

470MHz, Low Power, High Slew Rate Operational Amplifier

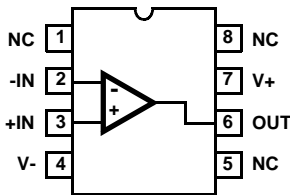
The HA-2850 is a wideband, high slew rate, operational amplifier featuring superior speed and bandwidth characteristics. Bipolar construction, coupled with dielectric isolation, delivers outstanding performance in circuits with a closed loop gain of 10 or greater.

A 340V/μs slew rate and a 470MHz gain bandwidth product ensure high performance in video and wideband amplifier designs. Differential gain and phase are a low 0.04% and 0.04 degrees respectively, making the HA-2850 ideal for video applications. A full ±10V output swing, high open loop gain, and outstanding AC parameters, make the HA-2850 an excellent choice for high speed Data Acquisition Systems.

For military grade product, refer to the HA-2850/883 data sheet.

Pinout

**HA-2850 (SOIC)
TOP VIEW**



Features

- Low Supply Current 7.5mA
- High Slew Rate 340V/μs
- Open Loop Gain 25kV/V
- Wide Gain-Bandwidth ($A_V \geq 10$) 470MHz
- Full Power Bandwidth 5.4MHz
- Low Offset Voltage 0.6mV
- Input Noise Voltage 11 nV/ $\sqrt{\text{Hz}}$
- Differential Gain/Phase 0.04%/0.04 Degrees
- Lower Power Enhanced Replacement for AD840 and EL2040

Applications

- Pulse and Video Amplifiers
- Wideband Amplifiers
- High Speed Sample-Hold Circuits
- Fast, Precise D/A Converters

Part Number Information

| PART NUMBER (BRAND) | TEMP. RANGE (°C) | PACKAGE | PKG. NO. |
|---------------------|------------------|-----------|----------|
| HA9P2850-5 (H28505) | 0 to 75 | 8 Ld SOIC | M8.15 |

HA-2850

Absolute Maximum Ratings

Voltage Between V+ and V- Terminals 35V
 Differential Input Voltage 6V

Operating Conditions

Temperature Range
 HA-2850-5 0°C to 75°C
 Recommended Supply Voltage Range ±6V To ±15V

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. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.
2. Maximum power dissipation, including output load, must be designed to maintain the maximum junction temperature below 150°C for plastic packages.

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} (°C/W)
 8 Ld SOIC Package 157
 Maximum Junction Temperature (Die) 175°C
 Maximum Junction Temperature (Plastic Package, Note 2) 150°C
 Maximum Storage Temperature Range -65°C to 150°C
 Maximum Lead Temperature (Soldering 10s) 300°C
 (SOIC - Lead Tips Only)

Electrical Specifications $V_{SUPPLY} = \pm 15V, R_L = 1k\Omega, C_L \leq 10pF$, Unless Otherwise Specified

| PARAMETER | TEST CONDITIONS | TEMP. (°C) | HA-2850-5 | | | UNITS |
|--------------------------------------|---------------------------------------------------------------------|------------|-----------|------|------|------------------|
| | | | MIN | TYP | MAX | |
| INPUT CHARACTERISTICS | | | | | | |
| Offset Voltage (Note 9) | | 25 | - | 0.6 | 2 | mV |
| | | Full | - | 2 | 6 | mV |
| Average Offset Voltage Drift | | Full | - | 20 | - | $\mu V/^\circ C$ |
| Bias Current (Note 9) | | 25 | - | 5 | 14.5 | μA |
| | | Full | - | 8 | 20 | μA |
| Offset Current | | 25 | - | 1 | 4 | μA |
| | | Full | - | - | 8 | μA |
| Input Resistance | | 25 | - | 10 | - | k Ω |
| Input Capacitance | | 25 | - | 1 | - | pF |
| Common Mode Range | | Full | ±10 | - | - | V |
| Input Noise Voltage (Note 9) | f = 1kHz, R _{SOURCE} = 0 Ω | 25 | - | 11 | - | nV \sqrt{Hz} |
| Input Noise Current (Note 9) | f = 1kHz, R _{SOURCE} = 10k Ω | 25 | - | 6 | - | pA \sqrt{Hz} |
| TRANSFER CHARACTERISTICS | | | | | | |
| Large Signal Voltage Gain | Note 4 | 25 | 20 | 25 | - | kV/V |
| | | Full | 15 | 20 | - | kV/V |
| Common-Mode Rejection Ratio (Note 9) | V _{CM} = ±10V | Full | 75 | 80 | - | dB |
| Minimum Stable Gain | | 25 | 10 | - | - | V/V |
| Gain Bandwidth Product (Note 9) | V _O = 90mV, A _V = 100 | 25 | - | 470 | - | MHz |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage Swing (Note 9) | Note 4 | Full | ±10 | ±11 | - | V |
| Output Current (Note 9) | Note 4 | Full | ±10 | ±20 | - | mA |
| Output Resistance | | 25 | - | 30 | - | Ω |
| Full Power Bandwidth (Note 5) | Note 4 | 25 | 4.8 | 5.4 | - | MHz |
| Differential Gain | A _V = +10, Note 3 | 25 | - | 0.04 | - | % |
| Differential Phase | A _V = +10, Note 3 | 25 | - | 0.04 | - | Degrees |
| Harmonic Distortion (Note 9) | A _V = +10, V _O = 2V _{P-P} , f = 1MHz | 25 | - | -74 | - | dBc |

HA-2850

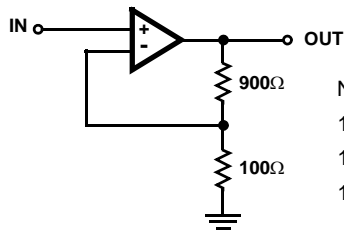
Electrical Specifications $V_{SUPPLY} = \pm 15V$, $R_L = 1k\Omega$, $C_L \leq 10pF$, Unless Otherwise Specified (Continued)

| PARAMETER | TEST CONDITIONS | TEMP. (°C) | HA-2850-5 | | | UNITS |
|---------------------------------------|------------------|------------|-----------|-----|-----|------------|
| | | | MIN | TYP | MAX | |
| TRANSIENT RESPONSE (Note 6) | | | | | | |
| Rise Time | | 25 | - | 5 | - | ns |
| Overshoot | | 25 | - | 25 | - | % |
| Slew Rate (Notes 8, 9) | Note 4 | 25 | 300 | 340 | - | V/ μ s |
| Settling Time | 10V Step to 0.1% | 25 | - | 200 | - | ns |
| POWER REQUIREMENTS | | | | | | |
| Supply Current (Note 9) | | Full | - | 7.5 | 8.0 | mA |
| Power Supply Rejection Ratio (Note 9) | Note 7 | Full | 75 | 90 | - | dB |

NOTES:

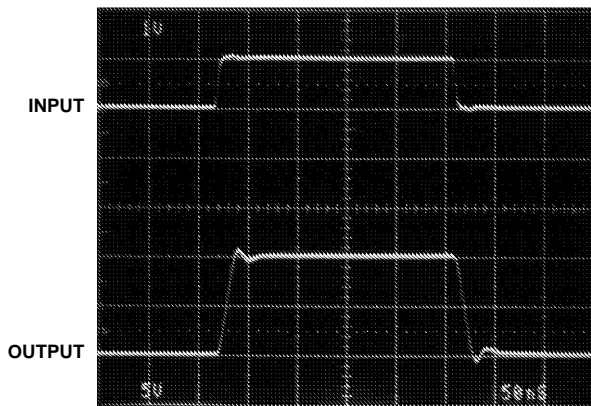
- Differential gain and phase are measured with a VM700A video tester, using a NTC-7 composite VITS.
- $R_L = 1k\Omega$, $V_O = \pm 10V$, $0V$ to $\pm 10V$ for slew rate.
- Full Power Bandwidth guaranteed based on slew rate measurement using: $FPBW = \frac{\text{Slew Rate}}{2\pi V_{PEAK}}$; $V_{PEAK} = 10V$.
- Refer to Test Circuit section of data sheet.
- $V_{SUPPLY} = \pm 10V$ to $\pm 20V$.
- This parameter is not tested. The limits are guaranteed based on lab characterization, and reflect lot-to-lot variation.
- See "Typical Performance Curves" for more information.

Test Circuits and Waveforms



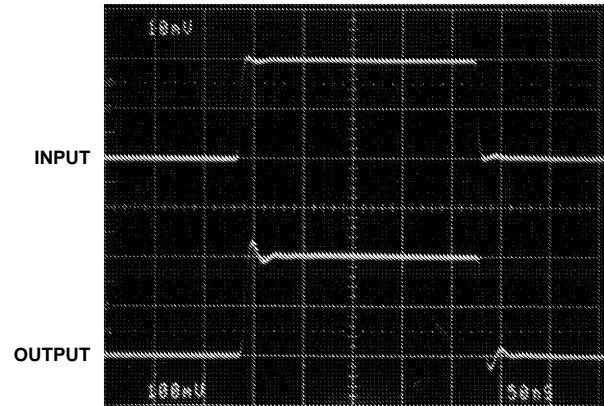
- NOTES:
- $V_S = \pm 15V$.
 - $A_V = +10$.
 - $C_L < 10pF$.

TEST CIRCUIT



Input = 1V/Div.
Output = 5V/Div.
50ns/Div.

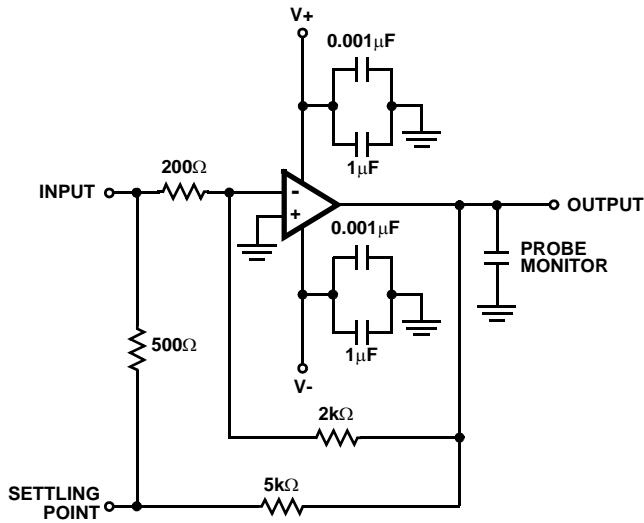
LARGE SIGNAL RESPONSE



Input = 10mV/Div.
Output = 100mV/Div.
50ns/Div.

SMALL SIGNAL RESPONSE

Test Circuits and Waveforms (Continued)



NOTES:

- 13. $A_V = -10$.
- 14. Load Capacitance should be less than 10pF.
- 15. It is recommended that resistors be carbon composition and that feedback and summing network ratios be matched to 0.1%.
- 16. SETTLE POINT (Summing Node) capacitance should be less than 10pF. For optimum settling time results, it is recommended that the test circuit be constructed directly onto the device pins. A Tektronix 568 Sampling Oscilloscope with S-3A sampling heads is recommended as a settle point monitor.

SETTLING TIME TEST CIRCUIT

Typical Performance Curves $T_A = 25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L < 10\text{pF}$, Unless Otherwise Specified

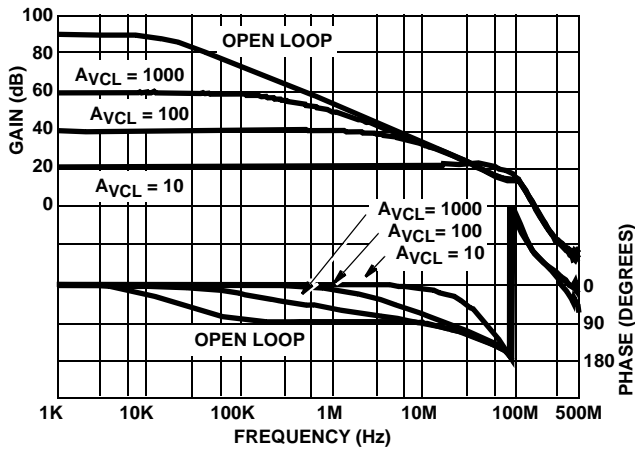


FIGURE 1. FREQUENCY RESPONSE FOR VARIOUS GAINS

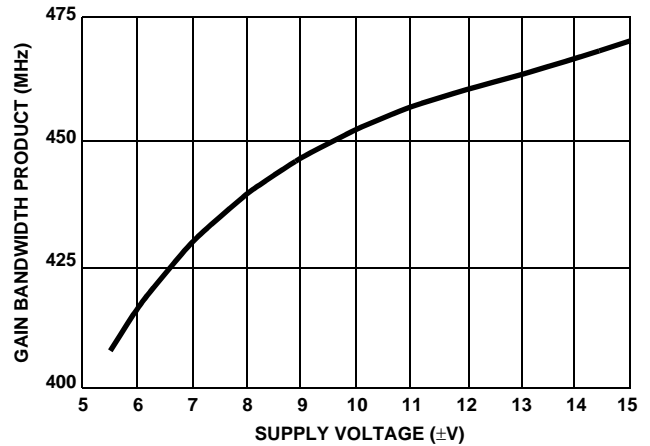


FIGURE 2. GAIN BANDWIDTH PRODUCT vs SUPPLY VOLTAGE

Typical Performance Curves $T_A = 25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L < 10\text{pF}$, Unless Otherwise Specified (Continued)

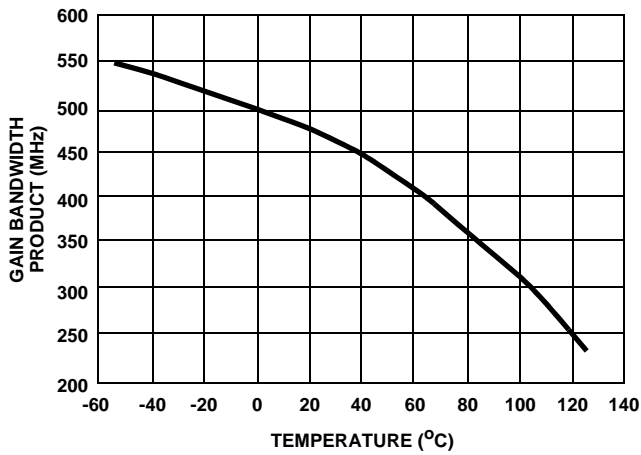


FIGURE 3. GAIN BANDWIDTH PRODUCT vs TEMPERATURE

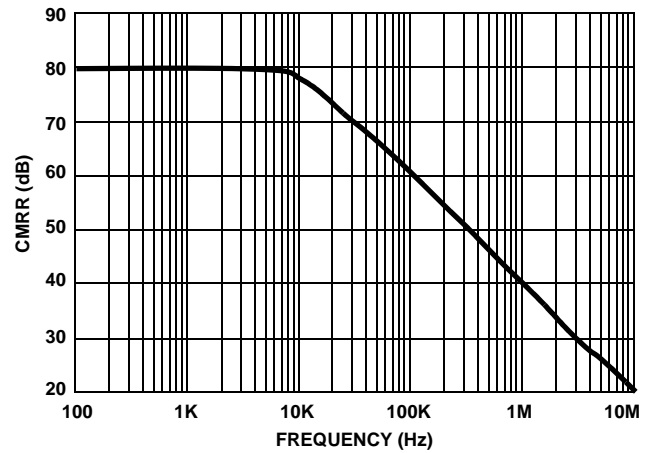


FIGURE 4. CMRR vs FREQUENCY

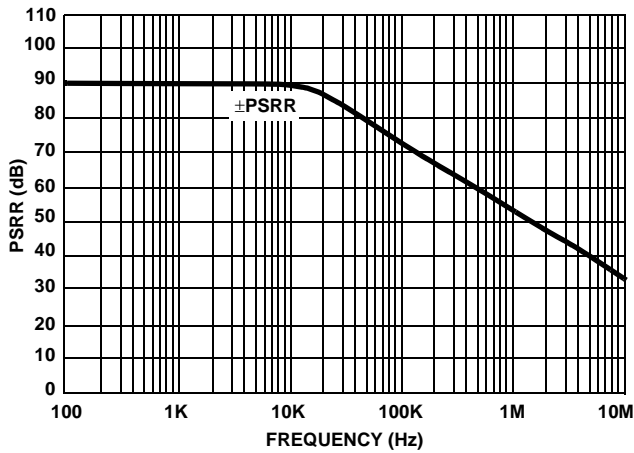


FIGURE 5. PSRR vs FREQUENCY

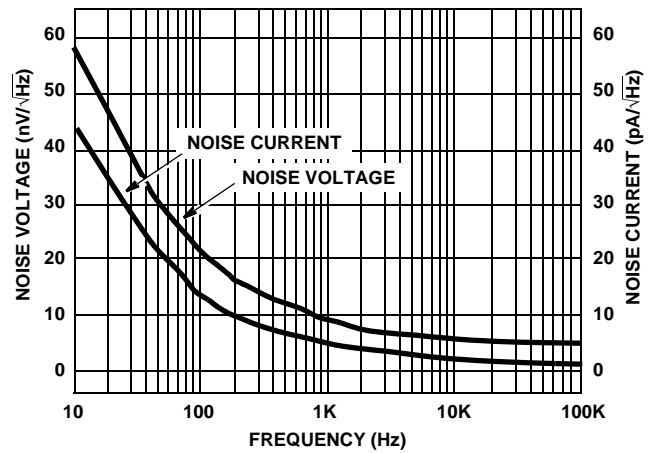


FIGURE 6. INPUT NOISE vs FREQUENCY

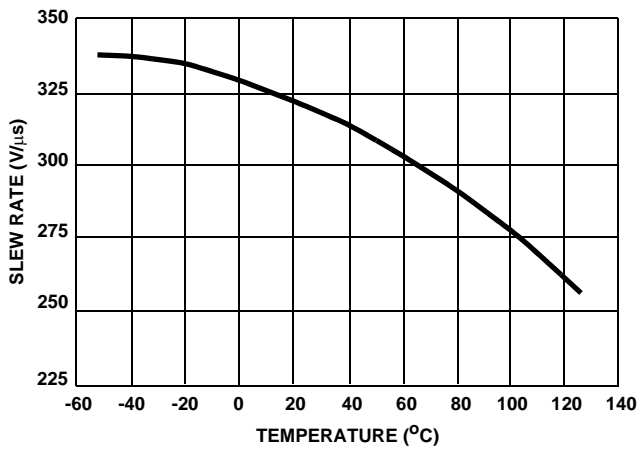


FIGURE 7. SLEW RATE vs TEMPERATURE

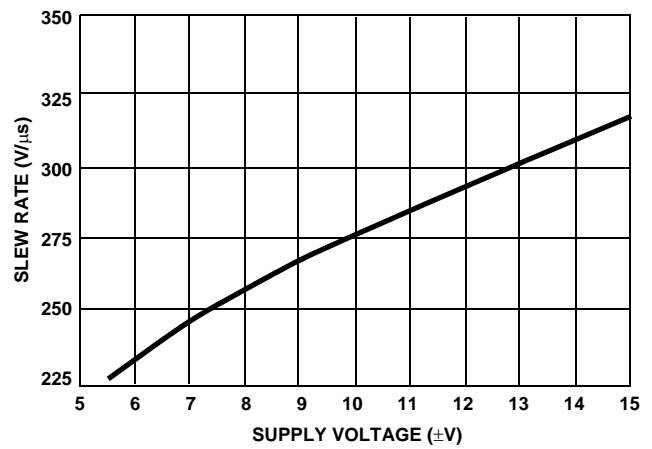


FIGURE 8. SLEW RATE vs SUPPLY VOLTAGE

Typical Performance Curves $T_A = 25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L < 10\text{pF}$, Unless Otherwise Specified (Continued)

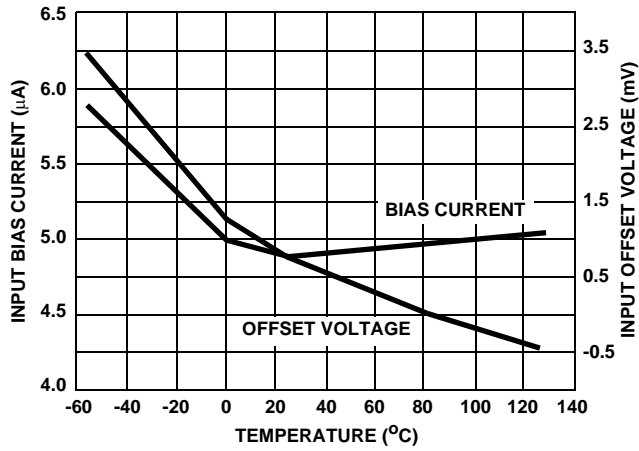


FIGURE 9. INPUT OFFSET VOLTAGE AND INPUT BIAS CURRENT vs TEMPERATURE

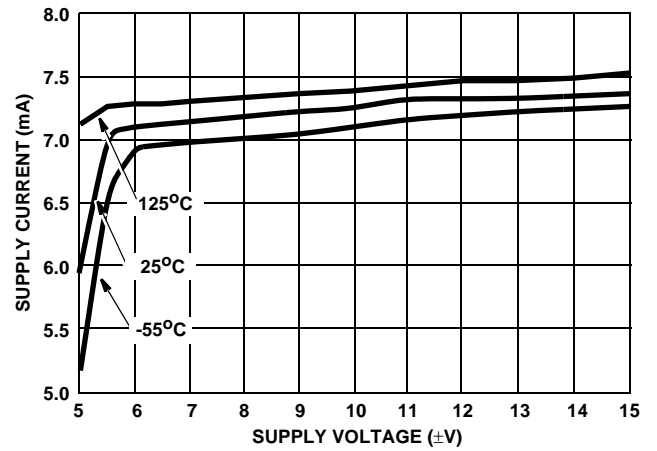


FIGURE 10. SUPPLY CURRENT vs SUPPLY VOLTAGE

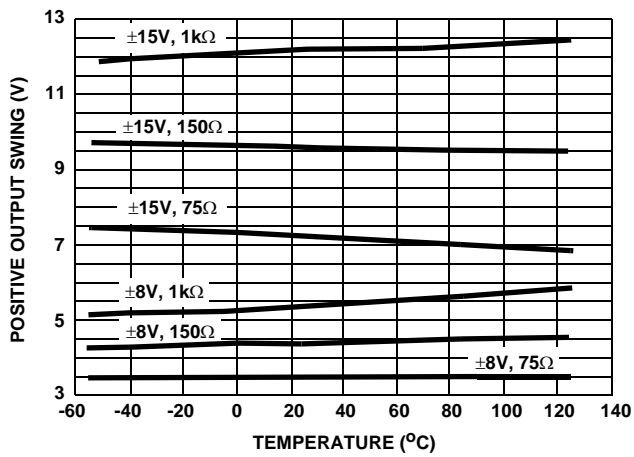


FIGURE 11. POSITIVE OUTPUT SWING vs TEMPERATURE

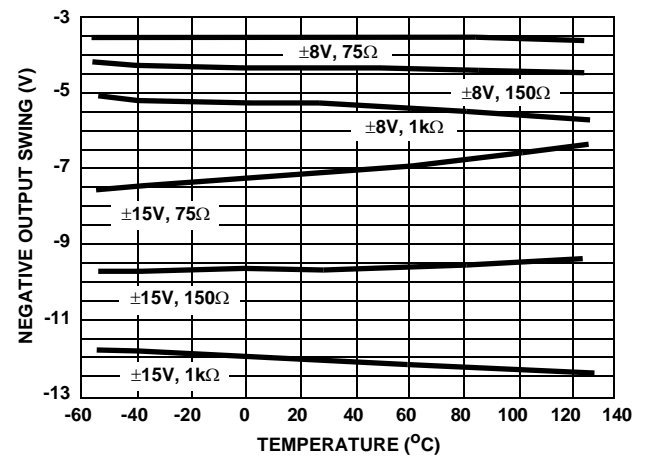


FIGURE 12. NEGATIVE OUTPUT SWING vs TEMPERATURE

Typical Performance Curves $T_A = 25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L < 10\text{pF}$, Unless Otherwise Specified (Continued)

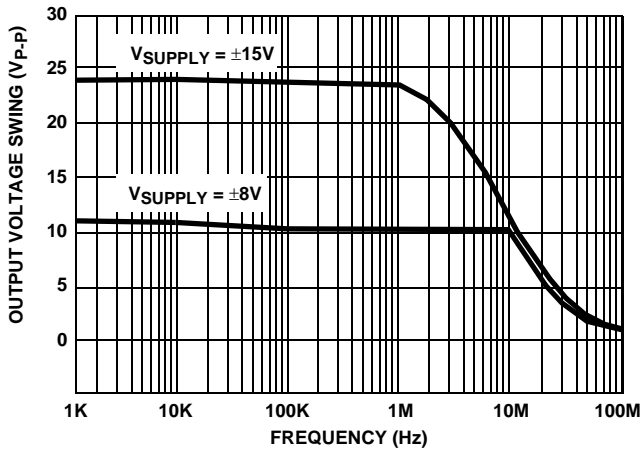


FIGURE 13. MAXIMUM UNDISTORTED OUTPUT SWING vs FREQUENCY

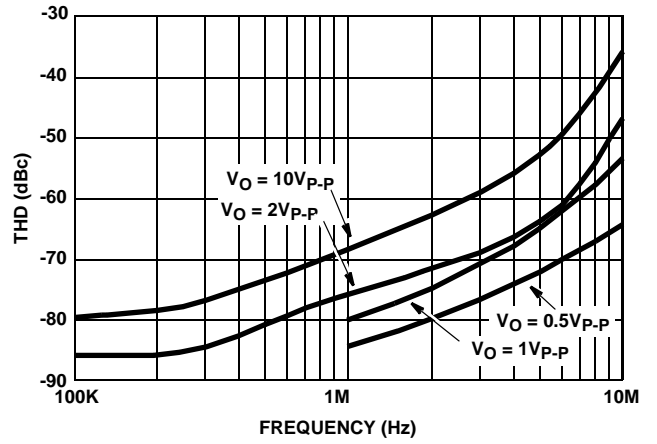


FIGURE 14. TOTAL HARMONIC DISTORTION vs FREQUENCY

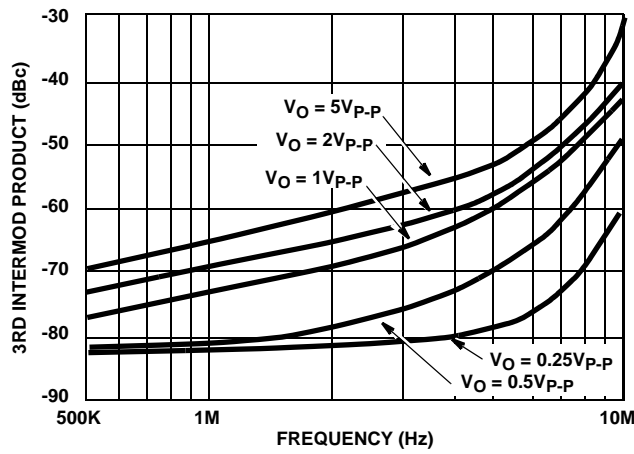


FIGURE 15. INTERMODULATION DISTORTION vs FREQUENCY (TWO TONE)

Die Characteristics

DIE DIMENSIONS:

65 mils x 52 mils x 19 mils
 1650 μ m x 1310 μ m x 483 μ m

METALLIZATION:

Type: Aluminum, 1% Copper
 Thickness: 16k \AA \pm 2k \AA

SUBSTRATE POTENTIAL

V-

PASSIVATION:

Type: Nitride over Silox
 Silox Thickness: 12k \AA \pm 2k \AA
 Nitride Thickness: 3.5k \AA \pm 1k \AA

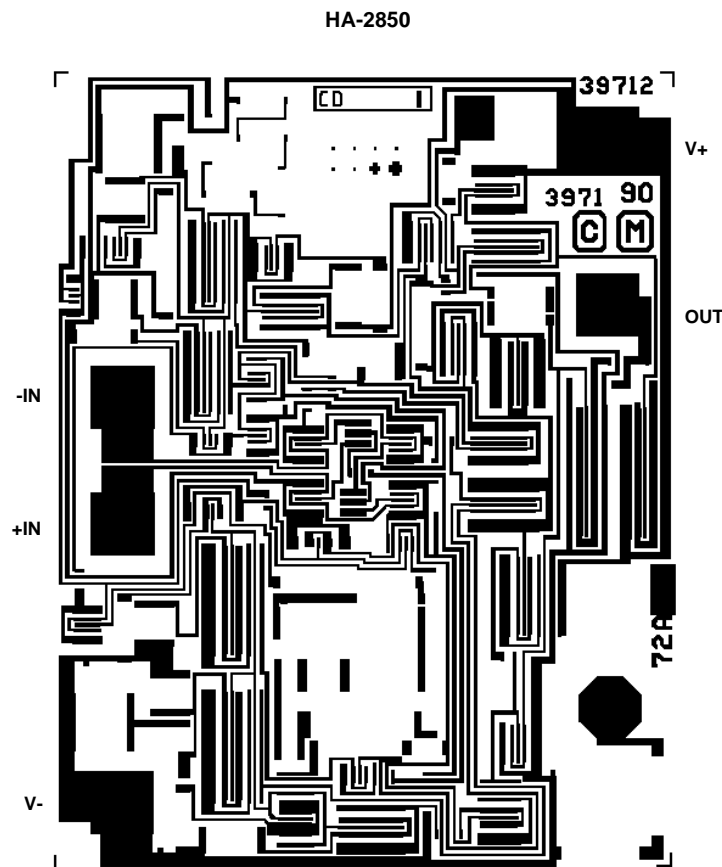
TRANSISTOR COUNT:

34

PROCESS:

High Frequency Bipolar Dielectric Isolation

Metallization Mask Layout



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