

FEATURES

- Output Current up to 1 A
- Low Dropout Voltage (1.2V at 1A Output current)
- Three Terminal Adjustable(ADJ) or Fixed 1.2V, 1.5V, 1.8V, 2.5V, 2.85V, 3.3V, 5.0V
- Line Regulation typically at 0.1% max.
- Load Regulation typically at 0.2% max.
- Internal Current and Terminal Protection
- Maximum Input Voltage 15V
- Surface Mount Package SOT-223, TO-252, SOT-89
- 100% Thermal Limit Burn-In
- Moisture Sensitivity Level 3

APPLICATION

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

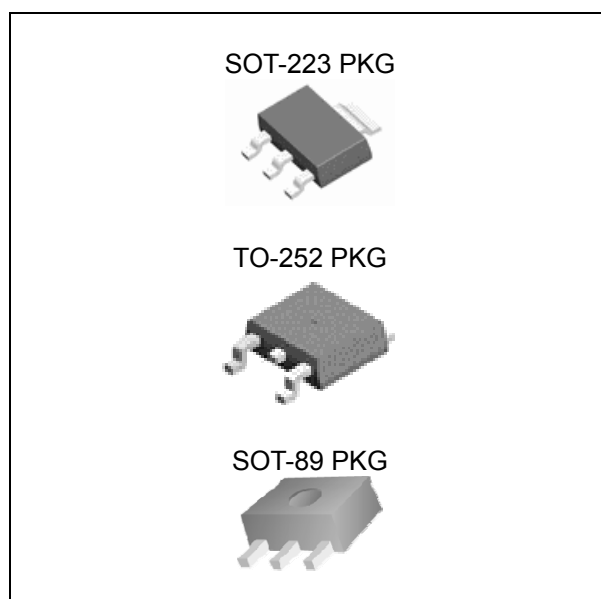
DESCRIPTION

The LM1117 is a low power positive-voltage regulator designed to meet 1A output current and comply with SCSI-II specifications with a fixed output voltage of 2.85V. 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 1V 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, 2.85, 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 μ F or larger is needed for output stability of LM1117 as required by most of the other regulator circuits.

Absolute Maximum Ratings

(T_A = 25°C, unless otherwise specified)

| CHARACTERISTIC | SYMBOL | MIN. | MAX. | UNIT |
|---|------------------|------|------|------|
| DC Input Voltage | V _{IN} | - | 15 | V |
| Lead Temperature (Soldering, 5 seconds) | T _{SOL} | - | 260 | °C |
| Operating Junction Temperature Range | T _{OPR} | -40 | 125 | °C |
| Storage Temperature Range | T _{STG} | -65 | 150 | °C |



ORDERING INFORMATION

| Device | Package |
|---------------|---------|
| LM1117S-ADJ | SOT-223 |
| LM1117S-X.X | |
| LM1117GS-ADJ | |
| LM1117GS-X.X | |
| LM1117RS-ADJ | TO-252 |
| LM1117RS-X.X | |
| LM1117GRS-ADJ | |
| LM1117GRS-X.X | |
| LM1117F-ADJ | SOT-89 |
| LM1117F-X.X | |

X.X = Output Voltage = 1.2V, 1.5V, 1.8V, 2.5V, 2.85V, 3.3V, 5.0V

Ordering Information

| V _{OUT} | Package | Order No. | Package Marking | Supplied As | Status |
|------------------|---------|--------------------|-----------------|-------------|------------|
| ADJ | SOT-223 | LM1117S-ADJ-3L | 1117S ADJ | Reel | Active |
| | SOT-223 | LM1117GS-ADJ-3L | 1117GS ADJ | Reel | Contact us |
| | TO-252 | LM1117RS-ADJ-3L | LM1117 ADJ | Reel | Active |
| | TO-252 | LM1117GRS-ADJ-3L | LM1117G ADJ | Reel | Contact us |
| | SOT-89 | LM1117F-ADJ-3L | 1117 ADJ | Reel | Active |
| 1.2V | SOT-223 | LM1117S-1.2V-3L | 1117S 1.2 | Reel | Active |
| | SOT-223 | LM1117GS-1.2V-3L | 1117GS 1.2 | Reel | Contact us |
| | TO-252 | LM1117RS-1.2V-3L | LM1117 1.2 | Reel | Active |
| | TO-252 | LM1117GRS-1.2V-3L | LM1117G 1.2 | Reel | Contact us |
| | SOT-89 | LM1117F-1.2V-3L | 1117 1.2 | Reel | Active |
| 1.5V | SOT-223 | LM1117S-1.5V-3L | 1117S 1.5 | Reel | Active |
| | SOT-223 | LM1117GS-1.5V-3L | 1117GS 1.5 | Reel | Contact us |
| | TO-252 | LM1117RS-1.5V-3L | LM1117 1.5 | Reel | Active |
| | TO-252 | LM1117GRS-1.5V-3L | LM1117G 1.5 | Reel | Contact us |
| | SOT-89 | LM1117F-1.5V-3L | 1117 1.5 | Reel | Active |
| 1.8V | SOT-223 | LM1117S-1.8V-3L | 1117S 1.8 | Reel | Active |
| | SOT-223 | LM1117GS-1.8V-3L | 1117GS 1.8 | Reel | Contact us |
| | TO-252 | LM1117RS-1.8V-3L | LM1117 1.8 | Reel | Active |
| | TO-252 | LM1117GRS-1.8V-3L | LM1117G 1.8 | Reel | Contact us |
| | SOT-89 | LM1117F-1.8V-3L | 1117 1.8 | Reel | Active |
| 2.5V | SOT-223 | LM1117S-2.5V-3L | 1117S 2.5 | Reel | Active |
| | SOT-223 | LM1117GS-2.5V-3L | 1117GS 2.5 | Reel | Contact us |
| | TO-252 | LM1117RS-2.5V-3L | LM1117 2.5 | Reel | Active |
| | TO-252 | LM1117GRS-2.5V-3L | LM1117G 2.5 | Reel | Contact us |
| | SOT-89 | LM1117F-2.5V-3L | 1117 2.5 | Reel | Active |
| 2.85V | SOT-223 | LM1117S-2.85V-3L | 1117S 2.85 | Reel | Active |
| | SOT-223 | LM1117GS-2.85V-3L | 1117GS 2.85 | Reel | Contact us |
| | TO-252 | LM1117RS-2.85V-3L | LM1117 2.85 | Reel | Active |
| | TO-252 | LM1117GRS-2.85V-3L | LM1117G 2.85 | Reel | Contact us |
| | SOT-89 | LM1117F-2.85V-3L | 1117 2.85 | Reel | Active |
| 3.3V | SOT-223 | LM1117S-3.3V-3L | 1117S 3.3 | Reel | Active |
| | SOT-223 | LM1117GS-3.3V-3L | 1117GS 3.3 | Reel | Contact us |
| | TO-252 | LM1117RS-3.3V-3L | LM1117 3.3 | Reel | Active |
| | TO-252 | LM1117GRS-3.3V-3L | LM1117G 3.3 | Reel | Contact us |
| | SOT-89 | LM1117F-3.3V-3L | 1117 3.3 | Reel | Active |

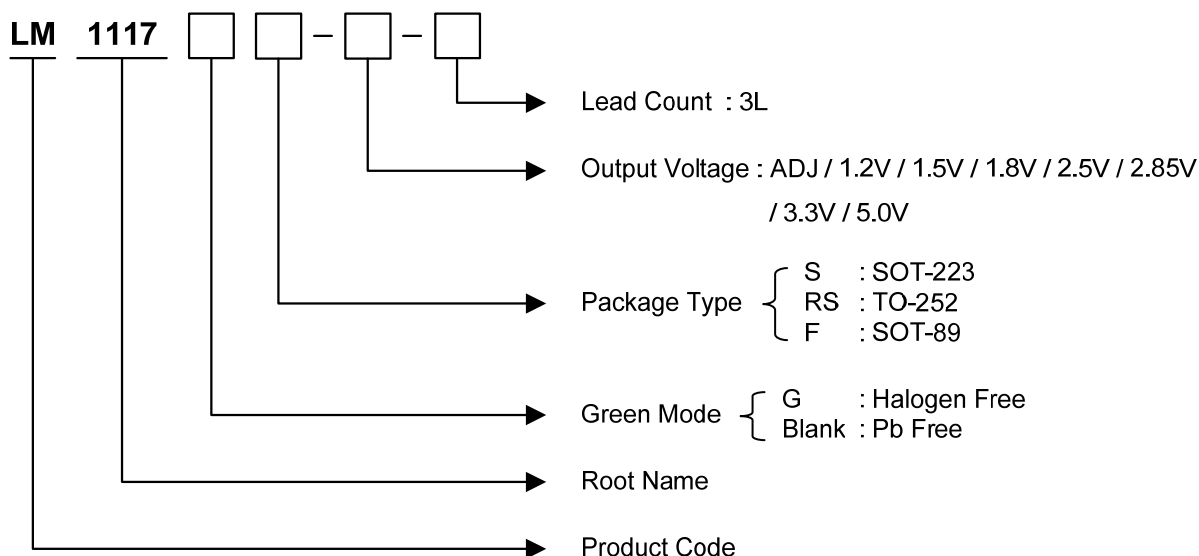
1A L.D.O VOLTAGE REGULATOR

LM1117

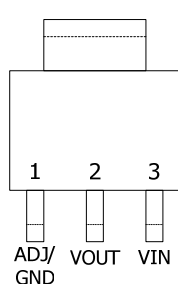
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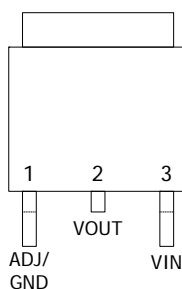
| V _{OUT} | Package | Order No. | Package Marking | Supplied As | Status |
|------------------|---------|-------------------|-----------------|-------------|------------|
| 5.0V | SOT-223 | LM1117S-5.0V-3L | 1117S 5.0 | Reel | Active |
| | SOT-223 | LM1117GS-5.0V-3L | 1117GS 5.0 | Reel | Contact us |
| | TO-252 | LM1117RS-5.0V-3L | LM1117 5.0 | Reel | Active |
| | TO-252 | LM1117GRS-5.0V-3L | LM1117G 5.0 | Reel | Contact us |
| | SOT-89 | LM1117F-5.0V-3L | 1117 5.0 | Reel | Active |



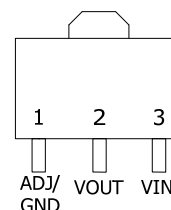
PIN CONFIGURATION



SOT-223



TO-252



SOT-89

PIN DESCRIPTION

| Pin No. | SOT-223 / TO-252 / SOT-89 | |
|---------|---------------------------|---------------------|
| | Name | Function |
| 1 | ADJ/GND | Adjustable / Ground |
| 2 | V _{OUT} | Output Voltage |
| 3 | V _{IN} | Input Voltage |

1A L.D.O VOLTAGE REGULATOR

LM1117

ELECTRICAL CHARACTERISTICS

For ADJ Output Voltage

($T_A=25^{\circ}\text{C}$, $C_O = 10\mu\text{F}$ unless otherwise specified)

| Symbol | Parameters | Condition | Min. | Typ. | Max. | Unit |
|--------------------------|-------------------------------|---|-------|-------|-------|---------------|
| V_{REF} | Reference Voltage | $V_{\text{IN}}=5\text{V}$, $I_O=10\text{mA}$ | 1.238 | 1.250 | 1.262 | V |
| V_{REF} | Reference Voltage | $I_O = 10\text{mA to } 1\text{A}$, $V_{\text{IN}} - V_{\text{REF}} = 1.5\text{V to } 13.75\text{V}$ ($T_J = 0 \sim 125^{\circ}\text{C}$) | 1.219 | | 1.281 | V |
| ΔV_{LINE} | Line Regulation | $I_O = 10\text{mA}$, $V_{\text{IN}} - V_{\text{REF}} = 1.5\text{V to } 12\text{V}$ | | 0.1 | 0.2 | % |
| ΔV_{LOAD} | Load Regulation | $I_O = 10\text{mA to } 1\text{A}$, $V_{\text{IN}} - V_{\text{REF}} = 2\text{V}$ | | 0.2 | 0.4 | % |
| V_{IN} | Operating Input Voltage | | | | 15 | V |
| I_{ADJ} | Adjustment pin Current | $V_{\text{IN}} - V_{\text{REF}} = 1.5\text{V to } 12\text{V}$, $I_O = 100\text{mA}$ | | 50 | 120 | μA |
| ΔI_{ADJ} | Adjustment Pin Current Change | $V_{\text{IN}} - V_{\text{REF}} = 1.5\text{V to } 12\text{V}$, $I_O = 100\text{mA to } 1\text{A}$ | | 0.5 | 5 | μA |
| $I_{O(\text{MIN})}$ | Minimum Load Current | $V_{\text{IN}}=5\text{V}$, $V_{\text{REF}}=0\text{V}$ | | 5 | 10 | mA |
| I_O | Current Limit | $V_{\text{IN}} - V_{\text{REF}} = 5\text{V}$ | 1000 | 1250 | 1600 | mA |
| ϵ_N | Output Noise(% V_O) | $B = 10\text{Hz to } 10\text{kHz}$, $T_J = 25^{\circ}\text{C}$ | | 0.003 | | % |
| SVR | Supply Voltage Rejection | $I_O = 1\text{A}$, $f = 120\text{Hz}$, $V_{\text{IN}} - V_{\text{REF}} = 3\text{V}$, $V_{\text{RIPPLE}} = 1\text{V}_{\text{PP}}$ | 60 | 75 | | dB |

For 1.2V Output Voltage

($T_A=25^{\circ}\text{C}$, $C_O = 10\mu\text{F}$ unless otherwise specified)

| Symbol | Parameters | Condition | Min. | Typ. | Max. | Unit |
|--------------------------|--------------------------|---|-------|-------|-------|------|
| V_O | Output Voltage | $V_{\text{IN}} = 2.7\text{V}$, $I_O = 10\text{mA}$ | 1.176 | 1.200 | 1.224 | V |
| V_O | Output Voltage | $V_{\text{IN}} = 2.7\text{V to } 12\text{V}$, $I_O = 0\text{mA to } 1\text{A}$ ($T_J = 0 \sim 125^{\circ}\text{C}$) | 1.152 | | 1.248 | V |
| ΔV_{LINE} | Line Regulation | $I_O = 0\text{mA}$, $V_{\text{IN}} = 2.7\text{V to } 12\text{V}$ | | 0.1 | 0.2 | % |
| ΔV_{LOAD} | Load Regulation | $I_O = 10\text{mA to } 1\text{A}$, $V_{\text{IN}} = 3.2\text{V}$ | | 0.2 | 0.4 | % |
| V_{IN} | Operating Input Voltage | | | | 15 | V |
| I_D | Quiescent Current | $V_{\text{IN}} - V_O = 5\text{V}$ | | 5 | 10 | mA |
| I_O | Current Limit | $V_{\text{IN}} - V_O = 5\text{V}$ | 1000 | 1250 | 1600 | mA |
| ϵ_N | Output Noise(% V_O) | $B = 10\text{Hz to } 10\text{kHz}$, $T_J = 25^{\circ}\text{C}$ | | 0.003 | | % |
| SVR | Supply Voltage Rejection | $I_O = 1\text{A}$, $f = 120\text{Hz}$, $V_{\text{IN}} - V_O = 1.5\text{V}$, $V_{\text{RIPPLE}} = 1\text{V}_{\text{PP}}$ | 60 | 75 | | dB |

For 1.5V Output Voltage

($T_A=25^{\circ}\text{C}$, $C_O = 10\mu\text{F}$ unless otherwise specified)

| Symbol | Parameters | Condition | Min. | Typ. | Max. | Unit |
|-------------------|--------------------------|--|-------|------|-------|---------------|
| V_O | Output Voltage | $V_{IN} = 3.0\text{V}$, $I_O = 10\text{mA}$ | 1.485 | 1.5 | 1.515 | V |
| V_O | Output Voltage | $V_{IN} = 3.0\text{V}$ to 12V , $I_O = 0\text{mA}$ to 1A ($T_J = 0 \sim 125^{\circ}\text{C}$) | 1.470 | | 1.530 | V |
| ΔV_{LINE} | Line Regulation | $I_O = 0\text{mA}$, $V_{IN} = 3.0\text{V}$ to 12V | | 0.1 | 0.2 | % |
| ΔV_{LOAD} | Load Regulation | $I_O = 0\text{mA}$ to 1A , $V_{IN} = 3.5\text{V}$ | | 0.2 | 0.4 | % |
| V_{IN} | Operating Input Voltage | $I_O = 100\text{mA}$ | | | 12 | V |
| I_D | Quiescent Current | $V_{IN} - V_O = 5\text{V}$ | | 5 | 10 | mA |
| I_O | Current Limit | $V_{IN} - V_O = 5\text{V}$ | 1000 | 1250 | 1600 | mA |
| e_N | Output Noise(% V_O) | $B = 10\text{Hz}$ to 10kHz , $T_J = 25^{\circ}\text{C}$ | | 100 | | μV |
| SVR | Supply Voltage Rejection | $I_O = 1\text{A}$, $f = 120\text{Hz}$, $V_{IN} - V_O = 3\text{V}$, $V_{RIPPLE} = 1V_{PP}$ | 60 | 75 | | dB |

For 1.8V Output Voltage

($T_A=25^{\circ}\text{C}$, $C_O = 10\mu\text{F}$ unless otherwise specified)

| Symbol | Parameters | Condition | Min. | Typ. | Max. | Unit |
|-------------------|--------------------------|--|-------|------|-------|---------------|
| V_O | Output Voltage | $V_{IN} = 3.3\text{V}$, $I_O = 10\text{mA}$ | 1.782 | 1.8 | 1.818 | V |
| V_O | Output Voltage | $V_{IN} = 3.3\text{V}$ to 12V , $I_O = 0\text{mA}$ to 1A ($T_J = 0 \sim 125^{\circ}\text{C}$) | 1.764 | | 1.836 | V |
| ΔV_{LINE} | Line Regulation | $I_O = 0\text{mA}$, $V_{IN} = 3.3\text{V}$ to 12V | | 0.1 | 0.2 | % |
| ΔV_{LOAD} | Load Regulation | $I_O = 0\text{mA}$ to 1A , $V_{IN} = 3.8\text{V}$ | | 0.2 | 0.4 | % |
| V_{IN} | Operating Input Voltage | $I_O = 100\text{mA}$ | | | 12 | V |
| I_D | Quiescent Current | $V_{IN} - V_O = 5\text{V}$ | | 5 | 10 | mA |
| I_O | Current Limit | $V_{IN} - V_O = 5\text{V}$ | 1000 | 1250 | 1600 | mA |
| e_N | Output Noise(% V_O) | $B = 10\text{Hz}$ to 10kHz , $T_J = 25^{\circ}\text{C}$ | | 100 | | μV |
| SVR | Supply Voltage Rejection | $I_O = 1\text{A}$, $f = 120\text{Hz}$, $V_{IN} - V_O = 3\text{V}$, $V_{RIPPLE} = 1V_{PP}$ | 60 | 75 | | dB |

For 2.5V Output Voltage

(T_A=25°C, C_O = 10uF unless otherwise specified)

| Symbol | Parameters | Condition | 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 = 0 ~ 125°C) | 2.450 | | 2.550 | V |
| ΔV _{LINE} | Line Regulation | I _O = 0mA, V _{IN} = 4.0V to 12V | | 0.1 | 0.2 | % |
| ΔV _{LOAD} | Load Regulation | I _O = 0mA to 1A, V _{IN} = 4.5 V | | 0.2 | 0.4 | % |
| V _{IN} | Operating Input Voltage | I _O = 100mA | | | 12 | V |
| I _D | Quiescent Current | V _{IN} - V _O = 5V | | 5 | 10 | mA |
| I _O | Current Limit | V _{IN} - V _O = 5V | 1000 | 1250 | 1600 | mA |
| εN | Output Noise(%V _O) | B = 10Hz to 10kHz, T _J = 25°C | | 100 | | uV |
| SVR | Supply Voltage Rejection | I _O = 1A, f = 120Hz, V _{IN} - V _O = 3V, V _{RIPPLE} = 1V _{PP} | 60 | 75 | | dB |

For 2.85V Output Voltage

(T_A=25°C, C_O = 10uF unless otherwise specified)

| Symbol | Parameters | Condition | Min. | Typ. | Max. | Unit |
|--------------------|--------------------------------|--|-------|------|-------|------|
| V _O | Output Voltage | V _{IN} = 4.4V, I _O = 10mA | 2.821 | 2.85 | 2.878 | V |
| V _O | Output Voltage | V _{IN} = 4.4V to 12V, I _O = 0mA to 1A (T _J = 0 ~ 125°C) | 2.793 | | 2.907 | V |
| ΔV _{LINE} | Line Regulation | I _O = 0mA, V _{IN} = 4.4 to 12V | | 0.1 | 0.2 | % |
| ΔV _{LOAD} | Load Regulation | I _O = 0mA to 1A, V _{IN} = 4.85 V | | 0.2 | 0.4 | % |
| V _{IN} | Operating Input Voltage | I _O = 100mA | | | 12 | V |
| I _D | Quiescent Current | V _{IN} - V _O = 5V | | 5 | 10 | mA |
| I _O | Current Limit | V _{IN} - V _O = 5V | 1000 | 1250 | 1600 | mA |
| εN | Output Noise(%V _O) | B = 10Hz to 10kHz, T _J = 25°C | | 100 | | uV |
| 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_A=25°C, C_O = 10uF unless otherwise specified)

| Symbol | Parameters | Condition | 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 = 0 ~ 125°C) | 3.234 | | 3.366 | V |
| ΔV _{LINE} | Line Regulation | I _O = 0mA, V _{IN} = 4.8V to 12V | | 0.1 | 0.2 | % |
| ΔV _{LOAD} | Load Regulation | I _O = 0mA to 1A, V _{IN} = 5.3 V | | 0.2 | 0.4 | % |
| V _{IN} | Operating Input Voltage | I _O = 100mA | | | 12 | V |
| I _D | Quiescent Current | V _{IN} - V _O = 5V | | 5 | 10 | mA |
| I _O | Current Limit | V _{IN} - V _O = 5V | 1000 | 1250 | 1600 | mA |
| εN | Output Noise(%V _O) | B = 10Hz to 10kHz, T _J = 25°C | | 100 | | uV |
| SVR | Supply Voltage Rejection | I _O = 1A, f = 120Hz, V _{IN} - V _O = 3V, V _{RIPPLE} = 1V _{PP} | 60 | 75 | | dB |

For 5.0V Output Voltage

(T_A=25°C, C_O = 10uF unless otherwise specified)

| Symbol | Parameters | Condition | 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 = 0 ~ 125°C) | 4.900 | | 5.100 | V |
| ΔV _{LINE} | Line Regulation | I _O = 0mA, V _{IN} = 6.5V to 15V | | 0.1 | 0.2 | % |
| ΔV _{LOAD} | Load Regulation | I _O = 0mA to 1A, V _{IN} = 7.0 V | | 0.2 | 0.4 | % |
| V _{IN} | Operating Input Voltage | I _O = 100mA | | | 15 | V |
| I _D | Quiescent Current | V _{IN} - V _O = 5V | | 5 | 10 | mA |
| I _O | Current Limit | V _{IN} - V _O = 5V | 1000 | 1250 | 1600 | mA |
| εN | Output Noise(%V _O) | B = 10Hz to 10kHz, T _J = 25°C | | 100 | | uV |
| 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

($T_A=25^{\circ}\text{C}$, $C_O = 10\mu\text{F}$ unless otherwise specified)

| Symbol | Parameters | Condition | 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 APPLICATION CIRCUIT

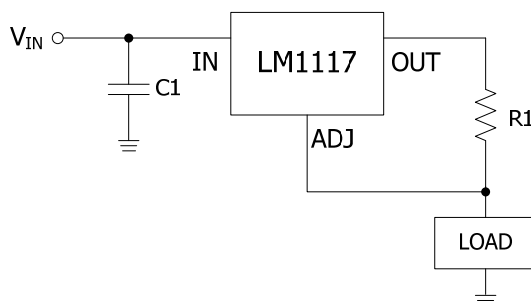


Fig.1 1A Current Output

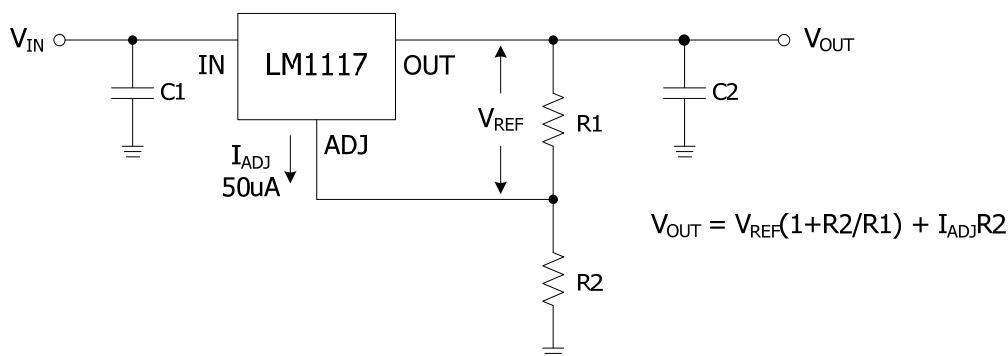


Fig.2 Typical Adjustable Regulator

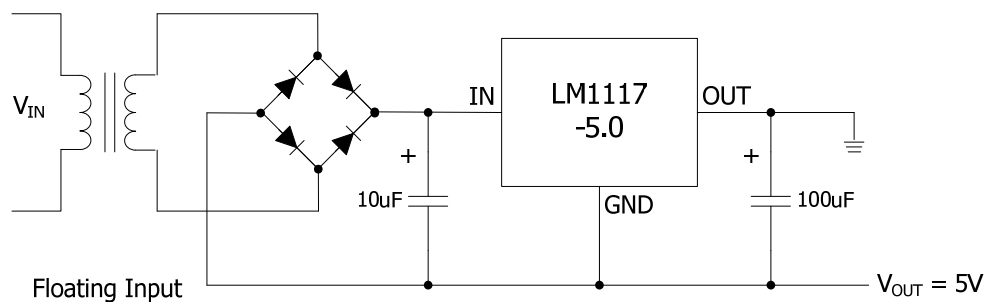


Fig.3 Negative Supply

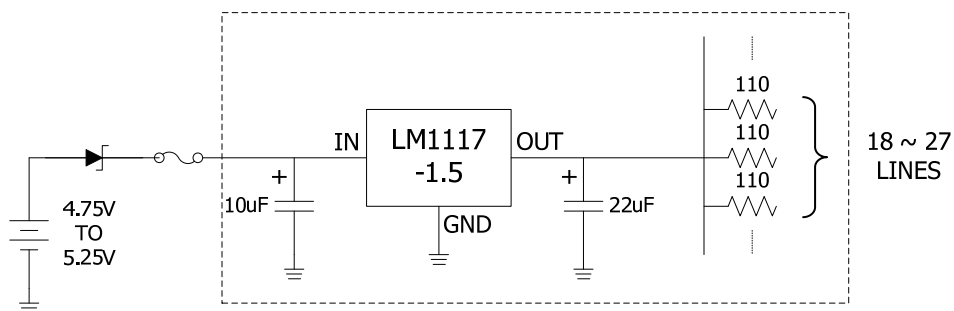


Fig.4 Active Terminator for SCSI-2BUS

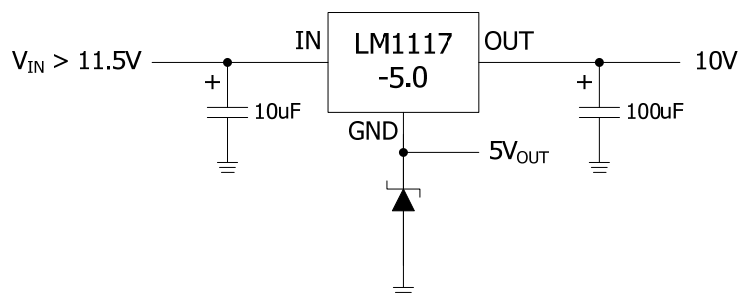


Fig.5 Voltage Regulator with Reference

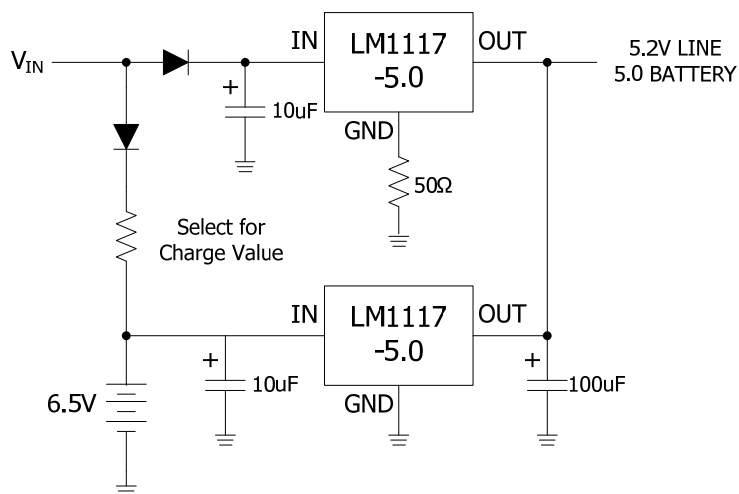


Fig.6 Battery Backed-up Regulated Supply

TYPICAL OPERATING CHARACTERISTICS

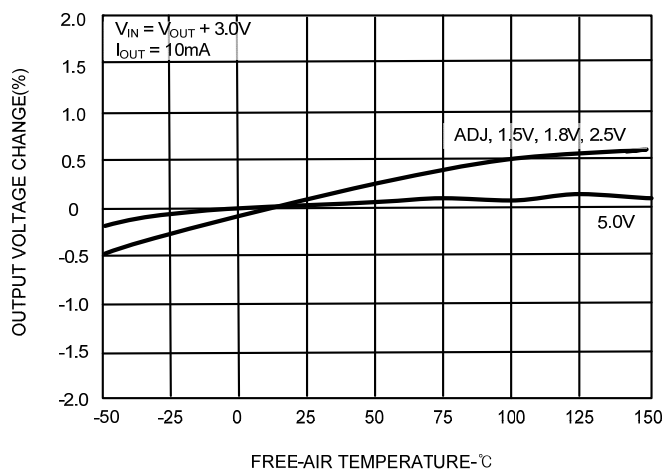


Fig.7 OUTPUT VOLTAGE CHANGE VS TEMPERATURE

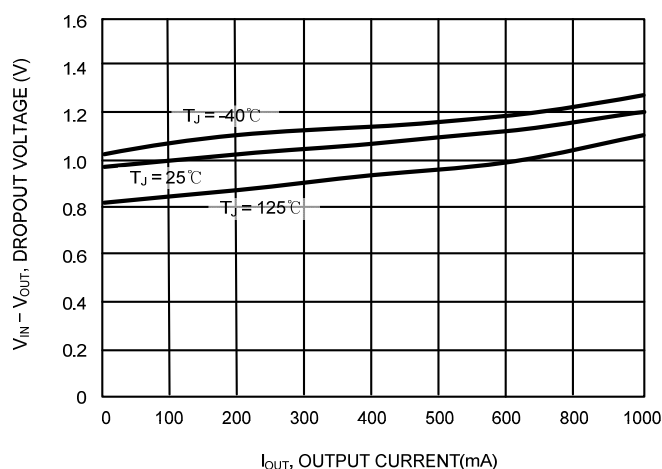


Fig.8 DROPOUT VOLTAGE VS OUTPUT CURRENT

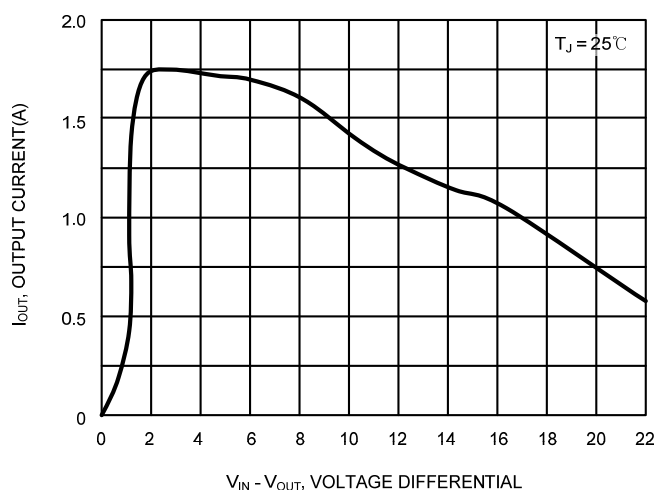


Fig.9 OUTPUT SHORT CIRCUIT CURRENT VS DIFFERENTIAL VOLTAGE

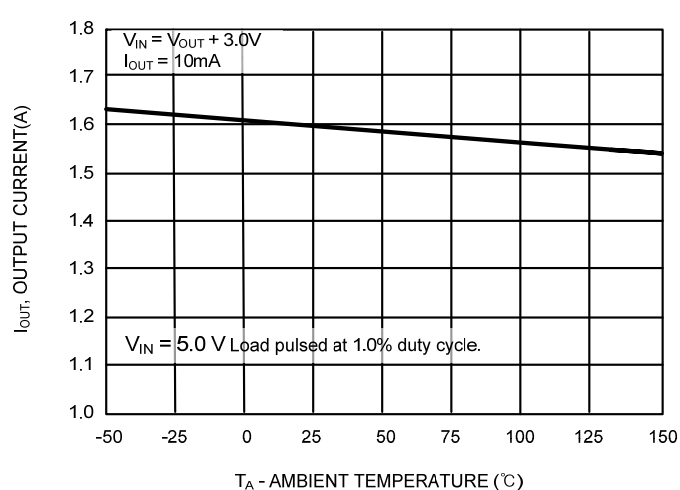


Fig.10 OUTPUT SHORT CIRCUIT CURRENT VS TEMPERATURE

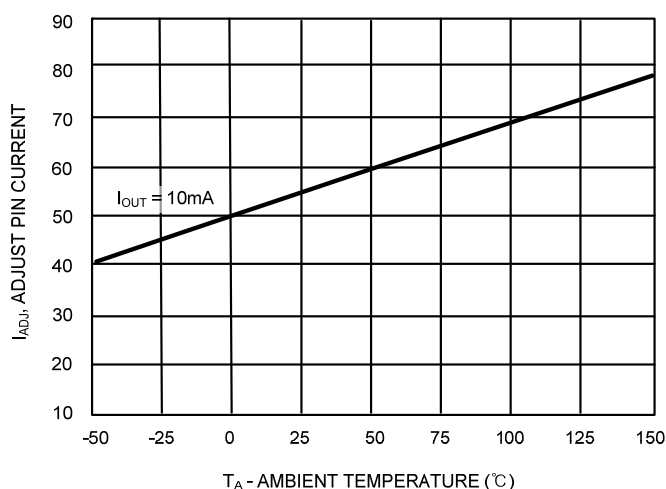


Fig.11 ADJ PIN CURRENT VS TEMPERATURE

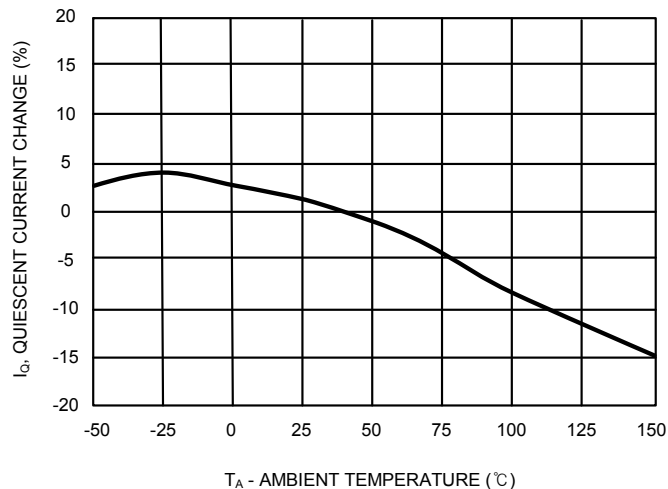


Fig.12 QUIESCENT CURRENT CHANGE VS TEMPERATURE

APPLICATION INFORMATION

Maximum Output Current Capability

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:

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

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 TO252 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:

Absolute Maximum Ratings of Thermal Resistance

| 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 / 0.066 inch² copper area. ($T_A=25^\circ\text{C}$)