LV52204MT Application Notes

Rev-O 2013/10/23

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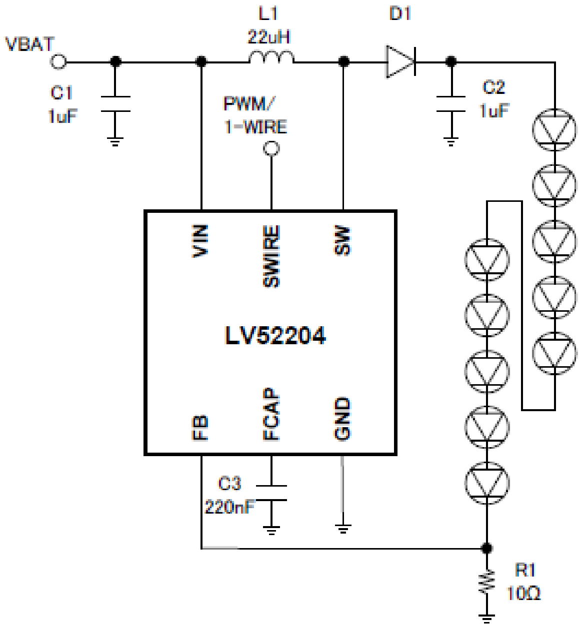
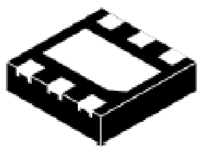
Typical Applications

- LED Display Backlight Control



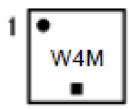
PACKAGE

http://onsemi.com



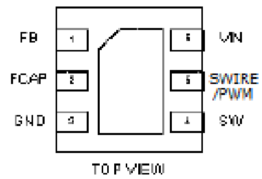
WDFN6 2x2, 0.65P
CASE 511BR-1

MARKING DIAGRAM



W4 = Device Code
M = Date Code
■ = Pb-Free Package
(Note: Microdot may be in either location)

PIN CONNECTIONS



< Overall composition >

LV52204 is a Boost type DC-DC convertor for White LED drive.
It integrated a MOSFET which can tolerate 40V.
The LED current is set by resistance connected to FB terminal.
We can set 32 steps of current values by using 1-wire control. (Digital mode)
We can adjust dimming for LED currents by PWM signal.
Change of LED current do not synchronize the PWM signal.
It is converted to DC current by LPF of FCAP PIN.

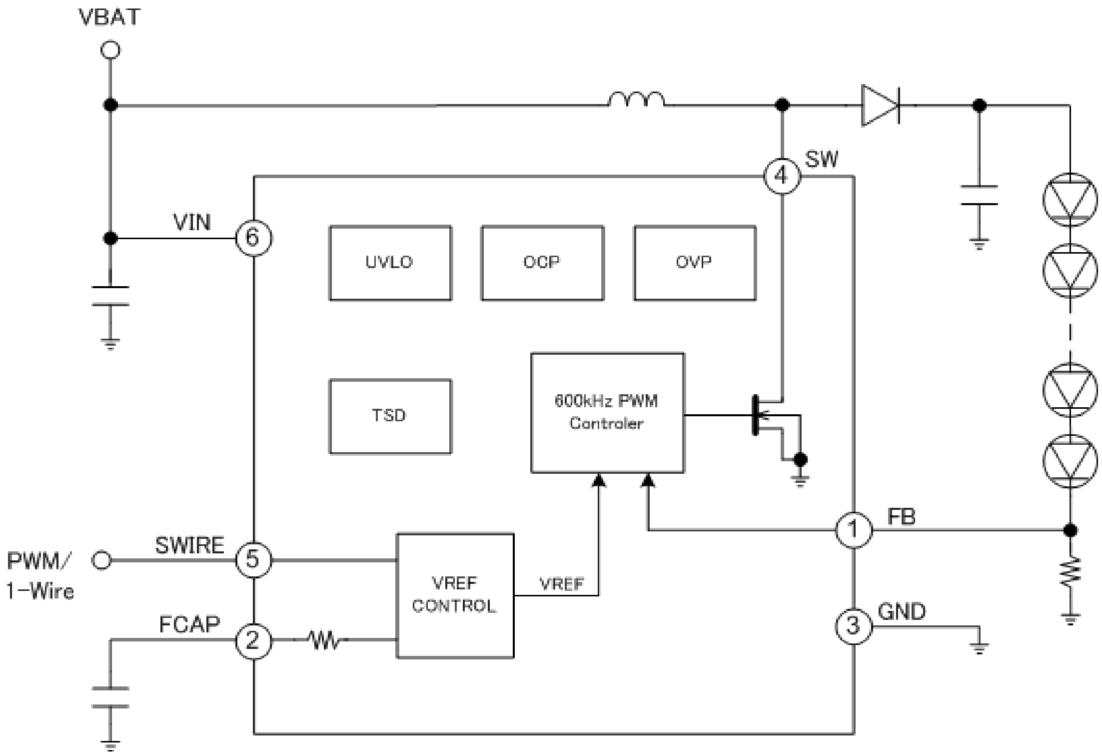
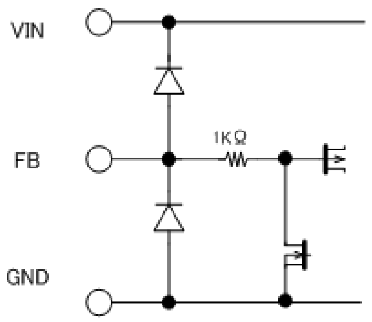
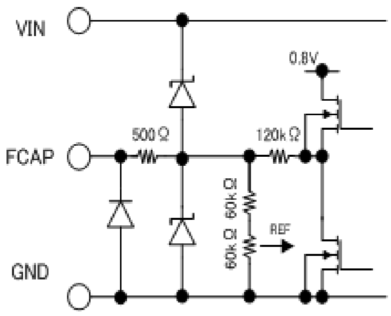
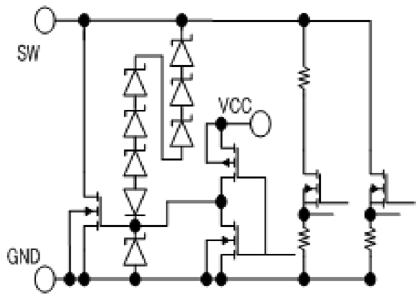
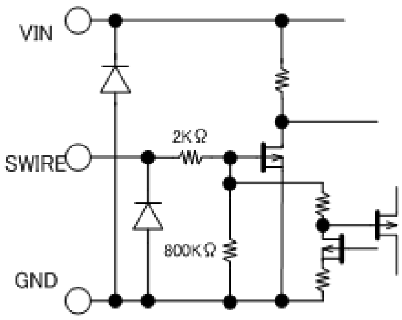


Fig.1 Block Diagram

< Explanation of the terminal >

PIN No.	PIN Sign	Equivalent circuit	Explanations
1	FB		Input PIN for Feedback Voltage ; It takes the feedback so that FB voltage becomes a certain value. The LED current is decided with the voltage and an external resistance value.
2	FCAP		Filter PIN for input PWM signals ; A capacitor to convert PWM signal into DC is connected to this PIN.
3	GND		GND PIN
4	SW		Switching PIN ; SW is output PIN of DC-DC convertor. It is used for overvoltage detection at the time of the LED opening.
5	SWIRE		Input PIN of 1-wire and PWM control signal ; This PIN is used for enabling and dimming of the LED.
6	VIN		Power supply PIN (2.7V-5.5V)

< LED Current setting and Select of control mode >

LED current (I_{LED}) is expressed by resistance (R_{FB}) connected between FB (V_{FB}) and GND as follows.

$$I_{LED} = V_{FB} / R_{FB}.$$

When we actually coordinate LED current, we control the FB voltage, because resistance R_{FB} is constant. Maximum FB voltage is 200mV (typ).

There are two methods to control FB terminal voltage. (PWM mode and Digital mode)
Please select the mode during mode select period (Tsel) just after the start.

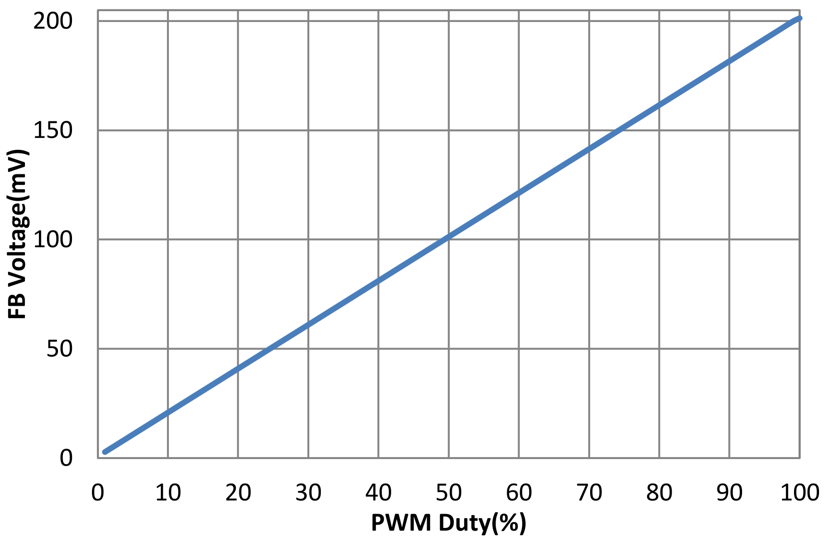


Fig.2 PWM Mode

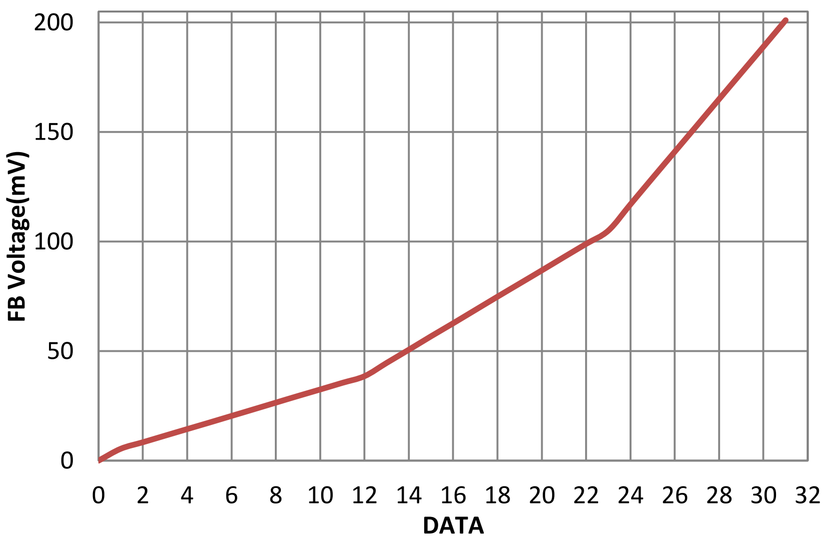


Fig.3 Digital Mode

< Start/Shut Down sequences >

1.Please input "High" into SWIRE PIN during the period that is longer than Ton(20uSec) to start IC.

2.Then, please select a mode during mode select period(Tsel) .

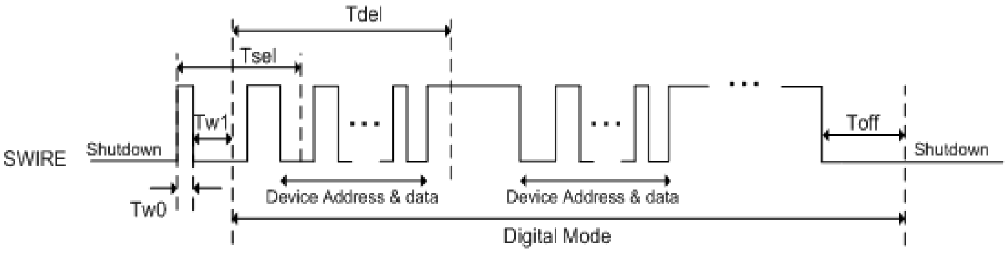
When you select Digital Mode, please input "Low" longer than Tw1 after "High" longer than Tw0(100uSec) within Tsel(1mSec) period.
It becomes PWM mode if you fail to set Digital mode in specified timing period.

In the case of PWM frequency is less than 6.6kHz, it may become Digital Mode when you input a narrow pulse of Duty.
To evade it, input "High" that is longer than Tsel(2.2mSec), and, please input PWM pulse afterwards.

3.IC shut down when you make SWIRE PIN Low longer than Toff(8.9ms) period.

The Data register is stored at this point. The reset of the power supply is necessary to clear
In addition, the mode is initialized when you shut down IC.
Please make mode select each time you reboot.

Digital Mode



PWM Mode

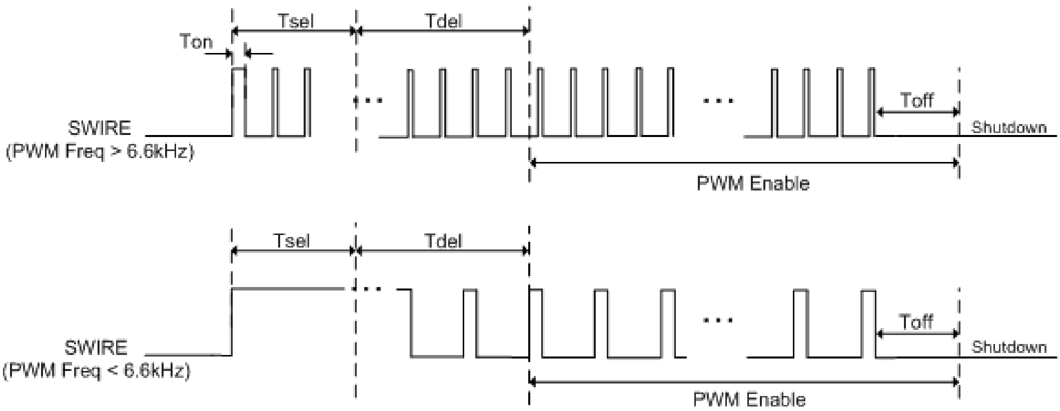


Fig.4 SWIRE Timing Diagram

< Board Layout >

The traces that carry the high-frequency switching current have to be carefully designed on the borad in order to minimize EMI, ripple and noise in general. The loop shown on Fig.5 corresponds to the current path when LV52204 internal switch is closed. The thicker lines show the switching current path. All these traces have to be short and wide enough to minimize parasitic inductance and resistance. Fig.6 shows the current loop, when LV52204 switch is open.
Both loop areas should be as small as possible.
Capacitor C1(VBAT-GND) has to be placed as close as possible to the VBAT pin and GND pin. The connection between SW pin to the inductor and schottky diode should be kept as short and wide as possible.
The trace between schottky diode and the output capacitor C2 should also be as short and wide as possible.
Capacitor C2(VOUT-GND) has to be placed as close as possible to the GND pin.
Resistor R1(FB-GND) has to be placed as close as possible to the FB pin.Capacitor C3(FCAP-GND) has to be placed as close as possible to the FCAP pin.

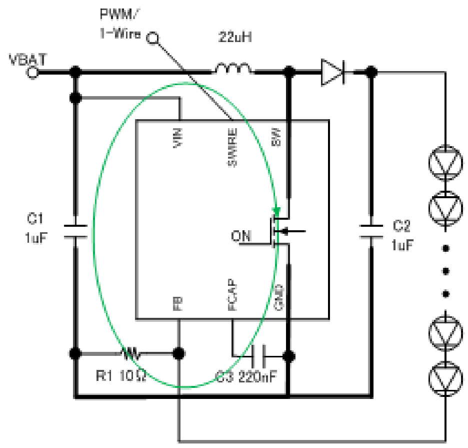


Fig5. Closed-switch Current Loop

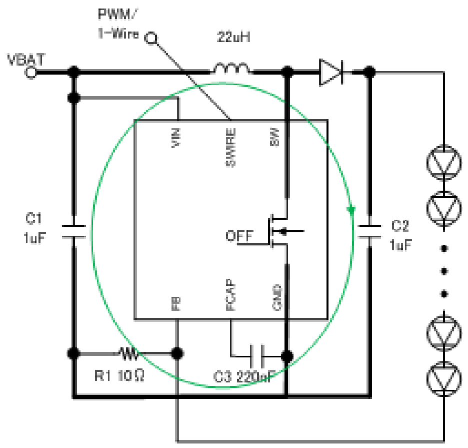


Fig.6 Open-switch Current Loop

< External Part Selection >

< Capacitor >

The ceramic capacitor from 1uF to 4.7uF is recommended as input capacitor C1.
A ceramic capacitor requires attention which capacitance value decreases to by applying rating DC voltage.
The ceramic capacitor from 1uF to 2.2uF is recommended as output capacitor C2.
When LED become OPEN, because the OVP voltage is applied to each parts, please use parts which can endure 50V.

< Schottky diode >

To get the optimum efficiency, LV52204 demands a low forward voltage, high-speed and low capacitance schottky diode . Ensure that the diode average and peak current rating exceeds the average output current and peak inductor current.
In addition, the diode’s reverse breakdown voltage must exceed the open LED protection voltage.

< Inductor >

Three different electrical parameters need to be considered when selecting an inductor, the value of the inductor, the saturation current and the DCR.

Calculation formula of the peak current

Ipeak_p = Iout / (n x (1- D)) + (VIN x D) / 2 x L1 x Fosc

VIN:battery voltage, IOUT:load current, L:inductor value, Fosc: OSC frequency,
D:duty cycle, n:converter efficiency varies with load current.

D = ((Vout + Vf) - VIN) / (Vout + Vf)

Vout:output voltage, Vf:forward voltage of Schottky diode.

It is important to ensure that the inductor current rating is high enough such that it not saturate.
As the inductor size is reduced, the peak current for a given set of conditions increases along with higher current ripple so it is not possible to deliver maximum output power at lower inductor values.
DCR should be small to make efficiency better.

The inductor value from 10uH to 22uH is recommended.

< Revision History >

Revision	Date	Discription of Revision & Writer	Revision Change Originator
O	2013/10/23	Initial release requested by Kazuyoshi Ishikawa	Tsutomu Tanaka