

100mA Ultra-Low Quiescent Current Low Dropout Regulator

Description

The FP6141 is a CMOS low dropout voltage (LDO) regulator with ultra-low quiescent current of 4 μ A, designed for battery-operated applications. Wide range of output voltages can be used, ranging from 1.2V to 3.3V.

Other features include current limit protection, thermal shutdown protection and high output voltage accuracy. The requirement of only 1 μ F input and output capacitor makes it ideal in space-sensitive applications.

The FP6141 is available in space saving SOT-23-3, SOT-23-5 and TDFN-6 packages.

Features

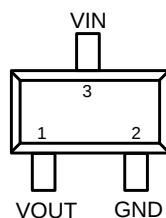
- Ultra-Low Quiescent Current at 4 μ A
- High Output Voltage Accuracy at $\pm 2\%$
- Low Dropout Voltage of 250mV at 100mA
- Operating Voltage Range from 2V to 5.5V
- Current Limit Protection
- Thermal Shutdown Protection
- 1 μ F Output Capacitor Required for Stability
- Chip Enable Control (FP6141XXS5 and FP6141XXWD only)
- RoHS Compliant

Applications

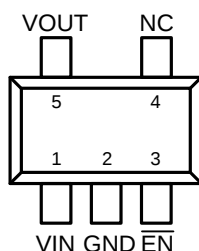
- Battery-Powered Equipment
- Notebook Computer
- Hand-Held Instrument
- DSC

Pin Assignments

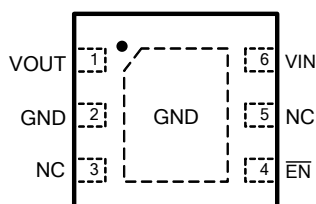
S3 Package (SOT-23-3)



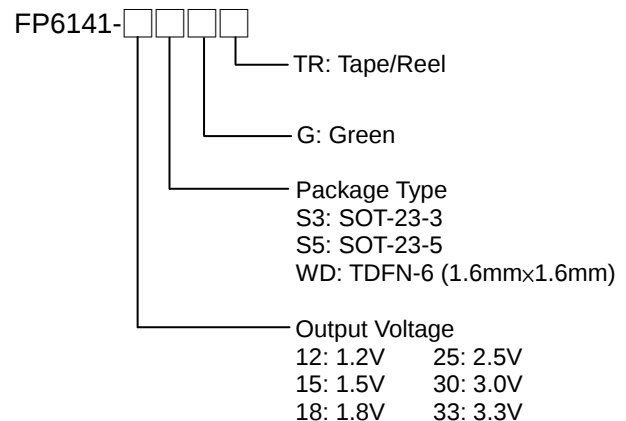
S5 Package (SOT-23-5)



WD Package (TDFN-6)(1.6mm×1.6mm)



Ordering Information



Note 1 : Please consult Fitipower sales office or authorized distributors for availability of special output voltages.

Figure 1. FP6141 Pin Assignments

SOT-23-3 Marking

Part Number	Product Code	Part Number	Product Code
FP6141-12S3G	BA=	FP6141-25S3G	BD=
FP6141-15S3G	BB=	FP6141-30S3G	BE=
FP6141-18S3G	BC=	FP6141-33S3G	BF=

TDFN-6 (1.6mm×1.6mm) Marking

Part Number	Product Code	Part Number	Product Code
FP6141-12WDG	R	FP6141-25WDG	U
FP6141-15WDG	S	FP6141-30WDG	V
FP6141-18WDG	T	FP6141-33WDG	W

SOT-23-5 Marking

Part Number	Product Code	Part Number	Product Code
FP6141-12S5G	BG=	FP6141-25S5G	BK=
FP6141-15S5G	BH=	FP6141-30S5G	BL=
FP6141-18S5G	BJ=	FP6141-33S5G	BM=

Typical Application Circuit

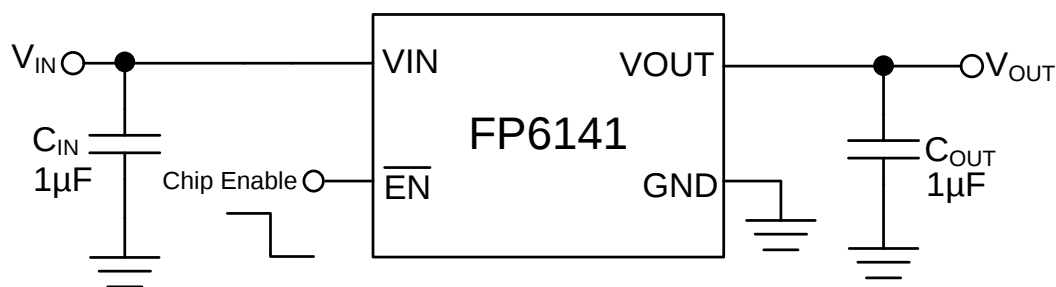


Figure 2. Typical Application Circuit of FP6141

Note 2 : 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
VOUT	Output Voltage
GND	Ground.
VIN	Power Input.
EN	Chip Enable Control Input. Pull the pin high to shut down IC, and pull the pin low to enable IC.
NC	No Connection.

Block Diagram

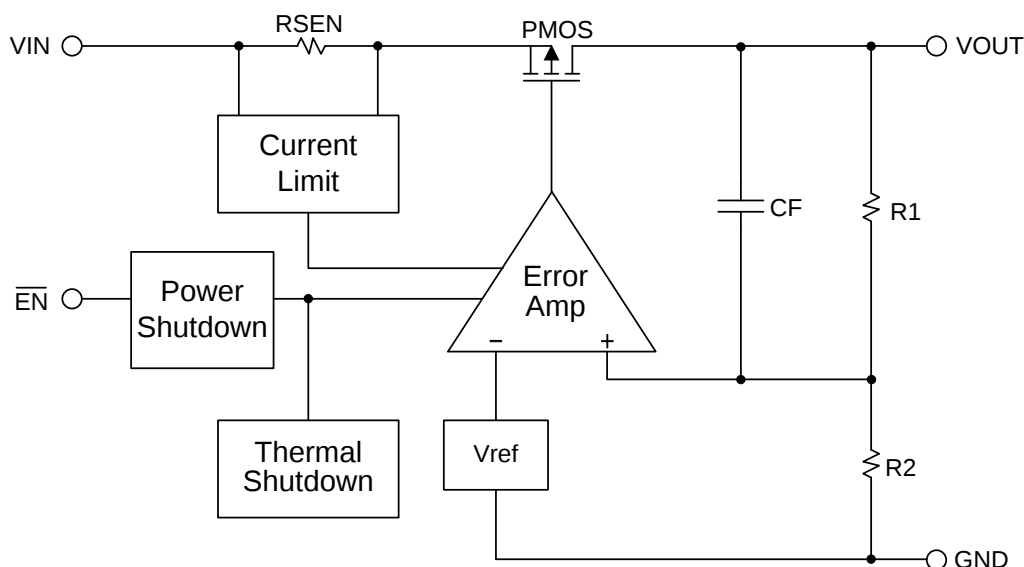


Figure 3. Block Diagram of FP6141

Absolute Maximum Ratings

- V_{IN} , $\overline{EN}$ to GND ----- +6V
- Power Dissipation @25°C, (P_D)
 - SOT-23-3 ----- +0.4W
 - SOT-23-5 ----- +0.4W
 - TDFN-6 (1.6mm×1.6mm) ----- +0.63W
- Package Thermal Resistance, (θ_{JA})
 - SOT-23-3 ----- +250°C/W
 - SOT-23-5 ----- +250°C/W
 - TDFN-6 (1.6mm×1.6mm) ----- +160°C/W
- Maximum Junction Temperature (T_J) ----- +150°C
- Storage Temperature Range (T_{STG}) ----- -65°C to +150°C
- Lead Temperature (Soldering, 10sec.) ----- +260°C

Note 3 : 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

($V_{IN} = 5.5V$, $V_{EN}=V_{IN}$, $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $T_A = 25^\circ C$, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ.	Max	Unit
Input Voltage Range	V_{IN}			2		5.5	V
Output Voltage Accuracy	ΔV_{OUT}	$I_{OUT} = 1mA$		-2		+2	%
Maximum Output Current	I_{MAX}	$V_{IN} = V_{OUT} + 0.6V$, $V_{IN} \geq 3.6V$		100			mA
Current Limit	I_{LIM}	$R_{Load}=1\Omega$		150			mA
Quiescent Current	I_Q	No load			4	7	μA
Standby Current	I_{SD}	$V_{EN} = V_{IN}$			0.1	1	μA
Dropout Voltage (Note4)	V_{DROP}	$I_O=100mA$	$V_{OUT}=1.5V$		1100	1250	mV
			$V_{OUT}=1.8V$		900	1000	
			$V_{OUT}=2.5V$		580	650	
			$V_{OUT}=3.0V$		300	340	
			$V_{OUT}=3.3V$		250	280	
Line Regulation	ΔV_{LINE}	$V_{IN} = (V_{OUT} + 0.3V)$ to 6V, $V_{IN} \geq 3.6V$, $I_{OUT} = 1mA$		-0.2		+0.2	%/V
Load Regulation (Note5)	ΔV_{LOAD}	$I_{OUT} = 0mA$ to 100mA			0.01		%/mA
Ripple Rejection (Note6)	PSRR	Freq.= 1kHz, $C_{OUT} = 1\mu F$			30		dB
$\overline{EN}$ Threshold		Shutdown		2			V
		Start-up				0.6	
Thermal Shutdown Threshold (Note6)	T_{SD}				150		$^\circ C$
	ΔT_{SD}	Hysteresis			20		$^\circ C$

Note 4 : 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 5 : Load regulation and dropout voltage are measured at a constant junction temperature by using a 40ms low duty cycle current pulse.

Note 6 : Guarantee by design.

Typical Performance Curves

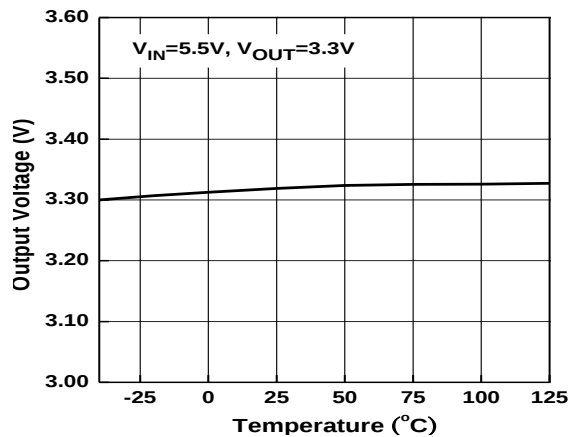


Figure 4. Output Voltage vs. Temperature

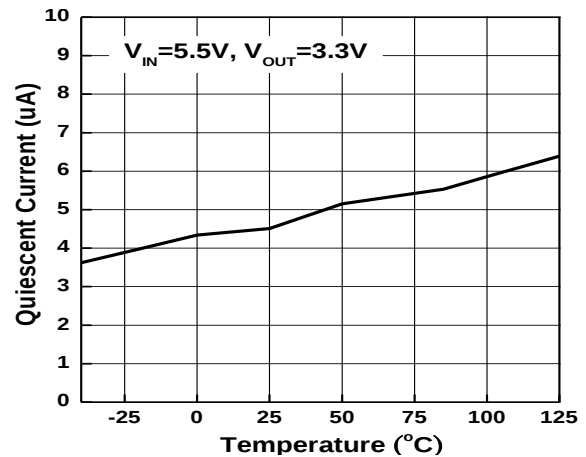


Figure 5. Quiescent Current vs. Temperature

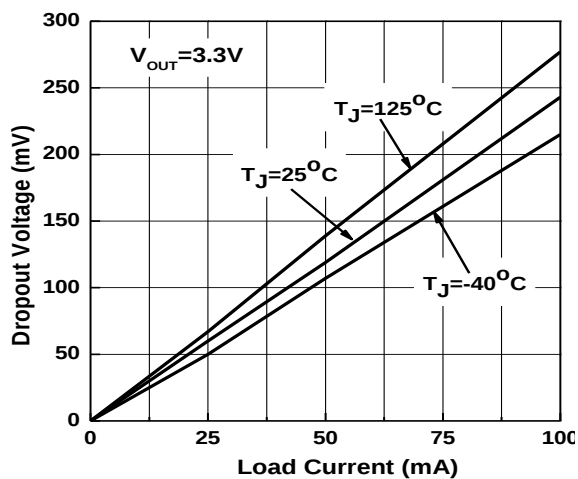


Figure 6. Dropout Voltage vs. Load Current

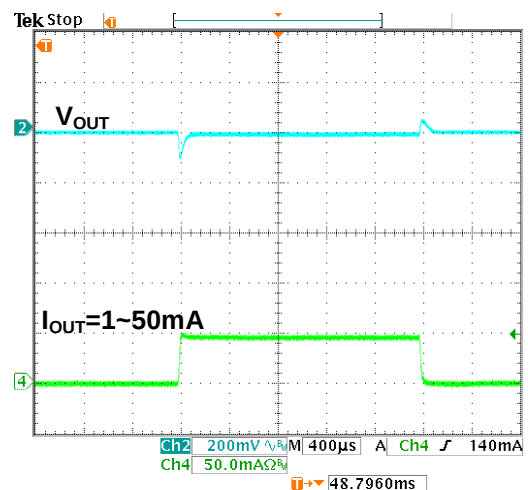


Figure 7. Load Transient Response

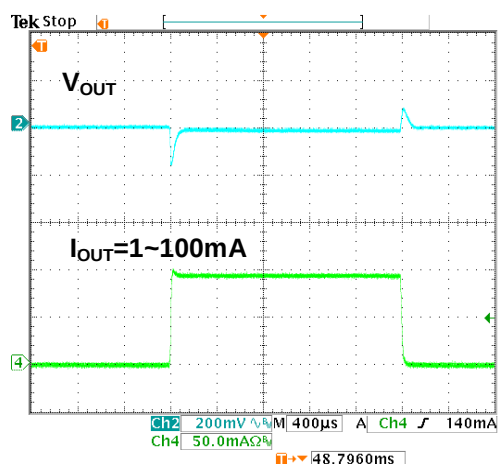


Figure 8. Load Transient Response

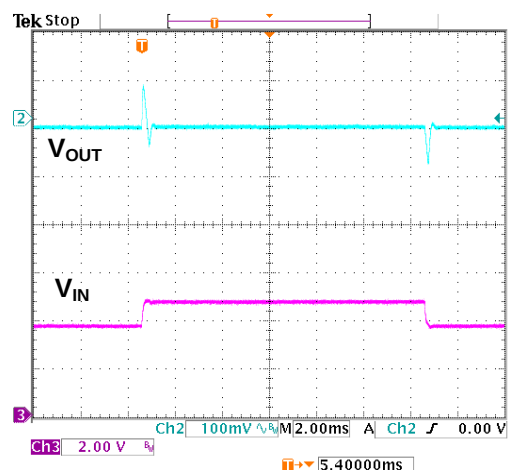


Figure 9. Line Transient Response

Typical Performance Curves (Continued)

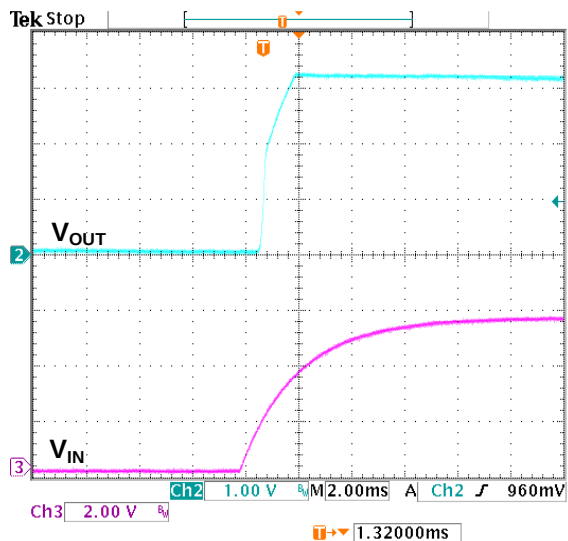


Figure 10. Power on Response

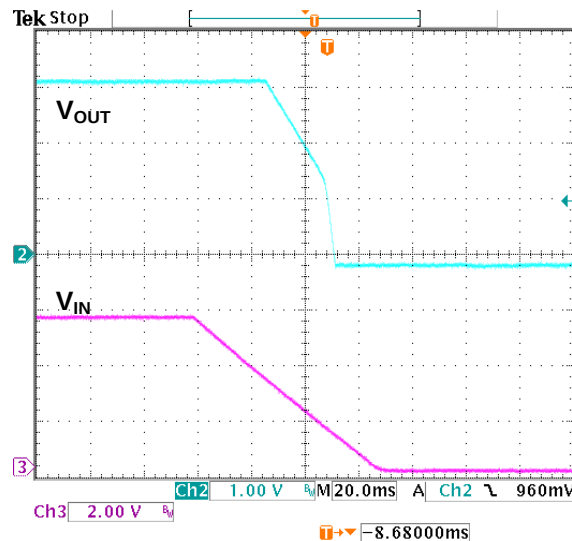


Figure 11. Power off Response

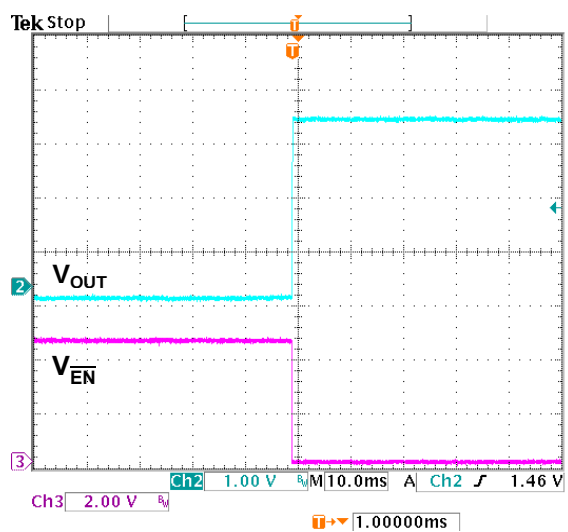


Figure 12. $\overline{EN}$ Start up Response

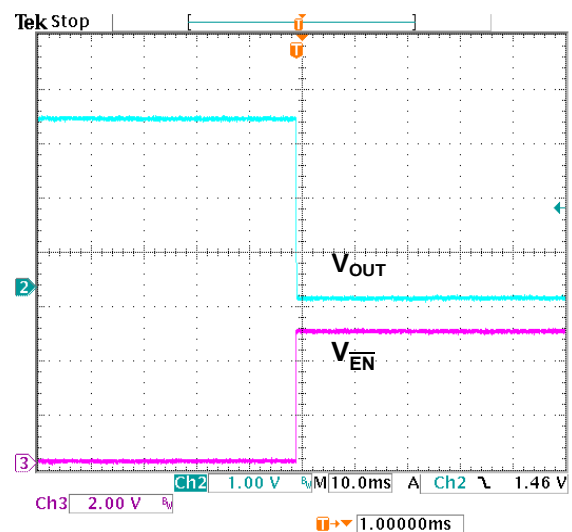


Figure 13. $\overline{EN}$ Shutdown Response

Application Information

The FP6141 is suitable for power saving battery application with ultra-low 4μA quiescent current. Current limit and on chip thermal shutdown features provide protection against any combination of overload or ambient temperature that could exceed maximum junction temperature.

Shutdown Control

Force $\overline{\text{EN}}$ pin low to enable the FP6141 and turn off the device by pulling it high. The $\overline{\text{EN}}$ pin can't be left floating and must be tied to the ground if not used.

Thermal Shutdown

Thermal shutdown is employed to prevent the device damaged from the junction temperature exceeding safe margins mainly due to short circuit or current limit. Moreover, the device will return to normal operation when the junction temperature is down to a constant temperature. Though temperature protection circuit is built in to protect IC, the maximum power dissipation design within T_j (max) is needed. The thermal protection is independent to each channel.

Thermal Consideration

The power handling capability of the device will be limited by maximum 125°C operation junction temperature. 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.

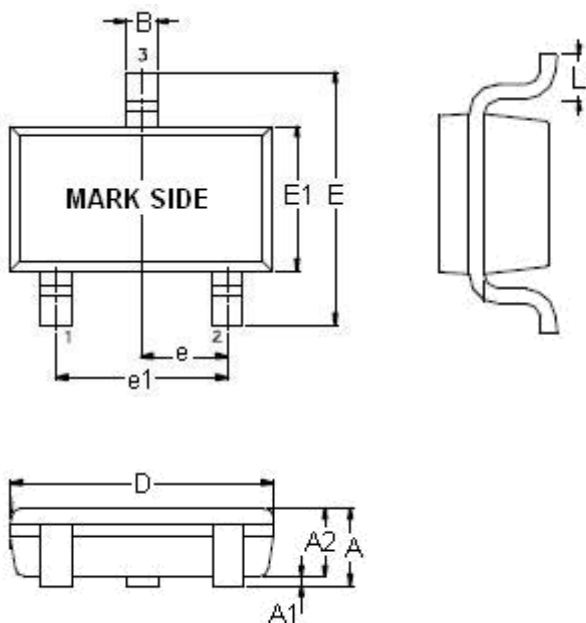
Capacitor Selection

The ceramic capacitor is ideal for FP6141 application. 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 (ceramic, aluminum and tantalum) have different characterizations such as voltage and temperature 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 1μF to 10μF X5R or X7R dielectric ceramic capacitors, because X5R or X7R hold their capacitance over wider voltage and temperature ranges than other Y5V or Z5U types. The ESR of output capacitor is very important, because it generates a zero to provide phase lead for loop stability. The input capacitor can reduced peak current and noise at power source.

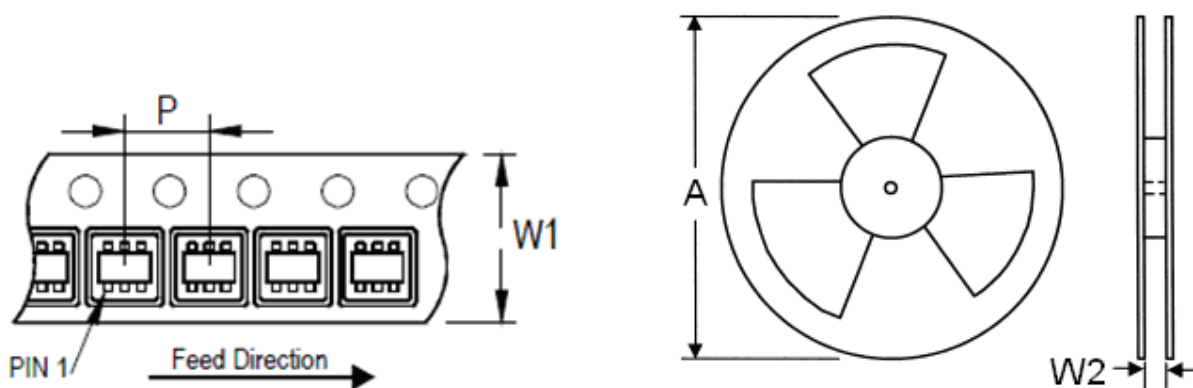
Outline Information

SOT-23-3 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
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

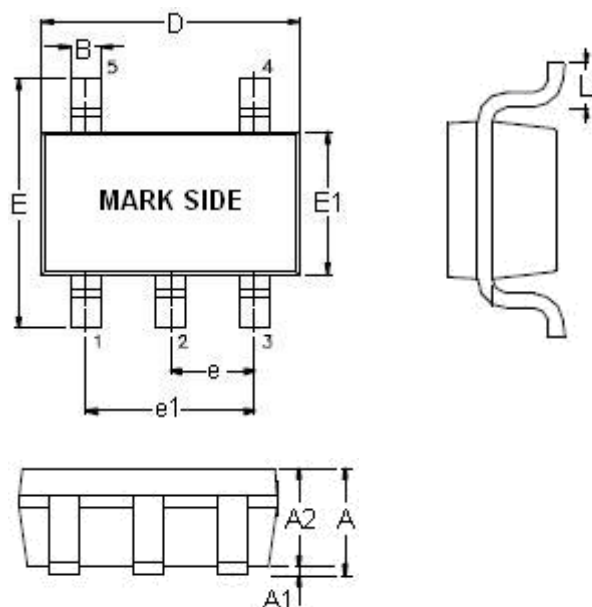
Carrier Dimensions



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

Outline Information (Continued)

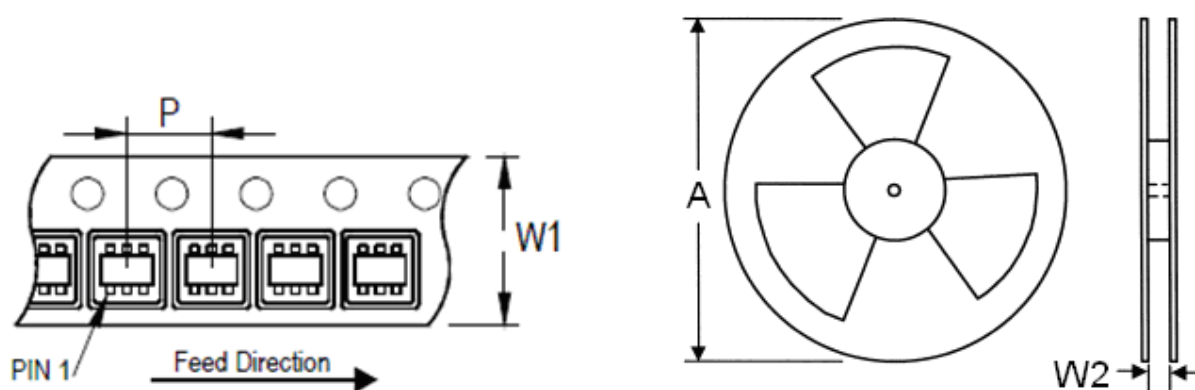
SOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
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 : Followed From JEDEC MO-178-C.

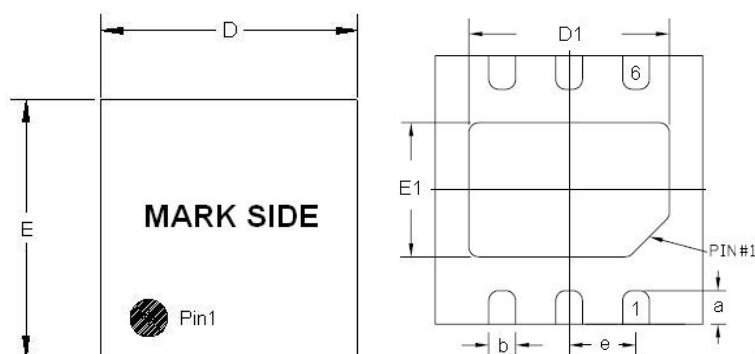
Carrier Dimensions



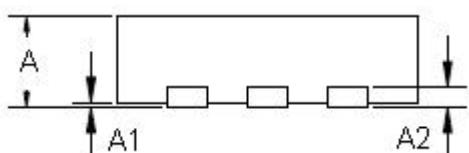
Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	300~1000	3,000

Outline Information (Continued)

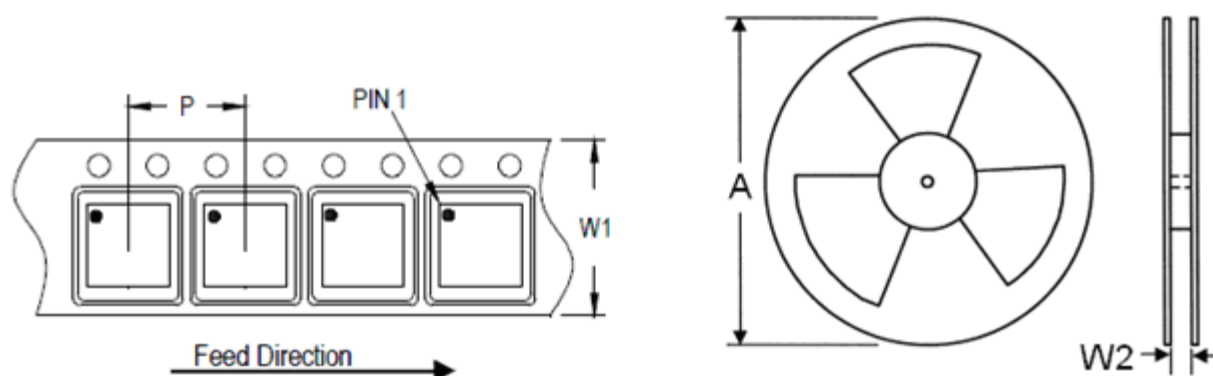
TDFN-6 (1.6mm × 1.6mm) Package (Unit: mm)



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



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	400~1000	3,000

Life Support Policy

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