GQ2163

CMOS Positive Voltage Regulator

Description

The GQ2163 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 GQ2163 is stable with an output capacitance of 2.2µF or greater.

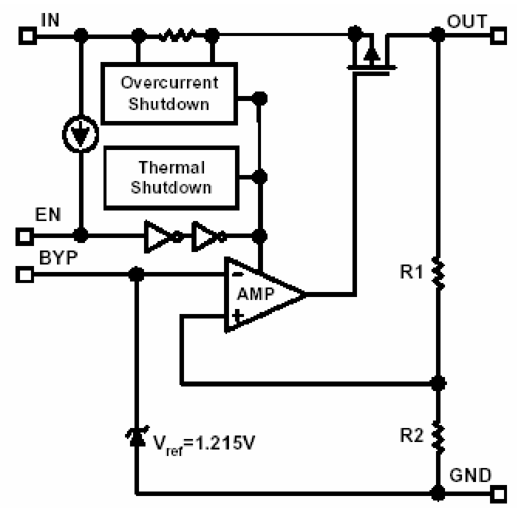
Features

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

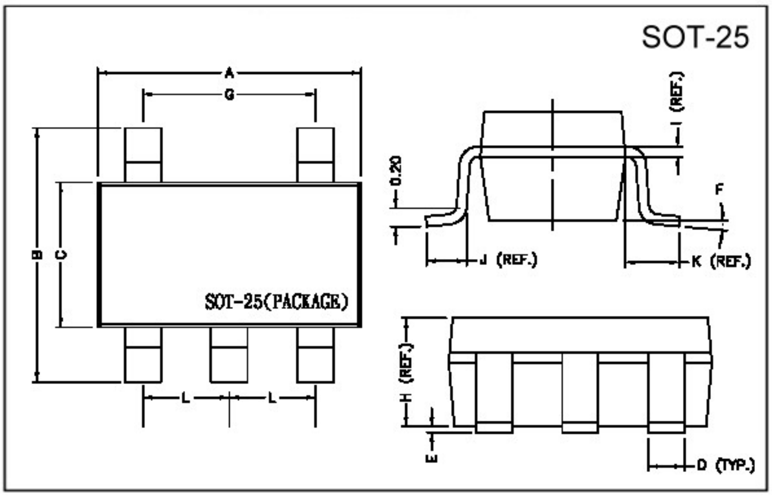
Applications

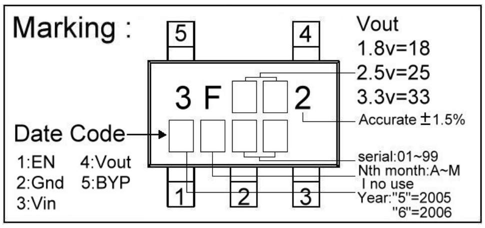
- Battery Powered Widgets
- Instrumentation
- Wireless Devices
- PC Peripherals
- Portable Electronics
- Cordless Phones
- Electronic Scales

Functional Block Diagram



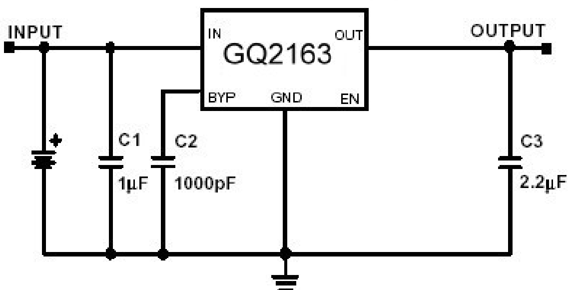
Package Dimensions





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.

Typical Application Circuit



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Input Max Voltage	V_{IN}	8	V
Output Current	I_{OUT}	$P_D/(V_{IN}-V_O)$	mA
Output Voltage	V_{OUT}	1.5~5.0	V
Operating Ambient Temperature	Topr	-40 ~ +85	℃
Junction Temperature	Tj	-40 ~ +125	℃
Maximum Junction Temperature	Tj_{Max}	150	℃
Power Dissipation(△T=100℃)	PD	380	mW
EDS Classification		B	

Electrical Characteristics Ta=25℃ unless otherwise noted

Parameter	Symbol	Condition		Min	TYP	Max	Unit
Output Voltage	$V_{OUT}(E)$ (Note1)	$V_{IN}=V_{OUT}(T)+2V$, $I_O=1mA$		-1.5%	$V_{OUT}(T)$ (Note2)	1.5%	V
		$V_{IN}=V_{OUT}(T)+2V$, $I_O=300mA$		-2.5%		2.5%	V
Output Current	I_O	$V_{IN}=V_{OUT}(T)+2V$, $V_{OUT} \geqq V_{OUT}(E)*0.96$		300	-	-	mA
Current Limit	I_{LIM}	$V_{IN}=V_{OUT}(T)+2V$, $V_O>1.2V$		300	450	-	mA
Load Regulation	REG_{LOAD}	$V_{IN}=V_{OUT}(T)+2V$, $I_O=1mA$ to 300mA		-1	0.2	1	%
Dropout Voltage	$V_{DROPOUT}$	$I_O=300mA$ $V_O=V_{OUT}(E)-2\%$	$1.2V \leqq V_{OUT}(T) \leqq 2.0V$	-	-	1300	mV
			$2.0V<V_{OUT}(T) \leqq 2.8V$	-	-	400	
			$2.8V<V_{OUT}(T)$	-	-	300	
Quiescent Current	I_Q	$V_{IN}=V_{OUT}(T)+1V$, $I_O=0mA$		-	30	50	μA
Ground Pin Current	I_{GND}	$V_{IN}=V_{OUT}(T)+2V$, $I_O=1mA\sim300mA$		-	35	-	μA
Line Regulation	REG_{LINE}	$I_O=1mA$ $V_{IN}=V_{OUT}(T)+1$ to $V_{OUT}(T)+2$	$1.2V \leqq V_{OUT}(T) \leqq 1.4V$	-0.2	-	0.2	%
			$1.4V<V_{OUT}(T) \leqq 2.0V$	-0.15	-	0.15	
			$2.0V<V_{OUT}(T)<4.0V$	-0.1	0.02	0.1	
			$4.0V \leqq V_{OUT}(T)$	-0.4	0.2	0.4	
Input Voltage	V_{IN}			Note3	-	7	V
Over Temperature Shutdown	OTS			-	150	-	℃
Over Temperature Hysterisis	OTH			-	30	-	℃
Output Voltage Temperature Coefficient	TC			-	30	-	ppm/℃
Short Circuit Current(Note4)	I_{SC}	$V_{IN}=V_{OUT}(T)+1V$, $V_{OUT}<0.8V$		-	150	300	mA
Power Supply Rejection	PSRR	Io=100mA Co=2.2μF	f=100Hz	-	60	-	dB
			f=1kHz	-	50	-	
			f=10kHz	-	20	-	
Output Voltage Noise	eN	f=10Hz~100kHz Io=10mA	Co=2.2μF	-	30	-	μVrms
EN Input Threshold	V_{EH}	$V_{IN}=2.7V$ to 7V		2.0	-	V_{IN}	V
	V_{EL}	$V_{IN}=2.7V$ to 7V		0	-	0.4	V
EN Input Bias Current	I_{EH}	$V_{EN}=V_{IN}$, $V_{IN}=2.7V$ to 7V		-	-	0.1	μA
	I_{EL}	$V_{EN}=0V$, $V_{IN}=2.7V$ to 7V		-	-	0.5	μA
Shutdown Supply Current	I_{SD}	$V_{IN}=5V$, $V_O=0V$, $V_{EN}<V_{EL}$		-	0.5	1	μA
Shutdown Output Voltage	$V_{O,SD}$	$I_O=0.4mA$, $V_{EN}<V_{EL}$		0	-	0.4	V

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

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

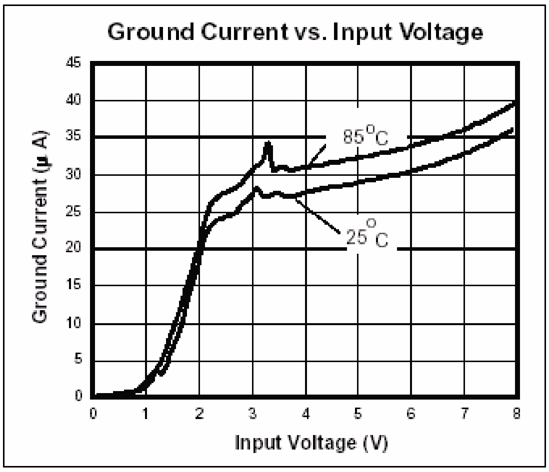
3: $V_{IN(MIN)}=V_{OUT}+V_{DROPOUT}$

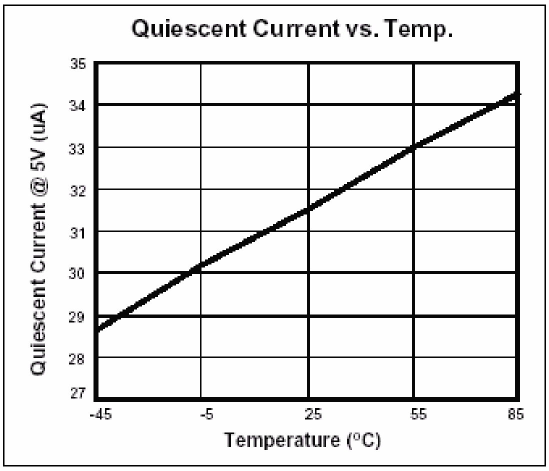
4: To prevent the Short Circuit Current protection feature from being prematurely activated, the input voltage must be applied before a current source load is applied.

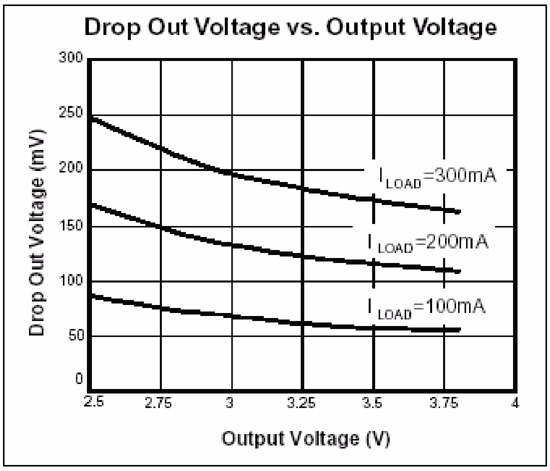
Ordering Information (contd.)

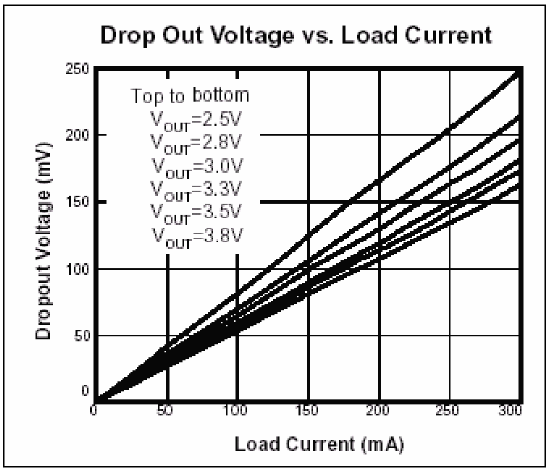
Part Number	Marking	Output Voltage	Part Number	Marking	Output Voltage
GQ2163-15	3F152 XXXX	1.5V	GQ2163-18	3F182 XXXX	1.8V
GQ2163-20	3F202 XXXX	2.0V	GQ2163-25	3F252 XXXX	2.5V
GQ2163-27	3F272 XXXX	2.7V	GQ2163-2H	3F2H2 XXXX	2.85V
GQ2163-28	3F282 XXXX	2.8V	GQ2163-29	3F292 XXXX	2.9V
GQ2163-30	3F302 XXXX	3.0V	GQ2163-31	3F312 XXXX	3.1V
GQ2163-33	3F332 XXXX	3.3V	GQ2163-34	3F342 XXXX	3.4V
GQ2163-35	3F352 XXXX	3.5V	GQ2163-36	3F362 XXXX	3.6V
GQ2163-37	3F372 XXXX	3.7V	GQ2163-38	3F382 XXXX	3.8V
GQ2163-50	3F502 XXXX	5.0V			

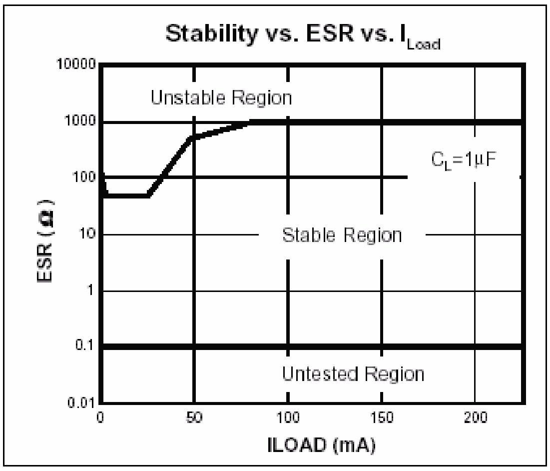
Characteristics Curve

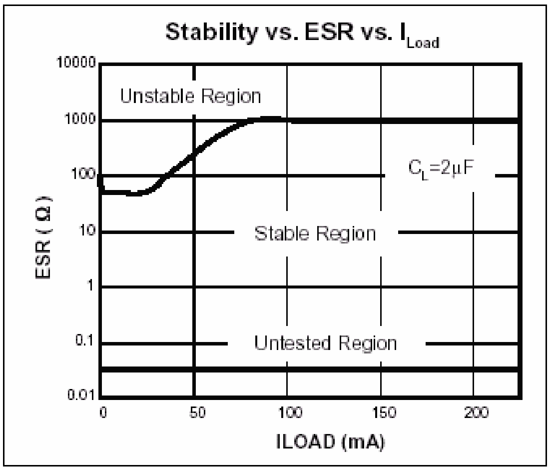


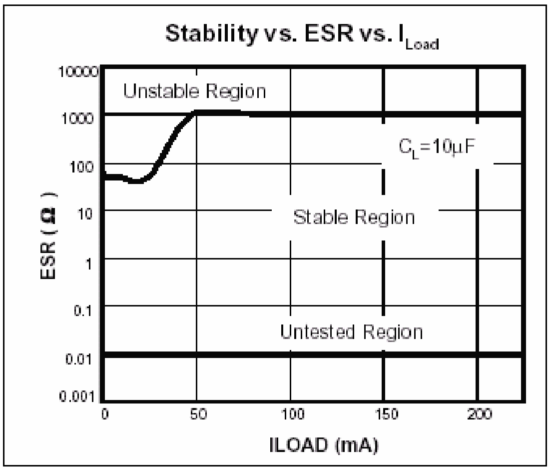


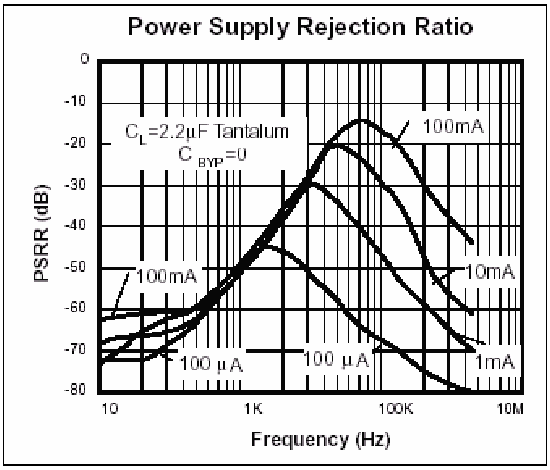


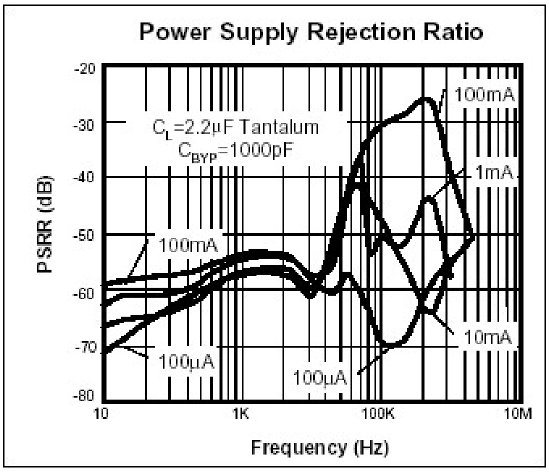


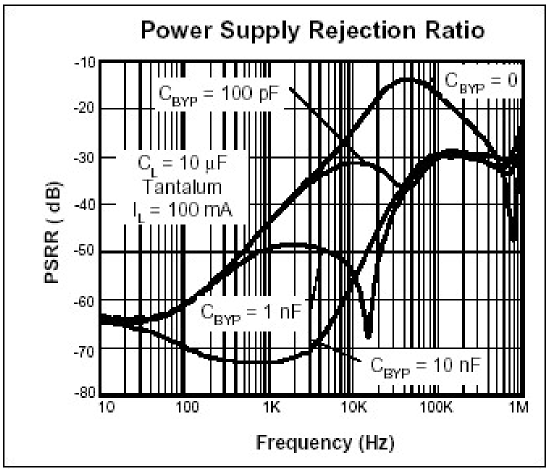

Stability vs. ESR vs. I_{Load}
Unstable Region
C_L=1μF
Stable Region
Untested Region
ESR (Ω)
10000
1000
100
10
1
0.1
0.01
0
50
100
150
200
ILOAD (mA)

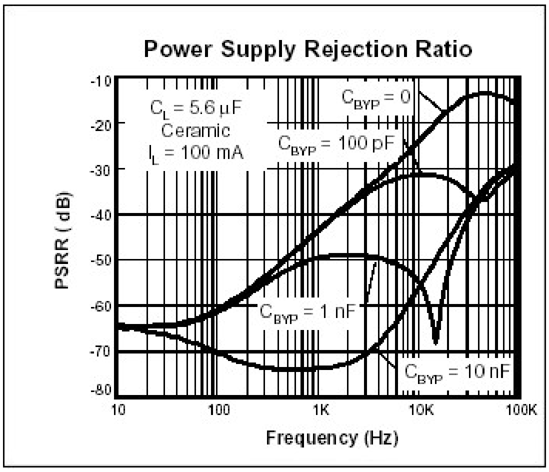

Stability vs. ESR vs. I_{Load}
Unstable Region
C_L=2μF
Stable Region
Untested Region
ESR (Ω)
10000
1000
100
10
1
0.1
0.01
0
50
100
150
200
ILOAD (mA)

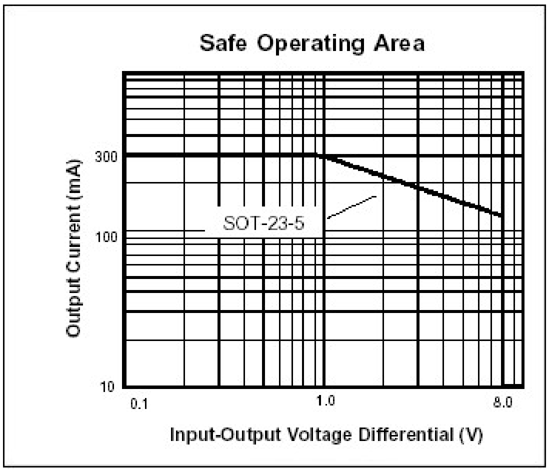

Stability vs. ESR vs. I_{Load}
Unstable Region
C_L=10μF
Stable Region
Untested Region
ESR (Ω)
10000
1000
100
10
1
0.1
0.01
0.001
0
50
100
150
200
ILOAD (mA)

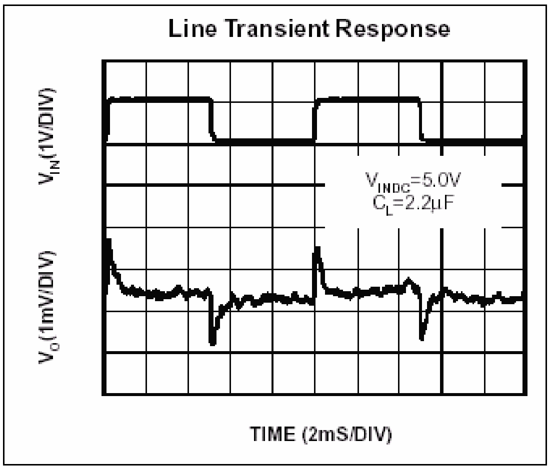

Power Supply Rejection Ratio
C_L=2.2μF Tantalum
C_{BYP}=0
100mA
10mA
1mA
100mA
100 μA
100 μA
PSRR (dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
10
1K
100K
10M
Frequency (Hz)

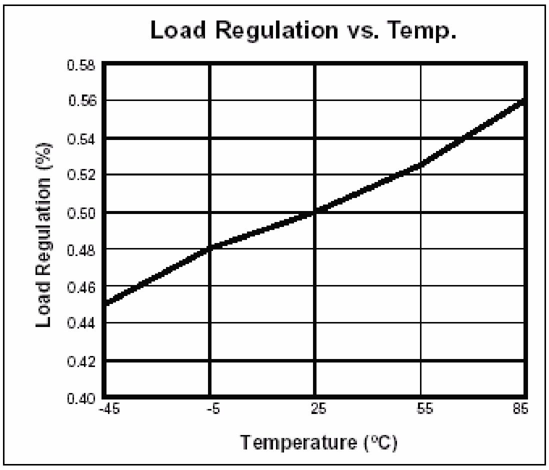

Power Supply Rejection Ratio
C_L=2.2μF Tantalum
C_{BYP}=1000pF
100mA
1mA
100mA
10mA
100μA
100μA
PSRR (dB)
-20
-30
-40
-50
-60
-70
-80
10
1K
100K
10M
Frequency (Hz)

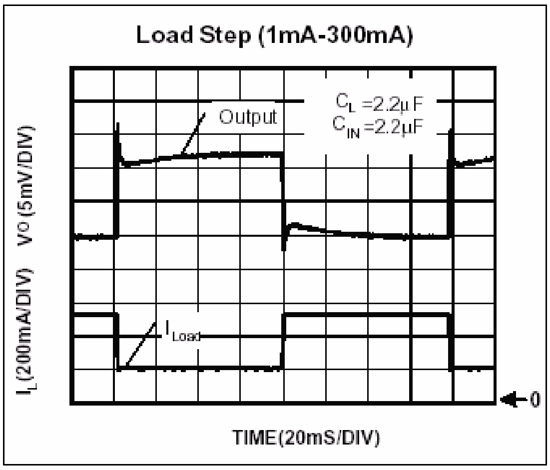

Power Supply Rejection Ratio
C_{BYP} = 100 pF
C_{BYP} = 0
C_L = 10 μF
Tantalum
I_L = 100 mA
C_{BYP} = 1 nF
C_{BYP} = 10 nF
PSRR (dB)
-10
-20
-30
-40
-50
-60
-70
-80
10
100
1K
10K
100K
1M
Frequency (Hz)

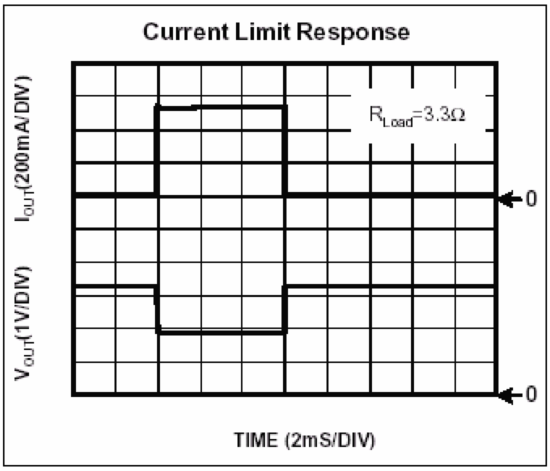

Power Supply Rejection Ratio
PSRR (dB)
Frequency (Hz)
CL = 5.6 µF
Ceramic
IL = 100 mA
CBYP = 0
CBYP = 100 pF
CBYP = 1 nF
CBYP = 10 nF
-10
-20
-30
-40
-50
-60
-70
-80
10
100
1K
10K
100K

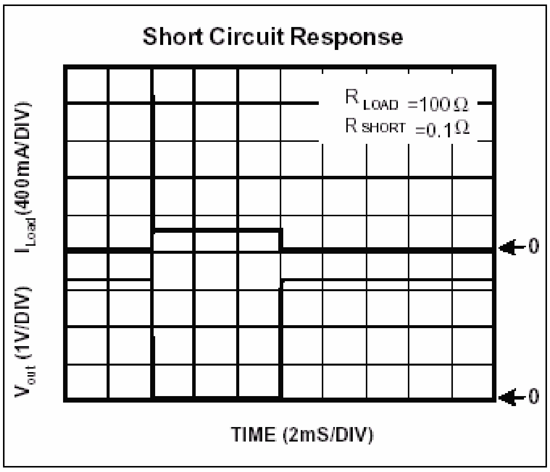

Safe Operating Area
Output Current (mA)
Input-Output Voltage Differential (V)
SOT-23-5
300
100
10
0.1
1.0
8.0

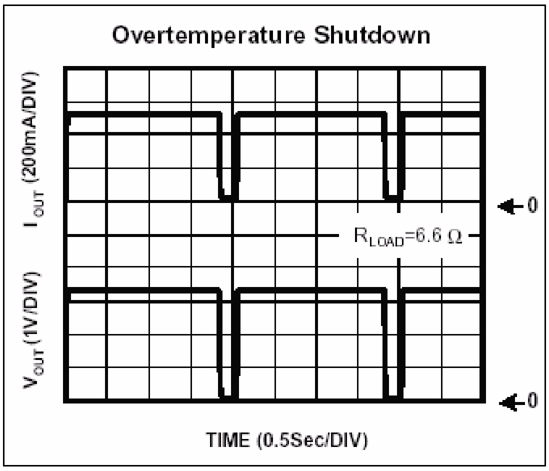

Line Transient Response
VIN(1V/DIV)
VO(1mV/DIV)
VINDC=5.0V
CL=2.2µF
TIME (2mS/DIV)

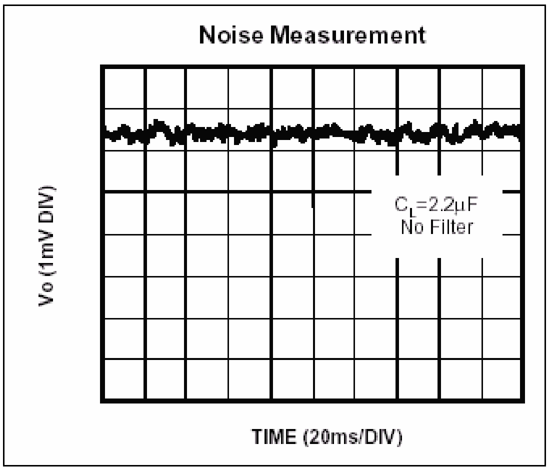

Load Regulation vs. Temp.
Load Regulation (%)
Temperature (°C)
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
-45
-5
25
55
85

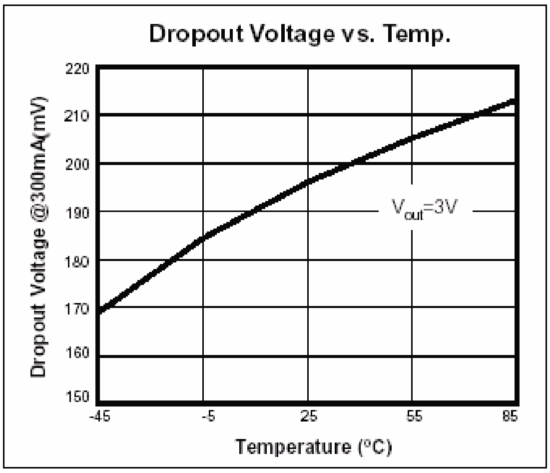

Load Step (1mA-300mA)
Output
CL =2.2µF
CIN =2.2µF
ILoad
VO (5mV/DIV)
IL(200mA/DIV)
0
TIME(20mS/DIV)

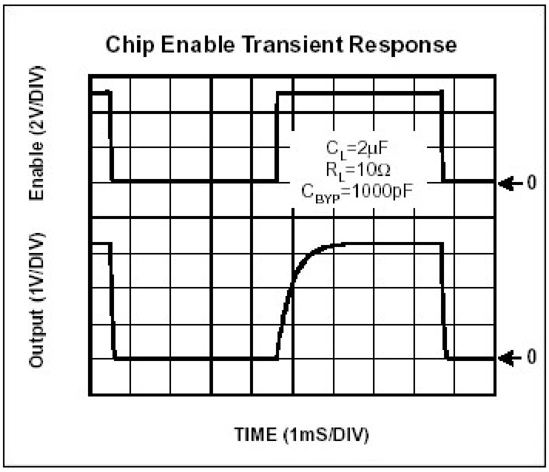

Current Limit Response
RLoad=3.3Ω
IOUT(200mA/DIV)
VOUT(1V/DIV)
0
0
TIME (2mS/DIV)

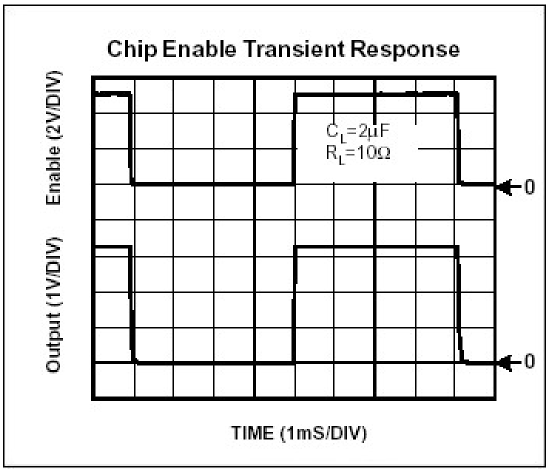

Short Circuit Response
I_{Load} (400mA/DIV)
V_{out} (1V/DIV)
R_{LOAD} =100Ω
R_{SHORT} =0.1Ω
0
0
TIME (2mS/DIV)

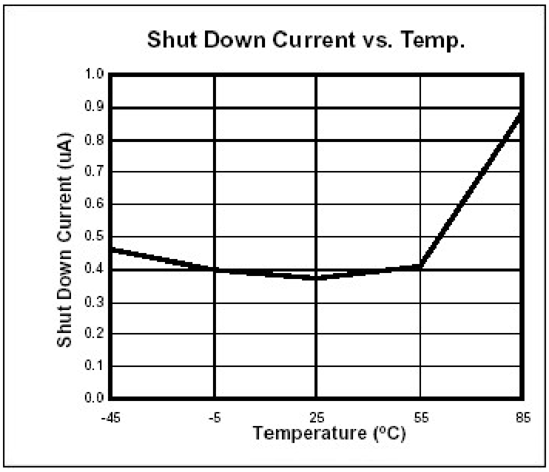

Overtemperature Shutdown
I_{OUT} (200mA/DIV)
V_{OUT} (1V/DIV)
R_{LOAD}=6.6 Ω
0
0
TIME (0.5Sec/DIV)

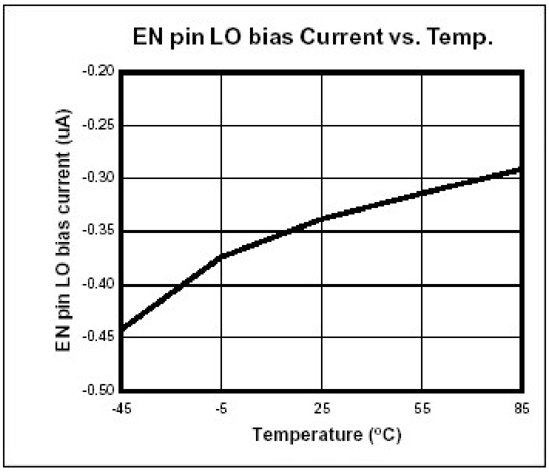

Noise Measurement
Vo (1mV DIV)
C_L=2.2µF
No Filter
TIME (20ms/DIV)


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


Chip Enable Transient Response
Enable (2V/DIV)
Output (1V/DIV)
C_L=2µF
R_L=10Ω
C_{BYP}=1000pF
0
0
TIME (1mS/DIV)


Chip Enable Transient Response
Enable (2V/DIV)
Output (1V/DIV)
C_L=2µF
R_L=10Ω
0
0
TIME (1mS/DIV)





Detailed Description

The GQ2163 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 shutdown circuits become active when the junction temperature exceeds 150℃, or the current exceeds 300mA. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120℃.

The GQ2163 switches from voltage mode to current mode when the load exceeds the rated output current. This prevents over-stress. The GQ2163 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 GQ2163 is stable with an output capacitance to ground of 2.2μF or greater. Ceramic capacitors have the lowest ESR, and will offer the best AC performance. Conversely, Aluminum Electrolytic 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 0.1μF ceramic capacitor with a 10μF 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 0.1μF 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 0.001~0.01μF. 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. This 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 1μA. This pin behaves much like an electronic switch.

Head Office And Factory:
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  TEL : 886-3-597-7061 FAX : 886-3-597-9220, 597-0785
- **China**: (201203) No.255, Jang-Jiang Tsai-Lueng RD. , Pu-Dung-Hsin District, Shang-Hai City, China
  TEL : 86-21-5895-7671 ~ 4 FAX : 86-21-38950165