300mA Low Drop-out Linear Regulator with Shutdown

Features

- Low Dropout Voltage of 250mV at 300mA
- Guaranteed 300mA Output Current
- Very Low Quiescent Current of about 30µA
- Output Voltage Accuracy of ±2%
- Needs only 1µF Capacitor for Stability
- Thermal Shutdown Protection
- Current Limit Protection
- Active-low Shutdown Control
- Low-ESR Ceramic Capacitor for Output Stability
- Tiny SOT-23-5 and TSOT-23-5 packages
- RoHS-compliant and Halogen-free

Applications

- DSC
- Wireless Devices
- LCD Modules
- Battery Power Systems
- Card Readers
- PDA

Description

The APE8800A-3 series are low dropout, positive linear regulators with very low quiescent current, and can supply 300mA of output current with a low drop-out voltage of 250mV.

Connecting a 10nF bypass capacitor to the BP pin can help reduce the output noise level. The shutdown function allows an external signal to control the on/off state of the APE8800A-3. With a logic high at the $\overline{SHDN}$ pin, the device is in the on state.

The APE8800A-3 regulator is able to operate with output capacitors as small as 1µF for stability. As well as current limit protection, the APE8800A-3 also offers an on-chip thermal shutdown feature providing protection against overload or conditions where the junction temperature exceeds the specified thermal shutdown temperature.

The APE8800-3 is available with several fixed output voltages from 1.2V to 5V, and is packaged in low-profile space-saving RoHS-compliant and halogen-free 5-lead SOT-23-5 and TSOT-23-5 packages.

Typical Application Circuit

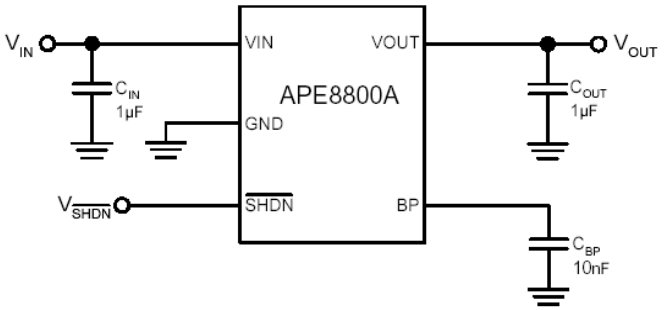


Figure 1. Typical Application Circuit of APE8800A-3

Note : To prevent oscillation, it is recommended to use X7R or X5R dielectric capacitors of at least 1µF if ceramic capacitors are used on the input or output .

Ordering Information

APE8800A-xxyy-HF-3TR

Package Type:

Y5 : RoHS-compliant halogen-free SOT-23-5

TY5 : RoHS-compliant halogen-free TSOT-23-5

Fixed Output Voltage Options

xx = 12 : 1.2V, 15 : 1.5V

18 : 1.8V, 25 : 2.5V, 28 : 2.8V

30 : 3.0V, 33 : 3.3V, 33 : 3.3V

36 : 3.6V, 45 : 4.5V, 50 : 5.0V

Packing:

TR : Products are shipped on tape and reel: 3000pcs/reel for both TSOT-23-5 and SOT-23-5. The device is rated MSL3 for moisture sensitivity, and the the reel is packed in a moisture-barrier bag.

Example: APE8800A-25TY5-HF-3TR : APE8800A with 2.5V output in TSOT-23-5 on tape and reel.

Absolute Maximum Ratings (at T_A=25°C)

Input Voltage (VIN) ---------- 6V
Power Dissipation, SOT-23-5 ---------- 0.4W
TSOT-23-5 ---------- 0.4W
Lead Temperature (Soldering, 10 sec.) T_{LEAD} ------ 260°C
Storage Temperature Range ---------- -65°C to +150°C
Maximum Junction Temperature ---------- 150°C
Maximum Thermal Resistance, Junction-ambient:
SOT-23-5 ------- 250°C/W
TSOT-23-5 ------- 250°C/W

Recommended Operating Conditions

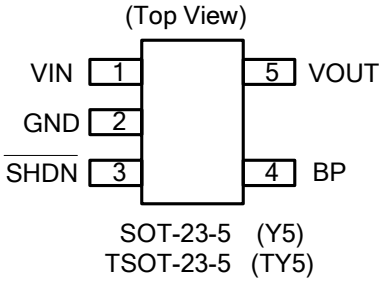
Input Voltage (VIN) ---------- 2.8 to 5.5V
Operating Junction Temperature Range (T_J) ------ -40°C to +125°C
Ambient Temperature (T_A) ---------- -40°C to +85°C

Electrical Specifications

(V_{IN}=V_{OUT}+1V or V_{IN}=2.8V whichever is greater, $\overline{SHDN}$ pin connected to VIN ,C_{IN}=1uF, C_{OUT}=1uF, T_A=25°C, unless otherwise specified)

Parameter	SYM	TEST CONDITION		MIN	TYP	MAX	UNITS
Output Voltage Accuracy	ΔV_{OUT}	I_O=1mA		-2	-	2	%
Current Limit	I_{LIMIT}	R_{Load}=1Ω		300	-	-	mA
Quiescent Current	I_Q	I_O= 0mA		-	30	55	µA
Standby Current	I_{STBY}	VIN=2.8 ~ 5V, Output Off		-	-	1.5	µA
Dropout Voltage (Note 1)	V_{DROP}	I_O=300mA	1.2V < V_{OUT} < 2.0V	-	1100	-	mV
			2.0V < V_{OUT} < 2.8V	-	350	-	
			2.8V < V_{OUT} < 4.5V	-	250	-	
Line Regulation	ΔV_{LINE}	I_O=1mA, V_{IN}=V_{OUT} +1V or 5V		-	1	5	mV
Load Regulation (Note 2)	ΔV_{LOAD}	I_O=0mA to 300mA		-	6	20	mV
Ripple Rejection	PSRR	V_{IN}=V_{OUT}+1V C_{OUT}=1µF , f_{RIPPLE} = 120Hz		-	60	-	dB
Output Noise	Δn	C_{BP}=10nF, f=1KHz, V_{IN}=5V		-	0.4	-	µV/√Hz
Temperature Coefficient	TC	I_{OUT} = 1mA, V_{IN} = 5V		-	50	-	ppm/°C
Thermal Shutdown Temperature	TSD			-	160	-	°C
Thermal Shutdown Hysteresis	ΔTSD			-	25	-	°C
Shutdown Pin Current	$I_{\overline{SHDN}}$			-	-	0.1	µA
Noise Bypass Terminal Voltage	V_{REF}			-	1.2	-	V
Shutdown Pin Voltage (ON)	$V_{\overline{SHDN}\ (ON)}$			1.4	-	-	V
Shutdown Pin Voltage (OFF)	$V_{\overline{SHDN}\ (OFF)}$			-	-	0.4	V
Shutdown Exit Delay Time	ΔT	C_{BP}=10nF, C_{OUT}=1uF, I_O=30mA		-	300	-	µs

Pin Configuration



Pin Descriptions

PIN SYMBOL	PIN DESCRIPTION
VIN	Power is supplied to the device through this pin, which requires an input filter capacitor. In general, an input capacitor in the range of 1μF to 10μF is sufficient.
VOUT	The output supplies power to the load. An output capacitor is required to prevent oscillations on the output voltage. The APE8800A is stable with an output capacitor of 1μF or greater. A larger output capacitor will be required for applications with larger load transients, and could also reduce output noise, improve stability, and PSRR.
GND	Common ground pin
BP	Bypass for Noise from the internal reference, connect to ground through a 1nF bypass capacitor
$\overline{\text{SHDN}}$	Chip Enable (Active High)

Block Diagram

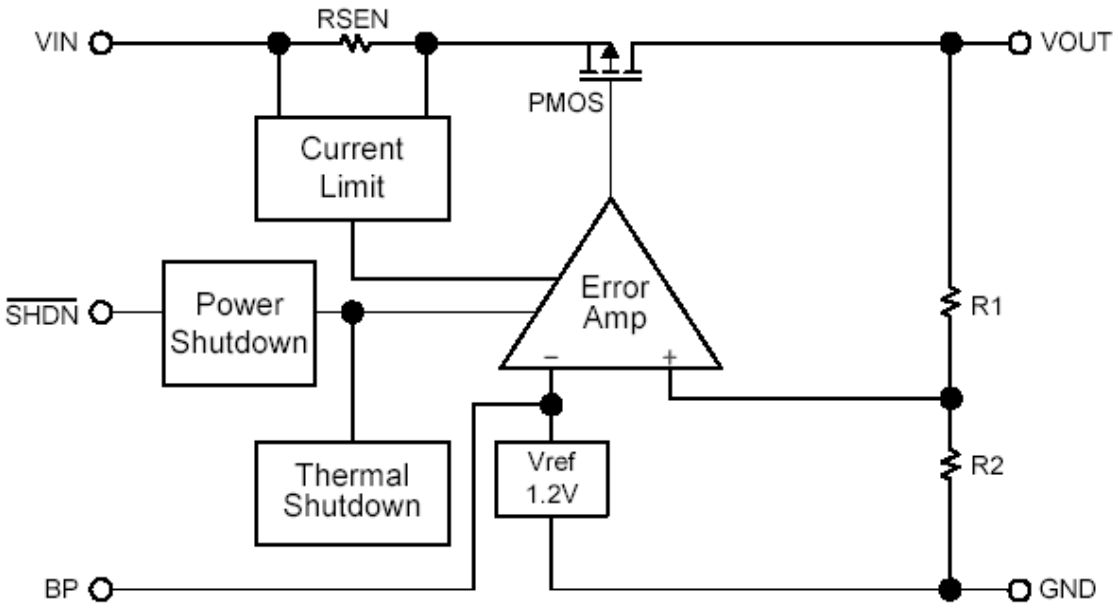


Figure 2. Block diagram of APE8800A-3

Application Description

The APE8800A-3 series are low dropout linear regulators that can provide 300mA output current with a drop-out voltage of about 250mV. Also, current limit and on-chip thermal shutdown features provide protection against any combination of overload or junction temperature that exceeds the shutdown temperature.

1.Output and Input Capacitor

The APE8800A-3 regulator is designed to be stable with a wide range of output capacitors. The ESR of the output capacitor affects stability. Larger values of the output capacitor decrease the peak deviations and provide improved transient response for larger current changes.

The various capacitor types (aluminum, ceramic, tantalum) have different characteristics such as temperature and voltage coefficients. All ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior across temperature and applications. Common dielectrics used are X5R, X7R and Y5V. It is recommended to use 1uF to 10uF X5R or X7R dielectric ceramic capacitors with 30mΩ to 50mΩ ESR range between device outputs to ground for transient stability.

The APE8800A-3 is designed to be stable with low ESR ceramic capacitors, and higher values of capacitors and ESR can improve output stability.

So the ESR of the output capacitor is very important because it generates a zero to provide phase lead for loop stability.

There are no requirements for the ESR on the input capacitor, but its voltage and temperature coefficient have to be considered for the device application environment.

2.Protection Features

In order to prevent overloading or a thermal condition from damaging the APE8800A-3, the device has internal thermal and current-limiting functions designed to protect the device. It will rapidly shut off the internal P-channel MOSFET pass element during overloading or an over-temperature condition.

3.Thermal Consideration

The power handling capability of the device is limited by the maximum operation junction temperature (125°C). The power dissipated by the device can be estimated as $P_D=I_{OUT}*(V_{in}-V_{out})$

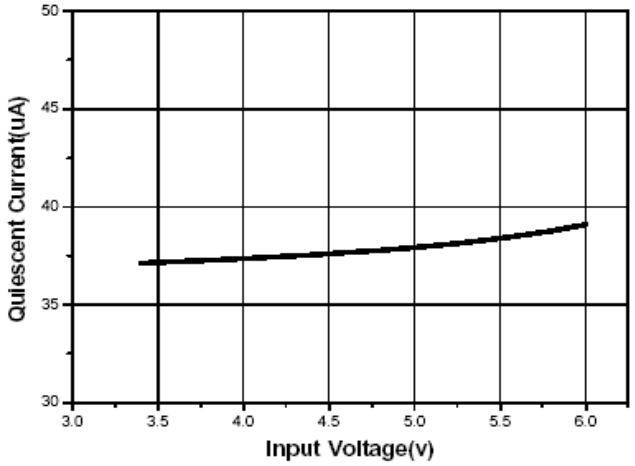
This power dissipation must be lower than the maximum power dissipation listed in the "Absolute Maximum Ratings" section.

4. Shutdown Operation

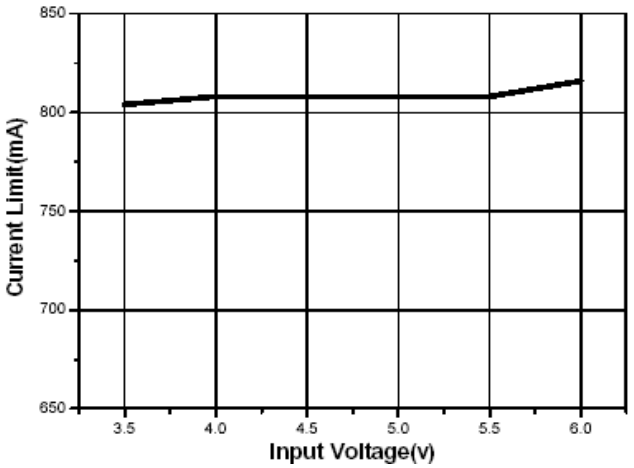
The APE8800A is shutdown by pulling the $\overline{SHDN}$ input low, and turned on by driving $\overline{SHDN}$ high. If this function is not used, the $\overline{SHDN}$ input should be tied to V_{IN} to keep the regulator on at all times (the $\overline{SHDN}$ pin must not be left floating).

Typical Performance Characteristics

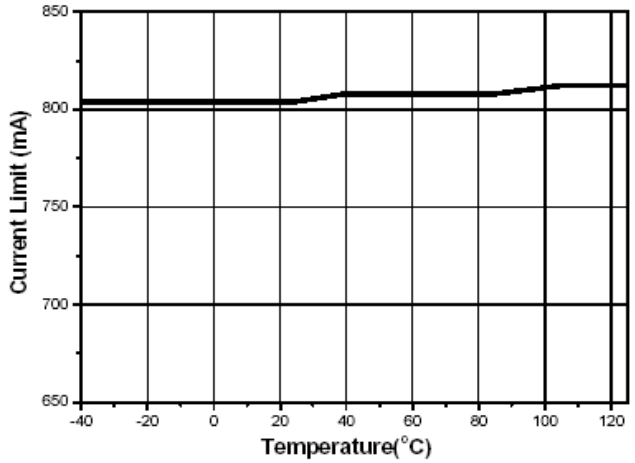
Quiescent Current vs. Input Voltage



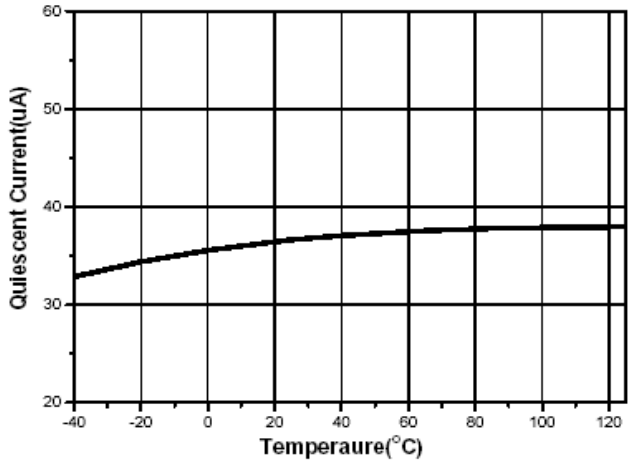
Current Limit vs. Input Voltage



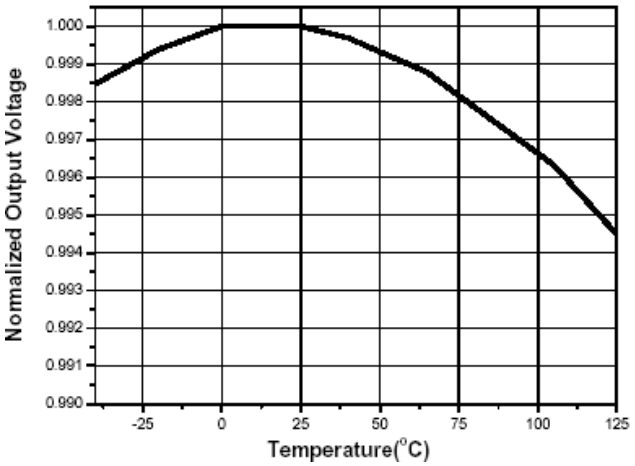
Current Limit vs. Temperature



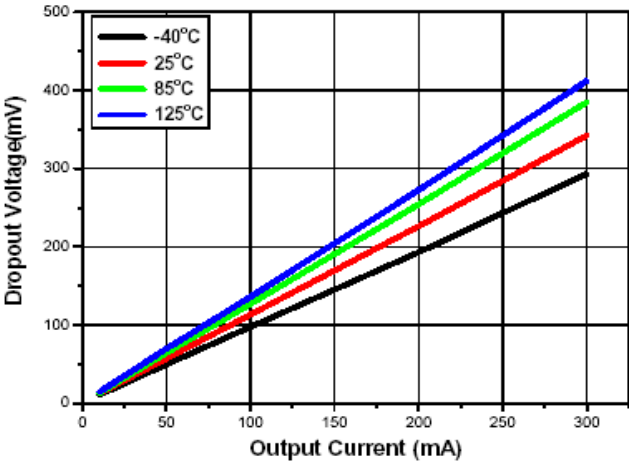
Quiescent Current vs. Temperature



Output Voltage vs. Temperature

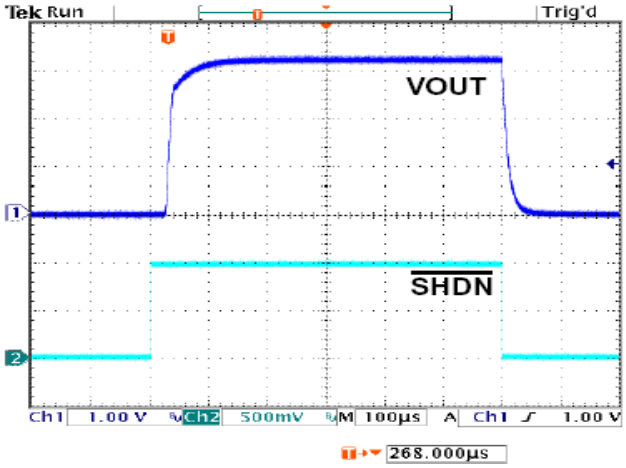


Dropout Voltage vs. Temperature



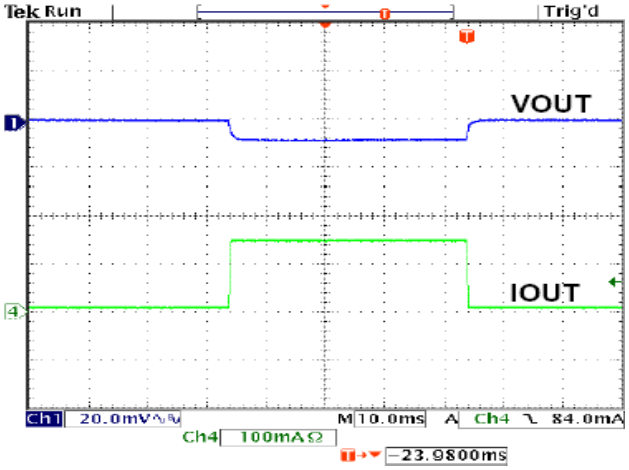
Typical Performance Characteristics

Shutdown Function



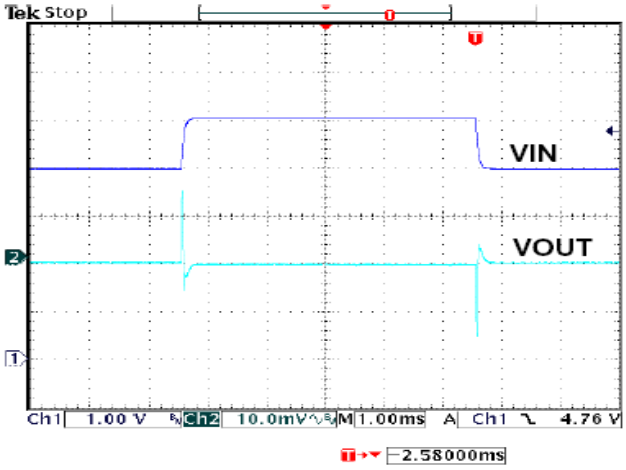
Load Transient Response

(V_{IN}=5V, I_{OUT}=150mA, C_{IN}=1uF, C_{OUT}=1uF)



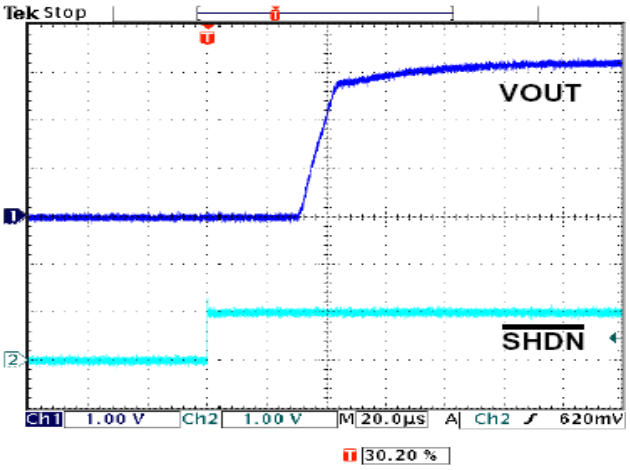
Line Transient Response

(V_{IN}=4~5V I_{OUT}=10mA C_{IN}=1uF C_{OUT}=1uF)

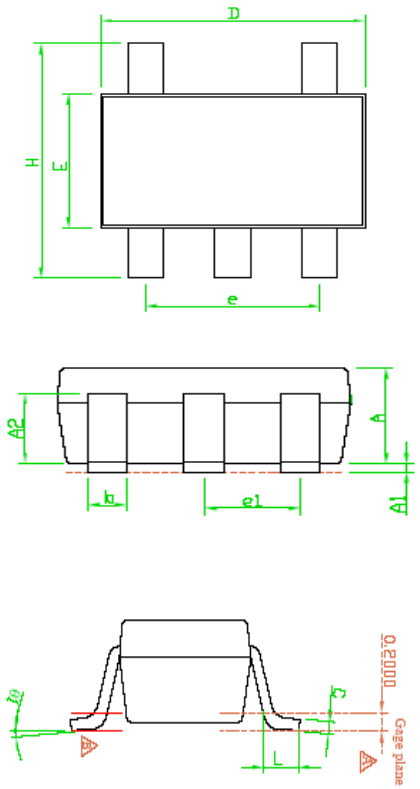


Shutdown Exit Delay Time

(V_{IN}=5V I_{OUT}=1mA C_{IN}=1uF C_{OUT}=1uF)



Package Dimensions: SOT-23-5



SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	1.00	1.10	1.30
A1	0.00	---	0.10
A2	0.70	0.80	0.90
b	0.35	0.40	0.50
C	0.10	0.15	0.25
D	2.70	2.90	3.10
E	1.50	1.60	1.80
e	---	1.90(TYP)	---
H	2.60	2.80	3.00
L	0.37	---	---
θ1	1°	5°	9°
e2	---	0.95(TYP)	---

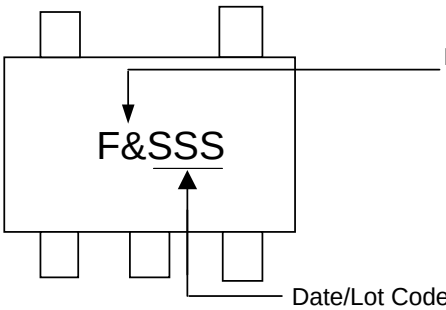
Note 1 : Dimensions do not include mold flash protrusions or gate burrs.

Note 2 : Tolerance ± 0.1000 mm (4mil) unless otherwise specified.

Note 3 : Coplanarity 0.1000 mm

Note 4 : Dimension L is measured in guage plane.

Marking Information



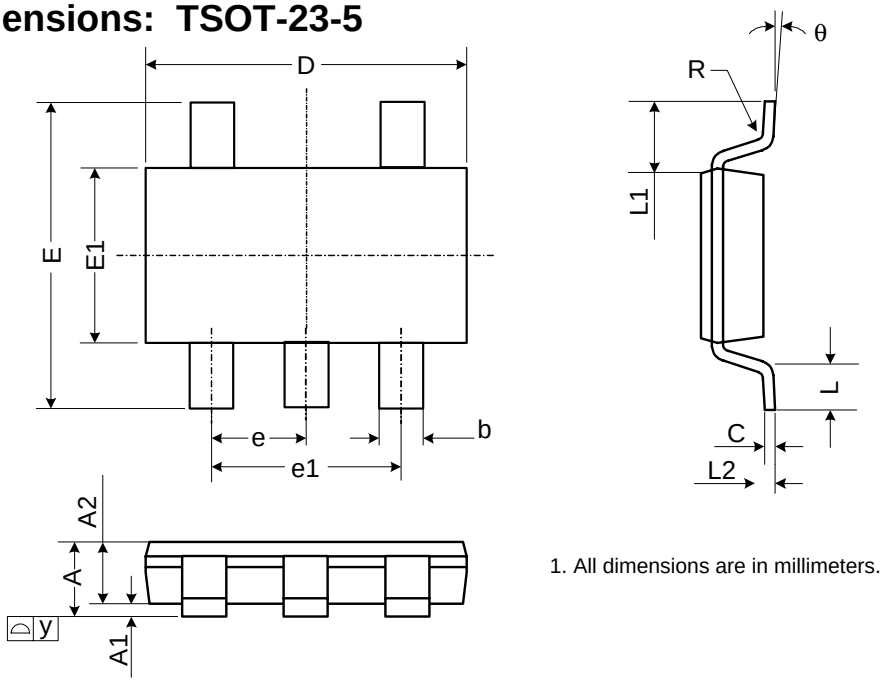
Part Number : APE8800A-xxY5-HF-3 = F& (see table below)

Date/Lot Code : SSS

For details on how to interpret this date/lot code, please contact APEC

Output Voltage	Identification Code	Output Voltage	Identification Code
1.2V	Fa	3.1V	Fx
1.5V	Fc	3.3V	Fh
1.8V	Fb	3.6V	Fw
2.5V	Fd	4.5V	FM
2.8V	Fe	5.0V	Fv
3.0V	Ff		

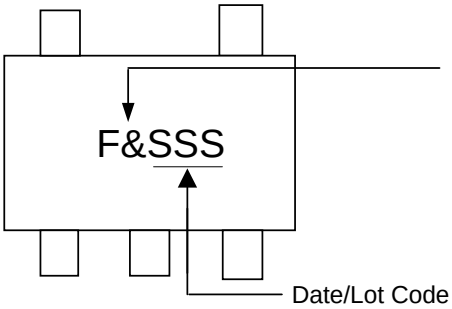
Package Dimensions: TSOT-23-5



1. All dimensions are in millimeters.

Symbol	Min.	Nom.	Max.
A	-	-	1.1
A1	0.00	-	0.10
A2	0.70	0.90	1.00
b	0.30	0.40	0.50
C	0.08	0.14	0.20
D	2.80	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95 BSC.		
e1	1.90 BSC.		
L	0.30	0.45	0.60
L1	0.60 REF.		
L2	0.25 BSC.		
y	-	-	0.10
R	0.10	-	-
θ	0°	-	8°

Marking Information



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Output Voltage	Identification Code	Output Voltage	Identification Code
1.2V	Fa	3.1V	Fx
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2.5V	Fd	4.5V	FM
2.8V	Fe	5.0V	Fv
3.0V	Ff		