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Low Dropout 600mA Linear Regulator in 3mm x 3mm Package

POWER MANAGEMENT

Features

- V_{IN} range: 2.7V to 5.5V
- Fixed 1.5V or adjustable output voltage
- 600mA output current
- Operate with ceramic capacitors
- 2µA quiescent current in shutdown
- No minimum load current requirement
- Over-current and over-temperature protection
- Reverse voltage protection
- 3mm x 3mm x 1mm MLPD-8 package (WEEE and RoHS compliant)

Applications

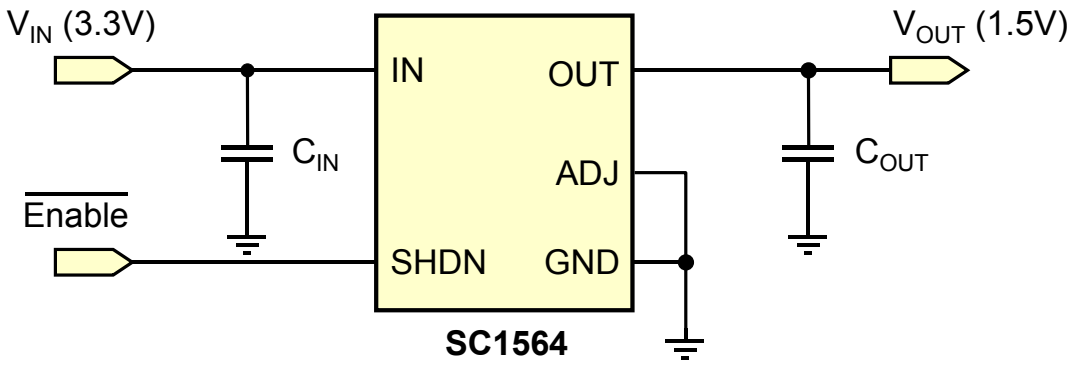
- Personal digital assistants
- Battery powered systems
- Motherboards
- Peripheral cards
- PCMCIA cards

Description

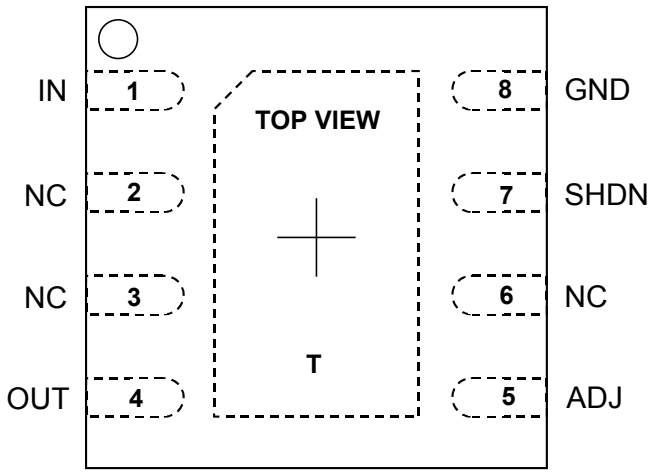
The SC1564 is a high performance positive voltage regulator designed for use in applications requiring low dropout voltages up to 600mA. Since it has superior dropout characteristics compared to regular LDOs, it can be used to supply 2.5V on motherboards, or 2.8V on peripheral cards from the 3.3V supply with no heatsink. Additionally, the SC1564 has a shutdown pin to further reduce power dissipation while in shut down mode. The SC1564 provides excellent regulation in line, load and temperature variations.

The output voltage of every device can be selected to be 1.5V or adjusted between 1.2V and 4.55V. The SC1564 comes in a space-saving 3mm x 3mm x 1mm MLPD-8 package.

Typical Application Circuit



Pin Configuration



3mm x 3mm x 1mm MLPD-8

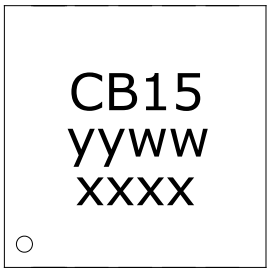
θ_{JA} = 41°C/W

Ordering Information

Part Number	Package
SC1564ML-1.5TRT[1][2][3]	3mm x 3mm x 1mm MLPD-8
SC1564-1.5EVB	Evaluation Board

Notes:
(1) Output voltage can be adjusted using external resistors, see Pin Descriptions.
(2) Only available in tape and reel packaging. A reel contains 3000 devices.
(3) Available in lead-free package only. Device is WEEE and RoHS compliant.

Marking Information



TOP MARK	
CHAR	ROWS
4/4/4	3

Marking for the 3 x 3mm MLPD 8 Lead Package:
nnnn = Part Number (Example: CB15) - Reference Part No. Code for small MLP
yyww = Datecode (Example: 0752)
xxxx = Semtech Lot No. (Example: E901)

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Absolute Maximum Ratings

IN Voltage ..... -0.3V to +7V
OUT Voltage ..... -0.3V to V_{IN}
ADJ Voltage ..... -0.3V to V_{IN}
SHDN Voltage ..... -0.3V to V_{IN}

Recommended Operating Conditions

IN Voltage Range ..... 2.7 to 5.5V
Maximum Output Current 600mA
Junction Temperature ..... -40 to 150°C

Thermal Information

Thermal Resistance, Junction to Ambient(1) .... 41°C/W
Storage Temperature ..... -65 to +150°C
Peak IR Reflow Temperature (10s to 30s) ..... +260°C

Exceeding the above specifications may result in permanent damage to the device or device malfunction. Operation outside of the parameters specified in the Electrical Characteristics section is not recommended.

NOTES:
(1) Calculated from package in still air, mounted to 3" x 4.5", 4 layer FR4 PCB with thermal vias under the exposed pad per JESD51 standards.
(2) This device is ESD sensitive. Use of standard ESD handling precautions is required.

Electrical Characteristics

Unless specified: V_{SHDN} = 0V, Adjustable mode: (V_{ADJ} = V_{REF}), Fixed mode: (V_{ADJ} = GND), V_{IN} = 2.7V to 5.5V and I_{OUT} = 10mA to 600mA. Values in **bold** apply over full operating temperature range.. T_J= -40°C to 150°C, typical value are at T_J= 25°C.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Supply						
IN Voltage Range	V_{IN}		**2.7**		**5.5**	V
Quiescent Current	I_Q	V_{IN} = 3.3V		85	**170**	µA
		V_{IN} = V_{SHDN} = 5.5V		0.01	**2.00**	
Output						
OUT Voltage(1) (Internal Fixed Voltage)	V_{OUT}	V_{IN} = 3.3V, I_{OUT} = 10mA, T_A = 25°C	1.482	1.500	1.518	V
			1.467		**1.533**	
Line Regulation(1)(2)	$REG_{(LINE)}$	V_{IN} = 2.7V to 5.5V, I_{OUT} = 10mA, $T_J \geq$ 0°C		0.10	**0.40**	%
Load Regulation(1)	$REG_{(LOAD)}$	V_{IN} = 2.7V		0.15	**0.40**	%
Current Limit(1)(3)	I_{LM}		**0.65**		**1.10**	A
Dropout Voltage(2)	V_D	I_{OUT} = 10mA		1		mV
		I_{OUT} = 100mA		70	115	mV
					185	
		I_{OUT} = 300mA		210	300	mV
					425	
		I_{OUT} = 600mA		420	600	mV
					835	

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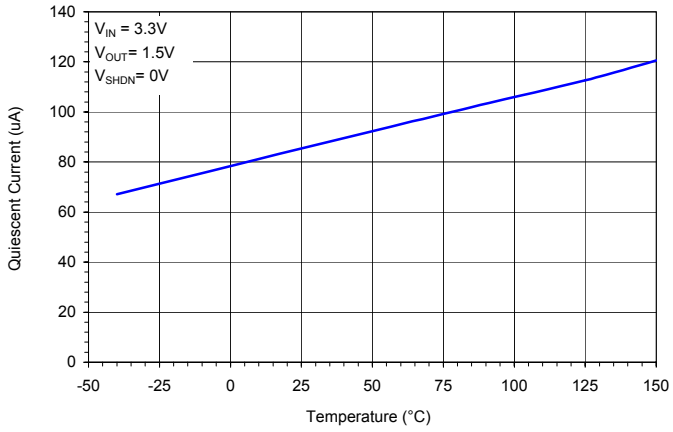
Electrical Characteristics (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Reference						
Reference Voltage[1]	V_{REF}	V_{IN} = 3.3V, V_{ADJ} = V_{OUT}, I_{OUT} = 10mA	1.186 **1.174**	1.200	1.214 **1.226**	V
ADJ Pin Current[4]	I_{ADJ}	V_{IN} = 3.3V, V_{ADJ} = V_{REF}		65	**150**	nA
ADJ Pin Threshold[5]	V_{ADJ-TH}	V_{IN} = 3.3V, V_{ADJ} = V_{REF}	**0.10**	0.25	**0.40**	V
Shutdown						
SHDN Pin Current	I_{SHDN}	V_{SHDN} = 0V, V_{IN} = 3.3V		1.5	**5.0**	µA
SHDN Pin Threshold	V_{IH}	V_{IN} = 3.3V	**1.8**			V
	V_{IL}	V_{IN} = 3.3V			**0.4**	
Over Temperature Protection						
High Trip Level	T_{HI}			170		°C
Hysteresis	T_{HYST}			10		°C

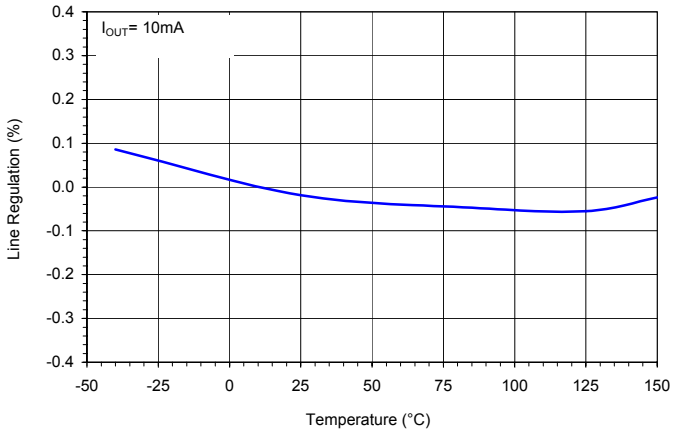
Notes:
(1) Low duty cycle pulse testing with Kelvin connections required.
(2) Defined as the input to output differential at which the output voltage drops to 1% below the value measured at a differential of 0.95V for 2.2V ≤ V_{OUT} ≤ 4.55V at adjustable mode configuration. Not measurable on outputs less than 2.2V due to minimum V_{IN} constraints. See typical characteristics curves.
(3) Defined as the output current at which the output voltage drops to 2% below the value measured at output current of 10mA.
(4) Guaranteed by design.
(5) When V_{ADJ} exceeds this threshold, the "Sense Select" switch disconnects the internal feedback chain from the error amplifier and connects V_{ADJ} instead.

Typical Characteristics

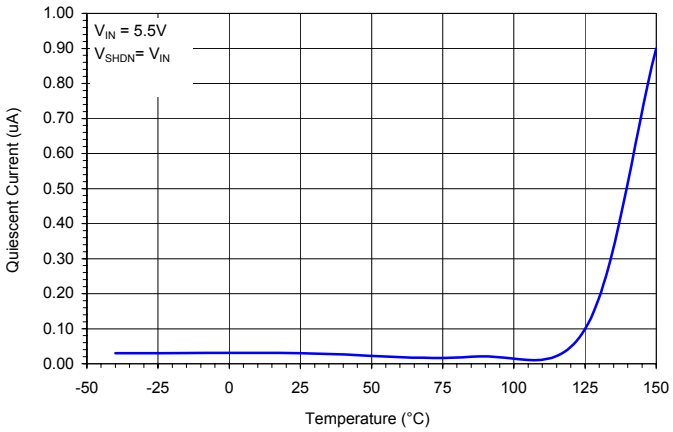
Quiescent Current vs Junction Temperature



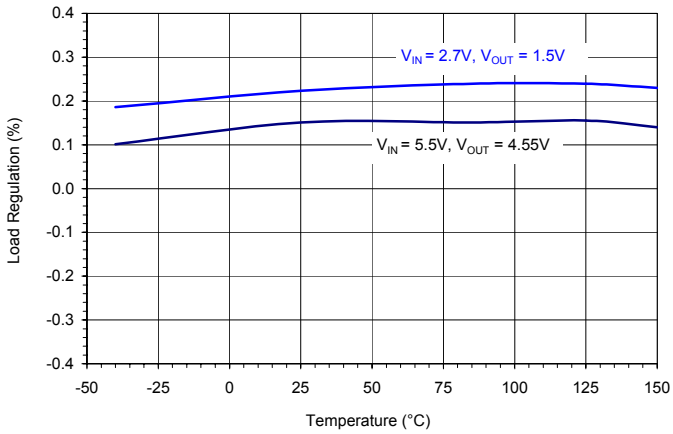
Line Regulation vs Junction Temperature



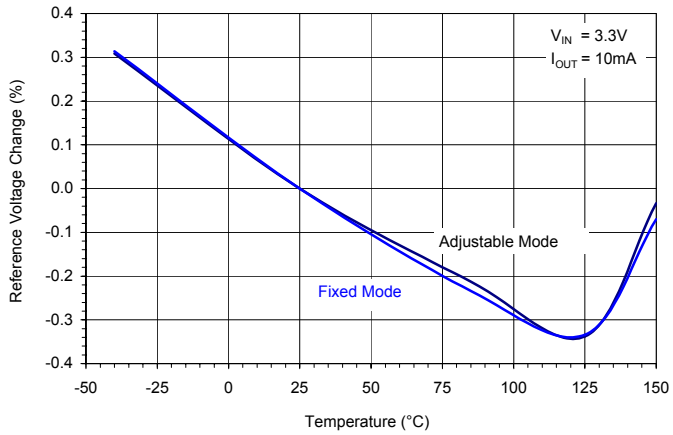
Quiescent Current at Shutdown



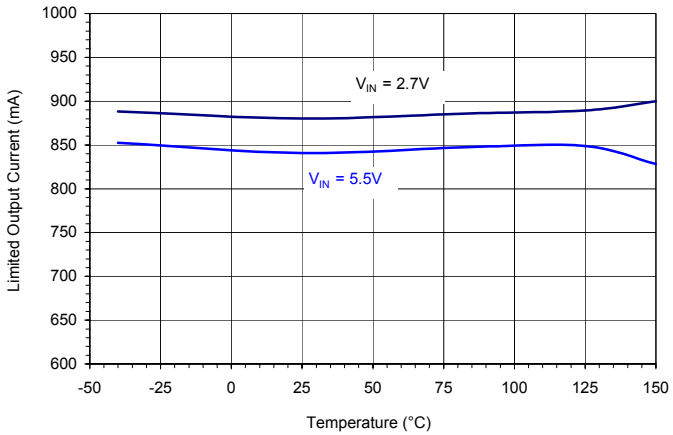
Load Regulation vs Junction Temperature



Output Voltage vs Junction Temperature

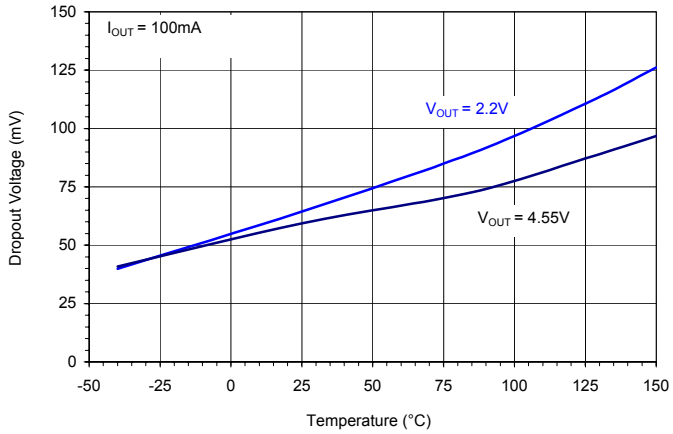


Current Limit vs Junction Temperature

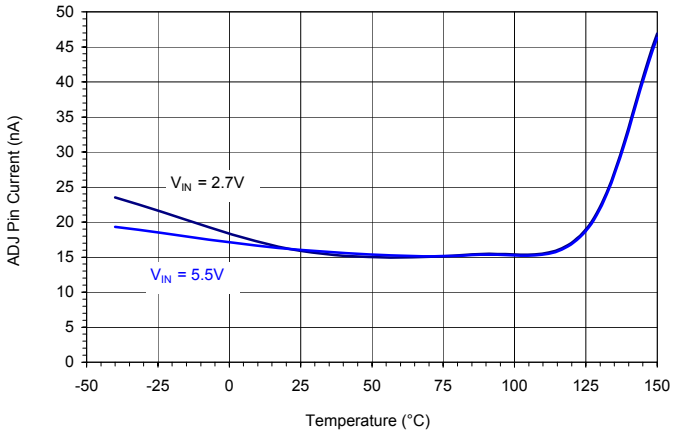


Typical Characteristics

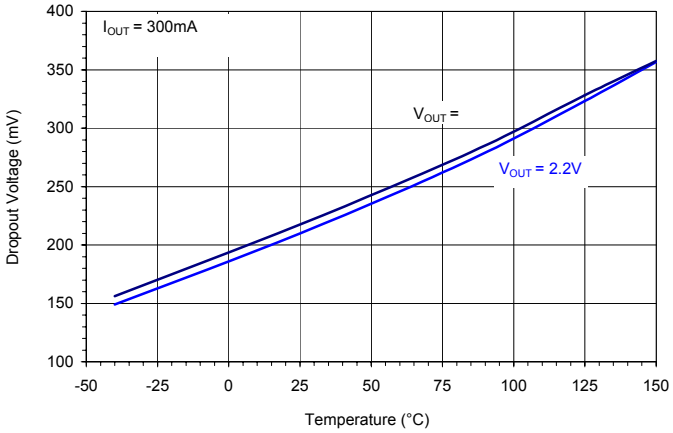
Dropout Voltage vs Output Voltage @ Iout= 100mA



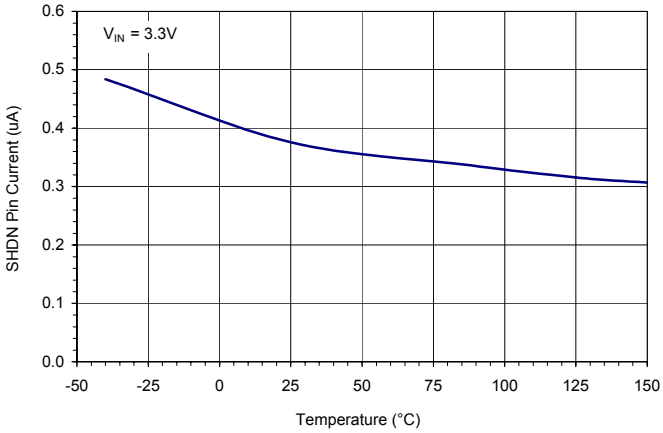
ADJ Pin Current vs Junction Temperature



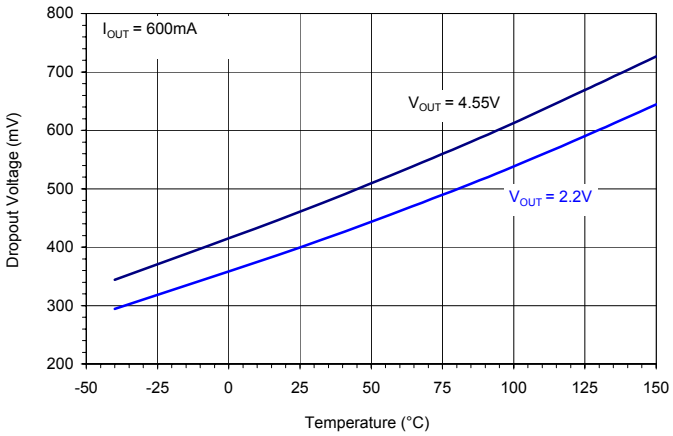
Dropout Voltage vs Output Voltage @ Iout= 300mA



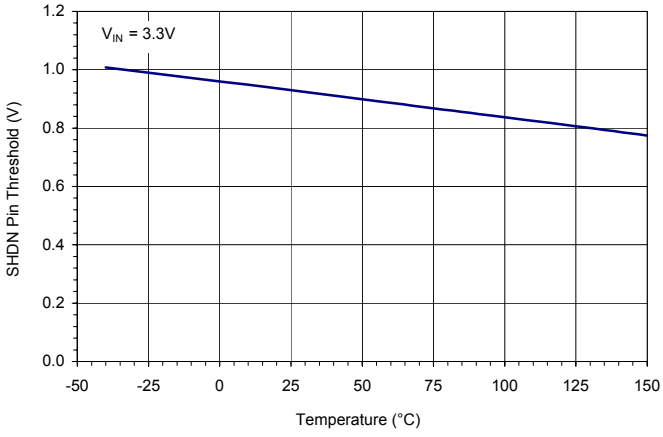
SHDN Pin Current vs Junction Temperature



Dropout Voltage vs Output Voltage @ Iout= 600mA



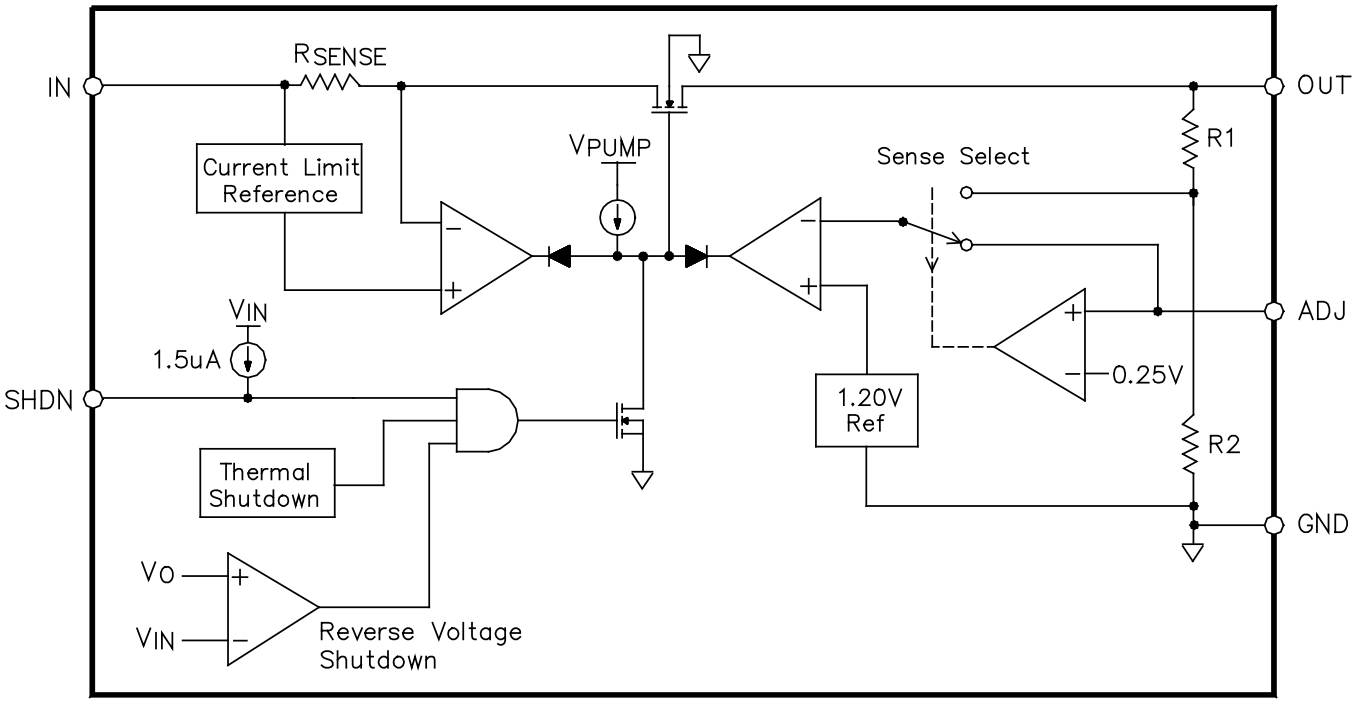
SHDN Pin Threshold vs Junction Temperature



Pin Descriptions

Pin #	Pin Name	Pin Function
1	IN	Input voltage. For regulation at full load, the input to this pin must be between (V_{OUT} + 0.95V) and 5.5V. Minimum V_{IN} = 2.7V.
2	NC	No connect
3	NC	No connect
4	OUT	This pin is the power output of this device, sourcing up to 600mA.
5	ADJ	This pin sets the output voltage when grounded by the set of internal feedback resistors. If external feedback resistors are used, the output voltage will be: $V_{OUT} = \frac{1.200 \cdot (R_1 + R_2)}{R_2} \cdot V$ R_1: The resistor connected from OUT to ADJ. R_2: The resistor connected from ADJ to GND.
6	NC	No connect
7	SHDN	Shutdown Input. Pulling this pin high turns the regulator off, reducing the quiescent current to a fraction of its operating value (typically < 300nA). The device will be enabled if this pin is pulled below 0.4V. Connect to GND if not being used.
8	GND	Reference ground.
T	Thermal Pad	Thermal pad for heatsinking purposes. Not connected internally

Block Diagram



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Applications Information

Introduction

The SC1564 is intended for applications such as graphics cards where high current capability and low dropout voltage are required. It provides a very simple, low cost solution that uses little PCB real estate. Additional features include a shutdown pin to allow for a very low power consumption standby mode, and a fully adjustable output.

Component Selection

Input capacitor: A 1µF ceramic capacitor is recommended. This allows for the device some distance from any bulk capacitance on the rail. Additionally, input droop due to load transients is reduced, improving load transient response. Additional capacitance may be added if required by the application.

Output capacitor: A minimum bulk capacitance of 1µF, along with a 0.1µF ceramic decoupling capacitor, is recommended. Increasing the bulk capacitance will improve the overall transient response. The use of multiple lower value ceramic capacitors in parallel to achieve the desired bulk capacitance will not cause stability issues. Although designed for use with ceramic output capacitors, the SC1564 is extremely tolerant of output capacitor ESR values and thus will also work comfortably with tantalum output capacitors.

Noise immunity: In very electrically noisy environents, it is recommended that 0.1µF ceramic capacitors be placed from IN to GND and OUT to GND as close to the device pins as possible.

External voltage selection resistors: the use of 1% resistors, designed for a current flow ≥ 10µA is recommended to ensure a well-regulated output (tus, R2 ≤ 120kΩ).

Thermal Considerations

The power dissipation in the SC1564 is approximately equal to the product of the output current and the input to output voltage differential:

$$P_O = (V_{IN} - V_{OUT}) \cdot I_{OUT}$$

The absolute worst-case dissipation is given by:

$$P_{O(MAX)} = (V_{IN(MAX)} - V_{OUT(MIN)}) \cdot I_{OUT(MAX)} + V_{IN(MAX)} \cdot I_{Q(MAX)}$$

For a typical scenario, V_{IN} = 3.3V ± 5%, V_{OUT} = 1.5V and I_{OUT} = 600mA, therefore:

$V_{IN(MAX)}$ = 3.465V,
$V_{OUT(MIN)}$ = 1.47V and
$I_{Q(MAX)}$ = 170µA,

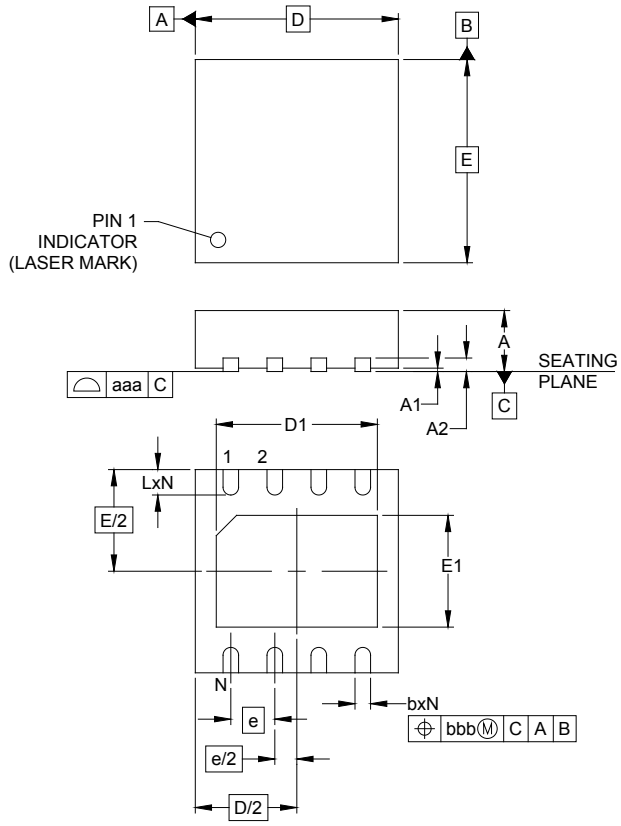
Thus $P_{D(MAX)}$ = 1.1976W.

Using this figure, and assuming $T_{A(MAX)}$ = 85°C, we can calculate the maximum thermal impedance allowable to maintain $T_J \leq$ 150°C:

$$R_{TH(J-A)(MAX)} = \left(\frac{T_{J(MAX)} - T_{A(MAX)}}{P_{O(MAX)}} \right) = \left(\frac{150°C - 85°C}{1.1976W} \right) = 54.3 \, °C/W$$

This should be achievable with the 3mm x 3mm MLPD-8 package using PCB copper area to aid in conducting the heat away from the device. Internal ground/power planes and air flow will also assist in removing heat.

Outline Drawing — 3mm x 3mm MLPD-8

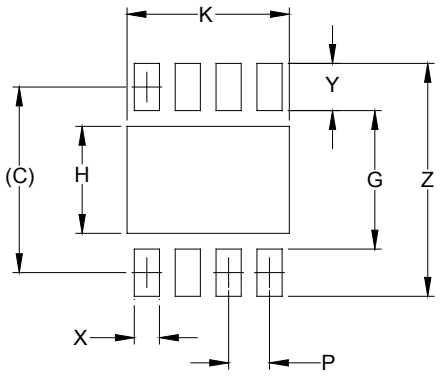


DIM	DIMENSIONS					
	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.031	.035	.039	0.80	0.90	1.00
A1	.000	.001	.002	0.00	0.02	0.05
A2	-	(.008)	-	-	(0.20)	-
b	.010	.012	.014	0.25	0.30	0.35
D	.114	.118	.122	2.90	3.00	3.10
D1	.085	-	.098	2.15	-	2.48
E	.114	.118	.122	2.90	3.00	3.10
E1	.053	-	.069	1.35	-	1.75
e	.026 BSC			0.65 BSC		
L	.012	.016	.020	0.30	0.40	0.50
N	8			8		
aaa	.003			0.08		
bbb	.004			0.10		

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS TERMINALS.

Land Pattern — 3mm x 3mm MLPD-8



DIMENSIONS		
DIM	INCHES	MILLIMETERS
C	(.116)	(2.95)
G	.087	2.20
H	.067	1.70
K	.102	2.58
P	.026	0.65
X	.016	0.40
Y	.030	0.75
Z	.146	3.70

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.
3. THERMAL VIAS IN THE LAND PATTERN OF THE EXPOSED PAD SHALL BE CONNECTED TO A SYSTEM GROUND PLANE. FAILURE TO DO SO MAY COMPROMISE THE THERMAL AND/OR FUNCTIONAL PERFORMANCE OF THE DEVICE.

Contact Information

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