

LR3988

Micropower 150mA Ultra Low-Dropout CMOS Voltage Regulator with Power Good

General Description

The LR3988 is a 150mA low dropout regulator designed specially to meet requirements of Portable battery applications.

The LR3988 is designed to work with space saving, small 1 μ F ceramic capacitor. The LR3988 features an Error Flag output that indicates a faulty output condition. The LR3988's performance is optimized for battery powered systems to deliver low noise, extremely low dropout voltage and low quiescent current. Regulator ground current increases only slightly in dropout, further prolonging the battery life.

Power supply rejection is better than 60 dB at low frequencies and starts to roll off at 10 kHz. High power supply rejection is maintained down to lower input voltage levels common to battery operated circuits.

The device is ideal for mobile phone and similar battery powered wireless applications. It provides up to 150 mA, from a 2.0V to 6.5V input, consuming less than 1 μ A in disable mode and has fast turn-on time less than 220 μ s.

The LR3988 is available SOT23(-3 -5) package and SC70(-3 -5) package. Performance is specified for -40°C to +125°C temperature range and is available in 1.5V~6.0V output voltages.

Key Specifications

- ★ 2.0V to 6.5 V input range
- ★ 150mA guaranteed output
- ★ 35dB PSRR at 10kHz
- ★ $\leq 1\mu$ A quiescent current when shut down
- ★ Fast Turn-On time: 150 μ s (type.)
- ★ 120 mV type dropout with 150mA load
- ★ -40°C to +125°C junction temperature range for operation
- ★ 1.5V~6.0V outputs

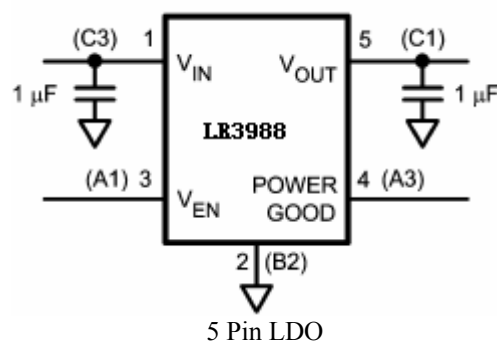
Features

- ★ SOT23-3 SOT23-5 package
- ★ SC70 SC70-5(SC88A) package
- ★ Power-good flag output
- ★ Logic controlled enable
- ★ Stable with ceramic and high quality tantalum capacitors
- ★ Fast turn-on
- ★ Thermal shutdown and short-circuit current limit

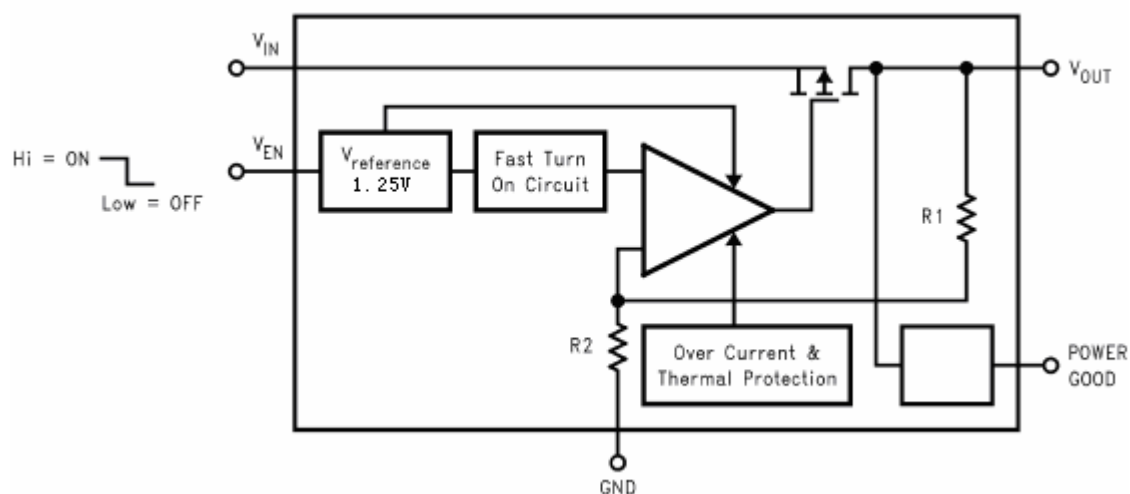
Applications

- ★ CDMA cellular handsets
- ★ Wideband CDMA cellular handsets
- ★ GSM cellular handsets
- ★ Portable information appliances
- ★ Tiny 3.3V $\pm$ 5% to 2.5V, 150mA converter

Typical Application Circuit



Block Diagram

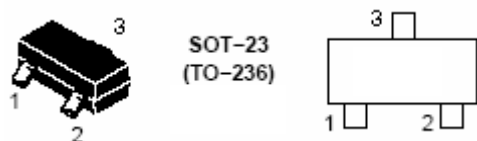


Pin Descriptions

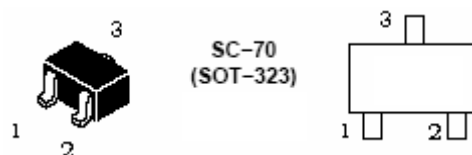
Name	SOT23 SC70	SOT23-5 SC88A	Function
V _{EN}		3	Enable Input Logic, Enable High
GND	2	2	Common Ground
V _{OUT}	3	5	Output Voltage of the LDO
V _{IN}	1	1	Input Voltage of the LDO
Power Good		4	Power Good Flag (output): open-drain output, connected to an external pull-up resistor. Active low indicates an output voltage out of tolerance condition.

Connection Diagrams

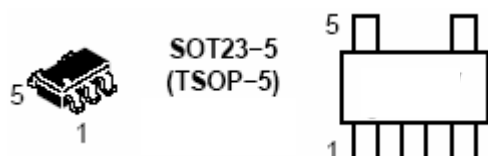
SOT23 package



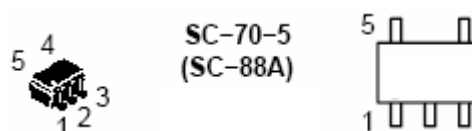
SC70 package



SOT23-5 package



SC88A package



Absolute Maximum Ratings

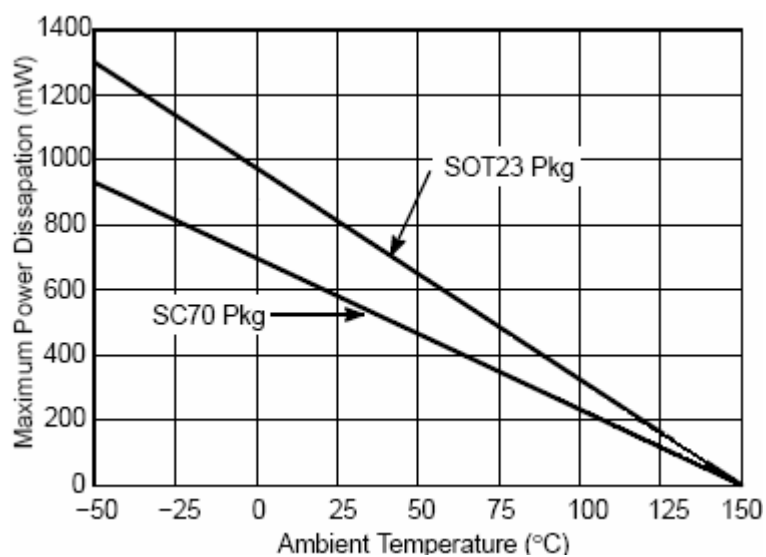
If Military/Aerospace specified devices are required, please contact the LRC Sales Office/Distributors for availability and specifications.

V_{IN}	-0.3 to 7.0V
V_{OUT} , V_{EN} , PowerGood	-0.3V to ($V_{IN}+0.3V$), with 6V max
Junction Temperature	150°C
Storage Temperature	-65°C to +150°C
Lead Temp, Pad Temp.	235°C
ESD Rating	
Human Body Model	2kV
Machine Model	150V

Operating Ratings

V_{IN} (note1)	2.0V to 6.5V
V_{OUT} , V_{EN}	0 to V_{IN}
Junction Temperature	-40°C to +125°C
Junction-to-Ambient Thermal Resistance (θ_{JA})	
SOT23	301°C /W
SOT23-5	220°C /W
SC70	314°C /W
SC88A	215°C /W

Maximum Power Dissipation (see graph)



Electrical Characteristics

Unless otherwise specified: $V_{EN} = 1.8V$, $V_{IN} = V_{OUT} + 0.5V$, $C_{IN} = 1\mu F$, $I_{OUT} = 1mA$, $C_{OUT} = 1\mu F$. Typical values and limits appearing in standard typeface are for $T_J = 25^\circ C$. Limits appearing in **boldface type** apply over the entire junction temperature range for operation, $-40^\circ C$ to $+125^\circ C$.

Symbol	Parameter	Conditions	Type	Limit		Units
				Min	Max	
ΔV_{OUT}	Output Voltage Tolerance	$-20^\circ C \leq T_J \leq 125^\circ C$		-2	2	% of $V_{OUT(nom)}$
		$-40^\circ C \leq T_J \leq 125^\circ C$		-3	3	
				-3.5	3.5	
	Line Regulation Error	$V_{IN} = V_{OUT(nom)} + 0.5V$ to $6.0V$		-0.15	0.15	%/V
	Load Regulation Error	$I_{OUT} = 1mA$ to $150mA$			0.01	%/mA
PSRR	Power Supply Rejection Ratio	$V_{IN} = V_{OUT(nom)} + 1V$ $f = 1kHz$, $I_{OUT} = 50mA$ (Figure 2)	60			dB
		$V_{IN} = V_{OUT(nom)} + 1V$, $f = 10kHz$, $I_{OUT} = 50mA$ (Figure 2)	35			
I_Q	Quiescent Current	$V_{EN} = 1.4V$, $I_{OUT} = 0mA$	85		130	μA
		$V_{EN} = 1.4V$, $I_{OUT} = 0$ to $150mA$	140		200	
		$V_{EN} = 0.4V$	0.003			
	Dropout Voltage	$I_{OUT} = 1mA$	1			mV
		$I_{OUT} = 150mA$	120			
I_{SC}	Short Circuit Current Limit		500			mA
e_n	Output Noise Voltage	$BW = 10Hz$ to $100kHz$, $C_{OUT} = 1\mu F$	220			μV_r ms
C_{OUT}	Output Capacitor	Capacitance		1	10	μF
		ESR		5	200	m Ω
TSD	Thermal Shutdown Temperature		150			$^\circ C$
	Thermal Shutdown Hysteresis					$^\circ C$
Enable Control Characteristics						
I_{EN}	Maximum Input Current at EN	$V_{EN} = 0$ and $V_{IN} = 5.5V$			0.1	μA

Electrical Characteristics (Continued)

Unless otherwise specified: $V_{EN} = 1.8V$, $V_{IN} = V_{OUT} + 0.5V$, $C_{IN} = 1\mu F$, $I_{OUT} = 1mA$, $C_{OUT} = 1\mu F$. Typical values and limits appearing in standard typeface are for $T_J = 25^\circ C$. Limits appearing in **boldface type** apply over the entire junction temperature range for operation, $-40^\circ C$ to $+125^\circ C$.

Symbol	Parameter	Conditions	Type	Limit		Units
				Min	Max	
V_{IL}	Logic Low Input threshold	$V_{IN} = 2.0V$ to $6.5V$			0.5	V
V_{IH}	Logic High Input threshold	$V_{IN} = 2.0V$ to $6.5V$		1.2		V
Power Good						
V_{THL}	Power Good Low threshold	% of V_{OUT} (PG ON)	93	90	95	%
V_{THH}	Power Good High Threshold	% of V_{OUT} (PG OFF)	95	92	98	
V_{OL}	PG Output Logic Low Voltage	$I_{PULL-UP} = 100\mu A$, fault condition	0.02			V
I_{PGL}	PG Output Leakage Current	PG Off, $V_{PG} = 6V$	0.02			μA
T_{ON}	Power Good Turn On time	$V_{IN} = 4.2V$	10			μs
T_{OFF}	Power Good Turn Off time	$V_{IN} = 4.2V$	10			μs

Note 1: The minimum VIN is dependant on the device output option.

For Vout(NOM) < 2.5V, VIN(MIN) will equal 2.5V. For Vout(NOM) ≥ 2.5V, VIN(MIN) will equal Vout(NOM) + 200mV.

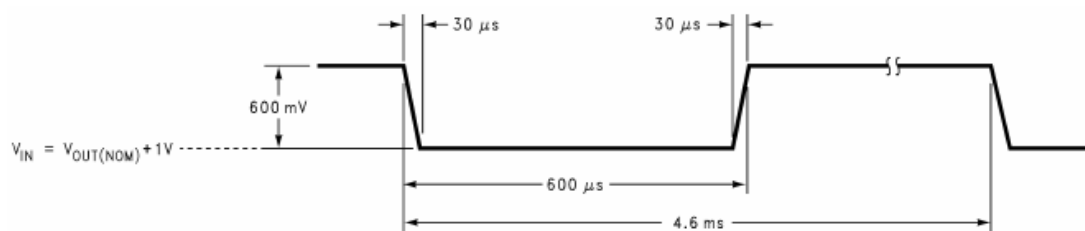


FIGURE 1. Line Transient response Input Perturbation

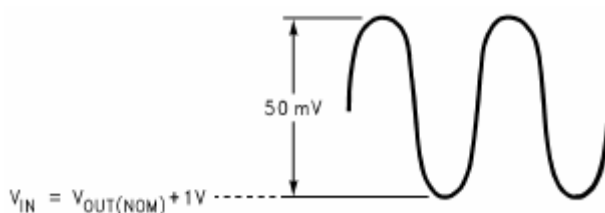


FIGURE 2. PSRR Input Perturbation

Ordering Information

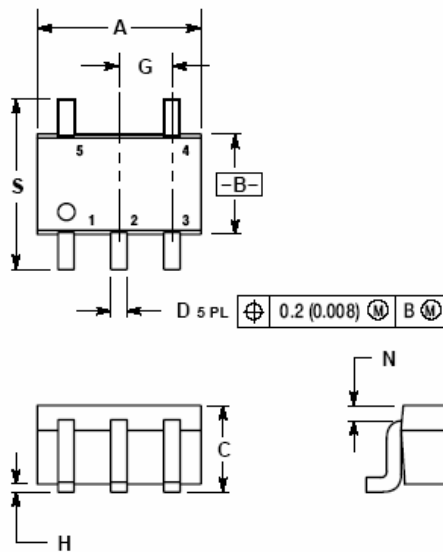
SOT23-5 Package

Output Voltage (V)	Grade	LR3988 Supplied as 3000 Units, Tape and Reel	LR3988 Supplied as 10000Units, Tape and Reel	Package Marking
1.5	STD	LR3988DW1T1G-1.5	LR3988DW1T3G-1.5	
2.5	STD	LR3988DW1T1G-2.5	LR3988DW1T3G-2.5	
2.6	STD	LR3988DW1T1G-2.6	LR3988DW1T3G-2.6	
2.7	STD	LR3988DW1T1G-2.7	LR3988DW1T3G-2.7	
2.8	STD	LR3988DW1T1G-2.8	LR3988DW1T3G-2.8	
2.9	STD	LR3988DW1T1G-2.9	LR3988DW1T3G-2.9	
3.0	STD	LR3988DW1T1G-3.0	LR3988DW1T3G-3.0	
3.1	STD	LR3988DW1T1G-3.1	LR3988DW1T3G-3.1	
3.2	STD	LR3988DW1T1G-3.2	LR3988DW1T3G-3.2	
3.3	STD	LR3988DW1T1G-3.3	LR3988DW1T3G-3.3	
4.2	STD	LR3988DW1T1G-4.2	LR3988DW1T3G-4.2	
5.0	STD	LR3988DW1T1G-5.0	LR3988DW1T3G-5.0	

Physical Dimensions

PACKAGE DIMENSIONS

SC-70-5 (SC-88A)

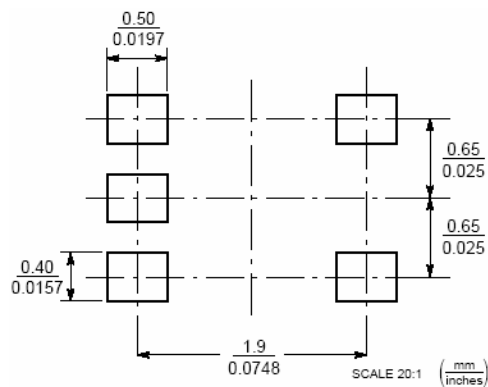


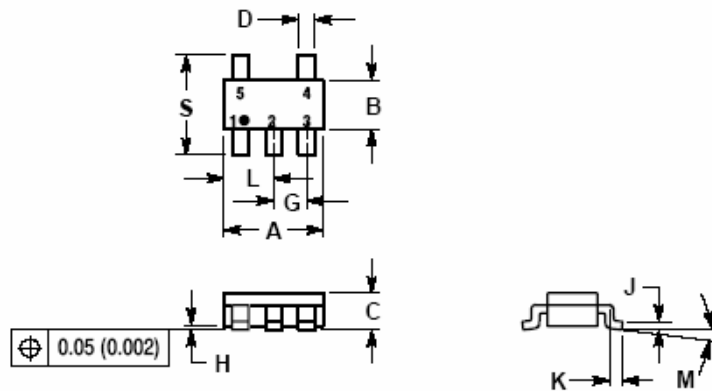
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418A-01 OBSOLETE. NEW STANDARD 418A-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026 BSC		0.65 BSC	
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008 REF		0.20 REF	
S	0.079	0.087	2.00	2.20

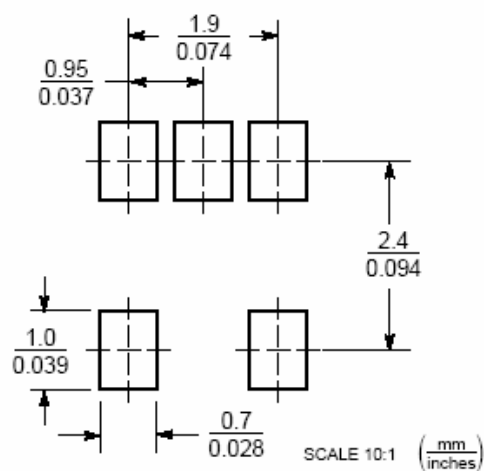
SOLDERING FOOTPRINT*



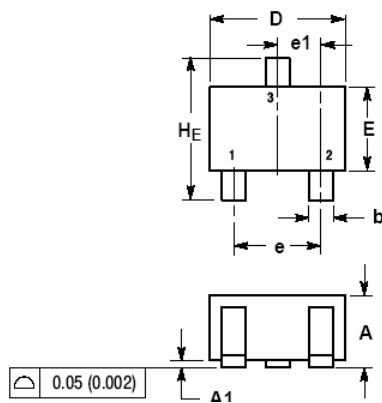
SOT23-5 (TSOP-5)

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. A AND B DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.90	3.10	0.1142	0.1220
B	1.30	1.70	0.0512	0.0669
C	0.90	1.10	0.0354	0.0433
D	0.25	0.50	0.0098	0.0197
G	0.85	1.05	0.0335	0.0413
H	0.013	0.100	0.0005	0.0040
J	0.10	0.26	0.0040	0.0102
K	0.20	0.80	0.0079	0.0315
L	1.25	1.55	0.0493	0.0610
M	0	10	0	10
S	2.50	3.00	0.0985	0.1181

SOLDERING FOOTPRINT*


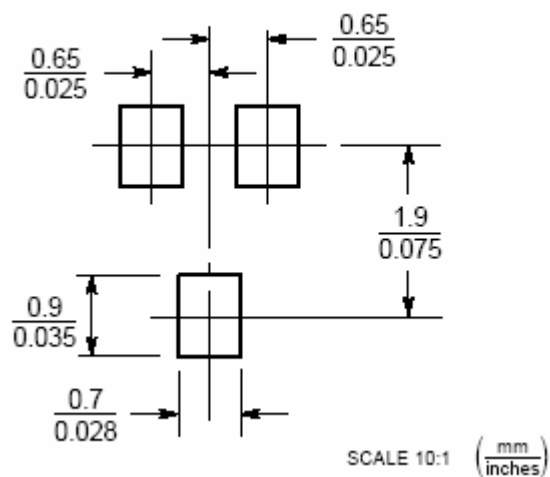
SC-70 (SOT-323)

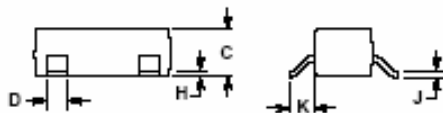
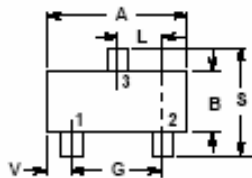


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.90	1.00	0.032	0.035	0.040
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	0.7 REF			0.028 REF		
b	0.30	0.35	0.40	0.012	0.014	0.016
c	0.10	0.18	0.25	0.004	0.007	0.010
D	1.80	2.10	2.20	0.071	0.083	0.087
E	1.15	1.24	1.35	0.045	0.049	0.053
e	1.20	1.30	1.40	0.047	0.051	0.055
e1	0.65 BSC			0.026 BSC		
L	0.425 REF			0.017 REF		
HE	2.00	2.10	2.40	0.079	0.083	0.095

SOLDERING FOOTPRINT*

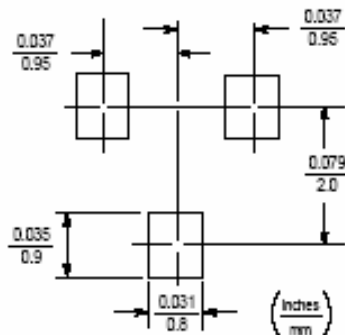


SOT-23

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.065	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

PIN 1. BASE
 2. EMITTER
 3. COLLECTOR



Remark: These packages above are available for RoHS.