

High-Current Over-Voltage Protectors with Adjustable OVLO and Input Moisture Detection

General Description

ET9545L can disconnect the systems from its output pin (OUT) in case wrong input operating conditions are detected. The system is positive over-voltage protected up to 28V. The internal over-voltage threshold (OVLO) is 6.8V.

ET9545L has internal Thermal-Shutdown Protection and Input Moisture detection.

The device is packaged in advanced full-Green compliant WLCSP12 package.

Features

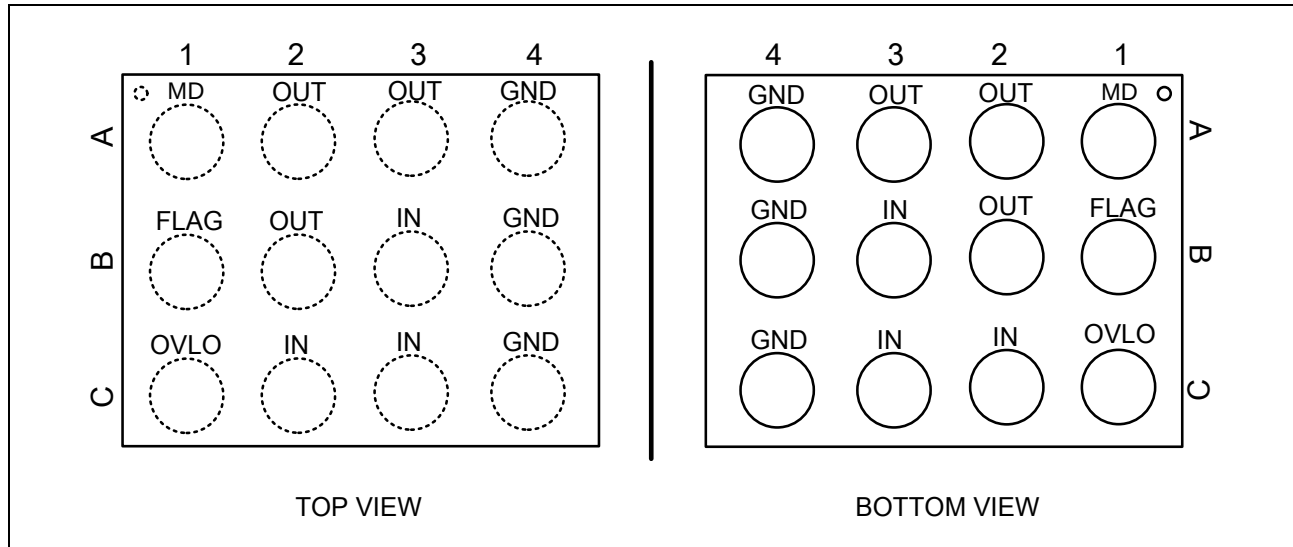
- 5.5A Continuous Current Capability
- Typical R_{ON} : 20m Ω N-Channel MOSFET
- VIN Operating Range: 3.2V to 28V
- Internal Over-Voltage Lockout: 6.8V
- Over-Voltage-Protection Response Time: 50ns (TYP)
- Moisture Detection for VIN
- Startup Debounce Time: 15ms (TYP)
- Internal Thermal-Shutdown Protection
- Surge Immunity to $\pm 80V$
- ESD Protected: Human Body Model (JESD22-A114) All pins $\pm 2KV$ Pass
- WLCSP12 (1.55mm $\times$ 1.10mm 0.4mm pitch) Package

Application

- Smartphones, Tablet PC
- HDD, Storage and Solid State Memory Devices
- Portable Media Devices, Laptop & MID
- SLR Digital Cameras
- GPS and Navigation Equipment
- Industrial Handheld and Enterprise Equipment

ET9545L

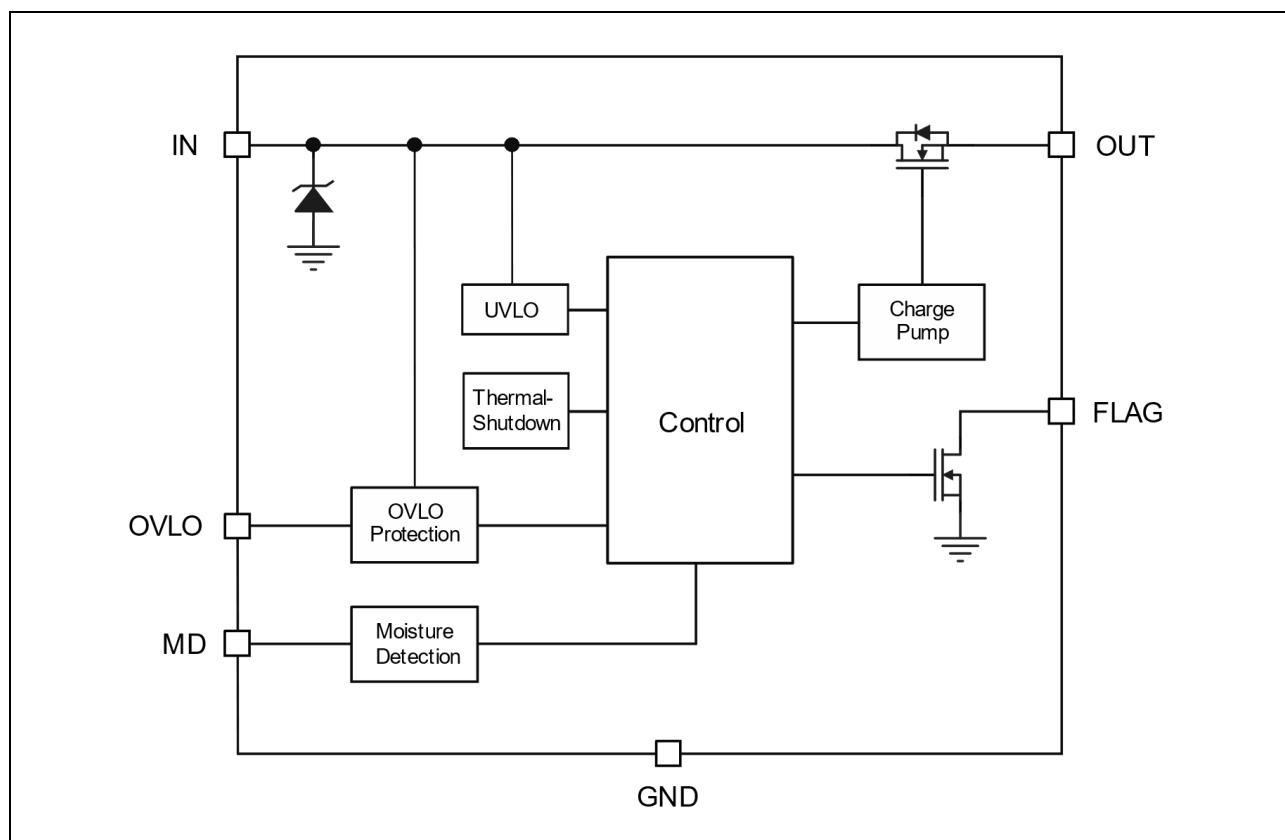
Pin Configuration



Pin Function

Pin	Name	Description		
A1	MD	Moisture Detection Input.		
A2,A3,B2	OUT	Output Voltage. Output of internal switch. Connect OUT pins together for proper operation.		
A4,B4,C4	GND	Ground. Connect GND pins together for proper operation.		
B1	FLAG	Power status indicator	1	V_{MD} shorted to IN or GND or $V_{IN} < V_{UVLO}$ or $V_{IN} > V_{OVLO}$
			0	V_{IN} Stable
B3,C2,C3	IN	Voltage Input. Connect IN pins together for proper operation.		
C1	OVLO	External OVLO Adjustment. Connect OVLO to GND when using the internal threshold. Connect a resistor-divider to OVLO to set a different OVLO threshold; this external resistor-divider is completely independent of the internal threshold.		

Block Diagram



Functional Description

The OVP switch with over-voltage protection feature a low 20mΩ (TYP) on-resistance (R_{ON}) internal FET and protect low-voltage systems against voltage faults up to 28 VDC. When the input voltage (V_{IN}) exceeds 6.8V, the internal FET is quickly turned off to prevent damage to the protected downstream components and the flag pin will output logic high state. If there is no input voltage at IN pin, the flag pin output logic high state.

When input (OVLO) is set lower than 0.2V. The over-voltage protection threshold is 6.8V.

The over-voltage protection threshold can also be adjusted by external resistors when input (OVLO) is set higher than 0.3V.

$$V_{IN_OVLO} = V_{OVLO_TH} \times (1 + R1/R2)$$

Note: $V_{OVLO_TH} = 1.2V$ (TYP)

The internal FET turns off when the junction temperature exceeds +155°C (TYP). The device exits thermal shutdown after the junction temperature cools by 20°C (TYP).

Moisture Detection

The moisture detection module is built into the ET9545L, and its principle is shown in the following [Figure 1](#).

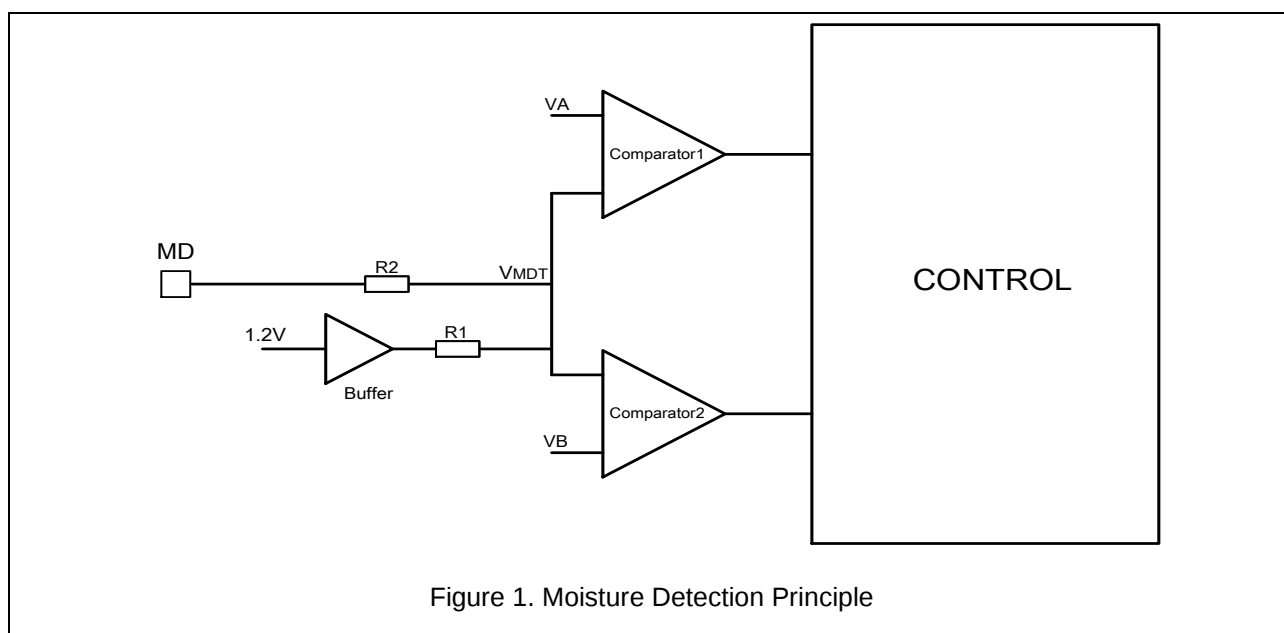


Figure 1. Moisture Detection Principle

When using, place the MD pin on the PCB close to the IN pin. Under normal circumstances, the MD pin is in a floating state, and at this time, $V_B = 0.9V < V_{MDT} = 1.2V < V_A = 2.2V$, no moisture is detected. If there is water vapor on the USB interface at this time, causing the MD pin to connect to the IN, the IN voltage will be transmitted to the V_{MDT} through the MD pin. At this time, $V_{MDT} > V_A$, the output of comparator 1 is inverted, and the FLAG is set high through control logic. If the water vapor from the USB interface causes the MD pin to connect to the GND, then $V_{MDT} < V_B$, the comparator 2 output flips, and the FLAG is set high through control logic.

Input Capacitor

To limit the voltage drop on the input supply caused by transient inrush current when the switch turns on into a discharged load capacitor or short-circuit, a capacitor 0.1 μ F or larger must be placed between the VIN and GND pins.

Output Capacitor

A 1 μ F or larger capacitor should be placed between the OUT and GND pins.

ET9545L

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameters			Min	Max	Unit
V _{IN}	V _{IN} to GND			-0.3	29	V
V _{OUT}	V _{OUT} to GND			-0.3	V _{IN} +0.3	V
V _{OVLO}	OVLO to GND			-0.3	7	V
V _{MD}	MD to GND			-0.3	29	V
V _{FLAG}	FLAG to GND			-0.3	7	V
I _{SW1}	Maximum Continuous Current of switch IN-OUT				5.5	A
I _{SW2}	Maximum Peak Current of switch IN-OUT(10ms)				8	A
P _D	Power Dissipation at T _A = +25°C				1.4	W
T _{STG}	Storage Junction Temperature			-65	+150	°C
T _A	Operating Temperature Range			-40	+85	°C
T _{SOLD}	Soldering Temperature (reflow).				+260	°C
T _J	Junction Temperature				+150	°C
ESD	Electrostatic Discharge Capability	IEC 61000-4-2 System Level ESD	Air Discharge	15.0		KV
			Contact Discharge	8.0		
		Human Body, ANSI/ESDA/JEDEC JS-001-2012	All Pins	>2.0		
		Charged Device Model, JESD22-C101	All Pins	>1.5		
Surge		IEC 61000-4-5, Surge Protection	VIN(NO DC)	-80	80	V

ET9545L

Electrical Characteristics

T_A=-40°C to 85°C unless otherwise noted, typical values are at V_{IN}=5V, I_{IN}≤2A, C_{IN}=0.1uF and T_A=25°C.

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
Basic Operation						
V _{IN}	Input Voltage		3.2		28	V
V _{IN_CLAMP}	Input Clamping Voltage	I _{IN} =10mA		33		V
I _{IN}	V _{IN} Quiescent Current	V _{IN} =5V, OUT Floating		100		μA
R _{ON}	On-Resistance of Switch IN-OUT	V _{IN} =5.0V, I _{OUT} =1A, T _A =25°C		20		mΩ
V _{OVLO}	Over-voltage protect of V _{IN}	V _{IN} Rising, OVLO=GND	6.6	6.8	7.0	V
	Over-voltage protect hysteresis of V _{IN}			0.25		V
	Adjustable OVLO Threshold Range	V _{IN} =3.2V to V _{OVLO}	4		20	V
V _{OVLO_TH}	OVLO Set Threshold	V _{IN} =3.2V to V _{OVLO}	1.18	1.2	1.22	V
V _{OVLO_SEL CET}	External OVLO Select Threshold		0.2		0.3	V
V _{UVLO_R}	Under Voltage	V _{IN} Rising		3.0		V
V _{UVLO_F}	Lockout Threshold	V _{IN} Falling		2.8		V
V _{OL_FLAG}	FLAG Output Logic Low Voltage	V _{PU} =1.8V, I _{SINK} =1mA		0.1	0.2	V
I _{FLAG_LEAK}	FLAG Output HIGH Leakage Current	V _{FLAG} =5V,			0.5	uA
I _{OVLO}	OVLO Input Leakage Current	V _{OVLO} =V _{OVLO_TH}	-100		100	nA
V _A	Moisture to IN Detect Threshold		2.15	2.2	2.25	V
V _B	Moisture to GND Detect Threshold		0.85	0.9	0.95	V
I _{MOI}	Moisture Detect Source/Sink Current			3		uA
T _{SHDN}	Thermal Shutdown ⁽¹⁾			155		°C
T _{SHDN_HYS}	Thermal-shutdown Hysteresis ⁽¹⁾			20		°C
Dynamic Characteristics						
t _{DEB_OVP}	Debounce Time For OVP	Time from V _{UVLO_R} <V _{IN} <V _{OVLO} to V _{OUT} =10% of V _{IN}		15		ms
t _{ON}	Switch Turn-On Time	R _L =100Ω, C _L =22uF, V _{OUT} from 0.1×V _{IN} to 0.9×V _{IN}		2		ms
t _{DEB_MD}	Debounce Time For Moisture Detection	Time from V _{UVLO_R} <V _{IN} <V _{OVLO} to V _{FLAG} become to 0		100		ms

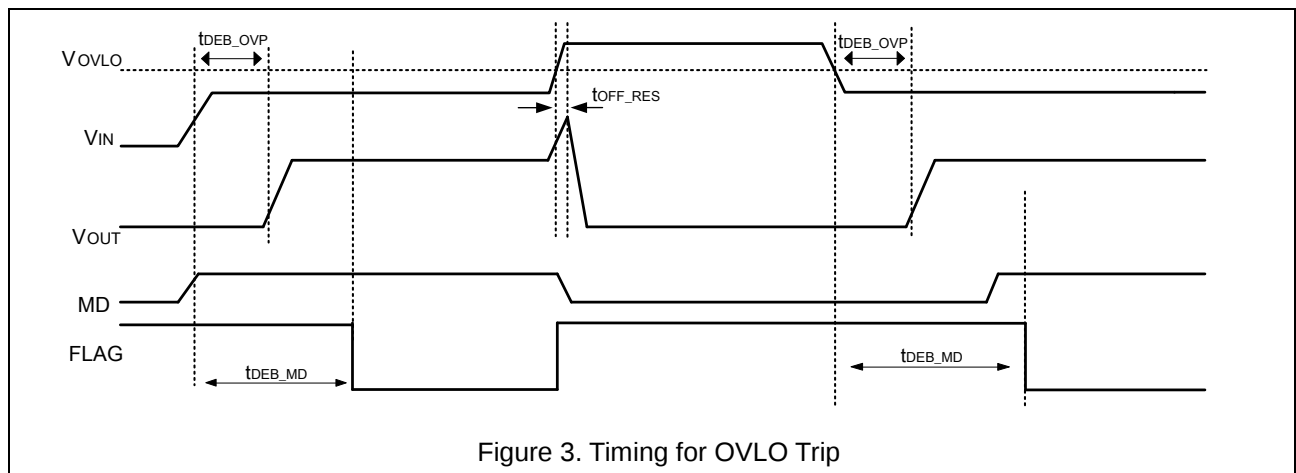
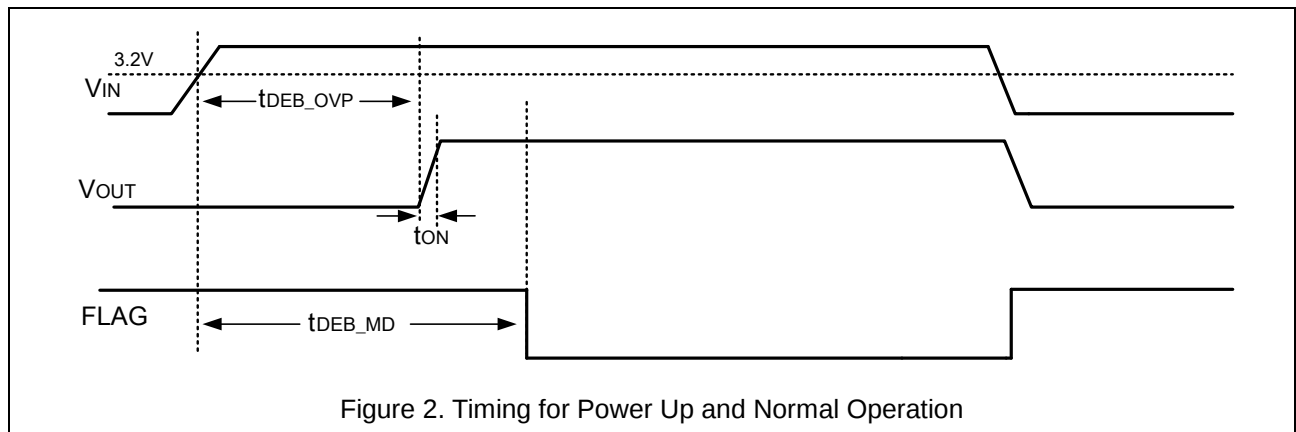
ET9545L

Electrical Characteristics (Continued)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
t_{DEG_MD}		Time from moisture detected to V_{FLAG} become to "H"		1		ms
t_{REC_MD}		Time from moisture disarmed to V_{FLAG} become to "L"		50		ms
$t_{OFF_RES}^{(1)}$	Switch turn-off response time	$V_{IN} > V_{OVLO}$ to V_{OUT} stop rising		50		ns

Note1: Guaranteed by characterization and design.

Timing Waveform



ET9545L

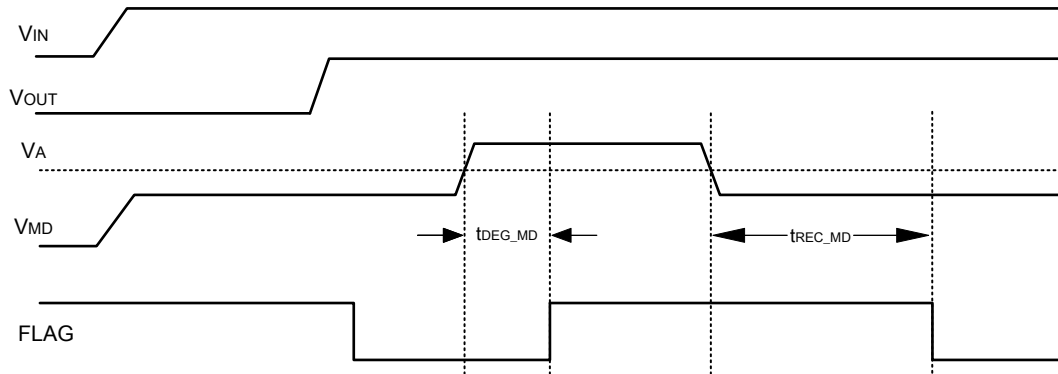
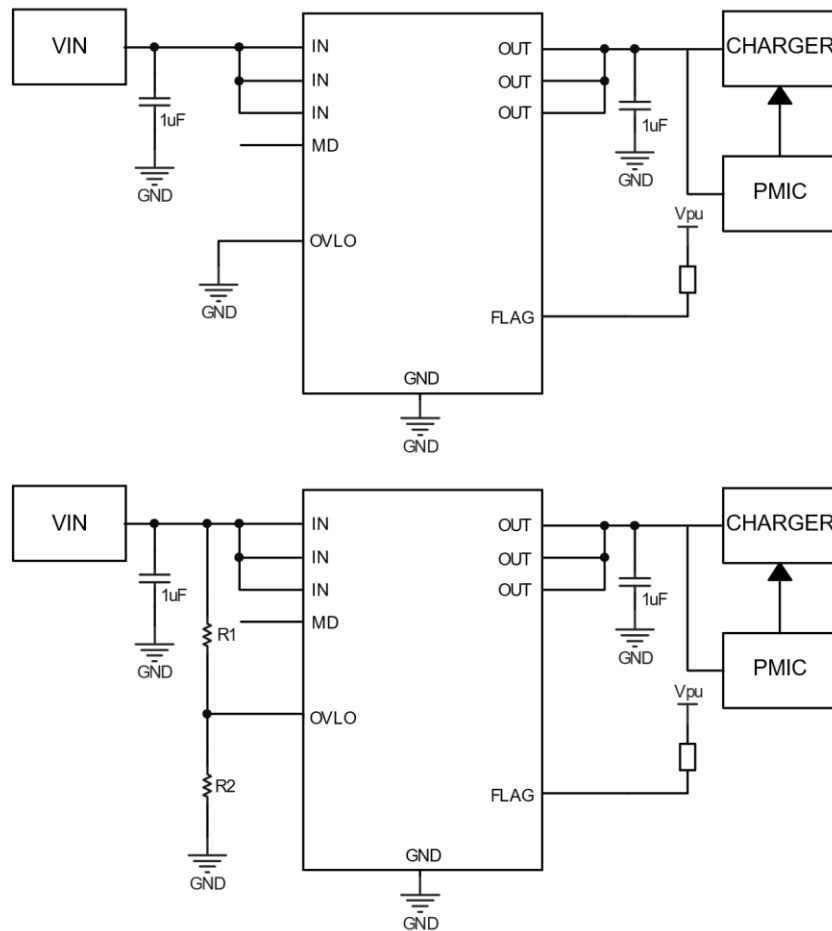


Figure 4. Timing for moisture detection

Application Circuits



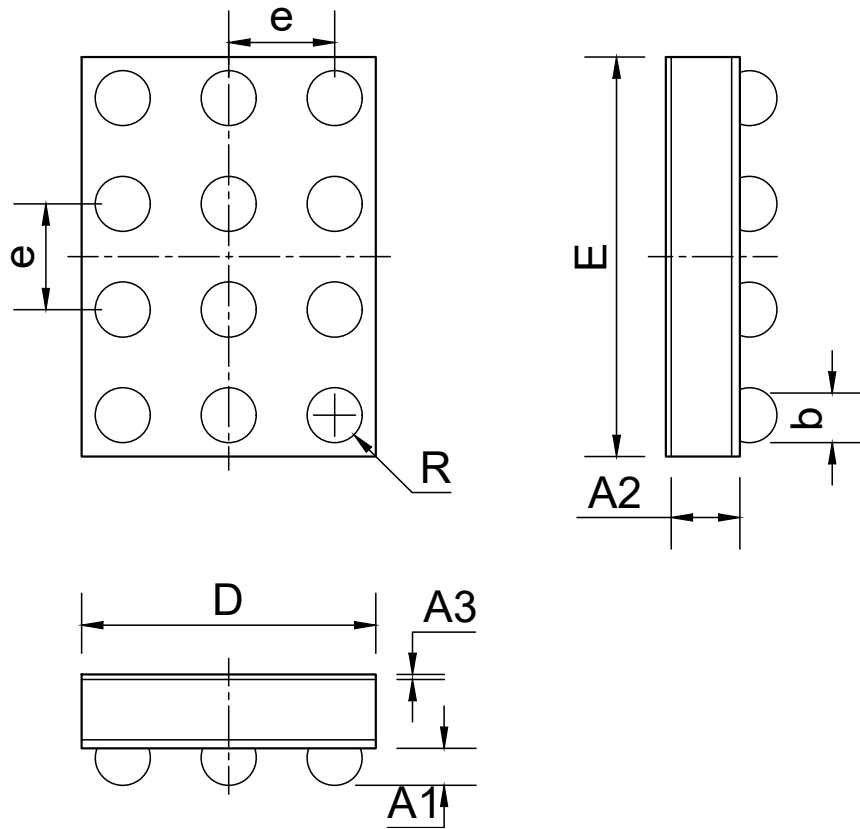
$R1$ and $R2$ are only required for adjustable $OVLO$; otherwise connect $OVLO$ to GND .
Recommend $30K \leq R2 \leq 51K$

Note*: This electric circuit only supplies for reference.

ET9545L

Package Dimension

WLCSP12

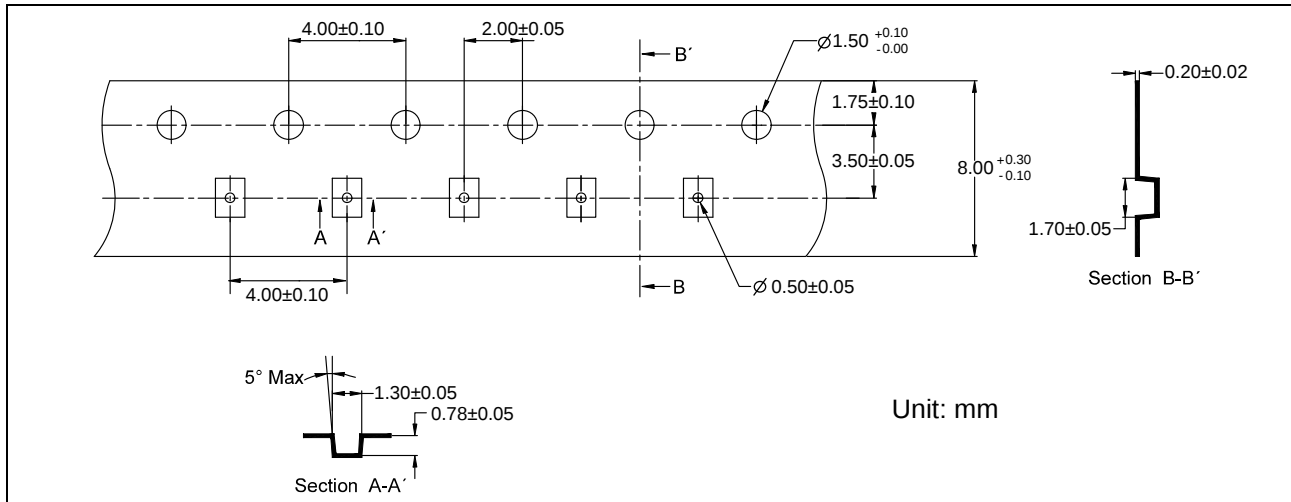


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

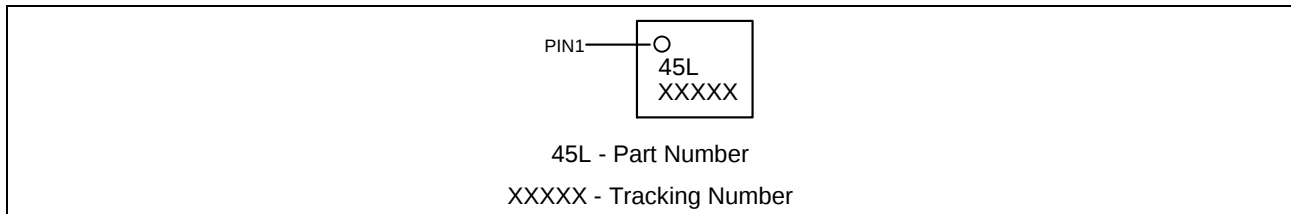
SYMBOL	MIN	NOM	MAX
A1	0.12	0.14	0.16
A2	0.39	0.40	0.41
A3	0.028	0.035	0.042
b	0.15	0.18	0.21
D	1.05	1.10	1.15
E	1.50	1.55	1.60
e	0.40BSC		
R	0.15	0.18	0.21

ET9545L

Tape Information



Marking



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2023.03	Preliminary Version	Wumin	Wuxj	liujy
0.1	2024.04	Preliminary Version	Caojc	Wumin	liujy
1.0	2024.10	Official Version	Caojc	Wumin	liujy