One Cell Lithium-ion/Polymer Battery Protection IC

Description

DW03C has built-in high-precision voltage detection circuit and delay circuit, which can realize overcharge, overdischarge and overcurrentprotection of the batterybydetecting the voltage and current of the battery. The protection circuit is suitablefor a single ithium ion/lithium polymerrechargeable battery.

Features

- High Precision Voltage Detection Function:

1.Overcharge Protection Voltage	4.300V	Accuracy: ±25mV
2.Overcharge Release Voltage	4.100V	Accuracy: ±50mV
3.Overdischarge Protection Voltage	2.400V	Accuracy: ±100mV
4.Overdischarge Release Voltage	3.000V	Accuracy: ±100mV
5.Discharge OverCurrent Detection	3.6A	Accuracy: ±25%
6.Short Circuit Current Detection	12.0A	Accuracy: ±30%
7.Charging OverCurrent Detection	2.5A	Accuracy: ±25%

- Internal Detection Delay Time:：

1.Overcharge Protection Delay	1.0S	Accuracy: ±50%
2.Overdischarge Protection Delay	64mS	Accuracy: ±50%
3.Delay of Discharge Overcurrent	10mS	Accuracy: ±50%
4.Delay of Charge Overcurrent	10mS	Accuracy: ±50%

- Charger Detection and Load Detection Function
- Function of Charging 0V Battery — Allow
- Dormancy Function — No
- Conditions for Relieving Discharge Overcurrent — Disconnect The Load
- The Release Voltage of Discharge Overcurrent State — V_{RIOV}
- Low Current Consumption

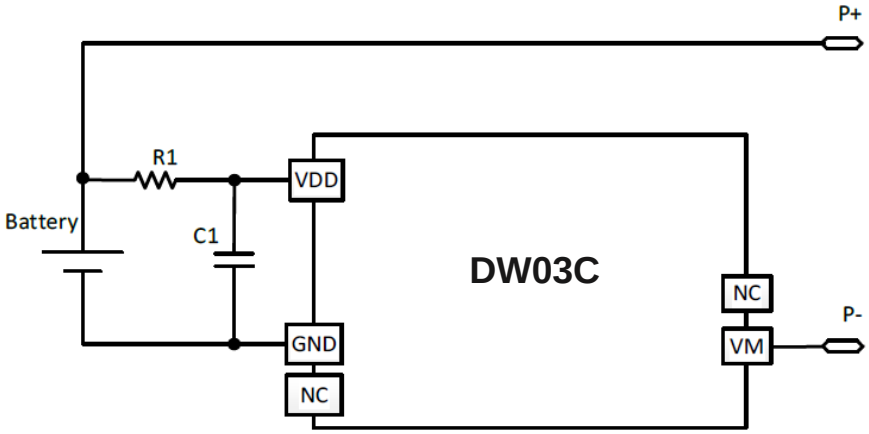
1. At Work	1.0μA(Typ.) (Ta=25°C)
2.Overdischarge	0.5μA(Typ.) (Ta=25°C)

- On-Resistance Ofinternal Power N-MOSFET: 60mΩ
- Lead-Free and Halogen-Free
- Operating Temperature Range: -40°C~+85°C
- Available Package: SOT-23-5

Applications

- Protection IC for One-Cell Lithium-Ion /Lithium-Polymer Battery Pack

Typical Application Circuit

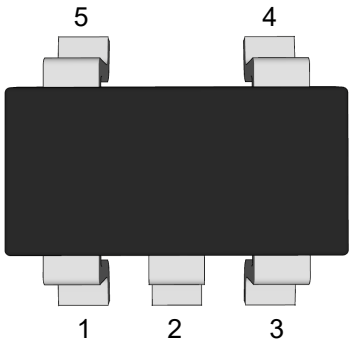


Device Identification	Min.	Typ.	Max.	Unit
R1	510	1000	1500	Ω
C1	0.047	0.1	0.22	μF

Note :
1. The above parameters may be changed without notice.
2. The schematic diagram and parameters of IC are notused asthe bass to ensure the circuit to work Please make fllmeasurement on the actual applcation crcuit before seting the parameters.

Pin Distribution

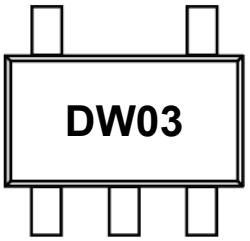
SOT-23-5



Functional Pin Description

Pin NO.	Symbol	Pin Description
1,5	NC	Not Connected
2	GND	Ground Pin
3	VDD	Power Supply
4	VM	The charging and discharging current detection terminal is linked with the charger load or the load

Ordering Information

Orderable Device	Package	Reel (inch)	Package Qty (PCS)	Eco Plan Note	MSL Level	Marking Code
DW03C	SOT-23-5	7	3000	RoHS & Green	MSL3	

Note:

RoHS：TN defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials.

Green：TN defines "Green" to mean Halogen-Free and Antimony-Free.

Product List

1.Detection Voltage Sheet

Device Name	$R_{DS(on)}$	Overcharge Protection Voltage V_{OC}	Overcharge Release Voltage V_{OCR}	Overdischarge Protection Voltage V_{OD}	Overdischarge Release Voltage V_{ODR}	Discharge OverCurrent Detection I_{DI}	Short Circuit Current Detection I_{SHORT}	Charging OverCurrent Detection I_{CI}
DW03C	33mΩ	4.300V	4.100V	2.400V	3.000V	3.6A	12A	2.5A

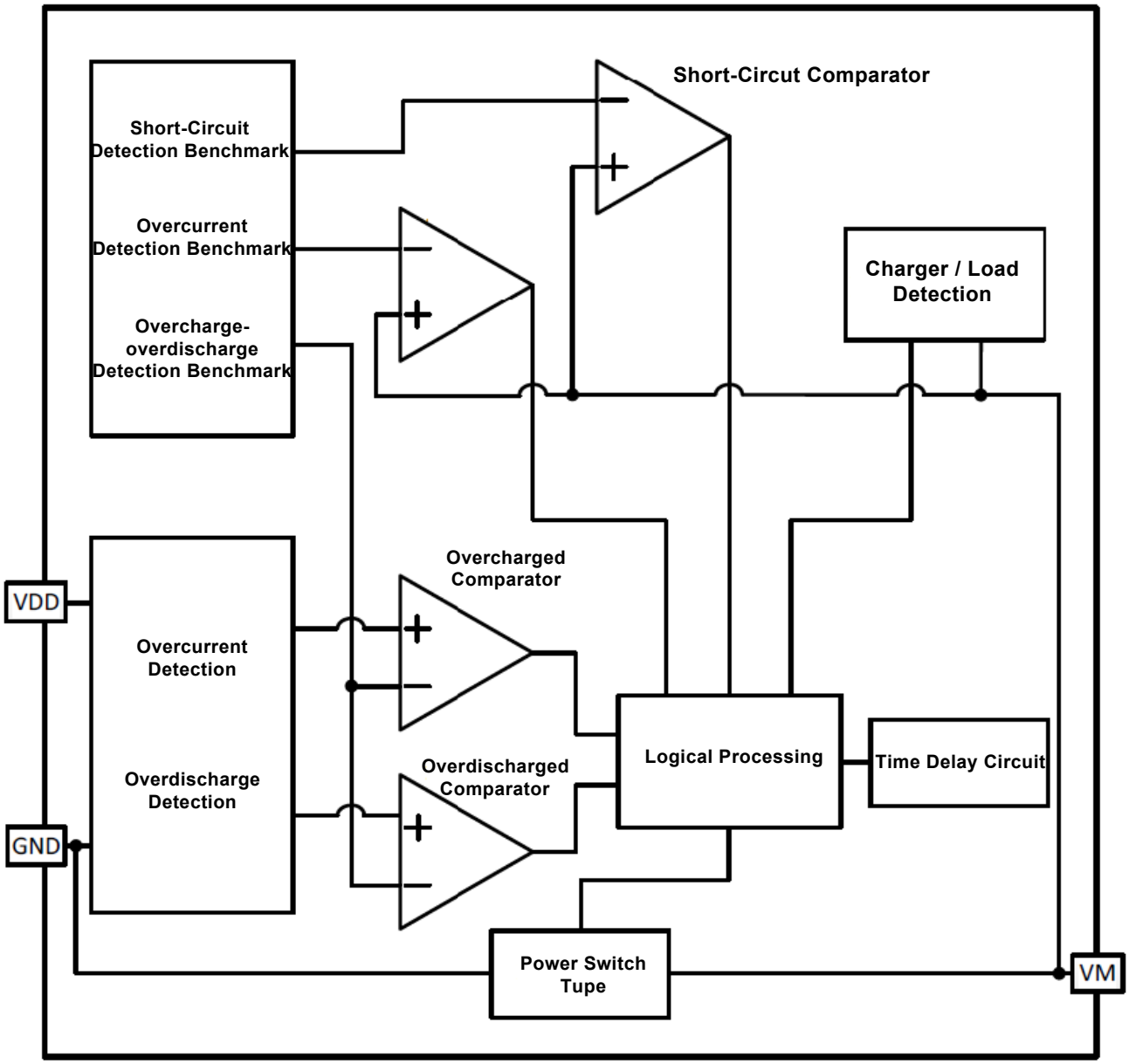
2.Product Function Sheet

Device Name	Function of Charging 0V Battery	The Release Condition of Discharge Overcurrent State	The Release Voltage of Discharge Overcurrent State	Overcharge Self-recovery Function	Dormancy Function
DW03C	Allow	断开负载	V_{RIOV}	有	无

3.Delay Time

Device Name	Overcharge Protection Delay T_{OC}	Overdischarge Protection Delay T_{OD}	Delay of Discharge Overcurrent T_{DI}	Delay of Charge Overcurrent T_{CI}	Short Circuit Delay T_{SHORT}
DW03C	1000ms	64ms	10ms	10ms	250μs

Block Diagram



Absolute Maximum Ratings Note

(T_A=25℃ , unless otherwise noted.)

Parameter	Symbol	Rating	Unit
Input Voltage Between VDD and GND	VDD	-0.3 ~6	V
VM Pin Outtput Voltage	V_{VM}	-6 ~10	V
Operating Ambient Temperature Range	T_{OPR}	-40 ~ 85	℃
Storage Temperature Range	T_{STG}	-55 ~ 125	℃
ESD(HBM State)	$V_{ESD(HBM)}$	4000	V

Note :
The applied voltage exceeds the absolute maximum rating, which may cause irreversible damage to the chip.

Electrical Characteristics

(T_A=25℃ , unless otherwise noted.)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Normal working current	I_{OPE}	VDD=3.6V, V_{VM}=0V	0.42	1.0	2.0	μA
Consume current during overdischarge	I_{OPED}	VDD=2.0V,V_{VM} floating	--	0.5	1.0	μA
Overcharge Protection Voltage	V_{OC}	VDD=3.5→4.8V	4.275	4.300	4.325	V
Overcharge Release Voltage	V_{OCR}	VDD=4.8→3.5V	4.050	4.100	4.150	V
Overdischarge Protection Voltage	V_{OD}	VDD=3.5→2.0V	2.300	2.400	2.500	V
Overdischarge Release Voltage	V_{ODR}	VDD=2.0→3.5V	2.900	3.000	3.100	V
Discharge Overcurrent Release Voltage	V_{RIOV}		VDD-1.2	VDD-0.8	VDD-0.5	V
Discharge OverCurrent Detection	I_{DI}	VDD=3.6V	2.7	3.6	4.5	A
Short Circuit Current Detection	I_{SHORT}	VDD=3.6V	8.4	12	15.6	A
Charging OverCurrent Detection	I_{CI}	VDD=3.6V	1.87	2.5	3.13	A
Overcharge Protection Delay	T_{OC}	VDD=3.5→4.8V	500	1000	1500	ms
Overdischarge Protection Delay	T_{OD}	VDD=3.5→2.0V	32	64	96	ms
Delay of Discharge Overcurrent	T_{DI}	VDD=3.6V	5	10	15	ms
Delay of Charge Overcurrent	T_{CI}	VDD=3.6V	5	10	15	ms
Short Circuit Delay	T_{SHORT}	VDD=3.6V	100	250	400	μs
Resistance Between VDD and VM	R_{CMD}	VDD=2V, V_{VM}=0V	750	1500	3000	kΩ
Resistance Between VDD and GND	R_{VMS}	VDD=3.6V, V_{VM}=1.0V	10	20	30	kΩ
On-Resistance Ofinternal Power N-MOSFET	$R_{SS(ON)}$	VDD=3.6V, I_{VM}=0.1A	--	60	--	mΩ
0V Charging, Charger Starting Voltage	V_{0CH}	Allow charging to 0V battery	0.0	1.5	2.0	V

Electrical Characteristics

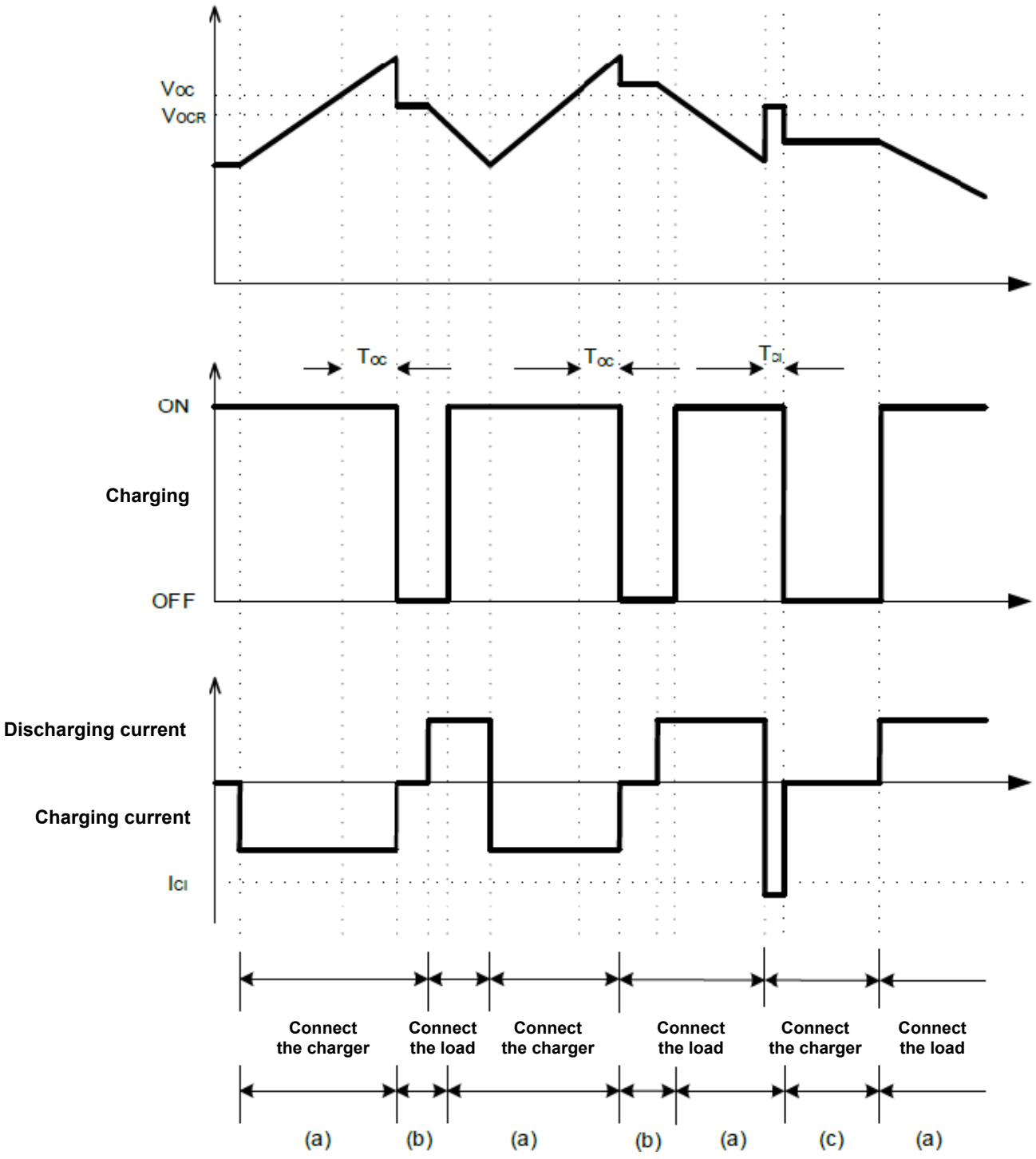
(T_A=20℃~60℃ , unless otherwise noted.)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Normal working current	I_{OPE}	VDD=3.6V, V_{VM}=0V	0.42	1.0	2.0	μA
Consume current during overdischarge	I_{OPED}	VDD=2.0V,V_{VM} floating	--	0.5	1.0	μA
Overcharge Protection Voltage	V_{OC}	VDD=3.5→4.8V	4.250	4.300	4.350	V
Overcharge Release Voltage	V_{OCR}	VDD=4.8→3.5V	4.000	4.100	4.200	V
Overdischarge Protection Voltage	V_{OD}	VDD=3.5→2.0V	2.200	2.400	2.600	V
Overdischarge Release Voltage	V_{ODR}	VDD=2.0→3.5V	2.800	3.000	3.200	V
Discharge Overcurrent Release Voltage	V_{RIOV}		VDD-1.3	VDD-0.8	VDD-0.4	V
Discharge OverCurrent Detection	I_{DI}	VDD=3.6V	1.8	3.6	5.4	A
Charging OverCurrent Detection	I_{CI}	VDD=3.6V	1.25	2.5	3.75	A
Overcharge Protection Delay	T_{OC}	VDD=3.5→4.8V	300	1000	1700	ms
Overdischarge Protection Delay	T_{OD}	VDD=3.5→2.0V	19.2	64	108.8	ms
Delay of Discharge Overcurrent	T_{DI}	VDD=3.6V	3	10	17	ms
Delay of Charge Overcurrent	T_{CI}	VDD=3.6V	3	10	17	ms
Short Circuit Delay	T_{SHORT}	VDD=3.6V	75	250	500	μs
Resistance Between VDD and VM	R_{CMD}	VDD=2V, V_{VM}=0V	500	1500	6000	kΩ
Resistance Between VDD and GND	R_{VMS}	VDD=3.6V, V_{VM}=1.0V	7	20	40	kΩ
On-Resistance Ofinternal Power N-MOSFET	$R_{SS(ON)}$	VDD=3.6V, I_{VM}=0.1A	--	60	--	mΩ
0V Charging, Charger Starting Voltage	V_{0CH}	Allow charging to 0V battery	0.0	1.5	2.5	V

Note :
The scieenine is not caried out under the conditions of hig temperature and low temperature,so only the inital votape of the esign specs in this temperature rane is guaranteed

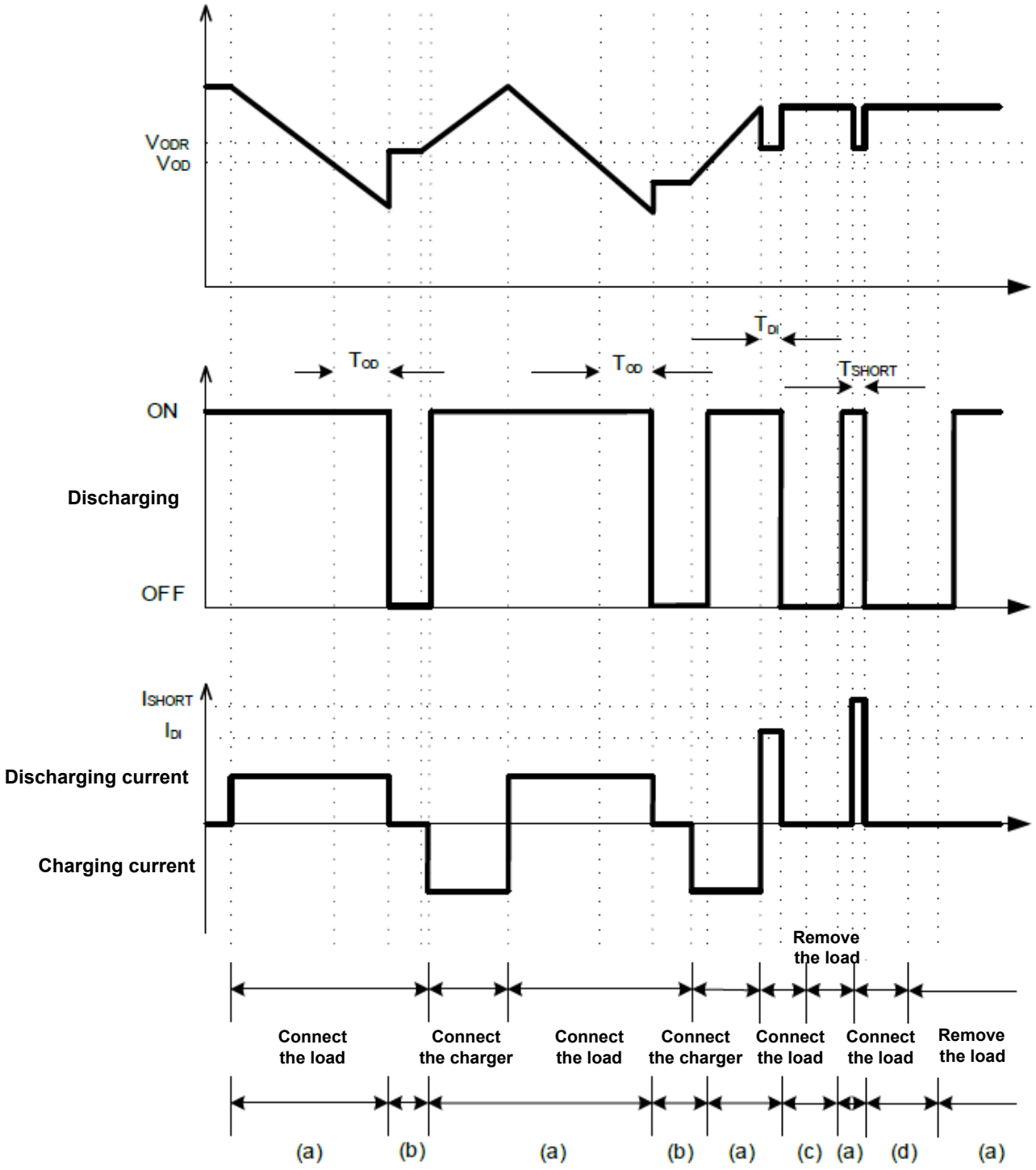
Sequence Chart

1、Overcharge protection and over-current protection



(a) Normal operating state
(b) Overcharged state
(c) charging overcurrent state

2、Overdischarge protection and discharge overcurrent protection



(a) Normal working state
(b) Overdischarge state
(c) Discharge overcurrent state
(d) load short-circuit state

Function Description

1. Normal Operating State

This IC continuously detects the battery voltage connected between the VDD and GND terminals, as well as the current flowing between the VM and GND terminals, to control charge and discharge. When the battery voltage is above the overdischarge protection voltage (V_{OD}) and below the overcharge protection voltage (V_{OC}), and the current flowing through the VM terminal to GND is between the charge overcurrent protection threshold (I_{CI}) and discharge overcurrent protection threshold (I_{DI}), the internal MOSFET of the IC is switched on. This state is called "normal working state". In this state, the MOSFET can be charged and discharged normally.

2. Overcharge State

When during the charging process under normal conditions, when the battery voltage is higher than the overcharge detection voltage (V_{OC}), and the duration reaches the overcharge voltage detection delay time (T_{OC}) or longer, the internal MOSFETof IC will turn off and stop charging, this situation is called overcharge voltage protection. The overcharge state can be lifted under the following two conditions:

(1). VM<V_{LD}, when the battery voltage is lowered below the overcharge release voltage (V_{OCR}), the overcharge state will be released.

(2). VM>V_{LD}， when the battery voltage is reduced to the overcharge protection voltage (V_{OC}) below, the overcharge state is lifted and returned to the normal working state, this function is called the load detection function.

Here (V_{LD}) =I_{DI}*$R_{SS(ON)}$, is the load detection voltage set inside the IC.

3. Overdischarge State

After the battery voltage drops below V_{OD} and the well continues T_{OD} for a period of time, the internal MOSFETof IC will turn off and stop discharging, which is called the overdischarge state. When the MOSFET inside the IC is turned off, the VM will be pulled up to VDD by the internal pull-up resistor R_{VMD}, and the IC power consumption will be reduced to I_{OPED}.

After entering the overdischarge state, to remove the overdischarge state and return to the normal state, there are several situations:

(1) Connect the charger, if VM<0V(typical value), when the battery voltage is higher than the overdischarge protection voltage (VOD), the overdischarge state is lifted and restored to the normal working state, this function is called the charger detection function.

(2) Connect the charger, if VM>0V(typical value), when the battery voltage is higher than the overdischarge release voltage (V_{ODR}), the overdischarge state is lifted and restored to the normal working state.

(3) When the charger is not connected, when the battery voltage is higher than the overdischarge release voltage (V_{ODR}), the overdischarge state is released and returned to the normal working state, that is, "no sleep function".

4. Discharge Overcurrent State

In the normal working state of the battery, the IC continuously detects the discharge current through the VM terminal voltage. If the discharge current exceeds the discharge current Limiting value (I_{DI}), and this state lasts longer than the discharge overcurrent Protection Delay time (T_{DI}), the internal MOSFETof IC will turn off and stop discharging. This state is called the discharge overcurrent state. If the discharge current exceeds the short-circuit protection current value, and this state lasts longer than the load short-circuit protection delay time (T_{SHORT}), the MOSFET inside the IC will turn off and stop discharging. This state is called the "load short-circuit state.

Discharge overcurrent state release condition "disconnect load" and discharge overcurrent state release voltage "V_{RIOV}"

In the discharge overcurrent state, the VM terminal inside the chip and the GND terminal can be connected through the R_{VMS} resistor. However, during the connection to the load, the VM terminal voltage changes to the VDD terminal voltage due to the connection to the load. If the connection to the load is disconnected, the VM terminal reverts to the GND terminal voltage. When the VM terminal voltage drops below V_{RIOV}, the discharge overcurrent state can be lifted.

5. Charge Overcurrent Protection

For a battery in normal working condition, if the current value flowing through GND to VM exceeds the charge overcurrent protection value (I_{CI}) during charging, and the state lasts longer than the charge overcurrent protection Delay time (T_{CI}), the internal MOSFETof IC will turn off and stop charging. This state is called charging overcurrent state. After entering the state of charge overcurrent detection, if disconnect the charger to make the flow through GND to When the current of the VM terminal is lower than the overcurrent protection value (I_{CI}), the charging overcurrent state is removed and returned to the normal working state.

6. Charging Function to 0V Battery(Allowed)

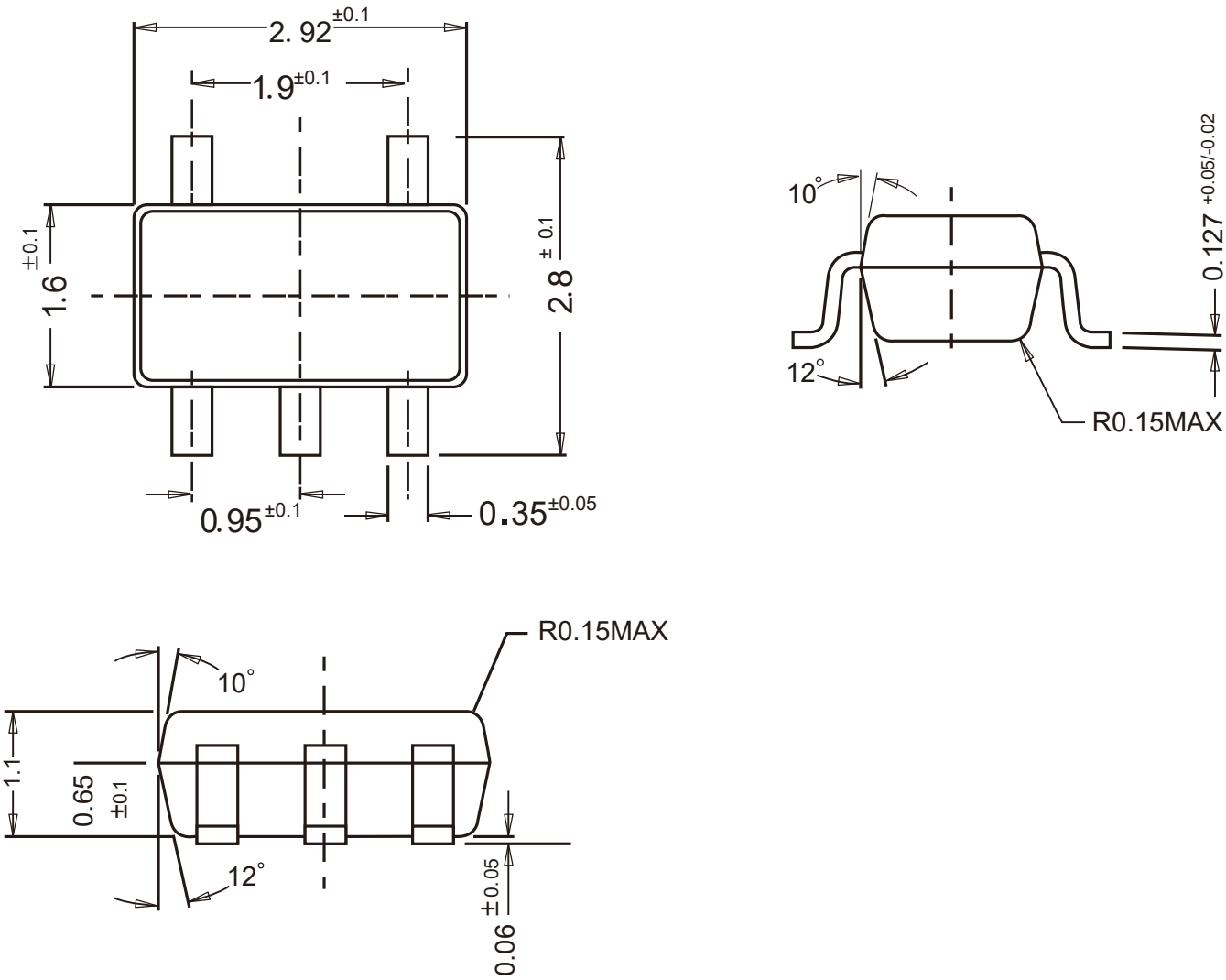
This function is used to recharge the battery that has self-discharged to 0V. When the charger voltage connected between the positive battery (P+) and the negative battery (P-) is higher than the charger starting voltage (V_{0CH}) to charge the 0V battery, the IC internal charge control MOSFET will switch on and start charging. When the battery voltage is higher than the overdischarge protection voltage (V_{OD}), the IC enters the normal working state.

Note: Please ask the battery supplier to confirm whether the purchased battery has the "allow charging to the 0V battery" function or the "do not charge to the 0V battery" function".

Package Outline

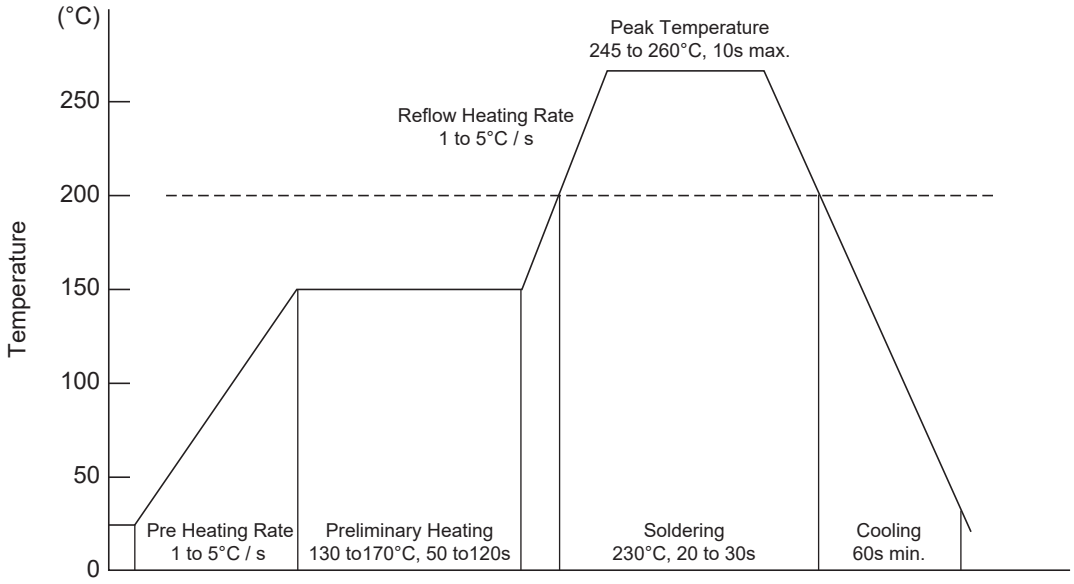
SOT-23-5

Dimensions in mm



Conditions of Soldering and Storage

◆ Recommended condition of reflow soldering



Recommended peak temperature is over 245°C. If peak temperature is below 245°C, you may adjust the following parameters:

- Time length of peak temperature (longer)
- Time length of soldering (longer)
- Thickness of solder paste (thicker)

◆ Conditions of hand soldering

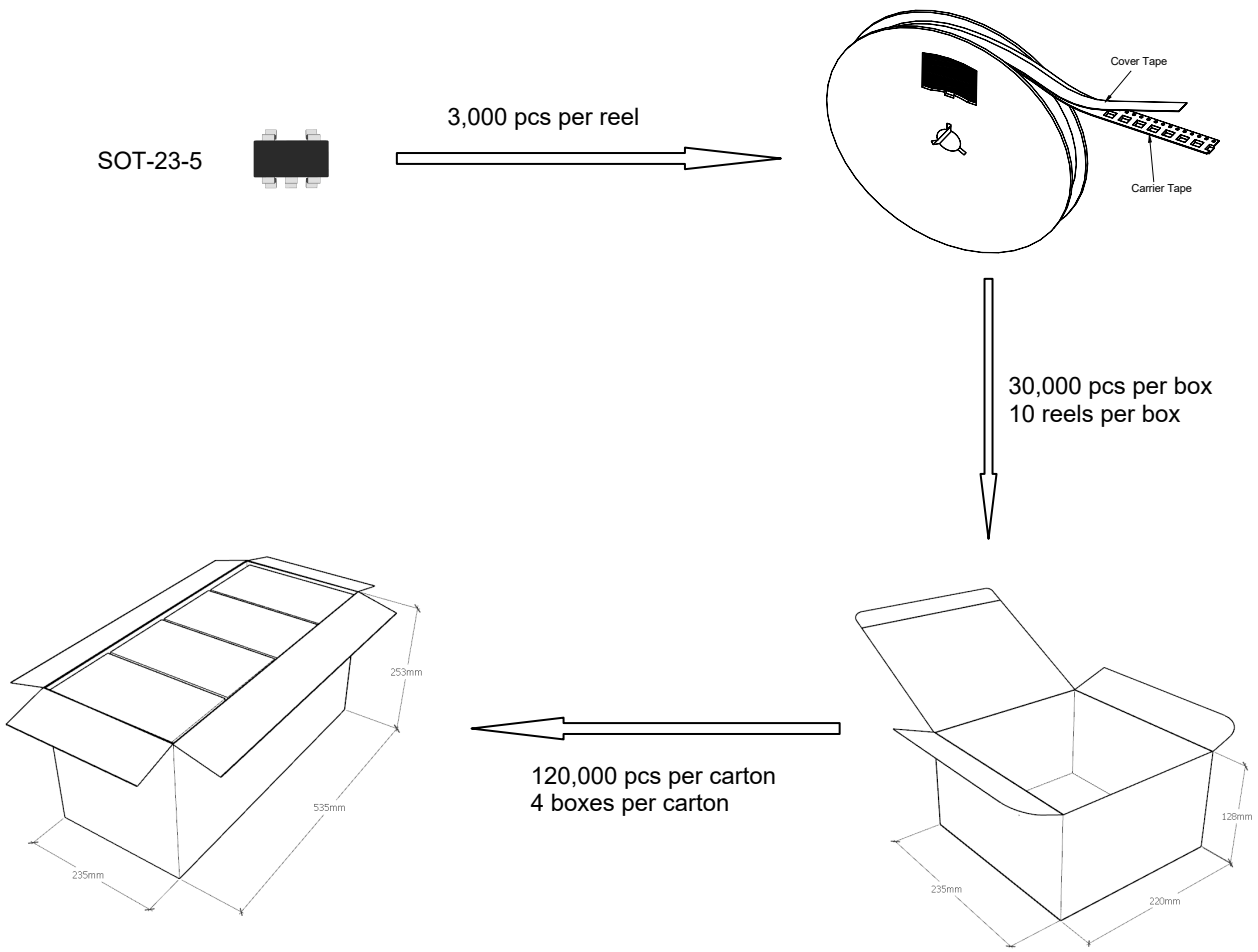
- Temperature: 300°C
- Time: 3s max.
- Times: one time

◆ Storage conditions

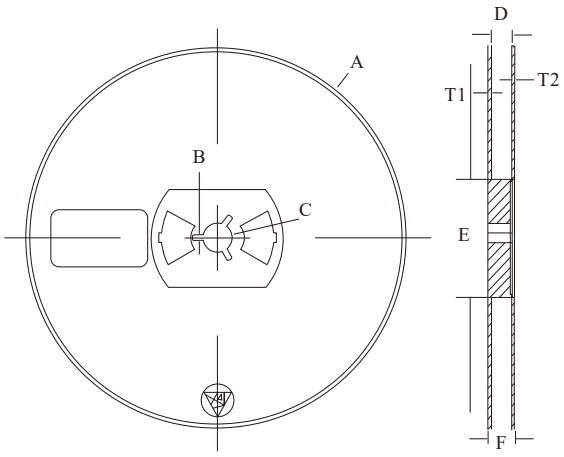
- **Temperature**
  5 to 40°C
- **Humidity**
  30 to 80% RH
- **Recommended period**
  One year after manufacturing

Package Specifications

- The method of packaging



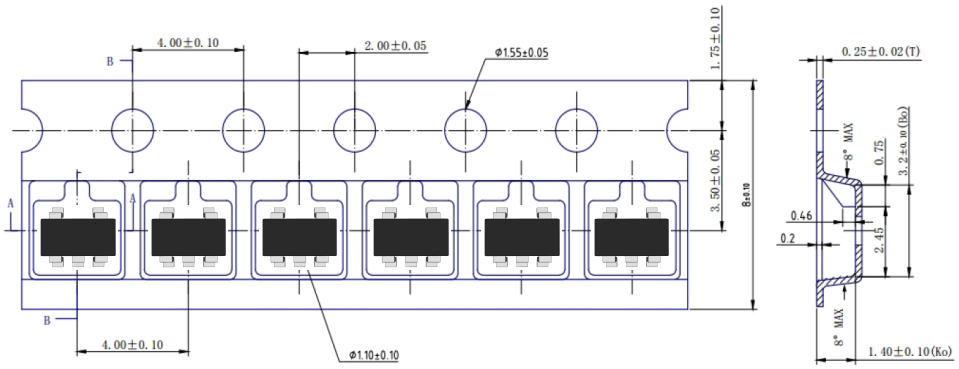
◆ **reel data**



Reel (7")

Symbol	Value (unit: mm)
A	Ø 177.8±1
B	2.7±0.2
C	Ø 13.5±0.2
E	Ø 54.5±0.2
F	12.3±0.3
D	9.6+2/-0.3
T1	1.0±0.2
T2	1.2±0.2

◆ **Embossed tape data**



Contact Information

TANI website: **http://www.tanisemi.com** Email:tani@tanisemi.com

For additional information, please contact your local Sales Representative.

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Product Specification Statement

The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. TANI shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and TANI assumes no responsibility for the application of the product. TANI strives to provide accurate and up -to- date information to the best of our ability. However, due to technical, human, or other reasons, TANI cannot guarantee that the information provided in the product specification is entirely accurate and error-free. TANI shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications.

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Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

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