HARRIS

HA-2620/883
HA-2622/883

Very Wideband, High Impedance Uncompensated Operational Amplifiers

January 1989

Features

- **This Circuit Is Processed In Accordance to Mil-Std-883 and Is Fully Conformant Under the Provisions of Paragraph 1.2.1.**
- **High Input Impedance (HA-2620/883) .... 65MΩ Min**
- **High Gain (HA-2620/883) .... 100kV/V Min**
  150kV/V Typ
- **High Slew Rate (HA-2620/883) .... 25V/μs Min**
  35V/μs Typ
- **Low Input Bias Current (HA-2620/883) .... 15nA Max**
  5nA Typ
- **Low Input Offset Voltage (HA-2620/883) .. 4mV Max**
- **Wide Gain Bandwidth Product ($A_V \geq 5$) ... 100MHz Typ**
- **Output Short Circuit Protection**

Applications

- **Video and R.F. Amplifiers**
- **Pulse Amplifiers**
- **Audio Amplifiers and Filters**
- **High-Q Active Filters**
- **High Speed Comparators**

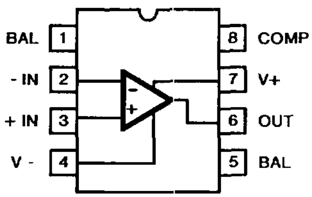
Description

HA-2620/883 and HA-2622/883 are bipolar operational amplifiers that feature very high input impedance coupled with wideband A.C. performance. The high resistance of the input stage is complemented by low offset voltage ($4mV_{max}$ @ +25°C for HA-2620/883) and low bias and offset current ($15nA_{max}$ @ +25°C for HA-2620/883) to facilitate accurate signal processing. Offset voltage can be reduced further by means of an external nulling potentiometer. With the HA-2620/883, which is stable for closed loop gains greater than 5, the 25V/μs minimum slew rate at +25°C and the 100kV/V minimum open loop gain at +25°C, enables the HA-2620/883 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 or video applications. The frequency response of the amplifier can be tailored to exact design requirements by means of an external bandwidth control capacitor. Other high performance designs such as high gain, low distortion audio amplifiers, high-Q and wideband active filters and high speed comparators are excellent uses of this part.

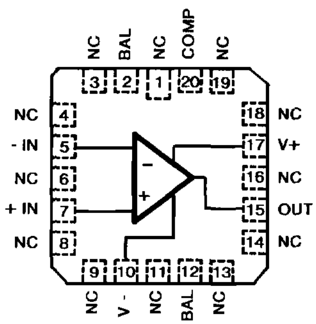
The HA-2620/883 and the HA-2622/883 are available as MIL-STD-883 compliant devices screened to class B level. These devices are sensitive to electrostatic discharge and are in microcircuit group number 49 (see MIL-M-38510, Appendix E). The HA-2620/883 and the HA-2622/883 have guaranteed operation over the military temperature range from -55°C to +125°C and are available in 8 pin Metal Can and Ceramic Mini-DIP packages. The HA-2622/883 is also available in a 20 pin Ceramic LCC package.

Pinouts

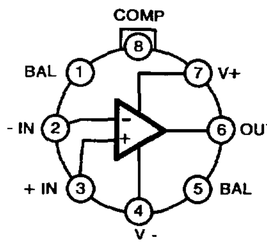
HA7-2620/883 (CERAMIC MINI-DIP)
HA7-2622/883 (CERAMIC MINI-DIP)
TOP VIEW



HA4-2622/883 (CERAMIC LCC)
TOP VIEW



HA2-2620/883 (METAL CAN)
HA2-2622/883 (METAL CAN)
TOP VIEW



Absolute Maximum Ratings

Voltage Between V+ and V- Terminals 40V
Differential Input Voltage 12V
Voltage at Either Input Terminal .... V+ to V-
Peak Output Current .... Full Short Circuit Protection
Junction Temperature (T_J) .... +175°C
Storage Temperature Range .... -65°C to +150°C
ESD Rating .... < 2000V
Lead Temperature (Soldering 10 sec) .... 275°C

CAUTION: 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.

Thermal Information

Thermal Resistance	θ_{ja}	θ_{jc}
Ceramic DIP Package	82°C/W	28°C/W
Ceramic LCC Package	74°C/W	20°C/W
Metal Can Package	136°C/W	41°C/W

Package Power Dissipation Limit at +75°C for $T_J \leq$ +175°C
Ceramic DIP Package 730mW
Ceramic LCC Package 1.35W
Metal Can Package 740mW

Package Power Dissipation Derating Factor Above +75°C
Ceramic DIP Package .... 7.4mW/°C
Ceramic LCC Package .... 13.4mW/°C
Metal Can Package .... 7.4mW/°C

Recommended Operating Conditions

Operating Temperature Range .... -55°C to +125°C
Operating Supply Voltage .... ±15V
$V_{INcm} \leq$ 1/2 (V+ - V-)
$R_L \geq$ 2kΩ

TABLE 1. D.C. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: Supply Voltage = ±15V, R_{SOURCE} = 100Ω, R_{LOAD} = 500kΩ, V_{OUT} = 0V, Unless Otherwise Specified.

D.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	HA-2620/883 MIN	HA-2620/883 MAX	HA-2622/883 MIN	HA-2622/883 MAX	UNITS
Input Offset Voltage	V_{IO}	V_{CM} = 0V	1	+25°C	-4	4	-5	5	mV
			2, 3	+125°C, -55°C	-6	6	-7	7	mV
Input Bias Current	$+I_B$	V_{CM} = 0V $+R_S$ = 100kΩ $-R_S$ = 100Ω	1	+25°C	-15	15	-25	25	nA
			2, 3	+125°C, -55°C	-30	30	-60	60	nA
	$-I_B$	V_{CM} = 0V $+R_S$ = 100Ω $-R_S$ = 100kΩ	1	+25°C	-15	15	-25	25	nA
			2, 3	+125°C, -55°C	-30	30	-60	60	nA
Input Offset Current	I_{IO}	V_{CM} = 0V $+R_S$ = 100kΩ $-R_S$ = 100kΩ	1	+25°C	-15	15	-25	25	nA
			2, 3	+125°C, -55°C	-30	30	-60	60	nA
Common Mode Range	+CMR	V+ = 4V V- = -26V	1	+25°C	11	-	11	-	V
			2, 3	+125°C, -55°C	11	-	11	-	V
	-CMR	V+ = 26V V- = -4V	1	+25°C	-	-11	-	-11	V
			2, 3	+125°C, -55°C	-	-11	-	-11	V
Large Signal Voltage Gain	$+A_{VOL}$	V_{OUT} = 0V and +10V R_L = 2kΩ	4	+25°C	100	-	80	-	kV/V
			5, 6	+125°C, -55°C	70	-	60	-	kV/V
	$-A_{VOL}$	V_{OUT} = 0V and -10V R_L = 2kΩ	4	+25°C	100	-	80	-	kV/V
			5, 6	+125°C, -55°C	70	-	60	-	kV/V
Common Mode Rejection Ratio	+CMRR	ΔV_{CM} = +10V +V = +5V -V = -25V V_{OUT} = -10V	1	+25°C	80	-	74	-	dB
			2, 3	+125°C, -55°C	80	-	74	-	dB
	-CMRR	ΔV_{CM} = -10V +V = +25V -V = -5V V_{OUT} = +10V	1	+25°C	80	-	74	-	dB
			2, 3	+125°C, -55°C	80	-	74	-	dB

CAUTION: This device is sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed.

TABLE 1. D.C. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: Supply Voltage = ±15V, R_{SOURCE} = 100Ω, R_{LOAD} = 500kΩ, V_{OUT} = 0V, Unless Otherwise Specified.

D.C. PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	HA-2620/883		HA-2622/883		UNITS
					MIN	MAX	MIN	MAX	
Output Voltage Swing	$+V_{OUT}$	R_L = 2kΩ	4	+25°C	10	-	10	-	V
			5, 6	+125°C, -55°C	10	-	10	-	V
	$-V_{OUT}$	R_L = 2kΩ	4	+25°C	-	-10	-	-10	V
			5, 6	+125°C, -55°C	-	-10	-	-10	V
Output Current	$+I_{OUT}$	V_{OUT} = -10V	4	+25°C	15	-	10	-	mA
			5, 6	+125°C, -55°C	10	-	7.5	-	mA
	$-I_{OUT}$	V_{OUT} = +10V	4	+25°C	-	-15	-	-10	mA
			5, 6	+125°C, -55°C	-	-10	-	-7.5	mA
Quiescent Power Supply Current	$+I_{CC}$	V_{OUT} = 0V	1	+25°C	-	3.7	-	3.7	mA
		I_{OUT} = 0mA	2, 3	+125°C, -55°C	-	4.0	-	4.0	mA
	$-I_{CC}$	V_{OUT} = 0V	1	+25°C	-3.7	-	-3.7	-	mA
		I_{OUT} = 0mA	2, 3	+125°C, -55°C	-4.0	-	-4.0	-	mA
Power Supply Rejection Ratio	+PSRR	ΔV_{SUP} = ± 5 +V = +10V, -V = -15V +V = +20V, -V = -15V	1	+25°C	80	-	74	-	dB
			2, 3	+125°C, -55°C	80	-	74	-	dB
	-PSRR	ΔV_{SUP} = ± 5V +V = +15V, -V = -10V +V = +15V, -V = -20V	1	+25°C	80	-	74	-	dB
			2, 3	+125°C, -55°C	80	-	74	-	dB

TABLE 2. A.C. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: Supply Voltage = ±15V, R_{SOURCE} = 50Ω, R_{LOAD} = 2kΩ, C_{LOAD} = 50pF, A_{VCL} = +5V/V, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	HA-2620/883		HA-2622/883		UNITS
					MIN	MAX	MIN	MAX	
Slew Rate	+SR	V_{OUT} = -5V to +5V	7	+25°C	25	-	20	-	V/μs
			8A, 8B	+125°C, -55°C	20	-	15	-	V/μs
	-SR	V_{OUT} = +5V to -5V	7	+25°C	25	-	20	-	V/μs
			8A, 8B	+125°C, -55°C	20	-	15	-	V/μs
Rise & Fall Time	T_R	V_{OUT} = 0 to +200mV 10% ≤ T_R ≤ 90%	7	+25°C	-	45	-	45	ns
			8A, 8B	+125°C, -55°C	-	60	-	70	ns
	T_F	V_{OUT} = 0 to -200mV 10% ≤ T_F ≤ 90%	7	+25°C	-	45	-	45	ns
			8A, 8B	+125°C, -55°C	-	60	-	70	ns
Overshoot	+OS	V_{OUT} = 0 to +200mV	7	+25°C	-	70	-	80	%
			8A, 8B	+125°C, -55°C	-	70	-	80	%
	-OS	V_{OUT} = 0 to -200mV	7	+25°C	-	70	-	80	%
			8A, 8B	+125°C, -55°C	-	70	-	80	%

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: Supply Voltage = ±15V, R_{LOAD} = 2kΩ, C_{LOAD} = 50pF, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	HA-2620/883		HA-2622/883		UNITS
					MIN	MAX	MIN	MAX	
Differential Input Resistance	R_{IN}	V_{CM} = 0V	1	+25°C	65	-	40	-	MΩ
Full Power Bandwidth	FPBW	V_{PEAK} = 10V	1, 2	+25°C	400	-	320	-	kHz
Minimum Closed Loop Stable Gain	CLSG	R_L = 2kΩ, C_L = 50pF	1	-55°C to +125°C	5	-	5	-	V/V
Output Short Circuit Current	$+I_{SC}$	V_{OUT} = 1V, R_L = 10Ω	1	+25°C	-	50	-	50	mA
			1	+125°C	-	45	-	45	mA
			1	-55°C	-	60	-	60	mA
	$-I_{SC}$	V_{OUT} = -1V, R_L = 10Ω	1	+25°C	-50	-	-50	-	mA
			1	+125°C	-45	-	-45	-	mA
			1	-55°C	-60	-	-60	-	mA
Output Resistance	R_{OUT}	Open Loop	1	+25°C	-	30	-	30	Ω
Quiescent Power Consumption	PC	V_{OUT} = 0V, I_{OUT} = 0mA	1, 3	-55°C to +125°C	-	240	-	240	mW

NOTES: 1. 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.

2. Full Power Bandwidth guarantee based on Slew Rate measurement using FPBW = Slew Rate/($2\pi V_{PEAK}$).

3. Quiescent Power Consumption based upon Quiescent Supply Current test maximum. (No load on outputs.)

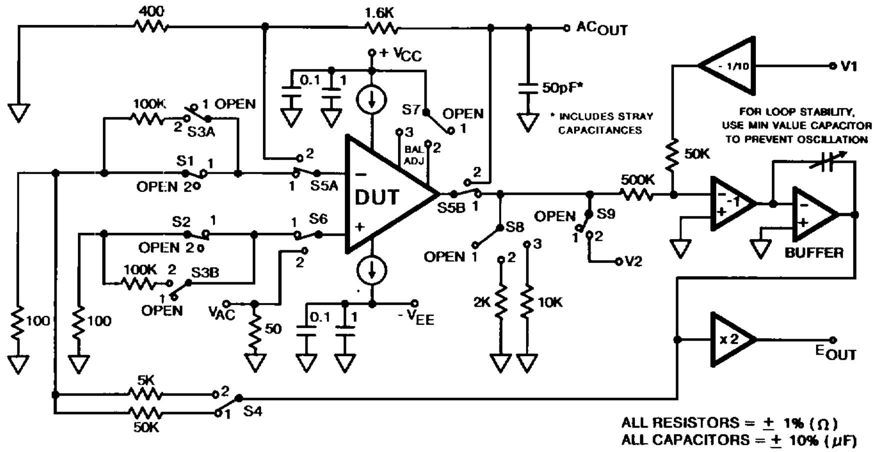
TABLE 4. ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUPS (SEE TABLES 1 & 2)
Interim Electrical Parameters (Pre Burn-In)	1
Final Electrical Test Parameters	1*, 2, 3, 4, 5, 6, 7, 8A, 8B
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7, 8A, 8B
Groups C & D Endpoints	1

* PDA applies to Subgroup 1 only.

The Subgroup assignment of the parameters in these tables were patterned after Mil-M-38510/112, device type 03.

Test Circuit (Applies to Table 1 and 2)

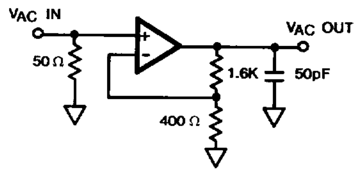


ALL RESISTORS = ± 1% (Ω)
ALL CAPACITORS = ± 10% (μF)

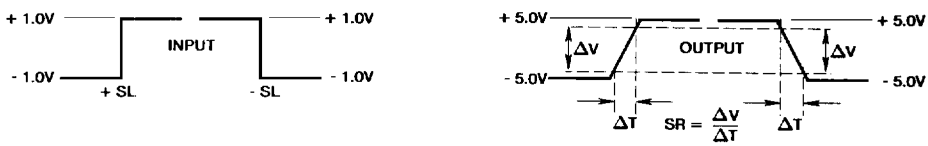
For Detailed Information, Refer to HA-2620/883; HA-2622/883 Test Tech Brief

Test Waveforms

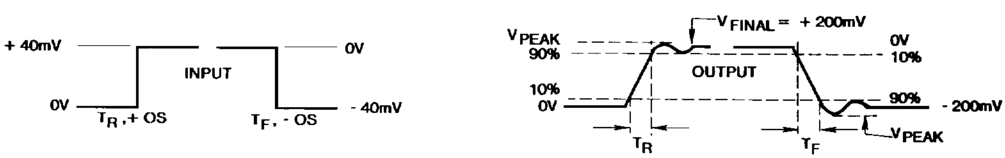
SIMPLIFIED TEST CIRCUIT (Applies to Table 2)



SLEW RATE WAVEFORMS



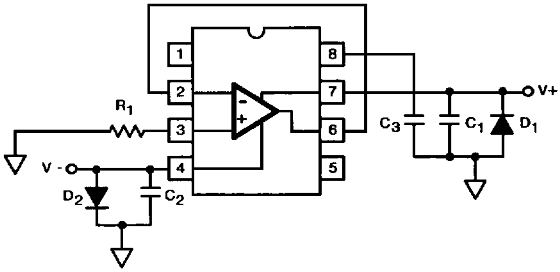
OVERSHOOT, RISE & FALL TIME WAVEFORMS



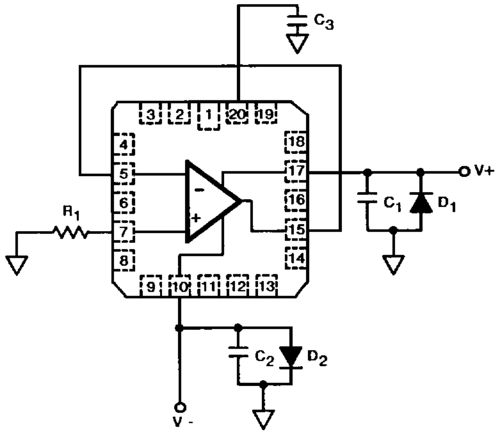
NOTE: Measured on both positive and negative transitions.
Capacitance at Compensation pin should be minimized.

Burn-In Circuits

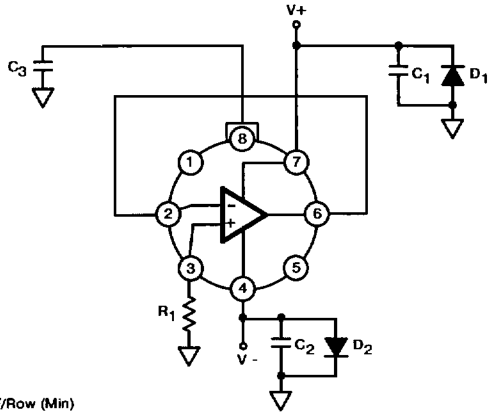
HA7-2620/883 CERAMIC MINI-DIP
HA7-2622/883 CERAMIC MINI-DIP



HA4-2622/883 CERAMIC LCC



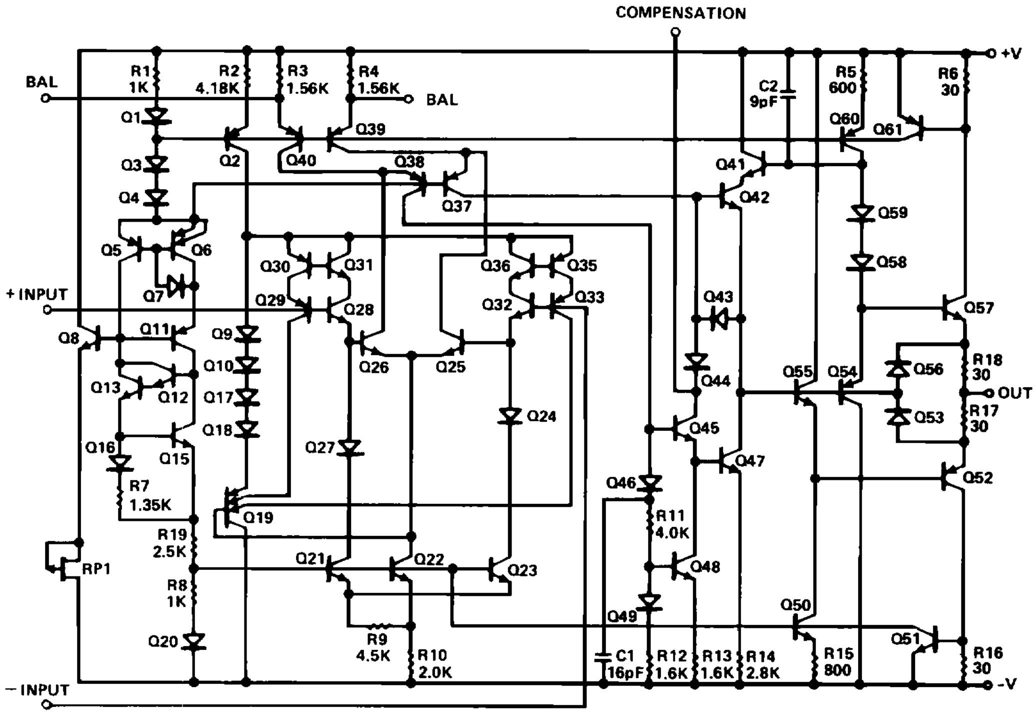
HA2-2620/883 (TO-99) METAL CAN
HA2-2622/883 (TO-99) METAL CAN



NOTES:

R_1 = 1MΩ, ±5%, 1/4W (Min)
$C_1 = C_2$ = 0.01µF/Socket (Min) or 0.1µF/Row (Min)
C_3 = 0.01µF/Socket (10%)
$D_1 = D_2$ = IN4002 or Equivalent/Board
$|(V+) - (V-)| = 30V$

Schematic Diagram



Die Characteristics

DIE DIMENSIONS:
73 x 52 x 19 mils
(1860 x 1320 x 483 μm)

METALLIZATION:
Type: Aluminum
Thickness: 16kÅ ± 2kÅ

WORST CASE CURRENT DENSITY:
$1.5 \times 10^5 A/cm^2$ @ 19mA

SUBSTRATE POTENTIAL (Powered Up):
Unbiased

GLASSIVATION:
Type: Nitride
Thickness: 7kÅ ± 0.7kÅ

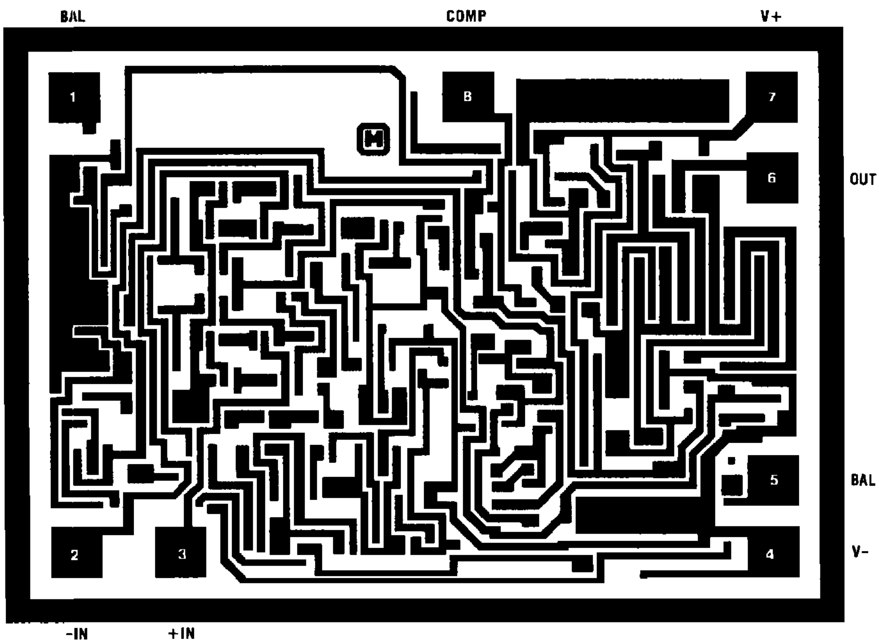
TRANSISTOR COUNT:
HA-2620/883: 140
HA-2622/883: 140

PROCESS: Std. Linear Bipolar Dielectric Isolation

DIE ATTACH:
Material: Gold/Silicon Eutectic Alloy
Temperature: Ceramic DIP — 460°C (Max)
Ceramic LCC — 420°C (Max)
Metal Can — 420°C (Max)

Metallization Mask Layout

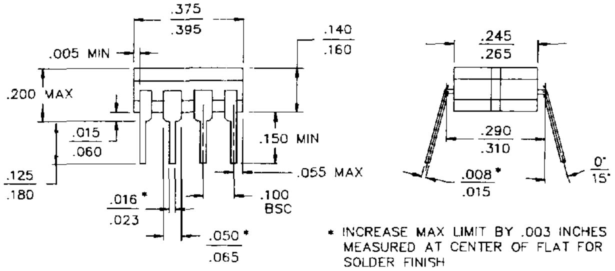
HA-2620/883 HA-2622/883



NOTE: Pin Numbers Correspond to 8 Pin Metal Can and Ceramic Mini-Dip Packages Only.

Packaging †

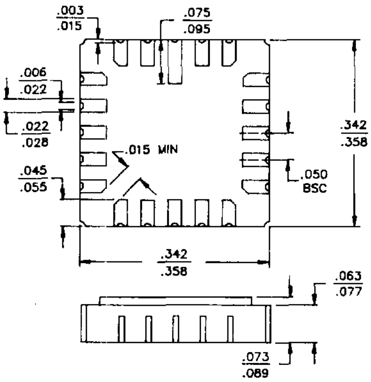
8 PIN CERAMIC DIP



* INCREASE MAX LIMIT BY .003 INCHES MEASURED AT CENTER OF FLAT FOR SOLDER FINISH

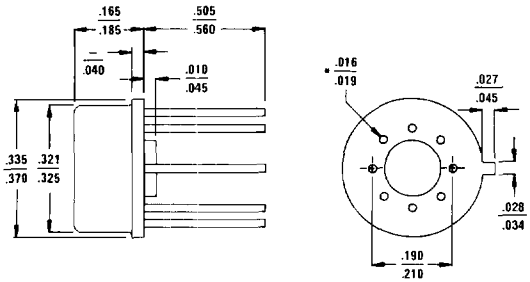
LEAD MATERIAL: Type B
LEAD FINISH: Type A
PACKAGE MATERIAL: Ceramic, 90% Alumina
PACKAGE SEAL:
Material: Glass Frit
Temperature: 450°C ± 10°C
Method: Furnace Seal
INTERNAL LEAD WIRE:
Material: Aluminum
Diameter: 1.25 Mil
Bonding Method: Ultrasonic
COMPLIANT OUTLINE: 38510 D-4

20 PAD CERAMIC LCC



PAD MATERIAL: Type C
PAD FINISH: Type A
FINISH DIMENSION: Type A
PACKAGE MATERIAL: Ceramic, 90% Al_2O_3
PACKAGE SEAL:
Material: Gold/Tin (80/20)
Temperature: 320°C ± 10°C
Method: Furnace Braze
INTERNAL LEAD WIRE:
Material: Aluminum
Diameter: 1.25 Mil
Bonding Method: Ultrasonic
COMPLIANT OUTLINE: 38510 C-2

8 PIN TO-99 METAL CAN



LEAD MATERIAL: Type A
LEAD FINISH: Type C
PACKAGE MATERIAL: Kovar Header with Nickel Can
PACKAGE SEAL:
Material: No Seal Material
Temperature: Room Temperature
Method: Resistance Weld
INTERNAL LEAD WIRE:
Material: Aluminum
Diameter: 1.25 Mil
Bonding Method: Ultrasonic Bonded
COMPLIANT OUTLINE: 38510 A-1

*Dimension Maximum Limits Are Increased by 0.003 inches for Solder Dip Finish

NOTE: All Dimensions are $\frac{\text{Min}}{\text{Max}}$, Dimensions are in inches.

† Mil-M-38510 Compliant Materials, Finishes, and Dimensions.

HARRIS

HA-2620
HA-2622

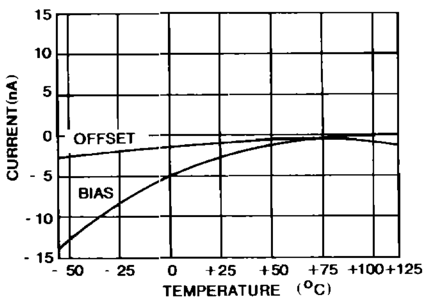
DESIGN INFORMATION

Very Wideband, Uncompensated Operational Amplifiers

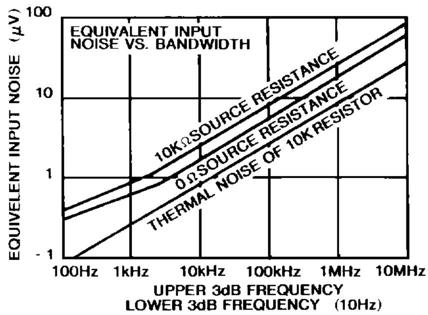
The information contained in this section has been developed through characterization by Harris Semiconductor and is for use as application and design aid only. These characteristics are not 100% tested and no product guarantee is implied.

Typical Performance Curves
Unless Otherwise Specified: $T_A = +25^oC$, $V_{SUPPLY} = \pm 15V$

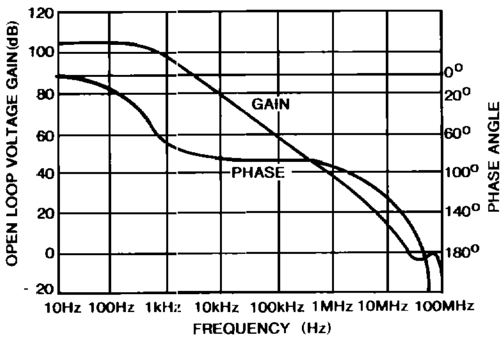
INPUT BIAS CURRENT AND OFFSET CURRENT AS A FUNCTION OF TEMPERATURE



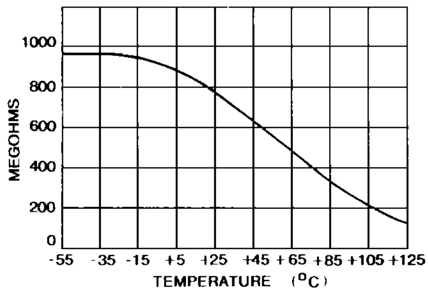
EQUIVALENT INPUT NOISE vs. BANDWIDTH



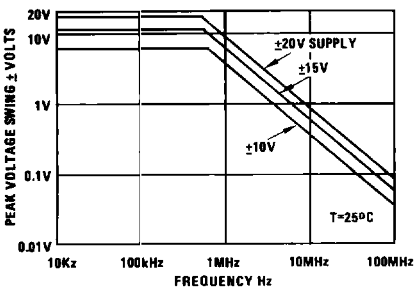
OPEN LOOP FREQUENCY AND PHASE RESPONSE



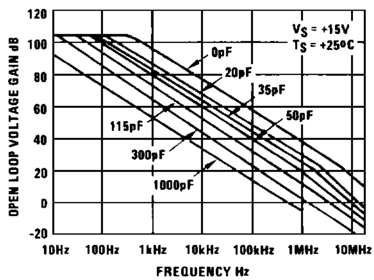
INPUT IMPEDANCE vs. TEMPERATURES, 100Hz



OUTPUT VOLTAGE SWING vs. FREQUENCY



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



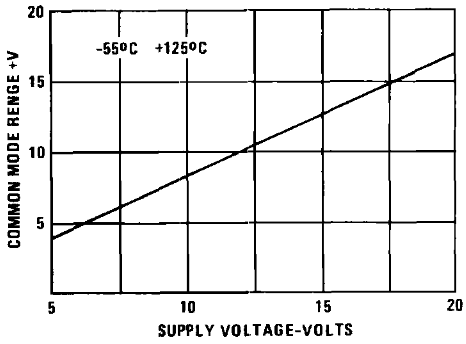
NOTE: External compensation components is required for Closed Loop Gain ≤ 5. If external compensation is used, also connect 100pF Capacitor from output to ground for H.F. filtering.

DESIGN INFORMATION (Continued)

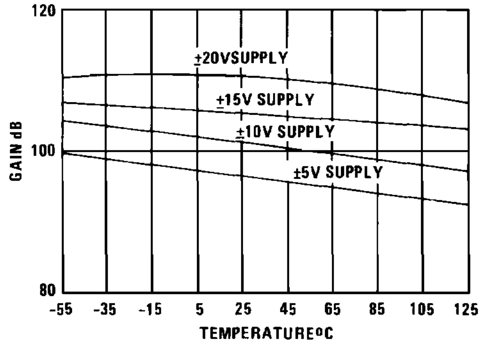
The information contained in this section has been developed through characterization by Harris Semiconductor and is for use as application and design aid only. These characteristics are not 100% tested and no product guarantee is implied.

Typical Performance Curves Unless Otherwise Specified: T_A = +25°C, V_{SUPPLY} = ±15V

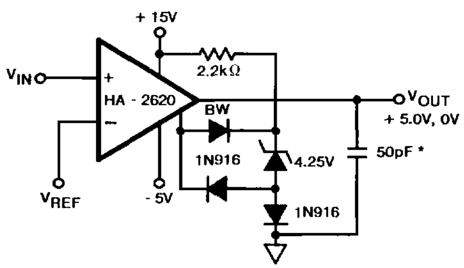
COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE



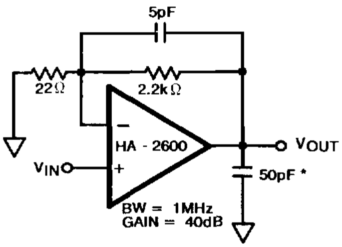
OPEN LOOP VOLTAGE GAIN vs. TEMPERATURE



HIGH IMPEDANCE COMPARATOR

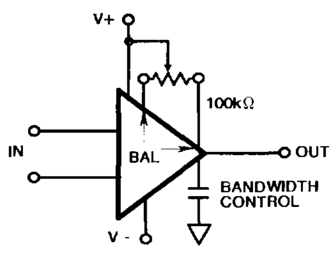


VIDEO AMPLIFIER

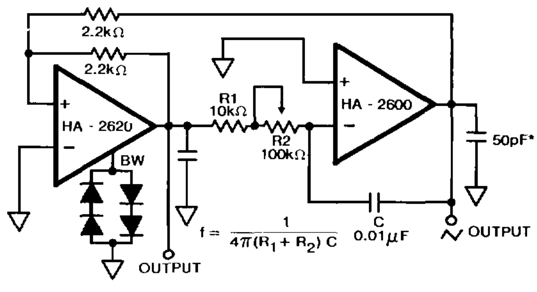


* A small load capacitance of at least 30pF (including stray capacitance) is recommended to prevent high frequency oscillations.

SUGGESTED V_{OS} ADJUSTMENT AND COMPENSATION HOOK-UP



FUNCTION GENERATOR



DESIGN INFORMATION (Continued)

The information contained in this section has been developed through characterization by Harris Semiconductor and is for use as application and design aid only. These characteristics are not 100% tested and no product guarantee is implied.

TYPICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: V_S = ±15V, R_L = 2K, C_L = 50pF, $A_V \leq 5$, Unless Otherwise Specified.

PARAMETERS	CONDITIONS	TEMP	HA-2620 TYPICAL	HA-2622 TYPICAL	DESIGN LIMIT	UNITS
Offset Voltage	V_{CM} = 0V	+25°C	0.5	3	Table 1	mV
		Full	2	4	Table 1	mV
Offset Voltage Average Drift	Versus Temperature	Full	5	5	15	μV/°C
Offset Current Average Drift	Versus Temperature	Full	100	100	200	pA/°C
Differential Input Resistance		+25°C	500	300	Table 3	MΩ
Input Noise Voltage Density	f_O = 10Hz	+25°C	45	45	60	$nV/\sqrt{Hz}$
	f_O = 100Hz	+25°C	25	25	40	$nV/\sqrt{Hz}$
	f_O = 1kHz to 100kHz	+25°C	15	15	Table 3	$nV/\sqrt{Hz}$
Input Noise Current Density	f_O = 10Hz	+25°C	1	1	2	$pA/\sqrt{Hz}$
	f_O = 100Hz	+25°C	0.25	0.25	0.5	$pA/\sqrt{Hz}$
	f_O = 1kHz to 100kHz	+25°C	0.16	0.16	0.3	$pA/\sqrt{Hz}$
Output Voltage Swing	R_L = 2kΩ	Full	±12	±12	Table 1	V
Large Signal Voltage Gain	V_{OUT} = ±10V	+25°C	150	150	Table 1	kV/V
CMRR	V_{CM} = ±10V	Full	100	100	Table 1	dB
PSRR	ΔV_{Supply} = ±10V	Full	90	90	Table 1	dB
Gain Bandwidth Product (Small Signal)	f_O = 10kHz, C_{COMP} = 0pF	+25°C	100	100	80	MHz
	f_O = 1MHz, C_{COMP} = 0pF	+25°C	100	100	60	MHz
Rise/Fall Time	V_{OUT} = ±200mV	+25°C	17	17	Table 2	ns
Overshoot	V_{OUT} = ±200mV	+25°C	35	35	Table 2	%
Slew Rate	V_{OUT} = ±10V	+25°C	±35	±35	Table 2	V/μs
Full Power Bandwidth	V_{PEAK} = 10V, (Note 2)	+25°C	600	600	Table 3	kHz
Settling Time	10V Step to 0.1%	+25°C	1	1	2	μs
Output Resistance	Open Loop	+25°C	30	30	65	Ω
Minimum Supply Voltage	Functional Operation Only. Other Parameters Will Vary.	+25°C	±7	±7	±8V	V

3

OP AMPs & COMPARATORS