

## DESCRIPTION

BM0650A is a step-down converter IC ,with integrated PFM controller and 200V power MOSFET for low-power non-isolated switching power supplies with extremely simple peripheral components.BM0650A built-in 200V high-voltage start and self-powered module to achieve fast start-up, ultra-low standby and self-power supply functions. The chip provides complete protection functions, including overload protection, undervoltage protection, over-temperature protection, and excellent EMI characteristics.

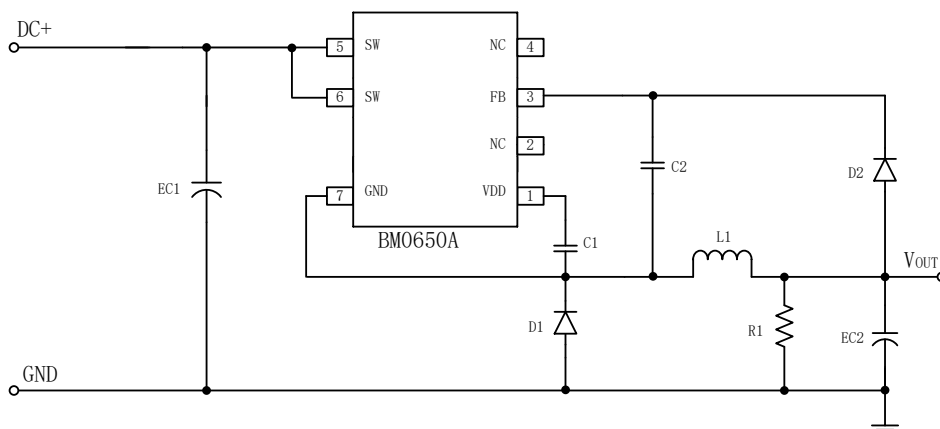
## FEATURES

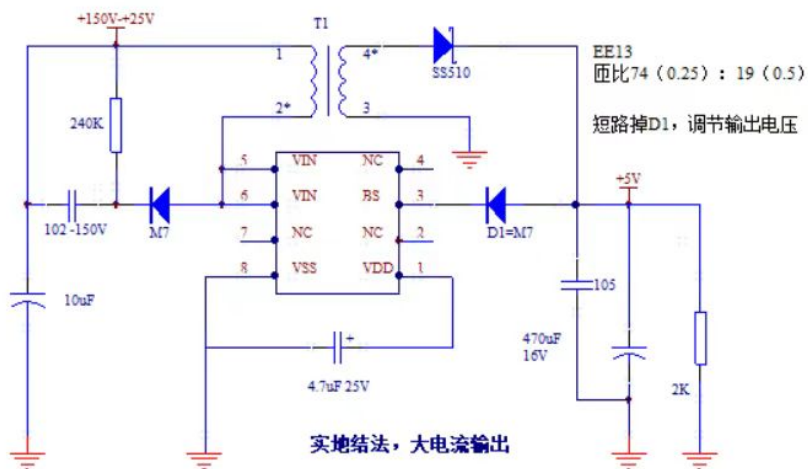
- Built-in 200V power MOSFET
- Built-in high-voltage starting and self-powered circuits
- The output voltage is fixed at 5V
- The output current is 800mA
- Excellent EMI performance
- Excellent load regulation and efficiency
- Comprehensive protection
- SOP-7package

## APPLICATIONS

- Electric vehicle controllers
- On-board equipment

## TYPICAL APPLICATION:





### PIN DESCRIPTION

PIN	Name	Description
1	VDD	IC power supply
3	FB	Feedback side
5、6	SW	High-voltage MOSFET drain
7	GND	IC ground
2、4	NC	

### TYPICAL POWER

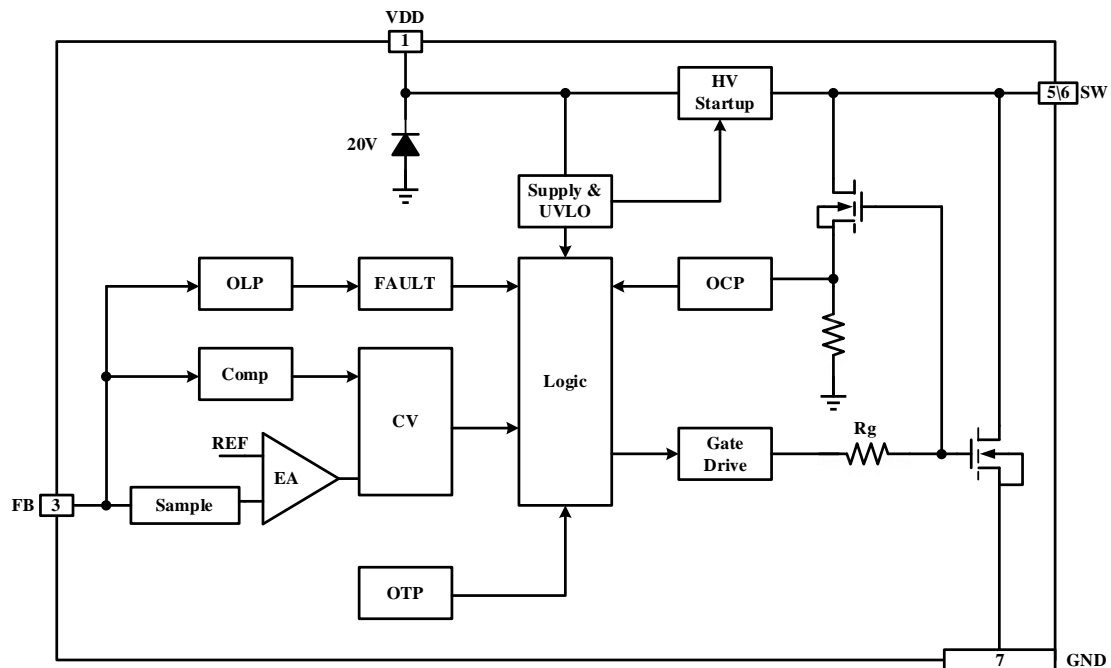
Parameter	Range
Product number	BM0650A
Input voltage	DC 35-170V
Steady state power	4W(5V/800mA)

**Note:** The actual output current depends on the heat dissipation conditions

### ORDER INFORMATION

Part number	Description
BM0650A	SOP-7,Tape reel,4000pcs/Reel

### BLOCK DIAGRAM



### ABSOLUTE MAXIMUM RATING (NOTE)

Parameter	Range
VDD pin voltage	-0.3 V to 40V
V <sub>SW</sub> pin voltage	-0.3V to 200V
FB Pin pressure-resistant	-0.3V to 7V
Operating Junction Temp	-40°C to 150°C
Storage temperature	-55°C to 150°C
Lead Temperature	260°C
Package thermal resistance( R <sub>θJc</sub> SOP-7)	80°C/W
ESD Susceptibility(Human Body Model)	±2kV
ESD Susceptibility(Machine Model)	200V

**Note:**Exceeding these ratings may damage the device.Devices that operate outside of the recommended operating range are not guaranteed to be characteristic.Prolonged operation under extreme parameters may affect the reliability of the device.

## ELECRICAL CHARACTERISTICS

$V_{DD}=18V$ ,  $T_A = 25^{\circ}C$ , unless otherwise stated

Symbol	Item	Condition	Min.	Typ.	Max.	Units
<b>Supply voltage</b>						
VDD	Operating voltage range	After turn-on	10		17	V
VDDon	VDD startup threshold voltage		12	13.5	15	V
VDDoff	VDD under voltage protection threshold voltage		10	11	12	V
VDDhys	VDD backbet			2.5		V
VDDclamp	VDD Clamping Voltage		16	20	23	V
IDDch	Starter tube charge current	VDD=9V		2.5		mA
IDD0	Quiescent current	VDD=15V	220	330	450	uA
IDD1	Operating current	fs=40KHz	80	120	220	uA
<b>Control section</b>						
Ilimit	Spike current limit		1.5	1.7	1.9	A
TLEB	Overcurrent detection leading-edge blanking time			300		ns
Toffmin	Minimum shutdown time		15	18	21	us
Tonmax	Maximum on-time			13		us
VREF	The MOS is turned onto feedback the reference voltage		5.1	5.3	5.5	V
VREF_OLP	The OLP triggers a feedback reference			3.6		V
TOLP	OLP trigger delay time			150		ms
TSD	Over-temperature protection temperature		135	150		°C
THYST	Over-temperature protection back			40		°C
<b>Power tubes</b>						
BVDSS	The power tube is pressure-tolerant	$I_{sw} = 250\mu A$	200	250		V
IOFF	Closed-state leakage current	$V_{sw} = 500V$			100	uA
VST	High voltage starting voltage	VDD=VDDon-1V		20		V

## FUNCTIONAL DESCRIPTION

BM0650A integrated PFM controller and 200V power MOSFET, for low-power non-isolated switching power supplies with very simple peripheral components. BM0650A built-in high-voltage start and self-power supply module to achieve fast start-up, ultra-low standby and self-power supply functions of the system. The chip provides complete intelligent protection functions, including overload protection, under-voltage protection, and over-temperature protection. In addition, BM0650A use frequency reduction modulation technology to improve EMI characteristics.

### 1.High-voltage start with self-powered

In the start-up phase, the internal high-voltage starter tube provides 2.5mA current to charge the external VDD capacitor, when the VDD voltage reaches  $VDD_{ON}$ , the chip starts to work, and the high-voltage starter tube stops charging the VDD capacitor, when the VDD voltage drops to  $VDD_{OFF}$ , the chip continues to work, the internal high-voltage starter tube provides 2.5mA current again to charge the external VDD capacitor.

### 2.Constant voltage working mode

The IC samples the output voltage through the FB pin. When the FB voltage is lower than the internal reference voltage, the chip turns on the integrated high-voltage power tube to charge the energy storage inductor, and when the inductor current reaches the internal reference current  $I_{PEAK}$ , the chip turns off the integrated high-voltage power tube, and the system diode continues to flow to the energy storage inductor. Figure 1-1 and Figure 1-2 show the working waveforms of key nodes of the system in continuous mode (CCM) and discontinuous mode (DCM), respectively. At the same time, the chip integrates the load compensation function, which can improve the constant voltage accuracy and achieve better load regulation.

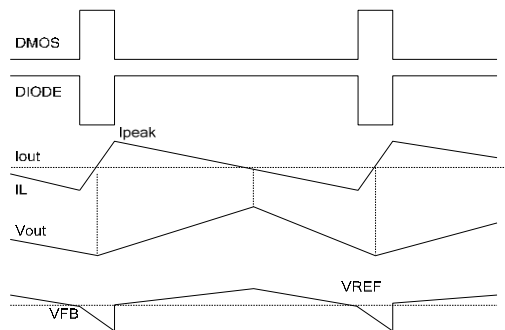


图 1-1 Operates wave forms in continuous mode

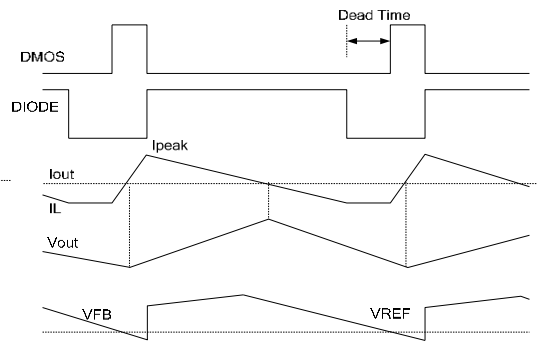


图 1-2 Working wave in discontinuous mode

### 3.PFM modulation

The chip works in PFM mode, and the internal  $I_{PEAK}$  decreases with the decrease of the chip working frequency  $F_{SW}$ , and the  $I_{PEAK}$  decreases by about 3.6mA for every 1us increase in the chip switching cycle. Due to the built-in sampling of the chip, the maximum  $I_{PEAK}$  is fixed, and when the output voltage and output current are fixed, the inductance is the only parameter that modulates the operating frequency.

### 4.Soft start

In order to avoid large current spikes caused by entering deep CCM mode during the start-up phase of the non-isolated system. BM0650A set the soft-start function, the maximum switching frequency is reduced by 25% in the first 10ms and 50% between 10ms and 15ms. At the same time, the chip is designed with a small time (300ns) to reduce the energy in the time to avoid high current spikes when the system starts.

### 5.Intelligent protection features

BM0650A integrates comprehensive protection functions, including: overload protection, over-temperature protection, FB abnormal protection, VDD under-voltage protection, and these protections have a self-recovery mode.

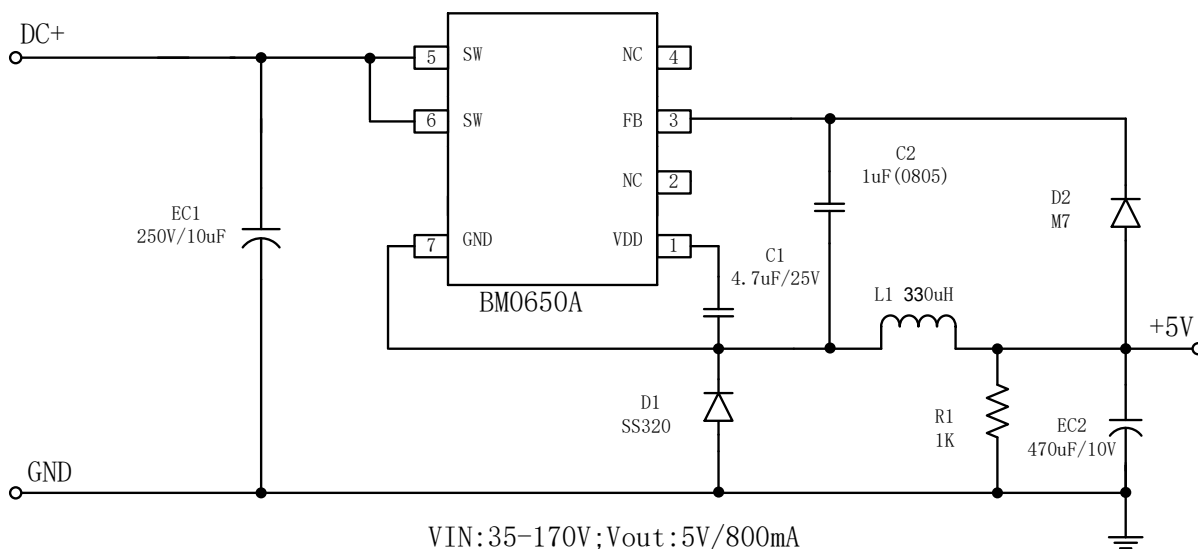
Overload protection-----When the FB detects that the voltage is lower than 3.6V and lasts for 150ms, the overload protection is triggered, and the chip restarts.

Over-temperature protection-----When the chip junction temperature exceeds 150°C, the chip enters the over-temperature protection state, the output is turned off, and when the chip junction temperature is lower than 120°C, the chip restarts.

FB anomaly protection-----After the soft start of the chip, if the FB potential is still lower than 150mV, it will be judged as an abnormal short circuit of FB and the chip will restart.

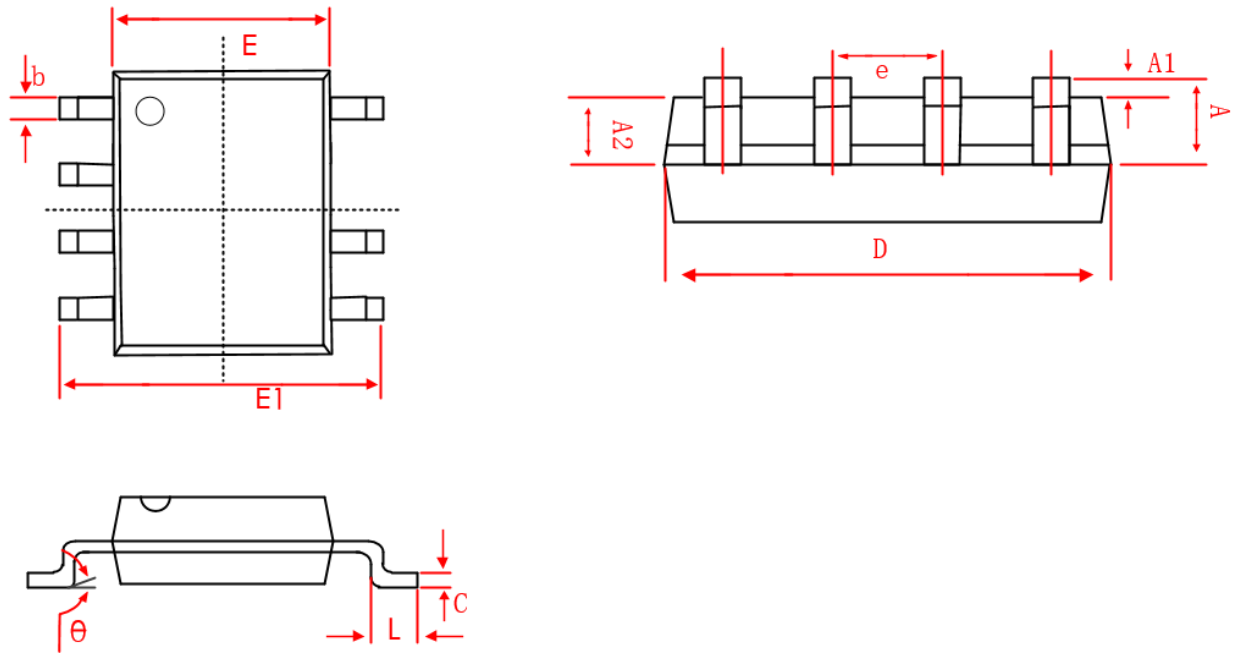
VDD under voltage protection-----When the VDD voltage of the chip is lower than 8V, the chip restarts. In addition, the abnormal self-recovery time of the chip can be adjusted by VDD capacitor, the larger the VDD capacitor, the longer the self-recovery time.

### REFERENCE DESIGN



**PACKAGE OUTLINE**

**SOP-7**



Symbol	Dimensions (mm)		Size (feet)	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(Center-to-center)		0.050 (Center-to-center)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°