MOTOROLA

MC33197A

Advance Information
Automotive Wash Wiper Timer

The MC33197A is a standard wiper timer control device designed for harsh automotive applications. The device can perform the intermittent, after wash, and continuous wiper timer functions. It is designed to directly drive a wiper motor relay. The MC33197A requires very few external components for full system implementation. The intermittent control pin can be switched to ground or V_{bat} to meet a large variety of possible applications. The intermittent timing can be fixed or adjustable via an external resistor. The MC33197A is built using bipolar technology and parametrically specified over the automotive ambient temperature range and 8.0 to 16 V supply voltage. The MC33197A can operate in both front and rear wiper applications.

- Adjustable Time Interval of Less Than 500 ms to More Than 30 s
- Intermittent Control Pin Can Be Switched to Ground or V_{bat}
- Adjustable After Wipe Time
- Priority to Continuous Wipe
- Minimum Number of Timing Components
- Integrated Relay Driver With Free Wheeling Protection Diode
- Operating Voltage Range From 8.0 to 16 V
- For Front Wiper and Rear Wiper Window Applications

AUTOMOTIVE WASH WIPER TIMER

SEMICONDUCTOR
TECHNICAL DATA
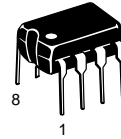
P SUFFIX
PLASTIC PACKAGE
CASE 626

D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO–8)

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC33197AD	$T_A = -40°$ to $+105°C$	SO–8
MC33197AP	$T_A = -40°$ to $+125°C$	DIP–8

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Continuous Supply Voltage ($V_{Pin\ 6}$)	V_{CC}	16	V
Storage Temperature	T_{stg}	–55 to +150	°C
Thermal Resistance (Junction–to–Ambient) DIP–8 Package SO–8 Package	$R_{\theta JA}$	 100 145	°C/W
Operating Ambient Temperature Range DIP–8 Package SO–8 Package	T_A	 –40 to +125 –40 to +105	°C
Operating Junction Temperature Range	T_J	–40 to +150	°C
Maximum Junction Temperature	$T_{J(max)}$	150	°C

NOTE: ESD data available upon request.

PIN CONNECTIONS

INT	1		8	Out
Osc2	2		7	Gnd
Osc1	3		6	V_{CC}
CONT	4		5	W/W

(Top View)

(SO–8)

Osc1	1		8	Osc2
CONT	2		7	INT
W/W	3		6	Out
V_{CC}	4		5	Gnd

(Top View)

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Rev 0

Representative Block Diagram

R1 = 220 Ω
R2 = 22 kΩ
R3 = 1.5 to 22 kΩ
R4 = 4.7 kΩ
R5 = 4.7 kΩ
C1 = 47 μF
C2 = 100 nF
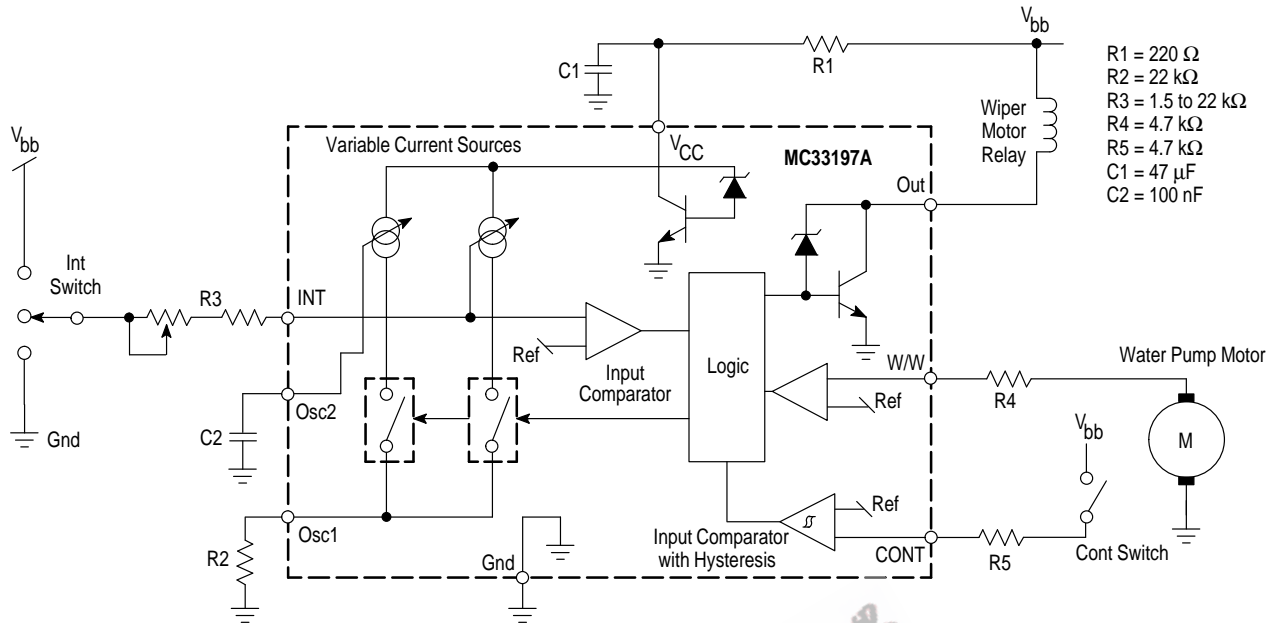
This device contains 390 active transistors.

ELECTRICAL CHARACTERISTICS ($-40°C \leq T_A \leq +125°C$, $8.0\ V \leq V_{CC} \leq 16\ V$, unless otherwise noted. Typical values reflect approximate mean at $T_A = 25°C$ with $V_{CC} = 14\ V$ at the time of initial device characterization.)

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Supply Voltage Range	V_{CCF}	8.0	–	18	V
Operating Supply Voltage Range	V_{CCOP}	8.0	–	16	V
Standby Supply Current ($V_{CC} = 16\ V$, R2 = 68 k)	I_{CC}	–	4.0	5.2	mA
Supply Current INT Active (R3 = 2.5 k)	I_{CC}	–	7.0	8.4	mA
Supply Current Relay "On" (R2 = 68 k)	I_{CC}	–	7.5	11.2	mA
Supply Current INT and Relay "On" (R2 = 68 k, R3 = 2.5 k)	I_{CC}	–	10	14.5	mA
Oscillator Variations with Supply Voltage and Temperature (excluding external component tolerances, C2 = 100 nF polyester capacitor) (Notes 1 & 2) $10\ V \leq V_{bb} \leq 16\ V$ $8.0\ V \leq V_{bb} \leq 16\ V$	K_{osc}	 – –	 10 15	 – –	%
Relay Resistance	R_L	60	–	–	Ω
Output Voltage ($I_{out} = 200\ mA$)	V_{out}	–	0.9	1.5	V
Output Clamp Voltage ($I_{out} = 20\ mA$)	V_{cl}	19.5	–	22	V
Oscillator Period Coefficient ($T_A = 25°C$) $V_{bb} = 13\ V$ (Note 3) $V_{bb} = 13\ V$ (INT Connected to Gnd) (Note 4) $V_{bb} = 13\ V$ (INT Connected to V_{bat}, R1 = 220 Ω) (Note 4)	 t_{b1} t_{b2g} t_{b2v}	 0.98 15.1 11.5	 1.0 15.5 12.1	 1.03 15.9 12.7	–
CONT Threshold ($V_{CC} = 13\ V$)	V_{ih}	6.0	–	8.5	V
CONT Threshold ($V_{CC} = 16\ V$)	V_{ih}	–	$V_{CC}/2$	–	V

NOTES: 1. The oscillator frequency is defined by the current flowing through the external resistor R2. The voltage at the INT pin is ($V_{CC}/2 - V_{be}$) and hence the current flowing through R3 is different if R3 is connected to V_{bb} or to Gnd because of the voltage drop across resistor R1. This voltage drop causes the oscillator coefficient for t_{b2} to be different for the two cases of INT terminated to Gnd or to V_{bb}. Because of this, the oscillator coefficient is specified with a specific value of R1 whenever INT is connected to V_{bb}. If R1 is changed, the coefficient will change. Also, any extra current through the resistor R1 other than the current used by the device will cause timing deviations in t_{b2} timings (as in the case where two devices are sharing a common R1 resistor).
2. The oscillator stability with temperature is dependent on the temperature coefficients of the external components. If the capacitance value of the external capacitor varies more than 5% over the parametric temperature range, the figures quoted for oscillator variation are not valid.
3. The t_{b1} duration is given by coefficient 4 x R2 x C2 (t_{b1} duration = t_{b1} x 4 x R2 x C2).
4. The t_{b2} duration is given by coefficient x R3 x C2 (t_{b2} duration = t_{b2} x R3 x C2).

MOTOROLA ANALOG IC DEVICE DATA

MC33197A

Figure 1. Intermittent Wash Wiper Typical Application
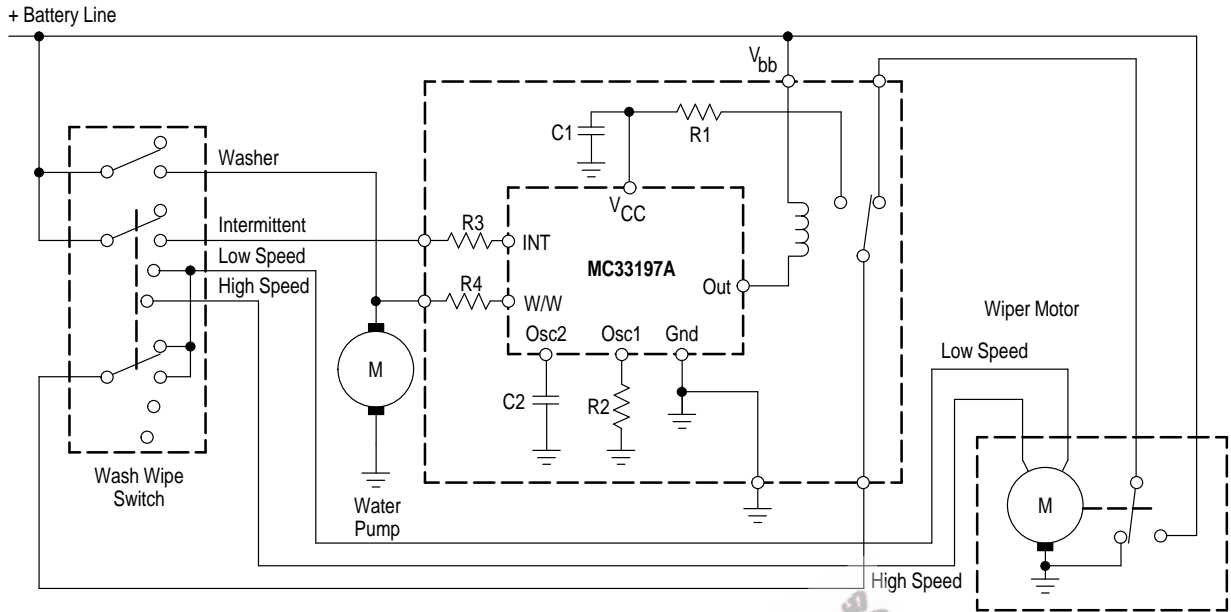
This application shows the MC33197A with the external wirings and two speed
wiper motor. This application has the Intermittent and Wash Wiper functions.

INTRODUCTION

The MC33197A is a wiper timer control device designed for use in harsh automotive applications. The device can perform the intermittent, after wash, and continuous wiper timer functions.

The MC33197A is designed to directly drive a wiper motor relay. The MC33197A is suitable for both front and rear wiper applications. The MC33197A connects directly to the vehicle's battery voltage (V_{bat}) through a 220 Ω resistor used with a 47 μF de–coupling filter capacitor. The device has an internal oscillator controlled by one of two external resistors (R2 and R3) in addition to one external capacitor (C2), dependent on the application function required. The values of C2 and R2 determine the t_{b1} time base. T_{b1} is used to generate the relay wiper activation during the INT function (T3) and the after wash timing (T2) during the wash wipe mode. The values C2 and R3 determine the t_{b2} time base. The t_{b2} time base is used to generate the pause or intermittent time (T4).

The intermittent wiper function can generate intermittent timing (T4) from less than 500 ms to more than 30 seconds. The intermittent function of the device can be activated by the INT input connected to either ground or V_{bat}. The intermittent timing is externally adjustable by changing the value of resistor R3.

The wash wiper timer function detects the water pump motor's operation. When the pump motor activation is detected, the MC33197A turns the wiper on for the entire duration of the pump motor's activation. When the motor is turned off, it generates an after wash timing (T2) to maintain the wiping action. The W/W pin is connected to the water pump motor through a protection resistor (R4).

The MC33197A also has a continuous function, which activates the wiper relay whenever the CONT input is activated. The CONT input is connected to a switch through a protection resistor (R5). The CONT input comparator has an input threshold of $V_{bb}/2$ with hysteresis.

The device has internal debounce circuitry, based on the oscillator period. This provides filtering of the intermittent (INT) and wash wipe (W/W) input signals (see T1 Debounce Timing paragraph that follows). The device directly drives the wiper motor relay. It internally incorporates a 20 V free wheeling zener diode to protect the device against overvoltage spikes produced when relay is switched off.
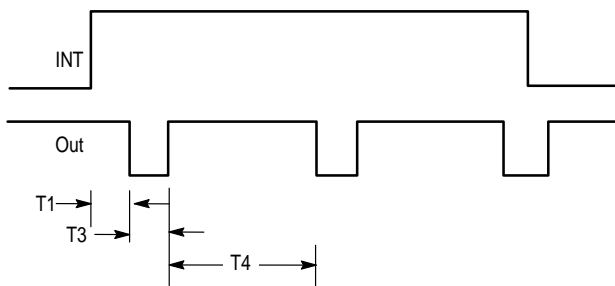
Intermittent Operation

Conditions:

- W/W not connected or connected to ground.
- CONT not connected or connected to ground.
- INT connected to V_{bb} or to ground.

In this configuration, the circuit will respond to the switching of INT to either V_{bb} or ground after a time T1 (see T1 Debounce Timing). If INT is disconnected before the end of T1; no action will be taken. After a time T1, the output will be switched on for a duration, $T3 = 16 \times 4 \times t_{b1}$ and then switched off for a duration, $T4 = 144 \times 4 \times t_{b2}$. This sequence will continue to repeat so long as INT is disconnected from V_{bb} or ground for a time duration greater than T1. If INT is disconnected during the time T3; the output will remain on for the remainder of T3. This is illustrated in the diagram on Figure 2.

Figure 2. Switching Waveform INT Timing

Wash Wipe Operation

Conditions:

- INT disconnected.
- CONT disconnected or connected to ground.

In this condition, the circuit will respond to the switching of W/W to V_{bb} after a time T1 (see T1 Debounce Timing). If W/W is disconnected or connected to ground before the end of T1; no action will be taken. After a time T1; the circuit will perform as shown on Figure 3. The output will turn on and remain on for the duration of W/W. When W/W becomes inactive, the output will remain on for $T2 = 96 \times 4 \times t_{b1}$.

Figure 3. Switching Waveform W/W Timing
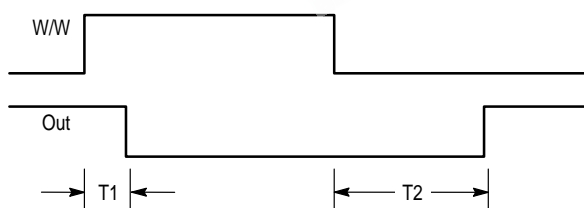
Continuous Operation

In this condition, the circuit responds to the switching of CONT to V_{bb}. If CONT is connected to V_{bb}, the output will turn on regardless of the state of any other input and remain on so long as CONT is active. This command operates directly on the relay output and does not interfere with any other timing. Therefore, the circuit will not be reset to a defined state.

Wash Wiper and Intermittent Operation

If W/W is activated during the time INT is also activated, the circuit will respond to W/W after a time T1 (see T1 Debounce Timing). The output will turn on after T1, and stay on for a time T2 + T3 after W/W is deactivated. Following this, normal operation of INT will occur. This is shown on Figure 4.

Figure 4. Switching Waveform W/W and INT Active
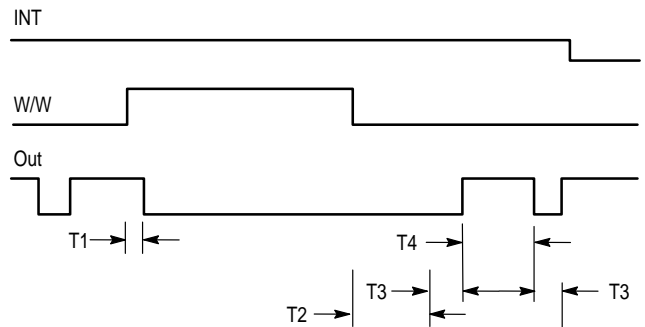
T1 Debounce Timing

The criteria for an input signal to be detected is that it should be active at two successive negative internal clock edges. The inputs are sampled on the negative edge of the internal clock. If two consecutive samples are the same, the input is detected as being in that state. Hence the time T1 from a signal becoming active to the time that the circuit responds can be anytime from $4 \times t_{b1}$ to $2 \times 4 \times t_{b1}$ (due to synchronizing the input to the oscillator period) when the oscillator is oscillating with a time base of t_{b1} and $4 \times t_{b2}$ to $2 \times 4 \times t_{b2}$, when the oscillator is oscillating with a time base of t_{b2}.

The following table summarizes all T1 debounce timings:

Condition	Debounce Time
INT Active	$4 \times t_{b1}$ to $2 \times 4 \times t_{b1}$
INT Inactive	$4 \times t_{b1}$ to $2 \times 4 \times t_{b1}$
W/W Active When INT Inactive	$4 \times t_{b1}$ to $2 \times 4 \times t_{b1}$
W/W Active When INT Active During T3	$4 \times t_{b1}$ to $2 \times 4 \times t_{b1}$
W/W Active When INT Active During T4	$4 \times t_{b2}$ to $2 \times 4 \times t_{b2}$

Two MC33197A Devices Using One Decoupling Resistor and Capacitor

Two devices may be connected to the power source using a common R1 resistor for protection against overvoltages. If this is done it should be noted that the current flowing through R1 is increased and hence the voltage drop across R1 is increased.

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Overvoltage Protection

In reference to the Block Diagram and Typical Application, all of the foregoing operational cases require:

R1 ≥ 100 Ω, C1 ≥ 47 µF

R3 ≥ 1.0 kΩ, R4 ≥ 4.7 kΩ, R5 ≥ 4.7 kΩ

The circuit will not operate during the transient conditions. By using the above component values, the circuit will be able to sustain the following overvoltages on V_{bb} without permanent damage:

1. +28 V for 5 minutes
2. –15 V for 5 minutes
3. –16 V cycled off for 1.0 minute
4. +80 V pulse decaying exponentially to 8.0 V in 400 ms repeated 3 times at 1.0 minute intervals.
5. ± 300 V pulse decaying exponentially to 30 V in 300 ms with a maximum energy of 1.0 Joule.
6. ±100 V pulse decaying exponentially to 10 V in 2 ms.

Recommended External Component Values

Below are the recommended component values to ensure the device will operate properly, and that all specified parameters will stay within their tolerances.

R1 should be greater than 100 Ω; recommended value of 220 Ω. R1 can be up to 500 Ω, but in this case the t_{b2v} parameter could be out of it's specified value (see Electrical Characteristics and Note 1). Also, the minimum operating voltage range should be greater than 8.0 V. The following values should be adhered to:

10 kΩ ≤ R2 ≤ 68 kΩ

1.5 kΩ ≤ R3 ≤ 47 kΩ

R4 ≥ 4.7 kΩ

R5 ≥ 4.7 kΩ

C1 ≥ 47 uF

47 nF ≤ C2 ≤ 470 nF

Application Information

The following is an example of timing calculations using the following external components values:

R2 = 22 kΩ, R3 = 2.2 kΩ, C2 = 100 nF (Referring to Block Diagram and Typical Application).

Oscillator Time Base Calculation:

t_{b1} duration = t_{b1} x 4 x R2 x C2 = 1 x 4 x 27e3 x 100e–9 = 10.8 ms

t_{b2} duration_g (INT to Gnd) = t_{b2g} x R3 x C2 = 15.5 x 2.2e3 x 100e–9 = 3.41 ms

t_{b2} duration_v (INT to V_{bb}) = t_{b2v} x R3 x C2 = 12.1 x 2.2e3 x 100e–9 = 2.66 ms

Intermittent timing calculation:

T3 = 16 x 4 x t_{b1} duration = 16 x 4 x 10.8 ms = 691 ms

T4 = 144 x 4 x t_{b2} duration_g = 144 x 4 x 3.41 ms = 1.96 s (INT connected to Gnd)

T4 = 144 x 4 x t_{b2} duration_v = 144 x 4 x 2.66 ms = 1.53 s (INT connected to V_{bb})

Wash wipe timing calculation:

T2 = 96 x 4 x t_{b1} = 96 x 4 x 10.8 ms = 4.15 s

T1 Debounce Time Calculation (see T1 Debounce Timing)

When oscillator is oscillating at t_{b1}:

T1 minimum = 4 x t_{b1} = 4 x 10.8 ms = 43.2 ms

T1 maximum = 2 x 4 x t_{b1} = 2 x 4 x 10.8 ms = 86.4 ms

When oscillator is oscillating at t_{b2}:

T1 minimum (INT connected to Gnd, t_{b2g}) = 4 x t_{b2} = 4 x 3.41 ms = 13.6 ms

T1 maximum (INT connected to Gnd, t_{b2g}) = 2 x 4 x t_{b2} = 2 x 4 x 3.41 ms = 27.3 ms

MC33197A

OUTLINE DIMENSIONS

P SUFFIX
PLASTIC PACKAGE
CASE 626–05
ISSUE K
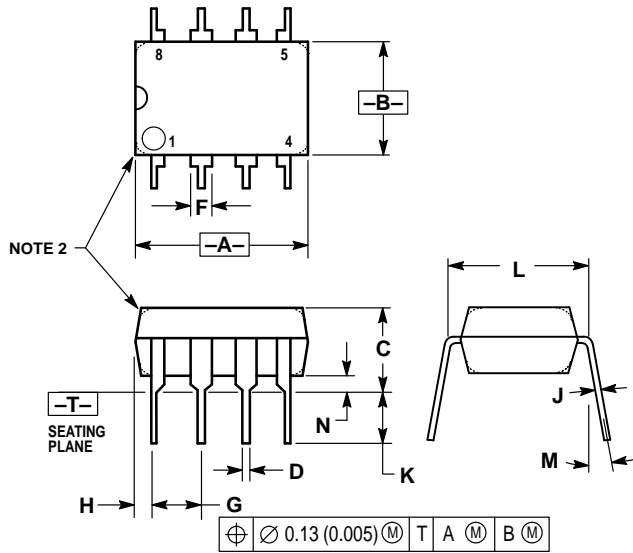
NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

NOTE 2

–T–
SEATING PLANE

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	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	1.78	0.040	0.070
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	7.62 BSC		0.300 BSC	
M	—	10°	—	10°
N	0.76	1.01	0.030	0.040

STYLE 1:
PIN 1. AC IN
2. DC + IN
3. DC – IN
4. AC IN
5. GROUND
6. OUTPUT
7. AUXILIARY
8. V_{CC}

⊕ | ∅ 0.13 (0.005) Ⓜ | T | A Ⓜ | B Ⓜ

D SUFFIX
PLASTIC PACKAGE
CASE 751–05
(SO–8)
ISSUE N
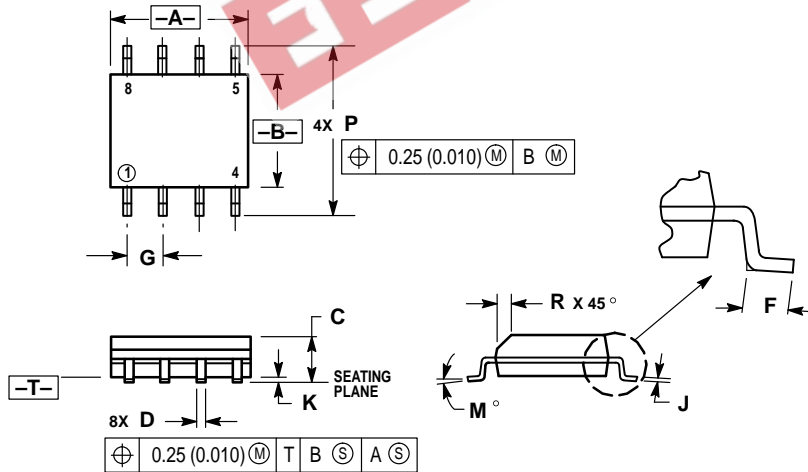
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

4X P

⊕ | 0.25 (0.010) Ⓜ | B Ⓜ

–T–
SEATING PLANE

8X D

R X 45°

M°

⊕ | 0.25 (0.010) Ⓜ | T | B Ⓢ | A Ⓢ

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.18	0.25	0.007	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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MC33197A/D