Ruyun Electronics ***CONSONANCE*** has

the maximum power point tracking function of solar cells

4A multi-cell battery charge management integrated circuit

CN3795

Overview:

CN3795 is a PWM step-down mode multi-cell battery charging management integrated circuit that can be powered by solar panels. It independently manages the charging of multiple batteries. It has the advantages of small package size, few peripheral components and simple use.

CN3795 features trickle, constant current and constant voltage charging modes, making it ideal for lithium battery, lithium iron phosphate battery and lithium titanate battery charge management. In constant voltage charging mode, CN3795 modulates the battery voltage to the voltage set by the external feedback resistor; in constant current charging mode, the charging current is set by an external resistor. When powered by a solar panel, the internal circuit can automatically track the maximum power point of the solar panel. Users do not need to consider the worst-case scenario and can maximize the output power of the solar panel. It is very suitable for applications that use solar panels to provide power. For deeply discharged lithium batteries, when the battery voltage is lower than 66.5% (typical value) of the constant voltage charging voltage, the CN3795 uses 17.5% of the set constant current charging current to trickle charge the battery. During the constant voltage charging stage, the charging current gradually decreases. When the charging current drops to 16% of the constant current charging current, charging ends. At the end of charging, if the charging current rises to more than 58.8% of the constant current charging current, a new charging cycle will automatically start. When the input power fails or the input voltage is lower than the battery voltage, CN3795 automatically enters sleep mode. Other functions include input low voltage latch, battery terminal overvoltage protection and charging status indication. CN3795 is available in 10-pin SSOP package.

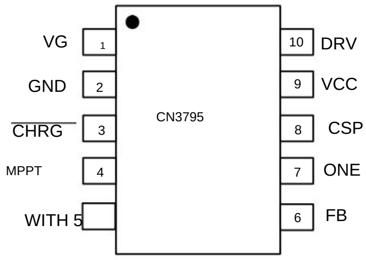
application:

ÿ Handheld devices ÿ
Emergency lights ÿ
Backup battery applications ÿ
Portable industrial and medical instruments ÿ
Power tools ÿ Lithium
batteries, lithium iron phosphate batteries and lithium titanate battery charging

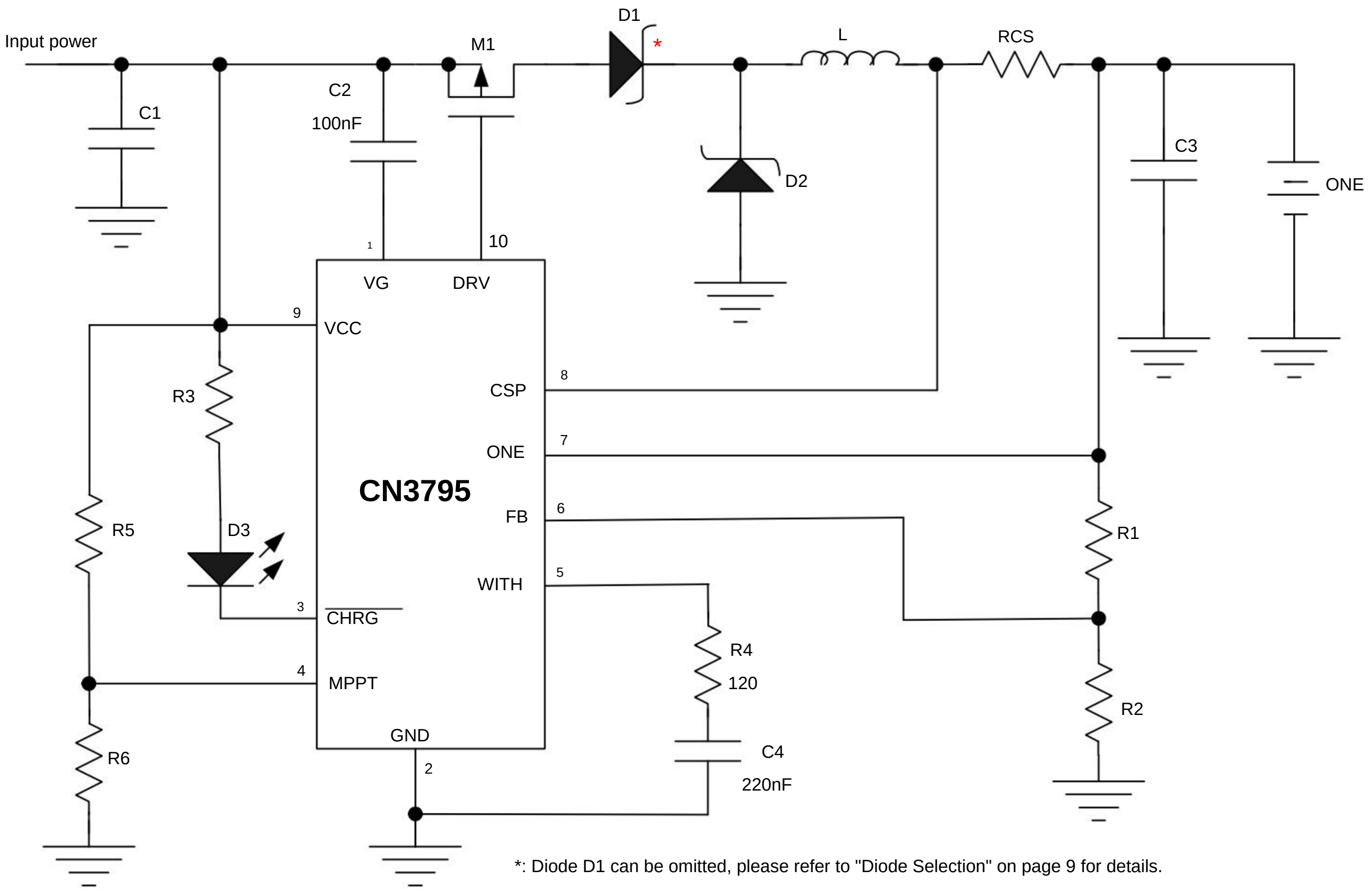
Features:

ÿ Solar panel maximum power point tracking function ÿ
Complete charging management for single or multi-cell lithium batteries, lithium iron phosphate batteries or lithium titanate batteries
ÿ Wide input voltage range: 6.6V to 30V ÿ Can be used as a constant voltage source when the battery is not connected ÿ Charging current up to 4A ÿ PWM switching frequency: 310KHz ÿ Constant charging voltage is set by an external resistor ÿ Constant charging current is set by an external Resistor setting ÿ Trickle charge for deeply discharged batteries ÿ Automatic recharge function ÿ Charging status indication ÿ Soft start function
ÿ Battery terminal overvoltage protection ÿ Working environment temperature: -40ÿ to +85ÿ ÿ Adopt 10-pin SSOP package ÿ The product is lead-free, meets Rohs and does not contain halogen

Pin arrangement:



Typical application circuit:



*: Diode D1 can be omitted, please refer to "Diode Selection" on page 9 for details.

and the "Sleep Mode Battery Current" section

Figure 1 Typical application circuit

Ordering Information:

model	Packed	Working temperature
CN3795	in trays, 3000 pieces per tray	-40ÿ to +85ÿ

Pin description:

Pin number	name	description
1	VG	Internal voltage modulator output. Provides power to the internal drive circuit, between the VG pin and A 100nF capacitor needs to be connected between the VCC pins.
2	GND	ground. Input the negative input terminal of the power supply and the negative terminal of the battery.
3	CHRG	charging status indicator terminal. Open drain output. In the charging state, the internal transistor turns this pin is pulled low; otherwise, this pin is in a high-impedance state.
4	MPPT	Solar panel maximum power point tracking end. Tracking state at the maximum power point of the solar panel, The voltage of this pin is modulated to 1.205V. This pin requires an external resistor divider network to Check the voltage of the solar panel.
5	WITH	Loop compensation input. Connect a 120ÿ resistor in series from this pin to ground and a 220nF capacitor.
6	FB	battery voltage feedback input terminal. Connect an external resistor voltage divider network to detect the battery voltage.
7	ONE	The positive terminal of the battery and the negative input terminal of the charging current detection. This pin is connected to the battery the positive pole. At the same time, this pin and the CSP pin are used to measure the current detection resistor RCS. terminal voltage, and this voltage signal is fed back to CN3795 for current modulation.
8	CSP	Charging current detection positive input terminal. This pin and the BAT pin are used to measure the current detection voltage. resist the voltage at both ends of RCS, and feed this voltage signal back to CN3795 for current regulation. system.
9	VCC	Positive input terminal of external power supply. VCC is also the power source for internal circuitry. This pin goes to ground A filter capacitor needs to be connected between them.
10	DRV	gate drive terminal. Drives the gate of an off-chip P-channel MOS field effect transistor.

Limit parameters

VCC, CHRG to GND voltage……………………………………………-0.3V to 33V VG, DRV pin to VCC pin voltage…………………… …………-8V to VCCÿ

0.3V CSP, BAT to GND voltage……………………………………………………-0.3V to 27V MPPT, COM, FB to GND Voltage…………………………………………-0.3V

to 6.5V Storage temperature…………………………………………… ……………ÿ65ÿ to 150ÿ

Working environment temperature…………………………………………………-40ÿ to 85ÿ

Welding temperature (10 seconds)………………………………………………………………260ÿ

Exceeding the limit parameters listed above may cause permanent damage to the device. The above given limits are only the limit ranges. Working under such limit conditions, The technical specifications of the device will not be guaranteed, and the reliability of the device will be affected under such conditions for a long time.

Electrical characteristics:

(VCC=15V, TA=-40ÿ to 85ÿ, unless otherwise noted)

Parameter symbol test conditions			Minimum Typical Maximum Unit			
Input voltage range	VCC		6.6		30 volts	
Low voltage latch	VLOOK		4	5.2	6.5 volts	
threshold Chip operating current	IVCC VBATÿVREG		0.7	1.0	1.3 mA	
FB pin feedback voltage	VREG constant voltage charging mode		1.193	1.205	1.22 volts	
FB pin bias current	IFB	VFBÿ1.2V		60	300 Naan	
Current Detection	VCS	VBATÿVPRE, VCSPÿVBAT VBATÿ	110	120	130	millivolt
		VPRE, VCSPÿVBAT IBAT1 charging	10	21	36	
Current flowing into BAT pin	end mode, VBATÿ7.4V IBAT2 sleep mode, VBATÿ			10	15	microampere
	7.4V VPRE BAT pin voltage rises HPRE BAT				15	
Trickle charge threshold	pin voltage falls Iterm charging current		64	66.5	69 %VREG	
Trickle charge threshold Hysteresis	falls VRE charging current Rising Vov			2.5		%VREG
charge end threshold	BAT pin voltage rising Vclr BAT			16		%ICC
Recharge threshold	pin voltage falling			58.8		%ICC
Overvoltage			1.04	1.07	1.1	VREG
threshold Overvoltage release threshold			1.0	1.02	1.04	
CHRG pin CHRG						
pin pull-down current ICHRG VCHRG=1V, charging state			7	12	18 mA	
CHRG pin leakage current	ILK1 VCHRGÿ30V, charging end state				1 microamp	
MPPT pin MPPT						
pin modulation voltage VMPPT is in the maximum power point tracking state			1.18	1.205 1.23 V		
MPPT pin current	IMPPT		ÿ100	0	100	nA
oscillator						
	dark		260	310	360 kHZ	
Frequency Maximum	Dmax			94		%
Duty Cycle Sleep Mode						
sleep mode threshold (Measuring VCC-VBAT)	VSLP VCC falling VBATÿ8V		0.0	0.05	0.1 volt	
Sleep mode release threshold (measure VCC-VBAT)	VSLPR VCC rising, VBATÿ8V		0.2	0.32	0.46 volts	
DRV pin						
VDRV high level (VCCÿVDRV)	VH IDRVÿÿ10mA			60		millivolt
VDRV low level (VCCÿVDRV) rise	VL IDRVÿ0mA			6.3		volt
time fall time	tr	Cloadÿ2nF, 10% to 90%	30	40	65 nanoseconds	
Note: VREG	tf	Cloadÿ2nF, 90% to 10%	30	40	65 nanoseconds	

represents constant voltage charging voltage; ICC represents constant current charging current.

A detailed description:

CN3795 is a PWM step-down multi-cell battery charge management integrated circuit that can be powered by solar panels. It can be used for charge management of single or multi-cell lithium batteries, lithium iron phosphate batteries or lithium titanate batteries. CN3795 features trickle, constant current and constant voltage charging modes. The constant charge current is set by the current sense resistor RCS between the CSP pin and the BAT pin. The constant voltage charging voltage is set by the feedback resistor connected to the FB pin. When the VCC pin voltage is greater than the low voltage latch threshold and greater than the battery voltage, the CN3795 operates normally. If the battery voltage is lower than the trickle charging threshold, the charger automatically enters trickle charging mode. At this time, the charging current is 17.5% of the set constant current charging current. When the battery voltage is greater than the trickle charging threshold, the charger enters constant current charging mode. At this time, the charging current is set by the internal 120mV reference voltage and an external resistor RCS, that is, the charging current is 120mV/RCS. When the battery voltage continues to rise close to the constant voltage charging voltage, the charger enters the constant voltage charging mode and the charging current gradually decreases. In the charging state, the transistor inside the open-drain output pin is turned on and outputs a low level to indicate the charging state. When the charging current reduces to 16% of the constant current charging current, charging ends and the DRV pin outputs a high level. The transistor inside the open-drain output pin is turned off and the output is in a high-impedance state to indicate the end of charge state. At the end of charging, if the input power is disconnected and then reconnected, a new charging cycle will start; if the charging current rises above the recharge threshold, a new charging cycle will automatically start.

CN3795 can be powered by solar panels and has the maximum power point tracking function of solar panels. The maximum power point voltage of the solar panel is divided by two resistors and fed back to the MPPT pin. In the maximum power point tracking state, the MPPT pin voltage is modulated at 1.205V (typical value). When the input voltage is powered off, CN3795 automatically enters sleep mode and the internal circuit is shut down.

There is also an overvoltage comparator inside the CN3795. When the BAT pin voltage rises due to load changes or sudden removal of the battery, etc., if the BAT pin voltage rises to 1.07 times the constant voltage charging voltage, the overvoltage comparator will act. , turn off the off-chip P-channel MOS field effect transistor, and the charger temporarily stops until the BAT pin voltage returns to less than 1.02 times the constant voltage charging voltage. In some cases, such as when the battery is not connected to the charger, or the battery is suddenly disconnected, the voltage of the BAT pin may reach the overvoltage protection threshold, which is normal. The schematic diagram of charging current and charging voltage is shown in Figure 2.

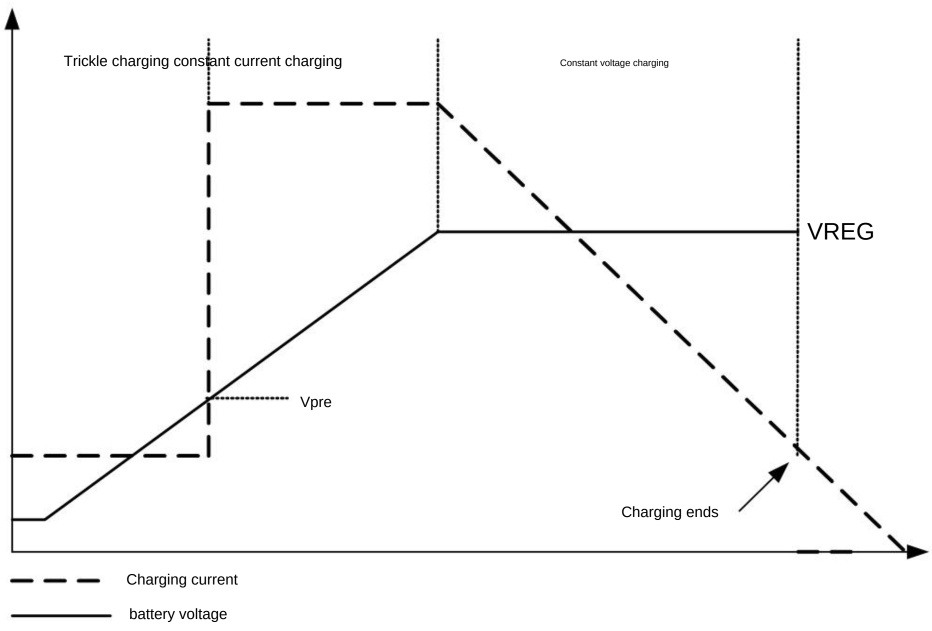


Figure 2 Schematic diagram of the charging process

Application information

The low voltage latch circuit inside the low

voltage latch **(UVLO)** chip monitors the input voltage. When the input voltage is lower than 6.5V (maximum value), the internal circuit is shut down and the CN3795 is prohibited from working. Trickle Charging In

the charging state,

if the battery voltage is lower than 66.5% (typical value) of the constant voltage charging voltage, the charger enters the trickle charging mode, and the charging current is 17.5% of the constant current charging current. Setting of constant

current charging current The constant

current charging current is determined by the following formula:

$$I_{CH} = \frac{120mV}{R_{CS}}$$

in:

ICH is constant current charging current

RCS is a current detection resistor connected between the CSP pin and the BAT pin to set the constant

voltage charging voltage . As shown in

Figure 1, the voltage at the battery end is fed back to the FB pin through the resistor voltage dividing network composed of resistors R1 and R2. CN3795 The voltage of the FB pin determines the charging status. When the voltage of the FB pin is close to 1.205V, the charger enters the constant voltage charging state. In the constant voltage charging state, the charging current gradually decreases while the battery voltage remains unchanged.

Considering the bias current flowing into the FB pin, the corresponding voltage at the battery terminal in the constant voltage charging state is:

VBATÿ1.205×(1ÿR1ÿR2)ÿIB×R1 Among them, IB is the bias

current of the FB pin, and its typical value is 60nA. As can be seen from the

above formula, the bias current of the FB pin causes an error in the voltage division result of the resistor voltage dividing network, and the error value is IB×R1. Assume R1= 500Kÿ, then the error value is about 30 millivolts. Therefore, the above error should be taken into consideration when designing the resistor voltage dividing network.

The settable constant voltage charging voltage cannot be greater

than 25V. Since resistors R1 and R2 will consume a certain amount of current from the battery, when selecting the resistance values of R1 and R2, you should first select the value of R1 + R2 based on the allowed current consumption, and then calculate the values of R1 and R2 respectively

according to the above formula. The solar cell maximum

power point tracking CN3795 uses the constant voltage method to track the maximum power point of the solar panel. In the volt-ampere characteristic curve of a solar panel, when the ambient temperature is constant, under different sunlight intensities, the output voltage corresponding to the maximum power output point is basically the same. That is, as long as the output terminal voltage of the solar panel is kept at a constant voltage, This can ensure that the solar panel outputs maximum power when the light intensity is different at this temperature.

The voltage of the MPPT pin of the maximum power point tracking terminal of the CN3795 solar panel is modulated at 1.205V. With the voltage dividing network composed of two external resistors (R5 and R6 in Figure 1), the maximum power point of the solar panel can be measured. track.

The maximum power point voltage of the solar panel is

determined by the following formula: VMPPTÿ1.205×(1ÿR5ÿR6)

When charging

ends in constant voltage charging mode, the charging current gradually decreases. When the charging current drops to 16% of the constant current charging current, the charging process ends, and the $\overline{CHRG}$ pin outputs a high-impedance state to indicate the end of charging. At this time, the CN3795 continues to charge the battery in a constant voltage manner to

ensure that the battery is fully charged. When the battery voltage is lower than 95.8% of the constant voltage charging voltage, even if the charging current drops to 16% of the constant current charging current, the charging process will not end. That is to say, there are two conditions for the end of charging. One is that the battery voltage is greater than 95.8% of the constant voltage charging voltage; the other condition

is that the charging

current drops to 16% of the constant current charging current. After automatic recharge, if the input power supply and battery are still connected to the charger, and the charging current rises to more than 58.8% of the constant current charging current due to battery self-discharge or load, the CN3795 automatically enters the charging state and starts New charging cycle.

status indication

CN3795 has an open-drain status indication output: $\overline{CHRG}$ pin. In the charging state, the $\overline{CHRG}$ pin is pulled down to low level by the internal transistor, and in other states the pin is in a high impedance state. When the battery is not connected to the charger, CN3795 can

be used as a voltage source to output a constant voltage. The voltage value is the set constant voltage charging voltage. At this time, the $\overline{CHRG}$ pin is in a high impedance state. When the status indication function is not

used, connect the $\overline{CHRG}$ pin to ground. Table 1 lists the charge status corresponding to the

$\overline{CHRG}$ pins. It is assumed here that the red LED is connected to the $\overline{CHRG}$ pin as shown in Figure 1.

$\overline{CHRG}$ Pin low	Status Description
level (red LED on)	Three
High resistance state (red LED off)	possible charging situations: ÿ The VCC pin voltage is lower than the low-voltage latch voltage, or ÿ The VCC pin voltage is lower than the BAT pin voltage, or ÿ Charging ends.

Table 1 Status indication description

The DRV pin of the off-chip power

transistor driver CN3795 is used to drive the gate of the off-chip MOS field effect transistor. This pin can provide a relatively large transient current to quickly turn on and off the off-chip MOS field effect transistor. Typical rise and fall times are 30nS when driving a 2nF load. Generally speaking, the equivalent capacitance of a 30V MOS field effect transistor with an on-resistance of 35 milliohms is approximately 2nF.

CN3795 has an internal clamp circuit to ensure that the low level of the DRV pin is 8V (maximum) lower than the voltage of the VCC pin. For example, assuming the voltage of VCC is 20V, then the low level of the DRV pin is a minimum of 12V. In this way, some low-voltage P-channel MOS field-effect transistors with extremely low on-resistance can be used with CN3795, thereby improving the working efficiency of the charger and giving customers more choices. Loop compensation In order to ensure the stability of the current modulation loop and

voltage modulation

loop, a 120ÿ resistor and a 220nF ceramic capacitor need to be connected in series from COM to ground.

CN3795 is used as a constant voltage source .

When the battery is not connected to the charger, the CN3795 can be used as a constant voltage source. Its output voltage value is the set constant voltage charging voltage, and the maximum output current is the set constant current charging current. Input

capacitor The input

capacitor (C1 in Figure 1) filters the input power supply and needs to absorb the ripple current generated on the input power supply, so the input capacitor must have sufficient rated ripple current. In the worst case, the input capacitor's rated RMS ripple current needs to be one-half the charging current. At the same time, in order to suppress high-frequency oscillation caused by parasitic inductance and other factors at the switching moment, the input capacitor is best composed of the following three capacitors in parallel:

ÿ Electrolytic capacitor: The capacitance value is determined by factors such as the characteristics of the input power supply and charging

current ÿ Ceramic capacitor: The capacitance value ranges from 1uF to 10uF

ÿ High-frequency ceramic capacitor: The capacitance value ranges from 47nF to 1uF

Output Capacitor

In order to reduce the ripple voltage at the output end and improve transient characteristics, the output capacitor (C3 in Figure 1) should be selected with a smaller equivalent series resistance (ESR). The output capacitor is best composed of the following two capacitors in

parallel: ÿ Electrolytic capacitor: capacitance value

10uF ÿ Ceramic capacitor: capacitance value between 1uF and 10uF

If the output capacitor can only use ceramic capacitors, it should be noted that the voltage coefficient of some ceramic capacitors is relatively large, and the effective capacitance value becomes low. The BAT pin voltage may be too high when the battery is not connected. In this case, the output should be appropriately increased. capacitance or use several small-capacitance ceramic capacitors in parallel to

Ensure that the BAT pin voltage is within a safe range when the battery is not connected.

Selection of Inductor

During normal operation, the inductor transient current changes periodically. During the turn-on period of the P-channel MOS field effect transistor, the input voltage charges the inductor and the inductor current increases; during the turn-off period of the P-channel MOS field effect transistor, the inductor discharges to the battery and the inductor current decreases. The ripple current of the inductor increases as the inductance value decreases and as the input voltage increases. Larger inductor ripple current will lead to larger ripple charging current and magnetic losses. Therefore, the ripple current of the inductor should be limited to a reasonable range. The ripple current of the inductor can be estimated by the following formula:

$$\triangle I_L = \frac{1}{(f)(L)} V_{BAT} \left(1 - \frac{V_{BAT}}{VCC}\right)$$

in:

f is the switching frequency, 300KHz

L is the inductance value

VBAT battery voltage

VCC is the input voltage

When selecting the inductor value, the inductor ripple current can be limited to ÿILÿ0.3×ICH, where ICH is the charging current. Please note that the maximum inductor ripple current ÿIL occurs at the maximum input voltage and the minimum inductor value. In addition to the above formula, the inductance value should also meet the following formula requirements:

$$L > 5 \times (VCC - V_{BAT}) \quad (uH)$$

In order to ensure lower electromagnetic radiation, the inductor is preferably a patch type shielded inductor.

MOSFET Selection The application circuit of CN3795 requires the use of a P-channel MOS field effect transistor. When selecting this MOS field effect transistor, the conversion efficiency, MOS field effect transistor power consumption and maximum temperature should be comprehensively considered. Inside the chip, the gate drive voltage is clamped at 6.3V (typ.), allowing the use of low turn-on voltage P-channel MOS field-effect transistors. Therefore, it is necessary to note that the breakdown voltage BVDSS of the MOS field effect transistor is greater than the maximum input voltage. Factors to consider when selecting a P-channel MOS field effect transistor include on-resistance Rds(on), total gate charge Qg, reverse conduction capacitance CRSS, input voltage and maximum charging current.

The maximum power dissipation of MOS field effect transistors can be approximated by the following formula:

$$Pd = \frac{VBAT}{VCC} \times Rds(on) \times ICH^2 \times (1+0.005dT)$$

in:

Pd is the power consumption of the MOS field effect transistor. VBAT is the maximum voltage of the battery. VCC is the minimum input voltage. Rds(on) is the on-resistance of the P-channel field effect transistor at room temperature (25ÿ).

ICH is the charging current dT is the temperature difference between the actual temperature of the P-channel MOS field effect transistor and room temperature (25°C)

In addition to the conduction loss I described by the previous formula[2] In addition to Rds(on), MOS field effect transistors also have switching losses, which increase as the input voltage increases . Generally speaking, when the input voltage is less than 20V, the conduction loss is greater than the switching loss, and MOS field effect transistors with smaller on-resistance should be given priority; when the input voltage is greater than 20V, the switching loss is greater than the conduction loss, and the reverse transistor should be given priority. The conduction capacitance CRSS is relatively small for MOS field effect transistors. Generally, the value of CRSS is listed in the technical specifications of MOS field effect transistors. If the capacitance value is not clearly listed, it can be estimated by the formula CRSS = QGD/ÿVDS. Many models of MOS field effect transistors, such as CN2305, 4435, 4459, 9435 (or 9435) and 3407A, are available. The models of MOS field effect transistors listed above are for reference only. Users need to choose the appropriate model according to specific requirements.

Selection of diodes In the

typical application circuit, diodes D1 and D2 in Figure 1 are both Schottky diodes. The current capability of these two diodes is at least greater than the charging current; the withstand voltage of the diodes must be greater than the maximum input voltage requirement.

The selection principle of diodes D1 and D2 is that they are sufficient. If the current capacity or withstand voltage of the selected diode far exceeds the required value, since such a diode has a high junction capacitance, it will increase the switching loss of the charger. ,Reduce efficiency. Diode D1 is used as a blocking diode to prevent battery energy from being consumed when the input power is lost. In sleep mode, if diode D1 is not used, the battery current consumed by CN3795 is about 51 microamps, so diode D1 may not be used based on factors such as battery capacity. Sleep Mode Battery Current In the typical application circuit shown

in Figure 1, the CN3795 enters sleep

mode when the input voltage drops or the input voltage is lower than the battery voltage. The current consumed by the battery in sleep mode includes: (1) The current flowing into the BAT pin and the CSP pin, which is about 10uA (VBAT =

8V) (2) The current flowing from the battery terminal to the input voltage terminal through the blocking diode

D1, this The current is determined by the leakage current of diode D1;

If diode D1 is not used, the battery voltage passes through the inductor, and the body diode of the MOS field effect transistor is applied to the VCC pin of CN3795, and the current flowing into the VCC pin is about 42uA (VBAT = 8V). (3) The current

flows from the battery terminal to the ground (GND) through diode D2. This current is determined by the leakage current of diode D2. Regarding the

suppression of high-frequency oscillation ,

in the case of high input voltage or large charging current, if the PCB layout is unreasonable, or the parasitic inductance of the diode or P-channel field effect transistor is relatively large, the P-channel field effect transistor will turn on or off. In an instant, high-frequency oscillations above tens of megahertz will occur. The high-frequency oscillation waveform can be observed with an oscilloscope at the positive pole of the input power supply and the negative pole of diode D2.

In order to suppress high-frequency radiation, in addition to improving the PCB layout, a high-frequency suppression circuit can also be added, such as R5 and C5 in Figure 3.

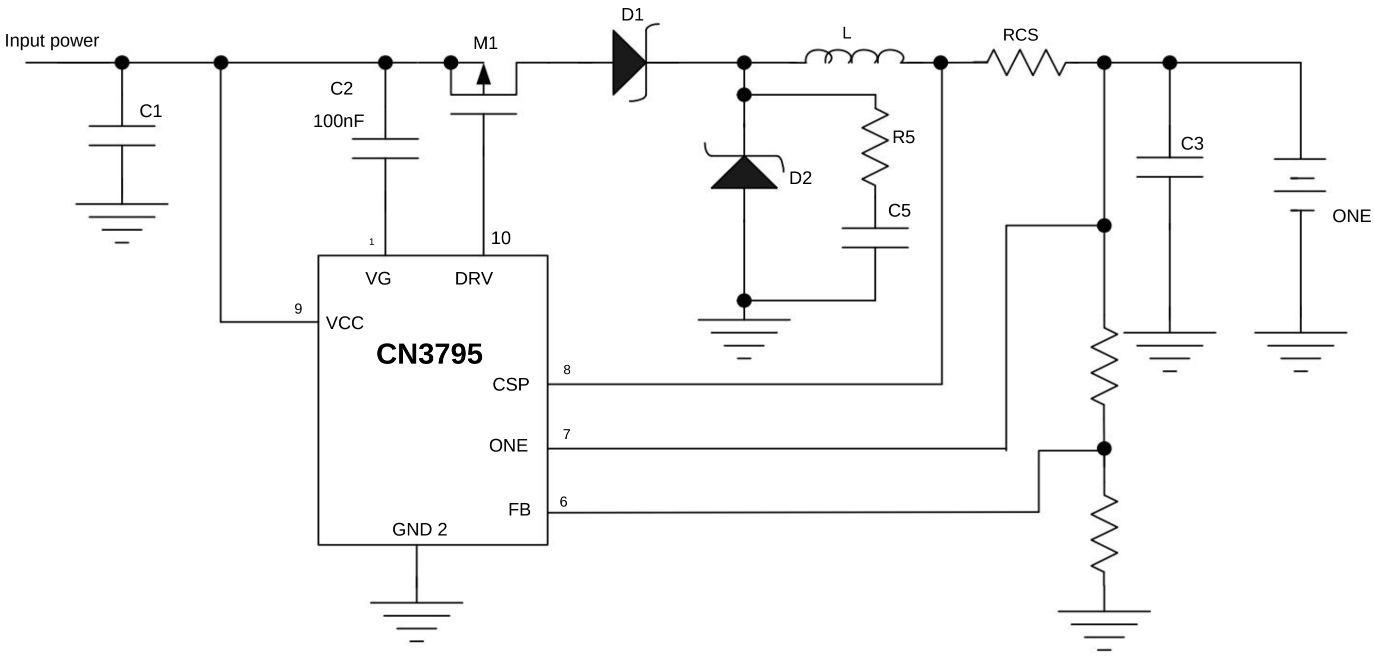


Figure 3 High-frequency oscillation suppression

Considerations in designing

PCB Good PCB design is very important to ensure the normal operation of CN3795, reduce electromagnetic radiation and improve conversion efficiency. For the circuit in Figure 1, the following points need to be considered when

designing the PCB: (1) The positive electrode of the input filter capacitor must be close to the source of the P-channel MOS field effect transistor; (2) Diodes D1 and D2 must be close to the inductor and current detection resistor. Must be close to the inductor; (3) The

output capacitor must be close to the current detection resistor; (4) The input filter capacitor, P-channel MOS field effect transistor, diodes D1 and D2, inductor, current detection resistor and output filter capacito

Be as short as possible;

(5) The resistors R1, R2, R4, R5, R6 and capacitor C4 should be as close as possible to the CN3795; (6) The GND pin of the CN3795, the ground terminals of the resistors R2, R6 and the COM pin of the loop compensation component should be separate Connected to the system ground, this can prevent switching noise from affecting the stability of the loop. The ground terminal of the input capacitor, the anode of diode D2 and the ground terminal of the output capacitor must be connected to the same piece of copper before returning to the system ground. This point is very important to ensure the normal operation of CN3795.

(7) The current sensing resistor RCS should be placed in such a direction that the connection from the CSP pin and BAT pin of the chip to RCS is relatively short. The connections from the CSP pin and BAT pin to RCS should be at the same level, and the distance should be as small as possible. In order to ensure the accuracy of charging current detection, the CSP pin and BAT pin should be directly connected to the current detection resistor. As shown in Figure 4.

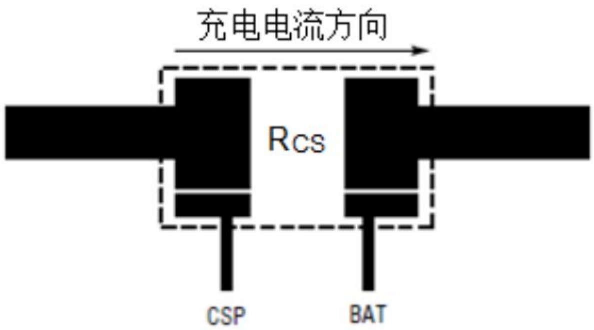
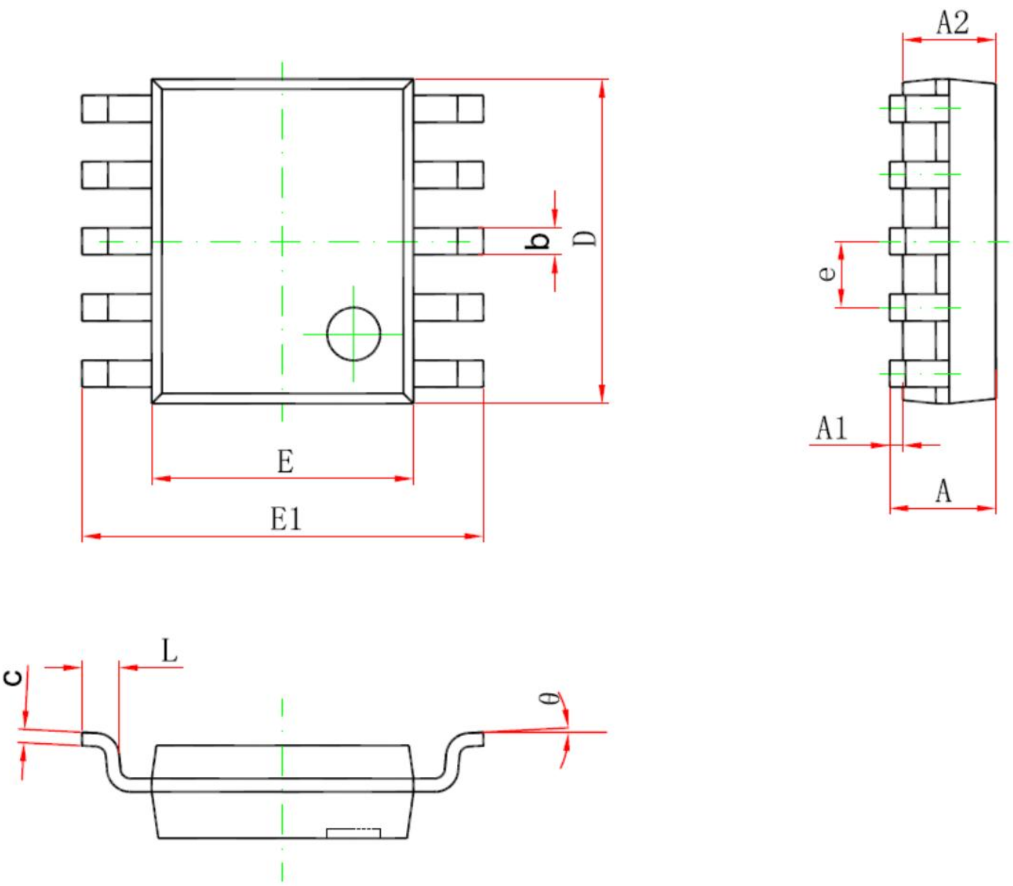


Figure 4 Detection of charging current

Package information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.300	0.450	0.012	0.018
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.000(BSC)		0.039(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	1°	8°