



## DUAL P-CHANNEL MATCHED MOSFET PAIR

### GENERAL DESCRIPTION

The ALD1102 is a monolithic dual P-channel matched transistor pair intended for a broad range of analog applications. These enhancement-mode transistors are manufactured with Advanced Linear Devices' enhanced AC MOS silicon gate CMOS process.

The ALD1102 offers high input impedance and negative current temperature coefficient. The transistor pair is matched for minimum offset voltage and differential thermal response, and it is designed for switching and amplifying applications in +2V to +12V systems where low input bias current, low input capacitance and fast switching speed are desired. Since these are MOSFET devices, they feature very large (almost infinite) current gain in a low frequency, or near DC, operating environment. When used with an ALD1101, a dual CMOS analog switch can be constructed. In addition, the ALD1102 is intended as a building block for differential amplifier input stages, transmission gates, and multiplexer applications.

The ALD1102 is suitable for use in precision applications which require very high current gain, beta, such as current mirrors and current sources. The high input impedance and the high DC current gain of the Field Effect Transistors result in extremely low current loss through the control gate. The DC current gain is limited by the gate input leakage current, which is specified at 50pA at room temperature. For example, DC beta of the device at a drain current of 5mA at 25°C is  $= 5\text{mA}/50\text{pA} = 100,000,000$ .

### FEATURES

- Low threshold voltage of 0.7V
- Low input capacitance
- Low Vos grades -- 2mV, 5mV, 10mV
- High input impedance --  $10^{12}\Omega$  typical
- Low input and output leakage currents
- Negative current ( $I_{DS}$ ) temperature coefficient
- Enhancement-mode (normally off)
- DC current gain  $10^9$
- RoHS compliant

### ORDERING INFORMATION ("L" suffix denotes lead-free (RoHS))

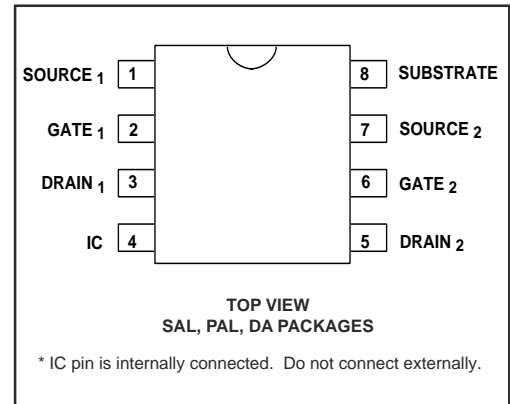
Operating Temperature Range		
0°C to +70°C	0°C to +70°C	-55°C to +125°C
8-Pin Small Outline Package (SOIC)	8-Pin Plastic Dip Package	8-Pin CERDIP Package
ALD1102ASAL	ALD1102APAL	
ALD1102BSAL	ALD1102BPAL	
ALD1102SAL	ALD1102PAL	ALD1102DA

\* Contact factory for leaded (non-RoHS) or high temperature versions.

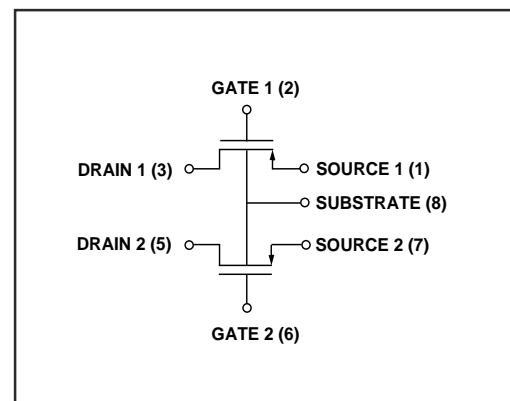
### APPLICATIONS

- Precision current mirrors
- Precision current sources
- Analog switches
- Choppers
- Differential amplifier input stage
- Voltage comparator
- Data converters
- Sample and Hold
- Analog inverter

### PIN CONFIGURATION



### BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Drain-source voltage,  $V_{DS}$  \_\_\_\_\_ -10.6V  
 Gate-source voltage,  $V_{GS}$  \_\_\_\_\_ -10.6V  
 Power dissipation \_\_\_\_\_ 500mW  
 Operating temperature range SAL, PAL packages \_\_\_\_\_ 0°C to +70°C  
 DA package \_\_\_\_\_ -55°C to +125°C  
 Storage temperature range \_\_\_\_\_ -65°C to +150°C  
 Lead temperature, 10 seconds \_\_\_\_\_ +260°C

CAUTION: ESD Sensitive Device. Use static control procedures in ESD controlled environment.

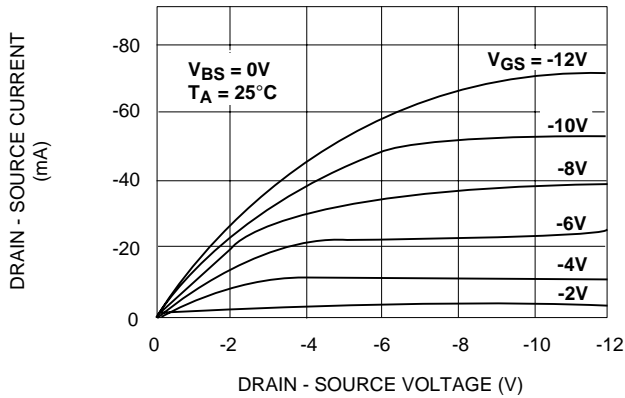
## OPERATING ELECTRICAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$  unless otherwise specified

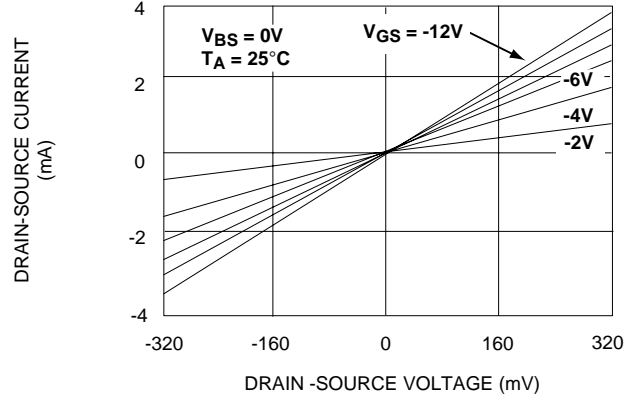
Parameter	Symbol	1102A			1102B			1102			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
Gate Threshold Voltage	$V_T$	-0.4	-0.7	-1.2	-0.4	-0.7	-1.2	-0.4	-0.7	-1.2	V	$I_{DS} = -10\mu\text{A}$ $V_{GS} = V_{DS}$
Offset Voltage $V_{GS1} - V_{GS2}$	$V_{OS}$			2			5			10	mV	$I_{DS} = -100\mu\text{A}$ $V_{GS} = V_{DS}$
Gate Threshold Temperature Drift	$TC_{VT}$		-1.3			-1.3			-1.3		mV/°C	
On Drain Current	$I_{DS(ON)}$	-8	-16		-8	-16		-8	-16		mA	$V_{GS} = V_{DS} = -5\text{V}$
Transconductance	$G_{fs}$	2	4		2	4		2	4		mmho	$V_{DS} = -5\text{V}$ $I_{DS} = -10\text{mA}$
Mismatch	$\Delta G_{fs}$		0.5			0.5			0.5		%	
Output Conductance	$G_{OS}$		500			500			500		$\mu\text{mho}$	$V_{DS} = -5\text{V}$ $I_{DS} = -10\text{mA}$
Drain Source ON Resistance	$R_{DS(ON)}$		180	270		180	270		180	270	$\Omega$	$V_{DS} = -0.1\text{V}$ $V_{GS} = -5\text{V}$
Drain Source ON Resistance Mismatch	$\Delta R_{DS(ON)}$		0.5			0.5			0.5		%	$V_{DS} = -0.1\text{V}$ $V_{GS} = -5\text{V}$
Drain Source Breakdown Voltage	$BV_{DSS}$	-12			-12			-12			V	$I_{DS} = -10\mu\text{A}$ $V_{GS} = 0\text{V}$
Off Drain Current	$I_{DS(OFF)}$		0.1	4		0.1	4		0.1	4	nA $\mu\text{A}$	$V_{DS} = -12\text{V}$ $V_{GS} = 0\text{V}$ $T_A = 125^\circ\text{C}$
Gate Leakage Current	$I_{GSS}$		1	50		1	50		1	50	pA nA	$V_{DS} = 0\text{V}$ $V_{GS} = -12\text{V}$ $T_A = 125^\circ\text{C}$
Input Capacitance	$C_{ISS}$		6	10		6	10		6	10	pF	

# TYPICAL PERFORMANCE CHARACTERISTICS

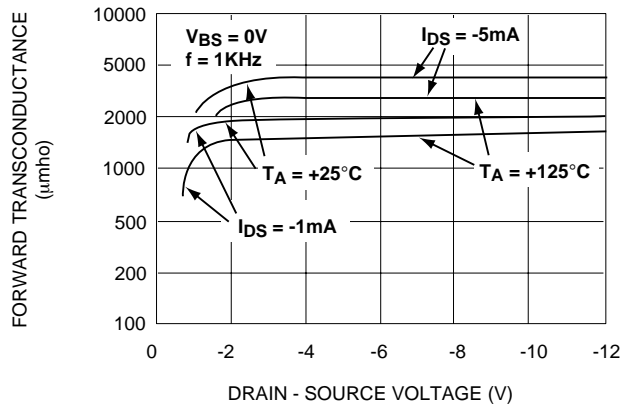
## OUTPUT CHARACTERISTICS



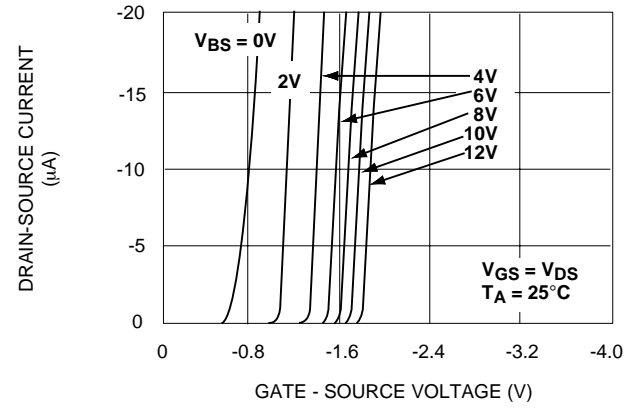
## LOW VOLTAGE OUTPUT CHARACTERISTICS



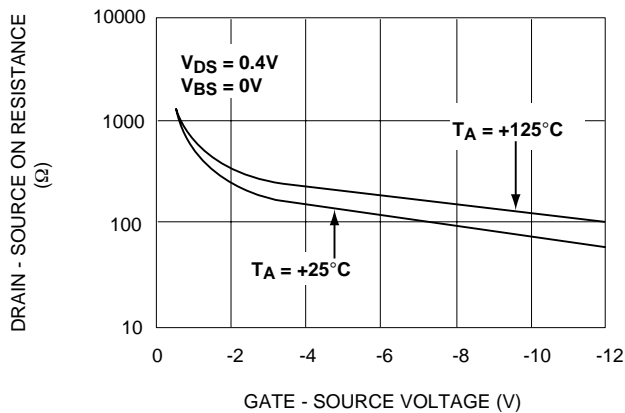
## FORWARD TRANSCONDUCTANCE vs. DRAIN - SOURCE VOLTAGE



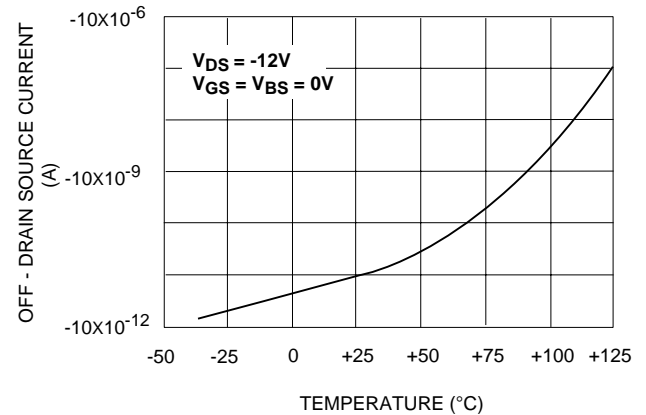
## TRANSFER CHARACTERISTIC WITH SUBSTRATE BIAS



## RDs (ON) vs. GATE - SOURCE VOLTAGE

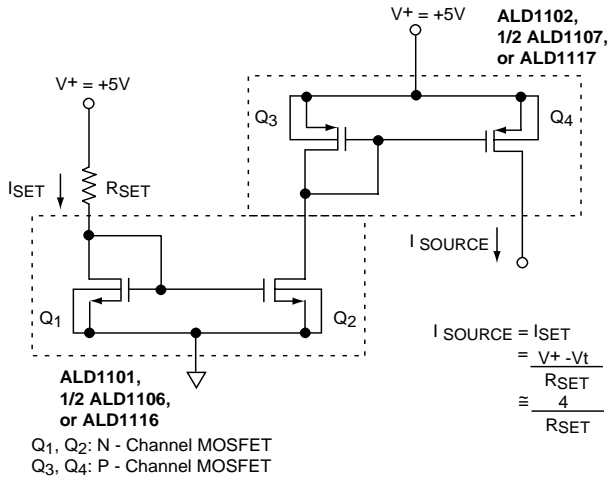


## OFF DRAIN - CURRENT vs. TEMPERATURE

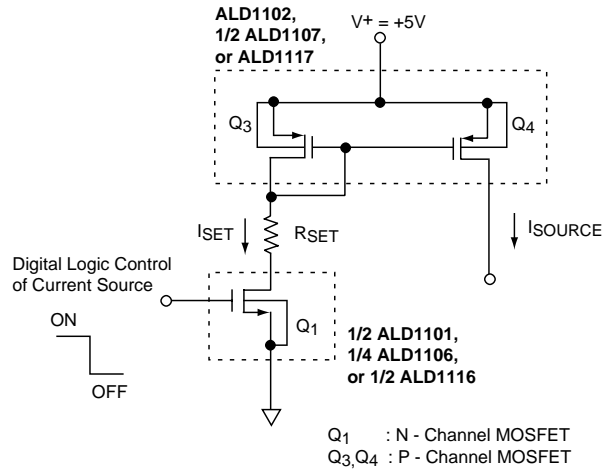


# TYPICAL APPLICATIONS

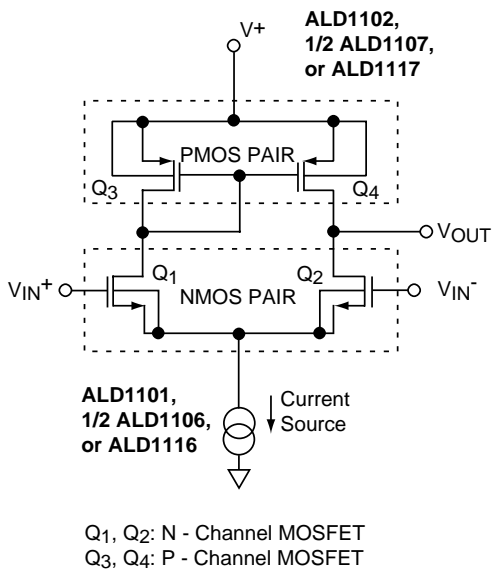
## CURRENT SOURCE MIRROR



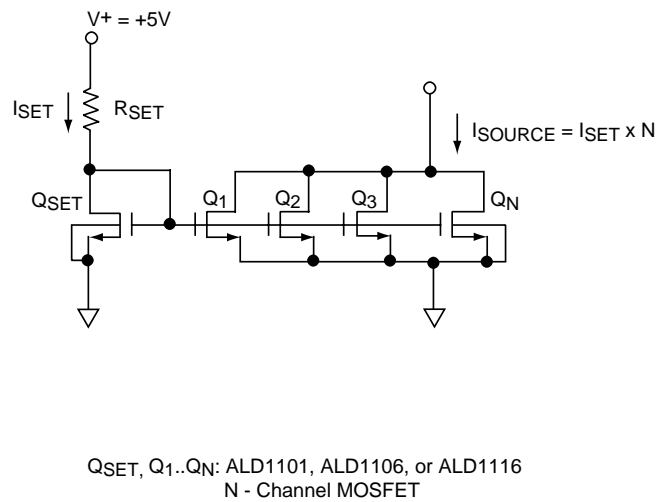
## CURRENT SOURCE WITH GATE CONTROL



## DIFFERENTIAL AMPLIFIER



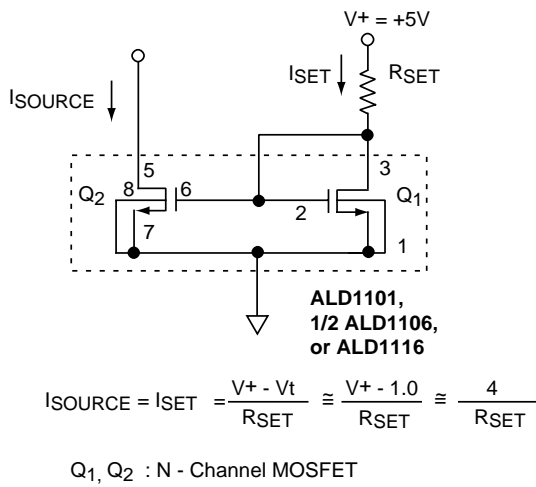
## CURRENT SOURCE MULTIPLICATION



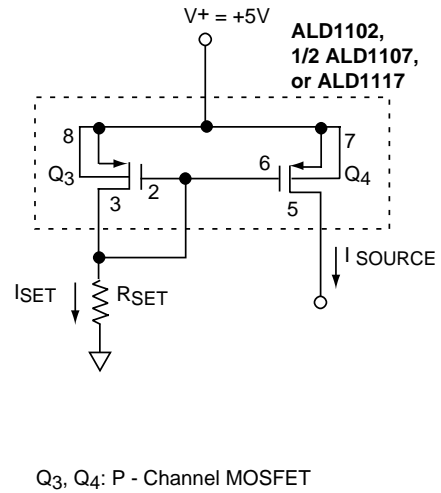
## TYPICAL APPLICATIONS (cont.)

### BASIC CURRENT SOURCES

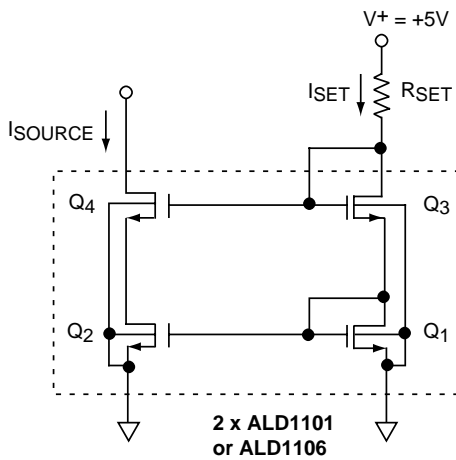
#### N- CHANNEL CURRENT SOURCE



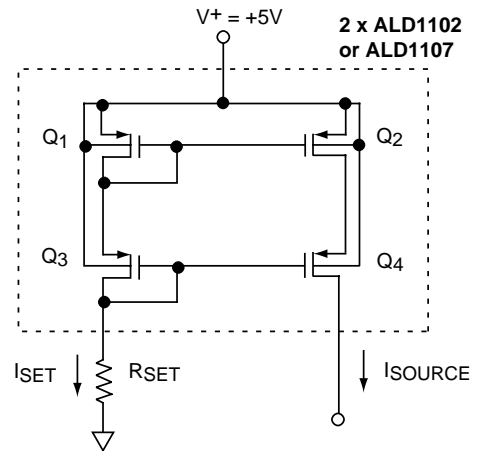
#### P- CHANNEL CURRENT SOURCE



### CASCADE CURRENT SOURCES



Q<sub>1</sub>, Q<sub>2</sub>, Q<sub>3</sub>, Q<sub>4</sub>: N - Channel MOSFET  
(ALD1101 or ALD1103)

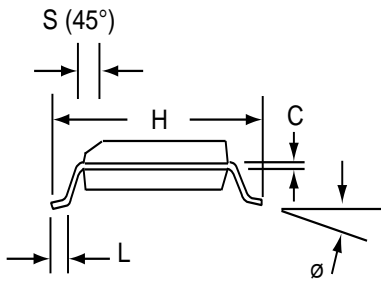
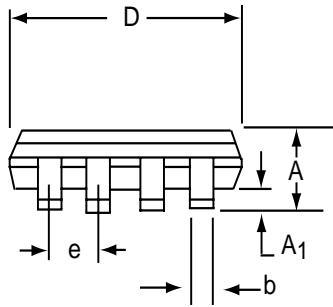
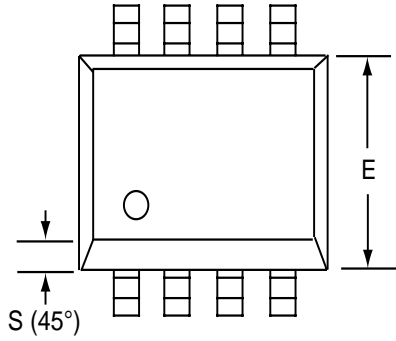


$$I_{SOURCE} = I_{SET} = \frac{V^+ - 2V_t}{R_{SET}} \cong \frac{3}{R_{SET}}$$

Q<sub>1</sub>, Q<sub>2</sub>, Q<sub>3</sub>, Q<sub>4</sub>: P - Channel MOSFET  
(ALD1102 or ALD1103)

# SOIC-8 PACKAGE DRAWING

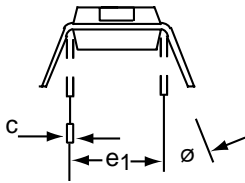
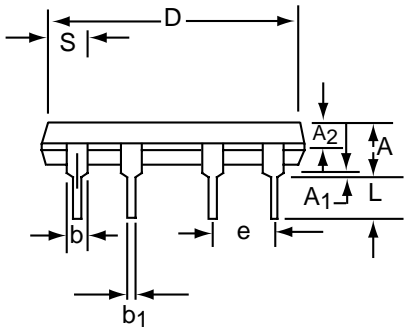
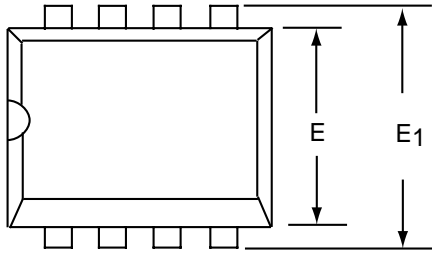
## 8 Pin Plastic SOIC Package



Dim	Millimeters		Inches	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A <sub>1</sub>	0.10	0.25	0.004	0.010
b	0.35	0.45	0.014	0.018
C	0.18	0.25	0.007	0.010
D-8	4.69	5.00	0.185	0.196
E	3.50	4.05	0.140	0.160
e	1.27 BSC		0.050 BSC	
H	5.70	6.30	0.224	0.248
L	0.60	0.937	0.024	0.037
∅	0°	8°	0°	8°
S	0.25	0.50	0.010	0.020

# PDIP-8 PACKAGE DRAWING

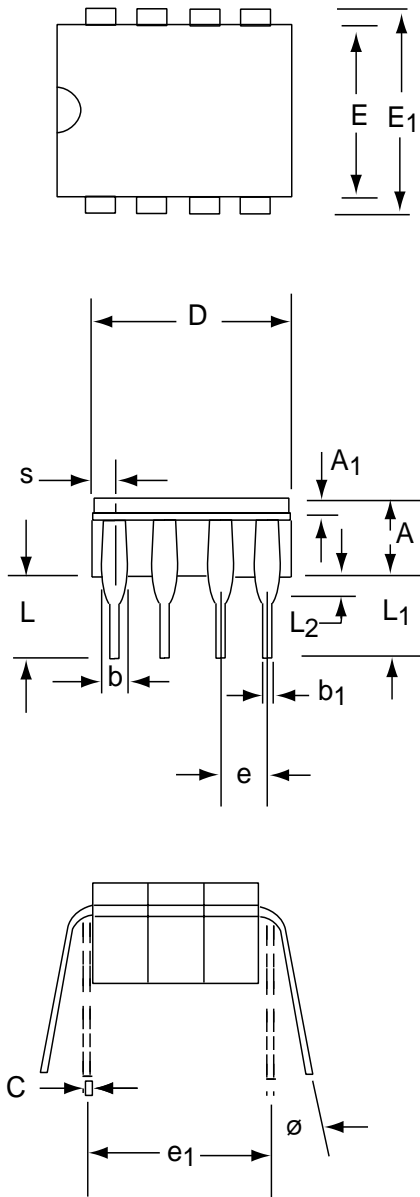
## 8 Pin Plastic DIP Package



Dim	Millimeters		Inches	
	Min	Max	Min	Max
A	3.81	5.08	0.105	0.200
A <sub>1</sub>	0.38	1.27	0.015	0.050
A <sub>2</sub>	1.27	2.03	0.050	0.080
b	0.89	1.65	0.035	0.065
b <sub>1</sub>	0.38	0.51	0.015	0.020
c	0.20	0.30	0.008	0.012
D-8	9.40	11.68	0.370	0.460
E	5.59	7.11	0.220	0.280
E <sub>1</sub>	7.62	8.26	0.300	0.325
e	2.29	2.79	0.090	0.110
e <sub>1</sub>	7.37	7.87	0.290	0.310
L	2.79	3.81	0.110	0.150
S-8	1.02	2.03	0.040	0.080
∅	0°	15°	0°	15°

# CERDIP-8 PACKAGE DRAWING

## 8 Pin CERDIP Package



Dim	Millimeters		Inches	
	Min	Max	Min	Max
A	3.55	5.08	0.140	0.200
A <sub>1</sub>	1.27	2.16	0.050	0.085
b	0.97	1.65	0.038	0.065
b <sub>1</sub>	0.36	0.58	0.014	0.023
C	0.20	0.38	0.008	0.015
D-8	--	10.29	--	0.405
E	5.59	7.87	0.220	0.310
E <sub>1</sub>	7.73	8.26	0.290	0.325
e	2.54 BSC		0.100 BSC	
e <sub>1</sub>	7.62 BSC		0.300 BSC	
L	3.81	5.08	0.150	0.200
L <sub>1</sub>	3.18	--	0.125	--
L <sub>2</sub>	0.38	1.78	0.015	0.070
S	--	2.49	--	0.098
∅	0°	15°	0°	15°