IP3036A

Single-Cell Li-ion Battery Protection IC with Integrated MOSFET

1 Features

- **High Precision Voltage Detection and Protection**
- **Overcharge Current Protection**
- **Discharge Overcurrent Protection**
- **Short Circuit Protection**
- **Protection of Battery Cell Reverse Connection (without external load)**
- **Built in Ultra-low on Resistance MOSFET**
  - ✧ $R_{SS(ON)}$=16.5mΩ（VDD=3.6V，I_{LOAD}=1A）
- **Ultra-small CPC8-5 Package**
- **Over-temperature Protection**
- **Charger Detection Function**
- **0V Battery Charging Permission**
- **Delay Times are Generated Inside**
- **Low Current Consumption**
  - ✧ Operation Mode: 3.6μA (typ.)
  - ✧ Power-down Mode: 1.8μA (typ.)
- **RoHS Certification (Environmental Compliance) and Lead-Free**

2 Applications

- **One-Cell Lithium-ion Battery Pack**
- **Lithium-Polymer Battery Pack**

3 Description

IP3036A is a high-precision single cell lithium-ion/lithium polymer battery protection chip, which is equipped with a power MOSFET with ultra-low on impedance, fully integrated with a delay circuit and high-precision detection and protection circuits for overcharge voltage, overdischarge voltage, overdischarge current, overcharge current, short circuit, etc.

IP3036A adopts a very small CPC8-5 package, providing an ideal solution for battery packs with limited space.

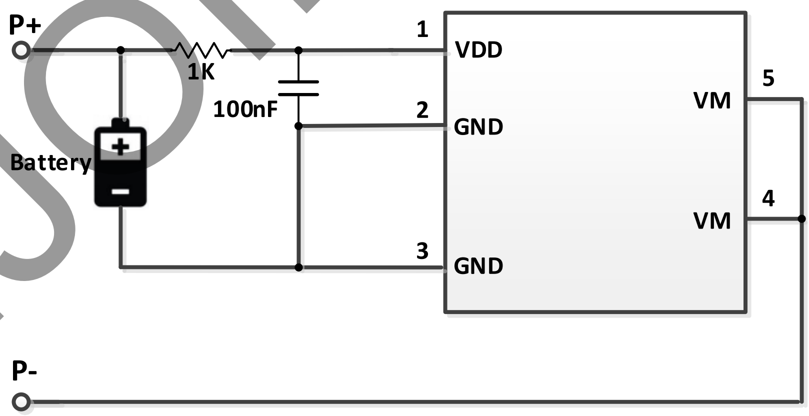


Figure 1 Brief application schematic

Contents

4 Reversion History

Note: The page numbers of previous versions may differ from those of the current version.

Initial version V1.00 (February 2025)	page number
● Initial release	1~20

V1.01 (April 2025)	page number
● Celsius unit modifications are displayed in the font "Time New Roman"	6,8
● Modify characteristics	1
● Modify the limit parameters	6

5 Pin Configuration And Function

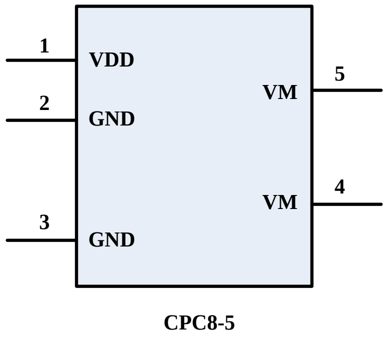


Figure 2 PIN Configuration(TOP View)

PIN NUMBER	PIN NAME	PIN DESCRIPTION
1	VDD	Power Supply,Connect the positive pole of the battery
2,3	GND	Ground,Connect the negative terminal of the battery to the power MOSFET inside the chip. (All GND must be connected, not floating)
4	VM	The negative terminal of the charger or load is connected to the power MOSFET inside the chip
5	VM	Connect to VM or floating

6 IP Comparison Table

Product Name	V_{OV}/V	V_{OVR} /V	V_{UV}/V	V_{UVR}/V	I_{DOC1}/A
IP3036A	4.30	4.10	2.40	3.00	6.5

Note: If you need products other than the above specifications, please contact our business department.

7 Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
VDD voltage range	VDD	-0.3 ~ 6	V
VM voltage range	VM	-6 ~ 10	V
Ambient Temperature	T_A	-40 ~ 85	℃
maximum junction temperature	T_{Jmax}	150	℃
Storage Temperature Range	T_{stg}	-55 ~ 150	℃
Thermal Resistance (Junction to Ambient)	θ_{JA}	110	℃/W
Thermal resistance (connected to the shell)	θ_{JC}	70	℃/W
ESD (Human Body Model)	ESD	2000	V

Stresses beyond these listed parameter may cause permanent damage to the device.Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.

8 Electrical Characteristics

Unless otherwise specified,VDD = 3.6V, typical value @T_A=25℃

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Detection voltage						
Overcharge protection voltage	V_{OV}		4.25	4.30	4.35	V
Overcharge release voltage	V_{OVR}		4.05	4.10	4.15	V
Overdischarge protection voltage	V_{UV}		2.30	2.40	2.50	V
Overdischarge release voltage	V_{UVR}		2.90	3.00	3.10	V
Detecting current						
Discharge overcurrent 1 protection current	*I_{DOC1}	V_{DD}=3.6V	5	6.5	8	A
Discharge overcurrent 2 protection current	*I_{DOC2}	V_{DD}=3.6V	10	20	30	A
Short circuit protection current	*I_{SC}	V_{DD}=3.6V	20	30	40	A
Charging overcurrent protection current	*I_{COC}	V_{DD}=3.6V	4.5	6	7.5	A
Detection delay						
Overcharge protection delay time	t_{OV}		50	90	130	ms
Overdischarge protection delay time	t_{UV}		20	30	40	ms
Discharge overcurrent 1 protection delay time	*t_{DOC1}	V_{DD}=3.6V	3	6	9	ms
Discharge overcurrent 2 protection delay time	*t_{DOC2}	V_{DD}=3.6V	2	4	6	ms
Discharge short-circuit protection delay time	*t_{SC}	V_{DD}=3.6V	80	130	180	μs
Charge overcurrent protection delay time	*t_{COC}	V_{DD}=3.6V	5	10	15	ms
power consumption						
Quiescent current(VDD current)	I_{OPE}	V_{DD}=3.6V，VM=0V		3.6	6	μA
Shut-down current(VDD current)	I_{PDN}	V_{DD}=2.0V，VM floating		1.8	4	μA

Over Temperature Protection						
Overtemperature protection temperature	$^*T_{SHD+}$			150		℃
Overtemperature release temperature	$^*T_{SHD-}$			110		℃
control system						
VM pull-up resistance	$^*R_{VMD}$	V_{DD}=2.0V，VM floating		300		kΩ
VM pull-down resistance	$^*R_{VMS}$	V_{DD}=3.6V，VM=1.0V		25		kΩ
0V allows charging charger voltage threshold	V_{0CHA}	VDD=0V, when the 0V battery allows charging	0.5	1.1	1.7	V
FET on-resistance						
MOSFET on-resistance	$^*R_{SS(ON)}$	V_{DD}=3.6V，I_{VM}=1.0A		16.5		mΩ

Note: * --- This parameter is guaranteed by design

9 Functional Block Diagram

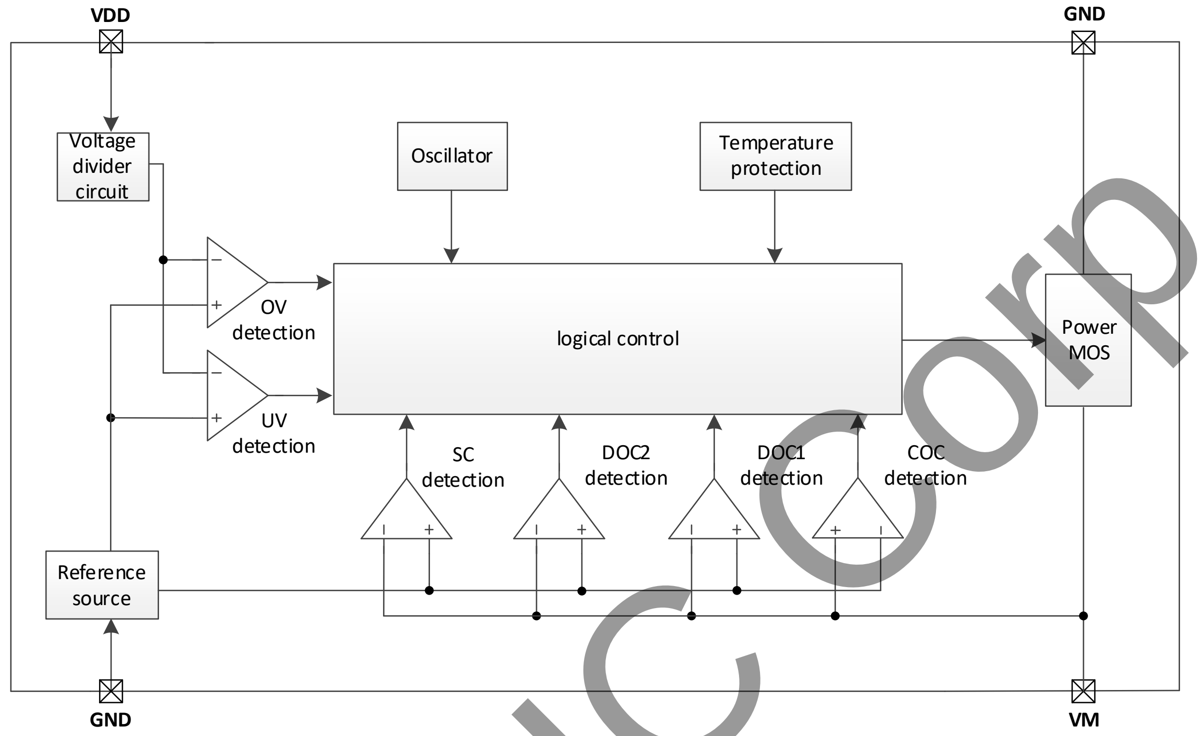


Figure 3 Internal functional structure diagram

10 Functional Description

10.1 Overcharge State

When the battery voltage exceeds V_{OV} and this condition persists beyond the overcharge protection delay (t_{OV}), the charge control switch is turned off to stop charging. This state is referred to as the overcharge state.

The overcharge state will be released when one of the following conditions is met:

(1) Automatic Release：VDD<$V_{OVR.}$

(2) Connect the load to discharge and VDD<V_{OV} (when connecting the load, due to the parallel diodes of the charging tube, the VM voltage increases to 0.7V, which is the forward conduction voltage drop of the diode); When VDD>V_{OV} and the load is connected, if the VM voltage is lower than the discharge overcurrent detection voltage, it will not release and return to a normal state.

Note: When VDD>V_{OV} and connected to overload, even if the VM voltage exceeds the discharge overcurrent protection voltage, the discharge overcurrent protection will not be triggered until VDD<V_{OV}; Due to the mΩ level internal resistance of actual batteries, heavy loads can cause a significant drop in battery voltage. When VDD<V_{OV}, discharge overcurrent protection can be triggered.

10.2 Overdischarge State

When the battery voltage is lower than V_{UV} and this state remains above the overdischarge protection delay (t_{UV}), the discharge control switch will be turned off to stop discharging, and this state is called overdischarge state. In the overdischarge state, the internal negative terminal detection terminal (VM) will be pulled up to VDD by R_{VMD}.

The overdischarge state will be released when one of the following conditions is met:

(1) Automatic Release：VDD>$V_{UVR.}$

(2) Charger connected & VDD>$V_{UV.}$

Note: During initial power-on, the IC may fail to enter normal operation mode. Short VM to ground or connect a charger to activate the normal state.

10.3 Discharge Overcurrent Condition

When the discharge current exceeds the preset threshold I_{DOCX} (x=1,2), and this state persists beyond the discharge overcurrent protection delay (t_{DOCX}), the discharge control switch is turned off to stop discharge. This state is defined as the discharge overcurrent condition. During this condition, the VM pin is pulled down to VSS via the resistor R_{VMS}.

Release method: Release the load to make the impedance between B+and B - (VM) higher than the automatic Release impedance. When the load is removed, due to the presence of the VM pull-down resistor, the VM voltage drops to GND and the IC returns to normal operation.

When the discharge current reaches the short-circuit detection current I_{SC} or above and remains above the short-circuit protection delay (t_{SC}), the discharge control switch will be immediately turned off to stop discharging and disconnect the battery from the load, entering the short-circuit protection state. In the short-circuit protection state, VM is pulled down to VSS by R_{VMS}. When the load is removed, due to the presence of the VM pull-down resistor, the VM voltage drops to GND, and the short-circuit protection state is released.

10.4 Charge Overcurrent Condition

When the charging current reaches the charging overcurrent detection current I_{COC} or above, if this state continues to remain above the charging overcurrent protection delay (t_{COC}), this state is called the charging overcurrent state. At this point, turn off the charging control switch and stop charging.

When in the charging overcurrent state, disconnect from the charger or add an external load. When the voltage at the VM terminal rises above the charging detection voltage, the charging overcurrent state can be released.

Due to the higher priority of 0V charging over overcurrent charging, overcurrent charging is not detected when the battery voltage is low enough to trigger the 0V charging function.

10.5 0V Battery Charging

Support charging batteries that have been discharged to 0V. When a charger with a voltage greater than 0V allows the charging charger voltage V_{0CHA} to be connected to P+and P -, the gate of the charging control FET of the IC is fixed at VDD voltage. When the gate source voltage of the charging FET is greater than the conduction voltage, the charging control switch opens, and the discharging control switch remains in the closed state. Charging is carried out through its parallel diode. When inserting charging, restore normal mode when the battery voltage is greater than the overdischarge detection voltage.

11 Timing Charts

11.1 Overcharge And OverDischarge Detection

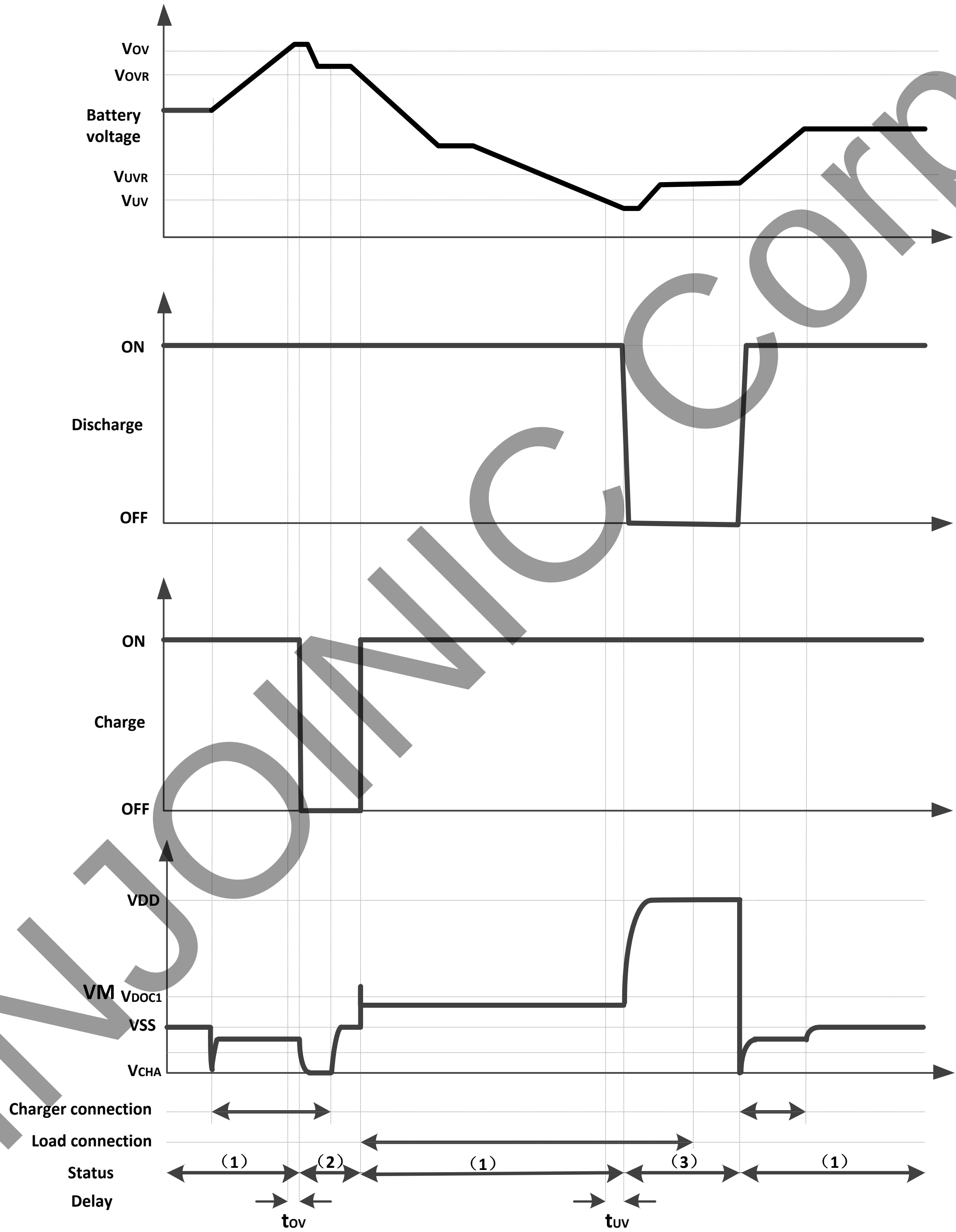


Figure 4 Overcharge and Overdischarge Detection

11.2 Discharge Overcurrent Detection

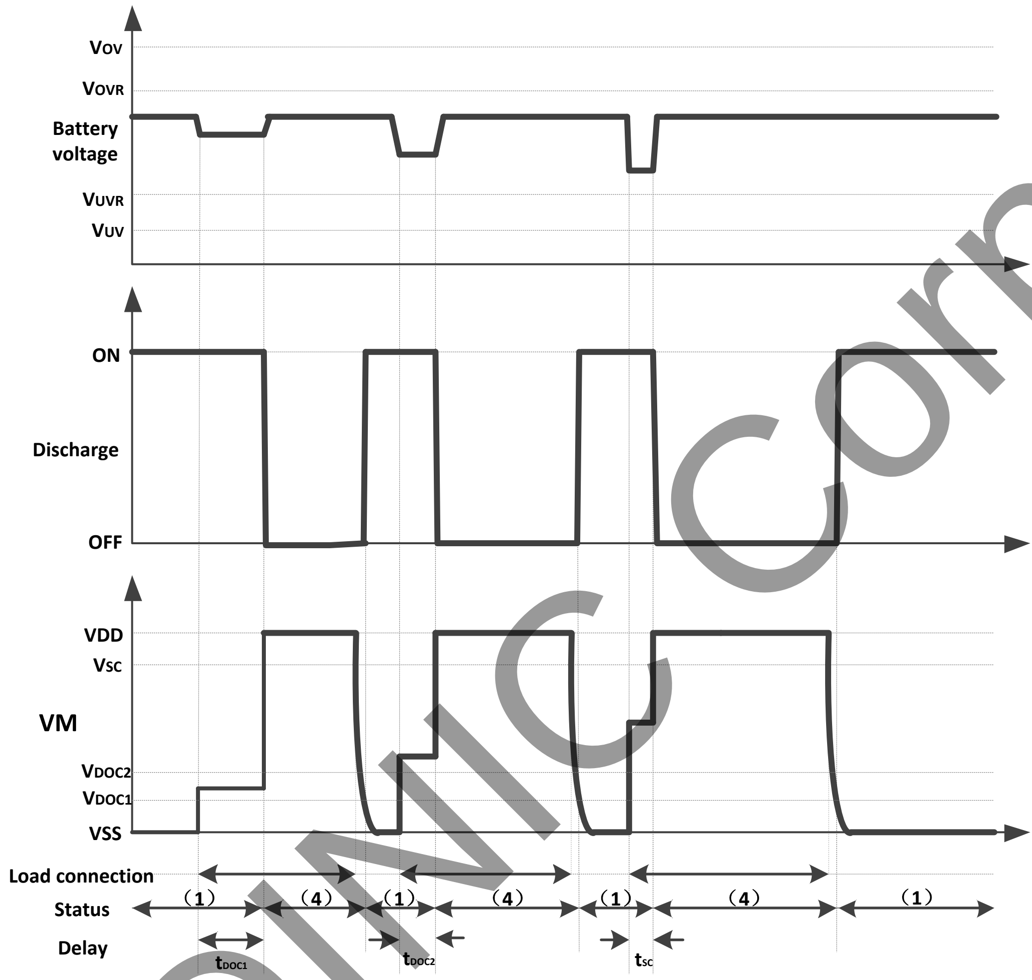


Figure 5 Discharge overcurrent detection

11.3 Charging Detection

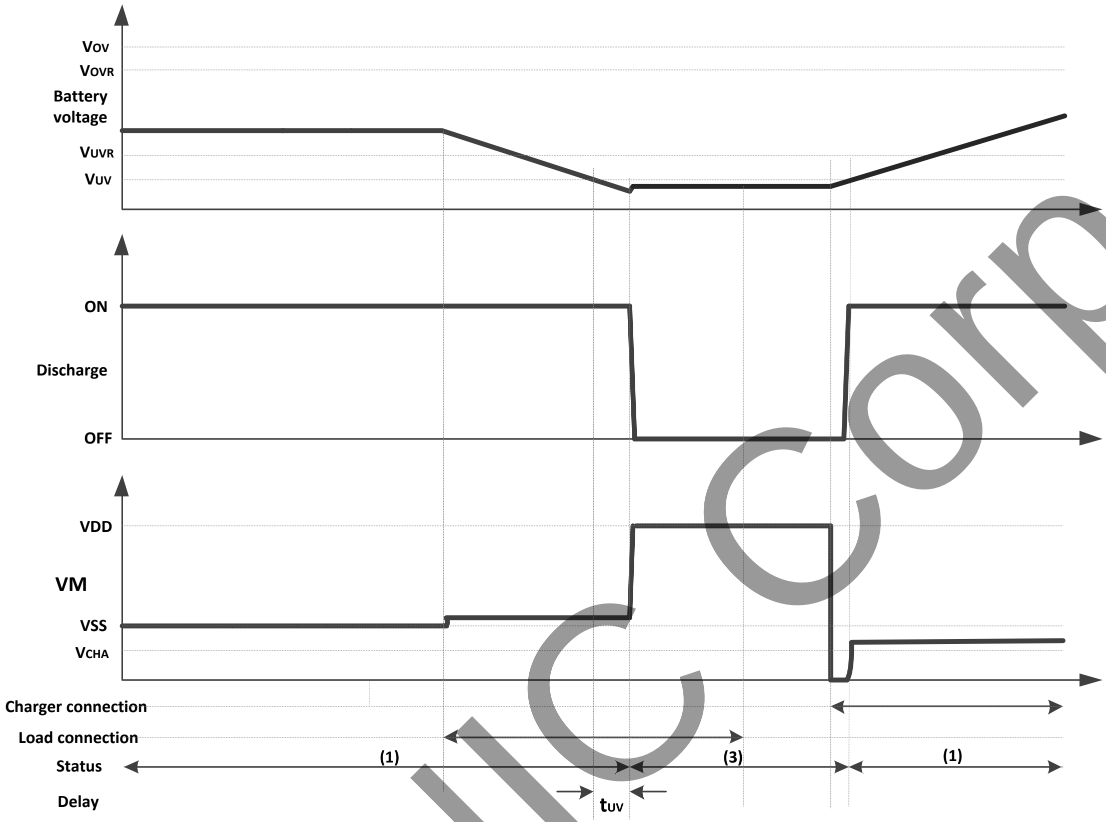


Figure 6 Charging detection

11.4 Charging Overcurrent Detection

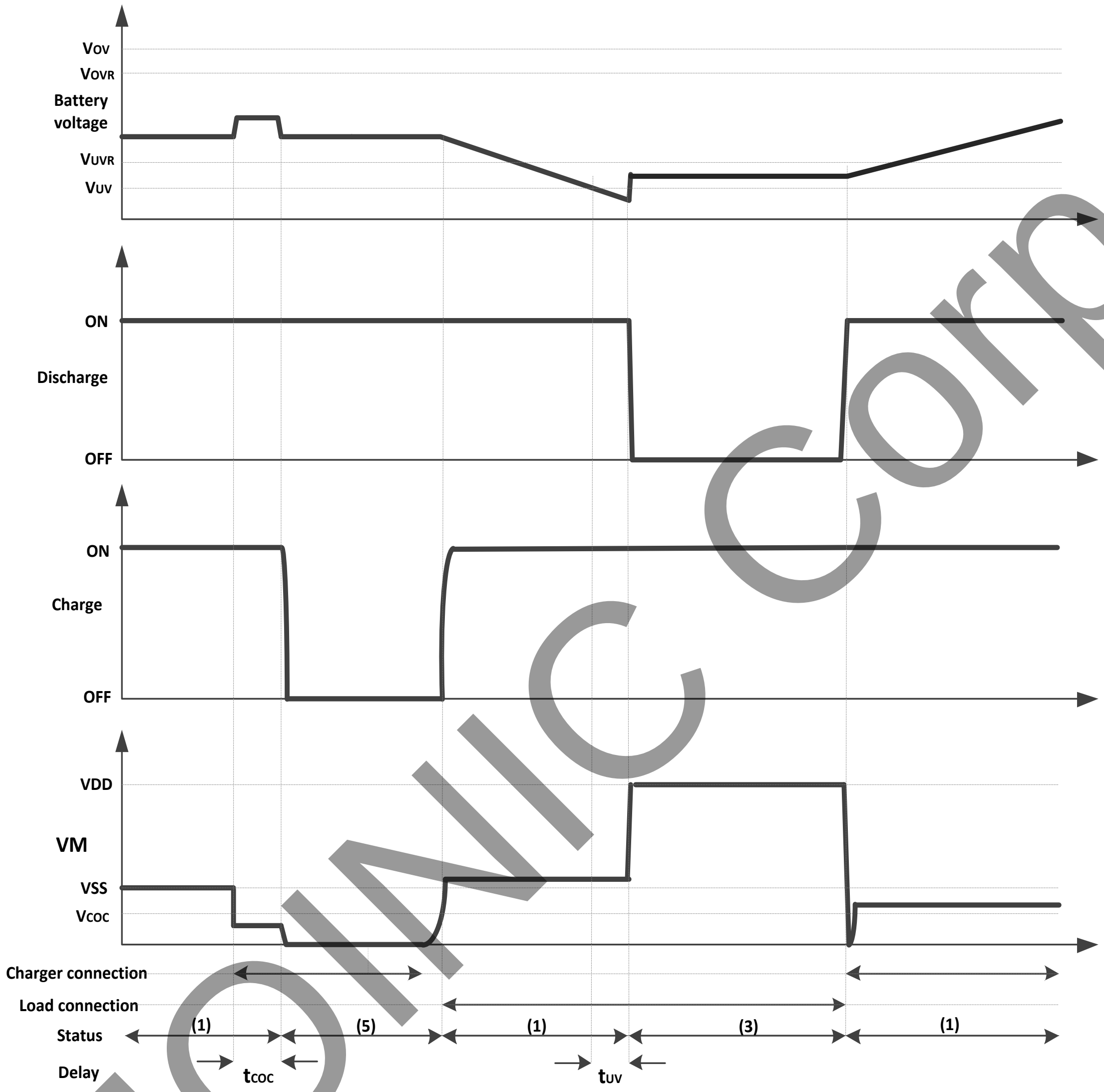


Figure 7 Charging overcurrent detection

Note:

(1) Normal working condition;
(2) Overcharged state;
(3) Overdischarge state;
(4) Discharge overcurrent state;
(5) Charging overcurrent status.

12 Typical Application Schematic

As shown in the typical application diagram of Figure 8, the thick line is the high current path of the chip, so it is necessary to ensure that the circuit is as short and the routing is as wide as possible to meet the considerations of power and heat generation; Please place capacitor C1 as close as possible to the IC.

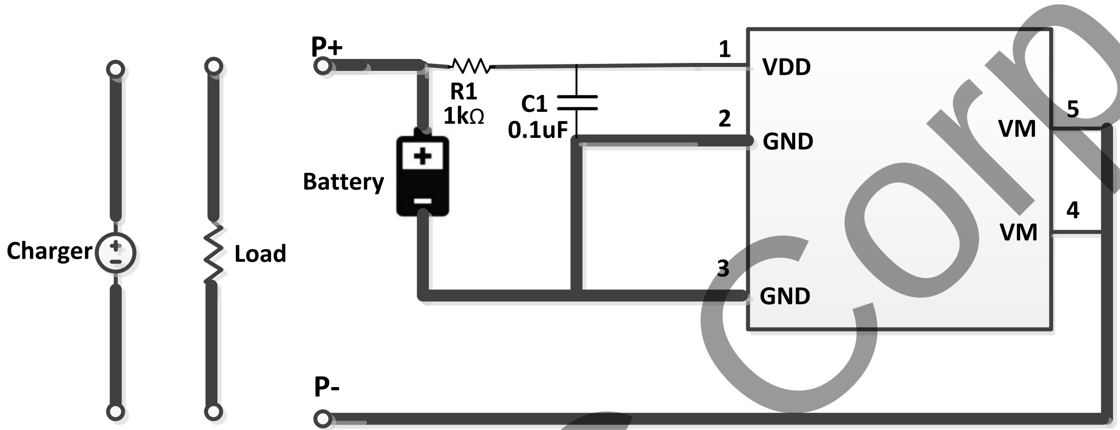


Figure 8 Typical Application Diagram

13 PACKAGE INFORMATION

Size Symbol	MIN(mm)	MAX(mm)	Size Symbol	MIN(mm)	MAX(mm)
A	2.50	2.70	b1	0.94	1.04
A1	0.35	0.45	C	0.85	1.05
e	1.20 (BSC)		C1	0.00	0.15
E1	0.53 (BSC)		C2	0.15	0.18
B	2.50	2.70	L	0.40	0.60
B1	3.90	4.10	θ	0°	8°
b	0.16	0.26			

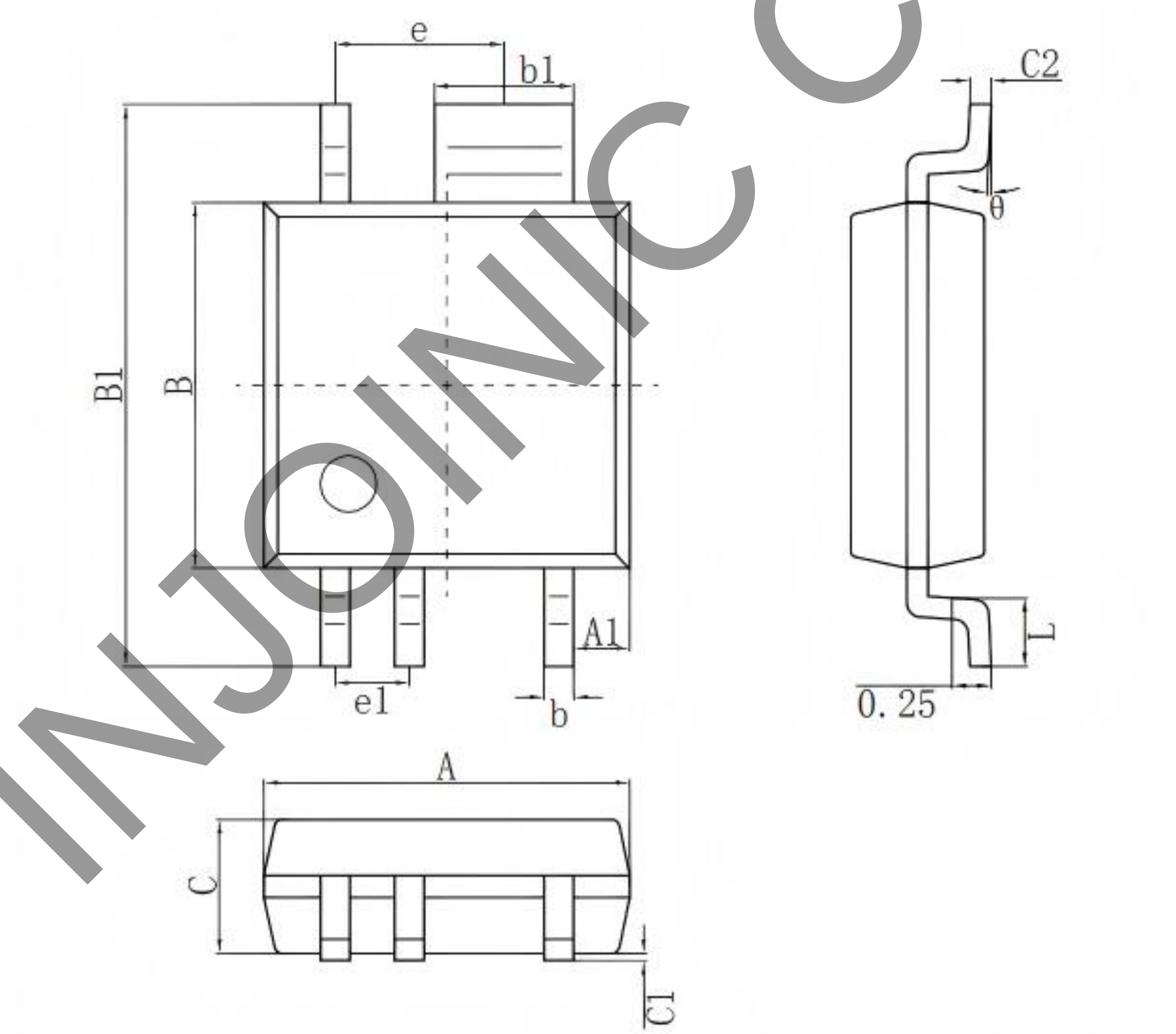


Figure 9 Outline dimension diagram of CPC8-5 package

14 LAND PATTERN LAYOUT EXAMPLE

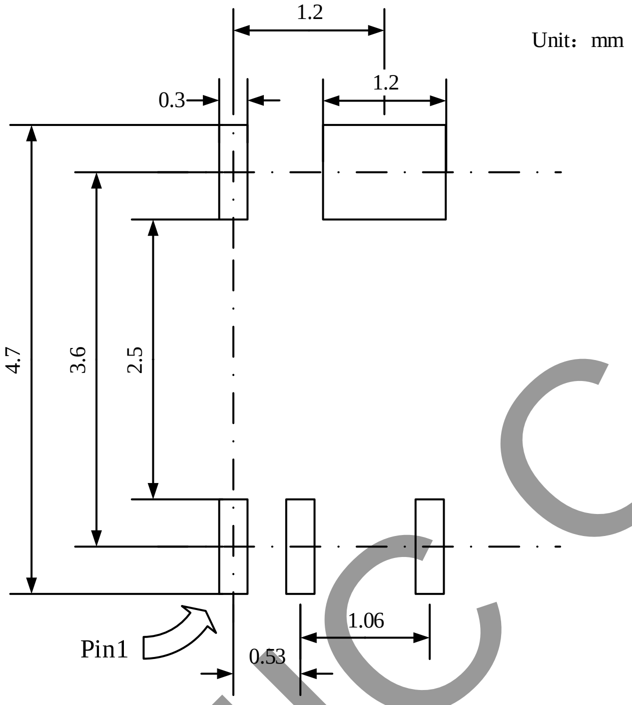
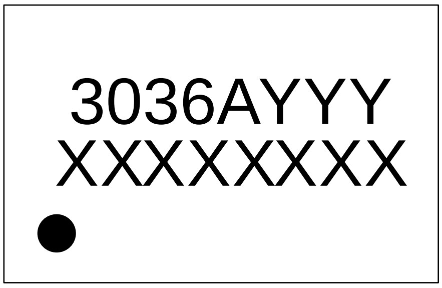


Figure 10 Land Pattern Layout Example

15 MARK DESCRIPTION



Note:

1. 3036A --Product model name IP3036A
2. YYY --Date of manufacture
3. XXXXXXXX --Batch number
4. ● --PIN1 foot position

Figure 11 Screen printing instructions

16 IMPORTANT NOTICE

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