

# MC34164, MC33164, NCV33164



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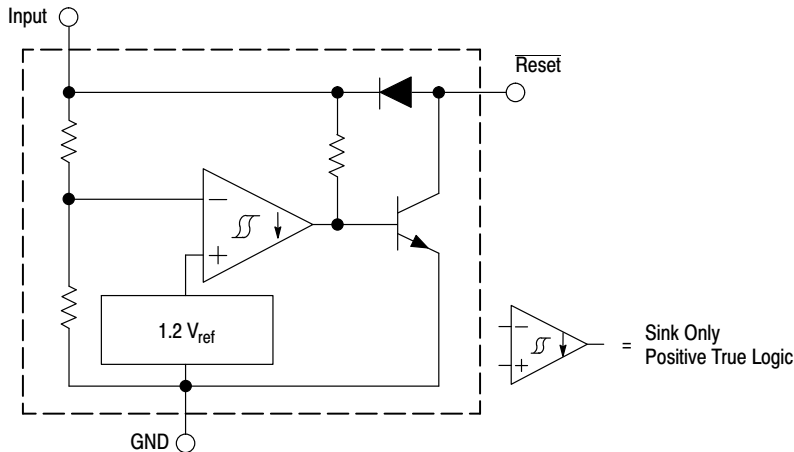
## Micropower Undervoltage Sensing Circuits

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. The MC devices are packaged in 3-pin TO-92 (TO-226AA), micro size TSOP-5, 8-pin SOIC-8 and Micro8™ surface mount packages. The NCV device is packaged in SOIC-8.

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

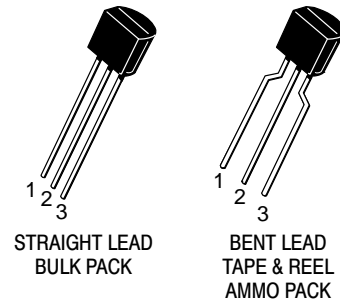
### Features

- 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  $\mu$ A
- Economical TO-92 (TO-226AA), TSOP-5, SOIC-8 and Micro8 Surface Mount Packages
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes
- These Devices are Pb-Free and are RoHS Compliant

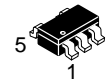


**Figure 1. Representative Block Diagram**

This device contains 28 active transistors.



TO-92 (TO-226AA)  
P SUFFIX  
CASE 29



TSOP-5  
SN SUFFIX  
CASE 483

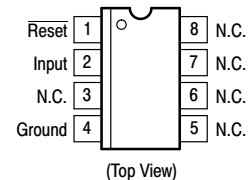


SOIC-8  
D SUFFIX  
CASE 751



Micro8  
DM SUFFIX  
CASE 846A

### PIN CONNECTIONS



#### TSOP-5

Pin 1. Ground  
2. Input  
3. Reset  
4. NC  
5. NC

#### TO-92

Pin 1. Reset  
2. Input  
3. Ground

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 8 of this data sheet.

# MC34164, MC33164, NCV33164

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Input Supply Voltage	$V_{in}$	-1.0 to 12	V
Reset Output Voltage	$V_O$	-1.0 to 12	V
Reset Output Sink Current	$I_{Sink}$	Internally Limited	mA
Clamp Diode Forward Current, Reset to Input Pin (Note 1)	$I_F$	100	mA
Power Dissipation and Thermal Characteristics			
P Suffix, Plastic Package			
Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	700	mW
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	178	$^\circ\text{C/W}$
D Suffix, Plastic Package			
Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	700	mW
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	178	$^\circ\text{C/W}$
DM Suffix, Plastic Package			
Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	520	mW
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	240	$^\circ\text{C/W}$
Operating Junction Temperature	$T_J$	+150	$^\circ\text{C}$
Operating Ambient Temperature Range	$T_A$		$^\circ\text{C}$
MC34164 Series		0 to +70	
MC33164 Series, NCV33164		-40 to +125	
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$
Electrostatic Discharge Sensitivity (ESD)	ESD		V
Human Body Model (HBM)		4000	
Machine Model (MM)		200	

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## MC34164-3, MC33164-3 SERIES, NCV33164-3

**ELECTRICAL CHARACTERISTICS** (For typical values  $T_A = 25^\circ\text{C}$ , 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
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### 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 ( $I_{Sink} = 100 \mu\text{A}$ )	$V_H$	0.03	0.06	-	

### RESET OUTPUT

Output Sink Saturation	$V_{OL}$				V
( $V_{in} = 2.4 \text{ V}$ , $I_{Sink} = 1.0 \text{ mA}$ )		-	0.14	0.4	
( $V_{in} = 1.0 \text{ V}$ , $I_{Sink} = 0.25 \text{ mA}$ )		-	0.1	0.3	
Output Sink Current ( $V_{in}$ , $\overline{\text{Reset}} = 2.4 \text{ V}$ )	$I_{Sink}$	6.0	12	30	mA
Output Off-State Leakage	$I_{R(Leak)}$				$\mu\text{A}$
( $V_{in}$ , $\overline{\text{Reset}} = 3.0 \text{ V}$ )		-	0.02	0.5	
( $V_{in}$ , $\overline{\text{Reset}} = 10 \text{ V}$ )		-	0.02	1.0	
Clamp Diode Forward Voltage, Reset to Input Pin ( $I_F = 5.0 \text{ mA}$ )	$V_F$	0.6	0.9	1.2	V

### TOTAL DEVICE

Operating Input Voltage Range	$V_{in}$	1.0 to 10	-	-	V
Quiescent Input Current	$I_{in}$				$\mu\text{A}$
$V_{in} = 3.0 \text{ V}$		-	9.0	15	
$V_{in} = 6.0 \text{ V}$		-	24	40	

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.  $T_{low} = 0^\circ\text{C}$  for MC34164                       $T_{high} = +70^\circ\text{C}$  for MC34164  
     =  $-40^\circ\text{C}$  for MC33164, NCV33164            =  $+125^\circ\text{C}$  for MC33164, NCV33164

# MC34164, MC33164, NCV33164

## MC34164-5, MC33164-5 SERIES, NCV33164-5

**ELECTRICAL CHARACTERISTICS** (For typical values  $T_A = 25^\circ\text{C}$ , for min/max values  $T_A$  is the operating ambient temperature range that applies [Notes 5 & 6], unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
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### 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 ( $I_{Sink} = 100 \mu\text{A}$ )	$V_H$	0.02	0.09	–	

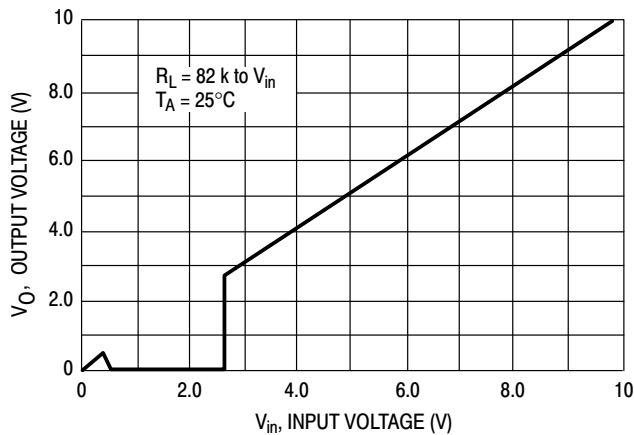
### RESET OUTPUT

Output Sink Saturation ( $V_{in} = 4.0 \text{ V}$ , $I_{Sink} = 1.0 \text{ mA}$ ) ( $V_{in} = 1.0 \text{ V}$ , $I_{Sink} = 0.25 \text{ mA}$ )	$V_{OL}$	–	0.14 0.1	0.4 0.3	V
Output Sink Current ( $V_{in}$ , $\overline{\text{Reset}} = 4.0 \text{ V}$ )	$I_{Sink}$	7.0	20	50	mA
Output Off-State Leakage ( $V_{in}$ , $\overline{\text{Reset}} = 5.0 \text{ V}$ ) ( $V_{in}$ , $\overline{\text{Reset}} = 10 \text{ V}$ )	$I_{R}(\text{leak})$	–	0.02 0.02	0.5 2.0	$\mu\text{A}$
Clamp Diode Forward Voltage, Reset to Input Pin ( $I_F = 5.0 \text{ mA}$ )	$V_F$	0.6	0.9	1.2	V

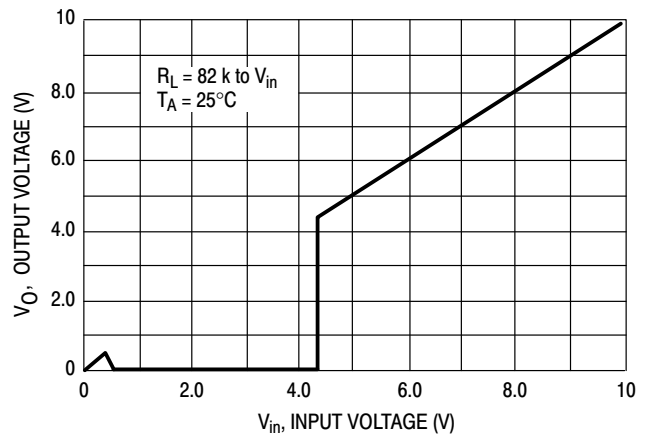
### TOTAL DEVICE

Operating Input Voltage Range	$V_{in}$	1.0 to 10	–	–	V
Quiescent Input Current $V_{in} = 5.0 \text{ V}$ $V_{in} = 10 \text{ V}$	$I_{in}$	–	12 32	20 50	$\mu\text{A}$

- Maximum package power dissipation limits must be observed.
- Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.
- $T_{low} = 0^\circ\text{C}$  for MC34164  $T_{high} = +70^\circ\text{C}$  for MC34164  
 $= -40^\circ\text{C}$  for MC33164, NCV33164  $= +125^\circ\text{C}$  for MC33164, NCV33164
- NCV prefix is for automotive and other applications requiring site and change control.

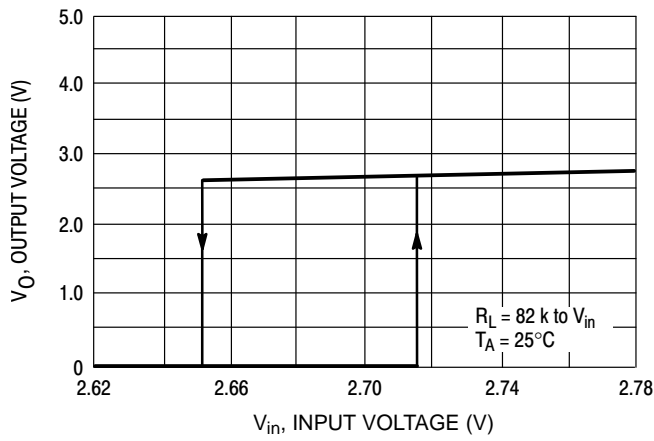


**Figure 2. MC3X164-3  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**

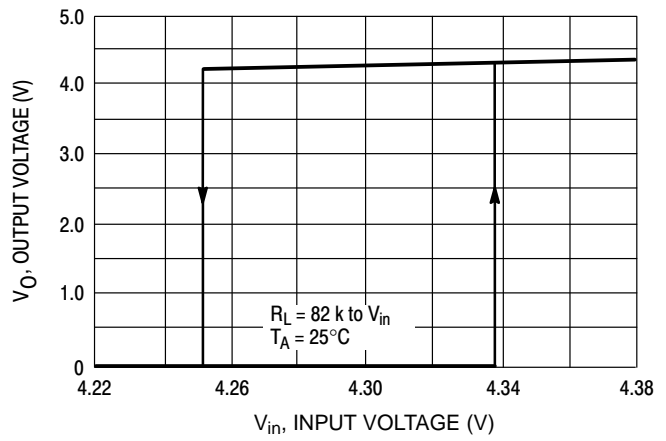


**Figure 3. MC3X164-5  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**

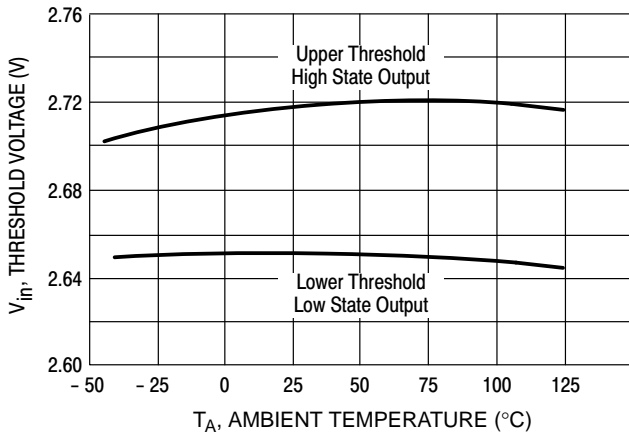
# MC34164, MC33164, NCV33164



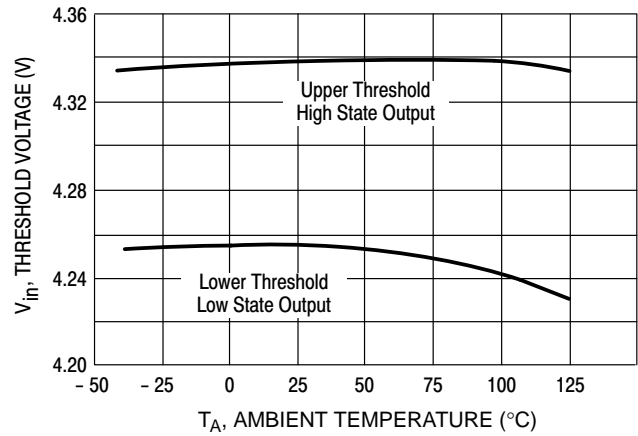
**Figure 4. MC3X164-3  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**



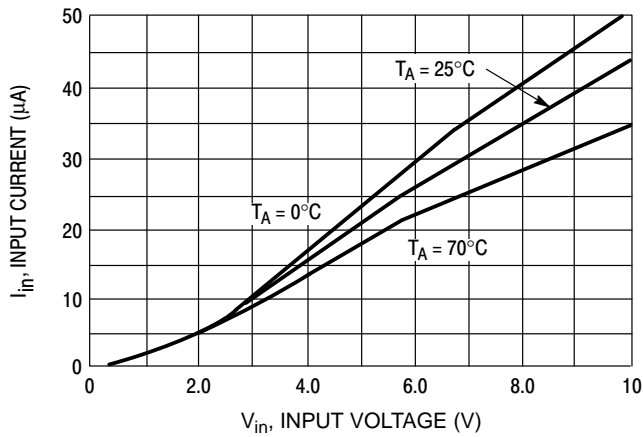
**Figure 5. MC3X164-5  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**



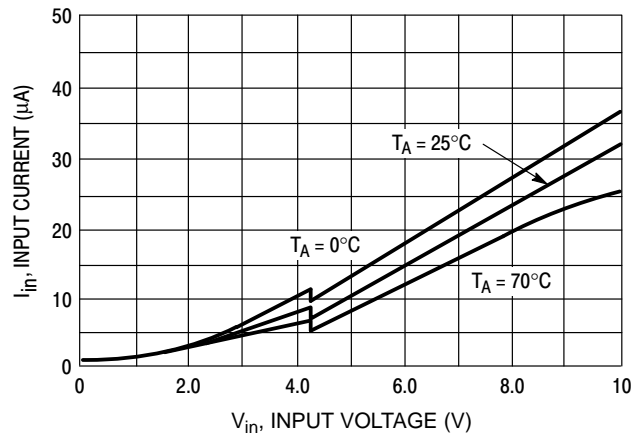
**Figure 6. MC3X164-3 Comparator Threshold Voltage versus Temperature**



**Figure 7. MC3X164-5 Comparator Threshold Voltage versus Temperature**

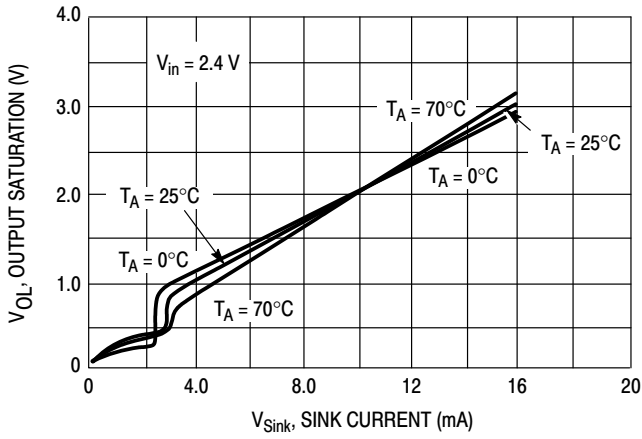


**Figure 8. MC3X164-3 Input Current versus Input Voltage**

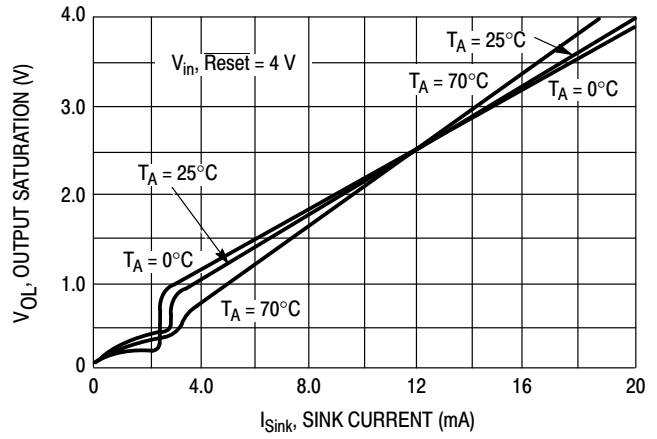


**Figure 9. MC3X164-5 Input Current versus Input Voltage**

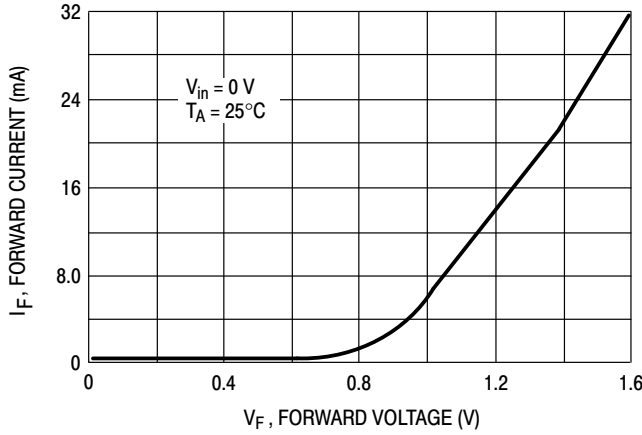
# MC34164, MC33164, NCV33164



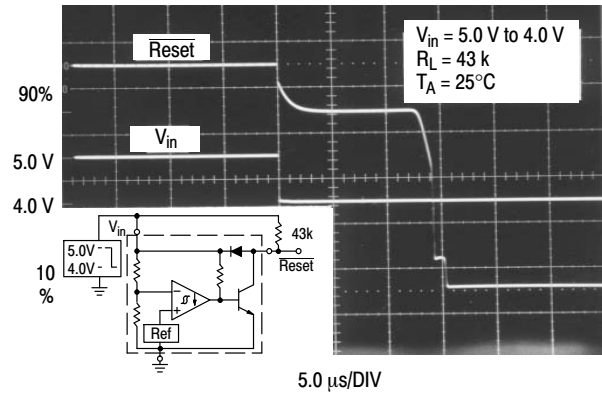
**Figure 10. MC3X164-3 Reset Output Saturation versus Sink Current**



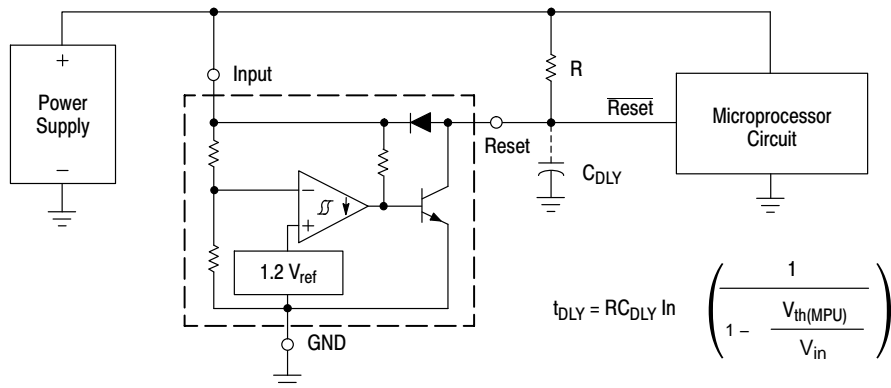
**Figure 11. MC3X164-5 Reset Output Saturation versus Sink Current**



**Figure 12. Clamp Diode Forward Current versus Voltage**



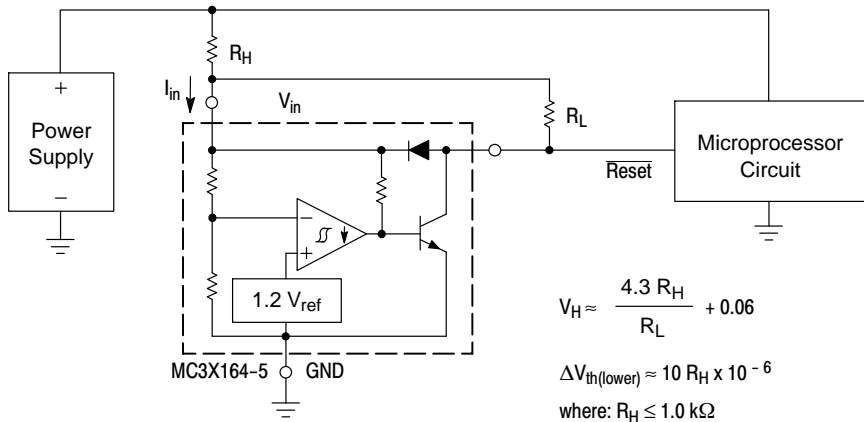
**Figure 13. Reset Delay Time (MC3X164-5 Shown)**



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  $5.0$   $\mu$ s.  $V_{th(MPU)}$  is the microprocessor reset input threshold.

**Figure 14. Low Voltage Microprocessor Reset**

# MC34164, MC33164, NCV33164



Test Data			
V <sub>H</sub> (mV)	ΔV <sub>th</sub> (mV)	R <sub>H</sub> (Ω)	R <sub>L</sub> (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

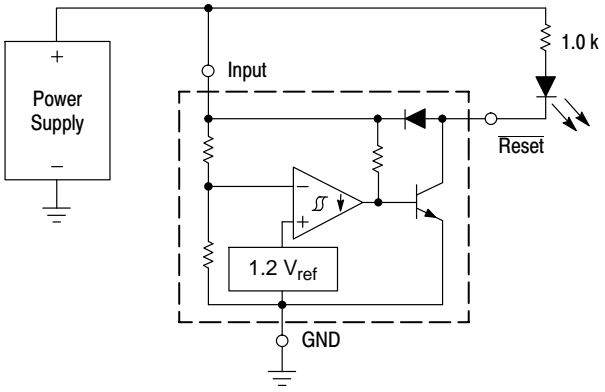
$$V_H \approx \frac{4.3 R_H}{R_L} + 0.06$$

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

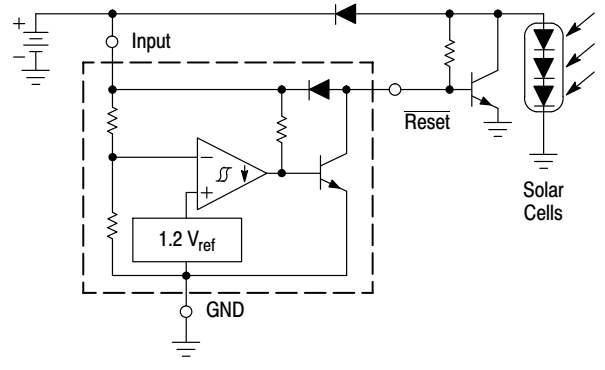
where:  $R_H \leq 1.0 \text{ k}\Omega$   
 $43 \text{ k}\Omega \geq R_L \geq 4.3 \text{ k}\Omega$

Comparator hysteresis can be increased with the addition of resistor R<sub>H</sub>. The hysteresis equation has been simplified and does not account for the change of input current I<sub>in</sub> as V<sub>in</sub> crosses the comparator threshold (Figure 8). An increase of the lower threshold ΔV<sub>th(lower)</sub> will be observed due to I<sub>in</sub> which is typically 10 μA at 4.3 V. The equations are accurate to ±10% with R<sub>H</sub> less than 1.0 kΩ and R<sub>L</sub> between 4.3 kΩ and 43 kΩ.

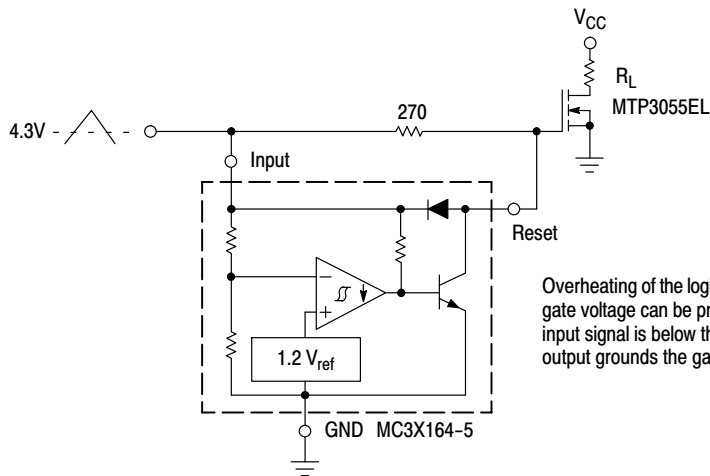
**Figure 15. Low Voltage Microprocessor Reset With Additional Hysteresis (MC3X164-5 Shown)**



**Figure 16. Voltage Monitor**



**Figure 17. Solar Powered Battery Charger**



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<sup>2</sup> MOSFET.

**Figure 18. MOSFET Low Voltage Gate Drive Protection Using the MC3X164-5**

# MC34164, MC33164, NCV33164

## ORDERING INFORMATION

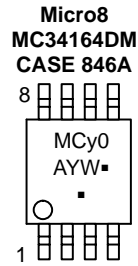
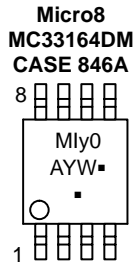
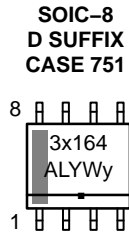
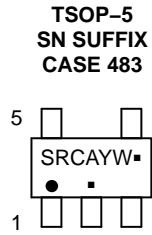
Device	Package	Shipping†
MC33164D-3G	SOIC-8 (Pb-Free)	98 Units / Rail
MC33164D-3R2G	SOIC-8 (Pb-Free)	2500 Units / Tape & Reel
NCV33164D-3R2G*	SOIC-8 (Pb-Free)	
MC33164DM-3R2G	Micro8 (Pb-Free)	4000 Units / Tape & Reel
MC33164P-3G	TO-92 (Pb-Free)	2000 Units / Box
MC33164P-3RAG	TO-92 (Pb-Free)	2000 Units / Tape & Reel
MC33164P-3RPG	TO-92 (Pb-Free)	2000 Units / Pack
MC33164D-5G	SOIC-8 (Pb-Free)	98 Units / Rail
MC33164D-5R2G	SOIC-8 (Pb-Free)	2500 Units / Tape & Reel
NCV33164D-5R2G*	SOIC-8 (Pb-Free)	
MC33164DM-5R2G	Micro8 (Pb-Free)	4000 Units / Tape & Reel
MC33164P-5G	TO-92 (Pb-Free)	2000 Units / Box
MC33164P-5RAG	TO-92 (Pb-Free)	2000 Units / Tape & Reel
MC33164P-5RPG	TO-92 (Pb-Free)	2000 Units / Pack
MC34164D-3G	SOIC-8 (Pb-Free)	98 Units / Rail
MC34164D-3R2G	SOIC-8 (Pb-Free)	2500 Units / Tape & Reel
MC34164DM-3R2G	Micro8 (Pb-Free)	4000 Units / Tape & Reel
MC34164P-3G	TO-92 (Pb-Free)	2000 Units / Box
MC34164P-3RPG	TO-92 (Pb-Free)	2000 Units / Pack
MC34164D-5G	SOIC-8 (Pb-Free)	98 Units / Rail
MC34164D-5R2G	SOIC-8 (Pb-Free)	2500 Units / Tape & Reel
MC34164DM-5R2G	Micro8 (Pb-Free)	4000 Units / Tape & Reel
MC34164SN-5T1G	TSOP-5 (Pb-Free)	3000 Units / Tape & Reel
MC34164P-5G	TO-92 (Pb-Free)	2000 Units / Box
MC34164P-5RAG	TO-92 (Pb-Free)	2000 Units / Tape & Reel
MC34164P-5RPG	TO-92 (Pb-Free)	2000 Units / Pack

\*NCV33164:  $T_{low} = -40^{\circ}\text{C}$ ,  $T_{high} = +125^{\circ}\text{C}$ . Guaranteed by design. NCV prefix is for automotive and other applications requiring site and change control.

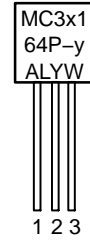
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MC34164, MC33164, NCV33164

## PIN CONNECTIONS AND MARKING DIAGRAMS



**TO-92**  
**MC3x164P-yRA**  
**MC3x164P-yRP**  
**MC3x164P-y**  
**CASE 29**

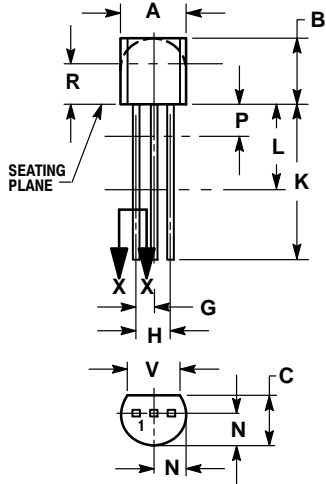


SRC = Device Code  
 x = Device Number 3 or 4  
 y = Suffix Number 3 or 5  
 A = Assembly Location  
 L = Wafer Lot  
 Y = Year  
 W = Work Week  
 ▪ = Pb-Free

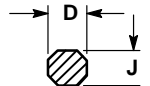


PACKAGE DIMENSIONS

TO-92 (TO-226AA)  
P SUFFIX  
CASE 29-11  
ISSUE AM



STRAIGHT LEAD  
BULK PACK

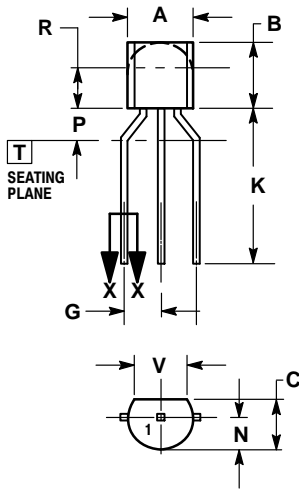


SECTION X-X

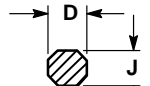
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. 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	0.021	0.407	0.533
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	---



BENT LEAD  
TAPE & REEL  
AMMO PACK



SECTION X-X

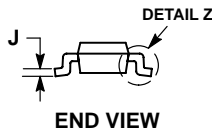
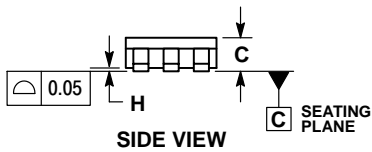
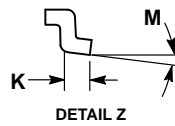
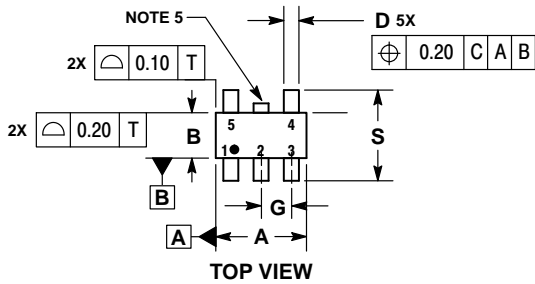
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	MILLIMETERS	
	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

PACKAGE DIMENSIONS

TSOP-5  
SN SUFFIX  
CASE 483-02  
ISSUE M

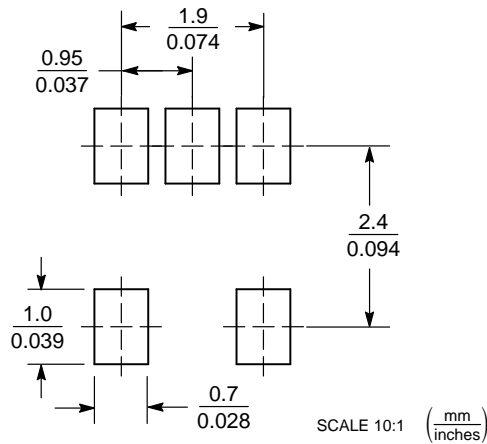


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSION A.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

DIM	MILLIMETERS	
	MIN	MAX
A	2.85	3.15
B	1.35	1.65
C	0.90	1.10
D	0.25	0.50
G	0.95 BSC	
H	0.01	0.10
J	0.10	0.26
K	0.20	0.60
M	0°	10°
S	2.50	3.00

SOLDERING FOOTPRINT\*

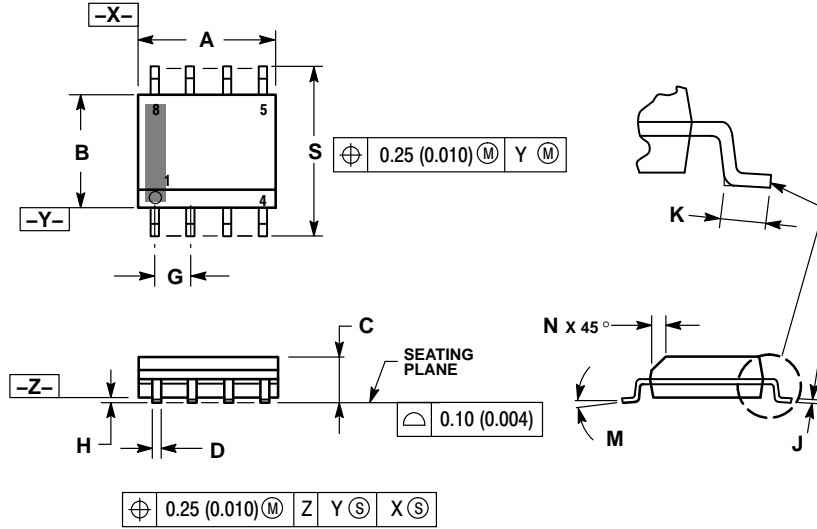


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# MC34164, MC33164, NCV33164

## PACKAGE DIMENSIONS

SOIC-8  
D SUFFIX  
CASE 751-07  
ISSUE AK

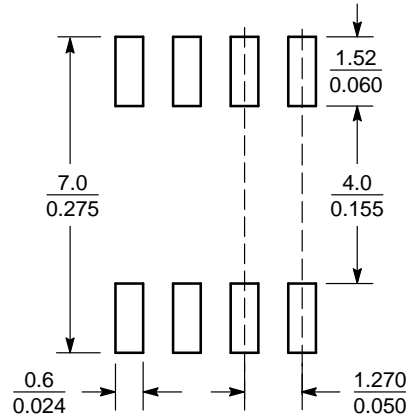


NOTES:

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 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

### SOLDERING FOOTPRINT\*



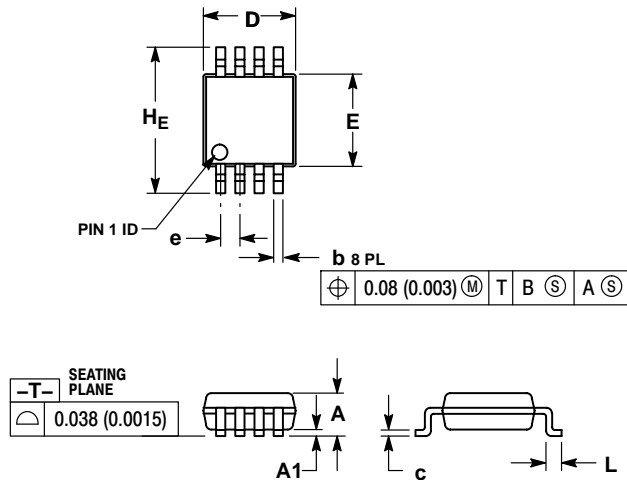
SCALE 6:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# MC34164, MC33164, NCV33164

## PACKAGE DIMENSIONS

Micro8  
DM SUFFIX  
CASE 846A-02  
ISSUE J

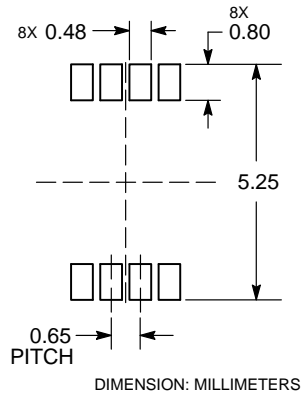


NOTES:

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.
5. 846A-01 OBSOLETE, NEW STANDARD 846A-02.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.10	---	---	0.043
A1	0.05	0.08	0.15	0.002	0.003	0.006
b	0.25	0.33	0.40	0.010	0.013	0.016
c	0.13	0.18	0.23	0.005	0.007	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
E	2.90	3.00	3.10	0.114	0.118	0.122
e	0.65 BSC			0.026 BSC		
L	0.40	0.55	0.70	0.016	0.021	0.028
HE	4.75	4.90	5.05	0.187	0.193	0.199

### RECOMMENDED SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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