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LGS5522 Datasheet

Synchronous Boost 2-Series 2A Lithium Battery
Charger Manager

LGS5522

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Jiangmiao Road, Jiangpu Street, Pukou District, Nanjing City, Jiangsu Province



Key Features

- **Adjustable Charging Current:** Up to 2A (limited by heat dissipation and input power).
- **Flexible Voltage Support:** Default 7.3V/8.4V full-charge voltage (customizable for other battery voltages).
- **High Voltage Tolerance:** Input and battery terminals withstand up to 28V.
- **Wide Input Range:** 3.0V–6.5V.
- **High Efficiency:** Up to 93% peak efficiency, 90% under heavy load.
- **Thermal Management:** Supports 110°C thermal throttling and NTC-based battery temperature monitoring.
- **Protections:** Input overvoltage (OVP), battery overvoltage (BAT OVP), short-circuit, overtemperature, and NTC fault protection.
- **Compact Package:** Ultra-low thermal resistance ESSOP10 ($\theta_{JC}= 3.9^{\circ}\text{C/W}$).
- **Status Indication:** Dual-LED or single-LED charging status display.

Applications

- Dual-cell lithium battery packs.
- Smart door locks.
- Portable devices with USB/AC adapter input.

Description

The LGS5522 is a synchronous boost charger designed for dual-series lithium-ion batteries. It integrates four charging phases: Short-Circuit Charge (SC), Trickle Charge (TC), Constant Current (CC), and Constant Voltage (CV), ensuring safe and efficient charging for deeply discharged batteries. Default Full-Charge Voltage: 8.4V (automatically recharges when voltage drops to 8.2V). Low Leakage: Battery terminal leakage $<25\mu\text{A}$ when input power is removed. Adaptive Input Current Limiting: Configurable via the V_{HOLD} pin.

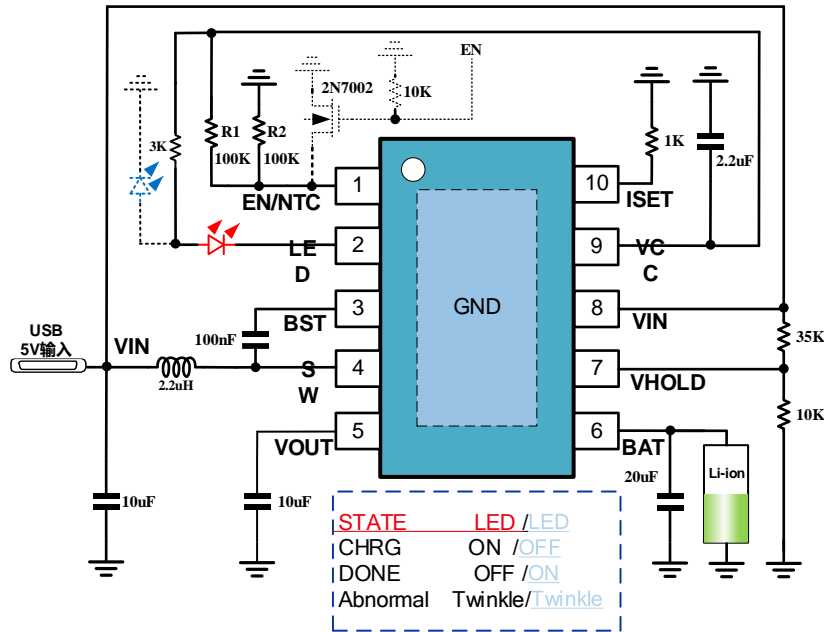
Ordering Information

Part	Package	Top Mark
LGS5522	ESSOP10	5522 YYWWD

YY: Production year code WW: Production week code D: Fixed version number



Typical Application Circuit (5V Input)



5V USB input; The dashed device is an optional feature (dual light)

NOTE:

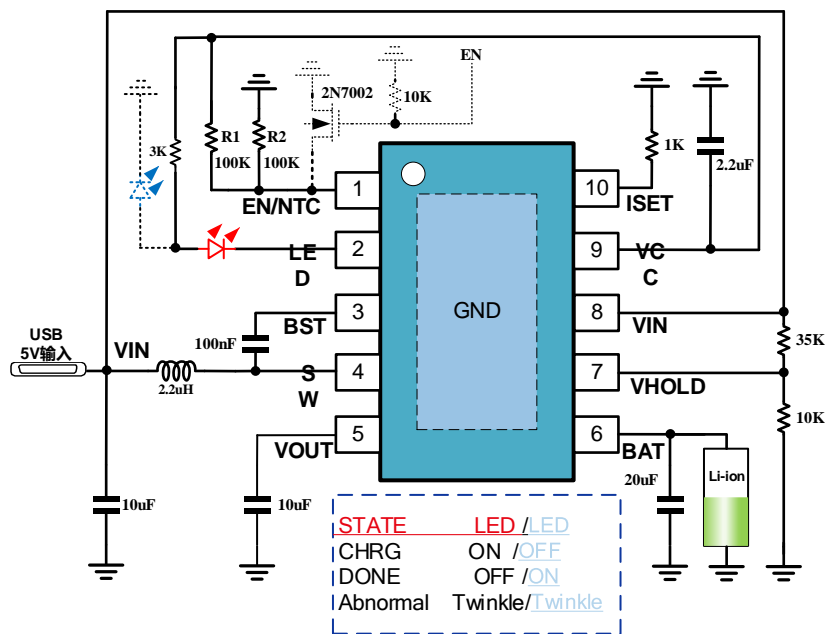
- The capacitors of the boost output VOUT and BAT should be as close to the chip as possible, and the circuit should be as short as possible. This capacitor has the highest priority and can be referenced for PCB layout examples.
- The NTC and EN pins are multiplexed, with EN1.1V being high and 0.7V being low. NTC enables charging only at 25%~85% VCC voltage (1.25V~3.25V).
- In typical NTC applications, a 100K resistance NTC resistor with a B value of 4250K is required to be connected in parallel with an R2 (150K) resistor and then in series with an R1 (57.6K) resistor at the VCC pin. This combination ensures normal charging of the battery in the 0C-60 °C range. If using other combinations, please refer to the temperature range provided in the NTC function explanation on page 11 for design or consult our FAE.
- The bottom e Pad GND pin should be connected to the ground plane using coated steel to minimize PCB conduction loss and thermal stress, and prevent a decrease in charging current caused by high chip temperature.
- When using the LED indicator light, a current limiting resistor should be connected to VCC, with a recommended value of 3K. **If you need to use the dual light scheme, you must configure the LED lights according to the colors shown in the picture (red and blue).** Please purchase LED lights of the corresponding colors for experimentation to ensure that the two lights do not have the same conducting voltage. When charging, the red light will turn on and the blue light will turn off; When full, the blue light is on and the red light is off; During abnormal situations, the red and blue lights flash alternately. If red and green lights are required, please refer to the circuit on page 10.

Recommended component selection

Symbol	meaning	Recommended value	remarks
C _{VIN}	USB charging input voltage regulator	10μF, 25V, 0805, 10%	Ceramic capacitors with a withstand voltage greater than 16V
C _{VCC}	System power supply stabilizing capacitor	2.2μF, 16V, 0603, 10%	Ceramic capacitors with a withstand voltage greater than 10V
C _{VOUT}	Boost output stabilizing capacitor	10μF, 25V, 0805, 10%	Ceramic capacitors with a withstand voltage greater than 16V



C _{BAT}	Charging output voltage regulator capacitor, battery end	20μF, 25V, 0805, 10%	Ceramic capacitors with a withstand voltage greater than 16V
C _{BST}	Bootstrap capacitor	100nF, 16V, 0603, 10%	Ceramic capacitors
L	Power inductor	2.2uH is sufficient	Saturation current greater than 5A
R _{ISET}	Set the constant current charging current of the battery	Accuracy 1%	
R1,R2	Assist NTC detection	R1=56K,R2=150K 0°C~60°C. This configuration ensures normal charging from 0 °C to 60C.	If NTC is disabled, R1=R2=100K Pin below 0.7V, enable shutdown.
R _{NTC}	NTC thermistor	100K, B value: 4250K, accuracy 1%	According to the design selection
R3,R4	Set VN voltage for adaptive input current limiting	Connect the VHOLD pin to the midpoint of the resistor network from VIN to GND. When the VHOLD voltage drops to 1V, the charger will reduce the charging current.	Short circuit to VCC without using this function



5V USB input; The dashed device is an optional feature (dual lights)



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Absolute Maximum Ratings ^(†)

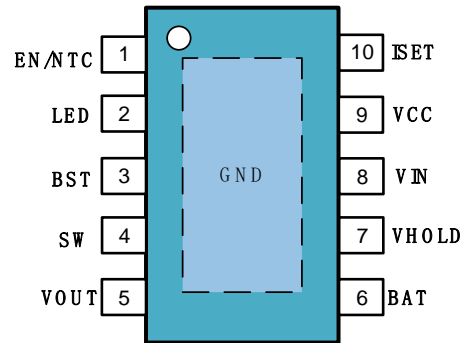
Table 4.1

Parameter	Range
Pin-to-GND voltage (VIN, BAT, VOUT)	-0.3V~28V
Pin-to-GND voltage (ISET, VHOLD, NTC, VCC)	-0.3V~6V
Pin-to-SW voltage (BST)	-0.3V~6V
Maximum current of pin (SW)	5A
Storage temperature	-65°C to 150°C
Operating temperature	-40°C to 125°C
ESD rating (HBM)	±2KV

† Note: If the device operating conditions exceed the above "Absolute Maximum Ratings," it may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Pin arrangement

Figure 4. Pin arrangement



ESD warning



ESD (electrostatic discharge) sensitive devices. Charged components and circuit boards may discharge without being noticed. Although this product has patented or proprietary protection circuits, the device may be damaged in the event of high-energy ESD. Therefore, appropriate ESD prevention measures should be taken to avoid device performance degradation or functional loss.



Functional block diagram and pin description

Table 3.2 Pin Function Description

Pin number	Pin Name	Description
ESSOP10		
1 ⁽¹⁾	EN/NTC	Combined enable/NTC input. EN: High >1.1V, Low <0.7V; NTC enabled charging can only operate at 25%~65% VCC voltage (1.25V~3.25V).
2	LED	Open-drain status output. Connect to LED via current-limiting resistor. Charging, the light is on; Full, lights off.
3	BST	Bootstrap capacitor connection (100nF to SW).
4	SW	Switching node for inductor and bootstrap capacitor.
5	VOUT	Boost output node. Requires 10μF capacitor near the pin.
6	BAT	Connect the positive pole of the battery. Bypass the 20uF ceramic capacitor to GND.
7 ⁽²⁾	VHOLD	Adaptive input current limit setting pin. Connect a resistive voltage divider network between VIN and GND to configure the minimum input voltage limit threshold. If VHOLD is less than 1V, it is considered that the adapter is current limiting.
8	VIN	Input power supply and detect pins.
9	VCC	Internal power pins. Connect at least 2.2uF ceramic capacitor to GND.
10	ISET	Set constant current charging current. Connect an external 1% precision resistor to ground to set the charging current. Under constant current charging (CC), the voltage of this pin is fixed at 1V. In all modes of the charging process, the charging current can be estimated by measuring the voltage of this pin, with the formula: $I_{2BAT} = (V_{I_CHG} / R_{I_CHG}) \times 1000$.
EP	EP	GND, Systematically.

(1) Without using adaptive current limiting, the VHOLD pin can be shorted to VCC.

(2) NTC pin does not support hanging or grounding. If the NTC function is disabled, two 100K resistors can be used to divide the voltage from VIN to NTC, and NTC will remain at the 50% VCC threshold

Technical Specifications

Unless otherwise specified, all voltages are relative to GND.

Table 5

Parameter	Test conditions	Min	Typ	Max	unit		
Power input							
V _{VIN}	Input the working voltage of the power supply	3	5	6.5	V		
V _{UVLO}	Input undervoltage lock	V _{VIN} rising edge	2.6	2.8	3.0	V	
		V _{VIN} Falling edge	2.5	2.6	2.9	V	
ΔV _{UVLO}	Input undervoltage locking hysteresis	50	150	300	mV		
V _{OVLP}	Over voltage protect	V _{VIN} rising edge	6.3	6.6	6.8	V	
		V _{VIN} Falling edge	5.5	6.3	6.7	V	
ΔV _{OVLP}	Input overvoltage protection hysteresis	200		350	mV		
static current							
I _{BAT}	Battery end leakage	EN=0, VIN=0, BAT=8.4V		18	22	25	μA
I _{VIN}	Input static current	EN=1, BAT NC		150	250	350	mA
	Shutdown Current	EN=0		20	26	30	μA
Power transistor							
f _{SW}	Boost switching frequency			750			kHz

Charging Voltage

V_{CV}	Battery full voltage setting	8.4V version (default)	8.35	8.4	8.45	V
ΔV_{RCH}	Recharging threshold after fully charged battery		8.1	8.2	8.3	V
V_{CC}	Constant current charging activation threshold	Constant current charging above this threshold Drip charging below this threshold	5.3	5.6	5.8	V
V_{TC}	Start threshold for trickle charging	Drip charging above this threshold, short-circuit charging below this threshold	1.6	2	2.4	V

Charging current

$I_{CC}^{(1)}$	Constant current charging (CC) current	$I_{SET}=1K$	900	1000	1100	mA
$I_{TC}^{(1)}$	Trickle current charging (TC) current	$I_{SET}=1K$	90	120	150	mA
$I_{SC}^{(1)}$	Short circuit charging (SC) current	$I_{SET}=1K$	30	60	90	mA
I_{TERM}	Constant voltage charging (CV) cut-off charging current	$I_{SET}=1K$	60	120	180	mA

BAT OVP

V_{OVP}	Output voltage OVP threshold	rising edge		1.2		V_{CV}
		Falling edge		1.1		V_{CV}

trickle charge V_{OUT}

V_{VOUT}	Bus voltage regulation			6.2		V
V_{TRON}	Blocking FET fully turn on threshold $V_{TRON}=V_{BAT}-V_{IN}$	$V_{BAT} > V_{TC}$		100		mV

Control logic signal EN

V_{ENH}	EN high Level Input Voltage	EN Rising		1.4		V
V_{ENL}	EN low level input voltage	EN Falling		0.76		V

Battery temperature detection NTC

$UTP^{(2)}$	Under temperature protection	Rising edge	62%	65%	68%	VCC
	Hysteresis		4%	5%	7%	VCC
$OTP^{(2)}$	Over Temperature Protection	Falling edge	22%	25%	27%	VCC
	Hysteresis		2%	2.6%	3%	VCC

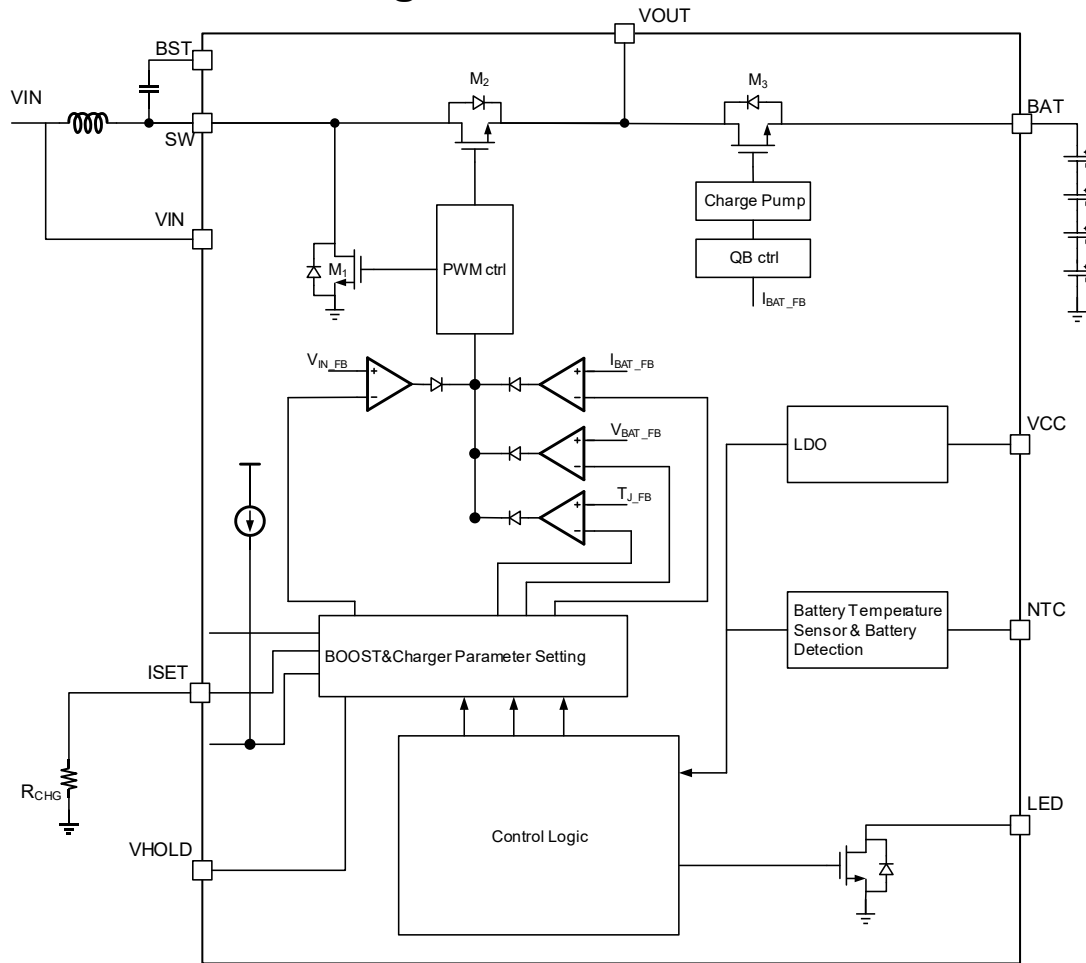
Thermal Regulation and Thermal shutdown

T_{REG}	Thermal regulation threshold			110		$^{\circ}C$
OTP	Thermal protection temperature	rising threshold		160		$^{\circ}C$
OTP_{HYS}	Thermal protection temperature hysteresis			30		$^{\circ}C$

(1) In order to protect the battery during the charging process, the chip detects the battery voltage and performs four different charging stages: Short Charge → Trickle Charge → Constant Current Charge → Constant Voltage Charge → Charging Stop.

(2) Battery temperature control, the chip will detect the NTC pin voltage to determine the temperature of the battery. The NTC resistor used is usually located inside the battery. Other combinations can be used according to the NTC cold and hot threshold. Please refer to the NTC voltage temperature threshold for design (page 11).

Functional Block Diagram



Function Description

Summary

LGS5522 is a boost type 2-cell lithium-ion battery boost charger designed for 5V adapters, with a wide input range of 3.0V~6.5V, a maximum continuous charging current of 2A, and a switching frequency of 750KHz.

Normal Charging Cycle (BAT)

LGS5522 offers four main charging stages: short-circuit charging, trickle charging, constant current charging, and constant voltage charging.

Short circuit mode: When VBAT is below the trickle charging turn-on threshold VTC (2V), Boost operates in light load, blocking FET operates in linear mode, and the battery will be charged through the body diode of HS FET. The charging current is 6% of ICC.

Trickle charging mode: When VBAT reaches VTC, Boost operates at light load, adjusts VVOUT to 6.2V, and blocks FET operation in linear mode. Charging current is 12% of ICC.

Constant current charging mode: When VBAT is higher than the constant current charging activation threshold VCC, the blocking field-effect transistor is fully conductive, Boost operates in constant current mode, and the charging current is ICC.

Constant voltage charging mode: When VBAT approaches the regulated voltage, the charging current begins to decrease. When the current drops to 1/10 ICC, turn off the charging mode. The charging cycle is completed.

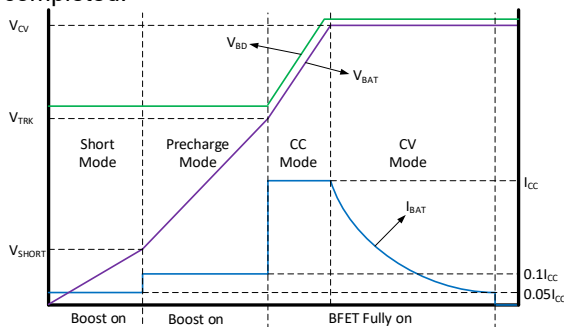


Figure 7. Battery Charging Cycle

Adaptive Input Current Limiting (VHOLD)

Adaptive input current limit setting function, VHOLD pin connects a resistive voltage divider network between VIN and GND to configure the minimum VIN limit threshold for input current limiting. LGS5522 has a VIN input voltage stabilization loop. When the VHOLD pin is detected to be less than 1V, the chip will automatically adjust and reduce the charging current to ensure that the input voltage is stable near the set input threshold and adapts to the load capacity of the adapter.

Constant current charging current setting (ISET)

The charging current of LGS5522 can be set through a resistor connected between the ISET pin and ground. Determine the resistance of the resistor based on the required charging current. In all modes of the charging process, the charging current can be estimated by measuring the voltage of this pin. VISET voltage constant current charging is 1V

Formula: $I\text{-BAT} = (V_{I\text{SET}} / R_{I\text{SET}}) \times 1000$.

R _{ISET}	ISC	IPRE	ICC	ITERM
2K	30mA	60mA	500mA	60mA
1K	60mA	120mA	1000mA	120mA

Charging status indicator light (LED)

Connect the LED pin to the LED light in series with the current limiting resistor RLED to VCC high level.

1. During the charging process, the LED pin will pull low and remain on, and the LED will stay on for a long time;
2. When charging is complete: the LED pin will pull high and hold, and the LED will turn off;
3. Fault mode: The LED pin will alternate between high and low levels at a frequency of 1Hz, causing the LED to flash.

Charging status	LED	Single lamp
Charging in progress	Low	bright
Charging completed	High	Extinguish
Input current limiting protection	Blinking at 6Hz	Approximately 6Hz flicker
Battery temperature overheating The battery temperature is too cold Charging timeout protection Input Overvoltage Protection Battery overvoltage protection Chip overheat protection	Blinking at 1Hz	Approximately 1Hz flicker

Typical application features

Figure 10.1 USB 5V Input charging process and efficiency

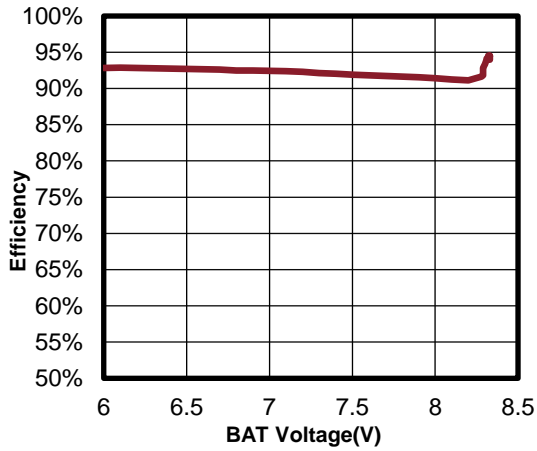


Figure 10.1.a $R_{ISET}=1K$, Efficiency of constant current and constant voltage charging stages

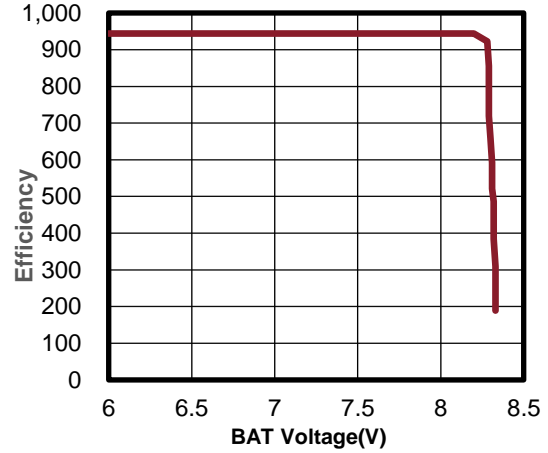


Figure 10.1.a $R_{ISET}=1K$, Constant current and constant voltage charging current

Figure 11.1 Waveform of charging switch in each stage

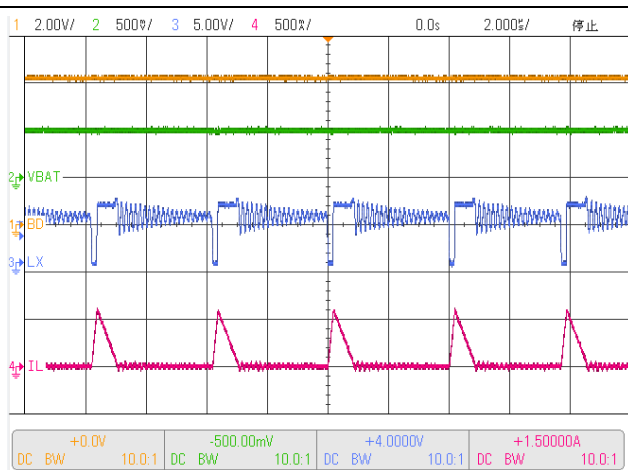


Figure 11.1.a Short circuit charging (SC) $V_{BAT}=0.5V$

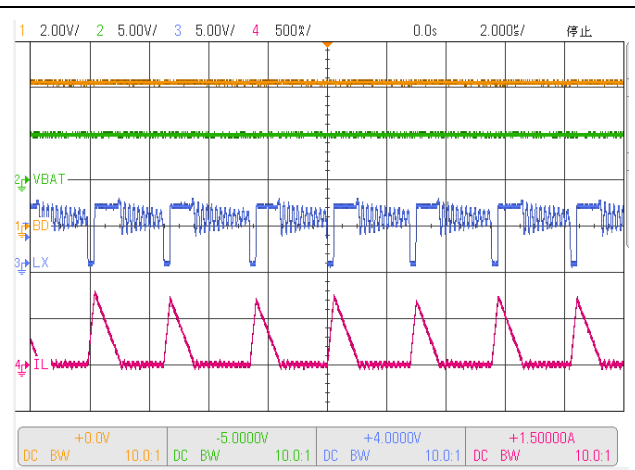


Figure 11.1.b Trickle current charging (TC) $V_{BAT}=5V$

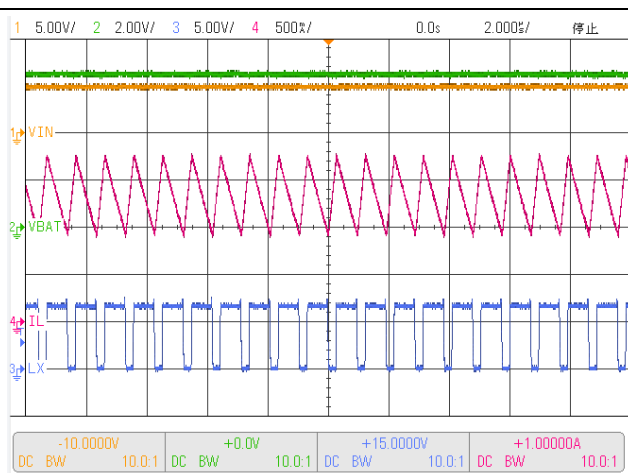


Figure 11.1.c Constant current charging (CC) $V_{BAT}=8V$

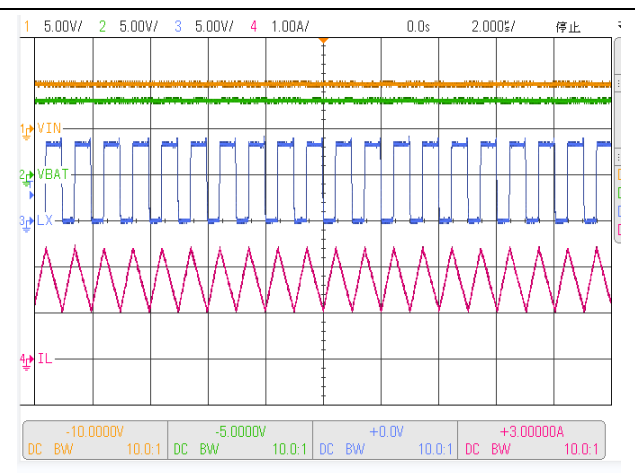


Figure 11.1.d Constant Voltage Charging Mode $V_{BAT}=8.3V$

Recommended components

Bootstrap capacitor CBST

The BST pin of LGS5522 is a bootstrap gate driver pin that provides the gate driver for the rectifying FET. Connect a 0.1 μ F ceramic capacitor to SW. CBST recommends using 0.1 μ F capacitors with a withstand voltage value higher than 10-16V.

Input capacitor CVIN

LGS5522 requires the use of decoupling capacitors to filter out noise interference at the input end. The typical recommended value for decoupling capacitors is 10F, and the rated voltage must be greater than the maximum input voltage required by the IC, preferably twice the maximum input voltage. The increase of this capacitor can reduce input voltage ripple and maintain stable input voltage during load transients. Recommend X5R or X7R ceramic capacitors above 10F.

BAT voltage regulator capacitor CBAT

Boost output capacitor COUP

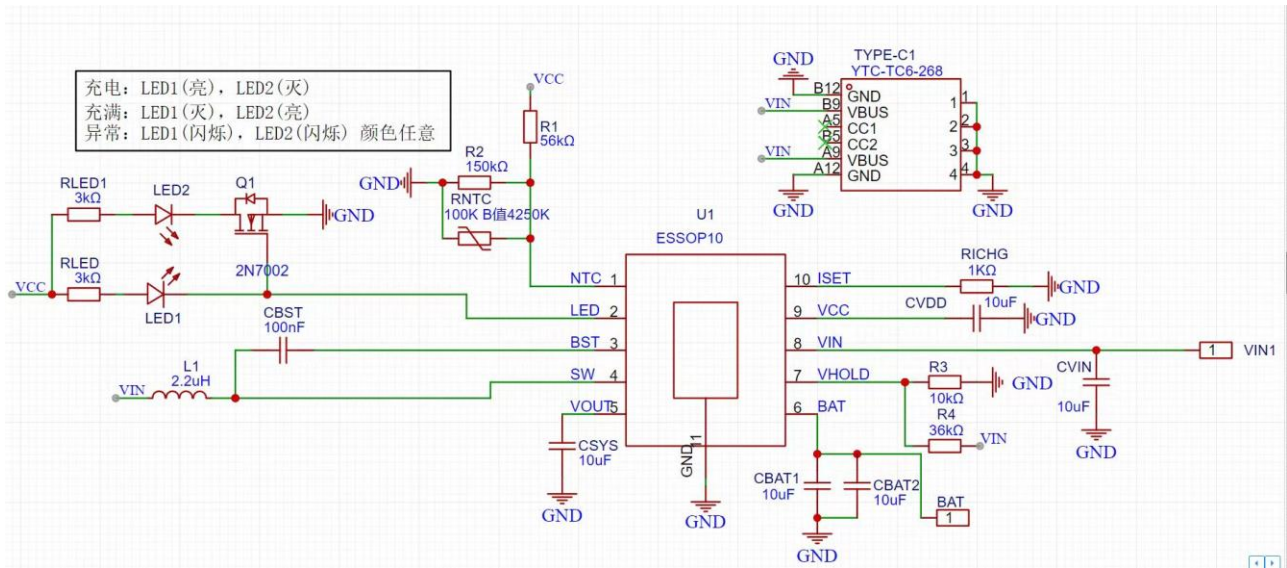
choose output capacitors to handle the requirements of output ripple noise. Ripple voltage is related to capacitance and its equivalent series resistance (ESR). For optimal performance, it is recommended to use X5R or better grade low ESR ceramic capacitors. The rated voltage of the output capacitor should be higher than the maximum output voltage. Recommend using capacitors larger than 10 μ F. And it should be close to the pins.

BAT voltage regulator capacitor CBAT

Choose output capacitors to handle the requirements of output ripple noise. Ripple voltage is related to capacitance and its equivalent series resistance (ESR). For optimal performance, it is recommended to use X5R or better grade low ESR ceramic capacitors. The rated voltage of the output capacitor should be higher than the maximum output voltage.

V_{RIPPLE} is the peak to peak value of the output ripple, and LCC is the recommended charging current for capacitors larger than 20 μ F. And it should be close to the pins.

Typical application circuit (dual lamp)

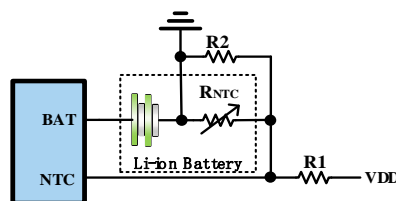


NTC device selection

NTC resistor

To prevent damage to the battery caused by high or low temperatures, LGS5522 monitors the battery temperature by measuring the NTC voltage. When the rate K ($K=V_{NTC}/V_{CC}$) reaches the UTP (K_{UT}) or OTP (K_{OT}) value, the controller triggers UTP or OTP. If the voltage of the NTC pin is less than 25% of the VCC voltage or greater than 65% of the VCC voltage, it means that the battery temperature is too low or too high, and charging is paused. The temperature sensing network is shown in the following figure.

Choose R_2 and R_1 to program appropriate UTP and OTP temperature threshold points.



Calculation steps:

1. Define K_{UT} , $K_{UT}=62\% \sim 68\%$, Typical value 65%
2. Define K_{OT} , $K_{OT}=22\% \sim 27\%$, Typical value 25%
3. Assuming the NTC thermistor of the battery is R_T at the UTP value and R_{OT} at the OTP value.
4. Calculate R_1

$$R_1 = \frac{R_{OT} R_{UT} (K_{UT} - K_{OT})}{(R_{UT} - R_{OT}) K_{UT} K_{OT}}$$

5. Calculate R_2

$$R_2 = \frac{R_{OT} R_{UT} (K_{UT} - K_{OT})}{R_{OT} (K_{OT} - K_{OT} K_{UT}) - R_{UT} (K_{UT} - K_{OT} K_{UT})}$$

If the typical values $K_{UT}=65\%$ and $K_{OT}=25\%$ are selected, then



$$R_1 = \frac{2.46R_{OT}R_{UT}}{R_{UT} - R_{OT}}$$

$$R_2 = \frac{0.4R_{UT}R_{OT}}{0.0875R_{UT} - 0.4875R_{OT}}$$

We choose the commonly used 100K NTC resistor with a B value of 4250K on the market, and calculate the R1 and R2 values that can be charged at battery temperatures between 0C and 60C

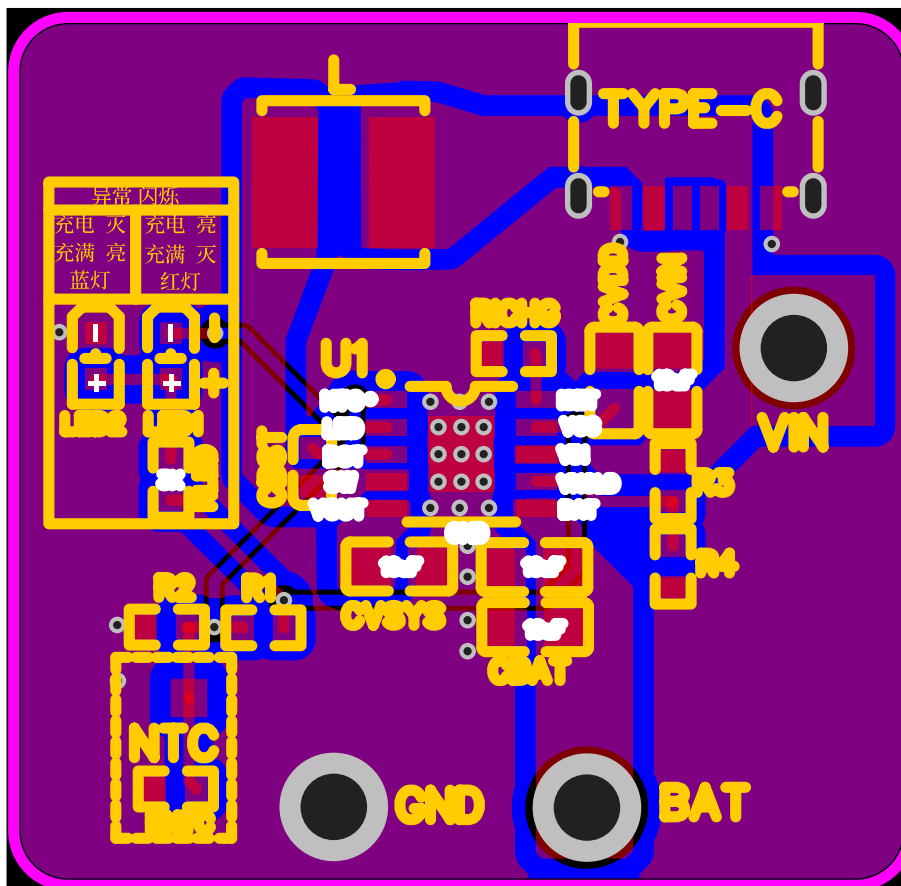
temperature	R _{NTC}	Resistance B value	R1	R2	Model
0°C~60°C	10K, accuracy 1%	3380K	8.2K	36K	
0°C~60°C	100K, accuracy 1%	4250K	56K	150K	
-10°C~60°C	10K, accuracy 1%	3380K	7.87K	22K	
0°C~45°C	10K, accuracy 1%	3380K	14.3K	820K	
0°C~45°C	100K, accuracy 1%	4250K	110K	470K	
0°C~45°C	10K, accuracy 1%	3380K	15K	NC	

Refer to PCB layout

summary

The layout design of the LGS5522 boost lithium-ion battery charger is relatively simple. To achieve optimal efficiency and minimize noise issues, we should place the following components near the IC:- CVIN, L, CVOUT (CVOUT capacitor must be close to the pin with the highest priority):

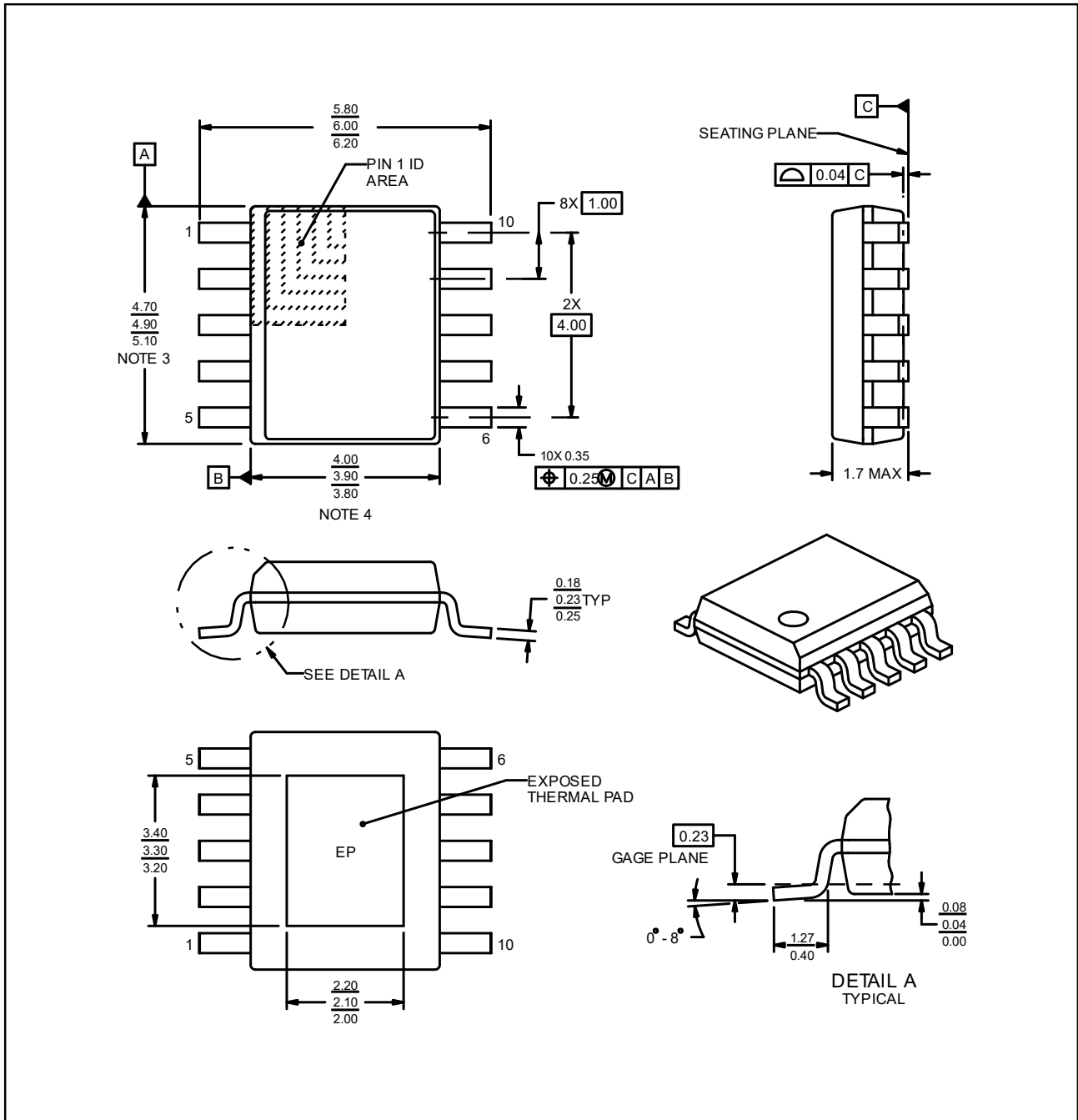
- The power circuit must be as short as possible.
- The C_{vout} capacitor of the output circuit is close to the VOUT and PGND pins of the chip; The CBST capacitor is a bootstrap capacitor that needs to be close to the chip pin BST; CBAT capacitors should be placed as close as possible to the BAT and PGND pins of the chip
- NTC should stay away from SW signals to reduce noise interference.
- For high current paths, larger PCB copper-clad areas should be used, including SW, PGND pins, and bottom heat dissipation pads. This helps to minimize PCB conduction losses and thermal stress to the greatest extent possible.
- To minimize via conduction loss and reduce module thermal stress, multiple vias should be used to achieve interconnection between the top layer and other power layers or layers (adding via windows to the bottom pads of the chip can help improve chip heat dissipation and performance).
- RNTC is a thermistor used to detect the temperature of the battery, usually located inside the battery. If it is on the PCB board, it is recommended to stay away from heating elements such as chips and inductors.
- The VOUT capacitor must be placed close enough to the chip and can be placed above and below the VOUT and GND pins





Encapsulation Outline Description (ESSOP10)

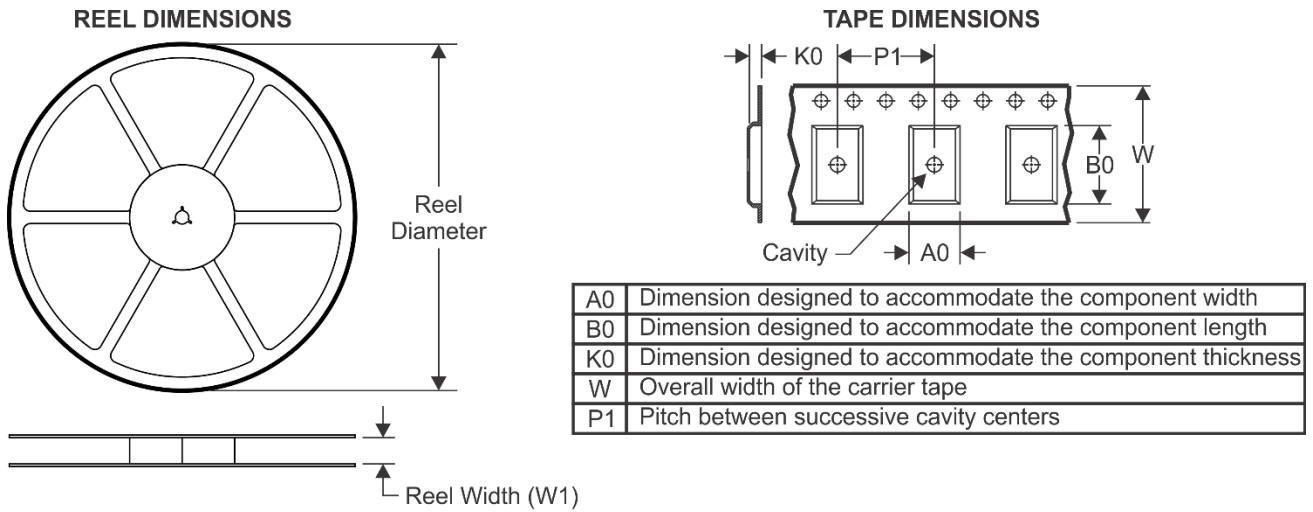
10 pin plastic encapsulated SOIC with bottom e Pad



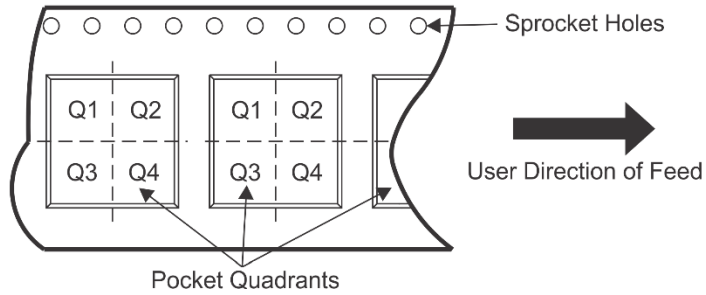
Note:

- (1) All data units are in millimeters, and any dimensions in parentheses are for reference only.
- (2) This image is subject to change without prior notice.
- (3) This size does not include mold burrs, protrusions, or nozzle burrs.

Packaging



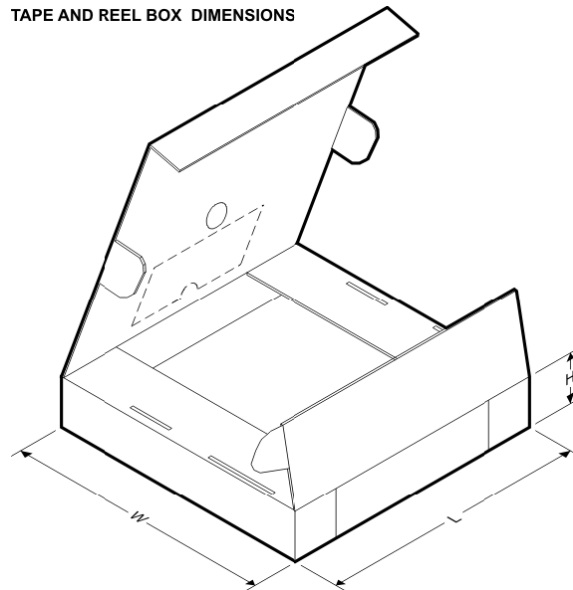
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*ALL dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1(mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LGS5522ES	ESSOP10	ES	10	4000	330	12.4	6.4	5.2	2.1	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS





Important Disclaimer and Disclaimer

Legend si provides technical and reliable data (including data sheets), design resources (including reference designs), application or other design suggestions, network tools, security information, and other resources' as is' without warranty or any express or implied warranties, including but not limited to implied warranties of merchantability, suitability for a particular purpose, or non infringement of any third-party intellectual property rights.

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Historical revision records

Rev. D V1.0	Page
※ D version. The relevant parameters in this manual only describe and acknowledge the indicators related to version ALL	
Rev. D V1.1	Page
※ Version D. Add typical application circuits for dual lamps (page 10)	ALL

† NOTE: The page numbers of previous versions may differ from those of the current version.