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BNC-2140 User Manual

Dynamic Signal Acquisition
Signal Conditioning Accessory

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Conventions

The following conventions are used in this manual:

<> Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, ACH<3..0>.

This icon denotes a note, which alerts you to important information.

This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

italic Italic text denotes variables, emphasis, or a cross reference.

`monospace` Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

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1 Introduction

This manual describes the electrical and mechanical aspects of the BNC-2140 accessory and contains information concerning its operation.

This chapter describes the BNC-2140 accessory, lists what you need to get started, explains how to unpack your BNC-2140, and describes optional equipment.

The BNC-2140 is a signal conditioning accessory specifically designed for use with a dynamic signal acquisition (DSA) device. It interfaces four BNC signal inputs and two BNC signal outputs directly to National Instruments DSA products including the PCI-4451, PCI-4452, NI 4551, and NI 4552. The BNC-2140 connects to Integrated Circuit Piezoelectric (ICP®) accelerometers and microphone preamplifiers as well as any other voltage source whose output is less than ±42.4 V.

Each input channel has an independent 4 mA current source suitable for use with ICP-type accelerometers and microphone preamplifiers. You can manually enable or disable the ICP signal conditioning on a per-channel basis. With ICP disabled, a BNC-2140 input channel acts as a direct voltage input. You can manually switch each input channel and each output channel from differential (DIFF) to single-ended (SE) mode. In SE mode, the BNC shell is tethered to a clean analog ground through a 50 Ω resistor.

The BNC-2140 receives power for ICP signal conditioning from the DSA plug-in device through the 68-pin high-density connector. A green LED indicates when the ICP circuitry is powered on. When you do not require ICP signal conditioning, you can manually turn off the power to the circuits.

What You Need to Get Started

To set up and use your BNC-2140 device, you will need the following:

- ❑ BNC-2140
- ❑ One of the following DSA devices and its documentation:
  - NI 4451 for PCI
  - NI 4452 for PCI
  - NI 4551for PCI
  - NI 4552 for PCI
- ❑ This manual
- ❑ Your computer
- ❑ SHC68-C68-A1 analog cable

For more information, refer to `ni.com/appnotes.nsf/` for the National Instruments Application Note 25, *Field Wiring and Noise Considerations*.

Unpacking

Your BNC-2140 is shipped in an antistatic plastic package to prevent electrostatic damage to the device. Several components on the device can be damaged by electrostatic discharge. To avoid such damage in handling the device, take the following precautions:

- Ground yourself with a grounding strap or by holding a grounded object.
- Touch the plastic package to a metal part of your computer chassis before removing the device from the package.
- *Never* touch exposed connector pins.

Remove the device from the package and inspect the device for loose components or any other sign of damage. Notify National Instruments if the device appears damaged in any way. Do *not* install a damaged device into your computer.

Optional Equipment

If your application requires that you use transducers with microdot connectors, use the BNC plug to screw-on receptacle adapter, part number 033-0101-0001, from Microdot Connectors. This accessory allows you to connect BNC and microdot connectors.

If your application requires that you use a prepolarized microphone with a microphone preamplifier, contact Brüel and Kjær.

2

Installation and Configuration

This chapter explains how to install and configure your BNC-2140 accessory.

Installation

Caution You must turn the power off to your computer before installing the BNC-2140.

The following are general installation instructions:

1. Insert either end of your SHC68-C68-A1 analog cable into the 68-pin connector on the BNC-2140. Insert the other end into the 68-pin connector on the DSA plug-in device.
2. Tighten the jackscrews finger-tight on both ends of the cable.
3. Check the installation.
4. Turn on your computer.

The BNC-2140 accessory is now installed.

Device Configuration

You must manually configure the BNC-2140 accessory by setting the channel switches. You can configure each input channel to have ICP signal conditioning enabled or disabled, and for DIFF and SE measurements. When ICP signal conditioning is enabled large DC offset voltages can occur on signal inputs due to the output bias voltage requirements of the ICP transducer you are using. To remove this offset you must enable AC coupling on the affected input channels of the DSA device. You can also configure each output channel for DIFF or SE measurements. You can turn the power on or off for the ICP signal conditioning circuitry. If you do not require ICP signal conditioning, turn off the ICP power. Refer to Figure 2-1 for the location of the switches.

Note You can connect or disconnect BNC cables carrying signals without turning off the computer.

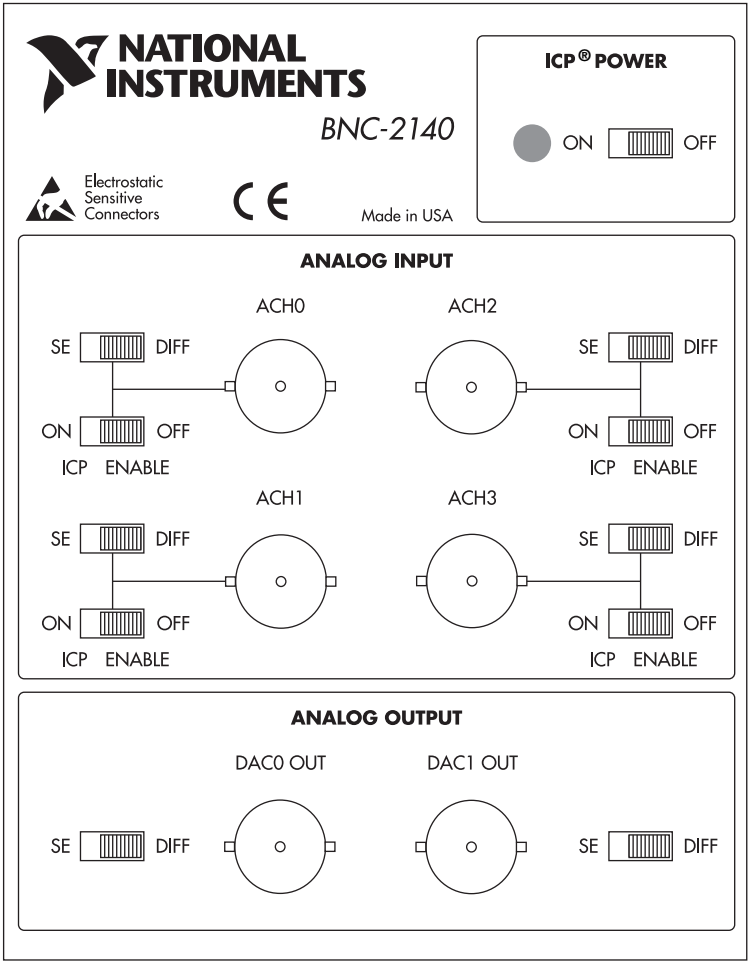

Figure 2-1. Switch Settings and Signal Connections

3

Signal Connections

This chapter describes how to connect input and output signals to your BNC-2140.

You can connect the external analog signals through six BNC connectors. Four of the BNC connectors are for input signals and two of them are for output signals.

The SHC68-C68-A1 shielded cable connects the BNC-2140 internal analog signal connector to the DSA plug-in device. A single 68-pin 0.8 mm VHDCI connector connects the analog I/O signals to the shielded cable.

I/O Connectors

Table 3-1 describes the pin assignments for the six external I/O BNC connectors.

Table 3-1. BNC Analog I/O Connector Signal Descriptions

Signal Name	Reference	Direction	Description
+ACH<0..3>	AIGND	Input	+Analog Input Channel 0 through 3—Each channel can have ICP enabled or disabled. This signal passes through the BNC internal conductor.
–ACH<0..3>	AIGND	Input	–Analog Input Channel 0 through 3—In SE mode the inverting (–) terminal is tethered to ground through a 50 Ω resistor. This signal passes through the external BNC shell.
+DAC0OUT	–DAC0OUT	Output	+Analog Output Channel 0—This pin supplies the analog non-inverting output channel 0. This signal passes through the internal BNC conductor.
–DAC0OUT	+DAC0OUT	Output	–Analog Output Channel 0—This pin supplies the analog inverting output channel 0. This signal passes through the external BNC shell. In SE mode, the inverting (–) terminal is tethered to ground through a 50 Ω resistor.
+DAC1OUT	–DAC1OUT	Output	+Analog Output Channel 1—This pin supplies the analog non-inverting output channel 1. This signal passes through the internal BNC conductor.
–DAC1OUT	+DAC1OUT	Output	–Analog Output Channel 1—This pin supplies the analog inverting output channel 1. This signal passes through the external BNC shell. In SE mode, the inverting (–) terminal is tethered to ground through a 50 Ω resistor.

Figure 3-1 illustrates the pin connections on the BNC-2140 68-pin connector.

–ACH0	1	35	+ACH0
AIGND†	2	36	AIGND
–ACH1	3	37	+ACH1
AIGND†	4	38	AIGND
–ACH2	5	39	+ACH2
AIGND†	6	40	AIGND
–ACH3	7	41	+ACH3
AIGND†	8	42	AIGND
NC	9	43	NC
NC	10	44	NC
NC	11	45	NC
NC	12	46	NC
NC	13	47	NC
NC	14	48	NC
NC	15	49	NC
NC	16	50	NC
NC	17	51	NC
NC	18	52	NC
NC	19	53	NC
NC	20	54	NC
NC	21	55	NC
NC	22	56	NC
NC	23	57	NC
NC	24	58	NC
–DAC0OUT	25	59	+DAC0OUT
AOGND†	26	60	AOGND
–DAC1OUT	27	61	+DAC1OUT
AOGND†	28	62	AOGND
NC	29	63	NC
NC	30	64	NC
NC	31	65	NC
NC	32	66	NC
+5 V	33	67	+5 V
DGND	34	68	DGND

†These AIGND and AOGND pins are not connected in the SHC68-C68-A1 cable

Figure 3-1. BNC-2140 External 68-Pin Analog Connector

Note This BNC-2140 pin assignment maps to the pin assignment of the DSA device you are connecting to the BNC-2140. Refer to your DSA device user manual for the pin assignments specific to your device connection.

Table 3-2 describes the signals for the internal 68-pin I/O connector.

Table 3-2. 68-Pin Analog I/O Connector Signal Descriptions

Signal Name	Reference	Direction	Description
AIGND	—	—	Analog Input Ground—These pins are the reference point for single-ended measurements in SE mode and the bias current return point for differential measurements.
+ACH<0..3>	AIGND	Input	+Analog Input Channel 0 through 3
–ACH<0..3>	AIGND	Input	–Analog Input Channel 0 through 3
+DAC0OUT	–DAC0OUT	Output	+Analog Output Channel 0
–DAC0OUT	+DAC0OUT	Output	–Analog Output Channel 0
+DAC1OUT	–DAC1OUT	Output	+Analog Output Channel 1
–DAC1OUT	+DAC1OUT	Output	–Analog Output Channel 1
AOGND	—	—	Analog Output Ground—The analog output voltages are ultimately referenced to this node.
DGND	—	—	Digital Ground—This pin supplies the reference for the +5 VDC supply.
+5 V	DGND	Output	+5 VDC Source—These pins are fused for up to 0.5 A of +5 V supply on the DSA plug-in device. The fuse is self-resetting. This source powers the ICP circuits of the BNC-2140.
Note: For +ACH<0..3>, –ACH<0..3>, +DAC0OUT, –DAC0OUT, +DAC1OUT, and –DAC1OUT descriptions, see Table 3-1.			

Refer to Figure 3-1 for the pin assignments for the 68-pin connector.

Caution Connections that exceed any of the maximum ratings for input or output signals on the BNC-2140 accessory can damage not only the BNC-2140 but also the DSA plug-in device and the computer. Maximum input ratings for each signal are given in Appendix A, *Specifications*. National Instruments is *not* liable for any damages resulting from signal connections exceeding maximum ratings.

The outer shell of the BNC connectors is not GND (0 V). The outer shell of the BNC is not physically connected to the metal box of the BNC-2140. In DIFF mode, the outer shell is the inverting differential signal; in SE mode, the outer shell is tethered to GND (0 V) through a 50 Ω, 1 W resistor.

Analog Input Signal Connections

The analog input signals for the BNC-2140 device are +ACH<0..3> and –ACH<0..3>. How you connect analog input signals to your BNC-2140 accessory depends on the configuration of the input signal sources.

For most signals, you use a DIFF configuration and simply connect the signal to +ACH*x* (where *x* is the BNC-2140 channel) and the signal ground (or signal minus), as appropriate, to –ACH*x*. If a signal has a high output impedance (greater than 1 kΩ) and is floating, you may find it useful to use an SE configuration that tethers the signal minus to AIGND. This reduces common-mode interference.

Analog Output Signal Connections

The BNC-2140 analog output signals are +DAC0OUT, –DAC0OUT, +DAC1OUT, and –DAC1OUT.

±DAC0OUT is the voltage output signal for analog output channel 0.
±DAC1OUT is the voltage output signal for analog output channel 1.

The way you connect analog output signals from your BNC-2140 accessory depends on the configuration of the devices receiving the signals. For most signals, you use a DIFF configuration and simply connect +DAC*x*OUT (where *x* is the BNC-2140 channel) to the signal and –DAC*x*OUT to the signal ground (or signal minus), as appropriate. When driving some devices with floating grounds, you may sometimes find it helpful to use the SE configuration and connect the floating ground system of the device to AOGND to reduce common-mode noise coupled from an interfering source to the device.

Caution When you configure an analog output channel in the SE mode, the voltage between AOGND and –DAC*x*OUT must *not* exceed ±7.07 V (5 V_{rms}). Voltage that exceeds this rating can damage the BNC-2140, the DSA plug-in device, and the computer. National Instruments is *not* responsible for any damages resulting from connections that exceed this rating.

4

Theory of Operation

This chapter contains a functional overview of the BNC-2140.

Functional Overview

Figure 4-1 is a block diagram of the BNC-2140.

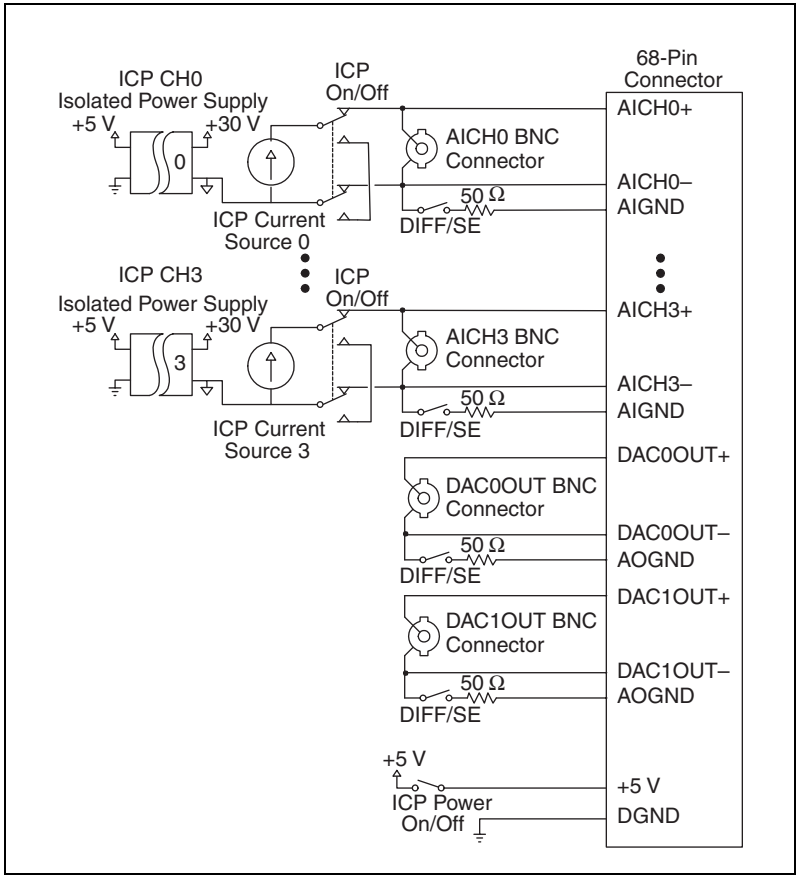

Figure 4-1. BNC-2140 Block Diagram

Analog Input Circuitry

The BNC-2140 has four identical analog input channels.

A principal function of the BNC-2140 is to supply a constant current for ICP-type accelerometers and microphone preamplifiers. Many accelerometers use piezoelectric materials to generate a charge that is proportional to the acceleration applied. Although these types of accelerometers have certain advantages, they are very susceptible to external noise. ICP-type sensor manufacturers embed a charge amplifier within the sensor to reduce the effect of cable length, noise, and other spurious effects. The BNC-2140 supplies the constant current required to power the embedded charge amplifier in the ICP sensor that allows you to use inexpensive cables such as BNC cables. Taking advantage of this technology, some manufacturers use ICP signal conditioning to power their prepolarized microphones. If your application requires a microphone preamplifier for use with a prepolarized microphone see the *Optional Equipment* section in Chapter 1, *Introduction*, for a supplier recommendation.

If you attach an ICP-type of accelerometer or microphone preamplifier to an analog input channel, you must turn on the BNC-2140 ICP power switch and enable the ICP circuit for that channel in order to generate the required power. The ICP circuitry of any input channel can be enabled or disabled independently of that of any other input channel. When you disable ICP for a channel, the connection from the ICP circuit to that channel breaks and has no effect on the incoming signal for that channel. If you do not require ICP to be enabled on any of the four input channels, disable ICP on all four channels and turn off the ICP power to de-energize the circuitry. Turning off the ICP power removes any noise the circuitry can induce on the incoming signal.

You can also use the BNC-2140 to select between DIFF and SE input modes. The BNC-2140 works with any DSA device that has a differential input stage for each input channel.

In DIFF mode, one line connects to the positive input of the channel, and the other connects to the negative input of that same channel. You can connect the differential input to either floating or ground-referenced signals.

You can use ICP signal conditioning when the BNC-2140 inputs are in either DIFF or SE mode.

Analog Output

The BNC-2140 has two analog output channels. The BNC-2140 can also select between DIFF and SE outputs.

In DIFF mode, one line connects to the positive output of the channel and the other connects to the negative output of that same channel. You can connect the differential output to either floating or ground-referenced signals.

A

Specifications

This appendix lists the specifications of the BNC-2140 accessory. All specifications are typical at 25 °C unless otherwise noted. All specifications are relative to measurement standards and require a 15 minute warm-up period. Specifications do not include transducer error.

Analog Input

Voltage Input

Number of channels 4

Maximum input voltage
(Signal + common mode voltage)..... Each input should remain within ±42.4 V (30 V_{rms}) of any other input or of AIGND

Inputs affected..... ACH0, ACH1, ACH2, ACH3

Input coupling ..... DC

Input capacitance[1]

Input Mode	Current Excitation	
	On	Off
DIFF	85 pF	75 pF
SE	150 pF	145 pF

Current Excitation

Level..... 4 mA

Accuracy ..... ±1.31%

Temperature coefficient ..... ±141 ppm/°C

[1] Includes the effects of the BNC-2140 with a 1 m SHC68-C68-A1 analog cable.

Voltage compliance .....24 V

Excitation overvoltage protection.....±42.4 V (30 V_{rms}) powered on or off

Analog Output

Number of channels.....2 (See the Caution in the *Analog Output Signal Connections* section in Chapter 3, *Signal Connections*.)

Output coupling .....DC

Power Requirement (from DSA device)

Power consumption .....400 mA at +5 VDC

Physical

Dimensions .....14.4 by 11.2 by 5.5 cm (5.7 by 4.4 by 2.2 in.)

I/O connectors

- I/O signals.....6 BNC connectors (outer shell isolated from box metal)
- DSA device connection .....68-pin 0.8 mm VHDCI female connector

Environment

Operating temperature .....0 to 40 °C

Storage temperature.....–55 to 150 °C

Relative humidity .....5 to 90% non-condensing

B

Technical Support Resources

Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of `ni.com`

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Glossary

Prefix	Meanings	Value
p-	pico-	10^{-12}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}

Numbers/Symbols

%	percent
+	positive of, or plus
–	negative of, or minus
/	per
°	degree
Ω	ohm
+5 V	+5 VDC source signal

A

A	amperes
AC	alternating current
AC coupled	allowing the transmission of AC signals while blocking DC signals
ACH	analog input channel signal
ADC	analog-to-digital converter—an electronic device, often an integrated circuit, that converts an analog voltage to a digital number
AOGND	analog output ground signal

B

BNC	a type of coaxial signal connector

C

C	Celsius
channel	pin or wire lead to which you apply or from which you read the analog or digital signal; analog signals can be single-ended or differential
common-mode signal	the mathematical average voltage, relative to the computer's ground, of the signals from a differential input
common-mode voltage	any voltage present at the instrumentation amplifier inputs with respect to amplifier ground
coupling	the manner in which a signal is connected from one location to another
current drive capability	the amount of current a digital or analog output channel is capable of sourcing or sinking while still operating within voltage range specifications
current excitation	a source that supplies the current needed by a sensor for its proper operation

D

DAC	digital-to-analog converter—an electronic device, often an integrated circuit, that converts a digital number into a corresponding analog voltage or current
DAC0OUT	analog channel 0 output signal
DAC1OUT	analog channel 1 output signal
DC	direct current
DC coupled	allowing the transmission of both AC and DC signals
DGND	digital ground signal
DIFF	differential mode

differential input	an analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured
differential measurement system	a way you can configure your device to read signals, in which you do not need to connect either input to a fixed reference, such as the earth or a building ground

F

F	farads—a unit of capacitance
floating signal sources	signal sources with voltage signals that are not connected to an absolute reference or system ground–also called nonreferenced signal sources; common examples are batteries, transformers, or thermocouples

G

grounded measurement system	*See* SE.

H

hardware	the physical components of a computer system such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, and cables

I

IC	integrated circuit
ICP	Integrated Circuit Piezoelectric—identifies products that operate using a constant current source and return the output signal in the form of voltage modulation on the same line as the constant current source
in.	inches
input bias current	the current that flows into the inputs of a circuit
input offset current	the difference in the input bias currents of the two inputs of an instrumentation amplifier

instrumentation amplifier	a circuit whose output voltage with respect to ground is proportional to the difference between the voltages at its two inputs
I/O	input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces

M

m	meters

N

NC	normally closed, or not connected
noise	an undesirable electrical signal—comes from external sources such as the AC power line, motors, generators, transformers, fluorescent lights, soldering irons, CRT displays, computers, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors; corrupts signals you are trying to send or receive
nonreferenced signal sources	signal sources with voltage signals that are not connected to an absolute reference or system ground–also called floating signal sources; common examples are batteries, transformers, or thermocouples

P

PCI	Peripheral Component Interconnect—a high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA; offers a theoretical maximum transfer rate of 132 Mbytes/s and is achieving widespread acceptance as a standard for PCs and work-stations
pF	picofarad—one-trillionth of a farad
ppm	parts per million

R

rms	root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude

S

s	seconds
SE	single-ended—a term used to describe an analog input that is measured with respect to a common ground
source impedance	a parameter of signal sources that reflects current-driving ability of voltage sources (lower is better) and the voltage-driving ability of current sources (higher is better)
system noise	a measure of the amount of noise seen by an analog circuit or an ADC when the analog inputs are grounded

T

transducer	a device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal
transducer excitation	a type of signal conditioning that uses external voltages and currents to excite the circuitry of a signal conditioning system into measuring physical phenomena

V

V	volts
VDC	volts direct current
V_{rms}	Volts RMS

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