

300mA, Low Noise High PSRR LDO Regulator

Description

The FP6187 is a low dropout, low noise, high PSRR, low quiescent current positive linear regulator. The FP6187 can supply 300mA output current with low dropout voltage at about 160mV 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 FP6187 that consumes less than 0.1 μ A during shutdown mode.

The FP6187 regulator is able to operate with output capacitors as small as 1 μ F for stability. The FP6187 fault protection includes the current limit protection and current foldback protection.

The FP6187 offers high precision output voltage of $\pm 1\%$. The FP6187 is available in UTDFN-4L (1.0mm $\times$ 1.0mm) and SOT-23-5 packages which features small size.

Features

- Low V_{IN} and Wide V_{IN} Range: 1.75V to 5.5V
- Output Current 300mA^{*1}
- $\pm 1\%$ Output Voltage Accuracy
- Output Noise 65 μ Vrms from 10Hz to 100kHz
- V_{OUT} Fixed 1.0V to 3.3V
- Low Dropout Voltage of 160mV at 2.8V/300mA
- Ripple Rejection 65dB at 1kHz
- Low Quiescent Current at 2 μ A
- Needs Only 1 μ F Capacitor for Stability
- Thermal Shutdown Protection
- Current Limit Protection
- Current Foldback Protection
- Output Discharge Function
- UTDFN-4L (1.0mm $\times$ 1.0mm) and SOT-23-5 Packages
- RoHS Compliant

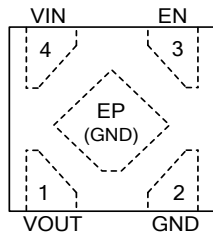
*1 Attention should be paid to the power dissipation of the package when the output current is large.

Applications

- PDAs, Mobile phones, GPS, Smartphones
- Wireless Handsets, Wireless LAN, Bluetooth®, Zigbee®
- Portable Medical Equipment
- Other Battery Powered Applications

Pin Assignment

X6 Package: UTDFN-4L (1.0mmx1.0mm) (Top view)



S5 Package: SOT-23-5

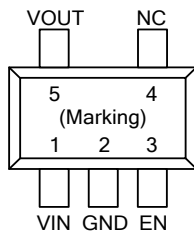


Figure 1. Pin Assignment of FP6187

Ordering Information

FP6187-		
	Package Type	
	X6: UTDFN-4L	
	S5: SOT-23-5	
	Output Voltage	
	10: 1.0V	1J: 1.05V
	11: 1.1V	12: 1.2V
	15: 1.5V	18: 1.8V
	22: 2.2V	25: 2.5V
	28: 2.8V	30: 3.0V
	33: 3.3V	

Marking Information

Part Number	Product Code
FP6187-10X6	YJ
FP6187-1JX6	YK
FP6187-11X6	YL
FP6187-12X6	YM
FP6187-15X6	YN
FP6187-18X6	YP
FP6187-22X6	YR
FP6187-25X6	YS
FP6187-28X6	YT
FP6187-30X6	YU
FP6187-33X6	YV
FP6187-10S5	GA9
FP6187-12S5	GA2
FP6187-18S5	GB0
FP6187-25S5	GD1
FP6187-28S5	GB1
FP6187-30S5	GB2
FP6187-33S5	GB3

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

Typical Application Circuit

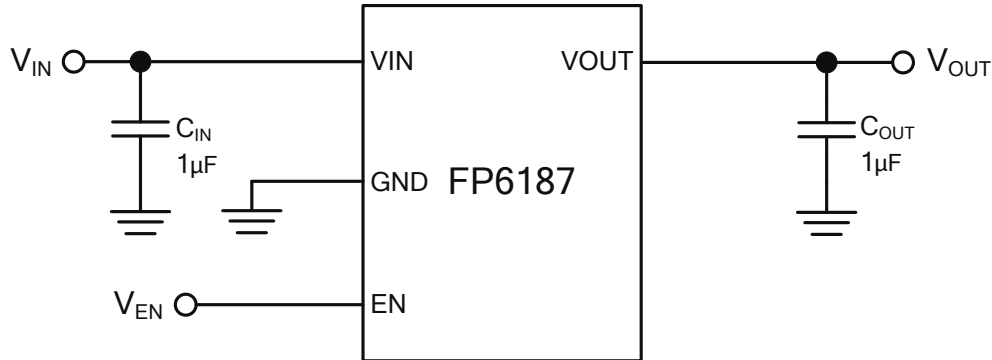


Figure 2. Typical Application Circuit of FP6187

Note 1: 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 No. (SOT-23-5)	Pin No. (UTDFN-4L)	Pin Function
VIN	1	4	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.
GND	2	2	Common ground pin.
EN	3	3	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.
NC	4	-	NC.
VOUT	5	1	The FP6187 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.
Exposed pad	-	EP	The exposed pad must be soldered to a large PCB area and connected to GND for maximum power dissipation.

Block Diagram

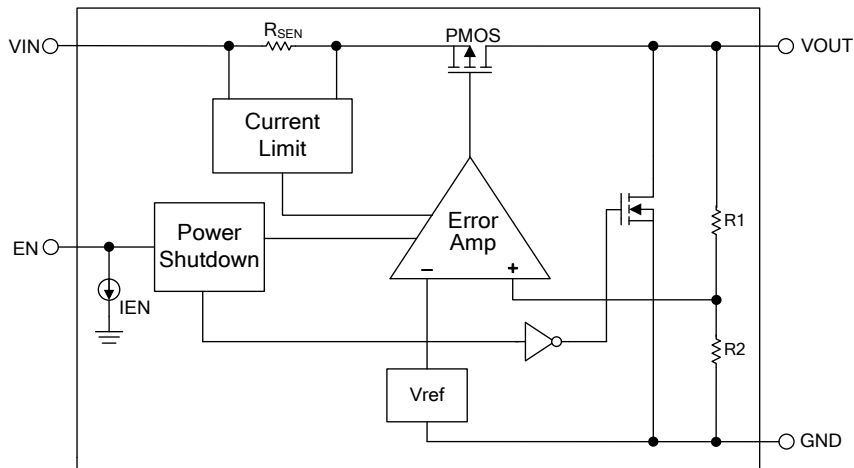


Figure 3. Block Diagram of FP6187

Absolute Maximum Ratings ^(Note 2)

- Supply Voltage V_{IN} ----- -0.3V to +6.5V
- Output Voltage V_{OUT} ----- -0.3V to +6.5V
- EN Voltage V_{EN} ----- -0.3V to $V_{IN} + 0.3V$
- Power Dissipation @ $T_A = 25^\circ C$ & $T_J = 125^\circ C$ (P_D)
 - UTDFN-4L (1.0mmx1.0mm) ----- 0.5W
 - SOT-23-5 ----- 0.4W
- Package Thermal Resistance (θ_{JA}) ^(Note 3)
 - UTDFN-4L (1.0mmx1.0mm) ----- $195^\circ C/W$
 - SOT-23-5 ----- $250^\circ C/W$
- Package Thermal Resistance (θ_{JC})
 - UTDFN-4L (1.0mmx1.0mm) ----- $65^\circ C/W$
 - SOT-23-5 ----- $130^\circ C/W$
- Lead Temperature (Soldering, 10sec.) ----- $+260^\circ C$
- Junction Temperature (T_J) ----- $-40^\circ C$ to $+150^\circ C$
- Storage Temperature (T_{STG}) ----- $-65^\circ C$ to $+150^\circ C$

Note 2: Stresses beyond this listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

Note 3: θ_{JA} is measured at $25^\circ C$ ambient with the component mounted on a high effective thermal conductivity 4-layer board of JEDEC-51-7. The thermal resistance greatly varies with layout, copper thickness, number of layers and PCB size.

Recommended Operating Conditions

- Supply Voltage V_{IN} ----- +1.75V to +5.5V
- Output Current I_{OUT} ----- 300mA
- Operating Ambient Temperature Range ----- $-40^\circ C$ to $+85^\circ C$
- Operating Junction Temperature Range ----- $-40^\circ C$ to $+125^\circ C$

Electrical Characteristics

($V_{IN}=V_{OUT}+1V$, EN pin connected to V_{IN} , $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^\circ C$, unless otherwise specified.)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Input Voltage Range	V _{IN}			1.75		5.5	V
Quiescent Current ^(Note 4)	I _Q	I _{OUT} =0A			2	4	μA
Standby Current	I _{STBY}	EN Pin Connected to GND			0.1	1	μA
Output Voltage Accuracy	ΔV _{OUT}	I _{OUT} =1mA		-1		+1	%
Dropout Voltage ^(Note 5)	V _{DROP}	I _{OUT} =300mA	V _{OUT} =1.0V		650	850	mV
			V _{OUT} =1.05V		590	770	
			V _{OUT} =1.1V		530	690	
			V _{OUT} =1.2V		440	570	
			V _{OUT} =1.5V		350	460	
			V _{OUT} =1.8V		230	300	
			V _{OUT} =2.2V		215	280	
			V _{OUT} =2.5V		180	230	
			V _{OUT} =2.8V		160	210	
			V _{OUT} =3.0V		150	200	
			V _{OUT} =3.3V		135	180	
Line Regulation	ΔV _{LINE}	I _{OUT} =1mA, V _{IN} =V _{OUT} +1V to 5V			1	8	mV
Load Regulation ^(Note 6)	ΔV _{LOAD}	I _{OUT} =0A to 300mA			6	30	mV
Ripple Rejection ^(Note 7)	PSRR	V _{IN} =V _{OUT} +1V _{DC} +0.2V _{P-P(AC)} , f _{RIPPLE} =1KHz,V _{OUT} =1.2V, I _{OUT} =30mA			65		dB
Output Noise Voltage ^(Note 7)	V _{NOISE}	C _{OUT} =1μF, I _{OUT} =30mA BW=10Hz ~ 100KHz			65		μV _{RMS}
Current Limit	I _{LIMIT}			320			mA
Current Foldback	I _{CFB}	R _{Load} =1Ω			100		mA
Output Discharge Resistance	R _{DIS}	V _{EN} =0V			60		Ω
Thermal Shutdown Threshold ^(Note 7)	T _{SD}				160		°C
Thermal Shutdown Threshold Hysteresis ^(Note 7)	ΔT _{SD}				30		°C
EN Pin Current	I _{EN}	V _{EN} =2.5V			0.3		uA
EN Pin Threshold	V _{EN(ON)}	Start-up		1.0			V
	V _{EN(OFF)}	Shutdown				0.4	V

Note 4: except EN pull down current (I_{EN})

Note 5: The dropout voltage is defined as $V_{IN}-V_{OUT}$, which is measured when V_{OUT} drops 2% of its normal value with the specified output current.

Note 6: Load regulation and dropout voltage are measured at a constant junction temperature by using a 40ms low duty cycle current pulse.

Note 7: Guarantee by design.

Typical Performance Curves

$V_{IN}=V_{OUT}+1V$, EN pin connected to V_{IN} , $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^\circ C$, unless otherwise specified.

$V_{OUT}=2.8V$, $I_{OUT}=0mA$

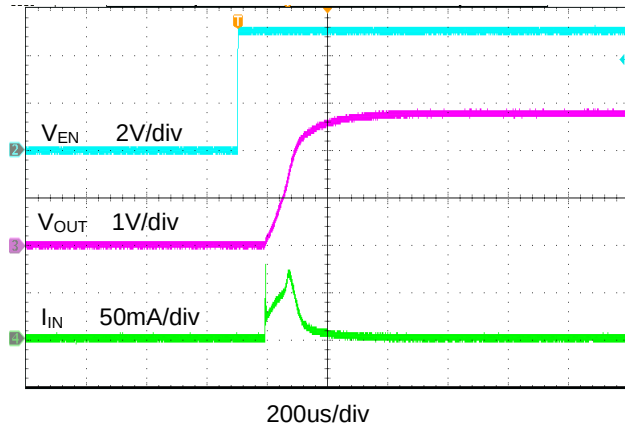


Figure 4. Turn ON Waveform

$V_{OUT}=2.8V$, $I_{OUT}=0mA$

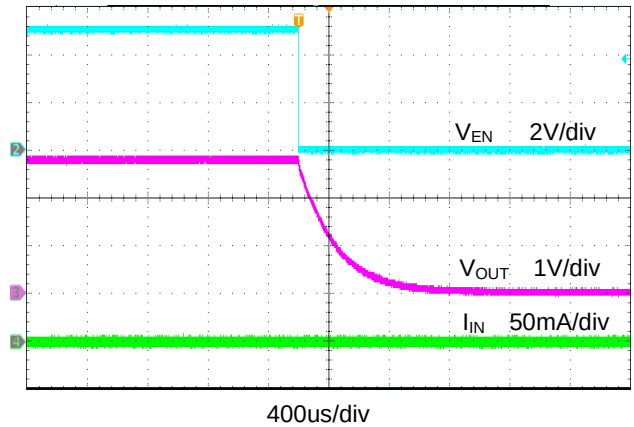


Figure 5. Turn OFF Waveform

$V_{OUT}=3.3V$, $I_{OUT}=0mA$

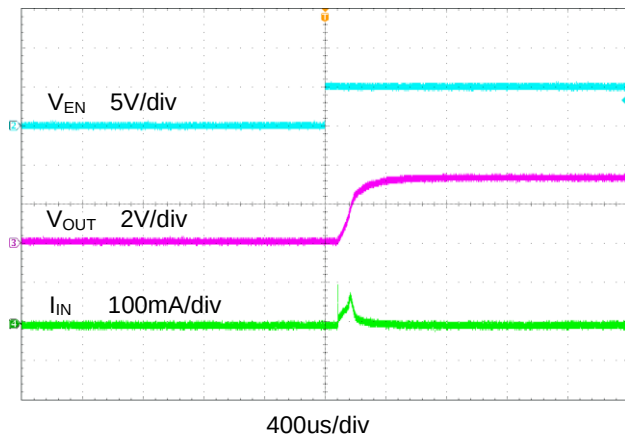


Figure 6. Turn ON Waveform

$V_{OUT}=3.3V$, $I_{OUT}=0mA$

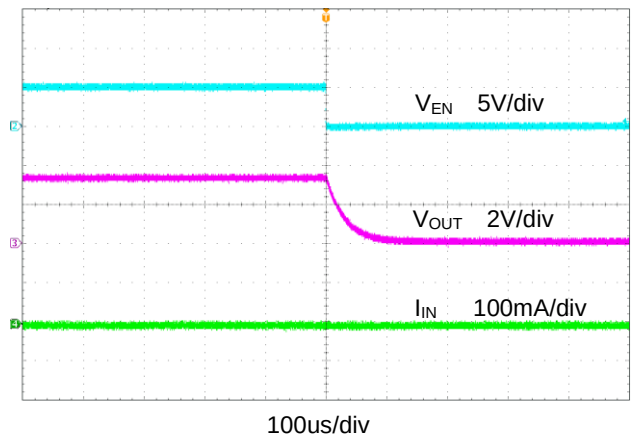


Figure 7. Turn OFF Waveform

$2.8V_{OUT}/V_{IN}=3.2V \rightarrow 5.5V \rightarrow 3.2V$ $I_{OUT}=10mA$, $C_{IN}=none$

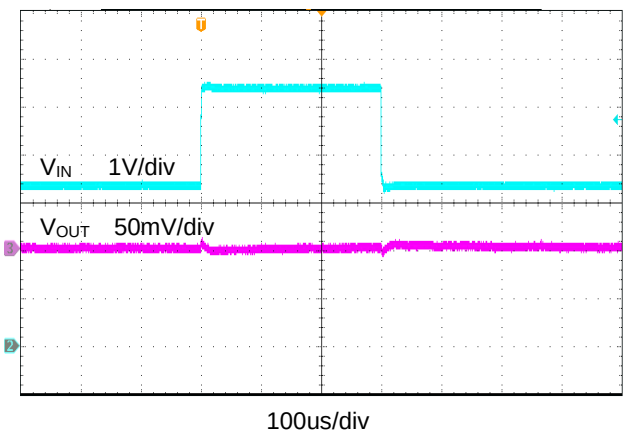


Figure 8. Line Transient Response

$3.3V_{OUT}/V_{IN}=3.6V \rightarrow 5.5V \rightarrow 3.6V$ $I_{OUT}=10mA$, $C_{IN}=none$

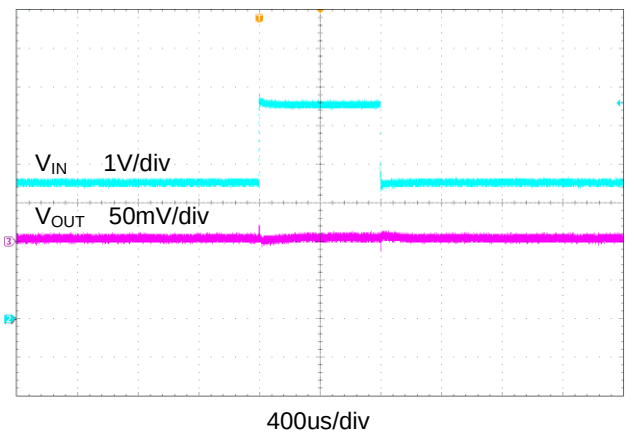


Figure 9. Line Transient Response

Typical Performance Curves (Continued)

$V_{IN}=V_{OUT}+1V$, EN pin connected to V_{IN} , $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^\circ C$, unless otherwise specified.

2.8V_{OUT}/I_{OUT}=1mA→300mA→1mA

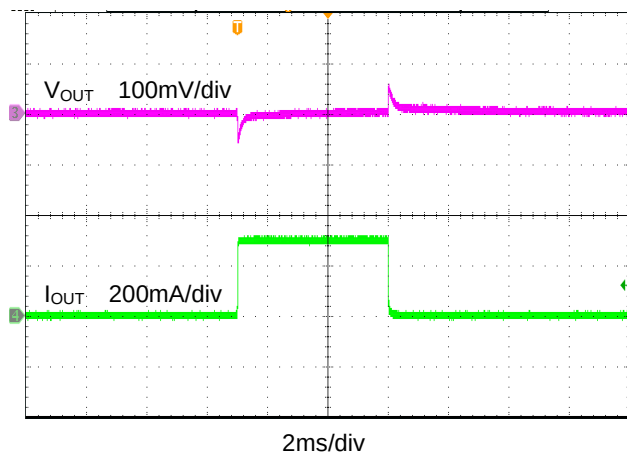


Figure 10. Load Transient Response

3.3V_{OUT}/I_{OUT}=1mA→300mA→1mA

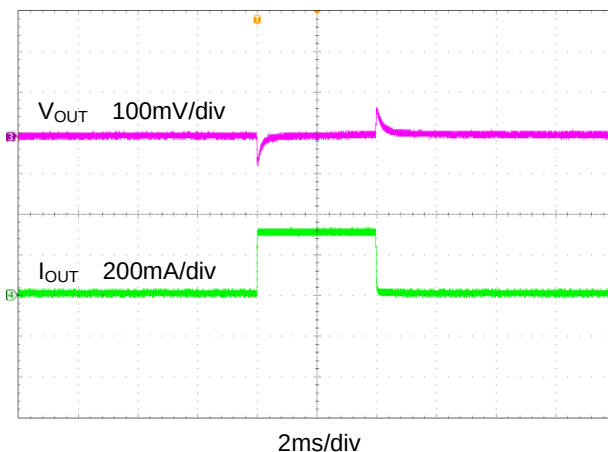


Figure 11. Load Transient Response

V_{IN} = Li-ion Battery 3.6V, $V_{OUT}=1.8V$, $I_{OUT}=0mA$

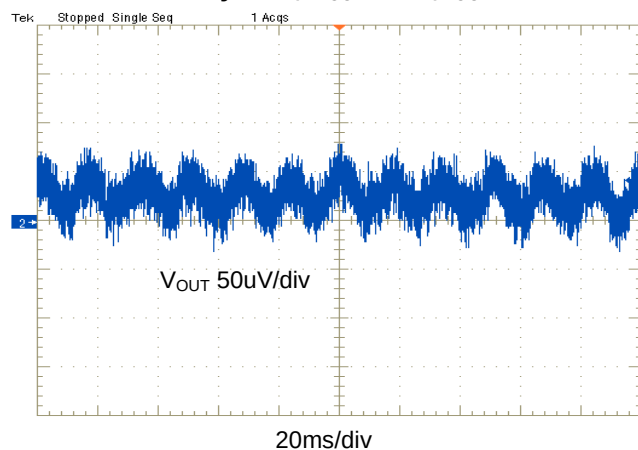


Figure 12. Output Noise Voltage

V_{IN} = Li-ion Battery 3.6V, $V_{OUT}=1.8V$, $I_{OUT}=1mA$

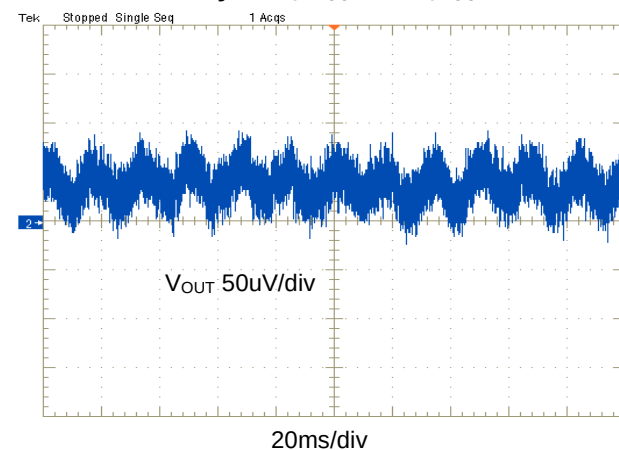


Figure 13. Output Noise Voltage

Typical Performance Curves (Continued)

$V_{IN}=V_{OUT}+1V$, EN pin connected to V_{IN} , $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^\circ C$, unless otherwise specified.

$V_{OUT}=1.2V$, $I_{OUT}=30mA$

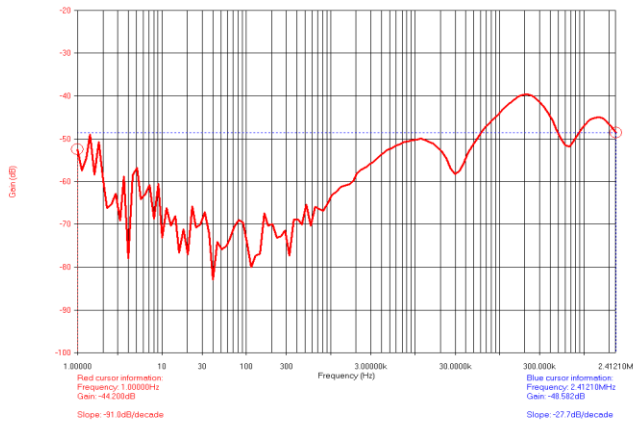


Figure 14. PSRR vs. Frequency

$V_{OUT}=2.8V$, $I_{OUT}=30mA$

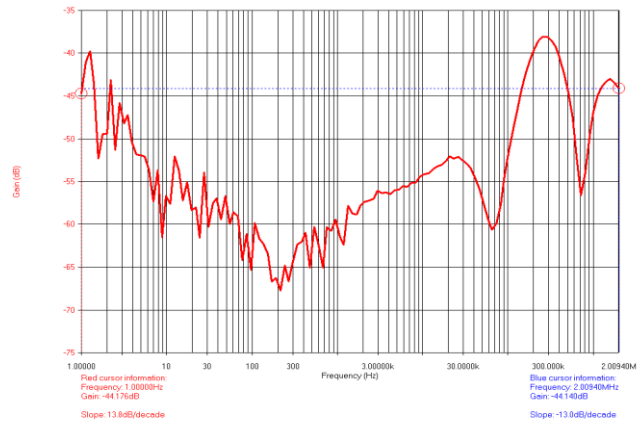


Figure 15. PSRR vs. Frequency

$V_{OUT}=3.3V$, $I_{OUT}=30mA$

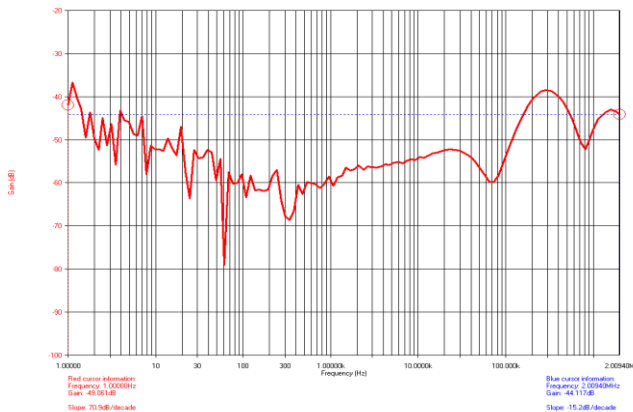


Figure 16. PSRR vs. Frequency

$V_{IN}=3.8V$, $V_{OUT}=2.8V$

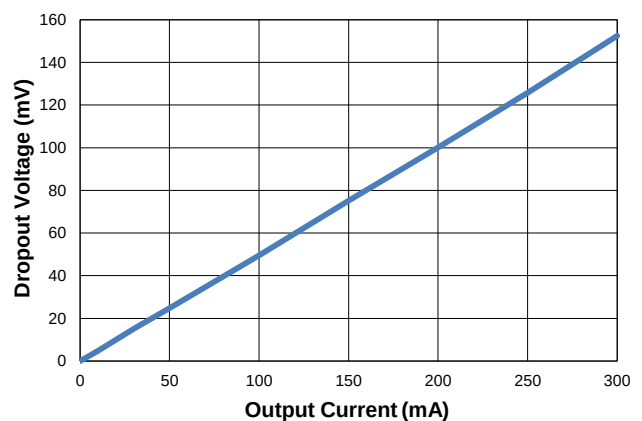


Figure 17. Dropout Voltage vs. Output Current

$V_{IN}=3.8V$, $V_{OUT}=2.8V$

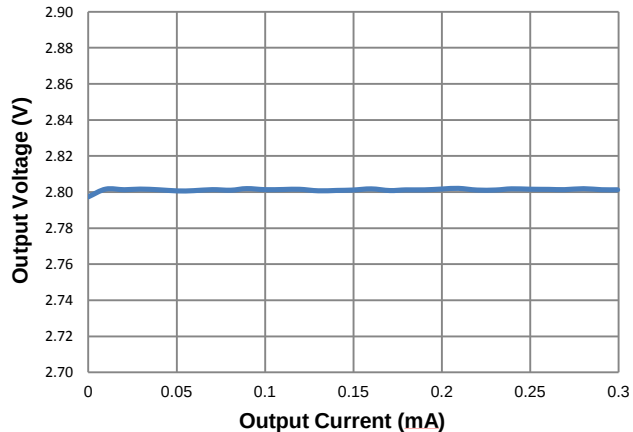


Figure 18. Output Voltage vs. Output Current

$V_{OUT}=2.8V$, $I_{OUT}=1mA$

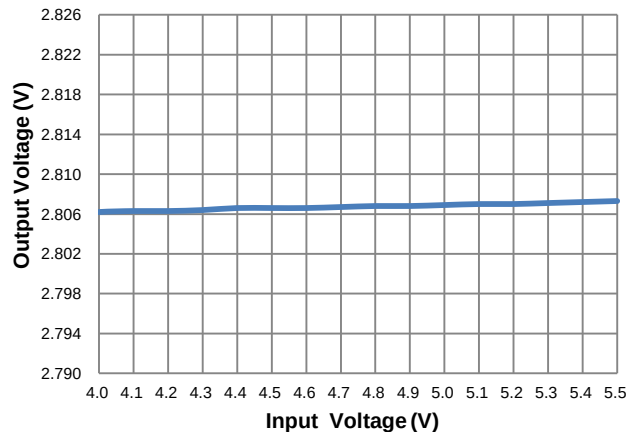


Figure 19. Output Voltage vs. Input Voltage

Typical Performance Curves (Continued)

$V_{IN}=V_{OUT}+1V$, EN pin connected to V_{IN} , $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^\circ C$, unless otherwise specified.

$V_{OUT}=2.8V$

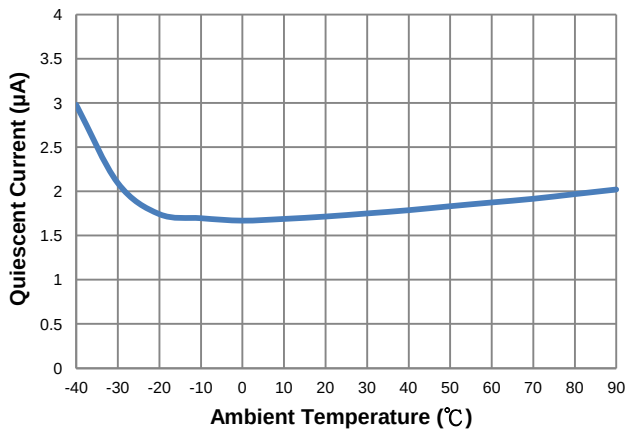


Figure 20. Quiescent Current vs. Ambient Temperature

$V_{OUT}=2.8V$

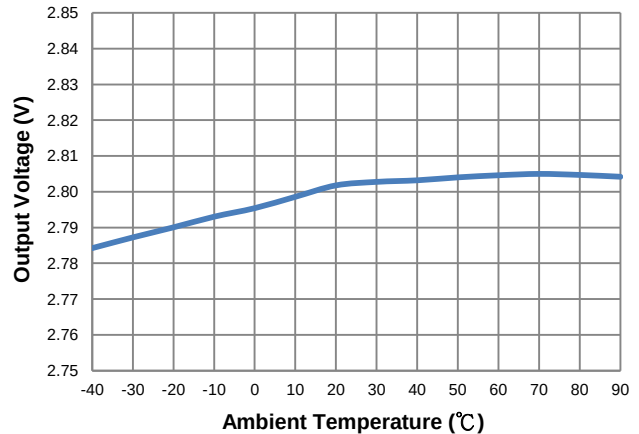


Figure 21. Output Voltage vs. Ambient Temperature

$V_{OUT}=1.2V$

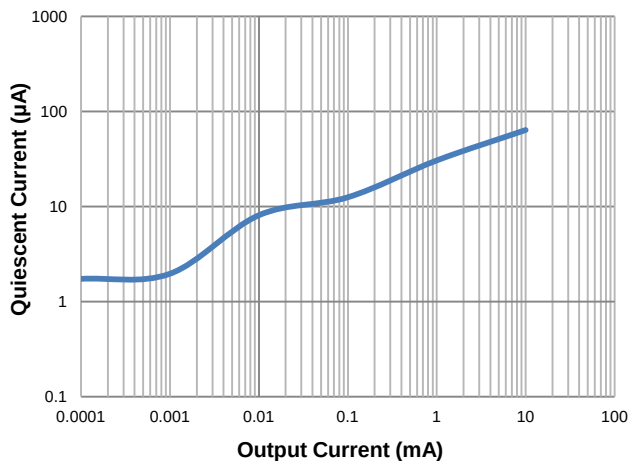


Figure 22. Quiescent Current vs. Output Current

$V_{OUT}=2.5V$

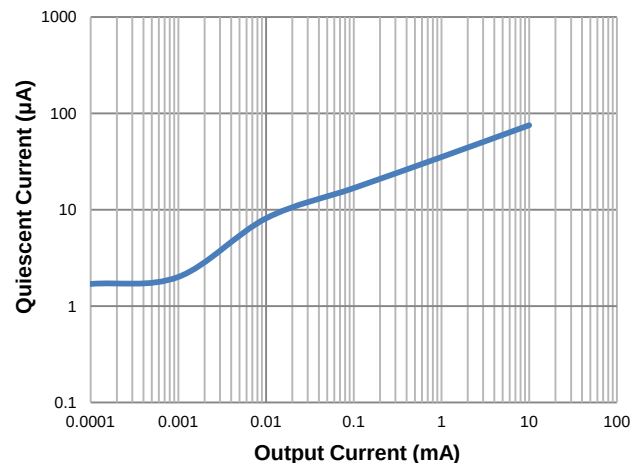


Figure 23. Quiescent Current vs. Output Current

$V_{OUT}=1.2V$

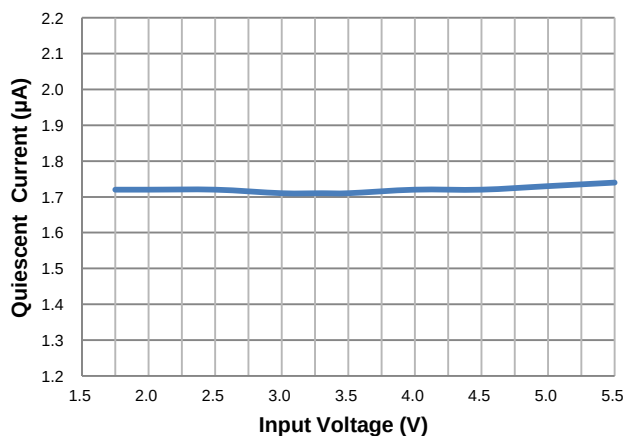


Figure 24. Quiescent Current vs. Input Voltage

$V_{OUT}=2.5V$

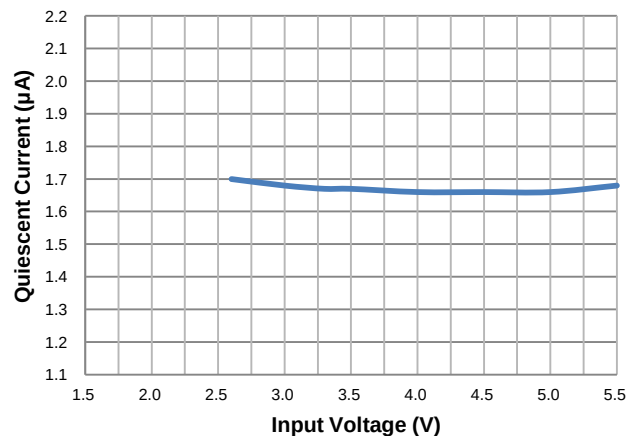


Figure 25. Quiescent Current vs. Input Voltage

Application Information

The FP6187 is a low dropout linear regulator that could provide 300mA output current at dropout voltage about 160mV (2.8V output voltage).

1. Output and Input Capacitor

The FP6187 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 1 μ F to 10 μ F X5R or X7R dielectric ceramic capacitors with 30m Ω to 50m Ω ESR range between device outputs and ground for stability. The FP6187 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 condition from damaging the device, FP6187 has current limiting function designed to protect the device.

3. Thermal Consideration

The power handling capability of the device will be limited by allowable operation junction temperature (125°C). 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 FP6187 is shutdown by pulling the EN input low, and turned on by driving the EN high. If EN pin floating, the FP6187 will shut down because EN pin has built-in a pull low resistor (refer to Block Diagram).

5. Output Discharge Function

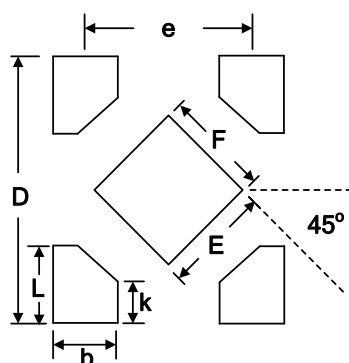
The FP6187 provides auto discharge function, an discharge MOSFET with $R_{DS(ON)}$ of 60 Ω typical is integrated between VOUT and GND pins, which can discharge the charge of the output capacitors quickly when turning off FP6187 with EN pin.

6. PCB Layout Recommendation

Place the input capacitors and output capacitors as close to the device as possible. The traces which connect to these capacitors should be as short and wide as possible to minimize parasitic inductance and resistance.

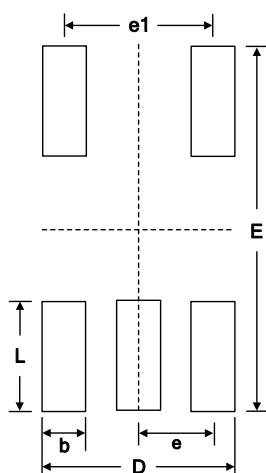
PCB Footprint

UTDFN-4L (1.0mmx1.0mm) Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER
D	1.3
E	0.48
F	0.48
L	0.4
k	0.22
b	0.25
e	0.625

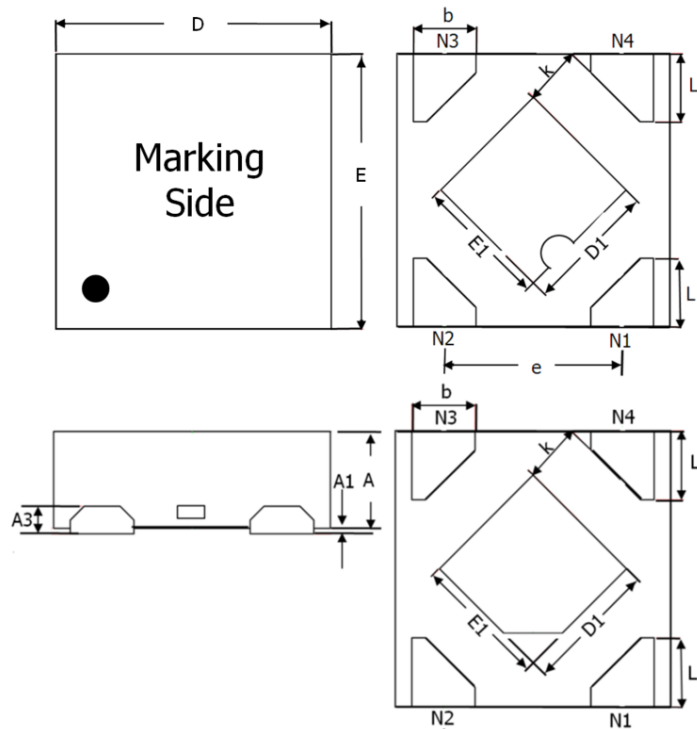
SOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER
b	0.55
D	2.45
E	3.80
L	1.27
e	0.95
e1	1.90

Outline Information

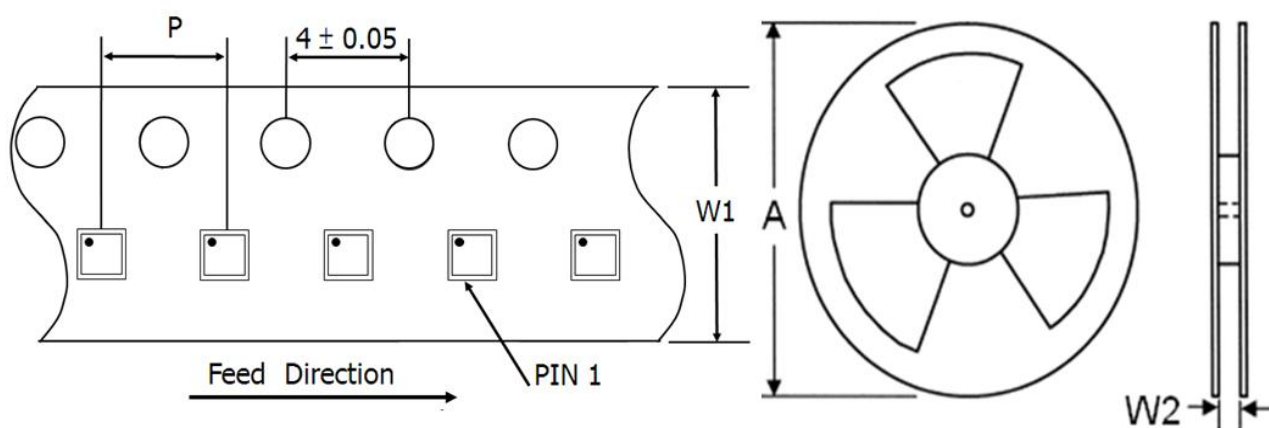
UTDFN-4L 1.0mm x 1.0mm (pitch 0.65 mm) Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.34	0.60
A1	0.00	0.05
A3	0.102 REF.	
D	0.95	1.05
E	0.95	1.05
D1	0.38	0.58
E1	0.38	0.58
k	0.20 REF.	
b	0.18	0.30
e	0.65 TYP.	
L	0.20	0.30

Note 8: Followed From JEDEC 664-1.

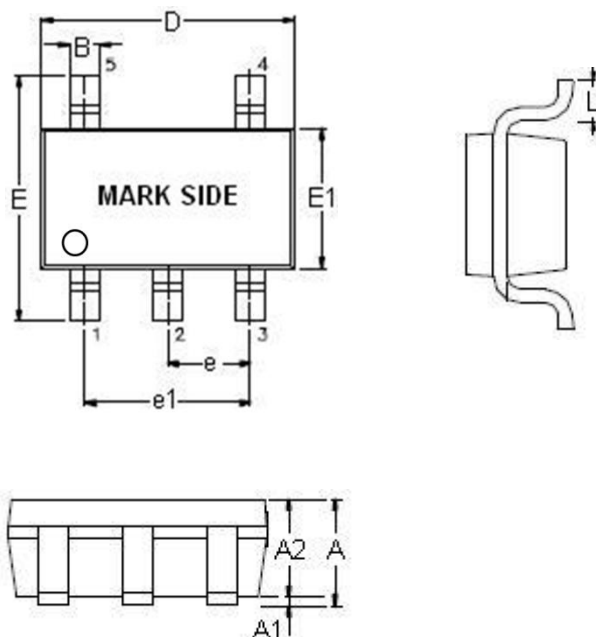
Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	9.5	400~1000	5000

Outline Information (Continued)

SOT-23-5 Package (Unit: mm)

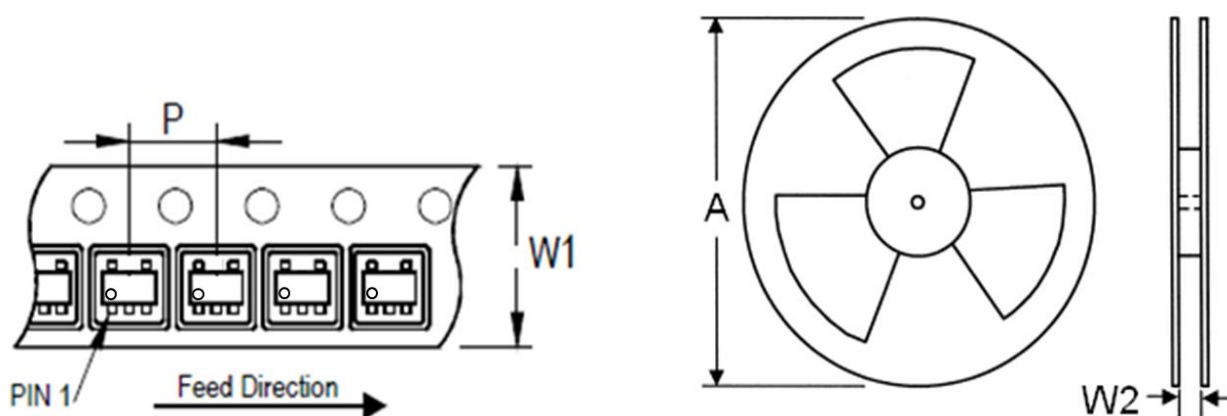


SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.30
A1	0.00	0.15
A2	0.90	1.15
B	0.30	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.30	0.60

Note 9: Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.3mm.

Note 10: Followed From JEDEC MO-178-C.

Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	300~1000	3,000

Life Support Policy

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