



# JW1572

## Offline Boost PFC CV Controller

*Preliminary Specifications Subject to Change without Notice*

### DESCRIPTION

JW1572 is a constant voltage controller with high voltage accuracy which applies to single stage boost power factor correction (PFC) applications. Constant on time control strategy ensures high power factor, and the input voltage detection circuit is not needed, which simplifies the system design and saves the loss.

Critical conduction mode operation reduces the switching losses, improves the EMI performance and largely increases the efficiency.

JW1572 has multi-protection functions which largely enhance safety and reliability of the system, including VCC UVLO, CS short current protection (SCP), FB over voltage protection, 2nd OVP and over temperature protection.

JW1572 is available in SOP8 package.

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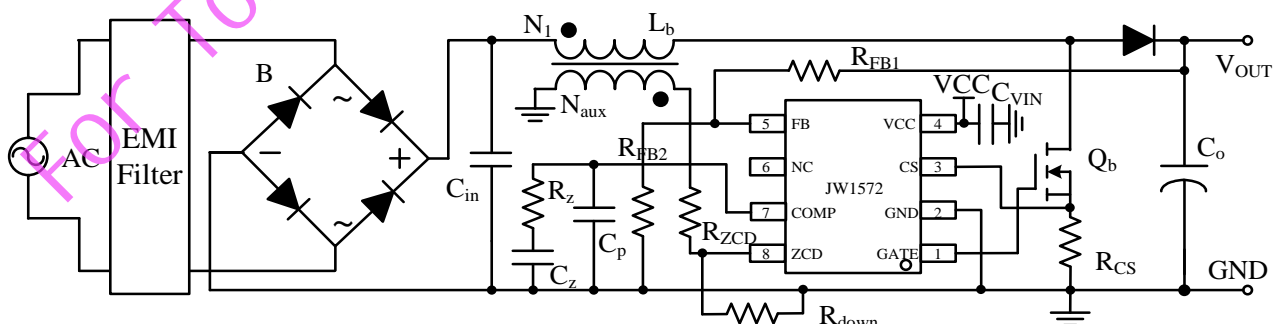
### FEATURES

- Low Quiescent Current
- +0.6A/-1.4A Peak Gate Drive Current
- High Power Factor and Low THD
- Critical Conduction Mode
- High Reference Voltage Accuracy
- High Efficiency over Wide Operating Range
- Reduce Frequency at Light Load
- Open Feedback Protection
- Disable Function
- Cycle by Cycle Current Limit by CS Voltage
- Internal over Temperature Protection
- 2nd OVP
- SOP8 Package

### APPLICATIONS

- SMPS
- AC-DC Adapter
- Flat TV

### TYPICAL APPLICATION

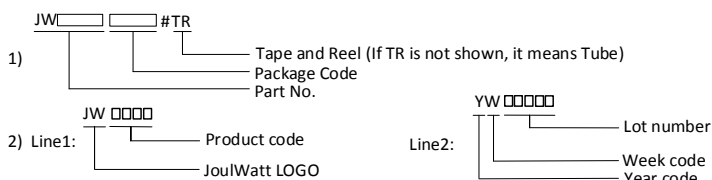


**JW1572 PFC Application**

**ORDER INFORMATION**

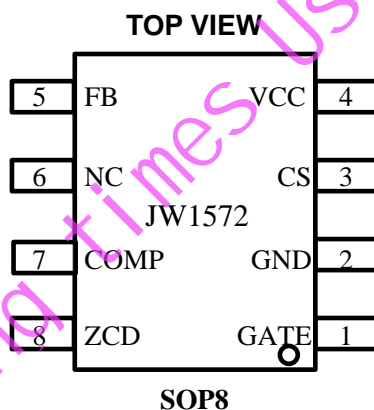
DEVICE <sup>1)</sup>	PACKAGE	TOP MARKING <sup>2)</sup>	ENVIRONMENTAL <sup>3)</sup>
JW1572SOPB#TR	SOP8	JW1572 YW□□□□□	Green

**Notes:**



3) All JoulWatt products are packaged with Pb-free and Halogen-free materials and compliant to RoHS standards.

**PIN CONFIGURATION**



**ABSOLUTE MAXIMUM RATING<sup>1)</sup>**

VCC.....	-0.3 to 45V
ZCD.....	-0.6 to 45V, -0.7 to -0.6V<100μs
CS, COMP.....	-0.3 to 5.5V
FB.....	-0.3 to 5V, 5 to 6V<100ms
GATE.....	-0.3 to 13V
Junction Temperature <sup>2)</sup> .....	150°C
Lead Temperature.....	260°C
Storage Temperature.....	-65°C to +150°C
ESD Susceptibility (Human Body Model).....	2kV

**RECOMMENDED OPERATING CONDITIONS**

VCC..... 10 to 40V  
 Operating Junction Temperature (T<sub>J</sub>)<sup>3)</sup>..... -40°C to 125°C

**THERMAL RESISTANCE<sup>4)</sup>**

$\theta_{JA}$   $\theta_{JC}$

SOP8.....120.....60°C/W

**Note:**

- 1) Exceeding these ratings may damage the device. These stress ratings do not imply function operation of the device at any other conditions beyond those indicated under RECOMMENDED OPERATING CONDITIONS.
- 2) The JW1572 includes thermal protection that is intended to protect the device in overload conditions. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.
- 3) The device is not guaranteed to function outside of its operating conditions.
- 4) Measured on JESD51-7, 4-layer PCB.

For Tongsheng times Use Only

## ELECTRICAL CHARACTERISTICS

$T_J = -40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ , typical values shown are for  $T_J = 25^{\circ}\text{C}$ , unless otherwise stated

*Advance Information, not production data, subject to change without notice.*

Item	Symbol	Condition	Min.	Typ.	Max.	Units
<b>Supply Voltage Management</b>						
VCC Start-up Voltage	$V_{CC\_ST}$		10.45	11	11.95	V
VCC Under Voltage Lockout	$V_{CC\_UVLO}$		7.5	8.2	8.9	V
VCC Operation Current	$I_{VCC\_OP}$	$f_{sw}=F_{MIN}$ , GATE Floating	200	300	400	$\mu\text{A}$
VCC Start-up Supply Current	$I_{VCC\_ST}$	$V_{CC}=V_{CC\_ST}-1\text{V}$	14	21.5	30	$\mu\text{A}$
VCC Supply Current during Green Mode	$I_{VCC\_GM}$	$V_{CC}=16\text{V}$ , $V_{FB}=0\text{V}$	30	50	70	$\mu\text{A}$
<b>Current Limit(CS Pin)</b>						
CS Cycle by Cycle Limit Voltage	$V_{CS\_MAX}$		0.35	0.4	0.45	V
Leading Edge Blanking Time	$T_{LEB2}$	$0.4\text{V}<V_{CS}<1.5\text{V}$	240	300	360	ns
SCP Voltage	$V_{CS\_SCP}$		1.4	1.5	1.6	V
Leading Edge Blanking Time of SCP	$T_{LEB1}$	$V_{CS}>1.5\text{V}$	190	250	310	ns
<b>Feedback and OVP(FB Pin)</b>						
FB Reference Voltage	$V_{FB\_REF}$		2.45	2.5	2.55	V
OVP Threshold of FB	$V_{FB\_OVP}$		2.56	2.68	2.80	V
FB OVP Hysteresis	$V_{FB\_OVP\_HYST}$		0.1	0.2	0.28	V
FB Start-up Voltage	$V_{FB\_ST}$		0.34	0.4	0.46	V
FB Ipeak Start-up Voltage	$V_{FB\_PK\_ST}$		2.18	2.3	2.41	V
FB Ipeak Stop Voltage	$V_{FB\_PK\_STOP}$		2.28	2.4	2.52	V
FB Ipeak Voltage Hysteresis	$V_{FB\_PK\_HYST}$		0.05	0.1	0.15	V
<b>Compensation(Comp pin)</b>						
Transconductance	$G_m$	$ V_{FB}-V_{FB\_REF} \leq 50\text{mV}$	8.85	13.9	19.3	$\mu\text{A/V}$
Source Current of COMP	$I_{SRC\_COMP}$	$V_{FB}=0\text{V}$ , $V_{comp}=1.6\text{V}$	18.41	21.26	24.11	$\mu\text{A}$
Sink Current of COMP	$I_{SINK\_COMP}$	$V_{FB}=2.6\text{V}$ , $V_{comp}=1.6\text{V}$	0.82	1.3	1.78	$\mu\text{A}$
Maximum Clamp Voltage of COMP	$V_{comp\_max}$	$V_{FB}=2.0\text{V}$	2.49	2.6	2.87	V
Minimum Clamp Voltage of COMP	$V_{comp\_min}$	$V_{FB}=2.6\text{V}$	0.41	0.64	0.88	V
<b>PFC on Timer and Frequency Foldback</b>						
Maximum On-time of GATE	$T_{MOT}$		28.5	33	37.5	$\mu\text{s}$

<i>T<sub>J</sub> = -40°C to 125°C, typical values shown are for T<sub>J</sub> = 25°C, unless otherwise stated</i>						
<i>Advance Information, not production data, subject to change without notice.</i>						
Item	Symbol	Condition	Min.	Typ.	Max.	Units
Maximum Switching Frequency	F <sub>MAX</sub>		130	140	149	kHz
Minimum Switching Frequency	F <sub>MIN</sub>	V <sub>FB</sub> =2.6V, V <sub>CS</sub> =1V	20.2	23	25.8	kHz
<b>Driver(GATE Pin)</b>						
Gate High Voltage	V <sub>GS_H</sub>		10	11.5	13	V
Maximum Source Current <sup>5)</sup>	I <sub>SRC_GATE</sub>	GBD, GATE=0V	/	0.6	/	A
Maximum Sink Current <sup>5)</sup>	I <sub>SINK_GATE</sub>	GBD, GATE=4V	/	1.4	/	A
<b>Demagnetization Sense(ZCD Pin)</b>						
Demagnetization Time-out	T <sub>DEM_MAX</sub>		38	44	50	μs
<b>Valley Sense(ZCD Pin)</b>						
Valley Sense Threshold <sup>5)</sup>	dv/dt	GBD	/	12.8	/	V/μs
Demagnetization sense low level <sup>5)</sup>	V <sub>ZCD_L</sub>	GBD	-100	-90	-80	mV
Demagnetization sense high level <sup>5)</sup>	V <sub>ZCD_H</sub>	GBD	-10	0	10	mV
Blanking time of ZCD	T <sub>delay</sub>		494	630	766	ns
Valley Sense Time-out <sup>5)</sup>	T <sub>valley</sub>	GBD	/	3.8	/	μs
2 <sup>nd</sup> OVP Threshold	I <sub>OVP2</sub>		1.15	1.3	1.45	mA
Fault Reset Delay Time	T <sub>FRD</sub>	SCP and 2nd OVP Fault	645	720	815	ms
<b>Internal OTP</b>						
Internal over Thermal Protection Threshold <sup>6)</sup>	T <sub>OTP</sub>	GBD	/	140	/	°C
Internal over Thermal Protection Hysteresis <sup>6)</sup>	T <sub>OTP_HYST</sub>	GBD	/	30	/	°C

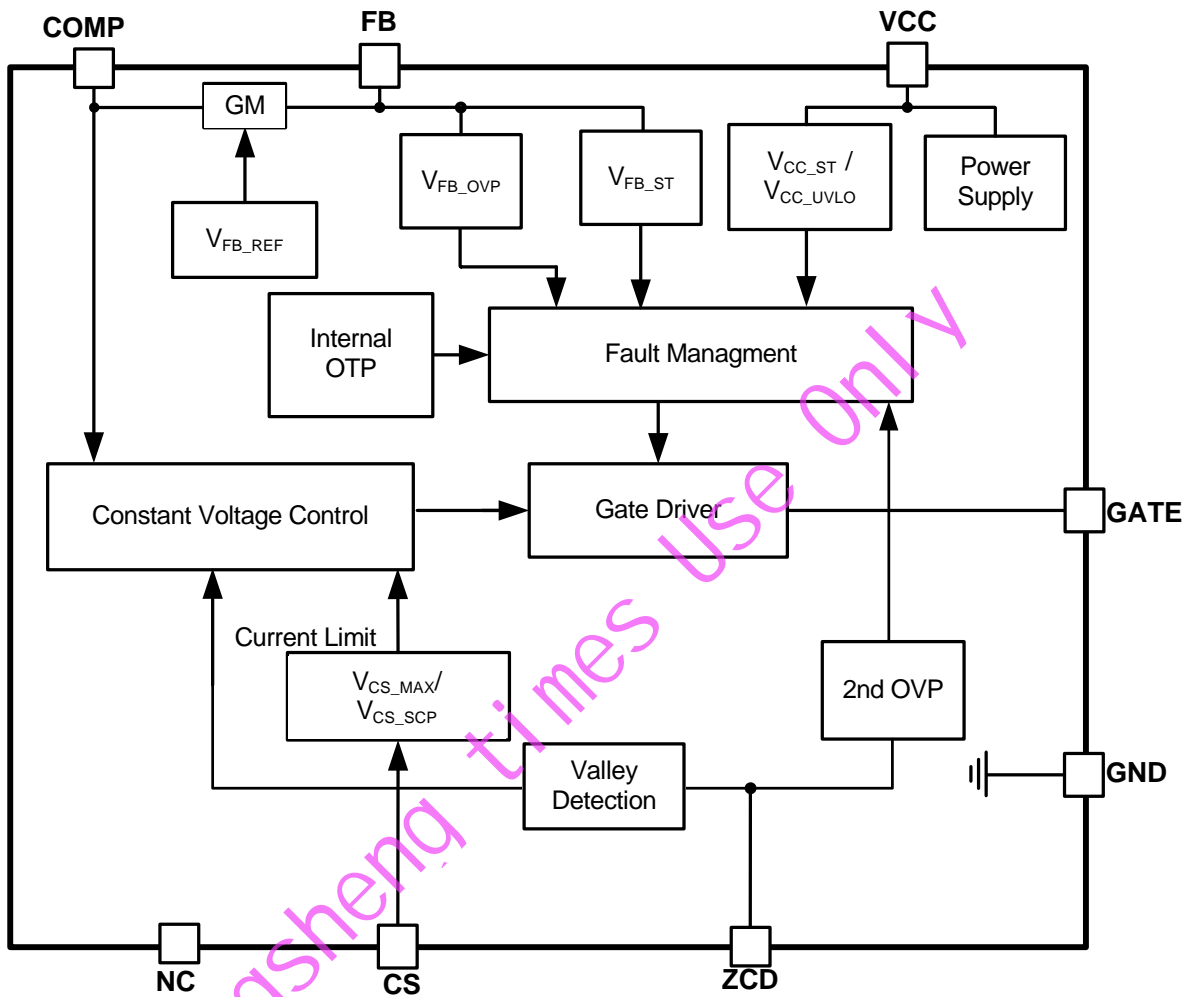
**Note:**

- 5) Guaranteed by design.  
6) Derived from bench characterization. Not tested in production.

**PIN FUNCTIONS**

Pin SOP8	Name	Description
1	GATE	Gate driver for PFC MOSFET.
2	GND	Chip ground.
3	CS	Current sensing pin.
4	VCC	Power supply of IC.
5	FB	Output voltage feedback pin.
6	NC	
7	COMP	The error amplifier output is available on this pin. The network connected between this pin.
8	ZCD	Input from auxiliary winding for demagnetization timing and valley detection for PFC.

**BLOCK DIAGRAM**



## FUNCTIONAL DESCRIPTION

JW1572 is a constant voltage (CV) controller which applies to non-isolation boost system with PFC. JW1572 can achieve excellent line and load regulation, high efficiency and low system cost with few peripheral components.

### 1. Start-up

When VCC is charged to VCC start-up voltage ( $V_{CC\_ST}$ ), GATE driver begins to switch. When VCC is lower than VCC under voltage lockout ( $V_{CC\_UVLO}$ ), IC stops switching.

### 2. Constant Voltage Control

JW1572 controls the output voltage by the information of FB pin. The output voltage is

$$V_{OUT} = \frac{V_{FB\_REF} \cdot (R_{FB1} + R_{FB2})}{R_{FB2}}$$

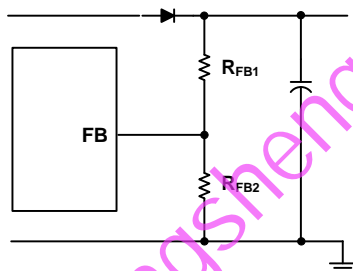


Figure.1 Output Sense

Where

$V_{FB\_REF}$ – FB Reference Voltage;

$R_{FB1}$ ,  $R_{FB2}$ – FB divide resistors.

### 3. Critical Conduction Mode Operation

JW1572 works in the critical conduction mode of the inductor current. When the power MOSFET is turned on, the inductor current increases from zero. Turn-on time of the MOSFET can be calculated as:

$$T_{ON} = \frac{I_{PK} \cdot L}{V_{IN}}$$

Where,

L– Inductance.

$V_{IN}$ – Input voltage.

$I_{PK}$  is the peak current in one switch period and the maximum value ( $I_{PK\_MAX}$ ) is limited by the MOSFET current sensing resistor ( $R_{CS}$ ).

$$I_{PK\_MAX} = \frac{V_{CS\_MAX}}{R_{CS}}$$

$V_{CS\_MAX}$ – CS Cycle by Cycle limit Voltage.

When the power MOSFET is turned off, the inductor current begins to decrease. The power MOSFET turns on again when the inductor current is zero. Turn-off time of the MOSFET can be calculated as:

$$T_{OFF} = \frac{I_{PK} \cdot L}{V_{OUT} - V_{IN}}$$

Where,

$V_{OUT}$  – output voltage.

The power inductance can be calculated as:

$$L = \frac{V_{IN} \cdot (V_{OUT} - V_{IN})}{f \cdot I_{PK} \cdot V_{OUT}}$$

Where, f is the frequency of the boost system.

### 4. Frequency Foldback

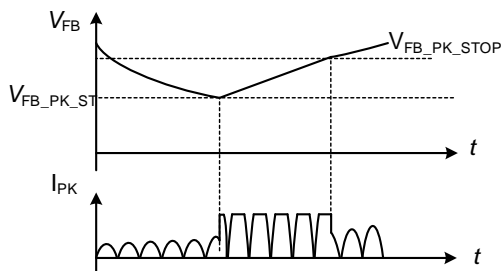
The maximum switching frequency is limited to  $F_{MAX}$ . At light load, switching frequency would fold back to  $F_{MIN}$ .

If the load further decreases, IC will enter the skip mode to minimize standby loss. Skip mode is realized by FB OVP.



**5. Ipeak Enable Function**

JW1572 enters  $I_{peak}$  enable mode when  $V_{FB}$  is lower than FB  $I_{peak}$  start-up Voltage ( $V_{FB\_PK\_ST}$ ). Peak current is set as  $I_{PK\_MAX}$ , which enhances heavy load dynamic response. JW1572 quits this mode when  $V_{FB}$  is higher than  $V_{FB\_PK\_STOP}$ .



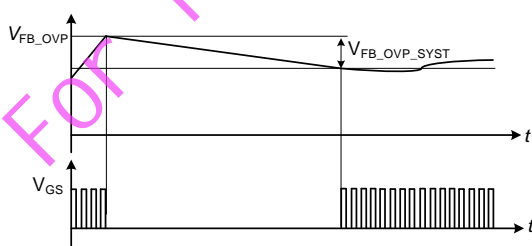
**Figure.2 Ipeak Enable**

**6. Protection**

JW1572 has multi-protection functions which largely enhance the safety and reliability of the system, including VCC UVLO, CS short current protection (SCP), FB over voltage protection, 2nd OVP and over temperature protection.

**6.1 FB Over Voltage Protection**

FB over voltage protection (OVP) is triggered if  $V_{FB}$  is higher than FB over voltage protection threshold ( $V_{FB\_OVP}$ ). The MOSFET gate driver stops unless FB voltage is decreased to  $V_{FB\_OVP} - V_{FB\_OVP\_HYST}$ .



**Figure.3 FB OVP**

**6.2 2nd OVP**

The input voltage  $V_{IN}$  is detected by the sink current of ZCD pin during the main MOSFET on

period, and the difference between output voltage  $V_{OUT}$  and input voltage  $V_{IN}$  can be detected by the source current of ZCD pin during the main MOSFET off period.

$$I_{SINK} = \frac{V_{IN} \cdot N_{aux}}{R_{ZCD} \cdot N_1}$$

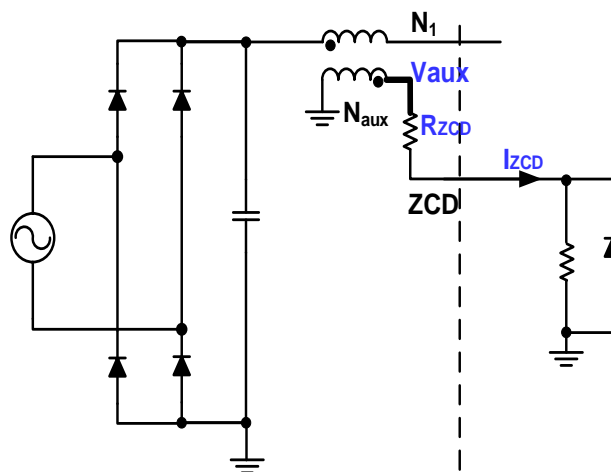
$$I_{SOURCE} = \frac{(V_{OUT} - V_{IN}) \cdot N_{aux}}{R_{ZCD} \cdot N_1}$$

The output voltage  $V_{OUT}$  can be calculated by the threshold  $I_{OVP2}$ .

$$I_{OVP2} = |I_{SINK}| + |I_{SOURCE}|$$

$$V_{OVP2} = \frac{I_{OVP2} \cdot R_{ZCD} \cdot N_1}{N_{aux}}$$

If the output voltage sample signal exceeds  $I_{OVP2}$  for 3 consecutive switching cycles, 2nd OVP fault is asserted, and then the device shuts down, and restart after  $T_{FRD}$ .



**Figure.4 ZCD and Valley Detection**

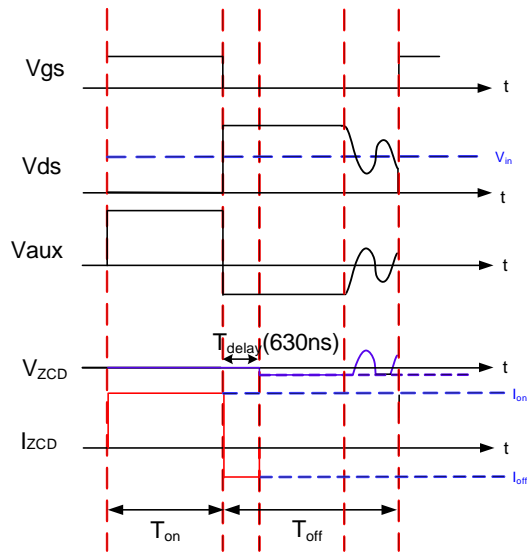


Figure.5 ZCD pin Current Sense Waveform

### 6.3 Disable Function

The FB pin can also be used for device disabling. If  $V_{FB}$  is pulled down and lower than FB start-up voltage ( $V_{FB\_ST}$ ), JW1572 stops switching and enters in green mode which

reduces the power consumption. JW1572 will restart if  $V_{FB} > V_{FB\_ST}$ .

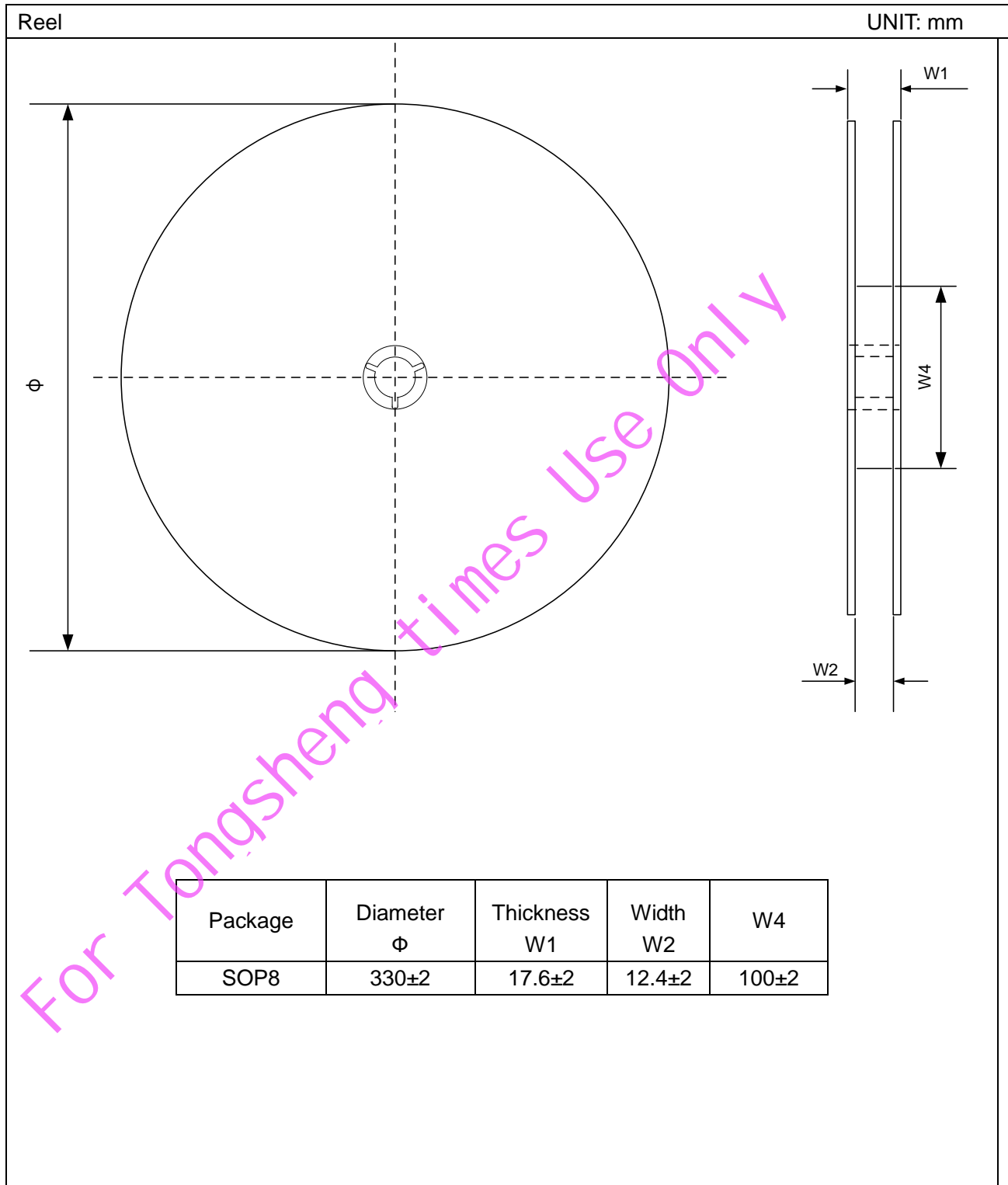
### 6.4 Over Temperature Protection

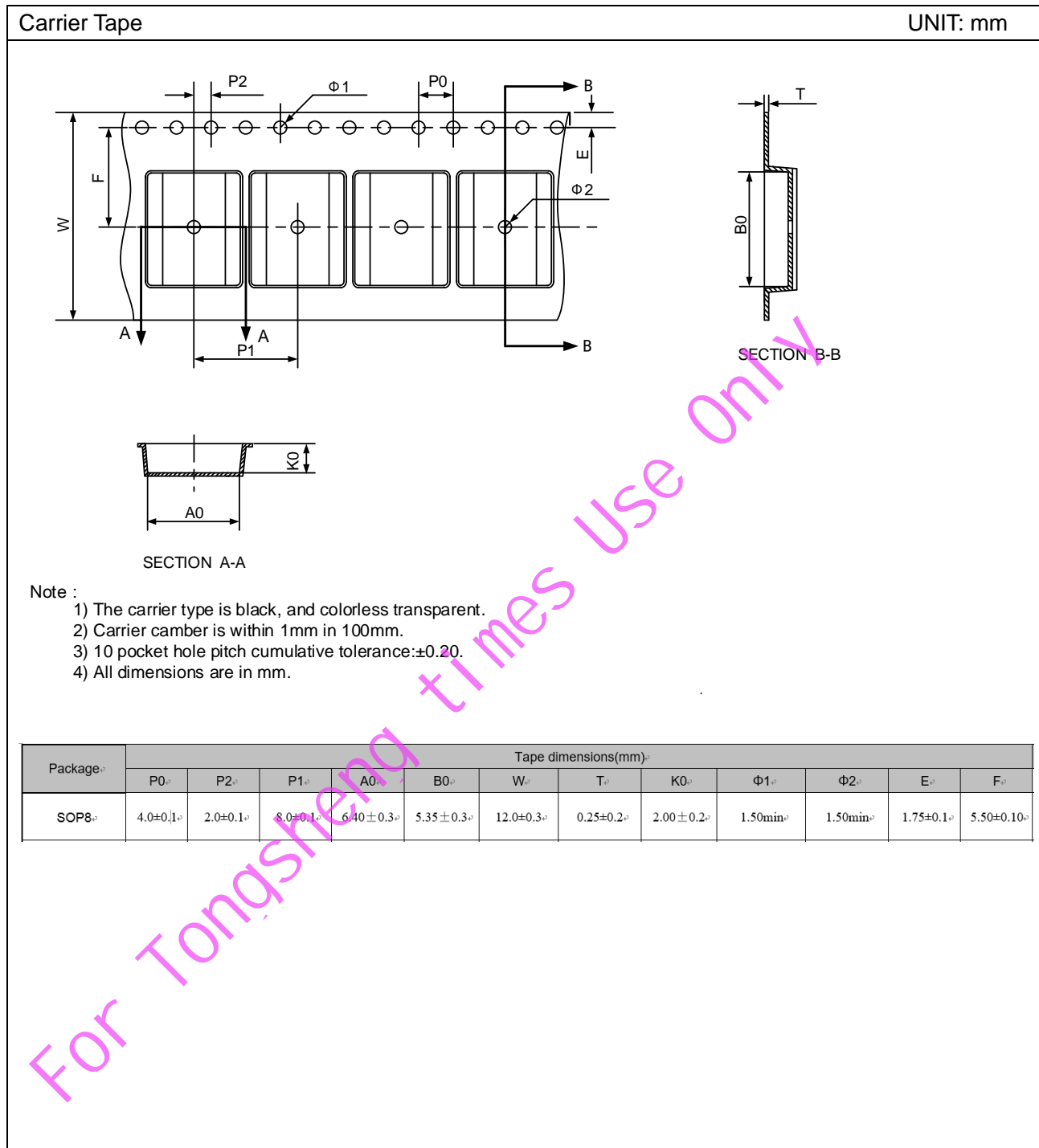
JW1572 provides internal over thermal protection. When internal temperature of IC exceeds the inner over thermal protection threshold ( $T_{OTP}$ ), JW1572 stops switching unless the junction temperature decreases to  $T_{OTP} - T_{OTP\_HYST}$ .

### 6.5 Short Current Protection

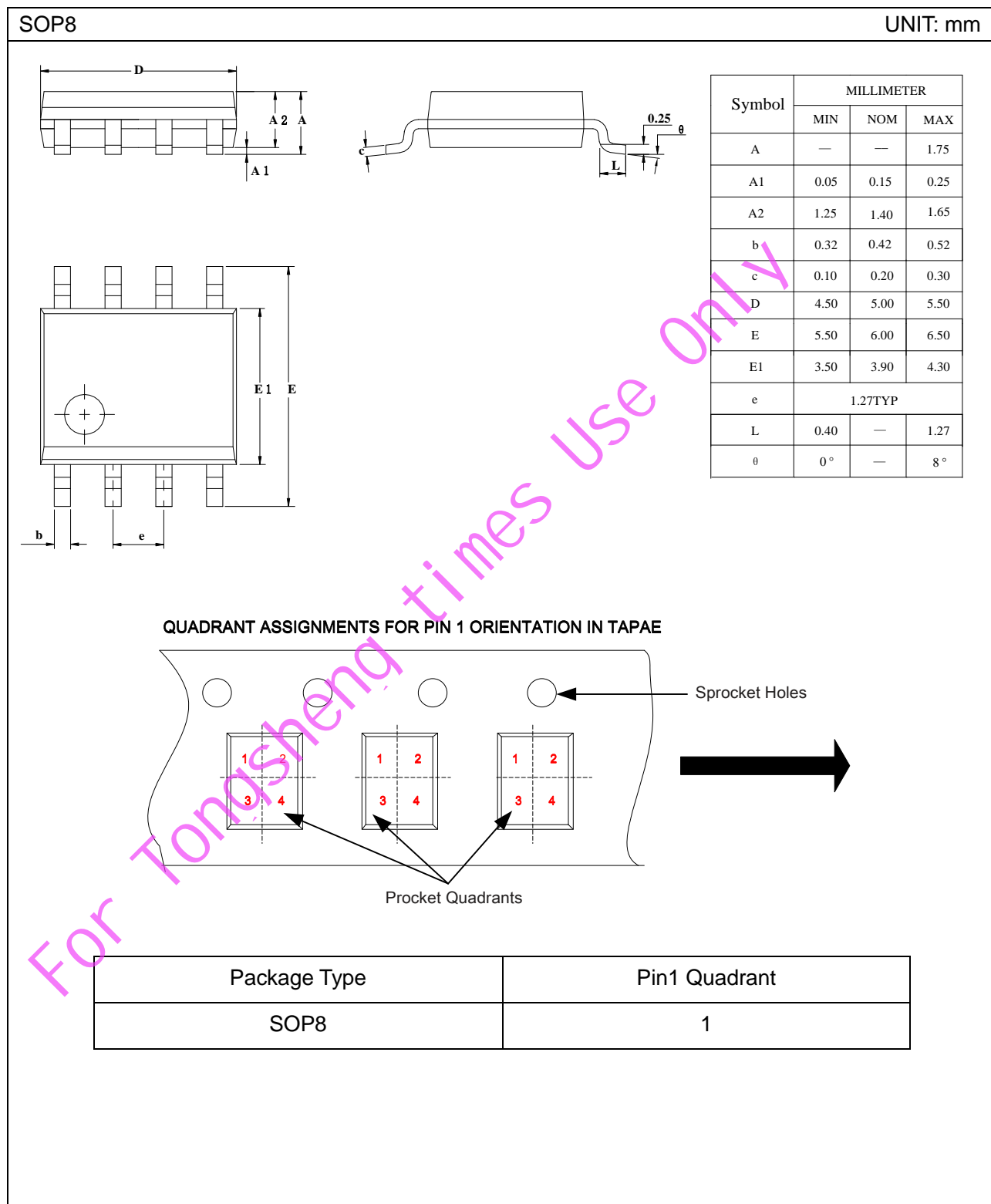
If  $V_{CS}$  exceeds  $V_{CS\_SCP}$  within  $T_{LEB1}$ , the switch will be turned off right now and restart after  $T_{FRD}$ . This causes the SCP fault.

**TAPE AND REEL INFORMATION**





**PACKAGE OUTLINE**



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