Power Distribution Switch with Adjustable Current Limit

Features

- Integrated P-channel MOSFET power switch
- Input voltage: 2.5V to 5.5V
- 0.4~2A adjustable current limit
- Switch on-resistance(typ.):
  Rdson=85mΩ at VIN=5V
- ±20% current limit accuracy
- Reverse current protection
- Internal EN pull-down resistor
- Under voltage lockout
- Over temperature protection
- Quick Output Discharge(QOD)
  - ✧ AW35002D/AW35012D: Auto QOD
  - ✧ AW35012: No QOD
- SOT23-5L package

General Description

The AW35002D/AW35012D/AW35012 is a P-channel MOSFET power distribution switch which intended for high-side load-switching applications. The device integrates adjustable current limit function with an external resistor from ISET pin to ground.

The AW35002D/AW35012D/AW35012 also features fast short-circuit response, under voltage lockout, over temperature protection, reverse current protection. The AW35002D/AW35012D build in quick output discharge function.

Set adjustable current limit:

AW35002D	$I_{LIMIT}=26000/R_{SET}$
AW35012D AW35012	$I_{LIMIT}=6800/R_{SET}$

Applications

USB Ports

Power Distribution Switch

Notebook and Desktop Computer

High-Definition Television(HDTV)

Typical Application Circuit

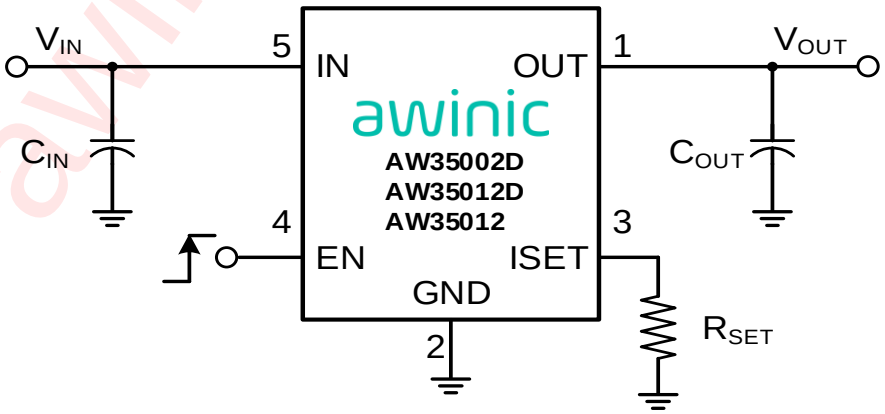


Figure 1 Typical Application Circuit of AW35002D/AW35012D/AW35012

Pin Configuration And Top Mark

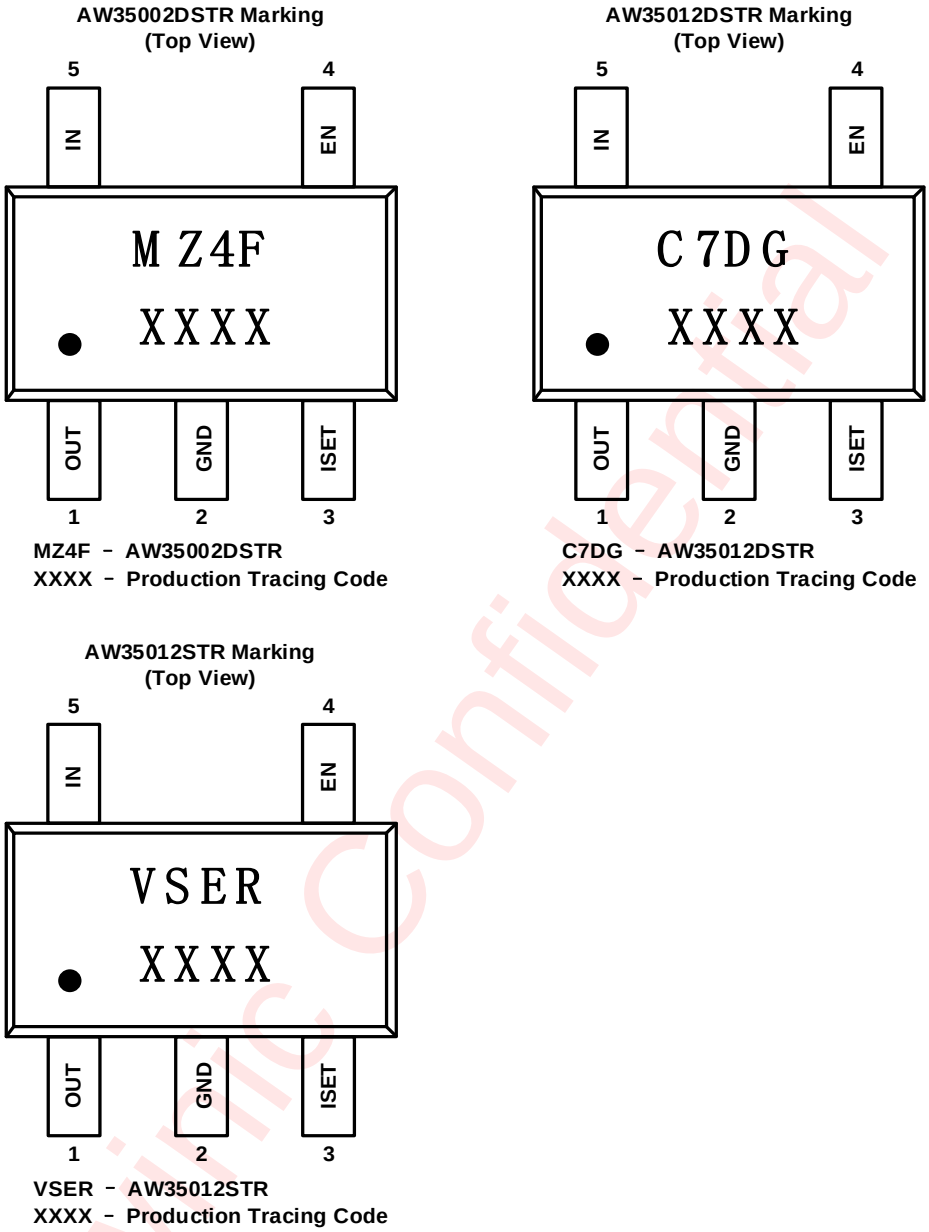


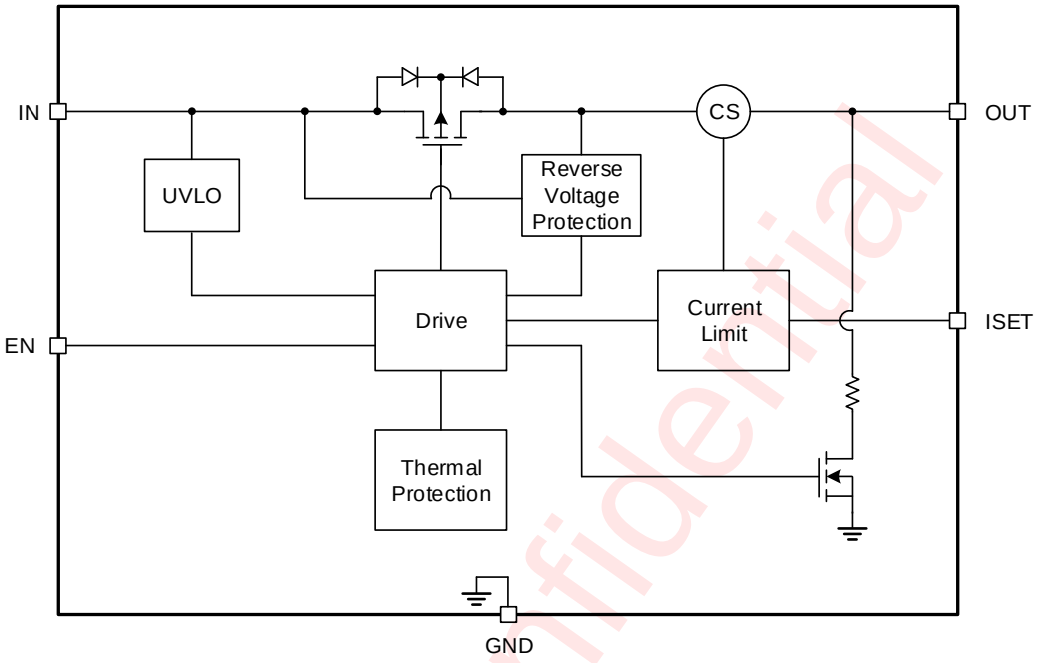
Figure 2 Pin Configuration and Top Mark

Pin Definition

Pin	Name	Description
1	OUT	Output pin
2	GND	Ground
3	ISET	Current limit threshold setting pin
4	EN	Chip enable (Active High)
5	IN	Power supply input

Functional Block Diagram

- **AW35002D/AW35012D**



- **AW35012**

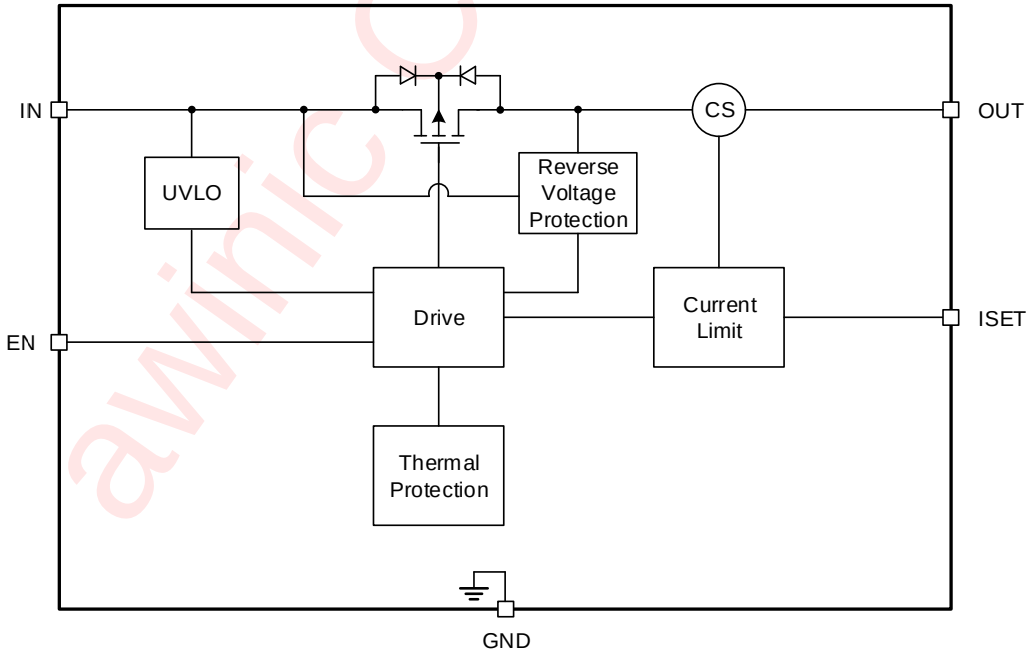


Figure 3 Functional Block Diagram

Typical Application Circuits

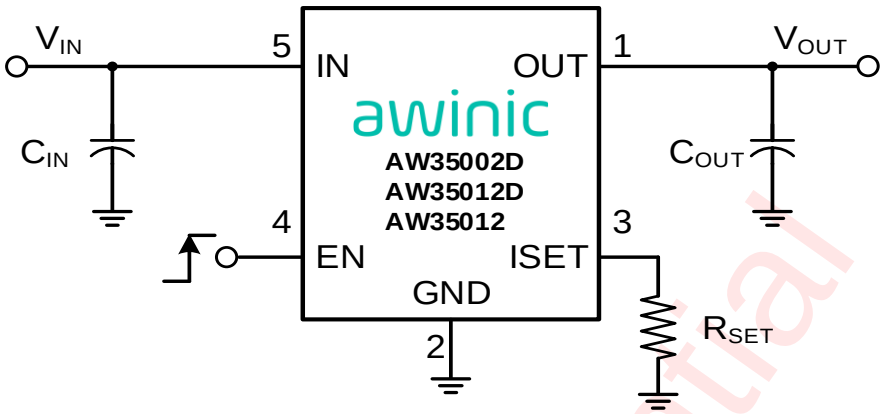


Figure 4 Typical Application Circuit of AW35002D/AW35012D/AW35012

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW35002DSTR	-40℃ ~ 85℃	SOT23 2.8mm×2.9 mm-5L	MZ4F	MSL3	ROHS+HF	3000 units/ Tape and Reel
AW35012DSTR			C7DG			
AW35012STR			VSER			

Absolute Maximum Ratings(NOTE1)

PARAMETERS		RANGE
Supply Voltage Range V_{IN}		-0.3V to 6V
Input 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)		2A
Maximum Peak Switch Current for VIN ≥ 2.5V(NOTE 3)		2.5A
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)		±1.0kV
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: JESD78E.

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}≤ 2A and T_A = 25°C.

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, Set I_{LIMIT}=1.0A (i.e. R_{SET}=26kΩ for AW35002D R_{SET}=6.8kΩ for AW35012D/AW35012)		30	70	μA
I_{SD}	Shutdown current from IN to GND	V_{IN}=5.0V, V_{EN}=0V, Set I_{LIMIT}=1.0A		0.55	2	μA
I_{LEAKEN}	EN pin leakage current	V_{IN}=0V, V_{EN}=5.5V		0.4	1	μA
POWER SWITCH						
R_{dson}	Internal switch MOSFET on-state resistance	V_{IN}=5.0V, V_{EN}=high, I_{OUT}=500mA		85		mΩ
R_{EN}	EN pin pull down resistor	V_{EN}=5.0V		12		MΩ
R_{DIS}	Output discharge resistance	V_{IN}=5.0V, V_{EN}=low, I_{OUT} Sinking 2mA (for AW35002D/AW35012D)		75		Ω
t_R	Output rise time	V_{IN}=5.0V, C_{OUT}=1μF, R_{OUT}=100Ω		60		μs
t_{ON}	Switch turn on time	V_{IN}=5.0V, C_{OUT}=1μF, R_{OUT}=100Ω		160		μs
t_F	Output fall time	V_{IN}=5.0V, C_{OUT}=1μF, R_{OUT}=100Ω		105		μs
t_{OFF}	Switch turn off time	V_{IN}=5.0V, C_{OUT}=1μF, R_{OUT}=100Ω		110		μs
V_{IH}	EN input high threshold level		1.55			V
V_{IL}	EN input low threshold level				0.8	V
CURRNET LIMIT						
I_{LIMIT}	Current limit threshold	R_{SET}=13kΩ for AW35002D R_{SET}=3.4kΩ for AW35012D/AW35012	1600	2000	2400	mA
		R_{SET}=26kΩ for AW35002D R_{SET}=6.8kΩfor AW35012D/AW35012	800	1000	1200	
		R_{SET}=65kΩ for AW35002D R_{SET}=17kΩfor AW35012D/AW35012	320	400	480	
t_{IOS}	Response time to short circuit	V_{IN}=5.0V		10		μs

Electrical Characteristics (continued)

T_A = 25°C unless otherwise noted. Typical values are guaranteed for V_{IN} = 5V, C_{IN} = 1μF, I_{IN}≤ 2A and T_A = 25°C.

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		80		mV
REVERSE VOLTAGE PROTECT						
V_{REV}	Reverse voltage trip point	V_{EN}=High, V_{OUT} > V_{IN}		90		mV
I_{REV}	Reverse leakage current	V_{OUT}=5V,V_{IN}=0V,V_{EN}=0V		0.33		μA
I_{REV_ACT}	Reverse activation current	V_{IN}=5V, C_{OUT}=1μF, V_{OUT} > V_{IN}		1.05		A
I_{REV_PRO}	Reverse protection current	V_{OUT} - V_{IN} > V_{REV}		5		μA
THERMAL PROTECTION						
T_{SD}	Thermal shutdown threshold			145		℃
T_{SD_HYS}	Thermal shutdown hysteresis			20		℃

Timing Diagram

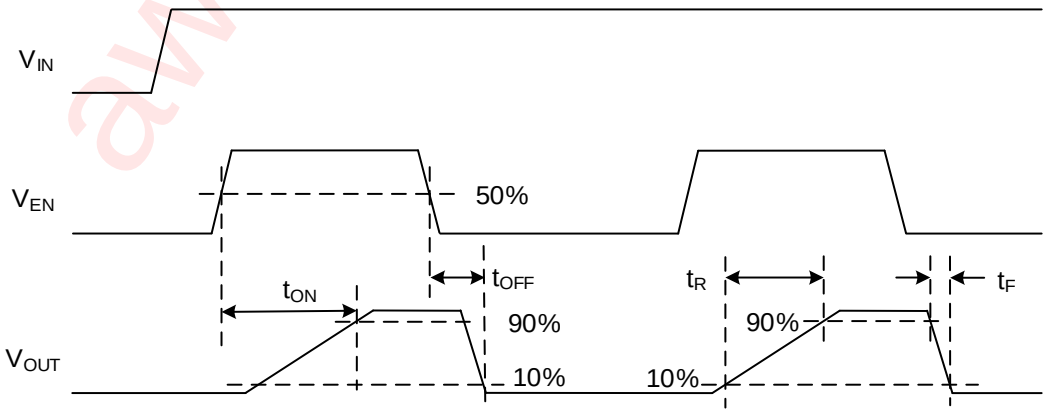


Figure 5 AW35002D/AW35012D/AW35012 Timing Diagram

Typical Characteristics

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

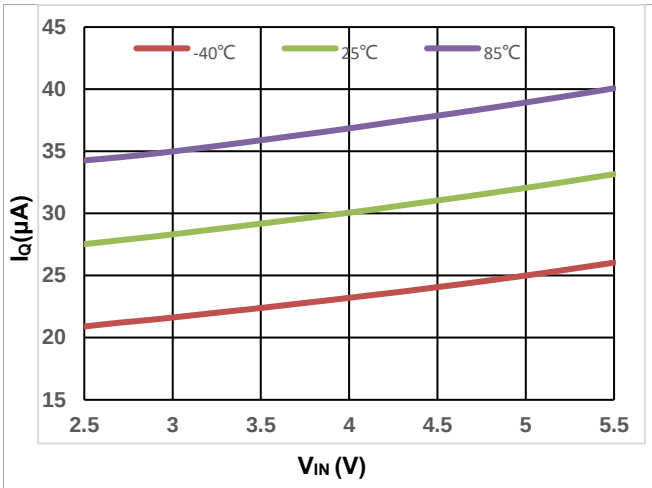


Figure 6 Quiescent Current vs. V_{IN}, No load

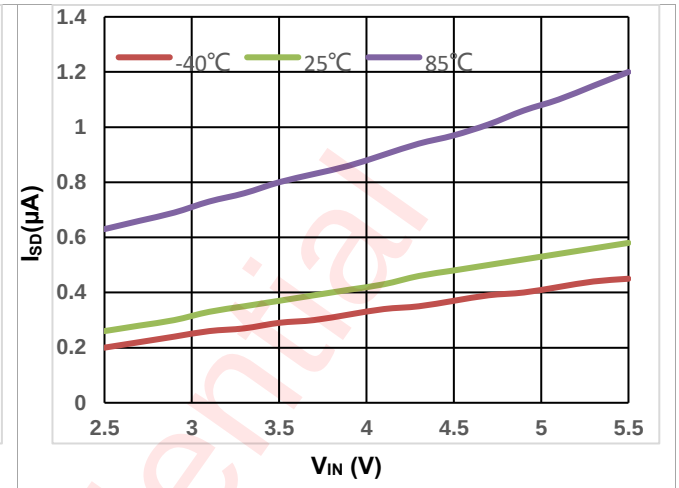


Figure 7 IN Shutdown Current vs. V_{IN}

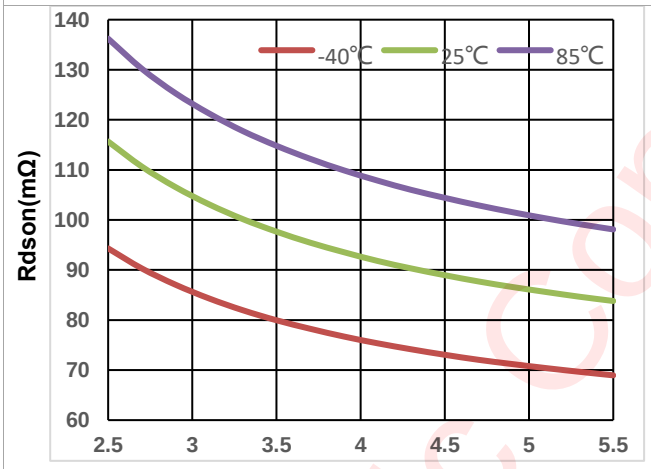


Figure 8 Rdson vs. V_{IN}(I_{OUT}=200mA)

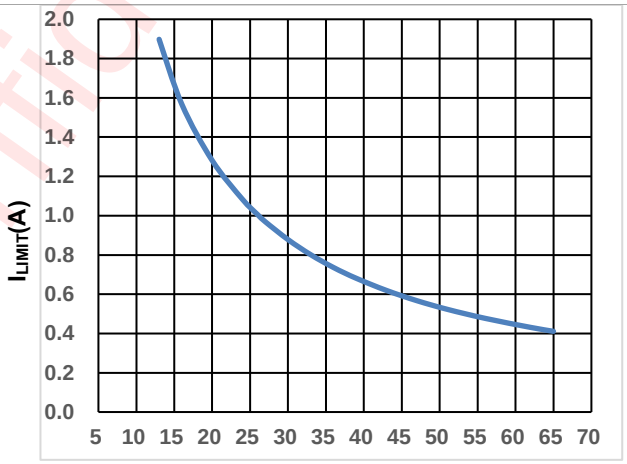


Figure 9 I_{LIMIT} vs. R_{ISET} (AW35002D)

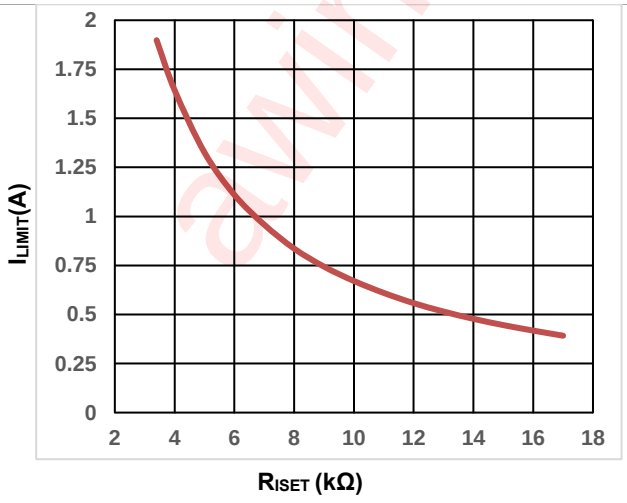


Figure 10 I_{LIMIT} vs. R_{ISET} (AW35012D/AW35012)

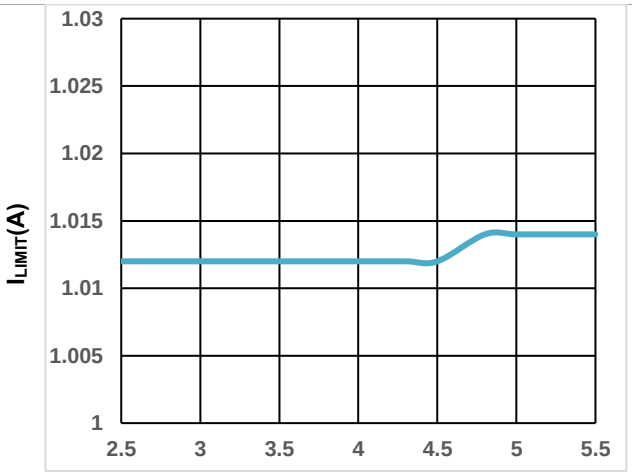


Figure 11 I_{LIMIT} vs. V_{IN}

Typical Characteristics (continued)

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

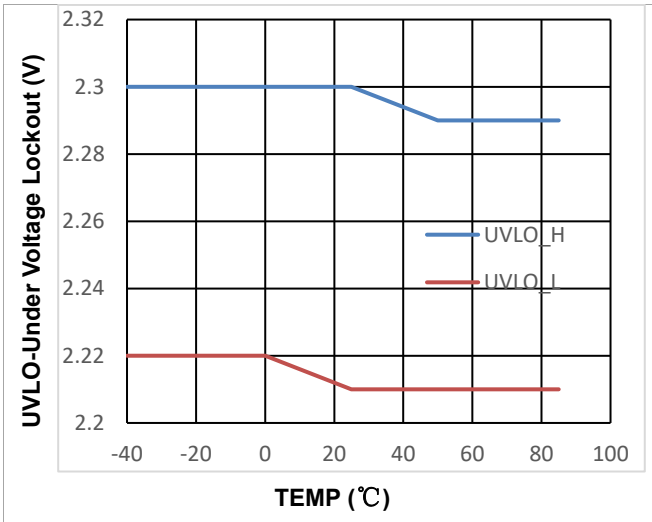
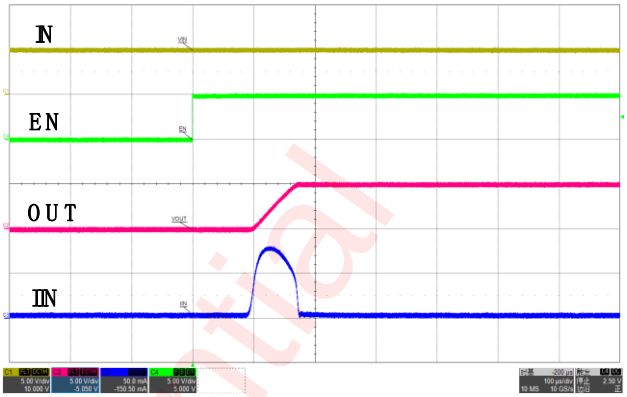


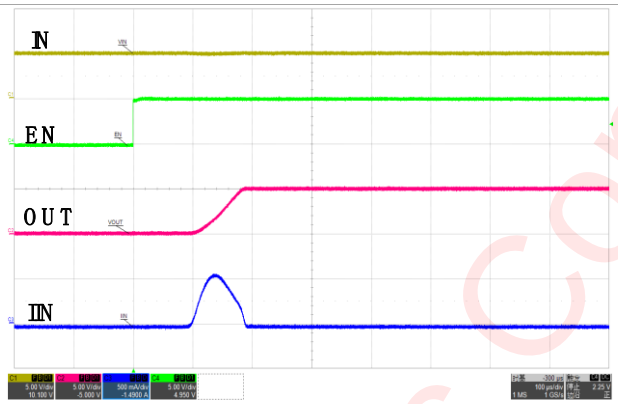
Figure 12 UVLO vs. TEMP



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，Set I_{LIMIT}=1.0A

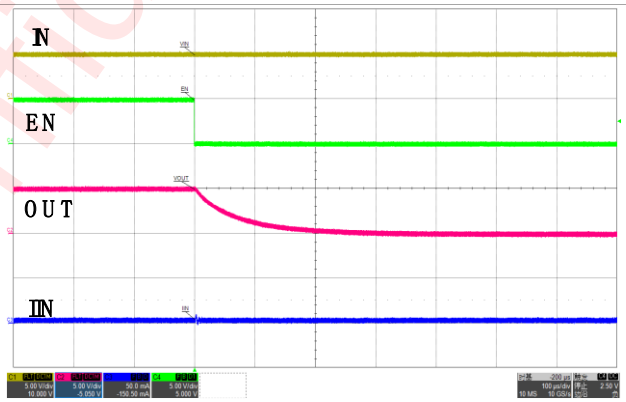
Figure 13 Turn On Response



C1: 5.00V/div C2: 5.00V/div t=100μs/div
C3: 500mA/div C4: 5.00V/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=10μF，Set I_{LIMIT}=1.0A

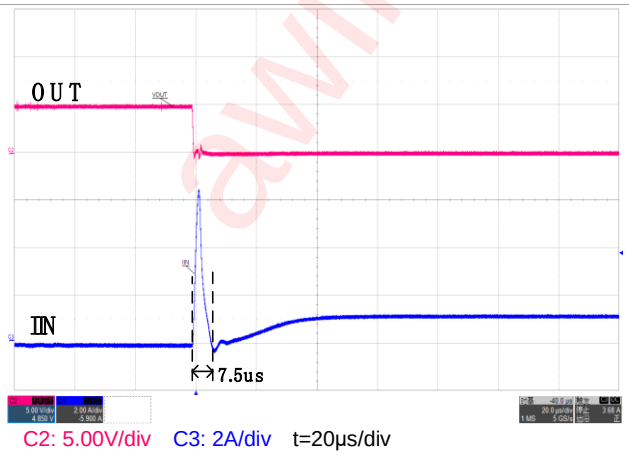
Figure 14 Turn On Response



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，Set I_{LIMIT}=1.0A

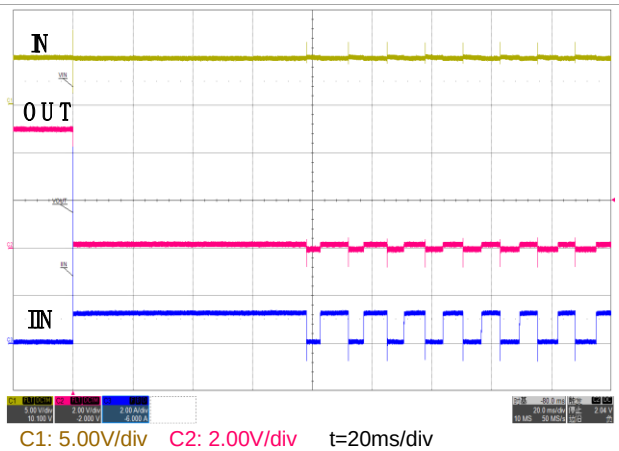
Figure 15 Turn Off Response



C2: 5.00V/div C3: 2A/div t=20μs/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=1μF，Set I_{LIMIT}=1.0A

Figure 16 Short Circuit Response



C1: 5.00V/div C2: 2.00V/div t=20ms/div
C3: 2A/div

V_{IN}=5V，C_{IN}=1μF，C_{OUT}=1μF，Set I_{LIMIT}=1.0A

Figure 17 Continuous Short Response

Functional Description

The AW35002D/AW35012D/AW35012 is a P channel MOSFET power distribution switch, which has adjustable current limit by the ISET pin. 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 AW35002D/AW35012D/AW35012 provides adjustable current limit threshold which implemented by an external resistor from ISET to ground, see figure 9 and figure 10. The current limit function can prevent the switch from over current condition. The current limit value can be calculated using the follow equation:

$I_{LIMIT}(A)=26000/R_{ISET}$ for AW35002D

$I_{LIMIT}(A)=6800/R_{ISET}$ for AW35012D/AW35012

The minimum current limit is 400mA，beyond 2A is forbidden.

FAST SHORT CIRCUIT PROTECTION

The AW35002D/AW35012D/AW35012 provides short circuit protection function which can limit the output current to a safe level without damaging the switch.

UNDER VOLTAGE LOCKOUT (UVLO)

The AW35002D/AW35012D/AW35012 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 80mV 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 145℃, the internal OTP circuit turn off the power switch. There is a temperature hysteresis 20℃, in other words, the OTP circuit can turn on the switch only if the junction temperature is below 125℃.

REVERSE CURRENT PROTECTION (RCP)

The AW35002D/AW35012D/AW35012 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 AW35002D/AW35012D/AW35012 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 18 can be calculated by the following formula: $I_{REV\_ACT} = \frac{V_{REV}}{R_{dson}}$

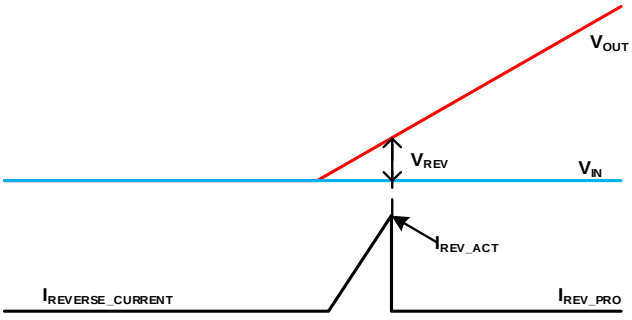


Figure 18 RCP parameter diagram

PCB Layout Consideration

AW35002D/AW35012D/AW35012 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 AW35002D/AW35012D/AW35012) and close to IN pin, and place the output capacitor C_{OUT} on the top layer (same layer as the AW35002D/AW35012D/AW35012) and close to OUT pin.

2. The AW35002D/AW35012D/AW35012 integrates an up to 2A 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. Red bold paths on Figure 19 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 AW35002D/AW35012D/ AW35012 to decrease EMI coupling.

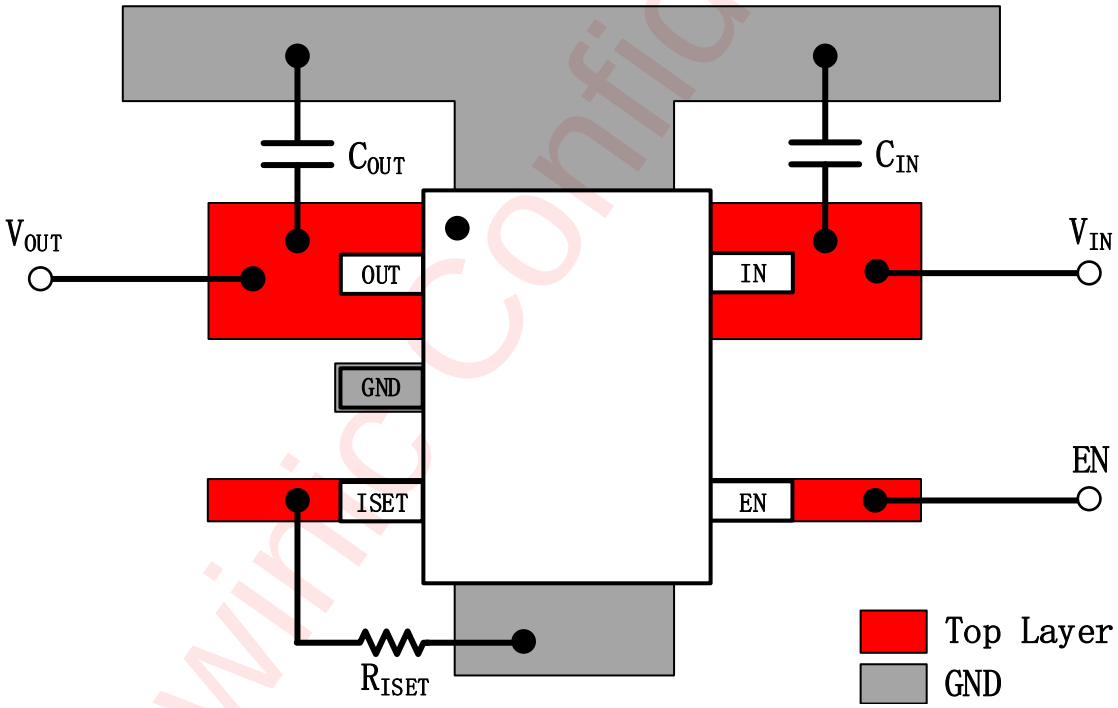
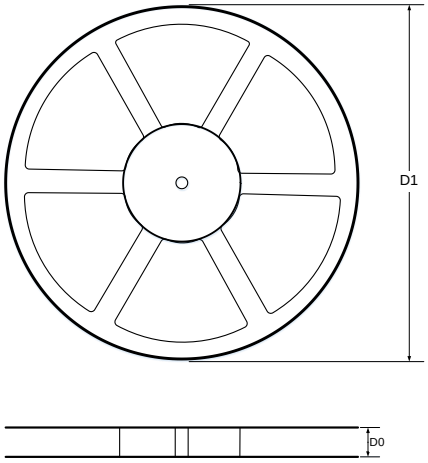


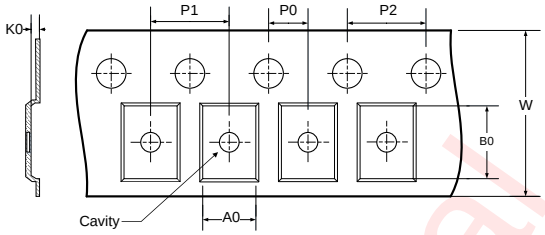
Figure 19 PCB layout example

Tape And Reel Information

REEL DIMENSIONS

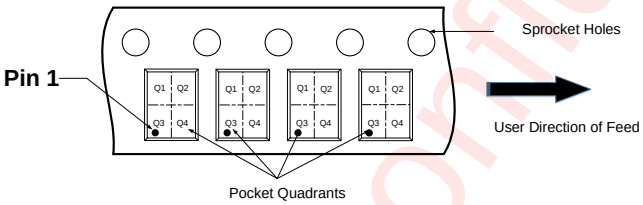


TAPE DIMENSIONS



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

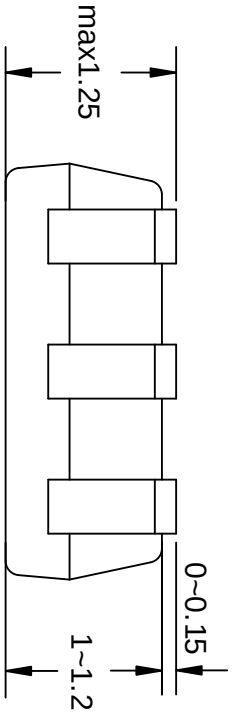


DIMENSIONS AND PIN1 ORIENTATION

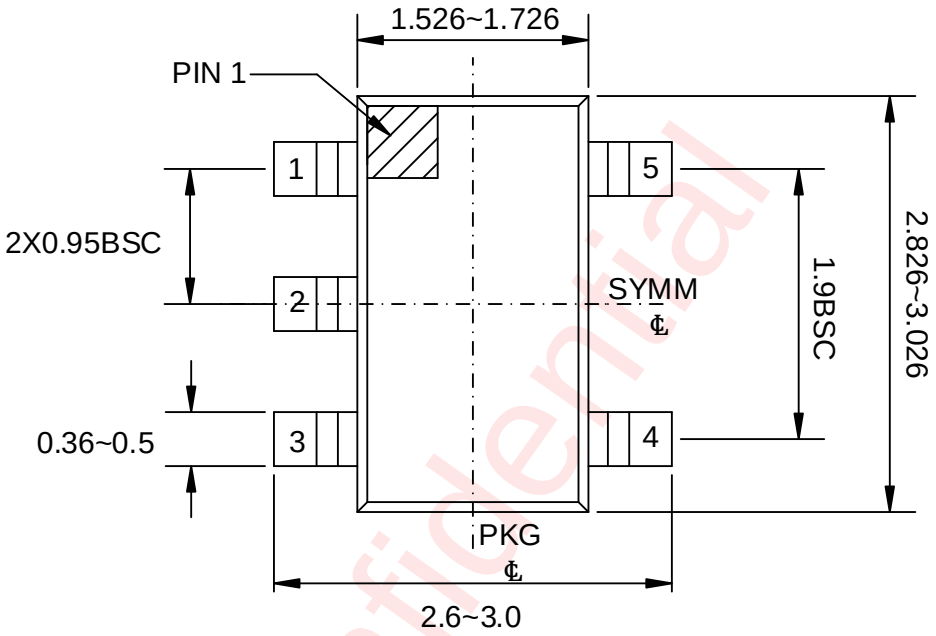
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	8.4	3.3	3.2	1.4	2	4	4	8	Q3

All dimensions are nominal

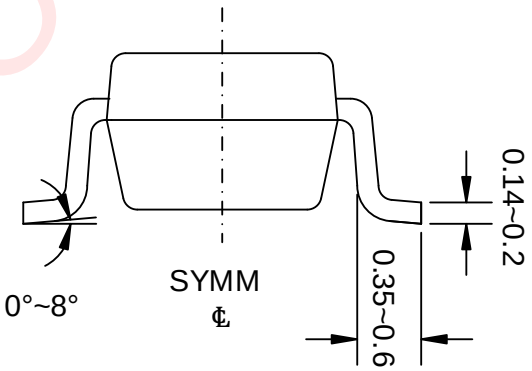
Package Description



Side View



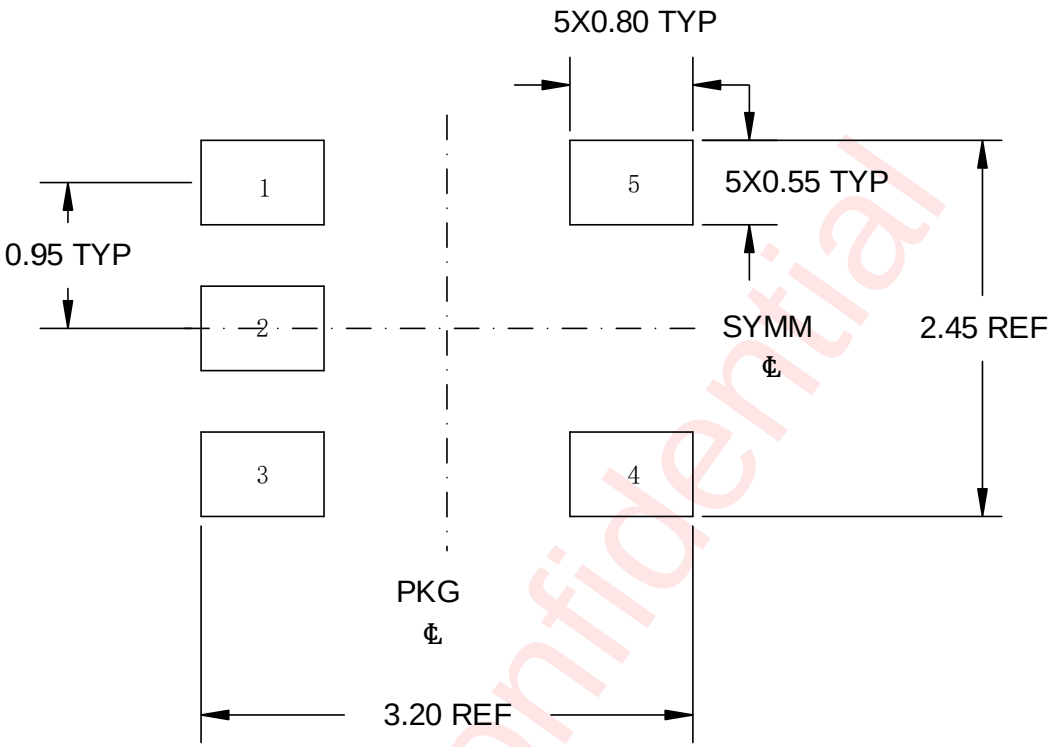
Top View

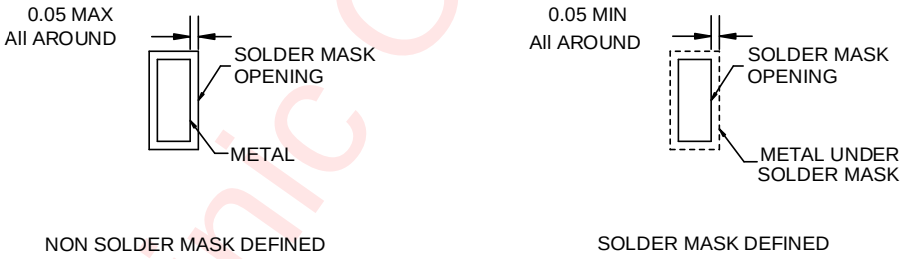


Side View

Unit: mm

Land Pattern Data





Unit: mm

Revision History

Version	Date	Change Record
V1.0	Feb 2020	Datasheet V1.0 Released
V1.1	Aug 2020	Modify the VIH minimum
V1.2	Nov 2020	Add AW35002D
V1.3	Jan 2021	Add AW35012

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