Instruction Sheet Product Group 60 070-8033-00

TEK PROBES AND ACCESSORIES P6602

Temperature Probe



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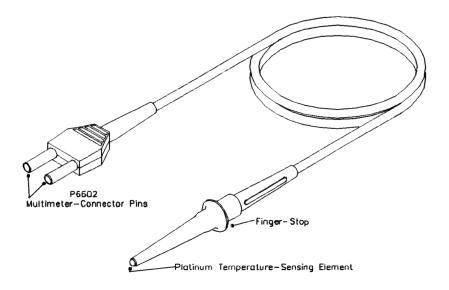


Figure 1. P6602 Temperature Probe.

INTRODUCTION

The P6602 Probe is a temperature-measuring device that operates with many Tektronix instruments. The P6602 operates with the DM504A, DM511, and DM5110 digital multimeters and Tektronix 2236A, 2445B, 2455B, and 2465B oscilloscopes. This probe has a temperature-sensing element that consists of a thin-film platinum resistor located in the tip. To make a temperature measurement, touch the temperature-sensing element to the surface of the object. The resulting multimeter readout shows the temperature in degrees Celsius

This instruction sheet provides information on five subjects: Operating Considerations, Specifications, Measuring Temperature, Theory of Operation, and Cleaning.

The P6602 Temperature Probe has no replaceable parts and is not repairable. If your probe fails during the warranty period, return it to your local Tektronix service center for replacement. Additional probes are available through your Tektronix field representative.

OPERATING CONSIDERATIONS

This section discusses probe handling, probe connection, and probe calibration. Figure 1 provides part location and nomenclature information.

PROBE HANDLING

Although the P6602 probe has been designed for easy, efficient, and reliable use, proper handling practices and precautions are necessary to prevent damage to the probe and tip.

To prevent tip damage, do not drop the probe or apply physical pressure to the probe tip. In particular, do not use the probe tip as a lever (to pry), as this will result in cracking or breaking the probe tip.

To prevent cable damage, do not crush or apply excessive strain to the cable.

Ensure that the probe connector pins and the multimeter jacks are properly aligned before connecting them together.

Do not immerse the probe-tip end of the probe further than the fingerstop ring (largest-diameter part of the probe just above the tip).

Do not immerse multimeter connector pins.

Because the probe is constructed with polyetheretherketone (PEEK) compounds, do not immerse it in liquids that are incompatible with PEEK compounds.

PROBE CONNECTION

Figure 1 shows the P6602 Temperature Probe. To connect the probe to an instrument, carefully align the multimeter connector pins with the multimeter input jacks and slowly insert the probe into the multimeter.

PROBE CALIBRATION

There are no adjustments for the P6602 Temperature Probe. If the multimeter needs to be adjusted to match the probe, consult your multimeter manual for appropriate procedures.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

Platinum Sensor: $F(T) = R_0 + \alpha T + \delta T^2$

Thermal Time Constant: ≤ 1.25 seconds

Accuracy: System accuracy is determined by the associated multimeter. Refer to the respective instrument technical manual for system temperature measurement accuracy specifications.

Maximum Safe Voltage on Measurement Surface: 400 V (dc + pk ac).

RF Frequency and Voltage Limits on Measurement Surface: See Figure 2.

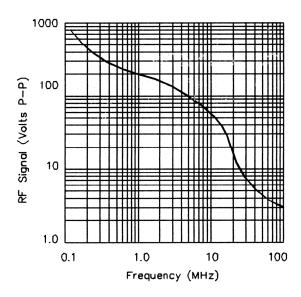


Figure 2. Typical RF-Signal Limits at Probe.

ENVIRONMENTAL CHARACTERISTICS

Temperature Range (Nonoperating): -62° C to 85° C (-80° F to 185° F)

Temperature Range (Operating):

Probe Tip to Finger-Stop Ring: -62° C to 240° C (-80° F to 464° F)

Cable to Connector: -62° C to 230° C (-80° F to 446° F)

Connector: -15° C to 85° C (+5° F to 185° F)

Humidity: Five cycles (120 hr) at 95% relative humidity. Class 3 as

specified in MIL-T-28800D, paragraph 4.5.5.1.2.2.

Altitude (Nonoperating): to 15,000 m (\approx 50,000 ft).

Altitude (Operating): to 4500 m (\approx 15,000 ft).

PHYSICAL CHARACTERISTICS

Probe Length: Probe Body--141 mm (5.55 in); Cable--1.5 m (4.92 ft).

Probe Net Weight: 102 g (3.6 oz)

SAFETY

This product meets the requirements of UL 1244.

MEASURING TEMPERATURE

This section describes how to make measurements with the probe and also discusses four error effects. The next section, "Theory of Operation," will also help you understand how to make measurements with the probe.

To measure the temperature of an object, touch the sensing element on the probe tip to the surface of the object. Usually the most accurate temperature reading is obtained when the position of the probe tip is held as close to 90° as possible to the surface being measured.

Application of the element to a device surface may cause a slight change in the temperature of the device. This is due to a combination of heat-sinking and thermal-gradient effects associated with heat transfer between two bodies. The temperature difference (or error) is comparable to the voltage change occurring in an electrical circuit as a result of probe loading.

Refer to Figure 3 when reading the following sections on error effects. By understanding these error effects, you will be able to correctly interpret the measurement data that you receive from the P6602 Temperature Probe.

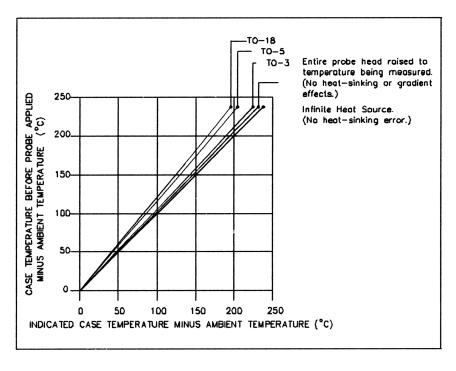


Figure 3. Heat-Sinking and Thermal Gradient Effects.

HEAT-SINKING EFFECT ERROR

The heat-sinking effect depends on the ambient temperature, the initial temperature, and the thermal mass of the device being measured. In addition, the initial temperature and thermal mass of the device used to measure the temperature also affect heat-sinking errors. When two objects are brought into thermal contact, heat flows from the warmer object to the cooler object. When the temperature probe is cooler than the object it contacts, the heat-sinking effect lowers the surface temperature of the contacted object.

COMBINED-EFFECTS ERROR

Combined-effect errors must be considered when determining the surface temperature that existed before the temperature probe was applied to an object. Minimize these errors by applying the tip of the probe normal (at a 90° degrees) to the surface and applying moderate pressure. Refer to the graph in Figure 3.

RF SIGNAL ERROR

RF-voltage signals on devices being measured for temperature may cause an error in the resulting temperature reading. Depending on the multimeter used, RF rejection may vary and should be known before using the P6602 Temperature Probe in high RF fields. When using Figure 2 (see "Specifications" section) as a reference, specified RF values near the curve can affect the reading approximately ± 0.1 °C, while the values specified below the curve will not significantly affect the temperature reading. Signal values above the curve may cause additional error.

THERMAL-GRADIENT EFFECT ERROR

The thermal-gradient effect is the rate of change in temperature of a substance, across a distance measured normal (at a 90° angle) to the isothermal surfaces. The final (steady state) surface temperature of the device being measured is affected by the thermal mass, initial temperature difference, angle, surface area, pressure, and duration of the thermal conduction contact. When measuring temperature, the error induced by thermal-gradient effects is the result of a flow of heat between the surface of the device being measured and the measuring device, in this case, the temperature probe body.

THEORY OF OPERATION

Temperature measurement is accomplished through the use of a thinfilm platinum resistor located in the tip of the probe. The temperature coefficient of resistance of the platinum resistor is used to determine temperature. Resistance of the thin-film platinum may be expressed by the following function of temperature:

$$F(T) = R_0 + \alpha T + \delta T^2$$

where:

 R_0 = Resistance at 0° C = 100 Ω ±1%

 α = Temperature coefficient of resistance = .3738 Ω /°C \pm 0.8%

 δ = Second order variation from a straight line -8.85 x 10⁻⁵ Ω/°C² ±12%

T = Platinum Resistor Temperature (°C)

The digital multimeter measures this resistance, corrects it for non-linearity, and scales the result to achieve readout in degrees Celsius. Figure 4 shows the actual probe-sensor resistance relative to temperature for a Tektronix DM502A Digital Multimeter. The multimeter you use will have a similar characteristic, but the circuitry for implementing resistance measurement, nonlinearity correction, and scaling may vary. Therefore, you should refer to the respective multimeter technical manual for overall system specifications and functional description.

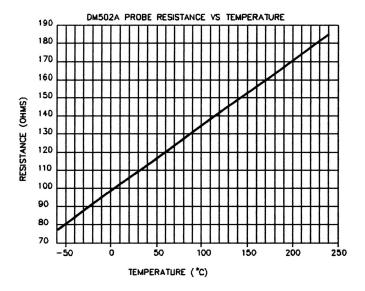


Figure 4. Probe Resistance vs. Temperature.

CLEANING

Occasionally clean the external surfaces of the temperature probe. Remove dirt that accumulates on the cable and multimeter-connector pins with a soft cloth dampened with a non-residue cleaner, preferably isopropyl alcohol. Use ONLY isopropyl alcohol to clean the probe temperature-sensing element to avoid errors in temperature readings or contaminating liquids into which it may be immersed.

Do not use chemical cleaning agents which might damage the materials used in this probe. In particular, avoid chemicals which contain sulfuric or nitric acids or similar solvents. Use only cleaning agents.



To avoid damage to the probe, do not immerse it in liquids that are incompatible with PEEK 450G molding compound, silicone rubber, Polymide or RTV adhesives.