5.5V 1.2A 1.5MHz Synchronous Step-Down Regulator

Features

- High Efficiency: Up to 96%
- 2.5V to 5.5V Input Voltage Range
- 1.5MHz Constant Frequency Operation
- No Schottky Diode Required
- Low Dropout Operation: 100% Duty Cycle
- PFM Mode for High Efficiency in Light Load
- Over Temperature Protected
- Low Quiescent Current: 40µA
- Short Circuit Protection
- Inrush Current Limit and Soft Start
- 1.2A Continuous Output Current
- DFN2×2-6 Package

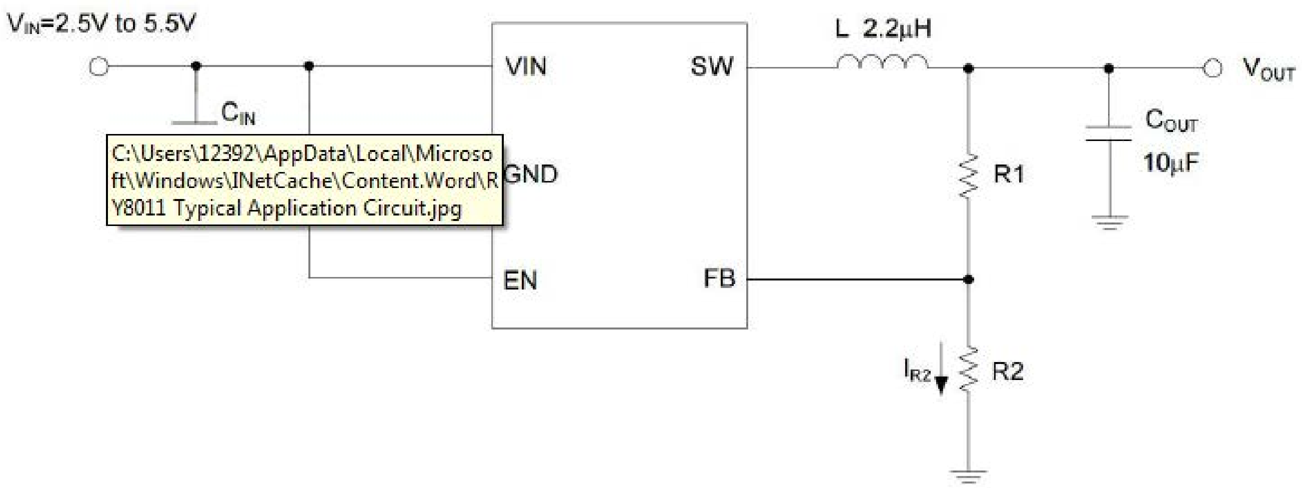
Applications

- Cellular and Smart Phones
- Wireless and DSL Modems
- PDAs
- Portable Instruments
- Digital Still and Video Cameras
- PC Cards

General Description

The HM3410D is a high-efficiency monolithic synchronous buck regulator using a constant frequency, current mode architecture. The device is available in an adjustable version. Supply current with no load is 40uA and drops to <1uA in shutdown. The 2.5V to 5.5V input voltage range makes the HM3410D ideally suited for single Li-Ion battery powered applications. 100% duty cycle provides low dropout operation, extending battery life in portable systems.
PWM/PFM mode operation provides very low output ripple voltage for noise sensitive applications.
Switching frequency is internally set at 1.5MHz, allowing the use of small surface mount inductors and capacitors.
Low output voltages are easily supported with the 0.6V feedback reference voltage.
The HM3410D is available in a space saving DFN2×2-6 package.

Typical Application Circuit



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Absolute Maximum Ratings (Note 1)

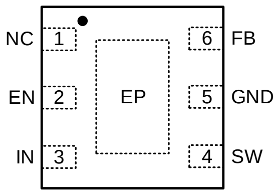
Input Supply Voltage ……… -0.3V to 6.0V
EN, FB Voltages……........... -0.3V to 6.0V
SW Voltage…………. -0.3V to (Vin+0.3V)
Peak SW Sink and Source Current 1.5A

Operating Temperature Range …………..... -40°C to +85°C
Junction Temperature(Note2) ………………...….. 150°C
Storage Temperature Range ...…...…...…. -65°C to 150°C
Lead Temperature(Soldering,10s)………………. +300°C

Pin Description

Pin Configuration

TOP VIEW



DFN2×2-6

Top Marking: ANYLL (device code: AN, Y=year code, LL= lot number code)

Pin Description

Pin	Name	Function
1	NC	
2	EN	Chip Enable Pin. Drive EN above 1.5V to turn on the part. Drive EN below 0.3V to turn it off. Do not leave EN floating.
3	VIN	Power Supply Input. Must be closely decoupled to GND with a 10µF or greater ceramic capacitor.
4	SW	Power Switch Output. It is the switch node connection to Inductor. This pin connects to the drains of the internal P-ch and N-ch MOSFET switches.
5	GND	Ground Pin
6	FB	Output Voltage Feedback Pin. An internal resistive divider divides the output voltage down for comparison to the internal reference voltage.

Order Information

Marking	Part No.	Model	Description	Package	MOQ
ANYLL	70301051	HM3410D	HM3410D Buck, 2.5-5.5V, 1.2A, 1.5MHz VFB 0.6V, DFN6-2×2	DFN6-2×2	5000PCS

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Electrical Characteristics (Note 3)

(V_{IN}=V_{EN}=3.6V, T_A = 25°C, unless otherwise noted.)

Parameter	Conditions	Min.	Typ.	Max.	Unit
Input Voltage Range		2.5		5.5	V
UVLO Threshold			2.4		V
Input DC Supply Current	FB = 90%, Iload=0mA		150	300	µA
	FB= 105%, Iload=0mA		40	70	µA
	V_{EN} = 0V, V_{IN}=4.2V		0.1	1.0	µA
Regulated Feedback Voltage	T_A = 25°C	0.588	0.600	0.612	V
Reference Voltage Line Regulation	Vin = 2.5V to 6.0V		0.04	0.40	%/V
Output Voltage Line Regulation	V_{IN} = 2.5V to 6.0V		0.04	0.4	%
Output Voltage Load Regulation			0.5		%
Oscillation Frequency			1.5		MHz
On Resistance of PMOS	I_{SW}=100mA		0.3		Ω
ON Resistance of NMOS	I_{SW}=-100mA		0.2		Ω
Peak Current Limit	V_{IN}= 3.6V, FB=90%	1	1.2	1.5	A
EN Threshold		0.30	1.0	1.50	V
EN Leakage Current			±0.01	±1.0	µA
SW Leakage Current	V_{EN}=0V,V_{IN}=Vsw=5V		±0.01	±1.0	µA
Thermal Shutdown			160		℃

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

Note 2: TJ is calculated from the ambient temperature TA and power dissipation PD according to the following formula: TJ = TA + (PD) x (250°C/W).

Note3: 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

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Functional Block Diagram

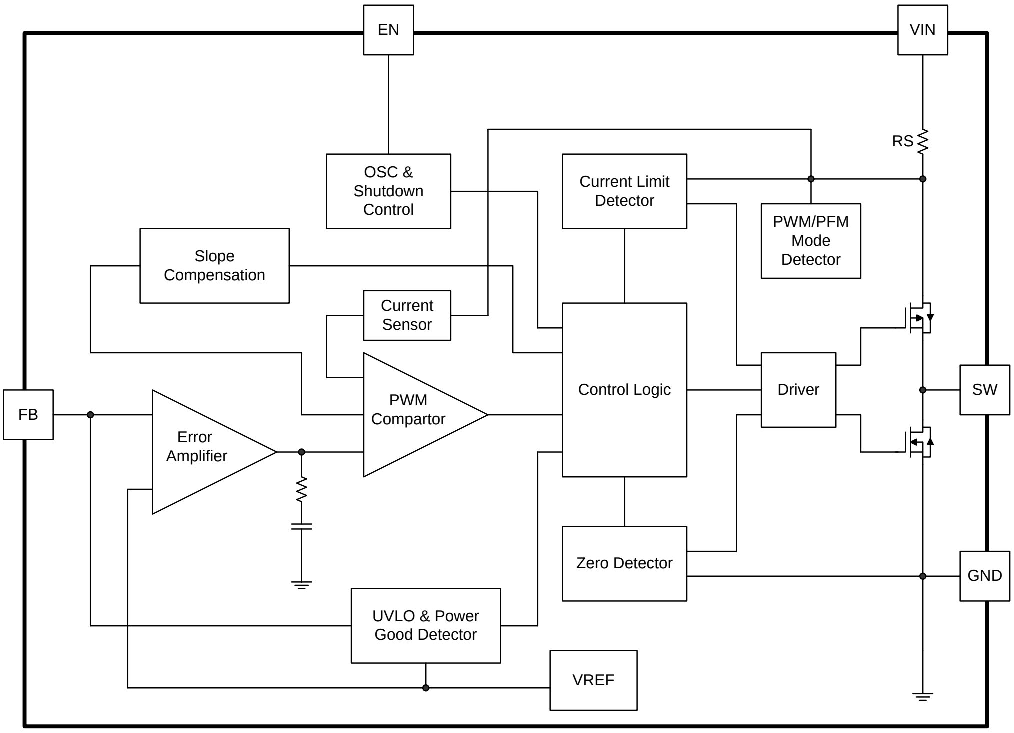

Figure 1. HM3410D Block Diagram

Operation

The HM3410D uses a constant frequency, current mode step-down architecture. Both the main (P-channel MOSFET) and synchronous (N-channel MOSFET) switches are internal. During normal operation, the internal top power MOSFET is turned on each cycle when the oscillator sets the RS latch, and turned off when the current comparator, ICOMP, resets the RS latch. The peak inductor current at which ICOMP resets the RS latch, is controlled by the output of error amplifier EA. When the load current increases, it causes a slight decrease in the feedback voltage, FB, relative to the 0.6V reference, which in turn, causes the EA amplifier's output voltage to increase until the average inductor current matches the new load current. While the top MOSFET is off, the bottom MOSFET is turned on until either the inductor current starts to reverse, as indicated by the current reversal comparator IRCMP, or the beginning of the next clock cycle.

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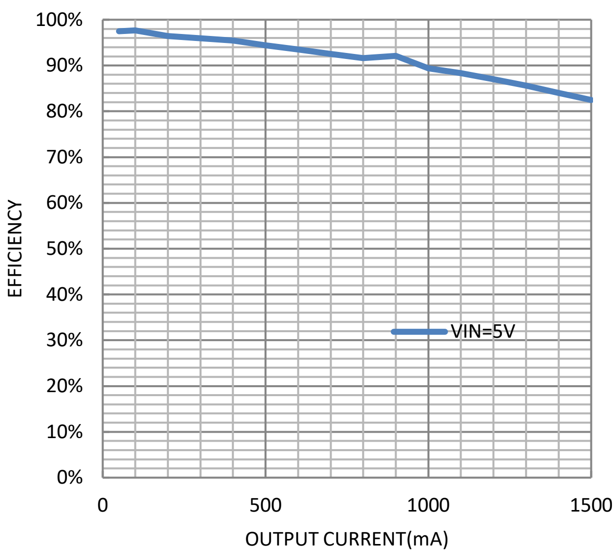
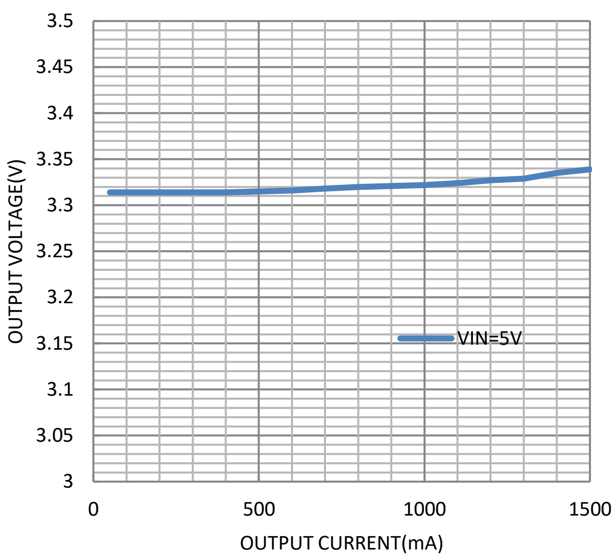
Typical Performance Characteristics

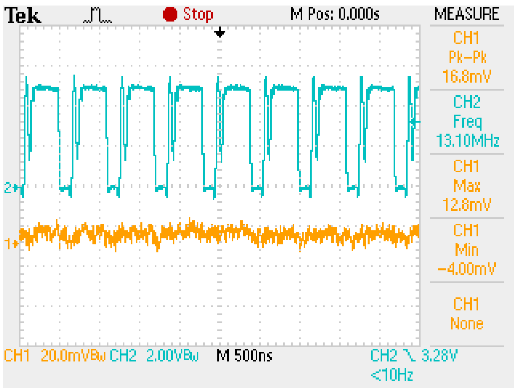
EFFICIENCY VS OUTPUT CURRENT (VOUT=3.3V)



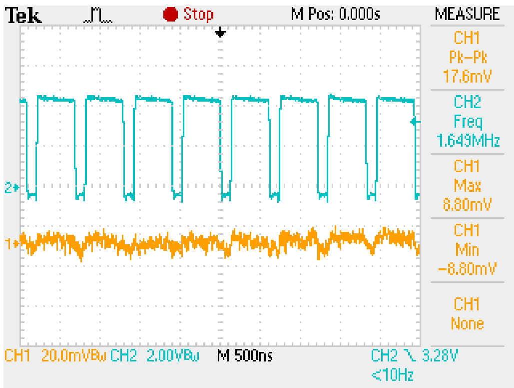
OUTPUT VOLTAGE VS OUTPUT CURRENT (VOUT=3.3V)



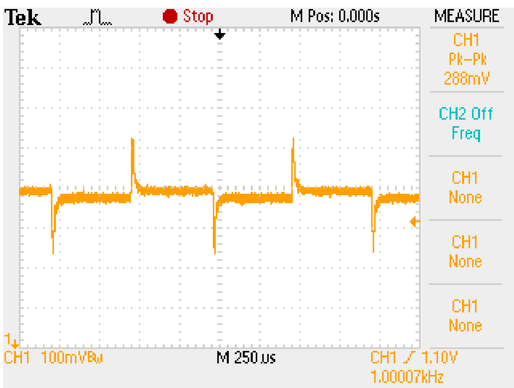
STEADY STATE OPERATION (VIN=5V,VOUT=3.3V,IOUT=100mA)



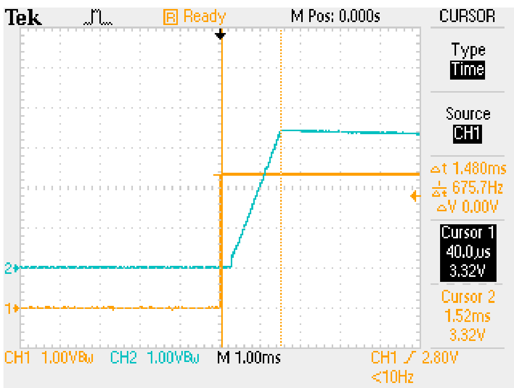
STEADY STATE OPERATION (VIN=5V,VOUT=3.3V,IOUT=1500mA)



LOAD TRANSIENT RESPONSE (VIN=5V,VOUT=3.3V,IOUT=500-1500mA,1A/uS)



STRAT UP (VIN=5V,VOUT=3.3V)



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Applications Information

Setting the Output Voltage

HM3410D require an input capacitor, an output capacitor and an inductor. These components are critical to the performance of the device. HM3410D are internally compensated and do not require external components to achieve stable operation. The output voltage can be programmed by resistor divider.

$$V_{OUT} = V_{FB} \times \frac{R1 + R2}{R2}$$

The external resistive divider is connected to the output, allowing remote voltage sensing as shown in on page 1.

Selecting the Inductor

The recommended inductor values are shown in the Application Diagram. It is important to guarantee the inductor core does not saturate during any foreseeable operational situation. The inductor should be rated to handle the peak load current plus the ripple current: Care should be taken when reviewing the different saturation current ratings that are specified by different manufacturers. Saturation current ratings are typically specified at 25°C, so ratings at maximum ambient temperature of the application should be requested from the manufacturer.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times F_{OSC}}$$

Where ΔIL is the inductor ripple current. Choose inductor ripple current to be approximately 30% if the maximum load current. 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.

Selecting the Output Capacitor

Special attention should be paid when selecting these components. The DC bias of these capacitors can result in a capacitance value that falls below the minimum value given in the recommended capacitor specifications table.
The ceramic capacitor’s actual capacitance can vary with temperature. The capacitor type X7R, which operates over a temperature range of −55°C to +125°C, will only vary the capacitance to within ±15%. The capacitor type X5R has a similar tolerance over a reduced temperature range of −55°C to +85°C. Many large value ceramic capacitors, larger than 1uF are manufactured with Z5U or Y5V temperature characteristics. Their capacitance can drop by more than 50% as the temperature varies from 25°C to 85°C. Therefore X5R or X7R is recommended over Z5U and Y5V in applications where the ambient temperature will change significantly above or below 25°C.
Tantalum capacitors are less desirable than ceramic for use as output capacitors because they are more expensive when comparing equivalent capacitance and voltage ratings in the 0.47uF to 44uF range. Another important consideration is that tantalum capacitors have higher ESR values than equivalent size ceramics. This means that while it may be possible to find a tantalum capacitor with an ESR value within the stable range, it would have to be

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larger in capacitance (which means bigger and more costly) than a ceramic capacitor with the same ESR value. It should also be noted that the ESR of a typical tantalum will increase about 2:1 as the temperature goes from 25°C down to −40°C, so some guard band must be allowed.

PC Board Layout Consideration

PCB layout is very important to achieve stable operation. It is highly recommended to duplicate EVB layout for optimum performance. If change is necessary, please follow these guidelines for reference.

1. Keep the path of switching current short and minimize the loop area formed by Input capacitor, high-side MOSFET and low-side MOSFET.
2. Bypass ceramic capacitors are suggested to be put close to the Vin Pin.
3. Ensure all feedback connections are short and direct. Place the feedback resistors and compensation components as close to the chip as possible.
4. VOUT, SW away from sensitive analog areas such as FB.
5. Connect IN, SW, and especially GND respectively to a large copper area to cool the chip to improve thermal performance and long-term reliability.

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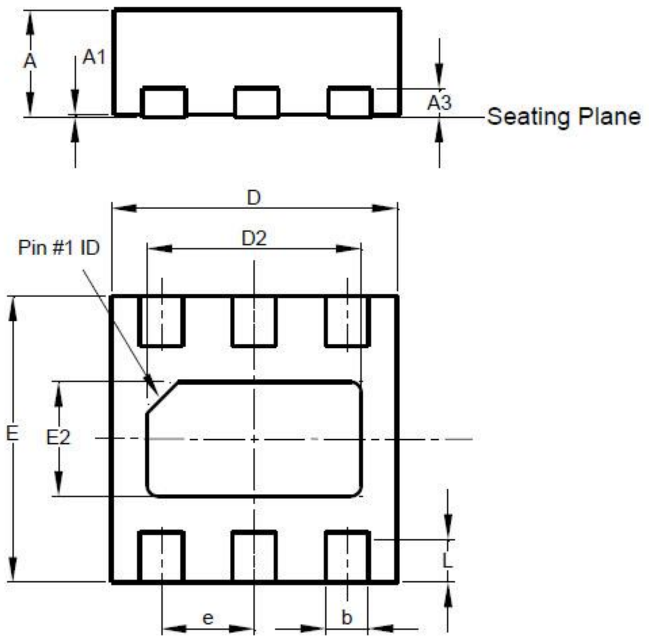
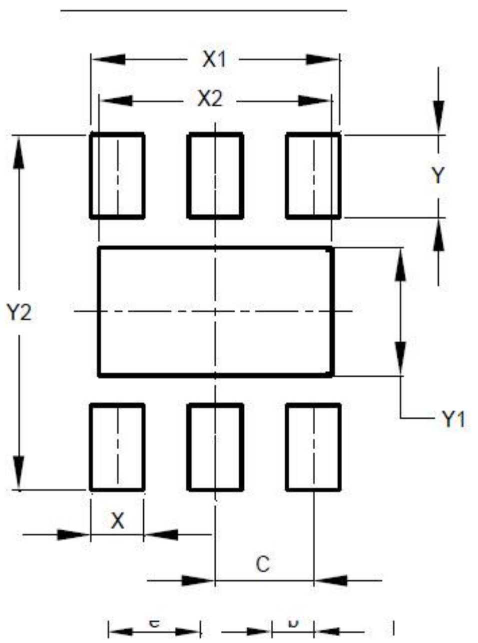
Package Description



Dim	Min	Max	Typ
A	0.70	0.80	0.75
A1	0.00	0.05	--
A3	0.20 REF		
b	0.25	0.35	0.30
D	1.95	2.075	2.00
D2	1.35	1.60	1.50
E	1.95	2.075	2.00
E2	0.65	0.90	0.80
e	0.65 BSC		
L	0.25	0.45	0.35
All Dimensions in mm			



Dimensions	Value (in mm)
C	0.650
X	0.350
X1	1.650
X2	1.550
Y	0.545
Y1	0.850
Y2	2.350