



## 2.5A I<sup>2</sup>C Controlled USB/Adaptor Li-ion Battery Charger with Power Path and 2.1A OTG Boost

### Features

- ◆ 20V Input Voltage Tolerance, 3.9V–7V Operating Voltage Range
- ◆ High Efficiency 2.5A Switch Mode Charger
- ◆ USB-compliant/Adapter Charger
  - USB1.0/2.0/3.0 Compliant Input Current Limit
  - 0.1-2.5A Programmable Input Current Limit
- ◆ Autonomous Preconditioning/CC/CV Charge Control, Termination and Recharge
- ◆ 1.5MHz Synchronous PWM Converter for Small 1 $\mu$ H Inductor
  - USB OTG Boost Programmable Vout: 4.55 V to 5.51 V
  - Max Iout: 2.1A@4.55-5.51V
  - 90% Efficiency at 1.5A
  - Hiccup Mode Over-Current Protection for Reliable Capacitive Load Start-up
- ◆ Power Path Management
  - Instant System On with No Battery or Deeply Discharged Battery
  - Ideal Diode Operation in Battery Assistant Mode
- ◆ Full Range Programmable Charge Parameter through I<sup>2</sup>C Compatible Interface
- ◆ Accuracy (0–125°C)
  - $\pm$ 1% Charge Voltage Regulation
  - $\pm$ 10% Charge Current Regulation
  - $\pm$ 15% Input Current Regulation
  - $\pm$ 2% Output Regulation in Boost Mode
- ◆ High Integration
  - Dynamic Power Path Management
  - Synchronous Switching MOSFET
  - Integrated Current Sensing
  - Bootstrap Diode
  - Internal Loop Compensation
- ◆ Comprehensive Protection
  - Safety Timer with Reset Control
  - Thermal Regulation and Shutdown
  - Input&Output Over-Voltage Protection
  - Output Over Current Protection
  - Reverse Battery Leakage Protection
- ◆ Charge Status Output for LED or Host Processor
- ◆ Shipping Mode and Low Battery Leakage Current
- ◆ 4mm X 4mm QFN-24 Package

### Applications

- ◆ Tablet PC
- ◆ Smart Phone
- ◆ Power Bank
- ◆ Portable Media Player



## Order Information

|                               |                   |
|-------------------------------|-------------------|
| Part Number                   | HL7059            |
| I <sup>2</sup> C Address      | 6BH               |
| USB Detection                 | PSEL              |
| Default Battery Voltage       | 4.208V            |
| Default Charge Current        | 2.048A            |
| Default Adaptor Current Limit | 2.5A              |
| Max Pre-charge Current        | 2.048A            |
| OTG Current (Max)             | 2.1A              |
| Charging Temperature Profile  | Cold/Hot,1 TS pin |
| Status Output                 | STAT,PGN          |
| STAT during Fault             | Blinking@1Hz      |
| Package                       | 4mm X 4mm QFN-24  |
| Packing Method                | Tape & Reel       |
| Package Qty                   | 3000              |



## Typical Application Diagram

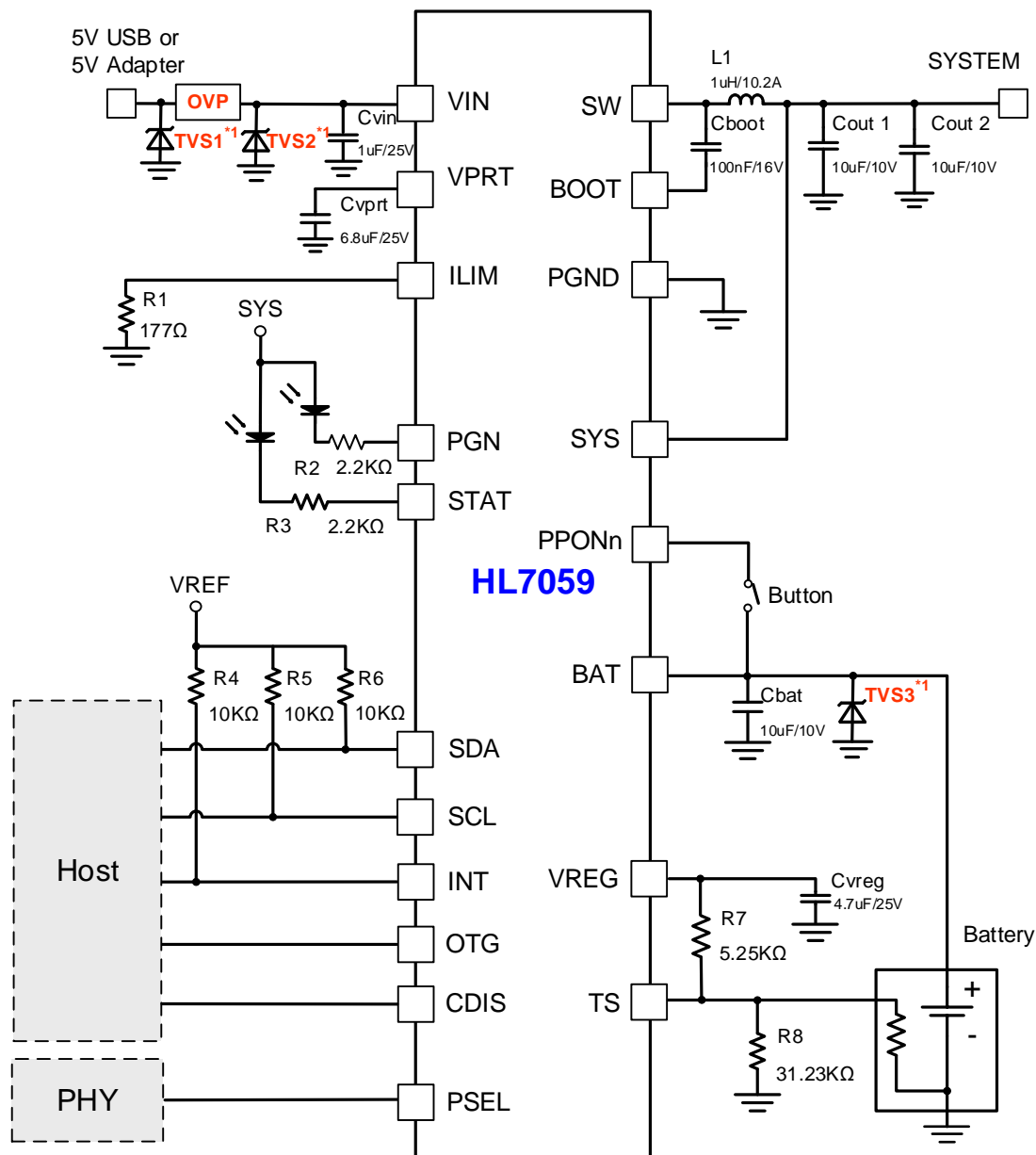


Figure1HL7059 Typical Application Diagram

### Notice

\*1. Careful board level surge protection using TVS diode and OVP device on VIN pin, and TVS diode on VBAT pin, is essential to withstand high voltage spikes that may appear in PCB manufacturing process or end user applications. Without such protection, the IC is prone to electrical over-stress damage.

| Component | Part Number          | Value     | Size | Vendor |
|-----------|----------------------|-----------|------|--------|
| L1        | IHLP2020ABER1R0M01   | 1µH/10.2A | -    | VISHAY |
| Cvin      | CGA5L2X7R1E105K160AD | 1µF/25V   | 1206 | TDK    |
| Cvprt     | C3225X5R1E685K       | 6.8µF/25V | 1210 | TDK    |
| Cboot     | C0603X5R1C104K       | 100nF/16V | 0603 | TDK    |



|                  |                  |                 |      |           |
|------------------|------------------|-----------------|------|-----------|
| Cvreg            | C1206C475K3PACTU | 4.7 $\mu$ F/25V | 1206 | KEMET     |
| Cbat,Cout1,Cout2 | C0805C106K8PACTU | 10 $\mu$ F/10V  | 0805 | KEMET     |
| R1               | -                | 177 $\Omega$    | -    | -         |
| R2, R3           | -                | 2.2k $\Omega$   | -    | -         |
| R4,R5,R6         | -                | 10k $\Omega$    | -    | -         |
| R7               | -                | 5.25k $\Omega$  | -    | -         |
| R8               | -                | 31.23k $\Omega$ | -    | -         |
| TVS1/TVS2/TVS3   | See Table2       | -               | -    | Will SEMI |
| OVP              | See Table3       | -               | -    | Will SEMI |

Table1Recommended Component list

| Component | Package   | P <sub>PK</sub> (W)tp<br>=8/20us | Part<br>Number  | V <sub>RWM</sub> (V) | V <sub>F</sub> (V)  <sub>F</sub> =20Ma |      | IR( $\mu$ A) | V <sub>BR</sub> (V) |      |      |
|-----------|-----------|----------------------------------|-----------------|----------------------|--|------|--------------|---------------------|------|------|
|           |           |                                  |                 | Max                  | Min                                    | Max  | Max          | Min                 | Typ  | Max  |
| TVS1      | DFN2x2-3L | 4000                             | ESD5641D<br>12  | 12.0                 | 0.45                                   | 1.25 | 0.1          | 13.0                | 15.0 | 17.0 |
| TVS2      | DFN2x2-3L | 4000                             | ESD5641D<br>07  | 7.5                  | 0.45                                   | 1.25 | 1.0          | 8.0                 | 9.0  | 10.0 |
| TVS3      | DFN2x2-3L | 3500                             | EDD5616<br>1D04 | 4.5                  | 0.50                                   | 1.10 | 8.0          | 5.1                 | 5.7  | 6.3  |

Table 2 Recommended TVS

| Component | Part Number | VIN(MAX) | RON          | Package  | Component Dimensions(mm) |       |       |
|-----------|-------------|----------|--------------|----------|--------------------------|-------|-------|
|           |             |          |              |          | L                        | W     | H     |
| OVP       | WS3210C68   | 30V      | 45m $\Omega$ | WLCSP-9B | 1.400                    | 1.400 | 0.586 |

Table 3 Recommended OVP



## Description

HL7059 is a fully integrated switch-mode Li-ion battery charger with power MOSFET, power path management, I<sup>2</sup>C interface and USB On-The-Go(OTG) boost function. It can be used with single cell or multiple-cell in parallel Li-ion and Li-polymer batteries in a wide range of cell-phones, smart phones, tablets, power banks and other portable devices. Its switch-mode operation and low-resistance power path maximize charging, discharging and boost efficiency, reduce battery charging time and extend battery life during the discharging phase.

This device supports a wide range of input sources, including standard USB host port, USB charging port and high power AC-DC adapter. It supports an input operating voltage from 3.9V to 7V, and can power up the system rail without a battery. It can automatically adjust to the maximum power output of the input source via the input dynamic power management control (INDPM).

HL7059 manages the complete charging cycle of a Li-ion battery autonomously with or without the presence of an I<sup>2</sup>C host. It detects the battery voltage and automatically charges the battery in four phases: trickle charge, pre-conditioning, constant current and constant voltage. It automatically terminates charging when the battery is full, and re-starts a charging cycle if the battery voltage falls below the recharge threshold. For a short-circuit protected battery, it can reactivate the battery by providing a float

voltage to the battery terminal before charging starts. Its I<sup>2</sup>C interface provides maximum programmability for charging parameters and system-level communication. When the I<sup>2</sup>C host is not present, a built-in watchdog timer stops charging after the timer expires to assure safety battery operation.

A built-in low-resistance power path management system enables instant power-up of the system rail when an input source is plugged in, even with a shorted battery or no battery. When a valid battery is present, it provides battery assistant mode during charging when the system load exceeds the capacity of the input source.

The USB OTG boost function provides a programmable 4.55V~5.5V boost output at VIN port from the battery, and supports up to 2.1A of current.

HL7059 integrates comprehensive protections mechanism to ensure safe operation of the battery, including battery temperature monitoring via negative temperature coefficient (NTC) thermistor, charging safety timer, over-voltage and under-voltage detection. The device also provides output over-current protection, and regulates its on-chip junction temperature ( $T_{J\_REG}$ ) to be no more than 120°C by regulating its charging current.

HL7059 is available in a 24-pin 4mm x4mm QFN package.



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