QUAD OPERATIONAL AMPLIFIER

DESCRIPITION

The **324** consist of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide voltage rang. Operation from split power supplies is also possible so long as the difference between the two supplies is 3 volts to 32 volts. Application areas include transducer amplifier, DC gain blocks and all the conventional OP-AMP circuits which now can be easily implemented in single power supply systems.

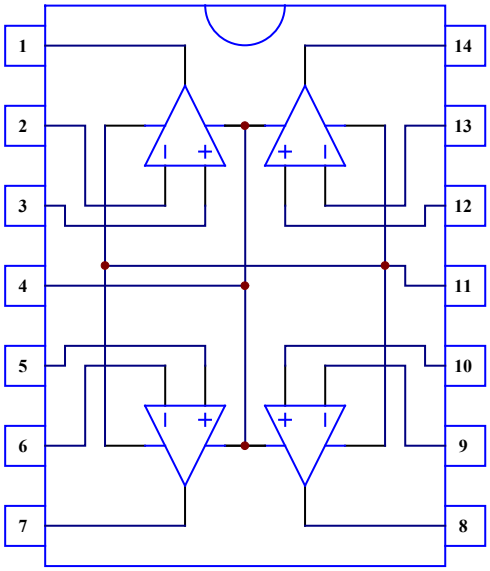
FEATURES

- Internally frequency compensated for unity gain.
- Large DC voltage gain: 100dB.
- Wide power supply range: 3V~32V(or ±1.5~±15V).
- Input common mode voltage range includes ground.
- Large output voltage swing: 0V to Vcc-1.5V
- Power drain suitable for battery operation.

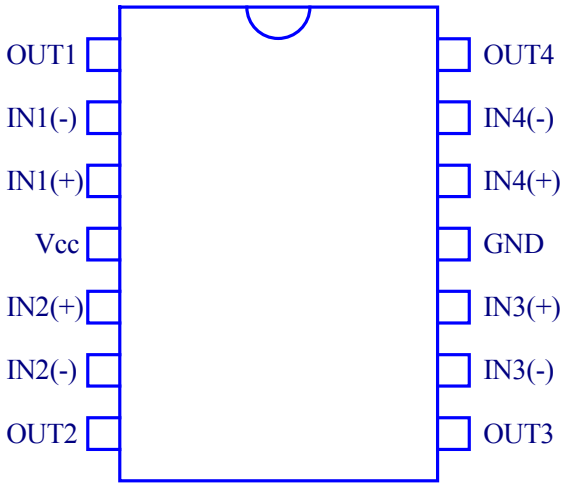
STRUCTURE

Bipolar monolithic IC

BLOCK DIAGRAM



PIN CONNECTION (Top view)



Pin No.	Symbol	Pin Name
1	OUT1	Output1
2	IN1 (-)	Inverting input 1
3	IN1 (+)	Non-inverting input 1
4	Vcc	Supply power
5	IN2 (+)	Non-inverting input 2
6	IN2 (-)	Inverting input 2
7	OUT2	Output 2
8	OUT3	Output 3
9	IN3 (-)	Inverting input 3
10	IN3 (+)	Non-inverting input 3
11	GND	Ground
12	IN4 (+)	Non-inverting input 4
13	IN4 (-)	Inverting input 4
14	OUT4	Output 4

ABSOLUTE MAXIMUM RATINGS

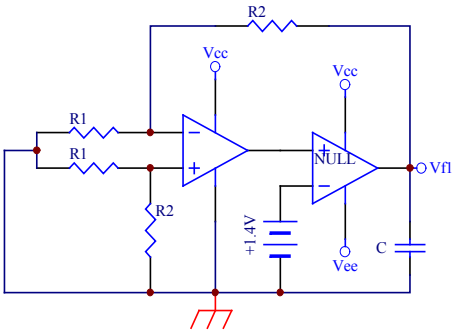
Symbol	Parameter		Value		Unit
			MIN	MAX	
V_{CC}	Power supply voltage			±16 or 32	V
V_{ID} (DIFF)	Differential input voltage			32	V
V_{IN}	Input voltage		-0.3	32	V
P_D	Total power dissipation	T amb=25˚C, 14-DIP		1130	mW
		T amb=25˚C, 14-SOP		1260	mW
		T amb=25˚C, 14-TSOP		800	mW
T amb	Operation temperature		0	70	˚C
T stg	Storage temperature		-65	150	˚C

ELECTRICAL CHARACTERISTICS(V_{CC}=5V, V_{EE}=GND, T amb=25°C, unless otherwise specified)

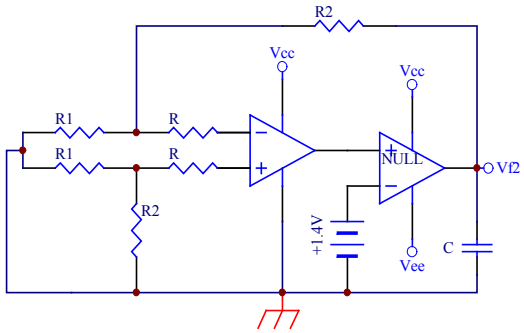
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{IO}	Input offset voltage	V_{CM} = 0V to V_{CC} – 0.5V, $V_{O(P)}$ = 1.4V, R_S = 0ohm		0.22	7.0	mV
I_{IO}	Input offset current			0.34	50	nA
I_{BIAS}	Input bias current			36.5	250	nA
V_{IRC}	Common-mode input voltage range	V_{CC} = 30V	0		V_{CC} – 1.5V	V
I_{CC}	Supply current	R_L = ∞, V_{CC} = 30V (all Amps)		1.64	3.0	mA
		R_L = ∞, V_{CC} = 5V (all Amps)		0.87	1.2	
G_V	Large signal voltage gain	V_{CC} = 15V, R_L≥2k, $V_{O(P)}$ = 1V to 11V	25	120		V/mV
V_{OH}	Output high level voltage swing	V_{CC} = 30V, R_L = 2k	26			V
		V_{CC} = 30V, R_L = 10k	27	28		
V_{OL}	Output low level voltage swing	V_{CC} = 15V, R_L≥10k		0.69	20	mV
CMRR	Common-mode rejection ratio		65	85		dB
PSRR	Power supply rejection ratio		65	100		dB
C_S	Channel separation	f = 1kHz to 20kHz		120		dB
I_{SC}	Short circuit to GND			40	60	mA
I_{SOURCE}	Output current	V_{IN} (+)=1V, V_{IN} (-)=0V, V_{CC}=15V, $V_{O(P)}$ = 2V	10	31		mA

I_{SINK}	Output current	V_{IN} (+)=0V, V_{IN} (-)=1V, V_{CC}=15V, $V_{O(P)}$=2V	5	9.9		mA
		V_{IN} (+)=0V, V_{IN} (-)=1V, V_{CC}=15V, $V_{O(P)}$= 200mV	12	50		μA
V_{ID} (DIFF)	Differential input voltage				V_{CC}	V

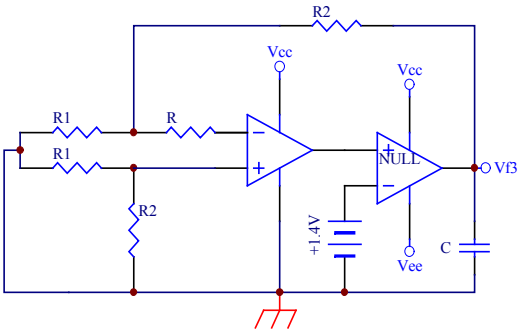
Figure: Test circuits (NULL is that the Gv of amplifier is 0.)

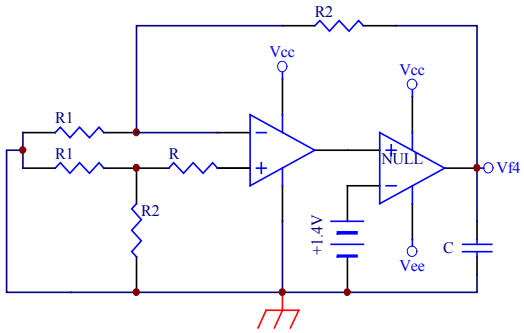


Vio = Vf1/(1+R2/R1)

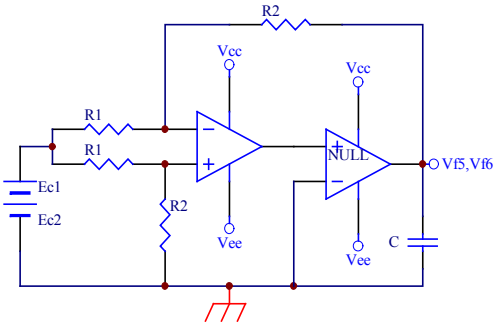


Iio = (Vf2-Vf1)/R(1+R2/R1)

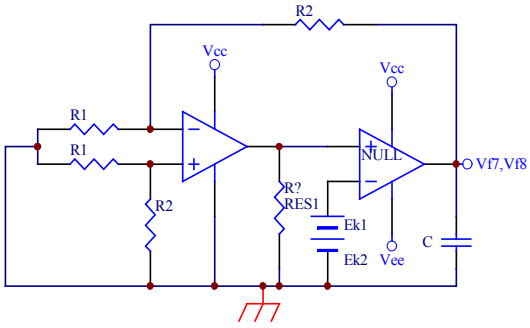




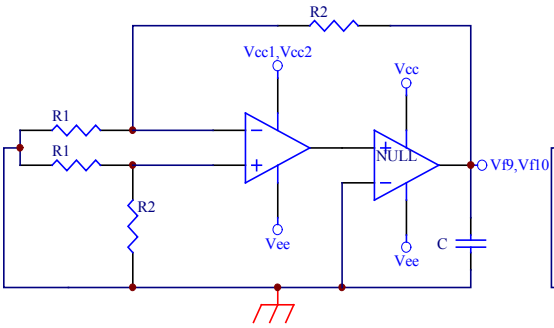
Iba = (Vf4-Vf3)/R(1+R2/R1)
Input bias current Iba



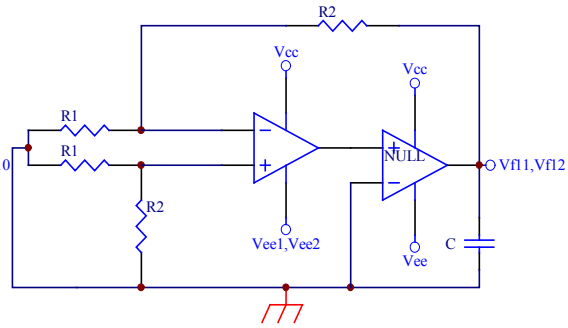
CMR = 20log|(Ec1-Ec2)(1+R2/R1)/(Vf5-Vf6)|



Gv = (Ek1-Ek2)(1+R2/R1)/(Vf8-Vf7)



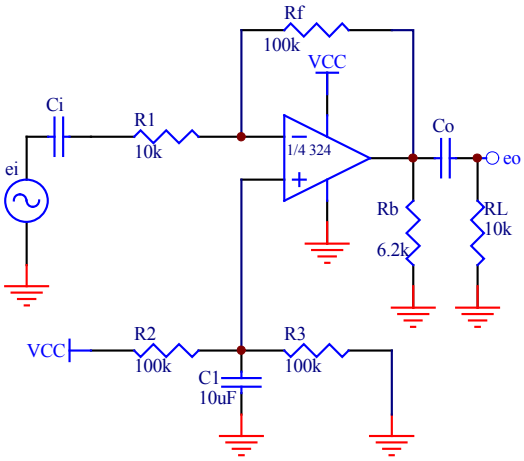
PSRR(+) = 20log|(Vcc1-Vcc2)(1+R2/R1)/(Vf9-Vf10)|



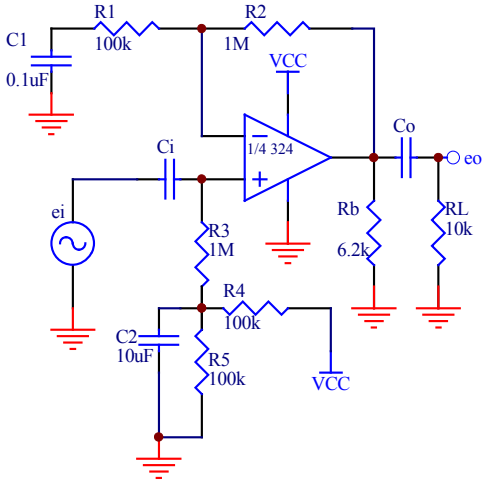
PSRR(-) = 20log|(Vee1-Vee2)(1+R2/R1)/(Vf11-Vf12)|

Figure: Typical single-supply application

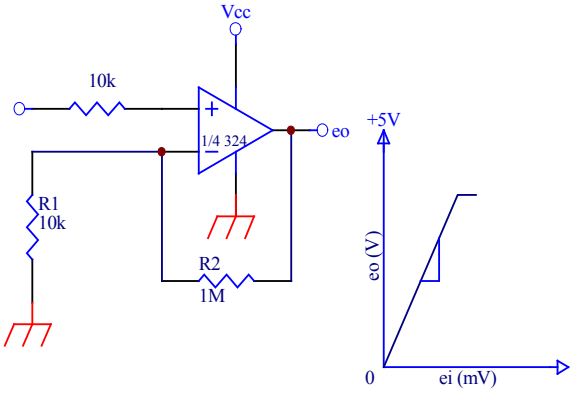
AC coupled inverting amplifier



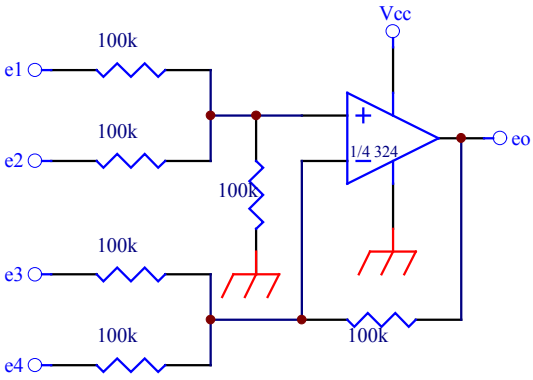
AC coupled non-inverting amplifier



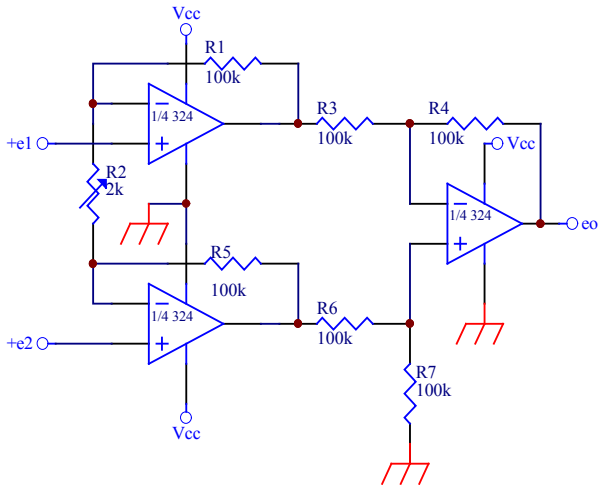
Non-inverting DC gain



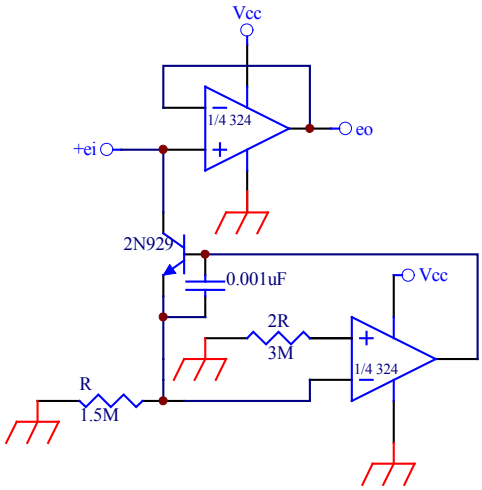
DC summing amplifier



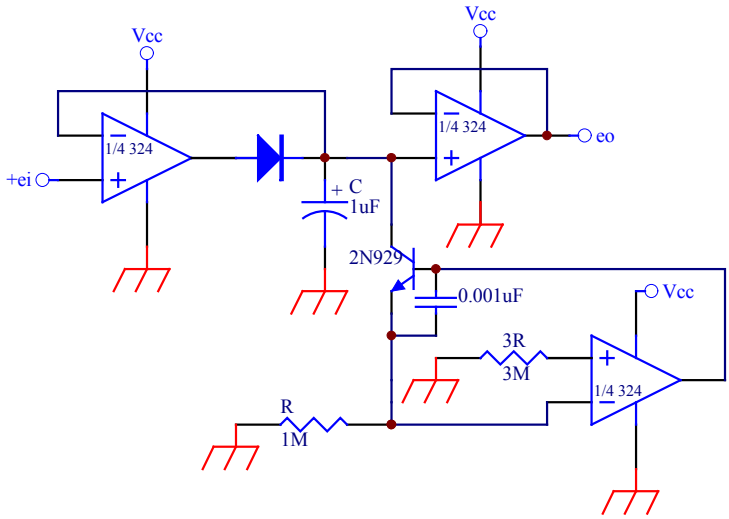
High input Z adjustable-gain DC instrumentation amplifier



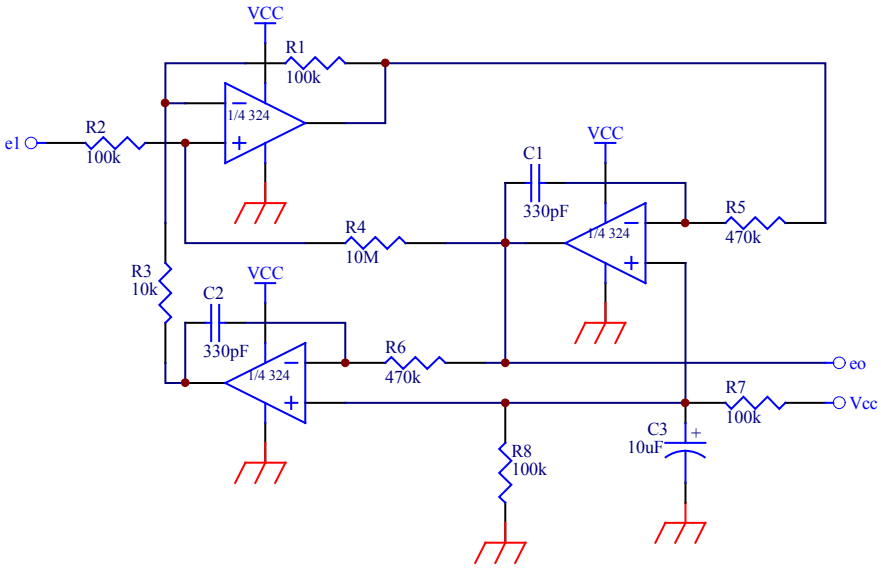
Using symmetrical amplifiers to reduce input current (general concept)



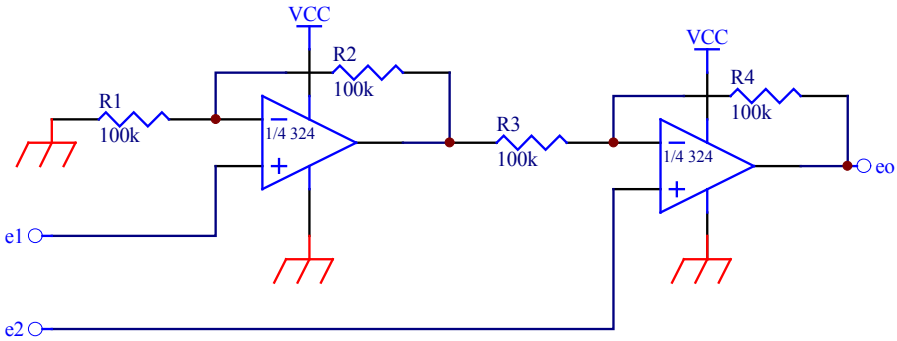
Low drift peak detector



RC active band-pass filter

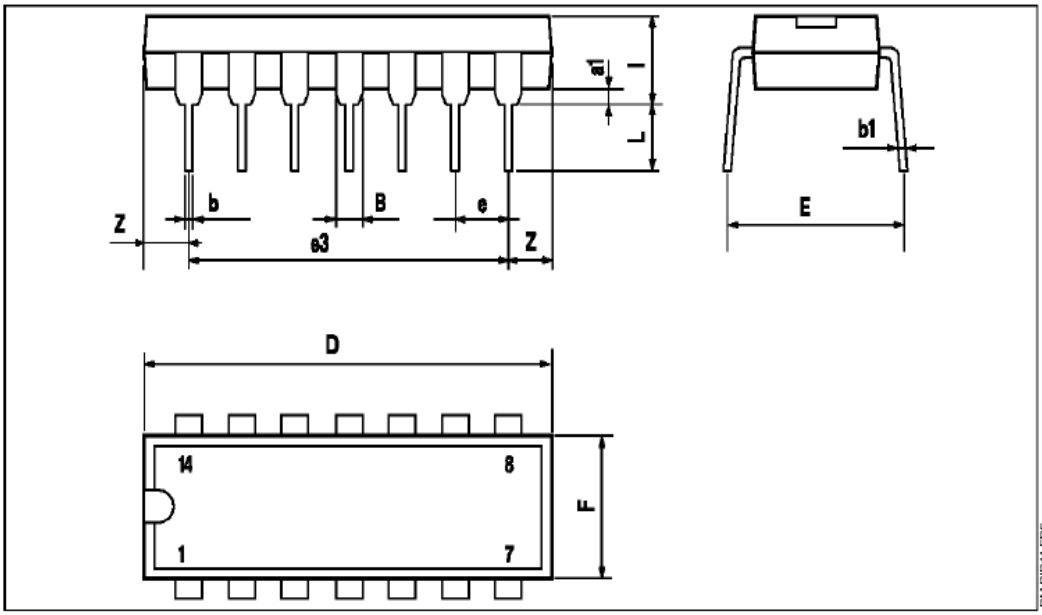


High input Z, DC differential amplifier



PACKAGE MECHANICAL DATA

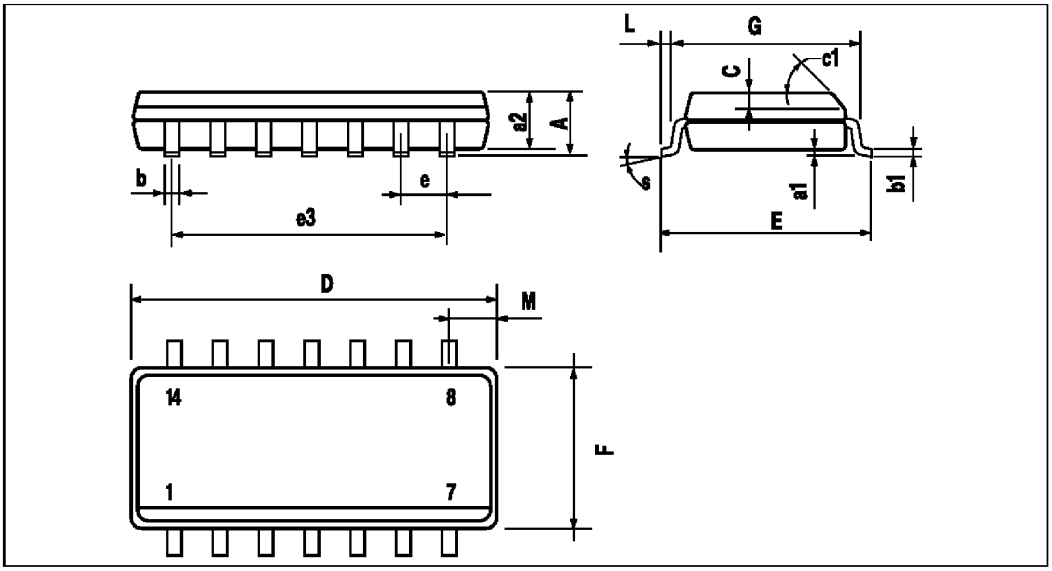
14 PINS - PLASTIC DIP



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

DIP14.TBL

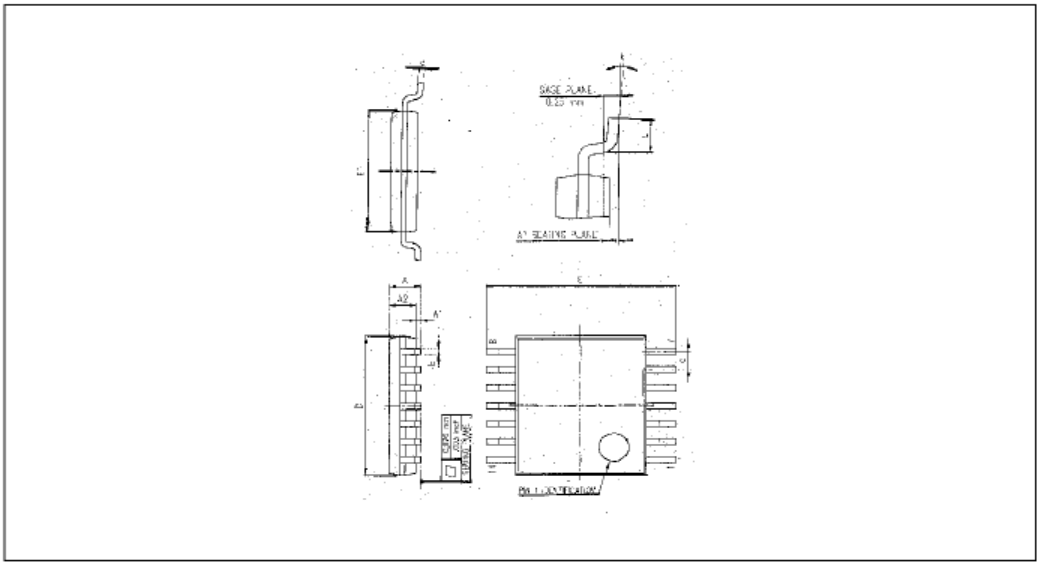
PACKAGE MECHANICAL DATA
14 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.334
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

SO14.TBL

PACKAGE MECHANICAL DATA
14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030