LM1117 800-mA Low-Dropout Linear Regulator

1 Features

- Available in 1.8 V, 2.5 V, 3.3 V, 5 V, and Adjustable Versions
- Space-Saving SOT-223 and WSON Packages
- Current Limiting and Thermal Protection
- Output Current 800 mA
- Line Regulation 0.2% (Maximum)
- Load Regulation 0.4% (Maximum)
- Temperature Range
  - LM1117: 0°C to 125°C
  - LM1117I: −40°C to 125°C

2 Applications

- Post Regulator for Switching DC–DC Converter
- High Efficiency Linear Regulators
- Battery Chargers
- Portable Instrumentation
- Active SCSI Termination Regulator

3 Description

The LM1117 is a low dropout voltage regulator with a dropout of 1.2 V at 800 mA of load current.

The LM1117 is available in an adjustable version, which can set the output voltage from 1.25 to 13.8 V with only two external resistors. In addition, it is available in five fixed voltages, 1.8 V, 2.5 V, 3.3 V, and 5 V.

The LM1117 offers current limiting and thermal shutdown. Its circuit includes a Zener trimmed bandgap reference to assure output voltage accuracy to within ±1%.

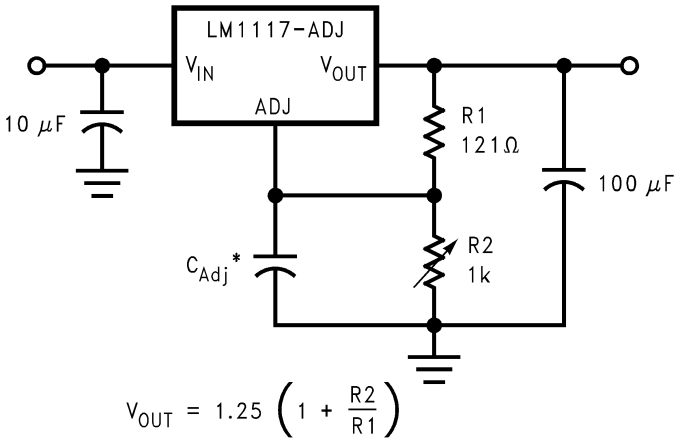
A minimum of 10-µF tantalum capacitor is required at the output to improve the transient response and stability.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM1117, LM1117I	SOT-223 (4)	6.50 mm × 3.50 mm
	TO-220 (3)	14.986 mm × 10.16 mm
	TO-252 (3)	6.58 mm × 6.10 mm
	WSON (8)	4.00 mm × 4.00 mm
	TO-263 (3)	10.18 mm × 8.41 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

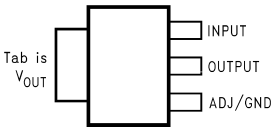
Adjustable Output Regulator



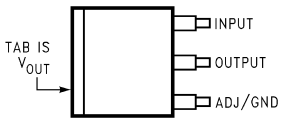
*C_{Adj} is optional, however it will improve ripple rejection.

5 Pin Configuration and Functions

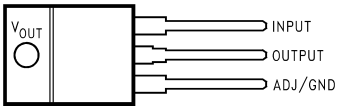
DCY Package
4-Pin SOT
Top View



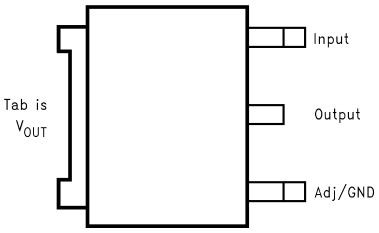
KTT Package
3-Pin TO-263
Top View



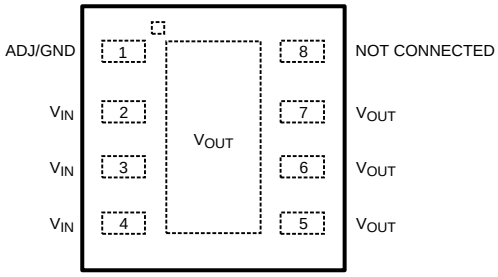
NDE Package
3-Pin TO-220
Top View



NDP Package
3-Pin TO-252
Top View



NGN Package
8-Pin WSON
Top View



When using the WSON package
Pins 2, 3 and 4 must be connected together and
Pins 5, 6 and 7 must be connected together

Pin Functions

PIN						I/O	DESCRIPTION
NAME	TO-252	WSON	SOT-223	TO-263	TO-220		
ADJ/GND	1	1	1	1	1	—	Adjust pin for adjustable output option. Ground pin for fixed output option.
V_{IN}	3	2, 3, 4	3	3	3	I	Input voltage pin for the regulator
V_{OUT}	2 , TAB	5, 6, 7, TAB	2, 4	2, TAB	2, TAB	O	Output voltage pin for the regulator

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Maximum Input Voltage (V_{IN} to GND)			20	V
Power Dissipation(2)		Internally Limited		
Junction Temperature (T_J)(2)			150	°C
Lead Temperature	TO-220 (T) Package, 10 s		260	°C
	SOT-223 (MP) Package, 4 s		260	
Storage Temperature, T_{stg}		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The maximum power dissipation is a function of $T_{J(max)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)}–T_A)/R_{\theta JA}$. All numbers apply for packages soldered directly into a PCB.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Pins listed as ±2000 V may actually have higher performance.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
Input Voltage (V_{IN} to GND)			15	V
Junction Temperature (T_J)(1)	LM1117	0	125	°C
	LM1117I	−40	125	

(1) The maximum power dissipation is a function of $T_{J(max)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)}–T_A)/R_{\theta JA}$. All numbers apply for packages soldered directly into a PCB.

6.4 Thermal Information

THERMAL METRIC(1)		LM1117, LM1117I					UNIT
		DCY (SOT-223)	NDE (TO-220)	NDP (TO-252)	NGN (WSON)	KTT (TO-263)	
		4 PINS	3 PINS	3 PINS	8 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	61.6	23.8	45.1	39.3	41.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	42.5	16.6	52.1	31.4	44.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	10.4	5.3	29.8	16.5	24.2	°C/W
ψ_{JT}	Junction-to-top characterization parameter	2.9	3.1	4.5	0.3	10.9	°C/W
ψ_{JB}	Junction-to-board characterization parameter	10.3	5.3	29.4	16.7	23.2	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	1.5	1.3	5.6	1.3	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

6.5 LM1117 Electrical Characteristics

unless otherwise specified, T_J = 25°C.

PARAMETER		TEST CONDITIONS		MIN(1)	TYP(2)	MAX(1)	UNIT
V_{REF}	Reference Voltage	LM1117-ADJ I_{OUT} = 10 mA, V_{IN} – V_{OUT} = 2 V, T_J = 25°C		1.238	1.25	1.262	V
		LM1117-ADJ 10 mA ≤ I_{OUT} ≤ 800 mA, 1.4 V ≤ V_{IN} – V_{OUT} ≤ 10 V	T_J = 25°C		1.25		
			over the junction temperature range 0°C to 125°C	1.225		1.27	
V_{OUT}	Output Voltage	LM1117-1.8 I_{OUT} = 10 mA, V_{IN} = 3.8 V, T_J = 25°C		1.782	1.8	1.818	V
		LM1117-1.8 0 ≤ I_{OUT} ≤ 800 mA, 3.2 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		1.8		
			over the junction temperature range 0°C to 125°C	1.746		1.854	
		LM1117-2.5 I_{OUT} = 10 mA, V_{IN} = 4.5 V, T_J = 25°C		2.475	2.5	2.525	V
		LM1117-2.5 0 ≤ I_{OUT} ≤ 800 mA, 3.9 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		2.5		
			over the junction temperature range 0°C to 125°C	2.45		2.55	
		LM1117-3.3 I_{OUT} = 10 mA, V_{IN} = 5 V T_J = 25°C		3.267	3.3	3.333	V
		LM1117-3.3 0 ≤ I_{OUT} ≤ 800 mA, 4.75 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		3.3		
			over the junction temperature range 0°C to 125°C	3.235		3.365	
		LM1117-5.0 I_{OUT} = 10 mA, V_{IN} = 7 V, T_J = 25°C		4.95	5	5.05	V
		LM1117-5.0 0 ≤ I_{OUT} ≤ 800 mA, 6.5 V ≤ V_{IN} ≤ 12 V	T_J = 25°C		5		
			over the junction temperature range 0°C to 125°C	4.9		5.1	
ΔV_{OUT}	Line Regulation(3)	LM1117-ADJ I_{OUT} = 10mA, 1.5V ≤ V_{IN}-V_{OUT} ≤ 13.75V	T_J = 25°C		0.035%		
			over the junction temperature range 0°C to 125°C			0.2%	
		LM1117-1.8 I_{OUT} = 0 mA, 3.2 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			6	
		LM1117-2.5 I_{OUT} = 0 mA, 3.9 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			6	
		LM1117-3.3 I_{OUT} = 0 mA, 4.75 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			6	
		LM1117-5.0 I_{OUT} = 0 mA, 6.5 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
ΔV_{OUT}	Load Regulation(3)	LM1117-ADJ V_{IN} – V_{OUT} = 3 V, 10 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		0.2%		
			over the junction temperature range 0°C to 125°C			0.4%	
		LM1117-1.8 V_{IN} = 3.2 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
		LM1117-2.5 V_{IN} = 3.9 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
		LM1117-3.3 V_{IN} = 4.75 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
		LM1117-5.0 V_{IN} = 6.5 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			15	

(1) All limits are ensured by testing or statistical analysis.
(2) Typical Values represent the most likely parametric normal.
(3) Load and line regulation are measured at constant junction room temperature.

LM1117 Electrical Characteristics (continued)

unless otherwise specified, T_J = 25°C.

PARAMETER		TEST CONDITIONS		MIN(1)	TYP(2)	MAX(1)	UNIT
$V_{IN} - V_{OUT}$	Dropout Voltage(4)	I_{OUT} = 100 mA	T_J = 25°C		1.1		V
			over the junction temperature range 0°C to 125°C			1.2	
		I_{OUT} = 500 mA	T_J = 25°C		1.15		V
			over the junction temperature range 0°C to 125°C			1.25	
		I_{OUT} = 800 mA	T_J = 25°C		1.2		V
			over the junction temperature range 0°C to 125°C			1.3	
I_{LIMIT}	Current Limit	$V_{IN} - V_{OUT}$ = 5 V, T_J = 25°C		800	1200	1500	mA
	Minimum Load Current(5)	LM1117-ADJ V_{IN} = 15 V	T_J = 25°C		1.7		mA
			over the junction temperature range 0°C to 125°C			5	
	Quiescent Current	LM1117-1.8 $V_{IN} \le$ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
		LM1117-2.5 $V_{IN} \le$ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
		LM1117-3.3 $V_{IN} \le$ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
		LM1117-5.0 $V_{IN} \le$ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
	Thermal Regulation	T_A = 25°C, 30-ms pulse			0.01	0.1	%/W
	Ripple Regulation	f_{RIPPLE} = 1 20 Hz, $V_{IN} - V_{OUT}$ = 3 V V_{RIPPLE} = 1 V_{PP}	T_J = 25°C		75		dB
			over the junction temperature range 0°C to 125°C	60			
	Adjust Pin Current	T_J = 25°C			60		µA
		over the junction temperature range 0°C to 125°C				120	
	Adjust Pin Current Change	10 ≤ I_{OUT} ≤ 80 0mA, 1.4 V ≤ $V_{IN} - V_{OUT} \le$ 10 V	T_J = 25°C		0.2		µA
			over the junction temperature range 0°C to 125°C			5	
	Temperature Stability				0.5%		
	Long Term Stability	T_A = 125°C, 1000 Hrs			0.3%		
	RMS Output Noise	(% of V_{OUT}), 10 Hz ≤ f ≤ 10 kHz			0.003%		

(4) The dropout voltage is the input/output differential at which the circuit ceases to regulate against further reduction in input voltage. It is measured when the output voltage has dropped 100 mV from the nominal value obtained at $V_{IN} = V_{OUT} + 1.5$ V.
(5) The minimum output current required to maintain regulation.

6.6 LM1117I Electrical Characteristics

unless otherwise specified, T_J = 25°C.

PARAMETER		TEST CONDITIONS		MIN(1)	TYP(2)	MAX(1)	UNIT
V_{REF}	Reference Voltage	LM1117I-ADJ I_{OUT} = 10 mA, V_{IN} – V_{OUT} = 2 V, T_J = 25°C		1.238	1.25	1.262	V
		LM1117I-ADJ 10 mA ≤ I_{OUT} ≤ 800 mA, 1.4 V ≤ V_{IN} – V_{OUT} ≤ 10 V	T_J = 25°C		1.25		
			over the junction temperature range –40°C to 125°C	1.2		1.29	
V_{OUT}	Output Voltage	LM1117I-3.3 I_{OUT} = 10 mA, V_{IN} = 5 V, T_J = 25°C		3.267	3.3	3.333	V
		LM1117I-3.3 0 ≤ I_{OUT} ≤ 800 mA, 4.75 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		3.3		
			over the junction temperature range –40°C to 125°C	3.168		3.432	
		LM1117I-5.0 I_{OUT} = 10 mA, V_{IN} = 7 V, T_J = 25°C		4.95	5	5.05	V
		LM1117I-5.0 0 ≤ I_{OUT} ≤ 800 mA, 6.5 V ≤ V_{IN} ≤ 12 V	T_J = 25°C		5		
			over the junction temperature range –40°C to 125°C	4.8		5.2	
ΔV_{OUT}	Line Regulation(3)	LM1117I-ADJ I_{OUT} = 10 mA, 1.5 V ≤ V_{IN} – V_{OUT} ≤ 13.75 V	T_J = 25°C		0.035%		
			over the junction temperature range –40°C to 125°C			0.3%	
		LM1117I-3.3 I_{OUT} = 0 mA, 4.75 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range –40°C to 125°C			10	
		LM1117I-5.0 I_{OUT} = 0 mA, 6.5 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range –40°C to 125°C			15	
ΔV_{OUT}	Load Regulation(3)	LM1117I-ADJ V_{IN} – V_{OUT} = 3 V, 10 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		0.2%		
			over the junction temperature range –40°C to 125°C			0.5%	
		LM1117I-3.3 V_{IN} = 4.75 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range –40°C to 125°C			15	
		LM1117I-5.0 V_{IN} = 6.5 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range –40°C to 125°C			20	

(1) All limits are ensured by testing or statistical analysis.
(2) Typical Values represent the most likely parametric normal.
(3) Load and line regulation are measured at constant junction room temperature.

LM1117I Electrical Characteristics (continued)

unless otherwise specified, T_J = 25°C.

PARAMETER		TEST CONDITIONS		MIN(1)	TYP(2)	MAX(1)	UNIT
V_{IN}-V_{OUT}	Dropout Voltage(4)	I_{OUT} = 100 mA	T_J = 25°C		1.1		V
			over the junction temperature range –40°C to 125°C			1.3	
		I_{OUT} = 500 mA	T_J = 25°C		1.15		V
			over the junction temperature range –40°C to 125°C			1.35	
		I_{OUT} = 800 mA	T_J = 25°C		1.2		V
			over the junction temperature range –40°C to 125°C			1.4	
I_{LIMIT}	Current Limit	V_{IN} – V_{OUT} = 5 V, T_J = 25°C		800	1200	1500	mA
	Minimum Load Current(5)	LM1117I-ADJ V_{IN} = 15 V	T_J = 25°C		1.7		mA
			over the junction temperature range –40°C to 125°C			5	
	Quiescent Current	LM1117I-3.3 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range –40°C to 125°C			15	
		LM1117I-5.0 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range –40°C to 125°C			15	
	Thermal Regulation	T_A = 25°C, 30ms Pulse			0.01	0.1	%/W
	Ripple Regulation	f_{RIPPLE} = 120 Hz, V_{IN} – V_{OUT} = 3 V V_{RIPPLE} = 1 V_{PP}	T_J = 25°C		75		dB
			over the junction temperature range –40°C to 125°C	60			
	Adjust Pin Current	T_J = 25°C			60		µA
		over the junction temperature range –40°C to 125°C				120	
	Adjust Pin Current Change	10 ≤ I_{OUT} ≤ 800 mA, 1.4 V ≤ V_{IN} – V_{OUT} ≤ 10 V	T_J = 25°C		0.2		µA
			over the junction temperature range –40°C to 125°C			10	
	Temperature Stability				0.5%		
	Long Term Stability	T_A = 125°C, 1000 Hrs			0.3%		
	RMS Output Noise	(% of V_{OUT}), 10 Hz ≤ f ≤ 10 kHz			0.003%		

(4) The dropout voltage is the input/output differential at which the circuit ceases to regulate against further reduction in input voltage. It is measured when the output voltage has dropped 100 mV from the nominal value obtained at V_{IN} = V_{OUT} + 1.5 V.
(5) The minimum output current required to maintain regulation.