300mA High PSRR Low Dropout Linear Regulator with Shutdown

Description

The FP6133 is a low dropout, positive linear regu- lator with very low quiescent current. The FP6133 can supply 300mA output current with low dropout voltage at about 250mV. The BP pin with a 0.1uF bypass capacitor can help reduce the output noise level. The shutdown function can provide remote control for the external signal to decide the on/off state of FP6133. With a logic high level at $\overline{SHDN}$ pin, the device is in the on state, and vice versa.

The FP6133 regulator is able to operate with output capacitors as small as 1μF for stability. Other than the current limit protection, FP6133 also offers the on chip thermal shutdown feature providing protection against overload or any condition when the ambient temperature exceeds the maximum junction tempe- rature.

The FP6133 offers high precision output voltage of ± 2%. It is available in fixed output voltages including 1.5V, 1.8V, 2.5V, 2.8V, 2.9V, 3.0V, 3.1V, 3.2V, 3.3V and 3.6V.

The FP6133 is housed in low-profile, space-saving 5-lead SOT-23-5 and SC-70-5 package.

Features

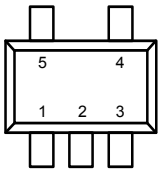
- Low Dropout Voltage of 250mV at 300mA
- High Ripple Rejection at 65 dB
- Guaranteed 300mA Output Current
- Very Low Quiescent Current at 30μA
- Max. ± 2% Output Voltage Accuracy
- Needs Only 1μF Capacitor for Stability
- Thermal Shutdown Protection
- Current Limit Protection
- Active Low Shutdown Control
- Low-ESR Ceramic Capacitor for Output Stability
- Tiny package: SOT-23-5 and SC-70-5
- RoHS Compliant

Applications

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

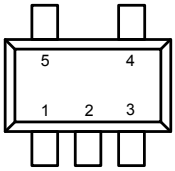
Pin Assignments

S5 Package (SOT-23-5)



TOP VIEW
1. VIN
2. GND
3. $\overline{SHDN}$
4. BP
5. VOUT

C5 Package (SC-70-5)



TOP VIEW
1. VIN
2. GND
3. $\overline{SHDN}$
4. BP
5. VOUT

Figure 1. Pin Assignment of FP6133

Ordering Information

FP6133-□□□□

- TR: Tape / Reel
  Blank: Tube
- P: Pb Free with Commercial Standard (RoHS Compliant)
- Package Type
  S5: SOT-23-5
  C5: SC-70-5
- Output Voltage
  15: 1.5V 29: 2.9V 33: 3.3V
  18: 1.8V 30: 3.0V 36: 3.6V
  25: 2.5V 31: 3.1V
  28: 2.8V 32: 3.2V

Note：Please consult Fitipower or authorized distributors for availability of special output voltages.

SOT-23-5 Marking

Part Number	Product Code	Part Number	Product Code
FP6133-15S5P	Fa	FP6133-30S5P	Ff
FP6133-18S5P	Fb	FP6133-31S5P	Ft
FP6133-25S5P	Fd	FP6133-32S5P	Fw
FP6133-28S5P	Fe	FP6133-33S5P	Fh
FP6133-29S5P	Fv	FP6133-36S6P	FH

SC-70-5 Marking

Part Number	Product Code	Part Number	Product Code
FP6133-15C5P	FA	FP6133-30C5P	FE
FP6133-18C5P	FB	FP6133-31C5P	FG
FP6133-25C5P	FC	FP6133-32C5P	Fz
FP6133-28C5P	FD	FP6133-33C5P	FF
FP6133-29C5P	Fx	FP6133-36C6P	FJ

Typical Application Circuit

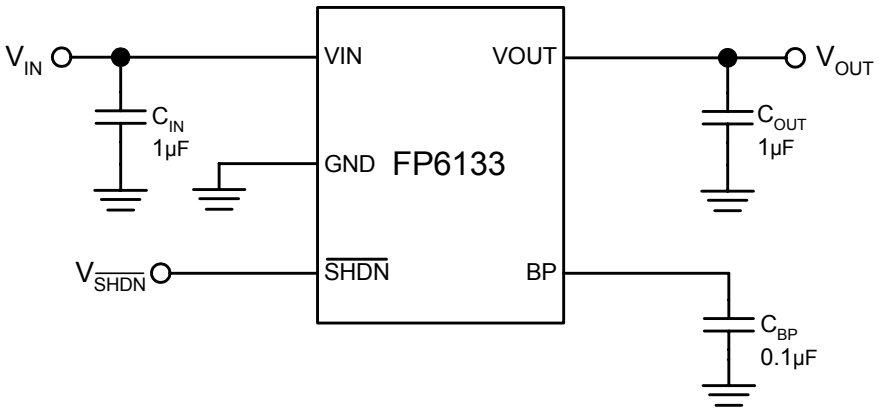


Figure 2. Typical Application Circuit of FP6133

Note：To prevent oscillation, it is recommended to use minimum 1μF X7R or X5R dielectric capacitors if ceramics are used as input/output capacitors.

Functional Pin Description

Pin Name	Pin Function
VIN	Power is supplied to this device from this pin which is required an input filter capacitor. In general, the input capacitor in the range of 1μF to 10μF is sufficient.
VOUT	The output supplies power to loads. The output capacitor is required to prevent output voltage from oscillation. The FP6133 is stable with an output capacitor 1μF or greater. The larger output capacitor will be required for application with larger load transients. The large output capacitor could reduce output noise, improve stability, and PSRR.
GND	Common ground pin
BP	Reference Noise Bypass
$\overline{SHDN}$	Pull this pin high to enable IC , pull this pin low to shutdown IC

Block Diagram

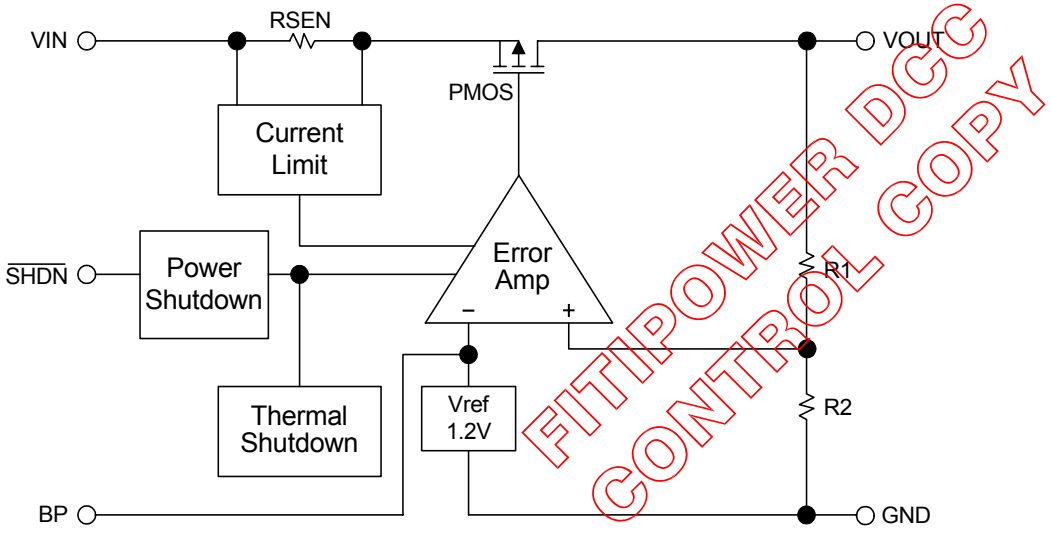


Figure 3. Block Diagram of FP6133

Absolute Maximum Ratings

- Supply Input Voltage (V_{IN})---------- + 6V
- Maximum Junction Temperature (T_J)---------- + 150℃
- Power Dissipation SOT-23 (P_D)---------- + 0.4W
- Power Dissipation SC-70-5(P_D)---------- + 0.3W
- Package Thermal Resistance SOT-23-5 (θ_{JA})---------- + 250℃/W
- Package Thermal Resistance SC-70-5 (θ_{JA})---------- + 330℃/W
- Storage Temperature Range (T_S)---------- - 65 to + 150℃
- Lead Temperature (Soldering, 10 sec.) (T_{LEAD})---------- + 260℃

Note：Stresses beyond those listed under “Absolute Maximum Ratings" may cause permanent damage to the device.

Recommended Operating Conditions

- Input Voltage (V_{IN})---------- + 2.8 to + 5.5V
- Operating Junction Temperature Range (T_J)---------- - 40 to + 125℃

Electrical Characteristics

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Current Limit	I_{LIMIT}	R_{Load}=1Ω	300			mA
Quiescent Current	I_Q	I_O= 0mA		30	50	μA
Standby Current	I_{STBY}	V_{IN}=2.8~5V, Output Off			0.1	μA
Output Voltage Accuracy	ΔV_{OUT}	I_O= 1mA	-2		+2	%
Dropout Voltage (Note 1)	V_{DROP}	I_O=150mA 1.5V ≤ V_{OUT} ≤ 2.0V		700		mV
		I_O=150mA 2.0V < V_{OUT} ≤ 2.7V		250		
		I_O=150mA 2.7V < V_{OUT} ≤ 4.5V		150		
Dropout Voltage (Note 1)	V_{DROP}	I_O=300mA 1.5V ≤ V_{OUT} ≤ 2.0V		1100		mV
		I_O=300mA 2.0V < V_{OUT} ≤ 2.7V		350		
		I_O=300mA 2.7V < V_{OUT} ≤ 4.5V		250		
Line Regulation	ΔV_{LINE}	I_O=1mA, V_{IN}=V_{OUT} +1V to 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_{BP}=0.1μF f_{RIPPLE} = 120Hz, C_{OUT} = 1μF		65		dB
Temperature Coefficient	TC	I_{OUT} = 1mA, V_{IN} = 5V		50		ppm/ ºC
Thermal Shutdown Temperature	TSD			160		ºC
Thermal Shutdown Hysteresis	ΔTSD			25		ºC
Shutdown Pin Current	$I_{\overline{SHDN}}$				0.1	μA
Noise Bypass Terminal Voltage	V_{REF}			1.23		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}=0.1uF, C_{OUT}=1uF, I_{OUT}=30mA		300		μs

Note 1：The dropout voltage is defined as V_{IN}-V_{OUT}, which is measured when V_{OUT} drops about 100mV.

Note 2：Regulation is measured at a constant junction temperature by using 40ms current pulse and load regulation in the load range from 0mA to 300mA.

Application Information

The FP6133 is a low dropout linear regulator that could provide 300mA output current at dropout voltage about 250mV. Current limit and on chip thermal shutdown features provide protection against any combination of overload or ambient temperature that could exceed maximum junction temperature.

1. Output and Input Capacitor

The FP6133 regulator is designed to be stable with a wide range of output capacitors. The ESR of the output capacitor affects stability. Larger value of the output capacitor decreases the peak deviations and improves transient response for larger current changes.

The capacitor types (aluminum, ceramic, and tantalum) have different characterizations 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 and ground for stability. The FP6133 is designed to be stable with low ESR ceramic capacitors and higher values of cap- acitors and ESR could improve output stability. The ESR of 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 device application environment.

2. Protection Features

In order to prevent overloading or thermal condition from damaging the device, FP6133 has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during overloading or over temperature condition.

3. Thermal Consideration

The power handling capability of the device will be limited by maximum operation junction temperature. The power dissipated by the device will be estimated by PD = IOUT × (VIN-VOUT). The power dissipation should be lower than the maximum power dissipation listed in “Absolute Maximum Ratings” section.

4. Shutdown Operation

The FP6133 is shutdown by pulling the $\overline{SHDN}$ input low, and turned on by driving the $\overline{SHDN}$ high. If this function is not used, the $\overline{SHDN}$ input should be tied to VIN to keep the regu- lator on at all times (the $\overline{SHDN}$ must not be left floating).

Typical Performance Curves

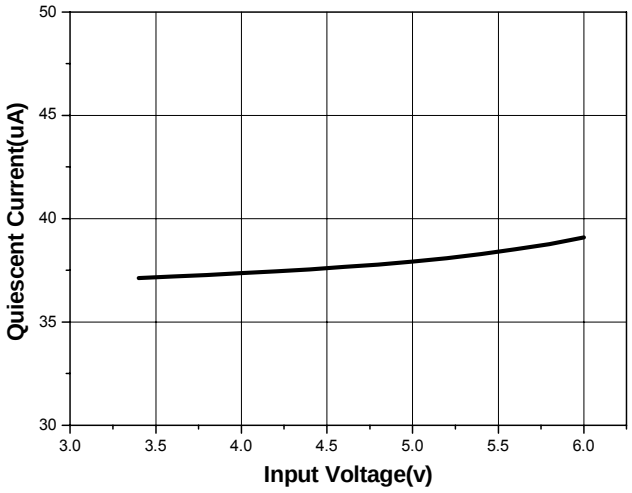


Figure 4. Quiescent Current vs. Input Voltage

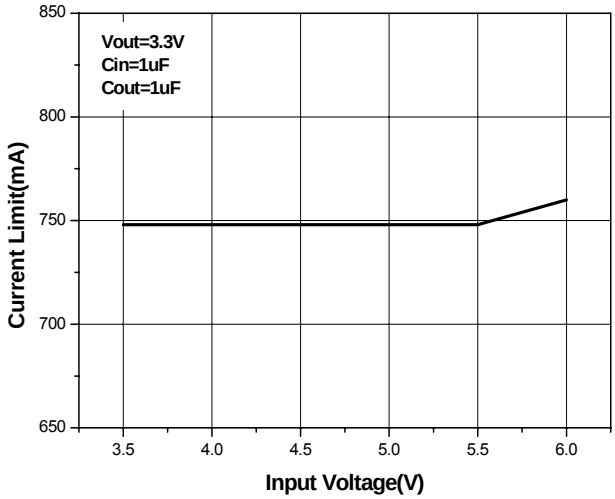


Figure 5. Current limit vs. Input Voltage

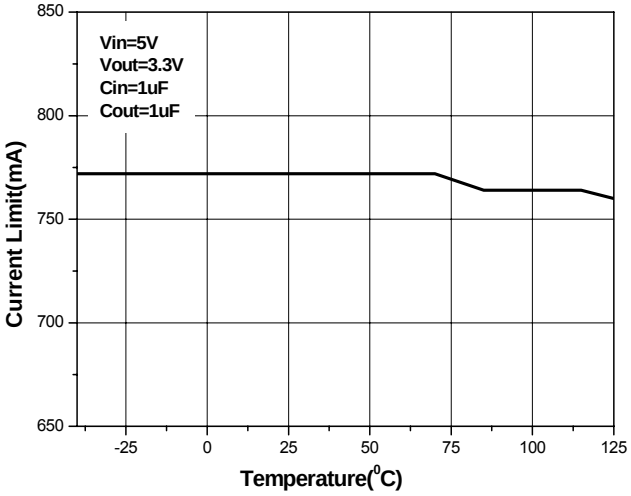


Figure 6. Current limit vs. Temperature

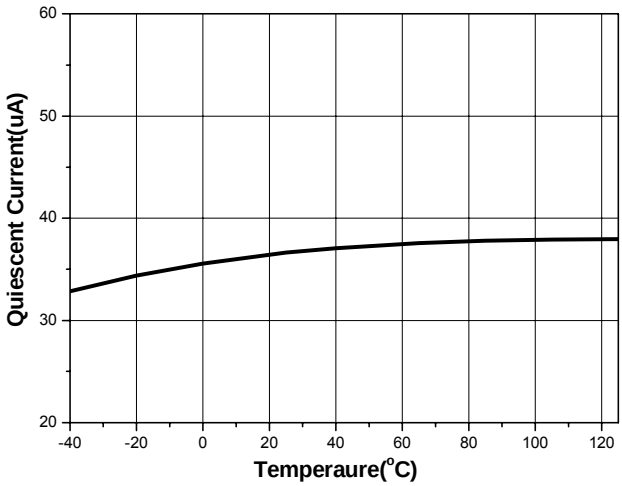


Figure 7. Quiescent Current vs. Temperature

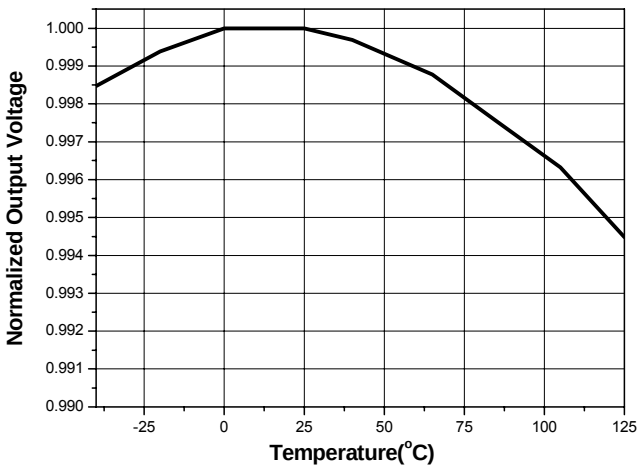


Figure 8. Output Voltage vs. Temperature

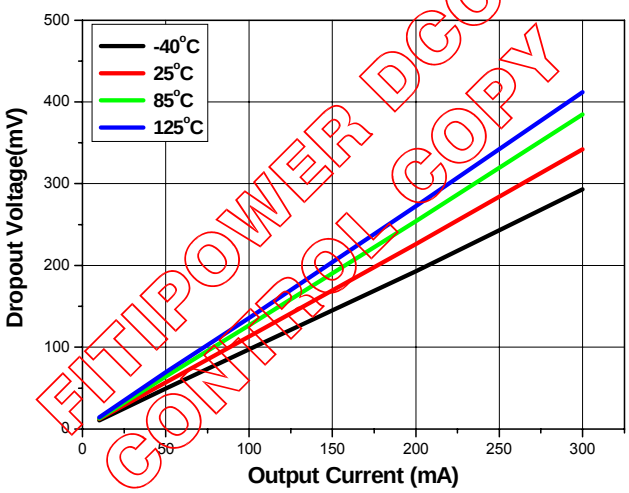


Figure 9. Dropout Voltage vs. Temperature (V_{OUT}=2.8V)

Typical Performance Curves (Continued)

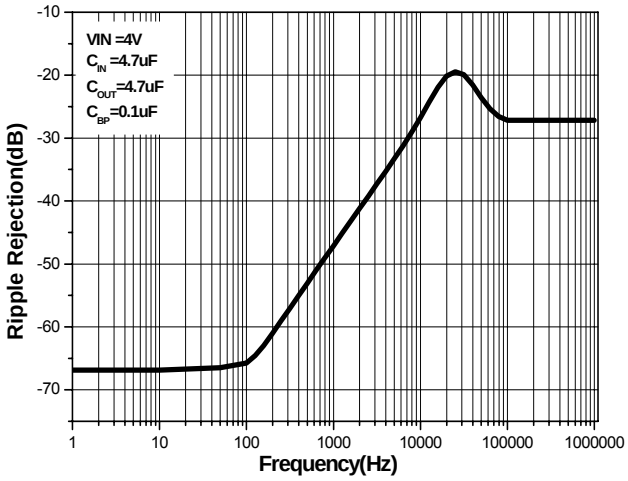


Figure 10. Ripple Rejection vs. Frequency

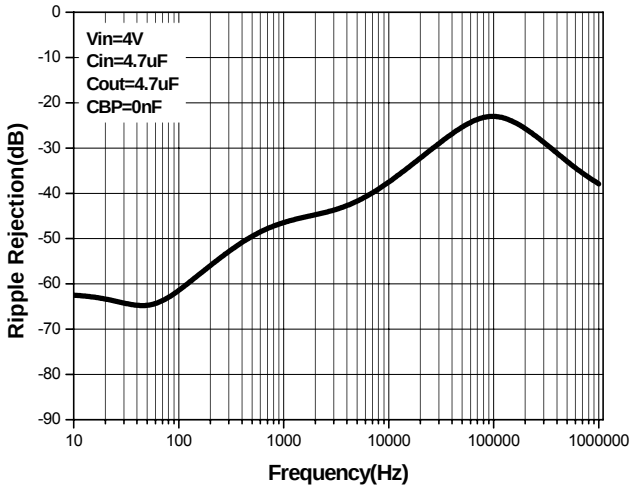


Figure 11. Ripple Rejection vs. Frequency

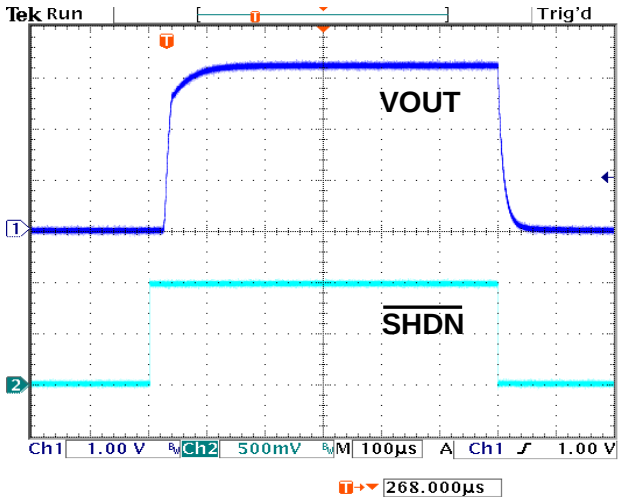


Figure 12. Shutdown Function

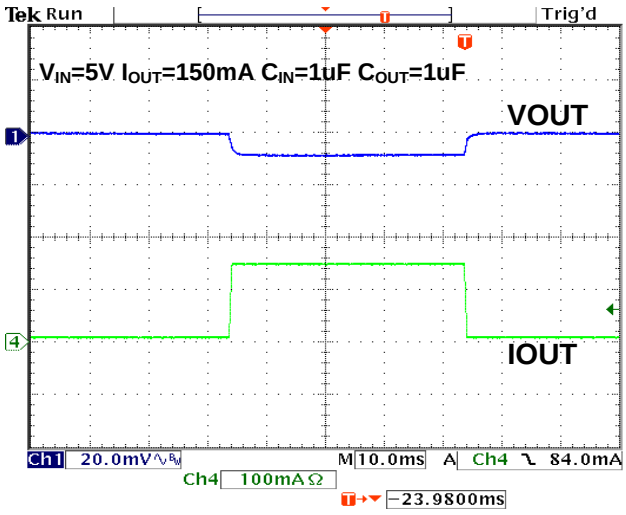


Figure 13. Load Transient Response

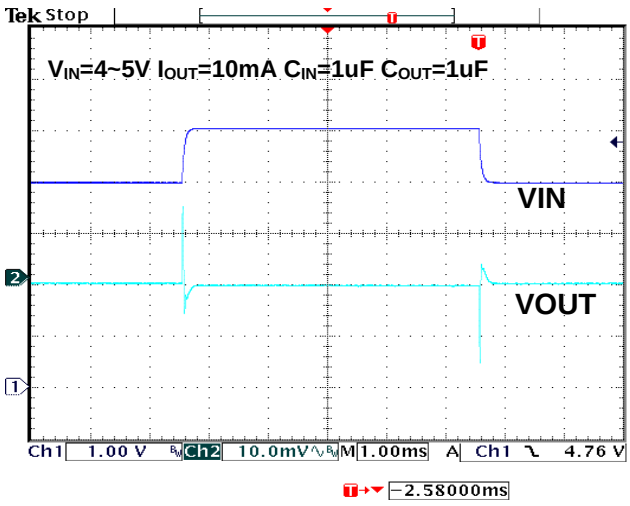


Figure 14. Line Transient Response

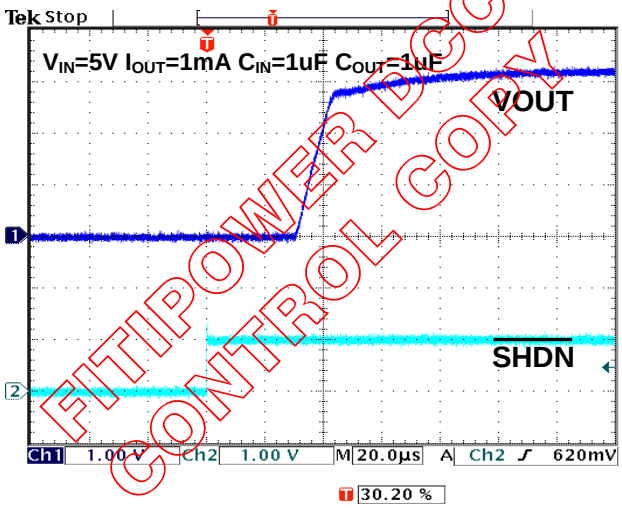
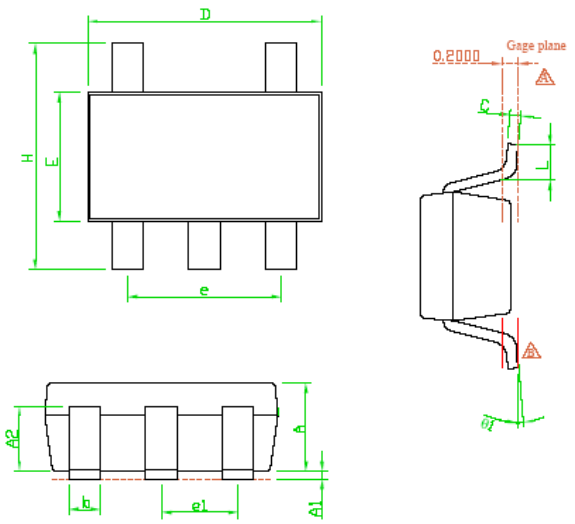


Figure 15. Shutdown Exit Delay Time

Outline Information

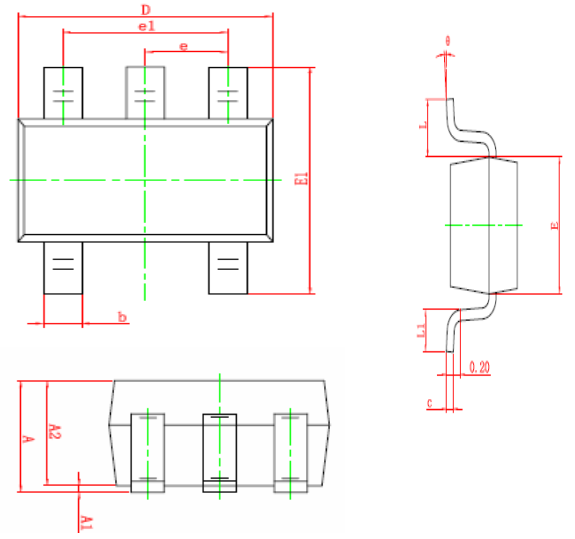
SOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER		
	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°
e1	---	0.95(TYP)	---

Note 1：Package Body Sizes Exclude 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 Gage plane.

SC-70-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER		
	MIN	NOM	MAX
A	0.900		1.100
A1	0.000		0.100
A2	0.900		1.000
b	0.150		0.350
c	0.080		0.150
D	2.000		2.200
E	1.150		1.350
E1	2.150		2.450
e	0.650 TYP		
e1	1.200		1.400
L	0.525 REF		
L1	0.260		0.460
θ	0°		8°