

具有浪涌保护功能的过压保护负载开关

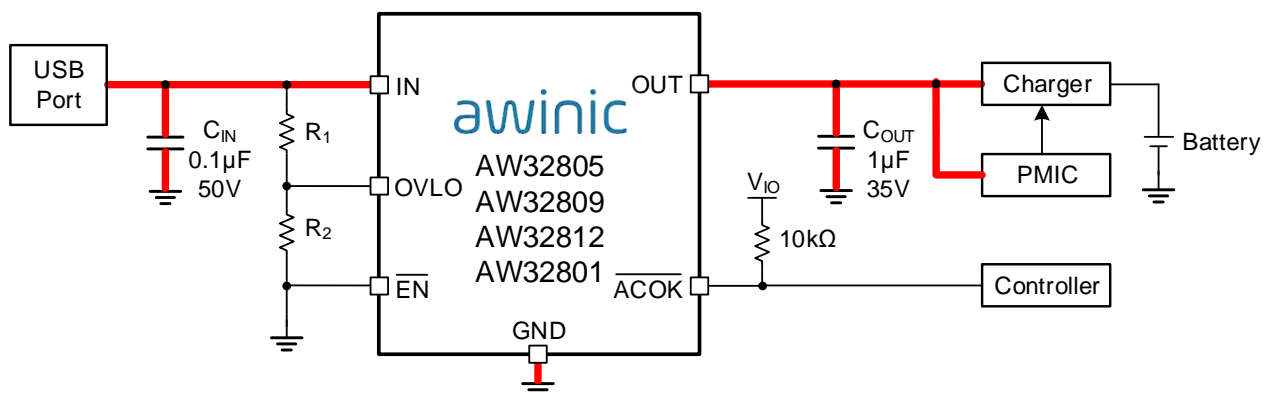
特性

- 浪涌保护
 - IEC 61000-4-5: >100V
- 集成 R_{dson} 仅 $28m\Omega$ (typ.) 的 nFET 开关
- 4.5A 连续电流能力
- 过压保护 (OVP) 默认阈值
 - AW32801: 5.95V
 - AW32805: 6.8V
 - AW32809: 9.98V
 - AW32812: 14V
- 过压保护阈值可调范围 4~20V
- IN 端系统级 ESD 保护
 - IEC 61000-4-2 接触放电: $\pm 8kV$
 - IEC 61000-4-2 空气放电: $\pm 15kV$
- 输入最大直流耐压 29V
- 过压关断响应时间仅 125ns (typ.)
- 过温保护 (OTP)
- 欠压关断 (UVLO)
- 纤小的 1.34mm x 1.78mm WLCSP-12 封装

应用

- 智能手机
- 平板电脑
- 5~20V 充电接口

典型应用图



电阻 R_1 和 R_2 用于调整 OVP 阈值, 使用默认 OVP 阈值时 OVLO 接地。

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概要

AW328xx 系列是具有防浪涌功能的 OVP 芯片, 芯片内部在 IN 端并联了钳位电路, 能够抑制高达 100V 的浪涌电压。

AW328xx 内部集成了 R_{dson} 仅 $28m\Omega$ (typ.) 的 nFET 负载开关。当 IN 端电压超过 OV 阈值, 直通功率管迅速关断, 防止 OUT 端所连接的器件被过压损坏。IN 端直流耐压达到 29V。

AW328xx 系列过压保护阈值默认为 5.95V (AW32801)、6.8V (AW32805)、9.98V (AW32809)、14V (AW32812), 也可通过在 OVLO 引脚外接分压电阻调节, 可调范围 4~20V。

AW328xx 具有漏端开路输出信号 \overline{ACOK} , 当 $V_{IN_UVLO} < V_{IN} < V_{IN_OVLO}$ 且 NMOS 功率管开启后, \overline{ACOK} 会被拉低, 指示芯片正常工作, 否则 \overline{ACOK} 输出为高阻态。

AW328xx 内置过温保护, 防止芯片过热烧毁。

AW328xx 采用纤小的 1.34mm x 1.78mm WLCSP-12 封装, 符合 RoHS 规范, 占板面积小。

Over-Voltage Protection Load Switch with Surge Protection

FEATURES

- Surge protection
 - IEC 61000-4-5: > 100V
- Integrated low $R_{ds(on)}$ nFET switch: typical 28m Ω
- 4.5A continuous current capability
- Default Over-Voltage Protection (OVP) threshold
 - AW32801: 5.95V
 - AW32805: 6.8V
 - AW32809: 9.98V
 - AW32812: 14V
- OVP threshold adjustable range: 4V to 20V
- Input system ESD protection
 - IEC 61000-4-2 Contact discharge: ± 8 kV
 - IEC 61000-4-2 Air gap discharge: ± 15 kV
- Input maximum voltage rating: 29V_{DC}
- Fast turn-off response: typical 125ns
- Over-Temperature Protection (OTP)
- Under-Voltage Lockout (UVLO)
- 1.34mm × 1.78mm WLCSP-12 package

APPLICATIONS

- Smartphones
- Tablets
- 5V to 20V Charging Ports

GENERAL DESCRIPTION

The AW328xx family OVP load switch features surge protection, an internal clamp circuit protects the device from surge voltages up to 100V.

The AW328xx features an ultra-low 28m Ω (typ.) $R_{ds(on)}$ nFET load switch. When input voltage exceeds the OVP threshold, the switch is turned off very fast to prevent damage to the protected downstream devices. The IN pin is capable of withstanding fault voltages up to 29V_{DC}.

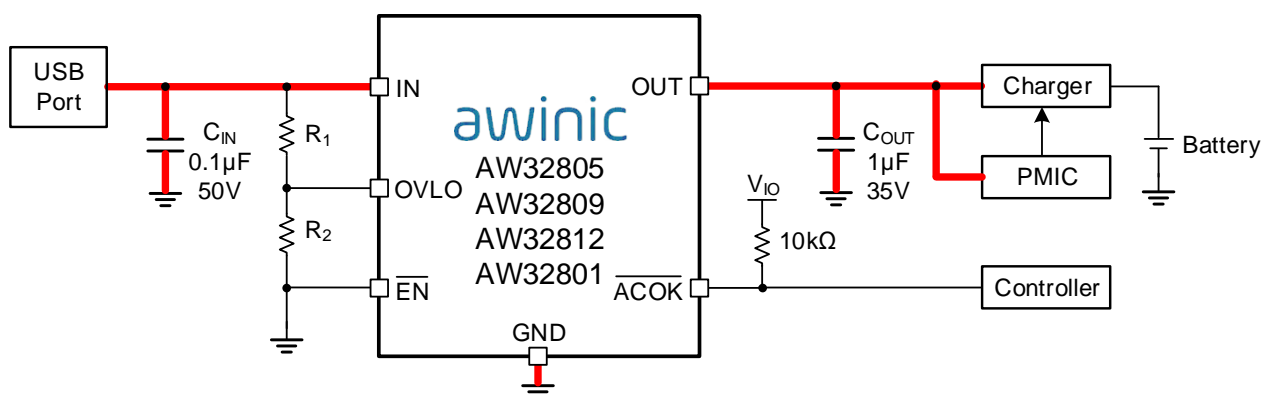
The default OVP threshold is 5.95V (AW32801), 6.8V (AW32805), 9.98V (AW32809) and 14V (AW32812), the OVP threshold can be adjusted from 4V to 20V through external OVLO pin.

The device features an open-drain output \overline{ACOK} , when $V_{IN_UVLO} < V_{IN} < V_{IN_OVLO}$ and the switch is on, \overline{ACOK} will be driven low to indicate a good power input, otherwise it is high impedance.

This device features over-temperature protection that prevents itself from thermal damaging.

The AW328xx is available in a RoHS compliant 12-bump 1.34mm × 1.78mm WLCSP.

TYPICAL APPLICATION CIRCUIT



R_1 and R_2 are used for OVP threshold adjustment, to use default OVP threshold, connect OVLO to ground.

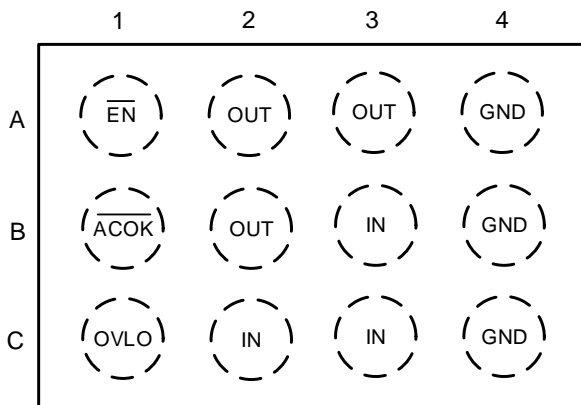
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DEVICE COMPARISON TABLE

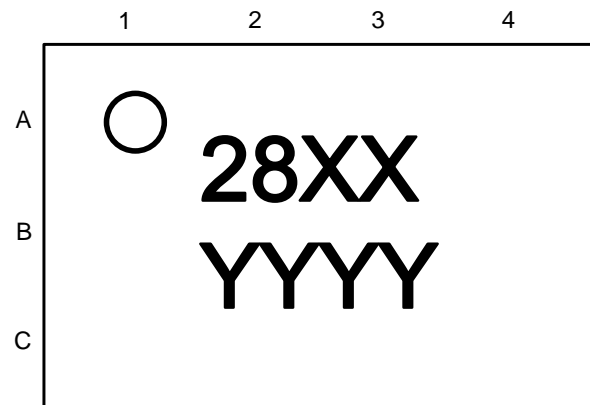
Device	V_{IN_OVLO} (V)			V_{IN_OVLO} hysteresis (mV)	
	Condition	Min.	Typ.		Max.
AW32805	V_{IN} rising	6.66	6.80	6.94	150
AW32809	V_{IN} rising	9.78	9.98	10.18	210
AW32812	V_{IN} rising	13.7	14.0	14.3	300
AW32801	V_{IN} rising	5.83	5.95	6.07	100

PIN CONFIGURATION AND TOP MARK

Pin Configuration (TOP VIEW)



Marking

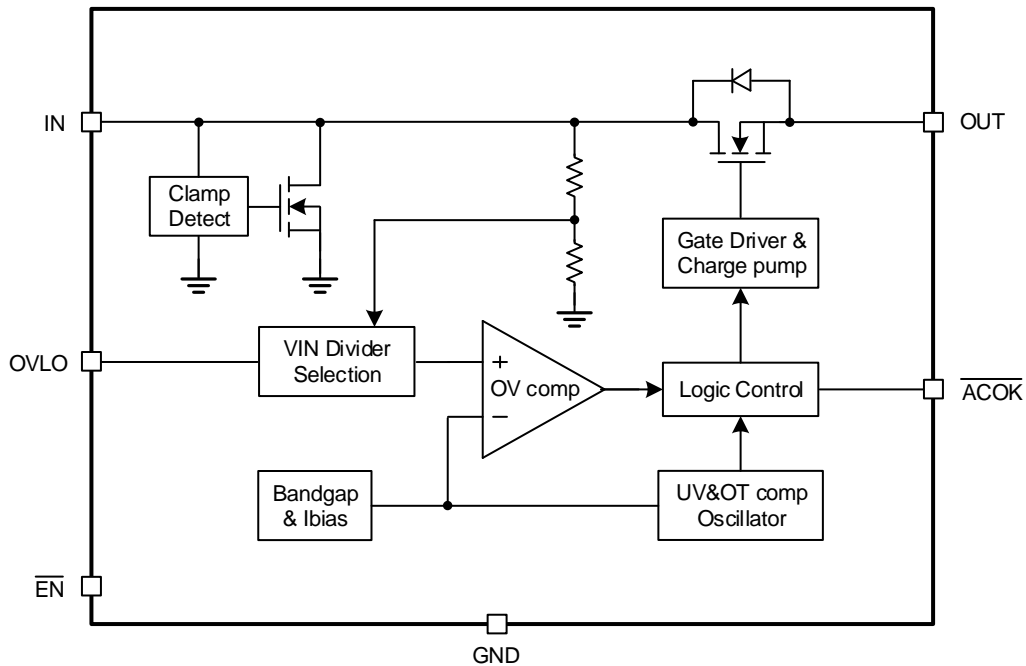


28XX – AW32801/AW32805/AW32809/AW32812
YYYY – Production tracking code

PIN DEFINITION

Pin	Name	Type	Description
A1	\overline{EN}	Input	Enable pin, active low
B1	\overline{ACOK}	Output	Power good flag, active-low, open-drain
C1	OVLO	Input	OVP threshold adjustment pin
C2, C3, B3	IN	Supply	Switch input and device power supply
A2, A3, B2	OUT	Output	Switch output
A4, B4, C4	GND	Supply	Device ground

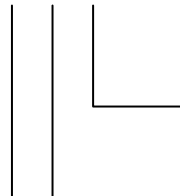
FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Temperature	Package	Marking	Delivery Form
AW32801CSR	-40°C – 85°C	1.340mm × 1.780mm × 0.575mm WLCSP-12	2801	Tape and Reel 3000pcs/Reel
AW32805CSR	-40°C – 85°C	1.340mm × 1.780mm × 0.575mm WLCSP-12	2805	Tape and Reel 3000pcs/Reel
AW32809CSR	-40°C – 85°C	1.340mm × 1.780mm × 0.575mm WLCSP-12	2809	Tape and Reel 3000pcs/Reel
AW32812CSR	-40°C – 85°C	1.340mm × 1.780mm × 0.575mm WLCSP-12	2812	Tape and Reel 3000pcs/Reel

AW328xx □ □ □



Shipping
R: Tape & Reel

Package Type
CS: CSP

ABSOLUTE MAXIMUM RATINGS (NOTE 1)

Symbol	Parameter	Condition	Min.	Max.	Unit
V_{IN}	Input voltage		0.3	29	V
V_{OUT}	Output voltage		-0.3	$V_{IN} + 0.3$	V
V_{OVLO}	OVLO voltage		-0.3	29	V
$V_{\overline{ACOK}}$	\overline{ACOK} voltage		-0.3	6	V
$V_{\overline{EN}}$	\overline{EN} voltage		-0.3	6	V
I_{IN}	Switch current	Continuous current		4.5	A
T_A	Ambient temperature		-40	85	°C
T_J	Junction temperature		-40	150	°C
T_{STG}	Storage temperature		-55	150	°C
T_{LEAD}	Soldering temperature	At leads, 10 seconds		260	°C
θ_{JA}	Thermal resistance from junction to ambient <small>(NOTE 2)</small>	In free air		85	°C/W
Surge	Input surge protection	IEC61000-4-5 test with 2Ω equivalent series resistance	100		V

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.

ESD RATINGS

Symbol	Parameter	Condition	Value	Unit
V_{ESD}	IEC61000-4-2 system ESD on IN pin	Contact discharge	±8	kV
		Air gap discharge	±15	kV
	Human Body Model	All pins, per MIL-STD-883J Method 3015.9	±4	kV
	Charged Device Model	All pins, per JEDEC EIA/JESD22-C101F	±1.5	kV
	Machine Model	All pins, per JEDEC EIA/JESD22-A115	±400	V

ELECTRICAL CHARACTERISTICS

$T_A = -40^{\circ}\text{C}$ to 85°C unless otherwise noted. Typical values are guaranteed for $V_{IN} = 5\text{V}$, $C_{IN} = 0.1\mu\text{F}$, $I_{IN} \leq 4.5\text{A}$ and $T_A = 25^{\circ}\text{C}$.

Symbol	Description	Test Conditions	Min.	Typ.	Max.	Units	
V_{IN_CLAMP}	Input clamp voltage	$I_{IN} = 10\text{mA}$		30.3		V	
V_{IN}	Input voltage range		2.5		20	V	
R_{dson}	Switch on resistance	$V_{IN} = 5\text{V}$, $I_{OUT} = 1\text{A}$, $T_A = 25^{\circ}\text{C}$		28	37	$\text{m}\Omega$	
I_Q	Input quiescent current	$V_{IN} = 5\text{V}$, $I_{OUT} = 0\text{A}$		65	100	μA	
I_{IN_OVLO}	Input current at over-voltage condition	$V_{OVLO} = 3\text{V}$, $V_{IN} = 5\text{V}$, $V_{OUT} = 0\text{V}$		69	110	μA	
V_{OVLO_TH}	OVLO set threshold	$2.5\text{V} < V_{IN} < 20\text{V}$	1.16	1.20	1.24	V	
V_{OVLO_RNG}	OVP threshold adjustable range	$2.5\text{V} < V_{IN} < 20\text{V}$	4		20	V	
V_{OVLO_SEL}	External OVLO select threshold	V_{IN} rising	0.3	0.42	0.50	V	
		Hysteresis		0.1			
I_{OVLO}	OVLO pin leakage current	$V_{OVLO} = V_{OVLO_TH}$	-0.1		0.1	μA	
C_{OUT}	Output load capacitance				100	μF	
Protection							
V_{IN_OVLO}	Default OVP trip level	AW32805	V_{IN} rising	6.66	6.80	6.94	V
			V_{IN} falling	6.51	6.65		
		AW32809	V_{IN} rising	9.78	9.98	10.18	
			V_{IN} falling	9.57	9.77		
		AW32812	V_{IN} rising	13.7	14.0	14.3	
			V_{IN} falling	13.4	14.7		
AW32801	V_{IN} rising	5.83	5.95	6.07			
	V_{IN} falling	5.73	5.85				
V_{IN_UVLO}	UVLO trip level	V_{IN} rising			2.25	2.4	V
		V_{IN} falling			2.10	2.2	
T_{SDN}	Shutdown temperature			130		$^{\circ}\text{C}$	
T_{SDN_HYS}	Shutdown temperature hysteresis			20		$^{\circ}\text{C}$	
Digital Logical Interface							
V_{OL}	$\overline{\text{ACOK}}$ output low voltage	$I_{SINK} = 1\text{mA}$			0.4	V	
I_{LEAK_ACOK}	$\overline{\text{ACOK}}$ leakage current	$V_{IO} = 5\text{V}$, $\overline{\text{ACOK}}$ de-asserted	-0.5		0.5	μA	
V_{IH}	$\overline{\text{EN}}$ input high voltage		1.2			V	
V_{IL}	$\overline{\text{EN}}$ input low voltage				0.5	V	
I_{LEAK_EN}	$\overline{\text{EN}}$ leakage current	$V_{\overline{\text{EN}}} = 5\text{V}$	-1		10	μA	

ELECTRICAL CHARACTERISTICS (CONTINUED)

$T_A = -40^{\circ}\text{C}$ to 85°C unless otherwise noted. Typical values are guaranteed for $V_{IN} = 5\text{V}$, $C_{IN} = 0.1\mu\text{F}$, $I_{IN} \leq 4.5\text{A}$ and $T_A = 25^{\circ}\text{C}$.

Symbol	Description	Test Conditions	Min.	Typ.	Max.	Units
Timing Characteristics (Figure 1)						
t_{DEB}	Debounce time	From $V_{IN} > V_{IN_UVLO}$ to 10% V_{OUT} , $\overline{\text{EN}}$ low		15		ms
t_{STAT}	Start-up time	From $V_{IN} > V_{IN_UVLO}$ to $\overline{\text{ACOK}}$ low, $\overline{\text{EN}}$ low		30		ms
t_{ON}	Switch turn-on time	$R_L = 100\Omega$, $C_L = 22\mu\text{F}$, V_{OUT} from 10% V_{IN} to 90% V_{IN}		1		ms
t_{OFF}	Switch turn-off time	$R_L = 100\Omega$, $C_L = 0\mu\text{F}$, $V_{IN} > V_{IN_OVLO}$ to V_{OUT} stop rising		125		ns

TIMING DIAGRAM

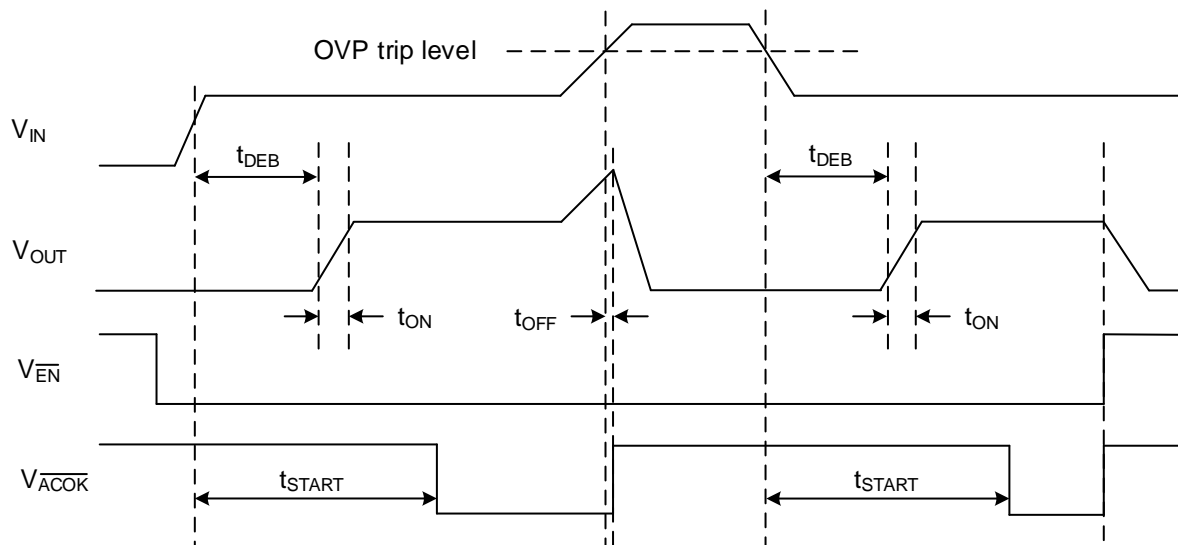
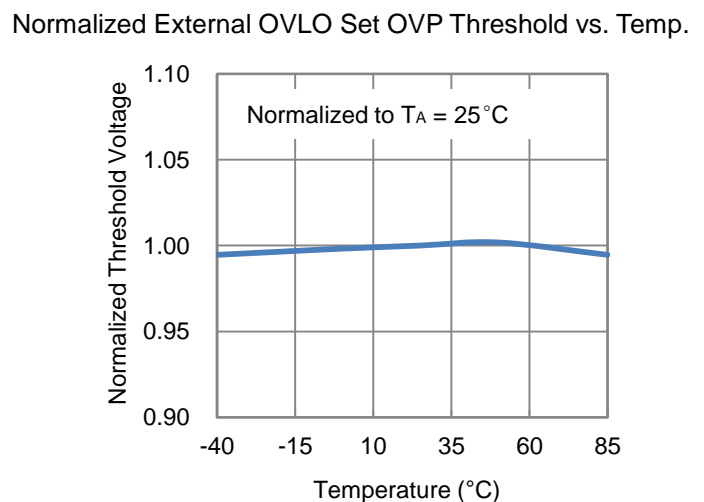
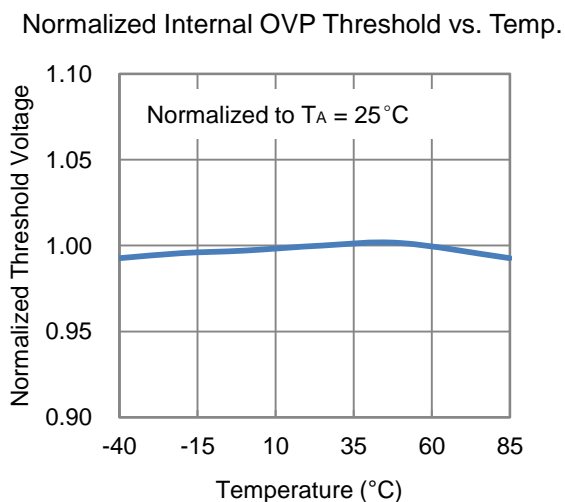
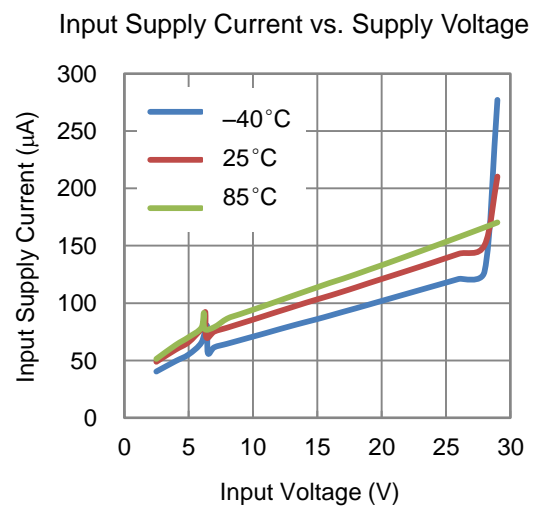
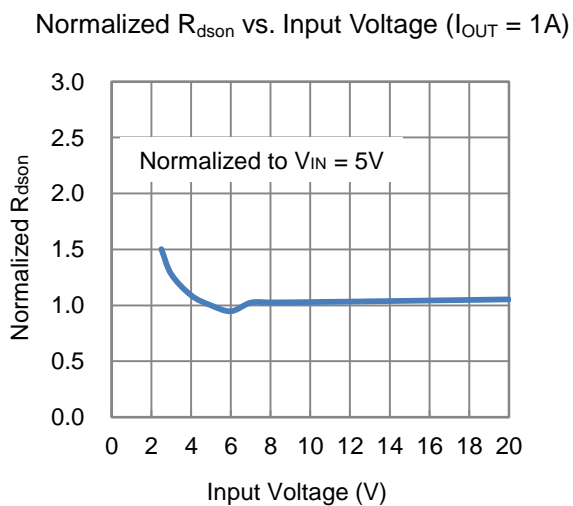
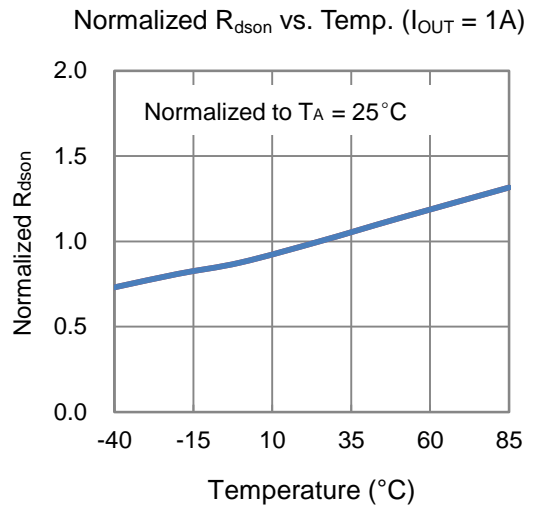
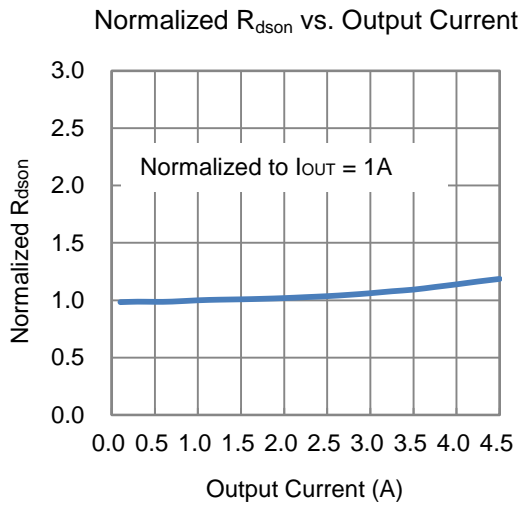


Figure 1. Timing diagram

TYPICAL CHARACTERISTICS

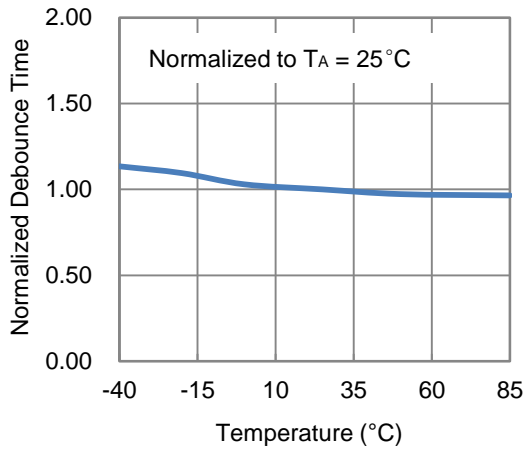
$V_{IN} = 5V$, $V_{\overline{EN}} = 0V$, $V_{OVLO} = 0V$, $C_{IN} = 0.1\mu F$, $C_{OUT} = 1\mu F$, and $T_A = 25^\circ C$ unless otherwise specified.



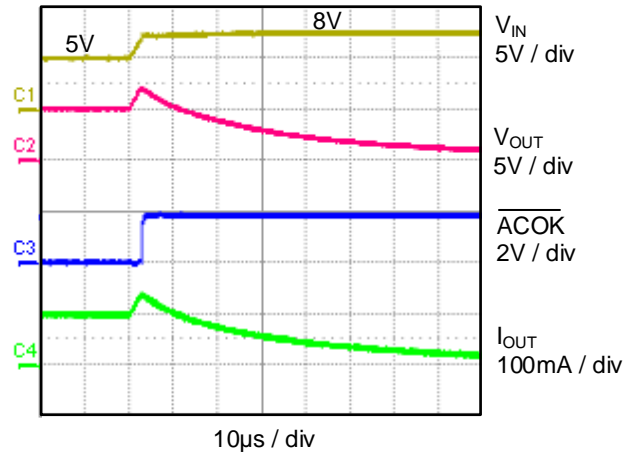
TYPICAL CHARACTERISTICS (CONTINUED)

$V_{IN} = 5V$, $V_{\overline{EN}} = 0V$, $V_{OVLO} = 0V$, $C_{IN} = 0.1\mu F$, $C_{OUT} = 1\mu F$, and $T_A = 25^\circ C$ unless otherwise specified.

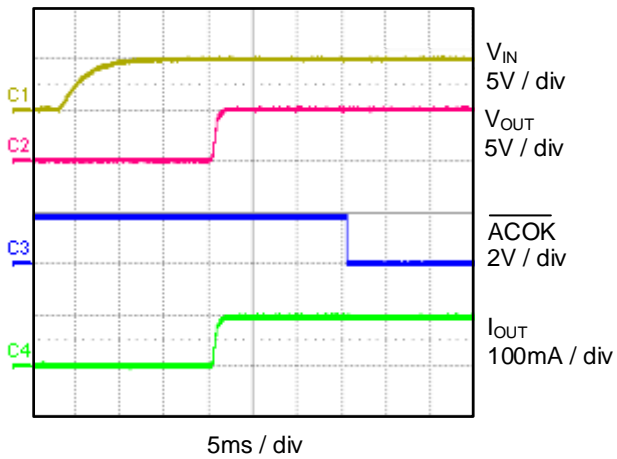
Normalized Debounce Time vs. Temp.



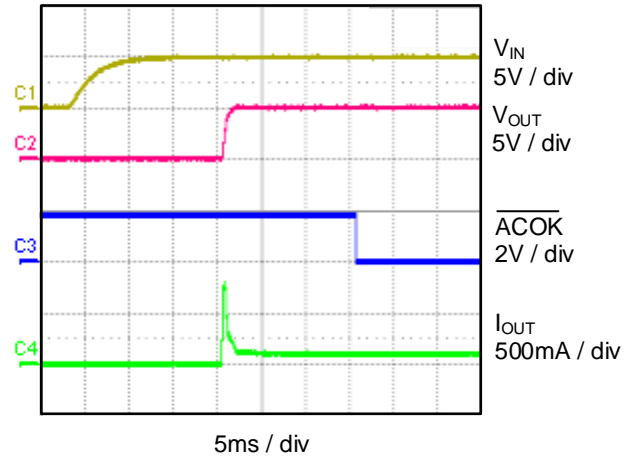
Over-Voltage Response (AW32805)



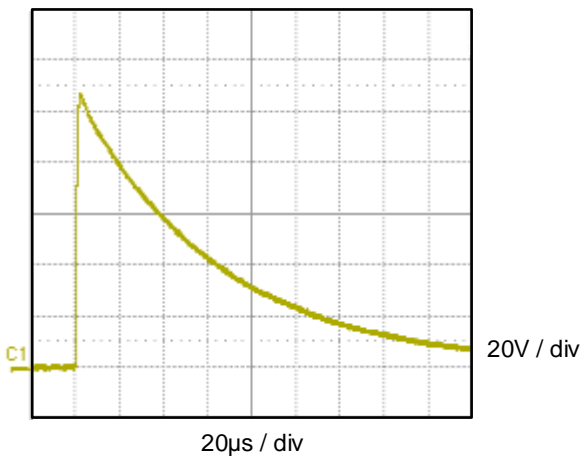
Power-up ($C_{OUT} = 1\mu F$, 100mA load)



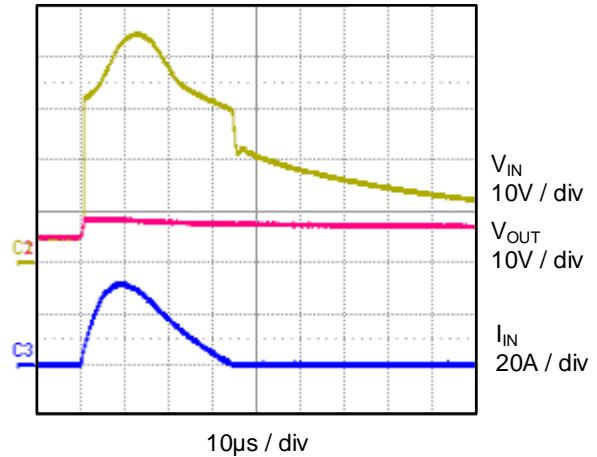
Power-up ($C_{OUT} = 100\mu F$, 100mA load)



108V Surge Without Device



108V Surge With Device (AW32805)



FUNCTIONAL DESCRIPTION

Device Operation

If the AW328xx is enabled and the input voltage is between UVLO and OVP threshold, the internal charge pump begins to work after debounce time, the gate of the nFET switch will be slowly charged high till the switch is fully on. \overline{ACOK} will be driven low about 30ms after V_{IN} valid, indicating the switch is on with a good power input. If the input voltage exceeds the OVP trip level, the switch will be turned off in about 125ns. If \overline{EN} is pulled high, or input voltage falls below UVLO threshold, or over-temperature happens, the switch will also be turned off.

Surge Protection

The AW328xx integrates a clamp circuit to suppress input surge voltage. For surge voltages between V_{IN_OVLO} and V_{IN_CLAMP} , the switch will be turned off but the clamp circuit will not work. For surge voltages greater than V_{IN_CLAMP} , the internal clamp circuit will detect surge voltage level and discharge the surge energy to ground. The device can suppress surge voltages up to 100V.

Over-Voltage Protection

If the input voltage exceeds the OVP rising trip level, the switch will be turned off in about 125ns. The switch will remain off until V_{IN} falls below the OVP falling trip level.

OVP Threshold Adjustment

If OVLO pin is not grounded, and by connecting external resistor divider to OVLO pin as shown in the typical application circuit, between IN and GND, the OVP threshold can be adjusted as following:

$$V_{IN_OVLO} = \frac{R_1+R_2}{R_2} V_{OVLO_TH}$$

The adjustment range is 4V to 20V. When the OVLO pin voltage V_{OVLO} exceeds V_{OVLO_SEL} (0.42V typical), V_{OVLO} is compared with the reference voltage V_{OVLO_TH} (1.2V typical) to judge whether input supply is over-voltage. For example, if we select $R_1 = 51k\Omega$ and $R_2 = 12.4k\Omega$, then the new OVP threshold calculated from the above formula is 6.14V.

\overline{ACOK} Output

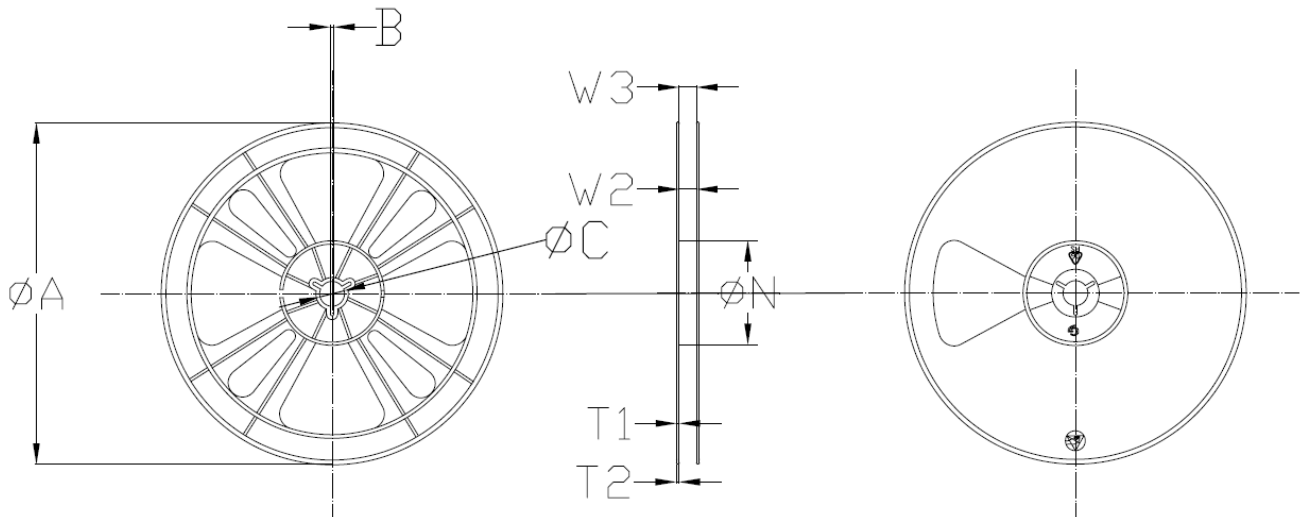
The device features an open-drain output \overline{ACOK} , it should be connected to the system I/O rail through a pull-up resistor. If the device is enabled and $V_{IN_UVLO} < V_{IN} < V_{IN_OVLO}$, \overline{ACOK} will be driven low indicating the switch is on with a good power input. If OVP, UVLO, or OT occurs, or \overline{EN} is pulled high, the switch will be turned off and \overline{ACOK} will be pulled high.

USB On-The-Go (OTG) Operation

If $V_{IN} = 0V$ and OUT is supplied by OTG voltage, the body diode of the load switch conducts current from OUT to IN and the voltage drop from OUT to IN is approximately 0.7V. When $V_{IN} > V_{IN_UVLO}$, internal charge pump begins to open the load switch after debounce time. After switch is fully on, current is supplied through switch channel and the voltage drop from OUT to IN is minimum.

TAPE AND REEL INFORMATION

CARRIER TAPE

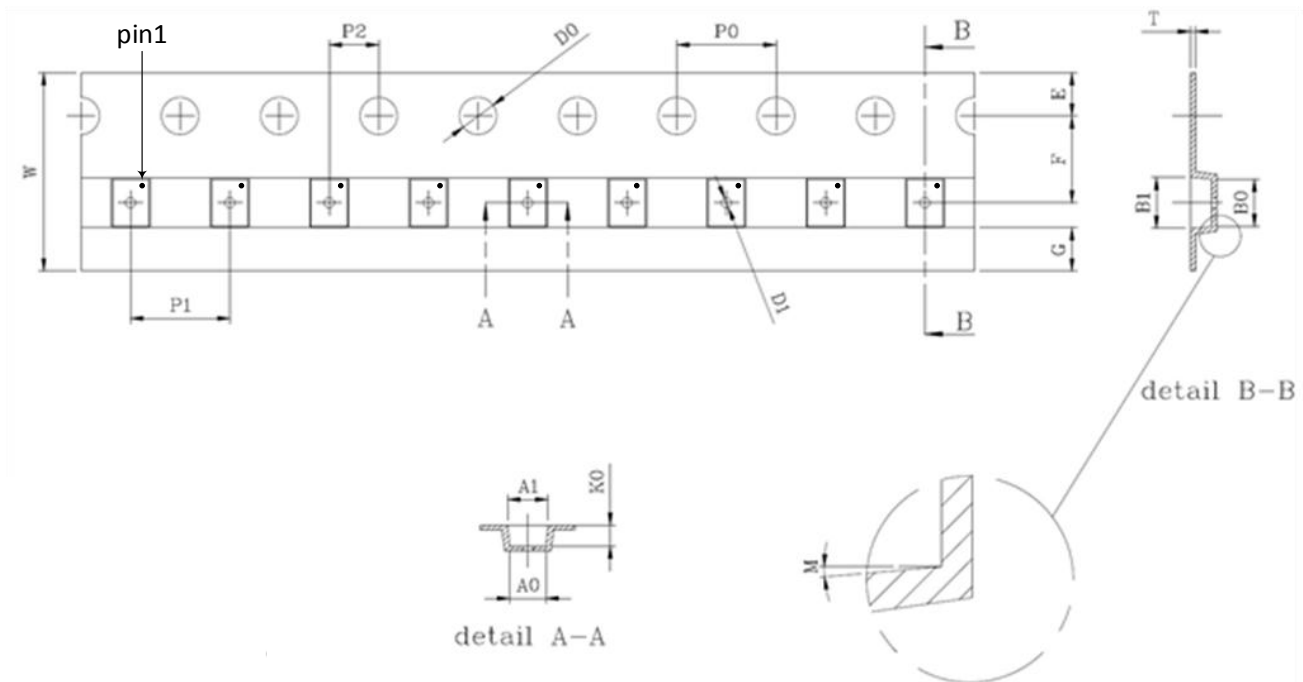


Item	Value&Tolerance
A	179±1.0
B	2.0±0.1
C	13.5±0.2
N	54.8±0.2
W2	9.0±0.2
W3	9.2±1.0
T1	1.2±0.2
T2	1.5±0.2

NOTE:

1. Unit: mm;
2. Surface resistivity: 10^5 to 10^{11} ohms/sq;
3. Restriction criterion of hazardous substance for packing material follow GP-M001.

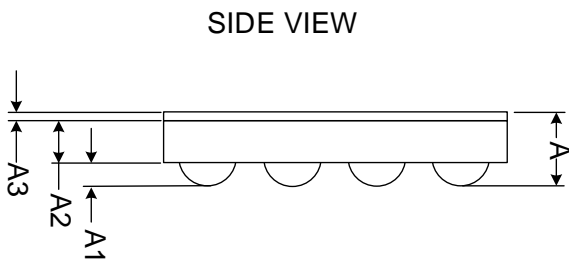
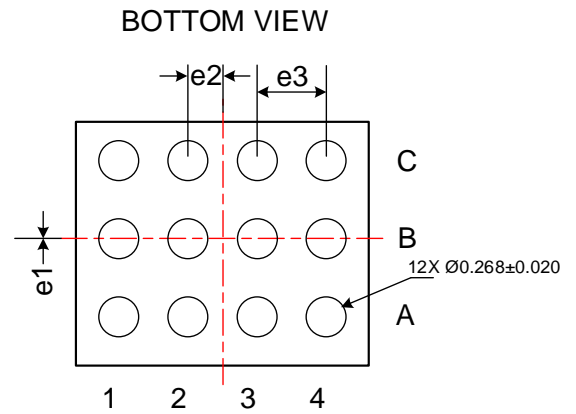
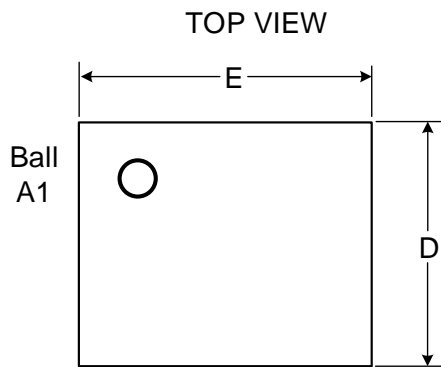
REEL



Item	Value&Tolerance
A0	1.46±0.05
B0	1.90±0.05
K0	0.81±0.05
A2	NA
B2	NA
D0	1.50 +0.10/-0.00
D1	0.40±0.05
P0	4.00±0.10
P1	4.00±0.10
P2	2.00±0.05
E	1.75±0.10
F	3.50±0.05
G	NA
T	0.20±0.03
W	8.00 +0.30/-0.10
M	Max 5°

Unit: mm.

PACKAGE DESCRIPTION



Symbol	NOM	Tolerance
A	0.575	±0.055
A1	0.195	±0.020
A2	0.340	±0.025
A3	0.040	±0.010
D	1.340	±0.025
E	1.780	±0.025
e1	0	NA
e2	0.200	NA
e3	0.400	NA

Unit: mm

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