CM1033-CS

3 Cell Li-Ion/Polymer Battery Protection IC

The CM1033-CS is a professional protection IC for 3 cell Li-Ion/Polymer battery packs, it works constantly to monitor each cell's voltage, the current of charge or discharge to provide overcharge, over-discharge, discharge overcurrent, short circuit, charge overcurrent protections.

■ Features

1) High- accuracy voltage detection for each cell

- overcharge threshold 4.250 V accuracy ±25 mV
- overcharge hysteresis 0.200 V accuracy ±50 mV
- over-discharge threshold 2.500 V accuracy ±80 mV
- over-discharge hysteresis 0.500 V accuracy ±100 mV

2) Three grades voltage detection of discharge overcurrent

- discharge overcurrent 1 0.100 V accuracy ±15 mV
- discharge overcurrent 2 0.200 V accuracy ±20%
- short circuit 0.400 V accuracy ±20%

3) Charge overcurrent detection -0.100 V accuracy ±30%

4) Charger detection and load detection

5) Setting of output delay time

- Built-in delay time for overcharge, over-discharge, discharge overcurrent protection

6) Open-wire Detection

7) Ultra-low power dissipation

- Normal working 7.0 μA (TYP) (Ta = +25°C)
- Sleep mode 4.0 μA (TYP) (Ta = +25°C)

■ Applications

- Power Tools
- Backup power supply

■ Packages

- SOP8

■ Block Diagram

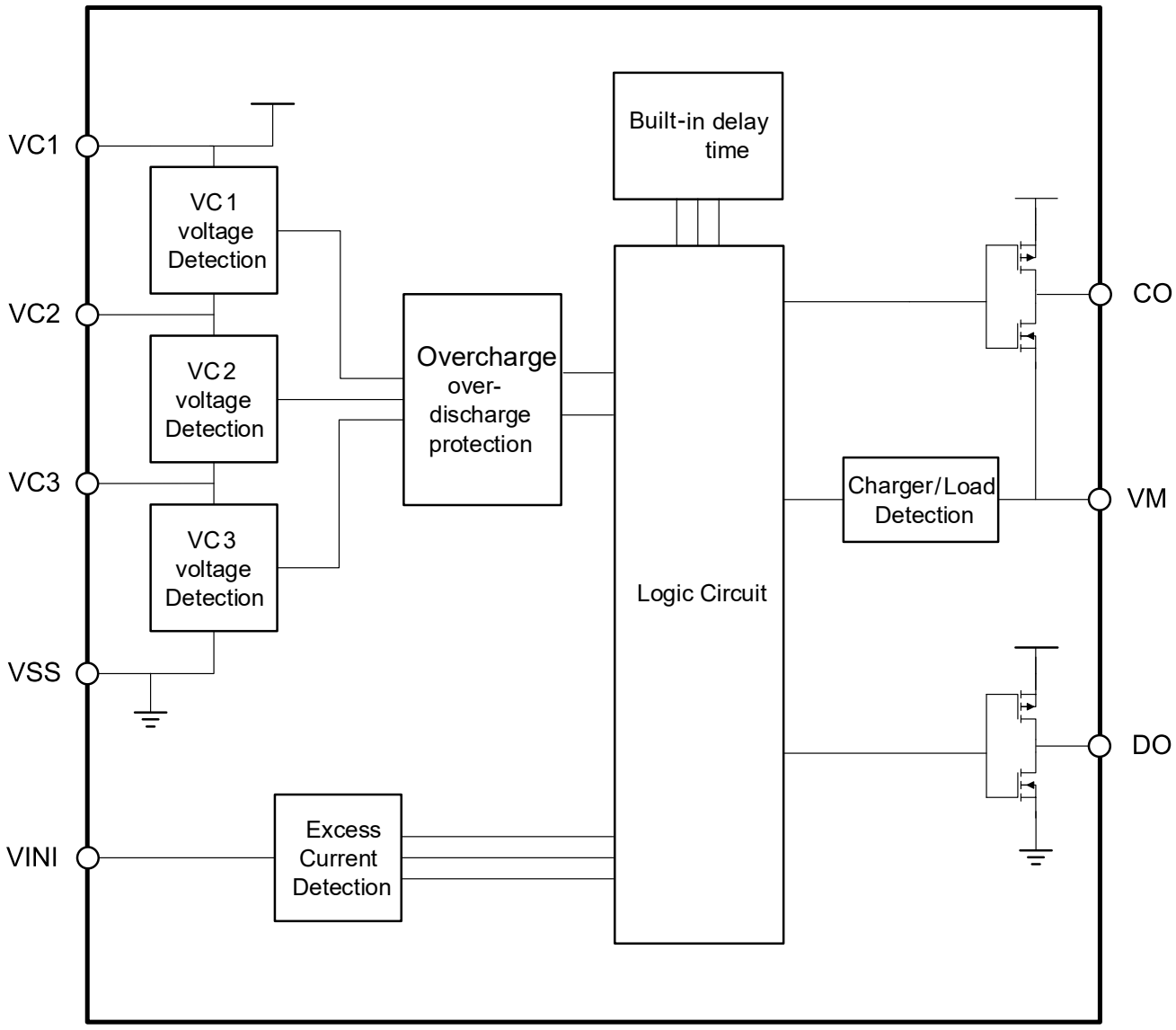


Figure 1

■ Product Name

CM1033-CS

Package type, S: SOP

Parameter, from A to Z

■ Products Catalogue

1. Voltage Detection Table

Part	Overcharge protection voltage V_{OC}	Overcharge release voltage V_{OCR}	Over-discharge protection voltage V_{OD}	Over-discharge release voltage V_{ODR}	Excess current1 detection voltage V_{EC1}	Excess current2 detection voltage V_{EC2}	Short circuit detection voltage V_{SHORT}	Charge overcurrent detection voltage V_{CHA}
CM1033-CS	4.250 V	4.050 V	2.500 V	3.000 V	0.100 V	0.200 V	0.400 V	-100 mV

Table 1

2. Delay Time Table

Part	Overcharge protection delay time T_{OC}	Over-discharge protection delay time T_{OD}	Excess current1 detection delay time T_{EC1}	Excess current2 detection delay time T_{EC2}	Short circuit detection delay time T_{SHORT}
CM1033-CS	1000 ms	1000 ms	1000 ms	125 ms	300 μs

Table 2

■ Pin Configurations

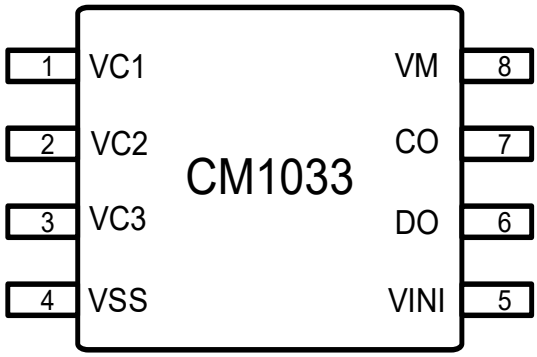


Figure 2

PIN	NAME	Description
1	VC1	Power supply, Cell1 positive input
2	VC2	Cell1 negative input, Cell2 positive input
3	VC3	Cell2 negative input, Cell3 positive input
4	VSS	Ground pin of the IC, Cell3 negative input
5	VINI	Charge and Discharge overcurrent Voltage detection terminal
6	DO	Discharge power mosfet control terminal
7	CO	Charge power mosfet control terminal
8	VM	Detecting load or charger

Table 3

■ Absolute Maximum Ratings

(unless otherwise specified: Ta = +25°C)

Item	Symbol	Description	Ratings	Unit
Power supply voltage	VC1	VC1	VSS-0.3 ~ VSS+30	V
Single cell input voltage	V_{CELL}	VC1-VC2, VC2-VC3, VC3-VSS	-0.3 ~ +5.5	V
Input Voltage1	V_{IN1}	VINI	VSS-0.3 ~ VSS+5.5	V
Input Voltage2	V_{IN2}	VM	VC1-30 ~ VC1+0.3	
CO output voltage	V_{CO}	CO	VC1-30 ~ VC1+0.3	V
DO output voltage	V_{DO}	DO	VSS-0.3 ~ VC1+0.3	V
Operating temperature	T_{OPR}	–	–40 ~ +85	°C
Storage temperature	T_{STG}	–	–55 ~ +125	°C

Table 4

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded in any conditions.

■ Electrical Characteristics

(unless otherwise specified: Ta = +25°C)

Item		Symbol	Test conditions	Min.	Typ.	Max.	Unit
Operating consumption		I_{VCC}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VM=VSS	-	7.0	14.0	μA
Sleeping consumption		I_{STB}	VC1~VC2=VC2~VC3=VC3~VSS=2.0V VM=VC1	-	4.0	8.0	μA
Overcharge	Protection threshold	V_{OC}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =3.5 → 4.4V	4.225	4.250	4.275	V
	Release threshold	V_{OCR}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =4.4 → 3.5V	4.000	4.050	4.100	V
	Protection delay time	T_{OC}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =3.5 → 4.4V	0.5	1.0	1.5	s
	Release delay time	T_{OCR}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =4.4 → 3.5V	64	128	192	ms
Over-discharge	Protection threshold	V_{OD}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =3.5 → 2.0V	2.420	2.500	2.580	V
	Release threshold	V_{ODR}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =2.0 → 3.5V	2.900	3.000	3.100	V
	Protection delay time	T_{OD}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =3.5 → 2.0V	0.5	1.0	1.5	s
	Release delay time	T_{ODR}	VC1~VC2=VC2~VC3=3.5V, VC3~VSS =2.0 → 3.5V	64	128	192	ms
Discharge overcurrent 1	Protection threshold	V_{EC1}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0 → 0.12V	0.085	0.100	0.115	V
	Protection delay time	T_{EC1}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0 → 0.12V	0.5	1.0	1.5	s
	Release delay time	T_{EC1R}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0.12 → 0V	64	128	192	ms
Discharge overcurrent 2	Protection threshold	V_{EC2}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0 → 0.35V	0.160	0.200	0.240	V
	Protection delay time	T_{EC2}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0 → 0.35V	62.5	125	187.5	ms
	Release delay time	T_{EC2R}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0.35V → 0V	64	128	192	ms
Short circuit	Protection threshold	V_{SHORT}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0 → 0.8V	0.320	0.400	0.480	V
	Protection delay time	T_{SHORT}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0 → 0.8V	100	300	600	μs
	Release delay time	T_{SHORTR}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS=0.8 → 0V	64	128	192	ms
Charge overcurrent	Protection threshold	V_{CHA}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS =0 → -0.2V	-0.130	-0.100	-0.070	V
	Protection delay time	T_{CHA}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS =0 → -0.2V	6	12	24	ms
	Release delay time	T_{CHAR}	VC1~VC2=VC2~VC3=VC3~VSS=3.5V VINI-VSS =-0.20 →0V	1	2	4	ms
Open-wire	Protection delay time	T_{OW}	-	5	10	15	ms
	Release delay time	T_{OWR}	-	1	2	3	ms

Table 5

■ Function Description

1. Overcharge

During charging, if any cell voltage is higher than V_{OC} and lasts longer than T_{OC}, the output voltage of CO will reverse, The charge MOSFET will be turned off and stop charging.

The overcharge protection state will be released if any of the next conditions occurs:

(1) All cells' voltage is less than the Overcharge release threshold V_{OCR} and stays period of time T_{OCR}

(2) VM> V_{EC1} (connecting to the load), Battery voltage is lower than V_{OC} and stays period of time T_{OCR}

2. Over-discharge

During discharging, if any cell voltage is lower than V_{OD} and lasts longer than T_{OD}. The output voltage of DO will reverse. The discharge MOSFET will be turned off and stop discharging.

The over-discharge protection state will be released if any of the next conditions occurs:

(1) VM <4V, all cells' voltage is higher than V_{ODR}.

(2) VM < V_{CHA} (connecting to the charger), All cells' voltage is higher than V_{OD}.

3. Discharge Overcurrent

During discharging, the voltage of VIN becomes higher with the current increasing. When the voltage of VIN is higher than V_{EC1} and stays longer than T_{EC1}, it works in the state of discharge overcurrent 1; When the voltage of VIN is higher than V_{EC2} and stays longer than T_{EC2}, it works in the state of discharge overcurrent 2; When the voltage of VIN is higher than V_{SHORT} and stays longer than T_{SHORT}, it works in the state of short circuit. When any of the three states occurs, the output voltage of DO changes to low level to turn off the discharge MOSFET and stop discharging. The over-current discharge protection state will be released when disconnect the load (VM<4V).

4. Charge Overcurrent

During charging, When the voltage of VIN is lower than V_{CHA} and stays longer than T_{CHA}, the CM1033-CS considers the batteries work in the state of charge overcurrent, the output voltage of CO will be pulled down to low level and the charge MOSFET will be turned off and stop charging. Charge overcurrent protection will be released when we disconnect the charger (VM>-0.20).

5. Open-wire Detection

When the wire disconnects and maintains (T_{OW}) time, the CM1033-CS will enter to the open-wire protection state. The output of CO and DO will reverse, the charge and discharge MOSFET will be turned off. Open-wire protection will release when all wires reconnect and stay longer than the release delay time (T_{OWR}).

■ Application Circuits

1. Charge & discharge circuit sharing (with R_{sense})

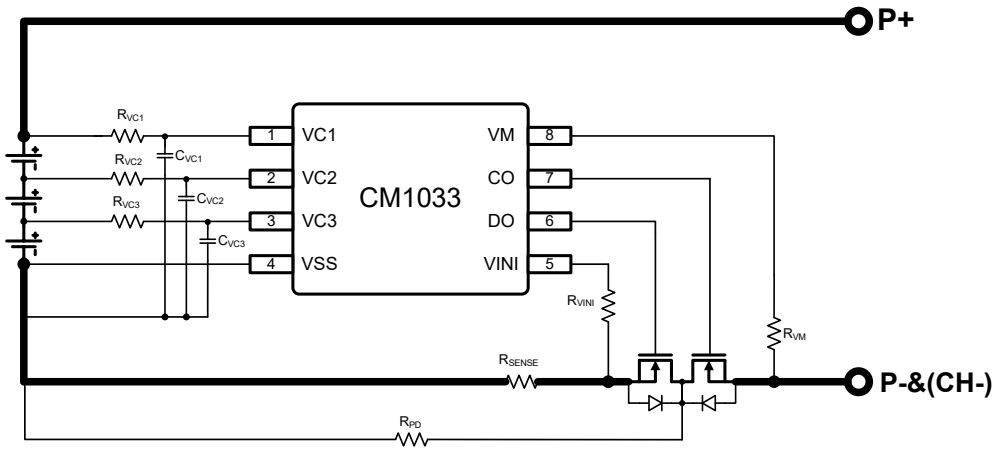


Figure 3

2. Charge & discharge circuit separation (with R_{sense})

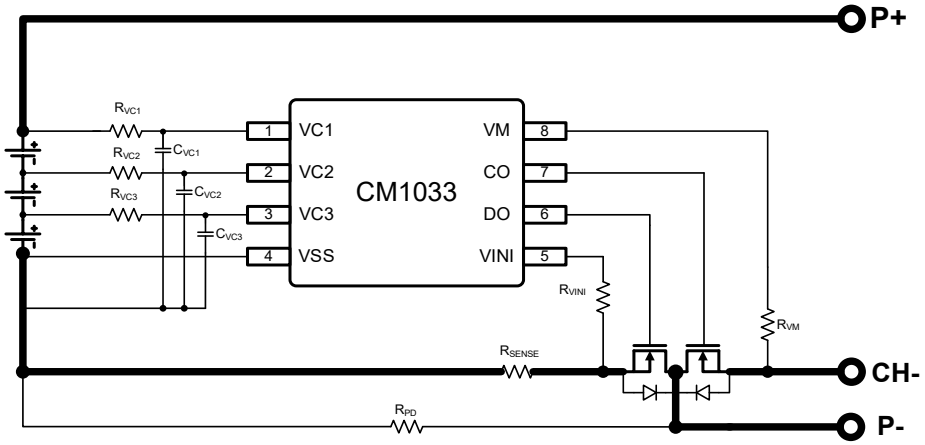


Figure 4

3. Charge & discharge circuit sharing (without R_{sense})

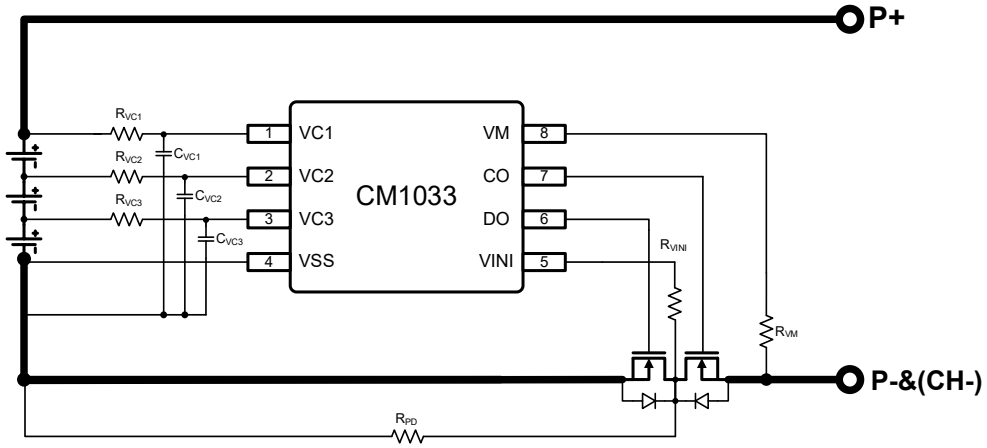


Figure 5

3. Charge & discharge circuit separation (without R_{sense})

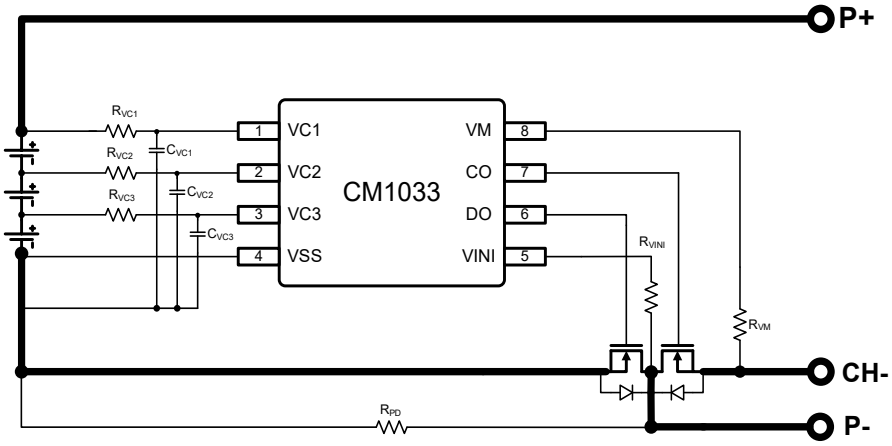


Figure 6

■ BOM List

Component Symbol	Type	Range	Unit
R_{VC1}	1	1 ~ 1.5	kΩ
R_{VC2}、R_{VC3}	1	0.33 ~ 2	kΩ
R_{VINI}	330	300 ~ 510	kΩ
R_{VM}	10	5 ~ 15	kΩ
R_{SENSE}	-		mΩ
C_{VC1}	1	1 ~ 10,≥25V	μF
C_{VC2}、C_{VC3}	0.1	0.1 ~ 1,≥10V	μF
R_{PD}	3	0.3 ~ 4	MΩ

Table 6

Caution :

1. **The above constants may be changed without notice.**
2. **Other special application circuits need to change part of the BOM**
3. **The above parameters may be changed without notice.**
4. **The example of connection shown above and the constant do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constant.**

■ Package

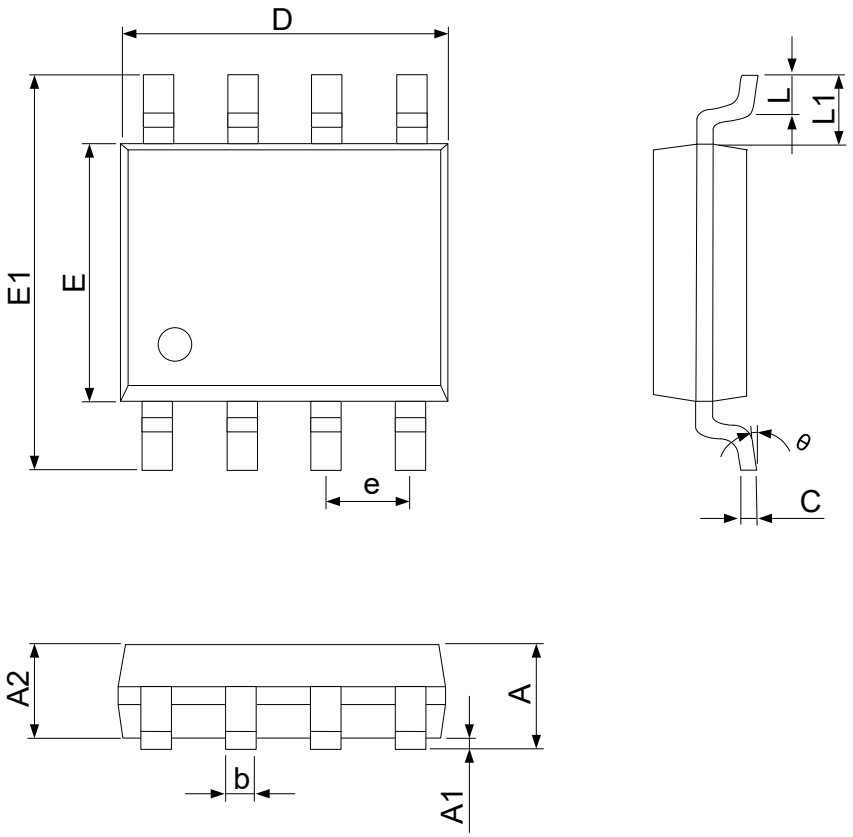


Figure 7

Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	—	0.25
A2	1.25	1.45	1.65
b	0.35	—	0.5
c	0.10	—	0.26
D	4.70	4.95	5.20
E	3.70	3.90	4.10
E1	5.80	6.00	6.20
e	1.27BSC		
L	0.4	—	0.80
L1	1.05REF		
θ	0°	—	8°

Table 7

■ Carrier Tape information

- **SOP8**

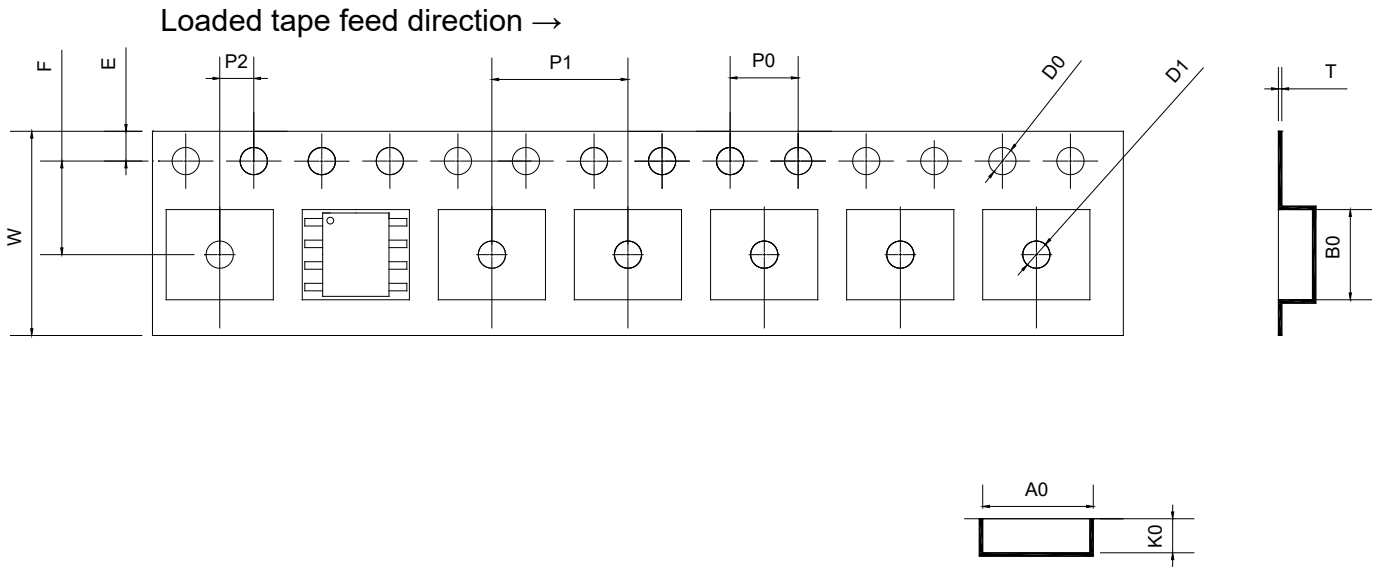
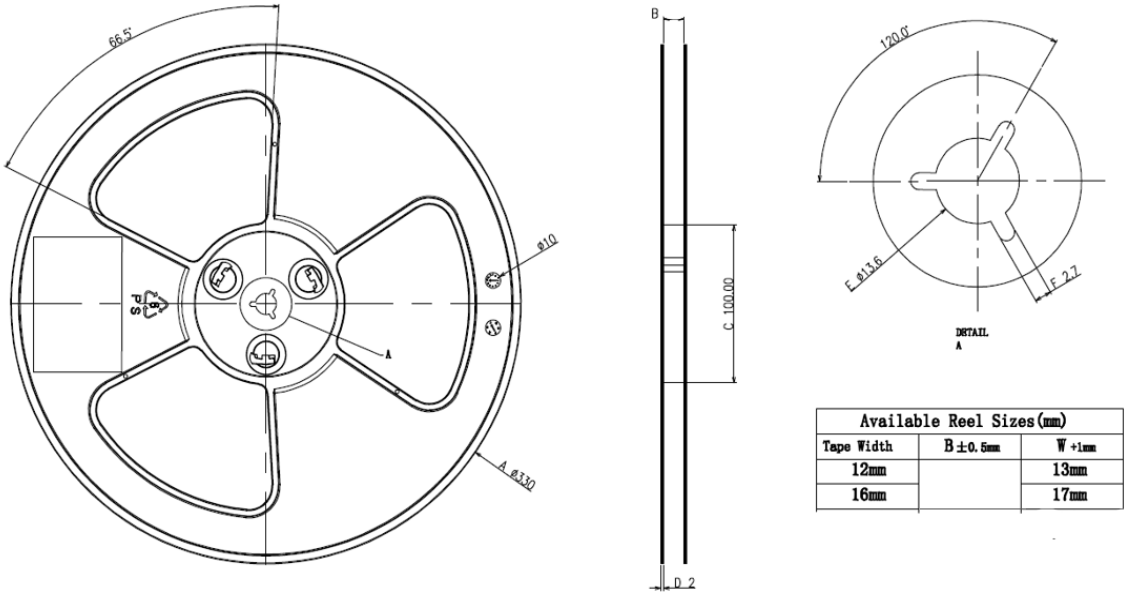


Figure 8

Type	W*P1	Unit
SOP8	12.0*8.0	mm
Item	**Specification**	**Tol（+/-）**
W	12.00	±0.10
F	5.50	±0.10
E	1.75	±0.10
P2	2.00	±0.10
P1	8.00	±0.10
P0	4.00	±0.10
P0*10	40.00	±0.20
D0	1.50	+0.10/-0
D1	1.50	+0.10/-0
T	0.20	±0.05
B0	5.30	±0.10
A0	6.30	±0.10
K0	2.00	±0.05

Table 8

■ Reel information



Available Reel Sizes(mm)		
Tape Width	B ±0.5mm	W +1mm
12mm		13mm
16mm		17mm

Figure 9

■ Package information

Reel	PCS/Plate	Plate/Box	Box/Package
13”×12mm	4000	2	8

Precautions for use

1. The content in this manual may be changed without notice as the product improves. For more detailed content, please contact our company's marketing department.
2. The circuit examples, usage methods, etc. in this specification are for reference only, and are not designed to guarantee mass production. The company does not assume any responsibility for problems caused by third-party ownership.
3. When this specification is used alone, our company guarantees that its performance, typical applications and functions meet the conditions in the specification. When using the customer's products or equipment, we do not guarantee the above conditions, we recommend that customers do adequate evaluation and testing.
4. Please pay attention to the use of the product within the conditions stated in the specification. Please pay special attention to the use conditions of input voltage, output voltage, and load current so that the power dissipation in the IC does not exceed the power dissipation of the package. The company will not be liable for any losses caused by customers using the product beyond the rated value specified in the specification, even if it is used instantaneously.
5. When using this product, please confirm the laws and regulations of the country, region and purpose of use, and test the ability and safety performance of the product.
6. The products in this specification, without written permission, cannot be used in high-reliability circuits of equipment or devices that may cause damage to the human body, life and property, such as: medical equipment, disaster prevention equipment, vehicle equipment, and vehicle Equipment, aviation equipment, space equipment, nuclear energy equipment, etc., shall not be used as their parts.
7. The company does not assume any responsibility for damages caused by using the products described in this specification for purposes other than those specified by the company.
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9. In order to prevent personal accidents, fire accidents, social damages, etc. caused by the probabilistic failure of this product, customers are requested to fully evaluate the entire system and be responsible for redundant design, measures to prevent fire spread, and safety design to prevent mishandling, you can avoid accidents.
10. This product will not affect human health under normal conditions of use, but because it contains chemical substances and heavy metals, please do not put it in your mouth. In addition, the cracked surface of the package and chip may be sharp, so please protect it when touching it with bare hands to avoid injury.
11. When disposing of this product, please abide by the laws and regulations of the country and region of use and dispose of it reasonably.
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