5V3.4A single chip Type-C mobile power solution

1. Overview

SW6115 is a highly integrated Type-C mobile power dedicated all-in-one chip, which integrates 2.5A high-efficiency switch charging,3.4A high-efficiency synchronous boost output, Type-C interface logic, lighting drive and corresponding management logic. Only a small number of peripherals are required,It can form a complete high-performance Type-C mobile power solution.

2. Application field

- mobile power
- Other battery-powered equipment

3. Specifications

- Switch charging
  - Current up to 2.5A, efficiency up to 96%
  - Support 4.2/4.3/4.35/4.4V battery type
  - Support battery temperature protection
  - Support temperature loop control
- Synchronous boost
  - Output current up to 3.4A, efficiency up to 95%
  - Support line loss compensation
  - Automatic load detection
  - Automatic light load detection
- **Type-C** interface
  - Built-in USBType-C interface logic
  - Support Try.SRC function
- **BC1.2** module
  - Support BC1.2DCP mode
  - Support Apple/Samsung high current charging mode recognition

- Electricity metering
  - Built-in 12bitADC
  - Support percentage battery
  - Adaptive to various types of batteries
  - Support 3-5 LEDs
  - Automatically identify the number of LEDs
- Lighting drive
  - Built-in lighting LED driver
- button
  - Support mechanical keys
- protection mechanism
  - Input overvoltage protection
  - Output over current/short circuit protection
  - Charge timeout/overvoltage protection
  - Temperature protection
- **I2C** interface
- **QFN-32(5x5mm)**   Encapsulation

4. Functional block diagram
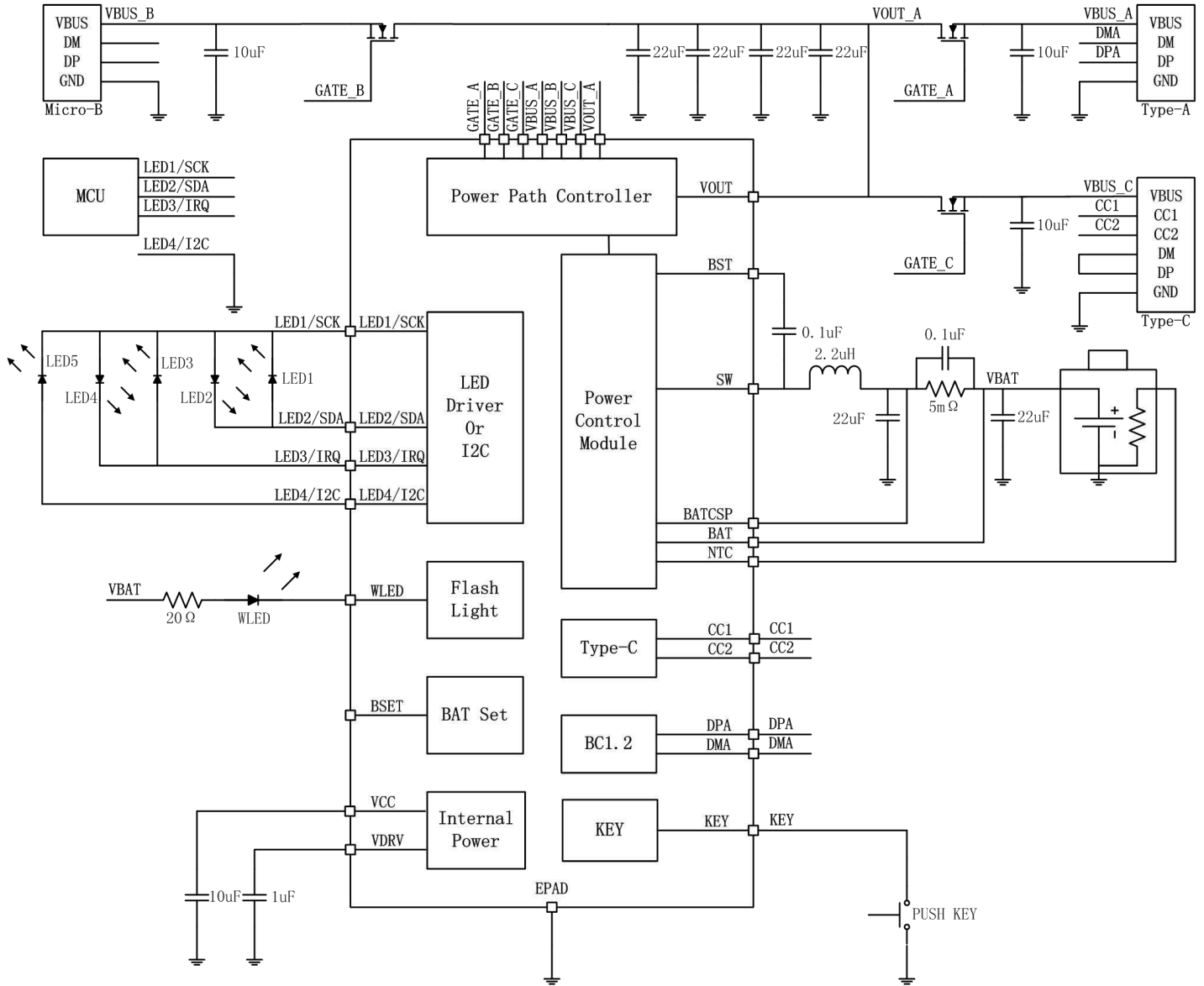
5. Pin definition and function description

5.1 Pin definition
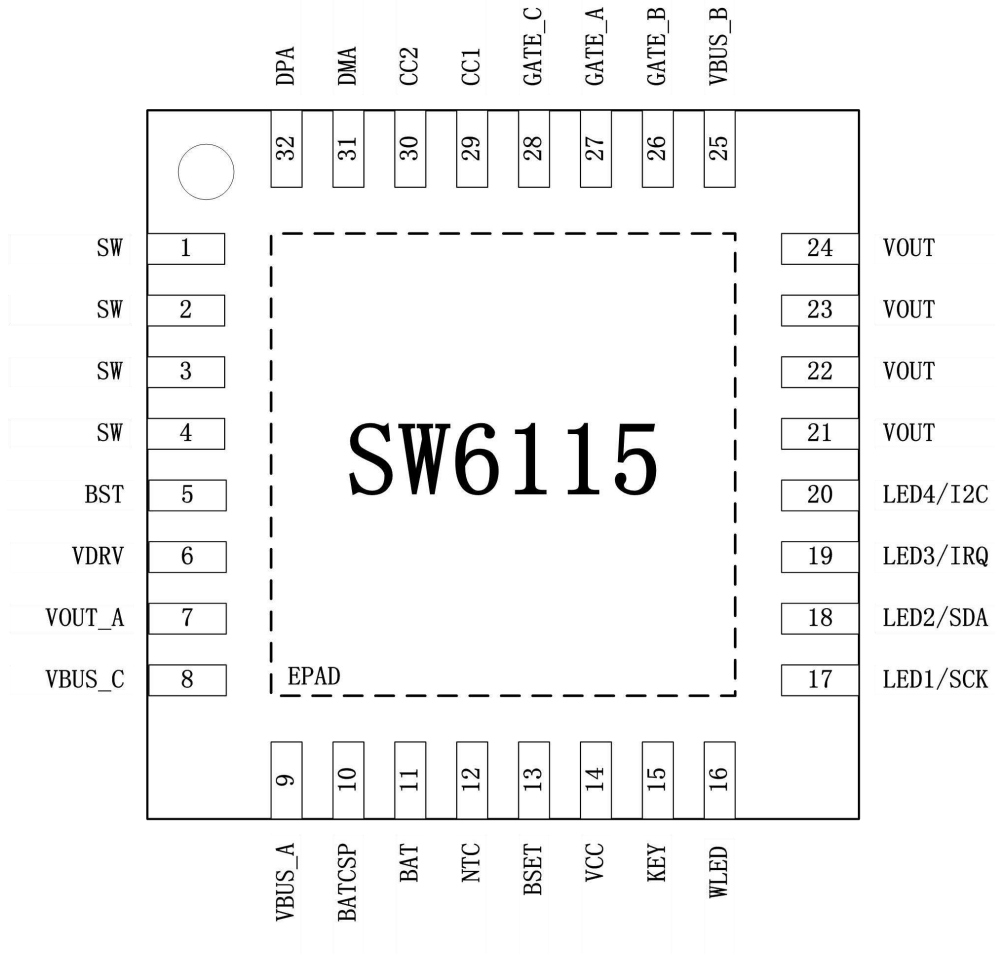
5.2 Pin description

Pin	Name	FunctionDescription
1,2,3,4	SW	Switch node.
5	BST	The upper N tube drives the Bootstrap pin.
6th	VDRV	Drive power.
7th	VOUT_A	Type-A port light load current detection pin.
8th	VBUS_C	Type-C port input and output voltage detection pin.
9	VBUS_A	Type-A port output voltage detection pin.
10	BATCSP	Battery current detection pin.
11	ONE	Battery current and voltage detection pin.
12th	NTC	Battery temperature detection pin.
13th	BSET	Battery target voltage setting.
14th	VCC	Internal working power supply.

15th	KEY	Mechanical key input.
16	WLED	Lighting output.
17th	LED1 / SCK	Power indicator port 1, which can reuse the I2C clock signal.
18th	LED2 / SDA	Power indicator port 2, which can reuse I2C data signals.
19th	LED3 / IRQ	The power indicator port 3 can reuse the interrupt signal.
20th	LED4/I2C	Power indicator port 4, LED or I2C setting signal.
21,22,23,24	VOUT	Charge circuit input, boost circuit output pin.
25th	VBUS_B	Micro-B port input voltage detection pin.
26	GATE_B	Micro-B port access control.
27	GATE_A	Type-A port access control.
28	GATE_C	Type-C port access control.
29	CC1	Type-C Configure channel 1.
30th	CC2	Type-C Configure channel 2.
31	DMA	Type-A port DM pin.
32	DPA	Type-A port DP pin.
	EPAD	PAD for heat dissipation and grounding.

6th Limit parameters

Parameters	symbol	MIN	MAX	UNIT
Input voltage	VBUS_B/VBUS_C	-0.3	16	V
The output voltage	VOUT / VOUT_A /VBUS_A/VBUS_C	-0.3	6th	V
SW pin voltage	SW	-0.3	16	V
BST pin voltage	BST-SW	-0.3	6th	V
Channel control voltage	GATE_A/GATE_B /GATE_C	-0.3	24	V
Other pin voltage		-0.3	6th	V
Thermostat		-40	+150	° C
storage temperature		-60	+150	° C
ESD（HBM）		-4	+4	KV

[Remarks] Conditions such as voltage, current and temperature exceeding this range may cause permanent damage to the device.

7th Recommended parameters

Parameters	symbol	MIN	Typical	MAX	UNIT
Input voltage	VBUS_B/VBUS_C	4.5		5.5	V
battery voltage	ONE	2.8		4.5	V
Operating temperature		-40		+85	° C

8. Electrical characteristics

（（V$_{IN}$ ==5V,,V$_{CC}$ $_{ONE}$ == 3..7V ,, T == 25 °$_A$ Unless otherwise specified.）

Parameters	symbol	TestConditions	MIN	TYPE	MAX	UNIT
Power supply						
VBUS_B input power	V$_{BUSB}$		4th		5.5	V
VBUS_B input undervoltage threshold	V$_{BUSB\_UVLO}$	VBUS_B input voltage drops		4th		V
VBUS_B input undervoltage threshold hysteresis	V$_{BUSB\_UVLO\_HYS}$	VBUS_B input voltage rises		400		mV
VBUS_C input power	V$_{BUSC}$		4th		5.5	V
VBUS_C input undervoltage threshold	V$_{BUSC\_UVLO}$	VBUS_C input voltage drops		4th		V
VBUS_C input undervoltage threshold hysteresis	V$_{BUSC\_UVLO\_HYS}$	VBUS_C input voltage rises		400		mV
VCC output voltage	V$_{CC}$	Boost or V$_{BUSB}$/V$_{BUSC}$ Access		5		V
		Shut down		V$_{ONE}$		V
VCC output current	I$_{CC}$	Boost or V$_{BUSB}$/V$_{BUSC}$ Access		60		mA
		Shut down		60		mA
Internal resistance of power tube						
NMOS upper tube	R$_{DSON\_H}$			22nd		mΩ
NMOS down tube	R$_{DSON\_L}$			16		mΩ
Charging mode						
Trickle cut-off voltage	V$_{TC}$			3		V
Trickle charge current	I$_{TC}$	IDK:::M꞉꞉:<3V		300		mA
		V$_{ONE}$ <1.5V		200		mA
Constant current charging current	I$_{CC}$			2.5		A
Cut off charging current	I$_{END}$			10		%
Charging target voltage	V$_{BAT\_FULL}$			4.2		V
Recharge voltage	V$_{BAT\_RECH}$			4.1		V
operating frequency	F.$_{CHG}$			400		KHz
Trickle charge timeout	t$_{TC\_OT}$			40		Min
Constant current and constant voltage charging timeout	t$_{CC\_OT}$			33		Hour
Constant temperature value	T$_{REGU\_CHG}$			115		℃
Boost mode						

VBAT input voltage	V_{ONE}		2.9		4.5	V
VBAT input undervoltage threshold	V_{BAT_UVLO}	VBAT input voltage drops		2.9		V
VBAT input undervoltage threshold hysteresis	$V_{BAT\_UVLO\_HYS}$	VBAT input voltage rises		500		mV
VOUT output voltage	V_{OUT}			5.05		V
VOUT output current	I_{OUT}			3.4		A
Light load current detection threshold	I_{LIGHT_LOAD}	$R_{DS\_PATH}=10m\Omega$		60		mA
Light load detection shutdown time	t_{LIGHT_LOAD}			32		S
Quiescent Current	I_Q	$V_{ONE}=3.7V$		40		among others
Line loss compensation	V_{OUT_WDC}	$I_{OUT}<1A$		0		mV
		$1A\ I_{OUT}<2A$		50		mV
		$I_{OUT}>2A$		100		mV
operating frequency	F_{BST}			400		KHz
Thermal control loop threshold	T_{REGU_BST}			115		℃
Type-C interface						
CC pin output current	I_{CC_SOURCE}	PowerLevel=3.0A		330		among others
CC pin termination resistance	R_D			5.1		kΩ
BC1.2						
DP/DM voltage	DP	Apple2.4AMode		2.7		V
	DM	Apple2.4AMode		2.7		V
LED battery indicator						
Power indicator LED drive current	I_{LED}			4th		mA
LED blinking frequency	f_{LED}			1		Hz
LED lighting						
WLED resistance	R_{WLED}			20th		Ω
KEY						
Short key	T_{SHORT}			32		mS
Long key	T_{LONG}			2		S
I2C						
rate	f_{CLK}			400		Kbit/S
Thermal shutdown protection						
Thermal shutdown threshold	T_{SHDT}	The temperature rises		150		℃

Thermal shutdown hysteresis	T $_{SHDT\_HYS}$	Temperature drop		70		℃

9. Functional description

9.1 Charging mode

SW6115 integrates a switching charging module with the highest efficiency up to 96%, which supports multiple battery types such as 4.2V/4.3V/4.35V/4.4V,

The switching frequency is 400KHz, and a small 2.2uH inductor can be used.

The charging process is divided into the following three processes: trickle mode, constant current mode, and constant voltage mode. When the battery voltage is lower than 3V, the charging moduleIn trickle mode, when the battery voltage is lower than 1.5V, the charging current is 200mA, and when the battery voltage is between 1.5V and 3V, the charging current is 200mA.The electric current is 300mA; when the battery voltage is greater than 3V, the charging module enters the constant current mode, and it charges at full speed according to the set target current;When the battery voltage rises to the charging target voltage (such as 4.2V), the charging module enters the constant voltage mode. At this time, the current gradually decreases, and the batteryThe battery terminal voltage remains unchanged; when the charging current is reduced to the charging cut-off current, which is the minimum of 10% of the set value and 300mA, the charging junctionbundle. After being fully charged, if the battery voltage drops to 0.1V lower than the target voltage, it will automatically restart charging.
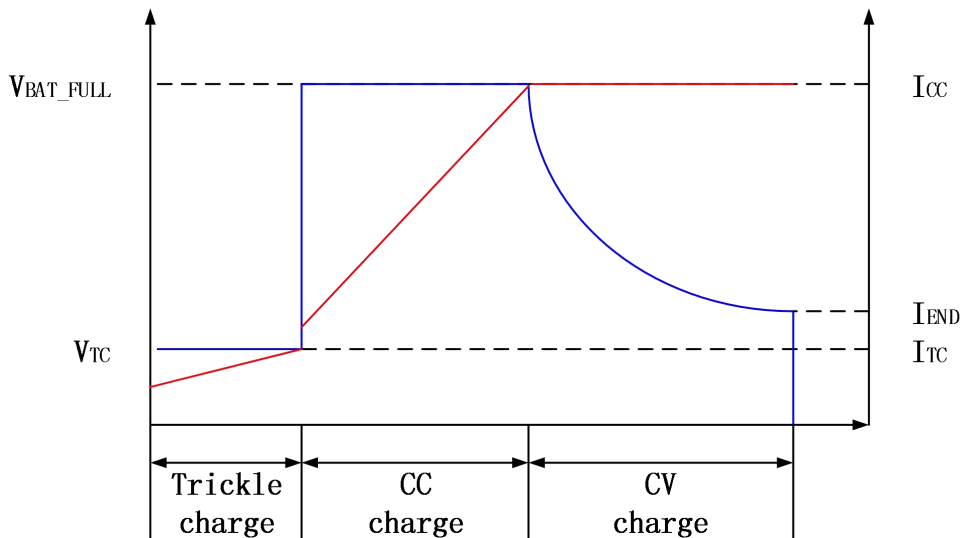
The battery type can be set via BSETPin. When floating, set 4.2V battery; when connecting 62KΩ resistor to ground, set 4.35V battery;When connecting a 30KΩ resistor to the ground, set a 4.4V battery; when connecting a 10KΩ resistor to the ground, set a 4.3V battery.

The charging module supports NTC protection. The NTC temperature protection module will always monitor the battery temperature.Charge within the normal temperature range. When the temperature is abnormal, reduce the charging current or turn off the charging. When the temperature is lower than 5℃, the charging currentDecrease by half, if the temperature continues to drop below 0°C, the charging will be turned off, and the charging will be automatically recharged after the temperature rises to 5℃, and the charging current will decreaseHalf of the time, when the temperature continues to rise to 10°C, the normal charging current is restored. When the temperature is higher than 45℃, the charging current is reduced by half.If the temperature continues to rise above 50°C, the charging will be turned off, and the temperature will be automatically recharged after the temperature drops to 45°C, the charging current will be reduced by half, and the temperature will continueWhen it drops to 40°C, the normal charging current is restored. Typical applications use 103ATNTC resistors, which can be used in series/parallel in actual applicationsThe way the resistance changes the temperature range. If NTC protection function is not needed, connect NTCPin to ground.

The charging module also contains a temperature control loop. When the chip temperature exceeds 115°C, the charging current begins to decrease.Over 150°C, the chip enters the over-temperature shutdown mode.

The charging module also includes a timeout mechanism, when the constant current charging time exceeds 33 hours or the trickle charging exceeds 40 minutes, the charging stops.

However, plugging and unplugging the adapter can release this state.

9.2 Boost Mode

SW6115 integrates a 3.4A boost module, the switching frequency is 400KHz, and the highest efficiency can reach 95%. Boost module includes PSM/PWMTwo modes, under light load, work in PSM mode; under heavy load, work in PWM mode. When the load is connected, the system automaticallyAutomatically detect and start the boost module; when the load is removed, the system monitors for more than a certain period of time, and shuts down the boost output.

The boost module supports NTC protection, and the NTC protection module will always monitor the battery temperature to keep it within the normal temperature range of -15~58℃Discharge, when it is not in the above temperature range, turn off the boost module to stop discharging. Typical applications use 103ATNTC resistors, in actualIn the application, the temperature range can be changed by means of series/parallel resistance. If the NTC protection function is not needed, connect NTCPin to ground.

The boost module also contains a temperature control loop. When the chip temperature exceeds 115°C, the output voltage begins to drop; if the temperature continues to exceedOver 150°C, the chip enters the over-temperature shutdown mode. After entering the over-temperature shutdown mode, even if the temperature drops below the over-temperature threshold, the chip will notIt will power on automatically, and it needs to detect load insertion or short key press action.

The boost module includes protections such as input undervoltage/output overvoltage/output overload/output short circuit.

9.3 Channel control

SW6115 supports Type-A+Type-C+Micro-B three ports.

Short keypress and load access open Type-A port to discharge externally, no-load detection close Type-A port, no-load detection current threshold and Type-AThe internal resistance of the access tube is related. When the internal resistance of the access tube is 10mΩ, the no-load current is about 60mA; DFP is connected to open the Type-C port for charging, UFPConnect to open the Type-C port for external discharge; connect the adapter to open the Micro-B port for charging.

SW6115 supports charging and discharging at the same time, and supports simultaneous discharge of Type-A and Type-C ports.

9.4Type-C interface

SW6115 integrates a Type-C interface controller, which not only supports input and output bidirectional, but also supports the role of try.SRC. When the adapter is connectedWhen the time, the chip automatically turns on and charges; when the adapter is unplugged, it automatically stops charging. When the electrical equipment is connected, the boost module is turned on to work,If the electrical equipment is unplugged, the boost module will be automatically turned off.

When the electrical equipment is connected and the boost function is turned on, SW6115 will broadcast 3A current capability on the CC pin. If VBUS_BWhen connected, the 3A current capability will also be broadcast on the CC.

9.5BC1.2 function

SW6115 contains a USB intelligent adaptive function module, which not only supports BC1.2 function, as well as the Chinese mobile phone charger standard, but also

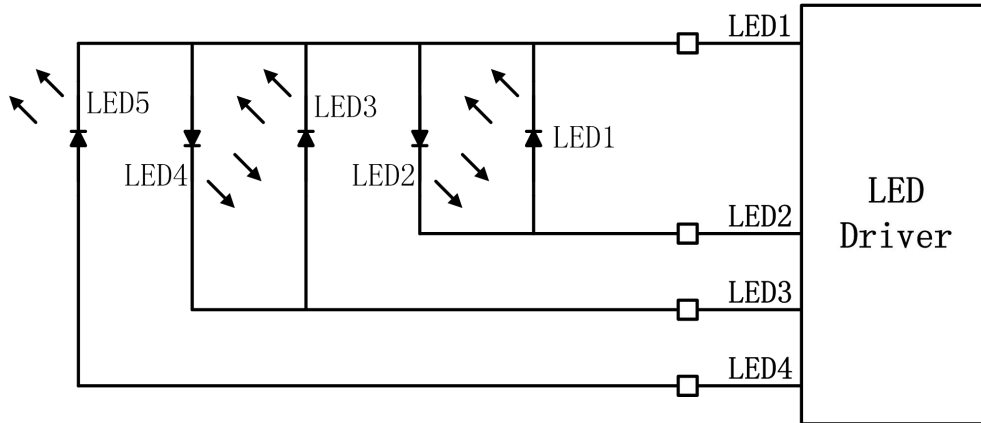It is well compatible with the high-current output recognition of Apple and Samsung:

Apple2.4Amode: DP = 2.7V, DM = 2.7V;

Samsung2Amode:DP=1.2V,DM=1.2V;

9.6 Battery indicator

SW6115 supports 3-5 LED lights to indicate power.

The connection method in the five-light state is as follows:

5 LED indicator table under discharge state:

Capacity	LED1	LED2	LED3	LED4	LED5
80 ~ 100%	On	On	On	On	On
60 ~ 80%	On	On	On	On	Off
40 ~ 60%	On	On	On	Off	Off
20 ~ 40%	On	On	Off	Off	Off
5 ~ 20%	On	Off	Off	Off	Off
1 ~ 5%	Flicker	Off	Off	Off	Off
0%	Off	Off	Off	Off	Off

5 LED indicator under charging status:

Capacity	LED1	LED2	LED3	LED4	LED5
100%	On	On	On	On	On
80 ~ 99%	On	On	On	On	Flicker
60 ~ 80%	On	On	On	Flicker	Off
40 ~ 60%	On	On	Flicker	Off	Off
20 ~ 40%	On	Flicker	Off	Off	Off
0 ~ 20%	Flicker	Off	Off	Off	Off

Connection mode in the four-light state:
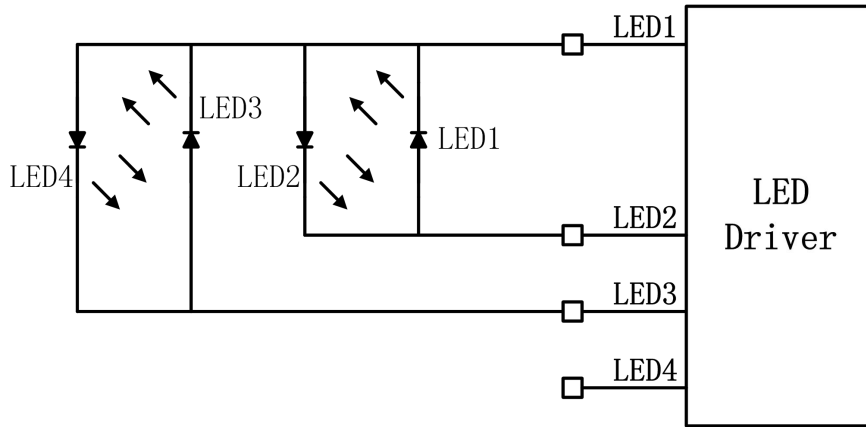
The battery power indicator table in the discharging state of the 4 lights:

Capacity	LED1	LED2	LED3	LED4
75 ~ 100%	On	On	On	On
50 ~ 75%	On	On	On	Off
25 ~ 50%	On	On	Off	Off
5 ~ 25%	On	Off	Off	Off
1 ~ 5%	Flicker	Off	Off	Off
0%	Off	Off	Off	Off

Battery level indicator under 4 lights charging state:

Capacity	LED1	LED2	LED3	LED4
100%	On	On	On	On
75 ~ 99%	On	On	On	Flicker
50 ~ 75%	On	On	Flicker	Off
25 ~ 50%	On	Flicker	Off	Off
0 ~ 25%	Flicker	Off	Off	Off

Connection mode in the three-light state:
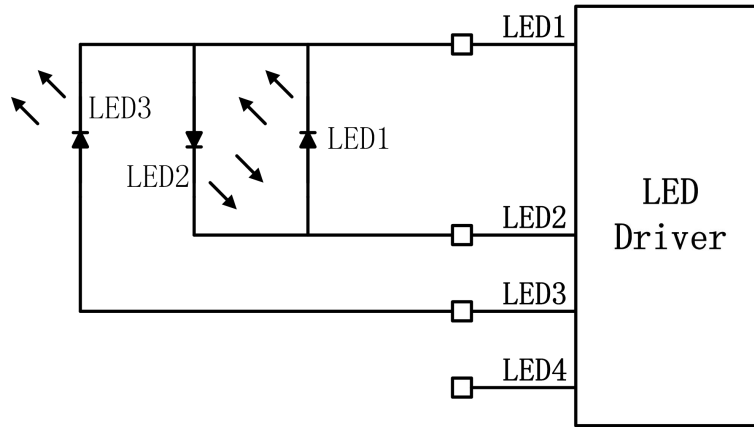
3 Indicator table under discharge state of lamp:

Capacity	LED1	LED2	LED3
66 ~ 100%	On	On	On
33 ~ 66%	On	On	Off
5 ~ 33%	On	Off	Off
1 ~ 5%	Flicker	Off	Off
0%	Off	Off	Off

The indicator under the charging state of 3 lights:

Capacity	LED1	LED2	LED3
100%	On	On	On
66 ~ 99%	On	On	Flicker
33 ~ 66%	On	Flicker	Off
0 ~ 33%	Flicker	Off	Off

In the low power state, the system shuts down after LED1 flashes 5 times.

9.7 Lighting Driver

The integrated lighting LED driver inside the SW6121 can be turned on and off by long pressing the button.

9.8 Button

SW6115 supports mechanical buttons, internally pulled up weakly, and supports short press and long press.

9.9I2C interface

SW6115 supports I2C interface and supports 100K/400K communication rate. Master can read the status information of the chip through the I2C interface.
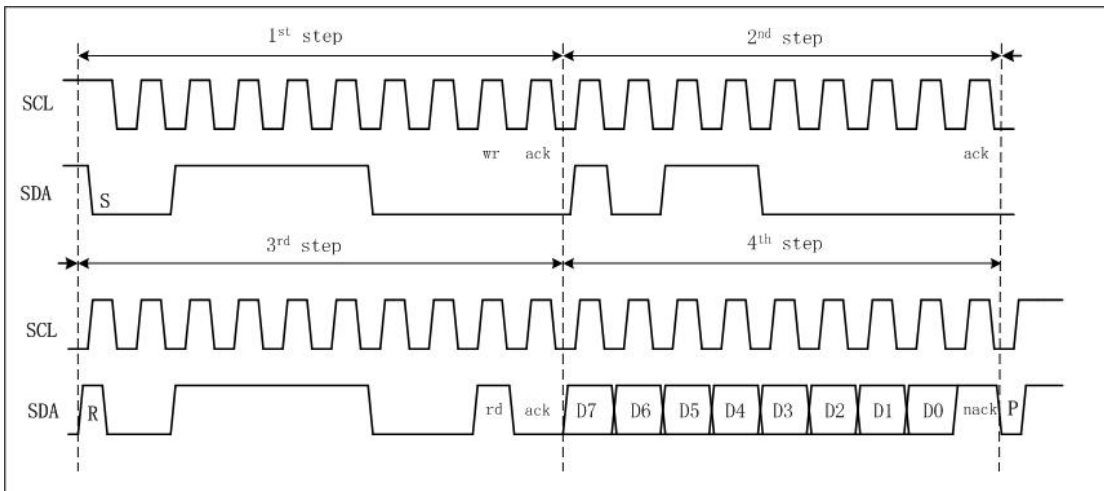
The I2C interface is multiplexed with the LED module. When it is set as an I2C interface, connect LED4/I2C to ground.
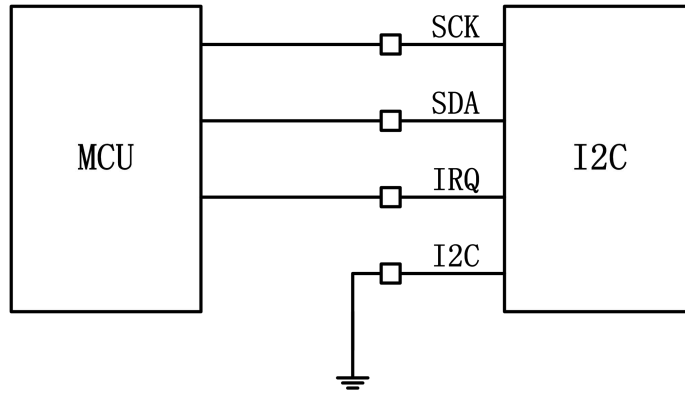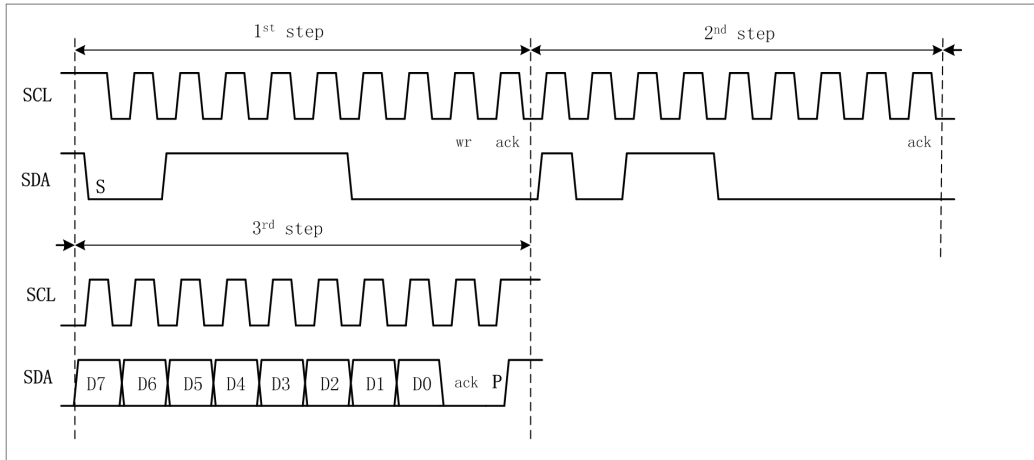
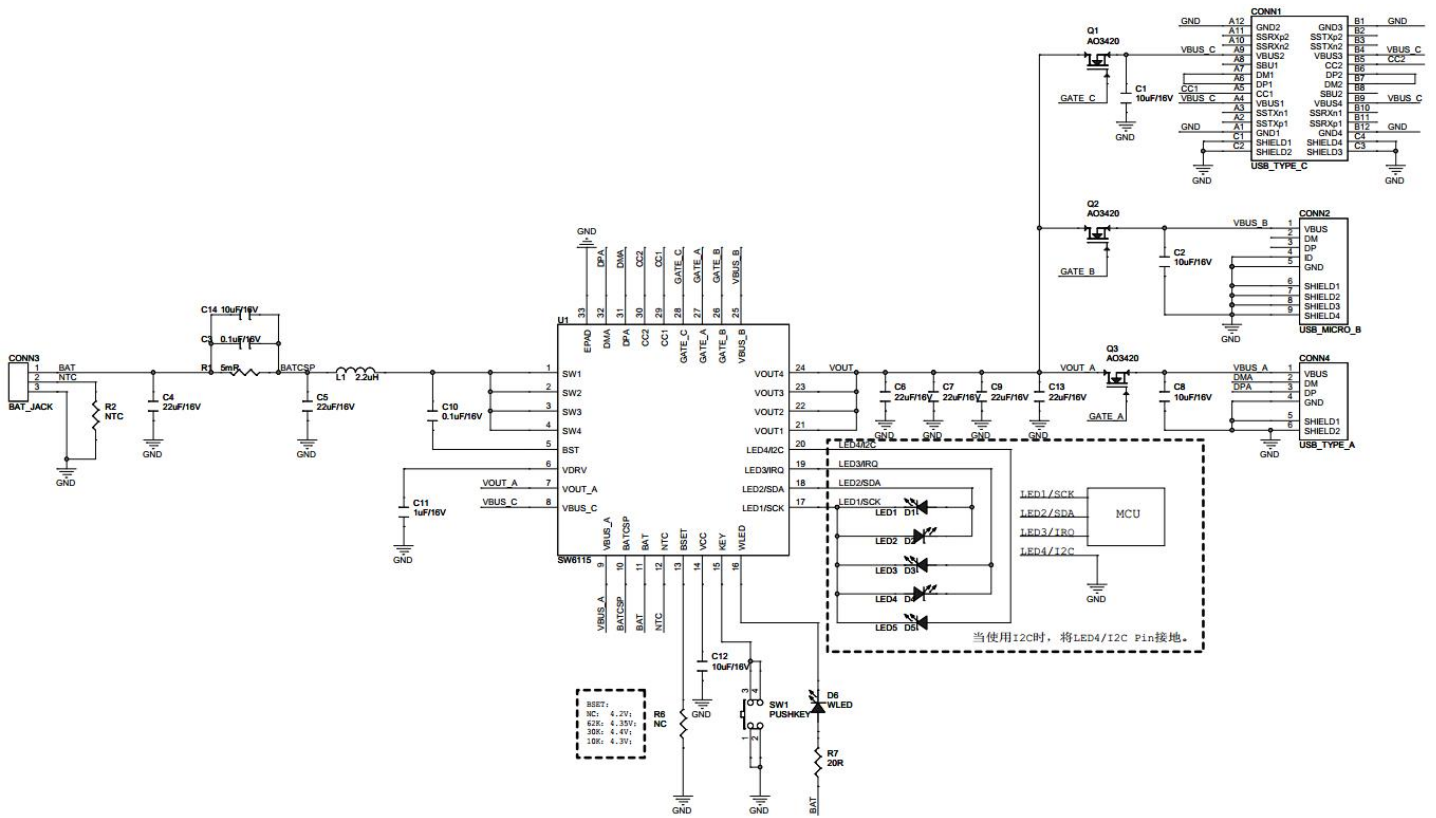Read operation:

Slaveaddress ：0x3C

Register address ： 0xB0

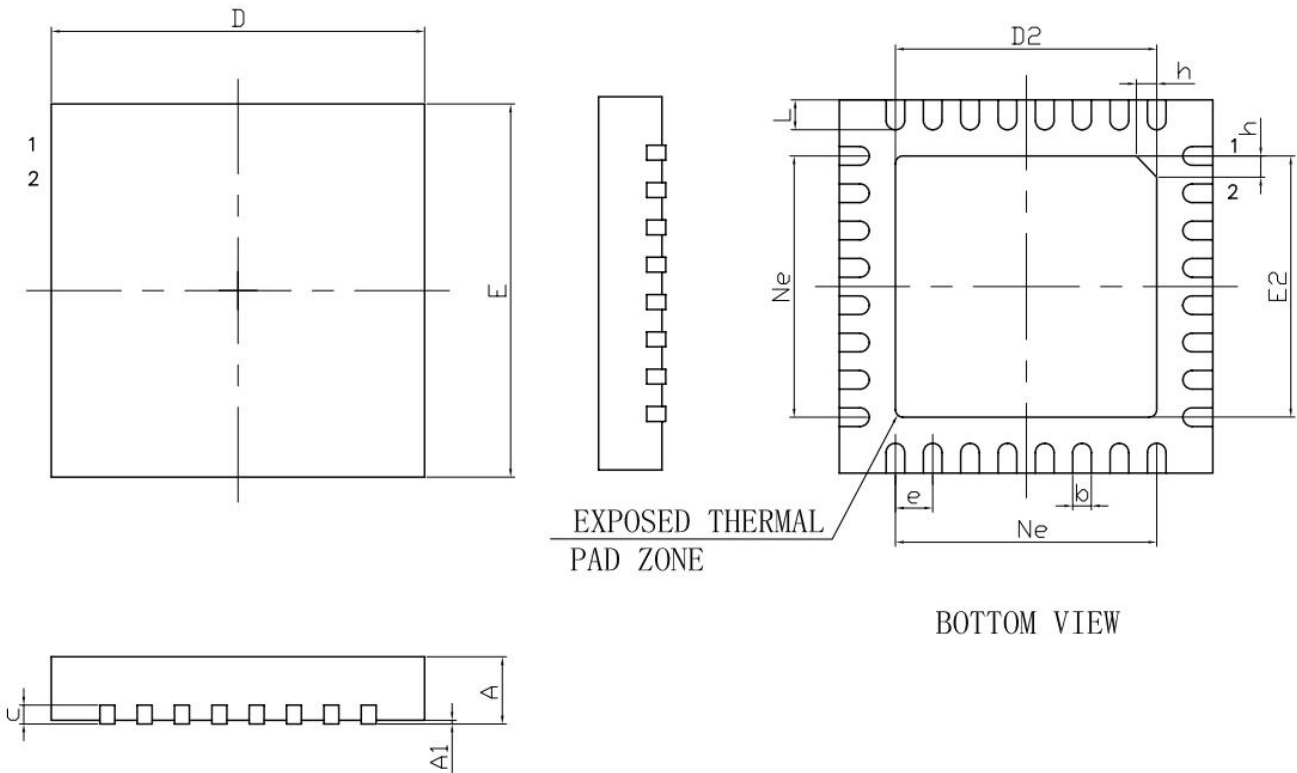Write operation:

Slaveaddress ：0x3C

Register address ： 0xB0

10. Typical application circuit diagram

11. Mechanical
dimensions

11.1 Package
drawing

EXPOSED THERMAL
PAD ZONE

BOTTOM VIEW

11.2 Package size

symbol	DimensioninMillimeters		
	MIN	**LAST NAME**	**MAX**
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	4.90	5.00	5.10
D2	3.40	3.50	3.60
is	0.50BSC		
Born	3.50BSC		
IS	4.90	5.00	5.10
E2	3.40	3.50	3.60
L	0.35	0.40	0.45
H	0.30	0.35	0.40

12. Version history

V1.0   initial version;