

LOW NOISE DUAL OPERATIONAL AMPLIFIER

- LOW VOLTAGE NOISE: **4.5nV/√Hz**
- HIGH GAIN BANDWIDTH PRODUCT: **15MHz**
- HIGH SLEW RATE: **7V/μs**
- 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 (4.5nV/√Hz) and high frequency performances (15MHz Gain Bandwidth product, 7V/μs slew rate).

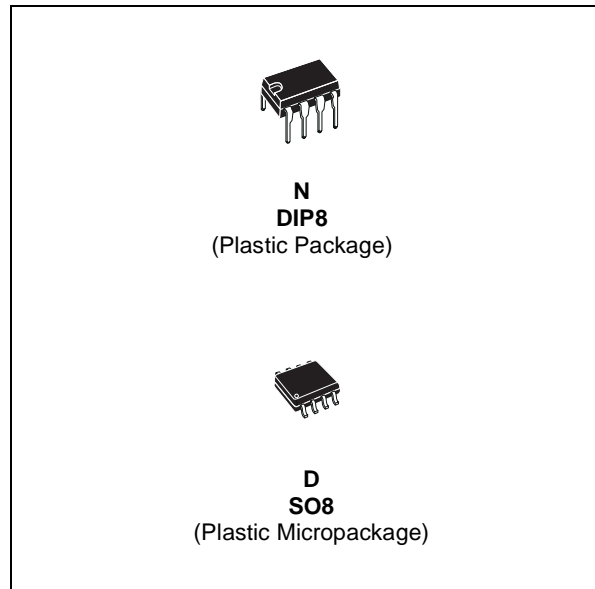
In addition the MC33078 has a very low distortion (0.002%) and excellent phase/gain margins.

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

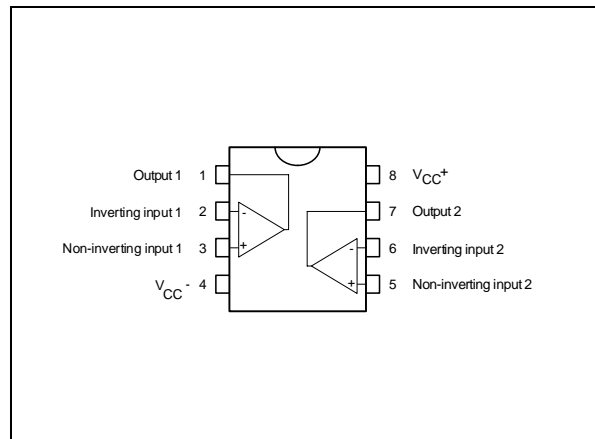
ORDER CODE

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

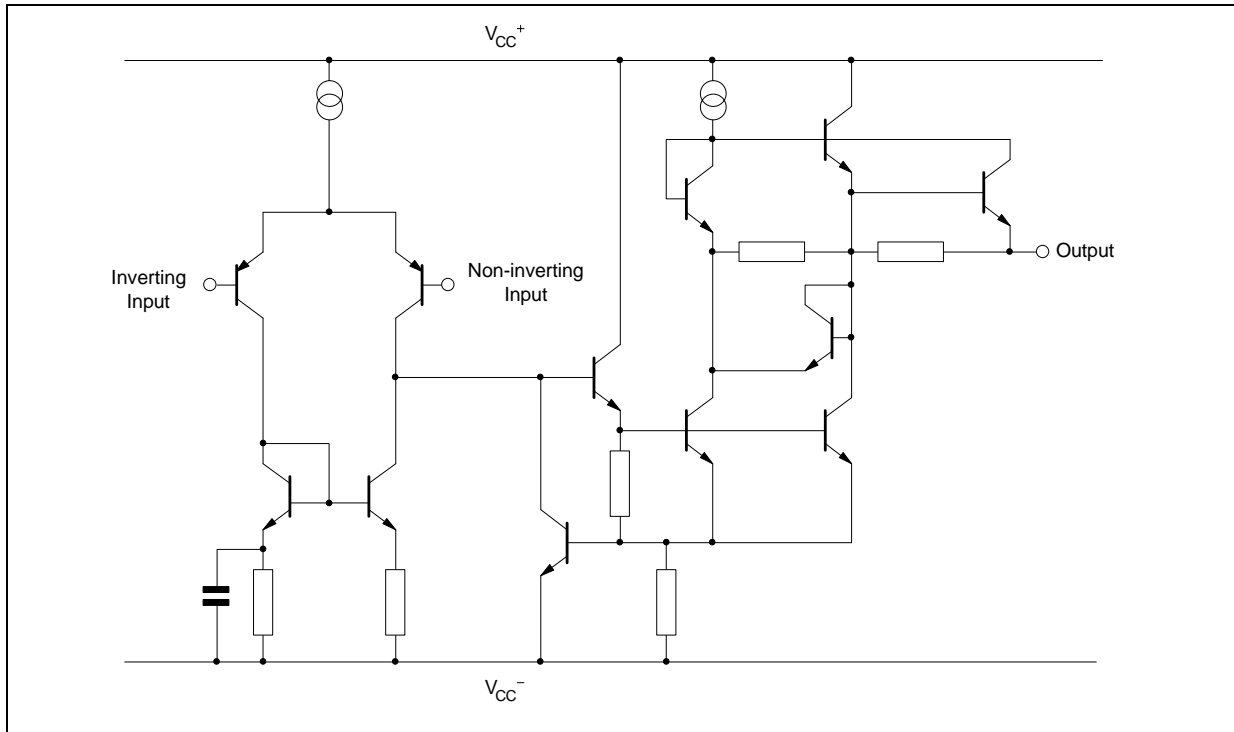
N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)



PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM (1/2 MC33078)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	±18 or +36	V
V _{id}	Differential Input Voltage - note ¹⁾	±30	V
V _i	Input Voltage - see note 1	±15	V
	Output Short Circuit Duration	Infinite	s
T _{oper}	Operating Free-Air Temperature Range	-40 to 105	°C
T _j	Junction Temperature	+150	°C
T _{stg}	Storage Temperature	-65 to +150	°C
P _{tot}	Maximum Power Dissipation - note ²⁾	500	mW

1. Either or both input voltages must not exceed the magnitude of V_{CC}⁺ or V_{CC}⁻.
2. Power dissipation must be considered to ensure maximum junction temperature (T_j) is not exceeded.

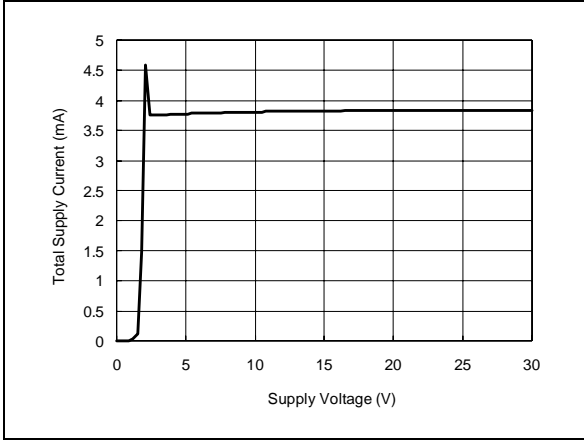
OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	±2.5 to ±15	V

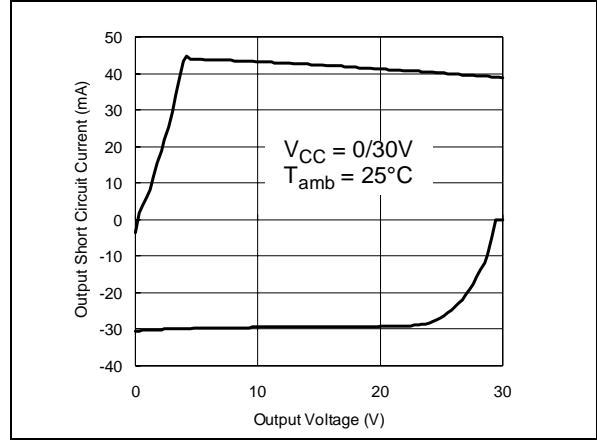
ELECTRICAL CHARACTERISTICS $V_{CC}^+ = +15V$, $V_{CC}^- = -15V$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

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 $V_o = 0V$, $V_{ic} = 0V$, $T_{min} \leq T_{amb} \leq T_{max}$.		2		$\mu V/^\circ C$
I_{io}	Input Offset Current ($V_o = 0V$, $V_{ic} = 0V$) $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$.		10	150 175	nA
I_{ib}	Input Bias Current ($V_o = 0V$, $V_{ic} = 0V$) $T_{amb} = +25^\circ C$ $T_{min} \leq T_{amb} \leq T_{max}$.		250	750 800	nA
V_{icm}	Input Common Mode Voltage Range ($\Delta V_{io} = 5mV$, $V_o = 0V$)	± 13	± 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 ($V_{id} = \pm 1V$) $R_L = 600\Omega$ $R_L = 600\Omega$ $R_L = 2.0k\Omega$ $R_L = 2.0k\Omega$ $R_L = 10k\Omega$ $R_L = 10k\Omega$	13.2 13.5	12.2 -12.7 14 -14.2 14.3 -14.6	-13.2 -14	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 27		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 ($R_L = 2k\Omega$, $C_L = 100pF$, $f = 100kHz$)	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
ϕ_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		Ω
R_i	Input Resistance ($V_{ic} = 0V$)		175		$k\Omega$
C_i	Input Capacitance ($V_{ic} = 0V$)		12		pF

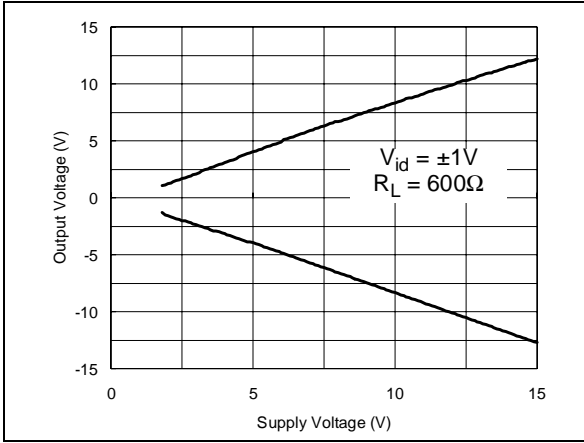
TOTAL SUPPLY CURRENT vs SUPPLY VOLTAGE



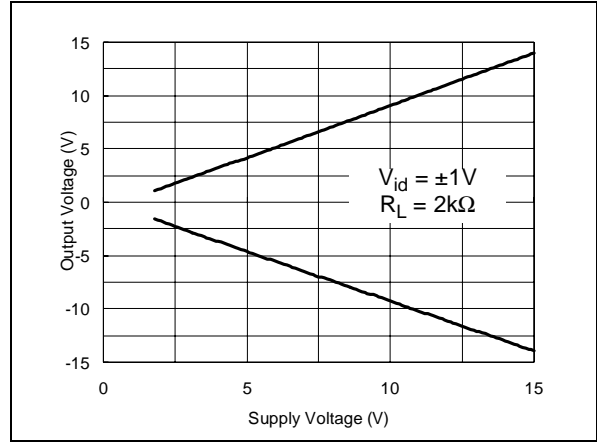
OUTPUT SHORT CIRCUIT CURRENT vs OUTPUT VOLTAGE



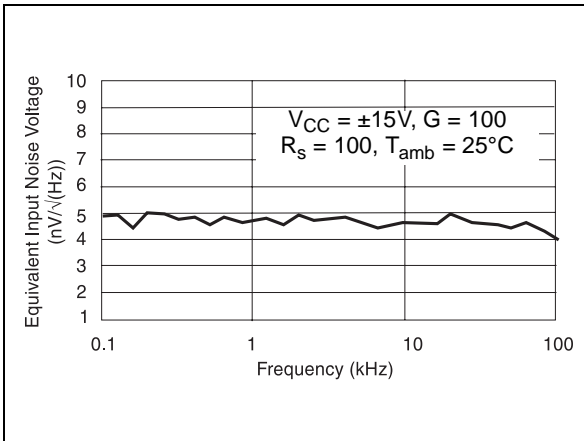
OUTPUT VOLTAGE vs SUPPLY VOLTAGE



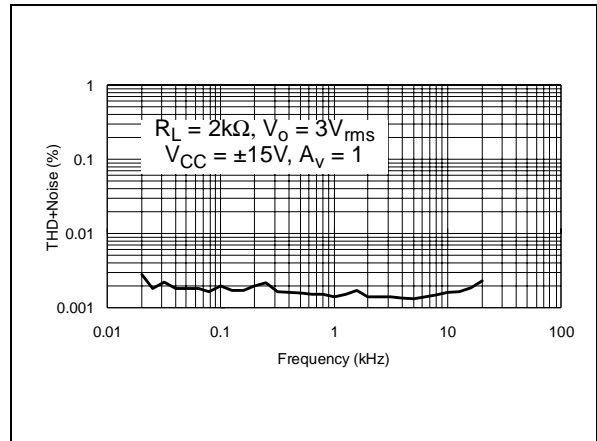
OUTPUT VOLTAGE vs SUPPLY VOLTAGE



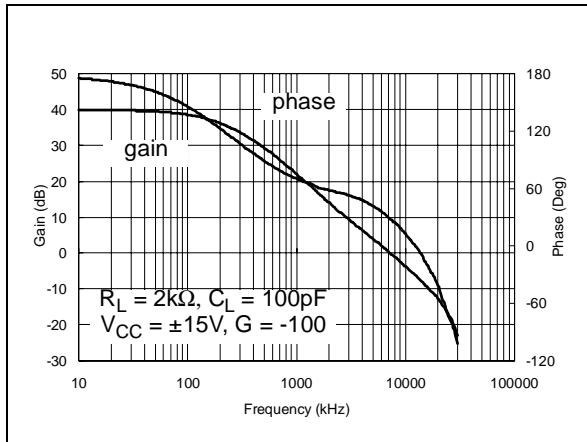
EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY



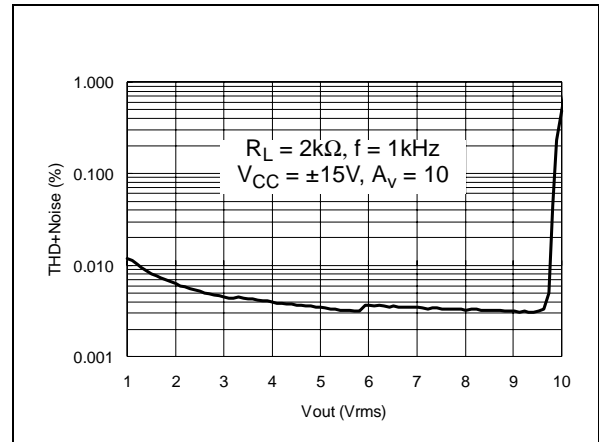
THD + NOISE vs FREQUENCY



VOLTAGE GAIN AND PHASE vs FREQUENCY



THD + NOISE vs Vout



MACROMODELS

** Standard Linear 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)

```
*****
.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
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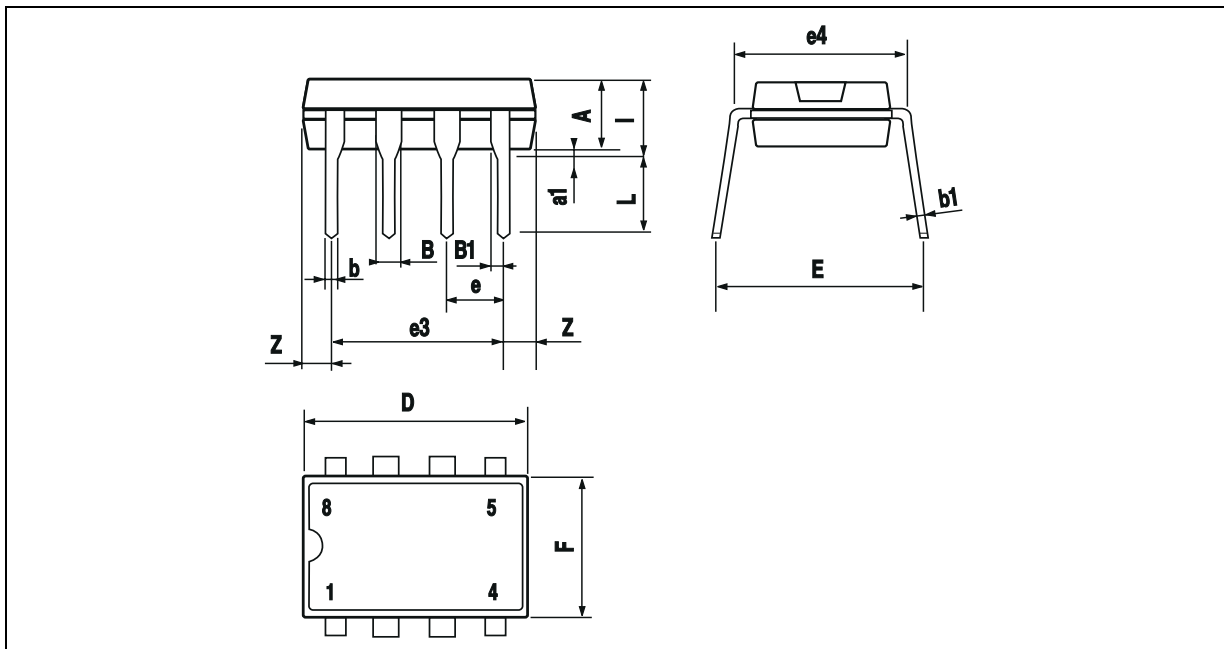
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HZTN 5 30 VOFN 1.523529E+02
DOPM 51 22 MDTH 400E-12
DONM 21 52 MDTH 400E-12
HOPM 22 28 VOUT 5.172414E+03
VIPM 28 4 1.500000E+02
HONM 21 27 VOUT 4.054054E+03
VINM 5 27 1.500000E+02
DBIDON1 19 53 MDTH 400E-12
V1 51 53 0.68
DBIDON2 54 19 MDTH 400E-12
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
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ELECTRICAL CHARACTERISTICS

V_{CC}⁺ = +15V, V_{CC}⁻ = -15V, T_{amb} = 25°C (unless otherwise specified)

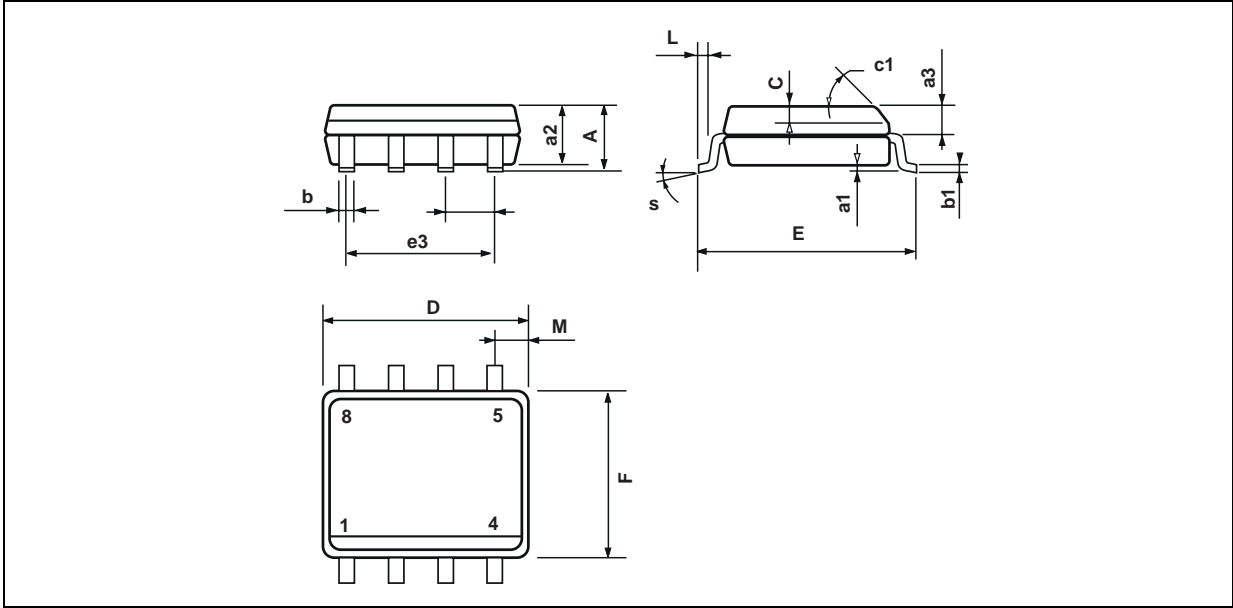
Symbol	Conditions	Value	Unit
V _{io}		0	mV
A _{vd}	R _L = 2kΩ, V _o = ±10V	100	dB
I _{CC}	No load, per operator	2	mA
V _{icm}	ΔV _{io} = 5mV, V _O = 0V	28	V
V _{opp}	R _L = 2kΩ	28.2	V
I _{sink}	V _O = 0V	37	mA
I _{source}	V _O = 0V	29	mA
GBP	R _L = 2kΩ, C _L = 100pF	15	MHz
SR	R _L = 10kΩ, C _L = 100pF, A _v = +1	7	V/μs
φ _m	R _L = 2kΩ, C _L = 0pF	55	Degrees

PACKAGE MECHANICAL DATA
8 PINS - PLASTIC DIP



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

PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (SO)



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.)					

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