HA-2500/02/05

Precision High Slew Rate Operational Amplifiers

Features

- High Slew Rate 30V/μs
- Fast Settling 330ns
- Wide Power Bandwidth 500KHz
- High Gain Bandwidth 12MHz
- High Input Impedance 50MΩ
- Low Offset Current 10nA
- Internally Compensated For Unity Gain Stability

Applications

- Data Acquisition Systems
- R.F. Amplifiers
- Video Amplifiers
- Signal Generators
- Pulse Amplification

Description

HA-2500/2502/2505 comprises a series of monolithic operational amplifiers whose designs are optimized to deliver excellent slew rate, bandwidth, and settling time specifications. The outstanding dynamic features of this internally compensated device are complemented with low offset voltage and offset current.

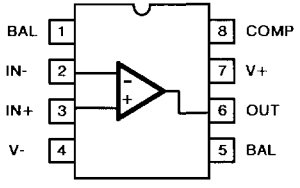
These dielectrically isolated amplifiers are ideally suited for applications such as data acquisition, R.F., video, and pulse conditioning circuits. Slew rates of ±25V/μs and 330ns (0.1%) settling time make these devices excellent components in fast, accurate data acquisition and pulse amplif cation designs. 12MHz small signal bandwidth and 500kHz power bandwidth make these devices well suited to R.F. and video applications. With 2mV typical offset voltage plus offset trim capability and 10nA offset current, HA-2500/2502/2505 are particularly useful components in sigr al conditioning designs.

The gain and offset voltage figures of the HA-2500 series are optimized by internal component value changes while the similar design of the HA-2510 series is maximized for slew rate.

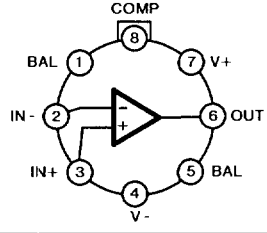
The HA-2500 and HA-2502 have guaranteed operation from -55°C to +125°C and are available in hermetic metal can and ceramic miniDIP packages. Both are offered as a /883 military grade part with the HA-2502 also available in LCC package. The HA-2505 has guaranteed operation from 0°C to +75°C and is available in plastic and ceramic miniDIP and metal can packages. Mil-Std-883 product and data sheets are available upon request.

Pinouts

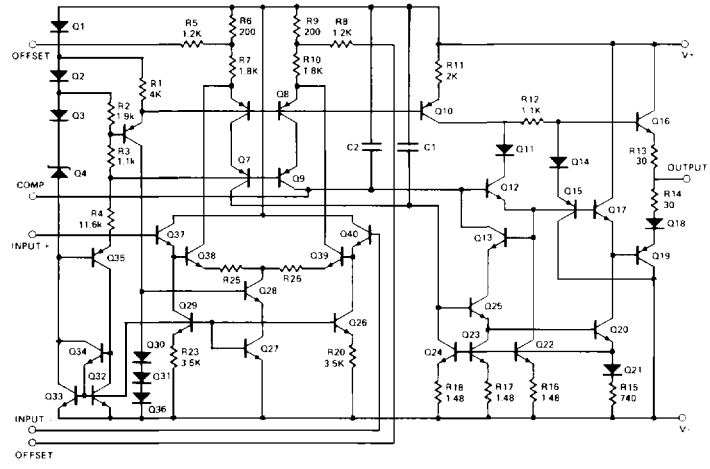
HA7-2500/02/02 (CERAMIC MINI-DIP)
HA3-2505 (PLASTIC MINI-DIP)
TOP VIEW



HA2-2500/02/05 (TO-99 METAL CAN)
TOP VIEW



Schematic



CAUTION: These devices are sensitive to electronic discharge. Proper IC handling procedures should be followed.

Absolute Maximum Ratings (Note 6)

Voltage Between V+ and V- Terminals 40.0V
Differential Input Voltage ..... ±15.0V
Peak Output Current 50mA
Internal Power Dissipation 300mW
Lead Solder Temperature (10 Seconds) ..... +275°C

Operating Temperature Range
HA-2510/2512 ..... -55°C ≤ T_A ≤ +125°C
HA-2515 ..... 0°C ≤ T_A ≤ +75°C
Storage Temperature Range ..... -65°C ≤ T_A ≤ +150°C
Maximum Junction Temperature ..... +175°C

Electrical Specifications V+ = +15V D.C., V- = -15V D.C.

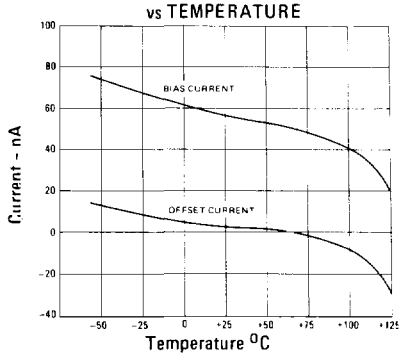
PARAMETER	TEMP.	HA-2500 -55°C to +125°C			HA-2502 -55°C to +125°C			HA-2505 0°C to +75°C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
INPUT CHARACTERISTICS											
Offset Voltage	+25°C		2	5		4	8		4	8	mV
	Full			8			10			10	mV
Offset Voltage Average Drift	Full		20			20			20		µV/°C
Bias Current	+25°C		100	200		125	250		125	250	nA
	Full			400			500			500	nA
Offset Current	+25°C		10	25		20	50		20	50	nA
	Full			50			100			100	nA
Input Resistance (Note 10)	+25°C	25	50		20	50		20	50		MΩ
Common Mode Range	Full	±10.0			±10.0			±10.0			V
TRANSFER CHARACTERISTICS											
Large Signal Voltage Gain (Note 1, 4)	+25°C	20K	30K		15K	25K		15K	25K		V/V
	Full	15K			10K			10K			V/V
Common Mode Rejection Ratio (Note 2)	Full	80	90		74	90		74	90		dB
Gain Bandwidth Product (Note 3)	+25°C		12			12			12		MHz
OUTPUT CHARACTERISTICS											
Output Voltage Swing (Note 1)	Full	±10.0	±12.0		±10.0	±12.0		±10.0	±12.0		V
Output Current (Note 4)	+25°C	±10	±20		±10	±20		±10	±20		mA
Full Power Bandwidth (Notes 4,11)	+25°C	350	500		300	500		300	500		KHz
TRANSIENT RESPONSE											
Rise Time (Notes 1, 5, 7 & 8)	+25°C		25	50		25	50		25	50	ns
Overshoot (Notes 1, 5, 7 & 8)	+25°C		25	40		25	50		25	50	%
Slew Rate (Notes 1, 5, 8 & 12)	+25°C	±25	±30		±20	±30		±20	±30		V/µs
Settling Time to 0.1% (Notes 1, 5, 8 & 12)	+25°C		0.33			0.33			0.33		µs
POWER SUPPLY CHARACTERISTICS											
Supply Current	+25°C		4	6		4	6		4	6	mA
Power Supply Rejection Ratio (Note 9)	Full	80	90		74	90		74	90		dB

NOTES
1. R_L = 2KΩ
2. V_{CM} = ±10V
3. A_V = 10
4. V_O = ±10.0V
5. C_L = 50pF
6. Absolute Maximum Ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired
7. V_O = ±200mV
8. See Transient Response Test Circuits and Waveforms
9. ΔV = ±5.0V
10. This parameter value is based on design calculations
11. Full Power Bandwidth guaranteed based on slew rate measurement using: FPBW = S.R. $2\pi V_{peak}$
12. V_{OUT} = ±5V

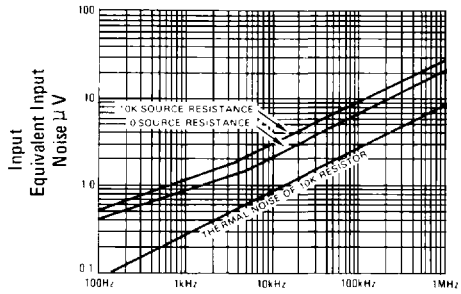
Performance Curves

V+ = +15VDC, V- = -15VDC, T_A = +25°C, Unless Otherwise Stated

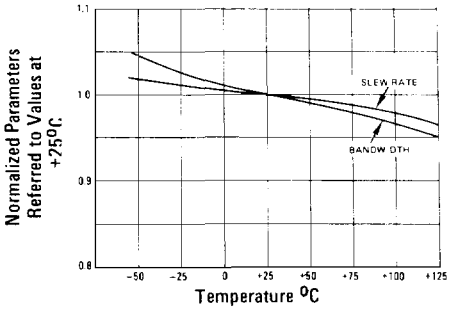
INPUT BIAS AND OFFSET CURRENT vs TEMPERATURE



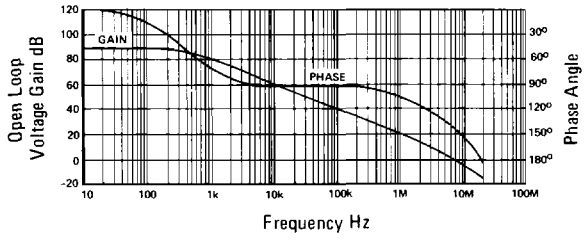
EQUIVALENT INPUT NOISE vs BANDWIDTH



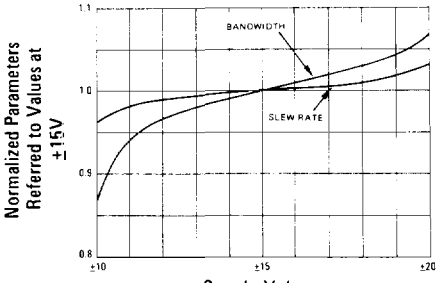
NORMALIZED AC PARAMETERS vs TEMPERATURE



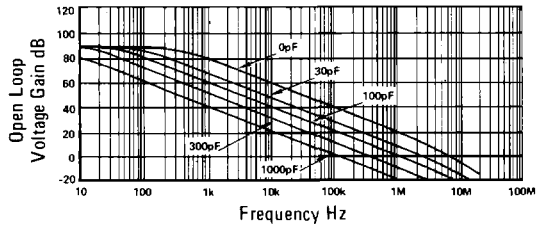
OPEN-LOOP FREQUENCY AND PHASE RESPONSE



NORMALIZED AC PARAMETERS vs SUPPLY VOLTAGE AT +25°C

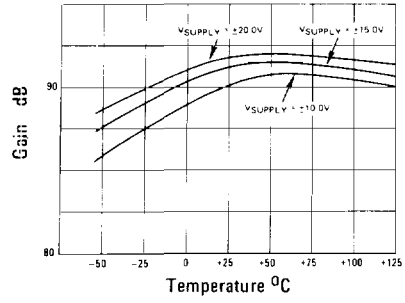


OPEN LOOP FREQUENCY RESPONSE FOR VARIOUS VALUES OF CAPACITORS FROM COMPENSATION PIN TO GROUND

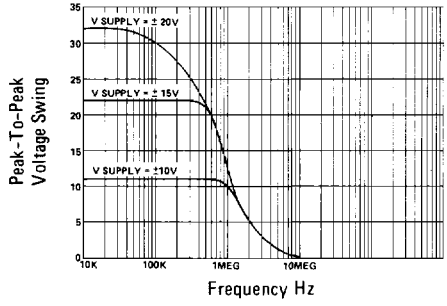


NOTE: External compensation components are not required for stability, but may be added to reduce bandwidth if desired.

OPEN LOOP VOLTAGE GAIN vs TEMPERATURE

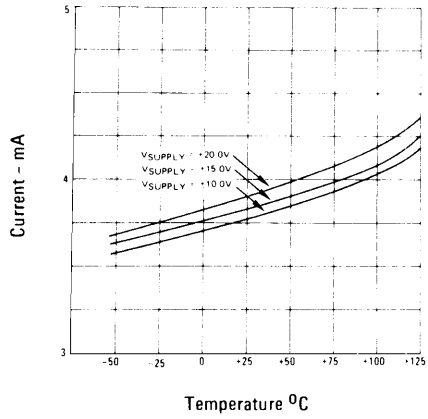


OUTPUT VOLTAGE SWING vs FREQUENCY AT +25°C

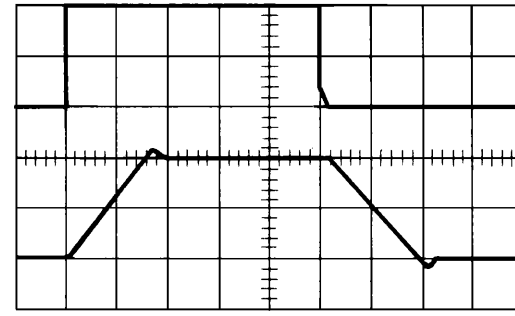


Typical Performance Curves (Continued)

POWER SUPPLY CURRENT vs TEMPERATURE



VOLTAGE FOLLOWER PULSE RESPONSE

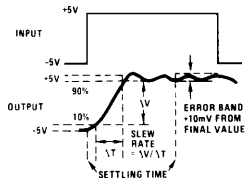


R_L = 2KΩ, C_L = 50pF
Upper Trace: Input
Lower Trace: Output

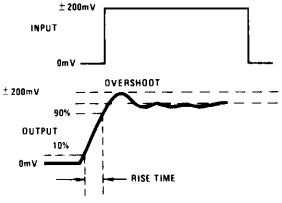
Vertical = 5V/Div.
Horizontal = 200ns/Div.
T_A = +25°C, V_S = ±15.0V

Test Circuits

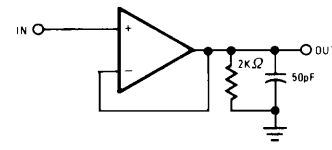
SLEW RATE AND SETTLING TIME



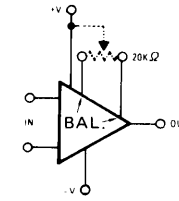
TRANSIENT RESPONSE



SLEW RATE AND TRANSIENT RESPONSE



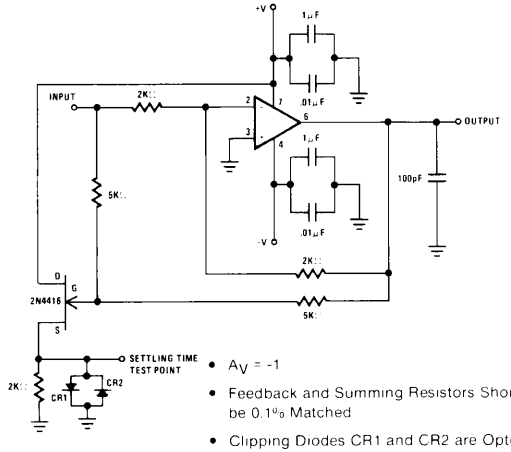
SUGGESTED VOS ADJUSTMENT



NOTE: Measurement on both positive and negative transitions from 0V to +200mV and 0V to -200mV at the output.

Tested Offset Adjustment Range is $|V_{OS}$ +1mV| minimum referred to output. Typical ranges is ±8mV with R_T = 20kΩ.

Settling Time Circuit



- A_V = -1
- Feedback and Summing Resistors Should be 0.1% Matched
- Clipping Diodes CR1 and CR2 are Optional. HP5082-2810 Recommended

Die Characteristics

Transistor Count 40
Die Dimensions ..... 57 x 65 x 19 mils
Substrate Potential ..... Unbiased
Process ..... Bipolar-DI

Thermal Constants (°C/W)	θ_{ja}	θ_{jc}
HA2- Metal Can (-2, -5, -7)	202	56
HA2- Metal Can (-8, /883)	168	52
HA3- Plastic Mini-DIP (-5)	84	34
HA4- Ceramic LCC (/883)	97	35
HA7- Ceramic Mini-DIP (-8, /883)	138	63
HA7- Ceramic Mini-DIP (-2, -5, -7)	204	112