500mA, Ultra-Low Noise, High PSRR CMOS LDO Regulator with Soft Start Function

REV: 00b

General Description

The LD6919 is a micro power linear regulator with very low output voltage drop during load transient, featuring ultra-low noise, low-dropout and high ripple rejection ratio for optimal performance of battery-powered systems. This SS pin can suppress the noise and is built in with soft start function. Using Leadtrend's own proprietary control scheme, the output voltage can be set by the value chosen for the R_J resistor on SS pin. As well, the LD6919 can be stable with an output capacitor of 1μF which reduces the board space and cost.

The LD6919 is available in a space saving SOT25, SC70-6 and WDFN-6L 1.6mm x 1.6mm package.

+Patented

Features

- Wide Operating Input Voltage Range：2.5V to 5.5V
- Very-Low Output Voltage Drop during Load Transient
- Ultra-Low Noise for RF Application
- Shutdown Current <1μA
- High PSRR 70dB@1kHz
- Stable with 1μF Output Capacitor
- Thermal Shutdown and Current Limiting Protection
- V_{OUT} Discharge Function
- Soft Start Operation
- Fixed Output Voltage: 1.5V to 3.3V (step：0.1V) and 3.45V or adjustable through R_J resistor

Applications

- Battery-Powered Equipment
- Hand-Held Instruments
- Palmtops, Notebook Computers

Typical Application

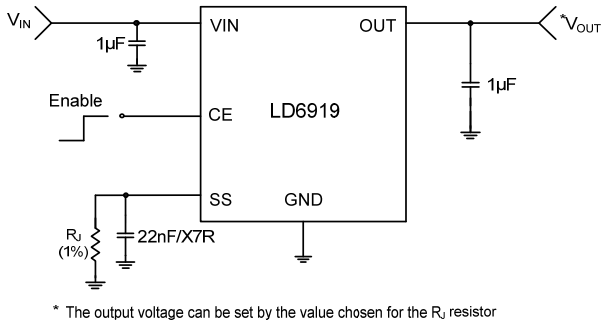
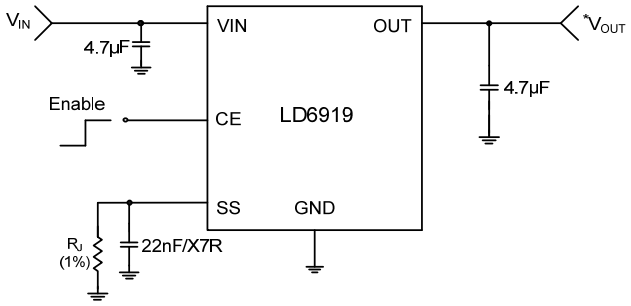


Fig. 1 Typical Application Circuit for General Purpose

Reference example

R_J (Ω)(1%)	V_{OUT}
R_J open	3.1V
2.2M	3.0V
680k	2.8V
510k	2.7V
300k	2.5V
100k	1.8V

$$V_{OUT}(w.R_J) = \frac{R_J(k\Omega)}{R_J(k\Omega)+73} \times V_{OUT}(w/o\,R_J)$$

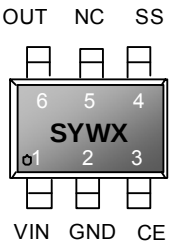


* The output voltage can be set by the value chosen for the R_J resistor

Fig.2 Typical Application Circuit for Analog Front-End Power

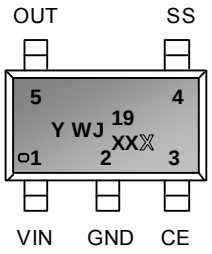
Pin Configuration

SC70-6 (TOP VIEW)



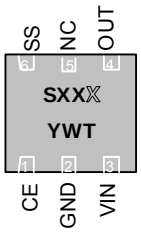
S : LD6919
Y : Year code (D: 2004, E: 2005.....)
W : Week code
X : voltage code (*note 1)

SOT-25 (TOP VIEW)



Y : Year code (D: 2004, E: 2005.....)
W : Week code
J19: LD6919
XX: voltage code (*note 2)

WDFN-6L (1.6mm x 1.6mm)



S : LD6919
XX: voltage code (*note 2)
T: Thickness
W: 0.75mm (normal)

*Note 1 : Voltage Code for SC70-6

Code	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f	g	h	i	j	p
(V)	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.45

*Note 2 : Voltage Code for SOT-25, WDFN-6L

Code	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	345
(V)	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.45

Ordering Information

Part number	Package	TOP MARK	Shipping
LD6919 GL-XX	SOT-25	YWJ/19XX	3000 /tape & reel
LD6919 GU- XX	SC70-6	SYWX	3000 /tape & reel
LD6919 GDAW- XX	WDFN-6L 1.6mm×1.6mm	SXX	3000 /tape & reel

Note 1: The LD6919 is Green Packaged.

Note 2: Part number XX: Output voltage, ex: 15:1.5V, …. 33:3.3V (step 0.1V) and 3.45V

Pin Descriptions

SOT25

PIN	NAME	FUNCTION
1	VIN	Input Voltage
2	GND	IC GND
3	CE	Chip Enable, High=Enable, Low=Disable
4	SS	This pin combines noise reduction and soft start function. Connect a capacitor to GND to adjust soft start time. For soft start operation C_{SS}>1nF is recommended.
5	OUT	Regulator output

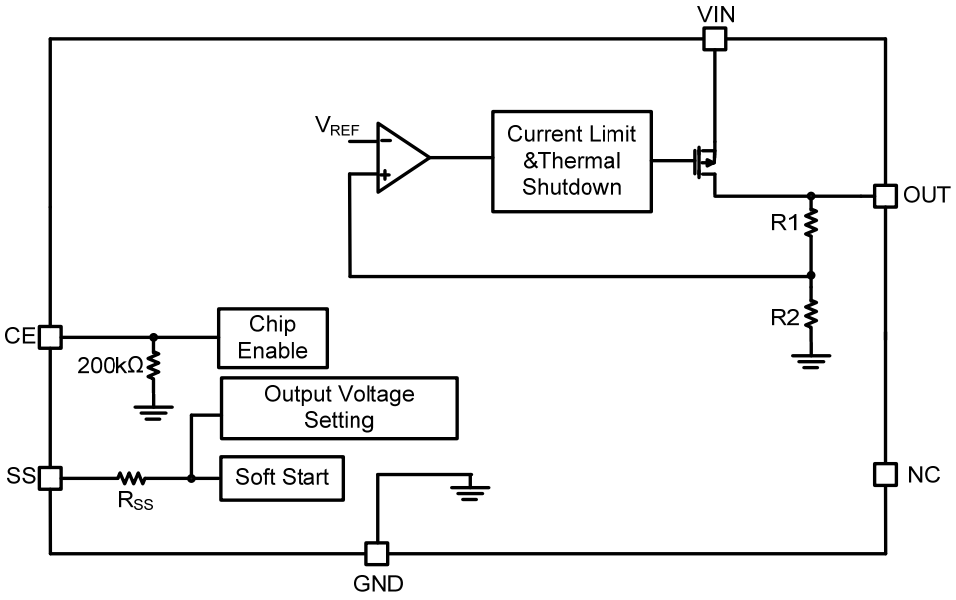
SC70-6

PIN	NAME	FUNCTION
1	VIN	Input Voltage
2	GND	IC GND
3	CE	Chip Enable, High=Enable, Low=Disable
4	SS	This pin combines noise reduction and soft start function. Connect a capacitor to GND to adjust soft start time. For soft start operation C_{SS}>1nF is recommended.
5	NC	No connection
6	OUT	Regulator output

WDFN-6L

PIN	NAME	FUNCTION
1	CE	Chip Enable, High=Enable, Low=Disable
2	GND	IC GND
3	VIN	Input Voltage
4	OUT	Regulator output
5	NC	No connection
6	SS	This pin combines noise reduction and soft start function. Connect a capacitor to GND to adjust soft start time. For soft start operation C_{SS}>1nF is recommended.

Block Diagram



Absolute Maximum Ratings

VIN, VOUT Pin	-0.3V~6V
SS, CE Pin	-0.3V~ (VIN+0.3) V
Power dissipation SOT23-5@Ta=25°C	400mW
Package Thermal Resistance SOT23-5	250°C/W
Power dissipation SC70-6@Ta=25°C	300mW
Package Thermal Resistance SC70-6	333°C/W
Power dissipation WDFN-6L 1.6×1.6 @TA=25°C	571mW
Package Thermal Resistance WDFN-6L 1.6×1.6	175°C/W
Maximum Junction Temperature	150°C
Operating Junction Temperature	-40°C to 125°C
Operating Ambient Temperature	-40°C to 85°C
Storage Temperature Range	-55°C to 125°C
Lead temperature (Soldering, 10sec)	260°C
ESD Level (Human Body Model)	2kV
ESD Level (Machine Model)	200V

Caution:

Stresses beyond the ratings specified in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electrical Characteristics

(VIN=VOUT+1V, T_A = 25 °C, unless otherwise stated. CIN=COUT=1μF, CSS=22nF; the LD6919 is tested with 3.1V output, unless other stated.) (Note 1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT POWER					
Input Voltage		2.5	-	5.5	V
Quiescent Current	CE>1.5V, I_{OUT}=0mA	-	80	105	μA
Shutdown Supply Current	CE=GND	-	0.1	1	μA
Dropt Voltage					
Dropt Voltage (Note2)	I_{OUT}=300mA, 3.6V≤V_{IN}≤5.5V		230	300	mV
	I_{OUT}=500mA, 3.6V≤V_{IN}≤5.5V		380	500	mV
Soft Start					
Soft Start Resistance, R_{SS}		65.7	73	80.3	kΩ
Output					
Output Current Limit	R_{LOAD}=1Ω	550	600		mA
Output Voltage Accuracy	I_{OUT}=10mA, R_J=open	-1.5		+1.5	%
*Reference Example (VOUT)	I_{OUT}=10mA, R_J=open		3.1		V
	I_{OUT}=10mA, R_J=2.2MΩ		3.0		V
	I_{OUT}=10mA, R_J=680KΩ		2.8		V
	I_{OUT}=10mA, R_J=510KΩ		2.7		V
	I_{OUT}=10mA, R_J=300KΩ		2.5		V
	I_{OUT}=10mA, R_J=100KΩ		1.8		V
Line Regulation	V_{IN}=V_{OUT} +1V, to 5.5V, I_{OUT}=1mA	-	0.05	0.2	%/V
Load Regulation	1mA<I_{OUT}<300mA V_{IN}=V_{OUT}+1V, 2.5V≤V_{OUT}≤3.3V	-		0.8	%
	1mA<I_{OUT}<500mA V_{IN}=V_{OUT}+1V, 2.5V≤V_{OUT}≤3.3V			1.6	%
Ripple Rejection	F=120Hz, E_{IN}=1Vrms, I_{OUT}=10mA		70		dB
	F=1kHz, E_{IN}=1Vrms, I_{OUT}=10mA		70	-	dB
	F=10kHz, E_{IN}=1Vrms, I_{OUT}=10mA	-	65	-	dB
Output Noise Voltage	V_{OUT}=1.8V,I_{OUT}=0mA C_{SS}=22nF	-	35	-	μVrms

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Discharge Resistance in shutdown	CE=High to Low	-	80	160	Ω
CE					
Impedance to GND			200		kΩ
CE Input Level	Enable, V_{IN}=2.5V~5.5V	1.5	-	-	V
	Disable, V_{IN}=2.5V~5.5V	-	-	0.6	V
THERMAL PROTECTION					
Thermal Shutdown	V_{OUT} short to GND		150		°C
Hysteresis			30		°C

Note1: Limits are 100% tested at T_A =+25°C. Limits over operating range are guarantee by design.
Note2: the drop voltage is defined as V_{IN}-V_{OUT}, which is measured when V_{OUT} is V_{OUT} (normal)-100mV.

Typical Performance Characteristics (In reference to: Fig. 1)

(V_{IN}=V_{OUT}+1V, C_{IN}=1μF, C_{OUT}=1μF, C_{SS}=22nF, T_A =+25°C, unless otherwise stated.)

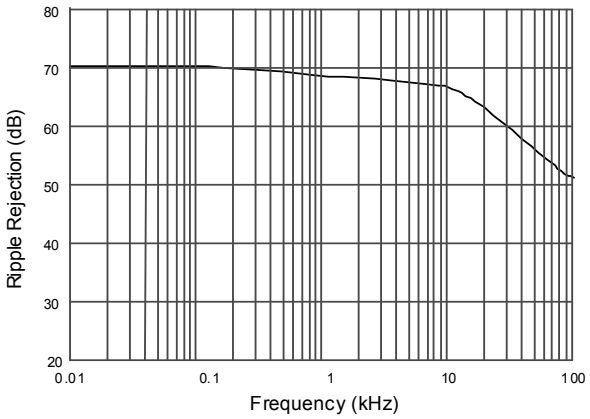


Fig.3 Ripple Rejection vs. Frequency

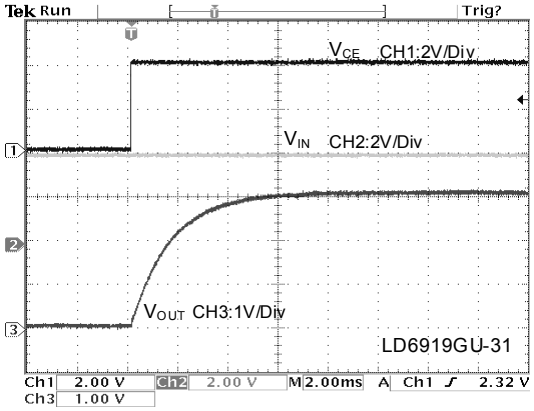


Fig.4 Start Up Waveform Css=22nF

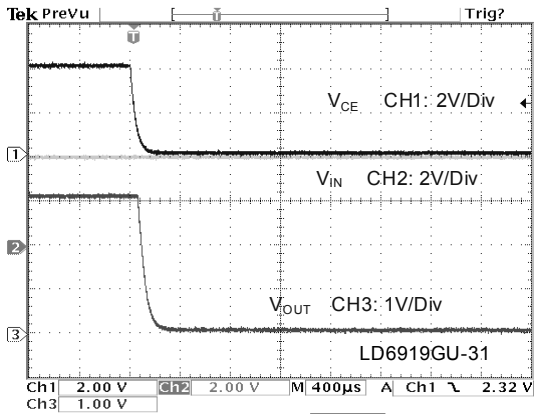


Fig. 5 EN Pin Shutdown Response

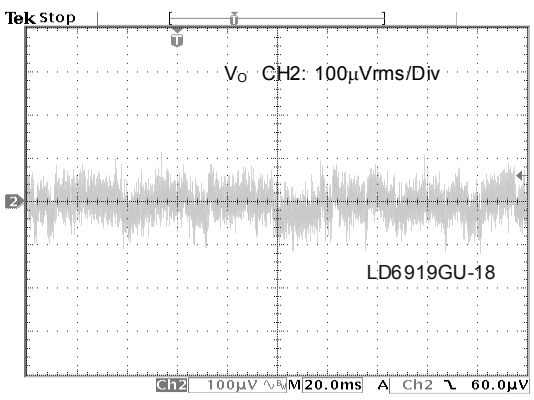


Fig.6 Output Noise (C_{SS}=22nF)

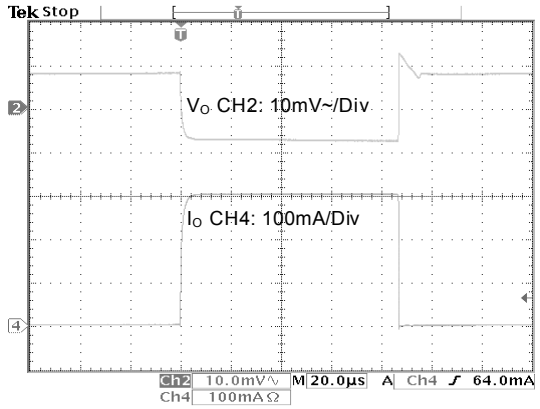


Fig.7 Load Transient Response (C_O=1µF)

Typical Performance Characteristics (In reference to: Fig. 2)

(V_{IN}=V_{OUT}+1V, C_{IN}=4.7µF, C_{OUT}=4.7µF, C_{SS}=22nF, T_A =+25°C, unless otherwise stated.)

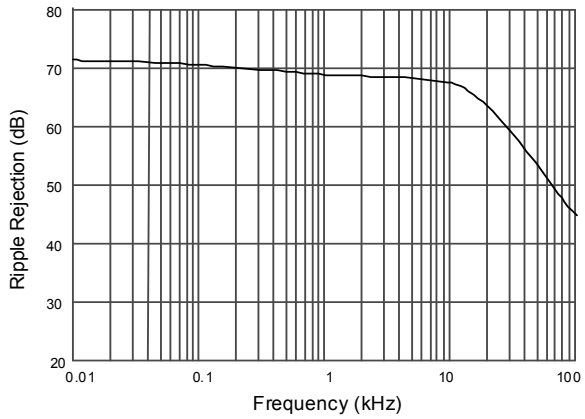


Fig.8 Ripple Rejection vs. Frequency

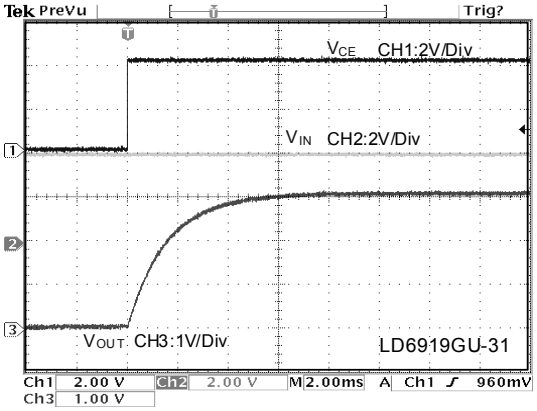


Fig.9 Start Up Waveform Css=22nF

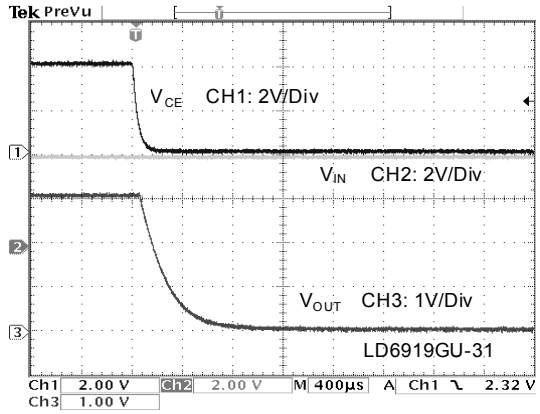


Fig. 10 EN Pin Shutdown Response

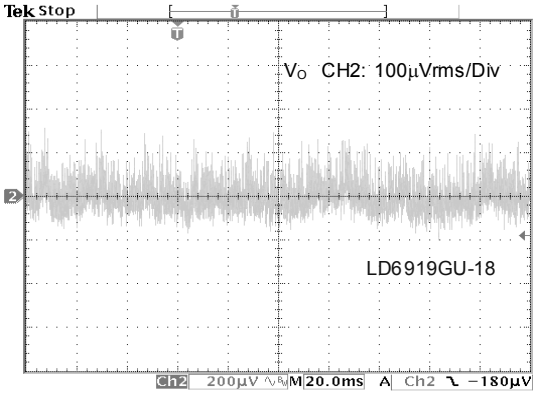


Fig.11 Output Noise (C_{SS}=22nF)

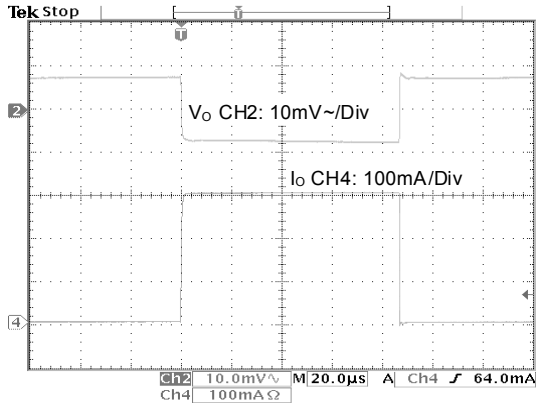


Fig.12 Load Transient Response(C_O=4.7µF)

Application Information

Operation Overview

An input capacitor whose value at least 1µF is necessary to place between the VIN pin and GND to stabilize VIN and obtain beneficial effect. Besides, the input capacitor should be located in the distance within 5mm from the VIN pin.

The output capacitor also should be located in the distance within 5mm from the OUT pin. The LD6919 is designed specifically operating with low ESR ceramic output capacitor in space-saving and performance consideration. Using a ceramic capacitor whose value is at least 1µF with ESR is > 25mΩ on the LD6919 output ensures stability. X5R or X7R types of capacitors are recommended for the input and output capacitors in full range of operation temperature.

Soft Start Operation and Noise Reduction

For LD6919, the external soft start capacitor, C_{SS} located between SS pin and GND can provide soft start operation and reduce output noise dramatically. The soft start time can be estimated by following formula.

$T_{SS} \cong 0.35C_{SS}$ (ms)

Where,

T_{SS}: soft start time (ms)

C_{SS}: soft start capacitor (nF)

EX:

V_{OUT}=3.1V and C_{SS}=22nF

The soft start time, TSS ≈ 0.35*22=7.7 (ms)

If the soft start function is not necessary, open this pin will achieve VOUT to quick start up.

Output Voltage

The output voltage can be set by the value chosen for the R_J resistor on SS pin, which can be calculated using the following formula.

$$V_{OUT}(w.R_J) = \frac{R_J(k\Omega)}{R_J(k\Omega)+73} \times V_{OUT}(w/o\ R_J)$$

For output voltage accuracy, 1% of R_J resistor is recommended.

Enable Function

The LD6919 features an enable/disable function. To apply to CE pin with a logic high level above 1.5V to assure the device will be complete turn-on. The LD6919 will enter shutdown mode when the CE voltage falls below 0.6V. During shutdown mode, the shutdown current for the device is less than 1µA (max).

Current Limit

Output current is limited to 600mA (typical). When current

limit engages, the output voltage scales back linearly until the over-current condition ends. Take care not to exceed the power dispassion ratings of the package.

Thermal Consideration

When the junction temperature exceeds Tj=150°C, the thermal sensor will turn off the pass transistor and cool down the IC. The thermal sensor turns the pass transistor on after the IC's junction temperature falls by 30°C (typical) For continuous operation, do not exceed absolute maximum operation junction temperature of 125°C. The maximum power dissipation is determined according to following equation.

$$P_{D(MAX)} = \frac{(T_{J(MAX)} - T_A)}{\theta_{JA}}$$

θ_{JA}: Package Thermal Resistance

The maximum power dispassion at Ta=25°C can be obtained by above formula.

P_{DMAX}=(125°C-25°C)/250=400mW

…….(SOT25 package)

P_{DMAX}=(125°C-25°C)/333=300mW

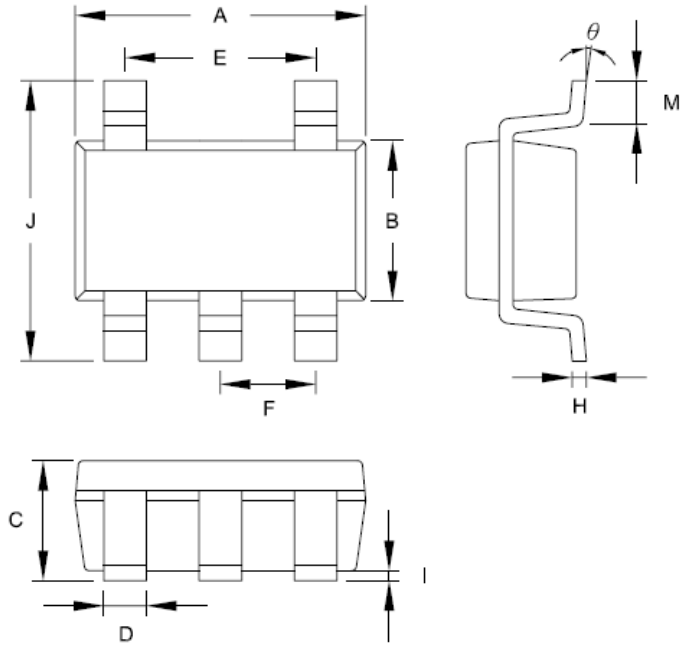
……..(SC70-6 package)

P_{DMAX}=(125°C-25°C)/175=571mW

……..(WDFN-6L 1.6x1.6 package)

Package Information

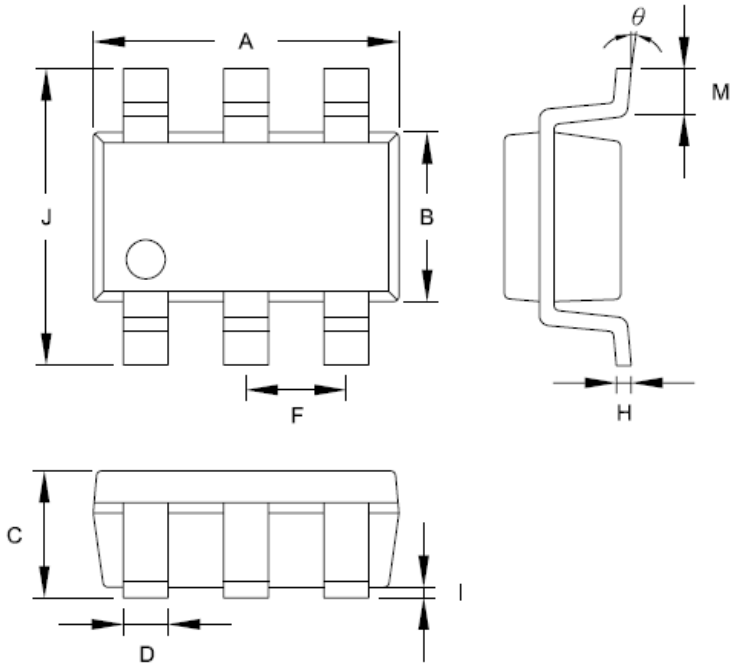
SOT-25



Symbol	Dimension in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	2.692	3.099	0.106	0.122
B	1.397	1.803	0.055	0.071
C	---	1.450	---	0.057
D	0.300	0.500	0.012	0.020
E	1.90 TYP		0.074 TYP	
F	0.95 TYP		0.037 TYP	
H	0.080	0.254	0.003	0.010
I	0.050	0.150	0.002	0.006
J	2.600	3.000	0.102	0.118
M	0.300	0.600	0.012	0.024
θ	0°	10°	0°	10°

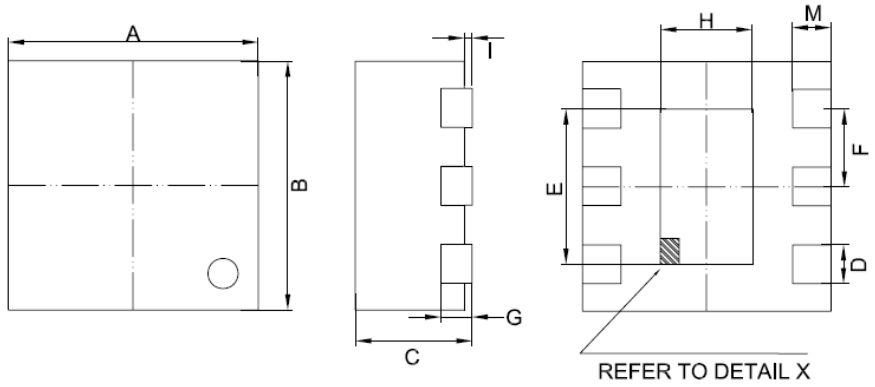
Package Information

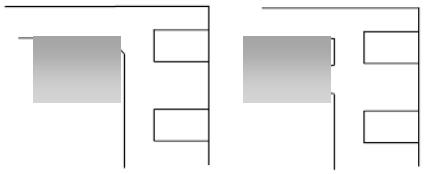
SC70-6



Symbol	Dimension in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.800	2.200	0.071	0.087
B	1.150	1.350	0.045	0.053
C	0.800	1.100	0.031	0.043
D	0.150	0.400	0.006	0.016
F	0.650 TYP		0.026 TYP	
H	0.080	0.250	0.003	0.010
I	0.000	0.100	0.000	0.004
J	1.800	2.400	0.071	0.094
M	0.200	0.460	0.009	0.018
θ	0°	8°	0°	8°

WDFN-6L (1.6mm × 1.6 mm)

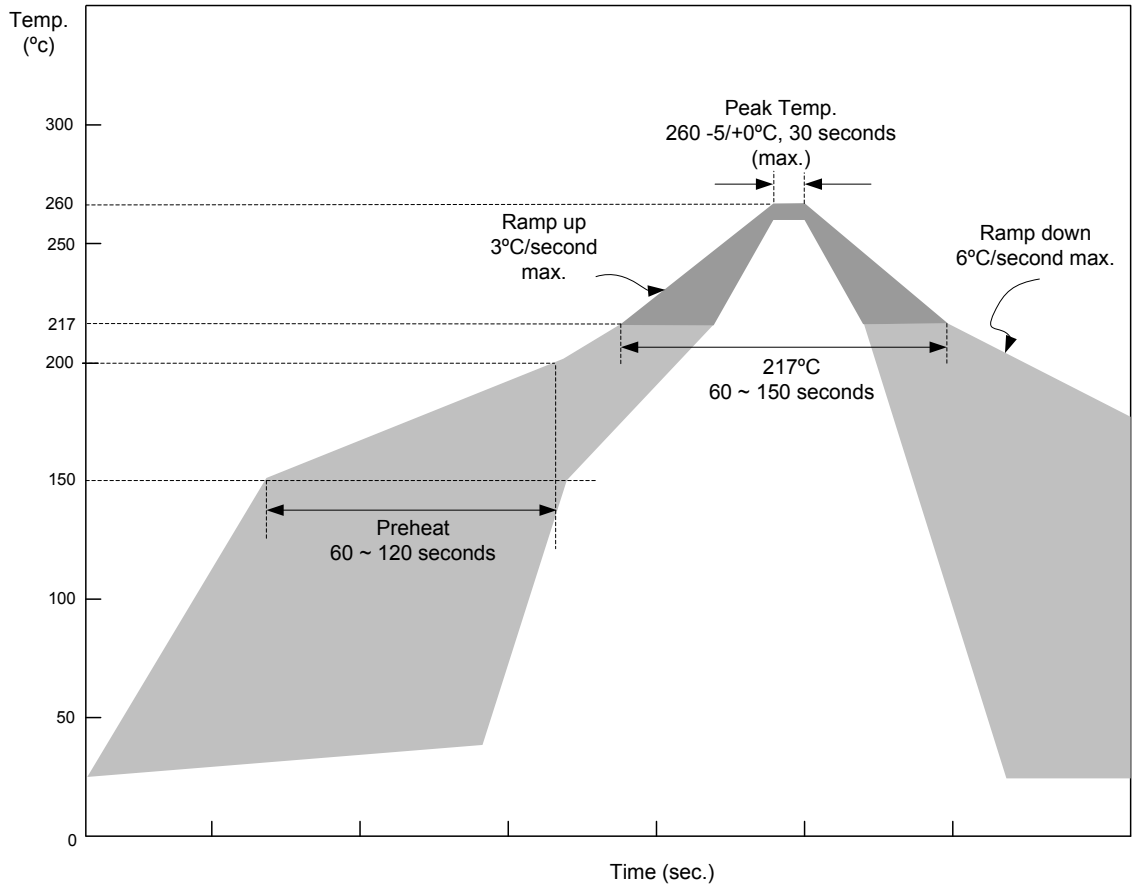




DETAIL X
THE CONFIGURATION OF THE PIN 1 IDENTIFIER IS OPTIONAL AS ABOVE.

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	1.500	1.700	0.059	0.067
B	1.500	1.700	0.059	0.067
C	0.700	0.800	0.028	0.031
D	0.200	0.300	0.008	0.012
E	0.900	1.100	0.035	0.043
F	0.500 TYP.		0.019 TYP.	
G	0.203 TYP.		0.008 TYP.	
H	0.500	0.700	0.020	0.028
I	0.000	0.050	0.000	0.002
M	0.200	0.300	0.009	0.012

IR Profile for SMD Devices



Item	Average Ramp-up Rate	Pre-heat (150 ~ 200°C)	Time Maintained Above 217°C	Peak Temp.	Ramp-down Rate
Required	3°C(max) /sec	60~120 sec	60~150 seconds	260 +0/-5°C 30 seconds	6°C (max) /sec

Important Notice

Leadtrend Technology Corp. reserves the right to make changes or corrections to its products at any time without notice. Customers should verify the datasheets are current and complete before placing order.

Revision History

Rev.	Date	Change Notice
00	9/8/2009	Original Specification.
00a	11/13/2009	Output voltage option: 3.45V
00b	4/12/2010	Output voltage accuracy