

**Die Characteristics**

**DIE DIMENSIONS:**

93 x 68 x 19 mils ± 1 mils  
 2360 x 1720 x 483µm ± 25.4µm

**METALLIZATION:**

Type: Al, 1% Cu  
 Thickness: 16kÅ ± 2kÅ

**GLASSIVATION:**

Type: Nitride (Si3N4) over Silox (SiO2, 5% Phos.)  
 Silox Thickness: 12kÅ ± 2kÅ  
 Nitride Thickness: 3.5kÅ ± 1.5kÅ

**WORST CASE CURRENT DENSITY:**

5.0 x 10<sup>4</sup> A/cm<sup>2</sup> at 12mA

**SUBSTRATE POTENTIAL (Powered Up):**

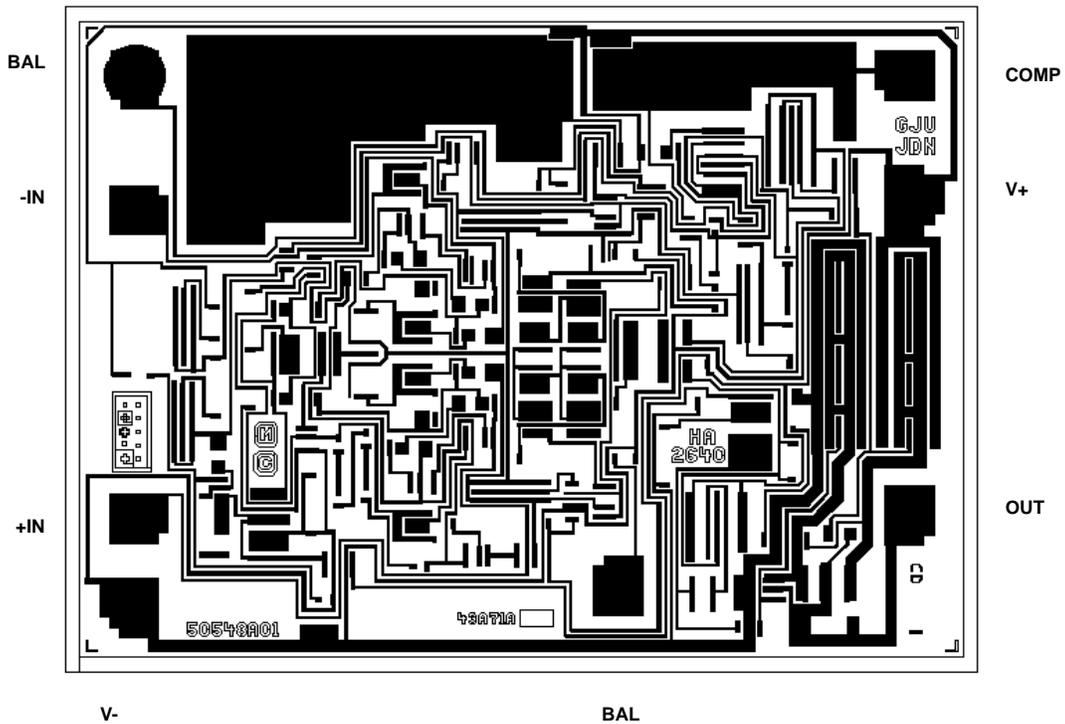
Unbiased

**TRANSISTOR COUNT: 76**

**PROCESS: HV200 Bipolar Dielectric Isolation**

**Metallization Mask Layout**

HA-2640/883



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## Specifications HA-2640/883

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Characterized at:  $V_{SUPPLY} = \pm 40V$ ,  $R_{LOAD} = 5k\Omega$ ,  $C_{LOAD} = 10pF$ ,  $A_V = 1V/V$ , Unless Otherwise Specified.

| PARAMETERS                      | SYMBOL           | CONDITIONS                        | NOTES | TEMPERATURE     | LIMITS |     | UNITS |
|---------------------------------|------------------|-----------------------------------|-------|-----------------|--------|-----|-------|
|                                 |                  |                                   |       |                 | MIN    | MAX |       |
| Differential Input Resistance   | $R_{IN}$         | $V_{CM} = 0V$                     | 1     | +25°C           | 50     | -   | MΩ    |
| Full Power Bandwidth            | FPBW             | $V_{PEAK} = 10V$                  | 1, 2  | +25°C           | 45     | -   | kHz   |
|                                 |                  | $V_{PEAK} = 35V$                  | 1, 2  | +25°C           | 13.6   | -   | kHz   |
| Minimum Closed Loop Stable Gain | CLSG             | $R_L = 5k\Omega$ , $C_L = 50pF$   | 1     | -55°C to +125°C | 1      | -   | V/V   |
| Output Short Circuit Current    | +I <sub>SC</sub> | $V_{OUT} = 0V$ , $R_L = 10\Omega$ | 1     | +25°C           | -      | 25  | mA    |
|                                 | -I <sub>SC</sub> | $V_{OUT} = 0V$ , $R_L = 10\Omega$ | 1     | +25°C           | -25    | -   | mA    |
| Output Resistance               | $R_{OUT}$        | Open Loop                         | 1     | +25°C           | -      | 600 | Ω     |
| Quiescent Power Consumption     | PC               | $V_{OUT} = 0V$ , $I_{OUT} = 0mA$  | 1, 3  | -55°C to +125°C | -      | 320 | mW    |

**NOTES:**

- Parameters listed in Table 3 are controlled via design or process parameters and are not directly tested at final production. These parameters are lab characterized upon initial design release, or upon design changes. These parameters are guaranteed by characterization based upon data from multiple production runs which reflect lot to lot and within lot variation.
- Full Power Bandwidth guarantee based on Slew Rate measurement using  $FPBW = \text{Slew Rate} / (2\pi V_{PEAK})$ .
- Power Consumption based upon Quiescent Supply Current test maximum. (No load on outputs.)

**TABLE 4. ELECTRICAL TEST REQUIREMENTS**

| MIL-STD-883 TEST REQUIREMENTS               | SUBGROUPS (SEE TABLES 1 AND 2) |
|---|--------------------------------|
| Interim Electrical Parameters (Pre Burn-In) | 1                              |
| Final Electrical Test Parameters            | 1 (Note 1), 2, 3, 4, 5, 6      |
| Group A Test Requirements                   | 1, 2, 3, 4, 5, 6               |
| Groups C and D Endpoints                    | 1                              |

**NOTE:**

- PDA applies to Subgroup 1 only.

## Specifications HA-2640/883

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

Device Tested at:  $V_{SUPPLY} = \pm 40V$ ,  $R_{SOURCE} = 100\Omega$ ,  $R_{LOAD} = 500k\Omega$ ,  $V_{OUT} = 0V$ , Unless Otherwise Specified.

| PARAMETERS                     | SYMBOL              | CONDITIONS  | GROUP A SUBGROUPS | TEMPERATURE   | LIMITS            |     | UNITS |
|--------------------------------|---------------------|---|-------------------|---------------|-------------------|-----|-------|
|                                |                     |   |                   |               | MIN               | MAX |       |
| Output Voltage Swing           | +V <sub>OUT</sub>   | R <sub>L</sub> = 5k $\Omega$  | 1                 | +25°C         | 35                | -   | V     |
|                                |                     |   | 2, 3              | +125°C, -55°C | 35                | -   | V     |
|                                | -V <sub>OUT</sub>   | R <sub>L</sub> = 5k $\Omega$  | 1                 | +25°C         | -                 | -35 | V     |
|                                |                     |   | 2, 3              | +125°C, -55°C | -                 | -35 | V     |
| Output Current                 | +I <sub>OUT</sub>   | V <sub>OUT</sub> = -10V   | 4                 | +25°C         | 12                | -   | mA    |
|                                | -I <sub>OUT</sub>   | V <sub>OUT</sub> = +10V   | 4                 | +25°C         | -                 | -12 | mA    |
| Quiescent Power Supply Current | +I <sub>CC</sub>    | V <sub>OUT</sub> = 0V, I <sub>OUT</sub> = 0mA   | 1                 | +25°C         | -                 | 3.8 | mA    |
|                                |                     |   | 2, 3              | +125°C, -55°C | -                 | 4.0 | mA    |
|                                | -I <sub>CC</sub>    | V <sub>OUT</sub> = 0V, I <sub>OUT</sub> = 0mA   | 1                 | +25°C         | -3.8              | -   | mA    |
|                                |                     |   | 2, 3              | +125°C, -55°C | -4.0              | -   | mA    |
| Power Supply Rejection Ratio   | +PSRR               | $\Delta V_{SUP} = 30V$ ,<br>V <sub>+</sub> = +10V, V <sub>-</sub> = -40V,<br>V <sub>+</sub> = +40V, V <sub>-</sub> = -40V | 4                 | +25°C         | 80                | -   | dB    |
|                                |                     |   | 5, 6              | +125°C, -55°C | 80                | -   | dB    |
|                                | -PSRR               | $\Delta V_{SUP} = 30V$ ,<br>V <sub>+</sub> = +40V, V <sub>-</sub> = -10V,<br>V <sub>+</sub> = +40V, V <sub>-</sub> = -40V | 4                 | +25°C         | 80                | -   | dB    |
|                                |                     |   | 5, 6              | +125°C, -55°C | 80                | -   | dB    |
| Offset Voltage Adjustment      | +V <sub>IOAdj</sub> | Note 1  | 1                 | +25°C         | V <sub>IO-1</sub> | -   | mV    |
|                                |                     |   | 2, 3              | +125°C, -55°C | V <sub>IO-1</sub> | -   | mV    |
|                                | -V <sub>IOAdj</sub> | Note 1  | 1                 | +25°C         | V <sub>IO+1</sub> | -   | mV    |
|                                |                     |   | 2, 3              | +125°C, -55°C | V <sub>IO+1</sub> | -   | mV    |

NOTE:

- Offset adjustment range is [V<sub>IO</sub>(Measured)  $\pm$ 1mV] minimum referred to output. This test is for functionality only to assure adjustment through 0V.

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at:  $V_{SUPPLY} = \pm 40V$ ,  $R_{SOURCE} = 50\Omega$ ,  $R_{LOAD} = 5k\Omega$ ,  $C_{LOAD} = 50pF$ ,  $A_{VCL} = +1V/V$ , Unless Otherwise Specified.

| PARAMETERS         | SYMBOL         | CONDITIONS   | GROUP A SUBGROUPS | TEMPERATURE | LIMITS |     | UNITS      |
|--------------------|----------------|--|-------------------|-------------|--------|-----|------------|
|                    |                |  |                   |             | MIN    | MAX |            |
| Slew Rate          | +SR            | V <sub>OUT</sub> = -3V to +3V  | 4                 | +25°C       | 3      | -   | V/ $\mu$ s |
|                    | -SR            | V <sub>OUT</sub> = +3V to -3V  | 4                 | +25°C       | 3      | -   | V/ $\mu$ s |
| Rise and Fall Time | T <sub>R</sub> | V <sub>OUT</sub> = 0 to +200mV<br>10% $\leq$ T <sub>R</sub> $\leq$ 90% | 4                 | +25°C       | -      | 135 | ns         |
|                    | T <sub>F</sub> | V <sub>OUT</sub> = 0 to -200mV<br>10% $\leq$ T <sub>F</sub> $\leq$ 90% | 4                 | +25°C       | -      | 135 | ns         |
| Overshoot          | +OS            | V <sub>OUT</sub> = 0 to +200mV   | 4                 | +25°C       | -      | 30  | %          |
|                    | -OS            | V <sub>OUT</sub> = 0 to -200mV   | 4                 | +25°C       | -      | 30  | %          |

# Specifications HA-2640/883

## Absolute Maximum Ratings

|  |                               |
|--|-------------------------------|
| Voltage Between V+ and V- Terminals    | 100V                          |
| Differential Input Voltage             | 37V                           |
| Output Current                         | Full Short Circuit Protection |
| Output Short Circuit Duration          | 5 Seconds                     |
| Junction Temperature (T <sub>J</sub> ) | +175°C                        |
| Storage Temperature Range              | -65°C to +150°C               |
| ESD Rating                             | <2000V                        |
| Lead Temperature (Soldering 10s)       | +300°C                        |

## Thermal Information

|  |               |               |
|--|---------------|---------------|
| Thermal Resistance   | $\theta_{JA}$ | $\theta_{JC}$ |
| CerDIP Package   | 115°C/W       | 28°C/W        |
| Ceramic LCC Package  | 65°C/W        | 15°C/W        |
| Metal Can Package  | 155°C/W       | 67°C/W        |
| Package Power Dissipation Limit at +75°C for T <sub>J</sub> ≤ +175°C |               |               |
| CerDIP Package   | 870mW         |               |
| Ceramic LCC Package  | 1.54W         |               |
| Metal Can Package  | 645mW         |               |
| Package Power Dissipation Derating Factor Above +75°C                |               |               |
| CerDIP Package   | 8.7mW/°C      |               |
| Ceramic LCC Package  | 15.4mW/°C     |               |
| Metal Can Package  | 6.5mW/°C      |               |

*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.*

## Operating Conditions

|                             |                 |                                   |
|-----------------------------|-----------------|-----------------------------------|
| Operating Temperature Range | -55°C to +125°C | V <sub>INCM</sub> ≤ 1/2 (V+ - V-) |
| Operating Supply Voltage    | ±10V to ±40V    | R <sub>L</sub> ≥ 500Ω             |

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at: V<sub>SUPPLY</sub> = ±40V, R<sub>SOURCE</sub> = 100Ω, R<sub>LOAD</sub> = 500kΩ, V<sub>OUT</sub> = 0V, Unless Otherwise Specified.

| PARAMETERS                  | SYMBOL            | CONDITIONS   | GROUP A SUBGROUPS | TEMPERATURE   | LIMITS |     | UNITS |
|-----------------------------|-------------------|--|-------------------|---------------|--------|-----|-------|
|                             |                   |  |                   |               | MIN    | MAX |       |
| Input Offset Voltage        | V <sub>IO</sub>   | V <sub>CM</sub> = 0V   | 1                 | +25°C         | -4     | 4   | mV    |
|                             |                   |  | 2, 3              | +125°C, -55°C | -6     | 6   | mV    |
| Input Bias Current          | +I <sub>B</sub>   | V <sub>CM</sub> = 0V,<br>+R <sub>S</sub> = 100kΩ,<br>-R <sub>S</sub> = 100Ω  | 1                 | +25°C         | -25    | 25  | nA    |
|                             |                   |  | 2, 3              | +125°C, -55°C | -50    | 50  | nA    |
|                             | -I <sub>B</sub>   | V <sub>CM</sub> = 0V,<br>+R <sub>S</sub> = 100Ω,<br>-R <sub>S</sub> = 100kΩ  | 1                 | +25°C         | -25    | 25  | nA    |
|                             |                   |  | 2, 3              | +125°C, -55°C | -50    | 50  | nA    |
| Input Offset Current        | I <sub>IO</sub>   | V <sub>CM</sub> = 0V,<br>+R <sub>S</sub> = 100kΩ,<br>-R <sub>S</sub> = 100kΩ | 1                 | +25°C         | -12    | 12  | nA    |
|                             |                   |  | 2, 3              | +125°C, -55°C | -35    | 35  | nA    |
| Common Mode Range           | +CMR              | V+ = 15V, V- = -65V  | 1                 | +25°C         | 25     | -   | V     |
|                             |                   |  | 2, 3              | +125°C, -55°C | 25     | -   | V     |
|                             | -CMR              | V+ = 65V, V- = -15V  | 1                 | +25°C         | -      | -25 | V     |
|                             |                   |  | 2, 3              | +125°C, -55°C | -      | -25 | V     |
| Large Signal Voltage Gain   | +A <sub>VOL</sub> | V <sub>OUT</sub> = 0V and +30V,<br>R <sub>L</sub> = 5kΩ                      | 4                 | +25°C         | 100    | -   | kV/V  |
|                             |                   |  | 5, 6              | +125°C, -55°C | 75     | -   | kV/V  |
|                             | -A <sub>VOL</sub> | V <sub>OUT</sub> = 0V and -30V,<br>R <sub>L</sub> = 5kΩ                      | 4                 | +25°C         | 100    | -   | kV/V  |
|                             |                   |  | 5, 6              | +125°C, -55°C | 75     | -   | kV/V  |
| Common Mode Rejection Ratio | +CMRR             | ΔV <sub>CM</sub> = +20V,<br>V+ = +20V, V- = -60V,<br>V <sub>OUT</sub> = -20V | 4                 | +25°C         | 80     | -   | dB    |
|                             |                   |  | 5, 6              | +125°C, -55°C | 80     | -   | dB    |
|                             | -CMRR             | ΔV <sub>CM</sub> = -20V,<br>V+ = +60V, V- = -20V,<br>V <sub>OUT</sub> = +20V | 4                 | +25°C         | 80     | -   | dB    |
|                             |                   |  | 5, 6              | +125°C, -55°C | 80     | -   | dB    |

### Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Output Voltage Swing .....  $\pm 35V$  (Min)
- Supply Voltage .....  $\pm 10V$  to  $\pm 40V$  (Min)
- Slew Rate .....  $3V/\mu s$  (Min)
- Common Mode Input Voltage Swing .....  $\pm 35V$  (Min)
- Offset Current ..... 12nA (Max)
- Unity Gain Bandwidth ..... 5MHz (Typ)
- Output Overload Protection

### Applications

- Industrial Control Systems
- Power Supplies
- High Voltage Regulators
- Resolver Excitation
- Signal Conditioning

### Description

HA-2640/883 monolithic operational amplifier is designed to deliver unprecedented dynamic specification for a high voltage internally compensated device. This dielectrically isolated device offer very low values for offset voltage and offset current coupled with large output voltage swing and common mode input voltage.

For maximum reliability, the HA-2640/883 offers unconditional output overload protection through output short circuit current limiting. This circuitry will limit the output to typically  $\pm 25mA$  output drive current.

These amplifiers deliver  $\pm 35V$  common mode input voltage swing,  $\pm 35V$  output voltage swing, and up to  $\pm 40V$  supply range for use in such designs as regulators, power supplies, and industrial control systems. The 5MHz typical gain-bandwidth product and  $5V/\mu s$  slew rate (typ) make these devices excellent components for high performance signal conditioning applications. To insure compliance, all devices are 100% tested for slew rate, rise/fall time and overshoot. Outstanding input and output voltage swings coupled with a low 5nA offset current (typ), make these amplifiers excellent components for resolver excitation designs.

### Ordering Information

| PART NUMBER  | TEMPERATURE RANGE | PACKAGE             |
|--------------|-------------------|---------------------|
| HA2-2640/883 | -55°C to +125°C   | 8 Pin Can           |
| HA4-2640/883 | -55°C to +125°C   | 20 Lead Ceramic LCC |
| HA7-2640/883 | -55°C to +125°C   | 8 Lead CerDIP       |

### Pinouts

