channel	Signal Description	Bundle
DIO <0..31>	Bidirectional digital data channels 0 through 31. Refer to the documentation for your NI digital waveform generator/analyzer for information about the number of available DIO channels on your device. DIO <20..31> may not apply to your device.	DIO<0..15>: Bundle A DIO<16..31>: Bundle B
STROBE / PFI 5	For devices that have a STROBE channel, this signal is the external Sample clock source for dynamic acquisition. Otherwise, this is programmable functional interface (PFI) 5.	Bundle A
CLKOUT / PFI 4	For devices that have a DDC CLK OUT channel, this signal is the exported sample clock signal. Otherwise, this is PFI 4.	Bundle A
PFI <1..3>	Programmable functional interface PFI <1..3>.	PFI 1: Bundle A PFI <2..3>: Bundle B
GND / PFI 0	For devices that have PFI 0 on a front-panel SMB connector, this channel is ground and should not be used. Otherwise, this channel serves as PFI 0.	Bundle B
GND	Each channel is split into a pair of leads. The lead attached with the black wire is the GND signal, which serves as the ground reference for that particular channel.	N/A

Using Your Accessory

The NI SCH68-H1X38 cable breaks out every signal through a 50 Ω characteristic impedance microcoaxial cable, which is then split into two leads with receptacles. This cable was designed for both acquisition and generation operations with your single-ended NI digital waveform generator/analyzer. Refer to the Termination sections in the *NI Digital Waveform Generator/Analyzer Help* to learn how to correctly terminate your signals to achieve optimal signal quality.

For optimal signal quality, connect both the signal and ground receptacles and twist the pair of leads together as shown in the following figure.

Figure 3. Using the NI SCH68-H1X38 Cable to Interface to a DUT



The receptacles on the NI SHC68-H1X38 easily attach to standard 0.1 inch pitch, 0.025 inch diameter header pins. The shipping kit for this cable also contains ten 4×2 header-to-receptacle strips for one-time arrangement of the flying leads. These strips are useful when you must disconnect and reconnect the cable to rows of 0.1 inch test pins on a circuit board, for example. You can easily find other adapters that provide male header pins on one side and an array of connectors on the other side.

Generation

Just like with the NI SHC68-C68-D2 cable, the NI SHC68-H1X38 cable allows you to perform pattern generation. The 50Ω output impedance of NI digital waveform generators/analyzers, coupled with the 50Ω characteristic impedance of this cable, allows you to generate clean signals up to the full rate of the device. The 0.1 inch-compatible receptacles provide a large array of connectivity options.

Acquisition

Direct Pattern Acquisition

The NI SHC68-H1X38 cable also allows you to easily acquire digital signals from your DUT to your digital input device by simply connecting the flying leads directly to your circuit board.

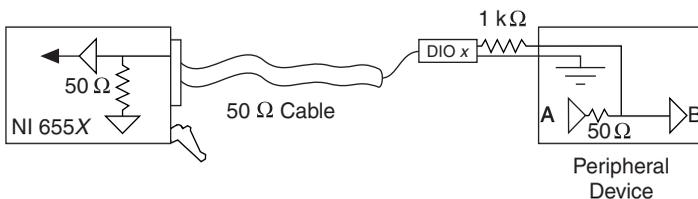
This cable is designed with a $50\ \Omega$ characteristic impedance. For optimal signal quality, your digital signal source should have an output impedance that is as close to $50\ \Omega$ as possible. For more information about signal integrity, refer to the Acquisition Termination topic for your device in the *NI Digital Waveform Generator/Analyzer Help*.

Attenuated Acquisition

In most applications, you can successfully acquire your signals by using the connections described in the *Direct Pattern Acquisition* section. In some specialized applications, you may need to acquire a digital signal without loading the signal. Any length of probe added to a digital signal adds some resistance, inductance, and capacitance to the circuit, degrading the signal integrity of that signal. It also adds a stub, which may introduce reflections. Refer to the *Signal Reflections* topic in the *NI Digital Waveform Generator/Analyzer Help* for more information about reflections. Using an optional attenuator, the NI 655x can operate while presenting a much smaller load on the digital signal itself. Logic analyzers frequently use attenuated inputs to acquire a digital signal.

This section describes how to implement attenuation with the NI SHC68-H1X38 cable, an NI 655x digital waveform generator/analyzer, and an attenuator (NI part number 194097-01). To create an attenuated input, you can attach an attenuator to the signal lead of the NI SHC68-H1X38 cable. Refer to Figure 2 for an illustration of the NI SHC68-H1X38 cable leads. The attenuator contains a $1\ \text{k}\Omega$ series resistor, changing the equivalent circuit to resemble the one shown in the following figure.

Figure 4. Attenuated Input Configuration



The load resistance as seen by the driver is dramatically increased from $50\ \Omega$ to $1,050\ \Omega$ when the attenuator is used as shown in Figure 4, so the DC voltage at the DUT is only reduced by approximately 5% ($50\ \Omega / 1000\ \Omega + 50\ \Omega$) by the load of the test system. In addition, the termination resistance into the NI 655x is $50\ \Omega$, so no part of the signal reflects through the cable to be injected into the circuit.

A voltage divider now exists at the NI 655x that cuts the voltage to 5% ($50\ \Omega / 1000\ \Omega + 50\ \Omega$) of the original value when it reaches the NI 655x. You must reduce the acquisition voltage

thresholds (using the niHSDIO Configure Voltage VI or the niHSDIO_ConfigureDataVoltageCustomLevels function) so that the NI 655x can detect a logic level on the signal. For example, if the driver provides 3.3 V, then the voltage present at the NI 655x receiver is 165 mV. Reduce your acquisition high and low threshold voltages to 80 mV and 90 mV, respectively, to provide some additional noise margin.



Note One set of programmable input voltage thresholds (high and low) is available on the NI 655x. Every acquisition channel must use the same threshold values. For this reason, NI recommends that you do not attempt to mix attenuated and non-attenuated signals on a single module since the input thresholds for each type of signal might be different. Refer to your device specifications for more information about the input voltage thresholds.

Another advantage to attenuated inputs is that they reduce the cable's effective input capacitance to approximately 1–2 pF as seen at the probe point. The large resistance effectively isolates the bulk capacitance of a cable from the signal source.

The following table summarizes the three probing options.

Table 2. Signal Probing Options

NI 655x Acquisition Impedance	Signal Quality	DC Voltage at DUT Receiver	DC Voltage at NI Device	Probe Load
High-impedance	50 Ω source output impedance needed for excellent signal quality	Close to 100%	Close to 100%	~ 100 pF + 50 k Ω *
50 Ω impedance	Excellent	50%	50%	~ 100 pF + 50 Ω
Attenuated	Excellent	95%	5%	~ 2 pF + 1,050 Ω
* NI 655x module assemblies labeled C and later support two selectable input impedance values: 50 Ω or 50 k Ω (default). NI 655x module assemblies A and B support input impedance values of 50 Ω or 10 k Ω (default).				

Refer to the *NI Digital Waveform Generator/Analyzer Help* and NI-HSDIO shipping examples for information on how to change the input threshold voltages and input impedance.

Interfacing to a DUT Interface Board

Many times when you are evaluating an IC, you can purchase an evaluation or interface board. Such a board typically contains a socket for the IC you wish to evaluate, as well as any supporting components that are necessary for IC functioning. The evaluation board frequently provides 0.1 inch pitch header pins as an interface to the digital inputs and outputs of the IC.

Using an NI SCH68-H1X38 cable and a single-ended NI digital waveform generator/analyzer, you can easily communicate with your IC using the header pins on the evaluation board. Simply

slide the receptacle for each channel onto the appropriate header pin. Connect the associated ground pin to the GND receptacle that is attached to the signal you are using. For example, if you need to write to a read from an EEPROM, you can connect the SCH68-H1X38 as shown in Figure 3.

In this application example, the NI digital device and the EEPROM can send data directly to each other.

Probing Signals between ICs

In some cases, you may need to evaluate the data being sent between two ICs without disturbing the signal. For example, you may want to observe the outputs from an A/D converter (ADC) as it sends its data to an FPGA on the same board. Many evaluation boards provide header pins for this purpose.

To use the NI SHC68-H1X38 in this situation, you can connect the cable in the same way as in the previous section. Refer to the [Attenuated Acquisition](#) section for more information.

Specifications

Digital I/O

DIO channels	32, single-ended
Control I/O channels	6, single-ended
Typical propagation delay	13.5 ns
Typical channel-to-channel skew	± 250 ps
Typical characteristic impedance	50 Ω
Typical input capacitance	150 pF

Physical

Length	1.5 m
I/O connectors	One 68-pin DDC Connector 38 header-receptacle pairs (signal and ground)

Environmental Management

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

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at ni.com/environment. This page contains the environmental regulations and

directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



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