



3- 5 cells Li-ion/polymer battery protection IC

MM3694 series

Outline

The MM3694 series are protection IC using high voltage CMOS process for overcharge, overdischarge, overcurrent and temperature protection of the rechargeable Lithium-ion or Lithium-polymer battery. The overcharge, overdischarge, discharging overcurrent, charging overcurrent, temperature of the rechargeable 3~5cell Lithium-ion or Lithium-polymer battery can be detected. The internal circuit of IC is composed by the voltage detector, the reference voltage source, delay time control circuit, and the logical circuit, etc.

Features

(Unless otherwise specified, Ta=25°C)

1) Range and accuracy of detection/release voltage

• Overcharge detection voltage	3.6V to 4.5V, 5mV steps	Accuracy±25mV (Ta=0~50°C)
• Overcharge release voltage	3.4V to 4.5V, 50mV steps	Accuracy±50mV
• Overdischarge detection voltage	2.0V to 3.0V, 50mV steps	Accuracy±80mV
• Overdischarge release voltage	2.0V to 3.5V, 50mV steps	Accuracy±100mV
• Discharging overcurrent detection voltage1	+30mV to +300mV, 5mV steps	Accuracy±15%
• Discharging overcurrent detection voltage2	2 or 4 times of VDET3-1	Accuracy±20%
• Short detection voltage	4 or 8 times of VDET3-1	Accuracy±100mV
• Charging overcurrent detection voltage	-300mV to -20mV, 5mV step	Accuracy±10mV

2) Range of detection delay time

• Overcharge detection delay time	Setting by a capacitor of COV pin
• Overdischarge detection delay time	Setting by a capacitor of CUV pin
• Discharging overcurrent detection delay time1	Setting by a capacitor of DCOC1 pin.
• Discharging overcurrent detection delay time2	Setting by a capacitor of DCOC2 pin.
• Short detection delay time	Selection from 100us, 200us, 300us
• Charging overcurrent detection delay time	Setting by a capacitor of CCOC pin.
• Temperature protection detection ON time	Setting by a capacitor of CIOT pin
• Temperature protection detection OFF time	Setting by a capacitor of CIOT pin

3) 0V battery charge function Selection from "Prohibition" or "Permission"

4) The setting for three cell , for four cell , and for five cell protection can be set with the SEL1,2 pin.

5) Power save mode Built-in

6) Achieve low consumption by making the temperature detection for regulator and temperature detection circuit to intermittent operation





7) Low current consumption

- VDD pin current consumption(Vcell=4.3V) Typ. 15.0uA Max. 25.0uA
- VDD pin current consumption(Vcell=3.5V) Typ. 10.0uA Max. 20.0uA
- VDD pin current consumption at power save (Vcell=1.8V) Typ. 3.0uA Max. 6.0uA

8) Package type

- VSOP-24A 7.90 × 7.60 × 1.25 [mm]

Pin explanations

VSOP-24A		Pin No.	Symbol	Function
		1	V-	Input terminal connected to charger negative voltage.
		2	OV	Charge control output pin. Output type is CMOS.
		3	DCHG	Discharge control output pin. Output type is CMOS.
		4	CUV	This pin is delay time setting of overdischarge.
		5	CDOC2	This pin is delay time setting of discharging overcurrent2.
		6	COV	This pin is delay time setting of overcharge 1.
		7	CDOC1	This pin is delay time setting of discharging overcurrent1.
		8	CCOC	This pin is delay time setting of charging overcurrent.
		9	CIOT	This pin is delay time setting of intermittent operation of temperature detection.
		10	N.C.	No Connection.
		11	SEL1	This pin is for changing function for 3cell in series or 4cell in series , 5cell in series. SEL1="L", SEL2="L" → 5Cell in series
		12	SEL2	SEL1="H", SEL2="L" → 4Cell in series SEL1="L", SEL2="H" → 3Cell in series SEL1="H", SEL2="H" → test mode
		13	CS	Input of overcurrent detection.
		14	TH	TH Temperature detection pin.
		15	REG	The regulator output pin for a thermo sense resistor drive.
		16	VSS_CS	Common pin of overcurrent detection circuit.
		17	VSS	The input pin of the negative voltage of V1 cell. The input pin of the ground of IC.
		18	V1	The input pin of the positive voltage of V1 cell, and the negative voltage of V2 cell
		19	V2	The input pin of the positive voltage of V2 cell, and the negative voltage of V3 cell
		20	V3	The input pin of the positive voltage of V3 cell, and the negative voltage of V4 cell
		21	V4	The input pin of the positive voltage of V4 cell, and the negative voltage of V5 cell
		22	V5	The input pin of the positive voltage of V5 cell
		23	VDD	The input terminal of the power supply of IC
		24	N.C.	No Connection.

TOP VIEW



Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
VDD pin supply voltage	V _{VDD_MAX}	VSS-0.3	VSS+30.0	V
Voltage between the input terminals of voltage of battery	V _{cell_MAX}	-0.3	10.0	V
V- pin supply voltage	V _{V-_MAX}	VDD-30	VDD+0.3	V
OV pin supply voltage	V _{OVMAX}	VDD-30	VDD+0.3	V
DCHG pin supply voltage	V _{DCHGMAX}	VSS-0.3	VDD+0.3	V
Storage temperature	T _{STG}	-55	125	°C

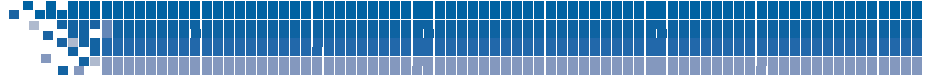
Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Operating ambient temperature	T _{OPR}	-40	85	°C
Operating voltage	V _{OPR}	VSS+3.5	VSS+22.5	V

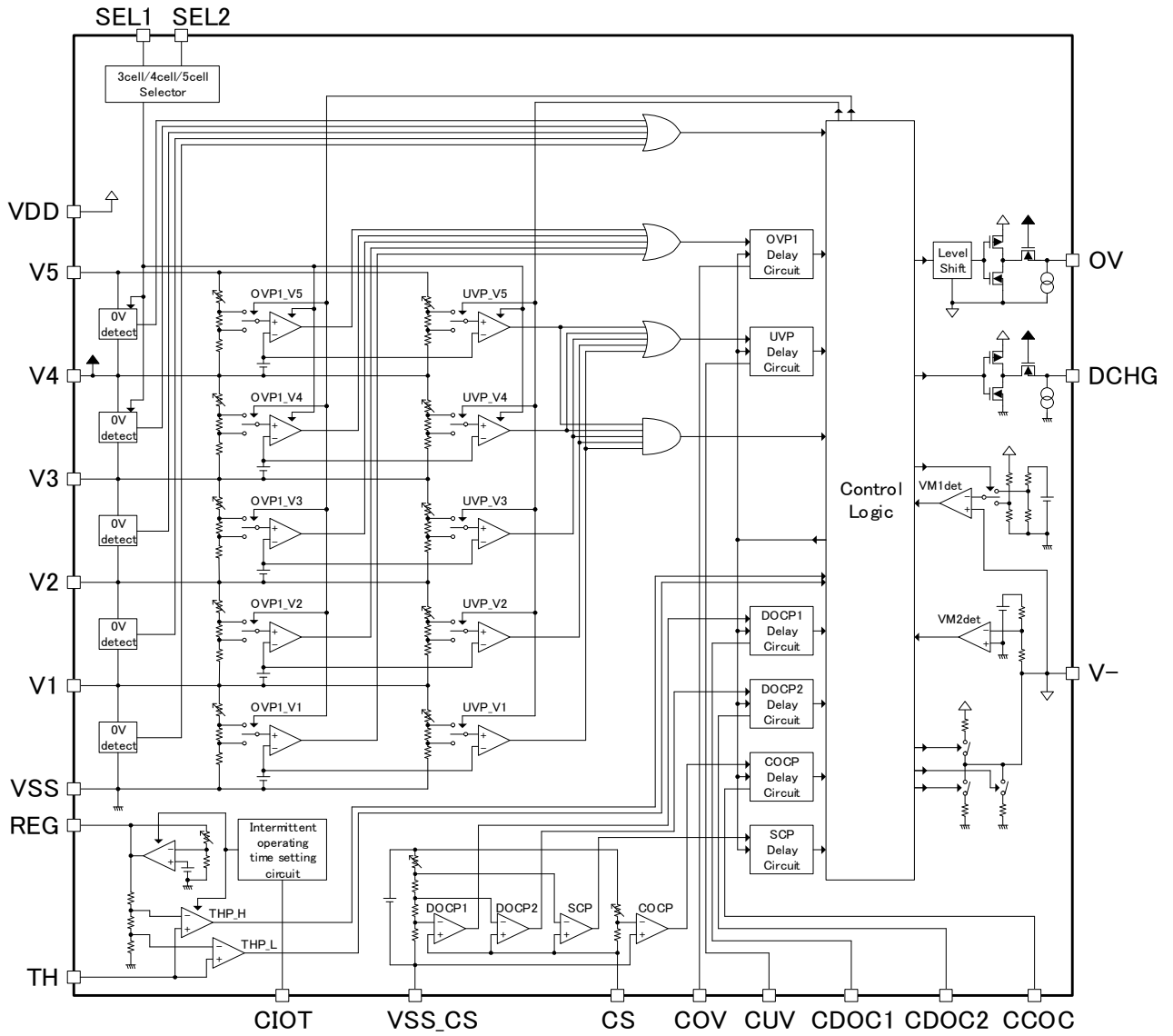
Electrical characteristics

(特記なき場合、Ta=25°C)

Parameter	Symbol	Note	Min	Typ	Max	Unit
Current consumption						
Current consumption1 (VDD)	I _{DD1}	Vcell=4.3V	-	15.0	25.0	uA
Current consumption2 (VDD)	I _{DD2}	Vcell=3.5V	-	10.0	20.0	uA
Current consumption3 (VDD)	I _{DD3}	Vcell=1.8V	-	3.0	6.0	uA
Detection / Release voltage and Temperature protection						
Overcharge detection voltage	V _{DET1}	Ta=0~50°C	Typ-0.025	V _{DET1}	Typ+0.025	V
Overcharge release voltage	V _{REL1}		Typ-0.050	V _{REL1}	Typ+0.050	V
Overdischarge detection voltage1	V _{DET2}		Typ-0.080	V _{DET2}	Typ+0.080	V
Overdischarge release voltage	V _{REL2}		Typ-0.100	V _{REL2}	Typ+0.100	V
Discharging overcurrent detection voltage 1	V _{DET3-1}		Typ-15%	V _{DET3-1}	Typ+15%	V
Discharging overcurrent detection voltage 2	V _{DET3-2}		Typ-20%	V _{DET3-2}	Typ+20%	V
Short detection voltage	V _{SHORT}		Typ-0.100	V _{SHORT}	Typ+0.100	V
Charging overcurrent detection voltage	V _{DET4}		Typ-0.010	V _{DET4}	Typ+0.010	V
Temperature protection detection temperature 1	V _{THD1}		Typ-7	V _{THD1}	Typ+7	°C
Temperature protection detection temperature 2	V _{THD2}		Typ-7	V _{THD2}	Typ+7	°C
Detection voltage delay time						
Overcharge detection delay time1	t _{VDET1}		Typ-50%	t _{VDET1}	Typ+50%	s
Overdischarge detection delay time	t _{VDET2}		Typ-50%	t _{VDET2}	Typ+50%	s
Discharging overcurrent detection delay time 1	t _{VDET3-1}		Typ-50%	t _{VDET3-1}	Typ+50%	ms
Discharging overcurrent detection delay time 2	t _{VDET3-2}		Typ-50%	t _{VDET3-2}	Typ+50%	ms
Short detection delay time	t _{SHORT}		Typ-50%	t _{SHORT}	Typ+50%	us
Charging overcurrent detection delay time	t _{VDET4}		Typ-50%	t _{VDET4}	Typ+50%	ms
Temperature protection detection ON time	t _{THON}		Typ-50%	t _{THON}	Typ+50%	s
Temperature protection detection OFF time	t _{THOFF}		Typ-50%	t _{THOFF}	Typ+50%	s



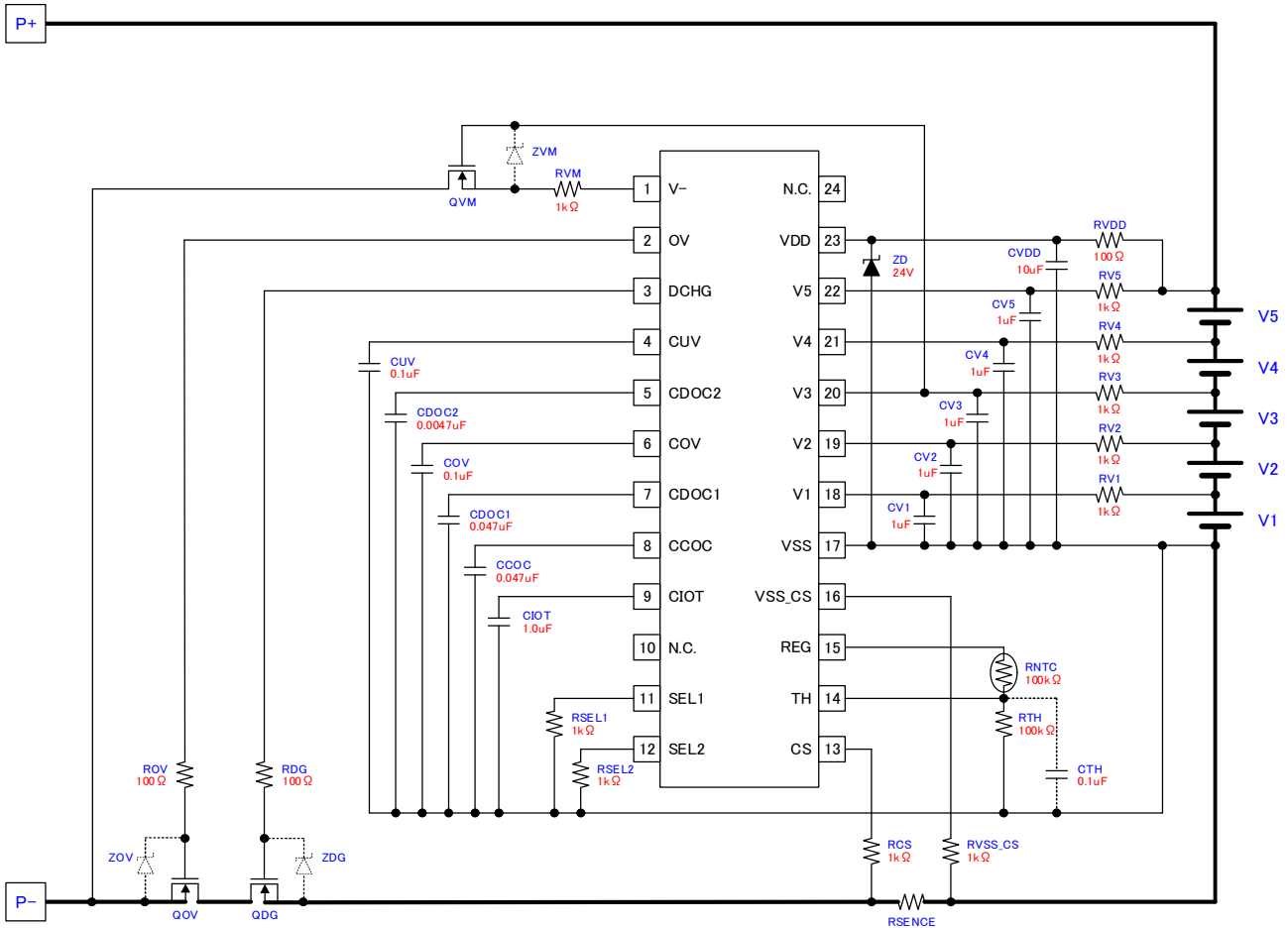
Block diagram





Typical application circuit

- 5 cells protection circuit



※ This circuits are typical examples provided for reference purposes, so in actual applications, the circuit constants, conditions and operations should be thoroughly studied. Mitsumi Electric Co., Ltd. assumes no responsibility for any trouble or damage as a result of the use of this circuits.

※ Temperature detection property is adjusted using the thermo sensitive register of the following part number, and resistance accuracy. In order to satisfy the characteristic of specification, it recommends using the following parts.

Symbol	Name	Function
RNTC	NTC Thermistor	10KΩ±1% B(25/50)=3950±1%
RTH	Resistor	10KΩ±1%

※ If temperature protection function is repealed, please make TH pin and VDD pin connection and make CIOT pin and VSS pin connection and make a REG pin open.

※ It's established so that CDOC1 and CDOC2 will be CDOC1>CDOC2 certainly.

