

## LOW NOISE DUAL OPERATIONAL AMPLIFIERS

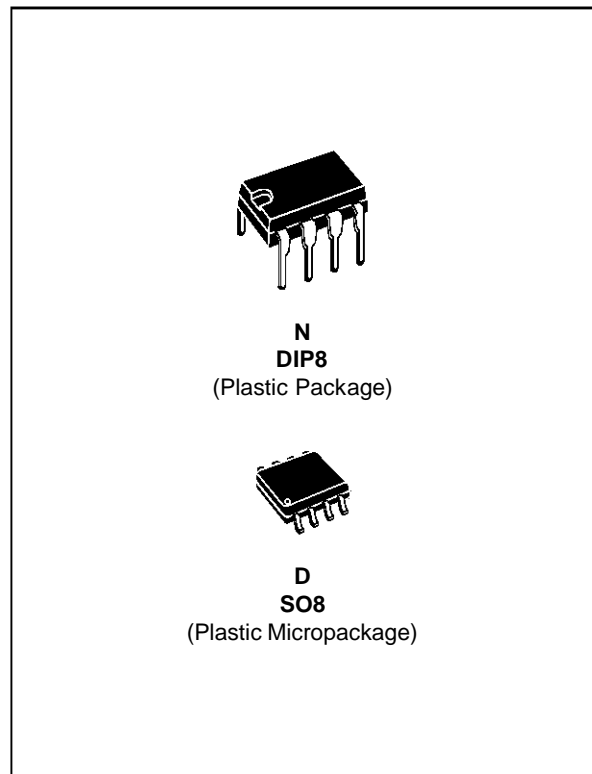
- LOW VOLTAGE NOISE :  $4.5\text{nV}/\sqrt{\text{Hz}}$
- HIGH GAIN BANDWIDTH PRODUCT : 15MHz
- HIGH SLEW RATE :  $7\text{V}/\mu\text{s}$
- LOW DISTORTION : 0.002%
- LARGE OUTPUT VOLTAGE SWING :  
+14.3V/-14.6V
- LOW INPUT OFFSET VOLTAGE
- EXCELLENT FREQUENCY STABILITY
- ESD PROTECTION 2kV
  
- MACROMODEL INCLUDED IN THIS SPECIFICATION

### DESCRIPTION

The MC33078 is a monolithic dual operational amplifier particularly well suited for audio applications. It offers low voltage noise ( $4.5\text{nV}/\sqrt{\text{Hz}}$ ) and high frequency performances (15MHz Gain Bandwidth product,  $7\text{V}/\mu\text{s}$  slew rate).

In addition the MC33078 has a very low distortion (0.002%) and excellent phase/gain margins.

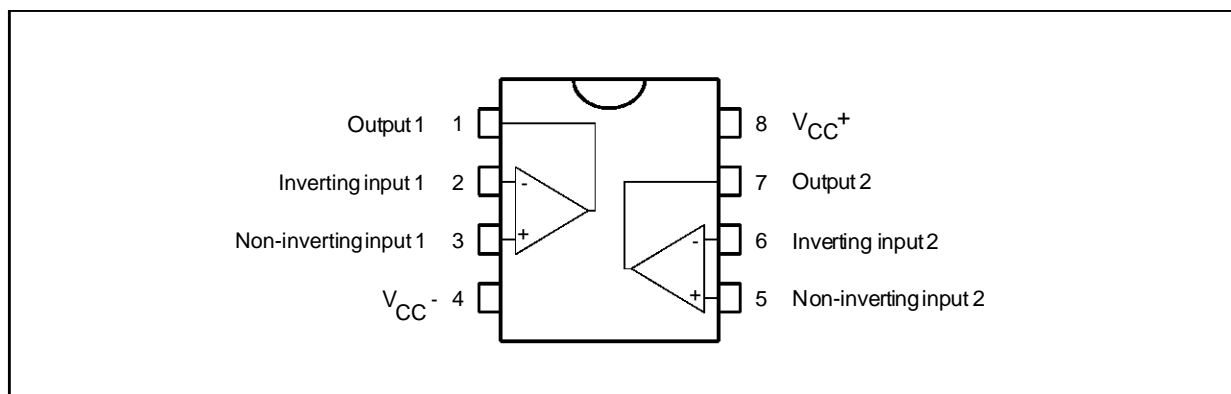
The output stage allows a large output voltage swing and symmetrical source and sink currents.



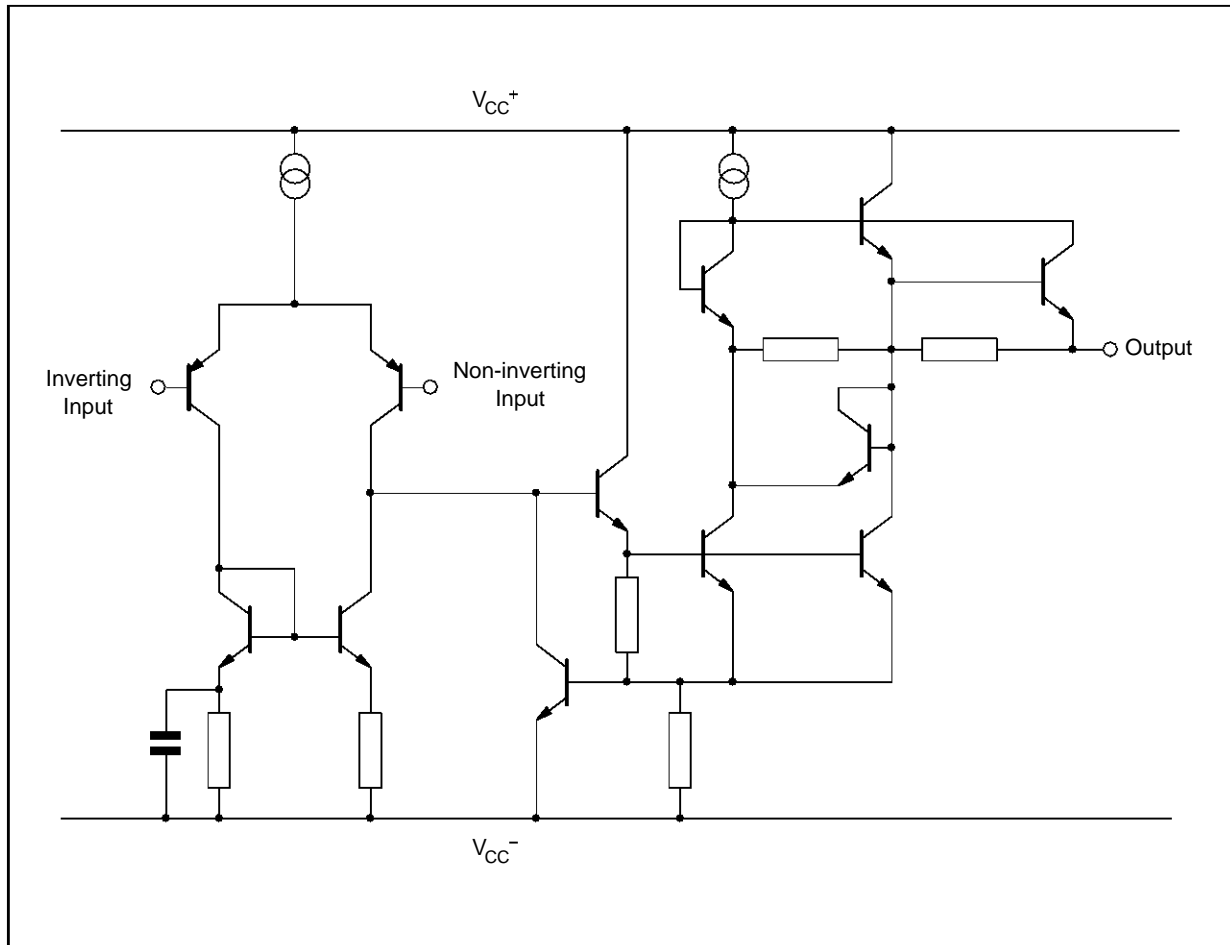
### ORDER CODES

Part Number	Temperature Range	Package	
		N	D
MC33078	-40, +105°C	•	•

### PIN CONNECTIONS (top view)



**SCHEMATIC DIAGRAM (1/2 MC33078)**



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	±18 or +36	V
V <sub>id</sub>	Differential Input Voltage - (note 1)	±30	V
V <sub>i</sub>	Input Voltage - (note 1)	±15	V
	Output Short-Circuit Duration - (note 2)	Infinite	
T <sub>oper</sub>	Operating Free-air Temperature Range	-40 to +105	°C
T <sub>j</sub>	Maximum Junction Temperature	+150	°C
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
P <sub>tot</sub>	Maximum Power Dissipation - (note 2)	500	mW

**Notes:** 1. Either or both input voltages must not exceed the magnitude of V<sub>CC</sub><sup>+</sup> or V<sub>CC</sub><sup>-</sup>  
 2. Power dissipation must be considered to ensure maximum junction temperature (T<sub>j</sub>) is not exceeded

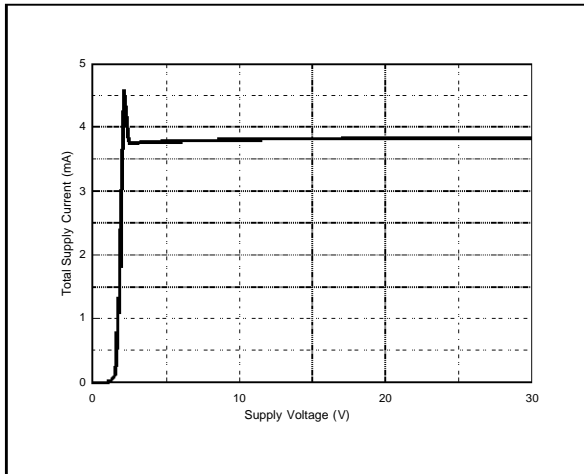
**OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	±2.5 to ±15	V

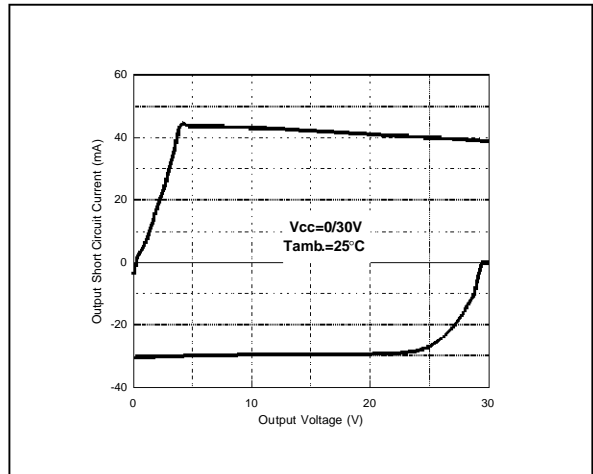
**ELECTRICAL CHARACTERISTICS**
 $V_{CC}^+ = +15V, V_{CC}^- = -15V, T_{amb} = 25^{\circ}C$  (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{io}$	Input Offset Voltage ( $V_o = 0V, V_{ic} = 0V$ ) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		0.15	2 3	mV
$DV_{io}$	Input Offset Voltage Drift $V_{ic} = 0V, V_o = 0V, T_{min.} \leq T_{amb} \leq T_{max.}$		2		$\mu V/^{\circ}C$
$I_{io}$	Input Offset Current ( $V_{ic} = 0V, V_o = 0V$ ) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		10	150 175	nA
$I_{ib}$	Input Bias Current ( $V_{ic} = 0V, V_o = 0V$ ) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		250	750 800	nA
$V_{icm}$	Common Mode Input Voltage Range ( $\Delta V_{IO} = 5mV, V_o = 0V$ )	$\pm 13$	$\pm 14$		V
$A_{vd}$	Large Signal Voltage Gain ( $R_L = 2k\Omega, V_o = \pm 10V$ ) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	90 85	100		dB
$\pm V_{opp}$	Output Voltage Swing ( $V_{id} = \pm 1V$ )  $R_L = 600\Omega$ $R_L = 600\Omega$  $R_L = 2.0k\Omega$ $R_L = 2.0k\Omega$  $R_L = 10k\Omega$ $R_L = 10k\Omega$		12.2 -12.7  14 -14.2  14.3 -14.6		V
CMR	Common Mode Rejection Ratio ( $V_{ic} = \pm 13V$ )	80	100		dB
SVR	Supply Voltage Rejection Ratio $V_{CC}^+ / V_{CC}^- = +15V / -15V$ to $+5V / -5V$	80	105		dB
$I_o$	Output Short Circuit Current ( $V_{id} = \pm 1V$ , Output to Ground) Source Sink	15 20	29 37		mA
$I_{CC}$	Supply current ( $V_o = 0V$ , All Amplifiers) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		4	5 5.5	mA
SR	Slew Rate $V_i = -10V$ to $+10V, R_L = 2k\Omega, C_L = 100pF, A_V = +1$	5	7		V/ $\mu s$
GBP	Gain Bandwidth Product ( $f = 100kHz, R_L = 2k\Omega, C_L = 100pF$ )	10	15		MHz
B	Unity Gain Bandwidth (Open loop)		9		MHz
$A_m$	Gain Margin ( $R_L = 2k\Omega$ ) $C_L = 0pF$ $C_L = 100pF$		-11 -6		dB
$\phi_m$	Phase Margin ( $R_L = 2k\Omega$ ) $C_L = 0pF$ $C_L = 100pF$		55 30		Degrees
$e_n$	Equivalent Input Noise Voltage ( $R_S = 100\Omega, f = 1kHz$ )		4.5		$\frac{nV}{\sqrt{Hz}}$
$i_n$	Equivalent Input Noise current ( $f = 1kHz$ )		0.5		$\frac{pA}{\sqrt{Hz}}$
THD	Total Harmonic Distortion $R_L = 2k\Omega, f = 20Hz$ to $20kHz, V_o = 3V_{rms}, A_V = +1$		0.002		%
$V_{O1}/V_{O2}$	Channel Separation ( $f = 20Hz$ to $20kHz$ )		120		dB
FPB	Full Power Bandwidth ( $V_o = 27V_{pp}, R_L = 2k\Omega, THD \leq 1\%$ )		120		kHz
$Z_o$	Output Impedance ( $V_o = 0V, f = 9MHz$ )		37		$\Omega$
$R_i$	Input Resistance ( $V_{ic} = 0V$ )		175		k $\Omega$
$C_i$	Input Capacitance ( $V_{ic} = 0V$ )		12		pF

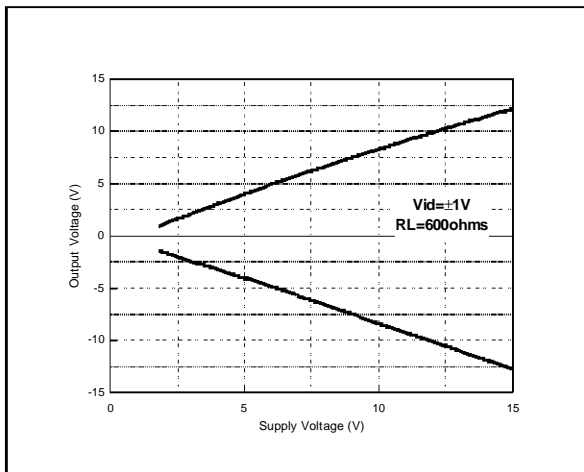
**TOTAL SUPPLY CURRENT vs SUPPLY VOLTAGE**



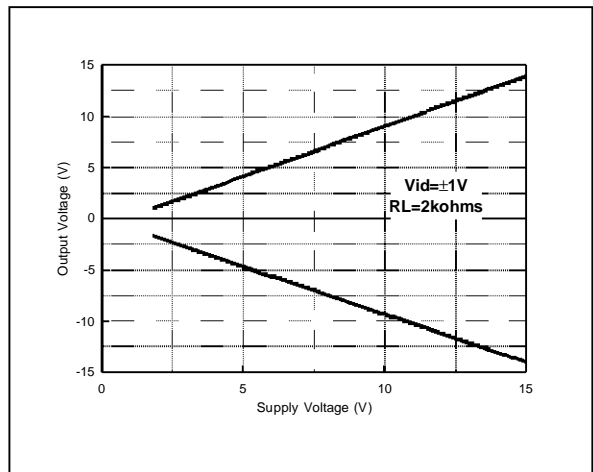
**OUTPUT SHORT CIRCUIT CURRENT vs OUTPUT VOLTAGE**



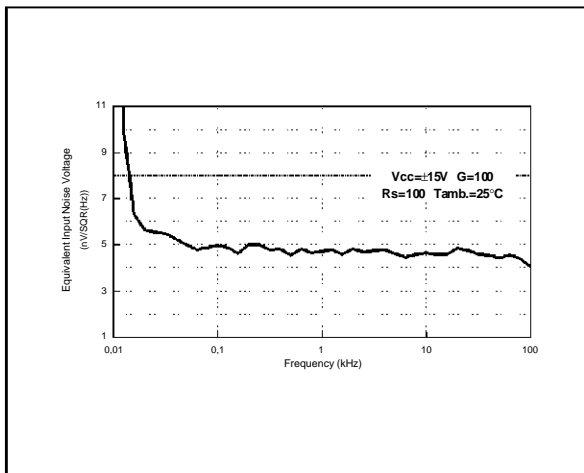
**OUTPUT VOLTAGE vs SUPPLY VOLTAGE**



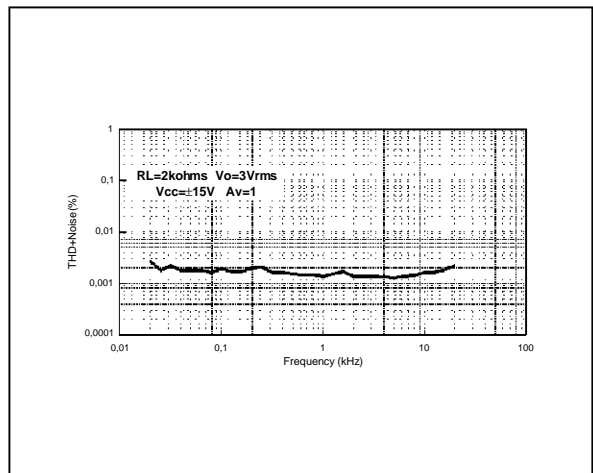
**OUTPUT VOLTAGE vs SUPPLY VOLTAGE**



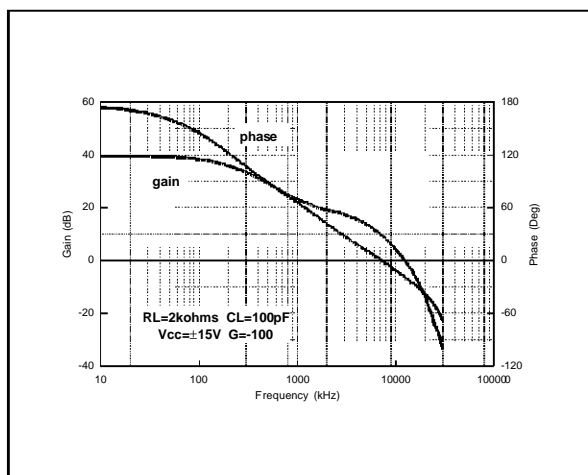
**EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY**



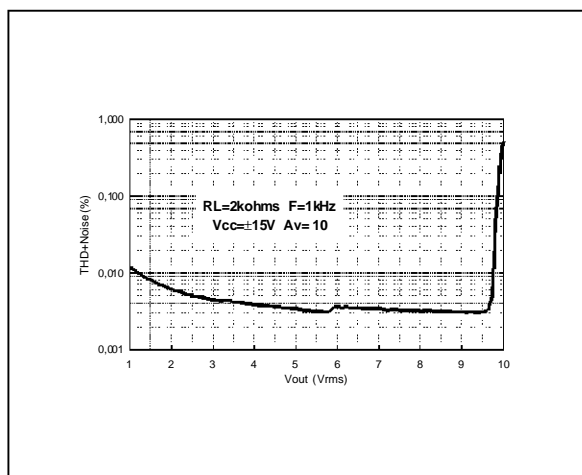
**THD + NOISE vs FREQUENCY**



VOLTAGE GAIN AND PHASE vs FREQUENCY



THD + NOISE vs Vout



**MACROMODEL**

- LOW VOLTAGE NOISE :  $4.5nV/\sqrt{Hz}$
- HIGH GAIN BANDWIDTH PRODUCT : **15MHz**
- HIGH SLEW RATE : **7V/ $\mu$ s**
- LOW DISTORTION : 0.002%

- LARGE OUTPUT VOLTAGE SWING : +14.3V/-14.6V
- LOW INPUT OFFSET VOLTAGE
- EXCELLENT FREQUENCY STABILITY
- ESD PROTECTION 2kV

\*\* StandardLinear Ics Macromodels, 1993.

\*\* CONNECTIONS :

- \* 1 INVERTING INPUT
- \* 2 NON-INVERTING INPUT
- \* 3 OUTPUT
- \* 4 POSITIVE POWER SUPPLY
- \* 5 NEGATIVE POWER SUPPLY

.SUBCKT MC33078 1 3 2 4 5 (analog)

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.MODEL MDTH D IS=1E-8 KF=2.286238E-16

CJO=10F

\* INPUT STAGE

CIP 2 5 1.200000E-11

CIN 1 5 1.200000E-11

EIP 10 5 2 5 1

EIN 16 5 1 5 1

RIP 10 11 2.363636E+00

RIN 15 16 2.363636E+00

RIS 11 15 1.224040E+01

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 1.100000E-04

CPS 11 15 2.35E-09

DINN 17 13 MDTH 400E-12

VIN 17 5 1.000000E+00

DINR 15 18 MDTH 400E-12

VIP 4 18 1.000000E+00

FCP 4 5 VOFP 1.718182E+01

FCN 5 4 VOFN 1.718182E+01

FIBP 2 5 VOFN 4.545455E-03

FIBN 5 1 VOFP 4.545455E-03

\* AMPLIFYING STAGE

FIP 5 19 VOFP 9.545455E+02

FIN 5 19 VOFN 9.545455E+02

CC 19 29 1.500000E-08

HZTP 30 29 VOFP 1.523529E+02

HZTN 5 30 VOFN 1.523529E+02

DOPM 51 22 MDTH 400E-12

DONM 21 52 MDTH 400E-12

HOPM 22 28 VOUT 5.172414E+03

VIPM 28 4 1.500000E+02

HONM 21 27 VOUT 4.054054E+03

VINM 5 27 1.500000E+02

DBIDON1 19 53 MDTH 400E-12

V1 51 53 0.68

DBIDON2 54 19 MDTH 400E-12

V2 54 52 0.68

RG11 51 5 3.04E+05

RG12 51 4 3.04E+05

RG21 52 5 0.6072E+05

RG22 52 4 0.6072E+05

E1 50 40 51 0 1 E2 40 39 52 0 1

EDEC1 38 39 4 0 0.5

EDEC2 0 38 5 0 0.5

DOP 51 25 MDTH 400E-12

VOP 4 25 1.474575E+00

DON 24 52 MDTH 400E-12

VON 24 5 1.474575E+00

RAJUS 50 5 1E12

GCOMP 5 4 4 5 8.1566068E-04

RPM1 5 80 1E+06

RPM2 4 80 1E+06

GAVPH 5 82 50 80 3.26E-03

RAVPHGH 82 4 613

RAVPHGB 82 5 613

RAVPHDH 82 83 1000

RAVPHDB 82 84 1000

CAVPHH 4 83 0.159E-09

CAVPHB 5 84 0.159E-09

EOUT 26 23 82 5 1

VOUT 23 5 0

ROUT 26 3 4.780354E+01

COUT 3 5 1.000000E-12

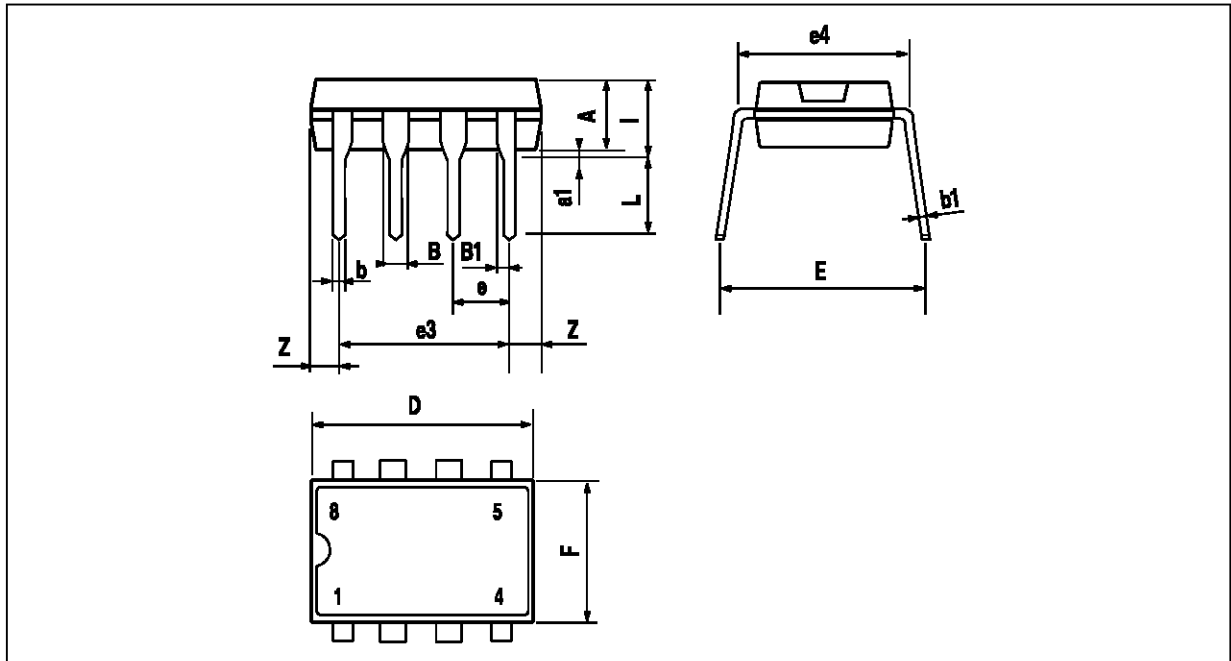
.ENDS

**ELECTRICAL CHARACTERISTICS**

$V_{CC}^+ = +15V$ ,  $V_{CC}^- = -15V$ ,  $T_{amb} = 25^{\circ}C$ , (unless otherwise specified)

Symbol	Conditions	Value	Unit
$V_{io}$		0	mV
$A_{vd}$	$R_L = 2k\Omega$ , $V_o = \pm 10V$	100	dB
$I_{CC}$	No load, per operator	2	mA
$V_{icm}$	$\Delta V_{io} = 5mV$ , $V_o = 0V$	28	V
$V_{opp}$	$R_L = 2k\Omega$	28.2	V
$I_{sink}$	$V_o = 0V$	37	mA
$I_{source}$	$V_o = 0V$	29	mA
GBP	$R_L = 2k\Omega$ , $C_L = 100pF$	15	MHz
SR	$R_L = 2k\Omega$ , $C_L = 100pF$ , $A_v = +1$	7	V/ $\mu s$
$\theta_m$	$R_L = 2k\Omega$ , $C_L = 0pF$	55	Degrees

**PACKAGE MECHANICAL DATA**  
8 PINS - PLASTIC DIP



PM-DIP8.EPS

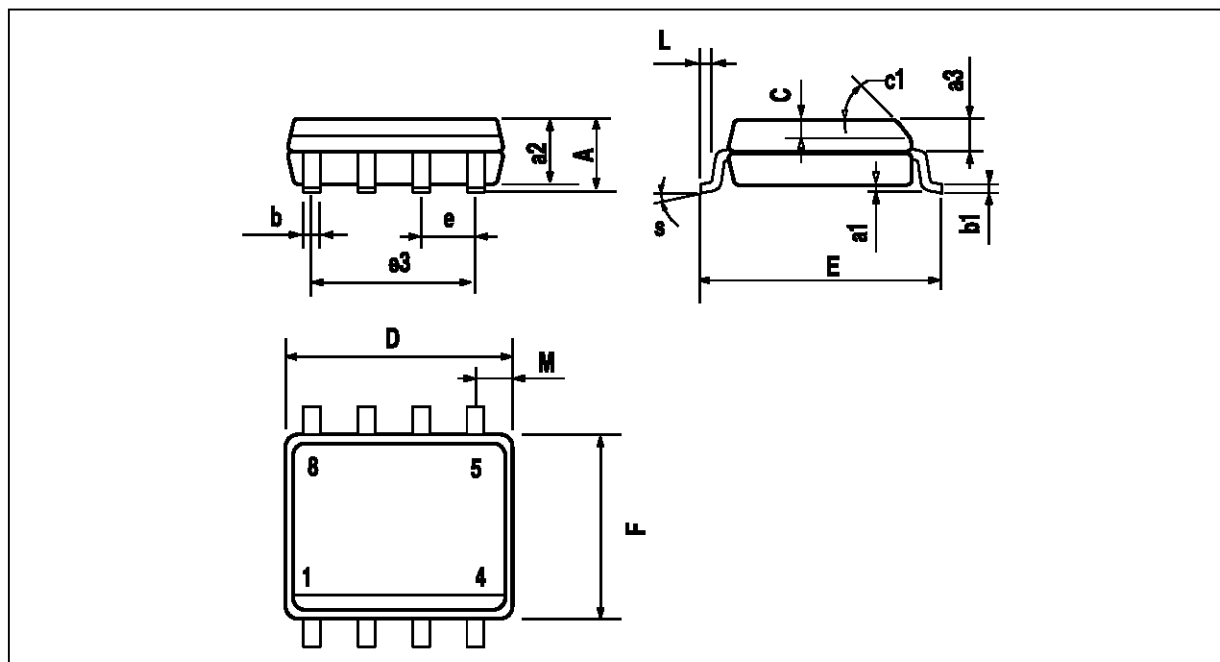
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

DIP8.TBL



## PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (SO)



PWA-S08.EPS

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

S08.TBL

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