LM158,A-LM258,A
LM358,A

LOW POWER DUAL OPERATIONAL AMPLIFIERS

- INTERNALLY FREQUENCY COMPENSATED
- LARGE DC VOLTAGE GAIN: 100dB
- WIDE BANDWIDTH (unity gain): 1.1MHz (temperature compensated)
- VERY LOW SUPPLY CURRENT/OP (500µA) ESSENTIALLY INDEPENDENT OF SUPPLY VOLTAGE
- LOW INPUT BIAS CURRENT: 20nA (temperature compensated)
- LOW INPUT OFFSET VOLTAGE: 2mV
- LOW INPUT OFFSET CURRENT: 2nA
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE POWER SUPPLY VOLTAGE
- LARGE OUTPUT VOLTAGE SWING 0V TO (Vcc - 1.5V)

N
DIP8
(Plastic Package**)**

D & S
SO8 & miniSO8
(Plastic Micropackage**)**

P
TSSOP8
(Thin Shrink Small Outline Package)

DESCRIPTION

These circuits consist of two independent, high gain, internally frequency compensated which were designed specifically to operate from a single power supply over a wide range of voltages. The low power supply drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op-amp circuits which now can be more easily implemented in single power supply systems. For example, these circuits can be directly supplied with the standard +5V which is used in logic systems and will easily provide the required interface electronics without requiring any additional power supply.

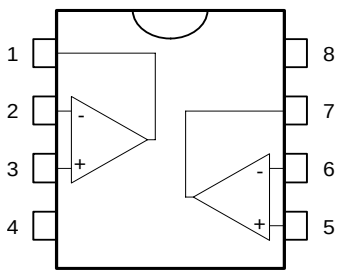
Inthe linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

ORDER CODE

Part Number	Temperature Range	Package			
		N	S	D	P
LM158,A	-55°C, +125°C	•		•	•
LM258,A	-40°C, +105°C	•		•	•
LM358,A	0°C, +70°C	•	•	•	•
Example : LM258N					

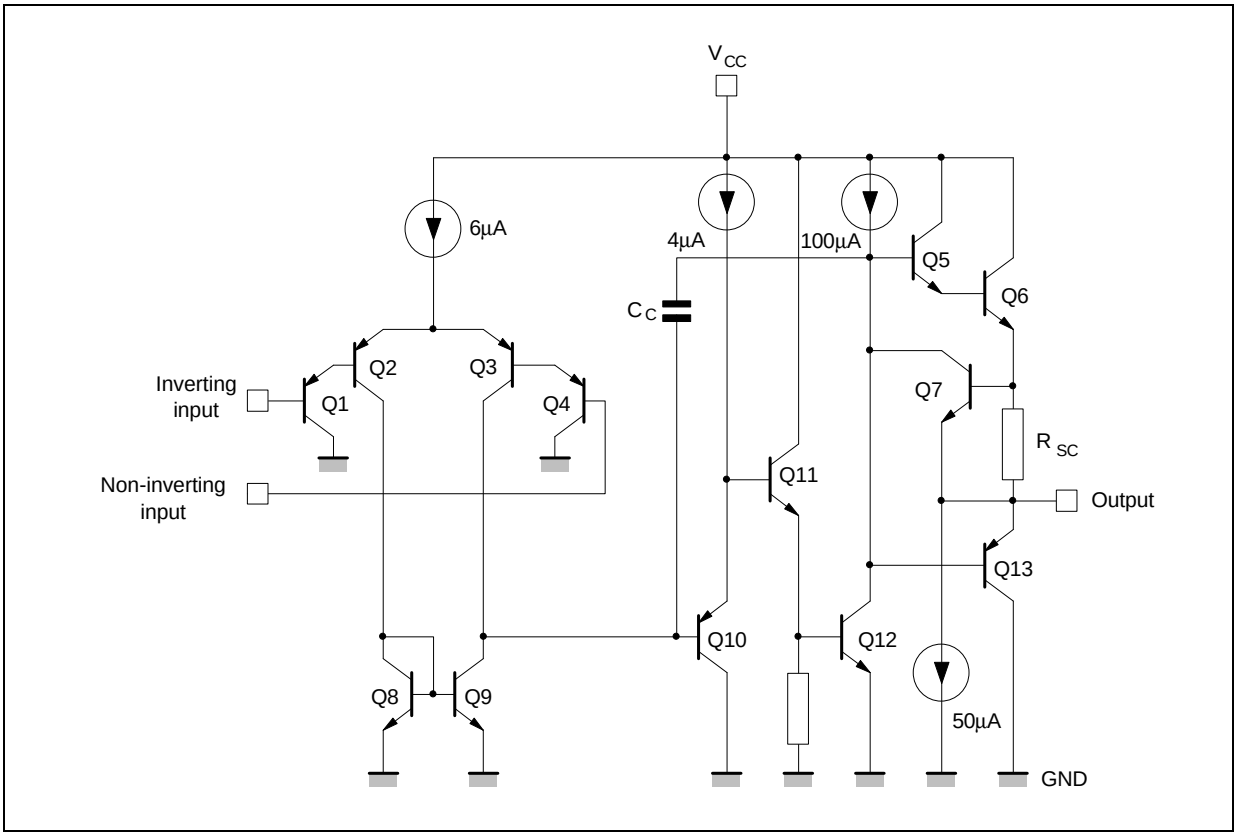
N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)
S = Small Outline Package (miniSO) only available in Tape & Reel (DT)
P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape &Reel (PT)

PIN CONNECTIONS (top view)



1 - Output 1
2 - Inverting input
3 - Non-inverting input
4 - V_{CC}^-
5 - Non-inverting input 2
6 - Inverting input 2
7 - Output 2
8 - V_{CC}^+

SCHEMATIC DIAGRAM (1/2 LM158)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM158,A	LM258,A	LM358,A	Unit
V_{CC}	Supply voltage	+32			V
V_i	Input Voltage	-0.3 to +32			V
V_{id}	Differential Input Voltage	+32			V
P_{tot}	Power Dissipation 1)	500			mW
	Output Short-circuit Duration 2)	Infinite			
I_{in}	Input Current 3)	50			mA
T_{oper}	Opearting Free-air Temperature Range	-55 to +125	-40 to +105	0 to +70	°C
T_{stg}	Storage Temperature Range	-65 to +150			°C

1. Power dissipation must be considered to ensure maximum junction temperature (Tj) is not exceeded.
2. 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.
3. 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.

ELECTRICAL CHARACTERISTICS

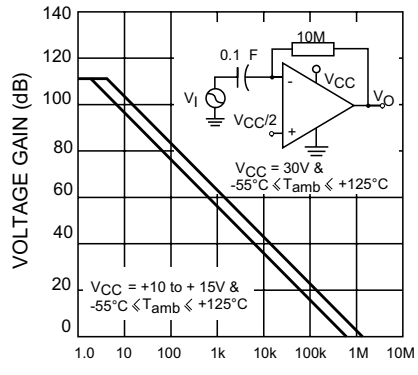
V_{CC}^+ = +5V, V_{CC}^-= Ground, V_o = 1.4V, T_{amb} = +25°C (unless otherwise specified)

Symbol	Parameter	LM158A-LM258A LM358A			LM158-LM258 LM358			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{io}	Input Offset Voltage - note 1) T_{amb} = +25°C LM158, LM258 LM158A $T_{min} \le T_{amb} \le T_{max}$ LM158, LM258		1	3 2 4		2	7 5 9 7	mV
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		2	10 30		2	30 40	nA
I_{ib}	Input Bias Current - note 2) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		20	50 100		20	150 200	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		 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	 100		 65 65	 100		dB
I_{CC}	Supply Current, all Amp, no load $T_{min} \le T_{amb} \le T_{max}$ V_{CC} = +5V $T_{min} \le T_{amb} \le T_{max}$ V_{CC} = +30V		0.7	1.2 1		0.7	1.2 2	mA
V_{icm}	Input Common Mode Voltage Range V_{CC} = +30V - note 3) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	 0 0		 V_{CC}^+ -1.5 V_{CC}^+ -2	 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	 85		 70 60	 85		dB
I_{source}	Output Current Source V_{CC} = +15V, V_o = +2V, V_{id} = +1V	20	40	60	20	40	60	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		 10 12	 20 50		mA µA
V_{OPP}	Output Voltage Swing (R_L = 2kΩ) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	 0 0		 V_{CC}^+ -1.5 V_{CC}^+ -2	 0 0		 V_{CC}^+ -1.5 V_{CC}^+ -2	

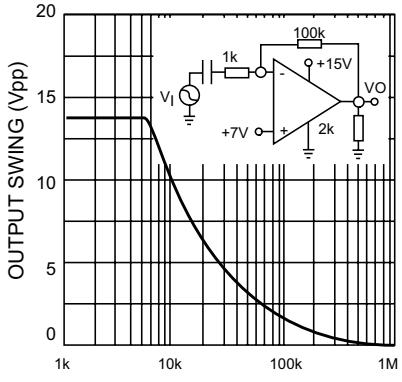
Symbol	Parameter	LM158A-LM258A LM358A			LM158-LM258 LM358			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{OH}	High Level Output Voltage (V_{CC}^+ = 30V) T_{amb} = +25°C R_L = 2kΩ $T_{min} \le T_{amb} \le T_{max}$ T_{amb} = +25°C R_L = 10kΩ $T_{min} \le T_{amb} \le T_{max}$	26 26 27 27	27 28 		26 26 27 27	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		5	20 20	mV
SR	Slew Rate V_{CC} = 15V, V_i = 0.5 to 3V, R_L = 2kΩ, C_L = 100pF, unity Gain	0.3	0.6		0.3	0.6		V/µs
GBP	Gain Bandwidth Product V_{CC} = 30V, f =100kHz,V_{in} = 10mV, R_L = 2kΩ, C_L = 100pF	0.7	1.1		0.7	1.1		MHz
THD	Total Harmonic Distortion f = 1kHz, A_v = 20dB, R_L = 2kΩ, V_o = $2V_{pp}$, C_L = 100pF, V_O = 2Vpp		0.02			0.02		%
e_n	Equivalent Input Noise Voltage f = 1kHz, R_s = 100Ω, V_{CC} = 30V		55			55		$\frac{nV}{\sqrt{Hz}}$
DV_{io}	Input Offset Voltage Drift		7	15		7	30	µV/°C
DI_{Iio}	Input Offset Current Drift		10	200		10	300	pA/°C
V_{o1}/V_{o2}	Channel Separation - note 4) 1kHz ≤ f ≤ 20kHZ		120			120		dB

1. V_o = 1.4V, R_s = 0Ω, 5V < V_{CC}^+ < 30V, 0 < V_{ic} < V_{CC}^+ - 1.5V
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. 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.
4. 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.

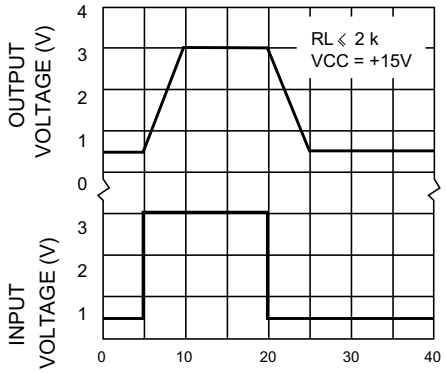
OPEN LOOP FREQUENCY RESPONSE (NOTE 3)



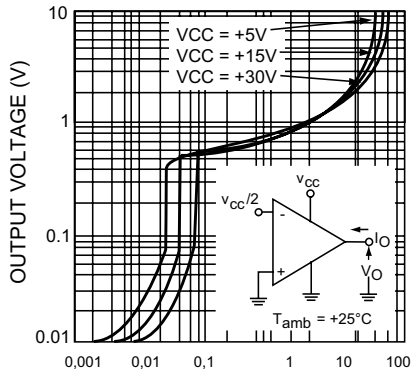
LARGE SIGNAL FREQUENCY RESPONSE



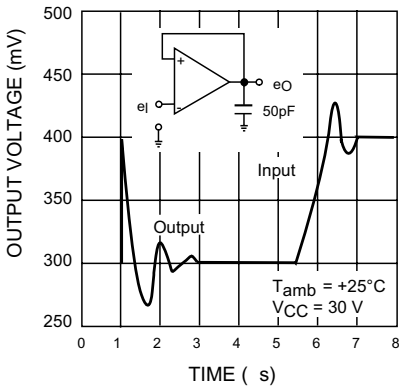
VOLAGE FOLLOWER PULSE RESPONSE



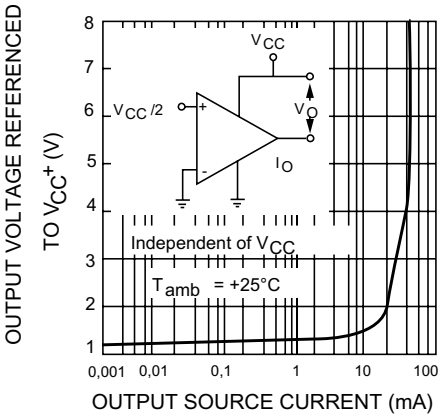
OUTPUT CHARACTERISTICS



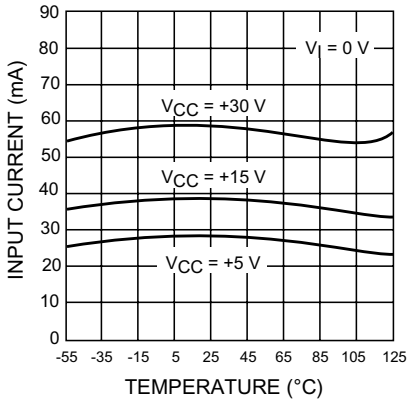
VOLTAGE FOLLOWER PULSSE RESPONSE (SMALL SIGNAL)



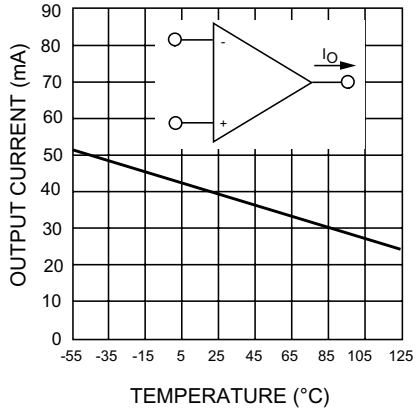
OUTPUT CHARACTERISTICS



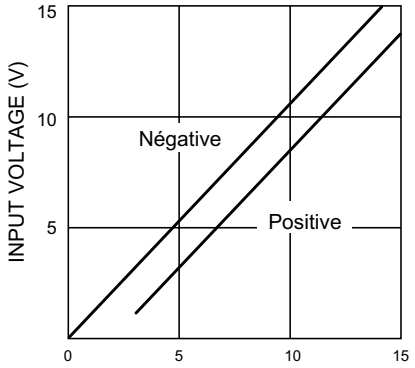
INPUT CURRENT (Note 1)



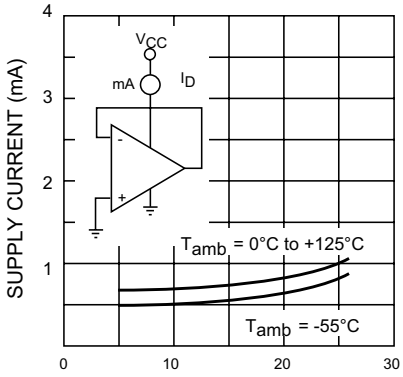
CURRENT LIMITING (Note 1)

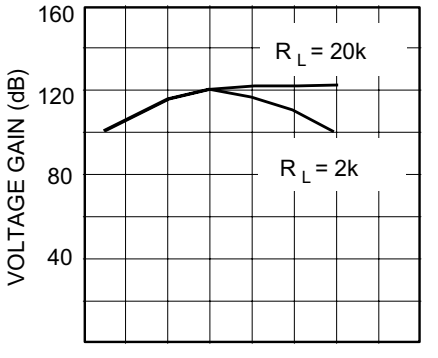


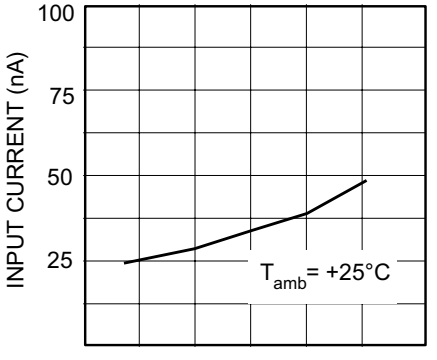
INPUT VOLTAGE RANGE

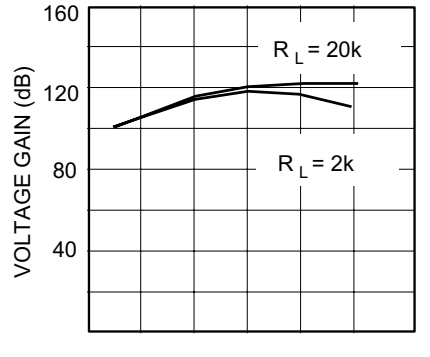


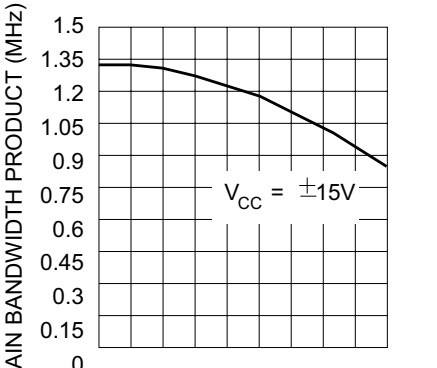
SUPPLY CURRENT

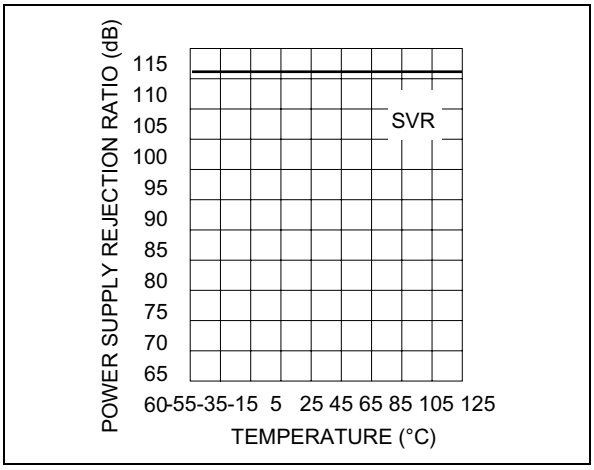


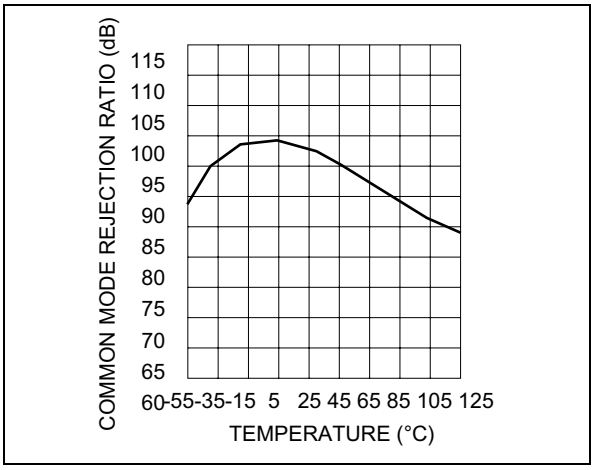






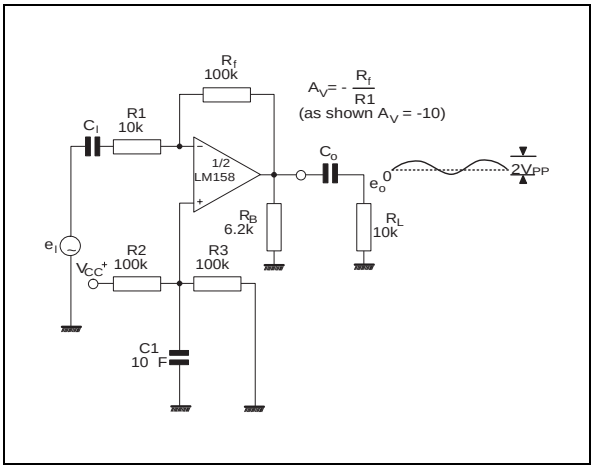




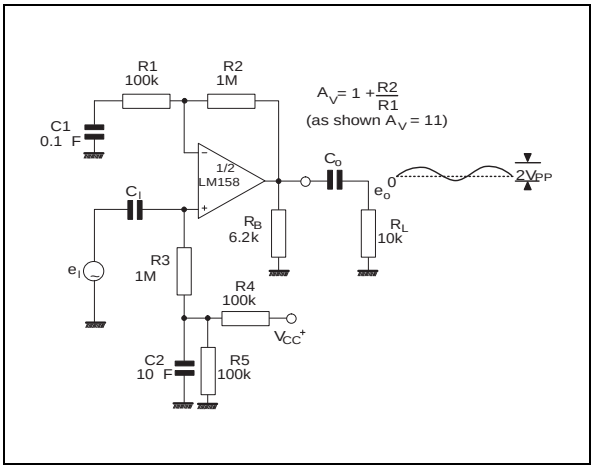


TYPICAL APPLICATIONS (single supply voltage) $V_{cc} = +5V_{dc}$

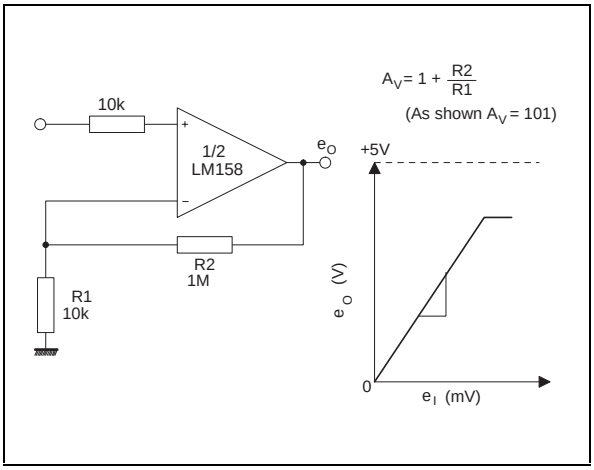
AC COUPLED INVERTING AMPLIFIER



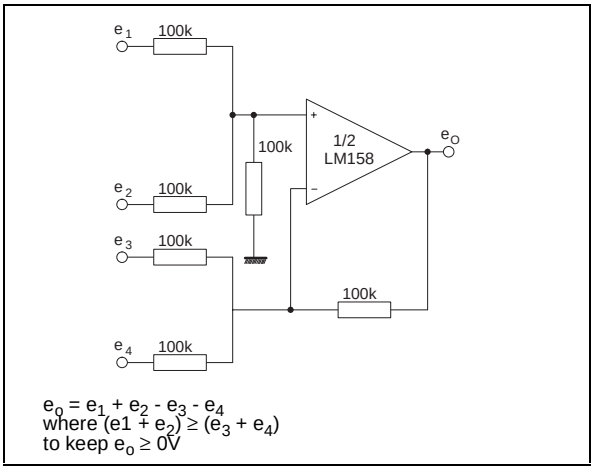
AC COUPLED NON-INVERTING AMPLIFIER



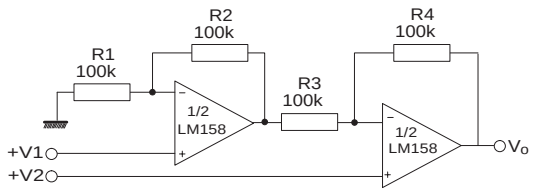
NON-INVERTING DC AMPLIFIER



DC SUMMING AMPLIFIER



HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER

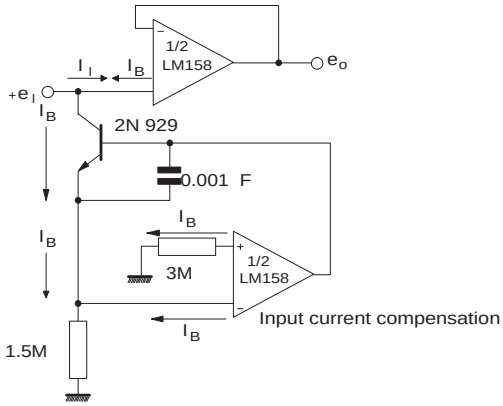


if R1 = R5 and R3 = R4 = R6 = R7

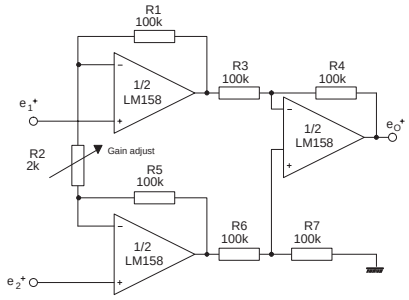
$e_o = [1 + \frac{2R1}{R2}] (e_2 + e_1)$

As shown $e_o = 101 (e_2 + e_1)$

USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT



HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER

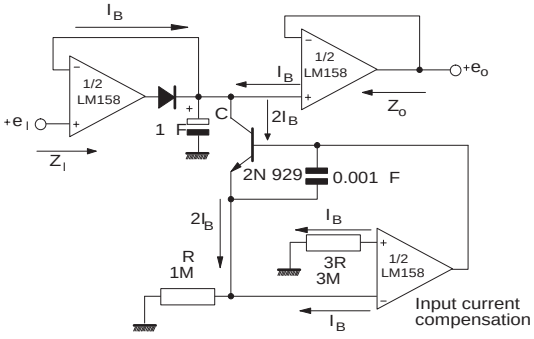


if R1 = R5 and R3 = R4 = R6 = R7

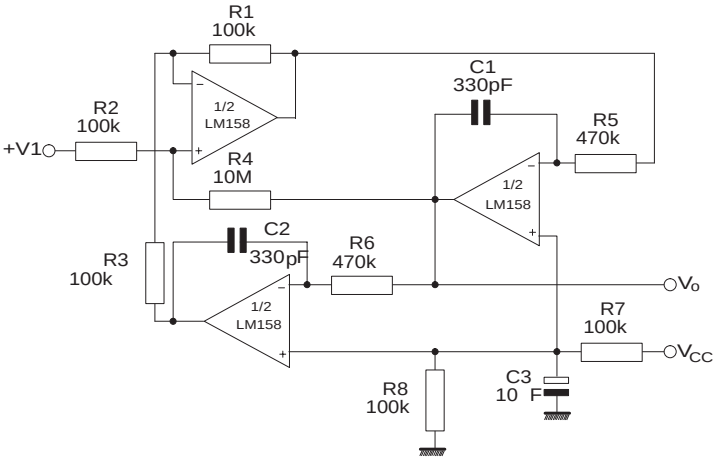
$e_o = [1 + \frac{2R1}{R2}] (e_2 + e_1)$

As shown $e_o = 101 (e_2 + e_1)$

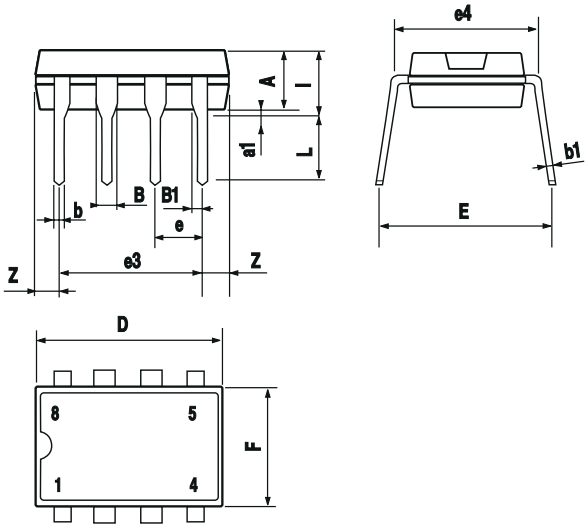
LOW DRIFT PEAK DETECTOR



ACTIVE BAND-PASS FILTER



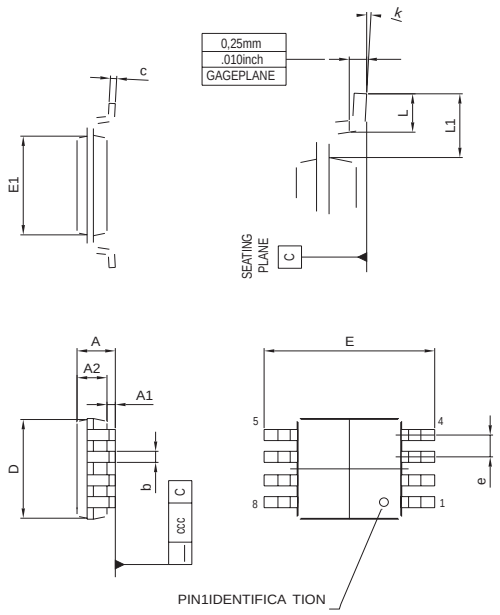
PACKAGE MECHANICAL DATA
8 PINS - PLASTIC DIP



Dim.	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

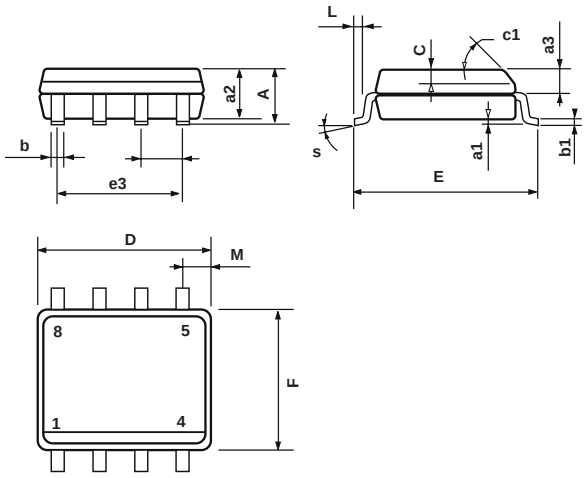
PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (miniSO)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.100			0.043
A1	0.050	0.100	0.150	0.002	0.004	0.006
A2	0.780	0.860	0.940	0.031	0.034	0.037
b	0.250	0.330	0.400	0.010	0.013	0.016
c	0.130	0.180	0.230	0.005	0.007	0.009
D	2.900	3.000	3.100	0.114	0.118	0.122
E	4.750	4.900	5.050	0.187	0.193	0.199
E1	2.900	3.000	3.100	0.114	0.118	0.122
e		0.650			0.026	
L	0.400	0.550	0.700	0.016	0.022	0.028
L1		0.950			0.037	
k	0d	3d	6d	0d	3d	6d
ccc			0.100			0.004

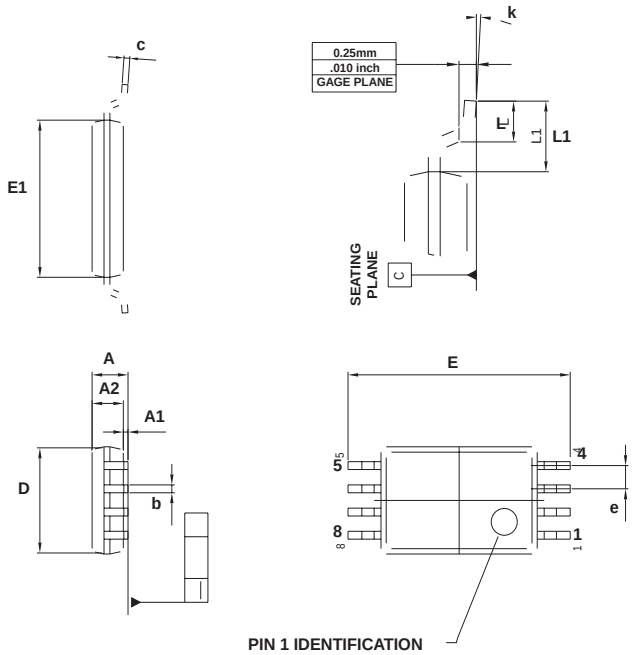
PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (SO)



Dim.	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.)					

PACKAGE MECHANICAL DATA

8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)



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	2.90	3.00	3.10	0.114	0.118	0.122
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
L	0.45	0.600	0.75	0.018	0.024	0.030
L1		1.000			0.039	