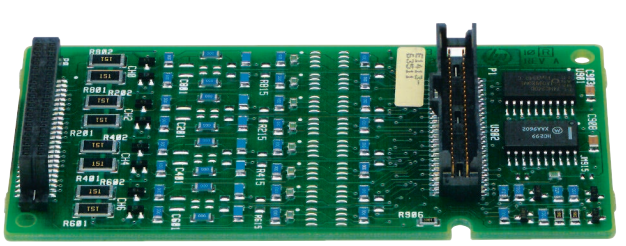
# Agilent E1501A
# 8-Channel Direct Input SCP
Data Sheet

- **Use with Agilent E1413C/E1415A/E1419A**
- **Direct connection to A/D's input**
- **± 16 V max sensor voltage with over-voltage protection**
- **Wide bandwidth input**
- **Open transducer detection**



**Agilent E1501A**

## Description

The Agilent E1501A Direct Input (>100 kHz BW) Signal Conditioning Plug-on, the most basic of Agilent Technologies' SCPs, provides eight hardwired paths that buffer the input signal. Each path has input over-voltage protection and open transducer detection.

Measurement applications include voltage, temperature, resistance, and strain measurements and general measurements of voltage output sensors.

Use the E1501A with the following VXI modules:

| Model | Description |
|---|---|
| **E1413C** | 64-Channel Scanning A/D Converter |
| **E1415A** | Algorithmic Closed Loop Controller |
| **E1419A** | Multifunction Measurement and Control Module |

Refer to the Agilent Technologies Website for recent product updates, if applicable.

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## Voltage Measurements

The E1501A is ideal for measuring wide bandwidth signals from sensors with full-scale voltage outputs from 62 mV to 16 V.

## Temperature Measurements

The E1501A can be used to make temperature measurements with thermocouples, thermistors, or RTDs. The E1501A can directly read thermocouples, however, the E1503A/E1508A/E1509A SCPs provide higher accuracy thermocouple measurements.

Temperature measurements with thermistors or RTDs require the E1505A Current Source SCP. Engineering units conversion to degrees C are made on-card at full speed.

## Resistance Measurements

Resistance is measured using the E1505A 8-Channel Current Source SCP with the E1501A SCP. Measurements are made by applying a dc current to the unknown and measuring the voltage drop across the unknown. The current source is provided through the E1505A. The recommended application is as shown here using 4-wire Ω connections. Two-wire Ω measurement is possible but not recommended since two 150 Ω series resistors protecting the input FET multiplexer are included in the measurement.

## Strain Measurements

The E1501A can be used to make strain measurements when combined with either the E1506A or E1507A Strain Completion SCPs. However, the E1503A, E1508A and E1509A SCPs provide higher accuracy strain measurements. Refer to the E1506A or E1507A *Technical Specifications* for more information.

## Temperature Measurement Accuracy

The thermocouple graphs following this description include the errors due to measuring the voltage output of the thermocouple, and the algorithm errors due to converting the thermocouple voltage to temperature or the Measurement/Conversion Error (MCE). To this error the Reference Junction Measurement Error (RJME) must be added due to measuring the reference junction temperature with an RTD or thermistor (this measurement requires an E1505A). Also, the Isothermal Reference Gradient Errors (IRGE) must be added due to gradients across the isothermal reference. If an external isothermal reference panel is used, consult the manufacturer's specifications. If Agilent terminal blocks are used as the isothermal reference, see the notes below.

Total Temperature Error = $[ (MCE)^2 + (RJME)^2 + (IRGE)^2 ]^{1/2}$

**NOTES:**

*1) When using the Terminal Block as the isothermal reference, add ± 0.6 °C to the thermocouple accuracy specs to account for temperature gradients across the Terminal Block. The ambient temperature of the air surrounding the Terminal Block must be within ± 2 °C of the temperature of the inlet cooling air to the VXI mainframe.*

*2) When using the Agilent E1586A Rack Mount Terminal Panel as the isothermal reference, add ± 0.2 °C to the thermocouple accuracy specs to account for temperature gradients across the E1586A. The E1586A should be mounted in the bottom part of the rack, below and away from other heat sources, for best performance.*

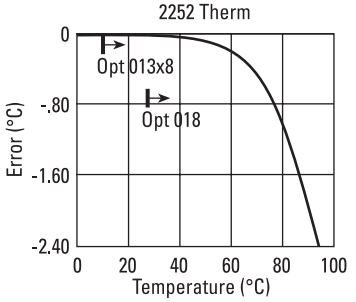
All specifications for the following were measured with the A/D filter off.

The following temperature accuracy graphs include instrument and firmware linearization errors. The linearization algorithm used is based on the ITS-90 transducer curves. Add your transducer accuracy to determine total measurement error.

**Conversion Chart**

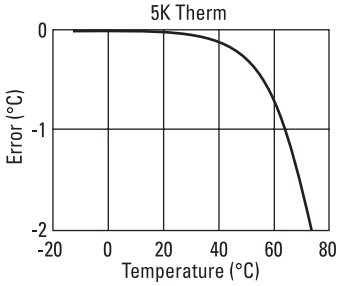
| | | |
|---|---|---|
| Opt 011 | = | E1501A |
| Opt 012 | = | E1502A |
| Opt 013 | = | E1503A |
| Opt 015 | = | E1505A |
| Opt 016 | = | E1506A |
| Opt 017 | = | E1507A |
| Opt 018 | = | E1508A |
| Opt 019 | = | E1509A |
| Opt 020 | = | E1510A |
| Opt 021 | = | E1511A |

2252 Therm



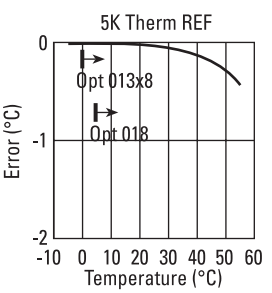

— Opt 011
— Opt 012
— Opt 013x8
— Opt 018

5K Therm



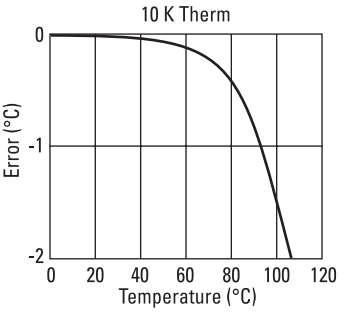

— Opt 011
— Opt 012
— Opt 013x8
— Opt 018

5K Therm REF



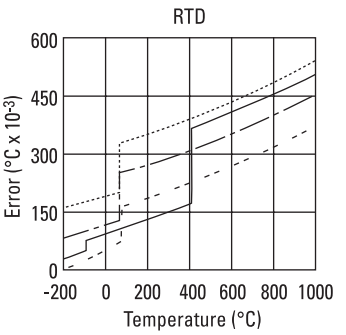

— Opt 011
— Opt 012
— Opt 013x8
— Opt 018

10 K Therm




— Opt 011
— Opt 012
— Opt 013x8
— Opt 018

RTD

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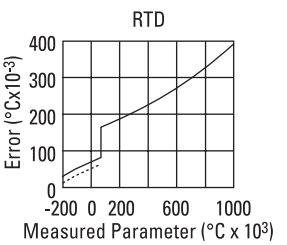
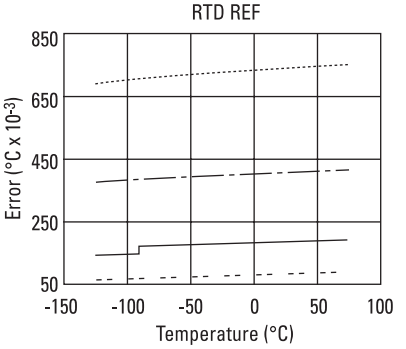
- - Opt 013x64

RTD



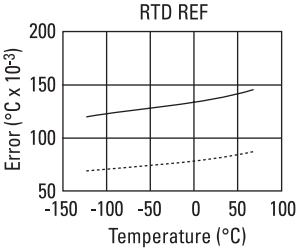

— Opt 018
···· Opt 019

RTD REF




— Opt 011
···· Opt 012
— Opt 013x8
- - Opt 013x64

RTD REF

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···· Opt 019

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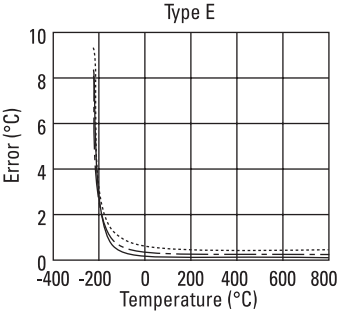


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···· Opt 012
— Opt 013x8
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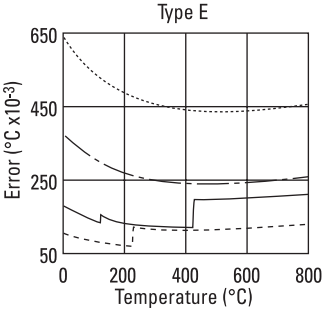


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— Opt 013x8
- - Opt 013x64

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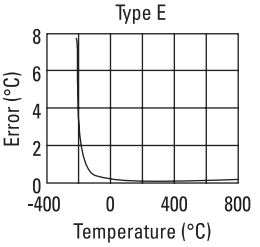


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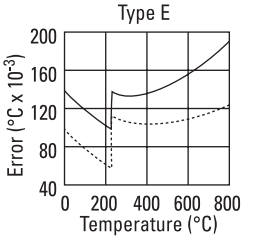


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···· Opt 019

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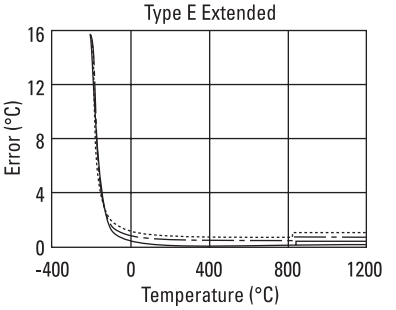


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— Opt 013x8
— Opt 013x64

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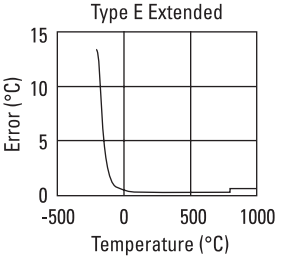


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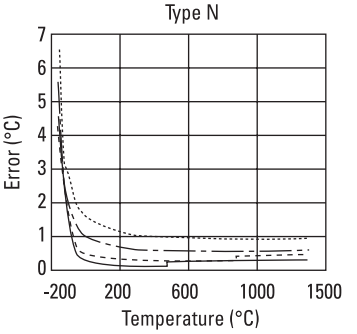
— Opt 019

Type N

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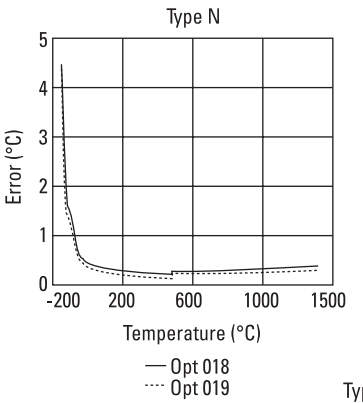
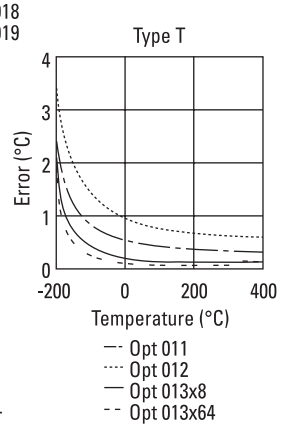
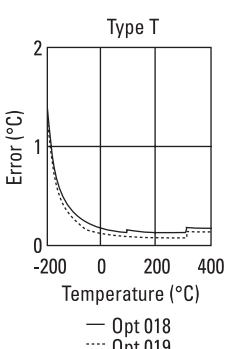
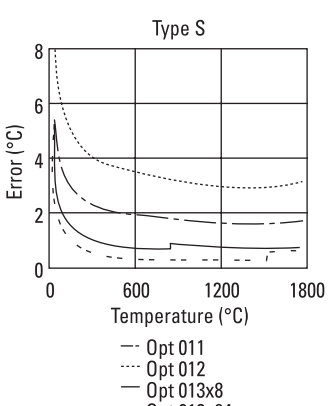
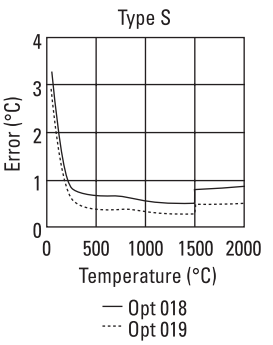
— Opt 013x8
- - Opt 013x64

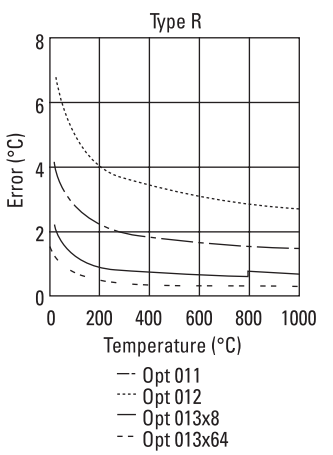

Type N
Error (°C)
5
4
3
2
1
0
-200
200
600
1000
1500
Temperature (°C)
Opt 018
Opt 019

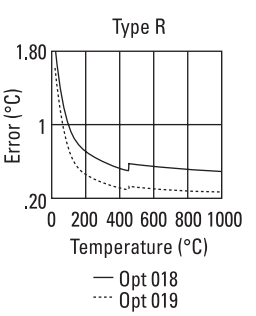

Type T
Error (°C)
4
3
2
1
0
-200
0
200
400
Temperature (°C)
Opt 011
Opt 012
Opt 013x8
Opt 013x64


Type T
Error (°C)
2
1
0
-200
0
200
400
Temperature (°C)
Opt 018
Opt 019


Type S
Error (°C)
8
6
4
2
0
0
600
1200
1800
Temperature (°C)
Opt 011
Opt 012
Opt 013x8
Opt 013x64


Type S
Error (°C)
4
3
2
1
0
0
500
1000
1500
2000
Temperature (°C)
Opt 018
Opt 019


Type R
Error (°C)
8
6
4
2
0
0
200
400
600
800
1000
Temperature (°C)
Opt 011
Opt 012
Opt 013x8
Opt 013x64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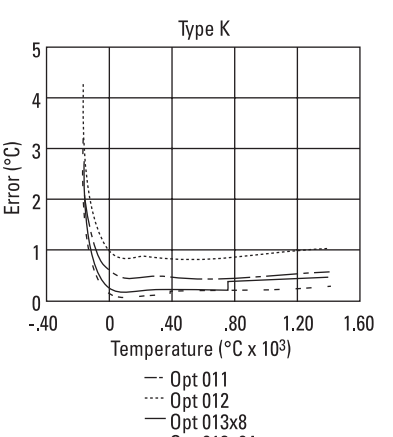
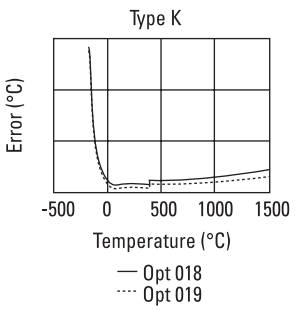
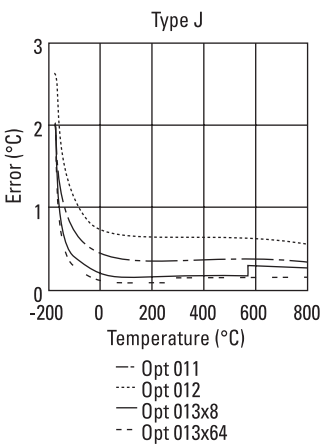
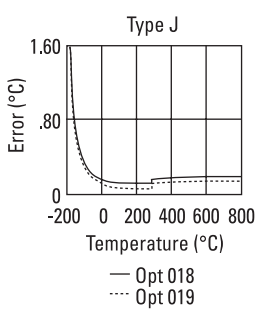
1
.20
0
200
400
600
800
1000
Temperature (°C)
Opt 018
Opt 019


Type K
Error (°C)
5
4
3
2
1
0
-.40
0
.40
.80
1.20
1.60
Temperature (°C x 10³)
Opt 011
Opt 012
Opt 013x8
Opt 013x64




## Product Specifications

These specifications for the E1501A reflect the combined performance of the scanning A/D and the E1501A 8-Channel Direct Input SCP.

### Measurement Ranges

| | |
|---|---|
| **DC Volts:** | ± 62.5 mV to ± 16 V Full Scale |
| **Temperature:** | |
| **Thermocouples:** | –200 to + 1700 °C |
| **Thermistors: *** | –80 to + 160 °C |
| **RTD's: *** | –200 to + 850 °C |
| **Resistance: *** | 512 Ω to 131K Ω FS |
| **Strain:**** | 25,000 με or limit of linear range of strain gage |

* Requires Agilent E1505A.
** Requires Agilent E1506A/E1507A.

## Input Characteristics

| | |
|---|---|
| **Maximum input voltage (normal mode plus common mode):** | |
| **Operating** | <± 16 V peak |
| **Damage level:** | >± 42 V peak |
| **Maximum common mode voltage:** | |
| **Operating:** | <± 16 V peak |
| **Damage level:** | >± 42 V peak |
| **Common mode rejection:** | |
| **0 to 60 Hz:** | –105 dB |
| **Input impedance:** | >100 MΩ differential |

## Maximum Tare Cal Offset

***Maximum tare cal offset depends on A/D range and SCP gain.***

| A/D Range ±V F. Scale | Maximum Offset |
|---|---|
| **16** | 3.2213 |
| **4** | .82101 |
| **1** | .23061 |
| **0.25** | .07581 |
| **0.0625** | .03792 |

## Measurement Accuracy DC Volts

**If autoranging is ON, add ± .02% FS to accuracy specifications.**

| A/D Range ±V F. Scale | Linearity % of Reading | Offset Error | Noise 3σ | Noise* 3σ |
|---|---|---|---|---|
| .0625 | 0.01% | 5.3 μV | 18 μV | 8 μV |
| .25 | 0.01% | 10.3 μV | 45 μV | 24 μV |
| 1 | 0.01% | 31 μV | 110 μV | 90 μV |
| 4 | 0.01% | 122 μV | 450 μV | 366 μV |
| 16 | 0.01% | 488 μV | 1.8 μV | 1.5 μV |

***** A/D filter ON (min sample period ≥145 μs: ≤100 Hz scan rate 64 ch).

**Temperature Coefficients**

| | Temp Range | Tempco |
|---|---|---|
| Gain: | | 10 ppm/°C |
| Offset: | 0-40 °C | 0.14 μV/°C |
| | 40-55 °C | 0.38 μV/°C + 0.8 μV |

| Normal Mode Rejection | Common Mode Rejections | Input Capacitance |
|---|---|---|
| 0 dB | >105 dB (0 to 60 Hz) | 80 pF typical |

## Current Requirements (Amps)

| 5 V typ | 5 V max | 24 V typ | 24 V max | -24 V typ | -24 V max |
|---|---|---|---|---|---|
| 0.01 | 0.01 | 0.006 | 0.01 | 0.006 | 0.01 |

## Ordering Information

| Description | Product No. |
|---|---|
| 8-Channel Direct Input SCP | E1501A |

## Related Literature

*2000 Test System and VXI Catalog CD-ROM,*
Agilent Pub. No. 5980-0308E (detailed specifications for VXI products)

*2000 Test System and VXI Catalog,*
Agilent Pub. No. 5980-0307E (overview of VXI products )

*1998 Test System and VXI Products Data Book,*
Agilent Pub. No. 5966-2812E

## Online

Internet access for Agilent product information, services and support
*www.agilent.com/find/tmdir*

VXI product information
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Agilent Technologies VXI Channel Partners
*www.agilent.com/find/vxichanpart*

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*www.agilent.com/find/vee*

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