ADVANCED
LINEAR
DEVICES, INC.

QUAD/DUAL N-CHANNEL MATCHED PAIR MOSFET ARRAY

GENERAL DESCRIPTION

The ALD1106/ALD1116 are monolithic quad/dual N-channel enhance-ment mode matched MOSFET transistor arrays intended for a broad range of precision analog applications. The ALD1106/ALD1116 offer high input impedance and negative current temperature coefficient. The transistor pairs are matched for minimum offset voltage and differential thermal response, and they are designed for precision analog switching and amplifying applications in +2V to +10V systems where low input bias current, low input capacitance and fast switching speed are desired. These MOSFET devices feature very large (almost infinite) current gain in a low frequency, or near DC, operating environment. The ALD1106/ALD1116 are building blocks for differential amplifier input stages, transmission gates, multiplexer applications, current sources and many precision analog circuits.

FEATURES

- Low threshold voltage of 0.7V
- Low input capacitance
- Low Vos -- 2mV typical
- High input impedance -- $10^{14}\Omega$ typical
- Negative current (I_{DS}) temperature coefficient
- Enhancement-mode (normally off)
- DC current gain 10^9
- Low input and output leakage currents
- RoHS compliant

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

| Operating Temperature Range*	
0°C to +70°C	0°C to +70°C
8-Pin SOIC Package	8-Pin Plastic Dip Package
ALD1116SAL	ALD1116PAL
14-Pin SOIC Package	14-Pin Plastic Dip Package
ALD1106SBL	ALD1106PBL

* Contact factory for high temperature versions.

APPLICATIONS

- Precision current mirrors
- Precision current sources
- Voltage choppers
- Differential amplifier input stage
- Voltage comparator
- Data converters
- Sample and Hold
- Analog signal processing

PIN CONFIGURATION

ALD1116

TOP VIEW
SAL, PAL PACKAGES

ALD1106

TOP VIEW
SBL, PBL PACKAGES

BLOCK DIAGRAMS

ALD1106

ALD1116
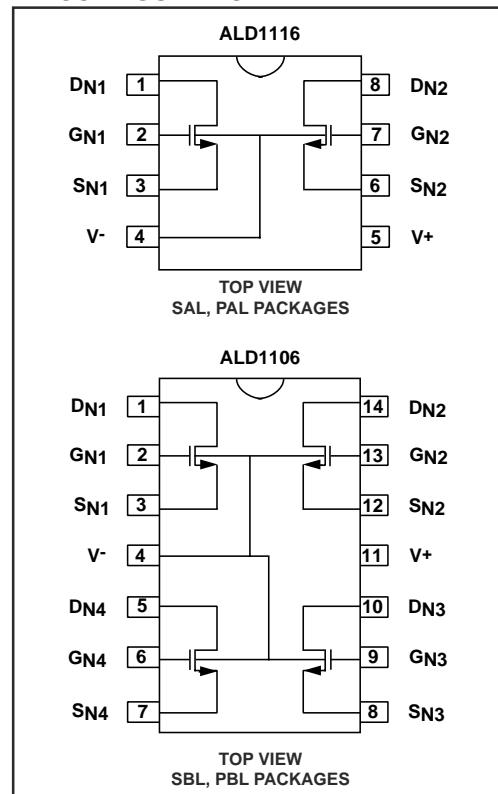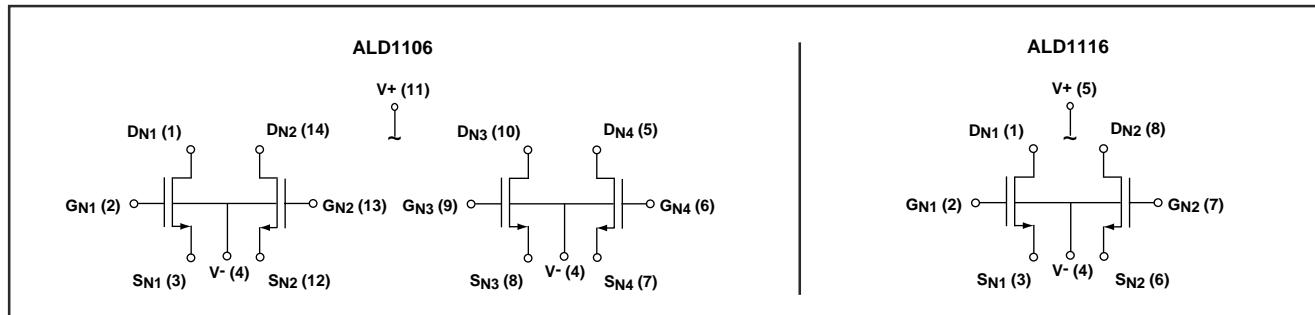
ABSOLUTE MAXIMUM RATINGS

Drain-source voltage, V_{DS} ———————————————————————— 10V
Gate-source voltage, V_{GS} ———————————————————————— 10V
Power dissipation ————————————————————————————— 500mW
Operating temperature range SAL, PAL, SBL, PBL packages ——————— 0°C to +70°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°C unless otherwise specified

| Parameter	Symbol	ALD1106			ALD1116			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
Gate Threshold Voltage	V_T	0.4	0.7	1.0	0.4	0.7	1.0	V	I_{DS} = 1.0µA V_{GS} = V_{DS}
Offset Voltage V_{GS1}-V_{GS2}	V_{OS}		2	10		2	10	mV	I_{DS} = 10µA V_{GS} = V_{DS}
Gate Threshold Temperature Drift [2]	TC_{VT}		-1.2			-1.2		mV/°C	
On Drain Current	$I_{DS(ON)}$	3.0	4.8		3.0	4.8		mA	V_{GS} = V_{DS} = 5V
Transconductance	G_{IS}	1.0	1.8		1.0	1.8		mmho	V_{DS} = 5V I_{DS} = 10mA
Mismatch	ΔG_{fs}		0.5			0.5		%	
Output Conductance	G_{OS}		200			200		µmho	V_{DS} = 5V I_{DS} = 10mA
Drain Source On Resistance	$R_{DS(ON)}$		350	500		350	500	Ω	V_{DS} = 0.1V V_{GS} = 5V
Drain Source On Resistence Mismatch	$\Delta_{DS(ON)}$		0.5			0.5		%	V_{DS} = 0.1V V_{GS} = 5V
Drain Source Breakdown Voltage	BV_{DSS}	10			10			V	I_{DS} = 1.0µA V_{GS} = 0V
Off Drain Current [1]	$I_{DS(OFF)}$		10	400 4		10	400 4	pA nA	V_{DS} = 10V V_{GS} = 0V T_A = 125°C
Gate Leakage Current	I_{GSS}		1	100 1		1	100 1	pA nA	V_{DS} = 0V V_{GS} = 10V T_A = 125°C
Input Capacitance [2]	C_{ISS}		1	3		1	3	pF	

Notes: [1] Consists of junction leakage currents
             [2] Sample tested parameters

# TYPICAL PERFORMANCE CHARACTERISTICS

OUTPUT CHARACTERISTICS

DRAIN SOURCE ON CURRENT $I_{DS(ON)}$ (mA)

$V_{BS} = 0V$
$T_A = +25°C$

$V_{GS} = 10V$

8V

6V

4V

2V

DRAIN SOURCE ON VOLTAGE - $V_{DS(ON)}$ (V)
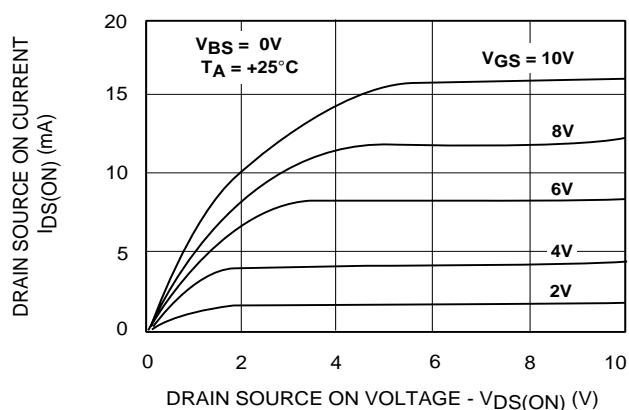
LOW VOLTAGE OUTPUT CHARACTERISTICS

DRAIN SOURCE ON CURRENT $I_{DS(ON)}$ (μA)

$V_{BS} = 0V$
$T_A = 25°C$

$V_{GS} = 10V$
8V
6V
4V
2V

DRAIN SOURCE ON VOLTAGE - $V_{DS(ON)}$ (mV)
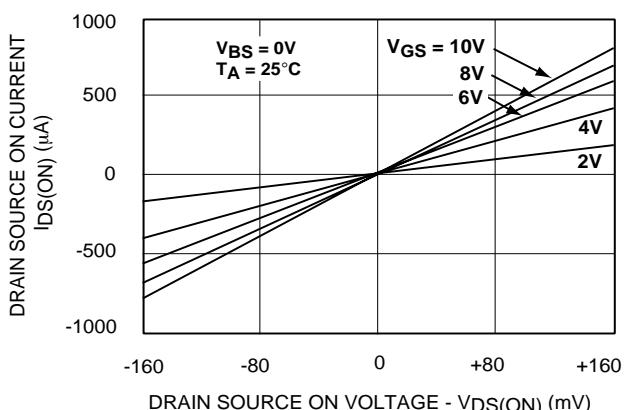
FORWARD TRANSCONDUCTANCE vs. DRAIN-SOURCE VOLTAGE

FORWARD TRANSCONDUCTANCE (mmho)

$V_{BS} = 0V$
$f = 1KHz$

$I_{DS} = 10mA$

$T_A = +125°C$

$T_A = +25°C$

$I_{DS} = 1mA$

DRAIN SOURCE ON VOLTAGE - $V_{DS(ON)}$ (V)
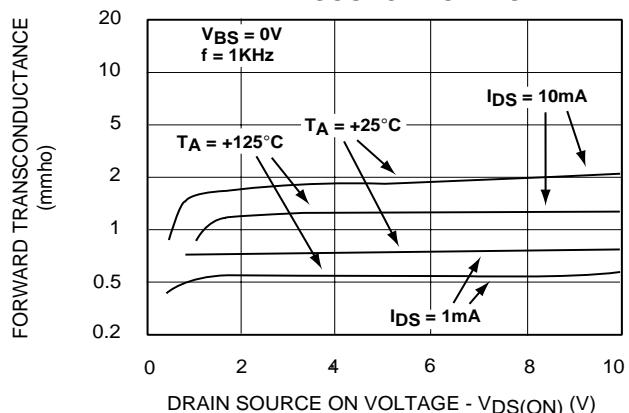
TRANSFER CHARACTERISTIC WITH SUBSTRATE BIAS

DRAIN SOURCE ON CURRENT $I_{DS(ON)}$ (μA)

$V_{BS} = 0V$
-2V
-4V
-6V
-8V
-10V

$V_{GS} = V_{DS}$
$T_A = +25°C$

GATE SOURCE ON VOLTAGE - $V_{GS(ON)}$ (V)
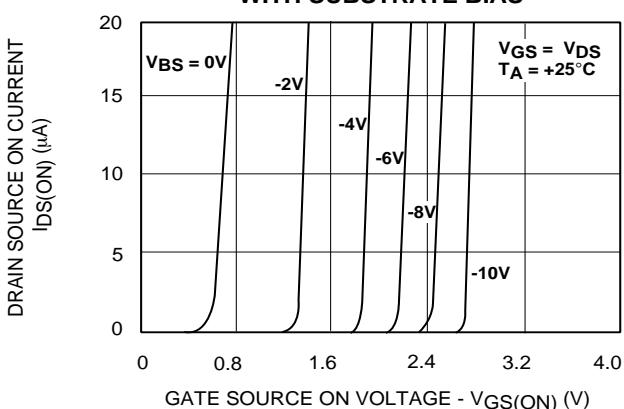
DRAIN SOURCE ON RESISTANCE vs. GATE-SOURCE VOLTAGE

DRAIN SOURCE ON RESISTANCE $R_{DS(ON)}$ (KΩ)

$V_{DS} = 0.2V$
$V_{BS} = 0V$

$T_A = +125°C$

$T_A = +25°C$

GATE SOURCE ON VOLTAGE - $V_{GS(ON)}$ (V)
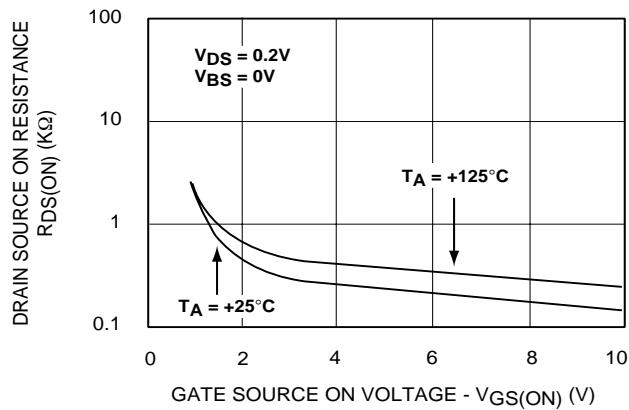
DRAIN SOURCE OFF CURRENT vs. AMBIENT TEMPERATURE

DRAIN SOURCE OFF CURRENT $R_{DS(OFF)}$ (pA)

$V_{DS} = 10V$
$V_{GS} = V_{BS} = 0V$

AMBIENT TEMPERATURE - T_A (°C)
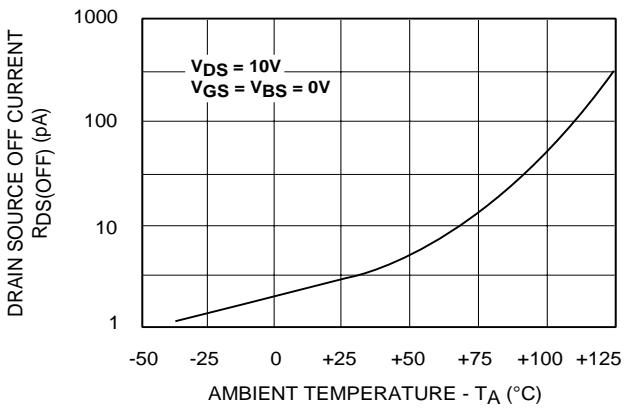
TYPICAL APPLICATIONS

CURRENT SOURCE MIRROR

V+ = +5V ALD1102, 1/2 ALD1107, or ALD1117

V+ = +5V

I_{SET} R_{SET}

Q_3 Q_4

I_{SOURCE}

Q_1 Q_2

$$I_{SOURCE} = I_{SET}$$
$$= \frac{V^+ - V_t}{R_{SET}}$$
$$\cong \frac{4}{R_{SET}}$$

ALD1101, 1/2 ALD1106, or ALD1116

Q_1, Q_2: N-Channel MOSFET
Q_3, Q_4: P-Channel MOSFET
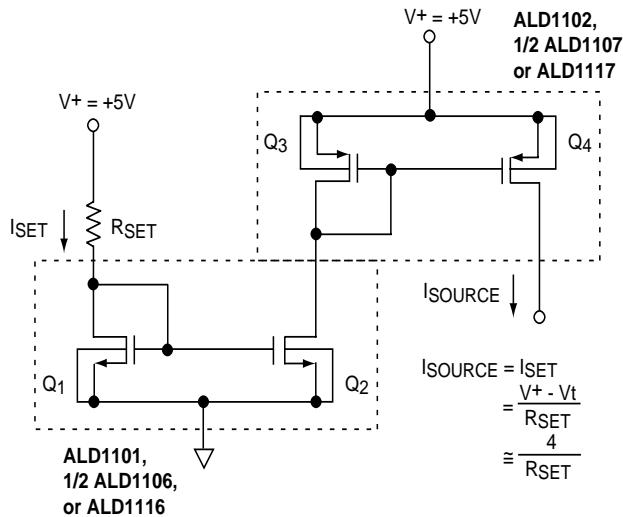
CURRENT SOURCE WITH GATE CONTROL

ALD1102, 1/2 ALD1107, or ALD1117 V+ = +5V

Q_3 Q_4

I_{SET} R_{SET} I_{SOURCE}

Digital Logic Control of Current Source

ON

OFF

Q_1

1/2 ALD1101, 1/4 ALD1106, or 1/2 ALD1116

Q_1 : N-Channel MOSFET
Q_3, Q_4: P-Channel MOSFET

DIFFERENTIAL AMPLIFIER

V+ **ALD1102, 1/2 ALD1107, or ALD1117**

PMOS PAIR

Q_3 Q_4

V_{OUT}

Q_1 Q_2

V_{IN}^+ NMOS PAIR V_{IN}^-

ALD1101, 1/2 ALD1106, or ALD1116
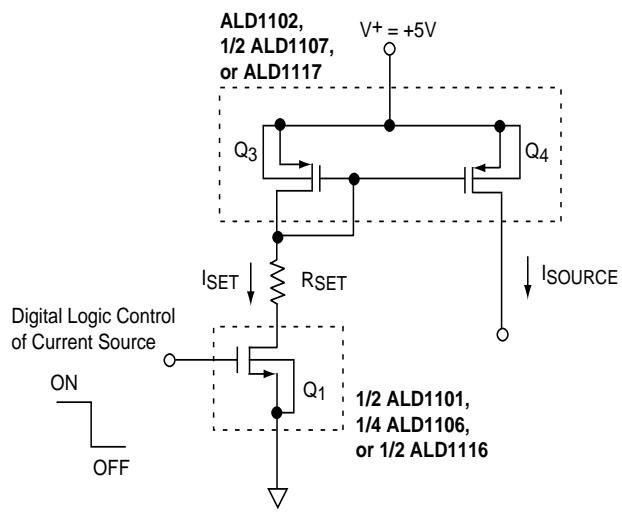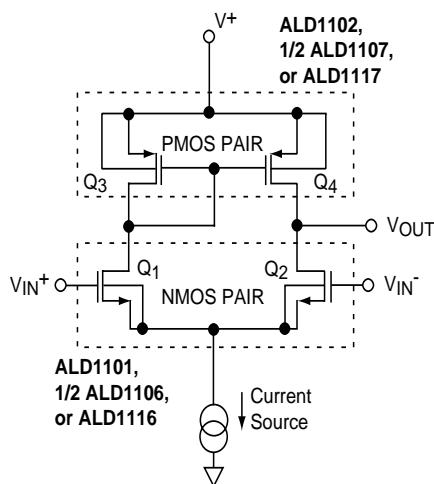
Current Source

Q_1, Q_2: N-Channel MOSFET
Q_3, Q_4: P-Channel MOSFET

CURRENT SOURCE MULTIPLICATION

V+ = +5V

$I_{SOURCE} = I_{SET} \times N$

I_{SET} R_{SET} I_{SOURCE}
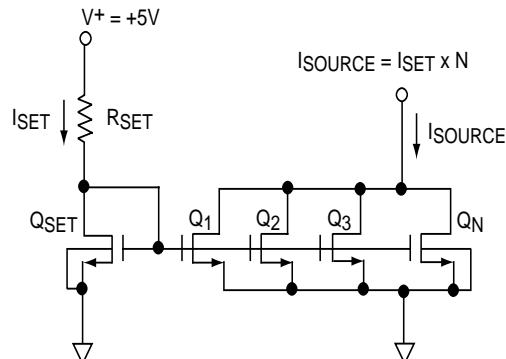
Q_{SET} Q_1 Q_2 Q_3 Q_N

Q_{SET}, $Q_1..Q_N$: ALD1101, ALD1106, or ALD1116
N-Channel MOSFET

TYPICAL APPLICATIONS (cont.)

BASIC CURRENT SOURCES

### N-CHANNEL CURRENT SOURCE

$I_{SOURCE} = I_{SET}$
$$= \frac{V+ - V_t}{R_{SET}}$$
$$\cong \frac{V+ - 1.0}{R_{SET}}$$
$$\cong \frac{4}{R_{SET}}$$
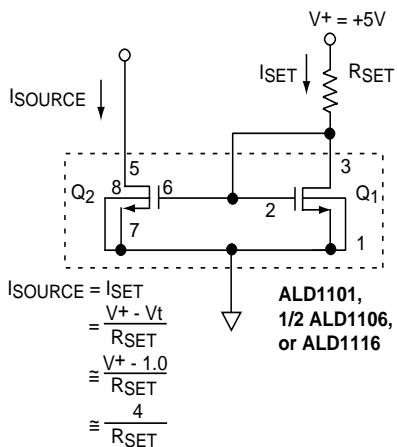
Q_1, Q_2: N-Channel MOSFET

P-CHANNEL CURRENT SOURCE
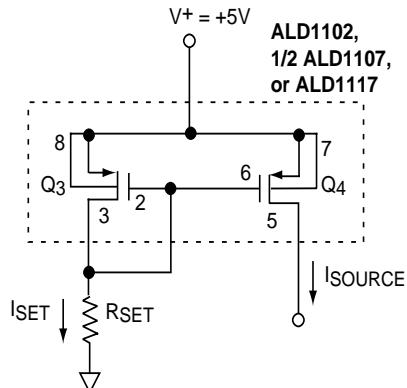
Q_3, Q_4: P-Channel MOSFET

CASCODE CURRENT SOURCES
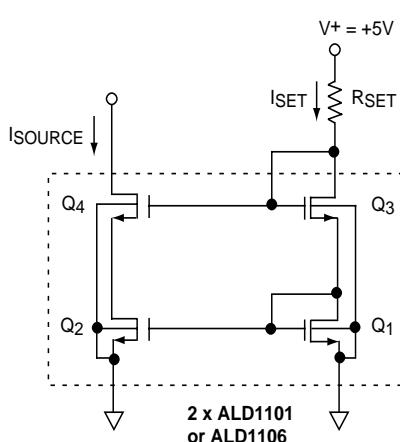
Q_1, Q_2, Q_3, Q_4: N-Channel MOSFET
(ALD1101 or ALD1103)

$$I_{SOURCE} = I_{SET} = \frac{V+ - 2V_t}{R_{SET}} \cong \frac{3}{R_{SET}}$$
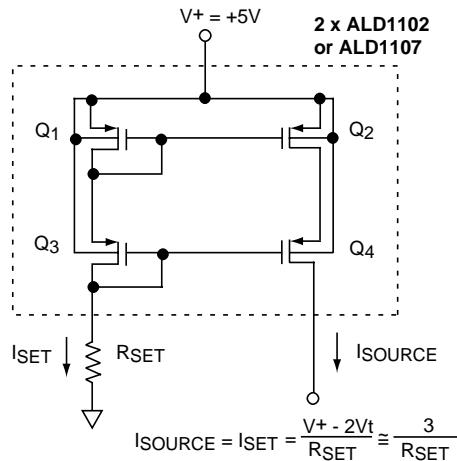
Q_1, Q_2, Q_3, Q_4: P-Channel MOSFET
(ALD1102 or ALD1103)

SOIC-8 PACKAGE DRAWING

8 Pin Plastic SOIC Package
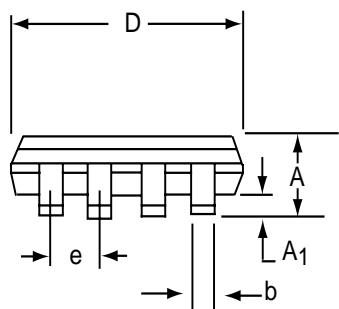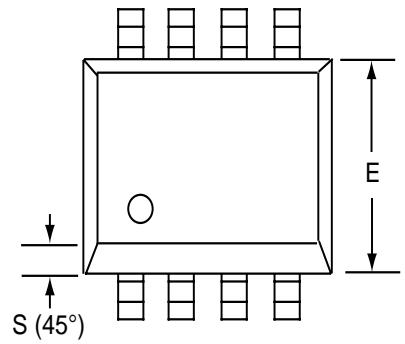
Dim	Millimeters		Inches	
	Min	**Max**	**Min**	**Max**
A	1.35	1.75	0.053	0.069
A₁	0.10	0.25	0.004	0.010
b	0.35	0.45	0.014	0.018
C	0.18	0.25	0.007	0.010
D-8	4.69	5.00	0.185	0.196
E	3.50	4.05	0.140	0.160
e	1.27 BSC		0.050 BSC	
H	5.70	6.30	0.224	0.248
L	0.60	0.937	0.024	0.037
Ø	0°	8°	0°	8°
S	0.25	0.50	0.010	0.020
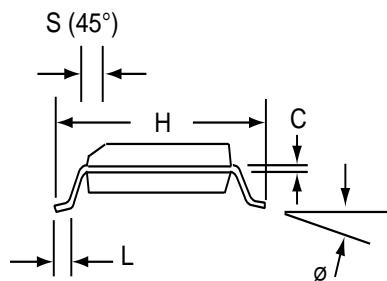
PDIP-8 PACKAGE DRAWING

8 Pin Plastic DIP Package
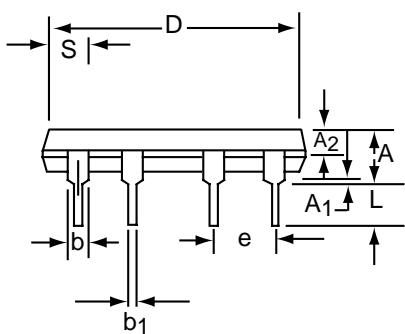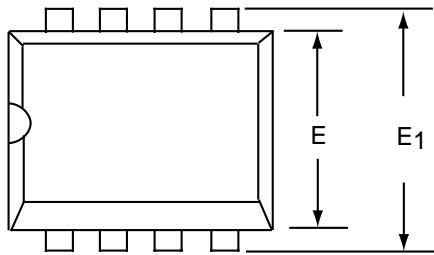
Dim	Millimeters		Inches	
	Min	**Max**	**Min**	**Max**
A	3.81	5.08	0.105	0.200
A$_1$	0.38	1.27	0.015	0.050
A$_2$	1.27	2.03	0.050	0.080
b	0.89	1.65	0.035	0.065
b$_1$	0.38	0.51	0.015	0.020
c	0.20	0.30	0.008	0.012
D-8	9.40	11.68	0.370	0.460
E	5.59	7.11	0.220	0.280
E$_1$	7.62	8.26	0.300	0.325
e	2.29	2.79	0.090	0.110
e$_1$	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
ø	0°	15°	0°	15°
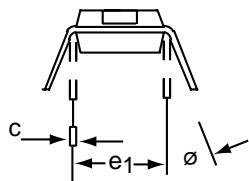
SOIC-14 PACKAGE DRAWING

14 Pin Plastic SOIC Package
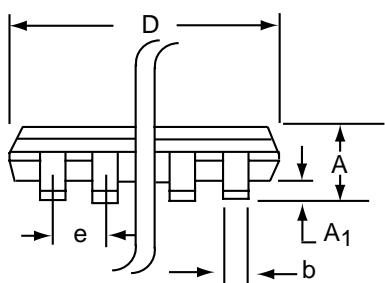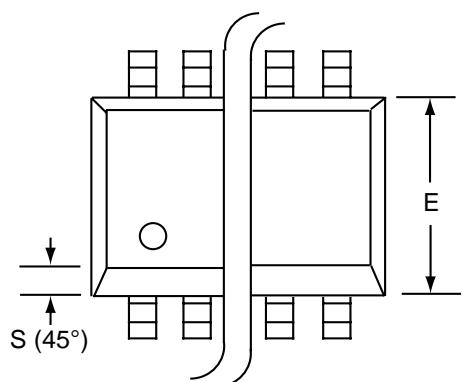
Dim	Millimeters		Inches	
	Min	**Max**	**Min**	**Max**
A	1.35	1.75	0.053	0.069
A$_1$	0.10	0.25	0.004	0.010
b	0.35	0.45	0.014	0.018
C	0.18	0.25	0.007	0.010
D-14	8.55	8.75	0.336	0.345
E	3.50	4.05	0.140	0.160
e	1.27 BSC		0.050 BSC	
H	5.70	6.30	0.224	0.248
L	0.60	0.937	0.024	0.037
Ø	0°	8°	0°	8°
S	0.25	0.50	0.010	0.020
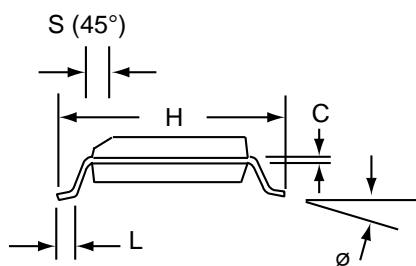
PDIP-14 PACKAGE DRAWING

14 Pin Plastic DIP Package
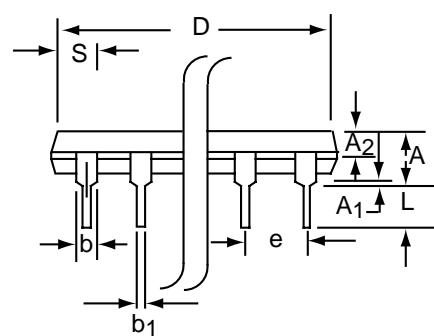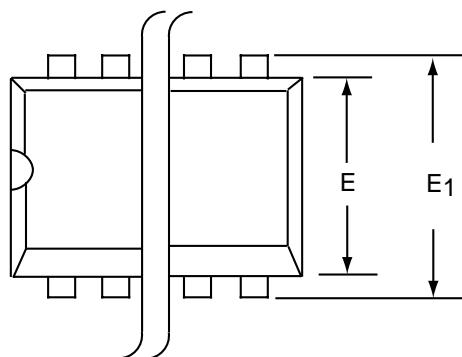
Dim	Millimeters		Inches	
	Min	Max	Min	Max
A	3.81	5.08	0.105	0.200
A_1	0.38	1.27	0.015	0.050
A_2	1.27	2.03	0.050	0.080
b	0.89	1.65	0.035	0.065
b_1	0.38	0.51	0.015	0.020
c	0.20	0.30	0.008	0.012
D-14	17.27	19.30	0.680	0.760
E	5.59	7.11	0.220	0.280
E_1	7.62	8.26	0.300	0.325
e	2.29	2.79	0.090	0.110
e_1	7.37	7.87	0.290	0.310
L	2.79	3.81	0.110	0.150
S-14	1.02	2.03	0.040	0.080
ø	0°	15°	0°	15°