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MOTOROLA

Undervoltage Sensing Circuit

MC34064
MC33064

UNDERVOLTAGE SENSING CIRCUIT

SEMICONDUCTOR
TECHNICAL DATA

The MC34064 is an undervoltage sensing circuit specifically designed for use as a reset controller in microprocessor-based systems. It offers the designer an economical solution for low voltage detection with a single external resistor. The MC34064 features a trimmed-in-package bandgap reference, and a comparator with precise thresholds and built-in hysteresis to prevent erratic reset operation. The open collector reset output is capable of sinking in excess of 10 mA, and operation is guaranteed down to 1.0 V input with low standby current. These devices are packaged in 3-pin TO-226AA, 8-pin SO–8 and Micro–8 surface mount packages.

Applications include direct monitoring of the 5.0 V MPU/logic power supply used in appliance, automotive, consumer and industrial equipment.

- Trimmed-In-Package Temperature Compensated Reference
- Comparator Threshold of 4.6 V at 25°C
- Precise Comparator Thresholds Guaranteed Over Temperature
- Comparator Hysteresis Prevents Erratic Reset
- Reset Output Capable of Sinking in Excess of 10 mA
- Internal Clamp Diode for Discharging Delay Capacitor
- Guaranteed Reset Operation with 1.0 V Input
- Low Standby Current
- Economical TO–226AA, SO–8 and Micro–8 Surface Mount Packages

P SUFFIX
PLASTIC PACKAGE
CASE 29
(TO–226AA)
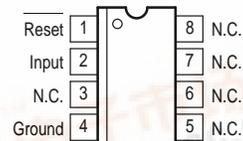
Pin 1. Reset
2. Input
3. Ground

D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO–8)

DM SUFFIX
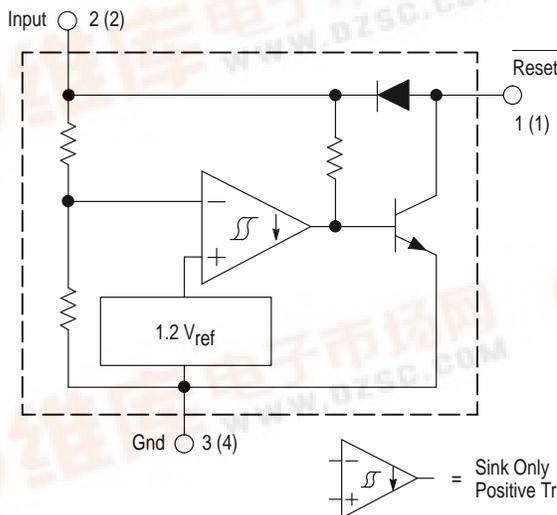PLASTIC PACKAGE
CASE 846A
(Micro–8)

Reset	1	8	N.C.
Input	2	7	N.C.
N.C.	3	6	N.C.
Ground	4	5	N.C.

(Top View)

Representative Block Diagram

Input 2 (2)

Reset
1 (1)

1.2 V$_{ref}$

Gnd 3 (4)

= Sink Only
Positive True Logic

Pin numbers adjacent to terminals are for the 3–pin TO–226AA package.
Pin numbers in parenthesis are for the 8–lead packages.

This device contains 21 active transistors.

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC34064D–5	T$_A$ = 0° to +70°C	SO–8
MC34064DM–5		Micro–8
MC34064P–5		TO–226AA
MC33064D–5	T$_A$ = −40° to +85°C	SO–8
MC33064DM–5		Micro–8
MC33064P–5		TO–226AA

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MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Input Supply Voltage	V_{in}	−1.0 to 10	V
Reset Output Voltage	V_O	10	V
Reset Output Sink Current (Note 1)	I_{Sink}	Internally Limited	mA
Clamp Diode Forward Current, Pin 1 to 2 (Note 1)	I_F	100	mA

Power Dissipation and Thermal Characteristics
  P Suffix, Plastic Package
    Maximum Power Dissipation @ T_A = 25°C
    Thermal Resistance, Junction–to–Air
  D Suffix, Plastic Package
    Maximum Power Dissipation @ T_A = 25°C
    Thermal Resistance, Junction–to–Air
  DM Suffix, Plastic Package
    Maximum Power Dissipation @ T_A = 25°C
    Thermal Resistance, Junction–to–Air
	P_D
	$R_{\theta JA}$
	
	P_D
	$R_{\theta JA}$
	
	P_D
	$R_{\theta JA}$
		625
		200
		
		625
		200
		
		520
		240
			mW
			°C/W
			
			mW
			°C/W
			
			mW
			°C/W

Operating Junction Temperature	T_J	+150	°C

Operating Ambient Temperature
  MC34064
  MC33064
	T_A	
		0 to +70
		−40 to +85
			°C

Storage Temperature Range	T_{stg}	−65 to +150	°C

NOTE: ESD data available upon request.

ELECTRICAL CHARACTERISTICS (For typical values T_A = 25°C, for min/max values T_A is the operating ambient temperature range that applies [Notes 2 and 3] unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
COMPARATOR					

Threshold Voltage
  High State Output (V_{in} Increasing)
  Low State Output (V_{in} Decreasing)
  Hysteresis
	
	V_{IH}
	V_{IL}
	V_H
		
		4.5
		4.5
		0.01
			
			4.61
			4.59
			0.02
				
				4.7
				4.7
				0.05
					V

RESET OUTPUT					

Output Sink Saturation
  (V_{in} = 4.0 V, I_{Sink} = 8.0 mA)
  (V_{in} = 4.0 V, I_{Sink} = 2.0 mA)
  (V_{in} = 1.0 V, I_{Sink} = 0.1 mA)
	V_{OL}	
		–
		–
		–
			
			0.46
			0.15
			–
				
				1.0
				0.4
				0.1
					V

Output Sink Current (V_{in}, Reset = 4.0 V)	I_{Sink}	10	27	60	mA
Output Off-State Leakage (V_{in}, Reset = 5.0 V)	I_{OH}	–	0.02	0.5	μA
Clamp Diode Forward Voltage, Pin 1 to 2 (I_F = 10 mA)	V_F	0.6	0.9	1.2	V
TOTAL DEVICE					
Operating Input Voltage Range	V_{in}	1.0 to 6.5	–	–	V
Quiescent Input Current (V_{in} = 5.0 V)	I_{in}	–	390	500	μA

NOTES: 1. Maximum package power dissipation limits must be observed.
  2. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
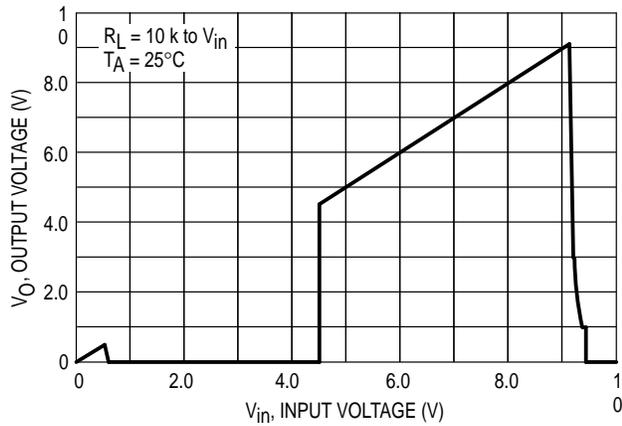 3. T_{low} =   0°C for MC34064 T_{high} = +70°C for MC34064
           −40°C for MC33064   +85°C for MC33064

MC34064 MC33064

Figure 1. $\overline{\text{Reset}}$ Output Voltage versus Input Voltage

$R_L = 10\ k$ to V_{in}
$T_A = 25°C$

V_O, OUTPUT VOLTAGE (V)

V_{in}, INPUT VOLTAGE (V)

Figure 2. $\overline{\text{Reset}}$ Output Voltage versus Input Voltage

$R_L = 10\ k$ to V_{in}
$T_A = 25°C$

V_O, OUTPUT VOLTAGE (V)
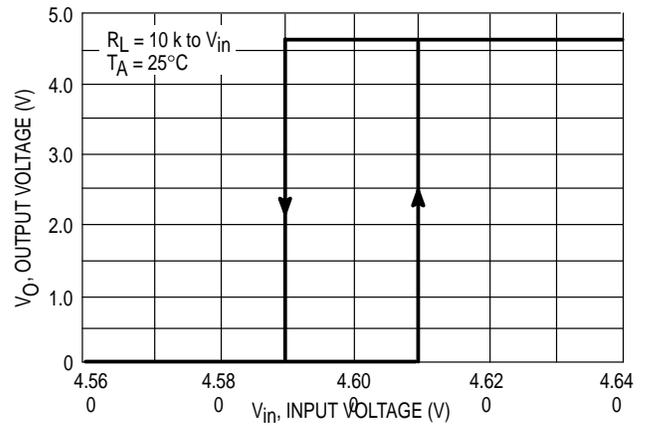
V_{in}, INPUT VOLTAGE (V)

Figure 3. Comparator Threshold Voltage versus Temperature

$R_L = 10\ k$ to V_{in}

Upper Threshold
High State Output

Lower Threshold
Low State Output

V_{th}, THRESHOLD VOLTAGE (V)

T_A, AMBIENT TEMPERATURE (°C)
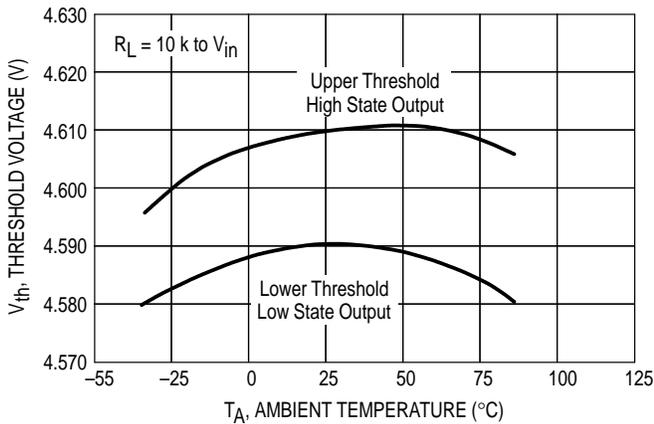
Figure 4. Input Current versus Input Voltage

$T_A = +25°C$
$-40°C$
$+85°C$

$T_A = +25°C$
$+85°C$
$-40°C$

I_{in}, INPUT CURRENT (mA)

V_{in}, INPUT VOLTAGE (V)
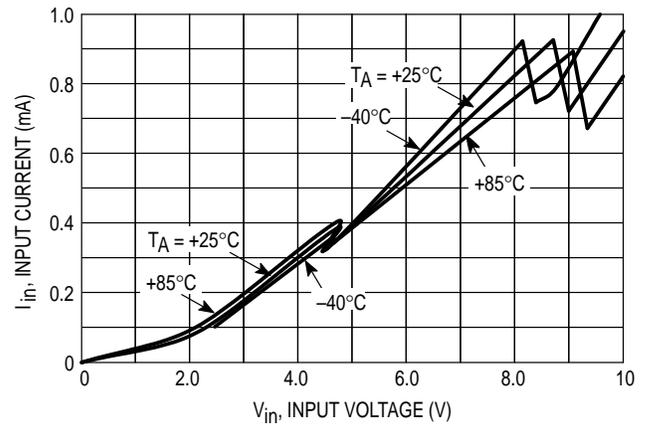
Figure 5. $\overline{\text{Reset}}$ Output Saturation versus Sink Current

$V_{in} = 4.0\ V$

$T_A = 85°C$
$T_A = 25°C$
$T_A = -40°C$

V_{OL}, OUTPUT SATURATION (V)

I_{Sink}, SINK CURRENT (mA)
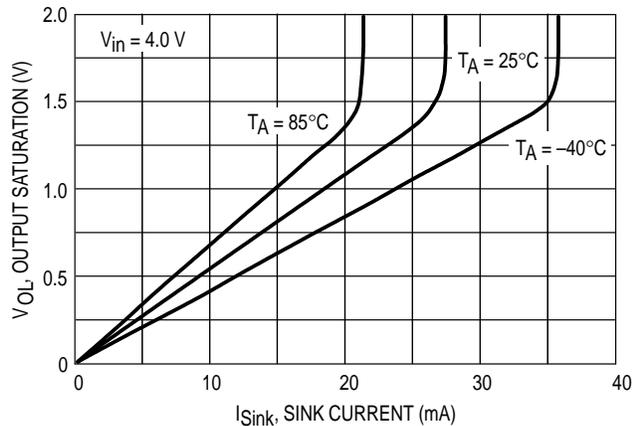
Figure 6. $\overline{\text{Reset}}$ Delay Time

Reset

90%

$V_{in} = 5.0\ V$ to $4.0\ V$
$R_L = 10\ k$
$T_A = 25°C$

V_{in}

5.0 V –

4.0 V –

10%

V_{in}
5.0V
4.0V
10k
Reset
REF

200 ns/DIV
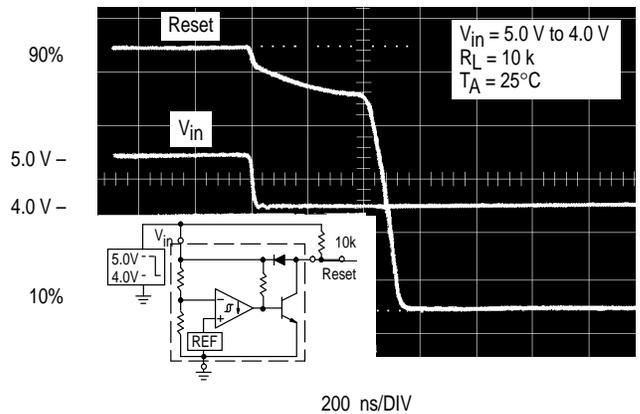
MC34064 MC33064

Figure 7. Clamp Diode Forward Current versus Voltage
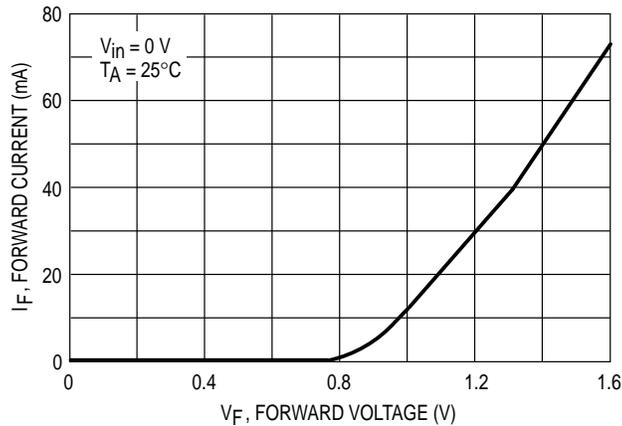
Figure 8. Low Voltage Microprocessor Reset
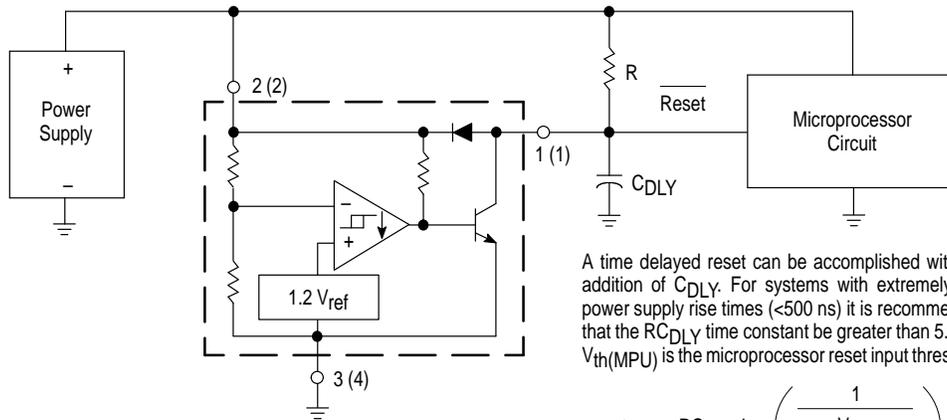
A time delayed reset can be accomplished with the addition of C_{DLY}. For systems with extremely fast power supply rise times (<500 ns) it is recommended that the RC_{DLY} time constant be greater than 5.0 μs. $V_{th(MPU)}$ is the microprocessor reset input threshold.

$$t_{DLY} = RC_{DLY} \ln \left(\frac{1}{1 - \dfrac{V_{th(MPU)}}{V_{in}}} \right)$$

Figure 9. Low Voltage Microprocessor Reset with Additional Hysteresis
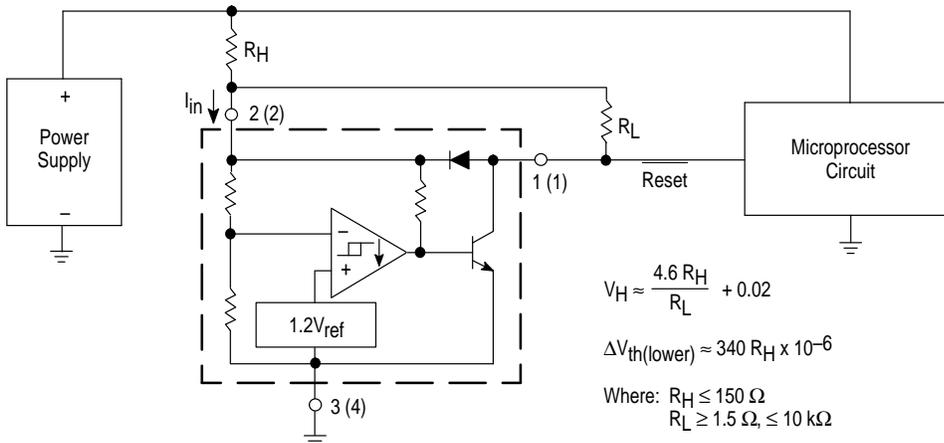
$$V_H \approx \frac{4.6 \, R_H}{R_L} + 0.02$$

$$\Delta V_{th(lower)} \approx 340 \, R_H \times 10^{-6}$$

Where: $R_H \le 150 \, \Omega$
$R_L \ge 1.5 \, \Omega, \le 10 \, k\Omega$

Test Data			
V_H (mV)	ΔV_{th} (mV)	R_H (Ω)	R_L (kΩ)
20	0	0	0
51	3.4	10	1.5
40	6.8	20	4.7
81	6.8	20	1.5
71	10	30	2.7
112	10	30	1.5
100	16	47	2.7
164	16	47	1.5
190	34	100	2.7
327	34	100	1.5
276	51	150	2.7
480	51	150	1.5

Comparator hysteresis can be increased with the addition of resistor R_H. The hysteresis equation has been simplified and does not account for the change of input current I_{in} as V_{CC} crosses the comparator threshold (Figure 4). An increase of the lower threshold $\Delta V_{th(lower)}$ will be observed due to I_{in} which is typically 340 μA at 4.59 V. The equations are accurate to ±10% with R_H less than 150 Ω and R_L between 1.5 kΩ and 10 kΩ.

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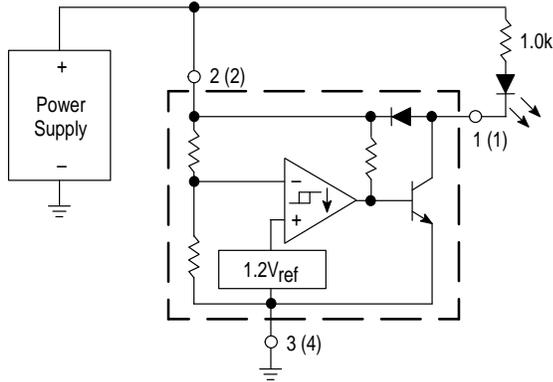**Figure 10. Voltage Monitor**

Figure 11. Solar Powered Battery Charger

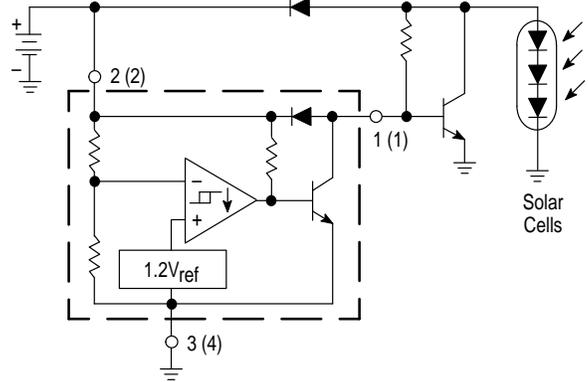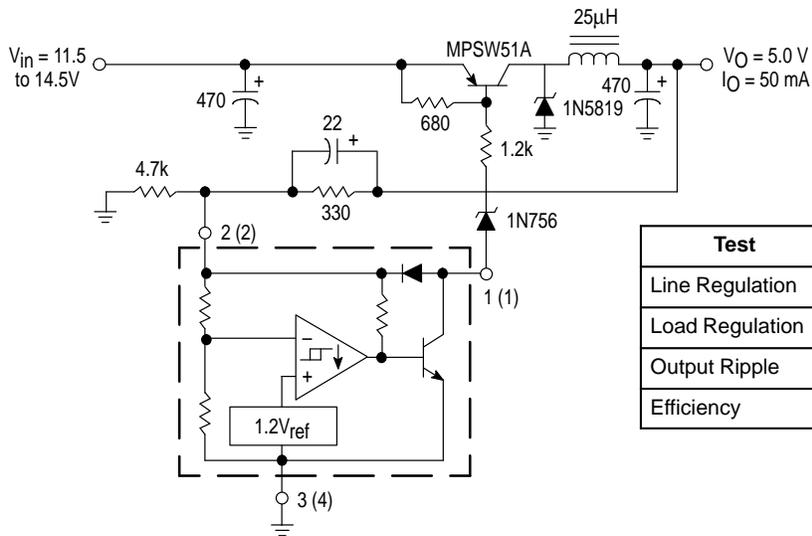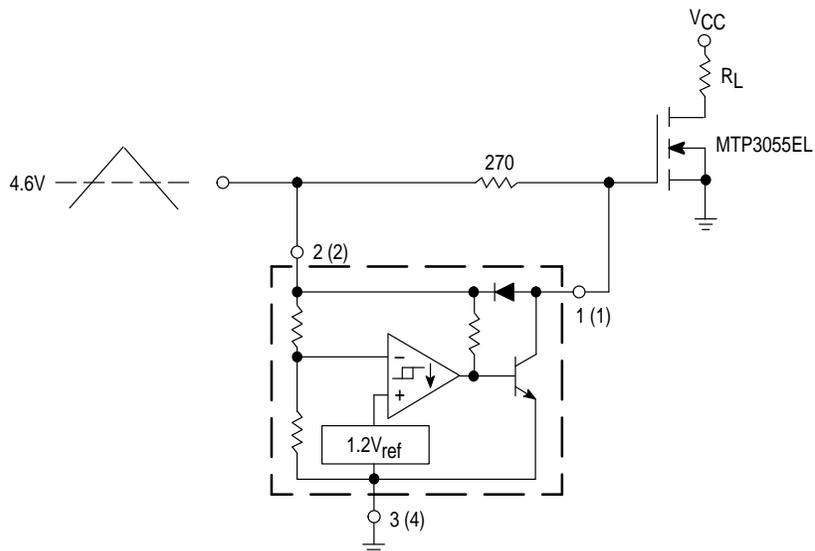**Figure 12. Low Power Switching Regulator**

Test	Conditions	Results
Line Regulation	V_{in} = 11.5 V to 14.5 V, I_O = 50 mA	35 mV
Load Regulation	V_{in} = 12.6 V, I_O = 0 mA to 50 mA	12 mV
Output Ripple	V_{in} = 12.6 V, I_O = 50 mA	60 mVpp
Efficiency	V_{in} = 12.6 V, I_O = 50 mA	77%

Figure 13. MOSFET Low Voltage Gate Drive Protection

Overheating of the logic level power MOSFET due to insufficient gate voltage can be prevented with the above circuit. When the input signal is below the 4.6 V threshold of the MC34064, its output grounds the gate of the L2 MOSFET.

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OUTLINE DIMENSIONS

P SUFFIX
PLASTIC PACKAGE
CASE 29–04
(TO–226AA)
ISSUE AD

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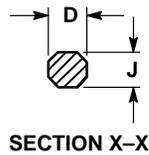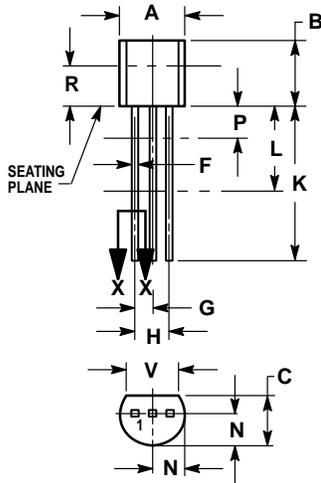
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

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	—

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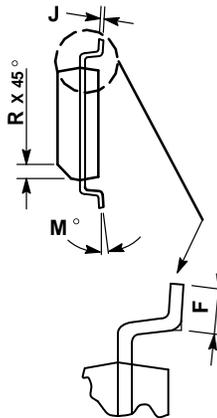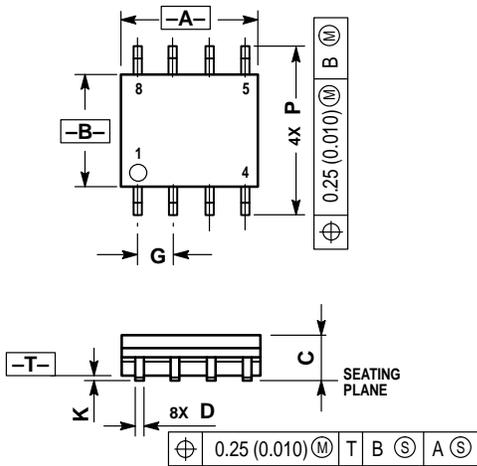
NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. DIMENSIONS ARE IN MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
6. DIMENSION D DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE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

DIM	MILLIMETERS	
	MIN	MAX
A	4.80	5.00
B	3.80	4.00
C	1.35	1.75
D	0.35	0.49
F	0.40	1.25
G	1.27 BSC	
J	0.18	0.25
K	0.10	0.25
M	0 °	7 °
P	5.80	6.20
R	0.25	0.50

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OUTLINE DIMENSIONS

DM SUFFIX
PLASTIC PACKAGE
CASE 846A–02
(Micro–8)
ISSUE B
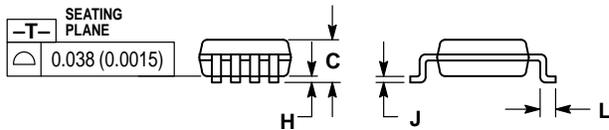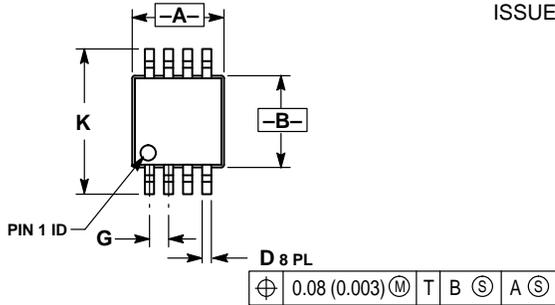
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION D DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

PIN 1 ID

D 8 PL

⊕ | 0.08 (0.003) Ⓜ | T | B Ⓢ | A Ⓢ

SEATING PLANE

−T−

△ | 0.038 (0.0015)

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

Ⓜ **MOTOROLA**