Elektronische Bauelemente

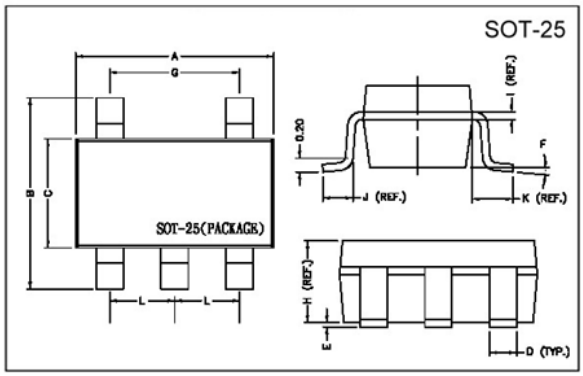
SQ2133

CMOS Positive Voltage Regulator

RoHS Compliant Product

Description

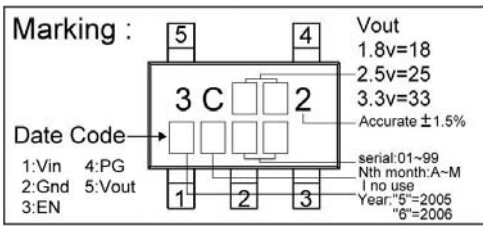
The SQ2133 series of positive,linear regulators feature low quiescent current (30μA typ.) with low dropout voltage, making them ideal for battery applications. These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" of operating conditions. In applications requiring a low noise, regulated supply, place a 1000pF capacitor between Bypass and Ground. The SQ2133 is stable with an output capacitance of 2.2μF or greater.



REF.	Millimeter		REF.	Dimensions
	Min.	Max.		Millimeter
A	2.70	3.10	G	1.90 REF.
B	2.60	3.00	H	1.20 REF.
C	1.40	1.80	I	0.12 REF.
D	0.30	0.55	J	0.37 REF.
E	0	0.10	K	0.60 REF.
F	0°	10°	L	0.95 REF.

Features

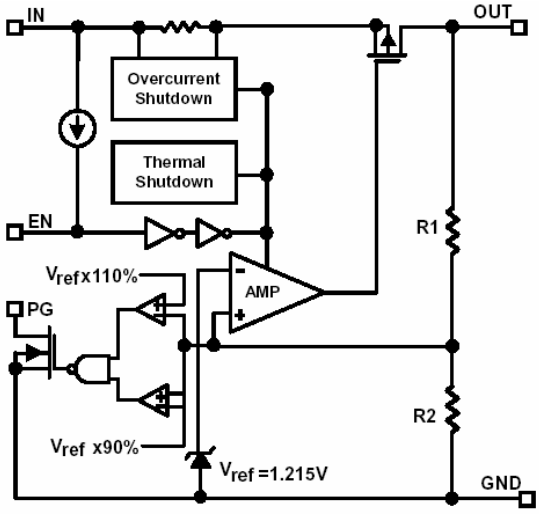
* High Accurate ±1.5%
* Over-Temperature Shutdown
* Factory Pre-set Output Voltage
* Very Low Dropout Voltage
* Power Good Output Function
* Short Circuit Current Fold-back
* Guaranteed 300mA output
* Current Limiting
* Power-Saving Shutdown Mode



Applications

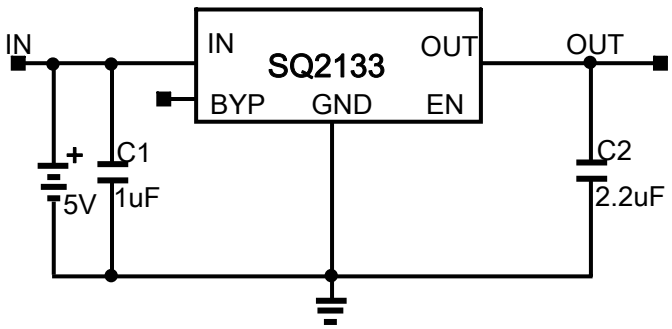
* PC Peripherals
* Wireless Devices
* Portable Electronics
* Battery Powered Widgets
* Electronic Scales
* Instrumentation
* Cordless Phones

Functional Block Diagram



Note: If output voltage specification is lower than 1.215V, Vref will trimmed to 1.2V

Typical Application Circuit



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Input Voltage	V_{IN}	8	V
Output Current	I_{OUT}	$P_D/(V_{IN}-V_O)$	mA
Output Voltage	V_{OUT}	1.2~3.8	V
Operating Ambient Temperature	Topr	-40~+85	°C
Junction Temperature	Tj	-40~+125	°C
Max. Junction Temperature	Tj Max.	150	°C
Thermal Resistance	θja	260	°C/W
Power Dissipation (△ T=100°C)	P_D	380	mW
EDS Classification		B	

Electrical Characteristics Ta=25°C unless otherwise noted

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition	
Output Voltage	$V_{OUT}(E)$[1]	-1.5%	$V_{OUT}(E)$[2]	1.5%	V	$V_{IN}=V_{OUT}(T)+2V$,1o=1mA	
Ground Pin Current	I_{GND}	–	35	–	uA	$V_{IN}=V_{OUT}(T)+2V$,Io=1mA~300mA	
Output Current	Io	300	–	–	mA	$V_{IN}=V_{OUT}(T)+2V$,$V_{OUT}\geq V_{OUT}(E)*0.96$	
Current Limit	I_{LIM}	300	450	–	mA	$V_{IN}=V_{OUT}(T)+2V$,Vo>1.2V	
Load Regulation	REG_{LOAD}	-1	0.2	1	%	$V_{IN}=V_{OUT}(T)+2V$,Io=1mA to300mA	
Dropout Voltage	$V_{DROPOUT}$	–	–	1300	mV	$1.2V\leq V_{OUT}(T)\leq 2.0V$	Io=300mA
		–	–	400		$2.0V < V_{OUT}(T)\leq 2.8V$	Vo=V_{OUT}(E)-2%
		–	–	300		$2.8V<V_{OUT}(T)$	
Quiescent Current	I_Q	–	30	50	uA	$V_{IN}=V_{OUT}(T)+1V$,Io=0mA	
Line Regulation	REG_{LINE}	-0.2	–	0.2	%	$1.2V\leq V_{OUT}(T)\leq 1.4V$	Io=1mA $V_{IN}=V_{OUT}(T)+1$ to $V_{OUT}(T)+2$
		-0.15	–	0.15		$1.4V<V_{OUT}(T)\leq 2.0V$	
		-0.1	0.02	0.1		$2.0V<V_{OUT}(T)<4.0V$	
		-0.4	0.2	0.4		$4.0V<V_{OUT}(T)$	
Input Voltage	V_{IN}	Note[3]	–	7	V		
Over Temperature Shutdown	O_{TS}	–	150	–	°C		
Over Temperature Hystersis	O_{TH}	–	30	–	°C		
Output Voltage Temperature Coefficient	T_C	–	30	–	ppm/°C		
Short Circuit Current[4]	I_{SC}	–	150	300	mA	$V_{IN}=V_{OUT}(T)+1V$,$V_{OUT}<0.8V$	
Power Supply Rejection	PSRR	–	60	–	dB	f=100Hz	Io=100mA Co=2.2uF
		–	50	–		f=1kHz	
		–	20	–		f=10kHz	
Output Voltage Noise	eN	–	30	–	uVrms	Co=2.2Mf	f=10Hz~100kHz Io=10mA
EN Input Threshold	V_{EH}	2	–	V_{IN}	V	V_{IN}=2.7V to 7V	
	V_{EL}	0	–	0.4			
EN Input Bias Current	I_{EH}	–	–	0.1	uA	$V_{EN}=V_{IN}$,V_{IN}=2.7V to 7V	
	I_{EL}	–	–	0.5		V_{EN}=0V,V_{IN}=2.7V to 7V	
Shutdown Supply Current	I_{SD}	–	0.5	1	uA	V_{IN}=5V,Vo=0V,$V_{EN}<V_{EL}$	
Shutdown Output Voltage	$Vo_{,SD}$	0	–	0.4	V	Io=0.4mA,$V_{EN}<V_{EL}$	
Output Under Voltage	V_{UV}	–	–	85	% $V_{OUT(T)}$	$2.5V\leq V_{OUT(T)}\leq 5.0V$	
		–	–	75		$1.2V\leq V_{OUT(T)}<2.5V$	
Output Over Voltage	V_{OV}	115	–	–	% $V_{OUT(T)}$	$2.5V\leq V_{OUT(T)}\leq 5.0V$	
		125	–	–		$1.2V\leq V_{OUT(T)}<2.5V$	
PG Leakage Current	I_{LC}	–	–	1.0	uA	V_{PG}=7V	
PG Voltage Rating	V_{PG}	–	–	7.0	V	Vo in regulation	
PG Voltage Low	V_{OL}	–	–	0.4	V	I_{SINK}=0.4mA	

Note 1: V_{OUT} (E) =Effective Output Voltage (i.e. the output voltage when "V_{OUT} (T) +2.0V" is provided at the VIN pin while maintaining a certain I_{OUT} value).

2: V_{OUT} (T) =Specified Output Voltage

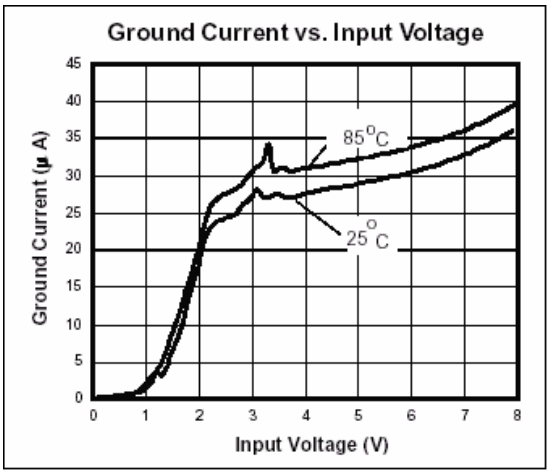
3: $V_{IN\ (MIN)} = V_{OUT} + V_{DROPOUT}$

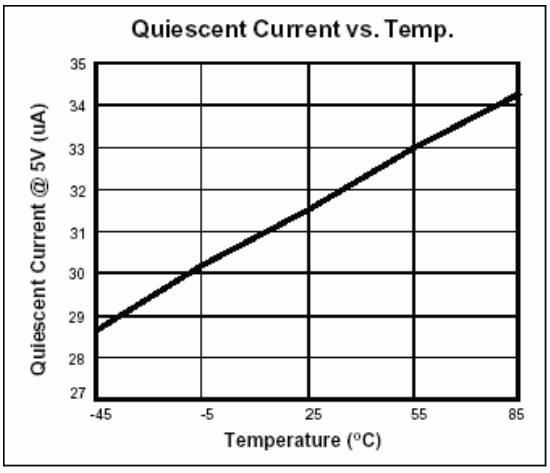
4: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.

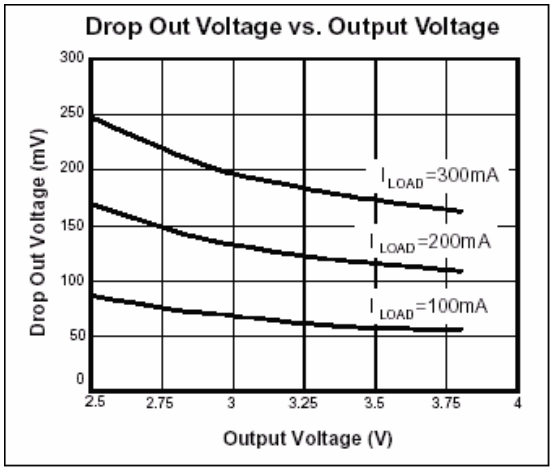
Ordering Information(contd.)

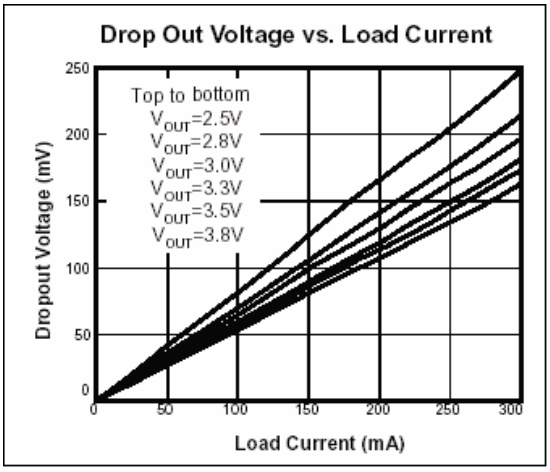
Part Number	Marking	Output Voltage	Part Number	Marking	Output Voltage
SQ2133-12	3C122 XXXX	1.2V	SQ2133-15	3C152 XXXX	1.5V
SQ2133-18	3C182 XXXX	1.8V	SQ2133-20	3C202 XXXX	2.0V
SQ2133-25	3C252 XXXX	2.5V	SQ2133-27	3C272 XXXX	2.7V
SQ2133-28	3C282 XXXX	2.8V	SQ2133-29	3C292 XXXX	2.9V
SQ2133-30	3C302 XXXX	3.0V	SQ2133-31	3C312 XXXX	3.1V
SQ2133-32	3C322 XXXX	3.2V	SQ2133-33	3C332 XXXX	3.3V
SQ2133-34	3C342 XXXX	3.4V	SQ2133-35	3C352 XXXX	3.5V
SQ2133-36	3C362 XXXX	3.6V	SQ2133-37	3C372 XXXX	3.7V
SQ2133-38	3C382 XXXX	3.8V	SQ2133-2H	3C2H2 XXXX	2.85V

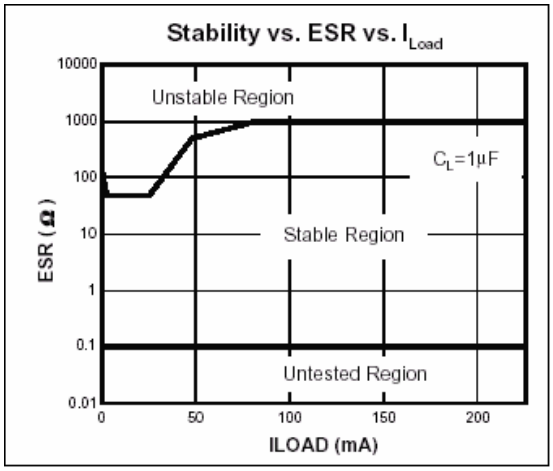
Characteristics Curve

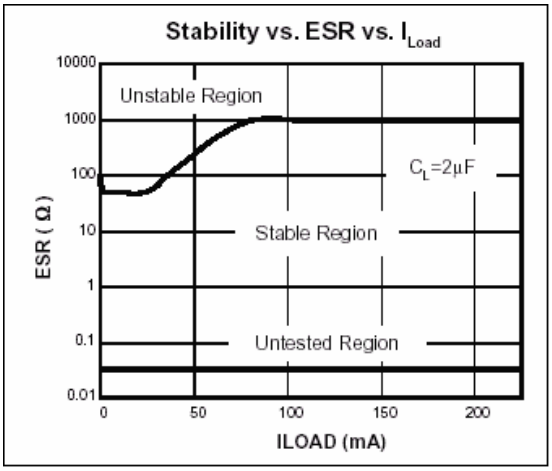


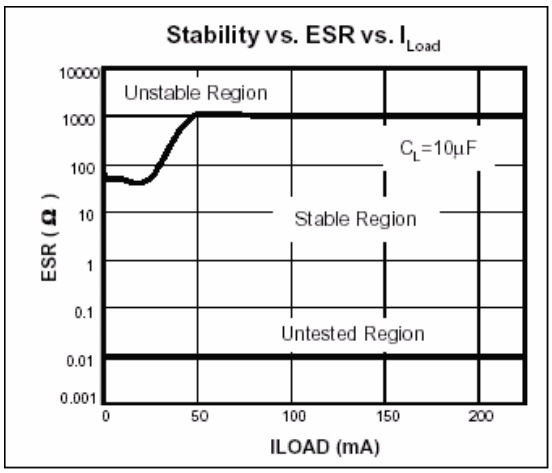


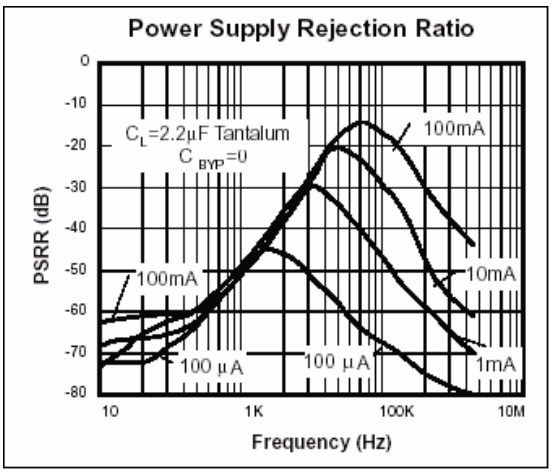


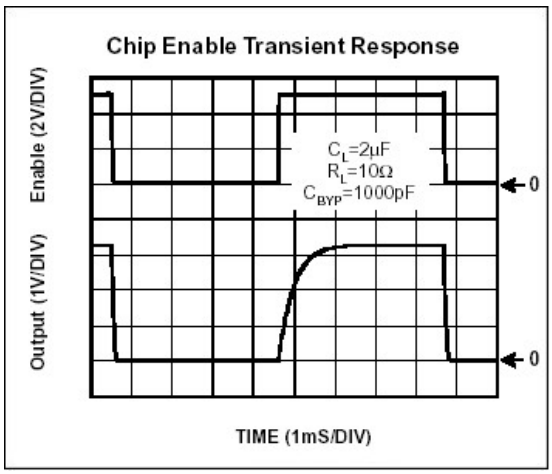


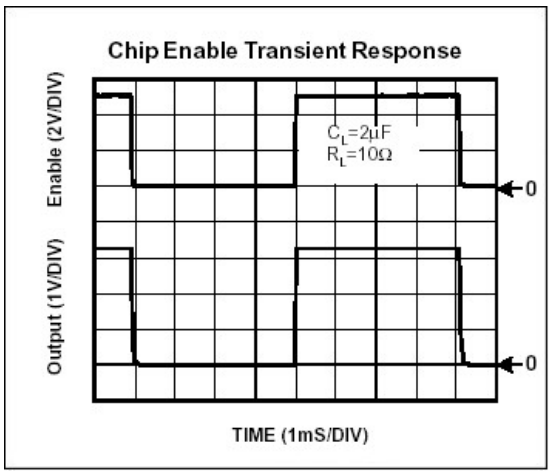

Stability vs. ESR vs. I Load
Unstable Region
C L=1µF
Stable Region
Untested Region
ESR (Ω)
ILOAD (mA)

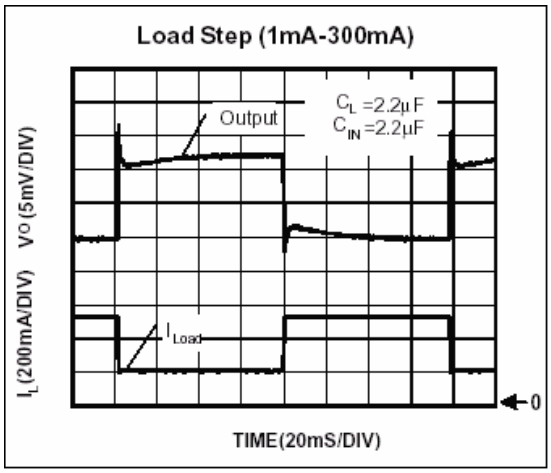

Stability vs. ESR vs. I Load
Unstable Region
C L=2µF
Stable Region
Untested Region
ESR (Ω)
ILOAD (mA)

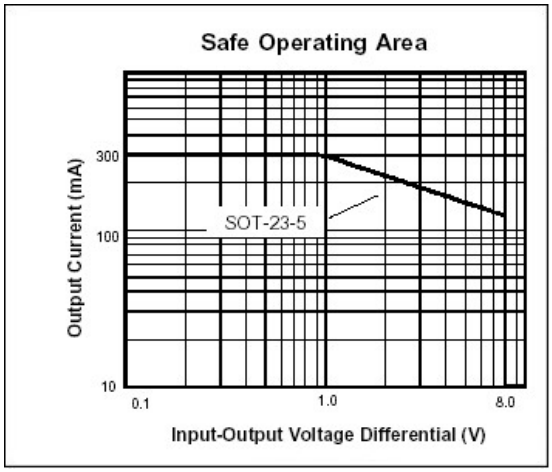

Stability vs. ESR vs. I Load
Unstable Region
C L=10µF
Stable Region
Untested Region
ESR (Ω)
ILOAD (mA)

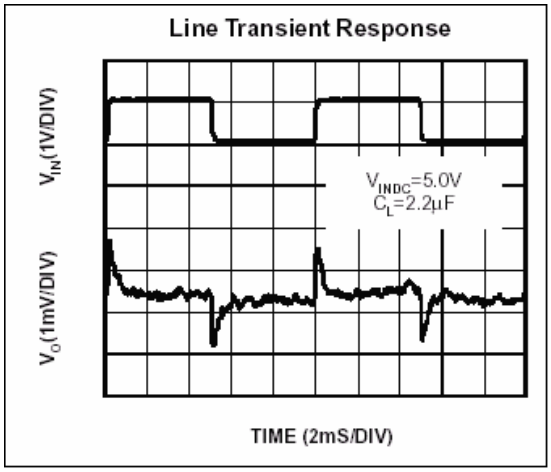

Power Supply Rejection Ratio
C L=2.2µF Tantalum
C BYP=0
100mA
100mA
10mA
100 µA
100 µA
1mA
PSRR (dB)
Frequency (Hz)

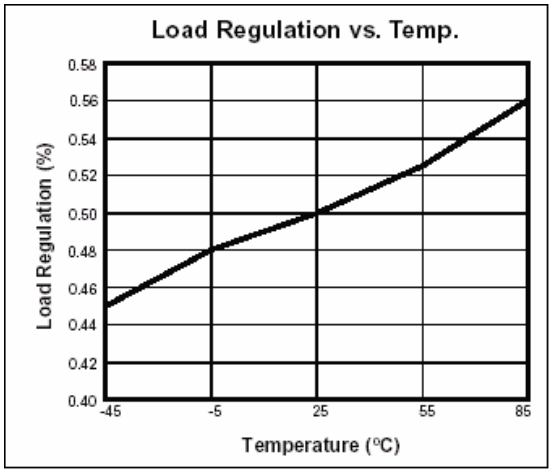

Chip Enable Transient Response
C L=2µF
R L=10Ω
C BYP=1000pF
Enable (2V/DIV)
Output (1V/DIV)
TIME (1mS/DIV)

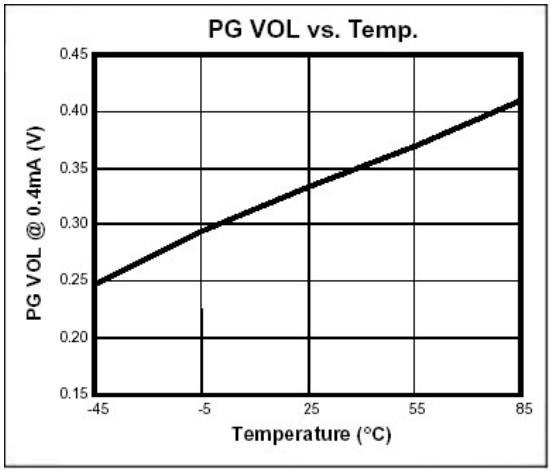

Chip Enable Transient Response
C L=2µF
R L=10Ω
Enable (2V/DIV)
Output (1V/DIV)
TIME (1mS/DIV)

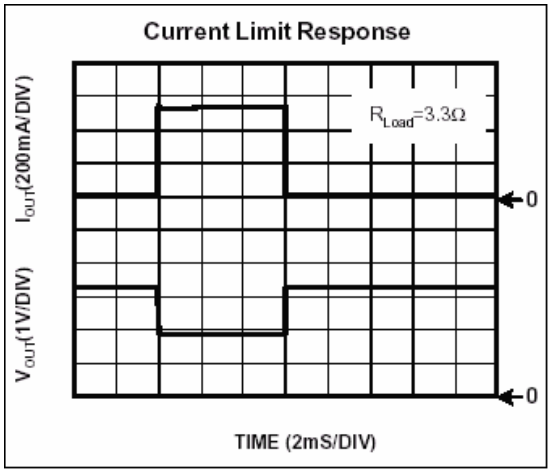

Load Step (1mA-300mA)
Output
C_L =2.2µF
C_{IN} =2.2µF
I_{Load}
I_L(200mA/DIV) V_O(5mV/DIV)
0
TIME(20mS/DIV)

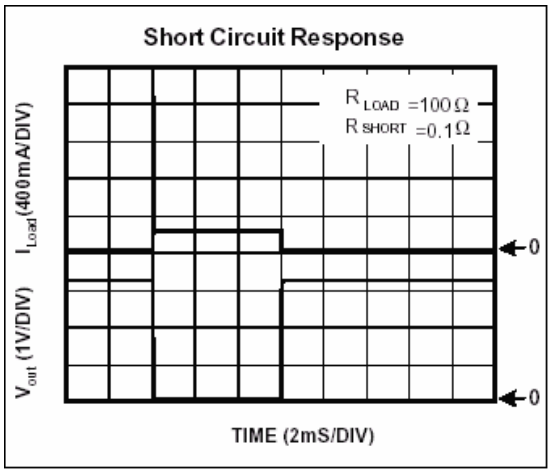

Safe Operating Area
SOT-23-5
Output Current (mA)
300
100
10
0.1
1.0
8.0
Input-Output Voltage Differential (V)

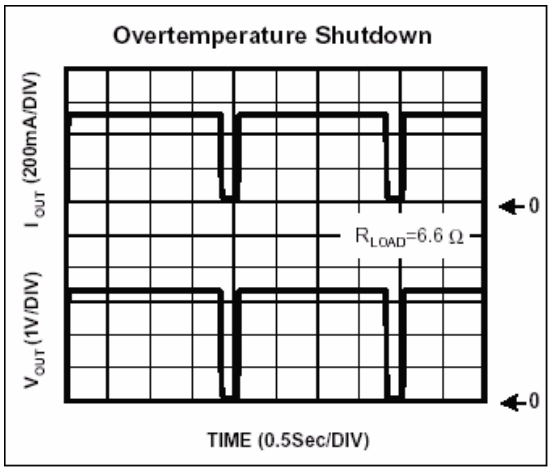

Line Transient Response
V_{IN}(1V/DIV)
V_O(1mV/DIV)
V_{INDC}=5.0V
C_L=2.2µF
TIME (2mS/DIV)

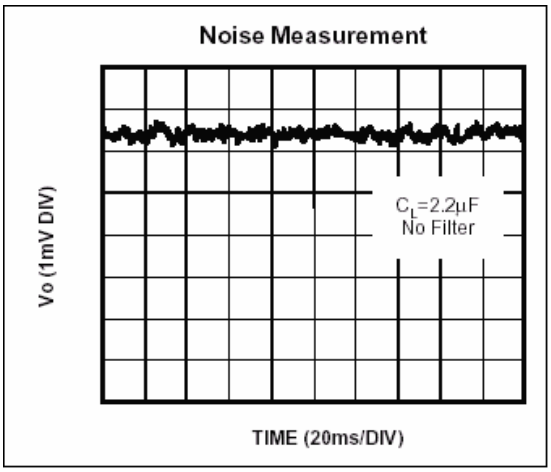

Load Regulation vs. Temp.
Load Regulation (%)
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
-45
-5
25
55
85
Temperature (°C)

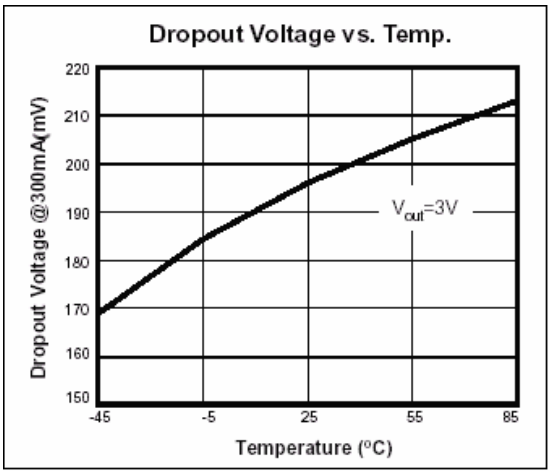

PG VOL vs. Temp.
PG VOL @ 0.4mA (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
-45
-5
25
55
85
Temperature (°C)

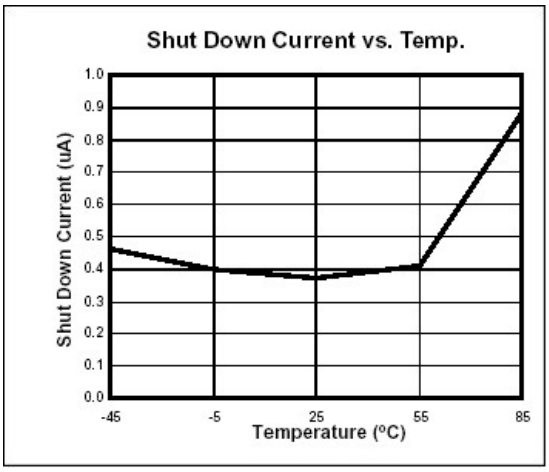

Current Limit Response
R_{Load}=3.3Ω
I_{OUT}(200mA/DIV)
V_{OUT}(1V/DIV)
0
0
TIME (2mS/DIV)

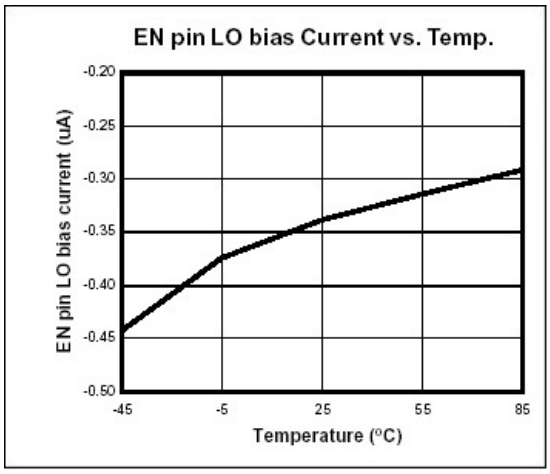

Short Circuit Response
R LOAD =100Ω
R SHORT =0.1Ω
V out (1V/DIV) I Load (400mA/DIV)
0
0
TIME (2mS/DIV)


Overtemperature Shutdown
I OUT (200mA/DIV)
V OUT (1V/DIV)
R LOAD=6.6 Ω
0
0
TIME (0.5Sec/DIV)


Noise Measurement
Vo (1mV DIV)
C L=2.2µF
No Filter
TIME (20ms/DIV)


Dropout Voltage vs. Temp.
Dropout Voltage @300mA(mV)
220
210
200
190
180
170
160
150
V out=3V
-45
-5
25
55
85
Temperature (°C)


Shut Down Current vs. Temp.
Shut Down Current (uA)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-45
-5
25
55
85
Temperature (°C)


EN pin LO bias Current vs. Temp.
EN pin LO bias current (uA)
-0.20
-0.25
-0.30
-0.35
-0.40
-0.45
-0.50
-45
-5
25
55
85
Temperature (°C)

Detailed Description

The SQ2133 of COMS regulators contain a PMOS pass transistor,voltage reference, error amplifier,over-current protection and thermal shutdown and Power Good function. The P-channel pass transistor receives data from the error amplifier,over-current shutdown, and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over-current and Thermal shutdown circuits become active when the junction temperature exceeds150^{o}C,or the current exceeds 300mA. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120^{o}C· The SQ2133 switches from voltage mode to current mode when the load exceeds the rated output current. This prevents over-stress. The SQ2133 also incorporates current fold-back to reduce power dissipation when the output is short circuited.This feature becomes active when the output drops below 0.8 volts, and reduces the current flow by 65%. Full current is restored when the voltage exceeds 0.8 volts.

External Capacitors

The SQ2133 is stable with an output capacitance to ground of 2.2uF or greater. Ceramic capacitors have the lowest ESR, and will offer the best AC performance. Conversely, Aluminum Elertrolytic capacitors exhibit the highest ESR, resulting in the poorest AC response. Unfortunately, large value ceramic capacitors are comparatively expensive. One option is to parallel a 0.1 uF ceramic capacitor with a 10 uF Aluminum Electrolytic. The benefit is low ESR, high capacitance, and low overall cost. A second capacitor is recommended between the input and ground to stabilize Vin. The input capacitor should be at least 0.1uF to have a beneficial effect. All capacitors should be placed in close proximity to the pins. A "Quiet" ground termination is desirable . The can be achieved with a "Star" connection.

Enable

The Enable pin normally floats high. When actively, pulled low, the PMOS pass transistor shuts off, and all internal circuits are powered down. In this state, the quiescent current is less than 1uA. This pin behaves much like an electronic switch.

Power Good

The SQ2133 includes the Power Good feature.When the output is not within ±15% of the specified voltage, it pulls low. This can occur under the following conditions: 1. Input Votage Too Low. 2. During Over-Temperature. 3. During Over-Current. 1. If Output Is Pulled Up. (Note: PG pin is an open-drain output.)