Elektronische Bauelemente

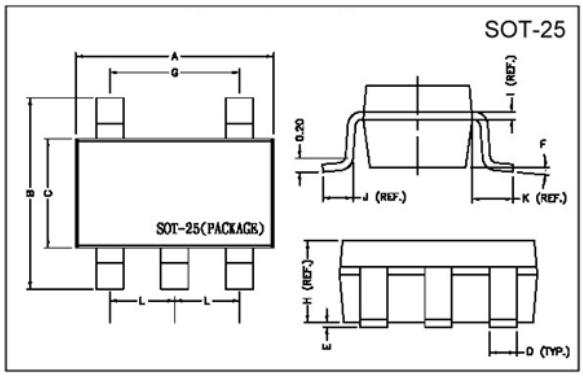
SQ2153

CMOS Positive Voltage Regulator

RoHS Compliant Product

Description

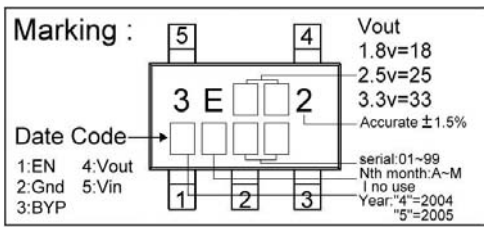
The SQ2153 series of positive,linear regulators feature low quiescent current (30μA typ.) with low dropout voltage, making them ideal for battery applications. These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" of operating conditions. In applications requiring a low noise, regulated supply, place a 1000pF capacitor between Bypass and Ground. The SQ2153 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

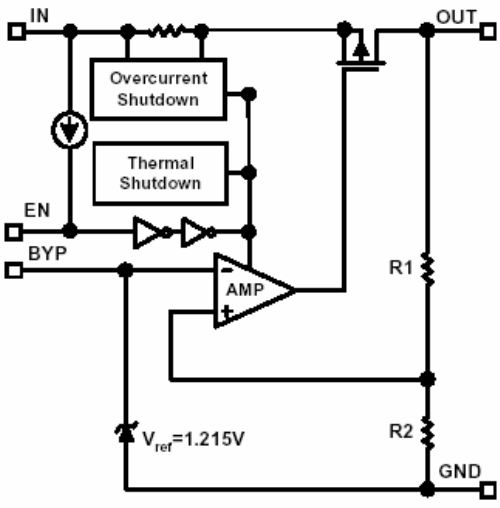
* High Accurate ±1.5%
* Over-Temperature Shutdown
* Factory Pre-set Output Voltage
* Very Low Dropout Voltage
* Noise Reduction Bypass Capacitor
* Short Circuit Current Fold-back
* Guaranteed 300mA output
* Current Limiting
* Power-Saving Shutdown Mode



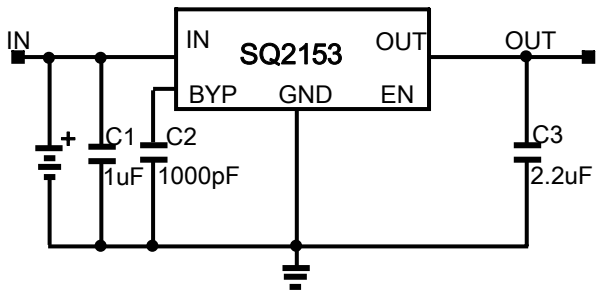
Applications

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

Functional Block Diagram



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}	1.5~3.8	V
Operating Ambient Temperature	Topr	-40~+85	°C
Junction Temperature	Tj	-40~+125	°C
Max. Junction Temperature	Tj Max.	150	°C
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
		-2.5%		2.5%		$V_{IN}=V_{OUT}(T)+2V$,1o=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		$2.8V < V_{OUT}(T)$ Vo=V_{OUT}(E)-2%
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		$1.4V < V_{OUT}(T) \leq 2.0V$ Io=1mA $V_{IN}=V_{OUT}(T)+1$ to $V_{OUT}(T)+2$
		-0.1	0.02	0.1		$2.0V < V_{OUT}(T) < 4.0V$ Io=1mA $V_{IN}=V_{OUT}(T)+1$ to $V_{OUT}(T)+2$
		-0.4	0.2	0.4		$4.0V < V_{OUT}(T)$ Io=1mA $V_{IN}=V_{OUT}(T)+1$ to $V_{OUT}(T)+2$
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 Io=100mA Co=2.2uF
		–	20	–		f=10kHz Io=100mA Co=2.2uF
Output Voltage Noise	eN	–	30	–	uVrms	Co=2.2uF f=10Hz~100kHz Io=10mA
Ground Pin Current	I_{GND}	–	35	–	uA	$V_{IN}=V_{OUT}(T)+2V$,Io=1mA~300mA
EN Input Threshold	V_{EH}	2	–	V_{IN}	V	V_{IN}=2.7V to 7V
	V_{EL}	0	–	0.4		V_{IN}=2.7V to 7V
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, $V_{EN}<V_{EL}$

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

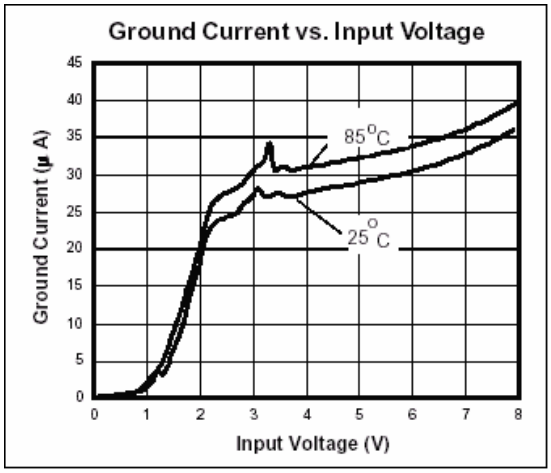
3: $V_{IN\ (MIN)}$ =V_{OUT}+$V_{DROPOUT}$

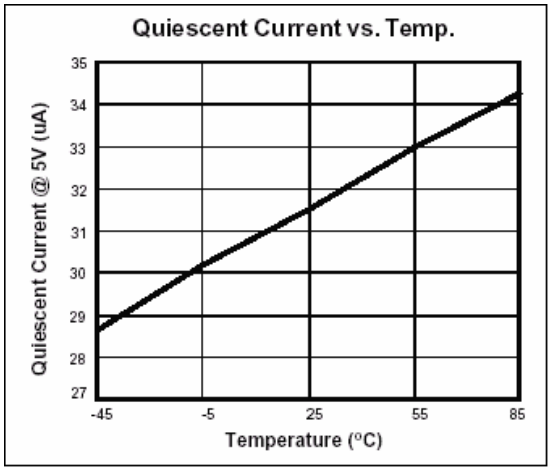
4: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.

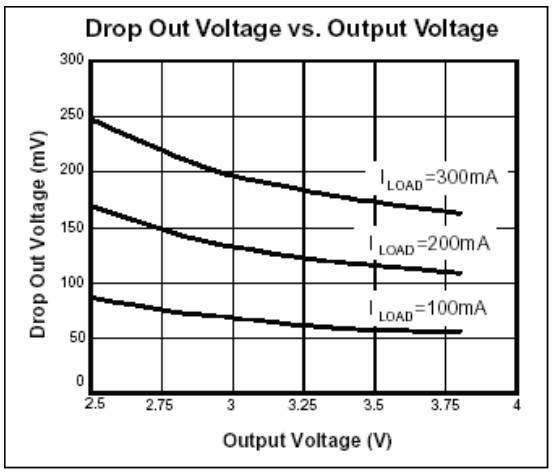
Ordering Information(contd.)

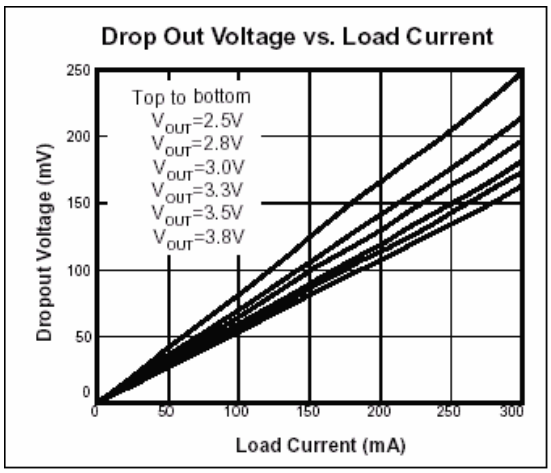
Part Number	Marking	Output Voltage	Part Number	Marking	Output Voltage
SQ2153-15	3E152 XXXX	1.5V	SQ2153-18	3E182 XXXX	1.8V
SQ2153-25	3E252 XXXX	2.5V	SQ2153-27	3E272 XXXX	2.7V
SQ2153-28	3E282 XXXX	2.8V	SQ2153-2H	3E2H2 XXXX	2.85V
SQ2153-29	3E292 XXXX	2.9V	SQ2153-30	3E302 XXXX	3.0V
SQ2153-31	3E312 XXXX	3.1V	SQ2153-33	3E332 XXXX	3.3V
SQ2153-34	3E342 XXXX	3.4V	SQ2153-35	3E352 XXXX	3.5V
SQ2153-36	3E362 XXXX	3.6V	SQ2153-37	3E372 XXXX	3.7V
SQ2153-38	3E382 XXXX	3.8V			

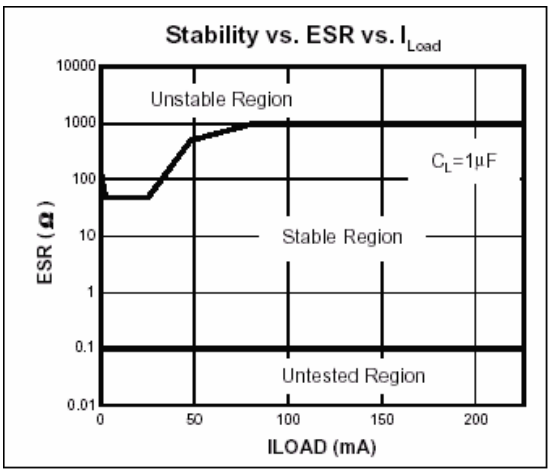
Characteristics Curve

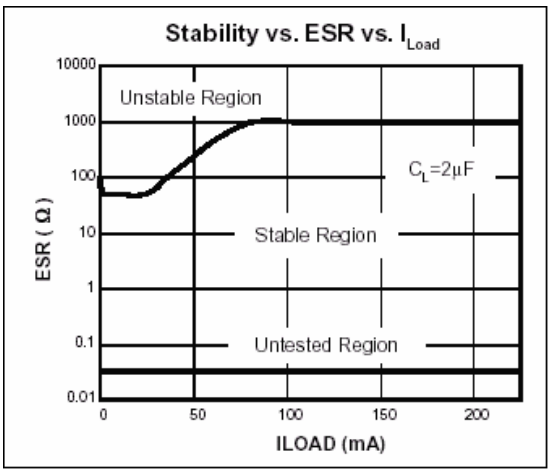


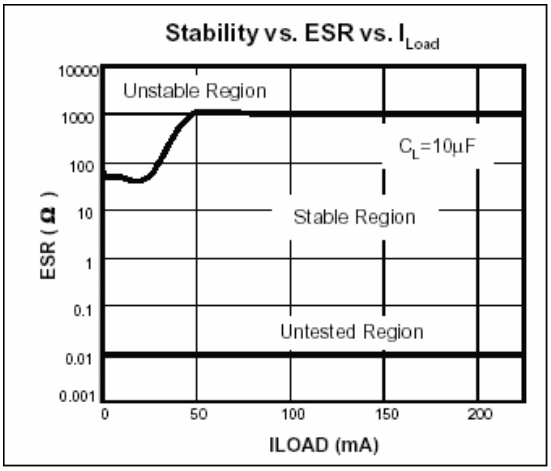


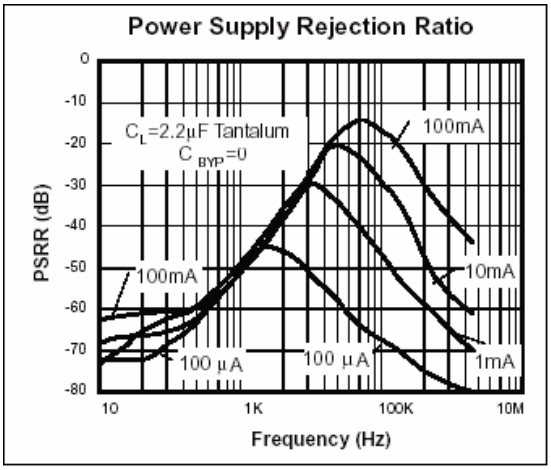

Drop Out Voltage vs. Output Voltage
Drop Out Voltage (mV)
Output Voltage (V)
I LOAD=300mA
I LOAD=200mA
I LOAD=100mA

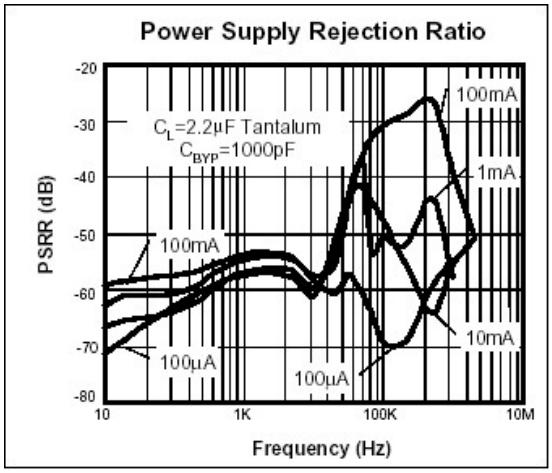

Drop Out Voltage vs. Load Current
Dropout Voltage (mV)
Load Current (mA)
Top to bottom
VOUT=2.5V
VOUT=2.8V
VOUT=3.0V
VOUT=3.3V
VOUT=3.5V
VOUT=3.8V

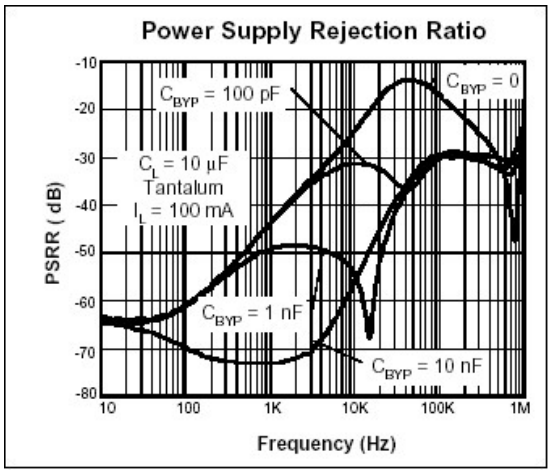

Stability vs. ESR vs. I Load
ESR (Ω)
ILOAD (mA)
Unstable Region
Stable Region
Untested Region
CL=1µF

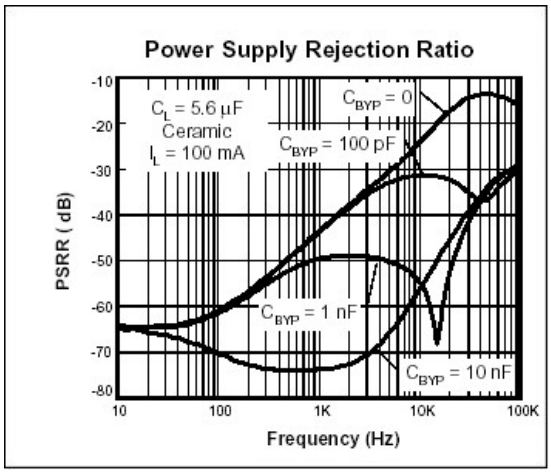

Stability vs. ESR vs. I Load
ESR (Ω)
ILOAD (mA)
Unstable Region
Stable Region
Untested Region
CL=2µF

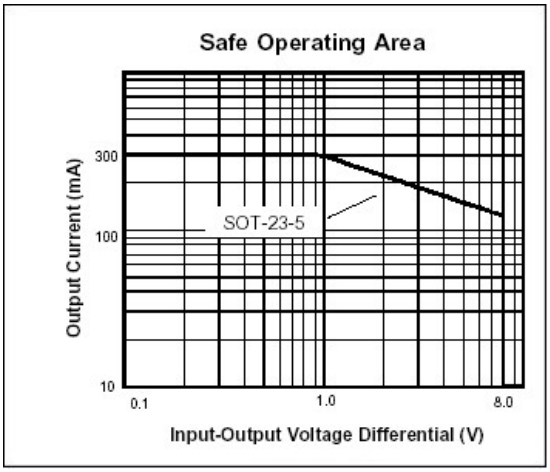

Stability vs. ESR vs. I Load
ESR (Ω)
ILOAD (mA)
Unstable Region
Stable Region
Untested Region
CL=10µF

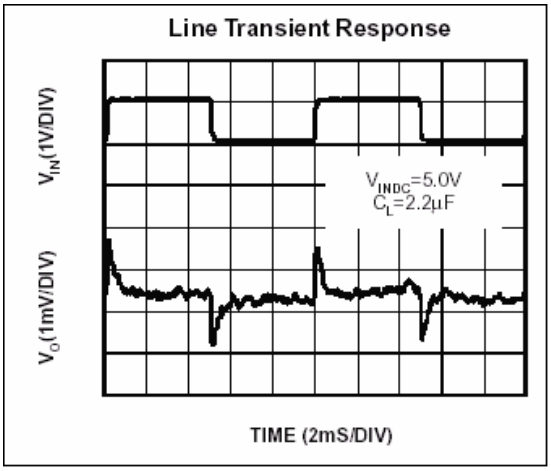

Power Supply Rejection Ratio
PSRR (dB)
Frequency (Hz)
CL=2.2µF Tantalum
C BYP=0
100mA
10mA
1mA
100 µA

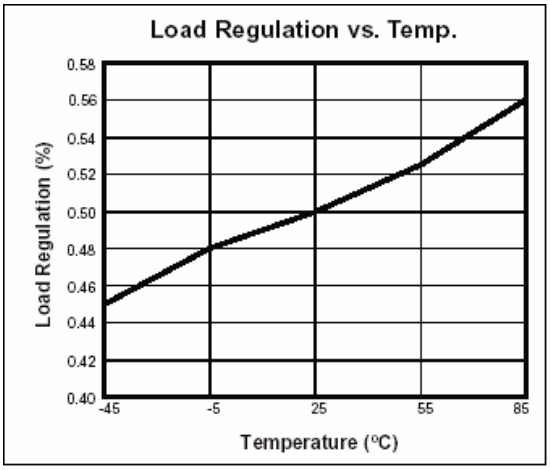

Power Supply Rejection Ratio
PSRR (dB)
Frequency (Hz)
C_L=2.2µF Tantalum
C_BYP=1000pF
100mA
1mA
10mA
100µA
100µA
100mA
10
1K
100K
10M

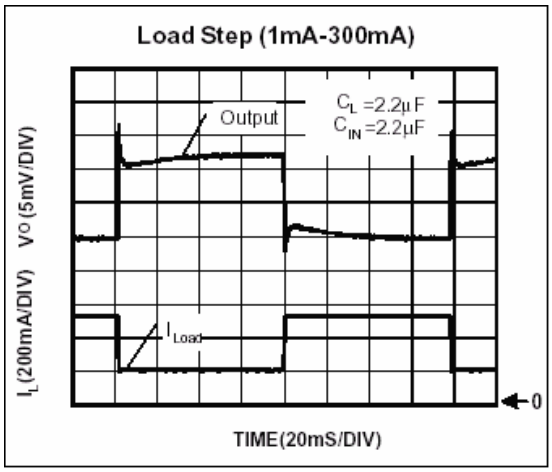

Power Supply Rejection Ratio
PSRR (dB)
Frequency (Hz)
C_BYP = 0
C_BYP = 100 pF
C_L = 10 µF
Tantalum
I_L = 100 mA
C_BYP = 1 nF
C_BYP = 10 nF
10
100
1K
10K
100K
1M

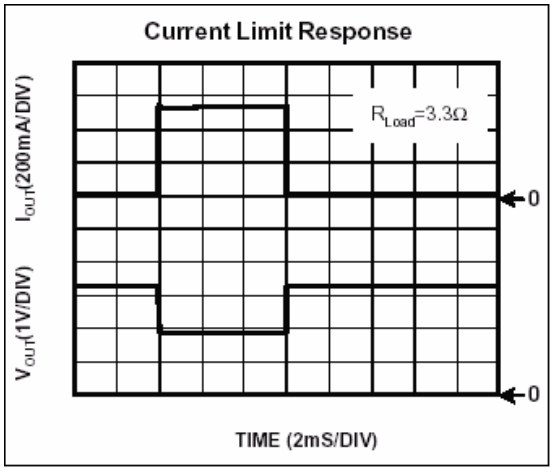

Power Supply Rejection Ratio
PSRR (dB)
Frequency (Hz)
C_L = 5.6 µF
Ceramic
I_L = 100 mA
C_BYP = 0
C_BYP = 100 pF
C_BYP = 1 nF
C_BYP = 10 nF
10
100
1K
10K
100K

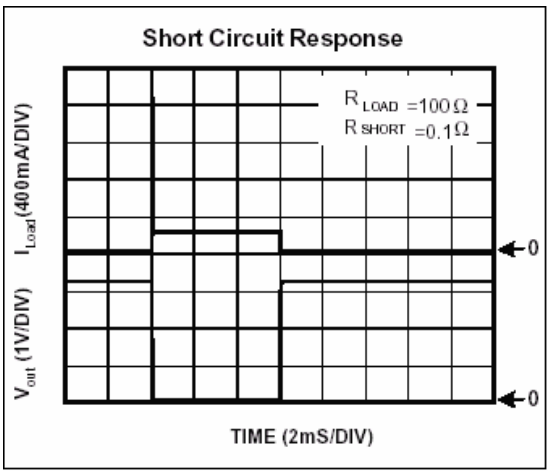

Safe Operating Area
Output Current (mA)
Input-Output Voltage Differential (V)
SOT-23-5
300
100
10
0.1
1.0
8.0

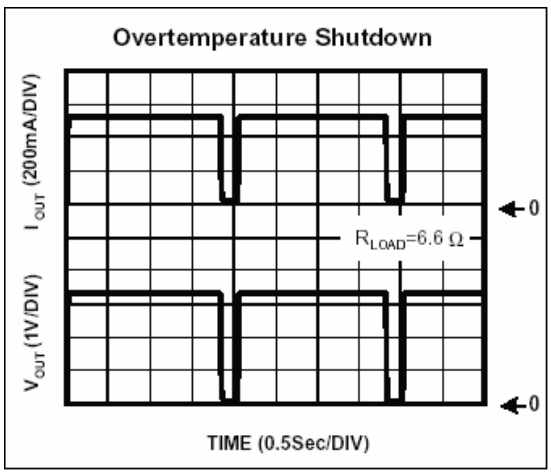

Line Transient Response
V_IN(1V/DIV)
V_O(1mV/DIV)
TIME (2mS/DIV)
V_INDC=5.0V
C_L=2.2µF

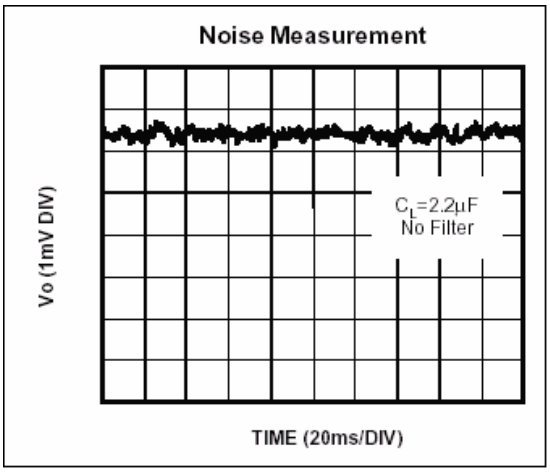

Load Regulation vs. Temp.
Load Regulation (%)
Temperature (°C)
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
-45
-5
25
55
85

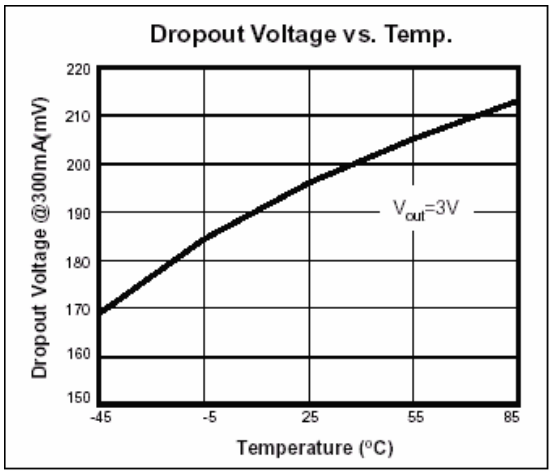

Load Step (1mA-300mA)
Output
C_L =2.2µF
C_{IN} =2.2µF
I_{Load}
V_O (5mV/DIV)
I_L (200mA/DIV)
0
TIME(20mS/DIV)

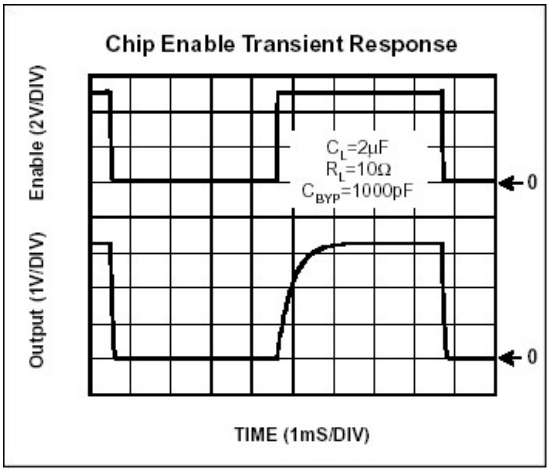

Current Limit Response
R_{Load}=3.3Ω
I_{OUT}(200mA/DIV)
V_{OUT}(1V/DIV)
0
0
TIME (2mS/DIV)

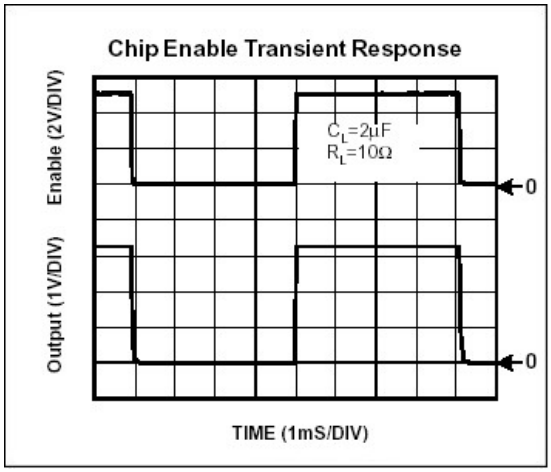

Short Circuit Response
R_{LOAD} =100Ω
R_{SHORT} =0.1Ω
I_{Load}(400mA/DIV)
V_{out} (1V/DIV)
0
0
TIME (2mS/DIV)

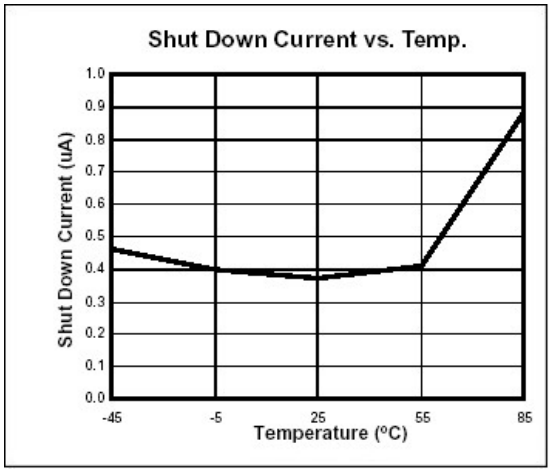

Overtemperature Shutdown
I_{OUT} (200mA/DIV)
R_{LOAD}=6.6 Ω
V_{OUT} (1V/DIV)
0
0
TIME (0.5Sec/DIV)

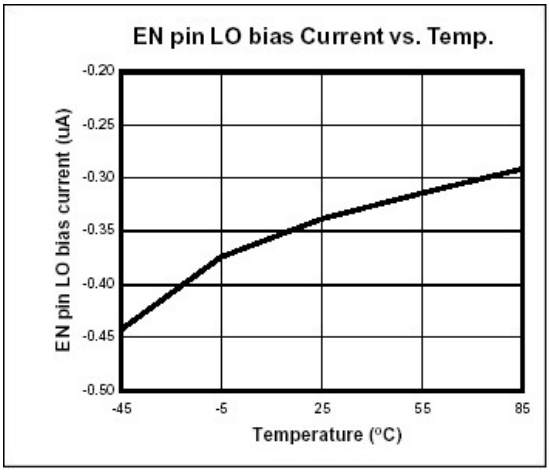

Noise Measurement
C_L=2.2µF
No Filter
Vo (1mV DIV)
TIME (20ms/DIV)


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









Detailed Description

The SQ2153 series of COMS regulators contain a PMOS pass transistor,voltage reference, error amplifier,over-current protection and thermal shutdown.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 shut-down 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 SQ2153 switches from voltage mode to current mode when the load exceeds the rated output current.This prevents over-stress. The SQ2153 also in-corporates 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 SQ2153 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. A third capacitor can be connected between the BY-PASS pin and GND. this capacitor can be a low cost Polyester Film variety between the value of 0.001 ~0.01 uF. A large capacitor improves the AC ripple rejection, but also makes the output come up slowly. This "Soft" turn-on is desirable in some applications to limit turn-on surges. 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.