# HF6250

# 38V 5A Synchronous Buck Converter
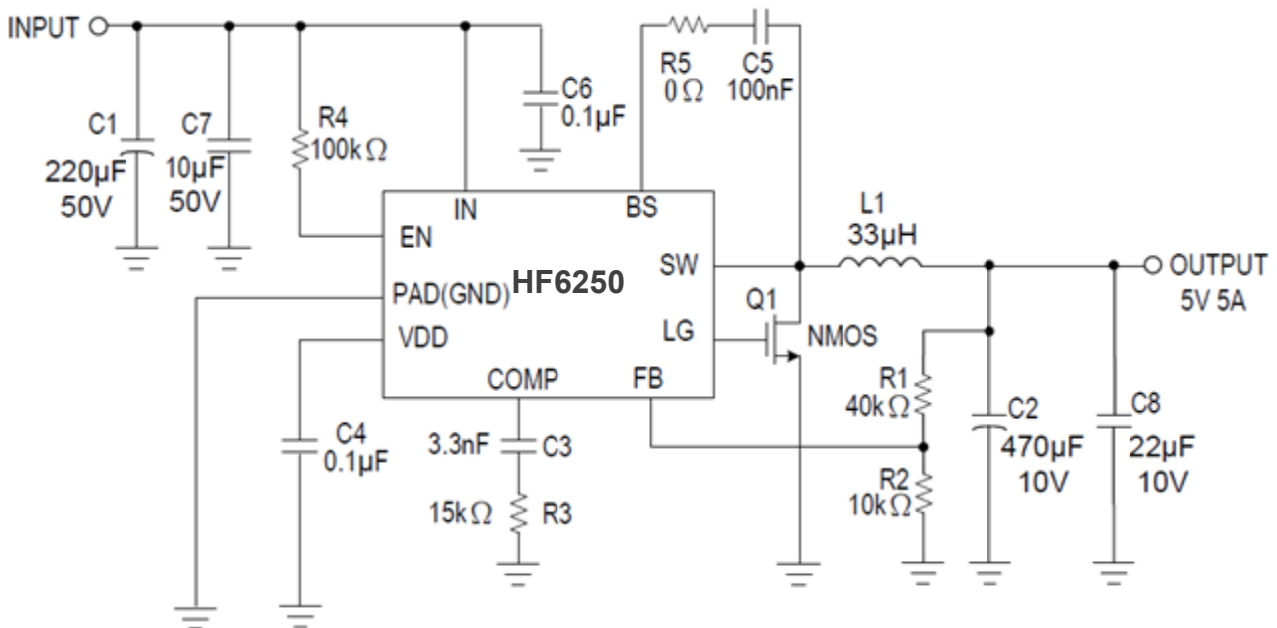
## Description

The HF6250 is a monolithic synchronous buck regulator. The device integrates internal high side and external low side power MOSFETs, and provides 5A of continuous load current over a wide input voltage of 8V to 38V. Current mode control provides fast transient response and cycle-by-cycle current limit.

An internal soft-start prevents inrush current at turn-on, This device, available in SOP8L-EP (Exposed pad) package, provides a very compact solution with minimal external components.

## Features

- Wide 8V to 38V Operating Input Range
- Integrated 90mΩ high side Power MOSFET Switches
- Output Adjustable from VFB(1V) to 20V
- Up to 95% Efficiency
- Internal Soft-Start
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 160KHz Frequency
- Cycle-by-Cycle Over Current Protection
- Input Under/Over Voltage Lockout
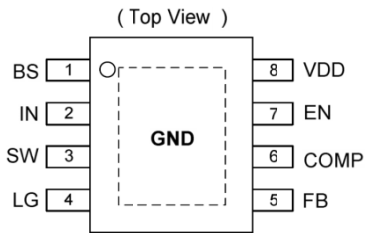
## Application Circuit



VOUT=VFB × (1+R1/R2), VFB = 1.00V, R2 suggest 10k~30kΩ

## Pin Assignment

The package of HF6250 is SOP8L-EP(Exposed pad); the pin assignment is given by:

( Top View )

```
BS  [1]   O┌───────┐      [8]  VDD
IN  [2]    │       │      [7]  EN
SW  [3]    │  GND  │      [6]  COMP
LG  [4]    └───────┘      [5]  FB
```

| Name | Description |
|---|---|
| **BS** | Boot-Strap Pin. Supply high side gate driver. Decouple this pin to LX pin with 0.1uF ceramic cap. |
| **IN** | Power Input pin. Bypass IN to GND with a suitably large capacitor to eliminate noise on the input to the IC. |
| **SW** | Power Switching Output. SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load. |
| **LG** | Gate drive for external low side N-MOSFET.. |
| **PAD** | Ground (Connect to GND). |
| **FB** | Feedback Input. FB senses the output voltage to regulate that voltage. Drive FB with a resistive voltage divider from the output voltage. |
| **COMP** | Compensation Node. COMP is used to compensate the regulation control loop. Connect a series RC network from COMP to GND to compensate the regulation control loop. |
| **EN** | Enable control. Pull high to turn on. Do not float. |
| **VDD** | Internal regulator pin. |

## Block Diagram
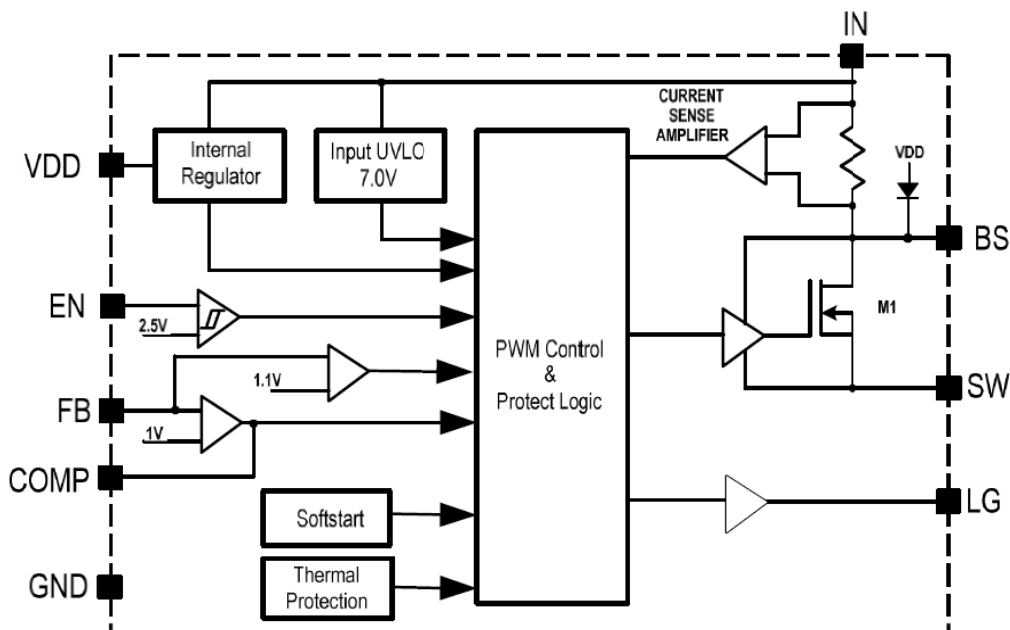
## Absolute Maximum Ratings (at $T_A$=25°C)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply Voltage | $V_{IN}$ | −0.3 to +42 | V |
| Switch Node Voltage | $V_{SW}$ | − 0.3 to $V_{IN}$ + 0.3 | V |
| Boost Voltage | $V_{BS}$ | $V_{SW}$ − 0.3 to $V_{SW}$ + 6 | V |
| All Other Pins | | −0.3 to +6 | V |
| Lead Temperature | | 260 | ℃ |
| Storage Temperature | | −65 to +150 | ℃ |
| Junction Temperature | $T_J$ | 150 | ℃ |
| Output Voltage | $V_{OUT}$ | VFB to 20 | V |
| Ambient Operating Temperature | | −40 to +85 | ℃ |
| Thermal Resistance from Junction to case | $θ_{JC}$ | 15 | ℃/W |
| Thermal Resistance from Junction to ambient | $θ_{JA}$ | 40 | ℃/W |

Note: $θ_{JA}$ is measured with the PCB copper area of approximately 1 in$^2$(Multi-layer). That need connect to exposed pad.

## Electrical Characteristics ($V_{IN}$ = 12V, $T_A$ = +25°C, unless otherwise noted.)

| Characteristics | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Input Voltage Range | | | 8 | - | 38 | V |
| Shutdown Supply Current | $I_{SD}$ | VEN = 0V | - | 0.7 | 1.3 | mA |
| Quiescent Current | $I_{CCQ}$ | VEN = 5.0V; VFB = 1.05V | - | 0.7 | 1.5 | mA |
| Feedback Voltage | $V_{FB}$ | 8V ≤ VIN ≤ 38V | 0.98 | 1.00 | 1.02 | V |
| Feedback Overvoltage Threshold | $OVP_{(FB)}$ | | - | 1.1X | - | VFB |
| High-Side Switch On Resistance (Note) | $R_{DS(ON)1}$ | | - | 90 | - | mΩ |
| High-Side Switch Leakage Current | | VEN = 0V, VSW = 0V | - | - | 10 | µA |
| High-Side Switch Current Limit | | Minimum Duty Cycle | 5.1 | 6.0 | - | A |
| LG Rise Time | $T_{LXR}$ | CLX=1000pF | - | 40 | - | ns |
| LG Fall Time | $T_{LXF}$ | CLX=1000pF | - | 40 | - | ns |
| LG driver bias supply voltage | | | - | 5 | - | V |
| Oscillation Frequency | $F_{OSC1}$ | | - | 160 | - | KHZ |
| Short Circuit Oscillation Frequency | $F_{OSC2}$ | VFB =< 0.5V | - | 60 | - | KHZ |
| Maximum Duty Cycle | $D_{MAX}$ | | - | 90 | - | % |
| Minimum On Time (Note) | $T_{ON(min)}$ | | - | 220 | - | nS |
| EN Lockout Threshold Voltage | $ENH_{(LOCK)}$ | | - | 2.5 | - | V |
| EN Lockout Hysterisis | | | - | 210 | - | mV |
| Input Under Voltage Lockout Threshold | UVLO | VIN Rising | 6.5 | 7.0 | 7.5 | V |

| Input Under Voltage Lockout Threshold Hysteresis | UVLO-Hys | | - | 800 | - | mV |
|---|---|---|---|---|---|---|
| Input Over Voltage Lockout Threshold | OVLO | VIN Rising | - | 40 | - | V |
| Input Over Voltage Lockout Threshold Hysteresis | OVLO-Hys | | - | 5 | - | V |
| Soft-Start Period | | | - | 3 | - | ms |
| Thermal Shutdown | $T_{SD}$ | | - | 150 | - | ℃ |
| Thermal Shutdown Hysterisis | $T_{SH}$ | | - | 30 | - | ℃ |

Note: Guaranteed by design.

# Function Descriptions

The HF6250 is a synchronous rectified, current-mode, step-down regulator. It regulates input voltages from 8V to 38V down to an output voltage as low as $V_{FB}$, and supplies up to 5A of load current.

The HF6250 uses current-mode control to regulate the output voltage. The output voltage is measured at FB through a resistive voltage divider and amplified through the internal Tran conductance error amplifier. The voltage at the COMP pin is compared to the switch current measured internally to control the output voltage.

The converter uses internal N-Channel MOSFET switches to step-down the input voltage to the regulated output voltage. Since the high side MOSFET requires a gate voltage greater than the input voltage, a boost capacitor connected between SW and BS is needed to drive the high side gate. The boost capacitor is charged from the internal 5V rail when SW is low.

When the HF6250 FB pin exceeds 10% of the nominal regulation voltage of $V_{FB}$, the over voltage comparator is tripped and the COMP pin is discharged to GND, forcing the high-side switch off.

# Application Information

## COMPONENT SELECTION
### Setting the Output Voltage

The output voltage is set using a resistive voltage divider from the output voltage to FB pin. The voltage divider divides the output voltage down to the feedback voltage by the ratio.

Thus the output voltage is: $v_{OUT} = v_{FB} \times \frac{R1+R2}{R2}$

For example, VFB =1.00V for a 5.0V output voltage, R2 is 10kΩ, and R1 is 40kΩ.

### Inductor Selection

The inductor is required to supply constant current to the output load while being driven by the switched input voltage. A larger value inductor will result in less ripple current that will result in lower output ripple voltage. However, the larger value inductor will have a larger physical size, higher series resistance, and/or lower saturation current. A good rule for determining the inductance to use is to allow the peak-to-peak ripple current in the inductor to be approximately 30% of the maximum switch current limit.

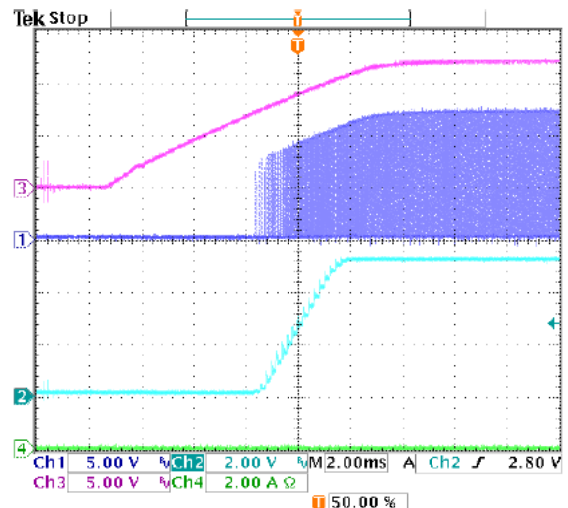| VIN | <28V | <35V |
|---|---|---|
| **Inductor** | 47uH | 33uH |

The choice of which style inductor to use mainly depends on the price vs. size requirements and any EMI requirements.
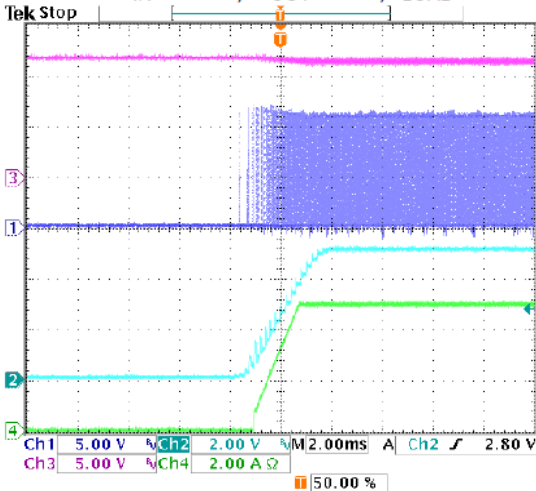
# Typical Characteristics

**Efficiency VS VOUT=5V**



**Quiescent Current VS Input Voltage**



**Load Regulation**
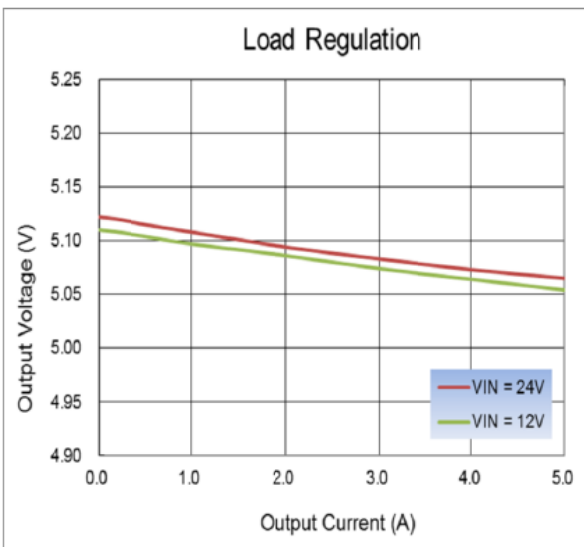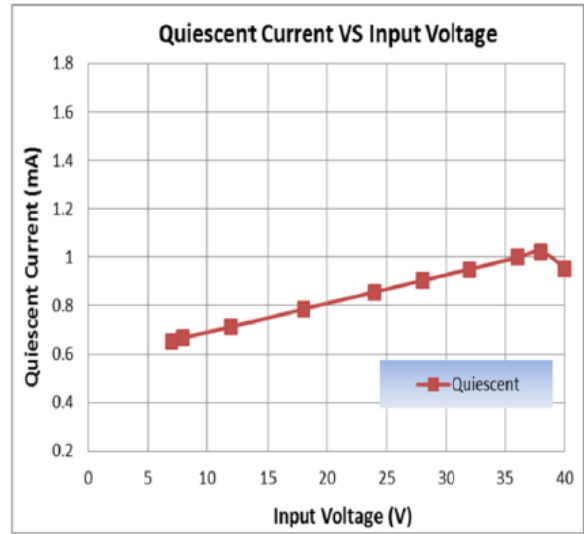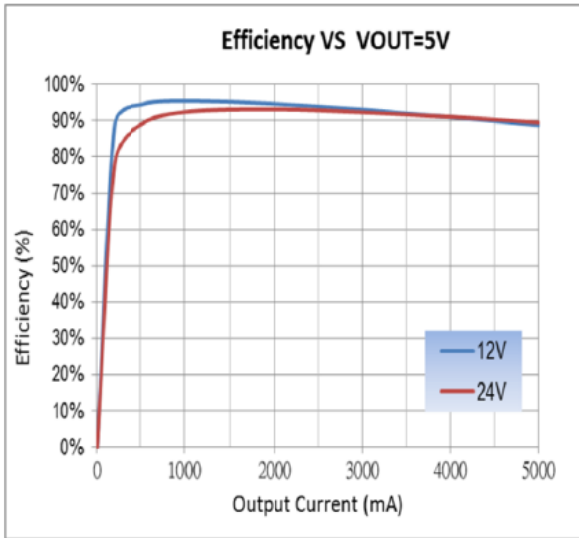


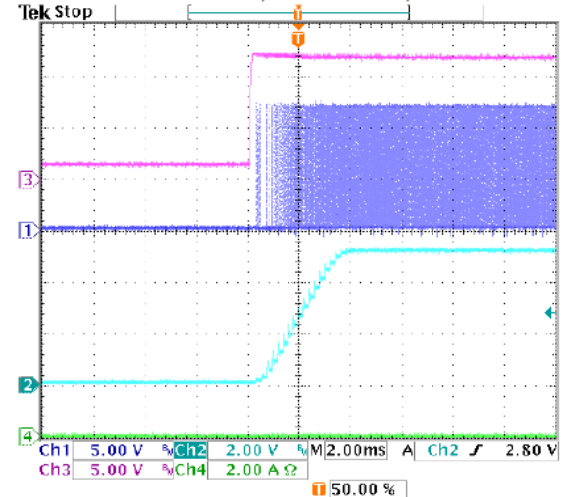Power On : $V_{IN}$ = 12V, $V_{OUT}$ = 5V, $I_{LOAD}$ = 0A



Ch1=SW , Ch2=$V_{OUT}$ , Ch3=$V_{IN}$ , Ch4=$I_{OUT}$

EN On: $V_{IN}$ = 12V, $V_{OUT}$ = 5V, $I_{LOAD}$ = 5A
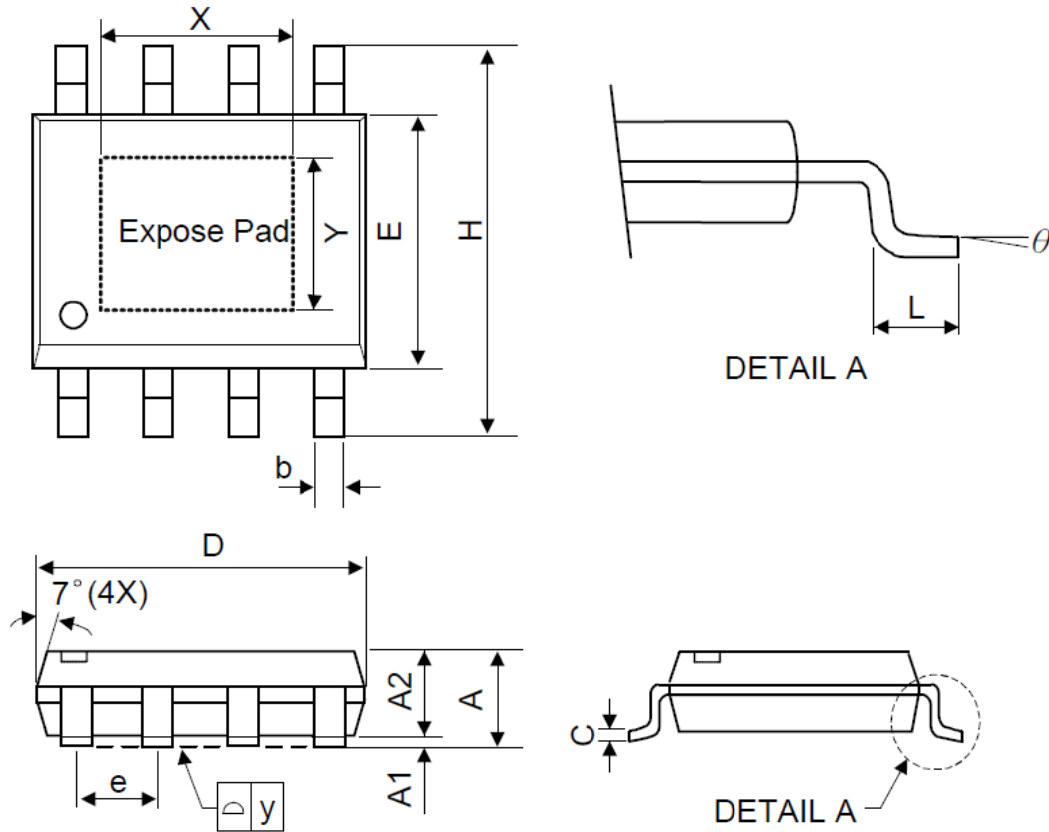


Ch1=SW , Ch2=$V_{OUT}$ , Ch3=$V_{IN}$ , Ch4=$I_{OUT}$

Cable On: $V_{IN}$ = 12V, $V_{OUT}$ = 5V, $I_{LOAD}$ = 5A



Ch1=SW , Ch2=$V_{OUT}$ , Ch3=$V_{IN}$ , Ch4=$I_{OUT}$

## Package Outlines



| Symbol | Dimensions in Millimeters | | | Dimensions in Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Nom. | Max. | Min. | Nom. | Max. |
| A | - | - | 1.75 | - | - | 0.069 |
| A1 | 0 | | 0.15 | 0 | - | 0.06 |
| A2 | 1.25 | - | - | 0.049 | - | - |
| C | 0.1 | 0.2 | 0.25 | 0.0075 | 0.008 | 0.01 |
| D | 4.7 | 4.9 | 5.1 | 0.185 | 0.193 | 0.2 |
| E | 3.7 | 3.9 | 4.1 | 0.146 | 0.154 | 0.161 |
| H | 5.8 | 6 | 6.2 | 0.228 | 0.236 | 0.244 |
| L | 0.4 | - | 1.27 | 0.015 | - | 0.05 |
| b | 0.31 | 0.41 | 0.51 | 0.012 | 0.016 | 0.02 |
| e | 1.27 BSC | | | 0.050 BSC | | |
| y | - | - | 0.1 | - | - | 0.004 |
| X | - | 2.34 | 3.33 | - | 0.092 | 0.131 |
| Y | - | 2.34 | 2.54 | - | 0.092 | 0.10 |
| θ | 0° | - | 8° | 0° | - | 8° |

| 日期<br>Date | 版本<br>Version | 说明<br>Description | 排版<br>Typeset | 工程师<br>Engineer | 状态<br>Status |
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