GS5801

3W, 0.85V Startup Voltage, Synchronous Step-Up Converter

Product Description

The GS5801 is a high efficiency synchronous step-up converter that can provide up to 3W of power to a boosted output from a low voltage source. Unlike most step-up converter, not only it starts up at a very low input voltage as low as 0.85V, it also incorporates circuits that disconnect the input from output, during shutdown, short-circuit, output current overloading, or other events when output is higher than the input. This eliminates the need for an external MOSFET and its control circuitry to disconnect the input from output, and provides robust output overload protection.

The GS5801 starts up from a voltage as low as 0.85V making it ideal for applications with single-cell or two-cell alkaline, NiCd, and NiMh batteries. A switching frequency of 2MHz minimizes solution footprint by allowing the use of tiny and low profile inductors and ceramic capacitors. An internal synchronous MOSFET provides highest efficiency and with a current mode control that is internally compensated, external parts count is reduced to minimal.

GS5801 is available in two types, fixed output voltage type and adjustable output voltage type. It has fixed output voltage from 2.1V, 3.3V and 5V.

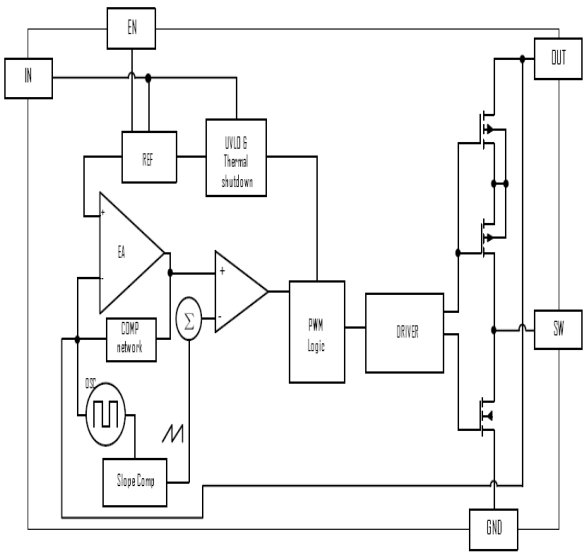
Features

- Output Disconnect
- Short-circuit Protection
- 3W Output Power
- Output to Input Reversed Current Protection
- 0.85V Low Start-up Voltage
- V_{IN} range from 0.6V to 4.5V
- Fixed Output Voltage : 2.1V, 3.3V and 5V
- Feedback Voltage : 0.6V (TYP)
- Up to 96% Efficiency
- 40μA No load I_Q and light load PFM Mode
- Internal Synchronous Rectifier
- Current Mode control
- Logic Control Shutdown and Thermal shutdown
- Miniature Packages : SOT-23-5L and DFN2x2-6L
- RoHS Compliant, 100%Pb & Halogen Free

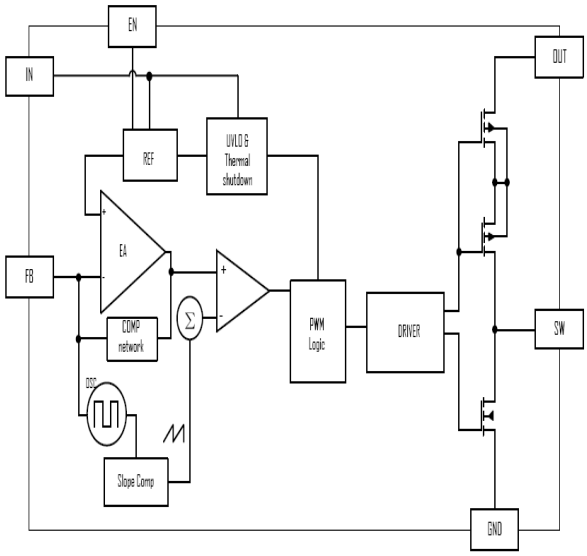
Applications

- USB OTG for MIDs, Smart phones
- Mobile back-up Battery Chargers
- Alkaline, NiCd, and NiMh batteries applications
- USB powered devices

Block Diagram

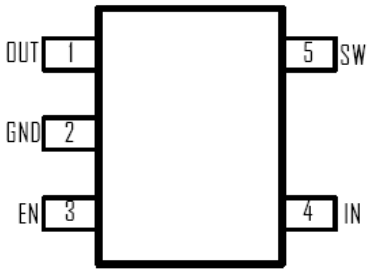
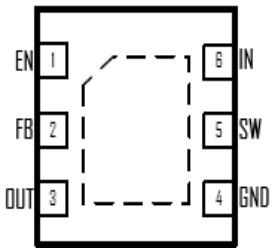


Fixed Voltage Type



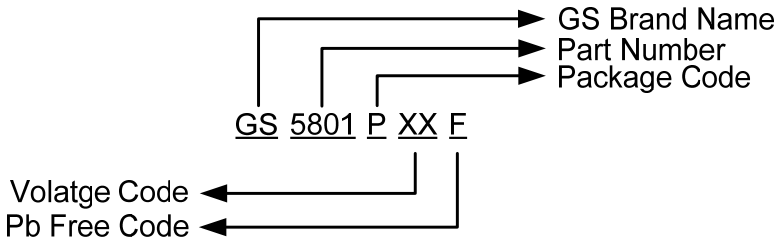
Adjustable Voltage Type

Packages & Pin Assignments

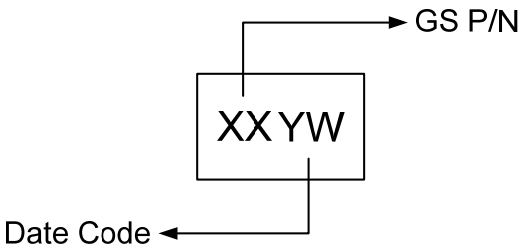
SOT-23-5L (Fixed)	DFN2x2-6L (ADJ)
	

Pin Name	Function
EN	Enable pin for the IC. Drive this pin high to enable the part, low to disable.
FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set V_{OUT}.
OUT	Output pin. Bypass with a 22μF or larger ceramic capacitor closely between this pin and GND.
GND	Ground Pin.
SW	Inductor Connection. Connect an inductor Between SW and the regulator output.
IN	Input Supply Voltage. Bypass with a 4.7μF ceramic capacitor to GND.

Ordering Information



Marking Information



Part Number	Package	Marking
GS5801L21F	SOT-23-5L	DaYW
GS5801L33F	SOT-23-5L	DzYW
GS5801L50F	SOT-23-5L	CPYW
GS5801FAF	DFN2x2-6L	DPYW

Absolute Maximum Ratings

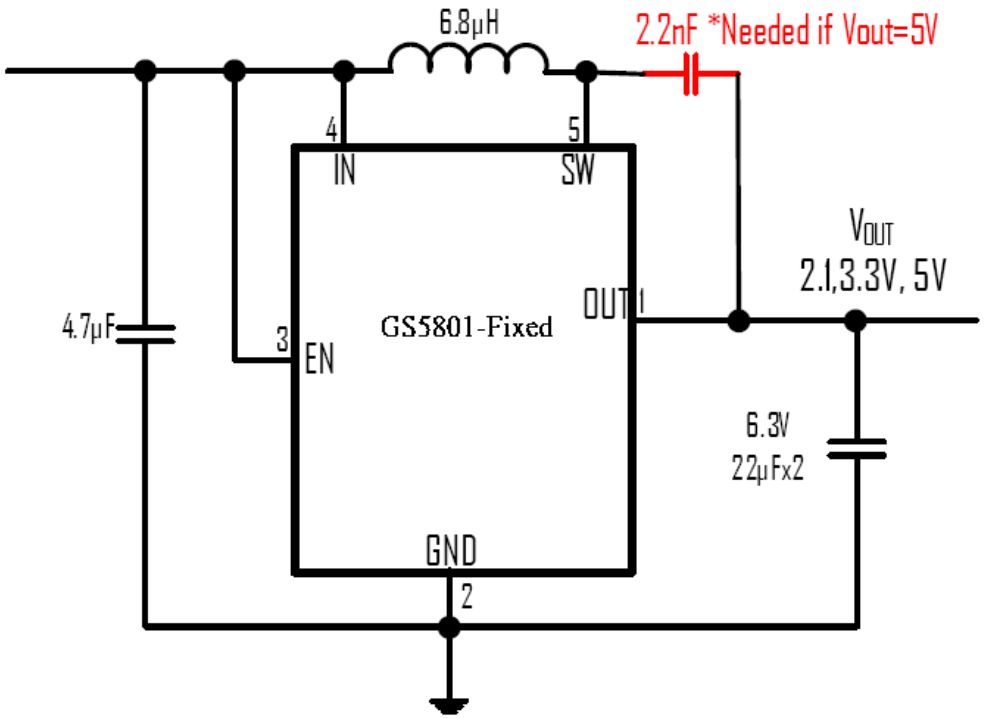
Symbol	Description		Value	Units
V_{SW}	SW Voltage		-0.3 to 5.5	V
	All Other Pin Voltages		-0.3 to 5	V
I_{PEAK}	SW to Ground Current		Internally limited	
θ_{JA}	Thermal Resistance Junction to Ambient	SOT-23-5L	220	°C/W
		DFN2x2-6L	80	°C/W
θ_{JC}	Thermal Resistance Junction to Case	SOT-23-5L	110	°C/W
		DFN2x2-6L	30	°C/W
T_A	Operating Temperature Range		-40 to +85	°C
T_{STG}	Storage Temperature Range		-55 to +150	°C

Electrical Characteristics

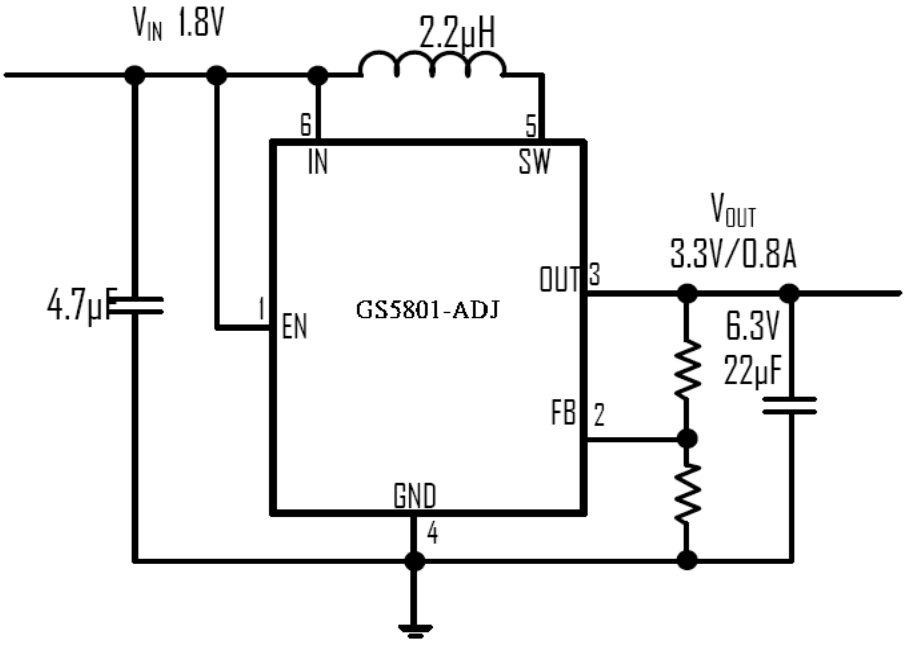
V_{IN}=1.8V, V_{OUT}=3.3V, T_A= 25°C, unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Minimum Input Voltage	-	-	0.6	-	V
-	Startup Voltage	I_{OUT}=0A	-	0.85	1.1	V
V_{FB}	FB Feedback Voltage	V_{OUT}=2.1V to 5V	0.582	0.6	0.618	V
I_{FB}	FB Input Current	-	-	-	50	nA
V_{OUT}	Output Voltage (Fix Mode)	V_{IN}=1.8V	-	2.1	-	V
			-	3.3	-	
			-	5.0	-	
V_{OUT}	Output Voltage (Adj Mode)	External Driver	1.2		5	V
I_Q	Quiescent Current	V_{FB}=0.7V	-	40	-	μA
I_{SHUT}	Shutdown Current	V_{EN}=GND	-	0.5	5	μA
F_{SW}	Switching Frequency	V_{IN}<4.3V	1.2	2	2.4	MHz
$D_{(MAX)}$	Maximum Duty Cycle	V_{FB}=0V	90	-	-	%
V_{EH}	EN Input High Voltage	-	0.6	-	-	V
V_{EL}	EN Input Low Voltage	-	-	-	0.3	V
$R_{DS(ON)\_H}$	NMOS Switching On Resistance	I_{SW}=100mA	-	150	350	mΩ
$R_{DS(ON)\_L}$	PMOS Switching On Resistance	I_{SW}=100mA	-	150	350	mΩ
I_{SW_LIM}	NMOS Switch Current Limit	-	1.2	1.5	-	A
-	Start-up Current Limit	-	-	0.5	-	A
-	Output to Input Reverse Leakage Current	V_{EN}=GND	-	0.1	5	μA
-	SW Leakage Current	V_{OUT}=5V, V_{SW}=0V or 5V, V_{EN}=GND	-	-	10	μA
I_{EN}	EN Input Current	-	-	0.1	1	μA
T_{SD}	Thermal Shutdown	Rising, Hysteresis=10°C	-	165	-	°C

Typical Application Circuit



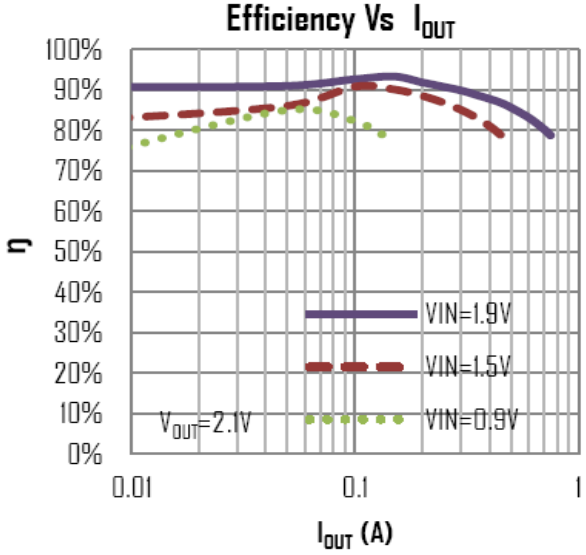
Fixed Voltage Operation

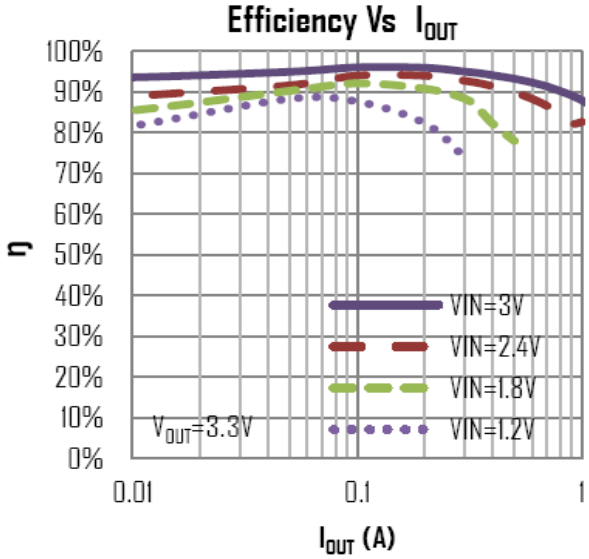


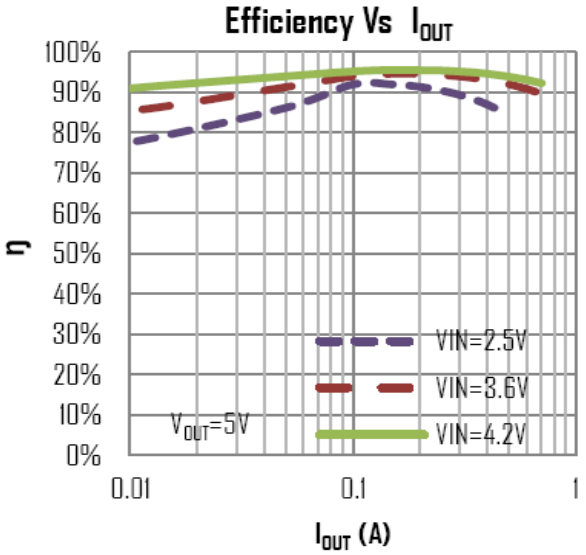
ADJ Voltage Operation

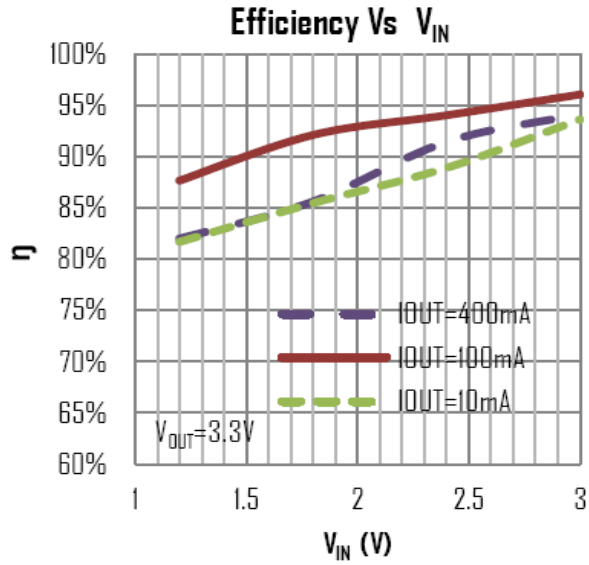
Note:
When output voltage is programmed to above 4.5V at GS5801-ADJ version, in order to maintain an acceptable peak voltage at SW, a small parallel capacitor snubber between SW and OUT is necessary.

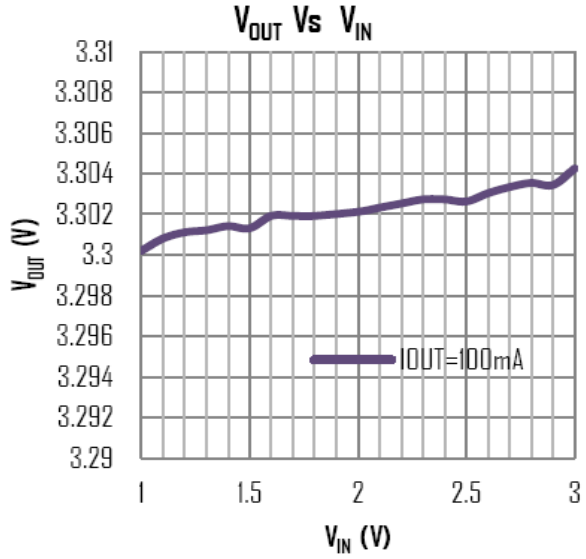
Typical Performance Characteristics

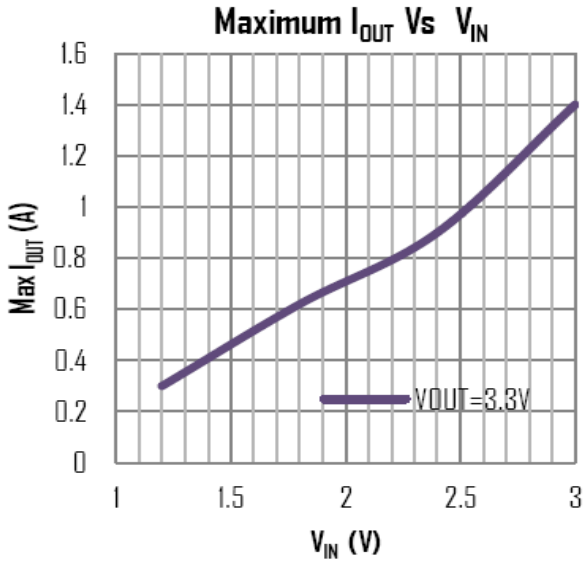






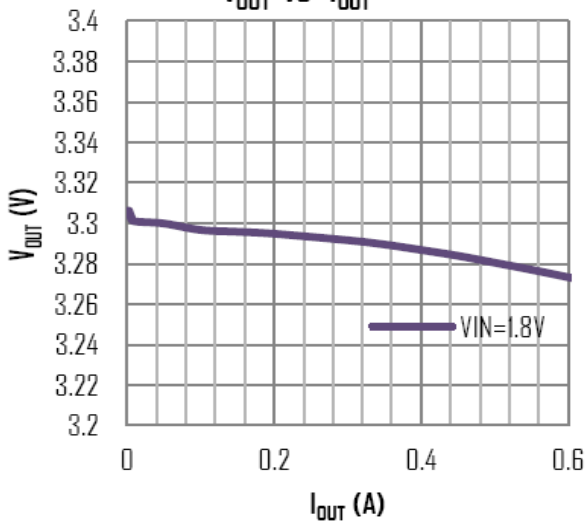




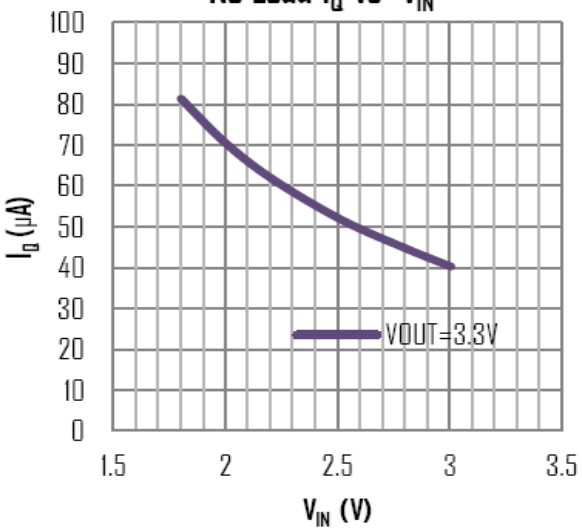


Typical Performance Characteristics

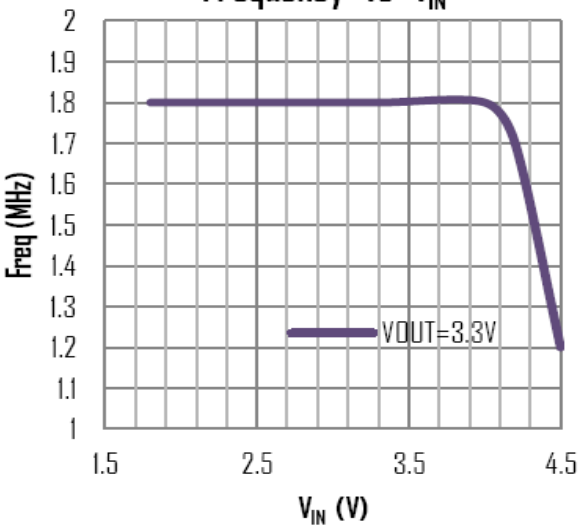
V_{OUT} Vs I_{OUT}



No Load I_Q Vs V_{IN}

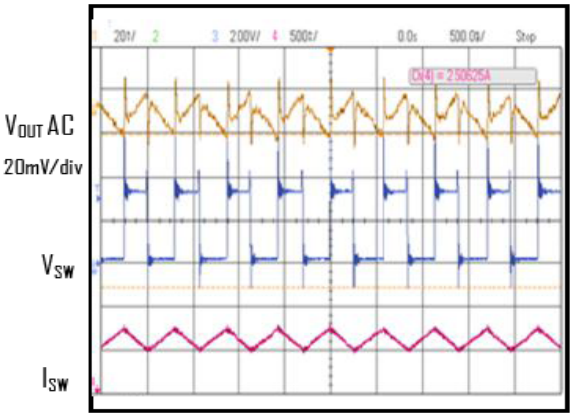


Frequency Vs V_{IN}



Heavy load Switching Waveform

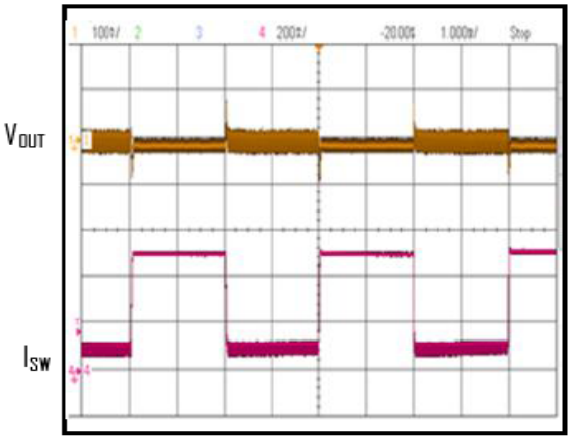
V_{IN}=1.8V, V_{OUT}=3.3V, I_{OUT}= 500mA



500ns/div

Load Transient Response

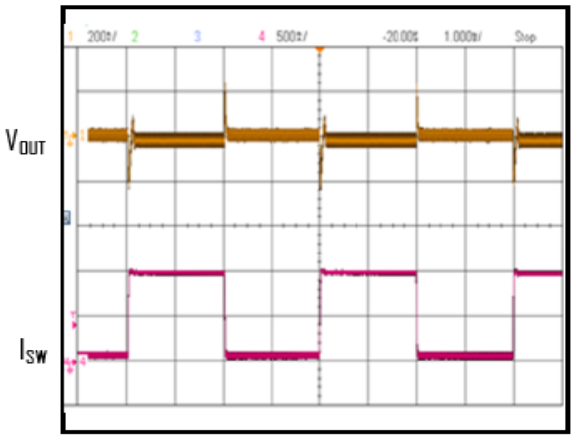
V_{IN}=3V, V_{OUT}=3.3V I_{OUT}=0.1A to 0.5A



1ms/div

Load Transient Response

V_{IN}=3V, V_{OUT}=3.3V I_{OUT}=0.1A to 1A



1ms/div

Applications Information

Loop Operation

The GS5801 is a wide input range, high-efficiency, DC-to-DC step-up switching regulator, capable of delivering up to 3W of output power, integrated with a 150mΩ high side MOSFET and 150mΩ synchronous rectifier. It uses a PWM current-mode control scheme. An error amplifier integrates error between the FB signal and the internal reference voltage. The output of t he integrator is then compared to the sum of a current-sense signal and the slope compensation ramp. This operation generates a PWM signal that modulates the duty cycle of the power MOSFETs to achieve regulation for output voltage.

Light Load Operation

Traditionally, a fixed constant frequency PWM DC-DC regulator always switches even when the output load is small. When energy is shuffling back and forth through the power MOSFETs, power is lost due to the finite R_{DSON} of the MOSFETs and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. GS5801 employs a proprietary control scheme that improves efficiency in this situation by enabling the device into a power save mode during light load, there by extending the range of high efficiency operation.

Short-Circuit Protection

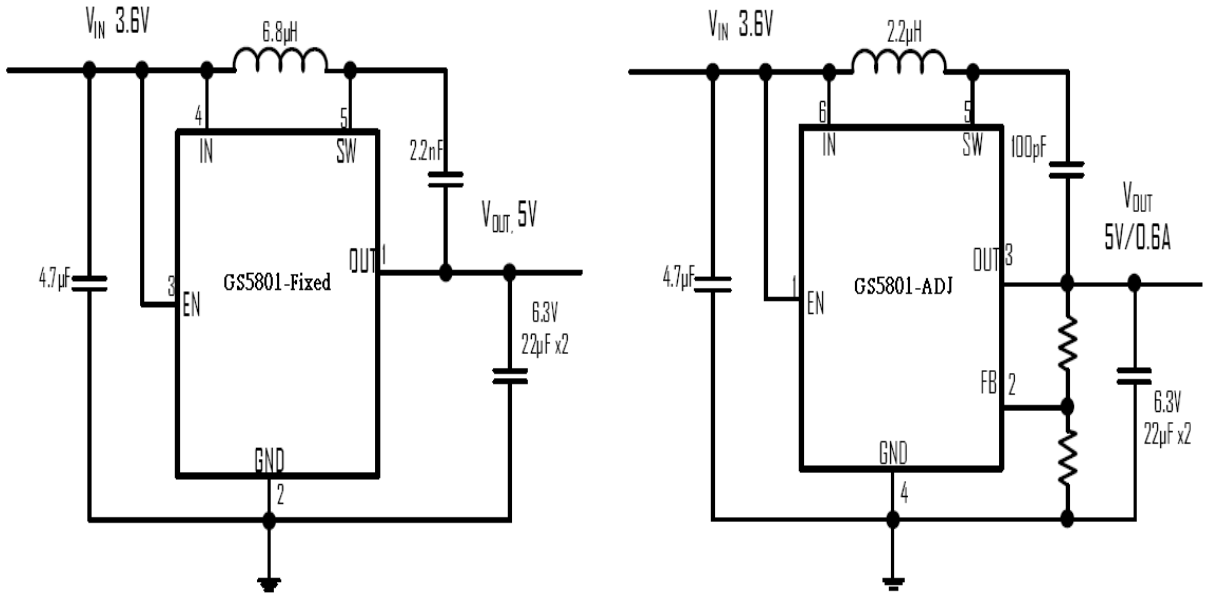
Unlike most step-up converters, the GS5801 allows for short circuits on the output. In the event of a short circuit, the device first turns off the NMOS when the sensed current reaches the current limit. After V_{OUT} drops below V_{IN} the device then enters a linear charge period with the current limited same as with the start-up period. In addition, the thermal shutdown circuits disable switching if the die temperature rises above 165°C.

Down Mode (V_{IN}>V_{OUT}) Operation

The GS5801 will continue to supply the output voltage even when the input voltage exceeds the output voltage. Since the PMOS no longer acts as a low-impedance switch in this mode, power dissipation increases within the IC to cause a sharp drop in efficiency. Limit the maximum output current to maintain an acceptable junction temperature.

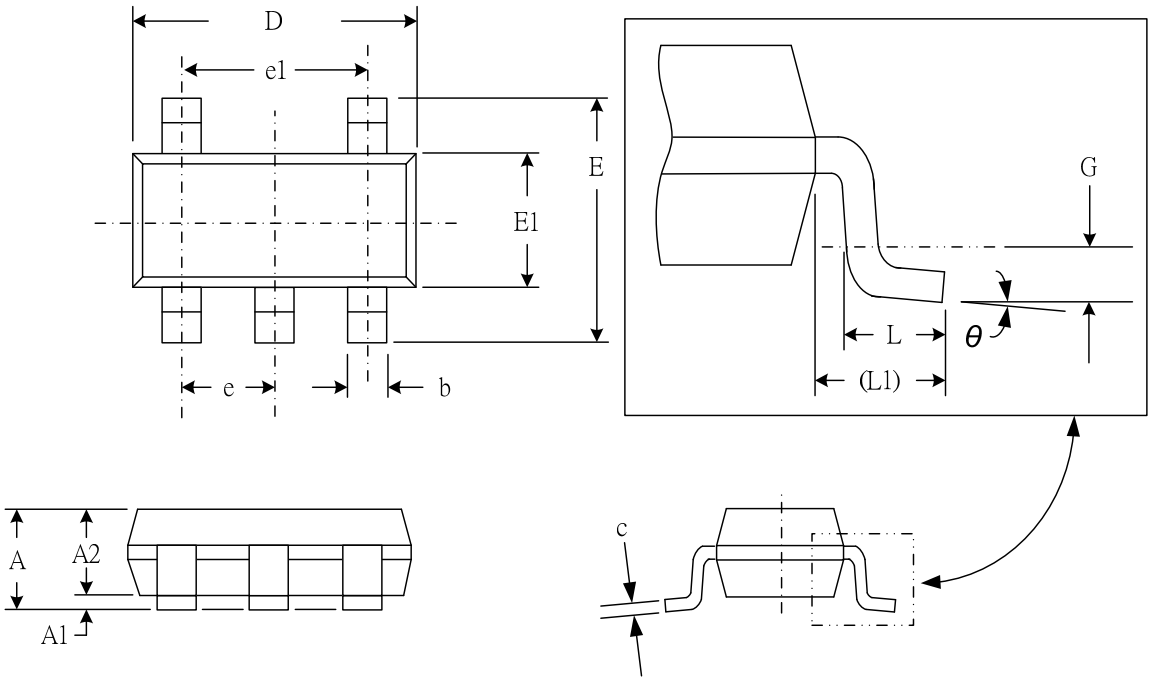
5V Applications

When output voltage is programmed to above 4.5V, in order to maintain an acceptable peak voltage at SW, a small parallel capacitor snubber between SW and OUT is necessary, and an output cap of greater than 44μF is also required as shown in below figure.



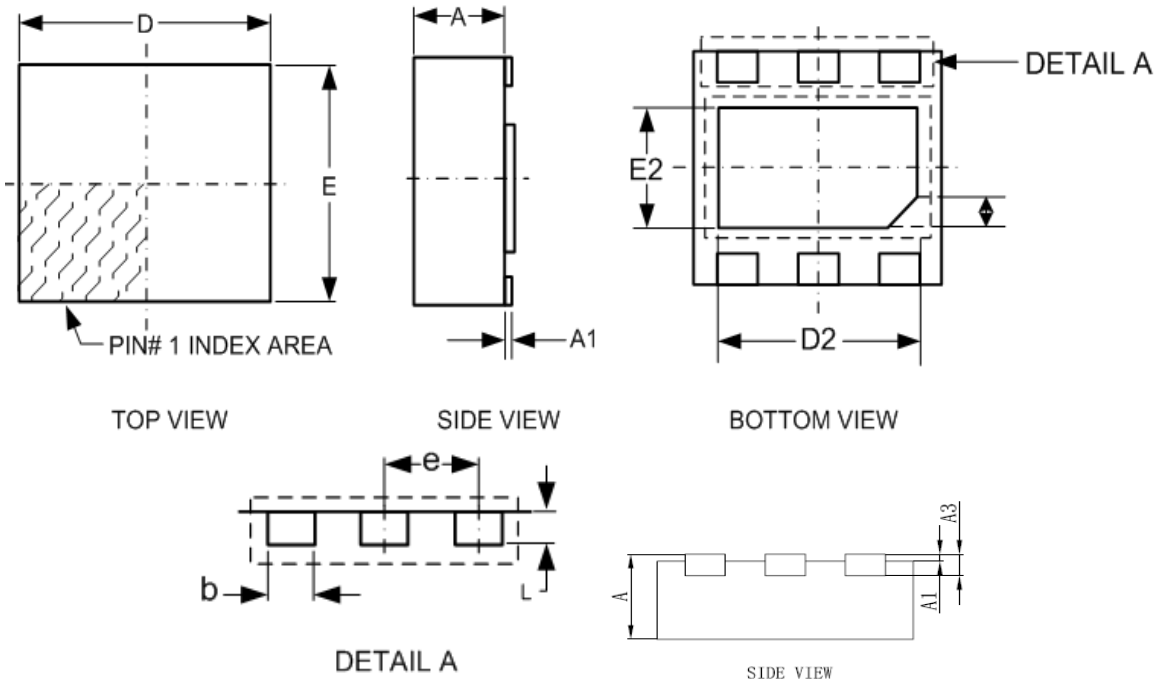
Package Dimension

SOT-23-5L PLASTIC PACKAGE



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	0.95	1.45	.037	.057
A1	0.05	0.15	.002	.006
A2	0.90	1.30	.035	.051
b	0.30	0.50	.012	.020
c	0.08	0.20	.003	.008
D	2.80	3.00	.110	.118
E	2.60	3.00	.102	.118
E1	1.50	1.70	.059	.067
e	0.95 (TYP)		.037 (TYP)	
e1	1.90 (TYP)		.075 (TYP)	
L	0.35	0.55	.014	.022
L1	0.60 (TYP)		.024 (TYP)	
G	0.25 (TYP)		.010 (TYP)	
θ	0°	8°	0°	8°

DFN2x2-6L



Dimensions

SYMBOL	Millimeters			Inches		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.70	0.75	0.80	0.028	0.030	0.031
A1	-	0.02	0.05	-	0.001	0.002
A3	0.18	0.20	0.25	0.007	0.008	0.010
b	0.25	0.30	0.35	0.010	0.012	0.014
D	1.95	2.00	2.05	0.077	0.079	0.081
D2	1.00	-	1.45	0.039	-	0.057
e	0.65 BSC			0.026 BSC		
E	1.95	2.00	2.05	0.077	0.079	0.081
E2	0.50	-	0.85	0.020	-	0.033
L	0.25	0.30	0.40	0.010	0.012	0.016
h	0.1	0.15	0.2	0.004	0.006	0.008

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