Standalone Li-ion Switch Mode Battery Charger

■ General Description

The XT2602 is a complete battery charger controller for two (8.4V) cell lithium-ion batteries. With a 500kHz switching frequency, the XT2062 provides a small, simple and efficient solution to fast charge Li-Ion batteries from a wide range of supply voltages. An external sense resistor sets the charge current. An internal resistor divider and precision reference set the final float voltage with ±1% accuracy.

When the input supply is removed, the XT2062 automatically enters a low current sleep mode, dropping the battery drain current to 20μA. An internal comparator detects the near end-of-charge condition while an internal timer sets the total charge time and terminates the charge cycle.

The chip includes an internal benchmark, bias, voltage comparator and a temperature sensing modules, the XT2062 is available in the 8-lead SOP package.

■ Features

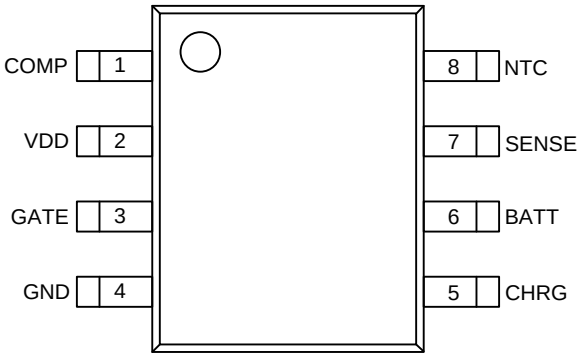
- Wide Input Supply Range: 8.9V to 20V
- Current Mode PWM Controller DC-DC
- ±1% Charge Voltage Accuracy
- ±10% Charge Current Accuracy
- End-of-Charge Current Detection Output
- Charge Termination Timer
- Constant Switching Frequency for Minimum Noise
- Automatic Battery Recharge
- Automatic Shutdown When Input Supply is Removed
- Automatic Trickle Charging of Low Voltage Batteries
- Stable with Ceramic Output Capacitor
- 8-Lead SOP Package

■ Applications

- Mobile Phone
- Digital Cameras
- MP4 players
- Bluetooth applications
- Electronic Dictionary
- Portable devices
- A variety of chargers

■ Package

- SOP-8



SOP-8
(Top View)

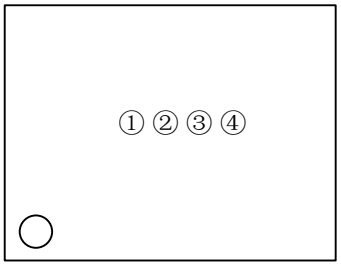
■ Ordering Information

XT2062 ①②③④

Designator	Represents	Symbol	Description
①	Type	W	External charger MOS
		U	Internal charger MOS
②	Regulator output voltage	0	8.2
		1	8.3
		2	8.4
③	Package Type	M	SOP-8
④	Device Orientation	R	Standard Feed
		L	Reverse Feed

■ Marking Rule

- **SOP-8**



① Represents the product name

Symbol	Product Name
2	XT2062◆◆◆◆

② Represents continuous charging voltage type

Symbol	MOS	Product Name
W	External	XT2062W◆◆◆
U	Internal	XT2062U◆◆◆

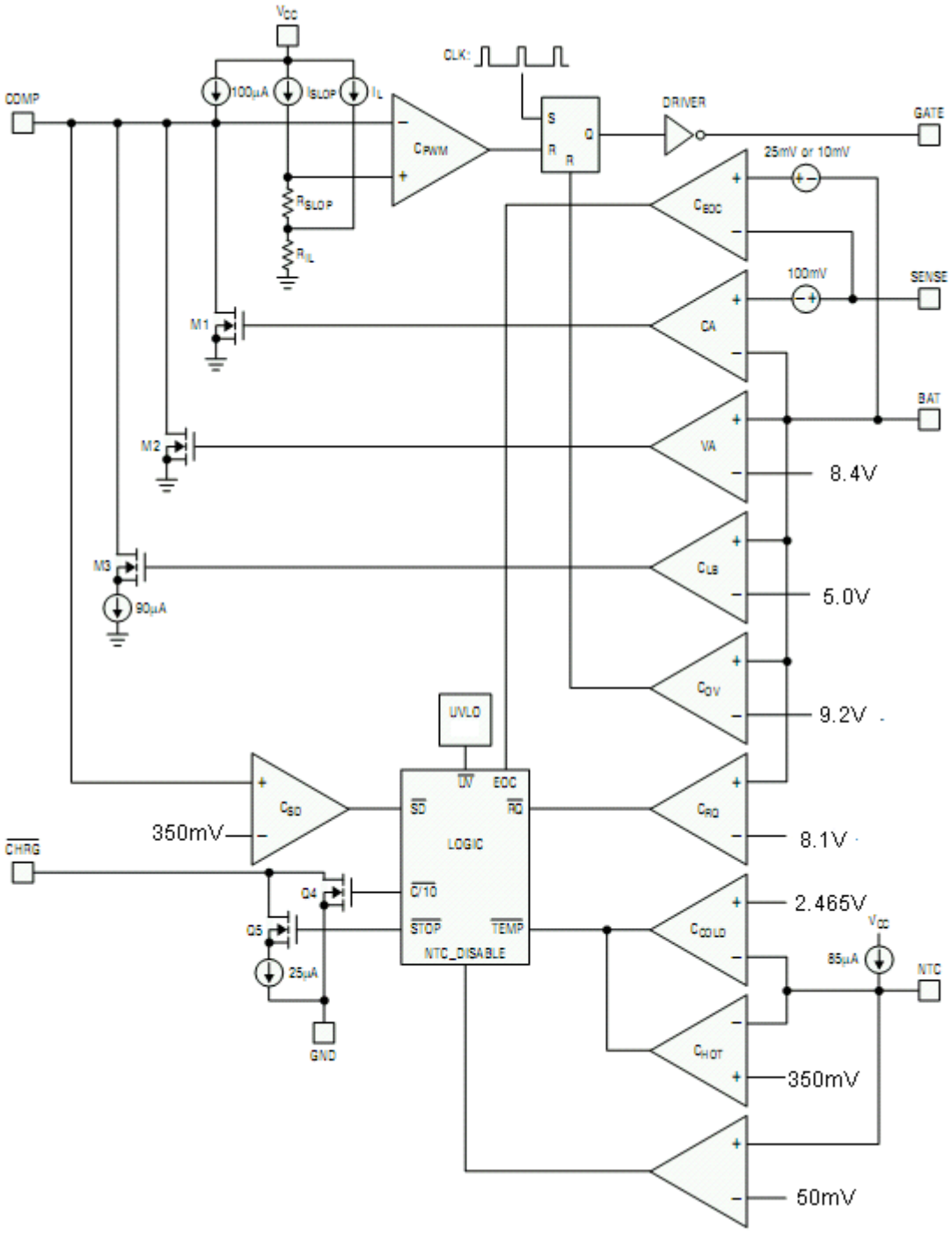
③ Represents the regulator output voltage

Symbol	Voltage		Symbol	Voltage
A	8.0		H	8.3
B	8.05		K	8.35
C	8.1		L	8.4
D	8.15		M	8.45
E	8.2		N	8.5
F	8.25		P	8.55

④ Represents the assembly lot No.

0-9，A-Z; 0-9，A-Z mirror writing，repeated（G，I，J，O，Q，W exception）

■ Function Block Diagram



■ Functional Pin Description

Pin Number	Pin Name	Function Description
1	COMP	Compensation and charge set
2	VDD	Power Supply
3	GATE	External MOS drive port
4	GND	Ground
5	CHRG	Charge status
6	BATT	Battery test input
7	SENSE	Current detection
8	NTC	Temperature detection

■ Absolute Maximum Ratings

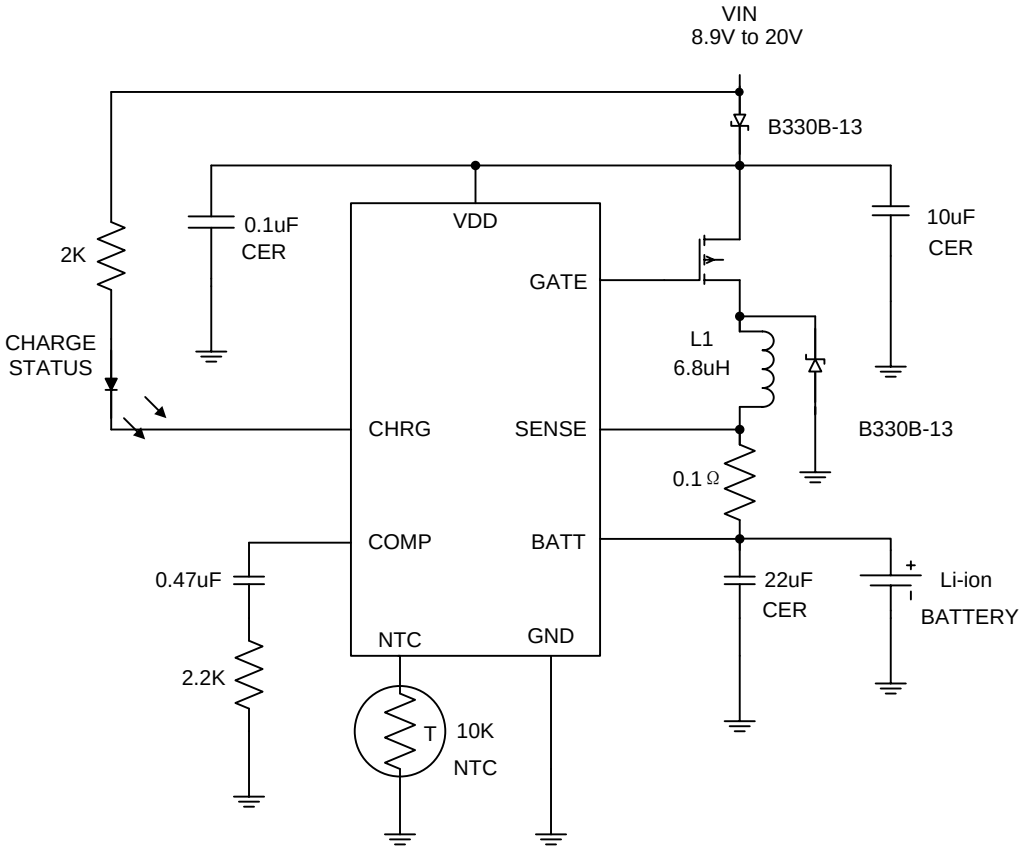
Parameter	Symbol	Maximum Rating	Unit
Input Voltage	V_{cc}	V_{SS}-0.3～V_{SS}+22	V
GATE pin voltage	Vgate	V_{SS}-0.3～V_{cc}+0.3	
BAT pin voltage	Vbat	Vss-0.3～14	
SENSE pin voltage	Vsense	V_{SS}-0.3～14	
CHAG pin voltage	Vchrg	V_{SS}-0.3～14	
COMP pin voltage	Vcomp	V_{SS}-0.3～7	
NTC pin voltage	Vntc	V_{SS}-0.3～7	
Operating Ambient Temperature	Topr	-40～+85	°C
Storage Temperature	Tstr	-65～+125	
ESD Discharge capacity (HBM)		2000	V
Reflow Temperature(soldeing,10s)		300	°C

■ Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	Test Circuit
Vcc Supply Voltage	Vcc		8.9		20	V	2
Vcc Supply Current	Icc	Current Mode		3	5	mA	1
		Shutdown Mode		3	5	mA	1
		Sleep Mode		20	30	μA	1
Battery Regulated Float Voltage	Vbatt	RL=100mA	8.316	8.4	8.484	V	2
Constant Current Sense Voltage	$V_{SNS(CHG)}$	5V<Vbatt<8V	90	100	110	mV	3
	$V_{SNS(TRKL)}$	Vbatt<4V	20	25	30	mV	3
Trickle Current Sense Voltage	Vtrikl		4.7	5.0	5.3	V	3
Manual Shutdown Threshold Voltage	Vmsd		200	350	500	mV	2
VCC Undervoltage Lockout Threshold Voltage	Vuvlo	Vcc Rising		8.4		V	2
End-of-Charge Ratio	Reoc	$V_{SNS(EOC)}$/ $V_{SNS(CHG)}$	5	10	15	%	2
COMP Pin Current	Icomp			100		uA	2
NTC Pin Current	Intc			85		uA	2
NTC Pin Threshold Voltage(Hot)	Vntc-hot		340	355	370	mV	2
NTC Pin Threshold Voltage(Cold)	Vntc-cold		2.291	2.35	2.386	V	2
Switching Frequency	Fosc	RL=100mA	450	500	550	KHZ	3
Temperature Proctection	T_HOT			155		℃	2
Battery Recharge Hysteresis voltage	Δ Vrecg	Vbatt - Vrecharge	200	300	400	mV	3

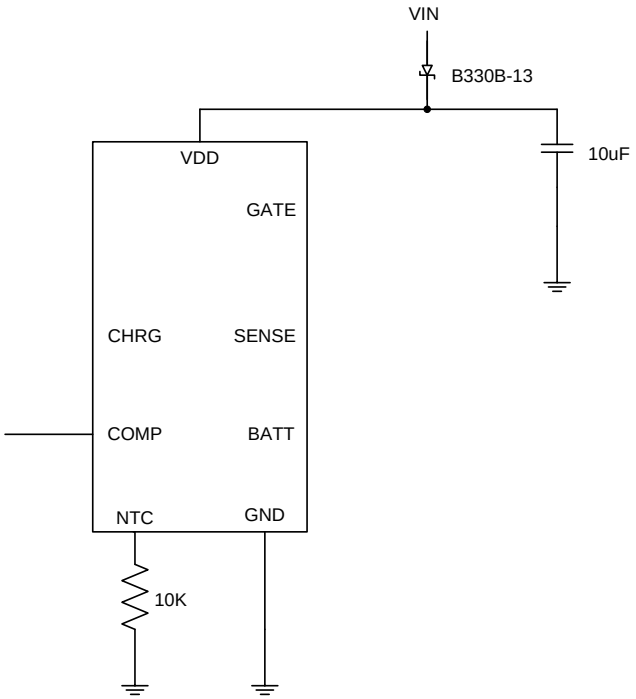
■ Typical Application Circuit

- **1 A two cell lithium-ion battery applications**

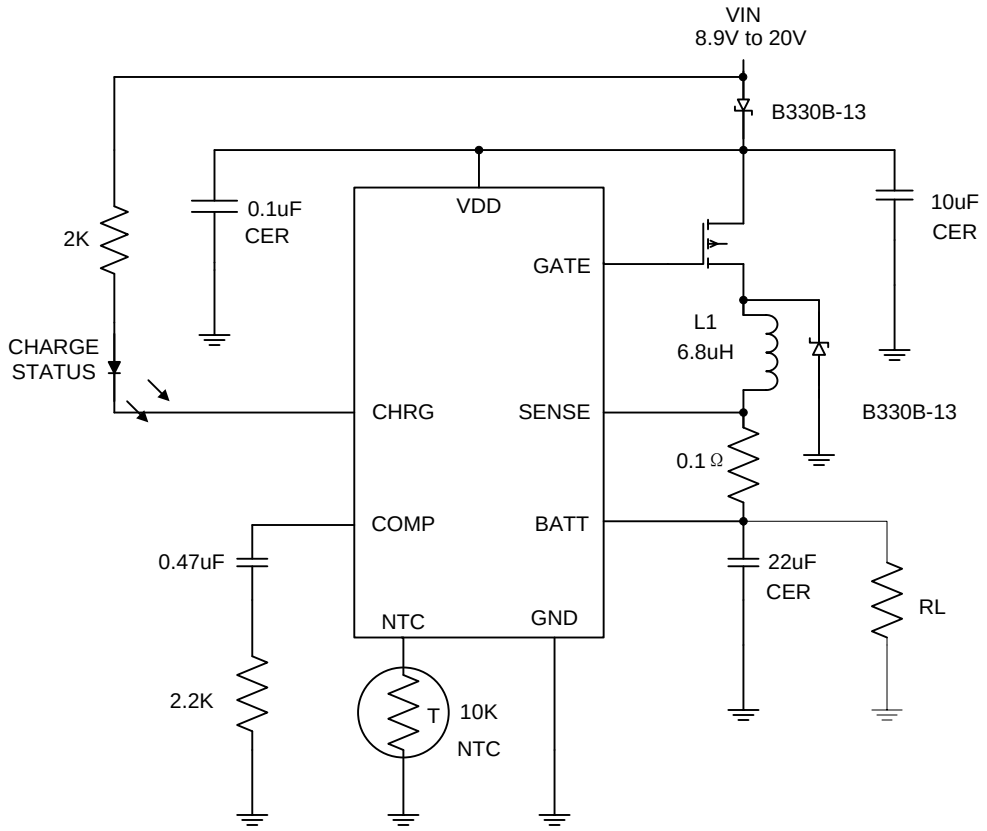


■ Test Circuit

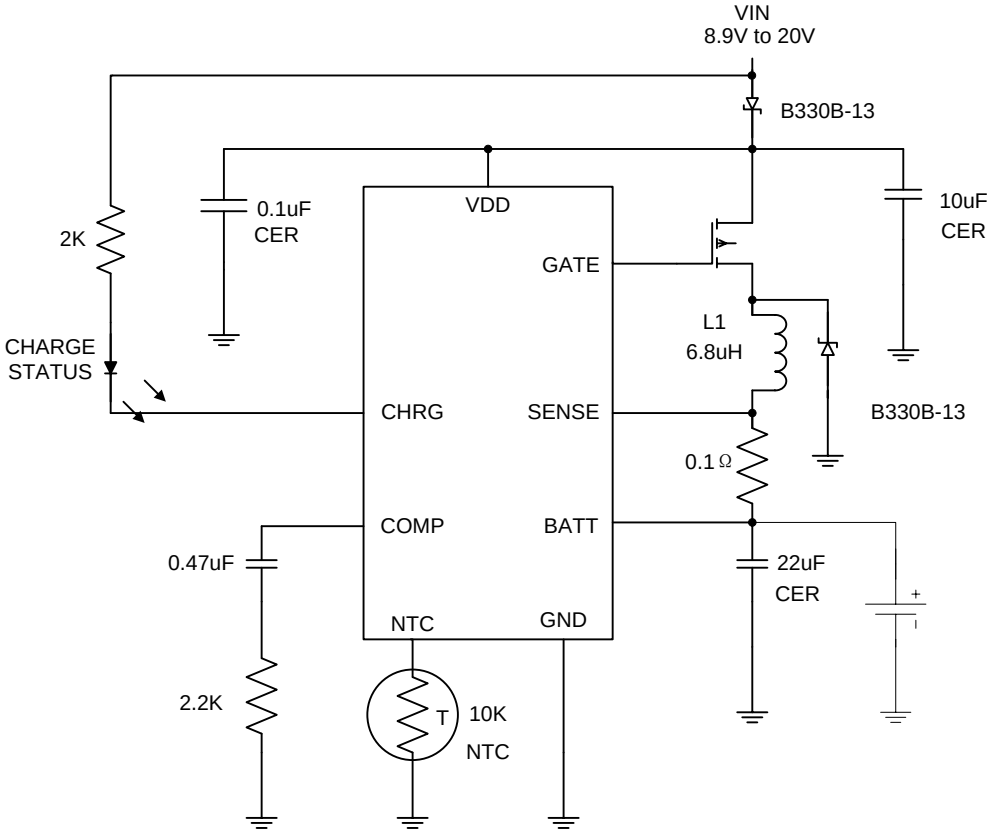
- **Test Circuit 1**



- **Test Circuit 2**

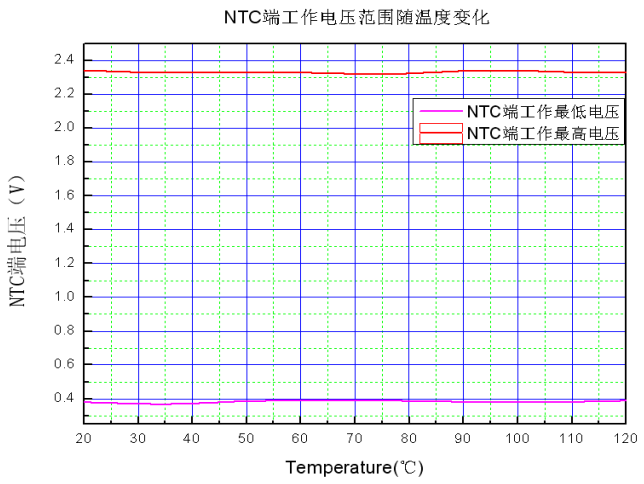


- **Test Circuit 3**

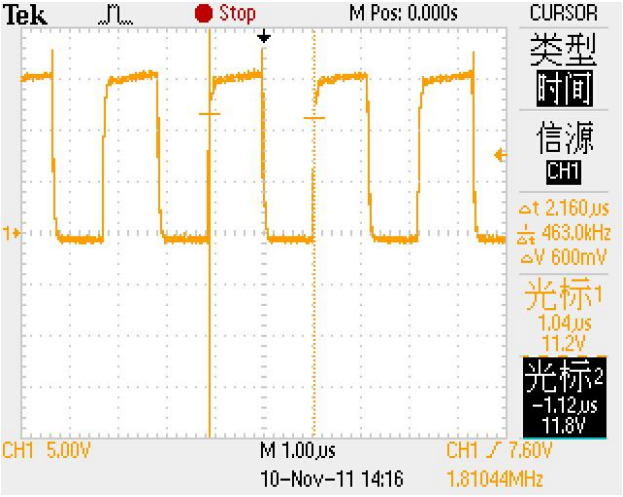


■ Typical Performance Characteristics

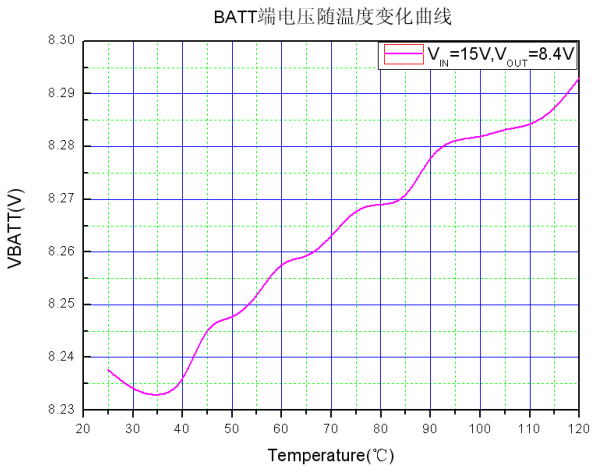
- **NTC Pin Operating Range VS Temperature**



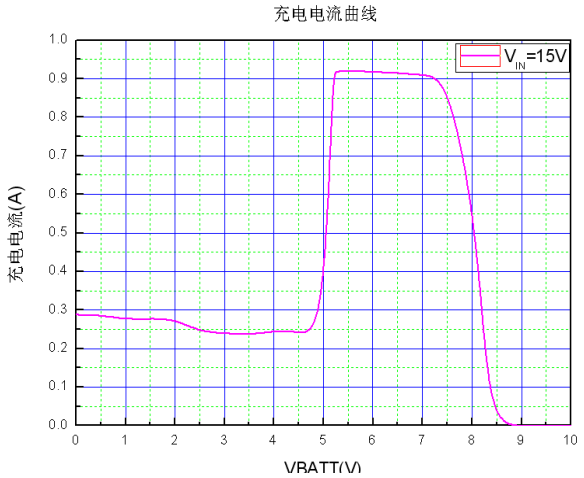
- **GATE Pin Waveform**



- **BATT Pin VS Temperature**



- **Chargering Current**



■ Operation

The XT2062 is a constant current, constant voltage Li-Ion battery charger controller that uses a current mode PWM step-down (buck) switching architecture. The charge current is set by an external sense resistor (RSENSE) across the SENSE and BAT pins.

A charge cycle begins when the voltage at the VCC pin rises above the UVLO level and is 250mV or more greater than the battery voltage. At the beginning of the charge cycle, if the battery voltage is less than the trickle charge thresh-old, 5V for the 8.4 version, the charger goes into trickle charge mode. The trickle charge current is internally set to 10% of the full-scale current. If the battery voltage stays low for 30 minutes, the battery is considered faulty and the charge cycle is terminated.
When the battery voltage exceeds the trickle charge thresh-old, the charger goes into the full-scale constant current charge mode. In constant current mode, the charge current is set by the external sense resistor RSENSE and an internal 100mV reference, The formula is as follows:

$$I_{BATT} = \frac{100mV}{R_{SENSE}}$$

When the battery voltage approaches the programmed float voltage, the charge current will start to decrease.When the current drops to 10% of the full-scale charge current, an internal comparator turns off the internal pull-down N-channel MOSFET at the CHRG pin, and connects a weak current source to ground to indicate a near end-of-charge condition.

An internal 6 hour timer determines the total charge time. After a time out occurs, the charge cycle is terminated and the CHRG pin is forced high impedance. To restart the charge cycle, remove and reapply the input voltage or momentarily shut the charger down. Also, a new charge cycle will begin if the battery voltage drops below the recharge threshold voltage of 8.1 V.

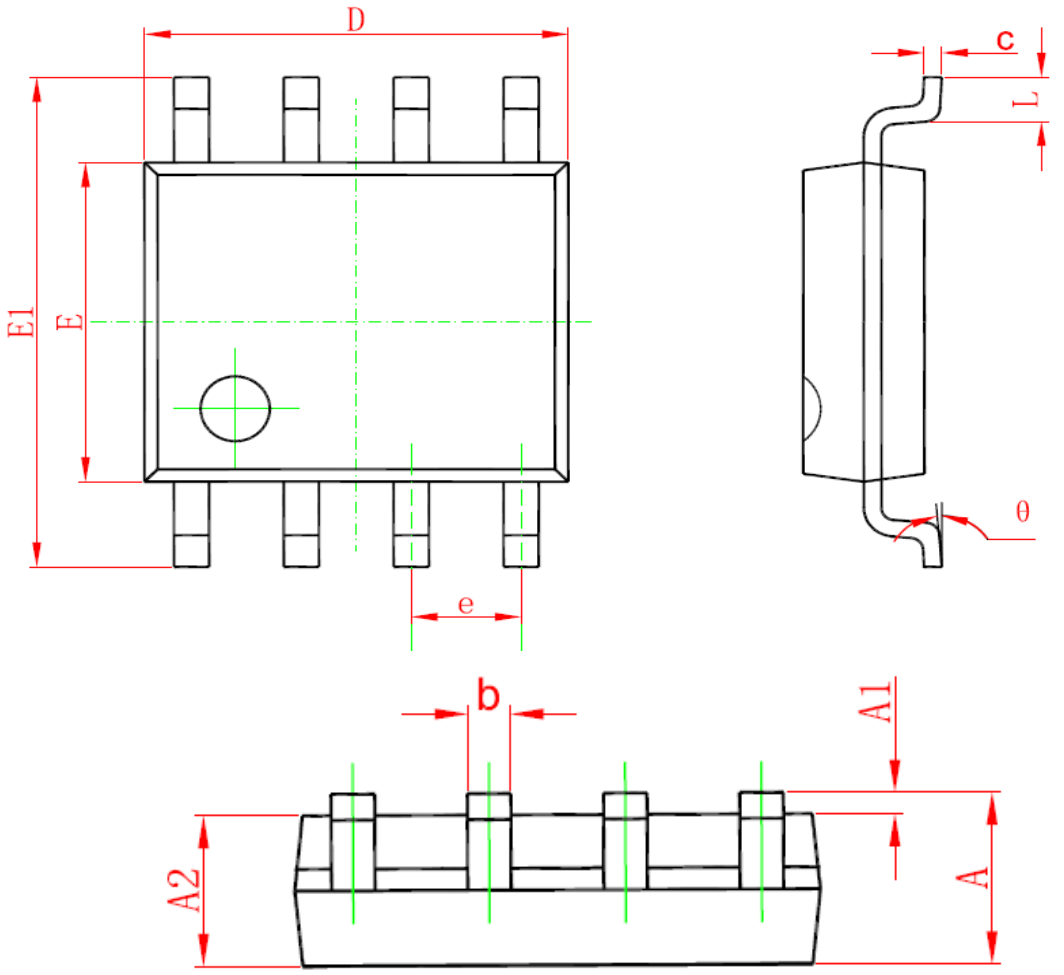
A 10kΩ NTC (negative temperature coefficient) thermistor can be connected from the NTC pin to ground for battery temperature qualification. The charge cycle is suspended when the temperature is outside of the 0°C to 50°C window (with DALE NTHS-1206N02).If the temperature rises to 50°C, the resistance of the NTC will be approximately 4.1kΩ. With the 85μA pull-up current source, the Hot temperature voltage threshold is 350mV. For Cold temperature, the voltage threshold is set at 2.35V which is equal to 0°C (RNTC ≅ 28.4kΩ) with 85μA of pull-up current. If the temperature is outside the window, the GATE pin will be pulled up to VCC and the timer frozen while the output status at the CHRG pin remains the same. The charge cycle begins or resumes once the temperature is within the acceptable range. Short the NTC pin to ground to disable the temperature qualification feature.

XT2062-chip status VS LED display status for the CHARGE Pin.

Work Status	Charge	Charge Full	No Battery	Error
LED Display status	Highlight	Weak Light	Flicker	OFF

■ Package Information

- **SOP-8**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°