1A Low Dropout Regulator

PRODUCTION DATA SHEET

DESCRIPTION

The LX8818 is a single channel positive-voltage linear regulator. The regulator output is configured as fixed (3.3v or 2.5v) or adjustable, featuring low-dropout and high accuracy.

The LX8818 regulator is stable with ceramic or tantalum low-value capacitors, typically 2.2µF on the outputs, allowing designers flexibility in external component selection.

The LX8818 provides designers with a flexible power management solution. The regulator design is optimized for system efficiency by consuming minimal ground current and directing quiescent current to the load.

The LX8818 features on-chip trimming of the internal voltage enabling precise output voltages, typically ±1% of it's specified value, while the BiPolar output transistor has a low dropout voltage even at full output current (V_{DO} < 1.2V typ. @ 1A). Output voltage overshoot is minimized when V_{IN} is applied, typically V_{OUT} overshoot < 2% for V_{IN} ≤ 1V/uS ramp.

Thermal and Short Circuit Current Protection are integrated on-chip.

Microsemi's D-PAK or Micro power package enables maximum power dissipation and ease of assembly using surface mount technology.

IMPORTANT: For the most current data, consult *MICROSEMI*'s website: **http://www.microsemi.com**

KEY FEATURES

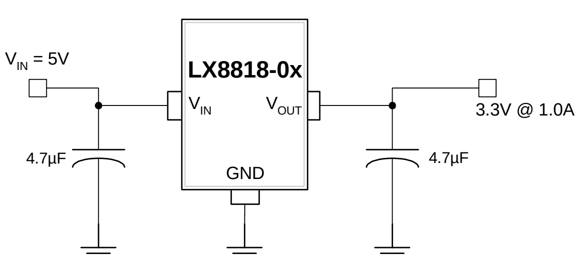
- Accurate Output Voltage
- Typical Dropout of 1.2V at 1A and 1.1V at 500mA
- Independent Thermal and Current Limit Protection
- Low Profile 3 Lead SMT Power Package
- Low Tolerance Load Regulation (0.4%)
- Wide DC Supply Voltage of 4.3V to 10V
- Loop Stability Independent of Output Capacitor Type

APPLICATIONS/BENEFITS

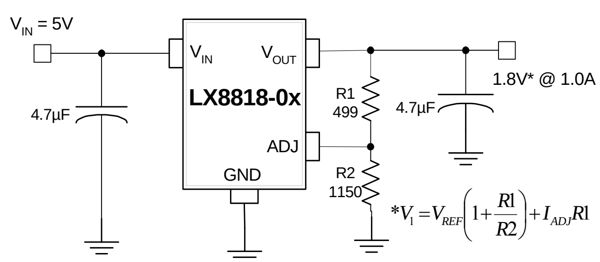
- 5V to 3.3V/2.5V Regulators
- Hard Disk Drives, CD-ROMs
- ADSL and Cable Modems
- Battery Charging Circuits
- Instrumentation
- PC Peripherals

APPLICATION CIRCUITS

Fixed Output



Adjustable Output



PACKAGE ORDER INFO

T_J (°C)	OUTPUT V	LM Plastic MLP 6-PIN	MLP Part Marking	DT Plastic TO-252 3-PIN
0 to 125	3.3V	LX8818-02CLM	8-02	LX8818-01CDT

Consult Factory for 2.5V and Adjustable Versions

Note: Available in Tape & Reel.
Append the letter "T" to the part number. (i.e. LX8818-01CDTT)

1A Low Dropout Regulator

PRODUCTION DATA SHEET

ABSOLUTE MAXIMUM RATINGS

Input Voltage (V_{IN}) 13.5V
Load Current (Internally Limited) 1A
Power Dissipation .... Internally Limited
Short-Circuit Protection .... Indefinite
Operating Junction Temperature .... 150°C
Lead Temperature (Soldering 180 seconds) .... 235°C

Note: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of specified terminal.

THERMAL DATA

DT **Plastic D-Pak 3-Pin**

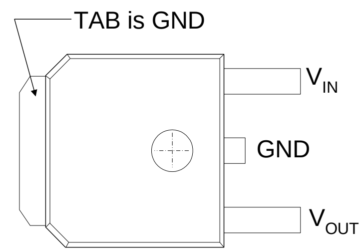
THERMAL RESISTANCE-JUNCTION TO TAB, θ_{JT}	6°C/W
THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA} (TYPICAL, DEPENDING ON MOUNTING/PCB LAYOUT)	25-35°C/W

LM **Plastic MLP 6-Pin**

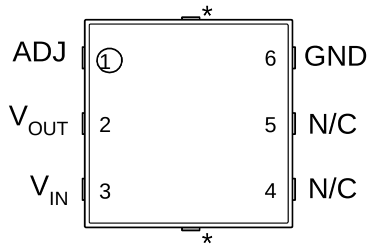
THERMAL RESISTANCE-JUNCTION TO TAB, θ_{JT}	8°C/W
THERMAL RESISTANCE-JUNCTION TO AMBIENT, θ_{JA} (TYPICAL, DEPENDING ON MOUNTING/PCB LAYOUT)	29-35°C/W

Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
The θ_{JA} numbers are guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow. θ_{JA} can vary significantly depending on mounting technique. (See Application Notes Section: Thermal considerations)

PACKAGE PIN OUT



DT PACKAGE
(Top View)



LM PACKAGE
(Top View)
* Must be connected to GND or left floating
(see pg 8 for details)

N/C = Not internally connected

FUNCTIONAL PIN DESCRIPTION

PIN NAME	DESCRIPTION
V_{IN}	Positive unregulated supply input for the regulator. Bypass to GND with at least 2.2µF of low ESR and ESL capacitance.
ADJ	Adjustable version only. The output voltage can be set by two external resistors with the following relationship: $V_{OUT} = V_{REF} * (1+ (R_1/R_2)) + (I_{ADJ} * R_1)$ where R_1 is the resistor connected between V_{OUT} and ADJ, and R_2 is the resistor connected between ADJ and GND (see figure 2 on page 7).
GND	Common terminal for ground reference. The input and output bypass capacitors should be connected to this pin. In addition the tab on the “DT” package is also used for heat sinking the device.
V_{OUT}	Regulator output. It is recommended to bypass to GND with at least 2.2uF. Size your output capacitor to meet the transient loading requirement. If you have a very dynamic load, a lower ESR capacitor will improve the response to these load steps.

RECOMMENDED MAX OPERATING CONDITIONS

Parameter	Symbol	LX8818-0x Min	LX8818-0x Typ	LX8818-0x Max	Units
Input Voltage	V_{IN}	4.5		10	V
Output Voltage (adjustable)	V_{OUT}			5.5	V
Load Current (with adequate heat sinking)	I_L			1000	mA
Operating Junction Temperature	T_J			125	°C

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, the following specifications apply over the operating ambient temperature 0°C ≤ T_A ≤ 125°C except where otherwise noted and the following test conditions: V_{IN} = 5V, I_{OUT} = 10mA, C_1= 10µF (Tantalum), C_2= 4.7µF (Tant.), & T_J = T_A using low duty cycling methods.

Parameter	Symbol	Test Conditions	LX8818-0x Min	LX8818-0x Typ	LX8818-0x Max	Units
Fixed Output (3.3V)						
Output Voltage	V_{OUT}	5mA < I_{OUT} < 1A, 4.75V < V_{IN} < 7V	3.250	3.300	3.353	V
Line Regulation	$\Delta V_{OUT}(V_{IN})$	4.75V < V_{IN} < 10V, I_{OUT} = 5mA		.0042	.0065	V/V(Vin)
Load Regulation	$\Delta V_{OUT}(I_{OUT})$	5mA < I_{OUT} < 1A, V_{IN} = 4.75V		4	7	mV
Dropout Voltage (PWR)	ΔV	I_{LOAD} = 1A, ΔV_{OUT} = -1%		1.25	1.33	V
		I_{LOAD} = 0.5A, ΔV_{OUT} = -1%		1.12	1.18	V
Current Limit	$I_{OUT\ (MAX)}$		1.0	1.32		A
Minimum Load Current	I_L	Note 1		0	0	mA
Fixed Output (2.5V)						
Output Voltage	V_{OUT}	5mA < I_{OUT} < 1A, 4.75V < V_{IN} < 7V	2.469	2.500	2.539	V
Line Regulation	$\Delta V_{OUT}(V_{IN})$	4.75V < V_{IN} < 10V, I_{OUT} = 5mA		.0042	.0065	V/V(Vin)
Load Regulation	$\Delta V_{OUT}(I_{OUT})$	5mA < I_{OUT} < 1A, V_{IN} = 4.75V		4	6	mV
Dropout Voltage (PWR)	ΔV	I_{LOAD} = 1A, ΔV_{OUT} = -1%		1.25	1.30	V
		I_{LOAD} = 0.5A, ΔV_{OUT} = -1%		1.12	1.15	
Current Limit	$I_{OUT\ (MAX)}$		1.0	1.32		A
Minimum Load Current	I_L	Note 1		0	0	mA
Adjustable Output						
Reference Voltage	V_{REF}	5mA < I_{OUT} < 1A, 4.75V < V_{IN} < 7V	1.234	1.250	1.266	V
Line Regulation	$\Delta V_{OUT}(V_{IN})$	4.5V < V_{IN} < 10V, I_{OUT} = 5mA		.06	.075	%/V_{OUT}
Load Regulation	$\Delta V_{OUT}(I_{OUT})$	5mA < I_{OUT} < 1A, V_{IN} = 4.75V		.14	0.2	%/V_{OUT}
Dropout Voltage (PWR)	ΔV	I_{LOAD} = 1A, ΔV_{OUT} = -1%		1.25	1.30	V
		I_{LOAD} = 0.5A, ΔV_{OUT} = -1%		1.12	1.15	
		I_{LOAD} = 5mA, ΔV_{OUT} = -1%		1.0	1.02	
Current Limit	$I_{OUT\ (MAX)}$		1.0	1.32		A
Minimum Load Current	I_L	Note 1		0	5	mA
Adjust Pin Bias Current	I_{ADJ}			0.05	0.5	µA

Note 1: Minimum load current is defined as the amount of output current required to maintain regulation.

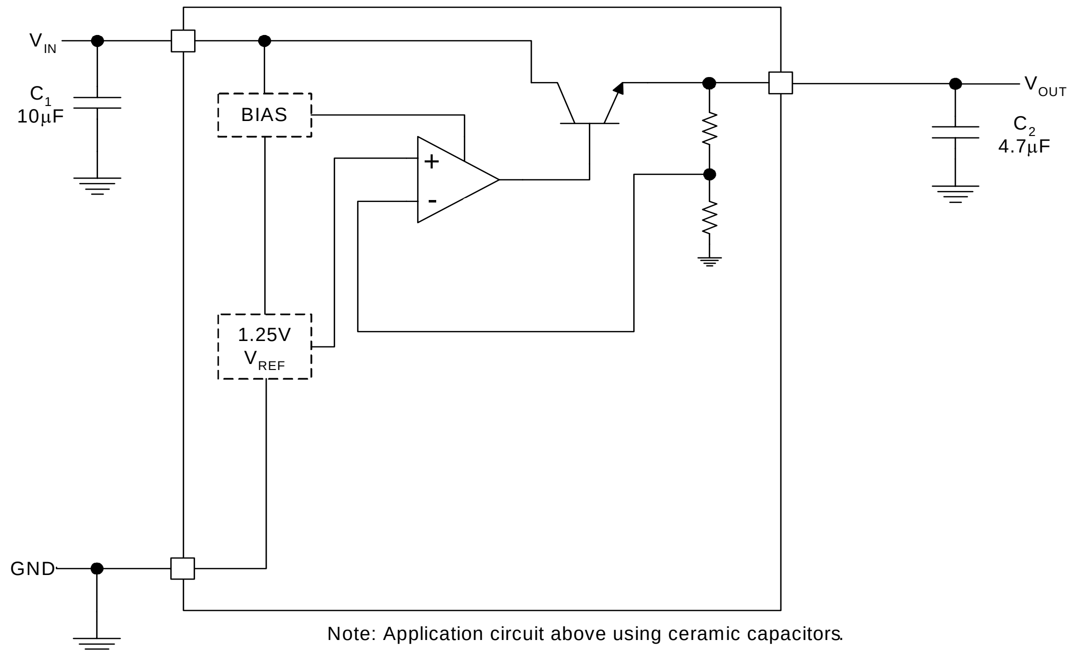
ELECTRICAL CHARACTERISTICS

Unless otherwise specified, the following specifications apply over the operating ambient temperature 0°C ≤ T_A ≤ 125°C except where otherwise noted and the following test conditions: V_{IN} = 5V, I_{OUT} = 10mA, C_1= 10µF (Tantalum), C_2= 4.7µF (Tant.), & T_J = T_A using low duty cycling methods.

Parameter	Symbol	Test Conditions	LX8818-0x			Units
			Min	Typ	Max	
Entire Regulator						
Quiescent Current	I_Q	V_{IN} < 7V		2.56	3.5	mA
Ripple Rejection	PSRR	f=120Hz, V_{IN} = 5V	60	75		DB
RMS Output Noise (% of V_{OUT})	$V_{OUT\ (RMS)}$	10Hz < f < 10kHz		0.003		%/V
Thermal Shutdown	T_{JSD}	5mA < I_{OUT} < 1A, V_{IN} = 4.75V	135	140		°C

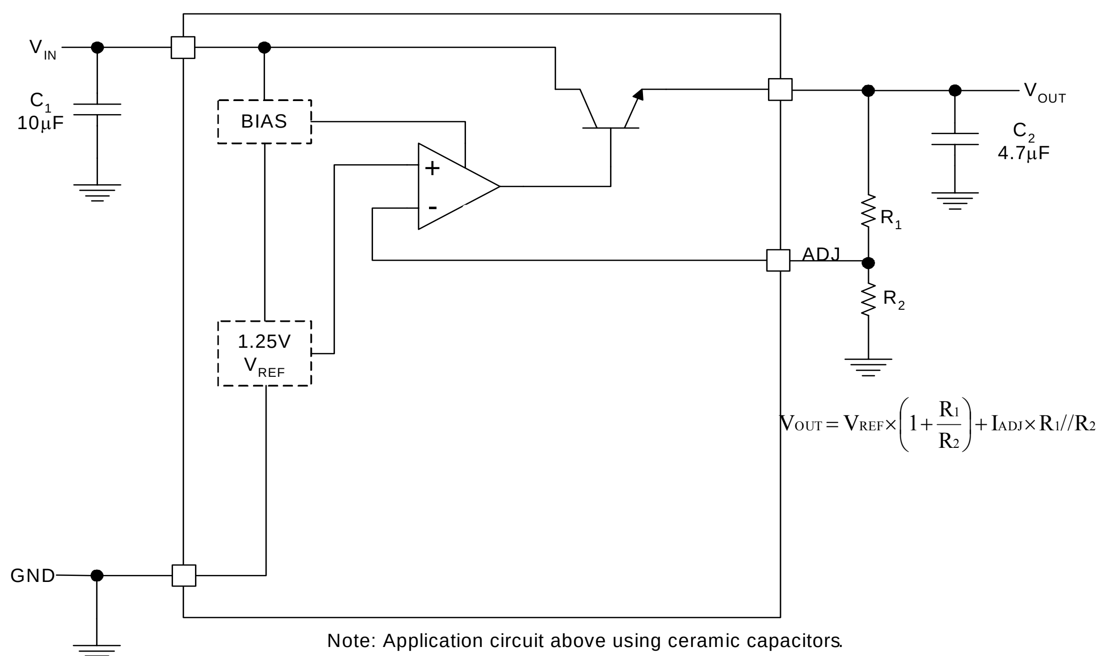
Note 1: Minimum load current is defined as the amount of output current required to maintain regulation.

BLOCK DIAGRAM



Note: Application circuit above using ceramic capacitors.

Figure 1 – Fixed Output

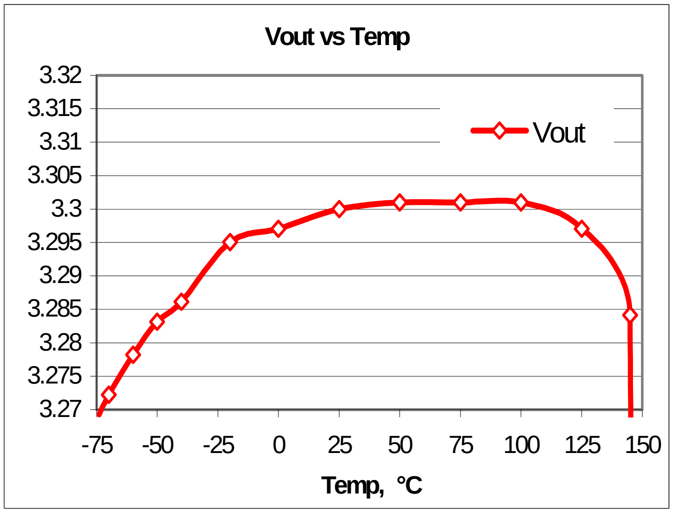


Note: Application circuit above using ceramic capacitors.

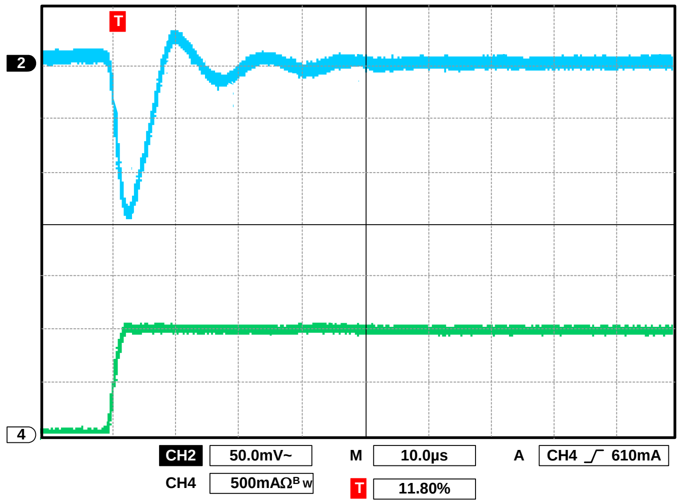
Figure 2 – Adjustable Output
(R1/R2 can be selected to satisfy the minimum load requirements)

CHARACTERISTIC CURVES

OUTPUT VOLTAGE TEMPERATURE STABILITY

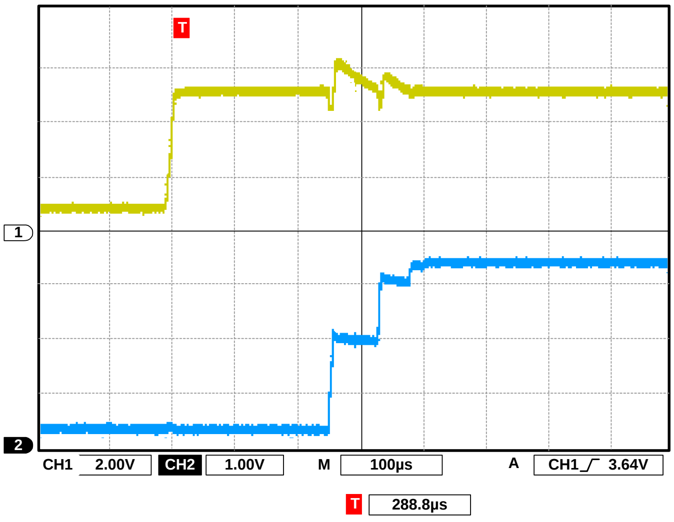


STEP LOAD STABILITY



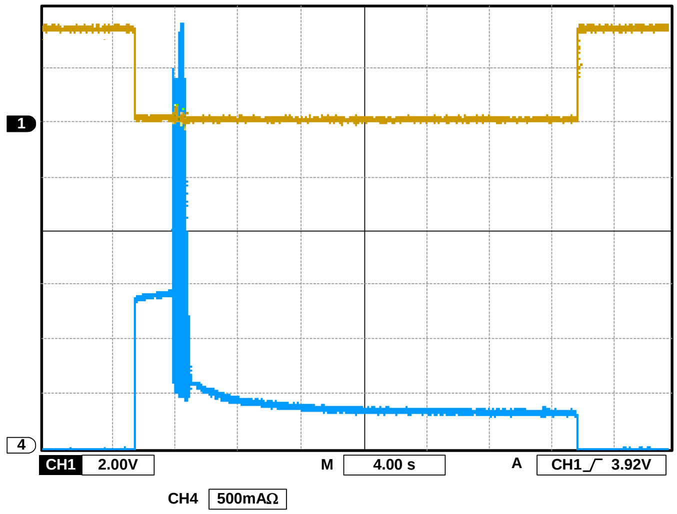
CH2: Vout, CH4: Istep, Cin = Cout = 10µF Ceramic,
Load Current, dc = 5mAVdroop=150mV

SUPPLY VOLTAGE, FAST TURN ON (Trise = 10uS)



CH1: Vin, CH2: Vout, Cin = Cout = 10µF Ceramic, Load Current, dc = 5mA

SHORT CIRCUIT AND RECOVERY



CH1: Vout, CH4: Iout, Cin = Cout = 10µF Ceramic

APPLICATION INFORMATION

Description

The LX8818 is part of a family of LDO (Low Drop-Out) linear regulators in the TO-252 or MO229 packages which offer maximum power dissipation in a low profile surface mount technology. The family includes either fixed or adjustable output versions. The output can supply up to one amp with a regulator design optimized for system efficiency by consuming minimal ground current and directing quiescent current to the load.

Input Capacitor

To improve load transient response and noise rejection an input bypass capacitor of at least 10uF is required. Generally we recommend a 10uF ceramic or tantalum or 22uF electrolytic capacitor.

Output Capacitor

The regulator requires an output capacitor connected between V_{OUT} to GND to stabilize the internal control loop. Many types of capacitors are available, with different capacitance values tolerances, temperature coefficients and equivalent series resistance. We recommend a minimum of 4.7uF. To ensure good transient response from the power supply system under rapidly changing current load conditions, designers generally use additional output capacitors connected in parallel. Such an arrangement serves to minimize the effects of the parasitic resistance (ESR) and inductance (ESL) that are present in all capacitors. The regulator has been tested stable with capacitor ESR's in the range of 0.05 to 2 ohms. We have found it best to use the same type of capacitor for both input and output bypass.

Adjustable Output Voltage

The LX8818 develops a 1.25V reference voltage between the adjust terminal and GND (See Figure 2). By placing a resistor, R2, between these two terminals, a constant current is caused to flow through R1 and down through R2 to set the overall output voltage.. Because I_{ADJ} is very small and constant when compared with the current through R2, it represents a small error and can usually be ignored.

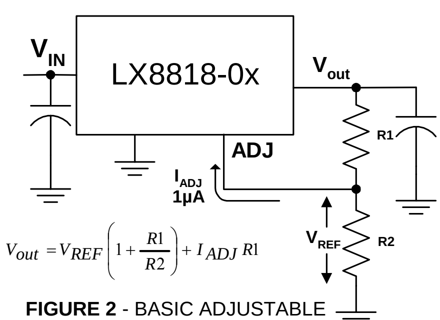


FIGURE 2 - BASIC ADJUSTABLE REGULATOR

Minimum Load Requirement

The LX8818 has a minimum load requirement for proper output regulation. This minimum current is specified at 0mA for the fixed output and 5ma for the adjustable output.

Temperature Protection

The thermal protection shuts the LX8818 down when the junction temperature exceeds 140^{0}C. Exposure to absolute maximum rated conditions for extended periods may affect device reliability (see Thermal Considerations below).

Current Limit Protection

The LX8818 includes over current protection. When the output load current exceeds typically 1.4A, the circuit forces the regulator output to decrease.

Thermal Considerations

Thermal shutdown protects the integrated circuit from thermal overload caused from a rise in junction temperature during power dissipation. This means of protection is intended for fault protection only and not as a means of current or power limiting during normal application usage. Proper thermal evaluation should be done to ensure that the junction temperature dose not exceed it's maximum rating. Operating at the maximum T_J of 150°C can impact reliability . Due to variation in individual device electrical characteristics and thermal resistance , the built in thermal overload protection may be activated at power levels slightly above or below the rated dissipation. Also peak output power should be considered for each individual output.

Power dissipation for regulator can be calculated using the following equation:

$$\mathbf{P_D = (V_{IN(MAX)} - V_{out}) * I_{out}}$$

(Note: power dissipation resulting from quiescent (ground) current is negligible)

For the D-PAK package, thermal resistance, $\theta_{TAB\text{-}AMB}$ is 25-45^{0}C/W depending on mounting technique when mounted on a FR4 copper clad PCB. Junction temperature of the integrated circuit can be calculated using:

$$\mathbf{T_{JUNCTION} = T_{JUNCTION\text{-}TAB\ RISE} + T_{TAB\text{-}AMB\ RISE} + T_{AMB}}$$

$$\mathbf{T_{TAB} = P_{D\ MAX} * \theta_{JT}\ ;\ T_{TAB\text{-}AMB} = P_{D\ REG} * \theta_{PCB}}$$

An example: Given conditions: T_A = 50°C, V_{IN}= 5.0V, V_{out}= 3.3V, I_{out}= 200mA.

Calculated values:

$\mathbf{T_{J\text{-}TAB\ REG}}$
= (5V-3.3V) * (200mA) * 6°C/W = (440mW) * 6°C/W = 2.6°C

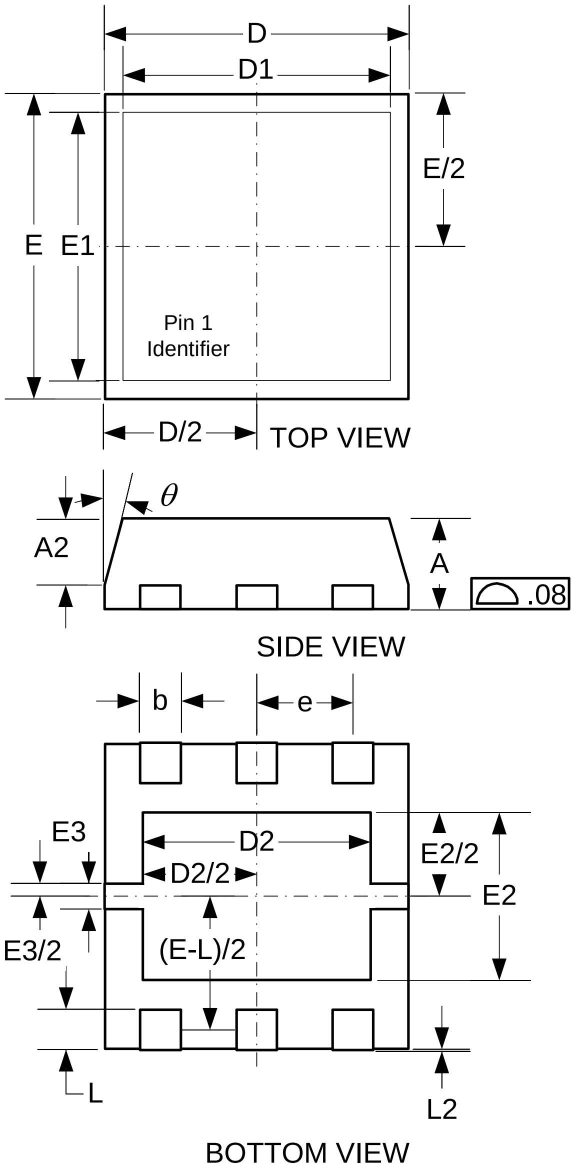
$\mathbf{T_{TAB\text{-}AMB\ RISE}}$ = (440mW) * 32°C/W = 14.1°C

$\mathbf{T_{JUNCTION}}$ **= 2.6°C + 14.1°C + 50°C = 66.7°C**

It is important to note that although each output of the regulator will produce up to 1A in current, the individual or total power dissipation may limit the useful total current draw. The junction temperature should be calculated for each individual output as well as the combined outputs to insure the maximum junction temperature in not exceeded.

MECHANICAL DRAWINGS

LM 6-Pin Plastic Exposed Pad JEDEC MO-229 Reference



Dim	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.80	1.05	0.031	0.041
A2	0.65	0.75	0.025	0.295
b	0.33	0.45	0.012	0.017
D	2.90	3.25	0.114	0.127
D1	2.70	---	0.106	---
D2	1.78	2.34	0.070	0.092
e	0.85	1.05	0.033	0.041
E	2.90	3.25	0.114	0.127
E1	2.70	---	0.106	---
E2	1.01	1.57	0.039	0.061
E3	0.17	0.30	0.006	0.012
L	0.20	0.60	0.007	0.024
L2	---	0.12	---	0.005
θ	0°	12°	0°	12°

Note:

1. Dimensions do not include mold flash or protrusions; these shall not exceed 0.155mm(.006”) on any side. Lead dimension shall not include solder coverage.

Microsemi
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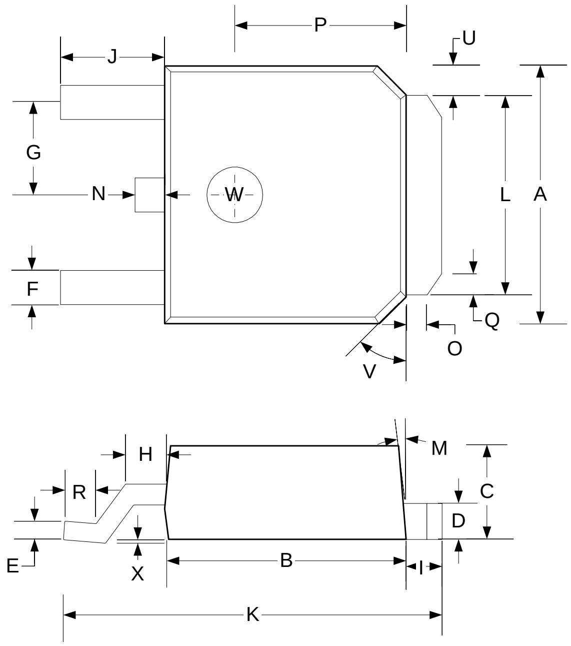
MECHANICAL DRAWINGS

DT 3-Pin Plastic TO-252



Dim	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.47	6.73	0.255	0.265
B	5.97	6.23	0.235	0.245
C	2.16	2.42	0.085	0.095
D	0.68	0.94	0.027	0.037
E	0.38	0.64	0.015	0.025
F	0.63	0.89	0.025	0.035
G	2.16	2.42	0.085	0.095
H	0.84	1.10	0.033	0.043
I	0.89	1.15	0.035	0.045
J	2.44	2.70	0.096	0.106
K	9.55	9.81	0.376	0.386
L	5.20	5.46	0.205	0.215
M	7.0°		7.0°	
N	0.51	0.77	0.020	0.030
O	0.51	0.77	0.020	0.030
P	4.19	4.45	0.165	0.175
Q	0.76	1.02	0.030	0.040
R	0.48	0.74	0.019	0.029
S	0.89	1.15	0.035	0.045
T	R0.20	R0.30	R0.008	R0.012
U	0.51	0.77	0.020	0.030
V	45°		45°	
W	1.44	1.70	0.057	0.067
X	0	0.10	0	0.004

NOTES