Voltage monitoring IC with protection IC
MW3790 Series

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

	1.50V	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

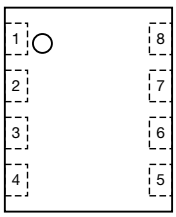
(5) EEPROM equipped

(6) Communication method. MIPI® BIF compliant

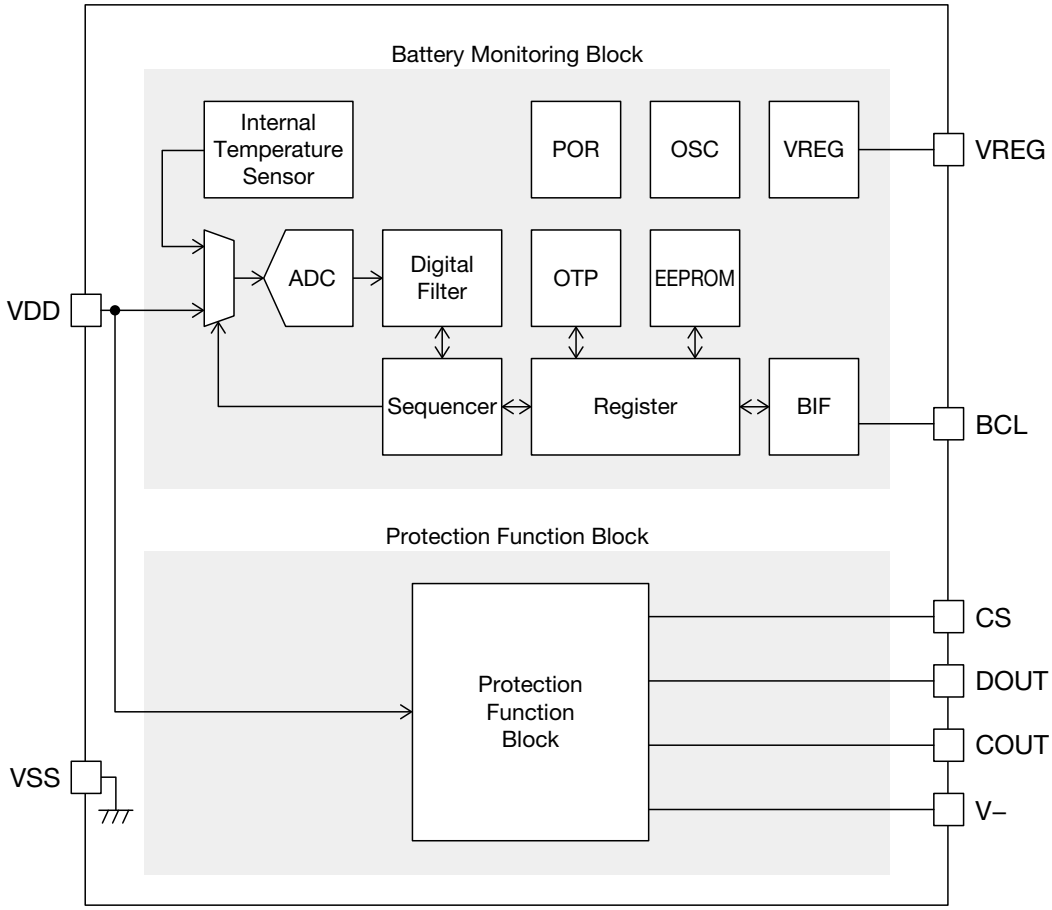
Applications

Voltage monitoring, Li-ion battery protection

Pin Assignment

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

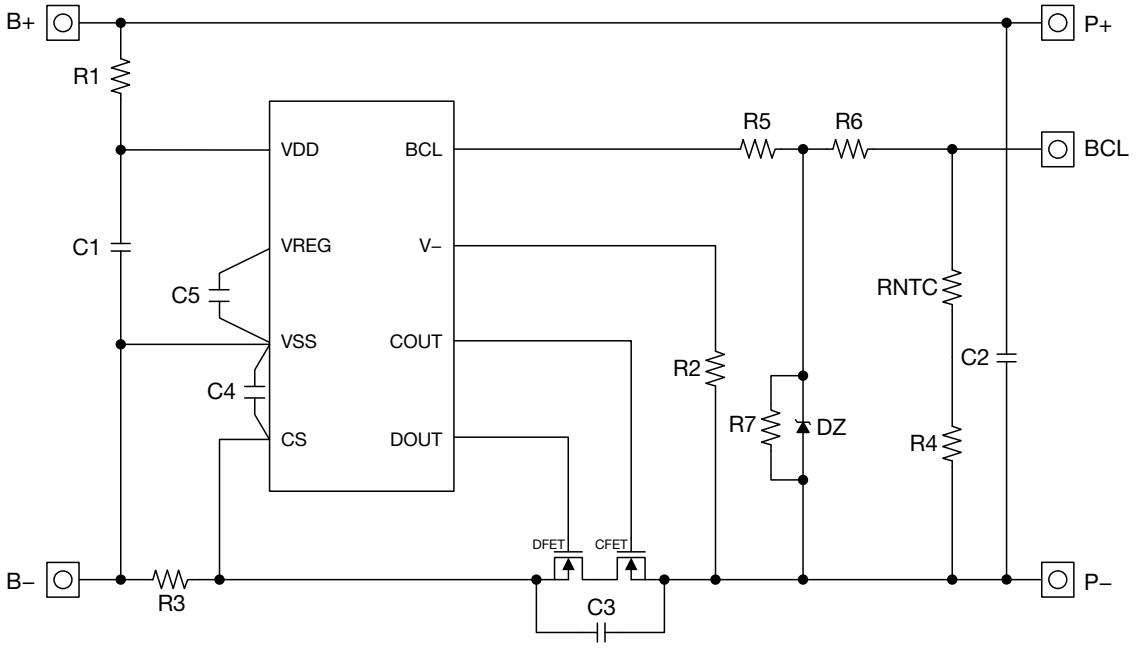
Block Diagram



Product Line up

Product name	Package	Overcharge detection voltage	Overcharge release voltage	Overdischarge detection voltage	Overdischarge release voltage	Discharging overcurrent detection voltage	Charging overcurrent detection voltage	Short detection voltage 1	Short detection voltage 2
		Vdet1	Vrel1	Vdet2	Vrel2	Vdet3	Vdet4	Vshort1	Vshort2
		V	V	V	V	V	V	V	V
MW3790MT1RRE	PLP-8G	4.425	4.225	2.450	2.800	0.034	–0.022	0.080	VDD-0.9
MW3790MT4RRE	PLP-8G	4.475	4.275	2.450	2.800	0.034	–0.028	0.080	VDD-0.9
MW3790MT5RRE	PLP-8G	4.425	4.225	2.450	2.800	0.035	–0.035	0.080	VDD-0.9

Application Circuit



Symbol	Part	Min.	Typ.	Max.	Purpose
R1	Resistor		10Ω		For voltage fluctuation, For ESD
R2	Resistor		1.0kΩ	1.0kΩ	Current limit for charger reverse connection
R3	Resistor			4mΩ	Current detection resistance
R4	Resistor		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		Thermistor
C1	Capacitor		1.0μF		For voltage fluctuation
C2	Capacitor		0.1μF		For exogenous noise
C3	Capacitor		0.1μF		For exogenous noise
C4	Capacitor		0.1μF		For exogenous noise
C5	Capacitor		0.1μF		For internal voltage regulator fluctuation
DZ	Zener Diode		6.8V		ESD protection diode
DFET CFET	Nch MOS FET		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.

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 (⊿VR1) arises in R1. Therefore, the cell voltage (Vrel2') at overdischarge release is expressed in the following equation.

$$Vrel2' = Vdet2 + \Delta VR1$$
$$= Vrel2 + R1 * Iv-$$
$$= Vrel2 + R1 * (Vdet2 + 0.7) / (R1 + Rpu + R2)$$

· 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.

$$Idoc = Vdet3 / R3$$
$$Ishort1 = Vshort1 / R3$$
$$Ishort2 = Vshort2 / (R3 + 2Ron)$$

*Ron : ON resistance of CFET and DFET

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

$$Icoc = -Vdet4 / R3$$

· 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 serge which is input to zenor diode (DZ) and the MW3790. R5 limits the electric current when ESD serge is applied.

· R6 is a limiting resistor of ESD serge input to the MW3790. R6 limits the electric current that the zenor diode cannot remove when ESD serge 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.