Features

- High accuracy voltage detection circuit
  - Over-charge detection: ±25mV
  - Over-discharge detection: ±80mV
  - Discharge over-current-1 detection: ±10%
  - Discharge over-current-2 detection: ±10%
  - Load short-circuiting detection: ±10%
  - Charge over-current detection: ±8mV/±10mV
  - Temperature detection: ±4℃
- High withstand voltage
  - Absolute maximum rating: 30V
  - Operating voltage range: 3.5V to 25V
- Low power consumption
  - Supply current: 6.6uA max. (Ta=+25℃)
- 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: 16 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 NT1777 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 NT1777 series with state-of-the-art design and process.

The NT1777 series have three types of discharge over-current protection and one type of charge over-current protection.

The NT1777 series have three types of over-temperature during charging, over-temperature during discharging and under-temperature during charging protection.

Typical Application Circuit

These devices have limited build-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

#### TSSOP-16L

**Pin No.** | **Symbol** | **Pin description**
--- | --- | ---
1 | CO | FET gate control pin for charging path (Pch open-drain output).
   |   | • 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 VSS pin. Detected charger and load connection.
4 | DO | FET gate control pin for discharging path (CMOS output)
   |   | • Normal mode : High
   |   | • Over-discharge mode : Low
5 | VRTH | Voltage regulator 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 | VSS | Cell V1 negative voltage input pin. The input terminal of the ground of IC.
10 | SEL1 | For 2, 3, 4 or 5-cell in series.
   |   | SEL1 pin | SEL2 pin | Application
   |   | VDD | VDD | 5 cells application
   |   | VDD | VSS | 4 cells application (Connect V5=VDD)
   |   | VSS | VDD | 3 cells application (Connect V5=VDD, V1=VSS)
   |   | VSS | VSS | 2 cells application (Connect V5=VDD, V2=V1=VSS)
11 | SEL2 | V1 | Cell V1 positive voltage and cell V2 negative voltage input pin
   |   | V2 | Cell V2 positive voltage and cell V3 negative voltage input pin
   |   | V3 | Cell V3 positive voltage and cell V4 negative voltage input pin
   |   | V4 | Cell V4 positive voltage and cell V5 negative voltage input pin
   |   | VDD | Power supply input pin and cell V5 positive voltage
Block Diagram

- VDD
- V4
- V3
- V2
- V1
- VSS
- MUX
- SEL1
- SEL2
- VTH
- VRTH
- CS
- CT3
- CT2
- DO
- CO
- 1
- 14
- 13
- 12
- 11
- 10
- 9
- 8
- 7
- 6
- 5
- 4
- 3

- Over-charge control and delay circuit
- Over-discharge control and delay circuit
- Charge over-current control and delay circuit
- Discharge over-current-1 control and delay circuit
- Discharge over-current-2 control and delay circuit
- Load short-circuit control and delay circuit
- Over-temperature control and delay circuit for discharging current
- Over-temperature control and delay circuit for charging current
- Under-temperature control and delay circuit for charging current
- Regulator 1
- Regulator 2
Ordering Information

NT1777A-XXX XX

- Q1: TSSOP-16L

Version Code

Product version code:

Table 1: Detection threshold level

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Version Code</th>
<th>Package Type</th>
<th>V_{DET1} (V)</th>
<th>V_{RELE} (V)</th>
<th>V_{DET2} (V)</th>
<th>V_{REL2} (V)</th>
<th>V_{DET3} (V)</th>
<th>V_{DET4} (V)</th>
<th>V_{SHORT} (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NT1777A TDA</td>
<td>Q1</td>
<td>3.750</td>
<td>3.600</td>
<td>2.200</td>
<td>2.700</td>
<td>0.100</td>
<td>-0.025</td>
<td>0.400</td>
<td></td>
</tr>
<tr>
<td>NT1777A FKA</td>
<td>Q1</td>
<td>4.250</td>
<td>4.150</td>
<td>2.500</td>
<td>3.000</td>
<td>0.100</td>
<td>-0.025</td>
<td>0.250</td>
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<tr>
<td>NT1777A FWA</td>
<td>Q1</td>
<td>4.250</td>
<td>4.150</td>
<td>2.750</td>
<td>3.000</td>
<td>0.100</td>
<td>0.400</td>
<td>0.100</td>
<td></td>
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<tr>
<td>NT1777A FQA</td>
<td>Q1</td>
<td>4.250</td>
<td>4.150</td>
<td>2.800</td>
<td>3.000</td>
<td>0.100</td>
<td>0.400</td>
<td>0.600</td>
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Remark: Please contact our sales for the products with detection voltage value other than those specified above.

Table 2: Temperature detection threshold

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Version Code</th>
<th>Package Type</th>
<th>TH1 (°C)</th>
<th>RELTH1 (°C)</th>
<th>TH2 (°C)</th>
<th>RELTH2 (°C)</th>
<th>TH3 (°C)</th>
<th>RELTH3 (°C)</th>
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<tbody>
<tr>
<td>NT1777A TDA</td>
<td>Q1</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>5</td>
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<tr>
<td>NT1777A FKA</td>
<td>Q1</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>NT1777A FWA</td>
<td>Q1</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>5</td>
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<tr>
<td>NT1777A FQA</td>
<td>Q1</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>45</td>
<td>-10</td>
<td>-5</td>
<td>-5</td>
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Table 3: Function

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Version Code</th>
<th>Package Type</th>
<th>Over-charge release condition</th>
<th>Over-discharge release condition</th>
<th>0 V battery charge function</th>
<th>Built-in breaking wire detector function</th>
<th>Delay time (Table 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NT1777A</td>
<td>TDA Q1</td>
<td>(a) Voltage release or (b) Discharge current release</td>
<td>(a) Voltage release or (b) Charge current release</td>
<td>Available</td>
<td>Yes</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>NT1777A</td>
<td>FKA Q1</td>
<td>(a) Voltage release or (b) Discharge current release</td>
<td>(a) Voltage release or (b) Charge current release</td>
<td>Available</td>
<td>Yes</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>NT1777A</td>
<td>FWA Q1</td>
<td>(a) Voltage release or (b) Discharge current release</td>
<td>(a) Voltage release or (b) Charge current release</td>
<td>Available</td>
<td>Yes</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>NT1777A</td>
<td>FQA Q1</td>
<td>(a) Voltage release or (b) Discharge current release</td>
<td>(a) Voltage release or (b) Charge current release</td>
<td>Available</td>
<td>Yes</td>
<td>(1)</td>
<td></td>
</tr>
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Remark: For the details, please refer to the description of “Operations”

Table 4: Delay time

<table>
<thead>
<tr>
<th>Delay time</th>
<th>Over-charge detection delay time t_VDET1 (s)</th>
<th>Over-discharge detection delay time t_VDET2 (s)</th>
<th>Discharge over-current-1 detection delay time t_VDET31 (ms)</th>
<th>Discharge over-current-2 detection delay time t_VDET32 (ms)</th>
<th>Load short-circuiting detection delay time t_SHORT (us)</th>
<th>Charge over-current detection delay time t_VDET4 (ms)</th>
<th>Temperature detection delay time t_VTH (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>1 ±30%</td>
<td>1 ±50%</td>
<td>60 ±50%</td>
<td>10 ±50%</td>
<td>250 ±60/-40%</td>
<td>100 ±30%</td>
<td>1 ±100%/-50%</td>
</tr>
</tbody>
</table>