General Description

This is a protection IC for one-cell series that protects lithium ion batteries during excess charging, discharging, or overcurrent. If abnormalities occur during charging and excess voltage is applied, it has a function that turns off the external FET switch when voltage is applied to each battery beyond a specified time (overcharging detection). It also has a function that turns off the external FET switch when the voltage for each battery falls below a set voltage, to prevent excess discharge when discharging the battery (discharging detection). At that time, the IC is switched to low current consumption mode. Also, when there is a large current flow due to shorting or other reasons, there is a function for turning off the external FET switch (overcurrent detection). These functions comprise a protection circuit, with few external parts, for lithium ion batteries.

Features

- Low supply current ……………………Supply current   TYP. 3.0μA

  Standby current (after detecting over-discharge) TYP. 0.3μA

- High withstand voltage ………………... Absolute maximum ratings 28V (V_{DD}-V-)

- High accuracy detector threshold …….Over-charge detector   ±25mV

  Over-discharge detector   ±100mV

- Variety of detector threshold …………..Over-charge detector threshold   4.25V to 4.35V/step of 0.05V

  Over-discharge detector threshold   2.4V to 2.6V/step of 0.1V

- Built-in protection circuit ………………Excess current trip/Short circuit protector

- Ultra small package……………………. SOT-23-6

Application

Cellular phones, PDA, MD, others

2003/5/14

Pin Assignment

SOT23-6

```
  6     5     4

      TOP MARK

  1     2     3
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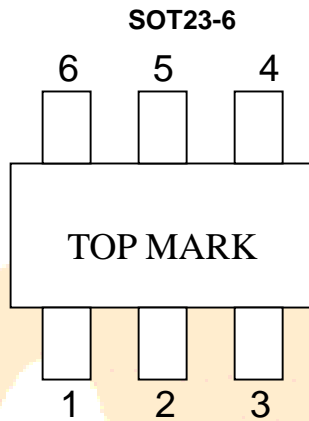
TOP MARK: 1854

BOTTOM MARK: X X X X

X: Assembly source code

X: 200X YEAR

X: Xth week at this month

X: Month code (A:Jan, B:Feb, C:Mar…..etc.)

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Ordering Information

NT1854A: 4.35V $\pm$ 25mV

NT1854B: 4.30V $\pm$ 25mV

NT1854C: 4.25V $\pm$ 25mV

Pin Assignment

Pin No.	Symbol	Pin description
1	D_{OUT}	FET gate connection pin for discharge control, CMOS output
2	V-	Voltage detection pin between V- and Vss
3	C_{OUT}	FET gate connection pin for charge control, CMOS output
4	NC	No connection
5	V_{DD}	Positive power input pin
6	V_{SS}	Negative power input pin

Absolute Maximum Rating

Symbol	Item		Rating	Unit
VDD	Supply Voltage		-0.3 to 12	V
V-	Input Voltage	V- pin	VDD-28 to VDD+0.3	V
VCOUT	Output Voltage	COUT pin	VDD-28 to VDD+0.3	V
VDOUT		DOUT pin	VSS-0.3 to VDD+0.3	V
PD	Power Dissipation		150	mW
Topt	Operating Temperature Range		-40 to +85	°C
Tstg	Storage Temperature Range		-55 to +125	°C

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Electrical Characteristics

Topt=25°C

Symbol	Item	Conditions		MIN.	TYP.	MAX.	Unit
VDD1	Operating input voltage	Voltage defined as VDD-VSS		1.5		10	V
Vst	Minimum operating voltage for 0V charging	Voltage defined as VDD-V-, VDD-VSS=0V				1.2	V
VDET1	Over-charge threshold voltage	Detect rising edge of supply voltage	A	4.325	4.35	4.375	V
			B	4.275	4.30	4.325	V
			C	4.225	4.25	4.275	V
VHYS1	Over-charge threshold hysteresis range			0.15	0.20	0.25	V
tVDET1	Output delay time of over-charge	VDD=3.6V→4.4V		50	-	270	ms
VDET2	Over-discharge threshold voltage	Detect falling edge of supply voltage		2.4	2.5	2.6	V
tVDET2	Output delay time of over-discharge	VDD=3.6V→2.3V		5	15	26	ms
VDET3	Excess current threshold voltage	Detect rising edge of "V-" pin voltage		0.13	0.15	0.17	V
tVDET3	Output delay time of excess current	VDD=3.0V		5	15	26	ms
Vshort	Short detection voltage	VDD=3.0V		VDD-1.0	VDD-0.5	VDD	V
tshort	Output delay time of short detection	VDD=3.0V			5	50	μs
IDD	Supply current	VDD=3.9V, V-=0V			3.0	6.0	μA
Istandby	Standby current	VDD=2.0V			0.3	0.6	μA

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Neotec Semiconductor Ltd.

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NEOTEC
semiconductor

NT1854
Li-Ion/Polymer 1Cell PROTECTOR
Draft Version 0.91

Timing Diagram
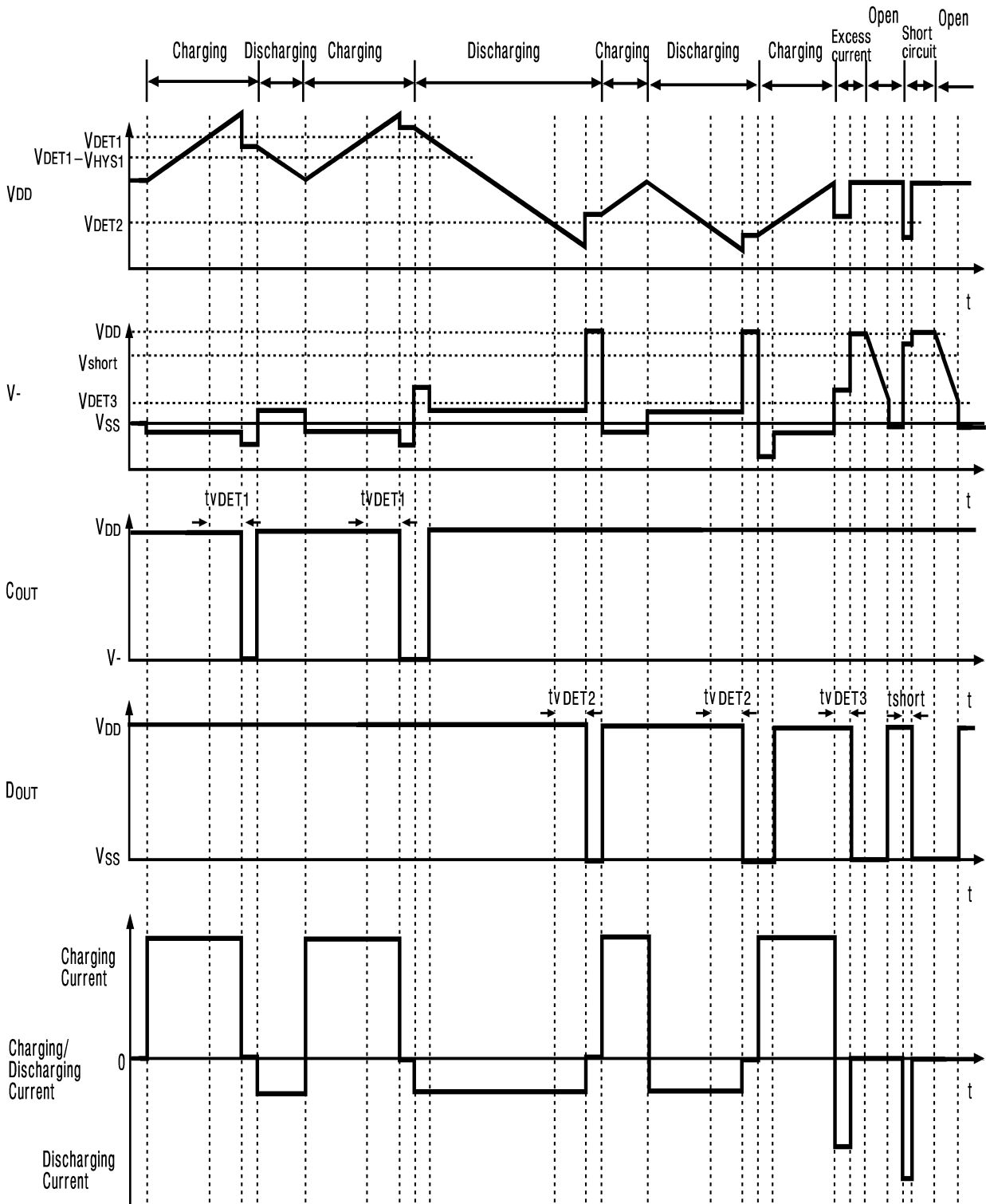
Operation

◆ *Over-Charge Detector*

The over-charge detector monitors VDD pin voltage. When the VDD voltage crosses over-charge detector threshold VDET1 from a low value to a value higher than the VDET1, the over-charge detector could sense over-charging and an external charge control Nch-MOSFEET turns to "OFF" mode with Cout pin set to "L". A level shifter incorporated in a buffer driver for the COUT pin makes the "L" of Cout pin to the V- pin voltage and the "H" of COUT pin is set to VDD voltage with CMOS buffer.

After detecting over-charge with the VDD voltage of higher than VDET1, connecting system load to the battery pack makes load current allowable through parasitic diode of external charge control Nch-MOSFET. The COUT would be "H" when the VDD level is coming down to a level below the VDET1 by continuous drawing of load current.

◆ *Over-Discharge Detector*

The over-discharge detector monitors VDD pin voltage. When the VDD voltage crosses the over-discharge threshold VDET2 from a high value to a value lower than the VDET2, the over-discharge detector can sense an over-discharging and the external discharge control Nch-MOSFET turns to "OFF" mode with the DOUT pin set to "L". Resetting the over-discharge detector with the DOUT pin level being "H" again after detecting over-discharge is only possible by connecting a charger to the battery pack. When the VDD voltage stays under over-discharge detector threshold Vdet2 charge current can flow through parasitic diode of external discharge control of Nch-MOSFET, the after VDD voltage comes up to a value larger than VDET2 discharging process would be advanced through "ON" mode. The output type of DOUT pin is CMOS having "H" level of VDD and "L" level of VSS.
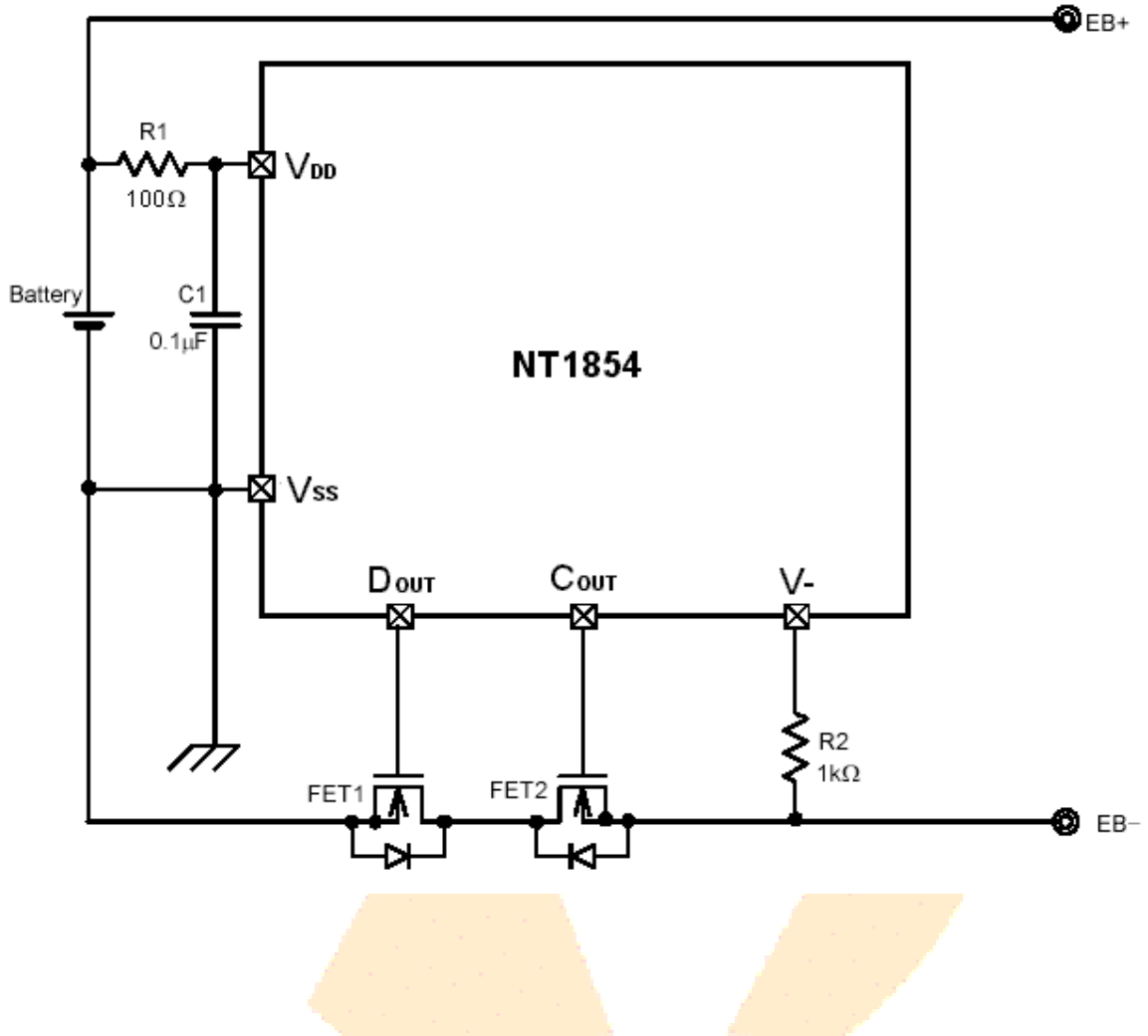
An output delay time for the over-discharge detection is fixed internally. Though the VDD voltage would be going down to a lower level than VDET2 if it is within a time period of output delay time, over-discharge detector would not output a signal for turning "OFF" of discharge control Nch-MOSFET.

◆ *Excess Current Detector & Short Circuit Protector*

Both of the excess current detector and short circuit protector can work when both control Nch-MOSFET are in "ON" mode. When V- pin voltage is going up to a value between the short protection Vshort and excess current threshold VDET3, the excess current detector operates and further soaring of V- pin voltage higher than Vshort makes the short circuit protector enabled. As a result the external discharge control Nch-MOSFET turns to "OFF" mode with DOUT pin set to "L". After an excess current or short circuit protection is detected, removing a cause of excess current or external short circuit makes an external discharge control Nch-MOSFET to an "ON" mode with V- pin voltage level being down to the VSS level through built-in pull down resistor.

An output delay time for the excess current detector is internally fixed. A quick recovery of V- pin level from a value between Vshort and VDET3 in the delay time keeps the discharge control Nch-MOSFET staying "ON" mode.

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Application Circuit

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NT1854
Li-Ion/Polymer 1Cell PROTECTOR
Draft Version 0.91

Dimension

SOT-23-6

Unit : mm

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