STRUCTURE Silicon Monolithic Integrated Circuit

PRODUCT White LED Driver for LCD Backlights with step-up DC/DC controller

TYPE **BD9203EFV**

FEATURE

- 6CH LED current driver up to 150mA/CH built-in *2
- Over voltage protection (OVP), Short circuit protection (SCP), LED open and short detection
- Step-up DC/DC controller built-in
- PWM and DC Dimming
- Programmable timer latch and soft-start period by external capacitor
- Over voltage protection (OVP), Short current protection (SCP), LED open and short detection
- Under voltage lock out (UVLO)
- HTSSOP-B28 package

○ ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

PARAMETER	Symbol	Limit	Unit
Power Supply Voltage	VCC	36	V
	VREF5V	7	V
STB Voltage	STB	36	V
LED Output Voltage	LED1～6	40	V
FAIL Output Voltage	FAIL	40	V
Pin Voltage	SEL, UVLO, PWM1, PWM2, RT, SS, SLOPE, ISET, VREF, CP, FB, OVP, CS	7	V
	N	15	V
Power Dissipation	Pd	3.30 *1	W
Operating Temperature Range	Topr	-40～+85	℃
Storage Temperature Range	Tstg	-55～+150	℃
LED Maximum Current	I_{LED}	150 *2	mA

*1 Pd derated at 26.4 mW/℃ for temperature above Ta=25℃,
mounted on 70mm × 70mm × 1.6mm 2 layer(cupper area 70mm × 70mm)glass-epoxy PCB.
*2 This is the constant current value per 1ch. Please perform setting of the constant current value in the range that is not beyond a value of Pd.
This product is not designed for protection against radioactive rays.

○ OPERATING CONDITIONS (Ta=25℃)

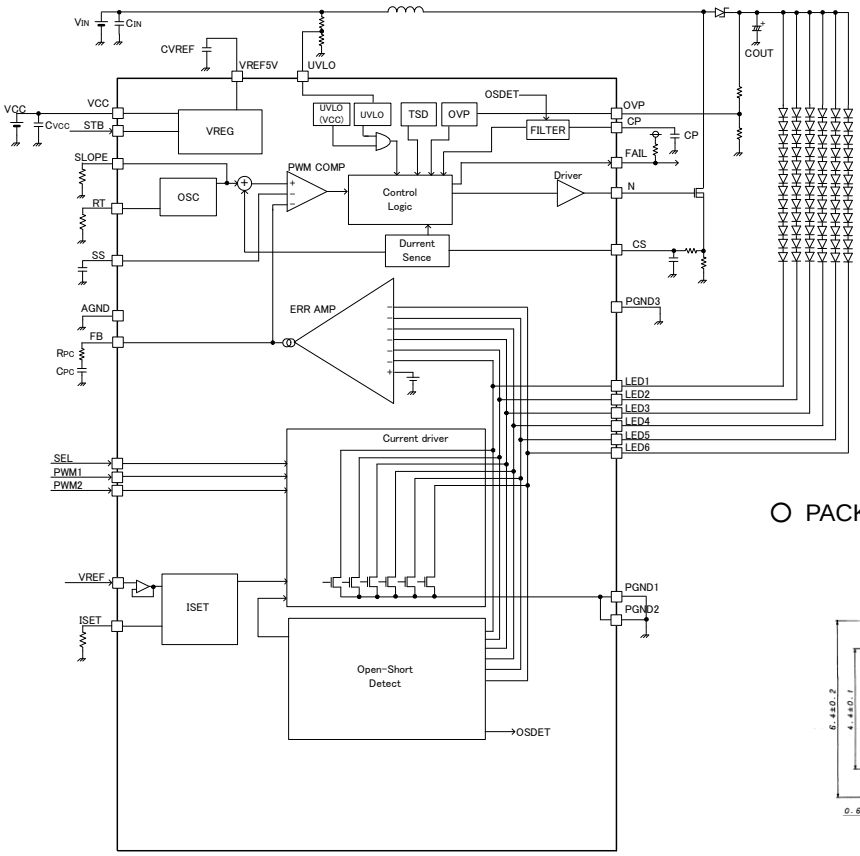
PARAMETER	Symbol	Limit	Unit
Power Supply Voltage	VCC	9～35	V
CT Oscillation Frequency Range	FCT	100～1000	kHz
VREF input voltage range	VREF	0～VREF5V	V

○ ELECTRICAL CHARACTERISTICS(unless otherwise specified VCC=24V, Ta=25℃)

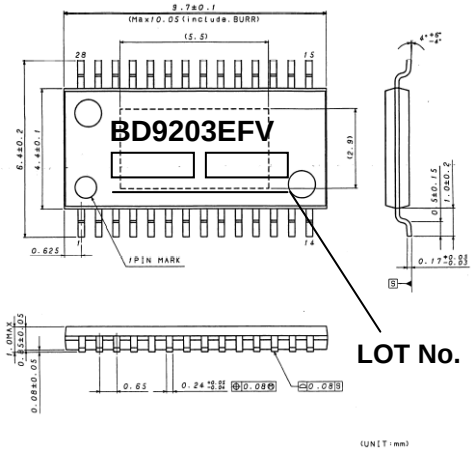
PARAMETER	Symbol	Limit			UNIT	Conditions
		MIN.	TYP.	MAX.		
【Total Current Consumption】						
Circuit Current	ICC	—	5	10	mA	STB=3V, LED1～6=ON, RT=100kΩ
Standby Current	IST	—	0	10	uA	STB=0V
【VREF5V】						
VREF5V Voltage	VREF5	4.9	5.0	5.1	V	IO=0mA
VREF5V source current	IREF5	20	—	-	V	
【Switching block】						
N source resistance	RONH	-	7	14	Ω	ION=-10mA
N sink resistance	RONL	-	3.4	7	Ω	ION=10mA
【SOFT START】						
SS source current	ISS	-2.0	-1.0	-0.5	uA	
SS END pin voltage	VSS	3.8	4.0	4.2	V	SS=SWEEP UP
【Error-Amp block】						
LED control voltage	VLED	0.65	0.75	0.85	V	
FB sink current	IFBSINK	40	100	200	uA	LED=2.0V, VFB=1.0V
FB source current	IFBSOURCE	-200	-100	-40	uA	LED=0V, VFB=1.0V
【CT Oscillator block】						
Oscillation Frequency	FCT	500	600	700	kHz	RT=100kΩ
RT pin output voltage	VRT	1.05	1.5	1.95	V	
SLOPE pin output voltage	VSLOPE	1.05	1.5	1.95	V	
MAX DUTY	DMAX	76	85	94	%	
【OVP】						
Over Voltage Protection voltage	VOVP	3.8	4.0	4.2	V	VOVP=SWEEP UP
OVP hysterisis	VOVPHYS	100	200	400	mV	VOVP=SWEEP DOWN
OVP Feedback Voltage	FBOVP	3.5	3.6	3.7	V	PWM1, 2=0V
【SCP】						
Short Circuit Protection voltage	VSCP	0.05	0.20	0.35	V	VOVP=SWEEP DOWN
【UVLO】						
Operating voltage (VCC)	VUVLO_VCC	6.0	7.0	8.0	V	VCC=SWEEP UP
hysterisis (VCC)	VUHYS_VCC	150	300	600	mV	VCC=SWEEP DOWN
Cancel voltage (UVLO)	VUVLO_U	2.375	2.5	2.625	V	UVLO=SWEEP UP
hysterisis (UVLO)	VUHYS_U	50	100	200	mV	UVLO=SWEEP DOWN
【FILTER(CP)】						
CP detection voltage	VCP	1.8	2.0	2.2	V	CP=SWEEP UP
CP source current	ICP	-2.0	-1.0	-0.5	uA	VCP=0V
【LED output (LED1～6)】						
LED current accuracy	⊿ILED	-3	-	3	%	ILED=40mA
Open detection voltage	VOPEN	0.05	0.20	0.35	V	VLED=SWEEP DOWN
Short detection voltage	VSHORT	4.5	5.0	5.5	V	VLED=SWEEP UP
【STB】						
Input High voltage	STBH	2.0	-	VCC	V	
Input Low voltage	STBL	-0.3	-	0.8	V	
Input current	IEN	13	25	38	uA	VIN=5V(STB)
【PWM1, PWM2】						
Input High voltage	PWMH	2.0	-	5.0	V	
Input Low voltage	PWML	-0.3	-	0.5	V	
Input current	IPWM	-5	0	5	uA	VIN=5V(PWM1, PWM2)
【FAIL output(open drain)】						
FAIL Low voltage	VOL	0.05	0.10	0.20	V	IOL=1mA

(This product is not designed for protection against radioactive rays.)

○ BLOCK DIAGRAM



○ PACKEGE, MARKING SPECIFICATION



HTSSOP-B28

○ PIN No. & PIN NAME

PIN No.	PIN Name	Function	PIN No.	PIN Name	Function
1	PGND3	Power GND	15	VREF	DC dimming input
2	N	DC/DC switching output	16	CP	Filter set Cap.
3	SEL	Active LED channel select pin (3 state)	17	FB	Error amp output
4	FAIL	Protect signal output	18	PGND1	LED output GND1
5	UVLO	Under voltage lock out input	19	LED1	LED output 1
6	PWM2	External PWM input 2	20	LED2	LED output 2
7	PWM1	External PWM input 1	21	LED3	LED output 3
8	VCC	Power Supply Voltage	22	LED4	LED output 4
9	STB	Enable pin	23	LED5	LED output 5
10	VREF5V	Internal regulator output	24	LED6	LED output 6
11	AGND	Analog GND	25	PGND2	LED output GND2
12	RT	CT frequency setting R	26	SS	Soft start period setting Cap.
13	SLOPE	Slope compensation setting R	27	OVP	DC/DC over voltage protection
14	ISET	LED output current setting R	28	CS	DC/DC current sense

○ Operation Notes

1) Absolute maximum ratings

An excess in the absolute maximum rating, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2) GND voltage

The potential of GND pin must be minimum potential in all condition. As an exception, the circuit design allows voltages up to -0.3 V to be applied to the ICT pin.

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 positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.

5) Actions in 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) Mutual impedance

Power supply and ground wiring should reflect consideration of the need to lower mutual 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).

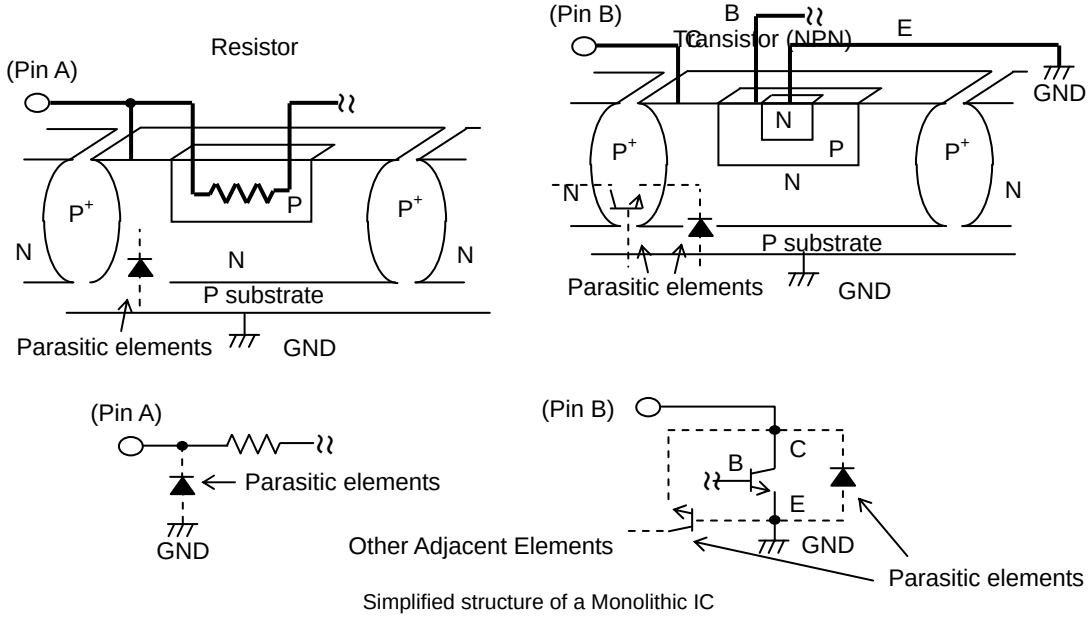
7) Regarding input pin of the IC

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, creating a parasitic diode or transistor. For example, as shown in the figures below, the relation between each potential is as follows:

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.

When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes can occur inevitable in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used. Although the circuit design allows voltages up to -0.3 V to be applied to the ICT pin, voltages lower than this may cause the behavior described above. Use caution when designing the circuit.



Simplified structure of a Monolithic IC

Notes

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