

## Single and Dual Cell Li+ Battery Charger IC –LP28007

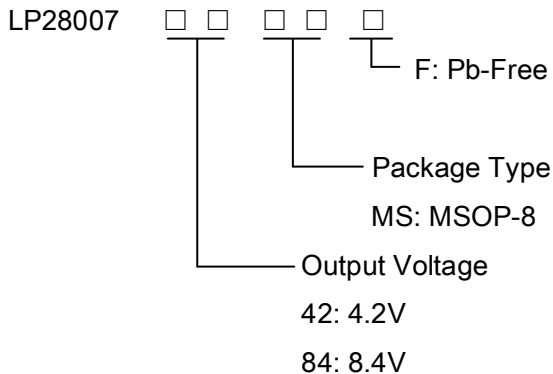
### General Description

The LP28007 is a fully integrated low cost single-cell Li-Ion battery charger IC ideal for portable applications. The LP28007 is capable of being powered up from AC adapter. The LP28007 enters sleep mode when AC adapter is removed. The LP28007 optimizes the charging task by using a control algorithm including preconditioning mode, fast charge mode and constant voltage mode. The charging task is terminated as the charge current drops below the preset threshold. The AC adapter charge current can be programmed up to 1A with an external resistor. The internal thermal feedback circuitry regulates the die temperature to optimize the charge rate for all ambient temperatures. The LP28007 features 18V maximum rating voltages for AC adapter. The other features is under voltage protection.

### Features

- 18V Maximum Rating for AC Adapter
- Internal Integrate P-MOSFETs
- AC Adapter Power Good Status Indicator
- Charge Status Indicator
- Under Voltage Protection
- Automatic Recharge Feature
- Battery Temperature Monitoring
- Small 8-Lead MSOP(EP) Package
- Thermal Feedback Optimizing Charge Rate
- ROHS Compliant and 100% Lead (Pb)-Free

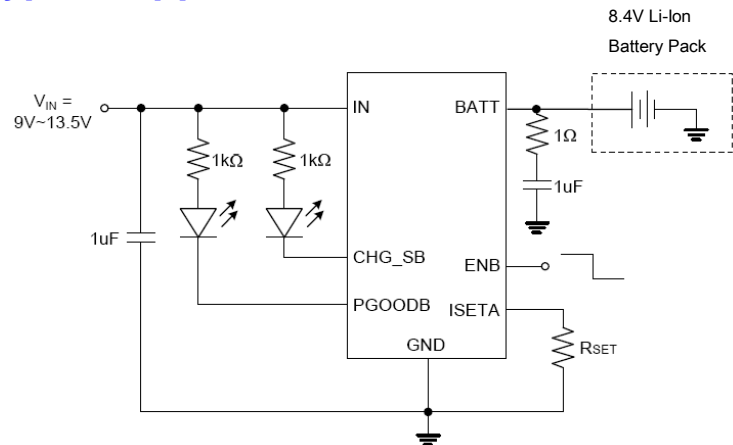
### Order Information



### Applications

- ✧ Portable Media Players/MP3 players
- ✧ Cellular and Smart mobile phone
- ✧ PDA/DSC
- ✧ Bluetooth Applications

### Typical Application Circuit



### Marking Information

Device	Marking	Package	Shipping
LP28007	LPS LP28007 XXXX	SP:MSOP-8	3K/REEL

## Functional Pin Description

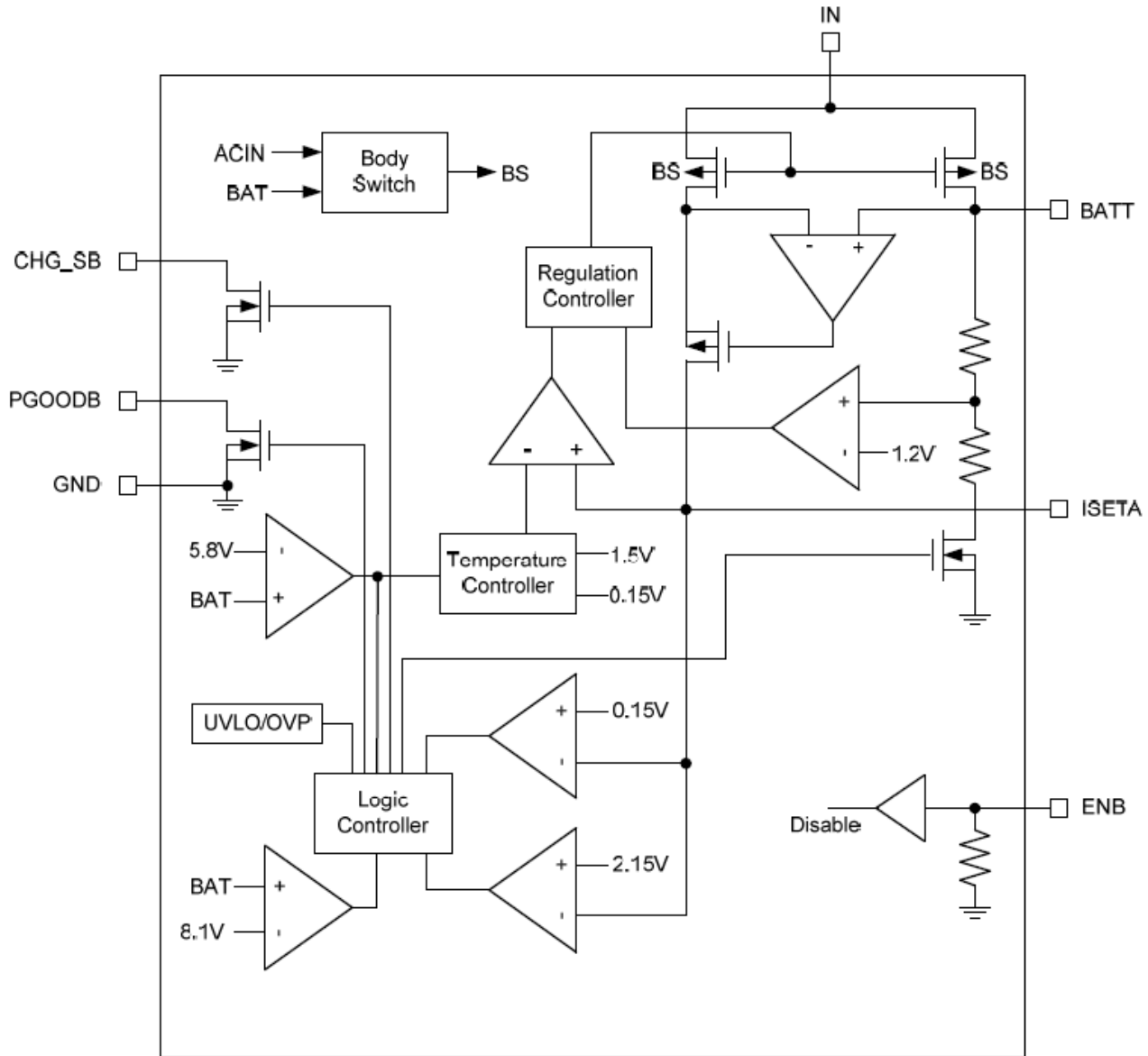
Package Type	Pin Configurations
EMSOP- 8	

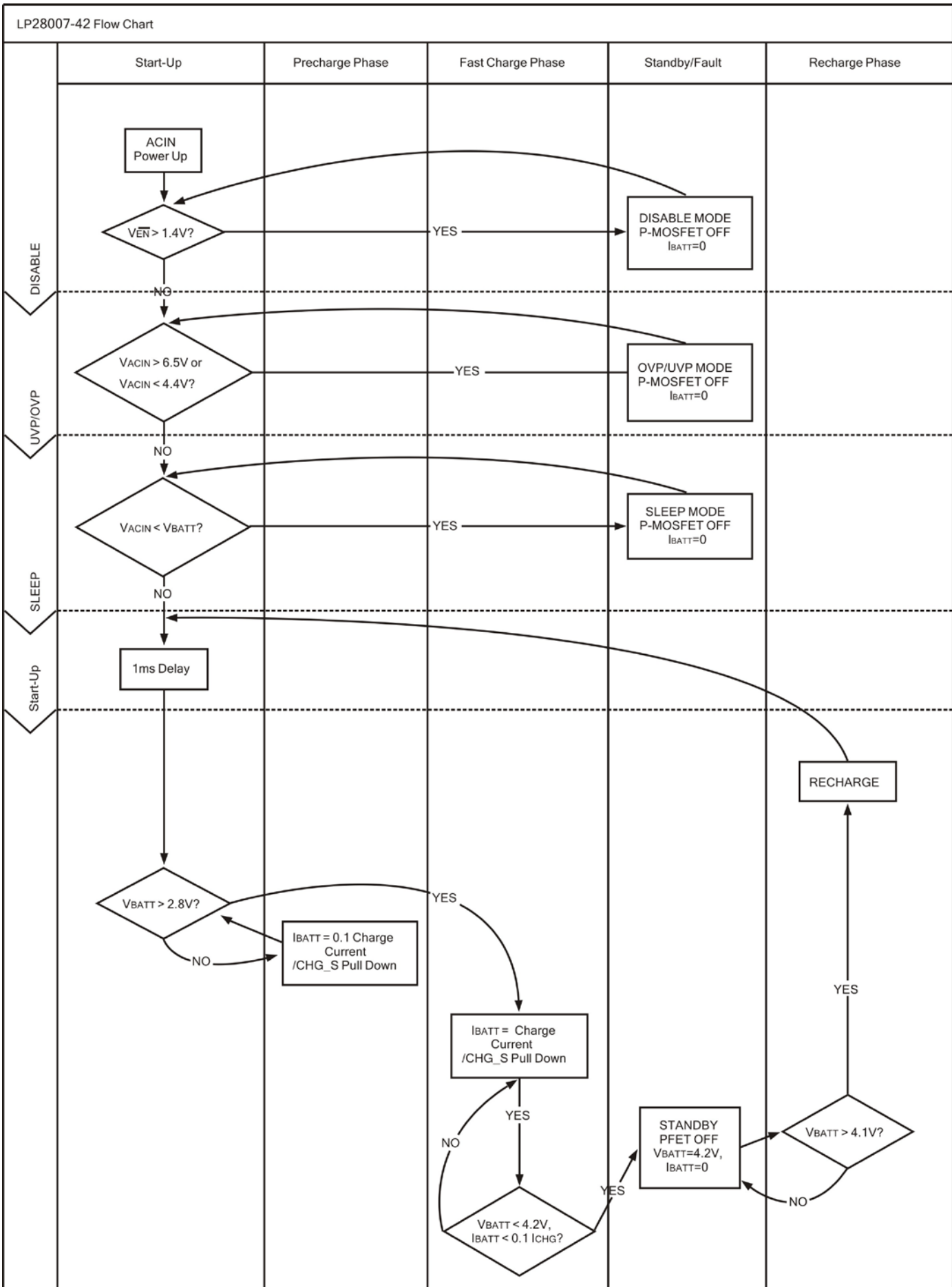
## Pin Description

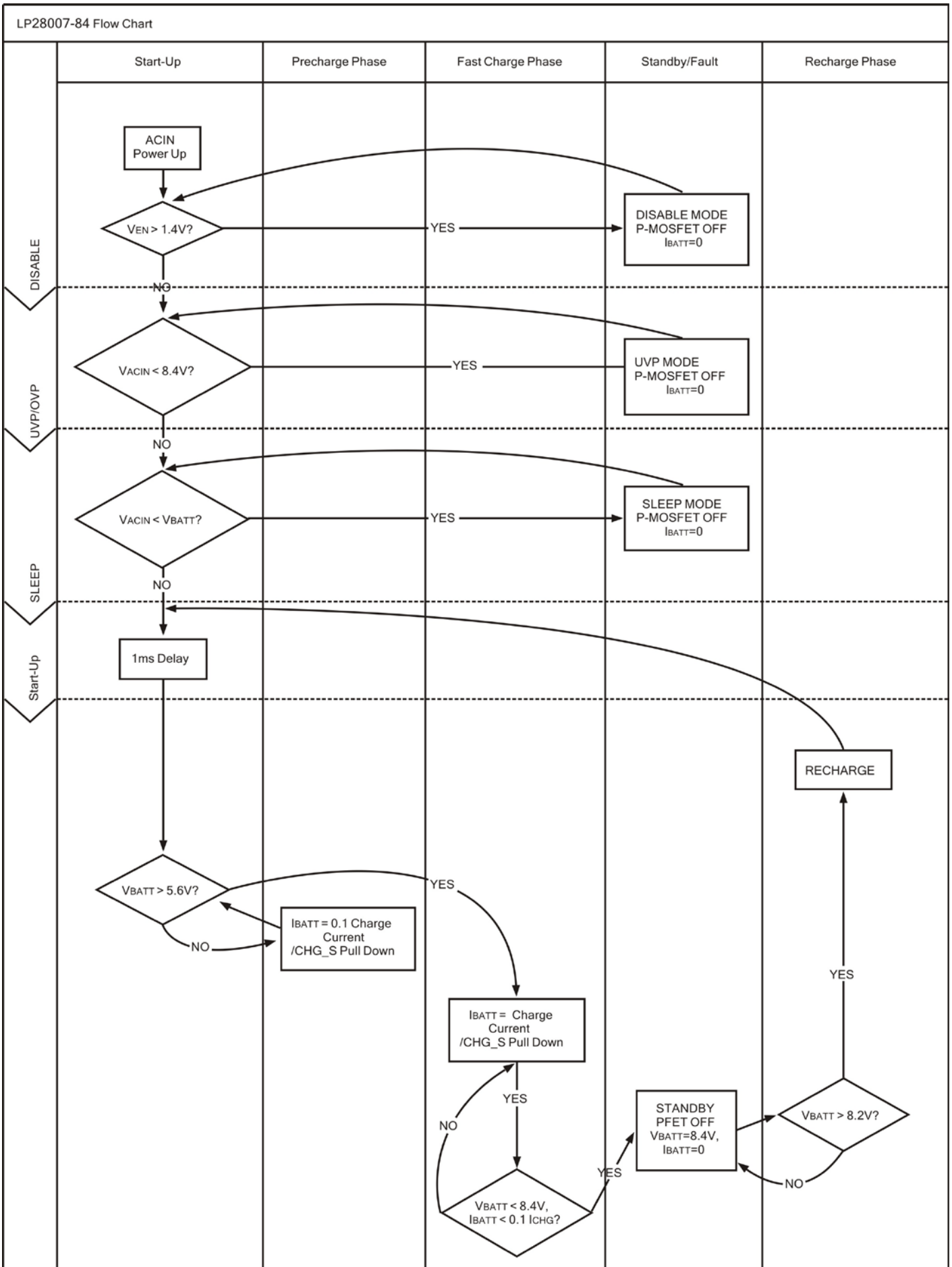
Pin No	Pin Name	Pin Function
1	ACIN	Wall Adaptor Charge Input Supply.
2	$\overline{\text{CHG\_S}}$	Charge Status Indicator Output (Open Drain).
3	$\overline{\text{PGOOD}}$	Power Good Indicator Output (Open drain).
4	GND	Ground.
5	ISETA	Wall Adaptor supply charge current Set point.
6	$\overline{\text{EN}}$	Charge Enable Input (active low).
7	NC	No Internal Connection.
8	BATT	Battery Charge Current Output. This pin provides charge current to the battery and regulates the final float voltage to 4.2 or 8.4V. An internal precision resistor divider from this pin sets the float voltage which is disconnected in shutdown mode.
9(Exposed Pad)	PGND	Exposed Pad Should be soldered to PCB Board and Connected to GND.

Note: LP28007-42MSF and LP28007-84MSF of Battery (Pin8) is output pin, the pin connects to Battery.

## Function Block Diagram







## Absolute Maximum Ratings (Notes 1,2)

$V_{IN}, V_{BATT}, V_{CHG}, V_{PGOOD}, V_{EN}$	-----	-0.3V to 18V
Storage Temperature Range	-----	-65°C to 150°C
$V_{ISETA}$	-----	-0.3V to 3.6V
Junction Temperature ( $T_J$ )	-----	150°C
Lead Temperature (soldering, 10 sec.)	-----	260°C

## Operating Ratings (Note 1, 2)

Supply Voltage	-----	4.5V to 13.5V
Thermal Resistance( $\theta_{JA}$ , Note 3))	-----	-20°C/W
Operating Temperature Range	-----	-40°C to 85°C
Thermal Resistance( $\theta_{JA}$ , Note 4))	-----	8.5°C/W

## Electrical Characteristics

( $T_A=25^\circ\text{C}$ ,  $V_{IN}=10\text{V}$ ; unless otherwise specified.)

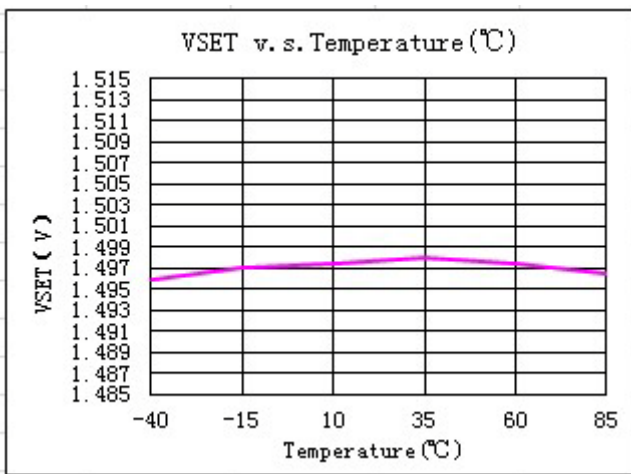
Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{IN}$	Input Operating Voltage Range		9		15	V
$I_{CC}$	Input Supply Current	Charge Mode. RSET=30K		300		$\mu\text{A}$
		Standby Mode (Charge Terminated)		250		$\mu\text{A}$
		Shutdown Mode (RSET Not Connected $V_{IN} < V_{BATT}$ or $V_{IN} < V_{UV}$ )		190		$\mu\text{A}$
$V_{FLOAT}$	Regulated Output(Float) Voltage	$0^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$	8.316	8.4	8.484	V
$I_{BATT}$	BATT Pin Current	RSET=1.5k, Current Mode		500		mA
		RSET=0.75k, Current Mode		1000		mA
		Standby Mode, $V_{BATT}=8.4\text{V}$	-1	0	1	$\mu\text{A}$
		Shutdown Mode	-1	0	1	$\mu\text{A}$
		Sleep Mode, $V_{IN}=0\text{V}$	-1	0	1	$\mu\text{A}$
$I_{TRICKLE}$	Trickle Charge Current	$V_{BATT} < V_{TRICKLE}$ , RSET=1.5K		60		mA
		$V_{BATT} < V_{TRICKLE}$ , RSET=0.75K		120		mA
$V_{TRICKLE}$	Trickle Charge Threshold Voltage	RSET=1.5K, $V_{BATT}$ Rising		5.8		V

V TRHYS	Trickle Charge Hysteresis Voltage	RSET=1.5K		250		mV
VMSD	Manual Shutdown Threshold Voltage	ISETA Pin Rising		2.15		V
		ISETA Pin Falling		2.05		V
VASD	VIN – VBATT Lockout Threshold Voltage	Vin from High to Low		30		mV
		Vin from Low to High		60		mV
ITERM	C/10Termination Current Threshold	RSET=1.5K		0.1		mA/ mA
		RSET=0.75K		0.1		mA/ mA
VSET	ISETA pin Voltage	RSET=1.5K,Current Mode		1.5		V
ICHG_SB	CHG_SB Pin Weak Pull-Down Current	VCHG_SB=5.0V		25		uA
VCHG_SB	CHG_SB Pin Output Low Voltage	ICHG_SB=5mA		0.35		V
VPGOOD	PGOOD Pin Output Low Voltage	IPGOOD_SB=5mA		0.35		V

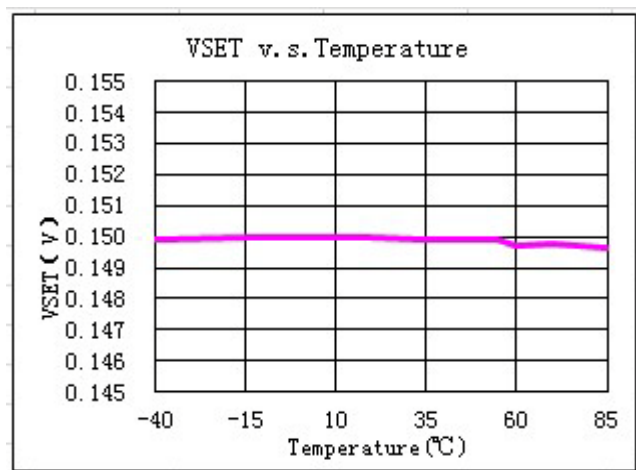
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
<b>Precharge</b>						
BATT Pre-Charge Rising Threshold	VPRECH		2.6	2.8	3	V
BATT Pre-Charge Threshold Hysteresis	ΔVPRECH		50	100	200	mV
Pre-Charge Current	IPCHG	VBATT=2V	8	10	12	%
<b>Recharge Threshold</b>						
BATT Pre-Charge Falling Threshold Hysteresis	ΔVPRECH_L	VREG – VBATT	60	100	150	mV
<b>Charge Termination Detection</b>						
Termination Current Ratio(default)	ITERM	VBATT=4.2V	--	10	--	%
<b>Logic Input/Output</b>						
CHG_S Pull Down Voltage	VCHG_S	TBD, ICHG_S=5mA	--	65	--	mV
PGOOD Pull Down Voltage	VPGOOD	TBD, IPGOOD=5mA	--	220	--	mV
EN Threshold	Logic-High Voltage	VIH	1.5	--	--	V
	Logic-Low Voltage	VIL	--	--	0.4	V
EN Pin Input Current	IEN	IEN=2V	--	--	2	μA
<b>Protection</b>						
Thermal Regulation			--	125	--	°C

- Note 1. Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.
- Note 2.  $\theta_{JA}$  Is measured in the natural convection at  $T_A=25^{\circ}\text{C}$  on a high effective thermal conductivity test board 4 layers,1S of JEDEC 51-7 thermal measurement standard. The case point of  $\theta_{Jc}$  is on the expose pad for the package.
- Note 3. Devices are ESD sensitive. Handling precaution is recommended.
- Note 4. The device is not guaranteed to function outside its operating conditions.

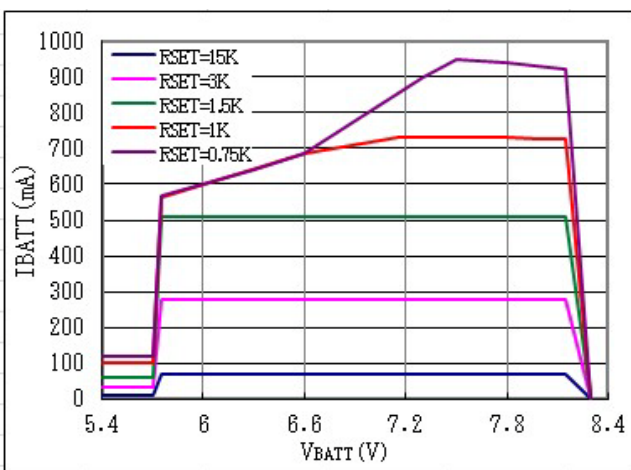
VSET VS. Temperature ( $V_{BATT} > 5.8\text{V}$ )



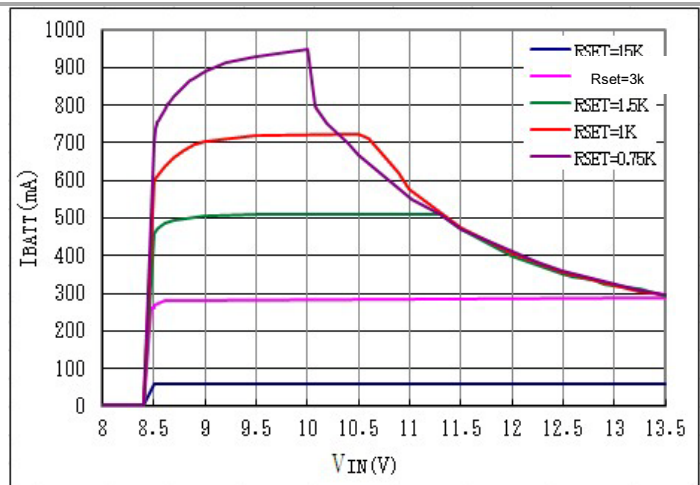
VSET VS. Temperature ( $V_{BATT} < 5.8\text{V}$ )



Charge Current VS. Battery Voltage ( $V_{IN}=10\text{V}$ )



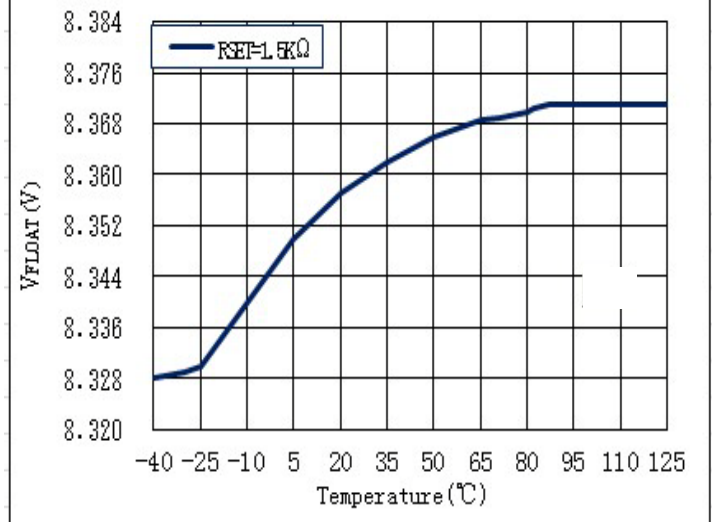
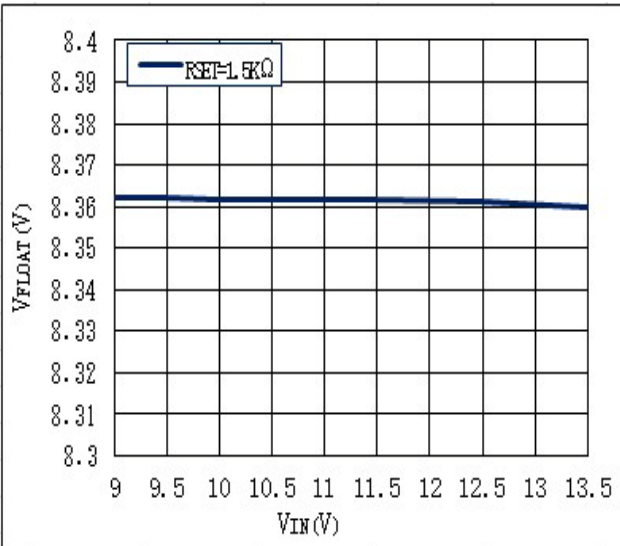
Charge Current VS.  $V_{IN}$  ( $V_{BATT}=8.0\text{V}$ )



Regulated Output Voltage vs. Supply Voltage

Regulated Output Voltage vs. Temperature





## Application Information

### Automatically Power Source Selection

The LP28007 is a battery charger IC which is designed for Li-ion Battery with 4.2V rated voltage.

ACIN Mode : When the ACIN input voltage is higher than the UVP voltage level (4.4V), the LP28007 will turn on ACINP-MOSFET. Sleep Mode : The LP28007 will enter Sleep Mode when ACIN input voltage are removed. This feature provides low leakage current from the battery during the absence of input supply.

### Fast-Charge Current Setting

The LP28007 offers ISETA pin to determine the ACIN charge rate from 100mA to 1200mA. The charge current can be calculated as following equation.

$$I_{charge\_ac} = K_{SET} \frac{V_{SET}}{R_{SETA}}$$

### Pre- Charge Current Setting

During a charge cycle if the battery voltage is below the VPRECH threshold, the LP28007 applies a pre-charge mode to the battery. This feature revives deeply discharged cell and protects battery life. The LP28007 internal determines the pre-charge rate as 10% of the fast-charge current.

### Battery Voltage Regulation

The LP28007 monitors the battery voltage through the BATT pin. Once the battery voltage level closes to the VREG threshold, the LP28007 voltage enters constant phase and the charging current begins to taper down. When battery voltage is over the VREG threshold, the LP28007 will stop charge and keep to monitor the battery voltage. However, when the battery voltage decreases 100mV below the VREG, it will be recharged to keep the battery voltage. Charge Status Outputs. The open-drain CHG\_S and PGOOD outputs indicate various charger operations as shown in the following table. These status pins can be used to drive LEDs or communicate to the host processor. Note that ON indicates the open-drain transistor is turned on and LED is bright.

Charge State		CHG_S	PGOOD
ACIN	Charge	ON	ON
	Charge done	OFF	ON

### Temperature Regulation and Thermal Protection

In order to maximize the charge rate, the LP28007 features a junction temperature regulation loop. If the power dissipation of the IC results in a junction temperature greater than the thermal regulation

threshold (125°C), the LP28007 throttles back on the charge current in order to maintain a junction temperature around the thermal regulation threshold (125°C). The LP28007 monitors the junction temperature,  $T_J$ , of the die and disconnects the battery from the input if  $T_J$  exceeds 125°C. This operation continues until junction temperature falls below thermal regulation threshold (125°C) by the hysteresis level. This feature prevents the chip from damage.

### Selecting the Input and Output Capacitors

In most applications, the most important is the high-frequency decoupling capacitor on the input of the LP28007. A 1uF ceramic capacitor, placed in close proximity to input pin and GND pin is recommended. In some applications depending on the power supply characteristics and cable length, it may be necessary to add an additional 10uF ceramic capacitor to the input.

The LP28007 requires a small output capacitor for loop stability. A 1uF ceramic capacitor placed between the BATT pin and GND is typically sufficient.

### Layout Consideration

The LP28007 is a fully integrated low cost single-cell Li-Ion battery charger ideal for portable applications. Careful PCB layout is necessary. For best performance, place all peripheral components as close to the IC as possible. A short connection is highly recommended. The following guide lines should be strictly followed when designing a PCB layout for the LP28007. Input capacitor should be placed close to IC and connected to ground plane.

The trace of input in the PCB should be placed far away the sensitive devices or shielded by the ground.

The GND should be connected to a strong ground plane for heat sinking and noise protection. The connection of RSETA should be isolated from other noisy traces.

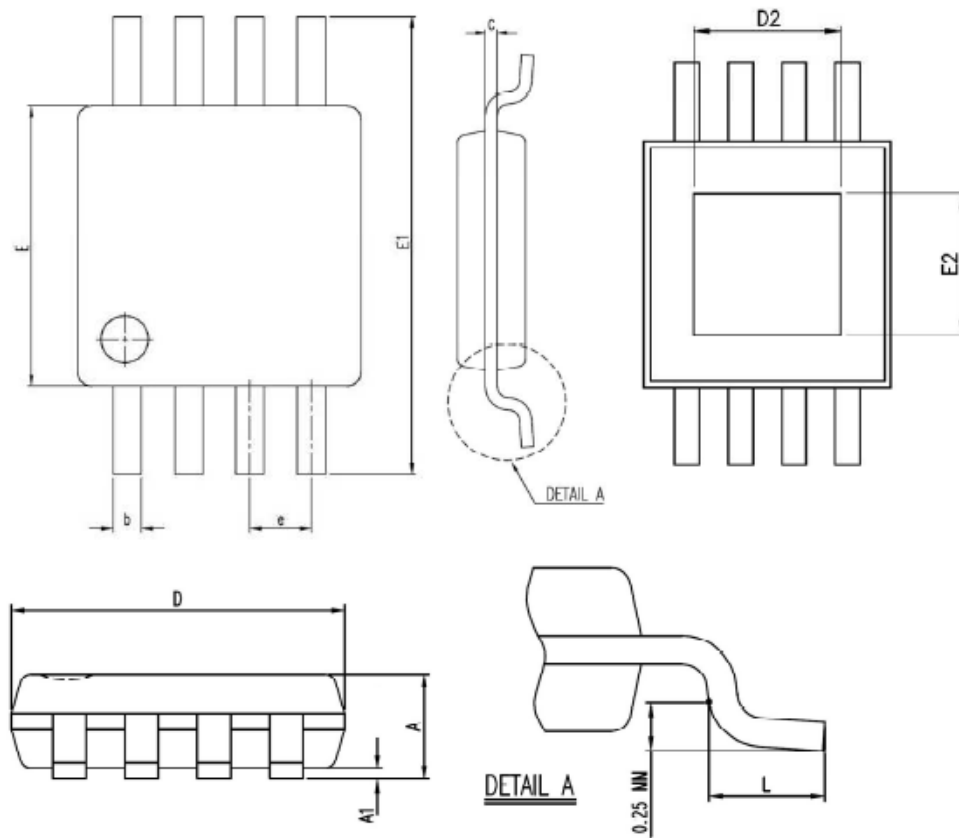
The short wire is recommended to prevent EMI and noise coupling.

Output capacitor should be placed close to IC and connected to ground plane to reduce noise coupling.

When PCB has poor layout, the 10uF is recommended to prevent noise.

## Packaging Information

### E-MSOP-8L



SYMBOLS	MIN.	MAX.
A	0.81	1.10
A1	0.00	0.15
b	0.22	0.38
c	0.08	0.23
D	2.90	3.10
D2	1.42	1.78
E	2.90	3.10
E1	4.80	5.00
E2	1.38	1.73
e	0.65 BSC.	
L	0.40	0.80

UNIT: MM