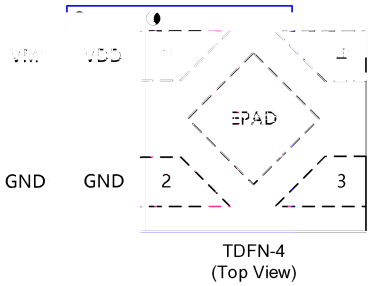
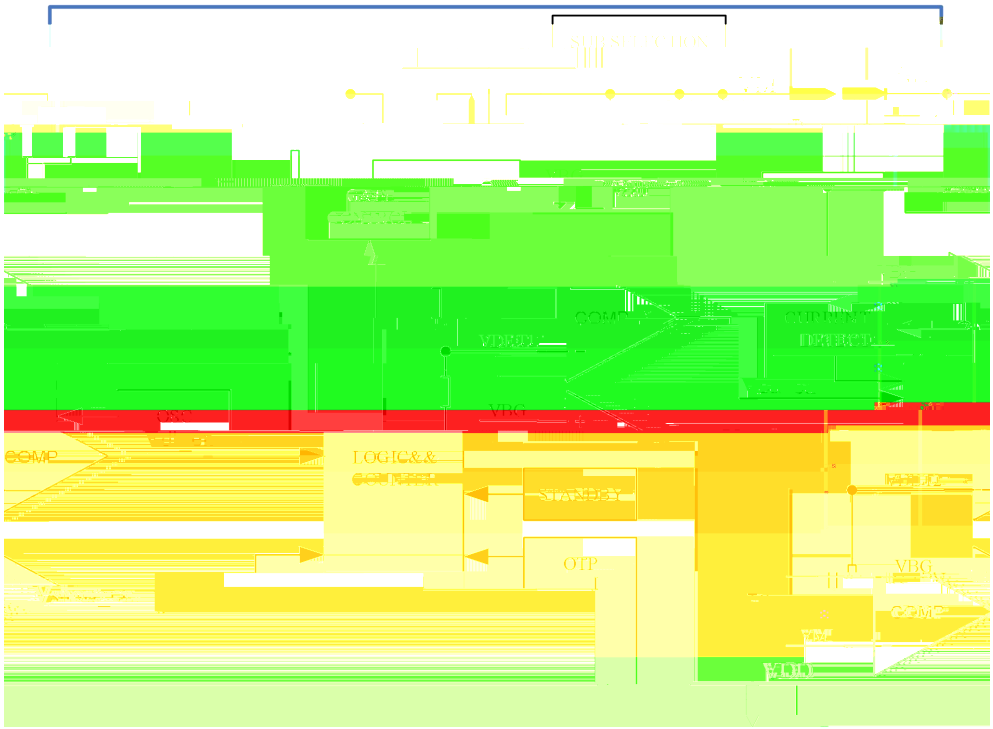
The LPB1001 product is a highly integrated solution for Li-Ion battery protection. It includes advanced power MOSFETs, precision voltage detection circuitry and delay circuitry for all the protection functions required in battery applications, including overcharge, overdischarge, overcurrent and load short circuit protection. Its accurate overcharge detection voltage ensures a safe and efficient charging cycle. The low standby current allows for almost no battery current to be consumed during storage.

The LPB1001 is available in

Package Type	Pin Configurations
TDNF-4(1*1)	

TDFN-4
(Top View)

Pin	Name	Description
2 3	GND	Ground, connect the negative terminal of the battery to this pin
1	VDD	Power Supply
4	VM	The internal FET switch connects this terminal to GND
EPAD	NC	Not Use, Suggest to connect with GND



- ✧ VDD to GND -0.3V to 6V
- ✧ VM to GND VDD-6V to VDD+0.3V

Note 1. Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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(Typicals and limits appearing in normal type apply for TA = 25 , unless otherwise specified.)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Current Consumption						
Current Consumption in Normal Operation	I_{OPE}					

The resistor (R_{VMS}) between VM pins and GND pins is not connected under this condition and overdischarge condition. When the charger is connected, the power-down condition will be released and the voltage difference between VM pins and VDD pins becomes a typical 1.2V value, or higher. At this point, the FET is still off. When the battery voltage is equal to or greater than the overdischarge detection voltage (V_{DL}), LPB1001 conducts the FET from the overdischarge condition to the normal condition.

Discharge Overcurrent Condition

In the normal condition, the discharge current is higher than the specified value (VM pin voltage is equal to or higher than the discharge overcurrent detection voltage), and the condition lasts for the discharge overcurrent detection delay time, the LPB1001 will turn off the discharge control FET to stop the discharge. This situation is called the discharge overcurrent condition.

In the discharge overcurrent condition, a short circuit occurs through the resistance (R_{VMS}) between the VM terminal and the GND terminal. However, as long as the load is connected, the VM pin voltage is equal to the VDD potential. After removing the load, the VM pin will return to the GND potential. If is detected to the VM pin voltage return to the discharge overcurrent detection voltage (V_{DIOV}) or lower, the IC returns to the normal condition.

Charge Overcurrent Detection

In the normal condition, the charge current is higher than the specified value (VM pin voltage is lower than the charge overcurrent detection voltage), and it continues for the overcharge detection delay time, the LPB1001 will turn off the charge control FET to stop the charge. This situation is called the charge overcurrent condition.

By removing the charger, when the VM pin voltage returns to the charge overcurrent detection voltage (V_{CIOV}) or higher, the LPB1001 will return from the charge overcurrent condition to the normal condition.

In the overdischarge condition, the charge overcurrent detection function does not work. In the overdischarge condition, the charge overcurrent detection function does not work as the resistor(R_{VMD}) between the VM pin and VDD pin and the resistor (R_{VMS}) between the VM pin and GND pin are not connected.

Load Short-circuiting condition

If voltage of VM pin is equal or greater than the short circuiting protection voltage (V_{SHORT}) and the duration exceeds the short-circuit delay time t_{SHORT}, the LPB1001 will stop discharging and disconnect the battery from the load. This condition is released when voltage of VM pin is below short protection voltage (V_{SHORT}), such as when disconnecting the load.

Delay Circuits

When the discharge overcurrent detection voltage (V_{DIOV}) is detected, the discharge overcurrent detection delay time (t_{DIOV}) and load short-circuit detection delay time (t_{SHORT}) are started. After the discharge overcurrent detection voltage (V_{DIOV}) is detected, if the load short-circuit detection voltage (V_{SHORT}) is detected within the load short-circuit detection delay time (t_{SHORT}), the LPB1001 turns the discharging control FET off within the load short-circuiting detection delay time (t_{SHORT}) from the

time of detecting V_{SHORT}.

When an overcurrent is detected and the overcurrent duration exceeds the overdischarge detection delay time (t_{DL}) without releasing the load, and when the battery voltage drops below the overdischarge detection voltage (V_{DL}), the state will change to the power-down condition in the following time. When the battery voltage drops below the overdischarge detection voltage (V_{DL}) due to overcurrent, the LPB1001 will turn off the discharge control FET through overcurrent detection. In this case, the LPB1001 will switch to the power-down condition because the battery voltage recovery is so slow that the battery voltage after the overdischarge detection delay time (t_{DL}) is still lower than the overdischarge detection voltage (V_{DL}).

0V Battery Charging Function (1) (2) (3)

This function is used to charge a connected battery whose voltage is 0 V caused by self-discharge. When the 0 V battery charge starting charger voltage (V_{0CHA}) or a higher voltage is applied between the P+ and P- pins by connecting the charger, the gate of the charge control FET is fixed to the VDD pin voltage. When the voltage between the gate and source of the charge control FET becomes equal to or higher than the turn-on voltage due to the charger voltage, the charge control FET turns on to start charging. At this time, the discharging control FET is off and the charging current flows through the internal parasitic diode in the discharging control FET. If the battery voltage becomes equal to or higher than the overdischarge release voltage (V_{DU}), the LPB1001 enters normal condition.

Note:

(1) Some battery suppliers do not recommend [redacted] refer to the battery supplier to determine whether to enable or disable the 0V battery charging function.

(2) The priority of 0V battery charging function is higher than charging overcurrent detection function. Therefore, products with 0V battery charging enabled will force the battery to be charged, and when the battery voltage is higher than the overdischarge detection voltage (V_{DL}), the charging overcurrent cannot be detected.

(3) When a battery is connected to the

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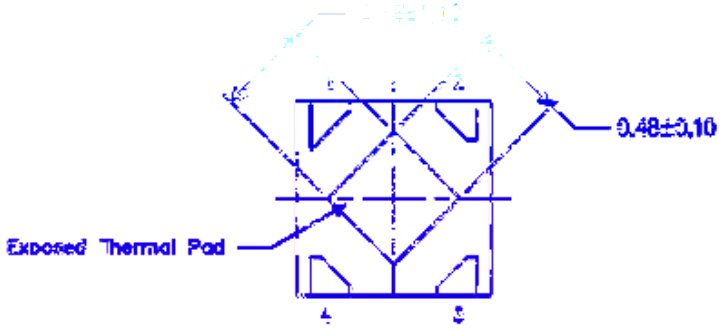

Bottom View

Exposed Thermal Pad Dimensions