1.2MHz, 2.5A Step-Up Current Mode PWM Converter

Features

- Adjustable Output up to 12V
- Input Voltage Range: 2.6 V to 5.5 V
- 1.2MHz switching frequency
- Precision Feedback Reference Voltage: 0.6V (±2%)
- Internal 0.1Ω, 2.5A, 18V Power MOSFET
- Shutdown Current: 0.1μA
- Over Temperature Protection
- Over Voltage Protection
- Adjustable Over Current Protection: 0.5A ~ 2.5A
- Automatic Pulse Frequency Modulation Mode at Light Loads
- Package: SOT23-6
- RoHS Compliant

Description

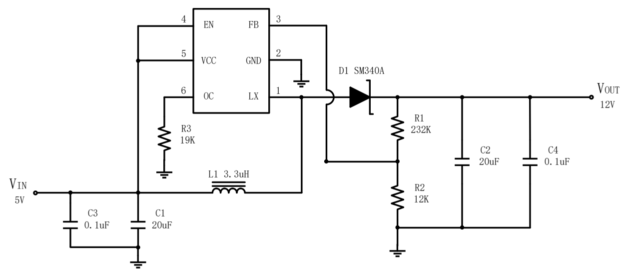
The **HL9220AM6R** is a current mode boost DC-DC converter. Its PWM circuitry with built-in 0.1Ω power MOSFET make this regulator highly power efficient. The internal compensation network also minimizes as much as 6 external component counts. The non-inverting input of error amplifier connects to a 0.6V precision reference voltage and internal soft-start function can reduce the inrush current.

The HL9220AM6R is available in the SOT23-6 package and provides space-saving PCB for the application fields.

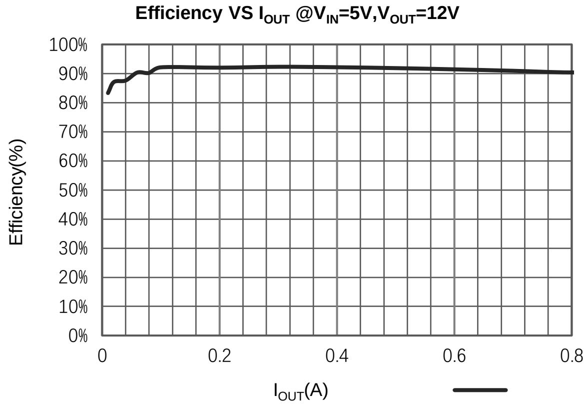
Applications

- Battery-Powered Equipment
- LCD Displays
- Digital Cameras
- Handheld Devices
- Portable Products

TYPICAL APPLICATION



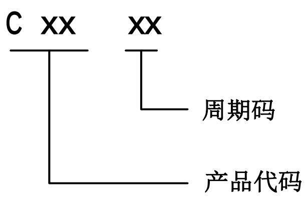
Efficiency



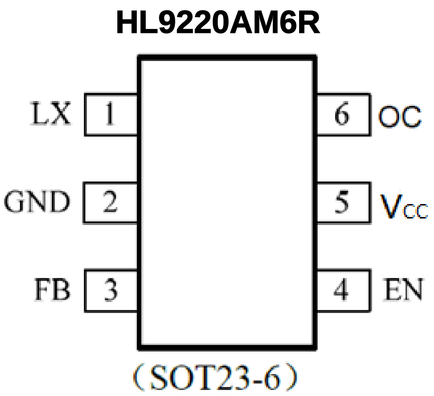
ORDERING INFORMATION

DEVICE	ORDER NUMBER	PACKAGE DESCRIPTION	AMBIENT TEMPERATURE	PACKAGE MARKING	PACKAGE OPTION
HL9220A	HL9220AM6R	SOT23-6	-40℃ to +85℃	Cxxxx	Tape and Reel

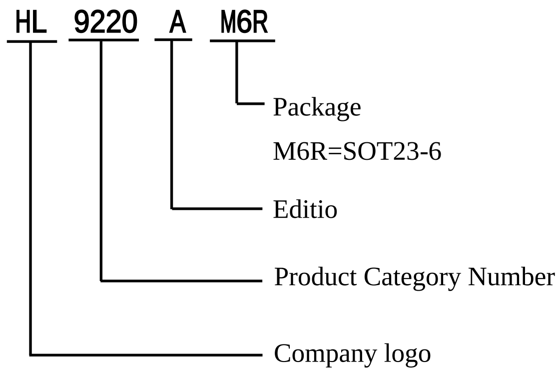
Marking Description



Pin Configuration and Functions



Selection Guide



Pin Functions

Pin NO.	Pin Name	Description
1	LX	It is connected to the inductor. Switch pin of the converter.
2	GND	Ground Pin.
3	FB	Error Amplifier Inverting Input. Connect a resistor R1 between V_{OUT} and FB, and a resistor R2 between FB and GND to program the output voltage: V_{OUT}=0.6V*(R1/R2+1).
4	EN	Enable pin for the chip. EN is logic high, the device is enable, EN is logic low, the device is disable.
5	VCC	Power Supply Input.
6	OC	Adjustable Current Limit (Floating Available).

Specifications

Absolute Maximum Ratings

Description		Min	Max	Units
VCC Supply Voltage		-0.3	6	V
LX Voltage		-0.3	18	V
EN,FB Voltage		0	6	V
Power Dissipation			0.5	W
Thermal Resistance(θJA)			250	℃/W
Junction Temperature		-40	150	°C
Operating Temperature		-40	85	°C
Storage Temperature Range		-65	150	°C
Lead Temperature		260		°C
ESD Rating	HBM (Human Body Mode)	2000		V
	MM (Machine Mode)	200		V

Recommended Operating Conditions

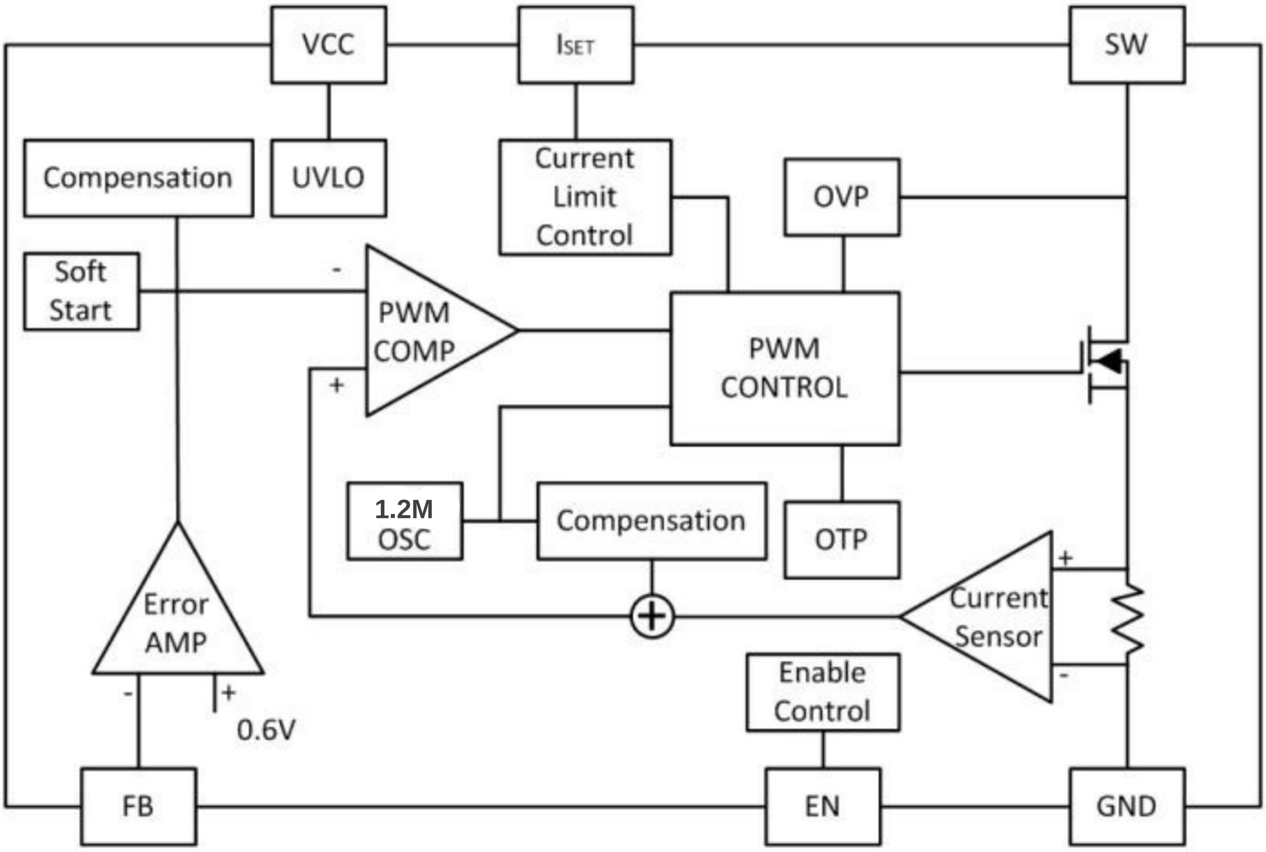
Description	Min	Max	Units
Supply Voltage	2.6	5.5	V
Operating junction temperature	-40	125	°C
Operating Temperature	-40	85	°C

Electrical Characteristics

(VCC=3.3V, TA=25°C, unless otherwise specified)

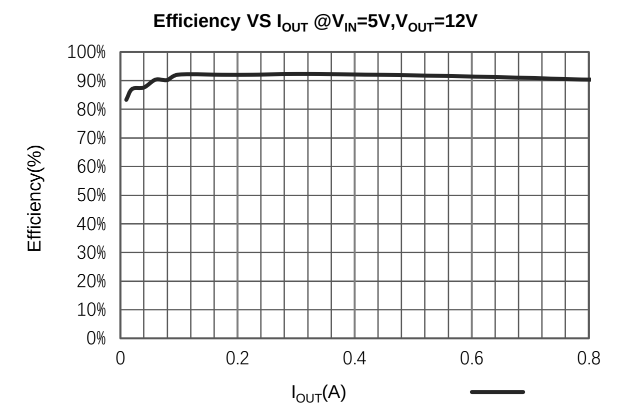
SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
System Supply Input						
VCC	Input Supply Range		2.6		5.5	V
V_{UVLO}	Under Voltage Lockout			2.2		V
	UVLO Hysteresis			0.1		V
I_Q	Quiescent Current	V_{FB}=0.66V, No switching		0.16		mA
	Average Supply Current	V_{FB}=0.55V, Switching		1.3		mA
I_{SD}	Shutdown Supply Current	V_{EN}=GND		0.1		uA
FREQUENCY						
F_{SW}	Switching frequency	V_{FB}=0.55V, Switching	1.02	1.2	1.38	MHz
△f / △V	Frequency Change with Voltage	VCC=2.6V to 5.5V		5		%
T_{DUTY}	Maximum Duty Cycle			90		%
LOGIC THRESHOLD						
V_{ENH}	EN high-level input voltage		0.96			V
V_{ENL}	EN low-level input voltage				0.6	V
V_{FB} VOLTAGE AND DISCHARGE RESISTANCE						
V_{FB}	V_{FB} threshold voltage		0.588	0.6	0.612	V
	Line Regulation	VCC=2.6V to 5.5V		0.2		%/V
MOSFET						
$R_{DS(ON)}$	On Resistance of Driver	I_{LX}=2A		0.1		Ω
CURRENT LIMIT						
I_{OCP}	Current limit			2.5		A
	Adjustable OCP Current	With External Resistor：19k~96k	0.5		2.5	A
THERMAL SHUTDOWN						
T_{SDN}	Thermal shutdown threshold	Shutdown temperature		145		°C
		Hysteresis		20		°C

Functional Block Diagram

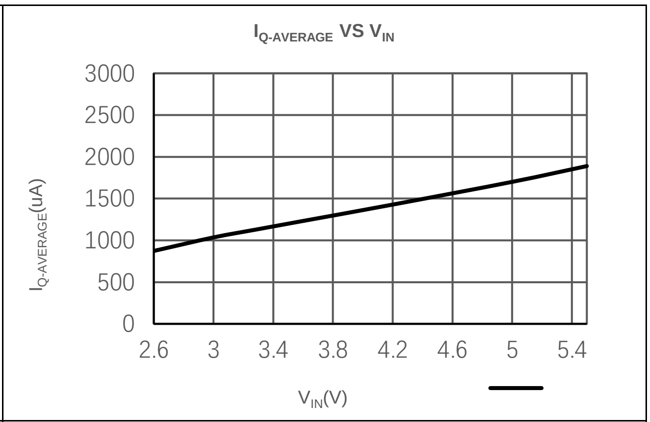


Typical Characteristics

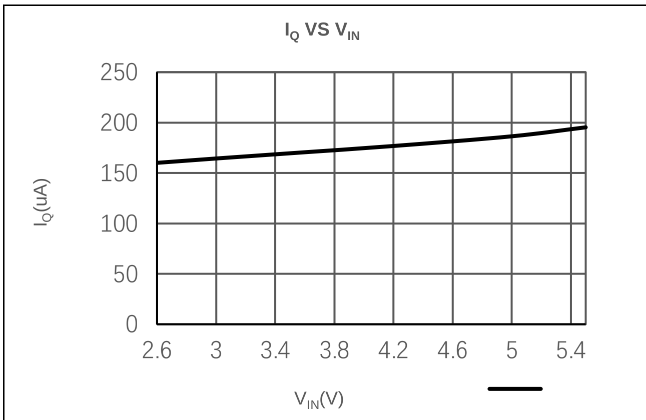
(VCC=5V, V_{OUT}=12V, TA= 25°C, unless otherwise noted)



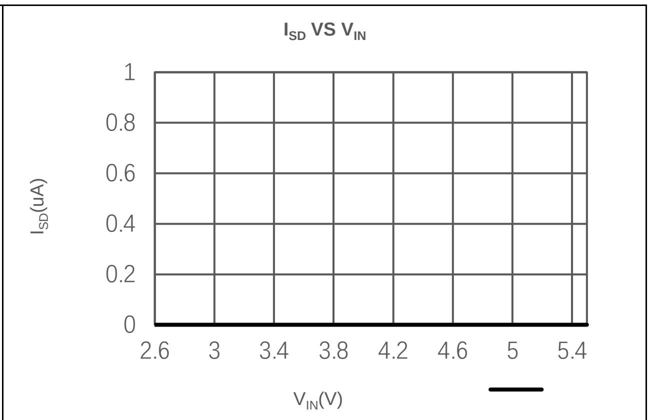
Efficiency vs Output Current



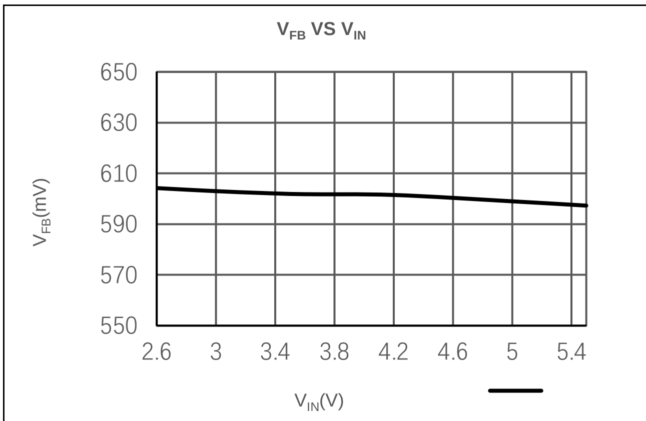
Average Supply Current vs Input Voltage



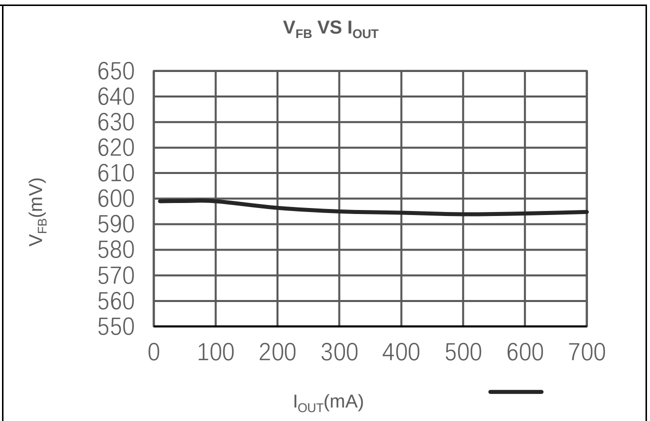
Quiescent Current vs Input Voltage



Shutdown Current vs Input Voltage



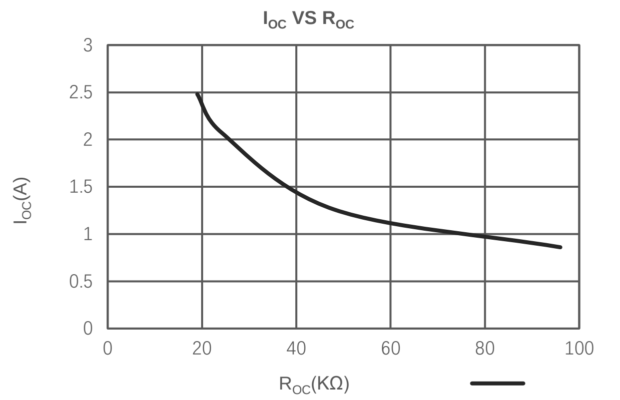
Reference Voltage vs Input Voltage



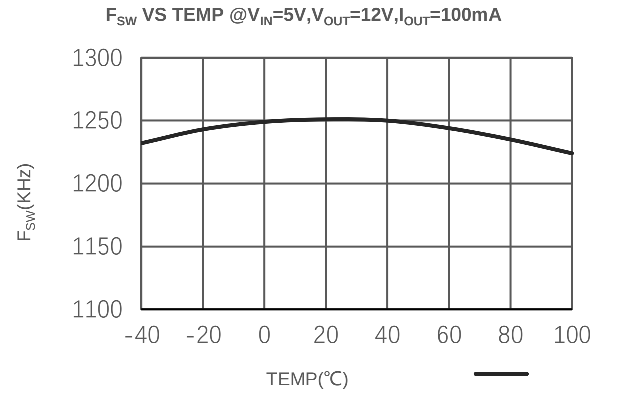
Reference Voltage vs Output Current

Typical Characteristics(continued)

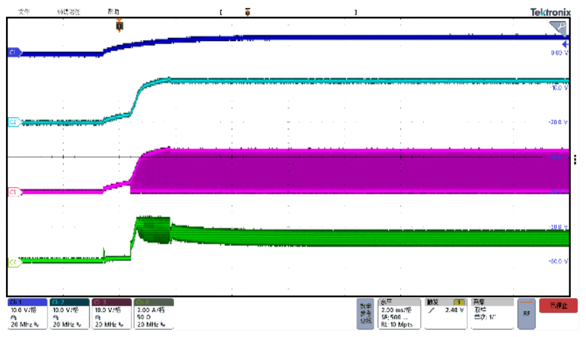
(VCC=5V, V_{OUT}=12V, TA= 25°C, unless otherwise noted)



Current Limit vs External Resistance (Roc)



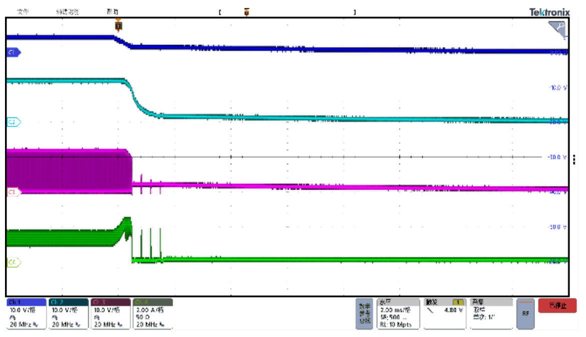
Operation Frequency vs Temperature



Startup by V_{IN}

CH1:V_{IN} CH2:V_{OUT} CH3:V_{SW} CH4:I_{SW}

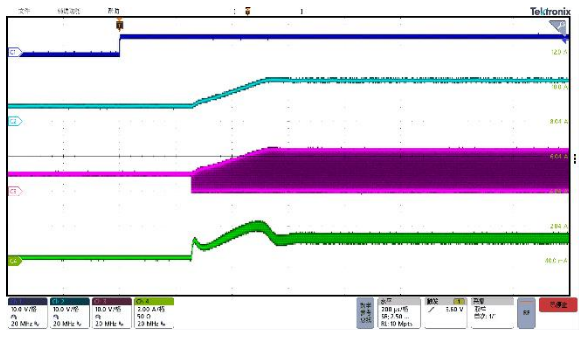
V_{IN}=5V,V_{OUT}=12V,I_{LOAD}=500mA



Shutdown by V_{IN}

CH1:V_{IN} CH2:V_{OUT} CH3:V_{SW} CH4:I_{SW}

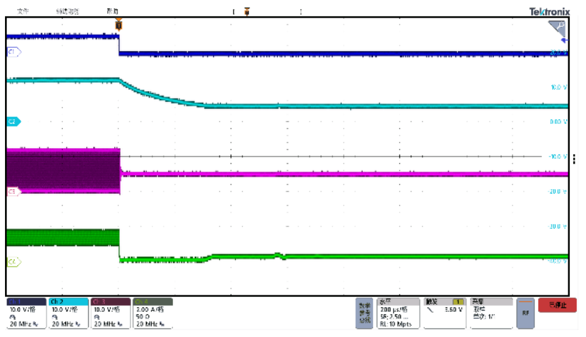
V_{IN}=5V,V_{OUT}=12V,I_{LOAD}=500mA



Startup by EN

CH1:V_{EN} CH2:V_{OUT} CH3:V_{SW} CH4:I_{SW}

V_{IN}=5V,V_{OUT}=12V,I_{LOAD}=500mA



Shutdown by EN

CH1:V_{EN} CH2:V_{OUT} CH3:V_{SW} CH4:I_{SW}

V_{IN}=5V,V_{OUT}=12V,I_{LOAD}=500mA

Detailed Description

Overview

The HL9220AM6R is a current mode boost converter. The constant switching frequency is 1.2MHz and operates with pulse width modulation (PWM). Build-in 18V / 2.5A MOSFET provides a high output voltage. The control loop architecture is peak current mode control; therefore slope compensation circuit is added to the current signal to allow stable operation for duty cycles larger than 50%.

Feature Description

Soft Start

Soft start circuitry is integrated into HL9220AM6R to avoid inrush current during power on. After the IC is enabled, the output of error amplifier is clamped by the internal soft-start function, which causes PWM pulse width increasing slowly and thus reducing input surge current.

Current Limit Resistors Selection

A resistor between OC and GND pin programs peak switch current. The resistor value should be between 19k and 96k. The current limit will be set from 2.5A to 0.5A. Keep traces at this pin as short as possible. Do not put capacitance at this pin. To set the over current trip point according to the following equation:

$$I_{OCP} = \frac{48000}{R3}$$

Undervoltage Lockout (UVLO) Protection

UVLO protection monitors the internal regulator voltage. When the voltage is lower than UVLO threshold voltage, the device is shut off. This protection is non-latching.

Thermal Shutdown

HL9220AM6R will turn off the power MOSFET automatically when the internal junction temperature is over 145°C. The power MOSFET wake up when the junction temperature drops 20°C under the OTP threshold temperature.

Over Voltage Protection (OVP)

In some condition, the resistive divider may be unconnected, which will cause PWM signal to operate with maximum duty cycle and output voltage is boosted higher and higher. The power MOSFET will be turned off immediately, when the output voltage exceeds the OVP threshold level. The HL9220AM6R’s OVP threshold is 16V.

APPLICATION INFORMATION

Inductor Selection

Inductance value is decided based on different condition. 3.3uH to 4.7μH inductor value is recommended for general application circuit. There are three important inductor specifications, DC resistance, saturation current and core loss. Low DC resistance has better power efficiency. Also, it avoid inductor saturation which will cause circuit system unstable and lower core loss at 1.2 MHz.

Capacitor Selection

The output capacitor is required to maintain the DC voltage. Low ESR capacitors are preferred to reduce the output voltage ripple. Ceramic capacitor of X5R and X7R are recommended, which have low equivalent series resistance (ESR) and wider operation temperature range.

Diode Selection

Schottky diodes with fast recovery times and low forward voltages are recommended. Ensure the diode average and peak current rating exceed the average output current and peak inductor current. In addition, the diode's reverse breakdown voltage must exceed the output voltage.

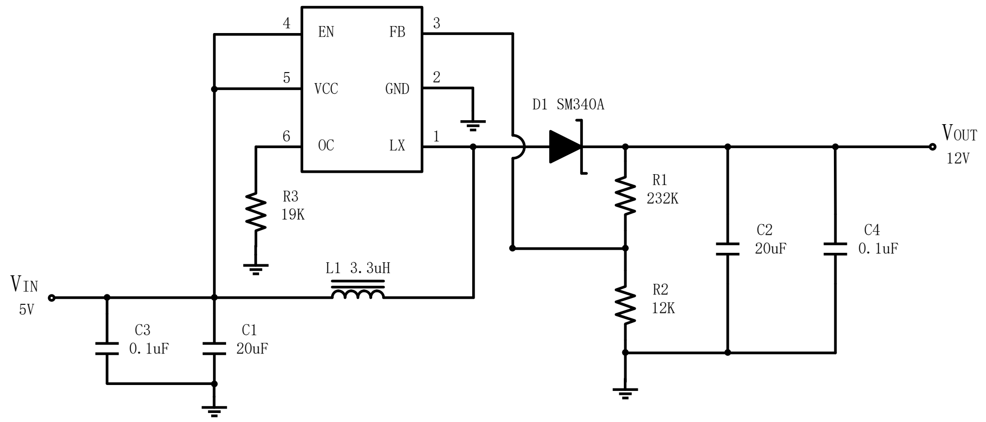
Output Voltage Resistors Selection

The output voltage is set by a resistive voltage divider from the output voltage to FB. The output voltage is:

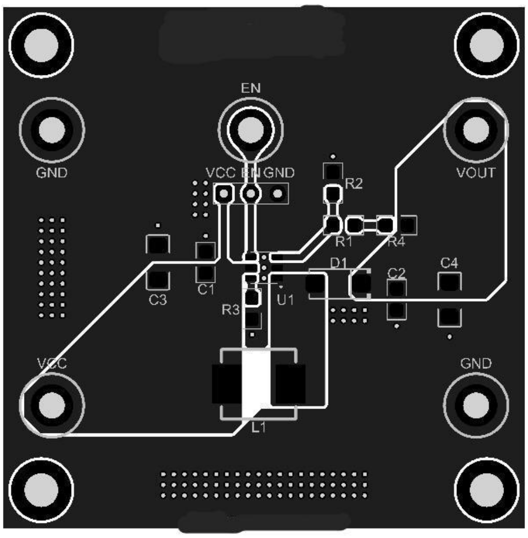
$$V_{OUT} = 0.6V\left(1 + \frac{R1}{R2}\right)$$

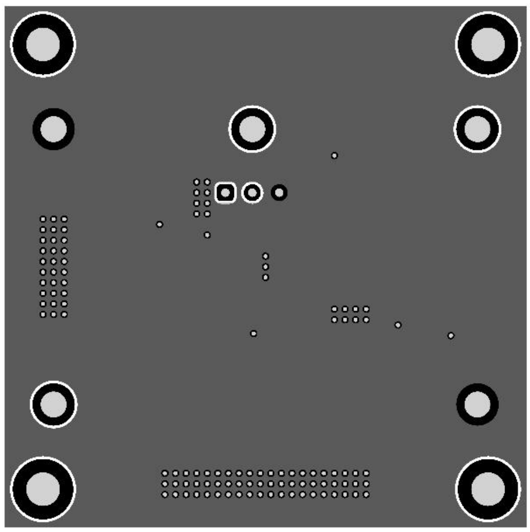
V_{OUT}	R1	R2
12V	232K(1%)	12K(1%)
9V	169K(1%)	12K(1%)
5V	88.7K(1%)	12K(1%)

Typical Application

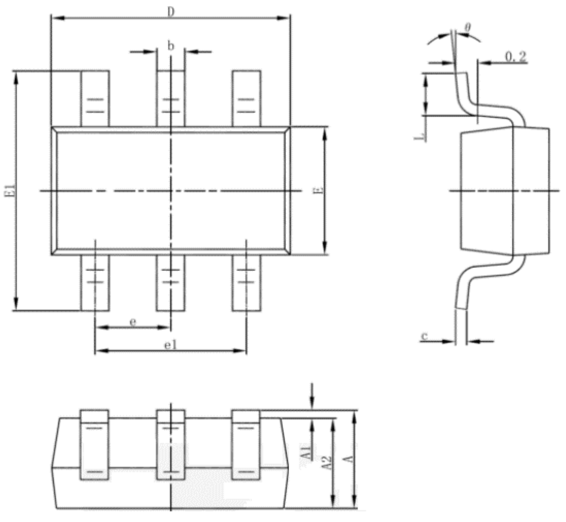


Layout Example





PACKAGE DESCRIPTION



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°