

# HA-2620, HA-2622, HA-2625

**100MHz, High Input Impedance, Very Wideband,  
Uncompensated Operational Amplifiers**

November 1996

## Features

- Gain Bandwidth Product ( $A_v \geq 5$ ) ..... 100MHz
- High Input Impedance ..... 500M $\Omega$
- Low Input Bias Current ..... 1nA
- Low Input Offset Current ..... 1nA
- Low Input Offset Voltage ..... 0.5mV
- High Gain ..... 150kV/V
- Slew Rate ..... 35V/ $\mu$ s
- Output Short Circuit Protection

## Applications

- Video and RF Amplifier
- Pulse Amplifier
- Audio Amplifiers and Filters
- High-Q Active Filters
- High Speed Comparators
- Low Distortion Oscillator

## Ordering Information

| PART NUMBER<br>(BRAND) | TEMP.<br>RANGE ( $^{\circ}$ C) | PACKAGE         | PKG.<br>NO. |
|------------------------|--------------------------------|-----------------|-------------|
| HA2-2620-2             | -55 to 125                     | 8 Pin Metal Can | T8.C        |
| HA2-2622-2             | -55 to 125                     | 8 Pin Metal Can | T8.C        |
| HA2-2625-5             | 0 to 75                        | 8 Pin Metal Can | T8.C        |
| HA3-2625-5             | 0 to 75                        | 8 Ld PDIP       | E8.3        |
| HA7-2620-2             | -55 to 125                     | 8 Ld Cerdip     | F8.3A       |
| HA7-2622-2             | -55 to 125                     | 8 Ld Cerdip     | F8.3A       |
| HA7-2625-5             | 0 to 75                        | 8 Ld Cerdip     | F8.3A       |
| HA9P2625-5<br>(H26255) | 0 to 75                        | 8 Ld SOIC       | M8.15       |
| HA9P2625-9<br>(H26259) | -40 to 85                      | 8 Ld SOIC       | M8.15       |

## Description

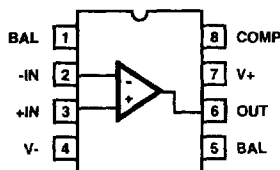
HA-2620/2622/2625 are bipolar operational amplifiers that feature very high input impedance (500M $\Omega$ , HA-2620) coupled with wideband AC performance. The high resistance of the input stage is complemented by low offset voltage (0.5mV, HA-2620) and low bias and offset current (1nA, HA-2620) to facilitate accurate signal processing. Input offset can be reduced further by means of an external nulling potentiometer. The 100MHz gain bandwidth product (HA-2620/2622/2625 are stable for closed loop gains greater than 5), 35V/ $\mu$ s slew rate and 150kV/V open loop gain enables HA-2620/2622/2625 to perform high gain amplification of very fast, wideband signals. These dynamic characteristics, coupled with fast settling times, make these amplifiers ideally suited to pulse amplification designs as well as high frequency (e.g., video) applications. The frequency response of the amplifier can be tailored to exact design requirements by means of an external bandwidth control capacitor connected from the Comp pin to GND.

In addition to its application in pulse and video amplifier designs, HA-2620/2622/2625 is particularly suited to other high performance designs such as high-gain low distortion audio amplifiers, high-Q and wideband active filters and high-speed comparators. For more information, please refer to Application Notes AN509, AN519 and AN546.

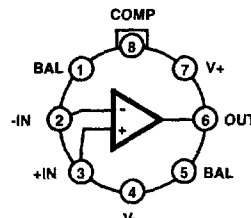
The HA-2620 and HA-2622 are both offered as /883 Military Grade with the HA-2622 also available in CLCC packages. MIL-STD-883 data sheets are available upon request Harris AnswerFAX (407-724-7800) Document #3701.

## Pinouts

HA-2620/22 (CERDIP)  
HA-2625 (CERDIP, PDIP, SOIC)  
TOP VIEW



HA-2620, HA-2622, HA-2625  
(METAL CAN)  
TOP VIEW



# HA-2620, HA-2622, HA-2625

## Absolute Maximum Ratings

Supply Voltage (Between V+ and V- Terminals) ..... 45V  
 Differential Input Voltage ..... 12V  
 Peak Output Current ..... Full Short Circuit Protection

## Operating Conditions

Temperature Range  
 HA-2620/HA-2622-2 ..... -55°C to 125°C  
 HA-2625-5 ..... 0°C to 75°C  
 HA-2625-9 ..... -40°C to 85°C

## Thermal Information

Thermal Resistance (Typical, Note 1)  $\theta_{JA}$  (°C/W)  $\theta_{JC}$  (°C/W)  
 PDIP Package ..... 96 N/A  
 CERDIP Package ..... 135 50  
 SOIC Package ..... 157 N/A  
 Metal Can Package ..... 165 80  
 Maximum Junction Temperature (Hermetic Package) ..... 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.

## NOTE:

1.  $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

## Electrical Specifications $V_{SUPPLY} = \pm 15V$ , Unless Otherwise Specified

| PARAMETER                                   | TEMP.<br>(°C) | HA-2620-2 |      |     | HA-2622-2 |      |     | HA-2625-5, -9 |      |     | UNITS  |
|---------------------------------------------|---------------|-----------|------|-----|-----------|------|-----|---------------|------|-----|--------|
|                                             |               | MIN       | TYP  | MAX | MIN       | TYP  | MAX | MIN           | TYP  | MAX |        |
| INPUT CHARACTERISTICS                       |               |           |      |     |           |      |     |               |      |     |        |
| Offset Voltage<br>(Note 3)                  | 25            | -         | 0.5  | 4   | -         | 3    | 5   | -             | 3    | 5   | mV     |
|                                             | Full          | -         | 2    | 6   | -         | -    | 7   | -             | -    | 7   | mV     |
| Average Offset<br>Voltage Drift             | Full          | -         | 5    | -   | -         | 5    | -   | -             | 5    | -   | μV/°C  |
| Bias Current                                | 25            | -         | 1    | 15  | -         | 5    | 25  | -             | 5    | 25  | nA     |
|                                             | Full          | -         | 10   | 35  | -         | -    | 60  | -             | -    | 40  | nA     |
| Offset Current                              | 25            | -         | 1    | 15  | -         | 5    | 25  | -             | 5    | 25  | nA     |
|                                             | Full          | -         | 5    | 35  | -         | -    | 60  | -             | -    | 40  | nA     |
| Differential Input<br>Resistance (Note 2)   | 25            | 65        | 500  | -   | 40        | 300  | -   | 40            | 300  | -   | MΩ     |
| Input Noise Voltage<br>Density (f = 1kHz)   | 25            | -         | 11   | -   | -         | 11   | -   | -             | 11   | -   | nV/√Hz |
| Input Noise Current<br>Density (f = 1kHz)   | 25            | -         | 0.16 | -   | -         | 0.16 | -   | -             | 0.16 | -   | pA/√Hz |
| Common Mode Range                           | Full          | ±11       | ±12  | -   | ±11       | ±12  | -   | ±11           | ±12  | -   | V      |
| TRANSFER CHARACTERISTICS                    |               |           |      |     |           |      |     |               |      |     |        |
| Large Signal Voltage<br>Gain (Notes 4, 5)   | 25            | 100       | 150  | -   | 80        | 150  | -   | 80            | 150  | -   | kV/V   |
|                                             | Full          | 70        | -    | -   | 60        | -    | -   | 70            | -    | -   | kV/V   |
| Common Mode Rejection<br>Ratio (Note 6)     | Full          | 80        | 100  | -   | 74        | 100  | -   | 74            | 100  | -   | dB     |
| Minimum Stable Gain                         | 25            | 5         | -    | -   | 5         | -    | -   | 5             | -    | -   | V/V    |
| Gain Bandwidth Product<br>(Notes 4, 7, 8)   | 25            | -         | 100  | -   | -         | 100  | -   | -             | 100  | -   | MHz    |
| OUTPUT CHARACTERISTICS                      |               |           |      |     |           |      |     |               |      |     |        |
| Output Voltage Swing<br>(Note 4)            | Full          | ±10       | ±12  | -   | ±10       | ±12  | -   | ±10           | ±12  | -   | V      |
| Output Current<br>(Note 5)                  | 25            | ±15       | ±22  | -   | ±10       | ±18  | -   | ±10           | ±18  | -   | mA     |
| Full Power Bandwidth<br>(Notes 4, 5, 9, 13) | 25            | 400       | 600  | -   | 320       | 600  | -   | 320           | 600  | -   | kHz    |
| TRANSIENT RESPONSE (Note 8)                 |               |           |      |     |           |      |     |               |      |     |        |
| Rise Time<br>(Notes 4, 9, 10)               | 25            | -         | 17   | 45  | -         | 17   | 45  | -             | 17   | 45  | ns     |

3

OPERATIONAL  
AMPLIFIERS

# HA-2620, HA-2622, HA-2625

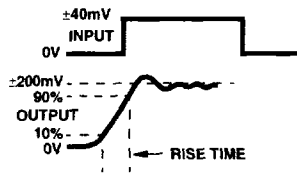
## Electrical Specifications $V_{SUPPLY} = \pm 15V$ , Unless Otherwise Specified (Continued)

| PARAMETER                              | TEMP.<br>(°C) | HA-2620-2 |     |     | HA-2622-2 |     |     | HA-2625-5, -9 |     |     | UNITS |
|----------------------------------------|---------------|-----------|-----|-----|-----------|-----|-----|---------------|-----|-----|-------|
|                                        |               | MIN       | TYP | MAX | MIN       | TYP | MAX | MIN           | TYP | MAX |       |
| Slew Rate<br>(Notes 4, 9, 10, 12)      | 25            | ±25       | ±35 | -   | ±20       | ±35 | -   | ±20           | ±35 | -   | V/μs  |
| <b>POWER SUPPLY CHARACTERISTICS</b>    |               |           |     |     |           |     |     |               |     |     |       |
| Supply Current                         | 25            | -         | 3   | 3.7 | -         | 3   | 4   | -             | 3   | 4   | mA    |
| Power Supply Rejection Ratio (Note 11) | Full          | 80        | 90  | -   | 74        | 90  | -   | 74            | 90  | -   | dB    |

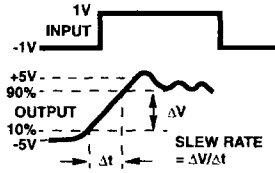
### NOTES:

- This parameter value guaranteed by design calculations.
- Offset may be externally adjusted to zero
- $R_L = 2k\Omega$ .
- $V_{OUT} = \pm 10V$ .
- $V_{CM} = \pm 10V$ .
- $V_{OUT} < 90mV$ .
- 40dB Gain.
- See Transient Response Test Circuits and Waveforms.
- $A_V = 5$  (The HA-2620 family is not stable at unity gain without external compensation).
- $\Delta V_S = \pm 5V$ .
- $V_{OUT} = \pm 5V$ .
- Full Power Bandwidth guaranteed by slew rate measurement:  $FPBW = \frac{\text{Slew Rate}}{2\pi V_{PEAK}}$

## Test Circuits and Waveforms

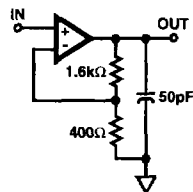


TRANSIENT RESPONSE

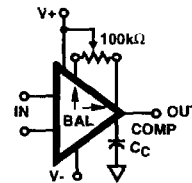


SLEW RATE

NOTE: Measured on both positive and negative transistions from 0V to +200mV and 0V to -200mV at output.



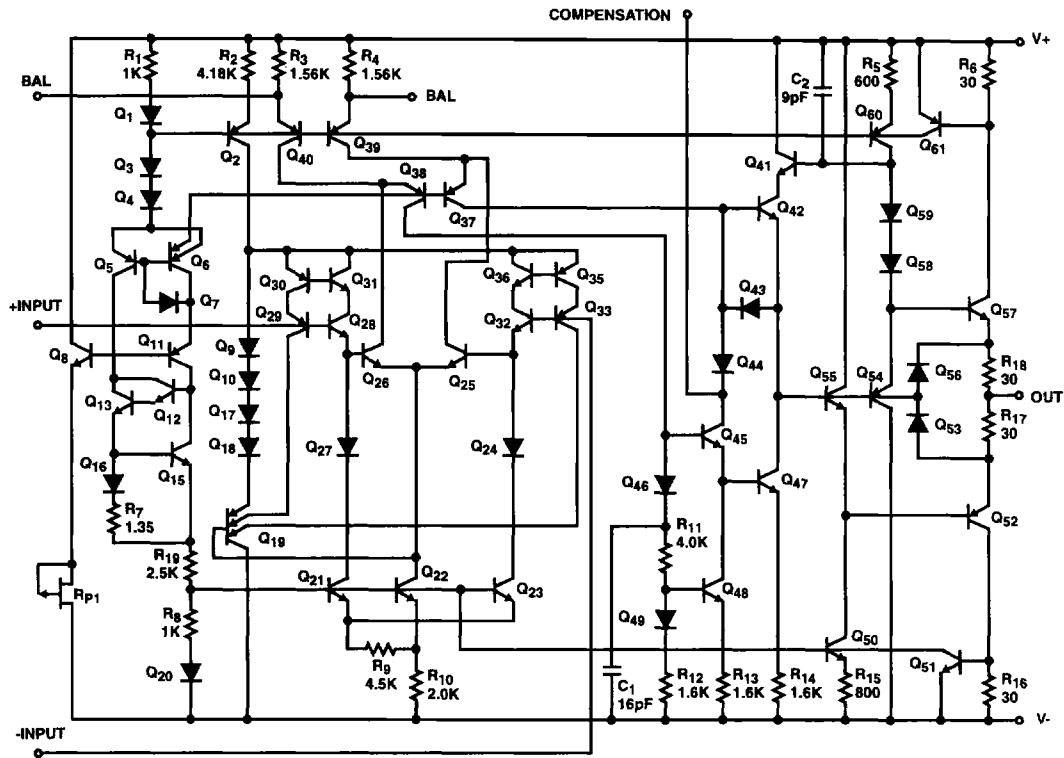
SLEW RATE AND TRANSIENT RESPONSE



NOTE: Tested Offset Adjustment is  $|V_{OS} + 1mV|$  minimum referred to output. Typical range is  $\pm 10mV$  with  $R_T = 100k\Omega$ .

SUGGESTED  $V_{OS}$  ADJUSTMENT AND COMPENSATION HOOK-UP

# Schematic Diagram



## Typical Applications

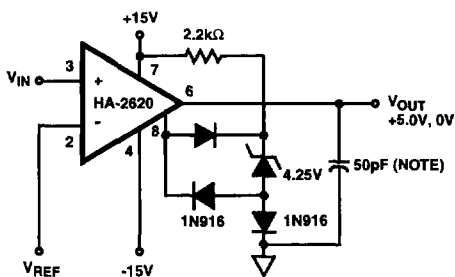


FIGURE 1. HIGH INPUT IMPEDANCE COMPARATOR

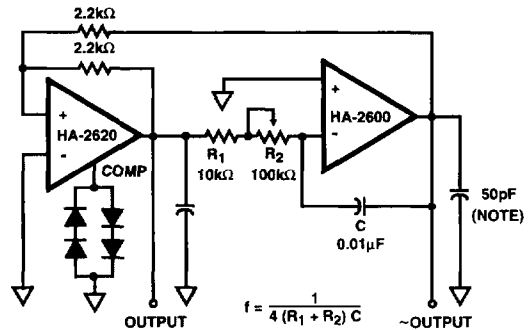
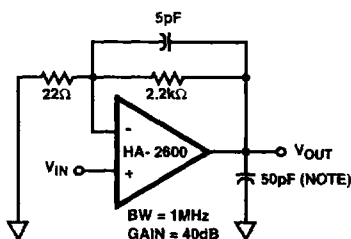


FIGURE 2. FUNCTION GENERATOR

# Typical Applications (Continued)



NOTE: A small load capacitance of at least 30pF (including stray capacitance) is recommended to prevent possible high frequency oscillations.

FIGURE 3. VIDEO AMPLIFIER

## Typical Performance Curves $V_S = \pm 15V$ , $T_A = 25^\circ C$ , Unless Otherwise Specified

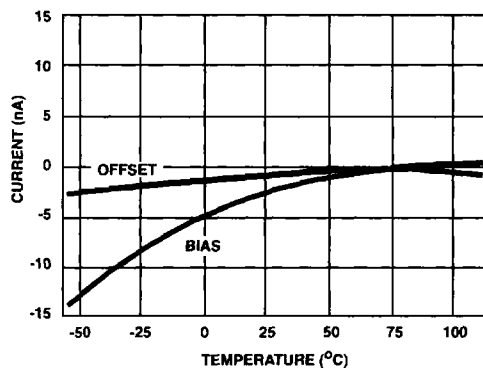


FIGURE 4. INPUT BIAS CURRENT AND OFFSET CURRENT vs TEMPERATURE

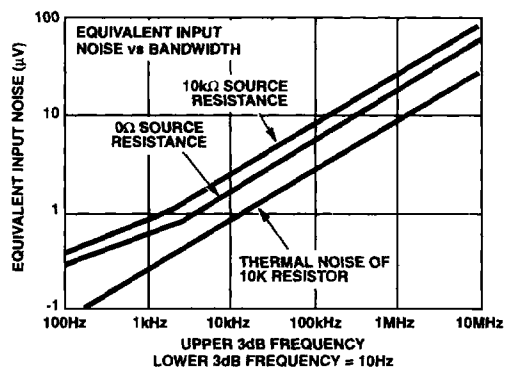


FIGURE 5. BROADBAND NOISE CHARACTERISTICS

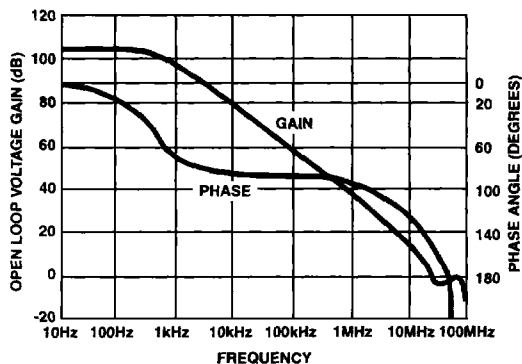


FIGURE 6. OPEN LOOP FREQUENCY RESPONSE

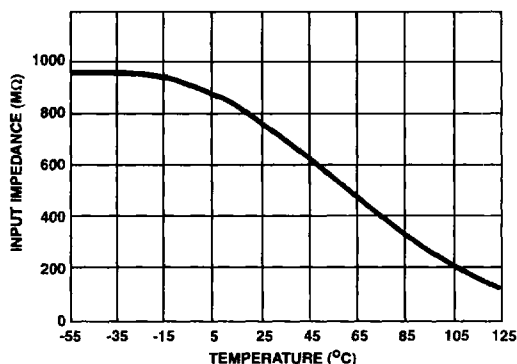


FIGURE 7. INPUT IMPEDANCE vs TEMPERATURE, 100Hz

**Typical Performance Curves**  $V_S = \pm 15V$ ,  $T_A = 25^\circ C$ , Unless Otherwise Specified (Continued)

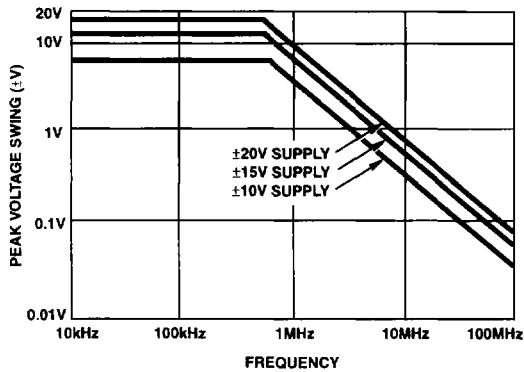
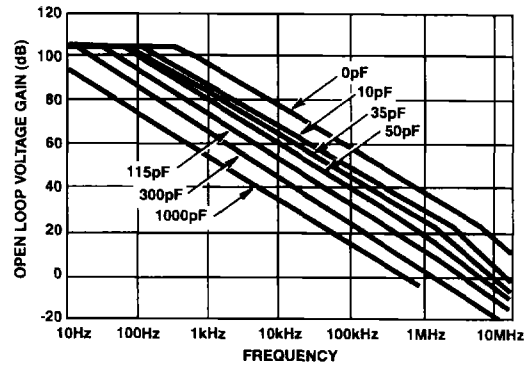


FIGURE 8. OUTPUT VOLTAGE SWING vs FREQUENCY



NOTE: External Compensation is required for closed loop gain < 5. If external compensation is used, also connect 100pF capacitor from output to ground.

FIGURE 9. OPEN LOOP FREQUENCY RESPONSE FOR VARIOUS VALUES OF CAPACITORS FROM COMP. PIN TO GND

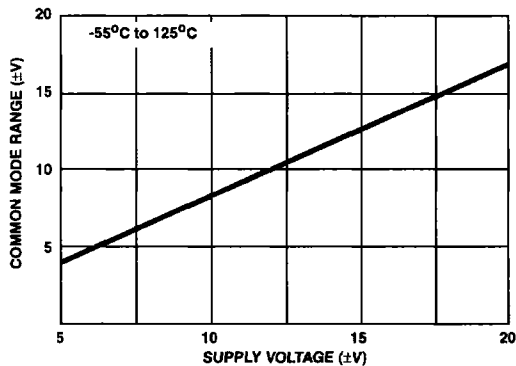


FIGURE 10. COMMON MODE VOLTAGE RANGE vs SUPPLY VOLTAGE

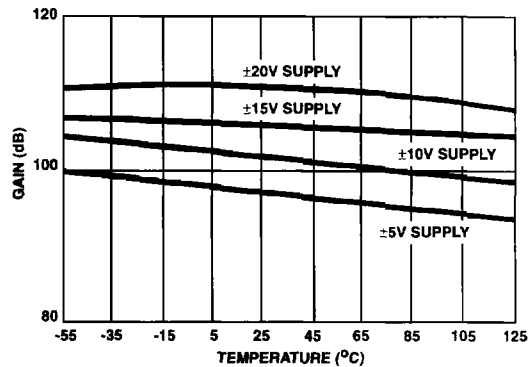


FIGURE 11. OPEN LOOP VOLTAGE GAIN vs TEMPERATURE

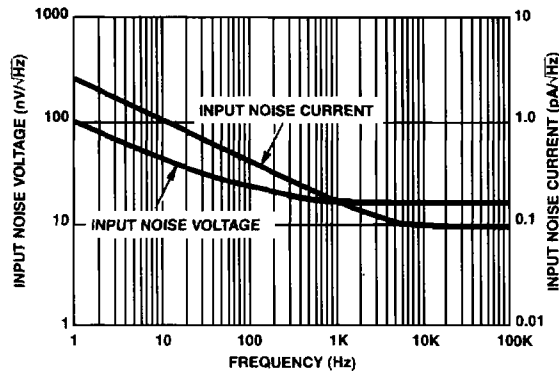


FIGURE 12. NOISE DENSITY vs FREQUENCY

## HA-2620, HA-2622, HA-2625

### Die Characteristics

#### DIE DIMENSIONS:

69 mils x 56 mils x 19 mils  
1750 $\mu$ m x 1420 $\mu$ m x 483 $\mu$ m

#### METALLIZATION:

Type: Al, 1% Cu  
Thickness: 16k $\text{\AA}$   $\pm$  2k $\text{\AA}$

#### SUBSTRATE POTENTIAL (Powered Up)

Unbiased

#### PASSIVATION:

Type: Nitride ( $\text{Si}_3\text{N}_4$ ) over Silox ( $\text{SiO}_2$ , 5% Phos.)  
Silox Thickness: 12k $\text{\AA}$   $\pm$  2k $\text{\AA}$   
Nitride Thickness: 3.5k $\text{\AA}$   $\pm$  1.5k $\text{\AA}$

#### TRANSISTOR COUNT:

140

#### PROCESS:

Bipolar Dielectric Isolation

### Metallization Mask Layout

HA-2620, HA-2622, HA-2625

