Tektronix®

COMMITTED TO EXCELLENCE

P6601 TEMPERATURE PROBE

INSTRUCTION MANUAL

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This Tektronix product is warranted against defective materials and workmanship, under normal use, for a period of one year from date of initial shipment. Tektronix will repair or replace, at its option, those products determined to be defective within the warranty period and returned, freight prepaid, to a Tektronix Service Center. There is no implied warranty for fitness of purpose.

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SAFETY SUMMARY

The general safety information in this summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply and do not appear in this summary.

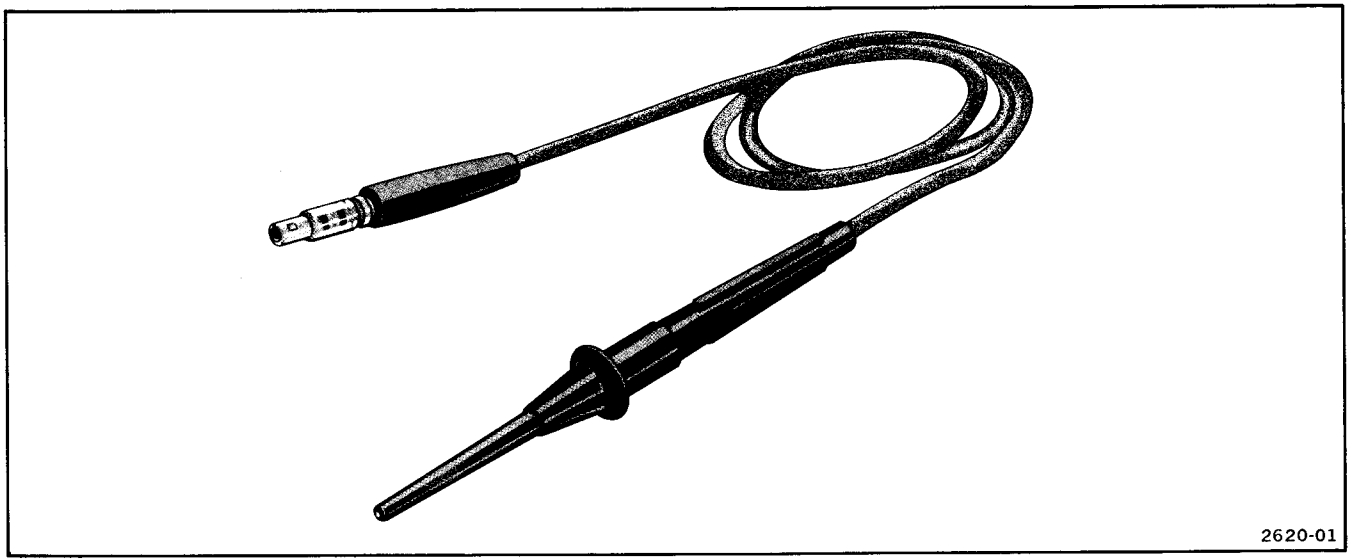
TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

INTRODUCTION



P6601 Temperature Probe.

The P6601 Probe is a temperature-measuring device designed to operate with a digital multimeter. The temperature-sensing element consists of a thin-film platinum resistor on the tip of the probe. Measurements are made by touching the sensing element to the surface whose temperature is in question. The thermal signal is transmitted to the associated digital multimeter through a two-conductor cable.

SPECIFICATION

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Platinum Sensor Resistance vs Temperature Characteristic Function	$R(T)=R_0+\alpha T+\delta T^2$.	R_0 = Resistance at 0° C = 100 Ω ±0.2%. α = Temperature Coefficient of Resistance = 0.3738 Ω/ °C ±0.8%. δ = 2nd Order Variation from Straight Line = $-8.85X10^{-5}$ Ω/ $°C^2$ ±12%. T = Platinum Resistor Temperature (°C).
Thermal Time Constant	0.5 s ±0.2 s.	
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 plus peak ac).	
RF Frequency and Voltage Limits on Measurement Surface	See Figure 1.	

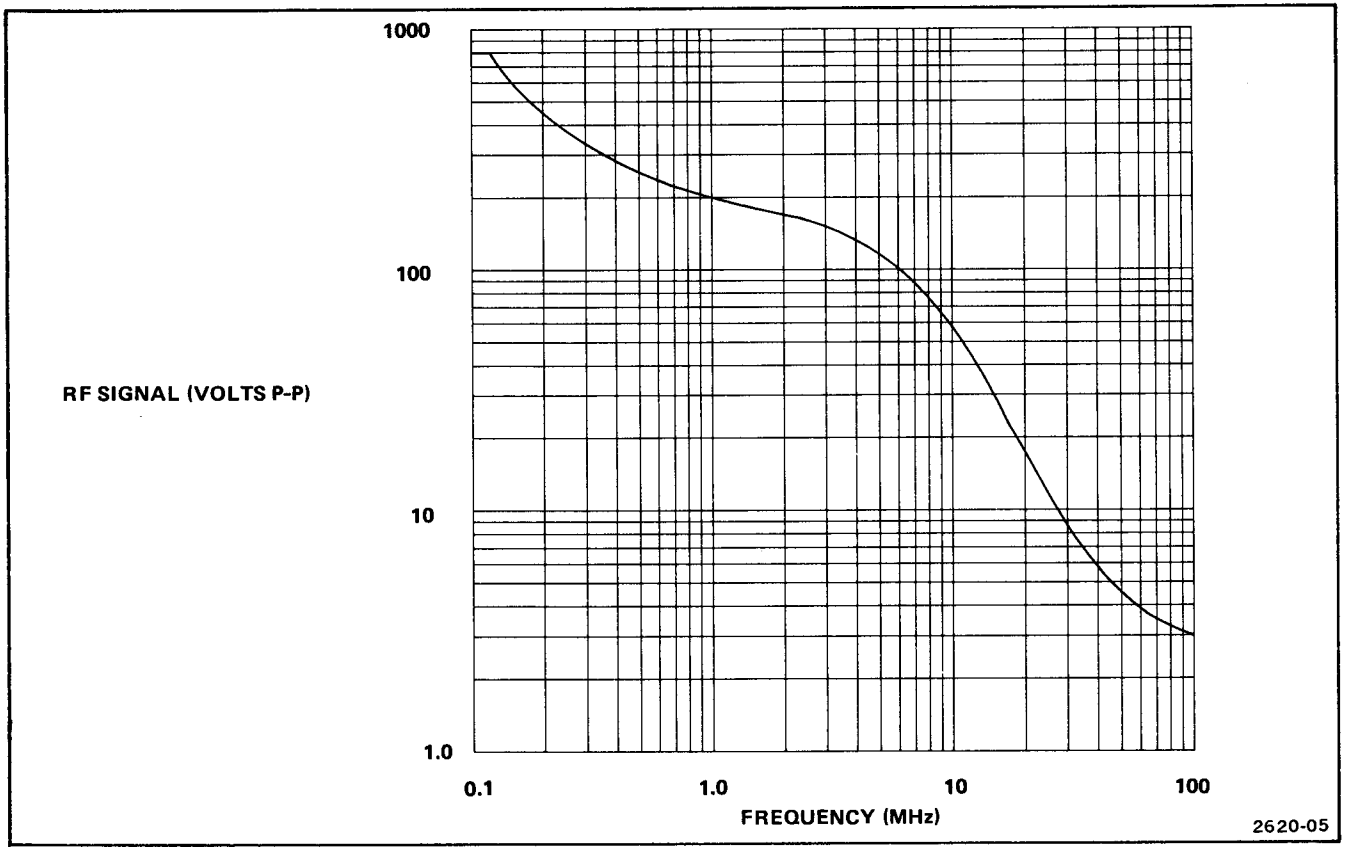


Figure 1. Typical allowable rf signal limits at probe tip.

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Description
Temperature, Storage	–62° to +120° C (–80° to +248° F).
Temperature, Operating	
Probe Body and Sensor	–62° to +240° C (–80° to +464° F).
Cable (Cable extends into probe body up to flange)	–62° to +140° C (–80° to +284° F).
Connector	–15° to +120° C (+5° to +248° F).
Humidity, Operating and Storage	Five cycles (120 hr) to 95% relative humidity referenced to MIL-STD-810C, Method 507.1, Procedure IV; modified as specified in MIL-T-28800B, paragraph 4.5.1.1.2.
Altitude	
Operating	To 4500 m (15,000 ft).
Storage	To 15,000 m (50,000 ft).
Transportation	Meets National Safe Transit Association Test 1A.

PHYSICAL CHARACTERISTICS

Characteristics	Description
Length	
Probe Body	141 mm (5.55 in).
Cable	1.5 m (4.92 ft).
Weight	102 g (3.6 oz).

OPERATING INSTRUCTIONS

CONNECTING PROBE CABLE TO DIGITAL MULTIMETER

CAUTION

Ensure that the probe cable connector pins and the multimeter input jack are correctly aligned before connecting. Damage to the terminals can result by forcing the connector and the jack together.

Carefully align the probe cable connector pins and the multimeter input jack, then slowly insert the cable connector into the jack.

PROBE ADJUSTMENT AND CALIBRATION

There are no adjustments necessary for the P6601 Probe. Procedures, if required, for calibrating the digital multimeter to match the probe are included in the respective digital multimeter technical manual.

MEASURING TEMPERATURE

CAUTION

To avoid damage to the probe, do not immerse it in liquids that are incompatible with Dow Corning 308 molding compound, BeO, silicone rubber, or epoxy adhesives.

To measure temperature, touch the sensing element on the probe tip to the surface of the device or object for which a reading is desired.

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 analogous to the voltage change occurring in an electrical circuit as a result of probe loading.

Heat Sinking Effect Error

Heat sinking effect depends on the thermal mass of the device being measured, the ambient temperature, and the initial device temperature above ambient. The error (in degrees Celsius) induced by the heat sinking effect for three common transistor cases (TO-3, TO-5, and TO-18) is illustrated in Figure 2.

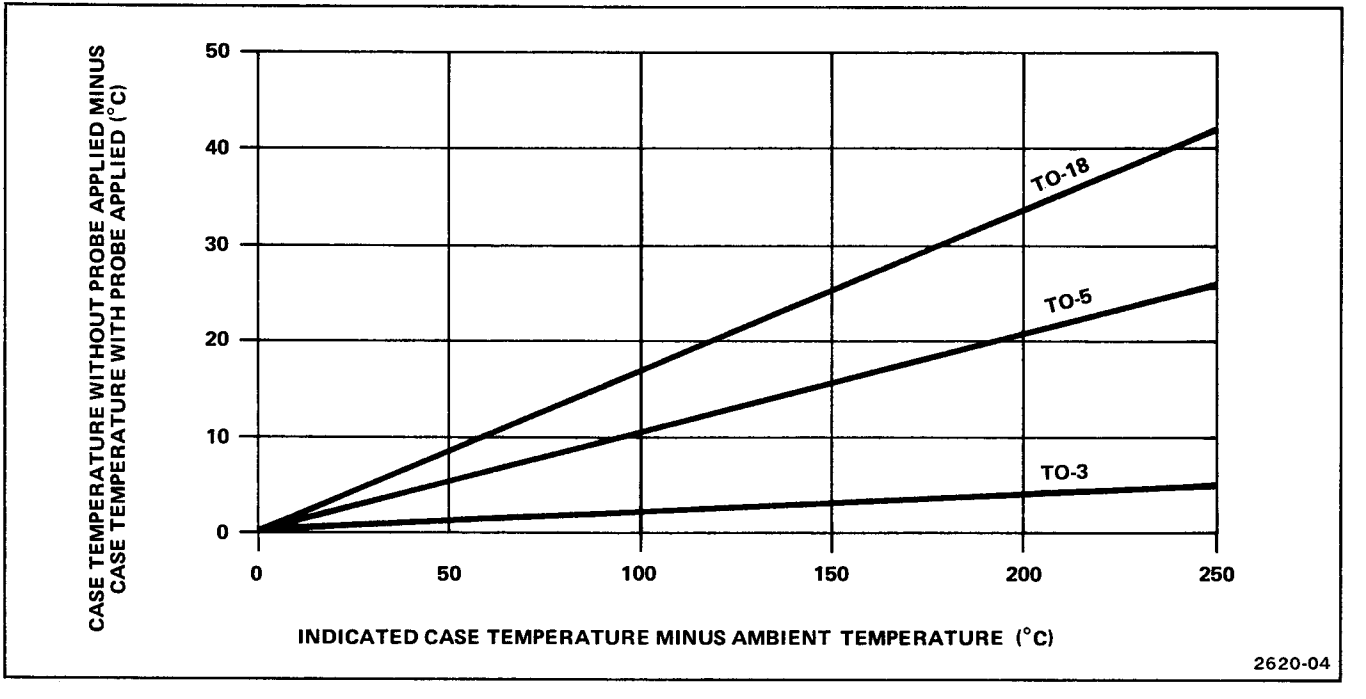


Figure 2. Heat sinking effect on temperature measurement of common transistor cases.

Thermal Gradient Effect Error

The thermal gradient effect depends on the final (steady state) surface temperature of the device being measured and on the ambient temperature. When measuring temperature, the error induced by the thermal gradient effect is the result of a steady state flow of heat from the surface of the device being measured to the probe body. Figure 3 is a graph illustrating the steady state thermal gradient effect on temperature measurement.

Combined Effects Error

To determine the approximate actual surface temperature that existed before the probe was applied to a device, both the heat sinking and the thermal gradient effects must be considered. The graph in Figure 4 provides a convenient means for approximating the combined heat sinking and thermal gradient errors for three common transistor cases: the TO-3, TO-5, and TO-18.

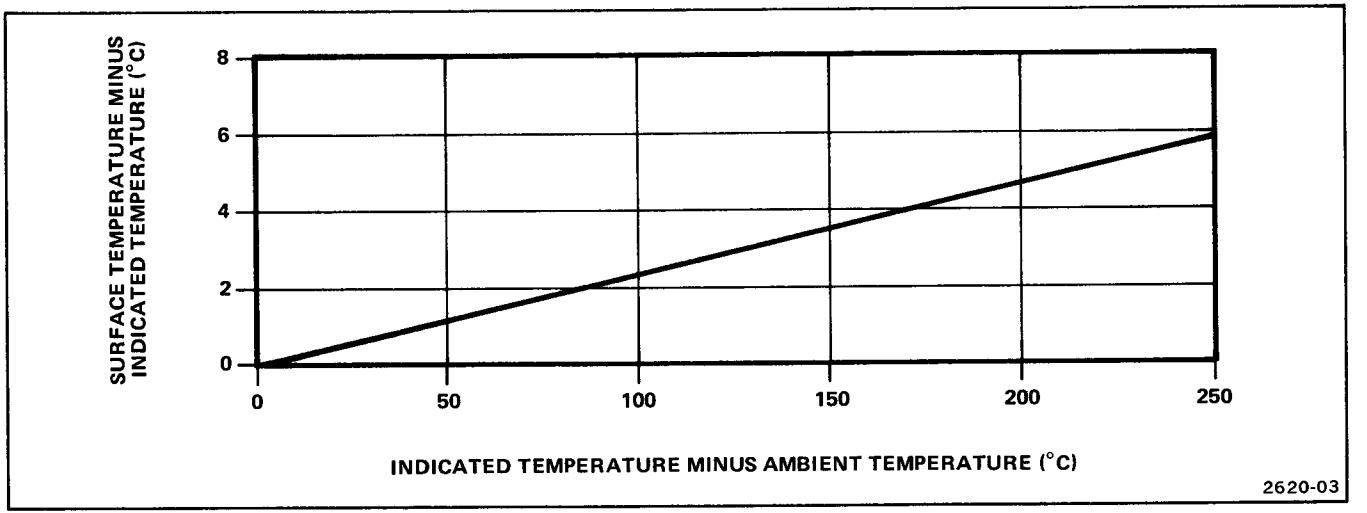


Figure 3. Thermal gradient effect on temperature measurement.

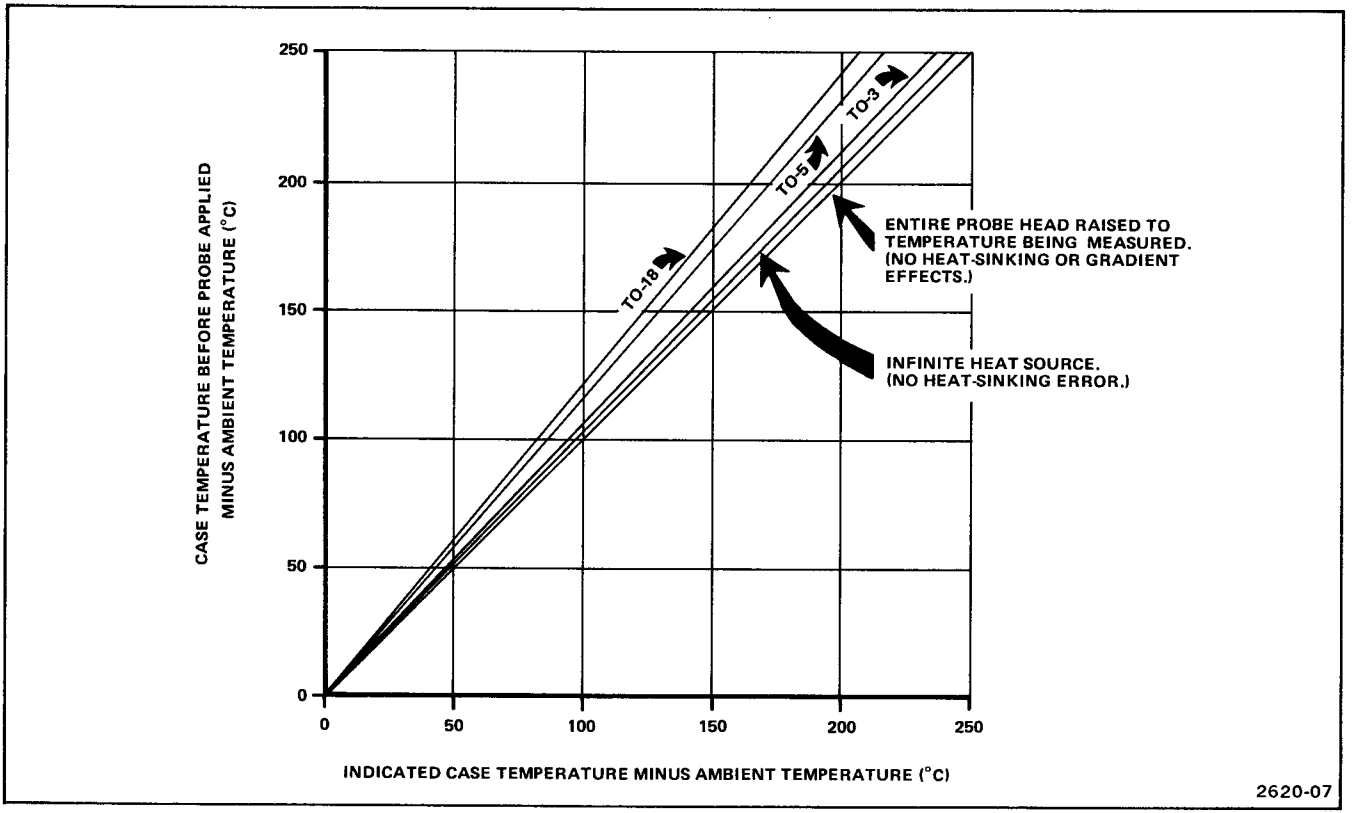


Figure 4. Combined heat sinking and thermal gradient errors for common transistor cases.

THEORY OF OPERATION

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

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

where:

$R_0 = 100\ \Omega$
$\alpha = 0.3738\ \Omega/°C$
$\delta = -8.85 \times 10^{-5}\ \Omega/°C^2$
T = Platinum Resistor Temperature (°C)

The associated digital multimeter measures this resistance, corrects it for non-linearity, and scales the result to achieve readout in degrees Celsius. Depending on the multimeter used, the circuitry for implementing resistance measurement, non-linearity correction, and scaling may vary. You therefore should refer to the respective multimeter technical manual for overall system specifications and functional description.

MAINTENANCE

The only maintenance required for the P6601 Probe is occasional cleaning. Maintenance instructions contained in this section are intended for use by qualified service personnel.

CLEANING

CAUTION

The sensing element on the probe tip is made with beryllium oxide (BeO). Do not sand, polish, machine, or clean in any manner that can produce BeO dust.

Do not use chemical cleaning agents which might damage the materials used in this probe. In particular, avoid chemicals which contain benzene, toluene, xylene, acetone, or similar solvents. Use only recommended cleaning agents.

Dirt that accumulates on the probe body, tip, and sensing element can be removed with a soft cloth dampened in any one of the following recommended cleaning agents: mild detergent and water solution, isopropyl alcohol (Isopropanol), or ethyl alcohol (Fotocol or Ethanol). Do not use abrasive cleaners.

PROBE REPLACEMENT

The P6601 Probe is sealed when manufactured and contains no user-serviceable or replaceable parts. Replacement probes are available from or through your local Tektronix, Inc. Field Office or representative.