High-Current Over-voltage Protectors with Adjustable OVLO and Integrated Reverse Blocking FET

General Description

ET9919B can disconnect the systems from its output pin(OUT) in case wrong input operating conditions are detected. It achieve wide input voltage range from 2.5V to 26V and reverse blocking voltage up to 36V. The inside reverse blocking FET prevents the leakage current from output side to input side when input power supply is removed. ET9919B has an internal 14.5V OUT over-voltage protect threshold voltage and thresholds can also be programmed by outside OVLO pin. High accuracy current indicator is set internally. Default 7.5A over current protection is also set inside. Enable control is available to cut off the energy path. ET9919B has internal Thermal-Shutdown Protection.

The device is packaged in advanced WLCSP12,which is ideal for small form factor portable equipment .

Features

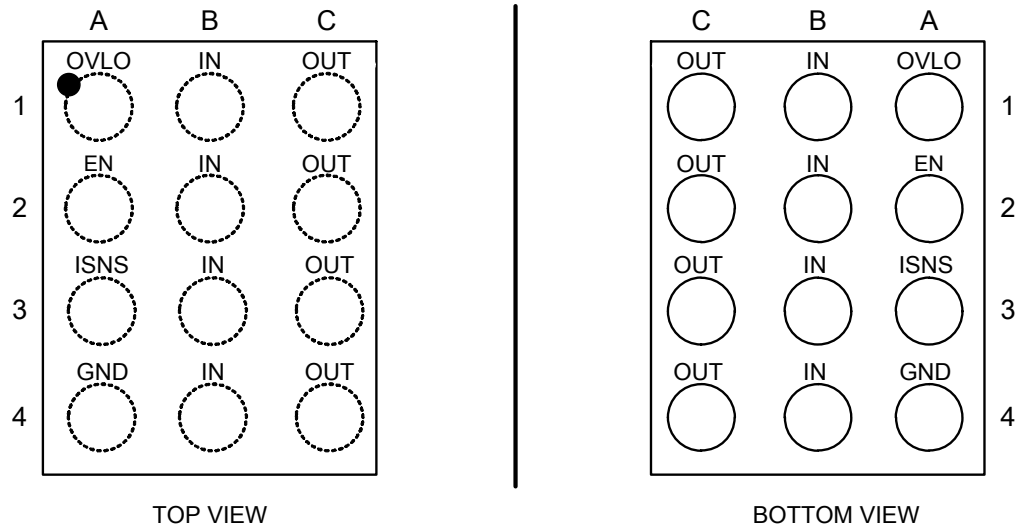
- 4A continuous current capability
- Typical R_{ON} is 38mΩ from input to output power path
- VIN operating range from 2.5V to 26V
- Internal reverse blocking FET up to 36V
- Internal OUT over-voltage lockout is 14.5V typical
- Programmable OVP through outside resistors connected to OVLO pin
- Over-voltage protection response time is70ns typical
- +/- 4% High accuracy current indicator
- Startup debounce time is 7.0ms typical
- Internal thermal-shutdown protection
- ESD protected: Human Body Model: JESD22-A114(All pins) ± 2KV
- MSL1
- Pat No. and Package

Part No.	Package
ET9919B	WLCSP12 (1.77mm×1.47mm, ball pitch=0.4mm)

Application

- Smartphones, Tablet PC
- Mobile Devices
- Tablet PCs

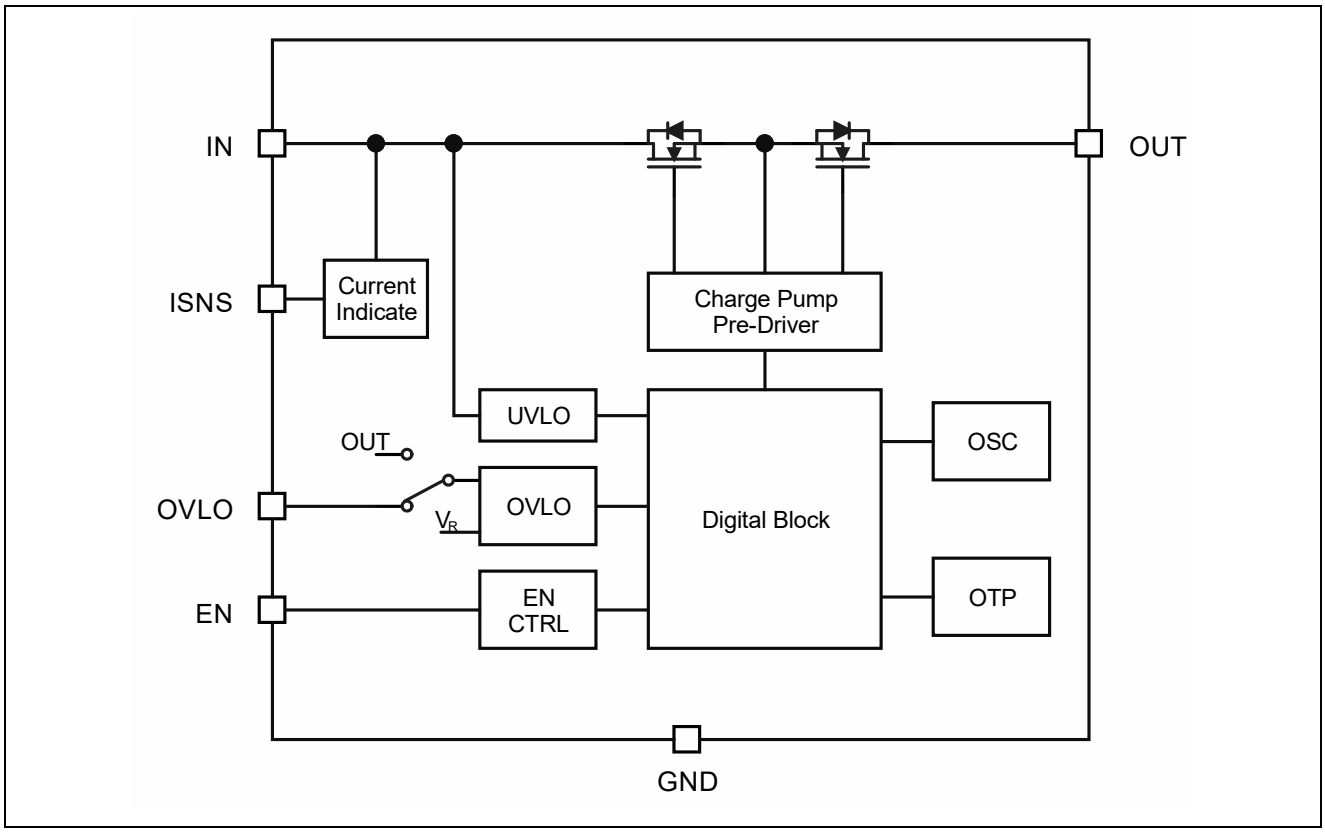
Pin Configuration



Pin Function

Pin No.	Pin Name	Function
A1	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.
A2	EN	Device Enable. Active high.
A3	ISNS	Current Indicator pin.
A4	GND	Ground. Connect GND pins together for proper operation.
B1,B2,B3,B4	IN	Voltage Input. Connect IN pins together for proper operation.
C1,C2,C3,C4	OUT	Output Voltage. Output of internal switch. Connect OUT pins together for proper operation.

Block Diagram



Functional Description

The OVP switch and reverse blocking FET are total 38mΩ (TYP) on-resistance (R_{ON}) and protect low-voltage systems against voltage faults up to 36VDC. If EN is in the logic high state, when the output voltage (V_{OUT}) exceeds 14.5V, the internal FET is quickly turned off to prevent damage to the protected downstream components. If EN is in the logic low state, the switch will be shutdown.

Reverse blocking FET can prevent the leakage current from output side to input side when the input power is removed. The RCB voltage is up to 36V.

Over-voltage Protection

When V_{OVLO} is set lower than 0.25V. The over-voltage protection threshold is 14.5V.

The over-voltage protection threshold can also be adjusted by external resistors when V_{OVLO} is set higher than 0.3V.

$$\mathbf{V_{OUT\_OVLO} = V_{OVLO\_TH} \times (1+R1/R2)}$$

Note: V_{OVLO_TH} = 1.20V (TYP.)

Current Indicate

Load current can be indicated by ISNS pin. It has high accuracy which is up to +/- 4%. Also a 7.5A over current protection is integrated inside.

Thermal Shutdown

The internal FET turns off when the junction temperature exceeds +160° C (TYP.). The device exits thermal shutdown after the junction temperature cools by 20° C (TYP.) and holds more than 100ms.

Input Capacitor

To limit the voltage drop on the input supply caused by transient inrush current when the switch turns on into load capacitor or short-circuit, a 1μF or lager capacitor must be placed between the IN and GND pins.

Output Capacitor

A 1μF or lager 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},V_{EN},V_{OVLO}	IN/EN/OVLO to GND	-0.3	36	V
V_{OUT}	OUT to GND	-0.3	29	V
V_{ISNS}	ISNS to GND	-0.3	7	V
I_{SW1}	Maximum Continuous Current of switch IN-OUT		4	A
I_{SW2}	Maximum Peak Current of switch IN-OUT(10ms)		5	A
P_D	Power Dissipation at T_A= +70°C		960	mW
T_{STG}	Storage Junction Temperature	-65	+150	°C
T_A	Operating Temperature Range	-40	+85	°C
T_{SOLD}	Soldering Temperature (reflow)		+260	°C
T_{JMAX}	Max Junction Temperature		+150	°C

Electrical Characteristics

Unless otherwise noted, typical values are at V_{IN}=5V and T_A=25°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Basic Operation						
V_{IN}	Input Voltage		2.5		26	V
V_{RB}	Reverse Blocking Range				26	V
I_{IN}	V_{IN} Quiescent Current	V_{IN}=5V, OUT floating		100		μA
I_{RB}	Reverse Blocking Current	V_{IN}=0V, V_{OUT}=16V, EN=0V		3	6	uA
I_{SD}	Shutdown Current	V_{IN}=5V, EN=0V		13	18	uA
R_{ON}	On-Resistance of Switch IN-OUT	V_{IN}=5.0V, I_{OUT}=1A		38		mΩ

Electrical Characteristics (Continued)

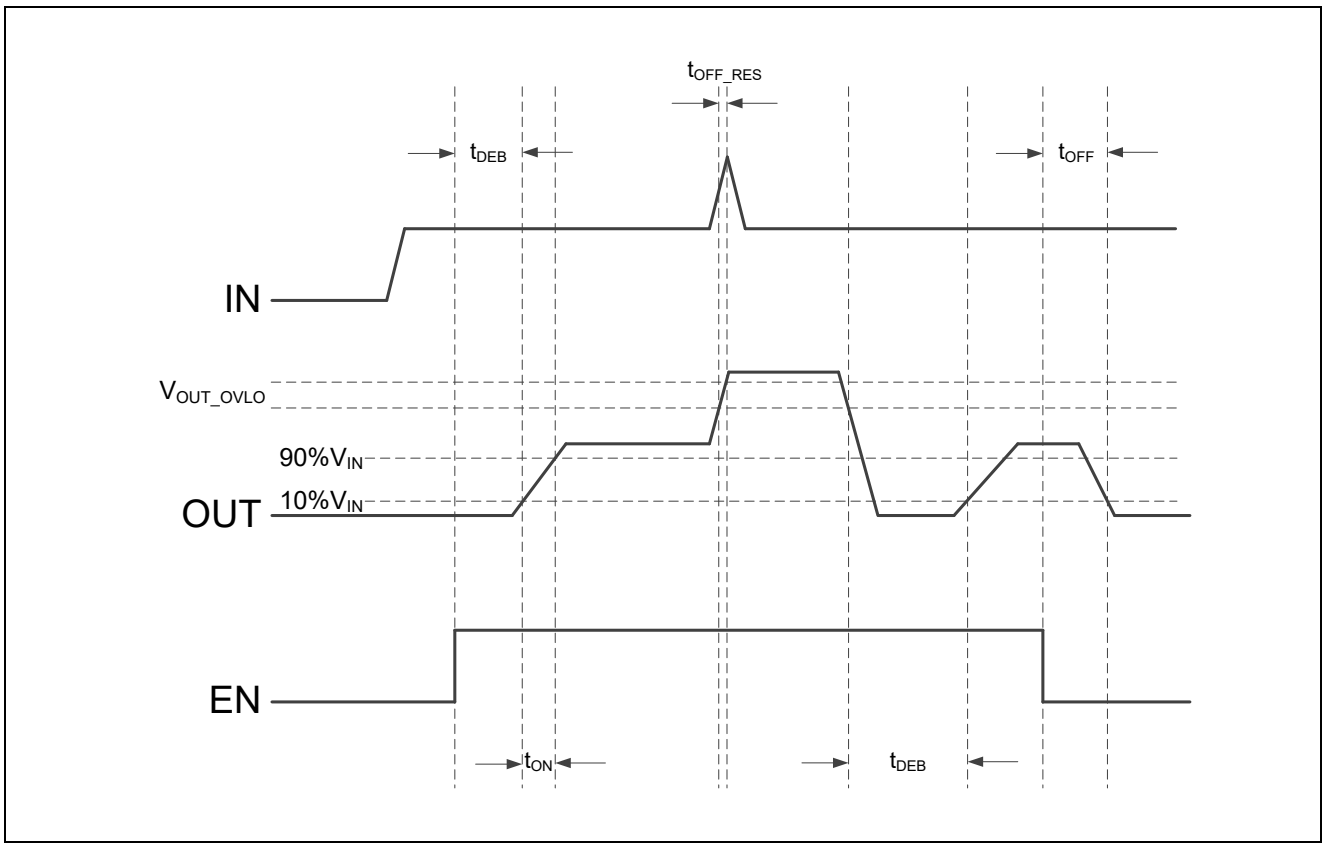
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OVLO}	Overvoltage Protect of V_{OUT}	V_{OUT} rising	13.5	14.5	15.5	V
		V_{OUT} falling		14.2		
	Over-voltage Protect Hysteresis of V_{IN}			0.30		V
V_{OVLO_ADJ}	Adjustable OVLO Threshold Range		4		20	V
V_{OVLO_TH}	OVLO Set Threshold		1.16	1.20	1.24	V
V_{OVLO_SEL}	External OVLO Select Threshold		0.2		0.3	V
V_{UVLO_R}	Under Voltage Lockout Threshold	V_{IN} rising		2.4	2.7	V
		V_{IN} falling		2.3		
V_{ISNS}[(1)]	Current Indicator Accuracy	I_{OUT}=0.5A,R_{SNS}=806Ω	302	315	328	mV
		I_{OUT}=1.0A,R_{SNS}=806Ω	604	630	656	mV
	Sampling Ratio			1280		
V_{IH}	EN Input Logic High Voltage		1.0			V
V_{IL}	EN Input Logic Low Voltage				0.3	V
T_{SHDN}	Thermal Shutdown			160		℃
T_{SHDN_HYS}	Thermal-Shutdown Hysteresis			20		℃
Dynamic Characteristics						
t_{DEB}	Debounce Time	Time from 2.1V<V_{IN}<V_{OVLO} to V_{OUT}=10% of V_{IN}		7.0		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}		2.0		ms
t_{OFF_RES}[(2)]	Switch Turn-off Response Time	V_{IN} > V_{OVLO} to V_{OUT} stop rising		70		ns
t_{OFF}	Switch Turn-off Time	Disable to V_{OUT}=10% V_{IN} V_{IN}=5.0V, C_{OUT}=10uF, R_{OUT}=100Ω		2.6		ms

Note1: Current Indicator Voltage can be calculated as below equation.

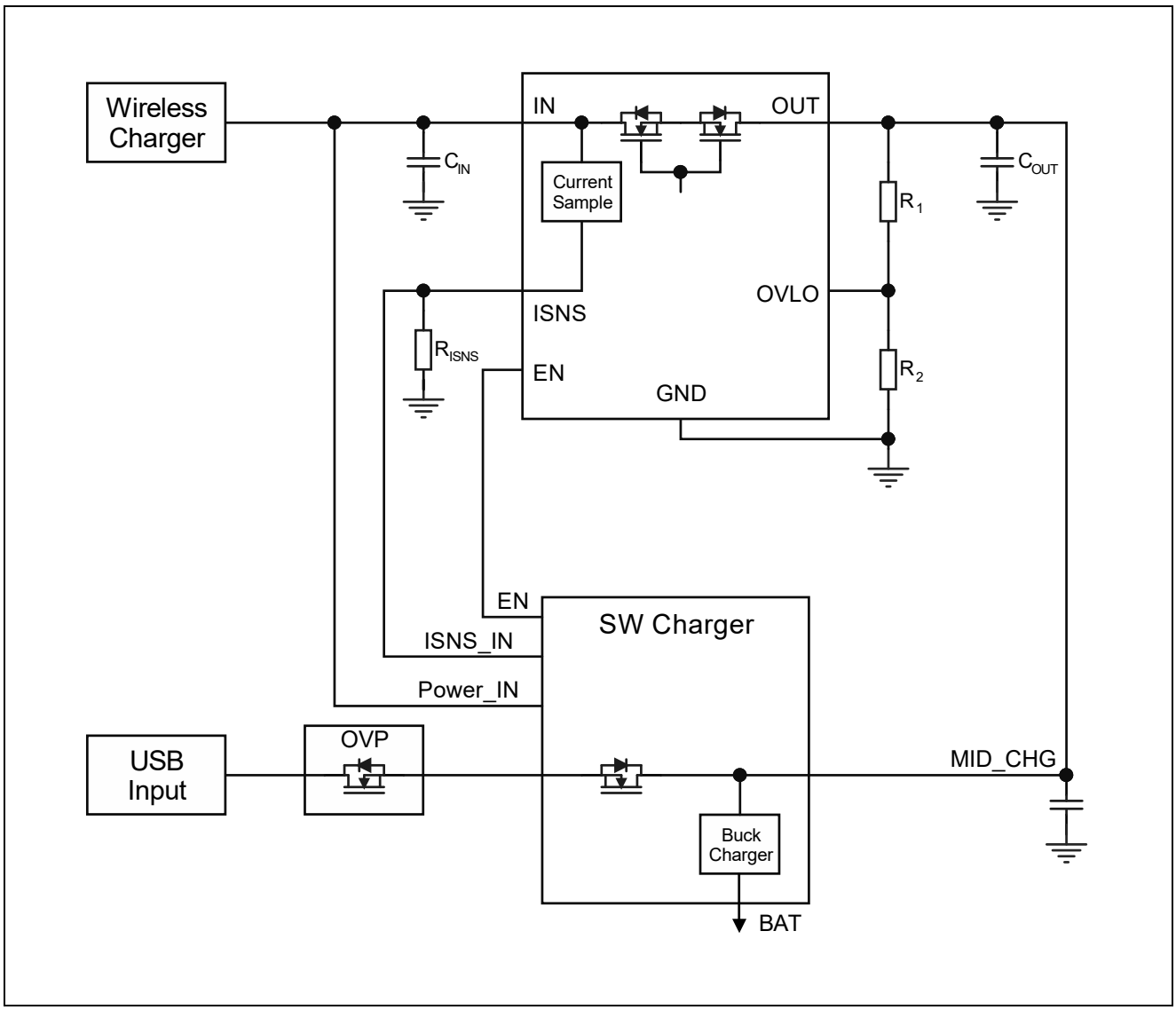
$$V_{ISNS} = \frac{I_{OUT} \times R_{SNS}}{K}$$

Note2: Guaranteed by characterization and design.

Timing Diagrams



Application Circuits

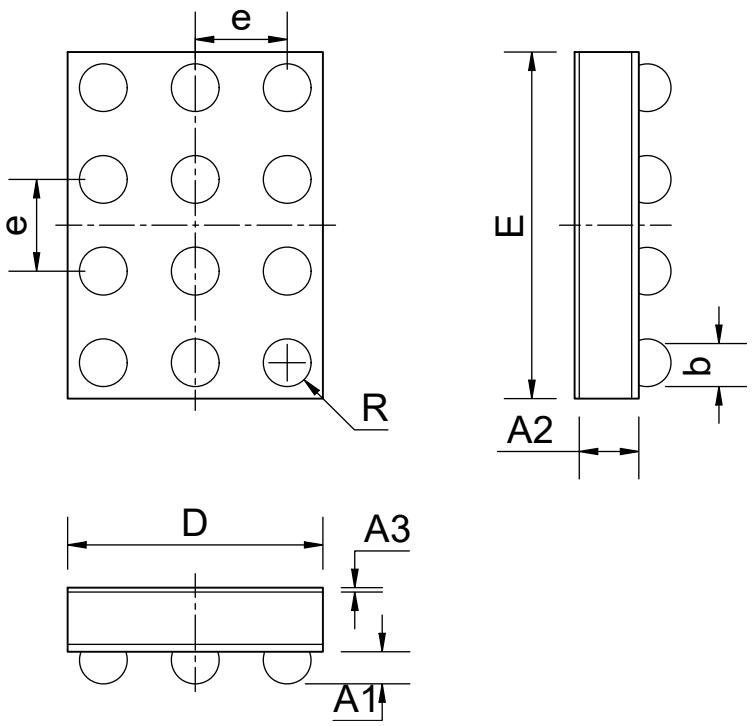


Notes*:

- This electric circuit only supplies for reference.
- Recommended RISNS value is 500Ω ~ 2000Ω.
- If the ISNS function is not used, the ISNS pin must be short-circuited to GND,can't be floating.

Package Dimension

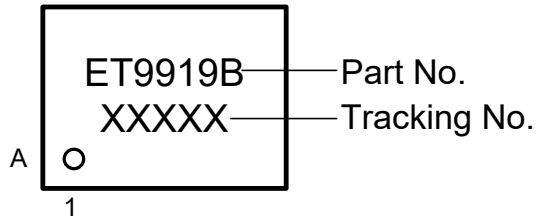
WLCSP12



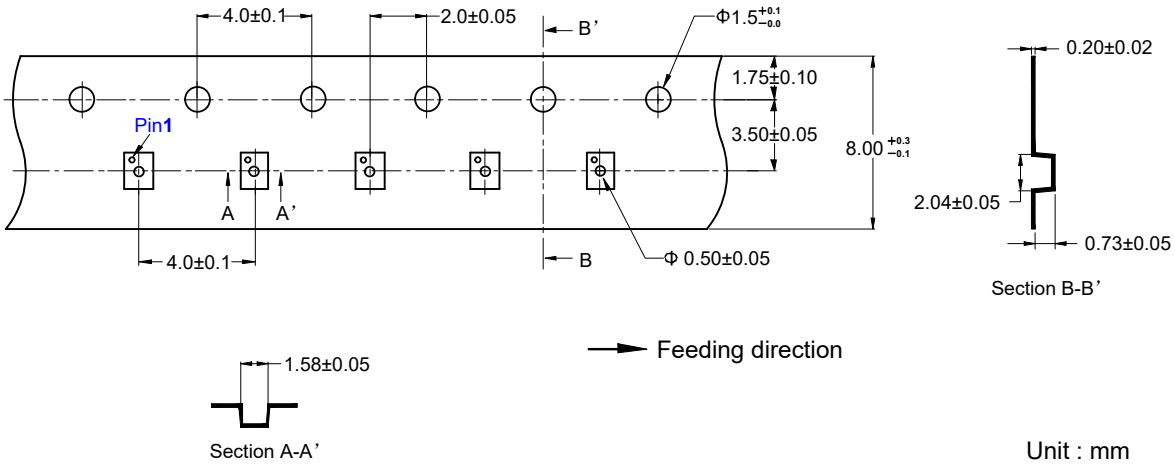
COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A1	0.17	0.20	0.23
A2	0.305	0.335	0.365
A3	0.03	0.04	0.05
b	0.21	0.24	0.27
D	1.44	1.47	1.50
E	1.74	1.77	1.80
e	0.40BSC		
R	0.21	0.24	0.27

Marking



Tape Information



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2021-1-13	Original Version	Yangz	Yangz	Zhujl
1.1	2021-3-31	1. Modify Maximum Continuous Current from 5A to 4A 2. Modify Maximum Peak Current of switch from 7A to 5A 3. Add Note of V_{ISNS} calculate equation.	Yangz	Yangz	Zhujl
1.2	2023-4-19	Update Typeset Add application diagram notes	Shib	Yangz	Zhujl