120mA Negative Voltage Linear Regulator

REV: 01

General Description

The LD6904 is a negative voltage, micropower linear regulator. It features wide input voltage, low-noise, low-dropout and low-quiescent current. The precision of feedback reference voltage is within ±1% and output current reaches up to 120mA. The built-in output current limiting and thermal shutdown protection could prevent from fault conditions.

The LD6904 is available in a space saving SOT23-6 or SC70-6 package.

Features

- ±1.5% feedback reference
- Shutdown current <1μA
- Negative voltage down to -11V
- Thermal shutdown and current limit
- V_{OUT} discharge function
- Soft start operation

Applications

- Microcontroller Power
- Hand-Held Instruments

Typical Application

*R2<15KΩ is recommended
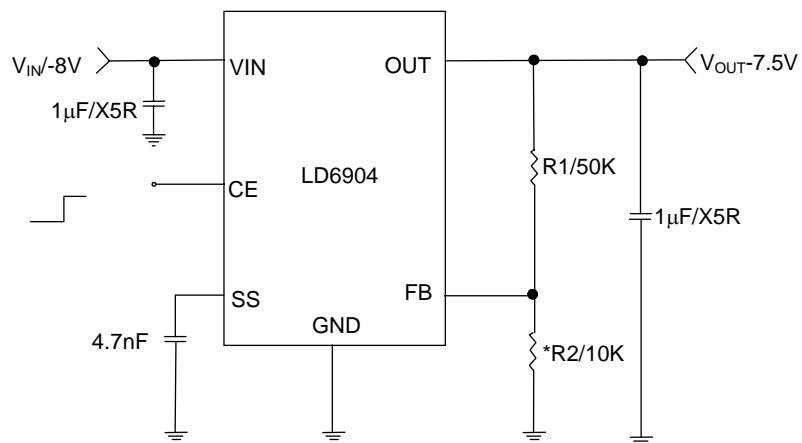
Fig.1 Negative voltage linear regulator application
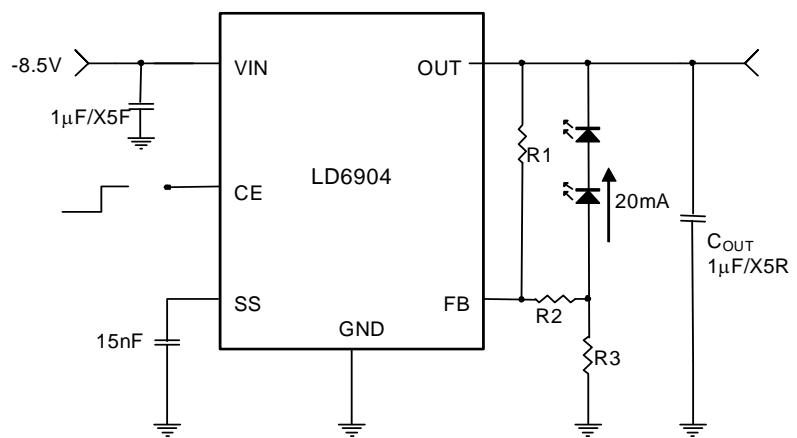
2WLED	
R1	62K
R2	3.24K
R3	47.5Ω

Fig.2   WLED driver application

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LD6904

Pin Configuration

SOT-26 (TOP VIEW)

SC70-6 (TOP VIEW)

```
SS    GND   CE
 6     5     4
    YWJ 04
o1     2     3
FB    VIN   OUT
```

```
SS    GND   CE
 6     5     4
     BYW0
o1     2     3
FB    VIN   OUT
```

```
 6     5     4
   YWJ 04
o1     2     3
```

B : Product Code (A: LD6904)
Y : Year code (E: 2005, F: 2006…)
W : Week code
0 : Voltage code (0: adjustable)
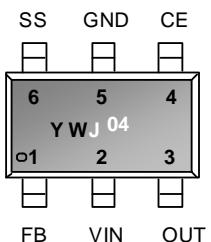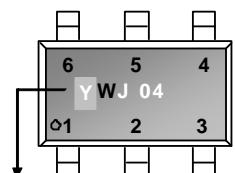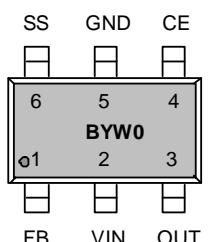
Y The PB freed package is identified in embossed font

YY, Y : Year code (D: 2004, E: 2005…..)
WW, W : Week code
J : LD6904
: Production code

Ordering Information

Part number	Package		TOP MARK	Shipping
LD6904 GL	SOT-26	Green Package	YWJ04	3000 /tape & reel
LD6904 PL	SOT-26	PB FREE	YWJ04	3000 /tape & reel
LD6904 GU	SC70-6	Green Package	BYW0	3000 /tape & reel
LD6904 PU	SC70-6	PB FREE	BYW0	3000 /tape & reel

The LD6904 is ROHS compliant.

Pin Descriptions

PIN	NAME	FUNCTION
1	FB	Output Feedback. Refer to Fig.1, R2<15K ohm is recommended
2	VIN	Input Voltage
3	OUT	Regulator Output
4	CE	Chip Enable, High=Enable, Low=Disable Note that this pin is high impedance. There should be a pull low resistor connected to GND, when this pin is floating.
5	GND	IC GND
6	SS	This pin combines noise reduction and soft start function. Connect a capacitor to GND to adjust soft start time. Css>1nF is recommended.

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Block Diagram

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LD6904-DS-01 March 2008
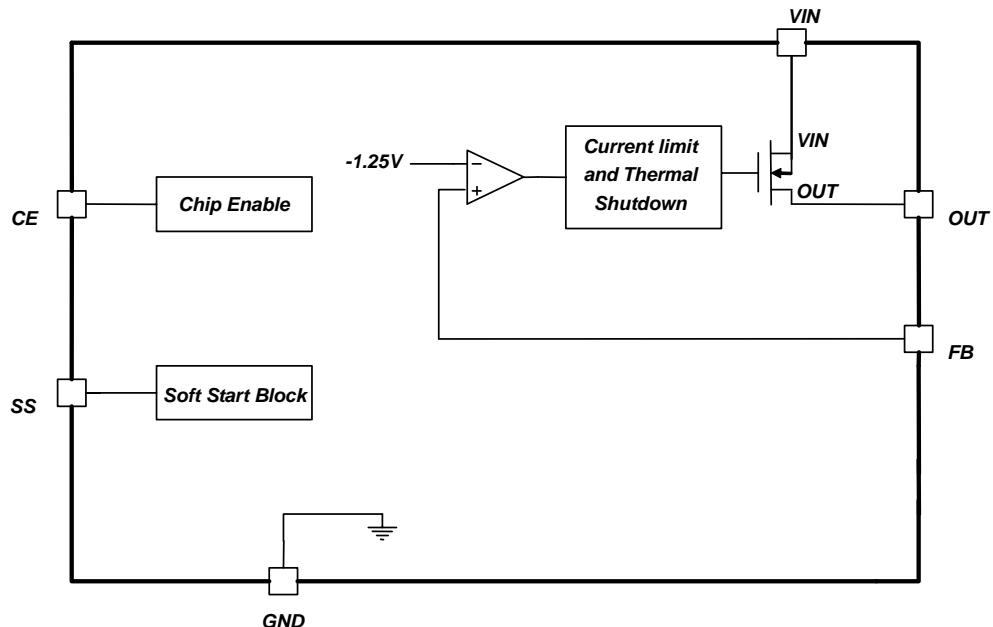
Absolute Maximum Ratings

VIN and FB Pin	-12V~+0.3V
OUT Pin	VIN-0.3V~ +0.3V
CE, Pin	-0.3V~ 5V
SS, Pin	-5V~0.3V
Power dissipation @Ta=25°C	300mW
Operating Temperature Range	-30°C to 85°C
Operating Junction Temperature	125°C
Storage Temperature Range	-55°C to 125°C
Package Thermal Resistance SOT23-6	250°C/W
Package Thermal Resistance SC70-6	333°C/W
Lead temperature (SC70-6, 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

(T_A = +25°C unless otherwise stated, V_{IN}=-10V, CE=3.3V, I_{LOAD}=5μA C_{IN}=1μF, C_{OUT}=1μF)

| PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT POWER					
Input Voltage		-11	-	-5	V
Nominal Supply Current	CE=3.3V	-	70	100	μA
Shutdown Supply Current	CE=GND	-		1	μA
REFERENCE VOLTAGE					
Feedback Reference	FB=OUT V_{IN}=-6V to -11V, I_{LOAD} =1mA		-1.25		V
Reference Voltage Tolerance		-1.0		+1.0	%
Feedback Input Current	V_{FB}=-1.3V		10		nA
OUTPUT					
Output Current Limit	VIN=-8V	120	150	-	mA
Load Regulation	I_{LOAD} =1mA to 120mA			0.8	%
Output Reverse Leakage Current	Vin=unconnected, Out set to -5V		50		uA
Dropout Voltage	I_{LOAD} =60mA		0.15	0.25	V
Ripple Rejection	F=120Hz, ein=1Vrms, Iout=10mA	-	60		dB
	F=10KHz, ein=1Vrms, Iout=10mA	-	50		dB
Discharge Current	CE=High to Low	-	60		mA
Soft Start					
Soft Start Current		-	3	-	μA
CE					
CE Input Current	CE= 3.3V		-	10	μA
CE Input Level	Enable	2.0	-	-	V
	Disable	-	-	0.6	V
THERMAL PROTECTION					
Thermal Protection	V_{OUT} short to GND		145		°C
Hysteresis			30		°C

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Typical Performance Characteristics
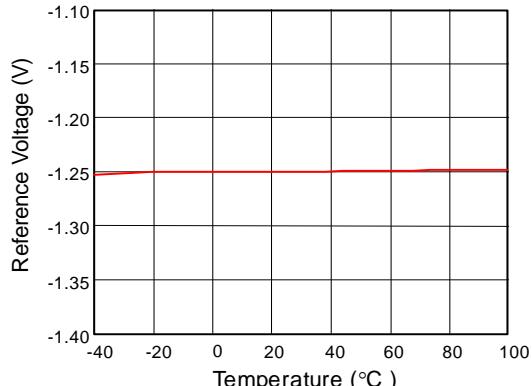
Fig. 1 Reference voltage vs. Temperature
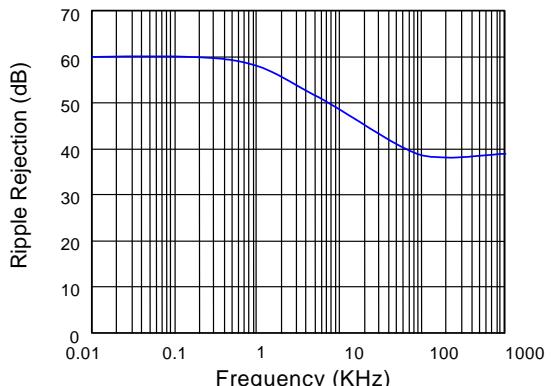
Fig. 2 Ripple Rejection vs. frequency
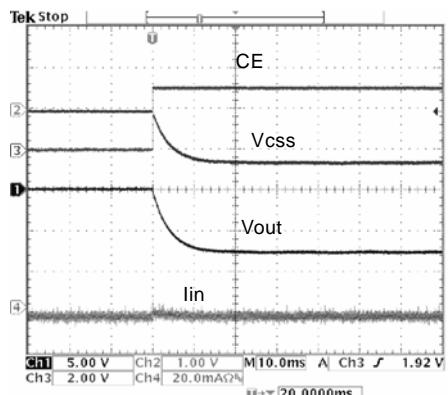
Fig. 3 Start Up Waveform C_{SS}=10nF
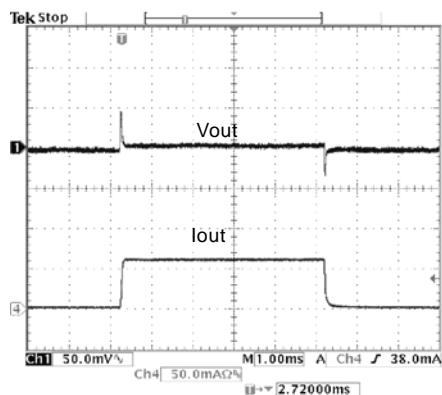
Fig. 4 Load Transient Response

Application Information

Capacitor Selection

An input capacitor is necessary to place between the input and GND to stabilize V_{IN}. The input capacitor should be at least 1μF to obtain beneficial effect. Higher values will improve more line transient response.

The LD6904 requires an output capacitor to stabilize the internal control loop. For the application of $V_{OUT} < -5V$, the output capacitor should be at least 1μF with ESR less than 1Ω. In the range of V_{OUT}= -1.25V~ -5V, it's necessary to choose a capacitor at least 2.2μF and with ESR less than 1Ω. Higher output capacitor values can improve the load transient response, stability and PSRR. The output capacitor should not be located far away than 5mm from the OUT pin.

It's recommended to use those types of X5R or X7R capacitors for input and output capacitors.

Current Limit

The output current is limited at 150mA (typical). When current limit engages, the output voltage scales back linearly until the overcurrent condition ends. Beware not to exceed the power dispassion ratings of the package.

Thermal Consideration

When the junction temperature exceeds T_J=145°C, the thermal sensor will turn off the pass transistor and allow the IC to cool down. The thermal sensor turns the pass transistor on after the IC's junction temperature is cooled down by 30°C (typical). For continue operation, do not exceed absolute maximum operation junction temperature

T_J=125°C. The maximum power dispassion depends on the thermal resistance of IC package, PCB layout, airflow and $P_{D(MAX)} = (T_{J(MAX)} - T_A)/\theta_{JA}$ temperature difference between junctions to ambient.

θ_{JA}: Package Thermal Resistance

Ex: the maximum power dispassion at Ta=25°C can be obtained by the following formula.

P_{DMAX}=(125°C-25°C)/250=400mW (SOT23-6 package)
P_{DMAX}=(125°C-25°C)/333=300mW (SC70-6 package)

Package Information

SOT-26
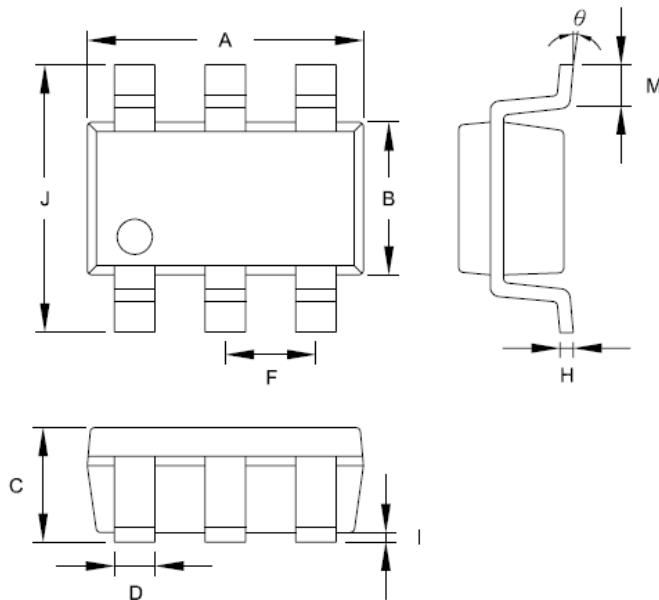
Symbol	Dimension in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	2.692	3.099	0.106	0.122
B	1.397	1.803	0.055	0.071
C	-------	1.450	-------	0.058
D	0.300	0.550	0.012	0.022
F	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
I	0.050	0.150	0.002	0.006
J	2.600	3.000	0.102	0.118
M	0.300	0.600	0.012	0.024
θ	0	10°	0	10°

SC70-6
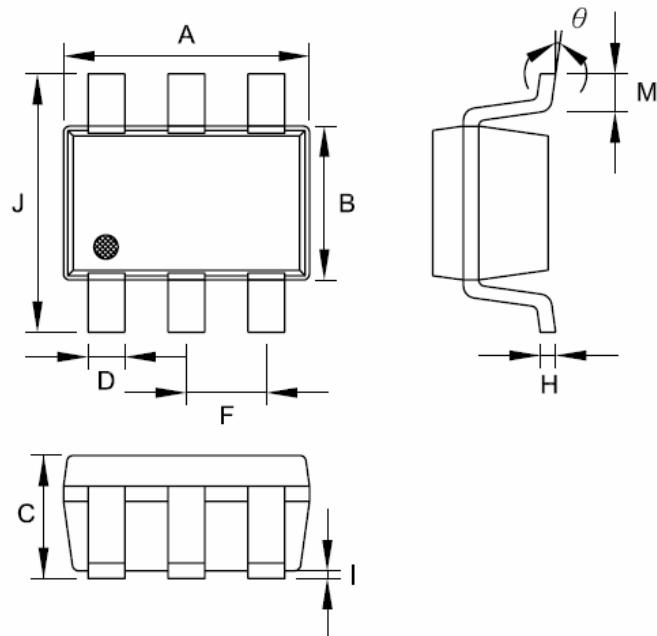
Symbol	Dimension in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.80	2.20	0.071	0.087
B	1.15	1.35	0.045	0.053
C	0.80	1.10	0.031	0.043
D	0.15	0.40	0.006	0.016
F	0.65 TYP.		0.026 TYP.	
H	0.08	0.25	0.003	0.010
I	0.00	0.10	0.000	0.004
J	1.80	2.40	0.071	0.094
M	0.10	0.46	0.004	0.018
θ	0°	12°	0°	12°

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.

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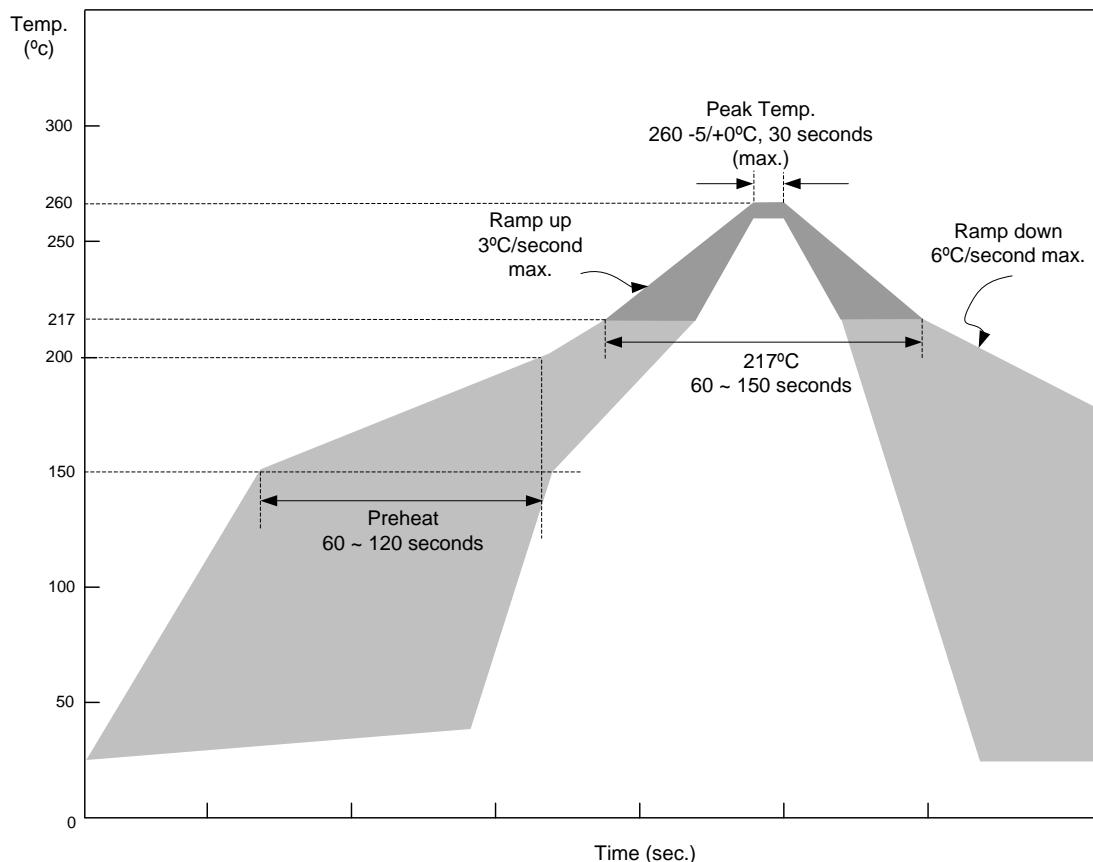
Item	Average Ramp-up Rate	Pre-heat (150 ~ 200°C)	Time Maintained Above 217°C	Peak Temp.	Ramp-down Rate
Required	3°C(max) /sec	60~120 sec	60~150 seconds	260 +0/-5°C 30 seconds	6°C (max) /sec

Revision History

Rev.	Date	Change Notice
00	6/5/06	Original Specification.
01	3/5/08	1.　　R2<15KΩ is recommended 2.　　Information of IR Profile