

# MC34064, MC33064, NCV33064

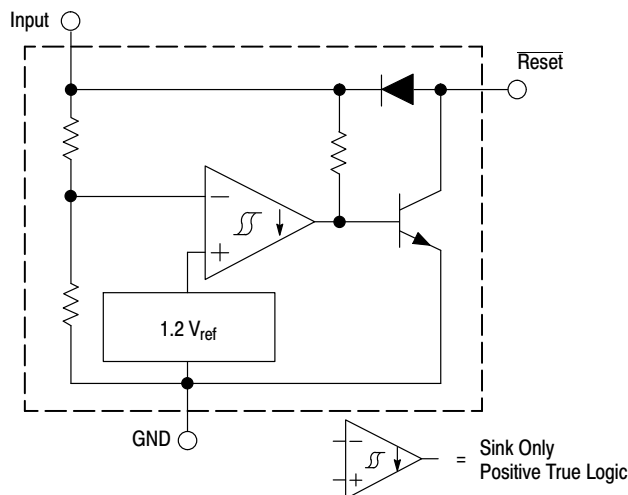
## Undervoltage Sensing Circuit

The MC34064 is an undervoltage sensing circuit specifically designed for use as a reset controller in microprocessor-based systems. It offers the designer an economical solution for low voltage detection with a single external resistor. The MC34064 features a trimmed-in-package bandgap reference, and a comparator with precise thresholds and built-in hysteresis to prevent erratic reset operation. The open collector reset output is capable of sinking in excess of 10 mA, and operation is guaranteed down to 1.0 V input with low standby current. The MC devices are packaged in 3-pin TO-92, micro size TSOP-5, 8-pin SOIC-8 and Micro8™ surface mount packages. The NCV device is packaged in SOIC-8 and TO-92.

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

### Features

- Trimmed-In-Package Temperature Compensated Reference
- Comparator Threshold of 4.6 V at 25°C
- Precise Comparator Thresholds Guaranteed Over Temperature
- Comparator Hysteresis Prevents Erratic Reset
- Reset Output Capable of Sinking in Excess of 10 mA
- Internal Clamp Diode for Discharging Delay Capacitor
- Guaranteed Reset Operation with 1.0 V Input
- Low Standby Current
- Economical TO-92, TSOP-5, SOIC-8 and Micro8 Surface Mount Packages
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes
- Pb-Free Packages are Available



This device contains 21 active transistors.

**Figure 1. Representative Block Diagram**

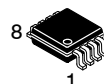


**ON Semiconductor®**

<http://onsemi.com>



**SOIC-8  
D SUFFIX  
CASE 751**

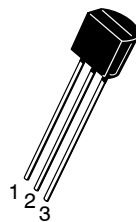


**Micro8  
DM SUFFIX  
CASE 846A**

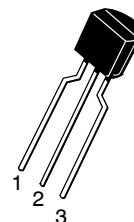


**TSOP-5  
SN SUFFIX  
CASE 483**

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



**STRAIGHT LEAD  
BULK PACK**

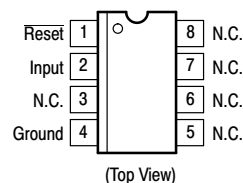


**BENT LEAD  
TAPE & REEL  
AMMO PACK**

**TO-92  
P SUFFIX  
CASE 29**

Pin 1. Reset  
2. Input  
3. Ground

### PIN CONNECTIONS



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 7 of this data sheet.

# MC34064, MC33064, NCV33064

## MAXIMUM RATINGS

| Rating                                                   | Symbol          | Value              | Unit               |
|----------------------------------------------------------|-----------------|--------------------|--------------------|
| Power Input Supply Voltage                               | $V_{in}$        | -1.0 to 10         | V                  |
| Reset Output Voltage                                     | $V_O$           | 10                 | V                  |
| Reset Output Sink Current (Note 2)                       | $I_{Sink}$      | Internally Limited | mA                 |
| Clamp Diode Forward Current, Reset to Input Pin (Note 2) | $I_F$           | 100                | mA                 |
| Power Dissipation and Thermal Characteristics            |                 |                    |                    |
| P Suffix, Plastic Package                                |                 |                    |                    |
| Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$     | $P_D$           | 625                | mW                 |
| Thermal Resistance, Junction-to-Air                      | $R_{\theta JA}$ | 200                | $^\circ\text{C/W}$ |
| D Suffix, Plastic Package                                |                 |                    |                    |
| Maximum Power Dissipation @ $T_A = 25^\circ\text{C}$     | $P_D$           | 625                | mW                 |
| Thermal Resistance, Junction-to-Air                      | $R_{\theta JA}$ | 200                | $^\circ\text{C/W}$ |
| 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                            | $T_A$           |                    | $^\circ\text{C}$   |
| MC34064                                                  |                 | 0 to +70           |                    |
| MC33064                                                  |                 | -40 to +85         |                    |
| NCV33064                                                 |                 | -40 to +125        |                    |
| Storage Temperature Range                                | $T_{stg}$       | -65 to +150        | $^\circ\text{C}$   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. ESD data available upon request.

**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 3 and 4] unless otherwise noted.)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|-----------------|--------|-----|-----|-----|------|
|-----------------|--------|-----|-----|-----|------|

### COMPARATOR

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

### RESET OUTPUT

|                                                                                  |            |     |      |     |               |
|----------------------------------------------------------------------------------|------------|-----|------|-----|---------------|
| Output Sink Saturation                                                           | $V_{OL}$   |     |      |     | V             |
| ( $V_{in} = 4.0\text{ V}$ , $I_{Sink} = 8.0\text{ mA}$ )                         |            | -   | 0.46 | 1.0 |               |
| ( $V_{in} = 4.0\text{ V}$ , $I_{Sink} = 2.0\text{ mA}$ )                         |            | -   | 0.15 | 0.4 |               |
| ( $V_{in} = 1.0\text{ V}$ , $I_{Sink} = 0.1\text{ mA}$ )                         |            | -   | -    | 0.1 |               |
| Output Sink Current ( $V_{in}$ , $\overline{\text{Reset}} = 4.0\text{ V}$ )      | $I_{Sink}$ | 10  | 27   | 60  | mA            |
| Output Off-State Leakage ( $V_{in}$ , $\overline{\text{Reset}} = 5.0\text{ V}$ ) | $I_{OH}$   | -   | 0.02 | 0.5 | $\mu\text{A}$ |
| Clamp Diode Forward Voltage, Reset to Input Pin ( $I_F = 10\text{ mA}$ )         | $V_F$      | 0.6 | 0.9  | 1.2 | V             |

### TOTAL DEVICE

|                                                     |          |            |     |     |               |
|-----------------------------------------------------|----------|------------|-----|-----|---------------|
| Operating Input Voltage Range                       | $V_{in}$ | 1.0 to 6.5 | -   | -   | V             |
| Quiescent Input Current ( $V_{in} = 5.0\text{ V}$ ) | $I_{in}$ | -          | 390 | 500 | $\mu\text{A}$ |

- 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 MC34064  $T_{high} = +70^\circ\text{C}$  for MC34064  
 $-40^\circ\text{C}$  for MC33064  $+85^\circ\text{C}$  for MC33064  
 $-40^\circ\text{C}$  for NCV33064  $+125^\circ\text{C}$  for NCV33064
- NCV prefix is for automotive and other applications requiring site and change control.

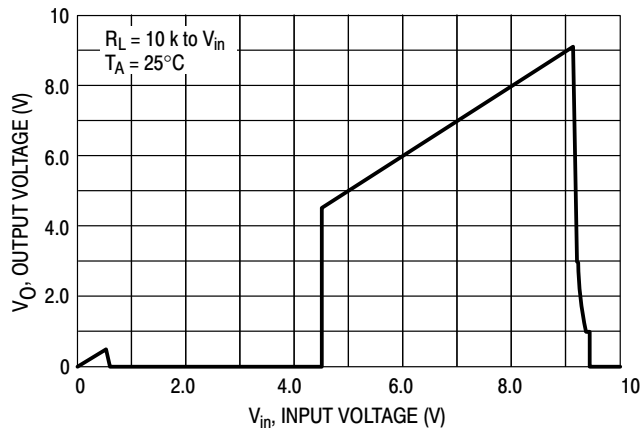


Figure 2. Reset Output Voltage versus Input Voltage

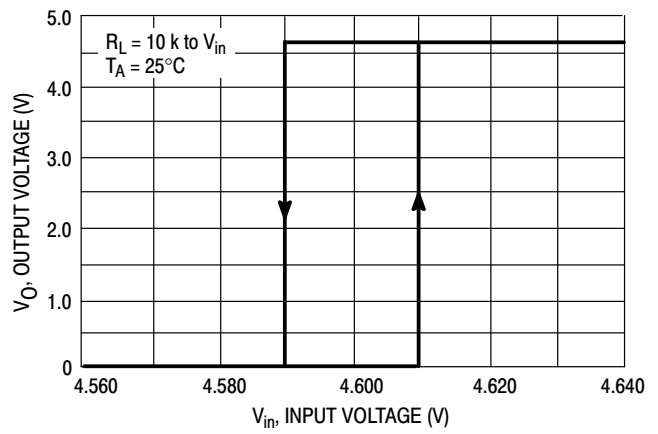


Figure 3. Reset Output Voltage versus Input Voltage

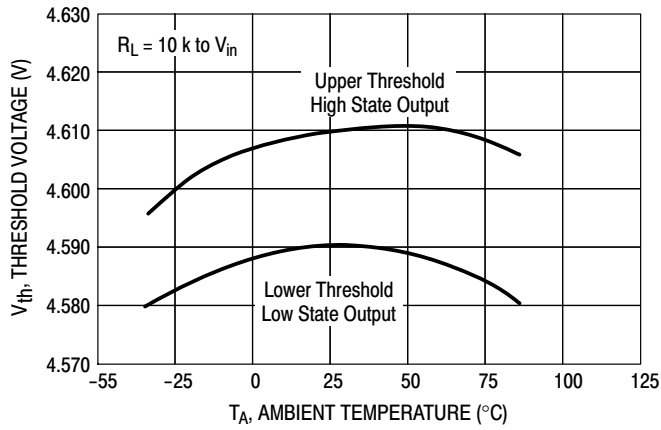


Figure 4. Comparator Threshold Voltage versus Temperature

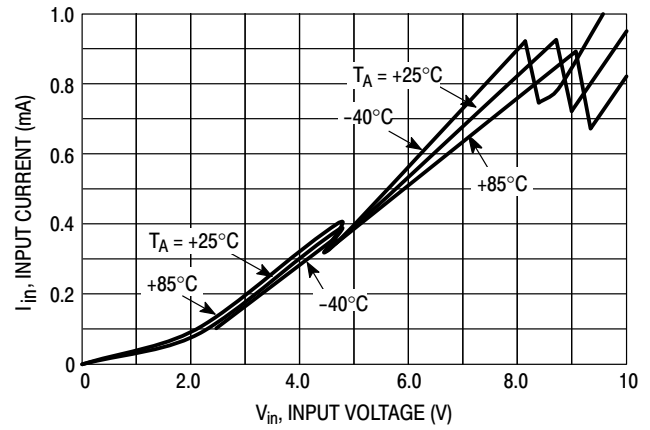


Figure 5. Input Current versus Input Voltage

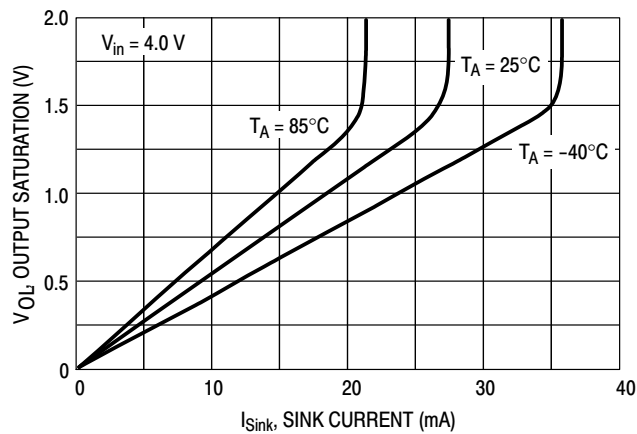


Figure 6. Reset Output Saturation versus Sink Current

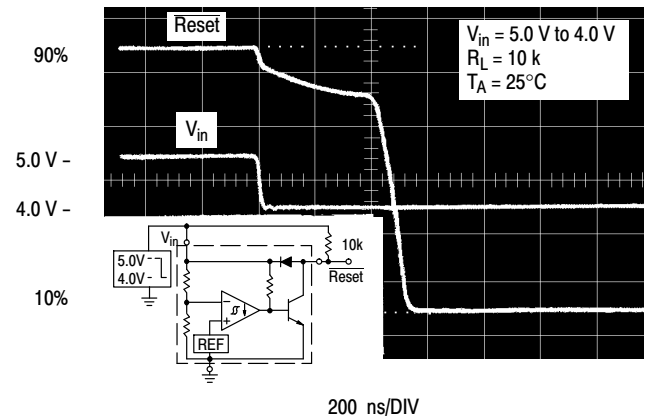


Figure 7. Reset Delay Time

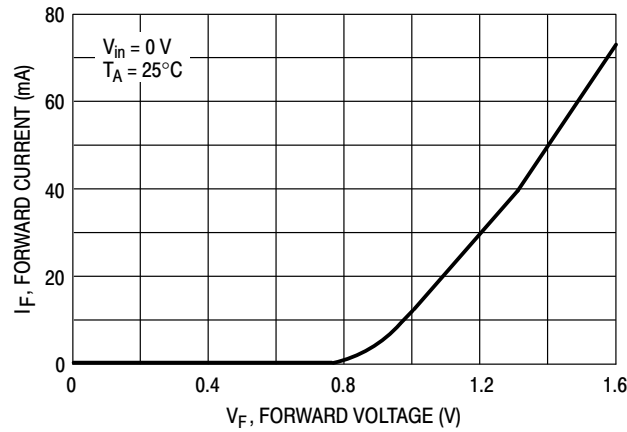


Figure 8. Clamp Diode Forward Current versus Voltage

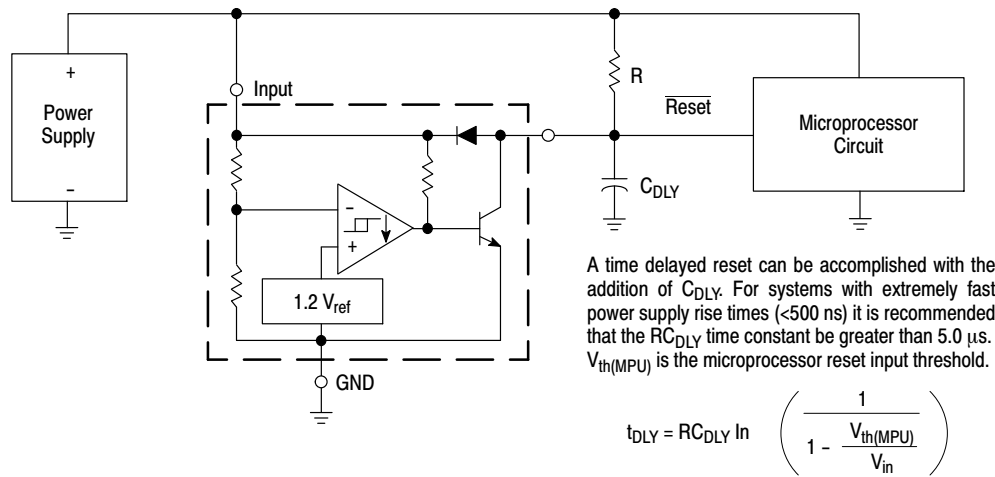
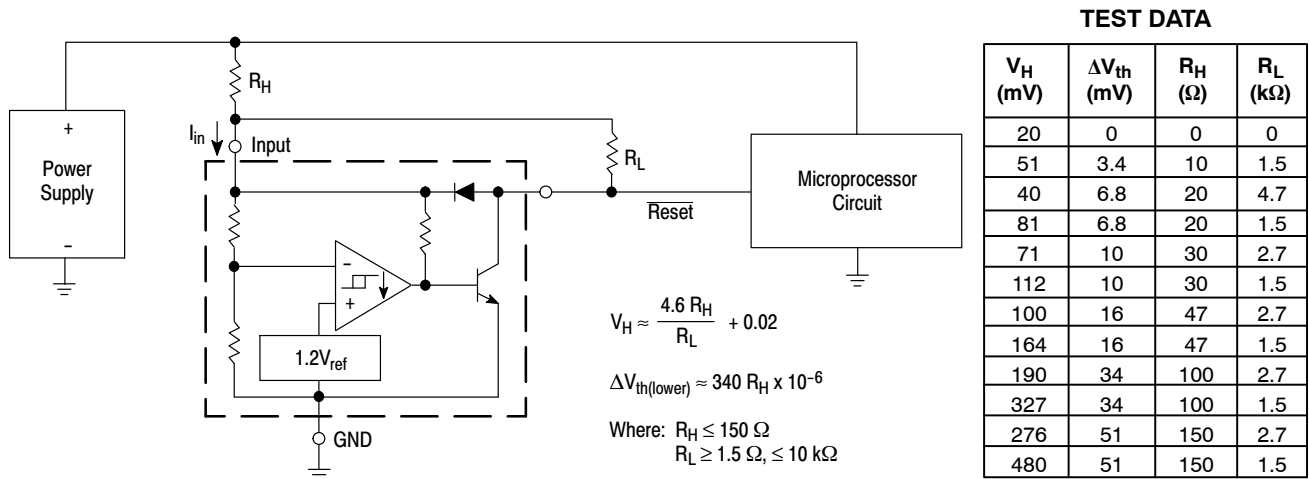


Figure 9. Low Voltage Microprocessor Reset



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>CC</sub> crosses the comparator threshold (Figure 4). An increase of the lower threshold ΔV<sub>th(lower)</sub> will be observed due to I<sub>in</sub> which is typically 340 μA at 4.59 V. The equations are accurate to ±10% with R<sub>H</sub> less than 150 Ω and R<sub>L</sub> between 1.5 kΩ and 10 kΩ.

Figure 10. Low Voltage Microprocessor Reset with Additional Hysteresis

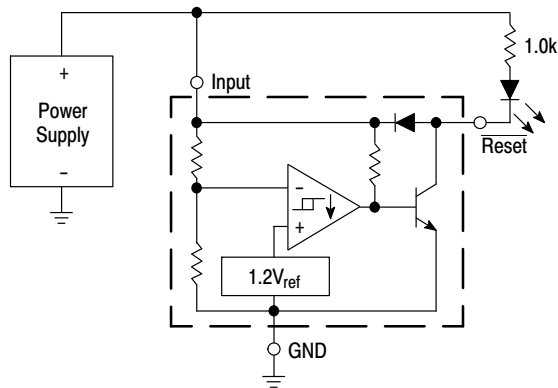


Figure 11. Voltage Monitor

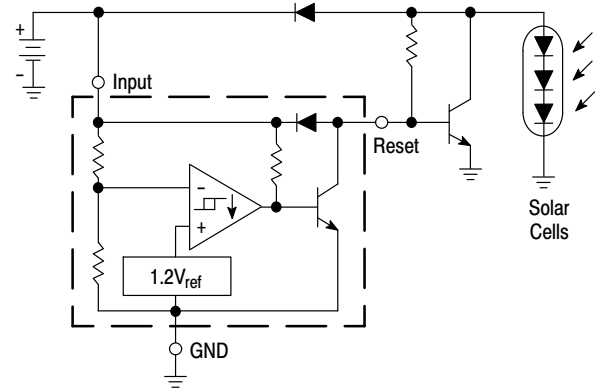
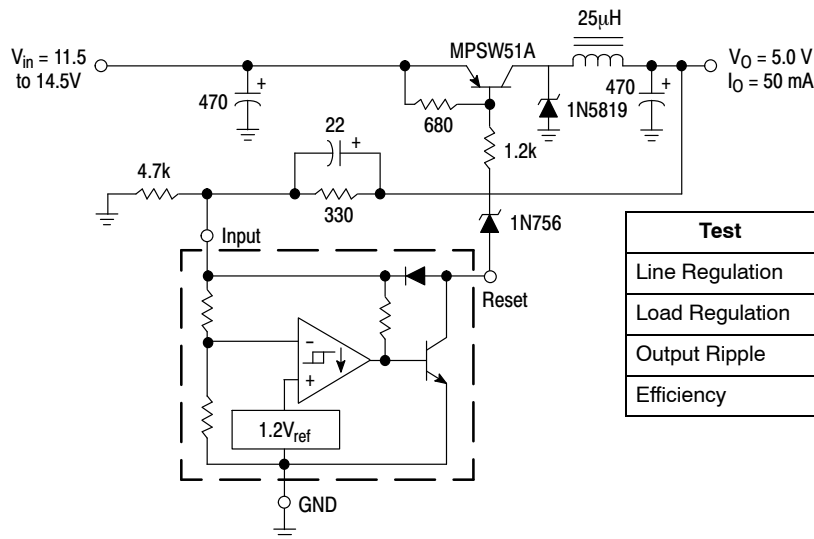
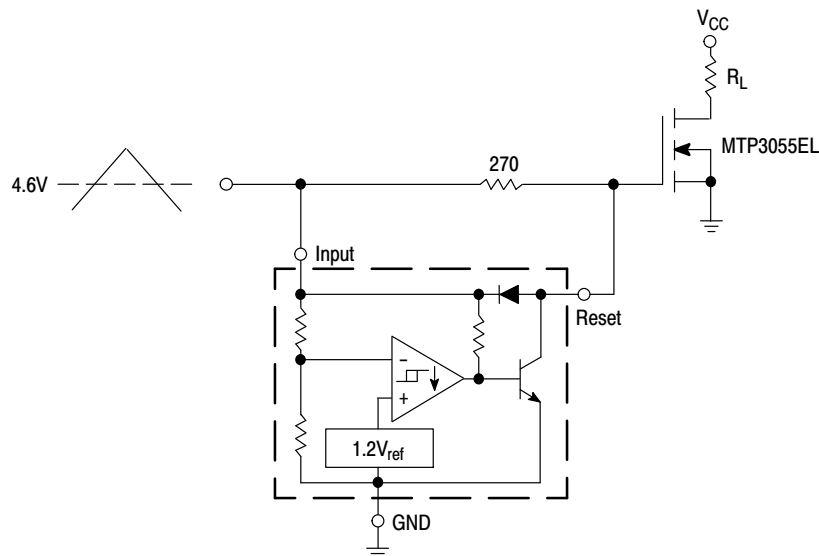


Figure 12. Solar Powered Battery Charger



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

Figure 13. Low Power Switching Regulator



Overheating of the logic level power MOSFET due to insufficient gate voltage can be prevented with the above circuit. When the input signal is below the 4.6 V threshold of the MC34064, its output grounds the gate of the L<sup>2</sup> MOSFET.

Figure 14. MOSFET Low Voltage Gate Drive Protection

# MC34064, MC33064, NCV33064

## ORDERING INFORMATION

| Device         | Operating Temperature Range     | Package          | Shipping <sup>†</sup>    |
|----------------|---------------------------------|------------------|--------------------------|
| MC34064D-005   | T <sub>A</sub> = 0°C to +70°C   | SOIC-8           | 98 Units / Rail          |
| MC34064D-5G    |                                 | SOIC-8 (Pb-Free) |                          |
| MC34064D-5R2   |                                 | SOIC-8           | 2500 Units / Tape & Reel |
| MC34064D-5R2G  |                                 | SOIC-8 (Pb-Free) |                          |
| MC34064DM-5R2  |                                 | Micro8           | 4000 Units / Tape & Reel |
| MC34064DM-5R2G |                                 | Micro8 (Pb-Free) |                          |
| MC34064P-005   |                                 | TO-92            | 2000 Units / Bag         |
| MC34064P-5G    |                                 | TO-92 (Pb-Free)  |                          |
| MC34064P-5RA   |                                 | TO-92            | 2000 Units / Tape & Reel |
| MC34064P-5RAG  |                                 | TO-92 (Pb-Free)  |                          |
| MC34064P-5RP   |                                 | TO-92            | 2000 Units / Ammo Pack   |
| MC34064P-5RPG  |                                 | TO-92 (Pb-Free)  |                          |
| MC34064P-5RM   |                                 | TO-92            |                          |
| MC34064P-5RMG  |                                 | TO-92 (Pb-Free)  |                          |
| MC34064SN-5T1  |                                 | TSOP-5           | 3000 Units / Tape & Reel |
| MC34064SN-5T1G |                                 | TSOP-5 (Pb-Free) |                          |
| MC33064D-005   | T <sub>A</sub> = -40°C to +85°C | SOIC-8           | 98 Units / Rail          |
| MC33064D-5G    |                                 | SOIC-8 (Pb-Free) |                          |
| MC33064D-5R2   |                                 | SOIC-8           | 2500 Units / Tape & Reel |
| MC33064D-5R2G  |                                 | SOIC-8 (Pb-Free) |                          |
| MC33064DM-5R2  |                                 | Micro8           | 4000 Units / Tape & Reel |
| MC33064DM-5R2G |                                 | Micro8 (Pb-Free) |                          |
| MC33064P-005   |                                 | TO-92            | 2000 Units / Bag         |
| MC33064P-5G    |                                 | TO-92 (Pb-Free)  |                          |
| MC33064P-5RA   |                                 | TO-92            | 2000 Units / Tape & Reel |
| MC33064P-5RAG  |                                 | TO-92 (Pb-Free)  |                          |
| MC33064P-5RP   |                                 | TO-92            | 2000 Units / Ammo Pack   |
| MC33064P-5RPG  |                                 | TO-92 (Pb-Free)  |                          |
| MC33064SN-5T1  |                                 | TSOP-5           | 3000 Units / Tape & Reel |
| MC33064SN-5T1G |                                 | TSOP-5 (Pb-Free) |                          |

<sup>†</sup>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.

\*NCV33064: T<sub>low</sub> = -40°C, T<sub>high</sub> = +125°C. Guaranteed by design. NCV prefix is for automotive and other applications requiring site and change control.

# MC34064, MC33064, NCV33064

## ORDERING INFORMATION

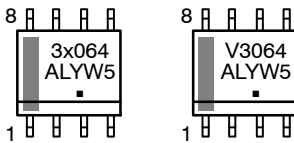
| Device           | Operating Temperature Range                           | Package             | Shipping <sup>†</sup>    |
|------------------|-------------------------------------------------------|---------------------|--------------------------|
| NCV33064D-5R2*   | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | SOIC-8              | 2500 Units / Tape & Reel |
| NCV33064D-5R2G*  |                                                       | SOIC-8<br>(Pb-Free) |                          |
| NCV33064P-5RA*   |                                                       | TO-92               | 2000 Units / Tape & Reel |
| NCV33064P-5RAG*  |                                                       | TO-92<br>(Pb-Free)  |                          |
| NCV33064P-5RP*   |                                                       | TO-92               | 2000 Units / Ammo Pack   |
| NCV33064P-5RPG*  |                                                       | TO-92<br>(Pb-Free)  |                          |
| NCV33064DM-5R2*  |                                                       | Micro8              | 4000 Units / Tape & Reel |
| NCV33064DM-5R2G* |                                                       | Micro8<br>(Pb-Free) |                          |

<sup>†</sup>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.

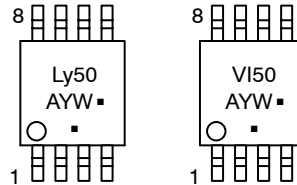
\*NCV33064:  $T_{\text{low}} = -40^{\circ}\text{C}$ ,  $T_{\text{high}} = +125^{\circ}\text{C}$ . Guaranteed by design. NCV prefix is for automotive and other applications requiring site and change control.

## MARKING DIAGRAMS

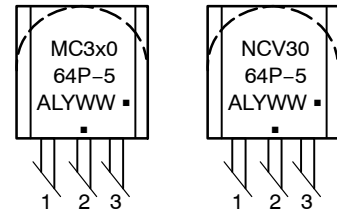
**SOIC-8**  
**D SUFFIX**  
**CASE 751**



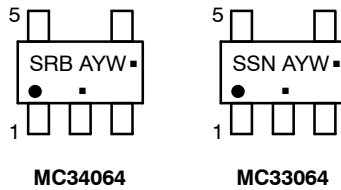
**Micro8**  
**DM SUFFIX**  
**CASE 846A**



**TO-92**  
**P SUFFIX**  
**CASE 29**



**TSOP-5**  
**SN SUFFIX**  
**CASE 483**



**MC34064**

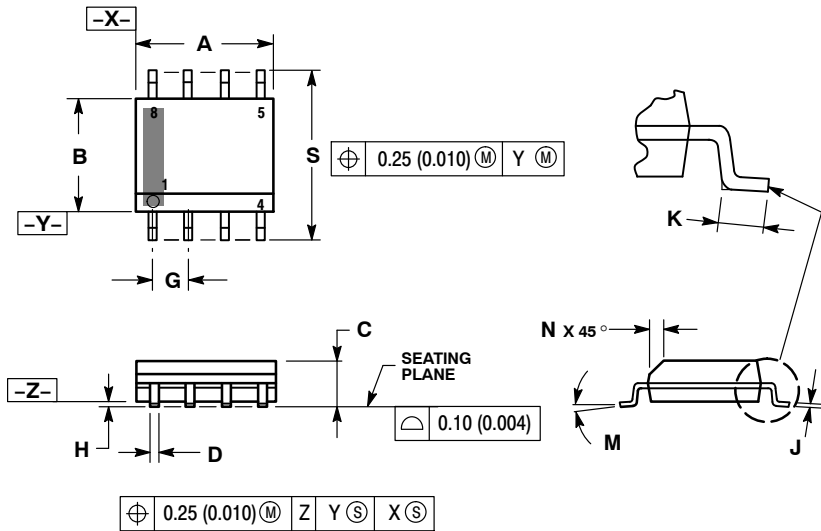
**MC33064**

- x = 3 or 4
- y = C or I
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W, WW = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

## PACKAGE DIMENSIONS

SOIC-8  
D SUFFIX  
CASE 751-07  
ISSUE AJ

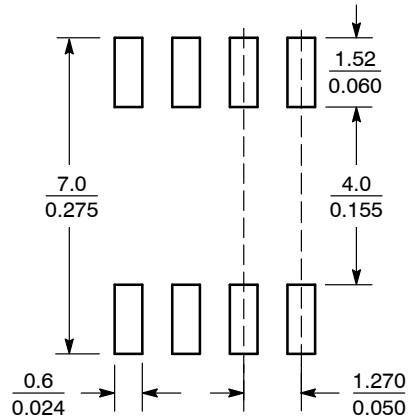


## NOTES:

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\*



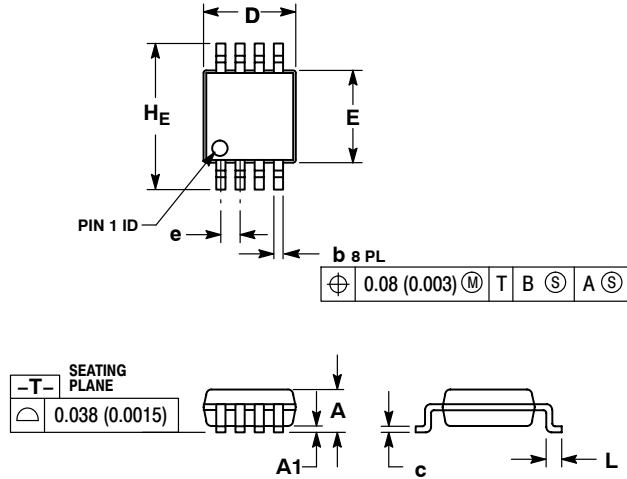
SCALE 6:1  $\left( \frac{\text{mm}}{\text{inches}} \right)$

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

# MC34064, MC33064, NCV33064

## PACKAGE DIMENSIONS

Micro8  
DM SUFFIX  
CASE 846A-02  
ISSUE G

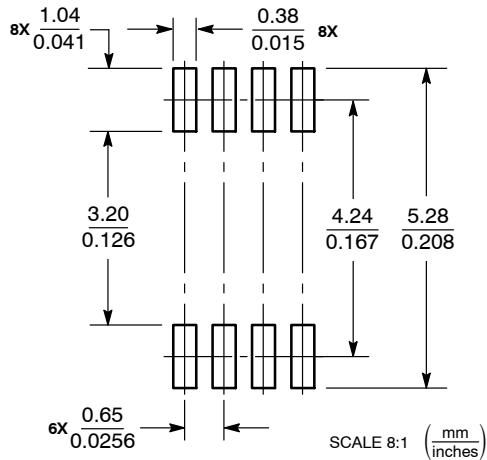


### NOTES:

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 |
| H <sub>E</sub> | 4.75        | 4.90 | 5.05 | 0.187     | 0.193 | 0.199 |

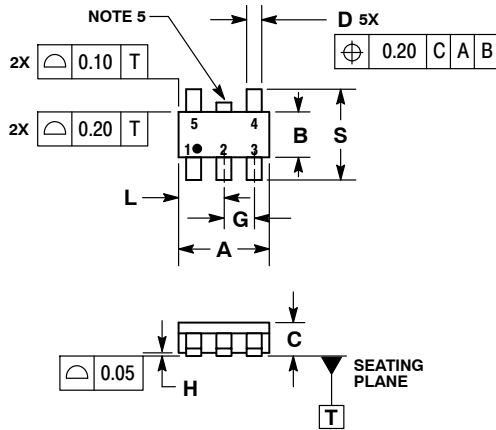
### SOLDERING FOOTPRINT\*



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

## PACKAGE DIMENSIONS

TSOP-5  
SN SUFFIX  
CASE 483-02  
ISSUE H

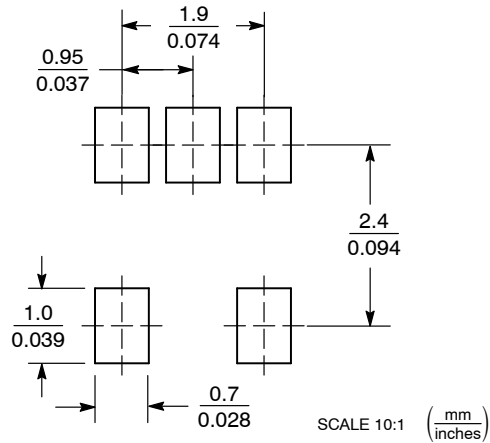


## NOTES:

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.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

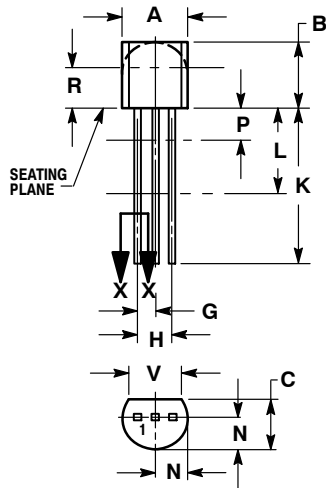
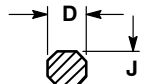
| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 3.00 BSC    |      |
| B   | 1.50 BSC    |      |
| C   | 0.90        | 1.10 |
| D   | 0.25        | 0.50 |
| G   | 0.95 BSC    |      |
| H   | 0.01        | 0.10 |
| J   | 0.10        | 0.26 |
| K   | 0.20        | 0.60 |
| L   | 1.25        | 1.55 |
| 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.

## PACKAGE DIMENSIONS

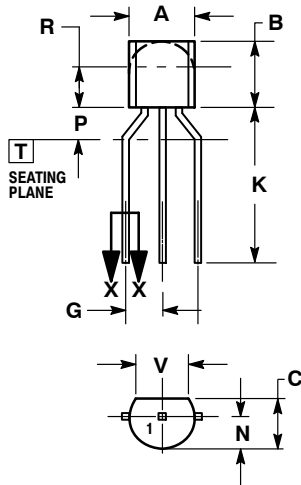
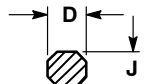
TO-92 (TO-226)  
P SUFFIX  
CASE 29-11  
ISSUE AMSTRAIGHT LEAD  
BULK PACK

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        | ---  |

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