

Power Distribution Switch with Fixed Current Limit

Features

- Integrated P-channel MOSFET power switch
- Input voltage: 2.5V to 5.5V
- Fix current limit
- Switch on-resistance(typ.):
 $R_{dson}=65m\Omega$ at $V_{IN}=5V$
- $\pm 10\%$ current limit accuracy
- Reverse current protection
- Internal EN pull-down resistor
- Under voltage lockout
- Over temperature protection
- Quick Output Discharge(QOD)
 - ◇ AW35005D/025D/035D/045D/055D: Auto QOD
 - ◇ AW35005/025/035/045/055: No QOD
- SOT23-5L package

Applications

USB Ports

Power Distribution Switch

Notebook and Desktop Computer

High-Definition Television(HDTV)

General Description

The AW350X5D/AW350X5 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 AW350X5D/AW350X5 also features fast short-circuit response, under voltage lockout, over temperature protection, reverse current protection. The AW350X5D builds in quick output discharge function.

Fixed current limit selection table:

AW35005D AW35005	0.5A fixed current limit
AW35025D AW35025	1.1A fixed current limit
AW35035D AW35035	1.5A fixed current limit
AW35045D AW35045	2.1A fixed current limit
AW35055D AW35055	2.5A fixed current limit

Typical Application Circuit

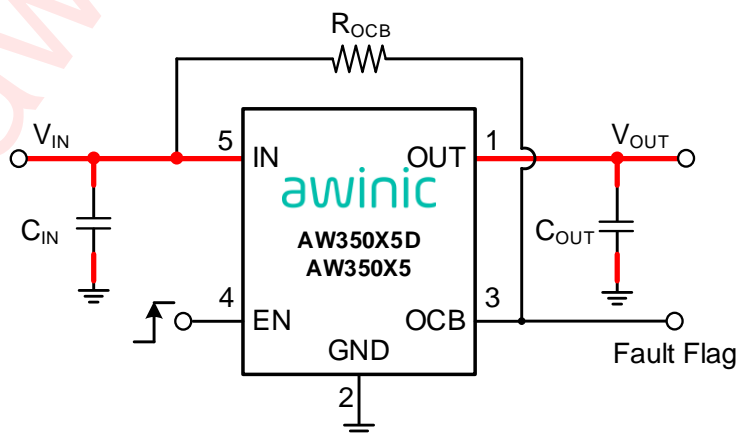


Figure 1 Typical Application Circuit of AW350X5D/AW350X5

Pin Configuration And Top Mark

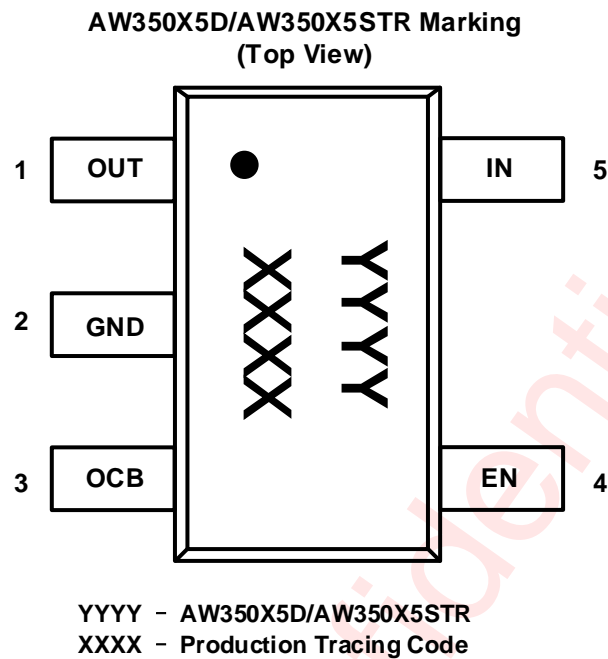


Figure 2 Pin Configuration and Top Mark

Pin Definition

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

Functional Block Diagram

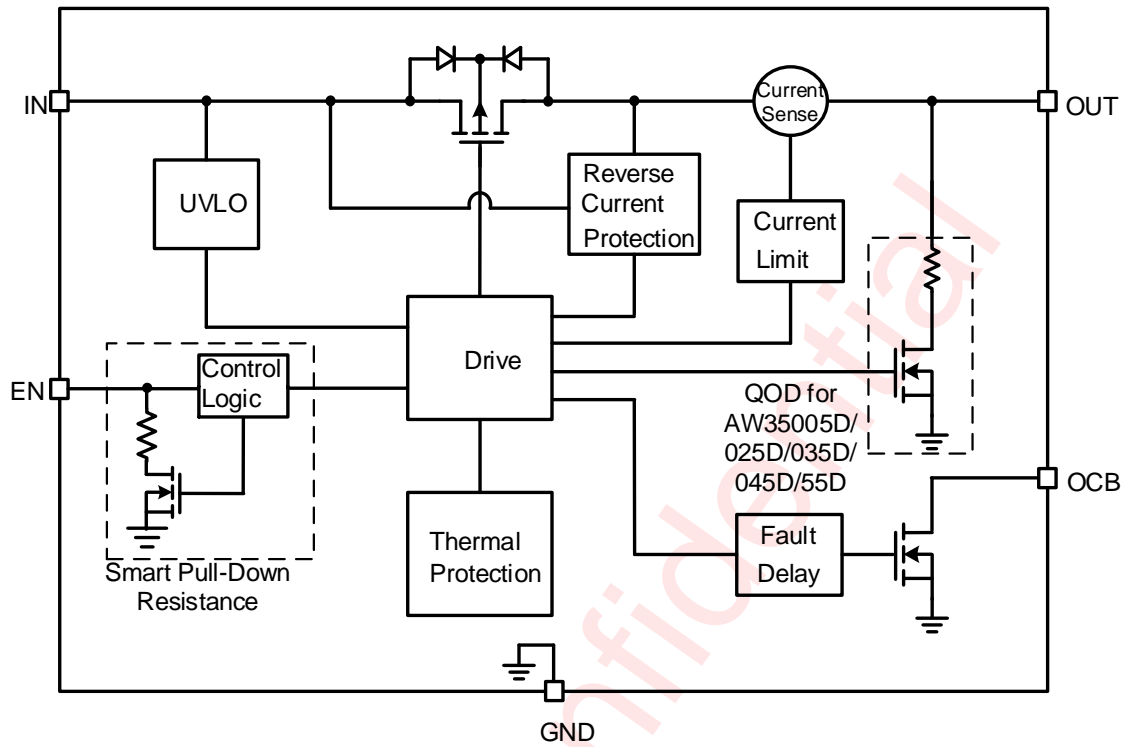


Figure 3 Functional Block Diagram

Typical Application Circuits

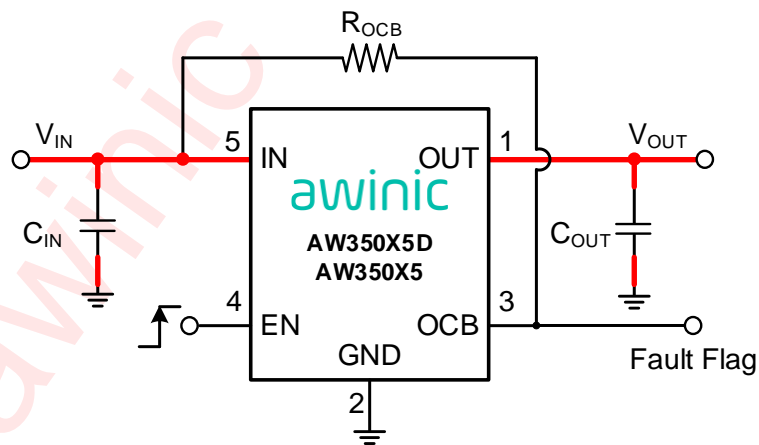


Figure 4 Typical Application Circuit of AW350X5D/AW350X5

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW35005DSTR	-40°C ~ 85°C	SOT23-5L	V1S0	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35025DSTR	-40°C ~ 85°C	SOT23-5L	72E5	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35035DSTR	-40°C ~ 85°C	SOT23-5L	EXZU	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35045DSTR	-40°C ~ 85°C	SOT23-5L	L1FK	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35055DSTR	-40°C ~ 85°C	SOT23-5L	6G6L	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35005STR	-40°C ~ 85°C	SOT23-5L	TA45	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35025STR	-40°C ~ 85°C	SOT23-5L	EK17	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35035STR	-40°C ~ 85°C	SOT23-5L	12CH	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35045STR	-40°C ~ 85°C	SOT23-5L	KW60	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35055STR	-40°C ~ 85°C	SOT23-5L	7T50	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 $V_{IN} \geq 2.5V$ ^(NOTE 2)		2.5A
Maximum Peak Switch Current for $V_{IN} \geq 2.5V$ ^(NOTE 3)		2.8A
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, V _{EN} =5.0V, I _{OUT} =0A		25	50	μA
I _{SD}	Shutdown current from IN to GND	V _{IN} =5.0V, V _{EN} =0V		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, V _{EN} =high, I _{OUT} =500mA		65		mΩ
R _{EN}	EN pin pull down resistor	V _{IN} =5V, V _{EN} =0.1V		9.2		MΩ
R _{DIS}	Output discharge resistance	V _{IN} =5.0V, V _{EN} =low, I _{OUT} Sinking 2mA (for AW350X5D)		75		Ω
t _R	Output rise time	V _{IN} =5.0V, C _{OUT} =1μF, R _L =100Ω		130		μs
t _{ON}	Switch turn on time			294		μs
t _F	Output fall time	V _{IN} =5.0V, C _{OUT} =1μF, R _L =100Ω	AW350X5	170		μs
			AW350X5D	73		μs
t _{OFF}	Switch turn off time		AW350X5	180		μs
			AW350X5D	75		μs
V _{IH}	EN input high threshold level		1.4			V
V _{IL}	EN input low threshold level				0.4	V
CURRENT LIMIT						
I _{LIMIT}	Current limit threshold	AW35005D/AW35005	450	500	550	mA
		AW35025D/AW35025	1000	1100	1210	
		AW35035D/AW35035	1350	1500	1650	
		AW35045D/AW35045	1890	2100	2310	
		AW35055D/AW35055	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}		1		ms

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	V _{EN} =High, V _{OUT} > V _{IN}		43		mV
I _{REV}	Reverse leakage current	V _{OUT} =5V, V _{IN} =0V, V _{EN} =0V		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

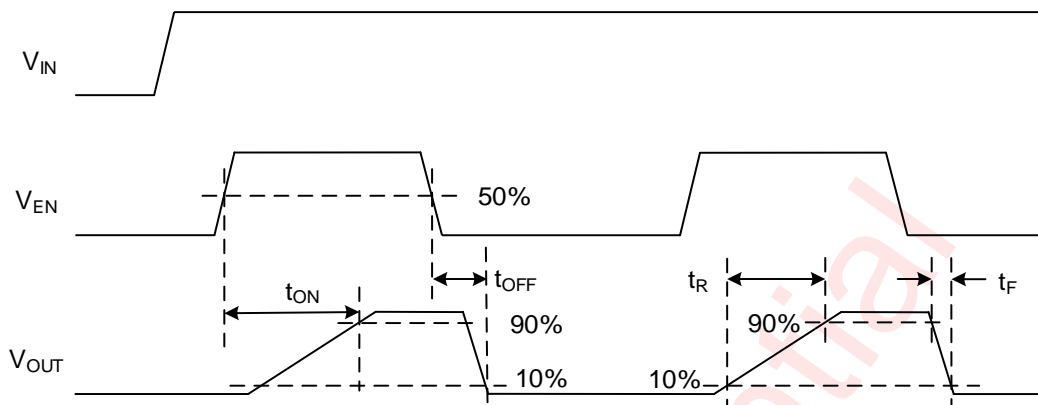


Figure 5 AW350X5D/AW350X5 Timing Diagram

Typical Characteristics

Ambient temperature is 25°C, $C_{IN} = C_{OUT} = 1\mu F$, unless otherwise noted.

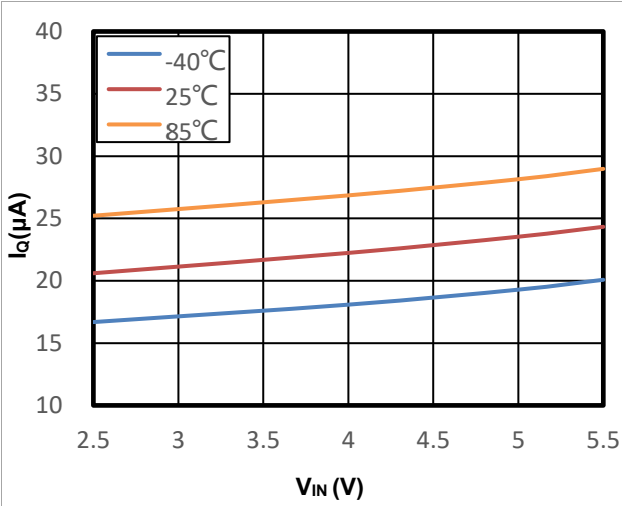


Figure 6 Quiescent Current vs. V_{IN}, No load

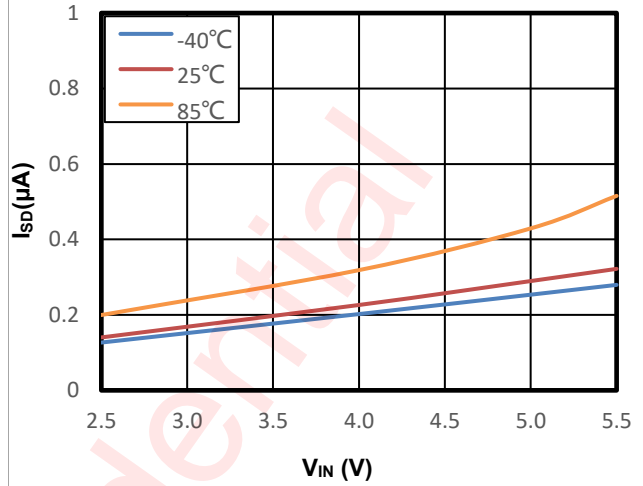


Figure 7 IN Shutdown Current vs. V_{IN}

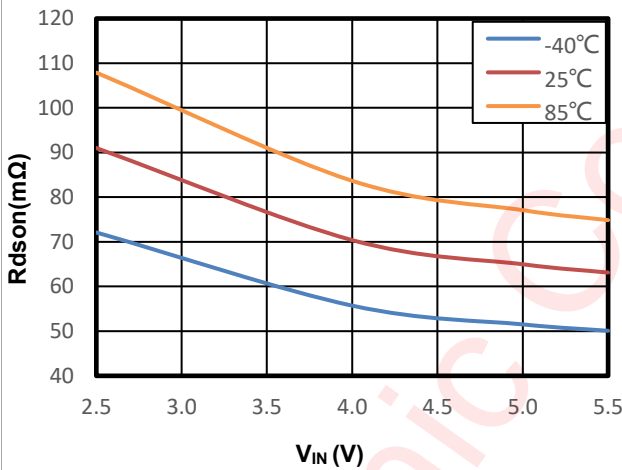


Figure 8 Rdson vs. V_{IN} (I_{OUT}=500mA)

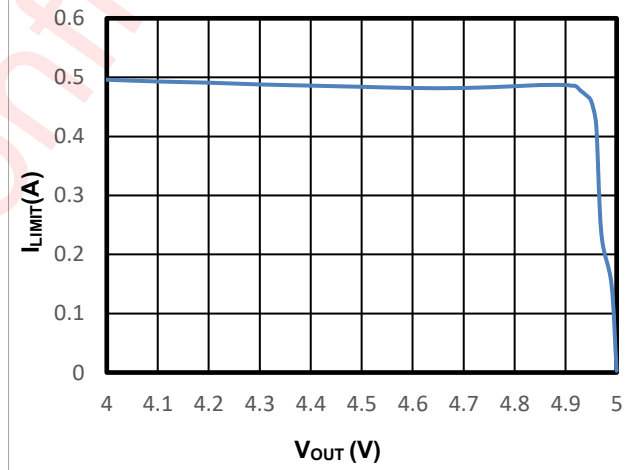


Figure 9 I_{LIMIT} vs. V_{OUT}
(AW35005/005D)

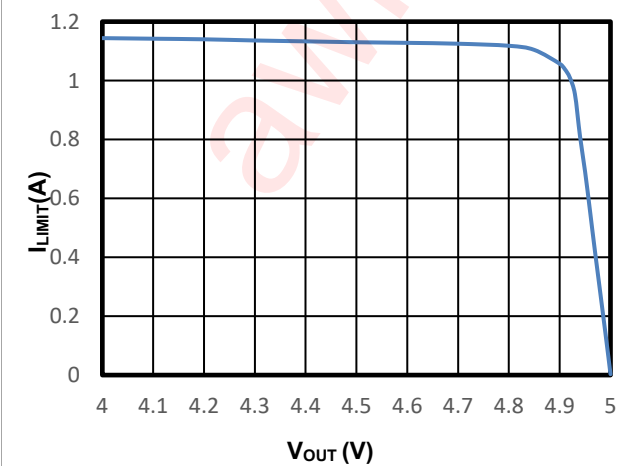


Figure 10 I_{LIMIT} vs. V_{OUT}
(AW35025/025D)

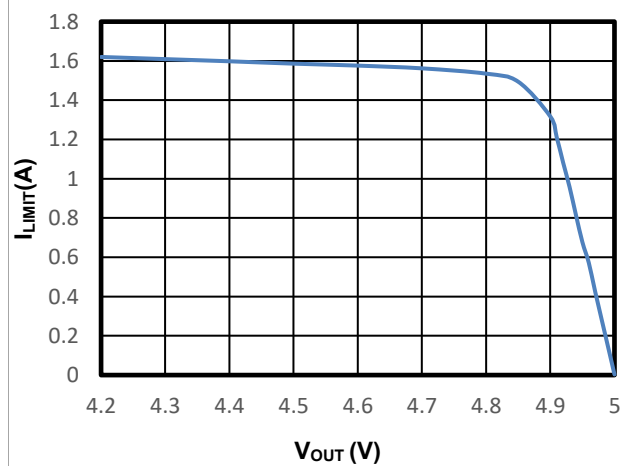
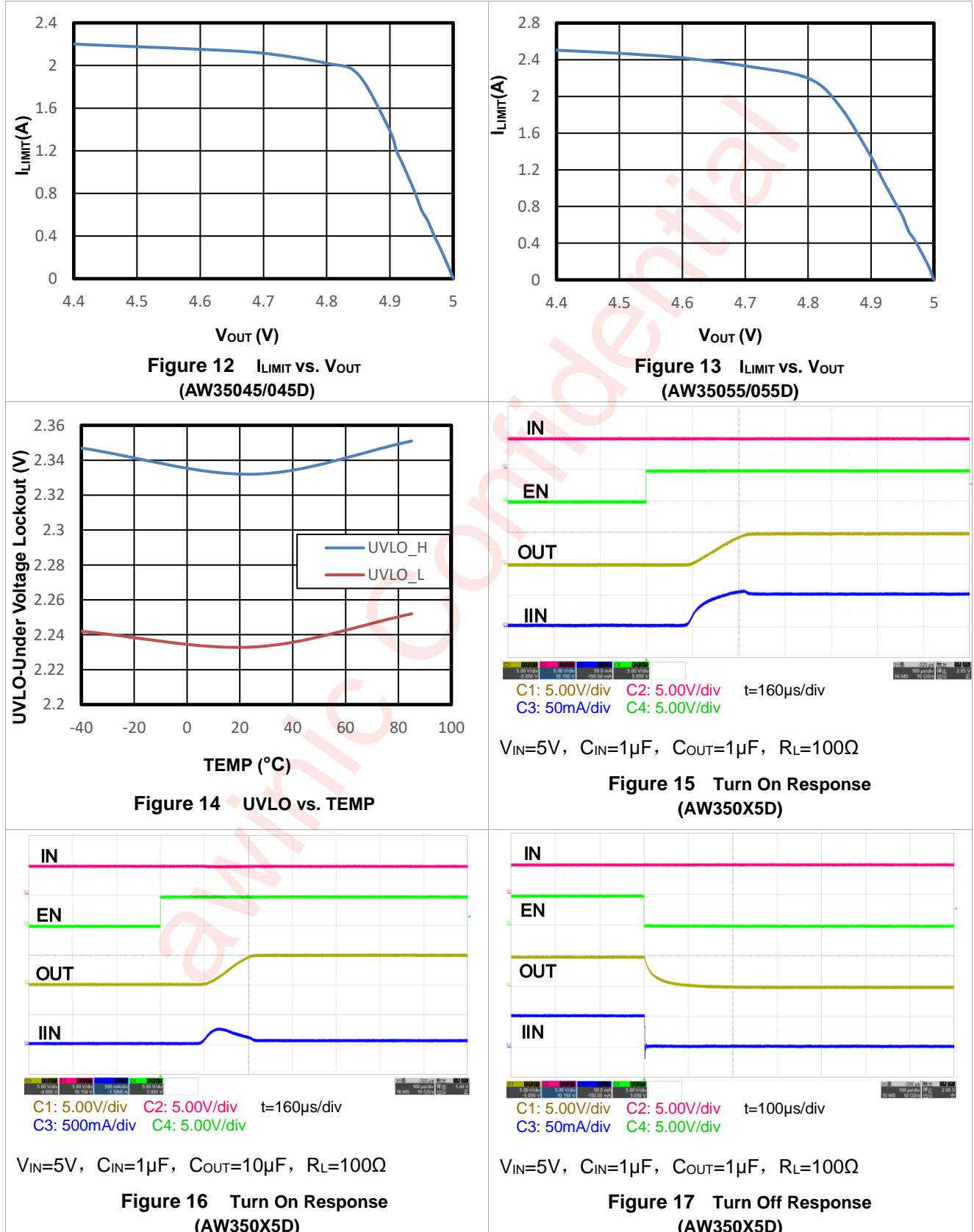
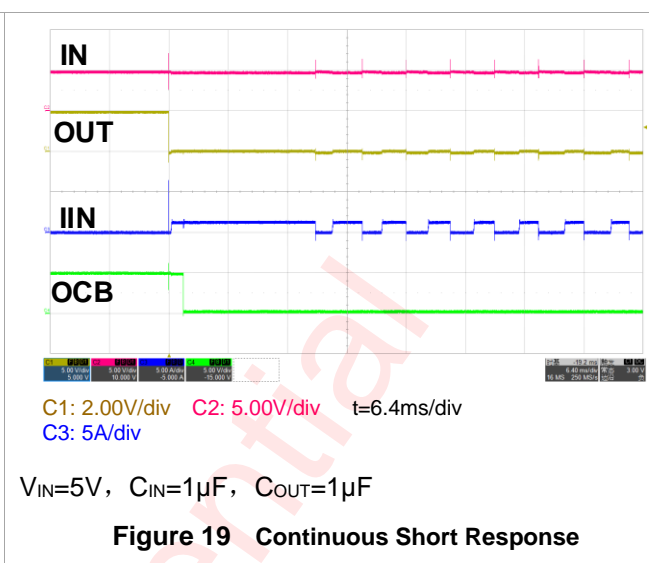
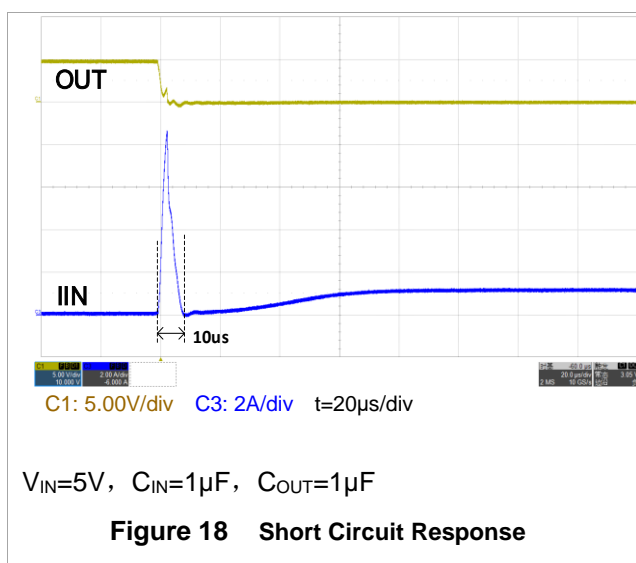


Figure 11 I_{LIMIT} vs. V_{OUT}
(AW35035/035D)

Typical Characteristics (continued)

Ambient temperature is 25°C, $C_{IN} = C_{OUT} = 1\mu F$, unless otherwise noted.





Functional Description

The AW350X5D/AW350X5 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 AW35005D/025D/035D/045D/055D/005/025/035/045/055 provides fixed current limit threshold. The current limit function can prevent the switch from over current condition.

AW35005D/AW35005	0.5A fixed current limit
AW35025D/AW35025	1.1A fixed current limit
AW35035D/AW35035	1.5A fixed current limit
AW35045D/AW35045	2.1A fixed current limit
AW35055D/AW35055	2.5A fixed current limit

FAST SHORT CIRCUIT PROTECTION

The AW350X5D/AW350X5 provides short circuit protection function which can limit the output current to a safe level without damaging the switch.

UNDER VOLTAGE LOCKOUT (UVLO)

The AW350X5D/AW350X5 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 AW35005D/AW35025D/AW35035D/AW3545D/AW35055D 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 AW350X5D/AW350X5 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 AW350X5D/AW350X5 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 6 can be calculated by the following formula: $I_{REV_ACT} = \frac{V_{REV}}{R_{dson}}$

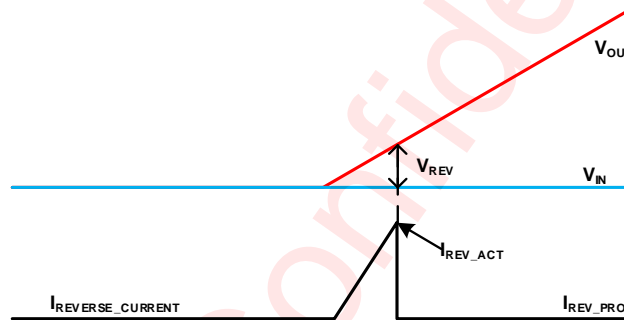


Figure 20 RCP parameter diagram

OCB OUTPUT

The AW350X5D/AW350X5 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

AW350X5D/AW350X5 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 AW350X5D/AW350X5) and close to IN pin, and place the output capacitor C_{OUT} on the top layer (same layer as the AW350X5D/AW350X5) and close to OUT pin.
2. The AW350X5D/AW350X5 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 21 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 AW350X5D/AW350X5 to decrease EMI coupling.

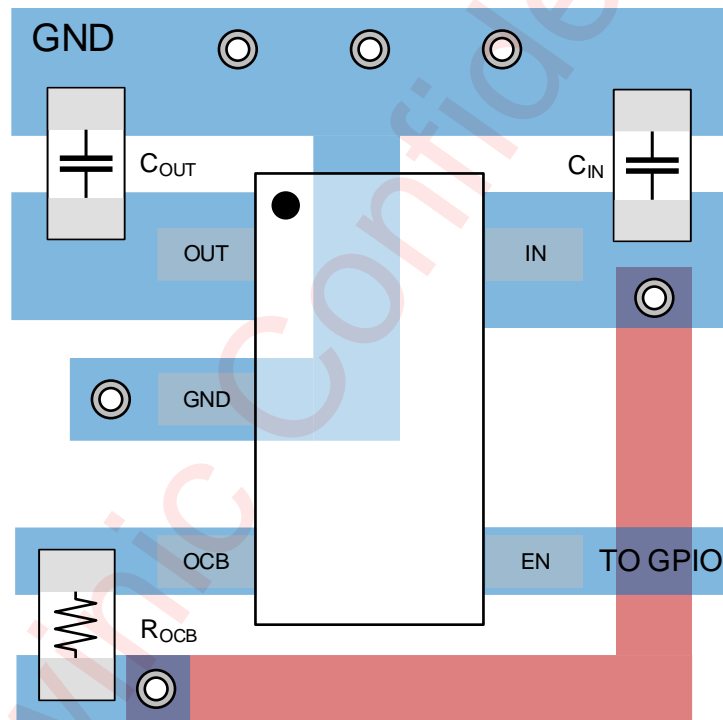
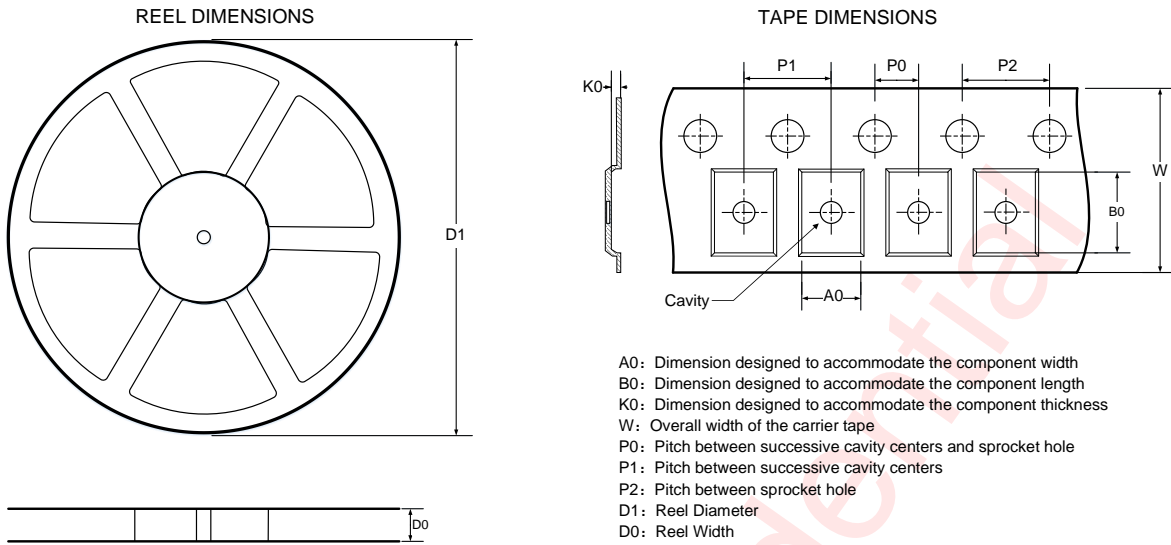
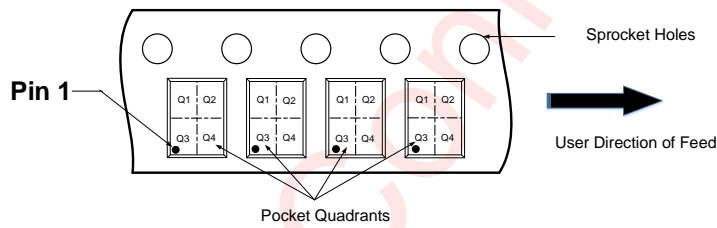


Figure 21 PCB layout example

Tape And Reel Information



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



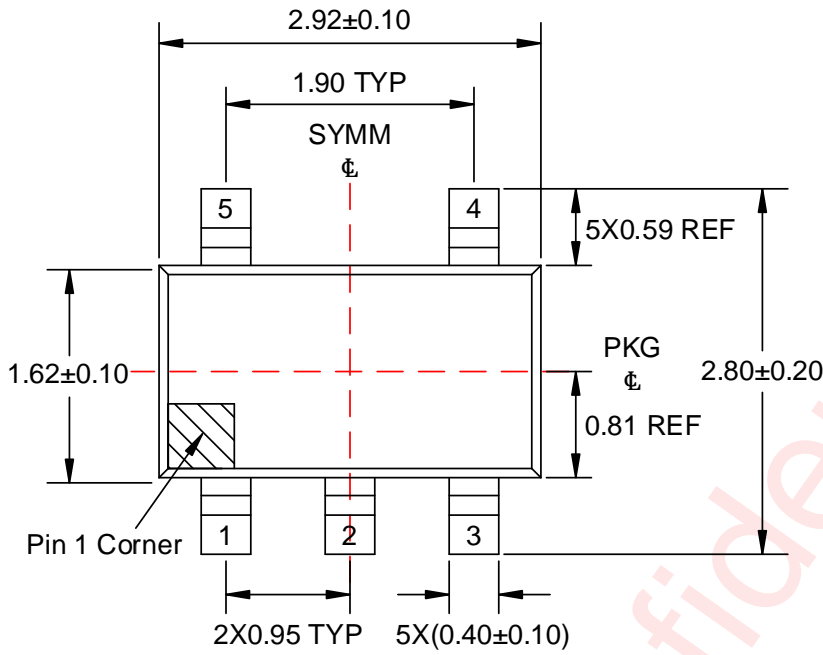
Note: The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

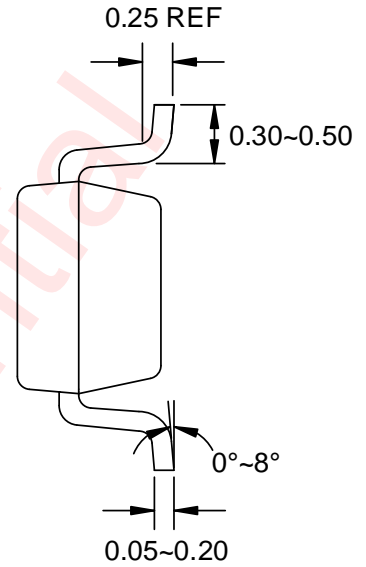
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	8.5	3.3	3.2	1.4	2	4	4	8	Q3

All dimensions are nominal

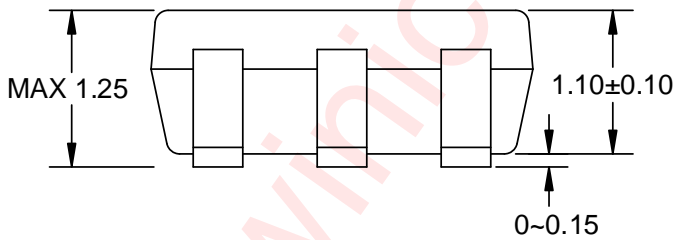
Package Description



Top View



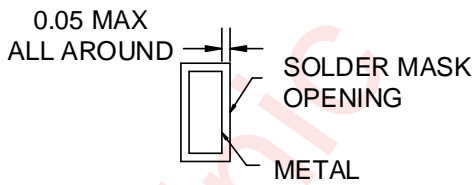
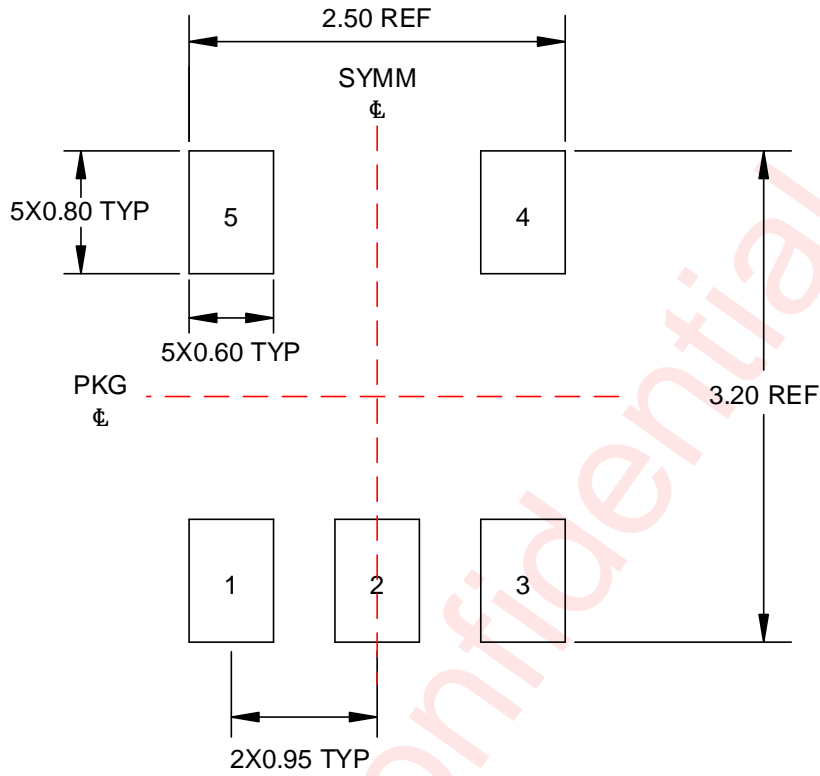
Side View



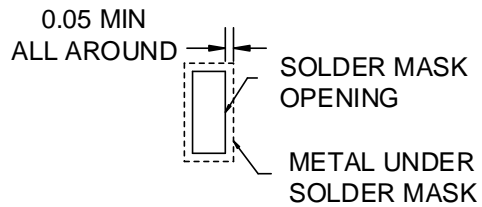
Side View

Unit: mm

Land Pattern Data



NON SOLDER MASK DEFINED



SOLDER MASK DEFINED

Unit: mm

Revision History

Version	Date	Change Record
V1.0	Apr. 2023	Officially released
V1.1	Oct. 2023	1. Modify the test condition of $R_{EN}(P6)$ 2. Add the parameters of t_F and $t_{OFF}(P6)$ 3. Modify the Current limit threshold of AW35025D/AW35025(P6)

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