1A 充电 P-MOSFET 的锂离子电池充电器

特性

- 输入过压保护
- 输入限流保护
- **输出碰地保护**
- 1A 充电 PMOSFET
- **内置专有的 K-CHARGE™ 技术，根据芯片温度智能调整输出电流**
- 内置过温保护
- ESD 保护：**±8kV**(HBM)
- 纤小的 DFN3×3-10L

应用

手机
数码相机

概要

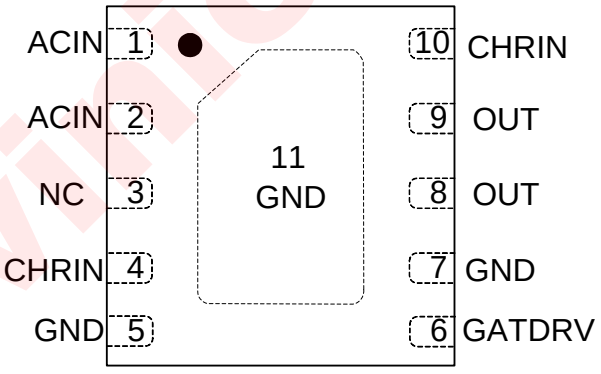
AW3210A 是一款高集成度的锂离子电池充电器。AW3210A 持续检测输入电压，若输入电压超过保护阈值电压且持续时间超过 100ns，则内部功率 P-MOSFET 关闭，CHRIN 电压拉低。AW3210A 内置限流保护电路，充电电流会限制在安全的范围内。AW3210A 内置专有的 K-Charge™ 技术，可根据芯片温度智能调整输出电流，以保证在充电期间整个充电系统的安全。

AW3210A 集成了充电 P-MOSFET，可省去手机充电系统中的外部充电 P-MOSFET 和肖特基二极管。AW3210A 具有防电流反灌功能，当 CHRIN 电压降至低于 OUT 电压，充电 P-MOSFET 关闭，防止电流从锂离子电池反灌至 AW3210A。

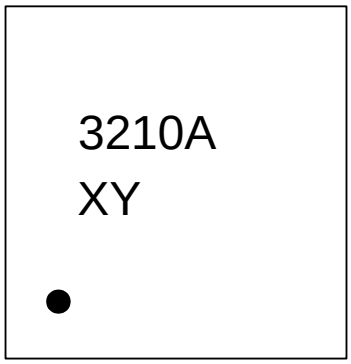
AW3210A 采用纤小的 DFN3×3-10L 封装，额定工作温度范围为-40~85℃。

引脚分布及标记图

器件俯视图
（DFN3x3-10L 封装）



器件标记
（DFN3x3-10L 封装）



3210A－AW3210ADNR

XY- 生产跟踪码

图 1 AW3210A 引脚分布(左)和标记图(右)

1A Li-ion Battery Charger Integrated with Protective PMOSFET

FEATURES

- Input Over-voltage Protection
- Input Current Limit Protection
- **Output Short to Ground Protection**
- 1A Charging PMOSFET
- **Specific K-Charge™: Junction Temperature Based Dynamic Output Current**
- Over Temperature Protection
- ESD Protection：**±8kV**(HBM)
- DFN3×3-10L Package

APPLICATIONS

Mobile Phones

Digital Camera

GENERAL DESCRIPTION

AW3210A is a highly integrated Li-Ion battery charger. AW3210A continuously detects the input voltage, if V_{IN} exceeds the threshold voltage and lasts longer than 100ns, the internal power P-MOSFET turned off, CHRIN pulled down. AW3210A Built-in current limiting protection circuit, the charging current is limited to a safe range. AW3210A possesses the specific K-Charge™ technology, the output current can be adjusted smartly according to the chip temperature to ensure safety during the entire charging process.

AW3210A integrates the charging P-MOSFET, eliminating the need for external charging P-MOSFET and Schottky Diode among a phone charging system. And the reverse current blocking function has been designed in AW3210A, when the CHRIN voltage drops below the OUT, charging P-MOSFET turned off, preventing current draining from the lithium-ion battery into AW3210A.

AW3210A is available in DFN 3×3-10L package.

PIN CONFIGURATION AND TOP MARK

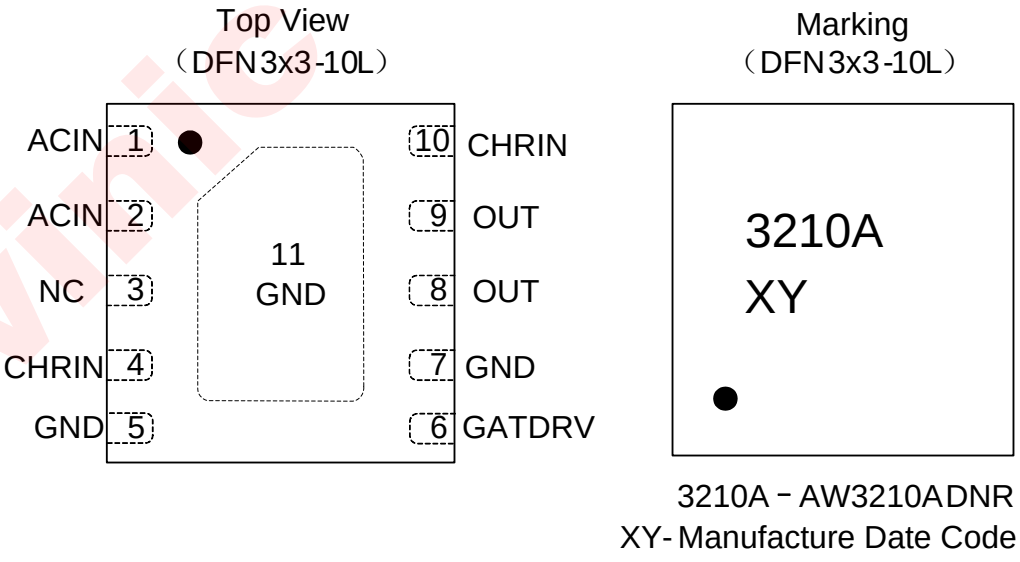


Figure 1 Pin configuration and marking

PIN DEFINITION

No.	NAME	DESCRIPTION
1	ACIN	Charger input voltage, connected to AC adapter or USB.
2	ACIN	
3	NC	
4	CHRIN	Voltage output pin.
5	GND	Ground.
6	GATDRV	PMOSFET gate input, connected to PMU drive pin.
7	GND	Ground.
8	OUT	Charge current output, connected to battery via a current sense resistor.
9	OUT	
10	CHRIN	Voltage output pin, connected to PMU via resistor.
11	GND	Ground.

FUNCTIONAL BLOCK DIAGRAM

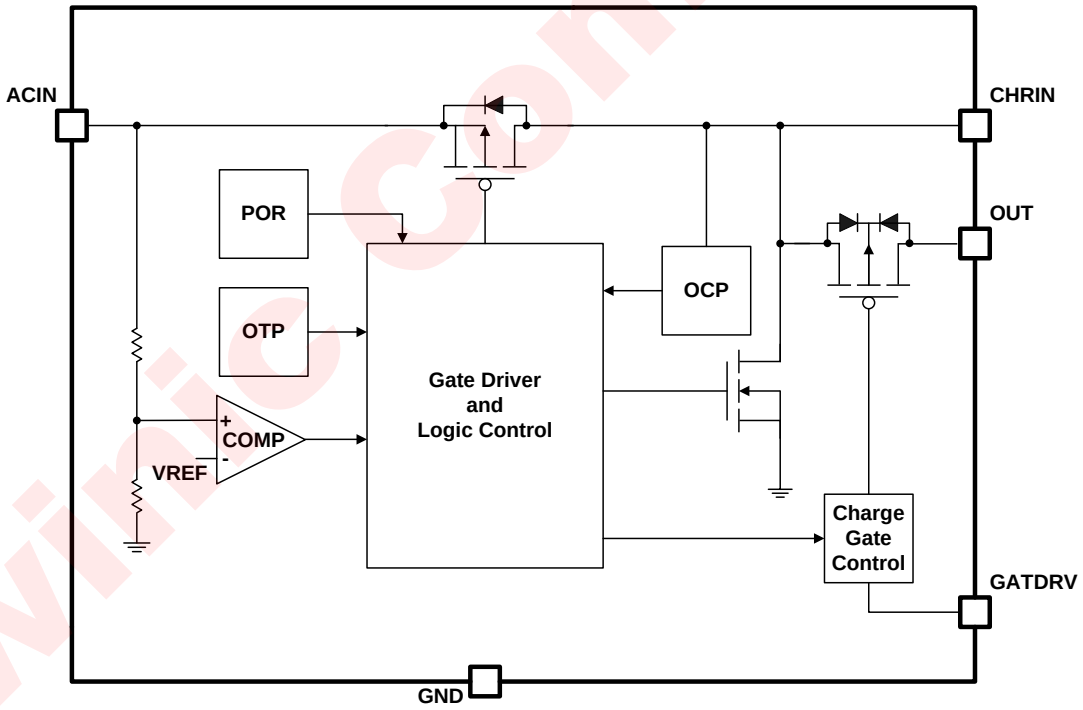


Figure 2 AW3210A FUNCTIONAL BLOCK DIAGRAM

TYPICAL APPLICATION CIRCUITS

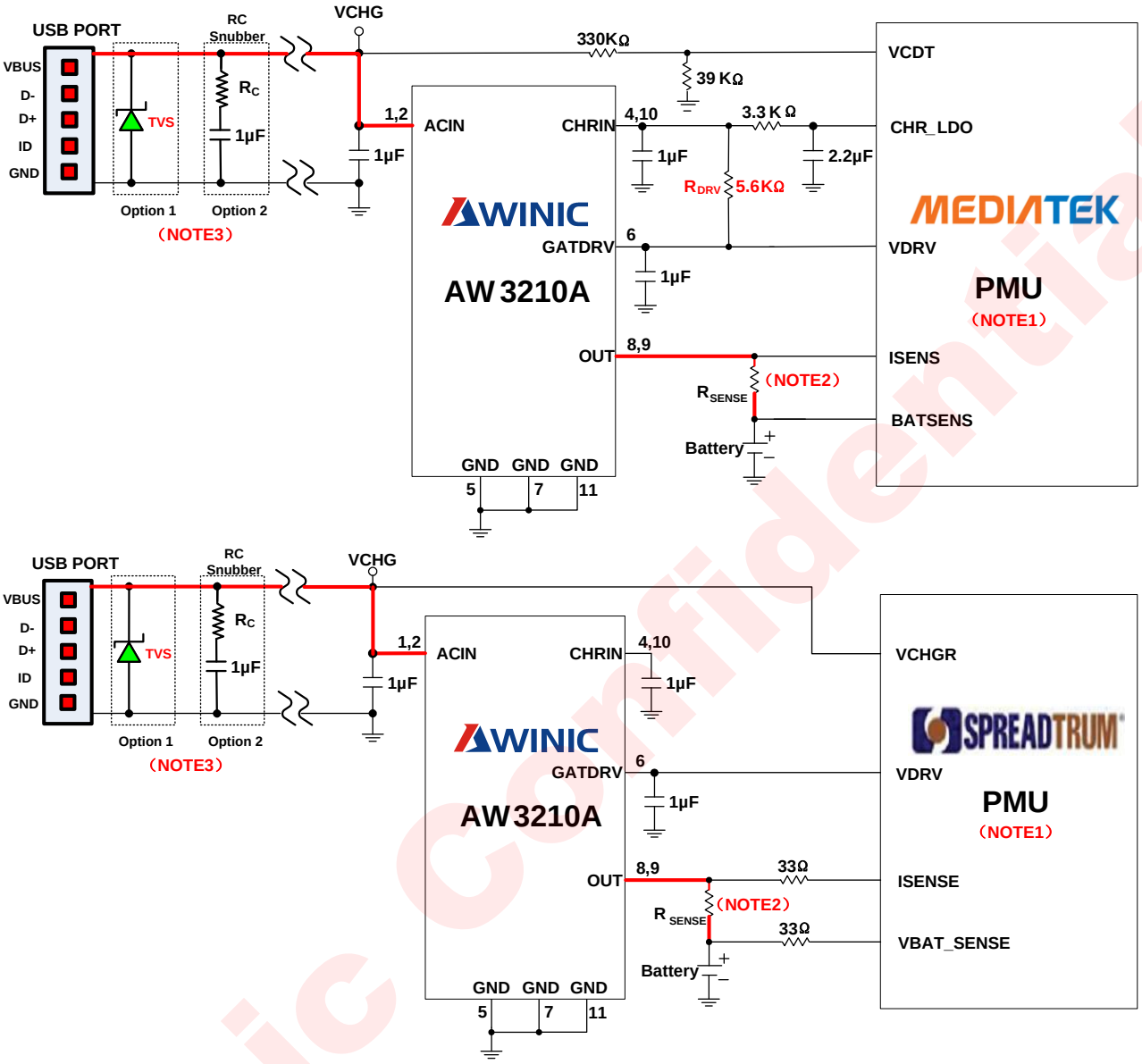


Figure 3 AW3210A Application Circuits with MTK or SPREADTRUM platform

NOTE1：The application circuits above corresponding to MTK current-driving PMUs and SPREADTRUM voltage-driving PMUs respectively, e.g. MT6320 MT6323 MT6329 and SC8825 SC8810 SC6820 SC6825.

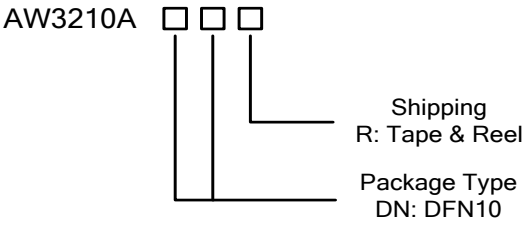
NOTE2：The general default value of R_{SENSE} is 200mΩ for MTK and 360mΩ for SPREADTRUM, but please refer to the platform official documents for the resistor value of a specific PMU. When AICN voltage goes too low due to bad performance of AC adapter or USB cable, a decrease of R_{SENSE} would be proposed to increase the voltage drop space through AW3210A, enhancing the charging performance. And don't forget to adjust the PMU registers corresponding to R_{SENSE} at the same time, keeping the charging current unchanged.

NOTE3：Option1&2 are applied to increase the USB port robustness against surge voltage/current. A proposed TVS model is ESD9N5V-2/TR, while the proposed R_C value in option2 is 1Ω. For more details about the two options, please refer to the Application Information part below.

NOTE4：The red route in the figures above indicate the large current path for AW3210A application, please pay attention to the path width on PCB board. In general, a factor of 40mil/A between path width and current is suitable. For example, the set current is 1A, then the path width should not less than 40×1=40mil.

ORDERING INFORMATION

Part Number	Temperature	Package	RoHS	Marking	Delivery Form
AW3210A DNR	-40℃～85℃	DFN3×3mm-10L	Yes	3210A	6000 units/ Tape and Reel



ABSOLUTE MAXIMUM RATINGS(NOTE5)

PARAMETERS	RANGE
ACIN voltage range	-0.3V to 15V
CHRIN, OUT, GATEDRV voltage range	-0.3V to 7V
Maximum OUT current	3A
Maximum power dissipation @T_A=25℃	1.48W
Junction-to-ambient thermal resistance θ_{JA}	67.4℃/W
Operating free-air temperature range	-40℃ to 85℃
Maximum Junction temperature T_{JMAX}	150℃
Storage temperature T_{STG}	-65℃ to 150℃
Lead Temperature (Soldering 10 Seconds)	260℃
ESD(NOTE 6)	
All pins, HBM (human body model)	±8kV
Latch-up	
Test Condition: JEDEC STANDARD NO.78B DECEMBER 2008	+IT：450mA -IT：-450mA

NOTE5: 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.

NOTE6: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: MIL-STD-883G Method 3015.7

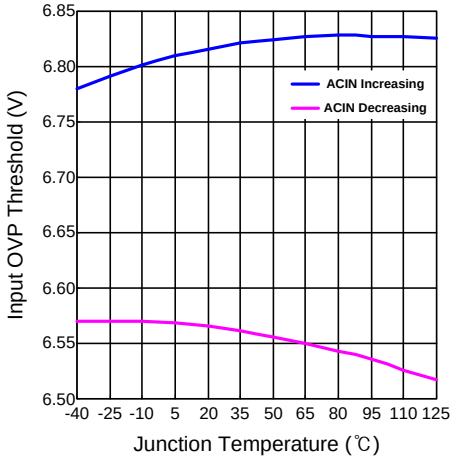
ELECTRICAL CHARACTERISTICS

ACIN=5V, VBAT=3.8V, T_A=25℃ for typical values (unless otherwise noted)

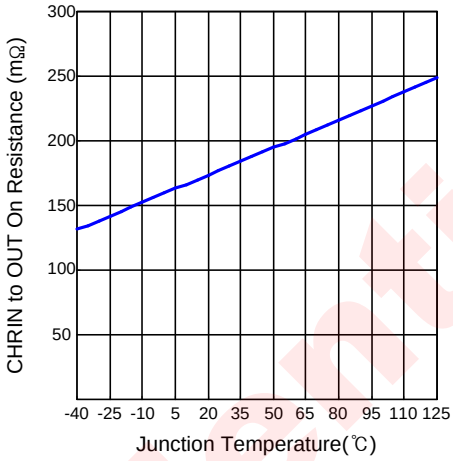
PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
ACIN						
I_{ACIN}	ACIN supply current control	I_{OUT}=0A，I_{CHRIN}=0A	2.1	3	3.9	mA
V_{POR}	Power on reset voltage	ACIN rising from 0 to 3V		2.6	3	V
$V_{hys(POR)}$	Power on reset hysteresis	ACIN falling from 3V to 0		300		mV
T_{BLK}	Power on reset delay			3		ms
R_{ON}						
R_{DSON}	ACIN to OUT	I_{OUT}=1A，ACIN=5.0V，GATDRV=0V		0.31		Ω
	CHRIN to OUT	I_{OUT}=1A，ACIN=5.0V，GATDRV=0V		0.155		Ω
INPUT OVERVOLTAGE PROTECTION						
V_{OVP}	Input overvoltage threshold	ACIN rising	6.5	6.8	7.1	V
$V_{hys(OVP)}$	Input overvoltage hysteresis		250	300	350	mV
$T_{DGL(OVP)}$	ACIN OVP deglitch time			100		ns
$T_{REC(OVP)}$	Release from OVP delay			3		ms
CURRENT LIMIT						
I_{OCP}	Input current limit threshold			1.8		A
I_{SHORT}	Current output when OUT to GND			110		mA
P-MOSFET						
	V_{CHRIN}-V_{OUT}, PMOSFET lockout threshold	CHRIN rising, PMOSFET released		160		mV
		CHRIN falling, PMOSFET off		40		mV
I_{OFF}	OUT current when P-MOSFET off	ACIN=5V, CHRIN= GATDRV, OUT=0V			1	μA
I_{GATDRV}	GATDRV leakage current				1	μA
I_{LKG}	OUT leakage current	ACIN=0V, OUT=4.2V, GATDRV=0V			1	μA
C_G	PMOSFET gate capacitor			200		pF
R_G	PMOSFET gate resistor			1000		Ω
OVER TEMPERATURE PROTECTION						
T_{OTP}	Overheat threshold			160		℃
T_{hys}	Overheat hysteresis			25		℃

TYPICAL CHARACTERISTICS

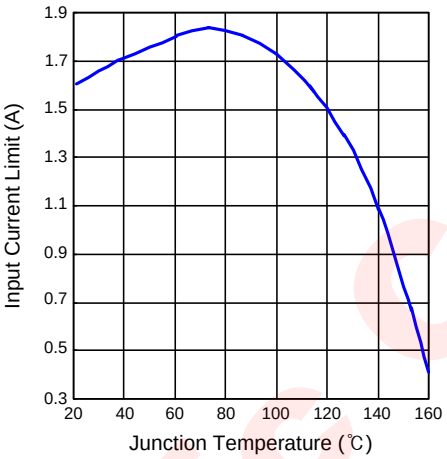
Input OVP Threshold Vs. Junction Temperature



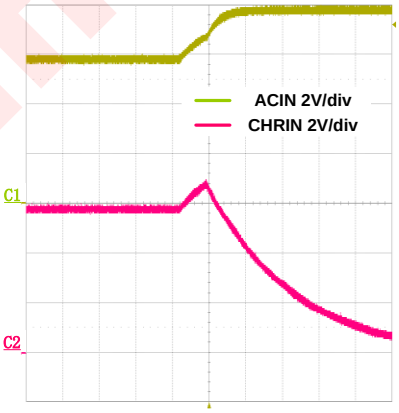
CHRIN to OUT On Resistance Vs. Junction Temperature



Input Current Limit Vs. Junction Temperature

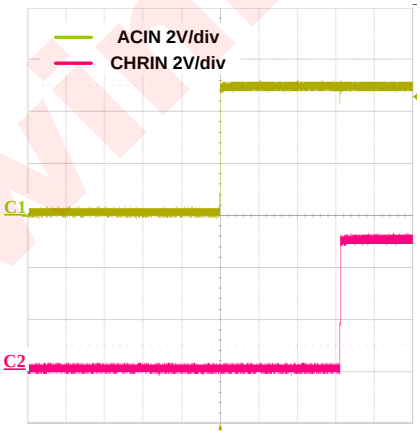


Input Over-Voltage Protection



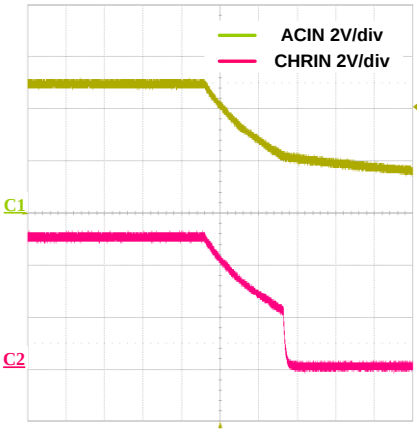
Time: 100μs/div

Normal Power On



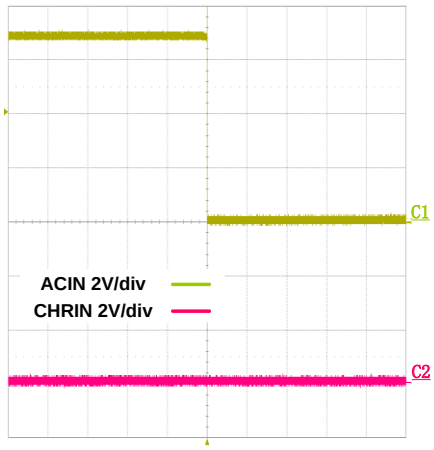
Time: 1ms/div

Normal Power Down



Time: 5ms/div

OVP at Power On



Time: 5ms/div

DETAILED FUNCTIONAL DESCRIPTION

AW3210A is a highly integrated Li-Ion battery charger. AW3210A integrates the charging P-MOSFET, eliminating the need for external charging P-MOSFET and Schottky Diode among a phone charging system. And the reverse current blocking function has been designed in AW3210A, when the CHRIN voltage drops below the OUT, charging P-MOSFET turned off, preventing current draining from the lithium-ion battery into AW3210A.

AW3210A continuously detects the input voltage, if V_{IN} exceeds the threshold voltage and lasts longer than 100ns, the internal power P-MOSFET turned off, CHRIN pulled down. AW3210A Built-in current limiting protection circuit, the charging current is limited to a safe range. AW3210A possesses the specific K-Charge™ technology, the output current can be adjusted smartly according to the chip temperature to ensure safety during the entire charging process.

Power On Reset

AW3210A includes the power-on reset function. During power on process, if ACIN voltage is lower than the power-on reset voltage 2.6V (typ), the internal registers would be reset, and the chip hold in shutdown state. When ACIN voltage rises above the power-on reset voltage 2.6V and stays above 0.7ms, the chip would start, and CHRIN voltage gradually increase. Power-on reset function includes voltage hysteresis and reset delay, in order to avoid the interference of input voltage glitch.

Input Overvoltage Protection

AW3210A continuously detects the input voltage, if V_{IN} exceeds the threshold voltage and lasts longer than 100ns, the internal power P-MOSFET turned off, CHRIN pulled down, protecting the devices connected to CHRIN and OUT. When ACIN voltage falls below V_{OVP}-$V_{hys(OVP)}$, and stay above 2.2ms(typ), the internal power P-MOSFET would turn on. Hysteresis voltage and release delay time keep the system away from the disturbance of input voltage glitch.

Input Current Limit & Output Short to Ground Protection

Input current limiting circuit samples output current. When the output current exceeds the limit current I_{OCP}, the current limiting circuit limits the input current to protect the chip and the lithium-ion battery. AW3210A also set a specific K-Charge™ technology, the output current can be adjusted smartly according to the die temperature. When the temperature is lower than 80℃, the current limit keeps the same as the typical value of 1.8A; when the chip temperature exceeds 80℃, current limit would gradually decrease along with the temperature rising. If the chip temperature reaches 120℃, the current limit would reduce to 1.2A. Input current limit and K-Charge™ technology can protect the chip and lithium-ion battery during charging, meanwhile accelerate the charging process to the maximum extent.

AW3210A also possesses the output shorted to ground protection, when CHRIN voltage goes too low, the input current would be limited to 110mA.

Charging PMOSFET

AW3210A integrates the charging P-MOSFET, eliminating the need for external charging P-MOSFET and Schottky Diode among a phone charging system. When the chip powers on, the internal P-MOSFET only controlled by GATDRV pin when CHRIN voltage is higher than the OUT pin voltage +160mV (typ). And if CHRIN voltage drops below VOUT+40mV after power on, the charging P-MOSFET would be turned off, and GATDRV would be disconnected from the gate of PMOSFET. What's more, charging P-MOSFET would be closed once either input overvoltage or over temperature protection is triggered.

Overheat Protection

The overheating protection of AW3210A would turn off the power P-MOSFET when the chip temperature exceeds 160℃ (typ). And the chip wouldn't recover to normal status, until the die temperature reduce to 135℃ (typ).

APPLICATION INFORMATION

CAPACITORS SELECTION

ACIN CAPACITOR C_{ACIN}

AW3210A advises to use a 1μF ceramic capacitor at ACIN pin as shown in Figure 3, for decoupling as well as reducing input voltage overshoot. When AC adapter hot-plugging or a sudden drop in the charge current occurs, a transient overshoot arise at the input port, due to the impact of the parasitic inductance of input power traces. Increasing the input capacitance at ACIN pin can reduce the overshoot voltage, avoiding to affect the charging system. A 1μF EYANG X5R/0402 ceramic capacitor is recommended here, whose rating voltage should no less than 16V, and location should be closed to ACIN pin.

CHRIN CAPACITOR C_{CHRIN}

A 1μF EYANG X5R/0402 ceramic capacitor is also recommended to be placed near CHRIN, whose rating voltage should no less than 10V.

PCB LAYOUT CONSIDERATION

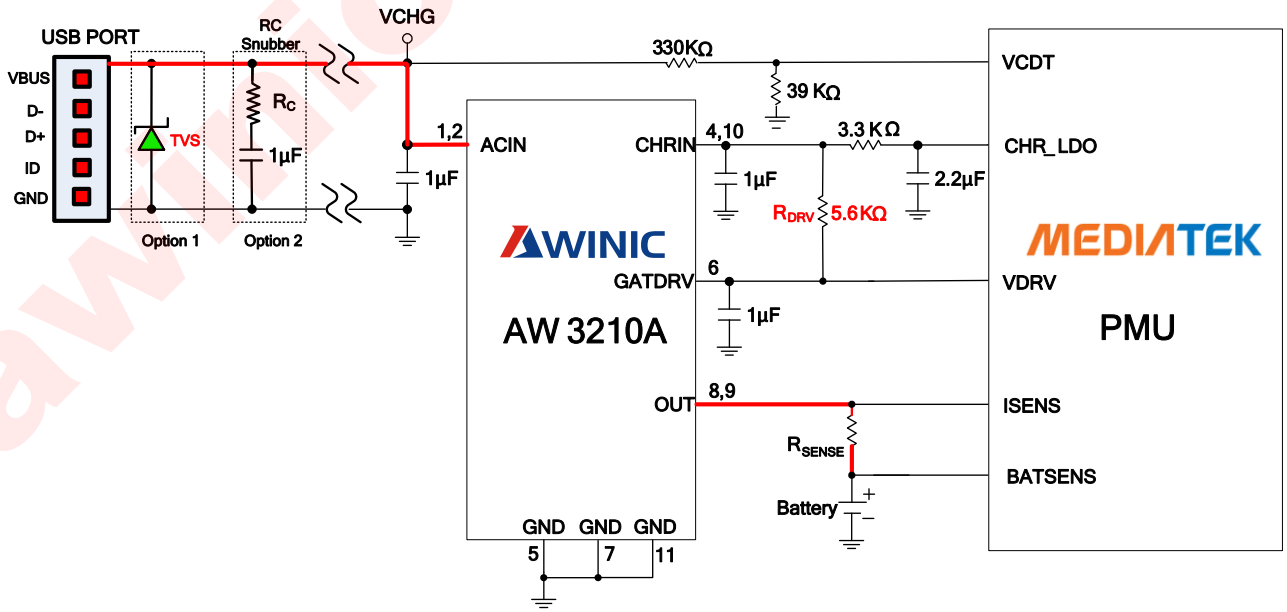
To obtain the optimal performance of AW3210A, PCB layout should be considered carefully. Here are some guidelines:

1、 The exposed plane of chip and GND pins must be connected to the large-area ground layer of PCB directly, meanwhile place sufficient vias below the exposed plane. Thus we can decrease the thermal resistor on the board to optimize heat-diffusion performance.

2、 Large current charging application may cause a local temperature rise. Keep high-temp zone away from the parts user can easily touch like buttons and LCD would achieve better heat dissipation effect.

3、 The connection lines between the planes of C_{ACIN}、C_{CHRIN} and respective chip pins should be as short and wide as possible.

4、 To achieve optimal large-current performance, the power path shown in red as the figure below must be widen. Please routing according to a factor of 40mil/A between path width and current, for example, the set current is 1A, then the path width should not less than 40×1=40mil.



INCREASE SYSTEM ROBUSTNESS AGAINST HOT-PLUG

A surge voltage would arise when charger is hot-plugged into a USB interface. The over-shoot depends on the relative value of the route resistance and the USB cable parasitic inductance as well as the USB output capacitance. To reduce over-shoot effectively, a snubber R_C or a TVS tube, or both of them is recommended to add to the USB power output port. Application circuit is shown below.

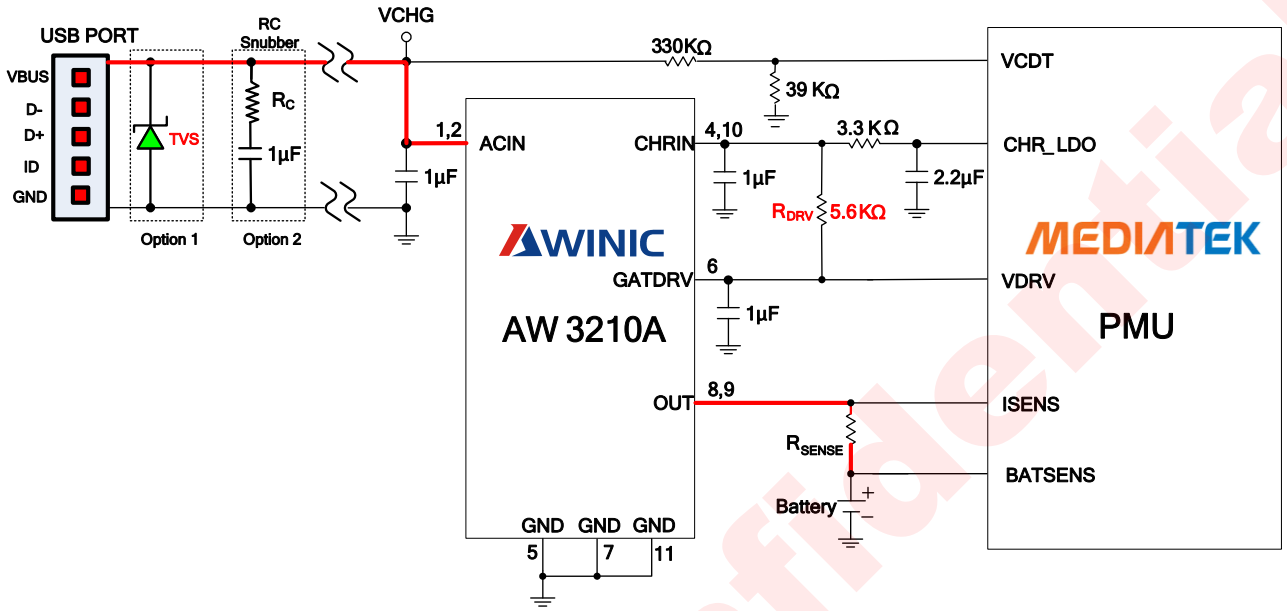


Figure 4 Application circuit of increasing robust against hot-plug for USB port

For the selection of TVS, a criterion as below can be used: the maximum clamp voltage of TVS when absorbs 1A peak-to-peak current should not exceed 8V, and a TVS of which part number is ESD9N5V-2/TR is recommended here.

The capacitor in series with R_C should not less than 1μF, and a X5R-0402 MLCC whose voltage rating no less than 16V is recommended.

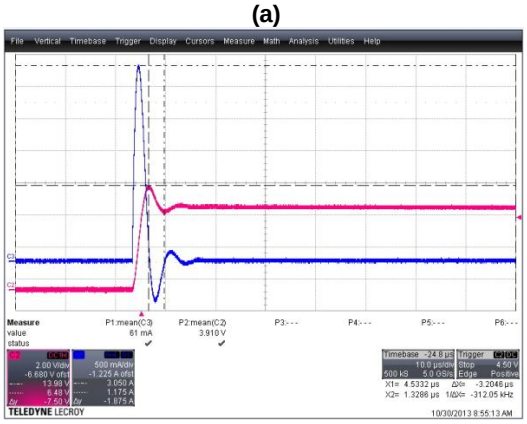
For a typical RLC second-order system, if the resistance "R" across the USB cable to USB port capacitor satisfies a relationship of $R > 2 \times \sqrt{\frac{L}{C}}$, then the system would be over-damping, which makes the overshoot lower. Among the $R > 2 \times \sqrt{\frac{L}{C}}$, L represents the parasitic USB cable inductance, C represents the capacitance in series with R_C, and R consists of R_C+R_{ESR}, where R_{ESR} represents parasitic resistance from USB cable and the capacitor which is in series with R_C.

Whereas the system in the figure 4 has become a third-order system as the adding of C_{ACIN}, which is close to the input port of AW3210A. For the third-order system, the relationship between R and L/C for over-damping is not linear any more. 1Ω is recommended as the optimized value of R_C, for typical condition of the capacitance in series with R_C ranges from 1μF and 10μF.

Both the TVS and R_C should be placed as close to the USB interface as possible.

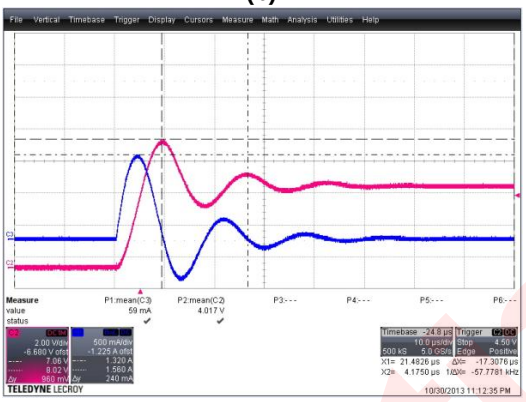
Detailed test waveforms are shown as below in figure 5, whose test condition is a 5V AC adapter with a 1-meter USB cable hot-plugged into the USB port. As the results contrast shown in table 1, a TVS tube or snubber R_C added at the USB interface can reduce the ACIN overshoot effectively, as a consequence of which can increase the robustness of a system against hot-plug.

(a)



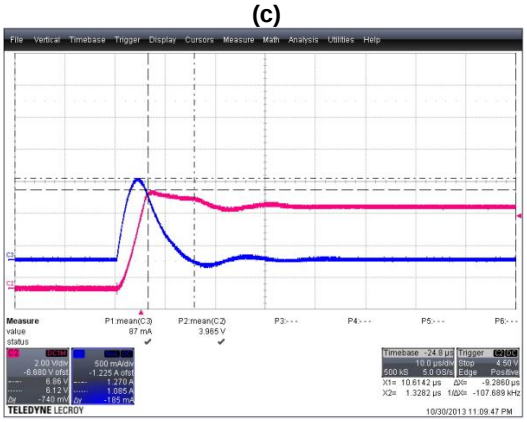
Red-ACIN，Blue- I_{IN}
$ACIN_{\_PEAK}$ = 6.5V, 10μs/div
5V adapter with original cable plugged in

(b)



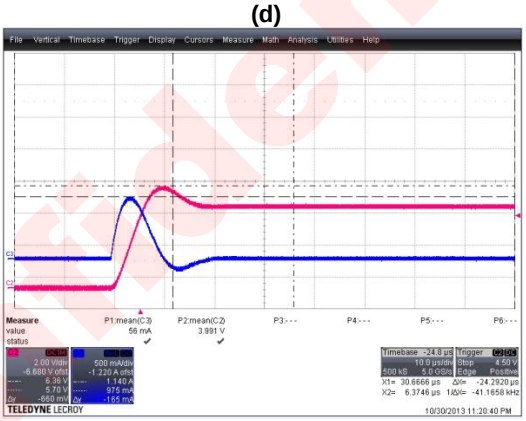
Red-ACIN，Blue- I_{IN}
$ACIN_{\_PEAK}$ = 8V, 10μs/div
Two 4.7μH inductors in series among the USB cable, hot plug

(c)



Red-ACIN，Blue- I_{IN}
$ACIN_{\_PEAK}$ = 6.12V, 10μs/div
Two 4.7μH inductors in series among the USB cable, and a TVS(V_C=5.4V) added at the USB port, hot plug

(d)



Red-ACIN，Blue- I_{IN}
$ACIN_{\_PEAK}$ = 6.36V, 10μs/div
Two 4.7μH inductors in series among the USB cable, and a 1Ω R_C in series with a 1μF capacitor added at the USB port, hot plug

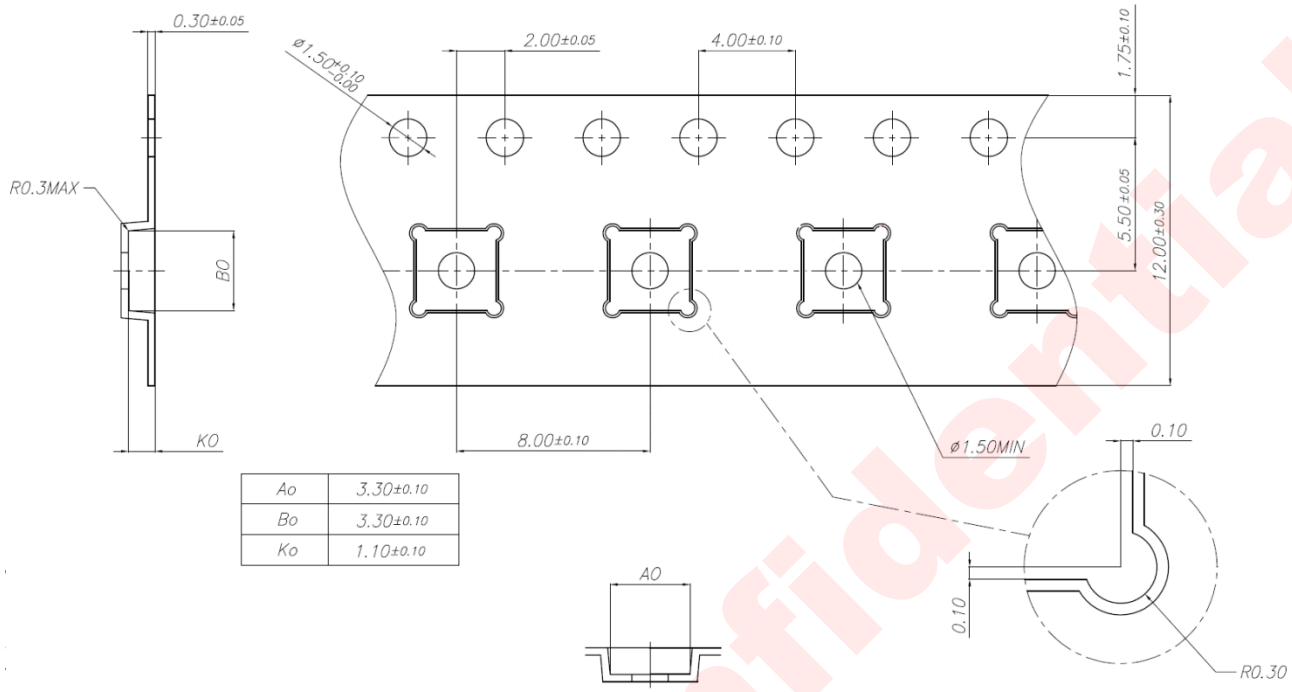
Figure 5 The overshoot at the AW3210A ACIN PIN when USB hot-plugged under different conditions

Table 1 Results contrast of Figure 5

Waveform	Test condition	ACIN_PEAK
(a)	5V adapter + original 1m USB cable	6.5V
(b)	5V adapter + 1m USB cable with two 4.7μH inductors in series	8V
(c)	5V adapter + 1m USB cable with two 4.7μH inductors in series + TVS (V_C=5.4V)	6.12V
(d)	5V adapter + 1m USB cable with two 4.7μH inductors in series + 1Ω R_C in series with 1μF capacitor	6.36V

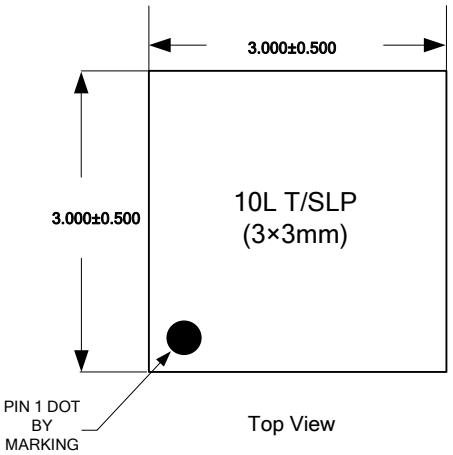
TAPE AND REEL INFORMATION

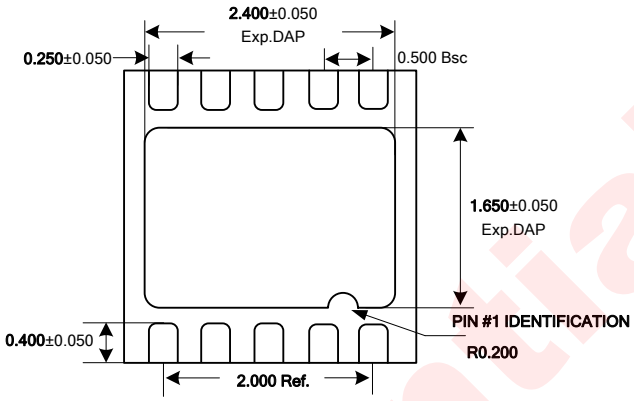
Carrier Tape

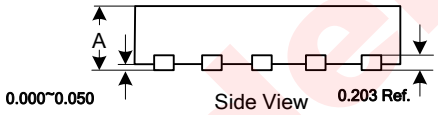


Ao	3.30±0.10
Bo	3.30±0.10
Ko	1.10±0.10

PACKAGE DESCRIPTION



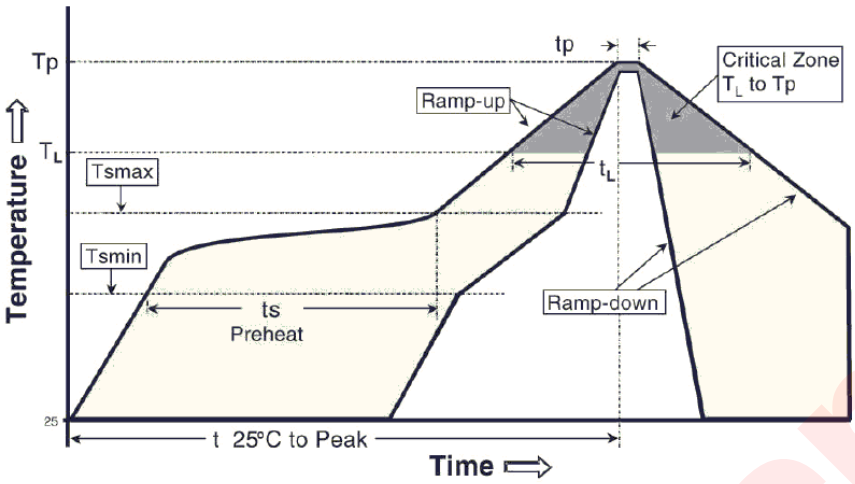




NOTE:
1) TSLP AND SLP SHARE THE SAME EXPOSE OUTLINE BUT WITH DIFFERENT THICKNESS

		SLP
A	MAX	0.900
	NOM	0.850
	MIN	0.800

REFLOW



Reflow profile

Figure 5 Package Reflow Standard Profile

Table 2 Package Reflow Standard

Reflow condition	Sn-Pb eutectic assembly		Pb-Free assembly	
	Pkg. thickness ≥ 2.5 mm or Pkg. volume ≥ 350 mm³	Pkg. thickness < 2.5 mm and Pkg. volume < 350 mm³	Pkg. thickness ≥ 2.5 mm or Pkg. volume ≥ 350 mm³	Pkg. thickness < 2.5 mm and Pkg. volume < 350 mm³
Average ramp-up rate (Liquidus Temperature (T_L) to Peak)	3 °C/second max.		3 °C/second max.	
Preheat - Temperature Min ($T_{s(min)}$) - Temperature Max ($T_{s(max)}$) - Time (min to max) (t_s)	100 °C 150 °C 60-120 seconds		150 °C 200 °C 60-180 seconds	
$T_{s(max)}$ to T_L - Ramp-up Rate			3 °C/second max.	
Time maintained above: - Temperature (T_L) - Time (t_L)	183 °C 60-150 seconds		217 °C 60-150 seconds	
Peak Temperature (T_p)	225 +0/-5 °C	240 +0/-5 °C	245 +0/-5 °C	250 +0/-5 °C
Time within 5 °C of actual Peak Temperature (t_p)	10-30 seconds	10-30 seconds	10-30 seconds	20-40 seconds
Ramp-down Rate	6 °C/second max.		6 °C/second max.	
Time 25 °C to Peak Temperature	6 minutes max.		8 minutes max.	

NOTE 7: All data are compared with the package-top temperature, measured on the package surface;

NOTE 8: AW3210A adopted the Pb-Free assembly.

REVISION HISTORY

Version	Date	Change Record
V1.0(CHN)	Nov 2013	Officially Released
V1.0(ENG)	May 2015	Officially Released

RELATED PARTS

Part No.	Description	Comments
AW3112 DNR	30V, 3A, PNP Low V_{CESAT} BJT Integration with 20V Trench NMOSFET	Integrated with NMOS switch, 32V V_{CE} Rating, 0.35V Max V_{CESAT}, 1.5W Power Dissipation Rating, DFN2×2-6L
AW3206 DNR	Li-ion Battery Charger Integrated with Protective PMOSFET	15V Input Rating, K-Charge™ Thermal Regulation, DFN2×2-8L
AW3208 DNR	LDO mode Li-ion Battery Charger Integrated with Protective PMOSFET	10.5V OVP, 15V Input Rating, K-Charge™ Thermal Regulation, LDO output mode, DFN2×2-8L
AW3282 DNR	LDO mode Li-ion Battery Charge Protector	15V Input Rating, K-Charge™ Thermal Regulation, LDO output mode, DFN2×2-8L
AW3210A DNR	1A Li-ion Battery Charger Integrated with Protective PMOSFET	Up to 1A Charge Current, 15V Input Rating, K-Charge™ Thermal Regulation, DFN3×3-10L
AW3215A DNR	1.5A Switch-mode Single Cell Li-ion Battery Charger	Max 88% Efficient Switch-mode Conversion, 1.5A Max Charge Current, 18V Input Rating, K-DPM™ Maximizes Available Power from USB Port/Wall Adapter, K-TEMP™ Thermal Regulation, DFN3×3-12L
AW3216 DNR		

DISCLAIMER

Information in this document is believed to be accurate and reliable. However, Shanghai AWINIC Technology Co., Ltd (AWINIC Technology) does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

AWINIC Technology reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. Customers shall obtain the latest relevant information before placing orders and shall verify that such information is current and complete. This document supersedes and replaces all information supplied prior to the publication hereof.

AWINIC Technology products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an AWINIC Technology product can reasonably be expected to result in personal injury, death or severe property or environmental damage. AWINIC Technology accepts no liability for inclusion and/or use of AWINIC Technology products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications that are described herein for any of these products are for illustrative purposes only. AWINIC Technology makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.
All products are sold subject to the general terms and conditions of commercial sale supplied at the time of order acknowledgement.

Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Reproduction of AWINIC information in AWINIC data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. AWINIC is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of AWINIC components or services with statements different from or beyond the parameters stated by AWINIC for that component or service voids all express and any implied warranties for the associated AWINIC component or service and is an unfair and deceptive business practice. AWINIC is not responsible or liable for any such statements.

单击下面可查看定价，库存，交付和生命周期等信息

>>AWINIC(艾为)