

## Description

The AP7375 series is a wide input voltage range (45V), low quiescent current (2.1µA), low-dropout linear regulator (LDO) able to provide 300mA load current. The AP7375 family LDO offers an EN pin that takes an input voltage of 45V to enable and disable the LDO output.

The device features very fast response times against line voltage transient and load current transient, and ensures no overshoot voltage during start-up and short-circuit recovery. It also features integrated short-circuit and thermal shutdown protection.

The AP7375 has 1.8V, 3.0V, 3.3V, 3.6V and 5.0V fixed output voltage versions, and is available in the SOT23, SOT25, SOT89 and U-DFN2020-6 (SWP) (Type UXC) packages.

## Features

- Wide Input Voltage Range: 3V to 45V
- Maximum Output Current: 300mA
- Low Dropout Voltage:  
 $V_{DROP} = 35mV @ I_{OUT} = 10mA (typ.)$   
 $V_{DROP} = 350mV @ I_{OUT} = 100mA (typ.)$
- Low Quiescent Current: 2.1µA (typ.)
- Fixed Output Voltages: 1.8V, 3.0V, 3.3V, 3.6V and 5.0V
- High Output Voltage Accuracy:  $\pm 2\%$
- High PSRR: 85dB @ 1kHz
- Excellent Line/Load Regulation
- Thermal Shutdown Function
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet ([AP7375Q](#))**

## Applications

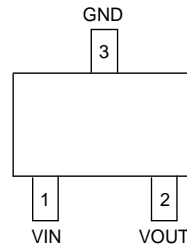
- Battery-powered equipments
- Smoke detectors and sensors
- Microcontroller applications
- Home appliances

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.

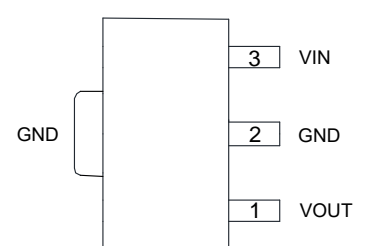
## Pin Assignments

(Top View)



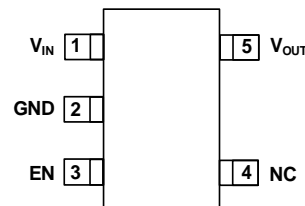
**SOT23**

(Top View)



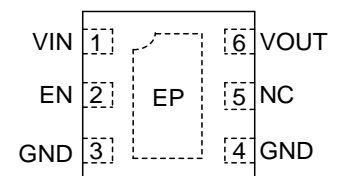
**SOT89**

(Top View)



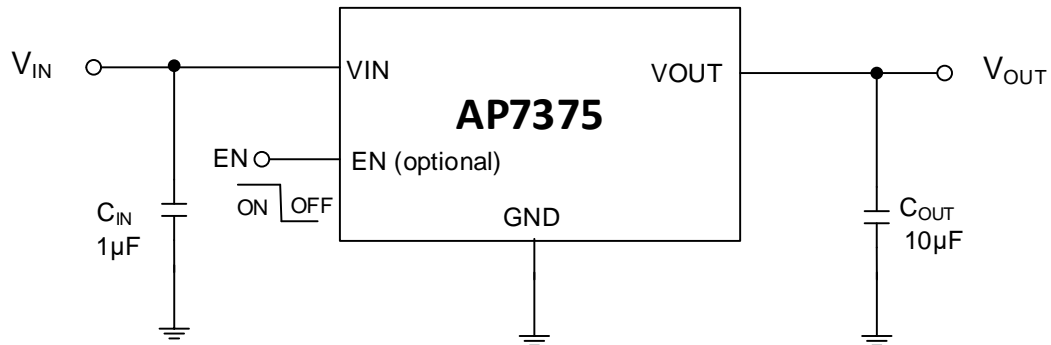
**SOT25**

(Top View)



**U-DFN2020-6 (SWP) (Type UXC)**

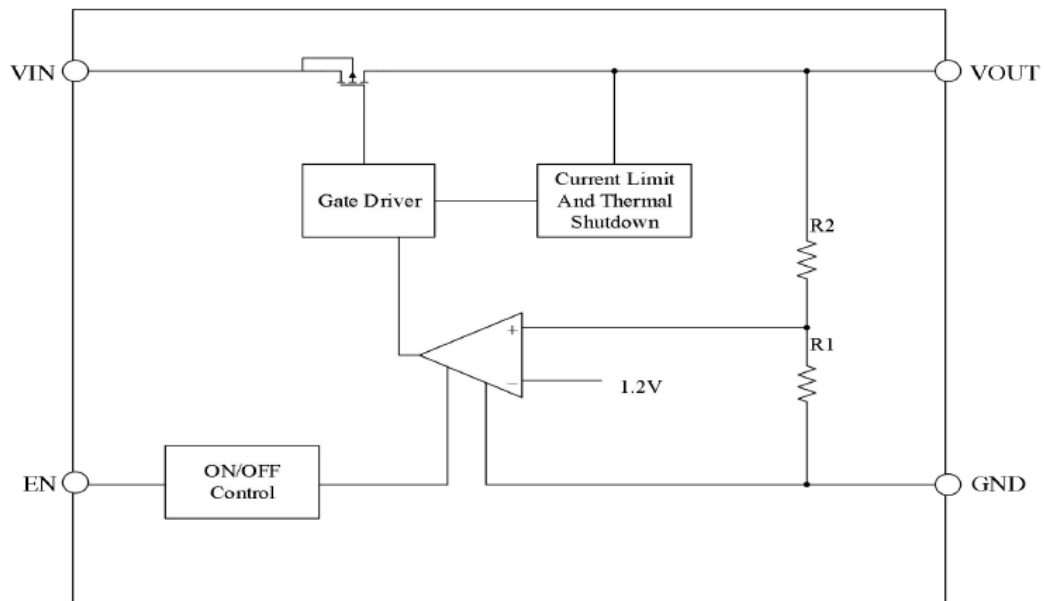
## Typical Applications Circuit



## Pin Descriptions

| Pin Number |       |       |                              | Pin Name   | Function  |
|------------|-------|-------|------------------------------|------------|---|
| SOT25      | SOT23 | SOT89 | U-DFN2020-6 (SWP) (Type UXC) |            |   |
| 1          | 1     | 3     | 1                            | VIN        | Input voltage   |
| 2          | 3     | 2     | 3, 4                         | GND        | Ground  |
| 3          | —     | —     | 2                            | EN         | Enable  |
| 5          | 2     | 1     | 6                            | VOUT       | Regulated output voltage  |
| 4          | —     | —     | 5                            | NC         | Not Connected internally, recommend connect to GND to maximize PCB copper for thermal dissipation.  |
| —          | —     | —     | EP                           | Expose Pad | In PCB layout, prefer to use large copper area to cover this pad for better thermal dissipation, then connect this area to GND or leave it open. However, do not use it as GND electrode function alone |

## Functional Block Diagram



## Absolute Maximum Ratings (Note 4) (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Symbol        | Parameter                                | Rating                       |      | Unit               |
|---------------|--|------------------------------|------|--------------------|
| $V_{IN}$      | Supply Input Voltage                     | -0.3 to 55                   |      | V                  |
| $V_{OUT}$     | Regulated Output Voltage                 | -0.3 to 6                    |      | V                  |
| —             | $V_{OUT}$ to $V_{IN}$                    | -55 to 0.3                   |      | V                  |
| $V_{EN}$      | EN to GND                                | -0.3 to 55                   |      | V                  |
| $I_{OUT}$     | Output Current                           | Internally limited           |      | mA                 |
| $T_{LEAD}$    | Lead Temperature (Soldering, 10sec)      | +260                         |      | $^\circ\text{C}$   |
| $T_J$         | Operating Junction Temperature           | +150                         |      | $^\circ\text{C}$   |
| $T_A$         | Operating Ambient Temperature            | -40 to +85                   |      | $^\circ\text{C}$   |
| $\theta_{JA}$ | Thermal Resistance (Junction to Ambient) | SOT25                        | 153  | $^\circ\text{C/W}$ |
|               |  | SOT23                        | 164  |                    |
|               |  | SOT89                        | 95   |                    |
|               |  | U-DFN2020-6 (SWP) (Type UXC) | 99.5 |                    |
| $T_{STG}$     | Storage Temperature Range                | -40 to +150                  |      | $^\circ\text{C}$   |
| CDM           | ESD (Change Device Model)                | 1.5V                         |      | kV                 |
| HBM           | ESD (Human Body Model)                   | 4V                           |      | kV                 |

Note: 4. a). Stresses greater than those listed under "Absolute Maximum Ratings" can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods can affect device reliability.  
 b). Ratings apply to ambient temperature at +25°C. The JEDEC STD.51 High-K board design used to derive this data was a 3 inch x 3 inch multilayer board with 1oz. internal power and ground planes and 2oz. copper traces on the top and bottom of the board.

## Recommended Operating Conditions

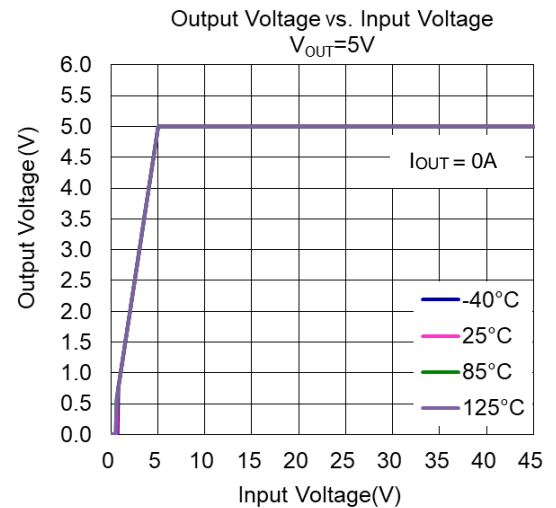
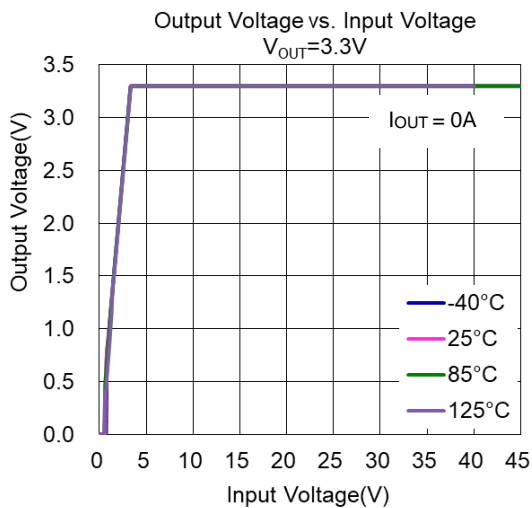
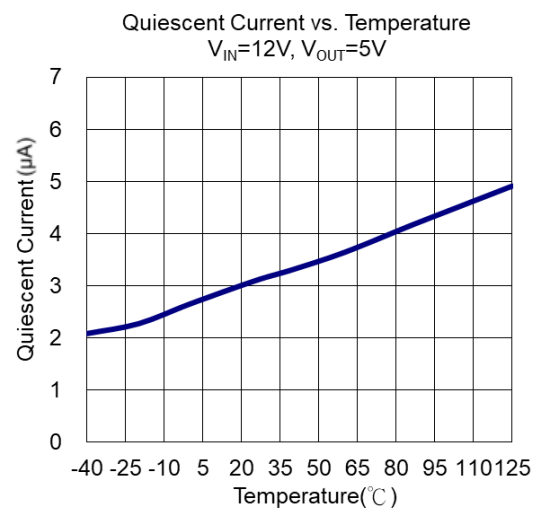
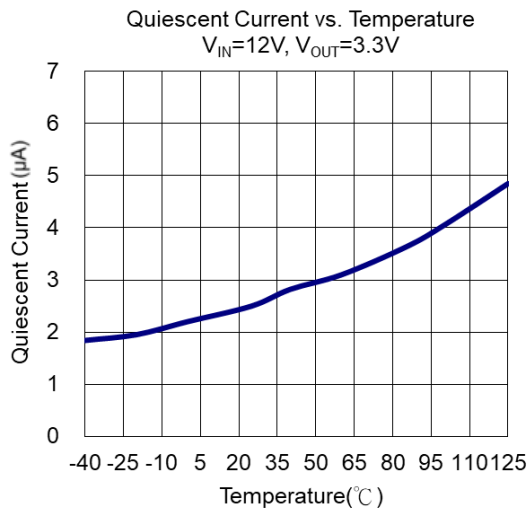
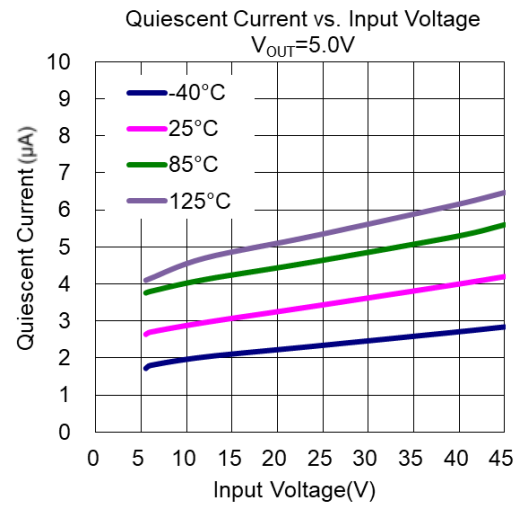
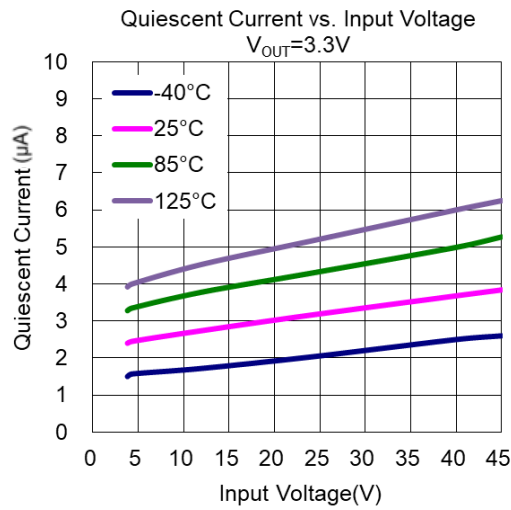
| Symbol           | Parameter                      | Min | Typ | Max  | Unit |
|------------------|--------------------------------|-----|-----|------|------|
| V <sub>IN</sub>  | Supply Input Voltage           | 3.0 | —   | 45   | V    |
| V <sub>OUT</sub> | Output Voltage                 | —   | —   | 5    | V    |
| T <sub>J</sub>   | Operating Junction Temperature | -40 | —   | +125 | °C   |
| C <sub>IN</sub>  | Input Capacitor                | —   | 1   | —    | μF   |
| C <sub>OUT</sub> | Output Capacitor               | 1   | 10  | —    | μF   |

## Electrical Characteristics (T<sub>A</sub> = +25°C, I<sub>OUT</sub> = 1mA, C<sub>IN</sub> = 1μF, C<sub>OUT</sub> = 10μF ceramic capacitor, V<sub>IN</sub> = V<sub>OUTNOM</sub> + 2.0V.)

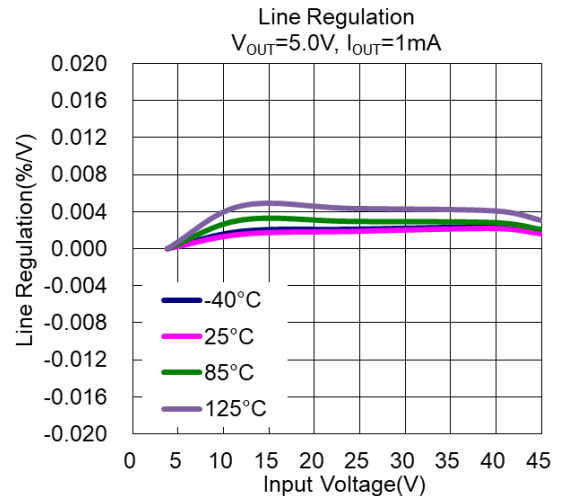
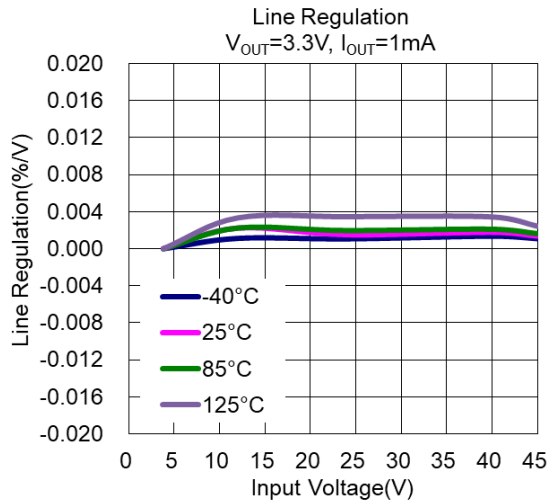
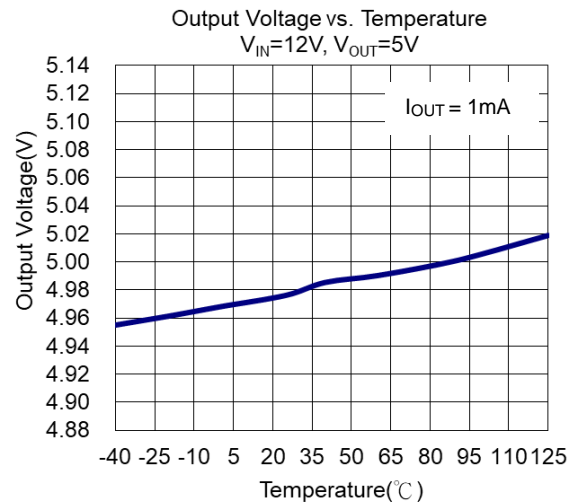
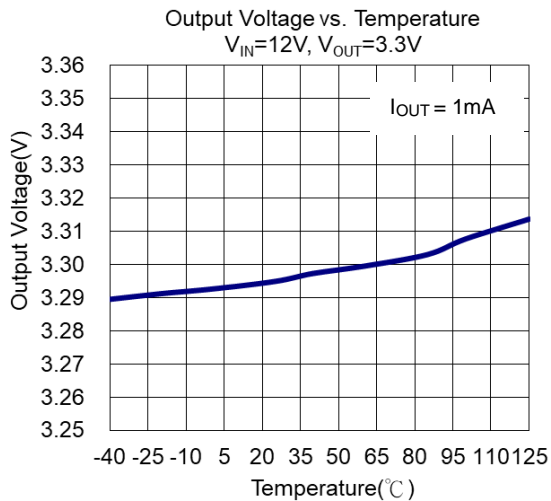
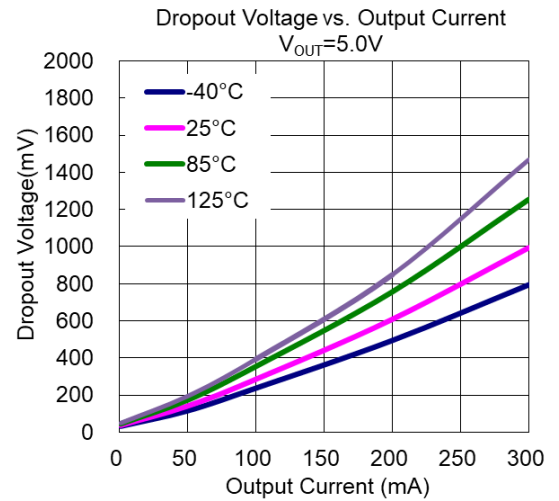
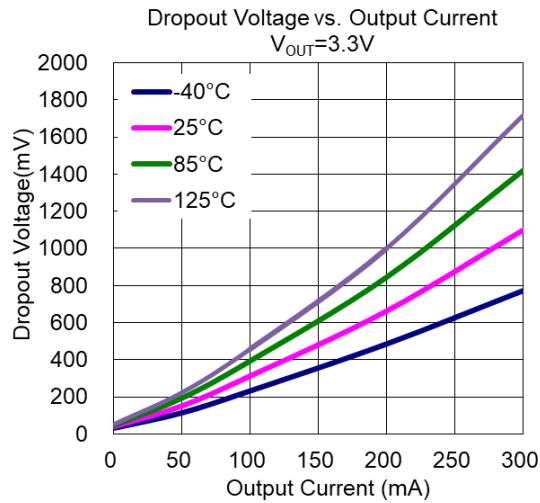
| Symbol                                 | Parameter                                    | Test Conditions  | Min                    | Typ  | Max                     | Unit |
|--|--|--|------------------------|------|-------------------------|------|
| V <sub>IN</sub>                        | Input Voltage                                | —  | 3                      | —    | 45                      | V    |
| I <sub>GND</sub>                       | Quiescent Current                            | V <sub>IN</sub> = 12V, No Load   | —                      | 2.1  | 5                       | μA   |
| V <sub>OUT</sub>                       | Output Voltage                               | V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 10mA                                 | V <sub>OUT</sub> × 98% | —    | V <sub>OUT</sub> × 102% | V    |
| I <sub>OUT_MAX</sub>                   | Output Current                               | —  | 300                    | 350  | —                       | mA   |
| V <sub>DROP</sub>                      | Dropout Voltage                              | I <sub>OUT</sub> = 10mA, V <sub>IN</sub> = V <sub>OUTNOM</sub> - 0.1V          | —                      | 35   | 50                      | mV   |
|  |  | I <sub>OUT</sub> = 100mA, V <sub>IN</sub> = V <sub>OUTNOM</sub> - 0.1V         | —                      | 350  | 360                     | mV   |
| ΔV <sub>OUT</sub> (ΔI <sub>OUT</sub> ) | Load Regulation (Note 5)                     | V <sub>IN</sub> = 12V, 1mA ≤ I <sub>OUT</sub> ≤ 100mA                          | —                      | 0.02 | 0.025                   | %/mA |
| ΔV <sub>OUT</sub> (ΔV <sub>IN</sub> )  | Line Regulation                              | V <sub>OUTNOM</sub> + 0.5 V ≤ V <sub>IN</sub> ≤ 45V, I <sub>OUT</sub> = 1mA    | —                      | 0.01 | 0.02                    | %/V  |
| I <sub>LIMIT</sub>                     | Current Limit                                | —  | —                      | 500  | —                       | mA   |
| T <sub>OTSD</sub>                      | Thermal Shutdown Temperature                 | —  | —                      | +150 | —                       | °C   |
| T <sub>HYOTSD</sub>                    | Thermal Shutdown Hysteresis                  | —  | —                      | +20  | —                       | °C   |
| PSRR                                   | Power Supply Rejection Ratio                 | V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 10mA, V <sub>OUT</sub> = 3.3V @ 1kHz | —                      | 85   | —                       | dB   |
| VENH                                   | EN High Level                                | Enabled  | 1                      | —    | —                       | V    |
| VENL                                   | EN Low Level                                 | Disabled   | —                      | —    | 0.4                     | V    |
| θ <sub>JC</sub>                        | Thermal Resistance Junction to Case (Note 4) | SOT25  | —                      | 54   | —                       | °C/W |
|  |  | SOT23  | —                      | 85   | —                       |      |
|  |  | SOT89  | —                      | 44   | —                       |      |
|  |  | U-DFN2020-6 (SWP) (Type UXC)   | —                      | 15.8 | —                       |      |

Notes: 4. a). Stresses greater than those listed under “Absolute Maximum Ratings” can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods can affect device reliability.  
b). Ratings apply to ambient temperature at +25°C. The JEDEC STD.51 High-K board design used to derive this data was a 3 inch x 3 inch multilayer board with 1oz. internal power and ground planes and 2oz. copper traces on the top and bottom of the board.  
5. The AP7375 internal circuitry is not fully operation until V<sub>IN</sub> is at least the greater of 3V or (V<sub>OUT</sub> + V<sub>DROPOUT(MAX)</sub>).

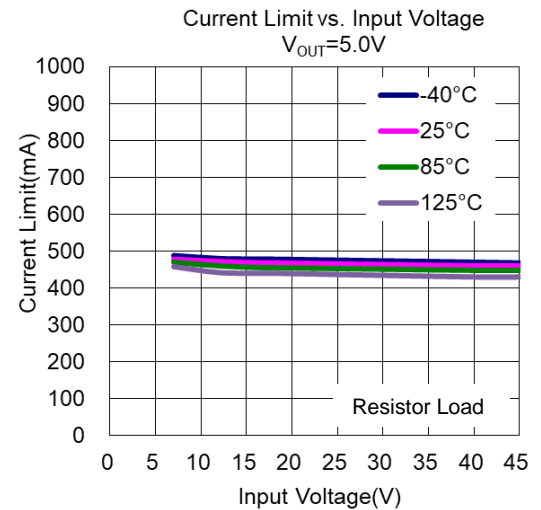
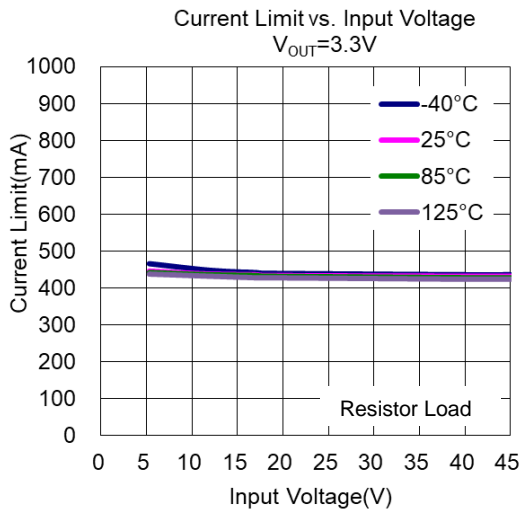
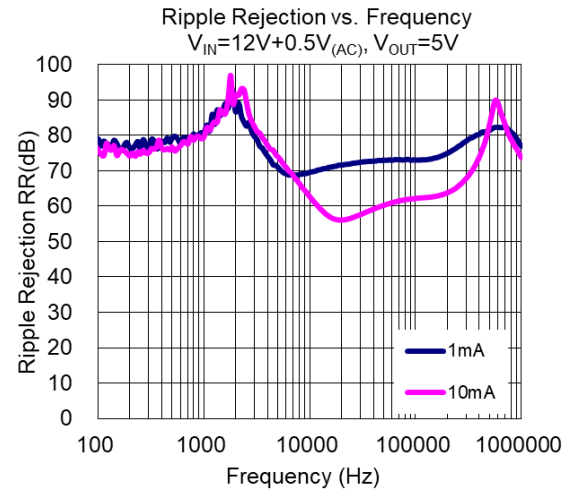
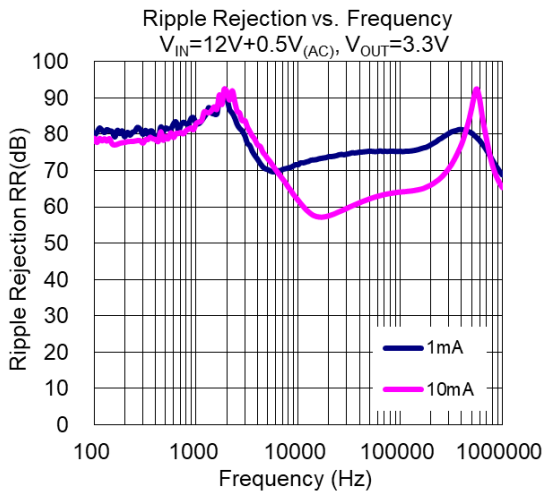
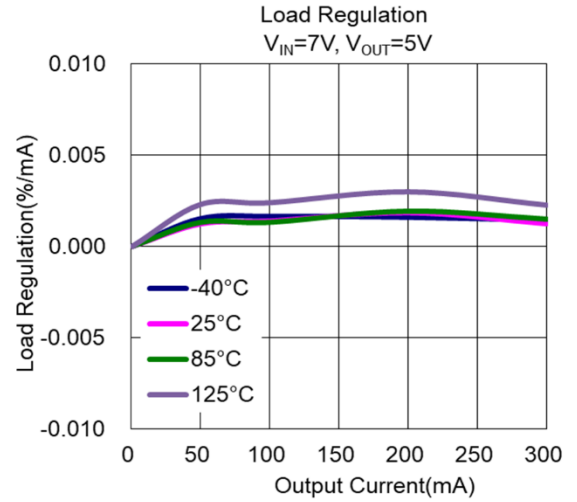
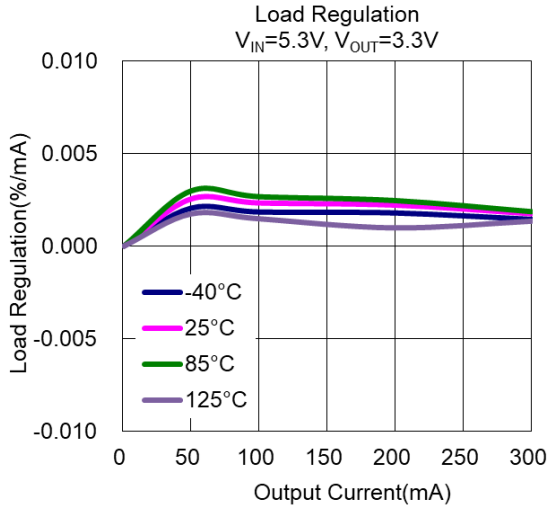
## Performance Characteristics



**Typical Characteristics** (continued)

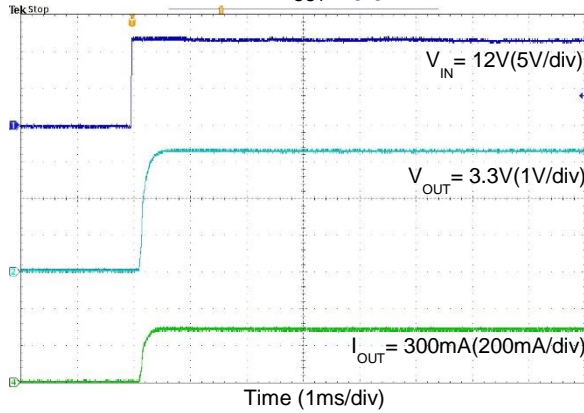


## Typical Characteristics (continued)

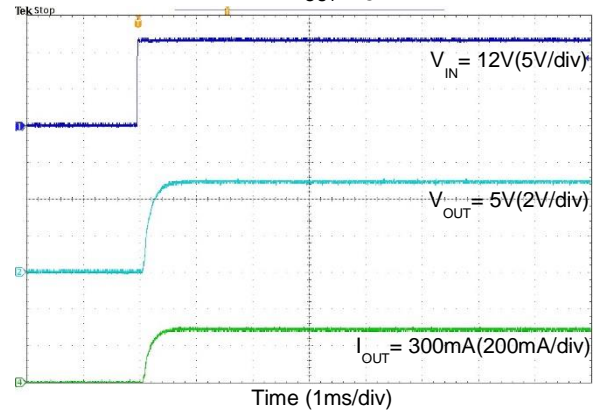


## Typical Characteristics (continued)

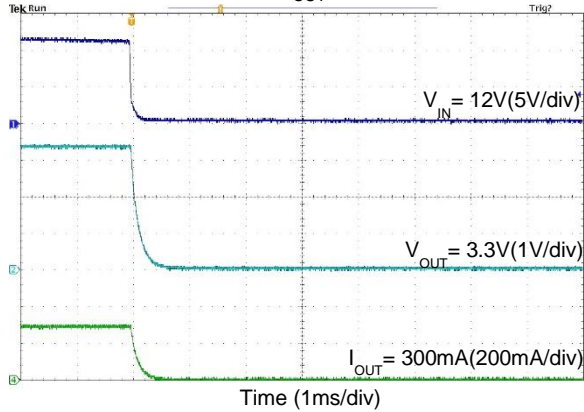
Power On  
 $V_{OUT} = 3.3V$



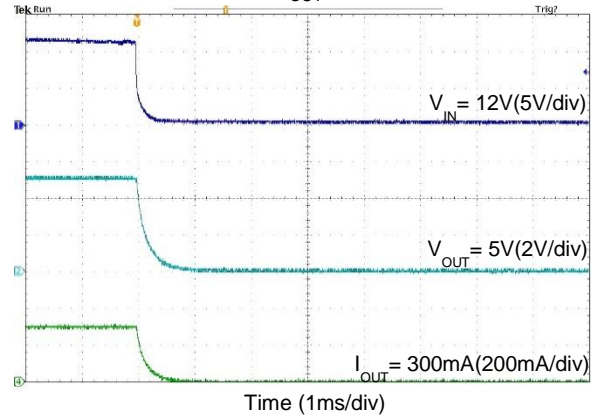
Power On  
 $V_{OUT} = 5V$



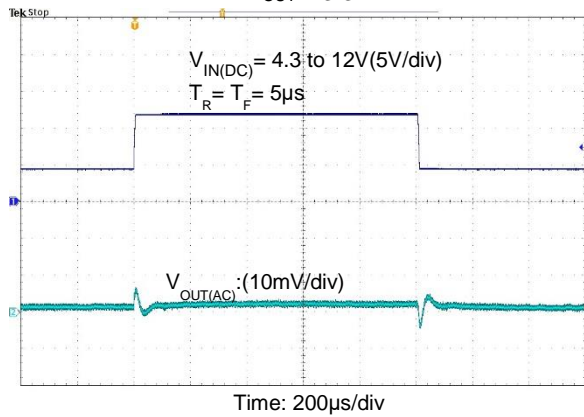
Power Off  
 $V_{OUT} = 3.3V$



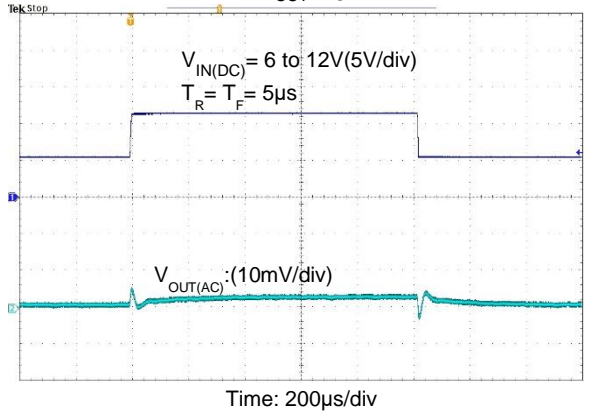
Power Off  
 $V_{OUT} = 5V$



Line Transient Response  
 $V_{OUT} = 3.3V$



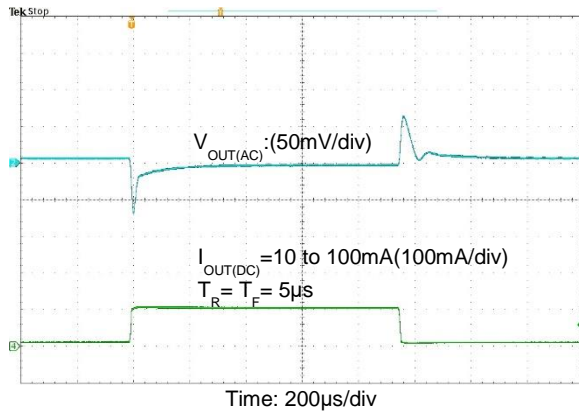
Line Transient Response  
 $V_{OUT} = 5V$



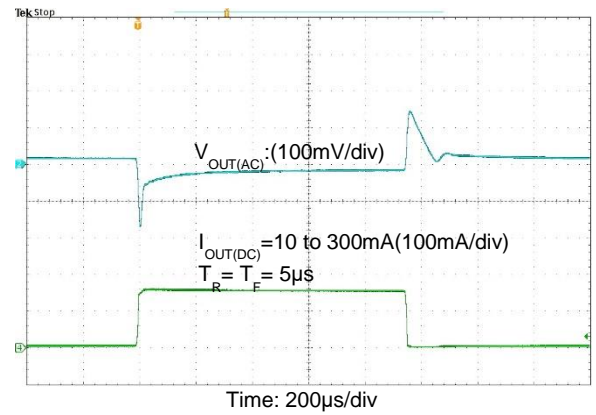


## Typical Characteristics (continued)

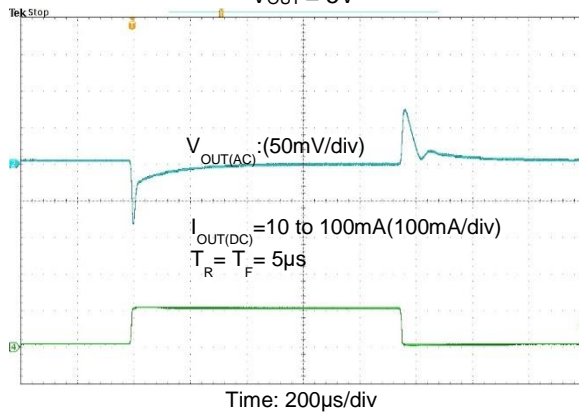
Load Transient Response  
 $V_{OUT} = 3.3V$



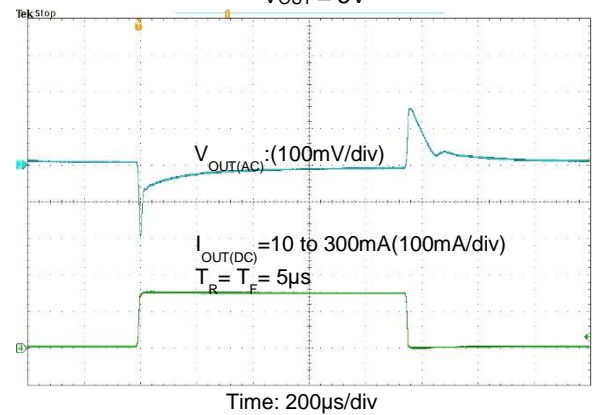
Load Transient Response  
 $V_{OUT} = 3.3V$



Load Transient Response  
 $V_{OUT} = 5V$



Load Transient Response  
 $V_{OUT} = 5V$



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## Application Information

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### Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended minimum output capacitance is 10 $\mu$ F. A ceramic capacitor is recommended, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to VOUT and GND pins.

### Input Capacitor

A 1 $\mu$ F ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

### Current Limit and Short Circuit Protection

When output current at VOUT pin is higher than current-limit threshold or the VOUT pin is direct short to GND, the current-limit protection will be triggered and clamp the output current at a pre-designed level to prevent overcurrent and thermal damage.

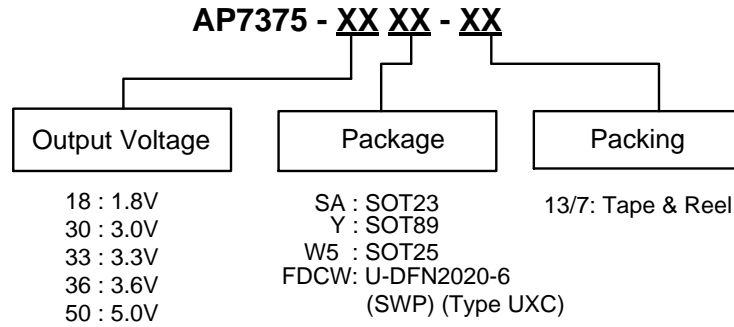
### Thermal Protection

The AP7375 has internal thermal sense and protection circuits. When excessive power dissipation happens on the device, such as short circuit at the output pin or very heavy load current with a large voltage drop across the device, the internal thermal protection circuit will be triggered, and it will shut down the power MOSFET to prevent the LDO from damage. As soon as excessive thermal condition is removed and the temperature of the device drops down, the thermal protection circuit will lease the control of the power MOSFET, and the LDO device goes to normal operation.

### Layout Considerations

For good ground loop and stability, the input and output capacitors should be located close to the input, output, and ground pins of the device. The regulator ground pin should be connected to the external circuit ground to reduce voltage drop caused by trace impedance. Ground plane is generally used to reduce trace impedance. Wide trace should be used for large current paths from VIN to VOUT, and load circuit.

## Ordering Information

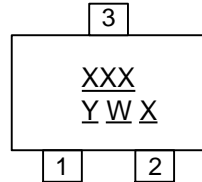


| Part Number     | Package Code | Package                      | Packing |                 |
|-----------------|--------------|------------------------------|---------|-----------------|
|                 |              |                              | Qty.    | Carrier         |
| AP7375-XXSA-7   | SA           | SOT23                        | 3000    | 7" Tape & Reel  |
| AP7375-XXY-13   | Y            | SOT89                        | 2500    | 13" Tape & Reel |
| AP7375-XXW5-7   | W5           | SOT25                        | 3000    | 7" Tape & Reel  |
| AP7375-XXFDCW-7 | FDCW         | U-DFN2020-6 (SWP) (Type UXC) | 3000    | 7" Tape & Reel  |

## Marking Information

### (1) SOT23

(Top View)



XXX : Identification Code

Y : Year 0 to 9

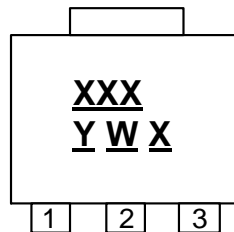
W : Week : A to Z : 1 to 26 Week;  
a to z : 27 to 52 Week; z Represents  
52 and 53 Week

X : Internal Code

| Part Number   | Package | Identification Code |
|---------------|---------|---------------------|
| AP7375-18SA-7 | SOT23   | H5A                 |
| AP7375-30SA-7 | SOT23   | H5B                 |
| AP7375-33SA-7 | SOT23   | H5C                 |
| AP7375-50SA-7 | SOT23   | H5D                 |

### (2) SOT89

(Top View)



XXX : Identification Code

Y : Year : 0 to 9

W : Week : A to Z : 1 to 26 Week;  
a to z : 27 to 52 Week;  
z Represents 52 and 53 Week

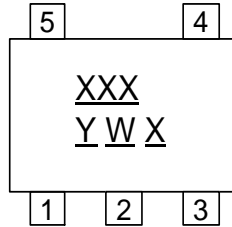
X : Internal Code

| Part Number   | Package | Identification Code |
|---------------|---------|---------------------|
| AP7375-18Y-13 | SOT89   | H5A                 |
| AP7375-30Y-13 | SOT89   | H5B                 |
| AP7375-33Y-13 | SOT89   | H5C                 |
| AP7375-50Y-13 | SOT89   | H5D                 |

## Marking Information (continued)

### (3) SOT25

(Top View)



XXX : Identification Code

Y : Year 0 to 9

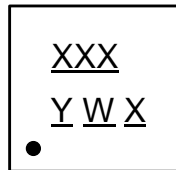
W : Week A to Z: 1 to 26 Week;  
a to z : 27 to 52 Week; z Represents  
52 and 53 Week

X : Internal Code

| Part Number   | Package | Identification Code |
|---------------|---------|---------------------|
| AP7375-18W5-7 | SOT25   | H5A                 |
| AP7375-30W5-7 | SOT25   | H5B                 |
| AP7375-33W5-7 | SOT25   | H5C                 |
| AP7375-36W5-7 | SOT25   | H5J                 |
| AP7375-50W5-7 | SOT25   | H5D                 |

### (4) U-DFN2020-6 (SWP) (Type UXC)

(Top View)



XXX : Identification Code

Y : Year : 0 to 9

W : Week : A to Z : 1 to 26 Week;  
a to z : 27 to 52 Week; z Represents  
52 and 53 Week

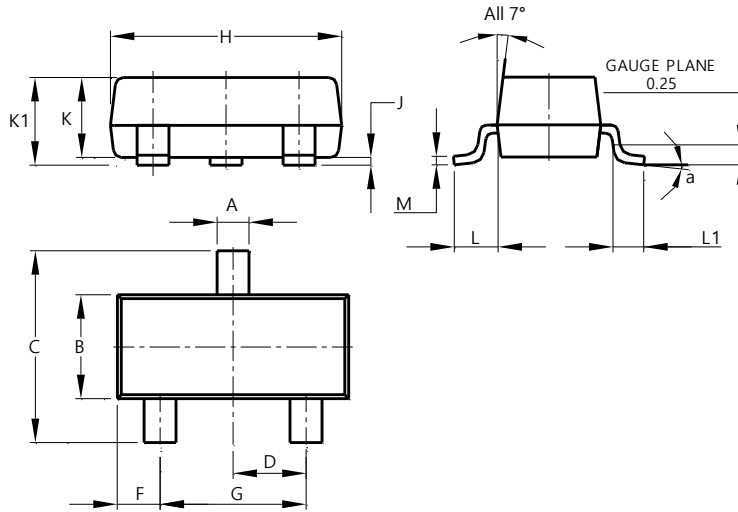
X : Internal Code

| Part Number     | Package                      | Identification Code |
|-----------------|------------------------------|---------------------|
| AP7375-18FDCW-7 | U-DFN2020-6 (SWP) (Type UXC) | H5A                 |
| AP7375-30FDCW-7 | U-DFN2020-6 (SWP) (Type UXC) | H5B                 |
| AP7375-33FDCW-7 | U-DFN2020-6 (SWP) (Type UXC) | H5C                 |
| AP7375-36FDCW-7 | U-DFN2020-6 (SWP) (Type UXC) | H5J                 |
| AP7375-50FDCW-7 | U-DFN2020-6 (SWP) (Type UXC) | H5D                 |

## Package Outline Dimensions

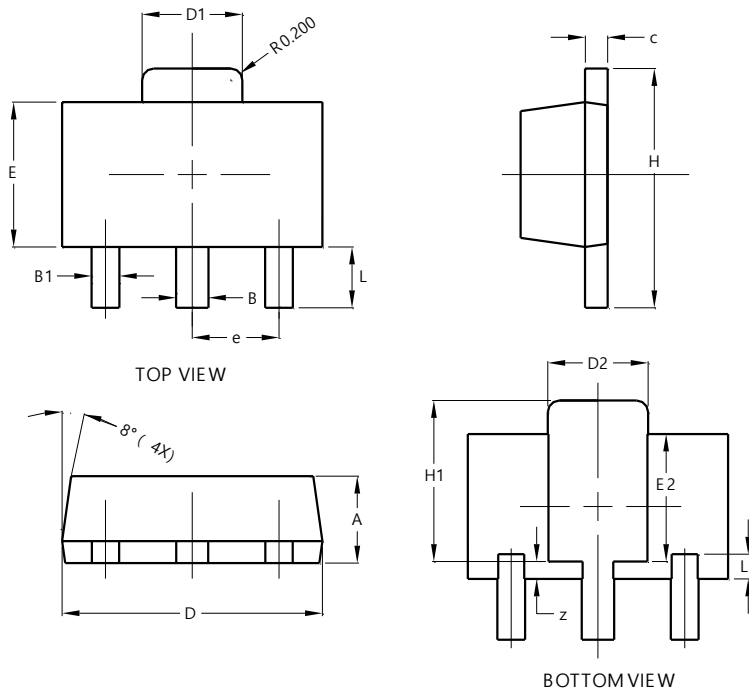
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### (1) SOT23



| SOT23                |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | 0.37  | 0.51  | 0.40  |
| B                    | 1.20  | 1.40  | 1.30  |
| C                    | 2.30  | 2.50  | 2.40  |
| D                    | 0.89  | 1.03  | 0.915 |
| F                    | 0.45  | 0.60  | 0.535 |
| G                    | 1.78  | 2.05  | 1.83  |
| H                    | 2.80  | 3.00  | 2.90  |
| J                    | 0.013 | 0.10  | 0.05  |
| K                    | 0.890 | 1.00  | 0.975 |
| K1                   | 0.903 | 1.10  | 1.025 |
| L                    | 0.45  | 0.61  | 0.55  |
| L1                   | 0.25  | 0.55  | 0.40  |
| M                    | 0.085 | 0.150 | 0.110 |
| a                    | 0°    | 8°    | --    |
| All Dimensions in mm |       |       |       |

### (2) SOT89

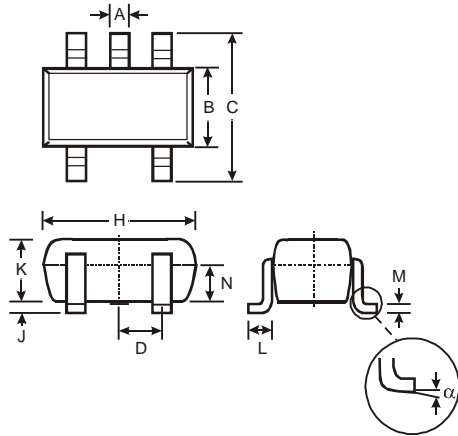


| SOT89                |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | 1.40  | 1.60  | 1.50  |
| B                    | 0.50  | 0.62  | 0.56  |
| B1                   | 0.42  | 0.54  | 0.48  |
| c                    | 0.35  | 0.43  | 0.38  |
| D                    | 4.40  | 4.60  | 4.50  |
| D1                   | 1.62  | 1.83  | 1.733 |
| D2                   | 1.61  | 1.81  | 1.71  |
| E                    | 2.40  | 2.60  | 2.50  |
| E2                   | 2.05  | 2.35  | 2.20  |
| e                    | -     | -     | 1.50  |
| H                    | 3.95  | 4.25  | 4.10  |
| H1                   | 2.63  | 2.93  | 2.78  |
| L                    | 0.90  | 1.20  | 1.05  |
| L1                   | 0.327 | 0.527 | 0.427 |
| z                    | 0.20  | 0.40  | 0.30  |
| All Dimensions in mm |       |       |       |

## Package Outline Dimensions (continued)

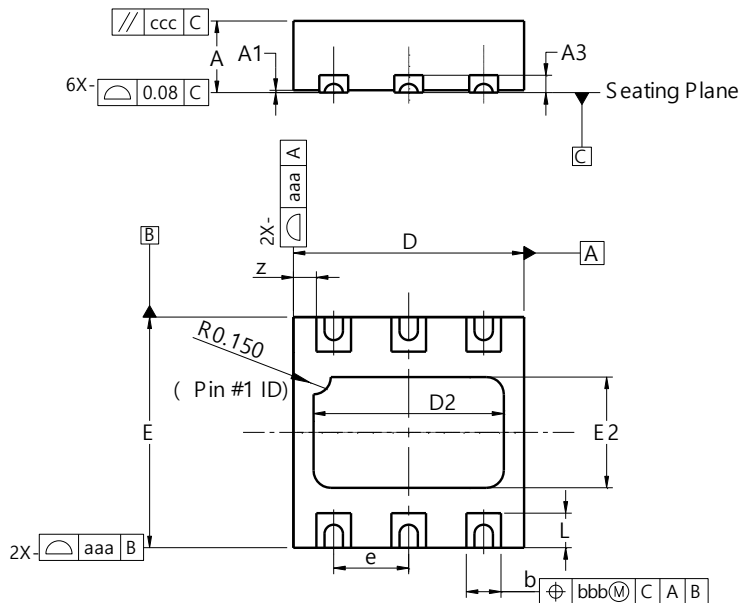
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### (3) SOT25



| SOT25                |       |      |      |
|----------------------|-------|------|------|
| Dim                  | Min   | Max  | Typ  |
| A                    | 0.35  | 0.50 | 0.38 |
| B                    | 1.50  | 1.70 | 1.60 |
| C                    | 2.70  | 3.00 | 2.80 |
| D                    | -     | -    | 0.95 |
| H                    | 2.90  | 3.10 | 3.00 |
| J                    | 0.013 | 0.10 | 0.05 |
| K                    | 1.00  | 1.30 | 1.10 |
| L                    | 0.35  | 0.55 | 0.40 |
| M                    | 0.10  | 0.20 | 0.15 |
| N                    | 0.70  | 0.80 | 0.75 |
| α                    | 0°    | 8°   | -    |
| All Dimensions in mm |       |      |      |

### (4) U-DFN2020-6 (SWP) (Type UXC)

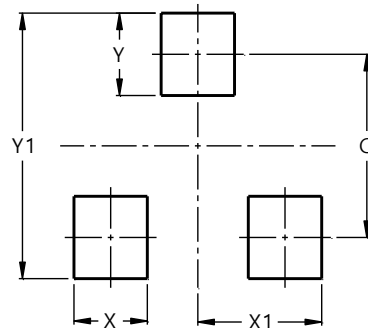


| U-DFN2020-6 (SWP)<br>(Type UXC) |      |       |      |
|---------------------------------|------|-------|------|
| Dim                             | Min  | Max   | Typ  |
| A                               | 0.57 | 0.63  | 0.60 |
| A1                              | 0.00 | 0.05  | 0.02 |
| A3                              | —    | —     | 0.13 |
| b                               | 0.25 | 0.35  | 0.30 |
| D                               | 1.95 | 2.075 | 2.00 |
| D2                              | 1.55 | 1.75  | 1.65 |
| E                               | 1.95 | 2.075 | 2.00 |
| E2                              | 0.86 | 1.06  | 0.96 |
| e                               | —    | —     | 0.65 |
| L                               | 0.25 | 0.35  | 0.30 |
| z                               | —    | —     | 0.20 |
| aaa                             | 0.25 |       |      |
| bbb                             | 0.10 |       |      |
| ccc                             | 0.10 |       |      |
| All Dimensions in mm            |      |       |      |

## Suggested Pad Layout

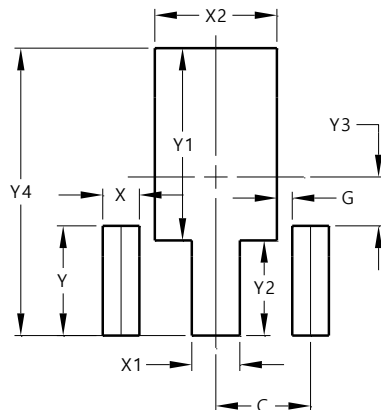
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### (1) SOT23



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 2.0           |
| X          | 0.8           |
| X1         | 1.35          |
| Y          | 0.9           |
| Y1         | 2.9           |

### (2) SOT89



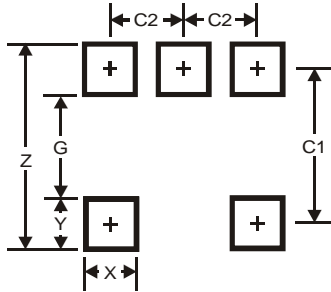
| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 1.500         |
| G          | 0.244         |
| X          | 0.580         |
| X1         | 0.760         |
| X2         | 1.933         |
| Y          | 1.730         |
| Y1         | 3.030         |
| Y2         | 1.500         |
| Y3         | 0.770         |
| Y4         | 4.530         |



## Suggested Pad Layout (continued)

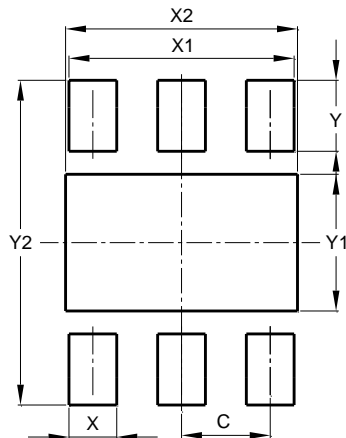
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### (3) SOT25



| Dimensions | Value |
|------------|-------|
| Z          | 3.20  |
| G          | 1.60  |
| X          | 0.55  |
| Y          | 0.80  |
| C1         | 2.40  |
| C2         | 0.95  |

### (4) U-DFN2020-6 (SWP) (Type UXC)



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.650         |
| X          | 0.350         |
| X1         | 1.650         |
| X2         | 1.700         |
| Y          | 0.525         |
| Y1         | 1.010         |
| Y2         | 2.400         |

## Mechanical Data

- Moisture Sensitivity: Level 1 Per J-STD-020
- Terminals:
  - SOT23/SOT25/SOT89: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 <sup>(e3)</sup>
  - U-DFN2020-6 (SWP) (Type UXC): Finish – NiPdAu over Copper Leads, Solderable per MIL-STD-202, Method 208 <sup>(e4)</sup>
- Weight:
  - SOT89: 0.054 grams (Approximate)
  - SOT23: 0.009 grams (Approximate)
  - SOT25: 0.018 grams (Approximate)
  - U-DFN2020-6 (SWP) (Type UXC): 0.007 grams (Approximate)

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