Structure Silicon Monolithic Integrated Circuit
Product series White LED driver for TFT back light
Type **BD8113EFV**

Function
- Integrated buck-boost current-mode DC/DC controller
  Built-in OSC (external R), External synchronous mode
- Two integrated LED current driver channel (Set by a standard external R current.)
- PWM light modulation
- FAIL output(self-diagnosis function)
- Built-in short detection circuit (SCP)
- Oscillation frequency accuracy ±5%
- Built-in under-voltage lock out circuit (UVLO)
- Built-in over-voltage protection circuit (OVP)
- Built-in thermal shut down circuit (TSD)
- Built-in over-current protection circuit (OCP)
- Built-in LED open short detection circuit

●Absolute maximum ratings(Ta=25℃)

Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	36	V
BOOT terminal voltage	V_{BOOT}	41	V
SW,CS,OUTH terminal voltage	V_{sw},V_{CS},V_{OUTH}	36	V
Between BOOT-SW terminal voltage	$V_{BOOT-SW}$	7	V
LED1～2 output voltage	$V_{LED1～2}$	36	V
VREG,OVP,OUTL,FAIL1,FAIL2,LEDEN, ISET,VDAC,PWM,SS,COMP,RT,SYNC,EN terminal voltage	V_{VREG},V_{OVP},V_{OUTL},V_{FAIL1}, V_{FAIL2},V_{LEDEN}, V_{ISET},V_{VDAC},V_{PWM},V_{SS},V_{COMP},V_{RT},V_{SYNC},V_{EN}	−0.3～7 < V_{CC}	V
Power dissipation	Pd	1.10 ※1	W
Operating temperature range	Topr	−40～+105	℃
Storage temperature range	Tstg	−55～+150	℃
LED maximum output current	I_{LED}	150 ※2※3	mA

※1 IC mounted on glass epoxy board measuring 70mm × 70mm × 1.6mm, power dissipated at a rate of 8.8mw/℃ at temperatures above 25℃.
※2 Dispersion figures for LED maximum output current and V_F are correlated. Please refer to data on separate sheet.
※3 Amount of current per channel.

●Operating conditions (Ta=25℃)

Parameter	Symbol	Target value	Unit
Power supply voltage	V_{CC}	5.0～30	V
Oscillation frequency range	f_{OSC}	250～600	kHz
External synchronization frequency range ※4 ※5	f_{SYNC}	fosc～600	kHz
External synchronization pulse duty range	f_{SDUTY}	40～60	%

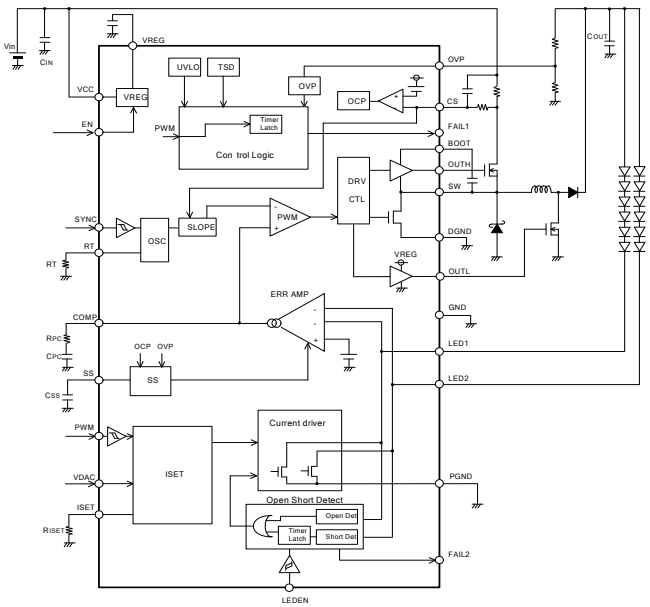
※4 Connect SYNC to GND or OPEN when not using external frequency synchronization.
※5 Do not switch between internal and external synchronization when an external synchronization signal is input to the device.

●Electrical characteristics (Unless otherwise noted VCC=12V,Ta=25℃)

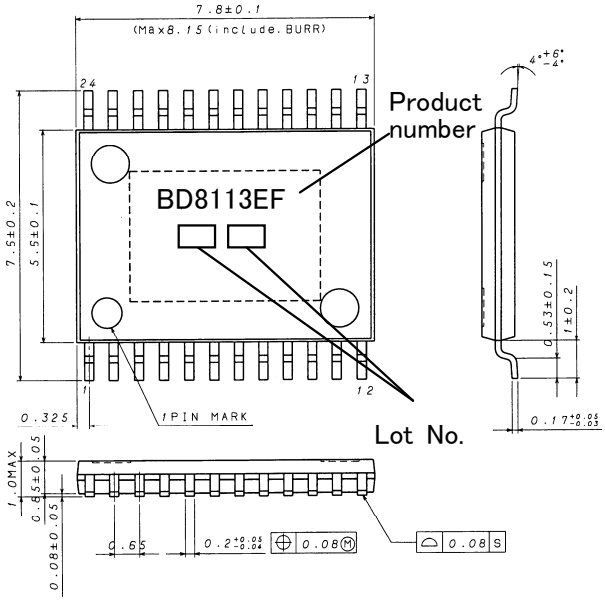
Parameter	Symbol	Target value			Unit	Conditions
		Min	Typ	Max		
Circuit current	ICC	–	7	14	mA	EN=Hi, SYNC=Hi, RT=OPEN PWM=Low, ISET=OPEN, CIN=10μF
Standby current	IST	–	4	8	μA	EN=Low
[VREG Block]						
Reference voltage	VREG	4.5	5.0	5.5	V	IREG=−5mA, CREG=2.2μF
[OUTH Block]						
OUTH high-side ON resistance	RONHH	1.5	3.5	7	Ω	ION=−10mA
OUTH low-side ON resistance	RONHL	1.0	2.5	5.0	Ω	ION=10mA
Over-current protection operating voltage	VOLIMIT	VCC−0.66	VCC−0.6	VCC−0.54	V	
[OUTL Block]						
OUTL high-side ON resistance	RONLH	2.0	4.0	8.0	Ω	ION=−10mA
OUTL low-side ON resistance	RONLL	1.0	2.5	5.0	Ω	ION=10mA
[SW Block]						
SW low-side ON resistance	Ron_sw	2.0	4.5	9.0	Ω	ION_SW=10mA
[Error amplifier Block]						
LED voltage	VLED	0.9	1.0	1.1	V	
COMP sink current	ICOMPSINK	15	25	35	μA	VLED=2V, Vcomp=1V
COMP source current	ICOMPSOURCE	−35	−25	−15	μA	VLED=0V, Vcomp=1V
[Oscillating Block]						
Oscillating frequency	fOSC	285	300	315	KHz	RT=100kΩ
[OVP Block]						
Over-voltage detection reference voltage	VOVP	1.9	2.0	2.1	V	VOVP=Sweep up
OVP hysteresis width	VOHYS	0.45	0.55	0.65	V	VOVP= Sweep down
SCP Latch OFF delay time	TSCP	70	100	130	ms	RT=100kΩ
[UVLO Block]						
UVLO voltage	VUVLO	3.7	4.0	4.3	V	VCC : Sweep down
UVLO hysteresis width	VUHYS	400	500	600	mV	VCC : Sweep up
[LED Output Block]						
LED current relative dispersion width	ΔILED1	−3	–	+3	%	ILED=50mA, ΔILED1=(ILED/ ILED_AVG−1)×100
LED current absolute dispersion width	ΔILED2	−5	–	+5	%	ILED=50mA, ΔILED2=(ILED/ 50mA−1)×100
ISET voltage	VISET	1.96	2.0	2.04	V	RISET=120kΩ
PWM minimum pulse width	Tmin	25	–	–	us	FPWM=150Hz, ILED=50mA
PWM maximum duty	Dmax	–	–	100	%	FPWM=150Hz, ILED=50mA
PWM frequency	fPWM	–	–	20	KHz	Duty=50%, ILED=50mA
VDAC gain	GVDAC	–	25	–	mA/V	VDAC=0～2V ILED=VDAC÷RISET×Gain, RISET=120kΩ
LED open detection voltage	VOPEN	0.2	0.3	0.4	V	VLED= Sweep down
LED short detection voltage	VSHORT	4.2	4.5	4.8	V	VLED= Sweep up
LED short latch OFF delay time	TSHORT	70	100	130	ms	RT=100kΩ
PWM latch OFF delay time	TPWM	70	100	130	ms	RT=100kΩ
[Logic Inputs (EN,SYNC,PWM,LEDEN)]						
Input High voltage	VINH	2.1	–	5.5	V	
Input Low voltage	VINL	GND	–	0.8	V	
Input current 1	IIN	20	35	50	μA	VIN=5V (SYNC,PWM,LEDEN)
Input current 2	IEN	15	25	35	μA	VEN=5V (EN)
[FAIL Output (open drain)]						
FAIL Low voltage	VOL	–	0.1	0.2	V	IOL=0.1mA

◎ This product is not designed for use in radioactive environments.

●Block diagram

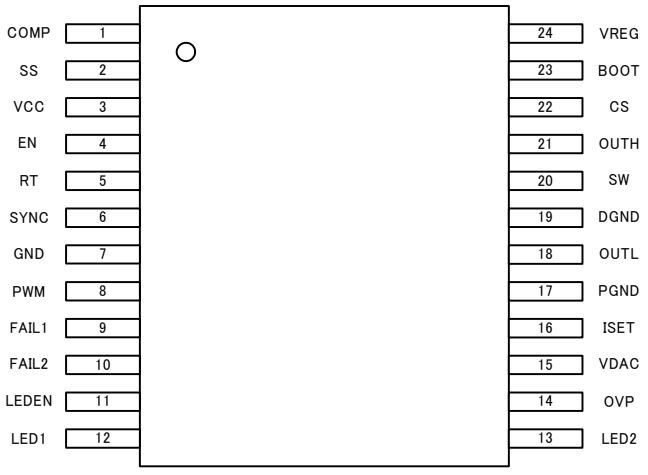


●Package outlines



●Pin layout

BD8113EFV(HTSSOP-B24)



●Pin function table

Pin	Symbol	Function
1	COMP	ERR amplifier output
2	SS	Soft start time-setting capacitance input
3	VCC	Input power supply
4	EN	Enable input
5	RT	Oscillation frequency-setting resistance input
6	SYNC	External synchronization signal input
7	GND	Small-signal GND
8	PWM	PWM light modulation input
9	FAIL1	Failure signal output
10	FAIL2	LED open/short detection signal output
11	LEDEN	LED output enable pin
12	LED1	LED output 1
13	LED2	LED output 2
14	OVP	Over-voltage detection input
15	VDAC	DC variable light modulation input
16	ISET	LED output current-setting resistance input
17	PGND	LED output GND
18	OUTL	Low-side external MOSFET Gate Drive
19	DGND	Low-side internal MOSFET Driver Source
20	SW	High-side external MOSFET Source
21	OUTH	High-side external MOSFET Gate Drive
22	CS	DC/DC Current Sense Pin
23	BOOT	High-side MOSFET Power Supply pin
24	VREG	Internal reference voltage output

●Cautions on use

1. Absolute maximum ratings
We are careful enough for quality control about this IC. So, there is no problem under normal operation, excluding that it exceeds the absolute maximum ratings. However, this IC might be destroyed when the absolute maximum ratings, such as impressed voltages or the operating temperature range(Topr), is exceeded, and whether the destruction is short circuit mode or open circuit mode cannot be specified. Please take into consideration the physical countermeasures for safety, such as fusing, if a particular mode that exceeds the absolute maximum rating is assumed.

2. Reverse polarity connection
Connecting the power line to the IC in reverse polarity (from that recommended) will damage the part. Please utilize the direction protection device as a diode in the supply line.

3. Power supply line
Due to return of regenerative current by reverse electromotive force, using electrolytic and ceramic suppress filter capacitors (0.1 μF) close to the IC power input terminals (Vcc and GND) are recommended. Please note the electrolytic capacitor value decreases at lower temperatures and examine to dispense physical measures for safety.
And, for ICs with more than one power supply, it is possible that rush current may flow instantaneously due to the internal powering sequence and delays. Therefore, give special consideration to power coupling capacitance, width of power wiring, GND wiring, and routing of wiring. Please make the power supply lines (where large current flow) wide enough to reduce the resistance of the power supply patterns, because the resistance of power supply pattern might influence the usual operation.

4. GND line
The ground line is where the lowest potential and transient voltages are connected to the IC.

5. Thermal design
Do not exceed the power dissipation (Pd) of the package specification rating under actual operation, and please design enough temperature margins.

6. Short circuit mode between terminals and wrong mounting
Do not mount the IC in the wrong direction and be careful about the reverse-connection of the power connector. Moreover, this IC might be destroyed when the dust short the terminals between them or power supply, GND.

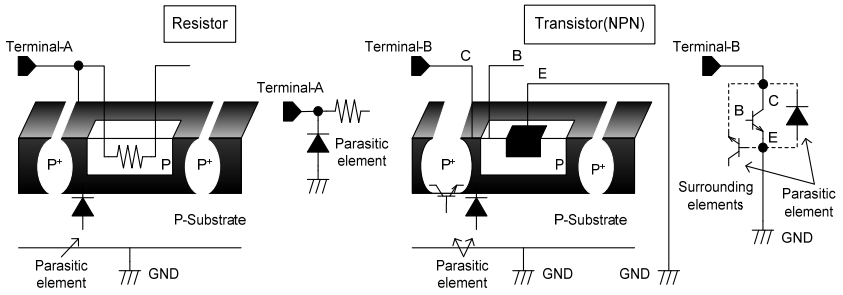
7. Radiation
Strong electromagnetic radiation can cause operation failures.

8. ASO(Area of Safety Operation.)
Do not exceed the maximum ASO and the absolute maximum ratings of the output driver.

9. TSD(Thermal shut-down)
The TSD is activated when the junction temperature (Tj) reaches 175℃(with 25℃ hysteresis), and the output terminal is switched to Hi-z. The TSD circuit aims to intercept IC from high temperature. The guarantee and protection of IC are not purpose. Therefore, please do not use this IC after TSD circuit operates, nor use it for assumption that operates the TSD circuit.

10. Inspection by the set circuit board
The stress might hang to IC by connecting the capacitor to the terminal with low impedance. Then, please discharge electricity in each and all process. Moreover, in the inspection process, please turn off the power before mounting the IC, and turn on after mounting the IC. In addition, please take into consideration the countermeasures for electrostatic damage, such as giving the earth in assembly process, transportation or preservation.

11. IC terminal input
This IC is a monolithic IC, and has P^+ isolation and P substrate for the element separation. Therefore, a parasitic PN junction is firmed in this P-layer and N-layer of each element. For instance, the resistor or the transistor is connected to the terminal as shown in the figure below. When the GND voltage potential is greater than the voltage potential at Terminals A or B, the PN junction operates as a parasitic diode. In addition, the parasitic NPN transistor is formed in said parasitic diode and the N layer of surrounding elements close to said parasitic diode. These parasitic elements are formed in the IC because of the voltage relation. The parasitic element operating causes the wrong operation and destruction. Therefore, please be careful so as not to operate the parasitic elements by impressing to input terminals lower voltage than GND(P substrate). Please do not apply the voltage to the input terminal when the power-supply voltage is not impressed. Moreover, please impress each input terminal lower than the power-supply voltage or equal to the specified range in the guaranteed voltage when the power-supply voltage is impressing.



Simplified structure of IC

12. Earth wiring pattern
Use separate ground lines for control signals and high current power driver outputs. Because these high current outputs that flows to the wire impedance changes the GND voltage for control signal. Therefore, each ground terminal of IC must be connected at the one point on the set circuit board. As for GND of external parts, it is similar to the above-mentioned.

Notes

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