

Demonstration of Battery Protection ICs

Description

The Battery protection demo is designed based on GLF73915 / GLF73910. It can display the status of charge, over-discharge voltage protection, short circuit protection (SCP), shipping mode through LEDs. Sales can use this demo to show customers the functions of GLF73915 / GLF73910 without equipment. Of course, this demo can also be used to test the functions of GLF73915 / GLF73910 (such as over-charge-voltage protection, 0V charging, reverse polarity connection protection, over-charge current protection), but it must be carried out under the guidance of FAE.

Demonstration and Accessories

The whole set of Demo consists of battery protection demo V1.0 and accessories, shown in *Fig 1*.

1. The Battery protection demo is shown in the lower right corner of *Figure 1*. The parameters of the charger are: CC = 45 mA, the charge cut-off current is 4 mA, CV = 4.2 V; the battery model is: LIR1054, 55 mAh, and the charge cut-off voltage is 4.35 V.
2. The accessories include 1 power adapter (input: 100 – 240 V ~ 50/60 Hz output: 5 V/2.1 A), 1 USB tester (display charging current), 1 USB cable (length : 1.5 meters)

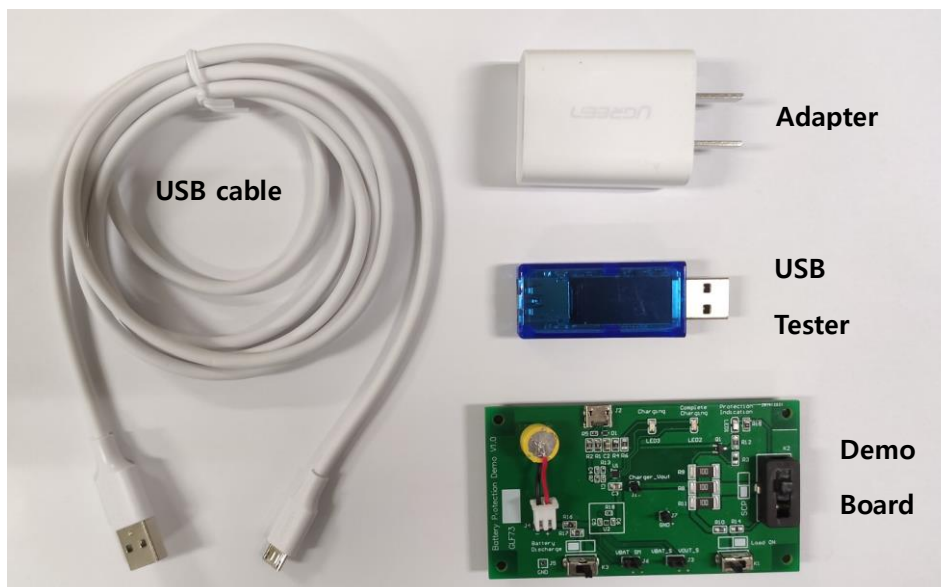


Fig 1. Battery protection demo and accessories

Terminal / switch Description

Fig 2 is the photo of the battery protection demo V1.0, the size is same as business card (5cm x 9cm). All the descriptions of terminals, interfaces and slide switches can be found in Table 1. The circuit in the white box is the GLF73915 / GLF73910 circuit. Sales can tell customers that the peripheral circuit of GLF73915 / GLF73910 is extremely simple, with only 4 devices: U2 is GLF73915/0, C6 and C5 are 1 uF capacitors, and R18 is a 330R resistor.

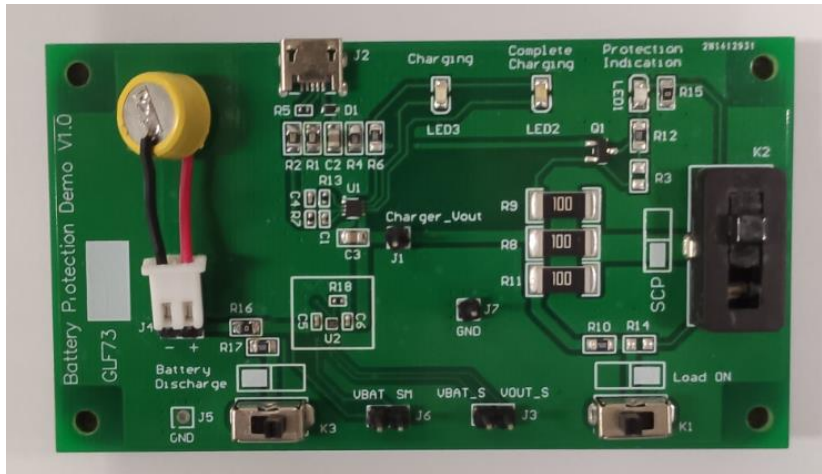


Fig 2. Battery protection demo V1.0

Table 1. Terminal / switch description

Terminal/Switch	Description
J2	Micro USB connector (female), used to connect the cable with Micro USB male connector
J4	Connected rechargeable lithium ion battery (model: lir1054, 55 mAh)
J3	Voltage detection of VBAT PIN and VOUT PIN of GLF73915 / GLF73910
J6	Shipping mode setting interface, you can trigger the Shipping mode function by short-circuiting VBAT and SM, thus closing GLF73915 / GLF73910.
J1	Charger output voltage (VOUT of GLF73915 / GLF73910) detection
J7, J5	GND
K1	Switch to "Load on", and the VOUT terminal of GLF73915 / GLF73910 will connect a 150 Ω resistor to GND. The 150 Ω resistor simulates the load when the earphone is working. If the switch is not switched to "Load on", the 150 Ω resistor is disconnected from the VOUT terminal of GLF73915 / GLF73910
K2	Switch to "SCP" to trigger the short circuit protection of GLF73915 / GLF73910, and the blue LED (LED1) will go out (Switch to "SCP", the VOUT terminal of GLF73915 / GLF73910 will be connected to GND through 3 parallel 10 Ω resistors to simulate a load short circuit. If the switch is not switched to "SCP", the VOUT terminal of GLF73915/0 is floating)
K3	Switch to "Battery Discharge", the battery will be discharged directly by 150Ω resistance, but will not pass GLF73915 / GLF73910

How to use the battery protection demo

Charging Function Demonstration

1. As shown in *Fig 3*, before connecting the USB cable, move K1, K2 and K3 to the corresponding positions.
2. As shown in *Fig 4* and *Fig 5*, the demo board can be powered by the power adapter or the USB port of the computer. We can find the charging current through the USB tester (shown in the figure is 14.7 mA) . LED3 (Red) is on, indicating that it is currently charging (as shown in *Fig 4* and *Fig 5*). LED2 (Green) is on, indicating that the battery is fully charged (as shown in *Fig 6*). LED1 (Blue) is off during the charging process.

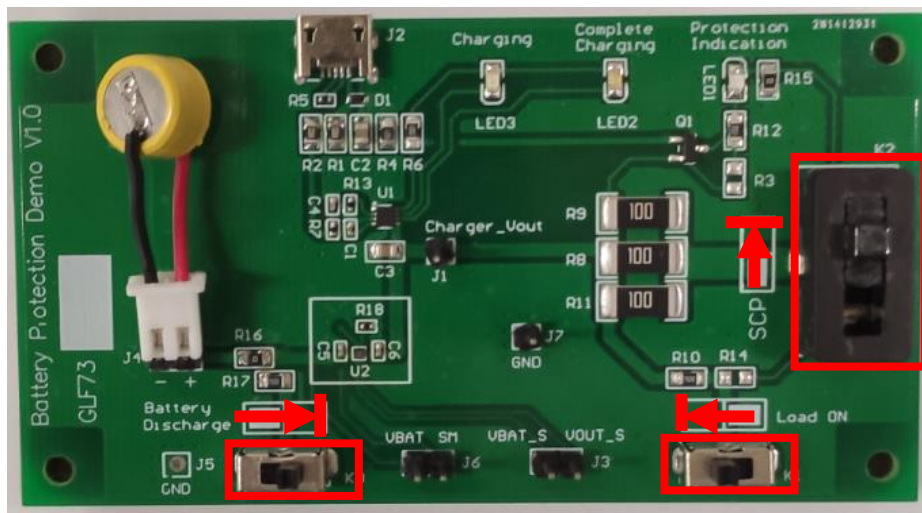


Fig 3. Battery protection demo V1.0



Fig 4. Connection diagram (power adapter)



Fig 5. Connection diagram (USB port)

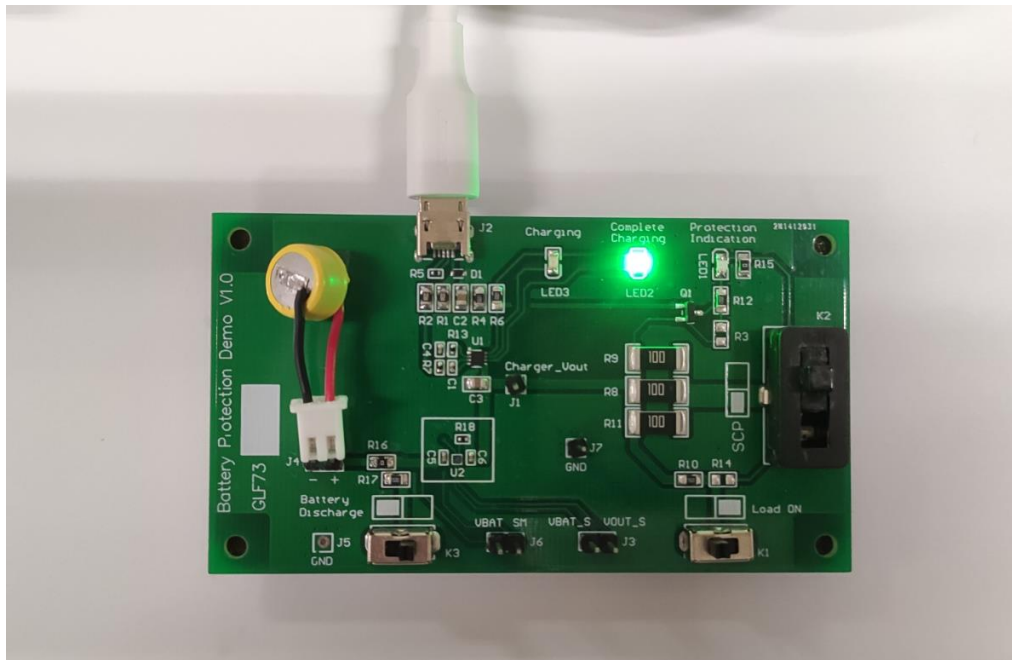


Fig 6. Fully Charged

Shipping Mode Demonstration

1. Unplug the USB cable and stop charging. As shown in Fig 7, we can see that both LED1 (Red) and LED2 (Green) are off, and LED3 (Blue) is on. When LED3 (Blue) is on, it means that GLF73915 is on, the circuit is working normally, and no abnormality occurs.
2. As shown in Fig 8, we short J6 by jumper cap or key, then GLF73915 enters Shipping mode (GLF73915 is off), LED3 (Blue) is off.
3. Reconnect the USB cable to charge, and then remove the USB cable. GLF73915 will exit Shipping mode, GLF73915 is on, LED3(Blue) is on.

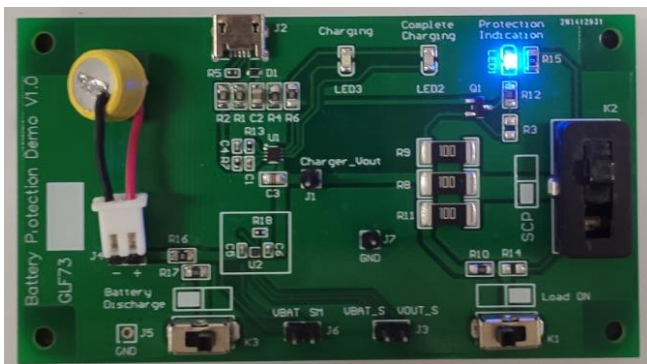


Fig 7. Shipping mode

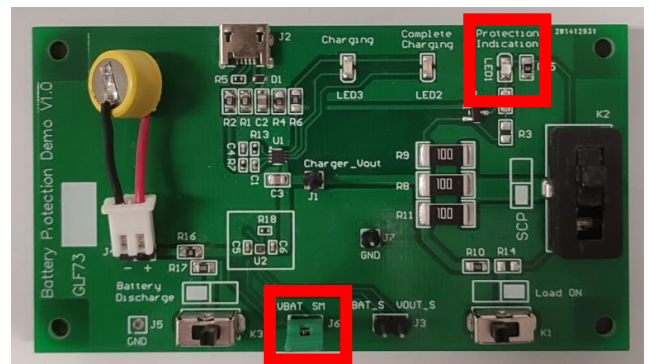


Fig 8. Shipping mode

Short Circuit Protection (SCP) Demonstration

1. Unplug the USB cable and stop charging. As shown in *Fig 7*, we can see that both LED1 (Red) and LED2 (Green) are off, and LED3 (Blue) is on. When LED3 (Blue) is on, it means that GLF73915 / GLF73910 is on, the circuit is working normally, and no abnormality occurs.
2. As shown in *Fig 9*, we switch K2 to the "SCP" side, the load short circuit protection of GLF73915 / GLF73910 is triggered, at this time GLF73915 / GLF73910 is turned off, and LED3 (Blue) is off. Note: After the demonstration of SCP, be sure to switch K2 to the opposite side of "SCP".
3. Reconnect the USB cable to charge, and then remove the USB cable. GLF73915 / GLF73910 will exit SCP, GLF73915 / GLF73910 is on, LED3(Blue) is on.

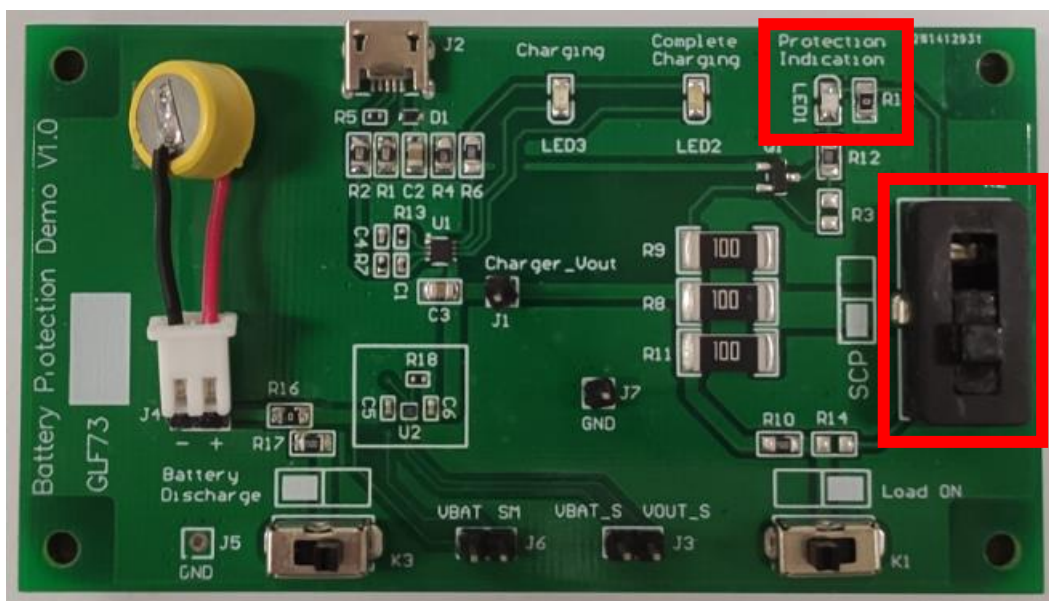


Fig 9. Trigger SCP

Over-Discharge Voltage Protection Demonstration

1. Unplug the USB cable and stop charging. As shown in *Fig 7*, we can see that both LED1 (Red) and LED2 (Green) are off, and LED3 (Blue) is on. When LED3 (Blue) is on, it means that GLF73915 / GLF73910 is on, the circuit is working normally, and no abnormality occurs.
2. As shown in *Fig 10*, we switch K1 to the "Load on" side, at this time, the battery will discharge through a 150 Ω resistor. When the battery voltage is lower than the over-discharge voltage detection voltage (2.8V), the Over-discharge voltage protection of GLF73915 / GLF73910 is triggered, at this time GLF73915 / GLF73910 is turned off, and LED3 (Blue) is off. If the battery is fully charged, it may take more than 30 minutes to trigger the over-discharge voltage protection. At this time, we can switch K3 to "Battery Discharge" to speed up the battery discharge. Note: After the demonstration of over-

discharge voltage protection, be sure to switch K1 to the opposite side of "Load on", switch K3 to the opposite side of "Battery Discharge".

3. Reconnect the USB cable to charge, and then remove the USB cable. GLF73915 / GLF7390 will exit over-discharge voltage protection, GLF73915 / GLF73910 is on, LED3(Blue) is on.

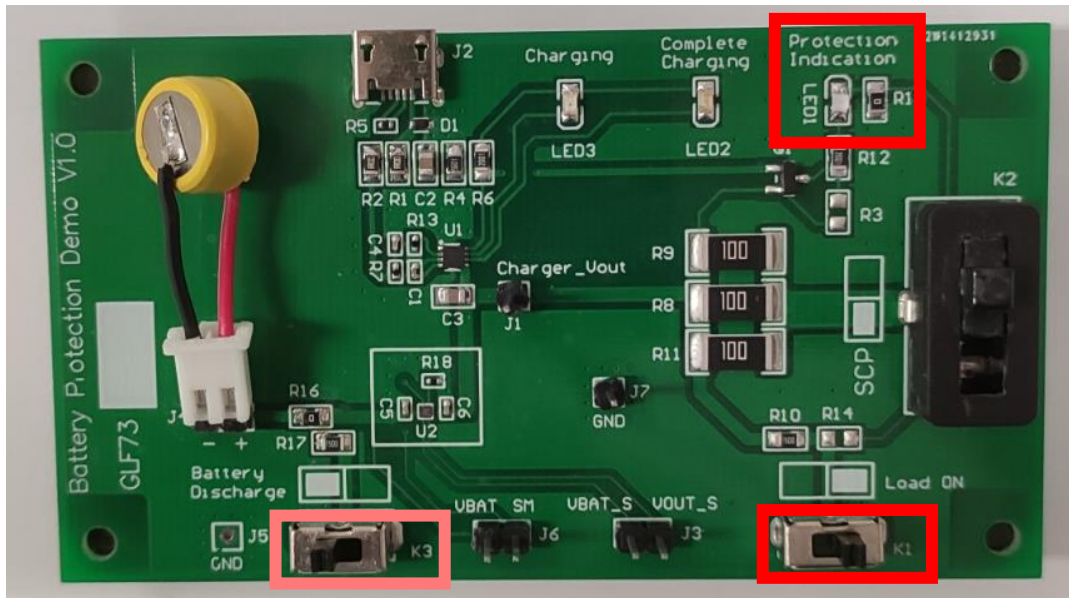


Fig 10. Over-discharge voltage protection

Reverse Polarity Connection Protection

1. Unplug the USB cable and stop charging. As shown in *Fig 7*, we can see that both LED1 (Red) and LED2 (Green) are off, and LED3 (Blue) is on. When LED3 (Blue) is on, it means that GLF73915 / GLF73910 is on, the circuit is working normally, and no abnormality occurs.
2. As shown in *Figure 11*, unplug the battery and then intentionally reverse the polarity of the battery, we will find that all LEDs are off.
3. We unplug the battery and restore the polarity connection of the battery to the normal state. As shown in *Fig 7*, reconnect the USB cable to charge, and then remove the USB cable. GLF73915 / GLF73910 is on, LED3(Blue) is on.

Note: Do not leave the battery connected reversely for long time. Just do the test very quickly to avoid any damage.

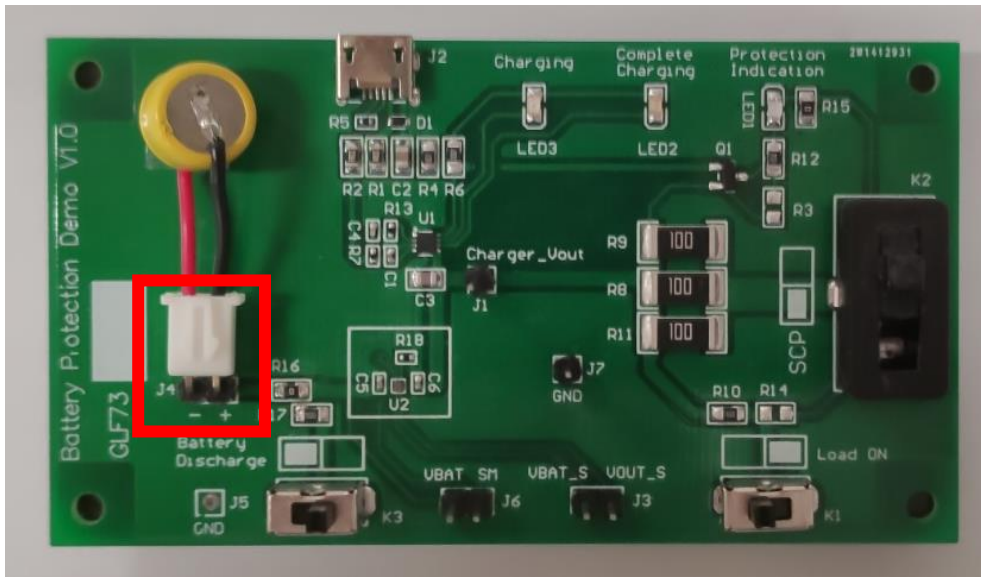


Fig 11. Reverse Polarity Connection Protection

The LED status quick reference table is shown in *Table 2*.

Table 2. LED status description

Status Description		LED1 (Red)	LED2 (Green)	LED3 (Blue)
Charging	The battery is not fully charged	ON	OFF	OFF
	Full battery status	OFF	ON	OFF
Not charging	GLF73915 / GLF73910 ON (shipping mode, short-circuit protection and over-discharge voltage protection are not triggered)	OFF	OFF	ON
	GLF73915 / GLF73910 OFF (reverse polarity connection protection, shipping mode, short-circuit protection and over-discharge voltage protection are triggered)	OFF	OFF	OFF

Schematic

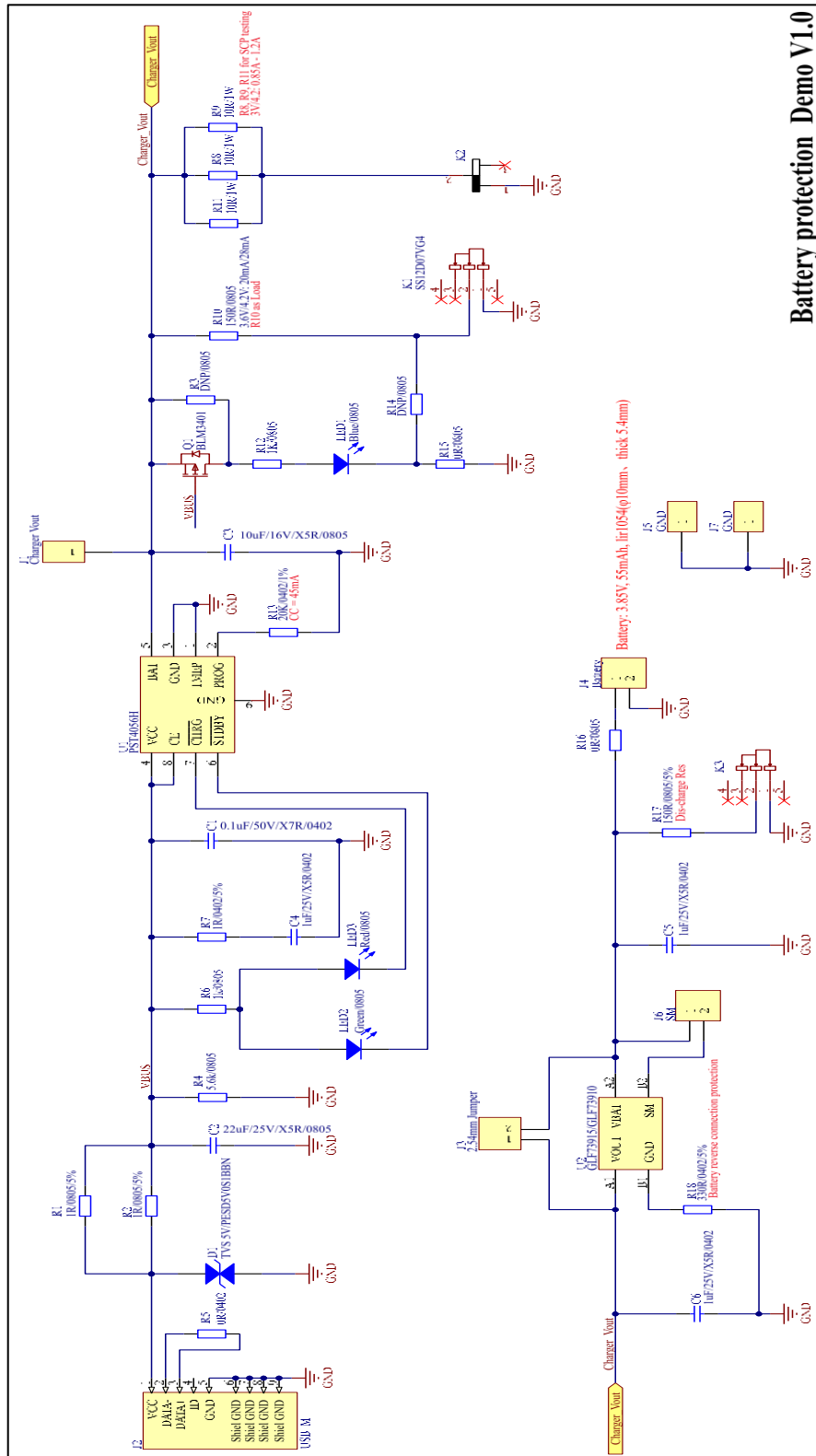


Fig 11. SCH of Battery protection demo V1.0

PCB Drawings

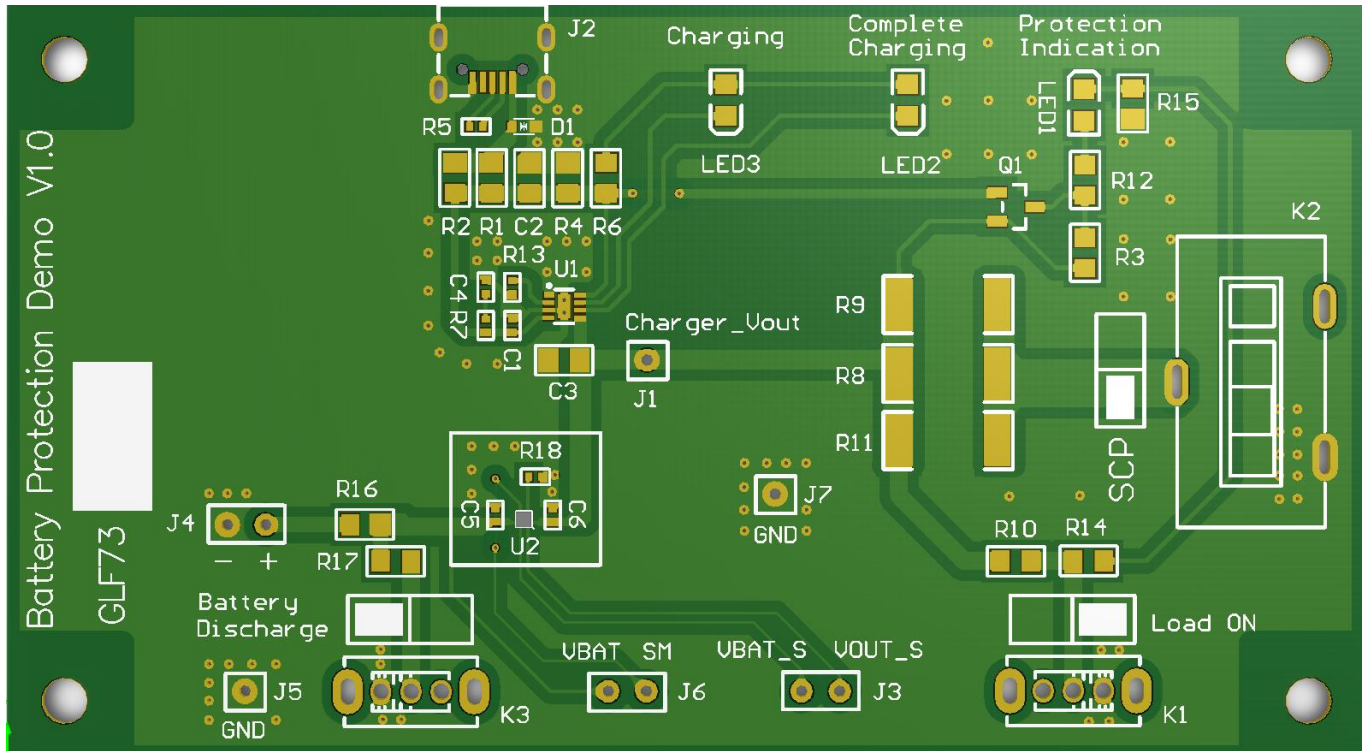


Fig 12. Top Silk screen

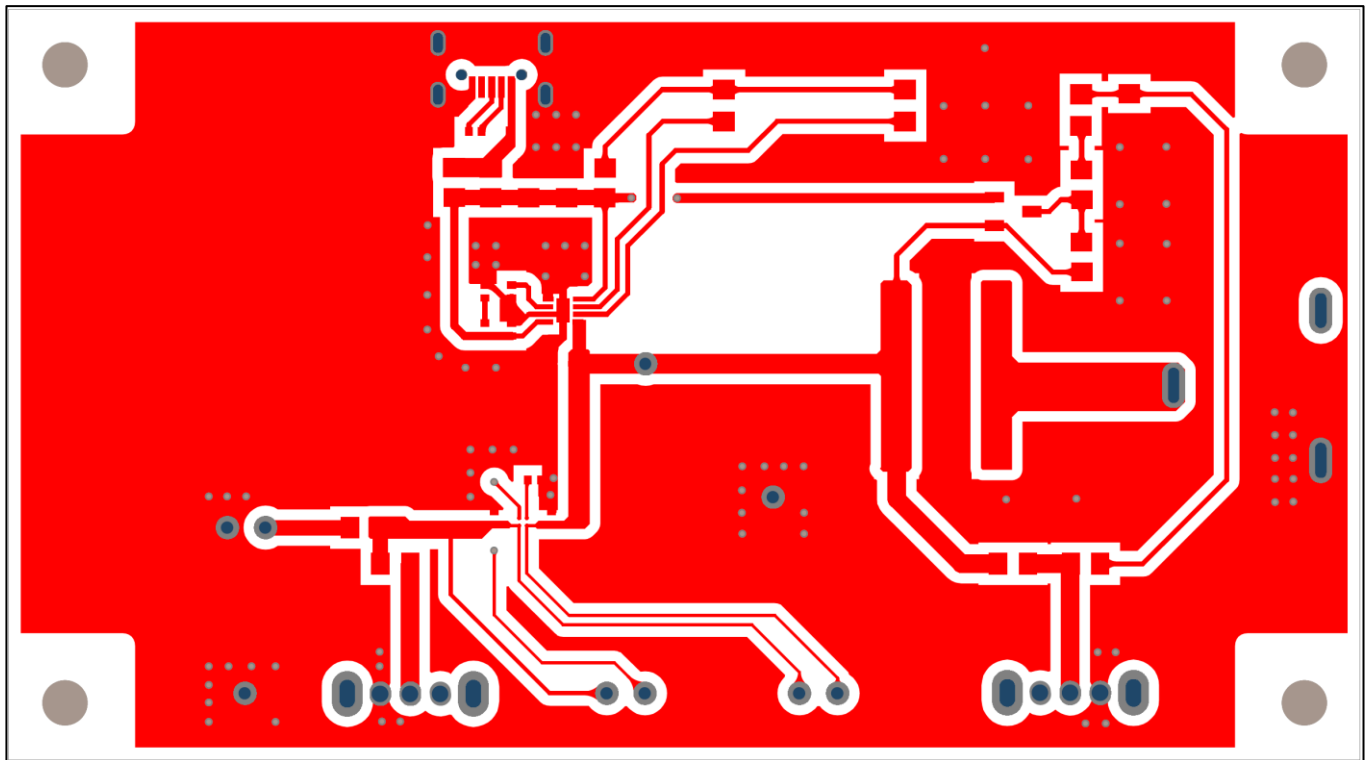


Fig 13. Top layer

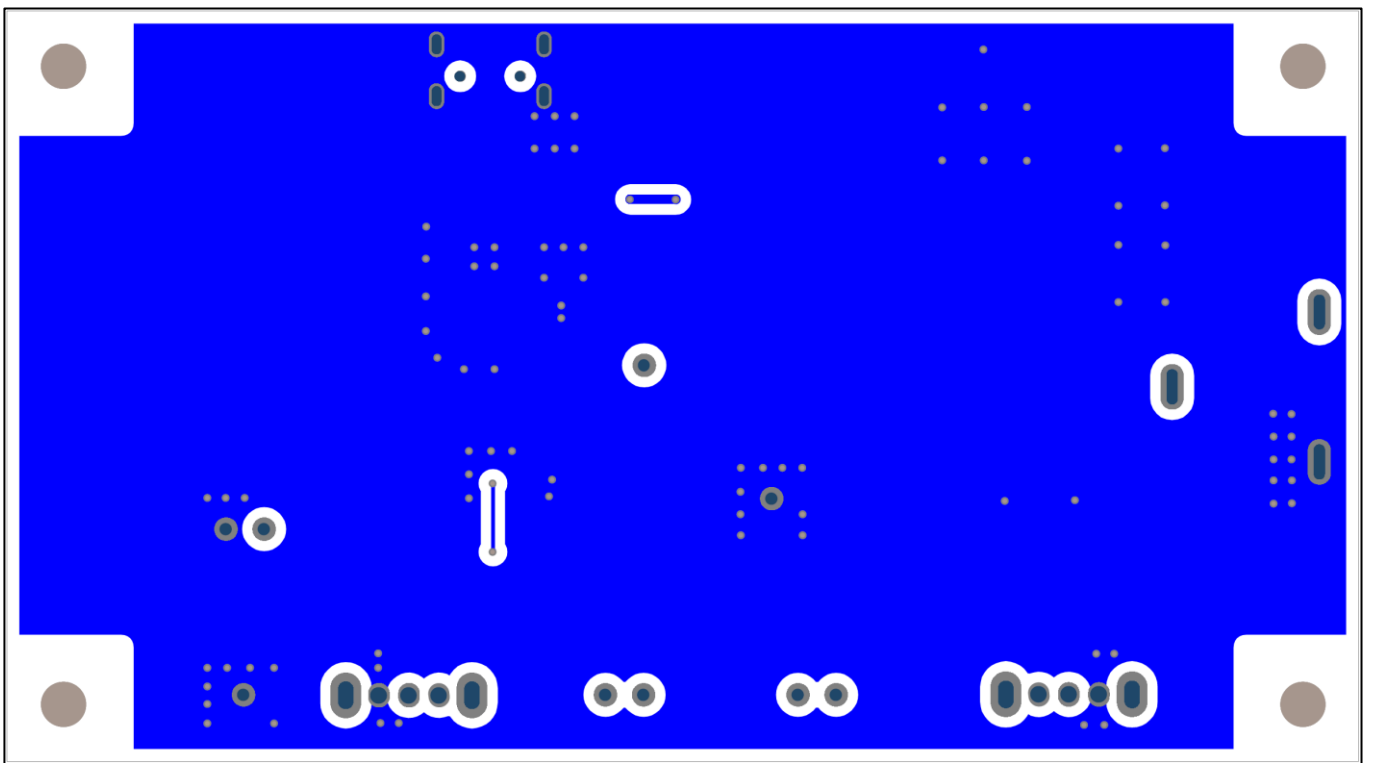


Fig 14. Bottom layer

BOM of Battery Protection Demo V1.0

No.	Designator	Part Description	Package Ref.	Part No.	MFR
1	C1	Capacitor, 0.1uF/50V/X7R/0402	0402	-	-
1	C2	Capacitor, 22uF/25V/X5R/0805	0805	-	-
3	C4, C5, C6	Capacitor, 1uF/25V/X5R/0402	0402	-	-
2	R1, R2	Resistor, 1R/0805/5%	0805		
2	R3, R14	Resistor, 0805/ DNP	0805	NC	NC
1	R4	Resistor, 5.6K/0805/5%	0805	-	-
1	R5	Resistor, 0R/0402	0402	-	-
2	R6, R12	Resistor, 1K/0805/5%	0805	-	-
1	R7	Resistor, 1R/0402/5%	0402	-	-
3	R8, R9, R11	Resistor, 10R/1W/5%	2510	-	-
1	R10	Resistor, 150R/0805/5%	0805	-	-
1	R13	Resistor, 20K/0402/1%	0402	-	-
2	R15, R16	Resistor, 0R/0805	0805	-	-
1	R17	Resistor, 150R/0805/5%	0805	-	-
1	R18	Resistor, 330R/0402/5%	0402	-	-
1	LED1	LED, Blue/0805	LED0805	-	-
1	LED2	LED, Green/0805	LED0805	-	-
1	LED3	LED, Red/0805	LED0805	-	-
3	J1, J5, J7	CON, TP	TP	-	-
1	J2	CON, micro-USB	USB_M	-	-
3	J3, J4, J6	CON, 2 PIN Jump/2.54mm	header 2	-	-
2	K1, K3	Switch, slide switch	SS12D07VG4	-	SHENZHEN SHOUHAN
1	K2	Switch, slide switch 6A	CSJ-1206-PAP31-14R	-	Defond
1	Q1	MOSFET, P-Ch/30V/4.2A/SOT23	SOT23	BLM3401	SHANGHAI BELLING
1		Battery, 3.85V, 55mAh, IIR1054(φ10mm、thick 5.4mm)			
1	U1	IC, Battery charger	DFN8	PST4056H	悦腾
1	U2	IC, Battery protection	WLCSP4	GLF73915/GLF73910	GLF

NOTICE: The evaluation board or demo board provided by GLF Integrated Power is intended for use for ENGINEERING DEVELOPMENT, OR EVALUATION PURPOSES ONLY and is not for any commercial use. The user assumes all responsibility and liability for proper and safe handling of the goods.