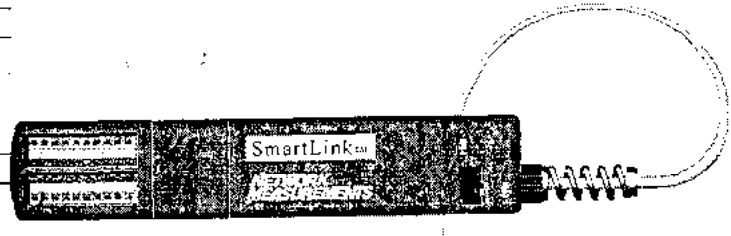
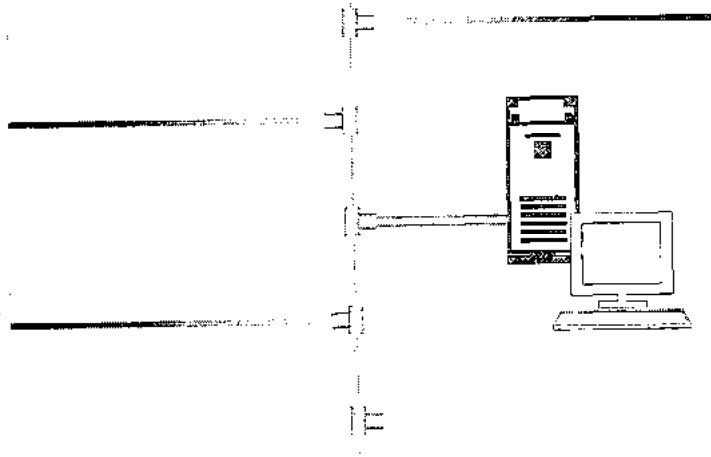
KEITHLEY

Complete SmartLink™
User Manual

User's Manual
&
Programmer's Reference

Network Measurements





KEITHLEY

NETWORK MEASUREMENTS

SmartLink™

June 1997

Warranty

Keithley Instruments, Inc. warrants its SmartLink™ products to be free from defects in material and workmanship for a period of 5 years from date of shipment. Cables, rechargeable batteries, diskettes, and documentation have a 90 day warranty from the date of shipment.

During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley Instruments, Inc. representative, or contact Keithley Instruments, Inc. at 1-800-552-1115. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs or replacements will be made and the product(s) returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from product modification without Keithley Instruments, Inc.'s express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, non-rechargeable batteries, damage from battery leakage, or problems arising from normal wear or failure to follow instructions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES.

NEITHER KEITHLEY INSTRUMENTS, INC. NOR ANY OF ITS EMPLOYEES SHALL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF ITS INSTRUMENTS AND SOFTWARE EVEN IF KEITHLEY INSTRUMENTS, INC. HAS BEEN ADVISED IN ADVANCE OF THE POSSIBILITY OF SUCH DAMAGES. SUCH EXCLUDED DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO: COSTS OF REMOVAL AND INSTALLATION, LOSSES SUSTAINED AS THE RESULT OF INJURY TO ANY PERSON, OR DAMAGE TO PROPERTY.

Safety Precautions

Safety Symbols

On an instrument: This symbol means the viewer should look in the manual for safety instructions before proceeding with installation or repair of the instrument.

In this manual: Warning! Only qualified personnel should make connections to the input connectors on these instruments.

On an instrument: This symbol means the instrument is protected throughout by double insulation and does not require a connection to earth ground.

Safety Instructions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60 VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before connecting or disconnecting signal cables or communications wires.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument back panel.

Do not connect SmartLink™ directly to unlimited power circuits. They are intended to be used with impedance limited sources.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections. Instrumentation and accessories should not be connected to humans.

Maintenance should be performed by qualified service personnel. Before performing any maintenance, disconnect power line cord and all test cables.

Inspection

This instrument was carefully inspected electrically and mechanically before shipment. After unpacking all items from the shipping carton, check for any obvious signs of physical damage that may have occurred during transit. Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment or freight claims. The following items are included with every order:

SmartLink™ instrument with integrated communication cable

Accessories as ordered

Green screw terminal power connector (inserted into the end of the SmartLink™)

User's manual, including Commands Reference

NetAcq startup software

Network Measurements screwdriver

Velcro mount

Local port cable is provided for non-RS232 instruments

Transceivers are included for appropriate Ethernet instruments.

Cleaning Instructions

Disconnect SmartLink™ from all power sources before cleaning. Apply a small amount of isopropyl alcohol to a clean, soft cloth and wipe down exterior of the unit only. Extinguish cigarettes and open flames before initiating cleaning procedure. Do NOT immerse unit in water. Any other cleaning method is NOT recommended.

Manual Print History

The print history shown below lists the printing dates of all Revisions and Addenda created for this manual. The Revision Level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between Revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new Revision is created, all Addenda associated with the previous Revision of the manual are incorporated into the new Revision of the manual. Each new Revision includes a revised copy of this print history page.

Revision 1.0 ..... November 1996

Revision 1.1 ..... December 1996

Revision 1.2C ..... March 1997

Revision 1.3 ..... July 1997

Table of Contents

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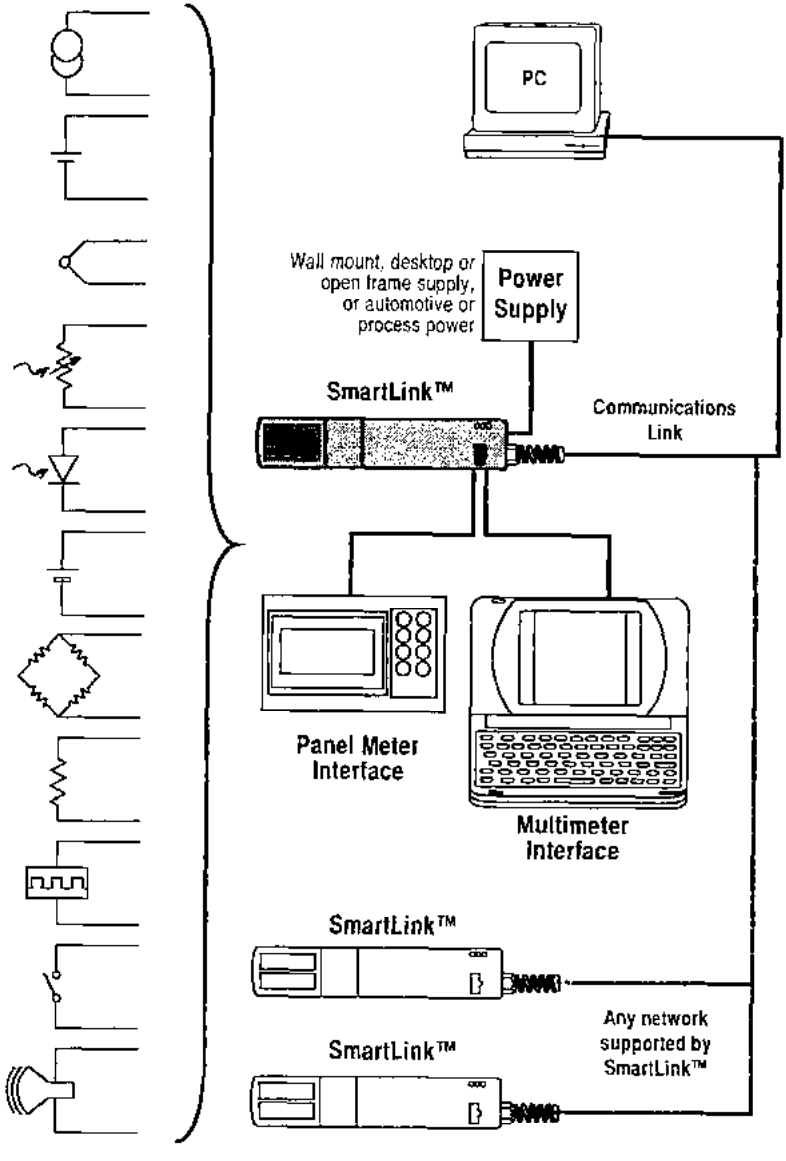
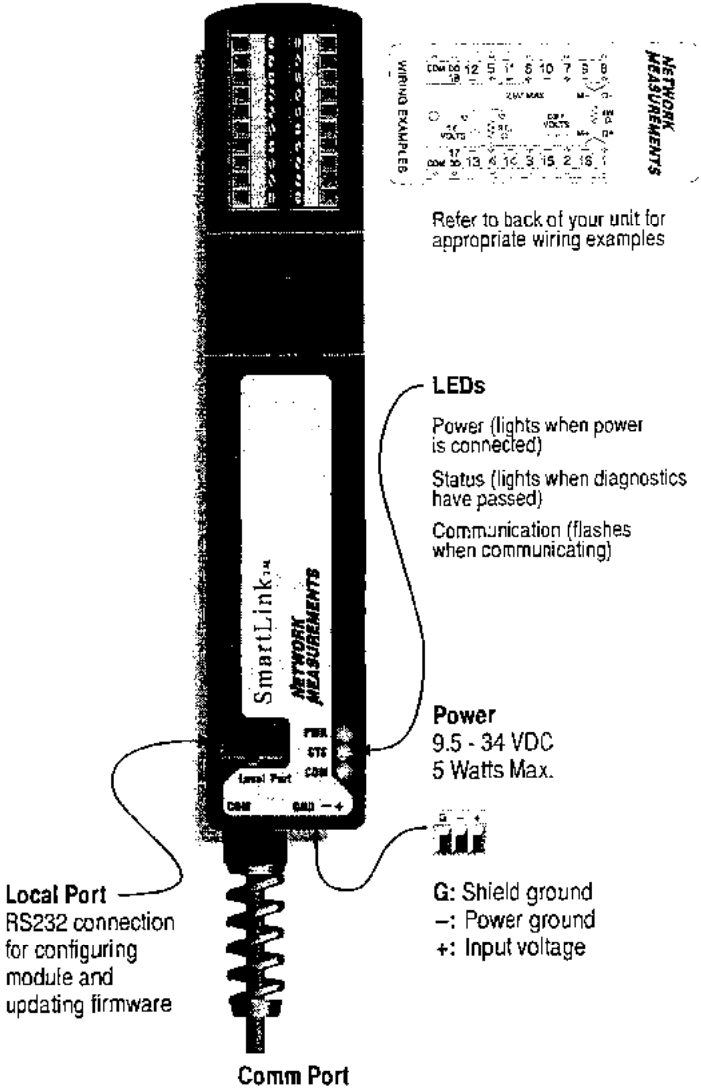
Functional Overview – System



SmartLink™ Connection Instructions



Getting Started

Install NetAcq Software

Your SmartLink™ is delivered with NetAcq, a companion software package that gives you a visual interface to configure SmartLink™ channels and take measurements. You can install NetAcq and then use it to get familiar with some SmartLink™ features.

Perform the following steps in order.

1 Place Disk 1 of the NetAcq software disk set in a 3½" drive (A:) on your computer.

2 Select Run... from your Windows™ program, type A:\setup into the command line, and click OK. Follow the on-screen instructions provided by the setup program.

3 Connect the SmartLink™ instrument's Local Port or RS232 Com Cable to Com1 or Com2 on your PC using the supplied cable.

Power-up SmartLink™

1 Connect devices you want to measure to channel input connectors (See the connection diagram on the back of your SmartLink™, or in this manual.)

2 Power up your SmartLink™ as follows:

Apply power (9.5 - 34 VDC) to power receptacle on end of unit. (Refer to SmartLink™ connection diagram.)

Power (PWR) LED will illuminate green if unit is properly powered.

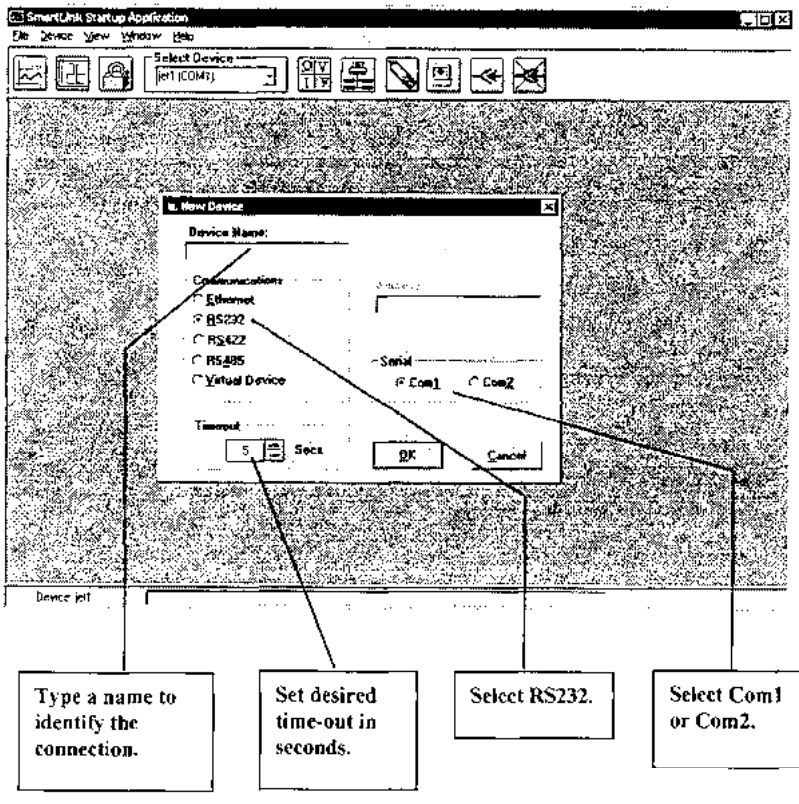
SmartLink™ automatically boots up and runs the following internal diagnostics:

Static RAM test
Flash Memory test
Input unit electronics test
A/D converter test
Microprocessor test

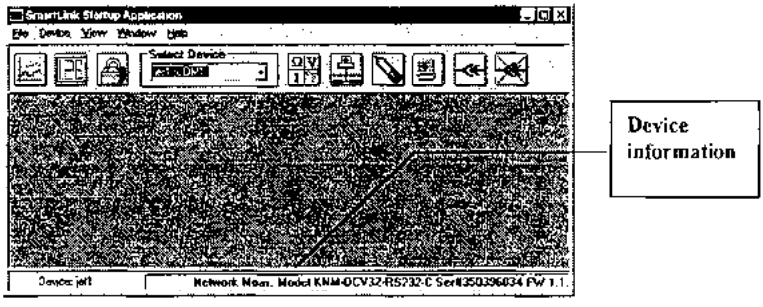
Status (STS) LED illuminates if all tests complete without failure.

Configure Channels

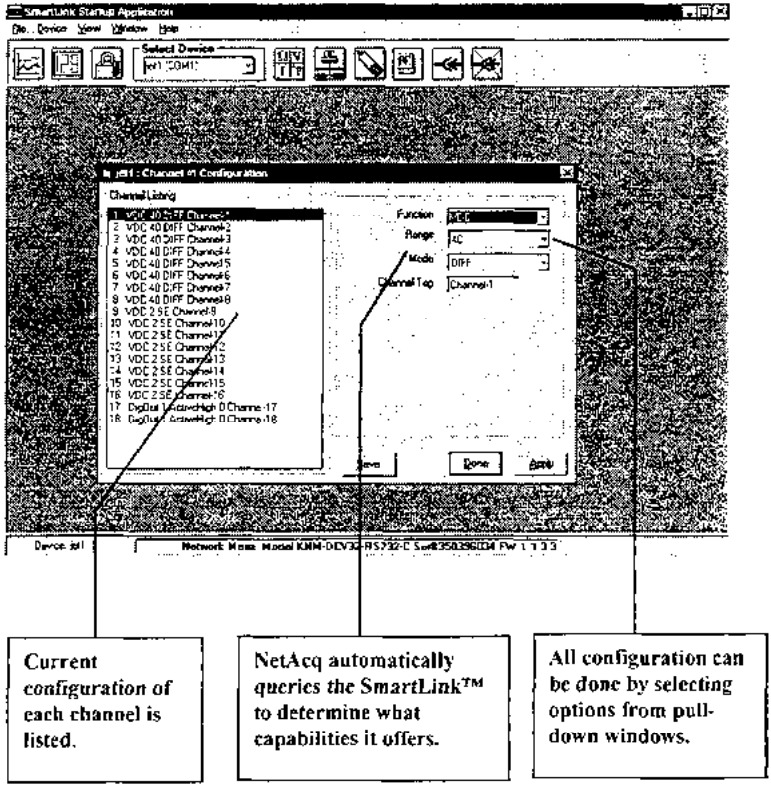
1 Start NetAcq by double-clicking on netacq.exe (in the directory where NetAcq was installed). The following window will open.



2 Click OK after performing the tasks shown above. NetAcq will establish the connection. The window will appear as shown below.



3 Select "Device" on the menu bar then "Configure Device...Channel Config" from the pull-down menu. The window will appear as shown below. (*Clicking the*  *icon on the toolbar brings up the same window.*)

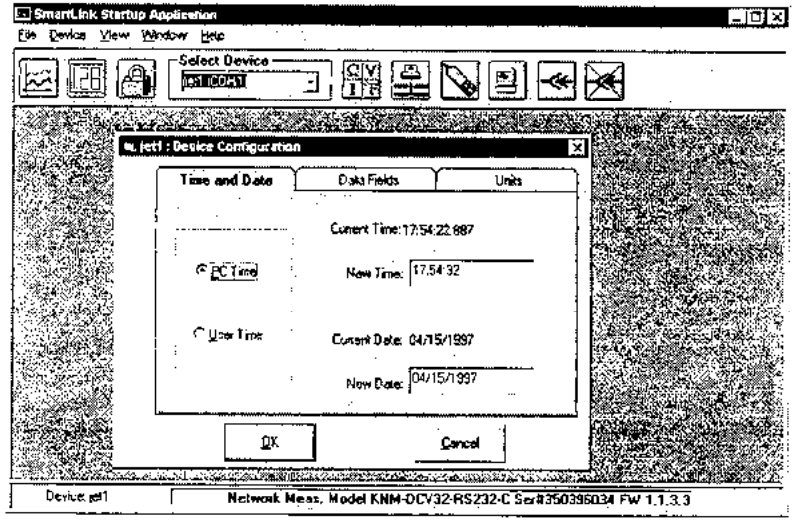


4 Use NetAcq to configure the connected channels as described above. Configure them to measure the correct parameters using the appropriate method (e.g. VDC/DIFF or Ohms/4W).

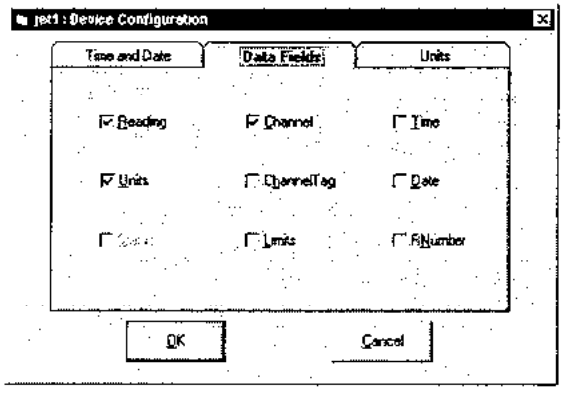
5 When you have finished configuring your channels click on the "Apply" button to use the new settings. If you want to use the new settings the next time you cycle power to the SmartLink™, click the "Save" button.

6 Click the "Done" button when you have finished.

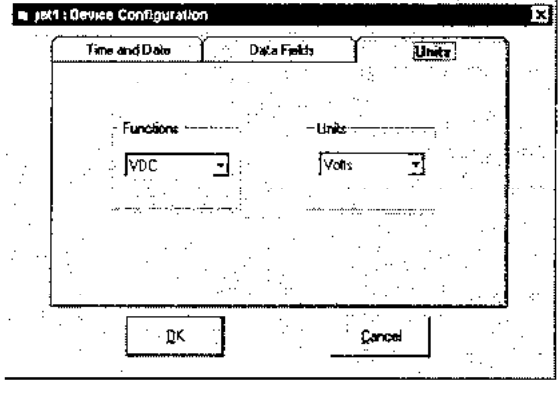
7 Choose "Device" on the menu bar and then "Configure Device...Device Config" from the pull-down menu. The following window will open.



8 Use the items under the "Time and Date" tab to set a specific time, or sync to the PC's clock.



9 Use the items under "Data Fields" to select the data that will be transmitted with each measurement.

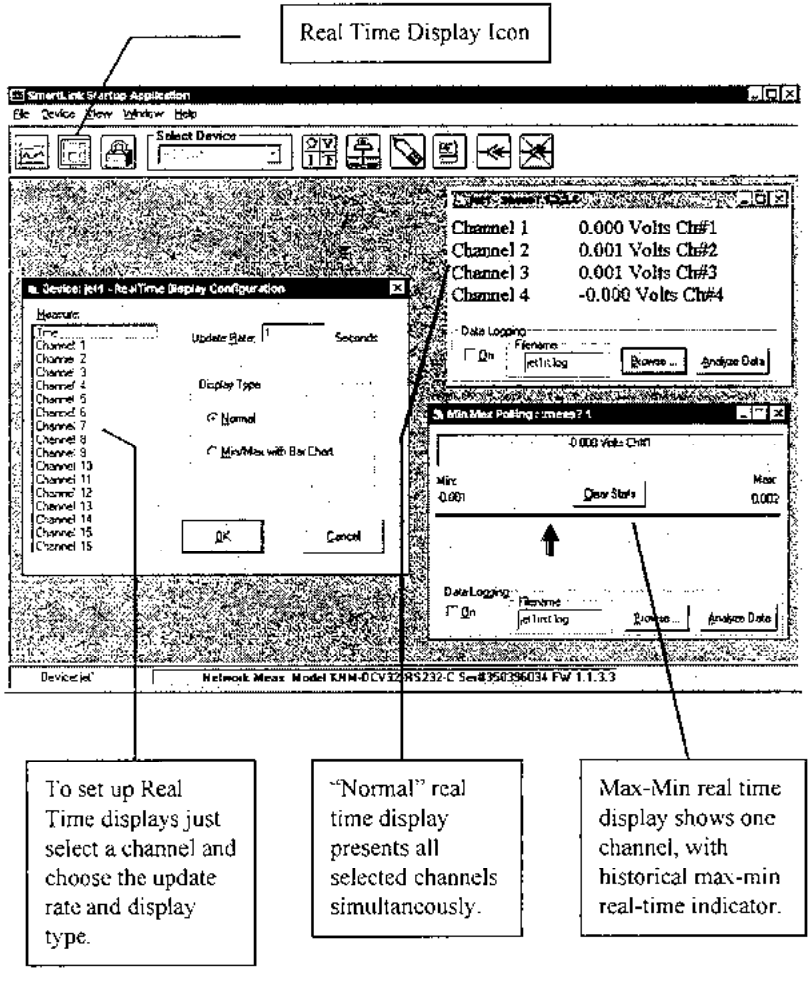


10 Use the items under "Units" to globally set the engineering units that will be applied to all channels measuring the same parameter (e.g. VDC).

Measure Channel Inputs

When you have configured the connected channels you are ready to begin taking data with them. You will use the Real Time Display capability of NetAcq for this task.

1 Select "Real Time Display" mode by clicking on its icon in the toolbar. The following window will open.



2 Select the channel(s) you want to monitor, select Normal or Max/Min, and set the update rate. When you click "OK" in the RealTime Display Configuration" window either the ":meas?" window or the "Max/Min" will open.

You can select multiple channels to monitor using the Normal "Display Type", then reopen the "RealTime Display Configuration" window and select a single channel to monitor using the Max/Min "Display Type" and have both windows open and actively monitoring their channels.

KNM-BRG11 & 12
High Speed Bridge Instruments

Functional Description

The Model BRG12 is a self-contained, strain gage, signal-conditioning instrument for up to three resistive, bridge-type sensor inputs in quarter, half, and full bridge configurations. A single-channel version, Model BRG11, is also available. Bridge completion resistors can be wired directly to SmartLink™ input terminals. High reading throughput of up to 31,000 readings per second make the Model BRG11 and BRG12 valuable for many dynamic strain applications. The on-board reading memory can buffer up to 15,000 8-bit readings or 7,500 16-bit readings.

Standard Features

Limits: Two, high or low per channel; can be associated with a digital output.

Scaling: Zero, span, or mX+b with units per channel.

Statistics: Maximum and minimum readings per channel.

Scanning: Time interval,on command, and level triggered scans. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value, channel number, channel tag, units, reading number, time & date and/or limit status.

Data Storage: Configure reading memory size and resolution; wrap or stop when full; ASCII or binary.

Product Highlights

- Complete bridge to network interface
- Single or 3-channel configurations
- Quarter, half or full bridges
- Full 6-wire bridge
- Throughput to 31,000 rdg/s
- Bridge resistances from 30Ω to 10kΩ
- 5 Year Warranty
- 5 Year ±30°C Accuracy ± < 10 uE
- Miniature Package

Specifications

General

Power Supply:	9.5 to 34 VDC , reverse polarity protected, up to 10% ripple with no degradation, maximum 34VDC.
Power Consumption:	3.5W, 5W max. w/Ethernet
Operating Environment:	-5°C to 65°C, 0-95% RH (NC), Specifications valid for 0-70%RH (NC) up to 35°C; up from 35°C - 65°C linearly derate 3% RH/°C
Storage Environment:	-20°C to 85°C
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231, UL3111
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A
Electrostatic Immunity:	EN50082-1, EIC 801-2 B
Common Mode Fast Transient Immunity:	EN50082-1, IEC801-4 B
Environmental Protection:	NEMA4, IP65 with optional industrial enclosure (-I)
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [3]					ACCURACY			
		RANGE			5 Years ±30°C [1]	24 Hour [2]		
Excitation	Sensitivity	Normal	Unbalanced [4]	GAIN	Raw	Raw	10rdg. Avg.	RESOLUTION
Strain								
1V	2mV/V/1000με	±12,000με	±7,000με	400	±14με	±10με	±4με	±0.4με
	2mV/V/1000με	±24,000με	±19,000με	200	±18με	±12με	±4με	±0.8με
	2mV/V/1000με	±48,000με	±43,000με	100	±34με	±16με	±7με	±1.6με
	2mV/V/1000με	±120,000με	±115,000με	40	±75με	±38με	±15με	±3.9με
2V	2mV/V/1000με	±6,000με	±1,000με	400	±9με	±6με	±2.5με	±0.2με
	2mV/V/1000με	±12,000με	±7,000με	200	±11με	±6με	±2.5με	±0.4με
	2mV/V/1000με	±24,000με	±19,000με	100	±17με	±8με	±3.2με	±0.8με
	2mV/V/1000με	±48,000με	±43,000με	40	±35με	±17με	±7με	±2.0με
	2mV/V/1000με	±120,000με	±115,000με	20	±80με	±45με	±18με	±3.9με
4V	2mV/V/1000με	±3,000με	—	400	±5με	±3με	±1.25με	±0.1με
	2mV/V/1000με	±6,000με	±1,000με	200	±5με	±3με	±1.25με	±0.2με
	2mV/V/1000με	±12,000με	±7,000με	100	±10με	±5με	±2.0με	±0.4με
	2mV/V/1000με	±24,000με	±19,000με	40	±18με	±9με	±3.6με	±1.0με
	2mV/V/1000με	±48,000με	±40,500με	20	±38με	±20με	±8.0με	±2.0με
	2mV/V/1000με	±120,000με	±115,000με	10	±75με	±38με	±15με	±3.9με
10V	2mV/V/1000με	±1,200με	—	400	±2.5με	±2με	±0.8με	±0.05με
	2mV/V/1000με	±2,400με	—	200	±4με	±3με	±1.2με	±0.1με
	2mV/V/1000με	±4,800με	—	100	±7με	±5με	±2.0με	±0.2με
	2mV/V/1000με	±12,000με	±7,000με	40	±14με	±9με	±3.6με	±0.4με
	2mV/V/1000με	±24,000με	±17,750με	20	±29με	±20με	±8.0με	±1.0με
	2mV/V/1000με	±48,000με	±41,750με	10	±48με	±30με	±12.0με	±2.0με

ACCURACY & RESOLUTION (continued) [3]					ACCURACY			
		RANGE			5 Years ±30°C [1]	24 Hour [2]		
Excitation	Sensitivity	Normal	Unbalanced [4]	GAIN	Raw	Raw	10rdg. Avg.	RESOLUTION
Pressure, Weight, Torque								
1V	2mV/V	±80%	—	4000	±1.2%	±0.8%	±0.32%	±0.0038%
		±100%	—	2000	±0.8%	±0.65%	±0.26%	±0.0076%
	3mV/V	±50%	—	4000	±1.2%	±0.8%	±0.32%	±0.0025%
		±100%	—	2000	±0.8%	±0.65%	±0.26%	±0.0052%
	5mV/V	±32%	—	4000	±1.2%	±0.8%	±0.32%	±0.0016%
		±80%	—	2000	±0.8%	±0.65%	±0.26%	±0.0031%
		±100%	—	1000	±0.46%	±0.32%	±0.13%	±0.0061%
	10mV/V	±16%	—	4000	±1.2%	±0.8%	±0.32%	±0.0008%
		±32%	—	2000	±0.8%	±0.65%	±0.26%	±0.0016%
		±80%	—	1000	±0.46%	±0.32%	±0.13%	±0.0031%
		±100%	—	400	±0.15%	±0.1%	±0.04%	±0.0076%
2V	2mV/V	±32%	—	4000	±1.4%	±0.96%	±0.38%	±0.0019%
		±100%	—	2000	±0.72%	±0.48%	±0.19%	±0.0039%
	3mV/V	±25%	—	4000	±1.4%	±0.96%	±0.38%	±0.0013%
		±50%	—	2000	±0.72%	±0.48%	±0.19%	±0.0025%
		±100%	—	1000	±0.44%	±0.32%	±0.13%	±0.0052%
	5mV/V	±16%	—	4000	±1.4%	±0.96%	±0.38%	±0.0008%
		±32%	—	2000	±0.72%	±0.48%	±0.19%	±0.0016%
		±80%	—	1000	±0.44%	±0.32%	±0.13%	±0.0031%
		±100%		400	±0.15%	±0.1%	±0.04%	±0.0076%
	10mV/V	±8%	—	4000	±1.4%	±0.96%	±0.38%	±0.0004%
		±16%	—	2000	±0.72%	±0.48%	±0.19%	±0.0008%
		±32%	—	1000	±0.44%	±0.32%	±0.13%	±0.0016%
		±100%	—	400	±0.15%	±0.1%	±0.04%	±0.0039%
4V	2mV/V	±20%	—	4000	±1.6%	±0.96%	±0.38%	±0.0009%
		±50%	—	2000	±0.8%	±0.48%	±0.19%	±0.0019%
		±100%	—	1000	±0.48%	±0.32%	±0.12%	±0.0038%
	3mV/V	±10%	—	4000	±1.6%	±0.96%	±0.38%	±0.0006%
		±30%	—	2000	±0.8%	±0.48%	±0.19%	±0.0013%
		±60%	—	1000	±0.48%	±0.32%	±0.12%	±0.0025%
		±100%	—	400	±0.16%	±0.1%	±0.04%	±0.0065%
	5mV/V	±8%	—	4000	±1.6%	±0.96%	±0.38%	±0.0004%
		±20%	—	2000	±0.8%	±0.48%	±0.19%	±0.0008%
		±40%	—	1000	±0.48%	±0.32%	±0.12%	±0.0016%
		±100%	—	400	±0.16%	±0.1%	±0.04%	±0.0039%

ACCURACY & RESOLUTION (continued) [3]					ACCURACY			
		RANGE			5 Years ±30°C [1]	24 Hour [2]		
Excitation	Sensitivity	Normal	Un-balanced [4]	GAIN	Raw	Raw	10rdg. Avg.	RESO-LUTION
Pressure, Weight, Torque (continued)								
	10mV/V	±4%	—	4000	±1.6%	±0.96%	±0.38%	±0.0002%
		±10%	—	2000	±0.8%	±0.48%	±0.19%	±0.0004%
		±20%	—	1000	±0.48%	±0.32%	±0.12%	±0.0008%
		±50%	—	400	±0.16%	±0.1%	±0.04%	±0.0019%
		±100%	—	200	±0.08%	±0.05%	±0.02%	±0.0039%
10V	2mV/V	±8%	—	2000	±0.8%	±0.4%	±0.16%	±0.0004%
		±20%	—	1000	±0.6%	±0.4%	±0.16%	±0.0008%
		±40%	—	400	±0.2%	±0.12%	±0.05%	±0.0016%
		±100%	—	200	±0.12%	±0.10%	±0.04%	±0.0039%
	3mV/V	±5%	—	4000	±1.2%	±0.8%	±0.32%	±0.0003%
		±10%	–	2000	±0.8%	±0.4%	±0.16%	±0.0005%
		±20%	–	1000	±0.6%	±0.4%	±0.16%	±0.0010%
		±70%	—	400	±0.2%	±0.12%	±0.05%	±0.0025%
		±100%	—	200	±0.12%	±0.10%	±0.04%	±0.0052%
	5mV/V	±3%	—	4000	±1.2%	±0.8%	±0.32%	±0.0002%
		±8%	-	2000	±0.8%	±0.4%	±0.16%	±0.0003%
		±16%	—	1000	±0.6%	±0.4%	±0.16%	±0.0006%
		±40%	—	400	±0.2%	±0.12%	±0.05%	±0.0013%
		±90%	—	200	±0.12%	±0.10%	±0.04%	±0.0031%
		±100%	—	100	±0.12%	±0.10%	±0.04%	±0.0062%
	10mV/V	±3%	—	2000	±0.8%	±0.4%	±0.16%	±0.0002%
		±8%	—	1000	±0.6%	±0.4%	±0.16%	±0.0003%
		±20%	—	400	±0.2%	±0.12%	±0.05%	±0.0008%
		±40%	—	200	±0.12%	±0.10%	±0.04%	±0.0016%
		±90%	—	100	±0.12%	±0.10%	±0.04%	±0.0032%
		±100%	—	40	±0.096%	±0.072%	±0.029%	±0.008%

To determine the accuracy for a transducer connected to the Smartlink BRG11/12:

Example 1: Calculate the 24 hr raw accuracy of the following Load Cell:

Load Cell: Sensitivity (Positive and Negative Scale Factor in mV/V) of 5.00, a full scale output of 50 lbs
With the Following Smartlink Configuration: 2 V excitation

Configuration Command: Config 1 Weight Gage 50 5.00 5.00 2

Step 1: Smartlink Automatic Selection of the Optimum Gain to maintain full scale measurement capability.

$$\text{Optimum gain} = \frac{10}{(\text{Sensitivity, mV/V}) \times (\text{Excitation, V})}$$

$$= \frac{10}{5\ \text{mV/V} \times 2\ \text{V}} = 1000$$ (Note: 1000 is a valid gain.)

The Smartlink Module will Round down to the nearest valid selectable gain to maintain full scale measurement capability.

Step 2: Calculate the % of range being used:

$$\%\ \text{Range} = \frac{(\text{Optimum Gain Selected from Step 1}) \times (\text{Excitation}) \times (\text{Sensitivity})}{10}$$

$$\%\ \text{Range} = \frac{(1000) \times (2\ \text{V}) \times (5\ \text{mV/V})}{10} = 1 \quad (\text{or } 100\ \%)$$

Step 3: Calculate the maximum value that can be measured:

$$\text{Maximum Engineering Units that can be measured} = \frac{\text{Full Scale Output of Transducer @ Rated Sensitivity}}{\%\ \text{Range from Step 2}}$$

$$\text{Maximum Engineering Units} = \frac{50\ \text{lbs}}{1.0} = 50\ \text{lbs}$$

Step 4: Calculation of Accuracy in Engineering Units

$$\text{Accuracy (In engineering Units)} = (\text{Maximum Engineering Units from Step 3}) \times (\text{Accuracy from Table in Manual})$$

$$\text{Accuracy (In engineering Units)} = (50\ \text{lbs}) \times (+/- 0.32\%) = +/- 0.16\ \text{lbs}$$

ACCURACY & RESOLUTION (continued) [3]		RANGE			ACCURACY 5 Years ±30°C [1]	ACCURACY 24 Hour [2]		
Excitation	Sensitivity	Normal	Unbalanced [4]	GAIN	Raw	Raw	10rdg. Avg.	RESOLUTION
Bridge Voltage								
1.2, or 4 V	2mV/V	±24mV	—	400	40µV	24µV	10µV	0.8µV
	2mV/V	±48mV	—	200	42µV	24µV	9.6µV	1.6µV
	2mV/V	±96mV	—	100	76µV	40µV	16µV	3µV
	2mV/V	±240mV	—	40	180µV	90µV	36µV	7.7µV
1 or 2V	2mV/V	±480mV	—	20	380µV	200µV	80µV	15.3µV
1V	2mV/V	±960mV	—	10	600µV	400µV	160µV	31µV
2 or 4V	2mV/V	±9600mV		10	600µV	360µV	150µV	31µV
	2mV/V	±480mV	—	20	380µV	200µV	80µV	15.3µV
10V	2mV/V	±24mV	—	400	50µV	30µV	12µV	0.8µV
	2mV/V	±48mV	—	200	68µV	50µV	20µV	1.6µV
	2mV/V	±96mV	—	100	136µV	100µV	40µV	3µV
	2mV/V	±240mV	—	40	270µV	180µV	72µV	8µV
	2mV/V	±480mV	—	20	580µV	400µV	160µV	16µV
	2mV/V	±960mV	—	10	960µV	600µV	240µV	31µV

1. Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over ±30°C for 5 years at 10,000 rdgs/sec or lower.
2. Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over ±1°C for 24 hours at 10,000 rdgs/sec or lower.
3. All accuracies include instrument errors such as A/D errors, reference junction errors and conformity errors. Sensor errors cannot be predicted and therefore are not included.
4. With up to 1% imbalance.

EXCITATION VOLTAGE LEVELS AND TOLERANCES		
Excitation Setpoint	Excitation Voltage	Tolerance
1 V	0.950 V	± 0.05 V
2 V	1.950 V	± 0.05 V
4 V	3.900 V	± 0.08 V
10 V	9.750 V	± 0.10 V

1. Use actual excitation voltage measured during calibration to determine power disapated at the sensor (strain gage).
2. With the azero feature on, the excitation voltage is switched from full scale for 450 ms to zero volts for 230 ms periodically.

No. of Bridges per Instrument

BRIDGE RESISTANCE	EXCITATION 1V	2V	4V	10V
5kΩ	>12	>12	>12	>12
1kΩ	>12	>12	10	4
700 Ω	>12	>12	7	2
350 Ω	>12	8	4	1
240 Ω	12	4	2	–
120 Ω	4	2	1	–
30 Ω	1	–	–	–

Analog Performance

Channels: Three (Model BRG12) or One (Model BRG11).

A/D Conversion: 12-16 bit, high-speed, successive approximation (effective resolution)

Excitation: 1V, 2V, 4V, 10V @ 38mA, short-circuit protected. Excitation accuracy is included in overall accuracy specification.

Speed: 0-31kHz.

Bridge Configuration: Full, Half, and Quarter Bridge with provision for external completion resistors.

Bridge Output: Gage factor 2 to 200.

Bridge Resistance: Accepts 30Ω to 10kΩ bridges, 120Ω to 10kΩ without accuracy degradation.

Input Overload Protection: 40V continuous, 8kV electrostatic discharge.

Input Impedance: $10^7\Omega$ minimum.

Frequency Response (Analog Output), typical: -3dB DC to 16kHz.

Measurement Processor

Measurement Resolution: 12-16 bits (effective resolution).

Channel Change Speed: 0.5ms.

Reading Memory (volatile):

Timestamp Resolution	8-Bit Readings		16-Bit Readings		24-Bit Readings	
	Sync [1]	Async [2]	Sync [1]	Async [2]	Sync [1]	Async [2]
None	15,000	15,000	7,500	7,500	5,000	5,000
8-bit	15,000	7,500	7,500	5,000	5,000	3,750
16-bit	15,000	5,000	7,500	3,750	5,000	3,000
24-bit	15,000	3,750	7,500	3,000	5,000	2,500
32-bit	15,000	3,000	7,500	2,500	5,000	2,143

[1] Synchronous (interpolated timestamp)

[2] Asynchronous (timestamp stored with every reading).

Configuration Memory: Non-volatile flash

Timing Accuracy: ± 0.002%/ month

Timing Resolution: 1 ms asynchronous (timestamp with each reading), 10µs synchronous.

Timing Synchronization: ±1 ms between multiple units

Peak Measurements: Stores Highest Absolute Value

Digital Filtering (Any Two in Combination): Average per reading, (1-50 rdgs/measurement) & Moving Average (1-50 measurements)

User Definable Units: 1–4 characters with mX+B scaling

Specific Calculations: Microstrain, pressure, weight, torque

Limits: L1(HI or LO); L2 (HI or LO) per channel

Recorder Output: ±10V (0±100%) for x10, x20, and x40; ±1V (0±100%) for x100, x200, and x400. ±0.1V (0±100%) for x1000, x2000, and x4000. Autozero OFF only.

Command Overview

Measure

:Meas? <chan_list> <#_of_rdgs> |Off>

:Capture? <chan_list> <#_of_rdgs|All> <Immediate|Level <chan#> <level> <HI|Lo>> <interval_usec> <ASCII|Binary>

Filter

:Filter:Dig <chan_list> <On|Off>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

Scaling

:Scaling <chan_list> <On|Off>

:Config:Scaling <chan_list> < &| <mb> &| <table> | <poly>>

:Config:Scaling:MB <chan_list> <m_value> <b_value>

:Config:Scaling:Span <chan_list> <zero_value> <+span> <-span>

:Config:Scaling:Units <chan_list> <"new_units">

Limits

:Limits <<chan_list> |All> <On|Off>

:Config:Limits <chan_list> <Lim1|Lim2> <Hi|Lo> <lim_value> <hysterysis>

:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

Statistics

:Stats:Max? <chan_list>

:Stats:Min? <chan_list>

Config Chans (Per Channel)

:Config <chan_list> Strain Gage <fs_strain_uE><bridge_type>
<gage_factor> <poisson_ratio>
<excitation_voltage> <"chan_tag">

:Config <chan_list> Torque GageDC <rated_cap><p_scale_factor>
<n_scale_factor> <excitation_voltage>
<"chan_tag">

:Config <chan_list> Weight Gage <rated_cap><p_scale_factor>
<n_scale_factor> <excitation_voltage>
<"chan_tag">

Config Units

:Config:Units:Force <Lb|N|Kg|Oz>

:Config:Units:Torque <FtLb|InLb|Nm|Kgm|InOz>

:Config:Units:Weight <Lb|N|Kg|Oz>

:Config:Units:Strain<μE|compmV>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yyy>

:Time:SyncGlobal

System

*Sav,*Rcl (Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (Identification)

Datamem

:DataMem? <All| <chan_list> <scan_list>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

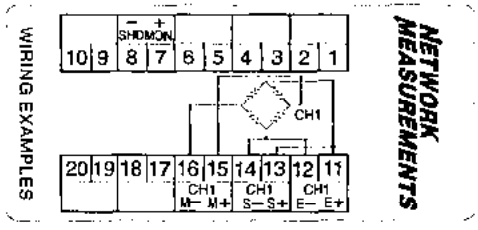
:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

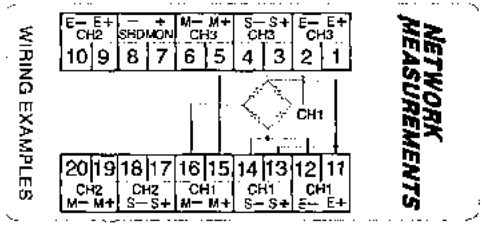
Config Data

:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|
Rnum&|Time&|Date&|Limits&|Stat>

BRG11 Connections

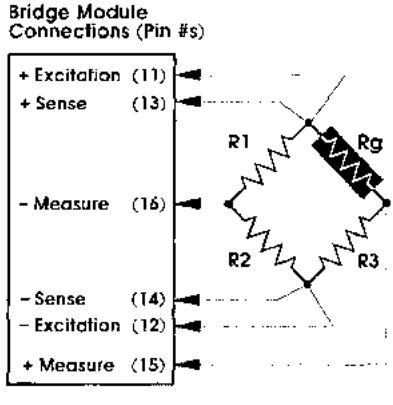


BRG12 Connections

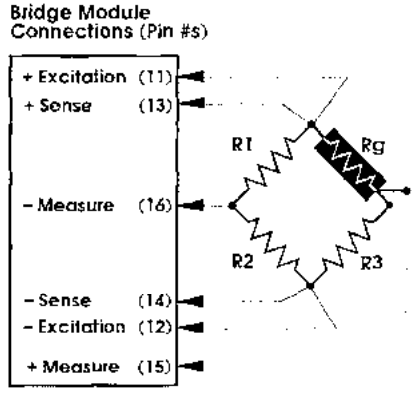


BRG11 & BRG12, Quarter-Bridge Sensor Connections

Note: For 4 wire connections, jumper sense and excitation leads together.



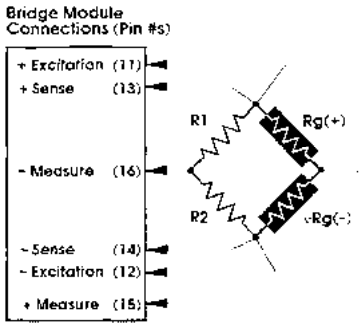
Type 1 — ¼ Bridge
Two-Wire Gage



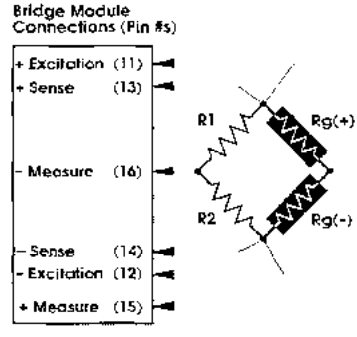
Type 1 — ¼ Bridge
Three-Wire Gage

BRG11 & BRG12, Half-Bridge Sensor Connections

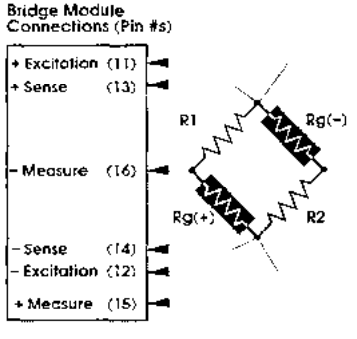
Note: For 4 wire connections, jumper sense and excitation leads together.



Type 2 — ½ Bridge



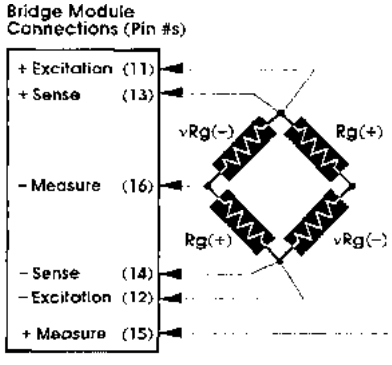
Type 3 — ½ Bridge



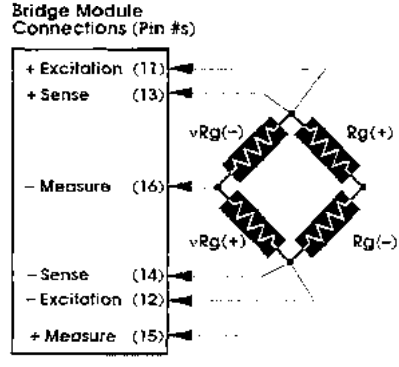
Type 4 — ½ Bridge

BRG11 & BRG12, Full-Bridge Sensor Connections

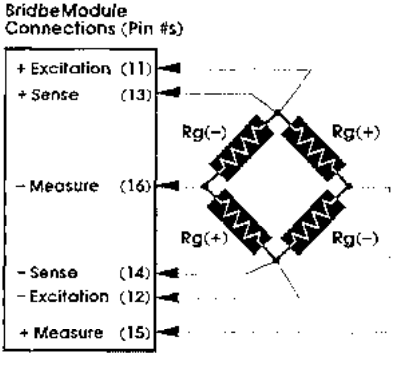
Note: For 4 wire connections, jumper sense and excitation leads together.



Type 5 — Full Bridge



Type 6 — Full Bridge



Type 7 — Full Bridge

KNM-DCV11 & 12

High Speed DC Volts and Ohms

Functional Description

The Models DCV11 and DCV12 are high speed, measuring instruments for computer based systems in field, factory or laboratory applications. A wide choice of interfaces is available to connect the measurements to any network. The Model DCV12 accommodates up to eight single-ended, four differential or two 4-Wire inputs in any combination. The Model DCV11 accommodates a single input of any type. Any input channel can be defined as any of the standard input types: DC Volts, Ohms, Thermistor, RTD, 1/4 or 1/2 Bridge or Digital Input. The user can also apply custom linear scaling, and has 8 characters available for custom units. A Trigger Input, and 4 Digital IO lines are available. The high speed A/D converter delivers 12-bit readings at 33,000 readings per second, and 16-bit readings at 2,000 readings per second. The on-board reading memory can buffer up to 10,000 8-bit readings or 5,000 16-bit readings. Digital filtering, high/low limits and peak hold are standard.

Standard Features

Limits: Two, high or low per channel; can be tied to a digital output.

Scaling: Zero, span, mX+b with units per channel.

Statistics: Maximum and minimum readings per channel.

Scanning: Time interval, discrete time and triggered scans. Trigger on command, level or digital input. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value and/or channel number and/or channel tag and/or units and/or reading number and/or time & date and/or limit status.

Data Storage: Configure reading memory size and resolution; wrap or stop when full; ASCII or binary.

Product Highlights

- Throughput to 33,000 rdgs/sec
- 8 Single-Ended, 4 Differential or two 4-Wire Inputs
- DC Volts, Ohms, RTD's, Thermistors, Digital Input on any channel
- 1 Hardware trigger input line
- 4 Configurable Digital I/O Lines
- 1 Recorder Output
- 5 Year Warranty
- 5 Year ±30°C Accuracy ±0.015%FS

Specifications

General

Power Supply:	9.5 to 34 VDC, reverse polarity protected, up to 10% ripple with no degradation, maximum 34VDC.
Power Consumption:	1.5W, 3W max. w/Ethernet.
Operating Environment:	-5°C to 65°C, 0-95% RH (NC).
Storage Environment:	-20°C to 85°C.
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating.
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231 UL3111.
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A.
Electrostatic Immunity:	EN50082-1, IEC 801-2 B
Common Mode Fast Transient:	EN50082-1, IEC 801-4 B
Environmental Protection:	NEMA 4, IP 65 For Industrial Enclosure (-I).
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [3,4]

Function	Range	5 Year Accuracy [1]	24 hr. Accuracy [2]	Resolution
DC & AC Volts				
	100mV	±0.015%+80 µV	±0.005%+50µV	±10µV
	1V	±0.015%+800 µV	±0.005%+300µV	±100µV
	10V	±0.015%+8 mV	±0.005%+4mV	±1mV
DC Amps, AC Amps (when used with Model DCI-Kit)				
	10mA	±0.17%+8 µA	±0.013%+5 µA	±1µA
	100mA	±0.18%+80 µA	±0.016%+50 µA	±10µA
Resistance				
	100Ω (4Wire)	±0.08% +80mΩ	±0.006%+30mΩ	±10mΩ
	1kΩ (4Wire)	±0.07% +800mΩ	±0.006%+300mΩ	±100mΩ
	10kΩ (4Wire)	±0.9% +8Ω	±0.005%+3Ω	±1Ω
	100kΩ (4Wire)	±0.12% +80Ω	±0.008%+30Ω	±10Ω
	1MΩ (4Wire)	±2% +800Ω	±0.03%+300Ω	±100Ω
RTD's - 4Wire [4] (100 Ω type 385 or 390)				
	-200°C to +70°C	±0.25°C	±0.09°C	±0.01°C
	+70°C to +200°C	±0.66°C	±0.095°C	±0.01°C
	+200°C to +800°C	±1.3°C	±1°C	±0.01°C
Thermistors - 4 Wire [4] (100 Ω to 1MΩ)				
	-80°C to +10°C	±0.1°C	±0.04°C	±0.1°C
	-10°C to +70°C	±0.1°C	±0.04°C	±0.1°C
	+70°C to +250°C	±0.02°C	±0.15°C	±0.1°C

[1] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over ±30°C range for 5 years, <10,000rps.

[2] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over ±1°C range for 24 hours, <10,000rps.

[3] All accuracies include instrument errors such as A/D errors, reference junction errors and conformity errors. Sensor errors cannot be predicted and therefore are not included

[4] Maximum uncertainty for Offset comp ON, Autozero ON, 5 reading filter. Typical accuracy is better.

STABILITY				
FUNCTION/ RANGE	±1°C	TEMPERATURE COEFFICIENT [1,2] ADDITIONAL ERROR AT AMBIENT OF: ±5°C	±10°C	±30°C
DC & AC Volts				
100mV	±0.0%	±0.02%+1µV	±0.044%+6µV	±0.136%+76µV
1V	±0.0%	±0.022%+0	±0.044%+0	±0.12%+530µV
10V	±0.0%	±0.022%+0.1mV	±0.046%+0.6mV	±0.012%+7.6mV
Resistance				
4 Wire				
100Ω (O.C. On)	±0.0%	±0.0046%+ 0Ω	±0.011%+ 0Ω	±0.04%+0Ω
(O.C. Off)	±0.0%	±0.0046%+ 0Ω	±0.011%+ 0Ω	±0.04%+0Ω
1kΩ (O.C. On)	±0.0%	±0.004%+ 0Ω	±0.0102%+ 0Ω	±0.036% +0Ω
(O.C. Off)	±0.0%	±0.004%+ 0Ω	±0.0102%+ 0Ω	±0.036% +0Ω
10kΩ (O.C. On)	±0.0%	±0.003%+ 0Ω	±0.0128 %+ 0Ω	±0.058% +0Ω
(O.C. Off)	±0.0%	±0.003%+ 0Ω	±0.0128 %+ 0Ω	±0.058% +0Ω
100kΩ (O.C. On)	±0.0%	±0.0064%+ 0Ω	±0.0156% + 0Ω	±0.078% +0Ω
(O.C. Off)	±0.0%	±0.0064%+ 0Ω	±0.0156% + 0Ω	±0.078% +0Ω
2 Wire				
1MΩ (O.C. On)	±0.0%	±0.072%+ 10Ω	±0.3% +30Ω	±1.82% +470Ω
(O.C. Off)	±0.0%	±0.072%+ 10Ω	±0.3% +30Ω	±1.82% +470Ω
RTD's – 4Wire [4] (100Ω type 385 or 3916)				
-80°C to 200°C	±0.0°C	±0.036°C	±0.03°C	±0.3°C
+200°C to 800°C	±0.0°C	±0.064°C	±0.52°C	±0.52°C
Thermistors – 4Wire [4] (100Ω to 1MΩ)				
-80°C to +250°C	±0.0°C	±0.002°C	±0.06°C	±0.6°C

[1] Maximum uncertainty for Offset comp ON, Autozero On, 5 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical

STABILITY (CONTINUED)						
FUNCTION/	TIME STABILITY [2] ADDITIONAL ERROR AFTER				NOISE [3] @ MAX SPEED	
RANGE	90 days	1 yr.	2 yr.	5 yr.	RMS	Pk-Pk
DC & AC Volts						
100mV	±0.0074%	±0.02%	±0.034%	±0.056%	±4μV	±20μV
1V	±0.006%	±0.018%	±0.032%	±0.054%	±40μV	±200μV
10V	±0.0108%	±0.024%	±0.042%	±0.070%	±400μV	±2000μV
Resistance						
4 Wire						
100Ω (O.C. On)	±0.0058%	±0.0124%	±0.024%	±0.034%	±0.004Ω	±0.02Ω
(O.C. Off)	±0.0058%	±0.0124%	±0.024%	±0.034%	±0.004Ω	±0.02Ω
1kΩ (O.C. On)	±0.0042%	±0.01%	±0.02%	±0.028%	±0.04Ω	±0.2Ω
(O.C. Off)	±0.0042%	±0.01%	±0.02%	±0.028%	±0.04Ω	±0.2Ω
10kΩ (O.C. On)	±0.0042%	±0.01%	±0.02%	±0.028%	±0.4Ω	±2Ω
(O.C. Off)	±0.0042%	±0.01%	±0.02%	±0.028%	±0.4Ω	±2Ω
100kΩ (O.C. On)	±0.0056%	±0.0102%	±0.0178%	±0.028%	±4Ω	±20Ω
(O.C. Off)	±0.0056%	±0.0102%	±0.0178%	±0.028%	±4Ω	±20Ω
2 Wire						
1MΩ (O.C. On)	±0.030%	±0.056%	±0.098%	±0.172%	±40Ω	±200Ω
(O.C. Off)	±0.030%	±0.056%	±0.098%	±0.172%	±40Ω	±200Ω
RTD's – 4W [4] (100 Ω type 385 or3916)						
-80°C to +200°C	±0.04°C	±0.096°C	±0.172°C	±0.26°C	±0.008°C	±0.04°C
+200°C to +800°C	±0.08°C	±0.168°C	±0.32°C	±0.44°C	±0.03°C	±0.15°C
Thermistors –4W(100 Ω to 1MΩ)						
–80°C to +250°C	±0.0068°C	±0.0124°C	±0.022°C	±0.038°C	±0.004°C	±0.02°C

[1] Maximum uncertainty for Offset comp ON, Autozero On, 5 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical

FUNCTION/ RANGE	INPUT[1,2] IMPEDANCE	EXCITATION/CURRENT O.C OFF[1]	O.C. ON[1]	MAX V
DC Volts				
100mV	>10MΩ			
1V	>10MΩ			
10V	>10MΩ			
Resistance				
100Ω		1mA	500µA	5V
1kΩ		1mµA	500 µA	5V
10kΩ		10µA	5 µA	5V
100kΩ		10µA	0.5 µA	5V
1MΩ		.1µA		5V
RTD's – 4Wire (100 Ω type 385 0r 3916)				
from -80°C to 250°C	see above	see above	see above	see above
Thermistors (100 Ω to 1MΩ)				
from -80°C to 250°C	see above	see above	see above	see above

FUNCTION/ RANGE	INTEGRAL LINEARITY TYPICAL	CONFORMITY ERROR[2]
DC Volts		
100mV	100ppm	–
1V	100ppm	–
10V	100ppm	–
Resistance		
100Ω	100ppm	–
1kΩ	100ppm	–
10kΩ	100ppm	–
100kΩ	100ppm	–
1MΩ	100ppm	–
RTD's – 4Wire (100 Ω type 385 0r 3916)		
from -80°C to 250°C	±0.005°C	±0.2°C
Thermistors (100 Ω to 1MΩ)		
from -80°C to 250°C	±0.002°C	±0.2°C

[1] Typical.
[2] Maximum conformity error of algorithm to standard sensor characteristics.

Analog and Digital Front Ends

Number of Channels DCV11: One of any type, and 2 digital outputs.

Number of Channels DCV12: Eight single-ended or four differential or two 4-wire, or a mix of the above and four digital input/outputs.

Counter/Timer: 1Hz to 20kHz, 0.3V zero crossing.

Trigger Input: TTL (low).

Input Configuration: Single-ended or differential.

A/D Conversion Method: High-speed, successive approximation.

Frequency Response: .±3dB DC to 50kHz.

Input Bias Current: .<10nA.

Common Mode Voltage: 10 Volts (max.).

Common Mode Rejection: >100dB @ DC, 50Hz or 60Hz.

Input Impedance: $10^7\Omega$ (minimum).

Input Overload Protection: >40V continuous, 8kV electrostatic discharge.

Digital Input/Output: 4 TTL, user selectable, 20mA source, 8mA sink.

DCI & ACI Measurement: 100mV burden (1kΩ for 100mA, 10Ω for 10mA), 30V max. ACI up to 1 kHz.

Measurement Processor

Measurement Resolution: 16 bits

Throughput/Resolution (Single Channel): 2000 rdgs/sec 16-bit, 33,000 rdgs/sec 12-bit.

Reading Memory (volatile):

Timestamp Resolution	8-Bit Readings		16-Bit Readings		24-Bit Readings	
	Sync [1]	Async [2]	Sync [1]	Async [2]	Sync [1]	Async [2]
None	15,000	15,000	7,500	7,500	5,000	5,000
8-bit	15,000	7,500	7,500	5,000	5,000	3,750
16-bit	15,000	5,000	7,500	3,750	5,000	3,000
24-bit	15,000	3,750	7,500	3,000	5,000	2,500
32-bit	15,000	3,000	7,500	2,500	5,000	2,143

[1] Synchronous (interpolated timestamp)

[2] Asynchronous (timestamp stored with every reading).

Configuration Memory: Non-volatile flash.

Timing Accuracy: ± 0.002%/month.

Timing Resolution: 1 ms.

Timing Synchronization: ±1 ms between multiple units.

Scaling: mX+B, zero and span, & units designation (4 char.).

Filtering: Average per reading, 1-50 average and moving average.

Peak Measurements: Stores Highest Absolute Values .

Specific Calculations: Callender Van Dusen (RTD), Steinhart & Hart (Thermistor), Microstrain.

Limits: L1 (Hi or Lo); L2 (Hi or Lo) per channel.

Command Overview

Measure

:Meas? <chan_list> <#_of_rdgs> |Off>

:Capture? <chan_list> <#_of_rdgs|All> <Immediate|Level <chan#> <level>
<HI|Lo>> <interval_usec> <ASCII|Binary>

Filter

:Filter:Dig <chan_list> <On|Off>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

Scaling

:Scaling <chan_list> <On|Off>

:Config:Scaling <chan_list> < &| <mb> &| <table> | <poly>>

:Config:Scaling:MB <chan_list> <m_value> <b_value>

:Config:Scaling:Span <chan_list> <zero_value> <+span>
<-span>

:Config:Scaling:Units <chan_list> <"new_units">

Limits

:Limits <<chan_list> |All> <On|Off>

:Config:Limits <chan_list> <Lim1|Lim2> <High|Low> <lim_value>
<hysterysis>

:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

Statistics

:Stats:Max? <chan_list>

:Stats:Min? <chan_list>

Config Chans (Per Channel)

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh| ActiveLow> <DIFF|SE> <"chan_tag">

:Config <chan_list> DigOut <#_of_bits> <ActiveHigh| ActiveLow> <Initial_state> <"chan_tag">

:Config <chan_list> Humidity <type_code> <"chan_tag">

:Config <chan_list> Ohms <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Temp RTD <PT385|PT3916|<User r0 alpha beta delta>> <range><4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Temp Thrmstr <type_code> <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> VDC <range> <DIFF|SE> <"chan_tag">

Config Units

:Config:Units:Ohms <Ohms|Kohms|Mohms>

:Config:Units:Temp <DegC|DegF|K>

:Config:Units:VDC <Volts|mVolts>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yyy>

:Time:SyncGlobal

System

*Sav,*Rcl (Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (Identification)

Output

:Output <chan_list> <value> <step_delay>

:Output <chan_list> <Track <chan#>

Datamem

:DataMem? <All| <chan_list> <scan_list>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

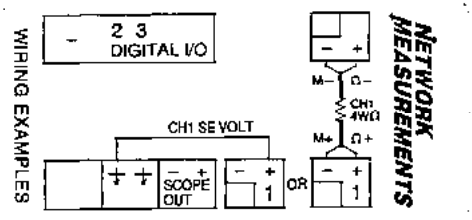
:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

Config Data

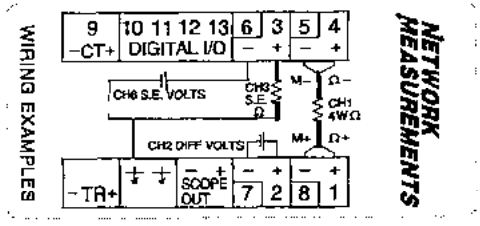
:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|
Rnum&|Time&|Date&|Limits&|Stat>

DCV11 Sensor Connections



Single Channel Volts and Resistance Wiring

DCV12 Sensor Connections



Mixed Wiring

KNM-DCV31 & 32
Precision DC Volts and Ohms

Functional Description

The Models DCV31 and DCV32 are high precision, general purpose, measuring SmartLink™ instruments designed for computer based systems in either field, factory or laboratory applications. A wide array of communication interfaces provides measurements to any network. Up to 8 Differential, 4 Four Wire, or 16 Single Ended inputs in any combination are accommodated by the Model DCV32. The Model DCV31 accommodates a single input of any type. Any input channel can be defined as any of the standard input types: DC Volts, Ohms, Thermistor, RTD, or Digital Input. Or, with mX+b scaling and user defined engineering units, a user can define another input type. A precision sigma delta A/D converter delivers up to 12 readings per second. On-board reading memory can buffer up to 10,000 8-bit readings, 8,000 16-bit readings or 3,500 20-bit readings. Two Form A solid state relay outputs, Digital Filtering, high/low Limits and Peak Hold are standard.

Standard Features

Limits: Two, high or low per channel; can be associated with a digital output

Scaling: Zero, span, mX+b with units per channel

Statistics: Maximum and minimum readings per channel

Scanning: Time interval, discrete time and triggered scans. Trigger on command, level or digital input. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value and/or channel number and/or channel tag and/or units and/or reading number and/or time & date and/or limit status

Data Storage: Configure reading memory to 10K, 5K or 3.5K readings (depends on resolution); wrap or stop when full; ASCII or binary

Product Highlights

Throughput to 12 readings/sec

- DCV32: 8 Differential, 4 Four Wire, or 16 Single Ended inputs
- DCV31: 1 Differential, 1 Four Wire, or 1 Single Ended input
- DC Volts, Ohms, RTD's, Thermistors, Digital Input on any channel
- 2 Digital Outputs
- 5 Year Warranty
- 5 Year ±30°C Accuracy ±0.01%FS
- Miniature DIN Package

Specifications

General

Power Supply:	9.5 to 34 VDC (reverse polarity protected).
Power Consumption:	1.5W, 3W max. w/Ethernet.
Operating Environment:	-5°C to 65°C, 0-95% *RH (NC)*, Specifications valid for 0-70%RH (NC) up to 35°C; up from 35°C - 65°C linearly derate 3% RH/°C
Storage Environment:	-20°C to 85°C.
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating.
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231 UL3111.
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A.
Electrostatic Immunity:	EN50082-1, IEC 801-2 B
Common Mode Fast Transient:	EN50082-1, IEC 801-4 B
Environmental Protection:	NEMA 4, IP 65 For Industrial Enclosure (-I).
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [4]

Function	Range	5 Year Accuracy [1]	24 hr. Accuracy [2]	Resolution
DC Volts [6]				
	200mV (Ch1-Ch16)	±0.099%+80 µV	±0.0030%+5µV	±1µV
	2V (Ch1-Ch16)	±0.099%+80 µV	±0.0028%+27µV	±10µV
	20V (Ch1-Ch8)	±0.12%+8 mV	±0.0031%+400µV	±100µV
	40V (Ch1-Ch8)	±0.12%+8 mV	±0.0034%+2.0mV	±1mV
Resistance				
	200Ω (4Wire) [4]	±0.04%+7mΩ	±0.0026%+5mΩ	±1mΩ
	2kΩ (4Wire) [4]	±0.035%+40mΩ	±0.0026%+40mΩ	±10mΩ
	20kΩ (4Wire) [4]	±0.047%+.7Ω	±0.0034%+500mΩ	±100mΩ
	200kΩ (4Wire) [4]	±0.057%+3Ω	±0.0042%+3Ω	±1Ω
	2MΩ (2Wire) [5]	±1.03%+320Ω	±0.055%+85Ω	±10Ω
	20MΩ (2Wire) [5]	±2.54%+2kΩ	±0.080%+500Ω	±100Ω
	200MΩ (2Wire) [5]	±17.4%+125kΩ	±0.500%+14kΩ	±1kΩ
RTD's - 4Wire [4] (100 Ω type 385 or 390)				
	-200°C to +70°C	±0.13°C	±0.019°C	±0.001°C
	+70°C to +200°C	±0.20°C	±0.025°C	±0.001°C
	+200°C to +800°C	±0.58°C	±0.180°C	±0.001°C
Thermistors - 4 Wire [4] (100 Ω to 1MΩ)				
	-80°C to +10°C	±0.64°C	±0.02°C	±0.0125°C
	+10°C to +70°C	±0.046°C	±0.013°C	±0.0125°C
	+70°C to +250°C	±0.064°C	±0.03°C	±0.0125°C

[1] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±30°C range for 5 years. Tcal = 23±3°C

[2] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±1°C range for 24 hours. Tcal = 23±3°C

[3] 2V maximum input on channels 8-16.

[4] All accuracies include instrument errors such as A/D errors, reference junction errors and conformity errors. Sensor errors cannot be predicted and therefore are not included

[5] 24-hr. specificatin for 4-wire affset compensation (OC) off, 14 reading avg. 5-year specs for 4-wire O.C. on, 8 reading avg.

[6] Specifications for 26 reading avg.

[7] Specifications for 8 reading avg.

TEMPERATURE COEFFICIENT [2]				
FUNCTION/ RANGE	TIME STABILITY [2] ADDITIONAL ERROR AT AMBIENT OF: ±1°C	±5°C	±10°C	±30°C
DC Volts				
200mV	±0.0%	±0.01%+1µV	±0.022%+6µV	±0.068%+76µV
2V	±0.0%	±0.01%+0	±0.022%+0	±0.068%+53µV
20V	±0.0%	±0.011%+.1mV	±0.023%+.6mV	±0.077%+7.6mV
40V	±0.0%	±0.011%+0	±0.023%+1mV	±0.077%+7mV
Resistance				
4 Wire				
200Ω (O.C. On)	±0.0%+2mΩ	±0.0023%+2mΩ	±0.0055%+2mΩ	±0.02%+2mΩ
(O.C. Off)	±0.0%	±0.0023%+2mΩ	±0.0055%+12mΩ	±0.02%+135mΩ
2kΩ (O.C. On)	±0.0%	±0.002%+0	±0.0051%+0	±0.018% +0
(O.C. Off)	±0.0%	±0.002%+2mΩ	±0.0051%+12mΩ	±0.018% +135mΩ
20kΩ (O.C. On)	±0.0%+200mΩ	±0.0015%+200mΩ	±0.0064 % 200mΩ	±0.029% +0
(O.C. Off)	±0.0%	±0.0015%+.1Ω	±0.0064 % +.7Ω	±0.029% +9Ω
200kΩ (O.C. On)	±0.0%	±0.0032%+0	±0.0078% +0	±0.039% +0
(O.C. Off)	±0.0%	±0.0032%+.1Ω	±0.0078% +.7Ω	±0.039% +9Ω
2 Wire				
2MΩ	±0.0%	±0.036%+5Ω	±0.15% +15Ω	±0.91% +235
20MΩ	±0.0%	±0.074%+0	±0.31% +100Ω	±2.38% +1.5kΩ
200MΩ	±0.0%	±0.45%+0	±2.21% +7kΩ	±16.9% +111kΩ
All Ranges	±65mΩ	±.32Ω	±.65Ω	±3.2Ω
RTD's – 4Wire [4] (100Ω type 385 or 390)				
-200°C to +70°C	±0.005°C	±0.012°C	±0.023°C	±0.07°C
+70°C to 200°C	+0.004°C	±0.016°C	+0.032°C	±0.1°C
+200°C to 800°C	±0.0°C	±0.031°C	±0.074°C	±0.26°C
Thermistors – 4Wire [4] (100Ω to 30kΩ				
-80°C to +10°C	±0.0°C	±0.01°C	±0.043°C	±0.33°C
+10°C to +70°C	±0.0°C	±0.005°C	±0.007°C	±0.015°C
+70°C to +190°C	±0.0°C	±0.008°C	±0.009°C	±0.012°C
+190°C to +250°C	±0.0°C	±0.012°C	+0.015°C	±0.025°C
(100kΩ to 1MΩ)				
-80°C to +250°C	±0.0°C	±0.013°C	±0.055°C	±0.44°C

[1] Maximum uncertainty for Offset Com. ON, 8 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical
[4] Specifications for O.C. on, 8 reading avg.

TEMPERATURE COEFFICIENT [2]

FUNCTION/ RANGE	NOISE [3] ADDITIONAL ERROR AFTER 90 days	1 yr.	2 yr.	5 yr.	@ MAX SPEED RMS	Pk-Pk
DC Volts						
200mV	±0.0037%	±0.01%	±0.017%	±0.028%	2.2µV	11µV
2V	±0.003%	±0.009%	±0.016%	±0.027%	19µV	95µV
20V	±0.0054%	±0.012%	±0.021%	±0.035%	220µV	1100µV
40V	±0.0051%	±0.012%	±0.021%	±0.035%	1mV	5mV
Resistance						
4 Wire						
200Ω (O.C. On)	±0.0029%	±0.0062%	±0.012%	±0.017%	5mΩ	25mΩ
(O.C. Off)	±0.0029%	±0.0062%	±0.012%	±0.017%	3.4mΩ	17mΩ
2kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	48mΩ	240mΩ
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	32mΩ	160mΩ
20kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	.44Ω	2.2Ω
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	.3Ω	1.5Ω
200kΩ (O.C. On)	±0.0028%	±0.0051%	±0.0089%	±0.014%	3.2Ω	16Ω
(O.C. Off)	±0.0028%	±0.0051%	±0.0089%	±0.014%	2.2Ω	11Ω
2 Wire						
2MΩ	±0.015%	±0.028%	±0.049%	±0.086%	140Ω	700Ω
20MΩ	±0.013%	±0.026%	±0.047%	±0.084%	1.2Ω	6kΩ
200MΩ	±0.01%	±0.02%	±0.04%	±0.07%	16kΩ	80kΩ
RTD's – 4W [4] (100 Ω type 385 or390)						
–200°C to +70°C	±0.015°C	±0.027°C	±0.045°C	±0.06°C	0.012°C	0.06°C
+70°C to +200°C	±0.022°C	±0.035°C	±0.06°C	±0.09°C	0.012°C	0.06°C
+200°C to +800°C	±0.04°C	±0.075°C	±0.16°C	±0.20°C	0.11°C	0.55°C
Thermistors –4W(100 Ωto30kΩ)						
–80°C to +10°C	±0.005°C	±0.0051°C	±0.01°C	±0.016°C	0.014°C	0.07°C
+10°C to +70°C	±0.006°C	±0.007°C	±0.008°C	±0.01°C	0.006°C	0.03°C
+70°C to +190°C	±0.008°C	±0.01°C	±0.012°C	±0.015°C	0.014°C	0.07°C
+190°C to +250°C	+0.012°C	±0.014°C	±0.0185°C	±0.022°C	0.018°C	0.09°C
(100kΩ to 1MΩ)						
–80°C to +250°C	±0.0073°C	±0.0062°C	±0.011°C	±0.019°C	0.016°C	0.08°C

[1] Maximum uncertainty for Offset Com. ON, 8 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical
[4] Specifications for O.C. on, 8 reading avg.

Function/ Range	Input[2,3] Impedance	Excitation Current O.C. OFF	O.C. ON	Max V
DC Volts				
200mV	>1GΩ			
2V	>1GΩ			
20V	>10MΩ			
40V	>10MΩ			
Resistance				
200Ω	>1GΩ	625 µA–595µA	397 µA	2.6V
2kΩ	>1GΩ	625 µA–416µA	277 µA	2.6V
20kΩ	>1GΩ	12.5 µA–10.9µA	7.3 µA	2.6V
200kΩ	>1GΩ	12.5µA–6.25µA	4.2 µA	2.6V
2MΩ	>1GΩ	.25 µA–.208µA		2.6V
20MΩ	>1GΩ	.25 µA–.083µA		2.6V
200MΩ	>1GΩ	.25 µA–.012µA		2.6V
RTD's – 4Wire (100 Ω type 385 0r 390)				
from –80°C to 250°C	see below	see above		
Thermistors (100 Ω to 1MΩ)				
from –80°C to 250°C	>1GΩ	se above		2.6V

FUNCTION/ RANGE	INTEGRAL LINEARITY TYPICAL	CONFORMITY ERROR[4]
DC Volts		
200mV	20ppm	
2V	20ppm	
20V	20ppm	
40V	20ppm	
Resistance		
200Ω	20ppm	–
2kΩ	20ppm	–
20kΩ	20ppm	–
200kΩ	20ppm	–
2MΩ	20ppm	–
20MΩ	20ppm	–
200MΩ	20ppm	–
RTD's – 4Wire (100 Ω type 385 0r 390)		
from - 80°C to 250°C	±0.005°C	±0.2°C
Thermistors (100 Ω to 1MΩ)		
from –80°C to 250°C	±0.002°C	±0.2°C

[1] Maximum uncertainty for Offset comp ON, Autozero ON, 13 reading filter. Typical accuracy is better.
[2] This uncertainty already included in 5 Year accuracy spec
[3] Typical.
[4] Maximum conformity error of algoritlim to standard sensor characteristics.

Analog and Digital Front Ends

Number of Channels DCV31: One of Any Type.

Number of Channels DCV32: 8 Differential, 4 4-Wire, 16 Single Ended or Digital inputs, or a mix of the above.

Input Configuration: Single Ended or Differential (non-isolated).

A/D Conversion Method: Precision Sigma Delta.

Common Mode Voltage: ±1.7 Volts (max.).

Common Mode Rejection: >100dB @ DC, 50Hz or 60Hz.

Normal Mode Rejection: >60dB @50Hz or 60Hz.

Input Impedance: $10^7\Omega$ (minimum).

Input Overload Protection: >40V continuous, 8kV electrostatic discharge, all pins.

Input Voltage Range (ch. 1-8): .40V.

Input Voltage Range (ch. 6-16): .2V.

Digital Output: 2 TTL, 20mA source, 8mA sink.

Measurement Processor

Measurement Resolution:	20 bits
Throughput:	12 rdgs/sec max.
Reading Memory (volatile):	10,000 8-bit, 5,000 16-bit, 3,500 20-bit.
Time Stamped Readings:	5,000 8-bit, 2,500 16-bit 1,250 20-bit.
Configuration Memory:	Non-volatile flash.
Timing Accuracy:	± 0.002%/month.
Timing Resolution:	1 ms.
Timing Synchronization:	±1 ms between multiple units.
Scaling:	mX+B, zero and span, & units designation (4 char.).
Filtering:	Multi-measurement per reading and moving Average.
Peak Measurements:	Stores Highest Absolute Values per Channel.
Specific Calculations:	Callender Van Dusen (RTD), Steinhart & Hart (Thermistor).
Limits:	L1 (Hi or Lo); L2 (Hi or Lo) per channel.

Command Overview

Measure

:Measure? <chan#> <ON|count|OFF>

:Meas:Max? <chan#>

:Meas:Min? <chan#>

:Meas:Chan?

:Meas:Minmax:Clear

Filter

:Config:Filter:Dig:Meas_per_rdg <#_of_rdgs>

Scaling

:Config:Scale:_MB <chan#> <M_value> <B_value> <disp_range>

Limits

:Limit <chan#><lim#> <sense> <lim_value> <hysteresis>

:Limit:Status? <chan#>

Output

:Output <chan_list> <value>

Statistics

:Stats:Max? <chan_list>

:Stats:Min? <chan_list>

Config Chans (Per Channel)

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh|ActiveLow> <Diff|SE> <"chan_tag">

:Config <chan_list> DigOut <#_of_bits> <ActiveHigh|ActiveLow> <Initial_State> <"chan_tag">

:Config <chan_list> Ohms <range><4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Temp RTD <PT385|PT3916| <UserR0 Alpha Beta Delta>> <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Temp Thrmstr <type_code> <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> VDC <range> <Diff|SE> <"chan_tag">

Config Units

:Config:Units:Ohms <Ohms|Kohms|Mohms>

:Config:Units:Temp <DegC|DegF|K>

:Config:Units:VDC <Volts|mVolts>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yyy>

:Time:SyncGlobal

System

*Sav,*Rcl (Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (Identification)

Datamem

:DataMem? <All| <chan_list> <scan_list>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

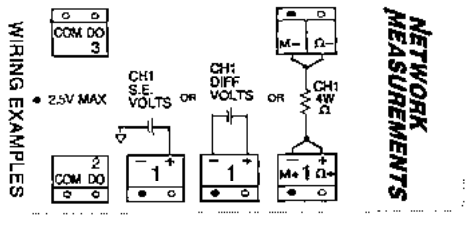
:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

Config Data

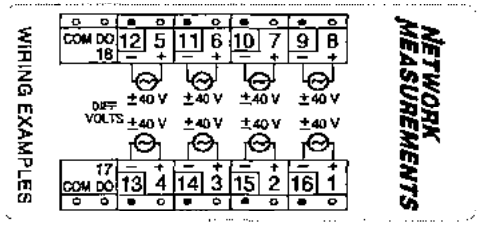
:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|
Rnum&|Time&|Date&|Limits&|Stat>

DCV31 Sensor Connections

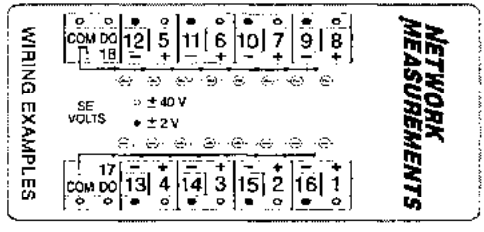


Single Channel Volts and Resistance Wiring

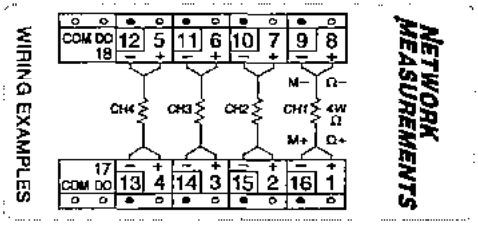
DCV32 SENSOR CONNECTIONS



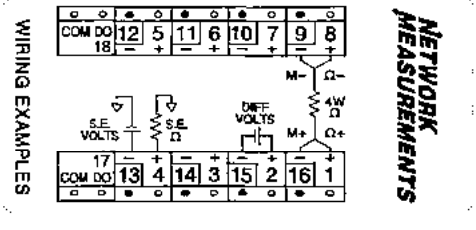
8 Channels Differential Volts Wiring



16 Channels Single-Ended Volts Wiring



4 Channels 4-Wire Resistance/RTD/Thermistor Wiring



Mixed Wiring ● 2.5V Max (Channels: 9-16)

KNM-DCV41 & 42

Isolated Precision DC Volts and Ohms

Functional Description

The Models DCV41 and DCV42 are isolated high precision, general-purpose measuring instruments designed for computer-based systems in field, factory and laboratory applications. A wide array of communication interfaces provide measurements to any network. Up to six differential or three 4-wire inputs in any combination are accommodated by the Model DCV42. The Model DCV41 accommodates one differential, 4-wire, or digital input. Any input channel can be defined as any of the standard input types: DC Volts, Ohms, Thermistor, RTD, thermocouple, or digital input. Other input types can be defined with user selectable scaling functions and four-character units designator. A precision sigma delta A/D converter delivers up to 15 readings per second at full accuracy. On-board reading memory can buffer up to 10,000 8-bit readings, 8,000 16-bit readings or 3,500 20-bit readings.

Standard Features

Limits: Two, high or low per channel; can be associated with a digital output

Scaling: Zero, span, mX+b with units per channel

Statistics: Maximum and minimum readings per channel

Scanning: Time interval, on command, and level triggered scans. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value and/or channel number and/or channel tag and/or units and/or reading number and/or time & date and/or limit status.

Data Storage: Configure reading memory size and resolution; wrap or stop when full; ASCII or binary

Product Highlights

- 1500V Isolation, 400V Inputs
- Throughput to 15 rdgs/sec max
- 6 Fully Isolated or 3 four-wire Channels
- DC Volts, Ohms, RTD's, Thermistors, Thermocouples, Digital Input on any channel
- 1 Digital Output
- 24 Hour Accuracy ±0.0028%
- 5 Year Warranty
- 5 Year ±30°C Accuracy ±0.01%FS
- Miniature Package

Specifications

General

Power Supply:	9.5 to 34 VDC, reverse polarity protected, up to 10% ripple with no degradation, maximum 36VDC.
Power Consumption:	3.5W, 5W max. w/Ethernet.
Operating Environment:	-5°C to 65°C, 0-95% RH (NC), Specifications valid for 0-70%RH (NC) up to 35°C; up from 35°C - 65°C linearly derate 3% RH/°C.
Storage Environment:	-20°C to 85°C.
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating.
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231, UL3111.
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A.
Electrostatic Immunity:	EN50082-1, IEC 801-2 B
Common Mode Fast Transient:	EN50082-1, IEC 801-4 B
Environmental Protection:	NEMA 4, IP 65 For Industrial Enclosure (-I).
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [4]

Function	Range	5 Year Accuracy [1]	24 hr. Accuracy [2]	Resolution
DC Volts [6]				
	20mV	±0.099%+20 µV	±0.0030%+2.5µV	±100µV
	200mV	±0.099%+80 µV	±0.0030%+5µV	±1µV
	2V [3]	±0.099%+80 µV	±0.0028%+27µV	±10µV
	20V [3]	±0.12%+8 mV	±0.0031%+400µV	±100µV
	200V [3]	±0.12%+10 mV	±0.0034%+5mV	±1mV
	400V [3]	±0.12%+20 mV	±0.0034%+20mV	±10mV
Resistance				
	200Ω (4Wire) [5]	±0.04%+7mΩ	±0.0026%+5mΩ	±1mΩ
	2kΩ (4Wire) [5]	±0.035%+40mΩ	±0.0026%+40mΩ	±10mΩ
	20kΩ (4Wire) [5]	±0.047%+.7Ω	±0.0034%+500mΩ	±100mΩ
	200kΩ (4Wire) [5]	±0.057%+3Ω	±0.0042%+3Ω	±1Ω
	2MΩ (2Wire) [7]	±1.03%+320Ω	±0.035%+85Ω	±10Ω
	20MΩ (2Wire) [7]	±2.54%+2kΩ	±0.080%+500Ω	±100Ω
	200MΩ (2Wire) [7]	±17.4%+125kΩ	±0.500%+14kΩ	±1kΩ
RTD's - 4Wire [5] (100 Ω type 385 or 3916)				
	-200°C to +70°C	±0.13°C	±0.019°C	±0.001°C
	-70°C to +200°C	±0.20°C	±0.025°C	±0.001°C
	-200°C to +800°C	±0.58°C	±0.180°C	±0.001°C
Thermistors - 4 Wire [6] (100 Ω to 1MΩ)				
	-80°C to +10°C	±0.64°C	±0.02°C	±0.0125°C
	-10°C to +70°C	±0.46°C	±0.013°C	±0.0125°C
	-70°C to +250°C	±0.064°C	±0.03°C	±0.0125°C
Thermocouples				
Type J	-100°C to 760°C	±0.5°C	±0.4°C	±0.01°C
Type K	-100°C to 1350°C	±0.8°C	±0.4°C	±0.01°C
Type R	0°C to1 767°C	±2.0°C	±0.5°C	±0.01°C
Type E	-100°C to 838°C	±0.5°C	±0.4°C	±0.01°C
Type S	-200°C to 1760°C	±1.8°C	±0.5°C	±0.01°C
Type T	-100°C to 400°C	±0.5°C	±0.4°C	±0.01°C
Type N	-100°C to 400°C	±0.5°C	±0.4°C	±0.01°C

1. Measurement Accuracy = [(measured value x % accuracy) / 100] + offset. e.g. 24 hour, 1kΩ accuracy = [(1000 x 0.0026%) /100] + 40mΩ = 66mΩ if running at higher speeds, add noise @ max speed from chart below. To adjust for intermediate temperature range or time, add values below to 24 hour accuracy.

STABILITY

FUNCTION/ RANGE	±1°C	TEMPERATURE COEFFICIENT [1,2] ADDITIONAL ERROR AT AMBIENT OF: ±5°C	±10°C	±30°C
DC Volts				
20mV	±0.0%	±0.01%+1µV	±0.022%+6µV	±0.068%+76µV
200mV	±0.0%	±0.01%+1µV	±0.022%+6µV	±0.068%+76µV
2V	±0.0%	±0.01%+0	±0.022%+0	±0.068%+53µV
20V	±0.0%	±0.011%+.1mV	±0.023%+.6mV	±0.077%+7.6mV
40V	±0.0%	±0.011%+0	±0.023%+1mV	±0.077%+7mV
400V	±0.0%	±0.011%+0	±0.023%+1mV	±0.077%+7mV
Resistance				
4 Wire				
200Ω (O.C. On)	±0.0%+2mΩ	±0.0023%+2mΩ	±0.0055%+2mΩ	±0.02%+2mΩ
(O.C. Off)	±0.0%	±0.0023%+2mΩ	±0.0055%+12mΩ	±0.02%+135mΩ
2kΩ (O.C. On)	±0.0%	±0.002%+0	±0.0051%+0	±0.018% +0
(O.C. Off)	±0.0%	±0.002%+2mΩ	±0.0051%+12mΩ	±0.018% +135mΩ
20kΩ (O.C. On)	±0.0%+200mΩ	±0.0015%+200mΩ	±0.0064 % 200mΩ	±0.029% +0
(O.C. Off)	±0.0%	±0.0015%+.1Ω	±0.0064 % +.7Ω	±0.029% +9Ω
200kΩ (O.C. On)	±0.0%	±0.0032%+0	±0.0078% +0	±0.039% +0
(O.C. Off)	±0.0%	±0.0032%+.1Ω	±0.0078% +.7Ω	±0.039% +9Ω
2 Wire				
2MΩ	±0.0%	±0.056%+5Ω	±0.15% +15Ω	±0.91% +235
20MΩ	±0.0%	±0.074%+0	±0.31% +100Ω	±2.38% +1.5kΩ
200MΩ	±0.0%	±0.45%+0	±2.21% +7kΩ	±16.9% +111kΩ
2-wire (200Ω-200kΩ)	±65mΩ	±.32Ω	±.65Ω	±3.2Ω
RTD's – 4Wire [4] (100Ω type 385 or 3916)				
200°C to -70°C	±0.005°C	±0.012°C	±0.023°C	±0.07°C
-70°C to 200°C	±0.004°C	±0.016°C	±0.032°C	±0.1°C
-200°C to 800°C	±0.0°C	±0.031°C	±0.074°C	±0.26°C
Thermistors – 4Wire [4] (100Ω to 30kΩ)				
-80°C to +10°C	±0.0°C	±0.01°C	±0.043°C	±0.33°C
+10°C to +70°C	±0.0°C	±0.005°C	±0.007°C	±0.015°C
+70°C to +190°C	±0.0°C	±0.008°C	±0.009°C	±0.012°C
+190°C to +250°C	±0.0°C	±0.012°C	±0.015°C	±0.025°C
(100kΩ to 1MΩ)				
-80°C to +250°C	±0.0°C	±0.013°C	±0.055°C	±0.44°C

[1] Maximum uncertainty for Offset Comp. ON, 8 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical
[4] Specifications for O.C. on, 8 reading avg.

STABILITY (CONTINUED)

FUNCTION/ RANGE	TEMPERATURE COEFFICIENT [1,2] ADDITIONAL ERROR AT AMBIENT OF: ±1°C	±5°C	±10°C	±30°C
Thermocouples				
Type J -210°C to + 760°C				
-100°C to -25°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
-25°C to +760°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type K -270°C to + 1372°C				
0°C to +900°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+900°C to +1350°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type R 0°C to + 1760°C				
+250°C to +450°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+450°C to +1767°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type E -270°C to + 1000°C				
-100°C to -25°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
-25°C to +750°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+750°C to +810°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type S 0°C to + 1760°C				
+200°C to +1767°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type T -270°C to + 390°C				
0°C to +200°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
-200°C to +600°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type N -200°C to + 400°C				
-100°C to -150°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+150°C to +400°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C

[1] Maximum uncertainty for Offset Comp. ON, 8 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical
[4] Specifications for O.C. on, 8 reading avg.

STABILITY (CONTINUED)

FUNCTION/ RANGE	TIME STABILITY [1,2] ADDITIONAL ERROR AFTER 90 days	1 yr.	2 yr.	5 yr.	NOISE [3] # MAX SPEED RMS	Pk-Pk
DC Volts						
200mV	±0.0037%	±0.01%	±0.017%	±0.028%	2.2µV	11µV
2V	±0.003%	±0.009%	±0.016%	±0.027%	19µV	95µV
20V	±0.0054%	±0.012%	±0.021%	±0.035%	220µV	1100µV
40V	±0.0081%	±0.012%	±0.021%	±0.035%	1mV	5mV
Resistance						
4 Wire						
200Ω (O.C. On)	±0.0029%	±0.0062%	±0.012%	±0.017%	5mΩ	25mΩ
(O.C. Off)	±0.0029%	±0.0062%	±0.012%	±0.017%	3.4mΩ	17mΩ
2kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	48mΩ	240mΩ
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	32mΩ	160mΩ
20kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	.44Ω	2.2Ω
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	.3Ω	1.5Ω
200kΩ (O.C. On)	±0.0028%	±0.0051%	±0.0089%	±0.014%	3.2Ω	16Ω
(O.C. Off)	±0.0028%	±0.0051%	±0.0089%	±0.014%	2.2Ω	11Ω
2 Wire						
2MΩ	±0.015%	±0.028%	±0.049%	±0.086%	140Ω	700Ω
20MΩ	±0.013%	±0.026%	±0.047%	±0.084%	1.2Ω	6kΩ
200MΩ	±0.01%	±0.02%	±0.04%	±0.07%	16kΩ	80kΩ
2-wire (200Ω-200kΩ)						
RTD's – 4W [4] (100Ω type 385 or 3916)						
–200°C to –70°C	±0.015°C	±0.027°C	±0.045°C	±0.06°C	0.012°C	0.06°C
–70°C to +200°C	±0.022°C	±0.035°C	±0.06°C	±0.09°C	0.012°C	0.06°C
+200°C to +800°C	+0.04°C	±0.075°C	±0.16°C	±0.20°C	0.11°C	0.55°C
Thermistors –4W(100Ω to 30kΩ)						
–80°C to +10°C	±0.005°C	±0.0051°C	±0.01°C	±0.016°C	0.014°C	0.07°C
+10°C to +70°C	±0.006°C	±0.007°C	±0.008°C	±0.01°C	0.006°C	0.03°C
+70°C to +190°C	±0.008°C	±0.01°C	±0.012°C	±0.015°C	0.014°C	0.07°C
+190°C to +250°C	±0.012°C	±0.014°C	+0.0185°C	±0.022°C	0.018°C	0.09°C
(100kΩ to 1MΩ)						
–80°C to +250°C	±0.0073°C	±0.0062°C	±0.011°C	±0.019°C	0.016°C	0.08°C

[1] Maximum uncertainty for Offset Comp. ON, 8 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical
[4] Specifications for O.C. on, 8 reading avg.

STABILITY (CONTINUED)

FUNCTION/ RANGE	90 days	TIME STABILITY [1,2] ADDITIONAL ERROR AFTER 1 yr.	2 yr.	5 yr.	NOISE [1] @ MAX SPEED RMS	Pk-Pk
Type J -210°C to + 760°C						
–100°C to –25°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
–25°C to +760°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type K -270°C to + 1372°C						
0°C to +900°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+900°C to +1350°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type R 0°C to + 1760°C						
+250°C to +450°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+450°C to +1767°C	+0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type E -270°C to + 1000°C						
–100°C to –25°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
–25°C to +750°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+750°C to +810°C	±0.04°C	±0.075°C	±0.16°C	±0.20°C	0.11°C	0.55°C
Type S 0°C to + 1760°C						
+200°C to +1767°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
Type T -270°C to + 390°C						
0°C to +200°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+200°C to +600°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	+0.0°C	+0.0°C
Type N -200°C to + 400°C						
-100°C to –150°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C
+150°C to +400°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C	±0.0°C

[1] Maximum uncertainty for Offset Comp. ON, 8 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical
[4] Specifications for O.C. on, 8 reading avg.

FUNCTION/ RANGE	INPUT[1,2] IMPEDANCE	EXCITATION CURRENT[4] O.C. OFF	O.C. ON	MAX V
DC Volts				
20mV	>1GW			
200mV	>1GW			
2V	>1GW			
20V	>10MW			
40V	>10MW			
400V	>10MW			
Resistance				
200W	>1GW	625 µA–595µA	397 µA	2.6V
2kW	>1GW	625 µA–416µA	277 µA	2.6V
20kW	>1GW	12.5 µA–10.9µA	7.3 µA	2.6V
200kW	>1GW	12.5µA–6.25µA	4.2 µA	2.6V
2MW	>1GW	0.25 µA–.208µA		2.6V
20MW	>1GW	0.25 µA–.083µA		2.6V
200MW	>1GW	0.25 µA–.012µA		2.6V
RTD's – 4Wire (100 Ω type 385 0r 390)				
from –80°C to 250°C	see below	see above		
Thermistors (100 Ω to 1MΩ)				
from –80°C to 250°C	>1GW	see above		2.6V
Thermocouples				
>1GΩ		see above		

[1] This uncertainty already included in 5 Year accuracy spec.
[2] Typical.
[3] Maximum conformity error of algorithm to standard sensor characteristics.
[4] Lower effective sensor currents can be realized when scanning multiple channels on DCV32.

FUNCTION/ RANGE	INTEGRAL LINEARITY TYPICAL	CONFORMITY ERROR[3]
DC Volts		
20mV	20ppm	
200mV	20ppm	
2V	20ppm	
20V	20ppm	
40V	20ppm	
400V	20ppm	
Resistance		
200Ω	20ppm	–
2kΩ	20ppm	–
20kΩ	20ppm	–
200kΩ	20ppm	–
2MΩ	20ppm	–
20MΩ	20ppm	–
200MΩ	20ppm	–
RTD's – 4Wire (100 Ω type 385 0r 390)		
from –80°C to 250°C	±0.005°C	±0.2°C
Thermistors (100 Ω to 1MΩ)		
from –80°C to 250°C	±0.002°C	±0.2°C
Thermocouple		
>1GΩ	±0.01°C	±0.2°C

[1] This uncertainty already included in 5 Year accuracy spec.
[2] Typical.
[3] Maximum conformity error of algorithm to standard sensor characteristics.
[4] Lower effective sensor currents can be realized when scanning multiple channels on DCV32.

Analog and Digital Front Ends

Number of Channels DCV41: One of any type, and one digital output.

Number of Channels DCV42: 6 Differential or three 4-wire, or a mix of the two. Also has one digital output.

Input Configuration: Isolated single ended or differential.

A/D Conversion Method: Precision Sigma Delta.

Common Mode Voltage: 400VDC, 240V rms, 373V peak.

Common Mode Rejection: >120dB @ DC, 50Hz or 60Hz.

Normal Mode Rejection: >60dB @50Hz or 60Hz.

Channel Isolation: 250V rms.

Instrument Isolation: 1500V (between channels, power and comms).

Input Impedance: $10^7\Omega$ (minimum).

Input Overload Protection: 8kV electrostatic discharge, all pins.

Diagnostics

Fault Detection:	**Fault Prediction**
Open sensor circuit	Degraded calibration
Power failure	Power out of tolerance

Measurement Processor

Measurement Resolution: 20 bits

Throughput: 15 rdgs/sec max.

Reading Memory:

Timestamp Resolution	8-Bit Readings		16-Bit Readings		24-Bit Readings	
	Sync [1]	Async [2]	Sync [1]	Async [2]	Sync [1]	Async [2]
None	10,000	10,000	5,000	5,000	3,333	3,333
8-bit	10,000	5,000	5,000	3,333	3,333	2,500
16-bit	10,000	3,333	5,000	2,500	3,333	2,000
24-bit	10,000	2,500	5,000	2,000	3,333	1,667
32-bit	10,000	2,000	5,000	1,667	3,333	1,429

[1] Synchronous (interpolated timestamp)

[2] Asynchronous (timestamp stored with every reading).

Configuration Memory: Non-volatile flash.

Timing Accuracy: ± 0.002%/month.

Timing Resolution: 1 ms.

Timing Synchronization: ±1 ms between multiple units.

Scaling: mX+B, zero and span, & units designation (4 char.).

Filtering: Multi-measurement per reading and moving Average.

Peak Measurements: Stores Highest Absolute Values per Channel.

Specific Calculations: Callender Van Dusen (RTD), Steinhart & Hart (Thermistor), Microstrain.

Limits: L1 (Hi or Lo); L2 (Hi or Lo) per channel.

Measurements Supported

	DCV41	DCV42
Digital Input Differential	1	6
Digital Output	1	1
Ohms 4-Wire	1	3
Ohms Single Ended	1	6
Temperature/RTD 4-Wire	1	3
Temperature/RTD Single Ended	1	6
Temperature/Thermistor 4-Wire	1	3
Temperature/Thermistor Single Ended	1	6
Temperature/Thermocouple	1	6
VDC Differential	1	6

Command Overview

Measure

:Meas? <chan_list> <#_of_rdgs> |Off>

:Capture? <chan_list> <#_of_rdgs|All> <Immediate|Level <chan#> <level>
<HI|Lo>> <interval_usec> <ASCII|Binary>

Filter

:Filter:Dig <chan_list> <On|Off>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

Scaling

:Scaling <chan_list> <On|Off>

:Config:Scaling <chan_list> < &| <mb> &| <table> | <poly>>

:Config:Scaling:MB <chan_list> <m_value> <b_value>

:Config:Scaling:Span <chan_list> <zero_value> <+span>
<-span>

:Config:Scaling:Units <chan_list> <"new_units">

Limits

:Limits <<chan_list> |All> <On|Off>

:Config:Limits <chan_list> <Lim1|Lim2> <High|Low> <lim_value>
<hysterysis>

:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

Statistics

:Stats:Max? <chan_list>

:Stats:Min? <chan_list>

Config Chans (Per Channel)

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh| ActiveLow> <DIFF>
<"chan_tag">

:Config <chan_list> DigOut <#_of_bits> <ActiveHigh| ActiveLow>
<Initial_state> <"chan_tag">

:Config <chan_list> Ohms <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Temp RTD <PT385|PT3916|<User r0 alpha beta delta>> <range><4W|SE|4WOC|SEOC> <"chan_tag">

:Config<chan_list> Temp TC<tc_type><OpenTCOn|OpenTCOff> <IntRJ|RefJcnTemp><"chan_tag">

:Config <chan_list> Temp Thrmstr <type_code> <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> VDC <range> <DIFF> <"chan_tag">

Config Units

:Config:Units:Ohms <Ohms|Kohms|Mohms>

:Config:Units:Temp <DegC|DegF|K>

:Config:Units:VDC <Volts|mVolts>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yyy>

:Time:SyncGlobal

System

*Sav,*Rcl (Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (Identification)

Output

:Output <chan_list> <value>

Datamem

:DataMem? <All| <chan_list> <scan_list>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

Config Data

:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|
Rnum&|Time&|Date&|Limits&|Stat>

DCV41-42 Safety Precautions

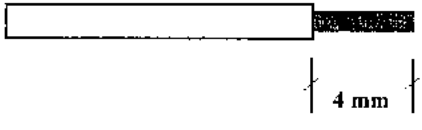
Warning! Only qualified personnel should make connections to the input connectors on these instruments.

Do not make any connections between this instrument and AC power mains!

When hazardous voltages are connected to this instrument, install them in an area protected from contact by non-qualified personnel. Ensure that the instrument stays in a protected area or that the instrument is placed in a safety enclosure that prevents contact with the hazardous voltage.

When you are connecting hazardous voltages and voltage sensitive devices to the same instrument **USE EXTREME CAUTION to ensure you don't create a safety hazard** by allowing the voltage sensitive device leads to contact the hazardous voltage connections.

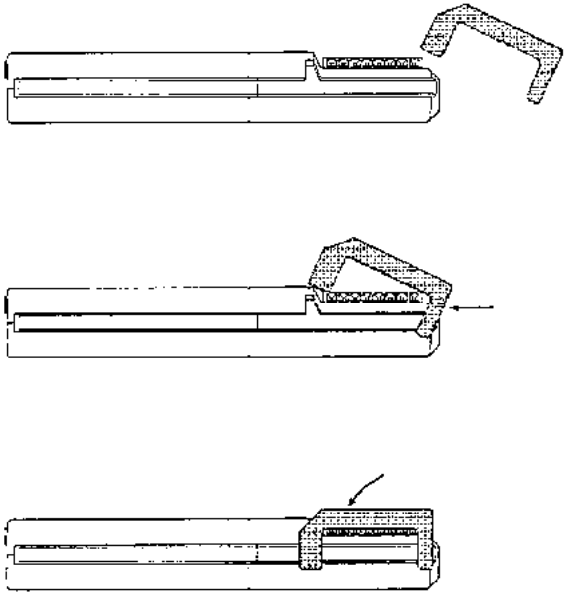
Use only wire guages between 26 - 16 AWG to insert in the input connectors. Strip the wire back a maximum of 4mm from the insertion end as shown in the following figure.



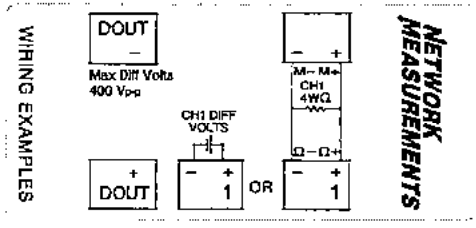
Ensure that the bare wire is inserted completely into the connector so there is none showing after the wire is tightly secured.

Thermocouple Connections

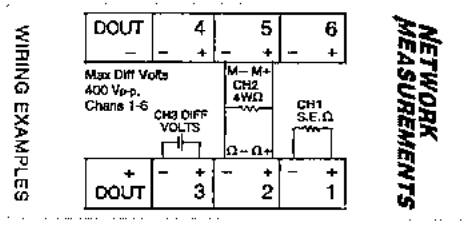
The DCV41-42 SmartLink™ instruments are shipped with an input connector cover that helps thermally stabilize thermocouple connections. You will improve the instrument's temperature measuring performance by installing the cover over the finished thermocouple connections. The following diagram illustrates the installation technique required to get the cover in place.



DCV41 Sensor Connections



DCV42 Sensor Connections



KNM-DYN11 & 12

Piezo & Capacitive Pressure-Force-Acceleration

Functional Description

Now there is an easy, convenient way to interface low impedance piezoelectric and capacitive sensors to your computer or network. With the DYN12, you can accurately measure up to eight channels of pressure, force and acceleration using low impedance, voltage mode piezo sensors—or use the digital instrument with capacitive sensors to measure up to four channels of low frequency or static acceleration. The DYN11 supports one channel.

Because of the small size and form factor, you can use these instruments anywhere: mount the interface on a panel, lay it on the bench, mount it on a DIN rail.

The piezoelectric inputs accept signals from up to eight 2-wire sensors with a low impedance, voltage output (ICP compatible). A built-in constant current supply provides the required excitation current to the sensors. You can also use capacitive accelerometers, and the unit will power and accept signals from up to four accelerometers.

The DYN11/12 is excellent for general vibration measurement, where it can support single channel or multichannel burst measurements. For modal analysis, multiple DYN11/12s can provide the simultaneity needed.

Twenty screw terminals are provided for the inputs. There is an analog recorder/scope output scaled from 0 to ±10 volts. The instrument circuitry includes gain settings and filtering, including second order high-pass and low-pass filters with a wide range of selectable corner frequencies.

These instruments are easy to interface to your computer or network. They contain an on-board microcomputer that provides a powerful combination of data acquisition, signal processing and communication capabilities, enabling processed information to be transmitted to the host computer.

You also eliminate signal processing and significantly reduce hardware and cabling.

Standard Features

Limits: Two per channel, high or low.

Scaling: Zero, span, or mX+b with units per channel.

Statistics: Maximum and minimum readings per channel.

Scanning: Time interval, on command, and level triggered scans. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value, channel number, channel tag, units, reading number, time & date and/or limit status.

Data Storage: Configure reading memory size and resolution; wrap or stop when full; ASCII or binary.

Product Highlights

- Power supply and signal conditioner for low impedance piezo & capacitive sensors
- Up to 8 transducer or digital inputs
- Throughput to 33,000 readings/second
- Microprocessor controlled
- Small size (6.2in. x 1.2in. x 0.9in.)
- 1 temperature input
- Analog monitor output

Specifications

General

Power Supply:	9.5 to 34 VDC reverse polarity protected, up to 10% ripple with no degradation, maximum 34VDC.
Power Consumption:	3W, 4.5W max. w/Ethernet
Operating Environment:	–5°C to 65°C, 0–95% RH (NC)
Storage Environment:	-20°C to 85°C
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231, UL3111
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A
Electrostatic Immunity:	EN50082-1, EIC 801-2 B
Common Mode Fast Transient Immunity:	EN50082-1, IEC801-4 B
Environmental Protection:	NEMA4, IP65 with optional industrial enclosure (–I)
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	<0.25 kg (<0.5 lb).
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [3,6]

Function	Range	Gain	5 Year Accuracy [1]	24 Hour Accuracy [2]	Noise RMS	P-P	Resolution
Response Volts [6]							
	±100mV	x100	0.8% + 20 µV	0.03% + 20µV	±12µV	±80µV	10µV
	±1V	x10	0.6% + 100 µV	0.02% + 100µV	±20µV	±150µV	100µV
	±10V	x1	0.3% + 1mV	0.02% + 1mV	±0.15mV	±1mV	1mV
Acceleration, Pressure, Weight [5]							
	To determine range, multiply expected full scale input (g, lb, psi, kg) by transducer sensitivity.		To determine accuracy, multiply measured input (g, lb, psi, kg) by the 5 year or 24 hour % accuracy, add mV or µV errors above divided by the transducer sensitivity for total accuracy.			To determine noise and resolution, divide figures above by transducer sensitivity.	
Thermistors – 2-Wire (10kΩ types) [4]							
	-40°C to 20°C		±4.0 °C	±3.5 °C			±0.1°C
	20°C to 0°C		±1.8 °C	±1.5 °C			±0.1°C
	0°C to +18°C		±0.7 °C	±0.6 °C			±0.1°C
	+18°C to +50°C		±0.35 °C	±0.3 °C			±0.1°C
	+50°C to +110°C		±0.7 °C	±0.5 °C			±0.1°C

[1] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over ±30°C range for 5 years, digital filter, 25 rdgs.

[2] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over +1°C range for 24 hours, digital filter, 25 rdgs.

[3] All accuracies include instrument errors such as A/D errors, reference junction errors and conformity errors. Sensor errors cannot be predicted and therefore are not included. Autozero on, Null off.

[4] Lead wires in excess of 2Ω may affect accuracy.

[5] Add ±40µV/°C and ±4mV if Null command used.

[6] For temperatures between ±1° and ±30°C, temperature coefficient is 0.007%/°C for 10V, 0.015%/°C for 1V, and 0.0225%/°C for 100mV.

Analog Performance

Number of Channels, DYN11: 1 channel piezo or capacitive, 1 channel thermistor, and scope output.

Number of Channels, DYN12: 8 channels piezo or 4 channels capacitive, 1 channel thermistor, and scope output.

Coupling: DC or AC (see high-pass filter) or DC with offset correction.

Sensor Excitation: 2.4mA ± 0.3mA, 20V typ. compliance for piezo; 12V ± 5% @ 40mA per SmartLink max. for capacitive.

Connections: 20 screw terminals.

Nulling: Auto offset for piezo & capacitive up to 15V.

A/D Conversion Method: High speed successive approximation.

Frequency Response: DC to 30kHz (±3dB).

Low pass Filter: 2 pole butterworth, –12dB/octave. 100, 1k, 10k, 30kHz (±10%) selectable 3dB cutoff frequencies. This corresponds to 60Hz, 600Hz, 6kHz, and 17kHz cutoff at 5% down.

High Pass Filter: 2 pole passive, –12dB/octave, 0.04Hz cutoff frequency (eliminates 1/f noise that can appear as short-term drift).

Input Bias Current: <10nA. At 25 °C

Input Slew Rate: 1.2V/µs typical.

Input Impedance: $10^6\Omega$ (minimum) for capacitive.

Input Overload Protection: ÷25V, –13V continuous, 8kV electrostatic discharge.

Measurement Processor

Measurement Resolution: 12-16 bits. effective resolution

Channel Change Speed: 1.5ms for DC coupling, longer for AC.

Reading Memory (volatile):

Timestamp Resolution	8-Bit Readings		16-Bit Readings		24-Bit Readings	
	Sync [1]	Async [2]	Sync [1]	Async [2]	Sync [1]	Async [2]
None	15,000	15,000	7,500	7,500	5,000	5,000
8-bit	15,000	7,500	7,500	5,000	5,000	3,750
16-bit	15,000	5,000	7,500	3,750	5,000	3,000
24-bit	15,000	3,750	7,500	3,000	5,000	2,500
32-bit	15,000	3,000	7,500	2,500	5,000	2,143

[1] Synchronous (interpolated timestamp)

[2] Asynchronous (timestamp stored with every reading).

Configuration Memory: Non-volatile flash

Timing Accuracy: ± 0.002%/month.

Timing Resolution: ±10µs for capture.

Timing Synchronization: ±1ms between multiple units.

Scaling: mX+B & units designation (4 char.).

Filtering: Average per reading, 1–50 measurements and moving average.

Peak Measurements: Stores highest absolute value.

Limits: LIM1 (HI or LO); LIM2 (HI or LO) per channel.

Measurements Supported

	DYN11	DYN12
Acceleration/Capacitive	1 chan.	4 chan.
Acceleration/Piezo	1	8
Calculated	1*	4*
Digital Input Single Ended	1	8
Force/Piezo	1	8
Pressure/Piezo	1	8
Temperature/Thermistor Single Ended	1	1

*Call factory for upgrading to this capability.

Commands Overview

Measure

:Meas? <chan_list> <#_of_rdgs> |Off>

:Capture? <chan_list> <#_of_rdgs|All> <Immediate|Level <chan#> <level> <Hl|Lo>> <interval_usec> <ASCII|Binary>

Filter

:Filter:Dig <chan_list> <On|Off>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

Scaling

:Scaling <chan_list> <On|Off>

:Config:Scaling <chan_list> < &| <mb> &| <table> | <poly>>

:Config:Scaling:MB <chan_list> <m_value> <b_value>

:Config:Scaling:Span <chan_list> <zero_value> <+span> <-span>

:Config:Scaling:Units <chan_list> <"new_units">

Limits

:Limits <<chan_list> |All> <On|Off>

:Config:Limits <chan_list> <Lim1|Lim2> <Hi|Lo> <lim_value> <hysterysis>

:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

Statistics

:Stats:Max? <chan_list>

:Stats:Min? <chan_list>

Config Chans (Per Channel)

:Config <chan_list> Accel <Piezo|Cap> <fs_accel_g>
<mV/g> <AC|DC> <30K|10K|1K|100>
<"chan_tag">

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh| ActiveLow> <SE>
<"chan_tag">

:Config <chan_list> Force Piezo <fs_force_lb> <mV/lb> <AC|DC>
<30K|10K|1K|100> <"chan_tag">

:Config <chan_list> Pressure Piezo <fs_psi> <mV/psi> <AC|DC>
<30K|10K|1K|100> <"chan_tag">

:Config <chan_list> Temp Thrmstr <type_code> <range> <SE|>
<"chan_tag">

Config Units

:Config:Units:Accel <g|mps2|fps2>

:Config:Units:Force <Lb|N|Kg|Oz>

:Config:Units:Temp <DegC|DegF|K>

:Config:Units:Pressure <psi|Atm|KPa>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yyy>

:Time:SyncGlobal

System

*Sav,*Rcl (Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (Identification)

Datamem

:DataMem? <All| <chan_list> <scan_list>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

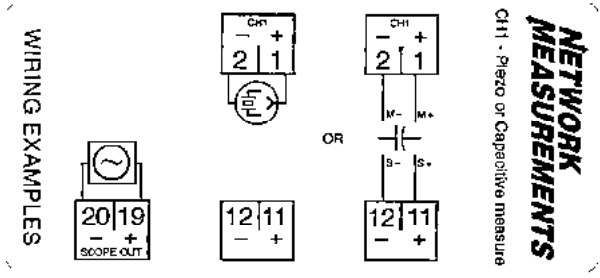
:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

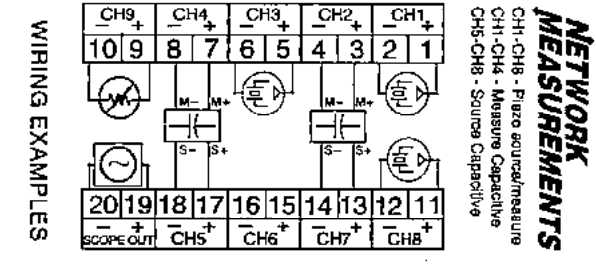
Config Data

:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|
Rnum&|Time&|Date&|Limits&|Stat>

DYN11 Connections



DYN12 Connections



KNM-RTD31 & 32
Platinum Resistance Thermometer

Functional Description

Models RTD31 and RTD32 are dedicated temperature measuring instruments designed for use in computer based systems in field, factory or laboratory applications using Platinum Resistance Thermometers (RTD's/PRT's). Both can also be used for general purpose measuring of ohms and digital inputs. Model RTD31 measures a single 4-wire or 2-wire RTD and has two digital outputs, while Model RTD32 accommodates eight 2-wire or four 4-wire RTD's and also has two digital outputs. A high precision, 20-bit sigma-delta A/D converter delivers 7 readings per second throughput in 2-wire and 4-wire modes or 5 per second in 4-wire with an offset compensation. On-board reading memory can buffer up to 10,000 8-bit readings, 5,000 16-bit readings and 3,500 20-bit readings. Digital filtering, peak measurements, limits and mX+b scaling are standard.

Standard Features

Limits: Two, high or low per channel; can be associated with a digital output.

Scaling: Zero, span, mX+b with units per channel.

Statistics: Maximum and minimum readings per channel.

Scanning: Time interval, on command, and level triggered scans. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value and/or channel number and/or channel tag and/or units and/or reading number and/or time & date and/or limit status.

Data Storage: Configure reading memory size and resolution; wrap or stop when full; ASCII or binary.

Product Highlights

- Complete Measuring Solution
- Four 4-Wire or eight 2-Wire RTDs
- Supports any RTD types
- 2 Digital Outputs
- 5 Year Warranty
- 5 Year ±30° C Accuracy: ±0.03°C
- 24 hr Accuracy: ±0.02°C
- Miniature Package
- Accepts Custom RTD Parameters

Specifications

General

Power Supply:	9.5 to 34 VDC, reverse polarity protected, up to 10% ripple with no degradation, maximum 34VDC.
Power Consumption:	1.5W, 3W max. w/Ethernet.
Operating Environment:	-5°C to 65°C, 0-95% RH (NC), Specifications valid for 0-70%RH (NC) Up to 35°C. Linearly derate 3% RH/°C, 35°C - 65°C.
Storage Environment:	-20°C to 85°C.
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating.
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231 UL3111.
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A.
Electrostatic Immunity:	EN50082-1, IEC 801-2 B
Common Mode Fast Transient:	EN50082-1, IEC 801-4 B
Environmental Protection:	NEMA 4, IP 65 For Industrial Enclosure (-I).
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION

Function	Range	5 Year Accuracy [1]	24 hr. Accuracy [2]	Resolution
Resistance				
	200Ω (4Wire) [3]	±0.04%+7mΩ	±0.0026%+5mΩ	±1mΩ
	2kΩ (4Wire) [3]	±0.035%+40mΩ	±0.0026%+40mΩ	±10mΩ
	20kΩ (4Wire) [3]	±0.047%+.7Ω	±0.0034%+500mΩ	±100mΩ
	200kΩ (4Wire) [3]	±0.057%+3Ω	±0.0042%+3Ω	±1Ω
	2MΩ (2Wire) [4]	±1.03%+320Ω	±0.035%+85Ω	±10Ω
	20MΩ (2Wire) [4]	±2.54%+2kΩ	±0.080%+500Ω	±100Ω
	200MΩ (2Wire) [4]	±17.4%+125kΩ	±0.500%+14kΩ	±1kΩ
RTD's - 4Wire [5] (100 Ω type 385 or 3916)				
	-200°C to +70°C	±0.13°C	±0.019°C	±0.001°C
	+70°C to +200°C	±0.20°C	±0.025°C	±0.001°C
	+200°C to +800°C	±0.58°C	±0.180°C	±0.001°C

[1] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±30°C range for 5 years. Tcal = 23±3°C

[2] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±1°C range for 24 hours. Tcal = 23±3°C

[3] 24 hr. specifications for 4 wire O.C. off. 14 reading avg. 5 year specs for 4 wire O.C. on, 8 reading avg.

[4] Specifications for 8 reading avg.

[5] All accuracies include instrument errors such as A/D errors, reference junction errors and conformity errors. Sensor errors cannot be predicted and therefore are not included.

STABILITY FUNCTION/ RANGE	±1°C	TEMPERATURE COEFFICIENT [2] ADDITIONAL ERROR AT AMBIENT OF: ±5°C	±10°C	±30°C
Resistance				
4 Wire				
200Ω (O.C. On)	±0.0%+2mΩ	±0.0023%+2mΩ	±0.0055%+2mΩ	±0.02%+2mΩ
(O.C. Off)	±0.0%	±0.0023%+2mΩ	±0.0055%+12mΩ	±0.02%+135mΩ
2kΩ (O.C. On)	±0.0%	±0.002%+0	±0.0051%+0	±0.018% +0
(O.C. Off)	±0.0%	±0.002%+2mΩ	±0.0051%+12mΩ	±0.018% +135mΩ
20kΩ (O.C. On)	±0.0%+200mΩ	±0.0015%+200mΩ	±0.0064 % 200mΩ	±0.029% +0
(O.C. Off)	±0.0%	±0.0015%+.1Ω	±0.0064 % +.7Ω	±0.029% +9Ω
200kΩ (O.C. On)	±0.0%	±0.0032%+0	±0.0078% +0	±0.039% +0
(O.C. Off)	±0.0%	±0.0032%+.1Ω	±0.0078% +.7Ω	±0.039% +9Ω
2 Wire				
2MΩ	±0.0%	±0.036%+5Ω	±0.15% +15Ω	±0.91% +235
20MΩ	±0.0%	±0.074%+0	±0.31% +100Ω	±2.38% +1.5kΩ
200MΩ	±0.0%	±0.45%+0	±2.21% +7kΩ	+16.9% +111kΩ
2 Wire 200Ω-200kΩ	±65mΩ	±.32Ω	±.65Ω	±3.2Ω
RTD's – 4Wire [4](100Ω type 385 or 390)				
–200°C to +70°C	±0.005°C	±0.012°C	±0.023°C	±0.07°C
+70°C to 200°C	±0.004°C	±0.016°C	±0.032°C	±0.1°C
+200°C to 800°C	±0.0°C	±0.031°C	±0.074°C	±0.26°C

FUNCTION/ RANGE	TIME STABILITY [2] ADDITIONAL ERROR AFTER 90 days	1 yr.	2 yr.	5 yr.	NOISE [3] @ MAX SPEED RMS	Pk-Pk
Resistance						
4 Wire						
200Ω (O.C. On)	±0.0029%	±0.0062%	±0.012%	±0.017%	5mΩ	25mΩ
(O.C. Off)	±0.0029%	±0.0062%	±0.012%	±0.017%	3.4mΩ	17mΩ
2kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	48mΩ	240mΩ
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	32mΩ	160mΩ
20kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	.44Ω	2.2Ω
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	.3Ω	1.5Ω
200kΩ (O.C. On)	±0.0028%	±0.0051%	±0.0089%	±0.014%	3.2Ω	16Ω
(O.C. Off)	±0.0028%	±0.0051%	±0.0089%	±0.014%	2.2Ω	11Ω
2 Wire						
2MΩ	±0.015%	±0.028%	±0.049%	±0.086%	140Ω	700Ω
20MΩ	±0.013%	±0.026%	±0.047%	±0.084%	1.2Ω	6kΩ
200MΩ	±0.01%	±0.02%	±0.04%	±0.07%	16kΩ	80kΩ
2 Wire 200Ω-200kΩ						
RTD's – 4W [4] (100 Ω type 385 or390)						
–200°C to –70°C	±0.015°C	±0.027°C	±0.045°C	±0.06°C	0.012°C	0.06°C
+70°C to +200°C	±0.022°C	±0.035°C	±0.06°C	±0.09°C	0.012°C	0.06°C
–200°C to +800°C	±0.04°C	±0.075°C	±0.16°C	±0.20°C	0.11°C	0.55°C

[1] Maximum uncertainty for Offset Comp. ON, 8 reading filter. Typical accuracy is better.

[2] This uncertainty already included in 5 Year accuracy spec.

[3] Typical.

[4] Specifications for O.C. ON, 8 reading avg.

FUNCTION/ RANGE	EXCITATION/CURRENT O.C OFF	O.C. ON	MAX V
Resistance			
200Ω	625 µA–595µA	397 µA	2.6V
2kΩ	625 µA–416µA	277 µA	2.6V
20kΩ	12.5 µA–10.9µA	7.3 µA	2.6V
200kΩ	12.5µA–6.25µA	4.2 µA	2.6V
2MΩ	.25 µA–.208µA		2.6V
20MΩ	.25 µA–.083µA		2.6V
200MΩ	.25 µA–.012µA		2.6V
RTD's – 4Wire (100 Ω type 385 0r 390)			
from –80°C to 250°C see above	see above		

FUNCTION/ RANGE	INTEGRAL LINEARITY TYPICAL	CONFORMITY ERROR[4]
Resistance		
200Ω	20ppm	–
2kΩ	20ppm	–
20kΩ	20ppm	–
200kΩ	20ppm	–
2MΩ	20ppm	–
20MΩ	20ppm	–
200MΩ	20ppm	–
RTD's – 4Wire (100 Ω type 385 0r 390)		
from –80°C to 250°C	±0.005°C	±0.2°C

[1] This uncertainty already included in 5 Year accuracy spec.
[2] Typical.
[3] Maximum conformity error of algorithm to standard sensor characteristics.
[4] Lower effective sensor currents can be realized when scanning muliple chanels on DCV32

Analog and Digital Front Ends

Number of Channels RTD31:	One input, any type and 2 digital outputs.
Number of Channels RTD32:	Eight single-ended, four 4-Wire or 8 digital inputs or mix, and 2 digital outputs.
Input configuration:	Differential.
A/D Conversion Method:	High Precision Sigma Delta.
Common Mode Voltage:	±1.7 Volts (max.).
Common Mode Rejection:	>100dB @ DC, 50Hz or 60Hz with 100Ω imbalance.
Normal Mode Rejection:	>60dB @50Hz or 60Hz.
Input Impedance:	$10^7\Omega$ (minimum).
Input Overload Protection:	40V continuous, 8kV electrostatic discharge.
Input Overload (Chan 9-16):	2V nominal.
Digital Output:	2 TTL, 20 mA source, 8 mA sink.

Measurement Processor

Measurement Resolution: 20 bits

Throughput: 15 rdgs/sec max.

Reading Memory (volatile):

Timestamp Resolution	8-Bit Readings		16-Bit Readings		24-Bit Readings	
	Sync [1]	Async [2]	Sync [1]	Async [2]	Sync [1]	Async [2]
None	15,000	15,000	7,500	7,500	5,000	5,000
8-bit	15,000	7,500	7,500	5,000	5,000	3,750
16-bit	15,000	5,000	7,500	3,750	5,000	3,000
24-bit	15,000	3,750	7,500	3,000	5,000	2,500
32-bit	15,000	3,000	7,500	2,500	5,000	2,143

[1] Synchronous (interpolated timestamp)

[2] Asynchronous (timestamp stored with every reading).

Configuration Memory: Non-volatile flash.

Timing Accuracy: ± 0.002%/month.

Timing Resolution: 1 ms.

Timing Synchronization: ±1 ms between multiple units.

Scaling: mX+B, zero and span, & units designation (4 char.).

Filtering: Multi-measurement per reading and moving Average.

Peak Measurements: Stores Highest Absolute Values per Channel.

Specific Calculations: Callender Van Dusen .

Limits: L1 (Hi or Lo); L2 (Hi or Lo) per channel.

Measurements Supported

	RTD31	RTD32
Calculated	1 chan*	4 chan*
Digital Input Differential	1	8
Digital Input Single Ended	1	8
Digital Output	2	2
Ohms 4-Wire	1	4
Ohms Single Ended	1	8
Temperature/RTD 4-Wire	1	4
Temperature/RTD Single Ended	1	8

*Call factory for upgrading to this capability, or use scaling.

Command Overview

Measure

:Meas? <chan_list> <#_of_rdgs> |Off>

:Capture? <chan_list> <#_of_rdgs|All> <Immediate|Level <chan#> <level> <Hi|Lo>> <interval_usec> <ASCII|Binary>

Filter

:Filter:Dig <chan_list> <On|Off>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

Scaling

:Scaling <chan_list> <On|Off>

:Config:Scaling <chan_list> < &| <mb> &| <table> | <poly>>

:Config:Scaling:MB <chan_list> <m_value> <b_value>

:Config:Scaling:Span <chan_list> <zero_value> <+span>
<-span>

:Config:Scaling:Units <chan_list> <"new_units">

Limits

:Limits <<chan_list> |All> <On|Off>

:Config:Limits <chan_list> <Lim1|Lim2> <High|Low> <lim_value>
<hysterysis>

:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

Statistics

:Stats:Max? <chan_list>

:Stats:Min? <chan_list>

Config Chans (Per Channel)

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh| ActiveLow> <DIFF|SE>
<"chan_tag">

:Config <chan_list> DigOut <#_of_bits> <ActiveHigh| ActiveLow>
<Initial_state> <"chan_tag">

:Config <chan_list> Ohms <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Temp RTD <type_code> <range>
<PT385|PT3916|<User r0 alpha beta delta>>
<range> <SE|4W|4WOC|SEOC> <"chan_tag">

Config Units

:Config:Units:Ohms <Ohms|Kohms|Mohms>

:Config:Units:Temp <DegC|DegF|K>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yyy>

:Time:SyncGlobal

System

*Sav,*Rcl (Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (Identification)

Output

:Output <chan_list> <value> <step_delay>

:Output <chan_list> <Track <chan#>

Datamem

:DataMem? <All| <chan_list> <scan_list>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

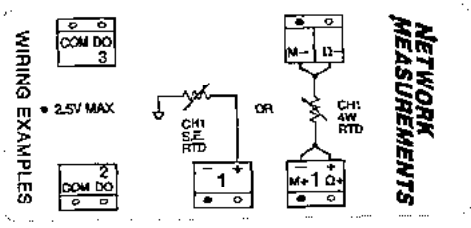
:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

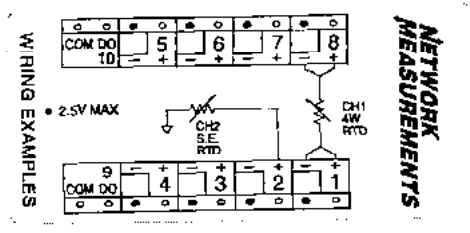
Config Data

:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|
Rnum&|Time&|Date&|Limits&|Stat>

RTD31 Sensor Connections



RTD32 Sensor Connections



KNM-THD01 & 02

Temperature, Humidity Dew Point

Functional Description

The Model THD01/02 is a complete measuring system for temperature, humidity and dew point that will interface to any computer-based network. The THD-02 adds two additional channels of either temperature or digital input, and four channels of selectable digital output or input. Outputs can be tied to limits for temperature and humidity control, and inputs can be used for sensing door openings, alarm signals, switches, or other external inputs. The on-board thermistor and solid-state humidity sensor require no periodic maintenance or calibration and can be used over a wide temperature range. Its highly stable and field-proven analog circuit design provides excellent short term accuracy is often good enough to eliminate the need for periodic calibration.

The reading memory can buffer up to 10,000 8-bit readings, 5,000 16-bit readings, or 3,500 20-bit readings. These can be stored as single measurement readings or as average or moving average of readings. The highest absolute value of temperature and humidity are also stored in memory.

Standard Features

Limits: Two, high or low per channel; can be associated with a digital output.

Scaling: Zero, span, mX÷b with units per channel.

Statistics: Maximum and minimum readings per channel.

Scanning: Time interval, discrete time and triggered scans. Trigger on command, level or digital input. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value and/or channel number and/or channel tag and/or units and/or reading number and/or time & date and/or limit status.

Data Storage: Configure reading memory size and resolution; wrap or stop when full; ASCII or binary.

Product Highlights

- On Board Sensors for Temperature & Humidity
- Dew Point
- 5 Year Warranty
- 5 Year Accuracy Specifications
- High Precision Sigma-Delta A/D
- Memory for 10,000 Readings with Peak Hold
- Real Time and Predictive Diagnostics
- THD-02 Digital Inputs and Outputs Expand Applications

Specifications

General

Power Supply:	9.5 to 34VDC, reverse polatity protected, up 10% ripple with no degradation, maximum 34 VDC.
Power Consumption:	1.5W, 3W max. w/Ethernet.
Operating Environment:	-5°C to 65°C, 0-95% RH (NC)
Storage Environment:	-20°C to 85°C.
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating.
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231 UL3111.
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A.
Electrostatic Immunity:	EN50082-1, IEC 801-2 B
Common Mode Fast Transient:	EN50082-1, IEC 801-4 B
Environmental Protection:	NEMA 4, IP 65 For Industrial Enclosure (-I).
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [3]

	MEASURING RANGE	RESOLUTION	5 YEAR ACCURACY [1,2,4]	24 HR. ACCURACY [2,4,5]
Temperature (supplied sensor, typical)	0°C to 50°C	±0.01°C	±1.0°C	±0.5°C
Humidity (non-condensing)	5 to 95%	±0.1% Abs.	±2% RH [5,6]	±1% RH [6]
Dew Point	0°C to 18°C	±1°C	±12°C	±0.8°C
	18°C to 28°C	±1°C	±3°C	±1.5°C
	28°C to 50°C	±1°C	±2°C	±1. 0°C
Thermistors - 4-wire (100Ω to 1MΩ)				
	-80°C to +10°C	±0.1°C	±0.1°C	±0.04°C
	+10°C to +70°C	±0.1°C	±0.1°C	±0.04°C
	+70°C to +250°C	±0.1°C	±0.2°C	±0.15°C

[1] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±30°C range for 5 years.

[2] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±1°C range for 24 hours.

[3] Temperature accuracy is with internal 10kΩ thermistor.

[4] No calibration is required when using internal temperature sensor.

[5] Typical @ 50% RH.

[6] Accuracy using saturated salt calibration. Without calibration add 2%.

Analog and Digital Front Ends

Number of ChannelsTHD01: 1 temperature, 1 humidity, 1 dew point.

Number of Channels, THD02: 1 temperature, 1 humidity, 1 dew point, plus 2 additional temperature or digital inputs, and 4 digital inputs/outputs.

A/D Conversion Method: Precision Sigma Delta.

Open Circuit Method: 2.6V.

Temperature Sensitivity: ± 0.04% RH/°C.

Humidity Settling Time: <15 sec moving air, <30 sec still air.

Temperature Sensor: Type 006 thermistor.

Humidity Sensor: Bulk capacitive polymer.

Measurement Processor

Measurement Resolution: 16 bits

Throughput: 7 rdgs/sec for temperature, 12 rdgs/sec for humidity.

Reading Memory (volatile):

Timestamp Resolution	8-Bit Readings		16-Bit Readings		24-Bit Readings	
	Sync [1]	Async [2]	Sync [1]	Async [2]	Sync [1]	Async [2]
None	10,000	10,000	5,000	5,000	3,333	3,333
8-bit	10,000	5,000	5,000	3,333	3,333	2,500
16-bit	10,000	3,333	5,000	2,500	3,333	2,000
24-bit	10,000	2,500	5,000	2,000	3,333	1,667
32-bit	10,000	2,000	5,000	1,667	3,333	1,429

[1] Synchronous (interpolated throughput.)

[2] Asynchronous (timestamp stored with every reading).

Configuration Memory: Non-volatile flash.

Timing Accuracy: ± 0.002%/month.

Timing Resolution: 1 ms.

Timing Synchronization: ±1 ms between multiple units.

Limits: L1 (Hi or Lo); L2 (Hi or Lo) per channel.

Units Scaling: mX+B, zero & span, and units designation (4 char.)

Filtering: Average per reading, 1-50 average and moving average.

Peak Measurements: Stores highest and lowest absolute values

Specific Calculations: Relative humidity, dew point

Measurements Supported

	THD01	THD02
Calculated	1 chan*	4 chan*
Dew Point/Calculated	1	1
Digital Input Differential	0	1
Digital Input Single Ended	0	2 + 4
Digital Output	0	4
Temperature/Thermistor Single Ended	1	2

*Call factory for upgrading to this capability, or use scaling.

Command Overview

Measure

:Meas? <chan_list><#_of_rdgs>|Off>

:Capture? <chan_list> <#_of_rdgs|All> <immediate|Level> <chan#> <level,>
<Hi|Lo> <Interval_usec> <ASCII|Binary>

Filter

:Filter:Dig <chan_list> <On|Off>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

Scaling

:Scaling <chan_list> <On|Off>

:Config:Scaling <chan_list> <<span>&|<mb>&|<table>|<poly>>

:Config:Scaling:MB <chan_list> <m_value> <b_value>

:Config:Scaling:Span <chan_list> <zero_value> <+span> <-span>

:Config:Scaling:Units <chan_list> <"new_units">

Limits

:Limits <<chan_list>|All><On|Off>

:Config:Limits <chan_list> <Lim1|Lim2> <High|Low> <lim_value> <hysterysis>

:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

Statistics

Stats:Max? <chan_list>

Stats:Min? <chan_list>

Config Chans (per channel)

:Config <chan_list> DewPoint <"chan_tag">

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh|ActiveLow> <DIFF|SE> <"chan_tag">

:Config <chan_list> DigOut <#_of_bits> <ActiveHigh|ActiveLow> <Initial_state> <"chan_tag">

:Config <chan_list> Humidity <type_code> <"chan_tag">

:Config <chan_list> TempThrmstr <type_code> <range> <4W|SE|4WOC|SEOC> <"chan_tag">

Config Units

:Config:Units:Temp <DegC|DegF|K>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yy>

:Time SyncGlobal

System

*Sav, *Rcl(Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (identification)

Output

:Output <chan_list> <value>

Datamem

:DataMem? <All | <chan_list> <scan_list>>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

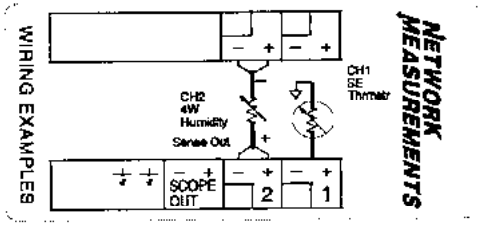
:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

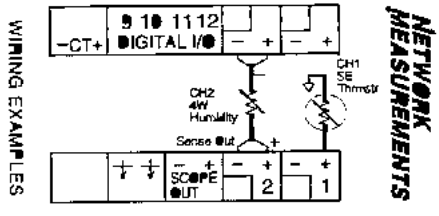
Config Data

:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|Rnum&
|Time&|Date&|Limits&|Stat>

THD01 Sensor Connections



THD02 Sensor Connections



KNM-THM31 & 32
Precision Thermistor

Functional Description

Models THM31 and THM32 are general purpose temperature measurement instruments designed for use in computer based systems in field, factory or laboratory applications. Both can also be used for general purpose measuring of ohms and digital inputs. Model THM31 is an inexpensive, single 4-wire or two 2-wire device with two digital outputs, while Model THM32 accommodates eight 2-wire or four 4-wire inputs and also has two digital outputs. A high precision, 20-bit sigma-delta A-to-D converter delivers 12 readings per second. On-board reading memory can buffer up to 10,000 8-bit readings, 5,000 16-bit readings and 3,500 20-bit readings. Two digital outputs, digital filtering and peak measurements are standard.

Standard Features

Limits: Two, high or low per channel; can be associated with a digital output.

Scaling: Zero, span, or mX+b with units per channel.

Statistics: Maximum and minimum readings per channel.

Scanning: Time interval, discrete time and triggered scans. Trigger on command, level or digital input. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value and/or channel number and/or channel tag and/or units and/or reading number and/or time & date and/or limit status.

Data Storage: Configure reading memory size and resolution; wrap or stop when full; ASCII or binary.

Product Highlights

- Complete Measuring Solution
- 8 Channels
- 2-Wire & 4-Wire Thermistors from 100Ω to 1 MΩ
- Digital Outputs
- 5 Year Warranty
- 5 Year ±30° C Accuracy: ±0.07°C
- 24 hr Accuracy: ±0.0013°C
- Miniature Package

Specifications

General

Power Supply:	9.5 to 34 VDC , reverse polarity protected, up to 10% ripple with no degradation, maximum 36VDC.
Power Consumption:	1.5W, 3W max. w/Ethernet.
Operating Environment:	-5°C to 65°C, 0-95% RH (NC), Specifications valid for 0-70%RH (NC) Up to 35°C. Linearly derate 3% RH/°C, 35°C - 65°C.
Storage Environment:	-20°C to 85°C.
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating.
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231 UL3111.
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A.
Electrostatic Immunity:	EN50082-1, IEC 801-2 B
Common Mode Fast Transient:	EN50082-1, IEC 801-4 B
Environmental Protection:	NEMA 4, IP 65 For Industrial Enclosure (-I).
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [4]

FUNCTION	RANGE	5 YEAR ACCURACY [1]	24 HR. ACCURACY [2]	RESOLUTION
Thermistors - 4 Wire [3] (100 Ω to 1MΩ)				
	-80°C to +10°C	±0.64°C	±0.02°C	±0.0125°C
	+10°C to +70°C	±0.046°C	±0.013°C	±0.0125°C
	+70°C to +250°C	±0.064°C	±0.03°C	±0.0125°C
Resistance				
	200Ω (4Wire) [4]	±0.04%+7mΩ	±0.0026%+5mΩ	±1mΩ
	2kΩ (4Wire) [4]	±0.035%+40mΩ	±0.0026%+40mΩ	±10mΩ
	20kΩ (4Wire) [4]	±0.047%+.7Ω	±0.0034%+500mΩ	±100mΩ
	200kΩ (4Wire) [4]	±0.057%+3Ω	±0.0042%+3Ω	±1Ω
	2MΩ (2Wire) [5]	±1.03%+320Ω	±0.035%+85Ω	±10Ω
	20MΩ (2Wire) [5]	±2.54%+2kΩ	±0.080%+500Ω	±100Ω
	200MΩ (2Wire) [5]	±17.4%+125kΩ	±0.500%+14kΩ	±1kΩ

[1] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±30°C range for 5 years. Tcal = 23±3°C

[2] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±1°C range for 24 hours. Tcal = 23±3°C

[3] 24-hr. specificatin for 4-wire O.C. off, 14 reading avg. 5-year specs for 4-wire O.C. on, 8 reading avg.

[4] Specifications for 8 reading avg.

[5] All accuracies include instrument errors such as A/D errors, reference junction errors and conformity errors. Sensor errors cannot be predicted and therefore are not included

STABILITY FUNCTION/ RANGE	±1°C	TEMPERATURE COEFFICIENT [1,2] ADDITIONAL ERROR AT AMBIENT OF: ±5°C	±10°C	±30°C
Thermistors – 4Wire [4] (100Ω to 1MΩ				
–80°C to –10°C	±0.0°C	±0.01°C	±0.043°C	±0.33°C
+10°C to –70°C	±0.0°C	±0.005°C	±0.007°C	±0.015°C
+70°C to +190°C	±0.0°C	±0.008°C	±0.009°C	±0.012°C
+190°C to –250°C	±0.0°C	±0.012°C	±0.015°C	±0.025°C
(100kΩ to 1MΩ)				
–80°C to +250°C	±0.0°C	±0.013°C	±0.055°C	±0.44°C
Resistance				
4 Wire				
200Ω (O.C. On)	±0.0%+2mΩ	±0.0023%+2mΩ	±0.0055%+2mΩ	±0.02%+2mΩ
(O.C. Off)	±0.0%	±0.0023%+2mΩ	±0.0055%+12mΩ	±0.02%+135mΩ
2kΩ (O.C. On)	±0.0%	±0.002%+0	±0.0051%+0	±0.018% +0
(O.C. Off)	±0.0%	±0.002%+2mΩ	±0.0051%+12mΩ	±0.018% +135mΩ
20kΩ (O.C. On)	±0.0%+200mΩ	±0.0015%+200mΩ	±0.0064 % 200mΩ	±0.029% +0
(O.C. Off)	±0.0%	±0.0015%+.1Ω	±0.0064 % +.7Ω	±0.029% +9Ω
200kΩ (O.C. On)	±0.0%	±0.0032%+0	±0.0078% +0	±0.039% +0
(O.C. Off)	±0.0%	±0.0032%+.1Ω	±0.0078% +.7Ω	±0.039% +9Ω
2 Wire				
2MΩ	±0.0%	±0.036%+5Ω	±0.15% +15Ω	+0.91% +235
20MΩ	±0.0%	±0.074%+0	±0.31% +100Ω	±2.38% +1.5kΩ
200MΩ	±0.0%	±0.45%+0	±2.21% +7kΩ	+16.9% +111kΩ
2 Wire 200Ω-200kΩ	±65mΩ	±.32Ω	±.65Ω	±3.2Ω

[1] Maximum uncertainty for Offset Comp. ON, 8 reading filter. Typical accuracy is better.

[2] This uncertainty already included in 5 Year accuracy spec.

[3] Typical.

[4] Specifications for O.C. ON, 8 reading avg.

STABILITY (CONTINUED)

FUNCTION/ RANGE	90 days	TIME STABILITY [1,2] ADDITIONAL ERROR AFTER 1 yr.	2 yr.	5 yr.	NOISE [3] @ MAX SPEED RMS	Pk-Pk
Thermistors –4W(100 Ωto30kΩ)						
–80°C to +10°C	±0.005°C	±0.0051°C	±0.01°C	±0.016°C	0.014°C	0.07°C
+10°C to +70°C	±0.006°C	±0.007°C	±0.008°C	±0.01°C	0.006°C	0.03°C
+70°C to +190°C	±0.008°C	±0.01°C	±0.012°C	±0.015°C	0.014°C	0.07°C
+190°C to +250°C	±0.012°C	±0.014°C	±0.0185°C	±0.022°C	0.018°C	0.09°C
(100kΩ to 1MΩ)						
–80°C to +250°C	±0.0073°C	±0.0062°C	±0.011°C	±0.019°C	0.016°C	0.08°C
Resistance						
4 Wire						
200Ω (O.C. On)	±0.0029%	±0.0062%	±0.012%	±0.017%	5mΩ	25mΩ
(O.C. Off)	±0.0029%	±0.0062%	±0.012%	±0.017%	3.4mΩ	17mΩ
2kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	48mΩ	240mΩ
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	32mΩ	160mΩ
20kΩ (O.C. On)	±0.0021%	±0.005%	±0.01%	±0.014%	.44Ω	2.2Ω
(O.C. Off)	±0.0021%	±0.005%	±0.01%	±0.014%	.3Ω	1.5Ω
200kΩ (O.C. On)	±0.0028%	±0.0051%	±0.0089%	±0.014%	3.2Ω	16Ω
(O.C. Off)	±0.0028%	±0.0051%	±0.0089%	±0.014%	2.2Ω	11Ω
2 Wire						
2MΩ	±0.015%	±0.028%	±0.049%	±0.086%	140Ω	700Ω
20MΩ	±0.013%	±0.026%	±0.047%	±0.084%	1.2Ω	6kΩ
200MΩ	±0.01%	±0.02%	±0.04%	±0.07%	16kΩ	80kΩ
2 Wire 200Ω-200kΩ						

[1] Maximum uncertainty for Offset Com. ON, 8 reading filter. Typical accuracy is better
[2] This uncertainty already included in 5 Year accuracy spec.
[3] Typical
[4] Specifications for O.C. on, 8 reading avg.

FUNCTION/ RANGE	EXCITATION3CURRENT O.C OFF	O.C. ON	MAX V
Thermistors (100 Ω to 1MΩ)			
from –80°C to 250°C	see below		2.6V
Resistance			
200Ω	625 µA–595µA	397 µA	2.6V
2kΩ	625 µA–416µA	277 µA	2.6V
20kΩ	12.5 µA–10.9µA	7.3 µA	2.6V
200kΩ	12.5µA–6.25µA	4.2 µA	2.6V
2MΩ	.25 µA–.208µA	—	2.6V
20MΩ	.25 µA.-083µA	—	2.6V
200MΩ	.25 µA–.012µA	—	2.6V

FUNCTION/ RANGE	INTEGRAL LINEARITY TYPICAL	CONFORMITY ERROR[4]
Thermistors (100 Ω to 1MΩ)		
from –80°C to 250°C	±0.002°C	±0.2°C
Resistance		
200Ω	20ppm	—
2kΩ	20ppm	—
20kΩ	20ppm	—
200kΩ	20ppm	—
2MΩ	20ppm	—
20MΩ	20ppm	—
200MΩ	20ppm	—

[1] This uncertainty already included in 5 Year accuracy spec.
[2] Typical.
[3] Maximum conformity error of algorithm to standard sensor characteristics.
[4] Lower effective sensor currents can be realized when scaning multiple channels on DCV32.

Analog and Digital Front Ends

Number of Channels THM31:	1 any type, and 2 digital outputs.
Number of Channels THM32:	8 2-Wire, 4 4-Wire or 16 digital inputs or mix, and 2 digital outputs.
Input configuration:	Differential.
A/D Conversion Method:	Precision Sigma Delta.
Common Mode Voltage:	±1.7 Volts (max.).
Common Mode Rejection:	>100dB @ DC, 50Hz or 60Hz.
Normal Mode Rejection:	>60dB @50Hz or 60Hz.
Input Impedance:	$10^7\Omega$ (minimum).
Input Overload Protection:	40V continuous, 8kV electrostatic discharge.
Digital Output:	2 TTL, 20 mA source, 8 mA sink.

Measurement Processor

Measurement Resolution: 20 bits

Throughput: 15 rdgs/sec max.

Reading Memory (volatile):

Timestamp Resolution	8-Bit Readings		16-Bit Readings		24-Bit Readings	
	Sync [1]	Async [2]	Sync [1]	Async [2]	Sync [1]	Async [2]
None	15,000	15,000	7,500	7,500	5,000	5,000
8-bit	15,000	7,500	7,500	5,000	5,000	3,750
16-bit	15,000	5,000	7,500	3,750	5,000	3,000
24-bit	15,000	3,750	7,500	3,000	5,000	2,500
32-bit	15,000	3,000	7,500	2,500	5,000	2,143

[1] Synchronous (interpolated timestamp)

[2] Asynchronous (timestamp stored with every reading).

Configuration Memory: Non-volatile flash.

Timing Accuracy: = 0.002%/month.

Timing Resolution: 1 ms.

Timing Synchronization: ±1 ms between multiple units.

Scaling: mX+B, zero and span, & units designation (4 char.).

Filtering: Multi-measurement per reading and moving Average.

Peak Measurements: Stores Highest Absolute Values per Channel.

Specific Calculations: Steinhart & Hart.

Limits: L1 (Hi or Lo); L2 (Hi or Lo) per channel.

Measurements Supported

	THM31	THM32
Calculated	1 chan*	4 chan*
Digital Input Differential	1	8
Digital Input Single Ended	1	8
Digital Output	2	2
Ohms 4-Wire	1	4
Ohms Single Ended	1	8
Temperature/Thermistor 4-Wire	1	4
Temperature/Thermistor Single Ended	1	8

*Call factory for upgrading to this capability, or use scaling.

Command Overview

Measure

:Meas? <chan_list> <#_of_rdgs> |Off>

:Capture? <chan_list> <#_of_rdgs|All> <Immediate|Level <chan#> <level> <Hi|Lo>> <interval_usec> <ASCII|Binary>

Filter

:Filter:Dig <chan_list> <On|Off>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

Scaling

:Scaling <chan_list> <On|Off>

:Config:Scaling <chan_list> < &| <mb> &| <table> | <poly>>

:Config:Scaling:MB <chan_list> <m_value> <b_value>

:Config:Scaling:Span <chan_list> <zero_value> <+span> <-span>

:Config:Scaling:Units <chan_list> <"new_units">

Limits

:Limits <<chan_list> |All> <On|Off>

:Config:Limits <chan_list> <Lim1|Lim2> <High|Low> <lim_value> <hysterysis>

:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

Statistics

:Stats:Max? <chan_list>

:Stats:Min? <chan_list>

Config Chans (Per Channel)

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh| ActiveLow> <DIFF|SE> <"chan_tag">

:Config <chan_list> DigOut <#_of_bits> <ActiveHigh| ActiveLow> <Initial_state> <"chan_tag">

:Config <chan_list> Ohms <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Temp Thrmstr <type_code> <range> <4W|SE|4WOC|SEOC> <"chan_tag">

Config Units

:Config:Units:Ohms <Ohms|Kohms|Mohms>

:Config:Units:Temp <DegC|DegF|K>

Time, Date

:Time <hh:mm:ss.sss>

:Date <mm/dd/yyy>

:Time:SyncGlobal

System

*Sav,*Rcl (Save & Recall)

:System:POSetup <Saved|Factory>

*Idn? (Identification)

Output

:Output <chan_list> <value>

Datamem

:DataMem? <All| <chan_list> <scan_list>

:DataMem:Last?

:DataMem:Next?

:DataMem:Memsize?

Config Datamem

:Config:DataMem:Scans?

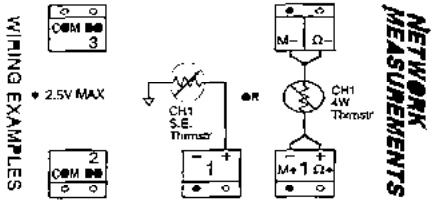
:Config:DataMem:Captures?

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

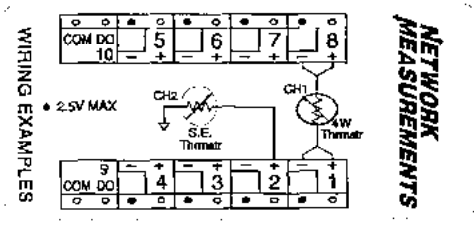
Config Data

:Config:Data:Fields <Read&|Units&|Chan&|Chan_Tag&|
Rnum&|Time&|Date&|Limits&|Stat>

THM31 Sensor Connections



THM32 Sensor Connections



KNM-TRQ31
Torque Transducer

Functional Description

The Model TRQ31 is a self contained signal conditioning SmartLink™ instrument for resistive, full-bridge type torque transducers. It can also be used for other full bridge transducers with bridge resistances from 30Ω to 700Ω. An on-board counter provides frequency measurements from 1Hz to 20kHz and, when configured for pulses per revolution, provides RPM data for horsepower calculations. Using precision sigma-delta A/D technology, readings at full ±0.005% FS accuracy are possible, making the Model TRQ31 for many high precision, dynamic torque applications. On-board reading memory can buffer up to 10,000 8-bit readings, 5,000 16-bit readings or 3,500 20-bit readings. Two Form A solid-state relay outputs, and a 0 - 2Volt recorder output and Digital Filtering are standard.

Standard Features

Limits: Two, high or low per channel; can be associated with a digital output.

Scaling: Zero, span, mX+b with units per channel.

Statistics: Maximum and minimum readings per channel.

Scanning: Time interval, discrete time and triggered scans. Trigger on command, level or digital input. Set number of scans and pre-trigger percent.

Data Fields: Configure readings by value and/or channel number and/or channel tag and/or units and/or reading number and/or time & date and/or limit status.

Data Filter: Readings can be selected by limit status as follows: all, during limit, after limit or limit transition.

Data Storage: Configure reading memory size and resolution; all or selected scans; wrap or stop when full; one reading per line or spreadsheet formats; ASCII or binary.

Product Highlights

- Complete Torque Transducer Measuring System
- Calculates Horsepower Directly
- Bridge Resistance from 30Ω to 700Ω
- 2 Digital Outputs
- 5 Year Warranty
- 5 Year ±30°C Accuracy ±0.025%FS
- Network Compatible
- Miniature DIN Package

Specifications

General

Power Supply:	9.5 to 28 VDC (30 VDC without damage, reverse polarity protected).
Power Consumption:	1.5W, 3W max. w/Ethernet.
Operating Environment:	-5°C to 65°C, 0-95% RH (NC)
Storage Environment:	-20°C to 85°C.
Altitude:	10,000 feet (3,050m) operating 40,000 feet (12,200m) non-operating.
Electrical Safety:	Designed to meet: IEC1010, CSA C22.2 No. 231 UL3111.
EMI Emissions:	EN55022 Class B, FCC Part 15 Class A
EMI Immunity:	EN50082-1, IEC 801-3 A.
Electrostatic Immunity:	EN50082-1, IEC 801-2 B
Common Mode Fast Transient:	EN50082-1, IEC 801-4 B
Environmental Protection:	NEMA 4, IP 65 For Industrial Enclosure (-I).
Vibration:	0.25mm @ resonance for 15 min.
Warm-up (full accuracy):	40 minutes (maximum)
Mounting:	DIN Rail or Screw Mount
Net Weight:	< 0.5 lb. (< 0.25 kg)
Dimensions (LWH):	6.7 in. x 1.3 in. x 1.1 in. 17.0 cm x 3.3 cm x 2.7 cm
Warranty:	5 Years

ACCURACY & RESOLUTION [3]			
Bridge Excitation	*5 Year Accuracy [1]*	*24 hr. Accuracy [2]*	*Resolution*
10V	±0.025% FS	±0.004% FS	±0.1 μ strain
4V	±0.025% FS	±0.002% FS	±0.1 μ strain
2V	±0.025% FS	±0.0035% FS	±0.1 μ strain
1V	±0.025% FS	±0.005% FS	±0.1 μ strain

[1] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±30°C range for 5 years at 10,000 rdgs/sec or lower.

[2] Accuracy specifications include the effects of non-linearity, hysteresis and non-repeatability over Tcal ±1°C range for 24 hours 10,000 rdgs/sec or lower.

[3] All accuracies include instrument errors such as A/D errors, reference junction errors and conformity errors. Sensor errors cannot be predicted and therefore are not included.

No. of Bridges per Instrument

BRIDGE RESISTANCE	EXCITATION 1V	2V	4V	10V
1kΩ	>12	>12	10	4
700 Ω	>12	>12	7	2
350 Ω	>12	8	4	1
240 Ω	12	4	2	–
120 Ω	4	2	1	–
30 Ω	1	–	–	–

Analog and Digital Front Ends

Number of Channels: 1 torque, 1 frequency (rpm)

A/D Conversion Method: Precision Sigma Delta.

Frequency Input: 1 Hz to 20 kHz, 0.3V zero crossing.

Channel Configuration: Differential, bipolar with Kelvin sensing.

Bridge Configuration: Full, 30Ω to 700Ω.

Excitation Voltage: 10, 4, 2,or 1VDC at 38mA. Short-circuit protected.

Bridge Output: 2 mV/V, 5mV/V at rated accuracy.

Input Overload Protection: >40V continuous, 8kV electrostatic discharge.

Common Mode Rejection: >100dB @ DC, 50Hz or 60Hz.

Normal Mode Rejection: >60dB @50Hz or 60Hz.

Input Impedance: $10^7\Omega$ (minimum).

Digital Output: Two solid state relays; 40V max, 100mA continuous, 300mA peak, R_{ON} = 32Ω.

Diagnostics

Fault Detection:	Fault Prediction
Open sensor circuit	Degraded calibration
Shorted sensor circuit	Intermittent opens
Input overload	Intermittent shorts
Static/Lightning overload	Power supply drift
Power failure	Power out of tolerance

Measurement Processor

Measurement Resolution:	16 bits
Throughput:	15 rdgs/sec max.
Reading Memory (volatile):	10,000 8-bit, 5,000 16-bit.
Time Stamped Readings:	5,000 8-bit, 2,500 16-bit.
Configuration Memory:	Non-volatile flash.
Timing Accuracy:	± 0.002%/month.
Timing Resolution:	1 ms.
Timing Synchronization:	±1 ms between multiple units.
Limits:	L1 (Hi or Lo); L2 (Hi or Lo) per channel.
Units Scaling:	mX+B with four characters.
Filtering:	Average per reading, 1-100 average and moving average.
Recorder Output:	0 to 2 VDC (0-100%) analog output.
Peak Measurements:	Stores highest and lowest absolute values
Specific Calculations:	Torque, horsepower, RPM, weight.

Command Overview

Measure

:Measure? <chan#> <ON|count|OFF>

:Meas:Max? <chan#>

:Meas:Min? <chan#>

:Meas:Chan?

:Meas:Minmax:Clear

Filter

:Config:Filter:Dig:Meas_per_rdg <#_of_rdgs>, 0-100

Scaling

:Config:Scale:_MB <chan#> <M_value> <B_value> <disp_range>

Limits

:Limit <chan#><lim#> <sense> <lim_value> <hysteresis>

:Limit:Status? <chan#>

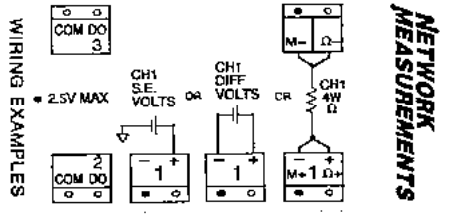
Output

:Output:Dig <chan#>

:Output:Digio? <chan#>

:Output:Analog <chan#>

TRQ31 Sensor Connections



Single Channel Volts and Resistance Wiring

Communications

Network Interface Specifications

Ethernet

Network Measurements has implemented a generic Attachment Unit Interface (AUI) to allow any Ethernet communication by simply plugging in the appropriate transceiver. The same pin-out applies to all of our Ethernet SmartLink™ instruments.

Every Ethernet SmartLink™ is shipped from the factory with an IP address of 0.0.0.0. When powered on with an address of 0.0.0.0. - the Smartlink™ will issue BootP requests for an IP address.

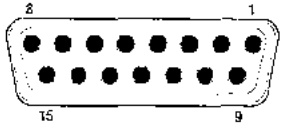
To assign a SmartLink™ a different IP address, use the ":config:comm:enet" command.

Example :config:comm:enet 100.90.80.70

This would assign the IP address of 100.90.80.70 to the SmartLink™. This can be done through the local port. Be sure to get a valid IP address from the Network Administrator. An invalid IP address can cause problems for other users on the network.

After assigning an IP address, use the ":system:posetup saved" and "*sav" commands to config the SmartLink™ to use the new address every time it is powered on.

To query a SmartLink™ for its current IP address, use the ":config:comm:enet?" command.



Contact	Use
1	Control In circuit Shield
2	Control In circuit A
3	Data Out circuit A
4	Data In circuit Shield
5	Data In circuit A
6	Voltage Common
7	Control Out circuit A
8	Control Out circuit Shield
9	Control In circuit B
10	Data Out circuit B
11	Data Out circuit Shield
12	Data In circuit B
13	Voltage Plus
14	Voltage Shield
15	Control Out circuit B
Shell	Protection Ground (Conductive Shell)

Ethernet 10BaseT

This Ethernet standard is growing in popularity because of its simple cabling requirements. A low cost and simple, twisted-pair cable using common RJ-45 telephone connectors is all that is required to get full 10 Mbps performance.

Protocol: UDP/IP, UDP port: 68
Boot P Protocol

Isolation: Per IEEE 802.3 (CSMA/CD)

Medium: Two-wire wisted-Pair,
24AWG,Unshielded

Segment Length: 100 Meters

Ethernet 10Base2

By far the most common Ethernet standard, 10Base2 uses small diameter coaxial cable ("thinnet" or thin coax) for a more noise immune network over longer distances, at 10Mbps.

Protocol:	UDP/IP, UDP port: 68 Boot P Protocol
Isolation:	Per IEEE 802.3 (CSMA/CD)
Medium:	Thin coaxial cable
Segment Length:	185 Meters

Ethernet 10BaseF

Fiber-optic transmission provides unparalleled noise immunity.

Protocol:	UDP/IP, UDP port: 68 Boot P Protocol
Isolation:	Per IEEE 802.3 (CSMA/CD)
Medium:	Fiber-optic cable
Segment Length:	2 kilometers

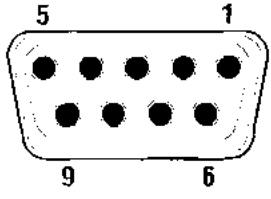
Ethernet 10BaseAUI

For 10Base5 thickwire or thicknet twinaxial networks, this provides an AUI interface to connect to the network adapters.

Protocol:	UDP/IP, UDP port: 68 Boot P Protocol
Isolation:	Per IEEE 802.3 (CSMA/CD)
Medium:	Twinaxial Cable
Segment Length:	500 Meters

RS232-C

The serial communications port built into every PC conforms to the RS232-C standard for connecting two digital devices point-to-point .



Contact	Use
1	N/C
2	TXD
3	RXD
4	N/C
5	GND
6	N/C
7	N/C
8	N/C
9	N/C
Shell	Protection Ground (Conductive Shell)

Protocol: Command/Response

Comm. Signals: TX, RX, Gnd. (pins 2, 3, 5)

Specific Commands.: None

Data Format: ASCII

Parity: None

Baud: 1200, 2400, 4800, 9600, 19.2K

Stop Bits: 1

Input Levels: Mark=False=-3 to -15 VDC; Space=True=+3 to +15VDC

Cable Distance: 50 Feet

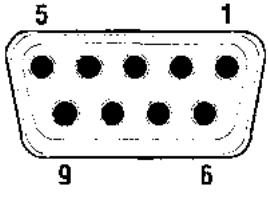
Timing Format: Asynchronous

Isolation: None

Duplex: Half, Full

RS422

Using a differential transmission technique RS422 extends the distance and noise immunity of point-to-point communications over what RS232-C can provide.



Contact	Use
1	GND
2	N/C
3	N/C
4	RX Data +
5	RX Data -
6	N/C
7	N/C
8	TX Data +
9	TX Data -
Shell	Protection Ground (Conductive Shell)

Protocol: Command/Response

Comm. Signals: Transmit +/-, Receive +/-, Common, Shield

Parity: one

Baud: 1200, 2400, 4800, 9600, 19.2K

Stop Bits: 1

Data Format: ASCII

Input Levels: Mark=False=-R+>-by>200mV; Space=True=R+<R-by<200mV

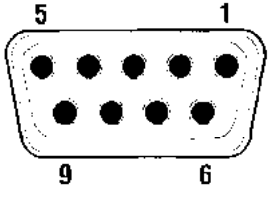
Cable Distance: 4,000 Feet

Timing Format: Asynchronous

Duplex: Half, Full

RS485

By adding multiple device addressing, RS485 permits up to 126 devices to communicate over the same serial network with the same distance and noise immunity specs that RS422 provides.



Contact	Use
1	GND
2	N/C
3	N/C
4	TX/RX +
5	TX/RX -
6	N/C
7	N/C
8	TX/RX +
9	TX/RX -
Shell	Protection Ground (Conductive Shell)

Note: 4 and 8 are tied together in the SmartLink cable, as well as 5 and 9. Therefore, only 3 connections are needed for RS485 - 1,4,5.

Protocol: Command/Response with Address

Addresses: Up to 124 devices, any single printable ASCII character

Comm. Signals: Transmit -Receive pair (+/-), Common, Shield

Parity: None

Baud: 1200, 2400, 4800, 9600, 19.2K

Stop Bits: 1

Data Format: ASCII

Input Levels: Mark=False=-R+>-by>200mV; Space=True=R+<R-by<200mV

Cable Distance: 4,000 Feet

Timing Format: Asynchronous

Duplex: Half, Multidrop

Use the "config:comm:RS485" command to configure the RS485 address. Any single printable ASCII character can be used. To send a command to an RS485 SmartLink™, append the address inside "()" before the command.

Examples:

:config:comm:RS485 9600 CR none A (This command can only be issued through the Local Port)

(A):meas? 1 (This command can be issued through the RS485 port.)

This will configure the SmartLink™ as address (A), then take a measurement from channel 1 on SmartLink (A).

Note: The ASCII space character ( ) is the broadcast message. All SmartLink™ instruments will execute the command sent to address ( ) but none will transmit a prompt back (to avoid collisions).

The (!) address is a special address. It functions like any other valid address but is the only address that will transmit back a response to the broadcast message. This means that it will execute and return a prompt to any command sent to the ( ) or (!) address.

Preliminary Specifications

Communications interfaces and architectures are evolving continuously. Contact factory for information on the following:

- HART
- DeviceNet
- ProfiBus
- Centronics
- 4-20mA/0-10V
- USB (Universal Serial Bus)
- Foundation Fieldbus H1

SmartLink™ Commands Tutorial

Measurement Setup Process

You can take quick measurements with your SmartLink™ right out of the box, using the instrument's default configurations and the **:Meas?** command.

For more complex measurements, you will want to use the three-step process outlined below to be certain you are getting measurement results that meet your needs.

Before you can take measurements or configure channels, you must already have established communication with the instrument. You configure the communications port on SmartLink™ using its Local Port and the **:Config:Comm** commands.

You should also set the instrument's internal time and date using the **:Time** and **:Date** commands at this time; although it is not mandatory.

Once you have established communication and set the time and date, you can complete the following tasks to ensure the measurement you make will give you the results you want.

1. **Configure the SmartLink™ Instrument.**
2. **Activate SmartLink™ Configurations.**
3. **Activate the Measurement.**

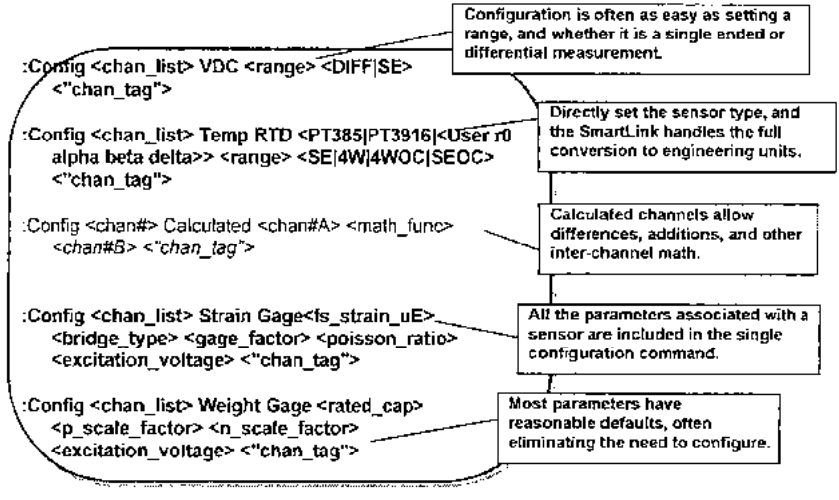
Keep in mind that you can take measurements with your SmartLink™ right out of the box, using the instrument's default configurations and the **:Meas?** command. You then only have to change those configurations that are necessary to meet your needs.

Please read the following sections in the order they appear to get the most benefit from this quick tutorial.

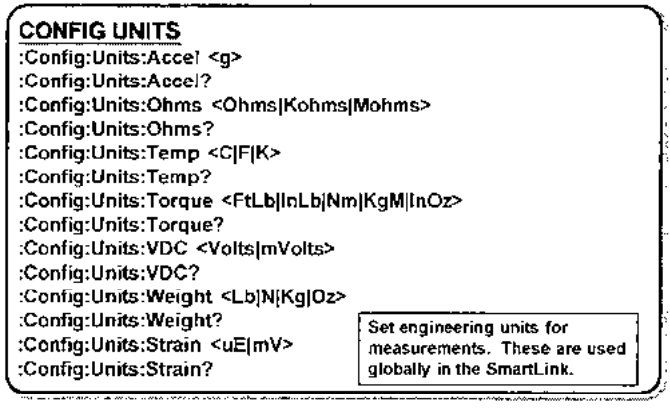
Configure the SmartLink™ Instrument

CONFIGURE SMARTLINK™ CHANNELS

1 Configure channels to measure the correct parameters with an appropriate measurement style (e.g. DCVolts-differential, DCVolts-single ended, 4-wire ohms-offset compensated, etc.) using **:Config <chan_list>** commands.

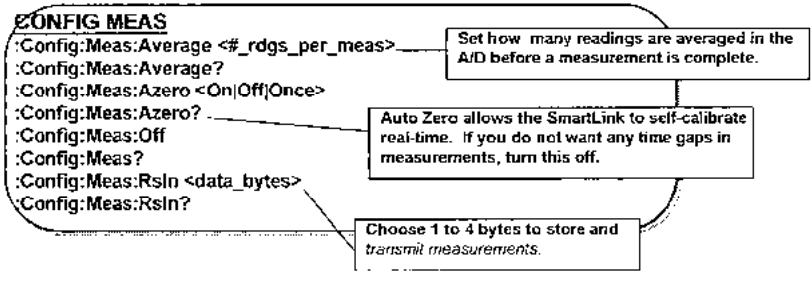


2 Configure units for each measurement parameter (e.g. FtLb for torque, K for temperature, etc.) using **:Config:Units** commands.



CONFIGURE SMARTLINK™ DATA CONDITIONING

1 Configure the instrument to average a number of readings for each measurement using **:Config:Meas** or **:Config:Filter** commands.

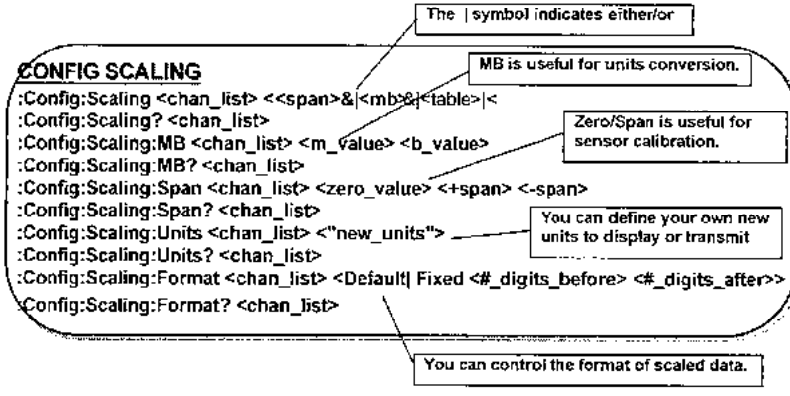


Since the digital filter is a moving average filter you get new readings at nearly the same rate as with unaveraged measurements.

CONFIG FILTER
:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>
:Config:Filter:Dig:MvgAvg? <chan_list>

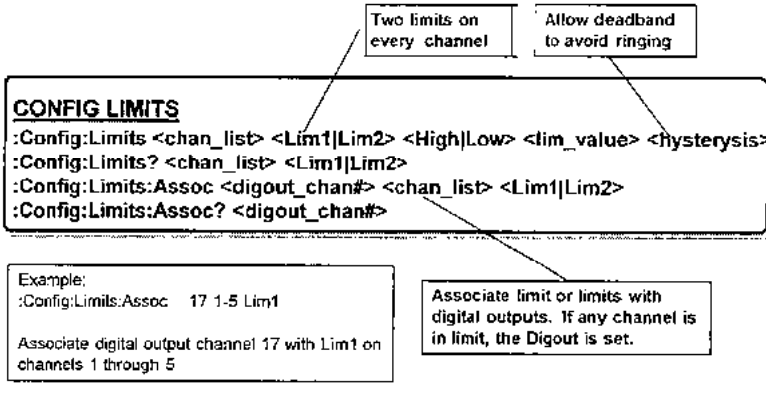
When using a Moving Average Digital Filter, it is important to note that the first "N" readings are not fully filtered. If they must be filtered, use the :config:meas:average command

2 Configure the instrument to scale data from each reading using the **:Config:Scaling** commands.



CONFIGURE SMARTLINK™ LIMIT CONDITIONS

1 Configure the instrument so it will check measurement data to see if it falls within desired limits, and specify what action the instrument takes when data is outside these limits using the **:Config:Limits** commands.



CONFIGURE SMARTLINK™ CHANNEL SCANNING & MEASUREMENT TIMING

You can configure the instrument to measure a list of channels at a specific time, at regular intervals of time, or after a trigger condition occurs in two ways.

Using the *:Config:Meas:Trig* **command**

Using the :Config:Scan command

Using the *:Config:Meas:Trig* command

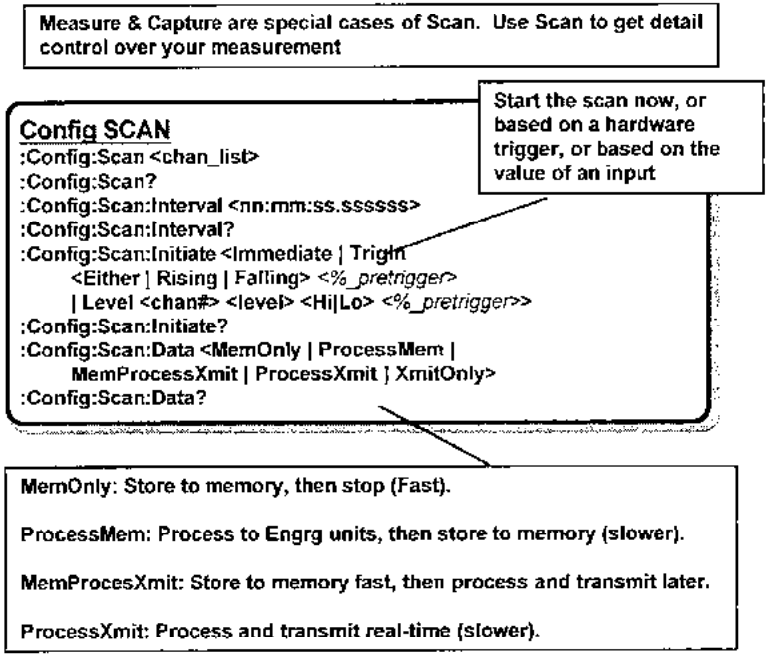
If you want the instrument to take a single measurement under certain conditions you use the *:Config:Meas:Trig <Immediate|TrigIn|DigIn|<chan#>>* command to specify the conditions.

You must then issue the **:Meas? <chan_list> <#_of_rdgs>** command to cause the instrument to watch for those conditions and take the number of readings specified by <#_of_rdgs> from each of the channels specified in <chan_list>.

Using the :Config:Scan command

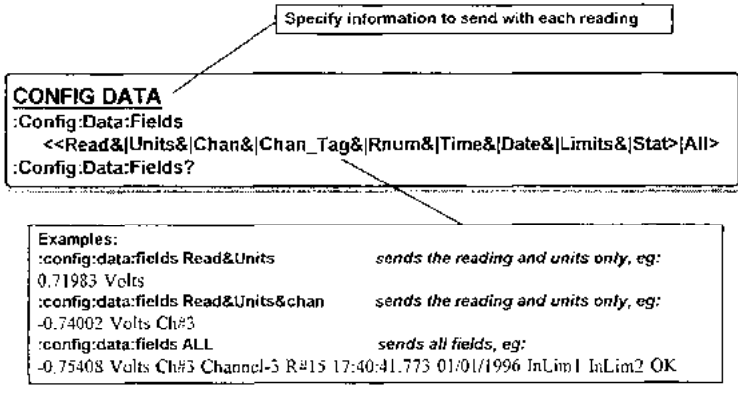
You can configure the instrument to scan a set of channels at regular intervals of time or after a specified trigger condition occurs using the **:Config:Scan** commands.

You must first define the channels you wish to scan using the **:Config:Scan <chan_list>** command and then define the conditions that will cause the scan to start using the **:Config:Scan:Initiate** command.

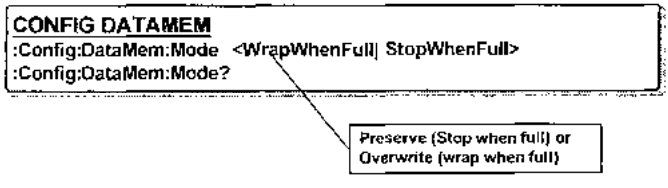


CONFIGURE SMARTLINK™ DATA COLLECTION

1 Configure which data as well as which fields in the data will be transmitted to memory or to the display using the **:Config:Data** commands.



2 Configure the way data is stored and the format in which it will be stored using the **:Config:DataMem** commands.



Activate SmartLink™ Configurations

There are a number of configurations you set up with **:Config** commands that you must activate before SmartLink™ will use them.

ACTIVATE FILTERING CONFIGURATIONS

You activate filtering configurations for specified channels using the **:Filter:Dig** commands. You must activate filtering before you tell the instrument to take a measurement using the **:Meas?** Command.

FILTER
:Filter:Dig <chan_list> <On|Off>
:Filter:Dig? <chan_list>

ACTIVATE SCALING CONFIGURATIONS

You activate scaling configurations for specified channels using the **:Scaling** command.

SCALING
:Scaling <chan_list> <On|Off>
:Scaling? <chan_list>

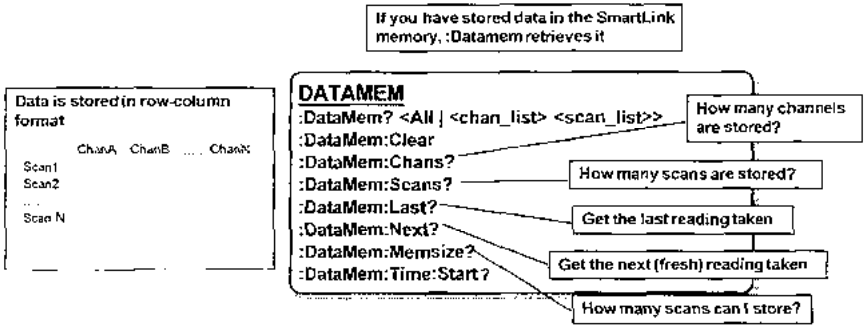
ACTIVATE LIMITS CONFIGURATIONS

You activate limits configurations for specified channels using the **:Limits** commands.

LIMITS
:Limits <<chan_list>|All> <On|Off>
:Limits? <chan_list>
:Limits:Status? <chan_list>

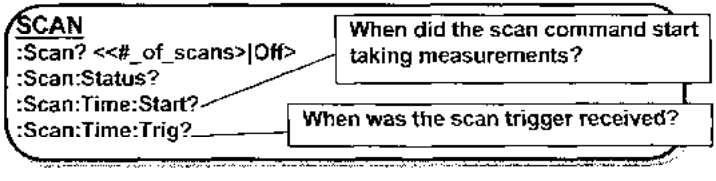
ACTIVATE DATA STORAGE CONFIGURATIONS

You activate data storage configurations using the **:DataMem** commands.



ACTIVATE SCAN CONFIGURATIONS

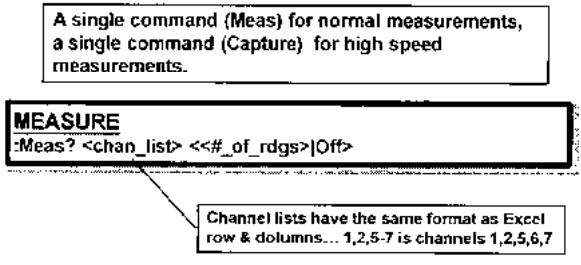
You activate Scan configurations using the **:Scan** commands.



Activate the Measurement

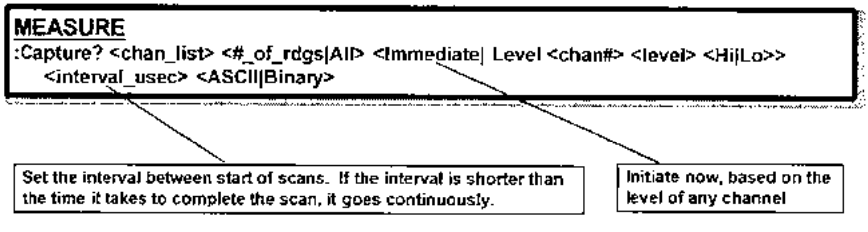
There are three ways to cause SmartLink™ to take a measurement.

ISSUE THE :MEAS? COMMAND.



ISSUE THE :SCAN? COMMAND.

ISSUE THE :CAPTURE? COMMAND.



*Note: *All commands in Italics will be available in future firmware upgrades.*

Command Reference

This section details all SmartLink™ commands. If your SmartLink™ does not support commands that you need, contact customer support to find out if you can upgrade for this specific capability.

SmartLink™ instruments use a command/response model for communication. This means that they will not transmit unless explicitly requested to do so from a client. In this model, the requesting computer is a client, and the SmartLink™ is a server. The point to remember is that a SmartLink™ will never initiate communications unless it is configured to transmit data when a limit event occurs.

When a client sends a command, the SmartLink™ will transmit a response and a prompt. There are three different prompts, depending upon whether or not there is an error.

=>	Command executed successfully
?>	Invalid command (command may be typed incorrectly)
!>	Valid command, but the SmartLink™ will not execute it because of its current configuration or state.
~>	A **:Scan** or **:Capture** command has been accepted and is currently executing. When the command is finished, the SmartLink™ will transmit one of the three prompts above, indicating the result.

Note: All commands are case insensitive

Examples

*Idn? (return the model number and serial number)

Network Meas. Model TMC-DCV32-RS232-C Ser#0 FW<**current rev**>
=>

*Idn (command typed incorrectly)

?>

To Specify a Channel Tag you use the <"chan_tag"> parameter to create a comment string that will be returned with each measurement. When you store or transmit the measurement to the display, the comment string is stored or displayed with the data. The default tag is "Channel-nn", where nn is the channel number. Maximum length for the string is 12 characters.

To Specify a Channel List you specify the <chan_list> parameter using numbers separated by commas, a range of channels separated by a dash, or a combination of the two as shown in the following channel list examples.

1,2,3,7,8	channels 1,2,3,7,8
1,2,4-6	channels 1,2,4,5,6
2-4,6-8	channels 2,3,4,6,7,8

Examples:

:meas? 1 5	Measure the input to channel 1, 5 times.
:meas? 1-4	Measure the input to channels 1,2,3,4 one time.
:meas? 1-4 1	Measure the input to channels 1,2,3,4 one time.
:meas? 1-4 10	Measure the input to channels 1,2,3,4 in sequence. Repeat the sequence 10 times.
:meas? 8,3,5,1-2 10	Measure the input to channels 1,2,3,5,8 in sequence. Repeat the sequence 10 times. The channels will be measured in sequence from lowest to highest regardless of the order you specify them in the channel list.

Commands

:Capture? Sets up High Speed Measurement

Capture takes the selected number of readings at the selected rate, and puts them into memory. After all of the readings have been taken, they are automatically transmitted to the client computer. Triggering is also supported.

:Capture <chan_list> <#_of_rdgs|All> <Immediate|Level <chan#> <level> <Hi|Lo>> <interval_usec> <ASCII|Binary>

<chan_list>	Any valid channel for the specific instrument.
<#_of_rdgs|All>	Number of Readings per Channel
<Immediate|Level <chan#> <level> <Hi|Lo>>	Trigger immediately or on a level
<interval_usec>	Measurement interval in micro-seconds
<ASCII|Binary>	Transmit the results in ASCII or Binary. Only ASCII is currently supported. Binary will be supported in future versions of the firmware.

:Comm? Shows Communication Port

Returns the communication port that is currently being used to receive information (e.g. local, RS232, etc.).

:Config CHANS Configure Channels for Measurement or Output

Sets up instrument hardware to its specific measurement or output configuration.

:Config <chan_list> Accel <Piezo|Cap> <fs_accel_g> <mV/g> <AC|DC> <30K|10K|1K|100> <"chan_tag">

:Config <chan#> Calculated <chan#A> <math_func> <chan#B> <"chan_tag">

:Config <chan_list> DewPoint <"chan_tag">

:Config <chan_list> DigIn <#_of_bits> <ActiveHigh|ActiveLow> <DIFF|SE> <"chan_tag">

:Config <chan_list> DigOut <#_of_bits> <ActiveHigh|ActiveLow>
<initial_state> <"chan_tag">

:Config <chan_list> Force Piezo <fs_force_lb> <mV/lb> <AC|DC>
<30K|10K|1K|100> <"chan_tag">

:Config <chan_list> Horsepower <torque_chan#> <rpm_chan#>
<"chan_tag">

:Config <chan_list> Humidity <type_code> <"chan_tag">

:Config <chan_list> IAC <range> <shuntohms> <DIFF|SE>
<CoupleAC|CoupleDC> <"chan_tag">

:Config <chan_list> IDC <range> <shuntohms> <DIFF|SE> <"chan_tag">

:Config <chan_list> Ohms <range> <4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Pressure Piezo <fs_psi> <mV/psi> <AC|DC>
<30K|10K|1K|100> <"chan_tag">

:Config <chan_list> Pressure Gage <fs_psi> <bridge_type> <gage_factor>
<poisson_ratio> <exitation_voltage>
<"chan_tag">

:Config <chan_list> Pressure Xmit <fs_psi> <fs_volts> <zero_volts>
<VDIFF|VSE|IDIFF<shuntohms>> <"chan_tag">

:Config <chan_list> RPM Encoder <pulses_per_revolution> <"chan_tag">

:Config <chan_list> Strain Gage <fs_strain_uE> <bridge_type>
<gage_factor> <poisson ratio>
<excitation_voltage> <"chan_tag">

:Config <chan_list> Temp RTD <PT385|PT3916|<User r0 alpha beta
delta>> <range> <SE|4W|4WOC|SEOC>
<"chan_tag">

:Config <chan_list> Temp TC <tc_type> <OpenTCOn|OpenTCOff>
IntRJ|<RefJcnTemp> <"chan_tag">

:Config <chan_list> Temp Thrmstr <type_code> <range>
<4W|SE|4WOC|SEOC> <"chan_tag">

:Config <chan_list> Torque GageDC <rated_cap> <p_scale_factor>
<n_scale_factor> excitation_voltage>
<"chan_tag">

:Config <chan#> VAC <range> <DIFF|SE> <AC|DC> <"chan_tag">

:Config <chan_list> VDC <range> <DIFF|SE> <"chan_tag">

:Config <chan_list> Weight Gage <rated_cap> <p_scale_factor> <n_scale_factor> <excitation_voltage> <"chan_tag">

<#_of_bits>	The number of bits to associate with this digital input or output channel. If more bits are specified than exist in subsequent channels, an error is generated. Note that a single channel can be associated with several subsequent bits, while still allowing the individual subsequent bits to be accessed individually. The response format is always the decimal equivalent of the binary pattern, e.g. 1011 is an 11. The first bit is the most significant.
<30K|10K|1K|100>	Filter frequencies available in DYN11 & 12 models.
<4W|SE|4WOC|SEOC>	Identifies the number of wires and measurement connections for a channel. SE is Single Ended, which is a common ground configuration. 4W is a 4-wire measurement, which increases accuracy. Note that if a common mode voltage exists, and is connected to SE channels, the unit may be damaged or destroyed. (See specifications for acceptable limits for each SmartLink™.) 4WOC is 4-wire mode with offset compensation enabled. SEOC is Single Ended with offset compensation enabled. Offset voltage compensation enhances accuracy; eliminating it maximizes measurement speed. Offset compensation is an additional measurement of the combined voltage offset which exists in a resistance measurement path when no excitation is supplied. By using this zero-excitation measurement as a correction factor, errors due to thermal voltages created at contact points can be eliminated.
<AC|DC>	Selects AD or DC coupling on DYN11 & 12 models.
<ActiveHigh|ActiveLow>	For output, ActiveHigh causes a digital "1" to be interpreted as an "ON" or +5V level. ActiveLow causes a digital "1" to be interpreted as an "OFF" or 0V level. For input, the threshold level is ≥2.5V for ON, <2.5V for OFF.

<chan#> This refers to a calculated channel, measurement which can be any channel number that is not a valid channel. For example, if your SmartLink™ has 18 measurement channels, Channel 19 is the first valid calculated channel.

<chan#A> Sets the input channels for a multi-channel calculation.

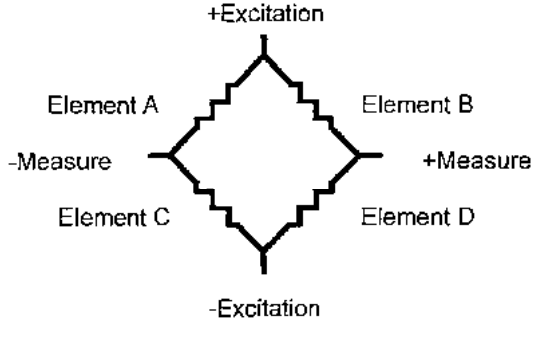
<chan#B> Sets the input channels for a multi-channel calculation.

<chan_list> Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify as a comma separated list, hyphenated range, or any combination. Even if a SE (single ended) or DIFF (differential) channel is part of a 4W (4 wire) channel, it can still be measured independently.

Configuring invalid channels is an error.

<"chan_tag"> Allows the user to set a label for each channel in a SmartLink™. This label can be stored and/or transmitted with each reading. Default is "chnn" where nn is the channel number. Max length of the string is 12 characters, and the string cannot contain any spaces.

<bridge_type> For bridge strain gage measurements, this indicates the bridge configuration being used, as indicated below.



The formula for strain is uE = (1/GageFactor) * (delta R/R) * 1e6

Type	Element A	Element B	Element C	Element D
1, ¼ Bridge	R	R	ε	R
2, ¼ Bridge	- νε	R	ε	R
3, ½ Bridge	- ε	R	ε	R
4, ½ Bridge	R	ε	ε	R
5, Full Bridge	−νε	ε	ε	−νε
6, Full Bridge	−ε	νε	ε	−νε
7, Full Bridge	-ε	ε	ε	−ε

R indicates a fixed value resistor
ε and -ε indicates a strain gage aligned with the principle strain.
νε and -νε indicates a strain gage aligned with the Poisson strain

<DIFF|SE> For voltage, this identifies the number of wires and measurement connections for a channel. DIFF is Differential, a two-wire measurement which allows a common mode voltage to be present between low of one channel and low of other channels, or to ground. SE is Single Ended, which is a common ground configuration. Note that if a common mode voltage exists, and is connected to SE channels, the unit may be damaged or destroyed. See specifications for acceptable common mode voltage limits for each SmartLink™.

<excitation_voltage> Sets the bridge excitation voltage. Acceptable values are shown below:

Model	Voltages
BRG11, 12	1,2,4,10V
TRQ31	1,2,4,10V

<fs_accel_g> Selects the full scale acceleration in g's.

<fs_psi> For a particular sensor or transmitter, this indicates the full scale pressure the sensor/transmitter is capable of outputting. The gain setting is determined by this value.

<fs_strain_uE>	For a particular sensor or transmitter, this indicates the full scale strain the sensor/transmitter is capable of outputting. The gain setting is determined by this value.
<fs_volts>	For a particular sensor transmitter, this indicates the full scale voltage output associated with the <fs_pressure> parameter.
<gage_factor>	The strain gage factor. Allowable values from 0 to 200 mV, default is 2 mV.
<initial_state>	When power is first applied to a SmartLink™, the digital outputs will be initialized to this state. Acceptable values are 0 or 1. The actual voltage level is set with the (ActiveHigh|ActiveLow) parameter.
<IntRJ|RefJcnTemp>	Allows using an external reference junction by specifying the external reference junction temperature. The default is IntRJ, the internal reference junction.
<math_func>	Acceptable values are +, -, /, *. Note that spaces must surround this field, e.g. 5 + 7, not 5+7.
<mV/g>	Sensiitivity in millivolts per gravitational unit.
<OpenTCOn|OpenTCOff>	Sets open thermocouple detector circuitry on or off. Default is OpenTCOn.
<Piezo|Cap>	Selects either Piezo or Capacitive for the channel.
<poisson_ratio>	The Poisson Ratio. Allowable values from 0.0 to 1.0, default is 0.2.
<pulses_per_revolution>	For RPM inputs, this is the number of pulses the instrument will receive for each full revolution of the shaft.

<PT385|PT3916|<User r0 alpha beta delta>>

Sets the RTD type. The first two choices are shown below, as well as the acceptable values for the User type.

Type	R0	Alpha	Beta	Delta
PT385	100	0.00385	0.111	0.507
PT3916	100	0.003916	0.11	0.511
User-(max)	10,000	0.1	.2	1
-(min)	1	0	0	0

<range>

Ranges for various functions are listed in the following table. Enter AUTO to select auto-ranging. Use of any other values causes an Execution Error. Default is AUTO.

BRG11	BRG12	DCV11	DCV12	DCV31	DCV32
Volts:	Volts:	Volts:	Volts:	Volts:	Volts:
0.2	0.2	0.2	0.2	0.2	0.2
		2	2	2	2
		20	20	20	20
		40	40	40	40
		Ohms:	Ohms:	Ohms:	Ohms:
		200	200	200	200
		2k	2k	2k	2k
		20k	20k	20k	20k
		200k	200k	200k	200k
		2M	2M	2M	2M
		20M	20M	20M	20M
		200M	200M	200M	200M

RTD31	RTD32	THD01	DCV31	DCV32	TRQ31
Ohms:	Ohms:	none	Ohms:	Ohms:	none
200	200		200	200	
2k	2k		2k	2k	
20k	20k		20k	20k	
200k	200k		200k	200k	
2M	2M		2M	2M	
20M	20M		20M	20M	
200M	200M		200M	200M	

<rpm_chan#> Tells the instrument which channel represents the RPM input, if one exists.

<tc_type> Sets the Thermocouple type being used on a specific channel. Acceptable values are J, K, T, E, R, S, B, N. Default is J.

<type_code> The empirical expression that is used for the resistance-temperature relationship of a negative temperature (NTC) coefficient thermistor is the Steinhart and Hart equation. It may be found explicit in T, where:

$$1/T = a + b(LnR) + c(LnR)^3$$

T = Kelvin units (°C + 273.15)
a,**b**,**c** = coefficients derived from measurements
LnR = the natural logarithm of resistance (in ohms).

To find **a**, **b**, and **c**, a thermistor is necessary at three different temperatures. The temperatures should be evenly spaced at least 10°C apart. Three simultaneous equations are solved using the three measured sets of resistance's and temperatures and the Steinhart and Hart equation, above. The equations derive **a**, **b** and **c** for any temperature range. Provided below are the coefficients for the range 0°C to 100°C with 50°C as the mid-point.

Thermistor Type	25°C resistance (in OHMS)	a	b	c
001A	100	0.0017709	0.0003406	1.479E-07
002A	300	0.0015632	0.0003108	9.747E-08
003A	1K	0.0013130	0.0002906	1.023E-07
004	2252	0.0014733	0.0002372	1.074E-07
005	3K	0.0014051	0.0002369	1.019E-07
007	5K	0.0012880	0.0002356	9.557E-08
017	6K	0.0012474	0.0002350	9.466E-08
016	10K	0.0011303	0.0002339	8.863E-08
006	10K	0.0010295	0.0002391	1.568E-07
008	30K	0.0009354	0.0002211	1.275E-07
011	100K	0.0008253	0.0002045	1.144E-07
014	300K	0.0008207	0.0001848	1.014E-07
015	1M	0.0008142	0.0001670	8.819E-08

You can use the Steinhart and Hart equation in two ways by knowing the **a**, **b** and **c** values for a thermistor. If resistance is known and temperature is desired, use the original equation above. If the resistance is desired and the temperature is known, use the following equation:

$$R = e \exp\left[(\beta - (\alpha/2))^{1/3} - (\beta + (\alpha/2))^{1/3}\right]$$

where $\alpha = (a-(1/T))/c$ and $\beta = \left[(b/3c)^3 + \alpha 2/4\right]^{1/2}$

<type_code> Identifies the type of humidity sensor used. Always is "BulkC".

Query:

:Config? <chan_list>. Responds with detail channel configuration. Format of the response is identical to the format of the command shown above.

See also: :Config:Meas and :Config:Units.

Examples:

:config 1 Ohms 20 4w chan1	config chan 1
:config 2,4 RTD PT385 4WOC	config chan 2 and 4
:config 3-6 VDC 2 DIFF	config chan 3,4,5 and 6

Instrument applicability:

BRG11	BRG12	DCV11	DCV12	DCV31	DCV32
calculated, DigIn, DigOut, RPM, Strain, Weight, VDC	calculated, DigIn, DigOut, RPM, Strain, Weight, VDC	calculated, DigIn, DigOut, OHMS, Pressure, Strain, TempRTD, Temp/Thermst, VDC	calculated, DigIn, DigOut, OHMS, Pressure, Strain, TempRTD, Temp/Thermst, VDC	calculated, DigIn, DigOut, OHMS, Pressure, Strain, TempRTD, Temp/Thermst, VDC	calculated, DigIn, DigOut, OHMS, Pressure, Strain, TempRTD, Temp/Thermst, VDC

RTD31	RTD32	THD01	DCV31	DCV32	TRQ31
calculated, DigIn, DigOut, OHMS, Temp/RTD	calculated, DigIn, DigOut, OHMS, Temp/RTD	calculated, dewpoint, Humidity, OHMS, Temp/Thermst, VDC	calculated, DigIn, DigOut, OHMS, Temp/Thermst,	calculated, DigIn, DigOut, OHMS, Temp/Thermst	calculated, DigIn, DigOut, Horse-power, RPM, Strain, Torque, Weight, VDC

:Config:Comm:EthernetID? Query Ethernet Address

Allows the user to determine the unique Ethernet ID number hard-coded in instrument firmware.

Query:

:Config:Comm:EthernetID? Responds with the Ethernet ID number

:Config:Comm:ENet Set Ethernet IP Address

Sets up Ethernet IP Address

:Config:Comm:ENet <IPAddress>

<IPAddress> The Internet protocol address is specified by your network system administrator. The address is in string format (xxx.xxx.xxx.xxx) . This parameter is not required if Boot P is running on the network server. Default is 0.0.0.0

Query:

:Config:Comm:ENet? Responds with the user-entered IP address. Format of the response is identical to the format of the command shown above.

See also: Communication Section

:Config:Comm:Local — Setup Local Communications Port

Sets up parameters for the local communications port.

:Config:Comm:Local <9600|1200|2400|4800|19200>
<CR|CRLF|LF|none>
<XonXoff|none>

<9600|1200|2400|4800|19200>	Sets baud rate. Default is 9600.
<CR|CRLF|LF|none>	Sets line terminator. Default is CR.
<XonXoff|none>	Sets flow control to Xon/Xoff or none. Default is XonXoff.

Query:

:Config:Comm:Local? Responds with configuration parameters for the local communications port. Format of the response is identical to the format of the command shown above.

See also: Communication Section

:Config:Comm:RS232 — Setup RS232 Communications

Sets up RS232 communications parameters

:Config:Comm:RS232 <9600|1200|2400|4800|19200>
<CR|CRLF|LF|none>
<XonXoff|none>

<9600|1200|2400|4800|19200>	Sets baud rate. Default is 9600.
<CR|CRLF|LF|none>	Sets line terminator. Default is CR.
<none|XonXoff>	Sets flow control to Xon/Xoff or none. Default is XonXoff.

Query:

:Config:Comm:RS232? Responds with configuration parameters for RS232 communication. Format of the response is identical to the format of the command shown above.

See also: Communication Section

Example:

:config:comm:RS232 19200 CRLF none

:Config:Comm:RS422 Setup RS422 Communications

Sets up RS422 communications parameters

:Config:Comm:RS422	<9600|1200|2400|4800|19200> <CR|CRLF|LF|none> <XonXoff|none>
<9600|1200|2400|4800|19200>	Sets baud rate. Default is 9600.
<CR|CRLF|LF|none>	Sets line terminator. Default is CR.
<XonXoff|none>	Sets flow control to Xon/Xoff or none. Default is XonXoff.

Query:

:Config:Comm:RS422? Responds with configuration for RS422 communications. Response is identical to the format of the command shown above.

See also: Communication Section

:Config:Comm:RS485 Setup RS485 Communications

Sets up RS485 communications parameters

:Config:Comm:RS485	<9600|1200|2400|4800|19200> <CR|CRLF|LF|none> <address>
<9600|1200|2400|4800|19200>	Sets baud rate. Default is 9600.
<CR|CRLF|LF|none>	Sets line terminator. Default is CR.
<address>	Sets address to any single, printable ASCII character. Default is 0 (zero).

Query:

:Config:Comm:RS485? Responds with configuration of RS485 communications. Format of the response is identical to the format of the command shown above.

See also: Communication Section

:Config:Data:Fields — Set Fields to be Stored or Transmitted

Use this command to specify the fields to be included in the data string for each measurement. You can specify any set of fields, in any order. Each element in the list must be separated by an ampersand (&).

:Config:Data:Fields	<Read&|Units&|Chan&|Chan_Tag&| Rnum&|Time&|Date&|Limits&|Stat>
<Read>	Instrument reading. The resolution of this reading tracks the display resolution of the instrument. An overflow reading reads as +9.9e37 with no units.
<Units>	This element attaches the function unit to the reading.
<Chan>	Indicates channel number being measured.
<Chan_Tag>	User pre-selected name that is associated with a measurement point and set by :Config CHANS.
<Rnum>	Since invoking a scan or measure, the number of measurements made on that channel, in an integer format.
<Time>	The time a reading was taken, in the format hh:mm:ss.sss.
<Date>	The date a reading was taken, in the format mm/dd/yyyy.
<Limits>	The condition of the limits on a channel, if enabled. The format is Lim# Hi, Lo or In.
<Stat>	The status register content. Call for information/availability on upgrading for this new capability.

Query:

:Config:Data:Fields? Responds with a list of the fields to be stored and transmitted with each reading. Format of the response is identical to the format of the command shown above.

Example:

```
:Config:Data:Fields Read&Chan&Units&Time
```

:Config:DataMem:Mode — Set Action When Memory is Full

Sets how the instrument responds to new scan data when memory is full.

:Config:DataMem:Mode <WrapWhenFull|StopWhenFull>

<WrapWhenFull>	Causes old data to be overwritten when memory becomes full.
<StopWhenFull>	Protects old data by terminating the scan.

Query:

:Config:DataMem:Mode? Responds with memory overflow mode. Format of the response is identical to the format of the command shown above.

:Config:DataMem:Scans? — Shows Number of Scans to be Stored in Memory

Returns the number of scans that can be stored in memory, using the current scan_list.

:Config:Filter:Advanced — Set Analog Filter

Configures advanced filtering. Call for information/availability on upgrading for this new capability.

:Config:Filter:Advanced <chan_list><Bessel|Buterworth>

:Config:Filter:Dig:MvgAvg — Set Digital Filter

Set configuration of Moving Average Digital Filtering. To enable, use :Filter:Dig on <chan_list>

:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.

<#_of_meas>	Sets number of readings to be used in the moving average digital filter. The number of readings to average can be set from 1 to 50 measurements. Beginning with the first reading and until <#_of_meas> has been reached, only those readings taken will actually be averaged. This filtering is separate from the (non-moving) averaging done on each reading using the **:Config:Meas:Avg** command.

Query:

:Config:Filter:Dig:MvgAvg ? <chan_list> Responds with setting for the digital filter. Format of the response is identical to the format of the command shown above.

See also: :Filter:Dig, Config:Meas:Avg

Example:

```
:config:Filter:Dig:MvgAvg 1,2,3-6 10
```

:Config:Limits — Set Limit Values per Channel

Store alarm limit information for the indicated channel and limit.

:Config:Limits <chan_list> <Lim1|Lim2> <Hi|Lo> <lim_value> <hysteresis>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the connection diagram in the specification section for your SmartLink™. Specify in form of a comma separated list, or hyphenated range, or a combination.
<Lim1|Lim2>	Specify either Lim1 or Lim2. One or two limits per channel can be set, one at a time.
<High|Low>	Specify either a **High** or **Low** limit. Lim1 defaults to **High**, Lim2 defaults to **Low**.
<lim_value>	Specify limit value, using decimal or exponential format in the units being measured.
<hysteresis>	The deadband around the lim_value, inside of which an alarm will not be set.

Query:

:Config:Limits? <chan_list> <Lim1|Lim2> Responds with limits configuration data. Format of the response is identical to the format of the command shown above.

See also: :Limits

Example:

```
:config:limits 3 Lim1 High 5 .5
```

:Config:Limits:Assoc — Set Digital Outputs Based on Limits

Sets a digital output when a limit is exceeded on a measurement channel.

Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>

<digout_chan#>	Specify the digital output channel(s) to be controlled by the limit. Valid channels are shown in the specifications for your SmartLink™.
<chan_list>	Specify the channel to control the digital output.
<Lim1|Lim2>	Specify the limit to be used to control the digital output.

Query:

:Config:Limits:Assoc? <digout_chan#> Responds with configuration of digital output linking to limits.

Format of the response is identical to the format of the command shown above. Call for information/availability on upgrading for this new capability.

Example:

```
:config:limits:assoc 17 3 Lim1
```

:Config:Meas:Average — Select Measurement Rate

Indirectly specifies the measurement rate by telling the unit how many readings to average to create one measurement.

:Config:Meas:Average <#_rdgs_per_meas>

<#_rdgs_per_meas> The number of readings taken (individual analog-to-digital conversions) and averaged before a measurement is sent to the other math functions. Defaults and maximums are as follows:

BRG11	BRG12	DCV11	DCV12	DCV31	DCV32
1 rdgs, 100 max	1 rdgs, 100 max	1 rdgs, 100 max	1 rdgs, 100 max	1 rdgs 100 rdg max	1 rdgs 100 rdg max

RTD31	RTD32	THD01	DCV31	DCV32	TRQ31
1 rdgs 100 rdg max	1 rdgs 100 rdg max	1 rdgs 100 rdg max	1 rdgs 100 rdg max	1 rdgs 100 rdg max	1 rdgs 100 rdg max

Query:

:Config:Meas:Average? Responds with the programmed number of measurements averaged. Format of the response is identical to the format of the command shown above.

See also: :Config:Filter:Dig:MvgAvg

Example:

```
:config:meas:average 8
```

:Config:Meas:Azero — Set Autozero

This command is used to disable or enable autozero and related background measurements. When enabled, accuracy is optimized, with reduced speed. When disabled, speed is increased at the expense of accuracy.

:Config:Meas:Azero <On|Off|Once>

<On|Off> On causes a new complete set of averaged backgrounds to periodically be taken. On is default.

<Once>	**Once** causes one new complete set of averaged background autozero measurements to be made, thus ensuring the unit is fully autozeroed. This set of backgrounds is then used with each measurement.

Query:

:Config:Meas:Azero? Responds with the current Azero configuration.

:Config:Meas:Off — Default Measurement Rate

Issuing this command disables all analog input channels. Excitation is turned off and measurement circuits are physically disconnected from connector sockets.

Query:

:Config:Meas? Query state of analog input channels. Format of the response is identical to the format of the command shown above.

:Config:Meas:Rsln — Set Measurement Resolution

Call for information/availability on upgrading for this new capability.

:Config:Meas:Rsln <data_bytes>

Query:

:Config:Meas:Rsln? Returns the current measurement resolution.

:Config:Meas:Trig

Call for information/availability on upgrading for this new capability.

: Config:Meas:Trig <Immediate|TrigIn|Digin <chan#>>

Query:

:Config:Meas:Trig? Returns the current measurement trigger.

:Config:Null — Set Null

Nulls the specified offset level at the input to the channels listed. Available only on pressure-force-acceleration instruments.

:Config:Null <chan_list><Input|level|off>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the connection diagram in the specification section for your SmartLink™. Specify as a comma separated list, hyphenated range, or a combination.
<Input|level|off>	Select level if you want the instrument to null a known level at the input of the specified channel(s). Select Input if you want to null the signal that is currently applied to the input of the specified channel(s). Default is Input.

Query:

:Config:Null? <chan_list> Returns a list of channels with the setting for each.

Example:

```
:Config:Null 1 Input
:Config:Null 2,4,5 200
:Config:Null 6 off
```

:Config:Scaling — Set Scaling Values

Set the scaling values for the indicated channel.

:Config:Scaling<chan_list> <<span>&|<mb>&|<table>|<poly>>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.
&|<mb>&|<table>|<poly>	One or more scalings can be enabled (e.g. span and mb). Call for information/availability on upgrading for <table> or <poly>.

Query:

:Config:Scaling? <**chan_list**> Responds with configuration of scaling. Format of the response is identical to the format of the command shown above.

:Config:Scaling:Format — Set Format of Scaled Data

Set the display format of scaled readings in number of digits

:Config:Scaling:Format <chan_list> <Default|Fixed|<#_digits_before> <#_digits_after>>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.
<fixed|exponent|default|>	One of the selectable scaling types: fixed, exponent or default.
<#_digits_before>	Desired number of digits to be displayed before the decimal point. Maximum is 9, minimum is 1.
<#_digits_after>	Desired number of digits to be displayed after the decimal point. Maximum is 9, minimum is 1.

Query:

:Config:Scaling:Format? <**chan_list**> Responds with configuration of scaling format. Format of the response is identical to the format of the command shown above.

:Config:Scaling:MB — Set Scaling Values

Sets values for mX+B linear scaling.

:Config:Scaling:MB <chan_list> <m_value> <b_value>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.

<m_value>	In the mX+B math function, this is the scaling value which is multiplied by the reading. When m=1 and B=0, mX+B scaling is effectively nonexistent. The values for m must be in the span ±9999.9 Meg (±9.9999 E+9).
<b_value>	In the mX+B math function, this is the offset value added to the scaled reading. The value for B must be in the span ±9999.9 Meg (±9.9999 E+9).

Query:

:Config:Scaling:MB? <chan_list> Responds with mX+B scaling values. Format of the response is identical to the format of the command shown above.

:Config:Scaling:Span — Set Zero & Span

Sets values for zero span scaling, which is often used to calibrate for a sensor.

:Config:Scaling:Span <chan_list> <zero_value> <+span> <-span>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.
<zero_value>	Represents the zero offset of a signal which is desired to "null out."
<+span>	Represents the desired positive full scale value for a particular signal or sensor.
<-span>	Represents the desired negative full scale value for a particular signal or sensor.

Query:

:Config:Scaling:Span? <chan_list> Responds with configuration of zero and span scaling calculation. Format of the response is identical to the format of the command shown above.

:Config:Scaling:Units — Set Scaling Units

Allows specification of new units to be stored or transmitted.

:Config:Scaling:Units <chan_list> <"new_units">

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.
<"new_units">	The new units designation to be applied to the channel list, up to 8 characters. The units designation can be enclosed with quotation marks (which will not be printed).

Query:

:Config:Scaling:Units? <chan_list> Responds with the scaling units designation. Format of the response is identical to the format of the command shown above.

:Config:Scan — Set Scan Channels

Sets which channels are included in a scan.

:Config:Scan <chan_list>

<chan_list>	Any valid channel for the specific instrument including calculated channels. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.

Query:

:Config:Scan? Responds with list of channels in the current scan list. Format of the response is identical to the format of the command shown above.

:Config:Scan:ConvertValues? Return the Conversion Values

Call for information/availability on upgrading for this new capability.

:Config:Scan:ConvertValues? <chan_list>

:Config:Scan:Data Set Data Destination

Selects the destination of the data from a scan.

:Config:Scan:Data <MemOnly|ProcessMem|MemProcessXmit|ProcessXmit>

<MemOnly>	Store only into memory
<Processmem>	(not currently supported)
<MemProcessXmit>	(not currently supported)
<ProcessXmit>	Process the data and transmit it

Query:

:Config:Scan:Data? Responds with the destination of scan data.

:Config:Scan:Delay Set Additional Channel Delay

Call for information/availability on upgrading for this new capability.

Adds additional delay in, milli-seconds, for additional settling time on the selected channel.

:Config:Scan:Delay <chan_list> <Default|usec>

Query:

:Config:Scan:Delay? <chan_list> Responds with the additional settling delay.

:Config:Scan:FastMode — Set FastMode On or Off

Call for information/availability on upgrading for this new capability.

:Config:Scan:FastMode <Off|On<AbortOnComm|AbortOnTimer <seconds>> <EngrUnitsOn| EngrUnitsOff>>

Query:

:Config:Scan:FastMode?

:Config:Scan:Initiate — Set up Scan Initiation

Controls when a scan is initiated. Call for information/availability on upgrading for <DigIn>, <TrigIn>, and <Level>.

:Config:Scan:Initiate <Immediate|TrigIn <Either|Rising|Falling> <%_pretrigger>|Level <chan#> <level> <Hi|Lo> <%_pretrigger>>

Immediate	Causes scan to begin immediately.
TrigIn <Either|Rising|Falling>	Causes scan to initiate when the trigger input line goes active.
Level <chan#> <level> <Hi|Lo>	Causes the unit to continuously monitor the value of the specified channel, and initiate a scan when the value of that channel exceeds or drops below the indicated level.
<%_pretrigger>	Param text

Query:

:Config:Scan:Initiate? Responds with the setting of scan initiation. Format of the response is identical to the format of the command shown above.

:Config:Scan:Interval — Set Scan Interval

Set scan interval time, when Immediate is selected for scan initiation.

:Config:Scan:Interval <hh:mm:ss.ssssss>

<hh:mm:ss.ssssss>	hh is hours in 24 hour format; mm is minutes; ss.sss is seconds (ssssss is microseconds). An Execution Error is generated if values outside the specified ranges are used or if a scan is active. Valid hh is from 00 to 23; mm from 00 to 59; ss from 0 to 59.

Query:

:Config:Scan:Interval? Responds with the set scan interval. Format of the response is identical to the format of the command shown above.

:Config:Scan:ValidData — Set ValidData Filter

Call for information/availability on upgrading for this new capability.

:Config:Scan:ValidData <chan_list> <Off|Lim1|Lim2>

Query:

:Config:Scan:ValidData? Responds with the current setup of the Valid Data Filter

:Config:Scan:XmitFormat — Transmit Format

Selects the format of data to be transmitted from the SmartLink.

:Config:Scan:XmitFormat <ASCII|Binary>

ASCII is default format.

Binary not currently supported.

Query:

:Config:Scan:XmitFormat? Responds with the format of measurements transmitted from the SmartLink.

:Config:Time:Format — Set Time Filter

Selects the number of bytes, 0 - 4, to use for time stamps. Also selects the resolution of time to store.

:Config:Time:Format <time_bytes> <time_rsln>

<time_bytes>	0, 1, 2, 3, 4
<time_rsln>	1us, 1ms, 1s

Query:

:Config:Time:Format? Responds with the format of the timestamp.

:Config:Units:AC — Set ACV & ACI Units

Sets units of measurement for AC voltage and current on applicable SmartLink™ instruments. Call for information/availability on upgrading for this new capability.

:Config:Units:AC <Volts|dB|dBM>

<Volts|dB|dBM>	Specify volts, dB (decibels) or dBM.

Query:

:Config:Units:AC? Responds with setting for AC units. Format of the response is identical to the format of the command shown above. Call for information/availability on upgrading for this new capability.

:Config:Units:Accel — Set Acceleration Units

Selects the units used for acceleration measurements.

:Config:Units:Accel <g|mps2|fps2>

<g|mps2|fps2>	g selects gravitational units. mps2 selects meters per second squared. fps2 selects feet per second squared. Default is g.

Query:

:Config:Units:Accel? Responds with the current acceleration units.

:Config:Units:Force — Set Force Units

Selects the units used for force measurements.

:Config:Units:Force <Lb|N|Kg|Oz>

<Lb|N|Kg|Oz>	Lb selects pounds. N selects newtons. Kg selects kilograms. Oz selects ounces. Default is Lb.

Query:

:Config:Units:Force? Responds with the current force units.

Example:

:Config:Units:Force N

:Config:Units:Ohms — Set Ohms Units

Sets units of measurements for DC Ohms.

:Config:Units:Ohms <Ohms|Kohms|Mohms>

<Ohms|Kohms|Mohms>	Ohms, Kohms, MegOhms

Query:

:Config:Units:Ohms? Responds with the configuration of Ohms units.

Config:Units:Pressure — Set Pressure Units

Sets units of measurement for pressure on applicable SmartLink™ instruments.

:Config:Units:Pressure <psi|Atm|KPa>

<psi|Atm|KPa>	Specify pressure units: pounds per square inch, atmospheres or KPascals.

Query:

:Config:Units:Pressure? Responds with configuration of pressure units. Format of the response is identical to the format of the command shown above. Call for information/availability on upgrading for this new capability.

:Config:Units:Strain — Set Strain Units

Sets units of measurement for strain on applicable SmartLink™ instruments.

:Config:Units:Strain <uE|compmV>

<uE|compmV>	µE is microstrain; compmV is compensated millivolts.

Query:

:Config:Units:Strain? Responds with configuration of strain units. Format of the response is identical to the format of the command shown above.

:Config:Units:Temp — Set Temperature Units

Set units for temperature on applicable SmartLink™ instruments.

:Config:Units:Temp <DegC|DegF|K>

<DegC|DegF|K>	DegC is degrees centigrade, DegF is degrees Fahrenheit, K is Kelvin.

Query:

:Config:Units:Temp? Responds with configuration for temperature units. Format of the response is identical to the format of the command shown above.

Example:

```
:Config:Units:Temp DegF
```

:Config:Units:Torque — Set Torque Units

Sets units of measurement for torque on applicable SmartLink™ instruments.

:Config:Units:Torque <FtLb|InLb|Nm|Kgm|InOz>

<FtLb|InLb|Nm|Kgm|InOz>	FtLb is Foot-pounds; InLb is Inch-pounds; Nm is Newton-meters; Kgm is kilogram-meters; InOz is Ounce-inches.

Query:

:Config:Units:Torque? Responds with configuration for torque units. Format of the response is identical to the format of the command shown above.

:Config:Units:VDC — Set DC Voltage Units

Sets units of measurement for DC Volts on applicable SmartLink™ instruments.

:Config:Units:VDC <Volts|mVolts>

<Volts|mVolts>	Volts or milliVolts

Query:

:Config:Units:VDC? Responds with configuration of Volts units.

:Config:Units:Weight — Set Weight Units

Sets units of measurement for weight on applicable SmartLink™ instruments.

:Config:Units:Weight <Lb|N|Kg|Oz>

<Lb|N|Kg|Oz>	Lb is pounds; N is Newtons; Kg is kilograms; Oz is ounces

Query:

:Config:Units:Weight? Responds with configuration for weight units. Format of the response is identical to the format of the command shown above.

:DataMem:Clear — Clear Data Memory

Clear all stored data.

:DataMem:Clear

:DataMem? — Retrieve Stored Readings

:DataMem? <All|<chan_list>> <All|<scan_list>> <ASCII|Binary>

<All|<chan_list>>	Transmits all data from memory for the specified channels.
<All|<scan_list>>	Transmits all data from memory for the specified scans.
<ASCII|Binary>	Selects ASCII or binary format for the transmitted data.

Queries:

:DataMem:Chans? Shows the channels that are being stored in memory.

:DataMem:Format? Shows the format of the data in Memory. The :Config:DataMem:Format command formats how future data will be stored in memory. The DataMem:Format? query returns the format of the data currently in memory.

See also: :Config:DataMem:Format

:DataMem:Last? Returns the last scanned line of data.

:DataMem:Memsize? Returns the number of total measurements that can be stored in memory using the current format.

:DataMem:Next? Returns the next scanned line of date, if the scanning function is on.

:DataMem:Time:Start? Returns the time when the scanning sequence started. Format is hh:mm:ss.sss.

:DataMem:Time:End? Returns the time when the scanning sequence ended. Format is hh:mm:ss.sss.

:DataMem:Time:Trig? Returns the time when the triggering occurred. Format is hh:mm:ss.sss.

:DataMem:Trig? Call for information/availability on upgrading for this new capability.

:DataMem:Scans? Responds with an indication of how many scans are stored. If this value is zero, then data memory has been cleared.

See also: :DataMem:Clear

:Date — Set the Current Date

:Date <mm/dd/yyyy>

Query:

:Date? Responds with current set date. Format of the response is identical to the command shown above.

:Filter:Dig — Control Action of Digital Filter

Turns digital filtering on or off . Default is off.

:Filter:Dig <chan_list> <On|Off>

Query:

:Filter:Dig? <chan_list> Responds with the status of the digital filter for each channel. Format of the response is identical to the format of the command shown above.

See also: :Config:Filter:Dig:MvgAvg

*IDN? — Identification Query

Returns the instrument identification code. The identification code consists of the instrument model number, serial number and firmware revision.

Response:

Network Meas. Model TMC-DCV32-RS232-C Ser#0 FW<current rev>

:Limits — Set Limits Checking On or Off

:Limits <<chan_list>|All> <On|Off>

<chan_list>|All>	Specify which channels are to be effected.
<On|Off>	Select On or Off.

Queries:

:Limits? <chan_list> Responds with the status of the limits checking for each channel. Format of the response is identical to the format of the command shown above.

:Limits:Status? <chan_list> Responds with limits status for the indicated channel(s). The value returned represents data from the most recent scan. Format of the response is OverLim1 OverLim2 UnderLim1 UnderLim2 or InLimit.

:Limits:Digio? <digout_chan#> Call for information/availability on upgrading for this new capability.

Examples:

```
:Limits 1 On       turn chan 1 limits on
:Limits All off    turn all channel's limits off
```

:Meas? Measure

Causes unit to initiate readings on the channels specified.

:Meas? <chan_list> <<#_of_rdgs>|Off>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination. Even if a SE (single ended) or DIFF (differential) channel is part of a 4W (4 wire) channel, it can still be measured independently. Measuring invalid channels returns a 9.9e-37 measurement and an error.
<#_of_rdgs|Off>	The parameter can have the value of Off, or a specific number of readings to be taken from each channel in the <chan_list>. Default is #_of_rdgs = 1.
Response format:	Fields transmitted or stored are specified by the **Config:Data:Fields** command. Which data is transmitted is specified by the **Config:Data** command. Each field is separated by a comma, while each line is separated by a CR, LF (carriage return, line feed)

Queries:

:Meas:Chan? Responds with the number of the last channel from which a measurement was taken. If no measurements are under way, it responds with channel number zero. Call for information/availability on upgrading for this new capability.

See also: Config CHANS and :Config:Meas.

:Output — Sets Output Level

Set Digital or Analog outputs.

:Output <chan_list> <value> <step_delay>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the SmartLink™ connection diagram in this manual. Specify in form of a comma separated list, or hyphenated range, or a combination.
<value>	A set of values to be associated identically with each channel in <chan_list>. Note that a single channel can be configured to control several bits, using the #_of_bits parameter in :Config CHANS. Values are expressed in binary, decimal, octal or hexadecimal form. The command associates the lowest bit with the first channel, the next lowest with the second channel and so on. If only one bit is specified, it is the lowest level bit.
<step_delay>	This field is not currently supported. Sequential bits or sets of bits can be presented on the digital outputs, each separated by a delay. The unit first sets the channel(s) to the first value, then waits for <step_delay> milliseconds, then sets the output to the next value in the list. To send a 50ms pulse on channel 17 and a 150 ms pulse on channel 18, the following command would be used: Output:Digout 17 0,2,1,1,0 2 50.

Call for information/availability on upgrading for this new capability.

Query:

:Output? <chan_list> Responds with values and delays associated for the specified channel(s). Format of the response is identical to the format of the command shown above.

*RCL — Return to Setup Stored in Memory

Use this command to return to the configuration stored in memory. The *SAV command is used to store the setup configuration in memory. Only one setup configuration can be saved and recalled. The SmartLink™ ships from the factory with factory defaults loaded into the available setup memory.

*RST — Reset

Performs a warm boot of the SmartLink. The saved User Configurations are not changed. Also, calibration data is retained.

See also: * SAV, :system:POSetup

*SAV — Save Present Setup in Memory

Saves all configuration information in non-volatile memory for later recall or for power-on settings. Only one setup configuration can be saved and recalled.

See also: *RST, :System:POSetup

:Scaling — Turn Scaling On or Off

:Scaling <chan_list> <On|Off>

<chan_list>	Any valid channel for the specific instrument. For valid channels, see the specification section for your SmartLink™. Specify in form of a comma separated list, or hyphenated range, or a combination.
<On|Off>	Select On or Off.

Query:

:Scaling? <chan_list> Responds with the status of scaling for each channel. Format of the response is identical to the format of the command shown above.

:Scan? Enable/Disable Scanning

Control automatic scanning on one or multiple channels.

:Scan <<#_of_scans>|Off>

<Off|<#_of_scans>>	Off disables scanning. <#_of_scans> causes only that number of complete scans.

Queries:

:Scan? Return Scan Status. If a scan is in progress, a "1" is returned at the end of the scan. (A response delay may occur if Scan? is sent early in a scan.) This feature allows synchronization for other commands that would not be recognized if received during a scan. For example, Scan?; *TRG could be used to trigger a new scan after completion of the current scan. Otherwise, a *TRG command sent while a scan is in progress would be discarded. If a scan is not in progress, a "0" is returned immediately. Call for information/availability on upgrading for this new capability.

:Scan:Time:Start? Returns values indicating the time and date at start of last scan. Uses a similar format as the Time? Query or the Date? Query. The data is returned in the following order: Hours (0-23), Minutes (0-59), Seconds (0-59), Month (1-12), Date (1-31), Year (1900-2100). Setting of time does not include seconds, but retrieval of time does.

:Scan:Time:End? Returns values indicating the time and date at end of last scan. Format is the same as in **:Scan:Time:Start?**

:Scan:Time:Trig? Call for information/availability on upgrading for this new capability.

:Scan:Status? Query Scan Status

Returns On if a scan is currently in progress, Off if no scan is in progress.

See also: See also :Scan?

:Stats — Sets Stats Collection On or Off

Turns stats collection on or off for a channel.

:Stats <chan_list> <On|Off>

<chan_list>	Any valid channel for the specific instrument.
<On|Off>	On is the default.

:Stats:Clear — Clear Statistics

Clear each channel's statistics values.

:Stats:Clear <<chan_list>|All>

<chan_list>|All>	Specify channels from which to clear statistics.

:Stats:Max? — Channel's Maximum Value

Returns maximum value(s) for channels measured since the last :Stats:Clear command, or power on. The response is a signed number with decimal point and exponent.

:Stats:Max? <chan_list>

:Stats:Min? — Channel's Minimum Value

Returns minimum value(s) for channels measured since the last :Stats:Clear, or power on. The response is a signed number with decimal point and exponent.

:Stats:Min? <chan_list>

:System:Cal — Calibration Command

This command performs internal calibration on the analog electronics.

:System:Cal <chan#> VDC <range> <cal_point> <Diff>

:System:Cal:<chan#>Ohms <range> <4W|SE|4WOC> <cal_point>

<chan#>	Specify the channel number being calibrated (one at a time).
<range>	Specify the range being calibrated.
<Diff>	For calibrating DC volts, a differential measurement must be specified.
<cal_point>	Specify the value that the calibration source is outputting.
<4W|SE|4WOC>	Identifies the number of wires and measurement connections for a channel. SE is Single Ended, which is a common ground configuration. 4W is a 4-wire measurement, which increases accuracy. Note that if a common mode voltage exists, and is connected to SE channels, the unit may be damaged or destroyed. See specifications for acceptable limits for each SmartLink™.4WOC is 4-wire mode with offset compensation enabled. Offset compensation is an additional measurement of the combined voltage.
	offset which exists in a resistance measurement path when no excitation is supplied. By using this zero-excitation measurement as a correction factor, errors due to thermal voltages created at contact points can be eliminated.

Query:

:System:Cal:? Responds with all of the calibration values of the SmartLink™.

See also: System Calibration section of this manual.

:System:Cal:Comment — Set System Calibration Comments

Allows the user to set a string up to 22 characters containing calibration information, i.e. ambient temperature, technician name, etc.

:System:Cal:Comment <"string">

<"string">	Specify pertinent calibration information for the "string".

Query:

:System:Cal:Comment? Responds with the data entered as the calibration information. Format of the response is identical to the format of the command shown above.

:System:Cal:Date — Set System Calibration Date

This is used to enter the date at which calibration is performed.

:System:Cal:Date <"string">

<"string">	Specify the date of calibration for the "string".

Query:

:System:Cal:Date? Responds with the date entered as the calibration date. Format of the response is identical to the format of the command shown above.

:System:Cal:Mode — Enable System Calibration

:System:Cal:Mode <<On<password>>|Off>

<<On<password>>Off>	SelectingOn and entering the password puts the SmartLink™ into calibrating mode. Call Customer Support for your calibration password.

Query:

:System:Cal:Mode? Responds with On or Off status of the cal mode. Format of the response is identical to the format of the command shown above.

:System:Cal:Save — Save System Calibration Settings

Allows new calibration settings to be saved.

:System:Cal:Save

:System:Model#? — Shows Model Number of SmartLink™

Query:

:System:Model#? Responds with the three letter, two number suffix of the model number of the SmartLink™.

:System:NodeID — Set Node I.D. of SmartLink™

Allows each SmartLink™ to have a user set name or identification code.

:System:NodeID <"id">

<"id"> Up to 12 characters can be used.

Query:

:System:NodeID? Returns the identification label of the SmartLink™. Format of the response is identical to the format of the command shown above.

:System:POSetup — Set Power-on Defaults

This command is used to select the power-on defaults.

:System:POSetup <Factory|Saved>

<Factory|Saved> With Factory selected, the instrument powers up to the factory default conditions. With Saved selected, the instrument powers up to the *SAV default conditions. Factory is default.

Query

:System:POSetup? Query power-on setup. Format of the response is identical to the format of the command shown above.

See also: *SAV, *RCL

:Time — Set Instrument Clock

:Time <hh:mm:ss.sss>

<hh:mm:ss.sss>	hh is hours in 24 hour format; mm is minutes; ss.sss is seconds (to milliseconds). 2ms resolution.

Query:

:Time? Responds with current time in the instrument clock. Format of the response is identical to the format of the command shown above.

:Time:SyncGlobal — Synchronize Clocks of Multiple Instruments

This command causes all SmartLink™ instruments to instantly load the time set by :Time:SyncTime command into their clocks. Call for information/availability on upgrading for this new capability.

:Time:SyncGlobal

:Time:SyncTime — Set Synchronization Time

Sets a synchronization time which will be loaded into the clock when a :Time:SyncGlobal command is received. Allows multiple instruments on a network to be synchronized. Call for information/availability on upgrading for this new capability.

:Time:SyncTime <hh:mm:ss.sss>

<hh:mm:ss.sss>	hh is hours in 24 hour format; mm is minutes; ss.sss is seconds (to milliseconds).

Query:

:Time:SyncTime? Responds with the synchronization time which was last set. Format of the response is identical to the format of the command shown above. Call for information/availability on upgrading for this new capability.

FAQ 1 — NetAcq-MMI PC to Omnigo Download

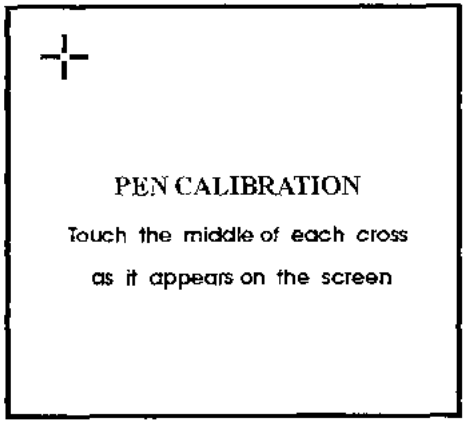
CAUTION – This procedure should be performed by someone with experience downloading software.

If your Omnigo loses the NetAcq-MMI software, (for example, if the main & backup batteries are removed simultaneously) you must follow the procedure below to reload NetAcq-MMI.

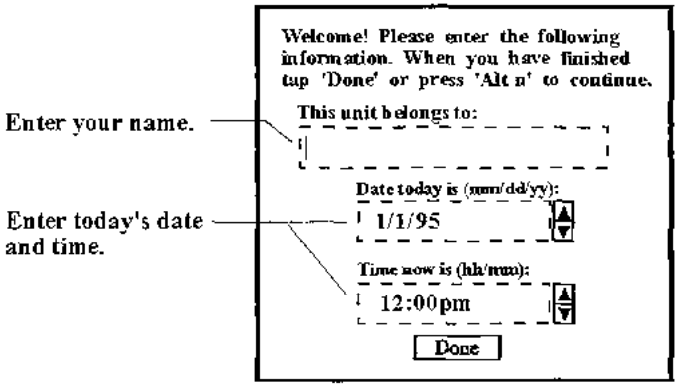
Preparing the Omnigo

1 Replace the Omnigo's AA batteries and/or lithium backup battery.

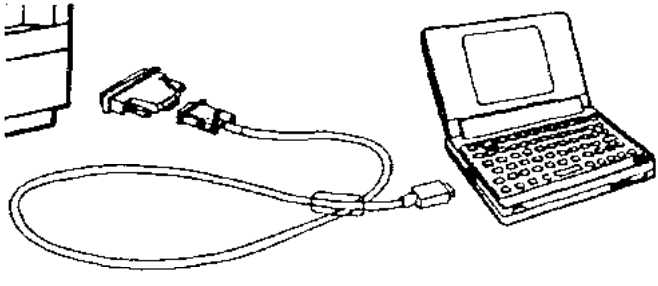
2 Turn on the Omnigo and perform the pen calibration process by following the instructions on the screen.



3 Label the Omnigo and set the proper time and date



4 Shut off the Omnigo and connect the RS232 cable between the PC and the Omnigo as shown below.



Download NetAcq-MMI

1 Insert the NetAcq-MMI disk into your PC and copy the files on the disk to a directory (folder) called Omnigo on one of your hard drives.

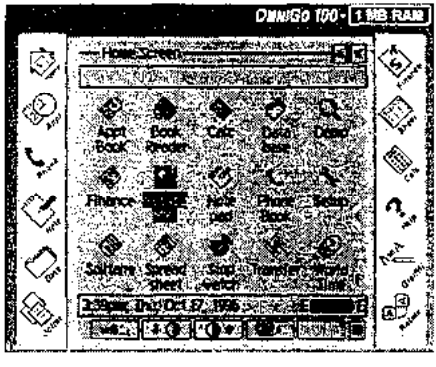
Note: You can install NetAcq MMI directly from the floppy disk to the Omnigo if you so desire.

2 Turn on the Omnigo and reboot by pressing ⇧ + ON + NEXT simultaneously.

3 When the Omnigo is ready, select the "**Transfer**" icon. Next, choose "**PC**" and then "**Connect**" from the menu. (Make sure the "Serial..." connection is set to 9600 baud.)

4 On the PC, open the Omnigo directory on your hard disk (or on the floppy if you choose) and run the appropriate program; **Omnigo1** if you're using the PC's '**comm port 1**' or **Omnigo2** if you're using the PC's '**comm port 2**'.

5 When the download is complete (i.e.if you see this message on your PC MS-DOS prompt **C:\OMNIGO>rem Congratulations! Netacq-MMI succesfully downloaded. Close this window.**), choose "cancel" on the Omnigo and press EXIT on the Omnigo. You should now have an app called "**NetAcq-MMI**".



6 Connect the Omnigo to your SmartLink™ local port using the supplied cable (10-pin connector on each end).

7 Select the NetAcq-MMI icon on the screen to send commands to your SmartLink™.

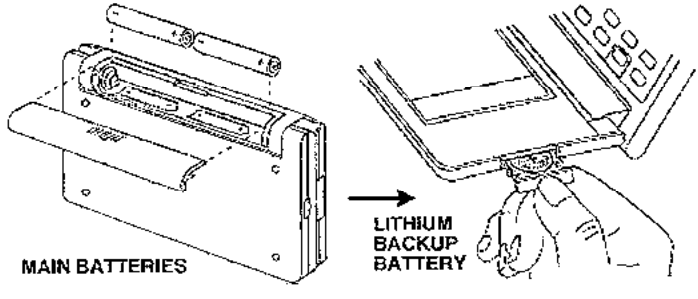
WARNING — If you remove the AA batteries and the lithium battery at the same time you will lose the NetAcq-MMI application since it is kept in Omnigo RAM. You must replace the AA batteries while the lithium battery is in place and then replace the lithium battery while the AA batteries are in place.

FAQ 2 — Changing Omnigo Batteries

WARNING — If you remove the AA main batteries and the lithium backup battery at the same time you will lose the NetAcq-MMI application since it is kept in Omnigo RAM.

1 Replace the AA main batteries first, leaving the lithium backup battery in place, as shown in the figure below.

2 Replace the lithium BACKUP battery while the AA main batteries are in place.



NOTE — If the above procedure is reversed you must reset the Omnigo in order for it to boot up. The reset button is located on the bottom of the Omnigo.

FAQ 3 — Example Measurement Tasks

Use the examples in this section to set up and make measurements by sending commands to your SmartLink™ using a terminal emulator or NetAcq software.

Measurement Tasks

Configure SmartLink™ to Measure VDC

You must configure a channel or set of channels to measure DC Volts before taking a measurement. You can make differential or single-ended measurements. Use the following format for this command.

:config <chan_list> vdc <ranges> <DIFF | SE> <"chan_tag">

To Specify a Channel List you specify the <chan_list> parameter using numbers separated by commas, a range of channels separated by a dash, or a combination of the two as shown in the following channel list examples.

1,2,3,7,8
1,2,4-6
2-4,6-8

To Specify the Voltage Range you set the <ranges> parameter to one of the following values: .2, 2, 20, 40, or Auto. SmartLink™ chooses the appropriate range when you set the <ranges> parameter to Auto.

To Specify the Measurement Type you set the <DIFF | SE> parameter to either DIFF or SE.

To Specify a Channel Tag you use the <"chan_tag"> parameter to create a comment string that will be returned with each measurement. When you store or transmit the measurement to the display, the comment string is stored or displayed with the data. The default tag is "Channel-nn", where nn is the channel number. Maximum length for the string is 12 characters.

Examples:

:config 1 vdc 2 diff "Ch1 2vdc"	Configures channel 1 to measure DC volts using the 2 volt range, making a differential measurement with "Ch1 2vdc" as the channel tag.
:config 1-4 vdc .2 se	Configures channels 1 through 4 to measure DC volts using the 200 millivolt range, making a single-ended measurement with "Channel n" as the channel tag (n is the channel number). "Channel n" is the default tag if you do not specify one.
:config 1,3-4,6-8 vdc Auto diff	Configures channels 1,3,4,6,8 to measure DC volts using autorange to select the correct range, making a differential measurement with "Channel n" as the channel tag (n is the channel number).

Configure SmartLink™ to Measure Ohms

You must configure a channel or set of channels to measure Ohms before taking a measurement. You can make four-wire or single-ended measurements. Use the following format for this command.

:config <chan_list> ohms <ranges> <4W|4WOC|SE|SEOC> <"chan_tag">

To Specify a List of Channels you list channel numbers as described for DC Volts.

To Specify the Ohms Range you set the <ranges> parameter to one of the following values: 200, 2k, 20k, 200k, 2M, 20M, 200M, or Auto. SmartLink™ chooses its own range when you set the <ranges> parameter to Auto.

To Specify the Connection Type you set the <4W|4WOC SE|SEOC> parameter to one of the four choices listed.

To Specify a Channel Tag you use the <"chan_tag"> parameter as described for DC Volts.

Examples:

:config 1 ohms 2k 4W "Ch1 2K"	Configures channel 1 to measure Ohms using the 2000 ohm range, making a four-wire measurement with "Ch1 2K" as the channel tag.
:config 1-4 ohms Auto se	Configures channels 1 through 4 to measure ohms using autorange to select the correct range, making a four-wire measurement with "Channel n" as the channel tag (n is the channel number). "Channel n" is the default tag if you do not specify one.
:config 1,3-4,6-8 ohms 200 se	Configures channels 1,3,4,6,8 to measure ohms using the 200 ohm range, making a single-ended measurement with "Channel n" as the channel tag.

Take a Measurement using SmartLink™

Make sure you have configured the channel(s) to measure the correct physical parameter (Ohms, DC Volts, etc) as described above.

The general form of the measure command is as follows:

:meas? <chan_list> <#_of_readings | ON | OFF>

To Specify a List of Channels you list channel numbers as described for DC Volts.

To Specify the Number of Readings you set the "#_of_readings" parameter to an integer number. The default value for the number of readings is one.

Examples:

:meas? 1 1	Measure the input to channel 1, one time.
:meas? 1 5	Measure the input to channel 1, 5 times.

:meas? 1-4	Measure the input to channels 1,2,3,4 one time.
:meas? 1-4 1	Measure the input to channels 1,2,3,4 one time.
:meas? 1-4 10	Measure the input to channels 1,2,3,4 in sequence. Repeat the sequence 10 times.
:meas? 8,3,5,1-2 10	Measure the input to channels 1,2,3,5,8 in sequence. Repeat the sequence 10 times. The channels will be measured in sequence from lowest to highest regardless of the order you specify them in the channel list.

Find the Maximum and Minimum Values in a Set of Measurement Data

The :stats command has the following format:

:stats:max? <chan_list> **or** :stats:min? <chan_list>

To Configure Channels for the correct physical parameter (Ohms, DC Volts, etc) you follow the same procedure as described for DC Volts or Ohms.

To Find Max and Min Values of Measured Channel Data perform the following steps in order.

1 Clear all previously-recorded data in channels 1 through 4 (we will use these channels for this example) using the following command:

:stats:clear 1-4 **or** :stats:clear all

2 Use the :meas? command to make 10 measurements on channels 1-4 as follows:

:meas? 1-4 10

3 Use the :stats command to find the maximum or minimum values for all the channels, or a specified channel as follows:

:stats:max?	Finds the maximum reading for channel 1 (default channnel), from all 10 measurements.
:stats:max? 3	Finds the maximum reading for channel 3, from all 10 measurements.
:stats:max? 2,3	Finds the maximum readings for channels 2 and 3, from all 10 measurements.
:stats:min?	Finds the maximum reading for channel 1 (default channnel), from all 10 measurements.
:stats:min? 3	Finds the minimum reading for channel 3, from all 10 measurements.
:stats:min? 2,3	Finds the minimum readings for channels 2 and 3, from all 10 measurements.

FAQ 4 — Averaging With SmartLink™

Introduction

SmartLink™ currently computes two types of averages — a repeating average and a moving average. You use a different command to compute each type of average.

Use the **:config:meas:average** command when you want a repeating average and the **:config:filter:dig:mvgavg** command when you want a moving average.

Using a Repeating Average

The **:config:meas:average** command configures all the instrument's analog channels to average the same number of readings. Use this command to specify the number of readings to be averaged into each measurement. The SmartLink™ will take the number of readings you specify, sum them, divide by the number of readings, and return this value as the result of the measurement.

You should use a repeating average when you want to increase the accuracy of a single measurement. Clearly, the measurement will take longer than if you collect a single reading from the channel. For example, if you choose to average over 10 readings the measurement will take more than 10 times as long as with a single reading.

EXAMPLE COMMAND SEQUENCE

1 Configure the SmartLink™ to average **n** new readings for each measurement.

:config:meas:average n, where n is an integer between 1 and 100

2 Take a measurement from channel 1 that will be the average of **n** readings.

:meas? 1

3 Turn the repeating average off.

:config:meas:average 1

Using a Moving Average

The **:config:filter:dig:mvgavg** command configures only the specified list of analog channels. Use this command to specify the number of readings to be averaged into each measurement taken from the specified channels.

Each time a **:Meas?** command is issued, one new measurement is taken and averaged with the last measurements, up to **n**. This new measurement is made by taking one new measurement, discarding the oldest measurement and then computing the average in the same way as with a repeating average. The advantage of this type of average is that you get an averaged measurement with each new measurement.

You should use a moving average when you want accurately monitor the value of a slowly varying input signal such as temperature. This technique allows an accurate, averaged measurement at the same speed as a single measurement.

EXAMPLE COMMAND SEQUENCE

You must first configure a channel to calculate the moving average of n readings and then activate digital filtering for that channel before the instrument will return a moving average as the measurement result.

1 Configure the SmartLink™ to compute the moving average of the last **n** readings after each reading from channel 4.

:config:filter:dig:mvgavg 4 n, where n is an integer between 1 and 50

2 Activate moving average for channel 4.

:filter:dig 4 on

3 Take a measurement from channel 4.

:meas? 1

4 Deactivate moving average for channel 4.

:filter:dig 4 off

FAQ 5 — Download SmartLink™ Firmware

CAUTION – This procedure should be performed by someone with experience downloading software.

When you upgrade your SmartLink™ firmware you will use NetAcq software to download new firmware from your PC to the instrument through its Local Port.

If you have not installed or used NetAcq, refer to the Getting Started section of the *User's Manual and Prorammer's Reference* that was shipped with your instrument.

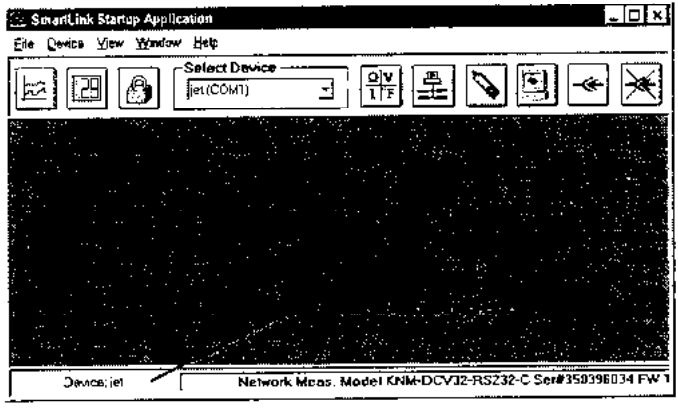
Preparing to Download Firmware

1 Place the version of appcode you wish to install in the same directory that contains your NetAcq files.

2 Use NetAcq to establish a connecion to your instrument.

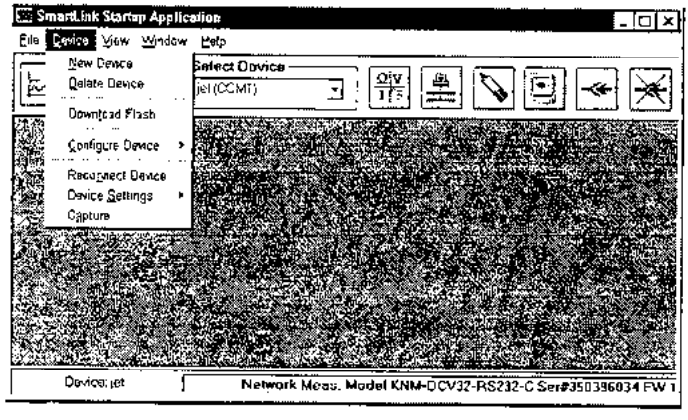
Downloading Firmware to SmartLink™

1 Move the cursor so that it is pointing to the bottom status bar as shown below and click with the left mouse button.

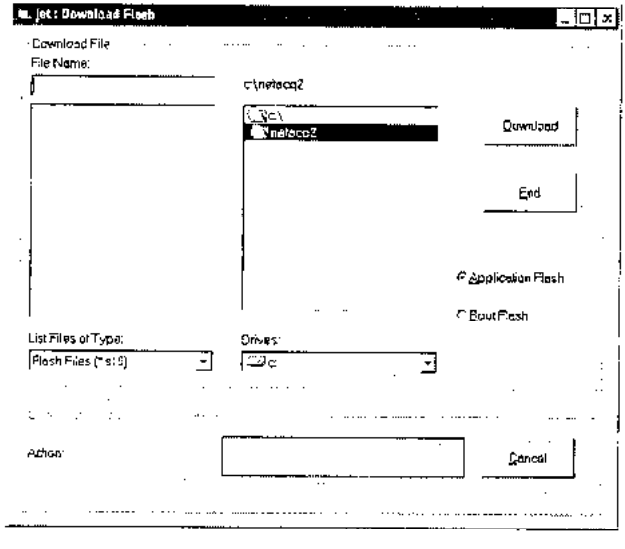


2 Press CTRL f on your keyboard.

3 Select Device on the menu bar. The following drop-down menu will appear.

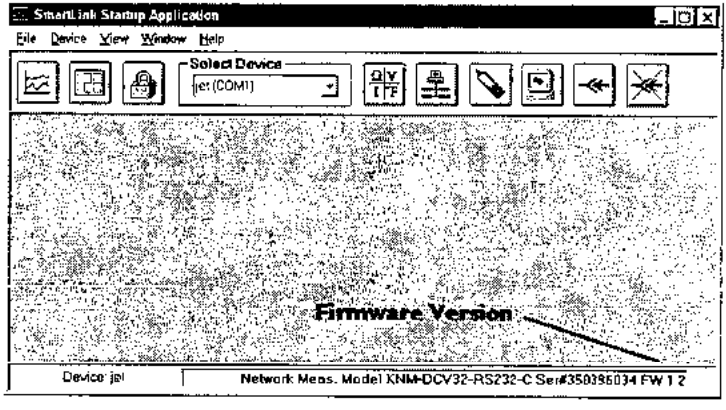


4 Select Download Flash from the drop-down menu. The following window will appear.



5 Click the Application Flash indicator , select the file containing the new appcode, and click the Download button.

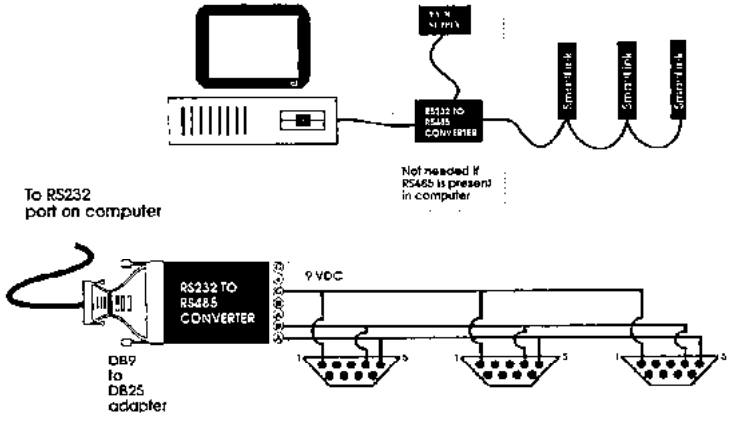
6 When the NetAcq finishes downloading the file the Download window will close. Click the Reconnect button on the toolbar check the bottom status window to ensure the new firmware version is indicated.



FAQ 7 — RS485 Overview

Configuring SmartLink™ Systems With RS485 Communication

The following figure shows how to create a network of individually-addressable SmartLink™ instruments.



Each SmartLink™ on an RS485 network must be configured by the user to have its own unique address. The default address (from the factory) of every SmartLink is 0. If any two or more SmartLink™ instruments on the network have the same address, they won't communicate properly! This situation might bring down the network. There are two ways to avoid this problem.

1. **Configure each SmartLink as you add it to the network.**

Connect the first SmartLink™ (power and communications) to the network and set its address to any printable ASCII character. Record the address so you won't duplicate it later. Connect the next SmartLink™, set its address to a different string. Continue adding instruments in this fashion until all are connect with unique addresses.

To set an address through the **RS485 port**, type the following command (choose appropriate values for your network):

(0):config:comm:rs485 9600 cr string

where: (0)=current address (0 is default),
9600 = Baud rate,
cr = EOL,
string = new address (any printable ASCII character)

2. Configure each SmartLink through the local port.

To configure an address through a local port, type the following command (choose appropriate values for your network).

:config:comm:rs485 9600 cr string

where: (0)=current address (0 is default),
9600 = Baud rate,
cr = EOL,
string = new address (any printable ASCII character)

Make sure to issue the ***sav** and the **:system:posetup saved** command, so that each SmartLink will use the new address the next time it is powered up (see *FAQ 8- Saving Configurations and Power-on Setups and FAQ9- Saving Communication Addresses*).

FAQ 8 — Saving Configurations and Power-on Setups

Every SmartLink™ is shipped with a default set of configurations. You can change these using **:Config** commands. You can change Limits, Scaling, Units, Channel configurations, Averaging, and many others. If you do not save the changes you make all of them will be lost the next time the SmartLink™ loses power.

You save and reuse new configurations with the following three commands: ***Sav**, ***Rcl**, and **:System:POSetUp <Saved|Factory>**.

Using *Sav and *Rcl to use your own configurations

If you want to be able to recall a setup after power is cycled you use the ***Sav** command to save the current setup into the instrument's memory. When power to the instrument is cycled it will still use the factory default configurations but you can reload the ones you saved by using the ***Rcl** command. When you issue the ***Rcl** command the instrument uses the last set of configurations you saved instead of the factory defaults.

Using *Sav and :System:POSetUp to use your own configurations at power-on

If you want the SmartLink™ to use your configurations instead of the factory defaults you must save your configurations as described above and then tell the instrument to use them.

You use the **:System:POSetUp <Saved|Factory>** command to choose whether the instrument will use the "Saved" or "Factory" settings at power up. The default is "Factory". If you choose "Saved", the SmartLink™ will use the last saved configurations. If you choose "Factory" it will use the factory default configurations.

FAQ 9 — Saving Communication Addresses

When you use a multidrop protocol network such as Ethernet or RS485, you must assign each SmartLink™ on the network a unique address. This is easily accomplished using the NetAcq software that shipped with your instrument. Just follow the procedure below.

Establish communication through the local port on your instrument. If you have not done this before refer to the Getting Started section of your SmartLink™ *User' Manual and Programmer's Reference.*

Change an Ethernet Address

1 Open the Command Prompt window in NetAcq and issue the following commands.

:Config:Comm:Enet <XXX.XXX.XXX.XXX> (Where XXX.XXX.XXX.XXX is a valid IP address for the user's network) The address that is assigned by the factory is 0.0.0.0

:System:POSetUp Saved

*Sav

The new ethernet address is now saved and the unit will power up with the new address.

Change an RS485 Address

1 Open the Command Prompt window in NetAcq and issue the following commands.

:Config:Comm:RS485 <baud> <CR|CRLF|None> <Address> (Where address any printable ASCII character). The address that is assigned by the factory is: 0, the zero character.

:System:POSetUp Saved

*Sav

The new RS485 address is now saved and the unit will power up with the new address.

When you issue the :Config:Comm:Enet or the :Config:Comm:RS485 command the instrument will have the new address you specify. The new address will be lost the next time the unit loses power unless you issue **both** of the commands,

:System:POSetUp Saved

*Sav

as show in the procedure above.

Accessories

SmartLink™ Communications Accessories

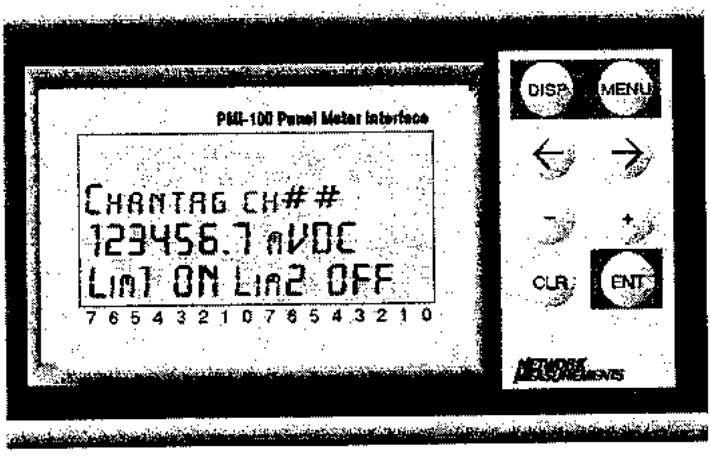
Panel Meter Interface

The Panel Meter Interface connects to the local communications port on any SmartLink™ to provide complete access to SmartLink™ configuration and measurement functions. Its two line alpha numeric display and simple keypad make this accessory useful for setup and debug during system startup or for maintenance operations. It also can serve as a local readout device eliminating the need for a computer at the SmartLink™ location. This product will become available in the future.

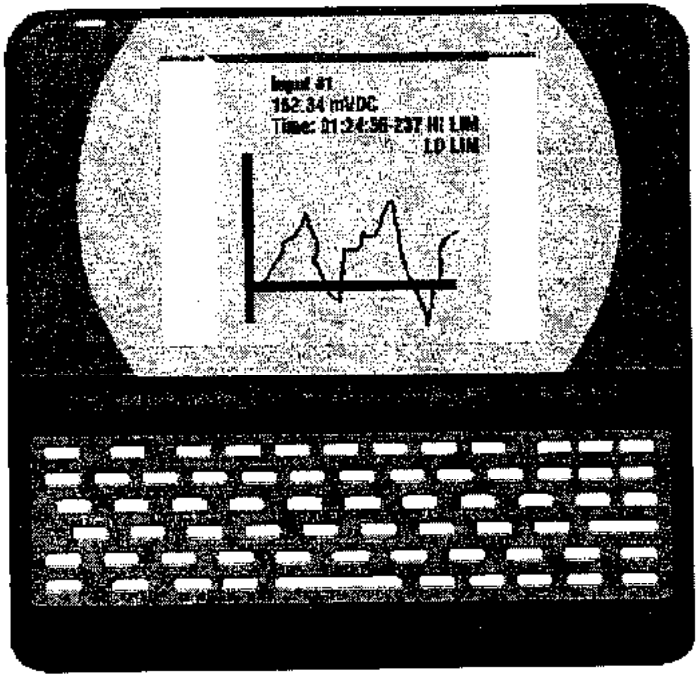
Multimeter Interface

With the Multimeter Interface connected to any SmartLink™ a virtual instrument is created. Based on a popular Personal Digital Assistant, the Multimeter Interface is a powerful measurement interface which provides extensive programming and display capability. To speed start up, predefined menus of screens step you through SmartLink™ configuration and display setup. Using the local communications port, the MMI permits complete SmartLink™ use independent of a computer connected to the network communications port.

Panel Meter Interface



Multimeter Interface



Other Options & Accessories

Calibration Data

Certain applications and calibration facilities require actual measured data in order to develop trend lines or to optimize performance. Keithley extensively tests and records the values of many parameters, both in development and in the manufacture of every product.

DIN Mount Hardware

A DIN rail mounting bracket is available and may be attached to a SmartLink™ body with two self-tapping screws. SmartLink™ units have insulated bosses molded in to prevent the mounting screws from contacting any internal circuitry.

Power Supplies

Any source of process power (9.5 - 34 VDC) is suitable for SmartLink™ operation. The accessory power supplies in the price list have been selected for their robustness and suitability for long term installations.

Power Supply Selection Guide

Model	Input	Output	Power	Size	Specs
See Catalog	90-260 VAC	24VDC	40 Watts	106mm X 66mm X 42mm	A-H
See Catalog	120 VAC	24VDC	9 Watts	66mm X 61mm X 50mm	A-H
See Catalog	240 VAC	24VDC	9 Watts	82mm X 56mm X 49mm	A,C,E, F,G,H
See Catalog	8-15 VDC	12VDC	7.5Watts	106mm X 66mm X 42mm	A,B,E, G,H
See Catalog	11-15 VDC	12VDC	40 Watts	106mm X 66mm X 42mm	A,B,E, G,H

Common Specifications for all power supplies listed:

A	Cable Type:	Shielded
B	Protection:	Thermal Shut Down, Overload
C	Input Power:	90-237 VAC, 47-63Hz
D	Power Cords Available:	US, European, Japanese
E	Humidity: Operating Temperature: Storage Temperature:	0 to 90% 0 to 50°C -40° to 50°C
F	Dielectric Strength: Isolation: Isolation Resistance:	3,750VAC for 1 minute 500 VDC 10 MK
G	MTBF:	50,000 hours
H	Safety:	UL: 1012,478,1950 CSA: 22.2 No. 220 CE EMI:FCC Class B and CE

PCMCIA and EISA Interface Boards

Most computers are equipped with RS-232-C, point-to-point communications interfaces. While this is sufficient for a basic single SmartLink™ system or for bench top debugging, a more capable interface provides multi-instrument system capability. A selection of serial and Ethernet plug-in EISA cards for desktop PC's and PCMCIA cards for notebook and laptop computers are available.

Calibration Setup

Connections, Warm-up, and Communication

Connections

Before starting the warm-up period, connect your SmartLink™ to the calibration source(s) and any test equipment required. These connections are shown in the Calibration Procedure sections, later in this manual.

Warm-up Period

Power up the instrument and allow it to warm-up for at least 1 hour before performing calibration. If the instrument has been subjected to temperature extremes, allow extra time for the instrument's internal temperature to stabilize. Typically, allow one extra hour to stabilize a unit that is 10°C (18°F) outside the specified temperature range. The instrument requires an input voltage of 9.5-28V VDC.

Environmental Conditions

Conduct the calibration procedures in a space that has:

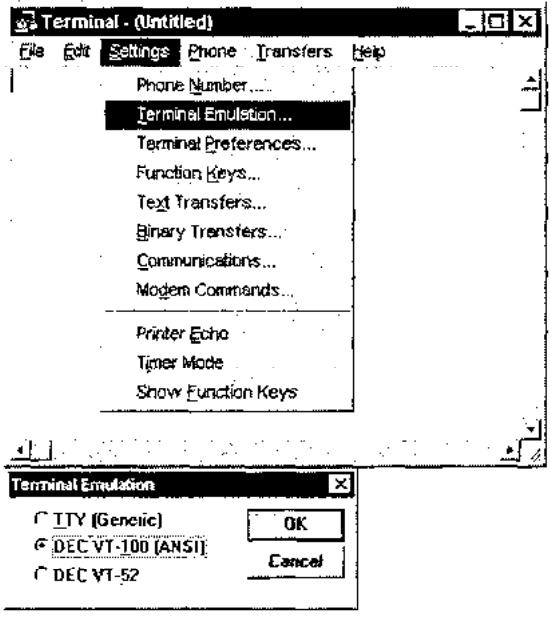
- An ambient temperature of 23°C ±5°C
- A relative humidity of less than 70% unless otherwise noted

Communication Software Setup

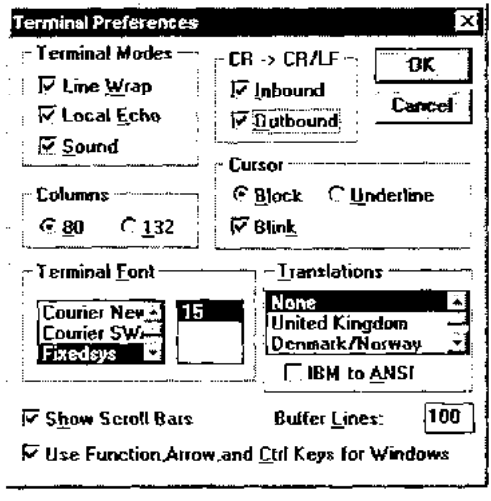
Win 3.1 users

1. Double-click on the Terminal icon under the Accessories window.

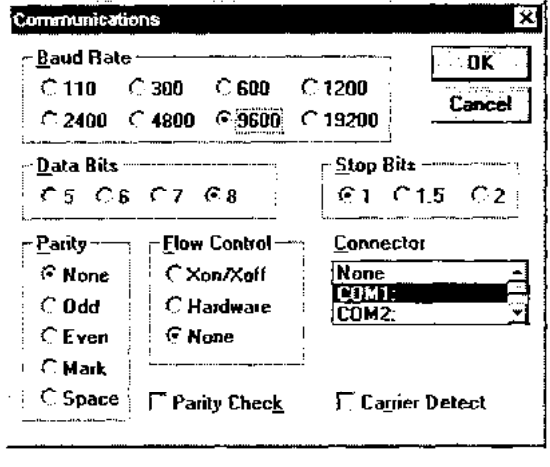
2. Under Settings menu select Terminal Emulation. Set terminal emulation to DEC VT-100 (ANSI)



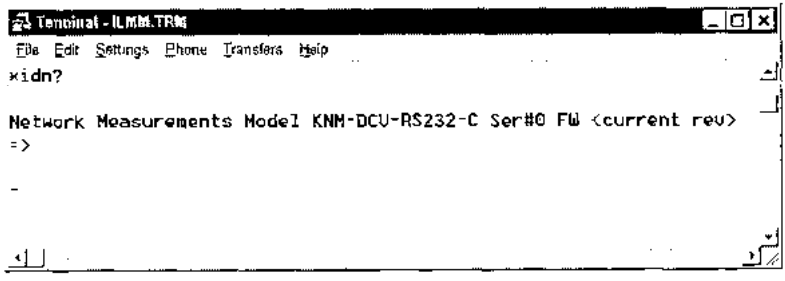
3. Next, under **Settings** Menu select **Terminal Preferences...** and set all the settings as given below.



4. Finally, under **Settings** Menu select **Communications...** and also follow settings as given below. **Note:** Check that the proper comm port is being used under the **Connector** settings (i.e. either **COM1** or **COM2**)



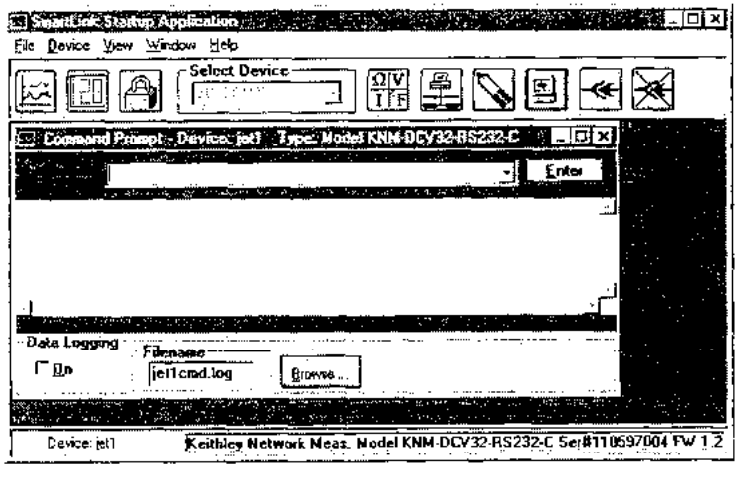
5. Save the **Terminal** settings. Type ***idn?**. If the terminal settings are correct you should get the following output in the **Terminal** window.



Win 95 users

1. Use NetAcq to establish connection to your SmartLink™. (The "Getting Started" section in this manual takes your through this process if you have not done this before.)

2. Open the Command Prompt window in NetAcq by clicking on the  button on the NetAcq toolbar or by selecting the "View" menu item and then "Command Prompt" from the drop-down menu. The following window will open.



Calibration Procedure: High Speed Bridge

Overview

The High Speed Bridge has two paths that you must calibrate; the **measurement path** and the **excitation path**. Since they are independent paths you can calibrate them separately. The High Speed Bridge must be placed in a special "calibrate" mode during the calibration process. The steps are outlined in the following sections.

NOTE: Before you exit the "calibrate" mode you must save the calibration constants that the High Speed Bridge generates. You save them by issuing the command, ***:system:cal save***.

When you issue the ***:system:cal save*** command any constants that have been generated since you entered the "calibrate" mode will be saved. (If you have completed both the measurement path calibration and the excitation path calibration, both will be saved.)

Measurement Path Calibration

Calibration Notes

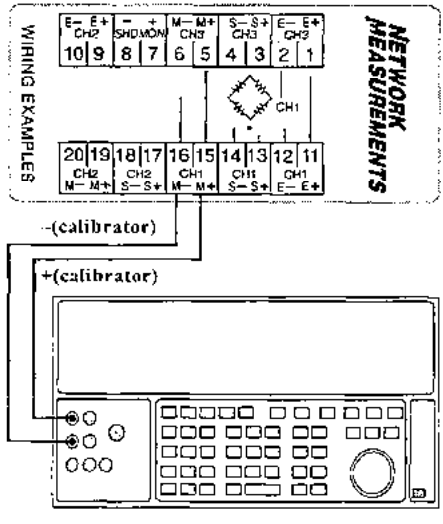
You must provide stable, precision voltages to the input connectors of the SmartLink™ during the measurement path calibration process.

You can either use a precision calibrator, such as the Fluke 5700A Calibrator, used in this procedure, or you can use a stable voltage source that will output voltages from 2mV to 800mV and a precision DMM that will measure voltages in this range with an accuracy of ± 1μV.

Connect SmartLink™ to the Calibrator

1 Connect the SmartLink™ instrument to a Fluke 5700A Calibrator as shown in following diagram.

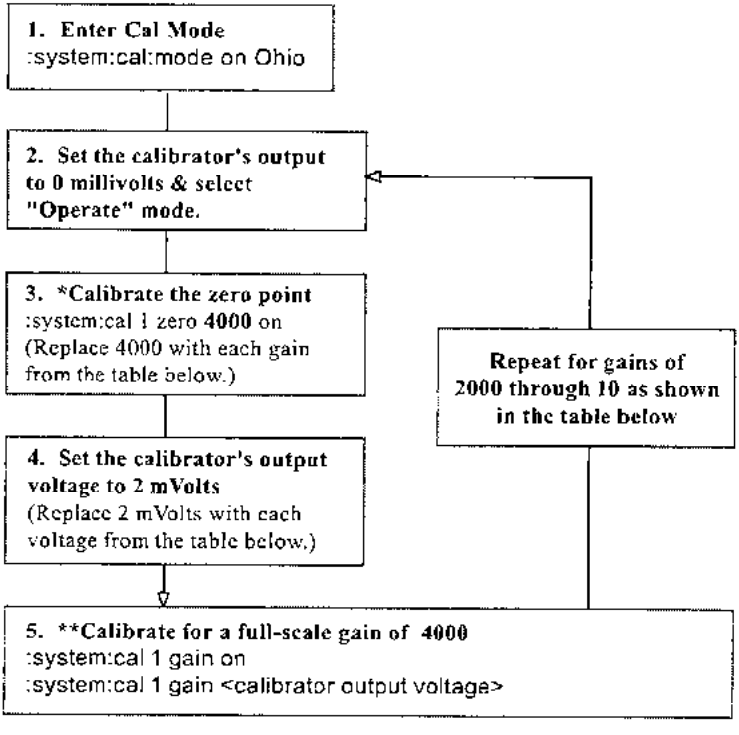
You will use channel 1 to calibrate the measurement path. This will calibrate all three channels since the same path is used by all three.



5700A Calibrator

Calibration Process

Apply power to the instrument and let it warm up for at least 45 minutes. When the unit is ready proceed with the calibration process as follows.



* When you issue the command, *:system:cal 1 zero <gainvalue> on*, SmartLink™ will measure the short on channel 1, calibrate the zero point, and return the measured value. It should have a value of 0V ±0.04mV.

** When you issue the command, *:system:cal 1 gain on*, SmartLink™ will measure the voltage on channel 1 and return the measured value. It should have a value that is equal to the calibrator's output voltage ± 5µV. The following table lists the full-scale voltages that must be applied to the "Measure" inputs on the SmartLink™ during the full-scale gain calibration process.

Measurement Path Calibration Voltages

Gain	Calibrator Output Voltage
4000	2 mV
2000	4 mV
1000	8 mV
400	20 mV
200	40 mV
100	80 mV
40	200 mV
20	400 mV
10	800 mV

Excitation Path Calibration

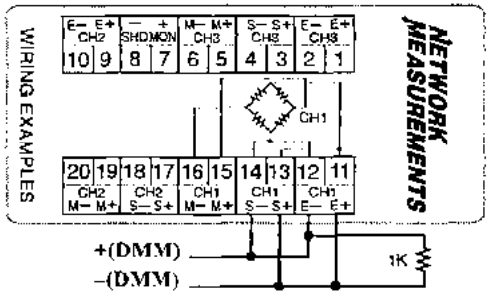
Calibration Notes

You must use a DMM that can read voltages ranging from 1Volt to 10 Volts with an accuracy of ± 10µV.

Connect SmartLink™ to the DMM

1 Connect the SmartLink™ instrument to a DMM as shown in following diagram. Set DMM to DC Volts.

You will use channel 1 to calibrate the excitation path. This will calibrate all three channels since the same path is used by all three.



Calibration Process

The calibration process proceeds as follows.

1 Activate the 1 volt excitation output for channel 1 with the following command.

:system:cal 1 excit 1 on

The SmartLink™ will output an uncalibrated voltage that should read 0.950V ± 0.1V on the DMM.

2 Calibrate the 1V excitation output using the following command.

:system:cal 1 excit 1 <actual DMM reading>

The SmartLink™ will use the actual DMM reading to calibrate the 1V excitation range.

3 Repeat steps one and two for the 2V, 4V, and 10V excitation outputs, substituting 2,4, and 10 for the 1 in both commands (e.g. **:system:cal 2 excit 2 on** for the 2V range). The following table gives the specifications for each excitation range.

BRG11 & 12 Excitation Voltage Levels and Tolerances		
Excitation Setpoint	**Excitation Voltage**	**Tolerance**
1V	0.950V	±0.05V
2V	1.950V	±0.05V

4V	3.950V	±0.08V
10V	9.750V	±0.10V

Note 1: Use actual excitation voltage measured during calibration to determine power dispated at the sensor (strain gage).

Note 2: With **Azero ON** the excitation voltage is switched from full scale for 450 msec to zero volts for 230 msec periodically.

5 Save both the measurement path and the excitation path calibration constants by issuing the following command:

:system:cal save

6 Check all the calibration constants by issuing the following command:

:system:cal? 1

The SmartLink™ will return the calibration constants for all the gains and excitation output voltages. All constants must be 1.000 ±0.01.

7 Exit calibration mode by issuing the following command:

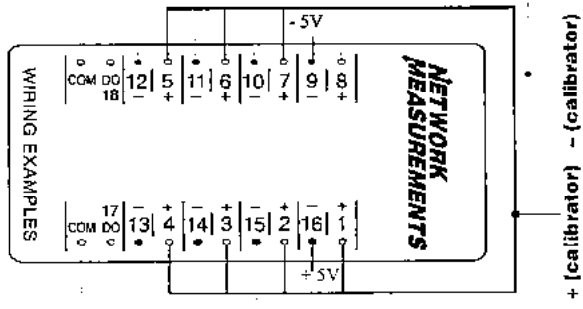
:system:cal:mode off

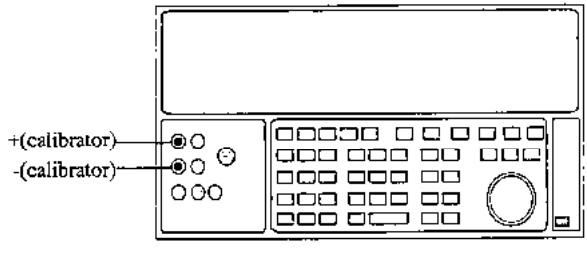
Calibration Procedure: DC Volts and Ohms

DC Volts Calibration

Connect SmartLink™ to the Calibrator

1 Connect the SmartLink™ instrument to a Fluke 5700A Calibrator as shown in following diagram.





5700A Calibrator

2 Set the calibrator to output DC volts, and turn external sense off.

3 In the Terminal or HyperTerminal window, type this command:

:system:cal:mode:on Ohio

4 Below is the general command used for DC voltage calibration.

:system:cal <chan_list> vdc <range> <se | diff> <stimulus>

Note: Use <chan_list> = 2. (Eg. :system:cal 2 vdc 0.2 diff 0)

5 Perform all the steps listed in the table below to complete the DC volts calibration. For each calibration step do the following:

- Set the calibrator to the indicated value, and make sure it is in operate.
- Press the ENTER key to calibrate that step.
- Wait until the instrument finishes each step.

DC voltage calibration Summary

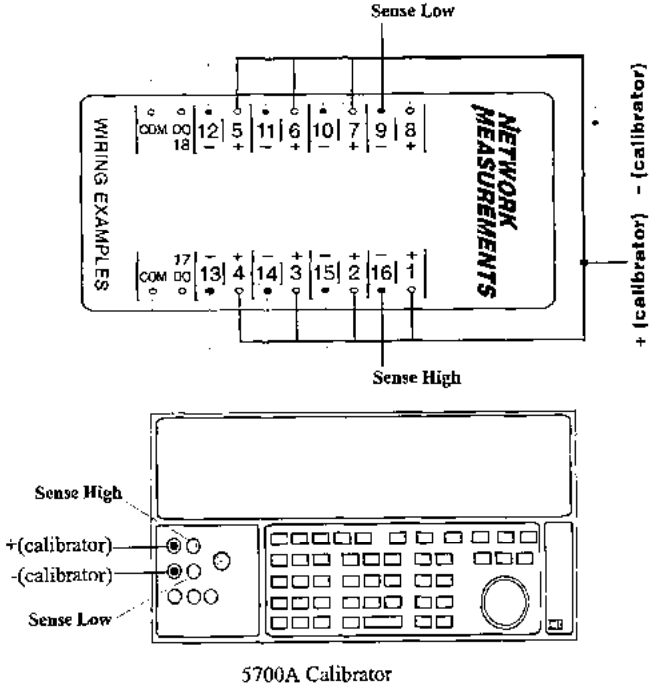
<Range>	<se | diff>	<stimulus>	Calibrator Voltage
0.2	diff	0	0V
0.2	diff	0.2	0.2V
0.2	se	0	0V
2	diff	0	0V
2	diff	2	2V
20	diff	0	0V
20	diff	20	20V
20	se	0	0V
20	se	20	20V
40	diff	0	0V
40	diff	40	40V
40	se	0	0V
40	se	40	40V

Note: Go *directly* to the Resistance Calibration procedure after completing the DC voltage calibration.

Ohms Calibration

Warning: *Do not perform Ohms Calibration until you have completed the DC Volts Calibration.*

1 Connect the calibrator to the instrument as shown below.



5700A Calibrator

2 Set the calibrator to output DC volts, and turn external sense off.

Below is the general command used for resistance calibration:

:system:cal <chan_list> ohms <range> <seoc | 4W | 4WOC> <stimulus>
(e.g. **:system:cal 1 ohms 200 seoc 0)**

3 Perform the calibration steps summarized in the following table.

- Set the calibrator to the indicated value, and make sure it is in Operate mode. (If the calibrator cannot output the exact resistance value, type the input <stimulus> value to agree with the Fluke 5700A calibrator resistance.
- Press the ENTER key to calibrate that step.
- Wait until the instrument finishes each step before continuing.

Ohms Calibration Summary

CHAN	<range>	<SEOC | 4W| 4WOC>	<stimulus>	Calibrator resistance
1	200	SEOC	0	0 Ω
2	200	SEOC	0	0 Ω
3	200	SEOC	0	0 Ω
4	200	SEOC	0	0 Ω
5	200	SEOC	0	0 Ω
6	200	SEOC	0	0 Ω
7	200	SEOC	0	0 Ω
8	200	SEOC	0	0 Ω
1	200	4W	0	0 Ω, EX SNS ON
1	200	4WOC	*<input>	190Ω
1	2k	4W	0	0 Ω, EX SNS ON
1	2k	4WOC	*<input>	1.9kΩ
1	20k	4W	0	0 Ω, EX SNS ON
1	20k	4WOC	*<input>	19kΩ
1	200k	4W	0	0 Ω, EX SNS ON
1	200k	4WOC	*<input>	190kΩ
1	2m	4W	0	0 Ω, EX SNS ON
1	2m	4W	*<input>	1.9MΩ **Wait 30 sec**
1	20m	4W	0	0 Ω, EX SNS ON
1	20m	4W	*<input>	19MΩ **Wait 60 sec**
1	200m	4W	0	0 Ω, EX SNS ON
1	200m	4W	*<input>	100MΩ **Wait 90 sec**

Nominal resistance. Type the *<input> value to agree with actual Fluke 5700A calibrator resistance value.
EX SNS - External Sense

4 Save the calibration constants by typing:

:system:cal:save

5 The calibration mode can the be turned off by typing:

:system:cal:mode off

Calibration Procedure: Piezo & Capacitive Pressure-Force-Acceleration

Pressure-Force-Acceleration Calibration

Calibration Notes

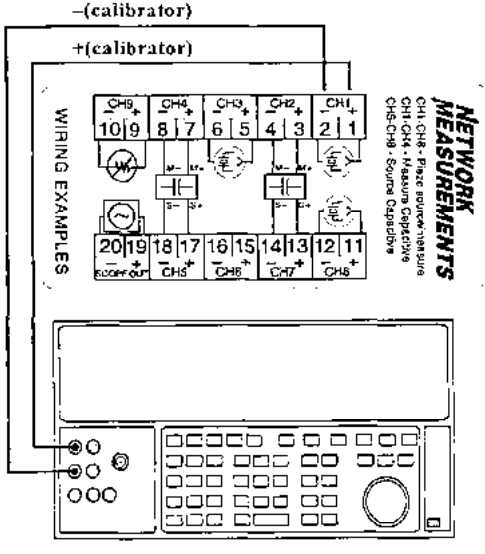
You must provide stable, precision voltages to the input connectors of the SmartLink™ during the measurement path calibration process.

You can either use a precision calibrator, such as the Fluke 5700A Calibrator, used in this procedure, or you can use a stable voltage source that will output voltages from 0V to 10V and a precision DMM that will measure voltages in this range with an accuracy of ± 1µV.

Connect SmartLink™ to the Calibrator

1 Connect the SmartLink™ instrument to a Fluke 5700A Calibrator as shown in following diagram.

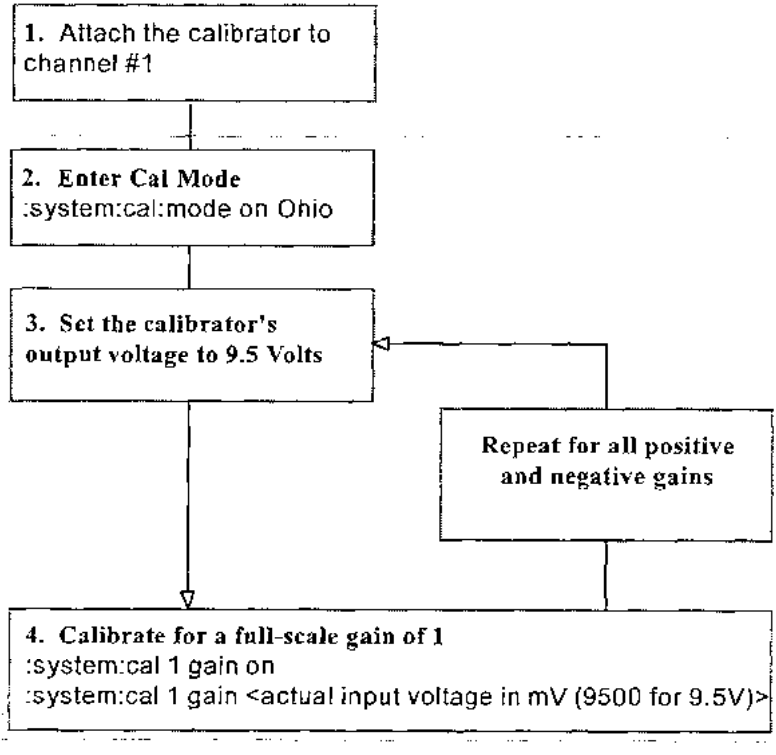
You will use channel 1 to calibrate all eight pressure-force-acceleration channels since they use the same measurement path.



5700A Calibrator

Calibration Process

Apply power to the instrument and let it warm up for at least 45 minutes. When the unit is ready proceed with the calibration process as follows.



The following table lists the full-scale voltages that must be applied to channel 1 inputs on the SmartLink™ during the full-scale gain calibration process.

Pressure-Force-Acceleration Calibration Voltages

Gain	Calibrator Output Voltage	
	+ cal value	- cal value
1	95 mV	95 mV
10	950 mV	950 mV
100	9500 mV	9500 mV

4 Save the calibration constants by issuing the following command:

:system:cal save

5 Check the calibration constants for each channel by issuing the following command:

:system:cal? 1

The SmartLink™ will return the calibration constants for the channel specified. Constants for a gain of 1 must be 1.000 ± 0.01. Constants for gains of 10 and 100 must be 1.000 0.05.

Temperature Calibration

Calibration Process

1 Connect a precision, 10 kOhm resistor or calibrator (10 kOhms ± 5Ω) across the terminals of channel 9.

2 Make sure the SmartLink™ is in calibration mode (see step one in the pressure-force-acceleration calibration process). Issue the following commands.

:system:cal 9 temp on
:system:cal 9 temp <actual value of resistor in ohms>

3 Save both the temperature calibration constants by issuing the following command:

:system:cal save

4 Check the calibration constants by issuing the following command:

:system:cal? 9

The SmartLink™ will return the calibration constants for the channel. All constants must be 1.000 ± 0.05.

5 Exit calibration mode by issuing the following command:

:system:cal:mode off

Notes

Notes

Notes

SmartLink™ Command Map

Signal
Signal
Sensor
Sensor
Sensor

MEASURE
:Meas? <chan_list>
<<#_of_rdgs>|Off>
:Meas:Chan?
:Capture? <chan_list>
<#_of_rdgs|All> <Immediate|Level <chan#> <level> <Hi|Lo>> <interval_usec>
<ASCII|Binary>

Multiple or Coordinated Measurements

Configure Measurements

SCAN
:Scan? <<#_of_scans>|Off>
:Scan:Status?
:Scan:Time:Start?
:Scan:Time:Trig?
:Scan:Time:End?

Config SCAN
:Config:Scan <chan_list>
:Config:Scan?
:Config:Scan:Interval
<nn:mm:ss.ssssss>
:Config:Scan:Interval?
:Config:Scan:Initiate <Immediate | TrigIn <Either|Rising|Falling> *<%_pretrigger>* | Level <chan#> <level> <Hi|Lo> *<%_pretrigger>*>
:Config:Scan:Initiate?
:Config:Scan:Data <MemOnly | ProcessMem | MemProcessXmit | ProcessXmit>
:Config:Scan:Data?
:Config:Scan:XmitFormat
<ASCII|Binary>
:Config:Scan:XmitFormat?
:Config:Scan:FastMode <Off|On <AbortOnComm | AbortOnTimer <seconds> ><EngrUnitsOn | EngrUnitsOff> >
:Config:Scan:FastMode?
:Config:Scan:Delay <chan_list>
<Default|usec>
:Config:Scan:Delay? <chan_list>
:Config:Scan:ConvertValues? <chan_list>
:Config:Scan:ValidData <chan_list> <Off | Lim1 Lim2>
:Config:Scan:ValidData?

Arguments inside brackets:
<argument> Replace with appropriate value
<A|B|C> Choose from selections A, B or C

Call for information/availability on upgrading for non-highlighted functions

FlashWare
Rev 1.3 7/22/97

FILTER
:Filter:Dig <chan_list> <On|Off>
:Filter:Dig? <chan_list>

CONFIG FILTER
:Config:Filter:Dig:MvgAvg <chan_list> <#_of_meas>
:Config:Filter:Dig:MvgAvg? <chan_list>
:Config:Filter:Advanced <chan_list> <Bessel|Butterworth>

:Config:Null <chan_list> <Input|level|Off>
:Config:Null? <chan_list>
(Dynamic Units Only)

SCALING
:Scaling <chan_list> <On|Off>
:Scaling? <chan_list>

CONFIG SCALING
:Config:Scaling <chan_list> <<span>&|<m:b>&|*<table>*|*<poly>*>
:Config:Scaling? <chan_list>
:Config:Scaling:MB <chan_list> <m_value> <b_value>
:Config:Scaling:MB? <chan_list>
:Config:Scaling:Span <chan_list> <zero_value> <+span> <-span>
:Config:Scaling:Span? <chan_list>
:Config:Scaling:Units <chan_list> <"new_units">
:Config:Scaling:Units? <chan_list>
:Config:Scaling:Format <chan_list> <Default| Fixed <#_digits_before> <#_digits_after>>
:Config:Scaling:Format? <chan_list>

LIMITS
:Limits <<chan_list>|All> <On|Off>
:Limits? <chan_list>
:Limits:Status? <chan_list>
:Limits:Digio? <digio_chan#>

CONFIG LIMITS
:Config:Limits <chan_list> <Lim1|Lim2> <Hi|Lo> <lim_value> <hysteresis>
:Config:Limits? <chan_list> <Lim1|Lim2>
:Config:Limits:Assoc <digout_chan#> <chan_list> <Lim1|Lim2>
:Config:Limits:Assoc? <digout_chan#>

Data Mem

Comm

CONFIG CHANS (Per Channel)
The commands in this box are model specific
:Config? <chan_list>
:Config <chan_list> Accel <Piezo|Cap> <fs_accel_g> <mV/g> <AC|DC> <30K|10K|1K|100> <"chan_tag">
:Config <chan#> Calculated <chan#A> <math_func> <chan#B> <"chan_tag">
:Config <chan_list> DewPoint <"chan_tag">
:Config <chan_list> DigIn <#_of_bits> <ActiveHigh|ActiveLow> <DIFF|SE> <"chan_tag">
:Config <chan_list> DigOut <#_of_bits> <ActiveHigh|ActiveLow> <initial_state> <"chan_tag">
:Config<chan_list> Flow Xmit <fs_flow> <fs_signal> <zero_signal> <VDIFF VSE|IDIFF <shuntohms>> <"chan_tag">
:Config <chan_list> Force Piezo <fs_force_Lb> <mV/Lb> <AC|DC> <30K|10K|1K|100> <"chan_tag">
:Config <chan_list> Horsepower <torque_chan#> <rpm_chan#> <"chan_tag">
:Config <chan_list> Humidity <type_code> <"chan_tag">
:Config <chan_list> IAC <range> <shuntohms> <DIFF SE> <AC|DC> <"chan_tag">
:Config <chan_list> IDC <range> <shuntohms> <DIFF\SE> <"chan_tag">
:Config <chan_list> Ohms <range> <4W|SE|4WOC|SEOC> <"chan_tag">
:Config <chan_list> Pressure Gage <fs_psi> <bridge_type> <gage_factor> <poisson_ratio> <excitation_voltage> <"chan_tag">
:Config <chan_list> Pressure Xmit <fs_psi> <fs_signal> <zero_signal> <VDIFF,VSE,IDIFF <shuntohms>> <"chan_tag">
:Config <chan_list> Pressure Piezo <fs_psi> <mV/psi> <AC|DC> <30K|10K|1K|100> <"chan_tag">
:Config <chan_list> RPM Encoder <pulses_per_revolution> <"chan_tag">
:Config <chan_list> Strain Gage <fs_strain_uE> <bridge_type> <gage_factor> <poisson_ratio> <excitation_voltage> <"chan_tag">
:Config <chan_list> Temp RTD <PT385|PT3916|<User r0 alpha beta delta>> <range> <SE|4W|4WOC|SEOC> <"chan_tag">
:Config <chan_list> Temp TC <tc_type> <OpenTCOn|OpenTCOff> <IntRJ|RefJcnTemp> <"chan_tag">
:Config <chan_list> Temp Thrmstr <type_code> <range> <4W|SE|4WOC|SEOC> <"chan_tag">
:Config <chan_list> Torque GageDC <rated_cap> <p_scale_factor> <n_scale_factor> <excitation_voltage> <"chan_tag">
:Config <chan#> VAC <range> <DIFF SE> <AC DC> <"chan_tag">
:Config <chan_list> VDC <range> <DIFF|SE> <"chan_tag">
:Config <chan_list> Weight Gage <rated_cap> <p_scale_factor> <n_scale_factor> <excitation_voltage> <"chan_tag">
:Config <chan_list>Weight Xmit <fs_weight> <fs_signal><zero_signal><VDIFF VSE IDIFF <shuntohms>> <"chan_tag">
:Config<chan_list>Strain Xmit <fs_strain> <fs_signal> <zero_signal> <VDIFF|VSE IDIFF <shuntohms>> <"chan_list">

CONFIG UNITS
The commands in this box are model specific
:Config:Units:Accel <g|mps2|fps2>
:Config:Units:Accel?
:Config:Units:Force <Lb|N|Kg|Oz>
:Config:Units:Force?
:Config:Units:Ohms <Ohms|Kohms|Mohms>
:Config:Units:Ohms?
:Config:Units:Temp <DegC|DegF|K>
:Config:Units:Temp?
:Config:Units:Torque <FtLb|InLb|Nm|Kgm|InOz>
:Config:Units:Torque?
:Config:Units:VDC <Volts|mVolts>
:Config:Units:VDC?
:Config:Units:Weight <Lb|N|Kg|Oz>
:Config:Units:Weight?
:Config:Units:Strain <uE|CompmV>
:Config:Units:Strain?
:Config:Units:Pressure <psi|Atm|KPa>
:Config:Units:Pressure?
:Config:Units:AC <Volts dB dBM>
:Config:Units:AC?

CONFIG MEAS
:Config:Meas:Average <#_rdgs_per_meas>
:Config:Meas:Average?
:Config:Meas:Azero <On|Off|Once>
:Config:Meas:Azero?
:Config:Meas:Off
:Config:Meas?
:Config:Meas:RsIn <data_bytes>
:Config:Meas:RsIn?
:Config:Meas:Trig <Immediate,TrigIn\ DigIn <chan#>>
:Config:Meas:Trig?

STATISTICS
:Stats <chan_list> <On|Off>
:Stats:Max? <chan_list>
:Stats:Min? <chan_list>
:Stats:Clear <<chan_list>|All>

TIME, DATE
:Time <hh:mm:ss.sss>
:Time?
:Date <mm/dd/yyyy>
:Date?
:Time:SyncTime <hh:mm:ss.sss>
:Time:SyncTime?
:Time:SyncGlobal
:Config:Time:Format <time_bytes> <time_rsln>
:Config:Time:Format?

DATAMEM
:DataMem? <All| <chan_list>> <All | <scan_list>> <ASCII | Binary>
:DataMem:Clear
:DataMem:Chans?
:DataMem:Scans?
:DataMem:Last?
:DataMem:Next?
:DataMem:Memsize?
:DataMem:Trig?
:DataMem:Format?
:DataMem:Time:Start?
:DataMem:Time:Trig?
:DataMem:Time:End?

CONFIG DATAMEM
:Config:DataMem:Scans?
:Config:DataMem:Captures?
:Config:DataMem:Mode <WrapWhenFull| StopWhenFull>
:Config:DataMem:Mode?

CONFIG DATA
:Config:Data:Fields <All|Read&|Units&|Chan&|Chan_Tag&|Rnum&|Time&|Date&|Limits&|Stat>
:Config:Data:Fields?

CONFIG COMM
The commands in this box are model specific.
:Config:Comm:RS232 <9600|1200|2400|4800|19200> <CR|CRLF|LF|None> <XonXoff|None>
:Config:Comm:RS232?
:Config:Comm:RS422 <9600|1200|2400|4800|19200> <CR|CRLF|LF|None> <XonXoff|None>
:Config:Comm:RS422?
:Config:Comm:RS485 <9600|1200|2400|4800|19200> <CR|CRLF|LF|None> <address>
:Config:Comm:RS485?
:Config:Comm:ENet <IPAddress>
:Config:Comm:Enet?
:Config:Comm:EthernetID?
:Config:Comm:Local <9600|1200|2400|4800|19200> <CR|CRLF|LF|None> <XonXoff|None>
:Config:Comm:Local?
:Comm?

System
*Sav, *Rcl (Save & Recall)
:System:POSetup <Saved|Factory>
:System:POSetup?
:System:Model#?
*Idn? (Identification) *Rst (Reset)
:System:NodeID <"id"> :System:NodeID?

DigOut
DigOut
DigOut
DigOut
DigOut

OUTPUT
:Output <chan_list> <value> *<step_delay>*
:Output <chan_list> Track <chan#>
:Output? <chan_list>