

STRUCTURE	Silicon Monolithic Integrated Circuit
TYPE	Flexible Step-Down Switching Regulator
PRODUCT SERIES	BD9009HFP
FEATURES	<ul style="list-style-type: none"> •Wide input Range : 7~35V •Integrated 4A P-ch Power MOS FET •High Precision(Reference Voltage) : $\pm 2\%$ •Adjustable Frequency : 50k~500kHz (it is possible external synchronization until 500kHz) •Oscillation frequency accuracy : $\pm 5\%$ (200~500kHz)

○ABSOLUTE MAXIMUM RATINGS(Ta=25°C)

Parameter	Symbol	Limits	Unit
Supply Voltage	V _{IN}	36	V
SW Pin Voltage	V _{sw}	V _{IN}	V
Output SW Current	I _{sw}	4 ⁽¹⁾	A
EN, SYNC Pin Voltage	V _{EN} /V _{SYNC}	V _{IN}	V
RT, FB, INV Pin Voltage	V _{RT} ,V _{FB} , V _{INV}	7	V
Power Dissipation	P _d	5.5 ⁽²⁾	W
Operating Temperature Range	T _{opr}	-40~+105	°C
Storage Temperature Range	T _{stg}	-55~+150	°C
Maximum Junction Temperature	T _{jmax}	150	°C

(1) Do not however exceed P_d.

(2) P_d derated at 44mW/°C for temperature above Ta=25°C, Mounted on a double layer PCB 70mm×70mm×1.6mm.
(with Thermal vias / Copper area : 70mm×70mm)

○OPERATING CONDITIONS(Ta=-40~+105°C)

Parameter	Symbol	Min.	Max.	Unit
Recommend Supply Voltage	V _{IN}	7	35	V
Output Switch Current	I _{sw}	—	4	A
Oscillator Frequency	F _{OSC}	50	500	kHz

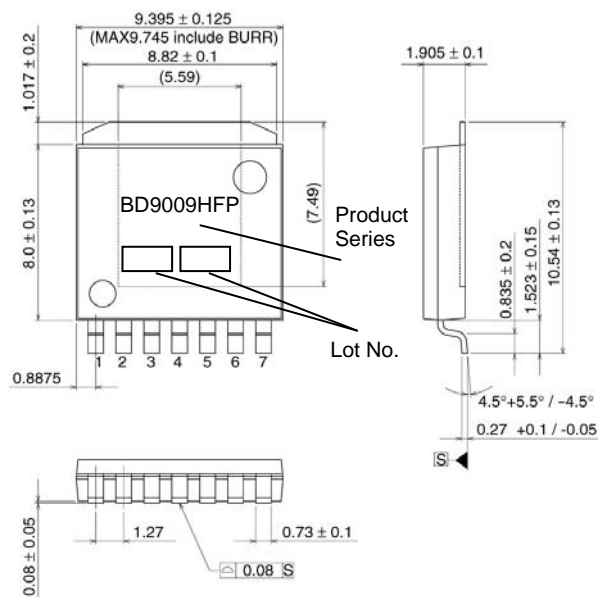
* Electrical characteristics are not guaranteed (especially when operating on reduce voltage)

* The product is not designed for protection against radioactive rays.

OELECTRICAL CHARACTERISTICS (Unless otherwise specified, Ta=25°C, VIN=13.2V, VEN=5V)

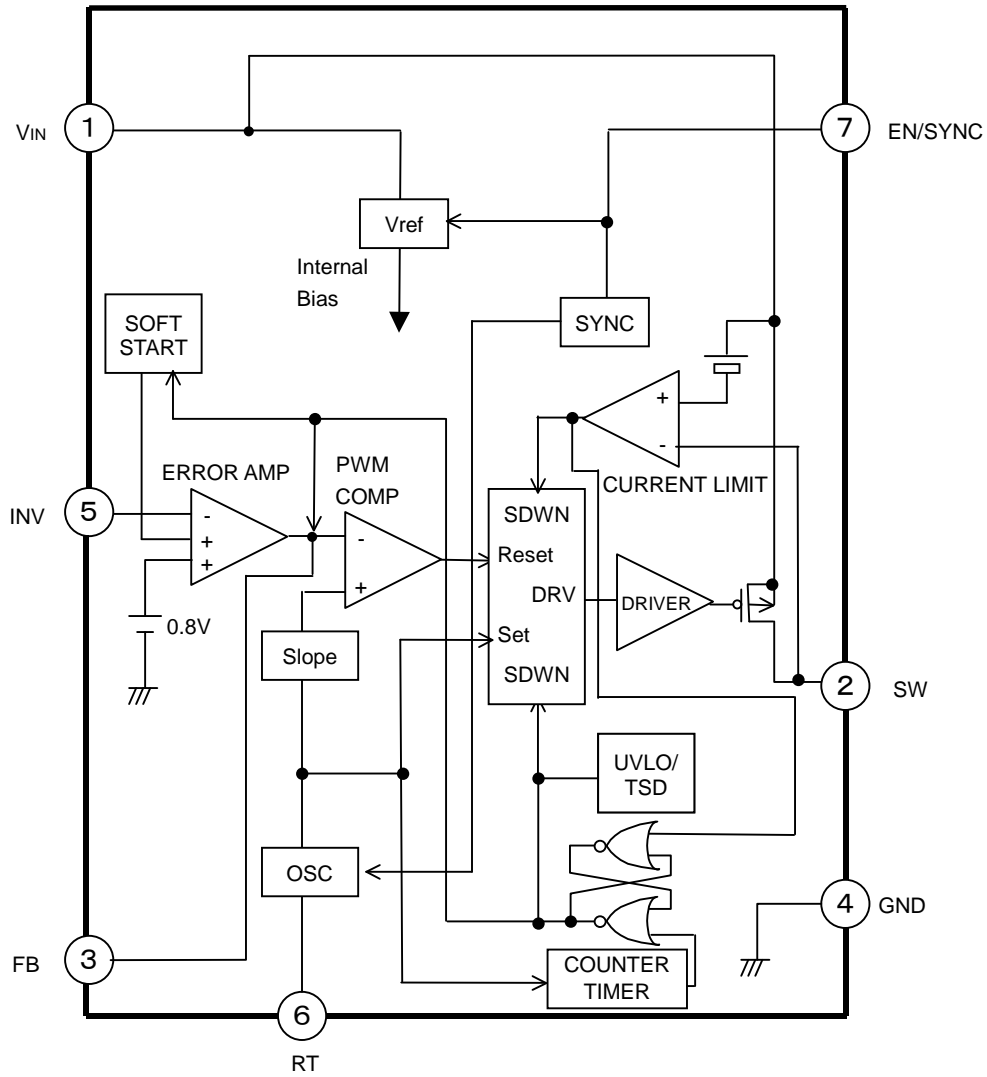
Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
[Entire Device]						
Stand-by Current	ISTB	—	0	10	μA	VEN=0V
Quiescent Current	IQ	—	4.2	6.5	mA	IO=0A, RT=51kΩ, INV=0.7V
[Switch]						
Leakage Current	IOLEAK	—	0	30	μA	VIN=35V, VEN=0V
[Error Amplifier]						
Reference Voltage1	VREF1	0.784	0.800	0.816	V	VFB=VINV
Reference Voltage2	VREF2	0.780	0.800	0.820	V	VIN=10~16V, VFB=VINV
Input Bias Current	IB	-1	—	—	μA	VINV=0.6V
[Oscillator Section]						
Switching Frequency1	FOSC1	285	300	315	kHz	VIN=7V, RT=51kΩ
Switching Frequency2	FOSC2	283.5	300	316.5	kHz	VIN=7~16V, RT=51kΩ
[Synchronized Frequency]						
Synchronous Frequency	FSYNC	495	500	505	kHz	RT=51kΩ, EN/SYNC=500kHz Duty=50%
[Enable]						
Output ON Voltage	VENON	2.6	—	—	V	
Output OFF Voltage	VENOFF	—	—	0.8	V	
Sense Current	IEN	—	35	90	μA	VEN=5V

OPHYSICAL DIMENTIONS・MARKING



HRP7 (unit : mm)

OBLOCK DIAGRAM



※Refer to the Technical Note about the details of the application.

OPin No. • Pin Name

Pin No.	Pin Name
1	VIN
2	SW
3	FB
4	GND
5	INV
6	RT
7	EN/SYNC
FIN	FIN

NOTES FOR USE

1. Absolute maximum range
Absolute Maximum Ratings are those values beyond which the life of a device may be destroyed we cannot be defined the failure mode, such as short mode or open mode.
Therefore physical security countermeasure, like fuse, is to be given when a specific mode to be beyond absolute maximum ratings is considered.
2. Operation supply voltage range
The circuit functionality is guaranteed within operation of ambient temperature range, as long as it is within operation supply voltage range. The standard electrical characteristic values are guaranteed at the test circuit voltage of $V_{IN}=13.2V$. They cannot be guaranteed at other voltages in the operating range of $7V-35V$. However, the variation will be small.
3. Grounding
It is recommended that every capacitor (bypass and another capacitors) is grounded to PIN4 using single-point connections.
4. Input supply voltage
Input supply pattern layout should be as short as possible.
5. VIN Terminal
For reduce the influence of switching noise, bypass capacitor is connected between VIN and GND.(over $3\mu F$)
6. SOFT START
The SOFT START block provides a function to prevent the overshoot of the output voltage V_o through gradually increasing the normal rotation input of the error amplifier when power supply turns ON to gradually increase the switching Duty. The soft start time is set to 5 msec. (Typ.).
7. FB Terminal
The FB terminal is for phase margin of the DC/DC system. A capacitor and a resistor or an only capacitor placed between the FB terminal and the INV terminal. The values of the capacitor and the resistor shall be adjusted according to the output current and the output capacitor value. The output may be oscillating if the value of capacitor is not sufficient, also the transient response may become insufficient if the value is too large. Therefore, the value of the capacitor and the resistor shall be adequately set up based on the condition of the temperature, and so on. Since the FB terminal also detects output short condition compulsorily applying an external voltage onto the FB terminal must not be performed because it may activate the timer latch protection circuit.
8. Electromagnetic Fields
The IC is susceptible to strong electromagnetic fields and may cause malfunction. Therefore, caution should be used when placing it on the PCB.
9. Application Design
When designing the external circuit, included adequate margins, including not only steady state but also transient characteristics.
10. Adjacent Pin short mistake fitting
Use caution when orienting and positioning the IC for mounting on printed circuit boards. Improper mounting may result in damage to the IC. When VIN and EN terminal are short and used, please note that the destruction of IC is caused with $V_{IN}=7V$ or more enough, when 7 pin EN terminal and 6 pin RT terminal are short-circuit.
11. Over Output Current Protection
SW Output terminal has over current protection circuit of $4A$ (Minimum load current ability), with prevents IC from being damage by short circuit at over current. When over current protection circuit operates, output is turned off immediately, and then this IC restart to operate after $4096/f_{osc}$ sec..
However, It is recommend not to use that continuously operates the protection circuit (For instance, always the load that greatly exceeds the output current ability is connected or the output is short-circuited, etc.) in these protection circuits by an effective one to the destruction prevention due to broken accident.
12. Over Output Current Protection at start up
This IC is designed that over current protection circuit operates at start up and normal operation. Therefore at start up when this IC's total load current (sum of load current and charge current to output capacitor) is exceeded $4A$ (Minimum load current ability), over current protection circuit operates, and this IC's start up times are excessive time by latch off counter timer($4096/f_{osc}[s]$). If this case is occurred, output capacitor is recommended to change small value.
13. Temperature protection (thermal down) circuit
This IC has a built-in temperature protection circuit to prevent the thermal destruction of the IC. As described above, be sure to use this IC within the power dissipation range. Should a condition exceeding the power dissipation range continue, the chip temperature T_j will rise to activate the temperature protection circuit, thus turning OFF the output power element. Then, when the tip temperature T_j falls, the circuit will be automatically reset. Furthermore, if the temperature protection circuit is activated under the condition exceeding the Maximum Junction Temperature, do not attempt to use the temperature protection circuit for set design.
14. Output terminal of application circuit short to GND mode
When this IC starts up with output-GND short, SW output current is exceeded $4A$, and this IC may be destroyed. When VIN input voltage is under $7V$ with output-GND short, over current protection may don't operates.
Please don't use this IC in these cases.

Notes

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