



# **MC34023, MC33023**

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## **High Speed Single-Ended PWM Controller**

The MC34023 series are high speed, fixed frequency, single-ended pulse width modulator controllers optimized for high frequency

# MC34023, MC33023

## ORDERING INFORMATION

Device	Package	Shipping†
MC33023DWG	SOIC-16W (Pb-Free)	47 Units / Rail
MC33023DWR2G	SOIC-16W (Pb-Free)	1000 Units / Reel
MC34023PG	PDIP-16 (Pb-Free)	25 Units / Rail

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	30	V
Output Driver Supply Voltage	$V_C$	20	V
Output Current, Source or Sink (Note 1)	$I_O$		A
DC		0.5	
Pulsed (0.5 $\mu$ s)		2.0	
Current Sense, Soft-Start, Ramp, and Error Amp Inputs	$V_{in}$	-0.3 to +7.0	V
Error Amp Output and Soft-Start Sink Current	$I_O$	10	mA
Clock and $R_T$ Output Current	$I_{CO}$	5.0	mA
Power Dissipation and Thermal Characteristics			
SO-16L Package (Case 751G)			
Maximum Power Dissipation @ $T_A = +25^\circ\text{C}$	$P_D$	862	mW
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	145	$^\circ\text{C/W}$
DIP Package (Case 648)			
Maximum Power Dissipation @ $T_A = +25^\circ\text{C}$	$P_D$	1.25	W
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	100	$^\circ\text{C/W}$
Operating Junction Temperature	$T_J$	+150	$^\circ\text{C}$
Operating Ambient Temperature (Note 2)	$T_A$		$^\circ\text{C}$
MC34023		0 to +70	
MC33023		-40 to +105	
Storage Temperature Range	$T_{stg}$	-55 to +150	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 15\text{ V}$ ,  $R_T = 3.65\text{ k}\Omega$ ,  $C_T = 1.0\text{ nF}$ , for typical values  $T_A = +25^\circ\text{C}$ , for min/max values  $T_A$  is the operating ambient temperature range that applies [Note 2], unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>REFERENCE SECTION</b>					
Reference Output Voltage ( $I_O = 1.0\text{ mA}$ , $T_J = +25^\circ\text{C}$ )	$V_{ref}$	5.05	5.1	5.15	V
Line Regulation ( $V_{CC} = 10\text{ V to }30\text{ V}$ )	$Reg_{line}$	–	2.0	15	mV
Load Regulation ( $I_O = 1.0\text{ mA to }10\text{ mA}$ )	$Reg_{load}$	–	2.0	15	mV
Temperature Stability	$T_S$	–	0.2	–	mV/ $^\circ\text{C}$
Total Output Variation over Line, Load, and Temperature	$V_{ref}$	4.95	–	5.25	V
Output Noise Voltage ( $f = 10\text{ Hz to }10\text{ kHz}$ , $T_J = +25^\circ\text{C}$ )	$V_n$	–	50	–	

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Characteristic	Symbol	Min	Typ	Max	Unit
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## CURRENT SENSE SECTION

Input Bias Current (Pin 9(12) = 0 V to 4.0 V)	$I_{IB}$	–	–	15	$\mu\text{A}$
Current Limit Comparator Input Offset Voltage (Pin 11(14) = 1.1 V)	$V_{IO}$	–	–	45	mV
Current Limit Reference Input Common Mode Range (Pin 11(14)) $T_J = +25^\circ\text{C}$	$V_{CMR}$	1.0	–	3.0	V
Shutdown Comparator Threshold	$V_{th}$	1.25	1.40	1.55	V
Propagation Delay (Current Limit/Shutdown to Output, $T_J = +25^\circ\text{C}$ )	$t_{PLH(in/out)}$	–	50	80	ns

## OUTPUT SECTION

Output Voltage					V
Low State ( $I_{SINK} = 20\text{ mA}$ )	$V_{OL}$	–	0.25	0.4	
( $I_{SINK} = 200\text{ mA}$ )		–	1.2	2.2	
High State ( $I_{SOURCE} = 20\text{ mA}$ )	$V_{OH}$	13	13.5	–	
( $I_{SOURCE} = 200\text{ mA}$ )		12	13	–	
Output Voltage with UVLO Activated ( $V_{CC} = 6.0\text{ V}$ , $I_{SINK} = 0.5\text{ mA}$ )	$V_{OL(UVLO)}$	–	0.25	1.0	V
Output Leakage Current ( $V_C = 20\text{ V}$ )	$I_L$	–	100	500	$\mu\text{A}$
Output Voltage Rise Time ( $C_L = 1.0\text{ nF}$ , $T_J = +25^\circ\text{C}$ )	$t_r$	–	30	60	ns
Output Voltage Fall Time ( $C_L = 1.0\text{ nF}$ , $T_J = +25^\circ\text{C}$ )	$t_f$	–	30	60	ns

## UNDERVOLTAGE LOCKOUT SECTION

Startup Threshold ( $V_{CC}$ Increasing)	$V_{th(on)}$	8.8	9.2	9.6	V
UVLO Hysteresis Voltage ( $V_{CC}$ Decreasing After Turn-On)	$V_H$	0.4	0.8	1.2	V

## TOTAL DEVICE

Power Supply Current	$I_{CC}$				mA
Startup ( $V_{CC} = 8.0\text{ V}$ )		–	0.5	1.2	
Operating		–	20	30	

3. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.

$T_{low} = 0^\circ\text{C}$  for MC34023

$T_{high} = +70^\circ\text{C}$  for MC34023

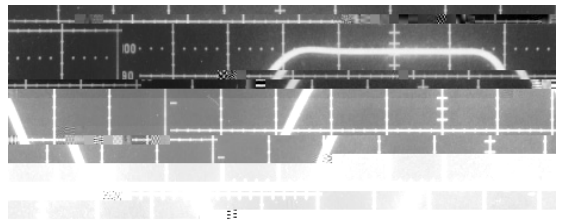
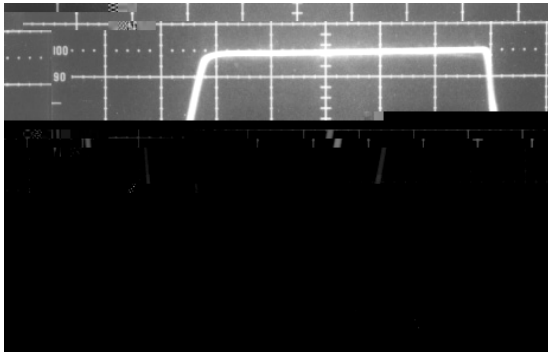
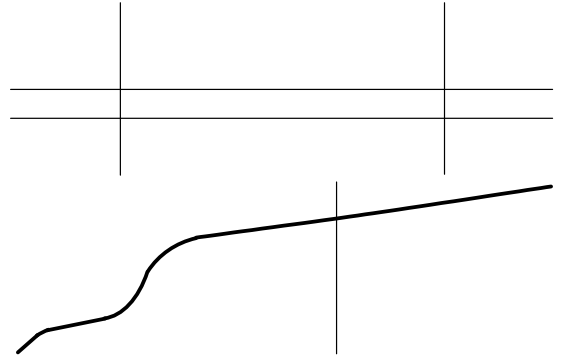
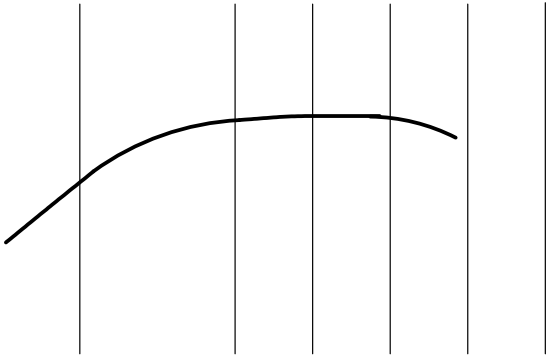
=  $-40^\circ\text{C}$  for MC33023

=  $+105^\circ\text{C}$  for MC33023

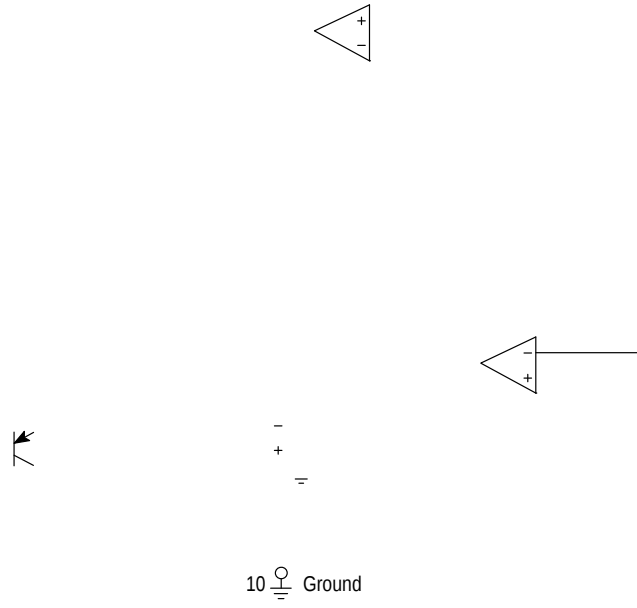




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## OPERATING DESCRIPTION

The MC33023 and MC34023 series are high speed, fixed frequency, single-ended pulse width modulator controllers optimized for high frequency operation. They are specifically designed for Off-Line and DC-to-DC converter applications offering the designer a cost effective solution with minimal external components. A representative block diagram is shown in Figure 19.

### Oscillator

The oscillator frequency is programmed by the values selected for the timing components  $R_T$  and  $C_T$ . The  $R_T$  pin is set to a temperature compensated 3.0 V. By selecting the value of  $R_T$ , the charge current is set through a current mirror for the timing capacitor  $C_T$ . This charge current runs continuously through  $C_T$ . The discharge current is ratioed to be 10 times the charge current, which yields the maximum duty cycle of 90%.  $C_T$  is charged to 2.8 V and discharged to 1.0 V. During the discharge of  $C_T$ , the oscillator generates an internal blanking pulse that resets the PWM Latch and, inhibits the outputs. The threshold voltage on the oscillator



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## PIN FUNCTION DESCRIPTION

Pin	Function	Description
1	Error Amp Inverting Input	This pin is usually used for feedback from the output of the power supply.
2	Error Amp Noninverting Input	This pin is used to provide a reference in which an error signal can be produced on the output of the error amp. Usually this is connected to $V_{ref}$ , however an external reference can also be used.
3	Error Amp Output	This pin is provided for compensating the error amp for poles and zeros encountered in the power supply system, mostly the output LC filter.
4	Clock	This is a bidirectional pin used for synchronization.
5	$R_T$	The value of $R_T$ sets the charge current through timing Capacitor, $C_T$ .
6	$C_T$	In conjunction with $R_T$ , the timing Capacitor sets the switching frequency.
7	Ramp Input	For voltage mode operation this pin is connected to $C_T$ . For current mode operation this pin is connected through a filter to the current sensing element.
8	Soft-Start	A capacitor at this pin sets the Soft-Start time.
9	Current Limit/Shutdown	This pin has two functions. First, it provides cycle-by-cycle current limiting. Second, if the current is excessive, this pin will reinitiate a Soft-Start cycle.
10	Ground	This pin is the ground for the control circuitry.
11	Current Limit Reference Input	This pin voltage sets the threshold for cycle-by-cycle current limiting.

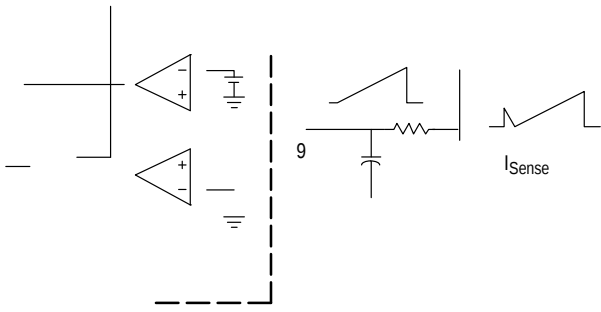
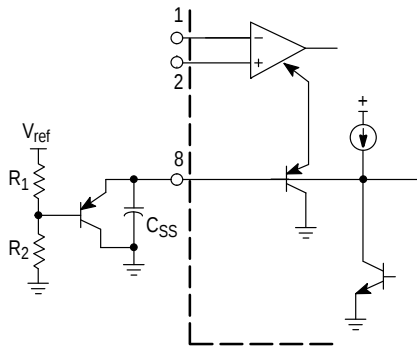


Figure 24. Resistive Current Sensing

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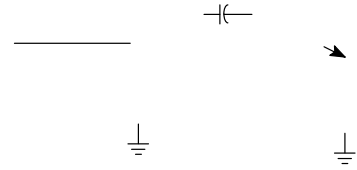


In voltage mode operation, the maximum duty cycle can be clamped. By the addition of a PNP transistor to buffer the clamp voltage, the Soft-Start current is not affected by  $R_1$ .

The new equation for Soft-Start is 
$$t \approx \frac{V_{\text{clamp}} + 0.6}{9.0 \mu\text{A}} (C_{\text{SS}})$$

In current mode operation, this circuit will limit the maximum voltage allowed at the ramp input to end a cycle.

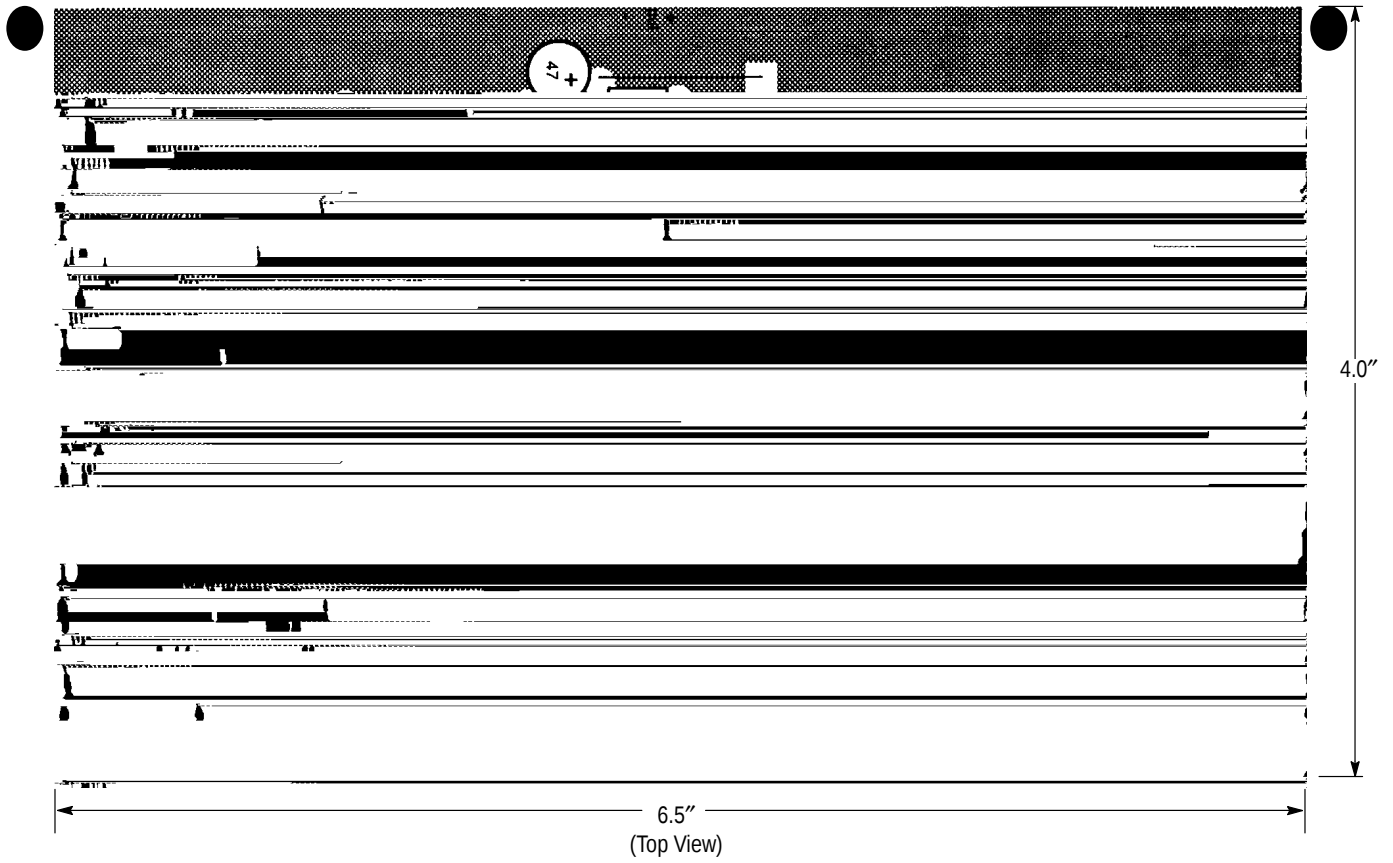
**Figure 31. Buffered Maximum Clamp Level**

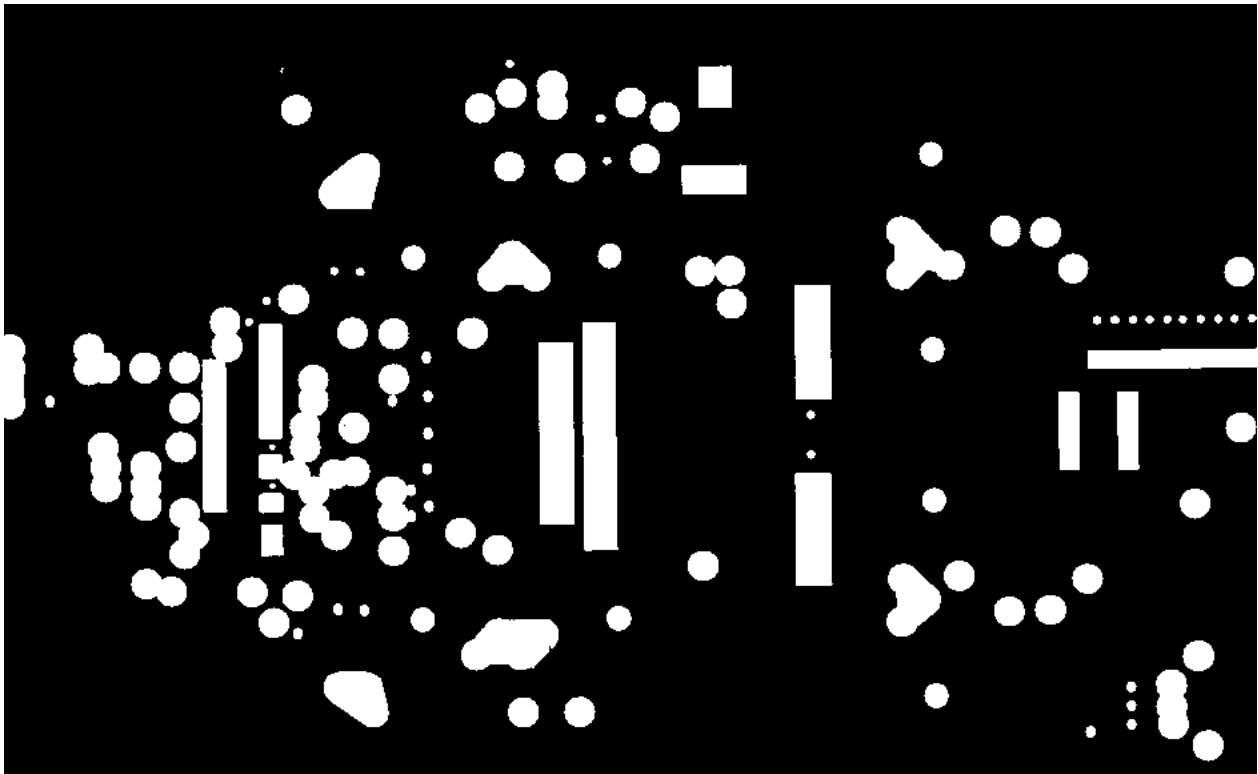




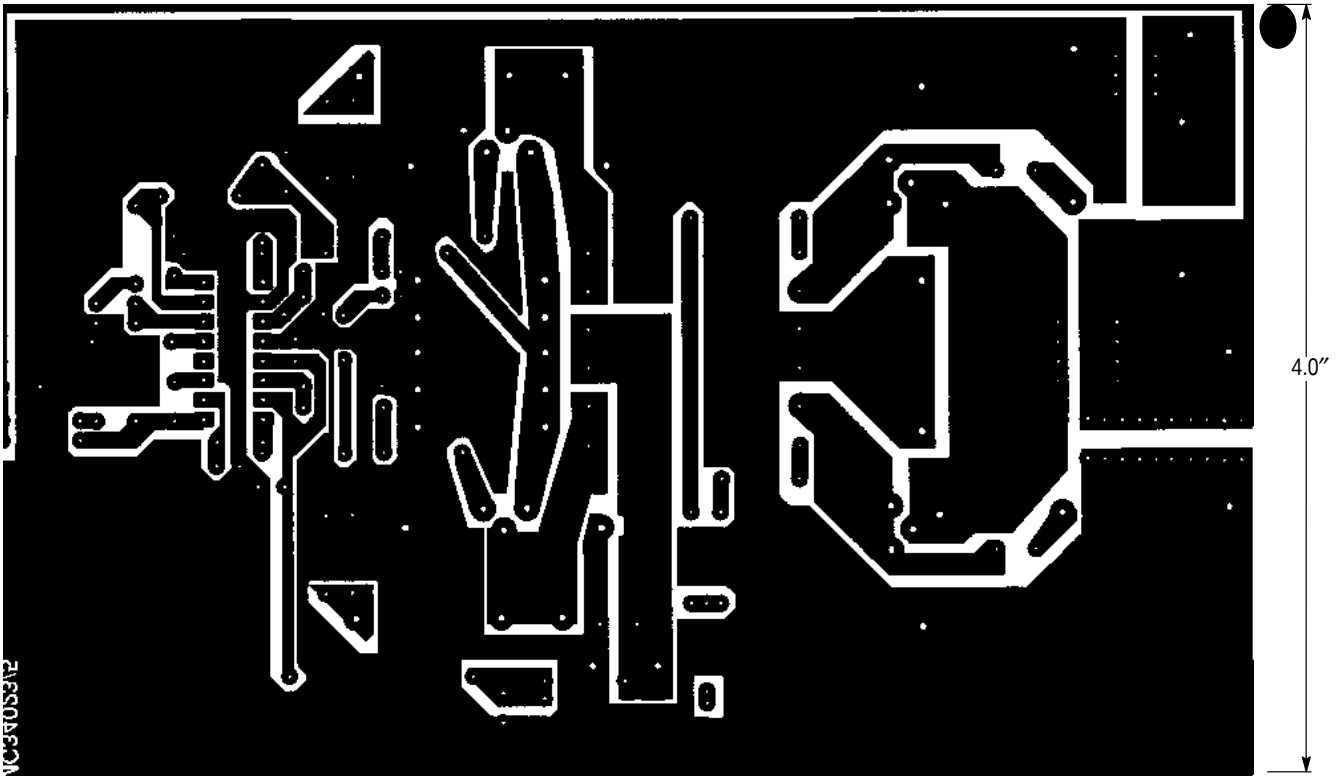


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(Top View)



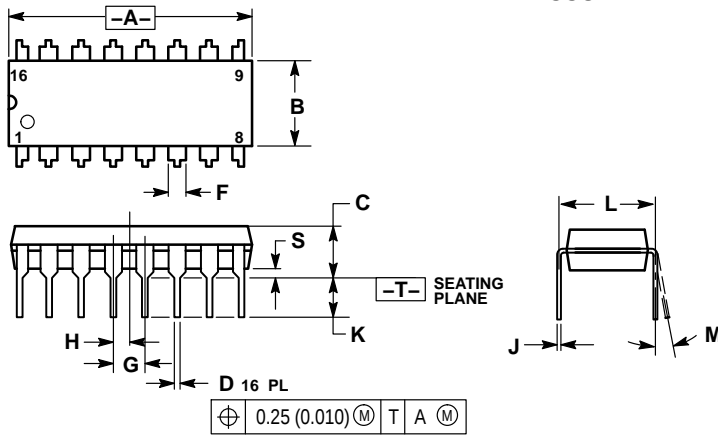
6.5"  
(Bottom View)

Figure 37. PC Board Without Components

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## PACKAGE DIMENSIONS

**PDIP-16**  
**P SUFFIX**  
 CASE 648-08  
 ISSUE T



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

**SOIC-16W**  
**DW SUFFIX**  
 CASE 751G-03  
 ISSUE C

