Rochester Electronics

# Datasheet

## CA3080A

*2MHz, Operational Transconductance Amplifier (OTA)*

The CA3080 and CA3080A types are GatabLe-Gain Blocks which utilize the unique operational transconductance amplifier (OTA) concept described in Application Note AN6668, “Applications of the CA3080 and CA3080A High-Performance Operational Transconductance Amplifiers”.

The CA3080 and CA3080A types have differential input and a single-ended, push-pull, class A output. In addition, these types have an amplifier bias input which may be used either for gating or for linear gain control. These types also have a high output impedance and their transconductance ($g_M$) is directly proportional to the amplifier bias current ($I_{ABC}$).

### Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All re-creations are done with the approval of the Original Component Manufacturer (OCM).

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceeds the OCM data sheet.

### Quality Overview

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-35835
  - Class Q Military
  - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
  - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

*The original manufacturer’s datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OCM specifications. ‘Typical’ values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.*

# CA3080, CA3080A

HARRIS SEMICONDUCTOR

## 2MHz, Operational Transconductance Amplifier (OTA)

November 1996

### Features

- **Slew Rate (Unity Gain, Compensated)........ 50V/µs**
- **Adjustable Power Consumption ......... 10µW to 30µW**
- **Flexible Supply Voltage Range .......... ±2V to ±15V**
- **Fully Adjustable Gain .............. 0 to $g_M R_L$ Limit**
- **Tight $g_M$ Spread:**
  - **CA3080 ................................. 2:1**
  - **CA3080A ............................... 1.6:1**
- **Extended $g_M$ Linearity .................. 3 Decades**

### Applications

- **Sample and Hold**
- **Multiplexer**
- **Voltage Follower**
- **Multiplier**
- **Comparator**

### Ordering Information

| PART NUMBER (BRAND) | TEMP. RANGE (°C) | PACKAGE | PKG. NO. |
|---|---|---|---|
| CA3080 | 0 to 70 | 8 Pin Metal Can | T8.C |
| CA3080A | -55 to 125 | 8 Pin Metal Can | T8.C |
| CA3080AE | -55 to 125 | 8 Ld PDIP | E8.3 |
| CA3080AM (3080A) | -55 to 125 | 8 Ld SOIC | M8.15 |
| CA3080AM96 (3080A) | -55 to 125 | 8 Ld SOIC Tape and Reel | M8.15 |
| CA3080E | 0 to 70 | 8 Ld PDIP | E8.3 |
| CA3080M (3080) | 0 to 70 | 8 Ld SOIC | M8.15 |
| CA3080M96 (3080) | 0 to 70 | 8 Ld SOIC Tape and Reel | M8.15 |

### Description

The CA3080 and CA3080A types are Gatable-Gain Blocks which utilize the unique operational-transconductance-amplifier (OTA) concept described in Application Note AN6668, "Applications of the CA3080 and CA3080A High-Performance Operational Transconductance Amplifiers".

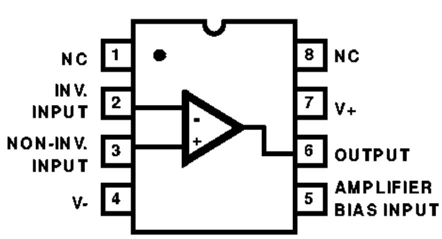
The CA3080 and CA3080A types have differential input and a single-ended, push-pull, class A output. In addition, these types have an amplifier bias input which may be used either for gating or for linear gain control. These types also have a high output impedance and their transconductance ($g_M$) is directly proportional to the amplifier bias current ($I_{ABC}$).

The CA3080 and CA3080A types are notable for their excellent slew rate (50V/µs), which makes them especially useful for multiplexer and fast unity-gain voltage followers. These types are especially applicable for multiplexer applications because power is consumed only when the devices are in the "ON" channel state.

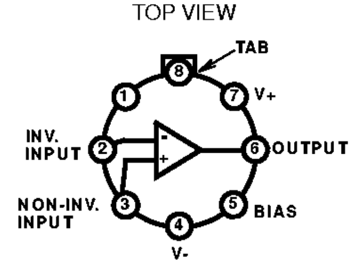
The CA3080A's characteristics are specifically controlled for applications such as sample-hold, gain-control, multiplexing, etc.

### Pinouts

**CA3080**
**(PDIP, SOIC)**
TOP VIEW




**CA3080**
**(METAL CAN)**
TOP VIEW




NOTE: Pin 4 is connected to case.

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.



File Number **475.3**

### Absolute Maximum Ratings

Supply Voltage (Between V+ and V- Terminal) . . . . . . . . . . . . . . 36V
Differential Input Voltage . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5V
Input Voltage . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . V+ to V-
Input Signal Current . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1mA
Amplifier Bias Current ($I_{ABC}$) . . . . . . . . . . . . . . . . . . . . . . . . . . 2mA
Output Short Circuit Duration (Note 1) . . . . . . . . . . . . No Limitation

### Operating Conditions

Temperature Range
CA3080 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0°C to 70°C
CA3080A . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . -55°C to 125°C

### Thermal Information

| Thermal Resistance (Typical, Note 2) | $\theta_{JA}$ (°C/W) | $\theta_{JC}$ (°C/W) |
|---|---|---|
| PDIP Package | 130 | N/A |
| SOIC Package | 170 | N/A |
| Metal Can Package | 200 | 120 |

Maximum Junction Temperature (Metal Can) . . . . . . . . . . . . . 175°C
Maximum Junction Temperature (Plastic Package) . . . . . . . 150°C
Maximum Storage Temperature Range . . . . . . . . . -65°C to 150°C
Maximum Lead Temperature (Soldering 10s) . . . . . . . . . . . . 300°C
(SOIC - Lead Tips Only)

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

NOTES:

1. Short circuit may be applied to ground or to either supply.
2. $\theta_{JA}$ is measured with the component mounted on an evaluation PC board in free air.

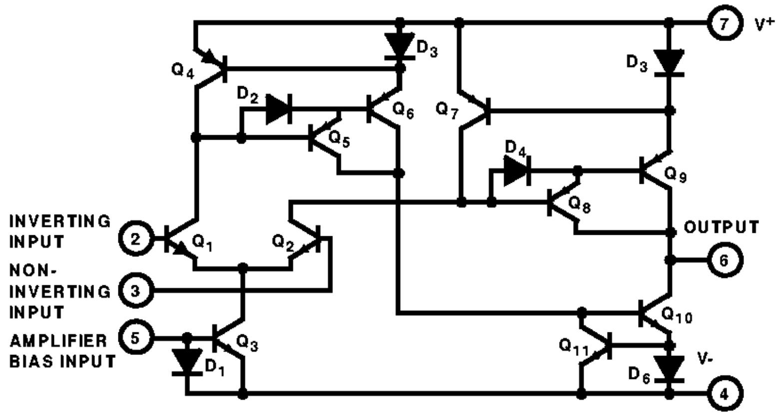
**Electrical Specifications** For Equipment Design, $V_{SUPPLY}$ = ±15V, Unless Otherwise Specified

| PARAMETER | | TEST CONDITIONS | TEMP | CA3080 | | | CA3080A | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | | $I_{ABC}$ = 5μA | 25 | - | 0.3 | - | - | 0.3 | 2 | mV |
| | | $I_{ABC}$ = 500μA | 25 | - | 0.4 | 5 | - | 0.4 | 2 | mV |
| | | | Full | - | - | 6 | - | - | 5 | mV |
| Input Offset Voltage Change | | $I_{ABC}$ = 500μA to 5μA | 25 | - | 0.2 | - | - | 0.1 | 3 | mV |
| Input Offset Voltage Temp. Drift | | $I_{ABC}$ = 100μA | Full | - | - | - | - | 3.0 | - | μV/°C |
| Input Offset Voltage Sensitivity | Positive | $I_{ABC}$ = 500μA | 25 | - | - | 150 | - | - | 150 | μV/V |
| | Negative | | 25 | - | - | 150 | - | - | 150 | μV/V |
| Input Offset Current | | $I_{ABC}$ = 500μA | 25 | - | 0.12 | 0.6 | - | 0.12 | 0.6 | μA |
| Input Bias Current | | $I_{ABC}$ = 500μA | 25 | - | 2 | 5 | - | 2 | 5 | μA |
| | | | Full | - | - | 7 | - | - | 15 | μA |
| Differential Input Current | | $I_{ABC}$ = 0, $V_{DIFF}$ = 4V | 25 | - | 0.008 | - | - | 0.008 | 5 | nA |
| Amplifier Bias Voltage | | $I_{ABC}$ = 500μA | 25 | - | 0.71 | - | - | 0.71 | - | V |
| Input Resistance | | $I_{ABC}$ = 500μA | 25 | 10 | 26 | - | 10 | 26 | - | kΩ |
| Input Capacitance | | $I_{ABC}$ = 500μA, f = 1MHz | 25 | - | 3.6 | - | - | 3.6 | - | pF |
| Input-to-Output Capacitance | | $I_{ABC}$ = 500μA, f = 1MHz | 25 | - | 0.024 | - | - | 0.024 | - | pF |
| Common-Mode Input-Voltage Range | | $I_{ABC}$ = 500μA | 25 | 12 to -12 | 13.6 to -14.6 | - | 12 to -12 | 13.6 to -14.6 | - | V |
| Forward Transconductance (Large Signal) | | $I_{ABC}$ = 500μA | 25 | 6700 | 9600 | 13000 | 7700 | 9600 | 12000 | μS |
| | | | Full | 5400 | - | - | 4000 | - | - | μS |
| Output Capacitance | | $I_{ABC}$ = 500μA, f = 1MHz | 25 | - | 5.6 | - | - | 5.6 | - | pF |
| Output Resistance | | $I_{ABC}$ = 500μA | 25 | - | 15 | - | - | 15 | - | MΩ |
| Peak Output Current | | $I_{ABC}$ = 5μA, $R_L$ = 0Ω | 25 | - | 5 | - | 3 | 5 | 7 | μA |
| | | $I_{ABC}$ = 500μA, $R_L$ = 0Ω | 25 | 350 | 500 | 650 | 350 | 500 | 650 | μA |
| | | | Full | 300 | - | - | 300 | - | - | μA |

**Electrical Specifications** For Equipment Design, $V_{SUPPLY}$ = ±15V, Unless Otherwise Specified **(Continued)**

| PARAMETER | | TEST CONDITIONS | TEMP | CA3080 MIN | CA3080 TYP | CA3080 MAX | CA3080A MIN | CA3080A TYP | CA3080A MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|
| Peak Output Voltage | Positive | $I_{ABC}$ = 5µA, $R_L$ = ∞ | 25 | - | 13.8 | - | 12 | 13.8 | - | V |
| | Negative | | 25 | - | -14.5 | - | -12 | -14.5 | - | V |
| | Positive | $I_{ABC}$ = 500µA, $R_L$ = ∞ | 25 | 12 | 13.5 | - | 12 | 13.5 | - | V |
| | Negative | | 25 | -12 | -14.4 | - | -12 | -14.4 | - | V |
| Amplifier Supply Current | | $I_{ABC}$ = 500µA | 25 | 0.8 | 1 | 1.2 | 0.8 | 1 | 1.2 | mA |
| Device Dissipation | | $I_{ABC}$ = 500µA | 25 | 24 | 30 | 36 | 24 | 30 | 36 | mW |
| Magnitude of Leakage Current | | $I_{ABC}$ = 0, $V_{TP}$ = 0 | 25 | - | 0.08 | - | - | 0.08 | 5 | nA |
| | | $I_{ABC}$ = 0, $V_{TP}$ = 36V | 25 | - | 0.3 | - | - | 0.3 | 5 | nA |
| Propagation Delay | | $I_{ABC}$ = 500µA | 25 | - | 45 | - | - | 45 | - | ns |
| Common-Mode Rejection Ratio | | $I_{ABC}$ = 500µA | 25 | 80 | 110 | - | 80 | 110 | - | dB |
| Open-Loop Bandwidth | | $I_{ABC}$ = 500µA | 25 | - | 2 | - | - | 2 | - | MHz |
| Slew Rate | | Uncompensated | 25 | - | 75 | - | - | 75 | - | V/µs |
| | | Compensated | 25 | - | 50 | - | - | 50 | - | V/µs |

## Schematic Diagram




## Typical Applications

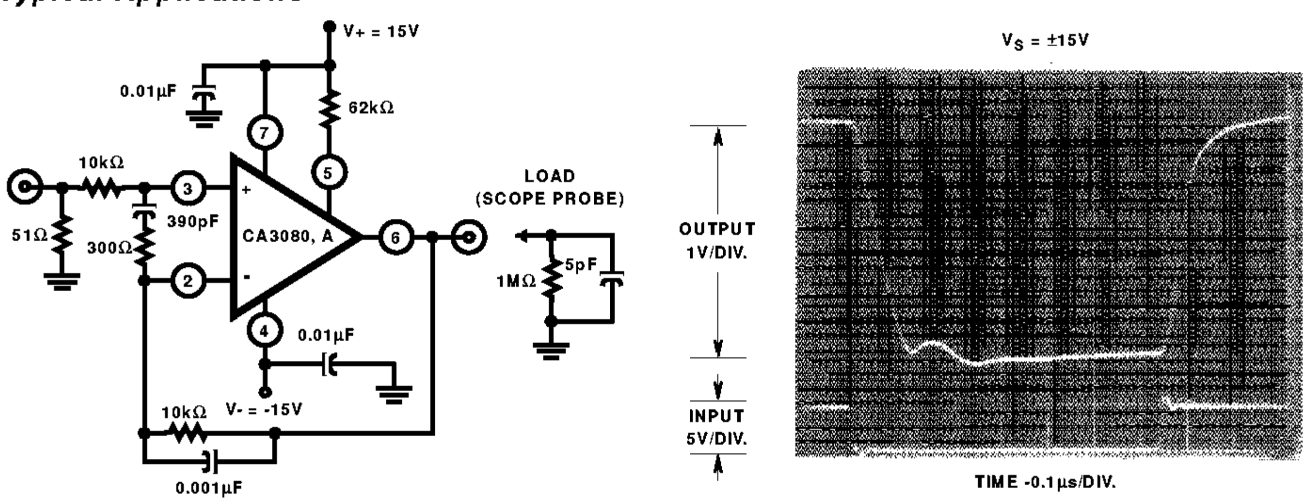



FIGURE 1. SCHEMATIC DIAGRAM OF THE CA3080 AND CA3080A IN A UNITY-GAIN VOLTAGE FOLLOWER CONFIGURATION AND ASSOCIATED WAVEFORM

## Typical Applications (Continued)

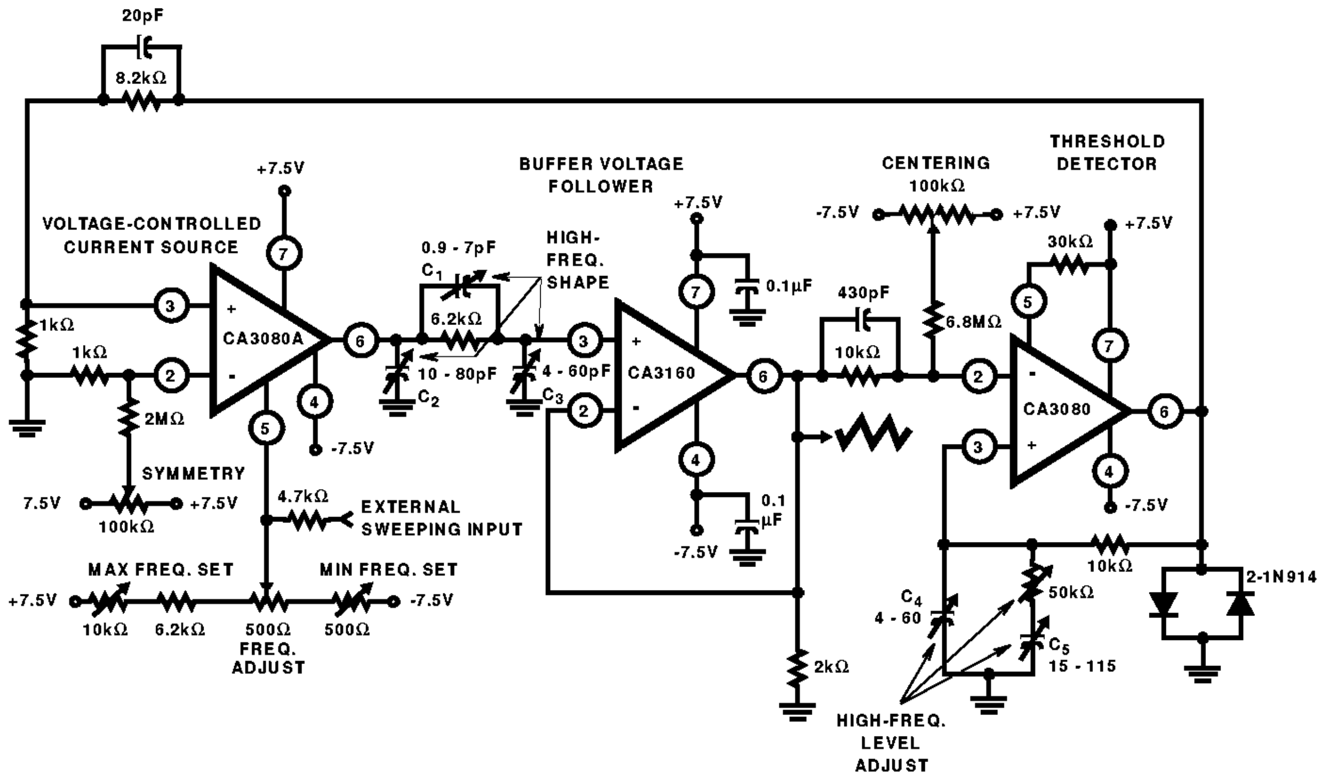
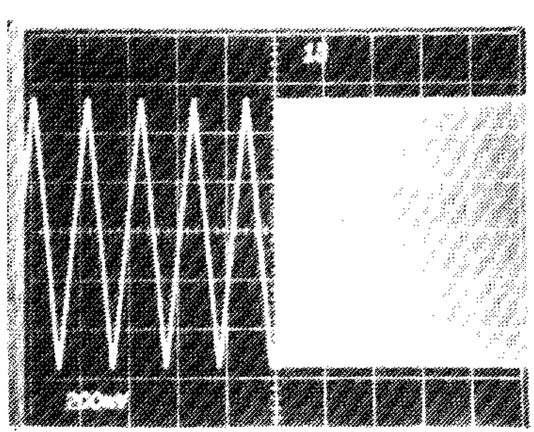
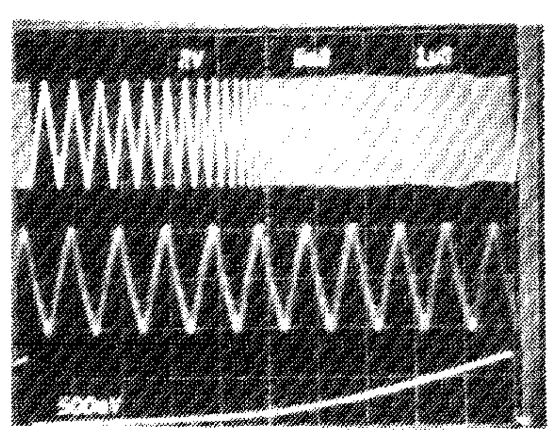



FIGURE 2. 1,000,000/1 SINGLE-CONTROL FUNCTION GENERATOR - 1MHz TO 1Hz



NOTE: A Square-Wave Signal Modulates The External Sweeping Input to Produce 1Hz and 1MHz, showing the 1,000,000/1 frequency range of the function generator.

FIGURE 3A. TWO-TONE OUTPUT SIGNAL FROM THE FUNCTION GENERATOR

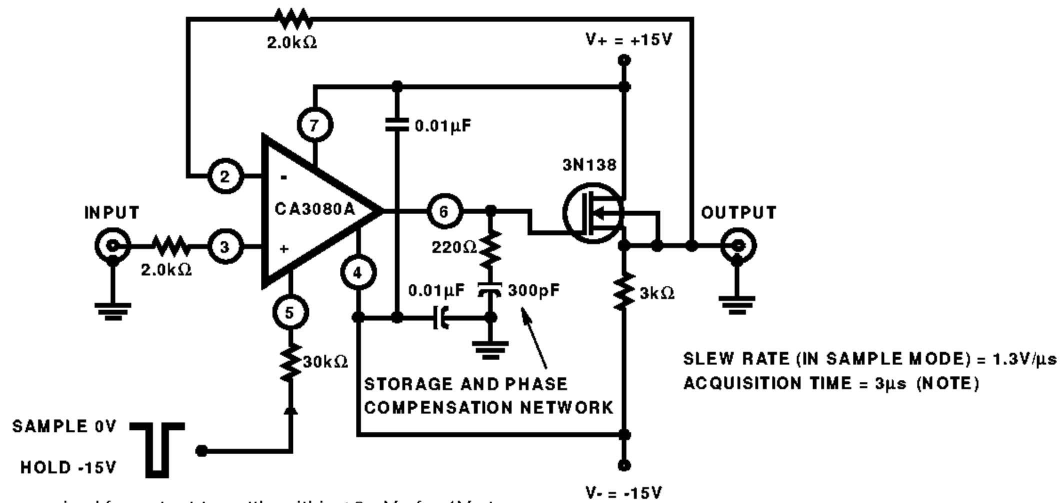


NOTE: The bottom trace is the sweeping signal and the top trace is the actual generator output. The center trace displays the 1MHz signal via delayed oscilloscope triggering of the upper swept output signal.

FIGURE 3B. TRIPLE-TRACE OF THE FUNCTION GENERATOR SWEEPING TO 1MHz

FIGURE 3. FUNCTION GENERATOR DYNAMIC CHARACTERISTICS WAVEFORMS

## Typical Applications (Continued)




NOTE: Time required for output to settle within ±3mV of a 4V step.

**FIGURE 4. SCHEMATIC DIAGRAM OF THE CA3080A IN A SAMPLE-HOLD CONFIGURATION**

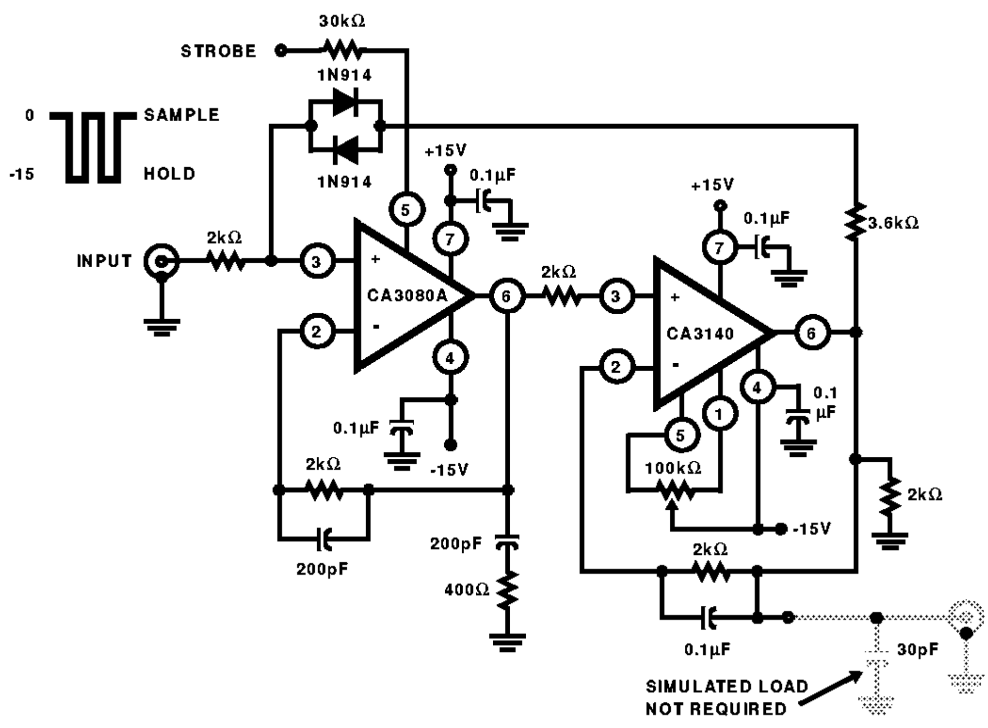
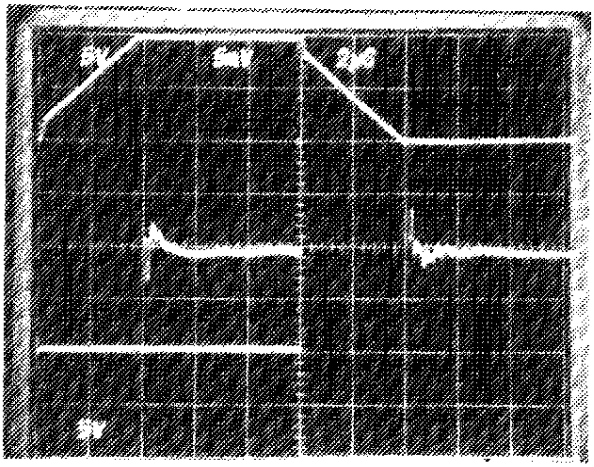



**FIGURE 5. SAMPLE AND HOLD CIRCUIT**

## *Typical Applications* (Continued)

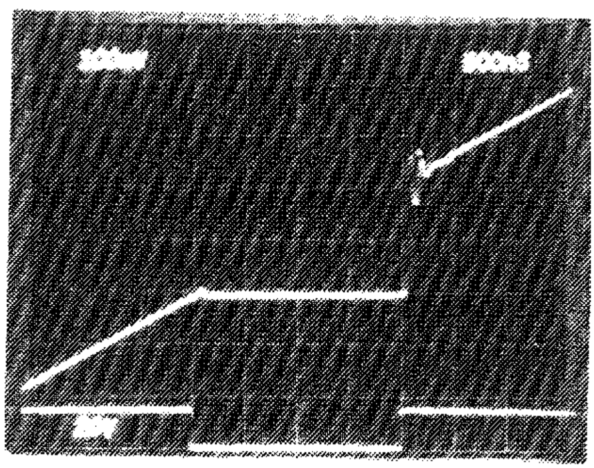


Top Trace: Output Signal
5V/Div., 2µs/Div.

Bottom Trace: Input Signal
5V/Div., 2µs/Div.

Center Trace: Difference of Input and Output Signals Through Tektronix Amplifier 7A13
5mV/Div., 2µs/Div.

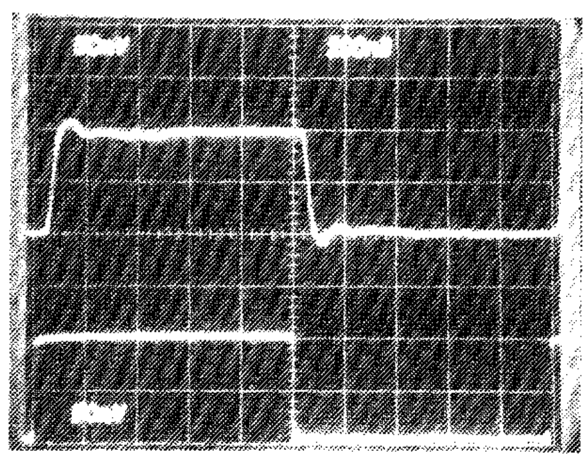
**FIGURE 6. LARGE SIGNAL RESPONSE AND SETTLING TIME FOR CIRCUIT SHOWN IN FIGURE 23**



Top Trace: System Output; 100mV/Div., 500ns/Div.

Bottom Trace: Sampling Signal; 20V/Div., 500ns/Div.

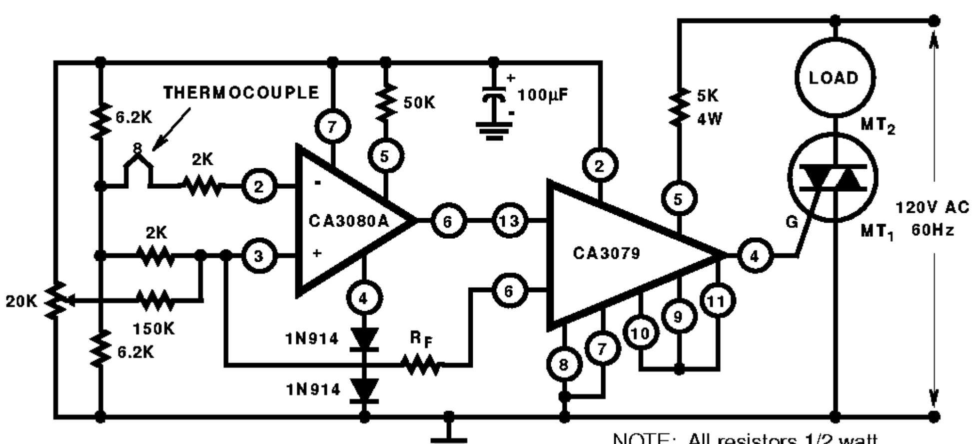
**FIGURE 7. SAMPLING RESPONSE FOR CIRCUIT SHOWN IN FIGURE 23**



Top Trace: Output; 50mV/Div., 200ns/Div.

Bottom Trace: Input; 50mV/Div., 200ns/Div.

**FIGURE 8. INPUT AND OUTPUT RESPONSE FOR CIRCUIT SHOWN IN FIGURE 23**




NOTE: All resistors 1/2 watt,
unless otherwise specified.

**FIGURE 9. THERMOCOUPLE TEMPERATURE CONTROL WITH CA3079 ZERO VOLTAGE SWITCH AS THE OUTPUT AMPLIFIER**

## Typical Applications (Continued)

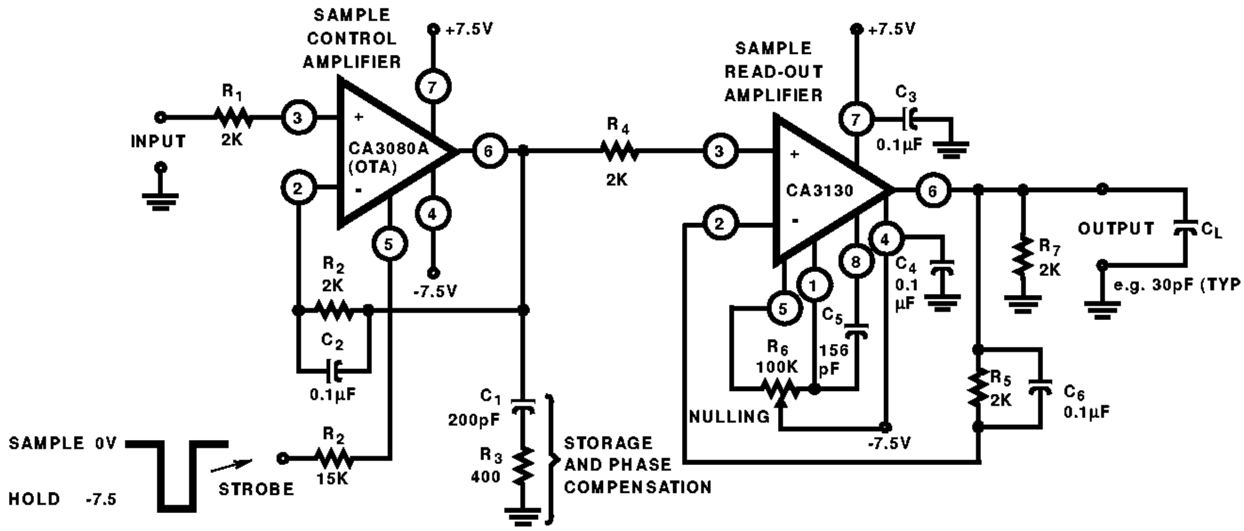
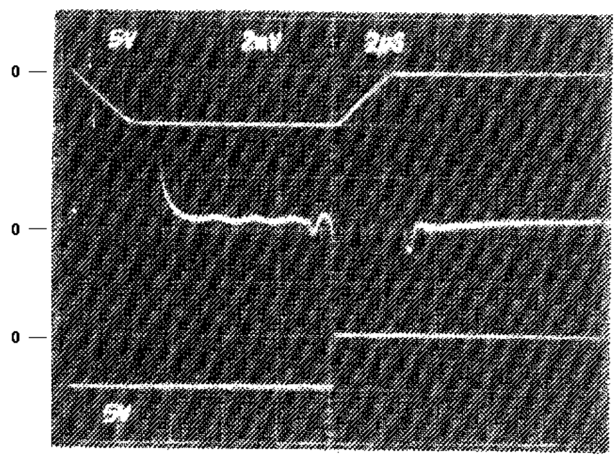
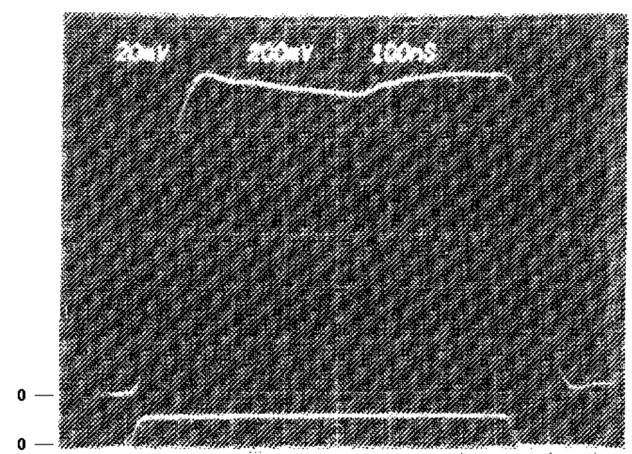



FIGURE 10. SCHEMATIC DIAGRAM OF THE CA3080A IN A SAMPLE-HOLD CIRCUIT WITH BIMOS OUTPUT AMPLIFIER




Top Trace: Output; 5V/Div., 2µs/Div.
Center Trace: Differential Comparison of Input and Output 2mV/Div., 2µs/Div.
Bottom Trace: Input; 5V/Div., 2µs/Div.

FIGURE 11. LARGE-SIGNAL RESPONSE FOR CIRCUIT SHOWN IN FIGURE 28




Top Trace: Output 20mV/Div., 100ns/Div.
Bottom Trace: Input 200mV/Div., 100ns/Div.

FIGURE 12. SMALL-SIGNAL RESPONSE FOR CIRCUIT SHOWN IN FIGURE 28

## Typical Applications (Continued)

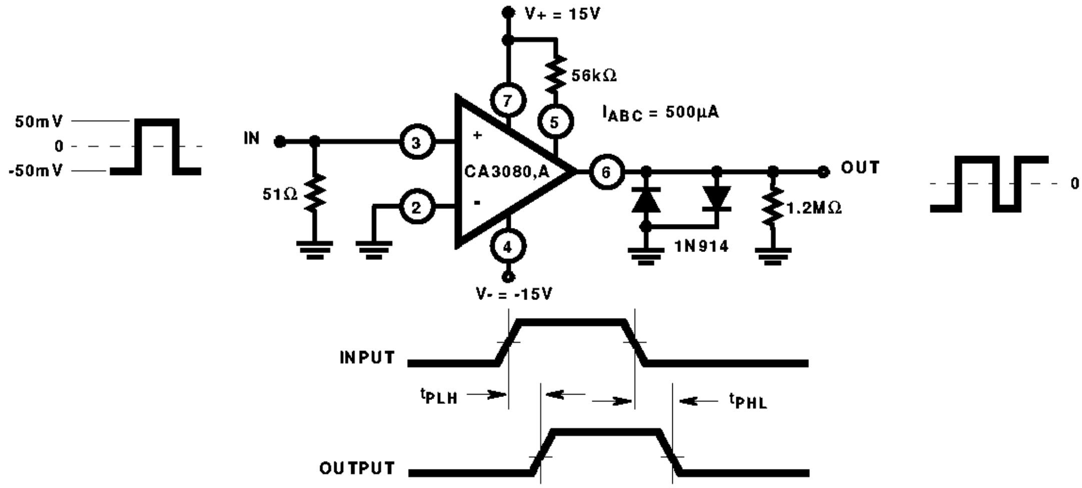



FIGURE 13. PROPAGATION DELAY TEST CIRCUIT AND ASSOCIATED WAVEFORMS

## Typical Performance Curves

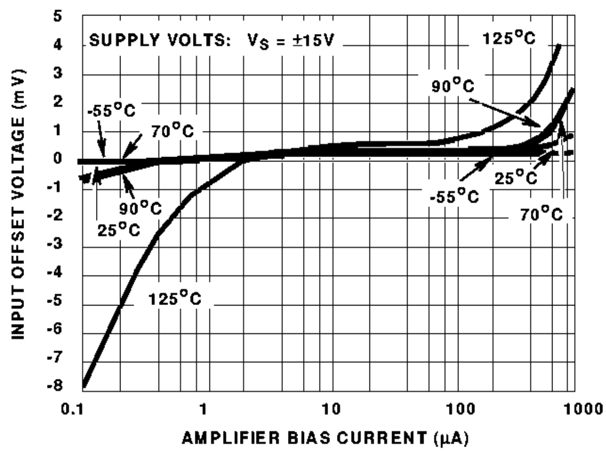



FIGURE 14. INPUT OFFSET VOLTAGE vs AMPLIFIER BIAS CURRENT

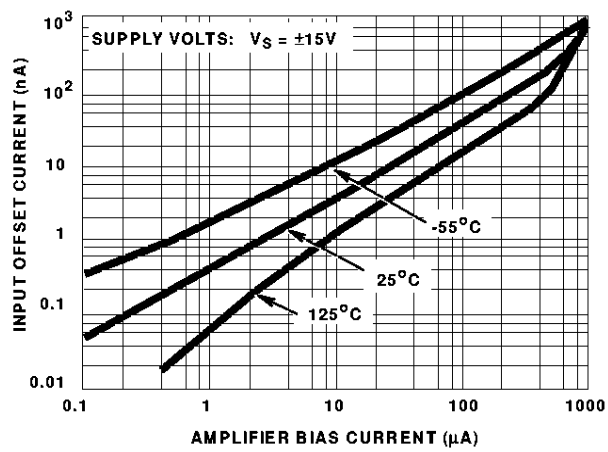



FIGURE 15. INPUT OFFSET CURRENT vs AMPLIFIER BIAS CURRENT

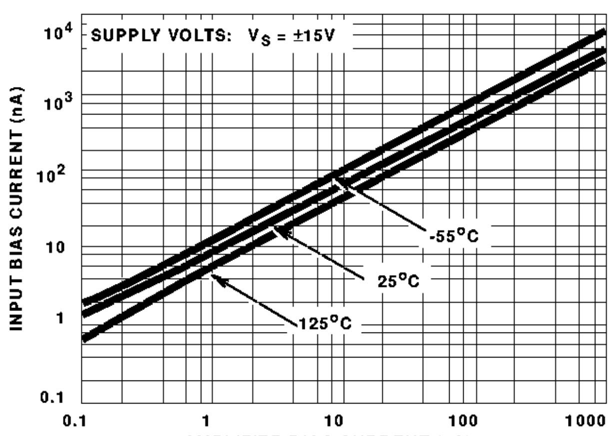



FIGURE 16. INPUT BIAS CURRENT vs AMPLIFIER BIAS CURRENT

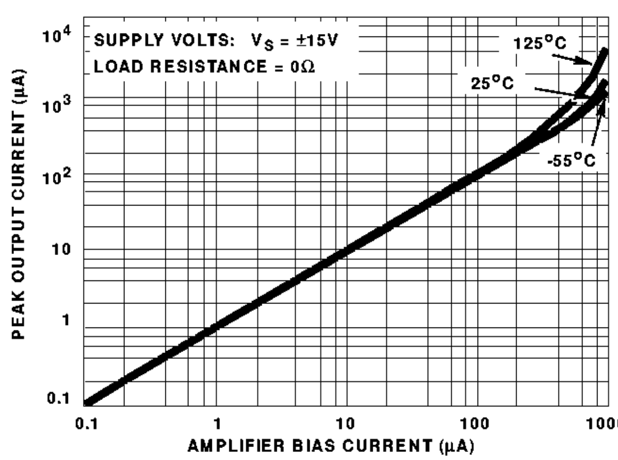



FIGURE 17. PEAK OUTPUT CURRENT vs AMPLIFIER BIAS CURRENT

## Typical Performance Curves (Continued)

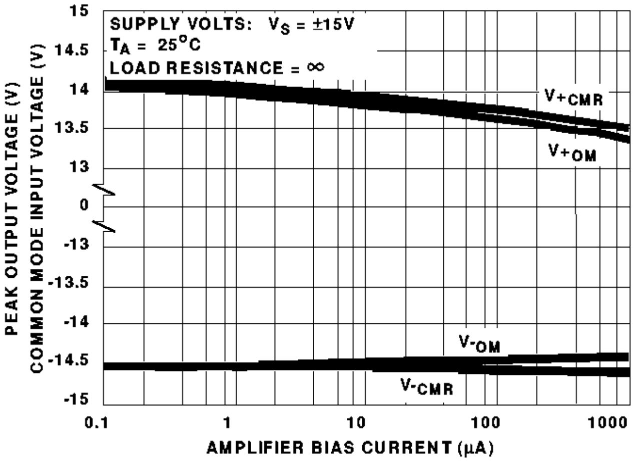



FIGURE 18. PEAK OUTPUT VOLTAGE vs AMPLIFIER BIAS CURRENT

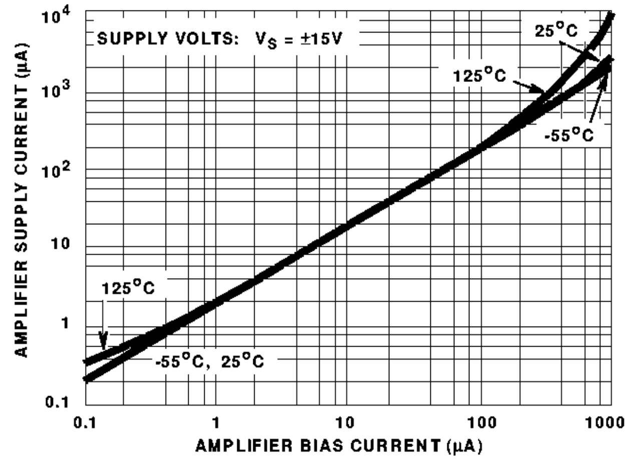



FIGURE 19. AMPLIFIER SUPPLY CURRENT vs AMPLIFIER BIAS CURRENT

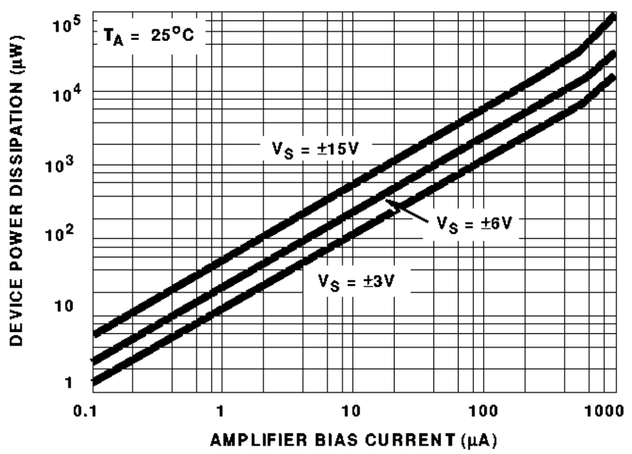



FIGURE 20. TOTAL POWER DISSIPATION vs AMPLIFIER BIAS CURRENT

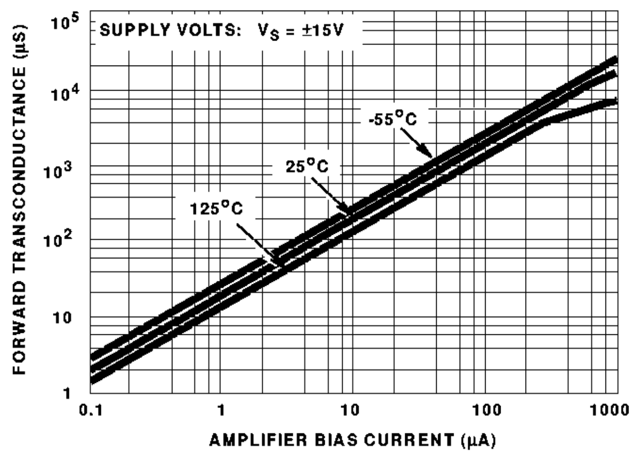



FIGURE 21. TRANSCONDUCTANCE vs AMPLIFIER BIAS CURRENT

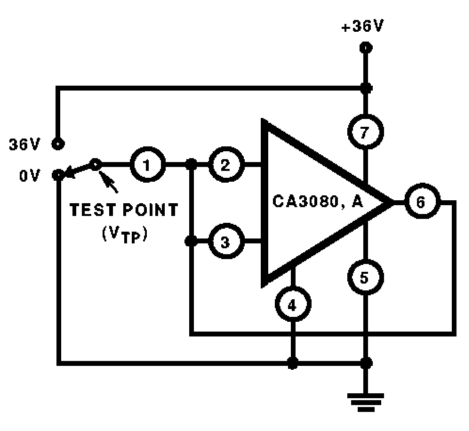



FIGURE 22. LEAKAGE CURRENT TEST CIRCUIT

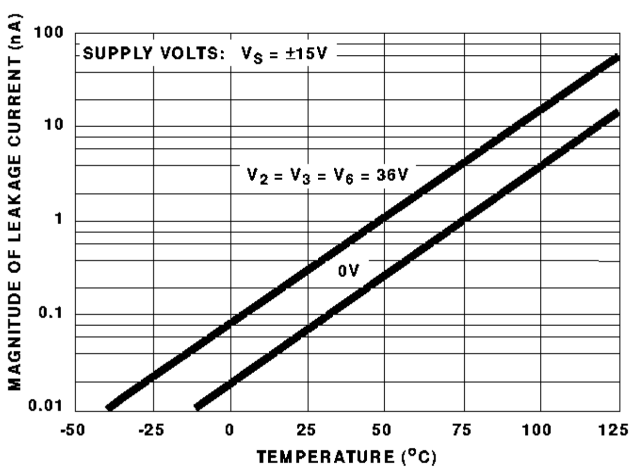



FIGURE 23. LEAKAGE CURRENT vs TEMPERATURE

## Typical Performance Curves (Continued)

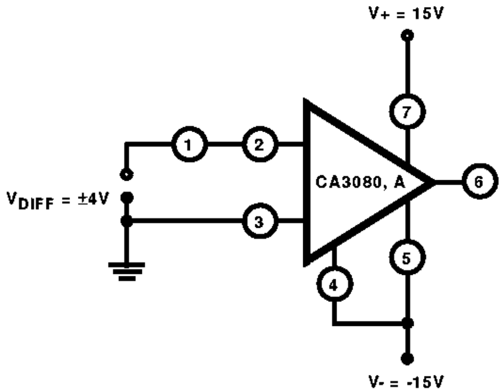



FIGURE 24. DIFFERENTIAL INPUT CURRENT TEST CIRCUIT

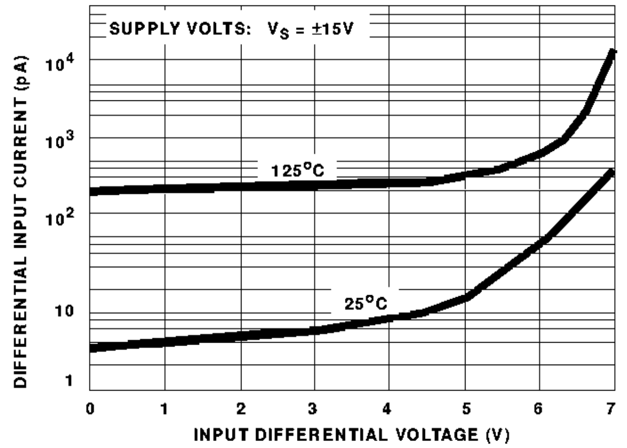



FIGURE 25. INPUT CURRENT vs INPUT DIFFERENTIAL VOLTAGE

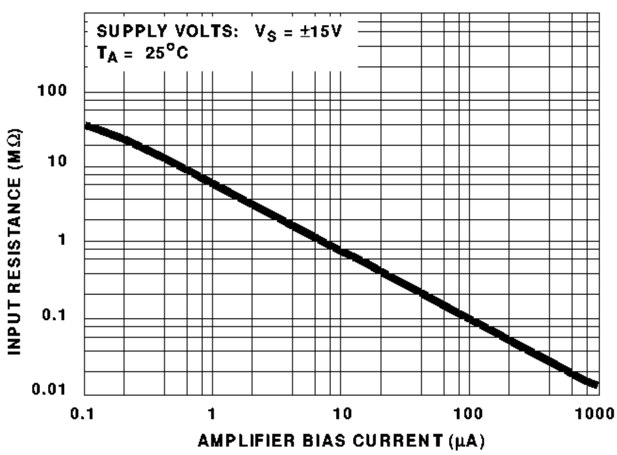



FIGURE 26. INPUT RESISTANCE vs AMPLIFIER BIAS CURRENT

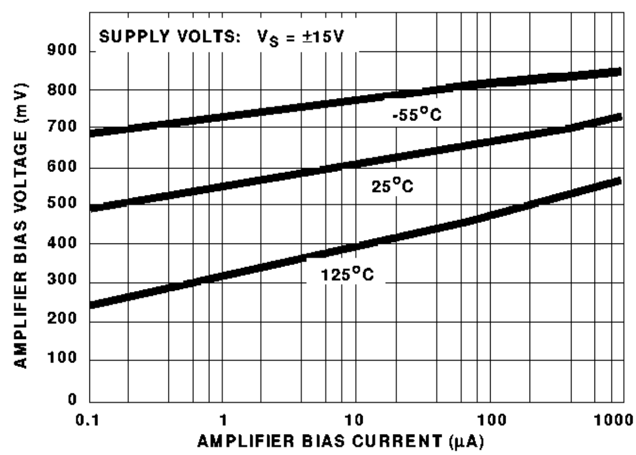



FIGURE 27. AMPLIFIER BIAS VOLTAGE vs AMPLIFIER BIAS CURRENT

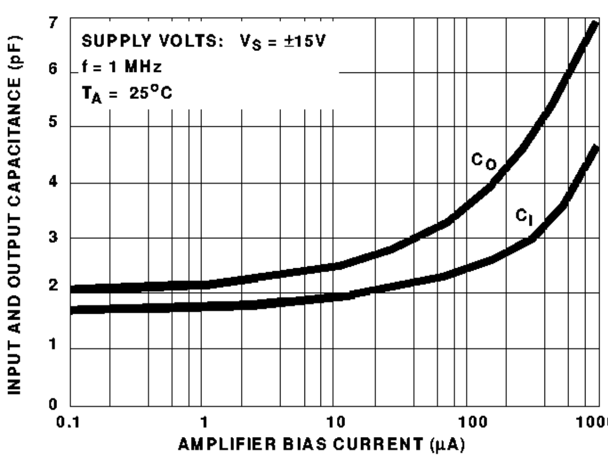



FIGURE 28. INPUT AND OUTPUT CAPACITANCE vs AMPLIFIER BIAS CURRENT

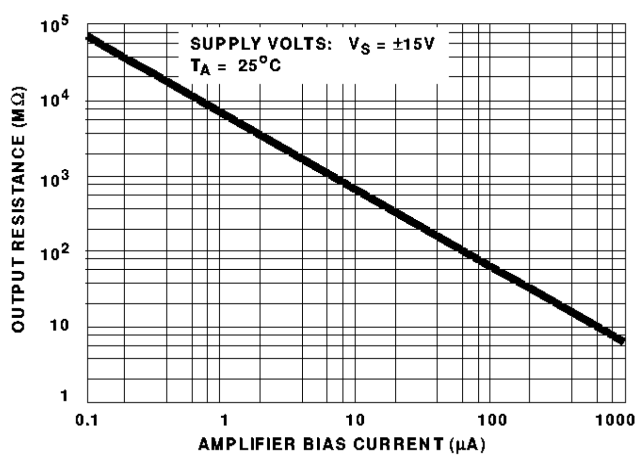



FIGURE 29. OUTPUT RESISTANCE vs AMPLIFIER BIAS CURRENT

## Typical Performance Curves (Continued)

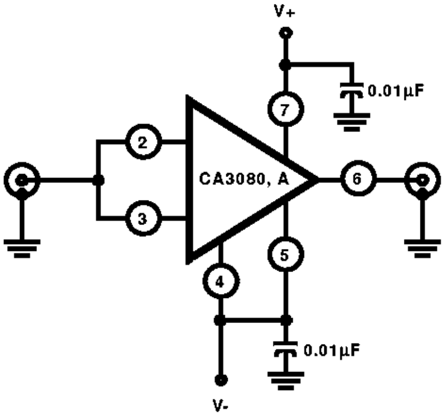



FIGURE 30. INPUT-TO-OUTPUT CAPACITANCE TEST CIRCUIT

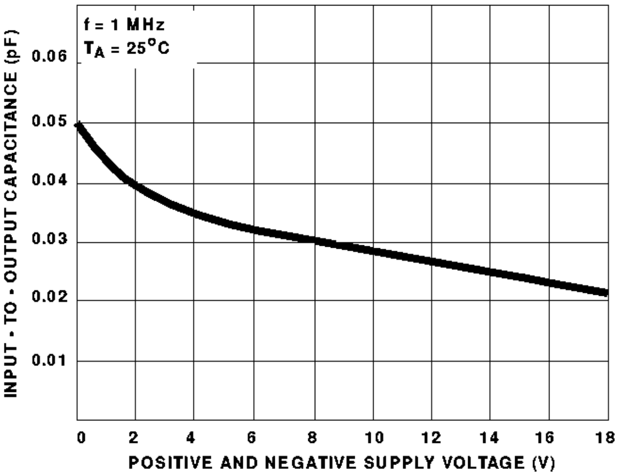



FIGURE 31. INPUT-TO-OUTPUT CAPACITANCE vs SUPPLY VOLTAGE



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