# IRU1011-33(PbF)

## 1.3A LOW DROPOUT POSITIVE FIXED REGULATOR

## FEATURES

- **Stable with Ceramic Capacitor**
- Guaranteed < 1.3V Dropout at Full Load Current
- Fast Transient Response
- Output Current Limiting
- Built-In Thermal Shutdown

## APPLICATIONS

- High Efficiency Linear Regulator
- Hard Disk Drivers, CD-ROMs, DVDs
- ADSL and Cable Modems

## DESCRIPTION

The IRU1011-33 is a fixed linear regulator and it is capable of supplying 1.3A of continuous current over line and temperature range. The IRU1011-33 is stable with low value ceramic capacitors, allowing designers flexibility in external component selection. The output is protected by both current limit and thermal shutdown.

## TYPICAL APPLICATION

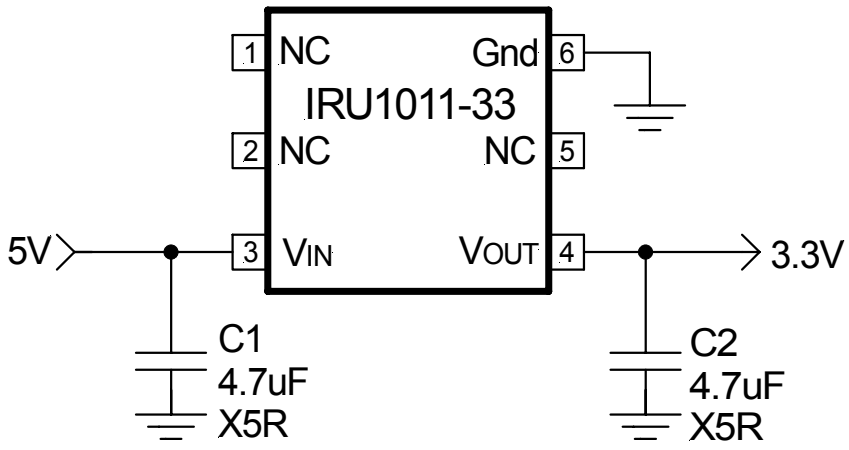



Figure 1 - Typical application of IRU1011-33.

## PACKAGE, SHIPMENT and ORDER INFORMATION

| PKG DESIGN | PACKAGE DESCRIPTION | PIN COUNT | PARTS PER TUBE | PARTS PER REEL | T & R Oriantation |
|---|---|---|---|---|---|
| H | IRU1011-33CH | 6 | ----- | ------ | n/a |
| H | IRU1011-33CH(PbF) | 6 | 3000 | 3000 | Fig A |

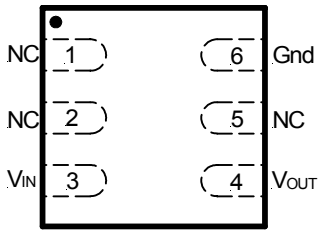
## ABSOLUTE MAXIMUM RATINGS

Input Voltage ($V_{IN}$) ..... 10V
Operating Junction Temperature Range ..... 0°C To 150°C
Operating Ambient Temperature Range ..... -40°C To 125°C
Storage Temperature Range ..... -65°C To 150°C

***CAUTION:*** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device.

## PACKAGE INFORMATION

6-PIN MLPM 3x3 (H)




$\theta_{JA}$=32°C/W
For 1" Square Pad

Exposed Pad on underside is connected to Gnd

## ELECTRICAL SPECIFICATIONS

Unless otherwise specified, these specifications apply over $V_{IN}$=4.5V to 7V, $I_{OUT}$=2mA to 1.3A, $C_{IN}$=$C_{OUT}$=4.7µF and 0°C<$T_J$<150°C.

| PARAMETER | SYM | TEST CONDITION | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage 3.3V | $V_{O(3.3)}$ | 4.75V<$V_{IN}$<5.25V, 5mA≤$I_O$≤1.3A:<br>$T_J$=25°C<br>0°C≤$T_J$≤150°C | <br>3.234<br>3.2175 | <br>3.3<br>3.3 | <br>3.366<br>3.3825 | V |
| Line Regulation | $Reg_{LINE}$ | 4.75V<$V_{IN}$<5.25V, $I_O$=10mA | | 5 | 15 | mV |
| Load Regulation | $Reg_{LOAD}$ | $V_{IN}$=4.75V, 10mA≤$I_O$≤1.3A | | 8 | 12 | mV |
| Dropout Voltage ΔVOUT= -1% | $V_D$ | $I_O$=1.3A | | 1.1 | 1.3 | V |
| Current Limit | $I_S$ | $V_{IN}$=5.5V | 1.3 | 1.9 | | A |
| Minimum Output Current | $I_{O(MIN)}$ | Note 3, 5 | | 0 | 2 | mA |
| Temperature Stability | $T_S$ | Note 4, 5 | | 1.5 | | % |
| RMS Output Noise | $V_N$ | $T_J$=25°C, 10Hz<BW<10KHz, Note 5 | | 0.003 | | %Vo |
| Ripple Rejection ($V_{IN}$ to Output) | $R_A$ | $V_{IN}$=5V, Note 5, f=120Hz | 60 | 65 | | dB |
| Thermal Shutdown | $T_{J(SD)}$ | 4.75V<$V_{IN}$<5.25V, 0mA≤$I_O$≤1.3A, Note 5 | 150 | 155 | | ℃ |
| Quiescent Current | $I_{GND}$ | $V_{IN}$≤7V, 2mA≤$I_O$≤1.3A<br>$V_{IN}$=5V, 0mA≤$I_O$≤50mA, $T_J$=25°C | | 4.3<br><4.2 | 5.4 | mA |
| Transient Response<br>Change of $V_{OUT}$ with Step Load Change | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | $V_{IN}$=5V, 10mA<$I_O$<1.3A, $t_r$≥1µs<br>$V_{IN}$=5V, 1.3A to 10mA, $t_f$≥1µs<br>$C_{IN}$=$C_O$=10µF, X7R & Note 5 | | 5<br>5 | ±10<br>±10 | % |
| Transient Response<br>Change of $V_{OUT}$ with Application of $V_{IN}$ | $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | 0 to 5V step input, $t_r$≥1µs,<br>1mA≤$I_O$≤1.3A, $C_{IN}$=$C_O$=10µF, X7R, Note 5 | | 1 | ±10 | % |
| Transient Response<br>Short Circuit Removal Response | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ @$I_O$=Short | $V_{IN}$=5V, Short≤$I_O$≤10mA,<br>$C_{IN}$=$C_O$=10µF, X7R, Note 5 | | 1 | ±20 | % |

**Note 1:** Low duty cycle pulse testing with Kelvin connections is required in order to maintain accurate data.

**Note 2:** Dropout voltage is defined as the minimum differential voltage between $V_{IN}$ and $V_{OUT}$ required to maintain regulation at $V_{OUT}$. It is measured when the output voltage drops 1% below its nominal value.

**Note 3:** Minimum load current is defined as the minimum current required at the output in order for the output voltage to maintain regulation.

**Note 4:** Temperature stability is the change in output from nominal over the operating temperature range.

**Note 5:** Guaranteed by design, but not tested in production.

## PIN DESCRIPTIONS

| PIN # | PIN SYMBOL | PIN DESCRIPTION |
|---|---|---|
| 1,2,5 | NC | No connection. |
| 3 | $V_{IN}$ | The power input pin of the regulator. A minimum of input capacitance must be connected from this pin to ground to insure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be higher than the $V_{OUT}$ pin by the amount of dropout voltage (see electrical specification) in order for the device to regulate properly. |
| 4 | $V_{OUT}$ | The output of the regulator. A minimum of output capacitance must be connected from this pin to ground to insure stability. |
| 6 | Gnd | This pin is connected with ground. It is also the tab of the package. |

## BLOCK DIAGRAM

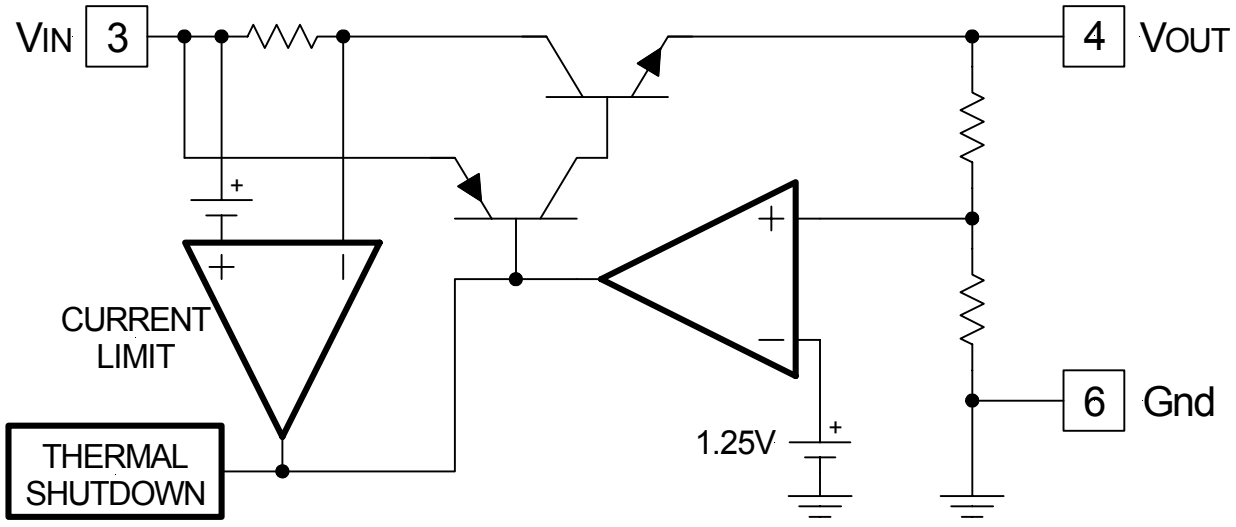



Figure 2 - Simplified block diagram of the IRU1011-33.

# APPLICATION INFORMATION

**Introduction**
The IRU1011-33 regulator is a 3-terminal device offered in a fixed output of 3.3V and it is designed specifically to provide an extremely low dropout voltage.

The IRU1011-33 is designed to meet the fast current transient needs as well as providing an accurate initial voltage, reducing the overall system cost with the need for fewer number of output capacitors.

**Thermal Protection**
When the junction temperature exceeds 150°C, the internal thermal protection shuts the IRU1011-33 down.

**Current Limit Protection**
The IRU1011-33 provides Over Current Protection when the output current exceeds typically 2A. The output decreases to limit the power dissipation.

**Stability**
The IRU1011-33 requires the use of an output capacitor as part of the frequency compensation in order to make the regulator stable. A minimum input capacitance of 4.7μF and a minimum output capacitance 4.7μF Ceramic capacitor is needed for regulator stage as well as the specified minimum loads to guarantee stability.

**Transient Response and PSRR**
The input and output capacitors are critical in order to ensure good transient response and PSRR. The most important aspects of this are capacitor selection, placement and trace routing. Place each capacitor as close as physically possible to its corresponding regulator pin. Use wide traces for a low inductance path. Couple directly to the ground and power planes as possible. The use of low ESR capacitors is crucial to achieving good results. Larger capacitance and lower ESR will improve both PSRR and transient response.

**Thermal Design**
The IRU1011-33 incorporates an internal thermal shutdown that protects the device when the junction temperature exceeds the allowable maximum junction temperature. Although this device can operate with junction temperatures in the range of 150°C, it is recommended that the selected heat sink be chosen such that during maximum continuous load operation the junction temperature is kept below this number. The example below shows the steps in selecting the proper surface mount package.

Assuming, the following conditions:

$V_{OUT}$ = 3.3V
$V_{IN}$ = 5V
$I_{OUT}$ = 1A (DC Avg)

Calculate the maximum power dissipation using the following equation:

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

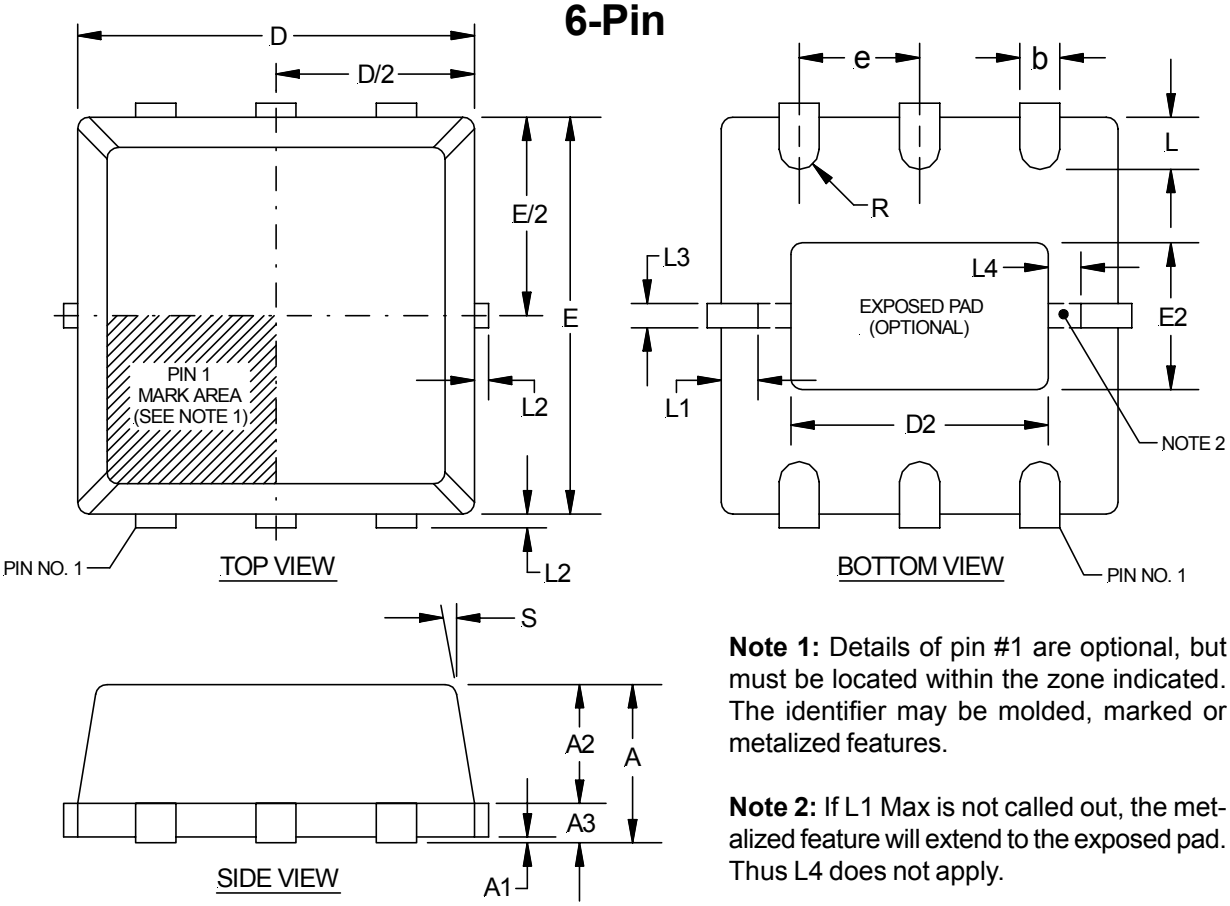
$$P_D = 1 \times (5 - 3.3) = 1.7W$$

For MLPM package, we have:

$R_{THJA}$ = 32°C/W
$T_A$ = 45°C
$\Delta T = P_D \times R_{THJA} = 1.7 \times 32 = 54.4$
$TJ = T_A + \Delta T = 99.4°C$

**Layout Consideration**
The IRU1011-33, like many other high-speed regulators, requires that the output capacitors be close to the device for stability. For power consideration, a ground plane pad of approximately one-inch square on the component side must be dedicated to the device where all Gnd pins are connected to dissipate the power. If a multilayer board is used, it is recommended that the inner layers of the board are also dedicated to the size of the pad for better thermal characteristics.

# (H) MLPM Package
## 6-Pin

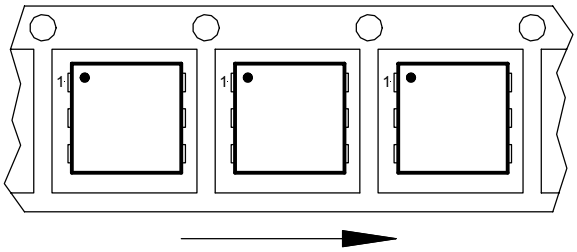



**Note 1:** Details of pin #1 are optional, but must be located within the zone indicated. The identifier may be molded, marked or metalized features.

**Note 2:** If L1 Max is not called out, the metalized feature will extend to the exposed pad. Thus L4 does not apply.

| SYMBOL DESIG | 6-PIN 3x3 | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 0.80 | 0.90 | 1.00 |
| A1 | 0.00 | 0.025 | 0.05 |
| A2 | 0.65 | 0.70 | 0.75 |
| A3 | 0.15 | 0.20 | 0.25 |
| b | 0.33 | 0.35 | 0.43 |
| D | 3.00 BSC | | |
| D2 | 1.92 | 2.02 | 2.12 |
| E | 3.00 BSC | | |
| E2 | 1.11 | 1.21 | 1.31 |
| e | 0.95 | | |
| L | 0.20 | 0.29 | 0.45 |
| L1 | 0.16 | 0.24 | 0.40 |
| L2 | --- | --- | 0.125 |
| L3 | 0.17 | --- | 0.30 |
| L4 | 0.17 | --- | --- |
| R | 0.127 REF | | |
| S | 0° | 10° | 12° |

NOTE: ALL MEASUREMENTS ARE IN MILLIMETERS.




Feed Direction
Figure A - Live Bug

International
IOR Rectifier

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