MOTOROLA

MC34164
MC33164

Micropower Undervoltage Sensing Circuits

The MC34164 series are undervoltage sensing circuits specifically designed for use as reset controllers in portable microprocessor based systems where extended battery life is required. These devices offer the designer an economical solution for low voltage detection with a single external resistor. The MC34164 series features a bandgap reference, a comparator with precise thresholds and built–in hysteresis to prevent erratic reset operation, an open collector reset output capable of sinking in excess of 6.0 mA, and guaranteed operation down to 1.0 V input with extremely low standby current. These devices are packaged in 3–pin TO–226AA, 8–pin SO–8 and Micro–8 surface mount packages.

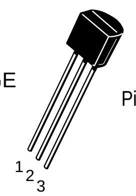
Applications include direct monitoring of the 3.0 or 5.0 V MPU/logic power supply used in appliance, automotive, consumer, and industrial equipment.

- Temperature Compensated Reference
- Monitors 3.0 V (MC34164–3) or 5.0 V (MC34164–5) Power Supplies
- Precise Comparator Thresholds Guaranteed Over Temperature
- Comparator Hysteresis Prevents Erratic Reset
- Reset Output Capable of Sinking in Excess of 6.0 mA
- Internal Clamp Diode for Discharging Delay Capacitor
- Guaranteed Reset Operation With 1.0 V Input
- Extremely Low Standby Current: As Low as 9.0 µA
- Economical TO–226AA, SO–8 and Micro–8 Surface Mount Packages

MICROPOWER UNDERVOLTAGE SENSING CIRCUITS

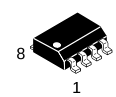
SEMICONDUCTOR TECHNICAL DATA

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

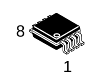


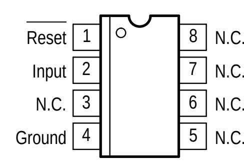
Pin 1. $\overline{\text{Reset}}$
2. Input
3. Ground

D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO–8)



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



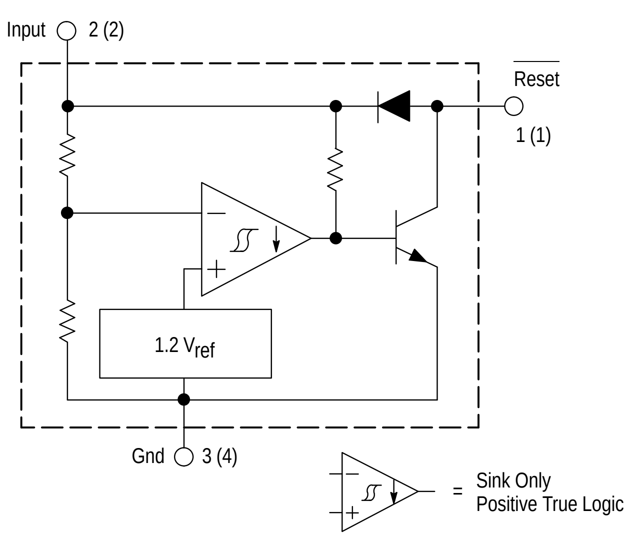


(Top View)

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC34164D–3	T_A = 0° to +70°C	SO–8
MC34164D–5		
MC34164DM–3		Micro–8
MC34164DM–5		
MC34164P–3		TO–226AA
MC34164P–5		
MC33164D–3	T_A = –40° to +125°C	SO–8
MC33164D–5		
MC33164DM–3		Micro–8
MC33164DM–5		
MC33164P–3		TO–226AA
MC33164P–5		

Representative Block Diagram



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 28 active transistors.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Input Supply Voltage	V_{in}	–1.0 to 12	V
$\overline{\text{Reset}}$ Output Voltage	V_O	–1.0 to 12	V
$\overline{\text{Reset}}$ Output Sink Current	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	P_D	700	mW
Thermal Resistance, Junction–to–Air	$R_{\theta JA}$	178	°C/W
D Suffix, Plastic Package			
Maximum Power Dissipation @ T_A = 25°C	P_D	700	mW
Thermal Resistance, Junction–to–Air	$R_{\theta JA}$	178	°C/W
DM Suffix, Plastic Package			
Maximum Power Dissipation @ T_A = 25°C	P_D	520	mW
Thermal Resistance, Junction–to–Air	$R_{\theta JA}$	240	°C/W
Operating Junction Temperature	T_J	+150	°C
Operating Ambient Temperature Range	T_A		°C
MC34164 Series		0 to +70	
MC33164 Series		– 40 to + 85	
Storage Temperature Range	T_{stg}	– 65 to +150	°C

NOTE: ESD data available upon request.

MC34164–3, MC33164–3 SERIES

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 & 3], unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
COMPARATOR					
Threshold Voltage					V
High State Output (V_{in} Increasing)	V_{IH}	2.55	2.71	2.80	
Low State Output (V_{in} Decreasing)	V_{IL}	2.55	2.65	2.80	
Hysteresis (I_{Sink} = 100 µA)	V_H	0.03	0.06	–	
$\overline{\text{RESET}}$ OUTPUT					
Output Sink Saturation	V_{OL}				V
(V_{in} = 2.4 V, I_{Sink} = 1.0 mA)		–	0.14	0.4	
(V_{in} = 1.0 V, I_{Sink} = 0.25 mA)		–	0.1	0.3	
Output Sink Current (V_{in}, $\overline{\text{Reset}}$ = 2.4 V)	I_{Sink}	6.0	12	30	mA
Output Off–State Leakage	$I_{\overline{R}(leak)}$				µA
(V_{in}, Reset = 3.0 V)		–	0.02	0.5	
(V_{in}, Reset = 10 V)		–	0.02	1.0	
Clamp Diode Forward Voltage, Pin 1 to 2 (I_F = 5.0 mA)	V_F	6.0	0.9	1.2	V
TOTAL DEVICE					
Operating Input Voltage Range	V_{in}	1.0 to 10	–	–	V
Quiescent Input Current	I_{in}				µA
V_{in} = 3.0 V		–	9.0	15	
V_{in} = 6.0 V		–	24	40	

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 MC34164, – 40°C for MC33164; T_{high} = + 70°C for MC34164, = + 85°C for MC33164

MC34164–5, MC33164–5 SERIES
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 & 3], unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
COMPARATOR					
Threshold Voltage					V
High State Output (V_{in} Increasing)	V_{IH}	4.15	4.33	4.45	
Low State Output (V_{in} Decreasing)	V_{IL}	4.15	4.27	4.45	
Hysteresis (I_{Sink} = 100 µA)	V_H	0.02	0.09	–	
RESET OUTPUT					
Output Sink Saturation	V_{OL}				V
(V_{in} = 4.0 V, I_{Sink} = 1.0 mA)		–	0.14	0.4	
(V_{in} = 1.0 V, I_{Sink} = 0.25 mA)		–	0.1	0.3	
Output Sink Current (V_{in}, $\overline{Reset}$ = 4.0 V)	I_{Sink}	7.0	20	50	mA
Output Off–State Leakage	$I_{\overline{R}(leak)}$				µA
(V_{in}, $\overline{Reset}$ = 5.0 V)		–	0.02	0.5	
(V_{in}, $\overline{Reset}$ = 10 V)		–	0.02	2.0	
Clamp Diode Forward Voltage, Pin 1 to 2 (I_F = 5.0 mA)	V_F	0.6	0.9	1.2	V
TOTAL DEVICE					
Operating Input Voltage Range	V_{in}	1.0 to 10	–	–	V
Quiescent Input Current	I_{in}				µA
V_{in} = 5.0 V		–	12	20	
V_{in} = 10 V		–	32	50	

NOTES: 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 MC34164, – 40°C for MC33164; T_{high} = + 70°C for MC34164, = + 85°C for MC33164

Figure 1. MC3X164–3 Reset Output Voltage versus Input Voltage

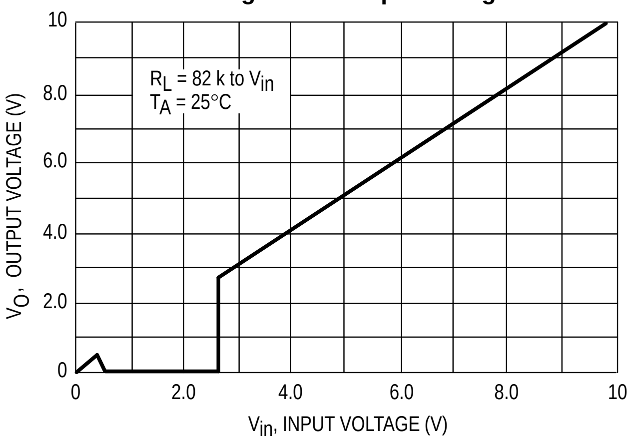


Figure 2. MC3X164–5 Reset Output Voltage versus Input Voltage

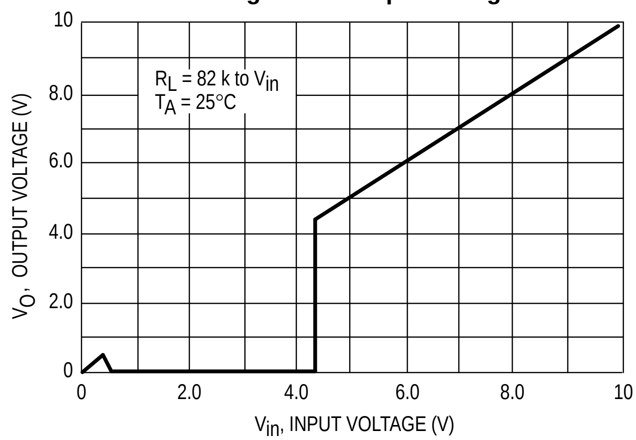


Figure 3. MC3X164–3 Reset Output Voltage versus Input Voltage

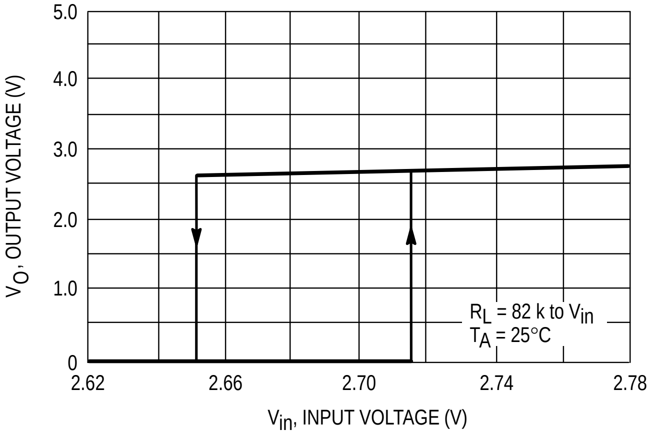


Figure 4. MC3X164–5 Reset Output Voltage versus Input Voltage

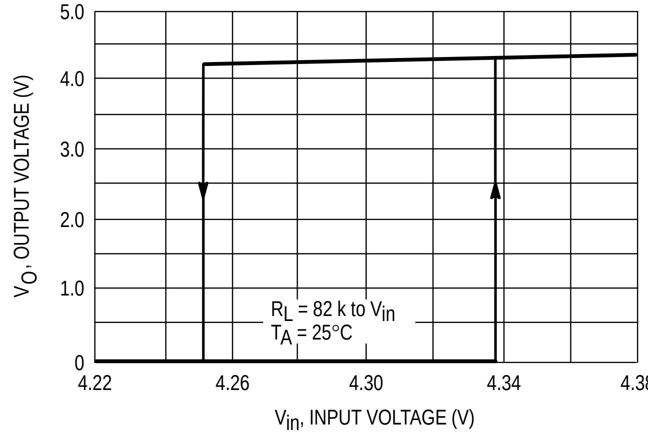


Figure 5. MC3X164–3 Comparator Threshold Voltage versus Temperature

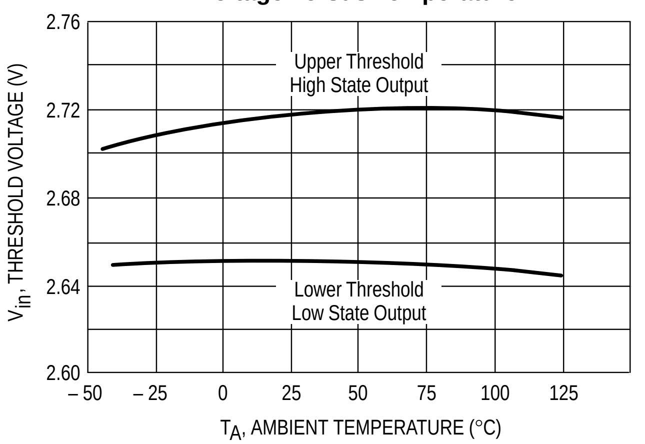


Figure 6. MC3X164–5 Comparator Threshold Voltage versus Temperature

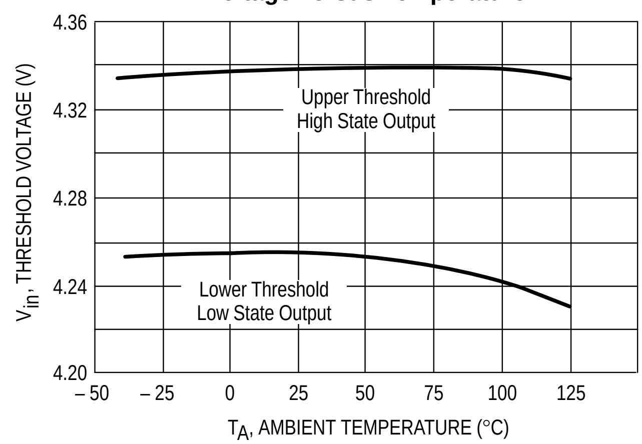


Figure 7. MC3X164–3 Input Current versus Input Voltage

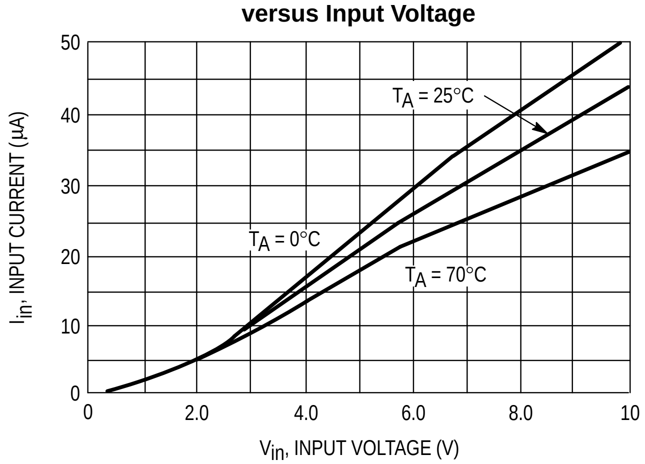


Figure 8. MC3X164–5 Input Current versus Input Voltage

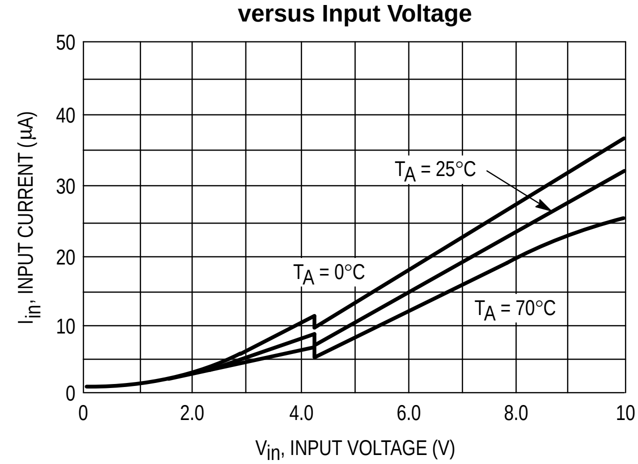


Figure 9. MC3X164–3 Reset Output Saturation versus Sink Current

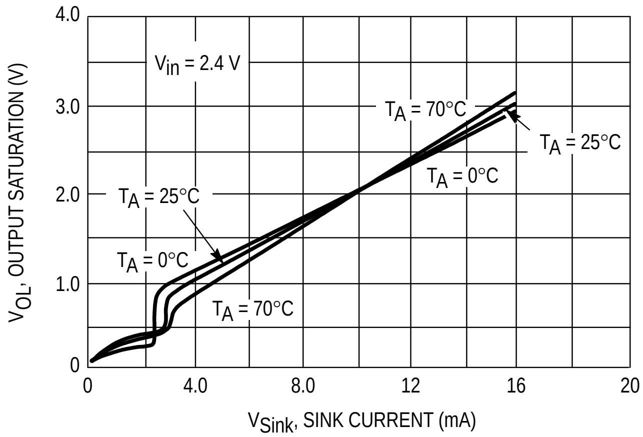


Figure 10. MC3X164–5 Reset Output Saturation versus Sink Current

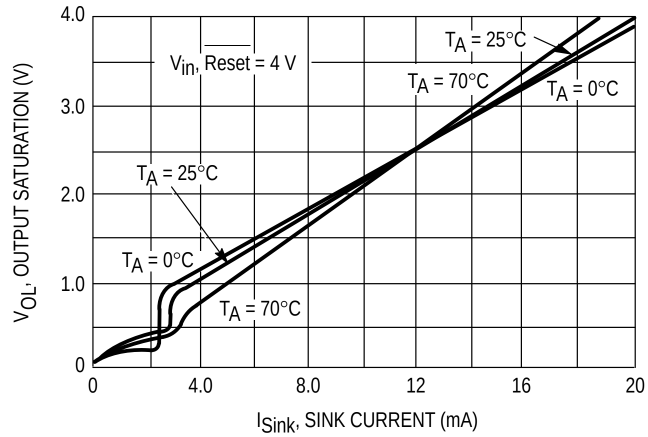


Figure 11. Clamp Diode Forward Current versus Voltage

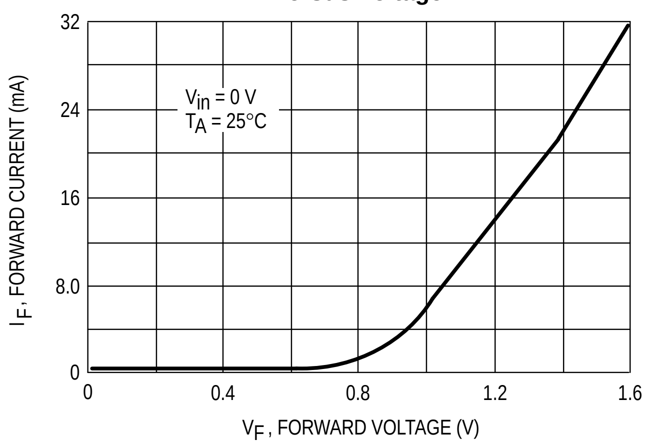


Figure 12. $\overline{\text{Reset}}$ Delay Time (MC3X164–5 Shown)

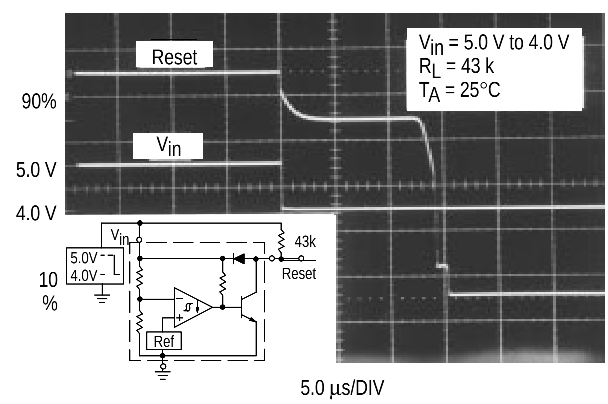
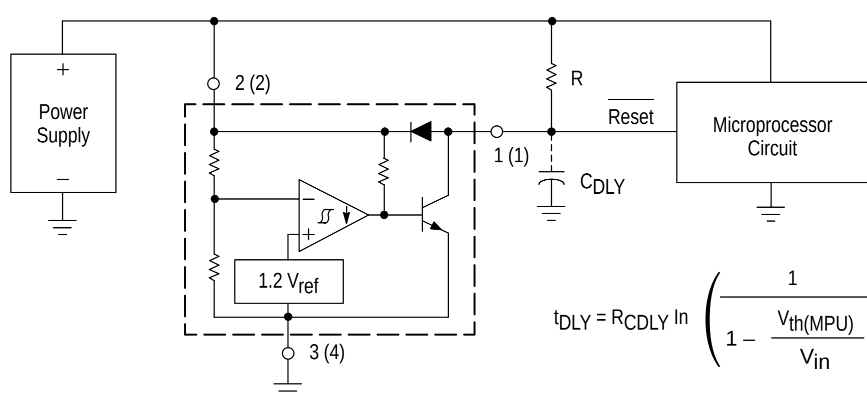


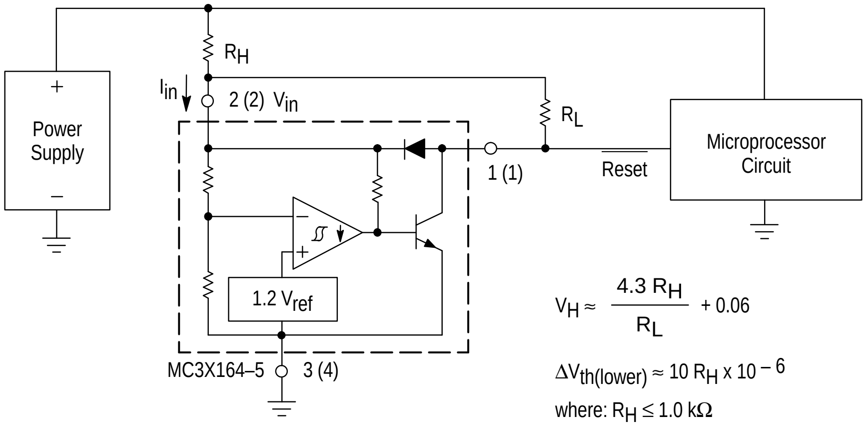
Figure 13. Low Voltage Microprocessor Reset



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

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 RCDLY time constant be greater than 5.0 µs. $V_{th(MPU)}$ is the microprocessor reset input threshold.

Figure 14. Low Voltage Microprocessor Reset With Additional Hysteresis (MC3X164–5 Shown)



$$V_H \approx \frac{4.3\,R_H}{R_L} + 0.06$$

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

where: $R_H \leq 1.0\ k\Omega$

$43\ k\Omega \geq R_L \geq 4.3\ k\Omega$

Test Data			
V_H (mV)	ΔV_{th} (mV)	R_H (Ω)	R_L (kΩ)
60	0	0	43
103	1.0	100	10
123	1.0	100	6.8
160	1.0	100	4.3
155	2.2	220	10
199	2.2	220	6.8
280	2.2	220	4.3
262	4.7	470	10
306	4.7	470	8.2
357	4.7	470	6.8
421	4.7	470	5.6
530	4.7	470	4.3

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_{in} crosses the comparator threshold (Figure 8). An increase of the lower threshold $\Delta V_{th(lower)}$ will be observed due to I_{in} which is typically 10 µA at 4.3 V. The equations are accurate to ±10% with R_H less than 1.0 kΩ and R_L between 4.3 kΩ and 43 kΩ.

Figure 15. Voltage Monitor

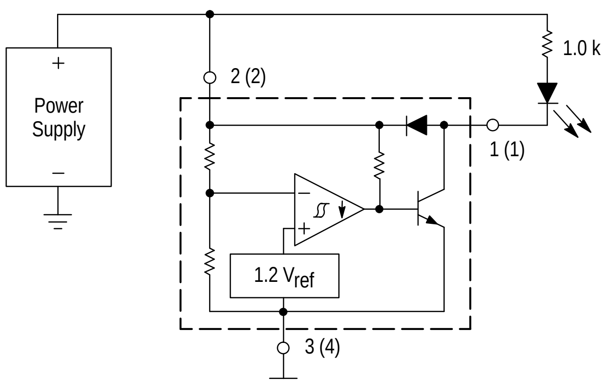


Figure 16. Solar Powered Battery Charger

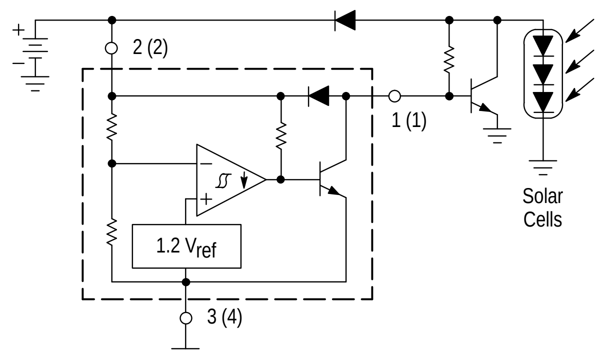
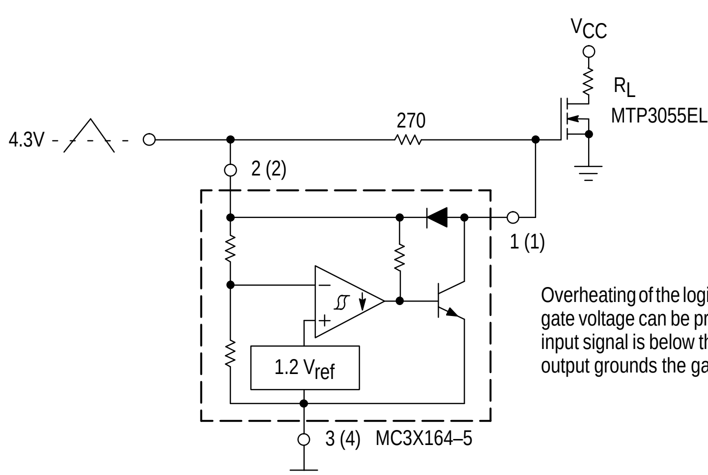


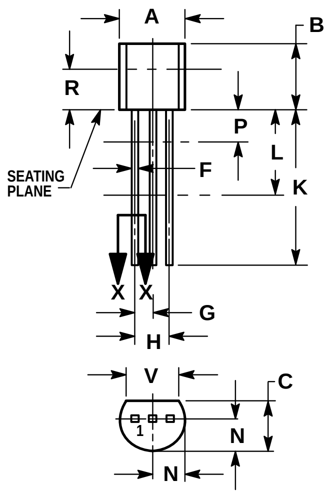
Figure 17. MOSFET Low Voltage Gate Drive Protection Using the MC3X164–5

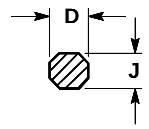


Overheating of the logic level power MOSFET due to insufficient gate voltage can be prevented with the above circuit. When the input signal is below the 4.3 V threshold of the MC3X164–5, its output grounds the gate of the L^2 MOSFET.

OUTLINE DIMENSIONS

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



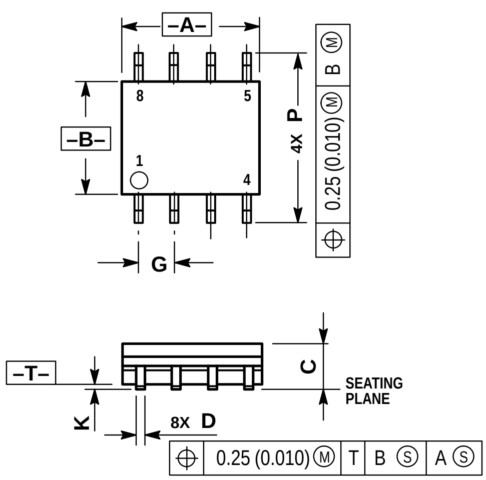


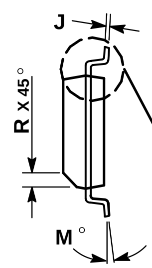
SECTION X–X

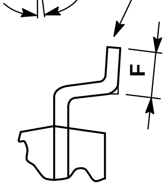
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	INCHES		MILLIMETERS	
DIM	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





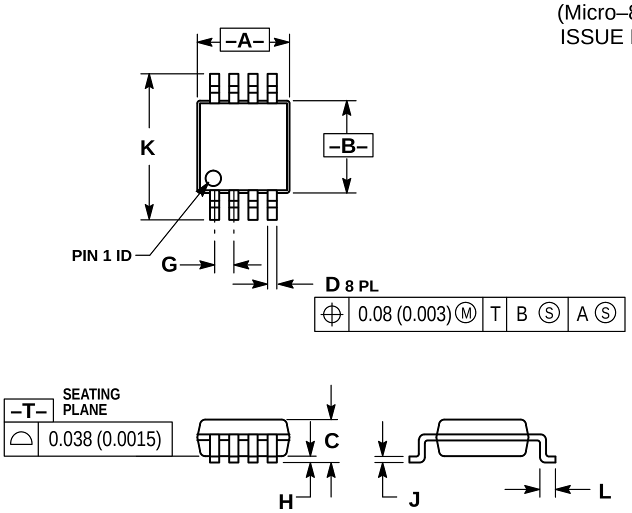


NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. DIMENSIONS ARE IN MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
6. DIMENSION D DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE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

	MILLIMETERS	
DIM	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

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.

	MILLIMETERS		INCHES	
DIM	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

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MFAX: RMFAX0@email.sps.mot.com – TOUCHTONE 602–244–6609
INTERNET: http://Design–NET.com

JAPAN: Nippon Motorola Ltd.; Tatsumi–SPD–JLDC, 6F Seibu–Butsuryu–Center, 3–14–2 Tatsumi Koto–Ku, Tokyo 135, Japan. 03–81–3521–8315

ASIA / PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298