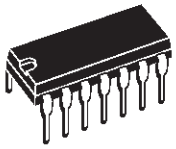
LAMPIRAN D

Datasheet Komponen

LM124
LM224 - LM324

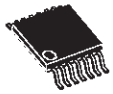
LOW POWER QUAD OPERATIONAL AMPLIFIERS

- WIDE GAIN BANDWIDTH : 1.3MHz
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LARGE VOLTAGE GAIN : 100dB
- VERY LOW SUPPLY CURRENT/AMPLI : 375µA
- LOW INPUT BIAS CURRENT : 20nA
- LOW INPUT OFFSET VOLTAGE : 5mV max.
  (for more accurate applications, use the equivalent parts LM124A-LM224A-LM324A which feature 3mV max)
- LOW INPUT OFFSET CURRENT : 2nA
- WIDE POWER SUPPLY RANGE :
  SINGLE SUPPLY : +3V TO +30V
  DUAL SUPPLIES : ±1.5V TO ±15V



N
DIP14
(Plastic Package)

D
SO14
(Plastic Micropackage)



P
TSSOP14
(Thin Shrink Small Outline Package)

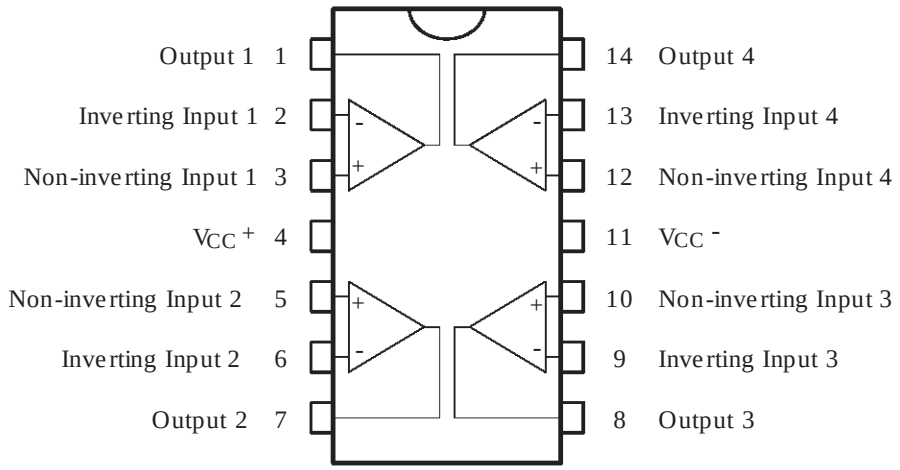
DESCRIPTION

These circuits consist of four independent, high gain, internally frequency compensated operational amplifiers . They operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

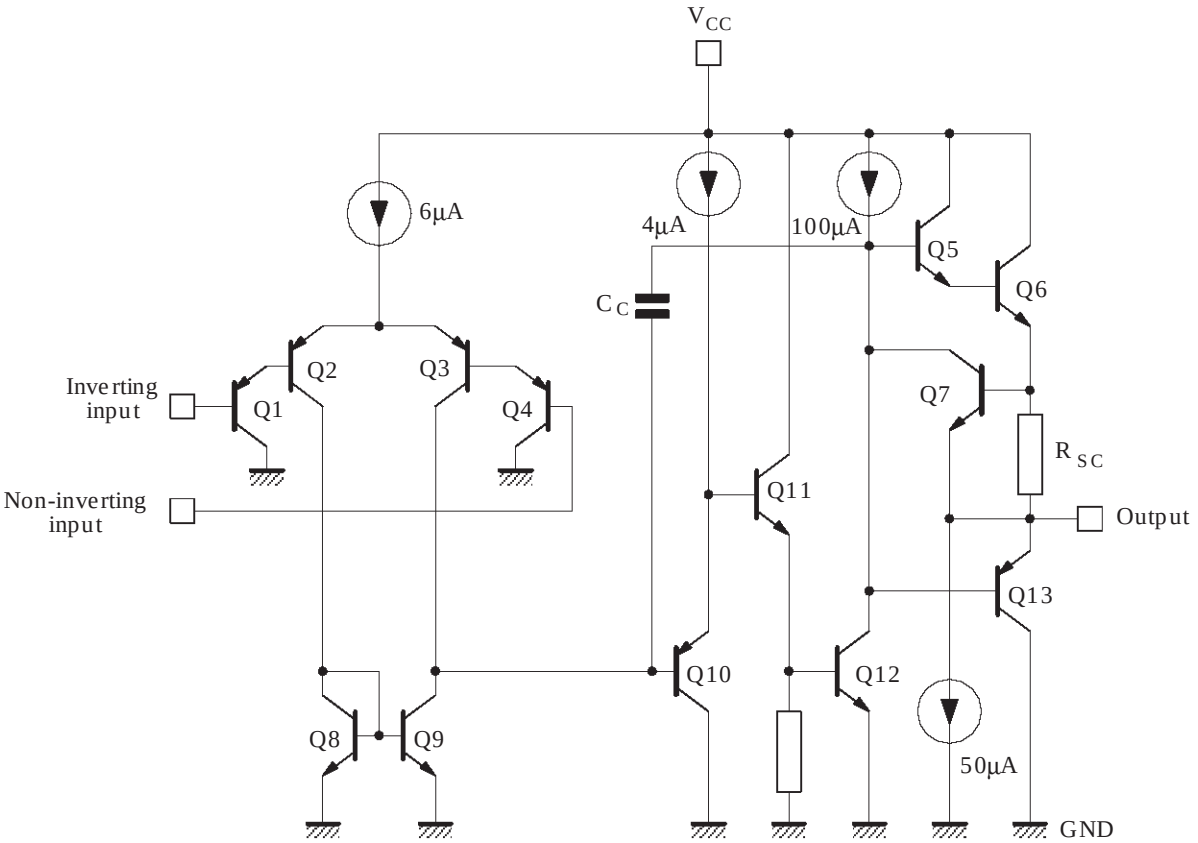
ORDER CODES

Part Number	Temperature Range	Package		
		N	D	P
LM124	-55°C, +125°C	•	•	•
LM224	-40°C, +105°C	•	•	•
LM324	0°C, +70°C	•	•	•
Example : LM224N				

PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM (1/4 LM124)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM124	LM224	LM324	Unit
V_{cc}	Supply Voltage	±16 or 32			V
V_i	Input Voltage	-0.3 to +32			V
V_{id}	Differential Input Voltage - (*)	+32	+32	+32	V
P_{tot}	Power Dissipation N Suffix D Suffix	500 -	500 400	500 400	mW mW
-	Output Short-circuit Duration - (note 1)	Infinite			
I_{in}	Input Current – (note 6)	50	50	50	mA
T_{oper}	Operating Free Air Temperature Range	-55 to +125	-40 to +105	0 to +70	°C
T_{stg}	Storage Temperature Range	-65 to +150	-65 to +150	-65 to +150	°C

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = +5V, V_{CC}^- = Ground, V_O = 1.4V, T_{amb} = +25°C (unless otherwise specified)

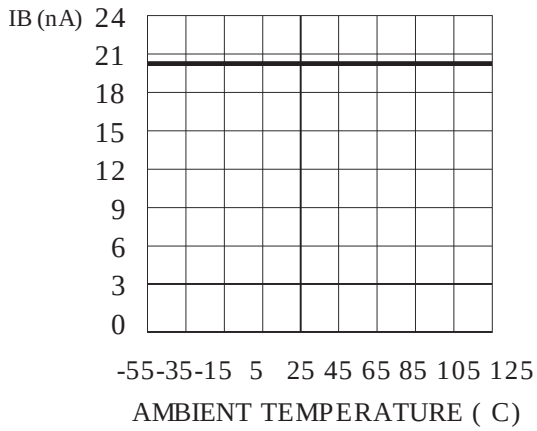
Symbol	Parameter	LM124 - LM224 - LM324			Unit
		Min.	Typ.	Max.	
V_{io}	Input Offset Voltage (note 3) T_{amb} = +25°C LM324 $T_{min.} \le T_{amb} \le T_{max}$. LM324		2	5 7 7 9	mV
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max}$.		2	30 100	nA
I_{ib}	Input Bias Current (note 2) T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max}$.		20	150 300	nA
A_{vd}	Large Signal Voltage Gain (V_{CC}^+ = +15V, R_L = 2kΩ, V_O = 1.4V to 11.4V) T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max}$.	 50 25	 100		V/mV
SVR	Supply Voltage Rejection Ratio ($R_S \le 10k\Omega$) (V_{CC}^+ = 5V to 30V) T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max}$.	 65 65	 110		dB
I_{CC}	Supply Current, all Amp, no load T_{amb} = +25°C V_{CC} = +5V V_{CC} = +30V $T_{min.} \le T_{amb} \le T_{max}$. V_{CC} = +5V V_{CC} = +30V		 0.7 1.5 0.8 1.5	 1.2 3 1.2 3	mA
V_{icm}	Input Common Mode Voltage Range (V_{CC} = +30V) - (note 4) T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max}$.	 0 0		 V_{CC} -1.5 V_{CC} -2	V
CMR	Common-mode Rejection Ratio ($R_S \le 10k\Omega$) T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max}$	 70 60	 80		dB
I_{source}	Output Current Source (V_{id} = +1V) V_{CC} = +15V, V_o = +2V	 20	 40	 70	mA
I_{sink}	Output Sink Current (V_{id} = -1V) V_{CC} = +15V, V_o = +2V V_{CC} = +15V, V_o = +0.2V	 10 12	 20 50		 mA µA

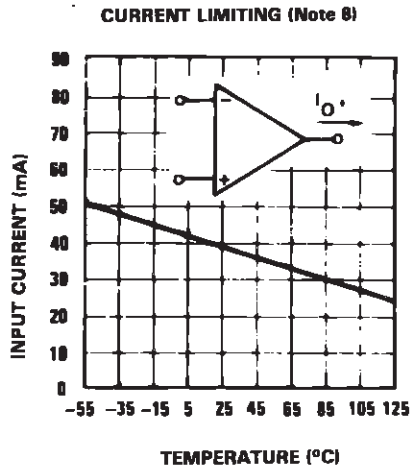
ELECTRICAL CHARACTERISTICS (continued)

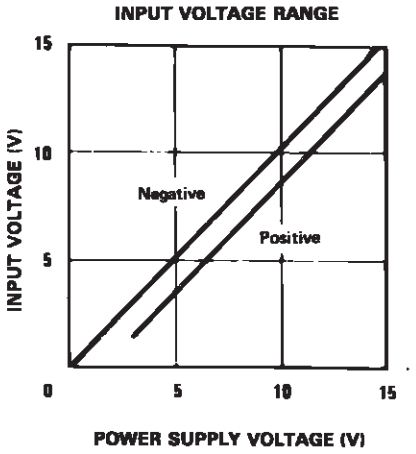
Symbol	Parameter	LM124 - LM224 - LM324			Unit
		Min.	Typ.	Max.	
V_{OH}	High Level Output Voltage (V_{CC} = +30V) T_{amb} = +25°C R_L = 2kΩ $T_{min.} \le T_{amb} \le T_{max.}$ T_{amb} = +25°C R_L = 10kΩ $T_{min.} \le T_{amb} \le T_{max.}$ (V_{CC} = +5V, R_L = 2kΩ) T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max.}$	 26 26 27 27 3.5 3	 27 28 	 	V
V_{OL}	Low Level Output Voltage (R_L = 10kΩ) T_{amb} = +25°C $T_{min.} \le T_{amb} \le T_{max.}$		 5	 20 20	mV
SR	Slew Rate V_{CC} = 15V, V_I = 0.5 to 3V, R_L = 2kΩ, C_L = 100pF, unity gain)		 0.4		V/µs
GBP	Gain Bandwidth Product V_{CC} = 30V, f = 100kHz, V_{in} = 10mV R_L = 2kΩ, C_L = 100pF		 1.3		MHz
THD	Total Harmonic Distortion f = 1kHz, A_V = 20dB, R_L = 2kΩ, V_O = $2V_{pp}$ C_L = 100pF, V_{CC} = 30V		 0.015		%
e_n	Equivalent Input Noise Voltage f = 1kHz, R_s = 100Ω, V_{CC} = 30V		 40		$\frac{nV}{\sqrt{Hz}}$
DV_{io}	Input Offset Voltage Drift		7	30	µV/°C
DI_{IO}	Input Offset Current Drift		10	200	pA/°C
V_O1/V_O2	Channel Separation (note 5) 1kHz ≤ f ≤ 20kHz		 120		dB

Notes :
1. Short-circuits from the output to V_{CC} can cause excessive heating if V_{CC} > 15V. The maximum output current is approximately 40mA independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuit on all amplifiers.
2. The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
3. V_o = 1.4V, R_s = 0Ω, 5V < V_{CC}^+ < 30V, 0 < V_{ic} < V_{CC}^+ - 1.5V
4. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V_{CC}^+ - 1.5V, but either or both inputs can go to +32V without damage.
5. Due to the proximity of external components insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequences.
6. This input current only exists when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as input diodes clamps. In addition to this diode action, there is also NPN parasitic action on the IC chip. this transistor action can cause the output voltages of the Op-amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time duration than an input is driven negative.
   This is not destructive and normal output will set up again for input voltage higher than -0.3V.

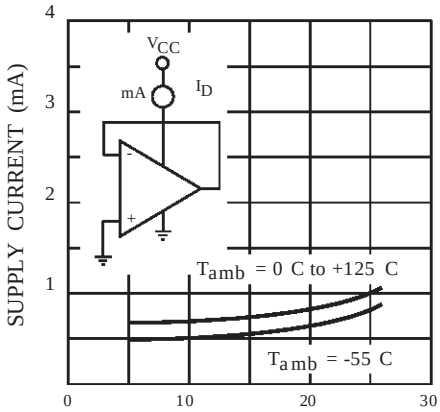
INPUT BIAS CURRENT
versus AMBIENT TEMPERATURE

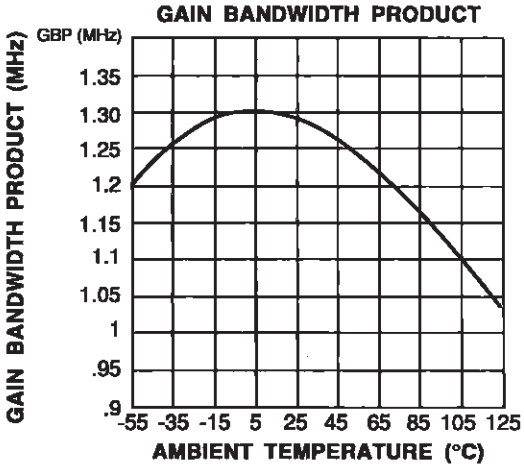


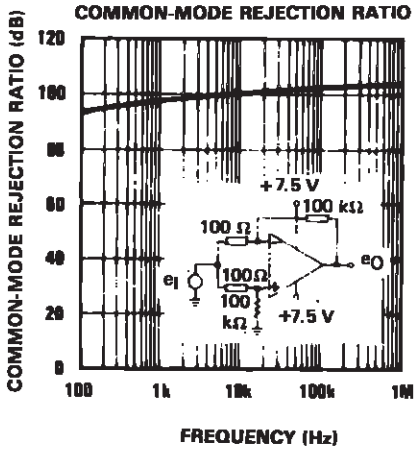




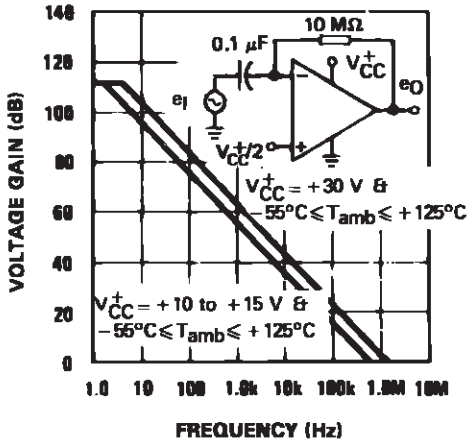
SUPPLY CURRENT



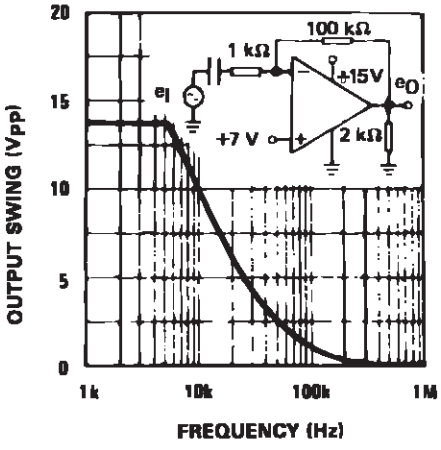




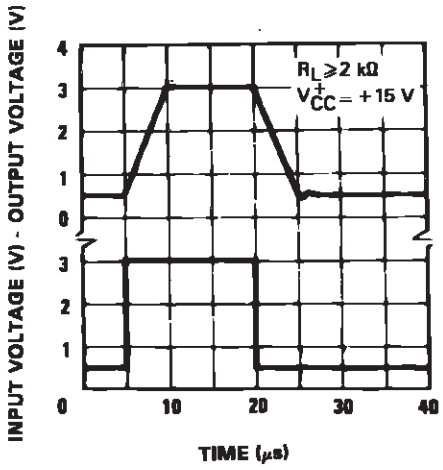
OPEN LOOP FREQUENCY RESPONSE



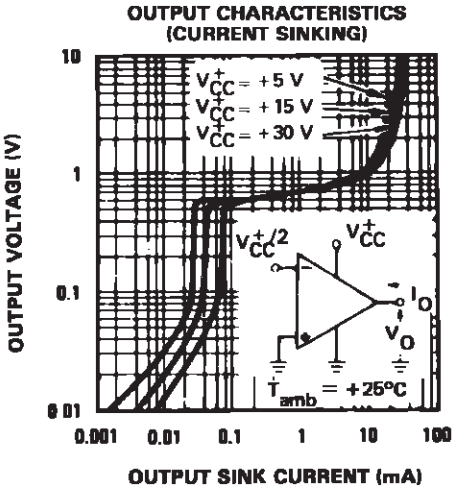
LARGE SIGNAL FREQUENCY RESPONSE



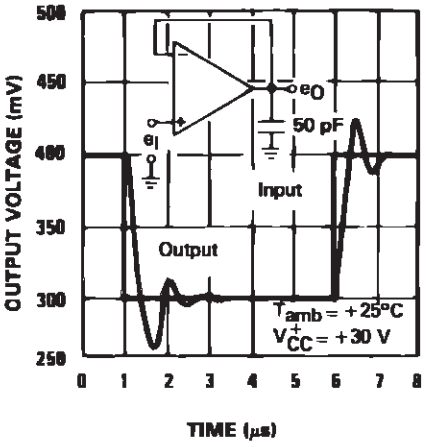
VOLTAGE FOLLOWER PULSE RESPONSE



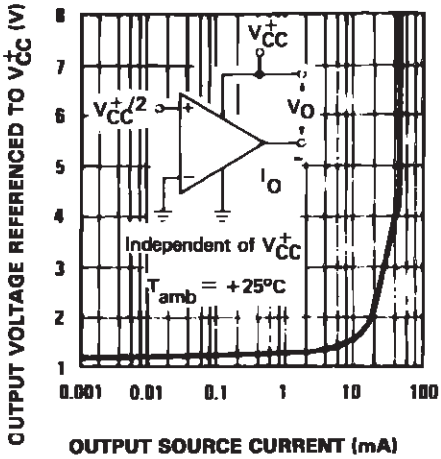
OUTPUT CHARACTERISTICS (CURRENT SINKING)

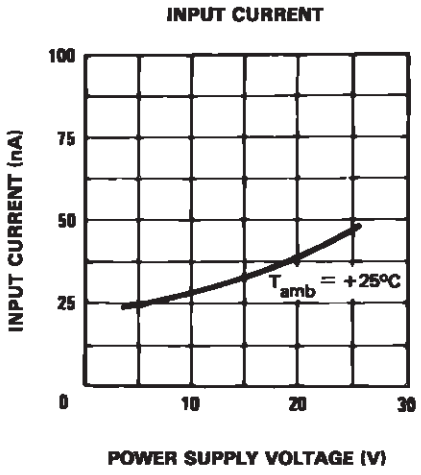


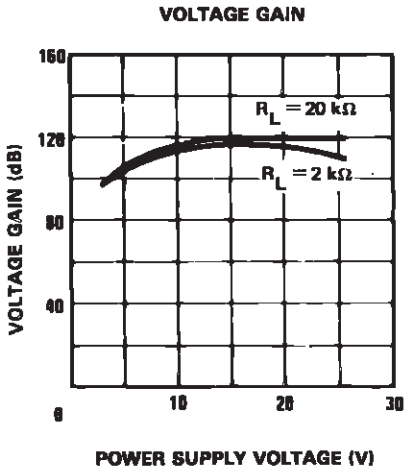
VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)

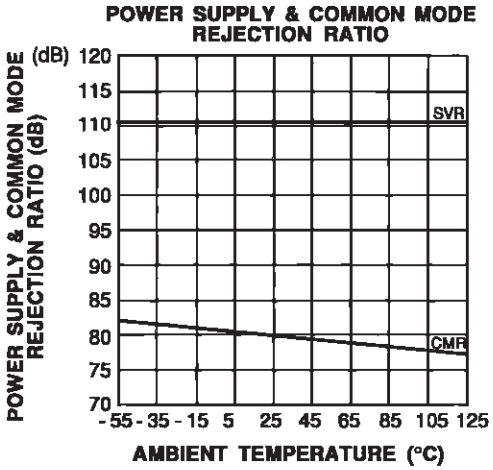


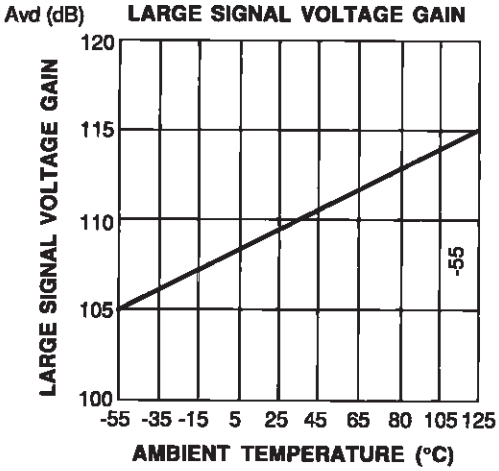
OUTPUT CHARACTERISTICS (CURRENT SOURCING)





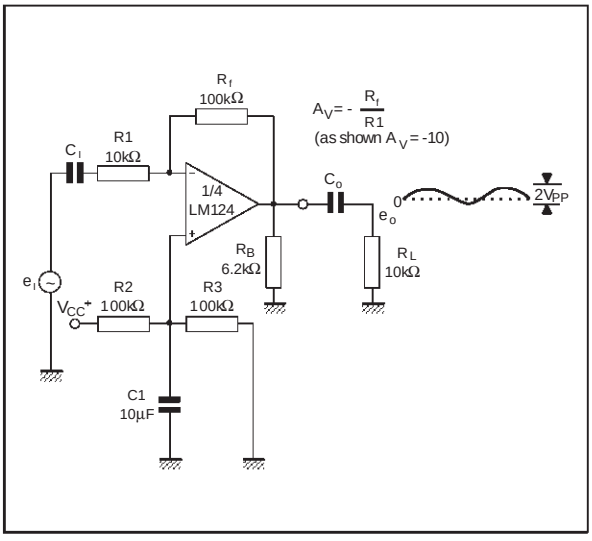




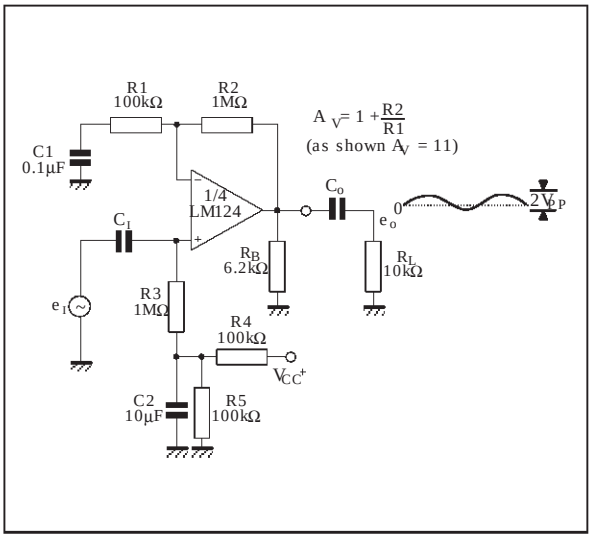


TYPICAL SINGLE - SUPPLY APPLICATIONS

AC COUPLED INVERTING AMPLIFIER

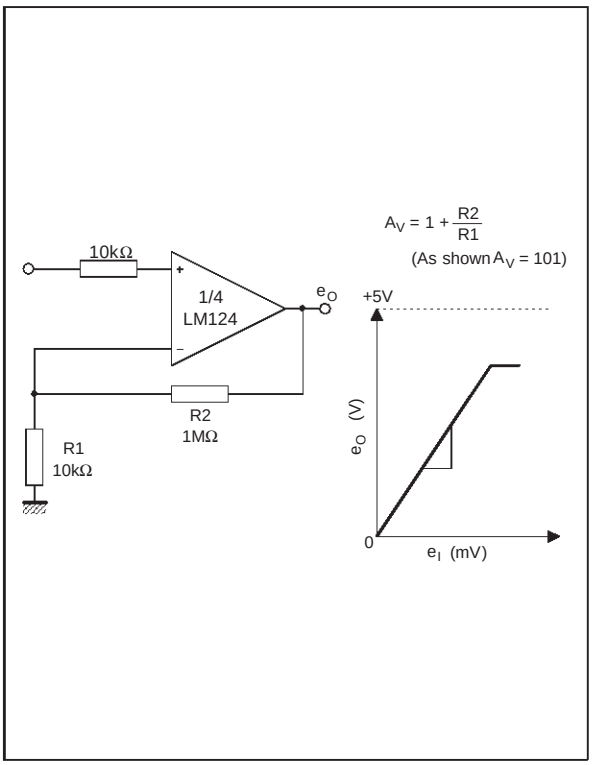


AC COUPLED NON-INVERTING AMPLIFIER

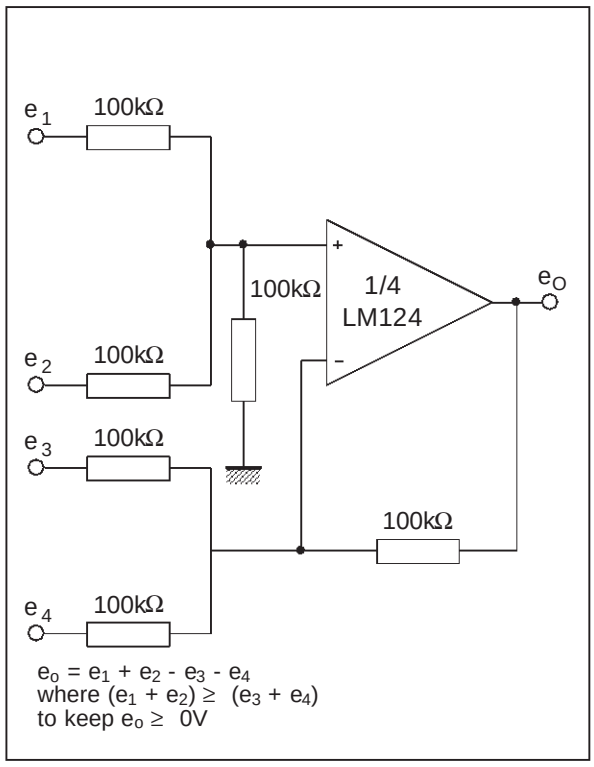


TYPICAL SINGLE - SUPPLY APPLICATIONS

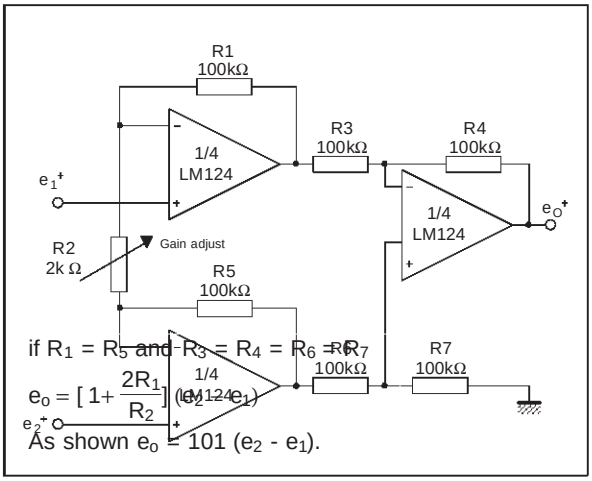
NON-INVERTING DC GAIN



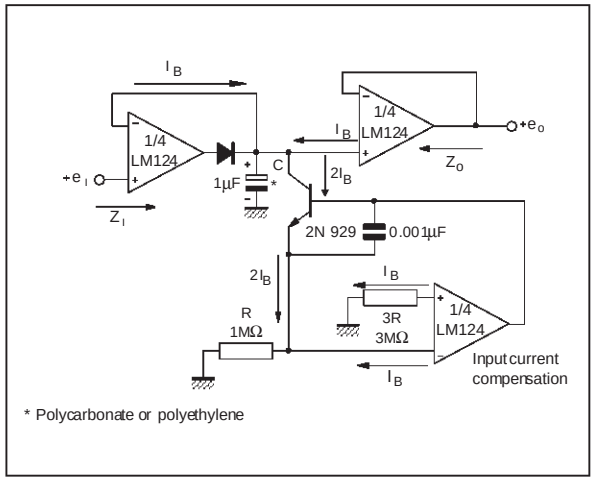
DC SUMMING AMPLIFIER



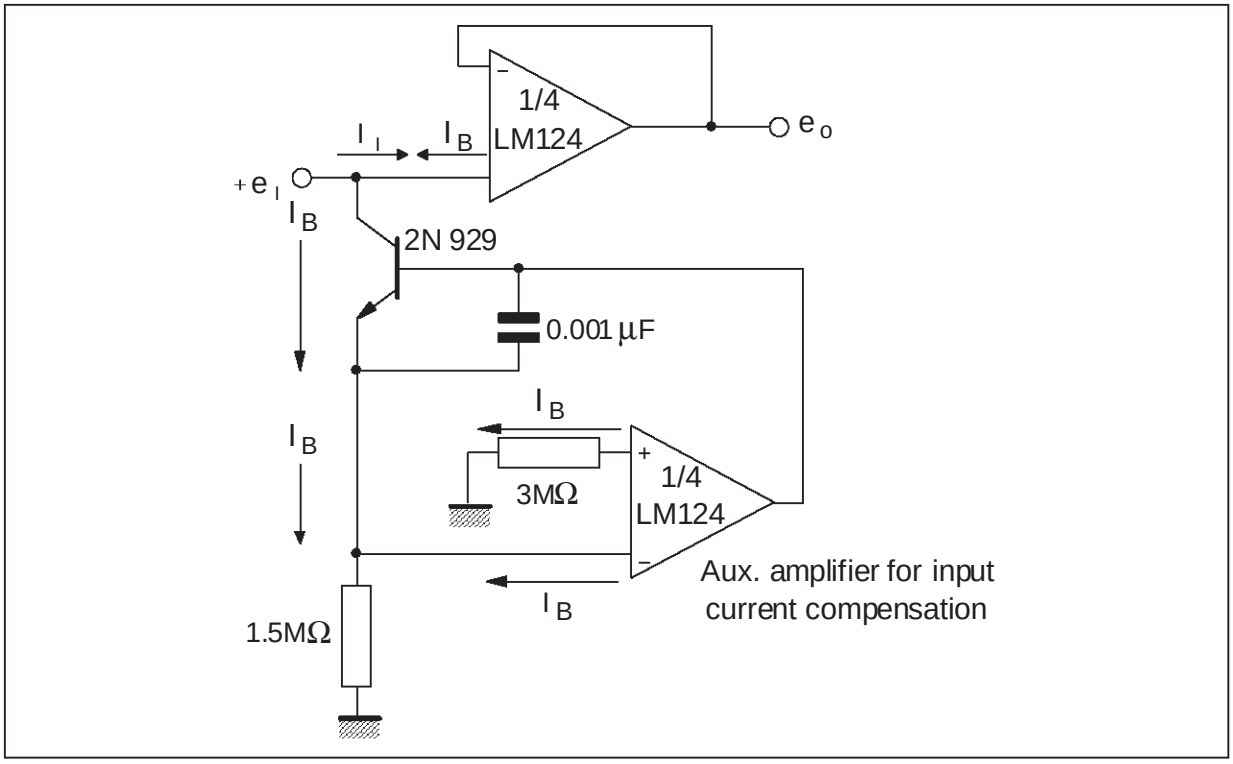
HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER



LOW DRIFT PEAK DETECTOR

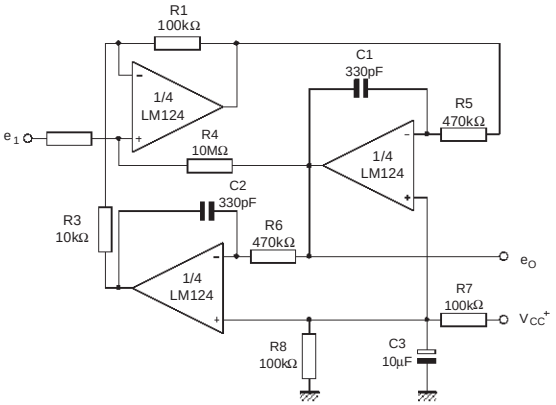


USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT (GENERAL CONCEPT)



TYPICAL SINGLE - SUPPLY APPLICATIONS

ACTIVER BANDPASS FILTER



F_O = 1kHz

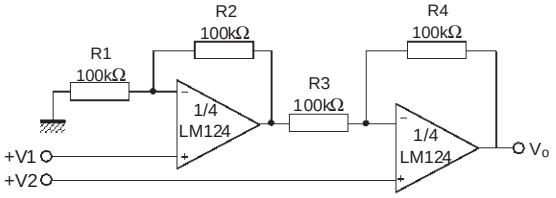
Q = 50

A_V = 100 (40dB)

HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER

For $\frac{R_1}{R_2} = \frac{R_4}{R_3}$

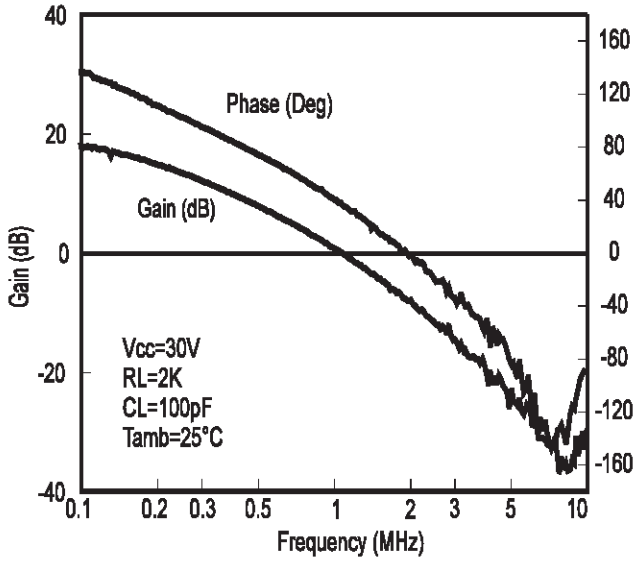
(CMRR depends on this resistor ratio match)



$e_o\ (1+\frac{R_4}{R_3})\ (e_2 - e_1)$

As shown $e_o = (e_2 - e_1)$

VOLTAGE GAIN AND PHASE vs FREQUENCY



- LARGE VOLTAGE GAIN : 100dB
- VERY LOW SUPPLY CURRENT/AMPLI : 375µA
- LOW INPUT BIAS CURRENT : 20nA
- LOW INPUT OFFSET VOLTAGE : 2mV
- LOW INPUT OFFSET CURRENT : 2nA
- WIDE POWER SUPPLY RANGE :
  SINGLE SUPPLY : +3V to +30V
  DUAL SUPPLIES : ±1.5V to ±15V

Applies to : LM124-LM224-LM324

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** Standard Linear Ics Macromodels, 1993.
** CONNECTIONS :
* 1 INVERTING INPUT
* 2 NON-INVERTING INPUT
* 3 OUTPUT
* 4 POSITIVE POWER SUPPLY
* 5 NEGATIVE POWER SUPPLY

.SUBCKT LM124 1 3 2 4 5 (analog)
*************************************************************
.MODEL MDTH D IS=1E-8 KF=3.104131E-15 CJO=10F
* INPUT STAGE
CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 5 2 5 1
EIN 16 5 1 5 1
RIP 10 11 2.600000E+01
RIN 15 16 2.600000E+01
RIS 11 15 2.003862E+02
DIP 11 12 MDTH 400E-12
DIN 15 14 MDTH 400E-12
VOFP 12 13 DC 0
VOFN 13 14 DC 0
IPOL 13 5 1.000000E-05
CPS 11 15 3.783376E-09
DINN 17 13 MDTH 400E-12
VIN 17 5 0.000000e+00
DINR 15 18 MDTH 400E-12
VIP 4 18 2.000000E+00
FCP 4 5 VOFP 3.400000E+01
FCN 5 4 VOFN 3.400000E+01
FIBP 2 5 VOFN 2.000000E-03
FIBN 5 1 VOFP 2.000000E-03
* AMPLIFYING STAGE
FIP 5 19 VOFP 3.600000E+02
FIN 5 19 VOFN 3.600000E+02
RG1 19 5 3.652997E+06
RG2 19 4 3.652997E+06
CC 19 5 6.000000E-09
DOPM 19 22 MDTH 400E-12
DONM 21 19 MDTH 400E-12
HOPM 22 28 VOUT 7.500000E+03
VIPM 28 4 1.500000E+02
HONM 21 27 VOUT 7.500000E+03
VINM 5 27 1.500000E+02
EOUT 26 23 19 5 1
VOUT 23 5 0
ROUT 26 3 20
COUT 3 5 1.000000E-12
DOP 19 25 MDTH 400E-12
VOP 4 25 2.242230E+00
DON 24 19 MDTH 400E-12
VON 24 5 7.922301E-01
.ENDS
```

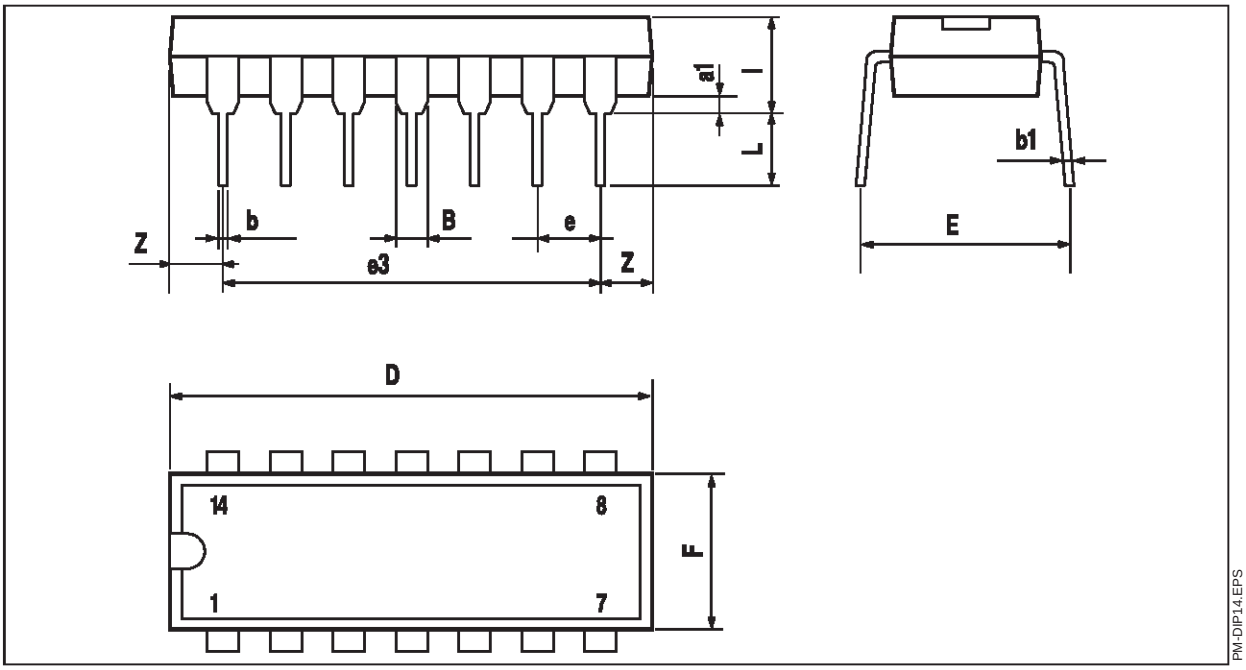
ELECTRICAL CHARACTERISTICS

V_{CC}^+ = +5V, V_{CC}^- = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
A_{vd}	R_L = 2kΩ	100	V/mV
I_{CC}	No load, per operator	350	µA
V_{icm}		-15 to +13.5	V
V_{OH}	R_L = 2kΩ (V_{CC}^+ = 15V)	+13.5	V
V_{OL}	RL = 10kΩ	5	mV
I_{OS}	V_O = +2V, V_{CC} = +15V	+40	mA
GBP	R_L = 2kΩ, C_L = 100pF	1.3	MHz
SR	R_L = 2kΩ, C_L = 100pF	0.4	V/µs

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC DIP

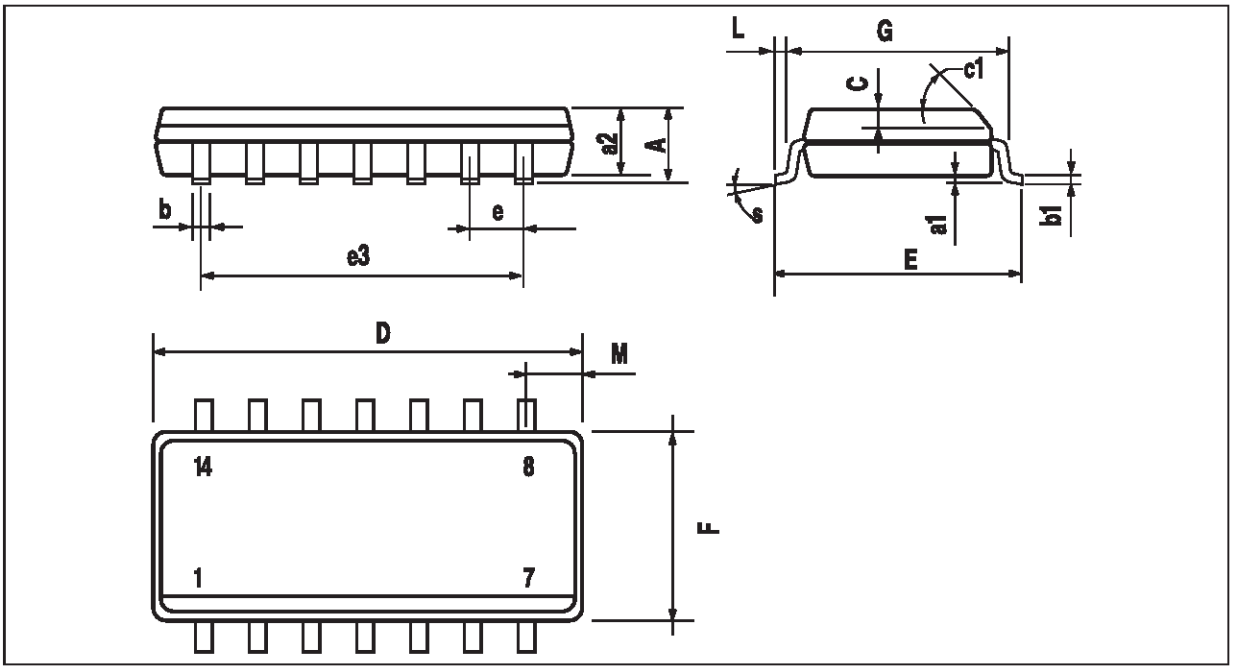


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

DIP14.TBL

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE (SO)

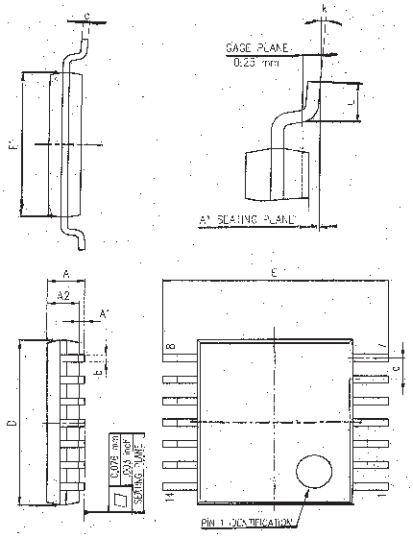


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45^o (typ.)					
D	8.55		8.75	0.336		0.334
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		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^o (max.)					

SO14.TBL

PACKAGE MECHANICAL DATA

14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



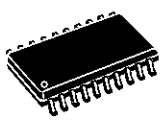
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0^o		8^o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

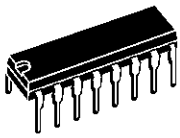
SGS-THOMSON MICROELECTRONICS

L293D
L293DD

PUSH-PULL FOUR CHANNEL DRIVER WITH DIODES

- 600mA OUTPUT CURRENT CAPABILITY PER CHANNEL
- 1.2A PEAK OUTPUT CURRENT (non repetitive) PER CHANNEL
- ENABLE FACILITY
- OVERTEMPERATURE PROTECTION
- LOGICAL "0" INPUT VOLTAGE UP TO 1.5 V (HIGH NOISE IMMUNITY)
- INTERNAL CLAMP DIODES





SO(12+4+4) **Powerdip (12+2+2)**

ORDERING NUMBERS:

L293DD L293D

DESCRIPTION

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoides, DC and stepping motors) and switching power transistors.

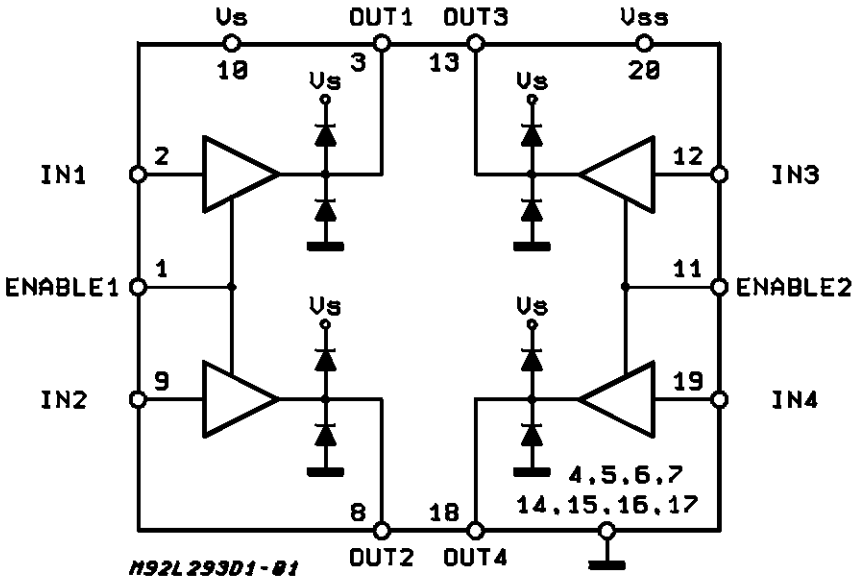
To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included.

This device is suitable for use in switching applications at frequencies up to 5 kHz.

The L293D is assembled in a 16 lead plastic packaage which has 4 center pins connected together and used for heatsinking

The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heatsinking.

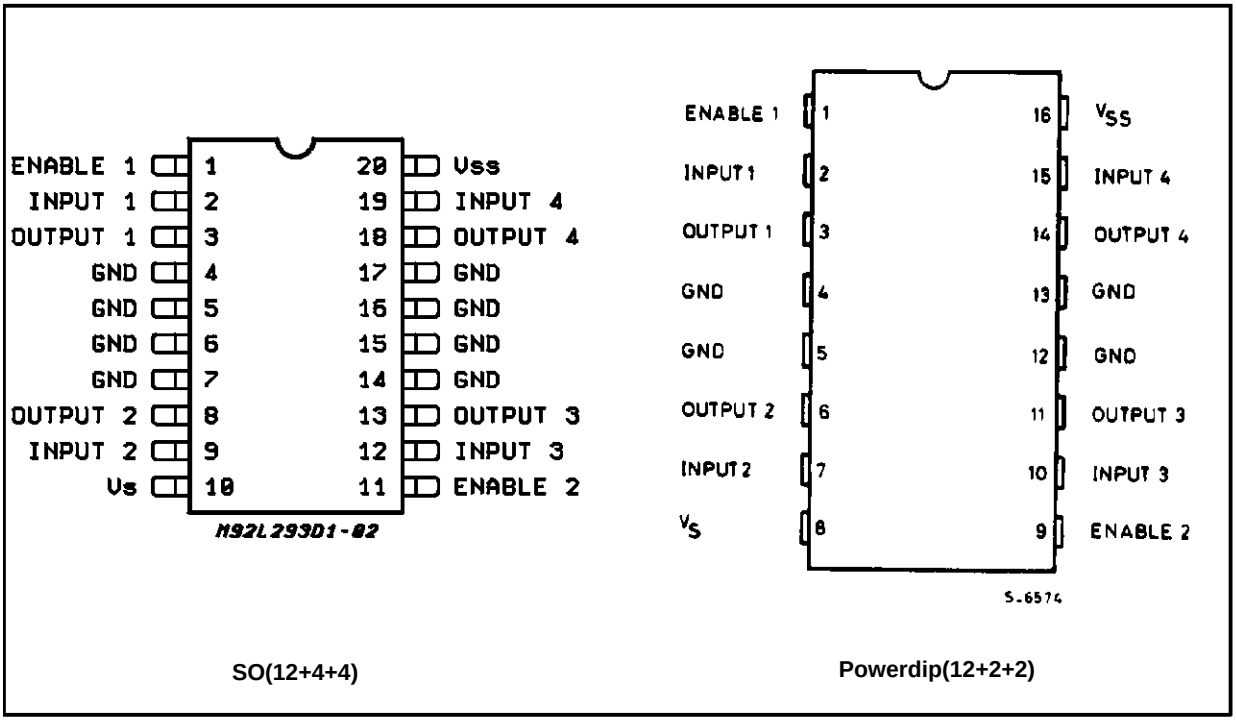
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	Supply Voltage	36	V
V_{SS}	Logic Supply Voltage	36	V
V_i	Input Voltage	7	V
V_{en}	Enable Voltage	7	V
I_o	Peak Output Current (100 µs non repetitive)	1.2	A
P_{tot}	Total Power Dissipation at T_{pins} = 90 °C	4	W
T_{stg}, T_j	Storage and Junction Temperature	– 40 to 150	°C

PIN CONNECTIONS (Top view)



SO(12+4+4) **Powerdip(12+2+2)**

THERMAL DATA

Symbol	Decription		DIP	SO	Unit
$R_{th\ j\text{-}pins}$	Thermal Resistance Junction-pins	max.	–	14	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance junction-ambient	max.	80	50 (*)	°C/W
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	max.	14	–	

(*) With 6sq. cm on board heatsink.

ELECTRICAL CHARACTERISTICS (for each channel, V_S = 24 V, V_{SS} = 5 V, T_{amb} = 25 °C, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_S	Supply Voltage (pin 10)		V_{SS}		36	V
V_{SS}	Logic Supply Voltage (pin 20)		4.5		36	V
I_S	Total Quiescent Supply Current (pin 10)	V_i = L ; I_O = 0 ; V_{en} = H		2	6	mA
		V_i = H ; I_O = 0 ; V_{en} = H		16	24	mA
		V_{en} = L			4	mA
I_{SS}	Total Quiescent Logic Supply Current (pin 20)	V_i = L ; I_O = 0 ; V_{en} = H		44	60	mA
		V_i = H ; I_O = 0 ; V_{en} = H		16	22	mA
		V_{en} = L		16	24	mA
V_{IL}	Input Low Voltage (pin 2, 9, 12, 19)		– 0.3		1.5	V
V_{IH}	Input High Voltage (pin 2, 9, 12, 19)	$V_{SS} \leq 7$ V	2.3		V_{SS}	V
		$V_{SS} > 7$ V	2.3		7	V
I_{IL}	Low Voltage Input Current (pin 2, 9, 12, 19)	V_{IL} = 1.5 V			– 10	µA
I_{IH}	High Voltage Input Current (pin 2, 9, 12, 19)	$2.3\ V \leq V_{IH} \leq V_{SS} - 0.6\ V$		30	100	µA
$V_{en\,L}$	Enable Low Voltage (pin 1, 11)		– 0.3		1.5	V
$V_{en\,H}$	Enable High Voltage (pin 1, 11)	$V_{SS} \leq 7$ V	2.3		V_{SS}	V
		$V_{SS} > 7$ V	2.3		7	V
$I_{en\,L}$	Low Voltage Enable Current (pin 1, 11)	$V_{en\,L}$ = 1.5 V		– 30	– 100	µA
$I_{en\,H}$	High Voltage Enable Current (pin 1, 11)	$2.3\ V \leq V_{en\,H} \leq V_{SS} - 0.6\ V$			± 10	µA
$V_{CE(sat)H}$	Source Output Saturation Voltage (pins 3, 8, 13, 18)	I_O = – 0.6 A		1.4	1.8	V
$V_{CE(sat)L}$	Sink Output Saturation Voltage (pins 3, 8, 13, 18)	I_O = + 0.6 A		1.2	1.8	V
V_F	Clamp Diode Forward Voltage	I_O = 600nA		1.3		V
t_r	Rise Time (*)	0.1 to 0.9 V_O		250		ns
t_f	Fall Time (*)	0.9 to 0.1 V_O		250		ns
t_{on}	Turn-on Delay (*)	0.5 V_i to 0.5 V_O		750		ns
t_{off}	Turn-off Delay (*)	0.5 V_i to 0.5 V_O		200		ns

(*) See fig. 1.

TRUTH TABLE (one channel)

Input	Enable (*)	Output
H	H	H
L	H	L
H	L	Z
L	L	Z

Z = High output impedance
(*) Relative to the considered channel

Figure 1: Switching Times

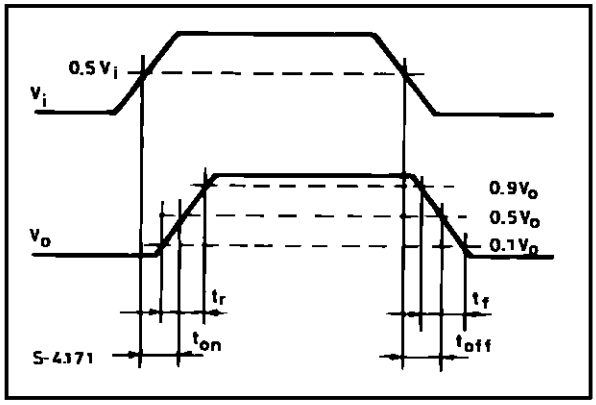
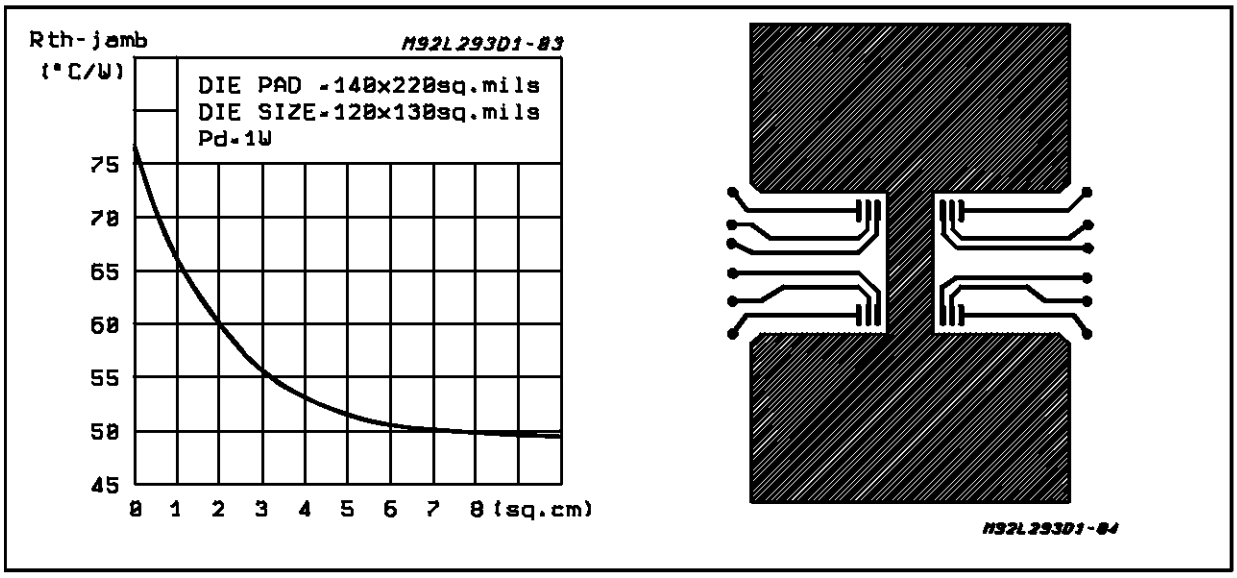
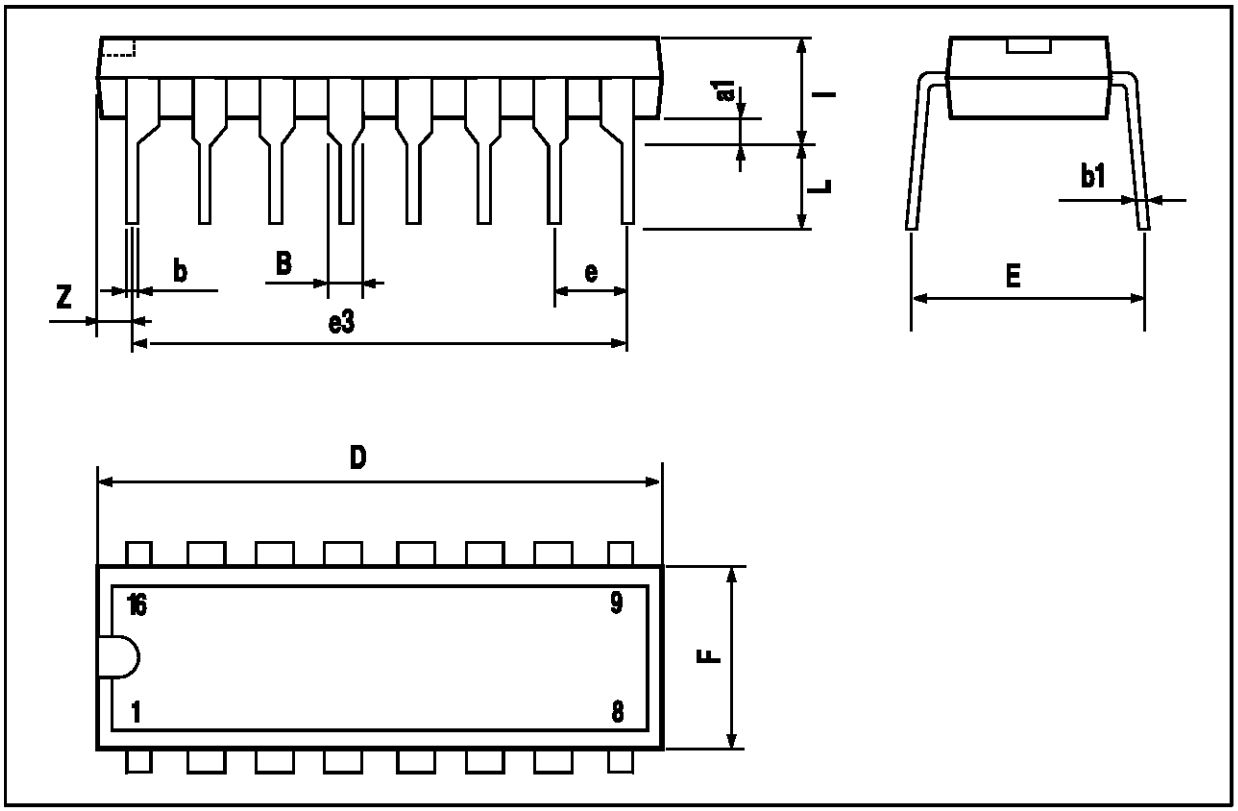


Figure 2: Junction to ambient thermal resistance vs. area on board heatsink (SO12+4+4 package)



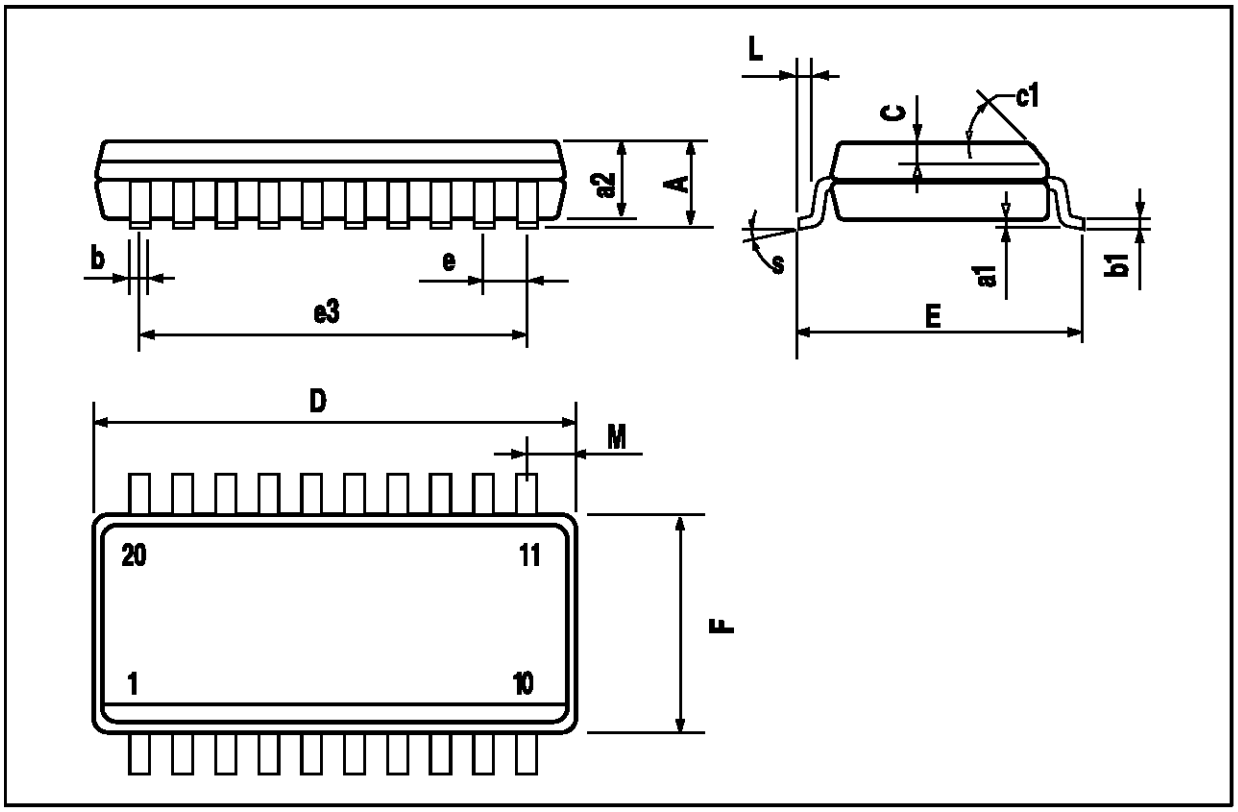
POWERDIP16 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.85		1.40	0.033		0.055
b		0.50			0.020	
b1	0.38		0.50	0.015		0.020
D			20.0			0.787
E		8.80			0.346	
e		2.54			0.100	
e3		17.78			0.700	
F			7.10			0.280
I			5.10			0.201
L		3.30			0.130	
Z			1.27			0.050

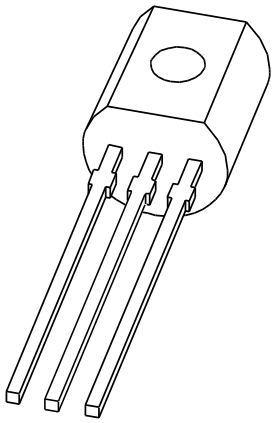


SO20 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.013
C		0.5			0.020	
c1		45			1.772	
D		1	12.6		0.039	0.496
E	10		10.65	0.394		0.419
e		1.27			0.050	
e3		11.43			0.450	
F		1	7.4		0.039	0.291
G	8.8		9.15	0.346		0.360
L	0.5		1.27	0.020		0.050
M			0.75			0.030
S	8° (max.)					



DATA SHEET



BC556; BC557; BC558
PNP general purpose transistors

Product specification
Supersedes data of September 1994
File under Discrete Semiconductors, SC04

1997 Mar 27

Philips
Semiconductors

PHILIPS

PNP general purpose transistors BC556; BC557; BC558

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: BC546, BC547 and BC548.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

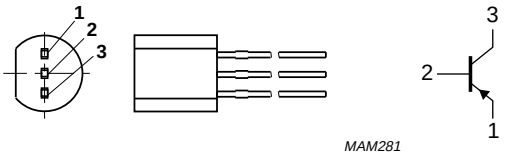


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC556		–	–80	V
	BC557		–	–50	V
	BC558		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC556		–	–65	V
	BC557		–	–45	V
	BC558		–	–30	V
I_{CM}	peak collector current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V			
	BC556		125	475	
	BC557; BC558		125	800	
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	100	–	MHz

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC556		–	–80	V
	BC557		–	–50	V
	BC558		–	–30	V
V_{CEO}	collector-emitter voltage	open base			
	BC556		–	–65	V
	BC557		–	–45	V
	BC558		–	–30	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

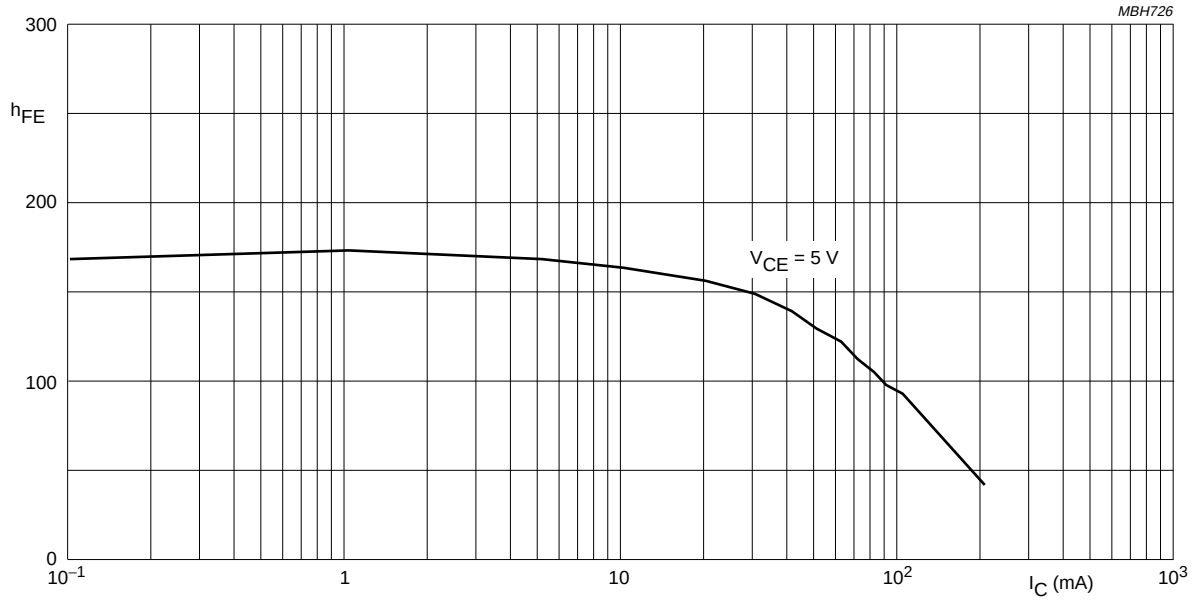
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = –30 V	–	–1	–15	nA
		I_E = 0; V_{CB} = –30 V; T_j = 150 °C	–	–	–4	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = –5 V	–	–	–100	nA
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –5 V; see Figs 2, 3 and 4				
	BC556		125	–	475	
	BC557; BC558		125	–	800	
	BC556A; BC557A; BC558A		125	–	250	
	BC556B; BC557B; BC558B		220	–	475	
	BC557C; BC558C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–60	–300	mV
		I_C = –100 mA; I_B = –5 mA	–	–180	–650	mV
V_{BEsat}	base-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA; note 1	–	–750	–	mV
		I_C = –100 mA; I_B = –5 mA; note 1	–	–930	–	mV
V_{BE}	base-emitter voltage	I_C = –2 mA; V_{CE} = –5 V; note 2	–600	–650	–750	mV
		I_C = –10 mA; V_{CE} = –5 V; note 2	–	–	–820	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = –10 V; f = 1 MHz	–	3	–	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = –0.5 V; f = 1 MHz	–	10	–	pF
f_T	transition frequency	I_C = –10 mA; V_{CE} = –5 V; f = 100 MHz	100	–	–	MHz
F	noise figure	I_C = –200 μA; V_{CE} = –5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	2	10	dB

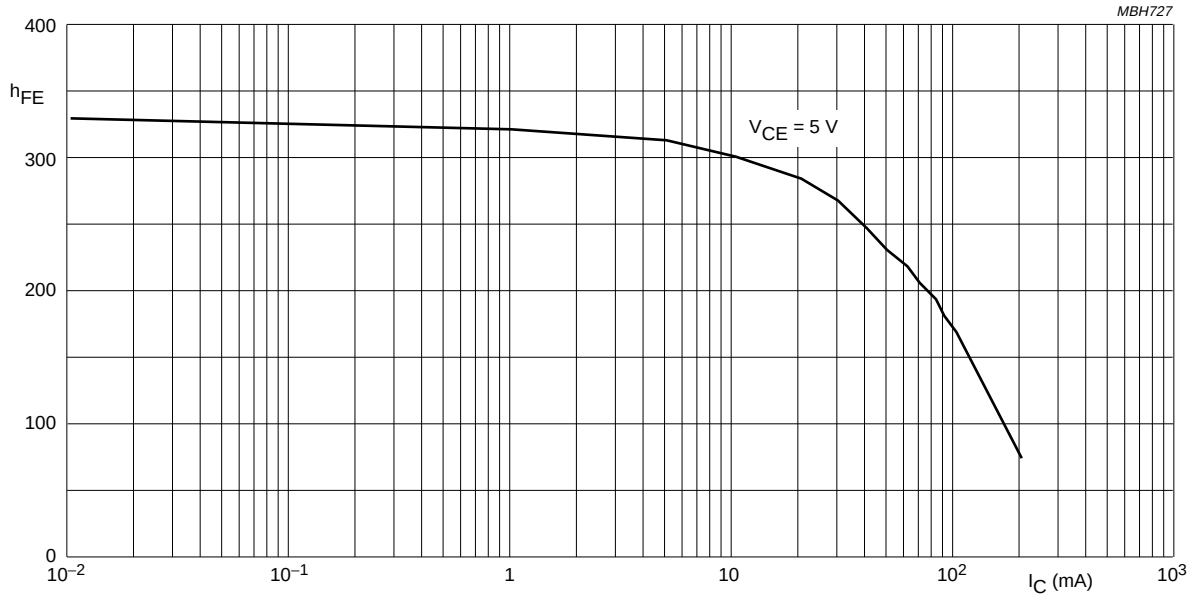
Notes

1. V_{BEsat} decreases by about –1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about –2 mV/K with increasing temperature.



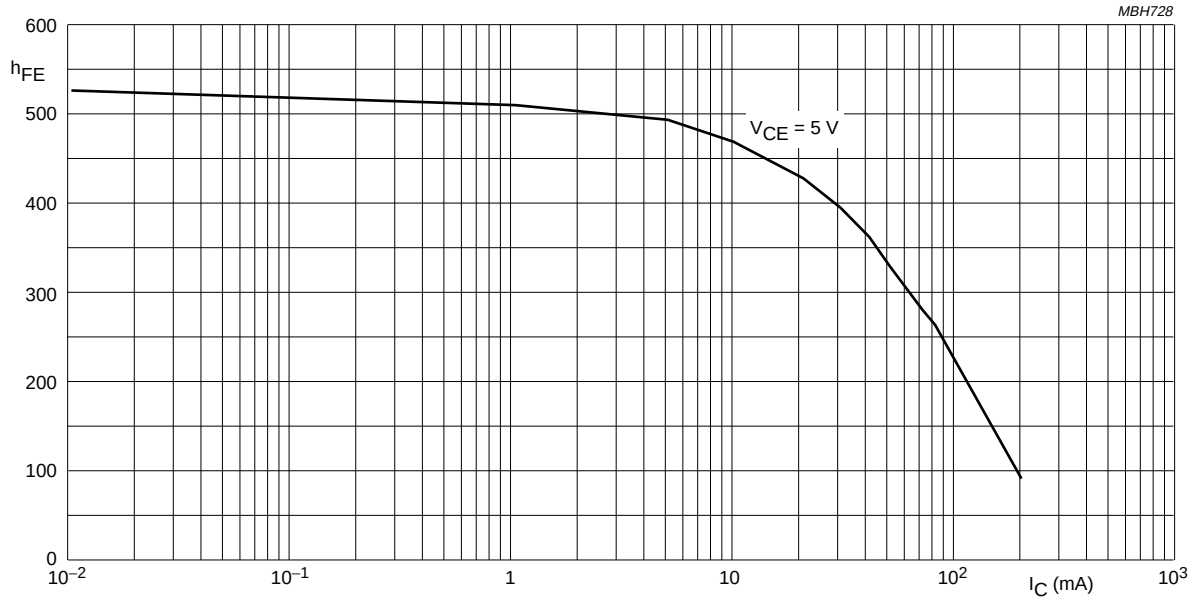
BC556A; BC557A; BC558A.

Fig.2 DC current gain; typical values.



BC556B; BC557B; BC558B.

Fig.3 DC current gain; typical values.

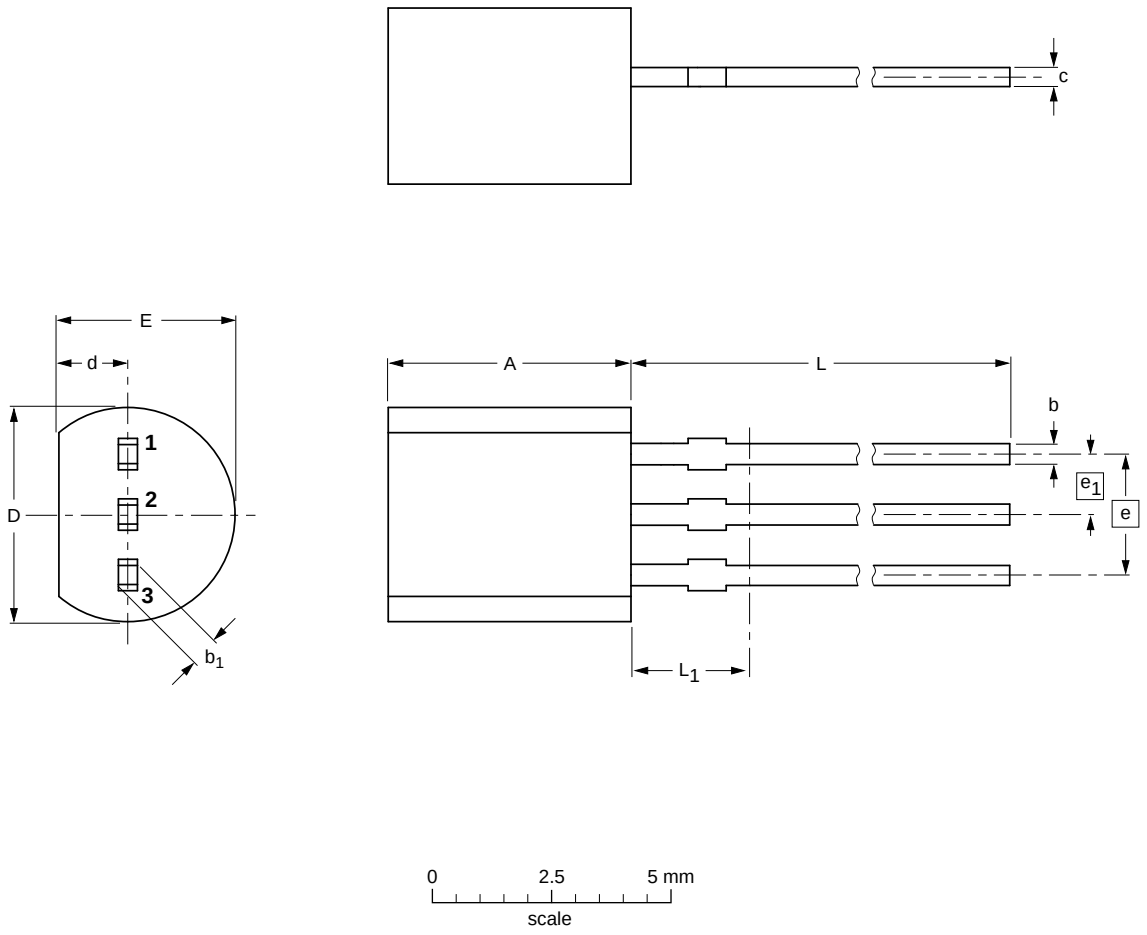


BC557C; BC558C.

Fig.4 DC current gain; typical values.

PACKAGE OUTLINE

Plastic single-ended leaded (through hole) package; 3 leads **SOT54**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b	b_1	c	D	d	E	e	e_1	L	L_1(1)
mm	5.2 5.0	0.48 0.40	0.66 0.56	0.45 0.40	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5

Note

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT54		TO-92	SC-43			97-02-28

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

NOTES

NOTES

NOTES

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