



**Agilent**  
U2802A 31-Channel Thermocouple Input Device

Data Sheet



## Features

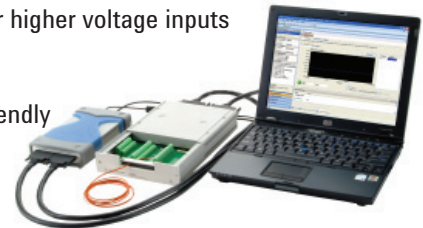
- **Up to 31 thermocouple inputs**
- **Supports thermocouple type J, K, R, S, T, N, E and B**
- **Up to 10 V voltage input range**
- **Open thermocouple detection**
- **Built-in isothermal terminal construction**
- **x 97.673 gain setting for thermocouple input mode**
- **Built-in thermistor**
- **Built-in zeroing function**
- **On-board EEPROM**
- **Sampling rate of 500 kSa/s for overall module**
- **Sampling rate of 10 kSa/s total for all channels in thermocouple mode**
- **Configurable for voltage input or thermocouple input mode independently on each channel**

## Overview

The Agilent U2802A is a 31-channel thermocouple signal conditioning module with a built-in thermistor for cold junction compensation. The U2802A is designed to convert low input voltage signals (less than  $\pm 100$  mV) from a thermocouple into an output voltage range suitable for data acquisition devices ( $\pm 10$  V). The U2802A device is to be used in conjunction with the Agilent U2355A or U2356A model DAQ device to enable temperature measurements using thermocouples. It works as a standalone device attached to a single DAQ device via two SCSI-II 68 conductor cables. The U2802A is compatible with eight standard thermocouple types and is suitable for a wide range of applications in various industrial environment.

### Features to meet your demands

- 31 input channels that can be independently configured to either differential thermocouple input mode, single-ended voltage input mode, or differential voltage input mode using two input channels set to voltage input mode
- Supports the standard thermocouple types defined in the NIST ITS-90 Thermocouple Database
- Error detection for open thermocouple channels
- Built-in isothermal construction on terminal block for improved measurement accuracy
- Built-in zeroing function to compensate for overall system offset errors due to temperature drift and long term drift
- On-board EEPROM to store factory calibration data and user calibration data
- Up to  $\pm 10$  V input voltage range for higher voltage inputs
- Quick and easy USB setup
- Robust, cost-effective, and user friendly



## Applications

The U2802A thermocouple input device is designed for robust and demanding industrial applications. This product is suitable and ideal for thermocouple measurement applications such as,

- product thermal analysis and characterization,
- environmental chamber profiling,
- process monitoring in consumer electronics markets,
- material properties testing in education environments, and
- study of electronic temperature properties.

### Thermocouple input mode

In thermocouple input mode, the U2802A can acquire up to  $\pm 100$  mV input signals. Each channel includes an instrumentation amplifier and a 4 Hz low-pass filter. The low-pass filter removes unwanted noise from the thermocouple wires to obtain accurate measurement data.

### Voltage input mode

Alternatively, you can select separate voltage input modes for each channel. The channel will be set to bypass the amplifier and filter, allowing up to  $\pm 10$  V input signals to be directly routed to the DAQ device analog input. The bandwidth in this mode is more than 500 kHz.

### Zero mode

In zero mode, the positive and negative inputs of the instrumentation amplifier are shorted together. The voltage measured in this mode corresponds to the offset voltage of the channel. You can subtract this offset voltage from subsequent thermocouple mode measurements to increase measurement accuracy. This mode is only applicable in thermocouple mode.

### Thermocouple compatibility

The U2802A is compatible with a wide range of standard thermocouple types defined in the NIST ITS-90 Thermocouple Database. This includes types J, K, R, S, T, N, E, and B.

### Open thermocouple detection

The U2802A includes open thermocouple detection circuitry to indicate the presence of an open thermocouple. The Agilent Measurement Manager (AMM) software allows you to enable the open thermocouple detection feature. Upon detection of an open thermocouple on your U2802A,  $-300$  °C will be displayed.

### Calibration EEPROM

The U2802A gain and offset calibration factors for each channel are stored in the EEPROM during factory calibration and can be retrieved prior to taking measurements. This on-board EEPROM also stores the module ID, serial number, and date of calibration for your reference. A section of the EEPROM is also allocated for you to save your calibration data.

### Restoring factory calibration

Using the AMM software, you can easily restore the U2802A calibration data from your settings to the original factory settings.

## System Requirements

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### PROCESSOR

1.6 GHz Pentium IV or higher

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### OPERATING SYSTEM

One of the following Microsoft Windows® versions:

- Windows 2000 Professional (Service Pack 4) or later
- Windows XP Professional or Home Edition (Service Pack 1 or later)

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### BROWSER

Microsoft Internet Explorer 5.01 or higher

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### AVAILABLE RAM

512 MB or higher is recommended

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### HARD DISK SPACE

1 GB hard disk space

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### PREREQUISITES

- Agilent IO Libraries Suite 14.2<sup>1</sup> or higher
- Agilent T&M Toolkit 2.1 Runtime version<sup>2</sup>
- Agilent T&M Toolkit Redistributable Package 2.1 patch<sup>2</sup>
- Microsoft .NET Framework version 1.0 and 2.0<sup>2</sup>

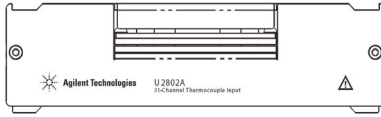
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<sup>1</sup> Available on Agilent Automation-Ready CD.

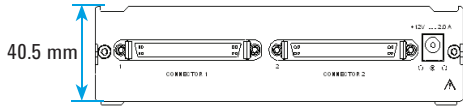
<sup>2</sup> Bundled with Agilent Measurement Manager application software installer.

## Product Outlook and Dimensions

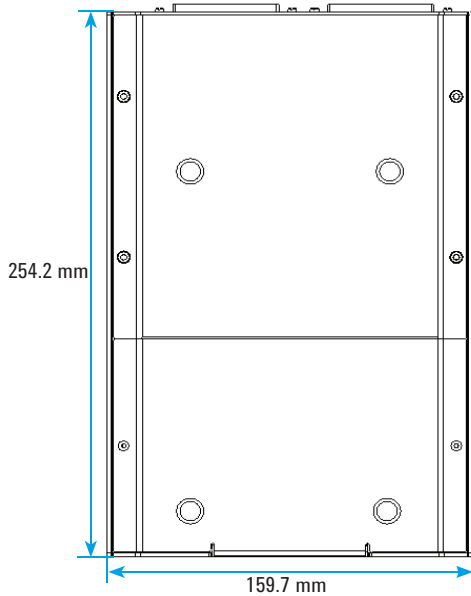
### Front View



### Rear View



### Top View



## General Specifications

### POWER CONSUMPTION

±12 VDC, 750 mA maximum

### OPERATING ENVIRONMENT

- Operating temperature from 0 °C to 55 °C
- Relative humidity at 50% to 85% RH (non-condensing)
- Altitude up to 2000 m

### STORAGE COMPLIANCE

-40 °C to 70 °C

### SAFETY COMPLIANCE

IEC 61010-1:2001 / EN 61010-1:2001 (2nd Edition)

### EMC COMPLIANCE

- IEC 61326-1:2002 / EN 61326-1:1997+A1:1998+A2:2001+A3:2003
- CISPR 11:1990/EN55011:1990 – Group 1, Class A
- CANADA: ICES-001: 2004
- Australia/New Zealand: AS/NZS CISPR11:2004

### SHOCK & VIBRATION

Tested to IEC/EN 60068-2

### IO CONNECTOR

- 2 x 68-pin female SCSI connector
- 2 x 34 pin screw terminal block
- 1 x 24 pin screw terminal block

### DIMENSION (WxDxH)

159.7 mm x 254.2 mm x 40.5 mm

### WEIGHT

1.036 KG

### WARRANTY

Three years

## Product Specifications

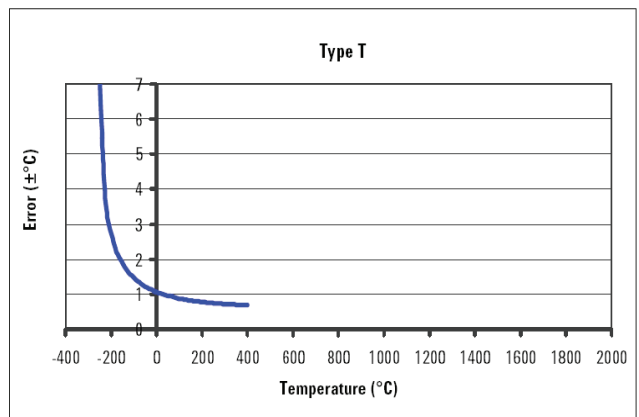
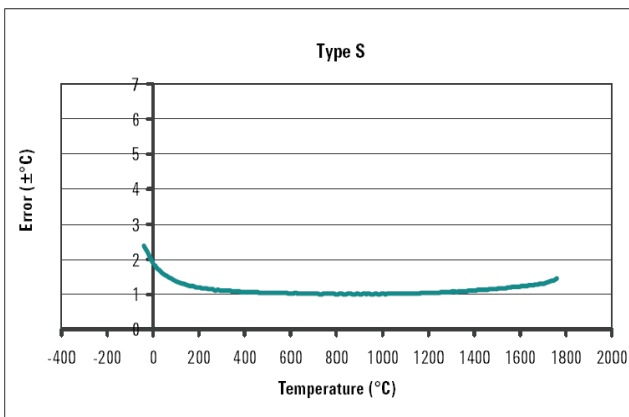
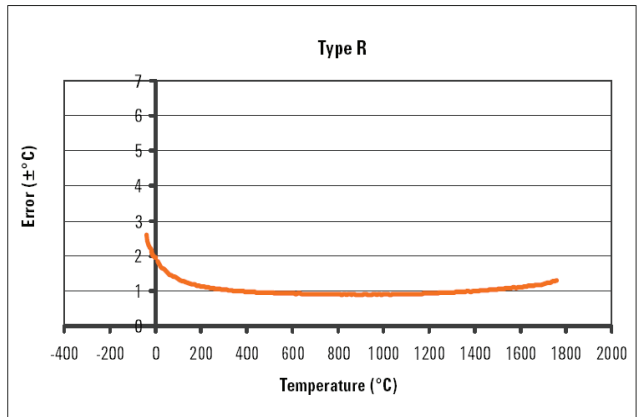
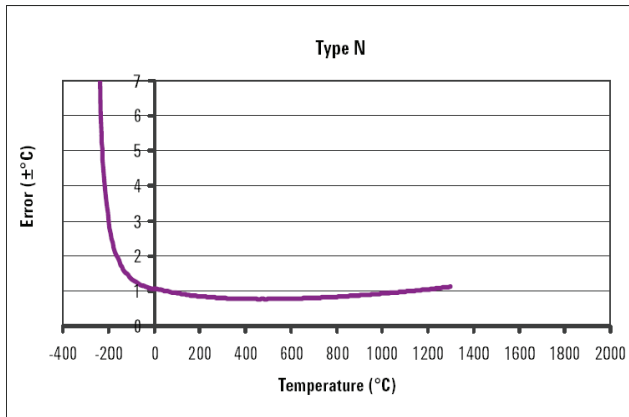
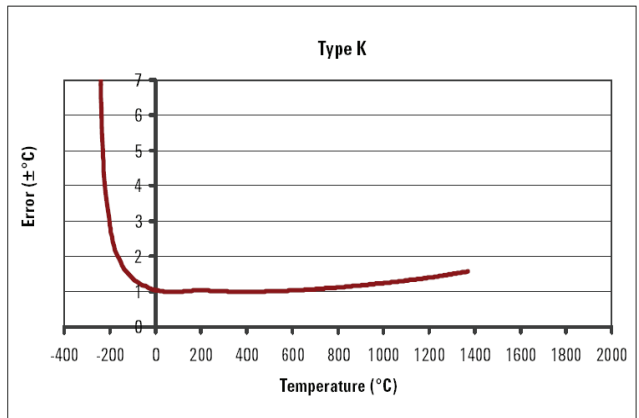
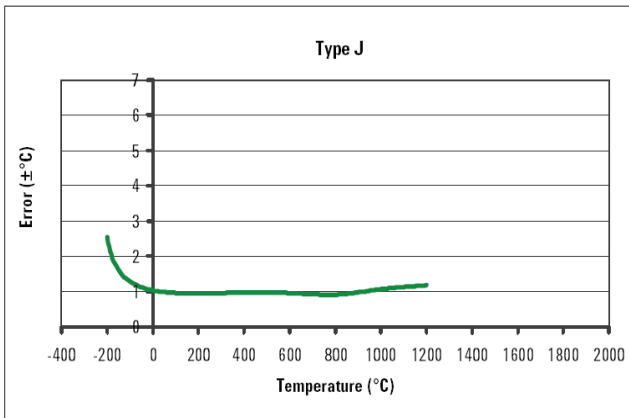
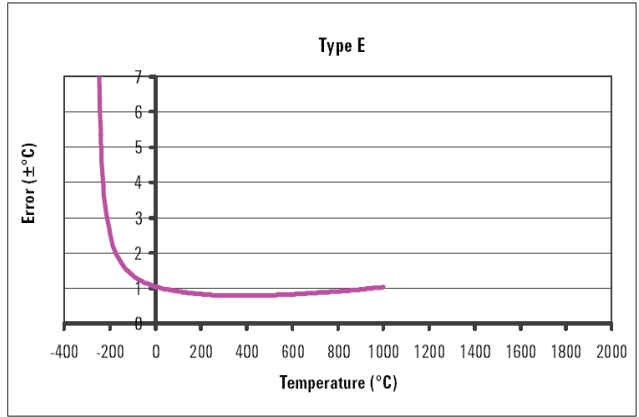
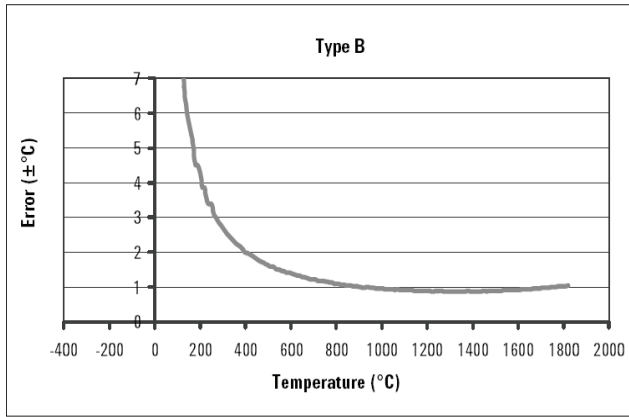
INPUT CHARACTERISTICS	
Number of channels	31 differential and 1 CJC
Input voltage range for voltage mode	$\pm 10$ V (signal + common mode)
Input voltage (thermocouple mode)	$\pm 100$ mV
Bandwidth when gain = 1 V mode	> 500 kHz
Bandwidth for thermocouple mode	4.0 Hz
Sampling rate for thermocouple mode	10 kSa/s total for all channels
Sampling rate for overall module	500 kSa/s
Overvoltage protection <sup>i</sup>	<p><b>TC Mode<sup>ii</sup></b></p> <ul style="list-style-type: none"> <li>• Common mode: <math>\pm 17</math> V (TC+ and TC– with respect to GND)</li> <li>• Differential mode: <math>\pm 7</math> V (Differential voltage between TC+ and TC–)</li> </ul> <p><b>Bypass mode</b></p> <p><math>\pm 20</math> V (TC+ input with respect to GND)</p> <p><b>Power Off Mode</b></p> <p><math>\pm 11</math> V (TC+, TC– input with respect to GND)</p>
Thermocouple types	J, K, R, S, T, N, E and B
CHARACTERISTICS	
Input impedance	> 1 G $\Omega$
Input bias current	$\pm 2.5$ nA max
Input offset current	$\pm 1.5$ nA max
Common mode rejection ratio	
Voltage mode	> 60 dB
Thermocouple mode	> 80 dB
Accuracy (thermocouple mode)	
Overall gain error	0.06% max
Overall gain offset error	15 $\mu$ V max (without zeroing) after calibration 6 $\mu$ V max (with zeroing) after calibration
Nonlinearity	< 0.005% of Full Scale Range
Gain drift	60 ppm / $^{\circ}$ C max
Offset drift	1 $\mu$ V / $^{\circ}$ C max
System noise (rms)	
Gain (x1)	100 $\mu$ Vrms
Gain (x100)	5 $\mu$ Vrms
Cold junction accuracy	$\pm 1.0$ $^{\circ}$ C typical (23 $^{\circ}$ C $\pm 5$ $^{\circ}$ C ) $\pm 1.5$ $^{\circ}$ C typical (0 $^{\circ}$ C to 18 $^{\circ}$ C, 28 $^{\circ}$ C to 55 $^{\circ}$ C)
FILTER CHARACTERISTICS (THERMOCOUPLE MODE)	
Filter cutoff frequency (–3 dB)	4.0 Hz
Filter type	Low Pass RC Filter
OTHER FEATURES	
Recommended warm up time	30 minutes

<sup>i</sup> The overvoltage protection levels specified above indicate the maximum voltage each input pin can tolerate without resulting in any damages. However, prolonged exposure to these levels may affect device safety and reliability. Hence, it should be avoided where possible.

<sup>ii</sup> On the channels configured for thermocouple mode, the TC+ and TC– pins can tolerate up to  $\pm 17$  V of differential voltage for a few minutes. However, exceeding a voltage range of  $\pm 100$  mV on these channels can cause additional current to be drawn from the device's power supply regulators, which may damage the device if multiple channels are overdriven for prolonged periods. This is the case when a voltage source is tied across the TC<sub>n</sub>+ and TC<sub>n</sub>– pin. Voltage sources greater than  $\pm 100$  mV should be tied to TC<sub>n</sub>+ and GND (floating source), or TC<sub>n</sub>+ and TC<sub>n+1</sub>+ (grounded source), and have the channels set for bypass mode.

# Thermocouples Typical Measurement Accuracy

The U28082A measurement error with U2355A or U2356A at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  is shown below.



## System Accuracy

Measurement accuracy of the U2355A and U2356A at 23 °C ± 5 °C.

Thermocouple Measurement Accuracy							
T/C Type	ITS-90 Temperature Range (°C)		Optimum Measurement Range (°C)		U2355A, U2356A @ 23 °C ± 5 °C		
	Low	High	Low	High	Without averaging	50 points averaging	500 points averaging
B	0	1820	1100	1820	1.9	1.2	1.0
			400	1100	4.4	2.5	2.0
E	-270	1000	-150	1000	1.7	1.6	1.6
			-200	-150	2.4	2.3	2.3
J	-210	1200	-150	1200	1.6	1.5	1.5
			-210	-150	2.7	2.6	2.5
K	-270	1372	-100	1200	1.5	1.4	1.4
			-200	-100	2.7	2.6	2.6
N	-270	1300	-100	1300	1.5	1.3	1.3
			-200	-100	3.0	2.7	2.6
R	-50	1768	300	1760	2.0	1.4	1.3
			-50	300	5.0	3.1	2.6
S	-50	1768	400	1760	2.1	1.6	1.4
			-50	400	4.5	2.8	2.4
T	-270	400	-100	400	1.5	1.4	1.4
			-200	-100	2.7	2.5	2.5

Measurement accuracy of the U2355A at 0 to 18 °C and 28 to 45 °C.

Thermocouple Measurement Accuracy							
T/C Type	ITS-90 Temperature Range (°C)		Optimum Measurement Range (°C)		U2355A @ 0 to 18 °C and 28 to 45 °C		
	Low	High	Low	High	Without averaging	50 points averaging	500 points averaging
B	0	1820	1100	1820	3.4	2.4	2.2
			400	1100	7.5	3.6	2.2
E	-270	1000	-150	1000	2.7	2.6	2.5
			-200	-150	3.8	3.6	3.6
J	-210	1200	-150	1200	2.5	2.4	2.4
			-210	-150	4.2	4.0	3.9
K	-270	1372	-100	1200	2.9	2.8	2.8
			-200	-100	4.3	4.0	3.9
N	-270	1300	-100	1300	2.6	2.5	2.5
			-200	-100	4.9	4.2	4.0
R	-50	1768	300	1760	3.8	3.1	3.0
			-50	300	8.5	4.6	3.3
S	-50	1768	400	1760	4.2	3.4	3.2
			-50	400	7.7	4.2	3.1
T	-270	400	-100	400	2.4	2.2	2.2
			-200	-100	4.3	4.3	3.9

Measurement accuracy of the U2356A at 0 to 18 °C and 28 to 45 °C.

Thermocouple Measurement Accuracy							
T/C Type	ITS-90 Temperature Range (°C)		Optimum Measurement Range (°C)		U2356A @ 0 to 18 °C and 28 to 45 °C		
	Low	High	Low	High	Without averaging	50 points averaging	500 points averaging
B	0	1820	1100	1820	6.1	3.1	2.4
			400	1100	14.4	6.3	2.7
E	-270	1000	-150	1000	3.0	2.6	2.6
			-200	-150	4.2	3.7	3.6
J	-210	1200	-150	1200	2.9	2.5	2.5
			-210	-150	4.9	4.1	4.0
K	-270	1372	-100	1200	3.3	2.9	2.9
			-200	-100	5.3	4.2	4.0
N	-270	1300	-100	1300	3.4	2.7	2.6
			-200	-100	6.8	4.6	4.1
R	-50	1768	300	1760	6.2	3.7	3.2
			-50	300	15.7	7.2	3.8
S	-50	1768	400	1760	6.4	4.0	3.4
			-50	400	14.2	6.6	3.4
T	-270	400	-100	400	3.0	2.4	2.2
			-200	-100	5.3	4.2	3.9

## Standard Shipped Items

- Agilent U2802A 31-channel thermocouple input device
- Power supply splitter
- Two 68-pin SCSI cables (1 m)
- One J- type thermocouple
- Quick start guide
- Product reference CD-ROM
- Agilent automation-ready CD (contains the Agilent IO Libraries Suite)
- Certificate of Calibration

## Ordering Information and Optional Accessories

Model number	Description
U2802A	31-channel thermocouple input
Optional accessories	Description
U2802A-001	Power supply adapter
U2802A-100	J- type Thermocouples (10 pcs)
U2802A-ABJ	Japanese user's guide (hardcopy)



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