

/883 Version Obsolete
 Replace with Equivalent SMD Device
 (See "Ordering Information" Table Below)
 or contact our Technical Support Center at
 1-888-INTERSIL or www.intersil.com/tsc

HA-5221/883

**Low Noise, Wideband,
 Precision Operational Amplifier**

Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Gain Bandwidth Product 100MHz (Min)
- Unity Gain Bandwidth 30MHz (Min)
 40MHz (Typ)
- High Slew Rate 25V/μs (Min)
 37V/μs (Typ)
- Low Offset Voltage 0.75mV (Max)
 0.30mV (Typ)
- High Open Loop Gain 106dB (Min)
 128dB (Typ)
- Low Voltage Noise (at 1kHz) 5.8nV/√Hz (Max)
 3.6nV/√Hz (Typ)
- Low Current Noise (at 1kHz) 2.0pA/√Hz (Max)
 1.4pA/√Hz (Typ)
- High Output Current ±30mA (Min)
 ±56mA (Typ)
- Low Supply Current 10mA (Max)
 8mA (Typ)

Applications

- Precision Test Systems
- Active Filtering
- Small Signal Video
- Accurate Signal Processing
- RF Signal Conditioning

Description

The HA-5221/883 is a high performance, dielectrically isolated, monolithic op amp, featuring precision DC characteristics while providing excellent AC characteristics. Designed for audio, video, and other demanding applications, noise (3.6nV/√Hz at 1kHz typ), total harmonic distortion (<0.005% typ), and DC errors are kept to a minimum.

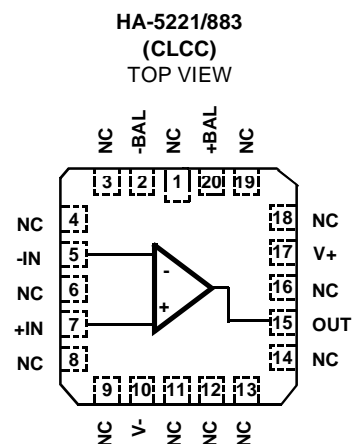
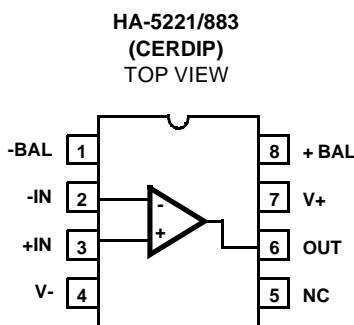
The precision performance is shown by low offset voltage (0.3mV typ), low bias currents (40nA typ), low offset currents (15nA typ), and high open loop gain (128dB typ). The combination of these excellent DC characteristics with fast settling time (0.4μs typ) make the HA-5221/883 ideally suited for precision signal conditioning.

The unique design of the HA-5221/883 gives this device outstanding AC characteristics, including high unity gain bandwidth (40MHz typ) and high slew rate (37V/μs typ), not normally associated with precision op amps. Other key specifications include high CMRR (95dB typ) and high PSRR (100dB typ). The combination of these specifications will allow the HA-5221/883 to be used in RF signal conditioning as well as video amplifiers.

Ordering Information

OBSOLETE PART NUMBER	SMD NO.	TEMP RANGE (°C)	PACKAGE
HA4-5221/883	5962-9163401M2A	-55 to 125	20 Ld CLCC
HA7-5221/883	5962-9163401MPA	-55 to 125	8 Ld CERDIP

Pinouts



Absolute Maximum Ratings

Voltage Between V+ and V- Terminals 36V
 Differential Input Voltage 5V
 Voltage at Either Input Terminal V+ to V-
 Peak Output Current (Pulsed at 1ms, 10% Duty Cycle) 100mA
 Continuous Output Current Short Circuit Protected
 Junction Temperature +175°C
 Storage Temperature Range -65°C to +150°C
 ESD Rating <2000V
 Lead Temperature (Soldering 10s) +300°C

Thermal Information

Thermal Resistance θ_{JA} θ_{JC}
 CerDIP Package 110°C/W 27°C/W
 Ceramic LCC Package 64°C/W 13°C/W
 Metal Can Package 148°C/W 67°C/W
 Package Power Dissipation Limit at +75°C
 CerDIP Package 0.91W
 Ceramic LCC Package 1.56W
 Metal Can Package 0.68W
 Package Power Dissipation Derating Factor Above +75°C
 CerDIP Package 9.1mW/°C
 Ceramic LCC Package 15.6mW/°C
 Metal Can Package 6.8mW/°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 $V_{INCM} \leq 1/2 (V+ - V-)$
 Operating Supply Voltage ±10V to ±15V $R_L \geq 1k\Omega$

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 1k\Omega$, $V_{OUT} = 0V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Offset Voltage	V_{IO}	$V_{CM} = 0V$	1	+25°C	-0.75	0.75	mV
			2, 3	+125°C, -55°C	-1.5	1.5	mV
Input Bias Current	+ I_B	$V_{CM} = 0V$, + $R_S = 100.1k\Omega$, - $R_S = 100\Omega$	1	+25°C	-80	80	nA
			2, 3	+125°C, -55°C	-200	200	nA
	- I_B	$V_{CM} = 0V$, + $R_S = 100\Omega$, - $R_S = 100.1k\Omega$	1	+25°C	-80	80	nA
			2, 3	+125°C, -55°C	-200	200	nA
Input Offset Current	I_{IO}	$V_{CM} = 0V$, + $R_S = 100.1k\Omega$, - $R_S = 100.1k\Omega$	1	+25°C	-50	50	nA
			2, 3	+125°C, -55°C	-150	150	nA
Common Mode Range	+CMR	$V+ = +3V$, $V- = -27V$	1	+25°C	12	-	V
			2, 3	+125°C, -55°C	12	-	V
	-CMR	$V+ = +27V$, $V- = -3V$	1	+25°C	-	-12	V
			2, 3	+125°C, -55°C	-	-12	V
Large Signal Voltage Gain	+ A_{VOL}	$V_{OUT} = 0V$ and +10V	4	+25°C	106	-	dB
			5, 6	+125°C, -55°C	100	-	dB
	- A_{VOL}	$V_{OUT} = 0V$ and -10V	4	+25°C	106	-	dB
			5, 6	+125°C, -55°C	100	-	dB
Common Mode Rejection Ratio	+CMRR	$\Delta V_{CM} = +10V$, $V+ = +5V$, $V- = -25V$, $V_{OUT} = -10V$	1	+25°C	88	-	dB
			2, 3	+125°C, -55°C	86	-	dB
	-CMRR	$\Delta V_{CM} = -10V$, $V+ = +25V$, $V- = -5V$, $V_{OUT} = +10V$	1	+25°C	88	-	dB
			2, 3	+125°C, -55°C	86	-	dB
Output Voltage Swing	+ V_{OUT}	$R_L = 1k\Omega$	4	+25°C	12.0	-	V
			5, 6	+125°C, -55°C	11.5	-	V
	- V_{OUT}	$R_L = 1k\Omega$	4	+25°C	-	-12.0	V
			5, 6	+125°C, -55°C	-	-11.5	V

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TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 1k\Omega$, $V_{OUT} = 0V$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Output Current	+I _{OUT}	V _{OUT} = +10V, R _L = 1kΩ	4	+25°C	30	-	mA
			5, 6	+125°C, -55°C	30	-	mA
	-I _{OUT}	V _{OUT} = -10V, R _L = 1kΩ	4	+25°C	-	-30	mA
			5, 6	+125°C, -55°C	-	-30	mA
Quiescent Power Supply Current	+I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	+25°C	-	10	mA
			2, 3	+125°C, -55°C	-	11	mA
	-I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	+25°C	-10	-	mA
			2, 3	+125°C, -55°C	-11	-	mA
Power Supply Rejection Ratio	+PSRR	$\Delta V_{SUP} = 10V$, V ₊ = +20V, V ₋ = -15V, V ₊ = +10V, V ₋ = -15V	1	+25°C	90	-	dB
			2, 3	+125°C, -55°C	86	-	dB
	-PSRR	$\Delta V_{SUP} = 10V$, V ₊ = +15V, V ₋ = -20V, V ₊ = +15V, V ₋ = -10V	1	+25°C	90	-	dB
			2, 3	+125°C, -55°C	86	-	dB
Offset Voltage Adjustment	+V _{IOAdj}	Note 1	1	+25°C	V _{IO} -1	-	mV
			2, 3	+125°C, -55°C	V _{IO} -1	-	mV
	-V _{IOAdj}	Note 1	1	+25°C	V _{IO} +1	-	mV
			2, 3	+125°C, -55°C	V _{IO} +1	-	mV

NOTE:

- Offset adjustment range is [V_{IO} (Measured ±1mV)] minimum referred to output. This test is for functionality only to assure adjustment through 0V.

TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

Table 2 Intentionally Left Blank. See AC specifications in Table 3.

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 1k\Omega$, $C_{LOAD} = 50pF$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Noise Voltage Density	E _N	R _S = 0Ω, f _O = 10Hz	1, 5	+25°C	-	24.0	nV/√Hz
		R _S = 0Ω, f _O = 100Hz	1, 5	+25°C	-	8.0	nV/√Hz
		R _S = 0Ω, f _O = 1kHz	1, 5	+25°C	-	5.8	nV/√Hz
Input Noise Current Density	I _N	R _S = 500kΩ, f _O = 10Hz	1, 5	+25°C	-	11.5	pA/√Hz
		R _S = 500kΩ, f _O = 100Hz	1, 5	+25°C	-	6.0	pA/√Hz
		R _S = 500kΩ, f _O = 1kHz	1, 5	+25°C	-	2.0	pA/√Hz
Gain Bandwidth Product	GBWP	V _{OUT} = 200mV _{P-P} , f _O = 100kHz	1	+25°C	100	-	MHz
				-55°C to +125°C	90	-	MHz
Unity Gain Bandwidth	UGBW	V _{OUT} = 200mV	1	+25°C	30	-	MHz
				-55°C to +125°C	25	-	MHz
Slew Rate	±SR	V _{OUT} = ±2.5V C _L = 50pF	1	-55°C to +125°C	25	-	V/μs

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TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Characterized at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 1k\Omega$, $C_{LOAD} = 50pF$, Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Full Power Bandwidth	FPBW	$V_{PEAK} = 10V$	1, 2	-55°C to +125°C	398	-	kHz
Minimum Closed Loop Stable Gain	CLSG	$R_L = 1k\Omega$, $C_L = 50pF$	1	-55°C to +125°C	1	-	V/V
Rise and Fall Time	t_R, t_F	$V_{OUT} = \pm 100mV$	1, 4	+25°C	-	20	ns
Overshoot	$\pm OS$	$V_{OUT} = \pm 100mV$	1	+25°C	-	25	%
				-55°C to +125°C	-	30	%
Power Consumption	PC	$V_{OUT} = 0V$, $I_{OUT} = 0mA$	1, 3	-55°C to +125°C	-	660	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.)
- Measured between 10% and 90% points.
- Input Noise Voltage Density and Input Noise Current Density limits are based on characterization data.

TABLE 4. ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUPS (SEE TABLE 1)
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.

Die Characteristics

DIE DIMENSIONS:

72 x 94 x 19 mils \pm 1 mils
1840 x 2400 x 483 μ m \pm 25.4 μ m

METALLIZATION:

Type: Al, 1% Cu
Thickness: 16k Å \pm 2k Å

GLASSIVATION:

Type: Nitride (Si₃N₄) over Silox (SiO₂, 5% Phos.)
Silox Thickness: 12k Å \pm 2k Å
Nitride Thickness: 3.5k Å \pm 1.5k Å

WORST CASE CURRENT DENSITY:

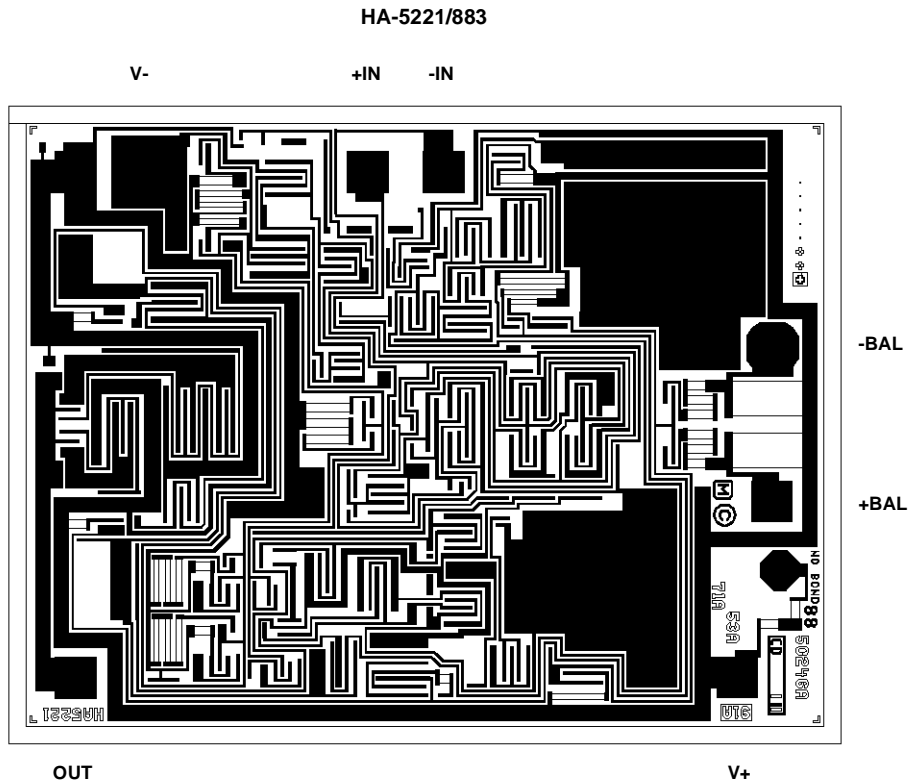
4.2 x 10⁴A/cm²

SUBSTRATE POTENTIAL (Powered Up): V-

TRANSISTOR COUNT: 62

PROCESS: Bipolar Dielectric Isolation

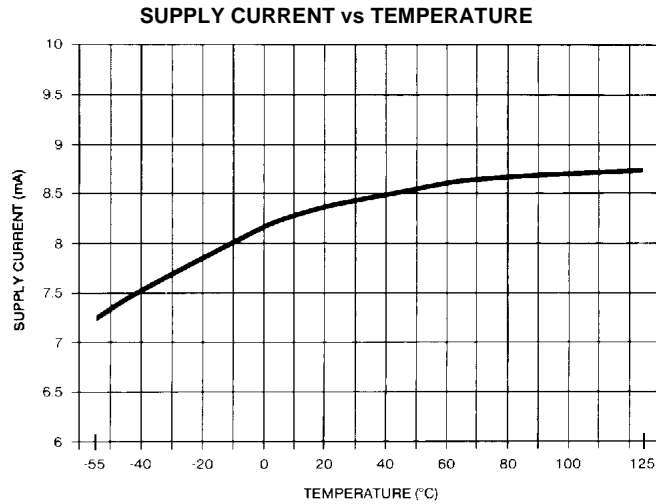
Metallization Mask Layout



DESIGN INFORMATION (Continued)

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



TYPICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: Supply Voltage = $\pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L = 50\text{pF}$, Unless Otherwise Specified

PARAMETERS	CONDITIONS	TEMPERATURE	TYPICAL	UNITS
Input Offset Voltage	See Table 1	+25°C	0.3	mV
		Full	0.35	mV
Average Offset Voltage Drift	See Table 1	Full	0.5	$\mu\text{V}/^\circ\text{C}$
Input Bias Current	See Table 1	+25°C	40	nA
		Full	70	nA
Input Offset Current	See Table 1	+25°C	15	nA
		Full	30	nA
Differential Input Resistance	See Table 1	+25°C	70	k Ω
Input Noise Voltage	$f_o = 0.1\text{Hz}$ to 10Hz	+25°C	0.25	$\mu\text{V}_{\text{P-P}}$
Input Noise Voltage Density	$f_o = 10\text{Hz}$	+25°C	10	$\text{nV}/\sqrt{\text{Hz}}$
	$f_o = 100\text{Hz}$	+25°C	5	$\text{nV}/\sqrt{\text{Hz}}$
	$f_o = 1\text{kHz}$	+25°C	3.6	$\text{nV}/\sqrt{\text{Hz}}$
Input Noise Current Density	$f_o = 10\text{Hz}$	+25°C	7	$\text{pA}/\sqrt{\text{Hz}}$
	$f_o = 100\text{Hz}$	+25°C	3	$\text{pA}/\sqrt{\text{Hz}}$
	$f_o = 1\text{kHz}$	+25°C	1.4	$\text{pA}/\sqrt{\text{Hz}}$
THD & N	See Note 1	+25°C	0.005	%
Large Signal Voltage Gain	$V_{\text{OUT}} = 0\text{V}$ to $\pm 10\text{V}$	+25°C	128	dB
		Full	120	dB

DESIGN INFORMATION (Continued)

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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Characterized at: Supply Voltage = $\pm 15V$, $R_L = 1k\Omega$, $C_L = 50pF$, Unless Otherwise Specified

PARAMETERS	CONDITIONS	TEMPERATURE	TYPICAL	UNITS	
Common Mode Rejection Ratio	$\Delta V_{CM} = \pm 10V$	Full	95	dB	
Unity Gain Bandwidth	(-3dB)	+25°C	40	MHz	
		+125°C	33	MHz	
		-55°C	45	MHz	
Gain Bandwidth Product	1kHz to 400kHz	+25°C	130	MHz	
		+125°C	110	MHz	
		-55°C	150	MHz	
Minimum Gain Stability		Full	1	V/V	
Output Voltage Swing	$R_L = 333\Omega$	Full	± 10	V	
	$R_L = 1K$	+25°C	± 12.5	V	
		Full	± 12.1	V	
Output Current	$V_{OUT} = \pm 10V$	Full	± 56	mA	
Output Resistance		+25°C	10	W	
Full Power Bandwidth	FPBW = $SR/2\pi V_{PEAK}$, $V_{PEAK} = 10V$	+25°C	398	kHz	
Slew Rate	$V_{OUT} = \pm 2.5V$	+25°C	37	V/ μs	
		+125°C	37	V/ μs	
		-55°C	34	V/ μs	
Rise Time	$V_{OUT} = \pm 100mV$	+25°C	13	ns	
		+125°C	13	ns	
		-55°C	15	ns	
Overshoot	$V_{OUT} = \pm 100mV$	+25°C	13	%	
		+125°C	13	%	
		-55°C	11	%	
Settling Time	10V _{STEP} , AV = -1	0.1%	+25°C	0.4	μs
		0.01%	+25°C	1.5	μs
Power Supply Rejection Ratio	$\Delta V_S = \pm 10V$ to $\pm 20V$	Full	100	dB	
Supply Current		Full	8	mA	
Minimum Supply Voltage	Functional Operation Only. Other Parameters May Vary.	+25°C	± 5	V	

NOTE:

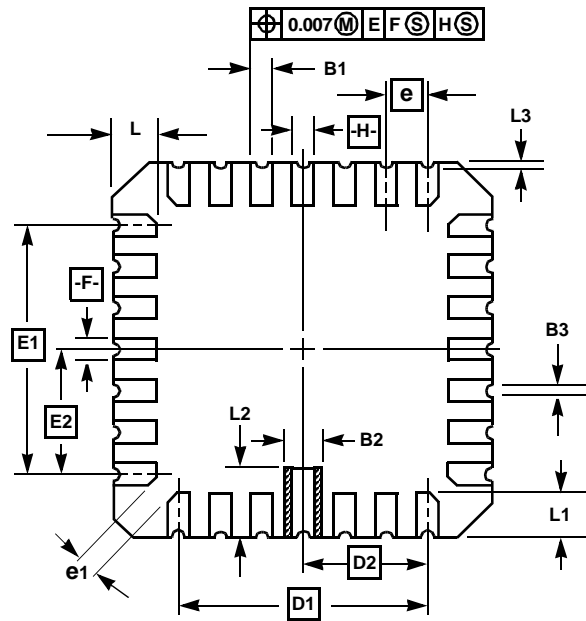
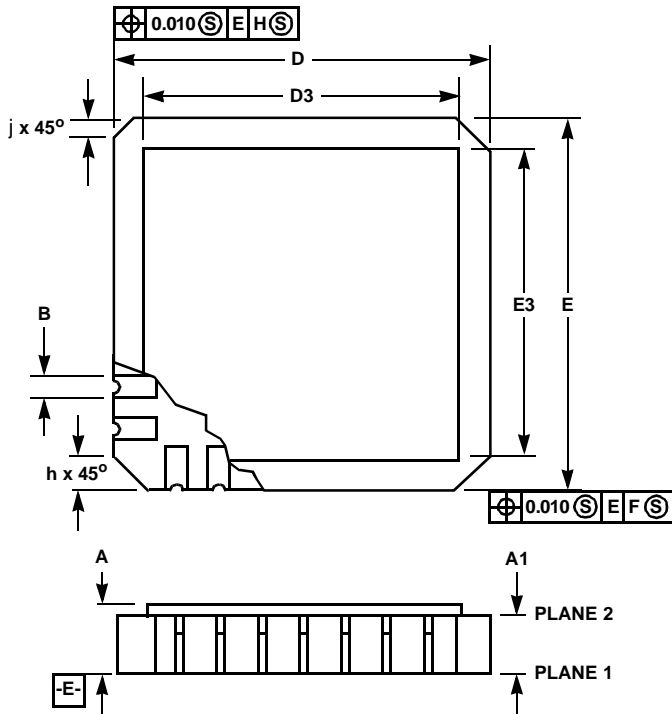
1. $A_{VCL} = 10$, $f_O = 1kHz$, $V_{OUT} = 5V_{rms}$, $R_L = 600\Omega$, 10Hz to 100Hz, Minimum resolution of test equipment is 0.005%.

DESIGN INFORMATION (Continued)

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PARAMETERS	CONDI- TIONS	TEMPERATURE	TYPICAL	UNITS
Input Noise Current Density	fO = 10Hz	+25oC	7	pA/qHz
	fO = 100Hz	+25oC	3	pA/qHz
	fO = 1kHz	+25oC	1.4	pA/qHz
THD & N	See Note 1	+25oC	0.005	%
Large Signal Voltage Gain	VOUT = 0 to 110V	+25oC	128	dB
		Full	120	dB
Common Mode Rejection Ratio	Delta VCM = 110V	Full	95	dB
Unity Gain Bandwidth	(-3)			

Ceramic Leadless Chip Carrier Packages (CLCC)



J20.A MIL-STD-1835 CQCC1-N20 (C-2)
20 PAD CERAMIC LEADLESS CHIP CARRIER PACKAGE

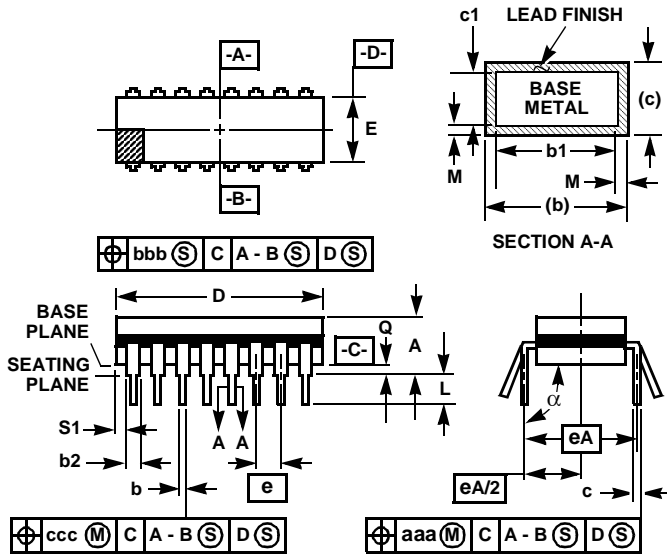
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.060	0.100	1.52	2.54	6, 7
A1	0.050	0.088	1.27	2.23	-
B	-	-	-	-	-
B1	0.022	0.028	0.56	0.71	2, 4
B2	0.072 REF		1.83 REF		-
B3	0.006	0.022	0.15	0.56	-
D	0.342	0.358	8.69	9.09	-
D1	0.200 BSC		5.08 BSC		-
D2	0.100 BSC		2.54 BSC		-
D3	-	0.358	-	9.09	2
E	0.342	0.358	8.69	9.09	-
E1	0.200 BSC		5.08 BSC		-
E2	0.100 BSC		2.54 BSC		-
E3	-	0.358	-	9.09	2
e	0.050 BSC		1.27 BSC		-
e1	0.015	-	0.38	-	2
h	0.040 REF		1.02 REF		5
j	0.020 REF		0.51 REF		5
L	0.045	0.055	1.14	1.40	-
L1	0.045	0.055	1.14	1.40	-
L2	0.075	0.095	1.91	2.41	-
L3	0.003	0.015	0.08	0.38	-
ND	5		5		3
NE	5		5		3
N	20		20		3

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NOTES:

1. Metallized castellations shall be connected to plane 1 terminals and extend toward plane 2 across at least two layers of ceramic or completely across all of the ceramic layers to make electrical connection with the optional plane 2 terminals.
2. Unless otherwise specified, a minimum clearance of 0.015 inch (0.38mm) shall be maintained between all metallized features (e.g., lid, castellations, terminals, thermal pads, etc.)
3. Symbol "N" is the maximum number of terminals. Symbols "ND" and "NE" are the number of terminals along the sides of length "D" and "E", respectively.
4. The required plane 1 terminals and optional plane 2 terminals (if used) shall be electrically connected.
5. The corner shape (square, notch, radius, etc.) may vary at the manufacturer's option, from that shown on the drawing.
6. Chip carriers shall be constructed of a minimum of two ceramic layers.
7. Dimension "A" controls the overall package thickness. The maximum "A" dimension is package height before being solder dipped.
8. Dimensioning and tolerancing per ANSI Y14.5M-1982.
9. Controlling dimension: INCH.

Ceramic Dual-In-Line Frit Seal Packages (CERDIP)



**F8.3A MIL-STD-1835 GDIP1-T8 (D-4, CONFIGURATION A)
8 LEAD CERAMIC DUAL-IN-LINE FRIT SEAL PACKAGE**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.200	-	5.08	-
b	0.014	0.026	0.36	0.66	2
b1	0.014	0.023	0.36	0.58	3
b2	0.045	0.065	1.14	1.65	-
b3	0.023	0.045	0.58	1.14	4
c	0.008	0.018	0.20	0.46	2
c1	0.008	0.015	0.20	0.38	3
D	-	0.405	-	10.29	5
E	0.220	0.310	5.59	7.87	5
e	0.100 BSC		2.54 BSC		-
eA	0.300 BSC		7.62 BSC		-
eA/2	0.150 BSC		3.81 BSC		-
L	0.125	0.200	3.18	5.08	-
Q	0.015	0.060	0.38	1.52	6
S1	0.005	-	0.13	-	7
alpha	90°	105°	90°	105°	-
aaa	-	0.015	-	0.38	-
bbb	-	0.030	-	0.76	-
ccc	-	0.010	-	0.25	-
M	-	0.0015	-	0.038	2, 3
N	8		8		8

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NOTES:

1. Index area: A notch or a pin one identification mark shall be located adjacent to pin one and shall be located within the shaded area shown. The manufacturer's identification shall not be used as a pin one identification mark.
2. The maximum limits of lead dimensions b and c or M shall be measured at the centroid of the finished lead surfaces, when solder dip or tin plate lead finish is applied.
3. Dimensions b1 and c1 apply to lead base metal only. Dimension M applies to lead plating and finish thickness.
4. Corner leads (1, N, N/2, and N/2+1) may be configured with a partial lead paddle. For this configuration dimension b3 replaces dimension b2.
5. This dimension allows for off-center lid, meniscus, and glass overrun.
6. Dimension Q shall be measured from the seating plane to the base plane.
7. Measure dimension S1 at all four corners.
8. N is the maximum number of terminal positions.
9. Dimensioning and tolerancing per ANSI Y14.5M - 1982.
10. Controlling dimension: INCH

All Intersil semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.

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