5V/1A Synchronous Buck Converter

Product Features

- Input operation range: 2.7 – 5.5V .
- Input over voltage protection at 6V.
- 40uA quiescent current in operation
- Output current up to 1A
- Efficiency up to 95%
- OCP, SCP and OTP protection
- SOT23-5L package

Product Overview

The FS3013 is a compact 5V Buck Converter which can deliver 1A output current.

FS3013 employs a proprietary control loop to achieve a fast transient load response. It keeps high converting efficiency in both light load and heavy load. FS3013 is equipped with all kinds of protection, such as input over voltage protection, output short circuit protection, over current protection and over temperature protection.

FS3013 is consists of internal power tree generator, bandgap voltage reference module, under-voltage-lockout (UVLO) module, error amplifier, protection circuitry, driver block, current sensing block and two power MOSFETs.

FS3013 is housed in a SOT23-5L package.

Order information

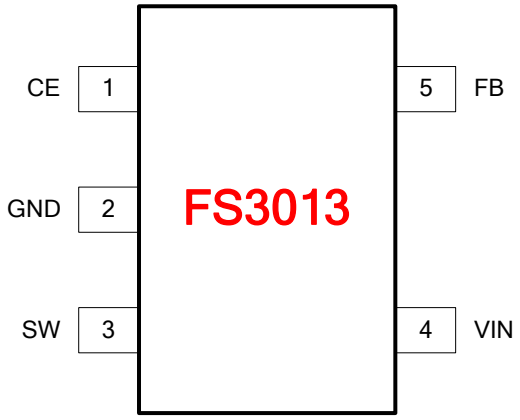
Part No	Package	Pcs/Reel
FS3013	SOT23-5	3000

Application field

- Set-top Box
- Solid State Drive
- WIFI and Network Devices
- Security surveillance system
- Toys
- TV
- All other electronic devices

V0.1(202310)

Chip packaging and pin definition



FS3013 Pin function description

SOT23-5L	Name of the pin	Description
1	CE	Chip enable pin, pull high to turn on the chip
2	GND	Ground
3	SW	The switching node, connecting a 2.2uH inductor to this node
4	VIN	The input power node, connecting a 10uF capacitor to ground
5	FB	Feedback node, with Vfb at 0.6V

Marking Information

Top Marking	Part Number Coding
C3YW1	FS3013PP
C3 Fixed, ID for FS3013	FS3013 Fixed, ID for FS3013
Y Code of year	BA Package Code
W Code of week	BA:SOT23-5L
1 Version control	

Absolute Maximum Ratings

Maximum working range

Parameter	value
V_{IN} (1)	-0.3V~6V
V_{OUT} (1)	-0.3V~5.5V
Continuous Power Dissipation (T_A = 25°C) (2)	
SOT23-5L	0.4W
Junction Temperature	-40°C to 125°C
Lead Temperature	260°C
Storage Temperature	-65°C to +150°C
hermal Resistance (3)	θ_{JA} θ_{JC}
SOT23-5L	170°C /W 75°C /W

Notes:

(1) Exceeding these ratings may damage the device.

(2) 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.

(3) Measured on JESD51-7, 4-layer PCB.

Electrical Characteristics

All typical values are at Tj=25°C (unless otherwise noted)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input voltage range, V_{IN}		2.7		5.5	V
Input over voltage protection		5.8	6	6.5	V
Quiescent current, I_Q	V_{IN} = 5V	20	40	60	μA
Shutdown current, I_{OFF}	V_{IN} = 5V, V_{CE} = 0		0.1	2	μA
Input voltage UVLO	Rising		2.55	2.65	V
	Falling	2.25	2.37		V
Feedback voltage	V_{IN} = 5V	0.588	0.6	0.612	V
Output current Limit	V_{IN} = 5V, V_{OUT} = 3.3V	1	1.2		A
Line regulation	V_{IN} = 3 to 5V		0.2		%
Load regulation	I_{OUT}= 0.1 – 1A		0.1	2	%
Switching frequency	V_{IN} = 5V	1	1.5	2	MHz
ON resistance PMOS	V_{IN} = 5V		0.38		Ω

ON resistance NMOS	V_{IN} = 5V		0.25		Ω
CE input threshold ON	V_{IN} = 5V		0.9	1.1	V
CE input threshold OFF	V_{IN} = 5V	0.4	0.7		V
CE input pull down resistor			750		KΩ
Output discharge resistor, R_{pd}	V_{IN} = 5V		600		Ω
Over temperature protection			150		°C
OTP hysteresis			40		°C

Application Information

Output Voltage Setting

FS3013's feedback voltage is set at 0.6V, and it requires a 10Kohm resistor from FB node to ground. Assuming the resistor between output node and FVB node is R1, the output voltage of DC-DC converting system is given by

$$\text{Vout} = \frac{0.6\text{V}}{10\text{Kohm}} \times (\text{R1}+10\text{Kom}).$$

Capacitor Selection

FS3013 requires one minimal 10uF MLCC capacitor at VIN node and one 10uF MLCC capacitor at VOUT node, however, it is always recommended to have two 10uF MLCC capacitors placed in parallel both at VIN and VOUT node to minimize the noise and withstand the current surge. It is also essential to place both input capacitors and output capacitors as close to FS3013's VIN pin and VOUT pin as possible. An PCB layout example is shown at PCB layout recommendation section.

Inductor Selection

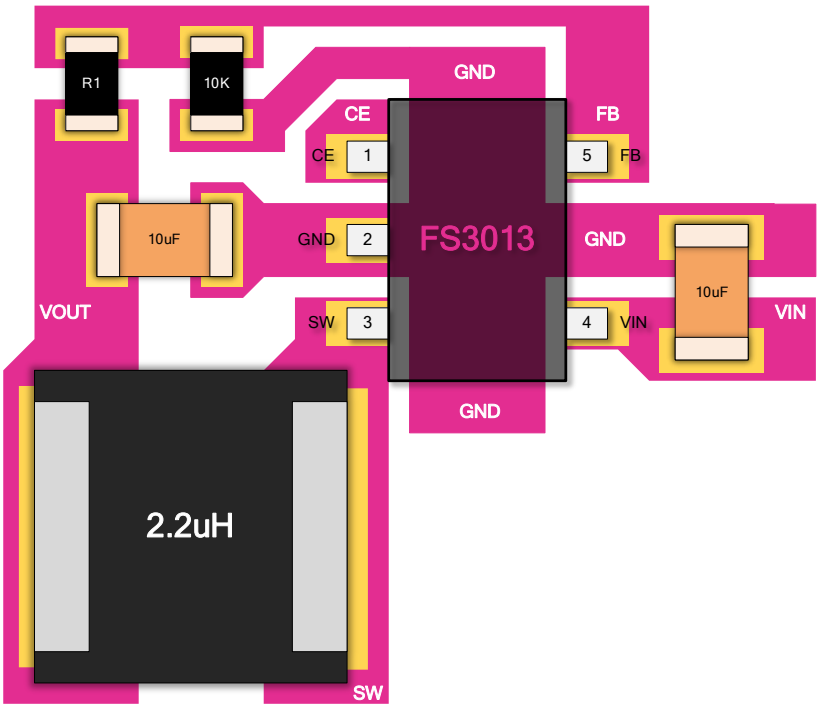
FS3013 works at a 1.5MHz oscillating frequency which helps to have a small voltage ripple at output. And 2.2uH inductor is found the most suitable value while meeting requirements on small output voltage ripple as well as a high-power conversion efficiency.

Thermal Considerations

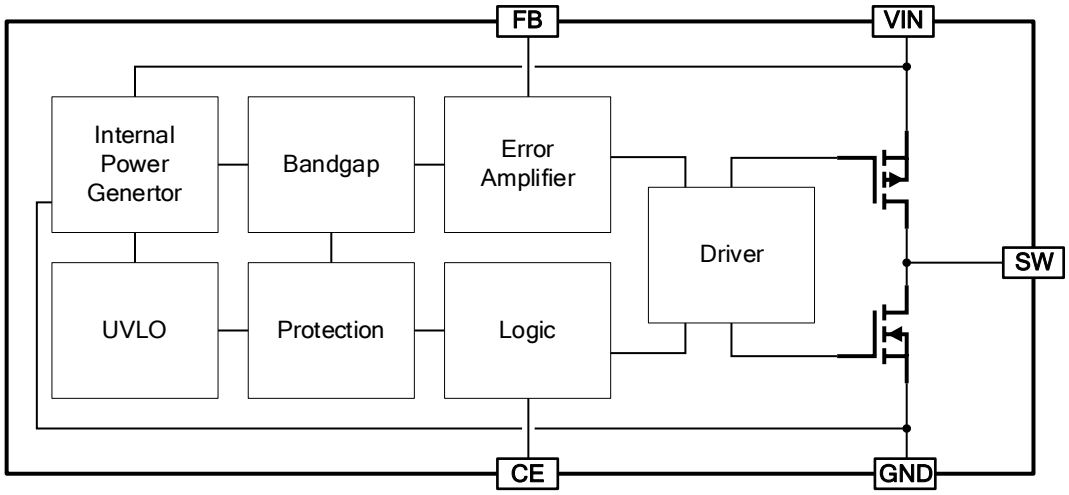
Though FS3013 is a high efficiency DC/DC converter, there will always be some power lost during conversion, most of which becomes heat to make junction temperature higher. PCB design to ensure a good heat dissipation is important. Because the heat dissipation of the SOT23-5L package is conducted through the pin No. 2, which is GND node of FS3013, please make sure the ground plate of PCB is big enough to carry away the heat generated in the chip.

PCB Layout

An illustration of PCB layout recommendation with key elements is laid out as following. Please follow this PCB instruction to place the key peripheral devices such as input capacitors, output capacitors and inductor. And star-like connection for ground node is essential. And keeping power loop area as small as possible will improve the EMI performance.

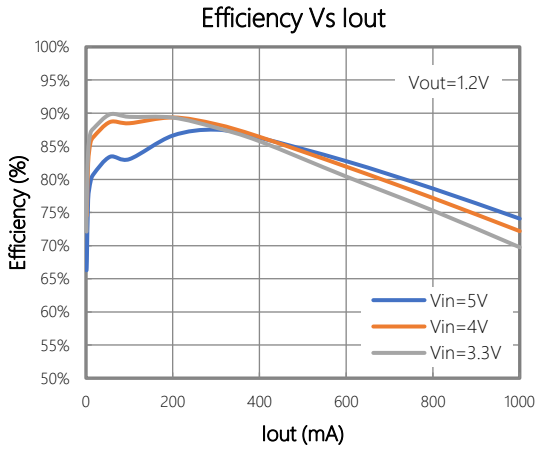


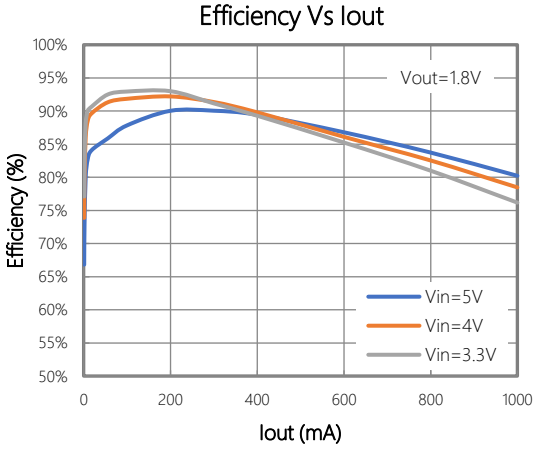
Block Diagram



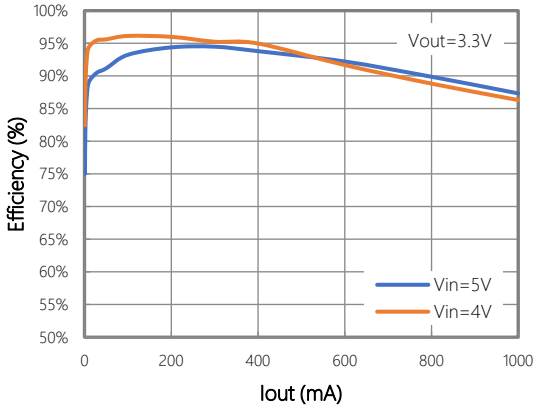
Typical Characteristics

C_{IN}=C_{OUT}=1uF, T_A = 25°C, unless otherwise specified

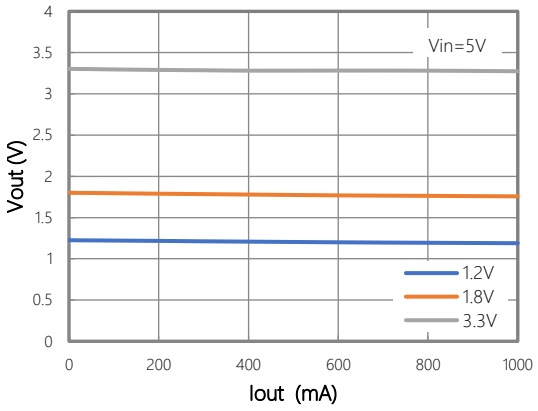




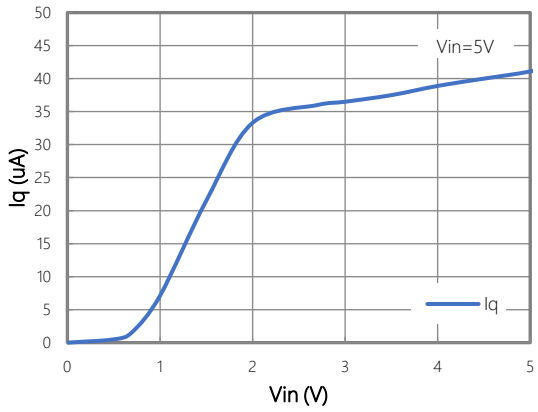
Efficiency Vs Iout



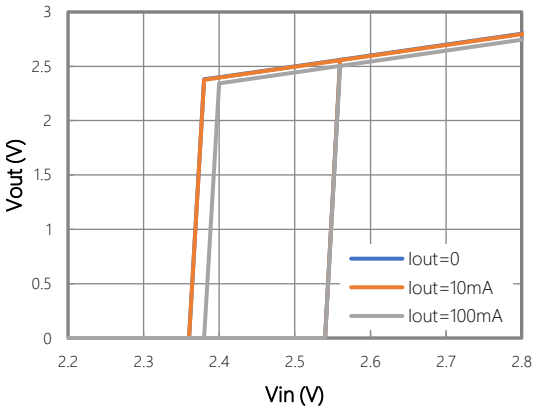
Vout Vs. Iout



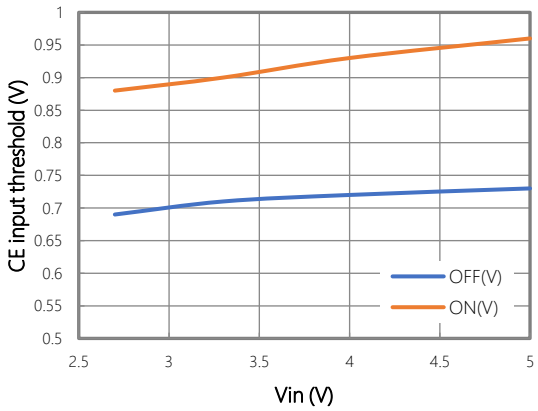
Iq Vs. Vin



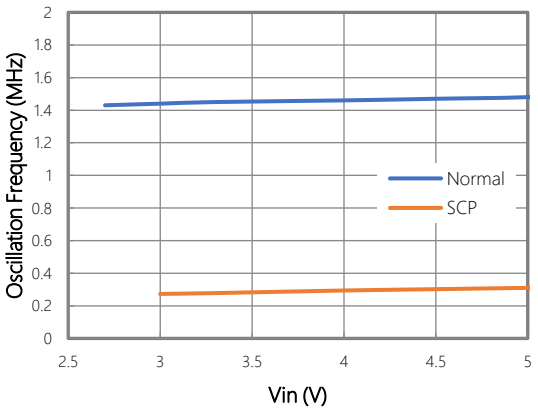
Vout Vs Vin



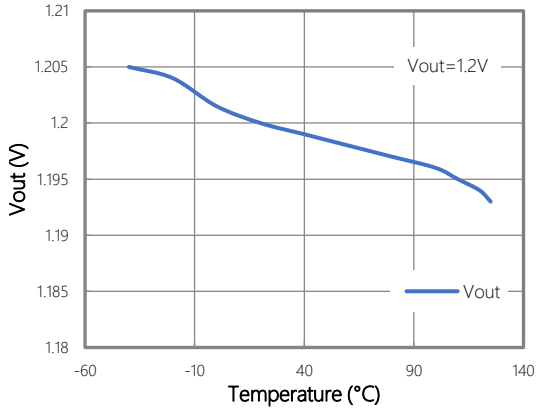
Threshold Vs. Vin



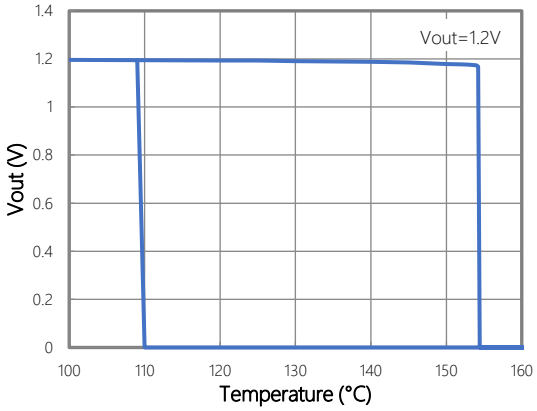
Frequency Vs. Vin



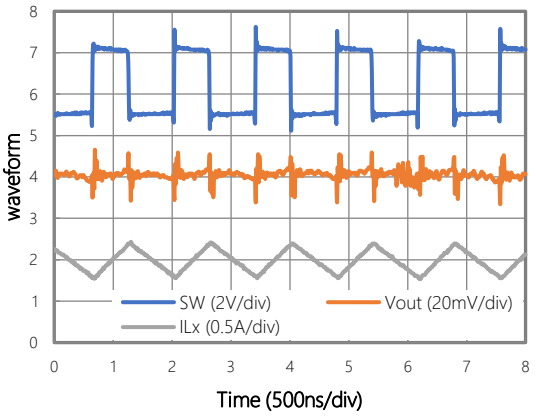
Vout Vs. Temp



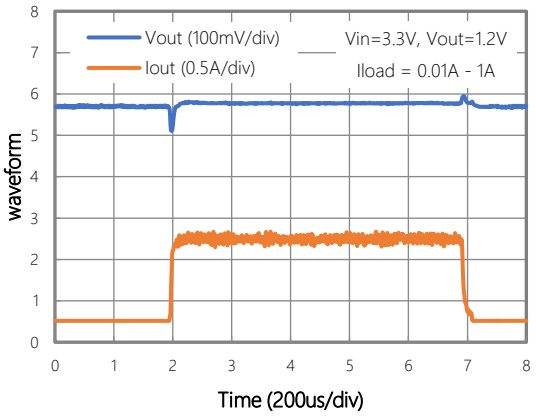
OTP Hystersis



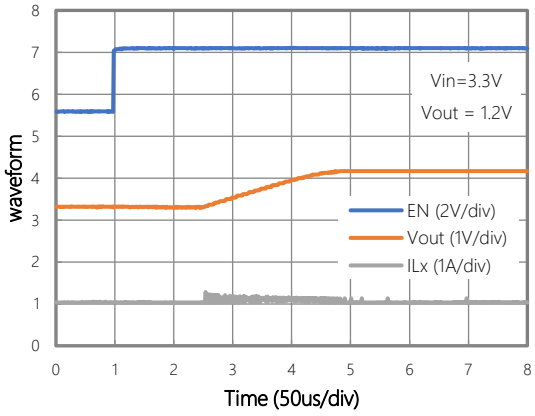
Switching Waveform



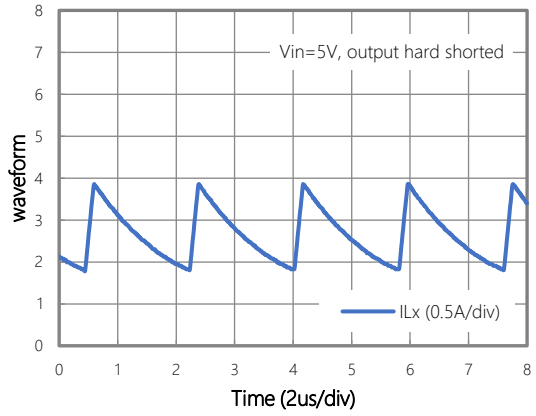
Load Transient Response



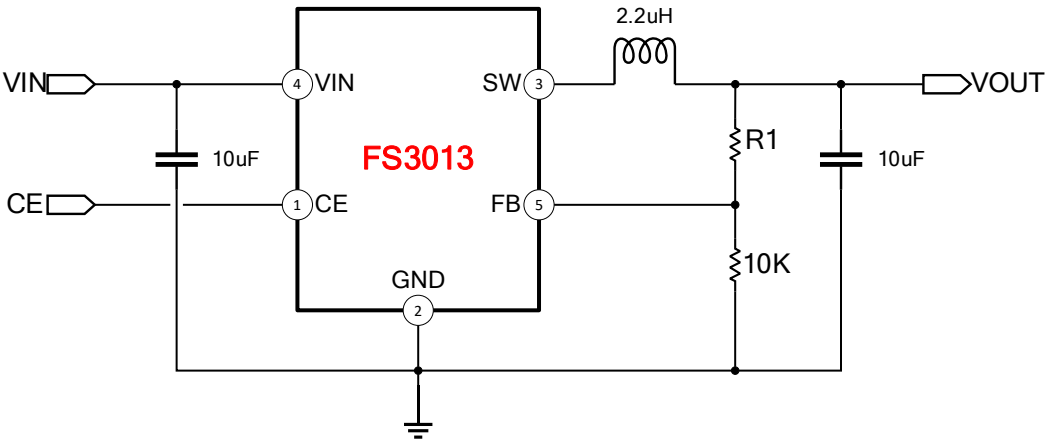
EN Startup



Short Circuit Response



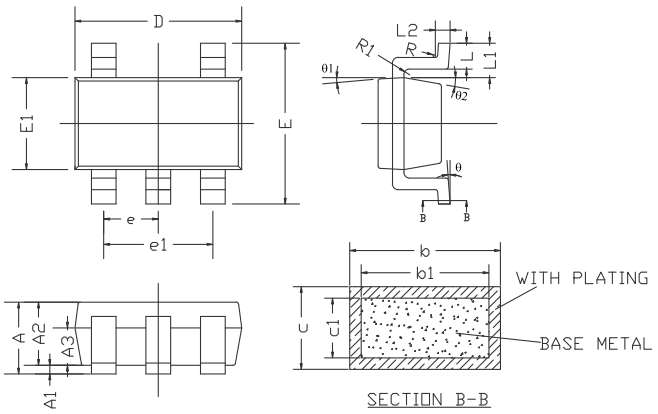
Application example



Package outline drawing

SOT23-5L

Package dimension (mm):



Symbol	MIN	NORM	MAX
A	-	-	1.25
A1	0.00	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.50
b1	0.36	0.38	0.45
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59 REF		
L2	0.25 BSC		
R	0.05	-	-
R1	0.05	-	0.20
Θ	0°	-	8°
Θ1	3°	5°	7°
Θ2	6°	-	14°

Company information and statement

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