Description

QK1301C is a dedicated IC for low-voltage LED lights. It features complete charging functions, comprehensive battery protection circuits and key switch control. QK1301C supports power-saving mode with static standby current less than 10μA. It is equipped with full battery protection including over-current, over-voltage, constant-current, constant-voltage and thermal protection. When the lithium battery charging voltage is lower than 2.7V, trickle charge is activated to prevent battery damage. When the battery voltage rises above 2.7V, high-current constant-current charging starts. As the voltage approaches 4.2V, the charging current decreases gradually. Once the charging current drops below a preset threshold, the IC terminates charging. The detection error of charging voltage is controlled within ±1.5%.

The IC also integrates battery and charging power reverse connection protection. No large current will be generated when the battery or charging power is connected reversely, protecting the chip from burnout.

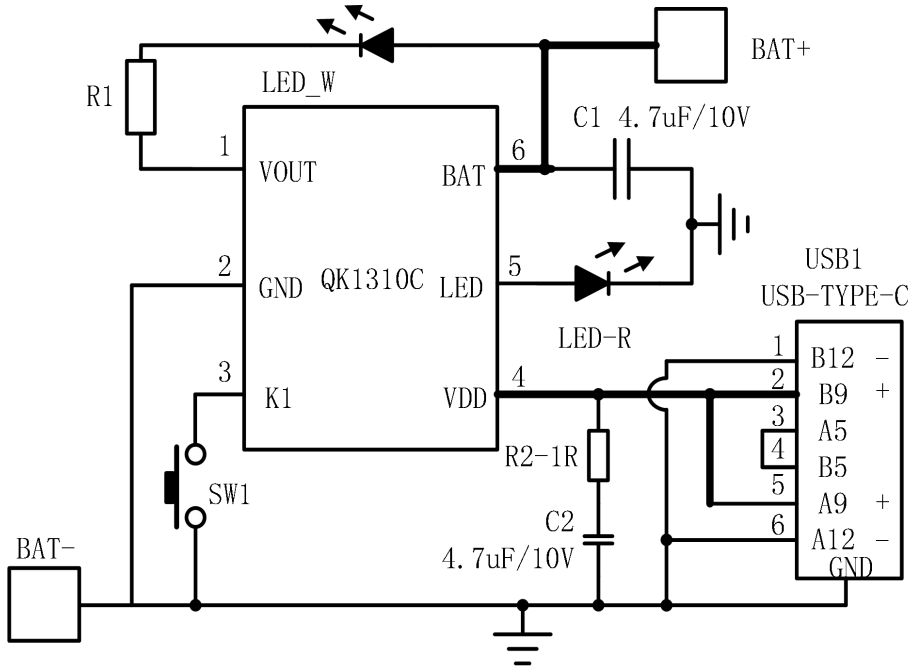
Features

- Low static standby current (<10μA)
- 0.5A charging current, maximum 1A output current
- Under-voltage protection
- internal chip over-temperature protection
- Direct single-cell lithium battery charging via USB port
- Preset 4.2V charging voltage
- Complete LED status indication function
- Supports 0V charging
- Trickle charge below 2.7V
- Battery reverse connection protection
- SOT23-6 package

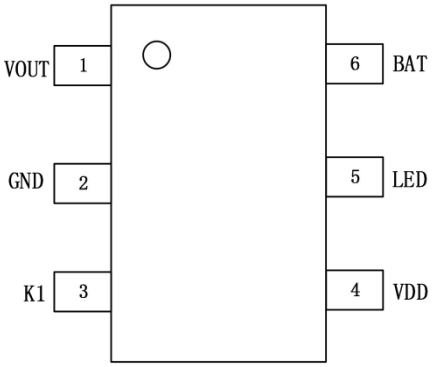
Applications

- protection　Handheld lamps, flashlights, headlamps, low-voltage bulb lights

Typical Application Circuit



Pin Configuration



SOT23-6

Pin Description

Pin No	Pin name	Description
1	VOUT	Negative terminal of LED
2	GND	Chip ground
3	K1	Key pin
4	VDD	Positive terminal of charging power supply
5	LED	Positive terminal of status indicator LED
6	BAT	Positive terminal of battery

Absolute Maximum Ratings (1)

VDD.....-0.3V~5.5V

BAT.....-4.2V~4.5V

L E D ,K 1 , L SE T.....0 . 3 V ~ 5.5 V

Operating Junction Temperature (TOP) ..40 ℃ ~+ 125 ℃

Storage Temperature (TSTG) .....-40℃~+150℃

Operating Conditions

VDD .....0.5V~5V

Working environment temperature(TA) .....-40℃~+70℃

(1) The device may be damaged if the IC operates beyond the absolute maximum ratings. Operation at absolute maximum ratings or any conditions exceeding recommended operating conditions is not recommended. Continuous operation under absolute maximum rating limits may degrade device reliability. Absolute maximum ratings are merely stress rating limits.

Functions & Parameters

LED Output Modes under Discharge Discharge mode: Four-stage cycle controlled by key K1; VOUT output duty cycle sequence: 100%→40%→20%→OFF, loop repeatedly.

Current Reduction Function

QK1301C provides automatic output current reduction:

Within the first 2 minutes of 100% duty cycle output, full current is supplied; from 2 min to 20 min, the current drops to 45% and remains at this level afterwards.

1. The current reduction function only works under a 100% duty cycle; it is disabled for other brightness stages.
2. When switching stages via key press and returning to the 100% brightness stage after a full cycle, the timing for current reduction restarts.

PCB Layout Notes

1. The chip GND pin is an exposed thermal pad (EPAD). Ensure tight contact between the EPAD and PCB ground during soldering.
2. Capacitors connected to the BAT and VDD pins shall be placed as close to the chip pins as possible, with traces routed through capacitors before reaching the pins.
3. An RC circuit is recommended for pluggable battery terminals at the BAT pin; the same parameters as the VIN terminal can be adopted.
4. Only X5R or X7R dielectric capacitors shall be used in the application circuit.
5. High-current loops (BAT, VIN, VOUT, GND) require wide copper traces. If vias are necessary for high-current paths, multiple vias are suggested to reduce impedance.

Electrical Characteristics

(Unless otherwise specified, VIN=5V, TA=25℃)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Stable output (float charge) voltage	VFLOAT	0℃≤T_A≤85℃,IBAT=40mA	4.15	4.2	4.25	V
Under-voltage protection point of charging voltage	Vuvlo_VDD			2.55		V
final discharging voltage	Vbatoff			2.6		V
Quiescent Standby Current	Iq	No output		5	10	uA
BAT Pin Operating Current	ICC_BAT	2.7V ⩽ VBAT ⩽ 4.1V		500		mA
Trickle charging current	ITRIKL	VBAT<2.7V		50		mA
Trickle charging threshold voltage	VTRIKL			2.7		V
LED output current	ILED			3		mA
Switching transistor conduction impedance	Rdson			180		mΩ
Thermal Foldback Start Temperature	Tsd	Internal chip temperature		130		℃
Thermal Current Reduction Ratio	KT	For every 10 ℃ rise above 130 ℃, output current drop percentage		4.50%		℃
Charging Thermal Shutdown Threshold	Tch	Internal chip temperature		160		℃
LED Output Switching Frequency	CLK			25		KHZ

Charging Operation Principle

A charging cycle initiates when the VDD voltage rises above the UVLO threshold, or when a battery is connected to the charger. If the BAT voltage is lower than 2.7V, the IC enters trickle charge mode, supplying approximately 1/10 of the rated charging current to safely raise battery voltage for full-current charging. When the BAT voltage exceeds 2.7V, constant-current charging is activated with a fixed charging current delivered to the battery. Once the BAT voltage reaches the 4.2V float voltage, the IC switches to constant-voltage charging and charging current decreases gradually. The charging cycle terminates when charging current falls to 1/10 of the preset value. After charging completion, a comparator with 3 ms filter time continuously monitors the BAT voltage. When battery voltage drops below 4.05V (equivalent to roughly 80%~90% state of charge), a new charging cycle restarts automatically. This maintains the battery at nearly full charge and eliminates the need for manual periodic charging triggers.

Key Function

Pin K1 continuously detects key signals. A press duration longer than 50 ms is recognized as a valid key trigger.

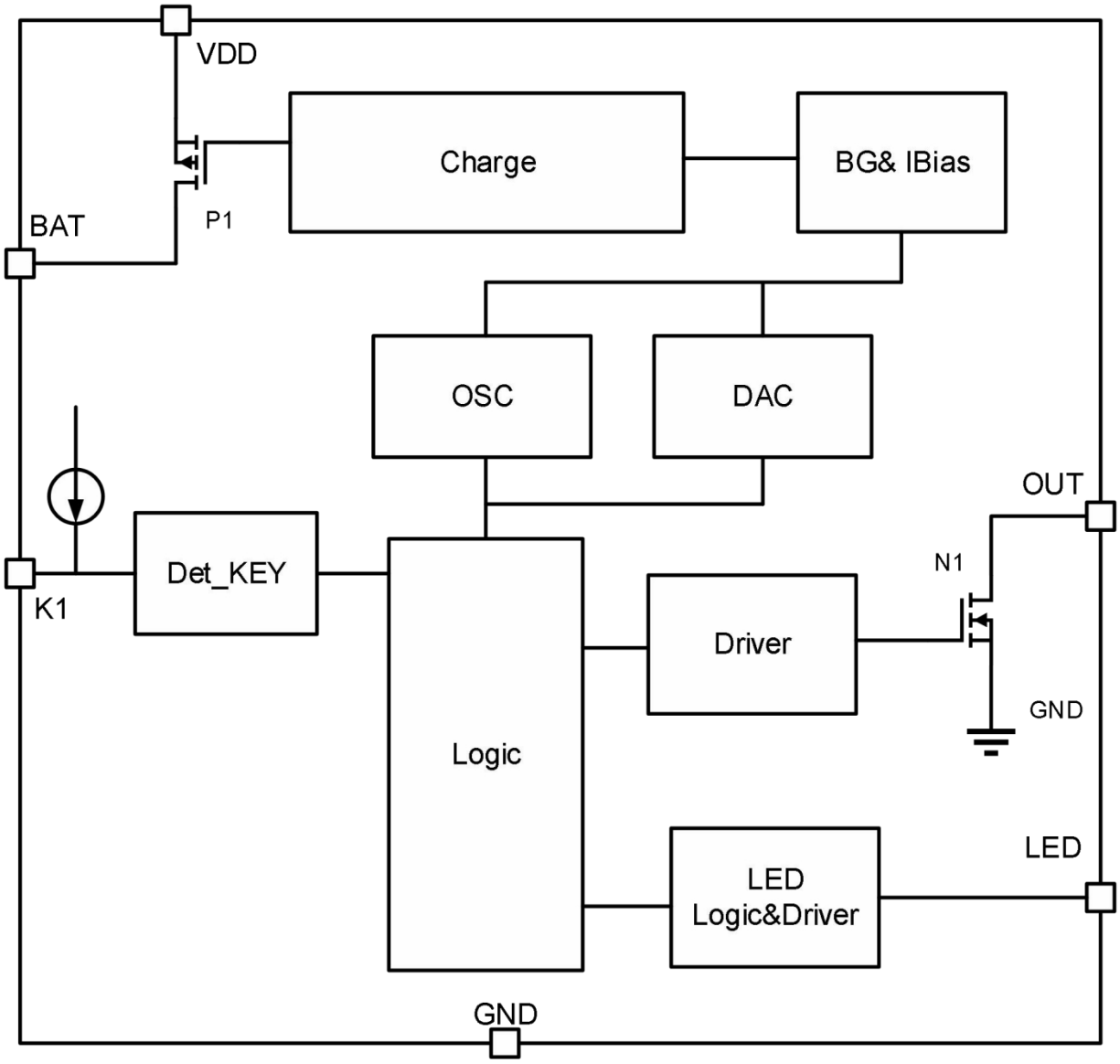
Charging Indicator LED Logic

When the VDD input voltage is higher than the BAT voltage and BAT < 4.2V, the LED flashes at 1Hz with 50% duty cycle during charging.Charging current is generated only if VDD input voltage is at least 0.3V higher than BAT voltage.When the battery is fully charged (BAT>4.2V), the LED stays solid ON.

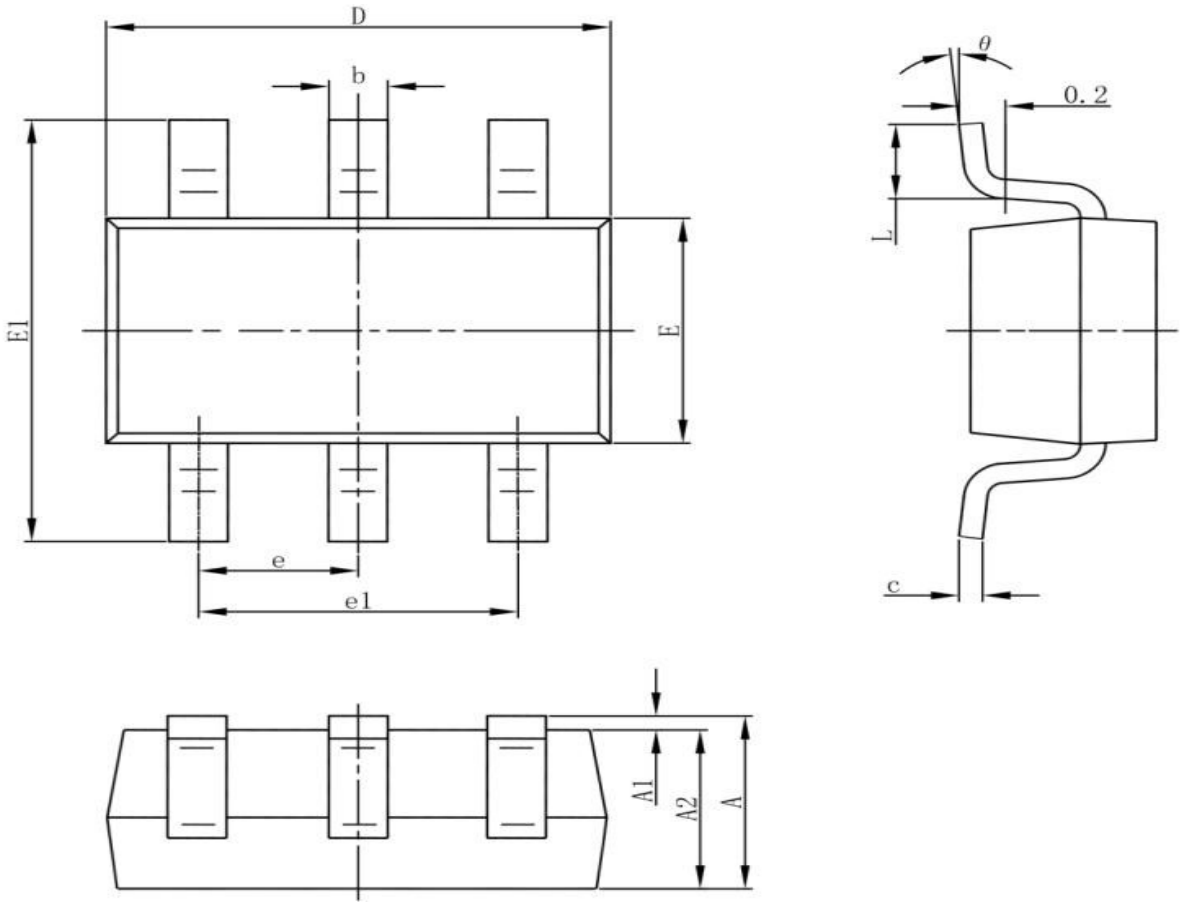
Discharging Indicator LED Logic

No LED indication during discharge operation.

Internal Block Diagram



Package Size: SOT23-6



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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