Power Distribution Switch with Fixed Current Limit

Features

- Integrated P-channel MOSFET power switch
- Input voltage: 2.5V to 5.5V
- Fixed current limit
- Switch on-resistance(typ.):
  Rdson=65mΩ at V_{IN}=5V
- ±10% current limit accuracy
- Reverse current protection
- Internal EN pull-down/up resistor
- Under voltage lockout
- Over temperature protection
- Quick Output Discharge(QOD)
  - ✧ AW35005BD/25BD/35BD/45BD/45LBD/55BD: Auto QOD
  - ✧ AW35005B/025B/035B/045B/055B: No QOD
- SOT23-5L package

Applications

USB Ports
Power Distribution Switch
Notebook and Desktop Computer
High-Definition Television(HDTV)

General Description

The AW350X5BD/AW350X5B/AW35045LBD is a P-channel MOSFET power distribution switch which intended for high-side load-switching applications. The device integrates current limit function to protect power source from over current and short circuit condition. Besides, a flag output is available to indicate fault conditions.

The AW350X5BD/AW350X5B/AW35045LBD also features fast short-circuit response, under voltage lockout, over temperature protection, reverse current protection. The AW350X5BD and the AW35045LBD build in quick output discharge function.

Fixed current limit selection table:

AW35005BD AW35005B	0.5A fixed current limit
AW35025BD AW35025B	1.1A fixed current limit
AW35035BD AW35035B	1.5A fixed current limit
AW35045BD AW35045LBD AW35045B	2.1A fixed current limit
AW35055BD AW35055B	2.5A fixed current limit

Typical Application Circuit

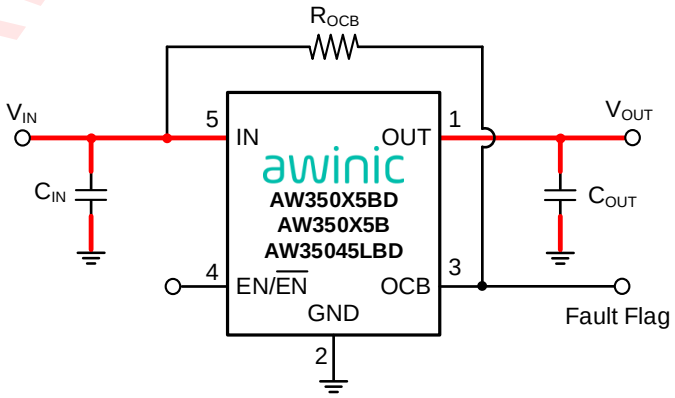
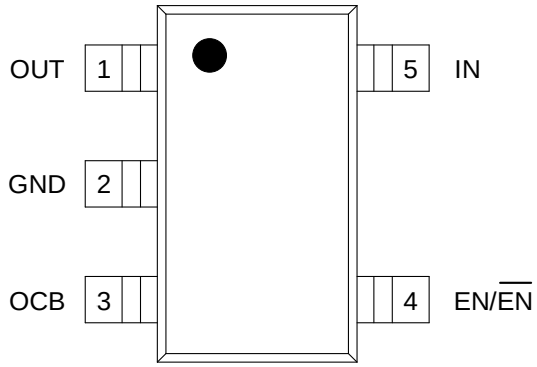


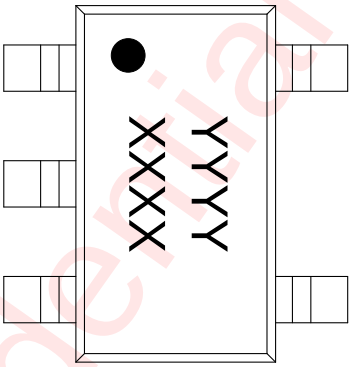
Figure 1 Typical Application Circuit of AW350X5BD/AW350X5B/AW35045LBD

Pin Configuration And Top Mark

AW350X5BD/AW350X5B/
AW35045LBDSTR
(Top view)



AW350X5BD/AW350X5B/
AW35045LBDSTR Marking
(Top view)



YYYY - AW350X5BD/AW350X5B/
AW35045LBDSTR
XXXX - Production Tracing Code

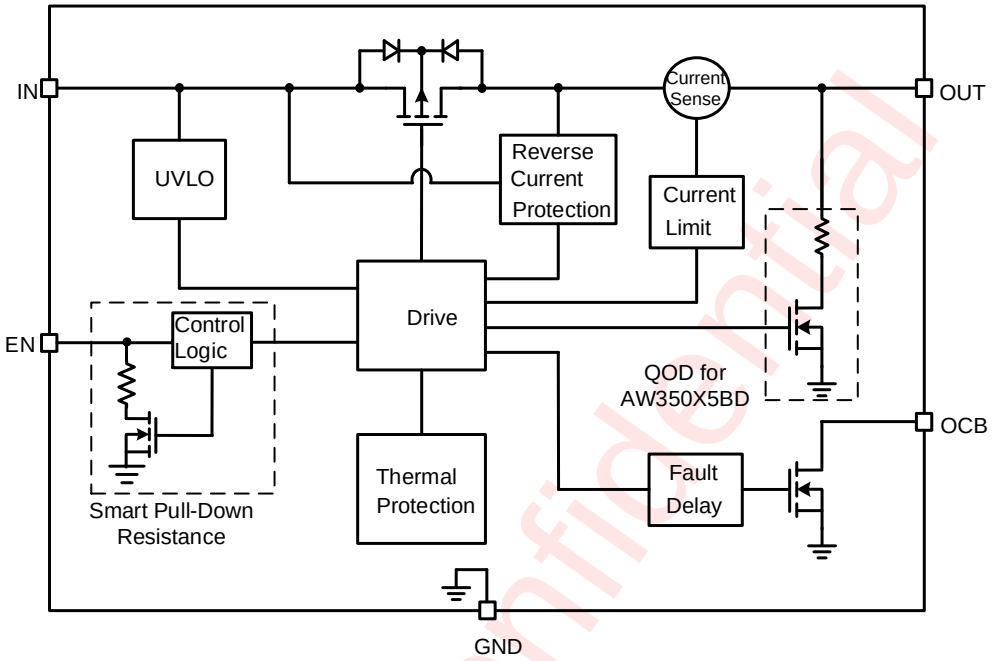
Figure 2 Pin Configuration and Top Mark

Pin Definition

Pin	Name	Description
1	OUT	Output pin
2	GND	Ground
3	OCB	Fault flag output
4	EN/$\overline{EN}$	Chip enable (Active High/Low)
5	IN	Power supply input

Functional Block Diagram

- **For Enable Active High Version**



- **For Enable Active Low Version**

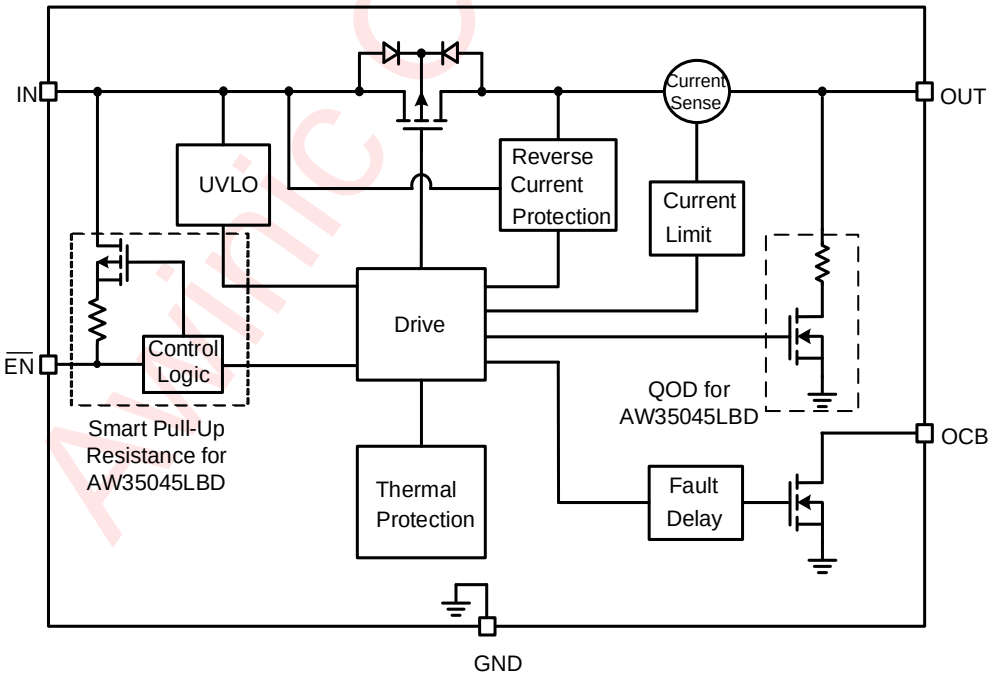


Figure 3 Functional Block Diagram

Typical Application Circuits

- **For Enable Active High Version**

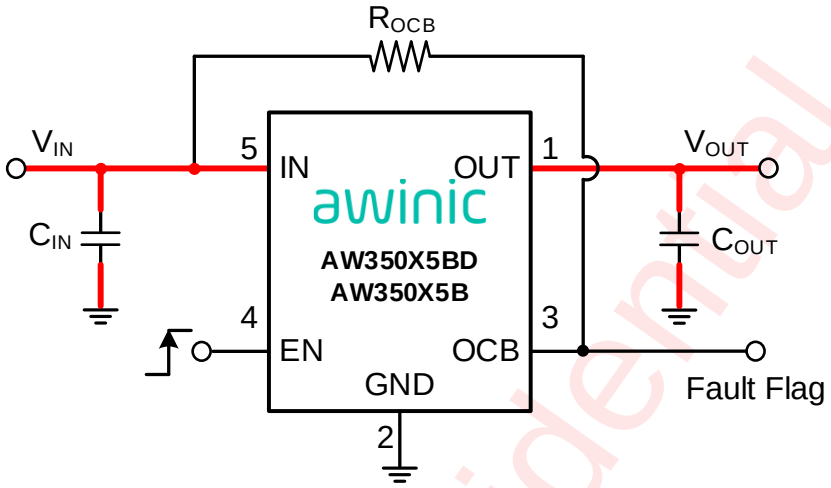


Figure 4 Typical Application Circuit of AW350X5BD/AW350X5B

- **For Enable Active Low Version**

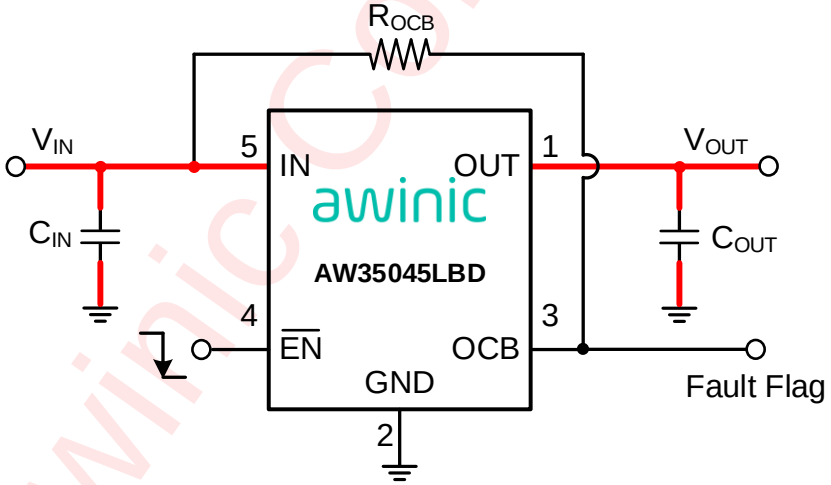


Figure 5 Typical Application Circuit of AW35045LBD

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW35005BDSTR	-40°C ~ 85°C	SOT23-5L	E9ZW	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35025BDSTR	-40°C ~ 85°C	SOT23-5L	DBPB	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35035BDSTR	-40°C ~ 85°C	SOT23-5L	C3TU	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35045BDSTR	-40°C ~ 85°C	SOT23-5L	BHXR	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35045LBDSTR	-40°C ~ 85°C	SOT23-5L	CE6C	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35055BDSTR	-40°C ~ 85°C	SOT23-5L	FHSN	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35005BSTR	-40°C ~ 85°C	SOT23-5L	4GLZ	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35025BSTR	-40°C ~ 85°C	SOT23-5L	4Y3W	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35035BSTR	-40°C ~ 85°C	SOT23-5L	H4ZD	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35045BSTR	-40°C ~ 85°C	SOT23-5L	JD8E	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35055BSTR	-40°C ~ 85°C	SOT23-5L	DX2P	MSL3	ROHS+HF	3000 units/ Tape and Reel

Absolute Maximum Ratings(NOTE1)

PARAMETERS		RANGE
Supply Voltage Range V_{IN}		-0.3V to 6V
EN Voltage Range	EN	-0.3V to 6V
Output Voltage Range	OUT	-0.3V to 6V
Maximum Continuous Switch Current for VIN ≥ 2.5V(NOTE 2)		2.5A
Maximum Peak Switch Current for VIN ≥ 2.5V(NOTE 3)		2.8A
Junction-to-ambient thermal resistance θ_{JA}		158.9°C/W
Operating Free-air Temperature Range		-40°C to 85°C
Maximum Junction Temperature T_{JMAX}		150°C
Storage Temperature T_{STG}		-65°C to 150°C
Lead Temperature (Soldering 10 Seconds)		260°C
ESD		
HBM (Human Body Model) (NOTE 4)		±2kV
CDM(Charged Device Model) (NOTE 5)		±1.5kV
Latch-Up		
Latch-Up (NOTE 6)		+IT：200mA -IT：-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: Limited by thermal design.

NOTE3: Limited by thermal design, and tested in 10ms width pulse current.

NOTE4: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ESDA/JEDEC JS-001-2017.

NOTE5: All pins. Test Condition: ESDA/JEDEC JS-002-2018.

NOTE6: Test Condition: JEDEC78E.

Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage	2.5		5.5	V
V_{EN}	EN Voltage	0		5.5	V
V_{OUT}	Output Voltage	0		V_{IN}	V
C_{IN}	Input capacitance	0.1	1		μF
C_{OUT}	Output load capacitance	0.1	1		μF

Electrical Characteristics

T_A = 25°C unless otherwise noted. Typical values are guaranteed for V_{IN} = 5V, C_{IN} = 1μF, I_{IN}≤ 2.5A.

PARAMETER		TEST CONDITION		MIN	TYP	MAX	UNIT
SUPPLY CURRENT							
I_Q	Input quiescent current	V_{IN}=5.0V, EN($\overline{EN}$)=Active, I_{OUT}=0A			28	50	μA
I_{SD}	Shutdown current from IN to GND	V_{IN}=5.0V, EN($\overline{EN}$)=Inactive			0.32	1	μA
I_{LEAKEN}	EN pin leakage current	V_{IN}=0V, V_{EN}=5.5V			0.52	1	μA
POWER SWITCH							
R_{dson}	Internal switch MOSFET on-state resistance	V_{IN}=5.0V, I_{OUT}=500mA			65		mΩ
R_{EN}	EN pin pull down resistor	V_{IN}=5V, V_{EN}=0.1V (AW350X5BD/AW350X5B)			9.2		MΩ
	EN pin pull up resistor	V_{IN}=5V, V_{EN}=3V (AW35045LBD)					
R_{DIS}	Output discharge resistance	V_{IN}=5.0V, EN($\overline{EN}$)=Inactive, I_{OUT} Sinking 2mA (for AW350X5BD/AW35045LBD)			75		Ω
t_R	Output rise time	V_{IN}=5.0V, C_{OUT}=1μF, R_L=100Ω			285		μs
t_{ON}	Switch turn on time				520		μs
t_F	Output fall time	V_{IN}=5.0V, C_{OUT}=1μF, R_L=100Ω	AW350X5B		185		μs
			AW350X5BD/45LBD		80		μs
t_{OFF}	Switch turn off time		AW350X5B		215		μs
			AW350X5BD/45LBD		95		μs
V_{IH}	EN input high threshold level			1.4			V
V_{IL}	EN input low threshold level					0.4	V
CURRNET LIMIT							
I_{LIMIT}	Current limit threshold	V_{OUT}=4V	AW35005BD/05B	450	500	550	mA
			AW35025BD/25B	1000	1100	1210	
			AW35035BD/35B	1350	1500	1650	
			AW35045BD/45B/45LBD	1890	2100	2310	
			AW35055BD/55B	2250	2500	2750	
t_{IOS}	Response time to short circuit	V_{IN}=5.0V			10		μs
t_{OCP}	Current limit response time	V_{IN}=5.0V, I_{OUT}=1.5 × I_{LIMIT}			100		μs

Electrical Characteristics (continued)

T_A = 25°C unless otherwise noted. Typical values are guaranteed for V_{IN} = 5V, C_{IN} = 1μF, I_{IN}≤ 2.5A.

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
UNDER VOLTAGE LOCKOUT						
V_{UVLO}	UVLO threshold voltage	V_{IN} rising		2.3	2.5	V
V_{UVLO_HYS}	UVLO hysteresis	V_{IN} falling		95		mV
REVERSE VOLTAGE PROTECT						
V_{REV}	Reverse voltage trip point	EN($\overline{EN}$)=Active, V_{OUT} > V_{IN}		43		mV
I_{REV}	Reverse leakage current	V_{OUT}=5V, V_{IN}=0V, EN($\overline{EN}$)=Inactive		0.68		μA
I_{REV_ACT}	Reverse activation current	V_{IN}=5V, C_{OUT}=1μF, V_{OUT} > V_{IN}		0.6		A
I_{REV_PRO}	Reverse protection current	V_{OUT} - V_{IN} > V_{REV}		5		μA
FAULT FLAG						
R_{OCB}	OCB output low Resistance	V_{IN}=5V, I_{SINK}=1mA		190		Ω
I_{LEAK_OCB}	OCB off-state leakage current	V_{OCB}=5.5V		0.03		μA
t_{OCB}	OCB delay time	V_{IN}=5V, From fault condition to OCB assertion		2		ms
THERMAL PROTECTION						
T_{SD}	Thermal shutdown threshold			155		°C
T_{SD_HYS}	Thermal shutdown hysteresis			25		°C

Timing Diagram

- **For Enable Active High Version**

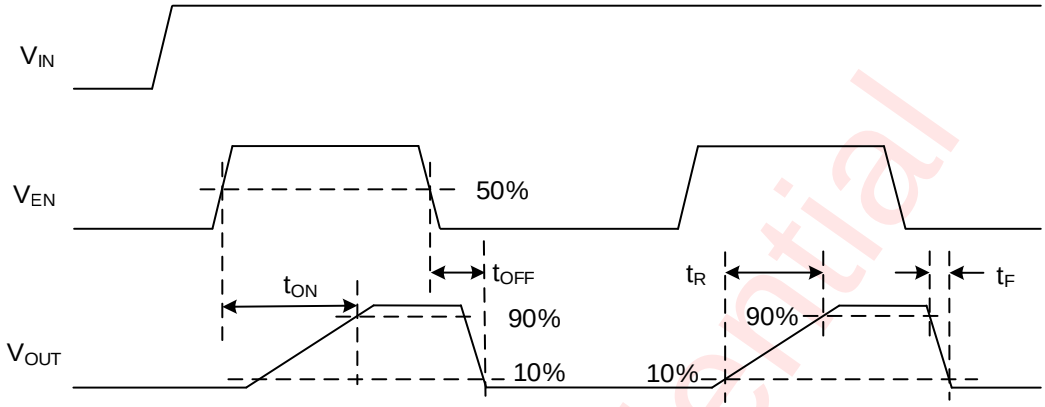


Figure 6 AW350X5BD/AW350X5B Timing Diagram

- **For Enable Active Low Version**

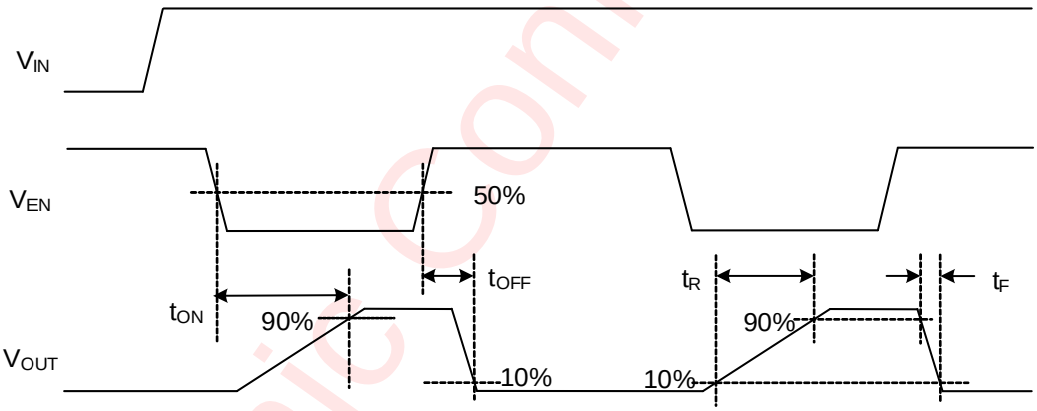


Figure 7 AW35045LBD Timing Diagram

Typical Characteristics

Ambient temperature is 25°C, C_{IN} = C_{OUT}=1μF, unless otherwise noted.

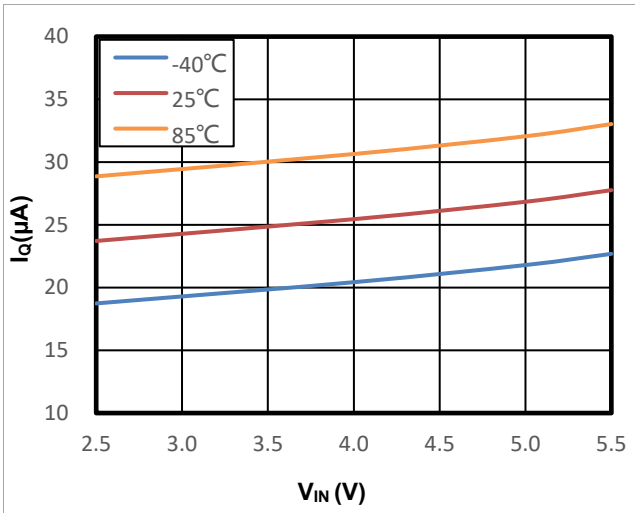


Figure 8 Quiescent Current vs. V_{IN}, No load

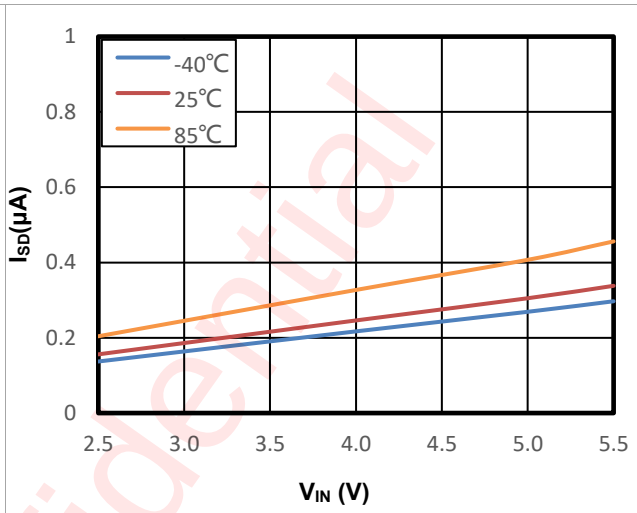


Figure 9 IN Shutdown Current vs. V_{IN}

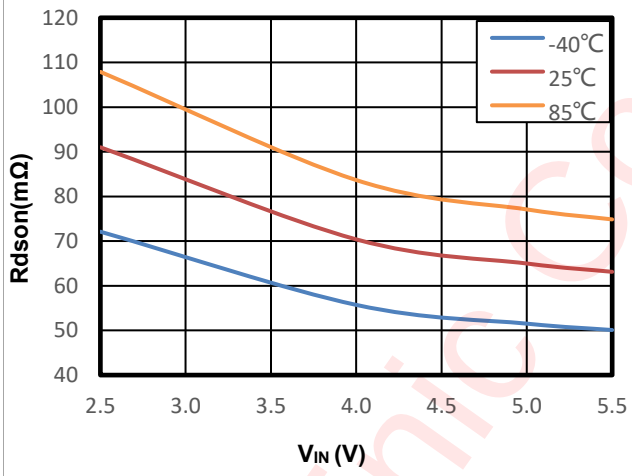


Figure 10 Rdson vs. V_{IN}(I_{OUT}=500mA)

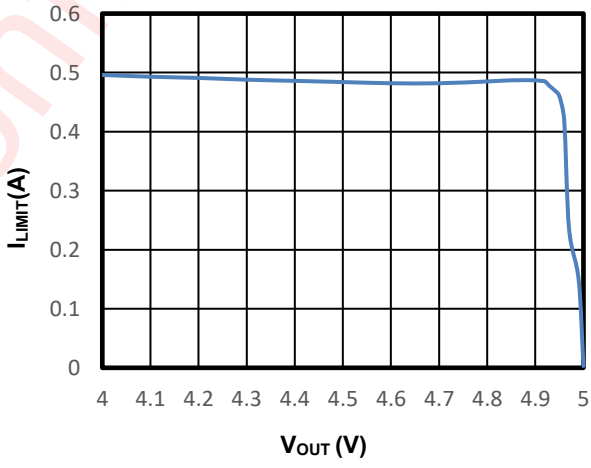


Figure 11 I_{LIMIT} vs. V_{OUT} (AW35005B/005BD)

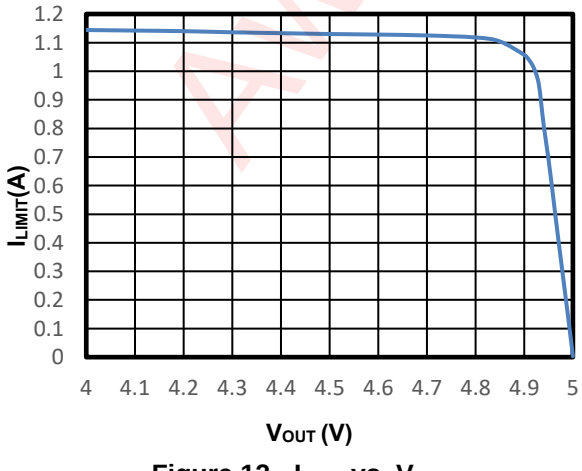


Figure 12 I_{LIMIT} vs. V_{OUT} (AW35025B/025BD)

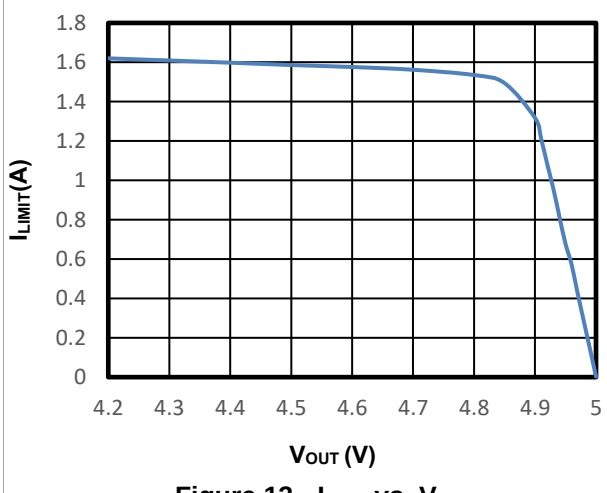


Figure 13 I_{LIMIT} vs. V_{OUT} (AW35035B/035BD)

Typical Characteristics (continued)

Ambient temperature is 25°C, C_{IN} = C_{OUT}=1μF, unless otherwise noted.

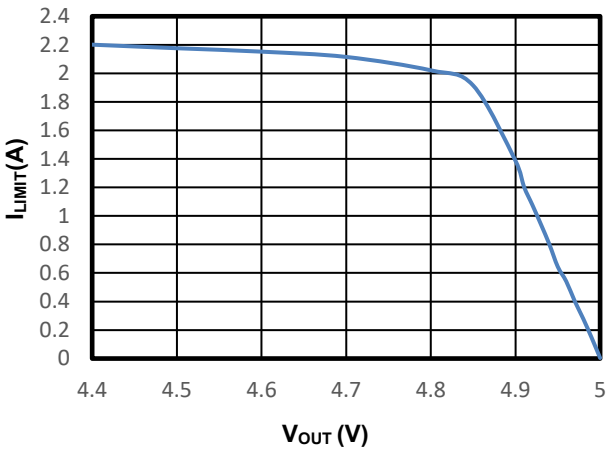


Figure 14 I_{LIMIT} vs. V_{OUT}
(AW35045B/045BD/045LBD)

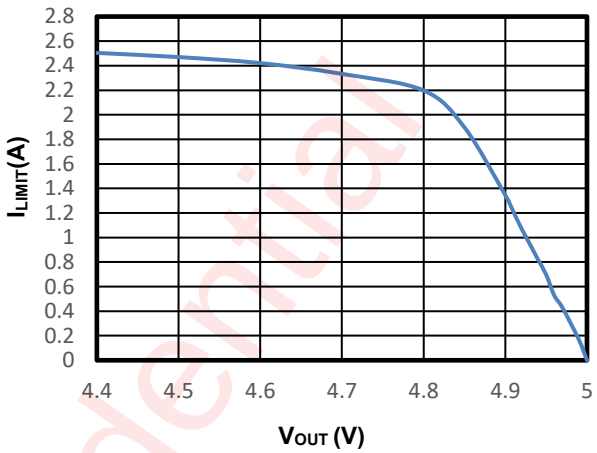


Figure 15 I_{LIMIT} vs. V_{OUT}
(AW35055B/055BD)

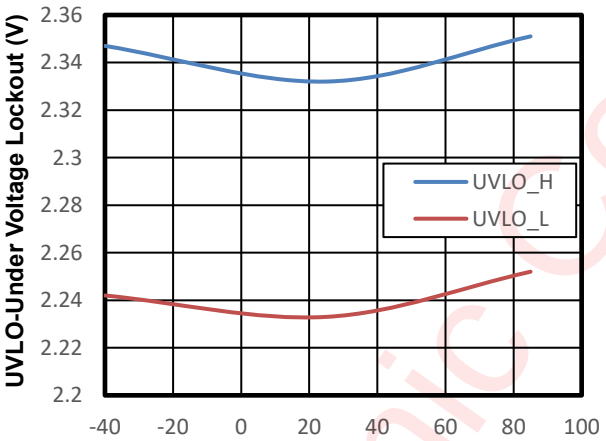
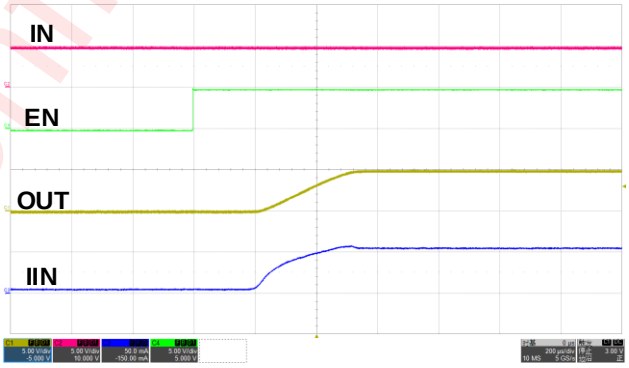


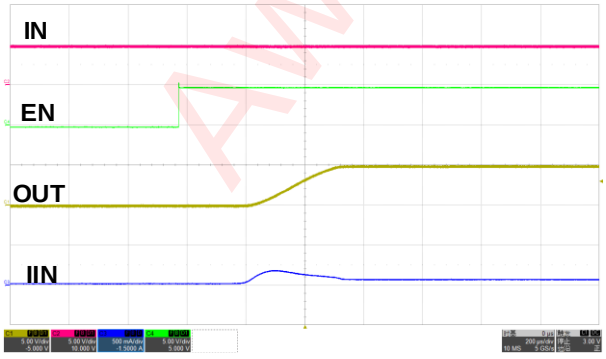
Figure 16 UVLO vs. TEMP



C1: 5.00V/div C2: 5.00V/div t=200μs/div
C3: 50mA/div C4: 5.00V/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=1μF，R_L=100Ω

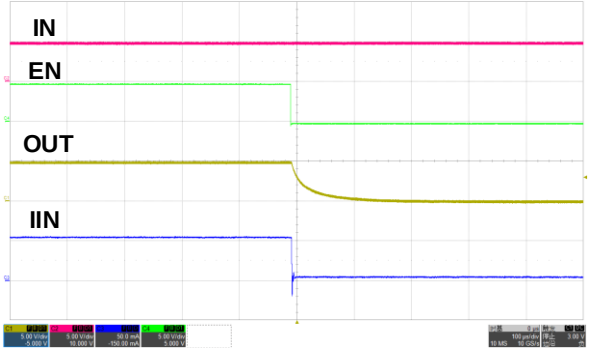
Figure 17 Turn On Response
(AW350X5BD)



C1: 5.00V/div C2: 5.00V/div t=200μs/div
C3: 500mA/div C4: 5.00V/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=10μF，R_L=100Ω

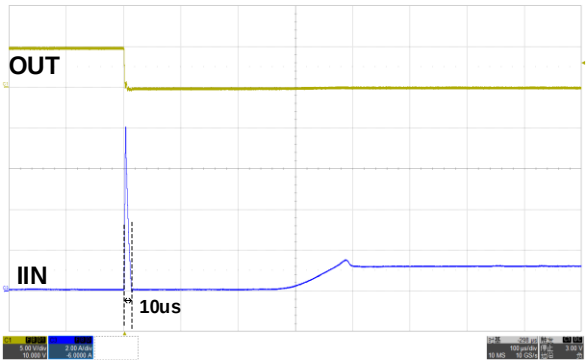
Figure 18 Turn On Response
(AW350X5BD)



C1: 5.00V/div C2: 5.00V/div t=100μs/div
C3: 50mA/div C4: 5.00V/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=1μF，R_L=100Ω

Figure 19 Turn Off Response
(AW350X5BD)



C1: 5.00V/div C3: 2A/div t=100μs/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=1μF

Figure 20 Short Circuit Response

C1:5.00V/div C2: 5.00V/div t=6.4ms/div
C3: 5A/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=1μF

Figure 21 Continuous Short Response

Functional Description

The AW350X5BD/AW350X5B/AW35045LBD is a P channel MOSFET power distribution switch with current limit function. In addition, the switch also features fast short-circuit response, under voltage lockout, over temperature protection and reverse current protection.

CURRENT LIMIT THRESHOLD SETTING

The AW350X5BD/AW350X5B provides fixed current limit threshold. The current limit function can prevent the switch from over current condition.

AW35005BD/AW35005B	0.5A fixed current limit
AW35025BD/AW35025B	1.1A fixed current limit
AW35035BD/AW35035B	1.5A fixed current limit
AW35045BD/AW35045B/AW35045LBD	2.1A fixed current limit
AW35055BD/AW35055B	2.5A fixed current limit

FAST SHORT CIRCUIT PROTECTION

The AW350X5BD/AW350X5B/AW35045LBD provides short circuit protection function which can limit the output current to a safe level without damaging the switch.

UNDER VOLTAGE LOCKOUT (UVLO)

The AW350X5BD/AW350X5B/AW35045LBD has under voltage lockout function which can disable the switch until the input voltage reaches the UVLO threshold (typical 2.3V). The UVLO threshold has a 95mV hysteresis voltage which can prevent the unwanted on/off cycling when there is noise on the input voltage.

OVER TEMPERATURE PROTECTION (OTP)

When the junction temperature exceeds 155°C, the internal OTP circuit turn off the power switch. There is a temperature hysteresis 25°C, in other words, the OTP circuit can turn on the switch only if the junction temperature is below 130°C.

QUICK OUTPUT DISCHARGE

The AW35005BD/AW35025BD/AW35035BD/AW3545BD/AW35045LBD/AW35055BD include the Quick Output Discharge (QOD) feature, in order to discharge the application capacitor connected on OUT pin. When EN pin is set to low level, a discharge resistance with a typical value of 75Ω is connected between the output and ground, pull down the output and prevent it from floating when the device is disabled.

REVERSE CURRENT PROTECTION (RCP)

The AW350X5BD/AW350X5B/AW35045LBD includes the Reverse Current Protection(RCP) function, which can prevent the current to flowing through the P-FET or the body diode when V_{OUT} greater than V_{IN}. Whatever the switch is on or off, the AW350X5BD/AW350X5B/AW35045LBD always has this function. When V_{OUT}-V_{IN} greater than V_{REV}, the internal comparator quickly turns off the switch, in order to prevent large reverse current from V_{OUT} to V_{IN}. The switch will return to normal operation once the reverse voltage scenario disappeared.

The I_{REV_ACT} parameter in the figure 22 can be calculated by the following formula: $I_{REV\_ACT} = \frac{V_{REV}}{R_{dson}}$

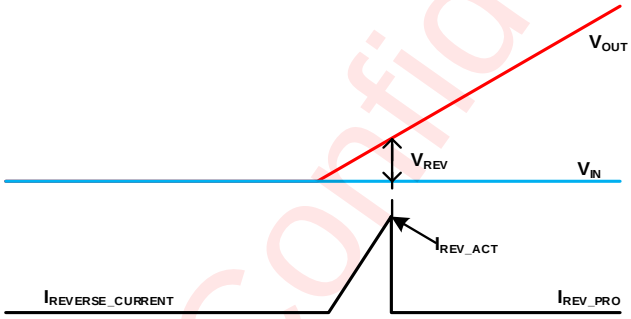


Figure 22 RCP parameter diagram

OCB OUTPUT

The AW350X5BD/AW350X5B/AW35045LBD provides an open-drain output to indicate that a fault condition has occurred. When any of over current or over temperature or reverse current protection occurs for a deglitch time of t_{OCB}, the OCB goes low. If fault condition remove, OCB will goes high. Connect a resistor to between OCB and V_{IN} for normal work.

Application Information

INPUT AND OUTPUT CAPACITOR SELECTION

Input and output capacitance improves the performance of the device, the actual capacitance should be optimized for the particular application. For all applications, a 1μF or greater ceramic bypass capacitor between IN and GND is recommended as close to the device as possible for local noise de-coupling. This precaution reduces ringing on the input due to power-supply transients. Additional input capacitance may be needed on the input to reduce voltage overshoot from exceeding the absolute maximum voltage of the device during heavy transient conditions.

Placing a 1μF or greater ceramic capacitor on the output pin is recommended when large transient currents are expected on the output.

PCB Layout Consideration

AW350X5BD/AW350X5B/AW35045LBD is a low ON-Resistance power switch, to obtain the optimal performance, PCB layout should be considered carefully. Here are some guidelines:

1. All the peripherals should be placed as close to the device as possible. Place the input capacitor C_{IN} on the top layer (same layer as the AW350X5BD/AW350X5B/AW35045LBD) and close to IN pin, and place the output capacitor C_{OUT} on the top layer (same layer as the AW350X5BD/AW350X5B/AW35045LBD) and close to OUT pin.

2. The AW350X5BD/AW350X5B/AW35045LBD integrates an up to 2.5A rated PMOS FET, and the PCB design rules must be respected to properly evacuate the heat out of the silicon. By increasing PCB area, especially around IN and OUT pins, the $R\theta_{JA}$ of the package can be decreased, allowing higher power dissipation. Blue bold paths on Figure 23 are power lines that will flow large current, please route them on PCB as straight, wide and short as possible.

3. Use rounded corners on the power trace from the power supply connector to AW350X5BD/AW350X5B/ AW35045LBD to decrease EMI coupling.

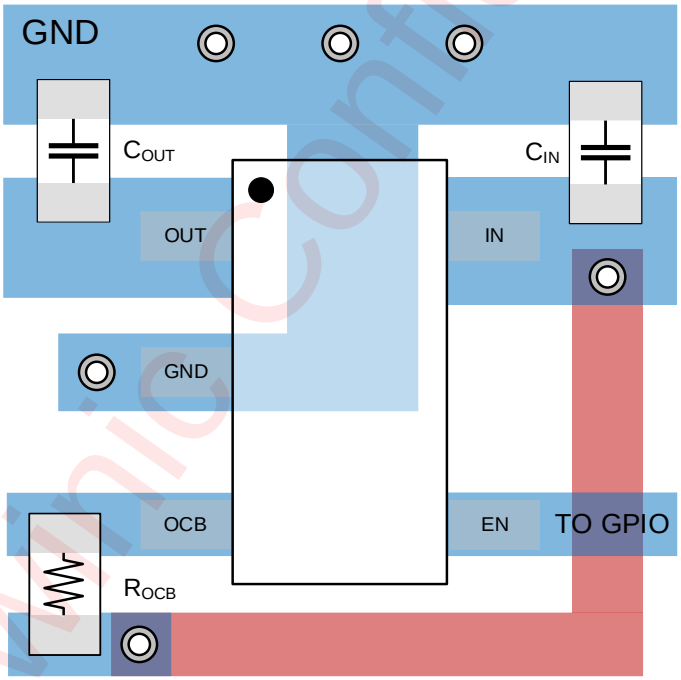
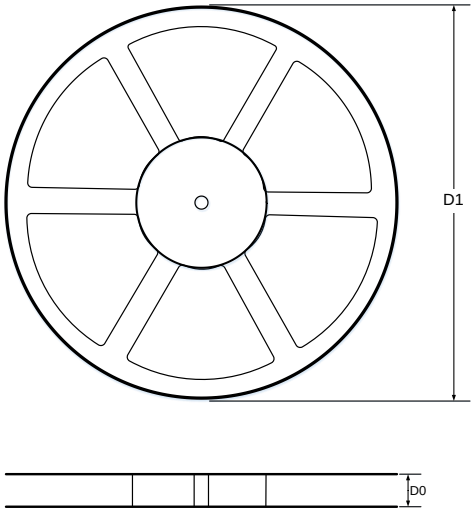


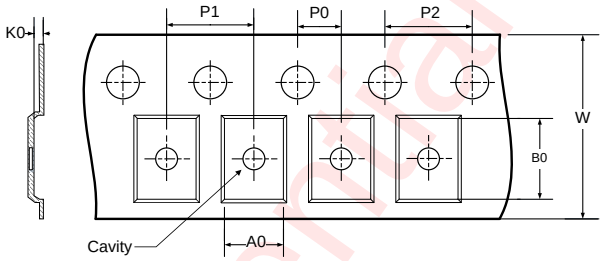
Figure 23 PCB layout example

Tape And Reel Information

REEL DIMENSIONS

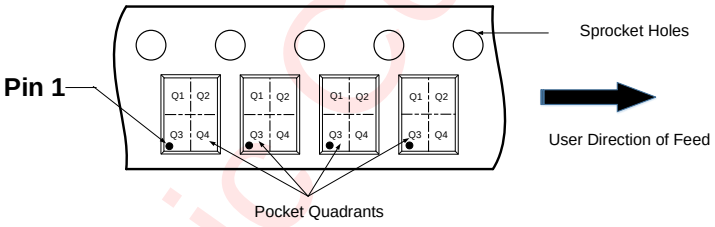


TAPE DIMENSIONS



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



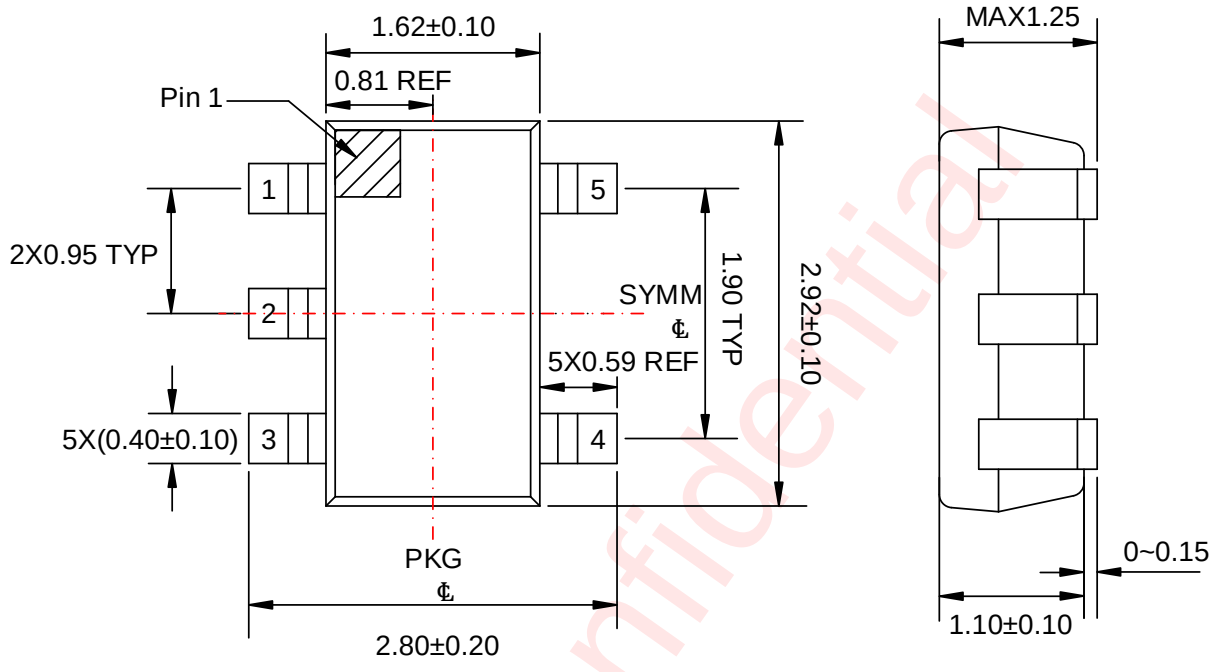
Note：The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

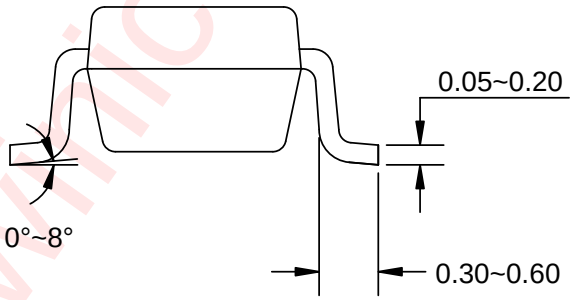
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	8.5	3.3	3.2	1.4	2	4	4	8	Q3

All dimensions are nominal

Package Description



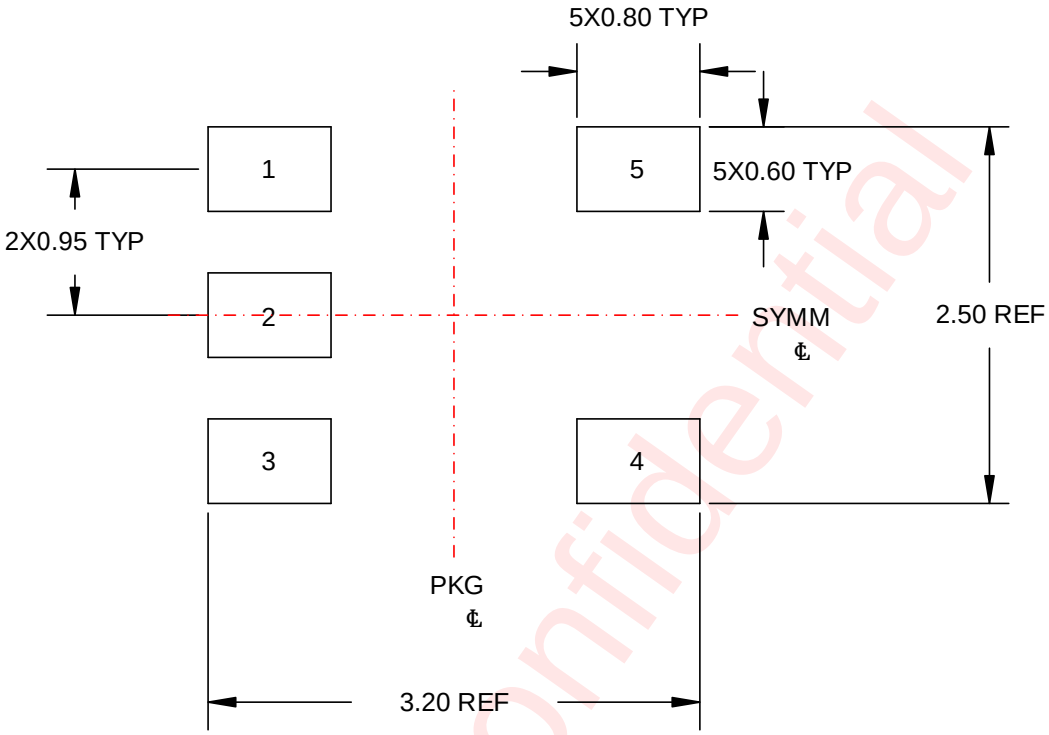
Top View **Side View**

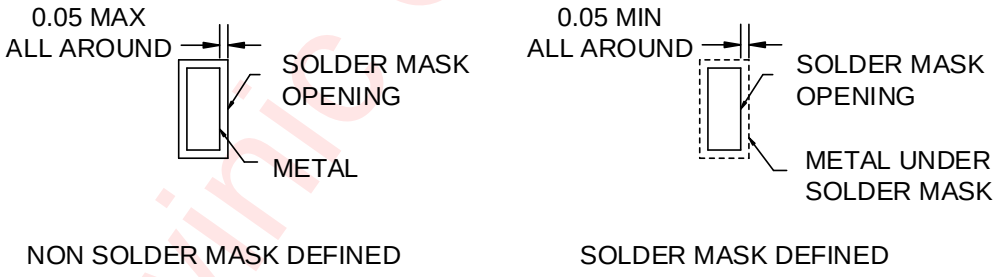


Side View

Unit: mm

Land Pattern Data





NON SOLDER MASK DEFINED

SOLDER MASK DEFINED

Unit: mm

Revision History

Version	Date	Change Record
V1.0	Feb. 2023	Officially released
V1.1	Jun. 2024	1. Add the product information of AW35045LBDSTR 2. Add the parameter of θ_{JA} (P6) 3. Add the test condition of R_{EN} (P7) 4. Add the parameters of t_F and t_{OFF} (P7) 5. Add the current limit response time t_{OCP} (P7) 6. Modify the Current limit threshold of AW35025BD/AW35025B (P7)

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