AW32001A Single Cell Li-ion Battery Charger with Power Path Management and Full USB Compliance

Features

- Charge Voltage Regulation Accuracy: ±0.5% (0°C to 50°C)

- Charge Current Accuracy: ±5%

- Maximum 28V Input Voltage Rating with Over-Voltage Protection

- Minimum -5V Input Voltage Protection

- Complete Charge Process with Pre-Charge, Fast Charge and Constant Voltage Regulation

- Programmable Charge Parameters Through I²C Compatible Interface

- Programmable Charge Termination and Autonomous Recharge

- Wide Range of Fast Charge Current: 2mA~500mA

- Strong and Robust Protection: V_{IN} OVP, Battery OVP, OCP, Reverse Leakage Protection, Short Protection, Thermal Protection, PCB Over Temperature Protection

- BATFET Control to Support Shipping Mode, Wake Up and System Reset Function

- Fully Integrated Power Path Management

- Ultra-low Battery Leakage Current to Support Shipping Mode

- WLCSP 1.68mm×1.68mm×0.63mm-9B, 0.5mm Pitch Package

- 7-bit slave address (A7~A1) is 1001001 binary(0x49H)

Applications

- Smart Handheld Devices

- Wearable Devices

- Smart Watches

- Fitness Accessories

General Description

The AW32001A is a highly-integrated Li-Ion/Li-Polymer battery linear charger with system power path management. The charge process of AW32001A includes: Pre-Charge, Fast Charge and Constant Voltage Regulation. The charge parameters and operating modes are programmable through I²C interface. The charge process runs automatically and recharging occurs when the battery voltage drops below V_{BAT_REG}-V_{RCH} after the charge done status.

The AW32001A is targeted at space limited portable applications. The chip can take input power from either an AC adaptor or a USB port to supply the system load and charge the battery. Meanwhile, the chip provides system short circuit protection function by limiting the current from the input to the system and the battery to the system. These features are effective to protect the battery or chip from damage. The parameters of input current limit, the discharge current limit and safety timer can be programmed by the I²C interface. Additionally, input over voltage protection, input under voltage lockout and input headroom voltage are integrated for good input source detection.

AW32001A separates the charging route from the system power supply to fulfill the power management function. The system power supply is at first priority with no dependency on battery existence. Once a bad power-limited adapter appears at the input, AW32001A would reduce the charging current firstly. If the system load is still too heavy for input source, AW32001A will reduce the input-system current to prevent the input source from being pulled down. Under this circumstance, if the system voltage drops 30mV below the battery voltage, the battery to system supply route will be fully turned on to power the system load, which is supplement mode.
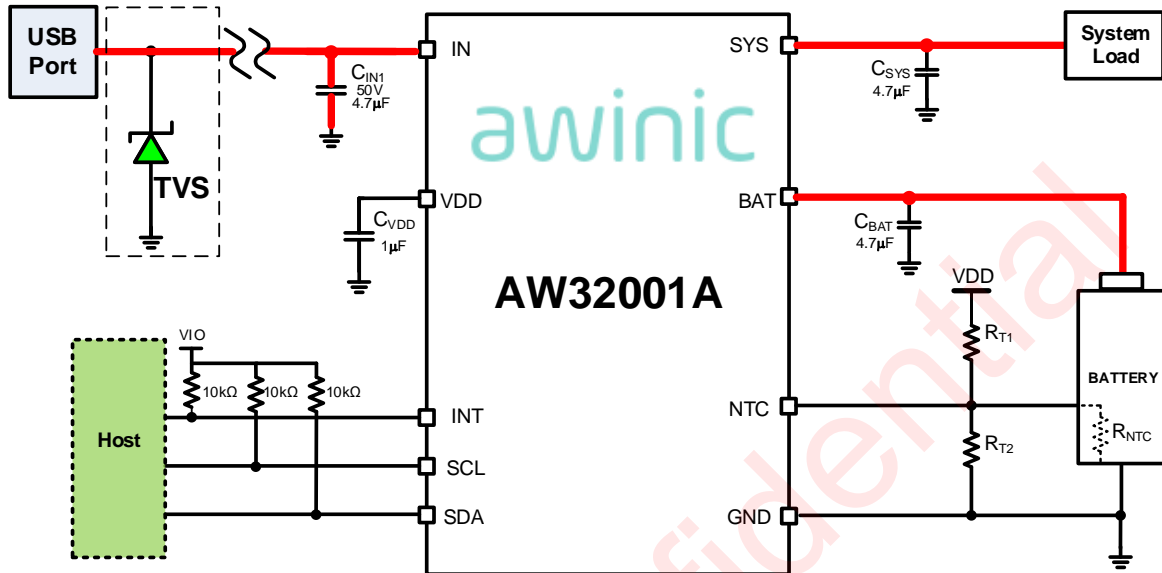
Typical Application Circuit

Figure 1   Typical Application Circuit of AW32001A

All trademarks are the property of their respective owners.
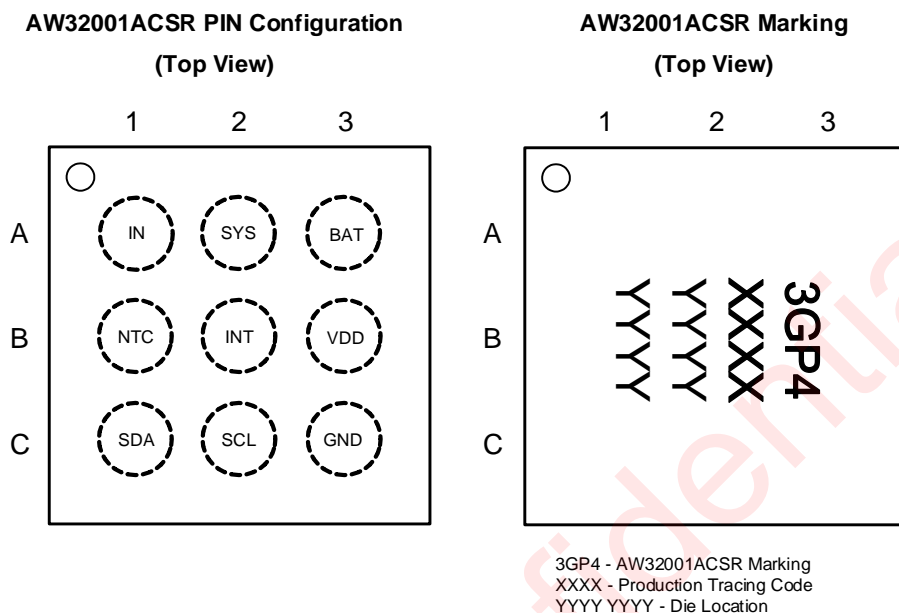
Pin Configuration and Top Mark

AW32001ACSR PIN Configuration
(Top View)

AW32001ACSR Marking
(Top View)

3GP4 - AW32001ACSR Marking
XXXX - Production Tracing Code
YYYY YYYY - Die Location

Figure 2   Pin Configuration and Top Mark

Pin Definition

Pin No.	Pin Name	Description
A1	IN	Input power pin. Bypass with a 4.7μF capacitor to GND.
A2	SYS	System power supply pin. Bypass with a 4.7μF capacitor to GND.
A3	BAT	Battery pin. Bypass with a 4.7μF capacitor to GND.
B1	NTC	Temperature sense input. Connect a negative temperature coefficient thermistor. Program the hot and cold temperature window with resistor dividers from VDD to GND, and NTC is the middle node. Pull NTC to VDD if NTC function is not used.
B2	INT	Interrupt output. The INT pin can send charge status and fault interrupt to the host. This pin is also used to disconnect the system from battery, and awake the chip from shipping mode.
B3	VDD	Internal power supply pin. Bypass with a 1μF capacitor to GND. No external load is allowed.
C1	SDA	I²C Interface serial date.
C2	SCL	I²C Interface clock.
C3	GND	Ground.

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW32001ACSR	-40℃～85℃	WLCSP 1.68mm×1.68mm-9B	3GP4	MSL1	ROHS+HF	3000 units/ Tape and Reel

Absolute Maximum Ratings(NOTE1)

PARAMETERS		MIN	MAX	UNIT
Input voltage range V_{IN} (with respect to GND)	IN	-5	28	V
NTC voltage range V_{NTC} (with respect to GND)	NTC	-0.3	V_{VDD}+0.3	V
Other pins voltage range (with respect to GND)	SYS, BAT, INT, VDD, SCL, SDA	-0.3	6	V
Operating free-air temperature range		-40	85	°C
Operating junction temperature T_J		-40	150	°C
Storage temperature T_{STG}		-65	150	°C
Lead temperature (Soldering 10 seconds)			260	°C

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.

ESD Rating and Latch Up

PARAMETERS	VALUE	UNIT
HBM (Human Body Model) (NOTE 2)	±2	kV
CDM(NOTE 3)	±1.5	kV
Latch-Up(NOTE 4)	+IT：200 -IT：-200	mA

NOTE2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ESDA/JEDEC JS-001-2017

NOTE3: Test method: ESDA/JEDEC JS-002-2018

NOTE4: Test method: JESD78E

Recommended Operating Conditions

PARAMETERS	MIN	NORM	MAX	UNIT
Supply voltage range V_{IN}	4		5.5	V
Supply current I_{IN}			500	mA
Discharge current I_{BAT}			3.2	A
Charge current I_{CHG}	2		456	mA
Battery regulated voltage V_{BAT_REG}	3.6		4.545	V
Operating junction temperature T_J	-40		125	°C

Thermal Information

PARAMETERS	VALUE	UNIT
Junction-to-ambient thermal resistance θ_{JA}	122	°C/W

Electrical Characteristics

V_{IN}=5V, V_{BAT}=3.5V, T_J=25°C for typical values (unless otherwise noted)

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
INPUT SOURCE AND BATTERY PROTECTION						
V_{IN_UVLO}	UVLO threshold voltage, entry UVLO	V_{IN} falling	3.5	3.6	3.7	V
	Hysteresis for UVLO	V_{IN} rising		300		mV
	Deglitch time for V_{IN_UVLO}	Exits UVLO		30		ms
V_{IN_OVP}	V_{IN_OVP} threshold voltage	V_{IN} rising	5.85	6	6.15	V
	V_{IN_OVP} hysteresis	V_{IN} falling from above V_{IN_OVP}		350		mV
V_{BAT}	BAT input voltage				4.6	V
V_{BAT_UVLO}	UVLO threshold voltage for BAT voltage, V_{BAT} falling, entry UVLO	REG01[2:0]=000	2.33	2.43	2.53	V
		REG01[2:0]=100	2.64	2.76	2.88	V
		REG01[2:0]=111	2.93	3.03	3.13	V
	Hysteresis voltage	V_{BAT_UVLO}=2.76V		190		mV
V_{HDRM}	Input vs battery voltage headroom threshold	V_{IN} rising	80	130	170	mV
	Input vs battery voltage headroom threshold hysteresis	V_{IN} falling		60		mV
CHARGE PROCESS						
V_{BAT_PRE}	Pre-charge to fast charge threshold	REG04[1]=1, V_{BAT} rising	2.9	3.0	3.1	V
	V_{BAT_PRE} hysteresis	V_{BAT} falling		200		mV
V_{BAT_REG}	Battery charge voltage regulation voltage	REG04[7:2]=000000, V_{BAT_REG}=3.6V	3.585	3.6	3.615	V
		REG04[7:2]=101000, V_{BAT_REG}=4.2V	4.18	4.2	4.22	V
		REG04[7:2]=110010, V_{BAT_REG}=4.38V	4.36	4.38	4.4	V
		REG04[7:2]=111110, V_{BAT_REG}=4.53V	4.507	4.53	4.553	V
V_{RECH}	Recharge threshold voltage	REG04[0]=0, V_{BAT_REG}=4.2V, below V_{BAT_REG}	60	100	140	mV
		REG04[0]=1, V_{BAT_REG}=4.2V, below V_{BAT_REG}	160	200	240	mV
	Deglitch time for V_{RCH}	V_{BAT} falling after charge termination		130		ms
V_{BAT_OVP}	Battery OVP threshold voltage	V_{BAT} threshold over V_{BAT_REG} to turn off charger during charging		130		mV
	V_{BAT_OVP} hysteresis			50		mV

Electrical Characteristics *(Continued)*

V_{IN}=5V, V_{BAT}=3.5V, T_J=25°C for typical values (unless otherwise noted)

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
POWER PATH MANAGEMENT						
V_{SYS}	Regulated system output voltage	V_{IN}=5.5V, EN_HIZ=0, R_{SYS}=100Ω, I_{CHG}=0A, V_{SYS_REG}=4.6V	4.51	4.60	4.69	V
I_{IN_LMT}	Input current limit	REG00[3:0]=0000, I_{IN_LMT}=50mA	30	45	60	mA
		REG00[3:0]=0011, I_{IN_LMT}=140mA	112	125	140	mA
		REG00[3:0]=1001, I_{IN_LMT}=320mA	275	296	320	mA
		REG00[3:0]=1111, I_{IN_LMT}=500mA	440	460	500	mA
V_{IN_DPM}	Dynamic input power management clamp voltage	REG00[7:4]=0000, V_{IN_DPM}=3.88V	3.68	3.88	4.18	V
		REG00[7:4]=1000, V_{IN_DPM}=4.52V	4.32	4.52	4.82	V
		REG00[7:4]=1111, V_{IN_DPM}=5.08V	4.88	5.08	5.35	V
R_{ON_Q1}	IN to SYS switch on resistance	V_{IN_DPM}=3.88V, V_{IN}=4.5V, I_{SYS}=100mA		300		mΩ
R_{ON_Q2}	BAT to SYS switch on resistance	V_{IN}<2V, V_{BAT}=3.5V, I_{SYS}=100mA		103		mΩ
I_{IN_Q}	Input quiescent current (not include the current from external NTC resistor)	V_{IN}=5V, EN_HIZ=0, CEB=0, charge enable, I_{CHG}=0, I_{SYS}=0		1.7		mA
		V_{IN}=5V, EN_HIZ=0, CEB=1, charge disabled, I_{CHG}=0, I_{SYS}=0		1.5		mA
I_{BAT_Q}	Battery quiescent current (not include the current from external NTC resistor)	V_{IN}=5V, CEB=0, charge done, I_{CHG}=0, I_{SYS}=0		58		µA
		V_{IN}=0, CEB=1, V_{BAT}=4.35V, DIS_PCB_OTP=1, I_{SYS}=0		21		µA
		V_{IN}=0, CEB=1, V_{BAT}=4.35V, DIS_PCB_OTP=0, I_{SYS}=0		27		µA
		V_{IN}=0, CEB=1, V_{BAT}=4.35V, DIS_PCB_OTP=1, I_{SYS}=0, enable watchdog		28		µA
		V_{BAT}=4.5V, V_{IN}=V_{SYS}=0, FET_DIS=1, shipping mode			1	µA
$I_{SYS-BAT\_LKG}$	SYS reverse to BAT switch leakage	V_{SYS}=4.60V, V_{IN}=5V, V_{BAT}=0, CEB=1, EN_HIZ=1, charge disabled			1	µA
I_{DSCHG}	BAT FET discharge current limit	I_{DSCHG}=400mA	300	440	500	mA
		I_{DSCHG}=2000mA		2000		mA
V_{FWD}	Ideal diode forward voltage in supplement mode	50mA discharge current		30		mV

Electrical Characteristics *(Continued)*

V_{IN}=5V, V_{BAT}=3.5V, T_J=25°C for typical values (unless otherwise noted)

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
CHARGE CURRENT						
I_{CHG}	Output charge regulation current programmable range Accuracy for charge current regulation	V_{BAT_PRE}<V_{BAT}<V_{BAT_REG} , REG0A[4]=1, I_{CHG}=2mA	1.5	2	2.5	mA
		V_{BAT_PRE}<V_{BAT}<V_{BAT_REG} , REG0A[4]=0, I_{CHG}=8mA	6.9	8	9	mA
		V_{BAT_PRE}<V_{BAT}<V_{BAT_REG} , REG0A[4]=0, I_{CHG}=96mA	89	96	103	mA
		V_{BAT_PRE}<V_{BAT}<V_{BAT_REG} , REG0A[4]=0, I_{CHG}=264mA	252	264	276	mA
		V_{BAT_PRE}<V_{BAT}<V_{BAT_REG} , REG0A[4]=0, I_{CHG}=456mA	434	456	478	mA
I_{PRE}	Pre-charge current programmable range, I_{PRE}=I_{TERM}	V_{BAT}<3.0V	1		31	mA
I_{TERM}	Termination charge current threshold, programmable	REG03[3:0]=0000, I_{CHG}=1mA	0.8	1	1.2	mA
		REG03[3:0]=0001, I_{CHG}=3mA	2.6	3	3.3	mA
		REG03[3:0]=0101, I_{CHG}=11mA	9.5	11	13	mA
		REG03[3:0]=1111, I_{CHG}=31mA	28	31	34	mA
T_{TERM}	Termination deglitch time	I_{CHG}<I_{TERM}, REG0C[6]=0		3.2		s
I_{DBAT}	Battery detection current before charge done (sink current)	Begins after termination detected and V_{BAT}< V_{BAT_REG}		0.5		mA
T_{DBAT}	Battery detection time			262		ms
INT						
$V_{OL(STAT)}$	Low-level output saturation voltage, INT pin	I_O=5mA, sink current			0.4	V
	High-level leakage current for INT	INT is in High-impedance status, V_{INT}=5V			1	µA
I²C BUS LOGIC LEVELS AND TIMING CHARACTERISITICS						
V_{OL}	Output low threshold level	I_O=5mA, sink current			0.4	V
V_{IL}	Input low threshold level	V_{pull_up}=1.8V, SDA and SCL			0.4	V
V_{IH}	Input high threshold level	V_{pull_up}=1.8V, SDA and SCL	1.3			V
I_{BIAS}	Input bias current	V_{pull_up}=1.8V, SDA and SCL			1	µA
THERMAL PROTECTION						
T_{J_REG}	Junction temperature regulation	Junction temperature rising		120		°C
T_{OTP}	Overheating shutdown protection temperature	Junction temperature rising		150		°C
	Thermal hysteresis for T_{OTP}	Junction temperature falling		20		°C

Electrical Characteristics *(Continued)*

V_{IN}=5V, V_{BAT}=3.5V, T_J=25°C for typical values (unless otherwise noted)

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
I_{NTC}	NTC pin output current	CEB=0, NTC=3V	-1	0	1	μA
V_{COLD}	NTC cold temp rising threshold	Percentage of VDD	62	64	66	%
	Hysteresis voltage			60		mV
V_{HOT}	NTC hot temp falling threshold	Percentage of VDD	31	33	35	%
	Hysteresis voltage			70		mV
V_{HOT_PCB}	NTC hot temp falling threshold for PCB OTP	Percentage of VDD	31	33	35	%
	Hysteresis voltage			70		mV
CLOCK FREQUENCY AND WATCHDOG TIMER						
F_{CLK}	Clock frequency			250		KHz
t_{WDT}	Watchdog timer	REG05[6:5]=11		160		s

I²C INTERFACE TIMING

SYMBOL	DESCRIPTION		MIN	TYP	MAX	UNIT
FSCL	Interface Clock Frequency				400	kHz
TDEGLITCH	Deglitch Time	SCL		83		ns
		SDA		115		ns
THD:STA	(Repeat-Start) Start Condition Hold Time		0.6			μs
TLOW	Low Level Width of SCL		1.3			μs
THIGH	High Level Width of SCL		0.6			μs
TSU:STA	(Repeat-Start) Start Condition Setup Time		0.6			μs
$T_{HD:DAT}$	Data Hold Time		0			μs
$T_{SU:DAT}$	Data Setup Time		0.1			μs
T_R	Rising Time of SDA and SCL				0.3	μs
T_F	Falling Time of SDA and SCL				0.3	μs

10

T_{SU:STO}	Stop Condition Setup Time	0.6			µs
T_{BUF}	Time Between Start and Stop Condition	1.3			µs
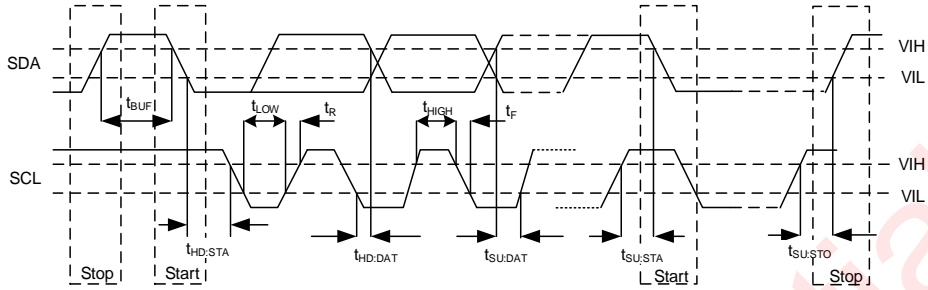
Figure 3   I²C Interface Timing

Typical Characteristics

VIN=5V, T$_J$=25°C, IIN_LIM=500mA, ICC=128mA, VIN_MIN=4.6V, unless other noted.

C1 2V/ **C2** 2V/ **C3** 2V/ **C4** 100mA/

VIN
VSYS
VBAT
IBAT
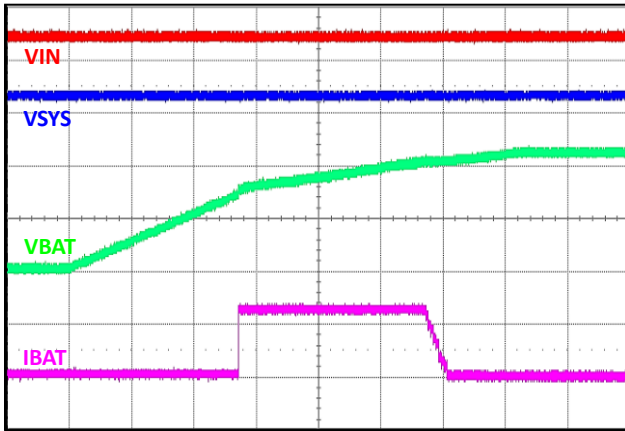
I$_{SYS}$=0A
Battery Charge Curve

C1 2V/ **C2** 2V/ **C3** 2V/ **C4** 100mA/

VIN
VSYS
VBAT
IBAT
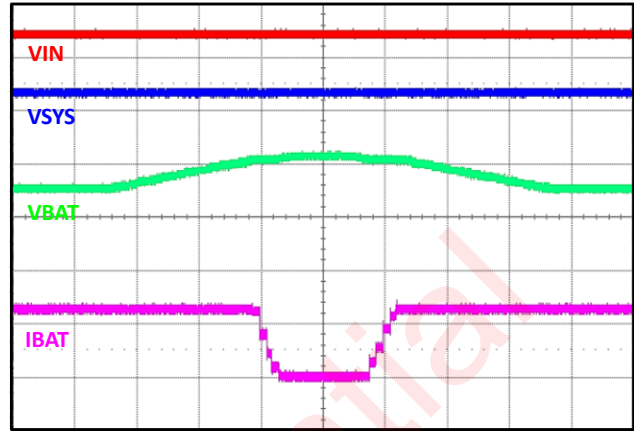
I$_{SYS}$=0A
Auto-Recharge Curve

C1 500mA/ **C2** 2V/ **C3** 2V/ **C4** 500mA/
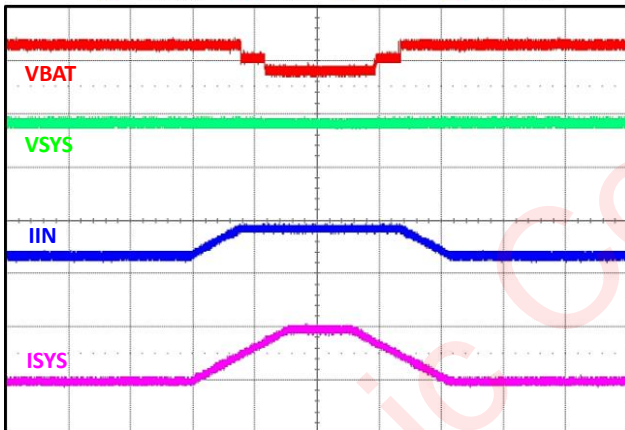
VBAT
VSYS
IIN
ISYS

V$_{BAT}$=3.7V
Input Current Limit-Based PPM

C1 500mA/ **C2** 1V/ **C3** 2V/ **C4** 1A/

VIN
VSYS
VBAT
ISYS
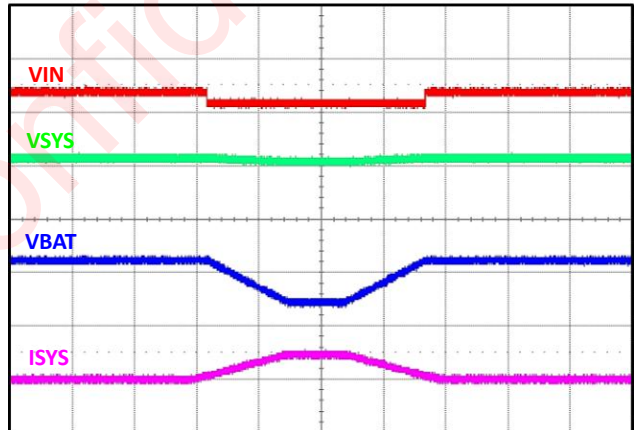
V$_{IN}$=5V/200mA, V$_{BAT}$=3.7V
Input Voltage Regulation-Based PPM

C1 500mA/ **C2** 1V/ **C3** 2V/ **C4** 1A/

VIN
VSYS
IBAT
ISYS
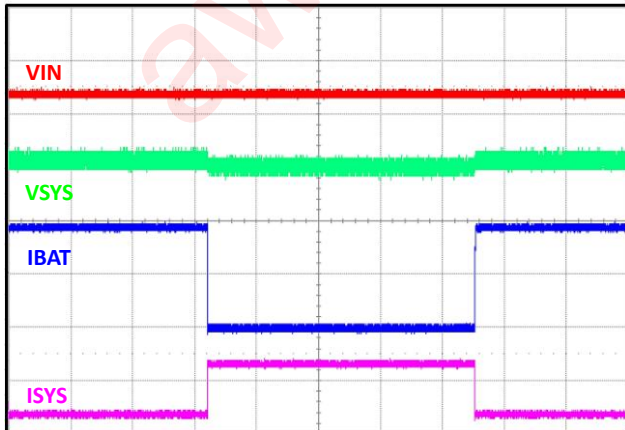
V$_{IN}$=5V, V$_{BAT}$=3.7V, I$_{CC}$=456mA, I$_{SYS}$=0A~1A
SYS Load Transient

C1 2V/ **C2** 2V/ **C3** 2V/ **C4** 100mA/

VIN
VSYS
VBAT
IBAT
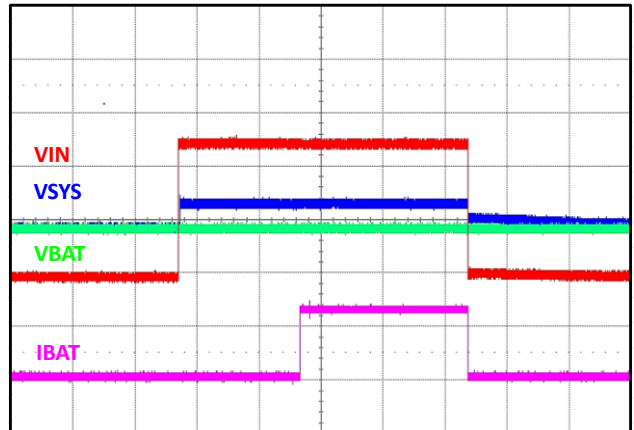
V$_{BAT}$=3.7V, I$_{SYS}$=0A
Power On/Off

Typical Characteristics *(Continued)*

VIN=5V, T$_J$=25°C, IIN_LIM=500mA, ICC=128mA, VIN_MIN=4.6V, unless other noted.

V$_{BAT}$=3.7V, I$_{SYS}$=0A
Charge Enable/Disable

V$_{BAT}$=3.7V, I$_{SYS}$=0A, PCB_OTP disabled
NTC Rising
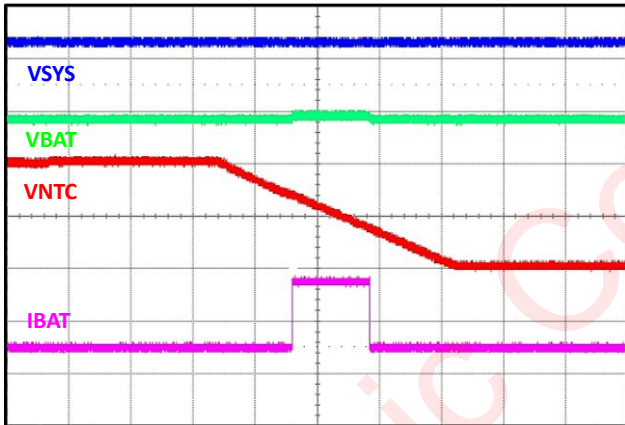
V$_{BAT}$=3.7V, I$_{SYS}$=0A, PCB_OTP disabled
NTC Falling
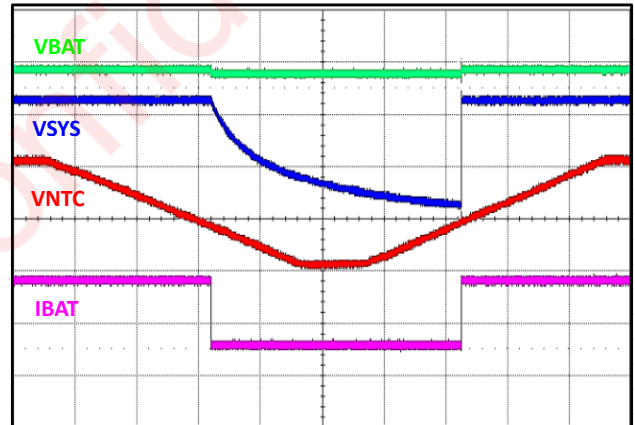
V$_{BAT}$=3.7V, I$_{SYS}$=0A
PCB_OTP @Charge mode
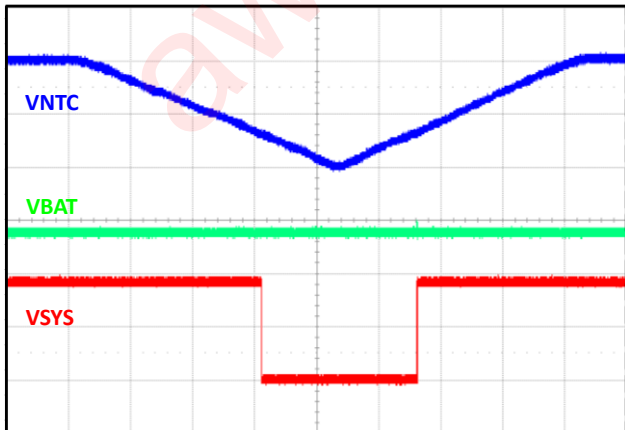
V$_{IN}$=0V, V$_{BAT}$=3.7V
PCB_OTP @Discharge mode
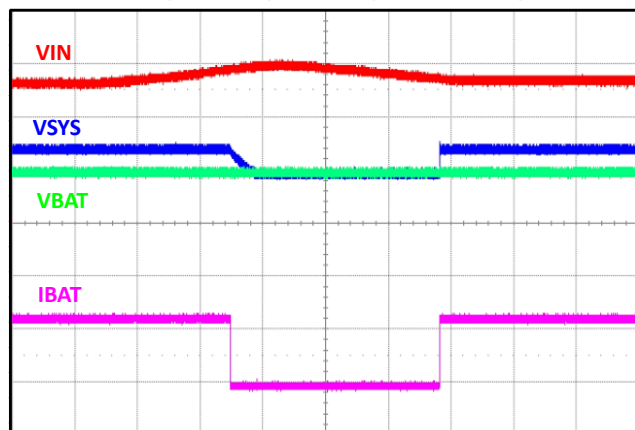
V$_{BAT}$=3.7V, I$_{SYS}$=0A
V$_{IN}$ OVP Operation

Functional Diagram

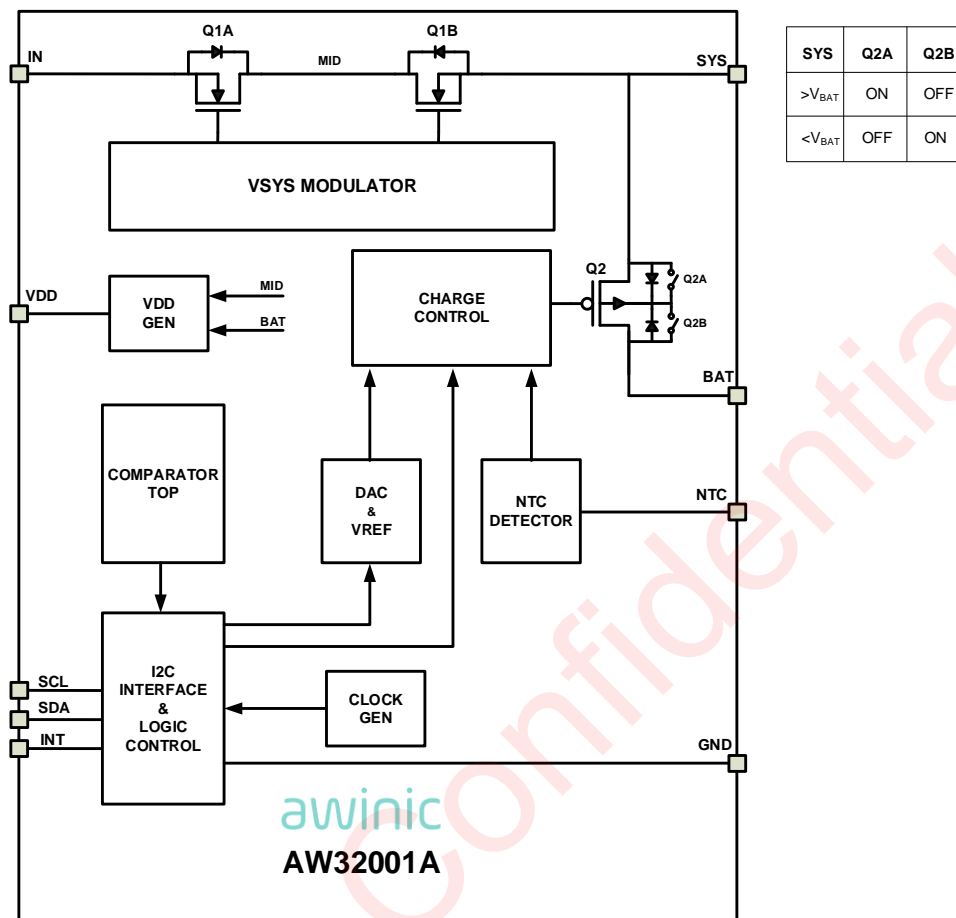| SYS	Q2A	Q2B
>V_{BAT}	ON	OFF
<V_{BAT}	OFF	ON

Figure 4 Functional Block Diagram

Detailed Functional Description

The AW32001A is a highly integrated linear battery charger with a complete power path management function (PPMF). The full-charge process of AW32001A not only includes pre-charge, constant-current fast charge (CC) and constant voltage (CV) regulation, but also charge termination, auto-recharge, etc. The PPMF can manage the input source to power the system load and charge the battery simultaneously. The system load has a higher priority than the charge current. When the input power is limited by input current or voltage, the charge current will decrease automatically.

The AW32001A integrates a LDO FET (Q1) between IN and SYS and a BFET (Q2) between SYS and BAT. In charging mode, the Q2 works as a fully featured linear charger with pre-charge, fast charge, constant voltage charge, charge termination, auto-recharge, thermal protection, built-in timer control and NTC monitoring. The charge current can be programmed via the I²C interface. When the chip's temperature exceeds the thermal regulation threshold (120°C default), the IC controls the charge current to reduce it's temperature.

In supplement mode, the AW32001A turn on the Q2 to power the system load. When the input power is removed, the Q2 is fully turned on to power the system load.

The charge current is limited to maintain the system power supply with higher priority all the time. When the system load demand is over the input power capacity, the PPMF of AW32001A will reduce the charging current or use power from the battery to satisfy the system load. Figure 5 shows the PPMF structure of the AW32001A.
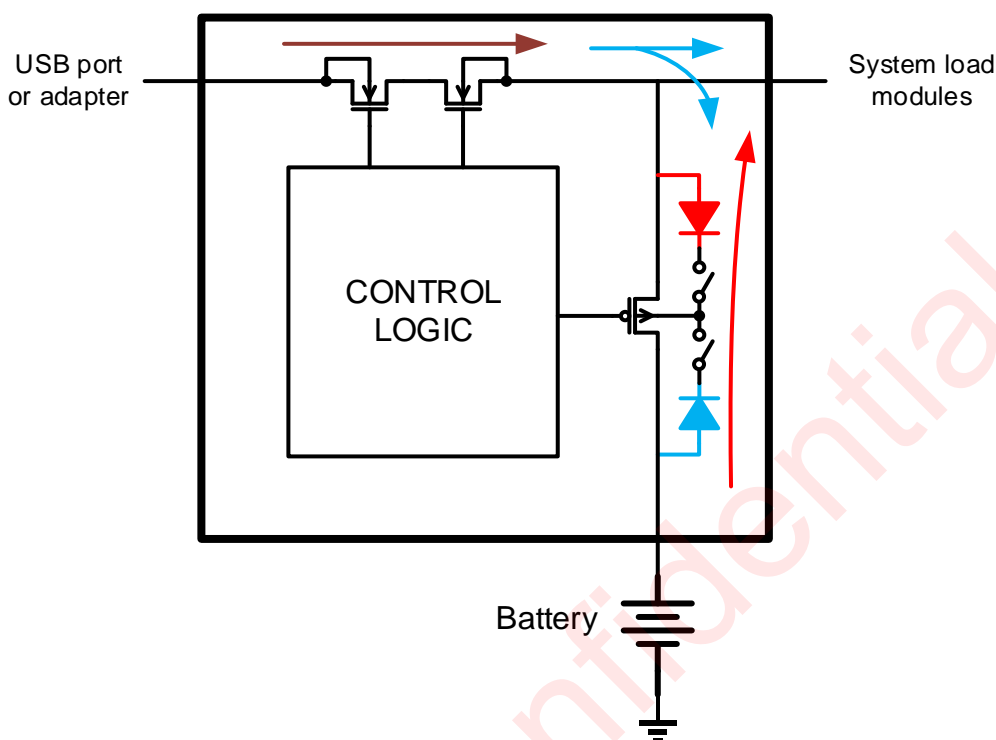

Figure 5 Power Path management Structure

Protection Operation

The AW32001A has input OVP, UVLO, battery OVP and other functions to protect it's normal operation. Additionally, NTC function is integrated to prevent battery from high temperature danger.

Power Supply

The AW32001A chooses the higher voltage of either BAT or IN to power the internal bias circuit. When BAT or IN voltage rises above its respective power on reset (POR) threshold, the internal control circuit will wake up and the I²C interface will be ready for communication with all of registers reset to default value. These registers can be controlled by the host.

Input OVP and UVLO

The AW32001A has an input UVLO and over-voltage protection (OVP) threshold. The Q1 is turned off immediately when the input voltage is out of its operating range,.

The input over-voltage protection is integrated to prevent the device and other components from damage of the high input voltage (Voltage from V_{IN} to GND). If the voltage at V_{IN} pin exceeds V_{IN_OVP} threshold(6V typical)，the chip will turn off Q1 and send out a fault pulse. When V_{IN} drops lower than the input overvoltage exit threshold (5.65V typical), Q1 will be turned on again.

When V_{IN} falls below V_{UVLO}, the Q1 is also turned off and the input to system loop controller is shut down. Once V_{IN} rises above V_{UVLO}+300mV, the Q1 is turned on and relative circuits start working.
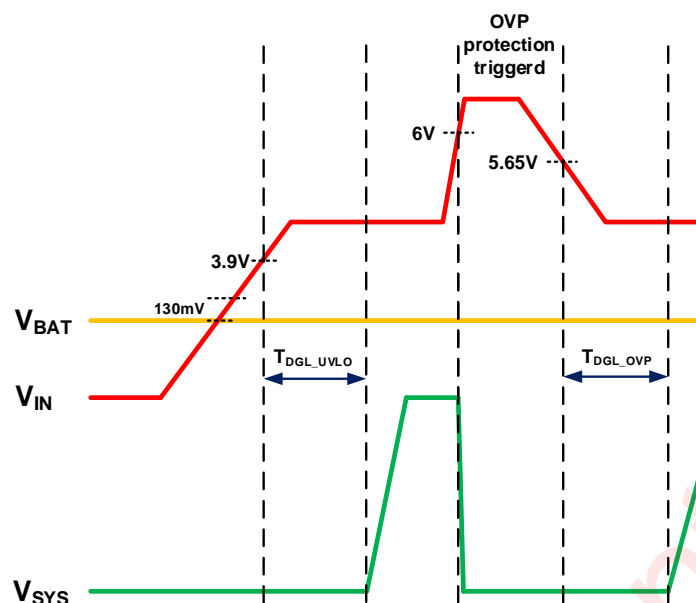
Figure 6 Input Power Detection Operation

Battery OVP

The AW32001A has battery over-voltage protection (BOVP) function (about 130mV higher than V_{BAT_REG}). When the battery OVP event occurs, AW32001A will stop the current charging cycle immediately and asserts a fault,.

Negative Temperature Coefficient (NTC) Temperature Sensor

The AW32001A is able to use NTC to sense the battery temperature. By monitoring the thermistor (usually available in the battery pack), the battery is guaranteed to operate in safe environment.

The NTC function demands appropriately valued resistors connecting from VDD to NTC to ground. At the same time, connect a thermistor from the NTC pin to ground. The NTC voltage is determined by the resistor divider and thermistor, and the divide ratio depends on the temperature of thermistor. The upper and lower bound of NTC voltage is pre-determined in AW32001A.

In the AW32001A, PCB_OTP function is default settings. The I²C can change the NTC and PCB_OTP functions (see Table 1).

Table 1: NTC Function Selection Table

I²C Control		Function
EN_NTC	**DIS_PCB_OTP**	
0	x	Disable
1	1	NTC(resistor-divided)
1	0	PCB_OTP

NOTE: x=Don't care

When PCB_OTP is selected and the NTC voltage is lower than the NTC hot threshold, both the Q2 and Q1 are turned off. The NTC_FAULT status is set (REG09H bit[1]) to 1 to show the PCB_OTP fault. The IC Operation resumes, when the NTC voltage returns to safe range.

The NTC function works only in charge mode. Once the temperature is outside of the safe operating range, the IC stops charging state and report it on the status bits. When the temperature comes back to the safe range, the charge process resumes automatically.

Thermal Regulation and Thermal Shutdown

The internal junction temperature is monitored continuously to avoid overheating the chip and maximize power delivery. When the internal junction temperature reaches the preset limit T_{J_REG} (120°C default), the charge current starts reducing to prevent dangerous high power dissipation. The IC can work in diffident thermal requirements applications, because it has multiple thermal regulation thresholds from 60°C to 120°C. register REG07H bit [5:4] can set The junction temperature regulation threshold.

The Q1 and Q2 will turn off, if the internal junction temperature reaches 150°C.
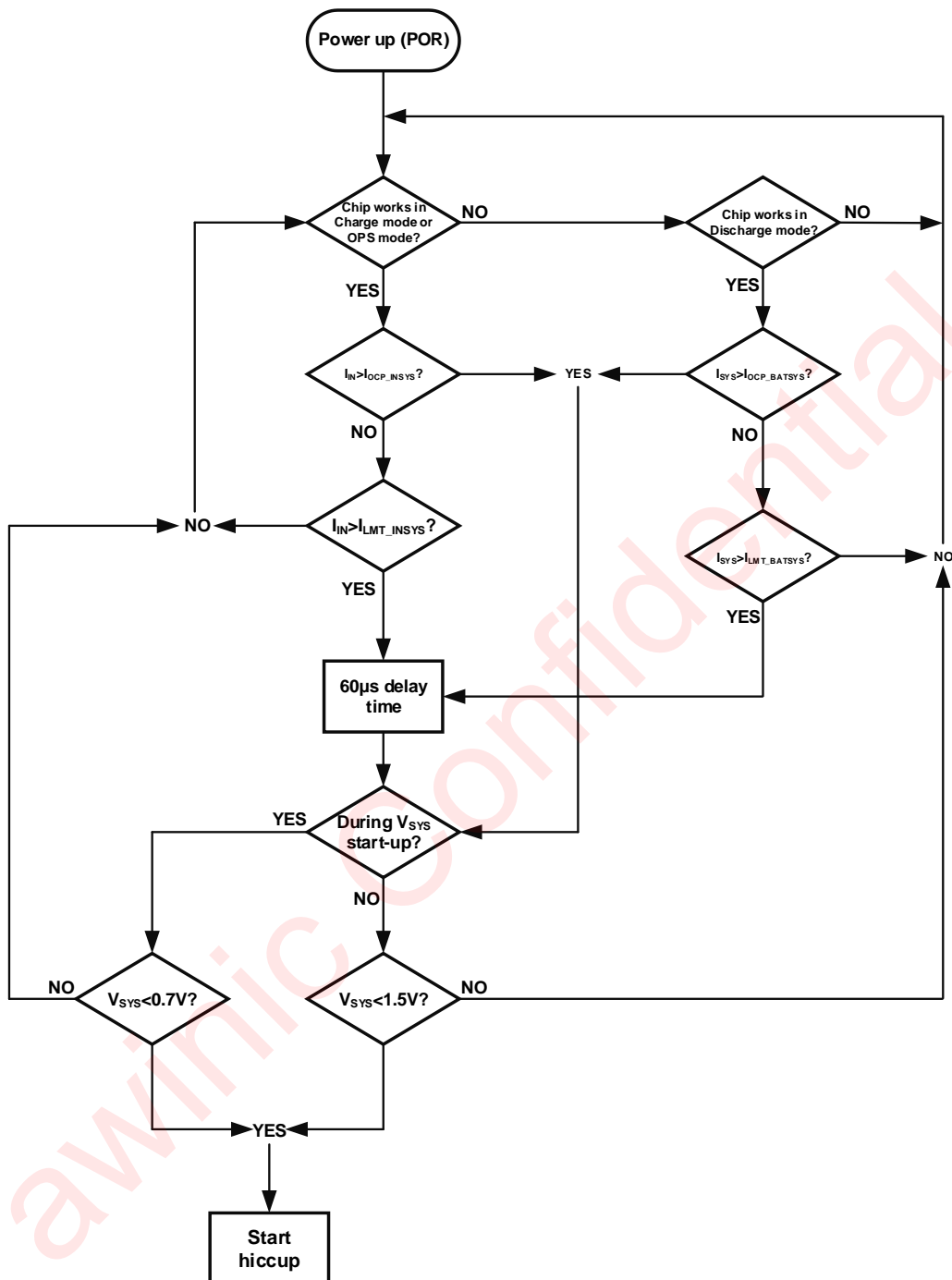
System Short-Circuit Protection

Figure 7 Short Circuit Hiccup Protection Flow Chart

The AW32001A has short-circuit protection (SCP) function in both the IN to SYS path and the BAT to SYS path. The IC monitor the system voltage continuously. If V_{SYS} is lower than 1.5V, The SCP is active, and I_{DSCHG} decreases to half of the original value. For the IN to SYS path, once I_{IN} is over the protection threshold, both the Q1 and Q2 are turned off immediately, and the AW32001A enters hiccup mode. When the setting input current limit is reached, I_{IN} is regulated at I_{IN_LIM}. After a 60μs delay, the hiccup mode starts, and the hiccup mode interval is 1ms.

For the BAT to SYS path, once I_{BAT} is over the 3.7A protection threshold, both the Q1 and Q2 are turned off immediately, and the AW32001A enters hiccup mode. When the battery discharge current limit threshold is

reached, hiccup mode starts after a 60µs delay, and the hiccup mode interval is 1ms.

Particularly, when system short-circuit occurs in both the input and battery, the both paths protection mechanism works together. The faster path dominates the hiccup operation.

Charge Mode Operation

When AW32001A operation in Charge Mode, the DPM, PPMF, Battery Supplement and other functions are available. These functions are useful in some application.

Input Current-and Input Voltage-Based Power Regulation

The AW32001A has an input current limit regulation to meet the input source's (typically USB) maximum current limit specification. The function is realized by monitoring the input current continuously. If the rating of input source is lower than the preset input current limit, the input current limitation works to protect the input source from being overloaded. The total input current limit value can be set by the I²C, and the function can prevent the input source from being over-loaded.

Otherwise, when the load is over the input power capacity, the input voltage also can be regulated to V_{IN_MIN} for the input voltage-based DPM regulation. V_{IN_MIN} can be set via the I²C, and the V_{IN_MIN} should be at least 250mV higher than V_{BAT_REG} to ensure the stable operation of the regulator. The register REG07H bit[6] can be set to disable the input voltage limit function .

Either the input voltage or input current limit is reached, the total input power is limited by regulating the Q1 FET between IN and SYS. As a result, the system voltage drops. When the system voltage decrease to a minimum value of V_{SYS_REG} - 135mV and V_{IN} - 345mV, the charge current is reduced to prevent the system voltage from dropping further.

Battery Supplement Mode

When DPM occurs, the charge current is reduced to keep the input current or input voltage in regulation. If the charge current has already reduced to zero and the input source is still overloaded, the system voltage begins decreasing. If the system voltage drops to 30mV below the battery voltage, the AW32001A will enters battery supplement mode, and the ideal diode is enabled. If I_{DSCHG} (supplement current) * R_{ON_BATT} is lower than 30mV, the Q2 is regulated to keep VBAT - V_{SYS} at 30mV. If this regulation cannot maintain 30mV voltage drop due to heavy load from SYS, the Q2 will fully turn on to maintain the ideal forward voltage. When the system load decreases, the system voltage starts to increase. The ideal diode mode is disabled, when V_{SYS} is higher than VBAT + 20mV. Figure 8 shows the DPM and battery supplement mode operation profile.

When V_{IN} is not available, the AW32001A operates in discharge mode. During in charging mode, the Q2 is fully on to reduce power loss.
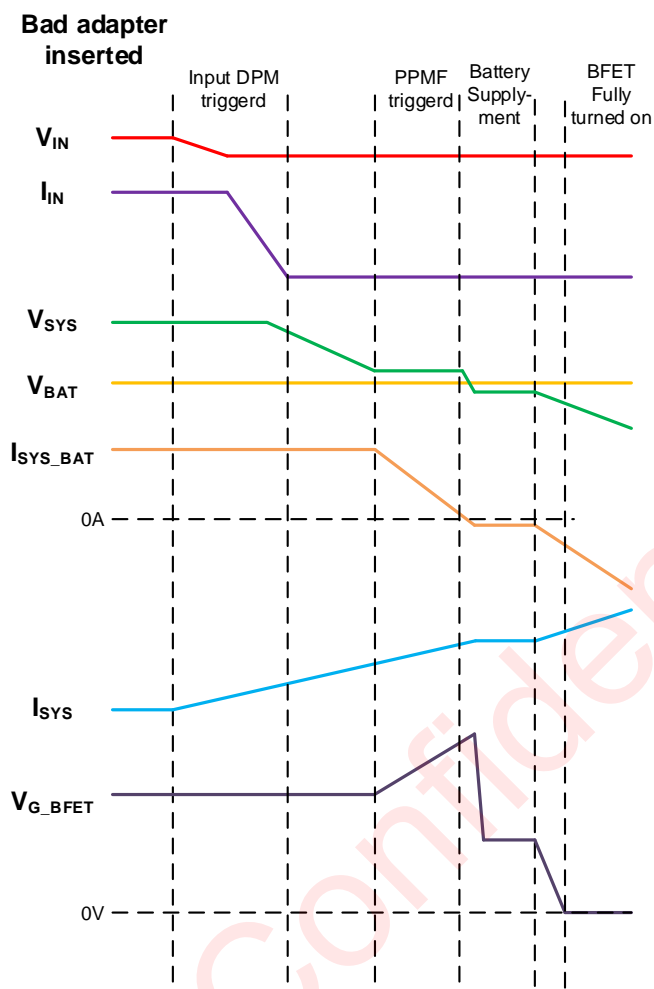
Figure 8 DPM and Battery Supplement Operation Profile Battery Regulation Voltage

Battery Regulation Voltage

The battery voltage of constant voltage regulation state is V_{BAT_REG}. When V_{BAT_REG} = 4.2V, the accuracy is ±0.5%in the range of 0°C to +50°C ambient temperature.

Power Path Management Function (PPMF)

The AW32001A can decouple the system from the battery by employs a PPMF with the Q2. This allows the IC to control Q2 between the system and the battery separately. The system has high priority to start up by regulating the integrated Q1 even the battery is in a deeply discharged or missing state. The function of Q1 and Q2 can be controlled by the I²C.

Table 2: FET Control via I²C

FET On/Off Changed by Control	HI-Z Mode and Charge Control	
	Set EN_HIZ to 1	Set CEB to 1
Q1	OFF	x
Q2(charging)	x	OFF
Q2(discharging)	x	x

NOTE: x=Don't care.

For the system voltage control, when the input voltage is lower than V_{SYS_REG}, the Q1 is fully on with the input current limit. When the input voltage is higher than V_{SYS_REG}, the system voltage is regulated to V_{SYS_REG}. The V_{SYS_REG} can be programmed through REG07H bit[3:0]. ***Battery Charge Profile***
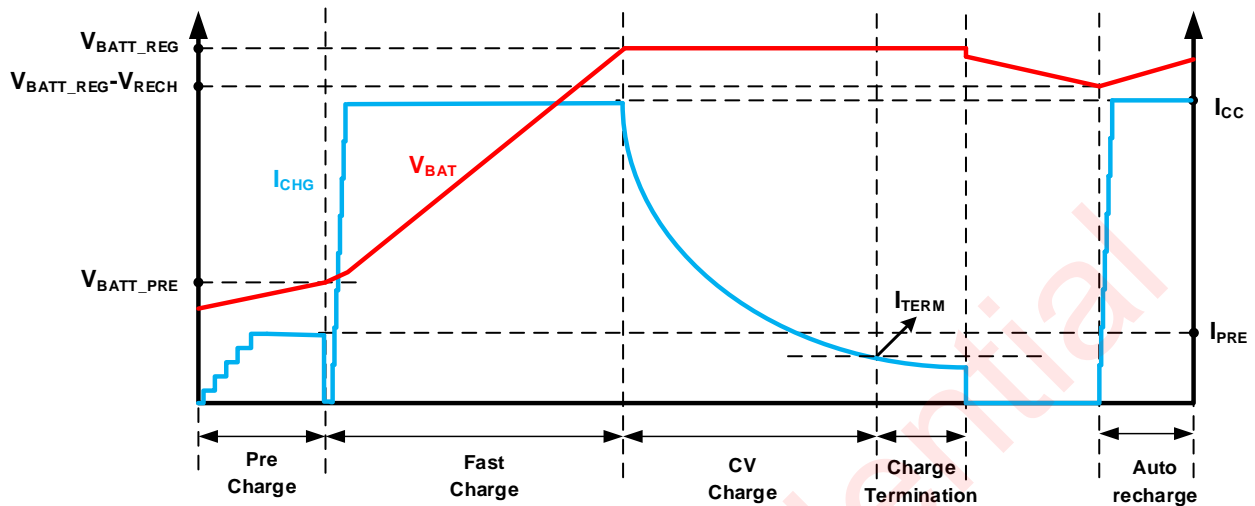

Figure 9 Battery Charge Profile

The AW32001A has three main charging processes: pre-charge, fast-current charge, and constant-voltage charge:

● Pre-charge: In the pre-charge process, the IC charges the deeply depleted battery safely with small current until the battery voltage rise to the pre-charge threshold (V_{BAT_PRE}), in which the chip enters the fast-charge process. If the V_{BAT} is not increasing to exceed than V_{BAT_PRE} before the pre-charge timer expires (1 hour), the charge cycle stops, and a corresponding timeout fault signal is asserted. The register REG03H[3:0] can be set the current of pre-charge.

● Fast charge: When V_{BAT} exceeds V_{BAT_PRE}, the AW32001A enters the fast charge process. The REG02H[5:0] can be set to change the fast-charge current .

● Constant-voltage charge: The charge mode changes from CC mode to CV mode when the V_{BAT} rises to the battery-full voltage (V_{BAT_REG}) set via REG04H[7:2]. At the same time, the charge current starts decreasing in CV charge process.

Due to multiple loop regulations, such as dynamic power management (DPM) regulation (input voltage, input current) or thermal regulation, the actual charge current may be less than the setting value.

When the charge current is smaller than termination current threshold I_{TERM} for 3.2s in CV process, the charge cycle will be completed, and the charge status is updated to charge done. The register REG03H[3:0] can set the termination charge current threshold I_{TERM}. The termination function can be disabled via EN_TERM=0 (REG05H[4]=0). Meanwhile, the register bit TERM_TMR (REG05H bit[0]) is able to control whether the charge process continue or not when the termination conditions are met. The termination function is shown as table 3.

Table 3: Termination Function Selection Table

EN_TERM	TERM_TMR	After Termination Condition is Met	
		Operation	Charge Status
0	x	Keep CV Charge	Charge
1	0	Charge done	Charge done
1	1	Keep CV Charge	Charge

Note: x=Don't care.

A new charge cycle starts when any of the following conditions are valid:

● Auto-recharge kicks in.

● Battery charging is enabled via the I^2C.

● The input power is recycled .

Under the following conditions:

● No safety timer fault.

● No thermistor fault at NTC.

● BFET is not forced off.

● No battery over-voltage event.

Automatic Recharge

After the charge process is completed and charge cycle is terminated, the system's consumption or battery self-discharge may cause the battery voltage to decrease. When the battery voltage falls below the recharge threshold and V_{IN} is still in the operating range, another new charging cycle will start automatically.

Discharge Operation

In Battery discharge mode, The IC has low quiescent current and low on-resistance of Q2 to help the battery working for a longer time. The Over-Discharge Current Protection is available to make the IC work safely in different applications.

Battery Discharge Function

When the input source is absent and battery is connected to chip with the VBAT above V_{BAT_UVLO} threshold, the Q2 is fully on. During discharge mode, the 90mΩ Q2 can minimizes conduction loss.

Over-Discharge Current Protection

In discharge mode and supplement mode, the AW32001A is designed to have an over-discharge current protection. Once the I_{BAT} exceeds the programmable discharge current limit (2A default), the Q2 turns off after a 60μs delay. At the same time, the AW32001A enters hiccup mode as part of the over-current protection (OCP). The discharge current can be programmed to maximal 3.2A through the I^2C. in addition, if the discharge current goes high and reaches the internal fixed peak current limit (about 3.7A), the Q2 turns off and begins hiccup mode immediately.

Battery Disconnection Function

In some applications where the battery is not removable, it is essential to allow the system power to be reset in some applications or disconnect the battery from the system for shipping mode. The AW32001A provides both system reset function and shipping mode for different applications.

Table 4: Shipping Mode Control

FET On/Off Changed by Control	Enter Shipping Mode	Exit Shipping Mode	
	Set FET_DIS to 1	INT H to L for 2s	Vin Plug-In
Q1	x	x	On
Q2 (charging)	Off	On	On(2s later)
Q2 (discharging)	Off	On	On(2s later)

Note: x=Don't care.

The IC has a register bit to control the battery disconnection (FET_DIS). If this bit is set to 1, after a delay time(default 1s) the AW32001A enters shipping mode. The delay time can be programmed by REG09H[7:6]. If the input source is present when FET_DIS is written to 1, chip will turn to shipping mode after 2s deglitch time with input voltage smaller than IN_UVLO threshold. Plug in the input adapter or pull the INT pin down for 2s to wake the AW32001A up from shipping mode.

If INT PIN is shorted to ground or left floating before entering Shipping Mode, REG0C[2]must be written to 1 to avoid bad Shipping Mode operation.

The INT pin can be reused to cut off the path from the battery to the system under certain condition to reset the system manually. The battery is disconnected from the system, when the logic of INT is set low for longer than RST_DGL (which can be programmed by REG01H[7:6]). After a delay time of t_{RST_DUR}, the Q2 is turned on automatically, and the system is powered by the battery again. The t_{RST_DUR} can be programmed by REG01bit [5]. During the off period, the INT pin is not limited to be high or low.
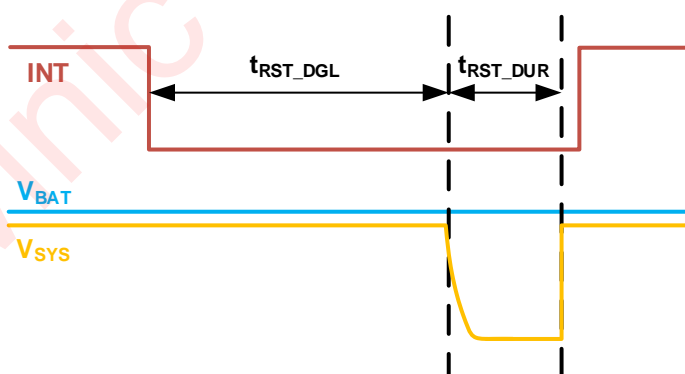
Figure 10   System Reset Function Operation Profile

Safety timer

Because the abnormal battery conditions, the AW32001A designed a pre-charge and fast-charge safety timer to prevent an extra-long time charging cycle. The pre-charge safety timer is 1hour, and the fast-charge safety timer can be programmed through the I²C. Once the battery enters fast-charge mode, The fast charge safety timer starts. The safety timer can be disabled via the I²C.

The following actions can restart the safety timer:

● Write REG05H [3] from 0 to 1 (safety timer enable).

- Write REG01H [3] from 1 to 0 (charge enable).

- Write REG02H [7] from 0 to 1 (software reset).

- A new charge cycle is kicked in.

Interrupt to host (INT)

The AW32001A can output a 256μs low-state INT pulse via INT to notify the system of the operation. All of the below events can trigger an INT output:

- Charge completed

- Good input source detected

- Charging status change

- UVLO or input over-voltage protection

- Any fault in REG09H (input fault, watchdog timer fault, safety timer fault, thermal fault, battery OVP fault, NTC fault)

When a fault occurs, an INT pulse is send out and latches the fault state in REG09H. After the AW32001A exits the fault state, the fault bit is reset to 0 after the host reads faults registers. The NTC fault bit constantly reports the current thermistor conditions without latches. The INT signal can be masked when the corresponding control bit is set in REG06H [4:0]. When an INT condition is masked, this means that the INT pin signal (and register bit) will not trigger when the corresponding condition occurs. Masking INT pulses is useful when writing software code to avoid unnecessary interruptions due to these events.

Host Mode and Default Mode

The AW32001A is a host-controlled device. After the power-on reset, the AW32001A starts up in a default mode or watchdog timer expiration state. All registers are in their default settings.

The watchdog timer works in both charge and discharge mode. Once the watchdog timer run out, both the Q1 and Q2 are turned off, and most registers return to the default value (refer to the I²C Register Map section). The Q1 and Q2 are turn on again automatically after t_{RST_DUR}, which can be programmed by REG01H [5]. Also the watchdog timer can be turned off in discharge mode by setting REG05H [7]=0. If the watchdog timer (REG05H [6:5]) is not disabled, the host must reset the watchdog timer regularly by writing 1 to REG02H [6] before the watchdog timer expires to keep the device in host mode. When the watchdog timer expires, the AW32001A goes back to default mode. And any writing to the AW32001A will switch it to host mode. The watchdog timer limit can also be programmed or disabled by the host control.

When the REG05H bit[6:5] is set to 00, the watchdog timer is disabled under both charge mode and discharge mode regardless of the status of REG05H [7]. Operation mode can be switched to default mode when one of the following conditions are valid:

- Register REG02H bit[7] is reset.

- Refresh input without battery.

- Re-insert battery with no VIN.

General I²C Operation

The AW32001A is compatible with I²C interface. The SCL line is an input and the SDA line is a bi-directional open-drain output. The I²C address of AW32001A is 49H.

Data Validation

When SCL is high level, SDA level must be constant. SDA can be changed only when SCL is low level.
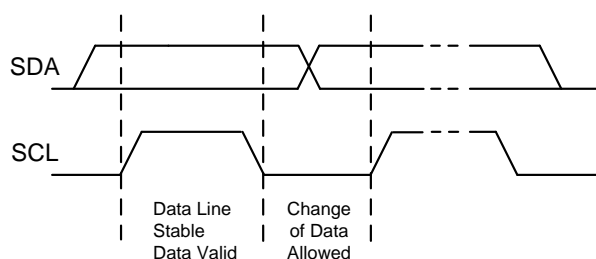
Figure 11　Data Validation Diagram

I²C Start/Stop

I²C start: SDA changes from high level to low level when SCL is high level.

I²C stop: SDA changes from low level to high level when SCL is high level.

S: START condition
Sr: START Repeated condition
P: STOP condition
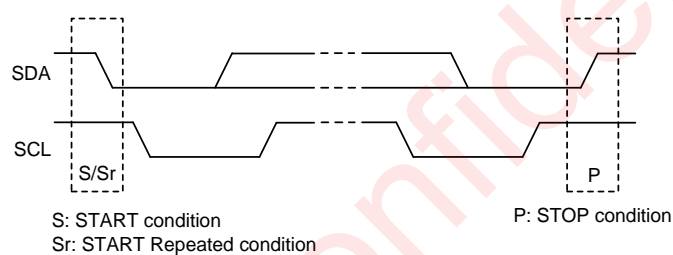
Figure 12　Start and Stop Conditions

ACK (Acknowledgement)

ACK means the successful transfer of I²C bus data. After master sends 8bits data, SDA must be released; SDA is pulled to GND by slave device when slave acknowledges.

When master reads, slave device sends 8bit data, releases the SDA and waits for ACK from master. If ACK is send and I²C stop is not send by master, slave device sends the next data. If ACK is not send by master, slave device stops to send data and waits for I²C stop.

Figure 13　Acknowledgement Diagram

Write Process

One data bit is transferred during each clock pulse. Data is sampled during the high state of the serial clock (SCL). Consequently, throughout the clock's high period, the data should remain stable. Any changes on the

SDA line during the high state of the SCL and in the middle of a transaction, aborts the current transaction. New data should be sent during the low SCL state. This protocol allows a single data line to transfer both command/control information and data using the synchronous serial clock.
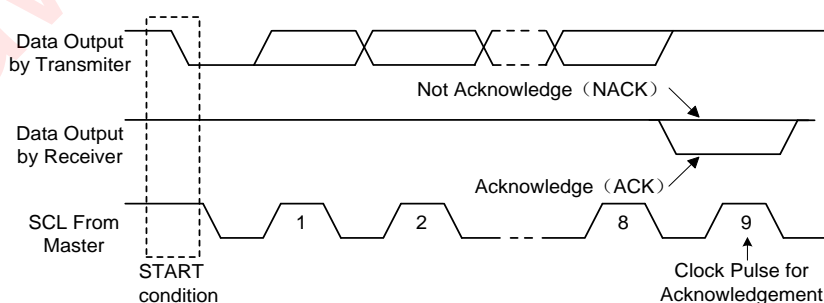
Each data transaction is composed of a Start Condition, a number of byte transfers (set by the software) and a Stop Condition to terminate the transaction. Every byte written to the SDA bus must be 8 bits long and is transferred with the most significant bit first. After each byte, an Acknowledge signal must follow.

In a write process, the following steps should be followed:

a) Master device generates START condition. The "START" signal is generated by lowering the SDA signal while the SCL signal is high.

b) Master device sends slave address (7-bit) and the data direction bit (r/w = 0).

c) Slave device sends acknowledge signal if the slave address is correct.

d) Master sends control register address (8-bit)

e) Slave sends acknowledge signal

f) Master sends data byte to be written to the addressed register

g) Slave sends acknowledge signal

h) If master will send further data bytes the control register address will be incremented by one after acknowledge signal (repeat steps f and g)

i) Master generates STOP condition to indicate write cycle end

Figure 14   I²C Write Timing

Read Process

In a read cycle, the following steps should be followed:

a) Master device generates START condition

b) Master device sends slave address (7-bit) and the data direction bit (r/w = 0).

c) Slave device sends acknowledge signal if the slave address is correct.

d) Master sends control register address (8-bit)

e) Slave sends acknowledge signal

f) Master generates STOP condition followed with START condition or REPEAT START condition

g) Master device sends slave address (7-bit) and the data direction bit (r/w = 1).

h) Slave device sends acknowledge signal if the slave address is correct.

i) Slave sends data byte from addressed register.

j) If the master device sends acknowledge signal, the slave device will increase the control register address by one, then send the next data from the new addressed register.

k) If the master device generates STOP condition, the read cycle is ended.
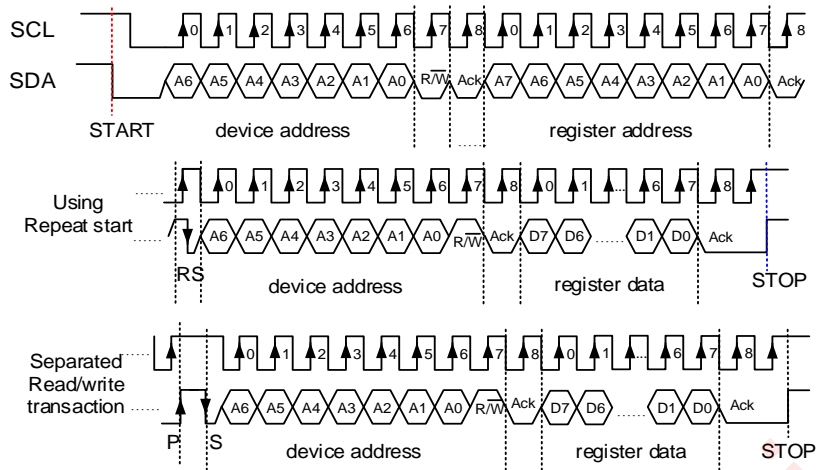
Figure 15 I²C Read Timing

AW32001A
Apr 2020 V1.0

Register List

Input Source Control Register

Address: 00H, Reset State: 1000 1111.

BIT Name	W/R	BIT	SFTRST	WTDRST	Function
VIN_MIN	W/R	B7-B4	Y	N	Input minimum voltage regulation setting: HEX VIN_MIN (V) 0000 3.88 **1000** **4.52 (default)** 0001 3.96 1001 4.60 0010 4.04 1010 4.68 0011 4.12 1011 4.76 0100 4.20 1100 4.84 0101 4.28 1101 4.92 0110 4.36 1110 5.00 0111 4.44 1111 5.08
IIN_LIM	W/R	B3-B0	Y	N	Input current limit setting: HEX IIN_LIM (mA) 0000 50 1000 290 0001 80 1001 320 0010 110 1010 350 0011 140 1011 380 0100 170 1100 410 0101 200 1101 440 0110 230 1110 470 0111 260 **1111** **500(default)**

Power On Configuration Register

Address: 01H, Reset State1010 1100.

BIT Name	W/R	BIT	SFTRST	WTDRST	Function
t_{RST_DGL}	W/R	B7-B6	Y	Y	Pull INT low time period to disconnect the battery: HEX time (s) 00: 8 01: 12 **10: 16(default)** 11: 20
t_{RST_DUR}	W/R	B5	Y	Y	Q2 lasts off time before auto-on: 0: 2s; **1: 4s (default).**
EN_HIZ	W/R	B4	Y	Y	**0: disable (default);** 1:enable.
CEB	W/R	B3	Y	Y	0: charge enable; **1: charge disable (default).**
VBAT_UVLO	W/R	B2-B0	Y	Y	Battery UVLO Threshold: HEX VBAT_UVLO (V) 000 2.43 **100** **2.76 (default)** 001 2.49 101 2.85 010 2.58 110 2.94 011 2.67 111 3.03

Charge Current Control Register

Address: 02H, Reset State:0000 1111

BIT Name	W/R	BIT	REGRST	WTDRST	Function
REG_RST	W/R	B7	Y	N	**0: keep current setting (default);** 1: reset.
WD_TMR_RST	W/R	B6	Y	Y	**0: normal (default);** 1: reset.
ICHG	W/R	B5-B0	Y	Y	Fast charge current setting: HEX ICHG(mA) 000000 8 100000 264 000001 16 100001 272 000010 24 100010 280 000011 32 100011 288 000100 40 100100 296 000101 48 100101 304 000110 56 100110 312 000111 64 100111 320 001000 72 101000 328 001001 80 101001 336 001010 88 101010 344 001011 96 101011 352 001100 104 101100 360 001101 112 101101 368 001110 120 101110 376 **001111** **128 (default)** 101111 384 010000 136 110000 392 010001 144 110001 400 010010 152 110010 408 010011 160 110011 416 010100 168 110100 424 010101 176 110101 432 010110 184 110110 440 010111 192 110111 448 011000 200 111000 456 011001 208 011010 216 011011 224 011100 232 011101 240 011110 248 011111 256

Discharge Current Control Register

Address: 03H, Reset State1001 0001.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
IDSCHG	W/R	B7-B4	Y	Y	BAT to SYS discharge current limit: HEX ISDCHG(mA) 0000 200 1000 1800 0001 400 **1001 2000 (default)** 0010 600 1010 2200 0011 800 1011 2400 0100 1000 1100 2600 0101 1200 1101 2800 0110 1400 1110 3000 0111 1600 1111 3200
ITERM	W/R	B3-B0	Y	Y	Termination current. current range: HEX ITERM(mA) 0000 1 1000 17 **0001 3 (default)** 1001 19 0010 5 1010 21 0011 7 1011 23 0100 9 1100 25 0101 11 1101 27 0110 13 1110 29 0111 15 1111 31

Charge Voltage Register

Address: 04H, Reset State:1010 0011.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
VBAT_REG	W/R	B7-B2	Y	Y	Battery regulation voltage: HEX VBAT_REG(V) 000000 3.600 100000 4.080 000001 3.615 100001 4.095 000010 3.630 100010 4.110 000011 3.645 100011 4.125 000100 3.660 100100 4.140 000101 3.675 100101 4.155 000110 3.690 100110 4.170 000111 3.705 100111 4.185 001000 3.720 **101000 4.200(default)** 001001 3.735 101001 4.215 001010 3.750 101010 4.230 001011 3.765 101011 4.245 001100 3.780 101100 4.260 001101 3.795 101101 4.275 001110 3.810 101110 4.290 001111 3.825 101111 4.305 010000 3.840 110000 4.320 010001 3.855 110001 4.335 010010 3.870 110010 4.350 010011 3.885 110011 4.365 010100 3.900 110100 4.380 010101 3.915 110101 4.395 010110 3.930 110110 4.410 010111 3.945 110111 4.425 011000 3.960 111000 4.440 011001 3.975 111001 4.455

					011010	3.990	111010	4.470
					011011	4.005	111011	4.485
					011100	4.020	111100	4.500
					011101	4.035	111101	4.515
					011110	4.050	111110	4.530
					011111	4.065	111111	4.545
VBAT_PRE	W/R	B1	Y	Y	Pre-charge to Fast charge threshold: 0:2.8V; **1: 3.0V (default).**			
VRECH	W/R	B0	Y	Y	Battery recharge threshold (below VBAT_REG): 0: 100mV; **1: 200mV (default).**			

Charger Termination/Timer Control Register

Address: 05H, Reset State:0111 1010.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
EN_WD_DISCHG	W/R	B7	Y	N	Watchdog control in discharge mode: **0: disable (default);** 1: enable.
WATCHDOG	W/R	B6-B5	Y	N	Watchdog setting: 00: disable timer 01: 40s 10: 80s **11: 160s (default)** If Bit[6:5]=00, then watchdog timer is disable no matter Bit 7 is set or no.
EN_TERM	W/R	B4	Y	Y	Termination Setting (control the termination is allowed or not): 0: disable ; **1: enable (default).**
EN_TIMER	W/R	B3	Y	Y	Safety timer Setting: 0: disable; **1: enable (default).**
CHG_TMR	W/R	B2-B1	Y	Y	Fast charge timer: 00: 3hrs **01: 5hrs (default);** 10: 8hrs 11: 12hrs.
TERM_TMR	W/R	B0	Y	Y	Termination timer Setting: **0: disable (default);** 1: enable.

Main Control Register

Address: 06H, Reset State:1100 0000.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
EN_NTC	W/R	B7	Y	Y	0: disable ; **1: enable (default).**
TMR2X_EN	W/R	B6	Y	Y	0: disable 2x extended safety timer during PPMF; **1: enable 2x extended safety timer during PPMF (default).**
FET_DIS	W/R	B5	Y	N	**0: enable (default);** 1: turn off.
PG_INT_CONTROL	W/R	B4	Y	Y	**0: on (default);** 1: off.
EOC_INT_CONTROL	W/R	B3	Y	Y	**0: on (default);** 1: off. (EOC: End of Charge)
CHG STATUS_INT _CONTROL	W/R	B2	Y	Y	**0: on (default);** 1: off.
NTC_INT_CONTROL	W/R	B1	Y	Y	**0: on (default);** 1: off.
BATOVP_INT _CONTROL	W/R	B0	Y	Y	**0: on (default);** 1: off.

System Voltage Control Register

Address: 07H, Reset State:0011 1000.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
DIS_PCB_OTP	W/R	B7	Y	Y	PCB OTP Disable. **0: enable (default);** 1: disable.
DIS_VINLOOP	W/R	B6	Y	Y	VIN_MIN loop Disable. **0: enable (default);** 1: disable.
TJ_REG	W/R	B5-B4	Y	Y	Thermal regulation threshold: HEX Temperature(℃) 00 60 01 80 10 100 **11** **120 (default)**
VSYS_REG	W/R	B3-B0	Y	N	System voltage regulation. Range: HEX VSYS_REG(V) 0000 4.20 **1000** **4.60 (default)** 0001 4.25 1001 4.65 0010 4.30 1010 4.70 0011 4.35 1011 4.75 0100 4.40 1100 4.80 0101 4.45 1101 4.85 0110 4.50 1110 4.90 0111 4.55 1111 4.95

System Status Register

Address: 08H, Reset State:0100 0000.

BIT Name	W/R	BIT	REG RST	WTDRST	Function
Watchdog_Fault	R	B7	NA	NA	**0: normal (default);** 1: watchdog timer expiration.
Rev	R	B6-B5	NA	NA	
CHG_STAT	R	B4-B3	NA	NA	**00: not charging (default);** 01: pre charge; 10: charge; 11: charge done.
PPM_STAT	R	B2	NA	NA	**0: no PPM (default);** 1: IN PPM.
PG_STAT	R	B1	NA	NA	0: Power fail; 1: Power good.
THERM_STAT	R	B0	NA	NA	**0: no thermal regulation (default);** 1: in thermal regulation.

Fault Register

Address: 09H, Reset State:0000 0000.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
EN_SHIPPING_DGL	W/R	B7-B6	Y	N	Enter shipping mode deglitch time: HEX deglitch time(s) **00: 1 (default);** 01: 2 10: 4 11: 8
VIN_FAULT	R	B5	NA	NA	**0: normal (default);** 1: input fault (OVP or bad source).
THEM_SD	R	B4	NA	NA	**0: normal (default);** 1: thermal shutdown.
BAT_FAULT	R	B3	NA	NA	**0: normal (default);** 1: battery OVP.
STMR_FAULT	R	B2	NA	NA	**0: normal (default);** 1: safety timer expiration.
NTC_FAULT[1]	R	B1	NA	NA	**0: normal (default);** 1: NTC hot.
NTC_FAULT[0]	R	B0	NA	NA	**0: normal (default);** 1: NTC cold.

Address Register

Address: 0AH, Reset State:0100 1001.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
CHIP ID	R	B7-B0	N	N	Chip ID used to be identified

Individual Charge Register

Address: 0BH, Reset State:0100 0011.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
EN_ICHG_DIVD	W/R	B7	Y	Y	1: reduce the current value of REG02H[3:0] configuration to 1/4; **0: keep the current value of REG02H[5:0] configuration. (default).**
Reserve	NA	B6	NA	NA	NA
EN_IPRE_SET	W/R	B5	Y	Y	**0: IPRE is set by REG03H[3:0] (default);** 1: IPRE is set by REG0BH[3:0].
IPRE[3]	W/R	B4	Y	Y	
IPRE[2]	W/R	B3	Y	Y	1mA~31mA pre-charge current configuration:
IPRE[1]	W/R	B2	Y	Y	2 mA/step, **3mA (default).**
IPRE[0]	W/R	B1	Y	Y	
EN_SHIPMD_0P1S	W/R	B0	Y	Y	VIN Plug: In deglitch time of shipping mode out： 0：2s; **1：100ms(default).**

Additional Function Control Register

Address: 0CH, Reset State:0000 0000.

BIT Name	W/R	BIT	REGRST	WTDRST	Function
EN0P55	W/R	B7	Y	Y	Increase input current limit: **0: The input current limit is set by REG00H[3:0] (default);** 1: If REG00H[3:0]=1111,this bit increase the input current limit to 550mA, otherwise, it is useless.
ITERMDEG	W/R	B6	Y	Y	Charge termination current deglitch time: **0:3s (default);** 1:1s.
Reserve	NA	B5~B4	NA	NA	NA

PRETO	W/R	B3	Y	Y	**0: Pre-charge timeout is 1h (default);** 1: Pre-charge timeout is 2h.
DIS_SHIPINT	W/R	B2	Y	Y	The function of disabling INT PIN during SHIPPING mode: **0: Nominal INT PIN function(Default);** 1: Disable INT PIN function during SHIPPING mode.
Reserve	NA	B1	NA	NA	NA
RSTDLAY	W/R	B0	Y	Y	The delay time after VSYS is Reset: **0: 0s (Default);** 1: 2s.

Application Information

NTC FUNCTION

NTC pin is connected to the thermistor paralleled with a resistor R_{F2} to ground. Another resistor R_{F1} is connected to the VDD which is the chip's internal power supply voltage. The high temperature limit and low temperature limit can be varied by using different R_{F1} and R_{F2}. Illustrated in Figure 16, the off chip resistors must be connected as the blue part demonstrated. The resistance of R_{F1} and R_{F2} can be calculated by Equation (1) and Equation (2):

$$R_{F2} = \frac{(V_{COLD} - V_{HOT}) \times R_{NTCH} \times R_{NTCL}}{(V_{HOT} - V_{COLD} \times V_{HOT}) \times R_{NTCL} - (V_{COLD} - V_{COLD} \times V_{HOT}) \times R_{NTCH}} \tag{1}$$

$$R_{F1} = \frac{1 - V_{COLD}}{V_{COLD}} \times (R_{F2}//R_{NTCL}) \tag{2}$$
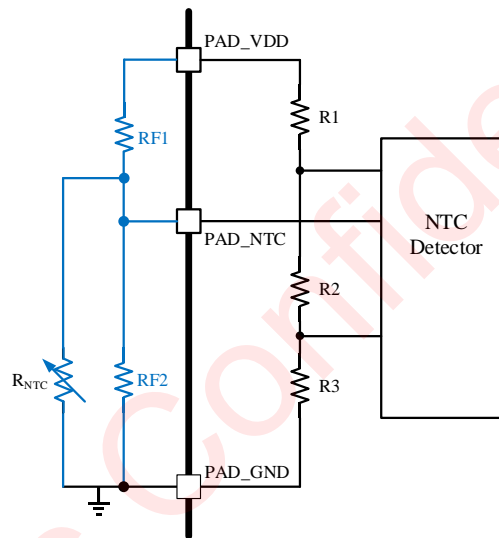
Figure 16   NTC Function

Where R_{NTCH} is the value of the NTC resistor at the high limit temperature, while the R_{NTCL} is the value of the NTC resistor at a low temperature limit.

External Capacitor

The external capacitor cannot be absent for the operation of AW32001A. Carefully selecting suitable capacitor is important to guarantee the AW32001A working perfectly on the space limited board.
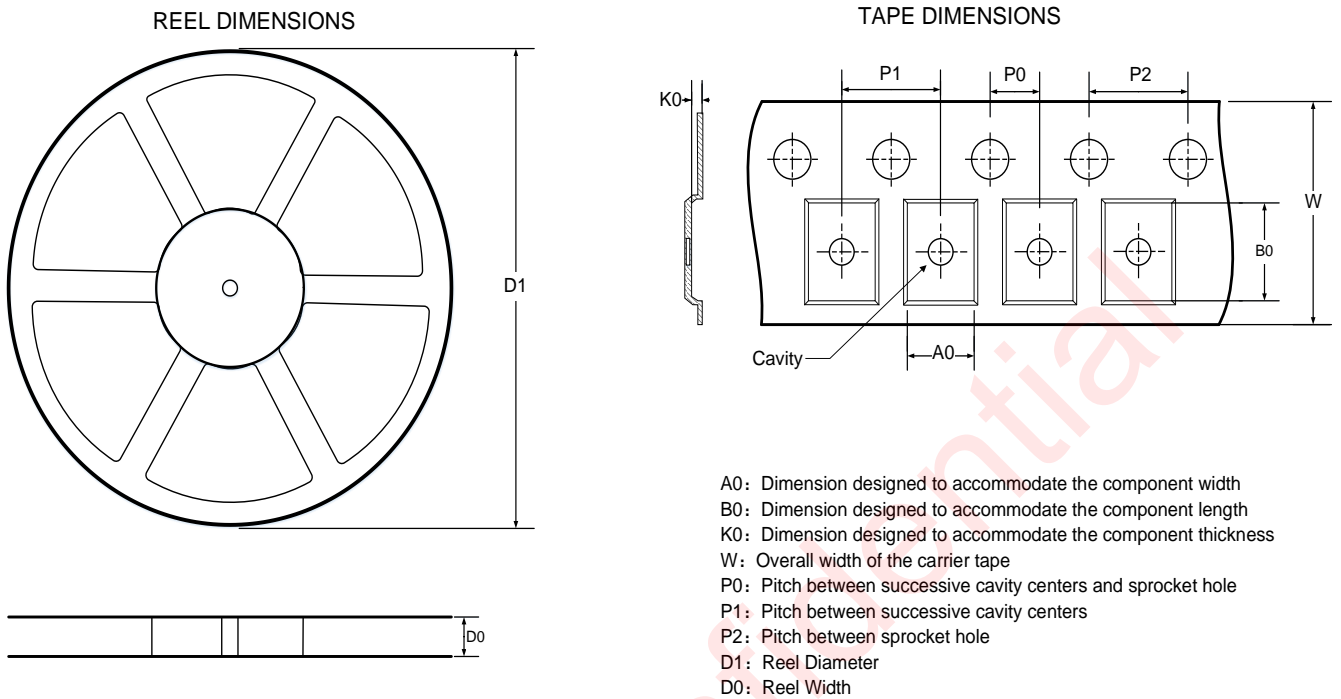
A 4.7μF ceramic capacitor with high level voltage endurance (at least 30V) between IN and GND is recommended. This capacitor rejects input power supply ripple and enhance the stability of DPM loop.

A 1μF ceramic capacitor is required between the VDD and GND to maintain internal power supply voltage higher than the POR threshold. Without this capacitor, the chip logic block may work abnormally when working state changes.
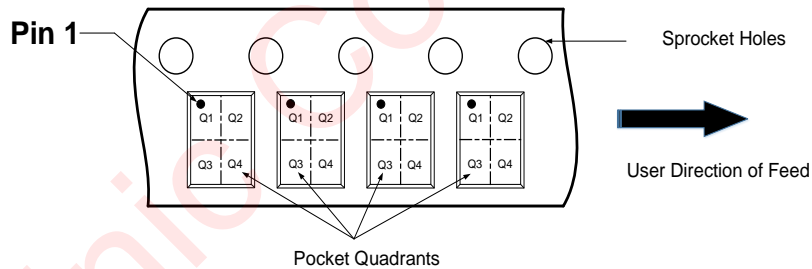
Connect a ceramic capacitor between SYS and GND with least capacitance of 4.7μF to guarantee the stability of the system power supply loop. Larger capacitor will further reduce the system output's overshoot and undershoot.

A least 4.7μF ceramic capacitor is also needed between BAT and GND for some application.

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

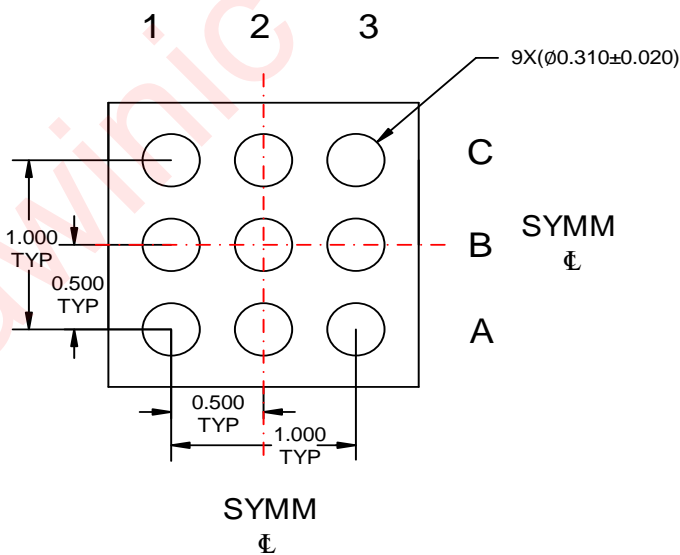| D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
179.00	9.00	1.81	1.81	0.76	2.00	4.00	4.00	8.00	Q1

All dimensions are nominal

Package Description(POD)
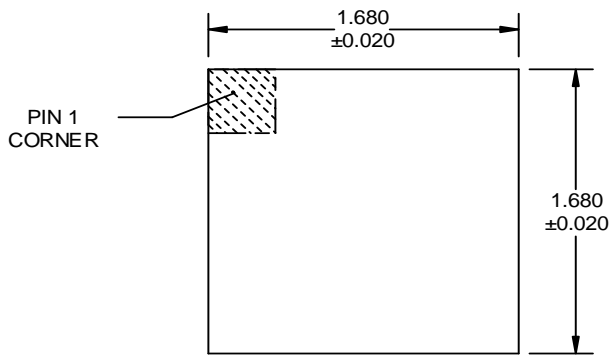
Top View
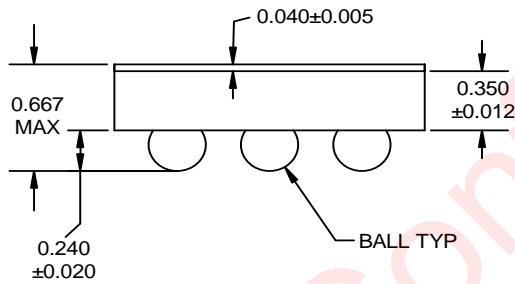
Side View
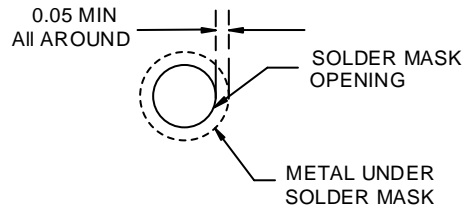

Bottom View

Unit：mm

Land Pattern Data

9X(Ø0.260)

0.500 TYP

0.500 TYP

SYMM ₵

SYMM ₵

0.05 MAX All AROUND

SOLDER MASK OPENING

METAL

NON-SOLDER MASK DEFINED

0.05 MIN All AROUND

SOLDER MASK OPENING

METAL UNDER SOLDER MASK
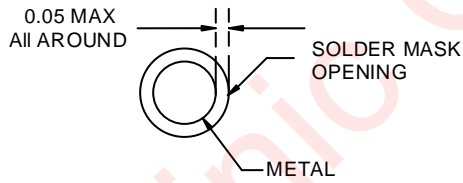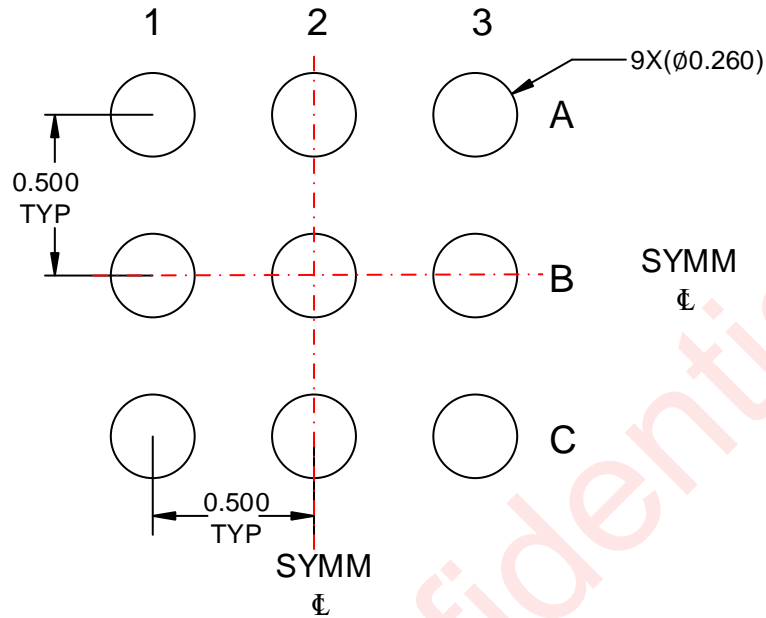
SOLDER MASK DEFINED

Unit: mm

Revision History

Version	Date	Change Record
V1.0	Apr 2020	Official Released

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.