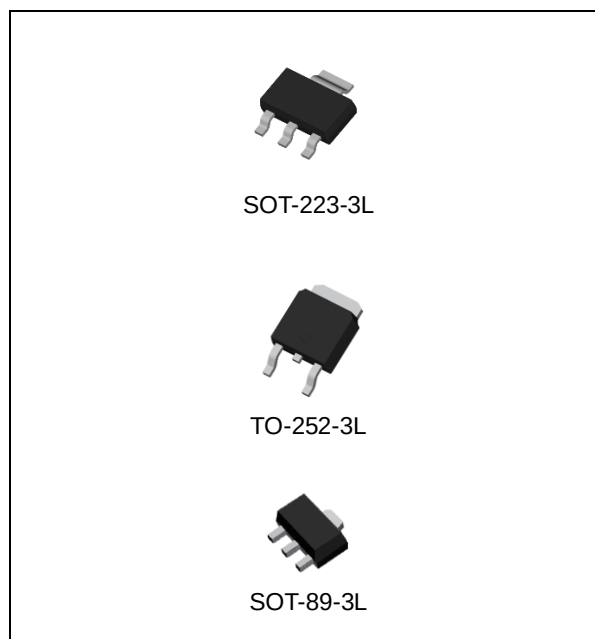


## FEATURES

- 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



## 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 10 $\mu$ F 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   |

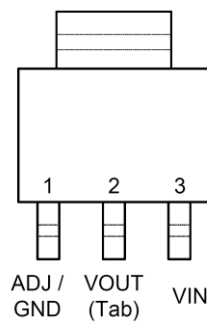
## ORDERING INFORMATION

| V <sub>OUT</sub> | 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 |

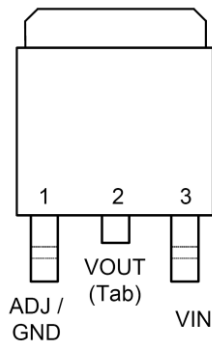
# 1A L.D.O VOLTAGE REGULATOR

LM1117

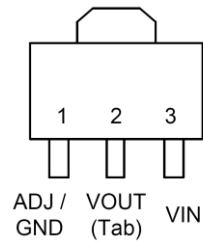
## PIN CONFIGURATIONS



SOT-223



TO-252



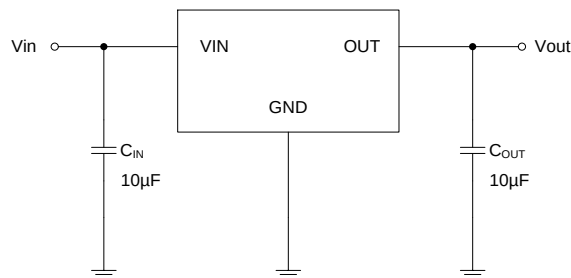
SOT-89

## PIN DESCRIPTION

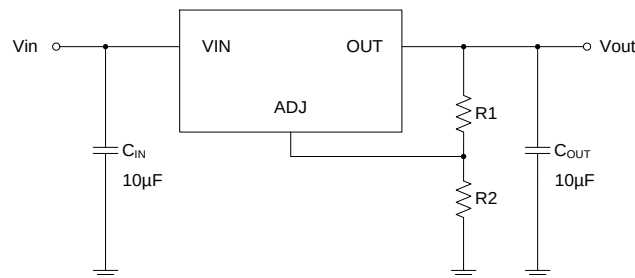
| Pin No. |        |        | Pin Name  | Pin Function                         |
|---------|--------|--------|-----------|--------------------------------------|
| SOT-223 | TO-252 | SOT-89 |           |                                      |
| 1       | 1      | 1      | ADJ / GND | Adjustable or Ground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

## TYPICAL APPLICATION CIRCUITS

< Fixed Version >



< Adjustable Version >



# 1A L.D.O VOLTAGE REGULATOR

**LM1117**

## ELECTRICAL CHARACTERISTICS

### For ADJ Output Voltage

(T<sub>J</sub>=25°C, C<sub>OUT</sub> = 10μF unless otherwise specified)

| SYMBOL              | PARAMETER                       | CONDITIONS                                                                                                         | MIN.  | TYP.  | MAX.  | UNIT |
|---------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------|-------|-------|-------|------|
| V <sub>REF</sub>    | Reference Voltage               | V <sub>IN</sub> = 5V, I <sub>O</sub> = 10mA                                                                        | 1.238 | 1.250 | 1.262 | V    |
| V <sub>REF</sub>    | Reference Voltage               | I <sub>O</sub> = 10mA to 1A, V <sub>IN</sub> - V <sub>REF</sub> = 1.5V to 13.75V (T <sub>J</sub> = -40 ~ 125°C)    | 1.219 |       | 1.281 | V    |
| ΔV <sub>LINE</sub>  | Line Regulation                 | I <sub>O</sub> = 10mA, V <sub>IN</sub> - V <sub>REF</sub> = 1.5V to 12V                                            |       | 0.1   | 0.2   | %    |
| ΔV <sub>LOAD</sub>  | Load Regulation                 | I <sub>O</sub> = 10mA to 1A, V <sub>IN</sub> - V <sub>REF</sub> = 2V                                               |       | 0.2   | 0.4   | %    |
| V <sub>IN</sub>     | Operating Input Voltage         |                                                                                                                    |       |       | 12    | V    |
| I <sub>ADJ</sub>    | Adjustment pin Current          | V <sub>IN</sub> - V <sub>REF</sub> = 1.5V to 12V, I <sub>O</sub> = 100mA                                           |       | 50    | 120   | μA   |
| ΔI <sub>ADJ</sub>   | Adjustment Pin Current Change   | V <sub>IN</sub> - V <sub>REF</sub> = 1.5V to 12V, I <sub>O</sub> = 100mA to 1A                                     |       | 0.5   | 5     | μA   |
| I <sub>O(MIN)</sub> | Minimum Load Current            | V <sub>IN</sub> = 5V, V <sub>REF</sub> = 0V                                                                        |       | 2     | 7     | mA   |
| I <sub>GND</sub>    | Ground Pin Current              | V <sub>IN</sub> = V <sub>O</sub> + 1.5V<br>I <sub>O</sub> = 10 mA to 1A                                            |       | 5     | 10    | mA   |
| I <sub>O</sub>      | Current Limit                   | V <sub>IN</sub> - V <sub>REF</sub> = 5V                                                                            | 1000  |       |       | mA   |
| eN                  | Output Noise (%V <sub>O</sub> ) | B = 10Hz to 10kHz, T <sub>J</sub> = 25°C                                                                           |       | 0.003 |       | %    |
| SVR                 | Supply Voltage Rejection        | I <sub>O</sub> = 1A, f = 120Hz,<br>V <sub>IN</sub> - V <sub>REF</sub> = 3V, V <sub>RIPPLE</sub> = 1V <sub>PP</sub> | 60    | 75    |       | dB   |

### For 1.2V Output Voltage

(T<sub>J</sub>=25°C, C<sub>OUT</sub> = 10μF unless otherwise specified)

| SYMBOL             | PARAMETER                       | CONDITIONS                                                                                                         | MIN.  | TYP.  | MAX.  | UNIT |
|--------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------|-------|-------|-------|------|
| V <sub>O</sub>     | Output Voltage                  | V <sub>IN</sub> = 2.7V, I <sub>O</sub> = 10mA                                                                      | 1.176 | 1.200 | 1.224 | V    |
| V <sub>O</sub>     | Output Voltage                  | V <sub>IN</sub> = 2.7V to 12V, I <sub>O</sub> = 0mA to 1A (T <sub>J</sub> = -40 ~ 125°C)                           | 1.152 |       | 1.248 | V    |
| ΔV <sub>LINE</sub> | Line Regulation                 | I <sub>O</sub> = 10mA, V <sub>IN</sub> = 2.7V to 12V                                                               |       | 0.1   | 0.2   | %    |
| ΔV <sub>LOAD</sub> | Load Regulation                 | I <sub>O</sub> = 10mA to 1A, V <sub>IN</sub> = 3.2V                                                                |       | 0.2   | 0.4   | %    |
| V <sub>IN</sub>    | Operating Input Voltage         |                                                                                                                    |       |       | 12    | V    |
| I <sub>GND</sub>   | Ground Pin Current              | V <sub>IN</sub> = V <sub>O</sub> + 1.5V<br>I <sub>O</sub> = 10 mA to 1A                                            |       | 5     | 10    | mA   |
| I <sub>O</sub>     | Current Limit                   | V <sub>IN</sub> - V <sub>O</sub> = 5V                                                                              | 1000  |       |       | mA   |
| eN                 | Output Noise (%V <sub>O</sub> ) | B = 10Hz to 10kHz, T <sub>J</sub> = 25°C                                                                           |       | 0.003 |       | %    |
| SVR                | Supply Voltage Rejection        | I <sub>O</sub> = 1A, f = 120Hz,<br>V <sub>IN</sub> - V <sub>O</sub> = 1.5V, V <sub>RIPPLE</sub> = 1V <sub>PP</sub> | 60    | 75    |       | dB   |

## For 1.5V Output Voltage

(T<sub>J</sub>=25°C, C<sub>OUT</sub> = 10μF unless otherwise specified)

| SYMBOL             | PARAMETER                      | CONDITIONS                                                                                                       | MIN.  | TYP. | MAX.  | UNIT |
|--------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------|-------|------|-------|------|
| V <sub>O</sub>     | Output Voltage                 | V <sub>IN</sub> = 3.0V, I <sub>O</sub> = 10mA                                                                    | 1.485 | 1.5  | 1.515 | V    |
| V <sub>O</sub>     | Output Voltage                 | V <sub>IN</sub> = 3.0V to 12V, I <sub>O</sub> = 0mA to 1A<br>(T <sub>J</sub> = -40 ~ 125°C)                      | 1.470 |      | 1.530 | V    |
| ΔV <sub>LINE</sub> | Line Regulation                | I <sub>O</sub> = 10mA, V <sub>IN</sub> = 3.0V to 12V                                                             |       | 0.1  | 0.2   | %    |
| ΔV <sub>LOAD</sub> | Load Regulation                | I <sub>O</sub> = 10mA to 1A, V <sub>IN</sub> = 3.5V                                                              |       | 0.2  | 0.4   | %    |
| V <sub>IN</sub>    | Operating Input Voltage        |                                                                                                                  |       |      | 12    | V    |
| I <sub>GND</sub>   | Ground Pin Current             | V <sub>IN</sub> = V <sub>O</sub> + 1.5V<br>I <sub>O</sub> = 10 mA to 1A                                          |       | 5    | 10    | mA   |
| I <sub>O</sub>     | Current Limit                  | V <sub>IN</sub> - V <sub>O</sub> = 5V                                                                            | 1000  |      |       | mA   |
| eN                 | Output Noise(%V <sub>O</sub> ) | B = 10Hz to 10kHz, T <sub>J</sub> = 25°C                                                                         |       | 100  |       | μV   |
| SVR                | Supply Voltage Rejection       | I <sub>O</sub> = 1A, f = 120Hz,<br>V <sub>IN</sub> - V <sub>O</sub> = 3V, V <sub>RIPPLE</sub> = 1V <sub>PP</sub> | 60    | 75   |       | dB   |

## For 1.8V Output Voltage

(T<sub>J</sub>=25°C, C<sub>OUT</sub> = 10μF unless otherwise specified)

| SYMBOL             | PARAMETER                      | CONDITIONS                                                                                                       | MIN.  | TYP. | MAX.  | UNIT |
|--------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------|-------|------|-------|------|
| V <sub>O</sub>     | Output Voltage                 | V <sub>IN</sub> = 3.3V, I <sub>O</sub> = 10mA                                                                    | 1.782 | 1.8  | 1.818 | V    |
| V <sub>O</sub>     | Output Voltage                 | V <sub>IN</sub> = 3.3V to 12V, I <sub>O</sub> = 0mA to 1A<br>(T <sub>J</sub> = -40 ~ 125°C)                      | 1.764 |      | 1.836 | V    |
| ΔV <sub>LINE</sub> | Line Regulation                | I <sub>O</sub> = 10mA, V <sub>IN</sub> = 3.3V to 12V                                                             |       | 0.1  | 0.2   | %    |
| ΔV <sub>LOAD</sub> | Load Regulation                | I <sub>O</sub> = 10mA to 1A, V <sub>IN</sub> = 3.8V                                                              |       | 0.2  | 0.4   | %    |
| V <sub>IN</sub>    | Operating Input Voltage        |                                                                                                                  |       |      | 12    | V    |
| I <sub>GND</sub>   | Ground Pin Current             | V <sub>IN</sub> = V <sub>O</sub> + 1.5V<br>I <sub>O</sub> = 10 mA to 1A                                          |       | 5    | 10    | mA   |
| I <sub>O</sub>     | Current Limit                  | V <sub>IN</sub> - V <sub>O</sub> = 5V                                                                            | 1000  |      |       | mA   |
| eN                 | Output Noise(%V <sub>O</sub> ) | B = 10Hz to 10kHz, T <sub>J</sub> = 25°C                                                                         |       | 100  |       | μV   |
| SVR                | Supply Voltage Rejection       | I <sub>O</sub> = 1A, f = 120Hz,<br>V <sub>IN</sub> - V <sub>O</sub> = 3V, V <sub>RIPPLE</sub> = 1V <sub>PP</sub> | 60    | 75   |       | dB   |

# 1A L.D.O VOLTAGE REGULATOR

# LM1117

## For 2.5V Output Voltage

( $T_J=25^{\circ}\text{C}$ ,  $C_{OUT} = 10\mu\text{F}$  unless otherwise specified)

| SYMBOL            | PARAMETER                | CONDITIONS                                                                                                             | MIN.  | TYP. | MAX.  | UNIT          |
|-------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------|-------|------|-------|---------------|
| $V_O$             | Output Voltage           | $V_{IN} = 4.0\text{V}$ , $I_O = 10\text{mA}$                                                                           | 2.475 | 2.5  | 2.525 | V             |
| $V_O$             | Output Voltage           | $V_{IN} = 4.0\text{V}$ to $12\text{V}$ , $I_O = 0\text{mA}$ to $1\text{A}$<br>( $T_J = -40 \sim 125^{\circ}\text{C}$ ) | 2.450 |      | 2.550 | V             |
| $\Delta V_{LINE}$ | Line Regulation          | $I_O = 10\text{mA}$ , $V_{IN} = 4.0\text{V}$ to $12\text{V}$                                                           |       | 0.1  | 0.2   | %             |
| $\Delta V_{LOAD}$ | Load Regulation          | $I_O = 10\text{mA}$ to $1\text{A}$ , $V_{IN} = 4.5\text{V}$                                                            |       | 0.2  | 0.4   | %             |
| $V_{IN}$          | Operating Input Voltage  |                                                                                                                        |       |      | 12    | V             |
| $I_{GND}$         | Ground Pin Current       | $V_{IN} = V_O + 1.5\text{V}$<br>$I_O = 10\text{mA}$ to $1\text{A}$                                                     |       | 5    | 10    | mA            |
| $I_O$             | Current Limit            | $V_{IN} - V_O = 5\text{V}$                                                                                             | 1000  |      |       | mA            |
| eN                | Output Noise(% $V_O$ )   | $B = 10\text{Hz}$ to $10\text{kHz}$ , $T_J = 25^{\circ}\text{C}$                                                       |       | 100  |       | $\mu\text{V}$ |
| SVR               | Supply Voltage Rejection | $I_O = 1\text{A}$ , $f = 120\text{Hz}$ ,<br>$V_{IN} - V_O = 3\text{V}$ , $V_{RIPPLE} = 1\text{V}_{PP}$                 | 60    | 75   |       | dB            |

## For 3.3V Output Voltage

( $T_J=25^{\circ}\text{C}$ ,  $C_{OUT} = 10\mu\text{F}$  unless otherwise specified)

| SYMBOL            | PARAMETER                | CONDITIONS                                                                                                             | MIN.  | TYP. | MAX.  | UNIT          |
|-------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------|-------|------|-------|---------------|
| $V_O$             | Output Voltage           | $V_{IN} = 4.8\text{V}$ , $I_O = 10\text{mA}$                                                                           | 3.267 | 3.3  | 3.333 | V             |
| $V_O$             | Output Voltage           | $V_{IN} = 4.8\text{V}$ to $12\text{V}$ , $I_O = 0\text{mA}$ to $1\text{A}$<br>( $T_J = -40 \sim 125^{\circ}\text{C}$ ) | 3.234 |      | 3.366 | V             |
| $\Delta V_{LINE}$ | Line Regulation          | $I_O = 10\text{mA}$ , $V_{IN} = 4.8\text{V}$ to $12\text{V}$                                                           |       | 0.1  | 0.2   | %             |
| $\Delta V_{LOAD}$ | Load Regulation          | $I_O = 10\text{mA}$ to $1\text{A}$ , $V_{IN} = 5.3\text{V}$                                                            |       | 0.2  | 0.4   | %             |
| $V_{IN}$          | Operating Input Voltage  |                                                                                                                        |       |      | 12    | V             |
| $I_{GND}$         | Ground Pin Current       | $V_{IN} = V_O + 1.5\text{V}$<br>$I_O = 10\text{mA}$ to $1\text{A}$                                                     |       | 5    | 10    | mA            |
| $I_O$             | Current Limit            | $V_{IN} - V_O = 5\text{V}$                                                                                             | 1000  |      |       | mA            |
| eN                | Output Noise(% $V_O$ )   | $B = 10\text{Hz}$ to $10\text{kHz}$ , $T_J = 25^{\circ}\text{C}$                                                       |       | 100  |       | $\mu\text{V}$ |
| SVR               | Supply Voltage Rejection | $I_O = 1\text{A}$ , $f = 120\text{Hz}$ ,<br>$V_{IN} - V_O = 3\text{V}$ , $V_{RIPPLE} = 1\text{V}_{PP}$                 | 60    | 75   |       | dB            |

# 1A L.D.O VOLTAGE REGULATOR

LM1117

## For 5.0V Output Voltage

( $T_J=25^{\circ}\text{C}$ ,  $C_{OUT} = 10\mu\text{F}$  unless otherwise specified)

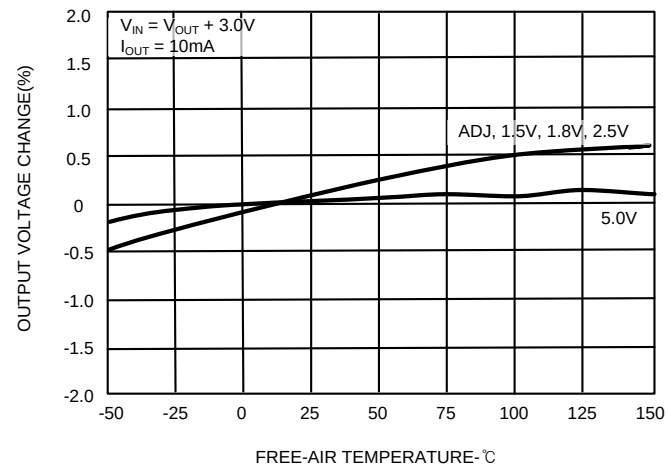
| SYMBOL            | PARAMETER                | CONDITIONS                                                                                                             | MIN.  | TYP. | MAX.  | UNIT          |
|-------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------|-------|------|-------|---------------|
| $V_O$             | Output Voltage           | $V_{IN} = 6.5\text{V}$ , $I_O = 10\text{mA}$                                                                           | 4.950 | 5.0  | 5.050 | V             |
| $V_O$             | Output Voltage           | $V_{IN} = 6.5\text{V}$ to $15\text{V}$ , $I_O = 0\text{mA}$ to $1\text{A}$<br>( $T_J = -40 \sim 125^{\circ}\text{C}$ ) | 4.900 |      | 5.100 | V             |
| $\Delta V_{LINE}$ | Line Regulation          | $I_O = 10\text{mA}$ , $V_{IN} = 6.5\text{V}$ to $15\text{V}$                                                           |       | 0.1  | 0.2   | %             |
| $\Delta V_{LOAD}$ | Load Regulation          | $I_O = 10\text{mA}$ to $1\text{A}$ , $V_{IN} = 7.0\text{V}$                                                            |       | 0.2  | 0.4   | %             |
| $V_{IN}$          | Operating Input Voltage  |                                                                                                                        |       |      | 15    | V             |
| $I_{GND}$         | Ground Pin Current       | $V_{IN} = V_O + 1.5\text{V}$<br>$I_O = 10\text{mA}$ to $1\text{A}$                                                     |       | 5    | 10    | mA            |
| $I_O$             | Current Limit            | $V_{IN} - V_O = 5\text{V}$                                                                                             | 1000  |      |       | mA            |
| eN                | Output Noise(% $V_O$ )   | $B = 10\text{Hz}$ to $10\text{kHz}$ , $T_J = 25^{\circ}\text{C}$                                                       |       | 100  |       | $\mu\text{V}$ |
| SVR               | Supply Voltage Rejection | $I_O = 1\text{A}$ , $f = 120\text{Hz}$ ,<br>$V_{IN} - V_O = 3\text{V}$ , $V_{RIPPLE} = 1\text{V}_{PP}$                 | 60    | 75   |       | dB            |

## For All Output Voltage

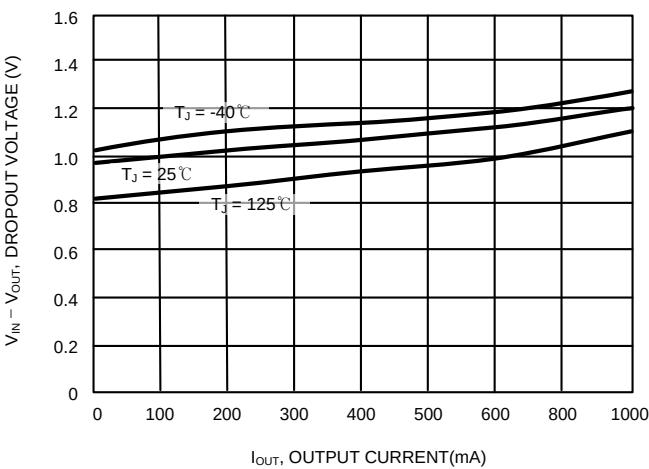
( $T_J=25^{\circ}\text{C}$ ,  $C_{OUT} = 10\mu\text{F}$  unless otherwise specified)

| SYMBOL | PARAMETER             | CONDITIONS                            | MIN. | TYP.  | MAX. | UNIT |
|--------|-----------------------|---------------------------------------|------|-------|------|------|
| $V_D$  | Dropout Voltage       | $I_O = 100\text{mA}$                  |      | 1.0   | 1.1  | V    |
|        |                       | $I_O = 500\text{mA}$                  |      | 1.1   | 1.2  | V    |
|        |                       | $I_O = 1\text{A}$                     |      | 1.2   | 1.3  | V    |
|        | Temperature Stability |                                       |      | 0.5   |      | %    |
|        | Long Term Stability   | 1000 hrs, $T_J = 125^{\circ}\text{C}$ |      | 0.3   |      | %    |
|        | Thermal Regulation    | $T_A = 25^{\circ}\text{C}$ 30ms Pulse |      | 0.003 |      | %/W  |

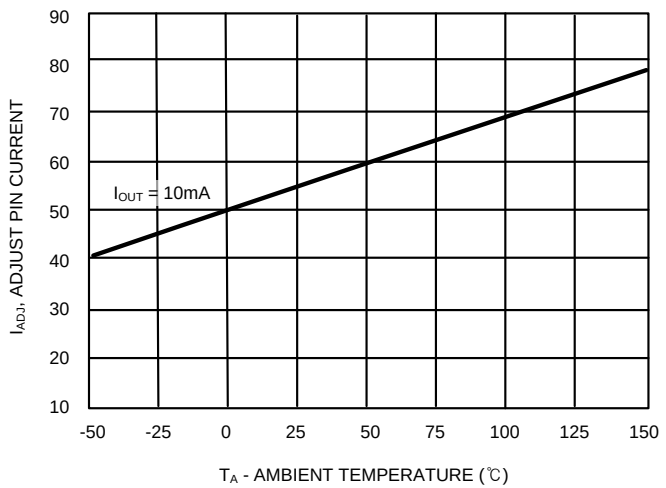
TYPICAL OPERATING CHARACTERISTICS



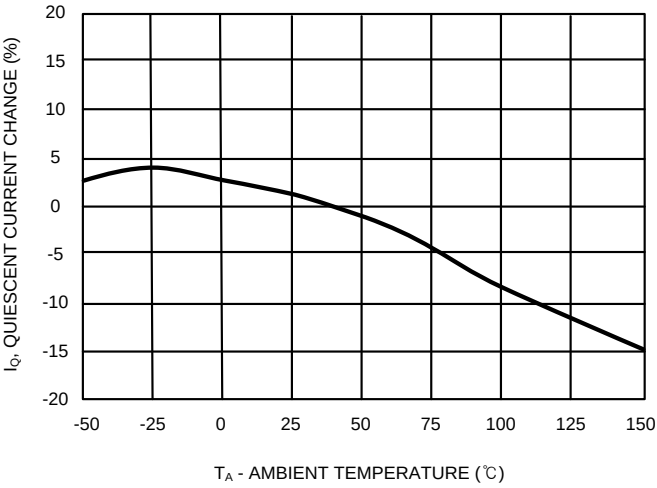
OUTPUT VOLTAGE CHANGE VS TEMPERATURE



DROPOUT VOLTAGE VS OUTPUT CURRENT



ADJ PIN CURRENT VS TEMPERATURE



QUIESCENT CURRENT CHANGE VS TEMPERATURE



## APPLICATION CIRCUITS

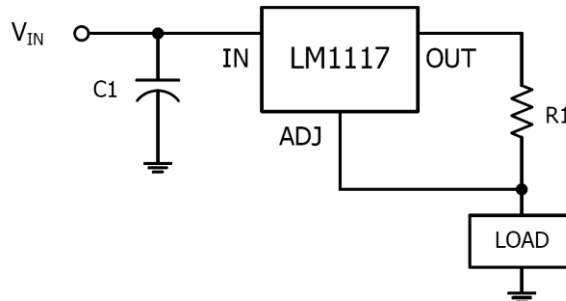


Fig.1 300mA Current Output

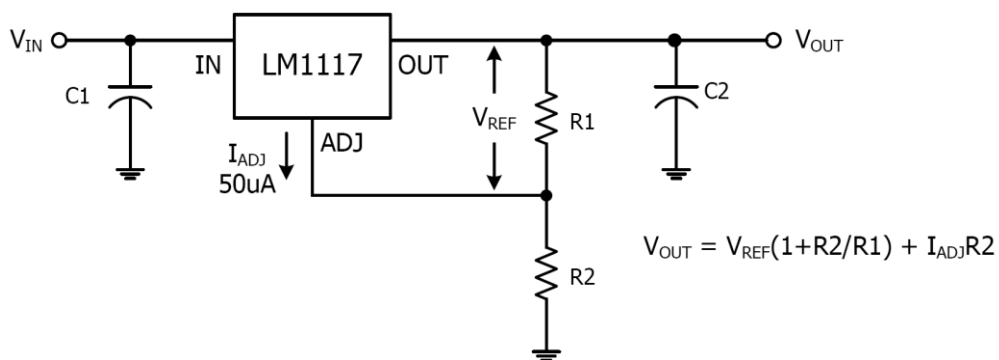


Fig.2 Typical Adjustable Regulator

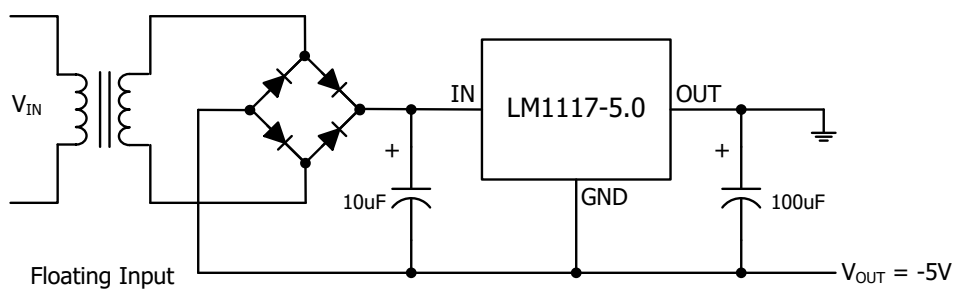


Fig.3 Negative Supply

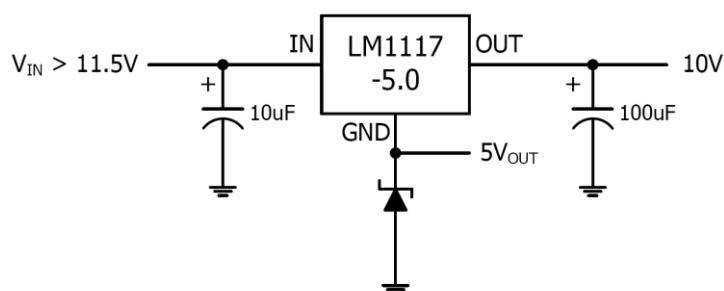


Fig.4 Voltage Regulator with Reference

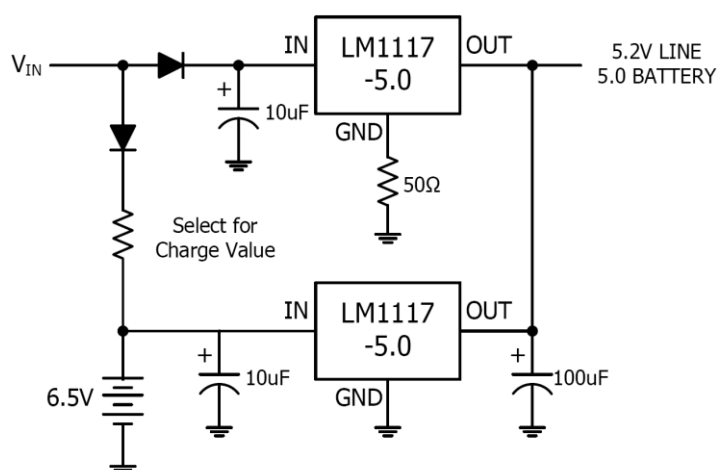


Fig.5 Battery Backed-up Regulated Supply

## 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,  $\theta_{CA}$  is the thermal resistance of case-to-ambient,  $\theta_{JC}$  is the thermal resistance of junction-to-case, and  $\theta_{JA}$  is the thermal resistance of junction to ambient. The total power dissipation of the device is given by:

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

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,  $\theta_{JA}$ , 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  $\theta_{JA}$  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  $\theta_{JA}$  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 | $\theta_{JA-SOT-223}$ | 137    | °C/W |
| Thermal Resistance Junction-to-Ambient / TO-252  | $\theta_{JA-TO-252}$  | 105    | °C/W |
| Thermal Resistance Junction-to-Ambient / SOT-89  | $\theta_{JA-SOT-89}$  | 315    | °C/W |

No heat sink / No air flow / No adjacent heat source /  $T_A=25^\circ\text{C}$

## REVISION NOTICE

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