

# Protection for Lithium-Ion Batteries (for double protection) Monolithic IC MM3284 Series

## Outline

This IC is a double protection IC for lithium-ion battery of 1-cell to 4-cell. It detects the battery voltage for every cell. It includes a timer, eliminating an external capacitor for overcharge detection delay that is used for our conventional ICs, which allows programmable detection delay time.

## Features

- |                                                    |                                                                                         |                                                           |
|----------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------|
| 1. Overcharge detection voltage                    | 4.0~4.5V                                                                                | Accuracy $\pm 30\text{mV}$ ( $-40\sim+85^\circ\text{C}$ ) |
| 2. Current consumption                             | ( $V_{\text{CELL}}=3.5\text{V}$ )                                                       | 2.5 $\mu\text{A}$ typ.                                    |
| 3. Current consumption                             | ( $V_{\text{CELL}}=2.5\text{V}$ )                                                       | 2.0 $\mu\text{A}$ typ.                                    |
| 4. Maximum rating                                  |                                                                                         | 28V                                                       |
| 5. Operating voltage range:                        | 2~24V                                                                                   |                                                           |
| 6. No external capacitance required for delay time | (Delay time is determined by the internal circuit, ranging from 1s to 12s upon request) |                                                           |

## Packages

SOT-26A  
SSON-6A

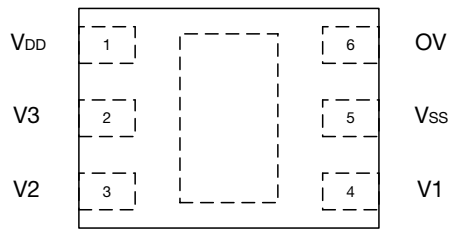
## Applications

1. Laptop PCs
2. Battery powered device

## Line-up

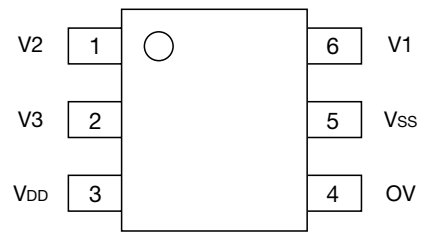
Model	Overcharge Detection Voltage	Overcharge Release Hysteresis Voltage	Overcharge Detection Dead Time
MM3284A	4.350 $\pm$ 0.03V	200 $\pm$ 60mV	1.2s typ.
MM3284B	4.350 $\pm$ 0.03V	1000 $\pm$ 300mV	1.2s typ.
MM3284C	4.350 $\pm$ 0.03V	1000 $\pm$ 300mV	10.0s typ.
MM3284E	4.450 $\pm$ 0.03V	200 $\pm$ 60mV	1.2s typ.
MM3284G	4.450 $\pm$ 0.03V	1000 $\pm$ 300mV	10.0s typ.
MM3284H	4.350 $\pm$ 0.03V	1000 $\pm$ 300mV	5.0s typ.
MM3284I	4.450 $\pm$ 0.03V	1000 $\pm$ 300mV	5.0s typ.
MM3284J	4.400 $\pm$ 0.03V	1000 $\pm$ 300mV	10.0s typ.
MM3284K	4.225 $\pm$ 0.03V	1000 $\pm$ 300mV	10.0s typ.
MM3284L	4.250 $\pm$ 0.03V	1000 $\pm$ 300mV	10.0s typ.
MM3284M	4.280 $\pm$ 0.03V	1000 $\pm$ 300mV	4.1s typ.
MM3284N	4.450 $\pm$ 0.03V	200 $\pm$ 60mV	4.1s typ.

Pin Assignment



SSON-6A  
(TOP VIEW)

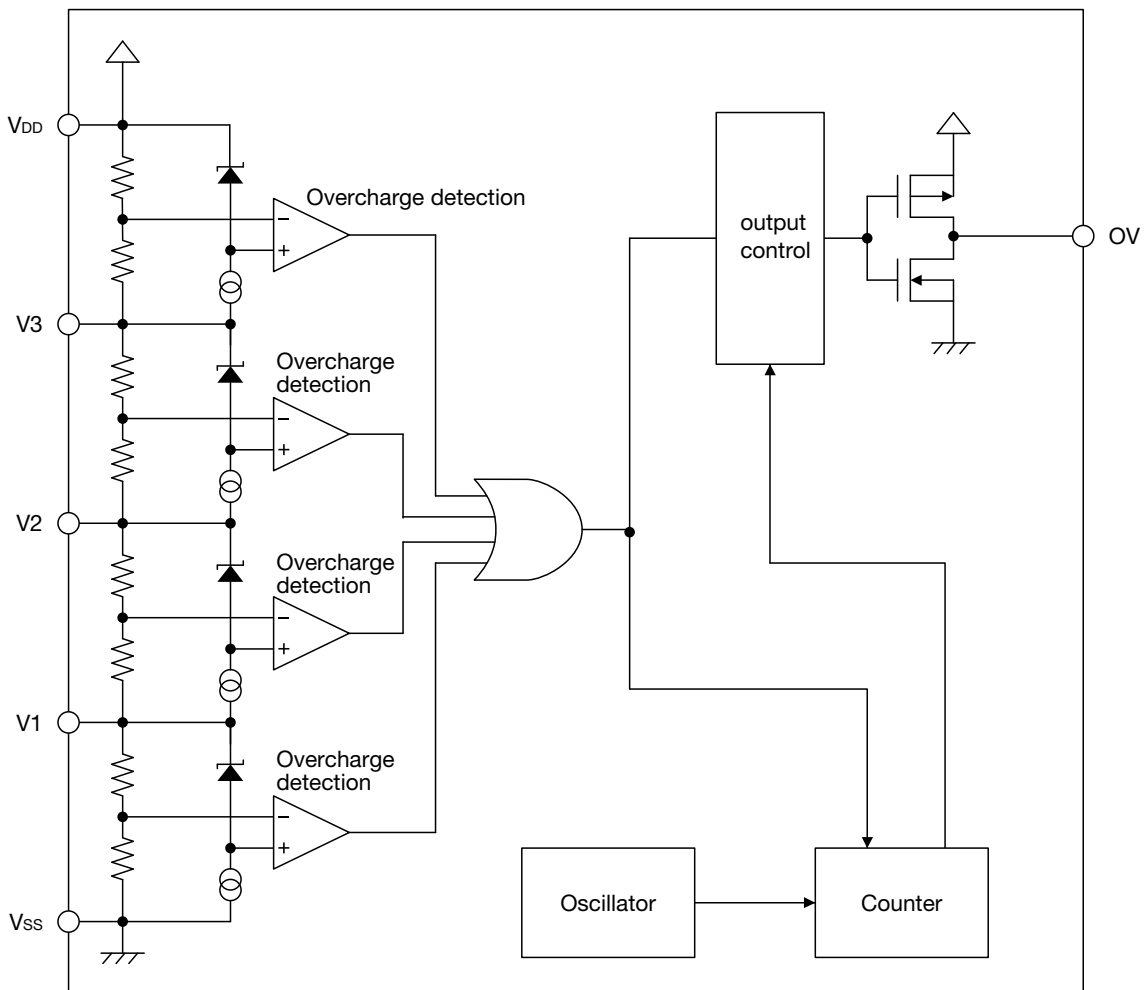
1	V <sub>DD</sub>
2	V <sub>3</sub>
3	V <sub>2</sub>
4	V <sub>1</sub>
5	V <sub>SS</sub>
6	OV



SOT-26  
(TOP VIEW)

1	V <sub>2</sub>
2	V <sub>3</sub>
3	V <sub>DD</sub>
4	OV
5	V <sub>SS</sub>
6	V <sub>1</sub>

Block Diagram



## Pin Description

Pin No.	Pin name	Input/Output	Functions
1	V <sub>DD</sub>	INPUT	The input terminal of the power supply for IC and of the positive voltage for V4 cell.
2	V3	INPUT	The input terminal of the positive voltage for V3 cell and of the negative voltage for V4 cell.
3	V2	INPUT	The input terminal of the positive voltage for V2 cell and of the negative voltage for V3 cell.
4	V1	INPUT	The input terminal of the positive voltage for V1 cell and of the negative voltage for V2 cell.
5	V <sub>SS</sub>	INPUT	The input terminal of the ground of IC and of the negative voltage for V1 cell.
6	OV	OUTPUT	The output terminal of over-charge detection. Output type is CMOS. · Normal mode : "Low" · Overcharge mode : "High"

## Absolute Maximum Ratings (Except where noted otherwise, Ta=25°C)

Item	Symbol	Ratings	Unit
Storage temperature range	T <sub>STG</sub>	-5~+125	°C
Operating temperature range	T <sub>OPR</sub>	-40~+110	°C
Supply voltage	V <sub>DDmax.</sub>	V <sub>SS</sub> -0.3~V <sub>SS</sub> +28	V
OV pin input voltage	V <sub>Omax.</sub>	V <sub>SS</sub> -0.3~V <sub>DD</sub> +0.3	V
Allowable loss	P <sub>d</sub>	150	mW

## Recommended Operating Conditions (Except where noted otherwise, Ta=25°C)

Item	Symbol	Ratings	Unit
Operating temperature range	T <sub>OPR</sub>	-40~+110	°C
Operating voltage range	V <sub>OPR</sub>	V <sub>SS</sub> +2.0~V <sub>SS</sub> +24	V

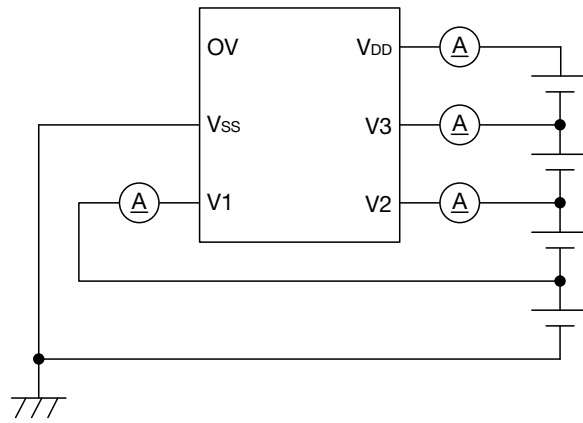
**Electrical Characteristics** (Except where noted otherwise, Ta=25°C, VCELL=3.5V)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit	Measuring Circuit
Consumption current 1	I <sub>DD1</sub>	V <sub>CELL</sub> =3.5V, I <sub>OUT</sub> =0mA		2.5	5	μA	A
Consumption current 2	I <sub>DD2</sub>	V <sub>CELL</sub> =2.3V, I <sub>OUT</sub> =0mA		2	4	μA	A
V3 pin input current	I <sub>V3</sub>	V <sub>CELL</sub> =3.5V	-300		300	nA	A
V2 pin input current	I <sub>V2</sub>	V <sub>CELL</sub> =3.5V	-300		300	nA	A
V1 pin input current	I <sub>V1</sub>	V <sub>CELL</sub> =3.5V	-300		300	nA	A
Overcharge detection voltage	V <sub>CELLU</sub>	Ta=0~+50°C *1 V <sub>CELL</sub> =3.5V→4.5V	4.320	4.350	4.380	V	B
Overcharge detection voltage	V <sub>CELLU</sub>	Ta=-40~+85°C *1 V <sub>CELL</sub> =3.5V→4.5V	4.300	4.350	4.400	V	B
Overcharge detection voltage	V <sub>CELLU</sub>	Ta=-40~+110°C *1 V <sub>CELL</sub> =3.5V→4.5V	4.270	4.350	4.430	V	B
Overcharge release voltage	V <sub>CELL0</sub>	V <sub>CELL</sub> =4.5V→3.5V	V <sub>CELLU</sub> 1.2V	V <sub>CELLU</sub> 1.0V	V <sub>CELLU</sub> 0.8V	V	B
Overcharge detection dead time	t <sub>OV</sub>	V <sub>CELL</sub> =3.5V→4.5V	7.0	10.0	13.0	s	B
0V pin source current	I <sub>SOOV</sub>	V <sub>CELL</sub> >V <sub>CELLU</sub> V <sub>OV</sub> =V <sub>IN</sub> -0.5V	20			μA	C
0V pin sink current	I <sub>SOV</sub>	V <sub>OV</sub> =0.5V Ta=-40~110°C *1	20			μA	C
0V pin output voltage H	V <sub>THOVH</sub>	V <sub>CELL</sub> >V <sub>CELLU</sub> V <sub>IN</sub> -V <sub>OV</sub> I <sub>SO</sub> =20μA			0.5	V	D
0V pin output voltage L	V <sub>THOVL</sub>	V <sub>OV</sub> -V <sub>SS</sub> I <sub>SO</sub> =-20μA Ta=-40~110°C *1			0.5	V	D
Voltage of delay time shortening	V <sub>DS</sub>	V <sub>CELL</sub> =6V→8V	6.0	7.0	8.0	V	B

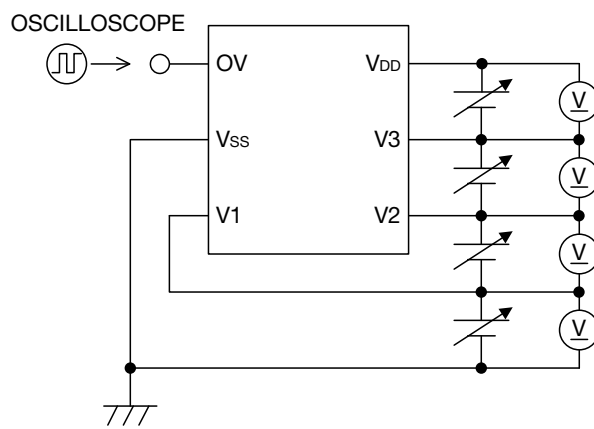
Note1: \*1 Guaranteed value

Measuring Circuit

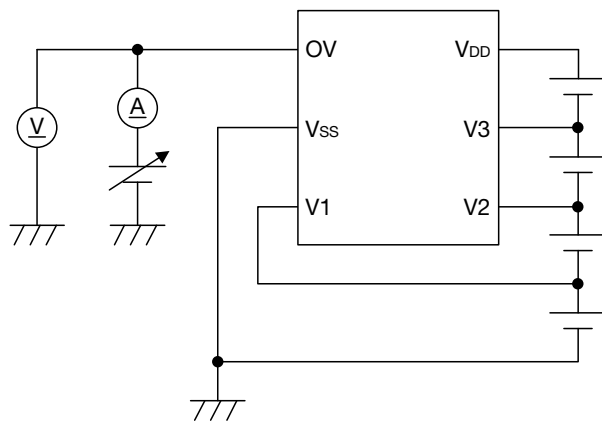
A.



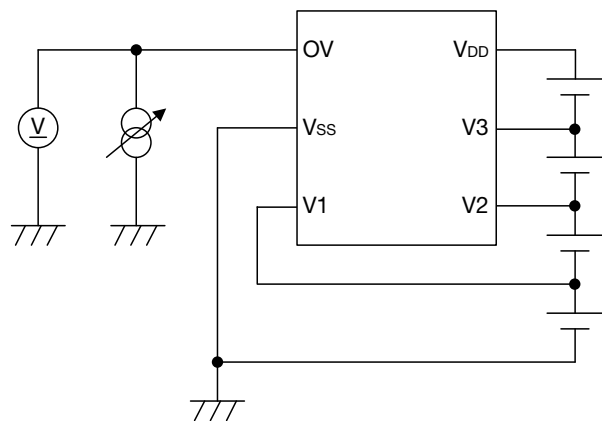
B.



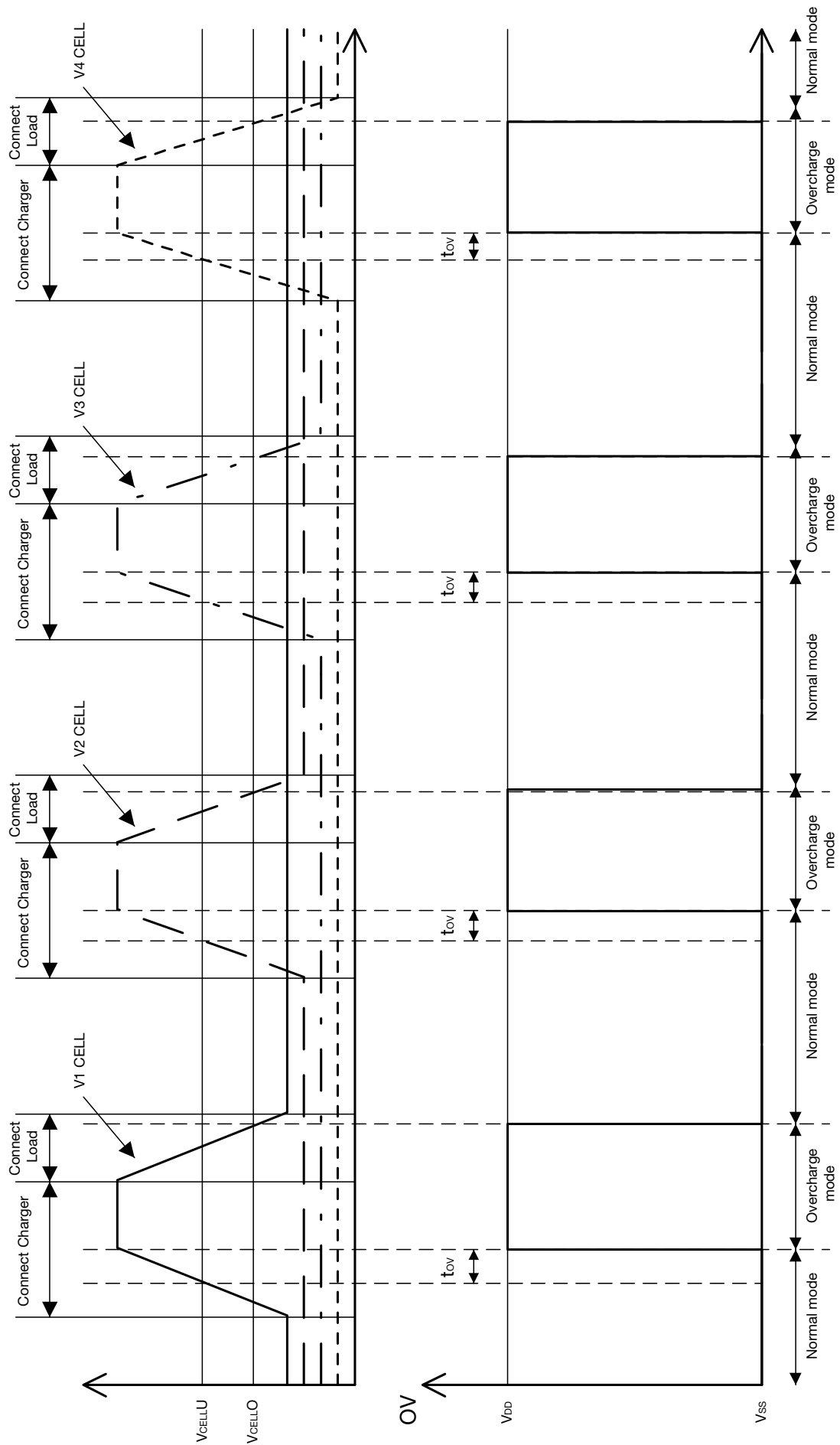
C.



D.

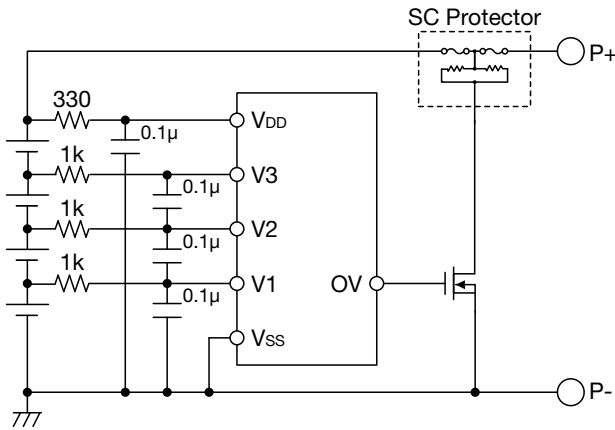


Timing Chart

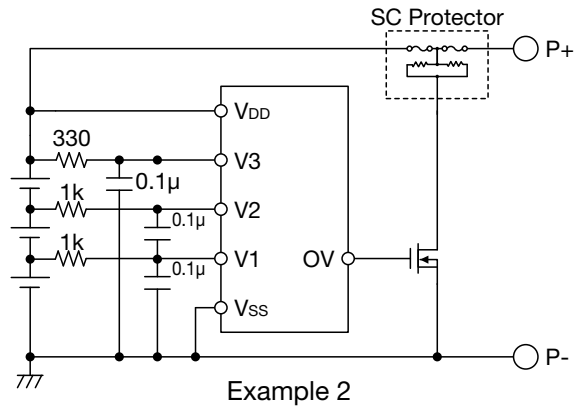
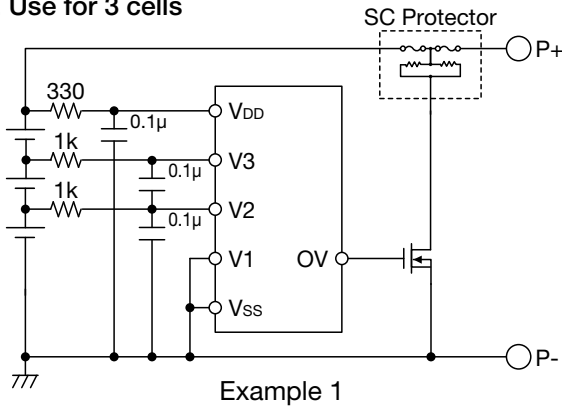


Application Circuit

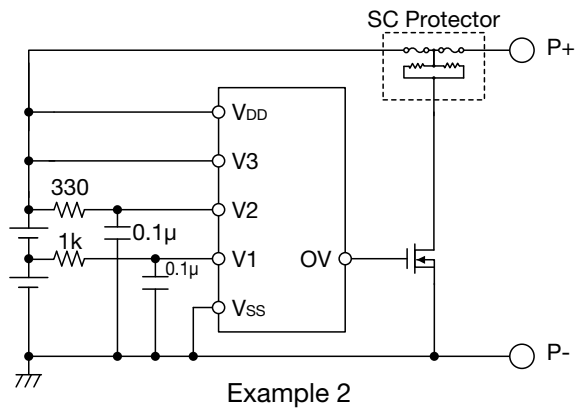
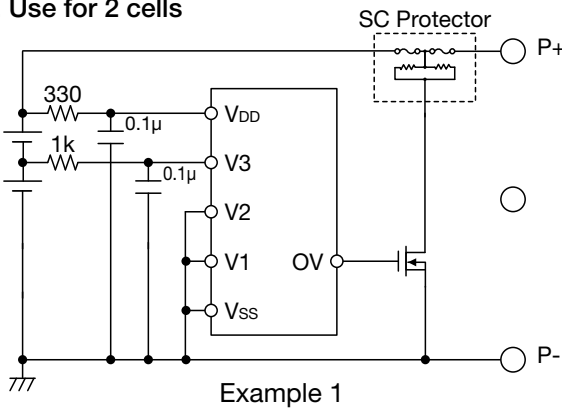
1. Use for 4 cells



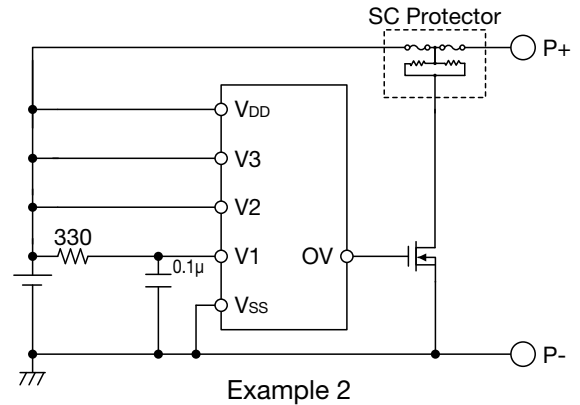
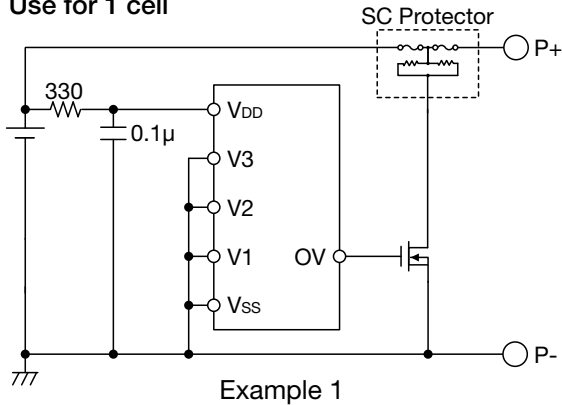
2. Use for 3 cells



3. Use for 2 cells



4. Use for 1 cell



When the battery is connected, OV and V<sub>SS</sub> are short-circuited by the jumper, and we recommend the method of removing the jumper that is short-circuited of OV and V<sub>SS</sub> when the connection of all cells is completed.

\* The fixed number is reference value.