

GS5413

High-Efficiency, 3A, 16V, 500kHz Synchronous, Step-Down Converter

Product Description

The GS5413 is a high-frequency, Synchronous, Rectified, Step down, Switch-mode converter With internal power MOSFETs. It offers a very compact solution to achieve a 2A continuous output current over a wide input supply range, with excellent load and line regulator.

The GS5413 has synchronous-mode operation for higher efficiency over the output current-load range. Current-mode operation provides fast transient response and eases loop stabilization. Protection features include over-current protection and thermal shutdown.

The GS5413 requires a minimal number of readily available, standard external components and is available in space-saving SOT23-6L package.

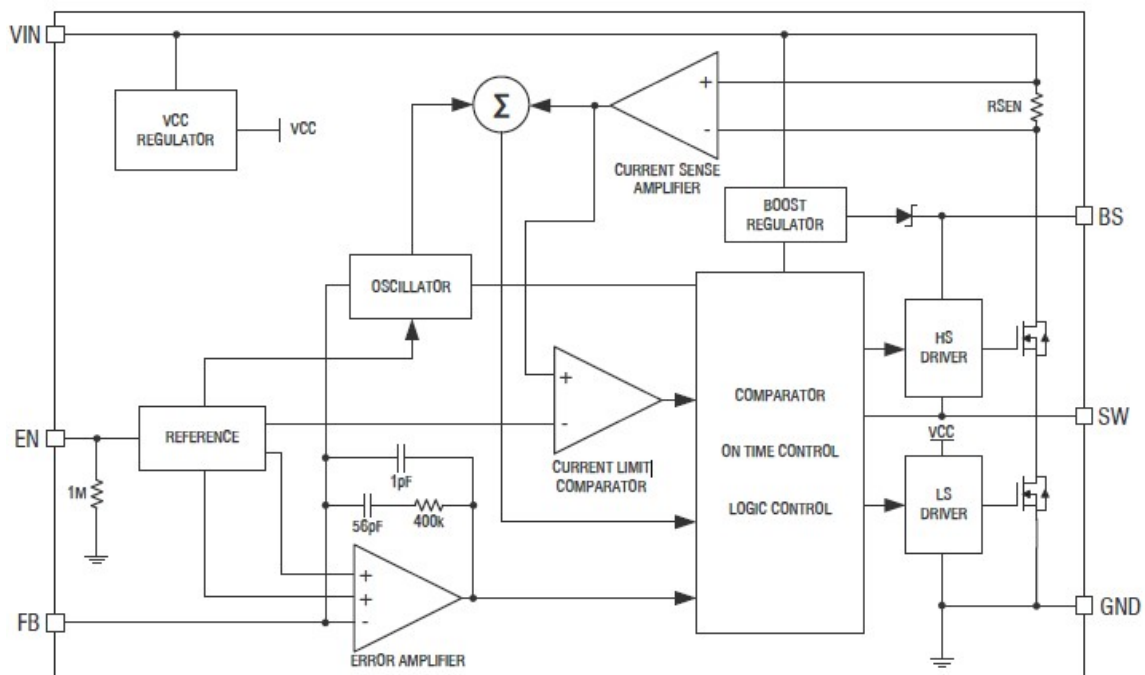
Features

- Wide 4.5V-to-16V Operating Input Range
- 80mΩ / 60mΩ Low-RDS(ON) Internal Power MOSFETs
- Power-Save Mode for High-Efficiency at Light Load
- Shutdown current 1uA typical
- Fixed 500kHz Switching Frequency and efficiency up to 96%
- Over-Current Protection and Hiccup
- Output Adjustable from 0.6V
- Output current up to 3A
- Internal soft start
- SOT23-6L Package
- RoHS Compliant, 100%Pb & Halogen Free

Applications

- Wireless AP/Router
- Display and Notebook computers
- Distributed power system
- Networking system PGA,DSP,ASIC power
- Portable Devices
- Set Top Boxes

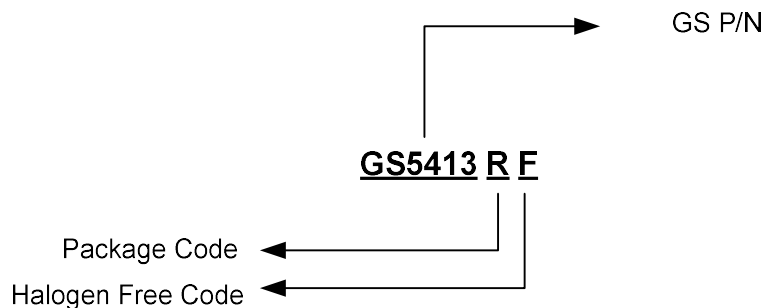
Functional Block Diagram



Packages & Pin Assignments

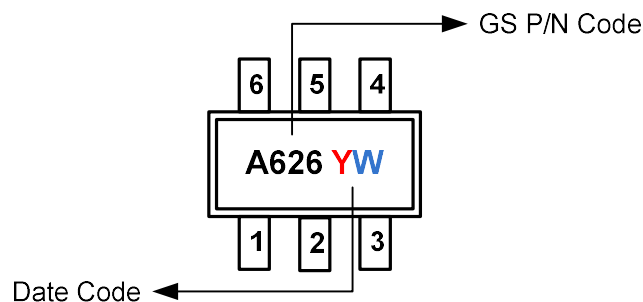
GS5413RF (SOT23-6L)	
<p style="text-align: center;">(Top View)</p>	
Pin Name	Description
GND	System Ground. Reference ground of the regulated output voltage: requires extra care during PCB layout. Connect to GND with copper traces and vias.
SW	Switch Output. Connect using wide a PCB trace.
V _{IN}	Supply Voltage. The GS5413 operates from a 4.5V to 16V input rail.
FB	Feedback Voltage.
EN	EN = Logic-High to enable the GS5413. For automatic start-up, connect EN to V _{IN} using a 100kΩ resistor.
BOOT	Bootstrap. Connect a capacitor and a resistor between SW and Boot pins to form a floating supply across the high-side switch driver. Recommend to use 0.1uF BST capacitor.

Ordering Information



Part Number	Package	Quantity
GS5413RF	SOT23-6L	3000 PCS

Marking Information



Absolute Maximum Rating (Note 1)

Symbol	Parameter	Maximum	Unit	
V _{IN} , V _{EN}	Input & Enable Pin Input Voltage	-0.3 to 17	V	
V _{SW}	Switch Pin Voltage	-0.3 to (V _{IN} +0.5)	V	
V _{BS}	Boost Pin Voltage	(V _{SW} -0.3) to (V _{SW} +5)	V	
V _{FB}	Feedback Pin Voltage	-0.3 to 6	V	
T _J (Note 2)	Maximum Operating Junction Temperature	150	°C	
T _{STG}	Storage temperature Range	-40 to 150	°C	
θ _{JA}	Thermal Resistance Junction to Ambient	SOT23-6L	170	°C/W
P _D	Power Dissipation	SOT23-6L	0.6	W

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied.

Exposure to Absolute Maximum Ratings conditions for extended periods may affect device reliability.

Electrical Characteristics (Note 3)

(Typical values V_{IN}=12V, V_{OUT}=5V with typical T_A=25°C, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V _{IN}	Input Voltage	-	4.5	-	16	V
I _Q	Quiescent Current	V _{FB} =1.1V, V _{EN} =2V	-	400	600	uA
I _{SHDN}	Shutdown Supply Current	V _{EN} =0V or GND	-	1.0	-	uA
V _{FB}	Feedback Voltage	4.5V ≤ V _{IN} ≤ 16V	0.588	0.6	0.623	V
R _{DS(ON)H}	High-Side MOSFET R _{DS(ON)} *	-	-	80	-	mΩ
R _{DS(ON)L}	Low-Side MOSFET R _{DS(ON)} *	-	-	60	-	mΩ
I _{LKGH}	High Side Switch Leakage Current	V _{EN} =0V, V _{SW} =0V	-	-	1	uA
I _{LKGL}	Low Side Switch Leakage Current	V _{EN} =0V, V _{SW} =12V	-	-	1	uA
F _{OSC}	Oscillation Frequency	-	-	500	-	KHz
I _{LIMIT}	Upper Switch Current Limit	Minimum Duty Cycle	-	5	-	A
D _{MAX}	Maximum Duty Cycle	V _{FB} =0.6V	-	92	-	%
T _{ON(MIN)}	Minimum On Time	-	-	60	-	ns
T _{SS}	Soft-Start Time	-	-	4	-	ms
T _{SD}	Thermal Shutdown Threshold*	-	-	160	-	°C

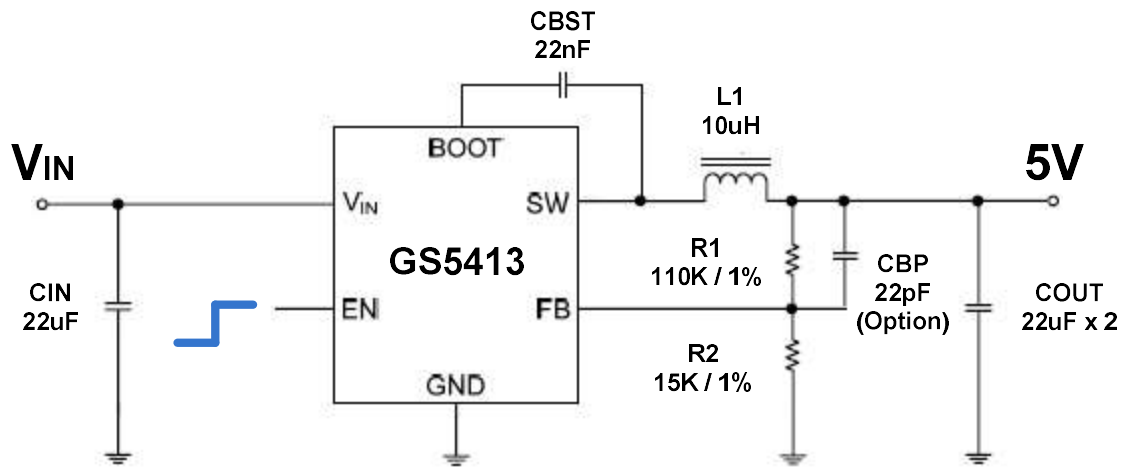
Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

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) × (170°C/W).

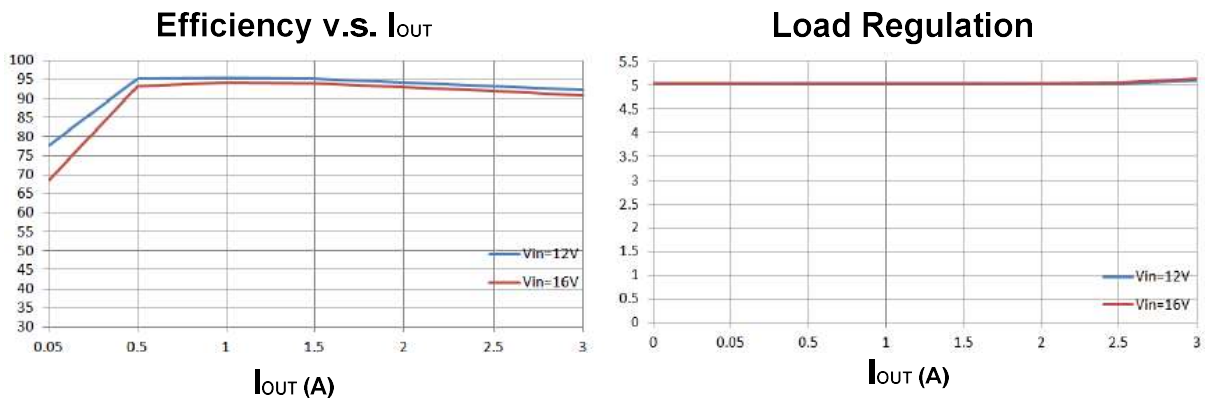
Note 3: 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

Note 4: Guaranteed by design, not tested.

Typical Application Circuit



Typical Characteristics



Function Description

The GS5413 is a synchronous rectified, current-mode step-down regulator. It regulates input voltage from 4.5V to 15V down to an output voltage as low as 0.8V, and supplies up to 3A of load current.

The GS5413 uses current-mode control to regulate the output voltage. The output voltage is measured at FB pin through a resistive voltage divider and amplifier. The converter uses internal N-Channel MOSFET switches to step-down the input voltage to the regulated output voltage. Since the high side MOSFET required a gate voltage greater than the input voltage, a boost capacitor connected between SW and BOOT is needed to drive the high side gate. The boost capacitor is charged from the internal 5V rail when SW is low. When the GS5413 FB pin exceeds 10% of the nominal regulator voltage of 0.6V, the over voltage comparator is tripped, facing the high-side switch off.

Applications Information

Setting the Output Voltage

The external resistor divider is used to set the output voltage (see Typical Application on page 1). The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. Choose R1 to be around 100kΩ for optimal transient response. R2 is then given by:

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R_1}{R_2}\right)$$

Inductor

A 4.7μH to 22μH inductor with a DC current rating of at least 25% percent higher than the maximum load current is recommended for most applications. For highest efficiency, the inductor DC resistance should be less than 15mΩ. For most designs, the inductance value can be derived from the following equation.

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

Where Δ IL is the inductor ripple current. Choose inductor ripple current to be approximately 30% if the maximum load current 3A. The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Under light load conditions below 100mA, larger inductance is recommended for improved efficiency.

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 22μF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

Output Capacitor Selection

The output capacitor (C_{OUT}) is required to maintain the DC output voltage. Ceramic, tantalum, or low ESR electrolytic capacitors are recommended. Low ESR capacitors are preferred to keep the output voltage ripple low. The output voltage ripple can be estimated by:

$$\Delta V_{OUT} = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times L \times f_{osc}} \times \left(R_{ESR} + \frac{1}{8 \times C_{OUT} \times f_{osc}} \right)$$

Where L is the inductor value and RESR is the equivalent series resistance (ESR) value of the output capacitor. In the case of ceramic capacitors, the impedance at the switching frequency is dominated by the capacitance. The output voltage ripple is mainly caused by the capacitance. For simplification, the output voltage ripple can be estimated by:

$$\Delta V_{OUT} = \frac{V_{OUT}}{8 \times C_{OUT} \times L \times f_{osc}^2} \times \left(1 - \frac{V_{OUT}}{V_{IN}} \right)$$

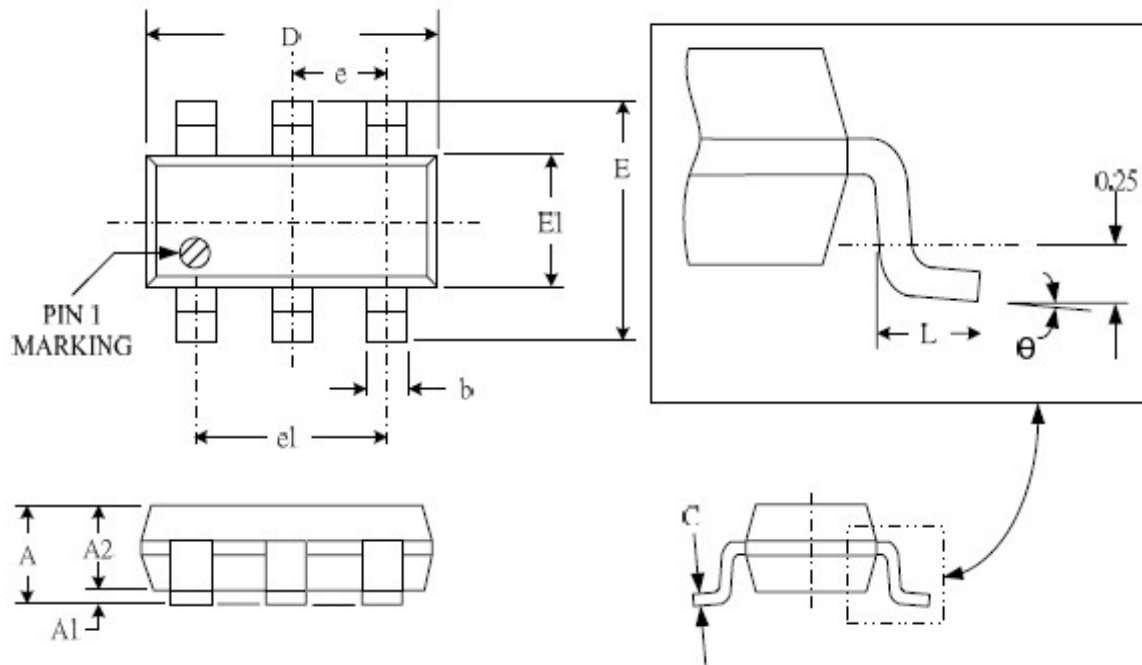
In the case of tantalum or electrolytic capacitors, the ESR dominates the impedance at the switching frequency. For simplification, the output ripple can be approximated to:

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_{osc} \times L} \times \left(1 - \frac{V_{OUT}}{V_{IN}} \right) \times R_{ESR}$$

The characteristics of the output capacitor also affect the stability of the regulation system. The GS5413 can be optimized for a wide range of capacitance and ESR values.

Package Dimension

SOT23-6L PLASTIC PACKAGE









Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	-	1.450	-	0.057
A1	0.000	0.150	0.000	0.006
A2	0.700	1.300	0.028	0.051
b	0.350	0.500	0.014	0.020
c	0.080	0.200	0.003	0.008
D	2.80	3.020	0.110	0.119
E1	1.500	1.700	0.059	0.067
E	2.600	3.000	0.102	0.118
e	0.95 (BSC)		0.037 (BSC)	
e1	1.90 (BSC)		0.075 (BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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