亞瑟萊特科技股份有限公司 AXElite Technology Co.,Ltd

100mA Ultra-Low Quiescent Current
Low Dropout Regulator

❖ GENERAL DESCRIPTION

The AX6648 is a CMOS low dropout voltage (LDO) regulator with ultra-low quiescent current of 4μA, 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 1μF for input and output capacitors makes it ideal in space-sensitive applications.

The AX6648 is available in space saving 3-pin TSOT-23-3L, 5-pin TSOT-23-5L and 6-pin TDFN-6L packages.
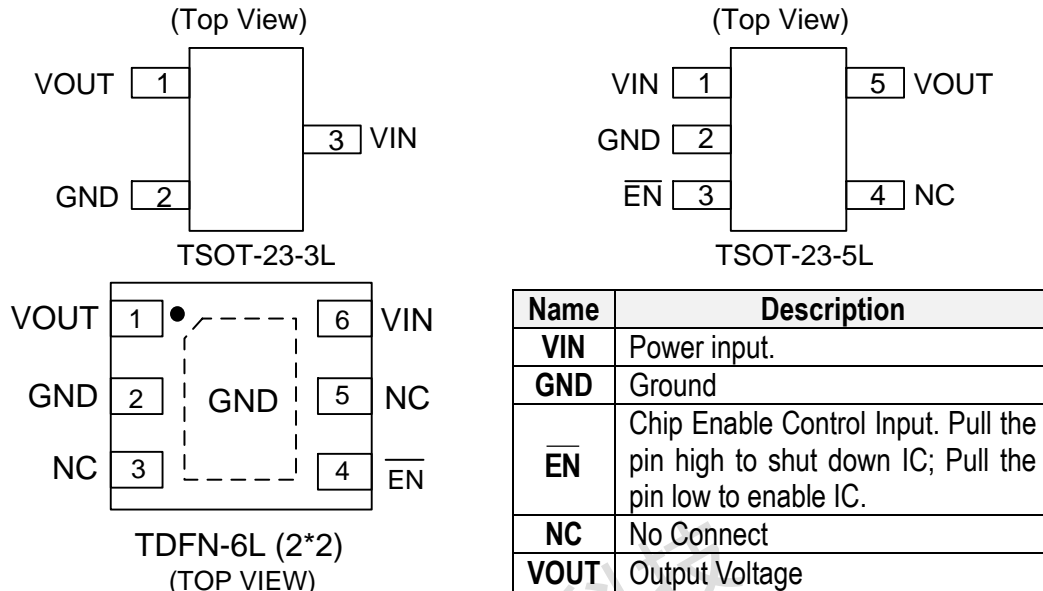
❖ FEATURES

- Ultra-Low Quiescent current at 4μA
- High Output Voltage Accuracy at ±2%
- Low Dropout Voltage of 450mV at 100mA
- Wide Input Operating Voltage Range from 2 to 5.5V
- Current Limit Protection
- Thermal Shutdown Protection
- 1μF Output Capacitor Required for Stability
- Chip Enable Control (AX6648XXBT and AX6648XXZ6 Only)
- RoHS Compliant
- Available in the TSOT-23-3L , TSOT-23-5L and TDFN-6L Packages

❖ BLOCK DIAGRAM
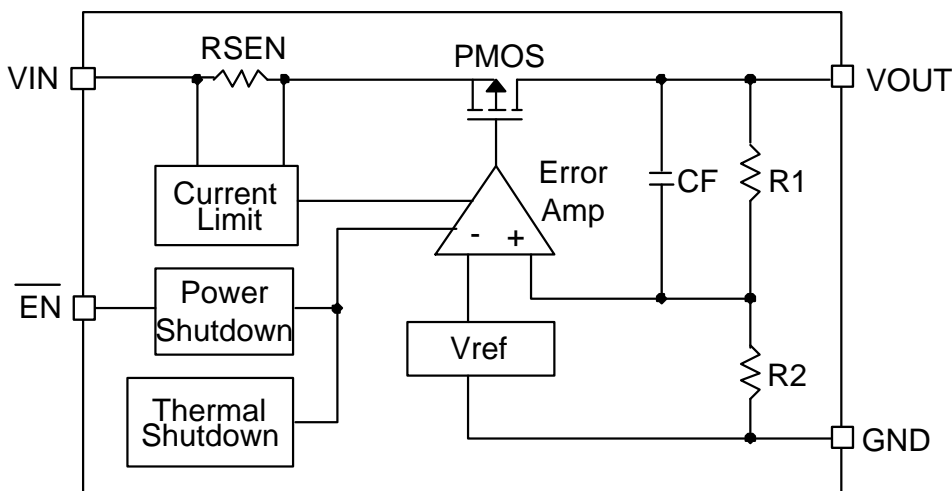
❖ **PIN ASSIGNMENT**

The packages of AX6648 are TSOT-23-3L, TSOT-23-5L and TDFN-6L; the pin assignment is given by:

(Top View)

| VOUT | 1 | | | |
| GND | 2 | | 3 | VIN |

TSOT-23-3L

(Top View)

VIN	1		5	VOUT
GND	2			
$\overline{EN}$	3		4	NC

TSOT-23-5L

VOUT	1		6	VIN
GND	2	GND	5	NC
NC	3		4	$\overline{EN}$

TDFN-6L (2*2)
(TOP VIEW)

Name	Description
VIN	Power input.
GND	Ground
$\overline{EN}$	Chip Enable Control Input. Pull the pin high to shut down IC; Pull the pin low to enable IC.
NC	No Connect
VOUT	Output Voltage

❖ **ORDER/MARKING INFORMATION**

Order Information
AX6648 - XX XX X
Output voltage   Package   Packing 12 : 1.2V   RT : TSOT-23-3L   Blank: Bag 15 : 1.5V   BT : TSOT-23-5L   A : Taping 18 : 1.8V   Z6 : TDFN-6L 25 : 2.5V 30 : 3.0V 33 : 3.3V

Top Marking (TSOT-23-3L/TSOT-23-5L)	Top Marking (TDFN-6L)

L L Y W X → ID code:internal
→ WW:01~26 (A~Z)
    27~52 (a~z)
→ Year: A=2010
    1=2011
Identification code
	L L → Identification Code
	Y W X → ID Code: Internal
	→ Week: 01~26(A~Z)
	    27~52(a~z)
	→ Year : A = 2010
	    1 = 2011

Appendix

Part Number	Identification Code
	TSOT-23-3L /TDFN-6L
AX6648-1.2V	AA
AX6648-1.5V	AB
AX6648-1.8V	AC
AX6648-2.5V	AD
AX6648-3.0V	AE
AX6648-3.3V	AF

❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

| Characteristics		Symbol	Rating	Unit
Input Voltage		V_{IN}	+2.0 to +5.5	V
$\overline{EN}$ Pin Voltage		V_{EN}	V_{IN} + 0.3	V
Power Dissipation		PD	$(T_J-T_A)/\theta_{JA}$	mW
Storage Temperature Range		T_{ST}	-65 to +150	°C
Lead Temperature (Soldering, 10sec.)			260	°C
Junction Temperature		T_J	+150	°C
Operating Temperature Range			-40 to +85	°C
Thermal Resistance from Junction to case	TSOT-23-3L	θ_{JC}	180	°C/W
	TDFN-6L		25	
Thermal Resistance from Junction to ambient	TSOT-23-3L	θ_{JA}	250	°C/W
	TDFN-6L		120	

Note: θ_{JA} is measured with the PCB copper area of approximately 1 in² (Multi-layer). That need connect to GND pin.

❖ ELECTRICAL CHARACTERISTICS

(V_{IN}=5.5V, V_{EN}=0V, C_{IN}= 1uF, T_A=25°C, unless otherwise noted)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
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} ≥3.6V	100	-	-	mA
Current Limit	I_{LIMIT}	R_{LOAD}=1Ω	150	-	-	mA
Quiescent Current	I_Q	No load	-	4	7	µA
Dropout Voltage	V_{DROP}	I_{OUT}=50mA	-	200	300	mV
		I_{OUT}=100mA	-	450	600	mV
Line Regulation	ΔV_{LINE}	V_{IN} =(V_{OUT}+0.3V) to 6V, V_{IN} ≥3.6V, I_{OUT}=1mA	-0.2	-	+0.2	%/V
Load Regulation	ΔV_{LOAD}	I_{OUT} =0 to 100mA	-	0.01	-	%/mA
Ripple Rejection	P_{SRR}	Freq.=1kHz, C_{OUT}=1µF	-	30	-	dB
Standby Current	I_{SD}	V_{EN}=V_{IN}	-	0.1	-	µA
$\overline{EN}$ Threshold Voltage	$V_{\overline{EN}}$		0.6	1	2	V
Temperature Shutdown	T_S		-	150	-	°C
Temperature Shutdown Hysterisis	T_{SH}		-	20	-	°C

Rev.1.2 Jan.13, 2011

❖ APPLICATION CIRCUIT
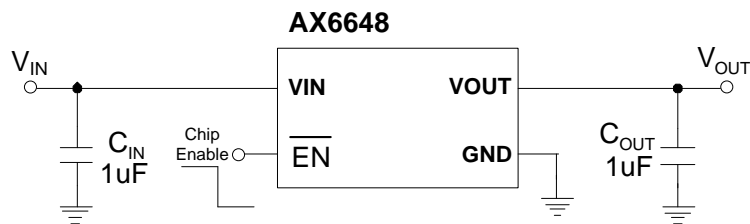
❖ APPLICATION INFORMATION

The AX6648 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 $\overline{EN}$ pin low to enable the AX6648 and turn off the device by pulling it high. The $\overline{EN}$ pin can't be floated and must be tied to the ground if not used.

Thermal Shutdown

Thermal shutdown is employed to protect the device damage from the junction temperature exceed safe margins due mainly to short circuit or current limit. Moreover, the device returns normally operation when the junction temperature protection circuit is built in to protect IC, the maximum power dissipation design within Tj (max) is needed. The thermal protection is independent to each channel.

Thermal Considerations

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.
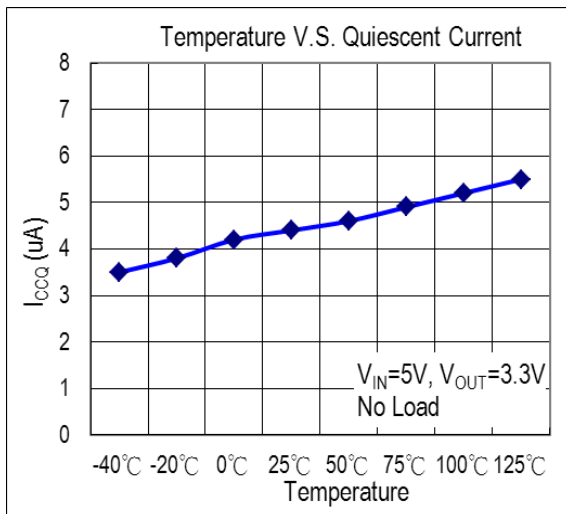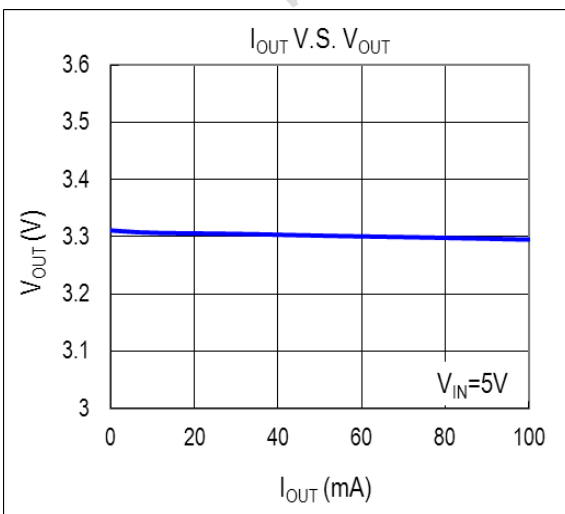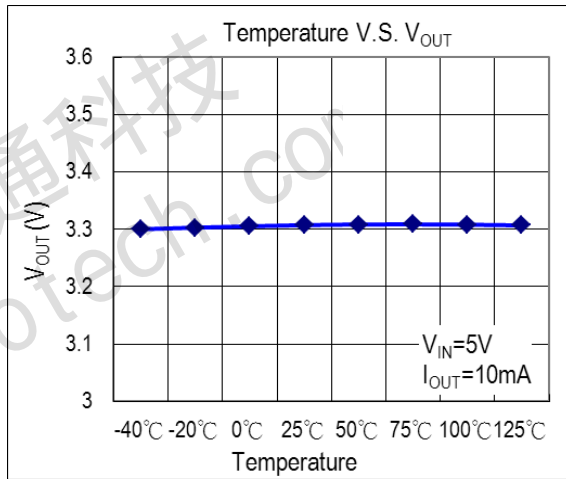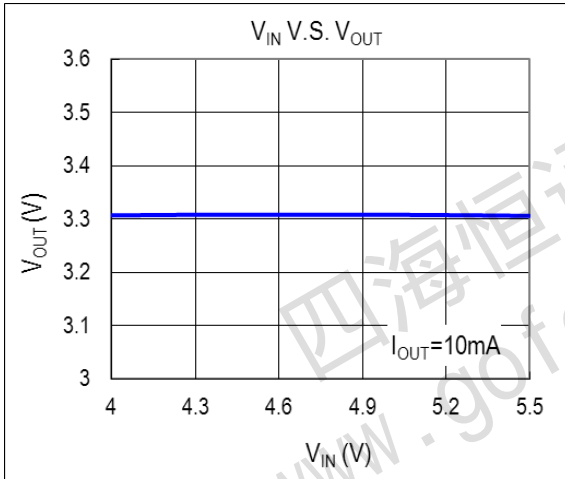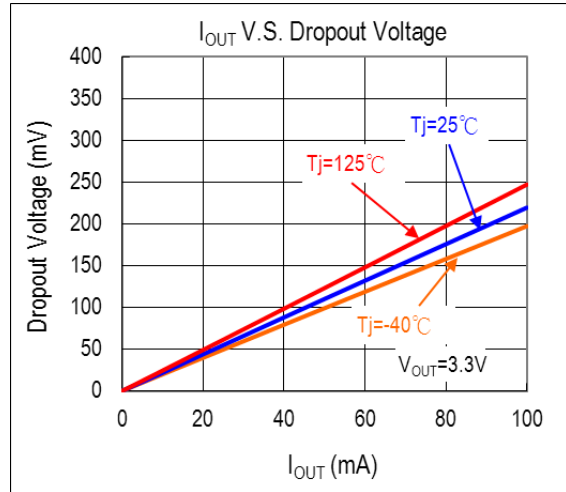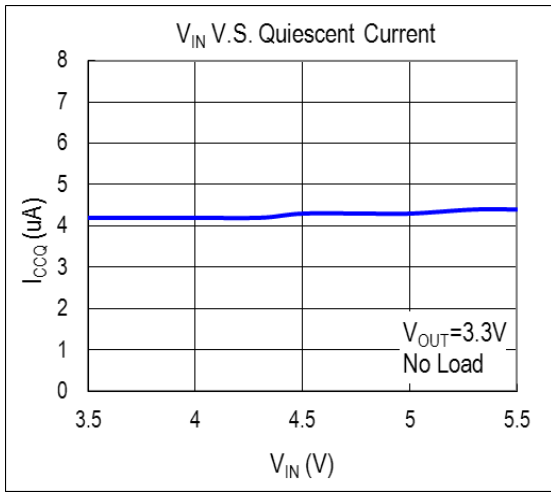
Capacitor Selection

The ceramic capacitor is ideal for AX6648 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.
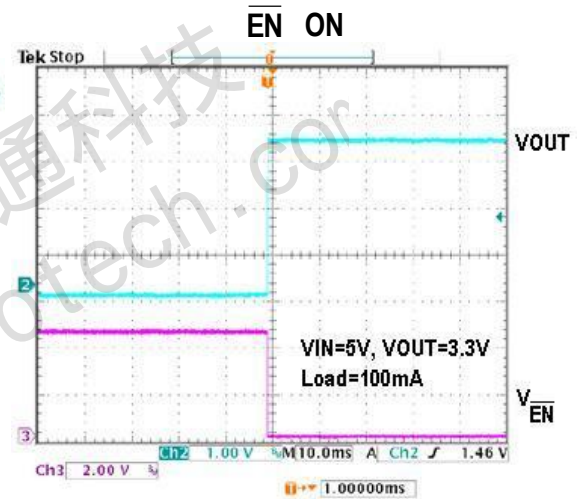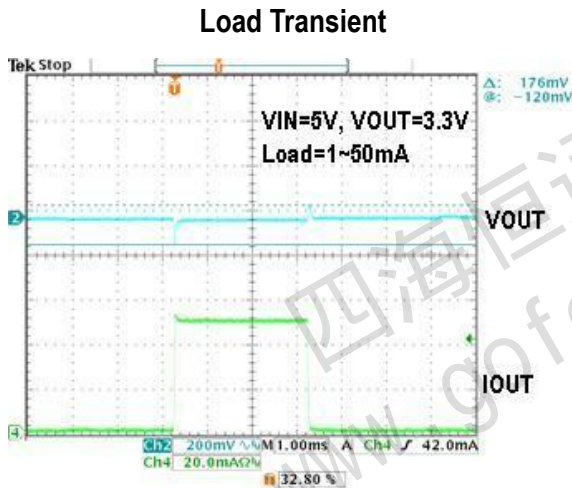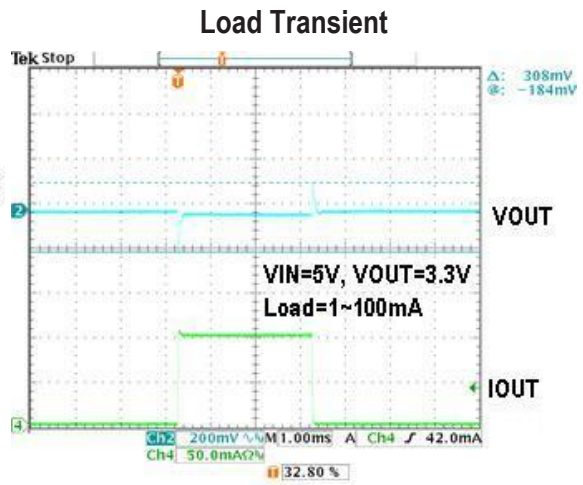
The capacitor types (ceramic, aluminum, and tantalum) have different characterizations such as voltage and temperature coefficients. All ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior across temperature and applications. Common dielectrics used are X5R, X7R and Y5V. It is recommended to use 1μF to 10μF X5R or X7R dielectric ceramic capacitors because X5E or X7R hold their capacitance over wide 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.

❖ TYPICAL CHARACTERISTICS

❖ **TYPICAL CHARACTERISTICS (CONTINUES)**
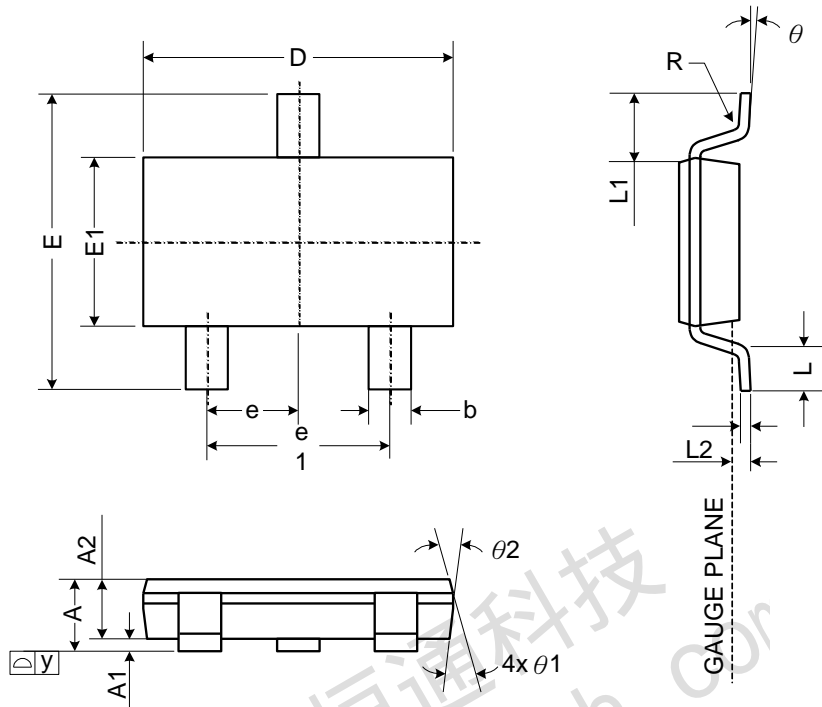
Power ON

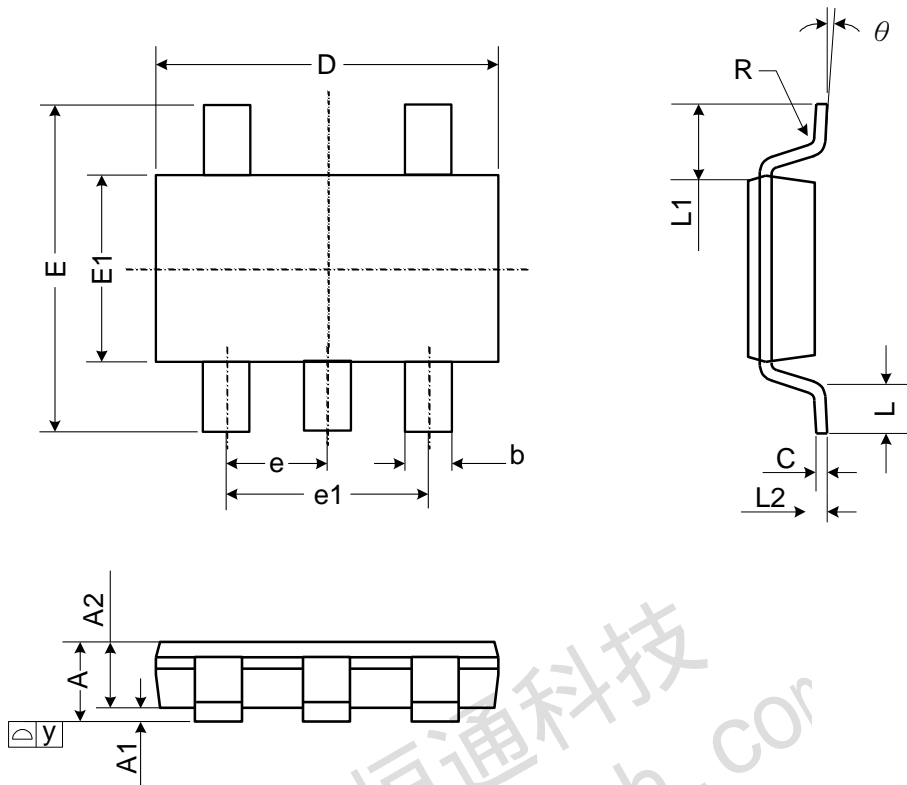

VIN=5V, VOUT=3.3V
Load=100mA

Load Transient

VIN=5V, VOUT=3.3V
Load=1~100mA

Load Transient

VIN=5V, VOUT=3.3V
Load=1~50mA

$\overline{EN}$ ON

VIN=5V, VOUT=3.3V
Load=100mA

Rev.1.2 Jan.13, 2011
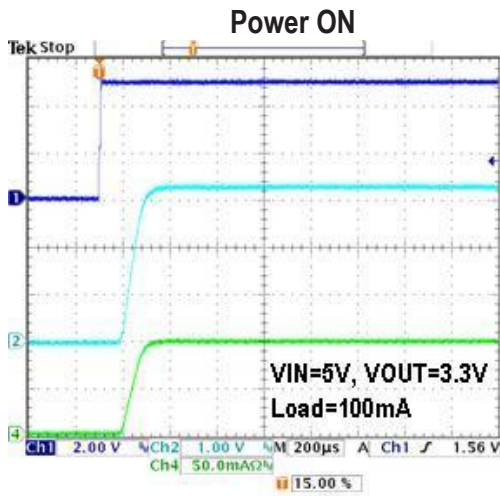
❖ PACKAGE OUTLINES

(1) TSOT-23-3L

Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.75	-	0.90	0.030	-	0.035
A1	0.00	-	0.10	0.000	-	0.004
A2	0.70	0.75	0.80	0.028	0.030	0.031
b	0.35	-	0.51	0.014	-	0.020
C	0.10	-	0.25	0.004	-	0.010
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC.			0.037 BSC.		
e1	1.90 BSC.			0.075 BSC.		
L	0.37	-	-	0.015	-	-
L1	0.60 REF.			0.024 REF.		
L2	0.25 BSC.			0.010 BSC.		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-
θ	0º	-	8º	0º	-	8º
θ1	7º NOM.			7º NOM.		
θ2	5º NOM.			5º NOM.		

Rev.1.2 Jan.13, 2011

(2) TSOT-23-5L

Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.10	-	-	0.043
A1	0.00	-	0.10	0	-	0.004
A2	0.70	0.90	1.00	0.028	0.035	0.039
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC.			0.037 BSC.		
e1	1.90 BSC.			0.075 BSC.		
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.60 REF.			0.024 REF.		
L2	0.25 BSC.			0.010 BSC.		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-
θ	0º	-	8º	0º	-	8º

JECED outline: MO-193 AB

Rev.1.2 Jan.13, 2011

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(3) TDNF-6L

(Top View)

(Bottom View)

(SIDE View)
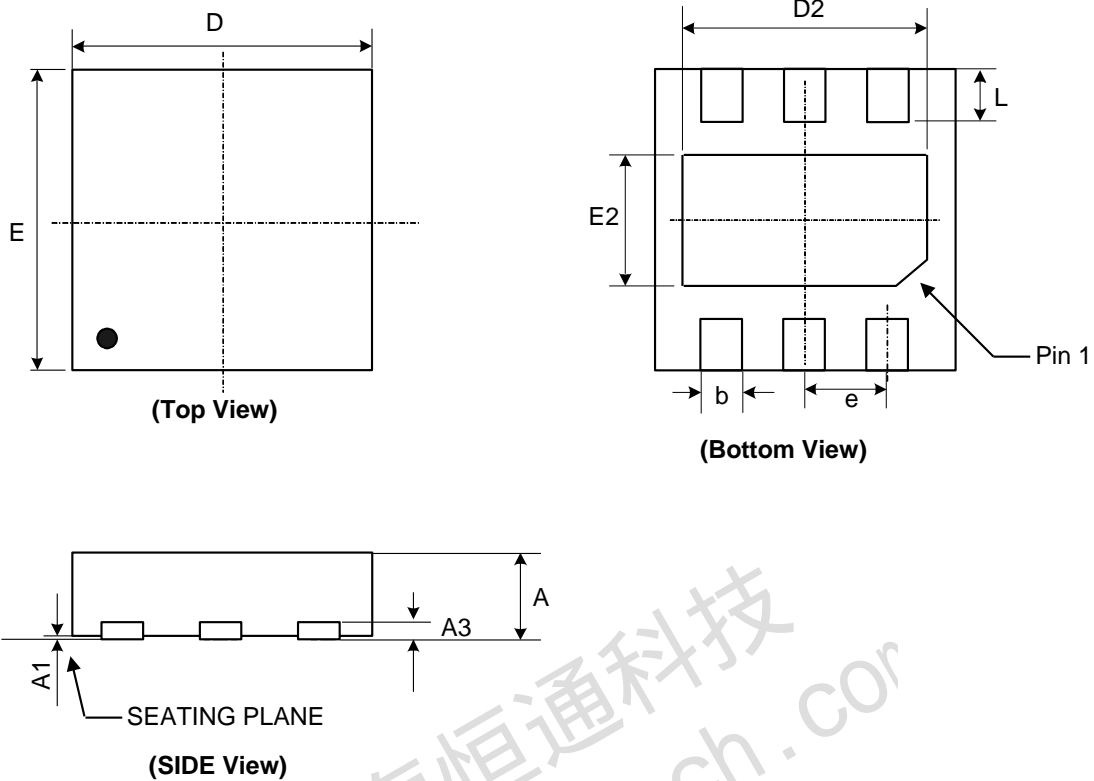
Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.70	0.75	0.80	0.028	0.030	0.031
A1	0.00	0.02	0.05	0.000	0.001	0.002
A3	0.203 REF.			0.008 REF.		
b	0.20	0.28	0.35	0.009	0.011	0.013
D	1.95	2.00	2.05	0.077	0.079	0.081
D2	1.35	1.50	1.65	0.055	0.059	0.063
E	1.95	2.00	2.05	0.077	0.079	0.081
E2	0.75	0.90	1.05	0.031	0.035	0.039
e	0.65 BSC.			0.026 BSC.		
L	0.20	0.30	0.40	0.008	0.012	0.016

Rev.1.2 Jan.13, 2011