

2/3/4/5-Cell Lithium-Ion/Polymer Protector

Features

- High accuracy voltage detection circuit
 - Over-charge detection : $\pm 25\text{mV}$
 - Over-discharge detection : $\pm 80\text{mV}$
 - Discharge over-current-1 detection : $\pm 10\%$
 - Discharge over-current-2 detection : $\pm 10\%$
 - Load short-circuiting detection : $\pm 10\%$
 - Charge over-current detection : $\pm 8\text{mV}/\pm 10\text{mV}$
 - Temperature detection : $\pm 4^\circ\text{C}$
- High withstand voltage
 - Absolute maximum rating: 30V
 - Operating voltage range: 3.5V to 25V
- Low power consumption
 - Supply current: 6.6 μA max. ($T_a=+25^\circ\text{C}$)
- Delay times of over-charge, load short-circuiting, charge over-current and over/under temperature are generated by an internal circuit (fixed).
- Delay times of over-discharge, discharge over-current-1 and -2 are controlled by external capacitors.
- Built-in breaking wire detector function
- Package: 20 pin TSSOP
- Lead-free, Sn 100%, Halogen-free

Applications

- Lithium-ion rechargeable battery pack
- Lithium-polymer rechargeable battery pack
- Lithium-iron phosphate rechargeable battery pack

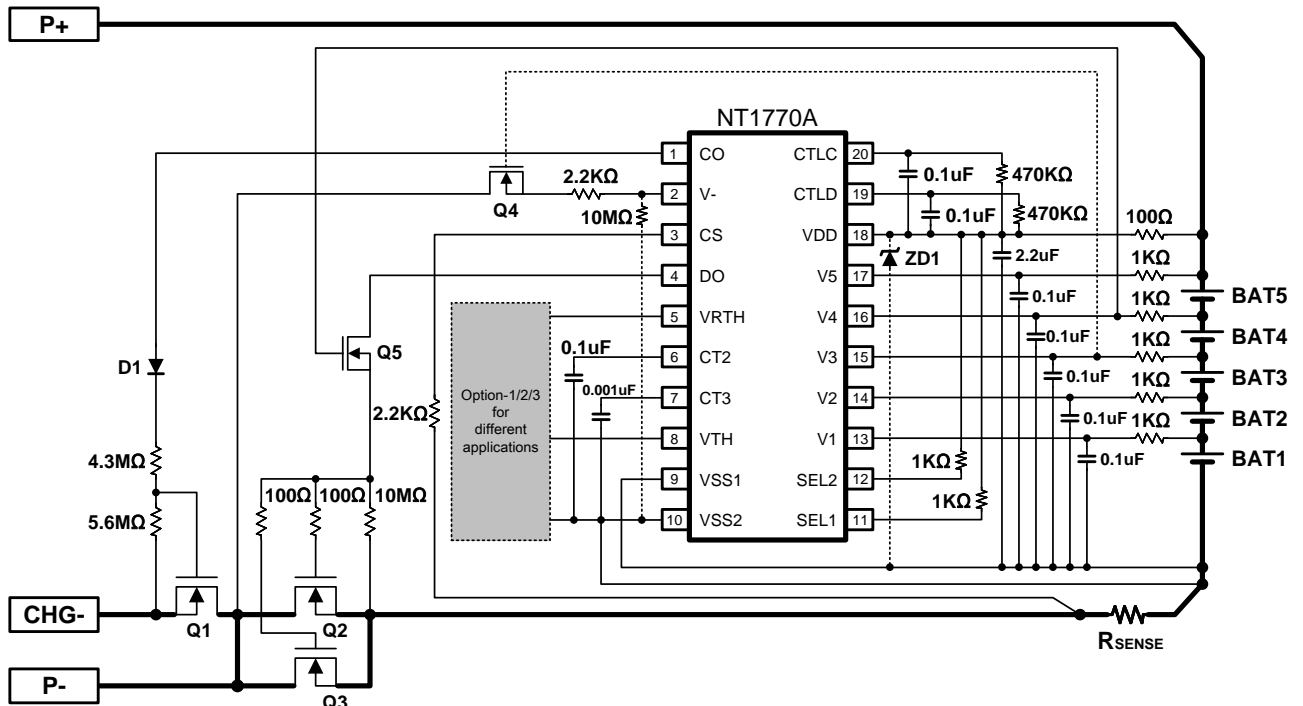
Description

The NT1770 series are the 2/3/4/5-cell protection IC with temperature protection for lithium-ion/lithium-polymer/lithium-iron phosphate rechargeable battery pack. The high accuracy voltage, current detector and delay time circuits are built in NT1770 series with state-of-the-art design and process.

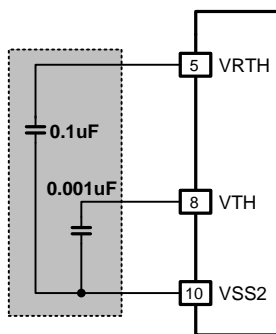
The NT1770 series have three types of discharge over-current protection and one type of charge over-current protection.

The NT1770 series have three types of over-temperature during charging, over-temperature during discharging and under-temperature during charging protection.

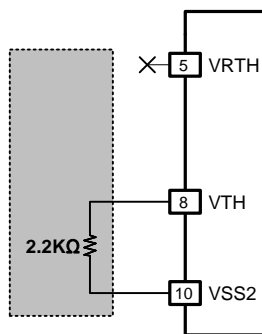
Typical Application Circuit



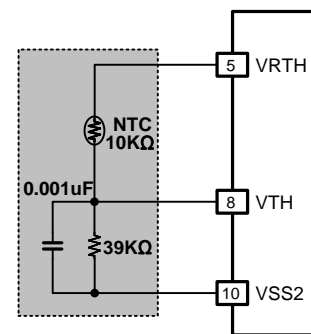
Option 1 —
Without temperature protection (1)



Option 2 —
Without temperature protection (2)

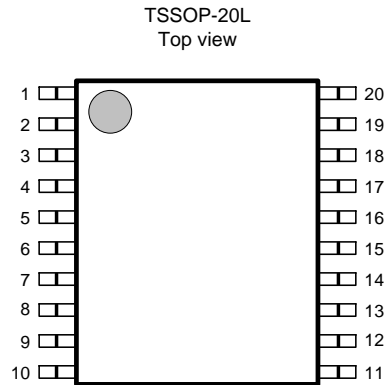


Option 3 —
With temperature protection



These devices have limited built-in ESD protection. The leads must be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

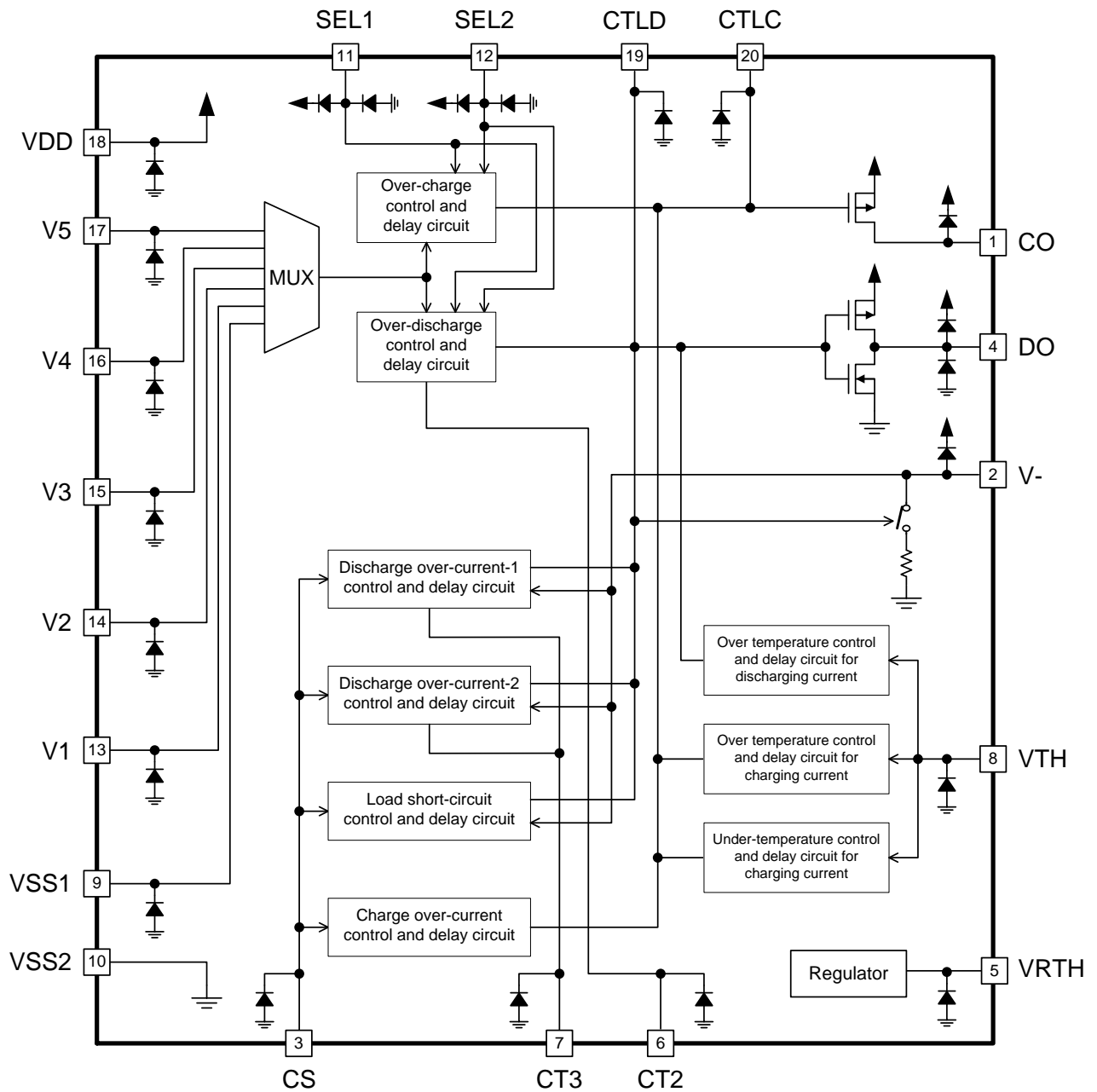
Package and Pin Configurations



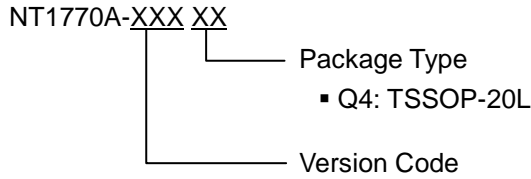
Pin No.	Symbol	Pin description															
1	CO	FET gate control pin for charging path (Pch open-drain output). <ul style="list-style-type: none"> ● Normal mode : High ● Over-charge mode : Hi-impedance 															
2	V-	Input terminal connected to charger negative voltage. Discharge over-current and load short-circuiting release detector.															
3	CS	Input of overcurrent detection. Detected overcurrent by sense resistor between CS pin and VSS2 pin. Detected charger and load connection.															
4	DO	FET gate control pin for discharging path (CMOS output) <ul style="list-style-type: none"> ● Normal mode : High ● Over-discharge mode : Low 															
5	VRTH	Voltage regulator 2 output pin															
6	CT2	Capacitor connection for over-discharge detection delay time.															
7	CT3	Capacitor connection for discharge over-current-1 and -2 detection delay time.															
8	VTH	Temperature detection terminal.															
9	VSS1	The input terminal of the negative voltage of V1 cell.															
10	VSS2	The input terminal of the ground of IC.															
11	SEL1	For 2cell, 3cell, 4cell or 5cell in series.															
12	SEL2																
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>SEL1 pin</th> <th>SEL2 pin</th> <th>Application</th> </tr> </thead> <tbody> <tr> <td>VDD</td> <td>VDD</td> <td>5 cells application</td> </tr> <tr> <td>VDD</td> <td>VSS2</td> <td>4 cells application (Connect V1=VSS1)</td> </tr> <tr> <td>VSS2</td> <td>VDD</td> <td>3 cells application (Connect V2=V1=VSS1)</td> </tr> <tr> <td>VSS2</td> <td>VSS2</td> <td>2 cells application (Connect V3=V2=V1=VSS1)</td> </tr> </tbody> </table>	SEL1 pin	SEL2 pin	Application	VDD	VDD	5 cells application	VDD	VSS2	4 cells application (Connect V1=VSS1)	VSS2	VDD	3 cells application (Connect V2=V1=VSS1)	VSS2	VSS2	2 cells application (Connect V3=V2=V1=VSS1)
SEL1 pin	SEL2 pin	Application															
VDD	VDD	5 cells application															
VDD	VSS2	4 cells application (Connect V1=VSS1)															
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VSS2	VSS2	2 cells application (Connect V3=V2=V1=VSS1)															
13	V1	Cell V1 positive voltage and cell V2 negative voltage input pin															
14	V2	Cell V2 positive voltage and cell V3 negative voltage input pin															
15	V3	Cell V3 positive voltage and cell V4 negative voltage input pin															
16	V4	Cell V4 positive voltage and cell V5 negative voltage input pin															
17	V5	Cell V5 positive voltage															
18	VDD	Power supply input pin															

(Continued)

Pin No.	Symbol	Pin description
19	CTLD	The control terminal of output over-discharge detection. <ul style="list-style-type: none">• $I_{CTLD} > I_{CTLDH}$ DO pin : Normal mode• $I_{CTLD} < I_{CTLDL}$ DO pin : Low level
20	CTLC	The control terminal of output over-charge detection. <ul style="list-style-type: none">• $I_{CTLC} > I_{CTLCH}$ CO pin : Normal mode• $I_{CTLC} < I_{CTLCL}$ CO pin : Hi-impedance

Block Diagram


Ordering Information



Product version code:

Table 1: Detection threshold level

Product Name	Version Code	Package Type	Over-charge detection voltage	Over-charge release voltage	Over-discharge detection voltage	Over-discharge release voltage	Discharge over-current-1 detection voltage	Discharge over-current-2 detection voltage	Charge over-current detection voltage	Load short-circuiting detection voltage
			V _{DET1} (V)	V _{REL1} (V)	V _{DET2} (V)	V _{REL2} (V)	V _{DET31} (V)	V _{DET32} (V)	V _{DET4} (V)	V _{SHORT} (V)
NT1770A	TDA	Q4	3.750	3.600	2.200	2.700	—	0.100	-0.025	0.400
NT1770A	FKA	Q4	4.250	4.150	2.500	3.000	—	0.100	-0.025	0.250
NT1770A	FWA	Q4	4.250	4.150	2.750	3.000	—	0.100	-0.025	0.400

Remark: Please contact our sales for the products with detection voltage value other than those specified above.

Table 2: Temperature detection threshold

Product Name	Version Code	Package Type	Discharge over temperature	Discharge over temperature release	Charge over temperature	Charge over temperature release	Charge under temperature	Charge under temperature release
			TH1 (°C)	RELTH1 (°C)	TH2 (°C)	RELTH2 (°C)	TH3 (°C)	RELTH3 (°C)
NT1770A	TDA	Q4	70	60	50	45	0	5
NT1770A	FKA	Q4	70	60	50	45	0	5
NT1770A	FWA	Q4	70	60	50	45	0	5

Table 3: Function

Product Name	Version Code	Package Type	Over-charge release condition	Over-discharge release condition	0 V battery charge function	Built-in breaking wire detector function	Delay time (Table 4)
NT1770A	TDA	Q4	Voltage release	(a) Voltage release or (b) Charge current release	Available	Yes	(1)
NT1770A	FKA	Q4			Available	Yes	(1)
NT1770A	FWA	Q4			Available	Yes	(1)

Remark: For the details, please refer to the description of “Operations”

Table 4: Delay time

Delay time	Over-charge detection delay time t_{VDET1} (s)	Over-discharge detection delay time t_{VDET2} (s) (at $C_{CT2}=0.1\mu F$)	Discharge over-current-1 detection delay time t_{VDET31} (ms) (at $C_{CT3}=0.001\mu F$)	Discharge over-current-2 detection delay time t_{VDET32} (ms) (at $C_{CT3}=0.001\mu F$)	Load short-circuiting detection delay time t_{SHORT} (us)	Charge over-current detection delay time t_{VDET4} (ms)	Temperature detection delay time t_{VTH} (s)
(1)	1 $\pm 30\%$	1 $\pm 50\%$	—	10 $\pm 50\%$	250 +60/-40%	100 $\pm 30\%$	1 +100%/-50%