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

MM3684 series

Outline

The MM3684 series are protection IC using high voltage CMOS process for overcharge, secondary 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 to 5 cells Lithium-ion or lithiumpolymer 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℃)

1) Range and accuracy of detection/release voltage
   - ・Overcharge detection voltage1   3.6V to 4.5V, 5mV steps   Accuracy±25mV（Ta=0〜50℃）
   - ・Overcharge detection voltage2   3.6V to 4.5V, 5mV steps   Accuracy±25mV（Ta=0〜50℃）
   - ・Overcharge release voltage   3.4V to 4.5V, 50mV steps   Accuracy±50mV
   - ・Overdischarge detection voltage1   2.0V to 3.0V, 50mV steps   Accuracy±80mV
   - ・Overdischarge detection voltage2   2.0V to 3.0V, 50mV steps   Accuracy±100mV
   - ・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 time1   Setting by a capacitor of COV pin
   - ・Overcharge detection delay time2   Setting by a capacitor of CPF pin
   - ・Overdischarge detection delay time   Setting by a capacitor of CUV pin
   - ・Discharging overcurrent detection delay time1 Setting by a capacitor of DCOC pin.
   - ・Discharging overcurrent detection delay time2 Setting by a capacitor of DCOC 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
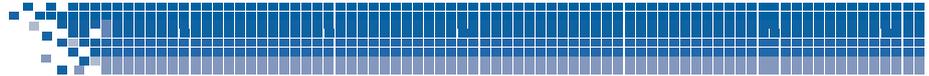
7) Threshold of over-discharge detection can be switched to over-discharge detection voltage 1, 2 at the DVSEL terminal.

8) 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

9) 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	CPF	This pin is delay time setting of overcharge detection 2.
	6	COV	This pin is delay time setting of overcharge 1.
	7	CDOC	This pin is delay time setting of discharging overcurrent.
	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	DVSEL	This pin is for changing function for overdischarge detection voltage
	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	PF	Charge control output pin. Output type is CMOS.

TOP VIEW (VSOP-24A diagram: pins 1–12 on left, 24–13 on right)

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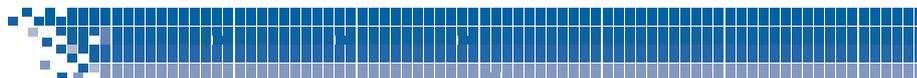
Absolute Maximum Ratings

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
PF pin supply voltage	V_{PF_MAX}	VSS-0.3	VDD+0.3	V
Storage temperature	T_{STG}	-55	125	℃

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Operating ambient temperature	T_{OPR}	-40	85	℃
Operating voltage	V_{OPR}	VSS+3.5	VSS+22.5	V

Electrical characteristics

(特記なき場合、Ta=25℃)

| 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 voltage1	V_{DET1-1}	Ta=0～50℃	Typ-0.025	V_{DET1-1}	Typ+0.025	V
Overcharge detection voltage2	V_{DET1-2}	Ta=0～50℃	Typ-0.025	V_{DET1-2}	Typ+0.025	V
Overcharge release voltage	V_{REL1}		Typ-0.050	V_{REL1}	Typ+0.050	V
Overdischarge detection voltage1	V_{DET2-1}		Typ-0.080	V_{DET2-1}	Typ+0.080	V
Overdischarge detection voltage2	V_{DET2-2}		Typ-0.100	V_{DET2-2}	Typ+0.100	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	℃
Temperature protection detection temperature 2	V_{THD2}		Typ-7	V_{THD2}	Typ+7	℃
Detection voltage delay time						
Overcharge detection delay time1	$t_{VDET1-1}$		Typ-50%	$t_{VDET1-1}$	Typ+50%	s
Overcharge detection delay time2	$t_{VDET1-2}$		Typ-50%	$t_{VDET1-2}$	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
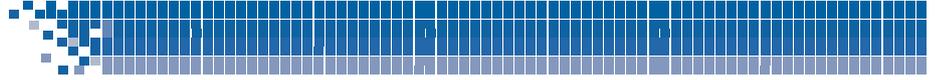
Block diagram
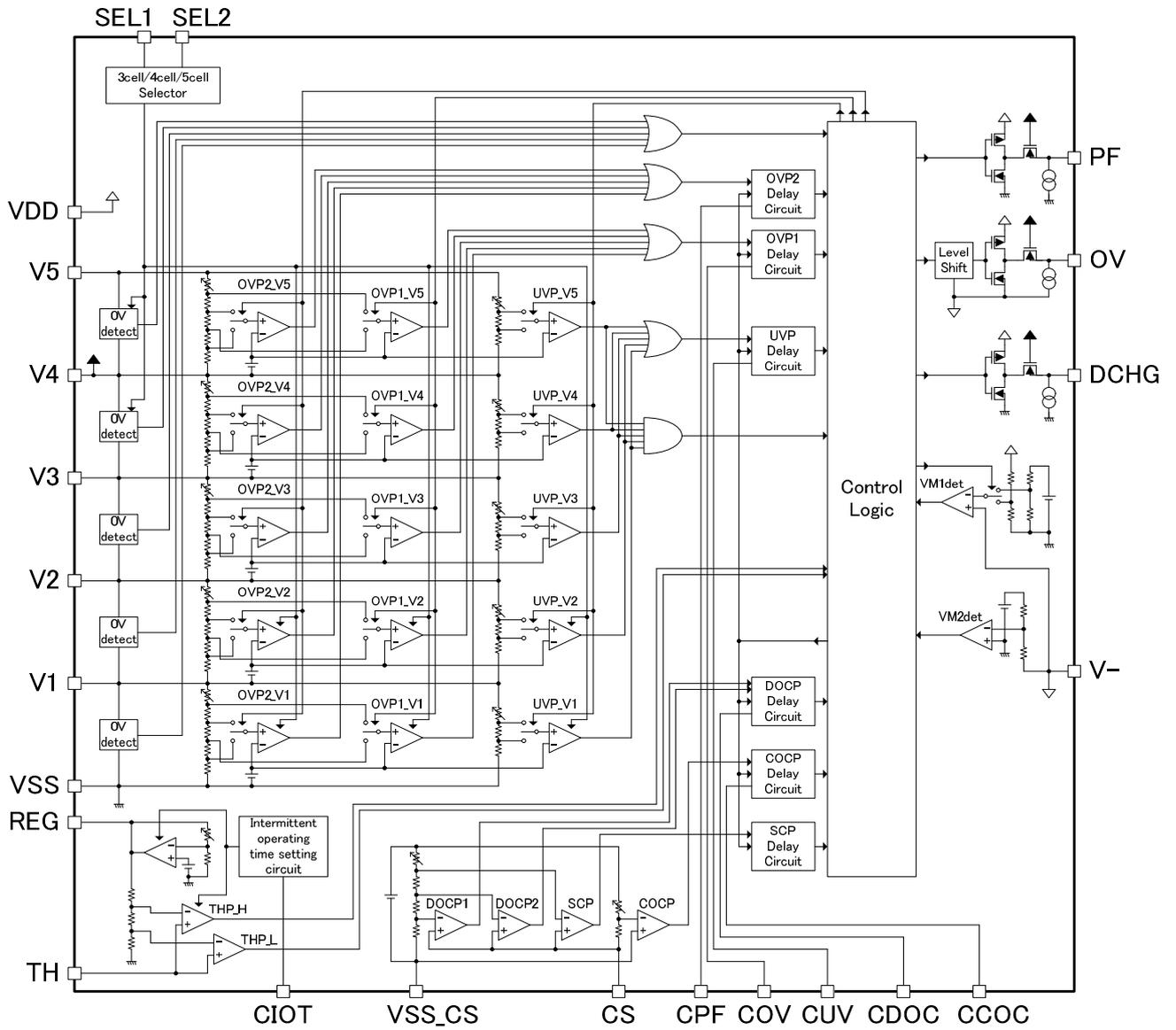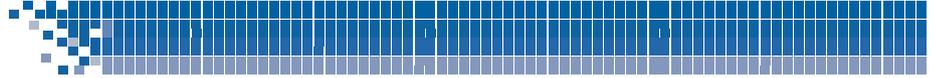
Typical application circuit

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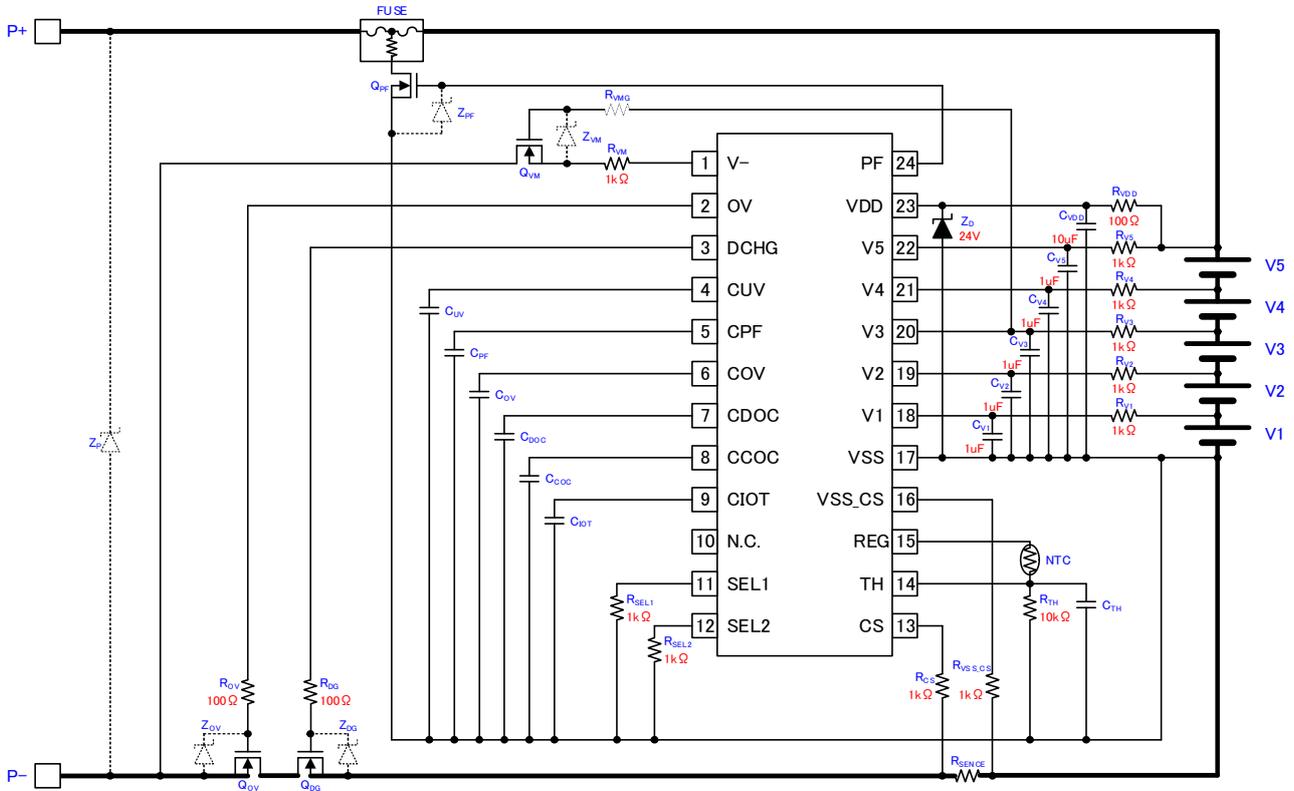
※ This circuits are typical examples provided for reference purposes, so in actual applications, the circuit constants, conditions and operations should be thoroughly studied. Mitsumi Electric Co., Ltd. assumes no responsibility for any trouble or damage as a result of the use of this circuits.

※ 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 a REG pin open.