

Specifications HA-2541

HA-2541

Absolute Maximum Ratings (Note 1)

Voltage Between V+ and V- 35V
 Differential Input Voltage ±6V
 Peak Output Current 50mA
 Continuous Output Current 28mA

Operating Temperature Range:

HA-2541-2 -55°C ≤ T_A ≤ +125°C
 HA-2541-5 0°C ≤ T_A ≤ +75°C
 Storage Temperature Range -65°C ≤ T_A ≤ +150°C
 Maximum Junction Temperature (Note 11) +175°C

Electrical Specifications V_{SUPPLY} = ±15 Volts; R_L = 2kΩ, C_L ≤ 10pF, Unless Otherwise Specified

| PARAMETER | TEMP | HA-2541-2 -55°C to +125°C | | | HA-2541-5 0°C to +75°C | | | UNITS |
|---|-------|------------------------------|-------|-----|---------------------------|-------|-----|--------|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| INPUT CHARACTERISTICS | | | | | | | | |
| Offset Voltage | +25°C | | 0.8 | 2 | | 1 | 2 | mV |
| | Full | | | 6 | | | 6 | mV |
| Average Offset Voltage Drift | Full | | 9 | | | 9 | | μV/°C |
| Bias Current | +25°C | | 11 | 25 | | 11 | 25 | μA |
| | Full | | | 30 | | | 30 | μA |
| Average Bias Current Drift | Full | | 85 | | | 85 | | nA/°C |
| Offset Current | +25°C | | 1 | 7 | | 1 | 7 | μA |
| | Full | | | 9 | | | 9 | μA |
| Input Resistance | +25°C | | 100 | | | 100 | | kΩ |
| Input Capacitance | +25°C | | 1 | | | 1 | | pF |
| Common Mode Range | Full | ±10 | ±11 | | ±10 | ±11 | | V |
| Input Noise Voltage (f = 1kHz, R _g = 0Ω) | +25°C | | 10 | | | 10 | | nV/√Hz |
| Input Noise Current (f = 1kHz, R _g = 0Ω) | +25°C | | 4 | | | 4 | | pA/√Hz |
| TRANSFER CHARACTERISTICS | | | | | | | | |
| Large Signal Voltage Gain (Note 3) | +25°C | 10k | 16k | | 10k | 16k | | V/V |
| | Full | 5k | | | 5k | | | V/V |
| Common-Mode Rejection Ratio (Note 5) | Full | 70 | 90 | | 70 | 90 | | dB |
| Minimum Stable Gain | +25°C | 1 | | | 1 | | | V/V |
| Unity Gain-Bandwidth (Note 6) | +25°C | | 40 | | | 40 | | MHz |
| OUTPUT CHARACTERISTICS | | | | | | | | |
| Output Voltage Swing (Note 4) | Full | ±10 | ±11 | | ±10 | ±11 | | V |
| Output Current (Note 4) | +25°C | ±10 | ±15 | | ±10 | ±15 | | mA |
| Output Resistance | +25°C | | 2 | | | 2 | | Ω |
| Full Power Bandwidth (Note 3 & 7) | +25°C | 3 | 4 | | 3 | 4 | | MHz |
| Differential Gain (Note 2) | +25°C | | 0.1 | | | 0.1 | | % |
| Differential Phase (Note 2) | +25°C | | 0.2 | | | 0.2 | | Degree |
| Harmonic Distortion (Note 10) | +25°C | | <0.01 | | | <0.01 | | % |
| TRANSIENT RESPONSE (Note 8) | | | | | | | | |
| Rise Time | +25°C | | 4 | | | 4 | | ns |
| Overshoot | +25°C | | 40 | | | 40 | | % |
| Slew Rate | +25°C | 200 | 250 | | 200 | 250 | | V/μs |
| Settling Time: | | | | | | | | |
| 10V Step to 0.1% | +25°C | | 90 | | | 90 | | ns |
| 10V Step to 0.01% | +25°C | | 175 | | | 175 | | ns |
| POWER REQUIREMENTS | | | | | | | | |
| Supply Current | +25°C | | 29 | | | 29 | | mA |
| | Full | | | 40 | | | 40 | mA |
| Power Supply Rejection Ratio (Note 9) | Full | 70 | 80 | | 70 | 78 | | dB |

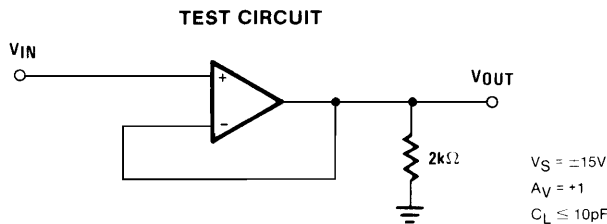
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OP AMPS & COMPARATORS

NOTES:

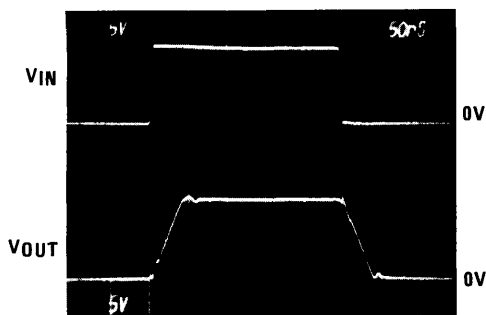
1. Absolute maximum ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired. Functional operability under any of these conditions is not necessarily implied.
2. Differential Gain and Phase are measured with a 1 Volt differential voltage at 5MHz.
3. $V_O = \pm 10V$
4. $R_L = 1k\Omega$
5. $V_{CM} = \pm 10V$
6. $V_O = 90mV$.
7. Full Power Bandwidth guaranteed based on slew rate measurement using $FPBW = \frac{Slew\ Rate}{2\pi V_{PEAK}}$
8. Refer to Test Circuits section of this data sheet.
9. $V_{SUPPLY} = \pm 5VDC$ to $\pm 15VDC$
10. $V_{IN} = 1V_{RMS}$; $f = 10kHz$; $A_V = 10$
11. This value assumes a no load condition: Maximum power dissipation with load conditions must be designed to maintain the maximum junction temperature below $+175^\circ C$. By using Application Note 556 on Safe Operating Area equations, along with the packaging thermal resistances listed in the Die Characteristics section, proper load conditions can be determined. Heat sinking is recommended above $+75^\circ C$ with suggested models:
 - 14 Lead Ceramic DIP: Thermalloy #6007 or AAVID #5602B ($\theta_{sa} = 16^\circ C/W$).
 - 12 Lead Metal Can (TO-8): Thermalloy #2240A ($\theta_{sa} = 27^\circ C/W$) or #2268B ($\theta_{sa} = 24^\circ C/W$)

Test Circuits



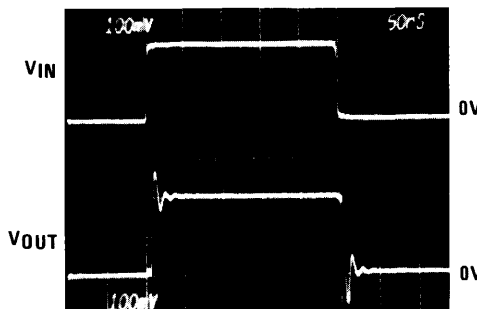
LARGE SIGNAL RESPONSE

Vertical Scale (Volts: 5V/Div.)
Horizontal Scale (Time: 50ns/Div.)



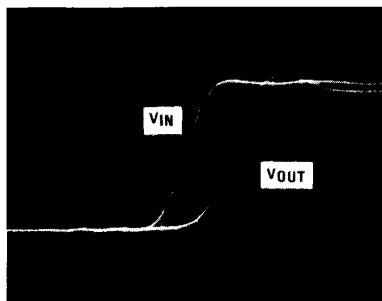
SMALL SIGNAL RESPONSE

Vertical Scale (Volts: 100mV/Div.)
Horizontal Scale (Time: 50ns/Div.)



PROPAGATION DELAY

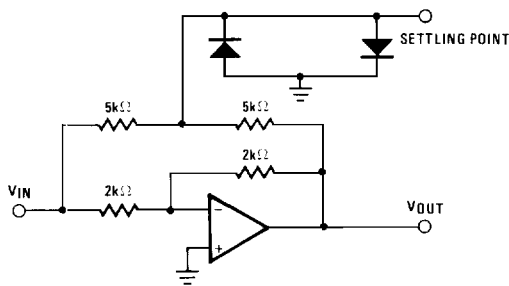
Vertical Scale (Volts: 100mV/Div.)
Horizontal Scale (Time: 5ns/Div.)



$V_S = \pm 15V$, $R_L = 1k\Omega$
 $T = +25^\circ C$
Propagation delay variance is negligible over full temperature range.

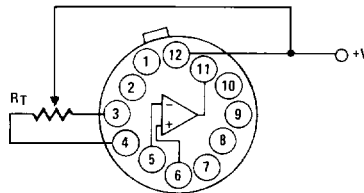
Test Circuits (Continued)

SETTLING TIME TEST CIRCUIT



- $A_V = -1$
- Feedback and Summing Resistors Must Be Matched (0.1%)
- HP5082-2810 Clipping Diodes Recommended
- Tektronix P6201 FET Probe Used At Settling Point.

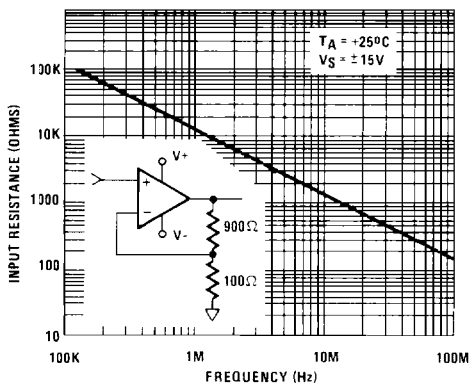
Suggested Offset Voltage Adjustment



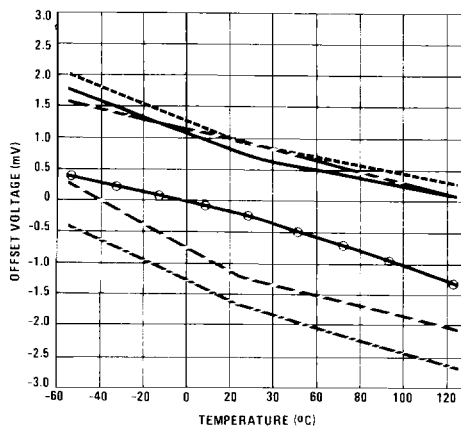
Tested Offset Adjustment Range is $|V_{OS} + 1mV|$ minimum referred to output. Typical range is $\pm 15mV$ with $R_T = 5k\Omega$

Typical Performance Curves

INPUT RESISTANCE vs. FREQUENCY

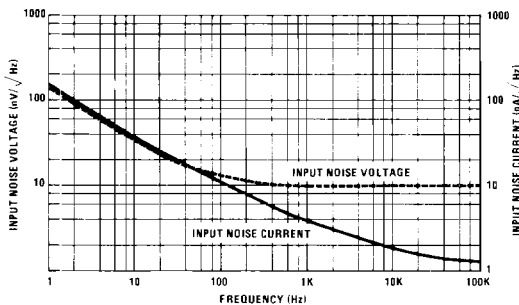


OFFSET VOLTAGE DRIFT WITH TEMPERATURE
Of 6 Representative Units



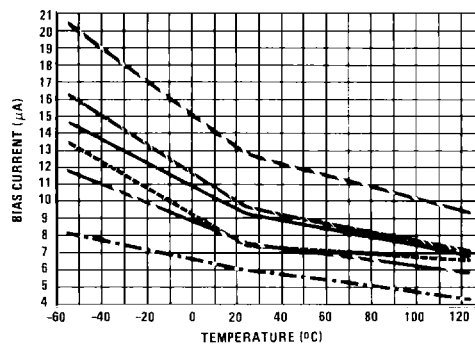
NOISE DENSITY vs. FREQUENCY

$T_A = +25^\circ C$



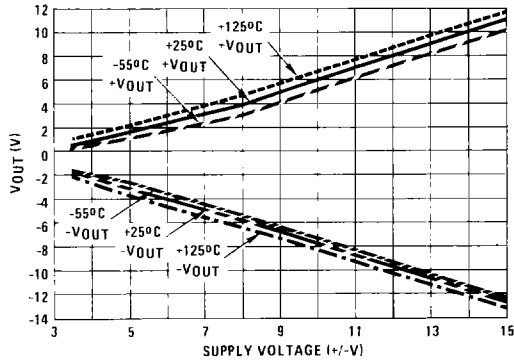
BIAS CURRENT DRIFT WITH TEMPERATURE

Of 6 Representative Units

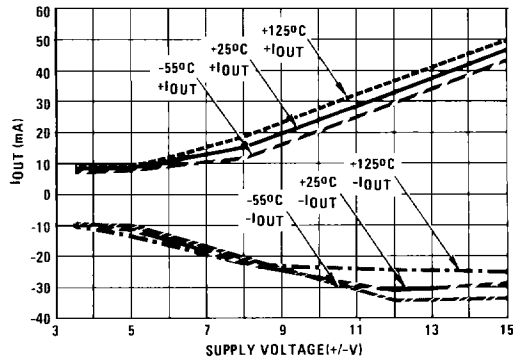


Typical Performance Curves (Continued)

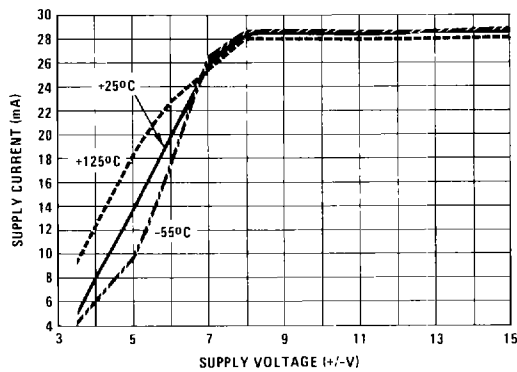
OUTPUT VOLTAGE SWING vs. SUPPLY VOLTAGE
At Various Temperatures



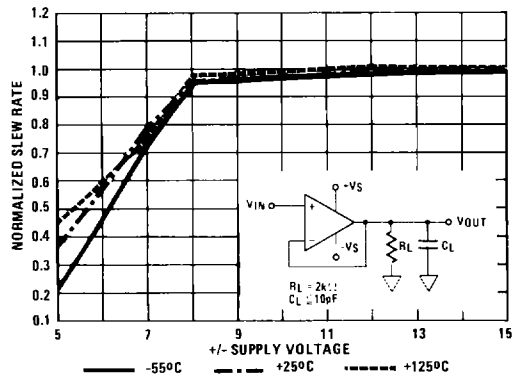
OUTPUT CURRENT vs. SUPPLY VOLTAGE
At Various Temperatures



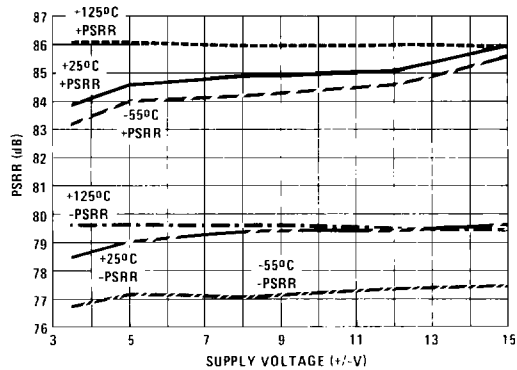
SUPPLY CURRENT vs. SUPPLY VOLTAGE
At Various Temperatures



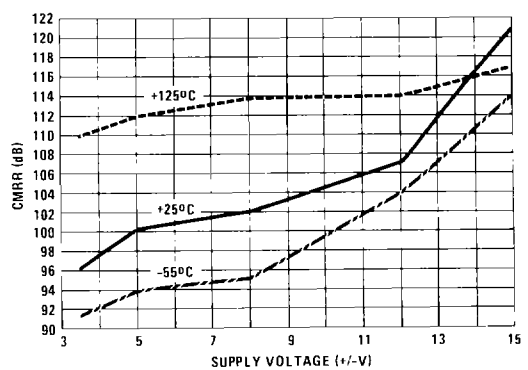
SLEW RATE vs. SUPPLY VOLTAGE
Normalized With V_S = ±15V at +25°C



PSRR vs. SUPPLY VOLTAGE
Average Of 3 Lots At Various Temperatures

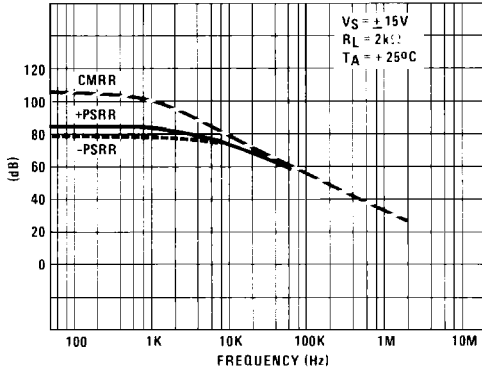


CMRR vs. SUPPLY VOLTAGE
Average of 3 Lots At Various Temperatures

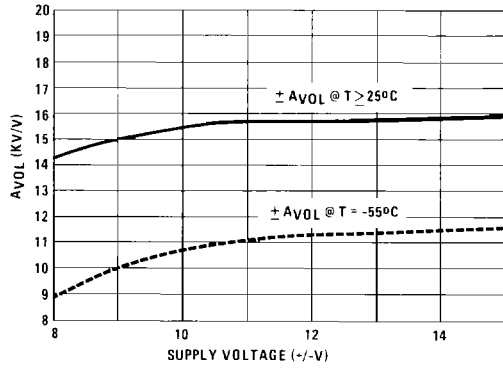


Typical Performance Curves (Continued)

REJECTION RATIOS vs. FREQUENCY

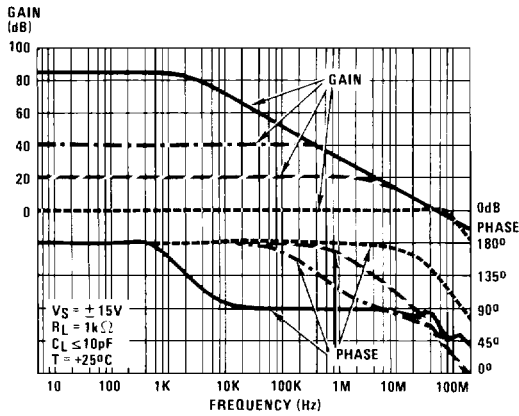


+/- OPEN LOOP GAIN vs. SUPPLY VOLTAGE
Average of 3 Lots Over Temperature



GAIN AND PHASE FREQUENCY RESPONSE

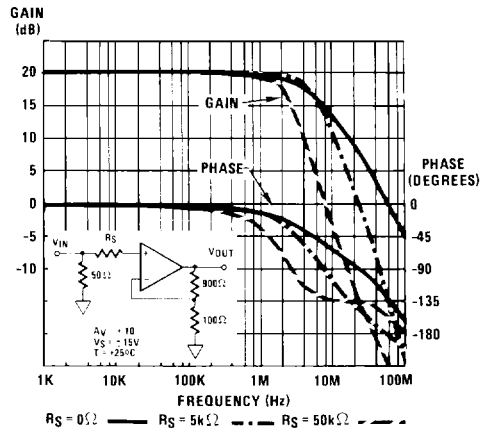
$V_S = \pm 15V, R_L = 1k, C_L \leq 10pF, T_A = +25^\circ C$



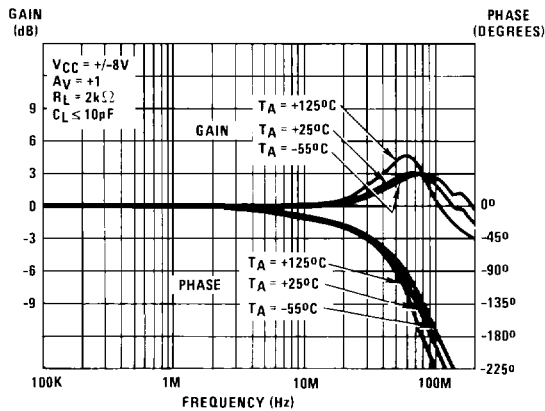
OPEN LOOP — $A_V = -100$ - - - $A_V = -10$ - - - $A_V = -1$ - - -

SMALL SIGNAL BANDWIDTH vs. SOURCE RESISTANCE

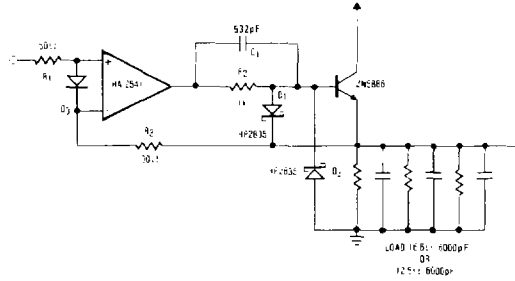
$V_S = \pm 15V, R_L = 1k\Omega$



CLOSE LOOP FREQUENCY RESPONSE vs. TEMPERATURE



Applications (Also See Application Note 550)



APPLICATION 1. DRIVING POWER TRANSISTORS TO GAIN ADDITIONAL CURRENT BOOSTING

APPLICATION 1

High power amplifiers and buffers are in use in a wide variety of applications. Many times the "high power" capability is needed to drive large capacitive loads as well as low value resistive loads. In both cases the final driver stage is usually a power transistor of some type, but because of their inherently low gain, several stages of pre-drivers are often required. The HA-2541, with its 10mA output rating, is powerful enough to drive a power transistor without additional stages of current amplification.

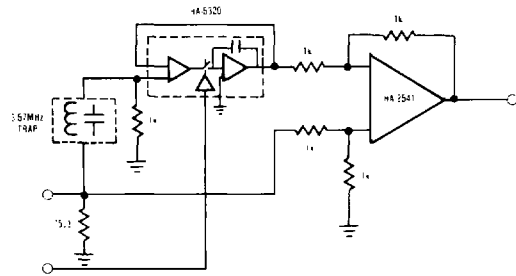
This capability is well demonstrated with the high power buffer circuit in Application 1.

The HA-2541 acts as the pre-driver to the output power transistor. Together, they form a unity gain buffer with the ability to drive three 50 ohm coaxial cables in parallel, each with a capacitance of 2000pF. The total combined load is 16.6 ohms and 6000pF capacitance.

APPLICATION 2

Video

One of the primary uses of the HA-2541 is in the area of video applications. These applications include signal construction, synchronization addition and removal, as well as signal modification. A wide bandwidth device such as the HA-2541 is well suited for use in this class of amplifier. This, however, is a more involved group of applications than ordinary amplifier applications since video signals contain precise DC levels which must be retained.



APPLICATION 2. VIDEO D.C. RESTORER

Die Characteristics

| | | |
|---|---|-----------------|
| Transistor Count..... | 41 | |
| Die Dimensions..... | .89 x .79 x .19 mils (2250μm x 1990μm x 485μm) | |
| Substrate Potential (Powered Up)* | V- | |
| Process | High Frequency Bipolar Dielectric Isolation | |
| Passivation | Silox | |
| Thermal Constants (°C/W) | θ _{ja} | θ _{jc} |
| Ceramic DIP | 91 | 35 |
| Metal Can | 66 | 30 |

*The substrate may be left floating (Insulating Die Mount) or it may be mounted on a conductor at V- potential.