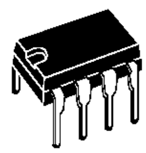
SGS-THOMSON MICROELECTRONICS

MC33078

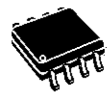
LOW NOISE DUAL OPERATIONAL AMPLIFIERS

- LOW VOLTAGE NOISE : **4.5nV/$\sqrt{Hz}$**
- 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



N
DIP8
(Plastic Package)



D
SO8
(Plastic Micropackage)

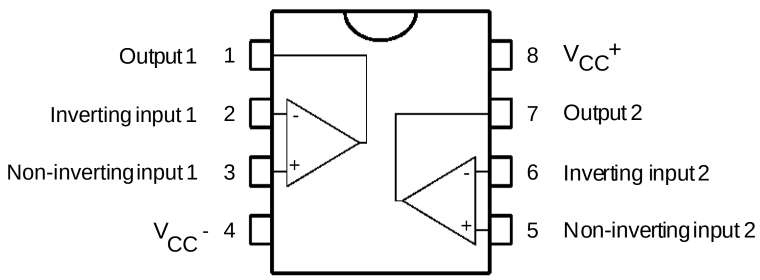
DESCRIPTION

The MC33078 is a monolithic dual operational amplifier particularly well suited for audio applications. It offers low voltage noise (4.5nV/$\sqrt{Hz}$) 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.

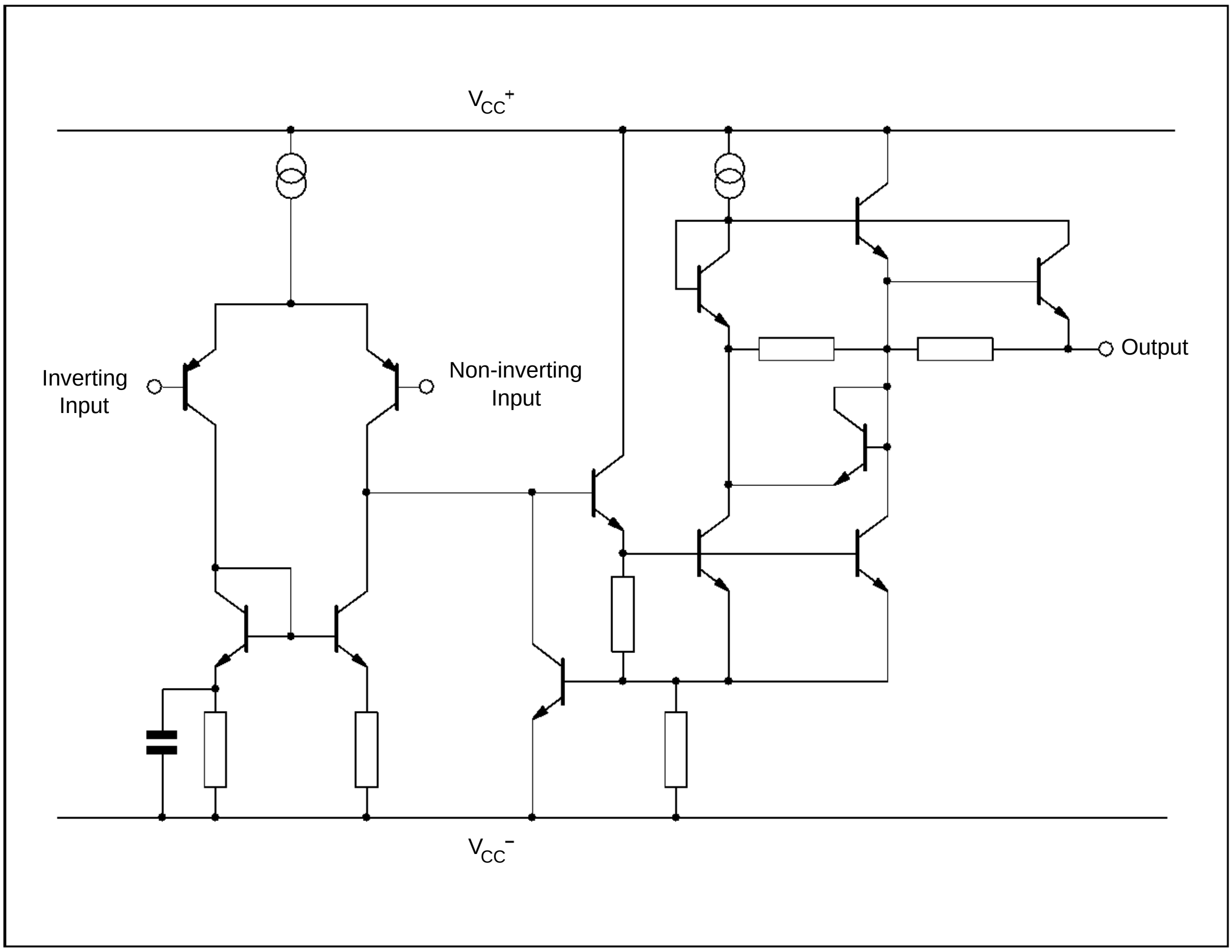
ORDER CODES

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_{CC}	Supply Voltage	±18 or +36	V
V_{id}	Differential Input Voltage - (note 1)	±30	V
V_i	Input Voltage - (note 1)	±15	V
	Output Short-Circuit Duration - (note 2)	Infinite	
T_{oper}	Operating Free-air Temperature Range	-40 to +105	°C
T_j	Maximum Junction Temperature	+150	°C
T_{stg}	Storage Temperature	-65 to +150	°C
P_{tot}	Maximum Power Dissipation - (note 2)	500	mW

Notes : 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

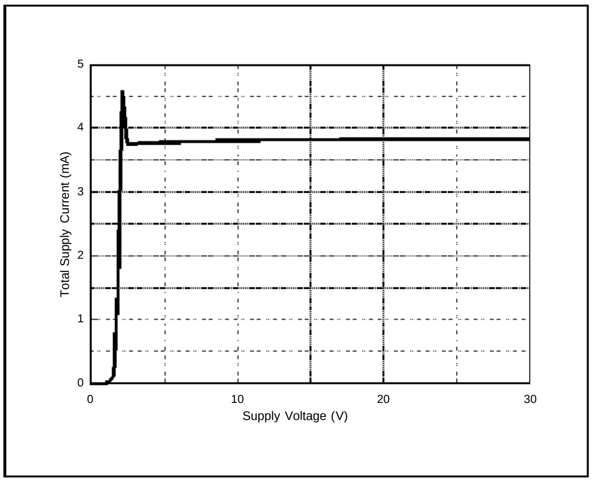
OPERATING CONDITIONS

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

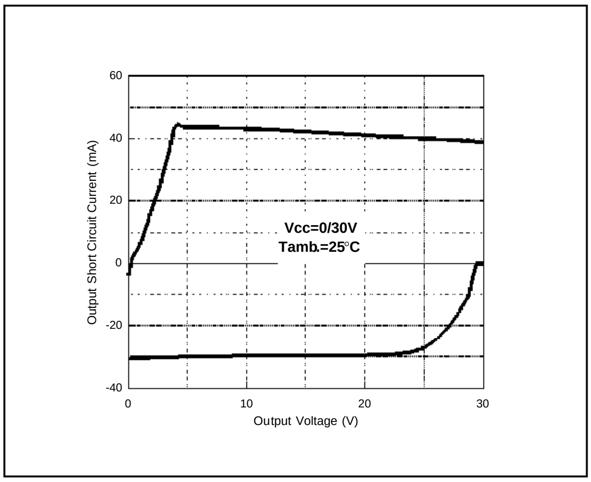
ELECTRICAL CHARACTERISTICS
V_{CC}^{+} = +15V, V_{CC}^{-} = -15V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage (V_o = 0V, V_{ic} = 0V) T_{amb} = +25°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		µV/°C
I_{io}	Input Offset Current (V_{ic} = 0V, V_O = 0V) T_{amb} = +25°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°C $T_{min.} \leq T_{amb} \leq T_{max.}$		250	750 800	nA
V_{icm}	Common Mode Input Voltage Range (ΔV_{IO} = 5mV, V_O = 0V)	±13	±14		V
A_{vd}	Large Signal Voltage Gain (R_L = 2kΩ, V_O = ±10V) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$	90 85	100		dB
$\pm V_{opp}$	Output Voltage Swing (V_{id} = ±1V) R_L = 600Ω R_L = 600Ω R_L = 2.0kΩ R_L = 2.0kΩ R_L = 10kΩ R_L = 10kΩ	 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} = ±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} = ±1V, Output to Ground) Source Sink	15 20	29 37		mA
I_{CC}	Supply current (V_O = 0V, All Amplifiers) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		4	5 5.5	mA
SR	Slew Rate V_i = -10V to +10V, R_L = 2kΩ, C_L = 100pF, A_V = +1	5	7		V/µs
GBP	Gain Bandwidth Product (f = 100kHz, R_L = 2kΩ, C_L = 100pF)	10	15		MHz
B	Unity Gain Bandwidth (Open loop)		9		MHz
A_m	Gain Margin (R_L = 2kΩ) C_L = 0pF C_L = 100pF		-11 -6		dB
Øm	Phase Margin (R_L = 2kΩ) C_L = 0pF C_L = 100pF		55 30		Degrees
e_n	Equivalent Input Noise Voltage (R_S = 100Ω, 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 = 2kΩ, 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 = 2kΩ, THD ≤ 1%)		120		kHz
Z_o	Output Impedance (V_O = 0V, f = 9MHz)		37		Ω
R_i	Input Resistance (V_{ic} = 0V)		175		kΩ
C_i	Input Capacitance (V_{ic} = 0V)		12		pF

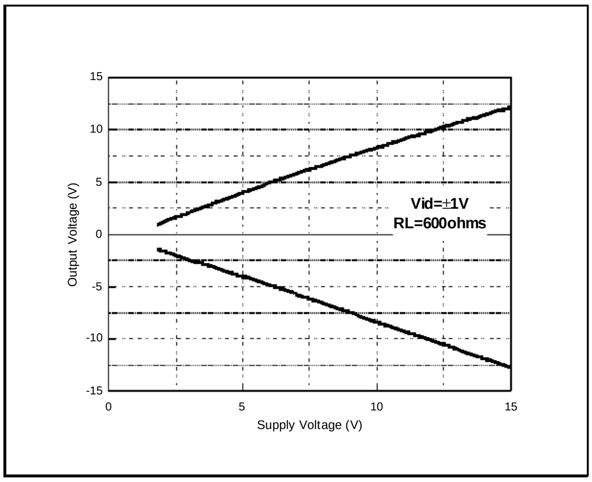
TOTAL SUPPLY CURRENT vs SUPPLY VOLTAGE



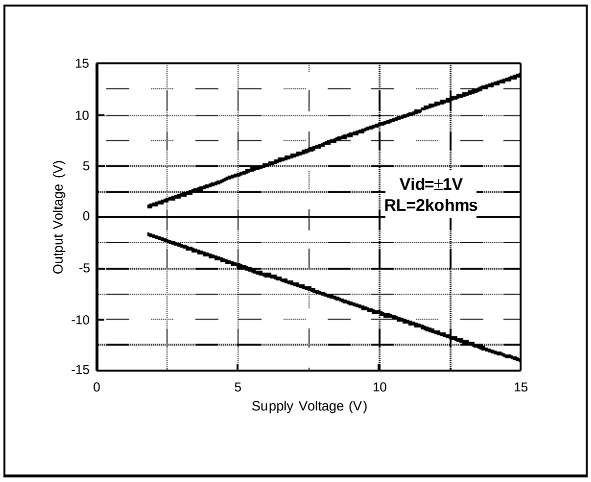
OUTPUT SHORT CIRCUIT CURRENT vs OUTPUT VOLTAGE



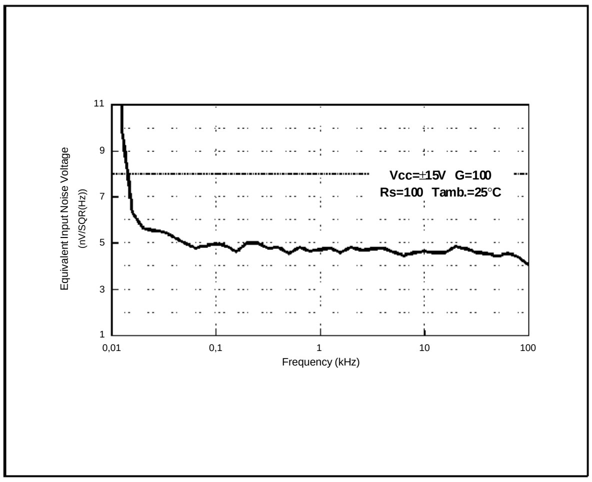
OUTPUT VOLTAGE vs SUPPLY VOLTAGE



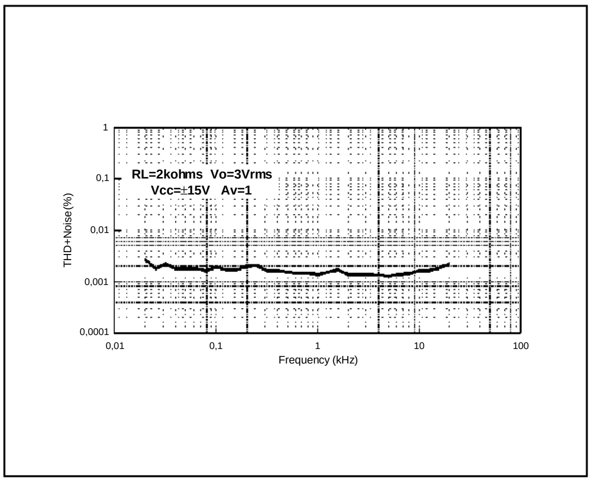
OUTPUT VOLTAGE vs SUPPLY VOLTAGE



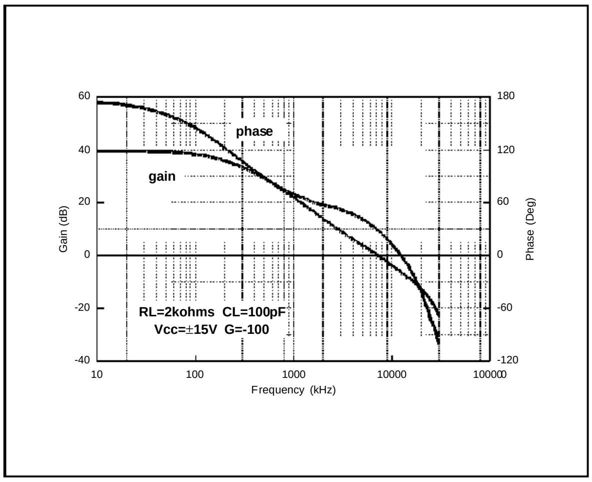
EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY



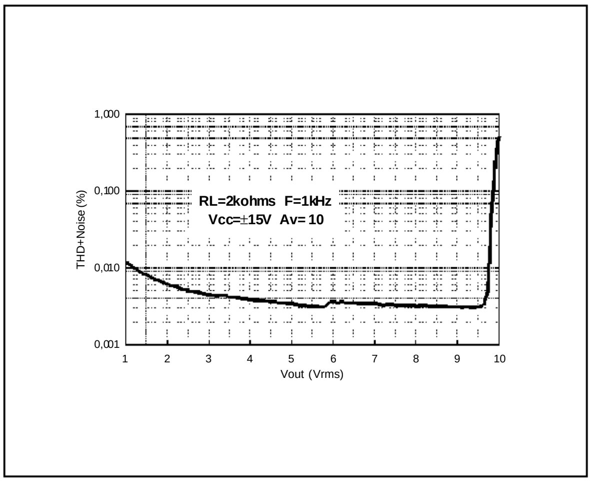
THD + NOISE vs FREQUENCY



VOLTAGE GAIN AND PHASE vs FREQUENCY



THD + NOISE vs Vout



MACROMODEL

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- EXCELLENT FREQUENCY STABILITY
- ESD PROTECTION 2kV

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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 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
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 8.156668E-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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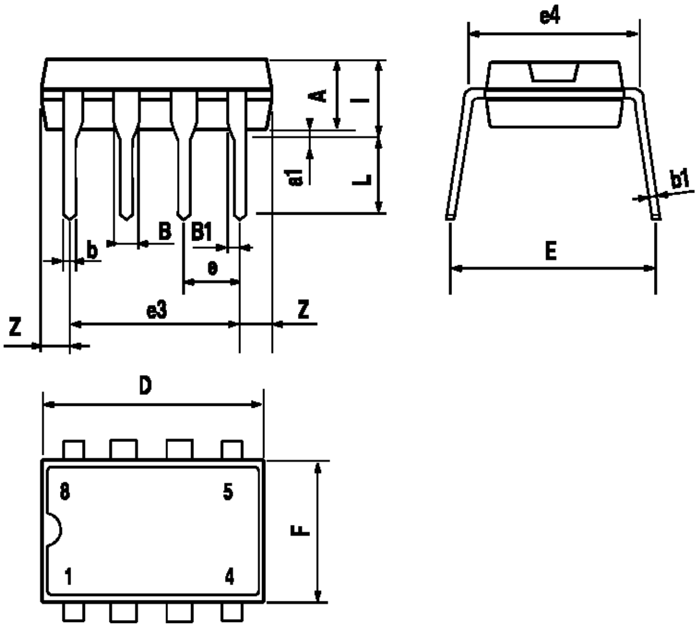
ELECTRICAL CHARACTERISTICS

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 = 2kΩ, C_L = 100pF, A_V = +1	7	V/µs
∅m	R_L = 2kΩ, C_L = 0pF	55	Degrees

PACKAGE MECHANICAL DATA

8 PINS - PLASTIC DIP



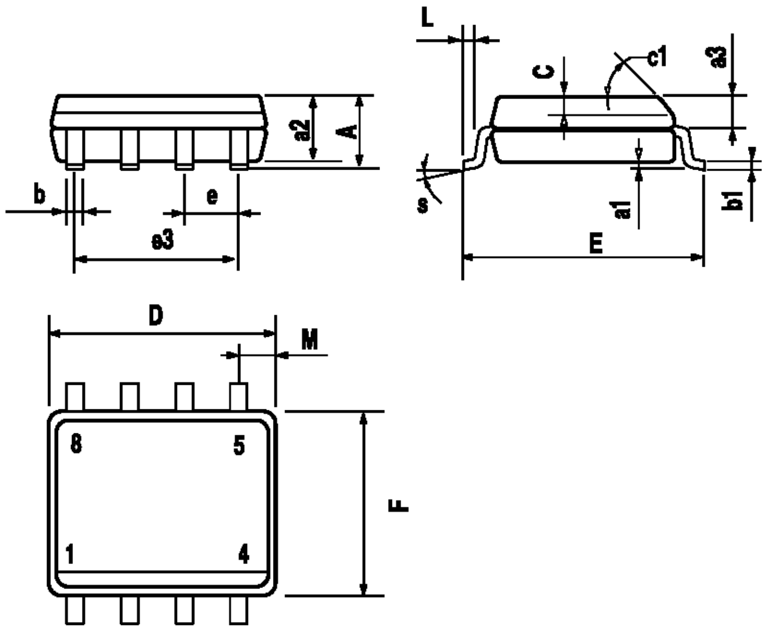
PM-DIP8.EPS

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			0260
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)



PM-SO8.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^o (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^o (max.)					

SO8.TBL