

July 1997

Precision High Slew Rate Operational Amplifiers

Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- High Slew Rate (HA-2500/883) 25V/μs (Min)
30V/μs (Typ)
- Wide Power Bandwidth (HA-2500/883) . . . 350kHz (Min)
- High Input Impedance (HA-2500/883) 25MΩ (Min)
50MΩ (Typ)
- Low Offset Current (HA-2500/883) 25nA (Max)
10nA (Typ)
- Low Quiescent Current 6mA (Max)
- Fast Settling Time (0.1% of 10V Step) 330ns (Typ)
- High Gain Bandwidth Product 12MHz (Typ)
- Internally Compensated For Unity Gain Stability

Applications

- Data Acquisition Systems
- RF Amplifiers
- Video Amplifiers
- Signal Generators
- Pulse Amplification

Description

HA-2500/883 and HA-2502/883 comprise 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, RF, video, and pulse conditioning circuits. Guaranteed slew rates of $\pm 25\text{V}/\mu\text{s}$ minimum (HA-2500/883) and $\pm 20\text{V}/\mu\text{s}$ minimum (HA-2502/883) make these devices excellent components in fast, accurate data acquisition and pulse amplification designs. To insure compliance, all devices are 100% tested for AC performance characteristics over the full temperature limits.

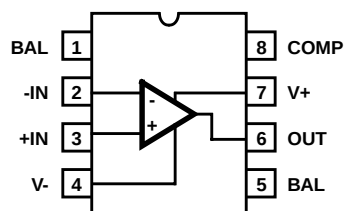
A typical 12MHz gain bandwidth product and 500kHz full power bandwidth make these devices well suited to RF and video applications. With guaranteed offset voltages of 5mV (HA-2500/883) and 8mV (HA-2502/883) plus external offset adjust flexibility and low offset current, these amplifiers are particularly useful components in signal conditioning designs.

Ordering Information

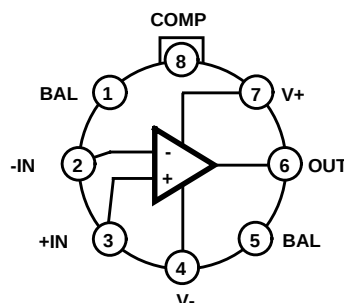
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
HA2-2500/883	-55 to 125	8 Pin Can	T8.C
HA2-2502/883	-55 to 125	8 Pin Can	T8.C
HA7-2500/883	-55 to 125	8 Ld CERDIP	F8.3A

Pinouts

HA-2500/883
(CERDIP)
TOP VIEW



HA-2500/883, HA-2502/883
(METAL CAN)
TOP VIEW



Absolute Maximum Ratings

Voltage Between V+ and V- Terminals 40V
 Differential Input Voltage 15V
 Voltage at Either Input Terminal V+ to V-
 Peak Output Current 50mA
 ESD Rating <2000V

Operating Conditions

Temperature Range -55°C to 125°C
 Supply Voltage ±15V
 $V_{INCM} \leq 1/2 (V+ - V-)$
 $R_L \geq 2k\Omega$

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} θ_{JC}
 CERDIP Package 115°C/W 28°C/W
 Metal Can Package 160°C/W 75°C/W
 Package Power Dissipation Limit at 75°C for $T_J \leq 175^\circ\text{C}$
 CERDIP Package 870mW
 Metal Can Package 625mW
 Package Power Dissipation Derating Factor Above 75°C
 CERDIP Package 8.7mW/°C
 Metal Can Package 6.3mW/°C
 Maximum Junction Temperature 175°C
 Maximum Storage Temperature Range -65°C to 150°C
 Maximum Lead Temperature (Soldering 10s) 300°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.

NOTE:

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

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{SOURCE} = 100\Omega$, $R_{LOAD} = 500k\Omega$, $V_{OUT} = 0V$, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMP (°C)	HA-2500/883		HA-2502/883		UNITS
					MIN	MAX	MIN	MAX	
Input Offset Voltage	V_{IO}	$V_{CM} = 0V$	1	25	-5	5	-8	8	mV
			2, 3	125, -55	-8	8	-10	10	mV
Input Bias Current	$+I_B$	$V_{CM} = 0V$, $+R_S = 100k\Omega$, $-R_S = 100\Omega$	1	25	-200	200	-250	250	nA
			2, 3	125, -55	-400	400	-500	500	nA
	$-I_B$	$V_{CM} = 0V$, $+R_S = 100\Omega$, $-R_S = 100k\Omega$	1	25	-200	200	-250	250	nA
			2, 3	125, -55	-400	400	-500	500	nA
Input Offset Current	I_{IO}	$V_{CM} = 0V$, $+R_S = 100k\Omega$, $-R_S = 100k\Omega$	1	25	-25	25	-50	50	nA
			2, 3	125, -55	-50	50	-100	100	nA
Common Mode Range	+CMR	$V+ = 5V$, $V- = -25V$	1	25	+10	-	+10	-	V
			2, 3	125, -55	+10	-	+10	-	V
	-CMR	$V+ = 25V$, $V- = -5V$	1	25	-	-10	-	-10	V
			2, 3	125, -55	-	-10	-	-10	V
Large Signal Voltage Gain	$+A_{VOL}$	$V_{OUT} = 0V$ and $+10V$, $R_L = 2k\Omega$	4	25	20	-	15	-	kV/V
			5, 6	125, -55	15	-	10	-	kV/V
	$-A_{VOL}$	$V_{OUT} = 0V$ and $-10V$, $R_L = 2k\Omega$	4	25	20	-	15	-	kV/V
			5, 6	125, -55	15	-	10	-	kV/V
Common Mode Rejection Ratio	+CMRR	$\Delta V_{CM} = +10V$, $V+ = +5V$, $V- = -25V$, $V_{OUT} = -10V$	1	25	80	-	74	-	dB
			2, 3	125, -55	80	-	74	-	dB
	-CMRR	$\Delta V_{CM} = -10V$, $V+ = +25V$, $V- = -5V$, $V_{OUT} = +10V$	1	25	80	-	74	-	dB
			2, 3	125, -55	80	-	74	-	dB

HA-2500/883, HA-2502/883

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{SOURCE} = 100\Omega$, $R_{LOAD} = 500k\Omega$, $V_{OUT} = 0V$, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMP (°C)	HA-2500/883		HA-2502/883		UNITS
					MIN	MAX	MIN	MAX	
Output Voltage Swing	+V _{OUT}	R _L = 2k Ω	4	25	10	-	10	-	V
			5, 6	125, -55	10	-	10	-	V
	-V _{OUT}	R _L = 2k Ω	4	25	-	-10	-	-10	V
			5, 6	125, -55	-	-10	-	-10	V
Output Current	+I _{OUT}	V _{OUT} = -10V	4	25	10	-	10	-	mA
			5, 6	125, -55	7.5	-	7.5	-	mA
	-I _{OUT}	V _{OUT} = +10V	4	25	-	-10	-	-10	mA
			5, 6	125, -55	-	-7.5	-	-7.5	mA
Quiescent Power Supply Current	+I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	25	-	6	-	6	mA
			2, 3	125, -55	-	6.5	-	7	mA
	-I _{CC}	V _{OUT} = 0V, I _{OUT} = 0mA	1	25	-6	-	-6	-	mA
			2, 3	125, -55	-6.5	-	-7	-	mA
Power Supply Rejection Ratio	+PSRR	$\Delta V_{SUP} = 10V$, V ₊ = +20V, V ₋ = -15V, V ₊ = +10V, V ₋ = -15V	1	25	80	-	74	-	dB
			2, 3	125, -55	80	-	74	-	dB
	-PSRR	$\Delta V_{SUP} = 10V$, V ₊ = +15V, V ₋ = -20V, V ₊ = +15V, V ₋ = -10V	1	25	80	-	74	-	dB
			2, 3	125, -55	80	-	74	-	dB
Offset Voltage Adjustment	+V _{IOAdj}	Note 2	1	25	V _{IO-1}	-	V _{IO-1}	-	mV
			2, 3	125, -55	V _{IO-1}	-	V _{IO-1}	-	mV
	-V _{IOAdj}	Note 2	1	25	V _{IO+1}	-	V _{IO+1}	-	mV
			2, 3	125, -55	V _{IO+1}	-	V _{IO+1}	-	mV

NOTE:

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

TABLE 2. ECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 2k\Omega$, $C_{LOAD} = 50pF$, $A_{VCL} = +1V/V$, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMP (°C)	HA-2500/883		HA-2502/883		UNITS
					MIN	MAX	MIN	MAX	
Slew Rate	+SR	V _{OUT} = -5V to +5V 25% $\leq$ +SR $\leq$ 75%	7	25	25	-	20	-	V/ μs
			8A, 8B	125, -55	20	-	15	-	V/ μs
	-SR	V _{OUT} = +5V to -5V 75% $\geq$ -SR $\geq$ 25%	7	25	25	-	20	-	V/ μs
			8A, 8B	125, -55	20	-	15	-	V/ μs

HA-2500/883, HA-2502/883

TABLE 2. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: $V_{SUPPLY} = \pm 15V$, $R_{SOURCE} = 50\Omega$, $R_{LOAD} = 2k\Omega$, $C_{LOAD} = 50pF$, $A_{VCL} = +1V/V$, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMP (°C)	HA-2500/883		HA-2502/883		UNITS
					MIN	MAX	MIN	MAX	
Rise and Fall Time	t_r	$V_{OUT} = 0$ to $+200mV$ $10\% \leq t_r \leq 90\%$	7	25	-	50	-	50	ns
			8A, 8B	125, -55	-	60	-	60	ns
	t_f	$V_{OUT} = 0$ to $-200mV$ $10\% \leq t_f \leq 90\%$	7	25	-	50	-	50	ns
			8A, 8B	125, -55	-	60	-	60	ns
Overshoot	+OS	$V_{OUT} = 0$ to $+200mV$	7	25	-	40	-	50	%
			8A, 8B	125, -55	-	50	-	60	%
	-OS	$V_{OUT} = 0$ to $-200mV$	7	25	-	40	-	50	%
			8A, 8B	125, -55	-	50	-	60	%

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Characterized at: $V_{SUPPLY} = \pm 15V$, $R_{LOAD} = 2k\Omega$, $C_{LOAD} = 50pF$, Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMP (°C)	HA-2500/883		HA-2502/883		UNITS
					MIN	MAX	MIN	MAX	
Differential Input Resistance	R_{IN}	$V_{CM} = 0V$	3	25	25	-	20	-	$M\Omega$
Full Power Bandwidth	FPBW	$V_{PEAK} = 10V$	3, 4	25	350	-	300	-	kHz
Minimum Closed Loop Stable Gain	CLSG	$R_L = 2k\Omega$, $C_L = 50pF$	3	-55 to 125	1	-	1	-	V/V
Quiescent Power Consumption	PC	$V_{OUT} = 0V$, $I_{OUT} = 0mA$	3, 5	-55 to 125	-	195	-	210	mW

NOTES:

3. 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.
4. Full Power Bandwidth guarantee based on Slew Rate measurement using $FPBW = \text{Slew Rate} / (2\pi V_{PEAK})$.
5. 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 AND 2)
Interim Electrical Parameters (Pre Burn-In)	1
Final Electrical Test Parameters	1 (Note 6), 2, 3, 4, 5, 6, 7, 8A, 8B
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7, 8A, 8B
Groups C and D Endpoints	1

NOTE:

6. PDA applies to Subgroup 1 only.

Die Characteristics

DIE DIMENSIONS:

57 x 65 x 19 milss
1450 x 1650 x 483μm

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:

$0.3 \times 10^5 \text{ A/cm}^2$

SUBSTRATE POTENTIAL (Powered Up):

Unbiased

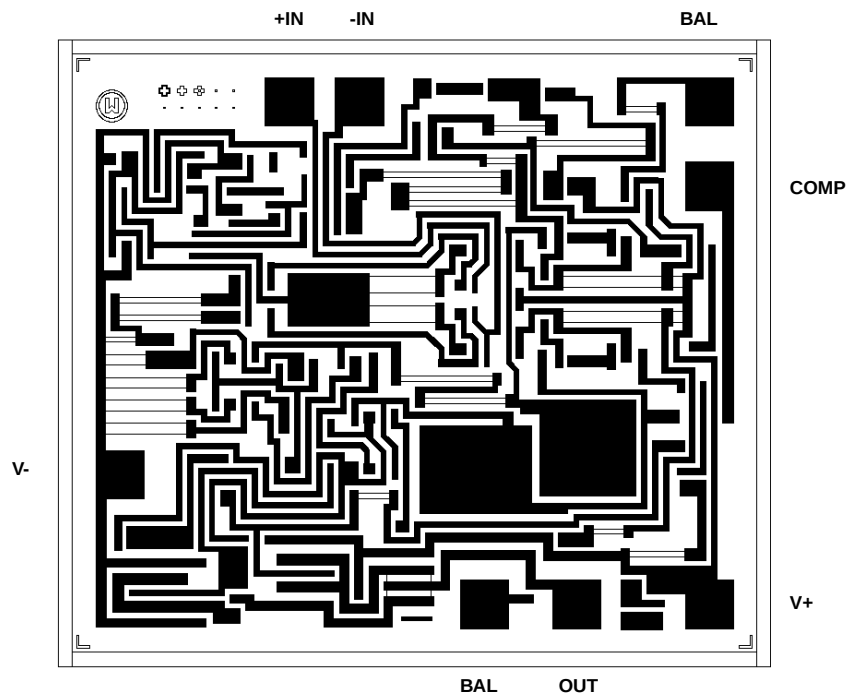
TRANSISTOR COUNT:

HA-2500/883: 40
HA-2502/883: 40

PROCESS: Bipolar Dielectric Isolation

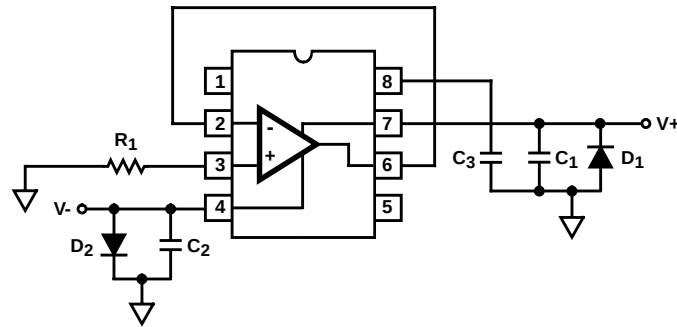
Metallization Mask Layout

HA-2500/883, HA-2502/883

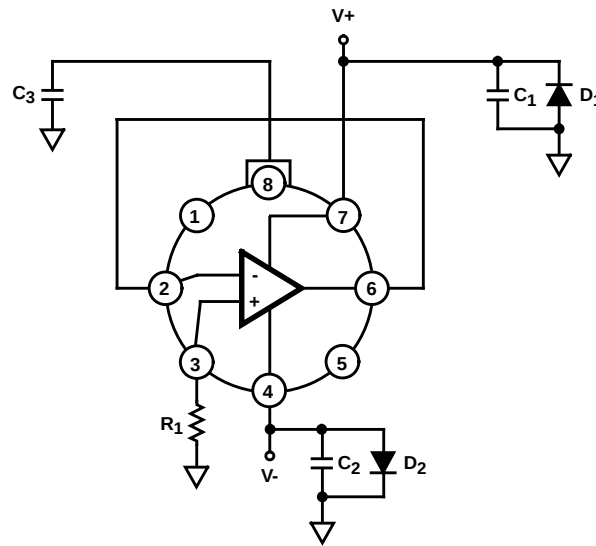


Burn-In Circuits

HA7-2500/883 CERDIP



HA2-2500/883 METAL CAN
HA2-2502/883 METAL CAN



NOTES:

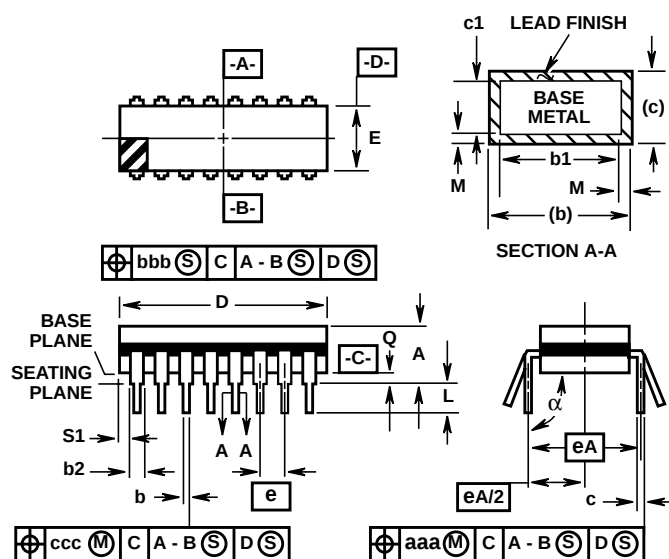
$R_1 = 1M\Omega$, $\pm 5\%$, 1/4W (Min)

$C_1 = C_2 = 0.01\mu F$ /Socket (Min) or $0.1\mu F$ /Row (Min)

$C_3 = 0.01\mu F$ /Socket (10%)

$D_1 = D_2 = 1N4002$ or Equivalent/Board

$|V^+ - V^-| = 30V$

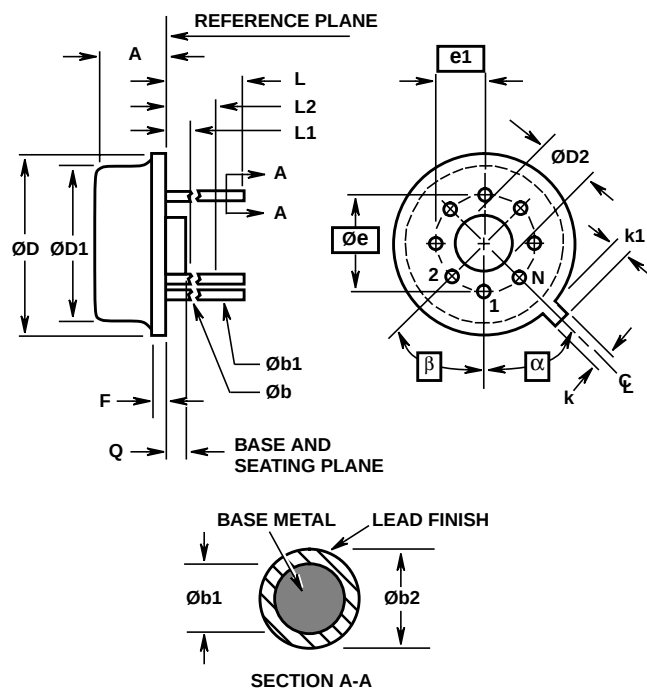
Ceramic Dual-In-Line Frit Seal Packages (CERDIP)**NOTES:**

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.

**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
α	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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Metal Can Packages (Can)**NOTES:**

1. (All leads) Øb applies between L1 and L2. Øb1 applies between L2 and 0.500 from the reference plane. Diameter is uncontrolled in L1 and beyond 0.500 from the reference plane.
2. Measured from maximum diameter of the product.
3. α is the basic spacing from the centerline of the tab to terminal 1 and β is the basic spacing of each lead or lead position (N -1 places) from α, looking at the bottom of the package.
4. N is the maximum number of terminal positions.
5. Dimensioning and tolerancing per ANSI Y14.5M - 1982.
6. Controlling dimension: INCH.

**T8.C MIL-STD-1835 MACY1-X8 (A1)
8 LEAD METAL CAN PACKAGE**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.165	0.185	4.19	4.70	-
Øb	0.016	0.019	0.41	0.48	1
Øb1	0.016	0.021	0.41	0.53	1
Øb2	0.016	0.024	0.41	0.61	-
ØD	0.335	0.375	8.51	9.40	-
ØD1	0.305	0.335	7.75	8.51	-
ØD2	0.110	0.160	2.79	4.06	-
e	0.200 BSC		5.08 BSC		-
e1	0.100 BSC		2.54 BSC		-
F	-	0.040	-	1.02	-
k	0.027	0.034	0.69	0.86	-
k1	0.027	0.045	0.69	1.14	2
L	0.500	0.750	12.70	19.05	1
L1	-	0.050	-	1.27	1
L2	0.250	-	6.35	-	1
Q	0.010	0.045	0.25	1.14	-
α	45° BSC		45° BSC		3
β	45° BSC		45° BSC		3
N	8		8		4

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