1A high voltage linear lithium battery charge management chip

1. Features

- **Support input voltage 4.0V-24V, withstand surge voltage up to 38V**
- **The battery end withstands up to 38V surge voltage**
- **Support external resistance to choose a variety of lithium battery types (target full charge voltage 4.2V/4.35V/4.4V), support 3.2V iron-lithium (target full charge voltage 3.6V); customization can achieve a single battery full charge voltage range: 3.6V~4.4V (step=50mV)**
- **Support 1/2/3 lithium battery charging (2/3 series lithium battery needs to be customized)**
- **Charging voltage accuracy ±0.5%**
- **Maximum 1A charging current, external resistor can set the charging current**
- **The cut-off current is 1/10 of the set charging current (customized optional 1/2.5, 1/5, 1/20 set the charging current), the minimum can reach 10mA**
- **Support to detect battery temperature through NTC**
- **Leakage current is as low as 1μA in standby mode of single cell battery**
- **Support battery status, charging status and fault status indication of single-color or double-color light**
- **Input overvoltage, battery overvoltage, IC overtemperature, NTC low temperature and high temperature protection**
- **ESOP8、DFN8(0303)、CPC8 package**

2. Typical Applications

- e-cigarette;
- Walkie-talkie charging stand;
- Handheld POS machine;
- Wearable device;
- Portable devices with small battery capacity such as Bluetooth speakers;

3. Description

IP2301 is a highly integrated, high-performance linear charger that supports 1 to 3 lithium-ion batteries. IP2301 has three charging processes: trickle charge (TC), constant current (CC) and constant voltage (CV); the trickle charge (TC) stage can be precharged to restore the fully discharged battery; safe in constant current (CC) mode Provides buck fast charging; the final stage constant voltage (CV) charging mode ensures that the full capacity of the battery is safely reached. IP2301 linear charger has a very flexible configuration, the programmable charging current is up to 1A, and its charging voltage accuracy can reach ±0.5%; during fast charging, the linear charger has the largest power consumption, if the chip junction temperature reaches the set temperature of 120 ℃ , enter the chip junction temperature loop adjustment, and reduce the charging current as needed to prevent the temperature from rising further. IP2301 allows factory configuration of pre-charge current/cut-off current/CV voltage and input over-voltage protection threshold, and its integrated high-voltage input protection circuit can withstand input surge voltages up to 38V. IP2301 has functions such as battery temperature NTC monitoring, charging overtime protection, input overvoltage, battery overvoltage, thermal protection and status indication.

IP2301 is mainly used for electronic cigarettes, walkie-talkie charging stations, handheld POS machines, wearable devices, Bluetooth speakers and other portable devices with small battery capacity.

IP2301 is available in ESOP-8 package.

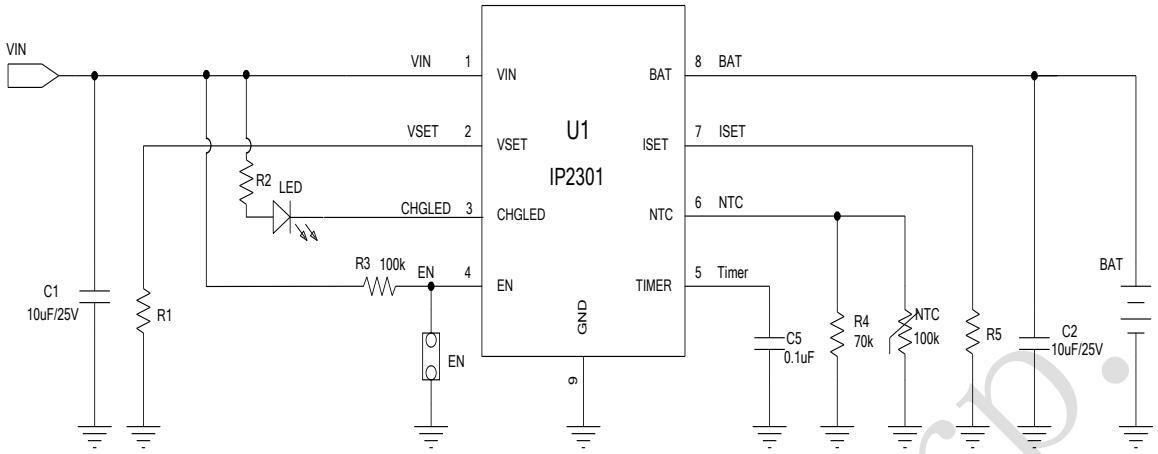


Figure 1 IP2301Simplified Application Schematic

4. PIN Description

ESOP8 Package（IP2301）

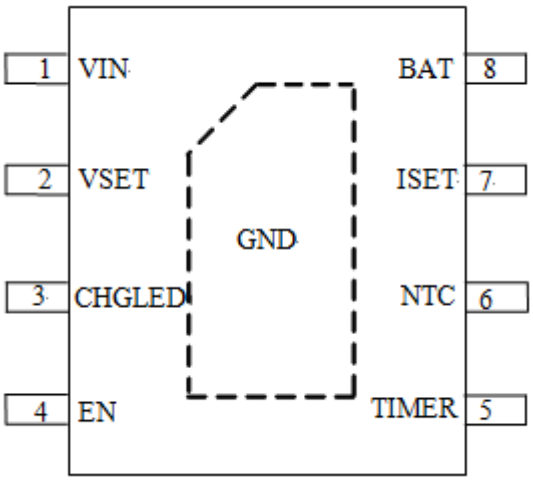


Figure 2 IP2301 ESOP8 Pin Assignment

Pin Name	Pin No.	Pin Description
1	VIN	Power input pin, connect to USB or adapter
2	VSET	Set the CV pin and connect a resistor RVSET to ground. The CV voltage corresponding to the specific resistance value is: R_{VSET} 1KΩ：CV=4.2V; R_{VSET} 15kΩ：CV=4.35V; R_{VSET} 39kΩ：CV=4.4V; R_{VSET} 75kΩ：CV=3.6V;

		R_{VSET} >150K or NC, select the default CV value set by the internal factory (the standardd product is 4.2V)
3	CHGLED	Charge status LED indicator pin
4	EN	Charge enable pin, high level enables charging, low level disable charging
5	TIMER	Charge timer frequency setting pin, connect a capacitor to the ground to set the oscillation frequency of the timer, the frequency formula is： $f = 1.25 \times \frac{1}{Ctimer(uF)} Hz$ If connect to ground, use the internal default timer frequency; this pin cannot float
6	NTC	For battery temperature detection pin, connect an NTC to ground, and connect a 70k ordinary resistor in parallel. The recommended NTC is TNL104AT050F-001, B25/50=3950K; When the NTC is connected to the 39K resistor to ground, the NTC function is shielded. this pin cannot float.
7	ISET	Constant current charging setting pin, connect a resistance of 1kΩ to 40kΩ to ground to set the charging current, the maximum charging current is 1A
8	BAT	Battery connection pin, connected to the positive electrode of the battery
9	GND	E-PAD. Chip GND

DFN8 Package（IP2301N）

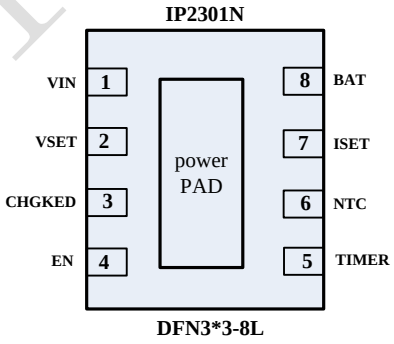
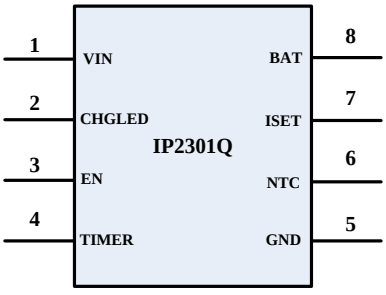


Figure 3 IP2301N DFN8 Pin Assignment

Pin Name	Pin No.	Pin Description
1	VIN	Power input pin, connect to USB or adapter
2	VSET	Set the CV pin and connect a resistor RVSET to ground. The CV voltage corresponding to the specific resistance value is: R_{VSET} 1KΩ：CV=4.2V; R_{VSET} 15kΩ：CV=4.35V; R_{VSET} 39kΩ：CV=4.4V;

		R_{VSET} 75kΩ：CV=3.6V; R_{VSET} >150K or NC, select the default CV value set by the internal factory (the standardd product is 4.2V)
3	CHGLED	Charge status LED indicator pin
4	EN	Charge enable pin, high level enables charging, low level disable charging
5	TIMER	Charge timer frequency setting pin, connect a capacitor to the ground to set the oscillation frequency of the timer, the frequency formula is： $f = 1.25 \times \frac{1}{Ctimer(uF)} Hz$ If connect to ground, use the internal default timer frequency; this pin cannot float
6	NTC	For battery temperature detection pin, connect an NTC to ground, and connect a 70k ordinary resistor in parallel. The recommended NTC is TNL104AT050F-001, B25/50=3950K; When the NTC is connected to the 39K resistor to ground, the NTC function is shielded. this pin cannot float.
7	ISET	Constant current charging setting pin, connect a resistance of 1kΩ to 40kΩ to ground to set the charging current, the maximum charging current is 1A
8	BAT	Battery connection pin, connected to the positive electrode of the battery
9	GND	E-PAD. Chip GND

CPC8 Package（IP2301Q）



CPC8

Figure 4 IP2301 CPC8 Pin Assignment

Pin Name	Pin No.	Pin Description
1	VIN	Power input pin, connect to USB or adapter
2	CHGLED	Charge status LED indicator pin
3	EN	Charge enable pin, high level enables charging, low level disable charging
4	TIMER	Charge timer frequency setting pin, connect a capacitor to the ground to set the

		oscillation frequency of the timer, the frequency formula is: $f = 1.25 \times \frac{1}{Ctimer(uF)} Hz$ If connect to ground, use the internal default timer frequency; this pin cannot float
5	GND	Chip ground
6	NTC	For battery temperature detection pin, connect an NTC to ground, and connect a 70k ordinary resistor in parallel. The recommended NTC is TNL104AT050F-001, B25/50=3950K; When the NTC is connected to the 39K resistor to ground, the NTC function is shielded. this pin cannot float.
7	ISET	Constant current charging setting pin, connect a resistance of 2kΩ to 40kΩ to ground to set the charging current, the maximum charging current is 0.5A
8	BAT	Battery connection pin, connected to the positive electrode of the battery

5. Common Model

Model Name	Package	Describe
IP2301	ESOP8	Standard product, single-cell battery linear charging, input 5.8V overvoltage protection
IP2301_2S	ESOP8	Linear charging of 2 strings of batteries, input 10.8V overvoltage protection
IP2301_3S	ESOP8	Linear charging of 3 strings of batteries, input 13.8V overvoltage protection
IP2301_DA	ESOP8	On the basis of the standard product, modify the light display: CHGLED pin is always on when it is pulled down during charging, the light is off when it is full of high impedance, and it will flash when charging is abnormal
IP2301_DA2	ESOP8	Modified to two-color light display: the red light is on during charging, the green light is on when it is full, and the red light flashes when charging is abnormal;
IP2301N	DFN8	DFN8 package, single-cell battery linear charging, input 5.8V overvoltage protection
IP2301N_DA	DFN8	DFN8 package, modify the light display: CHGLED pin is always on when it is pulled low during charging, the light is off when it is full of high impedance, and it will flash when charging is abnormal
IP2301N_DA2	DFN8	DFN8 package, modified to two-color light display: the red light is on during charging, the green light is on when it is full, and the red light flashes when charging is abnormal;
IP2301Q	CPC8	CPC8 package, single-cell battery linear charging, input 5.8V overvoltage protection
IP2301Q_DA	CPC8	CPC8 package, modify the light display: CHGLED pin is always on when it

		is pulled low during charging, the light is off when it is full of high impedance, and it will flash when charging is abnormal

6. Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Input port voltage range	VIN	-0.3 ~38	V
Battery port voltage range	VBAT	-0.3 ~38	V
CHGLED, EN pin voltage range	CHGLED, EN	-0.3 ~38	V
Low voltage pin voltage range	VSET, TIMER, ISET, NTC	-0.3 ~6	V
Junction temperature range	TJ	-40 ~ 125	℃
Storage temperature range	Tstg	-60 ~ 150	℃
Thermal resistance (junction temperature to environment)	θJA ESOP8	60	℃/W
	θJA DFN8	70	℃/W
	θJA CPC8	180	℃/W
Human Body Model (HBM)	ESD	4	KV

*Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.
*Voltages are referenced to GND unless otherwise noted.

7. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	VIN	5	--	24	V
Working Temperature	T_A	-40	--	85	℃

*Devices' performance cannot be guaranteed when working beyond those Recommended Operating Conditions.

8. Electrical Characteristics

Unless otherwise specified, TA = -40-85℃, VIN = 5V, EN=5V, NTC=1V, VBAT=3.6V

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input and output characteristics						
Input Voltage	V_{IN}		4	-	24	V
Input under-voltage threshold	VIN_{UVLO_Rising}	EN=1,VBAT=3V, VIN rising charge	3.8	4	4.2	V
	$VIN_{UVLO\_Falling}$	EN=1,VBAT=3V, VIN drops to stop charging	3.6	3.8	4	V
Input over-voltage	VIN_{OVP}	VIN voltage rise	5.6	5.8	6	V

threshold	VIN_{OVP_HYS}	VIN voltage drops to start charging, VIN-VINOVP	0.3	0.4	0.5	V
VIN-DPM threshold	VIN-DPM	VIN-CV	-	0.3	-	V
Standby Current	I_Q	EN=1,No load，VIN current	-	0.6	1	mA
	I_{S_VIN}	EN=0，VIN current	-	100	200	uA
	I_{S_BAT}	VIN=0，BAT current	-	1	2	uA
Charging voltage accuracy	CV	T_A=25℃	4.179	4.2	4.221	V
		TA=0 ℃ to +50 ℃	4.168	4.20	4.232	
Battery OVP accuracy	BAT_{OVP}	EN=1, BAT rising overvoltage protection，BAT-CV	150	200	250	mV
Constant current charging current accuracy	I_{CC}	VIN=5V, CC=1A（RISET=1K）	0.85	0.96	1.1	A
		VIN=5V, CC=0.5A（RISET=2K）	0.40	0.48	0.55	A
		VIN=5V, CC=0.1A（RISET=10K）	0.05	0.1	0.13	A
Trickle charge voltage threshold	V_{WK_TH}	VIN=5V, EN=1,CV=3.6-3.75V, BAT rising	2.3	2.5	2.7	V
		VIN=5V, EN=1,CV=3.8-3.95V，BAT rising	2.4	2.6	2.8	V
		VIN=5V, EN=1,CV=4.05-4.2V，BAT rising	2.5	2.7	2.9	V
		VIN=5V, EN=1,CV=4.25-4.4V，BAT rising	2.6	2.8	3	V
Cut-off charging current range	I_{TER}	I_{TER} / I_{CC}		1/10		I_{CC}
Logic signal						
EN high level input voltage	V_{EN-H}	VIN=5V to 20V	1.2	-	-	V
EN low level input voltage	V_{EN_L}	VIN=5V to 20V	-	-	0.4	V
EN pull-down current	I_{EN}	EN=3.3V	3	5	10	uA
CHGLED power supply/pull-down current	I_{CHGLED}	VIN=5V to 20V	3	5	10	mA
NTC bias current	I_{NTC}		23.75	25	26.25	μA
NTC voltage threshold	V_{NTC_DIS}	V_{NTC}		0.1	0.11	V
	V_{NTC_OT}	V_{NTC} falling，Enter NTC OT status	0.475	0.5	0.525	V
	$V_{NTC\_OT\_HYS}$	V_{NTC} rising，Exit NTC OT status	68	72	76	mV
	V_{NTC_WT}	V_{NTC} falling，Enter NTC WT status	0.62	0.65	0.68	V
	$V_{NTC\_WT\_HYS}$	V_{NTC} rising，Exit NTC WT status	75	80	85	mV

	V_{NTC_UT}	V_{NTC} rising，Enter NTC UT status	1.425	1.5	1.575	V
	$V_{NTC\_UT\_HYS}$	V_{NTC} falling，Exit NTC UT status	51	56	61	mV
Thermal shutdown						
Thermal shutdown junction temperature	T_{OTP}	The junction temperature of the chip rises to stop charging	135	150	165	℃
Thermal shutdown hysteresis	ΔT_{OTP}	The junction temperature of the chip drops to start charging	15	20	25	℃
Junction temperature loop	Tthermal	Die temperature	110	120	130	℃

9. Function Description

Functional Block Diagram

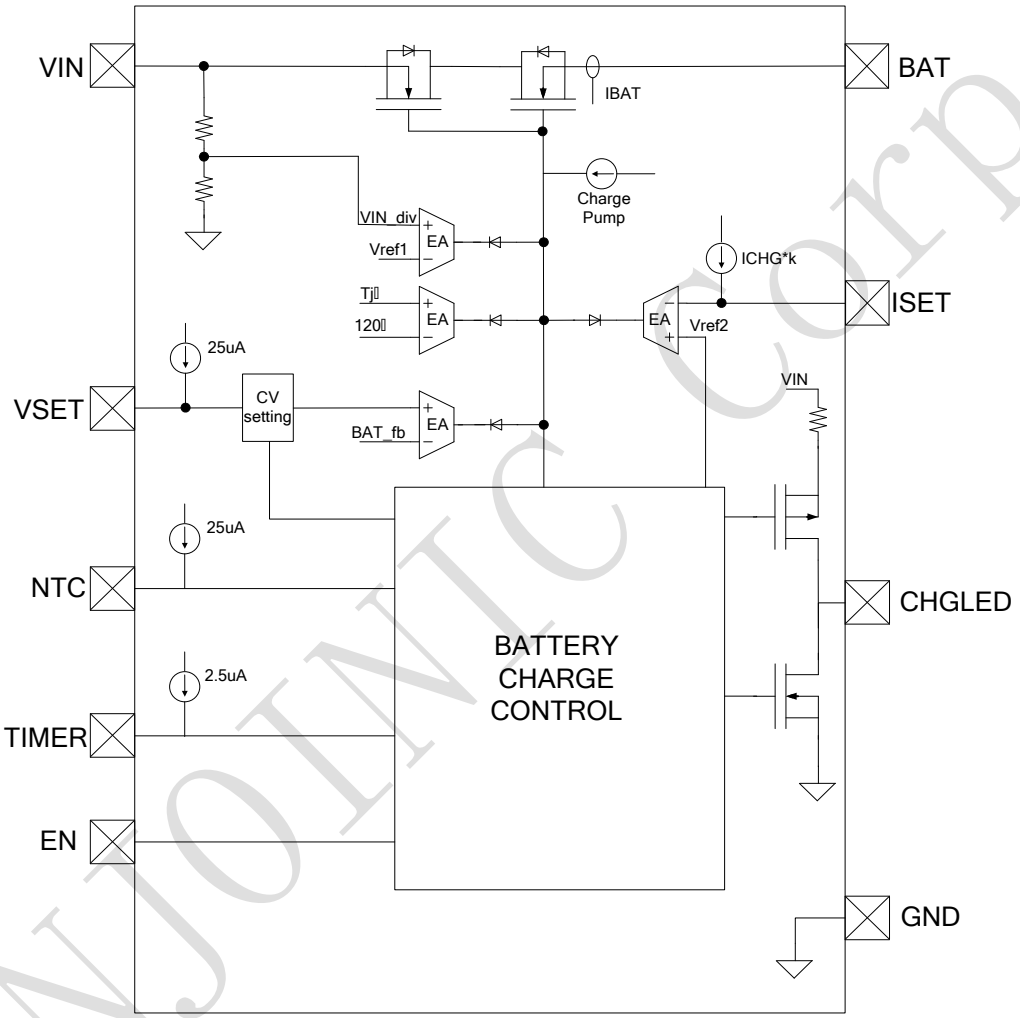


Figure 5 IP2301 Functional Block Diagram

Overview

IP2301 is a highly integrated, high-performance linear charger that supports 1 to 3 lithium-ion batteries. IP2301 has three charging processes: trickle charge (TC), constant current (CC) and constant voltage (CV)； the trickle charge (TC) stage can be precharged to restore the fully discharged battery; safe in constant current (CC) mode Provides step-down fast charging; the final stage constant voltage (CV) charging mode ensures that the full capacity of the battery is safely reached. IP2301 linear charger has a very flexible configuration, the programmable charging current is up to 1A, and its charging voltage accuracy can reach ±0.5%; during fast charging, the linear charger has the largest power consumption, if the chip junction temperature reaches the set temperature of 120 ℃ ,

enter the chip junction temperature loop adjustment, and reduce the charging current as needed to prevent the temperature from rising further. IP2301 allows factory configuration of pre-charge current/cut-off current/CV voltage and input over-voltage protection threshold, and its integrated high-voltage input protection circuit can withstand input surge voltages up to 38V. IP2301 has functions such as battery temperature NTC monitoring, charging overtime protection, input overvoltage, battery overvoltage, thermal protection and status indication.

Charge Cycle

Charging cycle (mode cycle: TC->CC->CV) The following figure shows the typical charging mode and typical charging process of the linear IP2301 charging 4.2V lithium battery. For deeply discharged batteries whose BAT voltage is lower than 2.5-2.8V, IP2301 starts trickle charge (trickle charge current I_{PRE}). When the battery voltage reaches the pre-charge threshold, the chip starts to charge (I_{CC}) with a constant current of the set value (set by the ISET pin). Once the battery voltage reaches 4.2V, the chip will work in constant voltage (CV) mode until the battery is fully charged. In CV mode, the charging current drops. When the charging current in CV mode drops to the charging cut-off current (I_{TER}), charging stops and the charging indicator light indicates that it is fully charged.

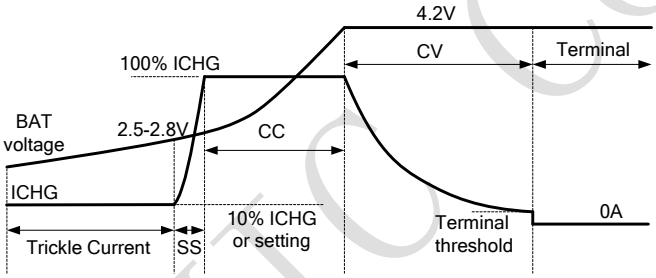


Figure 6 Charging process

IP2301 can set the charging cut-off current threshold. When entering the charging process in CV mode, the charging current will gradually drop to the charging cut-off current threshold, and the chip will stop charging; when the battery voltage is lower than the set recharge threshold, the chip will automatically restart charging .

When the IP2301 is not connected to the battery, the IP2301 will not always output the CV voltage, but directly enter the full detection mode: after the output voltage reaches the CV voltage for 500ms, stop charging for 500ms, and then perform the battery voltage detection. If the battery voltage has not reached the full charge, it will turn on the charging again, and keep repeating;

The default trickle charging current I_{PRE} and cut-off charging current I_{TER} of the standard product are both 1/10 of the set constant current charging current I_{CC};

The trickle charging current I_{PRE} and cut-off charging current I_{TER}, It can be modified to 1/20, 1/5, 1/2.5 I_{CC} through factory customization (I_{CC} is constant current charging current);

Charging Current Setting

Charging current setting:

The constant current charging current (I_{CC}) is set by the resistor (RISET) connected to the ISET pin to GND. The voltage of the ISET pin is 1V, and the charging current is 960 times the current flowing through the RISET resistor.

The charging current setting formula is as follows:

$$ICC = \frac{1}{RISET(\Omega)} \times 960\ (A)$$

If the charging current is too large and the chip temperature rises to the junction temperature loop threshold of 120℃, the chip will enter a constant temperature loop control, which will automatically reduce the charging current to stabilize the junction temperature of the chip at 120℃; the recommended range of RISET resistance is 1k- 40k.

Table 1 RISET vs. ICHG correspondence table

RISET(kΩ)	ICHG(A)
1k	960mA
1.5k	640mA
2.0k	480mA
3.3k	290mA
5k	192mA
10k	96mA
20k	48mA
30k	32mA
40k	24mA

Charging voltage setting

Charging target voltage (CV) setting:

The charging target voltage of a single battery can be set by external VSET pin resistance or factory options, and its range is 3.6-4.4V. The VSET connection resistance can set the charging target voltage (CV) of each battery 3.6V, 4.2V, 4.35V, 4.4V, and the corresponding RVSET resistance is shown in Table 2:

Table 2 R_{VSET} vs. Battery target voltage（CV）

R_{VSET}(kΩ)	CV（V）
1	4.2
15	4.35
39	4.4
75	3.6
>150K or NC	Factory default

If the VSET pin is left floating, select the factory-set battery charging target voltage, and the factory-customized single-cell battery charging target voltage range that can be selected is 3.6-4.4V with a step size of 50mV.

The target voltage of a multi-cell battery is N times that of a single cell, which is Vtarget*N, where N is the actual number of battery cells in the system.

The CPC8 package does not have a VSET pin, and the charging target CV voltage can only be set by the factory.

Charging Protection Function

VIN Input Overvoltage Protection Function

IP2301 can withstand input surge voltages up to 38V. In order to ensure the normal function of the system and

protect the battery, IP2301 integrates an input overvoltage protection circuit. Through customization, the input voltage range can reach 4.0-24V.

VIN-DPM Function

The VIN-DPM function is used to prevent excessive load from reaching its input source current limit. When the VIN voltage drops to the VIN-DPM threshold, the IC will begin to reduce the current until the input voltage no longer drops, ensuring that it can work well on the current-limiting 5V adapter and the USB port. The VIN-DPM threshold voltage of the input power supply is CV+300mV. This safety feature helps protect the input power supply from overload.

Battery Overvoltage Protection

When the battery is overvoltage (VBAT>CV+200mV), IP2301 prohibits charging to ensure the safety of the battery. In addition, the CV control loop always monitors the battery voltage, and automatically resumes battery charging when the battery is discharged below the set target voltage.

Charge Timeout Timer

The chip charging timeout timer can be set in two ways: internal clock and external RC oscillating clock: TIMER pin is grounded, charging timeout timer selects internal clock; TIMER pin is connected to capacitor, charging timeout timer selects external RC oscillator to do Clock, don't allow the TIMER pin to float.

When the chip enters the precharge stage, the precharge timer starts timing; when the chip enters the constant current and constant voltage charging stage, the fast charge timer starts timing. The corresponding charging timer expires at different stages, the chip stops charging and the CHGLED reports the corresponding status.

Once in the timeout state, the charging can be restarted under the following conditions:

- Re-insert the input voltage;
- EN reset;
- Battery plugging and unplugging;

If the internal clock is selected, means the TIMER pin is grounded, the default maximum trickle charge timeout time is 30 minutes, and the constant current and voltage charge timeout time is 4 hours.

If an external RC oscillator is selected as the charge timer clock, the oscillator frequency of the timer is:

$$fosc = 1.25 \times \frac{1}{\text{Ctimer}(\mu F)} \quad (\text{Hz})$$

The period is:

$$\text{Tosc} = \frac{\text{Ctimer}(\mu F)}{1.25} \quad (\text{s})$$

Internal counter, trickle charge timer duration is 32768 cycles, constant current constant voltage charge duration is 262144 cycles.

the constant current and constant voltage charging timeout time is:

$$Tcc = \frac{262144 \times Ctimer(\mu F)}{1.25 \times 3600}(hr)$$

The trickle charge timeout time is:

$$Tpre = \frac{32768 \times Ctimer(\mu F)}{1.25 \times 3600}(hr)$$

Otherwise, the TIMER pin capacitor can be selected according to the charging timeout time:

$$Ctimer = \frac{1.25 \times 3600 \times Tcc(hr)}{262144}(\mu F)$$

Temperature Protection

IP2301 has a special thermal protection control circuit, including chip junction temperature protection and battery thermal protection detected by NTC resistance.

When the chip junction temperature is close to the set value (120 ℃), the temperature control loop will reduce the charging current and the chip enters the thermal protection mode, which can effectively prevent the IC from entering the overheating protection state and maintain the IC at a constant temperature.

If the junction temperature of the chip reaches 150 ℃, the charger will turn off charging. When the chip temperature drops by 20 ℃, the chip will restart charging.

IP2301 can detect the battery temperature through a negative temperature coefficient (NTC) thermistor. When the battery temperature rises or drops to the set temperature, the chip will turn off the charging function; when the battery temperature reaches the medium temperature WT setting, the charging current is halved; When the NTC is connected to the 39K resistor to ground, the NTC function is shielded.

As shown in the NTC principle in the figure below, the internal thresholds of OT, WT, UT and disable are 0.5V, 0.65V, 1.5V and 0.1V:

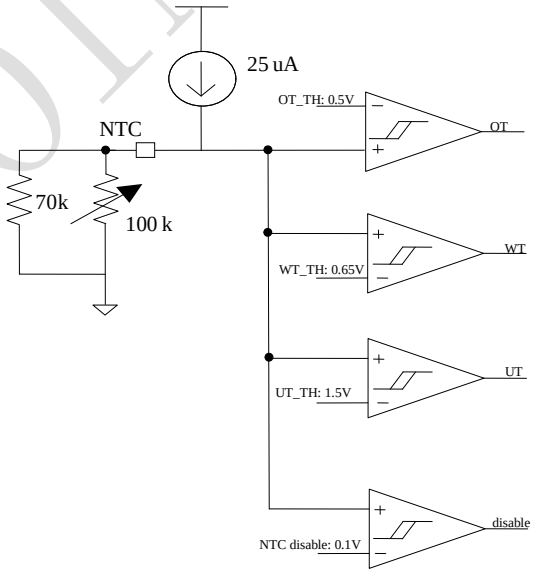


Figure 7 NTC setting principle

It is recommended to select an NTC resistor (TNL104AT050F-001, B25/50=3950K) and a 70K resistor connected in parallel to the NTC pin. The IC will inject 25uA current into the NTC pin, so the voltage of the NTC pin is determined by the resistance of the external NTC and the parallel resistor:

$$\mathrm{RNTC//70K} = \frac{0.5 \times 1000}{25} = 20\mathrm{k}$$

R_{NTC}=28k， The OT temperature is: 57 ℃;

Similarly: WT temperature value is 46.5 ℃; UT temperature value is -5.5 ℃.

When the NTC medium temperature WT charging current is halved or the junction temperature loop or VIN_DPM loop is working, in order to better match the low-power charging process, the duration of the pre-charge timer and fast-charge timer will be automatically doubled.

Charging Status Indication Function

IP2301 supports multiple status displays through CHGLED;

the default light display status of IP2301 standard product is: CHGLED pin flashes at 1Hz while charging, and keeps on when it is fully charged, 4Hz flash when charging is abnormal (input overvoltage, NTC protection, charging timeout, etc.) ;

The light display status of the IP2301_DA customized model is: the CHGLED pin is pulled down and on while charging, and the light is turned off when it is full of high impedance, and flashes when the charging is abnormally;

The light display status of the customized model of IP2301_DA2 dual-color light is:When VIN is charged and plugged in, the red and green lights keep on for 1.5S; the red light is on during charging (CHGLED output is low); the green light is on after full charge (CHGLED output is high); the red light flashes when charging is abnormal (CHGLED repeats output 500ms low, 500ms high impedance)；

10. Application Characteristics

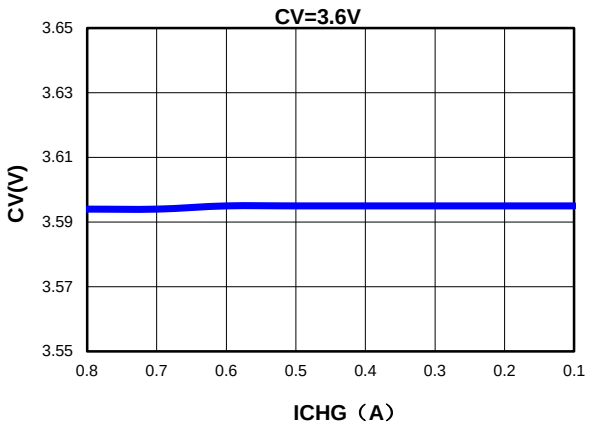


Chart 1 CV vs. ICHG@VIN=5V

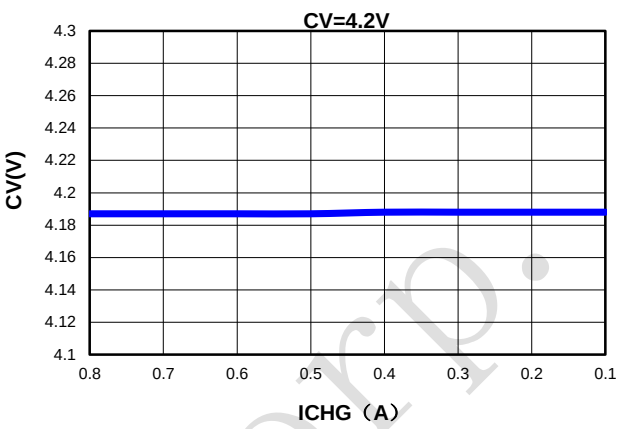


Chart 2 CV vs. ICHG@VIN=5V

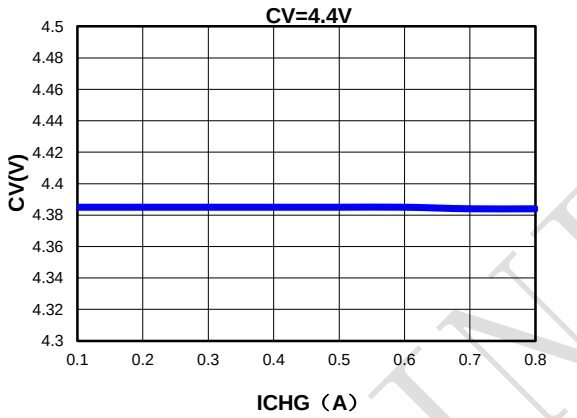


Chart 3 CV vs. ICHG@VIN=5V

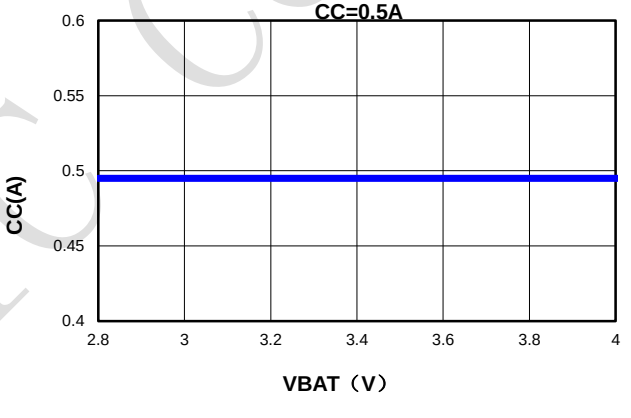


Chart 4 CC vs. VBAT@VIN=5V

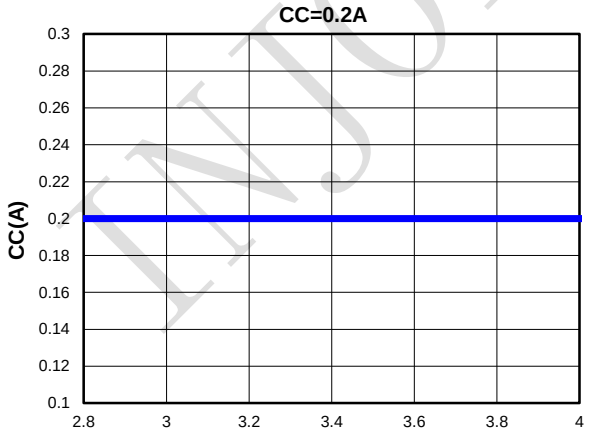


Chart 5 CC vs. VBAT@VIN=5V

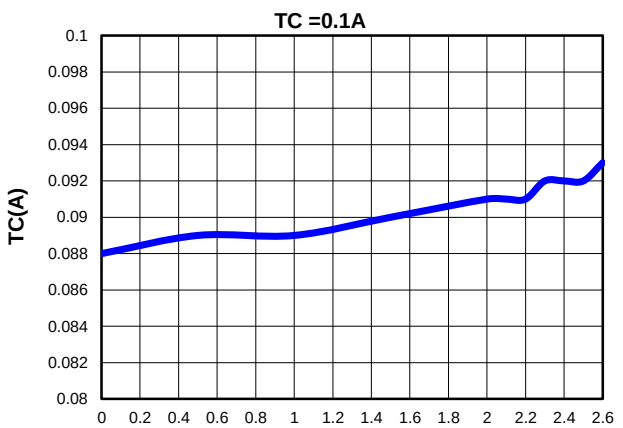


Chart 6 TC vs. VBAT@VIN=5V

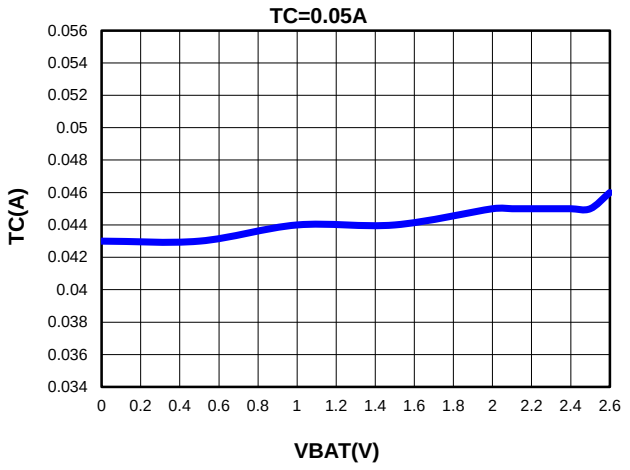


Chart 7 TC vs. VBAT@VIN=5V

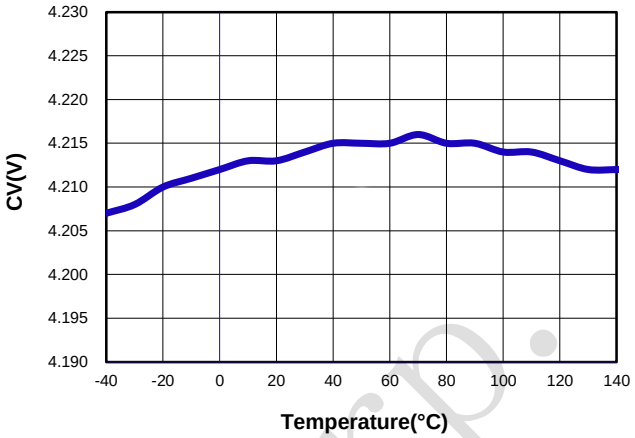


Chart 8 CV Vs. ambient temperature(@VIN=5V)

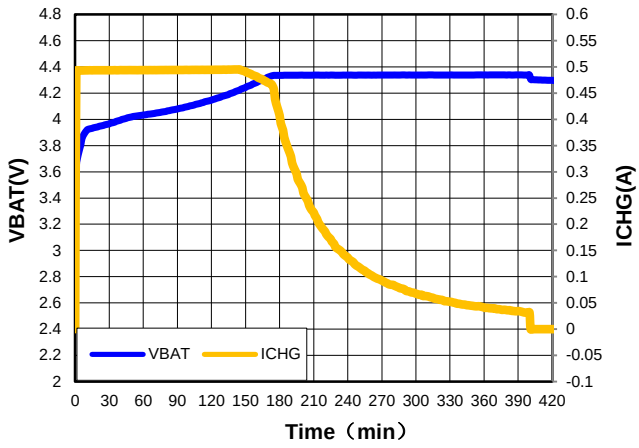


Chart 9 Real Bat (CV=4.35V,CC=0.5A， EOC=50mA)

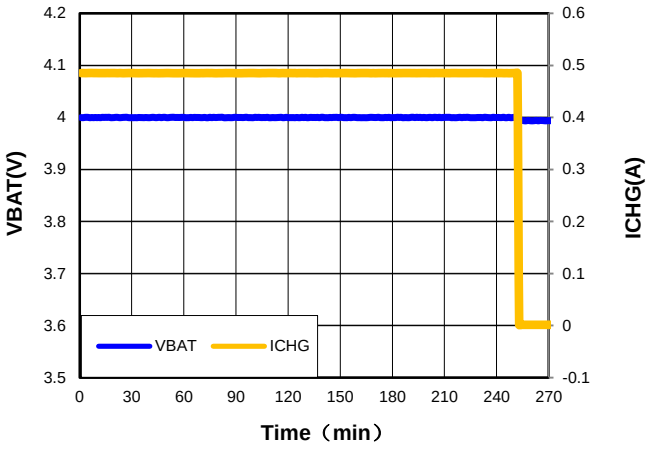


Chart 10 Internal Timer (CC Timer=4hr)

Chart 11 EN Start(CH1:VIN CH2: VBAT CH3: EN CH4: ICHG)

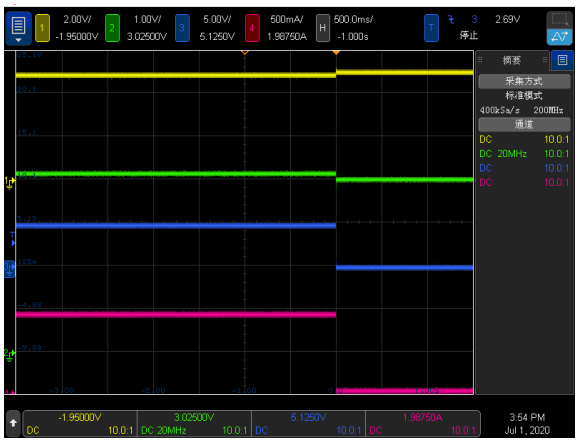
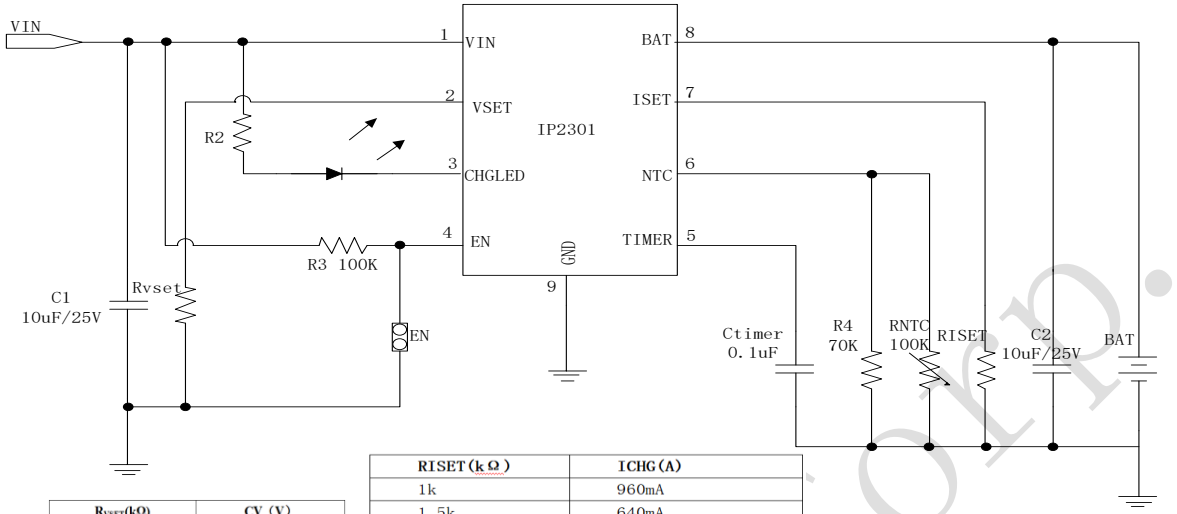


Chart 12 EN Shutdown(CH1:VIN CH2: VBAT CH3: EN CH4: ICHG)

11. Typical Application Schematic



R_{VSET}(kΩ)	CV (V)
1	4.2
15	4.35
39	4.4
75	3.6
>150K or NC	Factory default

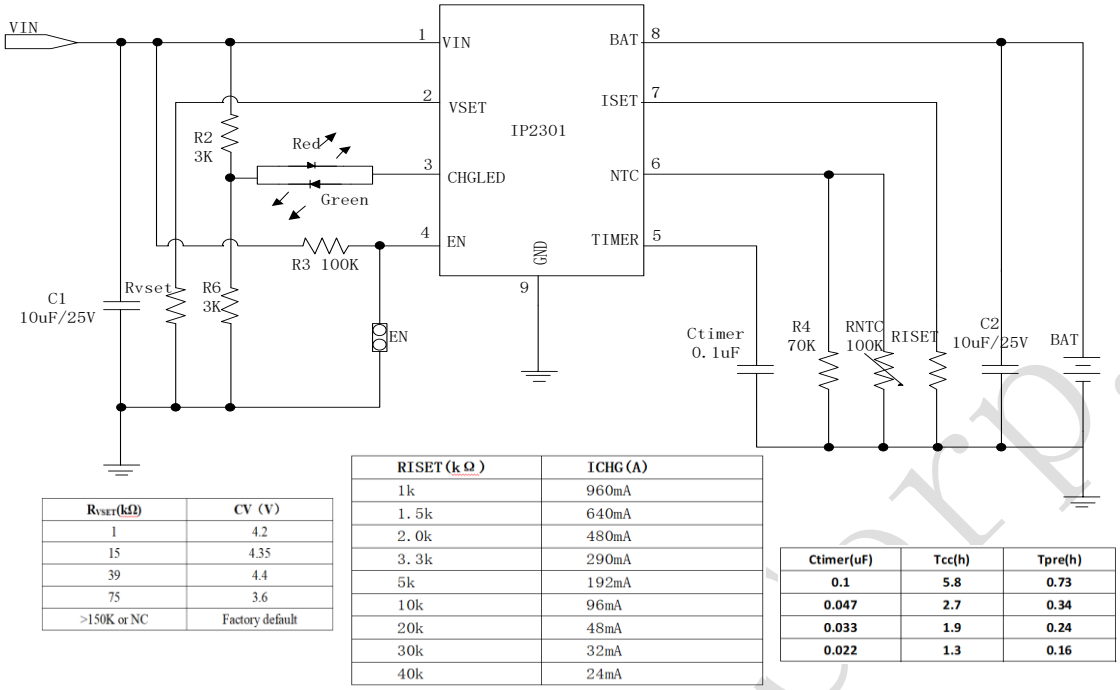
RISET (kΩ)	ICHG (A)
1k	960mA
1.5k	640mA
2.0k	480mA
3.3k	290mA
5k	192mA
10k	96mA
20k	48mA
30k	32mA
40k	24mA

Ctimer(uF)	Tcc(h)	Tpre(h)
0.1	5.8	0.73
0.047	2.7	0.34
0.033	1.9	0.24
0.022	1.3	0.16

Figure 8 IP2301 Typical Application Schematic

Note:

1. RVSET is selected according to the required CV value. If it is floating, the factory set CV value will be used. The standard product factory default CV=4.2V;
2. R2 is selected according to the brightness of the LED;
3. If the NTC function is not used, remove NTC and R4, and the NTC pin can be directly shorted to ground;
4. RISET is selected according to the charging current needs;
5. BAT can choose single battery, two battery and three battery, which can only be set at the factory, please select the chip of the corresponding model;
6. Ctimer is selected according to the charging timeout requirement;
7. The withstand voltage of C1 and C2 can be selected according to the number of battery cells and the actual application.



R_{VSET}(kΩ)	CV (V)
1	4.2
15	4.35
39	4.4
75	3.6
>150K or NC	Factory default

RISET(kΩ)	ICHG(A)
1k	960mA
1.5k	640mA
2.0k	480mA
3.3k	290mA
5k	192mA
10k	96mA
20k	48mA
30k	32mA
40k	24mA

Ctimer(uF)	Tcc(h)	Tpre(h)
0.1	5.8	0.73
0.047	2.7	0.34
0.033	1.9	0.24
0.022	1.3	0.16

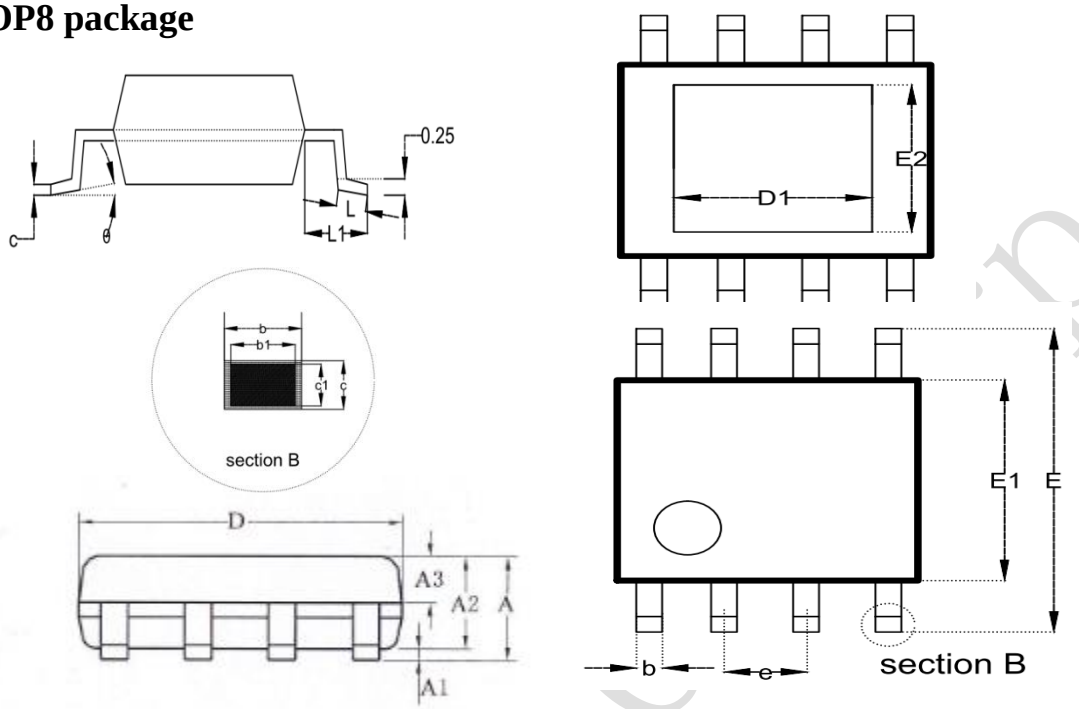
Figure 9 IP2301_DA2 two-color lamp application schematic diagram

Note:

When the two-color lamp scheme is adopted, in the original scheme, after the CHGLED pin is connected to the two-color lamp, it is pulled up to VIN and pulled down to ground through two 3K resistors respectively.

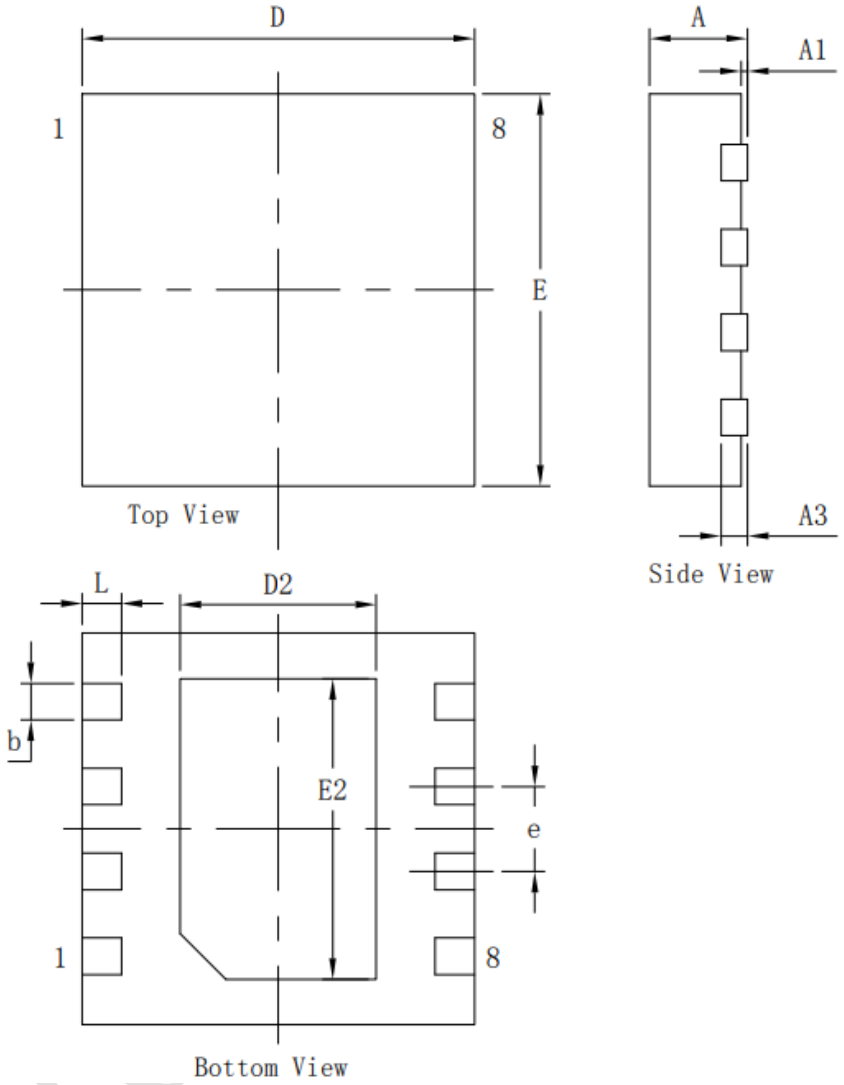
12.Package

ESOP8 package



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.65
A1	0.05	--	0.15
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	--	0.48
b1	0.38	0.41	0.43
c	0.21	--	0.25
c1	0.19	0.20	0.21
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
L	0.50	0.60	0.80
L1	1.05BSC		
θ	0	--	8°
D1	--	3.10	--
E2	--	2.21	--

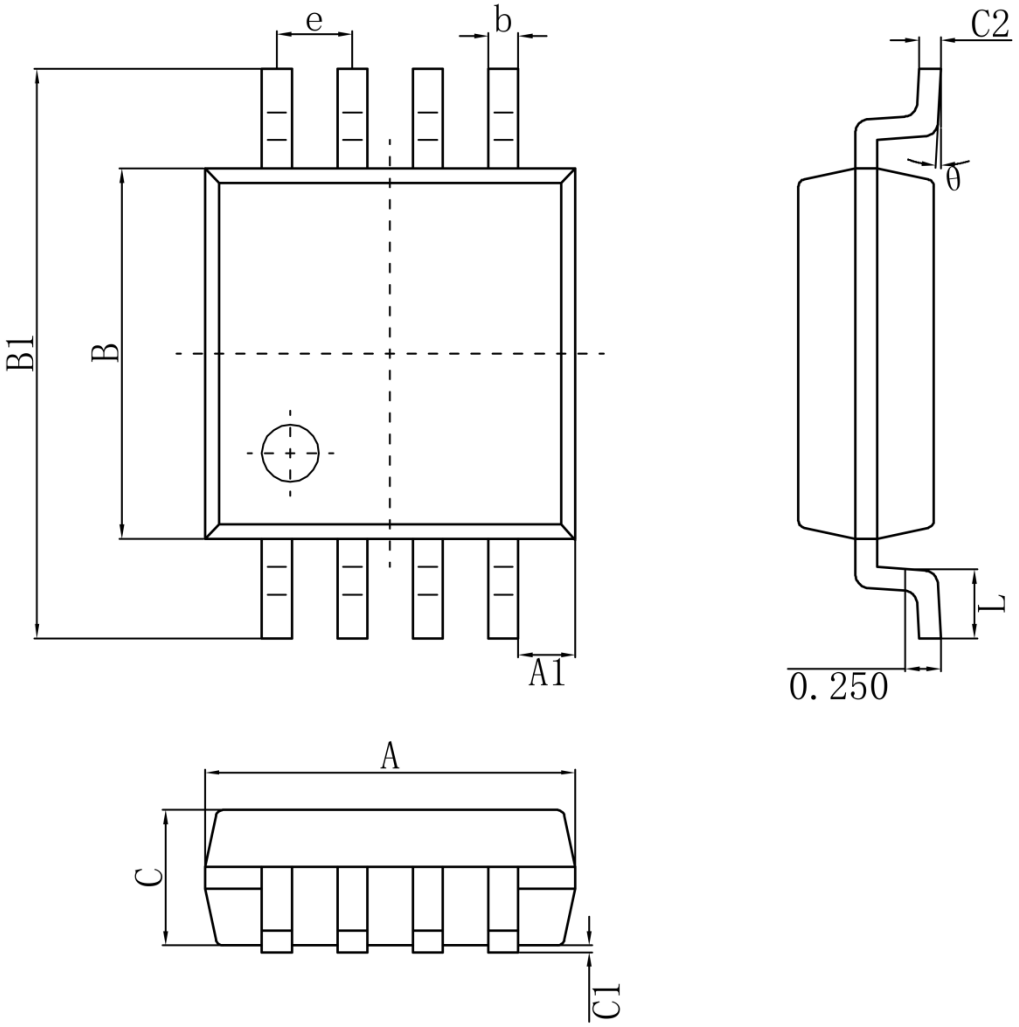
DFN8(0303) package



Lable \ Size	MIN(mm)	NOM(mm)	MAX(mm)	Lable \ Size	MIN(mm)	NOM(mm)	MAX(mm)
A	0.70	0.75	0.80	E	2.90	3.00	3.10
A1	-	-	0.05	D2	1.40	1.50	1.60
A3	0.203 REF			E2	2.20	2.30	2.40
b	0.23	0.28	0.33	e	0.65 TYP		
D	2.90	3.00	3.10	L	0.25	0.30	0.35

Figure 11 IP2301N DFN8 Package Dimensions

CPC8 package



Size / Lable	MIN(mm)	MAX(mm)	Size / Lable	MIN(mm)	MAX(mm)
A	2.50	2.70	C	0.85	1.05
A1	0.35	0.45	C1	0.00	0.15
e	0.53 (BSC)		C2	0.15	0.18
B	2.50	2.70	L	0.40	0.60
B1	3.85	4.15	θ	0°	8°
b	0.16	0.26			

Figure 12 IP2301Q CPC8 Package Dimensions

13.IC Silkscreen Instructions

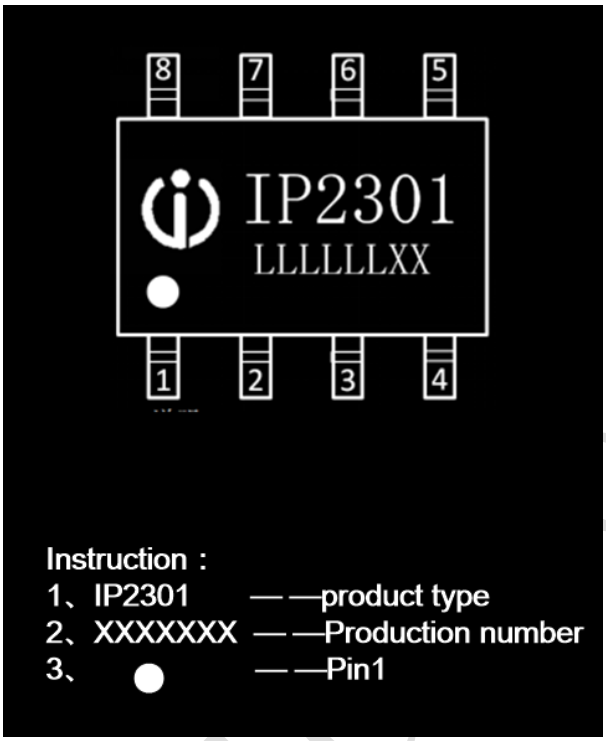


Figure 13 IP2301 IC Silkscreen Instructions

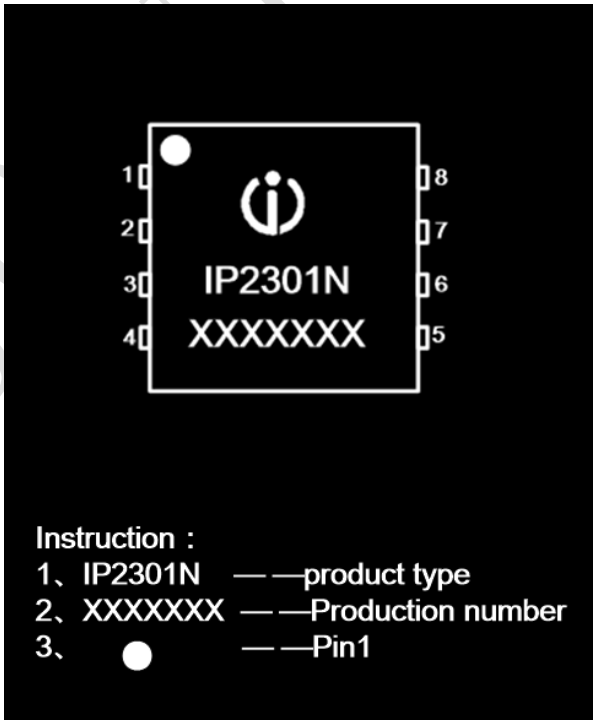


Figure 14 IP2301N IC Silkscreen Instructions

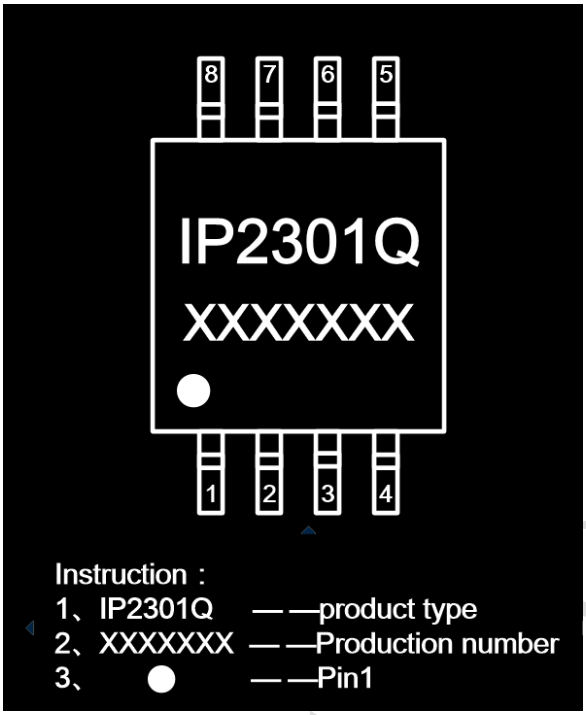


Figure 15 IP2301Q IC Silkscreen Instructions

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