



# LM2931 Series

## Low Dropout Voltage Regulators

The LM2931 series consists of positive fixed and adjustable output voltage regulators that are specifically designed to maintain proper regulation with an extremely low input-to-output voltage differential. These devices are capable of supplying output currents in excess of 100 mA and feature a low bias current of 0.4 mA at 10 mA output.

Designed primarily to survive in the harsh automotive environment, these devices will protect all external load circuitry from input fault conditions caused by reverse battery connection, two battery jump starts, and excessive line transients during load dump. This series also includes internal current limiting, thermal shutdown, and additionally, is able to withstand temporary power-up with mirror-image insertion.

Due to the low dropout voltage and bias current specifications, the LM2931 series is ideally suited for battery powered industrial and consumer equipment where an extension of useful battery life is desirable. The 'C' suffix adjustable output regulators feature an output inhibit pin which is extremely useful in microprocessor-based systems.

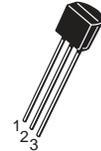
- Input-to-Output Voltage Differential of  $< 0.6\text{ V @ }100\text{ mA}$
- Output Current in Excess of 100 mA
- Low Bias Current
- 60 V Load Dump Protection
- -50 V Reverse Transient Protection
- Internal Current Limiting with Thermal Shutdown
- Temporary Mirror-Image Protection
- Ideally Suited for Battery Powered Equipment
- Economical 5-Lead TO-220 Package with Two Optional Leadforms
- Available in Surface Mount SOP-8, D<sup>2</sup>PAK and DPAK Packages

(See Following Page for Ordering Information.)

### LOW DROPOUT VOLTAGE REGULATORS

#### FIXED OUTPUT VOLTAGE

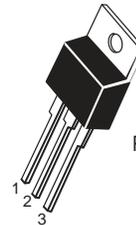
**Z SUFFIX**  
PLASTIC PACKAGE  
CASE 29



Pin 1. Output  
2. Ground  
3. Input

**T SUFFIX**  
PLASTIC PACKAGE  
CASE 221A

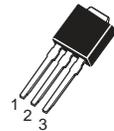
Heatsink surface  
connected to Pin 2.



Pin 1. Input  
2. Ground  
3. Output

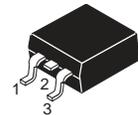


**DT SUFFIX**  
PLASTIC PACKAGE  
CASE 369A  
(DPAK)

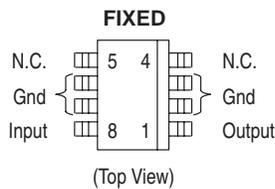


**DT-1 SUFFIX**  
PLASTIC PACKAGE  
CASE 369  
(DPAK)

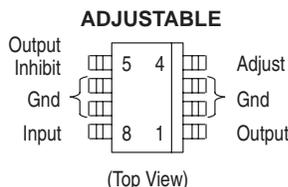
**D2T SUFFIX**  
PLASTIC PACKAGE  
CASE 936  
(D<sup>2</sup>PAK)



Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.

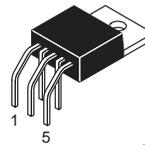


**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751  
(SOP-8)



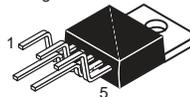
#### ADJUSTABLE OUTPUT VOLTAGE

**TH SUFFIX**  
PLASTIC PACKAGE  
CASE 314A

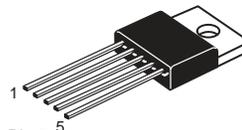


Pin 1. Adjust  
2. Output Inhibit  
3. Ground  
4. Input  
5. Output

**TV SUFFIX**  
PLASTIC PACKAGE  
CASE 314B



**T SUFFIX**  
PLASTIC PACKAGE  
CASE 314D



Heatsink surface connected to Pin 3.

**D2T SUFFIX**  
PLASTIC PACKAGE  
CASE 936A  
(D<sup>2</sup>PAK)

Heatsink surface (shown as terminal 6 in case outline drawing) is connected to Pin 3.

# LM2931 Series

## ORDERING INFORMATION

Device	Output		Case	Package	
	Voltage	Tolerance			
LM2931AD-5.0	5.0 V	± 3.8%	751	SOP-8 Surface Mount	
LM2931ADT-5.0			369A	Surface Mount DPAK	
LM2931ADT-1-5.0			369	DPAK	
LM2931AD2T-5.0			936	Surface Mount D <sup>2</sup> PAK	
LM2931AT-5.0			221A	TO-220 Type	
LM2931AZ-5.0			29	TO-92 Type	
LM2931D-5.0		± 5.0%	751	SOP-8 Surface Mount	
LM2931D2T-5.0			936	Surface Mount D <sup>2</sup> PAK	
LM2931DT-5.0			369A	Surface Mount DPAK	
LM2931DT-1-5.0			369	DPAK	
LM2931T-5.0			221A	TO-220 Type	
LM2931Z-5.0			29	TO-92 Type	
LM2931CD			Adjustable	751	SOP-8 Surface Mount
LM2931CD2T				936A	Surface Mount D <sup>2</sup> PAK
LM2931CT	314D			5-Pin TO-220 Type	
LM2931CTH	314A			5-Pin Horizontal Leadform	
LM2931CTV	314B	5-Pin Vertical Leadform			

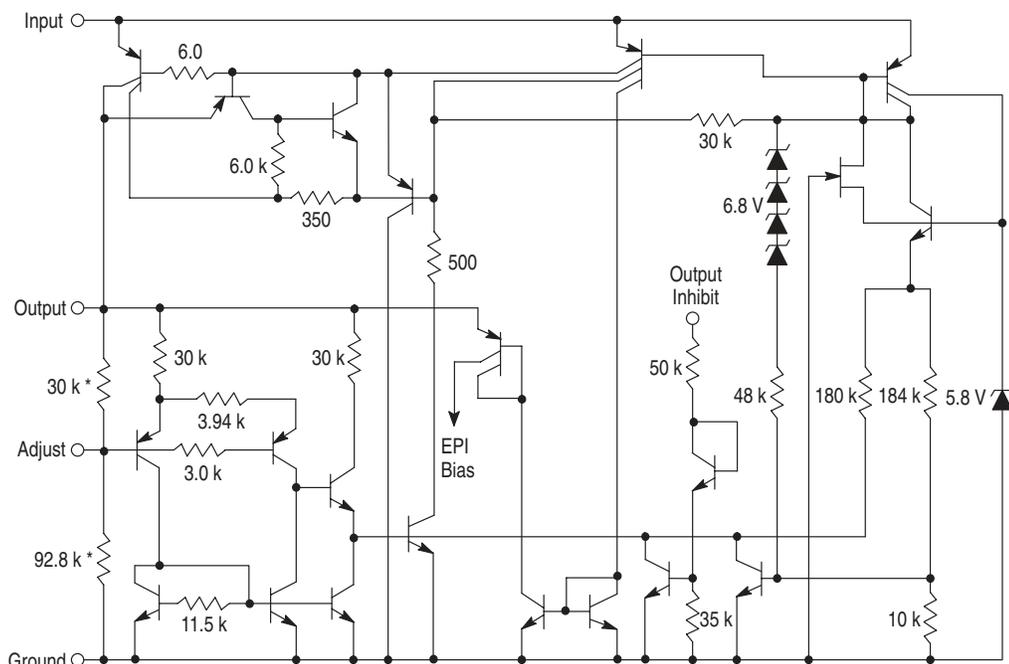
## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage Continuous	$V_I$	40	Vdc
Transient Input Voltage ( $\tau \leq 100$ ms)	$V_I(\tau)$	60	Vpk
Transient Reverse Polarity Input Voltage 1.0% Duty Cycle, $\tau \leq 100$ ms	$-V_I(\tau)$	-50	Vpk
Power Dissipation Case 29 (TO-92 Type) $T_A = 25^\circ\text{C}$ Thermal Resistance, Junction-to-Ambient Thermal Resistance, Junction-to-Case	$P_D$ $R_{\theta JA}$ $R_{\theta JC}$	Internally Limited 178 83	W $^\circ\text{C/W}$ $^\circ\text{C/W}$
Case 221A, 314A, 314B and 314D (TO-220 Type) $T_A = 25^\circ\text{C}$ Thermal Resistance, Junction-to-Ambient Thermal Resistance, Junction-to-Case	$P_D$ $R_{\theta JA}$ $R_{\theta JC}$	Internally Limited 65 5.0	W $^\circ\text{C/W}$ $^\circ\text{C/W}$
Case 369 and 369A (DPAK) [Note 1] $T_A = 25^\circ\text{C}$ Thermal Resistance, Junction-to-Ambient Thermal Resistance, Junction-to-Case	$P_D$ $R_{\theta JA}$ $R_{\theta JC}$	Internally Limited 92 6.0	W $^\circ\text{C/W}$ $^\circ\text{C/W}$
Case 751 (SOP-8) [Note 2] $T_A = 25^\circ\text{C}$ Thermal Resistance, Junction-to-Ambient Thermal Resistance, Junction-to-Case	$P_D$ $R_{\theta JA}$ $R_{\theta JC}$	Internally Limited 160 25	W $^\circ\text{C/W}$ $^\circ\text{C/W}$
Case 936 and 936A (D <sup>2</sup> PAK) [Note 3] $T_A = 25^\circ\text{C}$ Thermal Resistance, Junction-to-Ambient Thermal Resistance, Junction-to-Case	$P_D$ $R_{\theta JA}$ $R_{\theta JC}$	Internally Limited 70 5.0	W $^\circ\text{C/W}$ $^\circ\text{C/W}$
Tested Operating Junction Temperature Range	$T_J$	-40 to +125	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$

- NOTES:**
1. DPAK Junction-to-Ambient Thermal Resistance is for vertical mounting. Refer to Figure 23 for board mounted Thermal Resistance.
  2. SOP-8 Junction-to-Ambient Thermal Resistance is for minimum recommended pad size. Refer to Figure 23 for Thermal Resistance variation versus pad size.
  3. D<sup>2</sup>PAK Junction-to-Ambient Thermal Resistance is for vertical mounting. Refer to Figure 25 for board mounted Thermal Resistance.

# LM2931 Series

## Representative Schematic Diagram



\*Deleted on Adjustable Regulators

This device contains 26 active transistors.

### ELECTRICAL CHARACTERISTICS ( $V_{in} = 14\text{ V}$ , $I_O = 10\text{ mA}$ , $C_O = 100\text{ }\mu\text{F}$ , $C_{O(ESR)} = 0.3\text{ }\Omega$ , $T_J = 25^\circ\text{C}$ [Note 4].)

Characteristic	Symbol	LM2931-5.0			LM2931A-5.0			Unit
		Min	Typ	Max	Min	Typ	Max	
<b>FIXED OUTPUT</b>								
Output Voltage $V_{in} = 14\text{ V}$ , $I_O = 10\text{ mA}$ , $T_J = 25^\circ\text{C}$ $V_{in} = 6.0\text{ V to } 26\text{ V}$ , $I_O \leq 100\text{ mA}$ , $T_J = -40^\circ\text{ to } +125^\circ\text{C}$	$V_O$	4.75 4.50	5.0 -	5.25 5.50	4.81 4.75	5.0 -	5.19 5.25	V
Line Regulation $V_{in} = 9.0\text{ V to } 16\text{ V}$ $V_{in} = 6.0\text{ V to } 26\text{ V}$	$\text{Reg}_{\text{line}}$	- -	2.0 4.0	10 30	- -	2.0 4.0	10 30	mV
Load Regulation ( $I_O = 5.0\text{ mA to } 100\text{ mA}$ )	$\text{Reg}_{\text{load}}$	-	14	50	-	14	50	mV
Output Impedance $I_O = 10\text{ mA}$ , $\Delta I_O = 1.0\text{ mA}$ , $f = 100\text{ Hz to } 10\text{ kHz}$	$Z_O$	-	200	-	-	200	-	$\text{m}\Omega$
Bias Current $V_{in} = 14\text{ V}$ , $I_O = 100\text{ mA}$ , $T_J = 25^\circ\text{C}$ $V_{in} = 6.0\text{ V to } 26\text{ V}$ , $I_O = 10\text{ mA}$ , $T_J = -40^\circ\text{ to } +125^\circ\text{C}$	$I_B$	- -	5.8 0.4	30 1.0	- -	5.8 0.4	30 1.0	mA
Output Noise Voltage ( $f = 10\text{ Hz to } 100\text{ kHz}$ )	$V_n$	-	700	-	-	700	-	$\mu\text{Vrms}$
Long Term Stability	S	-	20	-	-	20	-	mV/kHR
Ripple Rejection ( $f = 120\text{ Hz}$ )	RR	60	90	-	60	90	-	dB
Dropout Voltage $I_O = 10\text{ mA}$ $I_O = 100\text{ mA}$	$V_I - V_O$	- -	0.015 0.16	0.2 0.6	- -	0.015 0.16	0.2 0.6	V
Over-Voltage Shutdown Threshold	$V_{\text{th(OV)}}$	26	29.5	40	26	29.5	40	V
Output Voltage with Reverse Polarity Input ( $V_{in} = -15\text{ V}$ )	$-V_O$	-0.3	0	-	-0.3	0	-	V

**NOTE:** 4. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.

## LM2931 Series

**ELECTRICAL CHARACTERISTICS** ( $V_{in} = 14\text{ V}$ ,  $V_O = 3.0\text{ V}$ ,  $I_O = 10\text{ mA}$ ,  $R_1 = 27\text{ k}$ ,  $C_O = 100\text{ }\mu\text{F}$ ,  $C_O(\text{ESR}) = 0.3\text{ }\Omega$ ,  $T_J = 25^\circ\text{C}$  [Note 4].)

Characteristic	Symbol	LM2931C			Unit
		Min	Typ	Max	
<b>ADJUSTABLE OUTPUT</b>					
Reference Voltage (Note 5, Figure 18) $I_O = 10\text{ mA}$ , $T_J = 25^\circ\text{C}$ $I_O \leq 100\text{ mA}$ , $T_J = -40\text{ to }+125^\circ\text{C}$	$V_{ref}$	1.14 1.08	1.20 –	1.26 1.32	V
Output Voltage Range	$V_O$ range	3.0 to 24	2.7 to 29.5	–	V
Line Regulation ( $V_{in} = V_O + 0.6\text{ V to }26\text{ V}$ )	$Reg_{line}$	–	0.2	1.5	mV/V
Load Regulation ( $I_O = 5.0\text{ mA to }100\text{ mA}$ )	$Reg_{load}$	–	0.3	1.0	%/V
Output Impedance $I_O = 10\text{ mA}$ , $\Delta I_O = 1.0\text{ mA}$ , $f = 10\text{ Hz to }10\text{ kHz}$	$Z_O$	–	40	–	$\text{m}\Omega/\text{V}$
Bias Current $I_O = 100\text{ mA}$ $I_O = 10\text{ mA}$ Output Inhibited ( $V_{th(OI)} = 2.5\text{ V}$ )	$I_B$	– – –	6.0 0.4 0.2	– 1.0 1.0	mA
Adjustment Pin Current	$I_{Adj}$	–	0.2	–	$\mu\text{A}$
Output Noise Voltage ( $f = 10\text{ Hz to }100\text{ kHz}$ )	$V_n$	–	140	–	$\mu\text{V}_{rms}/\text{V}$
Long-Term Stability	S	–	0.4	–	%/kHR
Ripple Rejection ( $f = 120\text{ Hz}$ )	RR	0.10	0.003	–	%/V
Dropout Voltage $I_O = 10\text{ mA}$ $I_O = 100\text{ mA}$	$V_I - V_O$	– –	0.015 0.16	0.2 0.6	V
Over-Voltage Shutdown Threshold	$V_{th(OV)}$	26	29.5	40	V
Output Voltage with Reverse Polarity Input ( $V_{in} = -15\text{ V}$ )	$-V_O$	-0.3	0	–	V
Output Inhibit Threshold Voltages Output "On": $T_J = 25^\circ\text{C}$ $T_J = -40^\circ\text{ to }+125^\circ\text{C}$ Output "Off": $T_J = 25^\circ\text{C}$ $T_J = -40^\circ\text{ to }+125^\circ\text{C}$	$V_{th(OI)}$	– – 2.50 3.25	2.15 – 2.26 –	1.90 1.20 – –	V
Output Inhibit Threshold Current ( $V_{th(OI)} = 2.5\text{ V}$ )	$I_{th(OI)}$	–	30	50	$\mu\text{A}$

**NOTES:** 4. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.  
5. The reference voltage on the adjustable device is measured from the output to the adjust pin across  $R_1$ .

Figure 1. Dropout Voltage versus Output Current

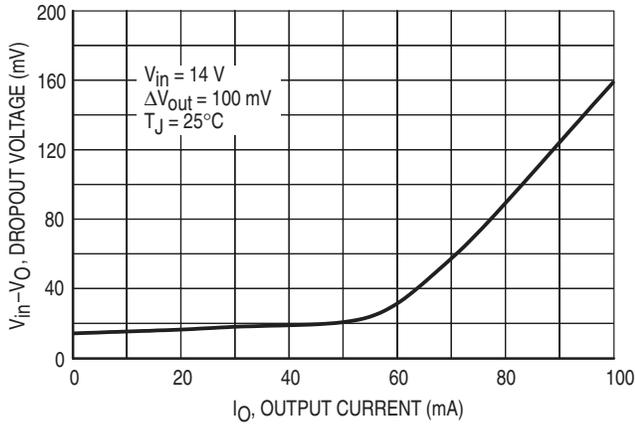


Figure 2. Dropout Voltage versus Junction Temperature

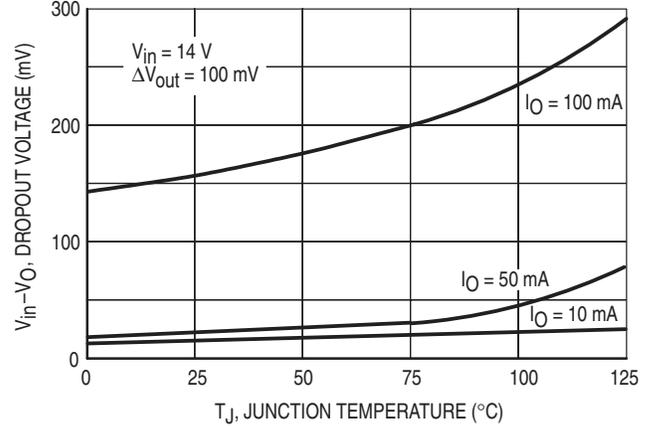


Figure 3. Peak Output Current versus Input Voltage

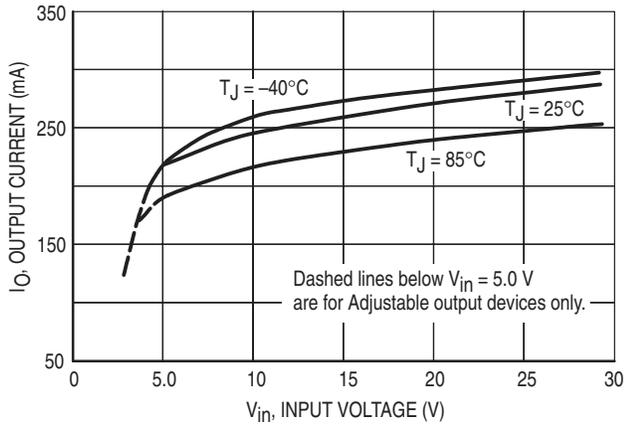


Figure 4. Output Voltage versus Input Voltage

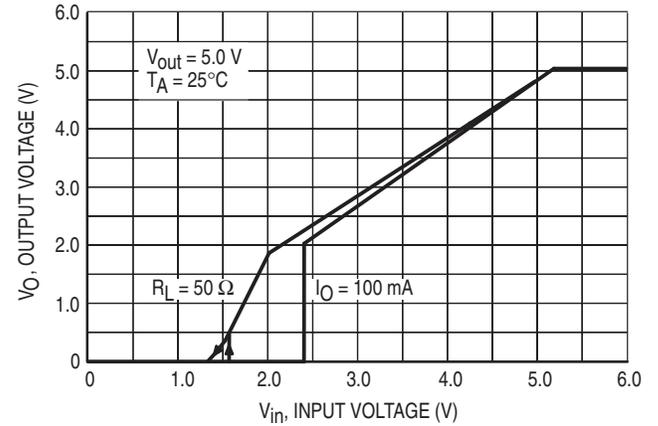


Figure 5. Output Voltage versus Input Voltage

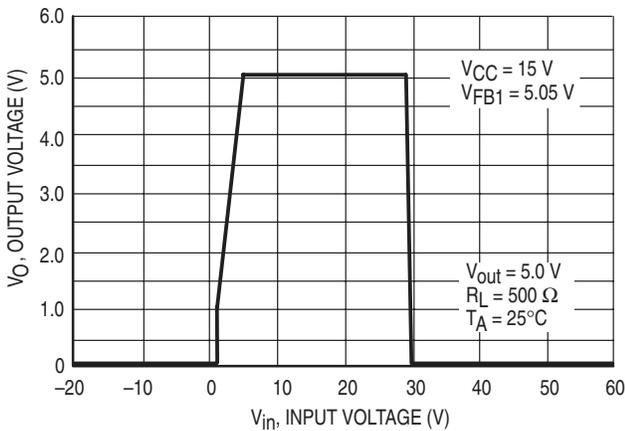


Figure 6. Load Dump Characteristics

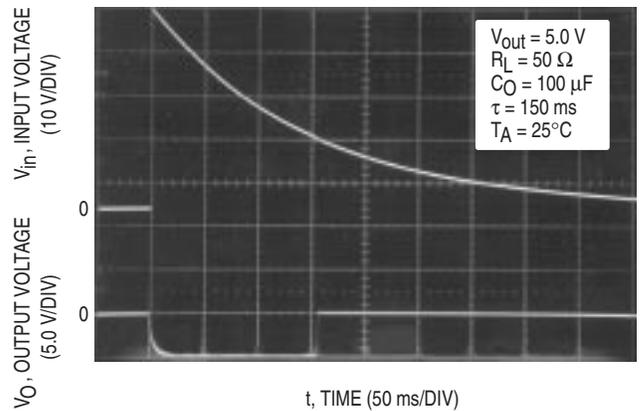


Figure 7. Bias Current versus Input Voltage

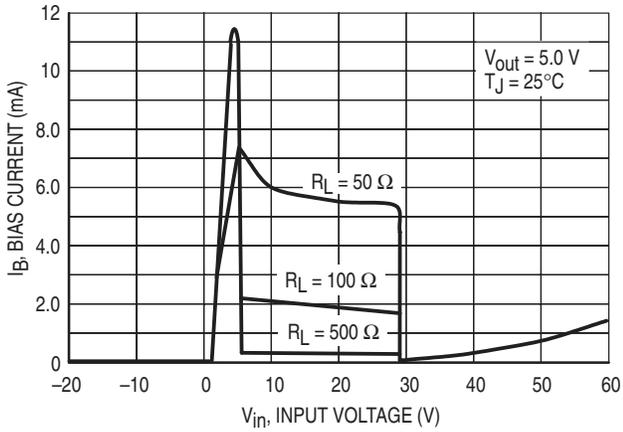


Figure 8. Bias Current versus Output Current

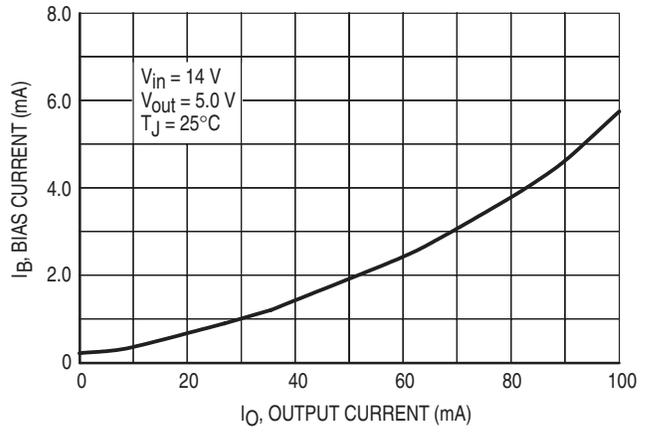


Figure 9. Bias Current versus Junction Temperature

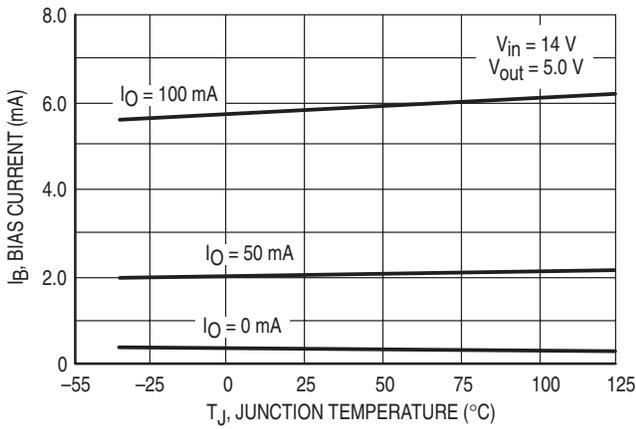


Figure 10. Output Impedance versus Frequency

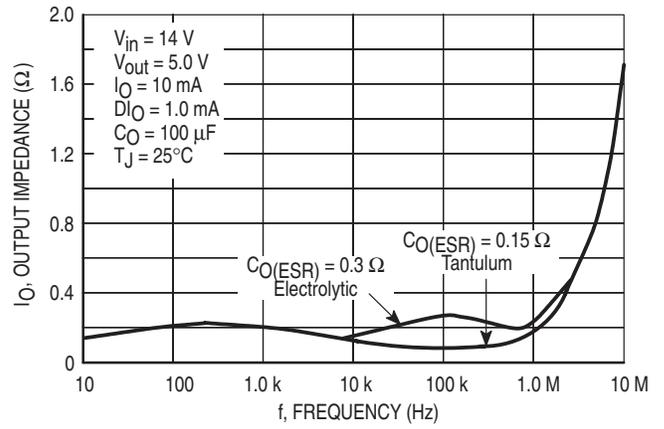


Figure 11. Ripple Rejection versus Frequency

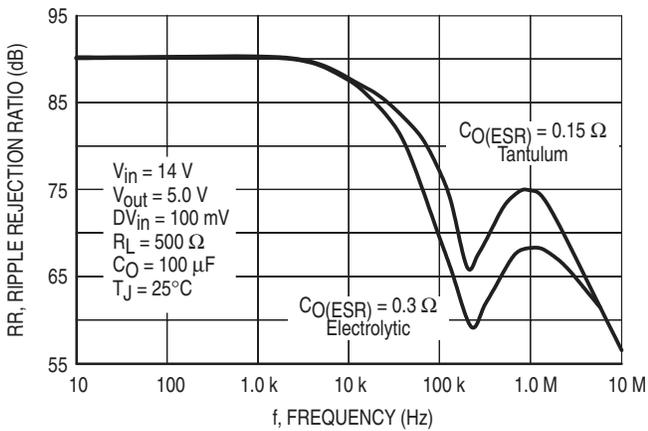


Figure 12. Ripple Rejection versus Output Current

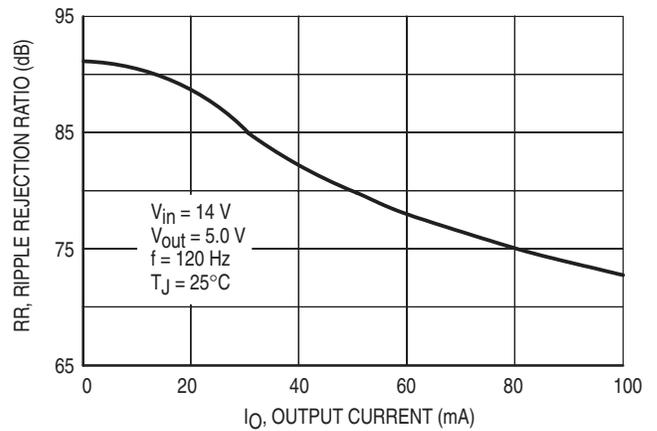


Figure 13. Line Regulation

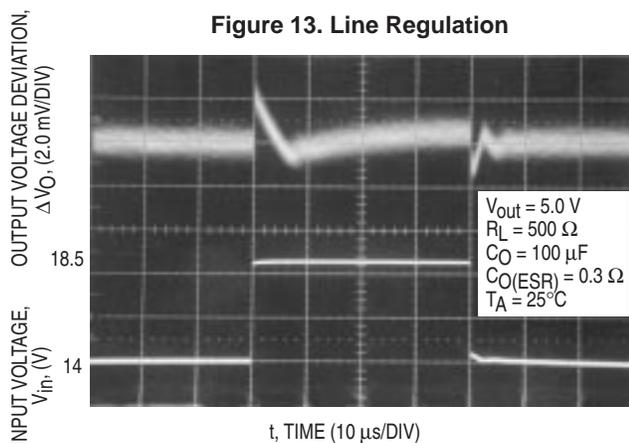


Figure 14. Load Regulation

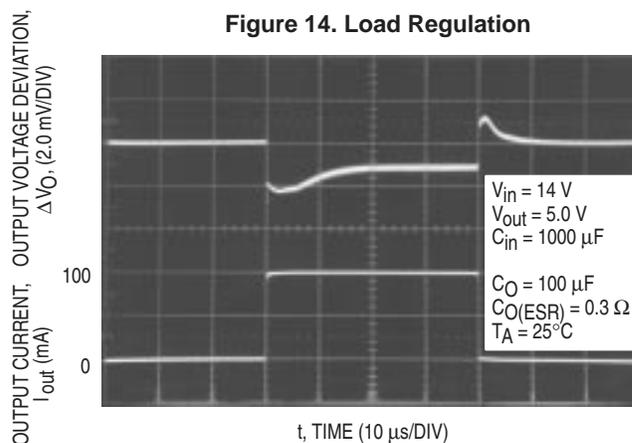


Figure 15. Reference Voltage versus Output Voltage

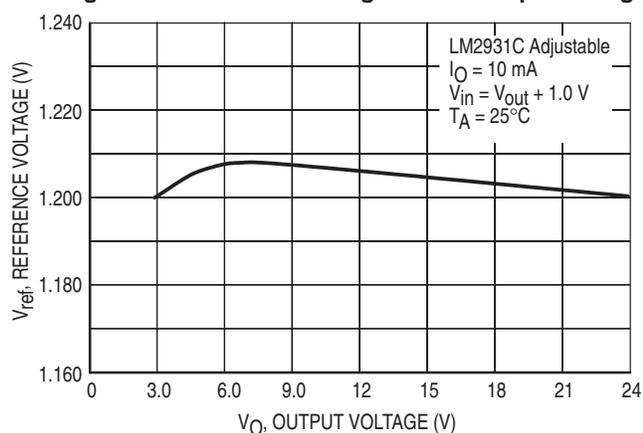
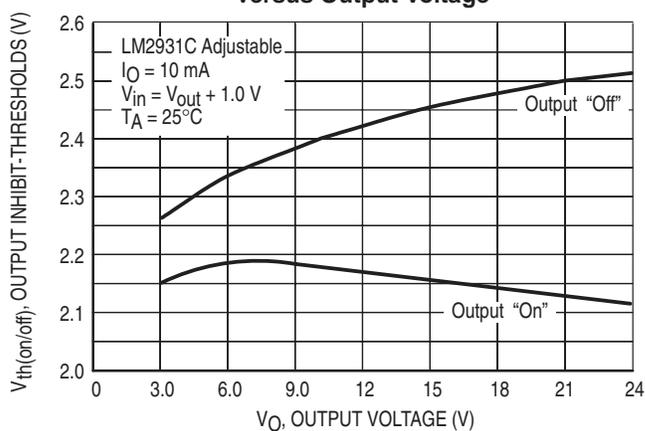


Figure 16. Output Inhibit-Thresholds versus Output Voltage



APPLICATIONS INFORMATION

The LM2931 series regulators are designed with many protection features making them essentially blow-out proof. These features include internal current limiting, thermal shutdown, overvoltage and reverse polarity input protection, and the capability to withstand temporary power-up with mirror-image insertion. Typical application circuits for the fixed and adjustable output device are shown in Figures 17 and 18.

The input bypass capacitor  $C_{in}$  is recommended if the regulator is located an appreciable distance ( $\geq 4"$ ) from the supply input filter. This will reduce the circuit's sensitivity to the input line impedance at high frequencies.

This regulator series is not internally compensated and thus requires an external output capacitor for stability. The capacitance value required is dependent upon the load current, output voltage for the adjustable regulator, and the type of capacitor selected. The least stable condition is encountered at maximum load current and minimum output voltage. Figure 22 shows that for operation in the "Stable" region, under the conditions specified, the magnitude of the output capacitor impedance  $|Z_O|$  must not exceed 0.4  $\Omega$ . This limit must be observed over the entire operating temperature range of the regulator circuit.

With economical electrolytic capacitors, cold temperature operation can pose a serious stability problem. As the electrolyte freezes, around  $-30^\circ\text{C}$ , the capacitance will decrease and the equivalent series resistance (ESR) will increase drastically, causing the circuit to oscillate. Quality electrolytic capacitors with extended temperature ranges of  $-40^\circ$  to  $+85^\circ\text{C}$  and  $-55^\circ$  to  $+105^\circ\text{C}$  are readily available. Solid tantalum capacitors may be a better choice if small size is a requirement, however, the maximum  $|Z_O|$  limit over temperature must be observed.

Note that in the stable region, the output noise voltage is linearly proportional to  $|Z_O|$ . In effect,  $C_O$  dictates the high frequency roll-off point of the circuit. Operation in the area titled "Marginally Stable" will cause the output of the regulator to exhibit random bursts of oscillation that decay in an under-damped fashion. Continuous oscillation occurs when operating in the area titled "Unstable". It is suggested that oven testing of the entire circuit be performed with maximum load, minimum input voltage, and minimum ambient temperature.

Figure 17. Fixed Output Regulator

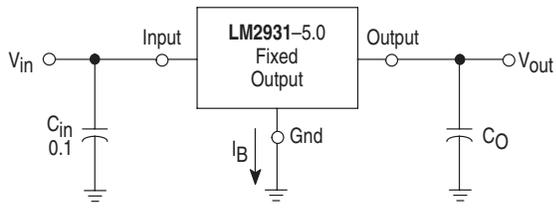
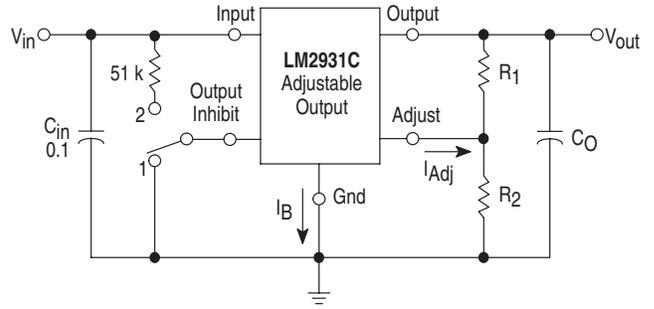


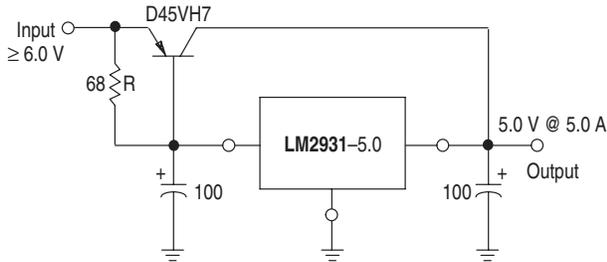
Figure 18. Adjustable Output Regulator



Switch Position 1 = Output "On", 2 = Output "Off"

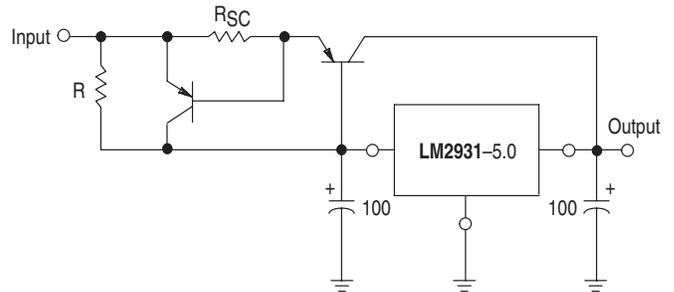
$$V_{out} = V_{ref} \left( 1 + \frac{R_2}{R_1} \right) + I_{Adj} R_2 \quad 22.5 \text{ k} \geq \frac{R_1 R_2}{R_1 + R_2}$$

Figure 19. (5.0 A) Low Differential Voltage Regulator



The LM2931 series can be current boosted with a PNP transistor. The D45VH7, on a heatsink, will provide an output current of 5.0 A with an input to output voltage differential of approximately 1.0 V. Resistor R in conjunction with the  $V_{BE}$  of the PNP determines when the pass transistor begins conducting. This circuit is not short circuit proof.

Figure 20. Current Boost Regulator with Short Circuit Projection



The circuit of Figure 19 can be modified to provide supply protection against short circuits by adding the current sense resistor  $R_{SC}$  and an additional PNP transistor. The current sensing PNP must be capable of handling the short circuit current of the LM2931. Safe operating area of both transistors must be considered under worst case conditions.

Figure 21. Constant Intensity Lamp Flasher

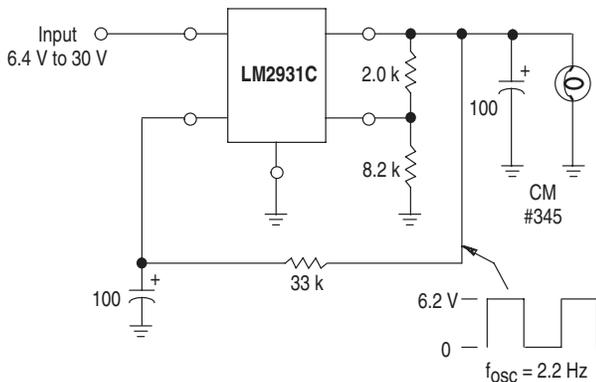
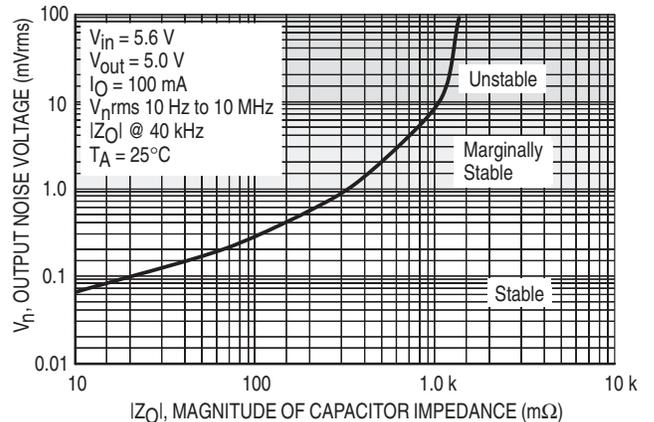
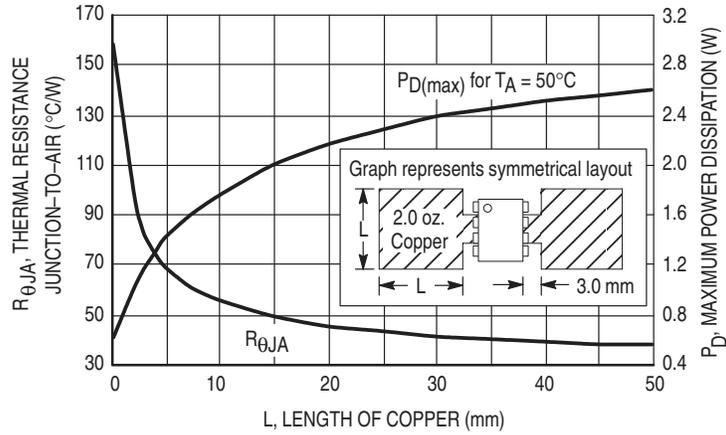


Figure 22. Output Noise Voltage versus Output Capacitor Impedance

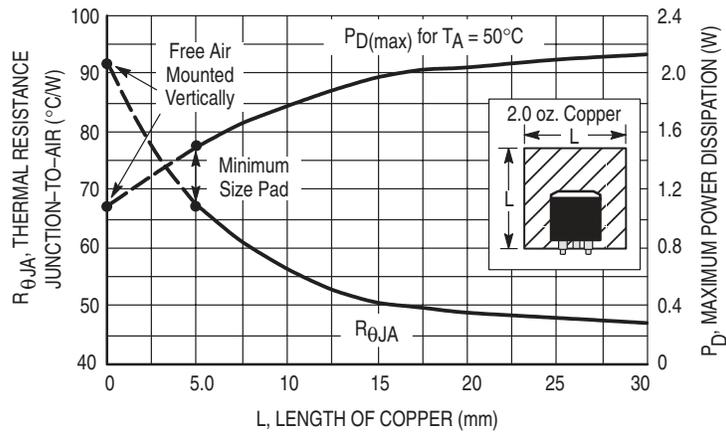


# LM2931 Series

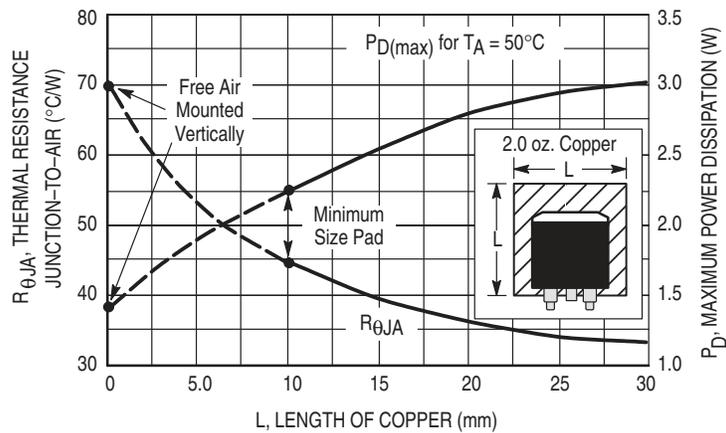
**Figure 23. SOP-8 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**



**Figure 24. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**



**Figure 25. 3-Pin and 5-Pin D<sup>2</sup>PAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length**



# LM2931 Series

## DEFINITIONS

**Dropout Voltage** – The input/output voltage differential at which the regulator output no longer maintains regulation against further reductions in input voltage. Measured when the output decreases 100 mV from nominal value at 14 V input, dropout voltage is affected by junction temperature and load current.

**Line Regulation** – The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

**Load Regulation** – The change in output voltage for a change in load current at constant chip temperature.

**Maximum Power Dissipation** – The maximum total device dissipation for which the regulator will operate within specifications.

**Bias Current** – That part of the input current that is not delivered to the load.

**Output Noise Voltage** – The rms AC voltage at the output, with constant load and no input ripple, measured over a specified frequency range.

**Long-Term Stability** – Output voltage stability under accelerated life test conditions with the maximum rated voltage listed in the devices electrical characteristics and maximum power dissipation.

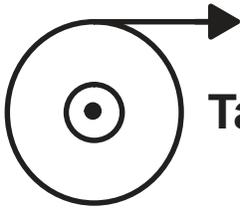
# Tape and Reel Options

---

## In Brief . . .

Motorola offers the convenience of Tape and Reel packaging for our growing family of standard integrated circuit products. Reels are available to support the requirements of both first and second generation pick-and-place equipment. The packaging fully conforms to the latest EIA-481A specification. The antistatic embossed tape provides a secure cavity, sealed with a peel-back cover tape.

	<b>Page</b>
Tape and Reel Configurations . . . . .	12-2
Tape and Reel Information Table . . . . .	12-4
Analog MPQ Table . . . . .	12-5

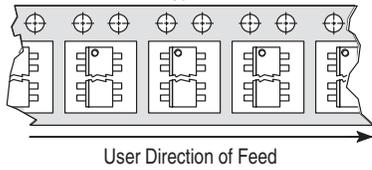


# Tape and Reel Configurations

## Mechanical Polarization

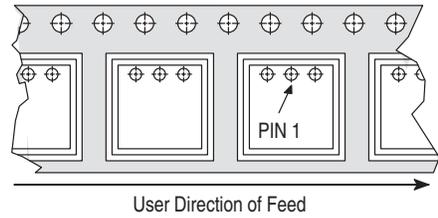
### SOIC and Micro-8 DEVICES

Typical



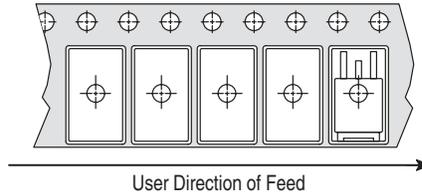
### PLCC DEVICES

Typical



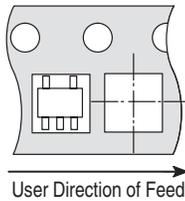
### DPAK and D<sup>2</sup>PAK DEVICES

Typical



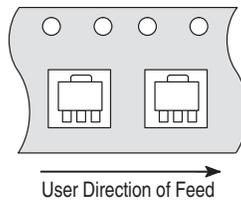
### SOT-23 (5 Pin) DEVICES

Typical



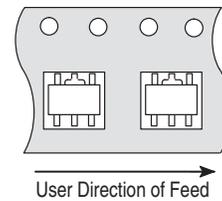
### SOT-89 (3 Pin) DEVICES

Typical



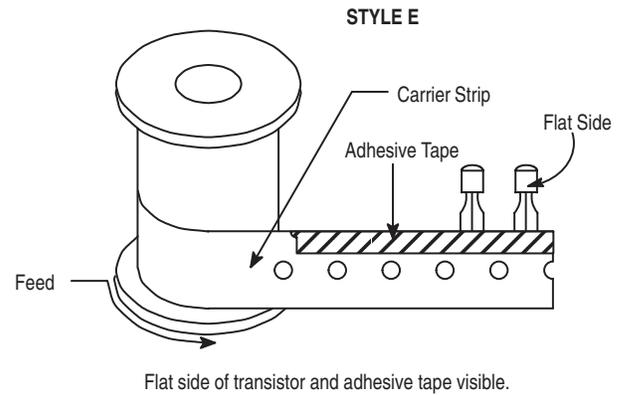
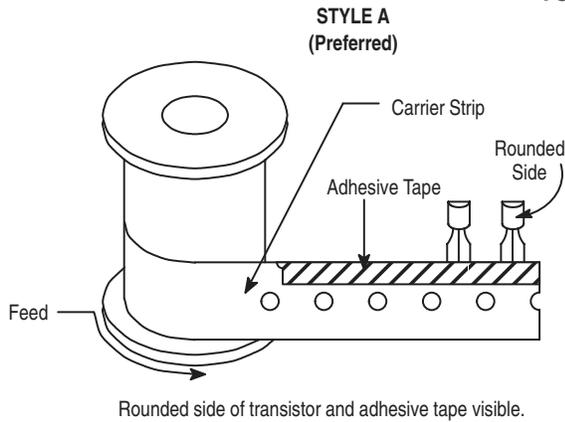
### SOT-89 (5 Pin) DEVICES

Typical

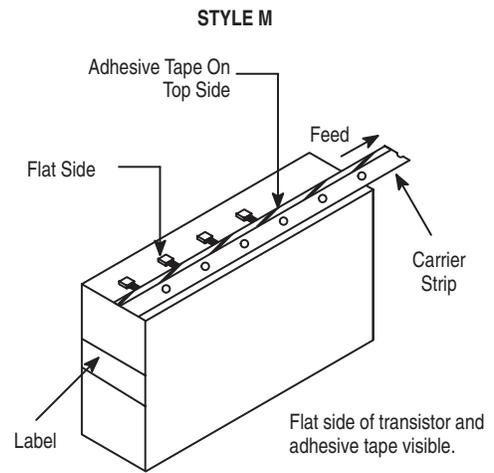
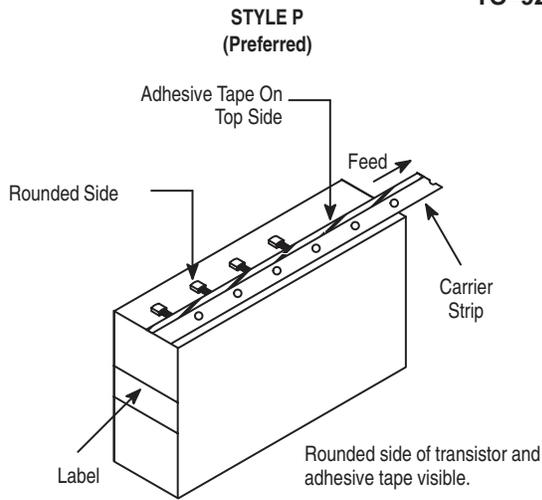


# Tape and Reel Configurations (continued)

## TO-92 Reel Styles



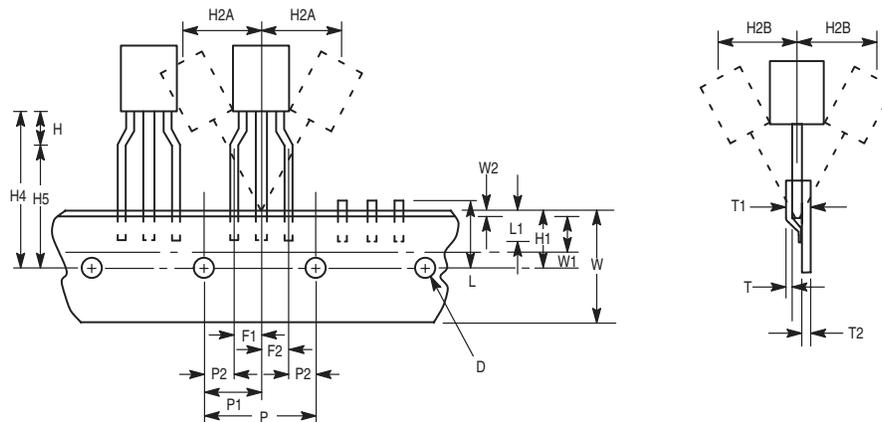
## TO-92 Ammo Pack Styles



Style P ammo pack is equivalent to Styles A and B of reel pack dependent on feed orientation from box.

Style M ammo pack is equivalent to Style E of reel pack dependent on feed orientation from box.

## TO-92 EIA Radial Tape in Fan Fold Box or On Reel



# Tape and Reel Information Table

Package	Tape Width (mm)	Devices <sup>(1)</sup> per Reel	Reel Size (inch)	Device Suffix
SO-8, SOP-8	12	2,500	13	R2
SO-14	16	2,500	13	R2
SO-16	16	2,500	13	R2
SO-16L, SO-8+8L WIDE	16	1,000	13	R2
SO-20L WIDE	24	1,000	13	R2
SO-24L WIDE	24	1,000	13	R2
SO-28L WIDE	24	1,000	13	R2
SO-28L WIDE	32	1,000	13	R3
Micro-8	12	2,500	13	R2
PLCC-20	16	1,000	13	R2
PLCC-28	24	500	13	R2
PLCC-44	32	500	13	R2
PLCC-52	32	500	13	R2
PLCC-68	44	250	13	R2
PLCC-84	44	250	13	R2
TO-226AA (TO-92) <sup>(2)</sup>	18	2,000	13	RA, RE, RP, or RM (Ammo Pack) only
DPAK	16	2,500	13	RK
D <sup>2</sup> PAK	24	800	13	R4
SOT-23 (5 Pin)	8	3,000	7	TR
SOT-89 (3/5 Pin)	12	1,000	7	T1

<sup>(1)</sup> Minimum order quantity is 1 reel. Distributors/OEM customers may break lots or reels at their option, however broken reels may not be returned.

<sup>(2)</sup> Integrated circuits in TO-226AA packages are available in Styes A and E only, with optional "Ammo Pack" (Suffix RP or RM). The RA and RP configurations are preferred. For ordering information please contact your local Motorola Semiconductor Sales Office.

# Analog MPQ Table

## Tape/Reel and Ammo Pack

Package Type	Package Code	MPQ
<b>PLCC</b>		
Case 775	0802	1000/reel
Case 776	0804	500/reel
Case 777	0801	500/reel
<b>SOIC</b>		
Case 751	0095	2500/reel
Case 751A	0096	2500/reel
Case 751B	0097	2500/reel
Case 751G	2003	1000/reel
Case 751D	2005	1000/reel
Case 751E	2008	1000/reel
Case 751F	2009	1000/reel
<b>Micro-8</b>		
Case 846A	-	2500/reel
<b>TO-92</b>		
Case 29	0031	2000/reel
Case 29	0031	2000/Ammo Pack
<b>DPAK</b>		
Case 369A	-	2500/reel
<b>D2PAK</b>		
Case 936	-	800/reel
<b>SOT-23 (5 Pin)</b>		
Case 1212	-	3000/reel
<b>SOT-89 (3 Pin)</b>		
Case 1213	-	1000/reel
<b>SOT-89 (5 Pin)</b>		
Case 1214	-	1000/reel



# Packaging Information

---

## In Brief . . .

*The packaging availability for each device type is indicated on the individual data sheets and the Selector Guide. All of the outline dimensions for the packages are given in this section.*

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

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

*where:*

$P_{D(TA)}$  = *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.*

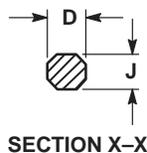
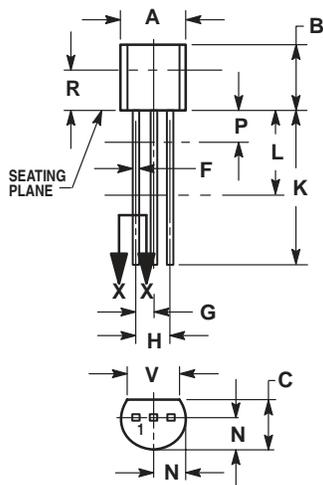
$T_{J(max)}$  = *Maximum operating Junction Temperature as listed in the Maximum Ratings Section. See individual data sheets for  $T_{J(max)}$  information.*

$T_A$  = *Maximum desired operating Ambient Temperature*

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

# Case Outline Dimensions

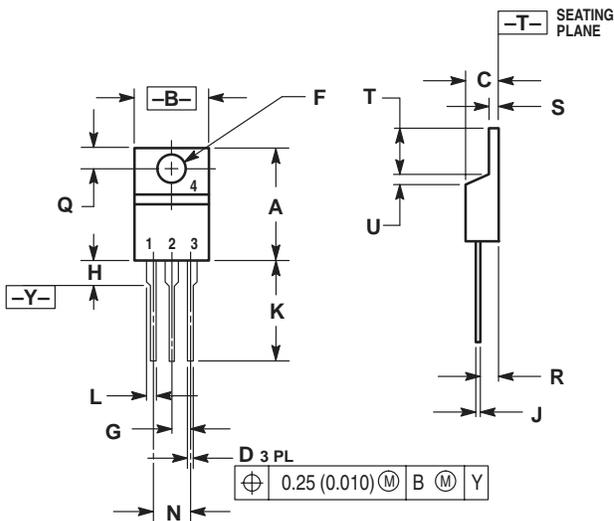
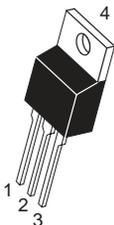
**LP, P, Z SUFFIX**  
**CASE 29-04**  
 Plastic Package  
 (TO-226AA/TO-92)  
 ISSUE AD



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
  4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.022	0.41	0.55
F	0.016	0.019	0.41	0.48
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	—	12.70	—
L	0.250	—	6.35	—
N	0.080	0.105	2.04	2.66
P	—	0.100	—	2.54
R	0.115	—	2.93	—
V	0.135	—	3.43	—

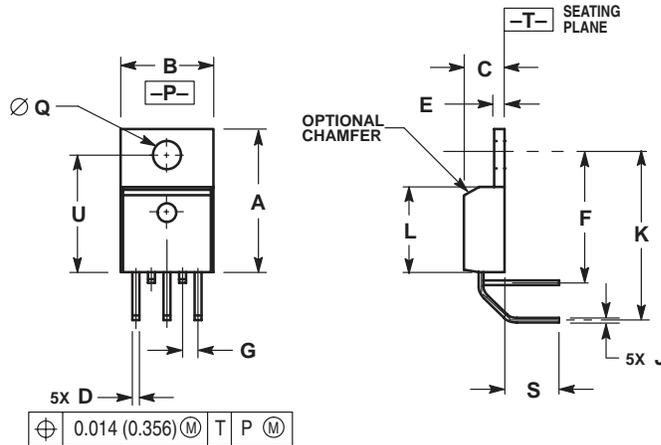
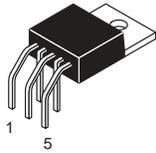
**KC, T SUFFIX**  
**CASE 221A-06**  
 Plastic Package  
 ISSUE Y



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.560	0.625	14.23	15.87
B	0.380	0.420	9.66	10.66
C	0.140	0.190	3.56	4.82
D	0.020	0.045	0.51	1.14
F	0.139	0.155	3.53	3.93
G	0.100 BSC	—	2.54 BSC	—
H	—	0.280	—	7.11
J	0.012	0.045	0.31	1.14
K	0.500	0.580	12.70	14.73
L	0.045	0.070	1.15	1.77
N	0.200 BSC	—	5.08 BSC	—
Q	0.100	0.135	2.54	3.42
R	0.080	0.115	2.04	2.92
S	0.020	0.055	0.51	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27

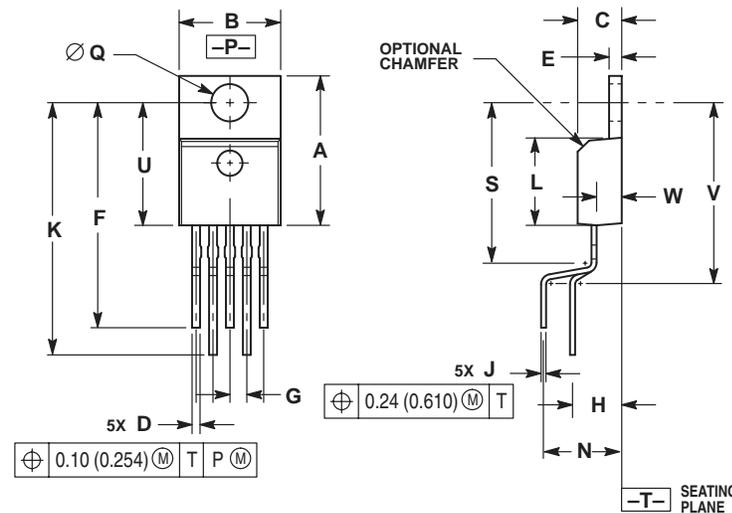
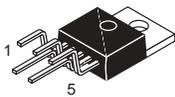
**TH SUFFIX**  
**CASE 314A-03**  
 Plastic Package  
 ISSUE D



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION D DOES NOT INCLUDE INTERCONNECT BAR (DAMBAR) PROTRUSION. DIMENSION D INCLUDING PROTRUSION SHALL NOT EXCEED 0.043 (1.092) MAXIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.572	0.613	14.529	15.570
B	0.390	0.415	9.906	10.541
C	0.170	0.180	4.318	4.572
D	0.025	0.038	0.635	0.965
E	0.048	0.055	1.219	1.397
F	0.570	0.585	14.478	14.859
G	0.067 BSC		1.702 BSC	
J	0.015	0.025	0.381	0.635
K	0.730	0.745	18.542	18.923
L	0.320	0.365	8.128	9.271
Q	0.140	0.153	3.556	3.886
S	0.210	0.260	5.334	6.604
U	0.468	0.505	11.888	12.827

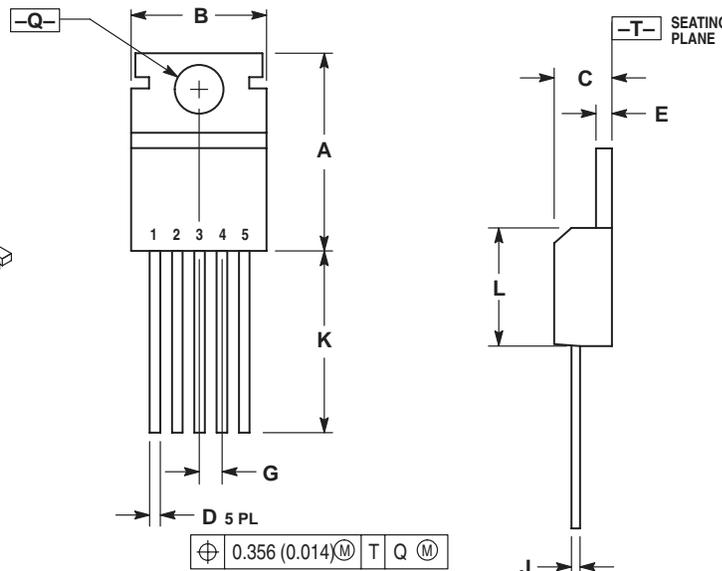
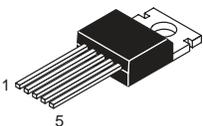
**T, TV SUFFIX**  
**CASE 314B-05**  
 Plastic Package  
 ISSUE J



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION D DOES NOT INCLUDE INTERCONNECT BAR (DAMBAR) PROTRUSION. DIMENSION D INCLUDING PROTRUSION SHALL NOT EXCEED 0.043 (1.092) MAXIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.572	0.613	14.529	15.570
B	0.390	0.415	9.906	10.541
C	0.170	0.180	4.318	4.572
D	0.025	0.038	0.635	0.965
E	0.048	0.055	1.219	1.397
F	0.850	0.935	21.590	23.749
G	0.067 BSC		1.702 BSC	
H	0.166 BSC		4.216 BSC	
J	0.015	0.025	0.381	0.635
K	0.900	1.100	22.860	27.940
L	0.320	0.365	8.128	9.271
N	0.320 BSC		8.128 BSC	
Q	0.140	0.153	3.556	3.886
S	—	0.620	—	15.748
U	0.468	0.505	11.888	12.827
V	—	0.735	—	18.669
W	0.090	0.110	2.286	2.794

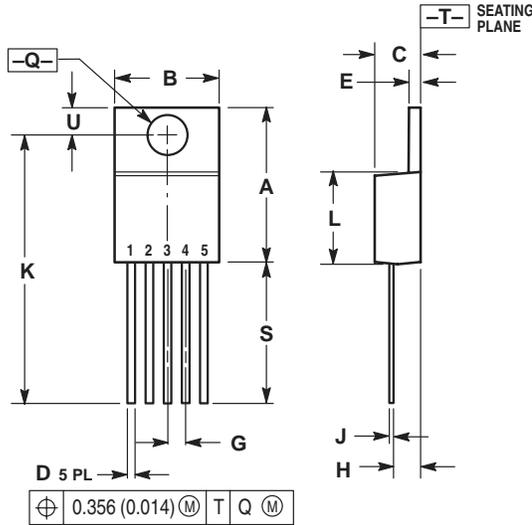
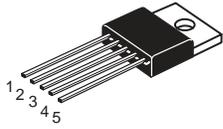
**T SUFFIX**  
**CASE 314C-01**  
 Plastic Package  
 ISSUE A



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION D DOES NOT INCLUDE INTERCONNECT BAR (DAMBAR) PROTRUSION. DIMENSION D INCLUDING PROTRUSION SHALL NOT EXCEED 10.92 (0.043) MAXIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.610	0.625	15.59	15.88
B	0.380	0.420	9.65	10.67
C	0.160	0.190	4.06	4.83
D	0.020	0.040	0.51	1.02
E	0.035	0.055	0.89	1.40
G	0.067 BSC		1.702 BSC	
J	0.015	0.025	0.38	0.64
K	0.500	—	12.70	—
L	0.355	0.370	9.02	9.40
Q	0.139	0.147	3.53	3.73

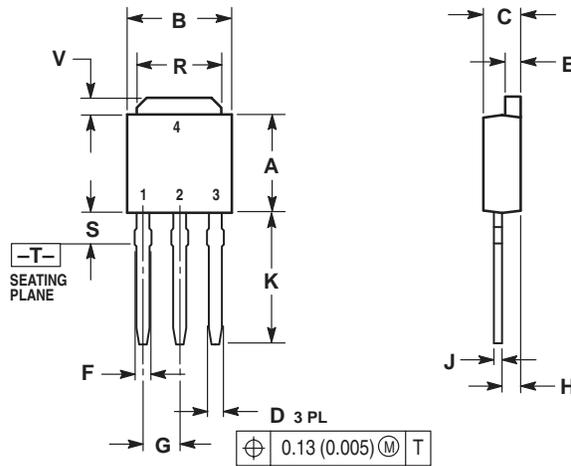
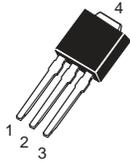
**T, T1 SUFFIX**  
**CASE 314D-03**  
 Plastic Package  
 ISSUE D



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION D DOES NOT INCLUDE INTERCONNECT BAR (DAMBAR) PROTRUSION. DIMENSION D INCLUDING PROTRUSION SHALL NOT EXCEED 10.92 (0.043) MAXIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.572	0.613	14.529	15.570
B	0.390	0.415	9.906	10.541
C	0.170	0.180	4.318	4.572
D	0.025	0.038	0.635	0.965
E	0.048	0.055	1.219	1.397
G	0.067 BSC		1.702 BSC	
H	0.087	0.112	2.210	2.845
J	0.015	0.025	0.381	0.635
K	1.020	1.065	25.908	27.051
L	0.320	0.365	8.128	9.271
Q	0.140	0.153	3.556	3.886
U	0.105	0.117	2.667	2.972
S	0.543	0.582	13.792	14.783

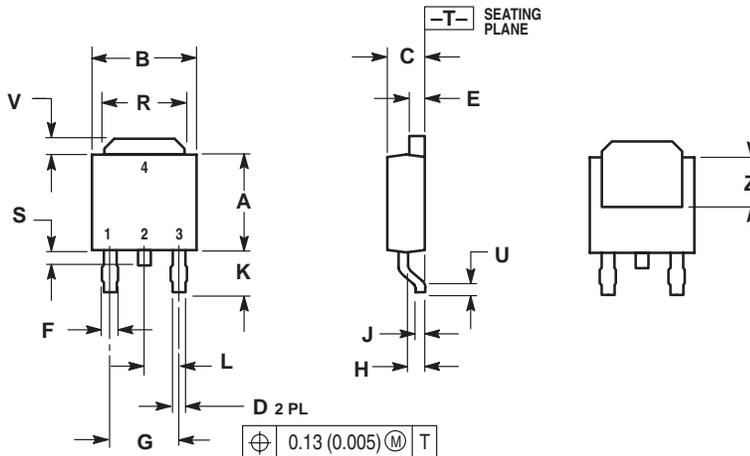
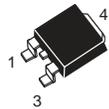
**DT-1 SUFFIX**  
**CASE 369-07**  
 Plastic Package (DPAK)  
 ISSUE K



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.250	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.033	0.040	0.84	1.01
F	0.037	0.047	0.94	1.19
G	0.090 BSC		2.29 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.350	0.380	8.89	9.65
R	0.175	0.215	4.45	5.46
S	0.050	0.090	1.27	2.28
V	0.030	0.050	0.77	1.27

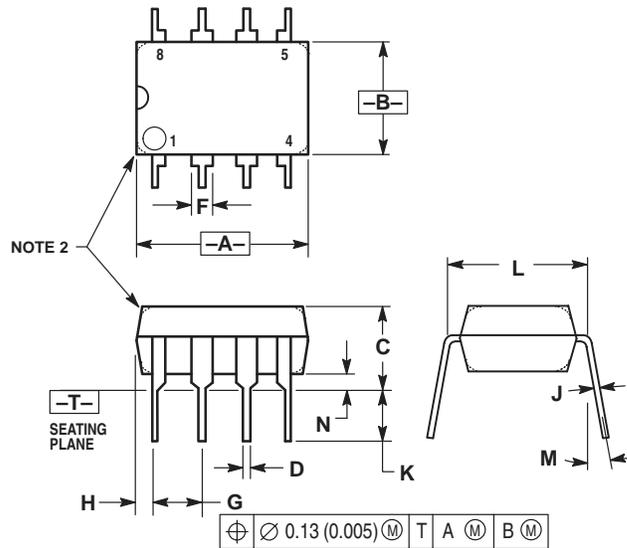
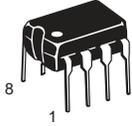
**DT SUFFIX**  
**CASE 369A-13**  
 Plastic Package (DPAK)  
 ISSUE Y



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.250	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.033	0.040	0.84	1.01
F	0.037	0.047	0.94	1.19
G	0.180 BSC		4.58 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090 BSC		2.29 BSC	
R	0.175	0.215	4.45	5.46
S	0.020	0.050	0.51	1.27
U	0.020	—	0.51	—
V	0.030	0.050	0.77	1.27
Z	0.138	—	3.51	—

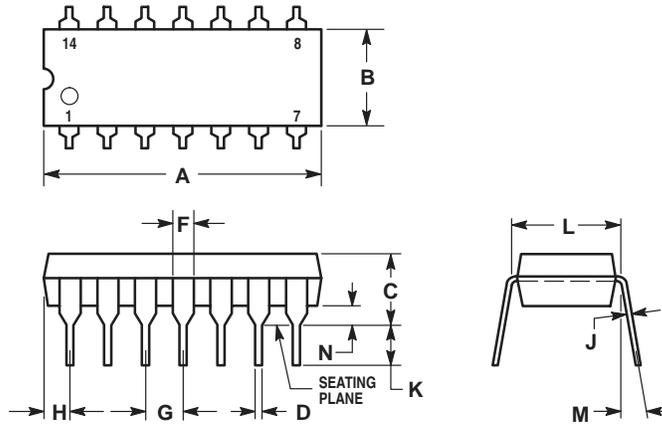
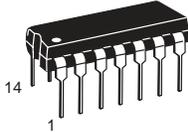
**DP1, N, P, P1 SUFFIX**  
**CASE 626-05**  
 Plastic Package  
 ISSUE K



- 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.

DIM	MILLIMETERS		INCHES	
	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

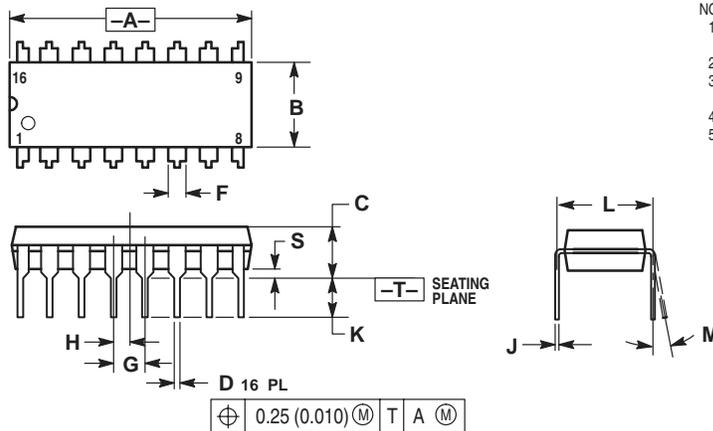
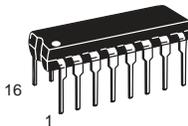
**N, P, N-14, P2 SUFFIX**  
**CASE 646-06**  
 Plastic Package  
 ISSUE L



- NOTES:
1. LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
  2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  4. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	19.56
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0°		10°	
N	0.015	0.039	0.39	1.01

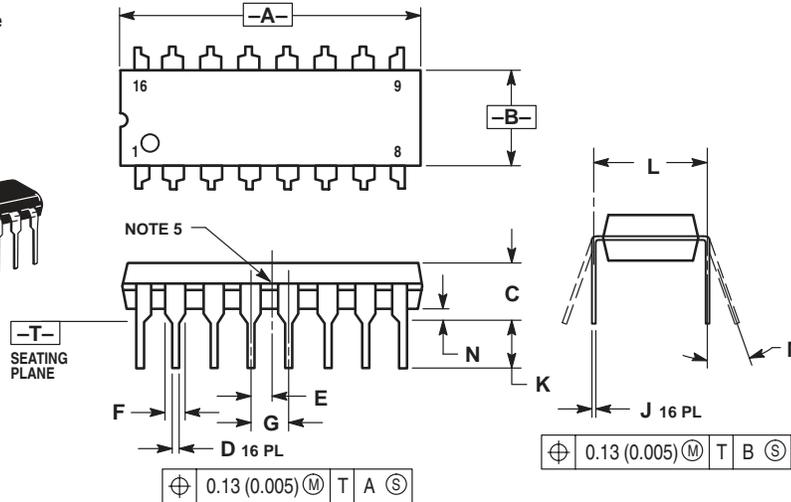
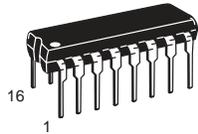
**DP2, N, P, PC SUFFIX**  
**CASE 648-08**  
 Plastic Package  
 ISSUE R



- 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°	
S	0.020	0.040	0.51	1.01

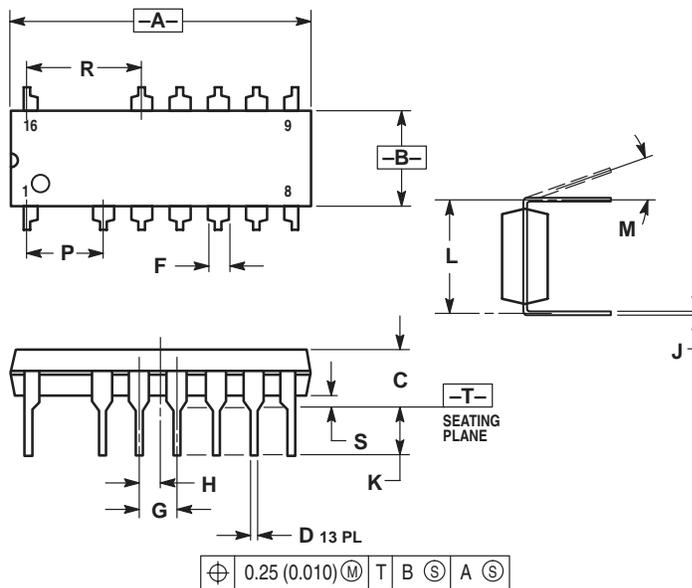
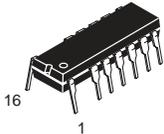
**B, P, P2, V SUFFIX**  
**CASE 648C-03**  
 Plastic Package  
 (DIP-16)  
 ISSUE C



- 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. INTERNAL LEAD CONNECTION BETWEEN 4 AND 5, 12 AND 13.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.840	18.80	21.34
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
E	0.050 BSC			
F	0.040	0.70	1.02	1.78
G	0.100 BSC			
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC			
M	0°		10°	
N	0.015	0.040	0.39	1.01

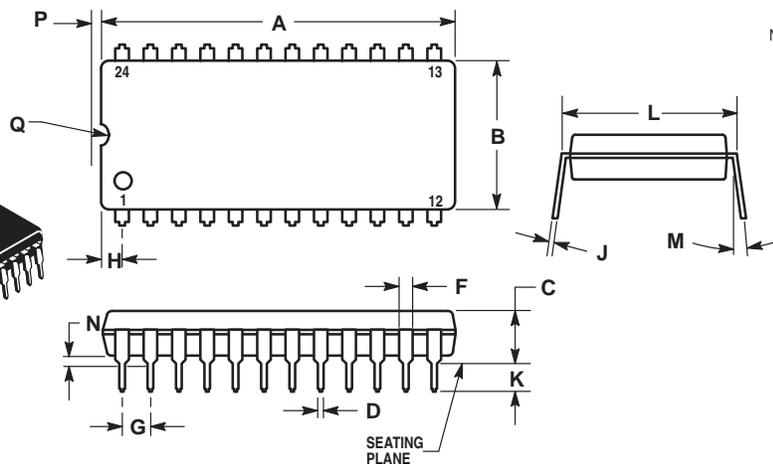
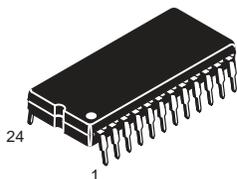
**P SUFFIX**  
**CASE 648E-01**  
 Plastic Package  
 (DIP-16)  
 ISSUE O



- 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 A AND B DOES NOT INCLUDE MOLD PROTRUSION.
  5. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.25 (0.010).
  6. ROUNDED CORNER OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.760	18.80	19.30
B	0.245	0.260	6.23	6.60
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.050	0.070	1.27	1.77
G	0.100 BSC			
H	0.050 BSC			
J	0.008	0.015	0.21	0.38
K	0.120	0.140	3.05	3.55
L	0.295	0.305	7.50	7.74
M	0°		10°	
P	0.200 BSC			
R	0.300 BSC			
S	0.015	0.035	0.39	0.88

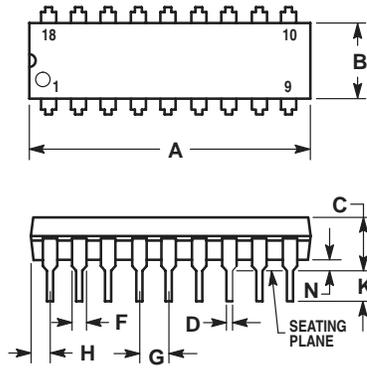
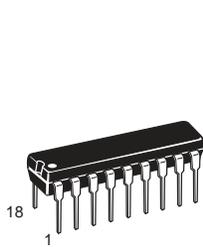
**P SUFFIX**  
**CASE 649-03**  
 Plastic Package  
 ISSUE D



- NOTES:
1. LEADS WITHIN 0.13 (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		INCHES	
	MIN	MAX	MIN	MAX
A	31.50	32.13	1.240	1.265
B	13.21	13.72	0.520	0.540
C	4.70	5.21	0.185	0.205
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	1.65	2.16	0.065	0.085
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	14.99	15.49	0.590	0.610
M	—		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

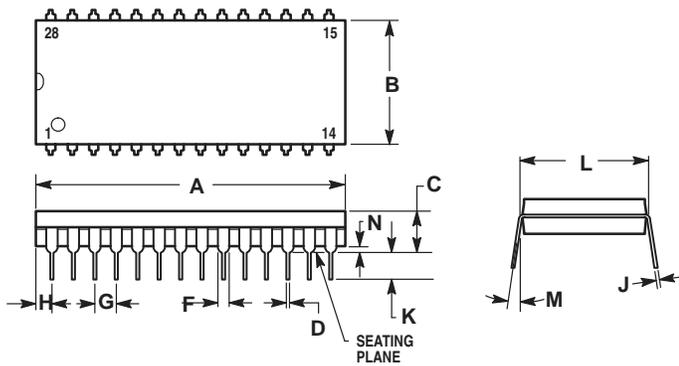
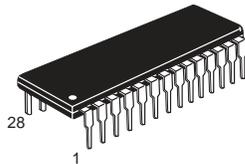
**A, B, N, P SUFFIX**  
**CASE 707-02**  
 Plastic Package  
 ISSUE C



- NOTES:
1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
  2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	22.22	23.24	0.875	0.915
B	6.10	6.60	0.240	0.260
C	3.56	4.57	0.140	0.180
D	0.36	0.56	0.014	0.022
F	1.27	1.78	0.050	0.070
G	2.54 BSC		0.100 BSC	
H	1.02	1.52	0.040	0.060
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	0°	15°	0°	15°
N	0.51	1.02	0.020	0.040

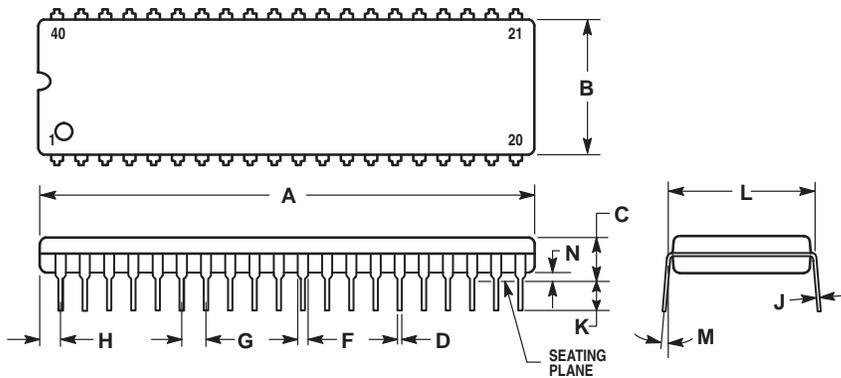
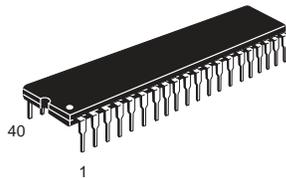
**P SUFFIX**  
**CASE 710-02**  
 Plastic Package  
 ISSUE B



- NOTES:
1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
  2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	36.45	37.21	1.435	1.465
B	13.72	14.22	0.540	0.560
C	3.94	5.08	0.155	0.200
D	0.36	0.56	0.014	0.022
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	1.65	2.16	0.065	0.085
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.115	0.135
L	15.24 BSC		0.600 BSC	
M	0°	15°	0°	15°
N	0.51	1.02	0.020	0.040

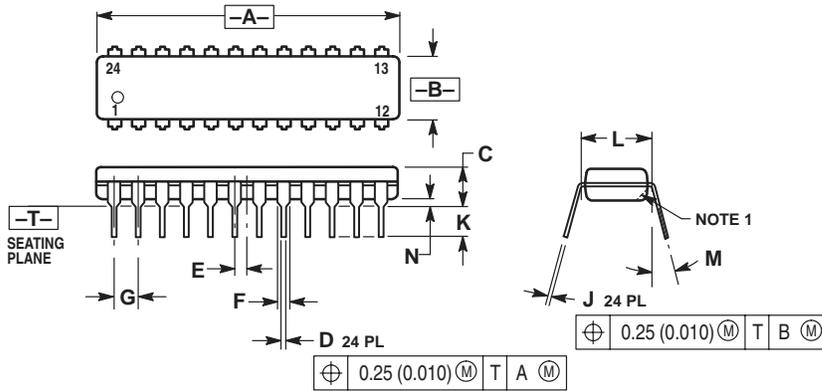
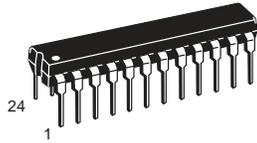
**P SUFFIX**  
**CASE 711-03**  
 Plastic Package  
 ISSUE C



- NOTES:
1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
  2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	51.69	52.45	2.035	2.065
B	13.72	14.22	0.540	0.560
C	3.94	5.08	0.155	0.200
D	0.36	0.56	0.014	0.022
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	1.65	2.16	0.065	0.085
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.115	0.135
L	15.24 BSC		0.600 BSC	
M	0°	15°	0°	15°
N	0.51	1.02	0.020	0.040

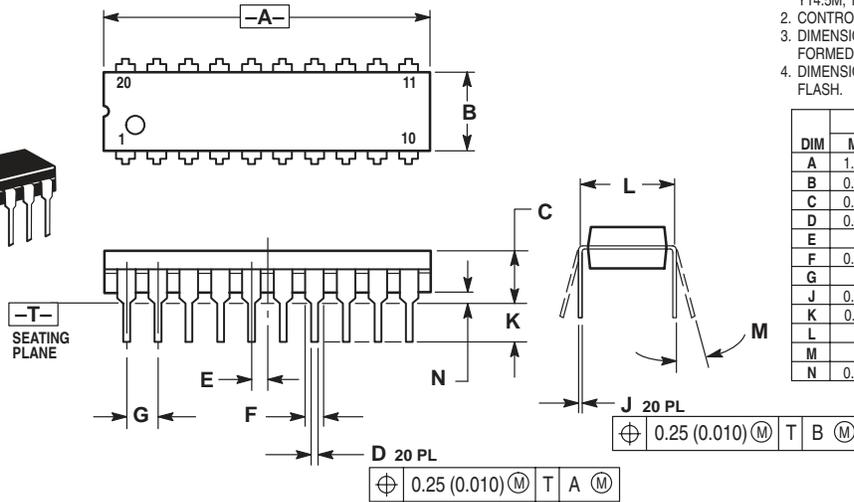
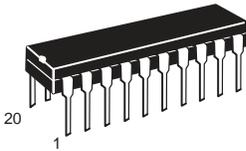
**F, P, P-3 SUFFIX**  
**CASE 724-03**  
 Plastic Package  
 (NDIP-24)  
 ISSUE D



- NOTES:
1. CHAMFERED CONTOUR OPTIONAL.
  2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  4. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.230	1.265	31.25	32.13
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.020	0.38	0.51
E	0.050 BSC		1.27 BSC	
F	0.040	0.060	1.02	1.52
G	0.100 BSC		2.54 BSC	
J	0.007	0.012	0.18	0.30
K	0.110	0.140	2.80	3.55
L	0.300 BSC		7.62 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.01

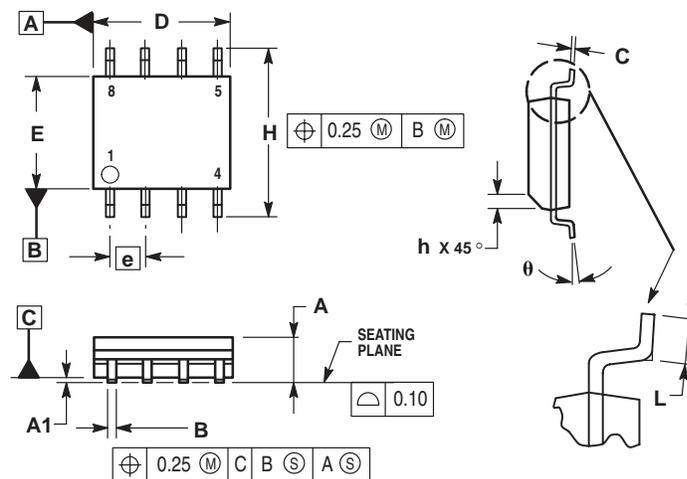
**H, P, DP SUFFIX**  
**CASE 738-03**  
 Plastic Package  
 ISSUE E



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.010	1.070	25.66	27.17
B	0.240	0.260	6.10	6.60
C	0.150	0.180	3.81	4.57
D	0.015	0.022	0.39	0.55
E	0.050 BSC		1.27 BSC	
F	0.050	0.070	1.27	1.77
G	0.100 BSC		2.54 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.140	2.80	3.55
L	0.300 BSC		7.62 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.01

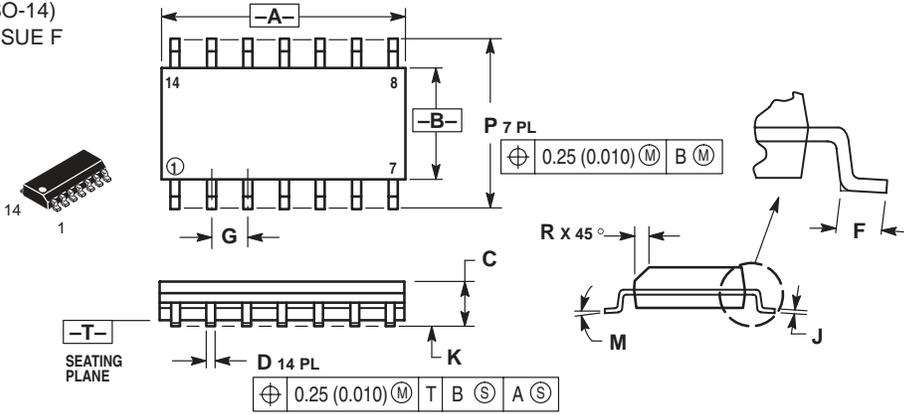
**D, D1, D2 SUFFIX**  
**CASE 751-05**  
 Plastic Package  
 (SO-8, SOP-8)  
 ISSUE R



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. DIMENSIONS ARE IN MILLIMETERS.
  3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
  5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS	
	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.18	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0°	7°

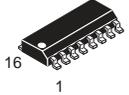
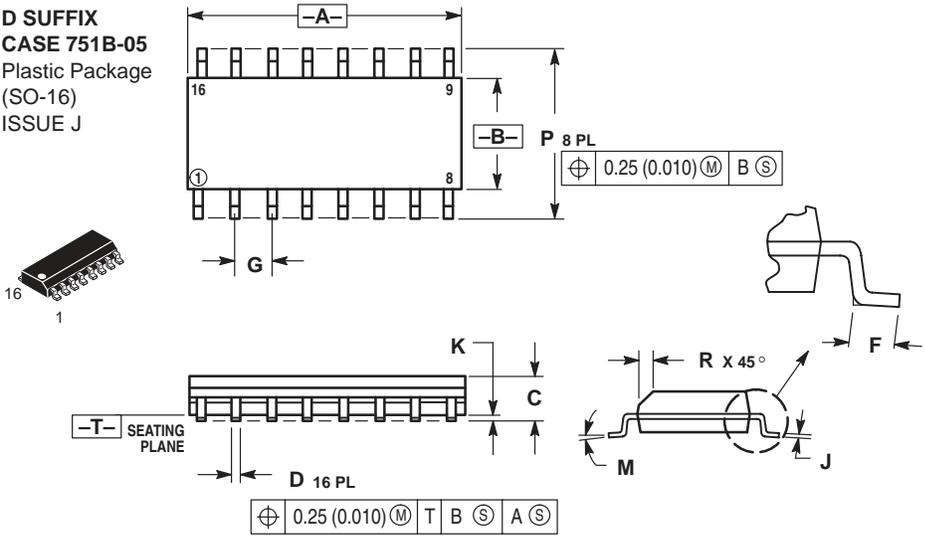
**D SUFFIX**  
**CASE 751A-03**  
 Plastic Package  
 (SO-14)  
 ISSUE F



- 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.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
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	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

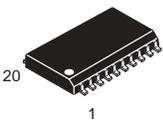
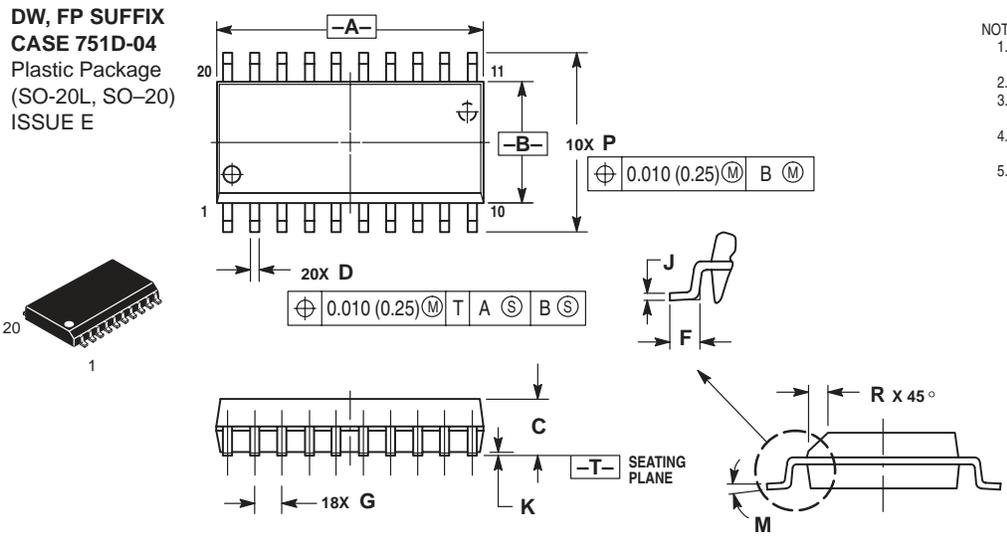
**D SUFFIX**  
**CASE 751B-05**  
 Plastic Package  
 (SO-16)  
 ISSUE J



- 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.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
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	0.19	0.25	0.008	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

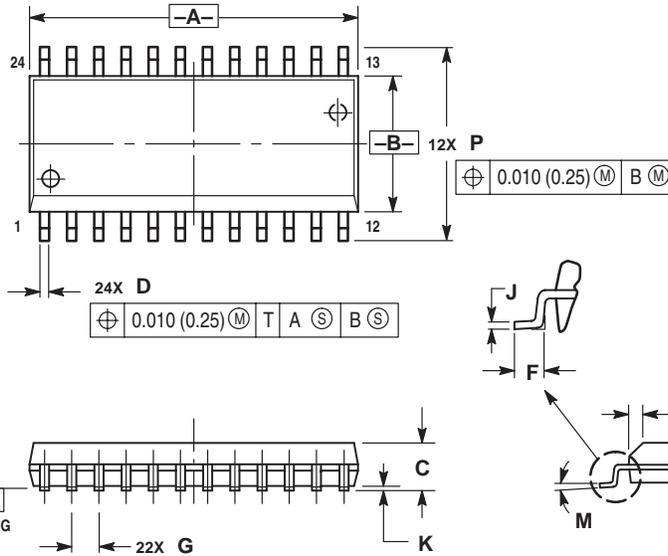
**DW, FP SUFFIX**  
**CASE 751D-04**  
 Plastic Package  
 (SO-20L, SO-20)  
 ISSUE E



- 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 0.150 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	12.65	12.95	0.499	0.510
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

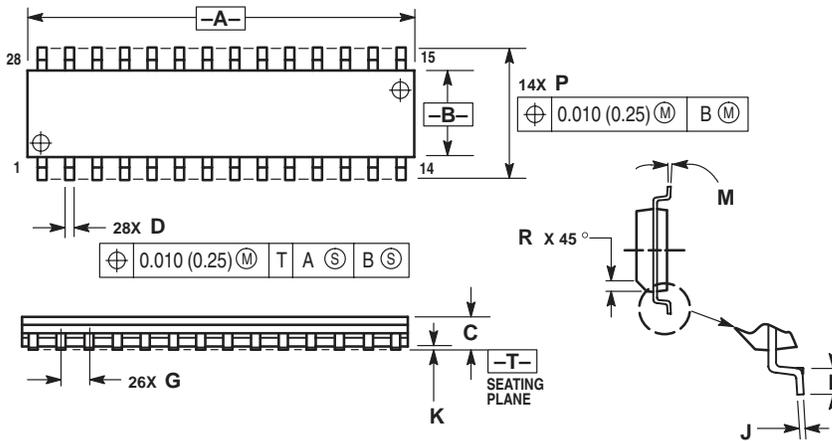
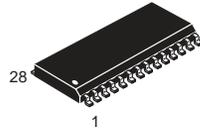
**DW SUFFIX**  
**CASE 751E-04**  
 Plastic Package  
 (SO-24L,  
 SOP (16+4+4)L)  
 ISSUE E



- 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 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	15.25	15.54	0.601	0.612
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0°	8°	0°	8°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

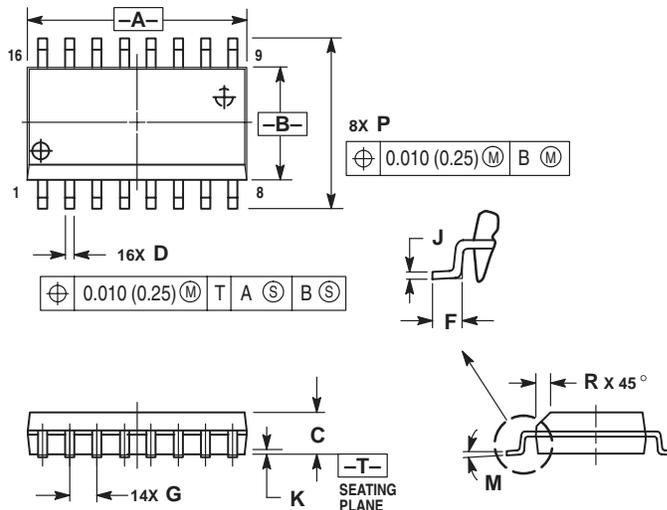
**DW SUFFIX**  
**CASE 751F-04**  
 Plastic Package  
 (SO-28L, SOIC-28)  
 ISSUE E



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION 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 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	17.80	18.05	0.701	0.711
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0°	8°	0°	8°
P	10.01	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

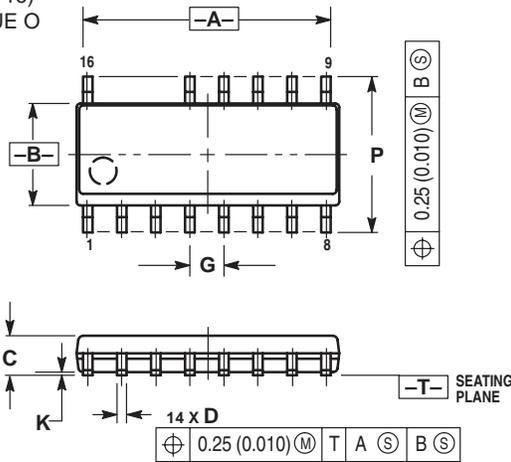
**DW SUFFIX**  
**CASE 751G-02**  
 Plastic Package  
 (SO-16L, SOP-16L,  
 SOP-8+8L)  
 ISSUE A



- 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 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.15	10.45	0.400	0.411
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

**D SUFFIX**  
**CASE 751K-01**  
 Plastic Package  
 (SO-16)  
 ISSUE O

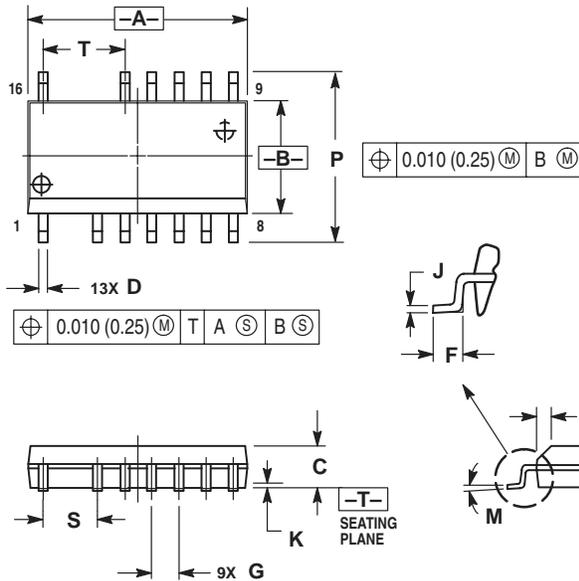


NOTES:

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.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.368	0.393
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	0.19	0.25	0.008	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

**DW SUFFIX**  
**CASE 751N-01**  
 Plastic Package  
 (SOP-16L)  
 ISSUE O

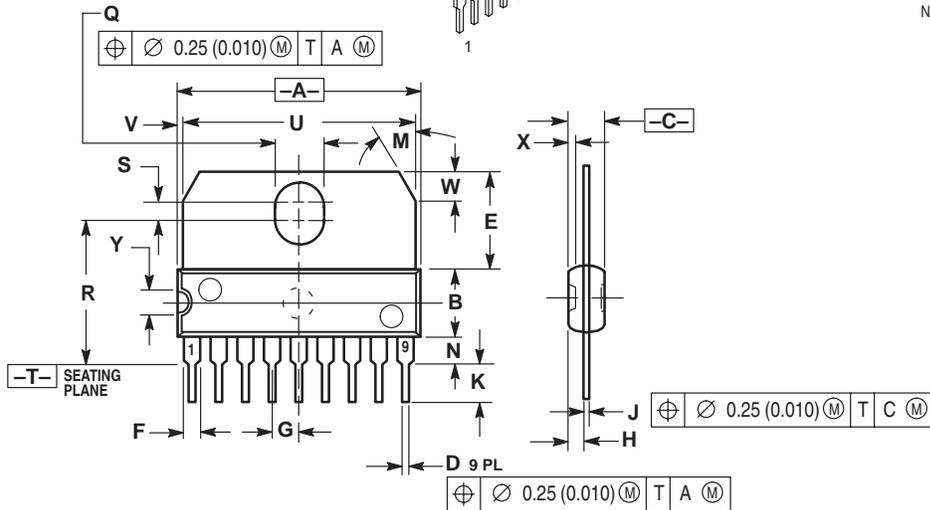
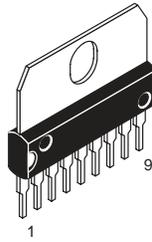


NOTES:

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 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.15	10.45	0.400	0.411
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029
S	2.54 BSC		0.100 BSC	
T	3.81 BSC		0.150 BSC	

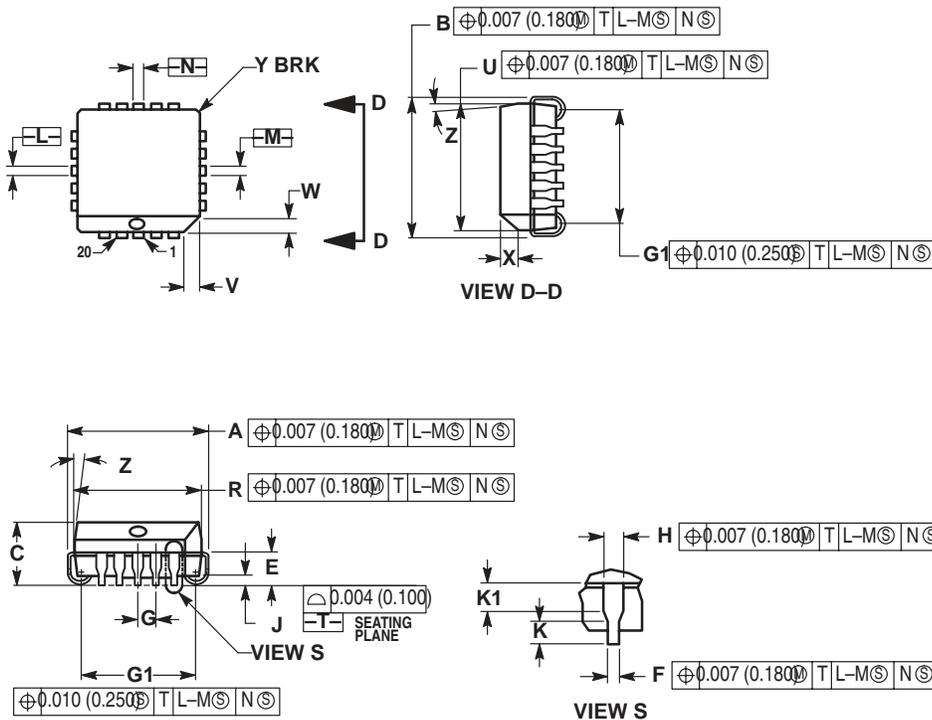
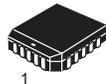
**CASE 762-01**  
 Plastic Medium Power Package  
 (SIP-9)  
 ISSUE C



- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1982.  
 2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	22.40	23.00	0.873	0.897
B	6.40	6.60	0.252	0.260
C	3.45	3.65	0.135	1.143
D	0.40	0.55	0.015	0.021
E	9.35	9.60	0.368	0.377
F	1.40	1.60	0.055	0.062
G	2.54 BSC		0.100 BSC	
H	1.51	1.71	0.059	0.067
J	0.360	0.400	0.014	0.015
K	3.95	4.20	0.155	0.165
M	30° BSC		30° BSC	
N	2.50	2.70	0.099	0.106
Q	3.15	3.45	0.124	0.135
R	13.60	13.90	0.535	0.547
S	1.65	1.95	0.064	0.076
U	22.00	22.20	0.866	0.874
V	0.55	0.75	0.021	0.029
W	2.89 BSC		0.113 BSC	
X	0.65	0.75	0.025	0.029
Y	2.70	2.80	0.106	0.110

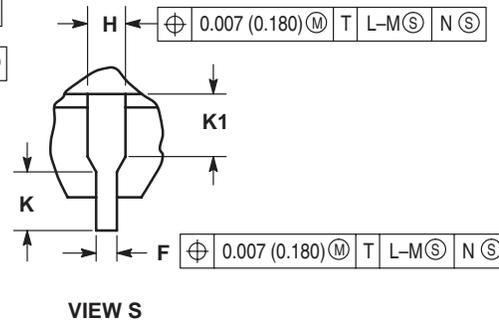
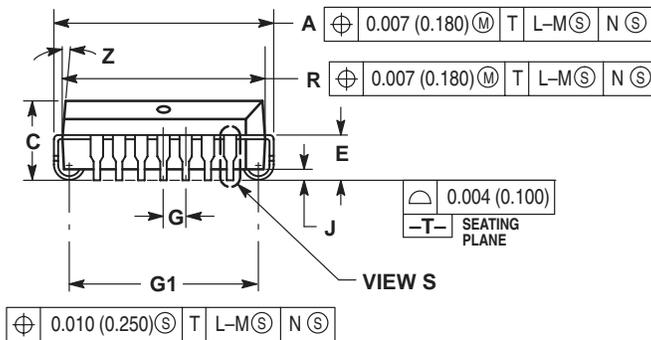
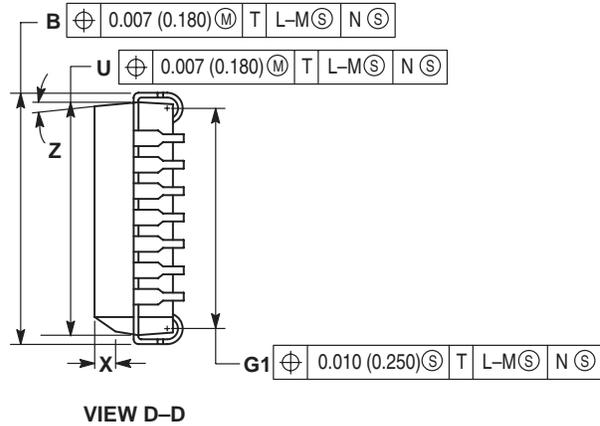
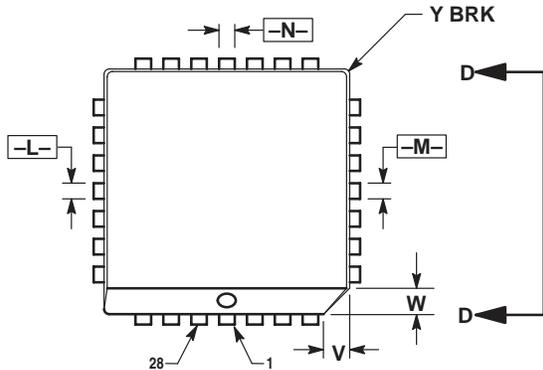
**FN SUFFIX**  
**CASE 775-02**  
 Plastic Package  
 (PLCC-20)  
 ISSUE C



- NOTES:  
 1. DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.  
 2. DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.  
 3. DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.  
 4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 5. CONTROLLING DIMENSION: INCH.  
 6. THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.  
 7. DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.385	0.395	9.78	10.03
B	0.385	0.395	9.78	10.03
C	0.165	0.180	4.20	4.57
E	0.090	0.110	2.29	2.79
F	0.013	0.019	0.33	0.48
G	0.050 BSC		1.27 BSC	
H	0.026	0.032	0.66	0.81
J	0.020	—	0.51	—
K	0.025	—	0.64	—
R	0.350	0.356	8.89	9.04
U	0.350	0.356	8.89	9.04
V	0.042	0.048	1.07	1.21
W	0.042	0.048	1.07	1.21
X	0.042	0.056	1.07	1.42
Y	—	0.020	—	0.50
Z	2°	10°	—	10°
G1	0.310	0.330	7.88	8.38
K1	0.040	—	1.02	—

**FN SUFFIX**  
**CASE 776-02**  
 Plastic Package  
 (PLCC-28)  
 ISSUE D

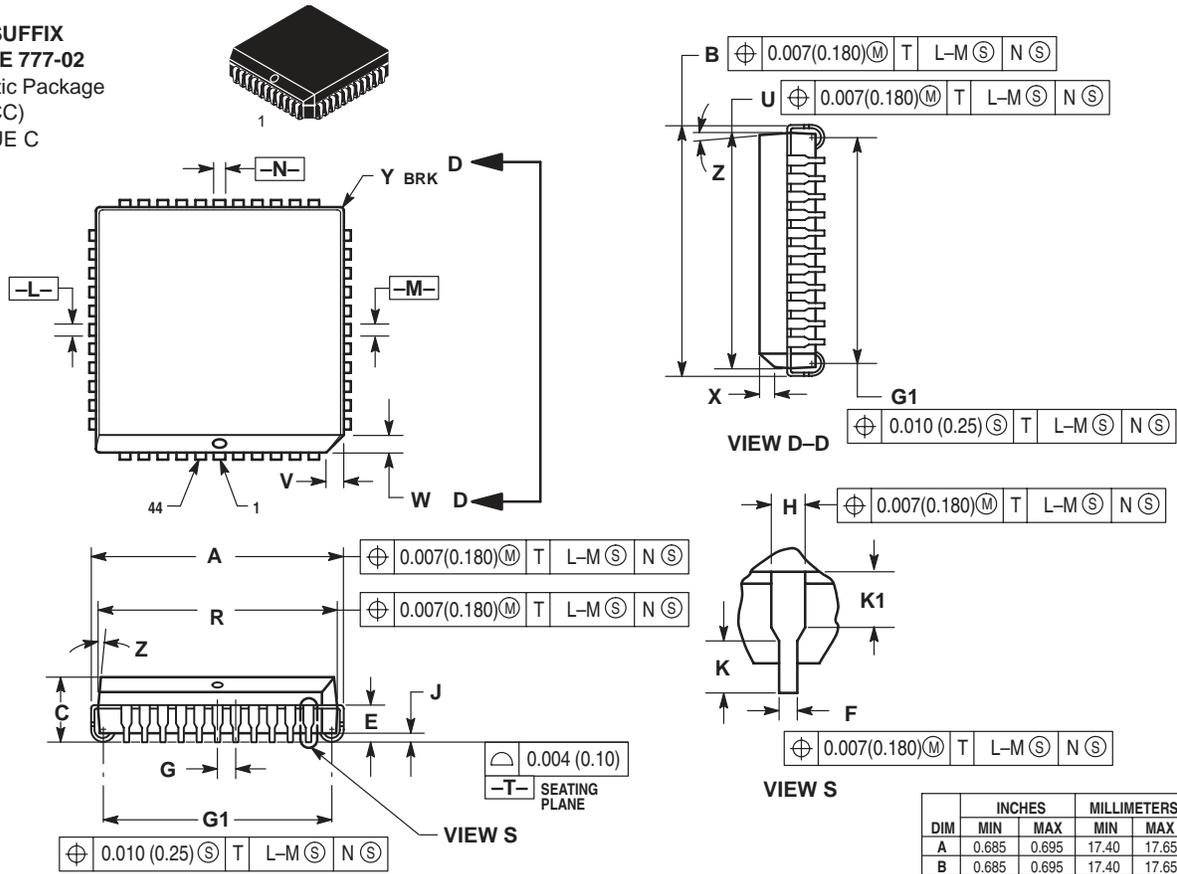


**NOTES:**

- DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
- DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
- DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
- DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.485	0.495	12.32	12.57
B	0.485	0.495	12.32	12.57
C	0.165	0.180	4.20	4.57
E	0.090	0.110	2.29	2.79
F	0.013	0.019	0.33	0.48
G	0.050 BSC		1.27 BSC	
H	0.026	0.032	0.66	0.81
J	0.020	—	0.51	—
K	0.025	—	0.64	—
R	0.450	0.456	11.43	11.58
U	0.450	0.456	11.43	11.58
V	0.042	0.048	1.07	1.21
W	0.042	0.048	1.07	1.21
X	0.042	0.056	1.07	1.42
Y	—	0.020	—	0.50
Z	2°	10°	2°	10°
G1	0.410	0.430	10.42	10.92
K1	0.040	—	1.02	—

**FN SUFFIX**  
**CASE 777-02**  
 Plastic Package  
 (PLCC)  
 ISSUE C

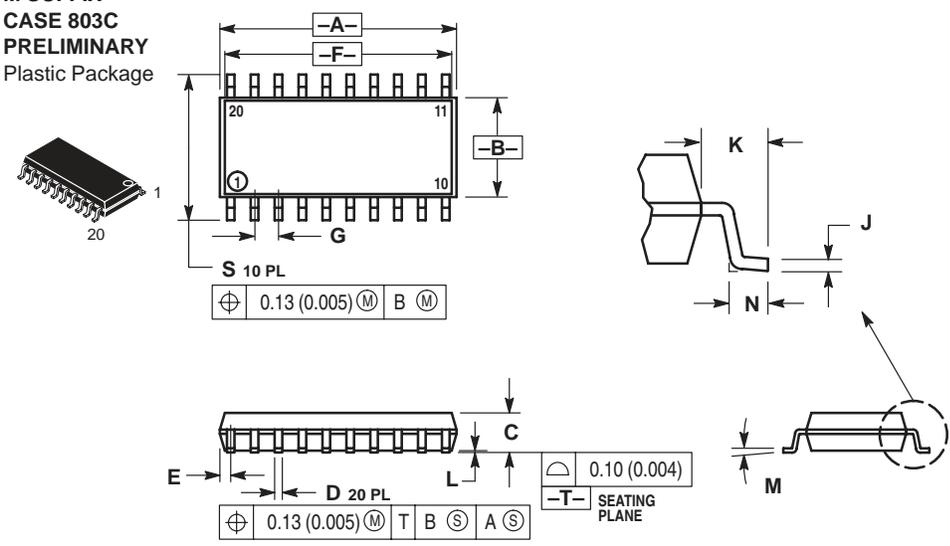


- NOTES:
- DATUMS -L-, -M-, AND -N- ARE DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
  - DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
  - DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.25) PER SIDE.
  - DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: INCH.

- THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
- DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.685	0.695	17.40	17.65
B	0.685	0.695	17.40	17.65
C	0.165	0.180	4.20	4.57
E	0.090	0.110	2.29	2.79
F	0.013	0.019	0.33	0.48
G	0.050 BSC		1.27 BSC	
H	0.026	0.032	0.66	0.81
J	0.020	—	0.51	—
K	0.025	—	0.64	—
R	0.650	0.656	16.51	16.66
U	0.650	0.656	16.51	16.66
V	0.042	0.048	1.07	1.21
W	0.042	0.048	1.07	1.21
X	0.042	0.056	1.07	1.42
Y	—	0.020	—	0.50
Z	2°	10°	2°	10°
G1	0.610	0.630	15.50	16.00
K1	0.040	—	1.02	—

**M SUFFIX**  
**CASE 803C**  
 PRELIMINARY  
 Plastic Package

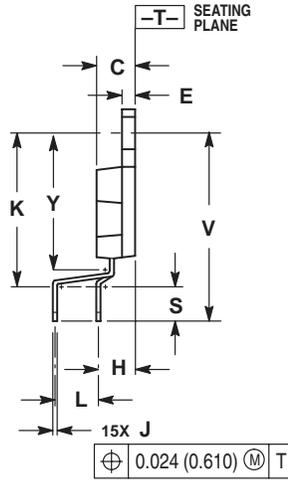
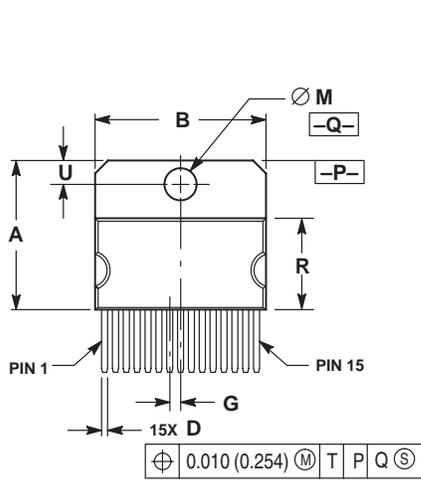
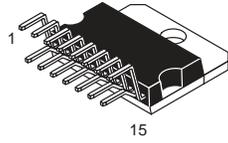


- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: MILLIMETER.
  - DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
  - MAXIMUM MOLD PROTRUSION 0.15 (0.008) PER SIDE.
  - DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.006) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	12.35	12.80	0.486	0.504
B	5.10	5.45	0.201	0.215
C	1.95	2.05	0.077	0.081
D	0.35	0.50	0.014	0.020
E	—	0.81	—	0.032
F	12.40*		0.488*	
G	1.15	1.39	0.045	0.055
H	0.59	0.81	0.023	0.032
J	0.18	0.27	0.007	0.011
K	1.10	1.50	0.043	0.059
L	0.05	0.20	0.001	0.008
M	0°	10°	0°	10°
N	0.50	0.85	0.020	0.033
S	7.40	8.20	0.291	0.323

\*APPROXIMATE

**TV SUFFIX**  
**CASE 821C-04**  
 Plastic Package  
 (15-Pin ZIP)  
 ISSUE D

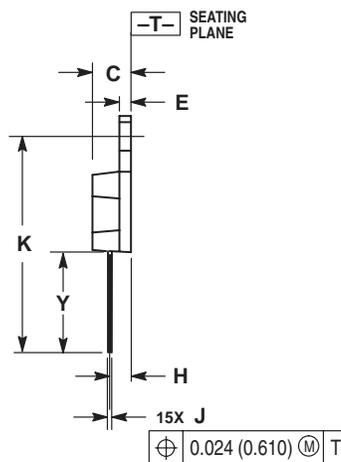
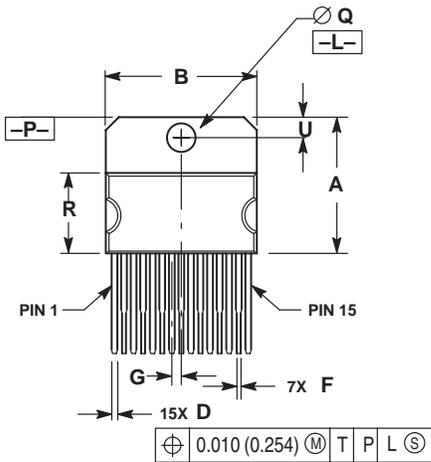
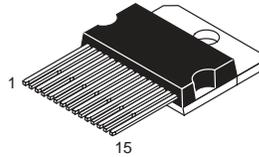


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION R DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
5. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 (0.250).
6. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.003 (0.076) TOTAL IN EXCESS OF THE D DIMENSION, AT MAXIMUM MATERIAL CONDITION.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.684	0.694	17.374	17.627
B	0.784	0.792	19.914	20.116
C	0.173	0.181	4.395	4.597
D	0.024	0.031	0.610	0.787
E	0.058	0.062	1.473	1.574
G	0.050 BSC		1.270 BSC	
H	0.169 BSC		4.293 BSC	
J	0.018	0.024	0.458	0.609
K	0.700	0.710	17.780	18.034
L	0.200 BSC		5.080 BSC	
M	0.148	0.151	3.760	3.835
R	0.416	0.426	10.567	10.820
S	0.157	0.167	3.988	4.242
U	0.105	0.115	2.667	2.921
V	0.868 REF		22.047 REF	
Y	0.625	0.639	15.875	16.231

**T SUFFIX**  
**CASE 821D-03**  
 Plastic Package  
 ISSUE C

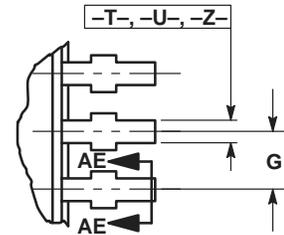
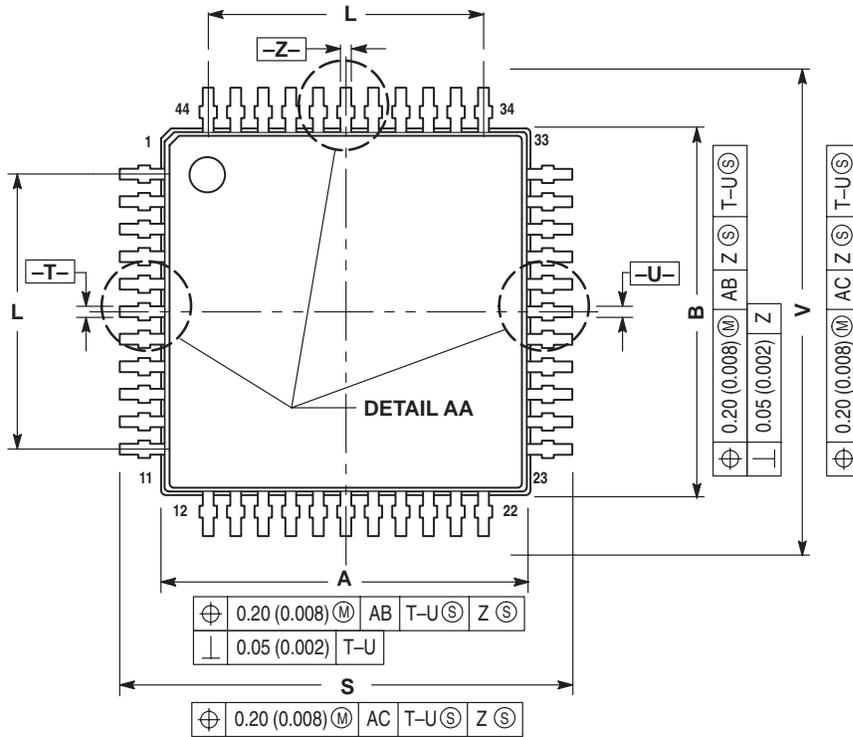


**NOTES:**

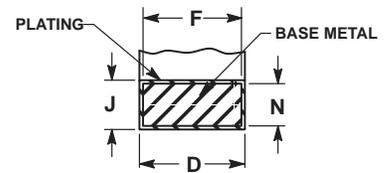
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION R DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
5. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 (0.250).
6. DELETED
7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.003 (0.076) TOTAL IN EXCESS OF THE D DIMENSION, AT MAXIMUM MATERIAL CONDITION.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.681	0.694	17.298	17.627
B	0.784	0.792	19.914	20.116
C	0.173	0.181	4.395	4.597
D	0.024	0.031	0.610	0.787
E	0.058	0.062	1.473	1.574
F	0.016	0.023	0.407	0.584
G	0.050 BSC		1.270 BSC	
H	0.110 BSC		2.794 BSC	
J	0.018	0.024	0.458	0.609
K	1.078	1.086	27.382	27.584
Q	0.148	0.151	3.760	3.835
R	0.416	0.426	10.567	10.820
U	0.110 BSC		2.794 BSC	
Y	0.503 REF		12.776 REF	

**FTB SUFFIX**  
**CASE 824D-01**  
 Plastic Package  
 (TQFP-44)  
 ISSUE O



**DETAIL AA**

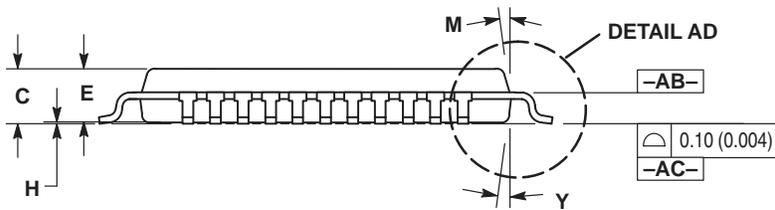


⊕	0.20 (0.008) (M)	AC	T-U (S)	Z (S)
---	------------------	----	---------	-------

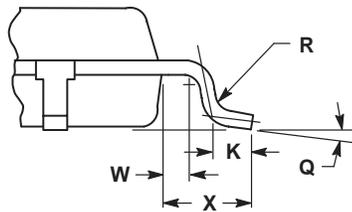
**SECTION AE-AE**

**NOTES:**

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
- DATUMS -T-, -U- AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
- DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -AC-.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -AB-.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.530 (0.021).



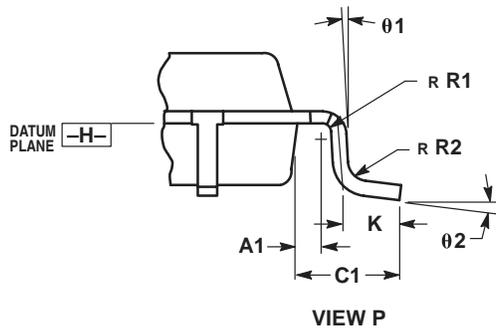
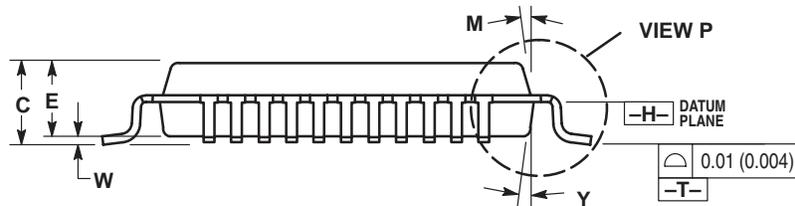
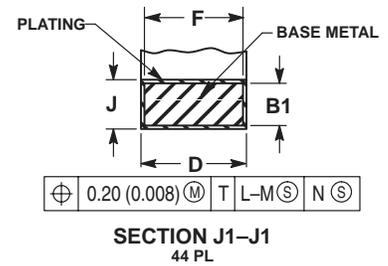
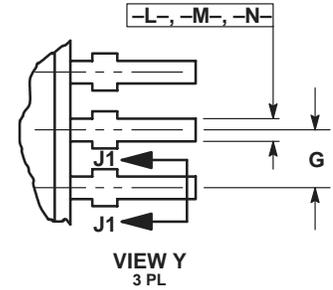
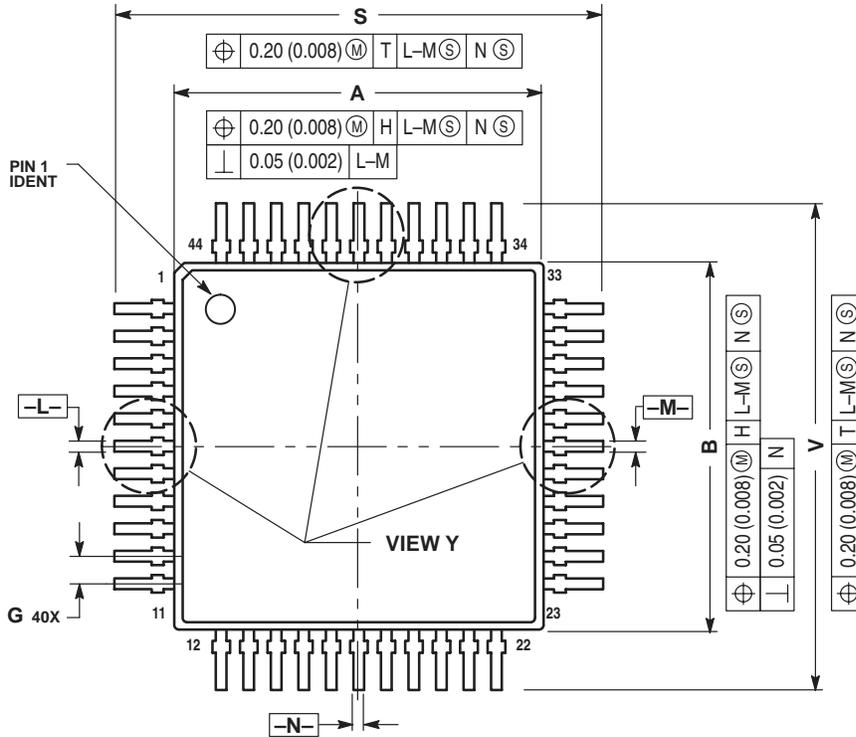
**DETAIL AD**



**VIEW AD**

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.950	10.050	0.392	0.396
B	9.950	10.050	0.392	0.396
C	1.400	1.600	0.055	0.063
D	0.300	0.450	0.012	0.018
E	1.350	1.450	0.053	0.057
F	0.300	0.400	0.012	0.016
G	0.800 BSC		0.031 BSC	
H	0.050	0.150	0.002	0.006
J	0.090	0.200	0.004	0.008
K	0.450	0.550	0.018	0.022
L	8.000 BSC		0.315 BSC	
M	12° REF		12° REF	
N	0.090	0.160	0.004	0.006
Q	1°	5°	1°	5°
R	0.100	0.200	0.004	0.008
S	11.900	12.100	0.469	0.476
V	11.900	12.100	0.469	0.476
W	0.200 REF		0.008 REF	
X	1.000 REF		0.039 REF	
Y	12° REF		12° REF	

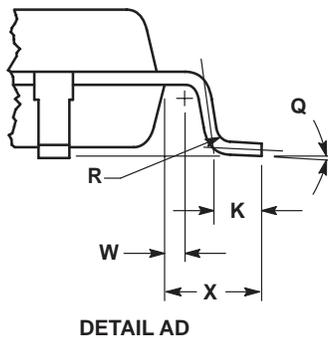
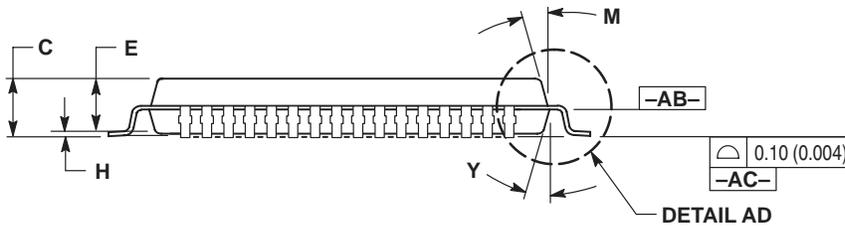
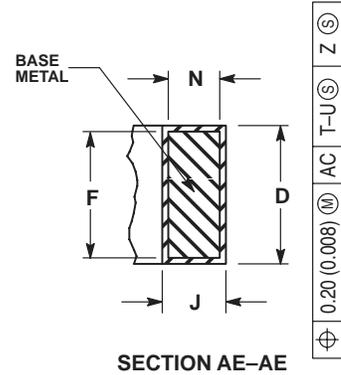
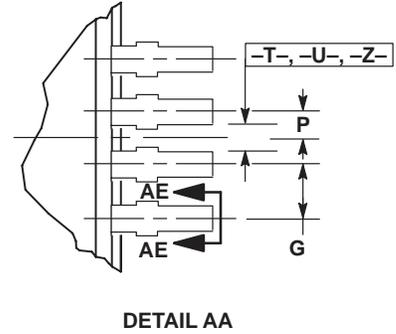
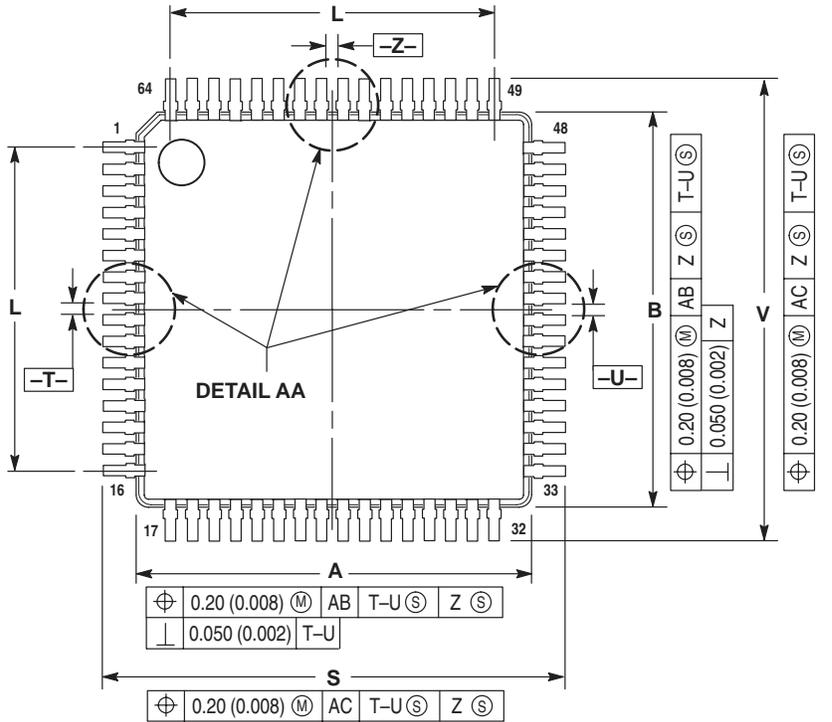
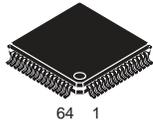
**FB SUFFIX**  
**CASE 824E-02**  
 Plastic Package  
 (QFP)  
 ISSUE A



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DATUM PLANE -H- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  4. DATUMS -L-, -M- AND -N- TO BE DETERMINED AT DATUM PLANE -H-.
  5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -T-.
  6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
  7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.530 (0.021).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.90	10.10	0.390	0.398
B	9.90	10.10	0.390	0.398
C	2.00	2.21	0.079	0.087
D	0.30	0.45	0.0118	0.0177
E	2.00	2.10	0.079	0.083
F	0.30	0.40	0.012	0.016
G	0.80 BSC		0.031 BSC	
J	0.13	0.23	0.005	0.009
K	0.65	0.95	0.026	0.037
M	5° 10°		5° 10°	
S	12.95	13.45	0.510	0.530
V	12.95	13.45	0.510	0.530
W	0.000	0.210	0.000	0.008
Y	5° 10°		5° 10°	
A1	0.450 REF		0.018 REF	
B1	0.130	0.170	0.005	0.007
C1	1.600 REF		0.063 REF	
R1	0.130	0.300	0.005	0.012
R2	0.130	0.300	0.005	0.012
theta 1	5° 10°		5° 10°	
theta 2	0° 7°		0° 7°	

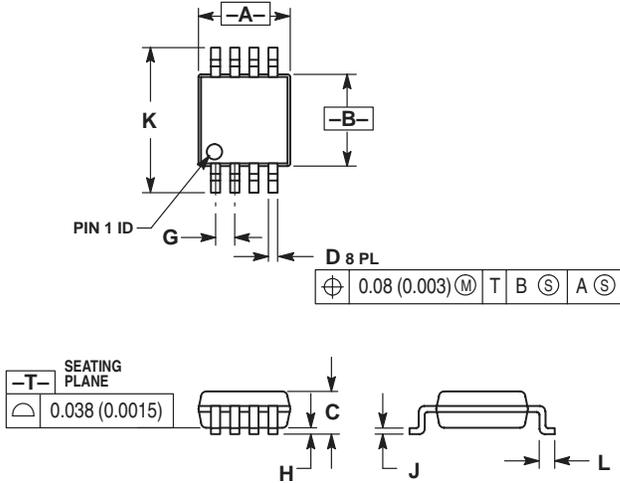
**FB SUFFIX**  
**CASE 840F-01**  
 Plastic Package  
 ISSUE O



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  4. DATUMS -T-, -U- AND -Z- TO BE DETERMINED AT DATUM PLANE -AC-.
  5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -AC-.
  6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -AB-.
  7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.350 (0.014).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.950	10.050	0.392	0.396
B	9.950	10.050	0.392	0.396
C	1.400	1.600	0.055	0.063
D	0.170	0.270	0.007	0.011
E	1.350	1.450	0.053	0.057
F	0.170	0.230	0.007	0.009
G	0.500 BSC		0.020 BSC	
H	0.050	0.150	0.002	0.006
J	0.090	0.200	0.004	0.008
K	0.450	0.550	0.018	0.022
L	7.500 BSC		0.295 BSC	
M	12° REF		12° REF	
N	0.090	0.160	0.004	0.006
P	0.250 BSC		0.010 BSC	
Q	1°	5°	1°	5°
R	0.100	0.200	0.004	0.008
S	11.900	12.100	0.469	0.476
V	11.900	12.100	0.469	0.476
W	0.200 REF		0.008 REF	
X	1.000 REF		0.039 REF	
Y	12° REF		12° REF	

**DM SUFFIX**  
**CASE 846A-02**  
 Plastic Package  
 (Micro-8)  
 ISSUE C

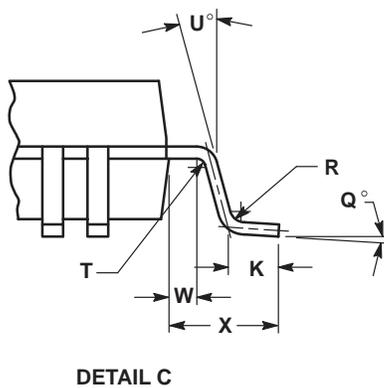
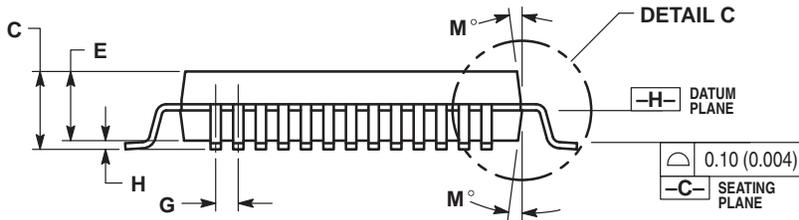
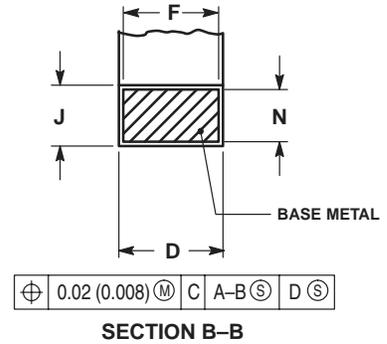
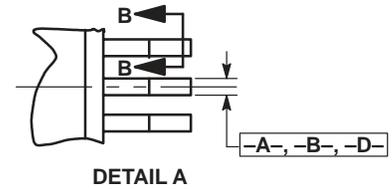
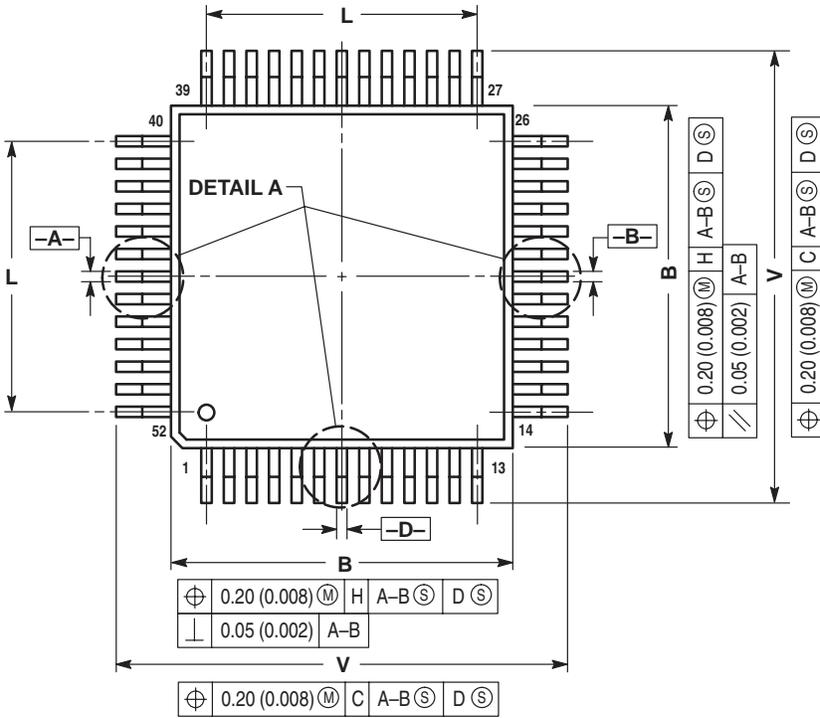
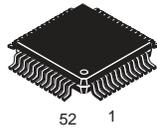


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	2.90	3.10	0.114	0.122
C	—	1.10	—	0.043
D	0.25	0.40	0.010	0.016
G	0.65 BSC		0.026 BSC	
H	0.05	0.15	0.002	0.006
J	0.13	0.23	0.005	0.009
K	4.75	5.05	0.187	0.199
L	0.40	0.70	0.016	0.028

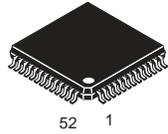
**FB SUFFIX**  
**CASE 848B-04**  
 Plastic Package  
 (TQFP-52)  
 ISSUE C



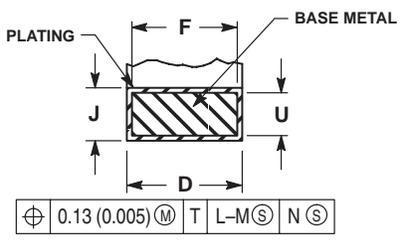
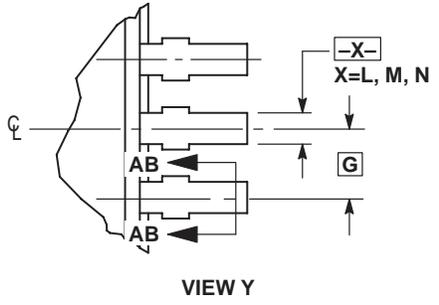
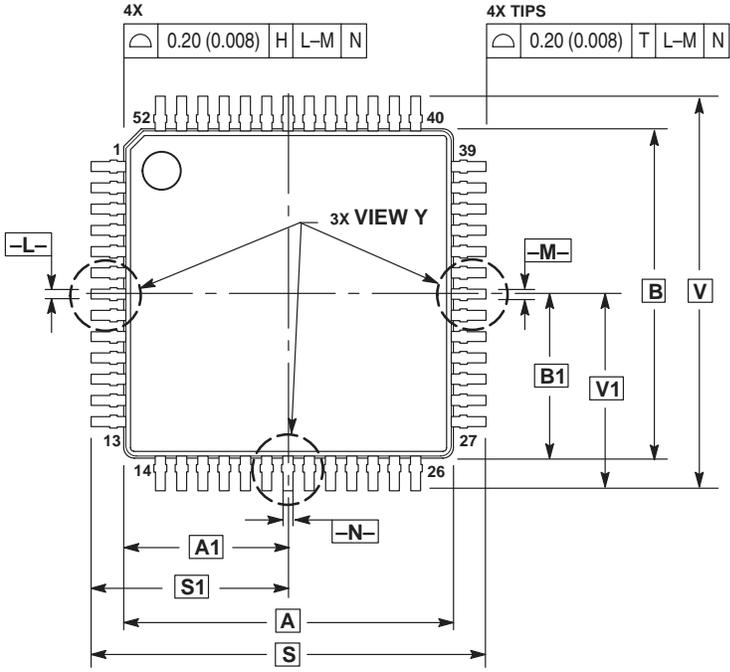
- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: MILLIMETER.
  - DATUM PLANE -H- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  - DATUMS -A-, -B- AND -D- TO BE DETERMINED AT DATUM PLANE -H-.
  - DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -C-.
  - DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
  - DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.90	10.10	0.390	0.398
B	9.90	10.10	0.390	0.398
C	2.10	2.45	0.083	0.096
D	0.22	0.38	0.009	0.015
E	2.00	2.10	0.079	0.083
F	0.22	0.33	0.009	0.013
G	0.65 BSC		0.026 BSC	
H	— 0.25		— 0.010	
J	0.13	0.23	0.005	0.009
K	0.65	0.95	0.026	0.037
L	7.80 REF		0.307 REF	
M	5°	10°	5°	10°
N	0.13	0.17	0.005	0.007
Q	0° 7°		0° 7°	
R	0.13	0.30	0.005	0.012
S	12.95	13.45	0.510	0.530
T	0.13		0.005	
U	0°		0°	
V	12.95	13.45	0.510	0.530
W	0.35	0.45	0.014	0.018
X	1.6 REF		0.063 REF	

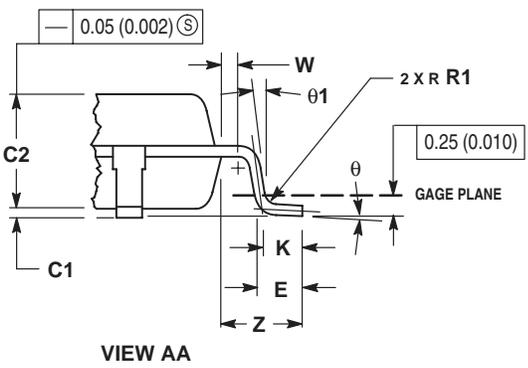
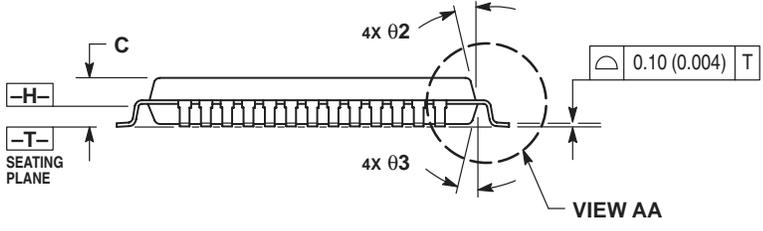
**FB SUFFIX**  
**CASE 848D-03**  
 Plastic Package  
 ISSUE C



52 1



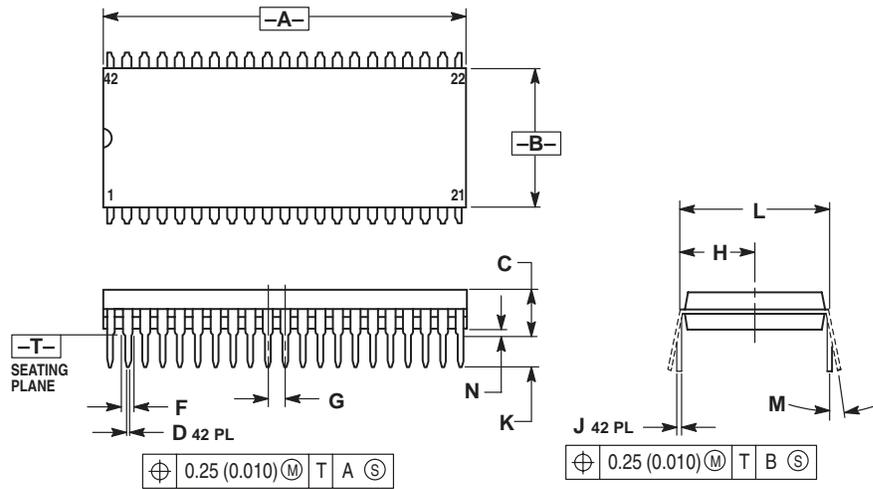
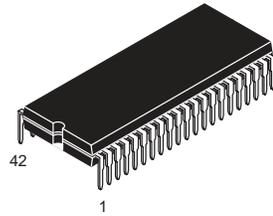
**SECTION AB-AB**  
 ROTATED 90° CLOCKWISE



- NOTES:**
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DATUM PLANE -H- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  4. DATUMS -L-, -M- AND -N- TO BE DETERMINED AT DATUM PLANE -H-.
  5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -T-.
  6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
  7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED 0.46 (0.018). MINIMUM SPACE BETWEEN PROTRUSION AND ADJACENT LEAD OR PROTRUSION 0.07 (0.003).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.00 BSC	0.394 BSC		
A1	5.00 BSC	0.197 BSC		
B	10.00 BSC	0.394 BSC		
B1	5.00 BSC	0.197 BSC		
C	—	1.70	—	0.067
C1	0.05	0.20	0.002	0.008
C2	1.30	1.50	0.051	0.059
D	0.20	0.40	0.008	0.016
E	0.45	0.75	0.018	0.030
F	0.22	0.35	0.009	0.014
G	0.65 BSC	0.026 BSC		
J	0.07	0.20	0.003	0.008
K	0.50 REF	0.020 REF		
R1	0.08	0.20	0.003	0.008
S	12.00 BSC	0.472 BSC		
S1	6.00 BSC	0.236 BSC		
U	0.09	0.16	0.004	0.006
V	12.00 BSC	0.472 BSC		
V1	6.00 BSC	0.236 BSC		
W	0.20 REF	0.008 REF		
Z	1.00 REF	0.039 REF		
theta	0°	7°	0°	7°
theta1	0°	—	0°	—
theta2	12° REF	12° REF		
theta3	5°	13°	5°	13°

**B SUFFIX**  
**CASE 858-01**  
 Plastic Package  
 ISSUE O

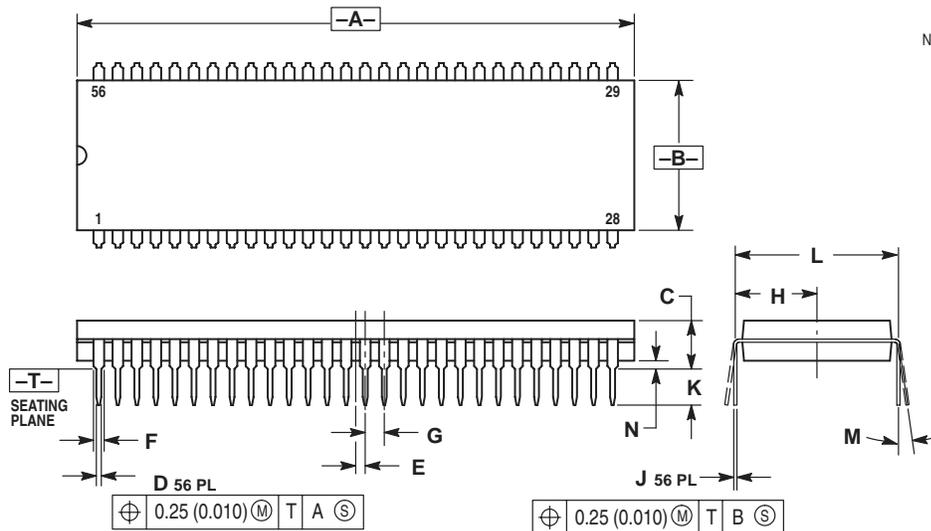
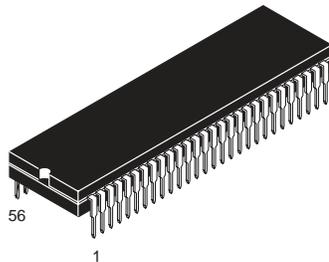


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH. MAXIMUM MOLD FLASH 0.25 (0.010).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.435	1.465	36.45	37.21
B	0.540	0.560	13.72	14.22
C	0.155	0.200	3.94	5.08
D	0.014	0.022	0.36	0.56
F	0.032	0.046	0.81	1.17
G	0.070 BSC		1.778 BSC	
H	0.300 BSC		7.62 BSC	
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.600 BSC		15.24 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.02

**B SUFFIX**  
**CASE 859-01**  
 Plastic Package  
 (SDIP)  
 ISSUE O

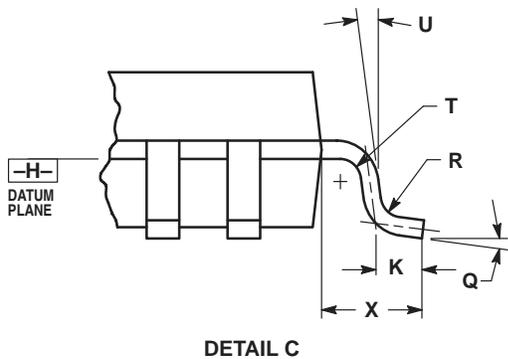
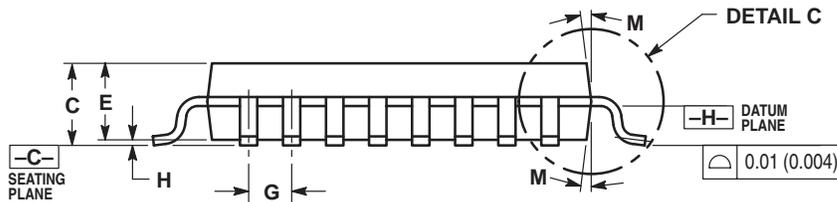
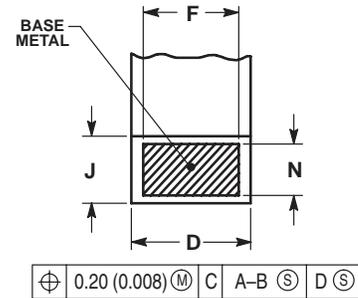
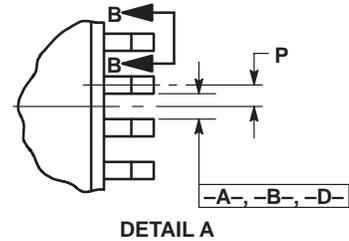
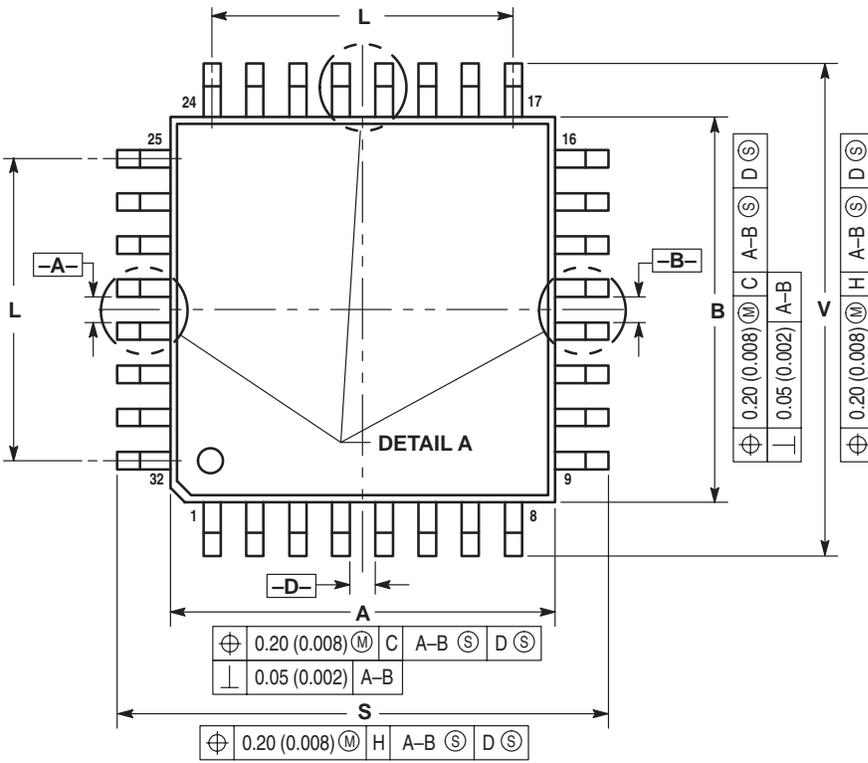


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH. MAXIMUM MOLD FLASH 0.25 (0.010)

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	2.035	2.065	51.69	52.45
B	0.540	0.560	13.72	14.22
C	0.155	0.200	3.94	5.08
D	0.014	0.022	0.36	0.56
E	0.035 BSC		0.89 BSC	
F	0.032	0.046	0.81	1.17
G	0.070 BSC		1.778 BSC	
H	0.300 BSC		7.62 BSC	
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.600 BSC		15.24 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.02

**FB, FTB SUFFIX**  
**CASE 873-01**  
 Plastic Package  
 (TQFP-32)  
 ISSUE A

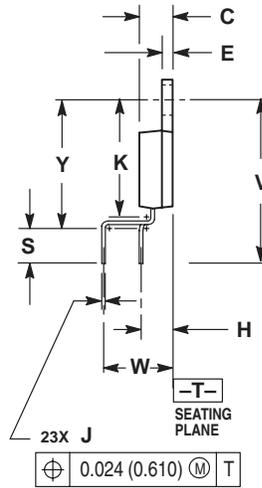
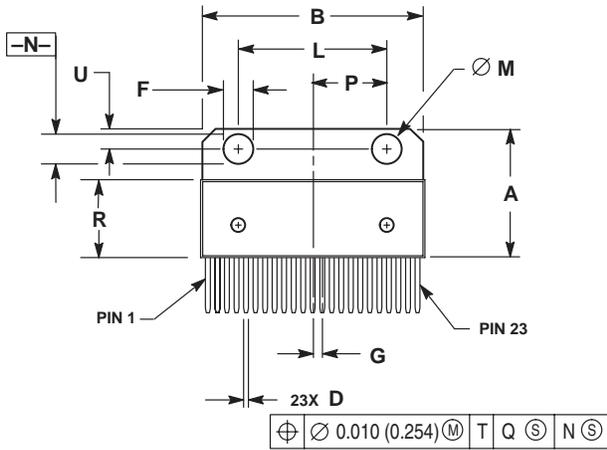
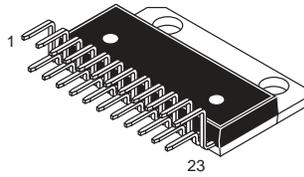


**NOTES:**

- DIMENSION AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DATUM PLANE -H- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
- DATUMS -A-, -B- AND -D- TO BE DETERMINED AT DATUM PLANE -H-.
- DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -C-.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.95	7.10	0.274	0.280
B	6.95	7.10	0.274	0.280
C	1.40	1.60	0.055	0.063
D	0.273	0.373	0.010	0.015
E	1.30	1.50	0.051	0.059
F	0.273	—	0.010	—
G	0.80	BSC	0.031	BSC
H	—	0.20	—	0.008
J	0.119	0.197	0.005	0.008
K	0.33	0.57	0.013	0.022
L	5.6	REF	0.220	REF
M	6°	8°	6°	8°
N	0.119	0.135	0.005	0.005
P	0.40	BSC	0.016	BSC
Q	5°	10°	5°	10°
R	0.15	0.25	0.006	0.010
S	8.85	9.15	0.348	0.360
T	0.15	0.25	0.006	0.010
U	5°	11°	5°	11°
V	8.85	9.15	0.348	0.360
X	1.00	REF	0.039	REF

**T SUFFIX**  
**CASE 894-03**  
 Plastic Package  
 (23-Pin SZIP)  
 ISSUE B

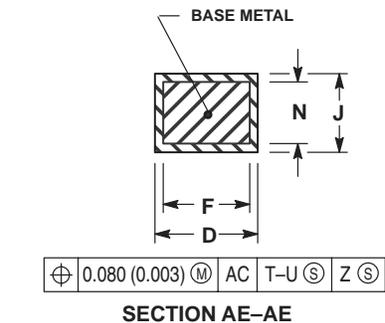
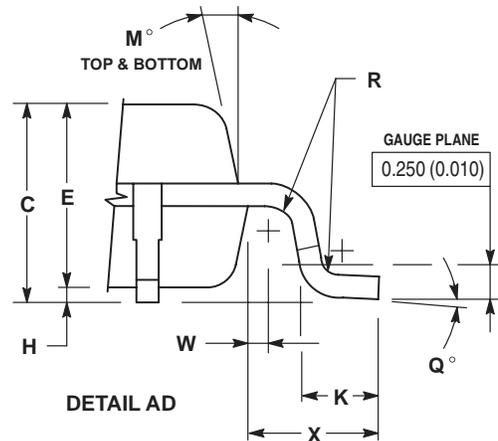
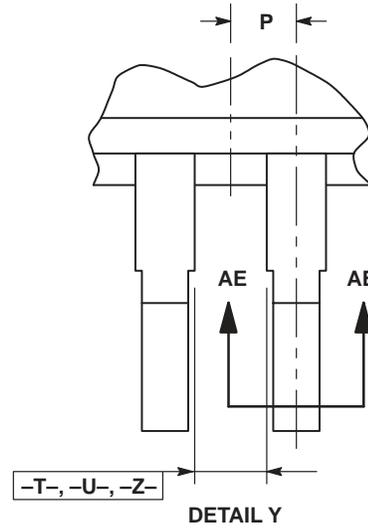
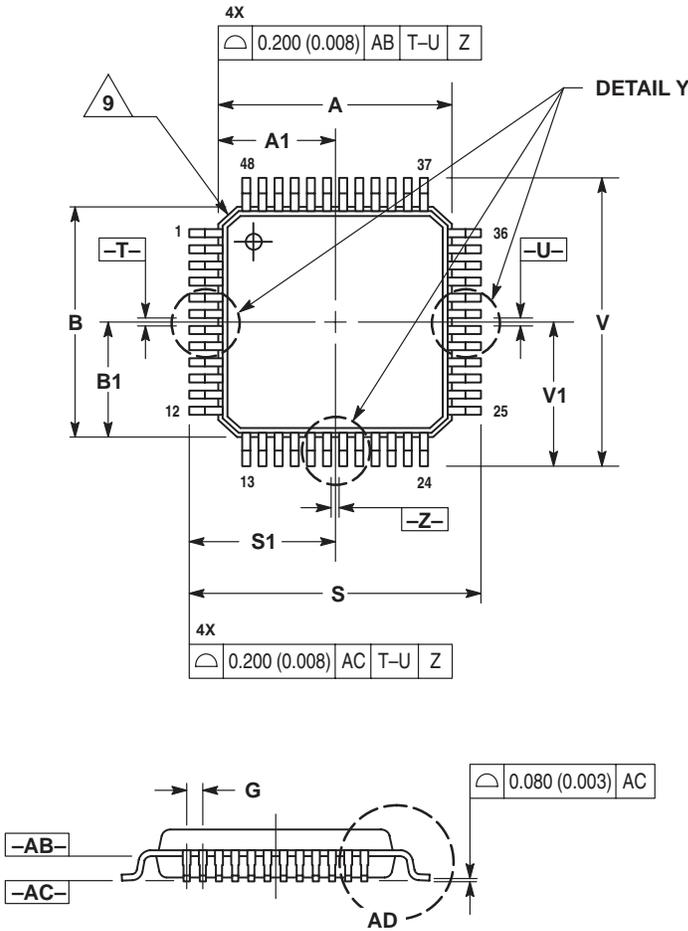
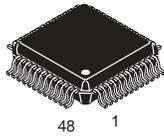


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION R DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
5. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 (0.250).
6. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.003 (0.076) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.684	0.694	17.374	17.627
B	1.183	1.193	30.048	30.302
C	0.175	0.179	4.445	4.547
D	0.026	0.031	0.660	0.787
E	0.058	0.062	1.473	1.574
F	0.165	0.175	4.191	4.445
G	0.050 BSC		1.270 BSC	
H	0.169 BSC		4.293 BSC	
J	0.014	0.020	0.356	0.508
K	0.625	0.639	15.875	16.231
L	0.770	0.790	19.558	20.066
M	0.148	0.152	3.760	3.861
N	0.148	0.152	3.760	3.861
P	0.390 BSC		9.906 BSC	
R	0.416	0.424	10.566	10.770
S	0.157	0.167	3.988	4.242
U	0.105	0.115	2.667	2.921
V	0.868 REF		22.047 REF	
W	0.200 BSC		5.080 BSC	
Y	0.700	0.710	17.780	18.034

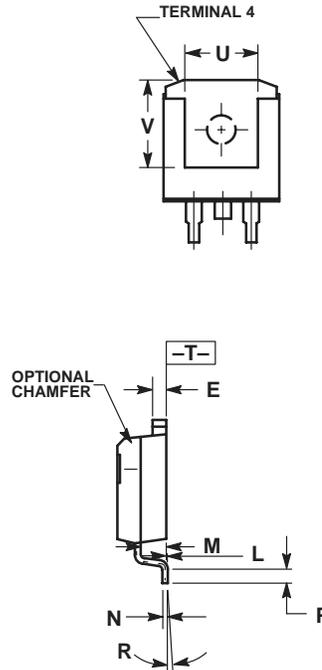
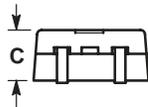
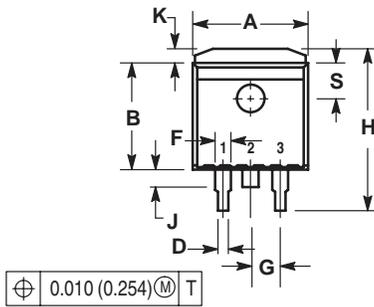
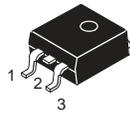
FTA SUFFIX  
CASE 932-02  
Plastic Package  
(TQFP-48)  
ISSUE D



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  4. DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
  5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -AC-.
  6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -AB-.
  7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.350 (0.014).
  8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076 (0.0003).
  9. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	7.000 BSC		0.276 BSC	
A1	3.500 BSC		0.138 BSC	
B	7.000 BSC		0.276 BSC	
B1	3.500 BSC		0.138 BSC	
C	1.400	1.600	0.055	0.063
D	0.170	0.270	0.007	0.011
E	1.350	1.450	0.053	0.057
F	0.170	0.230	0.007	0.009
G	0.500 BASIC		0.020 BASIC	
H	0.050	0.150	0.002	0.006
J	0.090	0.200	0.004	0.008
K	0.500	0.700	0.020	0.028
M	12° REF		12° REF	
N	0.090	0.160	0.004	0.006
P	0.250 BASIC		0.010 BASIC	
Q	1°	5°	1°	5°
R	0.150	0.250	0.006	0.010
S	9.000 BSC		0.354 BSC	
S1	4.500 BSC		0.177 BSC	
V	9.000 BSC		0.354 BSC	
V1	4.500 BSC		0.177 BSC	
W	0.200 REF		0.008 REF	
X	1.000 REF		0.039 REF	

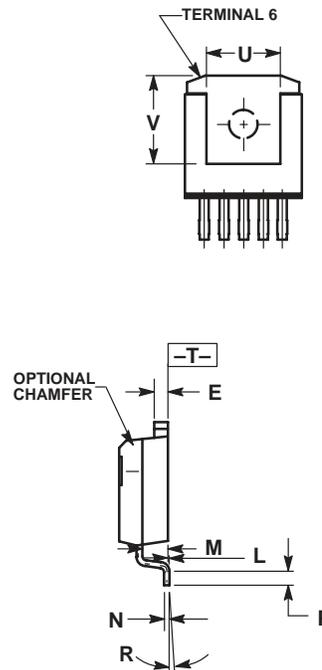
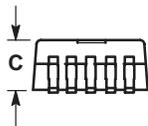
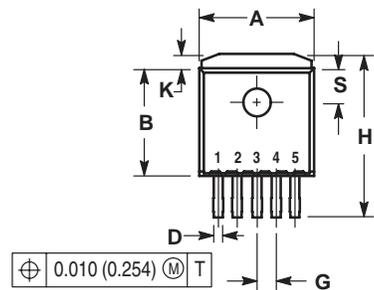
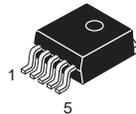
**D2T SUFFIX**  
**CASE 936-03**  
 Plastic Package  
 ISSUE B



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. TAB CONTOUR OPTIONAL WITHIN DIMENSIONS A AND K.
  4. DIMENSIONS U AND V ESTABLISH A MINIMUM MOUNTING SURFACE FOR TERMINAL 4.
  5. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.025 (0.635) MAXIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.386	0.403	9.804	10.236
B	0.356	0.368	9.042	9.347
C	0.170	0.180	4.318	4.572
D	0.026	0.036	0.660	0.914
E	0.045	0.055	1.143	1.397
F	0.051 REF		1.295 REF	
G	0.100 BSC		2.540 BSC	
H	0.539	0.579	13.691	14.707
J	0.125 MAX		3.175 MAX	
K	0.050 REF		1.270 REF	
L	0.000	0.010	0.000	0.254
M	0.088	0.102	2.235	2.591
N	0.018	0.026	0.457	0.660
P	0.058	0.078	1.473	1.981
R	5° REF		5° REF	
S	0.116 REF		2.946 REF	
U	0.200 MIN		5.080 MIN	
V	0.250 MIN		6.350 MIN	

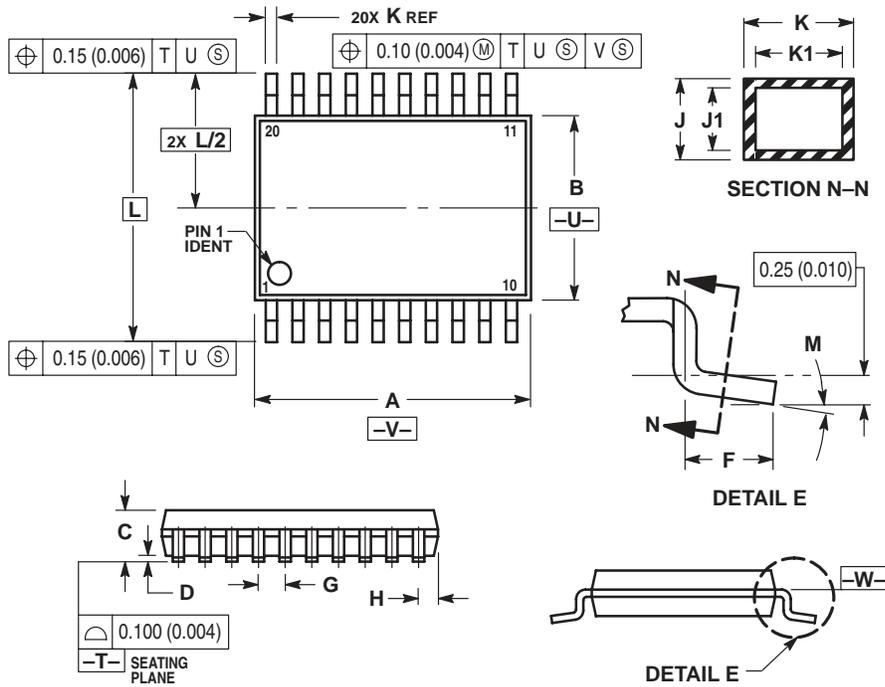
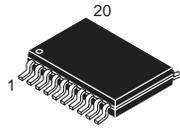
**D2T SUFFIX**  
**CASE 936A-02**  
 Plastic Package  
 (D<sup>2</sup>PAK)  
 ISSUE A



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. TAB CONTOUR OPTIONAL WITHIN DIMENSIONS A AND K.
  4. DIMENSIONS U AND V ESTABLISH A MINIMUM MOUNTING SURFACE FOR TERMINAL 6.
  5. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.025 (0.635) MAXIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.386	0.403	9.804	10.236
B	0.356	0.368	9.042	9.347
C	0.170	0.180	4.318	4.572
D	0.026	0.036	0.660	0.914
E	0.045	0.055	1.143	1.397
G	0.067 BSC		1.702 BSC	
H	0.539	0.579	13.691	14.707
K	0.050 REF		1.270 REF	
L	0.000	0.010	0.000	0.254
M	0.088	0.102	2.235	2.591
N	0.018	0.026	0.457	0.660
P	0.058	0.078	1.473	1.981
R	5° REF		5° REF	
S	0.116 REF		2.946 REF	
U	0.200 MIN		5.080 MIN	
V	0.250 MIN		6.350 MIN	

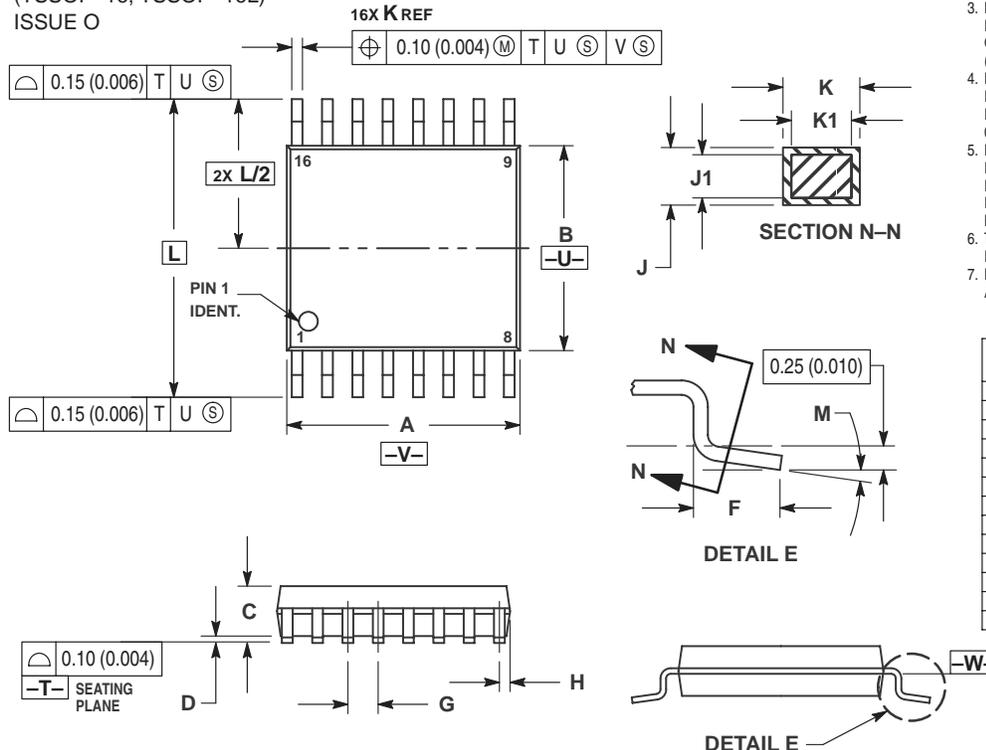
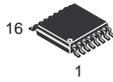
**DT, DTB SUFFIX**  
**CASE 948E-02**  
 Plastic Package  
 (TSSOP-20)  
 ISSUE A



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
  5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

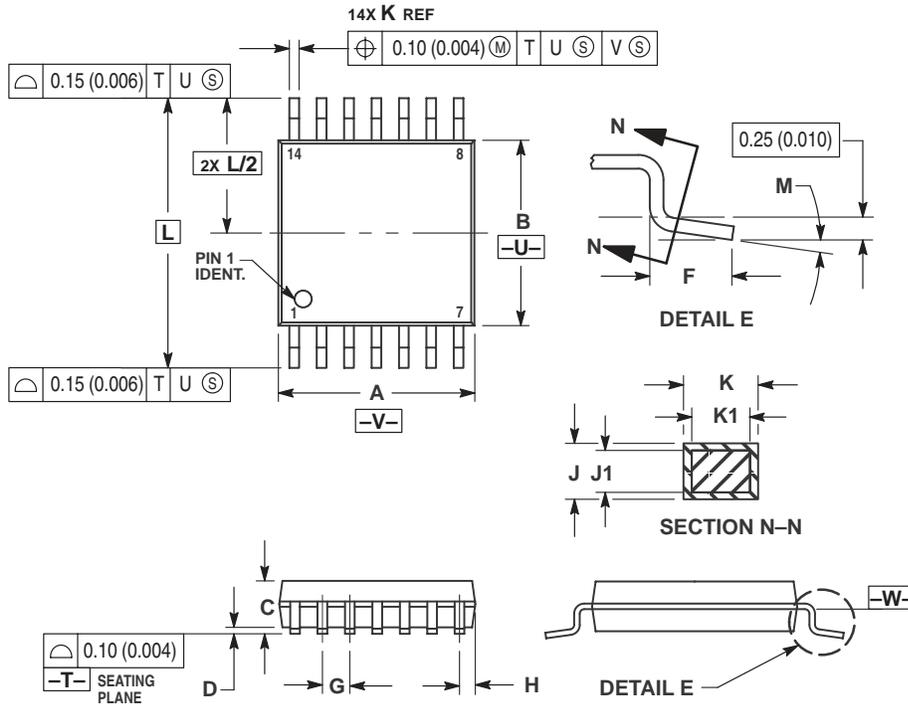
**DTB SUFFIX**  
**CASE 948F-01**  
 Plastic Package  
 (TSSOP-16, TSSOP-16L)  
 ISSUE O



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
  5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

**DTB SUFFIX**  
**CASE 948G-01**  
 Plastic Package  
 (TSSOP-14)  
 ISSUE O

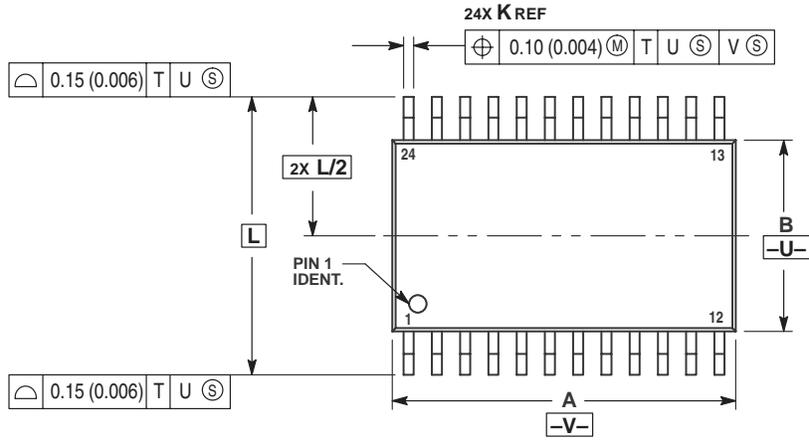
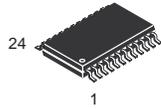


**NOTES:**

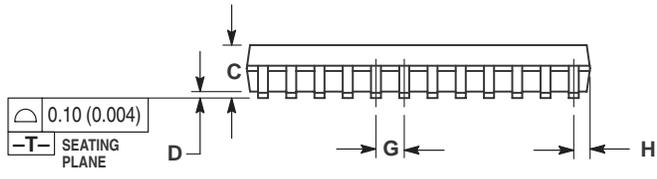
- 1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION: MILLIMETER.
- 3 DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
- 4 DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
- 5 DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
- 6 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
- 7 DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

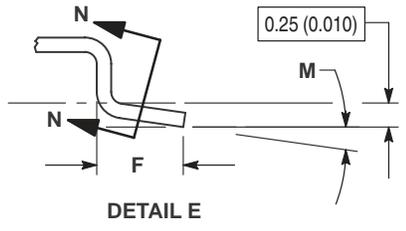
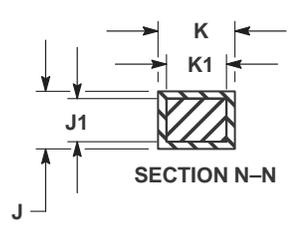
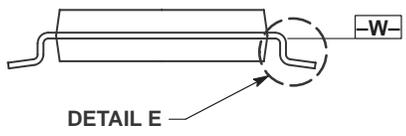
**DTB SUFFIX**  
**CASE 948H-01**  
 Plastic Package  
 ISSUE O



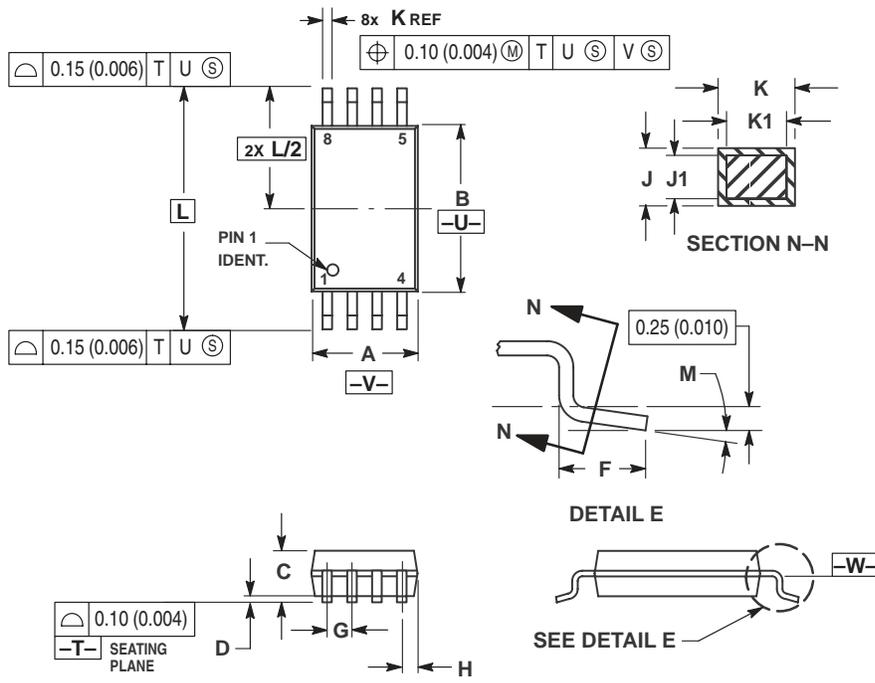
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
  5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	7.70	7.90	0.303	0.311
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°



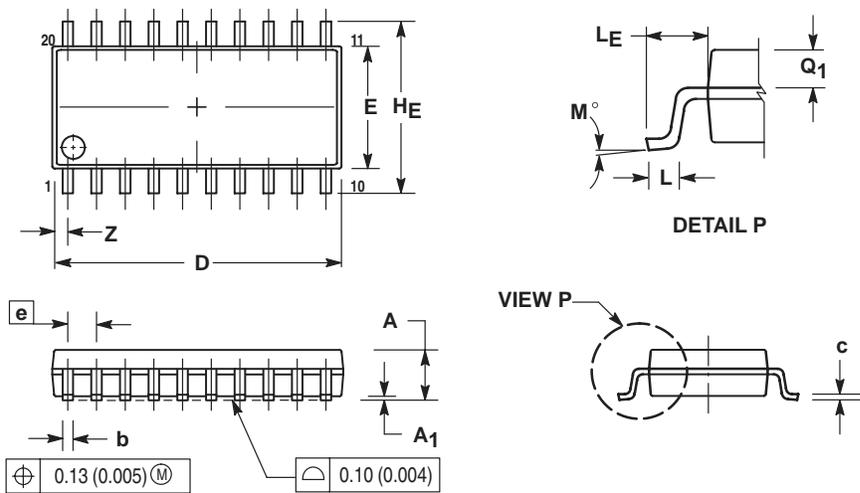
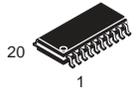
**DTB SUFFIX**  
**CASE 948J-01**  
 Plastic Package  
 (TSSOP-8)  
 ISSUE O



- NOTES:
- 1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - 2 CONTROLLING DIMENSION: MILLIMETER.
  - 3 DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  - 4 DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
  - 5 DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
  - 6 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  - 7 DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

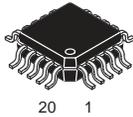
**M SUFFIX**  
**CASE 967-01**  
 Plastic Package  
 (EIAJ-20)  
 ISSUE O



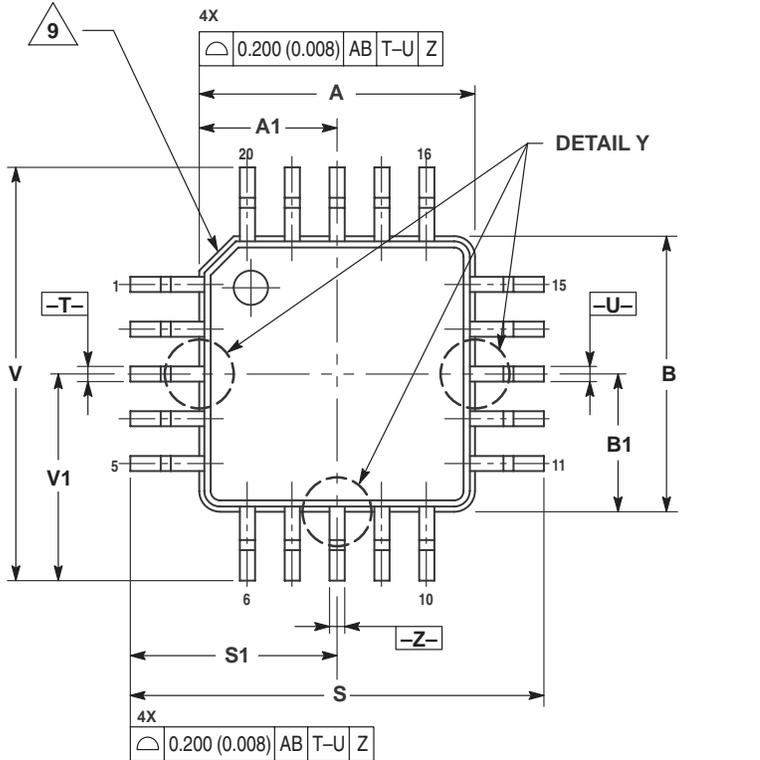
- NOTES:
- 1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - 2 CONTROLLING DIMENSION: MILLIMETER.
  - 3 DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  - 4 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
  - 5 THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	—	2.05	—	0.081
A1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	12.35	12.80	0.486	0.504
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
HE	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
LE	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q1	0.70	0.90	0.028	0.035
Z	—	0.81	—	0.032

**FTB SUFFIX**  
**CASE 976-01**  
 Plastic Package  
 (TQFP-20)  
 ISSUE O

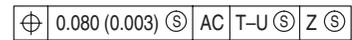
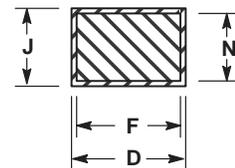
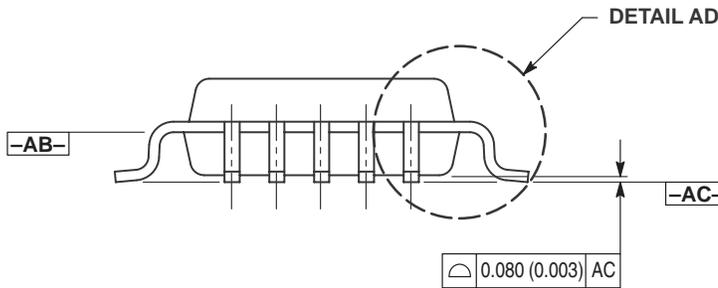


20 1

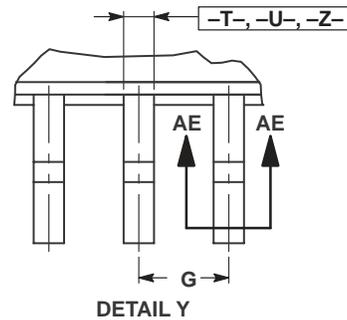
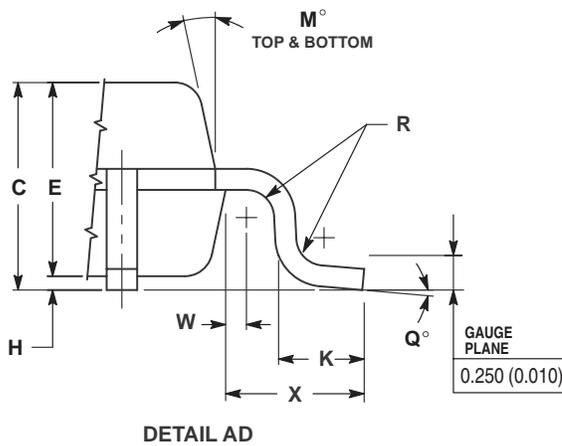


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  4. DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
  5. DIMENSIONS S AND V TO BE DETERMINED AT DATUM PLANE -AC-.
  6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -AB-.
  7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.350 (0.014).
  8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076 (0.0003).
  9. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

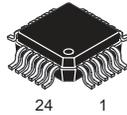
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.000 BSC		0.157 BSC	
A1	2.000 BSC		0.079 BSC	
B	4.000 BSC		0.157 BSC	
B1	2.000 BSC		0.079 BSC	
C	1.400	1.600	0.055	0.063
D	0.170	0.270	0.007	0.011
E	1.350	1.450	0.053	0.057
F	0.170	0.230	0.007	0.009
G	0.650 BSC		0.026 BSC	
H	0.050	0.150	0.002	0.006
J	0.090	0.200	0.004	0.008
K	0.500	0.700	0.020	0.028
M	12° REF		12° REF	
N	0.090	0.160	0.004	0.006
P	0.250 BSC		0.010 BSC	
Q	1°	5°	1°	5°
R	0.150	0.250	0.006	0.010
S	6.000 BSC		0.236 BSC	
S1	3.000 BSC		0.118 BSC	
V	6.000 BSC		0.236 BSC	
V1	3.000 BSC		0.118 BSC	
W	0.200 REF		0.008 REF	
X	1.000 REF		0.039 REF	



SECTION AE-AE

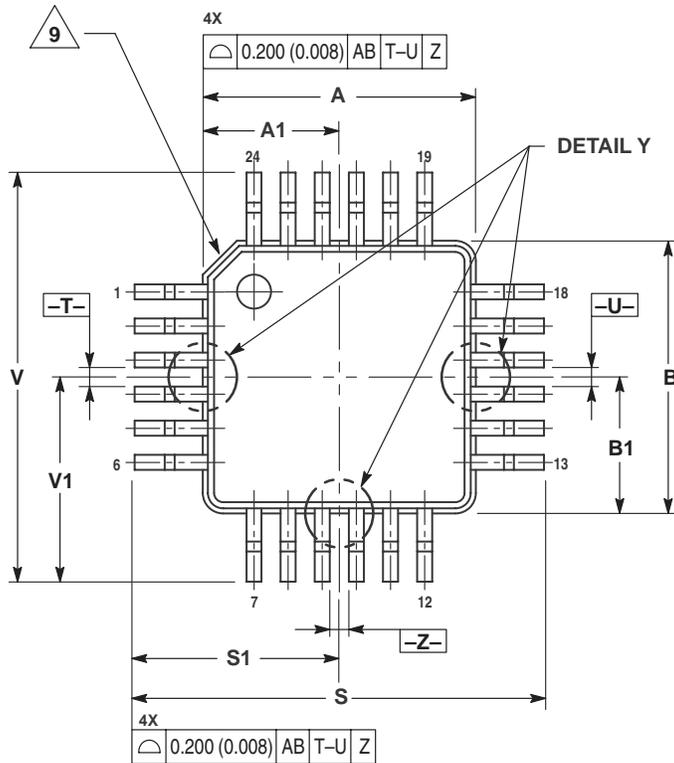


FTA SUFFIX  
CASE 977-01  
Plastic Package  
ISSUE O

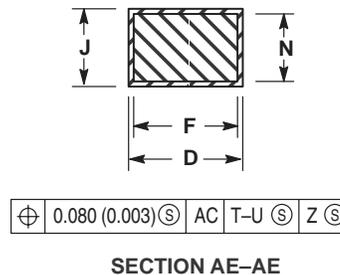
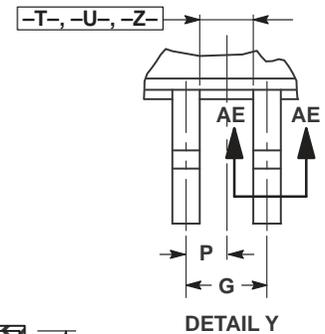
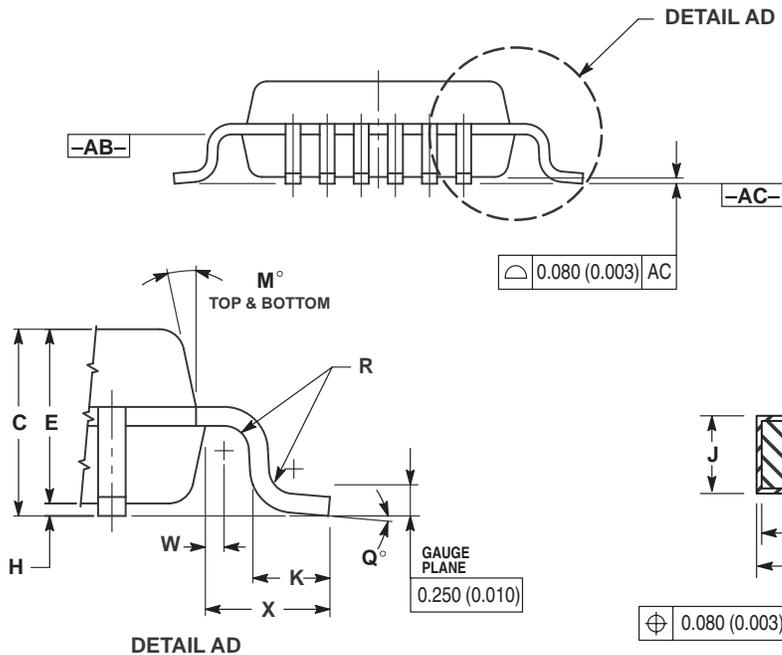


24 1

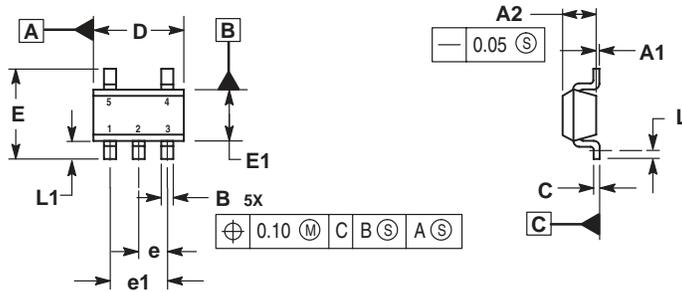
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  4. DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
  5. DIMENSIONS S AND V TO BE DETERMINED AT DATUM PLANE -AC-.
  6. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -AB-.
  7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.350 (0.014).
  8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076 (0.0003).
  9. EXACT SHAPE OF EACH CORNER IS OPTIONAL.



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.000 BSC		0.157 BSC	
A1	2.000 BSC		0.079 BSC	
B	4.000 BSC		0.157 BSC	
B1	2.000 BSC		0.079 BSC	
C	1.400	1.600	0.055	0.063
D	0.170	0.270	0.007	0.011
E	1.350	1.450	0.053	0.057
F	0.170	0.230	0.007	0.009
G	0.500 BSC		0.020 BSC	
H	0.050	0.150	0.002	0.006
J	0.090	0.200	0.004	0.008
K	0.500	0.700	0.020	0.028
M	12° REF		12° REF	
N	0.090	0.160	0.004	0.006
P	0.250 BSC		0.010 BSC	
Q	1°	5°	1°	5°
R	0.150	0.250	0.006	0.010
S	6.000 BSC		0.236 BSC	
S1	3.000 BSC		0.118 BSC	
V	6.000 BSC		0.236 BSC	
V1	3.000 BSC		0.118 BSC	
W	0.200 REF		0.008 REF	
X	1.000 REF		0.039 REF	



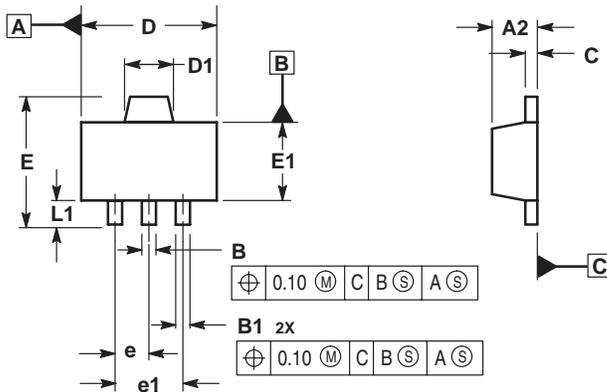
**N SUFFIX**  
**CASE 1212-01**  
 Plastic Package  
 (SOT-23)  
 ISSUE O



- NOTES:  
 1. DIMENSIONS ARE IN MILLIMETERS.  
 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.  
 3. DATUM C IS A SEATING PLANE.

MILLIMETERS		
DIM	MIN	MAX
A1	0.00	0.10
A2	1.00	1.30
B	0.30	0.50
C	0.10	0.25
D	2.80	3.00
E	2.50	3.10
E1	1.50	1.80
e	0.95 BSC	
e1	1.90 BSC	
L	0.20	—
L1	0.45	0.75

**H SUFFIX**  
**CASE 1213-01**  
 Plastic Package  
 (SOT-89)  
 ISSUE O



- NOTES:  
 1. DIMENSIONS ARE IN MILLIMETERS.  
 2. INTERPRET DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.  
 3. DATUM C IS A SEATING PLANE.

MILLIMETERS		
DIM	MIN	MAX
A2	1.40	1.60
B	0.37	0.57
B1	0.32	0.52
C	0.30	0.50
D	4.40	4.60
D1	1.50	1.70
E	—	4.25
E1	2.40	2.60
e	1.50 BSC	
e1	3.00 BSC	
L1	0.80	—