

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

General Description

ET9650M1 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 10.5V.

ET9650M1 has internal Thermal-Shutdown Protection and Input Voltage detection.

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

Features

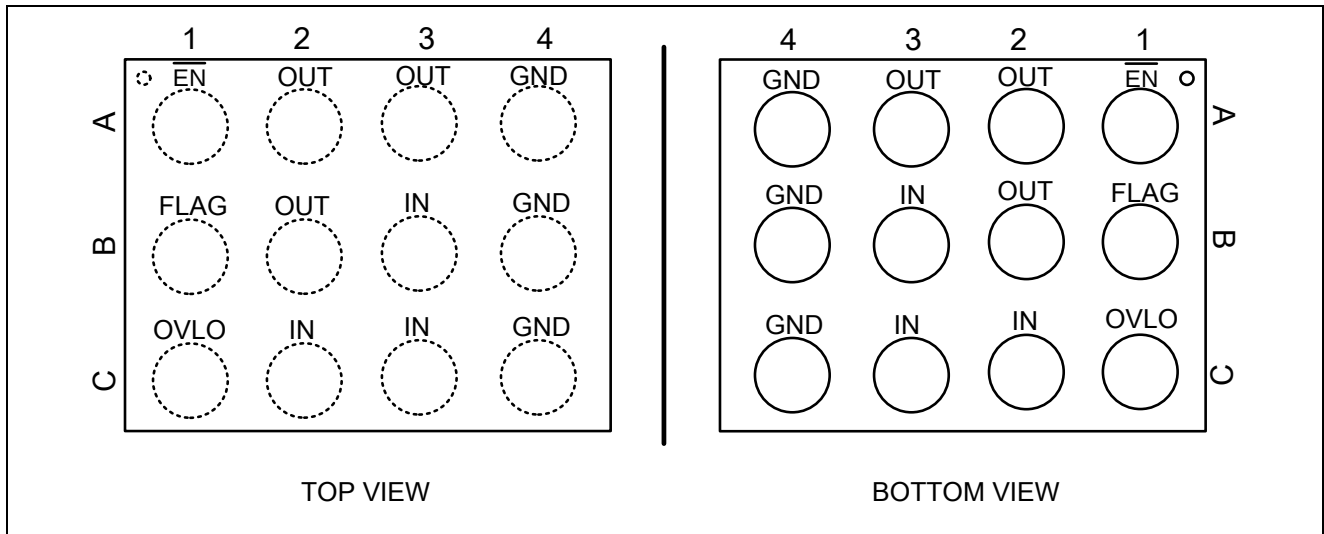
- 6A Continuous Current Capability
- Typical R_{ON} : 15m Ω N-Channel MOSFET
- VIN Operating Range: 2.5V to 28V
- Internal Over-voltage Lockout: 10.5V
- Over-voltage-Protection Response Time: 50ns(TYP)
- Startup Debounce Time:15ms(TYP)
- Internal Thermal-Shutdown Protection
- Surge Immunity to $\pm 100V$
- ESD Protected: Human Body Model (JESD22-A114) All pins $\pm 2KV$ Pass
- WLCSP12 (1.90mm $\times$ 1.29mm 0.4mm pitch) Package
- MSL 1

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

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Pin Configuration

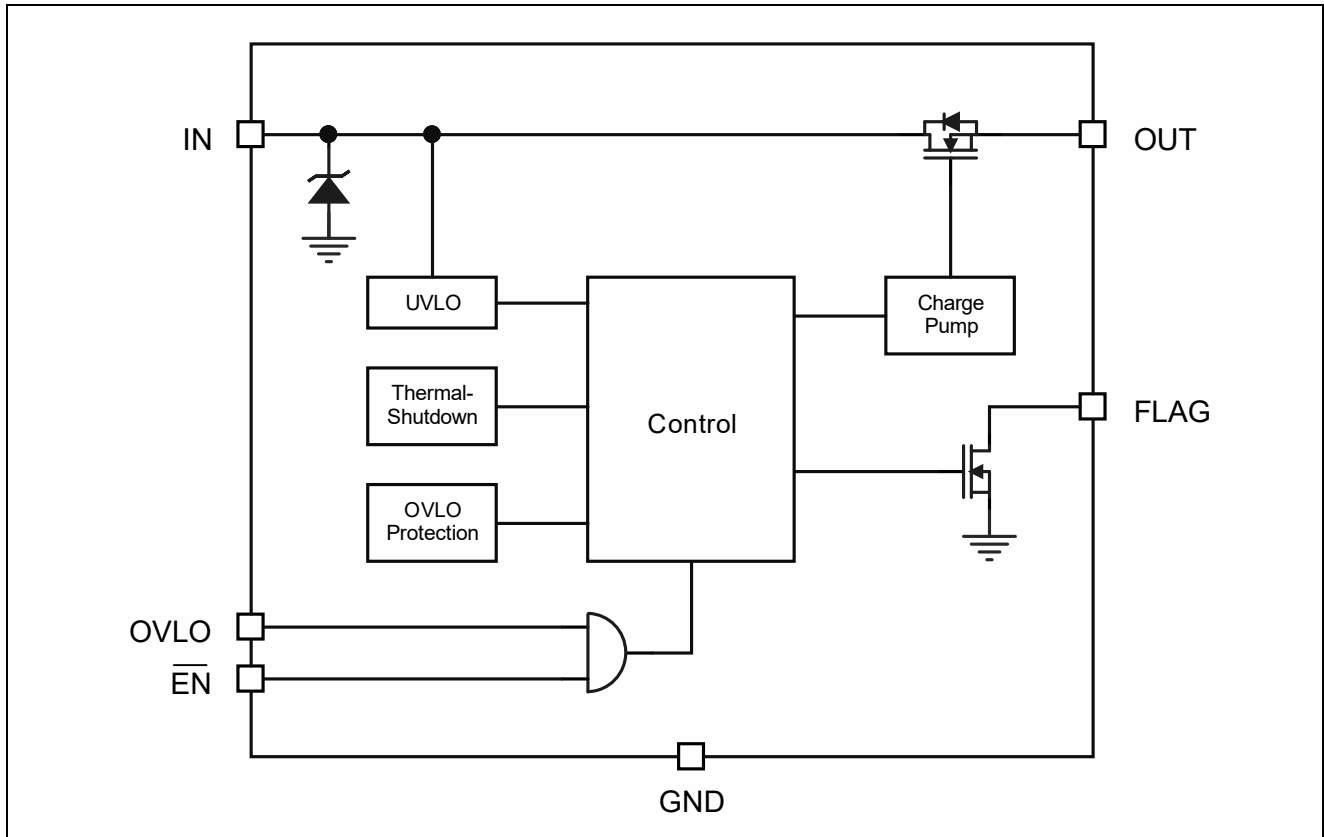


Pin Function

Pin	Name	Description		
A1	EN	Device Enable. Active low.		
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	$V_{IN} < V_{UVLO}$ 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.		

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Block Diagram



Functional Description

The OVP switch with over-voltage protection feature a low 15mΩ (TYP) on-resistance (R_{ON}) internal FET and protect low-voltage systems against voltage faults up to 28 V_{DC}. If $\overline{EN}$ is in the logic low state, when the input voltage (V_{IN}) exceeds 10.5V, 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 $\overline{EN}$ is in the logic high state, the switch will be shutdown. 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 10.5V.

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).

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 0.1μF or larger must be placed between the VIN and GND pins.

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Output Capacitor

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

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}	VIN to GND			-0.3	36	V
V _{OUT}	VOUT to GND			-0.3	See ^(NOTE 1)	V
V _{OVLO}	OVLO to GND			-0.3	7	V
V _{/EN}	$\overline{\text{EN}}$ to GND			-0.3	7	V
V _{FLAG}	FLAG to GND			-0.3	7	V
I _{SW1}	Maximum Continuous Current of switch IN-OUT				6	A
I _{SW2}	Maximum Peak Current of switch IN-OUT(10ms)				8	A
P _D	Power Dissipation at T _A = +25°C				1.48	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	VBUS	-100	100	V

NOTE1: 29V or V_{IN}+0.3V, whichever is smaller.

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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		2.5		28	V
V _{IN_CLAMP}	Input Clamping Voltage	I _{IN} =10mA		36		V
I _{IN}	V _{IN} Quiescent Current	V _{IN} =5V, OUT Floating		90		μA
I _{IN_OVLO}	OVLO Supply Current	V _{IN} =12V, V _{EN} =0V, OUT Floating		100		uA
R _{ON}	On-Resistance of Switch IN-OUT	V _{IN} =5.0V, I _{OUT} =1A, T _A =25°C		15	20	mΩ
V _{OVLO}	Over-voltage protect of V _{IN}	V _{IN} Rising, OVLO=GND	10.3	10.5	10.7	V
	Over-voltage protect hysteresis of V _{IN}			0.25		V
	Adjustable OVLO Threshold Range	V _{IN} =2.5V to V _{OVLO}	4		24	V
V _{OVLO_TH}	OVLO Set Threshold	V _{IN} =2.5V to V _{OVLO}	1.18	1.2	1.22	V
V _{OVLO_SEL}	External OVLO Select Threshold		0.2		0.3	V
V _{UVLO_R}	Under Voltage Lockout Threshold	V _{IN} Rising		2.3		V
V _{UVLO_F}		V _{IN} Falling		2.1		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 _{IH}	$\overline{\text{EN}}$ Input Logic High Voltage		1.2			V
V _{IL}	$\overline{\text{EN}}$ Input Logic Low Voltage	V _{IN} =2.5V			0.3	V
R _{EN}	Pull down Resistor on $\overline{\text{EN}}$			1		MΩ
R _{DIS_IN}	Discharge on IN	V _{IN} =5V, V _{EN} =1.8V		800		Ω
T _{SHDN}	Thermal Shutdown ⁽¹⁾			155		°C
T _{SHDN_HYS}	Thermal-shutdown Hysteresis ⁽¹⁾			20		°C

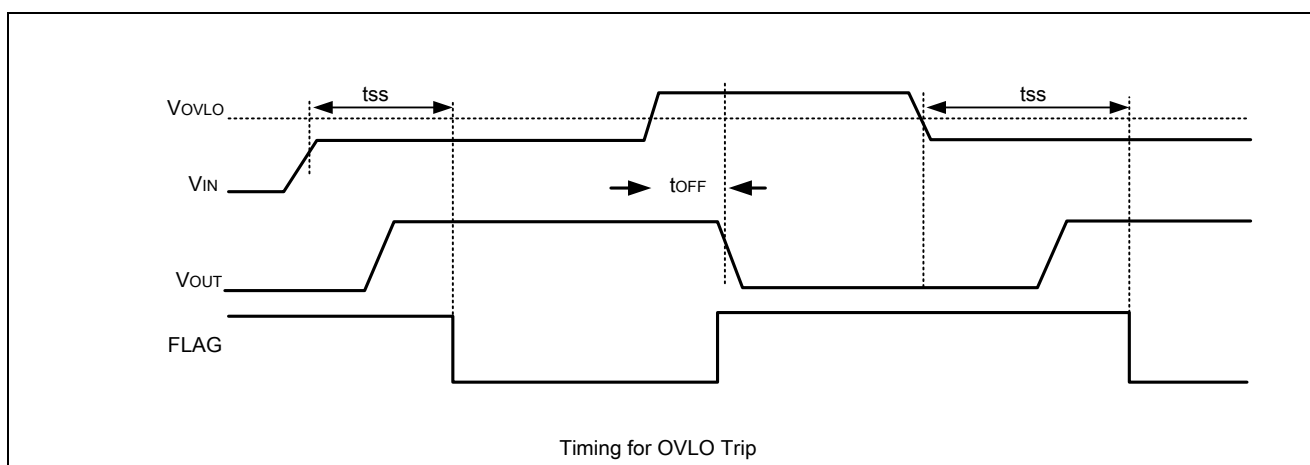
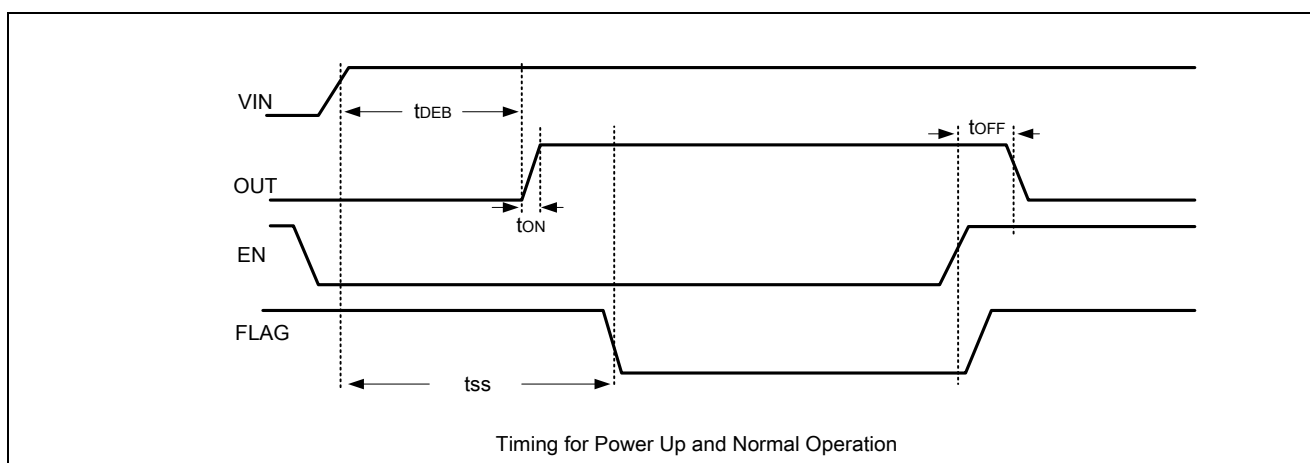
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Electrical Characteristics(Continued)

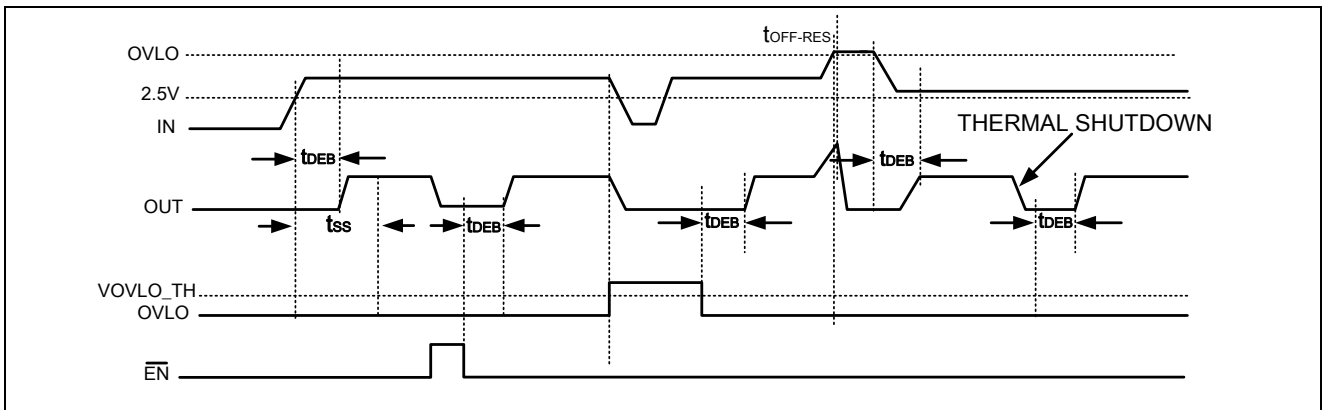
Symbol	Parameters	Conditions	Min	Typ	Max	Unit
Dynamic Characteristics						
t_{DEB}	Debounce Time	Time from $V_{UVLO_R} < V_{IN} < V_{OVLO}$ to $V_{OUT} = 10\%$ of V_{IN}		15		ms
t_{SS}	Soft-start time	Time from $V_{UVLO_R} < V_{IN} < V_{OVLO}$ to $0.2 \times FLAG$, $V_{IO} = 1.8V$ with $10k\Omega$ Pull-up Resistor		30		ms
t_{ON}	Switch Turn-On Time	$R_L = 100\Omega$, $C_L = 22\mu F$, V_{OUT} from $0.1 \times V_{IN}$ to $0.9 \times V_{IN}$		2		ms
$t_{OFF_RES}^{(1)}$	Switch turn-off response time	$V_{IN} > V_{OVLO}$ to V_{OUT} stop rising		50	80	ns

Note1: Guaranteed by characterization and design.

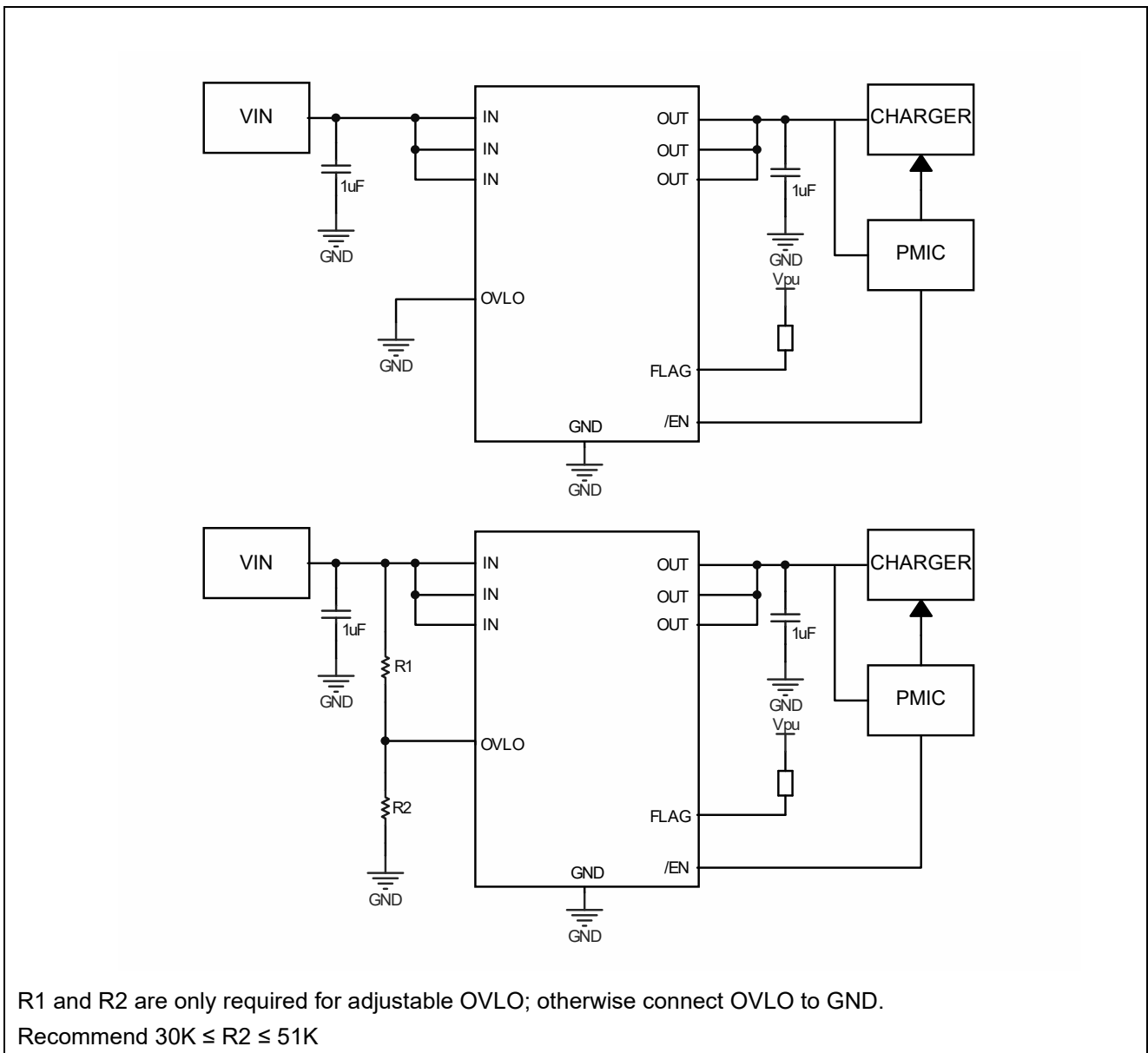
Timing Waveform



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Application Circuits

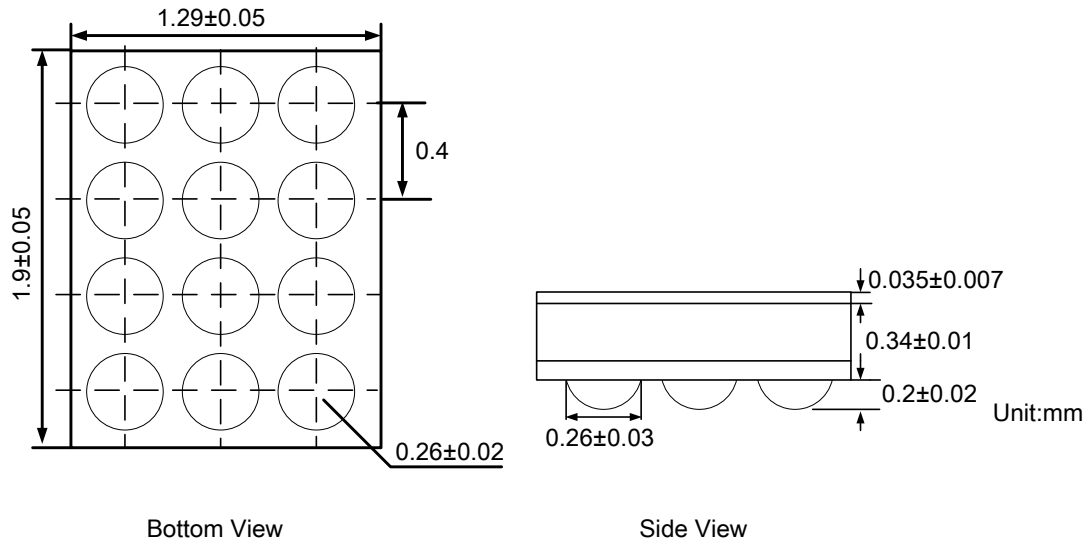


Note*: This electric circuit only supplies for reference.

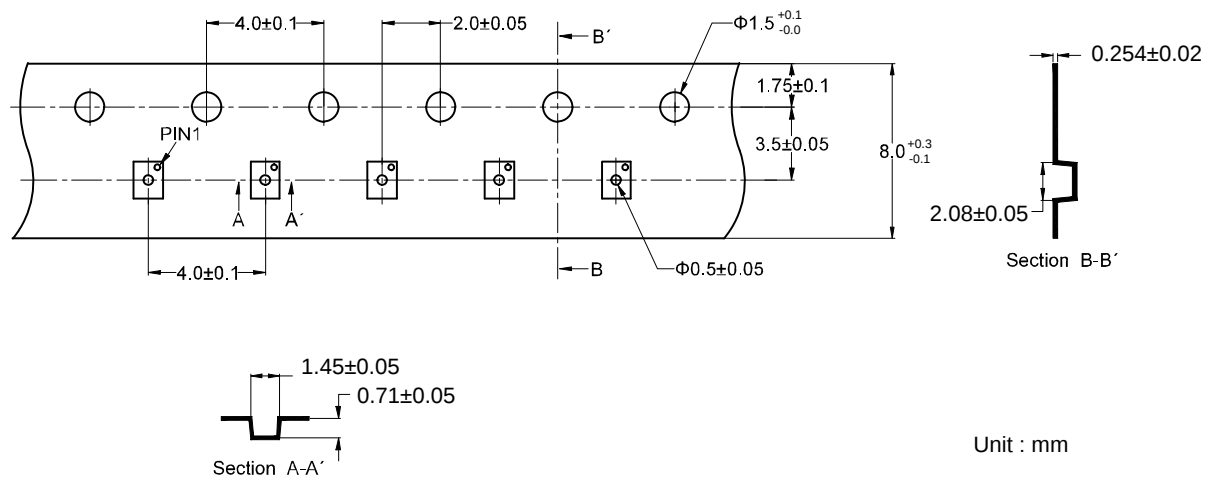
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Package Dimension

WLCSP12

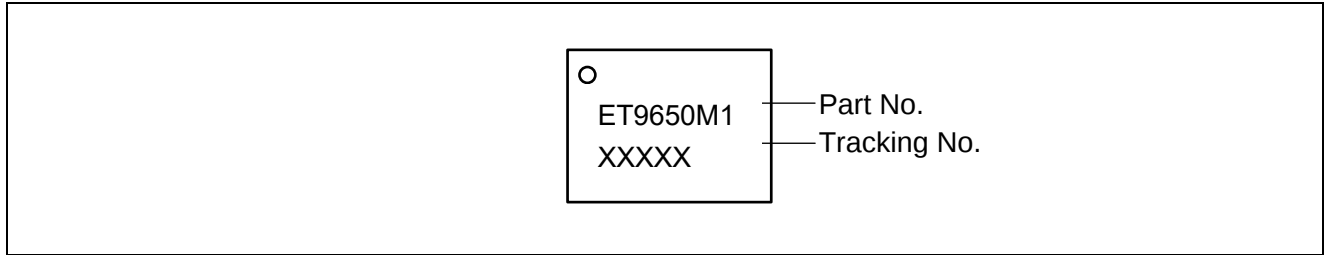


Tape Information



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Marking



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2019-07-18	Initial Version	Wum	Wum	Liuji
1.1	2019-08-20	Add Tape Information	Wum	Wum	Liuji
1.2	2019-11-01	Add Marking	Wum	Wum	Liuji
1.3	2020-03-17	Add MSL level	Wum	Wum	Liuji
1.4	2023-2-28	Update Typeset	Shibo	Wum	Liuji