G5U2187

750mA CMOS Positive Voltage Regulator

Description

The G5U2187 of positive, linear regulators feature low quiescent current (45μA typ.) with low dropout voltage, making then ideal for battery applications.
Output voltages are set at the factory and trimmed to 1.5% accuracy.
These rugged devices have both Thermal Shutdown, and Current Fold-back to prevent device failure under the "Worst" of operating conditions.
The G5U2187 is stable with an output capacitance of 4.7μF or greater.

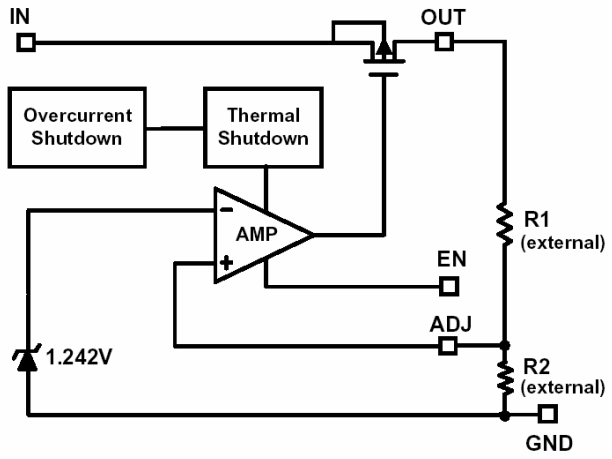
Features

- Very Low Dropout Voltage
- Guaranteed 750mA output
- Over-Temperature Shutdown
- Current Limiting
- Short Circuit Current Fold-back
- Low Temperature Coefficient
- Noise Reduction Bypass Capacitor
- Power-saving Shutdown Mode
- Adjustable Version

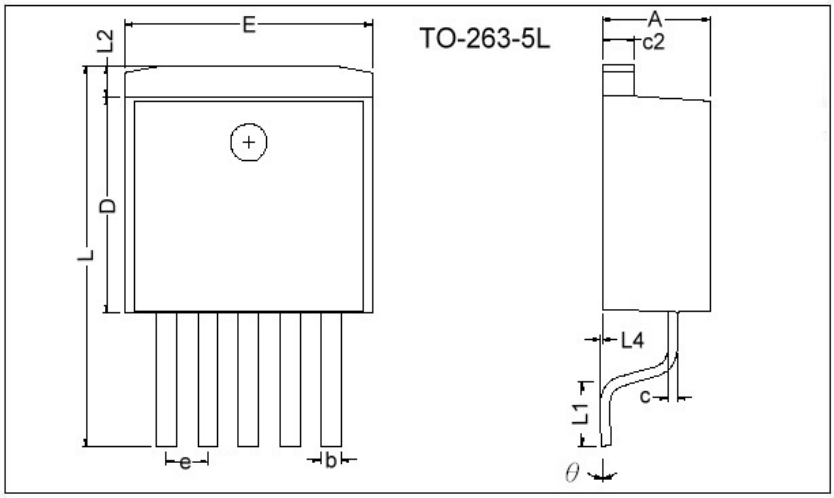
Applications

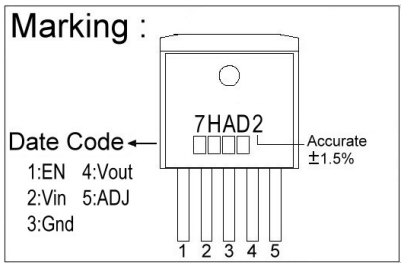
- Battery Powered Widgets
- Instrumentation
- Wireless Devices
- PC Peripherals
- Portable Electronics

Functional Block Diagram



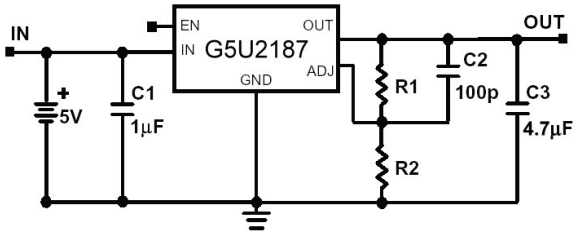
Package Dimensions





REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.40	4.80	c2	1.25	1.45
b	0.66	0.91	L2	1.27 REF.	
L4	0.00	0.30	D	8.6	9.0
c	0.36	0.5	e	1.70 REF.	
L1	2.29	2.79	L	14.6	15.8
E	9.80	10.4	θ	0°	8°

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}	Gnd-0.3 to V_{IN}+0.3	V
Operating Ambient Temperature	Topr	-40 ~ +85	℃
Junction Temperature	Tj	-40 ~ +125	℃
Maximum Junction Temperature	$T_{j\,Max}$	150	℃
Internal Power Dissipation(△T=100℃)	P_D	3.0	W
EDS Classification		B	

Electrical Characteristics T_A=25℃ unless otherwise noted

(V_{IN}=V_{OUT}(T) + 2V, V_{EN}=V_{IN}, C_{IN}=1uF, C_{OUT}=4.7uF)

Parameter	Symbol	Condition		Min	TYP	Max	Unit
Output Voltage	V_{OUT}(E) (Note1)	I_O=1mA, V_{IN}=V_{OUT}(T)+2V		-1.5	V_{OUT}(T) (Note2)	1.5	%
Output Current	I_O	V_O>1.2V		750	-	-	mA
Current Limit	I_{LIM}	V_O>1.2V		750	-	-	mA
Short Circuit Current	I_{SC}	V_{IN}=V_{OUT}(T)+1V, V_O< 0.4V		-	750	-	mA
Load Regulation	REG_{LOAD}	V_{IN}=V_{OUT}(T)+2V, I_O=1mA to 750mA		-1	0.2	1	%
Dropout Voltage	$V_{DROPOUT}$	I_O=750mA V_O=V_{OUT}(E)-2%	V_{OUT}(T)=1.5V	-	-	1000	mV
			V_{OUT}(T)=1.8V	-	-	650	
			V_{OUT}(T)≥2.0V	-	-	500	
Quiescent Current	I_Q	V_{IN}=V_{OUT}(T)+2V, I_O=0mA		-	45	70	μA
Ground Pin Current	I_{GND}	V_{IN}=V_{OUT}(T)+2V, I_O=1mA to 750mA		-	45	-	μA
Line Regulation	REG_{LINE}	I_O=1mA V_{IN}=V_{OUT}(T)+1 to V_{OUT}(T)+2	V_{OUT}(T)<2.0V	-0.15	-	0.15	%
			2.0V≤V_{OUT}(T)<4.0V	-0.1	0.02	0.1	
			4.0V≤V_{OUT}(T)	-0.4	-	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/℃
ADJ Input Bias Current	I_{ADJ}			-	1	-	μA
Minimum Load Current	I_{Load}	V_{IN}=2.5V		-	-	70	μA
ADJ Reference Voltage	V_{REF}			1.221	1.240	1.26	V
Power Supply Rejection	PSRR	Io=100mA Co=4.7μF (ceramic)	f=1kHz	-	75	-	dB
			f=10kHz	-	55	-	
			f=100kHz	-	30	-	
Output Voltage Noise	eN	f=10Hz~100kHz, Io=10mA, Co=4.7μF		-	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		-	-	1	μA
	I_{EL}	V_{EN}= 0V, V_{IN}=2.7V to 7V		-	-	1	μA
Shutdown Supply Current	I_{SD}	V_{IN}=5V, V_O=0V, V_{EN}<V_{EL}		-	0.5	2	μA

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}+$V_{DROPOUT}$

Ordering Information (contd.)

Part Number	Marking	Output Voltage	Part Number	Marking	Output Voltage
G5U2187-AD	7HAD2 XXXX	Adjustable			

Detailed Description

The G5U2187 of COMS regulator contains 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 140℃, or the current exceeds 2.2A. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120℃.

The G5U2187 behaves like a current source when the load reaches 2.2A. However, if the load impedance drops below 0.3ohms, the current drops back to 600mA to prevent excessive power dissipation. Normal operation is restored when the load resistance exceeds 0.75ohms.

External Capacitors

The G5U2187 is stable with an output capacitance to ground of 4.7μF 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 10uF 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 V_{IN}. The input capacitor should be at least 0.1μF to have a beneficial effect.

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

When EN pin is pulled low, the PMOS pass transistor shuts off, and all internal circuits are powered down. In this state, the quiescent current is less than 2μA. This pin behaves much like an electronic switch.

100KΩ resistor is necessary between V_{EN} source and EN pin when V_{EN} is high than V_{IN}.

(Note: There is no internal pull-up for EN pin. It can not be floating.)

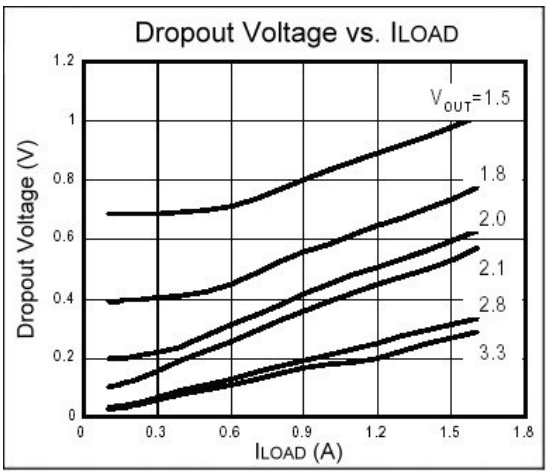
Adjustable Version

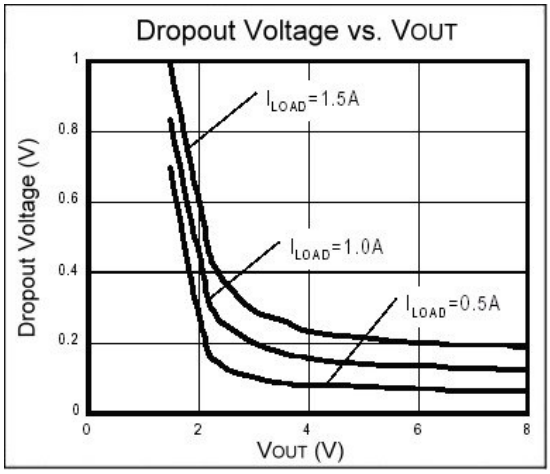
The adjustable version uses external feedback resistors to generate an output voltage anywhere from 1.5V to 5.0V. Vadj is trimmed to 1.24V and Vout is given by the equation:

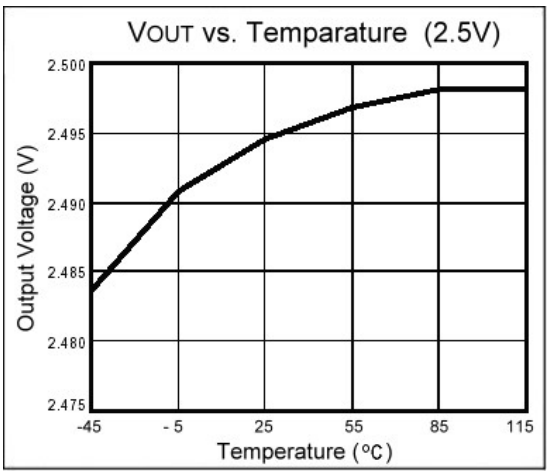
$$V_{OUT}=Vadj * (1+R1/R2)$$

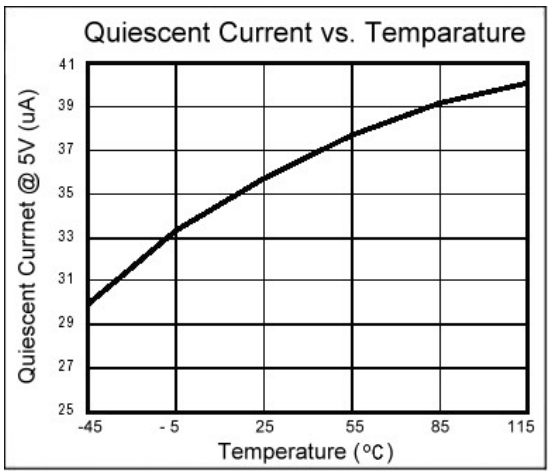
Feedback resistors R1 and R2 should be high enough to keep quiescent current low, but increasing R1+R2 will reduce stability. In general, R1 and R2 in the 10’s of kΩ will produce adequate stability, given reasonable layout precautions. To improve stability characteristics, keep parasitic on the ADJ pin to minimum, and lower R1 and R2 values.

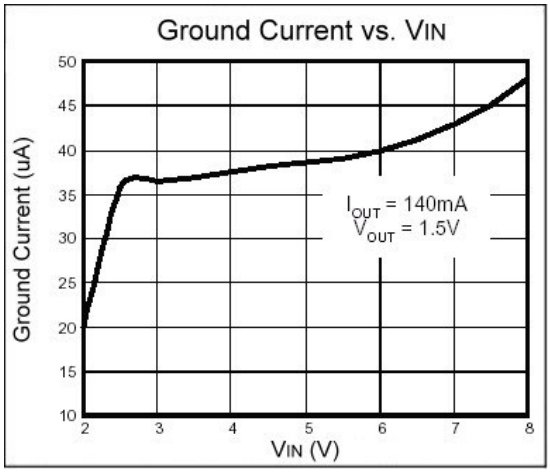
Characteristics Curve

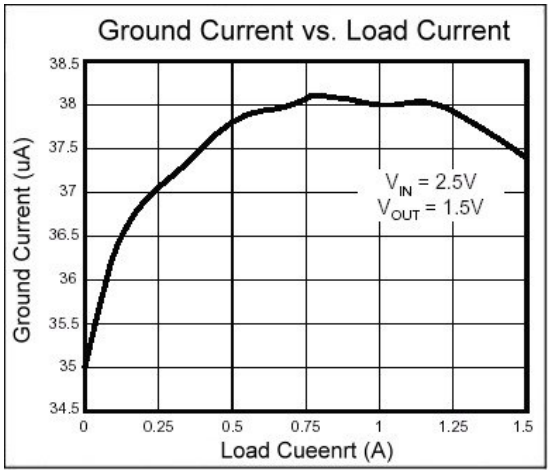


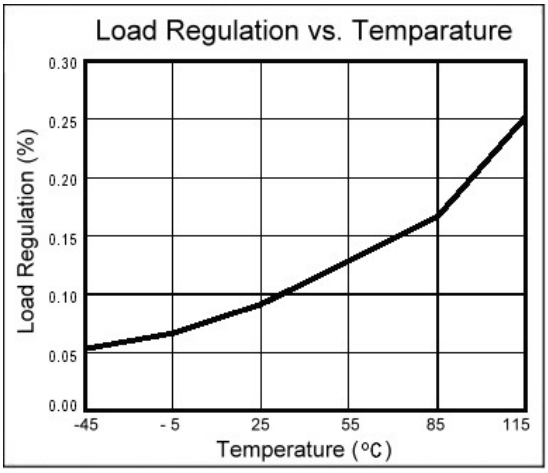


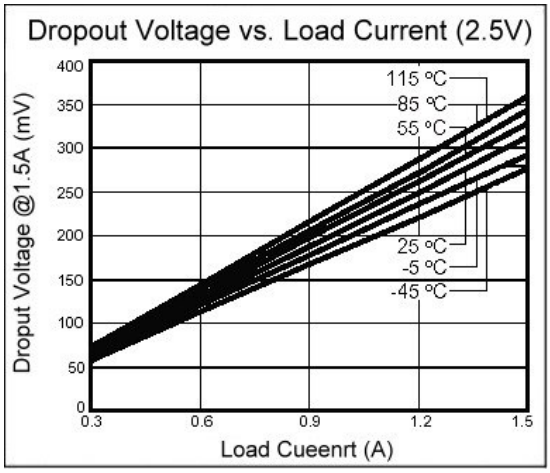


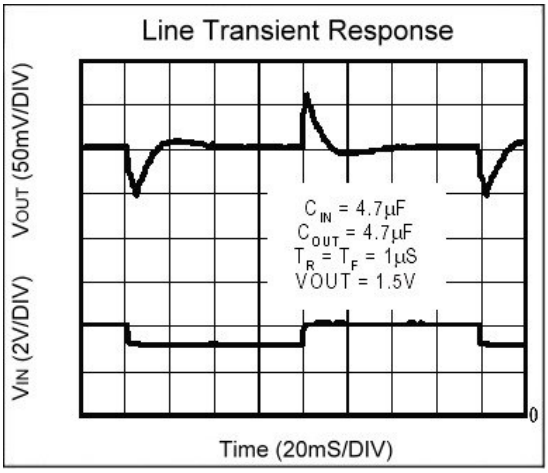


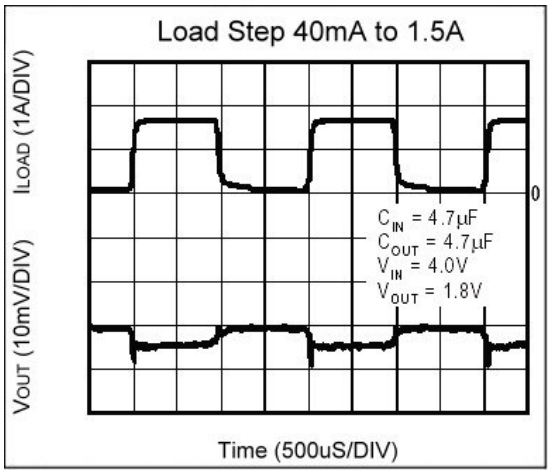


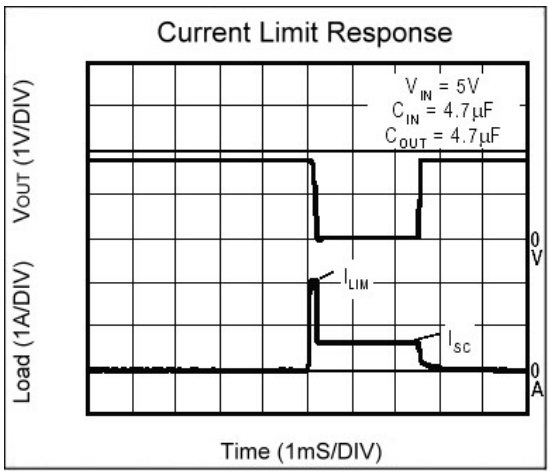


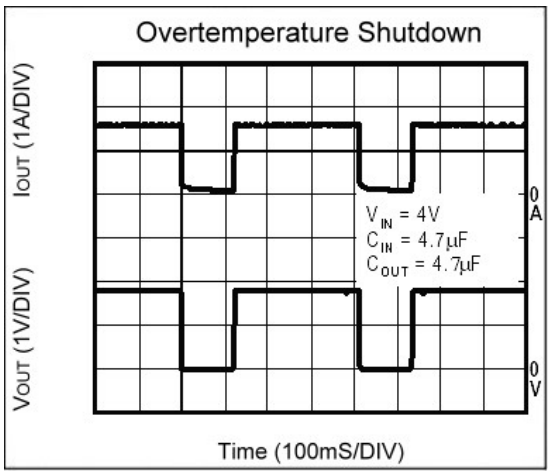

Load Regulation vs. Temparature
Load Regulation (%)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-45
- 5
25
55
85
115
Temperature (°C)

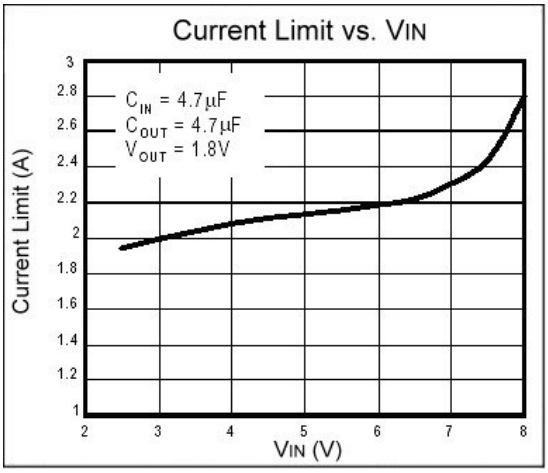

Dropout Voltage vs. Load Current (2.5V)
Droput Voltage @1.5A (mV)
400
350
300
250
200
150
100
50
0
115 °C
85 °C
55 °C
25 °C
-5 °C
-45 °C
0.3
0.6
0.9
1.2
1.5
Load Cueenrt (A)

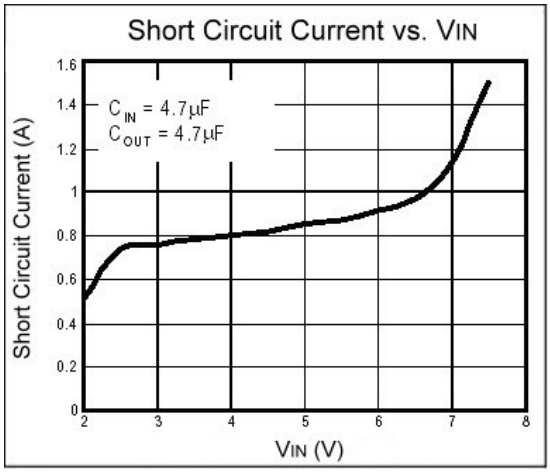

Line Transient Response
VOUT (50mV/DIV)
VIN (2V/DIV)
CIN = 4.7µF
COUT = 4.7µF
TR = TF = 1µS
VOUT = 1.5V
0
Time (20mS/DIV)

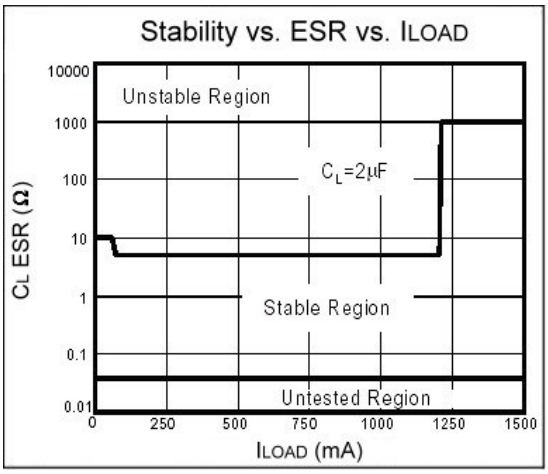

Load Step 40mA to 1.5A
ILOAD (1A/DIV)
VOUT (10mV/DIV)
CIN = 4.7µF
COUT = 4.7µF
VIN = 4.0V
VOUT = 1.8V
0
Time (500uS/DIV)

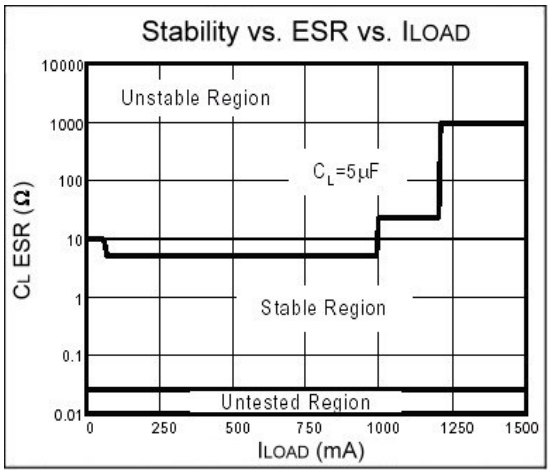

Current Limit Response
VOUT (1V/DIV)
Load (1A/DIV)
VIN = 5V
CIN = 4.7µF
COUT = 4.7µF
ILIM
ISC
0
V
0
A
Time (1mS/DIV)

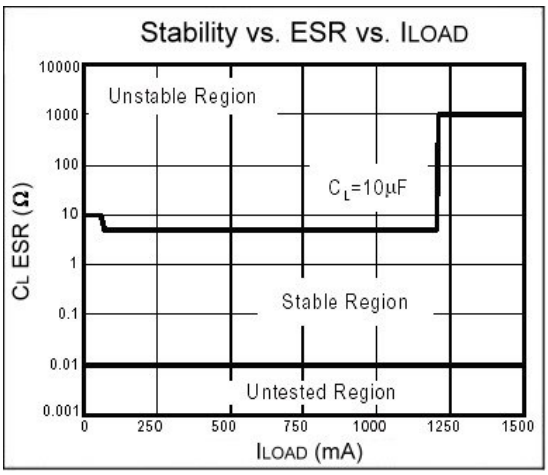

Overtemperature Shutdown
IOUT (1A/DIV)
VOUT (1V/DIV)
VIN = 4V
CIN = 4.7µF
COUT = 4.7µF
0
A
0
V
Time (100mS/DIV)

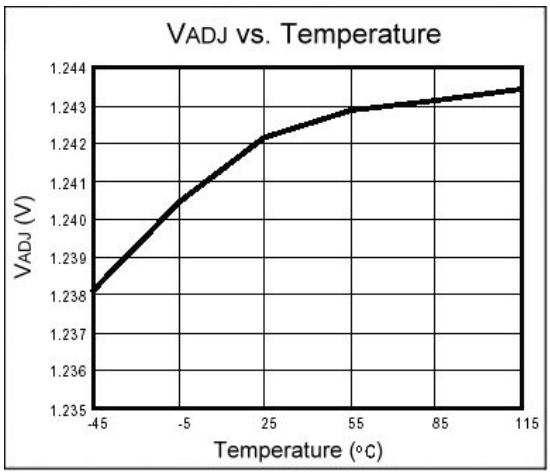

Current Limit vs. VIN
CIN = 4.7µF
COUT = 4.7µF
VOUT = 1.8V
Current Limit (A)
VIN (V)


Short Circuit Current vs. VIN
CIN = 4.7µF
COUT = 4.7µF
Short Circuit Current (A)
VIN (V)


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


Stability vs. ESR vs. ILOAD
Unstable Region
CL=5µF
Stable Region
Untested Region
CL ESR (Ω)
ILOAD (mA)


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


VADJ vs. Temperature
VADJ (V)
Temperature (°C)

External Resistor Divider Table

R1(kΩ)	1	2	5	10	20
VOUT	R2(kΩ)=(1.24*R1(kΩ))/(VOUT-1.24)				
1.30	20.67	41.33	103.33	206.67	413.33
1.35	11.27	22.55	56.36	112.73	225.45
1.40	7.75	15.50	38.75	77.50	155.00
1.45	5.90	11.81	29.52	59.05	118.10
1.50	4.77	9.54	23.85	47.69	95.38
1.55	4.00	8.00	20.00	40.00	80.00
1.60	3.44	6.89	17.22	34.44	68.89
1.65	3.02	6.05	15.12	30.24	60.49
1.70	2.7	5.39	13.48	26.96	53.91
1.75	2.43	4.86	12.16	24.31	48.63
1.80	2.21	4.43	11.07	22.14	44.29
1.85	2.03	4.07	10.16	20.33	40.66
1.90	1.88	3.76	9.39	18.79	37.58
1.95	1.75	3.49	8.73	17.46	34.93
2.00	1.63	3.26	8.16	16.32	32.63
2.05	1.53	3.06	7.65	15.31	30.62
2.10	1.44	2.88	7.21	14.42	28.84
2.15	1.36	2.73	6.81	13.63	27.25
2.20	1.29	2.58	6.46	12.92	25.83
2.25	1.23	2.46	6.14	12.28	24.55
2.30	1.17	2.34	5.85	11.70	23.40
2.35	1.12	2.23	5.59	11.17	23.34
2.40	1.07	2.14	5.34	10.69	21.38
2.45	1.02	2.05	5.12	10.25	20.50
2.50	0.98	1.97	4.92	9.84	19.68
2.55	0.95	1.89	4.73	9.47	18.93
2.60	0.91	1.82	4.56	9.12	18.24
2.65	0.88	1.76	4.40	8.79	17.59
2.70	0.85	1.70	4.25	8.49	16.99
2.75	0.82	1.64	4.11	8.21	16.42
2.80	0.79	1.59	3.97	7.95	15.90
2.85	0.77	1.54	3.85	7.70	15.40
2.90	0.75	1.49	3.73	7.47	14.94
2.95	0.73	1.45	3.63	7.25	14.50
3.00	0.70	1.41	3.52	7.05	14.09
3.05	0.69	1.37	3.43	6.85	13.70
3.10	0.67	1.33	3.33	6.67	13.33
3.15	0.65	1.30	3.25	6.49	12.98

R1(kΩ)	1	2	5	10	20
VOUT	R2(kΩ)=(1.242*R1(kΩ))/(VOUT-1.242)				
3.20	0.63	1.27	3.16	6.33	12.65
3.25	0.62	1.23	3.08	6.17	12.34
3.30	0.60	1.20	3.01	6.02	12.04
3.35	0.59	1.18	2.94	5.88	11.75
3.40	0.57	1.15	2.87	5.74	11.48
3.45	0.56	1.12	2.81	5.61	11.22
3.50	0.55	1.10	2.74	5.49	10.97
3.55	0.54	1.07	2.68	5.37	10.74
3.60	0.53	1.05	2.63	5.25	10.51
3.65	0.51	1.03	2.57	5.15	10.29
3.70	0.50	1.01	2.52	5.04	10.08
3.75	0.49	0.99	2.47	4.94	9.88
3.80	0.48	0.97	2.42	4.84	9.69
3.85	0.48	0.95	2.38	4.75	9.50
3.90	0.47	0.93	2.33	4.66	9.32
3.95	0.46	0.92	2.29	4.58	9.15
4.00	0.45	0.90	2.25	4.49	8.99
4.05	0.44	0.88	2.21	4.41	8.83
4.10	0.43	0.87	2.17	4.34	8.67
4.15	0.43	0.85	2.13	4.26	8.52
4.20	0.42	0.84	2.09	4.19	8.38
4.25	0.41	0.82	2.06	4.12	8.24
4.30	0.41	0.81	2.03	4.05	8.10
4.35	0.40	0.80	1.99	3.99	7.97
4.40	0.39	0.78	1.96	3.92	7.85
4.45	0.39	0.77	1.93	3.86	7.73
4.50	0.38	0.76	1.90	3.80	7.61
4.55	0.37	0.75	1.87	3.75	7.49
4.60	0.37	0.74	1.85	3.69	7.38
4.65	0.36	0.73	1.82	3.64	7.27
4.70	0.36	0.72	1.79	3.58	7.17
4.75	0.35	0.71	1.77	3.53	7.07
4.80	0.35	0.70	1.74	3.48	6.97
4.85	0.34	0.69	1.72	3.43	6.87
4.90	0.34	0.68	1.69	3.39	6.78
4.95	0.33	0.67	1.67	3.34	6.68
5.00	0.33	0.66	1.65	3.30	6.60

Note: Small load (greater than 2mA) is necessary as R1 or R2 is larger than 50kΩ. Otherwise, output voltage probably can not be pulled down to 0V on disable mode.

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