MOTOROLA Semiconductors

MC1558 MC1558N MC1458 MC1458N MC1458C

DUAL MC1741
INTERNALLY COMPENSATED, HIGH PERFORMANCE MONOLITHIC OPERATIONAL AMPLIFIERS

. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

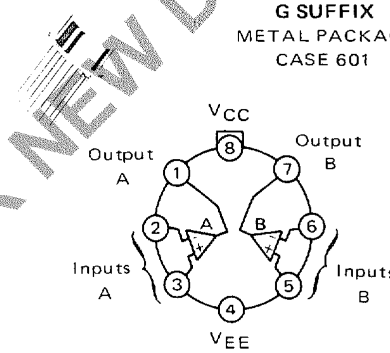
- No Frequency Compensation Required
- Short-Circuit Protection
- Wide Common-Mode and Differential Voltage Ranges
- Low-Power Consumption
- No Latch Up
- Low Noise Selections Offered — N Suffix

(DUAL MC1741)

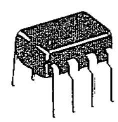
DUAL OPERATIONAL AMPLIFIER

SILICON MONOLITHIC INTEGRATED CIRCUIT

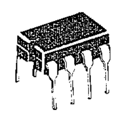
G SUFFIX
METAL PACKAGE
CASE 601

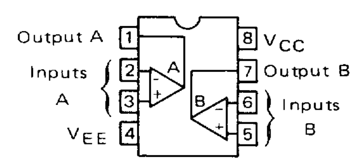


P1 SUFFIX
PLASTIC PACKAGE
CASE 626
(MC1458,MC1458C,MC1458N)

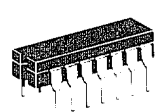


U SUFFIX
CERAMIC PACKAGE
CASE 693

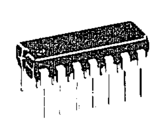


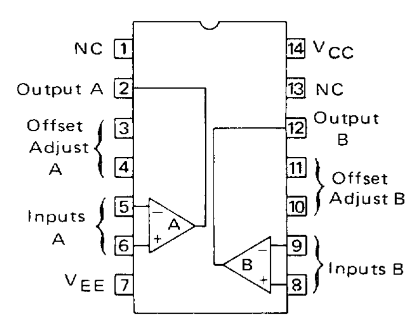


L SUFFIX
CERAMIC PACKAGE
CASE 632
TO-116



P2 SUFFIX
PLASTIC PACKAGE
CASE 646
(MC1458,MC1458C,MC1458N)





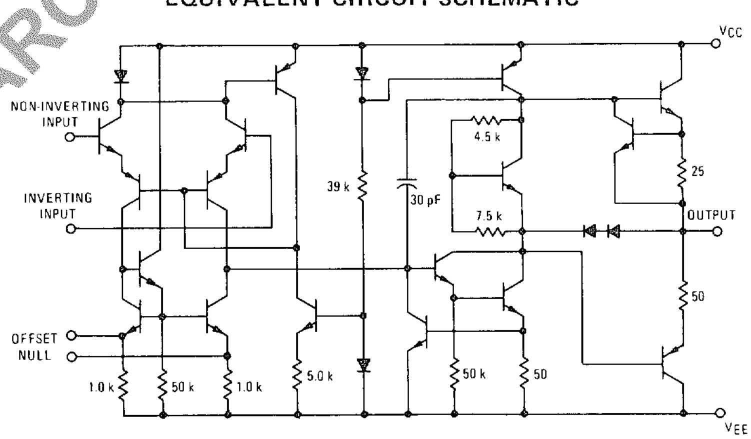
MAXIMUM RATINGS (T_A = +25°C unless otherwise noted)

Rating	Symbol	MC1458	MC1558	Unit
Power Supply Voltage	V_{CC} V_{EE}	+18 -18	+22 -22	Vdc Vdc
Input Differential Voltage	V_{ID}	±30		Volts
Input Common Mode Voltage (Note 1)	V_{ICM}	±15		Volts
Output Short Circuit Duration (Note 2)	t_S	Continuous		
Operating Ambient Temperature Range	T_A	0 to +70	-55 to +125	°C
Storage Temperature Range Metal, Flat and Ceramic Packages Plastic Packages	T_{stg}	 -65 to +150 -55 to +125		°C
Junction Temperature Metal and Ceramic Package Plastic Package	T_J	 175 150		°C

Note 1. For supply voltages less than ± 15 V, the absolute maximum input voltage is equal to the supply voltage.

Note 2. Supply voltage equal to or less than 15 V.

EQUIVALENT CIRCUIT SCHEMATIC



DS 9174 R1

ELECTRICAL CHARACTERISTICS (V_{CC} = 15 V, V_{EE} = 15 V, T_A = 25°C unless otherwise noted).

Characteristic	Symbol	MC1558			MC1458			MC1458C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage ($R_S \leq$ 10 k)	V_{IO}	–	1.0	5.0	–	2.0	6.0	–	2.0	10	mV
Input Offset Current	I_{IO}	–	20	200	–	20	200	–	20	300	nA
Input Bias Current	I_{IB}	–	80	500	–	80	500	–	80	700	nA
Input Resistance	r_i	0.3	2.0	–	0.3	2.0	–	–	2.0	–	MΩ
Input Capacitance	C_i	–	1.4	–	–	1.4	–	–	1.4	–	pF
Offset Voltage Adjustment Range	V_{IOR}	–	±15	–	–	±15	–	–	±15	–	mV
Common Mode Input Voltage Range	V_{ICR}	±12	±13	–	±12	±13	–	±11	±13	–	V
Large Signal Voltage Gain	A_v										V/mV
(V_O = ±10 V, R_L = 2.0 k)		50	200	–	20	200	–	–	–	–	
(V_O = ±10 V, R_L = 10 k)		–	–	–	–	–	–	20	200	–	
Output Resistance	r_o	–	75	–	–	75	–	–	75	–	Ω
Common Mode Rejection Ratio ($R_S \leq$ 10 k)	CMRR	70	90	–	70	90	–	60	90	–	dB
Supply Voltage Rejection Ratio ($R_S \leq$ 10 k)	PSRR	–	30	150	–	30	150	–	30	–	μV/V
Output Voltage Swing	V_O										V
($R_L \geq$ 10 k)		±12	±14	–	±12	±14	–	±11	±14	–	
($R_L \geq$ 2 k)		±10	±13	–	±10	±13	–	±9.0	±13	–	
Output Short-Circuit Current	I_{os}	–	20	–	–	20	–	–	20	–	mA
Supply Currents (Both Amplifiers)	I_D	–	2.3	5.0	–	2.3	5.6	–	2.3	8.0	mA
Power Consumption	P_C	–	70	150	–	70	170	–	70	240	mW
Transient Response (Unity Gain)											
(V_I = 20 mV, $R_L \geq$ 2 kΩ, $C_L \leq$ 100 pF) Rise Time	t_{TLH}	–	0.3	–	–	0.3	–	–	0.3	–	μs
(V_I = 20 mV, $R_L \geq$ 2 kΩ, $C_L \leq$ 100 pF) Overshoot	os	–	15	–	–	15	–	–	15	–	%
(V_I = 10 V, $R_L \geq$ 2 kΩ, $C_L \leq$ 100 pF) Slew Rate	SR	–	0.5	–	–	0.5	–	–	0.5	–	V/μs

ELECTRICAL CHARACTERISTICS (V_{CC} = 15 V, V_{EE} = 15 V, T_A = *T_{high} to T_{low} unless otherwise noted).

Characteristic	Symbol	MC1558			MC1458			MC1458C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage ($R_S \leq$ 10 kΩ)	V_{IO}	–	1.0	6.0	–	–	7.5	–	–	12	mV
Input Offset Current	I_{IO}										nA
(T_A = 125°C)		–	7.0	200	–	–	–	–	–	–	
(T_A = -55°C)		–	85	500	–	–	–	–	–	–	
(T_A = 0°C to +70°C)		–	–	–	–	–	300	–	–	400	
Input Bias Current	I_{IB}										nA
(T_A = 125°C)		–	30	500	–	–	–	–	–	–	
(T_A = -55°C)		–	300	1500	–	–	–	–	–	–	
(T_A = 0°C to +70°C)		–	–	–	–	–	800	–	–	1000	
Common Mode Input Voltage Range	V_{ICR}	±12	±13	–	–	–	–	–	–	–	V
Common Mode Rejection Ratio ($R_S \leq$ 10 k)	CMRR	70	90	–	–	–	–	–	–	–	dB
Supply Voltage Rejection Ratio ($R_S \leq$ 10 k)	PSRR	–	30	150	–	–	–	–	–	–	μV/V
Output Voltage Swing	V_O										V
($R_L \geq$ 10 k)		±12	±14	–	±12	±14	–	–	–	–	
($R_L \geq$ 2 k)		±10	±13	–	±10	±13	–	±9.0	±13	–	
Large Signal Voltage Gain	A_v										V/mV
(V_O = ±10 V, R_L = 2 k)		25	–	–	15	–	–	–	–	–	
(V_O = ±10 V, R_L = 10 k)		–	–	–	–	–	–	15	–	–	
Supply Currents (Both Amplifiers)	I_D										mA
(T_A = 125°C)		–	–	4.5	–	–	–	–	–	–	
(T_A = -55°C)		–	–	6.0	–	–	–	–	–	–	
Power Consumption (T_A = 125°C)	P_C	–	–	135	–	–	–	–	–	–	mW
Power Consumption (T_A = -55°C)		–	–	180	–	–	–	–	–	–	

*T_{high} = 125°C for MC1558 and 70°C for MC1458, MC1458C
T_{low} = -55°C for MC1558 and 0°C for MC1458, MC1458C

FIGURE 12 — NON-INVERTING PULSE RESPONSE

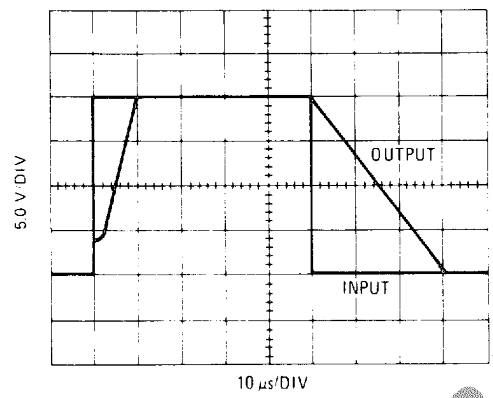


FIGURE 13 — TRANSIENT RESPONSE TEST CIRCUIT

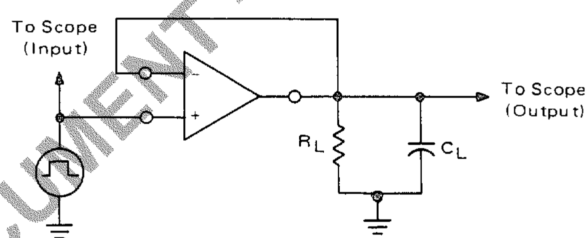
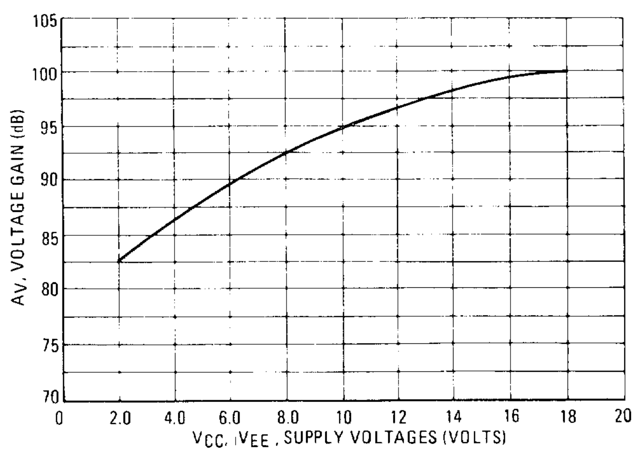


FIGURE 14 — OPEN LOOP VOLTAGE GAIN
versus SUPPLY VOLTAGE



TYPICAL CHARACTERISTICS

(V_{CC} = +15 Vdc, V_{EE} = -15 Vdc, T_A = +25°C unless otherwise noted).

FIGURE 6 — POWER BANDWIDTH (LARGE SIGNAL SWING versus FREQUENCY)

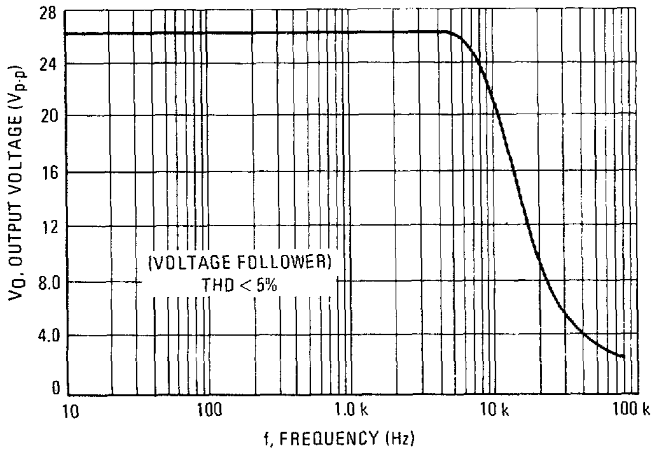


FIGURE 7 — OPEN LOOP FREQUENCY RESPONSE

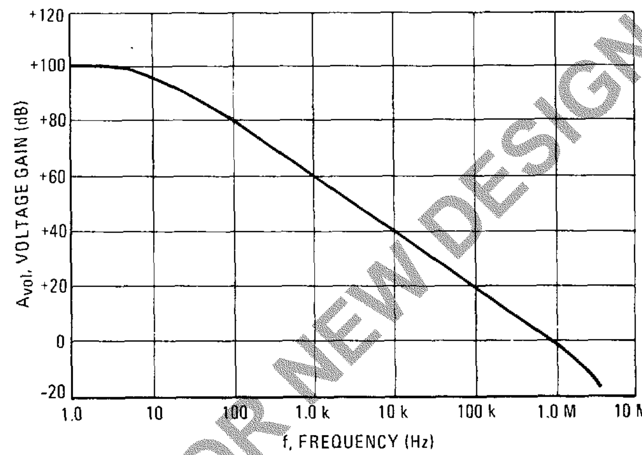


FIGURE 8 — POSITIVE OUTPUT VOLTAGE SWING versus LOAD RESISTANCE

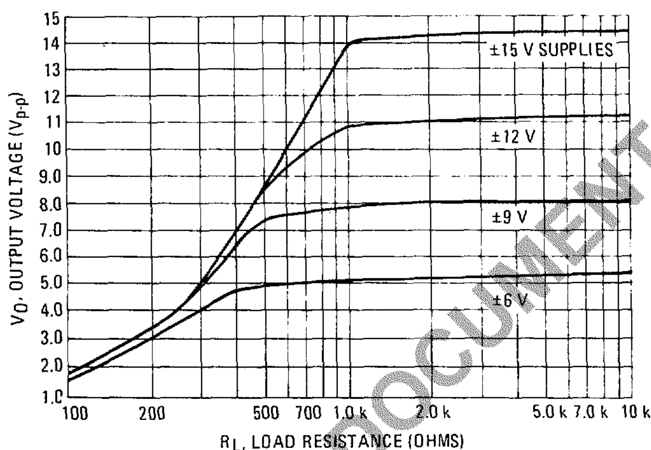


FIGURE 9 — NEGATIVE OUTPUT VOLTAGE SWING versus LOAD RESISTANCE

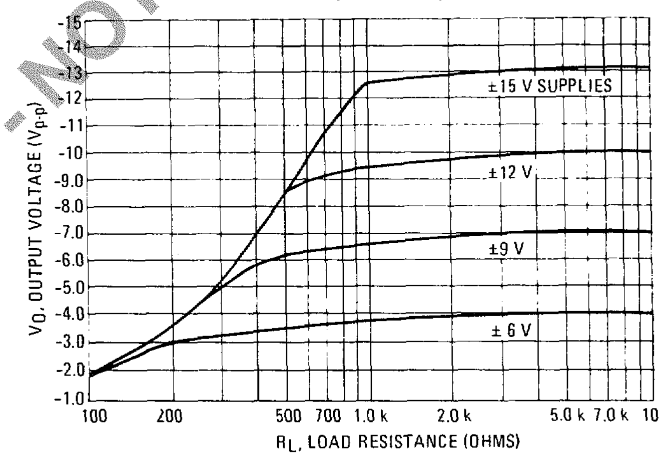


FIGURE 10 — OUTPUT VOLTAGE SWING versus LOAD RESISTANCE (Single Supply Operation)

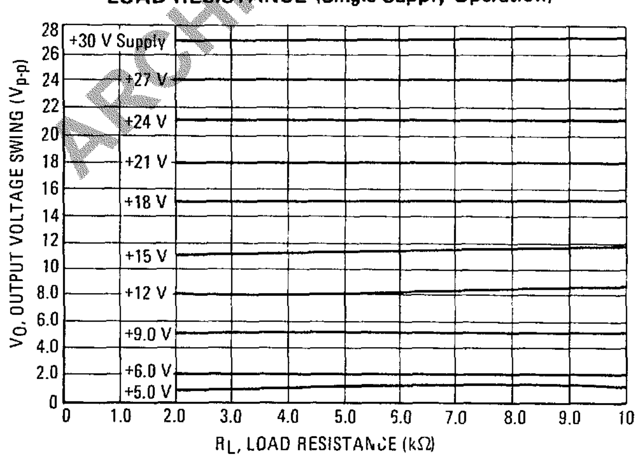
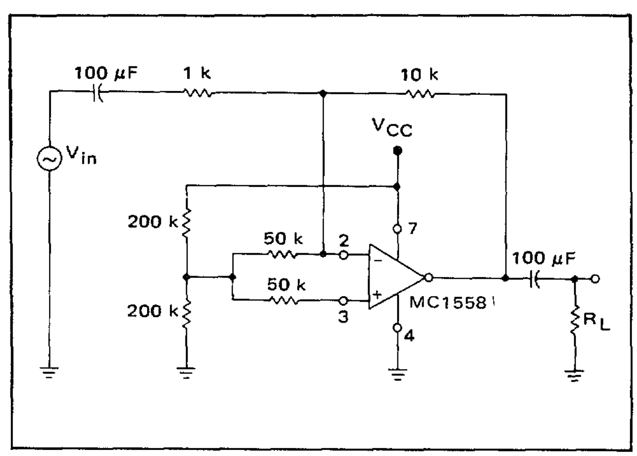


FIGURE 11 — SINGLE SUPPLY INVERTING AMPLIFIER



NOISE CHARACTERISTICS (Applies for MC1558N and MC1458N only, V_{CC} = 15 V, V_{EE} = -15 V, T_A = 25°C)

Characteristic	Symbol	MC1558N			MC1458N			Unit
		Min	Typ	Max	Min	Typ	Max	
Burst Noise (Popcorn Noise) (BW = 1.0 Hz to 1.0 kHz, t = 10 s, R_S = 100 kΩ) (Input Referenced)	E_n	–	–	20	–	–	20	μVpeak

FIGURE 1 – BURST NOISE versus SOURCE RESISTANCE

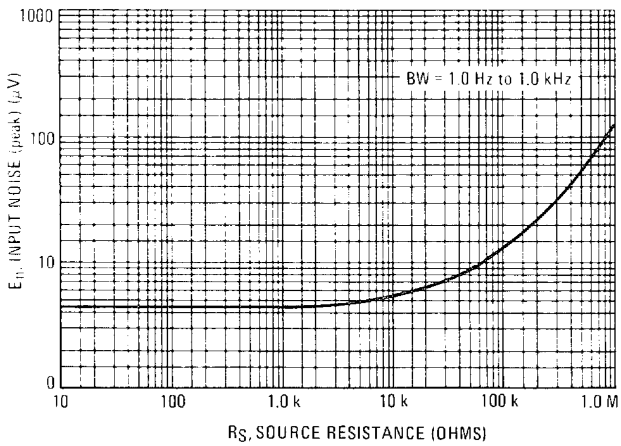


FIGURE 2 – RMS NOISE versus SOURCE RESISTANCE

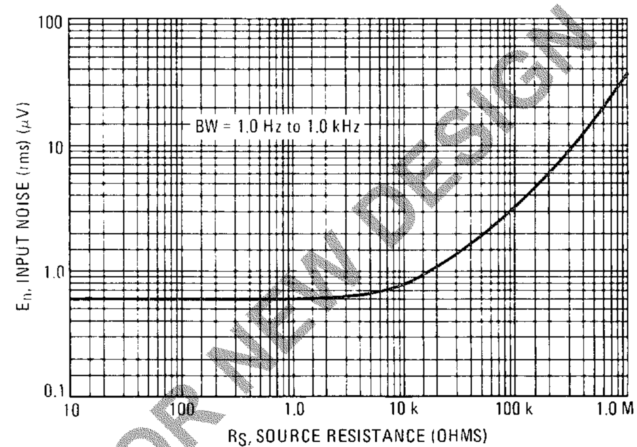


FIGURE 3 – OUTPUT NOISE versus SOURCE RESISTANCE

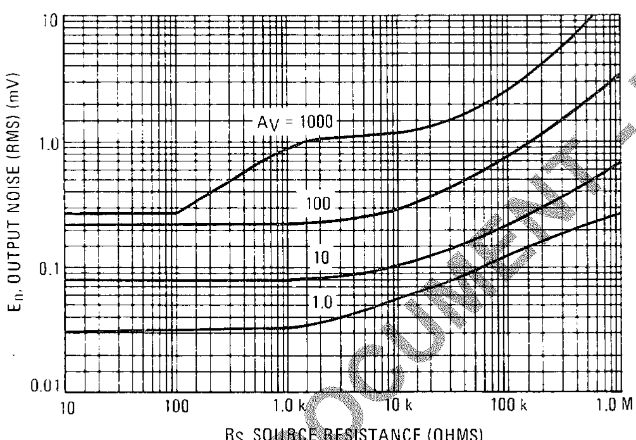


FIGURE 4 – SPECTRAL NOISE DENSITY

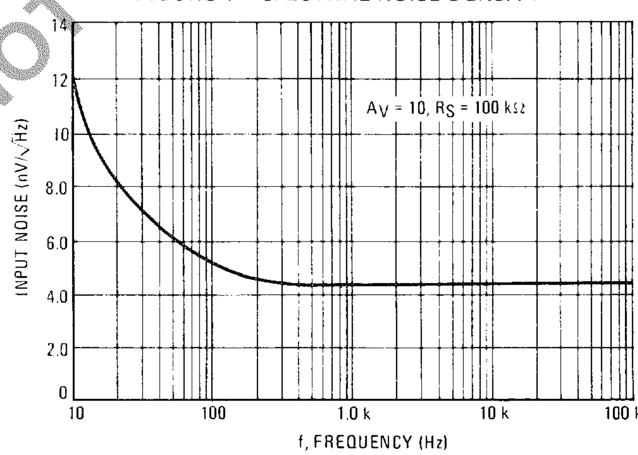
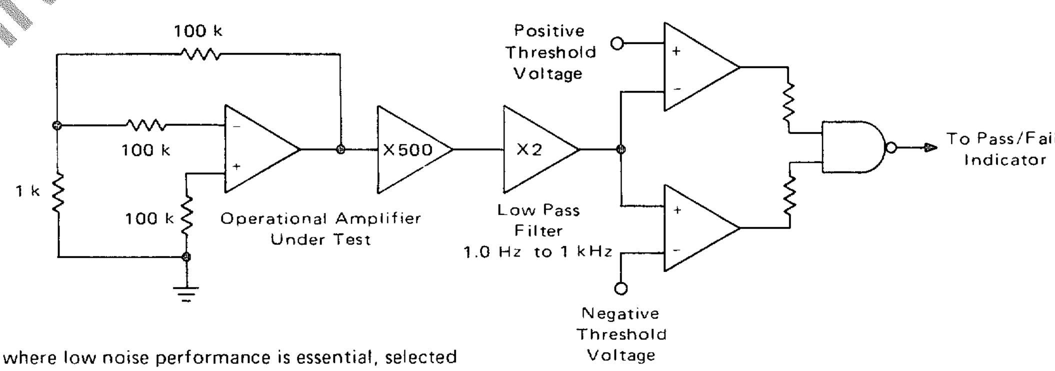


FIGURE 5 – BURST NOISE TEST CIRCUIT (N Suffixed Devices Only)



For applications where low noise performance is essential, selected devices denoted by an N suffix are offered. These units have been 100% tested for burst noise pulses on a special noise test system. Unlike conventional peak reading or RMS meters, this system was especially designed to provide the quick response time essential to burst (popcorn) noise testing.

The test time employed is 10 seconds and the 20 μV peak limit refers to the operational amplifier input thus eliminating errors in the closed-loop gain factor of the operational amplifier under test.

THERMAL INFORMATION

The maximum power consumption an integrated circuit can tolerate at a given operating ambient temperature, can be found from the equation:

$$P_{D(T_A)} = \frac{T_{J(max)} - T_A}{R_{\theta JA}(Typ)}$$

Where: $P_{D(T_A)}$ = Power Dissipation allowable at a given operating ambient temperature. This must be greater than the sum of the products of the supply voltages and supply currents at the worst case operating condition.

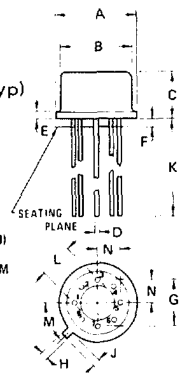
$T_{J(max)}$ = Maximum Operating Junction Temperature as listed in the Maximum Ratings Section

T_A = Maximum Desired Operating Ambient Temperature

$R_{\theta JA}(Typ)$ = Typical Thermal Resistance Junction to Ambient

G SUFFIX

METAL PACKAGE
CASE 601
$R_{\theta JC}$ = 160°C/W (Typ)

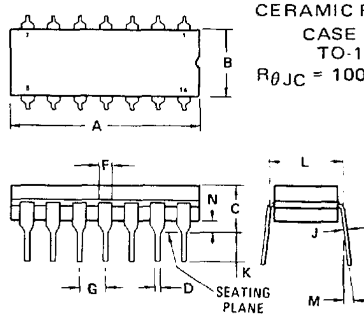


NOTE:
1. LEADS WITHIN 0.25 mm (0.010) DIA OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.51	9.40	0.335	0.370
B	7.75	8.51	0.305	0.335
C	4.19	4.70	0.165	0.185
D	0.41	0.48	0.016	0.019
E	0.25	1.02	0.010	0.040
F	0.25	1.02	0.010	0.040
G	5.08 BSC		0.200 BSC	
H	0.71	0.86	0.028	0.034
J	0.74	1.14	0.029	0.045
K	12.70	–	0.500	–
L	3.05	4.06	0.120	0.160
M	45° BSC		45° BSC	
N	2.41	2.67	0.095	0.105

L SUFFIX

CERAMIC PACKAGE
CASE 632
TO-116
$R_{\theta JC}$ = 100°C/W (Typ)

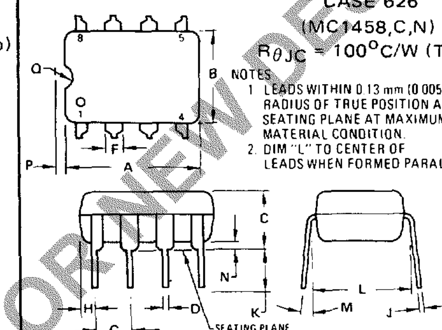


NOTE:
1. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	19.05	19.81	0.750	0.780
B	6.22	6.99	0.245	0.275
C	4.32	5.08	0.170	0.200
D	0.41	0.51	0.016	0.020
F	1.45	1.60	0.057	0.063
G	2.54 BSC		0.100 BSC	
H	1.91	2.29	0.075	0.090
J	0.20	0.30	0.008	0.012
K	3.18	4.06	0.125	0.160
L	7.62 BSC		0.300 BSC	
M	–	15°	–	15°
N	0.51	0.76	0.020	0.030

P1 SUFFIX

PLASTIC PACKAGE
CASE 626
(MC1458,C,N)
$R_{\theta JC}$ = 100°C/W (Typ)

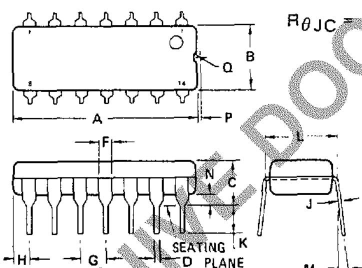


NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.37	7.87	0.290	0.310
M	–	10°	–	10°
N	0.51	0.76	0.020	0.030
P	0.13	0.38	0.005	0.015
Q	0.76	1.02	0.030	0.040

P2 SUFFIX

PLASTIC PACKAGE
CASE 646
(MC1458,C,N)
$R_{\theta JC}$ = 100°C/W (Typ)

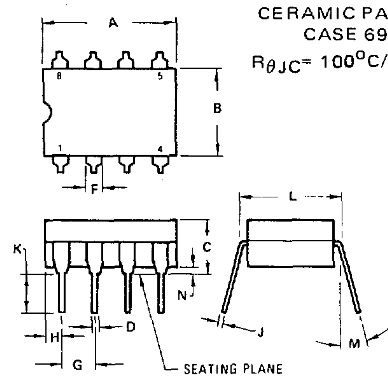


NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	18.16	18.80	0.715	0.740
B	6.10	6.60	0.240	0.260
C	4.06	4.57	0.160	0.180
D	0.38	0.51	0.015	0.020
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	1.32	1.83	0.052	0.072
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.37	7.87	0.290	0.310
M	–	10°	–	10°
N	0.51	1.02	0.020	0.040
P	0.13	0.38	0.005	0.015
Q	0.51	0.76	0.020	0.030

U SUFFIX

CERAMIC PACKAGE
CASE 693
$R_{\theta JC}$ = 100°C/W (Typ)



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.91	10.92	0.390	0.430
B	6.22	6.99	0.245	0.275
C	4.32	5.08	0.170	0.200
D	0.41	0.51	0.016	0.020
F	1.40	1.65	0.055	0.065
G	2.54 BSC		0.100 BSC	
H	1.14	1.65	0.045	0.065
J	0.20	0.30	0.008	0.012
K	3.18	4.06	0.125	0.160
L	7.37	7.87	0.290	0.310
M	–	15°	–	15°
N	0.51	1.02	0.020	0.040

NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RAD OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.

MOTOROLA Semiconductor Products Inc.

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