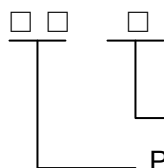# High Efficiency 2.7A Synchronous Boost Convertor

General Description

The HM6315 is a Synchronous current mode boost DC-DC converter. Its PWM circuitry with built-in 2.7A Current power MOSFET makes this converter highly power efficiently. Selectable high switching frequency allows faster loop response and easy filtering with a low noise output. The non-inverting input its error amplifier is connected to an internal 800mV precision reference voltage. Current mode control and external compensation network make it easy and flexible to stabilize the system.

Ordering Information

HM6315 ☐ ☐   ☐

　　　　　　　　　　 F: Pb-Free

　　　　　　　　 Package Type

　　　　　　　　　 MR: SOT23-6

　　　　　　　　　 DR: TDFN-6

Features

◆ Up to 95% efficiency

◆ Output to Input Disconnect at Shutdown Mode

◆ Shut-down current:<1uA

◆ Output voltage Up to 5.5V

◆ Over Output Voltage Protection

◆ Over Current Protection

◆ Over Temperature Protection

◆ Internal Compensation of Soft-start

◆ 1MHz fixed frequency switching

◆ High switch on current:2.7A

◆ Available in SOT23-6 and TDFN-6 Package

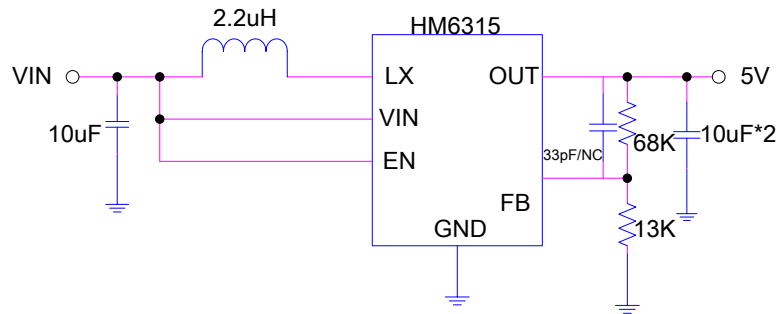## Pin Configurations

SOT23-6　　　　　　　　TDFN-6

Applications

✧ Battery products
✧ Host OTG
✧ Audio power
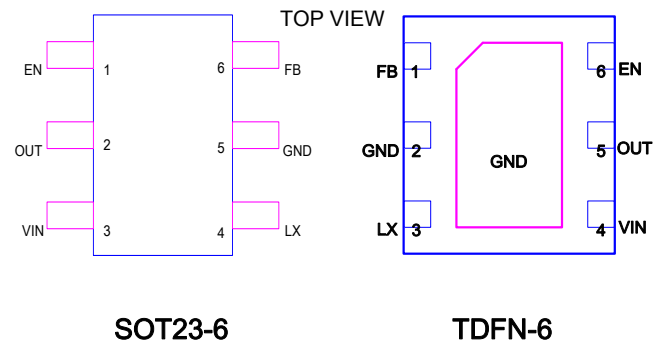
Marking Information

| Device	Marking	Package	Shipping
HM6315MRF	LPS 5∨YWX	SOT23-6	3K/REEL
HM6315DRF	HM6315D YWX	TDFN-6	
Marking indication: Y:Production year W:Production period X:Production batch			

Typical Application Circuit

Functional Pin Description

SOT23-6	TDFN-6	PIN Name	Description
6	1	FB	Regulation Feedback Input. Connect to an external resistive voltage divider from the output to FB to set the output voltage. The pin is 0.8V.
5	2	GND	Ground Pin.
4	3	LX	Pin for switching.
3	4	VIN	Voltage supply input pin.
2	5	OUT	Voltage output Pin.
1	6	EN	Chip enable pin. HM6315 will turn on when EN=high, and off when EN=0.

Function Block Diagram
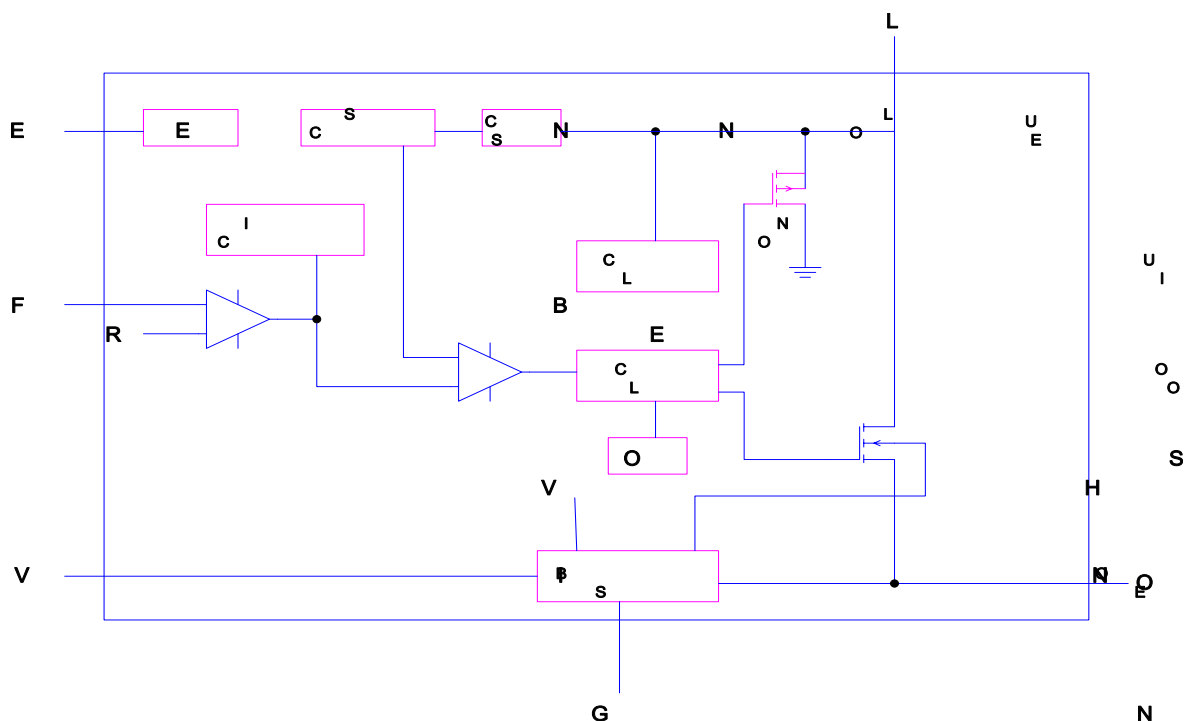
Absolute Maximum Ratings [Note 1]

- ◇ Input and Vout to GND -- 6V
- ◇ Other Pin to GND (VFB,VEN,VLX) -- 6V
- ◇ Maximum Junction Temperature -- 125°C
- ◇ Operating Junction Temperature Range (TJ) --- -40°C to 85°C
- ◇ Maximum Soldering Temperature (at leads, 10 sec) -- 260°C

Note 1. Stresses beyond 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 beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Information

- ◇ Maximum Power Dissipation (SOT23-6, PD,TA=25°C) --- 0.45W
- ◇ Thermal Resistance (SOT23-6, JA) --- 250°C/W
- ◇ Maximum Power Dissipation (TDFN-6, PD,TA=25°C) -- 1.2W
- ◇ Thermal Resistance (TDFN-6, JA) --- 95°C/W

ESD Susceptibility

- ◇ HBM(Human Body Mode) [Note 2] --- 2KV
- ◇ MM(Machine Mode) [Note 3] -- 200V

Note 2. The Human body model (HBM) is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. The testing is done according JEDEC.

Note 3. Machine Model (MM) is a 200pF capacitor discharged through a 500nH inductor with no series resistor into each pin. The testing is done according JEDEC.

Electrical Characteristics

(Vin=3.5V,Vout=5V,Cin=10uF,Cout=22uF,L=2.2uH,R1=68K,R2=13K)

Parameter	Conditions	HM6315			Units
		Min	Typ	Max	
Supply Voltage		2.5		5.5	V
Output Voltage Range		2.5		5.4	V
UVLO		1.8		2.4	V
Supply Current(Shutdown)	VEN=0V,Vin=5V		0.05	1	uA
Feedback Voltage		784	800	816	mV
Feedback Input Current	VFB=0.8V		50		nA
Switching Frequency			1000		KHz
Maximum Duty Cycle		80	90	95	%
EN Input Low Voltage				0.4	V
EN Input High Voltage		1.4			V
Low-side Current Limit		2.7	3		A
High-side On Resistance	Vout=3.3V		200		mΩ
Low-side On Resistance			150		mΩ

Note: Output Voltage: Vout = VFB X (1+R1/R2) Volts;
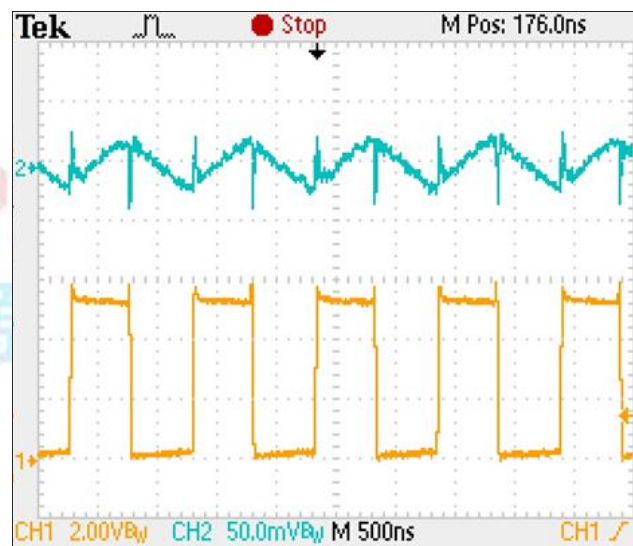
Typical Operating Characteristics

Vout=5V, Vin=3V, Iout=2mA, CH1=LX,CH2=△VOUT
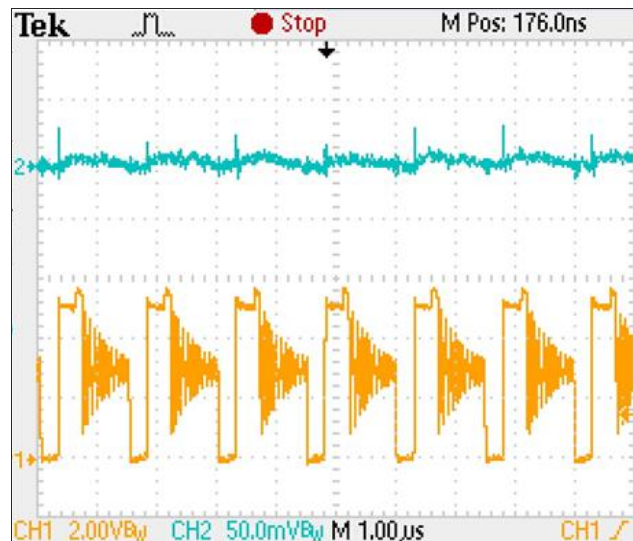
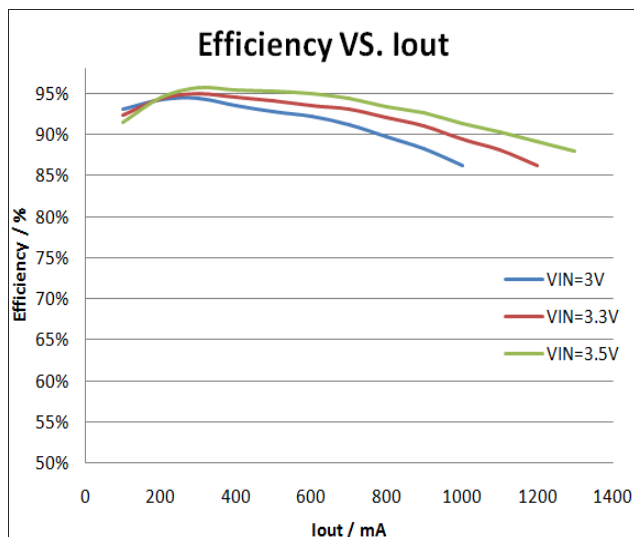Vout=5V, Vin=3V, Iout=100mA , CH1=LX,CH2=△VOUT

Vout=5V, Vin=3V, Iout=500mA, CH1=LX,CH2=△VOUT

Vout=5V, Vin=3V, Iout=1A , CH1=LX,CH2=△VOUT

Efficiency VS. Iout

Operation Information

The HM6315 uses a synchronous 1MHz fixed frequency, current-mode regulation architecture to regulate the output voltage. The HM6315 measures the output voltage through an external resistive voltage divider and compares that to the internal 0.8V reference to generate the error voltage to the inductor current to regulate the output voltage. The use of current-mode regulation improves transient response and control loop stability.

When the HM6315 is disable (EN=Low), both power switches are off. There is no current path from LX to OUT. Therefore, the output voltage discharges to ground. When the HM6315 is enabled(EN=High),a limited start-current charges the output voltage rising to LX, then the part operates in force PWM mode for regulating the output voltage to the target value. At the beginning of each cycle, the N-channel MOSFET switch is turned on, forcing the inductor current to rise, The current at the source of the switch is internally measured and converted to a voltage by the current sense amplifier. That voltage is compared to the error voltage. When the inductor current rises sufficiently, the PWM comparator turns off the switch, forcing the inductor current to the output capacitor through the internal P-Channel MOSFET rectifier, which forces the inductor current to decrease. The peak inductor current is controlled by the error voltage. Thus the output voltage controls the inductor current to satisfy the lode.

Setting the Output Voltage

Set the output voltage by selecting the resistive voltage divider ratio. The voltage divider drops the output voltage to the 0.8V feedback voltage. Determine the high-side resistor R1 by the equation:

$$Vout=(R1/R2+1) \times VFB$$

Pre-Boost Current and Short Circuit Protect

Initially output voltage is lower than battery voltage, and the HM6315 enters pre-boost phase. During pre-boost phase, the internal NMOSFET/PMOSFET is turned off/on and a constant current is provided from battery to output until the output voltage close to the battery voltage. The constant current is limited by internal controller. If the output short to ground, the HM6315 also limits the output current to avoid damage condition

Inductor Selection

For a better efficiency in high switching frequency converter, the inductor selection has to use a proper core material such as ferrite core to reduce the core loss and choose low ESR wire to reduce copper loss. The most important point is to prevent the core saturated when handling the maximum peak current. Using a shielded inductor can minimize radiated noise in sensitive applications. The maximum peak inductor current is the maximum input current plus the half of inductor ripple current. The calculated peak current has to be smaller than the current limitation in the electrical characteristics. A typical setting of the inductor ripple current is 20% to 40% of the maximum input current. If the selection is 40%, the maximum peak inductor current is

$$I_{PEAK} = I_{IN(MAX)} + \frac{1}{2} I_{RIPPLE} = 1.2 \times I_{IN(MAX)}$$

$$= 1.2 \times \left[\frac{I_{OUT(MAX)} \times V_{OUT}}{\eta \times V_{IN(MIN)}} \right]$$

The minimum inductance value is derived from the following equation :

$$L = \frac{\eta \times V_{IN(MIN)}^2 \times [V_{OUT}\text{-}V_{IN(MIN)}]}{0.4 \times I_{OUT(MAX)} \times V_{OUT}^2 \times f_{OSC}}$$

Depending on the application, the recommended inductor value is between 1µH to 4.7µH.

Input Capacitor Selection

For better input bypassing, low-ESR ceramic capacitors are recommended for performance. A 10µF input capacitor is sufficient for most applications. For a lower output power requirement application, this value can be decreased.

Output Capacitor Selection

For lower output voltage ripple, low-ESR ceramic capacitors are recommended. The tantalum capacitors can be used as well, but the ESR is bigger than ceramic capacitor. The output voltage ripple consists of two components: one is the pulsating output ripple current flows through the ESR, and the other is the capacitive ripple caused by charging and discharging.

$$V_{RIPPLE} = V_{RIPPLE\_ESR} + V_{RIPPLE\_C}$$

$$\cong I_{PEAK} \times R_{ESR} + \frac{I_{PEAK}}{C_{OUT}} \left(\frac{V_{OUT} - V_{IN}}{V_{OUT} \times f_{OSC}} \right)$$

Layout Guide

For high frequency switching power supplies, the PCB layout is important step in system application design. In order to let IC achieve good regulation, high efficiency and stability, it is strongly recommended the power components(Inductor, input and output Capacitor) should be placed as close as possible to chip. The set races should be wide and short. The feedback pin and then works of feedback and compensation should keep away from the power loops, and be shielded with a ground trace or plane to prevent noise coupling.
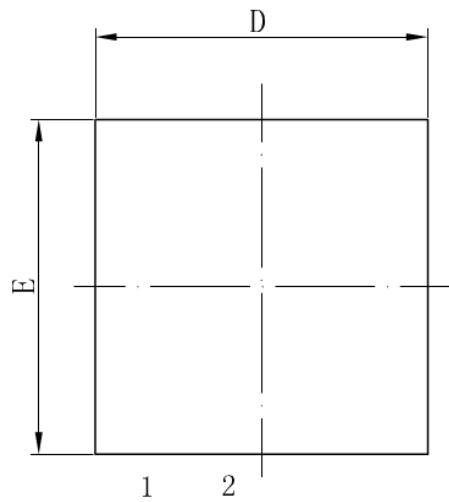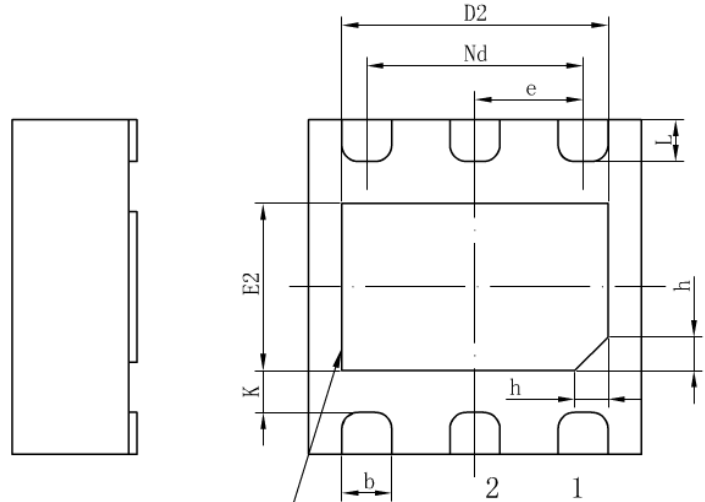
Packaging Information
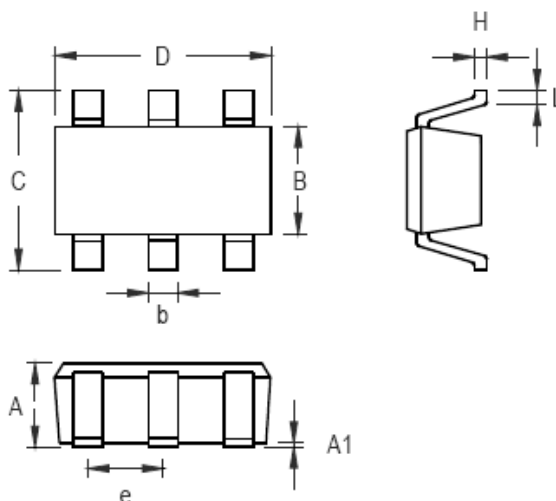
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.031	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.250	0.560	0.010	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

SOT-23-6 Surface Mount Package

TDFN-6

TOP VIEW

EXPOSED THERMAL PAD ZONE

BOTTOM VIEW
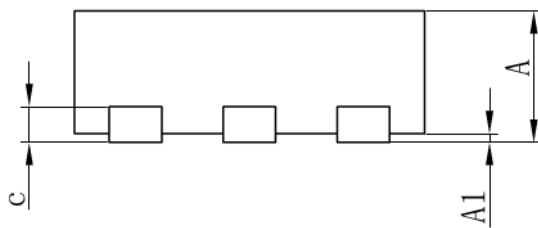
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
b	0.25	0.30	0.35
c	0.18	0.20	0.25
D	1.90	2.00	2.10
D2	1.50	1.60	1.70
e	0.65BSC		
Nd	1.30BSC		
E	1.90	2.00	2.10
E2	0.90	1.00	1.10
K	0.20	–	–
L	0.20	0.25	0.30
h	0.15	0.20	0.25
SIZE OF L/F (MIL)	69X47		