

TL081C,AC TL082C,AC TL084C,AC

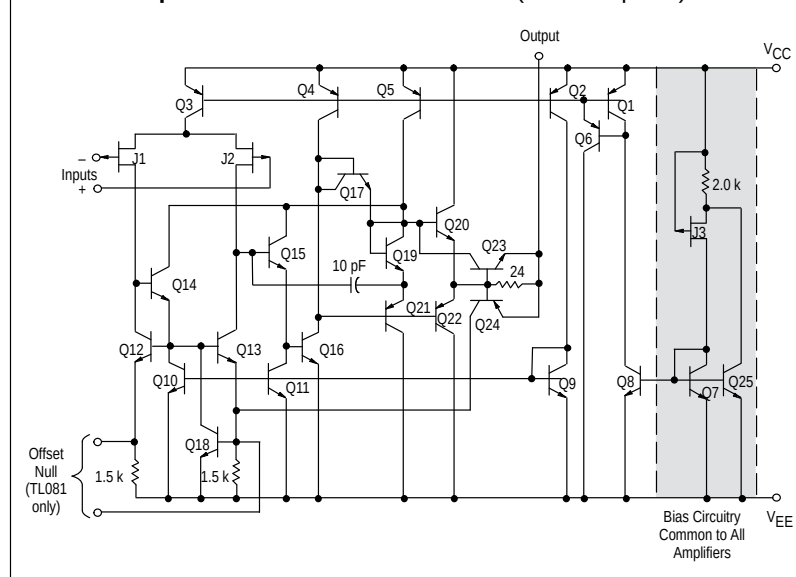
JFET Input Operational Amplifiers

These low-cost JFET input operational amplifiers combine two state-of-the-art linear technologies on a single monolithic integrated circuit. Each internally compensated operational amplifier has well matched high voltage JFET input devices for low input offset voltage. The BIFET technology provides wide bandwidths and fast slew rates with low input bias currents, input offset currents, and supply currents.

These devices are available in single, dual and quad operational amplifiers which are pin-compatible with the industry standard MC1741, MC1458, and the MC3403/LM324 bipolar products.

- Input Offset Voltage Options of 6.0 mV and 15 mV Max
- Low Input Bias Current: 30 pA
- Low Input Offset Current: 5.0 pA
- Wide Gain Bandwidth: 4.0 MHz
- High Slew Rate: 13 V/ μ s
- Low Supply Current: 1.4 mA per Amplifier
- High Input Impedance: $10^{12} \Omega$

Representative Circuit Schematic (Each Amplifier)

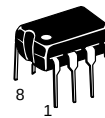


ORDERING INFORMATION

Op Amp Function	Device	Operating Temperature Range	Package
Single	TL081ACD, CD	$T_A = 0^\circ \text{ to } +70^\circ \text{C}$	SO-8
	TL081ACP, CP		Plastic DIP
Dual	TL082ACD, CD	$T_A = 0^\circ \text{ to } +70^\circ \text{C}$	SO-8
	TL082ACP, CP		Plastic DIP
Quad	TL084ACN, CN	$T_A = 0^\circ \text{ to } +70^\circ \text{C}$	Plastic DIP

JFET INPUT OPERATIONAL AMPLIFIERS

SEMICONDUCTOR TECHNICAL DATA

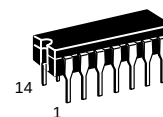
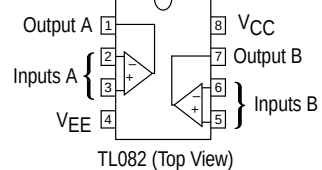
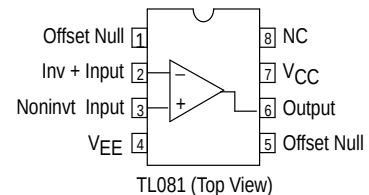


P SUFFIX
PLASTIC PACKAGE
CASE 626



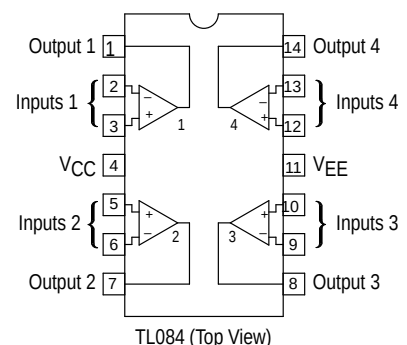
D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)

PIN CONNECTIONS



N SUFFIX
PLASTIC PACKAGE
CASE 646

PIN CONNECTIONS



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC} V_{EE}	+18 -18	V
Differential Input Voltage	V_{ID}	± 30	V
Input Voltage Range (Note 1)	V_{IDR}	± 15	V
Output Short Circuit Duration (Note 2)	t_{SC}	Continuous	
Power Dissipation Plastic Package (N, P) Derate above $T_A = +47^\circ\text{C}$	P_D $1/\theta_{JA}$	680 10	mW mW/ $^\circ\text{C}$
Operating Ambient Temperature Range	T_A	0 to +70	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-65 to +150	$^\circ\text{C}$

NOTES: 1. The magnitude of the input voltage must not exceed the magnitude of the supply voltage or 15 V, whichever is less.
2. The output may be shorted to ground or either supply. Temperature and/or supply voltages must be limited to ensure that power dissipation ratings are not exceeded.

ELECTRICAL CHARACTERISTICS ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $T_A = T_{low}$ to T_{high} [Note 3].)

Characteristics	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ($R_S \leq 10\text{ k}$, $V_{CM} = 0$) TL081C, TL082C TL084C TL08_AC	V_{IO}	— — —	— — —	20 20 7.5	mV
Input Offset Current ($V_{CM} = 0$) (Note 4) TL08_C TL08_AC	I_{IO}	— —	— —	5.0 3.0	nA
Input Bias Current ($V_{CM} = 0$) (Note 4) TL08_C TL08_AC	I_{IB}	— —	— —	10 7.0	nA
Large-Signal Voltage Gain ($V_O = \pm 10\text{ V}$, $R_L \geq 2.0\text{ k}$) TL08_C TL08_AC	A_{VOL}	15 25	— —	— —	V/mV
Output Voltage Swing (Peak-to-Peak) ($R_L \geq 10\text{ k}$) ($R_L \geq 2.0\text{ k}$)	V_O	24 20	— —	— —	V

NOTES: 3. $T_{low} = 0^\circ\text{C}$ for TL081AC,C
TL082AC,C
TL084AC,C
 $T_{high} = +70^\circ\text{C}$ for TL081AC
TL082AC,C
TL084AC,C
4. Input Bias currents of JFET input op amps approximately double for every 10°C rise in Junction Temperature as shown in Figure 3. To maintain junction temperature as close to ambient temperature as possible, pulse techniques must be used during testing.

Figure 1. Unity Gain Voltage Follower

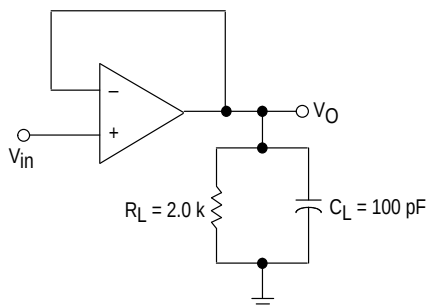
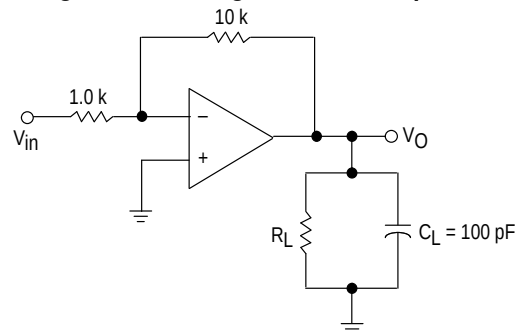


Figure 2. Inverting Gain of 10 Amplifier



TL081C,AC TL082C,AC TL084C,AC

ELECTRICAL CHARACTERISTICS ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $T_A = +25^\circ\text{C}$, unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ($R_S \leq 10\text{ k}$, $V_{CM} = 0$) TL081C, TL082C TL084C TL08_AC	V_{IO}	— — —	5.0 5.0 3.0	15 15 6.0	mV
Average Temperature Coefficient of Input Offset Voltage $R_S = 50\ \Omega$, $T_A = T_{low}$ to T_{high} (Note 3)	$\Delta V_{IO}/\Delta T$	—	10	—	$\mu\text{V}/^\circ\text{C}$
Input Offset Current ($V_{CM} = 0$) (Note 4) TL08_C TL08_AC	I_{IO}	— —	5.0 5.0	200 100	pA
Input Bias Current ($V_{CM} = 0$) (Note 4) TL08_C TL08_AC	I_{IB}	— —	30 30	400 200	pA
Input Resistance	r_i	—	10^{12}	—	Ω
Common Mode Input Voltage Range TL08_C TL08_AC	V_{ICR}	± 10 ± 11	+15, -12 +15, -12	— —	V
Large Signal Voltage Gain ($V_O = \pm 10\text{ V}$, $R_L \geq 2.0\text{ k}$) TL08_C TL08_AC	A_{VOL}	25 50	150 150	— —	V/mV
Output Voltage Swing (Peak-to-Peak) ($R_L = 10\text{ k}$)	V_O	24	28	—	V
Common Mode Rejection Ratio ($R_S \leq 10\text{ k}$) TL08_C TL08_AC	CMRR	70 80	100 100	— —	dB
Supply Voltage Rejection Ratio ($R_S \leq 10\text{ k}$) TL08_C TL08_AC	PSRR	70 80	100 100	— —	dB
Supply Current (Each Amplifier)	I_D	—	1.4	2.8	mA
Unity Gain Bandwidth	BW	—	4.0	—	MHz
Slew Rate (See Figure 1) $V_{in} = 10\text{ V}$, $R_L = 2.0\text{ k}$, $C_L = 100\text{ pF}$	SR	—	13	—	V/ μs
Rise Time (See Figure 1)	t_r	—	0.1	—	μs
Overshoot ($V_{in} = 20\text{ mV}$, $R_L = 2.0\text{ k}$, $C_L = 100\text{ pF}$)	OS	—	10	—	%
Equivalent Input Noise Voltage $R_S = 100\ \Omega$, $f = 1000\text{ Hz}$	e_n	—	25	—	$\text{nV}/\sqrt{\text{Hz}}$
Channel Separation $A_V = 100$	CS	—	120	—	dB

NOTES: 3. $T_{low} = 0^\circ\text{C}$ for TL081AC,C
TL082AC,C
TL084AC,C
 $T_{high} = +70^\circ\text{C}$ for TL081AC
TL082AC,C
TL084AC,C

4. Input Bias currents of JFET input op amps approximately double for every 10°C rise in Junction Temperature as shown in Figure 3. To maintain junction temperature as close to ambient temperature as possible, pulse techniques must be used during testing.

Figure 3. Input Bias Current versus Temperature

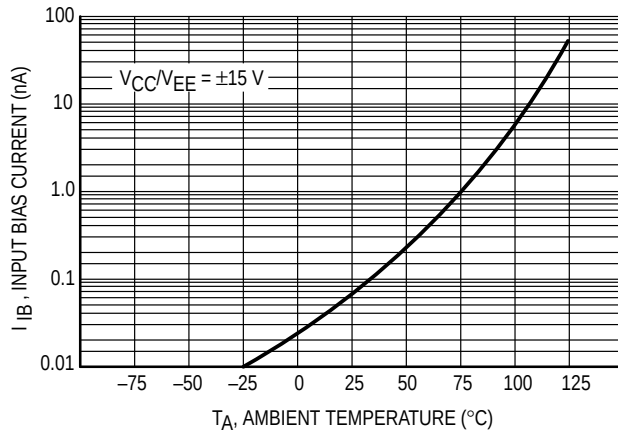


Figure 4. Output Voltage Swing versus Frequency

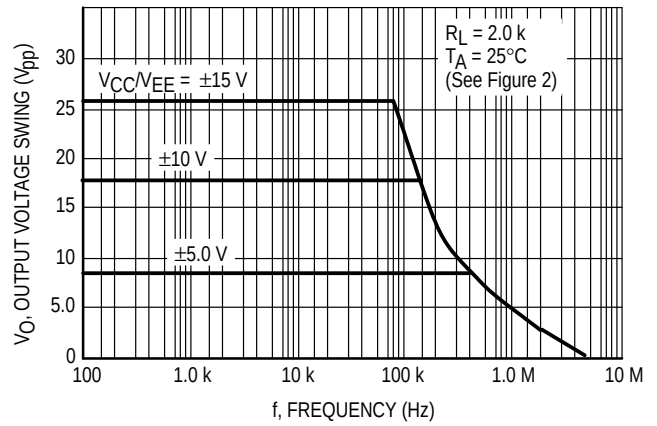


Figure 5. Output Voltage Swing versus Load Resistance

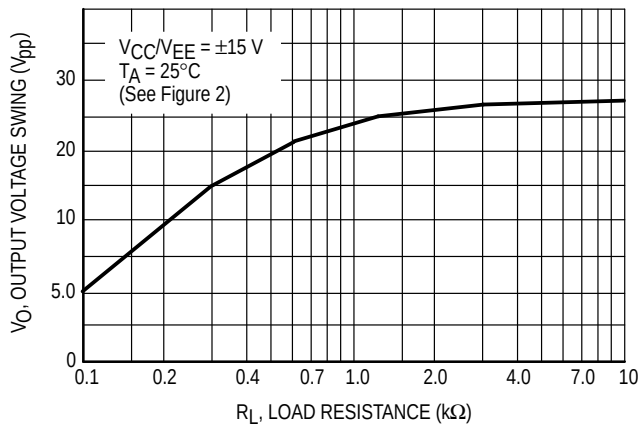


Figure 6. Output Voltage Swing versus Supply Voltage

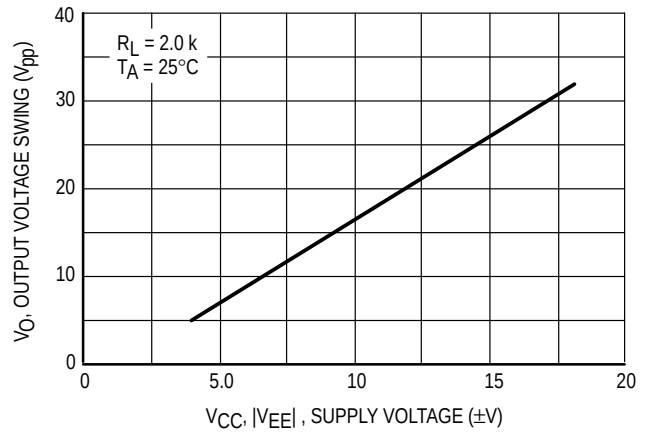


Figure 7. Output Voltage Swing versus Temperature

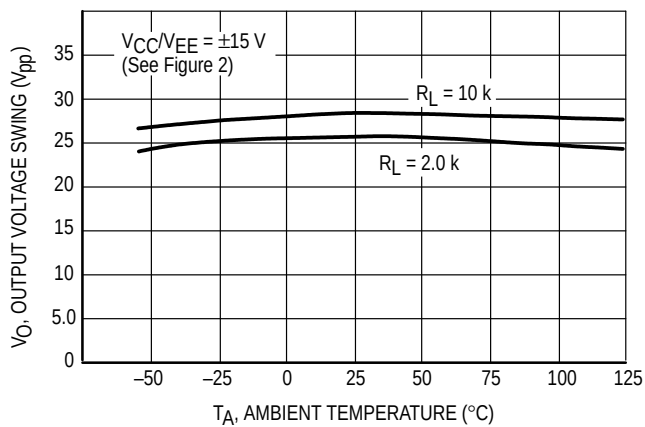


Figure 8. Supply Current per Amplifier versus Temperature

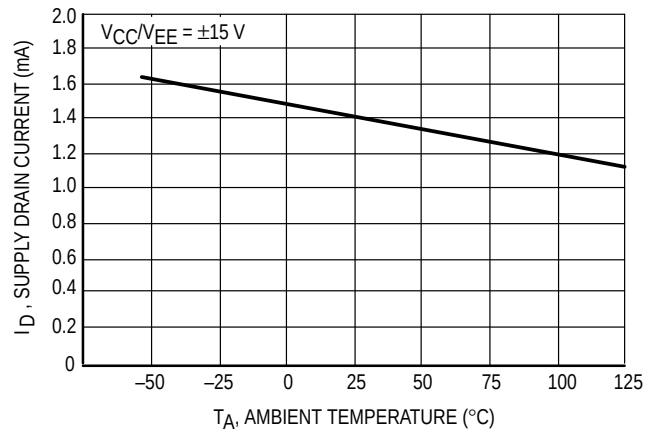


Figure 9. Large Signal Voltage Gain and Phase Shift versus Frequency

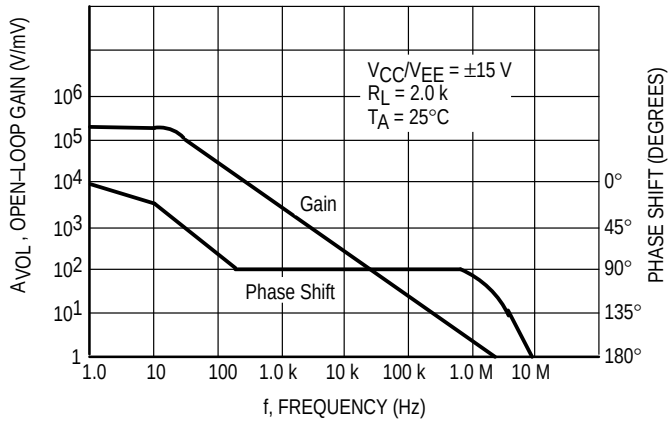


Figure 10. Large Signal Voltage Gain versus Temperature

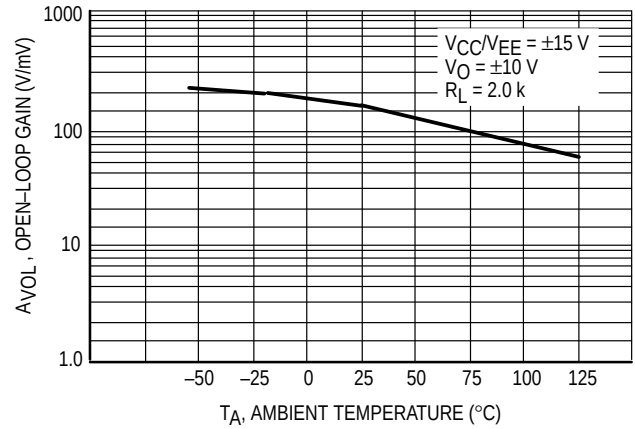


Figure 11. Normalized Slew Rate versus Temperature

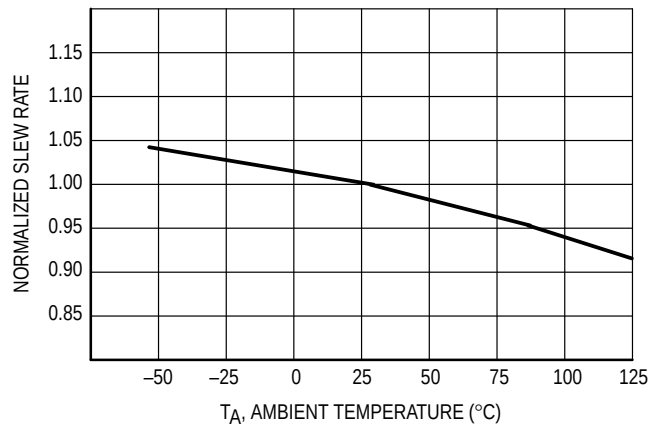


Figure 12. Equivalent Input Noise Voltage versus Frequency

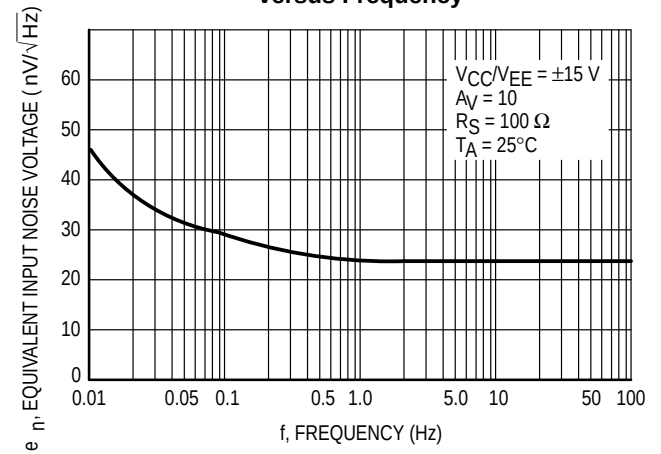


Figure 13. Total Harmonic Distortion versus Frequency

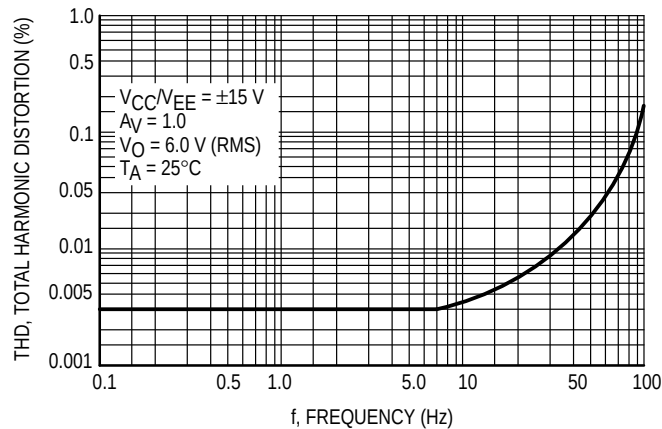


Figure 14. Positive Peak Detector

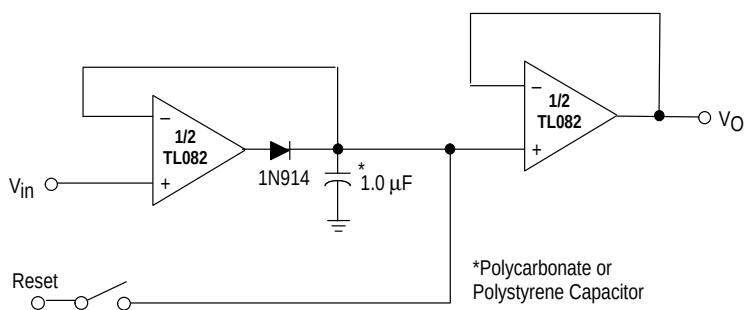


Figure 15. Voltage Controlled Current Source

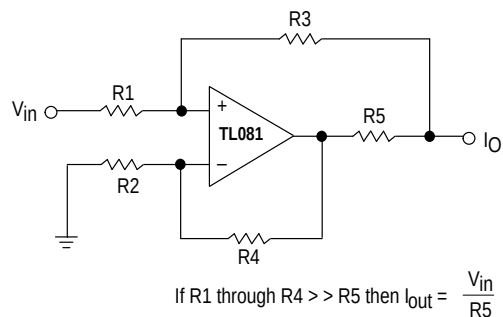
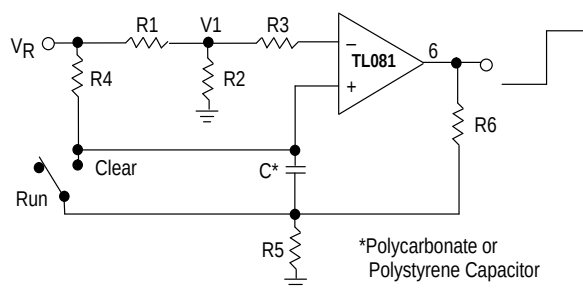


Figure 16. Long Interval RC Timer



$$\text{Time (t)} = R4 C \ln(V_R/V_R - V_I), R3 = R4, R5 = 0.1 R6$$

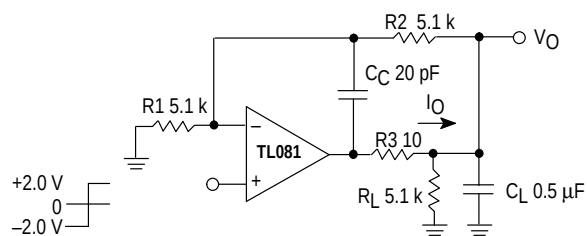
$$\text{If } R1 = R2: t = 0.693 R4 C$$

Design Example: 100 Second Timer

$$V_R = 10 \text{ V} \quad C = 1.0 \text{ mF} \quad R3 = R4 = 144 \text{ M}$$

$$R6 = 20 \text{ k} \quad R5 = 2.0 \text{ k} \quad R1 = R2 = 1.0 \text{ k}$$

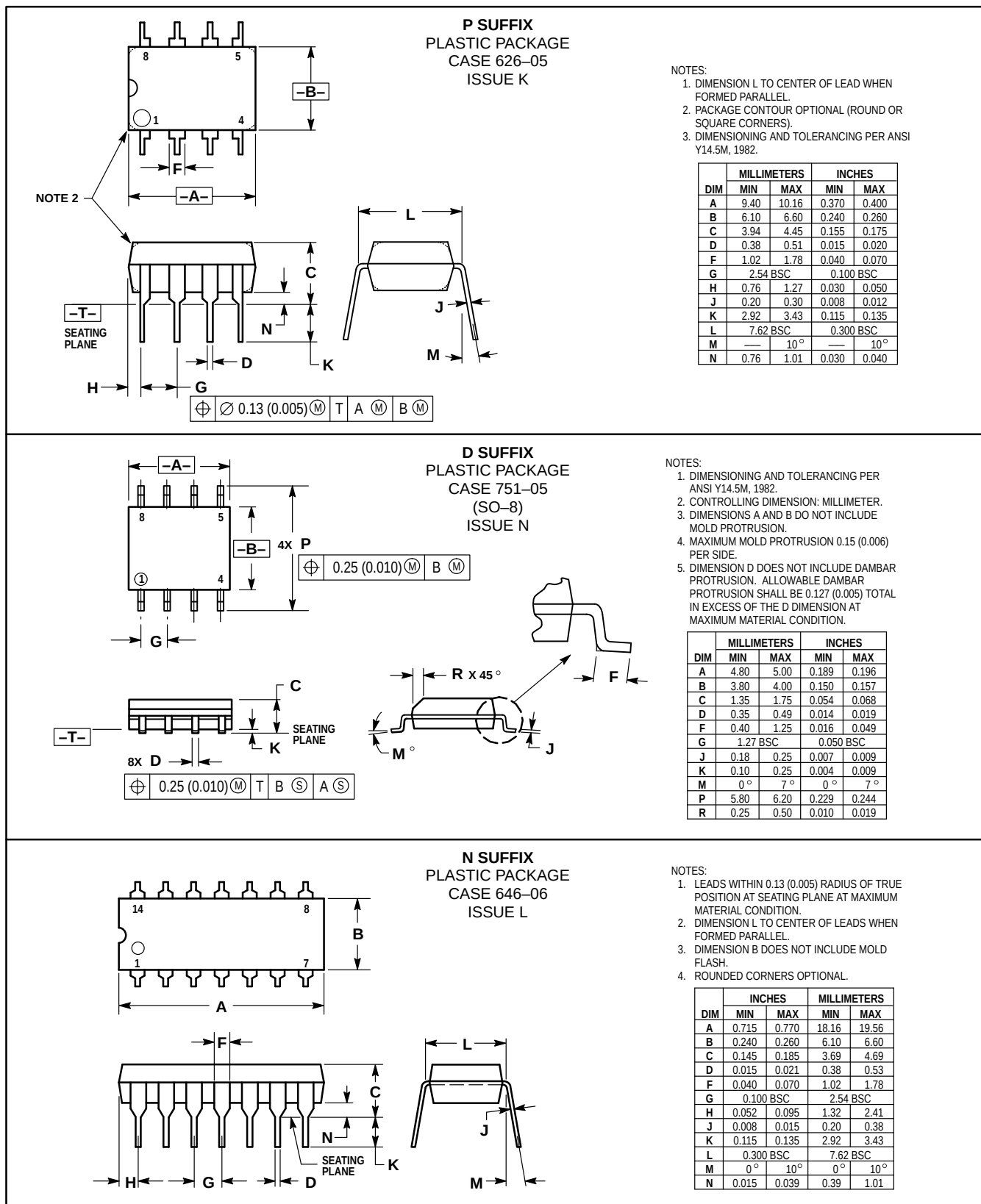
Figure 17. Isolating Large Capacitive Loads



- Overshoot < 10%
- $t_s = 10 \mu\text{s}$
- When driving large C_L , the V_O slew rate is determined by C_L and $I_O(\text{max})$:

$$\frac{\Delta V_O}{\Delta t} = \frac{I_O}{C_L} \approx \frac{0.02}{0.5} \text{ V}/\mu\text{s} = 0.04 \text{ V}/\mu\text{s} \text{ (with } C_L \text{ shown)}$$

OUTLINE DIMENSIONS



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