1.5MHz, 5.5V, 1.5A Synchronous Step-Down Converter

DESCRIPTION

The EUP3080A is a constant frequency, current mode PWM step-down converter. The device integrates a main switch and a synchronous rectifier for high efficiency without an external Schottky diode. It is ideal for powering portable equipment that runs from a single cell Lithium-Ion (Li+) battery. The output voltage can be regulated as low as 0.6V. The EUP3080A can also run at 100% duty cycle for low dropout operation, extending battery life in portable system. This device offers two operation modes, PWM control and PFM Mode switching control, which allows a high efficiency over the wider range of the load.

FEATURES

- Wide Input Voltage Range: 2.5V to 5.5V
- Output Voltage as Low as 0.6V
- High Efficiency: Up to 96%
- 1.5MHz Constant Frequency Operation
- Up to 1.5A Output Current(@Vout=1.2V)
- No Schottky Diode Required
- 100% Duty Cycle in Dropout
- Low Quiescent Current: 50μA
- Slope Compensated Current Mode Control for Excellent Line and Load Transient Response
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- Build in Input Over Voltage Protection
- <1μA Shutdown Current
- Available in SOT23-5 Package

APPLICATIONS

- Cellular and Smart Phones
- Wireless and DSL Modems
- PDA/MID/PAD
- Digital Still and Video Cameras

Typical Application Circuit

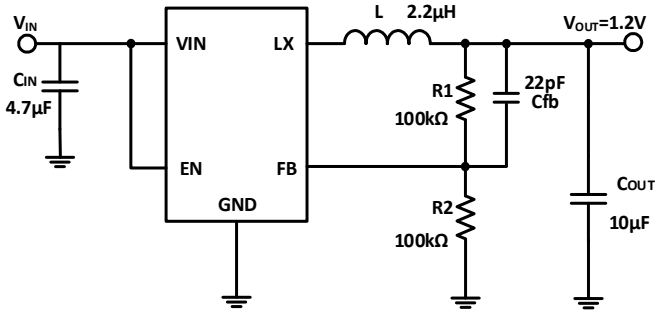
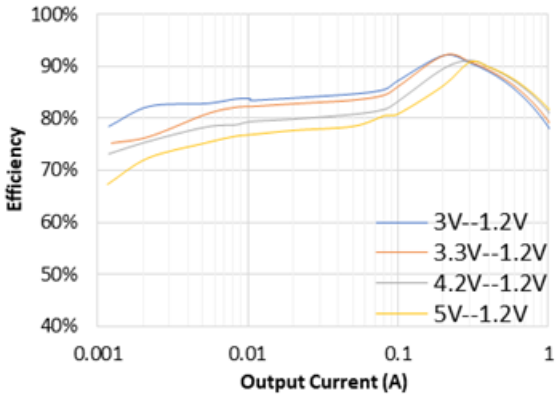


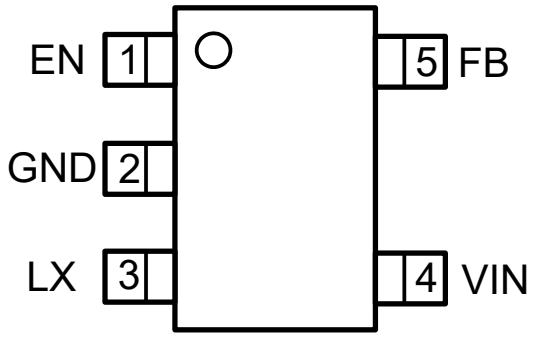
Figure 1. Basic Application Circuit

Efficiency

V_{OUT}=1.2V, I_{OUT}=0.01A to 1A, L_{OUT}=2.2μH, T_A=25°C



Pin Configurations

Package Type	Pin Configurations
SOT23-5	 (Top View)

Pin Description

PIN#	NAME	DESCRIPTION
1	EN	Chip Enable Pin. Drive EN above EN high threshold to turn on the part. Drive EN below EN low threshold to turn it off. Do not leave EN floating.
2	GND	Ground Pin.
3	LX	Power Switch Output. It is the switch node connection to Inductor.
4	VIN	Power Supply Input. Must be closely decoupled to GND with a 4.7µF or greater ceramic capacitor.
5	FB	Output Voltage Feedback Pin.

Functional Block Diagram

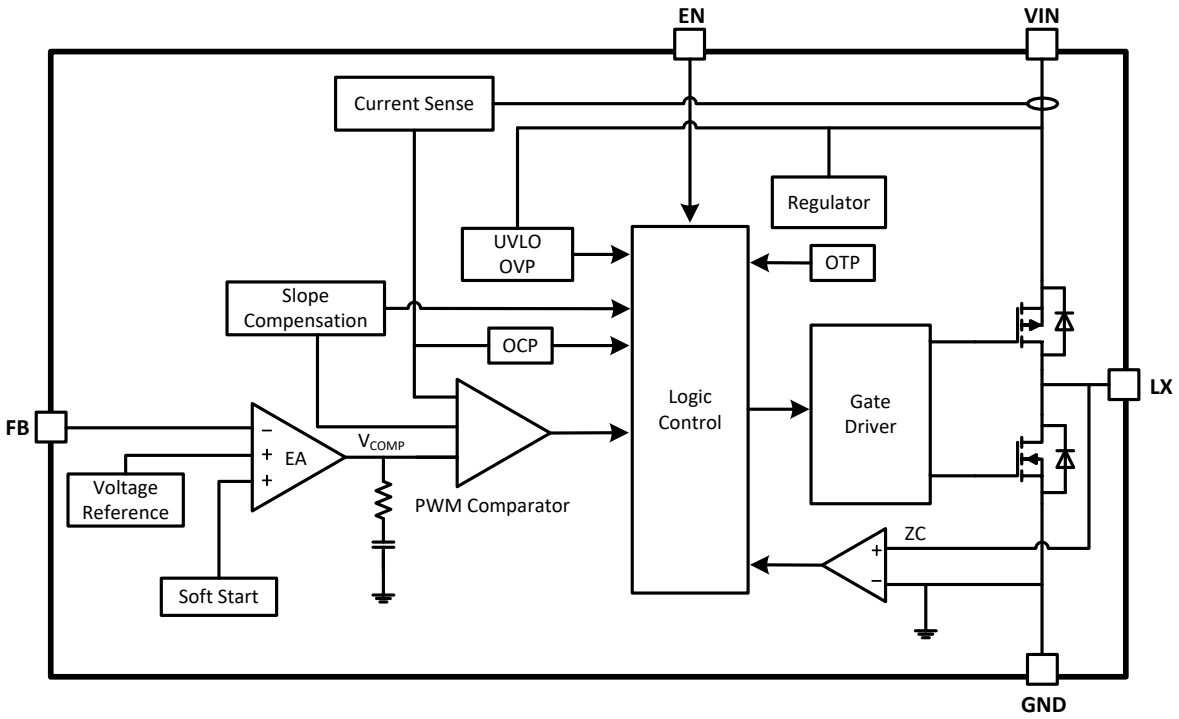


Figure 2. Functional Block Diagram

Ordering Information

Order Number	Package Type	Output Voltage	Marking	Quantity per Reel
EUP3080AVIR1	SOT23-5	2.5V to 5.5V	XXXXX DA00	3000

EUP3080A - □ □ □ □

- Lead Free Code
  1: Lead Free, Halogen-Free
- Packing
  R: Tape & Reel
- Operating Temperature Range
  I: Industry Standard
- Package Type
  V: SOT23-5

Absolute Maximum Ratings (1) Note 1

- Input Supply Voltage, EN ---------- -0.3V ~ +6.5V
- LX Voltages ---------- -0.3V ~ +6.5V
- LX Voltages (<10ns transient)---------- -2.5V ~ +7V
- FB Voltage---------- -3.5V ~ +7.5V
- BS Voltage---------- -0.3V ~ +6.5V
- Storage Output Current (T_S) ---------- -65 ~ +150°C
- Maximum Junction Temperature Note 2---------- 150°C
- Power Dissipation ---------- 600mW
- Reflow Temperature (soldering,10sec) ---------- 260°C

ESD Ratings (2)

- ESD Voltage Protection, HBM (Human Body Model) ---------- ±2kV
- ESD Voltage Protection, CDM (Charged Device Model) ---------- ±1kV

Recommend Operating Conditions (3)

- Supply Voltage (V_{IN}) ---------- 2.5V ~ +5.5V
- Operating Temperature Range (T_J) ---------- -40 ~ +125°C

Thermal Resistance Note 3

- Junction-to-ambient thermal resistance (θ_{JA}) ---------- 200°C/W
- Junction-to-case(top) thermal resistance (θ_{JC})---------- 65°C/W

Electrical Characteristics

V_{IN}=V_{EN}=3.6V, V_{OUT}=1.8V, T_A = 25°C, unless otherwise noted.

Parameter	Conditions	Min	Typ	Max	Unit
Input Voltage Range		2.5		5.5	V
OVP Threshold			6		V
UVLO Rising Threshold			2.1		V
Quiescent Current	V_{EN}=2.0V, I_{OUT}=0，V_{FB}=V_{REF}*105%		50	100	μA
Shutdown Current	V_{EN}=0V		0.1	10	μA
Regulated Feedback Voltage	T_A=25°C	0.588	0.600	0.612	V
	T_A = 0°C ≤ T_A ≤ 85°C	0.586	0.600	0.613	V
	T_A = -40°C ≤T_A≤ 85°C	0.585	0.600	0.615	V
Reference Voltage Line Regulation	V_{IN} = 2.5V to 6.0V		0.04	0.4	%/V
Output Voltage Line Regulation	V_{IN} = 2.5V to 6.0V		0.04	0.4	%
Output Voltage Load Regulation			0.5		%
Oscillation Frequency	V_{OUT}=100%		1.5		MHz
	V_{OUT}=0V		400		kHz
On Resistance of PMOS	I_{LX}=100mA		0.2		Ω
On Resistance of NMOS	I_{LX}=-100mA		0.18		Ω
Peak Current Limit	V_{IN}=5V, V_{OUT}=1.2V, L=4.7μH/2A	1.5			A
EN Rising Threshold	V_{IN}=5V, T_A=25°C	0.8	1.1	1.4	V
	V_{IN}=3.3V, T_A=25°C	0.6	0.9	1.2	V
EN Hysteresis			0.13		V

Electrical Characteristics (continued)

Parameter	Conditions	Min	Typ	Max	Unit
EN Leakage Current			±0.01	±1.0	μA
LX Leakage Current	V_{EN}=0V, V_{IN}=V_{LX}=5V		±0.01	±1.0	μA
Thermal Shutdown Threshold (Note 4)			150		°C
Thermal Shutdown Hysteresis (Note 4)			25		°C

Note 1: *Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.*

Note 2: *T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + (P_D) \times \theta_{JA}$..*

Note 3: *Measured on JESD51-7, 4-layer PCB.*

Note 4: *Guaranteed by design.*

Functional Description

Overview

The EUP3080A is a high performance 1.5MHz monolithic step-down converter. The EUP3080A requires only three external power components (Cin, Cout and L). The adjustable version can be programmed with external feedback to any voltage, ranging from 0.6V to the input voltage.

At dropout, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the $R_{DS(ON)}$ drop of the high-side MOSFET.

The internal error amplifier and compensation provides excellent transient response, load, and line regulation. Soft start function prevents input inrush current and output overshoot during start up.

Application Information

Setting the Output Voltage

Figure 1 shows the basic application circuit for the EUP3080A. The EUP3080A can be externally programmed. Resistors R1 and R2 in Figure 1 program the output to regulate at a voltage higher than 0.6V. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 0.6 \times (1 + \frac{R_1}{R_2})$$

$$R_1 = (V_{OUT} / 0.6 - 1) \times R_2$$

Inductor Selection

For most designs, 2.2µH inductance can satisfy most application conditions. Inductance value is related to inductor ripple current value, input voltage, output voltage setting and switching frequency. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where is inductor ripple current. Large value inductors result in lower ripple current and small value inductors result in high ripple current, so inductor value has effect on output voltage ripple value. DC resistance of inductor which has impact on efficiency of DC/DC converter should be taken into account when selecting the inductor.

Input Capacitor Selection

The input capacitor reduces the surge current drawn from the input and switching noise from the device.

The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input.

A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients.

A 4.7µF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output ripple V_{OUT} is determined by:

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(ESR + \frac{1}{8 \times f_{osc} \times C3} \right)$$

A 10µF ceramic can satisfy most applications.

Layout Consideration

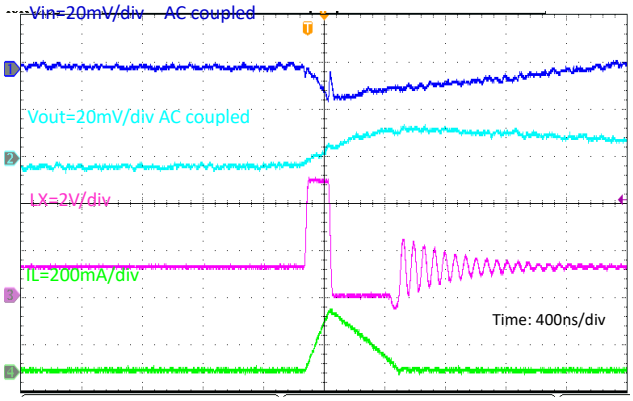
When laying out the printed circuit board, the Following checking should be used to ensure proper operation of the EUP3080A. Check the following in your layout:

1. The power traces, consisting of the GND trace, the LX trace and the V_{IN} trace should be kept short, direct and wide.
2. Does the (+) plates of Cin connect to V_{IN} as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
3. Keep the switching node, LX, away from the sensitive V_{OUT} node.
4. Keep the (-) plates of Cin and Cout as close as possible.

Typical Performance Characteristics

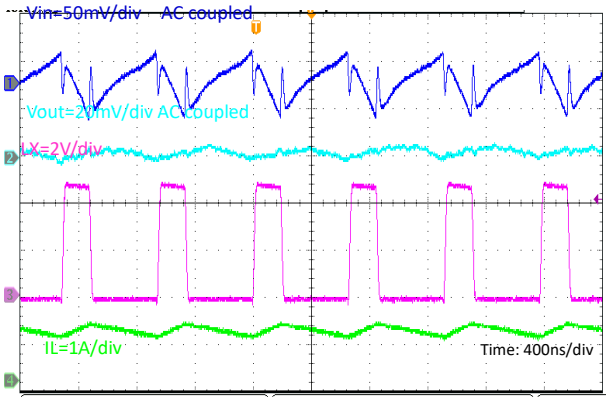
Steady State Operation

V_{IN} =5V, V_{OUT} =1.2V, No Load



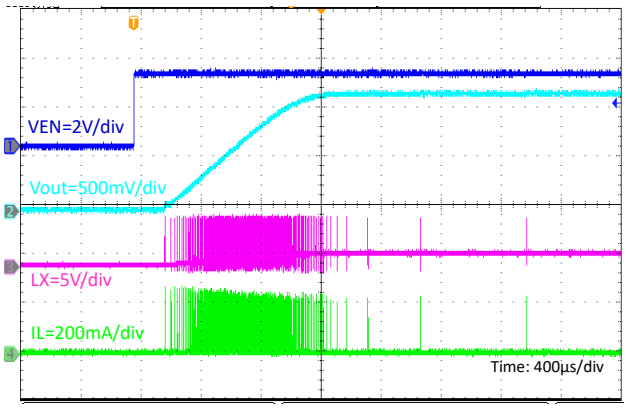
Steady State Operation

V_{IN} =5V, V_{OUT} =1.2V, I_o=1A



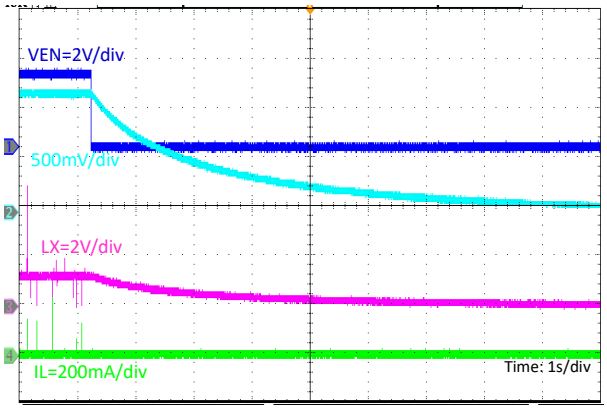
EN Enable Power On

V_{IEN}=3.6V, V_{OUT} =1.2V, No Load



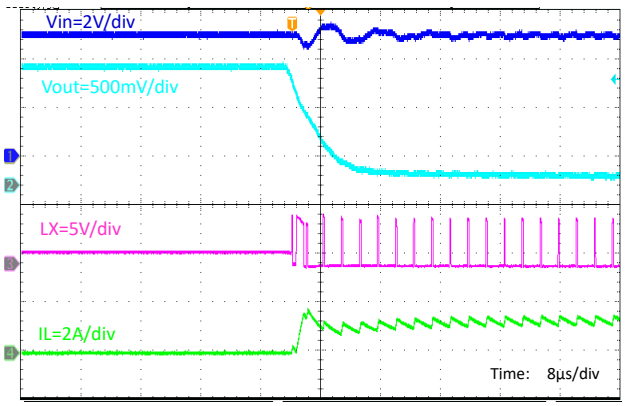
EN Disable Power down

VEN =3.6V, V_{OUT} =1.2V, No Load



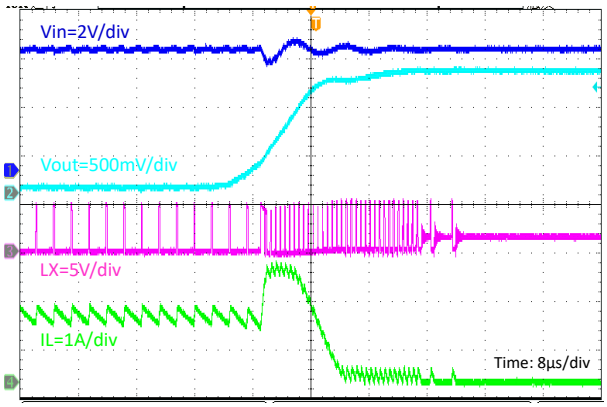
Output Short Entry

V_{IN} =5V, V_{OUT} =1.2V, No Load



Output Short Recovery

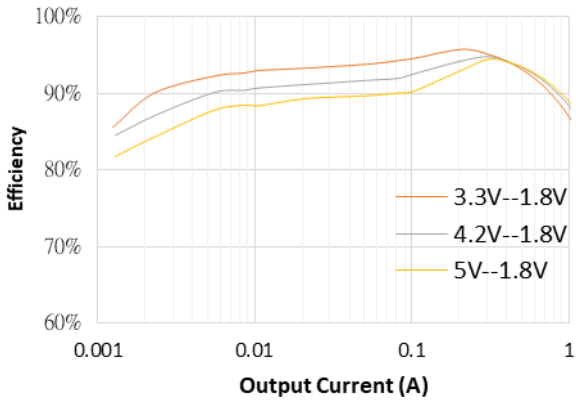
V_{IN} =5V, V_{OUT} =1.2V, No Load



Typical Performance Characteristics (continued)

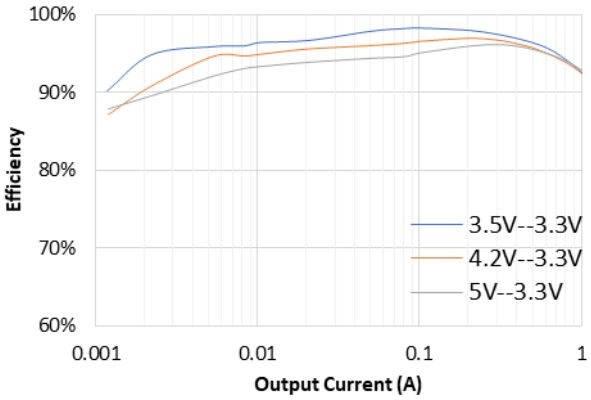
Efficiency at V_{OUT}=1.8V

V_{OUT} =1.8V, L=2.2µH



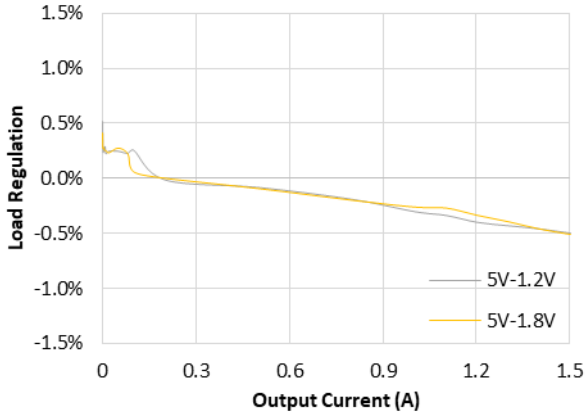
Efficiency at V_{OUT}=3.3V

V_{OUT} =3.3V, L=2.2µH



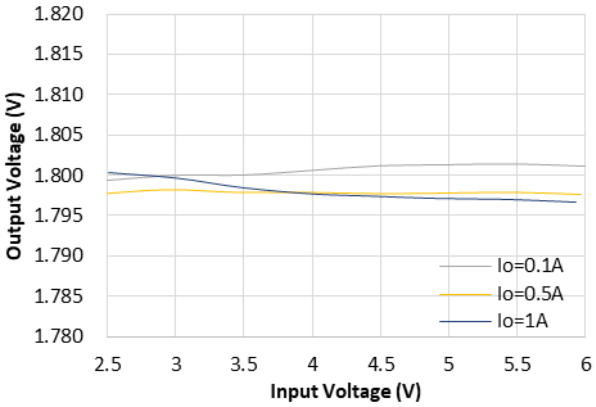
Load Regulation

I_{OUT}=0A to 1.5A



Line Regulation

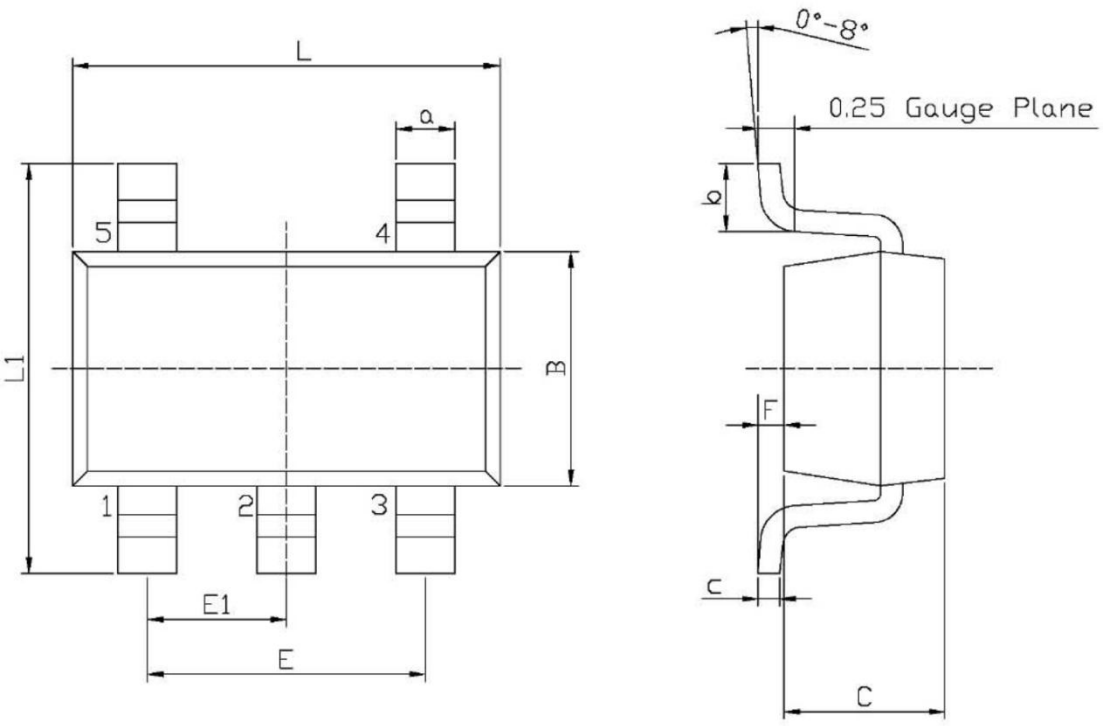
V_{OUT} =1.8V, L=2.2µH, V_{IN}=2.5V to 6V



Typical Performance Characteristics (continued)

Package Information

SOT23-5



Unit: mm

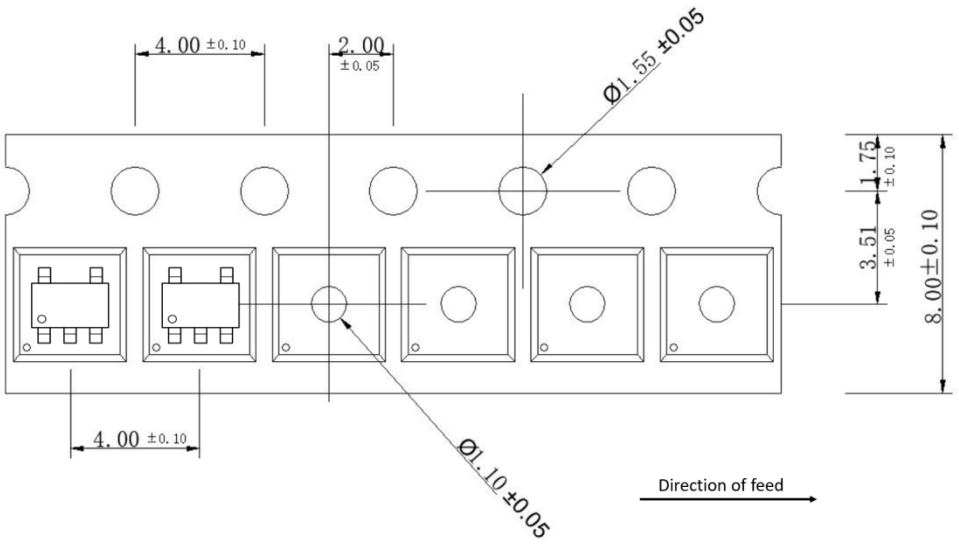
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

Note:

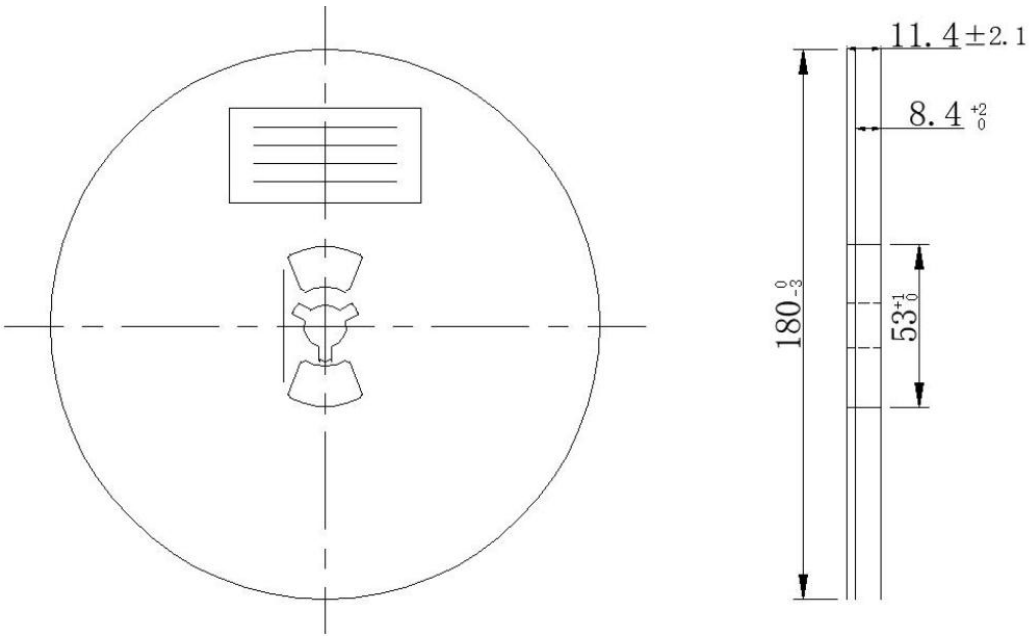
1) All dimensions are in millimeters.
2) Package length does not include mold flash, protrusion or gate burr.
3) Package width does not include inter lead flash or protrusion.
4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
5) Pin 1 is lower left pin when reading top mark from left to right.

Tape and Reel Information

Tape Dimensions: SOT23-5



Reel Dimensions: SOT23-5



Note:

1) All dimensions are in millimeter.
2) Quantity of units per reel is 3000.
3) MSL level is level 3.