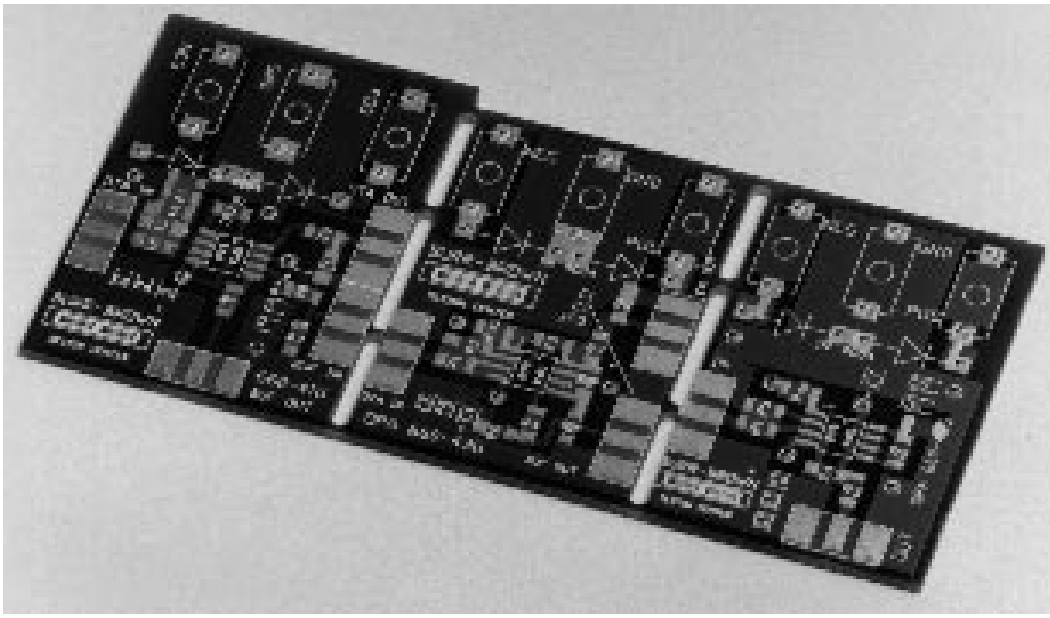
BURR - BROWN®

DEM-OPA660-4G EVALUATION FIXTURE



FEATURES

- EASY AND FAST PERFORMANCE TESTING
- SHOWS OPTIMIZED BOARD LAYOUT
- REPLACES SELF-MADE BOARDS

APPLICATIONS

- COMPONENTS INCOME CONTROL
- PERFORMANCE CHECKS
- CIRCUIT DESIGNS

DESCRIPTION

The unassembled demo board DEM-OPA660-4G contains three different configurations of the OPA660 building blocks OTA and buffer stage: the Diamond Transistor and Buffer (DEM-OPA660-41G), the Current-Feedback Amplifier (DEM-OPA660-42G), and the Direct-Feedback Amplifier (DEM-OPA660-43G). It is designed for engineers who want to test the various possibilities of the OPA660AU for themselves.

The board can be easily broken into three parts to design custom circuits as required by the particular application. For more information about applications with OPA660, please refer to the application notes AN-179 “Video Operational Amplifier,” AN-180 “Ultra High-Speed ICs,” and AN-181 “Diamond Transistor OPA660,” as well as the OPA660 data sheet.

Unlike the DEM-OPA660-1GC to -3GC, which are assembled and tested versions of the individual configurations in DIL packaging, the DEM-OPA660-4G offers the three circuits for the SO package. An unassembled DIP version of the configurations is available under the part number DEM-OPA660-5G.

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 LI-418 Printed in U.S.A. December, 1992

TEST FIXTURE: DIAMOND TRANSISTOR AND BUFFER

Description

This printed circuit board allows easy and fast performance testing of the OPA660AU building blocks OTA and buffer stage. The voltage-controlled current source or Operational Transconductance Amplifier (OTA) can be viewed as an "ideal" transistor. Like a transistor, it has three terminals: a high-impedance input (base), a low-impedance input/output (emitter), and the complementary current source or sink (collector). The OTA, however, is self-biased and bipolar. The transconductance of the OTA and the buffer amplifier can be adjusted by the external resistor R_{QC}, allowing bandwidth, quiescent current, and gain trade-offs to be optimized.

The voltage buffer is an open-loop buffer with gain slightly less than unity, which is ideal for interstage buffering. Figure 1 shows the schematic diagram of the board layout and the recommended power supply bypassing. Figure 3 illustrates the OTA transfer characteristics vs input voltage and I_Q, and the performance curve Total Quiescent Current vs R_{QC} shown in Figure 2 defines the resistor value for a certain I_Q.

RECOMMENDED COMPONENT VALUES

GAIN	R_1	R_4	R_6	R_7	I_Q	R_{QC}
1	100Ω	200Ω	25Ω	50Ω	20mA	250Ω
2	100Ω	51Ω	75Ω	50Ω	20mA	250Ω
10	100Ω	51Ω	475Ω	50Ω	20mA	250Ω

The low-frequency gain of a common emitter amplifier is determined by the following equation:

$$G = \frac{R_L}{\left(R_4 + \frac{1}{gm}\right)} \sim \frac{R_L}{R_4}$$

$$\text{where } R_L = R_2 + R_3$$

TEST FIXTURE: CURRENT-FEEDBACK AMPLIFIER

Description

When the OTA and buffer sections are combined, these sections of the OPA660 can be interconnected in a current-feedback amplifier configuration. Current-feedback amplifi-

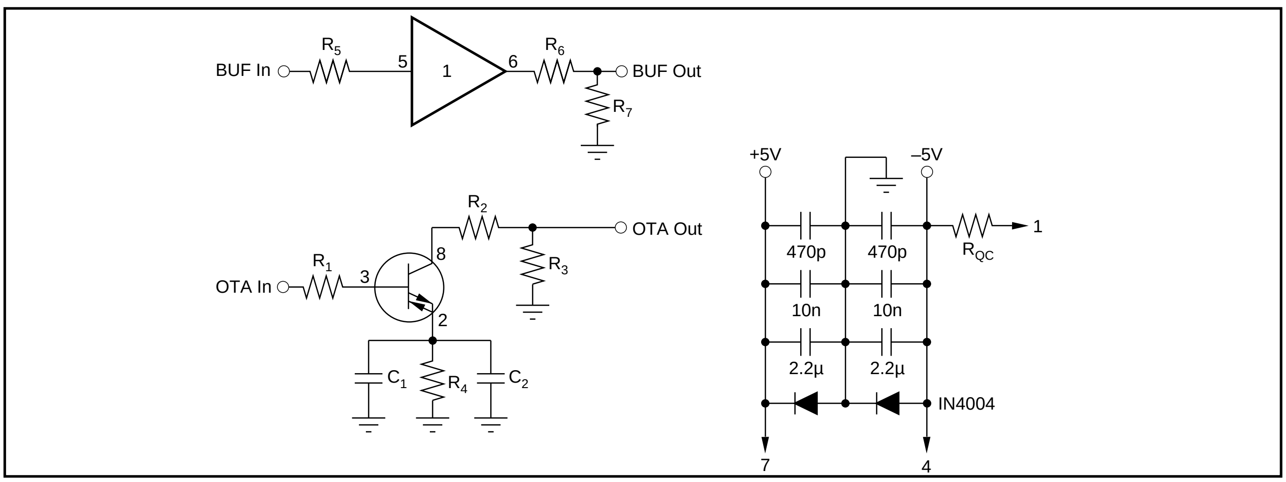

FIGURE 1. Block Diagram of the Test Fixture's Diamond Transistor and Buffer.

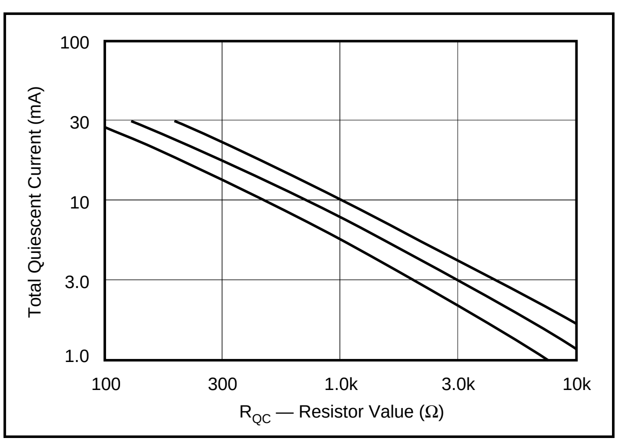

FIGURE 2. Total Quiescent Current vs R_{QC} of the Diamond Transistor and Buffer.

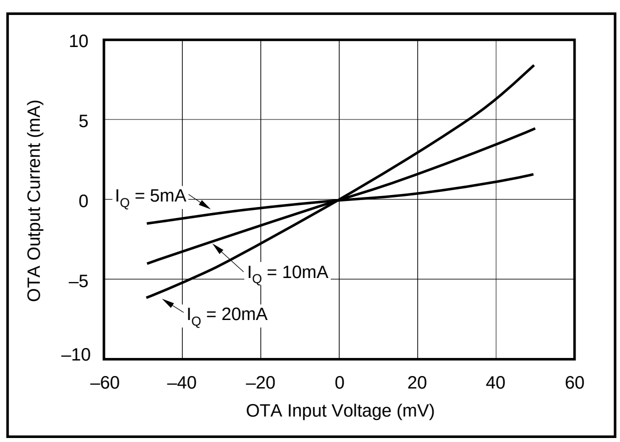

FIGURE 3. OTA Transfer Characteristics.

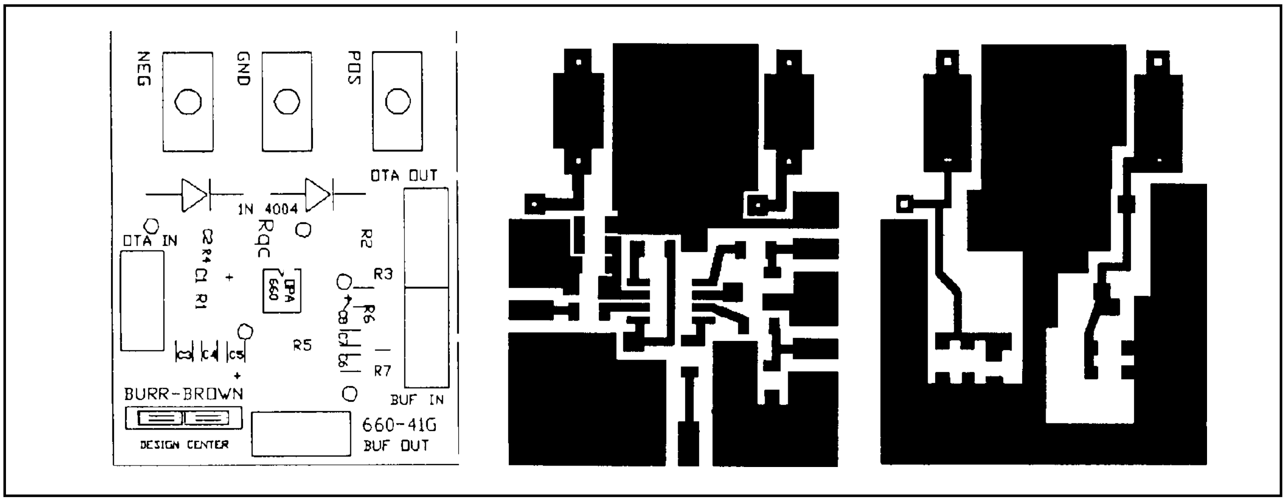

FIGURE 4. Silk Screen and Board Layouts of the Diamond Transistor and Buffer.

ers have nearly constant bandwidth for varying closed-loop gains. The reason is that the user can adjust the open-loop gain of the current-feedback amplifier by changing the feedback network, without affecting the open-loop pole. Figure 5 shows the block diagram of the Current-Feedback Amplifier test fixture.

The low-frequency gain of a noninverting current-feedback amplifier is determined by the following equation:

$$G = 1 + \frac{R_4}{R_5}$$

The flat frequency response can be adjusted by changing the size of R_4. The size of R_4 determines the transconductance (gm) of the OTA and the open-loop gain of the amplifier.

RECOMMENDED COMPONENT VALUES

GAIN	R_1	R_2	R_4	R_5	I_Q	R_{QC}
1	150Ω	220Ω	300Ω	—	20mA	250Ω
2	150Ω	220Ω	270Ω	270Ω	20mA	250Ω
10	47Ω	56Ω	200Ω	22Ω	20mA	250Ω

The size of R_3 is equal to the characteristic impedance of the transmission line minus the output resistance of the amplifier. Figure 6 illustrates the silk screen and double-sided layout.

TEST FIXTURE: DIRECT-FEEDBACK AMPLIFIER

Description

The demo board layout allows easy and fast performance testing of the OPA660AU in the so-called Direct-Feedback Amplifier configuration. We named this structure Direct-Feedback Amplifier due to its short feedback loop across the complementary current mirror. The currents at the collector and emitter flow in the same direction. The output current of the OTA is noninverting. The additional current flowing from the collector across R_3 and through R_5 causes a voltage drop and counteracts the base-emitter voltage. The reduced voltage difference, however, causes reduced collector flow. It functions like double feedback, and the low-frequency gain is adjusted according to the following equation:

$$G = 1 + \frac{R_3}{2R_5}$$

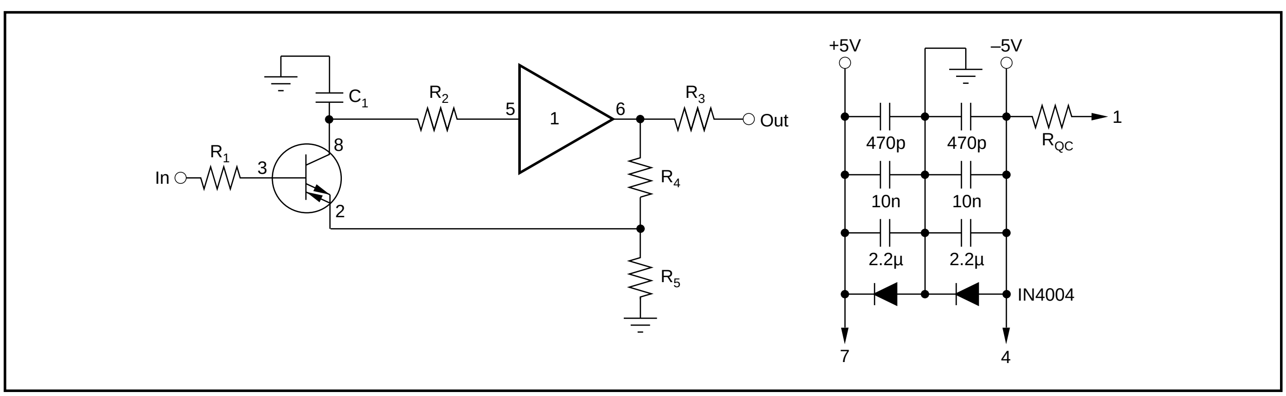

FIGURE 5. Block Diagram of the Test Fixture's Current-Feedback Amplifier.

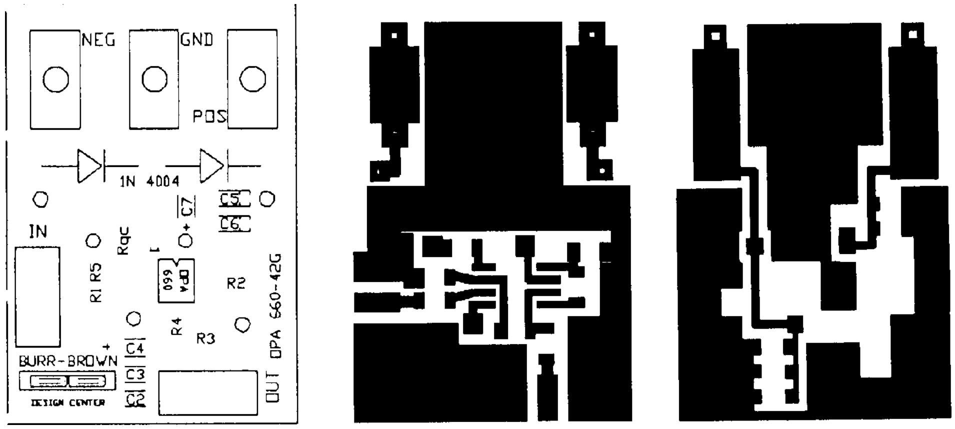

FIGURE 6. Silk Screen and Board Layouts of the Current-Feedback Amplifier.

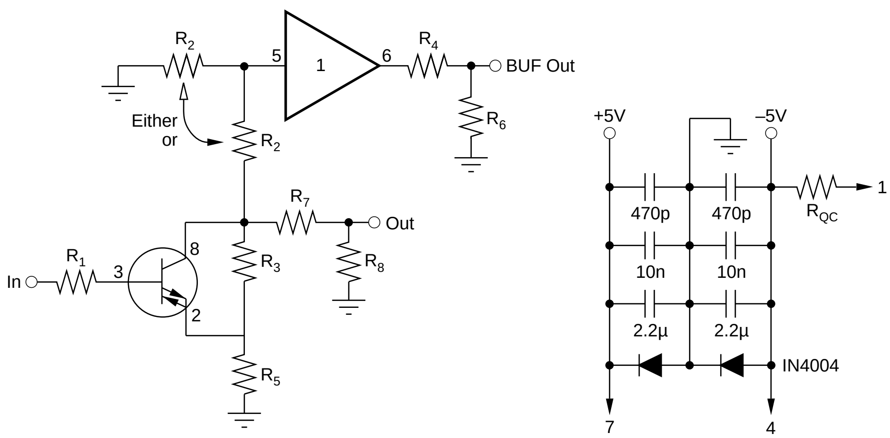

FIGURE 7. Block Diagram of the Test Fixture Direct-Feedback Amplifier.

Using an emitter compensation technique parallel to R_5, it is possible to achieve both excellent pulse responses and bandwidths of up to more than 500MHz at 1.4Vp-p output voltage. The RC combination parallel to R_5 increases the closed-loop gain at high frequencies. The PDS of the OPA660 shows an application circuit with gain of 3, as well as presenting a bandwidth diagram and small- and large-signal pulse responses.

The subsequent buffer amplifier decouples the relatively high-impedance collector when driving low-impedance load resistances. The board layout for the Direct-Feedback Amplifier configuration is illustrated in Figure 8.

APPLICATION INFORMATION

The OPA660 operates from ±5V power supplies (±6V maximum). Do not attempt to operate with larger power supply voltages, as permanent damage may occur.

The inputs of the OPA660 are protected by internal diode clamps. These protection diodes can safely, continuously conduct 10mA (30mA peak). If input voltages can exceed the power supply voltages by 0.7V, then the input signal current must be limited.

The buffer output is not current-limited or protected. If the output is shorted to ground, current of up to 60mA could flow. Momentary shorts to ground (a few seconds) should be avoided, but are unlikely to cause permanent damage. The same cautions apply to the OTA section when connected as a buffer.

BASIC CONNECTIONS

Figure 9 shows basic connections required for operation. Power supply bypass capacitors should be located as close as possible to the device pins. Solid tantalum capacitors are generally best. A resistor (25Ω to 200Ω) in series with the buffer and/or B input may help to reduce oscillations and peaking.

QUIESCENT CURRENT CONTROL PIN

The quiescent current of the OPA660 is set with the resistor R_Q connected from Pin 1 to $-V_{CC}$. It affects the operating currents of the buffer and OTA sections, thus controlling both the bandwidth and AC behavior and the transconductance of the OTA section.

R_{QC} = 250Ω sets approximately 20mA total quiescent current at 25°C. With a fixed 250Ω resistor, process variations could cause this current to vary from approximately 16mA to 26mA. It may be appropriate in some applications to trim this resistor to achieve the desired quiescent current or AC performance.

With a fixed R_{QC} resistor, the quiescent current increases with temperature (see typical performance curve, Quiescent Current vs Temperature). This variation of current with temperature holds the transconductance, gm, of the OTA relatively constant with temperature.

TEST CONFIGURATION

When testing the AC parameters of RF components, impedance matching is necessary at the input and output of the DUT. Double termination of the transmission cables between the signal and DUT and DUT and analyzer is the cleanest way to drive, since reflections are absorbed on both ends of the cable. The output resistance between the amplifier's output and the OUT socket should be equal to the characteristic impedance minus the output impedance of the amplifier. In turn, the input of the DUT should be terminated by the characteristic cable impedance. Figure 11 shows a typical test configuration.

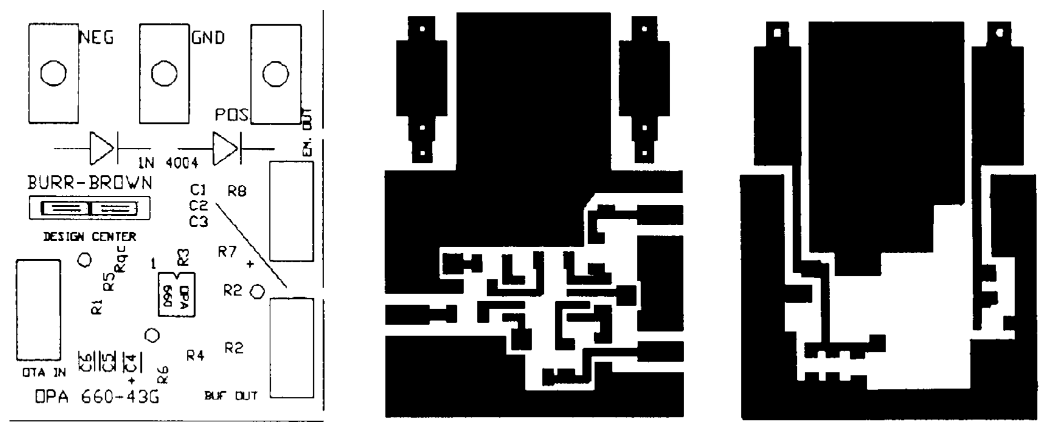

FIGURE 8. Silk Screen and Board Layouts of the Direct-Feedback Amplifier.

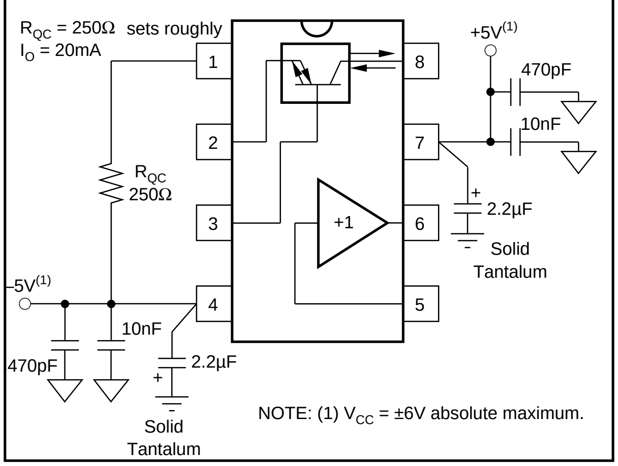

FIGURE 9. Basic Connections.

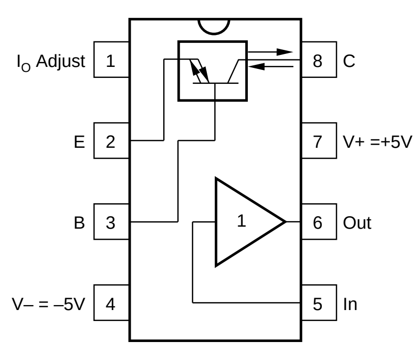

FIGURE 10. Pin Configuration.

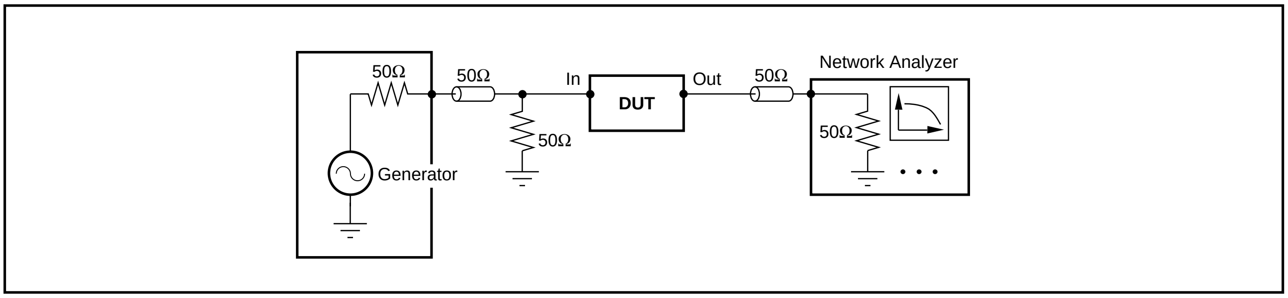

FIGURE 11. Test Configuration.

ABSOLUTE MAXIMUM RATINGS: OPA660AU

Power Supply Voltage	±6V
Input Voltage[(1)]	$\pm V_{CC}$, ±0.7V
Operating Temperature	–40°C to +85°C
Storage Temperature	–40°C to +125°C
Junction Temperature	+150°C
Lead Temperature (soldering,10s)	+300°C

NOTE: (1) Inputs are internally diode-clamped to $\pm V_{CC}$.

ORDERING INFORMATION

MODEL	DESCRIPTION	TEMPERATURE RANGE
DEM-OPA660-4G	Layouts for all applications using SO packages, unassembled	–25°C to +85°C