Description

The EC3690 devices provide a power supply solution for products powered by either a one-cell Li-Ion or Li-polymer battery. The converter generates a stable output voltage that is either adjusted by an external resistor divider or fixed internally on the chip. It provides high efficient power conversion and is capable of delivering output currents up to 2.5A at 5V at a supply voltage down to 3V. The maximum peak current in the step-up switch is limited to a value of 6A. The EC3690 operates at 800kHz switching frequency and enters pulse-skip-mode (PSM) operation at light load currents to maintain high efficiency over the entire load current range. During shutdown, the load is completely disconnected from the battery

.

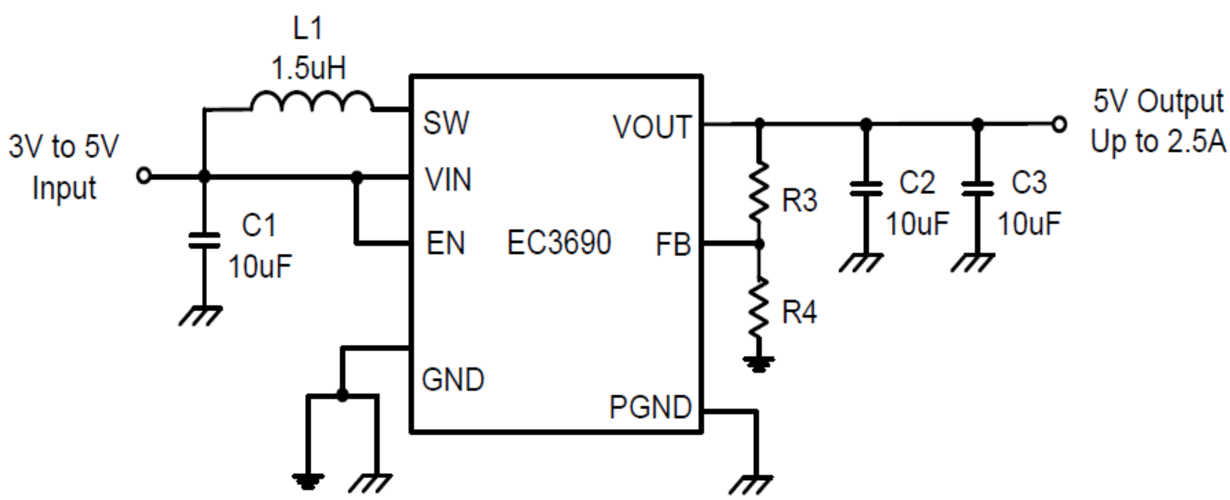
Features

- Synchronous Step-up Converter with 2.5A Output Current From 3V Input
- Wide VIN Range From 2.9V to 5.5V
- Input Under-voltage Lockout Protection
- Fixed and Adjustable Output Voltage
- Built-in Output Over-voltage Protection
- Light-Load Pulse Skip Mode
- Load Disconnect During Shutdown
- Output Short Circuit Protection
- Thermal Shutdown Protection
- Pb-Free(ROHS compliant)
- Available in a SOP8_EP Packages

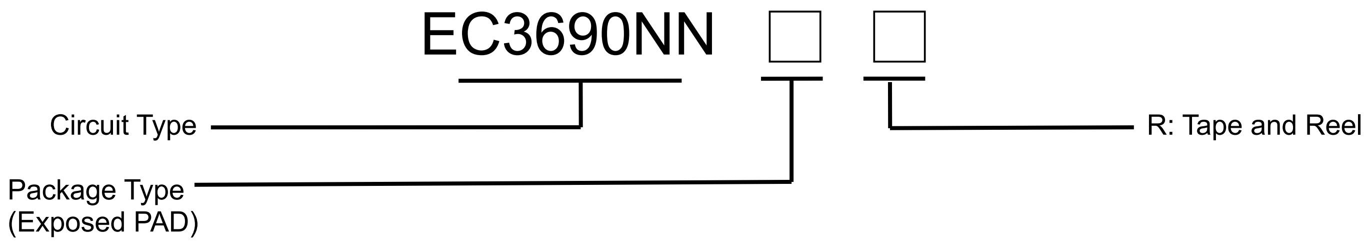
Applications

- Power Bank
- USB Charging Port (5V)
- DC/DC Micro Modules

Typical Application



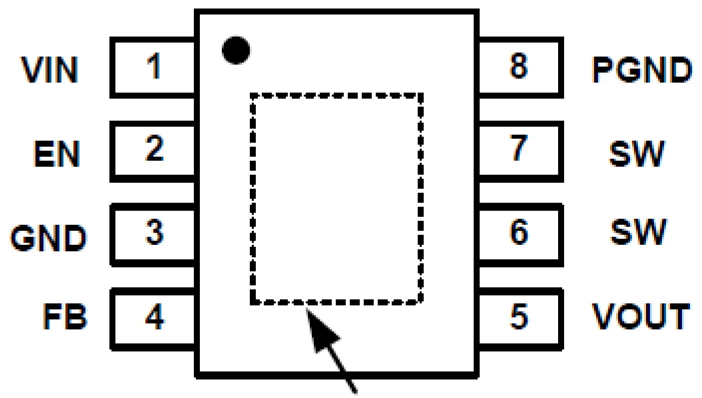
Ordering/Marking Information



Marking rule:

Part Number	Package	Marking	Marking Information
EC3690NNMHR	SOP-8 (Exposed PAD)	3690 LLLLL YYWWT	1. LLLLL ：Lot No 2. YYWW：Date Code 3. T：Internal Track Code

Pin Configurations



EXPOSED PAD ON BACKSIDE

TOP VIEW

Pin Description

NAME	PIN NO.	DESCRIPTION
VIN	1	Input Supply voltage
EN	2	Enable input. (1/VIN enabled, 0/GND disabled)
GND	3	Analog Ground pin. Connect GND to PGND under EP.
FB	4	Voltage feedback of adjustable versions. Connect FB to GND and set fixed 5.15V output voltage.
VOUT	5	Step-up convert output
SW	6, 7	Step-up and rectifying switch input
PGND	8	Power Ground pin.
EP		Exposed pad must be soldered to achieve appropriate power dissipation. Connect EP to GND.

Absolute Maximum Rating (Reference to GND) (1)

Supply Voltage V_{IN} to GND ....V to 6V
Output Voltage V_{OUT}..................................V to 6V
V_{EN}, V_{FB}, V_{SW} to GND...............................V to 6V
Peak Output Current ....Internal Limited

Junction temperature range .... 150°C
Storage temperature range ………. -55°C to 150°C
Lead Temperature....................................... 260°C
ESD Classification ....Class 2

Recommend Operating Conditions (2)

Input Voltage V_{IN}......................................V to 5.5V
Output Voltage V_{OUT}....................................V to 5.5V

Ambient Temperature Range ……… -40°C to 85°C
Junction temperature range ....135°C

Thermal Information (3,4)

Maximum Power Dissipation (T_A=25°C) … 2.15W

Thermal resistance θ_{JA} ....51°C/W
Thermal resistance θ_{JC} ....13°C/W

Note1: Stress exceeding those listed "Absolute Maximum Ratings" may damage the device.
Note2: The device is not guaranteed to function outside of the recommended operating conditions.
Note3: Measured on JESD51-7, 4-Layer PCB.
Note4: The maximum allowable power dissipation is a function of the maximum junction temperature T_{J_MAX}, the junction to ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_{D\_MAX}= (T_{J\_MAX}-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.

Electrical characteristics

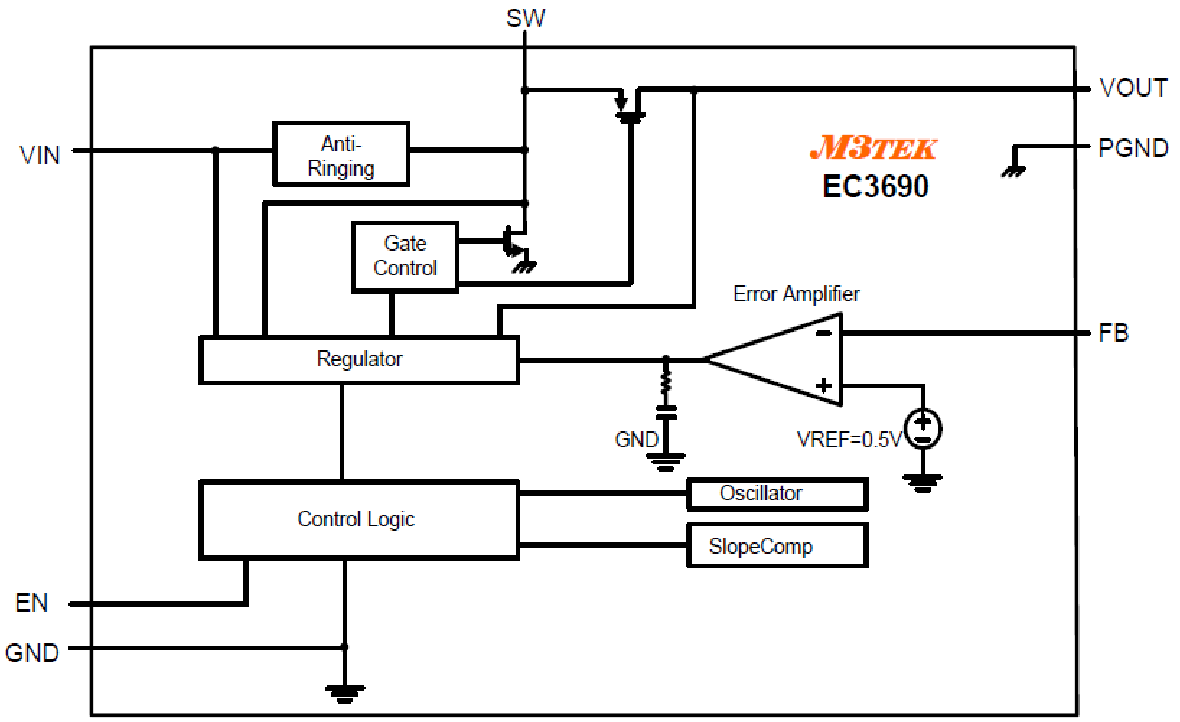
Unless otherwise noted, all parameter limits are established over the recommended operating conditions:
T_A = 25°C, 2.9V ≤ V_{IN} ≤ 5.5V, unless otherwise noted. Typical values are at V_{IN}= V_{EN} =3.6V and V_{OUT}=5V.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage range V_{IN}		2.5		5.5	V
Input Under-voltage Lockout Threshold V_{UVLO}			2.2		V
Output voltage adjustable range V_{OUT}		2.5		5.5	V
Fixed Output Voltage	FB=GND	4.95	5.15	5.25	V
Feedback voltage V_{FB}		490	500	510	mV
Oscillator frequency f_{OSC}		640	800	960	kHz
NCH Switch Current Limit	V_{OUT}= 5V		6		A
NCH Switch on resistance	V_{OUT}= 5V		50		mΩ

Electrical Characteristics (continued)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
PCH Switch on resistance	V_{OUT}= 5V		50		mΩ
Shutdown Current	V_{EN} = 0V, V_{IN} = 3.6V		0.1	1	µA
Quiescent Current V_{IN}	V_{FB} =0.55V , VOUT=5V		125	200	µA
EN logic low voltage				0.4	V
EN logic high voltage		1.4			V
EN leakage current	Clamped on GND or V_{IN}	-1		1	µA
Thermal Shutdown			150		℃
Thermal Shutdown Hysteresis			20		℃

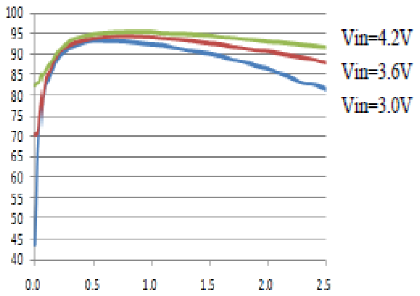
Functional Block Diagram



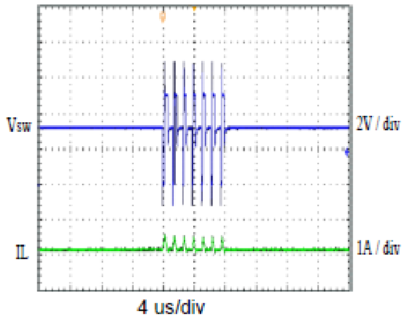
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 3.3V, EC3690 typical application circuit (Figure 1.), TA = +25°C, unless otherwise noted.

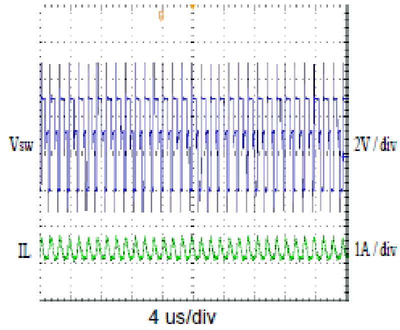
Efficiency vs. Load Current



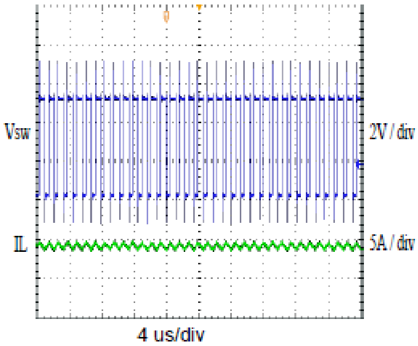
Steady State
VIN=3.3V,VOUT=5.0V,ILOAD=0A



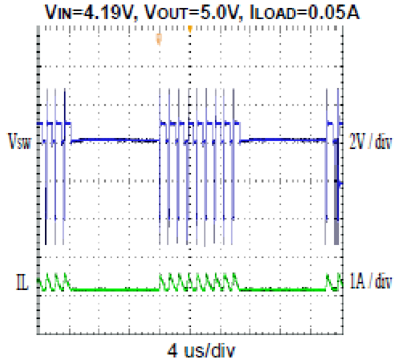
Steady State
VIN =3.3V, VOUT=5.0V, ILOAD=0.1A



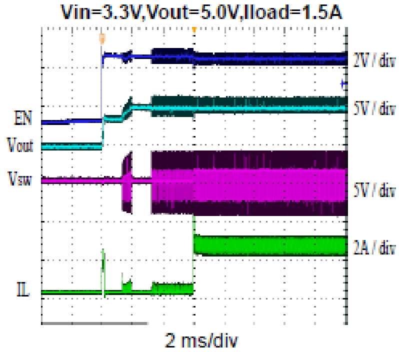
Steady State
VIN =3.3V, VOUT=5.0V, ILOAD=2A



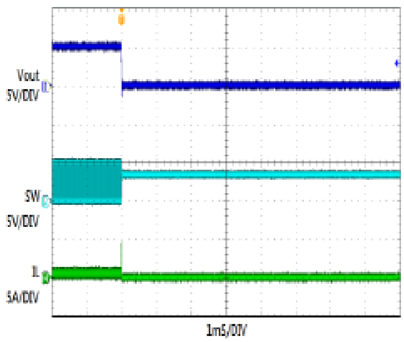
Steady State
VIN=4.19V, VOUT=5.0V, ILOAD=0.05A



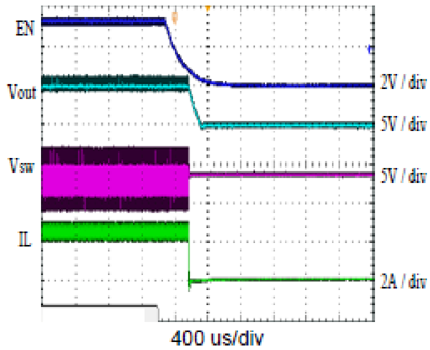
Startup from Enable
Vin=3.3V,Vout=5.0V,Iload=1.5A



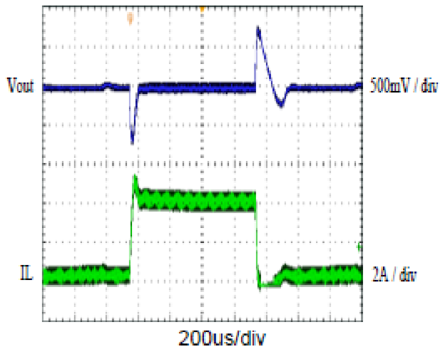
Short Circuit
VIN =3.3V, VOUT=5V,
ILOAD=0.3A to Short Circuit



Shutdown from Enable
VIN =3.3V, VOUT=5.0V,
ILOAD=1.5A



Load Transient
VIN =3.3V, VOUT=5.0V,
ILOAD=0.2A~1.8A



Detailed Description

The EC3690 is based on a fixed frequency current mode pulse width modulation topology. The peak current of the NMOS switch is sensed to limit the maximum current flowing through the switch and the inductor. The typical peak current limit is set to 6A. An internal temperature sensor prevents the device from getting overheated in case of excessive power dissipation.

Application Information

Because of the high integration of EC3690, the application circuit is simple. Only input capacitor CIN, output capacitor COUT, inductor L, output feedback resistors R3, R4 need to be selected for the targeted applications specifications.

Setting the Output Voltage

The EC3690output voltage can be adjusted with an external resistor divider (See Figure 1). The typical value of the voltage on the FB pin is 500mV. The maximum allowed value for the output voltage is 5.5 V. Choose the bottom resistor R4 in the 100kΩ~500kΩ range to set the divider current at 1 μA or higher. The value of resistor R3, depending on the needed output voltage VOUT, can be calculated using:

$$R_3 = R_4 \times \left(\frac{V_{OUT}}{V_{FB}} - 1 \right) = 200K\Omega \times \left(\frac{V_{OUT}}{500mV} - 1 \right)$$

Inductor Selection

The MT5030A 800 kHz high switching frequency allows for the use of small surface mount inductors. For high efficiency, choose inductors with high frequency core material, such as ferrite, to reduce core losses. Also to improve efficiency, choose inductors with bigger size for a given inductance. The inductor should have low DCR (copper-wire resistance) to reduce I2R losses, and must be able to handle the peak inductor current without saturating. The inductor DC current rating should be greater than the maximum input average current. For the full 2Amp output current applications, the inductor shall have enough core volume to support peak inductor currents in the 4A to 7A range and DCR less than 10mΩ. The highest peak current through the inductor and the switch depends on the output load, converter efficiency η, the input voltage (VBAT), and the output voltage (VOUT). Estimation of the maximum average inductor current can be done using:

$$I_L = I_{OUT} \times \frac{V_{OUT}}{V_{BAT} \times \eta}$$

A good estimation for the inductor ripple current is 20% to 40% of the output current.

$$\Delta I_L = (20\% \sim 40\%) \times I_{OUT(MAX)} \times \frac{V_{OUT}}{V_{IN}}$$

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

For example, for an output current of 2A at 5V with 85% efficiency, at least 4.7A of average current flows through the inductor at a minimum input voltage of 2.9V.
The MT5030 step-up converters can operate with an effective inductance in the range of 1μH to 2.2μH and with output capacitors in the range of 20μF to 100μF. The internal compensation is optimized for an output filter of L = 1.5μH and COUT = 20μF. To minimize radiated noise, use a toroidal or shielded inductor.

Input Capacitor

Place at least a 10 μF input ceramic capacitor close to the IC is to improve transient behavior of the regulator and EMI behavior of the total power supply circuit.

Output Capacitor

The output capacitor must completely supply the load during the charging phase of the inductor. A reasonable value of the output capacitance depends on the speed of the load transients and the load current during the load change. It is recommended to use X7R ceramic capacitors placed as close as possible to the VOUT and PGND pins of the IC. A recommended output capacitance value is around 20~100μF. Note that high capacitance ceramic capacitors have a DC Bias effect, which will have a strong influence on the final effective capacitance. A 10 V rated

0805 capacitor with 10μF can have an effective capacitance of less 5μF at an output voltage of 5V.

The first step to calculate the switch current is to determine the duty cycle D for the minimum input voltage. The minimum input voltage is used because this leads to the maximum switch current.

Layout consideration

Use wide and short traces for the main current path and for the power ground tracks. The input capacitor, output capacitor, and the inductor should be placed as close as possible to the IC. Use a common ground node for power ground and a different one for analog ground to minimize the effects of ground noise. Connect these ground nodes at any place close to the ground pins of the IC.

Thermal information

Implementation of integrated circuits in low-profile and fine-pitch surface-mount packages typically requires special attention to power dissipation. Many system-dependent issues such as thermal coupling, airflow, added heat sinks and convection surfaces, and the presence of other heat-generating components affect the power-dissipation limits of a given component.

Three basic approaches for enhancing thermal performance are listed below:

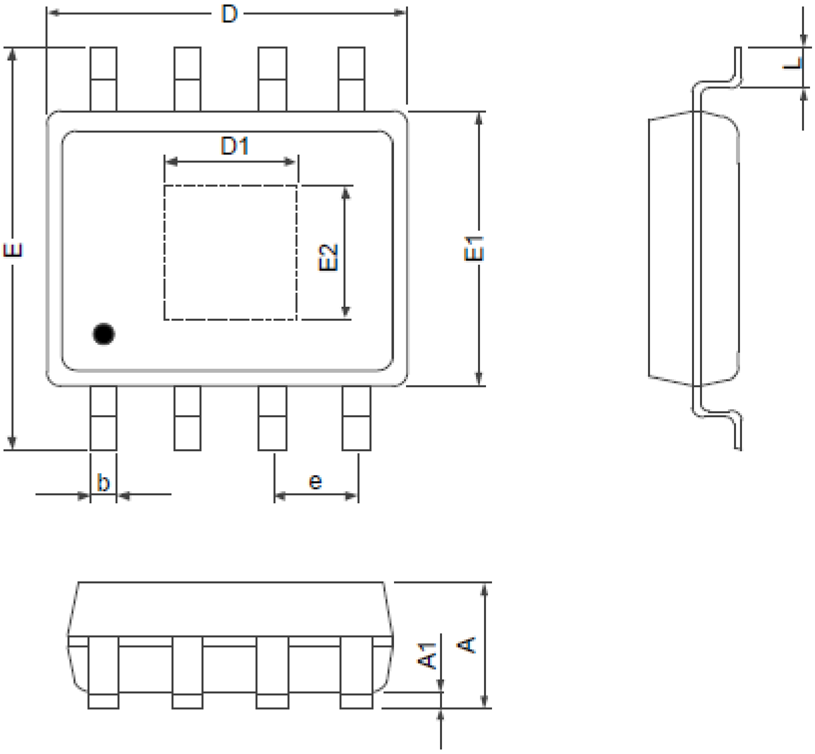
- High speed switching path (SW, PGND and VOUT with wide PCB traces) must be kept as short as possible.
- Solder the exposed pad of the MT5030A to the ground plane with multiple big thermal vias.
- Choose a bigger size 1.5uH Inductor with the lowest DCR value for given PCB space

The maximum junction temperature (TJ) of the MT5033devices is 125℃.The thermal resistance of the SOP8_EPpackage is RθJA = 38.2℃/W, if the Exposed PADis soldered. Specified regulator operation is assured to a maximum ambient temperature TAof +50 ℃. Therefore, the maximum power dissipation for the SOP8_EP package it is about 1.96W.More power can be dissipated if the maximum ambient temperature of the application is lower.

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{R_{\theta JA}} = \frac{125^{\circ}C - 50^{\circ}C}{38.2^{\circ}C / W} = 1.96W$$

Packaging Information

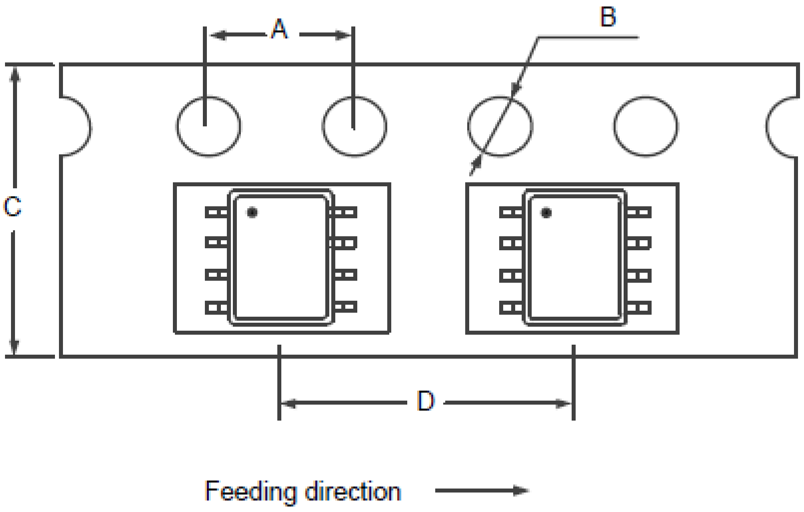
SOP_8L (EP) PACKAGE OUTLINE DIMENSONS



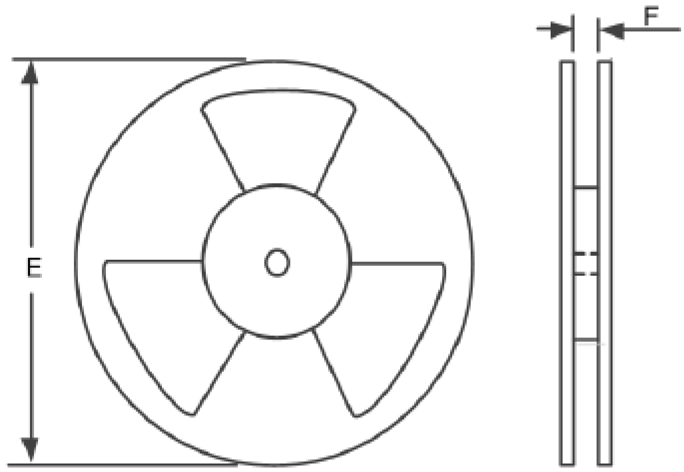
SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MIN.
A	1.35	1.75	0.053	0.069
A1	0.00	0.25	0.000	0.010
D	4.90		0.193	
E1	3.90		0.153	
D1	3.30		0.130	
E2	2.40		0.095	
E	5.80	6.20	0.228	0.244
L	0.40	1.27	0.016	0.050
b	0.31	0.51	0.012	0.020
e	1.27		0.050	

Carrier Tape & Reel Dimensions

1.Orientation / Carrier Tape Information :



2.Rokreel Information :



3.Dimension Details :

PKG Type	A	B	C	D	E	F	Q'ty/Reel
SOP 8L 150 mils	4.0 mm	1.5 mm	12.0 mm	8.0 mm	13 inches	13.0 mm	2,500

Reflow Profile

Classification Of IR Reflow Profile

Reflow Profile	Green Assembly
Average Ramp-Up Rate (Ts_{min} to Tp)	1~2℃/second
Preheat -Temperature Min(Ts_{min}) -Temperature Max(Ts_{max}) -Time(ts_{min} to ts ts_{max})	 150℃ 200℃ 60~180 seconds
Time maintained above: -Temperature(T_L) -Time(t_L)	 217℃ 40~50 seconds
Peak Temperature(Tp)	250 +0/-5 ℃
Time within 5℃ of actual Peak Temperature(tp)	15 seconds max.
Ramp-Down Rate	3℃/second
Time 25℃ to Peak Temperature	8 minutes max.

Note: For all temperature information, please refer to topside of the package, measured on the package body surface.