

# Micropower Undervoltage Sensing Circuits

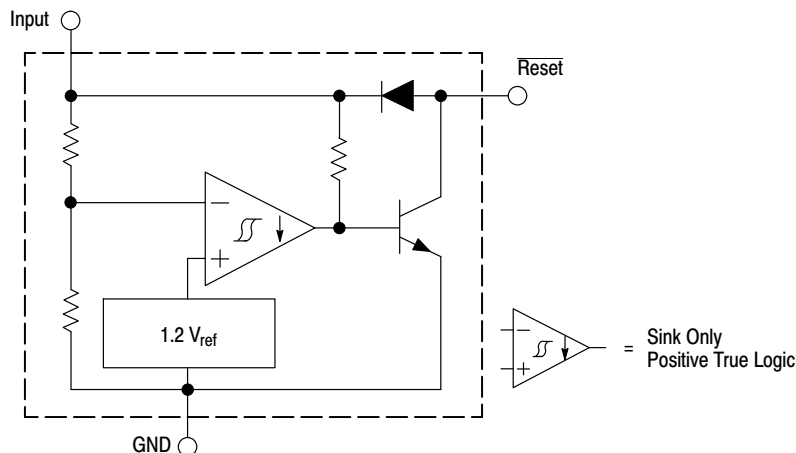
## MC34164, MC33164, NCV33164

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.

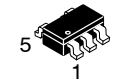
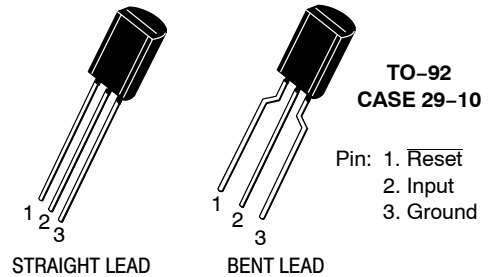
### Features

- 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.



**TSOP-5  
SN SUFFIX  
CASE 483**

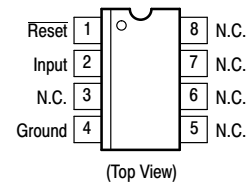


**SOIC-8  
D SUFFIX  
CASE 751**



**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 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<br>P Suffix, Plastic Package<br>Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$<br>Thermal Resistance, Junction-to-Air<br>D Suffix, Plastic Package<br>Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$<br>Thermal Resistance, Junction-to-Air<br>DM Suffix, Plastic Package<br>Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$<br>Thermal Resistance, Junction-to-Air | $P_D$<br>$R_{\theta JA}$<br>$P_D$<br>$R_{\theta JA}$<br>$P_D$<br>$R_{\theta JA}$ | 700<br>178<br>700<br>178<br>520<br>240 | mW<br>$^\circ\text{C/W}$<br>mW<br>$^\circ\text{C/W}$<br>mW<br>$^\circ\text{C/W}$ |
| Operating Junction Temperature                                                                                                                                                                                                                                                                                                                                                                                                     | $T_J$                                                                            | +150                                   | $^\circ\text{C}$                                                                 |
| Operating Ambient Temperature Range<br>MC34164 Series<br>MC33164 Series, NCV33164                                                                                                                                                                                                                                                                                                                                                  | $T_A$                                                                            | 0 to +70<br>- 40 to +125               | $^\circ\text{C}$                                                                 |
| Storage Temperature Range                                                                                                                                                                                                                                                                                                                                                                                                          | $T_{stg}$                                                                        | - 65 to +150                           | $^\circ\text{C}$                                                                 |
| Electrostatic Discharge Sensitivity (ESD)<br>Human Body Model (HBM)<br>Machine Model (MM)                                                                                                                                                                                                                                                                                                                                          | ESD                                                                              | 4000<br>200                            | V                                                                                |

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 |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### 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<br>( $V_{in} = 2.4 \text{ V}$ , $I_{Sink} = 1.0 \text{ mA}$ )<br>( $V_{in} = 1.0 \text{ V}$ , $I_{Sink} = 0.25 \text{ mA}$ ) | $V_{OL}$           | -<br>- | 0.14<br>0.1  | 0.4<br>0.3 | V             |
| Output Sink Current ( $V_{in}$ , Reset = 2.4 V)                                                                                                     | $I_{Sink}$         | 6.0    | 12           | 30         | mA            |
| Output Off-State Leakage<br>( $V_{in}$ , Reset = 3.0 V)<br>( $V_{in}$ , Reset = 10 V)                                                               | $I_R(\text{leak})$ | -<br>- | 0.02<br>0.02 | 0.5<br>1.0 | $\mu\text{A}$ |
| 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<br>$V_{in} = 3.0 \text{ V}$<br>$V_{in} = 6.0 \text{ V}$ | $I_{in}$ | -<br>-    | 9.0<br>24 | 15<br>40 | $\mu\text{A}$ |

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

### 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 | –    |   |

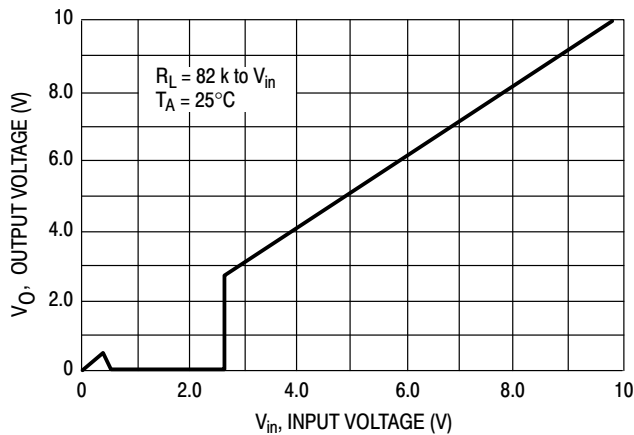
### RESET OUTPUT

|                                                                                                                                                     |               |        |              |            |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|--------------|------------|---------------|
| Output Sink Saturation<br>( $V_{in} = 4.0\ \text{V}$ , $I_{Sink} = 1.0\ \text{mA}$ )<br>( $V_{in} = 1.0\ \text{V}$ , $I_{Sink} = 0.25\ \text{mA}$ ) | $V_{OL}$      | –<br>– | 0.14<br>0.1  | 0.4<br>0.3 | V             |
| Output Sink Current ( $V_{in}$ , $\text{Reset} = 4.0\ \text{V}$ )                                                                                   | $I_{Sink}$    | 7.0    | 20           | 50         | mA            |
| Output Off-State Leakage<br>( $V_{in}$ , $\text{Reset} = 5.0\ \text{V}$ )<br>( $V_{in}$ , $\text{Reset} = 10\ \text{V}$ )                           | $I_{R(Leak)}$ | –<br>– | 0.02<br>0.02 | 0.5<br>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             |

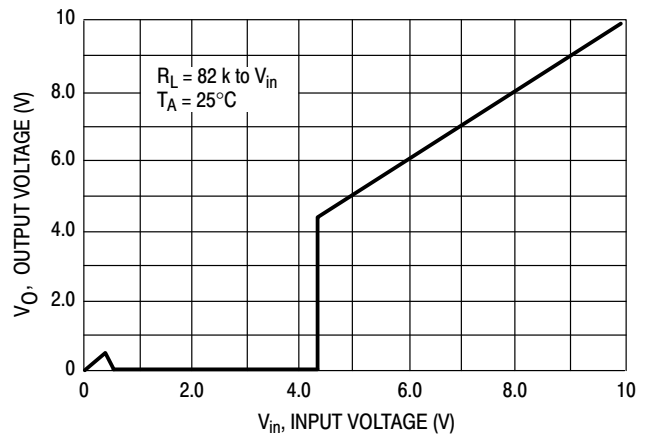
### TOTAL DEVICE

|                                                                                |          |           |          |          |               |
|--------------------------------------------------------------------------------|----------|-----------|----------|----------|---------------|
| Operating Input Voltage Range                                                  | $V_{in}$ | 1.0 to 10 | –        | –        | V             |
| Quiescent Input Current<br>$V_{in} = 5.0\ \text{V}$<br>$V_{in} = 10\ \text{V}$ | $I_{in}$ | –<br>–    | 12<br>32 | 20<br>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.

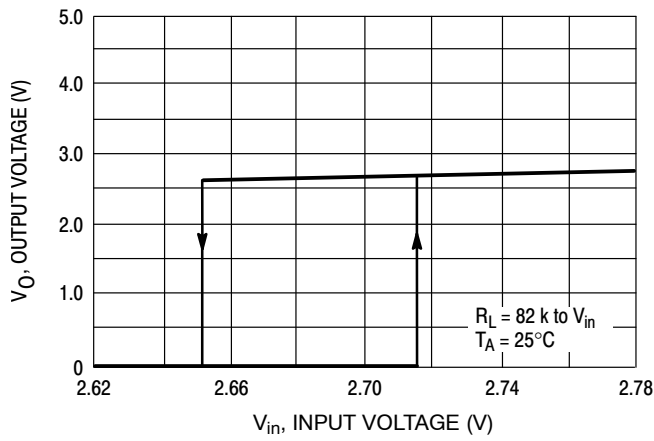


**Figure 2. MC3X164-3  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**

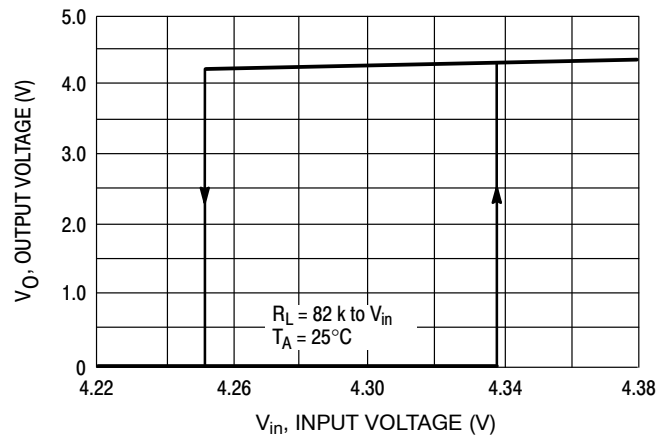


**Figure 3. MC3X164-5  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**

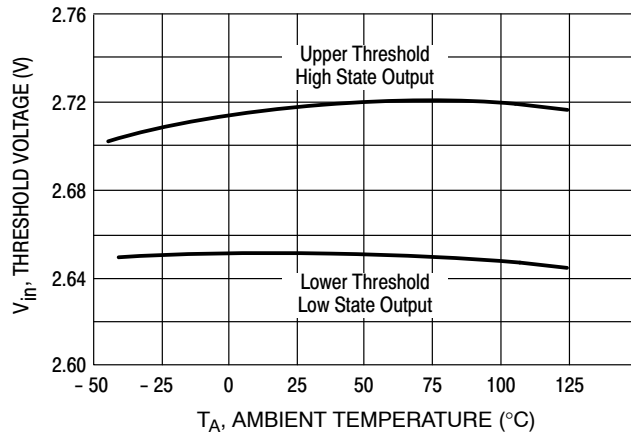
# MC34164, MC33164, NCV33164



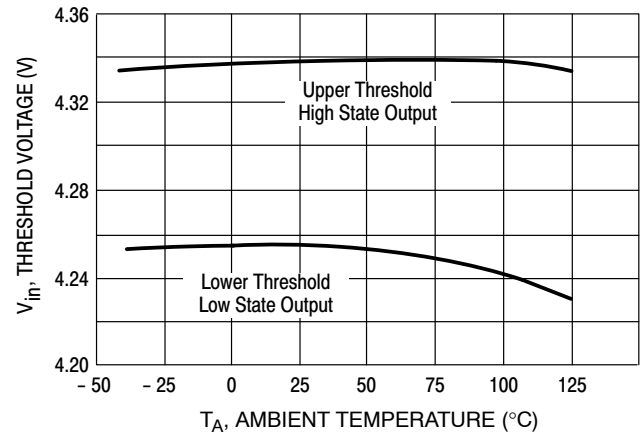
**Figure 4. MC3X164-3  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**



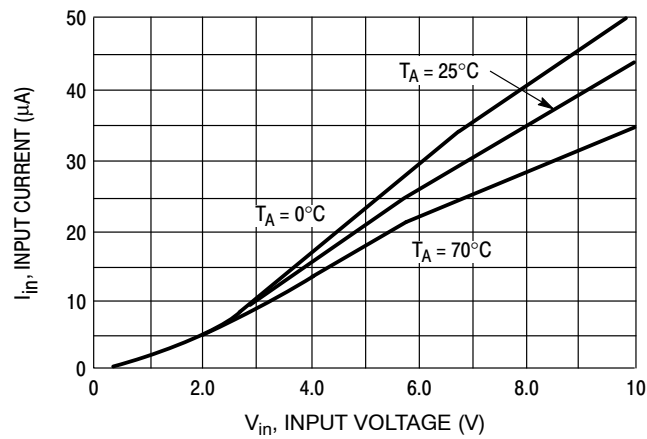
**Figure 5. MC3X164-5  $\overline{\text{Reset}}$  Output Voltage versus Input Voltage**



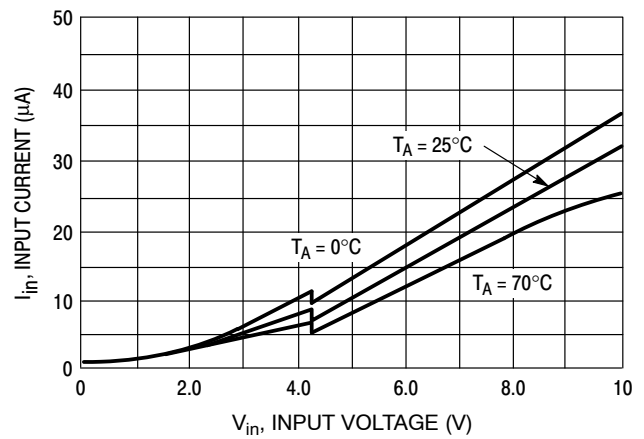
**Figure 6. MC3X164-3 Comparator Threshold Voltage versus Temperature**



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

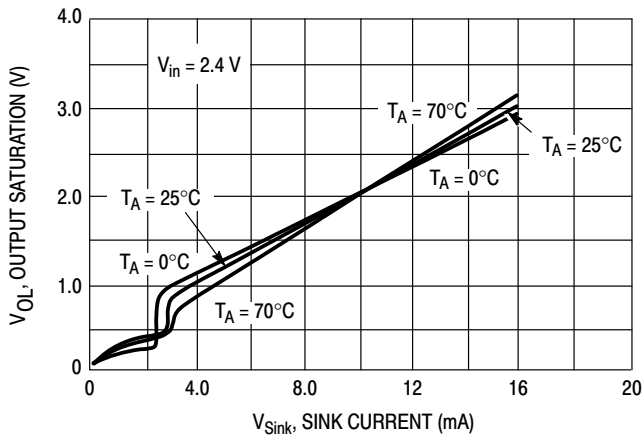


**Figure 8. MC3X164-3 Input Current versus Input Voltage**

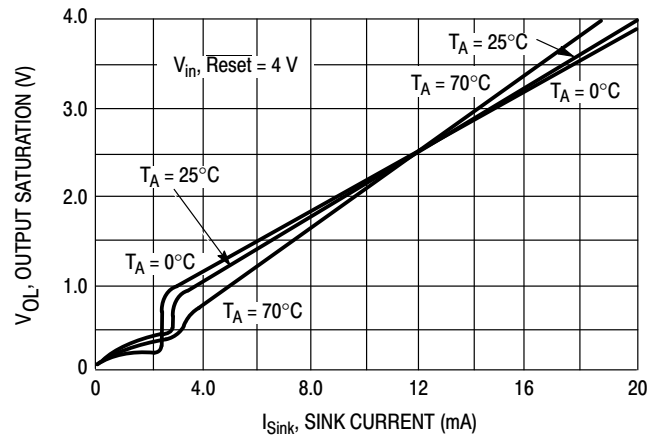


**Figure 9. MC3X164-5 Input Current versus Input Voltage**

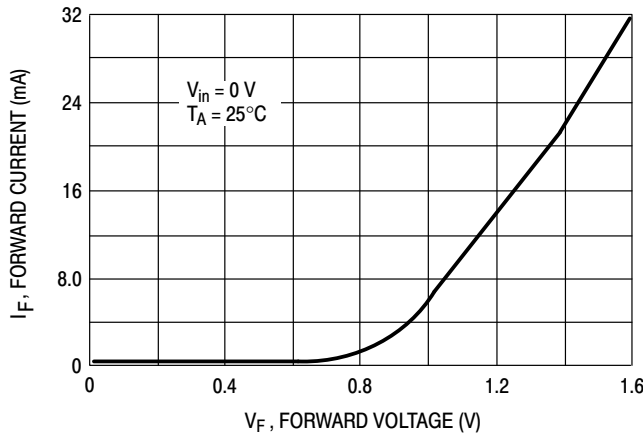
# MC34164, MC33164, NCV33164



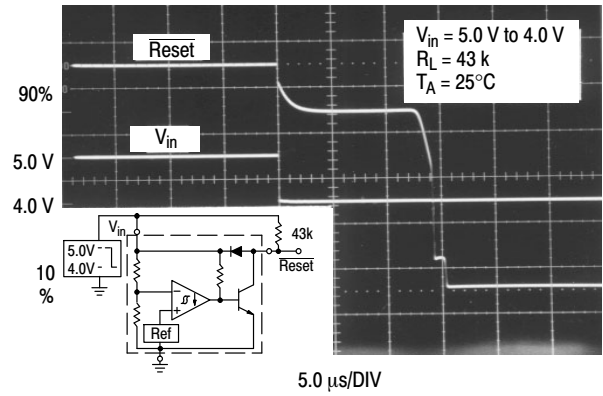
**Figure 10. MC3X164-3 Reset Output Saturation versus Sink Current**



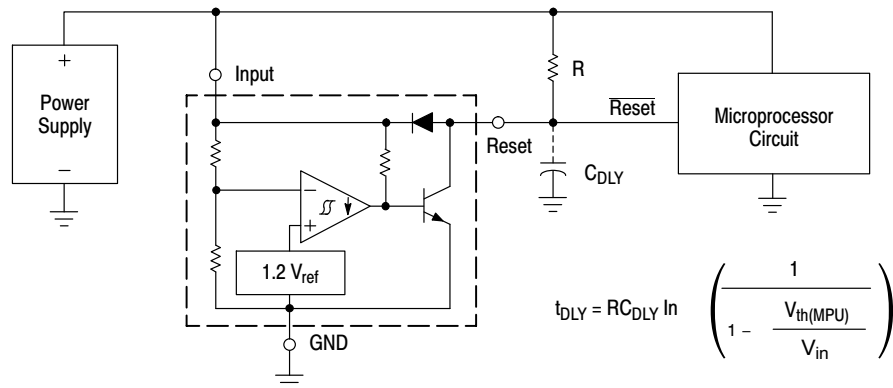
**Figure 11. MC3X164-5 Reset Output Saturation versus Sink Current**



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



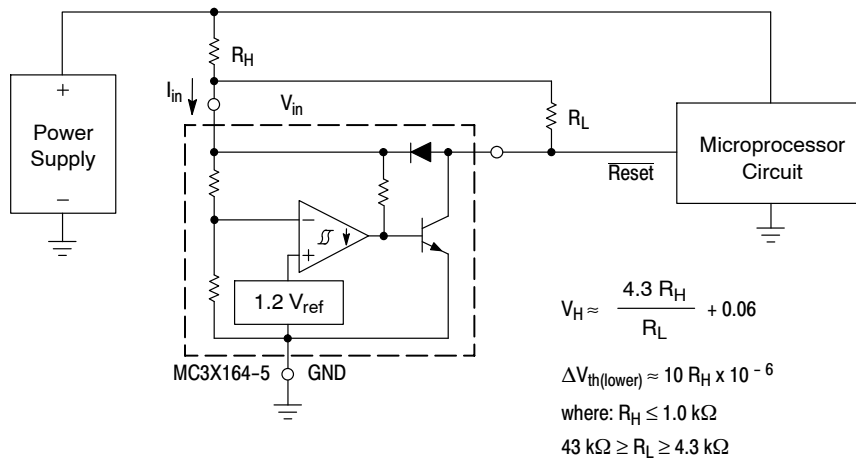
**Figure 13. Reset Delay Time (MC3X164-5 Shown)**



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**

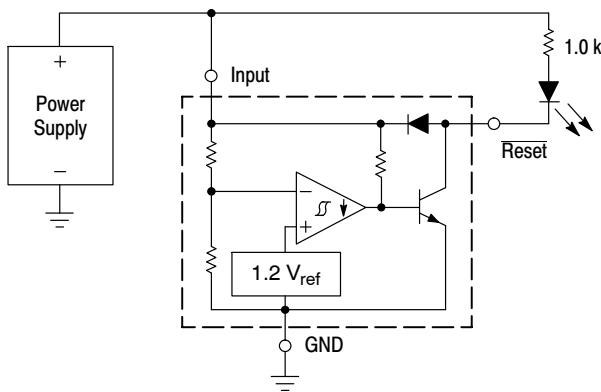
## MC34164, MC33164, NCV33164



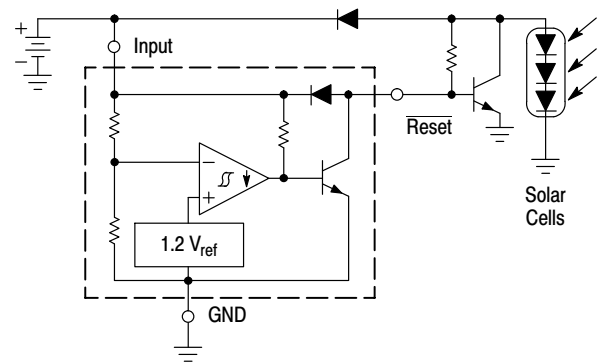
| Test Data  |                      |                    |                     |
|------------|----------------------|--------------------|---------------------|
| $V_H$ (mV) | $\Delta V_{th}$ (mV) | $R_H$ ( $\Omega$ ) | $R_L$ (k $\Omega$ ) |
| 60         | 0                    | 0                  | 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  $10 \mu\text{A}$  at  $4.3 \text{ V}$ . The equations are accurate to  $\pm 10\%$  with  $R_H$  less than  $1.0 \text{ k}\Omega$  and  $R_L$  between  $4.3 \text{ k}\Omega$  and  $43 \text{ k}\Omega$ .

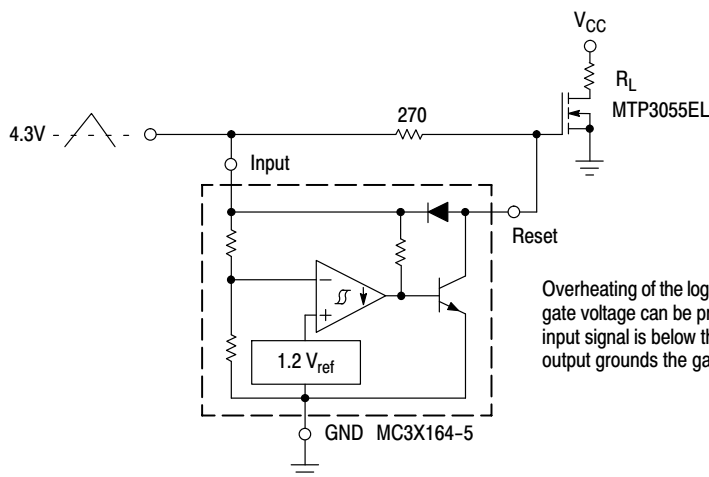
**Figure 15. Low Voltage Microprocessor Reset With Additional Hysteresis (MC3X164-5 Shown)**



**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  $4.3 \text{ V}$  threshold of the MC3X164-5, its output grounds the gate of the  $L^2$  MOSFET.

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

# MC34164, MC33164, NCV33164

## ORDERING INFORMATION

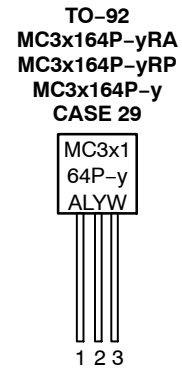
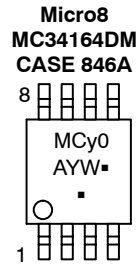
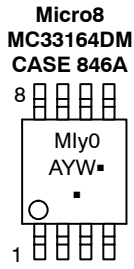
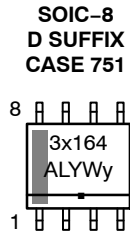
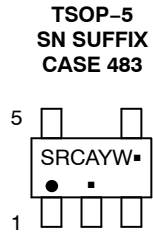
| Device          | Package             | Shipping†                |
|-----------------|---------------------|--------------------------|
| MC33164D-3G     | SOIC-8<br>(Pb-Free) | 98 Units / Rail          |
| MC33164D-3R2G   | SOIC-8<br>(Pb-Free) | 2500 Units / Tape & Reel |
| NCV33164D-3R2G* | SOIC-8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



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

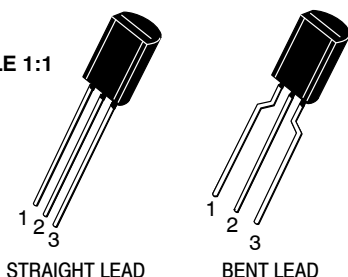
# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1



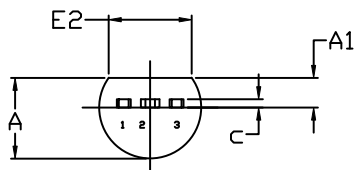
STRAIGHT LEAD

BENT LEAD

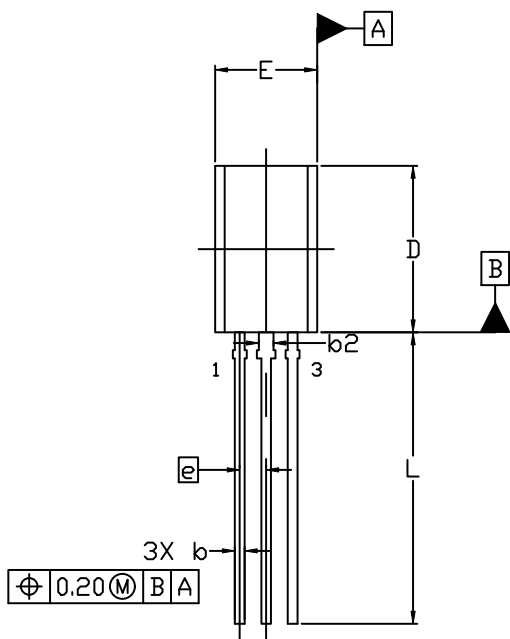
TO-92 (TO-226) 1 WATT  
CASE 29-10  
ISSUE D

DATE 05 MAR 2021

### STRAIGHT LEAD



END VIEW



TOP VIEW

#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS.
4. DIMENSION b AND b2 DOES NOT INCLUDE DAMBAR PROTRUSION. LEAD WIDTH INCLUDING PROTRUSION SHALL NOT EXCEED 0.20. DIMENSION b2 LOCATED ABOVE THE DAMBAR PORTION OF MIDDLE LEAD.

| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN.        | NOM.  | MAX.  |
| A   | 3.75        | 3.90  | 4.05  |
| A1  | 1.28        | 1.43  | 1.58  |
| b   | 0.38        | 0.465 | 0.55  |
| b2  | 0.62        | 0.70  | 0.78  |
| c   | 0.35        | 0.40  | 0.45  |
| D   | 7.85        | 8.00  | 8.15  |
| E   | 4.75        | 4.90  | 5.05  |
| E2  | 3.90        | ---   | ---   |
| e   | 1.27 BSC    |       |       |
| L   | 13.80       | 14.00 | 14.20 |

### STYLES AND MARKING ON PAGE 3

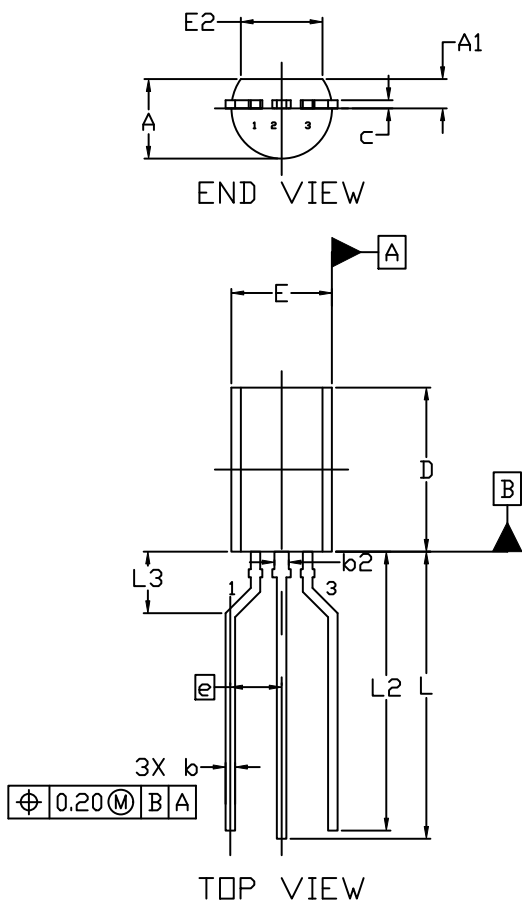
|                  |                       |                                                                                                                                                                                  |
|------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | TO-92 (TO-226) 1 WATT | PAGE 1 OF 3                                                                                                                                                                      |

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**TO-92 (TO-226) 1 WATT**  
**CASE 29-10**  
**ISSUE D**

DATE 05 MAR 2021

**FORMED LEAD**



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS.
4. DIMENSION b AND b2 DOES NOT INCLUDE DAMBAR PROTRUSION. LEAD WIDTH INCLUDING PROTRUSION SHALL NOT EXCEED 0.20. DIMENSION b2 LOCATED ABOVE THE DAMBAR PORTION OF MIDDLE LEAD.

| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN.        | NOM.  | MAX.  |
| A   | 3.75        | 3.90  | 4.05  |
| A1  | 1.28        | 1.43  | 1.58  |
| b   | 0.38        | 0.465 | 0.55  |
| b2  | 0.62        | 0.70  | 0.78  |
| c   | 0.35        | 0.40  | 0.45  |
| D   | 7.85        | 8.00  | 8.15  |
| E   | 4.75        | 4.90  | 5.05  |
| E2  | 3.90        | ---   | ---   |
| e   | 2.50 BSC    |       |       |
| L   | 13.80       | 14.00 | 14.20 |
| L2  | 13.20       | 13.60 | 14.00 |
| L3  | 3.00 REF    |       |       |

**STYLES AND MARKING ON PAGE 3**

|                         |                              |                                                                                                                                                                                  |
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| <b>DESCRIPTION:</b>     | <b>TO-92 (TO-226) 1 WATT</b> | <b>PAGE 2 OF 3</b>                                                                                                                                                               |

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**TO-92 (TO-226) 1 WATT**  
**CASE 29-10**  
**ISSUE D**

DATE 05 MAR 2021

|                                                                 |                                                                      |                                                              |                                                                 |                                                             |
|-----------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------|
| STYLE 1:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR           | STYLE 2:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR                | STYLE 3:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE           | STYLE 4:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE            | STYLE 5:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE            |
| STYLE 6:<br>PIN 1. GATE<br>2. SOURCE & SUBSTRATE<br>3. DRAIN    | STYLE 7:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE                     | STYLE 8:<br>PIN 1. DRAIN<br>2. GATE<br>3. SOURCE & SUBSTRATE | STYLE 9:<br>PIN 1. BASE 1<br>2. EMITTER<br>3. BASE 2            | STYLE 10:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          |
| STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE & ANODE<br>3. CATHODE   | STYLE 12:<br>PIN 1. MAIN TERMINAL 1<br>2. GATE<br>3. MAIN TERMINAL 2 | STYLE 13:<br>PIN 1. ANODE 1<br>2. GATE<br>3. CATHODE 2       | STYLE 14:<br>PIN 1. EMITTER<br>2. COLLECTOR<br>3. BASE          | STYLE 15:<br>PIN 1. ANODE 1<br>2. CATHODE<br>3. ANODE 2     |
| STYLE 16:<br>PIN 1. ANODE<br>2. GATE<br>3. CATHODE              | STYLE 17:<br>PIN 1. COLLECTOR<br>2. BASE<br>3. EMITTER               | STYLE 18:<br>PIN 1. ANODE<br>2. CATHODE<br>3. NOT CONNECTED  | STYLE 19:<br>PIN 1. GATE<br>2. ANODE<br>3. CATHODE              | STYLE 20:<br>PIN 1. NOT CONNECTED<br>2. CATHODE<br>3. ANODE |
| STYLE 21:<br>PIN 1. COLLECTOR<br>2. EMITTER<br>3. BASE          | STYLE 22:<br>PIN 1. SOURCE<br>2. GATE<br>3. DRAIN                    | STYLE 23:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN            | STYLE 24:<br>PIN 1. EMITTER<br>2. COLLECTOR/ANODE<br>3. CATHODE | STYLE 25:<br>PIN 1. MT 1<br>2. GATE<br>3. MT 2              |
| STYLE 26:<br>PIN 1. V <sub>CC</sub><br>2. GROUND 2<br>3. OUTPUT | STYLE 27:<br>PIN 1. MT<br>2. SUBSTRATE<br>3. MT                      | STYLE 28:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE           | STYLE 29:<br>PIN 1. NOT CONNECTED<br>2. ANODE<br>3. CATHODE     | STYLE 30:<br>PIN 1. DRAIN<br>2. GATE<br>3. SOURCE           |
| STYLE 31:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE               | STYLE 32:<br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER               | STYLE 33:<br>PIN 1. RETURN<br>2. INPUT<br>3. OUTPUT          | STYLE 34:<br>PIN 1. INPUT<br>2. GROUND<br>3. LOGIC              | STYLE 35:<br>PIN 1. GATE<br>2. COLLECTOR<br>3. EMITTER      |

**GENERIC  
MARKING DIAGRAM\***



XXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

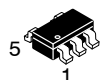
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

|                         |                              |                                                                                                                                                                                     |
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| <b>DESCRIPTION:</b>     | <b>TO-92 (TO-226) 1 WATT</b> | <b>PAGE 3 OF 3</b>                                                                                                                                                                  |

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

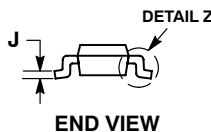
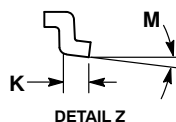
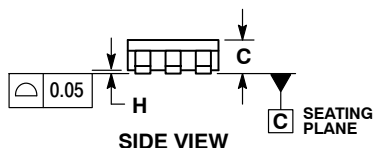
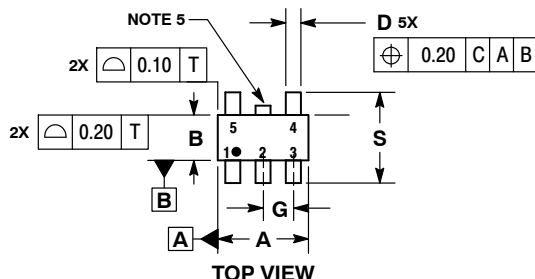
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SCALE 2:1

## TSOP-5 CASE 483 ISSUE N

DATE 12 AUG 2020

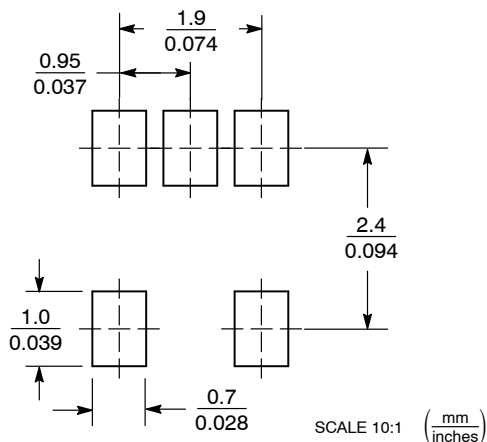


### NOTES:

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.

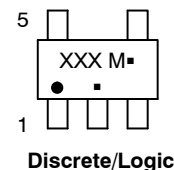
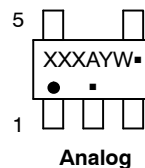
| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 2.85        | 3.15 |
| B   | 1.35        | 1.65 |
| C   | 0.90        | 1.10 |
| D   | 0.25        | 0.50 |
| G   | 0.95 BSC    |      |
| H   | 0.01        | 0.10 |
| J   | 0.10        | 0.26 |
| K   | 0.20        | 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.

### GENERIC MARKING DIAGRAM\*



XXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

DOCUMENT NUMBER: 98ARB18753C

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DESCRIPTION: TSOP-5

PAGE 1 OF 1

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011



## 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 |

## GENERIC MARKING DIAGRAM\*



SCALE 6:1 (mm/inches)



XXXXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

XXXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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

## STYLES ON PAGE 2

|                  |             |                                                                                                                                                                                  |
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| DESCRIPTION:     | SOIC-8 NB   | PAGE 1 OF 2                                                                                                                                                                      |

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**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

DATE 16 FEB 2011

|                                                                                                                                                                                                   |                                                                                                                                                                                          |                                                                                                                                                                                    |                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>STYLE 1:</b><br>PIN 1. EMITTER<br>2. COLLECTOR<br>3. COLLECTOR<br>4. EMITTER<br>5. EMITTER<br>6. BASE<br>7. BASE<br>8. EMITTER                                                                 | <b>STYLE 2:</b><br>PIN 1. COLLECTOR, DIE, #1<br>2. COLLECTOR, #1<br>3. COLLECTOR, #2<br>4. COLLECTOR, #2<br>5. BASE, #2<br>6. EMITTER, #2<br>7. BASE, #1<br>8. EMITTER, #1               | <b>STYLE 3:</b><br>PIN 1. DRAIN, DIE #1<br>2. DRAIN, #1<br>3. DRAIN, #2<br>4. DRAIN, #2<br>5. GATE, #2<br>6. SOURCE, #2<br>7. GATE, #1<br>8. SOURCE, #1                            | <b>STYLE 4:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE<br>4. ANODE<br>5. ANODE<br>6. ANODE<br>7. ANODE<br>8. COMMON CATHODE                                                                           |
| <b>STYLE 5:</b><br>PIN 1. DRAIN<br>2. DRAIN<br>3. DRAIN<br>4. DRAIN<br>5. GATE<br>6. GATE<br>7. SOURCE<br>8. SOURCE                                                                               | <b>STYLE 6:</b><br>PIN 1. SOURCE<br>2. DRAIN<br>3. DRAIN<br>4. SOURCE<br>5. SOURCE<br>6. GATE<br>7. GATE<br>8. SOURCE                                                                    | <b>STYLE 7:</b><br>PIN 1. INPUT<br>2. EXTERNAL BYPASS<br>3. THIRD STAGE SOURCE<br>4. GROUND<br>5. DRAIN<br>6. GATE 3<br>7. SECOND STAGE Vd<br>8. FIRST STAGE Vd                    | <b>STYLE 8:</b><br>PIN 1. COLLECTOR, DIE #1<br>2. BASE, #1<br>3. BASE, #2<br>4. COLLECTOR, #2<br>5. COLLECTOR, #2<br>6. EMITTER, #2<br>7. EMITTER, #1<br>8. COLLECTOR, #1                              |
| <b>STYLE 9:</b><br>PIN 1. EMITTER, COMMON<br>2. COLLECTOR, DIE #1<br>3. COLLECTOR, DIE #2<br>4. EMITTER, COMMON<br>5. EMITTER, COMMON<br>6. BASE, DIE #2<br>7. BASE, DIE #1<br>8. EMITTER, COMMON | <b>STYLE 10:</b><br>PIN 1. GROUND<br>2. BIAS 1<br>3. OUTPUT<br>4. GROUND<br>5. GROUND<br>6. BIAS 2<br>7. INPUT<br>8. GROUND                                                              | <b>STYLE 11:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. SOURCE 2<br>4. GATE 2<br>5. DRAIN 2<br>6. DRAIN 2<br>7. DRAIN 1<br>8. DRAIN 1                                               | <b>STYLE 12:</b><br>PIN 1. SOURCE<br>2. SOURCE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                                 |
| <b>STYLE 13:</b><br>PIN 1. N.C.<br>2. SOURCE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                              | <b>STYLE 14:</b><br>PIN 1. N-SOURCE<br>2. N-GATE<br>3. P-SOURCE<br>4. P-GATE<br>5. P-DRAIN<br>6. P-DRAIN<br>7. N-DRAIN<br>8. N-DRAIN                                                     | <b>STYLE 15:</b><br>PIN 1. ANODE 1<br>2. ANODE 1<br>3. ANODE 1<br>4. ANODE 1<br>5. CATHODE, COMMON<br>6. CATHODE, COMMON<br>7. CATHODE, COMMON<br>8. CATHODE, COMMON               | <b>STYLE 16:</b><br>PIN 1. EMITTER, DIE #1<br>2. BASE, DIE #1<br>3. EMITTER, DIE #2<br>4. BASE, DIE #2<br>5. COLLECTOR, DIE #2<br>6. COLLECTOR, DIE #2<br>7. COLLECTOR, DIE #1<br>8. COLLECTOR, DIE #1 |
| <b>STYLE 17:</b><br>PIN 1. VCC<br>2. V2OUT<br>3. V1OUT<br>4. TXE<br>5. RXE<br>6. VEE<br>7. GND<br>8. ACC                                                                                          | <b>STYLE 18:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. CATHODE<br>8. CATHODE                                                                 | <b>STYLE 19:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. SOURCE 2<br>4. GATE 2<br>5. DRAIN 2<br>6. MIRROR 2<br>7. DRAIN 1<br>8. MIRROR 1                                             | <b>STYLE 20:</b><br>PIN 1. SOURCE (N)<br>2. GATE (N)<br>3. SOURCE (P)<br>4. GATE (P)<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                   |
| <b>STYLE 21:</b><br>PIN 1. CATHODE 1<br>2. CATHODE 2<br>3. CATHODE 3<br>4. CATHODE 4<br>5. CATHODE 5<br>6. COMMON ANODE<br>7. COMMON ANODE<br>8. CATHODE 6                                        | <b>STYLE 22:</b><br>PIN 1. I/O LINE 1<br>2. COMMON CATHODE/VCC<br>3. COMMON CATHODE/VCC<br>4. I/O LINE 3<br>5. COMMON ANODE/GND<br>6. I/O LINE 4<br>7. I/O LINE 5<br>8. COMMON ANODE/GND | <b>STYLE 23:</b><br>PIN 1. LINE 1 IN<br>2. COMMON ANODE/GND<br>3. COMMON ANODE/GND<br>4. LINE 2 IN<br>5. LINE 2 OUT<br>6. COMMON ANODE/GND<br>7. COMMON ANODE/GND<br>8. LINE 1 OUT | <b>STYLE 24:</b><br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR/ANODE<br>4. COLLECTOR/ANODE<br>5. CATHODE<br>6. CATHODE<br>7. COLLECTOR/ANODE<br>8. COLLECTOR/ANODE                                      |
| <b>STYLE 25:</b><br>PIN 1. VIN<br>2. N/C<br>3. REXT<br>4. GND<br>5. IOUT<br>6. IOUT<br>7. IOUT<br>8. IOUT                                                                                         | <b>STYLE 26:</b><br>PIN 1. GND<br>2. dv/dt<br>3. ENABLE<br>4. ILIMIT<br>5. SOURCE<br>6. SOURCE<br>7. SOURCE<br>8. VCC                                                                    | <b>STYLE 27:</b><br>PIN 1. ILIMIT<br>2. OVLO<br>3. UVLO<br>4. INPUT+<br>5. SOURCE<br>6. SOURCE<br>7. SOURCE<br>8. DRAIN                                                            | <b>STYLE 28:</b><br>PIN 1. SW_TO_GND<br>2. DASIC_OFF<br>3. DASIC_SW_DET<br>4. GND<br>5. V_MON<br>6. VBULK<br>7. VBULK<br>8. VIN                                                                        |
| <b>STYLE 29:</b><br>PIN 1. BASE, DIE #1<br>2. EMITTER, #1<br>3. BASE, #2<br>4. EMITTER, #2<br>5. COLLECTOR, #2<br>6. COLLECTOR, #2<br>7. COLLECTOR, #1<br>8. COLLECTOR, #1                        | <b>STYLE 30:</b><br>PIN 1. DRAIN 1<br>2. DRAIN 1<br>3. GATE 2<br>4. SOURCE 2<br>5. SOURCE 1/DRAIN 2<br>6. SOURCE 1/DRAIN 2<br>7. SOURCE 1/DRAIN 2<br>8. GATE 1                           |                                                                                                                                                                                    |                                                                                                                                                                                                        |

|                         |                    |                                                                                                                                                                                     |
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| <b>DESCRIPTION:</b>     | <b>SOIC-8 NB</b>   | <b>PAGE 2 OF 2</b>                                                                                                                                                                  |

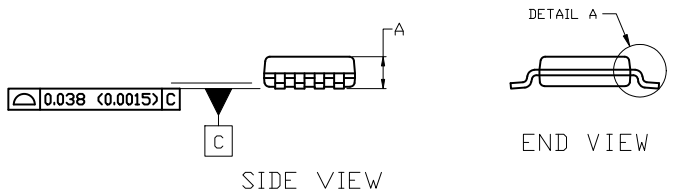
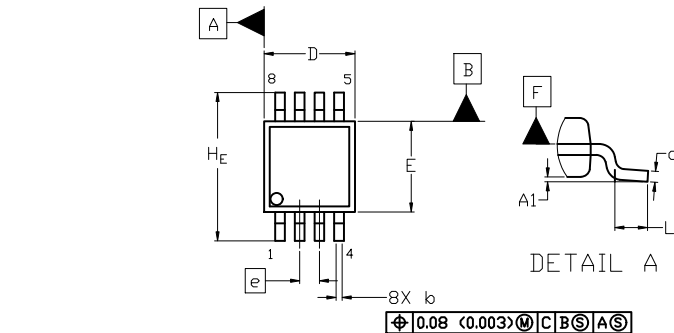
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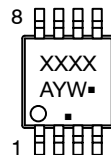
SCALE 2:1

### Micro8 CASE 846A-02 ISSUE K

DATE 16 JUL 2020



### GENERIC MARKING DIAGRAM\*



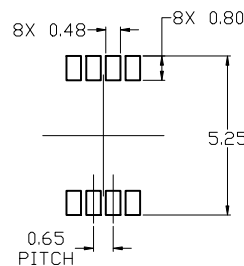
XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION *b* DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS *D* AND *E* DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER SIDE. DIMENSION *E* DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 mm PER SIDE. DIMENSIONS *D* AND *E* ARE DETERMINED AT DATUM *F*.
5. DATUMS *A* AND *B* ARE TO BE DETERMINED AT DATUM *F*.
6. *A1* IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.



For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, [SOLDERM-10](#).

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | ---         | ---  | 1.10 |
| A1  | 0.05        | 0.08 | 0.15 |
| b   | 0.25        | 0.33 | 0.40 |
| c   | 0.13        | 0.18 | 0.23 |
| D   | 2.90        | 3.00 | 3.10 |
| E   | 2.90        | 3.00 | 3.10 |
| e   | 0.65 BSC    |      |      |
| HE  | 4.75        | 4.90 | 5.05 |
| L   | 0.40        | 0.55 | 0.70 |

### STYLE 1:

- PIN 1. SOURCE
- SOURCE
- SOURCE
- GATE
- DRAIN
- DRAIN
- DRAIN
- DRAIN

### STYLE 2:

- PIN 1. SOURCE 1
- GATE 1
- SOURCE 2
- GATE 2
- DRAIN 2
- DRAIN 2
- DRAIN 1
- DRAIN 1

### STYLE 3:

- PIN 1. N-SOURCE
- N-GATE
- P-SOURCE
- P-GATE
- P-DRAIN
- P-DRAIN
- N-DRAIN
- N-DRAIN

|                  |             |                                                                                                                                                                                     |
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| DESCRIPTION:     | MICRO8      | PAGE 1 OF 1                                                                                                                                                                         |

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