Programmable Current Limit Switch with Over-Voltage Protection

Features

- Wide input voltage range from 3V to 6.8V
- Maximum input voltage is 32V
- Integrated low R_{dson} switch: 105mΩ
- Programmable current limit from 100mA to 1.5A
  - 1.5A with 10% Accuracy
- 6.8V input over-voltage shut-off
- OVP response time: less than 1μs
- 5.8V output clamp voltage
- Thermal shutdown protection
- Fault output
- Enable interface pin
- DFN 2mmx2mm-8L

Applications

- White goods, Appliances
- Set-top boxes, DVD and Gaming consoles
- Adapter power devices
- Smart meters, Gas analyzers
- Smart load switches/USB switches

General Description

AW35018 is a smart e-Fuse with robust over-current and over-voltage protection. The wide operating voltage allows control of many popular DC buses.

AW35018 uses N-channel MOSFET as power switch, and allows the user to program the current-limit threshold between 100mA to 1.5A with an external resistor.

AW35018 can withstand 32V DC voltage. In the events that an incorrect voltage is IN, the output voltage clamps to 5.8V to protect the load. If the voltage at IN exceeds 6.8V, the device disconnects the load to prevent damage to the device and load.

Additional features include enable, under-voltage, over-temperature and fault flag output are provided to monitor system status.

Typical Application Circuit

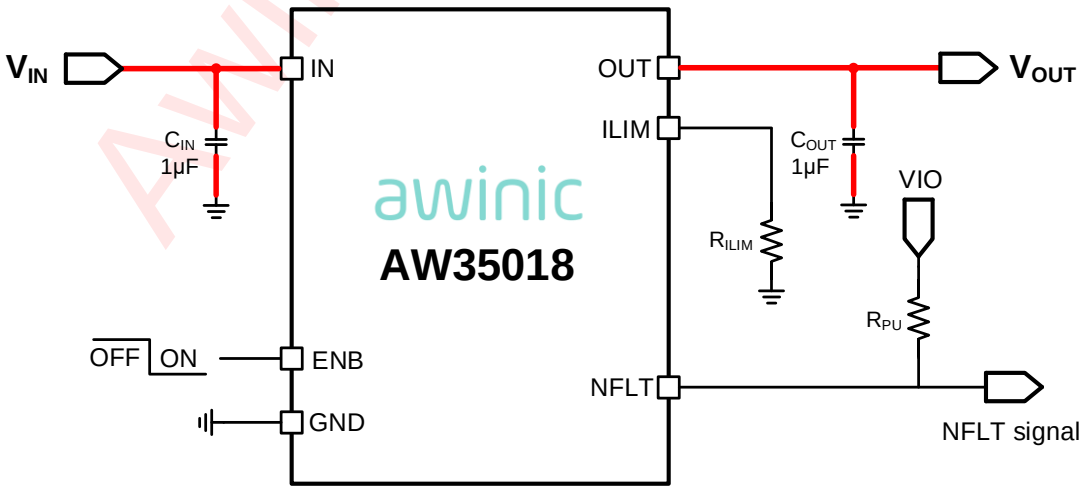
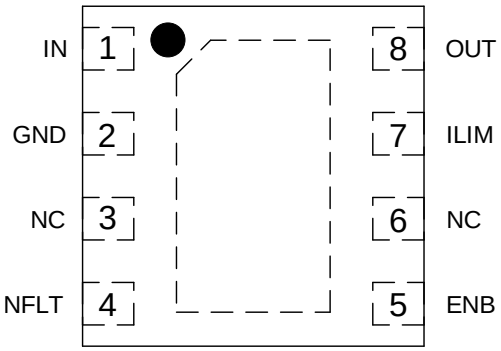


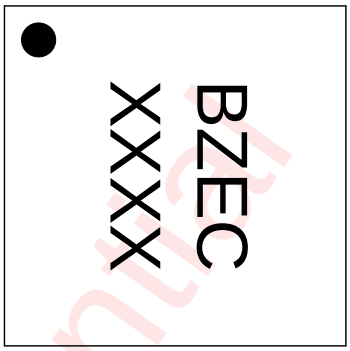
Figure 1 Typical Application Circuit

Pin Configuration And Top Mark

AW35018DNR
(Top View)



AW35018DNR Marking
(Top View)



BZEC - AW35018DNR
XXXX - Production Tracing Code

Figure 2 Pin Configuration

Pin Definition

No.	NAME	DESCRIPTION
1	IN	Power input. Supply voltage of the device.
2	GND	Ground.
3	NC	Not connect.
4	NFLT	Active-low open-drain output, connect a pull up resistor to high. Asserted low during over-voltage, over-current, over-temperature.
5	ENB	Chip enable pin. When ENB is driven low, the power switch is enabled. When it is driven high, turn power switch off.
6	NC	Not connect.
7	ILIM	An external resistor R_{ILIM} from this pin to GND. Setting current limit threshold，The calculation formula is as follows $I_{LIM} = 25 / R_{ILIM}$ (A) where R_{ILIM} is in kΩ. Recommended 16.6 kΩ ≤ R_{ILIM} ≤ 250 kΩ. When ILIM shorts to GND, current-limit threshold is about 2.5A. ILIM pin is not allowed to float.
8	OUT	Power output.
	Thermal pad	Connect Thermal PAD to GND terminal externally, used to heat-sink the part to the circuit board traces.

Functional Block Diagram

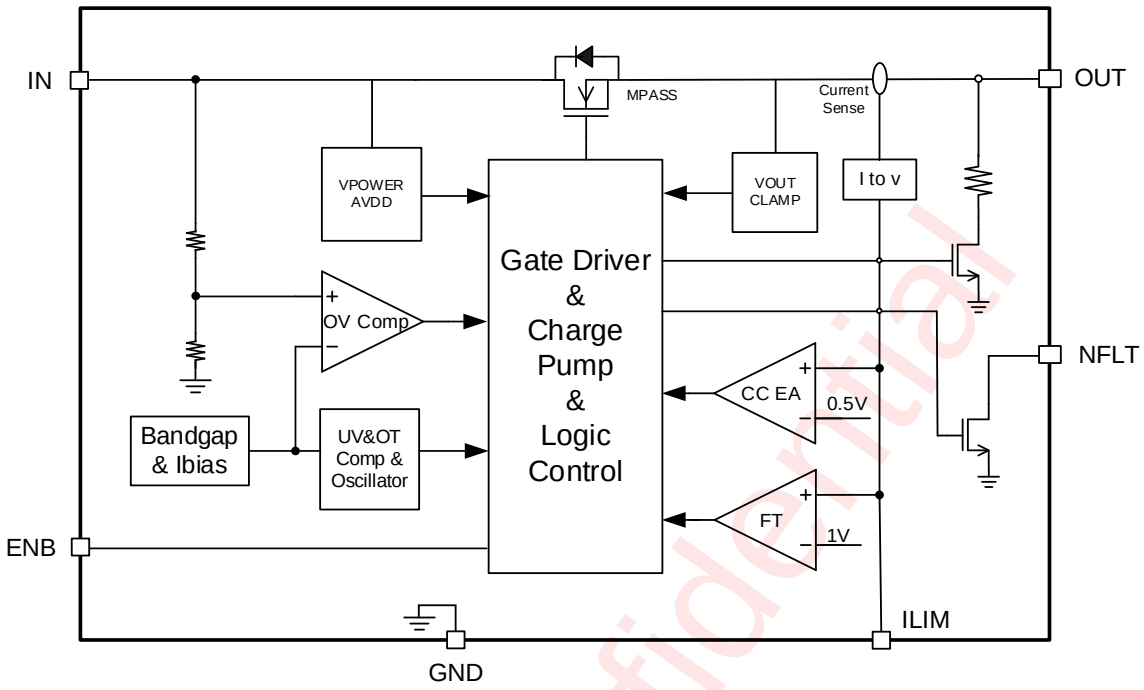


Figure 3 Functional Block Diagram

Typical Application Circuits

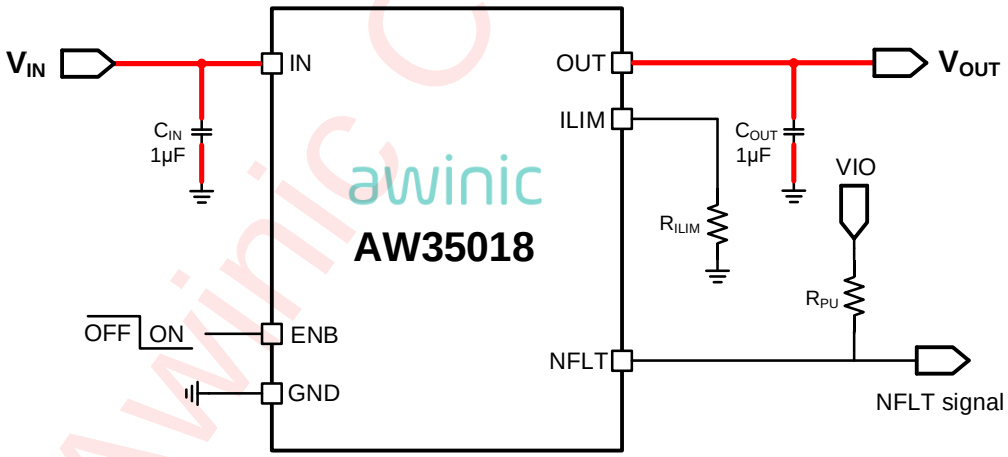


Figure 4 Application Circuit

Notice for typical application circuits:

1. All peripheral devices should be as close as possible to the chip, C_{IN}, C_{OUT} should be close to V_{IN}, V_{OUT} pins respectively. Besides the metal traces between them should be short and wide.
2. The traces routing the RILIM resistor to the device must be as short as possible to reduce parasitic effects on the current limit accuracy.
3. If NFLT is not used, it can be left floating.
4. IN, OUT support 1.5A current, the routing lines should be as wide as possible.
5. The Thermal PAD must be directly connected to PCB ground plane using wide and short copper trace.

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW35018DNR	-40°C to 85°C	DFN 2mm×2mm-8L	BZEC	MSL1	ROHS+HF	4500 units/ Tape and Reel

Absolute Maximum Ratings(NOTE1)

PARAMETERS		RANGE
Input voltage range	IN	-0.3V to 32V
	ENB, ILIM	-0.3V to 6V
Output voltage range	OUT	-0.3V to 7V
	NFLT	-0.3V to 6V
Junction-to-ambient thermal resistance θ_{JA}(NOTE2)		124.7°C/W
Maximum operating junction temperature T_{JMAX}		150°C
Storage temperature T_{STG}		-65°C to 150°C
Lead temperature (soldering 10 seconds)		260°C
ESD and Latch-Up		
HBM (Human Body Model) (NOTE3)		±2kV
CDM (NOTE4)		±1.5kV
Latch-Up (NOTE5)		±200mA

NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE2: Thermal resistance from junction to ambient is highly dependent on PCB layout.

NOTE3: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ESDA/JEDEC JS-001-2017

NOTE4: Test method: ESDA/JEDEC JS-002-2018

NOTE5: Test method: JESD78E

Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IN}	Power voltage	3		6.8	V
V_{NFLT}, V_{ENB}, V_{ILIM}	Input/output voltage	0		5.5	V
I_{OUT}	Current limit	0.1		1.5	A
T_A	Ambient temperature	-40		85	°C
R_{ILIM}	Current-limit set resistor	16.6		250	kΩ
C_{IN}	Input capacitor	0.1	1	100	μF
C_{OUT}	Output capacitor	1		100	μF

Electrical Characteristics

T_A = 25°C, V_{IN} = 5V, V_{ENB}=0V, R_{ILIM}=25kΩ, C_{IN} = 1μF, C_{OUT} =1μF, unless otherwise noted.

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
INPUT VOLTAGES and CURRENTS						
V_{IN_RNG}	V_{IN} supply voltage range		3		6.8	V
V_{IN_UVLO}	Under-voltage lockout threshold	V_{IN} rising	2.6	2.75	2.9	V
		V_{IN} falling	2.5	2.65	2.8	V
I_Q	VIN supply current	V_{ENB}=0V, V_{IN}=5V, I_{OUT}=0mA		170	230	μA
I_{SD}	Shutdown current	V_{ENB}=2V, V_{IN}=5V		1	1.8	μA
t_{DEG}	V_{IN} power on deglitch time			8	12	ms
OVER-VOLTAGE PROTECTION						
V_{IN_OVLO}	OVP threshold voltage	V_{IN} rising	6.5	6.8	7.1	V
		Hysteresis		120		mV
$t_{OVP\_REC\_DEG}$	OVP recovery deglitch time			8	12	ms
t_{OFF}	OVP turn off response time	C_{OUT}=1μF, R_L=100Ω, V_{IN}>V_{IN_OVLO} to V_{OUT} stop rising, V_{IN} rise at 3V/μs		200		ns
V_{OVC}	Output-voltage clamp	C_{OUT}=1μF, R_L=100Ω, V_{IN}=6.5V	5.65	5.8	6	V
CURRENT LIMIT						
I_{LIM}	Current limit	V_{IN}=5V, R_{ILIM}=16.6kΩ, T_A=25°C	1.35	1.5	1.65	A
		V_{IN}=5V, R_{ILIM}=25kΩ, T_A=25°C	0.9	1	1.1	A
		V_{IN}=5V, R_{ILIM}=50kΩ, T_A=25°C	0.45	0.5	0.55	A
t_{DEG_OCP}	OCP deglitch time			8		ms
t_{OCP_RETRY}	OCP retry delay			130		ms
POWER MOSFET						
R_{dson}	Switch on resistance	I_{OUT}=0.2A	90	105	120	mΩ
		I_{OUT}=0.45A	90	105	120	mΩ
THERMAL						
T_{SDN}	Thermal shutdown threshold	Temperature rising		150		°C

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
T_{SDN_HYS}	Hysteresis	Temperature falling		20		°C
t_{TSD_RETRY}	Thermal shutdown retry delay			130		ms
LOGIC						
V_{ENB_R}	ENB threshold voltage	V_{ENB} rising	0.84			V
V_{ENB_F}	ENB threshold voltage	V_{ENB} falling			0.36	V
V_{OL}	NFLT output low voltage	I_{NFLT}=1mA		0.3		V
I_{NFLT}	NFLT leakage current	Device not in fault condition, V_{NFLT}=0V ~ 5V			1	μA

Typical Characteristics

Ambient temperature is 25°C, V_{IN} = 5V, C_{IN} = C_{OUT} = 1μF, V_{ENB} = 0V, R_{ILIM} = 25kΩ, unless otherwise noted .

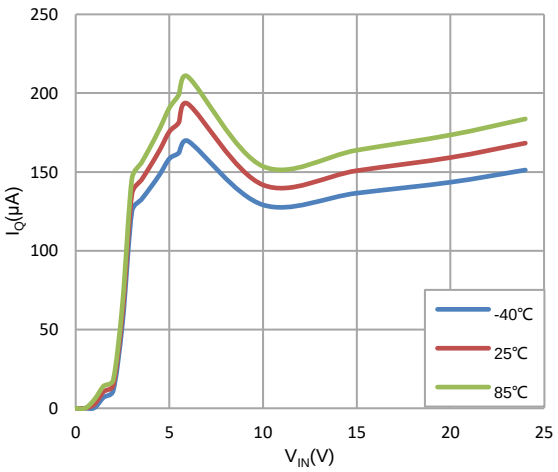


Figure 5 I_Q vs. V_{IN} supply voltage

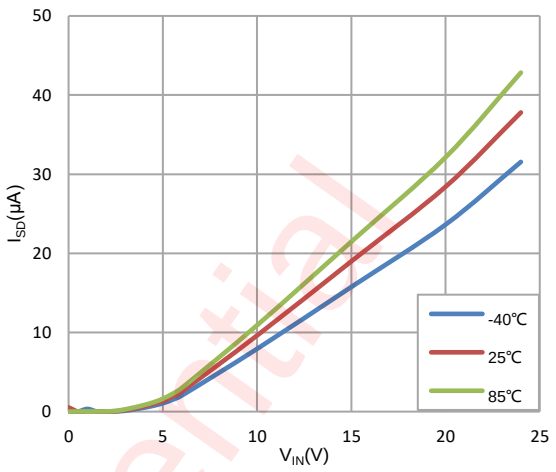


Figure 6 I_{SD} vs. V_{IN} supply voltage

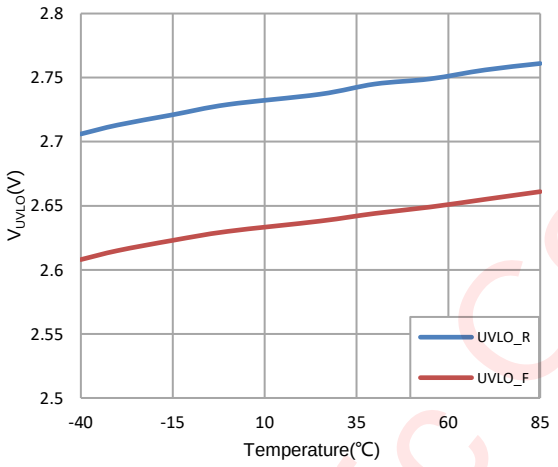


Figure 7 UVLO threshold voltage vs. Temperature

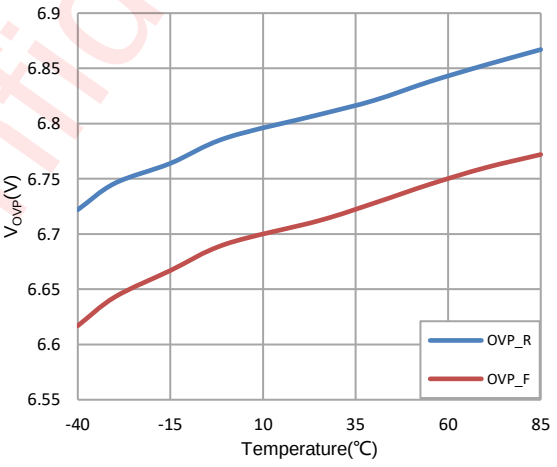


Figure 8 OVP threshold voltage vs. Temperature

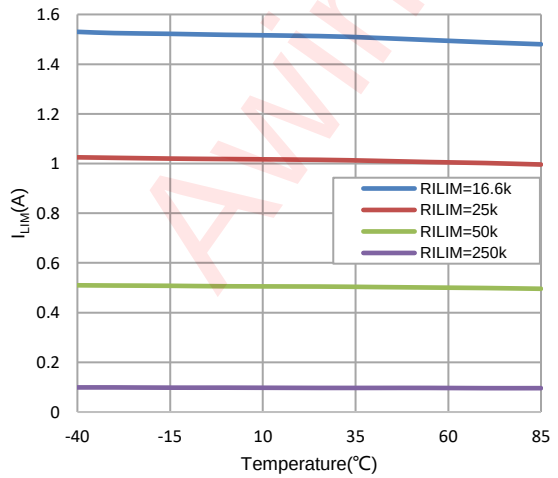


Figure 9 ILIM Current vs. Temperature

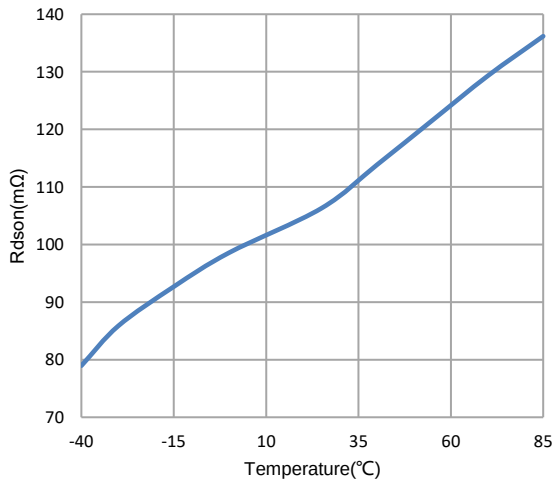


Figure 10 Rdson vs. Temperature

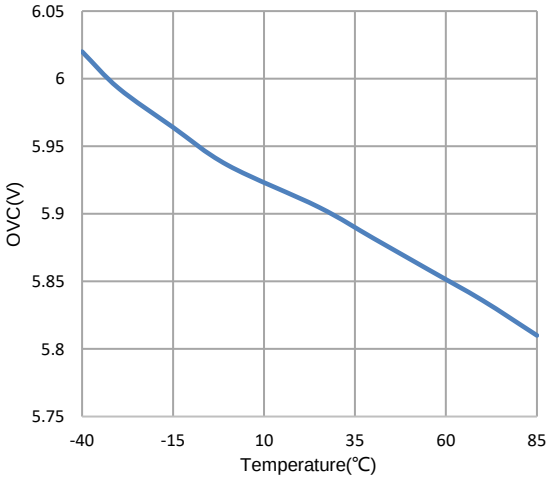


Figure 11 V_{OUT} Clamp Voltage vs. Temperature

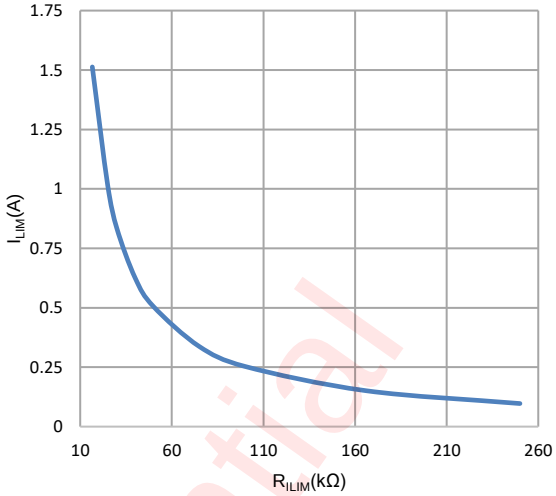


Figure 12 Current Limit vs. R_{ILIM}

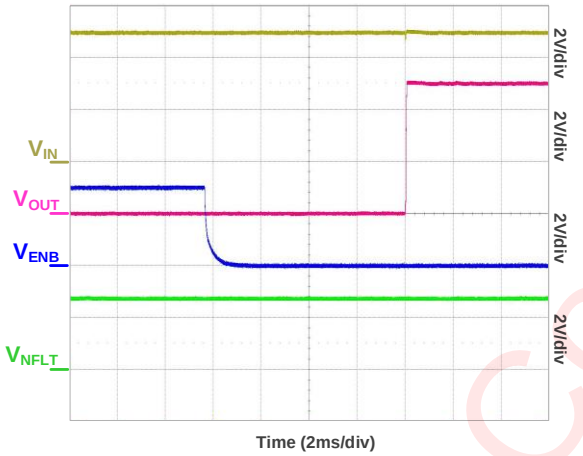


Figure 13 ENB Turn-On Delay: ENB↓ to Output Ramp↑

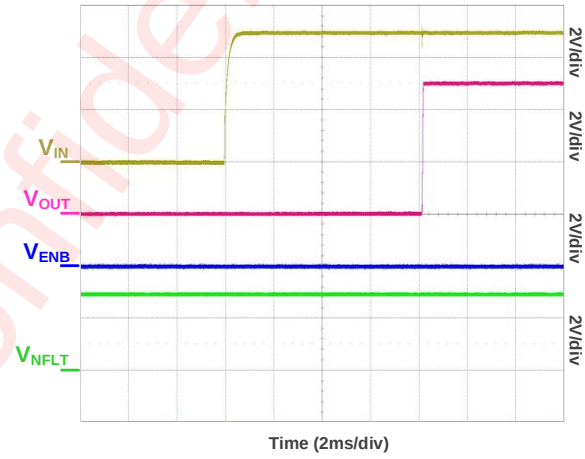


Figure 14 V_{IN} Turn-On Delay: Input↑ to Output Ramp↑

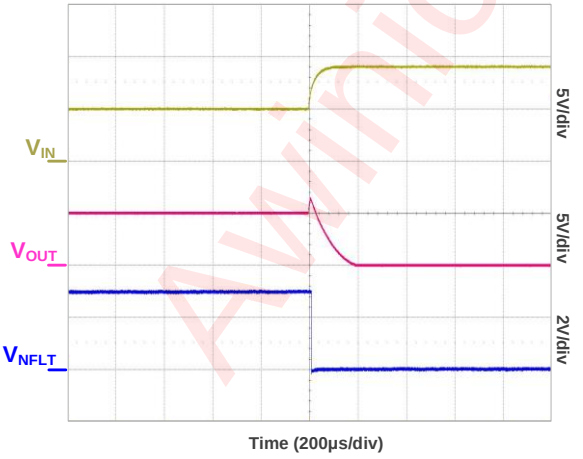


Figure 15 Over-voltage Protection Response

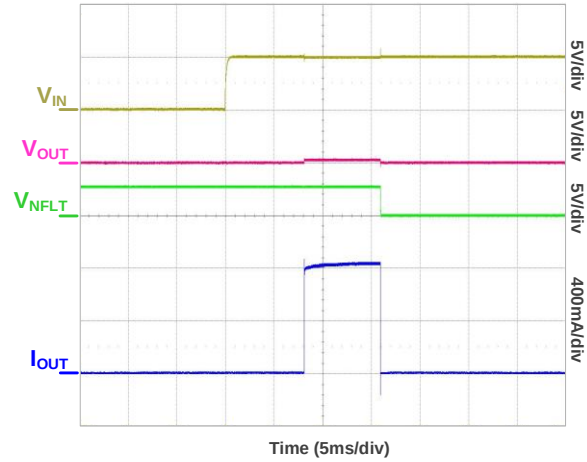


Figure 16 V_{OUT} Short starting

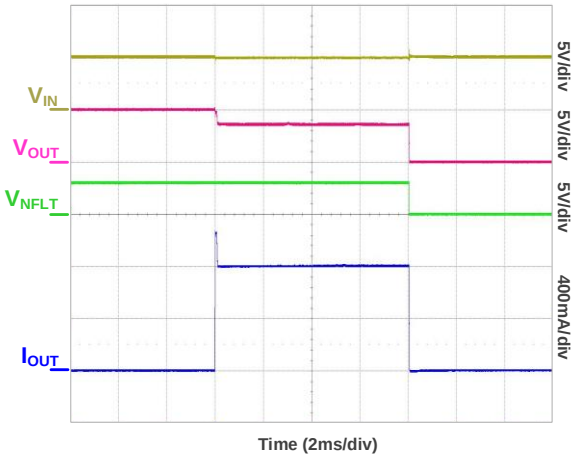


Figure 17 Over-current Protection (2ms)

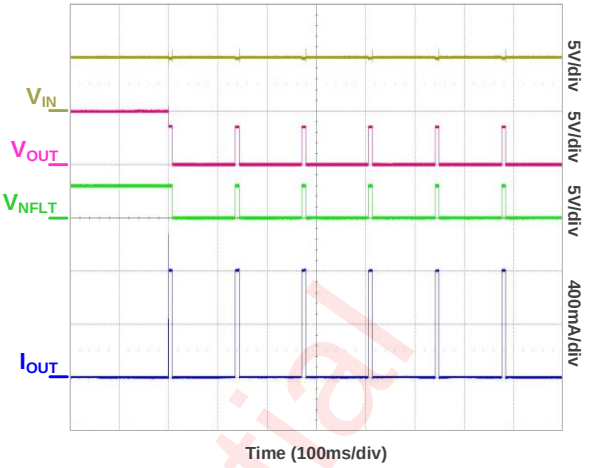


Figure 18 Over-current Protection (100ms)

Detailed Functional Description

AW35018 is a smart e-Fuse with robust over-current and over-voltage protection. It provides robust protection for all systems and applications powered from 3V to 6.8V. V_{IN} can withstand up to 32V.

The device allows the user to program the over current limit threshold between 0.1A and 1.5A via an external resistor by the ILIM pin. If the current value of the system exceeds a certain range, the device limits the input current value to a safe range for a period of time and then turns off the MOSFET. The device also monitors its internal temperature and turns off the internal MOSFETs when it exceeds 150°C. The device allows the processor to control its operating state and provide information about the fault state to the host.

Enable

ENB enables the control circuits, and power switch turns on when V_{ENB}<0.36V. It turns off power switch when V_{ENB}>0.84V. When V_{ENB} is high, it will reset AW35018 that have latched off due to a fault condition.

Over-voltage protection

The device has internal over-voltage protection, and its threshold voltage is 6.8V. When over voltage event happens, power switch is turned off to protect downstream load.

Over-load and short-circuit protection

Load current is monitored by sensing voltage across an internal sense resistor. Current limit threshold is programmed by connecting external resistor R_{ILIM} to GND.

$$\mathrm{ILIM\_typ(A)} = \frac{25}{\mathrm{R_{ILIM}}}$$

Where R_{ILIM} is in kΩ. When over load happens, current is limited to the current limit threshold and persists the t_{DEG_OCP} time, where t_{DEG_OCP} is the over-current protection deglitch time. If the over-current duration is less than the t_{DEG_OCP}, the device continues to work. If the over-current duration is greater than the t_{DEG_OCP}, the device turns off the internal MOSFETs and pulls the NFLT down. After passing through the t_{OCP_RETRY}, the device turns on the MOSFETs and monitors the load current again.

Output-voltage clamp (OVC)

When the V_{IN} < 5.8V, the output voltage changes with the input voltage, and when 5.8V< V_{IN} < 6.8V, the output-voltage clamp (OVC) circuit clamps the output voltage to 5.8V. When the V_{IN} is in the range of 0 to 32V, it can be divided to four modes as shown in Figure 19.

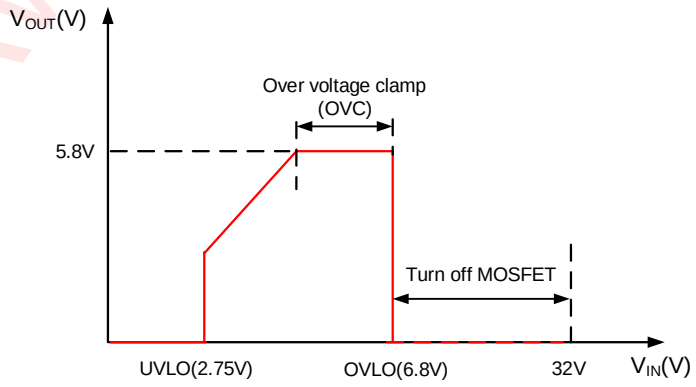


Figure 19 Output vs Input voltage

NFLT Fault Report

NFLT pin is asserted low during over-voltage, over-current, and thermal shut down. It is de-asserted after the fault condition is removed and then recover normal operation. It's recommended to be pulled up by 100kΩ pull-up resistor to input. During normal operation, NFLT is pulled up to logic high by pull-up resistor, when fault event happens, NFLT will output logic low.

Thermal Shutdown

The device has a built-in temperature sensor which monitors the internal junction temperature. When the junction temperature exceeds 150°C, power switch turns off. When the junction temperature falls below the thermal recovery temperature, approximately 130°C, the device auto-recovery after 130ms.

PCB Layout Consideration

To obtain the optimal performance of AW35018, PCB layout should be considered carefully. Here are some guidelines:

1. Place C_{IN} as close as possible to IN.
2. Place C_{OUT} as close as possible to OUT.
3. Place R_{ILIM} as close as ILIM.
4. IN, OUT support 1.5A current, the connection lines should be as wide as possible.
5. Connect the IN and OUT pads to a large IN and OUT plane respectively to achieve better thermal performance.

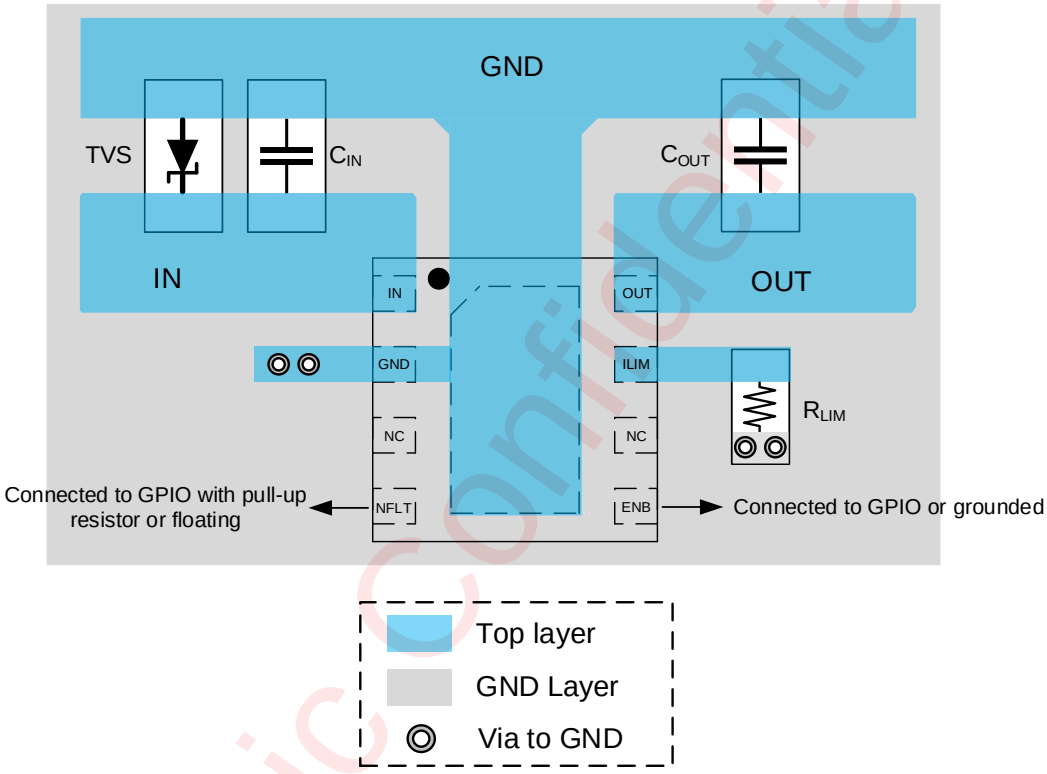
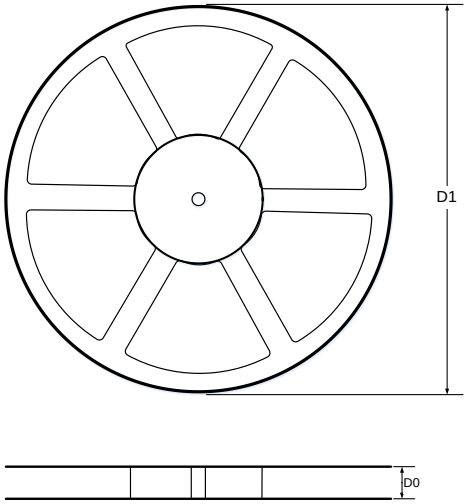


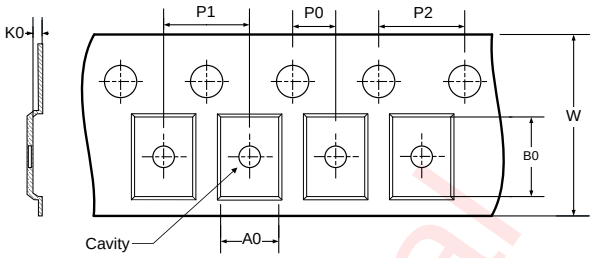
Figure 20 External Components Placements and PCB Layout Example

Tape And Reel Information

REEL DIMENSIONS

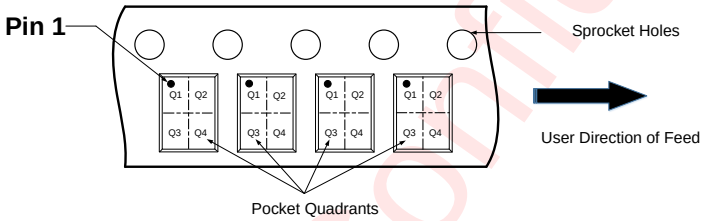


TAPE DIMENSIONS



A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



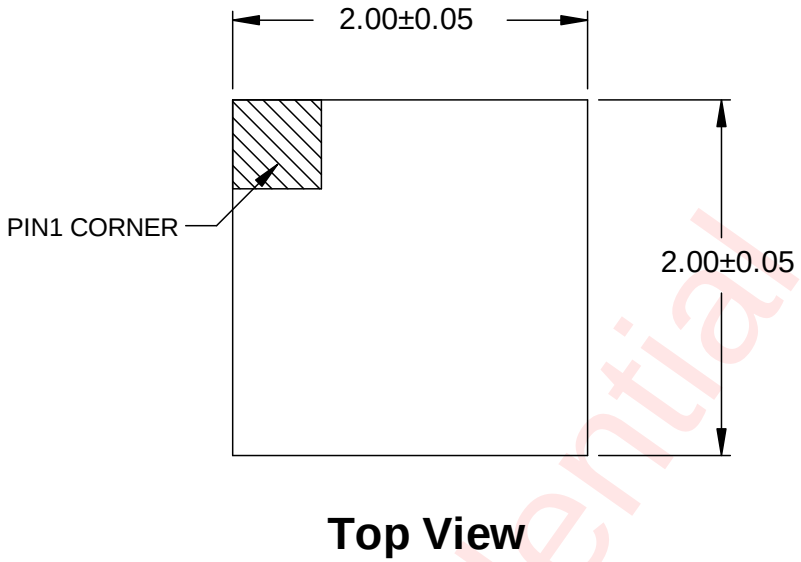
Note：The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

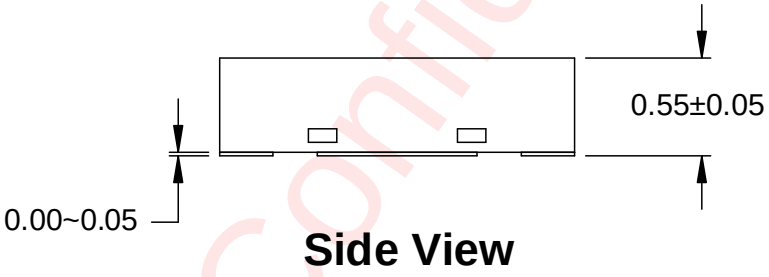
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	8.4	2.25	2.25	0.75	2	4	4	8	Q1

All dimensions are nominal

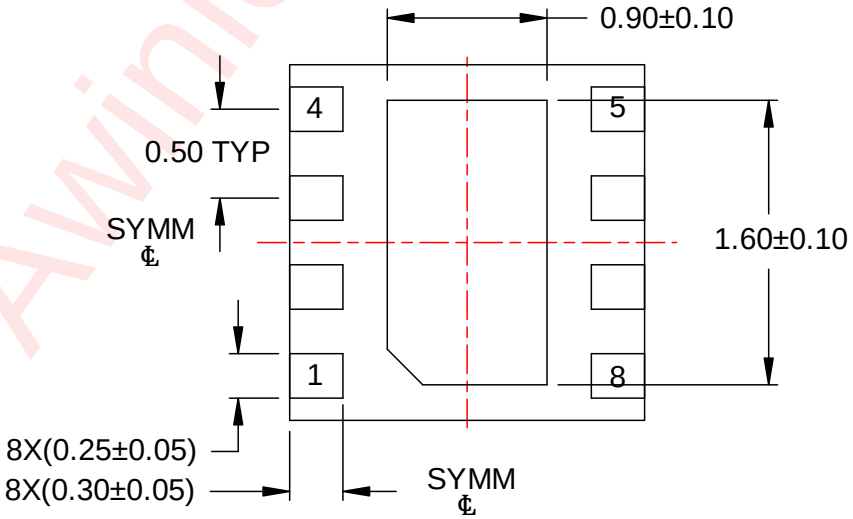
Package Description



Top View



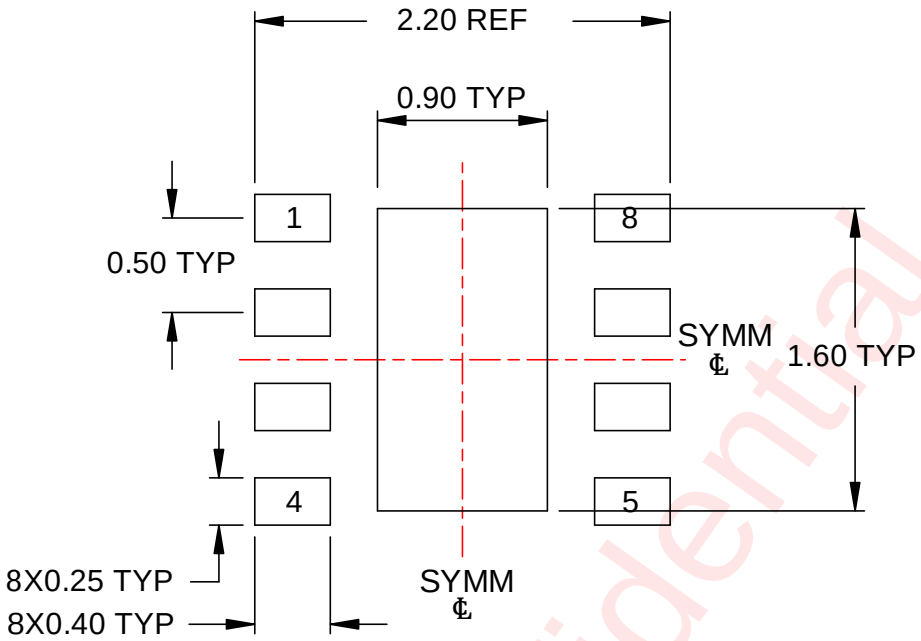
Side View

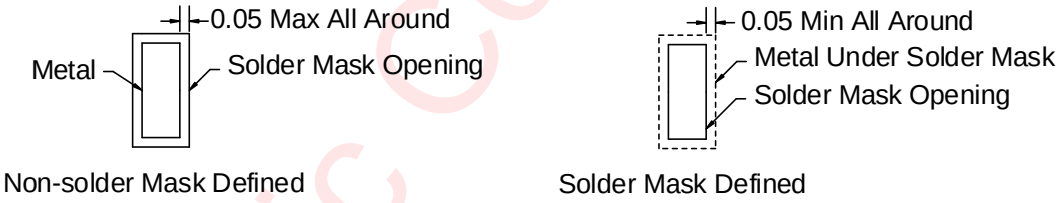


Bottom View

Unit:mm

Land Pattern Data





Unit: mm

REVISION HISTORY

Version	Date	Change Record
V1.0	Dec. 2024	Officially released
V1.1	Oct. 2025	Changed the typical and maximum values of V_{OVC} in EC Table.(Page 6)
V1.2	Dec. 2025	Changed the Absolute Maximum Ratings of the IN pin from 28V to 32V.

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