

Protection for Lithium-Ion Batteries (2-serial cells) Monolithic IC MM3112 Series

Outline

This IC integrates overcharge/overdischarge protection functions for lithium-ion/lithium polymer rechargeable batteries and the regulator functions into one chip by high voltage CMOS process. It can be used with other gas gauge IC, security IC, etc. as it includes a regulator. Overcharge/overdischarge can be detected to protect 2-cell lithium-ion/lithium polymer batteries. Charge/discharge control is performed using two external Pch MOS FETs.

Features

- | | |
|--|--|
| 1. Overcharge detection voltage | Selectable between 4.0~4.5V by 5mV steps
Accuracy $\pm 25\text{mV}$ |
| 2. Overdischarge detection voltage | Selectable between 2.0~3.0V by 100mV steps
Accuracy $\pm 80\text{mV}$ |
| 3. No external capacitor for delay time required (delay time is set by the internal circuit) | |
| 4. Regulator output voltage | Selectable between 2.0~4.0V by 0.2V steps
Accuracy $\pm 3\%$ |
| 5. Regulator load current | 100mA max. |
| 6. Operating temperature range | -40~85°C |

Package

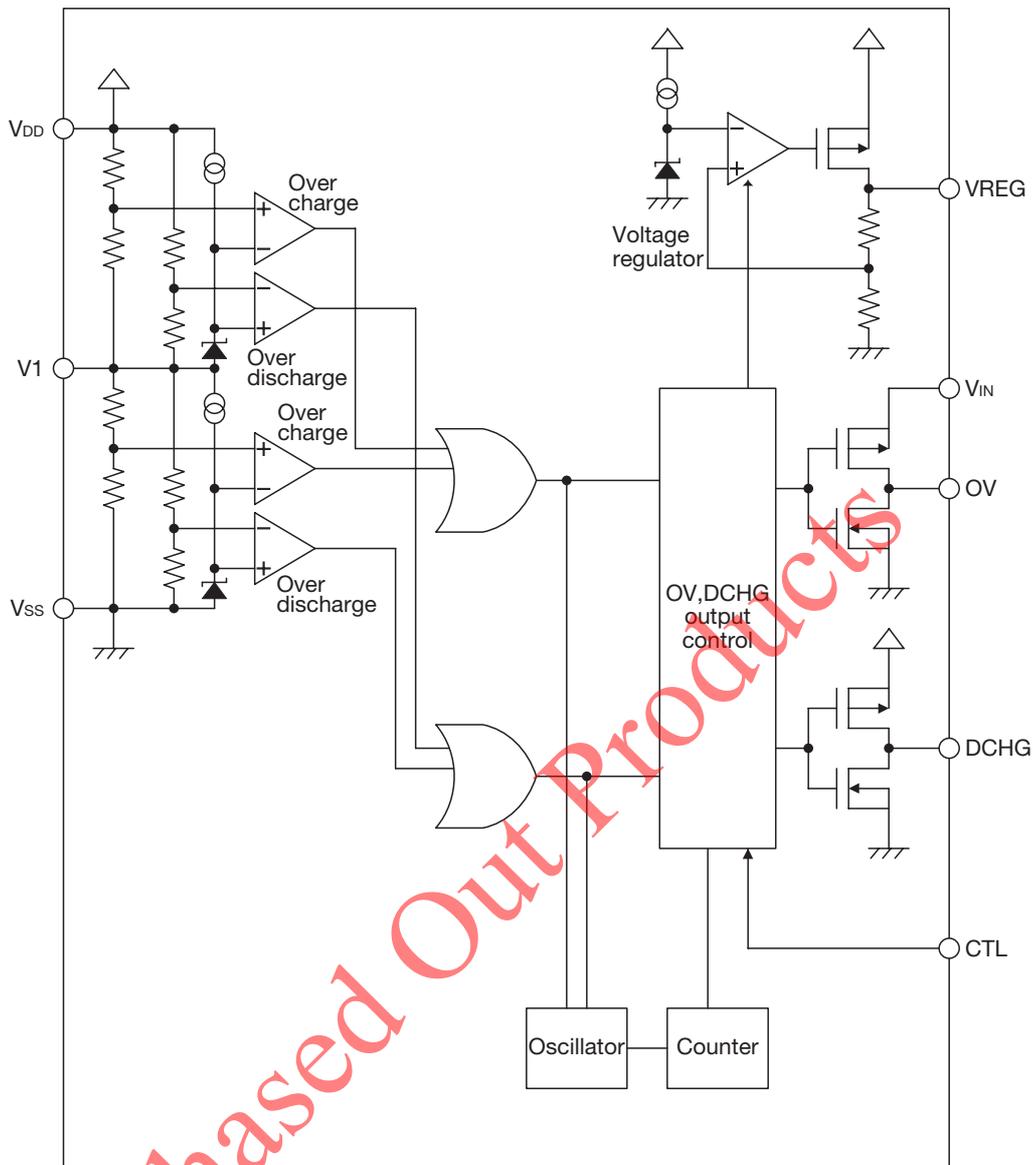
VSOP-10A

Applications

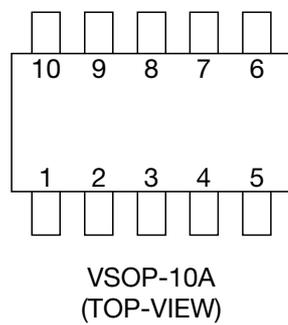
1. Lithium-ion battery pack (two cells).

Phased Out Products

Block Diagram



Pin Assignment



1	DCHG
2	V _{DD}
3	V ₁
4	V _{SS}
5	V _{SS}
6	V _{SS}
7	VREG
8	CTL
9	V _{IN}
10	OV

Pin Description

Pin No.	Symbol	I/O	Function
1	DCHG	Output	Output of over discharge detection. Output type is CMOS. · Normal mode : "Low" · Overdischarge mode : "High"
2	V _{DD}	Input	The input terminal of the power supply of IC, and the positive voltage of V2 cell.
3	V1	Input	The input terminal of the positive voltage of V1 cell, and the negative voltage of V2 cell .
4	V _{SS}	Input	The input terminal of the ground of IC, and the negative voltage of V1 cell.
5	V _{SS}	Input	The input terminal of the ground of IC, and the negative voltage of V1 cell.
6	V _{SS}	Input	The input terminal of the ground of IC, and the negative voltage of V1 cell.
7	VREG	Output	The output terminal of a voltage regulator. (3.3V) .
8	CTL	Input	The control terminal of FET for charge, and FET for discharge. · CTL= "Low" : DCHG= "Low" Normal mode : OV= "Low" Normal mode · CTL= "High" or "Open" : DCHG= "High" discharge prohibition : OV= "High" charge prohibition
9	V _{IN}	Input	The input terminal of the charger voltage.
10	OV	Output	Output of over charge detection. Output type is CMOS. · Normal mode : "Low" · Overcharge mode : "High"

Absolute Maximum Ratings (Ta=25°C)

Item	Symbol	Ratings	Units
Storage temperature	T _{STG}	-55~+125	°C
Operating temperature	T _{OPR}	-40~+85	°C
Supply voltage	V _{DD max.}	V _{SS} -0.3~V _{SS} +24	V
V _{IN} pin supply voltage	V _{VIN max.}	V _{SS} -0.3~V _{SS} +24	V
OV pin supply voltage	V _{OV max.}	V _{SS} -0.3~V _{IN} +24	V
DCHG pin supply voltage	V _{DCHG max.}	V _{SS} -0.3~V _{DD} +0.3	V
CTL pin supply voltage	V _{CTL max.}	V _{SS} -0.3~V _{DD} +0.3	V
Allowable loss	P _d	300	mW

Recommended Operating Conditions

Item	Symbol	Ratings	Units
Operating temperature	T _{OPR}	-40~+85	°C
Supply voltage	V _{OPR}	V _{SS} +2.0~V _{SS} +18	V

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

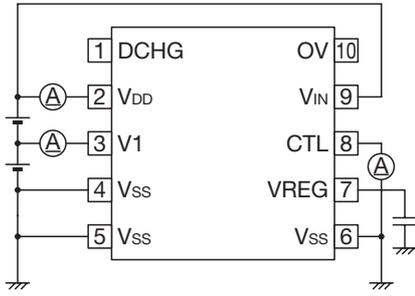
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units	Circuit *2
Consumption current	I _{DD}	V _{CELL} =3.5V, I _{OUT} =0mA		10	20	μA	A
Current consumption at stand-by	I _S	V _{CELL} =1.8V, I _{OUT} =0mA			0.1	μA	B
Pin5 (V1) input current	I _{V1}	V _{CELL} =3.5V			±300	nA	A
Overcharge detection voltage	V _{CELLU}	Ta=0~+50°C *1 V _{CELL} =3.5V→4.5V	4.325	4.35	4.375	V	C
Overcharge release voltage	V _{CELLO}	V _{CELL} =4.5V→3.5V	V _{CELLU} -260mV	V _{CELLU} -200mV	V _{CELLU} -140mV	V	C
Overcharge detection dead time	t _{OV}	V _{CELL} =3.5V→4.5V	50	100	150	ms	C
Overcharge release dead time	t _{OVREL}	V _{CELL} =4.5V→3.5V	10	20	40	ms	C
Overdischarge detection voltage	V _{CELLS}	V _{CELL} =3.5V→1.8V	2.22	2.3	2.38	V	D
Overdischarge release voltage	V _{CELLD}	V _{IN} =V _{DD} V _{CELL} =1.8V→3.5V	2.7	2.8	2.9	V	D
Overdischarge detection dead time	t _{DC}	V _{CELL} =3.5V→1.8V	15	30	45	ms	D
Overdischarge release dead time	t _{DCREL}	V _{CELL} =1.8V→3.5V	10	20	40	ms	D
Pin1 (DCHG) source current	I _{SO} DCH	V _{CELL} < V _{CELLS} V _{DCHG} =V _{DD} -0.5V	20			μA	E
Pin1 (DCHG) sink current	I _{SI} DCH	V _{DCHG} =0.5V	20			μA	F
Pin1 (DCHG) output voltage H	V _{TH} DCH	V _{CELL} < V _{CELLS} V _{DD} -V _{DCHG} I _{SO} =20μA			0.5	V	E
Pin1 (DCHG) output voltage L	V _{TH} DCL	V _{DCHG} -V _{SS} I _{SI} =-20μA			0.5	V	F
Pin10 (OV) source current	I _{SO} OV	V _{CELL} < V _{CELLU} V _{OV} =V _{IN} -0.5V	20			μA	G
Pin10 (OV) sink current	I _{SI} OV	V _{OV} =0.5V Ta=-40~85°C *1	20			μA	F
Pin10 (OV) output voltage H	V _{TH} OVH	V _{CELL} < V _{CELLU} V _{IN} -V _{OV} I _{SO} =20μA			0.5	V	G
Pin10 (OV) output voltage L	V _{TH} OVL	V _{OV} -V _{SS} I _{SI} =-20μA Ta=-40~85°C *1			0.5	V	F
Pin7 (CTL) High current	I _{CTLH}	V _{CELL} =3.5V, V _{CTL} =V _{DD}			0.1	μA	H
Pin7 (CTL) Low current	I _{CTLL}	V _{CELL} =3.5V, V _{CTL} =V _{SS}	-3	-1.7		μA	A
Pin7 (CTL) High voltage	V _{CTLH}		V _{DD} × 0.8			V	I
Pin7 (CTL) Low voltage	V _{CTLL}				0.5	V	I
Pin8 (VREG) output voltage	V _{OUT}	V _{CELL} =3.5V, I _{OUT} =1mA	3.221	3.300	3.379	V	J
Pin8 (VREG) line regulation	ΔV _{OUT1}	V _{CELL} =2.4V→6V, I _{OUT} =1mA		5	15	mV	J
Pin8 (VREG) load regulation	ΔV _{OUT2}	V _{CELL} =3.5V, I _{OUT} =1→20mA		40	80	mV	J

*1 : The parameter is guaranteed by design.

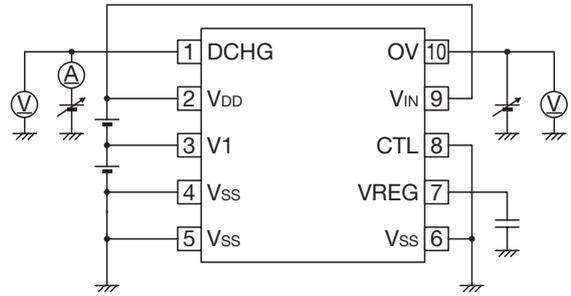
*2 : The test circuit symbols on next page.

Measuring Circuit

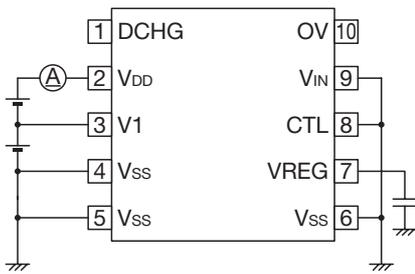
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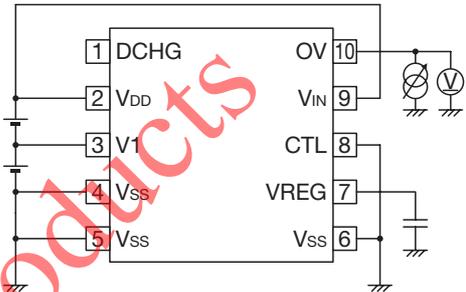
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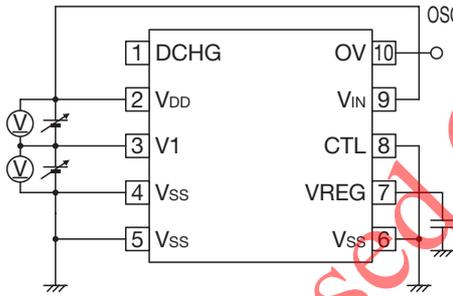
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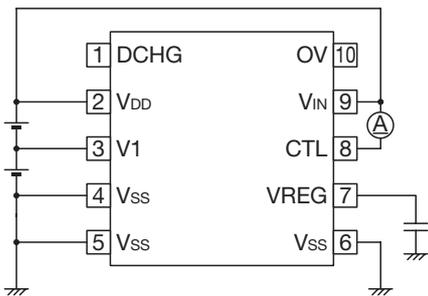
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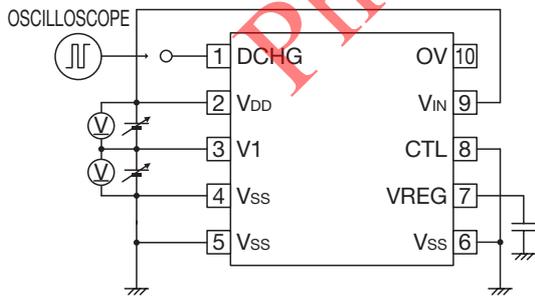
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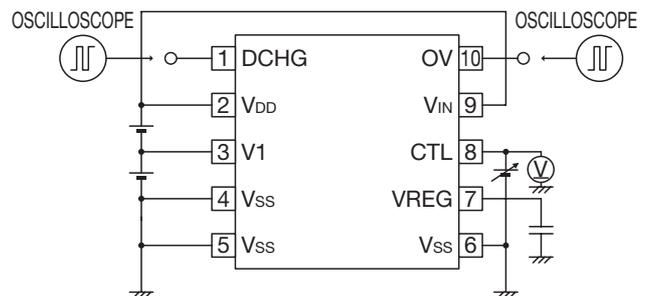
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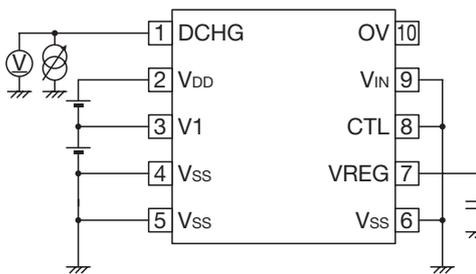
D



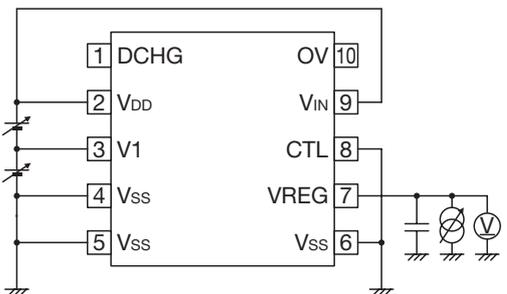
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E

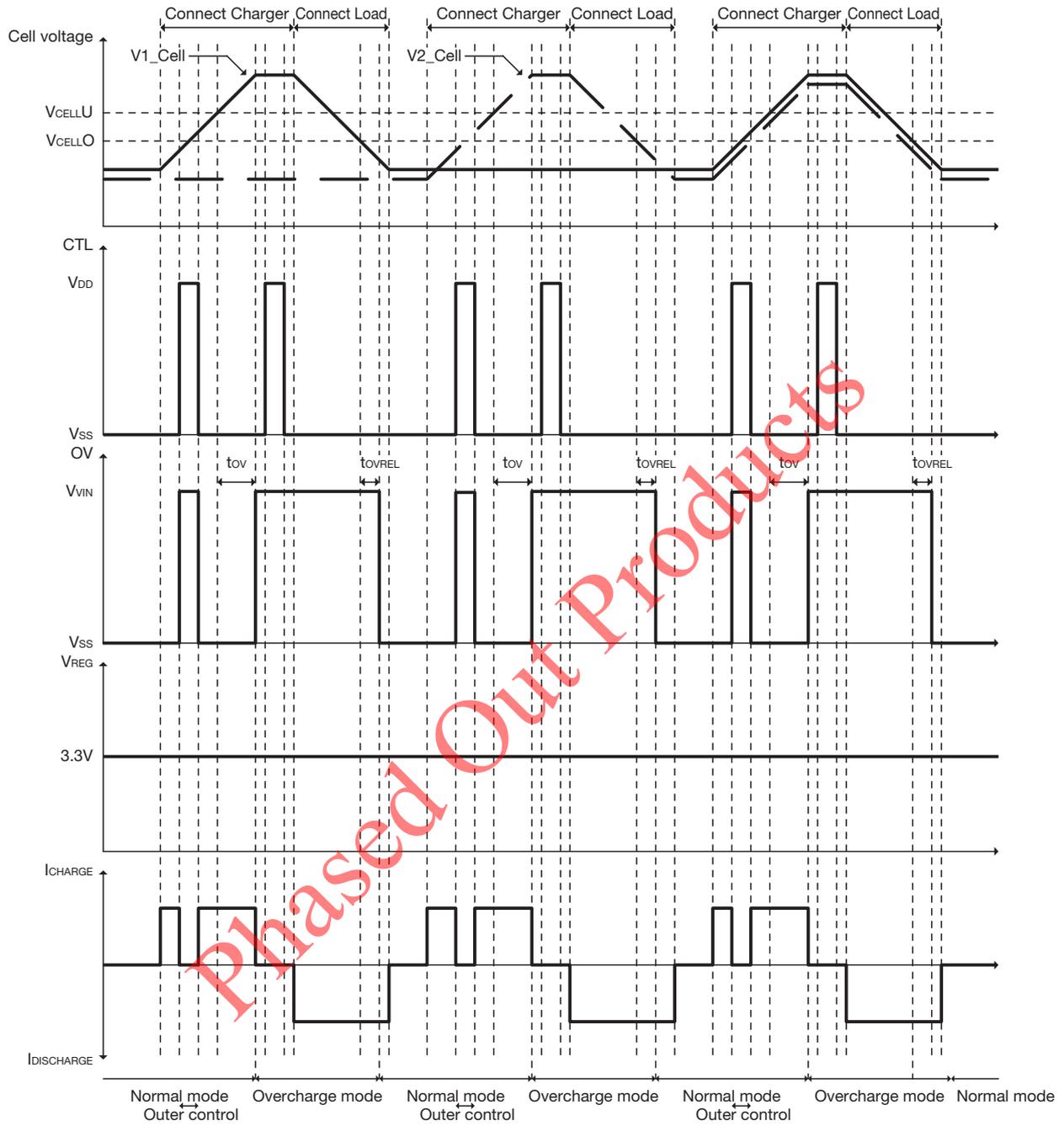


J

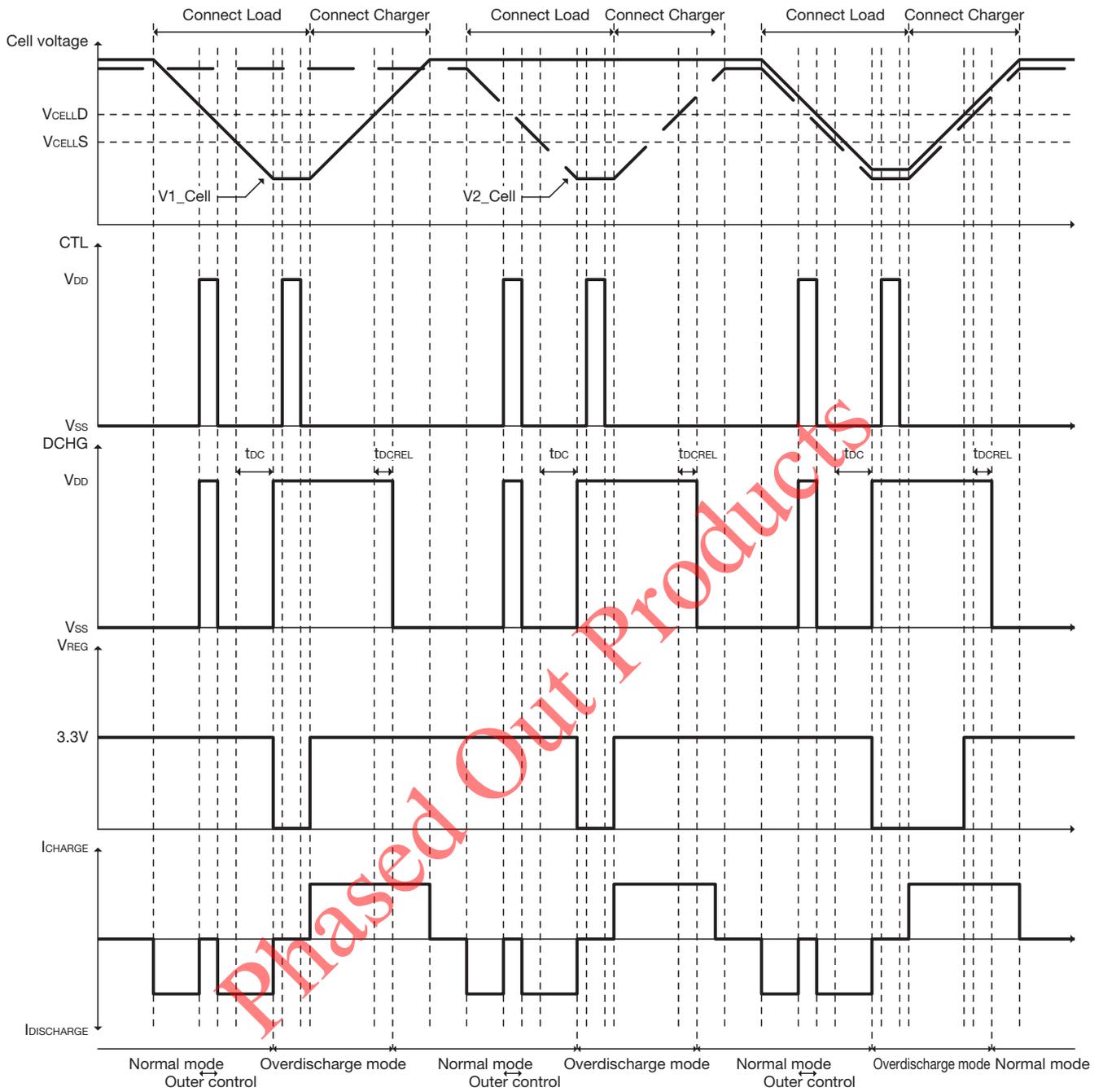


Timing chart

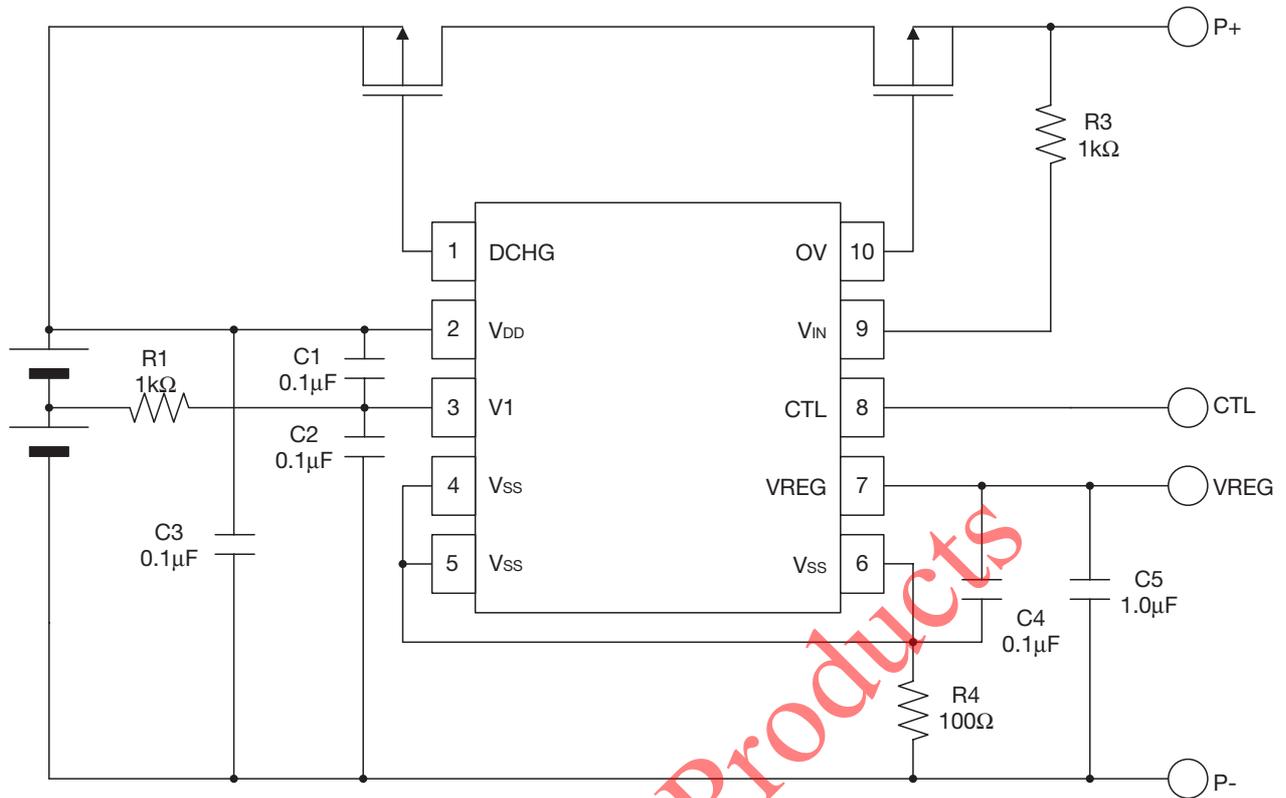
Overcharge Function



Overdischarge Function



Application Circuit



- These circuits are typical examples provided for reference purposes, so in actual applications, the circuit constants, conditions and operations should be thoroughly studied.
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