

#### CMOS LDO Regulator Series for Portable Equipments

## Standard CMOS LDO Regulators



BH 
BH 
FB1WG series, BH 
FB1WHFV series, BH 🗌 🗆 LB1WG series, BH 🗌 🗆 LB1WHFV series

# Large Current 300mA **CMOS LDO Regulators**

BH 

BH

MA3WHFV

Series

No.10020ECT02

#### Description

The BH FB1W, BH LB1W and BH MA3W series are low dropout CMOS regulators with 150 mA and 300 mA output that have  $\pm 1\%$  high accuracy output voltage.

The BH I FB1W series combines 40µA low current consumption and a 70 dB high ripple rejection ratio by utilizing output level CMOS technology. The components can be easily mounted into the small standard SSOP5 and the ultra-small HVSOF5/HVSOF6 packages.

#### Features

1) High accuracy output voltage:  $\pm 1\%$ 

2) High ripple rejection ratio: 70 dB (BH EFB1WHFV/WG, BH ELB1WHFV/WG)

3) Low dropout voltage: 60 mV (when current is 100 mA) (BH 
MA3WHFV)

4) Stable with ceramic output capacitors

5) Low Bias current :  $40\mu A$  (Io = 50 mA) (BH  $\Box$  FB1WHFV/WG)

6) Output voltage ON/OFF control

7) Built-in over-current protection and thermal shutdown circuits

9) Ultra-small power package: HVSOF6 (BH 
MA3WHFV)

#### Applications

Battery-driven portable devices and etc.

#### Line up

■ 150mA BH□□FB1W and BH□□LB1W Series

Part Number	1.5	1.8	1.85	2.5	2.8	2.9	3.0	3.1	3.3	Package
BHDDFB1WG	-	-	-	~	7	7	~	~	~	SSOP5
BHDDFB1WHFV	-	-	-	~	V	~	~	~	~	HVSOF5
BHDDLB1WG	~	~	-	-	-	-	-	-	-	SSOP5
BH LB1WHFV	V	V	~	_	-	-	-	-	-	HVSOF5

#### 300mA BH MA3WHFV series

Part Number	1.5	1.8	2.5	2.8	2.9	3.0	3.1	3.3	Package
BH I MA3WHFV	レ	$\checkmark$	7	7	7	~	7	7	HVSOF6

Part Number: B H \_\_\_\_ F B 1 W \_\_\_ , B H \_\_\_ L B 1 W \_\_\_\_

Part Number: B H 
A 3 W а

		a	D	a
Symbol		Det	ails	
	(	Output Voltag	e Designatio	on
		Output Voltage (V)		Output Voltage (V)
	15	1.5V (Typ.)	29	2.9V (Typ.)
а	18	1.8V (Typ.)	30	3.0V (Typ.)
	1J	1.85V (Typ.)	31	3.1V (Typ.)
	25	2.5V (Typ.)	33	3.3V (Typ.)
	28	2.8V (Typ.)		
b	Package:	G : SSOP5	HFV : HVS	OF5

ymbol		Det	tails	
	(	Dutput Voltag	je Designati	on
		Output Voltage (V)		Output Voltage (V)
	15	1.5V (Typ.)	29	2.9V (Typ.)
а	18	1.8V (Typ.)	30	3.0V (Typ.)
	25	2.5V (Typ.)	31	3.1V (Typ.)
	28	2.8V (Typ.)	33	3.3V (Typ.)
b	Package:	HFV : HVSC	DF6	

b

#### • Absolute maximum ratings (Ta = $25^{\circ}$ C)

Parameter	Symbol	Limits	Unit	
Applied supply voltage	VMAX	-0.3 ~ +6.5	V	
		680 <sup>*1</sup> (HVSOF6)		
Power dissipation	Pd	410 *2(HVSOF5)	mW	
		540 <sup>*3</sup> (SSOP5)		
Operating temperature range	Topr	-40 <sup>*4</sup> ~ +85	°C	
Storage temperature range	Tstg	-55 ~ +125	°C	
* 1 Derated at 6.8mW/°C for temperature * 2 Derated at 4 1mW/°C for temperature	above Ta = $25^{\circ}$	C, when mounted on a glass epoxy PCB (70	mm X 1.6 mm ).	

• ∠ ∪=rateb at 4. ITMV/°C for temperature above 1a = 25°C, when mounted on a glass epoxy PCB (70 mm X 1.6 mm ).
• 3 Derated at 5.4mW/°C for temperature above Ta = 25°C, when mounted on a glass epoxy PCB (70 mm X 1.6 mm ).
• 4 BH□□FB1W series: -30°C and up.

#### Recommended operating range

Parameter		Symbol	Min.	Тур.	Max.	Unit
Power supply volta	ige	VIN	2.5	-	5.5	V
	BHDDMA3W		-	-	300	mA
Output current	BH□□FB1W	IOUT	-	-	150	mA
	BHDDLB1W		-	-	150	mA

#### Recommended operating conditions

Parameter	Symbol	Min.	Тур.	Max.	Unit	Conditions
Input capacitor	CIN	0.1 *1	-	-	μF	Ceramic capacitor recommended
Output capacitor	Co	1.0 <sup>*2</sup>	-	-	μF	Ceramic capacitor recommended
Noise decrease capacitor	Cn	-	0.01	0.22	μF	Ceramic capacitor recommended

∗ 1 BH□□MA3WHFV: 1.0 μF \* 2 The output may become unstable at low temperatures and with light loads, so a capacitance of 2.2 µF or much more is recommended when using at low temperatures. (BH = FB1W)

Electrical characteristics (Unless otherwise noted, Ta=25°C, VIN=VOUT+1V<sup>\*2</sup>, STBY=1.5V, CIN=0.1μF, Co=1μF) ■BH□□FB1WHFV/WG,BH□□LB1WHFV/WG

Paramet	er	Symbol	Min.	Тур.	Max.	Unit	Conditions
Output voltage	*1	VOUT	Vout~0.99	Vout	Vout ~ 1.01	V	Ιουτ=1mA
Circuit current		I GND	-	40	70	μA	Iout=50mA
Circuit current(ST	ΓBY)	I STBY	-	-	1.0	μA	STBY=0V
Ripple rejection r	atio	RR	-	70	-	dB	VRR=-20dBv, fRR=1kHz, lout=10mA
Load response 1		LTV1	-	50	-	mV	IOUT=1mA to 30mA
Load response 2		LTV2	-	50	-	mV	IOUT=30mA to 1mA
Dropout voltage	*3	VSAT	-	250	450	mV	VIN=0.98 ~ VOUT, IOUT=100mA
Line regulation		VDL1	-	2	20	mV	VIN=VOUT+0.5V to 5.5V *4
Load regulation	(1)	VDL01	-	10	30	mV	IOUT=1mA to 100mA
Load regulation	(2)	VDL02	-	15	90	mA	IOUT=1mA to 150mA
Over current prot	ection		150 * <sup>3</sup>	250 * <sup>3</sup>	420 * <sup>3</sup>		
limit current		ILIVIAX	150 * <sup>5</sup>	300 <sup>*5</sup>	450 <sup>*5</sup>	mA	V0=V0UT~0.98
Short ourront			-	50 <sup>*3</sup>	-	A	N/2 0)/
Short current		ISHURI	-	40 <sup>*5</sup>	-	mA	VO=UV
STBY pull-down re	esistor	RSTB	550	1100	2200	kΩ	
STBY	ON	VSTBH	1.5	-	Vcc	V	
control voltage	OFF	VSTBL	-0.3	-	0.3	V	
* =====================================			.ee				

\* This product is not designed for protection against radio active rays.
 \*1 BH15, 18LB1WHFV/WG: ±25 mV precision
 \*2 BH15, 18LB1WHFV/WG: VIN = 3.5 V

\*3 Excluding BH15, 18LB1WHFV/WG \*4 BH15, 18LB1WHFV/WG: VIℕ = 3.0 to 5.5 V \*5 Excluding BH25,28,29,30,31,33WHFV/G

● Electrical characteristics (Unless otherwise noted, Ta=25°C, VIN=VouT+1V\*4, STBY=1.5V, CIN=1µF, Co=1µF) ■BH□□MA3WHFV

Parameter	Symbol	Min.	Тур.	Max.	Unit	Conditions
Output voltage*1	Vout	Vout x 0.99	Vout	Vout x 1.01	V	IOUT=1mA
Circuit current	I GND	-	65	95	μA	IOUT=1mA
Circuit current (STBY)	I STBY	-	-	1.0	μA	STBY=0V
Ripple rejection ratio	RR	-	60	-	dB	VRR=-20dBv, fRR=1kHz, Iout=10mA
Dropout voltage*2	VSAT1	-	60	90	mV	VIN=0.98 X VOUT, IOUT=100mA
Line regulation	VDL1	-	2	20	mV	VIN=VOUT+0.5V to 5.5V *3
Load regulation 1	VDL01	-	6	30	mV	IOUT=1mA to 100mA
Load regulation 2	VDL02	-	18	90	mV	IOUT=1mA to 300mA
Output voltage temperature	ΔVουτ/ΔΤ	-	±100	-	ppm/°C	Iou⊤=1mA, Ta=-40 to +85°C
Over current protection limit current	ILMAX	-	600	-	mA	Vo=Vout X 0.85
Short current	I SHORT	-	100	-	mA	Vo=0V

\* This product is not designed for protection against radio active rays.
 \*1 BH15, 18MA3WHFV: ±25 mV precision \*3 BH15, 18MA3WHFV: 3.0 to 5.5 V
 \*2 Excluding BH15, 18MA3WHFV \*4 BH15, 18MA3WHFV: 3.5 V

#### • Typical characteristics

• Output voltage-input voltage



BH

#### • GND current-input voltage





#### • Output voltage-output current



#### • Dropout voltage-output current





BH FB1WHFV series, BH LB1WHFV series, BH

MA3WHFV series

Typical Characteristics













- Load response characteristics (CO = 1.0  $\mu F)$ 









Fig.20

• Output voltage startup time



MA3WHFV series

Block diagrams



Power dissipation Pd

1. Power dissipation

Power dissipation calculation include estimates of power dissipation characteristics and internal IC power consumption and should be treated as guidelines. In the event that the IC is used in an environment where this power dissipation is exceeded, the attendant rise in the junction temperature will trigger the thermal shutdown circuit, reducing the current capacity and otherwise degrading the IC's design performance. Allow for sufficient margins so that this power dissipation is not exceeded during IC operation.

Calculating the maximum internal IC power consumption (PMAX)



\* Circuit design should allow a sufficient margin for the temperature range so that PMAX < Pd.

#### Input capacitor

It is recommended to insert bypass capacitors between input and GND pins, positioning them as close to the pins as possible. These capacitors will be used when the power supply impedance increases or when long wiring routes are used, so they should be checked once the IC has been mounted.

Ceramic capacitors generally have temperature and DC bias characteristics. When selecting ceramic capacitors, use X5R or X7R or better models that offer good temperature and DC bias characteristics and high torelant voltages.









Output capacitor

To prevent oscillation at the output, it is recommended that the IC be operated at the stable region show in below Fig. It operates at the capacitance of more than  $1.0\mu$ F. As capacitance is larger, stability becomes more stable and characteristic of output load fluctuation is also improved.

#### BH LB1WHFV/WG



#### BH BFB1WHFV/WG



#### BH MA3WHFV



#### Other precautions

#### • Over current protection circuit

The IC incorporates a built-in over current protection circuit that operates according to the output current capacity. This circuit serves to protect the IC from damage when the load is shorted. The protection circuits use fold-back type current limiting and are designed to limit current flow by not latching up in the event of a large and instantaneous current flow originating from a large capacitor or other component. These protection circuits are effective in preventing damage due to sudden and unexpected accidents. However, the IC should not be used in applications characterized by the continuous operation or transitioning of the protection circuits.

• Thermal shutdown circuit

This system has a built-in thermal shutdown circuit for the purpose of protecting the IC from thermal damage. As shown above, this must be used within the range of power dissipation, but if the power dissipation happens to be continuously exceeded, the chip temperature increases, causing the thermal shutdown circuit to operate. When the thermal shutdown circuit operates, the operation of the circuit is suspended. The circuit resumes operation immediately after the chip temperature decreases, so the output repeats the ON and OFF states. There are cases in which the IC is destroyed due to thermal runaway when it is left in the overloaded state. Be sure to avoid leaving the IC in the overloaded state.

#### • Actions in strong magnetic fields

Use caution when using the IC in the presence of a strong magnetic field as such environments may occasionally cause the chip to malfunction.

Back current

In applications where the IC may be exposed to back current flow, it is recommended to create a route t dissipate this current by inserting a bypass diode between the VIN and VOUT pins.

#### GND potential

Ensure a minimum GND pin potential in all operating conditions.

In addition, ensure that no pins other than the GND pin carry a voltage less than or equal to the GND pin, including during actual transient phenomena.

#### Noise terminal (BH MA3WHFV)

The terminal is directly connected to inward normal voltage source. Because this has low current ability, load exceeding 100nA will cause some instability at the output. For such reasons, we urge you to use ceramic capacitors which have less leak current. When choosing noise the current reduction capacitor, there is a trade-off between boot-up time and stability. A bigger capacitor value will result in lesser oscillation but longer boot-up time for VOU T.



Fig. 35: V OUT startup time vs. noise-filtering capacitor capacitance characteristics (Example)

#### Regarding input pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P/N junctions are formed at the intersection of these P layers with the N layers of other elements to create a variety of parasitic elements. For example, when a resistor and transistor are connected to pins as shown in Fig.37

- $\bigcirc$  The P/N junction functions as a parasitic diode when GND > (Pin A) for the resistor or GND > (Pin B) for the transistor (NPN).
- Similarly, when GND > (Pin B) for the transistor (NPN), the parasitic diode described above combines with the N layer of other adjacent elements to operate as a parasitic NPN transistor.

The formation of parasitic elements as a result of the relationships of the potentials of different pins is an inevitable result of the IC's architecture. The operation of parasitic elements can cause interference with circuit operation as well as IC malfunction and damage. For these reasons, it is necessary to use caution so that the IC is not used in a way that will trigger the operation of parasitic elements, such as by the application of voltage lower than the GND (P substrate) voltage to input pins.

FB1 : 150mA

LB1 : 150mA



Fig. 36: Example of bypass diode connection



HVSOF5

G:SSOP5

W: With switch

#### FB1WHFV series, LB1WHFV series, BH BH FB1WG series, LB1WG series, BH BH **Technical Note MA3WHFV** series BH (Unit:mm) (Unit:mm) (Unit:mm) 1.<u>6±0.0</u> .05) 0 2 Ms 1 0+0 05 0.13±0.05 ).145±0.05 0.13 +0.05 25Ma 0.42 +0.05 1+0.05 0.95 0.1|S \_\_\_\_\_0.1\_\_ 0.22±0.05 HVSOF5 SSOP5 HVSOF6





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