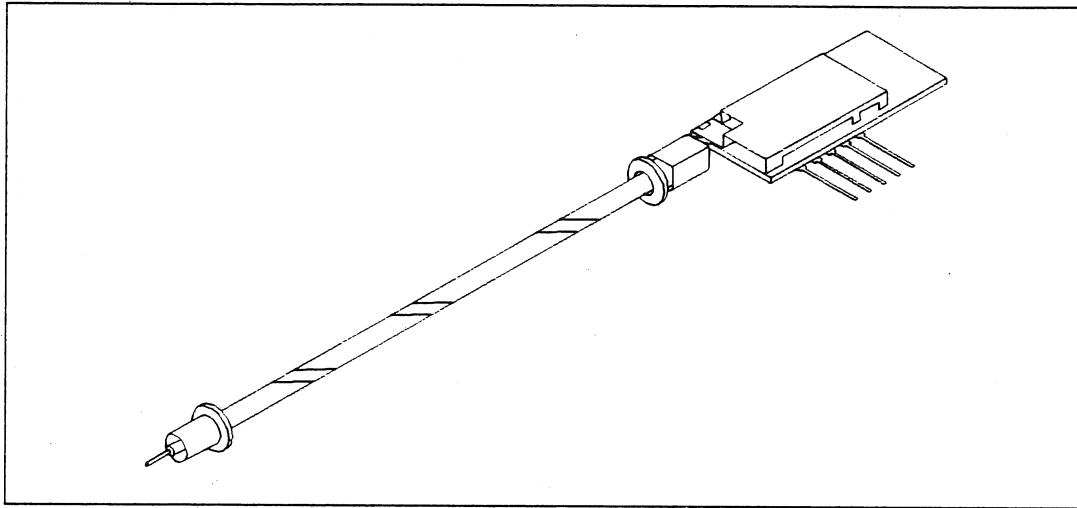


Instructions A6501 Buffer Amplifier



The A6501 Buffer Amplifier.

SPECIFICATIONS

Description

The A6501 is a 10X, dc-to-1GHz buffer amplifier designed for placement on a probe card or test fixture. The amplifier allows for custom configurations with low input capacitance, high input impedance, and drives a 50-Ω load.

Electrical Characteristics

Attenuation: 10X \pm 1% at dc. (External amplifier load = 50Ω \pm 0.5%.)

Input Capacitance: < 2.5 pF.

Input Impedance (Amplifier): 1 MΩ \pm 1%. See Figure C.

Low-Frequency Compensation: Fixed, flat \pm 3%.

Propagation Delay: 2.1 ns \pm 150 ps (input to end of 10-1/4 inch PELTOLA™ cable), 1.2 ns \pm 150 ps (input to end of 3-3/4 inch Peltola cable).

System Bandwidth (-3 dB): DC to 1GHz. (Instrument risetime \leq 100 ps.) See Figure A.

System Rise-time: 350 ps. (Instrument risetime \leq 100 ps.) See Figure B.

Amplifier Aberrations: \pm 8%, 12% p-p 1st 10 ns; \pm 2%, 3% p-p after. (Instrument risetime \geq 100 ps.)

Output Zero: \pm 3 mV (from \pm 1% power supplies).

DC Thermal Drift: 100 μ V/°C.

Input Linear Dynamic Range: -10 V to +10 V with 1.2% typical linearity.

Maximum Nondestructive Input Voltage: \pm 26.5 V (dc + peak ac). See Figure D for voltage derating curve.

Power Requirements: +15 V: 18-25 mA max. -15 V: 18-25 mA max. +5 V: 15-20 mA max. -5 V: 13-20 mA max.

Environmental Characteristics

Temperature Range (Operating): 0°C to +50°C (+32°F to +122°F).

Temperature Range (Nonoperating): -55°C to +75°C (-67°F to +167°F).

Humidity: Five cycles (120 hr) at 90% relative humidity, at +30°C to +60°C. Per Tek Standard 062-2847-00, Class 5.

Physical Characteristics

Net Weight (Includes accessories, excludes packaging) 182 g (6.4 oz).

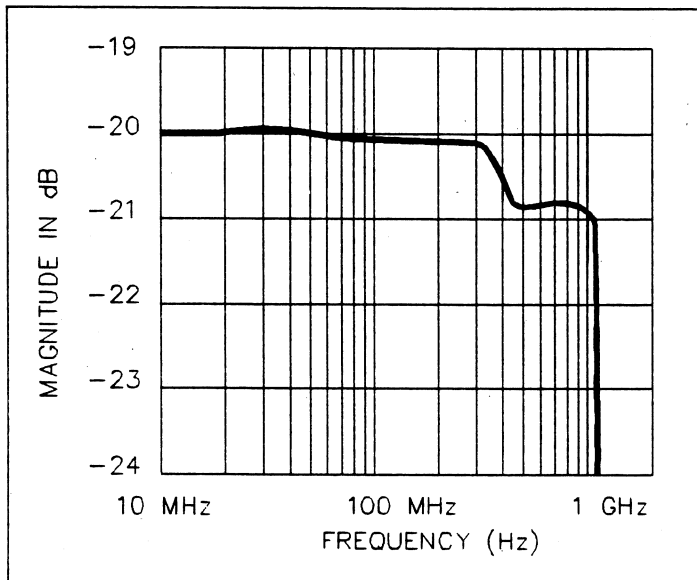


Figure A. Typical Frequency Response.

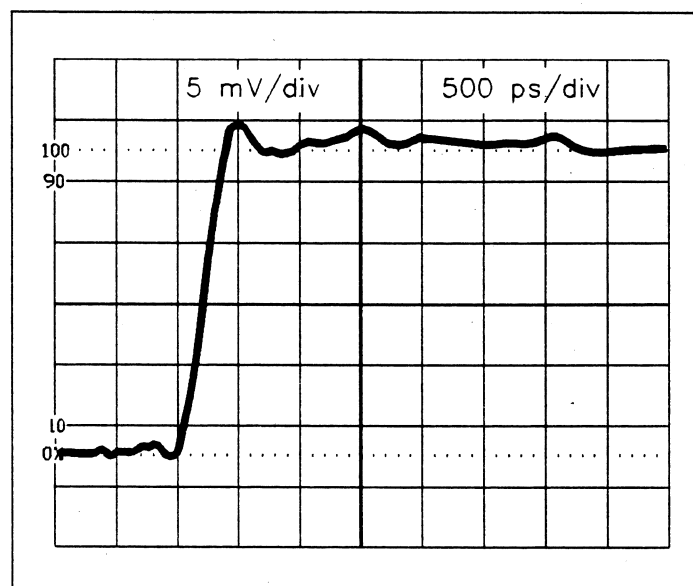


Figure B. Typical Transient Response.

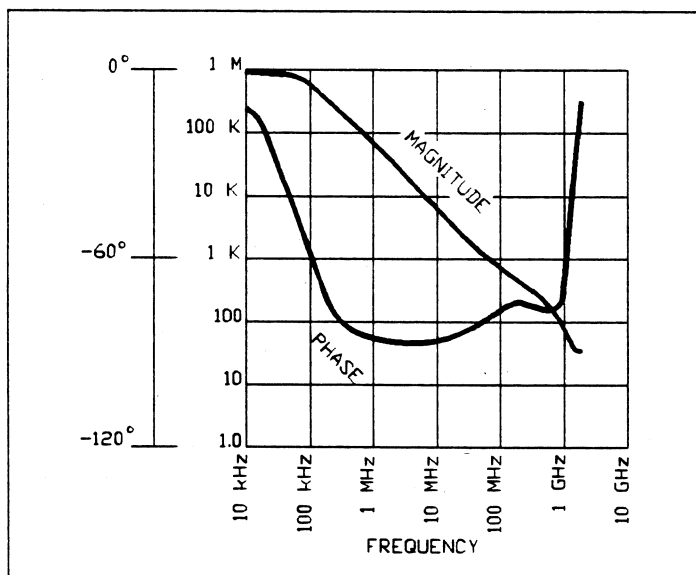


Figure C. Input Impedance.

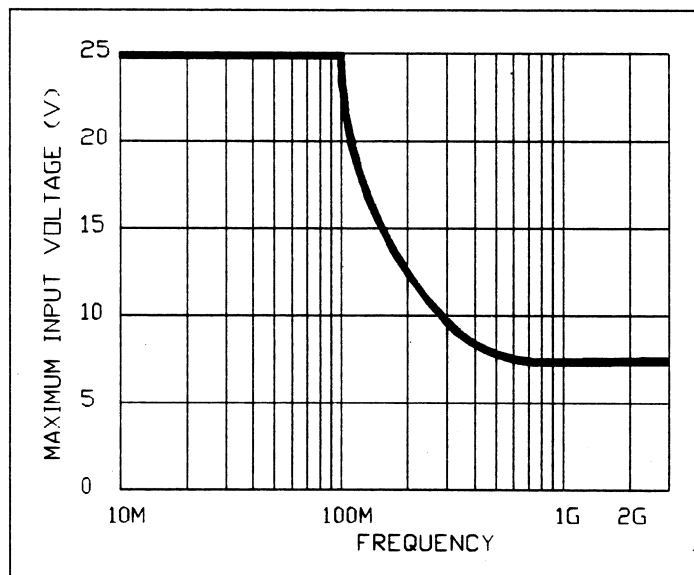


Figure D. Voltage Derating Curve.

OPERATING CONSIDERATIONS

The TEKTRONIX A6501 is a high performance 10X, dc-to-1.0 GHz FET input buffer amplifier designed for placement onto a circuit board or probe card test fixture. The A6501's versatile connection design provides connection to the circuit board or card fixture by either twisted wires, spring loaded contacts, or .100-inch pitch leads. (See Figure 2.) The A6501 features low input capacitance, high input impedance, and drives a 50-Ω load.

HANDLING

The buffer amplifier is a thick-film hybrid constructed on an alumina substrate on which components are printed and mounted. Dropping or flexing the buffer amplifier can cause the substrate to break.

CAUTION

To avoid static damage to the buffer amplifier, do not touch the exposed alumina substrate. Use a ground strap and other standard static-prevention procedures when handling, installing, or positioning the buffer amplifier.

ACCESSORIES

Each A6501 is supplied with the following Standard Accessories:

- 1) Instruction Sheet/Application Notes.
- 2) 3-3/4" (9.5 cm) Peltola (50 Ω) signal cable.
- 3) 10-1/4" (26.0 cm) Peltola (50 Ω) signal cable.
- 4) Peltola-cable-to-circuit-board adapter.
- 5) Three 0.100" (2.54 mm) centers spring-loaded contacts.
- 6) Three miniature sockets for spring-loaded contacts.
- 7) 0.100" (2.54 mm) pitch lead frame.

Additional spring-loaded contact tips may be purchased in packages of 10 from Tektronix (part number 016-0946-00) or ordered directly from Q.A. Technology Inc. (phone 603-926-1193) by requesting 2500-Series compatible spring contact tips. Contact tips with various point styles are also available from Q.A. Technology. Receptacles and spring-loaded contacts may also be purchased from other sources. The amplifier can also be readily fitted with spring-loaded contacts designed for 0.050 inch (1.27 mm) center to center spacings.

Optional Accessories:

- 1) Standard Accessories Kit: includes all the standard accessories except the data/application notes.
- 2) 2 X 3 Female Power Connector.
- 3) 2 X 3 Male Power Connector.
- 4) Wall Mount Power Supply.
- 5) 1102 Power Supply.
- 6) Power Cable for the 1102 Power Supply.
- 7) Peltola Cable-to-BNC adapter.

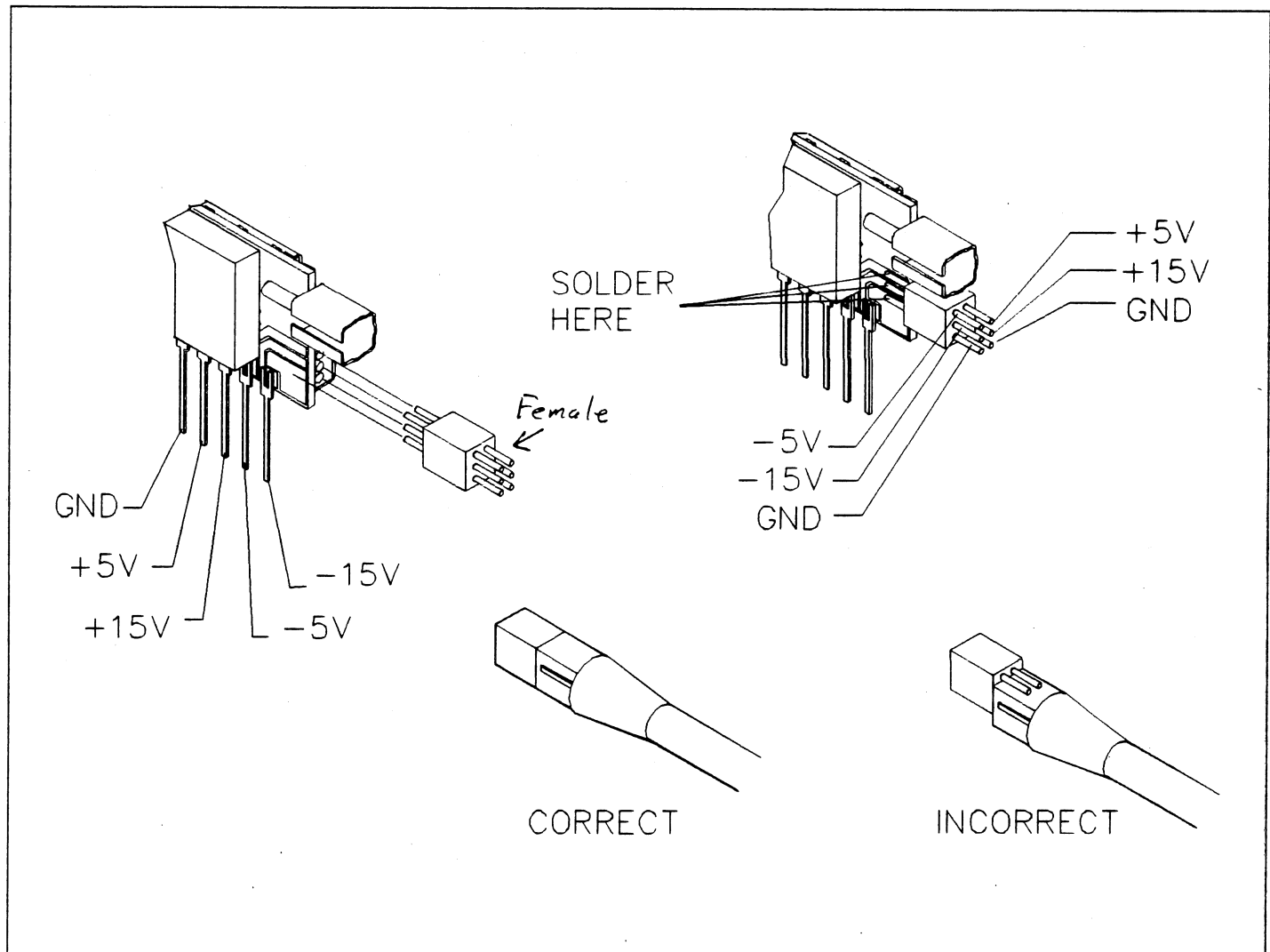


Figure 1. Pinouts, power connector and alignment.

GENERAL SOLDERING NOTES

The exposed portions of the buffer amplifier have a moisture-resistant protective coating. Before soldering the accessories to the buffer amplifier, remove the protective coating from the silver conductors by rubbing with a soft pencil eraser to ensure a good solder joint.

CAUTION

Do not overheat the hybrid when soldering on accessories. Excessive heat will cause damage to other components. Apply the solder system as briefly as possible during removal or installation of any accessories. Due to the nature of the silver conductor material, solder may no longer adhere properly after repeated replacements.

MECHANICAL MOUNTING OF THE BUFFER AMPLIFIER

Five pre-mounted leads are provided for mounting and powering the buffer amplifier from the circuit board. These leads have a center-to-center spacing of 0.100" (2.54 mm). By bending the leads 90 degrees the A6501 can be mounted on its side.

When using the optional 2 X 3 female power connector, the pre-mounted leads can be used to mount the amplifier to the circuit board if they are carefully soldered into electrically ISOLATED feedthroughs. Be sure the feedthroughs are isolated from the power supplies, ground and from each other.

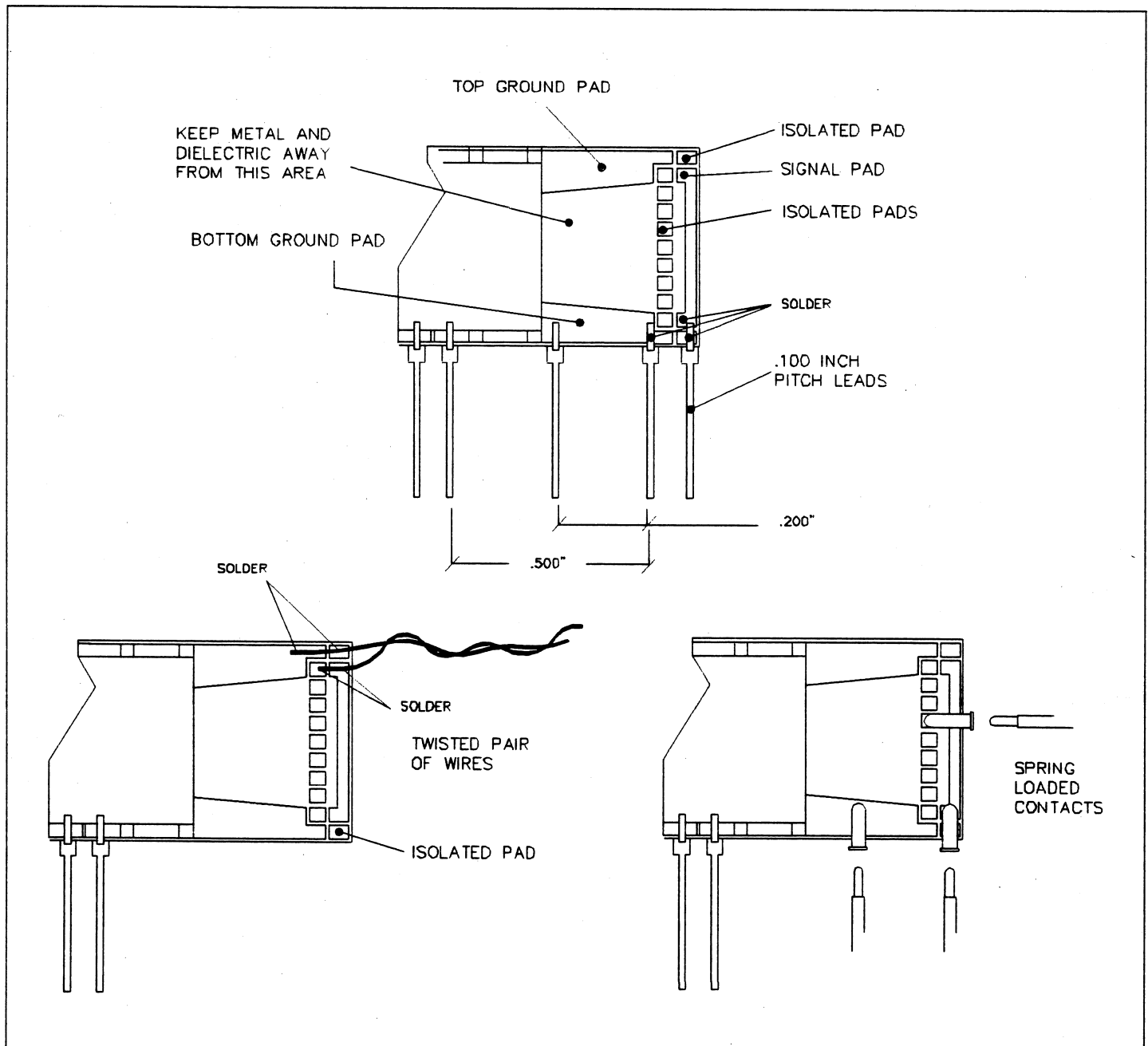


Figure 2. Signal, ground and isolated pad locations.

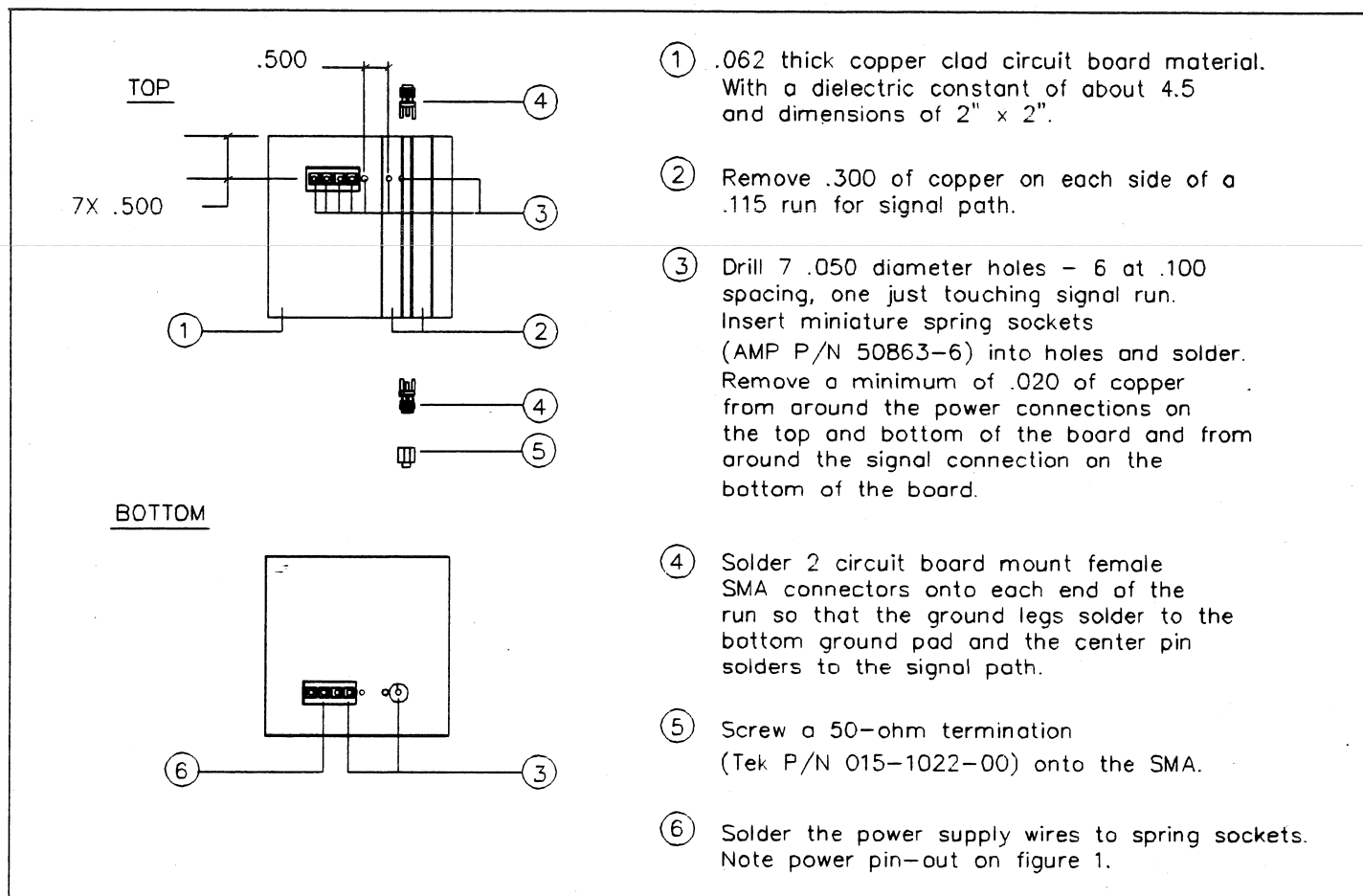


Figure 3. Test Verification Circuit.

Power Supply

Two power connector alternatives are available:

1) The five standard pre-mounted leads can be plugged directly into the circuit board. This is the recommended configuration (Refer to Figure 1 for pin outs of the A6501). For optimum amplifier performance, power supply specifications should meet or exceed those listed in the "Specifications" section.

2) A 2 X 3 female power connector, (Optional Accessory) can be soldered to the amplifier. Figure 1 illustrates how the power connector is soldered to the buffer amplifier. This connector will allow the buffer amplifier to obtain power through:

- A wall-mount power supply with a cable that connects directly to the amplifier. (Tektronix Part Number 119-2461-00.)
- The Tektronix 1102 power supply, capable of powering up to four amplifiers, and power cable (Tektronix Part Number 174-0943-00.)
- Any other power source (+5V, -5V, +15V, -15V) through the mating 2 x 3 male power connector (Tektronix Part number 131-3941-00.) For proper amplifier performance, power supply specifications should meet or exceed those specifications listed in the "Specifications" section.

Up to 33 amplifiers can obtain power from the following Power-One Inc. Power Supplies: HBB5 -3/0 VP-A (for ± 5 Volts) and HBB -15/A (for ± 15 Volts). The 15 volt Power One supply must be adjusted to 15 volts before connecting the supply to the amplifier (phone 1-800-235-5943).

When using the power connectors on the A6501, be certain that the buffer amplifier's power connector and the power supply connector are properly aligned (refer to Figure 1). Do not power up the amplifier until the connectors are properly installed. Both supplies should be powered simultaneously.

CAUTION

Damage to the amplifier or power supply will result if power supply connectors are installed inverted or misaligned. Make certain that all connectors are installed properly before applying power to the amplifier.

When using the power connector, the standard pre-mounted leads can be used to mechanically mount the amplifier to the circuit board if they are carefully soldered into ISOLATED feedthroughs. See "Mechanical Mounting of the Buffer Amplifier" for more information.

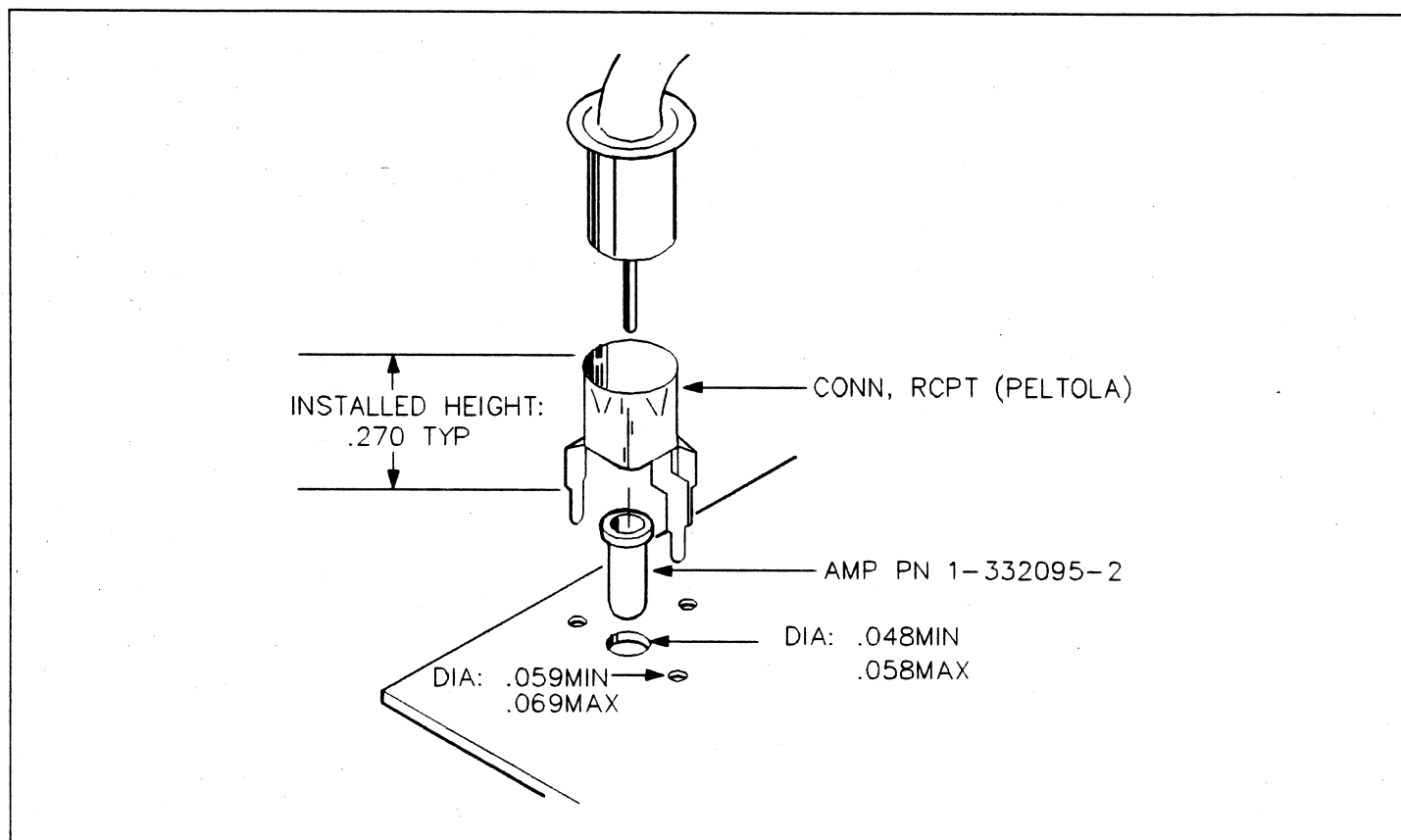


Figure 4. Peltola to Circuit Board Adapter.

Input Connectors

The signal pad on the A6501 buffer amplifier allows for a wide variety of input signal configurations. Available methods for connecting input signals to the buffer amplifier include spring contact tips, twisted pair of wires, coaxial cable, and 0.100-inch-pitch leads.

To preserve the high performance of the buffer amplifier, refer to the "Application Notes" section on how different input configurations affect the performance of the buffer amplifier.

Mounting of Input Signal And Ground Connectors

Figure 2 illustrates the locations for soldering the signal and ground leads to the buffer amplifier. The electrically isolated pads are to be used for additional support for spring loaded contact sockets. **Be sure to remove the protective coating with a soft pencil eraser before soldering to the silver conductors on the alumina substrate.**

It is important to keep metal away from the front of the amplifier to maintain its low input capacitance. If the A6501 is mounted on its side, keep the ground plane away from the input of the amplifier. (See Figure 2.)

CAUTION

Do not extend any input connector or receptacle past the isolated pads, this will adversely affect the low frequency compensation of the buffer amplifier.

Mounting Spring-Loaded Contacts

Mount the spring-loaded contacts through a rigid plate material at least 0.375 inches (0.953 cm) thick so that the amplifier does not bear the mechanical load. Epoxy glass laminate is widely accepted for this application.

Mounting Of Output Connectors

Install one of the two output Peltola cables into the output connector of the buffer amplifier. Be sure the inner conductor of the cable is inserted into the receptacle on the ceramic hybrid.

The other end of the output Peltola cable can be connected to either a circuit board or BNC coaxial cable. A Peltola cable-to-circuit-board adapter is included with the A6501 (See Figure 4 for installation details) and a Peltola-cable-to BNC adapter (Tektronix Part Number 131-1315-01) is available as an optional accessory.

For applications where repeated connects and disconnects need to be made, a Peltola-cable-to-BNC adapter should be used to protect the Peltola cable from damage.

The output connector on the buffer amplifier is fragile. To avoid putting mechanical stresses on the output connector, mount the Peltola cable, with appropriate adapters, to a circuit board or any other solid object.

APPLICATION NOTES

The A6501 buffer amplifier offers high performance for a variety of applications. To obtain the best possible performance from the amplifier, care needs to be taken when connecting the input and the output to the A6501.

Effects Due To Lead Configurations

Long signal and ground leads will add distributed inductance and capacitance at the input to the buffer amplifier and also loads the device under test (DUT). These parasitic impedances will form a series resonant circuit at the input of the buffer amplifier. If the input signal contains significant frequency components at the resonating frequency of the parasitic circuit, the output waveform will become distorted. Shorter signal and ground leads will greatly reduce the parasitic impedances and improve performance of the buffer amplifier.

Signal Lead

The location of the signal lead on the signal pad of the buffer amplifier has little effect on the performance of the amplifier. Do not extend any part of the input connector or receptacle past the isolated pads, (refer to Figure 2) since this has adverse effects on the low-frequency compensation of the buffer amplifier.

Ground Lead

Optimum signal response is achieved when the ground lead is soldered to the bottom grounding strip. (Refer to Figure 2.) The integrated circuit and the input signal ground return are directly connected to the bottom grounding strip. The bottom ground strip provides the shortest ground lead length and best signal response in terms of bandwidth and risetime.

The top ground strip is connected to the bottom ground strip through the back metal shield. The path distance through the metal shield adds to the series ground inductance and reduces the bandwidth and risetime of the amplifier.

General Guidelines

The A6501 allows for many custom input configurations. Listed below are general guidelines for connecting inputs such as twisted pair, coax and spring-loaded contacts to the A6501. These guidelines are most important when input risetimes are about 1ns or less (bandwidth exceeding 350 MHz). For slower risetimes these guidelines are less important.

1. Use the shortest length possible for the input and ground leads.
2. If long input lengths are needed (greater than 1-1/2 inches (3.8 cm)) add approximately 30 Ω every inch (2.54 cm) along the length of the signal conductor line to reduce aberrations and dampen reflections.
3. Lowest aberrations and highest bandwidths can be achieved when the source impedance matches the characteristic impedance (Z_0) of the transmission line formed by the input and ground leads. If the source impedance is constant and is lower than the Z_0 , you can add a lumped resistance at the source (in series with the input lead) to match Z_0 .
4. When source impedances are smaller than the Z_0 of the transmission line formed by the input and ground leads, the amplifier will have an over-peaked response. For source impedances larger than Z_0 , the amplifier will have a slower risetime (lower bandwidth). These effects are important for lead lengths over 1/2 inch (1.27 cm).

Coaxial Cable

When a coaxial cable is used on the input of the buffer amplifier, a good response can be obtained when the source impedance equals the characteristic impedance of the coaxial cable. When these impedances can not be matched, coaxial cable is not recommended due to multiple reflections that occur at the input of the buffer amplifier and at the source. It is also difficult to add distributed resistance along the signal conductor for reducing aberrations.

Output Considerations

The A6501 buffer amplifier can drive a considerable length of output cable or stripline with negligible loss in bandwidth. For example, the A6501 is able to drive 84 inches (2.1 m) of high quality 50- Ω cable (Tek PN 012-0057-01) and maintain a bandwidth of 850 MHz. The shortest path possible between the buffer amplifier and the test equipment should be used to obtain the optimum performance.

Peltola Cable to Circuit Board Adapter

The Peltola-cable-to-circuit-board adapter enables the A6501 to drive a 50- Ω stripline on a circuit board. This adapter offers the best 50- Ω connection between the output cable and the 50- Ω stripline when it is mounted as illustrated in Figure 4. The Peltola-cable-to-circuit board adapter can also be mounted on the side opposite of the 50- Ω stripline. This mounting method produces an inductive connection and may distort the output signal.

Spring Loaded Contacts

The buffer amplifier with 0.100 inch (2.54 mm) spring loaded contacts can be expected to have the approximate performance specifications listed below. (Refer to Figure 2 for typical application.)

Setup

$R_{\text{source}} = 25 \Omega$, Source risetime $T_r \approx 100$ ps
Spring loaded contacts spaced apart by 1/8 inch (0.32 cm) Grounded on the bottom ground pad.
10-1/4 inch (26.0 cm) peltola output cable.

Specification

Input Capacitance: 3.5 pF
Bandwidth: ≈ 900 MHz
Risetime: ≈ 389 ps
Aberrations: $\approx 33\%$ p-p

$R_{\text{source}} = 25 \Omega$, Source risetime $T_r \approx 100$ ps
Spring loaded contacts spaced apart by 3/8 inch (0.95 cm). Grounded on the top ground pad.
10-1/4 inch (26.0 cm) peltola output cable.

Input Capacitance: 3.4pF
Bandwidth: ≈ 550 MHz
Risetime: ≈ 636 ps
Aberrations: $\approx 20\%$ p-p

In applications where shorter leads can be used, the 0.050 inch (1.27 mm) centers spring contacts [1/2 inch (1.27 cm) in length] are recommended. The spring contacts can be inserted directly into a 0.026 inch (0.66 mm) diameter socket (without the contact receptacle) to obtain shortest lengths for best performance. Approximate performance specifications follow:

Setup

$R_{\text{source}} = 25 \Omega$ Source risetime $T_r \approx 100$ ps.
Spring loaded contacts spaced apart by 1/4 inch (0.64 cm). Grounded on the bottom ground pad.
10-1/4 inch (26.0 cm) peltola output cable.

Specification

Input Capacitance: 3.5 pF
Bandwidth: ≈ 1 GHz
Risetime: ≈ 350 ps
Aberrations: $\approx 14\%$ p-p

0.100 Inch (2.54 mm) Pitch Leads

The 0.100 inch (2.54 mm) pitch leads offer the best performance possible due to the short leads for input and ground. Two ground leads should be used, as shown in Figure 2. The buffer amplifier with these leads can be expected to have the approximate performance specifications listed below.

Circuit board runs from the input source to the amplifier can be used. Longer runs (greater than 1-1/2 inches (3.8 cm) will degrade the performance of the amplifier. Aberrations can be reduced if distributed resistance is added in the signal lead. (See General Guideline 2.)

Setup:

$R_{\text{source}} = 25 \Omega$ Source risetime $T_r \sim 100$ ps.
Leads spaced apart 0.100 inches (2.54 mm) center to center.
10-1/4 inch (26.0 cm) peltola output cable.

Specification

Input Capacitance: 2.5 pF
Bandwidth: ≈ 1.0 GHz
Risetime: ≈ 350 ps
Aberrations: $\approx 14\%$ p-p

Twisted Pair of Wires

Performance of the amplifier will vary depending on the length of twisted pair used and the source impedance. (Refer to Figure 2 for a typical application.) The buffer amplifier with 4 inches (10.2 cm) of twisted pair can be expected to have the approximate performance specifications listed below.

Setup:

$R_{\text{source}} = 25 \Omega$, Source risetime $T_r \sim 100$ ps
4 inches (10.2 cm) of twisted pair with 30 Ω added every inch (2.54 cm) to the signal conductor line.
10-1/4 inch (26.0 cm) peltola output cable.

Specification

Input Capacitance: ≈ 8 pF
Bandwidth: ≈ 350 MHz
Risetime: ≈ 1 ns
Aberrations: $\approx 14\%$ p-p

MAINTENANCE

Static-Sensitive Components

Static discharge can damage any semiconductor component in this buffer amplifier. Use caution to avoid static discharge to the buffer amplifier.

Cleaning

Exterior dirt can be removed by using low-pressure air. Do not use solvents or strong chemical cleaners. Dirt remaining after using air may be removed with a swab dipped in a small amount of isopropyl alcohol.

CAUTION

Avoid the use of chemical cleaning agents which may damage the circuitry used in the amplifier, in particular, avoid chemicals which contain benzene, toluene, xylene, acetone, MEK, or similar solvents. Do not use abrasive cleaners.

Replaceable Parts

If the spring contacts show signs of wear, they can be easily removed by simply pulling the tip from the receptacle. Spring contact should be replaced with Tektronix supplied parts or Q.A. Technology 2500 Series spring contacts. Refer to the Replaceable Parts List (page 9).

Amplifiers not functioning properly should be repackaged in the original shipping materials and returned to Tektronix, Inc. or to a Tektronix Service Center.

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-	-----		1	A6501 AMPLIFIER		
				STANDARD ACCESSORIES		
	020-1722-00		1	ACCESSORY KIT:A6501	80009	020-1722-00
	-----		1	.CONN,RCPT,ELEC:CKT BD MT,3 PRONG		
	-----		3	.CONTACT,ELEC:PROBE SPRING		
				.(SEE OPTIONAL ACCESSORIES - 016-0946-00)		
	-----		1	.TERMINAL PIN:0.071 X 0.051 X 0.01,PHOSPHOR		
				.BRONZE,TIN PLATED		
	-----		1	.SOCKET,PIN TERM:U/W 0.019 DIA PINS		
	-----		3	.SKT,PL-IN ELEK:SIGNAL RCPT,ELEC		
				.(SEE OPTIONAL ACCESSORIES - 016-0946-00)		
	-----		3	.SKT,PLG-IN ELEK:AMP,MINIATURE,GOLD SPRING		
	-----		1	.CABLE ASSY,RF:50 OHM COAX,10.25 L,9-N		
	-----		1	.CABLE ASSY,RF:50 OHM COAX,3.75 L,6-1		
	070-7308-00		1	SHEET,TECHNICAL:INSTRUCTION,A6501	80009	070-7308-00
				OPTIONAL ACCESSORIES		
	016-0946-00		1	ACCESS KIT,SIG:PROBE RCPT,SPR PROBE,10 EA	80009	016-0946-00
	020-1722-00		1	ACCESSORY KIT:A6501	80009	020-1722-00
	119-2461-00		1	POWER SUPPLY:5V,3.8A OUT,110V INP	80009	119-2461-00
	131-1315-01		1	CONN,RCPT,ELEC:BNC,FEMALE	80009	131-1315-01
	-----		1	1102 POWER SUPPLY		
	131-3821-01		1	CONN,RCPT,ELEC:POWER,2 X 3.0.05 SPACING <i>Female</i>	80009	131-3821-01
	131-3941-00		1	CONN,RCPT,ELEC:2 X 3,PWR,MALE,0.05 CTR	71468	MTN21-6PS-1
	174-0943-00		1	CA ASSY,SP,ELEC:6,26 AWG,1.5M L	80009	174-0943-00

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTUER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
71468	ITT CONNON DIV OF ITT CORP	666 E DYER RD	SANTA ANA CA 92702
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001
TK2176	Q A TECHNOLOGY CO INC	4 MERRILL INDUSTRIAL DR	HAMPTON NH 03842