# 1A L.D.O VOLTAGE REGULATOR   LM1117

FEATURES

- Output Current up to 1.0A
- Low Dropout Voltage (1.2V at 1.0A Output current)
- Three Terminal Adjustable(ADJ) or Fixed 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, and 5.0V
- Line Regulation typically at 0.1% typ.
- Load Regulation typically at 0.2% typ.
- Internal Current and Thermal Protection
- Maximum Input Voltage 20V
- Surface Mount Package SOT-223, TO-252, and SOT-89
- Moisture Sensitivity Level 3

APPLICATIONS

- Active SCSI Terminators
- Portable/ Plan Top/ Notebook Computers
- High Efficiency Linear Regulators
- SMPS Post Regulators
- Mother B/D Clock Supplies
- Disk Drives
- Battery Chargers

SOT-223 PKG

TO-252 PKG

SOT-89 PKG
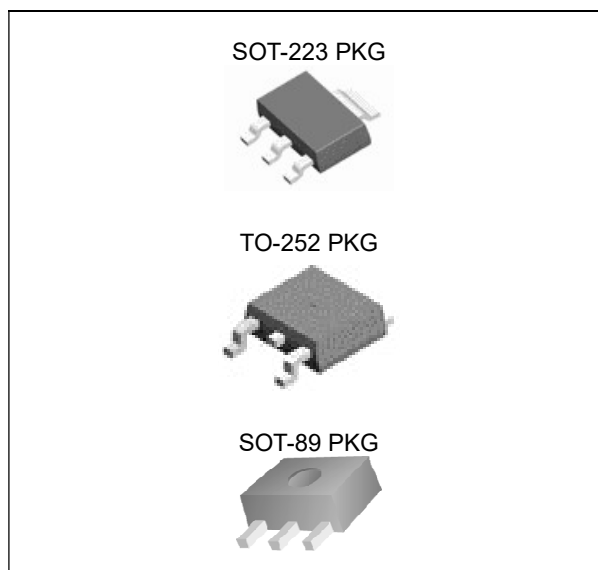
ORDERING INFORMATION

Device	Package
LM1117S-ADJ	SOT-223 3L
LM1117S-x.x	
LM1117RS-ADJ	TO-252 3L
LM1117RS-x.x	
LM1117F-ADJ	SOT-89 3L
LM1117F-x.x	

x.x: Output Voltage = 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, and 5.0V

DESCRIPTION

The LM1117 is a low power positive-voltage regulator designed to meet 1A output current. This device is an excellent choice for use in battery-powered applications, as active terminators for the SCSI bus, and portable computers. The LM1117 features very low quiescent current and very low dropout voltage of 1.2V at a full load and lower as output current decreases. LM1117 is available as an adjustable or fixed 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, and 5.0V output voltages. The LM1117 is offered in a 3-pin surface mount package SOT-223, TO-252 & SOT-89. The output capacitor of 10µF or larger is needed for output stability of LM1117 as required by most of the other regulator circuits.

ABSOLUTE MAXIMUM RATINGS

| CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Input Supply Voltage	V_{IN}	-	20	V
Lead Temperature	T_{SOL}	-	260	°C
Storage Temperature Range	T_{STG}	−65	150	°C
Operating Junction Temperature Range	T_{OPR}	−40	125	°C

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ORDERING INFORMATION

| V$_{OUT}$	Package	Order No.	Package Marking	Supplied As	Status
ADJ	SOT-223	LM1117S-ADJ	1117C ADJ	Tape & Reel	Active
	TO-252	LM1117RS-ADJ	LM1117C ADJ	Tape & Reel	Active
	SOT-89	LM1117F-ADJ	1117C ADJ	Tape & Reel	Active
1.2V	SOT-223	LM1117S-1.2	1117C 1.2	Tape & Reel	Active
	TO-252	LM1117RS-1.2	LM1117C 1.2	Tape & Reel	Active
	SOT-89	LM1117F-1.2	1117C 1.2	Tape & Reel	Active
1.5V	SOT-223	LM1117S-1.5	1117C 1.5	Tape & Reel	Active
	TO-252	LM1117RS-1.5	LM1117C 1.5	Tape & Reel	Active
	SOT-89	LM1117F-1.5	1117C 1.5	Tape & Reel	Active
1.8V	SOT-223	LM1117S-1.8	1117C 1.8	Tape & Reel	Active
	TO-252	LM1117RS-1.8	LM1117C 1.8	Tape & Reel	Active
	SOT-89	LM1117F-1.8	1117C 1.8	Tape & Reel	Active
2.5V	SOT-223	LM1117S-2.5	1117C 2.5	Tape & Reel	Active
	TO-252	LM1117RS-2.5	LM1117C 2.5	Tape & Reel	Active
	SOT-89	LM1117F-2.5	1117C 2.5	Tape & Reel	Active
3.3V	SOT-223	LM1117S-3.3	1117C 3.3	Tape & Reel	Active
	TO-252	LM1117RS-3.3	LM1117C 3.3	Tape & Reel	Active
	SOT-89	LM1117F-3.3	1117C 3.3	Tape & Reel	Active
5.0V	SOT-223	LM1117S-5.0	1117C 5.0	Tape & Reel	Active
	TO-252	LM1117RS-5.0	LM1117C 5.0	Tape & Reel	Active
	SOT-89	LM1117F-5.0	1117C 5.0	Tape & Reel	Active

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PIN CONFIGURATIONS
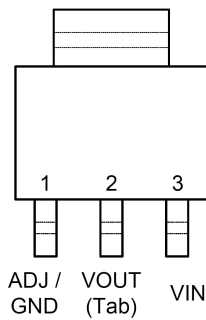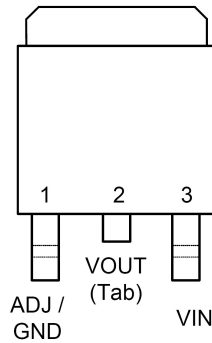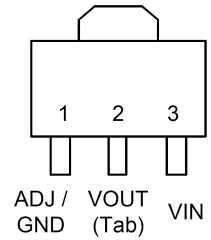
SOT-223   TO-252   SOT-89

PIN DESCRIPTION

Pin No.			Pin Name	Pin Function
SOT-223	TO-252	SOT-89		
1	1	1	ADJ / GND	Adjustable or Ground (Fixed Version)
2	2	2	VOUT	Output Voltage
3	3	3	VIN	Input Voltage

TYPICAL APPLICATION CIRCUITS

< Fixed Version>   <Adjustable Version>

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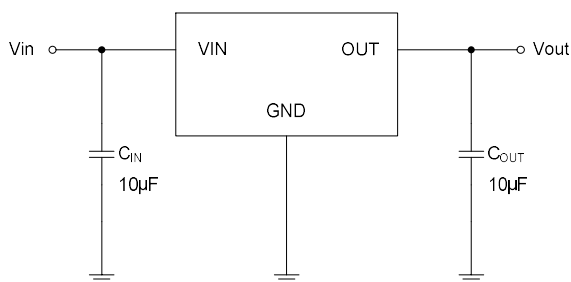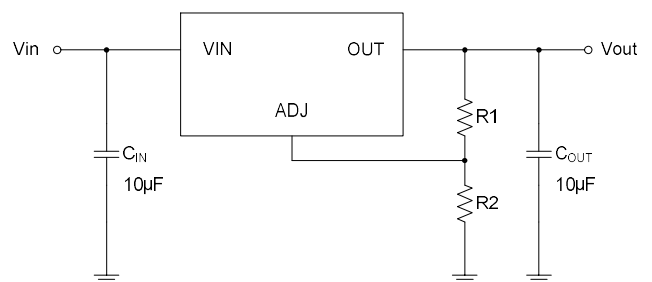
ELECTRICAL CHARACTERISTICS

For ADJ Output Voltage   (T_J=25°C, C_{OUT} = 10μF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{REF}	Reference Voltage	V_{IN} = 5V, I_O = 10mA	1.238	1.250	1.262	V
V_{REF}	Reference Voltage	I_O = 10mA to 1A, V_{IN} - V_{REF} = 1.5V to 13.75V (T_J = -40 ~ 125°C)	1.219		1.281	V
ΔV_{LINE}	Line Regulation	I_O = 10mA , V_{IN} - V_{REF} = 1.5V to 12V		0.1	0.2	%
ΔV_{LOAD}	Load Regulation	I_O = 10mA to 1A, V_{IN} - V_{REF} = 2V		0.2	0.4	%
V_{IN}	Operating Input Voltage				12	V
I_{ADJ}	Adjustment pin Current	V_{IN} - V_{REF} = 1.5V to 12V, I_O = 100mA		50	120	μA
ΔI_{ADJ}	Adjustment Pin Current Change	V_{IN} - V_{REF} = 1.5V to 12V, I_O = 100mA to 1A		0.5	5	μA
$I_{O(MIN)}$	Minimum Load Current	V_{IN} = 5V, V_{REF} = 0V		5	10	mA
I_O	Current Limit	V_{IN} - V_{REF} = 5V	1000			mA
e_N	Output Noise (%V_O)	B = 10Hz to 10kHz, T_J = 25°C		0.003		%
SVR	Supply Voltage Rejection	I_O = 1A, f = 120Hz, V_{IN} - V_{REF} = 3V, V_{RIPPLE} = 1V_{PP}	60	75		dB

For 1.2V Output Voltage   (T_J=25°C, C_{OUT} = 10μF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_O	Output Voltage	V_{IN} = 2.7V, I_O = 10mA	1.176	1.200	1.224	V
V_O	Output Voltage	V_{IN} = 2.7V to 12V, I_O = 0mA to 1A (T_J = -40 ~ 125°C)	1.152		1.248	V
ΔV_{LINE}	Line Regulation	I_O = 10mA , V_{IN} = 2.7V to 12V		0.1	0.2	%
ΔV_{LOAD}	Load Regulation	I_O = 10mA to 1A, V_{IN} = 3.2V		0.2	0.4	%
V_{IN}	Operating Input Voltage				12	V
I_D	Quiescent Current	V_{IN} - V_O = 5V		5	10	mA
I_O	Current Limit	V_{IN} - V_O = 5V	1000			mA
e_N	Output Noise (%V_O)	B = 10Hz to 10kHz, T_J = 25°C		0.003		%
SVR	Supply Voltage Rejection	I_O = 1A, f = 120Hz, V_{IN} - V_O = 1.5V, V_{RIPPLE} = 1V_{PP}	60	75		dB

For 1.5V Output Voltage $\qquad$ (T_J=25°C, C_{OUT} = 10µF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_O	Output Voltage	V_{IN} = 3.0V, I_O = 10mA	1.485	1.5	1.515	V
V_O	Output Voltage	V_{IN} = 3.0V to 12V, I_O = 0mA to 1A (T_J = -40 ~ 125°C)	1.470		1.530	V
ΔV_{LINE}	Line Regulation	I_O = 10mA , V_{IN} = 3.0V to 12V		0.1	0.2	%
ΔV_{LOAD}	Load Regulation	I_O = 10mA to 1A, V_{IN} = 3.5V		0.2	0.4	%
V_{IN}	Operating Input Voltage				12	V
I_D	Quiescent Current	V_{IN} - V_O = 5V		5	10	mA
I_O	Current Limit	V_{IN} - V_O = 5V	1000			mA
e_N	Output Noise(%V_O)	B = 10Hz to 10kHz, T_J = 25°C		100		µV
SVR	Supply Voltage Rejection	I_O = 1A, f = 120Hz, V_{IN} - V_O = 3V, V_{RIPPLE} = 1V_{PP}	60	75		dB

For 1.8V Output Voltage $\qquad$ (T_J=25°C, C_{OUT} = 10µF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_O	Output Voltage	V_{IN} = 3.3V, I_O = 10mA	1.782	1.8	1.818	V
V_O	Output Voltage	V_{IN} = 3.3V to 12V, I_O = 0mA to 1A (T_J = -40 ~ 125°C)	1.764		1.836	V
ΔV_{LINE}	Line Regulation	I_O = 10mA , V_{IN} = 3.3V to 12V		0.1	0.2	%
ΔV_{LOAD}	Load Regulation	I_O = 10mA to 1A, V_{IN} = 3.8V		0.2	0.4	%
V_{IN}	Operating Input Voltage				12	V
I_D	Quiescent Current	V_{IN} - V_O = 5V		5	10	mA
I_O	Current Limit	V_{IN} - V_O = 5V	1000			mA
e_N	Output Noise(%V_O)	B = 10Hz to 10kHz, T_J = 25°C		100		µV
SVR	Supply Voltage Rejection	I_O = 1A, f = 120Hz, V_{IN} - V_O = 3V, V_{RIPPLE} = 1V_{PP}	60	75		dB

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For 2.5V Output Voltage   (T_J=25°C, C_{OUT} = 10μF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_O	Output Voltage	V_{IN} = 4.0V, I_O = 10mA	2.475	2.5	2.525	V
V_O	Output Voltage	V_{IN} = 4.0V to 12V, I_O = 0mA to 1A (T_J = -40 ~ 125°C)	2.450		2.550	V
ΔV_{LINE}	Line Regulation	I_O = 10mA , V_{IN} = 4.0V to 12V		0.1	0.2	%
ΔV_{LOAD}	Load Regulation	I_O = 10mA to 1A, V_{IN} = 4.5V		0.2	0.4	%
V_{IN}	Operating Input Voltage				12	V
I_D	Quiescent Current	V_{IN} - V_O = 5V		5	10	mA
I_O	Current Limit	V_{IN} - V_O = 5V	1000			mA
eN	Output Noise(%V_O)	B = 10Hz to 10kHz, T_J = 25°C		100		μV
SVR	Supply Voltage Rejection	I_O = 1A, f = 120Hz, V_{IN} - V_O = 3V, V_{RIPPLE} = 1V_{PP}	60	75		dB

**For 3.3V Output Voltage**   (T_J=25°C, C_{OUT} = 10μF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_O	Output Voltage	V_{IN} = 4.8V, I_O = 10mA	3.267	3.3	3.333	V
V_O	Output Voltage	V_{IN} = 4.8V to 12V, I_O = 0mA to 1A (T_J = -40 ~ 125°C)	3.234		3.366	V
ΔV_{LINE}	Line Regulation	I_O = 10mA , V_{IN} = 4.8V to 12V		0.1	0.2	%
ΔV_{LOAD}	Load Regulation	I_O = 10mA to 1A, V_{IN} = 5.3V		0.2	0.4	%
V_{IN}	Operating Input Voltage				12	V
I_D	Quiescent Current	V_{IN} - V_O = 5V		5	10	mA
I_O	Current Limit	V_{IN} - V_O = 5V	1000			mA
eN	Output Noise(%V_O)	B = 10Hz to 10kHz, T_J = 25°C		100		μV
SVR	Supply Voltage Rejection	I_O = 1A, f = 120Hz, V_{IN} - V_O = 3V, V_{RIPPLE} = 1V_{PP}	60	75		dB

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**For 5.0V Output Voltage**   (T$_J$=25°C, C$_{OUT}$ = 10μF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V$_O$	Output Voltage	V$_{IN}$ = 6.5V, I$_O$ = 10mA	4.950	5.0	5.050	V
V$_O$	Output Voltage	V$_{IN}$ = 6.5V to 15V, I$_O$ = 0mA to 1A (T$_J$ = -40 ~ 125°C)	4.900		5.100	V
ΔV$_{LINE}$	Line Regulation	I$_O$ = 10mA , V$_{IN}$ = 6.5V to 15V		0.1	0.2	%
ΔV$_{LOAD}$	Load Regulation	I$_O$ = 10mA to 1A, V$_{IN}$ = 7.0V		0.2	0.4	%
V$_{IN}$	Operating Input Voltage				15	V
I$_D$	Quiescent Current	V$_{IN}$ - V$_O$ = 5V		5	10	mA
I$_O$	Current Limit	V$_{IN}$ - V$_O$ = 5V	1000			mA
eN	Output Noise(%V$_O$)	B = 10Hz to 10kHz, T$_J$ = 25°C		100		μV
SVR	Supply Voltage Rejection	I$_O$ = 1A, f = 120Hz, V$_{IN}$ - V$_O$ = 3V, V$_{RIPPLE}$ = 1V$_{PP}$	60	75		dB

For All Output Voltage   (T$_J$=25°C, C$_{OUT}$ = 10μF unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V$_D$	Dropout Voltage	I$_O$ = 100mA		1.0	1.1	V
		I$_O$ = 500mA		1.1	1.2	V
		I$_O$ = 1A		1.2	1.3	V
	Temperature Stability			0.5		%
	Long Term Stability	1000 hrs, T$_J$ = 125°C		0.3		%
	Thermal Regulation	T$_A$ = 25°C 30ms Pulse		0.003		%/W

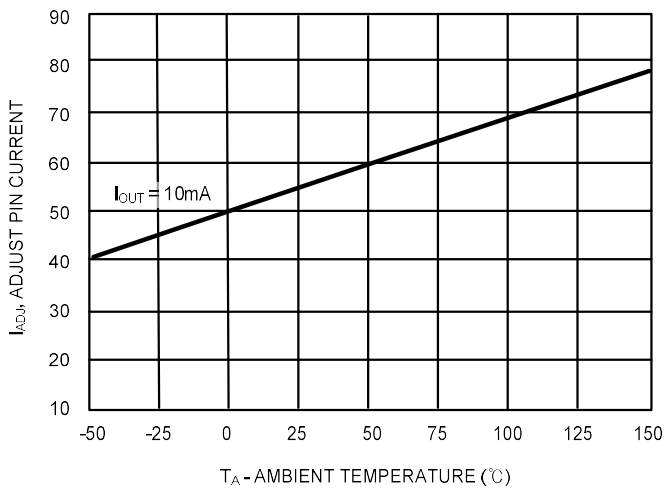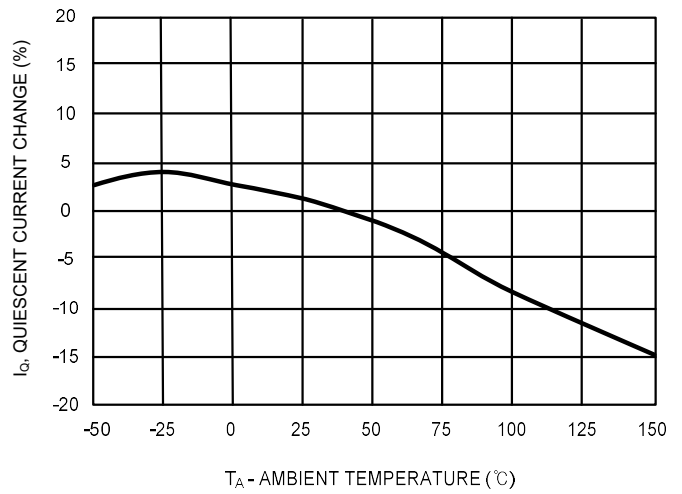## TYPICAL OPERATING CHARACTERISTICS
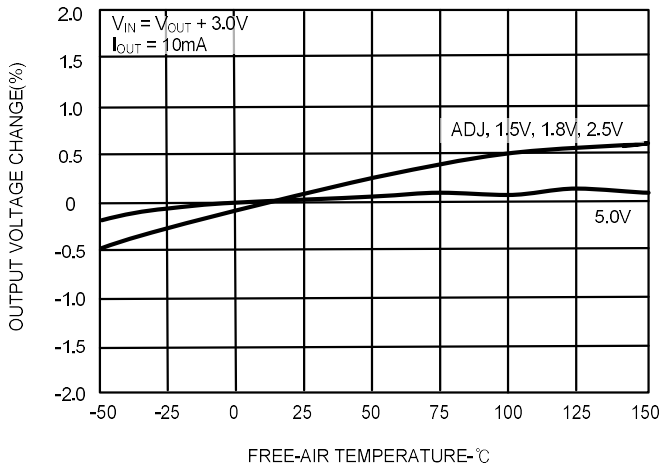
OUTPUT VOLTAGE CHANGE VS TEMPERATURE
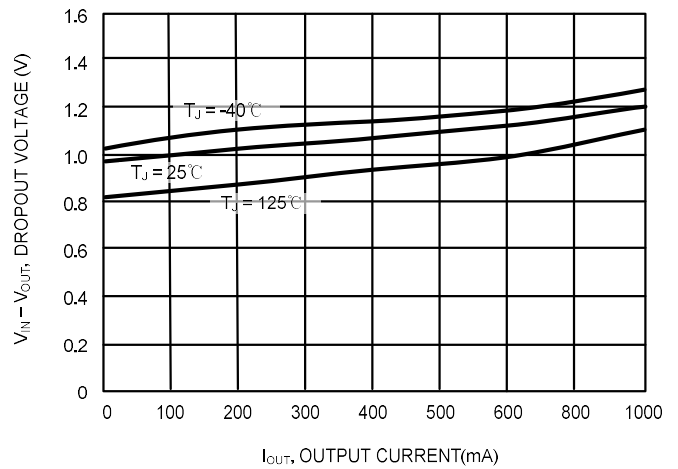
DROPOUT VOLTAGE VS OUTPUT CURRENT

ADJ PIN CURRENT VS TEMPERATURE
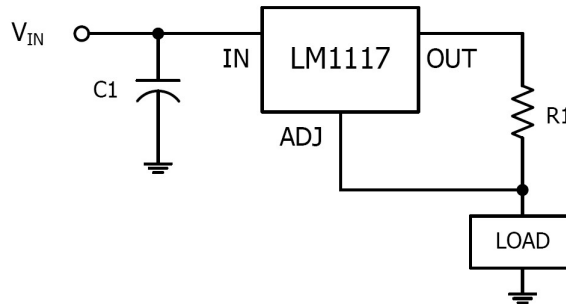

QUIESCENT CURRENT CHANGE VS TEMPERATURE

 HTC

APPLICATION CIRCUITS

Fig.1 300mA Current Output
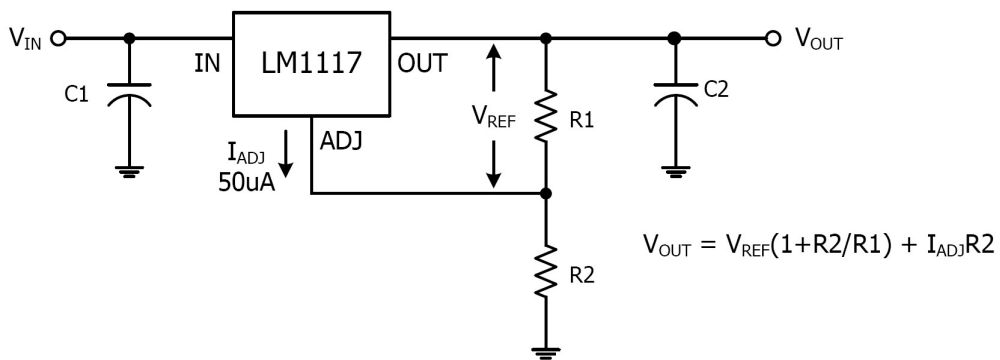

$$V_{OUT} = V_{REF}(1+R2/R1) + I_{ADJ}R2$$
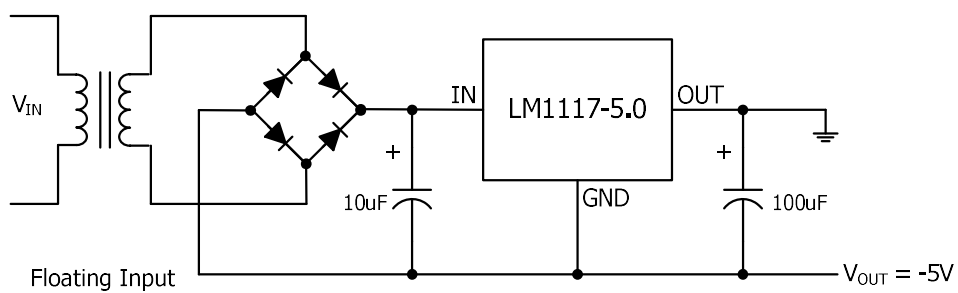
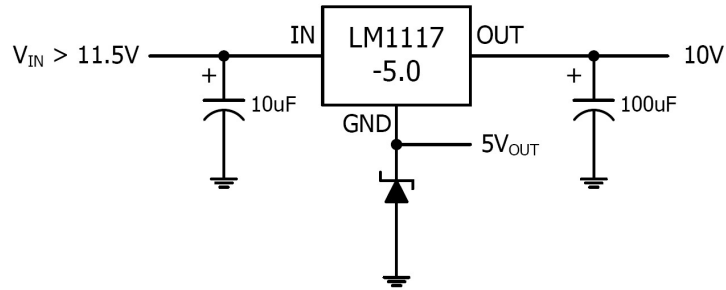Fig.2 Typical Adjustable Regulator

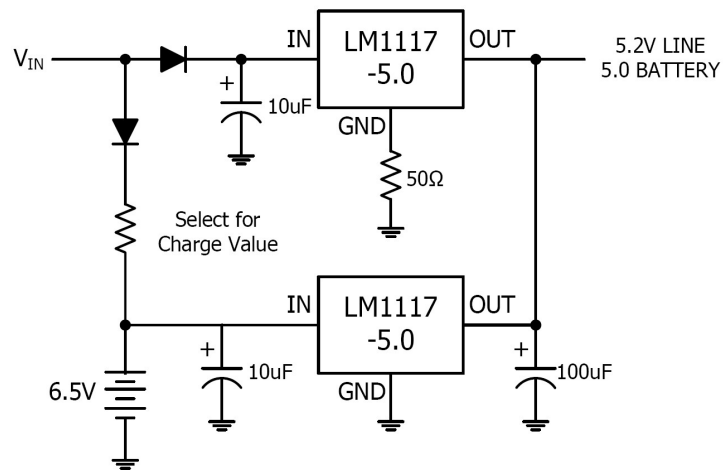Fig.3 Negative Supply

Fig.4 Voltage Regulator with Reference

Fig.5 Battery Backed-up Regulated Supply

APPLICATION INFORMATION

The LM1117 can deliver a continuous current of 1A over the full operating junction temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 1A may be still undeliverable due to the restriction of the power dissipation of LM1117. Under all possible conditions, the junction temperature must be within the range specified under operating conditions. The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA} \quad / \quad T_J = T_C + P_D \times \theta_{JC} \quad / \quad T_J = T_A + P_D \times \theta_{JA}$$

where T_J is the junction temperature, T_C is the case temperature, T_A is the ambient temperature, P_D is the total power dissipation of the device, θ_{CA} is the thermal resistance of case-to-ambient, θ_{JC} is the thermal resistance of junction-to-case, and θ_{JA} is the thermal resistance of junction to ambient. The total power dissipation of the device is given by:

$$P_D = P_{IN} - P_{OUT} = (V_{IN} \times I_{IN}) - (V_{OUT} \times I_{OUT})$$
$$= (V_{IN} \times (I_{OUT} + I_{GND})) - (V_{OUT} \times I_{OUT}) = (V_{IN} - V_{OUT}) \times I_{OUT} + (V_{IN} \times I_{GND})$$

where I_{GND} is the operating ground current of the device which is specified at the Electrical Characteristics. The maximum allowable temperature rise (T_{Rmax}) depends on the maximum ambient temperature (T_{Amax}) of the application, and the maximum allowable junction temperature (T_{Jmax}):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

The maximum allowable value for junction-to-ambient thermal resistance, θ_{JA}, can be calculated using the formula:

$$\theta_{JA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D$$

LM1117 is available in SOT223, TO252 and SOT89 packages. The thermal resistance depends on amount of copper area or heat sink, and on air flow. If the maximum allowable value of θ_{JA} calculated above is over 137°C/W for SOT-223 package, over 105 °C/W for TO-252 package, over 315 °C/W for SOT-89 package, no heat sink is needed since the package can dissipate enough heat to satisfy these requirements. If the value for allowable θ_{JA} falls near or below these limits, a heat sink or proper area of copper plane is required. In summary, the absolute maximum ratings of thermal resistances are as follow:

Characteristic	Symbol	Rating	Unit
Thermal Resistance Junction-to-Ambient / SOT-223	θ_{JA}-SOT-223	137	°C/W
Thermal Resistance Junction-to-Ambient / TO-252	θ_{JA}-TO-252	105	°C/W
Thermal Resistance Junction-to-Ambient / SOT-89	θ_{JA}-SOT-89	315	°C/W

No heat sink / No air flow / No adjacent heat source / T_A=25°C

REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.