

## 2A, 22V Step-Up Regulator

### DESCRIPTION

The HM5663B is a high efficiency step-up converter with an internally integrated 22V power MOSFET. It runs with an optimal 1MHz frequency that enables the use of small external components while still providing the best efficiency. It can drive up to 2A output current. The incorporated true PWM-Dimming feature through EN pin enable one further digitally program the output voltage lower. For maximum protection, the HM5663B has an OVP protection feature that prevents the output voltage exceeding the maximum rating of the HM5663B and the output cap during open conditions.

HM5663B is available in a space-saving SOT23-6 package.

### ORDERING INFORMATION

| PART #  | PACKAGE PIN | TOP MARK                                  |
|---------|-------------|-------------------------------------------|
| HM5663B | SOT23-6     | GVYW<br>└─ Date Code<br>└─ Product Number |

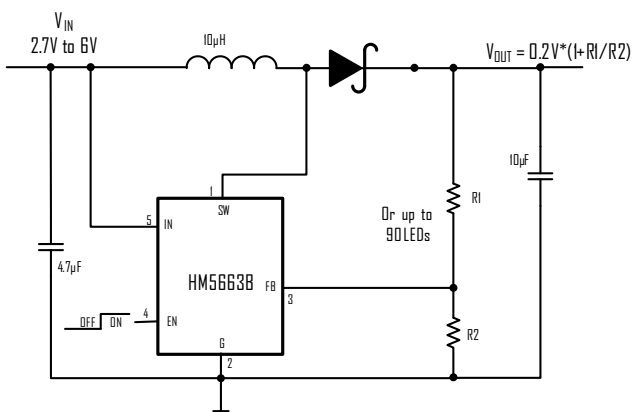
### FEATURES

- Up to 95% Efficiency
- 22V OVP protection
- True PWM Brightness Control
- 200mV Feedback Voltage
- 2.8A current limit
- SOT23-6 Package

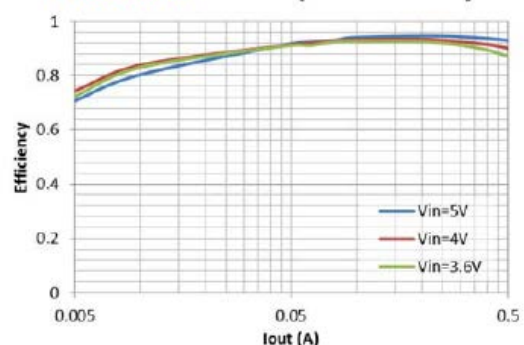
### APPLICATIONS

- Portable power bank
- Powering 3G module
- Large LCD display backlight driving up to 90 LEDs
- Satellite STB
- Bluetooth Speaker
- Large TFT screen bias
- Other application which needs high voltage and high current generation

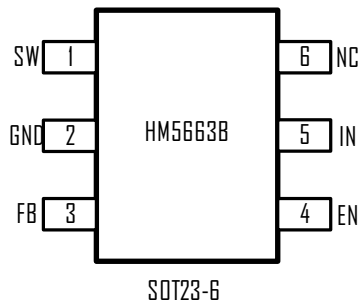
### TYPICAL APPLICATION



HM5663B 12V output efficiency



## PIN CONFIGURATION



## ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

SW Voltage.....-0.3V to 25V

All Other PIN Voltages.....-0.3V to 6.5V

SW to ground current .....Internally limited

Operating Temperature Range .....-40°C to 85°C

Storage Temperature Range .....-55°C to 150°C

Thermal Resistance  $\theta_{JA}$   $\theta_{JC}$

SOT23-6.....134.....50 .....°C/W

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = 3.6V$ , unless otherwise specified. Typical values are at  $T_A = 25^\circ C$ .)

| PARAMETER                     | CONDITIONS                          | MIN  | TYP  | MAX | UNITS    |
|-------------------------------|-------------------------------------|------|------|-----|----------|
| Input Voltage Range           |                                     | 2.7  |      | 6   | V        |
| Input UVLO                    | Rising                              | 2.00 | 2.32 | 2.6 | V        |
| UVLO HYS                      |                                     |      | 140  |     | mV       |
| FB Feedback Voltage           | $V_{IN} = V_{CTRL} = 3.6V$          | 194  | 200  | 206 | mV       |
| FB Input Current              |                                     |      |      | 50  | nA       |
| Quiescent Current at IN       | Switching at $I_{OUT} = 0$          |      | 1.8  |     | mA       |
|                               | No Switching                        |      | 0.25 |     | mA       |
| Shutdown Supply Current at IN | $V_{EN} = GND$                      |      | 0    | 5   | $\mu A$  |
| Switching Frequency           | $V_{IN} < 4.3V$                     | 0.8  | 1    | 1.2 | MHz      |
| Maximum Duty Cycle            |                                     |      | 90   |     | %        |
| NMOS Switch On Resistance     | $I_{SW} = 100mA$                    |      | 0.1  |     | $\Omega$ |
| NMOS Switch Current Limit     |                                     |      | 2.8  |     | A        |
| SW Leakage Current            | $V_{SW} = 0$ or 20V, $V_{EN} = GND$ |      |      | 10  | $\mu A$  |
| EN Input Low Voltage          |                                     |      |      | 0.6 | V        |
| EN Input High Voltage         |                                     | 1.2  |      |     | V        |
| Thermal Shutdown              | Rising, Hysteresis=10°C             |      | 150  |     | °C       |

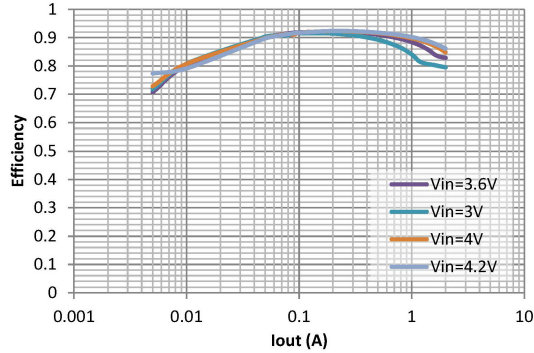
## PIN DESCRIPTION

| PIN # | NAME | DESCRIPTION                                                                                                                       |
|-------|------|-----------------------------------------------------------------------------------------------------------------------------------|
| 1     | SW   | Inductor Connection. Connect an inductor Between SW and IN.                                                                       |
| 2     | GND  | Ground Pin                                                                                                                        |
| 3     | FB   | Feedback Input for Current. Connect an external resistor FB to GND to set $I_{OUT}$                                               |
| 4     | EN   | Control pin for the IC. It is a multi-functional pin for enable control, PWM dimming. If the pin is floating will disable the IC. |
| 5     | IN   | Input Supply pin. Bypass with a 4.7 $\mu F$ or larger ceramic capacitor to GND                                                    |
| 6     | NC   | Not connected, leave this PIN floating                                                                                            |

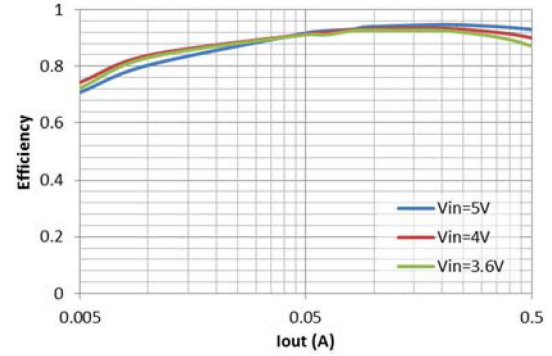
## TYPICAL CHARACTERISTICS

(Typical values are at  $T_A = 25^{\circ}\text{C}$  unless otherwise specified.)

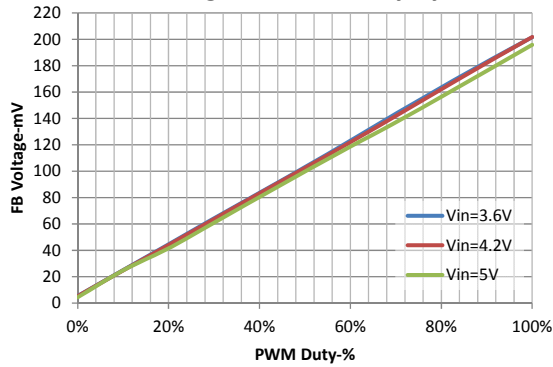
HM5663B 5V output efficiency



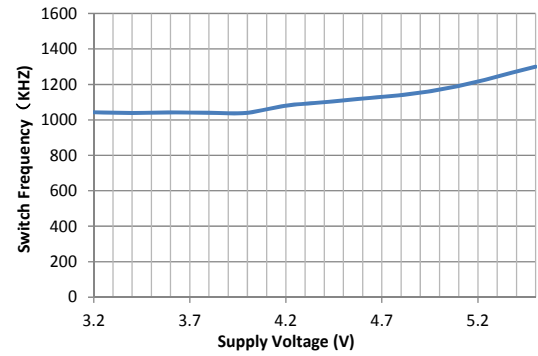
HM5663B 12V output efficiency



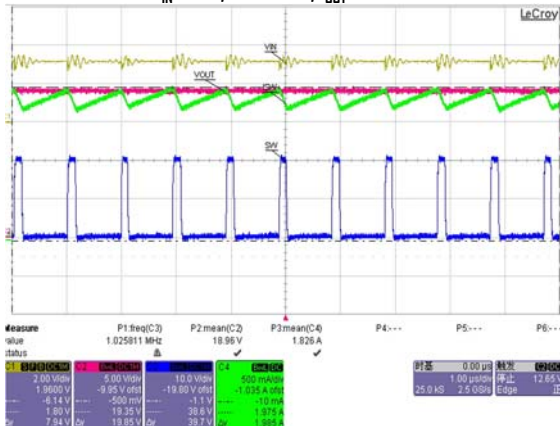
FB Voltage VS PWM Duty Cycle



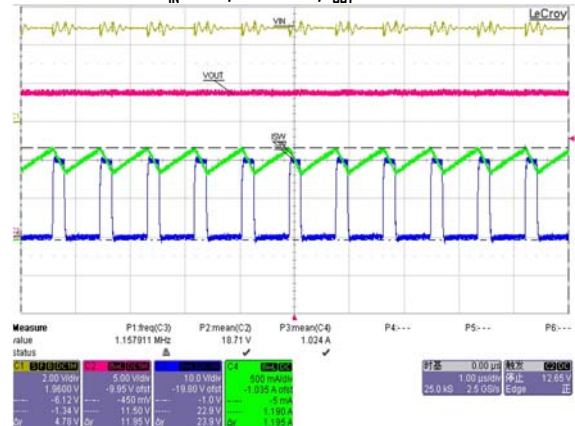
Switch Frequency VS Supply Voltage



Switching Waveform  
 $V_{in}=3.2\text{V}$ ,  $V_{out}=20\text{V}$ ,  $I_{out}=280\text{mA}$



Switching Waveform  
 $V_{in}=5.0\text{V}$ ,  $V_{out}=20\text{V}$ ,  $I_{out}=280\text{mA}$



## FUNCTIONAL DESCRIPTIONS

The HM5663B is a high efficiency, high output voltage boost converter in a small package size. The device is ideal for delivering 1-2A current when boosting up the output voltage. The device integrates 22V/2.8A switch FET and operates in pulse width modulation (PWM) with 1MHz fixed switching frequency. For operation details, please check the block diagram at the "Block Diagram" chapter. The duty cycle of the converter is set by the error amplifier output and the current signal applied to the PWM control comparator. The feedback loop regulates the FB pin to a low reference voltage (200mV typical), reducing the power dissipation in the current sense resistor.

### *Output Open Circuit Protection*

Output open circuit protection circuitry prevents IC damage as the result of output open circuit (e.g. LED string absence). The HM5663B monitors the voltage at the SW pin and FB pin during each switching cycle. The circuitry turns off the switch FET and shuts down the IC when both of the following conditions persist for 8 switching clock cycles: (1) the SW voltage exceeds the VOVP threshold, which is 25V and (2) the FB voltage is less than half of regulation voltage. As a result, the output voltage falls to the level of the input supply. The device remains in shutdown mode until it is enabled by toggling the EN pin logic. The output voltage plus the 200mV reference voltage cannot exceed the minimum OVP threshold or  $OUTPUT\ VOLTAGE + 200\ mV \leq VOVP(MIN)$ .

### *Shutdown*

The HM5663B enters shutdown mode when the EN voltage is logic low for more than 2.5ms. During shutdown, the input supply current for the device is less than 1μA (max). Although the internal FET does not switch in shutdown, there is still a DC current path between the input and the output through the inductor and Schottky diode.

For LED driving application, the minimum forward voltage of the LED array must exceed the maximum input voltage to ensure that the LEDs remain off in shutdown. However, in the typical application with two or more LEDs, the forward voltage is large enough to reverse bias the Schottky and keep leakage current low.

### *Output Voltage Setting*

The FB voltage is regulated by a low 0.2V reference voltage. The output voltage is set externally by using a resistor divider. The value of the R1/R2 divider is calculated using Equation 1.1:

$$VOUT = VFB/R2 * (R1 + R2) \quad (1.1)$$

Where

VOUT = output voltage, R2 = resistance between FB and GND, R1 = resistance between OUT and FB.

The output current tolerance depends on the FB accuracy and the current sensor resistor accuracy.

### *LED Driving Current Setting*

The FB voltage is regulated by a low 0.2V reference voltage. The LED current is set externally using a current-sense resistor in series with the LED string. The value of the RSET is calculated using Equation 1.2:

$$ILED = VFB/RSET \quad (1.2)$$

Where

ILED = output current of LEDs, RSET = current sense resistor

The output current tolerance depends on the FB accuracy and the current sensor resistor accuracy.

### *PWM Dimming Control or Output Voltage Programming*

When the CTRL pin is constantly high, the FB voltage is regulated to 200mV typically. However, the EN pin allows a PWM signal to reduce this regulation voltage; therefore, it achieves LED brightness dimming or output voltage programming (only to make output voltage lower). The relationship between the duty cycle and FB voltage is given by Equation 1.3:

$$V_{FB} = \text{Duty} \times 200 \text{ mV} \quad (1.3)$$

Where

Duty = duty cycle of the PWM signal, 200 mV = internal reference voltage

This PWM dimming eliminates the audible noise which often occurs when the output current is pulsed in replica of the frequency and duty cycle of PWM control. Unlike other scheme which filters the PWM signal for analog dimming, HM5663B regulation voltage is independent of the PWM logic voltage level which often has large variations for optimum performance, use the PWM dimming frequency in the range of 25kHz to 100kHz.

## APPLICATION INFORMATION

### Inductor Selection

Using an inductor with a smaller inductance value forces discontinuous PWM when the inductor current ramps down to zero before the end of each switching cycle. This reduces the boost converter's maximum output current, causes large input voltage ripple and reduces efficiency. Large inductance value provides much more output current and higher conversion efficiency. For these reasons, a 4.7μH to 10μH inductor value range is recommended. A 10μH inductor optimized the efficiency for most application while maintaining low inductor peak to peak ripple. Below table lists the recommended inductor for the HM5663B.

**Recommended Inductors for HM5663B**

| Part #    | L(μH)    | Saturation Current (mA) | Vendor  |
|-----------|----------|-------------------------|---------|
| SWRH3D1GS | 4.7 - 10 | >2500                   | Sunlord |

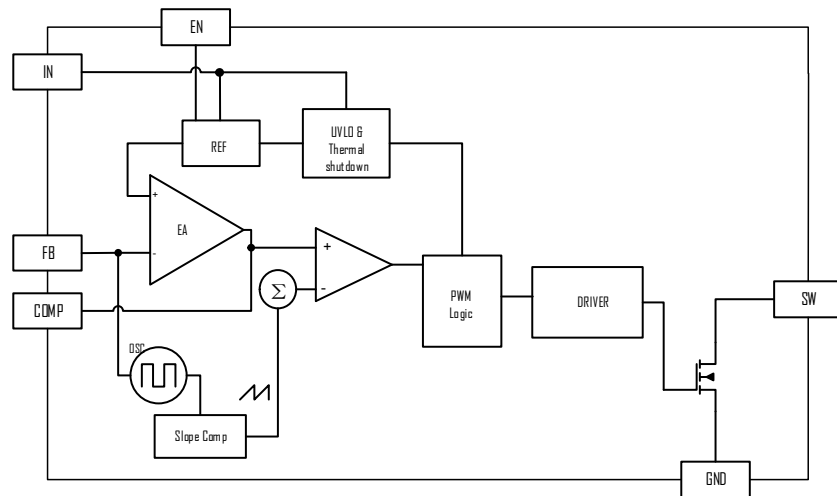
### Schottky Diode Selection

A high-speed rectifying Schottky is recommended for HM5663B for maximum efficiency due to its high switching frequency. The diode average and peak current rating must be larger than the average output current and peak inductor current to ensure reliability. In addition, the diode's reverse breakdown voltage must exceed the open LED protection voltage.

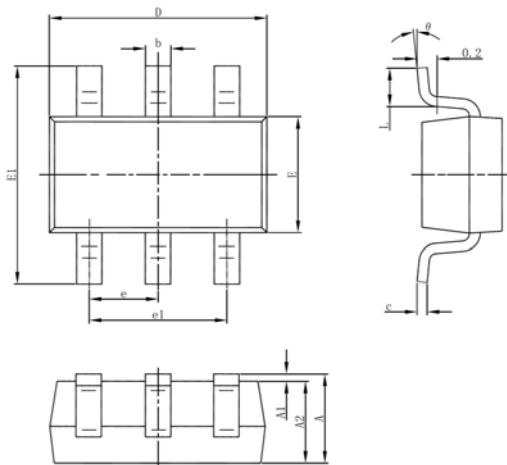
### Input and Output Capacitor Selection

The output capacitor is mainly selected to meet the requirements for the output ripple and loop stability. The output requires a capacitor in the range of 10μF to 22μF.

## BLOCK DIAGRAM



## PACKAGE OUTLINE



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.050                     | 1.250 | 0.041                | 0.049 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 1.050                     | 1.150 | 0.041                | 0.045 |
| b      | 0.300                     | 0.500 | 0.012                | 0.020 |
| c      | 0.100                     | 0.200 | 0.004                | 0.008 |
| D      | 2.820                     | 3.020 | 0.111                | 0.119 |
| E      | 1.500                     | 1.700 | 0.059                | 0.067 |
| E1     | 2.650                     | 2.950 | 0.104                | 0.116 |
| e      | 0.950(BSC)                |       | 0.037(BSC)           |       |
| e1     | 1.800                     | 2.000 | 0.071                | 0.079 |
| L      | 0.300                     | 0.600 | 0.012                | 0.024 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |