

### Features

- 2μA Ground Current at no Load
- ±2% Output Accuracy
- 600mA Output Current
- 10nA Disable Current ( by option )
- Wide Operating Input Voltage Range: 1.2V to 5.5V
- Dropout Voltage: 0.32V at 600mA/ V<sub>OUT</sub> 3.3V
- Support Fixed Output Voltage 1.2V, 1.5V, 1.6V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V
- Stable with Ceramic or Tantalum Capacitor
- Current Limit Protection
- Over Temperature Protection
- SOT23-3, SOT23-5, DFN-4(1x1) and DFN-6(2x2) Packages

### General Description

The TP162C series are a group of low-dropout ( LDO ) voltage regulators offering the benefits of wide input voltage range from 1.2V to 5.5V, low dropout voltage, low power consumption, and miniaturized packaging. Quiescent current of only 2μA makes these devices ideal for powering the battery-powered, always-on systems that require very little idle-state power dissipation to a longer service life. There is an option of

shutdown mode by selecting the parts with the EN pin and pulling it low. The shutdown current in this mode goes down to only 10nA ( typical ).

The TP162C series of linear regulators are stable with the ceramic output capacitor over its wide input range from 1.2V to 5.5V and the entire range of output load current ( 0mA to 600mA ).

### Ordering Information

#### TP162C33S5

S5: SOT23-5 Package  
S3L: SOT23-3 Package  
D4: DFN1X1-4L Package  
D6: DFN2X2-6LPackage

Output voltage: 12=1.2V  
15=1.5V  
18=1.8V  
30=3.0V  
33=3.3V  
XX=X.XV

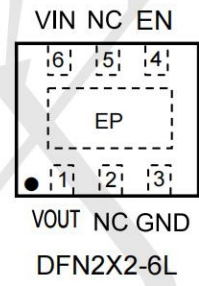
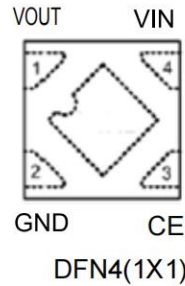
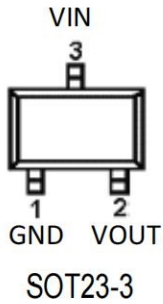
### Applications

- Portable, Battery Powered Equipment
- Low Power Microcontrollers
- Laptop, Palmtops and PDAs
- Wireless Communication Equipment
- Audio/Video Equipment
- Car Navigation Systems

### Marking:

TP162C33S5 : P E33  
TP162C30S5 : P E30  
TP162C28S5 : P E28  
TP162C18S5 : P E18  
TP162C15S5 : P E15  
TP162C12S5 : P E12

**PIN CONFIGURATION**



**Typical Application Circuit**

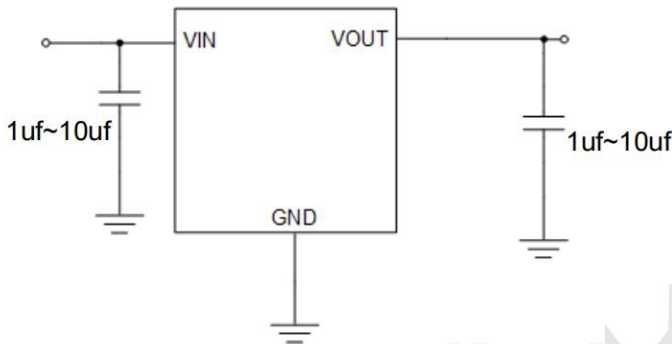


Figure 1: Application circuit of Fixed  $V_{OUT}$  LDO

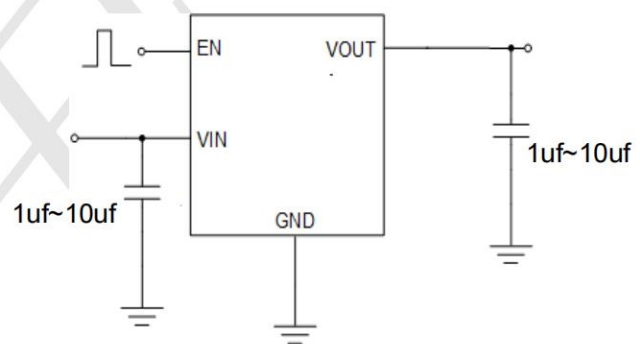


Figure 2: Application circuit of Fixed  $V_{OUT}$  LDO with enable function

**ABSOLUTE MAXIMUM RATINGS**

VIN Pin to GND Pin Voltage .....		-0.3V to 6.5V
VOUT Pin and EN Voltage .....		-0.3V to 6V
VOUT Pin to VIN Pin Voltage .....		-6V to 0.3V
Storage Temperature Range .....		-60°C~150°C
Lead Temperature (Soldering, 10 sec) .....		260°C
Junction Temperature .....		150°C
Operating Ambient Temperature Range $T_A$ .....		-40°C~85°C
Thermal Resistance Junction to Case, $R_{\theta JC}$	SOT23-3 .....	115°C/W
	SOT23-5 .....	115°C/W
	DFN-4(1x1) .....	65°C/W
	DFN-6(2x2) .....	30°C/W
Thermal Resistance Junction to Ambient, $R_{\theta JA}$	SOT23-3 .....	250°C/W
	SOT23-5 .....	250°C/W
	DFN-4(1x1) .....	195°C/W
	DFN-6(2x2) .....	165°C/W

**Electrical Characteristics** ( $T_A=25\text{ C}$  unless otherwise noted)

( $V_{IN}=5V$ ,  $V_{EN}=5V$   $T_A=25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Supply Voltage	$V_{IN}$		1.2	--	5.5	V	
DC Output Voltage Accuracy		$I_{LOAD}=0.1\text{mA}$	-2		2	%	
Dropout Voltage ( $I_{LOAD}=600\text{mA}$ ) (Note 3)	$V_{DROP\_3V}$	$V_{OUT} \geq 3V$		0.32		V	
	$V_{DROP\_2.8V}$	$V_{OUT} = 2.8V$		0.36			
	$V_{DROP\_2.5V}$	$V_{OUT} = 2.5V$		0.36			
	$V_{DROP\_1.8V}$	$V_{OUT} = 1.8V$		0.57			
	$V_{DROP\_1.5V}$	$V_{OUT} = 1.5V$		0.71			
	V	$V = 1.2V$		0.8			
Ground Current	$I_Q$	$I_{LOAD}=0\text{mA}$		2		$\mu\text{A}$	
Shutdown Ground Current	$I_{SD}$	$V_{EN}=0V$ ,		0.01	0.5	$\mu\text{A}$	
$V_{OUT}$ Shutdown Leakage Current	$I_{LEAK}$	$V_{OUT}=0V$		0.01	0.5		
Enable Threshold Voltage	$V_{IH}$	EN Rising			2	V	
	$V_{IL}$	EN Falling	0.6				
EN Input Current	$I_{EN}$	$V_{EN}=5V$		10	100	nA	
Line Regulation	$\Delta_{LINE}$	$I_{LOAD}=30\text{mA}$ , $1.5V \leq V_{IN} \leq 5.5V$ or $(V_{OUT} + 0.2V) \leq V_{IN} \leq 5.5V$		0.2		%	
Load Regulation	$\Delta_{LOAD}$	$10\text{mA} \leq I_{LOAD} \leq 0.3A$		0.2		%	
Output Current Limit	$I_{LIM}$	$V_{OUT}=0$	601	1100		mA	
Power Supply Rejection Ratio ( $I_{LOAD}=5\text{mA}$ )	PSRR	$V_{OUT}=1.2V$ ,	f = 100Hz	--	80	--	dB
		$V_{IN}=2V$	f = 1kHz	--	75	--	
Output Voltage Noise (BW = 10Hz to 100kHz, $C_{OUT}=1\mu\text{F}$ .)		$V_{IN}=3.5V$	$V_{OUT}=0.9V$	--	40	--	$\mu\text{V}_{RMS}$
		$I_{LOAD}=0.1A$	$V_{OUT}=2.8V$	--	50	--	
Thermal Shutdown Temperature	$T_{SD}$	$I_{LOAD}=10\text{mA}$		--	155	--	$^\circ\text{C}$
Thermal Shutdown Hysteresis	$\Delta T_{SD}$			--	15	--	$^\circ\text{C}$
Discharge Resistance		$EN=0V$ , $V_{OUT}=0.1V$	--	100	--	$\Omega$	

**Note 1.** Stresses beyond those listed “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

**Note 2.**  $\theta_{JA}$  is measured at  $T_A = 25^\circ\text{C}$  on a TECH PUBLICboard.

**Note 3.**  $V_{DROP} = V_{IN} - V_{OUT}$  when the  $V_{OUT}$  is 98% of its target value.

**Typical Characteristics**

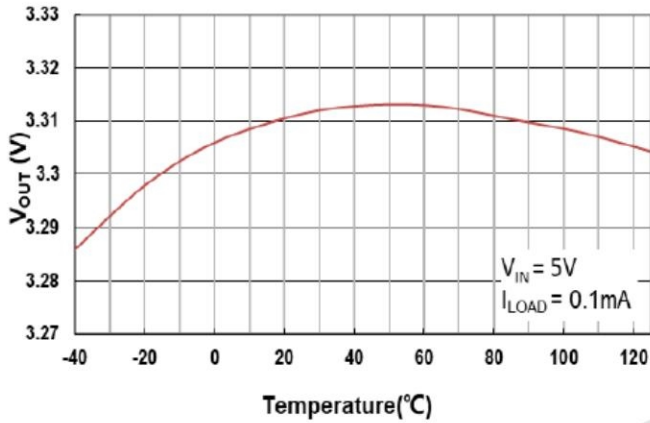


Fig. 5 Output Voltage vs. Temperature

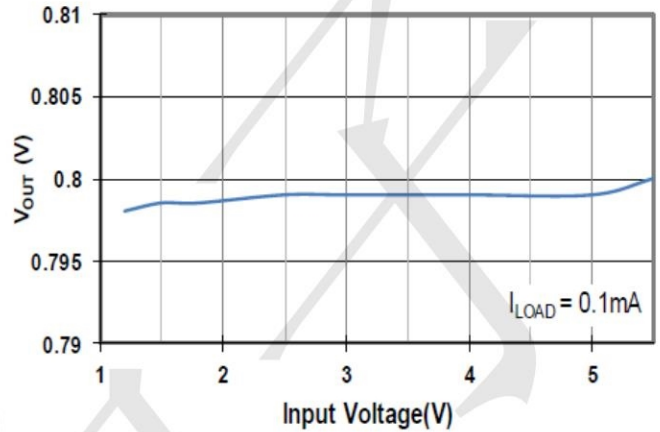


Fig. 6 Output Voltage vs. Input Voltage

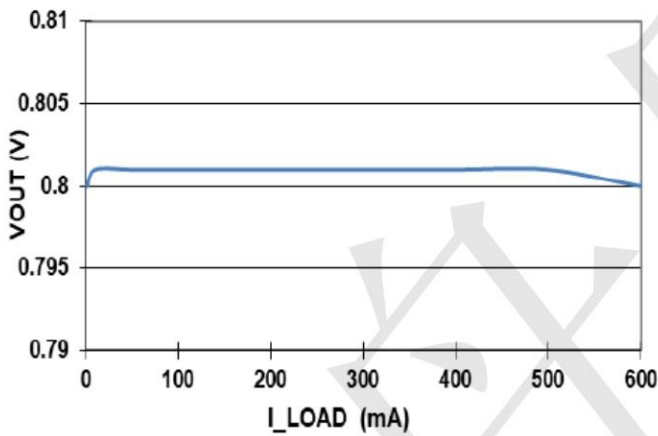


Fig. 7 Output Voltage vs. Load Current

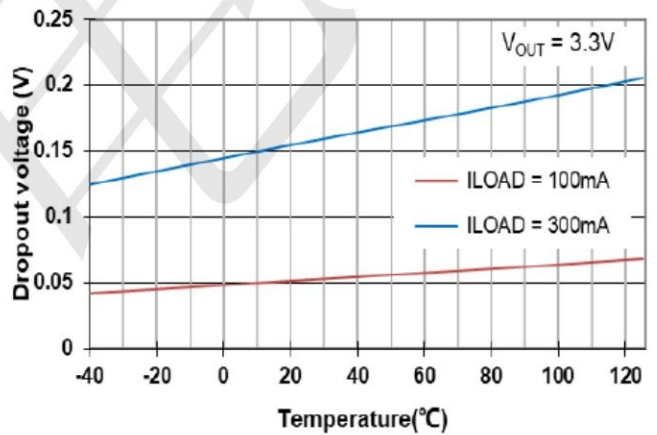


Fig. 8 Dropout Voltage vs. Temperature

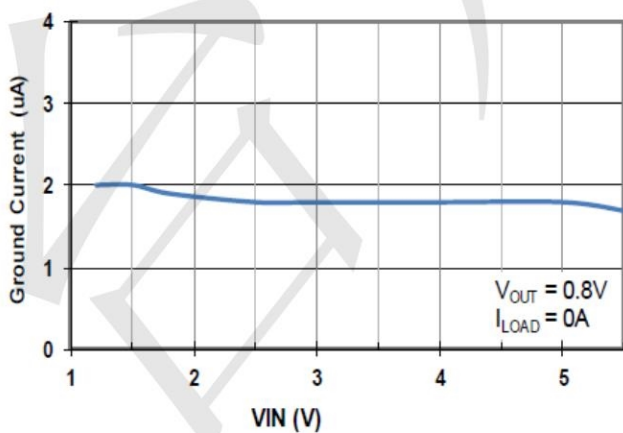


Fig. 9 Ground Current vs. Input Voltage

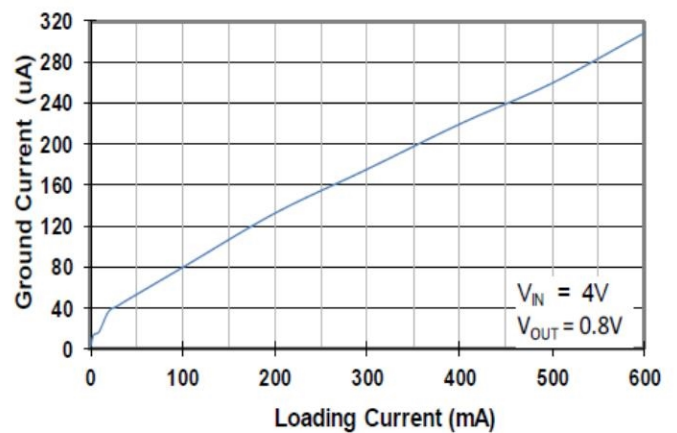
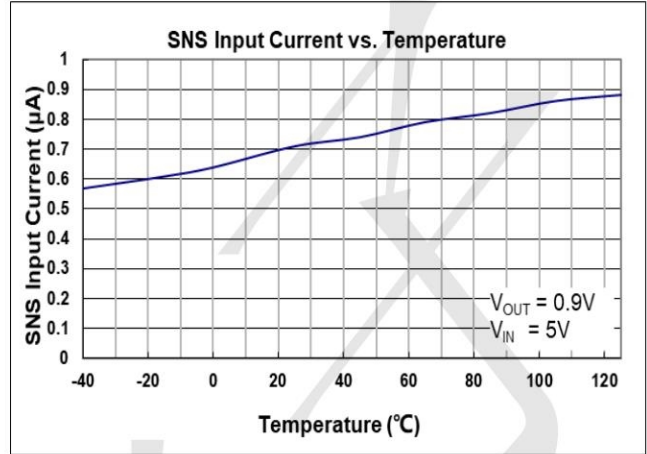
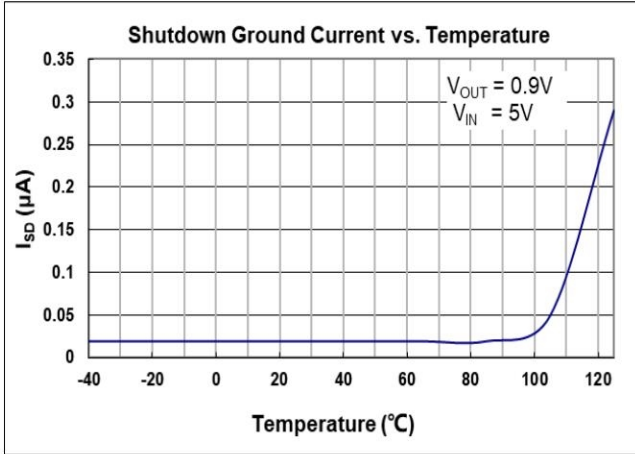
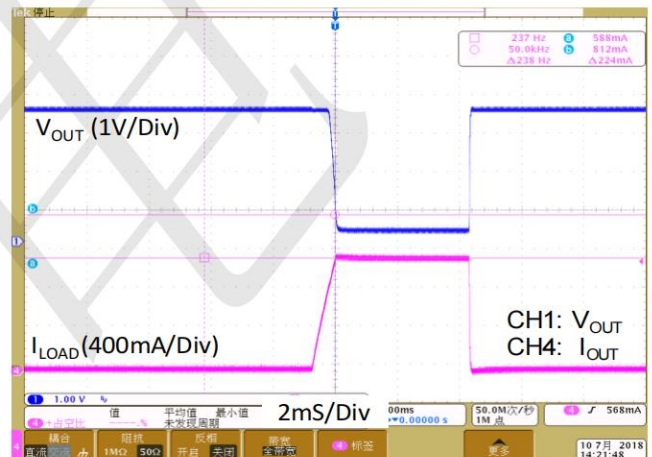
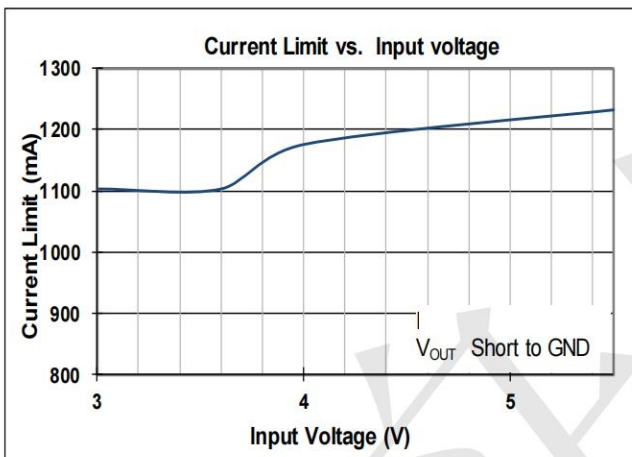


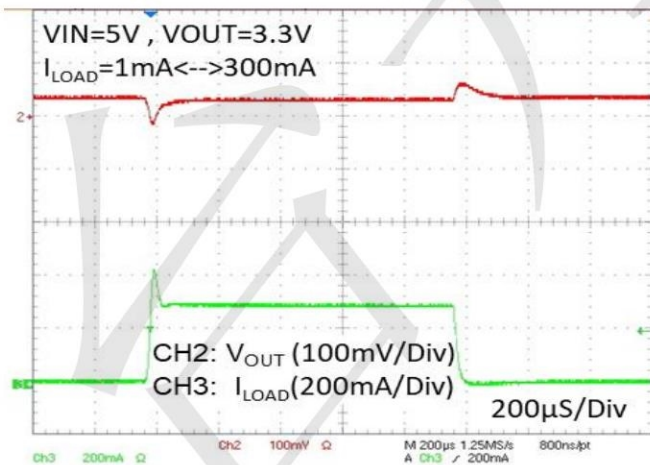
Fig. 10 Ground Current vs. Loading Current



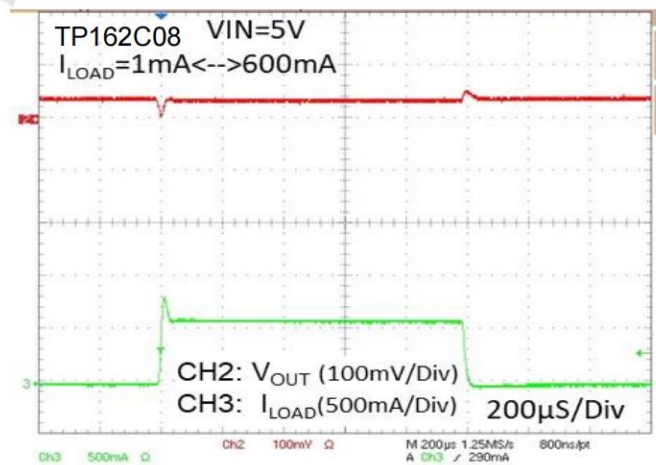
**Current Limit Response**



**Load Transient Response I**



**Load Transient Response II**



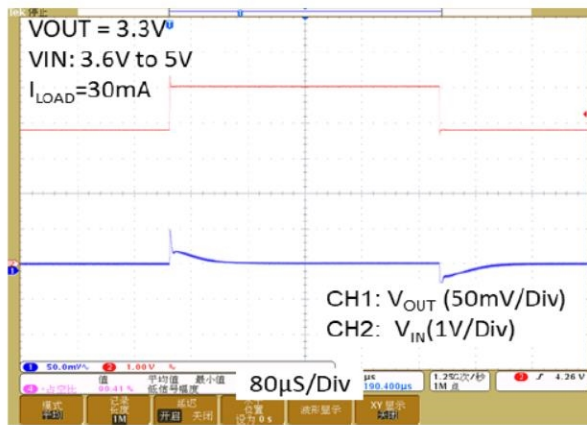


Fig. 17 Line Transient Response

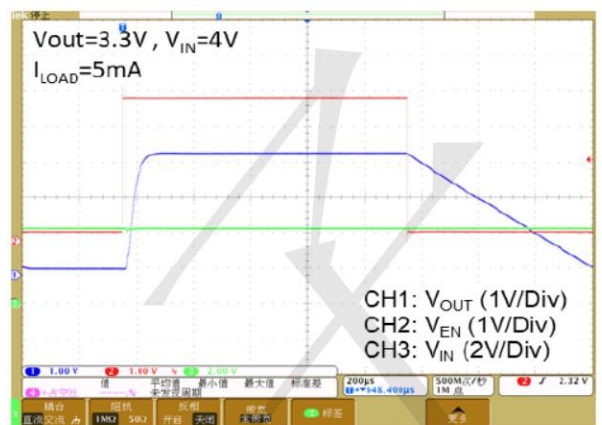


Fig. 18 V<sub>OUT</sub> Turn On/Off by EN

**BLOCK DIAGRAM**

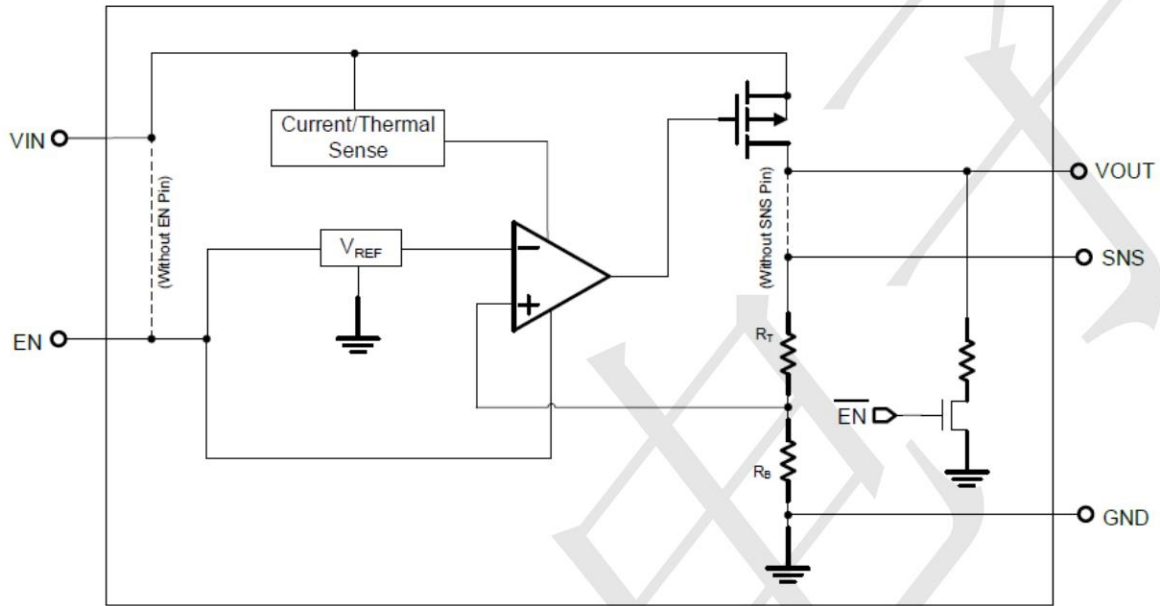


Figure 2. TP162C Block Diagram



### **Input and Output Capacitor Requirements**

The external input and output capacitors of TP162C series must be properly selected for stability and performance. Use a 1 $\mu$ F or larger input capacitor and place it close to the IC's  $V_{IN}$  and GND pins. Any output capacitor meeting the minimum 1m $\Omega$  ESR (Equivalent Series Resistance) and effective capacitance between 1 $\mu$ F and 22 $\mu$ F requirement may be used. Place the output capacitor close to the IC's  $V_{OUT}$  and GND pins. Increasing capacitance and decreasing ESR can improve the circuit's PSRR and line transient response.

### **Current Limit**

The TP162C series contain the current limiter of output power transistor, which monitors and controls the transistor, limiting the output current to 1100mA (typical).

The output can be shorted to ground indefinitely without damaging the part.

### **Dropout Voltage**

The TP162C series use a PMOS pass transistor to achieve low dropout. When ( $V_{IN} - V_{OUT}$ ) is less than the dropout voltage ( $V_{DROP}$ ), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the  $R_{DS(ON)}$  of the PMOS pass element.  $V_{DROP}$  scales approximately with the output current because the PMOS device behaves as a resistor in dropout condition.

As any linear regulator, PSRR and transient response are degraded as ( $V_{IN} - V_{OUT}$ ) approaches dropout condition.

### **OTP (Over Temperature Protection)**

The over temperature protection function of TP162C series will turn off the P-MOSFET when the junction temperature exceeds 155°C (typ.). Once the junction temperature cools down by approximately 15°C, the regulator will automatically resume operation.

### **Thermal Application**

For continuous operation, do not exceed the absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated as below:

$$T_A = 25^\circ\text{C}, \text{TECHPUBLIC PCB},$$

$$\text{The max PD (Max)} = (125^\circ\text{C} - 25^\circ\text{C}) / (200^\circ\text{C/W}) = 0.5\text{W for SOT-23-3 \& SOT-23-5 packages.}$$

Power dissipation (PD) is equal to the product of the output current and the voltage drop across the output pass element, as shown in the equation below:

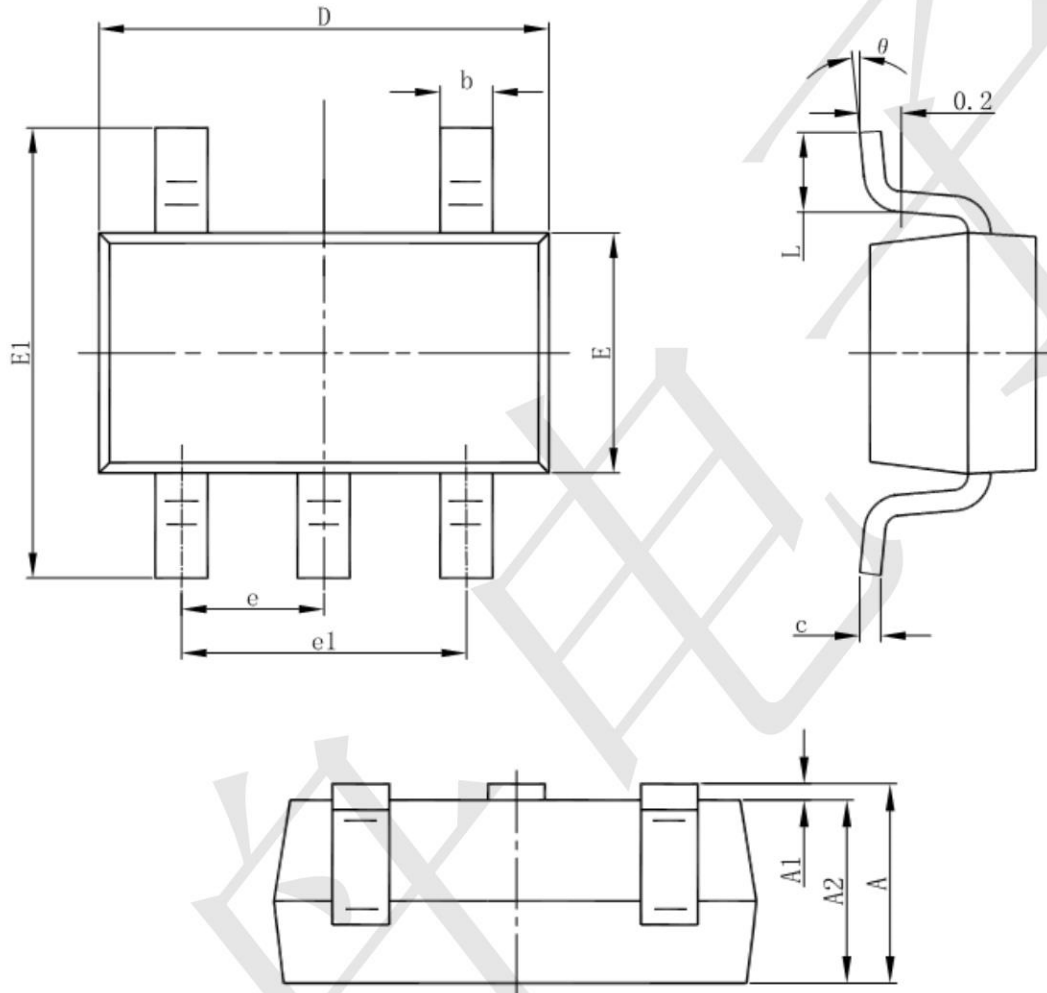
$$PD = (V_{IN} - V_{OUT}) \times I_{OUT}$$

### **Layout Consideration**

By placing input and output capacitors on the same side of the PCB as the LDO, and placing them as close as is practical to the package can achieve the best performance. The ground connections for input and output capacitors must be back to the TP162C ground pin using as wide and as short of a copper trace as is practical.

Connections using long trace lengths, narrow trace widths, and/or connections through via must be avoided. These add parasitic inductances and resistance that results in worse performance especially during transient conditions.

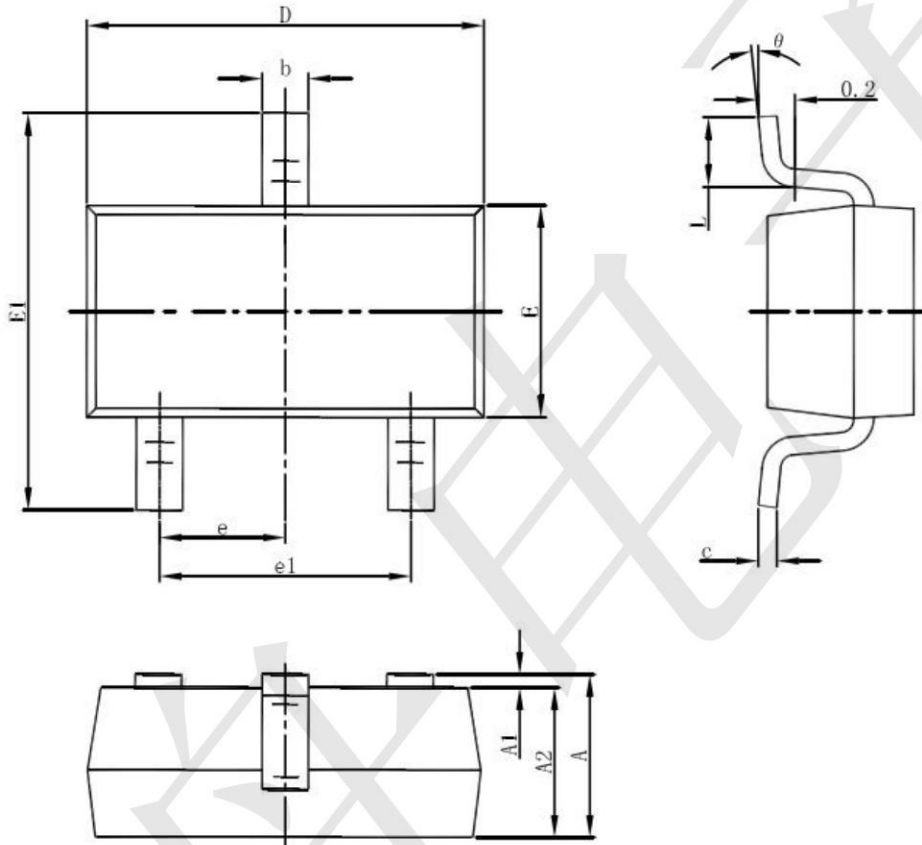
**Package informantion**  
SOT23-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°

**Package informantion**

SOT23-3

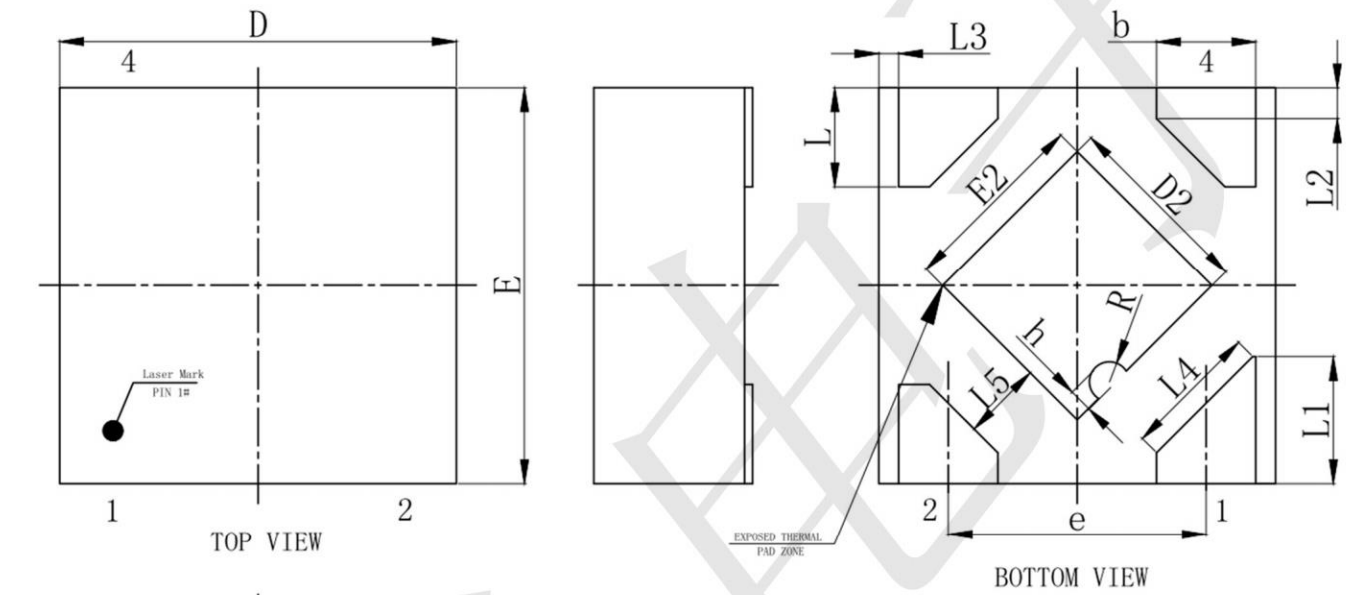


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

**Package informantion**

[www.sot23.com.tw](http://www.sot23.com.tw)

DFN1X1-4L

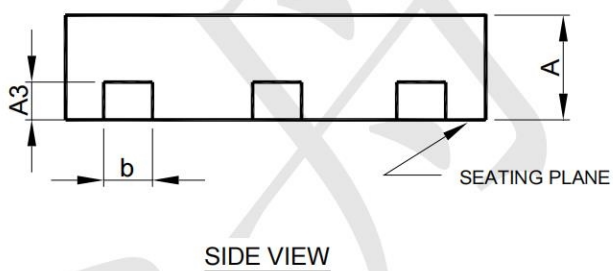
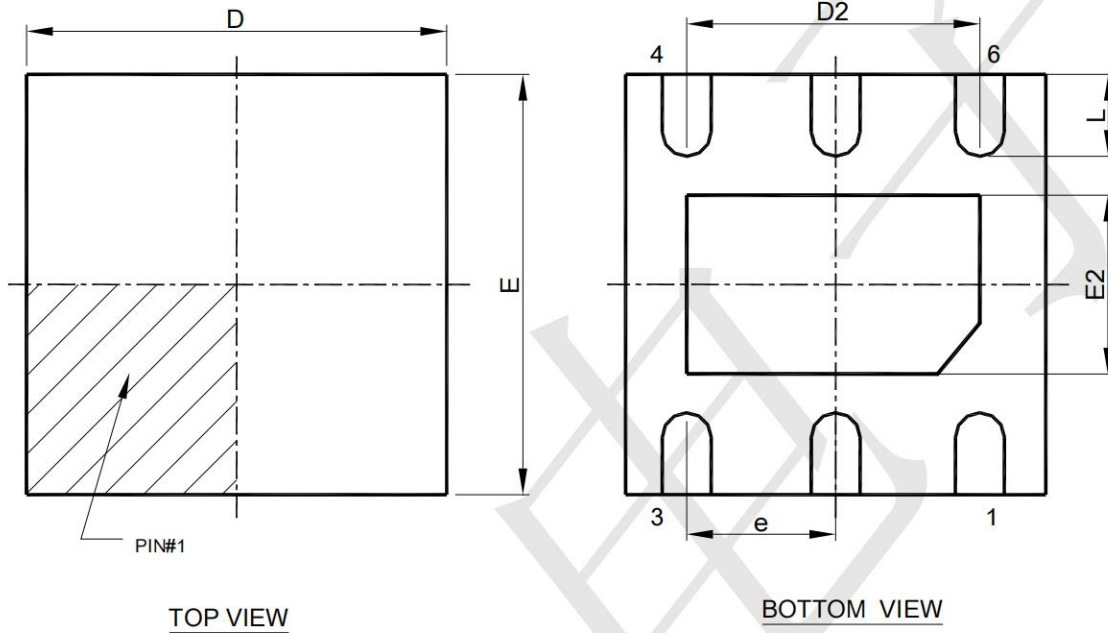


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.35	-	0.40
A1	0.00	0.02	0.05
b	0.20	0.25	0.30
c	0.07	0.12	0.17
D	0.95	1.00	1.05
D2	0.38	0.48	0.58
e	0.65BSC		
E	0.95	1.00	1.05
E2	0.38	0.48	0.58
L	0.20	0.25	0.30
L1	0.27	0.32	0.37
L2	0.077REF		
L3	0.05REF		
L4	0.34REF		
L5	0.20REF		
R	0.05REF		
h	0.06REF		

**Package informantion**

[www.sot23.com.tw](http://www.sot23.com.tw)

DFN2X2-6L



SYMBOL	DFN-6 (2x2x0.75-0.65)	
	MILLIMETERS	
	MIN.	MAX.
A	0.70	0.80
A3	0.20 BSC	
b	0.20	0.35
D	2.00 BSC	
D2	1.10	1.60
E	2.00 BSC	
E2	0.55	0.85
e	0.65 BSC	
L	0.25	0.45