# PT7A7611-7615/7621-7625/7631-7635

**µP Supervisor Circuits**

NEW PRODUCT

## Description

The PT7A7611-7615/7621-7625/7631-7635 family micro-processor (µP) supervisory circuits are targeted to improve reliability and accuracy of power-supply circuitry in µP's systems. These devices reduce the complexity and number of components required to monitor power-supply and battery functions.

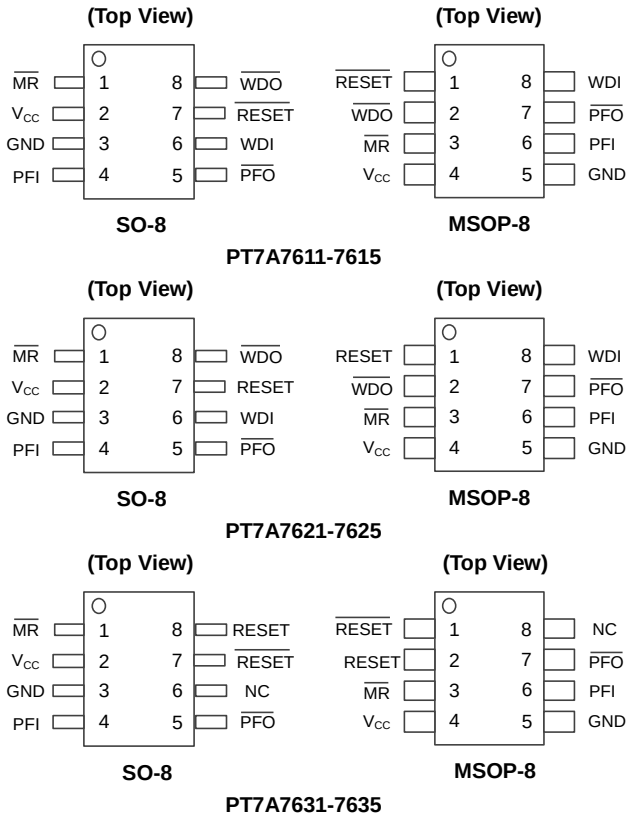
The main functions are:

1. Asserting reset output during power-up, power-down and brownout conditions for µP system.
2. Detecting power failure or low-battery conditions with a 1.25V threshold detector.
3. Watchdog functions (not for PT7A7631-7635).

## Features

- Precision Supply-voltage Monitor
  - 4.63V (PT7A7611/7621/7631)
  - 4.38V (PT7A7612/7622/7632)
  - 3.08V (PT7A7613/7623/7633)
  - 2.93V (PT7A7614/7624/7634)
  - 2.63V (PT7A7615/7625/7635)
- 200ms Reset Pulse Width
- Debounced TTL/CMOS-compatible Manual-reset Input
- Independent Watchdog Timer 1.6sec Time-out (Not Available for PT7A7631-7635)
- Voltage Monitor for Power-fail or Low Battery Warning
- Reset Output Signal:
  - Active-low Only (PT7A7611-7615)
  - Active-high Only (PT7A7621-7625)
  - Active-high and Active-low (PT7A7631-7635)
- Guaranteed $\overline{\text{RESET}}$/RESET Valid at $V_{CC}$ = 1V
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

## Pin Assignments




## Applications

- Computers
- Controllers
- Intelligent Instruments
- Critical µP and µC Power Monitoring
- Portable/Battery Powered Equipment

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.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## Typical Applications Circuit

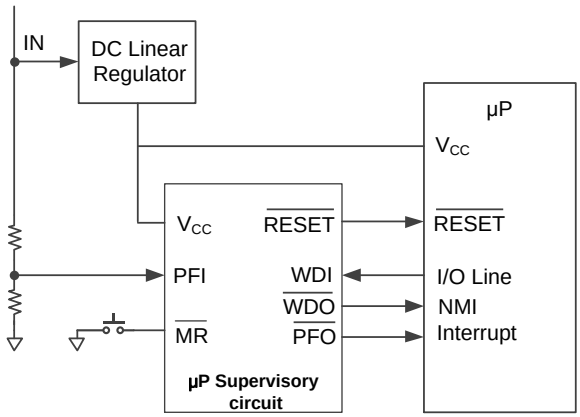


Figure 1. Typical Application Diagram

## Pin Descriptions

| Pin Number | | | | | | Pin Name | Description |
|---|---|---|---|---|---|---|---|
| PT7A7611-7615 | | PT7A7621-7625 | | PT7A7631-7635 | | | |
| SO-8 | MSOP-8 | SO-8 | MSOP-8 | SO-8 | MSOP-8 | | |
| 1 | 3 | 1 | 3 | 1 | 3 | $\overline{MR}$ | **Manual-Reset:** triggers a reset pulse when pulled below 0.8V, active low. It has an internal 250µA pull-up current and be driven from a TTL or CMOS logic line as well as shorted to ground with a switch. |
| 2 | 4 | 2 | 4 | 2 | 4 | $V_{CC}$ | Supply Voltage. |
| 3 | 5 | 3 | 5 | 3 | 5 | GND | **Ground Reference** for all signals. |
| 4 | 6 | 4 | 6 | 4 | 6 | PFI | **Power-Fail Voltage Monitor Input.** When PFI is less than 1.25V, $\overline{PFO}$ goes low. Connect PFI to GND or $V_{CC}$ when not used. |
| 5 | 7 | 5 | 7 | 5 | 7 | $\overline{PFO}$ | **Power-Fail Output:** it gets low and sinks current when PFI is less than 1.25V; otherwise $\overline{PFO}$ stays high. |
| 6 | 8 | 6 | 8 | — | — | WDI | **Watchdog Input:** If WDI remains high or low for 1.6sec, the internal watchdog timer runs out and $\overline{WDO}$ goes low. Floating WDI or connecting WDI to a high-impedance three-state buffer disables the watchdog feature. The internal watchdog timer clears whenever reset is asserted. WDI is three-stated, or WDI sees a rising or falling edge. |
| — | — | — | — | 6 | 8 | NC | Not Connected. |
| 7 | 1 | — | — | 7 | 1 | $\overline{RESET}$ | **Reset Output pulses:** low for 200ms when triggered, and stays low whenever $V_{CC}$ is below the reset threshold. It remains low for 200ms after $V_{CC}$ rises above the reset threshold or $\overline{MR}$ goes from low to high. A watchdog timeout will not trigger $\overline{RESET}$ unless $\overline{WDO}$ is connected to $\overline{MR}$. |
| 8 | 2 | 8 | 2 | — | — | $\overline{WDO}$ | **Watchdog Output:** pulls low when the internal watchdog timer finishes its 1.6sec count and does not go high again until the watchdog is cleared. $\overline{WDO}$ also goes low during low-line conditions. Whenever $V_{CC}$ is below the reset threshold, $\overline{WDO}$ stays low; however, unlike $\overline{RESET}$, $\overline{WDO}$ does not have minimum pulse width. As soon as $V_{CC}$ rises above the reset threshold, $\overline{WDO}$ goes high with no delay. |
| — | — | 7 | 1 | 8 | 2 | RESET | **The inverse of** $\overline{RESET}$, active high. Whenever $\overline{RESET}$ is high, RESET is low. |


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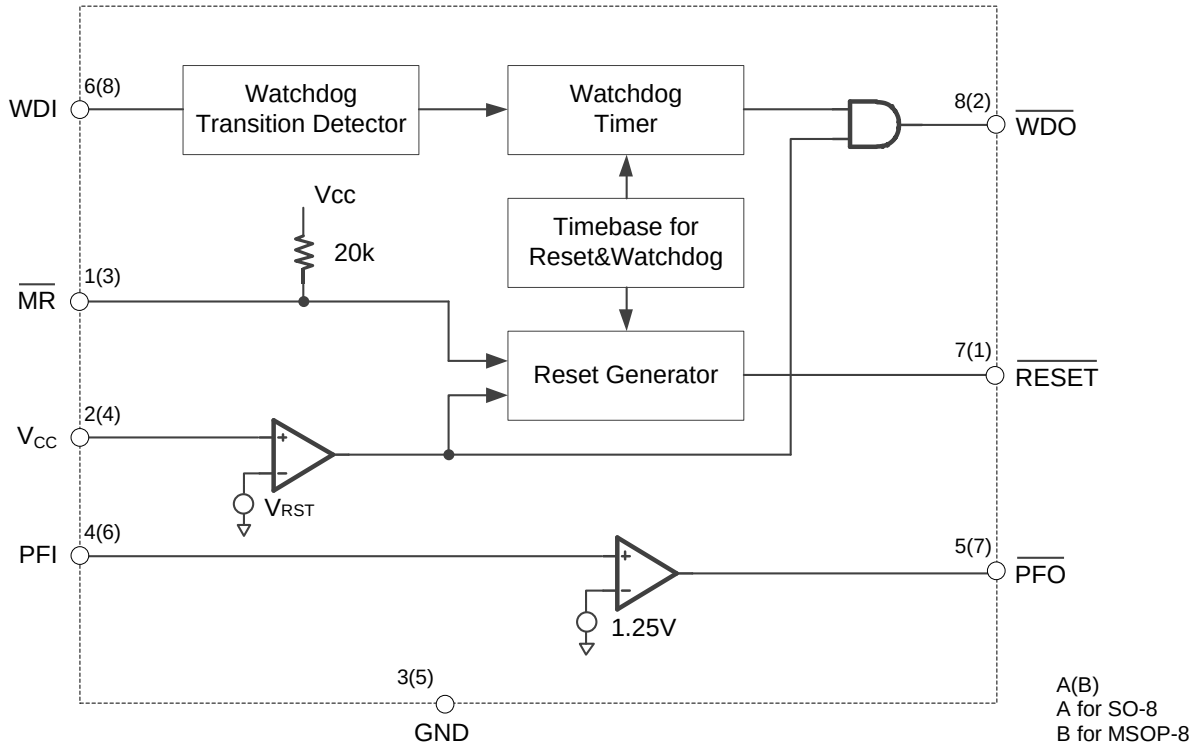
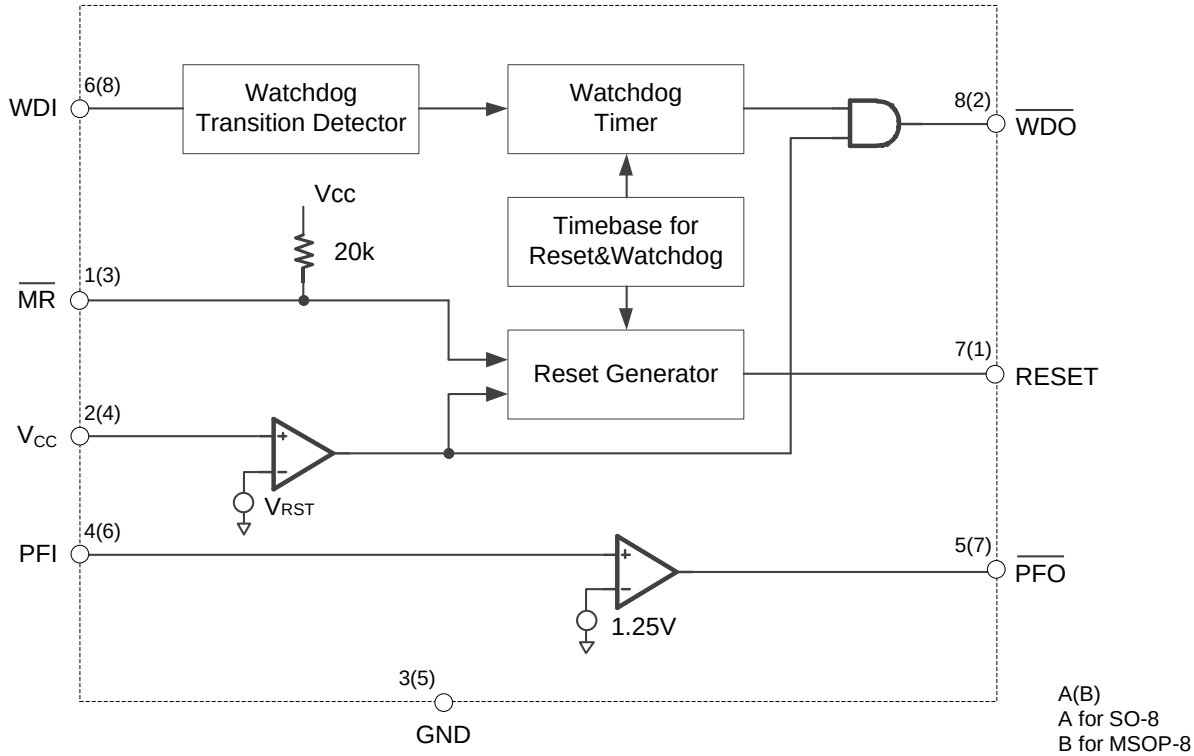
## Functional Block Diagram




Block Diagram of PT7A7611-7615




Block Diagram of PT7A7621-7625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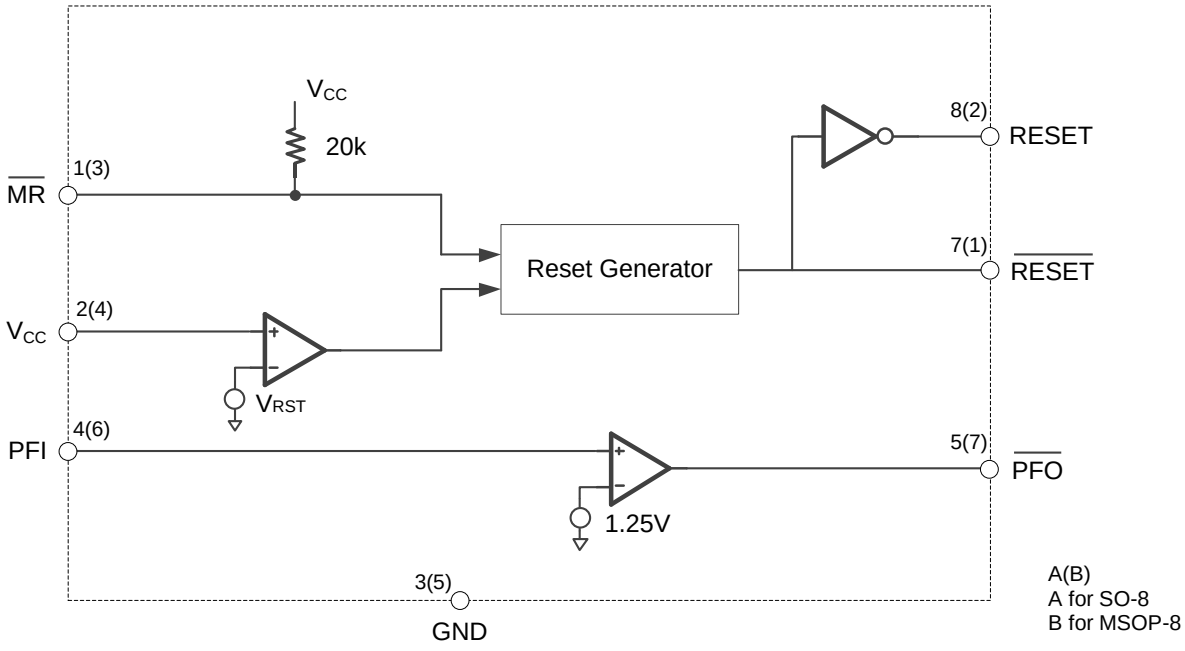
## Functional Block Diagram (Cont.)




Block Diagram of PT7A7631-7635

## Maximum Ratings (Note 4)

| Parameter | Rating | Unit |
|---|---|---|
| Supply Voltage to Ground Potential ($V_{CC}$ to GND) | -0.3 to +6.0 | V |
| DC Input Voltage (All inputs except $V_{CC}$ and GND) | -0.3 to $V_{CC}$+0.3 | V |
| DC output Current (All Output) | 20 | mA |
| Power Dissipation (Depend on Package) | 500 | mW |
| Ambient Temperature with Power Applied | -40 to +85 | °C |
| Storage Temperature Range | -65 to +150 | °C |

Note: 4. Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## ESD Ratings

| Symbol | Parameter | Rating | Unit |
|---|---|---|---|
| ESD HBM | Human Body Model ESD Protection | 2.5 | kV |
| ESD CDM | Charged Device Model ESD Protection | 1 | kV |

## Recommended Operating Conditions (@$T_A$ = +25°C, unless otherwise specified.)

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage for PT7A76x1/76x2 | 4.5 | 5.0 | 5.5 | V |
| | Supply Voltage for PT7A76x3/76x4 | 3.0 | 3.3 | 5.5 | V |
| | Supply Voltage for PT7A76x5 | 2.7 | 3.0 | 5.5 | V |
| $T_A$ | Operating Temperature Range | -40 | — | +85 | °C |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## DC Electrical Characteristics ($V_{CC}$ = $V_{RN}$ + 5% to 5.5V, $T_A$ = -40 to +85°C, unless otherwise noted.) (Note 5)

| Symbol | Description | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{CC}$ | Supply Current | PT7A76x1/76x2 $V_{CC}$ = 5V, PT7A76x3/76x4 $V_{CC}$ = 3.3V, PT7A76x5 $V_{CC}$ = 3.0V, Left WDI unconnected (No output load) | — | 10 | 200 | µA |
| $V_{IH}$ | $\overline{MR}$ Input High Voltage | 4.5V < $V_{CC}$ < 5.5V | 2.0 | — | — | V |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | 0.7$V_{CC}$ | — | — | |
| | WDI Input High Voltage | $V_{CC}$ = 5.0V | 3.5 | — | — | |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | 0.7$V_{CC}$ | — | — | |
| $V_{IL}$ | $\overline{MR}$ Input Low Voltage | 4.5V < $V_{CC}$ < 5.5V | — | — | 0.8 | V |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | — | — | 0.6 | |
| | WDI Input Low Voltage | $V_{CC}$ = 5.0V | — | — | 0.8 | |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | — | — | 0.6 | |
| $V_{RST}$ | Reset Threshold Voltage (Note 6) | — | $V_{RN}$-2.0% | $V_{RN}$ | $V_{RN}$+2.0% | V |
| | | PT7A76x1 | 4.537 | 4.630 | 4.723 | |
| | | PT7A76x2 | 4.292 | 4.380 | 4.468 | |
| | | PT7A76x3 | 3.018 | 3.080 | 3.142 | |
| | | PT7A76x4 | 2.871 | 2.930 | 2.989 | |
| | | PT7A76x5 | 2.577 | 2.630 | 2.683 | |
| $V_{HYS}$ | Reset Threshold Hysteresis (Note 6) | — | — | 0.80 | — | %$V_{RN}$ |
| $V_{OH}$ | Output High Voltage | 4.5V < $V_{CC}$ < 5.5V, $I_{SOURCE}$ = 800µA | $V_{CC}$-1.5 | — | — | V |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V, $I_{SOURCE}$ = 500µA | 0.8×$V_{CC}$ | — | — | |
| $V_{OL}$ | Output Low Voltage | 4.5V < $V_{CC}$ < 5.5V, $I_{SINK}$ = 3.2mA | — | — | 0.4 | V |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V, $I_{SINK}$ = 1.2mA | — | — | 0.3 | |
| | | $V_{CC}$ = 1.2V, $I_{SINK}$ = 100µA | — | — | 0.3 | |
| $V_{PFT}$ | PFI Input Threshold | PFI falling | 1.225 | 1.250 | 1.275 | V |
| $I_{PFI}$ | PFI Input Current | — | -1 | 0.1 | +1 | µA |
| $I_{WDI}$ | WDI Input Current (Note 7) | WDI = 0 or $V_{CC}$ | -7 | 3 | +7 | µA |
| $R_{MR}$ | $\overline{MR}$ Pull-up Resistor | — | — | 20 | — | kΩ |

Notes: 5. Parameters of room temperature guaranteed by production test and parameters of full-temperature guaranteed by design.

6. Valid for both RESET and $\overline{RESET}$. $V_{RST}$ is the Reset threshold voltage when $V_{CC}$ from high to low level, $V_{RN}$ is nominal reset threshold voltage.

7. WDI is internally serviced within the watchdog period if WDI is left unconnected.

## AC Electrical Characteristics

| Symbol | Description | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $t_{RS}$ | Reset Pulse Width | — | 140 | 200 | 280 | ms |
| $t_{WD}$ | Watchdog Timeout Period | — | 1.0 | 1.6 | 2.25 | s |
| $t_{MR}$ | $\overline{MR}$ Pulse Width | 4.5V < $V_{CC}$ < 5.5V | 150 | — | — | ns |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | 500 | — | — | |
| $t_{MD}$ | $\overline{MR}$ to RESET Delay | 4.5V < $V_{CC}$ < 5.5V | — | — | 250 | ns |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | — | — | 750 | |
| $t_{WP}$ | WDI Pulse Width | 4.5V < $V_{CC}$ < 5.5V | 50 | — | — | ns |
| | | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | 100 | — | — | ns |


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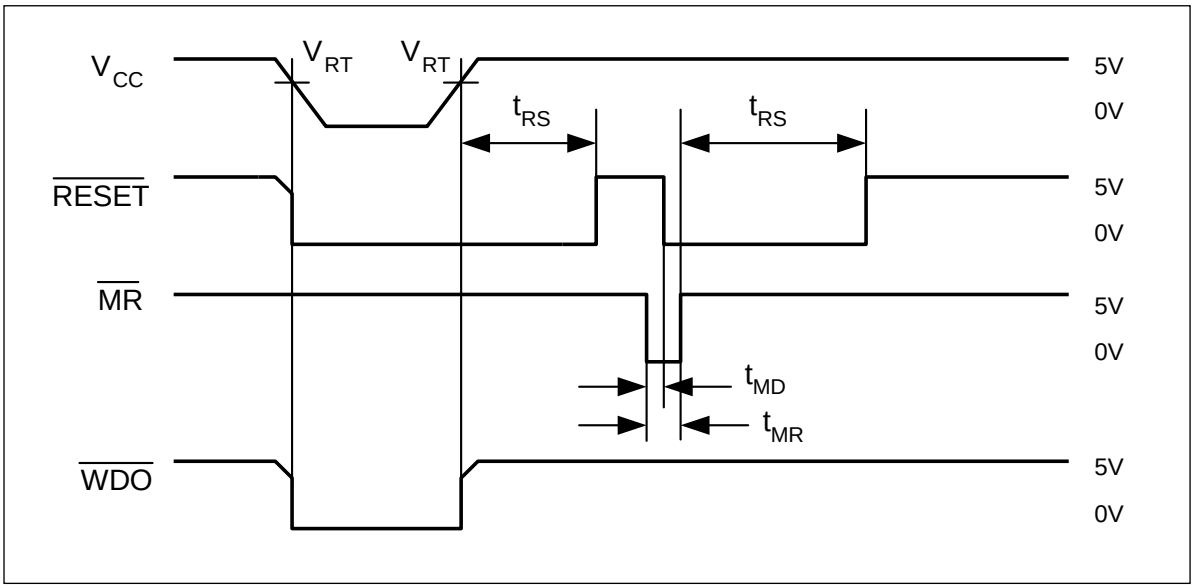
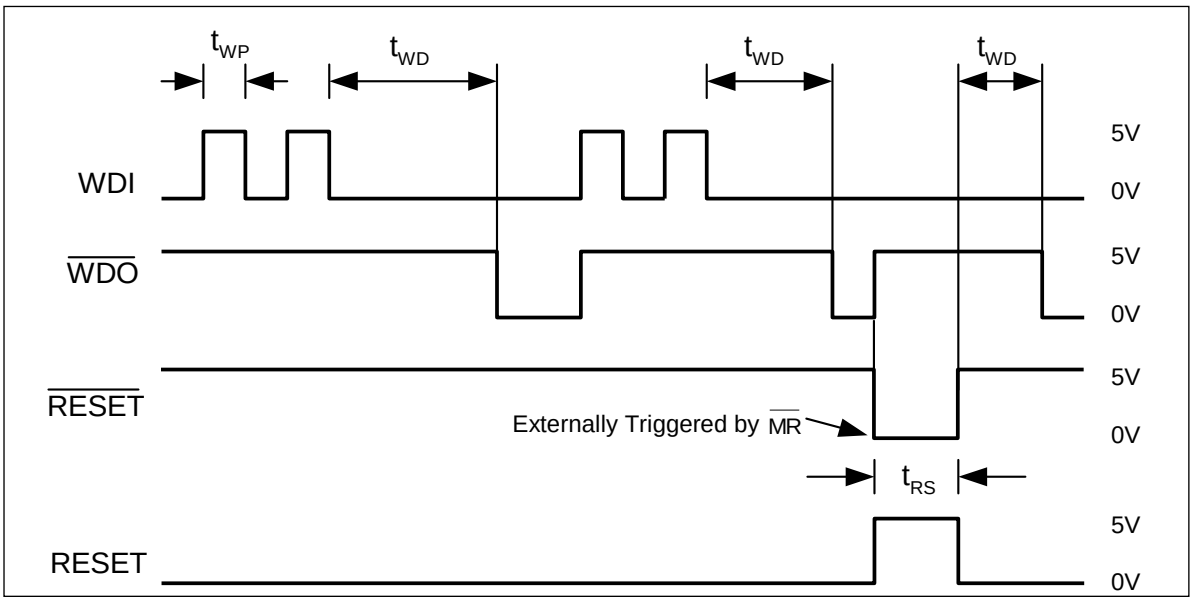
## Timing Diagram

**Watchdog Timing Diagram**





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## Functional Description

The PT7A7611-7615/7621-7625/7631-7635 family can assert reset output during power-up, power-down and brownout conditions for µP system, detect power failure or low-battery conditions with a 1.25V threshold detector and have watchdog functions. Refer to Function Comparison Table of PT7A7611-7615/7621-7625/7631-7635 family for their individual features. Figure 1 shows typical application.

**Reset Output**

The supervisory circuits can assert reset for a microprocessor during power-up, power-down and brownout to prevent code execution errors.

On power-up, once $V_{CC}$ reaches about 1.0V, $\overline{RESET}$ is a guaranteed logic low of 0.4V or less. As $V_{CC}$ rises, $\overline{RESET}$ stays low. When $V_{CC}$ rises above the reset threshold, an internal timer releases $\overline{RESET}$ after about 200ms. $\overline{RESET}$ pulses low whenever $V_{CC}$ drops below the reset threshold, i.e. brownout condition. If brownout occurs in the middle of a previously initiated reset pulse, the pulse continues for at least another 140ms. On power-down, once $V_{CC}$ falls below the reset threshold, $\overline{RESET}$ stays low and is guaranteed to be 0.4V or less until $V_{CC}$ drops below 1.0V.

The PT7A7621-7625 and PT7A7631-7635 active-high RESET output is simply the inverse of the $\overline{RESET}$ output, and is guaranteed to be valid with $V_{CC}$ down to 1.2V. Some µPs, such as Intel's 80C51, require an active-high reset pulse.

**Watchdog Timer**

The watchdog circuit monitors the µP activity. If the µP does not toggle the watchdog input (WDI) within 1.6sec and WDI is not in high impedance, $\overline{WDO}$ goes low. As long as $\overline{RESET}$ is asserted or the WDI input is in high impedance, the watchdog timer will stay cleared and will not count. As soon as reset is released and WDI is driven high or low, the timer will start counting. Pulses as short as 50ns can be detected.

Typically, $\overline{WDO}$ will be connected to the non-maskable interrupt input (NMI) of a µP. When $V_{CC}$ drops below the reset threshold, $\overline{WDO}$ will go low whether or not the watchdog timer has timed out yet. Normally this would trigger an NMI interrupt, but $\overline{RESET}$ goes low simultaneously, and thus overrides the NMI interrupt. If WDI is left unconnected, $\overline{WDO}$ can be used as a low-line output. Since floating WDI disables the internal timer, $\overline{WDO}$ goes low only when $V_{CC}$ falls below the reset threshold, thus functioning as a low-line output.

**Manual Reset**

The manual-reset input ($\overline{MR}$) allows reset to be triggered by a push button switch. The switch is effectively debounced by the 140ms minimum reset pulse width. $\overline{MR}$ is TTL/CMOS logic compatible, so it can be driven by any logic reset output.

**Power-Fail Comparator**

The power-fail comparator will send out a Low signal once detects a voltage lowered than 1.25V. It can be used for various purposes because its output and non-inverting input are not internally connected. The inverting input is internally connected to a 1.25V reference.


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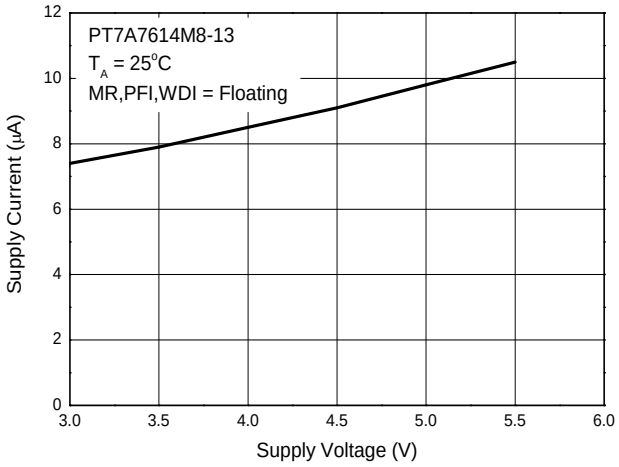
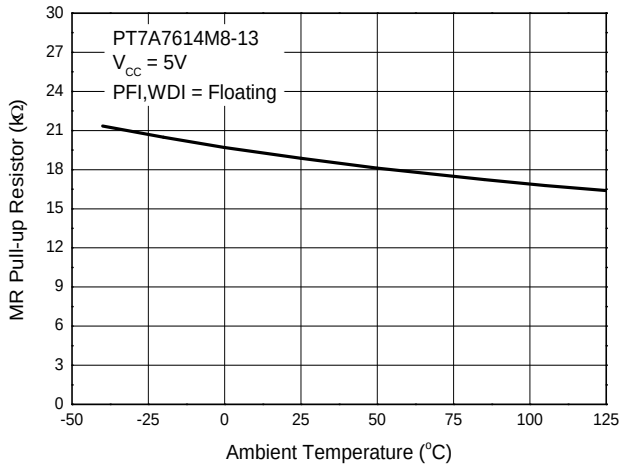
## Performance Characteristics

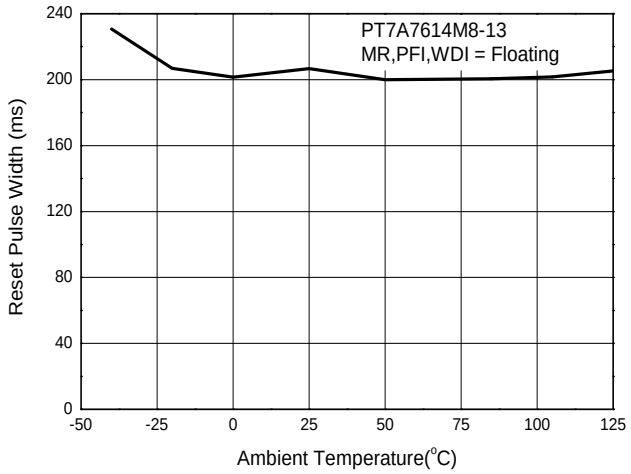
### Supply Current vs. Supply Voltage




### MR Pull-up Resistor vs. Temperature




### Reset Pulse Width vs. Temperature





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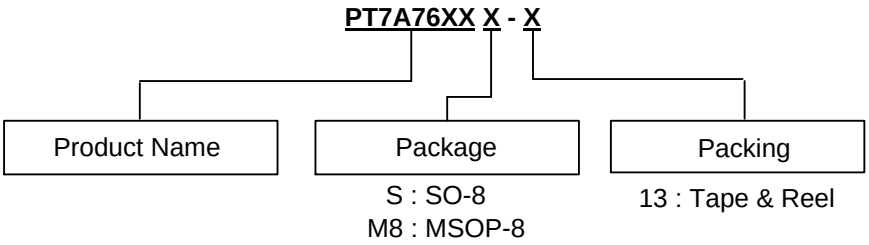
## Ordering Information




| Part Number | Package Code | Packaging (Note 8) | 13" Tape and Reel | |
|---|---|---|---|---|
| | | | Quantity | Part Number Suffix |
| PT7A761xS-13 | S | SO-8 | 2500/Tape & Reel | -13 |
| PT7A762xS-13 | S | SO-8 | 2500/Tape & Reel | -13 |
| PT7A763xS-13 | S | SO-8 | 2500/Tape & Reel | -13 |
| PT7A761xM8-13 | M8 | MSOP-8 | 2500/Tape & Reel | -13 |
| PT7A762xM8-13 | M8 | MSOP-8 | 2500/Tape & Reel | -13 |
| PT7A763xM8-13 | M8 | MSOP-8 | 2500/Tape & Reel | -13 |

Note: 8. Pad layout as shown in Diodes Incorporated's package outline PDFs, which can be found on our website at http://www.diodes.com/package-outlines.html.

**Function Comparison Table**

| Part Number | Reset Threshold | Reset Active Low or High | Nom. Reset Time (ms), $t_{RS}$ | Nom. Watchdog Time (sec), $t_{WD}$ | Power Fail Comparator | Manual Reset Input |
|---|---|---|---|---|---|---|
| PT7A7611 | 4.63V | LOW | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7621 | 4.63V | HIGH | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7631 | 4.63V | LOW, HIGH | 200 | Unavailable | 1.25V Detector | Yes |
| PT7A7612 | 4.38V | LOW | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7622 | 4.38V | HIGH | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7632 | 4.38V | LOW, HIGH | 200 | Unavailable | 1.25V Detector | Yes |
| PT7A7613 | 3.08V | LOW | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7623 | 3.08V | HIGH | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7633 | 3.08V | LOW, HIGH | 200 | Unavailable | 1.25V Detector | Yes |
| PT7A7614 | 2.93V | LOW | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7624 | 2.93V | HIGH | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7634 | 2.93V | LOW, HIGH | 200 | Unavailable | 1.25V Detector | Yes |
| PT7A7615 | 2.63V | LOW | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7625 | 2.63V | HIGH | 200 | 1.6 | 1.25V Detector | Yes |
| PT7A7635 | 2.63V | LOW, HIGH | 200 | Unavailable | 1.25V Detector | Yes |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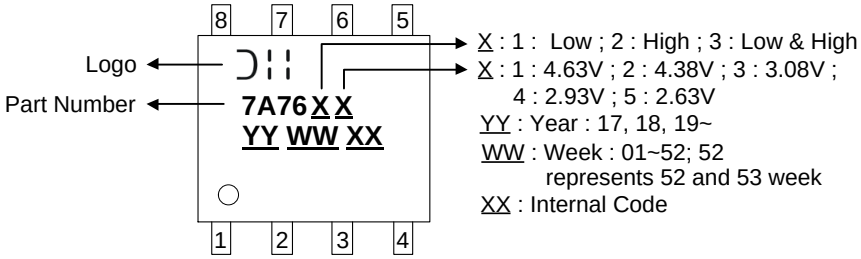
## Marking Information

**(1) SO-8**

**(Top View)**




| Part Number | Package | Identification Code |
|---|---|---|
| PT7A7611S-13 | SO-8 | 7A7611 |
| PT7A7612S-13 | SO-8 | 7A7612 |
| PT7A7613S-13 | SO-8 | 7A7613 |
| PT7A7614S-13 | SO-8 | 7A7614 |
| PT7A7615S-13 | SO-8 | 7A7615 |
| PT7A7621S-13 | SO-8 | 7A7621 |
| PT7A7622S-13 | SO-8 | 7A7622 |
| PT7A7623S-13 | SO-8 | 7A7623 |
| PT7A7624S-13 | SO-8 | 7A7624 |
| PT7A7625S-13 | SO-8 | 7A7625 |
| PT7A7631S-13 | SO-8 | 7A7631 |
| PT7A7632S-13 | SO-8 | 7A7632 |
| PT7A7633S-13 | SO-8 | 7A7633 |
| PT7A7634S-13 | SO-8 | 7A7634 |
| PT7A7635S-13 | SO-8 | 7A7635 |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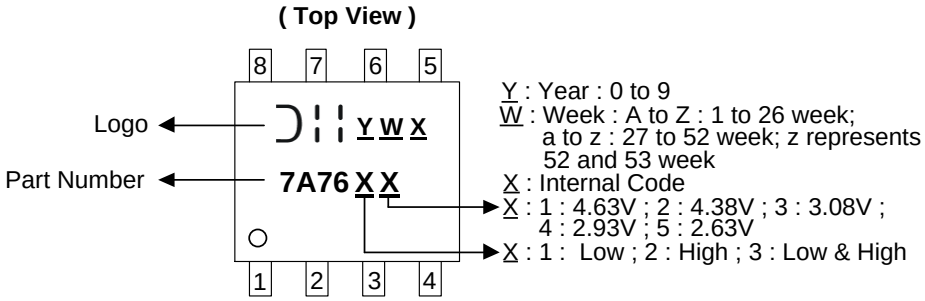
## Marking Information (Cont.)

**(2) MSOP-8**




| Part Number | Package | Identification Code |
|---|---|---|
| PT7A7611M8-13 | MSOP-8 | 7A7611 |
| PT7A7612M8-13 | MSOP-8 | 7A7612 |
| PT7A7613M8-13 | MSOP-8 | 7A7613 |
| PT7A7614M8-13 | MSOP-8 | 7A7614 |
| PT7A7615M8-13 | MSOP-8 | 7A7615 |
| PT7A7621M8-13 | MSOP-8 | 7A7621 |
| PT7A7622M8-13 | MSOP-8 | 7A7622 |
| PT7A7623M8-13 | MSOP-8 | 7A7623 |
| PT7A7624M8-13 | MSOP-8 | 7A7624 |
| PT7A7625M8-13 | MSOP-8 | 7A7625 |
| PT7A7631M8-13 | MSOP-8 | 7A7631 |
| PT7A7632M8-13 | MSOP-8 | 7A7632 |
| PT7A7633M8-13 | MSOP-8 | 7A7633 |
| PT7A7634M8-13 | MSOP-8 | 7A7634 |
| PT7A7635M8-13 | MSOP-8 | 7A7635 |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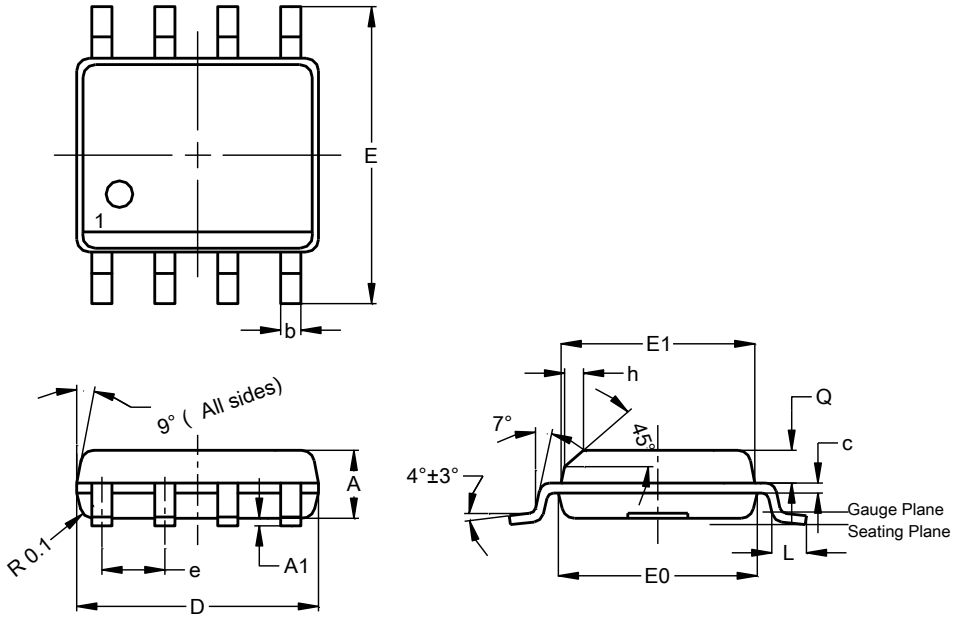
## Package Outline Dimensions

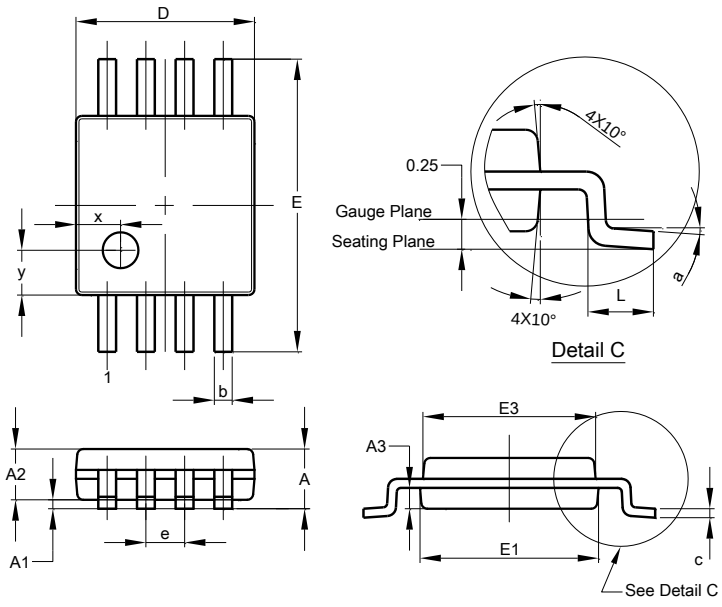
Please see http://www.diodes.com/package-outlines.html for the latest version.

**(1) Package Type: SO-8**




| SO-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 1.40 | 1.50 | 1.45 |
| **A1** | 0.10 | 0.20 | 0.15 |
| **b** | 0.30 | 0.50 | 0.40 |
| **c** | 0.15 | 0.25 | 0.20 |
| **D** | 4.85 | 4.95 | 4.90 |
| **E** | 5.90 | 6.10 | 6.00 |
| **E1** | 3.80 | 3.90 | 3.85 |
| **E0** | 3.85 | 3.95 | 3.90 |
| **e** | -- | -- | 1.27 |
| **h** | - | -- | 0.35 |
| **L** | 0.62 | 0.82 | 0.72 |
| **Q** | 0.60 | 0.70 | 0.65 |
| **All Dimensions in mm** | | | |

**(2) Package Type: MSOP-8**




| MSOP-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | - | 1.10 | - |
| **A1** | 0.05 | 0.15 | 0.10 |
| **A2** | 0.75 | 0.95 | 0.86 |
| **A3** | 0.29 | 0.49 | 0.39 |
| **b** | 0.22 | 0.38 | 0.30 |
| **c** | 0.08 | 0.23 | 0.15 |
| **D** | 2.90 | 3.10 | 3.00 |
| **E** | 4.70 | 5.10 | 4.90 |
| **E1** | 2.90 | 3.10 | 3.00 |
| **E3** | 2.85 | 3.05 | 2.95 |
| **e** | - | - | 0.65 |
| **L** | 0.40 | 0.80 | 0.60 |
| **a** | 0° | 8° | 4° |
| **x** | - | - | 0.750 |
| **y** | - | - | 0.750 |
| **All Dimensions in mm** | | | |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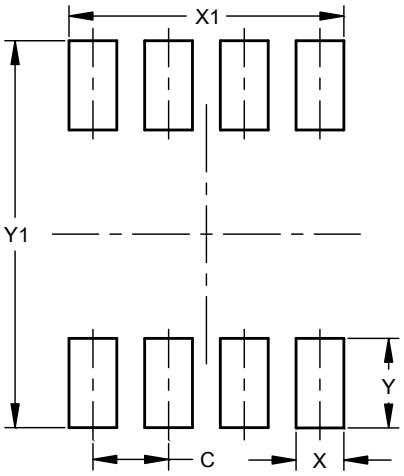
## Suggested Pad Layout

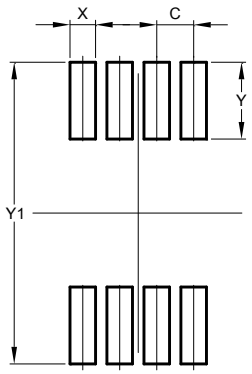
Please see http://www.diodes.com/package-outlines.html for the latest version.

**(1) Package Type: SO-8**




| Dimensions | Value (in mm) |
|---|---|
| C | 1.27 |
| X | 0.802 |
| X1 | 4.612 |
| Y | 1.505 |
| Y1 | 6.50 |

**(2) Package Type: MSOP-8**




| Dimensions | Value (in mm) |
|---|---|
| C | 0.650 |
| X | 0.450 |
| Y | 1.350 |
| Y1 | 5.300 |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