Single 1A Li-Ion Battery Charge IC

DESCRIPTION

The SUM9512 is a single cell, fully integrated constant current (CC)/constant voltage (CV) Li- ion battery charger. Its compact package with minimum external components requirement makes the SUM9512 ideal for portable applications.

No external sense resistor or blocking diode is necessary for the SUM9512. Build-in thermal feedback mechanism regulates the charge current to control the die temperature during high power operation or at elevated ambient temperature.

The SUM9512 has a pre-charge function for trickle charging deeply discharged batteries. The fast charge current can be programmed by an external resistor. CV regulation mode is automatically enabled once the battery's charging curve reaches the constant voltage portion. The output current then decays and is finally terminated once the charge current drops to 1/10 of the programmed value. The SUM9512 keeps monitoring the battery voltage and enables a new charge cycle once the voltage drops by 150mV below the CV value.

Power supply state is constantly monitored and the battery drain current is reduced to minimum value automatically when the SUM9512 senses a lack of input power. A status pin outputs a logic HIGH/LOW to indicate the charging status and the presence of power supply.

The SUM9512 is available in DFN2.0 × 2.0-8 and ESOP-8 packages.

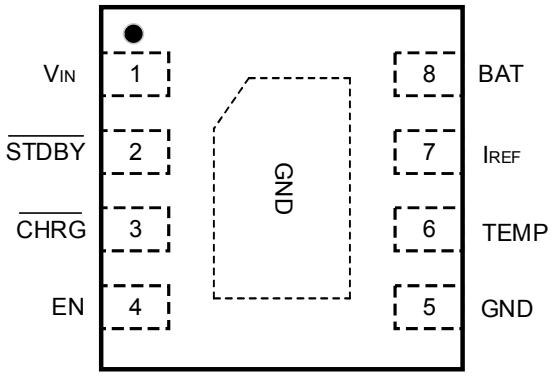
FEATURES

- Standalone Capability with no Requirement of External MOSFET, Sense Resistor or Blocking Diode.
- Complete Linear Charger in Compact Package for Single Cell Lithium-Ion Batteries
- Programmable Pre-charge, Fast Charge and Termination Current.
- Constant-Current/Constant-Voltage Operation with Thermal Regulation to Maximize Charge Rate Without Risk of Overheating
- Charges Single Cell Li-Ion Batteries Directly from USB Port
- Preset 4.24V Charge Voltage maximum
- Automatic Recharge
- Charge Status double light indication
- C/10 Charge Termination
- Soft-Start Limits Inrush Current
- Available in DFN2.0 × 2.0-8 and ESOP-8 Packages
- Constant current function without LED current limiting resistor.

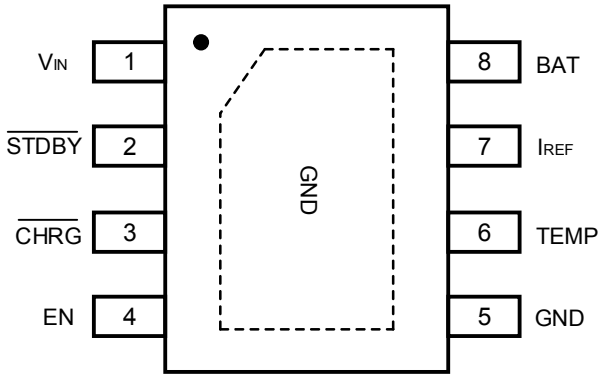
ORDER INFORMATION

Model	Package	Ordering Number	Packing Option
SUM9512	DFN2.0 × 2.0-8	SUM9512DNE8	Tape and Reel, 4000
	ESOP-8	SUM9512ES8	Tape and Reel, 4000

PIN CONFIGURATION (Top View)



DFN2.0 × 2.0-8

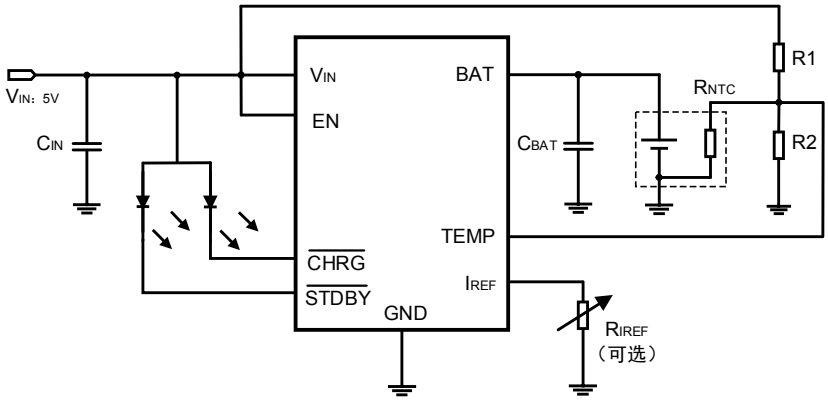


ESOP-8

PIN DESCRIPTIONS

Pin	Name	Function
1	V_{IN}	Power Input.
2	$\overline{STDBY}$	Charge terminated status output. This pin is pulled low by an internal switch to indicate battery charge terminated; this means Charge termination. therwise this pin is in high impedance state.
3	$\overline{CHRG}$	Charge status output. When the battery is being charged, this pin is pulled low by an internal switch, otherwise, this pin is in high impedance state.
4	EN	Enable Input.
5	GND	Ground.
6	TEMP	Battery temperature detection
7	I_{REF}	Charge-Current Programming and Monitoring Pin.
8	BAT	Charger Output Pin. Connect this pin to the battery.

TYPICAL APPLICATIONS



ELECTRONIC COMPONENT SELECTION

Symbol	Describe	Requirement	Quantity
C_{IN} /C_{BAT}	Bypass Capacitor	10 μF	2
R_{IREF}	Programming Resistor	1% precision resistor , About 500mA charges default	1
R_1 /R_2 /R_{NTC}	Temp Protection	R1 /R2 choose 1% precision resistor	3

ABSOLUTE MAXIMUM RATING

V_{IN}		–0.3 V to 7.5 V
Other pin voltage		– 0.3 V to V_{IN} + 0.3 V
Maximum Junction Temperature		125°C
Operating Ambient Temperature Range		–40°C to 85°C
Storage Temperature Range		–40°C to 125°C
Lead Temperature (Soldering, 10 sec)		260°C
ESD	HBM	2000 V
	MM	200 V

Stresses beyond those listed under “ABSOLUTE MAXIMUM RATINGS” 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 the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

CAUTION

This integrated circuit can be damaged by ESD if you don’t pay attention to ESD protection. SUMSEMI recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

SUMSEMI reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SUMSEMI sales office to get the latest datasheet.

ELECTRICAL CHARACTERISTICS

V_{IN} = 5 V, Ta = 25 °C, R_{IREF} = 2 K, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IN}	Input Supply Voltage		4.5		6.0	V
I_{IN}	Input Supply Current	Charge Mode, R_{IREF} = 10K		200		μA
		Standby Mode (ChargeTerminated)		110		μA
V_{FLOAT}	Regulated Output (Float) Voltage	Output voltage before the full charge indicator lamp switch		4.2	4.24	V
I_{BAT}	BAT Pin Current	Charge Mode, R_{IREF} = 10 K	-13%	100	+13%	mA
		Charge Mode, R_{IREF} = 1 K	-13%	1050	+13%	mA
		Charge Mode, I_{REF} pin floating	450	500	550	mA
		Power off Mode (V_{IN} = 0)		-0.7		μA
I_{TRIKL}	Trickle Charge Current	V_{BAT} = 2.6 V, R_{IREF} = 10 K		15		mA
		V_{BAT} = 2.6 V, R_{IREF} = 2 K		65		mA
V_{TRIKL}	Trickle Charge Threshold Voltage	V_{BAT} Rising, R_{IREF} = 10 K	2.8	2.9	3	V
V_{TRHYS}	Trickle Charge Hysteresis Voltage	V_{BAT} Falling, R_{IREF} = 10 K		150		mV
V_{UV}	V_{IN} Undervoltage Lockout Threshold	V_{IN} Rising	3.0	3.3	3.6	V
V_{UVHYS}	V_{IN} Undervoltage Lockout Hysteresis	V_{IN} Falling		300		mV
V_{ASD}	V_{IN}–V_{BAT} Lockout Threshold Voltage	V_{BAT} = 3.7 V, V_{IN} Rising		150		mV
		V_{BAT} = 3.7 V, V_{IN} Falling		50		mV
I_{TERM}	C/10 Termination Current Threshold	R_{IREF} = 10 K		15		mA
		R_{IREF} = 2 K		65		mA
V_{RECHRG}	Recharge BAT Threshold Voltage	V_{FLOAT} - V_{RECHRG}		150		mV
T_{CC}	Over temperature protection threshold			120		°C
$t_{RECHARGE}$	Recharge Comparator Filter Time			2		ms
t_{TERM}	Termination Comparator Filter Time			2		ms
I_{LED}	LED lighting current	$V_{CHRG/STDBY}$ = 0.5 V	1	2.8	4	mA
V_{EN}	EN enable threshold	V_{EN} Rising		0.88		V
	EN Shut off threshold	The difference between V_{EN} Rising		0.05		V
V_{NTCL}	NTC 40% V_{IN} threshold	V_{NTC} Rising		2.2		V
		V_{NTC} Falling		1.9		V
V_{NTCH}	NTC 80% V_{IN} threshold	V_{NTC} Rising		4.0		V
		V_{NTC} Falling		3.8		V

DETAILED DESCRIPTION

The SUM9512 is a single cell, fully integrated constant current (CC)/constant voltage (CV) Li-ion battery charger. It can deliver up to 1000mA of charge current with a final float voltage accuracy of 1%. The SUM9512 has a build-in thermal regulation circuitry that ensures its safe operation. No blocking diode or external current sense resistor is required; hence reduce the external components for a basic charger circuit to two. The SUM9512 is also capable of operating from a USB power source.

NORMAL CHARGE CYCLE

The SUM9512 initiates a charge cycle once the voltage at the V_{IN} pin rises above the UVLO threshold level. A 1% precision resistor needs to be connected from the I_{REF} pin to ground. If the voltage at the BAT pin is less than 2.9V, the charger enters trickle harge mode. In this mode, the charge current is reduced to nearly 1/10 the programmed value until the battery voltage is raised to a safe level for full current charging.

The charger switches to constant-current mode as the BAT pin voltage rises above 2.9V, the charge current is thus resumed to full programmed value. When the final float voltage (4.2V) is reached, the SUM9512 enters constant-voltage mode and the charge current begins to decrease until it drops to 1/10 of the preset value and ends the charge cycle.

PROGRAMMING CHARGE CURRENT

The charge current out of the BAT pin can be determined at any time by monitoring the I_{REF} pin voltage using the following equation:

$$I_{BAT} = \frac{1000}{R_{IREF}}$$

When the I_{REF} pin is floating, The value of charging current approximates 1000mA.

SUM9512 has a self-temperature-limiting (STL) function, the chip starts to limit its charge current by reducing V_{IREF} gradually after silicon temperature rises above 120℃. Say if the difference of junction and ambient temperature is 45℃ at certain power rating, SUM9512 would have the same charge current and junction temperature as chips without STL function at room temperature. As the ambient temperature rises up to 105℃, a chip without STL would have 130℃ of junction temperature, while SUM9512 would reduce its charge current and hence the junction temperature would be much lower. The STL function helps to improve system reliability.

CHARGE TERMINATION

The SUM9512 keeps monitoring the I_{REF} pin during the charging process. It terminates the charge cycle when the charge current falls to 1/10 the programmed value after the final float voltage is reached. When the I_{REF} pin voltage falls below 200mV for longer than t_{TERM} (typically 1ms), charging is terminated. The charge current is latched off and the SUM9512 enters standby mode, where the input supply current drops to 50μA. (Note: C/10 termination is disabled in trickle charging and thermal limiting modes).

CHARGE STATUS INDICATOR($\overline{CHRG}$)

There are two different states of the charge status output, namely pull-down and high impedance.The pull-down state indicates that the SUM9512 is in a charge cycle. When the charge cycle has terminated, the pin state is then determined by undervoltage lockout conditions. Integrated with constant current control technology, SUM9512's indicator pin can ensure the indicator brightness stability without external current limiting resistor.

State	CHRG LED	STDBY LED
Charging	ON	OFF
EOC	OFF	ON
UVLO	OFF	OFF

THERMAL LIMITING

Build-in feedback circuitry mechanism can reduce the value of the programmed charge current once the die temperature tends to rise above 120°C, hence prevents the temperature from further increase and ensure device safeoperation.

UNDERVOLTAGE LOCKOUT (UVLO)

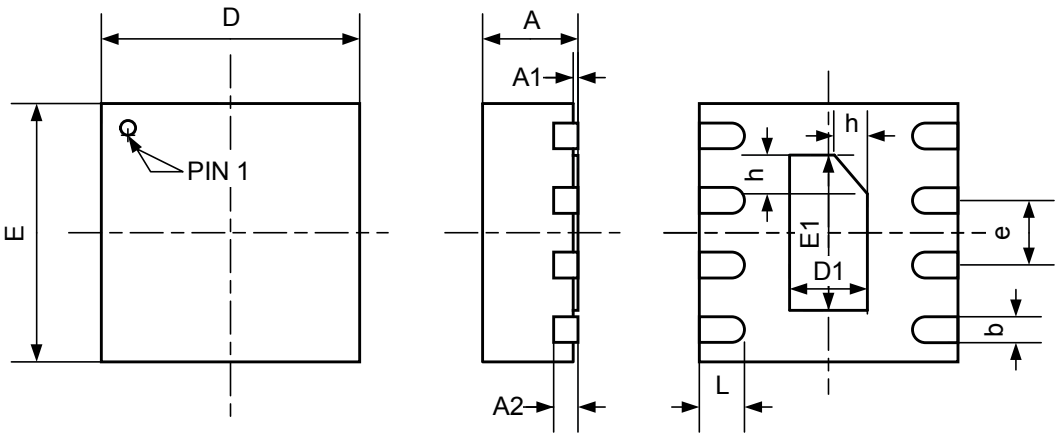
Build-in undervoltage lockout circuit monitors the input voltage and keeps the charger in shutdown mode until V_{IN} rises above the undervoltage lockout threshold. The UVLO circuit has a built-in hysteresis of 250mV. Furthermore, to protect against reverse current in the power MOSFET, the UVLO circuit keeps the charger in shutdown mode if V_{IN} falls to within 80mV of the battery voltage. If the UVLO comparator is tripped, the charger will not come out of shutdown mode until V_{IN} rises 130mV above the battery voltage.

AUTOMATIC RECHARGE

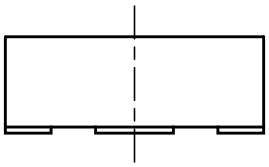
After the termination of the charge cycle, the SUM9512 constantly monitors the BAT pin voltage and starts a new charge cycle when the battery voltage falls below 4.05V, keeping the battery at fully charged condition. $\overline{CHRG}$ output enters a pull-down state during recharge cycles.

PACKAGE OUTLINE

DFN2.0×2.0-8



TOP VIEW SIDE VIEW BOTTOM VIEW

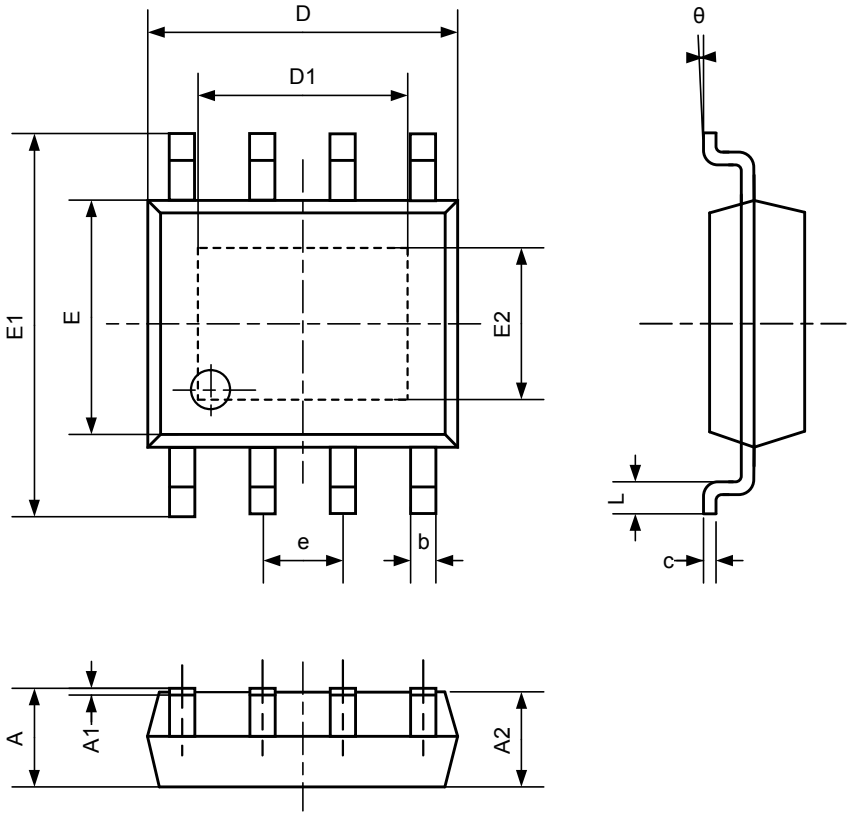


SIDE VIEW

Symbol	Dimensions In Millimeters	
	MIN	MAX
A	0.700	0.800
A1	0.000	0.050
A2	0.200REF	
b	0.180	0.300
D	1.950	2.050
D1	0.700	0.800
E	1.950	2.050
E1	1.500	1.600
e	0.500BSC	
L	0.250	0.350
h	0.100	0.200

PACKAGE OUTLINE

ESOP-8



Symbol	Dimensions In Millimeters	
	MIN	MAX
A	1.300	1.700
A1	0.000	0.100
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
D1	3.202	3.402
E	3.800	4.000
E1	5.800	6.200
E2	2.313	2.513
e	1.270(BSC)	
L	0.400	1.270
θ	0°	8°

V 1.5