500mA Low-Noise LDO Voltage Regulator

December 2019 Rev. 2.0.5

GENERAL DESCRIPTION

The SPX3819 is a positive voltage regulator with a low dropout voltage and low noise output. In addition, this device offers a very low ground current of 800µA at 100mA output. The SPX3819 has an initial tolerance of less than 1% max and a logic compatible ON/OFF switched input. When disabled, power consumption drops to nearly zero. Other key features include reverse battery protection, current limit, and thermal shutdown. The SPX3819 includes a reference bypass pin for optimal low noise output performance. With its very low output temperature coefficient, this device also makes a superior low power voltage reference.

The SPX3819 is an excellent choice for use in battery-powered applications such as cordless telephones, radio control systems, and portable computers. It is available in several fixed output voltage options or with an adjustable output voltage.

This device is offered in 8 pin NSOIC, 8 pin DFN and 5-pin SOT-23 packages.

APPLICATIONS

- **Portable Consumer Equipment**
- **Portable Instrumentation**
- **Industrial Equipment**
- **SMPS Post Regulators**

FEATURES

- **Low Noise: 40µV Possible**
- **High Accuracy: 1%**
- **Reverse Battery Protection**
- **Low Dropout: 340mV at Full Load**
- **Low Quiescent Current: 90µA**
- **Zero Off-Mode Current**
- **Fixed & Adjustable Output Voltages:**
  - 1.2V, 1.5V, 1.8V, 2.5V, 3.0V, 3.3V & 5.0V Fixed Output Voltages
  - ≥1.235V Adjustable Output Voltages
- **Available in RoHS Compliant, Lead Free Packages:**
  - 5-pin SOT-23, 8-pin SOIC and 8-pin DFN

TYPICAL APPLICATION DIAGRAM

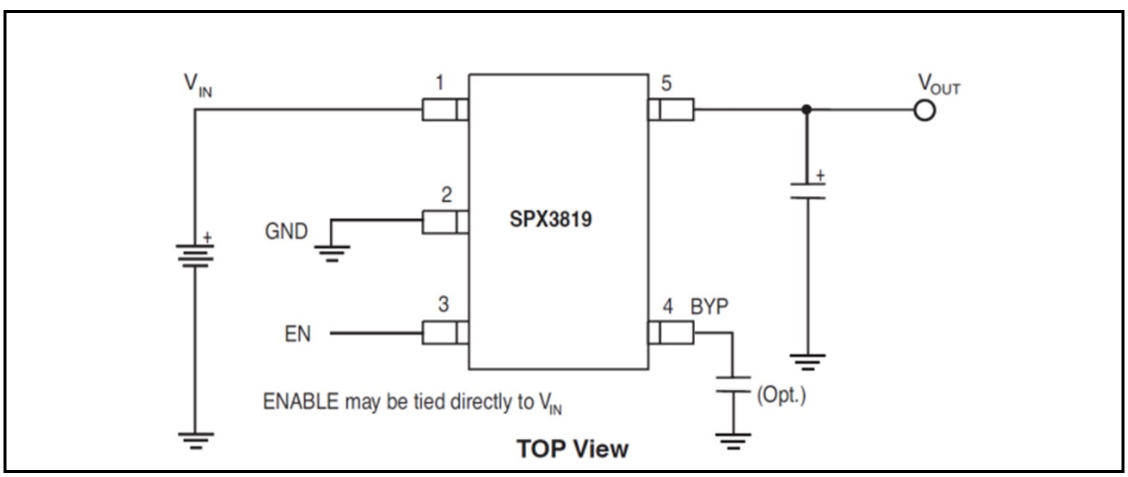


Fig. 1: SPX3819 Application Circuit

ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

V_{IN}, EN ....-20V to +20V
Storage Temperature .... -65°C to 150°C
Junction Temperature .... 150°C
Power Dissipation .... Internally Limited
Lead Temperature (Soldering, 5 sec) .... 260°C
ESD Rating (HBM - Human Body Model) 1kV

OPERATING RATINGS

Input Voltage Range V_{IN}...............................2.5V to 16V
Enable Pin EN .... 0.0V to V_{IN}
Junction Temperature Range .... -40°C to +125°C
Thermal Resistance[1] ....
θ_{JA} (SOT23-5)..191°C/W
θ_{JA} (NSOIC-8)..128.4°C/W
θ_{JA} (DFN-8) .... 59°C/W

Note 1: The maximum allowable power dissipation is a function of maximum operating junction temperature, $T_{J(max)}$ the junction to ambient thermal resistance, and the ambient θ_{JA}, and the ambient temperature T_A. The maximum allowable power dissipation at any ambient temperature is given: $P_{D(max)} = (T_{J(max)}-T_A)/\theta_{JA}$, exceeding the maximum allowable power limit will result in excessive die temperature; thus, the regulator will go into thermal shutdown.

ELECTRICAL SPECIFICATIONS

Specifications with standard type are for an Operating Junction Temperature of T_J = 25°C only; limits applying over the full Operating Junction Temperature range are denoted by a "•". Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only. Unless otherwise indicated, $V_{IN} = V_{OUT}$ + 1V ($V_{IN} = V_{OUT}$ + 1.2V for 1.2V option), I_L = 100µA, C_L = 1µF, $V_{EN} \geq$ 2.5V, $T_A = T_J$ = 25°C.

Parameter	Min.	Typ.	Max.	Units		Conditions
Output Voltage Tolerance	-1		+1	%		
	-2		+2		•	
Output Voltage Temperature Coefficient		57		ppm/°C		
Line Regulation		0.04	0.1	%/V		$V_{IN} = V_{OUT}$ +1 to 16V and $V_{EN} \leq$ 6V
			0.2		•	$V_{IN} = V_{EN} = V_{OUT} +1 \leq$ 8V
			0.2			$V_{IN} = V_{EN} = V_{OUT} +1 \leq$16V T_A = 25°C to 85°C
Load Regulation		0.05	0.4	%		I_L = 0.1mA to 500mA
Dropout Voltage (V_{IN}-V_{OUT}) [2]		10	60	mV		I_L = 100µA
			80		•	
		125	175			I_L = 50mA
			250		•	
		180	350			I_L = 150mA
			450		•	
		340	550			I_L = 500mA
			700		•	
Quiescent Current (I_{GND})		0.05	3	µA		$V_{ENABLE} \leq$ 0.4V
			8		•	V_{ENABLE} = 0.25V
Ground Pin Current (I_{GND})		90	150	µA		I_L = 100µA
			190		•	
		250	650			I_L = 50mA
			900		•	
		1.0	2.0	mA		I_L = 150mA
			2.5		•	
		6.5	25.0			I_L = 500mA
			30.0		•	
Ripple Rejection (PSRR)		70		dB		

Parameter	Min.	Typ.	Max.	Units		Conditions
Current Limit (I_{LIMIT})		800		mA		V_{OUT}=0V
			950		•	
Output Noise (e_{NO})		300		μV_{RMS}		I_L = 10mA, C_L = 1.0µF, C_{IN} = 1µF, (10Hz – 100kHz)
		40		μV_{RMS}		I_L = 10mA, C_L = 1.0µF, C_{BYP} = 1µF, C_{IN} = 1µF, (10Hz – 100kHz)
Input Voltage Level Logic Low (V_{IL})			0.4	V		OFF
Input Voltage Level Logic High (V_{IH})	2			V		ON
ENABLE Input Current		0.01	2	µA		VIL ≤ 0.4V
		3	20			VIH ≥ 2.0V

Note 2: Not applicable to output voltage 2V or less.

PIN ASSIGNMENT

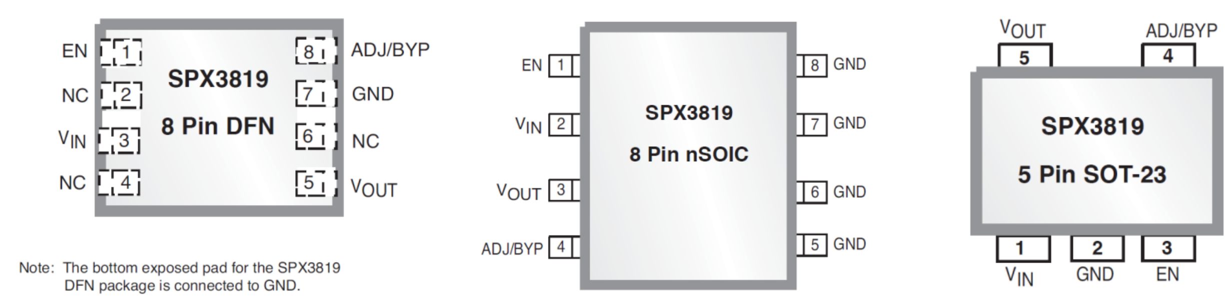


Fig. 2: SPX3819 Pin Assignment

PIN DESCRIPTION

Name	Pin # nSOIC	Pin # DFN	Pin # SOT-23	Description
VIN	2	3	1	Supply Input
GND	5, 6, 7, 8	7	2	Ground
VOUT	3	5	5	Regulator Output
EN	1	1	3	Enable(input). CMOS compatible control input. Logic high – enable; logic low or open = shutdown
ADJ	4	8	4	Adjustable part only. Feedback input. Connect to resistive voltage-divider network
BYP				Fixed version only. Internal reference bypass pin. Connect 10nF to ground to reduce thermal noise on the output.
NC	-	2, 4, 6	-	No Connect

ORDERING INFORMATION[1]

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method
SPX3819M5-L/TR	$-40°C \le T_J \le +125°C$	Yes[2]	SOT-23-5	Tape & Reel
SPX3819M5-L-1-2/TR				
SPX3819M5-L-1-5/TR				
SPX3819M5-L-1-8/TR				
SPX3819M5-L-2-5/TR				
SPX3819M5-L-3-0/TR				
SPX3819M5-L-3-3/TR				
SPX3819M5-L-5-0/TR				
SPX3819R2-L/TR			DFN-8	
SPX3819R2-L-1-2/TR				
SPX3819S-L/TR			NSOIC-8	
SPX3819S-L-5-0/TR				

NOTES:

1. Refer to www.maxlinear.com/SPX3819 for most up-to-date Ordering Information
2. Visit www.maxlinear.com for additional information on Environmental Rating.

TYPICAL PERFORMANCE CHARACTERISTICS

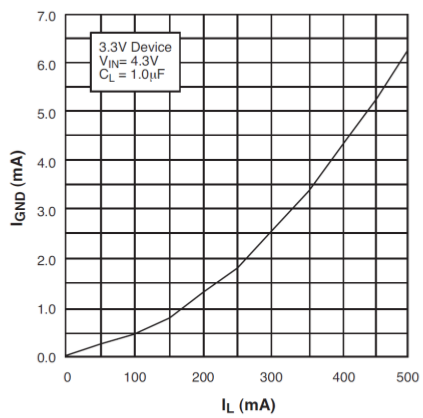


Fig. 3: Ground Current vs Load Current

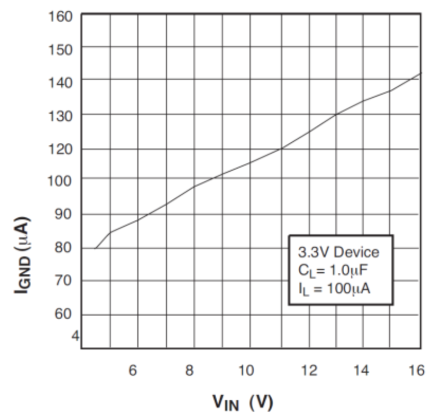


Fig. 4: Ground Current vs Input Voltage

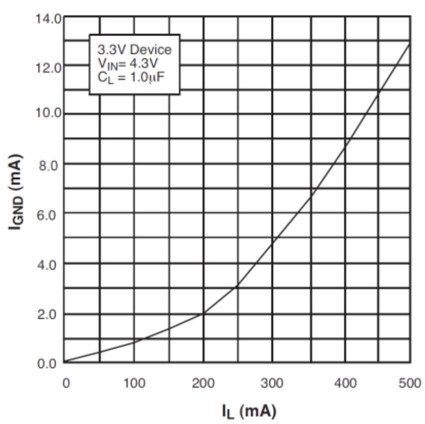


Fig. 5 Ground Current vs Load Current in Dropout

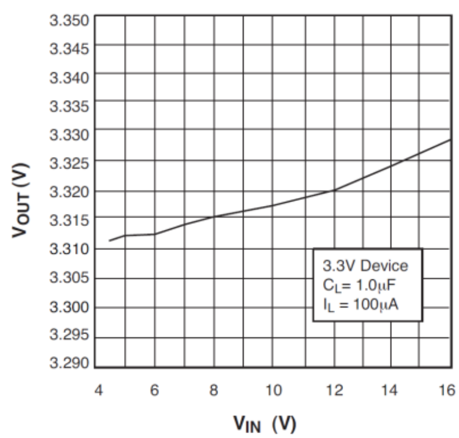


Fig. 6 Output Voltage vs Input Voltage

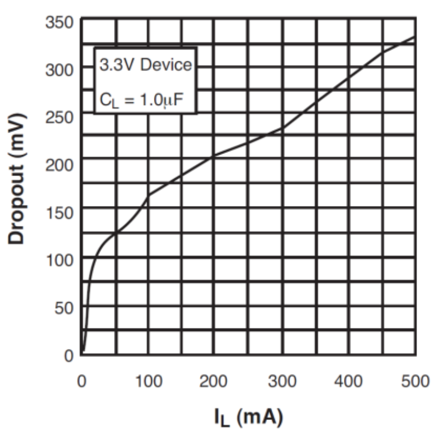


Fig. 7 Dropout Voltage vs Load Current

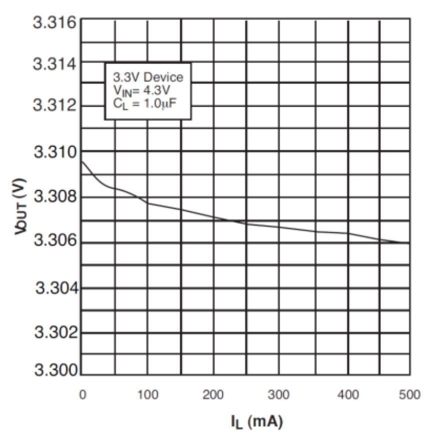


Fig. 8 Output Voltage vs Load Current

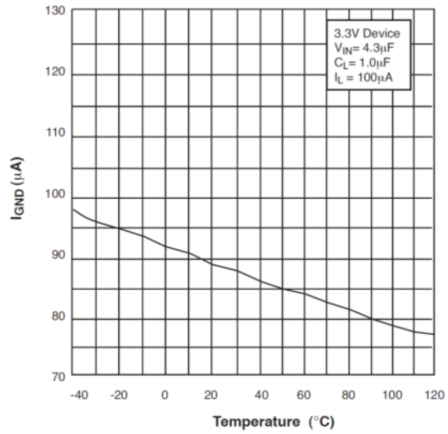


Fig. 9 Ground Current vs Temperature with 100μA Load

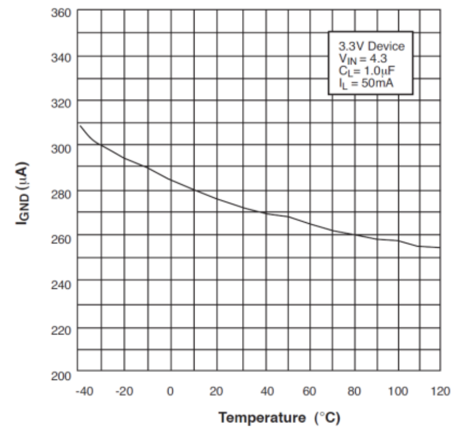


Fig. 10 Ground Current vs Temperature with 50mA Load

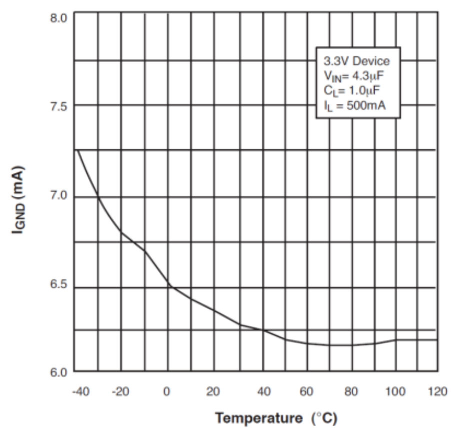


Fig. 11 Ground Current vs Temperature with 500mA Load

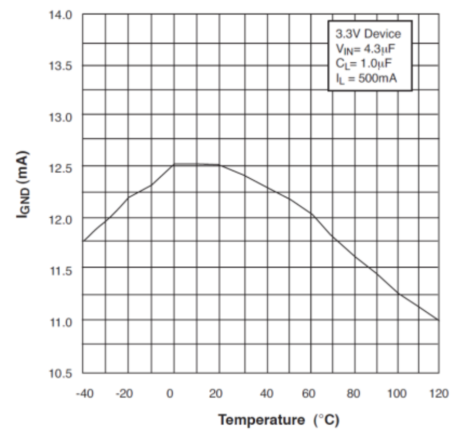


Fig. 12 Ground Current vs Temperature in Dropout

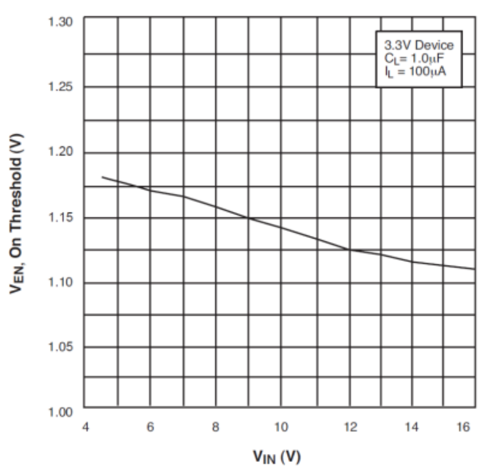


Fig. 13 ENABLE Voltage, ON threshold, vs Input Voltage

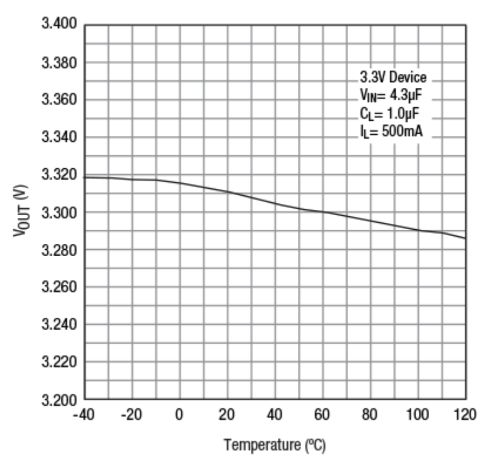


Fig. 14 Output Voltage vs Temperature

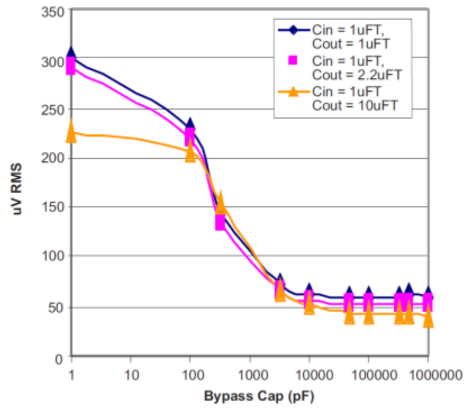


Fig. 15 Output Noise vs Bypass Capacitor Value IL = 10mA, 10Hz - 100kHz

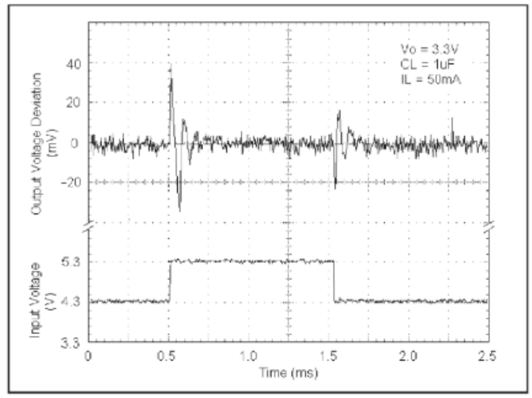


Fig. 16 Line Transient Response for 3.3V Device

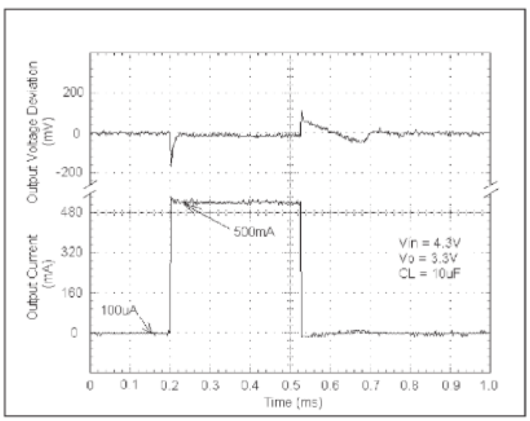


Fig. 17 Load Transient Response for 3.3V Device

APPLICATION INFORMATION

The SPX3819 requires an output capacitor for device stability. Its value depends upon the application circuit. In general, linear regulator stability decreases with higher output currents. In applications where the SPX3819 is sourcing less current, a lower output capacitance may be sufficient. For example, a regulator outputting only 10mA, requires approximately half the capacitance as the same regulator sourcing 150mA.

Bench testing is the best method for determining the proper type and value of the capacitor since the high frequency characteristics of electrolytic capacitors vary widely, depending on type and manufacturer. A high quality 2.2μF aluminum electrolytic capacitor works in most application circuits, but the same stability often can be obtained with a 1μF tantalum electrolytic.

With the SPX3819 adjustable version, the minimum value of output capacitance is a function of the output voltage. The value decreases with higher output voltages, since closed loop gain is increased.

TYPICAL APPLICATIONS CIRCUITS

For fixed voltage options only. A 10nF capacitor on the BYP pin will significantly reduce output noise, but it may be left unconnected if the output noise is not a major concern. The SPX3819 start-up speed is inversely proportional to the size of the BYP capacitor.

Applications requiring a slow rampup of the output voltage should use a larger CBYP. However, if a rapid turn-on is necessary, the BYP capacitor can be omitted.

The SPX3819's internal reference is available through the BYP pin.

Figure 18 represents a SPX3819 standard application circuit. The EN (enable) pin is pulled high (>2.0V) to enable the regulator. To disable the regulator, EN < 0.4V.

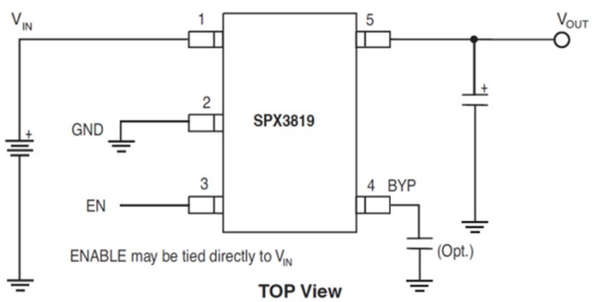


Fig. 18: Standard Application Circuit

The SPX3819 in Figure 19 illustrates a typical adjustable output voltage configuration. Two resistors (R1 and R2) set the output voltage. The output voltage is calculated using the formula:

$$VOUT = 1.235V \times [1 + R1/R2]$$

R2 must be >10kΩ and for best results, R2 should be between 22kΩ and 47kΩ.

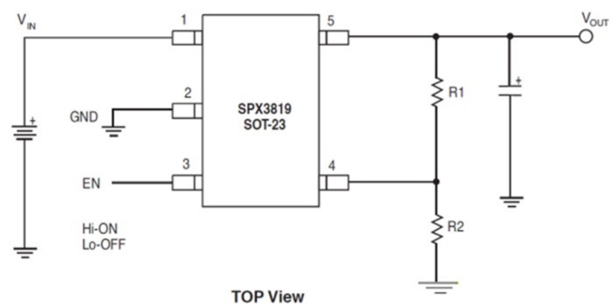
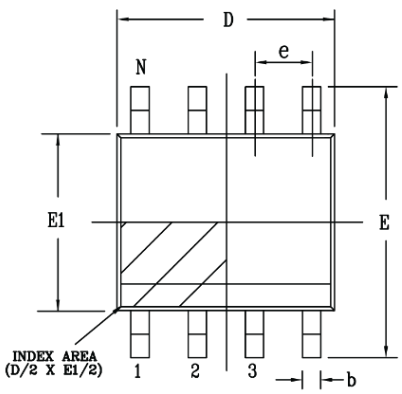


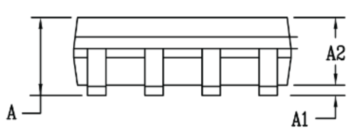
Fig. 19: Typical Adjustable Output Voltage Configuration

MECHANICAL DIMENSIONS

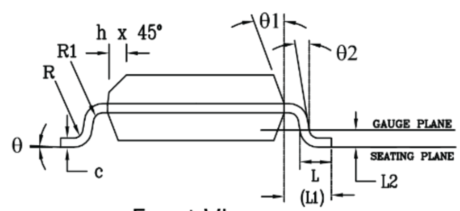
8-PIN SOICN

Top View





Side View



Front View

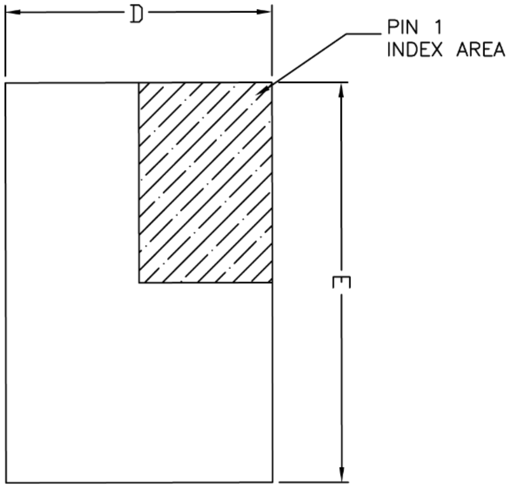
PACKAGE OUTLINE NSOIC .150" BODY
JEDEC MS−012 VARIATION AA

SYMBOLS	COMMON DIMENSIONS IN MM (Control Unit)			COMMON DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	—	1.75	0.053	—	0.069
A1	0.10	—	0.25	0.004	—	0.010
A2	1.25	—	1.65	0.049	—	0.065
b	0.31	—	0.51	0.012	—	0.020
c	0.17	—	0.25	0.007	—	0.010
E	6.00 BSC			0.236 BSC		
E1	3.90 BSC			0.154 BSC		
e	1.27 BSC			0.050 BSC		
h	0.25	—	0.50	0.010	—	0.020
L	0.40	—	1.27	0.016	—	0.050
L1	1.04 REF			0.041 REF		
L2	0.25 BSC			0.010 BSC		
R	0.07	—	—	0.003	—	—
R1	0.07	—	—	0.003	—	—
q	0°	—	8°	0°	—	8°
q1	5°	—	15°	5°	—	15°
q2	0°	—	—	0°	—	—
D	4.90 BSC			0.193 BSC		
N	8					

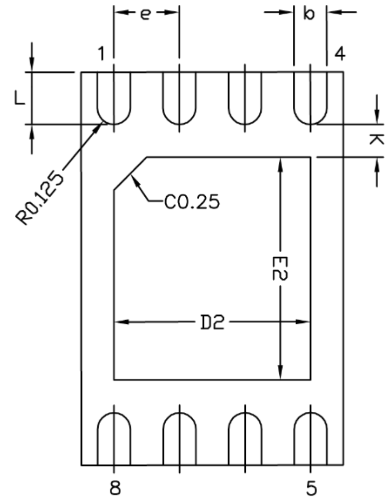
Drawing No: POD-00000108

Revision: A

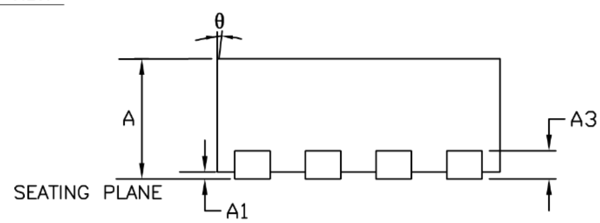
MECHANICAL DIMENSIONS (CONTINUED) 8-PIN 2X3 DFN



TOP VIEW



BOTTOM VIEW



SIDE VIEW

SYMBOL \ DIM	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
A3	0.20 REF		
b	0.18	0.25	0.30
D	2.00 BSC		
E	3.00 BSC		
e	0.50 BSC		
D2	1.50	–	1.75
E2	1.60	–	1.90
K	0.20	–	–
L	0.30	0.40	0.50
θ	0	–	14
N	8		

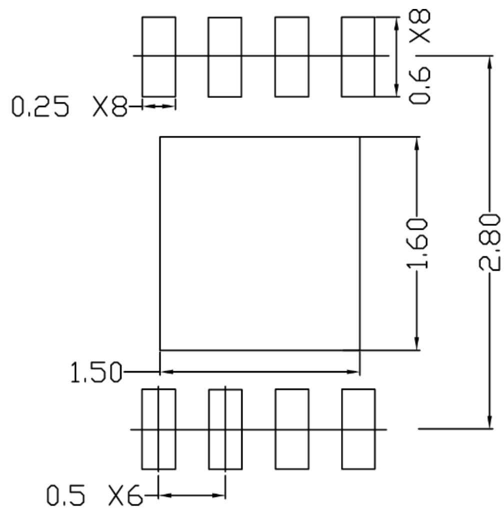
TERMINAL DETAILS

- ALL DIMENSIONS ARE IN MILLIMETERS, ANGLES ARE IN DEGREES.
- DIMENSIONS AND TOLERANCE PER JEDEC MO-229.

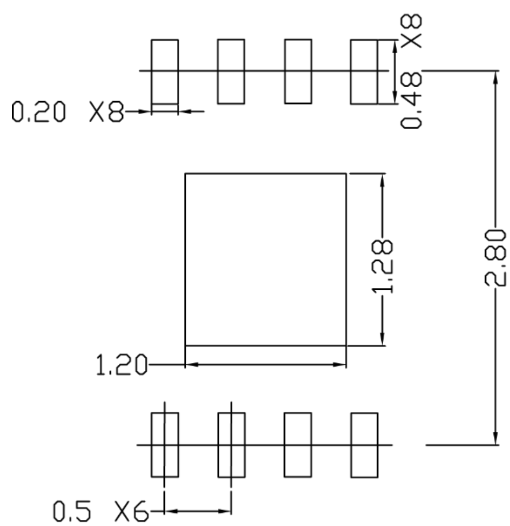
Drawing No.: POD-000000132

Revision: A

RECOMMENDED LAND PATTERN AND STENCIL **8-PIN 2X3 DFN**



TYPICAL RECOMMENDED LAND PATTERN

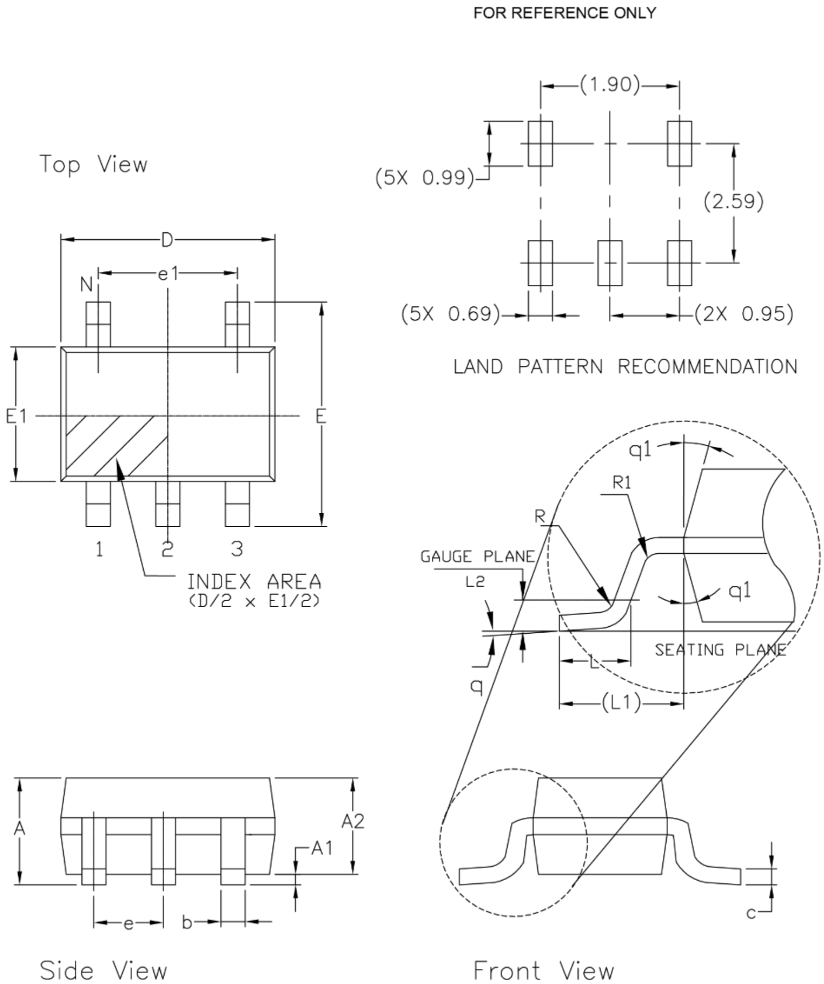


TYPICAL RECOMMENDED STENCIL

Drawing No.: POD-000000132

Revision: A

MECHANICAL DIMENSIONS (CONTINUED) 5-PIN SOT-23



5 Pin SOT-23 JEDEC MO-178 Variation AA						
SYMBOLS	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	—	—	1.45	—	—	0.057
A1	0.00	—	0.15	0.000	—	0.006
A2	0.90	1.15	1.30	0.036	0.045	0.051
b	0.30	—	0.50	0.012	—	0.020
c	0.08	—	0.22	0.003	—	0.009
D	2.90 BSC			0.115 BSC		
E	2.80 BSC			0.111 BSC		
E1	1.60 BSC			0.063 BSC		
e	0.95 BSC			0.038 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.60 REF			0.024 REF		
L2	0.25 BSC			0.010 BSC		
R	0.10	—	—	0.004	—	—
R1	0.10	—	0.25	0.004	—	0.010
q	0°	4°	8°	0°	4°	8°
q1	5°	10°	15°	5°	10°	15°
N	5			5		

Drawing No: POD-00000025
Revision: B