

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 μ 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
- Pb-Free Packages are Available

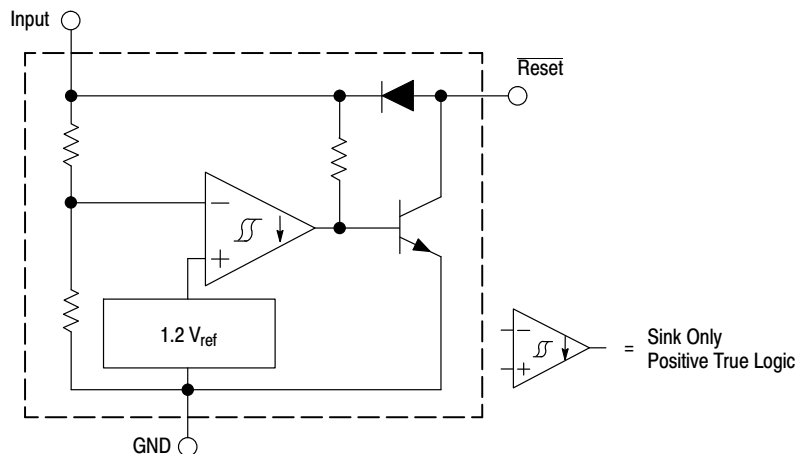
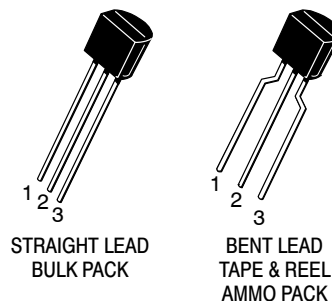
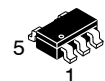


Figure 1. Representative Block Diagram

This device contains 28 active transistors.



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



**TSOP-5
SN SUFFIX
CASE 483**

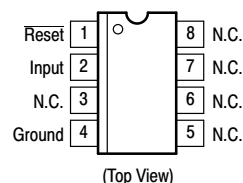


**SOIC-8
D SUFFIX
CASE 751**



**Micro8
DM SUFFIX
CASE 846A**

PIN CONNECTIONS



TSOP-5

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

TO-92

- Pin 1. Reset
Pin 2. Input
Pin 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 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.

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 | 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 | $I_R(\text{leak})$ | | | | μA |
| (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} | | | | μA |
| $V_{in} = 3.0 \text{ V}$ | | - | 9.0 | 15 | |
| $V_{in} = 6.0 \text{ V}$ | | - | 24 | 40 | |

- 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°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 |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

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} , $\overline{\text{Reset}} = 10 \text{ V}$) | $I_{\overline{R}}$ (leak) | - | 0.02 0.02 | 0.5 2.0 | μA |
| 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 | μA |

- 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.

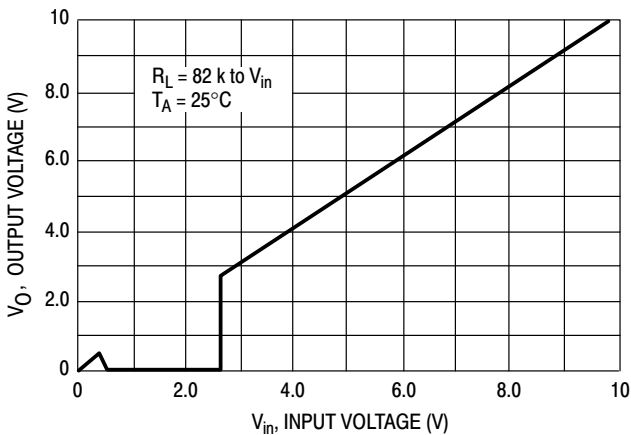


Figure 2. MC3X164-3 $\overline{\text{Reset}}$ Output Voltage versus Input Voltage

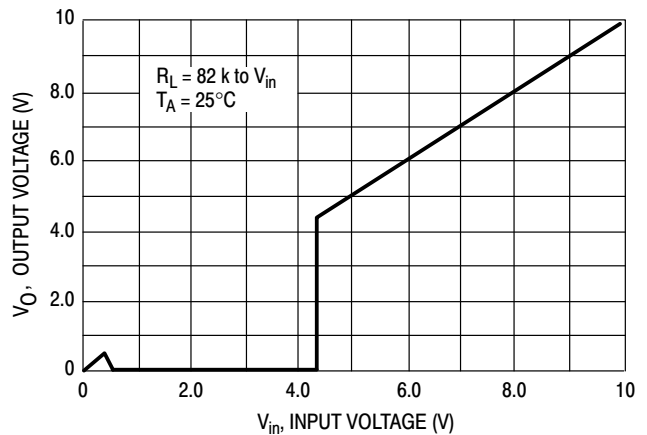


Figure 3. MC3X164-5 $\overline{\text{Reset}}$ Output Voltage versus Input Voltage

MC34164, MC33164, NCV33164

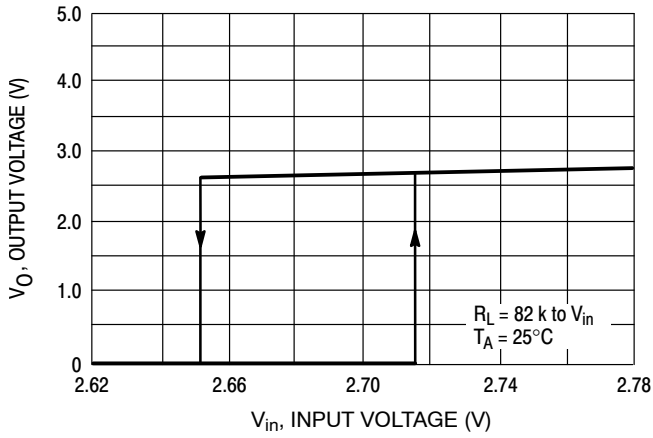


Figure 4. MC3X164-3 $\overline{\text{Reset}}$ Output Voltage versus Input Voltage

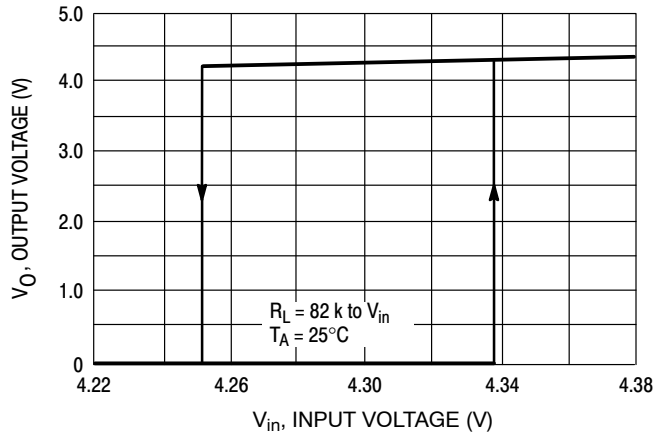


Figure 5. MC3X164-5 $\overline{\text{Reset}}$ Output Voltage versus Input Voltage

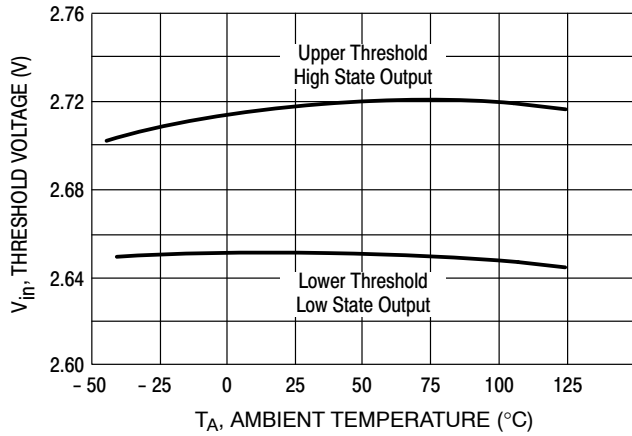


Figure 6. MC3X164-3 Comparator Threshold Voltage versus Temperature

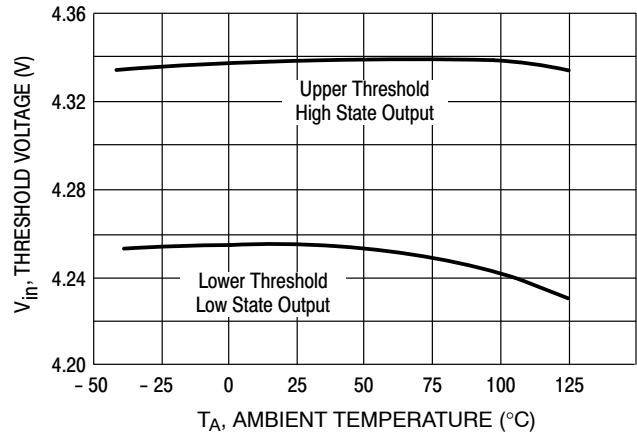


Figure 7. MC3X164-5 Comparator Threshold Voltage versus Temperature

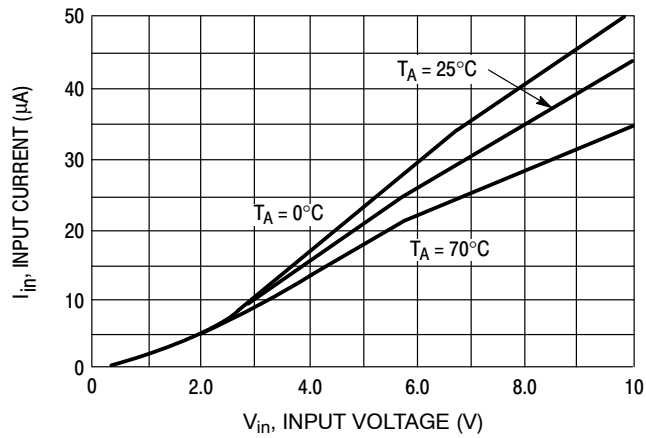


Figure 8. MC3X164-3 Input Current versus Input Voltage

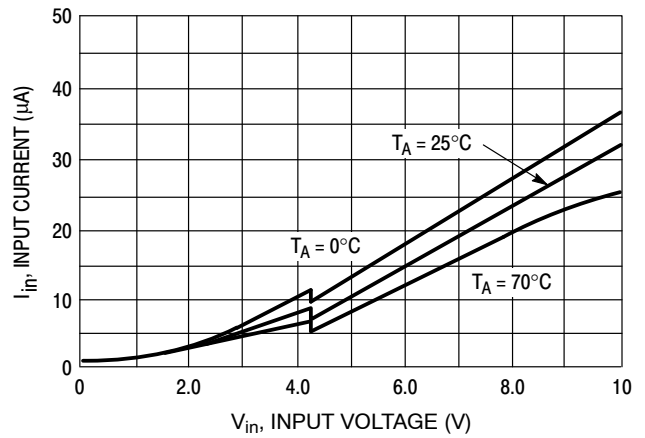


Figure 9. MC3X164-5 Input Current versus Input Voltage

MC34164, MC33164, NCV33164

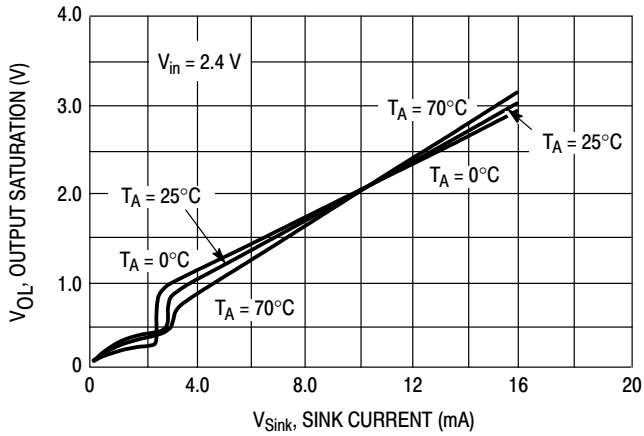


Figure 10. MC3X164-3 Reset Output Saturation versus Sink Current

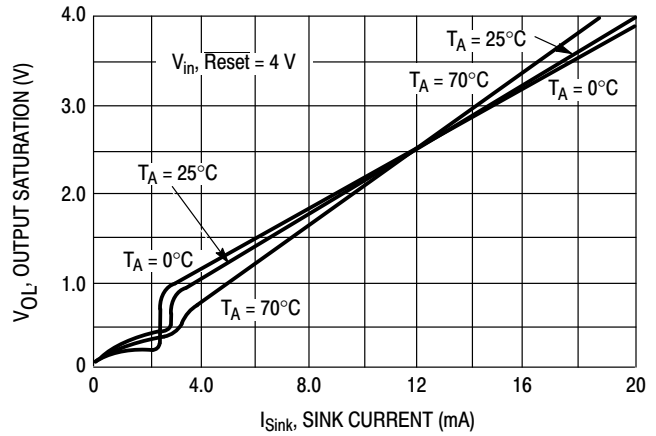


Figure 11. MC3X164-5 Reset Output Saturation versus Sink Current

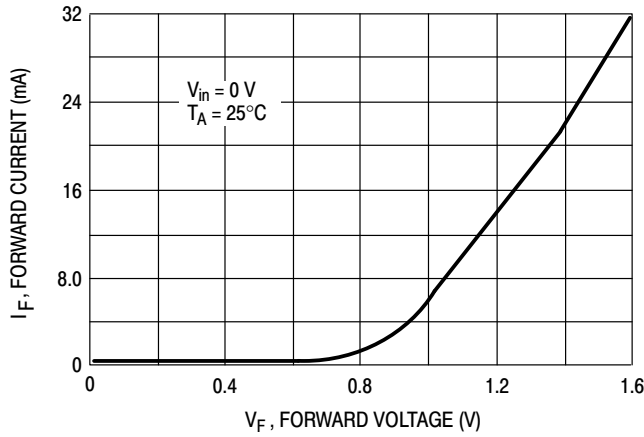


Figure 12. Clamp Diode Forward Current versus Voltage

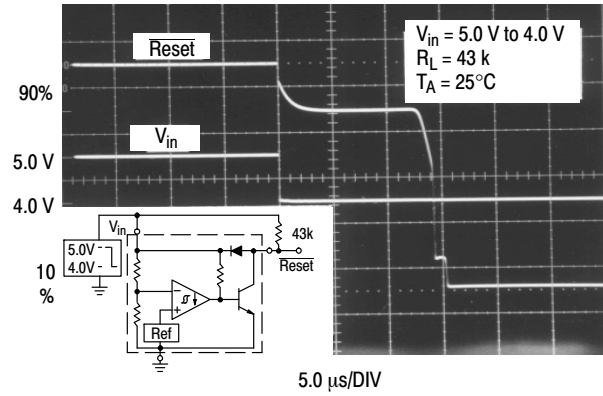
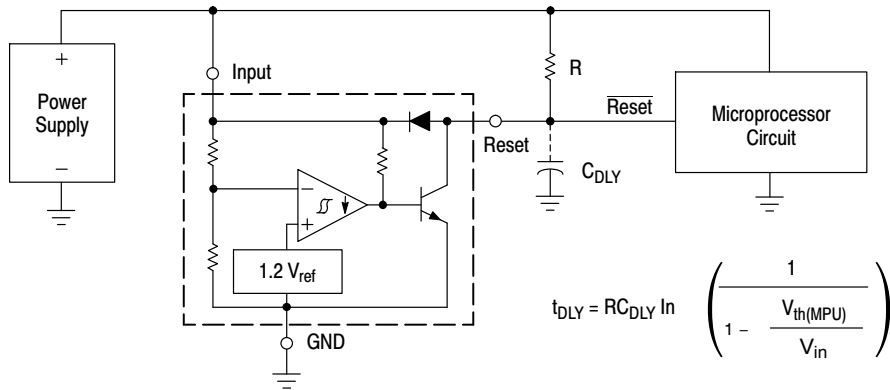


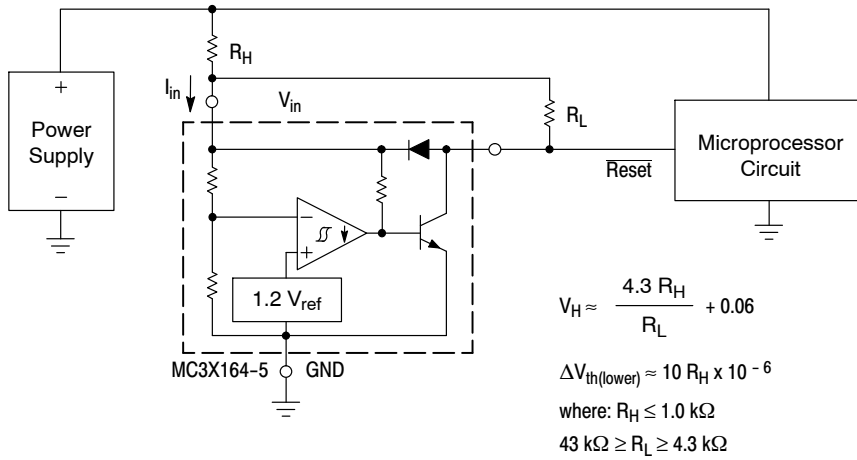
Figure 13. Reset Delay Time (MC3X164-5 Shown)



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

Figure 14. Low Voltage Microprocessor Reset

MC34164, MC33164, NCV33164



| Test Data | | | |
|---------------------|-----------------------|--------------------|---------------------|
| V _H (mV) | ΔV _{th} (mV) | R _H (Ω) | R _L (kΩ) |
| 60 | 0 | 0 | 43 |
| 103 | 1.0 | 100 | 10 |
| 123 | 1.0 | 100 | 6.8 |
| 160 | 1.0 | 100 | 4.3 |
| 155 | 2.2 | 220 | 10 |
| 199 | 2.2 | 220 | 6.8 |
| 280 | 2.2 | 220 | 4.3 |
| 262 | 4.7 | 470 | 10 |
| 306 | 4.7 | 470 | 8.2 |
| 357 | 4.7 | 470 | 6.8 |
| 421 | 4.7 | 470 | 5.6 |
| 530 | 4.7 | 470 | 4.3 |

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

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

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_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 ΔV_{th(lower)} will be observed due to I_{in} which is typically 10 μA at 4.3 V. The equations are accurate to ±10% with R_H less than 1.0 kΩ and R_L between 4.3 kΩ and 43 kΩ.

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

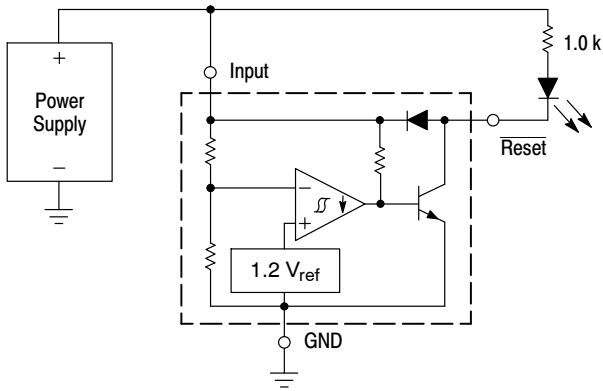


Figure 16. Voltage Monitor

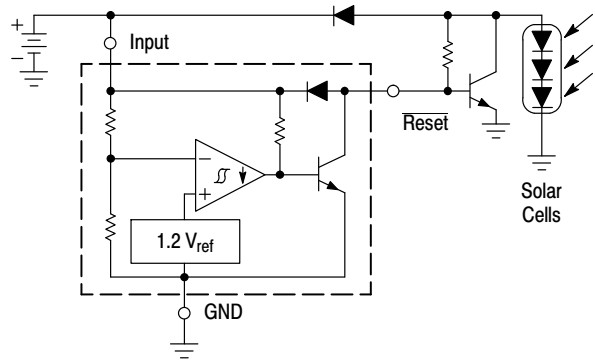
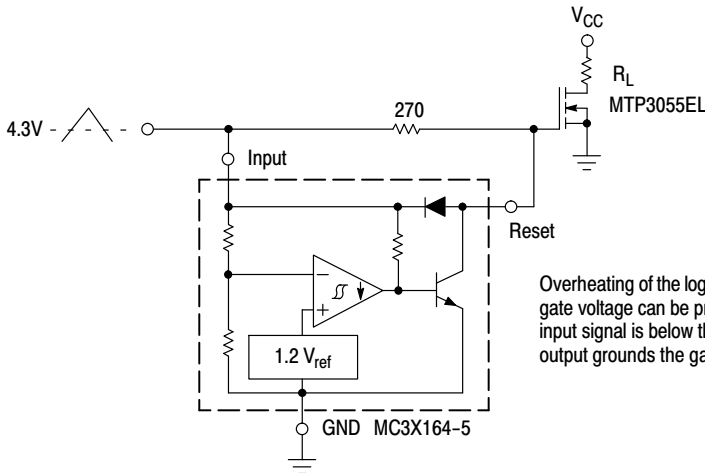


Figure 17. Solar Powered Battery Charger



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 L² MOSFET.

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

MC34164, MC33164, NCV33164

ORDERING INFORMATION

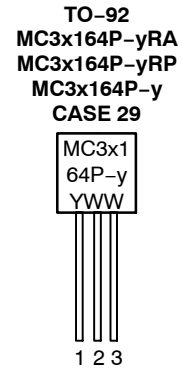
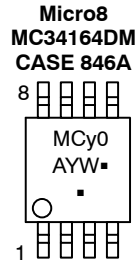
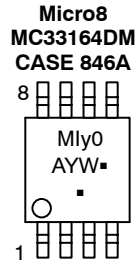
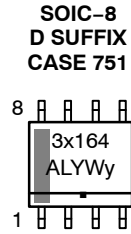
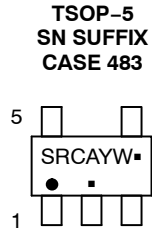
| Device | Package | Shipping† |
|-----------------|---------------------|--------------------------|
| MC33164D-3G | SOIC-8 (Pb-Free) | 98 Units / Rail |
| MC33164D-3R2G | SOIC-8 (Pb-Free) | 2500 Units / Tape & Reel |
| NCV33164D-3R2* | SOIC-8 | |
| NCV33164D-3R2G* | SOIC-8 (Pb-Free) | |
| MC33164DM-3R2 | Micro8 | 4000 Units / Tape & Reel |
| MC33164DM-3R2G | Micro8 (Pb-Free) | |
| 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-5R2 | SOIC-8 | 2500 Units / Tape & Reel |
| MC33164D-5R2G | SOIC-8 (Pb-Free) | |
| 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°C, T_{high} = +125°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.

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PIN CONNECTIONS AND MARKING DIAGRAMS

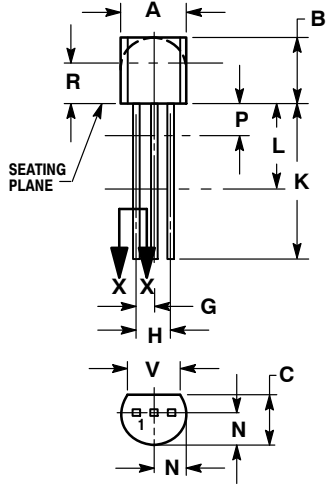


- SRC = Device Code
- x = Device Number 3 or 4
- y = Suffix Number 3 or 5
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W, WW = Work Week
- = Pb-Free

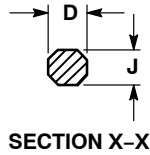
MC34164, MC33164, NCV33164

PACKAGE DIMENSIONS

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



STRAIGHT LEAD
BULK PACK

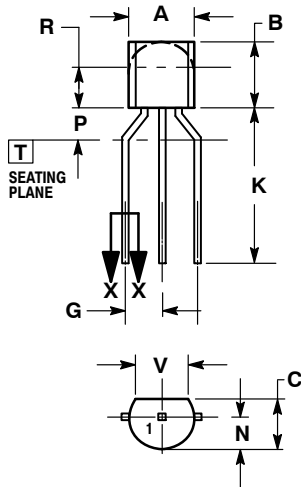


SECTION X-X

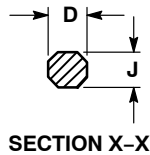
NOTES:

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

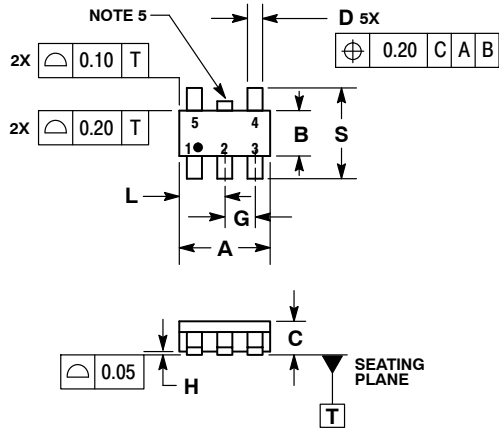
NOTES:

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 H

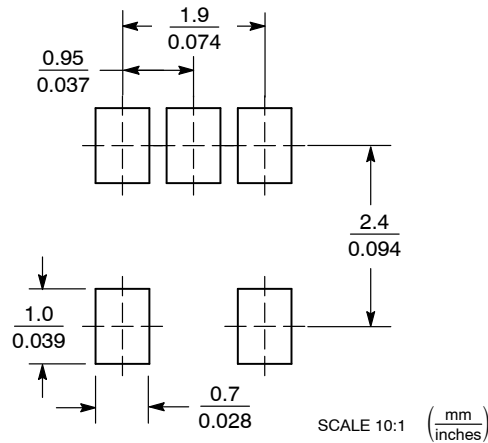


NOTES:

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*

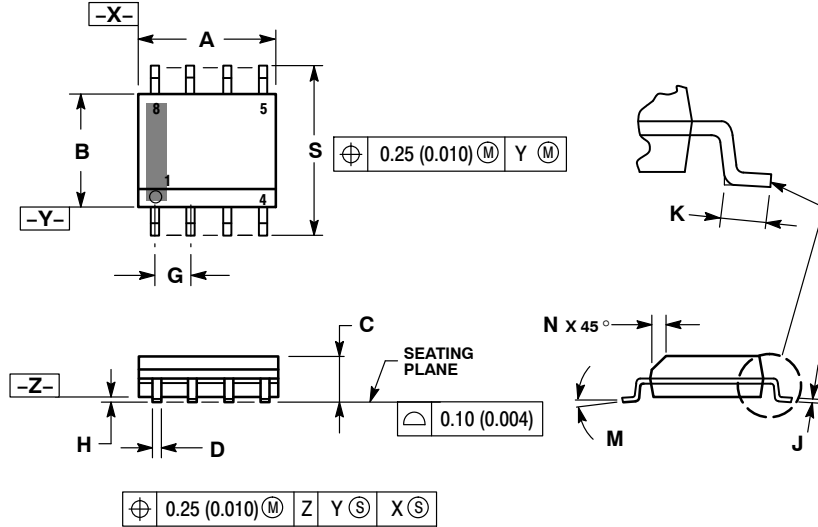


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

MC34164, MC33164, NCV33164

PACKAGE DIMENSIONS

SOIC-8
D SUFFIX
CASE 751-07
ISSUE AJ

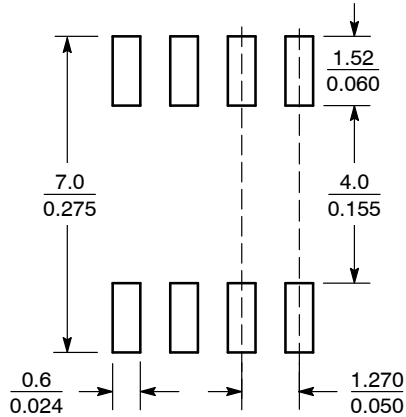


NOTES:

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*



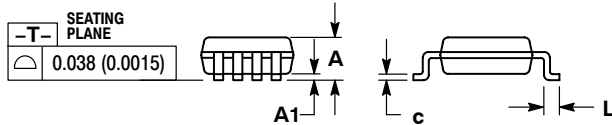
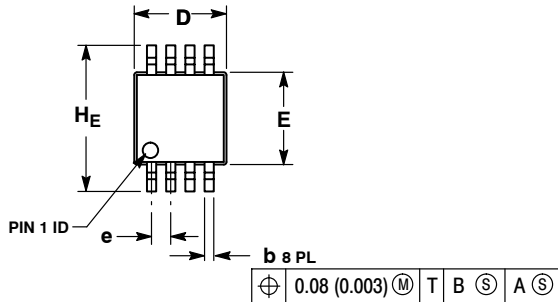
SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

MC34164, MC33164, NCV33164

PACKAGE DIMENSIONS

Micro8
DM SUFFIX
CASE 846A-02
ISSUE H

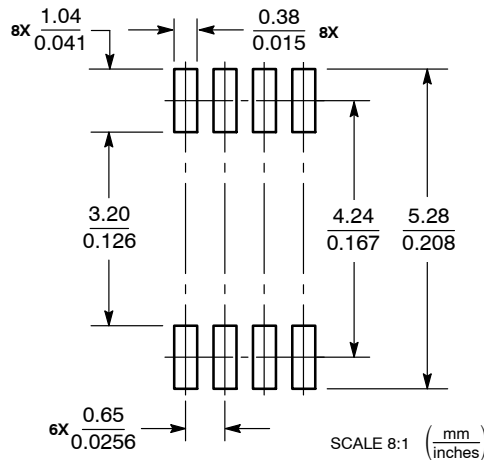


NOTES:

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 |

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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