300mA Low Noise High PSRR LDO with Shutdown

Description

The FP6146 is a low dropout, low noise, high PSRR, very low quiescent current positive linear regulator. The FP6146 can supply 200mA output current with low dropout voltage at about 300mV that optimized for battery-powered systems or portable wireless devices such as mobile phones. The shutdown function can provide remote control for the external signal to decide the on/off state of FP6146 that consumes less than 0.1μA during shutdown mode.

The FP6146 regulator is able to operate with output capacitors as small as 1μF for stability. Other than the current limit protection, FP6146 also offers the on chip thermal shutdown feature providing protection against overload or any condition when the ambient temperature exceeds the maximum junction temperature.

The FP6146 offers high precision output voltage of ±2%. It is housed in low-profile, space-saving SOT-23-5, TSOT-23-5 ,TDFN-6 (1.6mm×1.6mm) and SC-82-4 packages.

Features

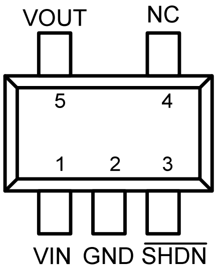
- Low Dropout Voltage of 300mV at 200mA
- Low 30μVrms Output Noise
- Guaranteed 300mA Output Current
- High Power Supply Rejection Ratio of 70dB at 10kHz
- Very Low Quiescent Current at 35μA
- Max. ± 2% Output Voltage Accuracy
- Needs Only 1μF Capacitor for Stability
- Fast Response in Line/Load Transient
- Thermal Shutdown Protection
- Current Limit Protection
- Low-ESR Ceramic Capacitor for Output Stability
- Miniature Packages:
  SOT-23-5,TSOT-23-5 ,TDFN-6 (1.6mm×1.6mm) and SC-82-4
- RoHS Compliant

Applications

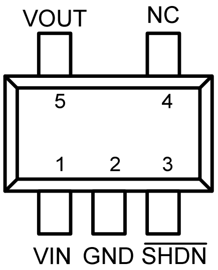
- Mobile Phones
- Notebook, Sub-Notebook and Tablet Computers
- DSC
- Portable Information Appliances
- Battery Power Systems

Pin Assignments

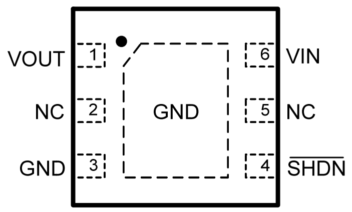
S5 Package (SOT-23-5)



S8 Package (TSOT-23-5)



WD Package TDFN-6 (1.6mm×1.6mm)



C8 Package (SC-82-4)

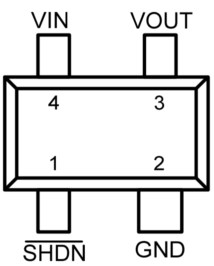


Figure 1. Pin Assignment of FP6146

Ordering Information

FP6146-□□□□

- TR: Tape / Real
- G: Green
- Package Type
  - S5: SOT-23-5
  - S8: TSOT-23-5
  - WD: TDFN-6 (1.6mm×1.6mm)
  - C8: SC-82-4
- Output Voltage
  - 12: 1.2V 26: 2.6V
  - 15: 1.5V 28: 2.8V
  - 18: 1.8V 30: 3.0V
  - 25: 2.5V 33: 3.3V

Note1 : Please consult Fitipower sales office or authorized distributors for availability of special output voltages.

SOT-23-5 Marking

Part Number	Product Code	Part Number	Product Code
FP6146-12S5G	H2=	FP6146-26S5G	r5=
FP6146-15S5G	H3=	FP6146-28S5G	H6=
FP6146-18S5G	H4=	FP6146-30S5G	H7=
FP6146-25S5G	H5=	FP6146-33S5G	H8=

TSOT-23-5 Marking

Part Number	Product Code	Part Number	Product Code
FP6146-12S8G	H9=	FP6146-26S8G	r6=
FP6146-15S8G	H0=	FP6146-28S8G	K3=
FP6146-18S8G	K1=	FP6146-30S8G	K4=
FP6146-25S8G	K2=	FP6146-33S8G	K5=

TDFN-6 (1.6mm×1.6mm) Marking

Part Number	Product Code	Part Number	Product Code
FP6146-12WDG	f	FP6146-26WDG	B-
FP6146-15WDG	h	FP6146-28WDG	m
FP6146-18WDG	i	FP6146-30WDG	n
FP6146-25WDG	k	FP6146-33WDG	r

SC-82-4 Marking

Part Number	Product Code	Part Number	Product Code
FP6146-12C8G	T1=	FP6146-26C8G	r4=
FP6146-15C8G	T2=	FP6146-28C8G	T5=
FP6146-18C8G	T3=	FP6146-30C8G	T6=
FP6146-25C8G	T4=	FP6146-33C8G	T7=

Typical Application Circuit

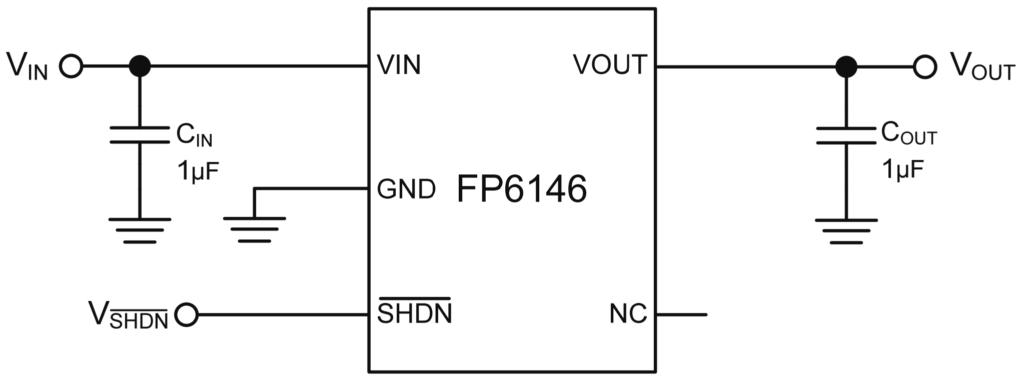


Figure 2. Typical Application Circuit of FP6146

Note2：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 FP6146 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.
NC	No connection
GND	Common ground pin
$\overline{\text{SHDN}}$	Pull this pin high to enable IC, Pull this pin low to shutdown IC. Floating this pin will be shutdown due to the built-in pull-low resistor.

Block Diagram

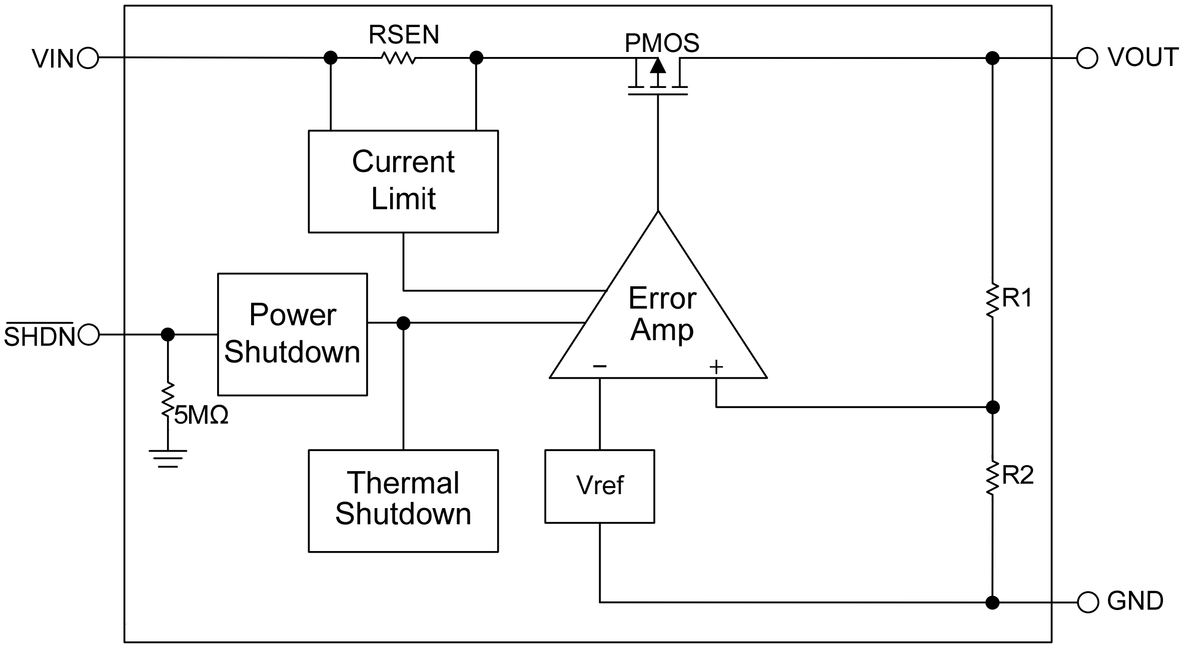


Figure 3. Block Diagram of FP6146

Absolute Maximum Ratings

- VIN, /SHDN to GND-- + 6V
- Power Dissipation @T_A=25°C (P_D)
  - SOT-23-5-- +0.4W
  - TSOT-23-5 -- +0.4W
  - TDFN-6,1.6mm×1.6mm -- +1.25W
  - SC-82-4 -- +0.2W
- Package Thermal Resistance (θ_{JA})
  - SOT-23-5-- +250°C/W
  - TSOT-23-5 -- +250°C/W
  - TDFN-6,1.6mm×1.6mm -- +80°C/W
  - SC-82-4 -- +500°C/W
- Maximum Junction Temperature (T_J)--- +150°C
- Storage Temperature Range (T_{STG})--- - 65V to +150°C
- Lead Temperature (Soldering, 10 sec.) (T_{LEAD})-- +260°C

Note3：Stresses beyond those listed under “Absolute Maximum Ratings" may cause permanent damage to the device.

Recommended Operating Conditions

- Input Voltage (V_{IN})-- + 2.0V to + 5.5V
- Operating Temperature Range (T_{OPR})--- - 40°C to + 85°C

Electrical Characteristics

(V_{IN}=V_{OUT}+1V, $\overline{SHDN}$ 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_{OUT}= 0mA			35	60	μA
Standby Current	I_{STBY}	$\overline{SHDN}$ pin connected to GND			0.1	1	μA
Output Voltage Accuracy	ΔV_{OUT}	I_{OUT}= 1mA		-2		+2	%
Dropout Voltage (Note4)	V_{DROP}	I_{OUT}=150mA	V_{OUT}=1.5V		910	1100	mV
			V_{OUT}=1.8V		750	900	
			V_{OUT}=2.5V		500	600	
			V_{OUT}=3.0V		270	330	
			V_{OUT}=3.3V		230	270	
		I_{OUT}=300mA	V_{OUT}=1.5V		1600	1920	
			V_{OUT}=1.8V		1450	1750	
			V_{OUT}=2.5V		980	1170	
			V_{OUT}=3.0V		510	610	
			V_{OUT}=3.3V		400	480	
Line Regulation	ΔV_{LINE}	I_{OUT}=1mA, V_{IN}=V_{OUT} +1V to 5V			1	8	mV
Load Regulation (Note5)	ΔV_{LOAD}	I_{OUT}=0mA to 150mA			6	30	mV
Ripple Rejection (Note6)	PSRR	V_{IN}=V_{OUT}+1V, f_{RIPPLE} = 10kHz			70		dB
Output Noise Voltage (Note6)	V_{NOISE}	C_{OUT}=1μF, I_{OUT}=0mA			30		μV_{RMS}
Temperature Coefficient (Note6)	TC	I_{OUT} = 1mA, V_{IN} = 5V			100		ppm/ºC
Thermal Shutdown Threshold (Note6)	T_{SD}				145		ºC
	ΔT_{SD}	Hysteresis			25		ºC
$\overline{SHDN}$ Pull-Low Resistance	$R_{\overline{SHDN}}$				5		MΩ
$\overline{SHDN}$ Pin Threshold	$V_{\overline{SHDN}(ON)}$	Start-up		1.0			V
	$V_{\overline{SHDN}(OFF)}$	Shutdown				0.4	V

Note4: The dropout voltage is defined as VIN-VOUT, which is measured when VOUT drops 2% of its normal value with the specified output current.
Note5: Load regulation and dropout voltage are measured at a constant junction temperature by using a 40ms low duty cycle current pulse.
Note6: Guarantee by design.

Typical Performance Curves

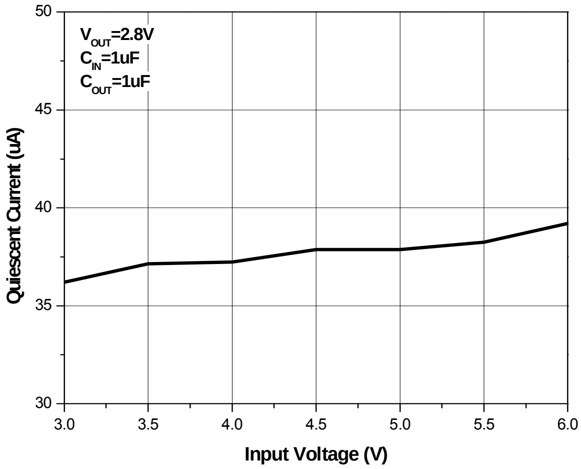


Figure 4. Quiescent Current vs. Input Voltage

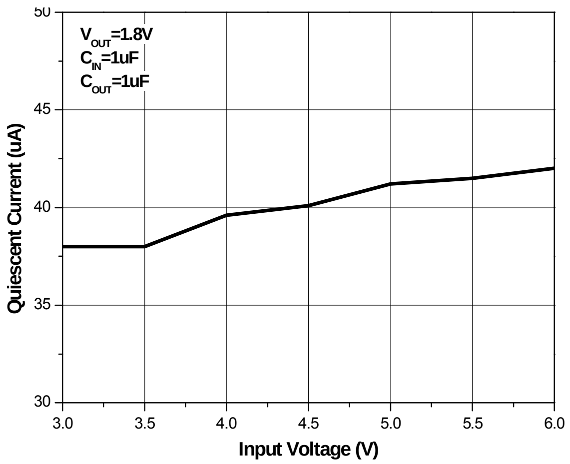


Figure 5. Quiescent Current vs. Input Voltage

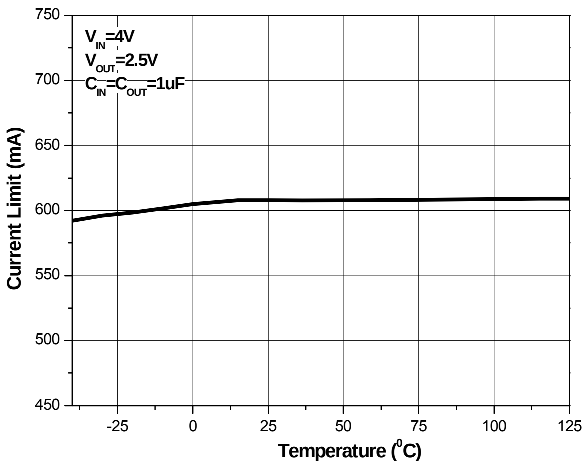


Figure 6. Current Limit vs. Temperature

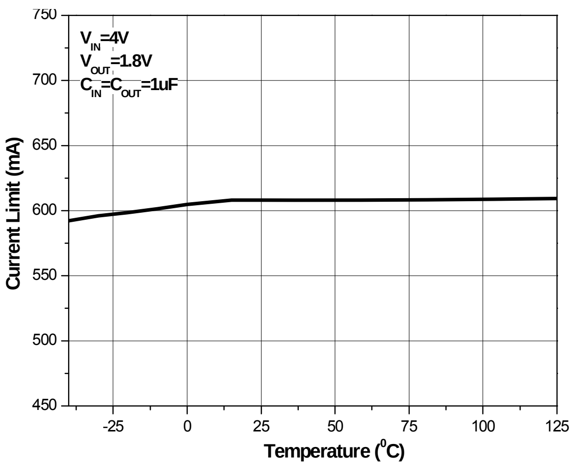


Figure 7. Current Limit vs. Temperature

V_{IN}=2.8V , V_{OUT}=1.8V, I_{OUT}= 1mA to 100mA

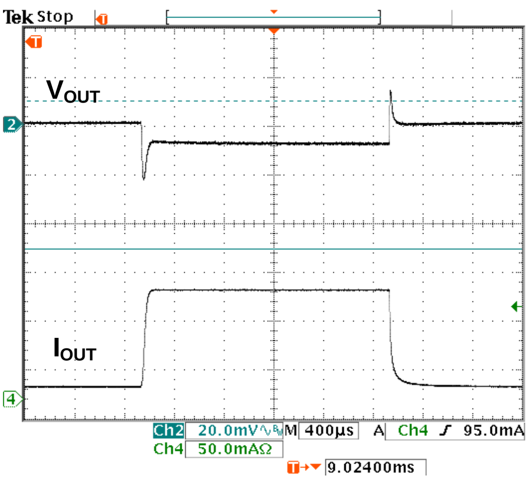


Figure 8. Load Transition Response

V_{IN}=3.8V , V_{OUT}=2.8V , I_{OUT}=1mA to 100mA

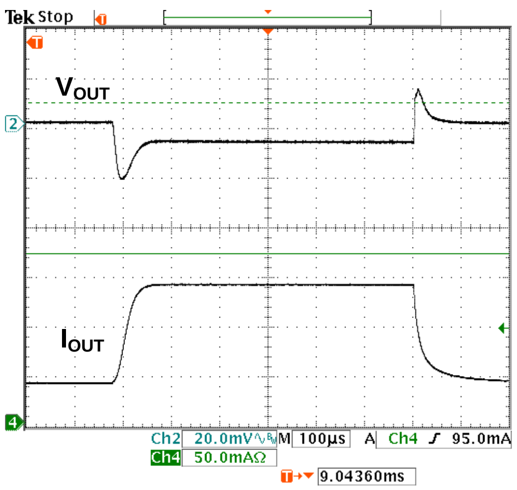


Figure 9. Load Transition Response

Typical Performance Curves (Continued)

V_{IN}=4.3V , V_{OUT}=3.3V , I_{OUT}=1mA to 100mA

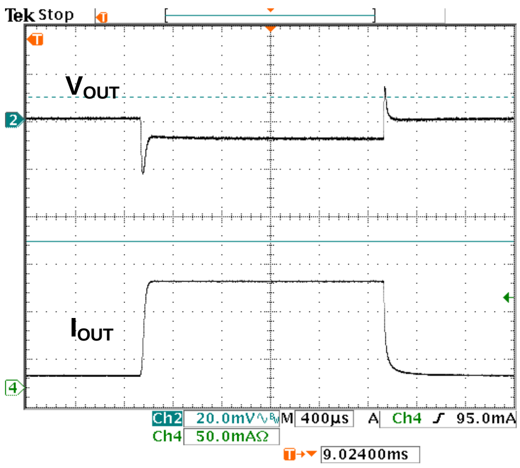


Figure 10. Load Transition Response

V_{IN}=3.5V , V_{OUT}=2.5V , I_{OUT}=1mA to 100mA

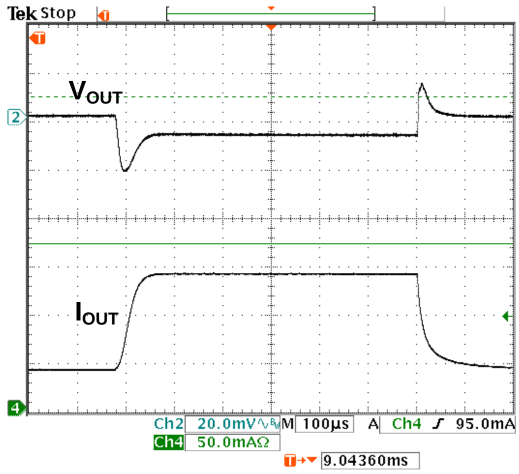


Figure 11. Load Transition Response

V_{IN}=3.8V , V_{OUT}=2.8V , I_{OUT}=1mA to 150mA

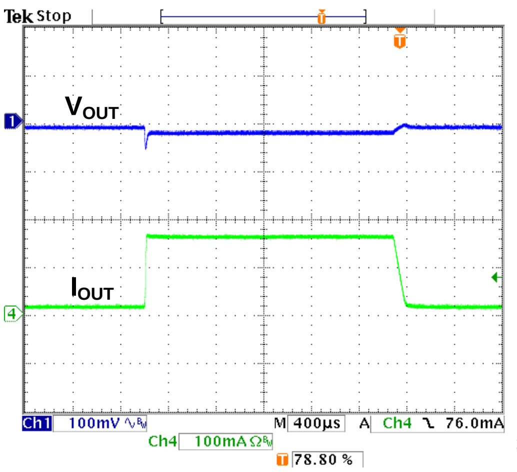


Figure 12. Load Transition Response

V_{IN}=3.8V , V_{OUT}=2.8V , I_{OUT}=0mA to 150mA

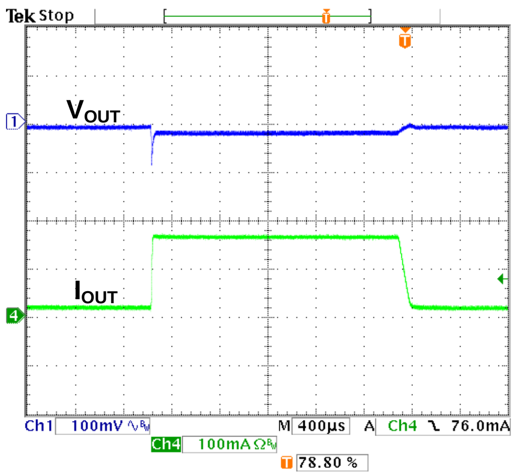


Figure 13. Load Transition Response

V_{IN}=4V , V_{OUT}=2.8V , I_{OUT}=100mA

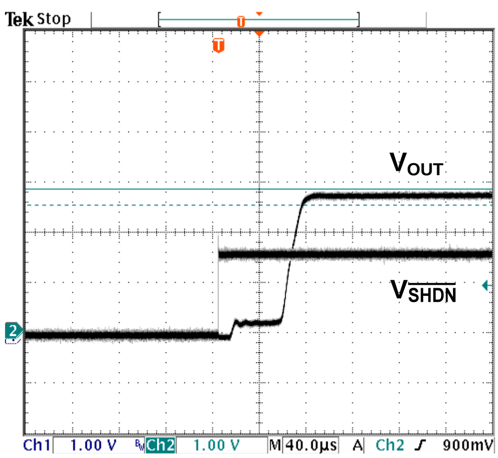


Figure 14. Shutdown /Enable Test

V_{IN}=4V , V_{OUT}=2.8V , I_{OUT}=100mA

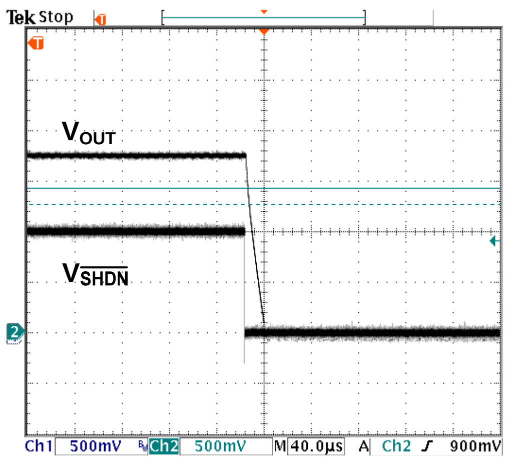


Figure 15. Shutdown /Enable Test

Typical Performance Curves (Continued)

V_{IN}=3V→ 4V , V_{OUT}=1.8V , I_{OUT}=10mA

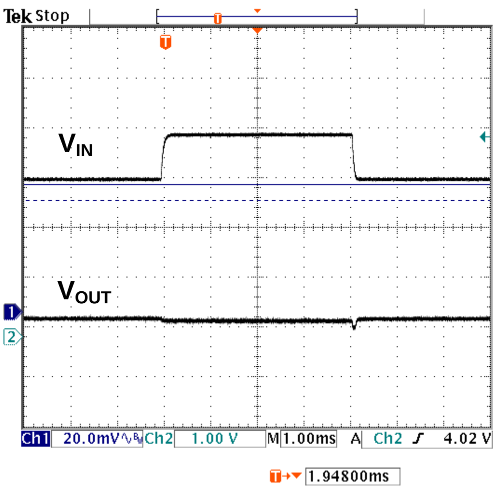


Figure 16. Line Transition Response

V_{IN}=4V→ 5V , V_{OUT}=2.8V , I_{OUT}=10mA

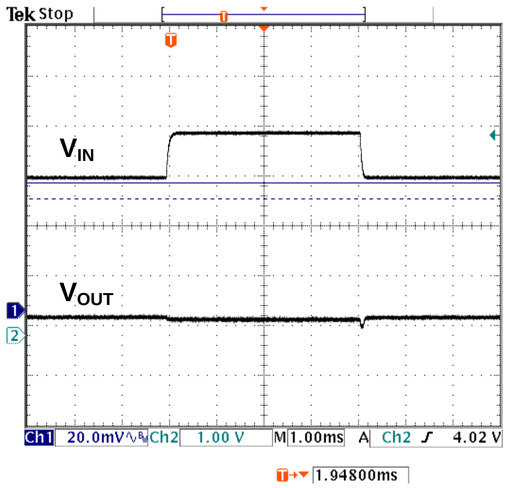


Figure 17. Line Transition Response

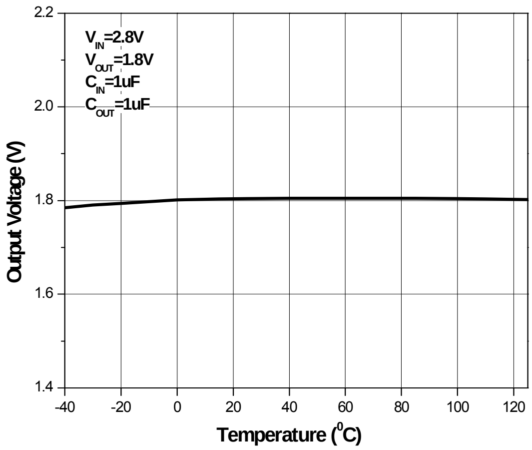


Figure 18. Output Voltage vs. Temperature

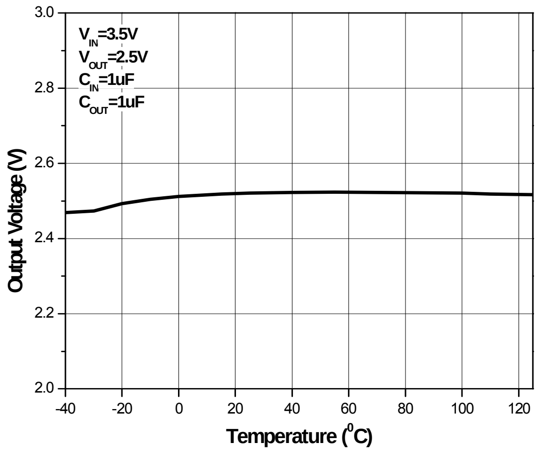


Figure 19. Output Voltage vs. Temperature

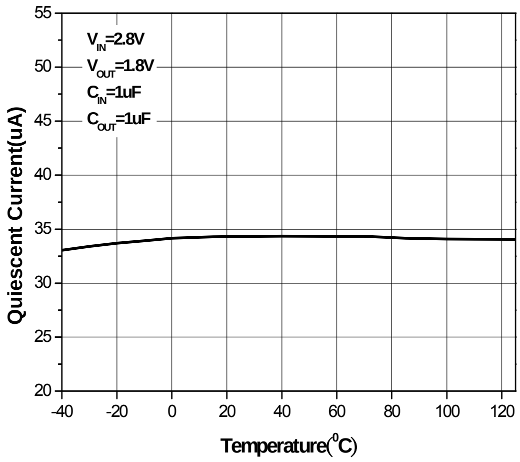


Figure 20. Quiescent Current vs. Temperature

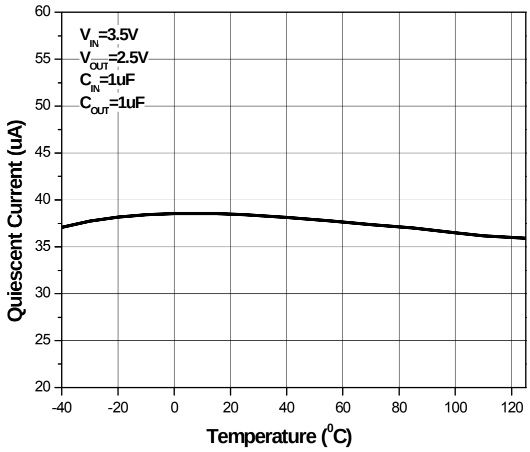


Figure 21. Quiescent Current vs. Temperature

Typical Performance Curves (Continued)

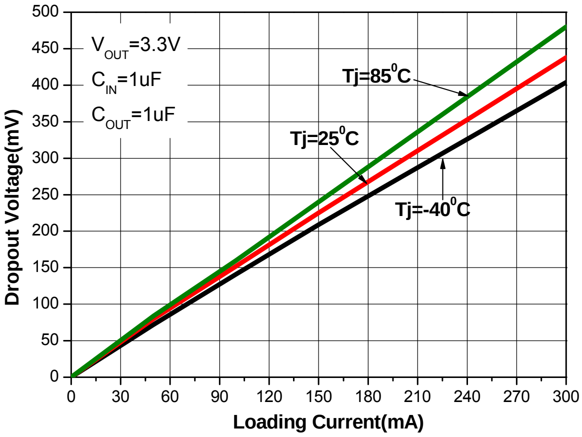


Figure 22. V_{OUT}=3.3V Dropout vs. Temperature

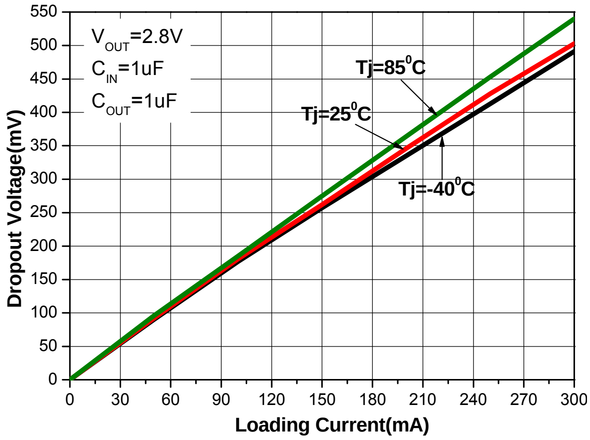


Figure 23. V_{OUT}=2.8V Dropout vs. Temperature

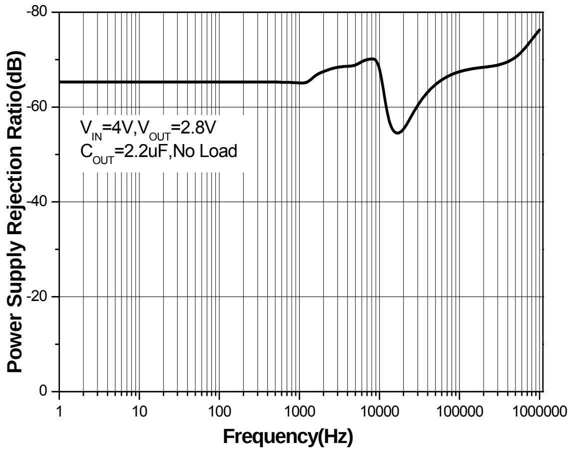


Figure 24. Power Supply Rejection Ratio vs. Frequency

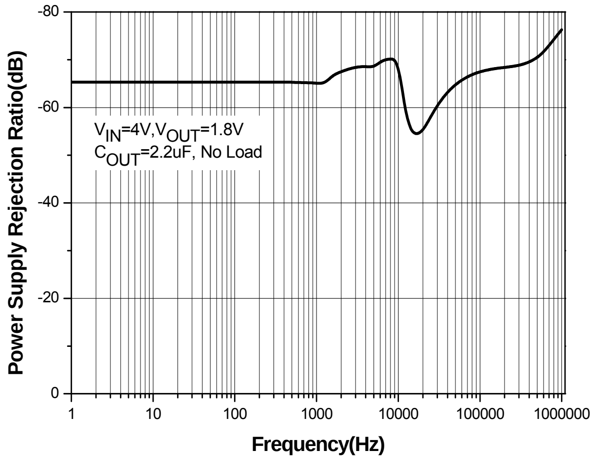


Figure 25. Power Supply Rejection Ratio vs. Frequency

Application Information

The FP6146 is a low dropout linear regulator that could provide 200mA output current at dropout voltage about 300mV. 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 FP6146 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 FP6146 is designed to be stable with low ESR ceramic capacitors and higher values of capacitors 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, FP6146 has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during over-temperature condition.

3. Thermal Consideration

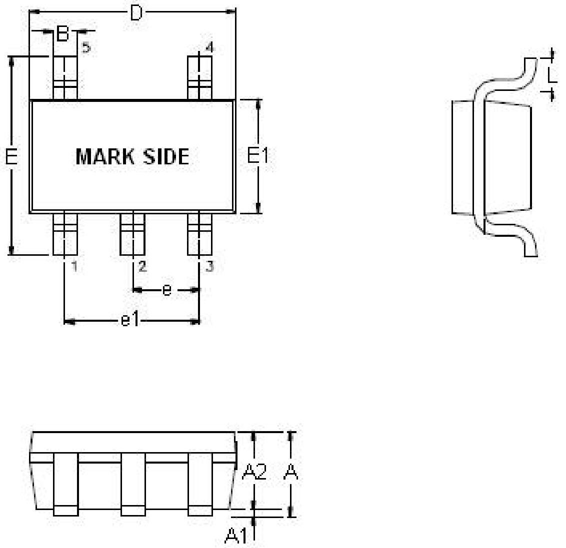
The power handling capability of the device will be limited by allowable operation junction temperature (125ºC). The power dissipated by the device will be estimated by $P_D = I_{OUT} \times (V_{IN}-V_{OUT})$. The power dissipation should be lower than the maximum power dissipation listed in “Absolute Maximum Ratings” section.

4. Shutdown Operation

The FP6146 is shutdown by pulling the $\overline{SHDN}$ input low, and turned on by driving the $\overline{SHDN}$ high. If $\overline{SHDN}$ pin floating, the FP6146 will shutdown because $\overline{SHDN}$ pin has built-in a pull low resistor (refer to Block Diagram).

Outline Information

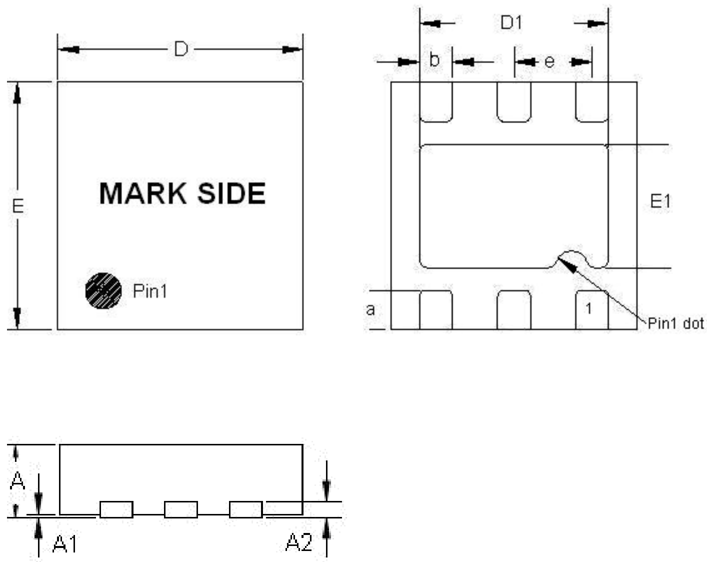
TSOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.75	0.90
A1	0.00	0.10
A2	0.71	0.80
B	0.35	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.35	0.55

Note：Followed From JEDEC MO-193-C.

TDFN- 6 1.6mmX1.6mm Package (Unit: mm)

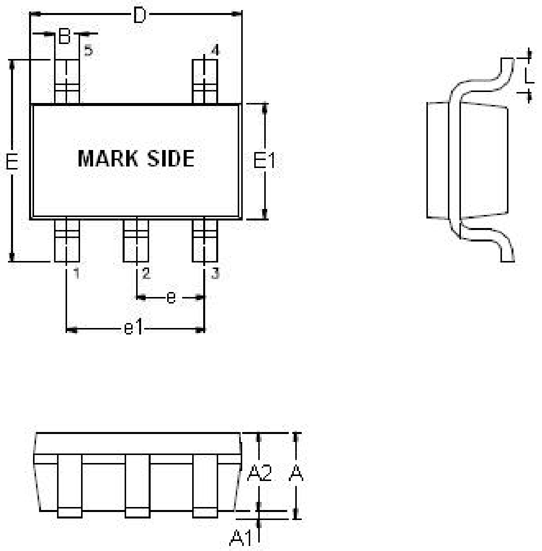


SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A2	0.18	0.25
D	1.55	1.65
E	1.55	1.65
a	0.18	0.30
b	0.18	0.30
e	0.45	0.55
D1	0.95	1.05
E1	0.55	0.65

Note :Followed From JEDEC MO-229-C

Outline Information (Continued)

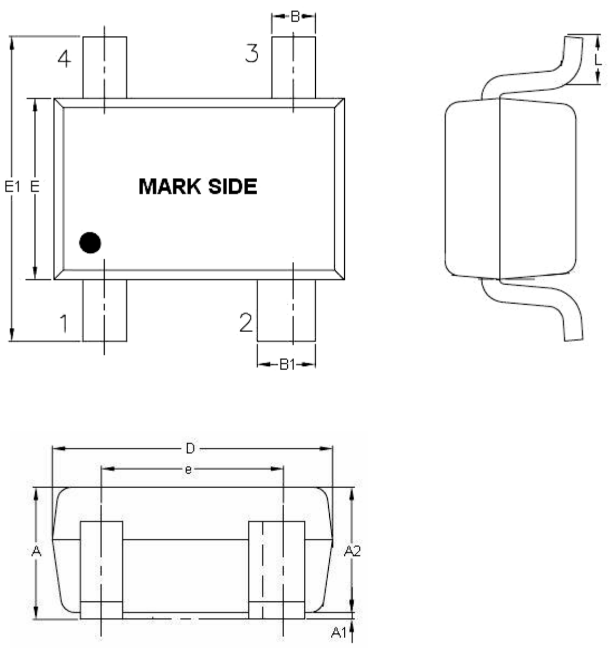
SOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	1.00	1.20
A1	0.00	0.10
A2	1.00	1.10
B	0.35	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.35	0.55

Note：Followed From JEDEC MO-178-C.

SC-82 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.80	1.10
A1	0.00	0.10
A2	0.80	1.00
B	0.25	0.40
B1	0.35	0.50
D	1.80	2.20
E	1.15	1.35
E1	1.80	2.40
e	1.20	1.40
L	0.25	0.45

Life Support Policy
Fitipower's products are not authorized for use as critical components in life support devices or other medical systems.