

## Low Dropout 600mA Fixed Voltage Linear Regulator

### Features

- **Low Dropout Voltage: 220mV (Typical) @600mA**
- **Wide 2.9V~6V Input Voltage**
- **Low Quiescent Current: 140mA (Typical)**
- **Fixed Output Voltage with  $\pm 2\%$  Accuracy**
- **Stable with Ceramic, 2.2mF Output Capacitor**
- **Short-Circuit Current-Limit**
- **Over-Temperature Protection**
- **Current-Limit Protection**
- **Internal Soft-Start**
- **SOT-23-5, TSOT-23-5, SOP-8, and DFN3x3-8 Packages**
- **Lead Free and Green Devices Available (RoHS Compliant)**

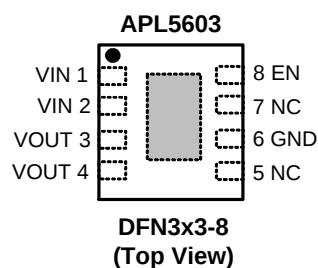
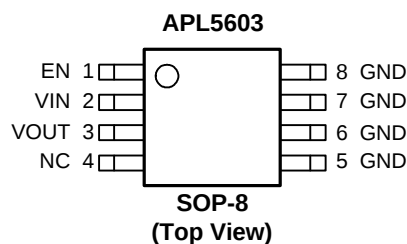
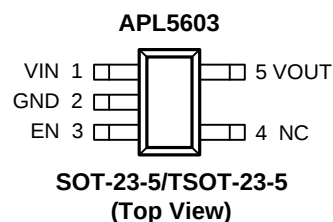
### Applications

- **CD/DVD-ROM, CD-R/W**
- **Networking System, LAN Card, ADSL/Cable Modem**
- **Set-Top Box**
- **PC Peripherals**
- **Battery-Powered System**

### General Description

The APL5603 is a low-power and low dropout linear regulators which operates from 2.9V to 6V input voltage and delivers up to 600mA output current. Typical dropout voltage is only 220mV (typical) at 600mA output. The APL5603 regulators with low 140mA quiescent current are ideal for battery-powered system appliances. The APL5603 regulators are stable with a 2.2μF ceramic capacitor. The features of current-limit, short-circuit current-limit, and over-temperature protections can prevent the device against current overload and over-temperature. The APL5603 regulators are available in SOT-23-5, TSOT-23-5, SOP-8, and DFN3x3-8 packages.

### Pin Configurations



ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

## Ordering and Marking Information

|                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div> <div>APL5603</div> <div> <div>□□□□-□□□</div> <div> <div>Assembly Material</div> <div>Handling Code</div> <div>Temperature Range</div> <div>Package Code</div> <div>Voltage Code</div> </div> </div> </div> | <div> <div>Voltage Code (Note 1)</div> <div>12 : 1.2V 15 : 1.5V 18 : 1.8V 25 : 2.5V</div> <div>28 : 2.8V 30 : 3.0V 33 : 3.3V</div> <div>Package Code</div> <div>B : SOT-23-5 BT : TSOT-23-5</div> <div>K : SOP-8 QA : DFN3x3-8</div> <div>Operating Ambient Temperature Range</div> <div>I : -40 to 85 °C</div> <div>Handling Code</div> <div>TR : Tape &amp; Reel</div> <div>Assembly Material</div> <div>G : Halogen and Lead Free Device</div> </div> |
| APL5603-18 K : <div> <div>APL5603</div> <div>XXXXX 18</div> </div>                                                                                                                                               | XXXXX - Date Code ; 18 - Voltage Code                                                                                                                                                                                                                                                                                                                                                                                                                    |
| APL5603-18 QA : <div> <div>L5603</div> <div>18</div> <div>XXXXX</div> </div>                                                                                                                                     | XXXXX - Date Code ; 18 - Voltage Code                                                                                                                                                                                                                                                                                                                                                                                                                    |

Note : ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. ANPEC defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

Note 1: For other voltage versions please contact ANPEC for details.

### Marking for SOT-23-5 package

| Product Name | Marking | Product Name | Marking | Product Name | Marking |
|--------------|---------|--------------|---------|--------------|---------|
| APL5603-12B  | 635X    | APL5603-15B  | 639X    | APL5603-18B  | 63CX    |
| APL5603-25B  | 63JX    | APL5603-28B  | 63MX    | APL5603-30B  | 63OX    |
| APL5603-33B  | 63RX    |              |         |              |         |

\* "X" in the marking indicates data code.

### Marking for TSOT-23-5 package

| Product Name | Marking | Product Name | Marking | Product Name | Marking |
|--------------|---------|--------------|---------|--------------|---------|
| APL5603-12BT | 635X    | APL5603-15BT | 639X    | APL5603-18BT | 63CX    |
| APL5603-25BT | 63JX    | APL5603-28BT | 63MX    | APL5603-30BT | 63OX    |
| APL5603-33BT | 63RX    |              |         |              |         |

\* "X" in the marking indicates data code.

## Absolute Maximum Ratings (Note 2)

| Symbol    | Parameter                                      | Rating               | Unit |
|-----------|------------------------------------------------|----------------------|------|
| $V_{IN}$  | VIN Supply Voltage (VIN to GND)                | -0.3 to 6.5          | V    |
| $T_J$     | Maximum Junction Temperature                   | 150                  | °C   |
| $V_{OUT}$ | Output Voltage (VOUT to GND)                   | -0.3 to $V_{IN}+0.3$ | V    |
| $V_{EN}$  | EN Pin Voltage (VEN to GND)                    | -0.3 to 6.5          | V    |
| $T_{STG}$ | Storage Temperature Range                      | -65 to 150           | °C   |
| $T_{SDR}$ | Maximum Lead Soldering Temperature, 10 Seconds | 260                  | °C   |
| $P_D$     | Power Dissipation                              | Internally Limited   |      |

Note 2: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Thermal Characteristics (Note 3, 4)

| Symbol        | Parameter                          | Typical Value | Unit |
|---------------|------------------------------------|---------------|------|
| $\theta_{JA}$ | Junction to Air Thermal Resistance |               |      |
|               | SOT-23-5                           | 260           | °C/W |
|               | TSOT-23-5                          | 260           |      |
|               | SOP-8                              | 150           |      |
|               | DFN3x3-8                           | 110           |      |

Note 3: At elevated temperatures, device power dissipation must be derated based on package thermal resistance and heatsink values. The junction-to-ambient thermal resistance is measured on a PC board mounting with the device soldered down to minimum copper area. If power dissipation causes the junction temperature to exceed specified limits, the device will go into thermal shutdown.

Note 4: The maximum allowable power dissipation at any  $T_A$  (ambient temperature) is calculated using:  $P_{D(max)} = (T_J - T_A) / \theta_{JA}$ ;  $T_J = 125^\circ\text{C}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature.

## Recommended Operating Conditions

| Symbol    | Parameter            | Range       | Unit          |
|-----------|----------------------|-------------|---------------|
| $V_{IN}$  | VIN to GND           | 2.9 to 6    | V             |
| $I_{OUT}$ | Output Current       | 0 to 0.6    | A             |
| $C_{IN}$  | Input Capacitor      | 0.82 to 470 | $\mu\text{F}$ |
| $C_{OUT}$ | Output Capacitor     | 1 to 330    | $\mu\text{F}$ |
| $T_J$     | Junction Temperature | -40 to 125  | °C            |
| $T_A$     | Ambient Temperature  | -40 to 85   | °C            |

## Electrical Characteristics

Refer to the typical application circuit.  $V_{IN} = V_{OUT} + 1\text{V}$  or 2.9V (minimum), whichever is great,  $V_{EN} = V_{IN}$ ,  $I_{OUT} = 1\text{mA}$ ,  $T_J = -40$  to  $125^\circ\text{C}$ ,  $T_A = -40$  to  $85^\circ\text{C}$ , unless otherwise specified. Typical values are at  $T_A = 25^\circ\text{C}$ .

| Symbol                | Parameter                     | Test Conditions                                              | APL5603 |      |      | Unit              |
|-----------------------|-------------------------------|--------------------------------------------------------------|---------|------|------|-------------------|
|                       |                               |                                                              | Min.    | Typ. | Max. |                   |
| SUPPLY CURRENT        |                               |                                                              |         |      |      |                   |
| I <sub>Q</sub>        | Quiescent Current             | V <sub>EN</sub> = 0V                                         | -       | -    | 1    | μA                |
|                       |                               | V <sub>IN</sub> =V <sub>EN</sub> =5V, I <sub>OUT</sub> =0mA  | -       | 140  | 200  | μA                |
| UNDER-VOLTAGE-LOCKOUT |                               |                                                              |         |      |      |                   |
|                       | VIN UVLO Threshold            | V <sub>IN</sub> rising                                       | 2.1     | 2.5  | 2.9  | V                 |
|                       | VIN UVLO Hysteresis           |                                                              | -       | 0.15 | -    | V                 |
| OUTPUT VOLTAGE        |                               |                                                              |         |      |      |                   |
| V <sub>OUT</sub>      | Output Voltage                | T <sub>A</sub> = 25°C                                        | -1      | -    | +1   | %V <sub>OUT</sub> |
|                       |                               | T <sub>A</sub> = -40 to 85°C (T <sub>J</sub> = -40 to 125°C) | -2      | -    | +2   |                   |
|                       | Line Regulation               | V <sub>IN</sub> = V <sub>OUT</sub> + 1V to 6V                | -       | 0.03 | 0.19 | %/V               |
|                       | Load Regulation               | I <sub>OUT</sub> = 1mA to 600mA                              | -       | 0.6  | 1.5  | %/A               |
| V <sub>DROP</sub>     | Dropout Voltage               | V <sub>OUT</sub> =2.8V, I <sub>OUT</sub> =600mA              | -       | 240  | 500  | mV                |
|                       |                               | V <sub>OUT</sub> =3.3V, I <sub>OUT</sub> =600mA              | -       | 220  | 450  |                   |
|                       |                               | V <sub>OUT</sub> =5V, I <sub>OUT</sub> =600mA                | -       | 200  | 420  |                   |
| PSRR                  | Power Supply Ripple Rejection | V <sub>IN</sub> = V <sub>OUT</sub> + 2V, f = 1kHz            | -       | 55   | -    | dB                |

## Electrical Characteristics (Cont.)

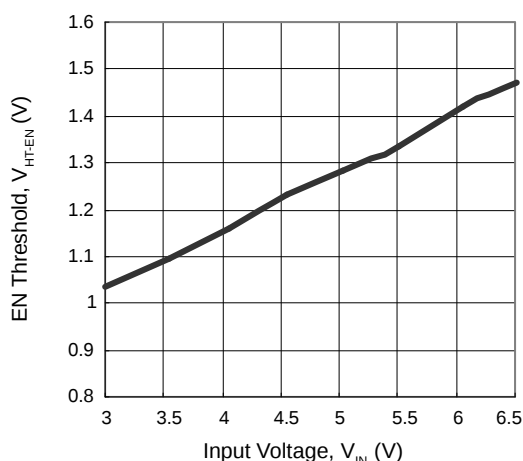
Refer to the typical application circuit.  $V_{IN} = V_{OUT} + 1V$  or  $2.9V$  (minimum), whichever is great,  $V_{EN} = V_{IN}$ ,  $I_{OUT} = 1mA$ ,  $T_J = -40$  to  $125^\circ C$ ,  $T_A = -40$  to  $85^\circ C$ , unless otherwise specified. Typical values are at  $T_A = 25^\circ C$ .

| Symbol                    | Parameter                    | Test Conditions         | APL5603 |      |      | Unit |
|---------------------------|------------------------------|-------------------------|---------|------|------|------|
|                           |                              |                         | Min.    | Typ. | Max. |      |
| SOFT-START AND PROTECTION |                              |                         |         |      |      |      |
| I <sub>LIM</sub>          | Output Current-Limit         |                         | 700     | -    | -    | mA   |
|                           | Thermal Shutdown Temperature |                         | -       | 150  | -    | °C   |
|                           | Thermal Shutdown Hysteresis  |                         | -       | 40   | -    | °C   |
|                           | Short-Circuit Current-Limit  | V <sub>OUT</sub> < 0.6V | -       | 250  | -    | mA   |
| T <sub>SS</sub>           | Soft-Start Time              |                         | -       | 130  | 300  | μs   |
| LOGIC INPUT               |                              |                         |         |      |      |      |
|                           | EN Logic Input-High Level    |                         | 1.6     | -    | -    | V    |
|                           | EN Logic Input-Low Level     |                         | -       | -    | 0.4  | V    |
|                           | EN Pull-Low Resistance       | V <sub>EN</sub> <3V     | -       | 2    | -    | MΩ   |

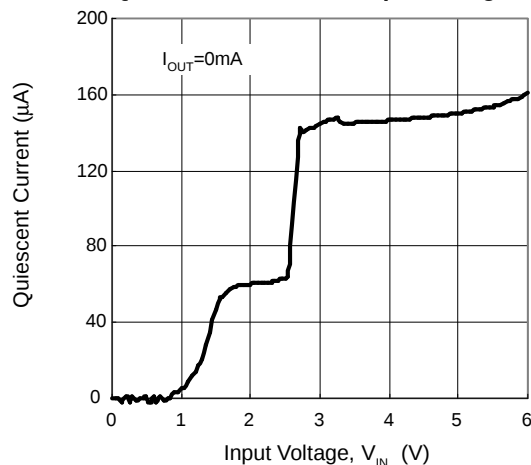
## Typical Operating Characteristics

(Refer to the application circuit 1 in the section "Typical Application Circuits,"  $V_{IN}=5V$ ,  $V_{OUT}=3.3V$ ,  $C_{OUT}=2.2\mu F$ , unless otherwise specified.)

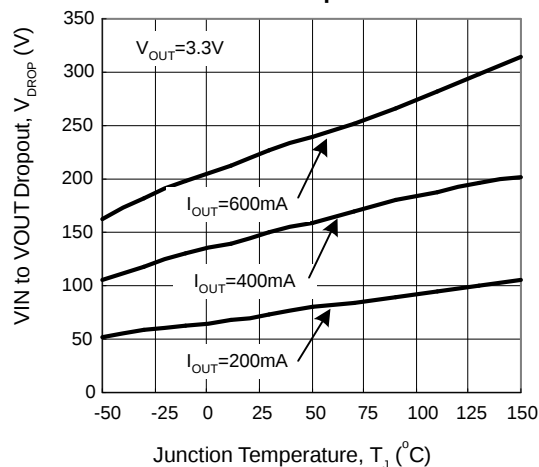
EN Threshold vs. Input Voltage



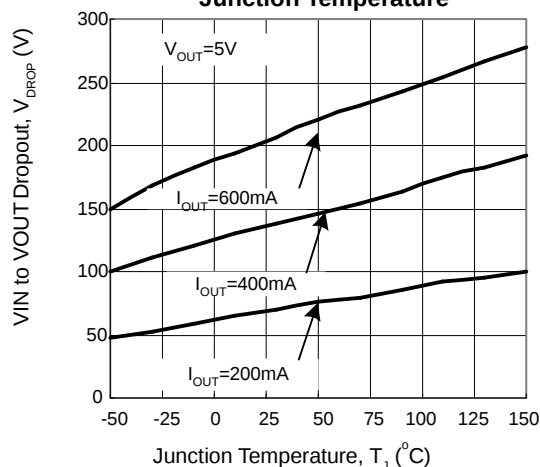
Quiescent Current vs. Input Voltage



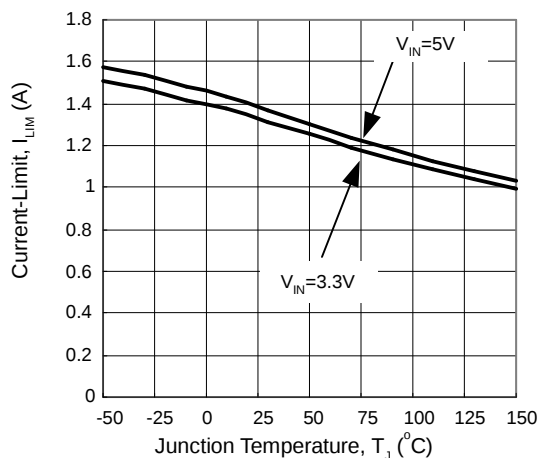
VIN to VOUT Dropout vs. Junction Temperature



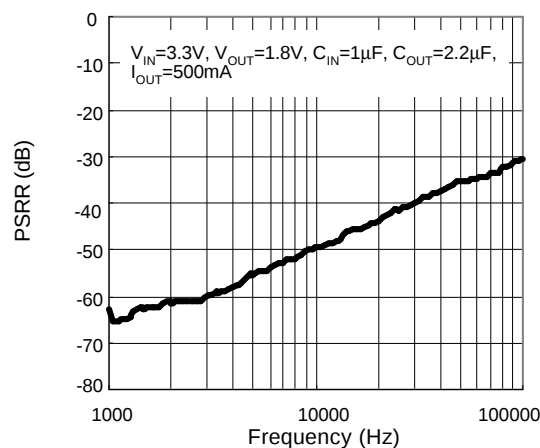
VIN to VOUT Dropout vs. Junction Temperature



Current-Limit vs. Junction Temperature



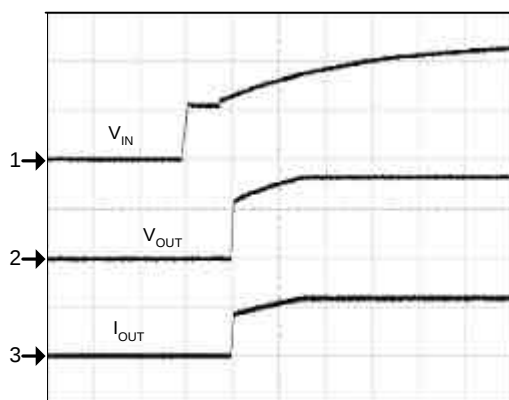
Power Supply Ripple Rejection



## Operating Waveforms

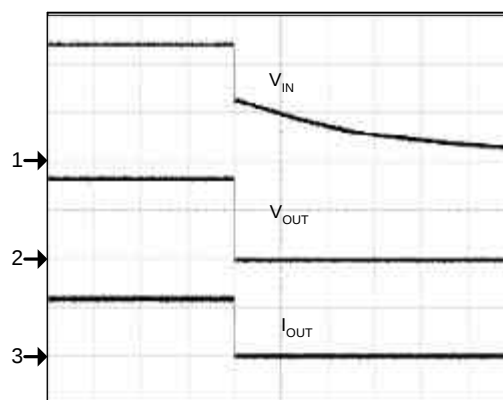
(Refer to the application circuit 1 in the section "Typical Application Circuits,"  $V_{IN}=5V$ ,  $V_{OUT}=3.3V$ ,  $C_{OUT}=2.2\mu F$ , unless otherwise specified.)

**Power On**



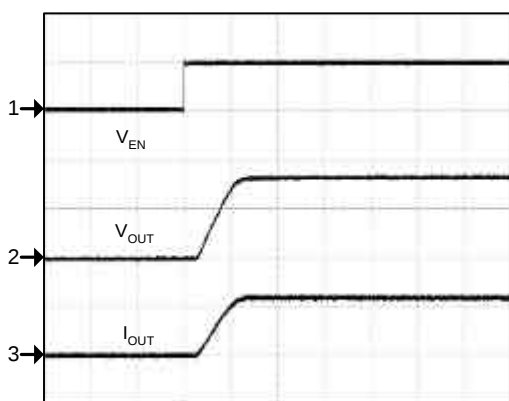
CH1 :  $V_{IN}$ , 2V/div  
CH3 :  $V_{OUT}$ , 2V/div  
CH4 :  $I_{OUT}$ , 500mA/div  
Time : 1ms/div

**Power Off**



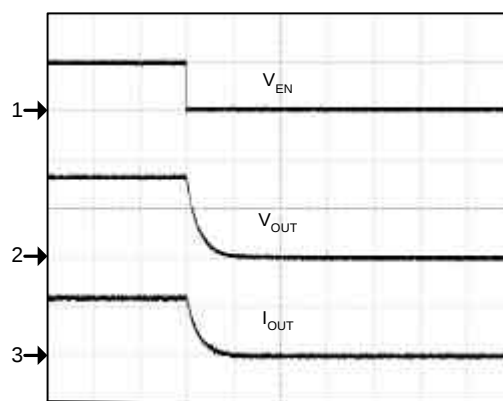
CH1 :  $V_{IN}$ , 2V/div  
CH2 :  $V_{OUT}$ , 2V/div  
CH3 :  $I_{OUT}$ , 500mA/div  
Time : 200ms/div

**Enable**



CH1 :  $V_{EN}$ , 5V/div  
CH2 :  $V_{OUT}$ , 2V/div  
CH3 :  $I_{OUT}$ , 500mA/div  
Time : 100μs/div

**Shutdown**

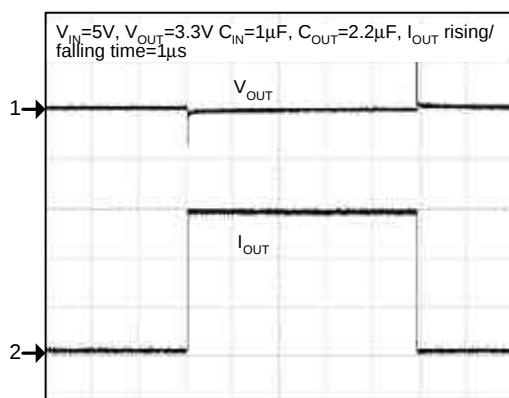


CH1 :  $V_{EN}$ , 5V/div  
CH2 :  $V_{OUT}$ , 2V/div  
CH3 :  $I_{OUT}$ , 500mA/div  
Time : 20μs/div

## Operating Waveforms (Cont.)

(Refer to the application circuit 1 in the section "Typical Application Circuits,"  $V_{IN}=5V$ ,  $V_{OUT}=3.3V$ ,  $C_{OUT}=2.2\mu F$ , unless otherwise specified.)

### Load Transient

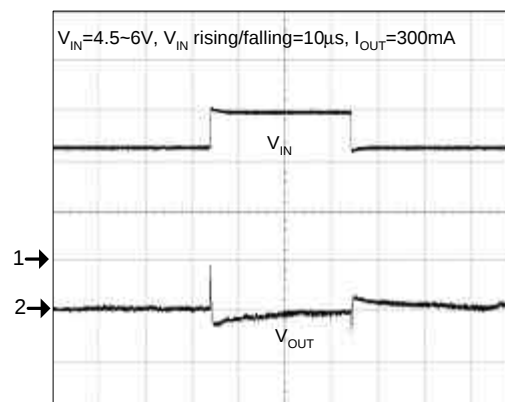


CH1 :  $V_{OUT}$ , 100mV/div (offset=3.3V)

CH2 :  $I_{OUT}$ , 200mV/div

Time : 200 $\mu s$ /div

### Line Transient

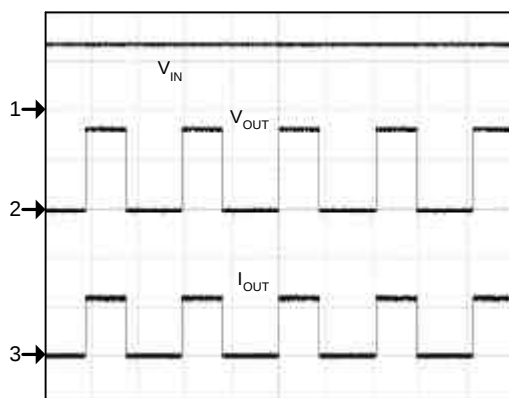


CH1 :  $V_{IN}$ , 2V/div

CH2 :  $V_{OUT}$ , 20mV/div (offset=3.3V)

Time : 200 $\mu s$ /div

### Thermal Shutdown



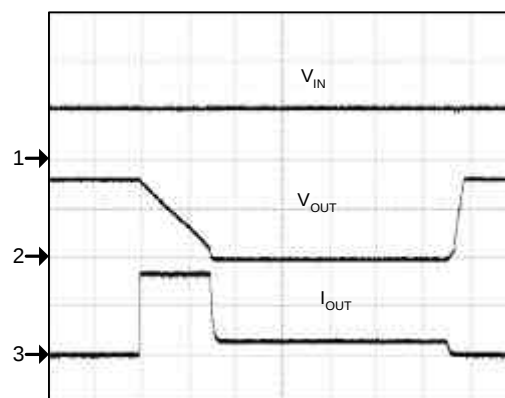
CH1 :  $V_{IN}$ , 5V/div

CH2 :  $V_{OUT}$ , 2V/div

CH3 :  $I_{OUT}$ , 500mA/div

Time : 500ms/div

### Current-Limit and Short-Circuit Current-Limit



CH1 :  $V_{IN}$ , 5V/div

CH2 :  $V_{OUT}$ , 2V/div

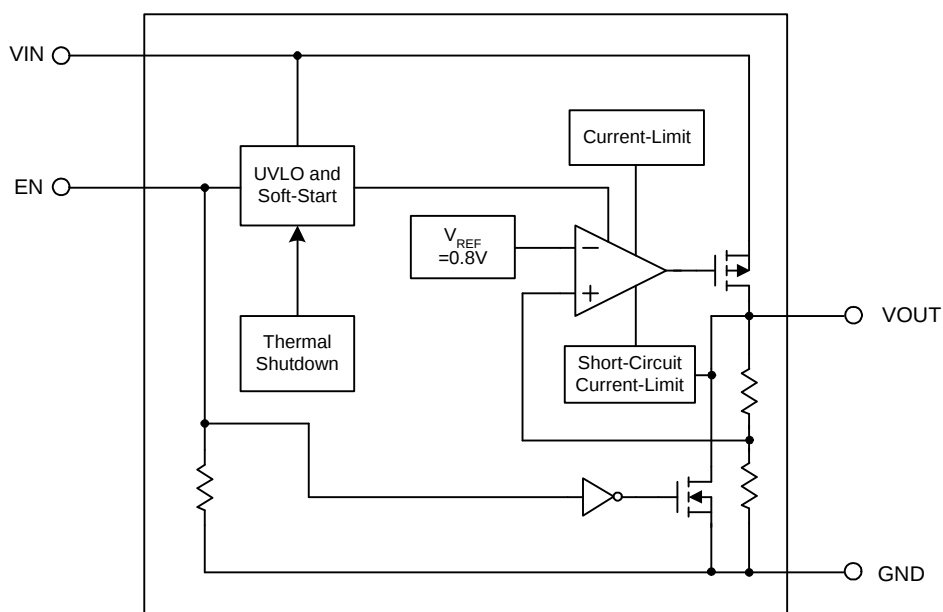
CH3 :  $I_{OUT}$ , 1A/div

Time : 2ms/div

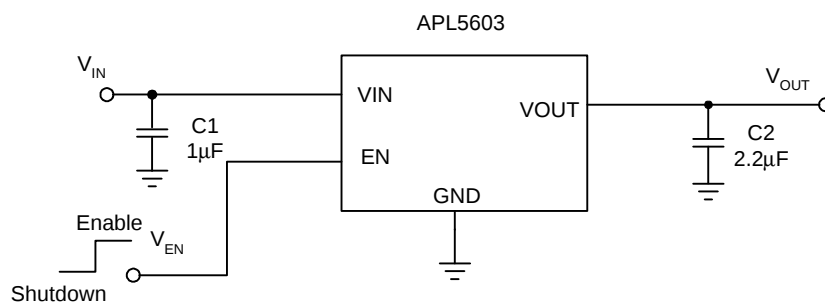
## Pin Description

| PIN NAME | FUNCTION                                                                                                                                                                            |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VIN      | Input Supply Pin. Supply voltage can range from 2.9V to 6V. Bypass with a 1 $\mu$ F capacitor to GND.                                                                               |
| VOUT     | Regulator Output. Sources up to 600mA. A small capacitor (2.2 $\mu$ F, typical) is needed from this pin to ground to assure stability.                                              |
| EN       | Shutdown Control Input. Driving the EN high turns on the regulator. Driving the EN pin low puts the regulator into shutdown mode. The EN pin is pulled low by an internal resistor. |
| GND      | Ground.                                                                                                                                                                             |

## Block Diagram



## Typical Application Circuit



## Function Description

### Under-Voltage Lockout (UVLO)

The APL5603 regulator has a built-in under-voltage lock-out circuit to keep the output shut off until internal circuitry is operating properly. The UVLO function initiates a soft-start process after input voltage exceeds its rising UVLO threshold during power on. Typical UVLO threshold is 2.4V with 0.15V hysteresis.

### Soft-Start

The APL5603 provides an internal soft-start circuitry to control rise rate of the output voltage and limit the current surge during start-up. Approximate 20 $\mu$ s delay time after the  $V_{IN}$  is over the UVLO threshold, the output voltage starts the soft-start. The typical soft-start interval is about 130 $\mu$ s.

### Current-Limit

The APL5603 provides a current-limit circuitry, which monitors and controls P-MOS's gate voltage, limiting the output current to 700mA. For reliable operation, the device should not be operated in current-limit for extended period.

### Short-Circuit Current-Limit

When the output voltage drops below 0.6V due to overload or short-circuit, the internal short-circuit current-limit circuitry limits the output current down to 250mA. The short-circuit current-limit is used to reduce the power dissipation during short-circuit condition. In some high  $V_{IN}$ - $V_{OUT}$  conditions, if the junction temperature is over the thermal shutdown temperature, the device will enter the thermal shutdown. Please refer to the section on thermal considerations for power dissipation calculations. The short-circuit current-limit has featured with blanking time after the UVLO threshold is reached, so that it will avoid the output causing short-circuit current-limit protection during start-up; the blanking time is about 600 $\mu$ s.

### Enable and Shutdown

Driving the EN high turns on the regulator, driving the EN low puts the regulator into shutdown mode. A logic low also causes the output voltage to discharge to the GND. The EN is pulled low by an internal resistor.

### Thermal Shutdown

A thermal shutdown circuit limits the junction temperature of APL5603. When the junction temperature exceeds +150°C, the thermal shutdown circuitry disables the output, which allows the device to cool down. The output circuitry is enabled again after the junction temperature cools down by 40°C, resulting in a pulsed output during continuous thermal overload conditions. Thermal protection is designed to protect the IC in the event of over-temperature conditions. For reliable operation, the junction temperature cannot exceed  $T_J=+125^{\circ}\text{C}$ .

## Application Information

### Input Capacitor

The APL5603 requires proper input capacitors to supply surge current during stepping load transients to prevent the input rail from dropping. Because the parasitic inductor from the voltage sources or other bulk capacitors to the VIN limits the slew rate of the surge current, it is necessary to place the input capacitors near VIN as close as possible. Input capacitors should be larger than 0.82μF.

### Output Capacitor

The APL5603 needs a proper output capacitor to maintain circuit stability and to improve transient response over-temperature and current. In order to insure the circuit stability, the proper output capacitor value should be larger than 1μF. With X5R and X7R dielectrics, 2.2μF is sufficient at all operating temperatures. Maximum output capacitor should be less than 330μF to insure the system can be powered on effectively.

### Operation Region and Power Dissipation

The APL5603 maximum power dissipation depends on the thermal resistance and temperature difference between the die junction and ambient air. The power dissipation  $P_D$  across the device is:

$$P_D = (T_J - T_A) / \theta_{JA}$$

where  $(T_J - T_A)$  is the temperature difference between the junction and ambient air.  $\theta_{JA}$  is the thermal resistance between junction and ambient air. Assuming the  $T_A = 25^\circ\text{C}$  and maximum  $T_J = 150^\circ\text{C}$  (typical thermal limit threshold), the maximum power dissipation is calculated as:

$$\begin{aligned} P_{D(\max)} &= (150 - 25) / 260 \\ &= 0.48(\text{W}) \end{aligned}$$

For normal operation, do not exceed the maximum operating junction temperature of  $T_J = 125^\circ\text{C}$ . The calculated power dissipation should be less than:

$$\begin{aligned} P_D &= (125 - 25) / 260 \\ &= 0.38(\text{W}) \end{aligned}$$

The GND provides an electrical connection to ground and channels heat away. Connect the GND to the ground by using a large pad or ground plane.

### Layout Consideration

Figure 1 illustrates the layout. Below is a checklist for your layout:

1. Please place the input capacitors close to the VIN.
2. Ceramic capacitors for load must be placed near the load as close as possible.
3. To place APL5603 and output capacitors near the load is good for performance.
4. Large current paths, the bold lines in figure 1, must have wide tracks.

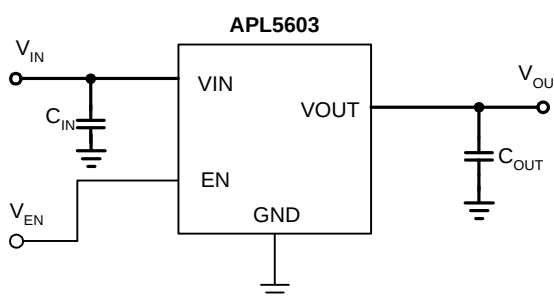


Figure 1.

Large ground plane is good for heating. Optimum performance can only be achieved when the device is mounted on a PC board according to the Board layout diagrams which are shown as Figure 2, 3, and 4.

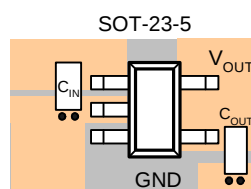


Figure 2.

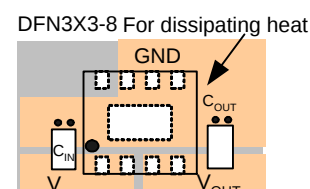


Figure 3.

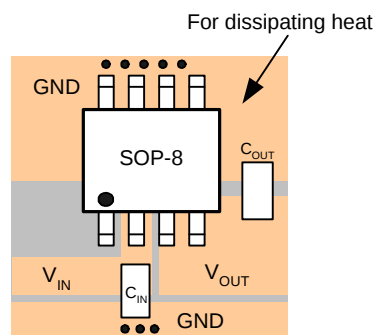
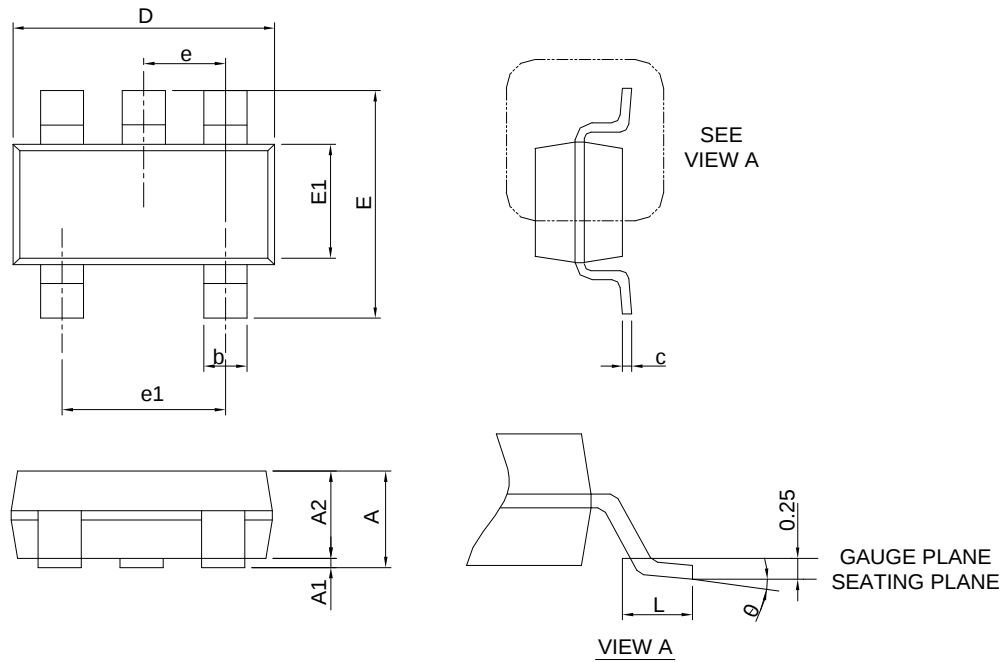


Figure 4.

## Package Information

### SOT-23-5



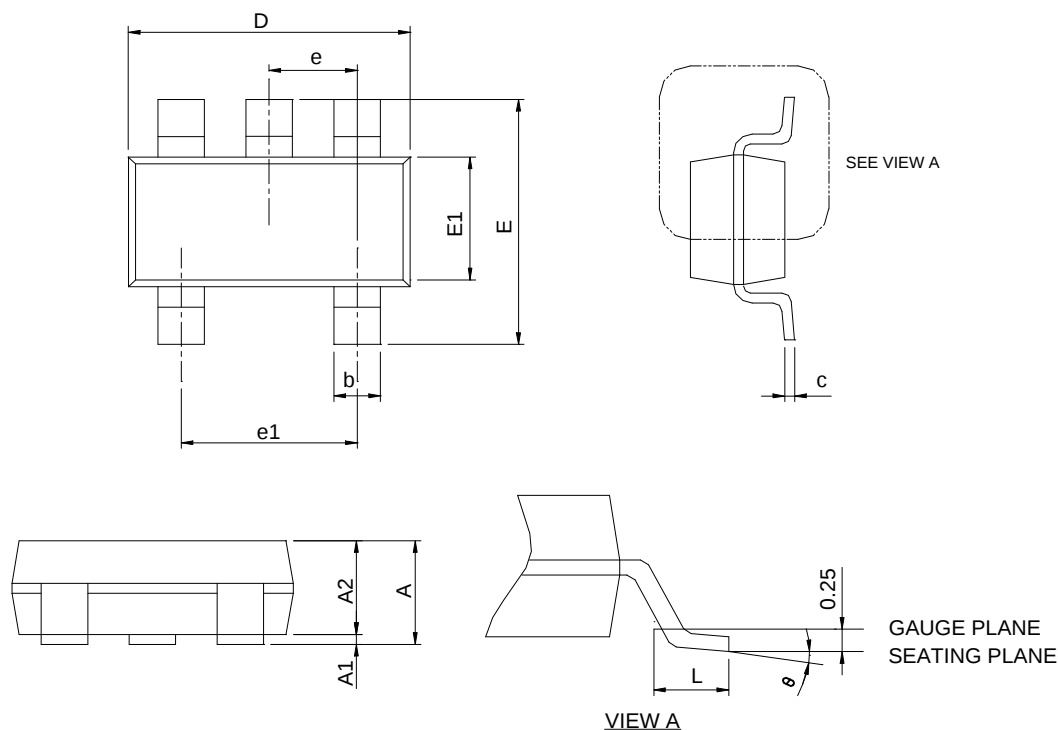
| SYMBOL | SOT-23-5    |      |           |       |
|--------|-------------|------|-----------|-------|
|        | MILLIMETERS |      | INCHES    |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |
| A      |             | 1.45 |           | 0.057 |
| A1     | 0.00        | 0.15 | 0.000     | 0.006 |
| A2     | 0.90        | 1.30 | 0.035     | 0.051 |
| b      | 0.30        | 0.50 | 0.012     | 0.020 |
| c      | 0.08        | 0.22 | 0.003     | 0.009 |
| D      | 2.70        | 3.10 | 0.106     | 0.122 |
| E      | 2.60        | 3.00 | 0.102     | 0.118 |
| E1     | 1.40        | 1.80 | 0.055     | 0.071 |
| e      | 0.95 BSC    |      | 0.037 BSC |       |
| e1     | 1.90 BSC    |      | 0.075 BSC |       |
| L      | 0.30        | 0.60 | 0.012     | 0.024 |
| θ      | 0°          | 8°   | 0°        | 8°    |

Note : 1. Follow JEDEC TO-178 AA.

2. Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.

## Package Information

### TSOT-23-5



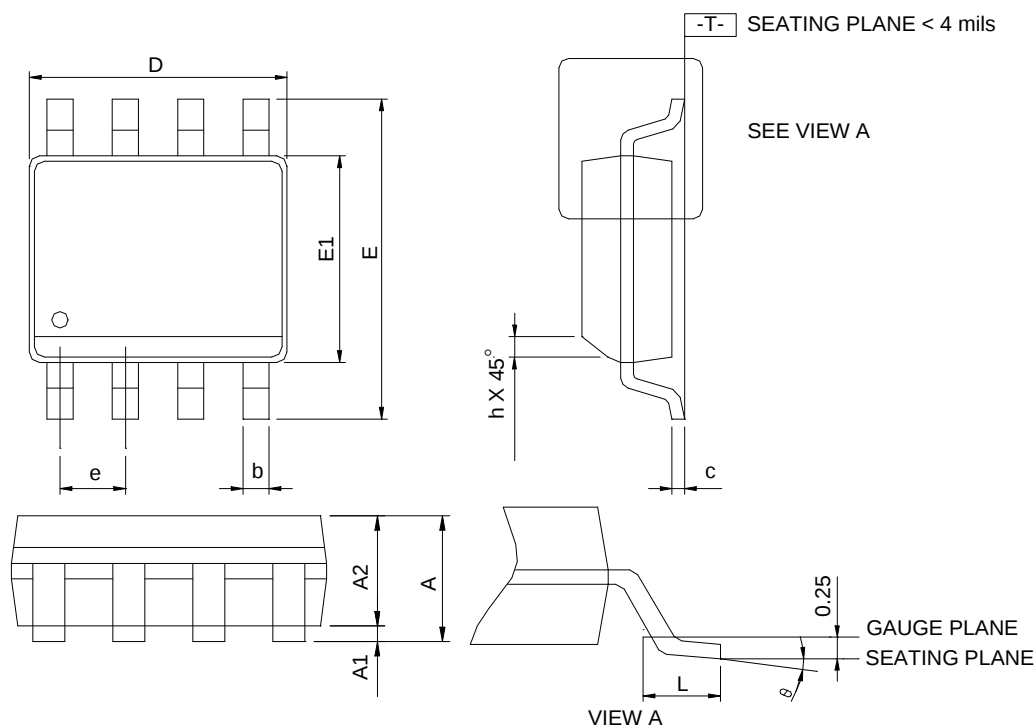
| SYMBOL | TSOT-23-5   |      |           |       |
|--------|-------------|------|-----------|-------|
|        | MILLIMETERS |      | INCHES    |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |
| A      | 0.70        | 1.00 | 0.028     | 0.039 |
| A1     | 0.01        | 0.10 | 0.000     | 0.004 |
| A2     | 0.70        | 0.90 | 0.028     | 0.035 |
| b      | 0.30        | 0.50 | 0.012     | 0.020 |
| c      | 0.08        | 0.22 | 0.003     | 0.009 |
| D      | 2.70        | 3.10 | 0.106     | 0.122 |
| E      | 2.60        | 3.00 | 0.102     | 0.118 |
| E1     | 1.40        | 1.80 | 0.055     | 0.071 |
| e      | 0.95 BSC    |      | 0.037 BSC |       |
| e1     | 1.90BSC     |      | 0.075 BSC |       |
| L      | 0.30        | 0.60 | 0.012     | 0.024 |
| θ      | 0°          | 8°   | 0°        | 8°    |

Note : 1. Followed from JEDEC TO-178 AA.

2. Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.

## Package Information

### SOP-8

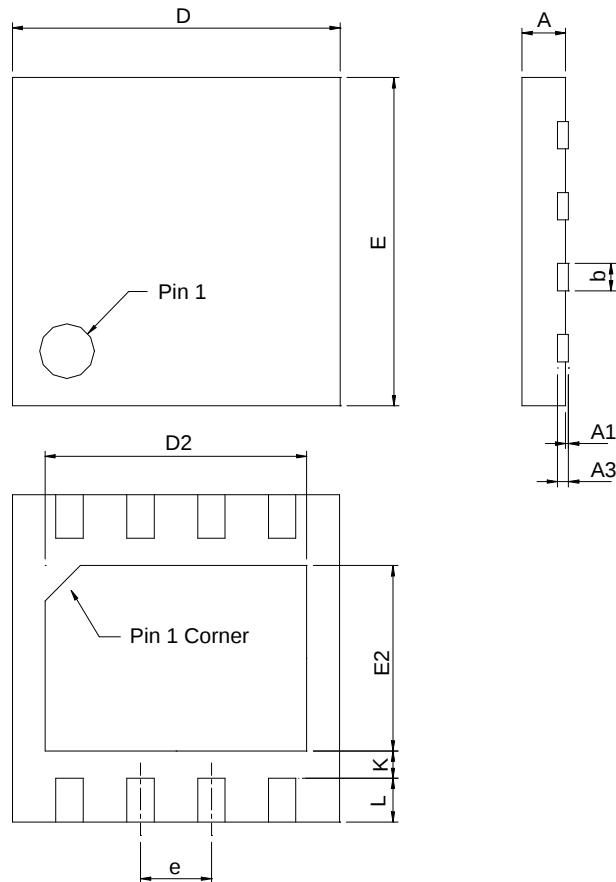


| SYMBOL | SOP-8       |      |           |       |
|--------|-------------|------|-----------|-------|
|        | MILLIMETERS |      | INCHES    |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |
| A      |             | 1.75 |           | 0.069 |
| A1     | 0.10        | 0.25 | 0.004     | 0.010 |
| A2     | 1.25        |      | 0.049     |       |
| b      | 0.31        | 0.51 | 0.012     | 0.020 |
| c      | 0.17        | 0.25 | 0.007     | 0.010 |
| D      | 4.80        | 5.00 | 0.189     | 0.197 |
| E      | 5.80        | 6.20 | 0.228     | 0.244 |
| E1     | 3.80        | 4.00 | 0.150     | 0.157 |
| e      | 1.27 BSC    |      | 0.050 BSC |       |
| h      | 0.25        | 0.50 | 0.010     | 0.020 |
| L      | 0.40        | 1.27 | 0.016     | 0.050 |
| θ      | 0°          | 8°   | 0°        | 8°    |

- Note: 1. Follow JEDEC MS-012 AA.  
 2. Dimension "D" does not include mold flash, protrusions or gate burrs.  
 Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.  
 3. Dimension "E" does not include inter-lead flash or protrusions.  
 Inter-lead flash and protrusions shall not exceed 10 mil per side.

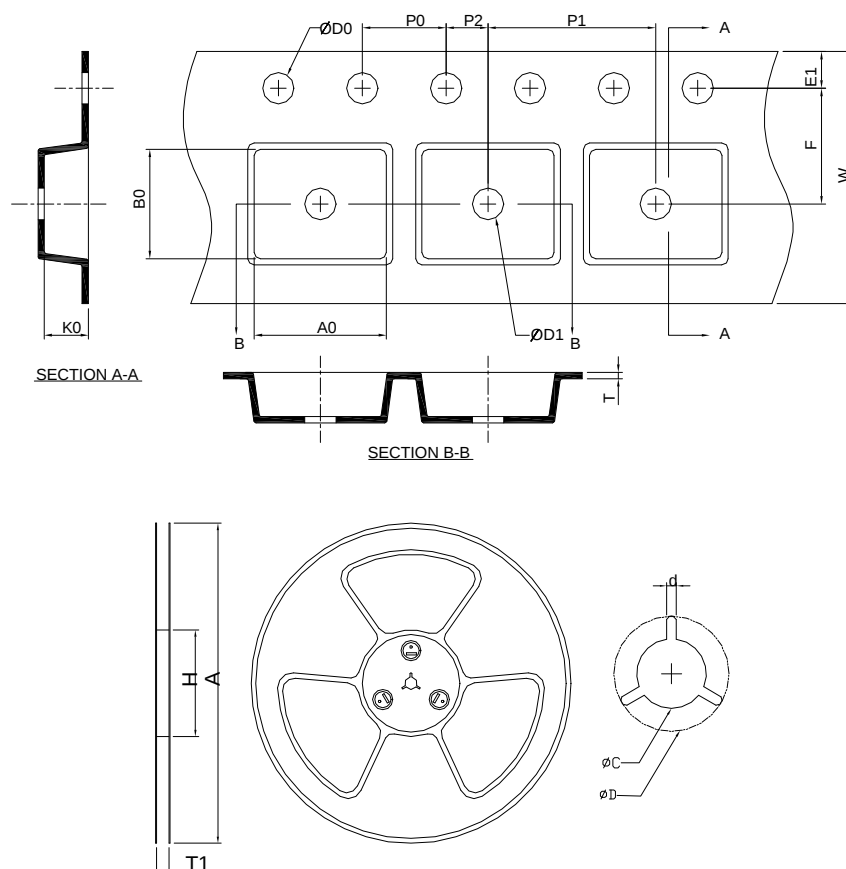
## Package Information

DFN3x3-8



| SYMBOL | DFN3x3-8    |      |           |       |
|--------|-------------|------|-----------|-------|
|        | MILLIMETERS |      | INCHES    |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |
| A      | 0.80        | 1.00 | 0.031     | 0.039 |
| A1     | 0.00        | 0.05 | 0.000     | 0.002 |
| A3     | 0.20 REF    |      | 0.008 REF |       |
| b      | 0.25        | 0.35 | 0.010     | 0.014 |
| D      | 2.90        | 3.10 | 0.114     | 0.122 |
| D2     | 1.90        | 2.40 | 0.075     | 0.094 |
| E      | 2.90        | 3.10 | 0.114     | 0.122 |
| E2     | 1.40        | 1.75 | 0.055     | 0.069 |
| e      | 0.65 BSC    |      | 0.026 BSC |       |
| L      | 0.30        | 0.50 | 0.012     | 0.020 |
| K      | 0.20        |      | 0.008     |       |

## Carrier Tape & Reel Dimensions



| Application | A           | H         | T1                 | C                  | d        | D                 | W          | E1         | F          |
|-------------|-------------|-----------|--------------------|--------------------|----------|-------------------|------------|------------|------------|
| SOT-23-5    | 178.0 ±0.00 | 50 MIN.   | 8.4+2.00<br>-0.00  | 13.0+0.50<br>-0.20 | 1.5 MIN. | 20.2 MIN.         | 8.0 ±0.30  | 1.75 ±0.10 | 3.5 ±0.05  |
|             | P0          | P1        | P2                 | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 4.0 ±0.10 | 2.0 ±0.05          | 1.5+0.10<br>-0.00  | 1.0 MIN. | 0.6+0.00<br>-0.40 | 3.20 ±0.20 | 3.10 ±0.20 | 1.50 ±0.20 |
| Application | A           | H         | T1                 | C                  | d        | D                 | W          | E1         | F          |
| TSOT-23-5   | 178.0 ±0.00 | 50 MIN.   | 8.4+2.00<br>-0.00  | 13.0+0.50<br>-0.20 | 1.5 MIN. | 20.2 MIN.         | 8.0 ±0.30  | 1.75 ±0.10 | 3.5 ±0.05  |
|             | P0          | P1        | P2                 | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 4.0 ±0.10 | 2.0 ±0.05          | 1.5+0.10<br>-0.00  | 1.0 MIN. | 0.6+0.00<br>-0.40 | 3.20 ±0.20 | 3.10 ±0.20 | 1.50 ±0.20 |
| Application | A           | H         | T1                 | C                  | d        | D                 | W          | E1         | F          |
| SOP- 8      | 330.0 ±0.00 | 50 MIN.   | 12.4+2.00<br>-0.00 | 13.0+0.50<br>-0.20 | 1.5 MIN. | 20.2 MIN.         | 12.0 ±0.30 | 1.75 ±0.10 | 5.5 ±0.05  |
|             | P0          | P1        | P2                 | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 8.0 ±0.10 | 2.0 ±0.05          | 1.5+0.10<br>-0.00  | 1.5 MIN. | 0.6+0.00<br>-0.40 | 6.40 ±0.20 | 5.20 ±0.20 | 2.10 ±0.20 |

(mm)

## Carrier Tape & Reel Dimensions (Cont.)

| Application | A           | H         | T1                 | C                  | d        | D                 | W          | E1         | F          |
|-------------|-------------|-----------|--------------------|--------------------|----------|-------------------|------------|------------|------------|
| DFN3x3-8    | 178.0 ±0.00 | 50 MIN.   | 12.4+2.00<br>-0.00 | 13.0+0.50<br>-0.20 | 1.5 MIN. | 20.2 MIN.         | 12.0 ±0.30 | 1.75 ±0.10 | 5.5 ±0.05  |
|             | P0          | P1        | P2                 | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 8.0 ±0.10 | 2.0 ±0.05          | 1.5+0.10<br>-0.00  | 1.5 MIN. | 0.6+0.00<br>-0.40 | 3.30 ±0.20 | 3.30 ±0.20 | 1.30 ±0.20 |

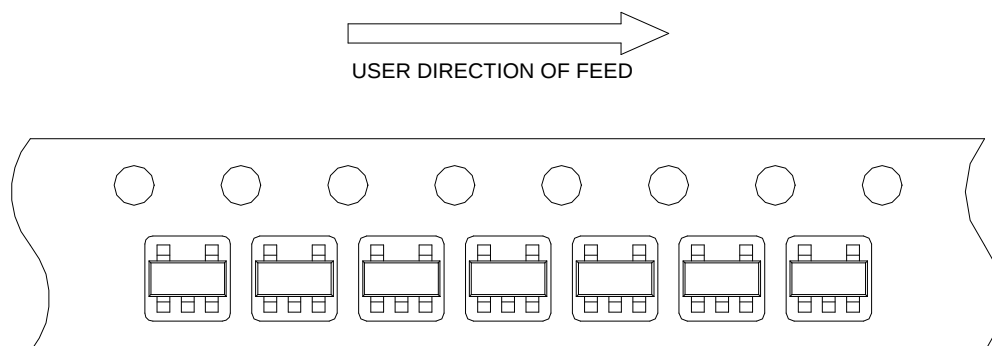
(mm)

## Devices Per Unit

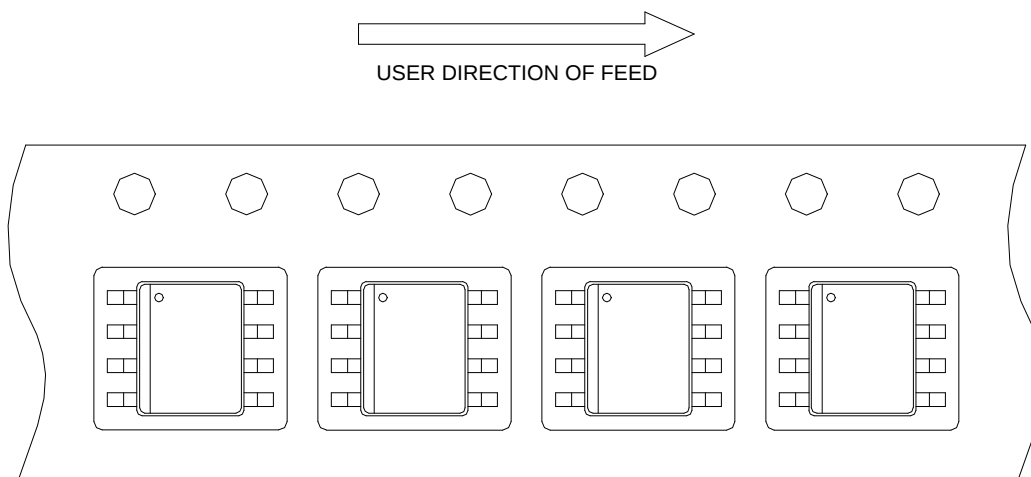
| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| SOT-23-5     | Tape & Reel | 3000     |
| TSOT-23-5    | Tape & Reel | 3000     |
| SOP-8        | Tape & Reel | 2500     |
| DFN3x3-8     | Tape & Reel | 3000     |

## Taping Direction Information

(T)SOT-23-5

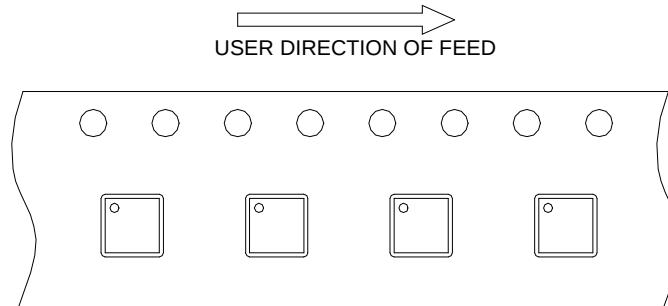


SOP-8

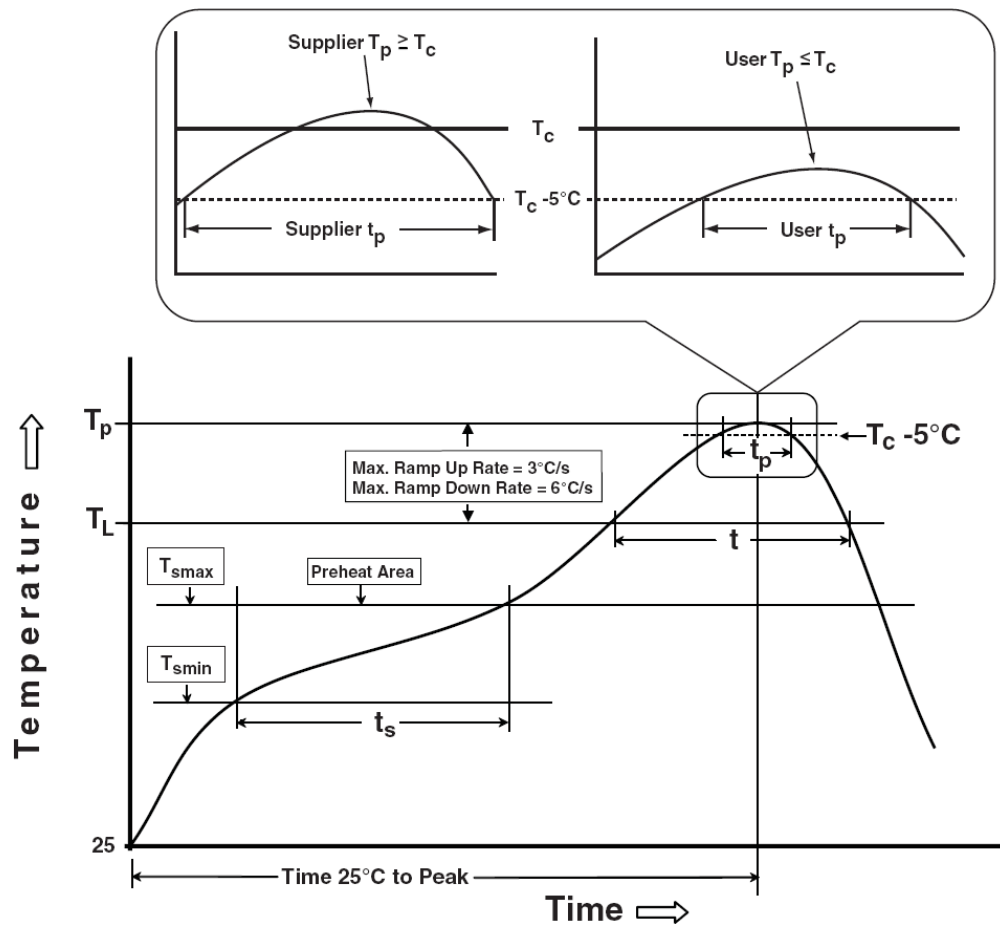


## Taping Direction Information (Cont.)

DFN3x3-8



## Classification Profile



## Classification Reflow Profiles

| Profile Feature                                                                                                                                                                                                             | Sn-Pb Eutectic Assembly            | Pb-Free Assembly                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------|
| <b>Preheat &amp; Soak</b><br>Temperature min ( $T_{smin}$ )<br>Temperature max ( $T_{smax}$ )<br>Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                                                                | 100 °C<br>150 °C<br>60-120 seconds | 150 °C<br>200 °C<br>60-120 seconds |
| Average ramp-up rate ( $T_{smax}$ to $T_p$ )                                                                                                                                                                                | 3 °C/second max.                   | 3 °C/second max.                   |
| Liquidous temperature ( $T_L$ )<br>Time at liquidous ( $t_L$ )                                                                                                                                                              | 183 °C<br>60-150 seconds           | 217 °C<br>60-150 seconds           |
| Peak package body Temperature ( $T_p$ )*                                                                                                                                                                                    | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_c$ )                                                                                                                                           | 20** seconds                       | 30** seconds                       |
| Average ramp-down rate ( $T_p$ to $T_{smax}$ )                                                                                                                                                                              | 6 °C/second max.                   | 6 °C/second max.                   |
| Time 25°C to peak temperature                                                                                                                                                                                               | 6 minutes max.                     | 8 minutes max.                     |
| * Tolerance for peak profile Temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.<br>** Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum. |                                    |                                    |

Table 1. SnPb Eutectic Process – Classification Temperatures ( $T_c$ )

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350 |
|-------------------|--------------------------------|-------------------------------|
| <2.5 mm           | 235 °C                         | 220 °C                        |
| ≥2.5 mm           | 220 °C                         | 220 °C                        |

Table 2. Pb-free Process – Classification Temperatures ( $T_c$ )

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>>2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm           | 260 °C                         | 260 °C                             | 260 °C                          |
| 1.6 mm – 2.5 mm   | 260 °C                         | 250 °C                             | 245 °C                          |
| ≥2.5 mm           | 250 °C                         | 245 °C                             | 245 °C                          |

## Reliability Test Program

| Test item     | Method             | Description                                |
|---------------|--------------------|--------------------------------------------|
| SOLDERABILITY | JESD-22, B102      | 5 Sec, 245°C                               |
| HOLT          | JESD-22, A108      | 1000 Hrs, Bias @ $T_j=125^{\circ}\text{C}$ |
| PCT           | JESD-22, A102      | 168 Hrs, 100%RH, 2atm, 121°C               |
| TCT           | JESD-22, A104      | 500 Cycles, -65°C~150°C                    |
| HBM           | MIL-STD-883-3015.7 | VHBM 2KV                                   |
| MM            | JESD-22, A115      | VMM 200V                                   |
| Latch-Up      | JESD 78            | 10ms, $I_{tr}$ 100mA                       |

## Customer Service

### **Anpec Electronics Corp.**

#### Head Office :

No.6, Dusing 1st Road, SBIP,  
Hsin-Chu, Taiwan, R.O.C.  
Tel : 886-3-5642000  
Fax : 886-3-5642050

#### Taipei Branch :

2F, No. 11, Lane 218, Sec 2 Jhongsing Rd.,  
Sindian City, Taipei County 23146, Taiwan  
Tel : 886-2-2910-3838  
Fax : 886-2-2917-3838