STURUCTURE	Silicon Monolithic Integrated Circuit
Type	6 Channel Switching Regulator control system
PRODUCUT SERIES	**BD9839MWV**
THYSICAL DIMENSIONS	Fig. 1 (Plastic Mold)
BLOCK DIAGRAM	Fig. 2

FEATURES
- Step Down 5CH, Step Up 1CH total 6CH included.
- FET 4ch (CH1~CH4) for Synchronous Switching Regulator
- Short Circuit Protection (SCP)
- Under Voltage Lockout Function (UVLO)
- Thermal Shut Down Function (TSD)
- Independent ON/OFF Function Each Channel(Stand_by Current Is Under 5uA)
- UQFN056V7070 Package

Absolute Maximum Ratings（Ta=25℃）

Parameter	Symbol	Limits	Units
Power Supply Voltage	VCC,PVCC1～6	12	V
Input Voltage	BOOT1～4	17.5	V
	Lx1～4,OUT5,6	12	V
BOOT-Lx Voltage	ΔBOOT1～4	6.5	V
Power Dissipation	Pd	420(*1)	mW
		930(*2)	mW
Operating Temperature	Topr	−30～+85	℃
Storage Temperature	Tstg	−55～+125	℃
Junction Temperature	Tjmax	125	℃

(*1) Without external heat sink, the power dissipation degrades by 4.2mW/℃ above 25℃.
(*2)Power dissipation degrades by 9.3mW/℃ above 25℃, when mounted on a PCB (74.2mm×74.2mm×1.6mm).

Recommended Operating Conditions（Ta=25℃）

Parameter	Symbol	Spec.			Units
		Min	Typ	Max	
Power Supply Voltage	VCC,PVCC1～56	4	7	11	V
	BOOT1～4	3.5	−	16	V
BOOT-Lx Voltage	⊿BOOT1～4	3.5	−	5.0	V
CH1～4 H NMOS Drain Current	Idhnl	−	−	1.5(*3)	A
CH1～4 L NMOS Drain Current	Idlnl	−	−	1.5(*3)	A
Frequency Stability (*4)	fosc	300	500	2000	kHz
VREGA – GND Capacitor	CVREGA	0.47	1.0	2.2	uF
VCC – VREGD Capacitor	CVREGD	0.47	1.0	2.2	uF
BOOT – Lx Capacitor	CBOOT	0.047	0.1	0.22	uF

(*3) FET Drain Current Max value.Set the current value within Power dissipation in the application.
(*4) Max 1MHz for Ch1 ~ Ch4.

Status of this document

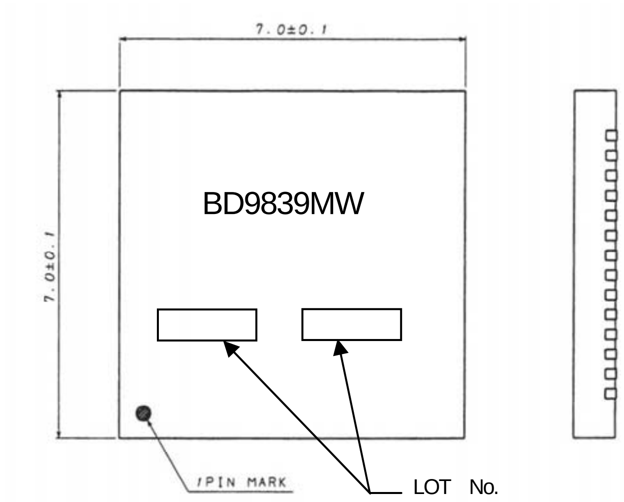
The Japanese language version of this document shall be the official specification.

Any translation of this document shall be for reference only.

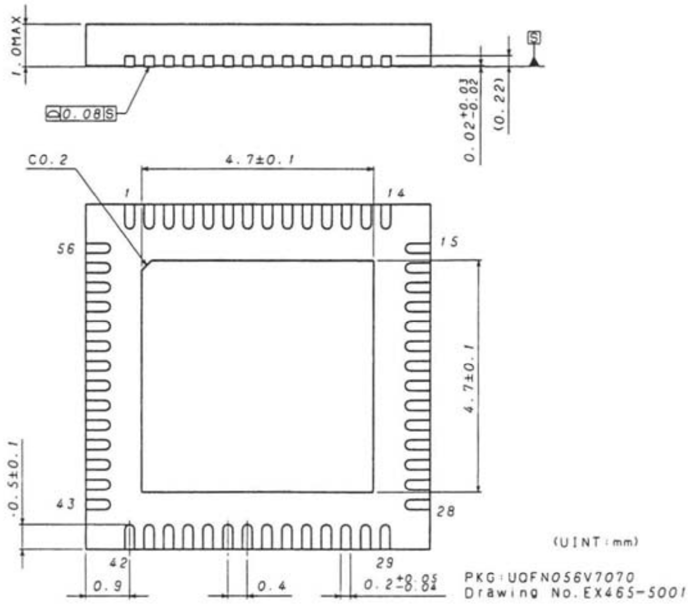
● Electrical Characteristics（Ta=25℃, VCC=7V, fosc=500kHz with no designation）

Parameter		Symbol	Limits Min.	Typ.	Max.	Units	Condition
【Whole Device】							
Standby Current		Ist	－	0.1	5	uA	
Circuit Current		Icc	－	6.0	9.0	mA	FB=0V
【Reference Voltage】							
Output Voltage		VREGA	2.475	2.500	2.525	V	VREGA=-1mA
Line regulation		DVli	－	－	10	mV	VCC=4V～10V、VREGA=-1mA
Load regulation		DVlo	－	－	10	mV	VREGA=-1mA～-5mA
Output current at VREGA PIN shorted		Ios	-30	－	-5	mA	VREGA=0V
【Bias Voltage】							
Output Voltage		VREGD	4.90	5.00	5.10	V	VREGD=-10mA
【Oscillator】							
Oscillator Frequency CH1～6		fosc	450	500	550	kHz	RT=10kΩ、CT=220pF、SEL="L"
Oscillator Frequency coefficient		Df	－	0	2	%	VCC=4V～10V
【Current Mode Circuit】							
Minimum OFF time of H Nch(CH1)		Toffmin1	－	－	100	nsec	
Minimum OFF time of H Nch(CH2)		Toffmin2	－	－	100	nsec	
Minimum OFF time of H Nch(CH3)		Toffmin3	－	－	100	nsec	
Minimum OFF time of H Nch(CH4)		Toffmin4	－	－	100	nsec	
SEL control voltage		VSELH	2	－	VCC	V	(fosc=fosc/2) (CH1～4)
		VSELL	-0.3	－	0.8	V	
【PWM Comparator】							
0%Duty threshold(CH5,6)		Vt0	1.00	1.10	－	V	
100%Duty threshold(CH5)		Vt100	－	1.60	1.70	V	
MAX Duty cycle CH6		Dmax6	81	90	99	%	
【ERRORAMP1】(CH1)							
Threshold Voltage		VETH	0.790	0.800	0.810	V	
Output Voltage L		VOL	－	0.03	0.2	V	INV=0.9V
Output Voltage H		VOH	2.2	2.4	－	V	INV=0.7V
Output Sink Current		ISINK	1.8	3.6	－	mA	INV=0.9V、FB=1.25V
Output Source Current		ISOURCE	－	-100	-50	uA	INV=0.7V、FB=1.25V
Input Bias Current		IBIAS	-150	-50	－	nA	INV=0V
Voltage Gain		AV	60	80	－	dB	Open loop gain
Frequency Bandwidth		BW	1	4	－	MHz	
【ERRORAMP2】(CH2～5)							
Threshold Voltage		VETH	0.990	1.000	1.010	V	
Output Voltage L		VOL	－	0.03	0.2	V	INV=1.1V
Output Voltage H		VOH	2.2	2.4	－	V	INV=0.9V
Output Sink Current		ISINK	1.8	3.6	－	mA	INV=1.1V、FB=1.25V
Output Source Current		ISOURCE	－	-100	-50	uA	INV=0.9V、FB=1.25V
Input Bias Current		IBIAS	-150	-50	－	nA	INV=0V
Voltage Gain		AV	60	80	－	dB	Open loop gain
Frequency Bandwidth		BW	1	4	－	MHz	
【ERRORAMP3】(CH6)							
Threshold Voltage		VETH	0.285	0.300	0.315	V	
Output Voltage L		VOL	－	0.03	0.2	V	INV=0.4V
Output Voltage H		VOH	2.2	2.4	－	V	INV=0.2V
Output Sink Current		ISINK	1.8	3.6	－	mA	INV=0.4V、FB=1.25V
Output Source Current		ISOURCE	－	-100	-50	uA	INV=0.2V、FB=1.25V
Input Bias Current		IBIAS	-150	-50	－	nA	INV=0V
Voltage Gain		AV	60	80	－	dB	Open loop gain
Frequency Bandwidth		BW	1	4	－	MHz	
【Driver 部】							
Lx Pull-down resistor(CH1～CH4)		RLx	300	500	700	Ω	CTL=0V
Simultaneous off time setting(CH1～CH4)		TUPPER	－	25	50	nsec	
		TLOWER	－	25	50	nsec	
H Nch resistor(CH1)		RonH1	－	0.38	0.65	Ω	Lx1=-50mA
L Nch resistor(CH1)		RonL1	－	0.18	0.31	Ω	Lx1=50mA
H Nch resistor(CH2)		RonH2	－	0.28	0.48	Ω	Lx2=-50mA
L Nch resistor(CH2)		RonL2	－	0.28	0.48	Ω	Lx2=50mA
H Nch resistor(CH3)		RonH3	－	0.27	0.46	Ω	Lx3=-50mA
L Nch resistor(CH3)		RonL3	－	0.22	0.37	Ω	Lx3=50mA
H Nch resistor(CH4)		RonH4	－	0.28	0.48	Ω	Lx4=-50mA
L Nch resistor(CH4)		RonL4	－	0.28	0.48	Ω	Lx4=50mA
Output ON resistor(CH5)		RonH5	－	9	16	Ω	IOUT5=-15mA
		RonL5	－	9	16	Ω	IOUT5=15mA
Output ON resistor(CH6)		RonH6	－	9	16	Ω	IOUT6=-15mA
		RonL6	－	9	16	Ω	IOUT6=15mA
【Control Block】							
CTL vol	ON	VCTLH	2	－	VCC	V	
	OFF	VCTLL	-0.3	－	0.8	V	
CTL1～6Pull-down resistor		RCTL	250	400	700	kΩ	
【Soft Start Block】							
Standby Voltage		Vstsc	－	10	100	mV	
Input Charge Current		ISOFT	-1.4	-1.0	-0.6	uA	SOFT1～6=0.1V
【Short Circuit Protection (SCP) Timer】							
Timer Start Voltage		Vtime	2.1	2.2	2.3	V	FB1～6 voltage
Threshold Voltage		Vtsc	0.9	1.0	1.1	V	
Source Current		Iscp	-1.4	-1.0	-0.6	uA	SCP=0.1V
Standby Voltage		Vstsc	－	10	100	mV	
【Short Circuit Detective Comparator】							
Threshold Voltage		VTH	0.95	1.0	1.05	V	
Input Bias Current		IBIAS	-15	-10	-5	uA	SCP1=0V
【Under Volatge Lockout (UVLO)】							
Threshold Voltage1		Vstd1	3.3	3.4	3.5	V	VCC voltage
Hysteresis Voltage		⊿Vst	25	100	200	mV	VCC voltage
Threshold Voltage2		Vstd2	1.8	2.0	2.2	V	VREGA voltage
Threshold Voltage3		Vstd3	2.8	3.0	3.2	V	VREGD voltage

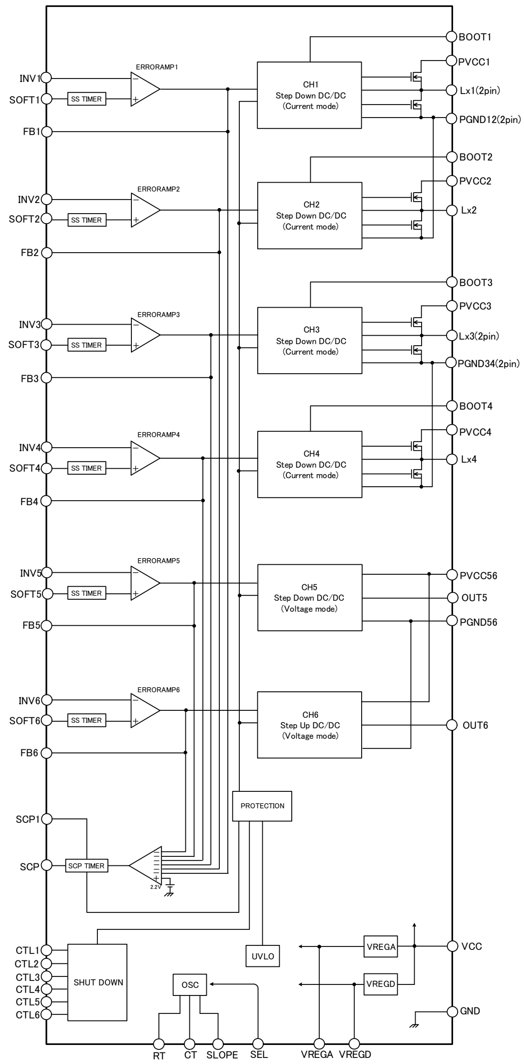
● Package



Fig－1



● Block Diagram



Fig－2

● Pin Description

Pin No.	Pin Name	Pin Descriptions	Pin No.	Pin Name	Pin Descriptions
1	SEL	CH1～CH4 Oscillator Frequency Cotrol Pin	29	BOOT4	Input Supply Voltage Pin for CH4 Output
2	SOFT1	CH1 Soft Start Delay time Setting Pin with External Capacitor	30	PVCC4	Input Supply Voltage Pin for CH4 Output
3	INV1	CH1Error Amplifier Negative Input Pin	31	Lx4	Pin for Connecting to Inductor
4	FB1	CH1 Error Amplifier Output Pin	32	PGND34	Ground Pin for CH3、4 Output
5	SOFT2	CH2 Soft Start Delay time Setting Pin with External Capacitor	33	PGND34	Ground Pin for CH3、4 Output
6	INV2	CH2 Error Amplifier Negative Input Pin	34	Lx3	Pin for Connecting to Inductor
7	FB2	CH2 Error Amplifier Output Pin	35	Lx3	Pin for Connecting to Inductor
8	SOFT3	CH3 Soft Start Delay time Setting Pin with External Capacitor	36	PVCC3	Input Supply Voltage Pin for CH3 Output
9	INV3	CH3 Error Amplifier Negative Input Pin	37	BOOT3	Input Supply Voltage Pin for CH3 Output
10	FB3	CH3 Error Amplifier Output Pin	38	BOOT2	Input Supply Voltage Pin for CH2 Output
11	SOFT4	CH4 Soft Start Delay time Setting Pin with External Capacitor	39	PVCC2	Input Supply Voltage Pin for CH2 Output
12	INV4	CH4 Error Amplifier Negative Input Pin	40	Lx2	Pin for Connecting to Inductor
13	FB4	CH4 Error Amplifier Output Pin	41	CTL3	CH3 ON/OFF Control Pin
14	SOFT5	CH5 Soft Start Delay time Setting Pin with External Capacitor	42	CTL2	CH2 ON/OFF Control Pin
15	INV5	CH5 Error Amplifier Negative Input Pin	43	CTL1	CH1 ON/OFF Control Pin
16	FB5	CH5 Error Amplifier Output Pin	44	PGND12	Ground Pin for CH1、2 Output
17	SOFT6	CH6 Soft Start Delay time Setting Pin with External Capacitor	45	PGND12	Ground Pin for CH1、2 Output
18	INV6	CH6 Error Amplifier Negative Input Pin	46	Lx1	Pin for Connecting to Inductor
19	FB6	CH6 Error Amplifier Output Pin	47	Lx1	Pin for Connecting to Inductor
20	SCP1	Short Detective Comparator Negative Input Pin	48	PVCC1	Input Supply Voltage Pin for CH1Output
21	SCP	Short Circuit Protection Delay time Setting Pin with External Capacitor	49	BOOT1	Input Supply Voltage Pin for CH1Output
22	OUT6	CH6 NchFET Driver Output Pin	50	VREGD	Bias Output Voltage Pin
23	PGND56	Ground Pin for CH5、6 Driver	51	VCC	Input Supply Voltage Pin
24	OUT5	Output Pin for CH5 PchFET Driver	52	VREGA	Reference Output Voltage Pin
25	PVCC56	Input Supply Voltage Pin for CH5、6 Driver	53	GND	Ground Pin
26	CTL6	CH6 ON/OFF Control Pin	54	SLOPE	Slope Setting Pin with external Resistor
27	CTL5	CH5 ON/OFF Control Pin	55	RT	Oscillator Frequency Adjustment Pin with external Resistor
28	CTL4	CH4 ON/OFF Control Pin	56	CT	Oscillator Frequency Adjustment Pin with external Capacitor

● Operation Notes

1.) Absolute maximum ratings

Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range may result in IC deterioration or damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure such as a fuse should be implemented when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.

2.) 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 lower than or equal to the GND pin, including during actual transient phenomena.

3.) Thermal design

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

4.) Inter-pin shorts and mounting errors

Use caution when orienting and positioning the IC for mounting on printed circuit boards. Improper mounting may result in damage to the IC. Shorts between output pins or between output pins and the power supply and GND pin caused by the presence of a foreign object may result in damage to the IC.

5.) Operation in a strong electromagnetic field

Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

6.) Common impedance

Power supply and ground wiring should reflect consideration of the need to lower common impedance and minimize ripple as much as possible (by making wiring as short and thick as possible or rejecting ripple by incorporating inductance and capacitance).

7.) Voltage of CTL pin

The threshold voltages of CTL pin are 0.8V and 2.0V. STB state is set below 0.8V while action state is set beyond 2.0V.
The region between 0.8V and 2.0V is not recommended and may cause improper operation.
The rise and fall time must be under 10msec. In case to put capacitor to STB pin, it is recommended to use under 0.01 μF.

8.) Thermal shutdown circuit (TSD circuit)

This IC incorporates a built-in thermal shutdown circuit (TSD circuit). The TSD circuit is designed only to shut the IC off to prevent runaway thermal operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of the thermal shutdown circuit is assumed.

9.) Applications with modes that reverse VCC and pin potentials may cause damage to internal IC circuits.

For example, such damage might occur when VCC is shorted with the GND pin while an external capacitor is charged. It is recommended to insert a diode for preventing back current flow in series with VCC or bypass diodes between VCC and each pin.

10.) Relationship between PVCC - VCC

Because diode was connecting between PVCC (Anode) – VCC (Cathode) for prevent electrostatic breakdown,
it must be set PVCC – VCC < 0.3V voltage relationship.

11.) Rush current at the time of power supply injection.

An IC which has plural power supplies, or CMOS IC could have momentaly rush current at the time of power supply injection.
Because there exists inside logic uncertainty state. Please take care about power supply coupling capacity and width of power Supply and GND pattern wiring.

12.) Please use it so that VCC and PVCC terminal should not exceed the absolute maximum ratings. Ringing might be caused by L element of the pattern according to the position of the input capacitor, and ratings be exceeded. Please will assume the example of the reference ,the distance of IC and capacitor, use it by 5.0mm or less when thickness of print pattern are 35um, pattern width are 1.0mm.

13.) Testing on application boards

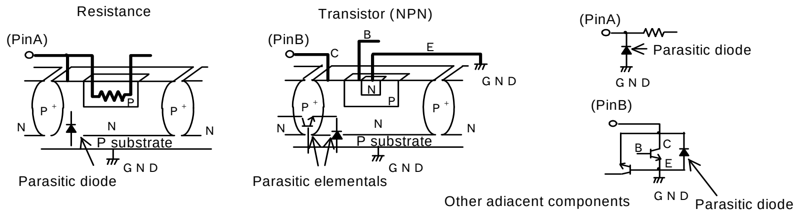
When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Ground the IC during assembly steps as an antistatic measure, and use similar caution when transporting or storing the IC. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process.

14.) IC pin input

This monolithic IC contains P+ isolation and PCB 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 following chart,

- ○ 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 voltages lower than the GND (PCB) voltage to input and output pins.



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