Outline

The MW3790 is a voltage monitoring IC with a function of the protection IC for lithium ion batteries. For a solution including a charge circuit, the MW3790 on the battery pack realizes accurate measurement of the battery voltage. This solution can maximize the CC (constant current) charge mode of the charge circuit, and reduce the charge. As a communication interface, MIPI® BIF, which is a battery interface developed by MIPI® Alliance (an international organization), is used.

Features

(1) 0V battery charge function permission or inhibition
   - inhibition
   - Accuracy±0.10V

(2) High accuracy of voltage detection circuit
   - Overcharge detection voltage: 4.425V, Accuracy±0.020V
   - Overdischarge detection voltage: 2.450V, Accuracy±0.035V
   - Discharge overcurrent detection voltage: 34.0mV, Accuracy±5.0mV
   - Charge overcurrent detection voltage: −22.0mV, Accuracy±3.3mV
   - Short detection voltage1: 80.0mV, Accuracy±9.0mV

(3) Low current consumption

(4) Protection mode latch function
   - Overcharge: Disable
   - Overdischarge: Disable
   - Discharge overcurrent: Disable
   - Charge overcurrent: Enable

(5) EEPROM equipped

(6) Communication method. MIPI® BIF compliant

Applications

Voltage monitoring, Li-ion battery protection

Pin Assignment

<table>
<thead>
<tr>
<th>Top view</th>
<th>Pin No.</th>
<th>Symbol</th>
<th>IN/OUT</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLP-8G</td>
<td>1</td>
<td>VREG</td>
<td>OUT</td>
<td>Regulator output terminal</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>VSS</td>
<td></td>
<td>VSS terminal</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>VDD</td>
<td>IN</td>
<td>VDD terminal</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>CS</td>
<td>IN</td>
<td>Current detection terminal</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>V–</td>
<td>IN</td>
<td>Negative power supply voltage input terminal</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>COUT</td>
<td>OUT</td>
<td>Charge FET control terminal</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>DOUT</td>
<td>OUT</td>
<td>Discharge FET control terminal</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>BCL</td>
<td>IN/OUT</td>
<td>BCL terminal for BIF communication</td>
</tr>
</tbody>
</table>

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* The details listed here are not a guarantee of the individual products at the time of ordering. When using the products, you will be asked to check their specifications.
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**Block Diagram**

**Product Line up**

<table>
<thead>
<tr>
<th>Product name</th>
<th>Package</th>
<th>Overcharge detection voltage</th>
<th>Overcharge release voltage</th>
<th>Overdischarge detection voltage</th>
<th>Overdischarge release voltage</th>
<th>Discharging overcurrent detection voltage</th>
<th>Charging overcurrent detection voltage</th>
<th>Short detection voltage 1</th>
<th>Short detection voltage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW3790MT1RRE</td>
<td>PLP-8G</td>
<td>4.425</td>
<td>4.225</td>
<td>2.450</td>
<td>2.800</td>
<td>0.034</td>
<td>-0.022</td>
<td>0.080</td>
<td>VDD+0.9</td>
</tr>
<tr>
<td>MW3790MT4RRE</td>
<td>PLP-8G</td>
<td>4.475</td>
<td>4.275</td>
<td>2.450</td>
<td>2.800</td>
<td>0.034</td>
<td>-0.028</td>
<td>0.080</td>
<td>VDD+0.9</td>
</tr>
<tr>
<td>MW3790MT5RRE</td>
<td>PLP-8G</td>
<td>4.425</td>
<td>4.225</td>
<td>2.450</td>
<td>2.800</td>
<td>0.035</td>
<td>-0.035</td>
<td>0.080</td>
<td>VDD+0.9</td>
</tr>
</tbody>
</table>
### Application Circuit

**Symbol** | **Part** | **Min.** | **Typ.** | **Max.** | **Purpose**
--- | --- | --- | --- | --- | ---
R1 | Resistor | 10Ω | 10Ω | For voltage fluctuation, For ESD
R2 | Resistor | 1.0kΩ | 1.0kΩ | | Current limit for charger reverse connection
R3 | Resistor | 4mΩ | 4mΩ | | Current detection resistance
R4 | Resistor | 16kΩ | 16kΩ | | ID resistor
R5 | Resistor | 100Ω | 100Ω | | For ESD
R6 | Resistor | 100Ω | 100Ω | | For ESD
R7 | Resistor | 1MΩ | 1MΩ | | Pull-down resistor
RNTC | Thermistor | 10kΩ | 10kΩ | | Thermistor
C1 | Capacitor | 1.0µF | 1.0µF | | For voltage fluctuation
C2 | Capacitor | 0.1µF | 0.1µF | | For exogenous noise
C3 | Capacitor | 0.1µF | 0.1µF | | For exogenous noise
C4 | Capacitor | 0.1µF | 0.1µF | | For exogenous noise
C5 | Capacitor | 0.1µF | 0.1µF | | For internal voltage regulator fluctuation
DZ | Zener Diode | 6.8V | 6.8V | | ESD protection diode
DFET | Nch MOS FET | 5mΩ | 5mΩ | | Charge and discharge control

This typical application circuit and constant value do not guarantee proper operation. Please evaluate thoroughly by actual application to set up constants.

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Precautions for safe handling

- R1 and C1 stabilize a supply voltage fluctuation. However, the detection voltage of protection operation rises and voltage sensor error of voltage monitor function increases by the current consumption of IC when R1 is too large. Therefore, R1 should be 10ohm. Please use 1.0µF for C1 to stabilize the operation.

- R1 and R2 resistors are current limit resistance if a charger is connected reversely or a high-voltage charger that exceeds the absolute maximum rating is connected. If "R1+R2" is too small, the power consumption have potential to exceeding the allowed power dissipation of IC, and "R1 and R2" should be more than 1kohm. R2 should be 1kohm as well.

- In the over discharge mode, V- terminal is pulled up to VDD by Rpu. If a charger is connected, P- terminal is dropped to about -0.7V by parasitical Di of DFET. And Iv- flows from P+ to P- terminal and the voltage drop (ΔVR1) arises in R1. Therefore, the cell voltage (Vrel2') at overdischarge release is expressed in the following equation.

\[
V_{rel2'} = V_{det2} + \Delta VR1 \\
= V_{rel2} + R1 \times \text{Iv-} \\
= V_{rel2} + R1 \times (V_{det2} + 0.7) / (R1 + Rpu + R2)
\]

- C2 and C3 have effect of stabilizing the system by improving the capacity for voltage ripples and exogenous noises. Please decide the necessity of insertion, position, and capacitance value in consideration of the system characteristic.

- If R3 is too large, the power loss increases. Moreover, the power consumption might exceed the allowable power dissipation of resistance by the overcurrent. Please select R3 according to the cell and system spec.

- C4 capacitors will improve the tolerated capacity for exogenous noise and prevent false discharge overcurrent detection. Please arrange C4 near the CS and VSS terminal.

- Current thresholds of discharging overcurrent detection and short detection (Idoc, Ishort) are expressed in the following equations.

\[
\text{Idoc} = \frac{V_{det3}}{R3} \\
\text{Ishort1} = \frac{V_{short1}}{R3} \\
\text{Ishort2} = \frac{V_{short2}}{(R3 + 2R_{on})}
\]

*Ron : ON resistance of CFET and DFET

- Current threshold of charging overcurrent detection (Icoc) is expressed in the following equation.

\[
\text{Icoc} = -\frac{V_{det4}}{R3}
\]

- R4 and RNTC are an ID resistor and a thermistor for a set device, respectively.

- C5 is a capacitor stabilizing the internal regulator operation of the MW3790. The sensors, AD converter, and logic circuit of the MW3790 are designed on the assumption that the internal regulator supplies exactly 1.8V to them. Hence it’s necessary to connect the capacitor with VREG pin which is output pin of the internal regulator voltage to guarantee the accuracy of the voltage sensor and temperature sensor. The capacitance value of C5 shall be 0.1µF.

- R5 is a limiting resistor of ESD surge which is input to zero diode (DZ) and the MW3790. R5 limits the electric current when ESD surge is applied.

- R6 is a limiting resistor of ESD surge input to the MW3790. R6 limits the electric current that the zero diode cannot remove when ESD surge is applied.

- DZ is a device protecting communication terminal from ESD.

- R7 is an optional pull-down resistor. The resistor ensures that the BCL is pulled down to GND when BCL line is not pulled up by the external circuit, for example when the battery pack is not connected to a host device. If RNTC and RID are connected between BCL and GND, the R7 is unnecessary as the RNTC and RID work as pull-down resistors.