

## Description

The ISL9230 is a fully integrated high input voltage single-cell Li-ion battery charger with power path management function. This charger performs the CC/CV charge function required by Li-ion batteries. The charger can withstand an input voltage up to 26V but is disabled when the input voltage exceeds 6.6V OVP threshold. The input current limit and charge current are programmable with external resistors. When the battery voltage is lower than 3.0V, the charger preconditions the battery with 10% of the programmed charge current. When the charge current reduces to the programmable end-of-charge (EOC) current level during the CV charge phase, the EOC indicator (CHG) will toggle to a logic High to indicate the end-of-charge condition.

The ISL9230 uses separate power paths to supply the system load and charge the battery. This feature allows the system to immediately operate with a completely discharged battery. This feature also allows the charge to terminate when the battery is full while continuing to supply the system power from the input source, thus minimizing unnecessary charge/discharge cycles and prolonging the battery life.

Two indication pins ( $\overline{PG}$  and  $\overline{CHG}$ ) allow simple interface to a microprocessor or LEDs.

## Ordering Information

PART #	DESCRIPTION
ISL9230EVAL1Z	Evaluation Board for ISL9230

## Features

- Complete Charger for Single-Cell Li-ion/Polymer Batteries
- Current Path Management Optimize for Charge and System Currents
- Intelligent Timeout Interval Based on Actual Charge Current
- 1% Charger Output Voltage Accuracy
- Programmable Input Current Limit
- Programmable Charge Current
- Charge Current Thermal Foldback for Thermal Protection
- Trickle Charge for Fully Discharged Batteries
- 26V Maximum Voltage at VIN pin
- Power Presence and Charge Indications
- Ambient Temperature Range: -40°C to +85°C
- 16 Ld 3x3 TQFN Package
- Pb-Free (RoHS Compliant)

## What is Needed

The following instruments will be needed to perform testing:

- Power supplies:
  - 1) PS1: DC 30V/2A
  - 2) PS2: DC 20V/2A
- DC Electronic load: 20V/2A
- Multimeters
- Function generator
- Oscilloscope
- Cables and wires

**Quick Setup Guide (Refer to Figure 1)**

**DO NOT APPLY POWER UNTIL STEP 7**

- Step 1: Connect a 5V supply PS1 capable to deliver 1.5A current as shown
- Step 2: Connect a 3.7V supply PS2 with current capability 1.5A as shown
- Step 3: Connect voltmeters V1, V2 and V3 to monitor VIN, VBAT and VOUT as shown
- Step 4: Connect a 2nd dc electronic load at CC mode, E-load 2 as shown.
- Step 5: Insert a thermistor of type 103AT between 2 and 3 of jumper header JP9, or place a jumper shunt between pin 1 and 2 to use the on board 10K resistor to skip the NTC evaluation

- Step 6: Configure jumper shunts on JP2, JP3, JP4 and JP5 to set max input current limit
- Step 7: Turn on Power Supplies and dc electronic load
- Step 8: LEDs D1 and D2 should be on, indicating normal charging operation
- Step 9: Turn off E-load 2 to check charge current only
- Step 10: Check charge current as configured in Table 3
- Step 11: With a fixed charge current at CC mode, turn on E-load 2 at constant current mode and slowly increase the current, monitor the currents out of both J1 and J3, until the current at J1 starts to decrease. Further increase the current at J3 will result in the a current decrease at J1 at the same rate, indicating that the power DPPM function if working

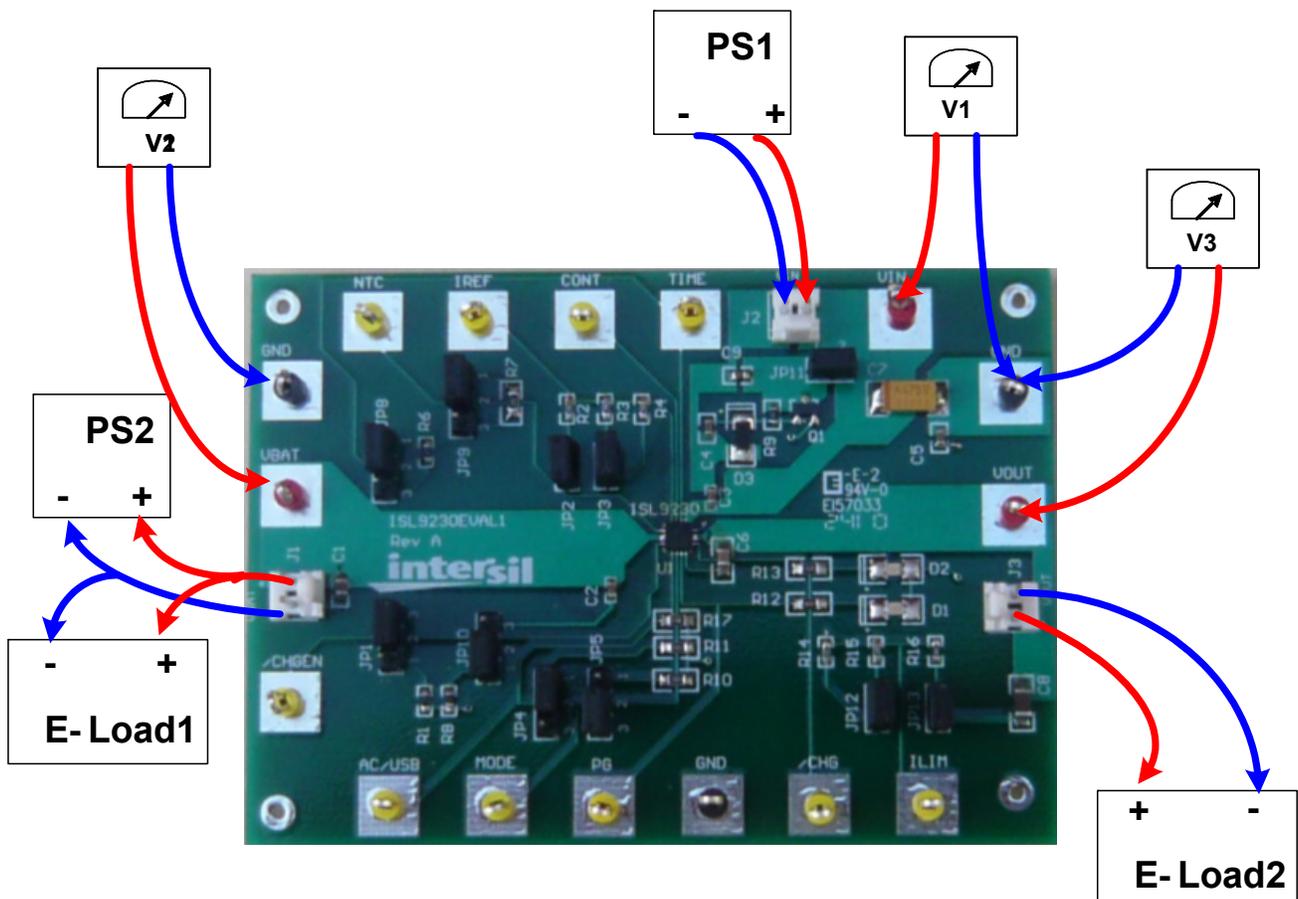


FIGURE 1. CONNECTION OF INSTRUMENTS

## Detailed Description

The ISL9230EVAL1 is a complete evaluation platform addressing all datasheet specifications and functionalists. The jumpers on the board facilitate the necessary connections, such as current measurement.

### Jumper Settings

**JP1** - Insert a shunt installed between pin1 and pin2 to disable the charging function. Insert a shunt installed between pin2 and pin3 to enable the charging function.

**JP2** - Install or remove a jumper shunt to set the fast charge current as shown in Table 3.

**JP3** - Install or remove a jumper shunt to set the fast charge current as shown in Table 3.

**JP4** - Selects the input current limit along with JP5, as shown on Table 2. A shunt installed between pin1 and pin2 pulls the AC/USB pin to high (5.5V) through the internal pullup resistor. If a shunt is installed between 2 and 3, the AC/USB is pulled to low.

**JP5** - Selects the input current limit along with JP4, as shown on Table 2. A shunt installed between pin1 and pin2 pulls the Mode pin to high (5.5V) through the internal pullup resistor. If a shunt is installed between 2 and 3, the Mode is pulled to low.

**JP8** - A shunt installed between pin1 and pin2 sets the TIME pin to use the on board resistor (49.9K) to set the timeout interval. If the shunt is installed on between pin 2 and pin3, the default timeout is used. Connecting an external resistor on pin2 and pin3 to set other timeout intervals.

**JP9** - Thermistor input. Connect a thermistor of type 103AT with 10K @ RT, between pin 2 and pin3. If temperature monitoring is not needed, simply install a jumper shunt on pin 1 and pin2 to connect the on board 10K resistor to GND to skip the NTC function.

**JP10** - A shunt installed between pin1 and pin2 sets the continuous mode. i.e. the charger continues to deliver current to the battery after an EOC condition has been reached. If the shunt is installed between pin2 and pin 3, the charge will be terminated when the EOC current is reached.

**JP11** - Install a jumper shunt to use VIN as the bias power for the LEDs and the internal pollup source. If an external source is used for these house keeping sources, connect a 5V supply between pin 1 and GND.

**JP12** - Install or remove a jumper shunt to set the input current limit as shown in Table 2.

**JP13** - Install or remove a jumper shunt to set the input current limit as shown in Table 2.

**TABLE 1. Input current limit settings for AC/USB=1 and MODE=0)**

	Resistor value	ILIM
JP12 and JP13 off	3.09K	493mA
JP12 on and JP13 off	1.62K	993mA
JP12 off and JP13 on	1.56K	1030mA
JP12 and JP13 on	1.07K	1505mA

**TABLE 2. Input Current Limit Selection**

Jumper	AC/USB	MODE	DESCRIPTION
Shunt on 2-3 JP4 Shunt on 2-3 JP5	0	0	USB 100mA limit
Shunt on 2-3 JP4 Shunt on 1-2 JP5	0	1	USB 500mA limit
Shunt on 1-2 JP4 Shunt on 2-3 JP5	1	0	R <sub>LIM</sub> current programming
Shunt on 1-2 JP4 Shunt on 1-2 JP5	1	1	Suspend mode

**TABLE 3. Fast charge current settings**

	Resistor value	ICHG
JP2 and JP3 off	1.96K	454mA
JP2 on and JP3 off	1.1K	809mA
JP2 off and JP3 on	1.08K	820mA
JP2 and JP3 on	0.68K	1309mA

Board Layout Information

Schematic of PCB Board

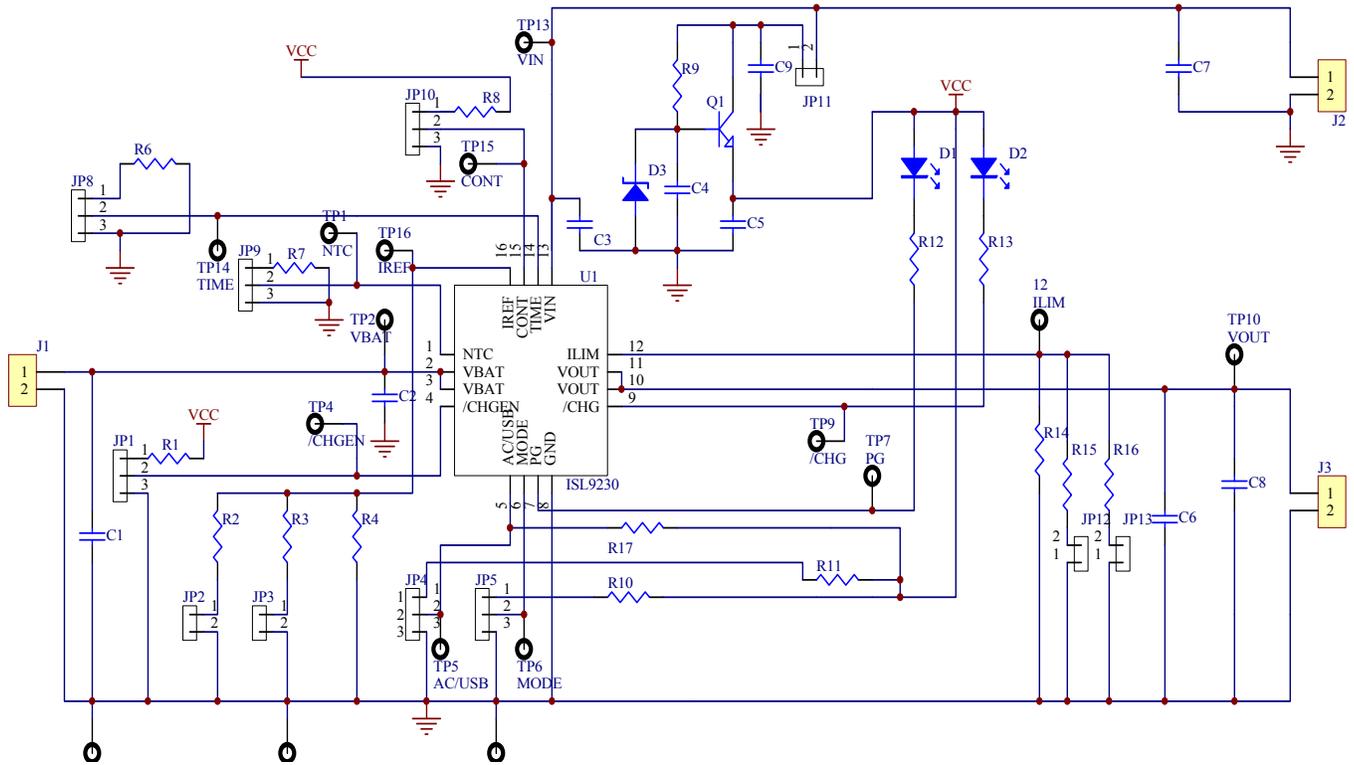
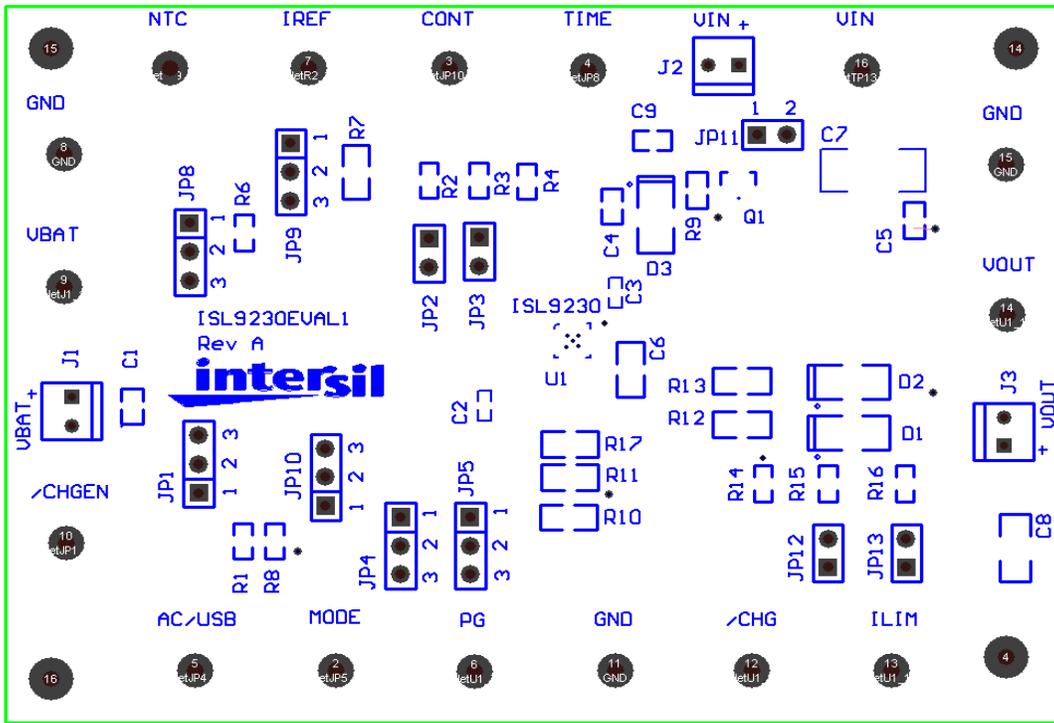
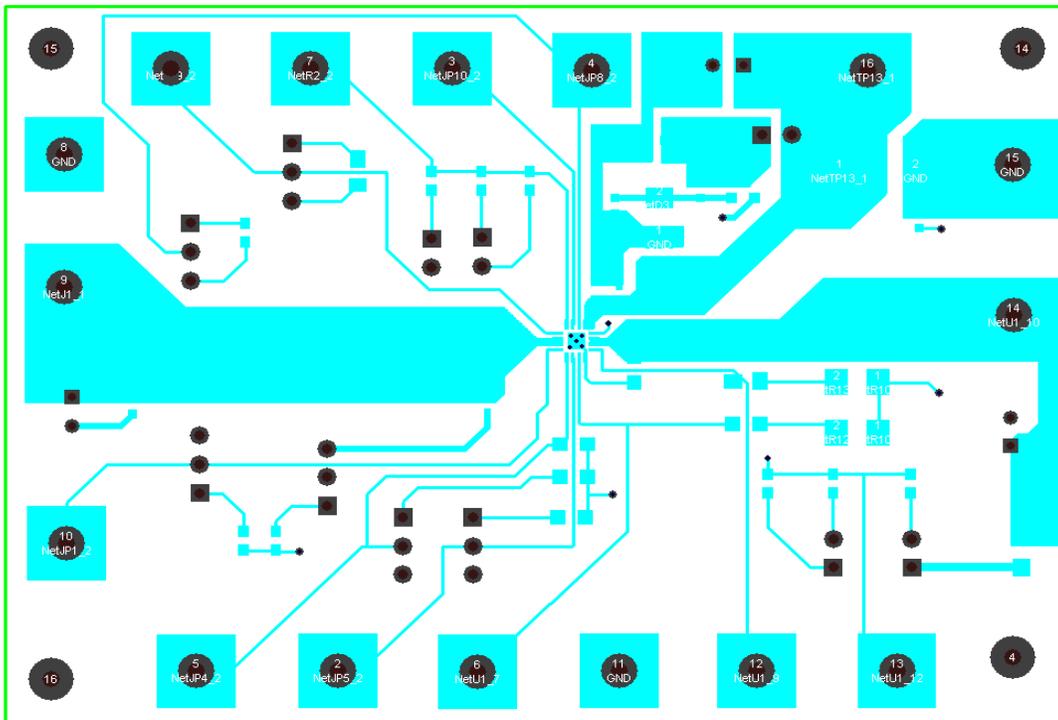


FIGURE 2. SCHEMATIC

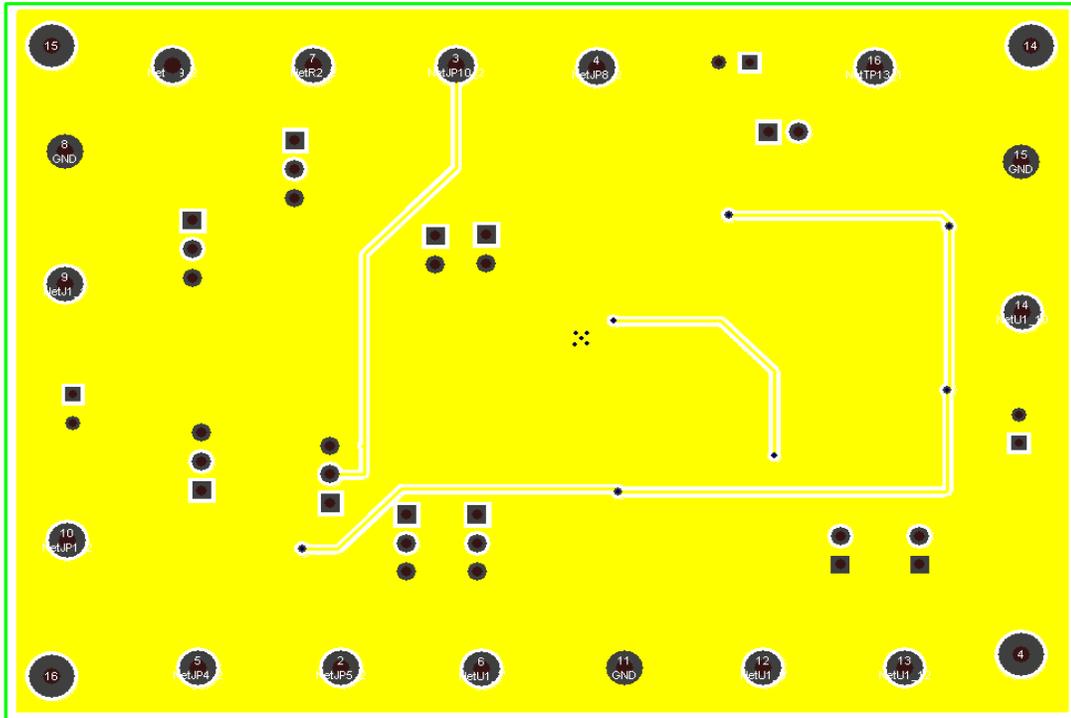
PCB Layout



SILK LAYER



TOP LAYER



BOTTOM LAYER

Intersil Corporation reserves the right to make changes in circuit design, software and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that the Application Note or Technical Brief is current before proceeding.

For information regarding Intersil Corporation and its products, see [www.intersil.com](http://www.intersil.com)

## Application Note xxxx

### Bill of Materials

<i>Item</i>	<i>Qty</i>	<i>Reference</i>	<i>Part Description</i>	<i>PCB Footprint</i>	<i>Part Number</i>	<i>Vendor</i>
1	1	U1	Charger IC	3x3 TQFN	ISL9230	Intersil
2	2	R1, R8	10K, 5%	0603		Any
3	1	R2	1.96K 1%	0603		Any
4	1	R3	2.49K, 1%	0603		Any
5	1	R4	2.43K, 1%	0603		Any
6	1	R6	49.9K, 1%	0603		Any
7	3	R7, R10, R11	10K, 1%	0805		Any
8	1	R9	3.3K, 5%	0603		Any
9	2	R12, R13	330 ohm, 5%, SMD Resistor	0805	ERJ-6GEYJ331V	Panasonic
10	1	R14	3.09K 1%	0603		Any
11	1	R15	3.4K 1%	0603		Any
12	1	R16	3.16K 1%	0603		Any
13	1	R17	301K 1%	0805		Any
14	1	C1	2.2UF/6.3V, X7R Ceramic	0603		Any
15	1	C2	0.1UF/6.3V, X7R Ceramic	0402		Any
16	1	C3	0.1UF/35V, X7R Ceramic	0402		Any
17	3	C4, C5, C9	0.1uF, 50V, X7R Ceramic	0603	ECJ-1VB1H104K	Panasonic
18	1	C6	0.1uF, 50V, X7R Ceramic	0805	GRM21BR71C475KA73L	MURATA
19	1	C7	4.7uF, 35V, Tantalum	6032-28	ECS-T1VC475R	Panasonic
20	1	C8	4.7uF, 6.3V, X7R Ceramic	1206		Any
21	1	D1	RED	LED THIN 635NM RED DIFF 0805 SMD	67-1552-1-ND	Digikey
22	1	D2	GREEN	LED THIN 565NM GRN DIFF 0805 SMD	67-1553-1-ND	Digikey
23	1	D3	Zener, 6.2V, 0.5W	138-80	BZX84C6V2T	
24	1	Q1	60V, 1A NPN transistor	SOT-23	FMMT491TA	Zetex
25	10	General test ponits	TEST POINT	TEST POINT PC MULTI PURPOSE YEL	5014K-ND	Digikey
26	3	GND	TEST POINT	TEST POINT PC MULTI PURPOSE BLK	5011K-ND	Digikey
27	3	VIN, VBAT, VOUT	TEST POINT	TEST POINT PC MULTI PURPOSE RED	5010K-ND	Digikey
28	5	JP2, JP3, JP11, JP12, JP13	CON2	JUMPER	538-22-28-4020	Mouser
29	6	JP1, JP4, JP5, JP8, JP9, JP10	CON3	JUMPER	538-22-28-4020	Mouser
30	3	J1, J2, J3	CONN	CONN HEADER VERT 2POS .100 TIN	A1921-ND	Digikey