30V OVP, Supports 20W Fast Charging, 2A , with NTC and Enabling Function, 2 Lithium Battery in Series Boost Charger

General Description

IU5207E is a boost charging chip for two lithium batteries in series that supports 20W fast charging. IU5207E integrates power MOS and adopts asynchronous switch architecture, so that it requires only a few peripheral devices in application, which can effectively reduce the overall scheme size and BOM cost. The operating frequency of the boost switch charging converter of it is 500KHz.

The IU5207E has four built-in loops to control the charging process, including constant current (CC) loop, constant voltage (CV) loop, chip temperature regulating loop, intelligently regulating the charging current to prevent the adapter output from collapsing, and matching the input adaptive loop of all adapters. Its input adaptive point is flexibly adjustable through the external voltage dividing resistor.

The IU5207E integrates the 30V OVP function. The input port can stably and reliably withstand the withstand voltage impact within 30V, and stop charging when the input exceeds 8.7v. It is very suitable for the application of type-C interface. At the same time, the chip bat output port withstands 30V, which greatly improves the reliability of the system.

IU5207E provides customers with a slim eqa16 package type for selection, and its rated working temperature range is -40 ℃ to 85 ℃.

Features

- 20W Asynchronous Switch Boost Charging
- Automatically Apply for Fast Charging Input According to Battery Voltage to Improve Charging Efficiency
- 30V Withstand Voltage at BAT PIN, Internal Integrated High Voltage Transistor
- Maximum 2A Charging Current, External Resistance of Charging Current is Adjustable
- NTC Function, Reuse with Enabling Function
- Input Current Adaptive Function, Adaptive Point Externally Adjustable
- Support Led Charging Status Indication
- 500KHz Switching Frequency
- Output Overvoltage and Short Circuit Protection
- Integrated 30V OVP Function
- IC Over Temperature Protection
- IC Temperature Adaptive Adjustment Function
- Good EMI Characteristics

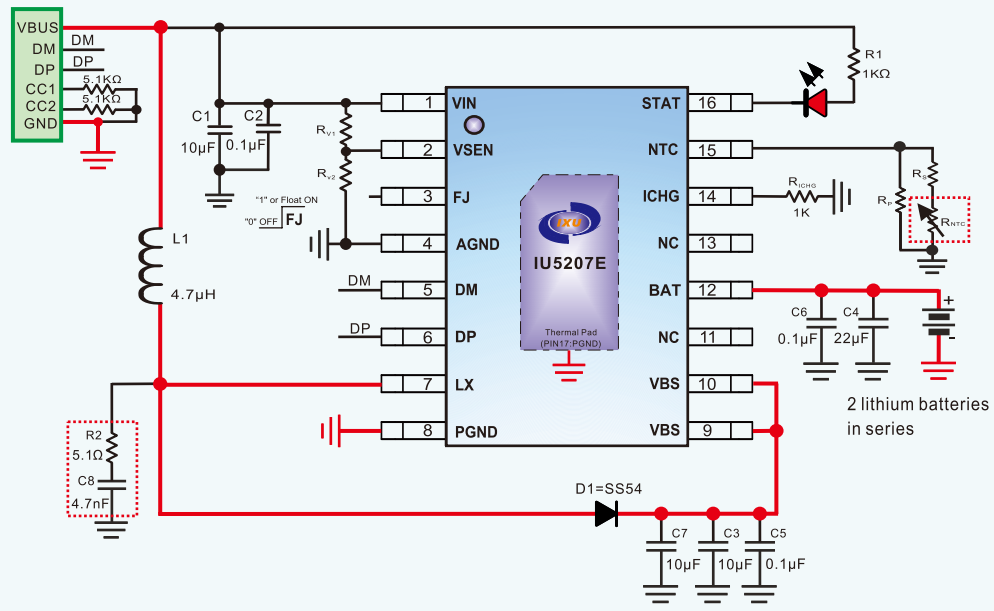
Applications

- POS Machine
- Bluetooth Speakers
- Toys
- Electronic Cigarette
- Interphone
- Lithium Iron Phosphate Battery Pack

Package

- EQA16

Typical Applications



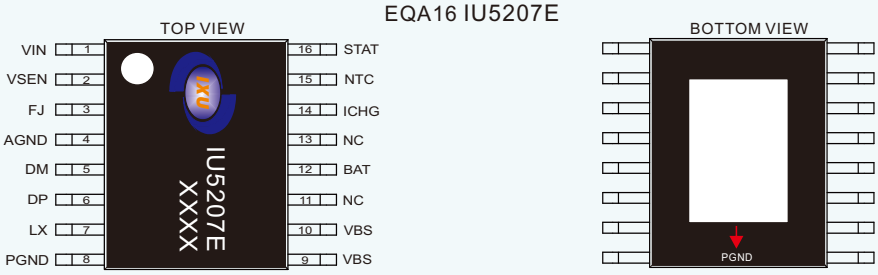
IU5207E Application Circuit

Note:

(1) L1 is the power inductance with a saturation current of 5A; SS54 is a low-voltage drop Schottky diode.
(2) All chip capacitors should be arranged as close to the chip pin as possible.
(3) The 15th pin of the chip, namely the NTC pin, can be reused as an enable pin. When it is set to zero potential, chip charging is prohibited. The pin cannot float. If the NTC function is not used or the NTC resistance of the battery is not connected during production test, the pin must be connected to the ground with a total resistance of 47KΩ.
(4) In order to further improve EMI characteristics, it is necessary to add a microwave absorbing network composed of R2 and C8.
(5) The setting value of constant current charging current must be greater than 500mA, that is, R_{ICHG} must be less than 2KΩ.
(6) When the battery end needs hot plug operation, or is connected to inductive loads such as motors, it is recommended to add another capacitor of at least 100 μF next to C4 to further improve reliability.
(7) The 16th pin of the chip, namely the stat pin, is an output pin of open drain od structure, which outputs 0 level or high resistance state. If this pin is not used at all, it is recommended to be grounded.
(8) It is recommended to add a 1KΩ resistor to the ground at the first pin of the chip to eliminate the phenomenon that the voltage at the first pin may not be 0 when the input power is unplugged due to the reverse leakage current of the Schottky diode itself.
(9) When the DM and DP pins in the figure are not used, they are directly suspended.
(10) The 11th and 13th pins of the chip are empty and can be directly grounded.
(11) The solid red line in the figure shows the path of high current flow.

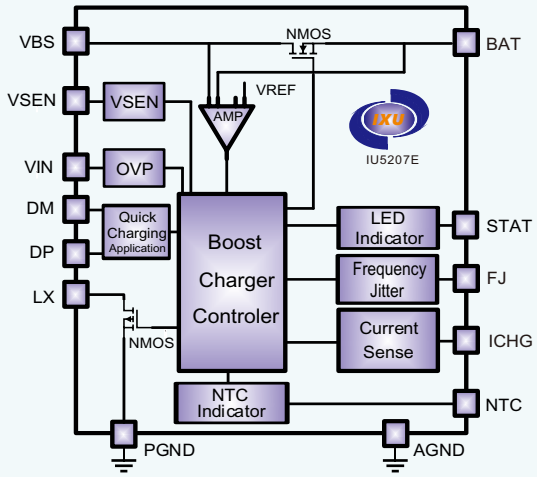
PIN Configuration and Functions

EQA16 IU5207E



IU5207E PIN	NAME	TYPE	DESCRIPTION
1	VIN	P	Analog power input pin.
2	VSEN	I	Input adaptive function pin
3	FJ	I	The frequency jitter function pin. suspended or connected to the power supply to enable this function, and grounded to disable this function
4	AGND	-	Analog ground pin.
5	DM	I/O	USB DM
6	DP	I/O	USB DP
7	LX	I	Switch node pin, connect to external inductor.
8	PGND	-	Power ground pin.
9,10	VBS	O	Boost output pin.
11,13	NC	-	Empty pin, can be grounded
12	BAT	P	Battery positive pin.
14	ICHG	I	Charge current program pin, pull down to GND with a resistor can change the value of charging current.
15	NTC	O	Thermistor input pin, through the external thermistor to detect the battery temperature. And can be multiplexed as an enable port.
16	STAT	O	Charge status indication pin: output 0 level or high resistance state.
Thermal PAD	PGND	-	Power ground pin.

Functional Block Diagram



Absolute Maximum Ratings [1]

SYMBOL	PARAMETER	VALUE	UNIT
VMAX	VIN, BAT, LX, VBS, STAT, NTC, VSEN, FJ	-0.3~30	V
	ICHG, DP, DM	-0.3~6	V
T_J	Junction operating temperature range	-40~150	℃
T_{STG}	Storage temperature range	-55~150	℃
T_{SDR}	Lead temperature (Soldering, 10 sec.)	260	℃

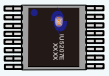
Recommended Operating Conditions

SYMBOL	PARAMETER	VALUE	UNIT
VIN	Input voltage	3.6~8	V
T_J	Junction operating temperature range	-40~125	℃
T_A	Ambient temperature range	-40~85	℃

Thermal Information [2]

SYMBOL	PARAMETER	VALUE	UNIT
θ_{JA}	Package thermal resistance - chip to environment thermal resistance	45	℃/W

Ordering Information

Device	Package	Making	Reel Size	Tape Width	Quantity
IU5207E	EQA16		13”	12mm	4000 units

ESD Range

HBM (Human Body Model) ---------- ±2kV

MM (Machine model) ---------- ±200V

1. The above parameters are only the limit values of device operation. It is not recommended that the working conditions of the device exceed the limit values. Otherwise, the reliability and life of the device will be affected, and even permanent damage will be caused.
2. Where the PCB board is placed in IU5207E, a heat dissipation design is needed. The heat sink at the bottom of IU5207E is connected with the heat sink area of PCB board.

Electrical Characteristics (V_{IN}=5V , R_{ICHG}=1KΩ , L=4.7uH, unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
VIN	Supply voltage		3. 6	5	8	V
VIN_{OVP}	VIN over voltage protection	VIN Rising		8.7		V
ΔVIN_{OVP}	VIN over voltage protection hysteresis			400		mV
I_Q	Input quiescent current			0.6		mA
I_{SD}	Input turned off current	V_{NTC}=0		200		μA
I_{BAT}	Battery leakage current	Without charger or V_{NTC}=0		5		μA
		Plug in charger, V_{BAT}=8.4		20		
V_{CV}	Terminal battery voltage		8.316	8.4	8.484	V
V_{RCH}	Recharge voltage threshold	V_{BAT} Falling		8.2		V
V_{TRK}	TC charge mode battery voltage threshold	V_{BAT} Rising		5.6		V
V_{SHORT}	Battery short threshold	V_{BAT} Falling		2.1		V
V_{OVPB}	BAT over voltage threshold	V_{BAT} Rising		9.24		V
I_{CC}	CC charge mode current	R_{ICHG}=1KΩ	0.9	1	1.1	A
I_{TC}	TC charge mode current			10%		I_{CC}
I_{BS}	Output short circuit charge mode current			10%		I_{CC}
I_{BF}	Terminate charge current			10%		I_{CC}
f_{SW}	Switching frequency			500		KHz
A_I	CC charge mode current gain	A_I=I_{CC}/I_{ICHG}		1000		
I_{NTC}	NTC PIN output current		18	20	22	μA
V_{NTCL}	NTC low temp threshold	V_{NTC} rising		1.31		V
V_{NTCH}	NTC high temp threshold	V_{NTC} falling		0.4		V

Electrical Characteristics (V_{IN}=5V，R_{ICHG}=1KΩ，L=4.7uH, unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
T_{REG}	Chip thermal regulation threshold			120		℃
T_{SD}	Thermal shutdown temperature			150		℃
ΔT	Thermal shutdown temperature hysteresis			20		℃
TMR_{TC}	Trick charge time limit			9.5		Hour
$TMR_{CC/CV}$	CC/CV charge time limit			15.5		Hour

IU5207E Application Points

1. Charge Process

IU5207E adopts complete cc/cv charging mode. When the battery voltage is less than 5.6V, the system charges the battery with trickle current. When the battery voltage is greater than 5.6V, the system enters the constant current charging mode. When the battery voltage approaches 8.4V, the system enters the constant voltage mode. When the system enters the constant voltage mode, if the charging current is less than the termination charging current, the system will stop charging, indicating that the battery is fully charged. After that, if the battery voltage drops below the restart voltage, the system will restart to charge the battery. The so-called charging current I_{CC} here refers to the current value flowing from the bat port to the battery positive pole.

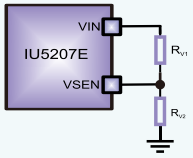
2. Protection Function

IU5207E has perfect battery charging protection function. When the chip has over voltage at the input end, over voltage at the output end and over temperature of the chip, the boost charging function will be turned off immediately. When the battery voltage is lower than V_{SHORT}, the output undervoltage protection function is turned on, the main power tube is turned off first, and the block tube will enter the linear mode and charge the battery with a small short-circuit mode charging current; When the battery voltage is higher than V_{SHORT}, the output short-circuit protection function is turned off.

3. Adaptive Input Current Limit Function

The IU5207E has a special built-in loop, which can automatically adjust the size of the charging current, so as to prevent the input DC power from entering the overdrive state, so as to prevent the adapter from collapsing due to any improper setting. Because the excessive charging current will lead to the decline of the input power supply voltage, with the decline of the power supply voltage, the input of the internal adaptive loop op amp will also decline. When it is reduced to the internal reference value, the built-in adaptive loop will automatically adjust the duty cycle of the system, reduce the charging current and the driving pressure of the input power supply, so that the input voltage is fixed at the set minimum value VIN_{AJ}.

The voltage of the VSEN pin of the IU5207E input adaptive function is modulated at 1.2V. By selecting R_{V1} and R_{V2} resistors, the lowest value that the input voltage can be reduced to VIN_{AJ} is determined. The specific calculation formula is as follows:



$$VIN_{AJ} = \frac{1.2*(R_{V1}+R_{V2})}{R_{V2}}$$

If this pin is connected to VIN, this function is disabled.

4. Chip Temperature Adaptive Adjustment Function

IU5207E has a built-in temperature control loop. When the chip is in the constant current charging process, if the temperature rises to 120℃, the temperature control loop will start to work. The charging current will gradually decrease, and the chip temperature will decrease. Finally, the chip temperature will stabilize at the set value, thus protecting the chip.

5. Charging LED Indication

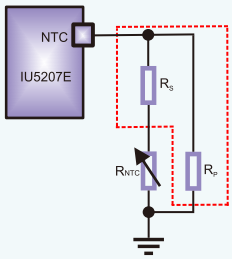
The stat state pin of the chip outputs level 0 or high resistance state. If the LED lamp is not connected, but is directly connected to the master control, there must be a pull-up resistor to convert the high resistance state to the exact high level.

- It is always on during charging and extinguished after being fully charged.
- When the battery terminal overvoltage, battery short circuit, charging time timeout, chip overheating, NTC port detects abnormal battery temperature, input overvoltage and other conditions occur, it flashes at a frequency of 1.6Hz.

6. NTC Resistance Setting

The IU5207E supports the NTC protection function when charging the battery, and detects the battery temperature through the NTC pin. When the detection temperature exceeds the set temperature window value, the system will stop charging.

The working mode of NTC protection function is: the NTC pin is externally connected to the resistance network to GND, and a constant 20μA current is output from the NTC pin. The temperature range of the battery is determined by the voltage drop generated by the current on the resistance network. The internal judgment point of low temperature is 1.31V, and the internal judgment point of high temperature is 0.4V. As shown in the figure, the resistance network composed of R_P and R_S can be designed with appropriate NTC resistance. The NTC pin cannot float. If the NTC function is not used or the NTC resistance of the battery is not connected during the production test, the pin must be connected to the ground with a total resistance of 47KΩ.



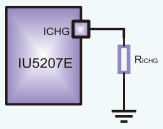
7. Enable Function

The NTC pin can be reused as a chip enable pin. When the NTC pin voltage is connected to the zero level (the

maximum is not more than 0.2V), the chip charging is prohibited, and the STAT pin outputs the high resistance state at the same time.

8. Calculation of ICHG Resistor R_{ICHG}

The value of the ICHG terminal resistance reflects the size of the charging current. According to different applications, the size of the charging current can be easily determined by adjusting the value of the ICHG terminal resistance R_{ICHG} (R_{ICHG} must be less than 2KΩ). The specific circuit is shown in the following figure:



The relationship between I_{CC} and R_{ICHG} during constant current charging is determined by the following formula:

$$I_{CC}= \frac{1*1000}{R_{ICHG}}$$

9. Input Fast Charging Application

- When the battery voltage V_{BAT}<6.2V, do not apply for fast charging, and charge with 5V input;
- When the battery voltage 6.2V ≤ V_{BAT}<6.7V, apply for 5.4V input fast charging;
- When the battery voltage 6.7V ≤ V_{BAT}<7.8V, apply for 6V input fast charging;
- When the battery voltage V_{BAT} ≥ 7.8V, apply for 7V input fast charging;

Every time the battery voltage state changes and the input voltage needs to be reapplied, it will be reset: that is, the input voltage returns to 5V first, and then the required value is applied through DP/DM. During the application of input voltage, the peak current of the system will be limited and the system will restart after the application is completed.

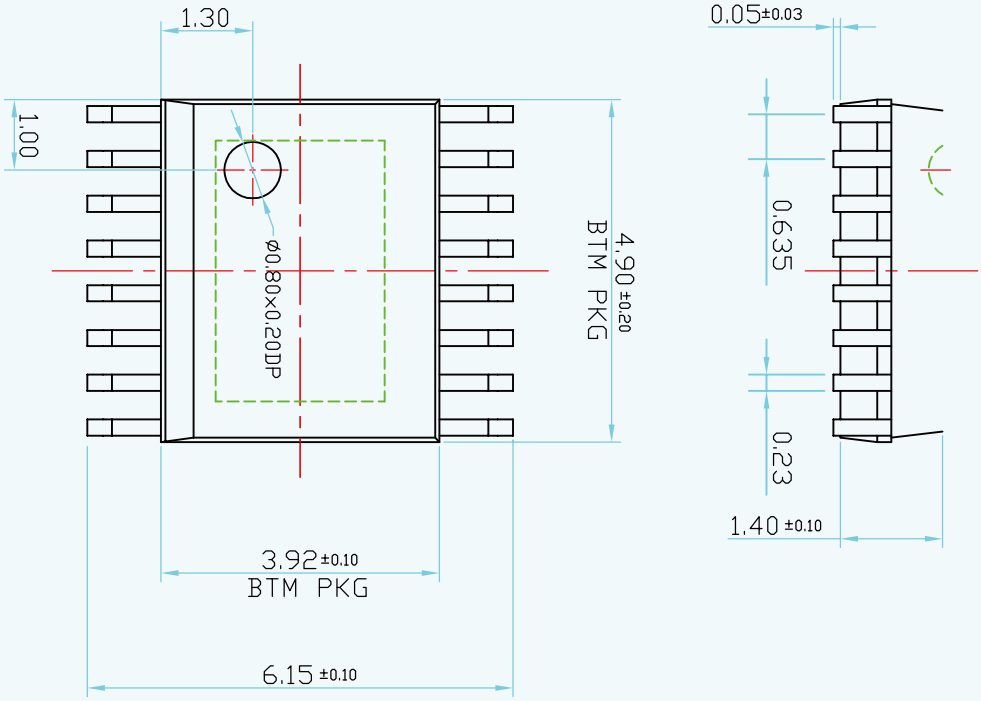
If the fast charge input cannot be successfully applied, it will always be charged with 5V input.

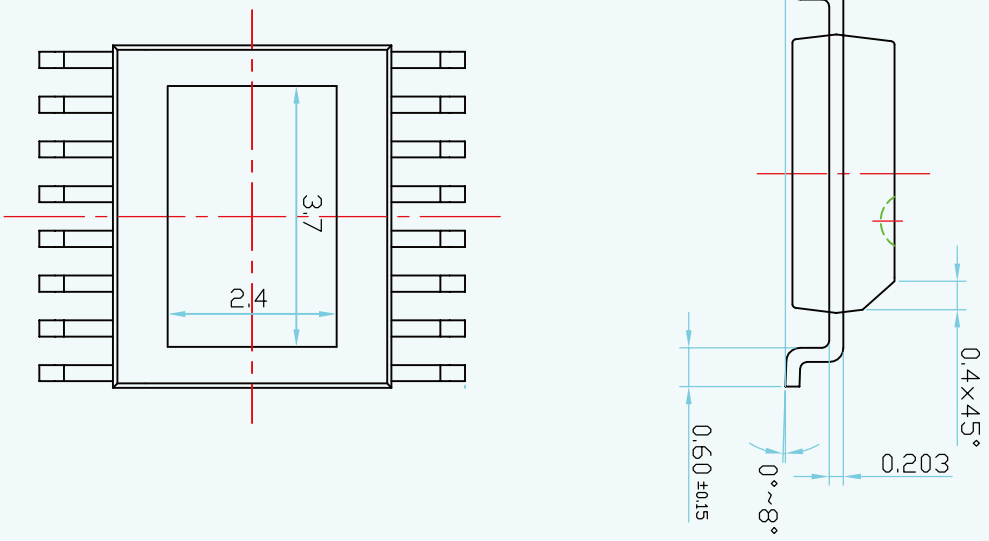
10. chip spread spectrum function

The IU5207E has a built-in frequency jitter module to realize the spread spectrum function and improve the EMI characteristics of the chip. When the FJ pin of the chip is low level, turn off this function; This function is enabled when the FJ pin of the chip is high level or floating.

Package Information

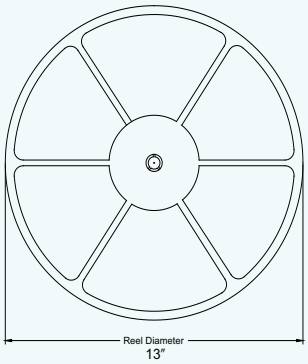
IU5207E PACKAGE OUTLINE DIMENSIONS (units:mm)

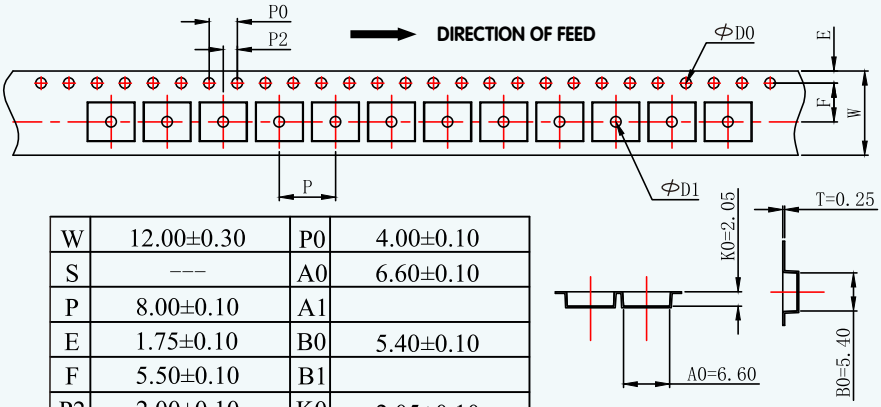




TAPE AND REEL INFORMATION

REEL DIMENSIONS





W	12.00±0.30	P0	4.00±0.10
S	---	A0	6.60±0.10
P	8.00±0.10	A1	
E	1.75±0.10	B0	5.40±0.10
F	5.50±0.10	B1	
P2	2.00±0.10	K0	2.05±0.10
D0	1.50+0.10/-0.00	K1	
D1	1.50+0.10/-0.00	t	0.25±0.05

Precautions for MOS Circuit Operation:

Static electricity can be generated in many places. The following precautions can effectively prevent MOS circuit from being damaged due to the sound of electrostatic discharge:

- Operators shall be grounded through anti-static wrist strap.
- The equipment enclosure must be grounded.
- Tools used during assembly must be grounded.
- Conductor packaging or anti-static materials must be used for packaging or transportation.

Declaration:
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